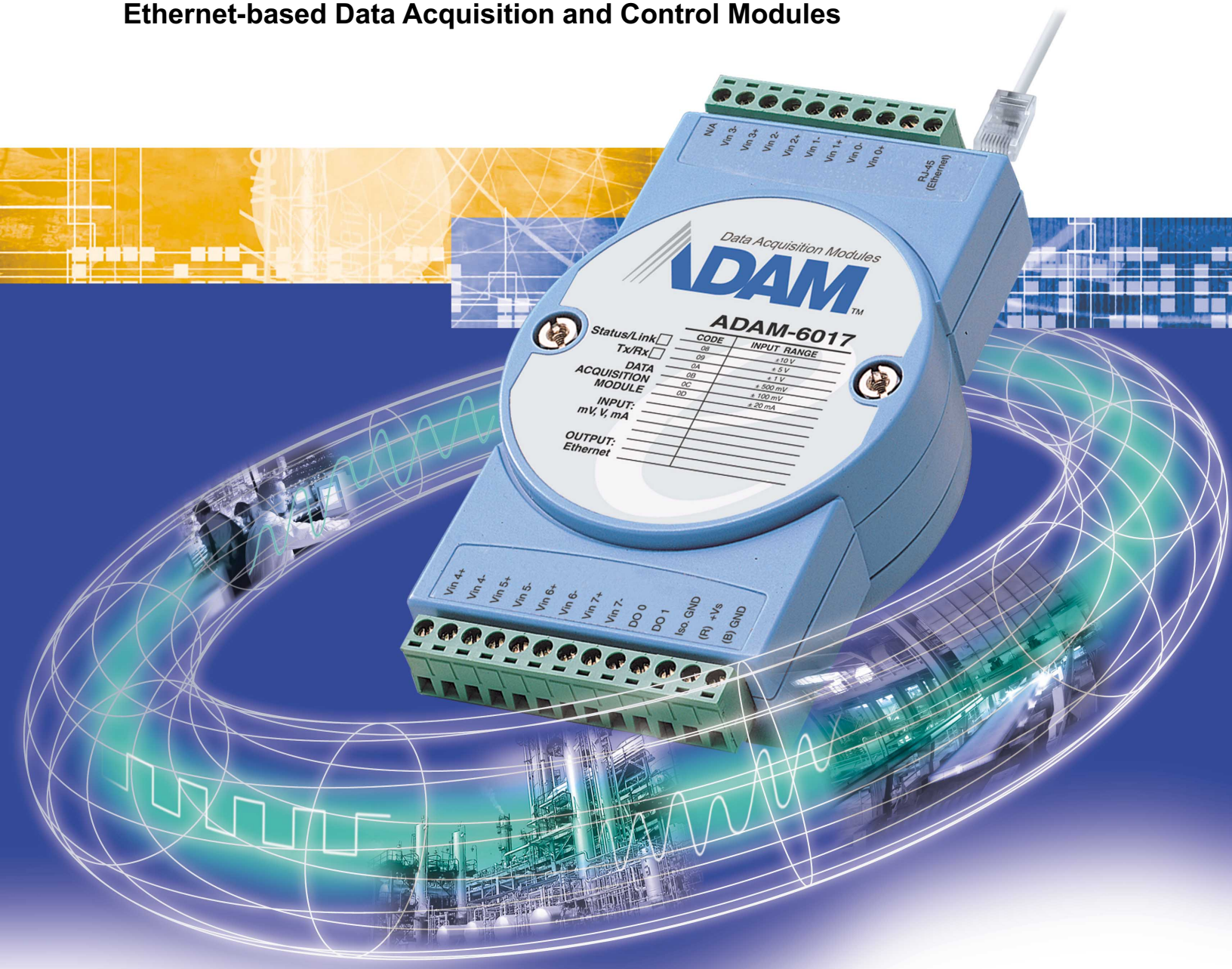
First Edition

ADAM-6000

Ethernet-based Data Acquisition and Control Modules



User's Manual

- Select Your Hardware Component
- Hardware Installation Guide
- I/O Module introduction
- System Configuration Guide
- Plan Your Application Program

Evolved for the eWorld

ADVANTECH

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Manual Organization

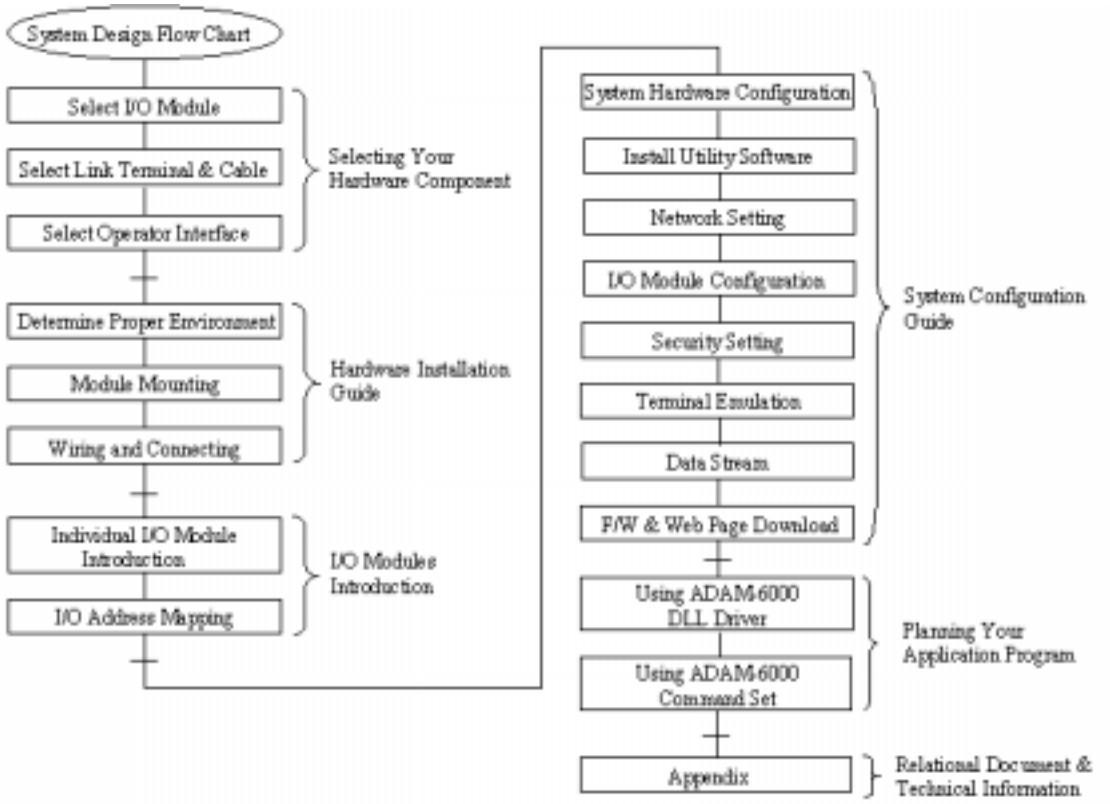
This Manual has six chapters, three appendices.

The following table lists each chapter or appendices with its corresponding title and a brief overview of the topics covered in it.

Chapter / Appendix	Title	Topics Covered
1	Understanding Your System	Introduces the suitable applying industries and the position in an Ethernet remote system. Summarize the features and the common specification of ADAM-6000. Explains the functions of the LED indicators.
2	Selecting Your Hardware	Provides a briefly selection chart and specification table of ADAM-6000 I/O modules for users to organize their system easily. Give a direction to calculate system capacity and select a certain power supply. Recommend a standard for communication cable and connector.
3	Hardware Installation Guide	Lists the necessary components and proper environment in installing process. Describes the Hardware dimension and the way to place or mount it. Explains the rule of mapping I/O address. Describes the wiring and connecting detail for ADAM-6000.
4	I/O Module Introduction	Introduces the detail specifications, functions and application wiring of each ADAM-6000 I/O modules.
5	System Configuration Guide	Guides users to use Windows Utility for network & security setting, I/O range configuration, accuracy calibration, command setting, and so on.
6	Planning Your Application Program	Demonstrate the standard web page operation and the customization web page development. Introduces the functions and structure of DLL drivers and command sets. Explain how to integrate these programming tools to plan your application program.
A	Design Worksheets	Provides organized worksheets for users to establish system configuration document in order.
B	Data Formats and I/O Range	Provides detail information about Data formats and I/O Range of Analog Module.
C	Grounding Reference	Explains the concepts about field grounding and shielding.

How to use this manual

The following flow chart demonstrates a thought process that you can use when you plan your ADAM-6000 Ethernet Data Acquisition and Control System.



Chapter 1

Understanding Your System

Using this Chapter

1-1 Introduction

ADAM-6000, Ethernet-based data acquisition and control module, provides I/O, data acquisition and networking in one module to build a cost-effective, distributed monitoring, and control solutions for a wide variety of industries and applications. Through de-factor standard Ethernet networking, ADAM-6000 retrieves I/O values from sensors and publishes these real-time I/O value to networking nodes at local area network or Intranet, Internet. With Ethernet-enabled technology, ADAM-6000 series modules build up a cost-effective DA&C system for Building Automation, environmental monitoring, facility management and eManufacturing applications. Please refer to Figure 1-1 to have a brief view of ADAM-6000 system architecture.

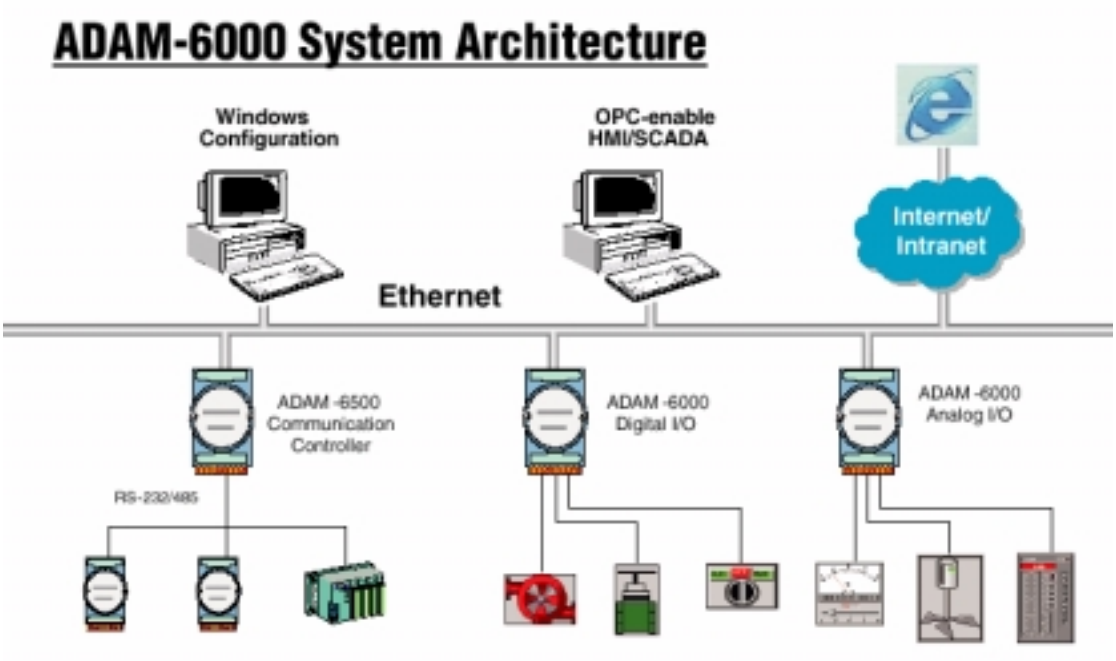


Figure 1-1 ADAM-6000 System Architecture

1-2 Major Features

1-2-1 Ethernet-enabled DA&C I/O Modules

ADAM-6000 is based on the popular Ethernet networking standards used today in most business environments. Users can easily add ADAM-6000 I/O modules to existing Ethernet networks or use ADAM-6000 modules in new Ethernet-enabled eManufacturing networks. ADAM-6000 module features a 10/100 Mbps Ethernet chip and supports industrial popular Modus/TCP protocol over TCP/IP for data connection. ADAM-6000 also supports UDP protocol over Ethernet networking. With UDP/IP, ADAM-6000 I/O modules can actively send I/O data stream to 8 Ethernet nodes. Through Ethernet networking HMI/SCADA system and controller can access or gather real-time data from ADAM-6000 Ethernet enabled DA&C modules. And, these real-time data can be integrated with business system to create valuable, competitive business information immediately.

1-2-2 Intelligent I/O Modules

Enhancing from traditional I/O modules, ADAM-6000 I/O modules have pre-built intelligent mathematic functions to empower the system capacity. The Digital Input modules provide Counter, Totalizer functions; the Digital Output modules provide pulse output, delay output functions; the Analog Input modules provide the Max./Min./Average data calculation; the Analog Output modules provide the PID loop control function.

1-2-3 Mixed I/O in One Module to fit all application's

ADAM-6000 mixed I/O module design concept provides the most cost-effective I/O usage for application system. The most common used I/O type for single function unit are collected in ONE module. This design concept not only save I/O usage and spare modules cost but also speed up I/O relative operations. For small DA&C system or standalone control unit in a middle or large scale, ADAM-6000 mixed I/O design can easily fit application needs by one or two modules only. With additional embedded control modules, ADAM-6000 can easily create a localized, less complex, and more distributed I/O architecture.

1-2-4 Embedded web built web page for remote monitoring and diagnose

Each ADAM-6000 module features a pre-built I/O module web page to display real-time I/O data value, alarm and module status thru LAN or Internet. Just Internet browser, users can easily monitor real-time I/O data value and alarm no matter local site or remote site. Then, the web-enabled monitoring system is completed immediately without any programming effort.

1-2-5 Industrial standard Modbus/TCP protocol supported for open connectivity

ADAM-6000 modules support the popular industrial standard, Modbus/TCP protocol, to connect with Ethernet Controller or HMI/SCADA software built with Modbus/TCP driver. Advantech also provides OPC server for Modbus/TCP to integrate ADAM-6000 I/O real-time data value with OPC client enabled software. Users don't need to take care of special drivers development.

1-2-6 Customization Web Page

Since ADAM-6000 modules built in a default web page, users has allowed to monitor and control the I/O status in anywhere through Internet Explorer Browser. Move over, the ADAM-6000 modules could be downloaded the user-defined web page for individual applications. Advantech has provided sample programs of JAVA Script for users' reference to design their own operator interface, then download it into the specific ADAM-6000 modules via Windows Utility.

1-2-7 Software Support

Based on the Modbus/TCP standard, the ADAM-6000 firmware is a built-in Modbus/TCP server. Therefore, Advantech provides the necessary DLL drivers, OPC Server, and Windows Utility for users for client data for the ADAM-6000P. Users can configure this DA&C system via Windows Utility; integrate with HMI software package via Modbus/TCP driver or Modbus/TCP OPC Server. Even more, you can use the DLL driver and ActiveX to develop your own applications.

1-3 Common technical specification of ADAM-6000

• **Ethernet:** 10 BASE-T IEEE 802.3

100 BASE-TX IEEE 802.3u

• **Wiring:** UTP, category 5 or greater

• **Bus Connection:** RJ45 modular jack

• **Comm. Protocol:** Modbus/TCP on TCP/IP and UDP

• **Data Transfer Rate:** Up to 100 Mbps

• **Unregulated 10 to 30VDC**

• **Protection:** Over-voltage and power reversal

• **Ethernet Communication:** 1500 V DC

• **I/O Module:** 3000 V DC

• **Status Indicator:**

Power, CPU, Communication (Link, Collide, 10/100 Mbps, Tx, Rx)

• **Case:** ABS with captive mounting hardware

• **Plug-in Screw Terminal Block:**

Accepts 0.5 mm ^{2} to 2.5 mm ^{2} , 1 - #12 or 2 - #14 to #22 AWG

• **Operating Temperature:** - 10 to 70º C (14 to 158º F)

• **Storage Temperature:** - 25 to 85º C (-13 to 185º F)

• **Humidity**: 5 to 95%, non-condensing

• **Atmosphere**: No corrosive gases

NOTE: Equipment will operate below 30% humidity. However, static electricity problems occur much more frequently at lower humidity levels. Make sure you take adequate precautions when you touch the equipment. Consider using ground straps, anti-static floor coverings, etc. if you use the equipment in low humidity environments.

1-4 Dimensions

The following diagrams show the dimensions of the ADAM-6000 I/O module in millimeters.

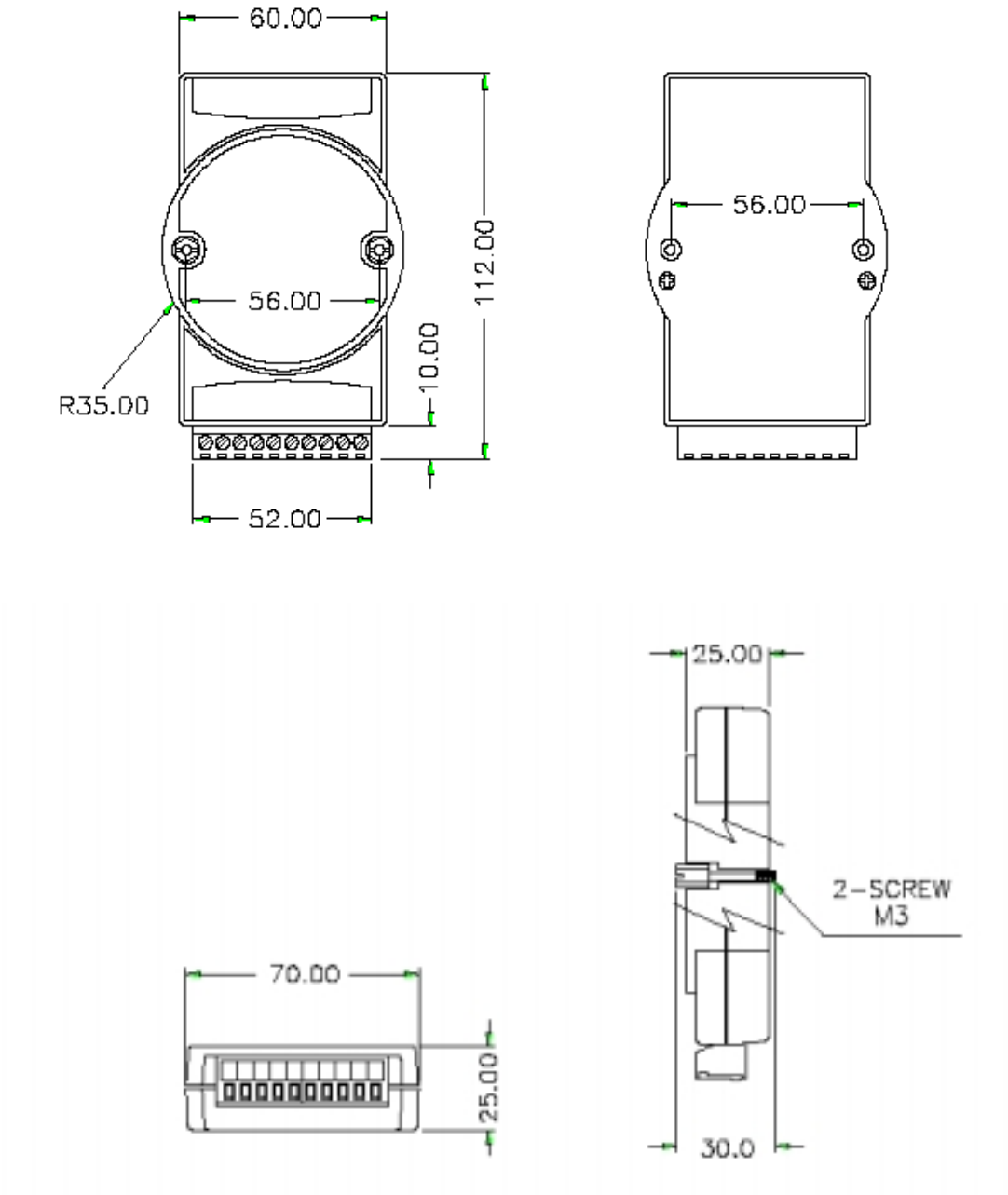


Figure 1-2: ADAM-6000 Module Dimension

1-5 LED Status of ADAM-6000 I/O Modules

There are two LEDs on the ADAM-6000 I/O Modules front panel. Each LEDs built with two indicators to represent the ADAM-6000 system status, as explained below:

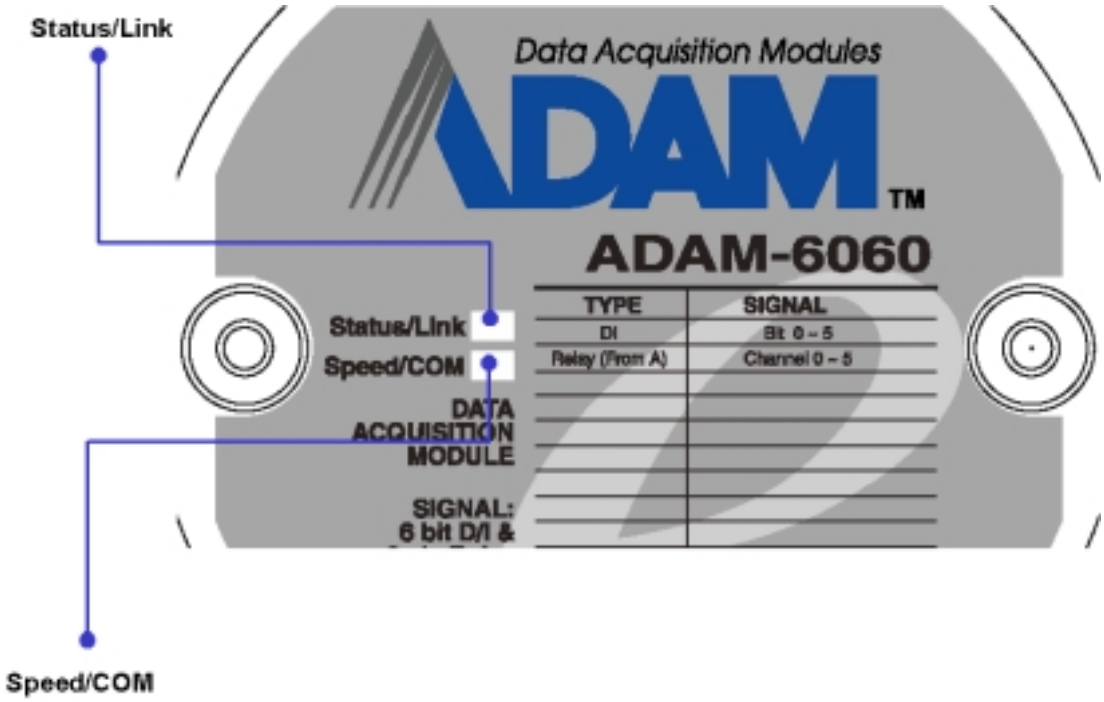


Figure 1-3: ADAM-6000 I/O Modules' LED Indicators

(1) **Status**: Red indicator. This LED is blanking when ADAM-6000 module is running.

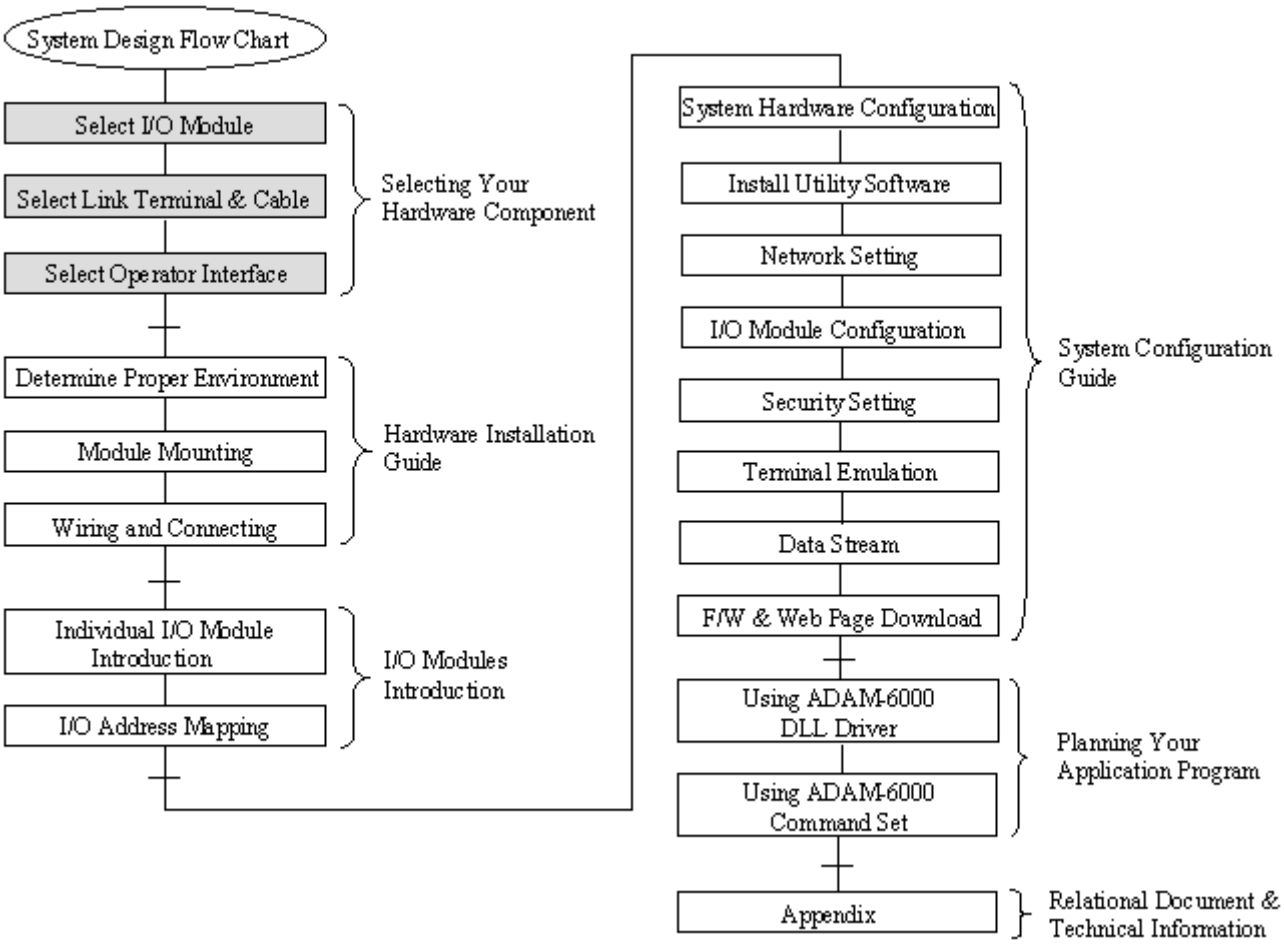
(2) **Link**: Green indicator. This LED is normal on whenever the ADAM-6000 module's Ethernet wiring is connected.

(3) **Speed**: Red indicator. This LED is on when the Ethernet communication speed is 100 Mbps.

(4) **COM**: Green indicator. This LED blinks whenever the ADAM-5000/TCP transmitting or receiving data on Ethernet.

Chapter 2

Selecting Your Hardware Components



Using this Chapter

2-1 Selecting I/O Module

To organize an ADAM-6000 remote data acquisition & control system, you need to select I/O modules to interface the host PC with field devices or processes that you have previously determined. There are several things should be considered when you select the I/O modules.

What type of I/O signal is applied in your system?

How much I/O is required to your system?

How will you place the I/O Modules to handle the I/O points in individual area of an entire field site.

How many ADAM-6000 I/O modules are required for distributed I/O points arrangement.

How many hubs are required for the connection of these Ethernet devices?

What is the required voltage range for each I/O module?

What isolation environment is required for each I/O module?

What are the noise and distance limitations for each I/O module?

Refer to table 2-1 as I/O module selection guidelines

Choose this type of I/O module:	For these types of field devices or operations (examples):	Explanation:
Discrete input module and block I/O module	Selector switches, pushbuttons, photoelectric eyes, limit switches, circuit breakers, proximity switches, level switches, motor starter contacts, relay contacts, thumbwheel switches	Input modules sense ON/OFF or OPENED/CLOSED signals.
Discrete output module and block I/O module	Alarms, control relays, fans, lights, horns, valves, motor starters, solenoids	Output module signals interface with ON/OFF or OPENED/CLOSED devices.
Analog input module	Thermocouple signals, RTD signals, temperature transducers, pressure transducers, load cell transducers, humidity transducers, flow transducers, potentiometers.	Convert continuous analog signals into input values for host device
Analog output module	Analog valves, actuators, chart recorders, electric motor drives, analog meters	Interpret host device's output to analog signals (generally through transducers) for field devices.

Table 2-1 I/O Selection Guidelines

2-2 Selecting Link Terminal and Cable

Use the RJ-45 connector to connect the Ethernet port of the ADAM-6000 to the Hub. The cable for connection should be Category 3 (for 10Mbps data rate) or Category 5 (for 100Mbps data rate) UTP/STP cable, which is compliant with EIA/TIA 586 specifications. Maximum length between the Hub and any ADAM-6000 modules is up to 100 meters (approx. 300 ft).

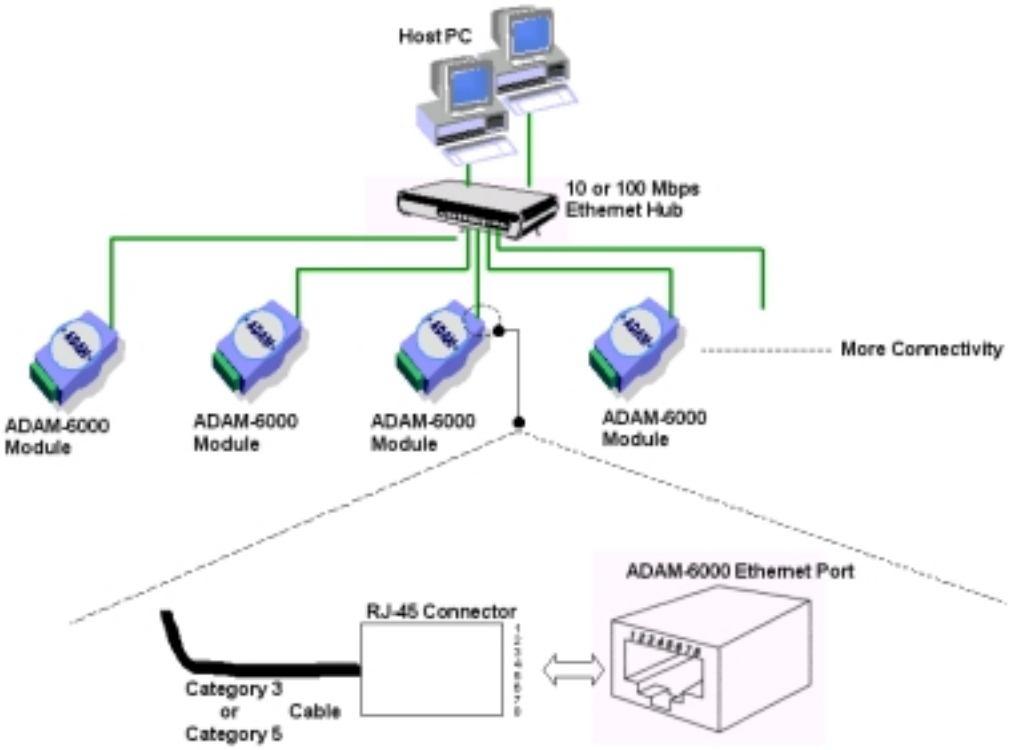


Figure 2-1 Ethernet Terminal and Cable Connection

PIN NUMBER	SIGNAL	FUNCTION
1	RD+	Receive (+)
2	RD-	Receive (-)
3	TD+	Transmit (+)
4	(Not Used)	-
5	(Not Used)	-
6	TD-	Transmit (-)
7	(Not Used)	-
8	(Not Used)	-

Table 2-2 Ethernet RJ-45 port Pin Assignment

2-3 Selecting Operator Interface

To complete your data acquisition and control system, selecting the operator interface is necessary. Adopting by Modbus/TCP Protocol, ADAM-6000 I/O modules exhibit high ability in system integration for various applications.

If you want to read the real-time status of ADAM-6000 modules through the web page from anywhere without any engineering effort, there are many Internet browser software:

☑ Internet Explorer, Netscape, and other browser with JAVA Machine…

If you want to develop your own web pages in the ADAM-6000 modules, the JAVA Script will be the quick and easy programming tool to design a specific operator interface.

☑ J2EE Development Kit

If you want to integrate ADAM-6000 I/O with HMI (Human Machine Interface) software in a SCADA (Supervisory Control and Data Acquisition) system, there are a lot of HMI software packages, which support Modbus/TCP driver.

☑ Advantech Studio

☑ Wonderware InTouch

☑ Intellution Fix of i-Fix

☑ Any other software support Modbus/TCP protocol

Moreover, Advantech also provides OPC Server, the most easy-to-use data exchange tool in worldwide. Any HMI software designed with OPC Client would be able to access ADAM-6000 I/O modules.

☑ Modbus/TCP OPC Server

If you want to develop your own application, the DLL driver and ActiveX will be the best tools to build up user's operator interface.

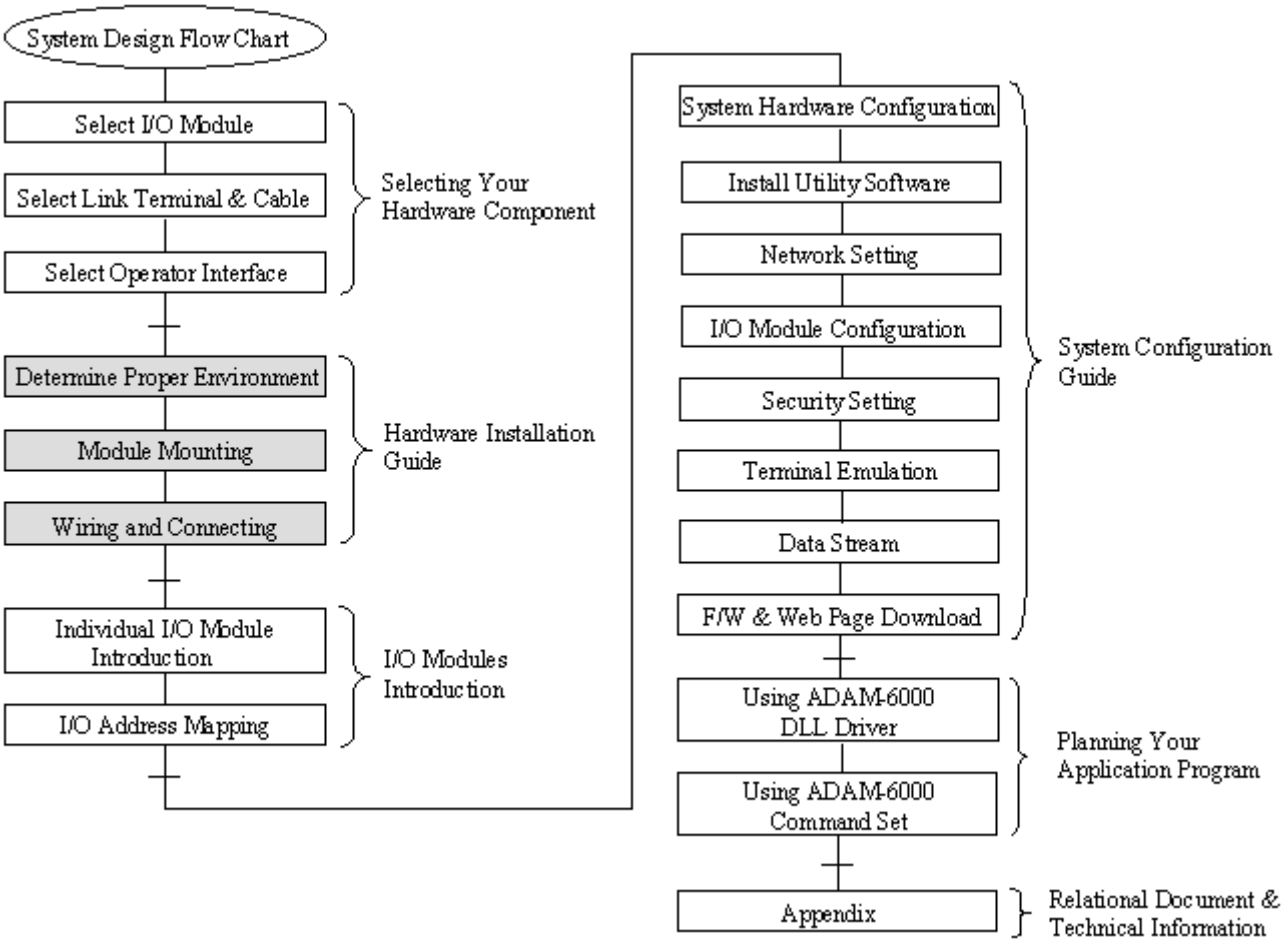
☑ ADAM-6000 DLL driver

☑ ADAM-6000 ActiveX

With these ready-to-go application software packages, tasks such as remote data acquisition, process control, historical trending and data analysis require only a few keystrokes.

Chapter 3

Hardware Installation Guide



Using this Chapter

3-1 Determining the proper environment

Before you start to install the ADAM-6000 modules, there are something needed to check.

3-1-1 Check the content of shipping box

Unpack the shipping boxes and make sure that the contents include:

- ADAM-6000 module with one bracket and DIN Rail adapter
- ADAM-6000 module User's Notes

3-1-2 System Requirements

- Host computer
  - IBM PC compatible computer with 486 CPU (Pentium is recommended)
  - Microsoft 95/98/2000/NT 4.0 (SP3 or SP4)/XP or higher versions
  - At least 32 MB RAM
  - 20 MB of hard disk space available
  - VGA color monitor
  - 2x or higher speed CD-ROM
  - Mouse or other pointing devices
  - 10 or 100 Mbps Ethernet Card
- 10 or 100 Mbps Ethernet Hub (at least 2 ports)
- Two Ethernet Cable with RJ-45 connector
- Power supply for ADAM-6000 (+10 to +30 V unregulated)

3-2 Mounting

The ADAM-6000 modules designed with compact size and allowed to install in the field site as following methods.

3-2-1 Panel mounting

Each ADAM-6000 Module has packed with a plastic panel mounting bracket. Users can refer the dimension of the bracket to configure an optimal placement in the panel or cabinet. Fix the bracket first, then, fix the ADAM-6000 module on the bracket.

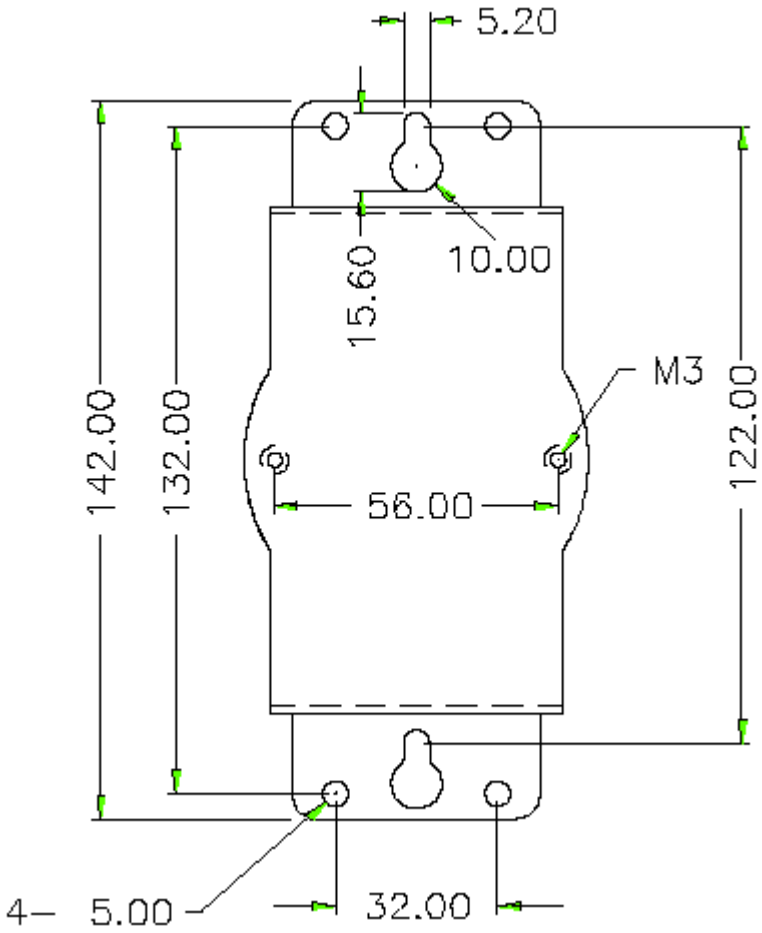


Figure 3-1: ADAM-6000 panel mounting dimension

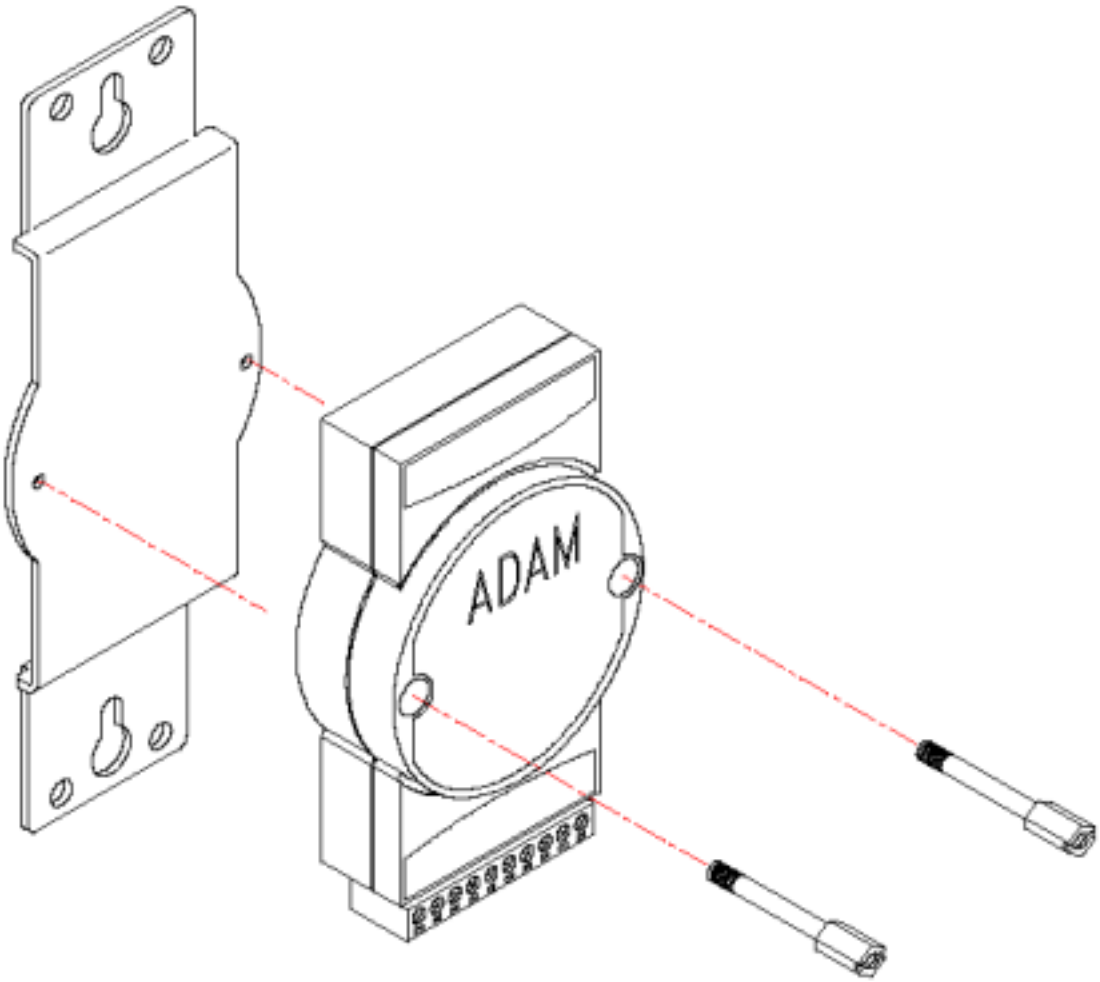


Figure 3-2: Fix ADAM-6000 module on the bracket

3-2-2 DIN rail mounting

The ADAM-6000 module can also be secured to the cabinet by using mounting rails. Fix the ADAM-6000 module with the DIN Rail adapter as figure 3-3. Then secured it on the DIN rail as figure 3-4. If you mount the module on a rail, you should also consider using end brackets at each end of the rail. The end brackets help keep the modules from sliding horizontally along the rail.

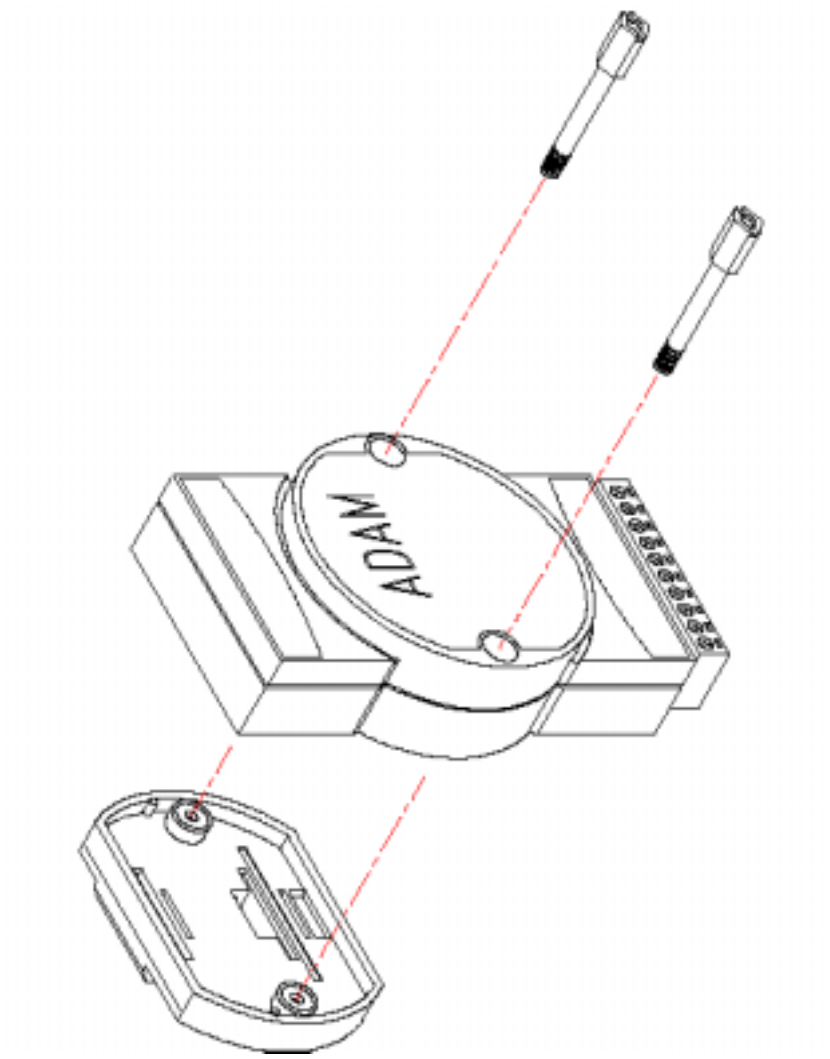
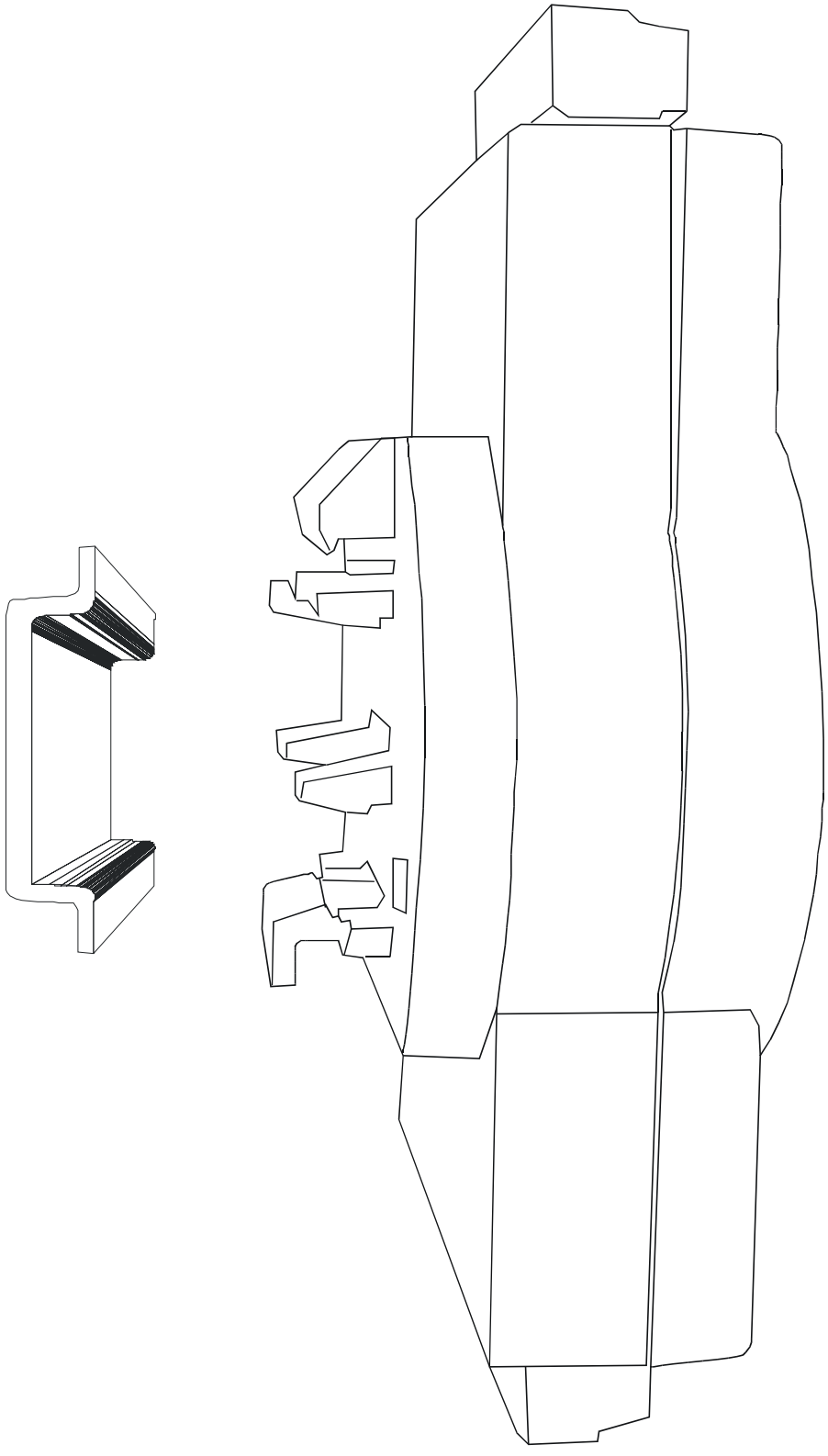


Figure 3-3: Fix ADAM-6000 module on the DIN rail adapter



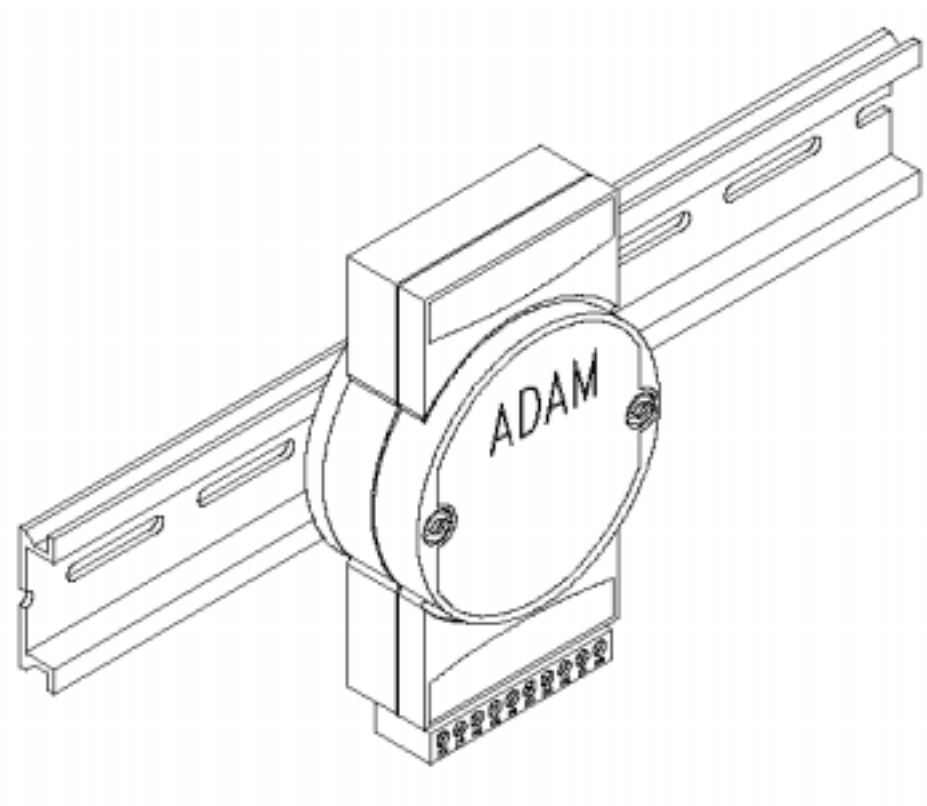


Figure 3-4: Secure ADAM-6000 Module to a DIN rail

3-3 Wiring and Connections

This section provides basic information on wiring the power supply, I/O units, and network connection.

3-3-1 Power supply wiring

Although the ADAM-6000/TCP systems are designed for a standard industrial unregulated 24 V DC power supply, they accept any power unit that supplies within the range of +10 to +30 V_{DC}. The power supply ripple must be limited to 200 mV peak-to-peak, and the immediate ripple voltage should be maintained between +10 and +30 V_{DC}. Screw terminals +Vs and GND are for power supply wiring.

Note: The wires used should be sized at least 2 mm.

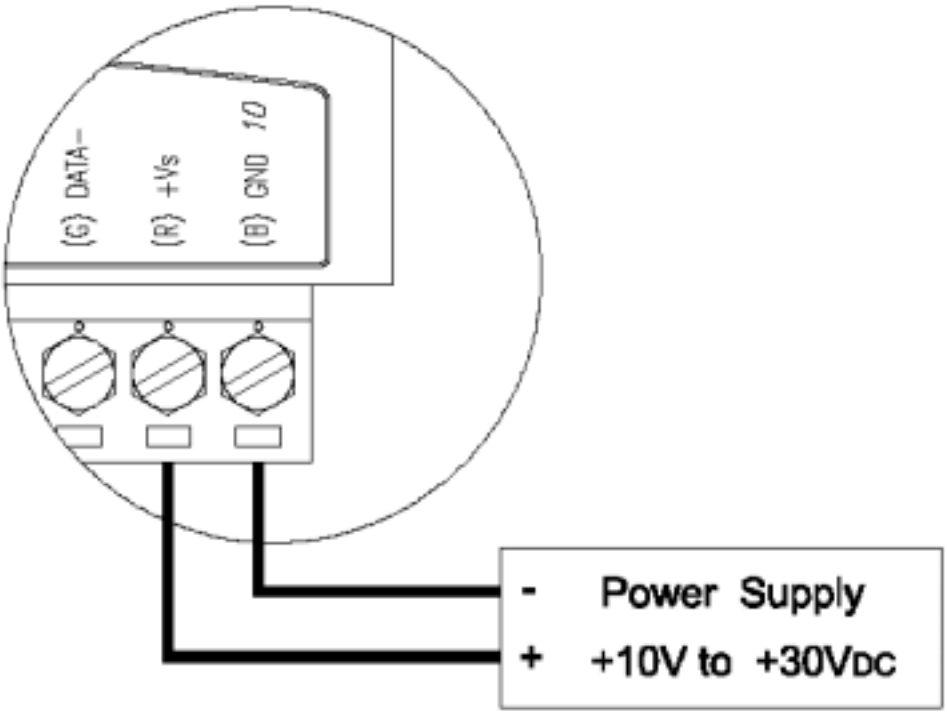


Figure 3-5: ADAM-6000 Module power wiring

We advise that the following standard colors (as indicated on the modules) be used for power lines:

+Vs (R) **Red**

GND (B) **Black**

3-3-2 I/O modules wiring

The system uses a plug-in screw terminal block for the interface between I/O modules and field devices.

The following information must be considered when connecting electrical devices to I/O modules.

1. The terminal block accepts wires from 0.5 mm to 2.5 mm.
2. Always use a continuous length of wire. Do not combine wires to make them longer.
3. Use the shortest possible wire length.
4. Use wire trays for routing where possible.
5. Avoid running wires near high-energy wiring.
6. Avoid running input wiring in close proximity to output wiring where possible.
7. Avoid creating sharp bends in the wires.

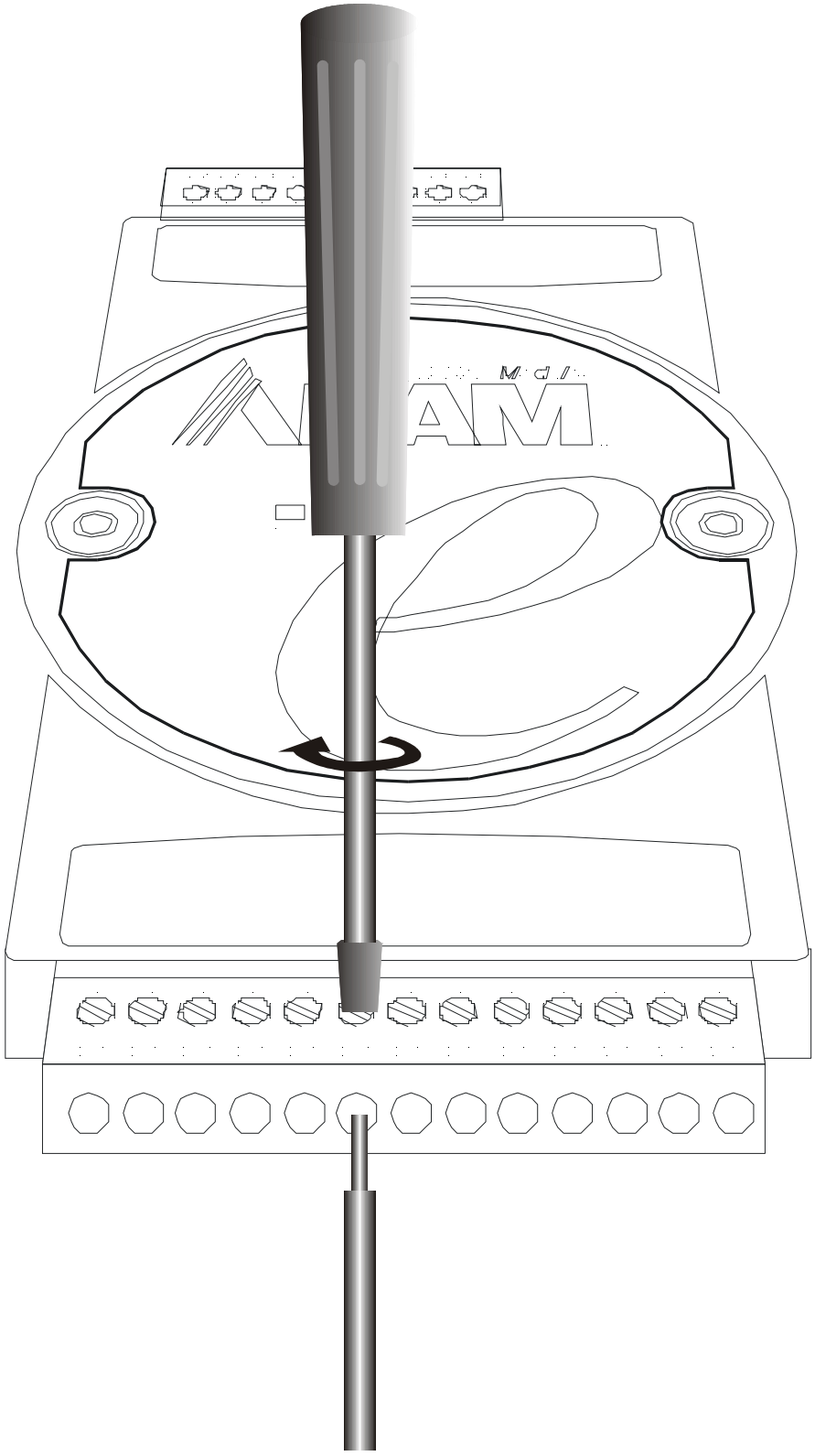
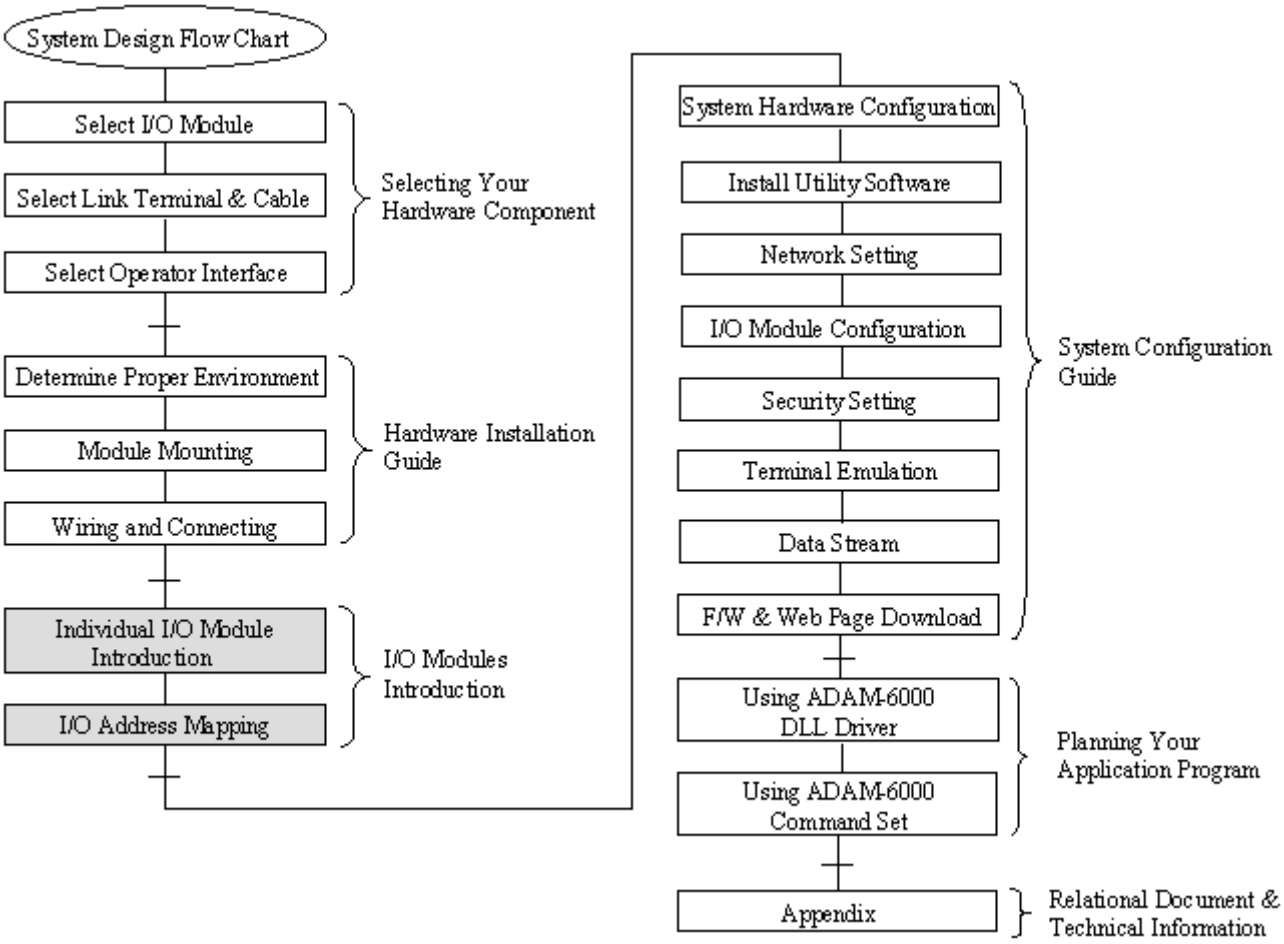


Figure 3-6: ADAM-6000 I/O Module Terminal Block wiring

Chapter 4

I/O Module Introduction



Using this Chapter

4-1 Analog Input Module

Analog input modules use an A/D converter to convert sensor voltage, current, thermocouple or RTD signals into digital data. The digital data is then translated into engineering units. When prompted by the host computer, the data is sent through a standard 10/100 based-T Ethernet interface. Users would able to read the current status via pre-built web page or any HMI software package supported Modbus/TCP protocol. The analog input modules protect your equipment from ground loops and power surges by providing opto-isolation of the A/D input and trans-former based isolation up to 3,000 V_{DC} .

ADAM-6017 8-channel Analog Input with 2/DO Module

The ADAM-6017 is a 16-bit, 8-channel analog differential input module that provides programmable input ranges on all channels. It accepts millivoltage inputs (±100mV, ±500mV), voltage inputs (±1V, ±5V and ±10V) and current input (±20 mA, 4~20 mA) and provides data to the host computer in engineering units (mV, V or mA). In order to satisfy all plant needs in one module, ADAM-6017 has designed with 8 analog inputs and 2 digital outputs. Each analog channel is allowed to configure an individual range for variety of applications.

ADAM-6017

Figure 4-1: ADAM-6017 8-channel Analog Input w/2DO Module

ADAM-6017 Specification

Analog Input:

- **Effective resolution:** 16-bit
- **Channels:** 8 differential
- **Input type:** mV, V, mA
- **Input range**: ±150 mV, ±500 mV, 0-5 V, ±10 V, 0-20 mA, 4-20 mA
- **Isolation voltage**: 3000 V_{DC}
- **Fault and overvoltage protection:** Withstands overvoltage up to ±35 V
- **Sampling rate:** 10 samples/sec.
- **Input impedance:** 20 MW
- **Bandwidth:** 13.1 Hz @ 50 Hz, 15.72 Hz @ 60 Hz
- **Accuracy:** ±0.1% or better
- **Zero drift:** ±6 μV/° C
- **Span drift:** ±25 ppm/° C
- **CMR @ 50/60 Hz:** 92 dB min.

Digital Output:

- **Channel:** 2

  Open Collector to 30 V

  200 mA max. load

- **Optical Isolation:** 5000V_{RMS}

Built-in Watchdog Timer

Power

- **Power requirements:** Unregulated +10 ~ +30 VDC
- **Power consumption:** 2 W

Application Wiring

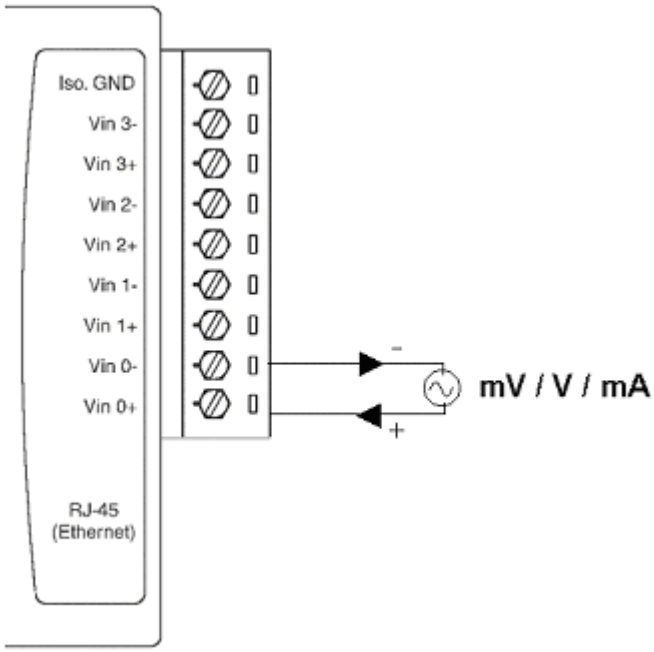


Figure 4-2: ADAM-6017 millivoltage, voltage, and current Input Wiring

ADAM-6017 has built with a 120 Ω resistor in each channel, users do not have to add any resistors in addition for current input measurement. Just adjust the jumper setting to choose the specific input type you need. Refer to Figure 4-3, each analog input channel has built-in a jumper on the PCB for users to set as a voltage mode or current mode.

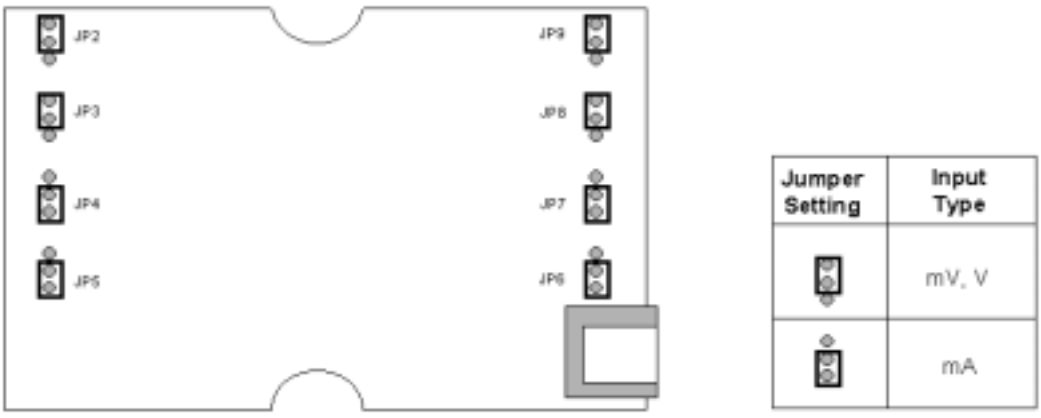


Figure 4-3: ADAM-6017 Analog Input Type Setting

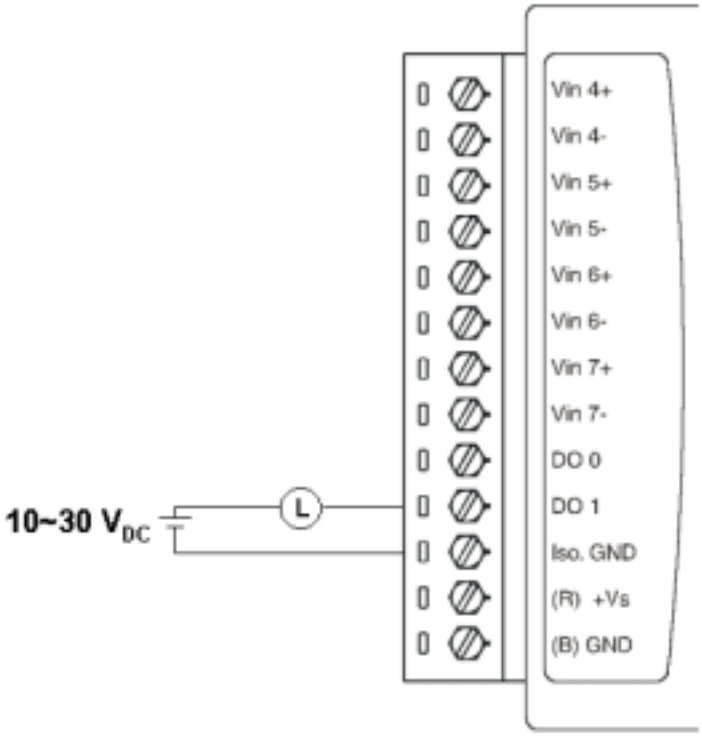


Figure 4-4: ADAM-6017 Digital Output wiring

Assigning address for ADAM-6017 Modules

Basing on Modbus/TCP standard, the addresses of the I/O channels in ADAM-6000 modules you place in the system are defined by a simple rule. Please refer the Figures 4-5 to map the I/O address.

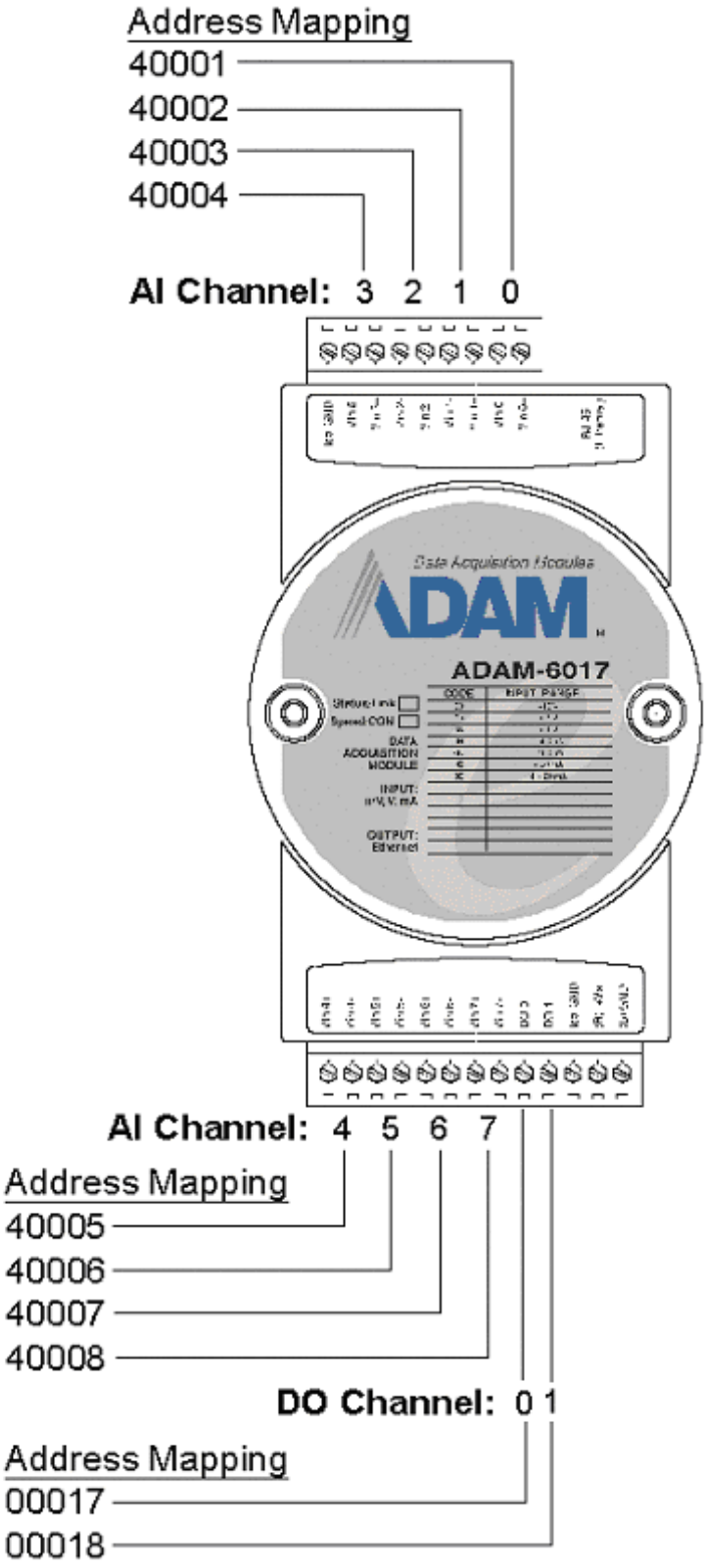


Figure 4-5: ADAM-6017 I/O Address Mapping

4-2 Digital I/O Module

ADAM-6050 18-channel Digital I/O Module

The ADAM-6050 is a high-density I/O module built-in a 10/100 based-T interface for seamless Ethernet connectivity. It provides 12 digital input and 6 digital output channels with 5000V_{RMS} Isolating protection. All of the Digital Input channels support input latch function for important signal handling. Mean while, these DI channels allow to be used as 1 KHz counter. Opposite to the intelligent DI functions, the Digital Output channels also support pulse output function.

ADAM-6050

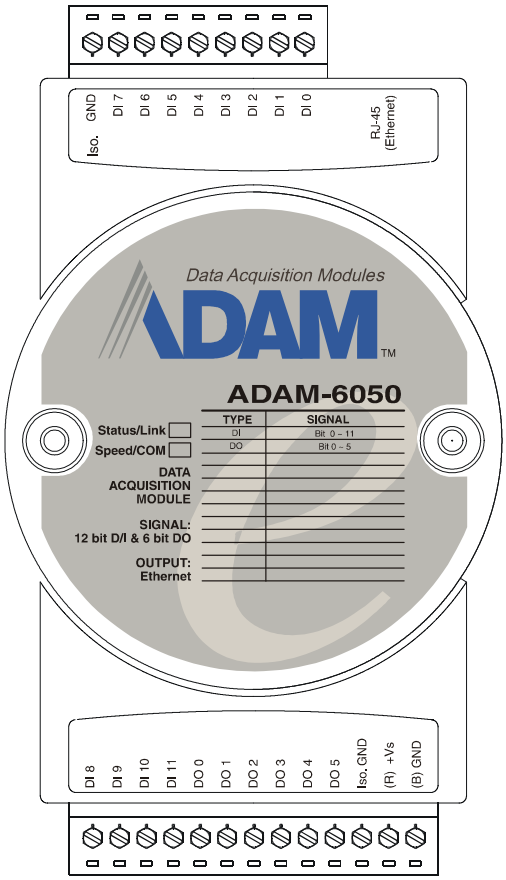


Figure 4-6: ADAM-6050 18-channel Digital I/O Module

ADAM-6050 Specification

Analog Input:

• **Channel:** 18

• **I/O type:** 12 DI & 6 DO

• **Digital Input:**

Dry Contact:

Logic level 0: Close to GND

Logic level 1: Open

(Logic level status can be inversed by Utility)

• **Digital Output:**

Open Collector to 30 V

200 mA max. load

• **Optical Isolation:** 5000V_{RMS}

• **Power Consumption:** 2 W (Typical)

Application Wiring

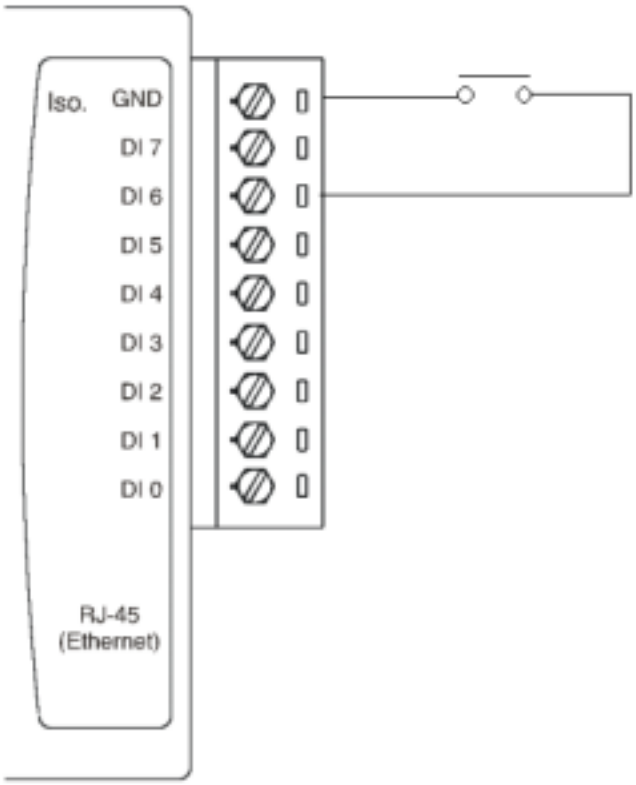


Figure 4-7: ADAM-6050 Digital Input Wiring

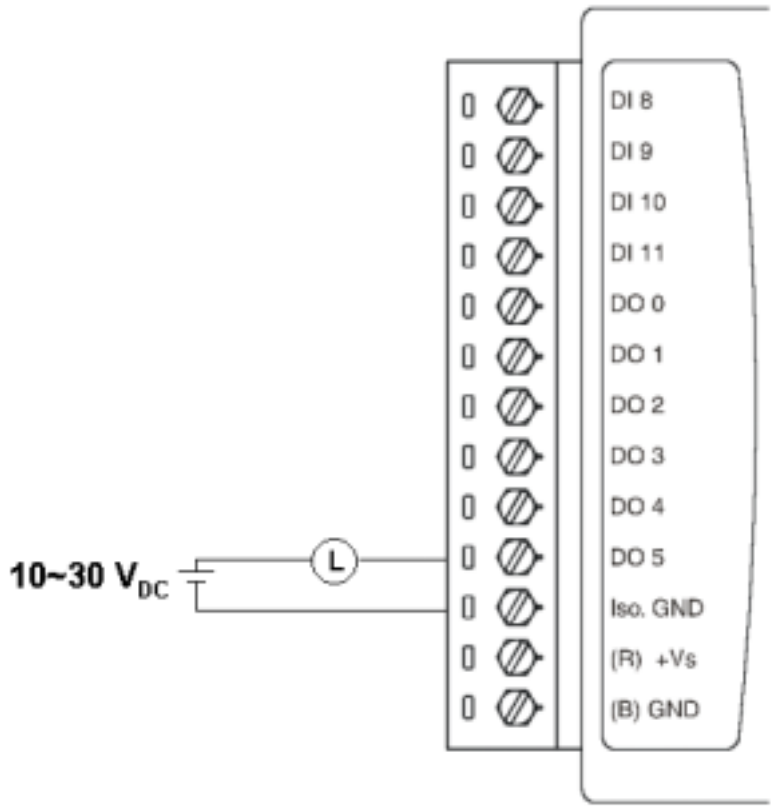


Figure 4-8: ADAM-6050 Digital Output Wiring

Assigning address for ADAM-6050 Modules

Basing on Modbus/TCP standard, the addresses of the I/O channels in ADAM-6000 modules you place in the system are defined by a simple rule. Please refer the Figures 4-10 to map the I/O address.

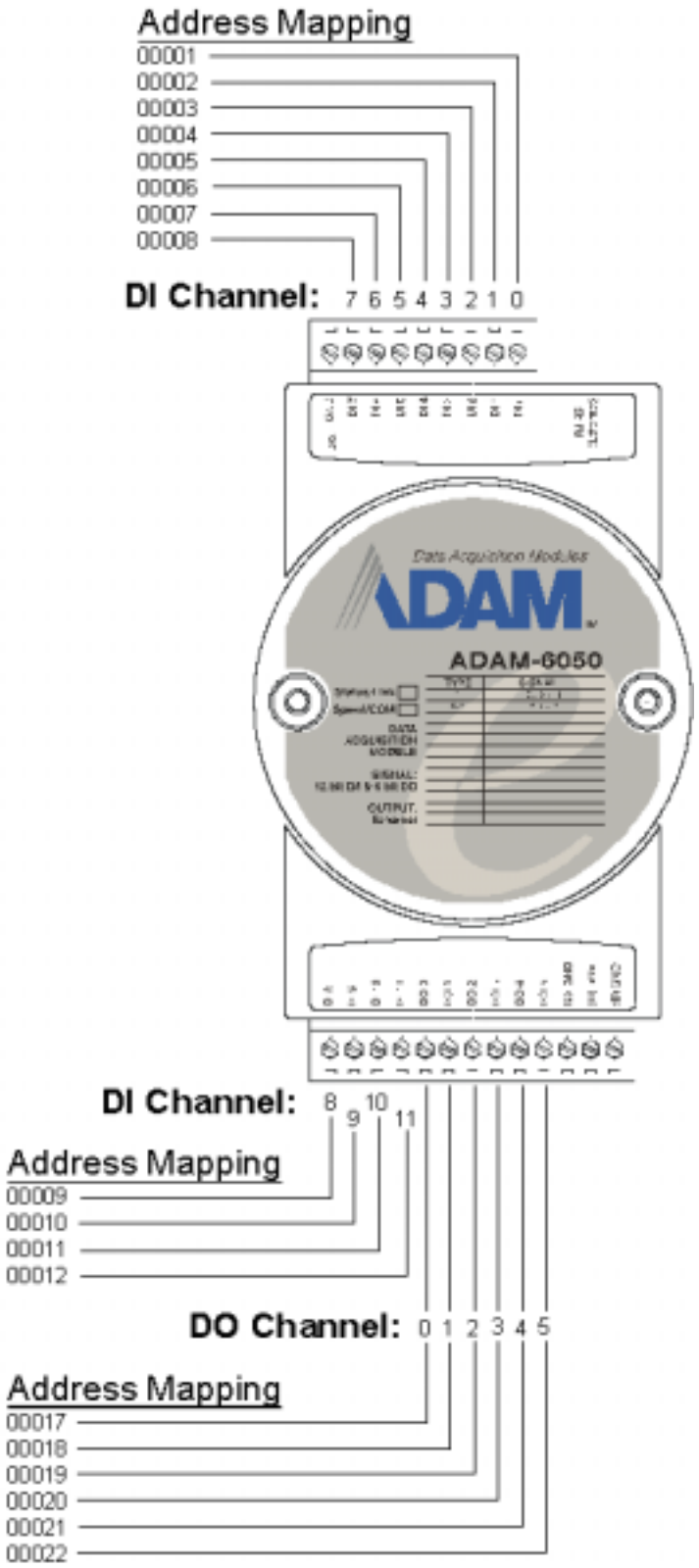


Figure 4-9 ADAM-6050 I/O Address Mapping

All Digital Input channels in ADAM-6050 are allowed to use as 32-bit counters (Each counter is consisted of two addresses, Low word and High word). Users could configure the specific DI channels to be counters via Windows Utility. The I/O address will be mapped as Figures 4-10.

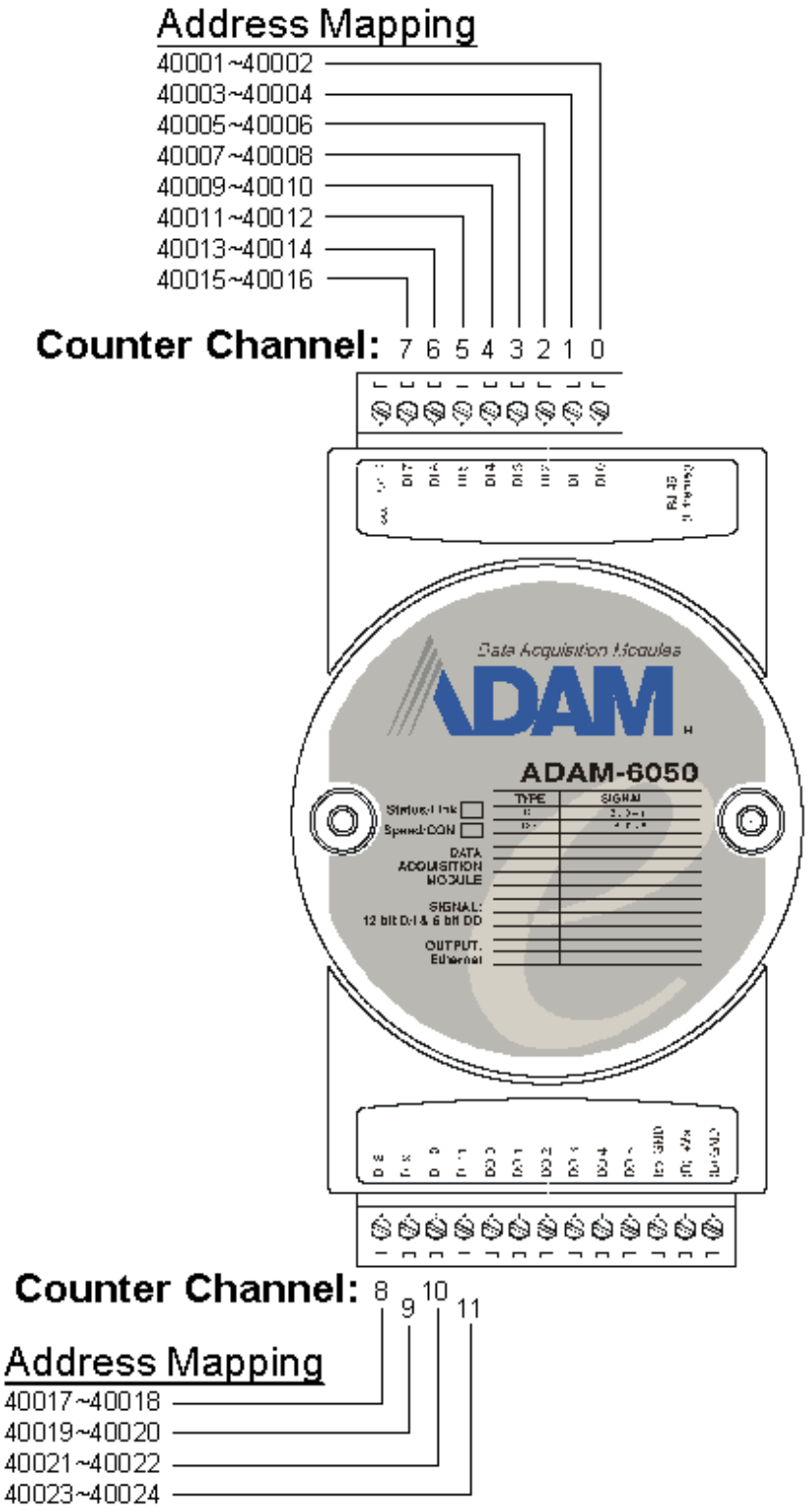


Figure 4-10 ADAM-6050 Counter Address Mapping

ADAM-6051 16-channel Digital I/O w/Counter Module

The ADAM-6051 is a high-density I/O module built-in a 10/100 based-T interface for seamless Ethernet connectivity. It provides 12 digital input, 2 digital output, and 2 counter (10 KHz) channels with 5000V_{RMS} Isolating protection. All of the Digital Input channels support input latch function for important signal handling. Mean while, these DI channels allow to be used as 1 KHz counter. Opposite to the intelligent DI functions, the Digital Output channels also support pulse output function.

ADAM-6051

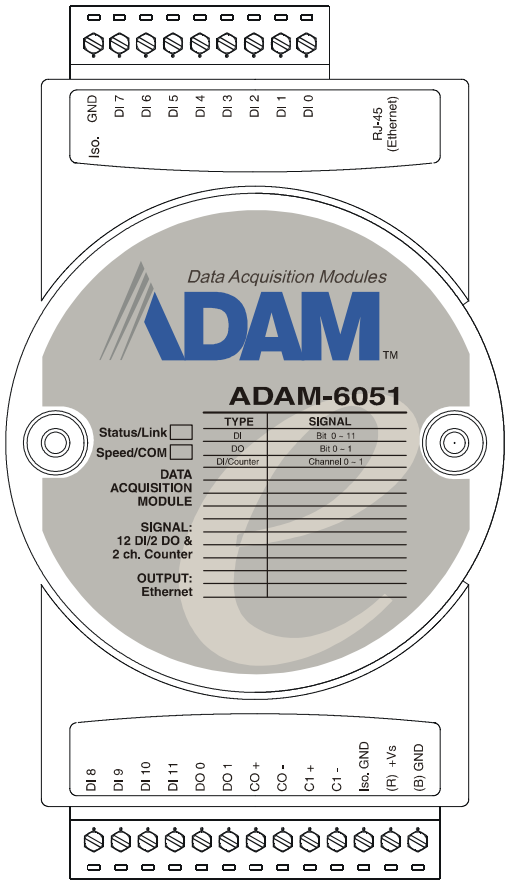


Figure 4-11: ADAM-6051 16-channel Digital I/O w/Counter Module

ADAM-6051 Specification

• **Channel:** 16

• **I/O type:** 12DI / 2DO / 2Counter

• **Digital Input:**

Dry Contact:

Logic level 0: Close to GND

Logic level 1: Open

(Logic level status can be inversed by Utility)

• **Digital Output:**

Open Collector to 30 V

200 mA max. load

• **Optical Isolation:** 5000V_{RMS}

• **Counter:**

Maximum Count: 4,294,967,285(32 bit)

Input frequency: 0.3 ~ 1000 Hz max. (frequency mode)

5000 Hz max. (counter mode)

Isolation voltage: 2500 V_{RMS}

Mode: Counter (Up/Down, Bi-direction), Frequency

• **Power Consumption:** 2 W (Typical)

Application Wiring

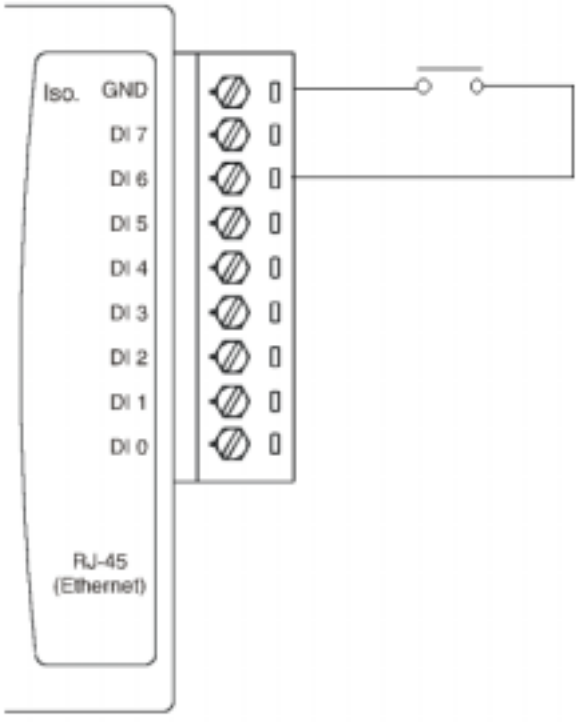


Figure 4-12: ADAM-6051 Digital Input Wiring

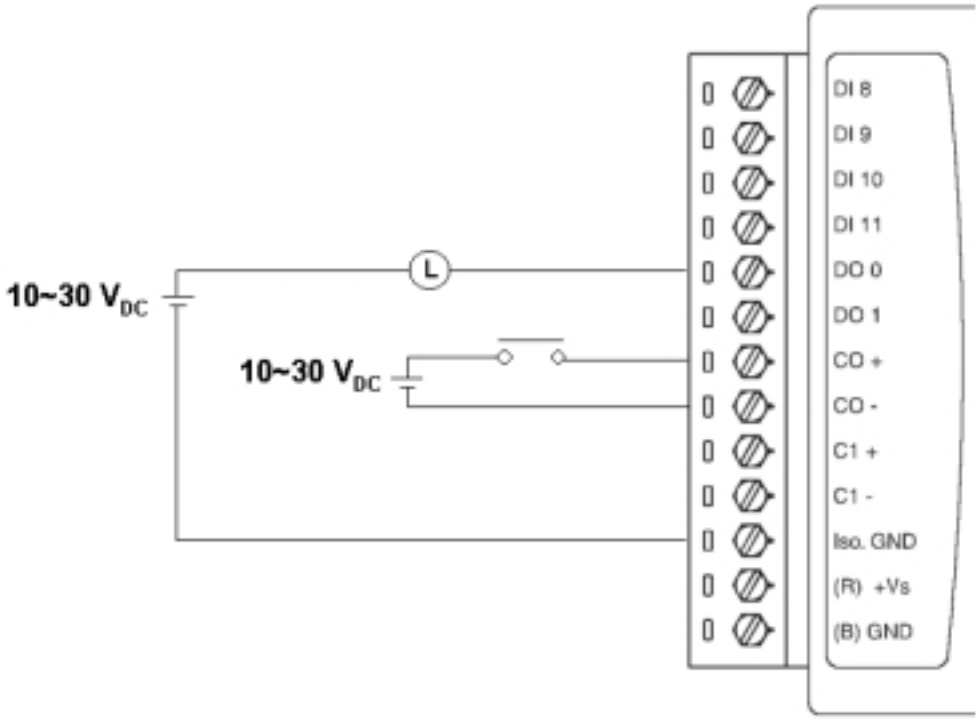


Figure 4-13: ADAM-6051 Digital Output and Counter Wiring

Assigning address for ADAM-6051 Modules

Basing on Modbus/TCP standard, the addresses of the I/O channels in ADAM-6000 modules you place in the system are defined by a simple rule. Please refer the Figures 4-14 to map the I/O address.

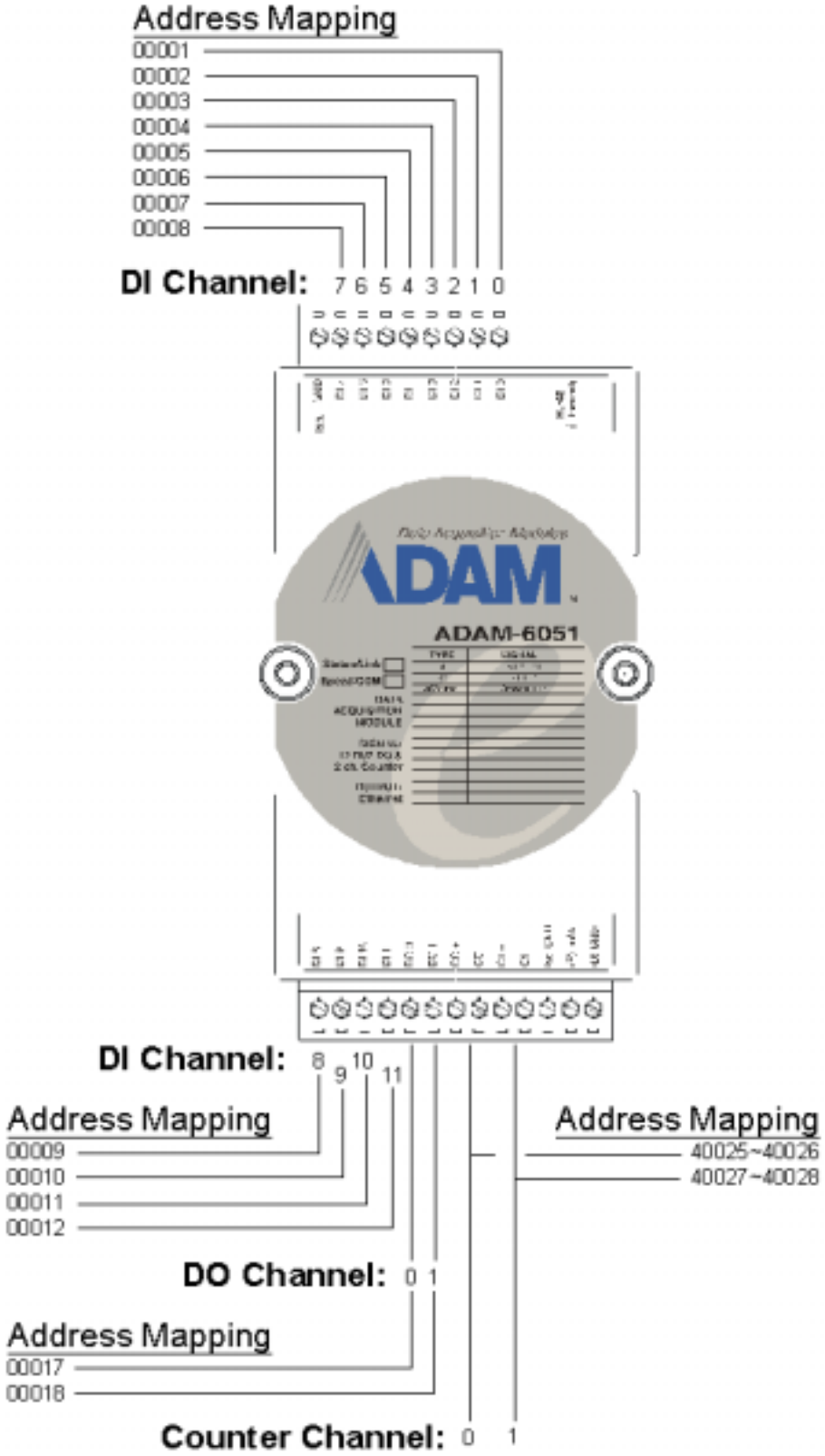


Figure 4-14: ADAM-6051 I/O Address Mapping

All Digital Input channels in ADAM-6051 are allowed to use as 32-bit counters (Each counter is consisted of two addresses, Low word and High word). Users could configure the specific DI channels to be counters via Windows Utility. The I/O address will be mapped as Figures 4-15.

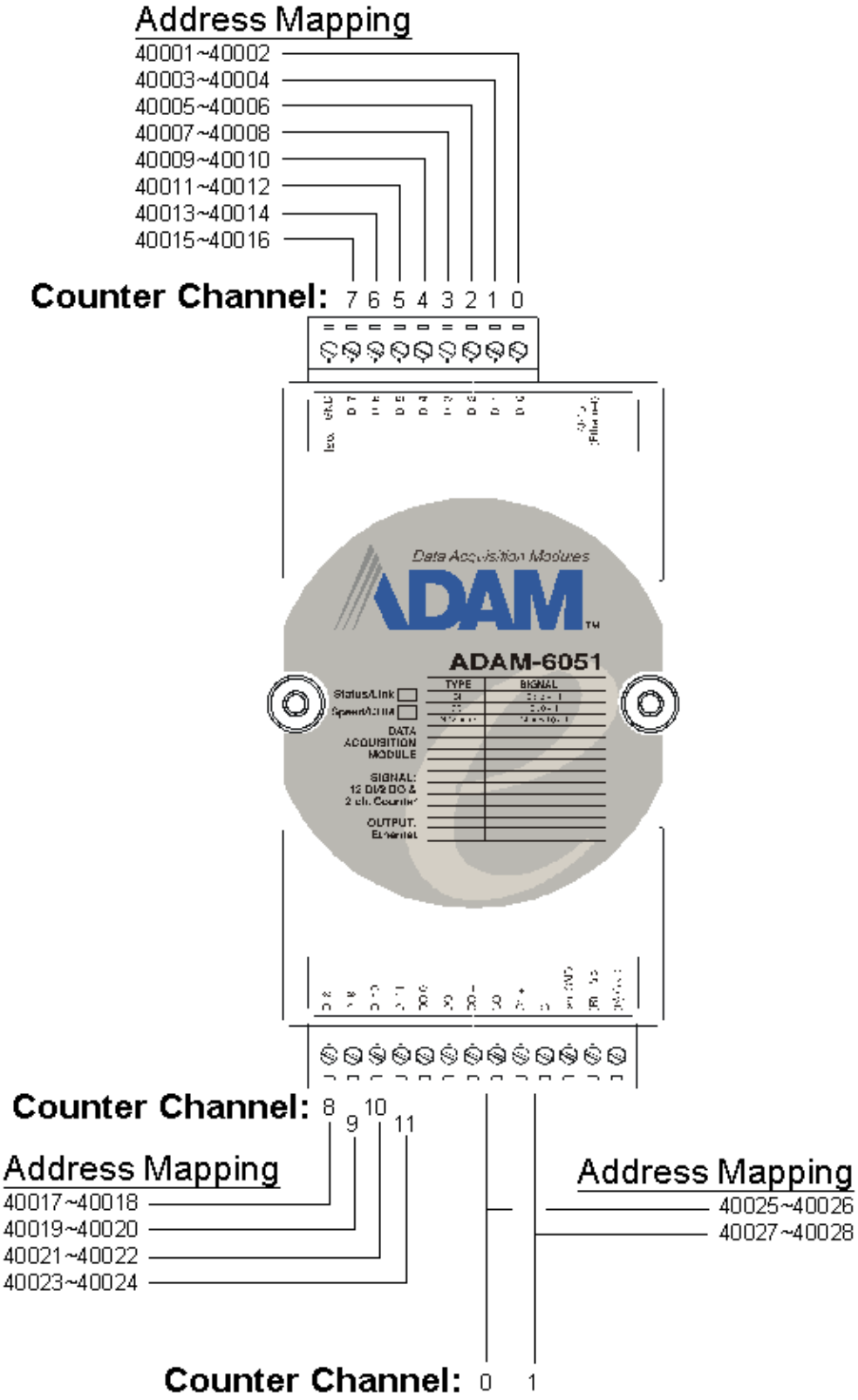


Figure 4-15: ADAM-6051 Counter Address Mapping

ADAM-6060 6-channel Relay Output with DI Module

The ADAM-6060 is a high-density I/O module built-in a 10/100 based-T interface for seamless Ethernet connectivity. Bonding with an Ethernet port and web page, the ADAM-6060 offers 6 relay (form A) output and 6 digital input channels. It supports contact rating as AC 120V @ 0.5A, and DC 30V @ 1A. All of the Digital Input channels support input latch function for important signal handling. Mean while, these DI channels allow to be used as 1 KHz counter. Opposite to the intelligent DI functions, the Digital Output channels also support pulse output function.

ADAM-6060

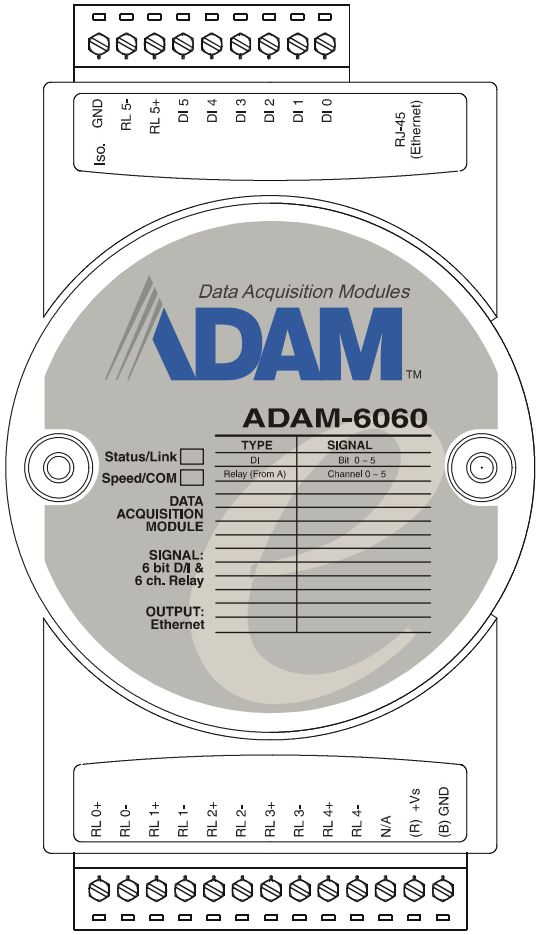


Figure 4-16: ADAM-6060 6-channel Relay Output w/DI Module

ADAM-6060 Specification

• **Channel:** 12

• **I/O type:** 6 Relay & 6 DI

• **Relay Output** (Form A)**:**

Contact rating: AC: 120 V @ 0.5 A

DC: 30 V @ 1 A

Breakdown voltage: 500 V_{AC} (50/60 Hz)

Relay on time: 7 msec; Relay off time: 3 msec.

Total switching time: 10 msec.

Insulation resistance: 1000 MW minimum at 500 V_{DC}

• **Digital Input:**

Dry Contact:

Logic level 0: Close to GND

Logic level 1: Open

(Logic level status can be inversed by Utility)

• **Optical Isolation:** 5000V_{RMS}

• **Power Consumption:** 2 W (Typical)

Application Wiring

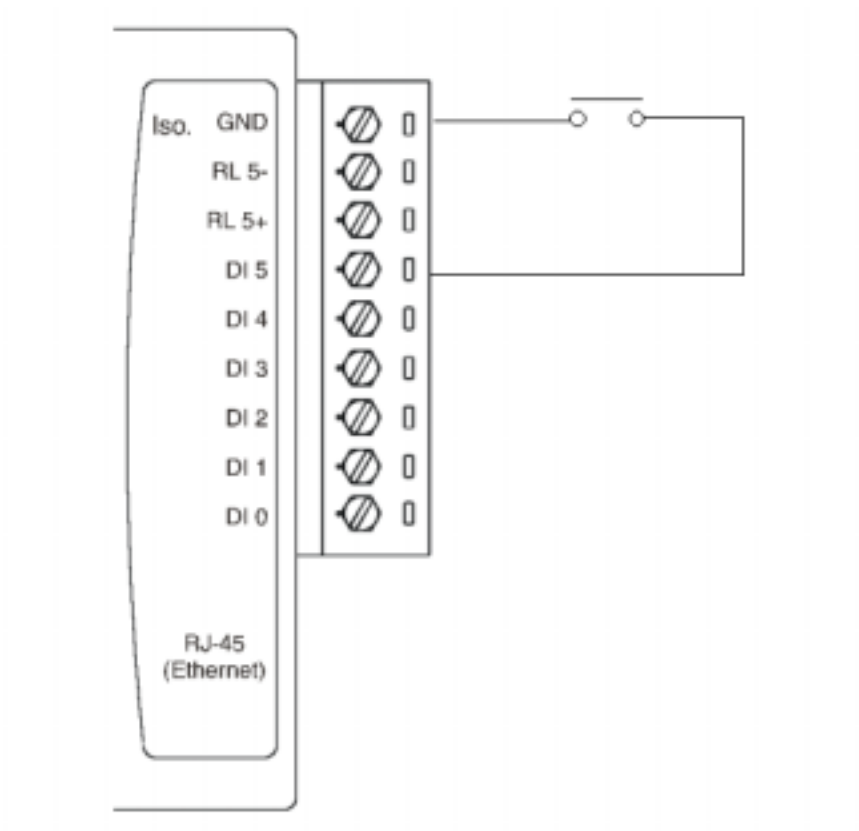


Figure 4-17: ADAM-6060 Digital Input Wiring

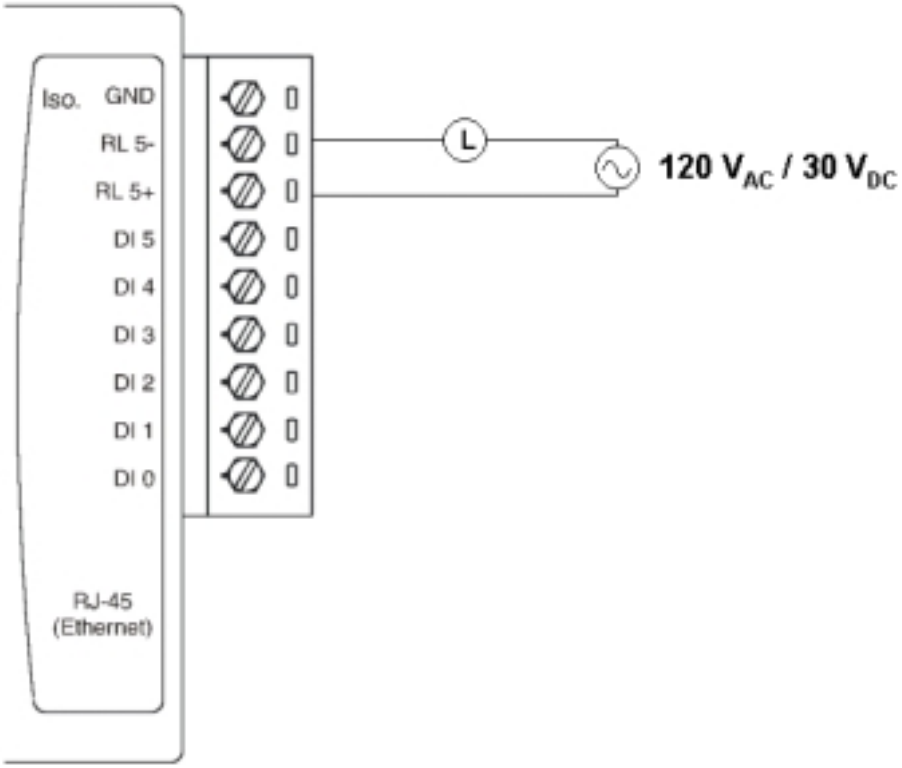


Figure 4-18: ADAM-6060 Relay Output Wiring

Assigning address for ADAM-6060 Modules

Basing on Modbus/TCP standard, the addresses of the I/O channels in ADAM-6000 modules you place in the system are defined by a simple rule. Please refer the Figures 4-19 to map the I/O address.

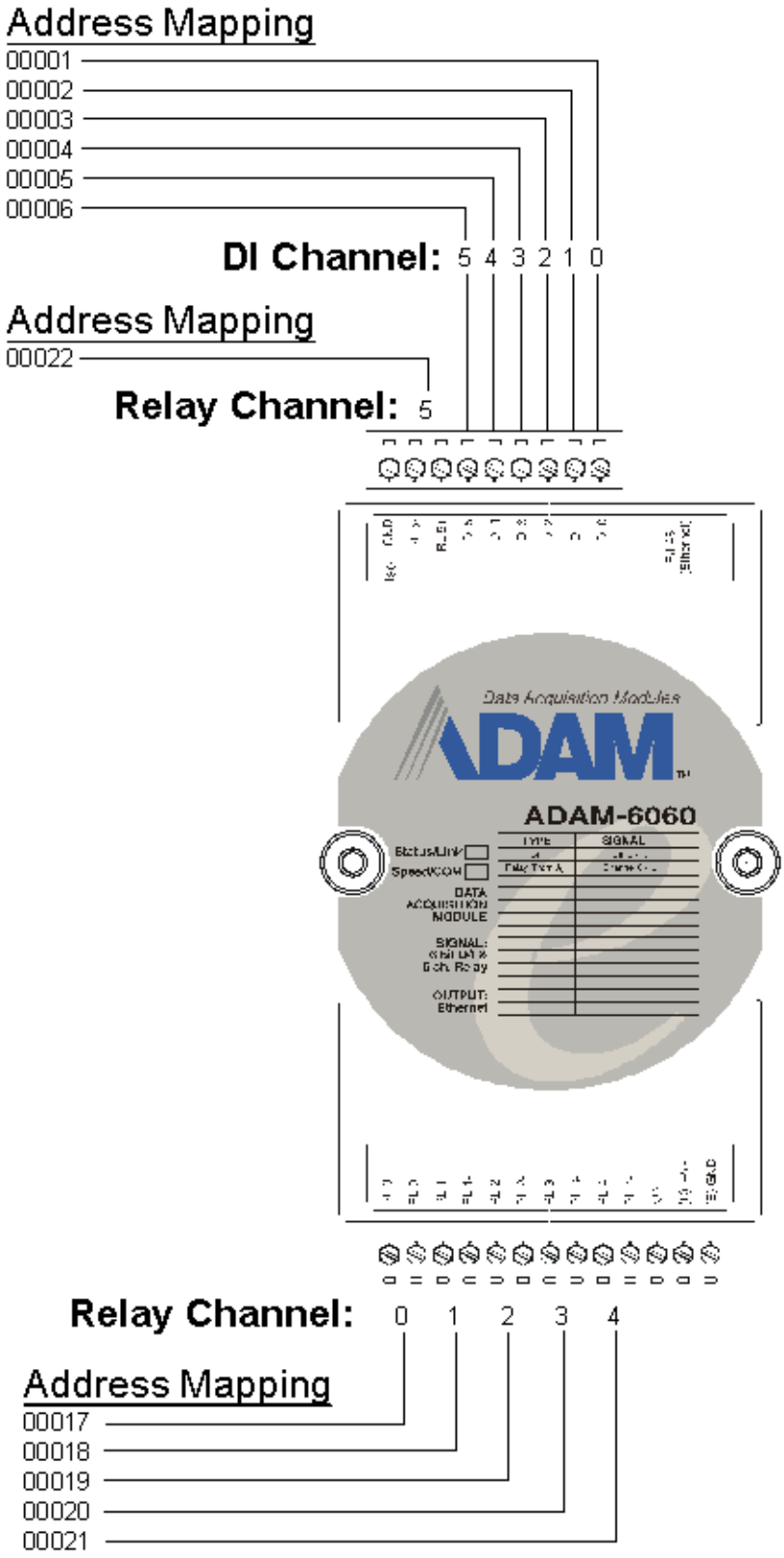


Figure 4-19: ADAM-6060 I/O Address Mapping

All Digital Input channels in ADAM-6060 are allowed to use as 32-bit counters (Each counter is consisted of two addresses, Low word and High word). Users could configure the specific DI channels to be counters via Windows Utility. The I/O address will be mapped as Figures 4-20.

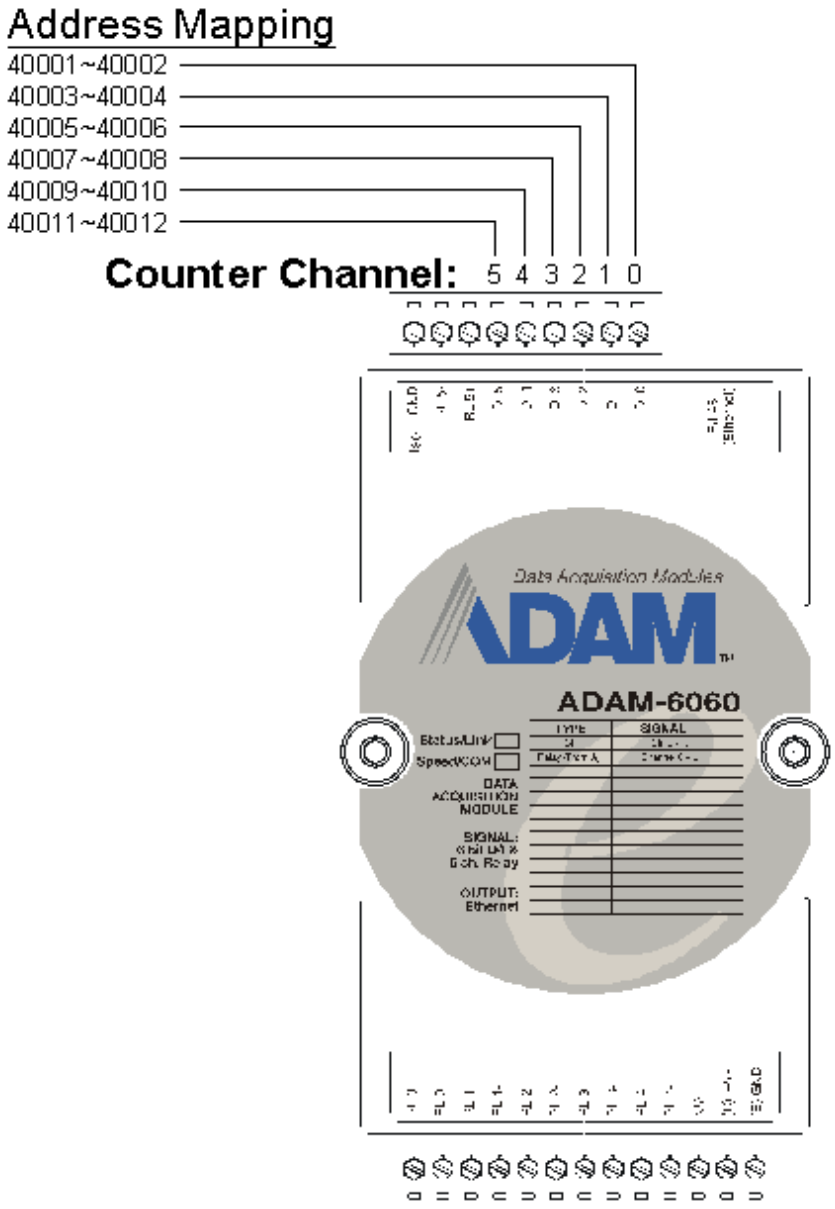
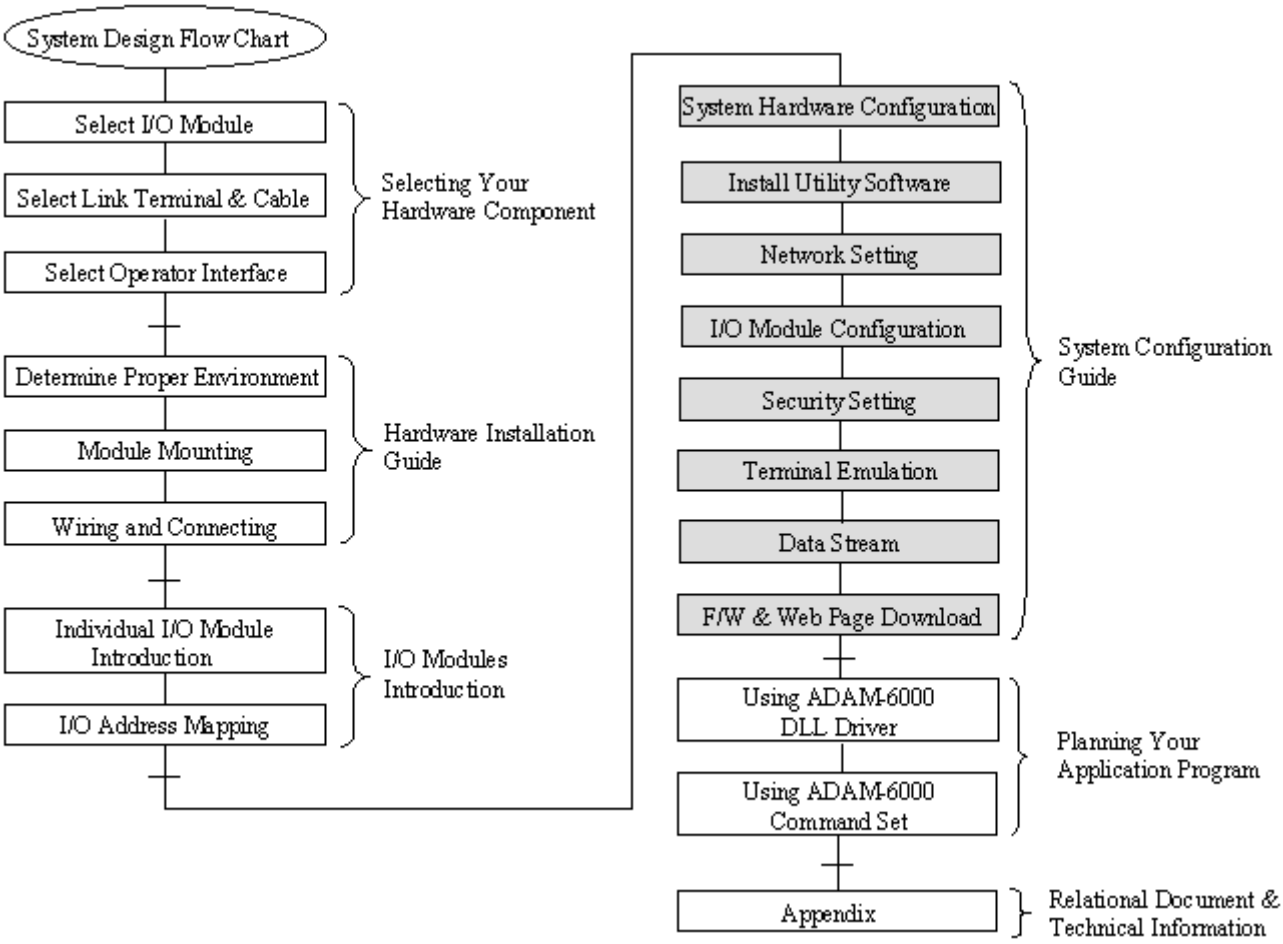


Figure 4-20: ADAM-6060 Counter Address Mapping

Chapter 5

System Configuration Guide



Using this Chapter

This chapter explains how to use ADAM Ethernet I/O Utility to configure the ADAM-6000 modules for various applications. Users can learn the hardware connection, software installation, communication setting and every procedure for system configuration from these sections.

5-1 System Hardware Configuration

As we mentioned in chapter 3-1, you will need following items to complete your system hardware configuration.

System Requirement

- Host computer
  - IBM PC compatible computer with 486 CPU (Pentium is recommended)
  - Microsoft 95/98/2000/NT 4.0 (SP3 or SP4) or higher versions
  - At least 32 MB RAM
  - 20 MB of hard disk space available
  - VGA color monitor
  - 2x or higher speed CD-ROM
  - Mouse or other pointing devices
  - 10 or 100 Mbps Ethernet Card
- 10 or 100 Mbps Ethernet Hub (at least 2 ports)
- Two Ethernet Cable with RJ-45 connector
- Power supply for ADAM-6000 (+10 to +30 V unregulated)

Make sure to prepare all of the items above, then connect the power and network wiring as figure 5-1.

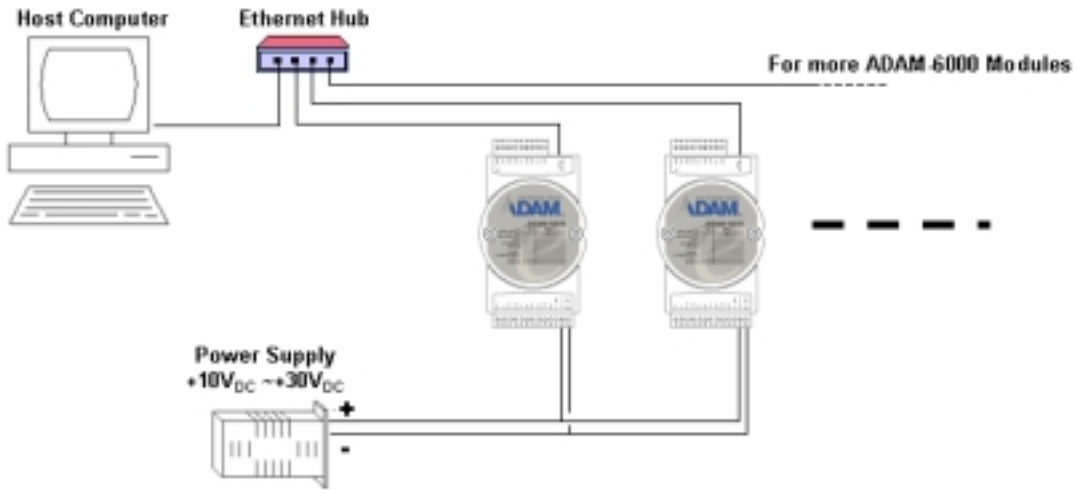


Figure 5.1 Hardware Configuration

5-2 Install Utility Software on Host PC

Advantech provide free download Manual and Utility software for ADAM-6000 modules' operation and configuration. Link to the web site: www.advantech.com and click into the "Download Area" under Service & Support site to get the latest version ADAM-6000 manual and Ethernet I/O Utility.
Once you download and setup the Utility software, there will be a shortcut of the Utility executive program on Windows' desktop after completing the installation.

Notes: This Utility would be able to support ADAM-5000/TCP and ADAM-6000 I/O modules.

5-3 ADAM Ethernet I/O Utility Overview

The Utility software offers a graphical interface that helps you configure the ADAM-6000 modules. It is also very convenient to test and monitor your Remote DA&C System. The following guidelines will give you some brief instructions on how to use this Utility.

- Main Menu
- Network Setting
- Adding Remote Station
- I/O Module Configuration
- Alarm Setting
- I/O Module Calibration
- Firmware and Web Page Update
- Security Setting
- Terminal emulation
- Data Stream
- RS-458 Modbus Network Setting

5-3-1 Main Menu

Double Click the icon of ADAM Ethernet I/O Utility shortcut, the Operation screen will pop up as Figure 5-2.

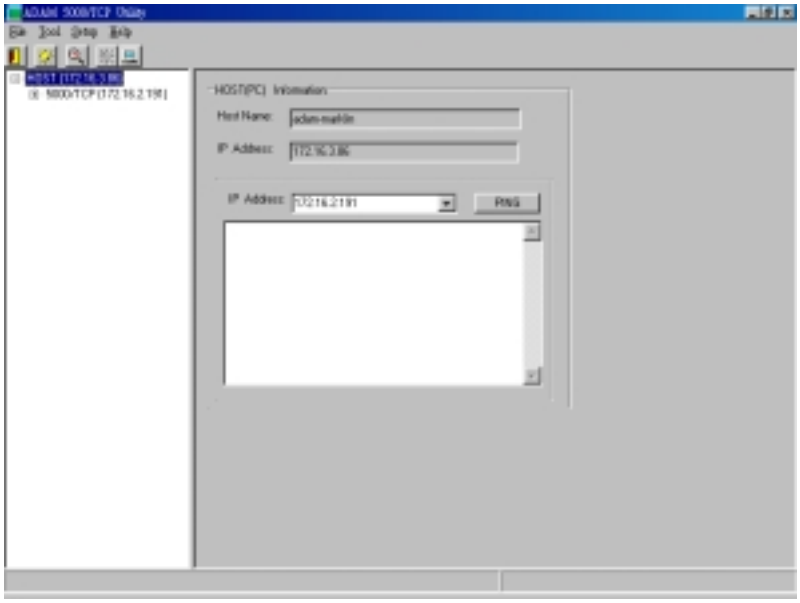
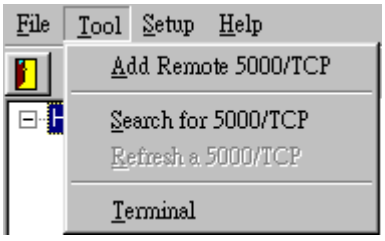


Figure 5-2 Operation Screen

The top of the operation screen consists of a function menu and a tool bar for user's commonly operating functions.

Function Menu

Item **File** contents "Exit" Function, using to exit this Utility program.



Item **Tool** contents functions as below:

Add Remote Ethernet Device□Create a new ADAM-6000 module or ADAM-5000/TCP located in other Ethernet domination, both available to local LAN and Internet application.

Search for Ethernet Device□Search all ADAM-6000 and ADAM-5000/TCP units in the specific Ethernet domination. (The same with host PC's Ethernet domination)

Refresh a Ethernet Device□Refresh the specific ADAM-6000 or ADAM-5000/TCP unit to verify the system status.

Terminal：Call up the operation screen of Terminal emulation to do the request / response command execution.

Item **Setup** contents Timeout and Scan Rate setting functions. Please be aware of the time setting for other Ethernet domination usually longer than local network.

Item **Help** contents on-line help function as user's operation guide; the item **About** contents information about software version, released date, and support modules.

Tool Bar

There are five push buttons in the tool bar.

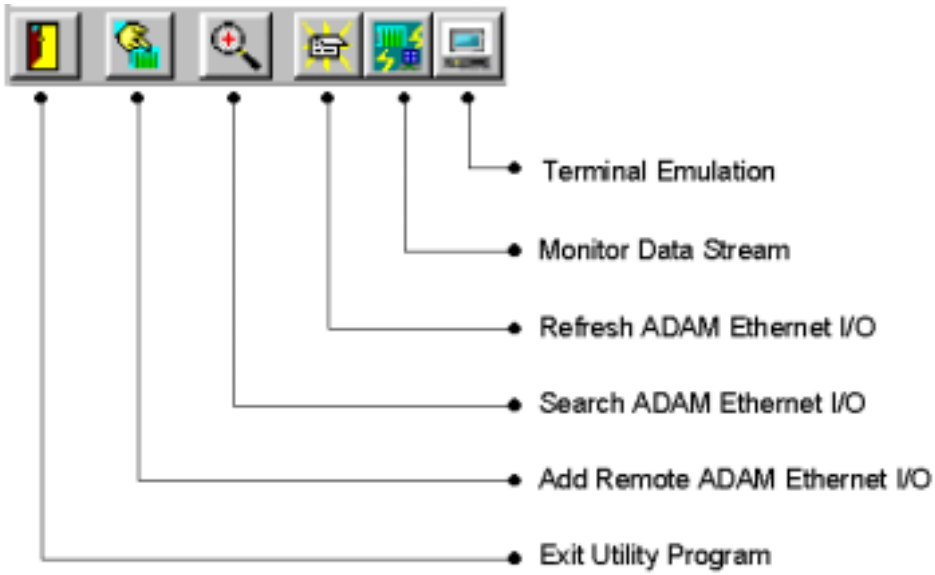


Figure 5-3 Tool Bar

5-3-2 Network Setting

As the moment you start up this Windows Utility, it will search all ADAM-6000 I/O modules and ADAM-5000/TCP on the host PC's domination Ethernet network automatically. Then the tree-structure display area will appeal with the searched units and the relative IP address.

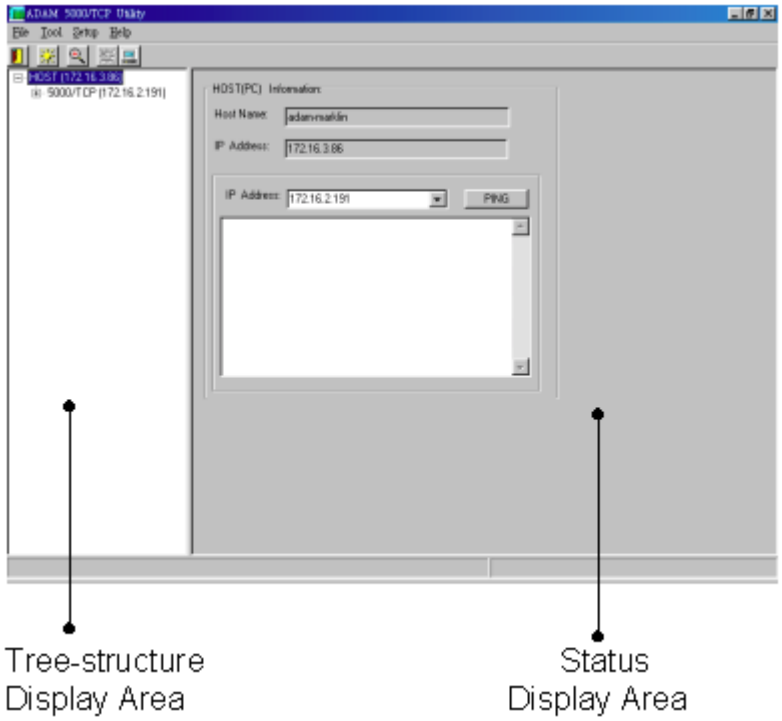


Figure 5-4 Network Setting

See Figure 5-4, there are also Host PC's information in the status display area, include host name and IP address. Moreover, the Windows Utility provides network connection test tool for user to verify whether the communication is workable. Key-in the specific IP address you want to connect and click the **PING** button, the testing result will show as Figure 5-5.

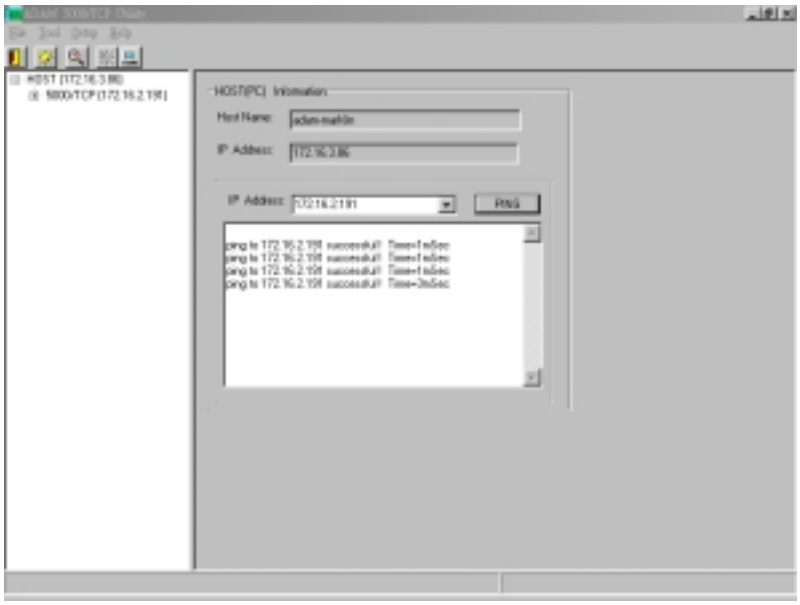


Figure 5-5 Communication testing function

Since Utility software detects the ADAM-6000 and 5000/TCP on the network, user can begin to setup each unit with following steps.

Step1. Choose any one station, all I/O modules plugged in the main unit will be listed on the tree-structure display area. Mean while, the "Device Name" and "Device Description" are editable by operator's needs.

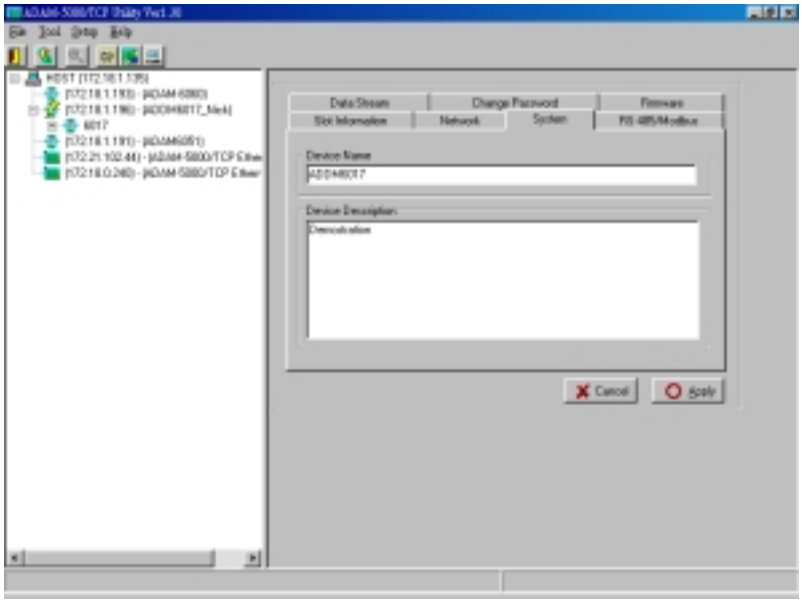


Figure 5-6 Define Device Name and Description

Step2. Click the Network Tab to configure the TCP/IP network setting

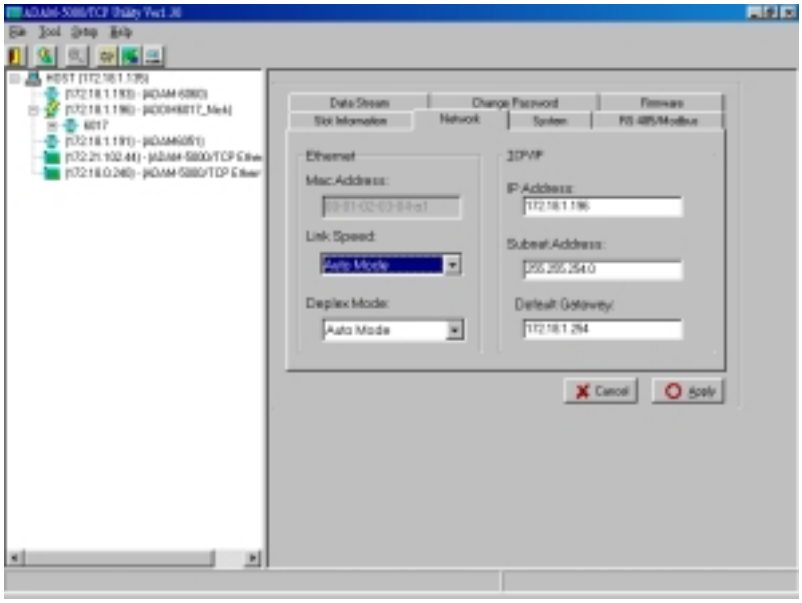


Figure 5-7 TCP/IP Network setting

MAC Address：This is also called Ethernet address and needs no further configuration.

Link Speed：This function will show the current linking speed to be either 10Mbps or 100Mbps. However, the utility will auto-detect the current transmission speed on the network segment and set the transmission speed for the device accordingly without your further efforts.

Duplex Mode：The utility will detect the current transmission mode (half-duplex or full-duplex) on the network segment, and set the transmission mode for the device accordingly without your further efforts.

IP Address, Subnet Mask, Default Gateway：

The IP address identifies your ADAM-6000 and ADAM-5000/TCP devices on the global network. Each ADAM-6000 and ADAM-5000/TCP has same default IP address **10.0.0.1**. Therefore, please do not initial many ADAM-6000 and ADAM-5000/TCP at the same time to avoid the Ethernet collision.

If you want to configure the ADAM-6000 and ADAM-5000/TCP in the host PC's dominating network, only the IP address and Subnet Mask will need to set (The host PC and ADAM Ethernet I/O must belong to same subnet Mask).

If you want to configure the ADAM-6000 and ADAM-5000/TCP via Internet or other network domination, you have to ask your network administrator to obtain a specific IP and Gateway addresses, then configure each ADAM-6000 and ADAM-5000/TCP with the individual setting.

5-3-3 Add Remote Stations

To meet the remote monitoring and maintenance requirements, The ADAM-6000 and ADAM-5000/TCP System does not only available to operate in local LAN, but also allowed to access from Internet or Intranet. Thus users would able to configure an ADAM-6000 and ADAM-5000/TCP easily no matter how far it is.

Select item **Tool**\Add Remote Ethernet I/O in function menu or click the  button, the adding station screen will pop up as Figure 5-8. Then key-in the specific IP address and click the **Add** button. If the communication success, the added ADAM Ethernet I/O unit should appeal on the tree-structure display area.

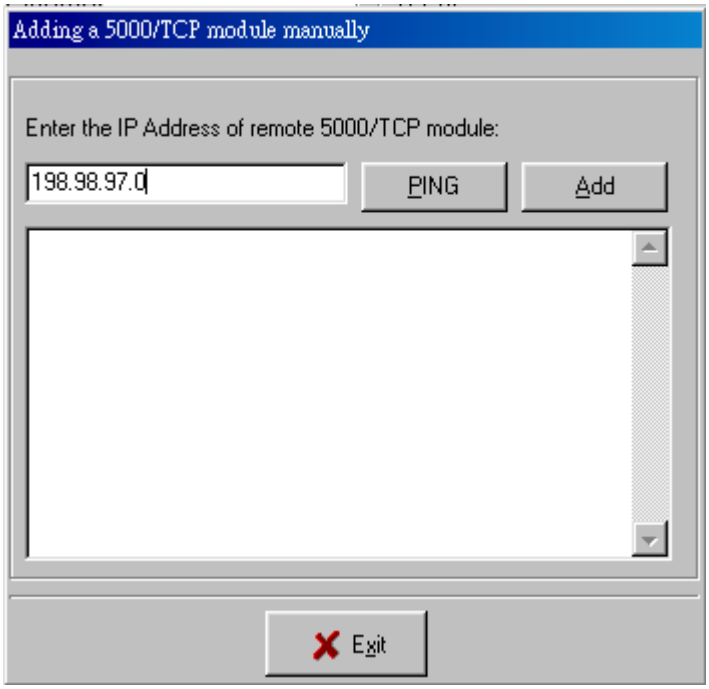


Figure 5-8 Adding ADAM Ethernet I/O Screen

Note There are several conditions need to be sure before adding a remote ADAM-6000 or ADAM-5000/TCP system in the windows Utility.

1. Be sure the specific IP is existed and available.
2. Be sure to complete the network linkage for both sides.
3. Be sure to adjust the best timing of timeout setting.
4. Even you are not sure whether the communication is workable or not, there is also a “PING” function for testing the network connection.

5-3-4 I/O Module Configurations

Digital Input Output Module

Selecting ADAM-6000 Digital Modules includes ADAM-6050/605/6060, user can read following information from the Utility.

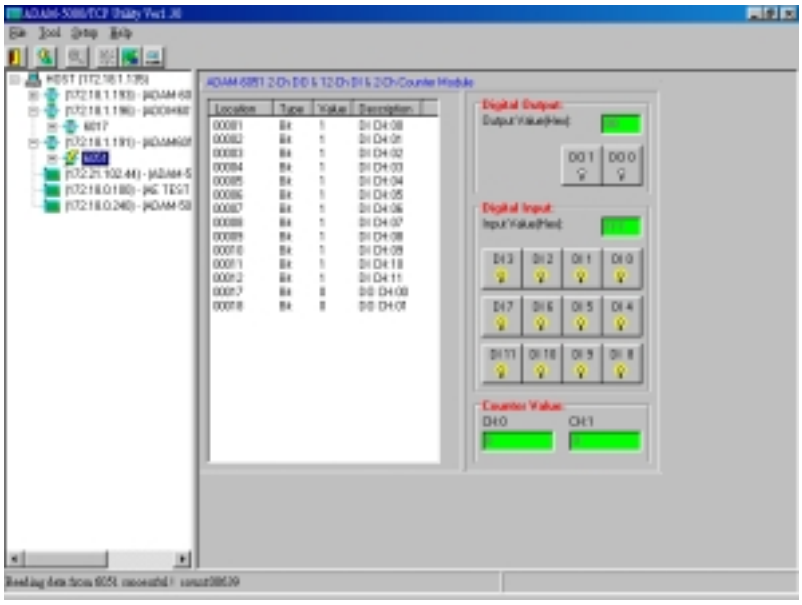


Figure 5-9 Digital I/O Module Configuration

Location：Standard Modbus address. ADAM Ethernet I/O Utility shows the Modbus mapping address of each I/O channel. (Please refer to chapter 4 to see the address mapping for I/O Modules) And the addresses will be the indexes for applying into the database of HMI or OPC Server.

Type：Data Type of the I/O channel. The data type of Digital I/O modules is always “Bit”.

Value：The current status on each channel of I/O Module. The value of digital I/O modules could be “0” (OFF) or “1” (ON).

Description：Describes the channel numbers and I/O types of the specific module.

In addition to monitor the current DI/DO status, the Windows Utility offers a graphical operating interface as figure 5-10. You can read the Digital input status through the change of the indicator icons. Oppositely, you can write the digital output status through clicking the indicator icons.

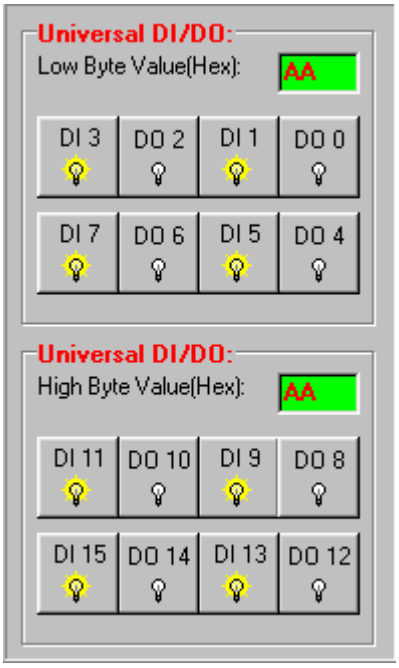


Figure 5-10 Operating and Indicating Icons

Note：① The indicator icons are only available to click for digital output channel.

② The hexadecimal code will be calculated automatically for any status.

With intelligent design concept, the digital input channels support counter and signal latch functions. Click the specific channel, there will be four working modes for choosing.

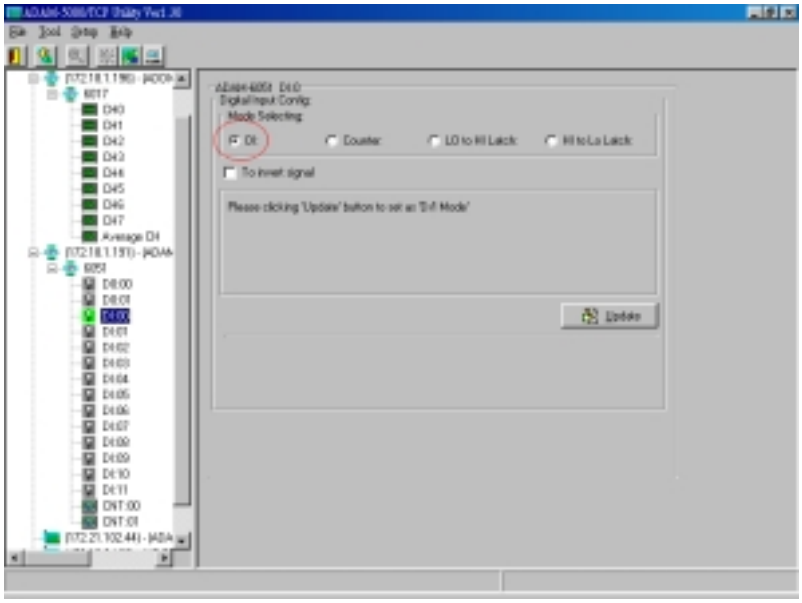


Figure 5-11 General Digital Input Mode

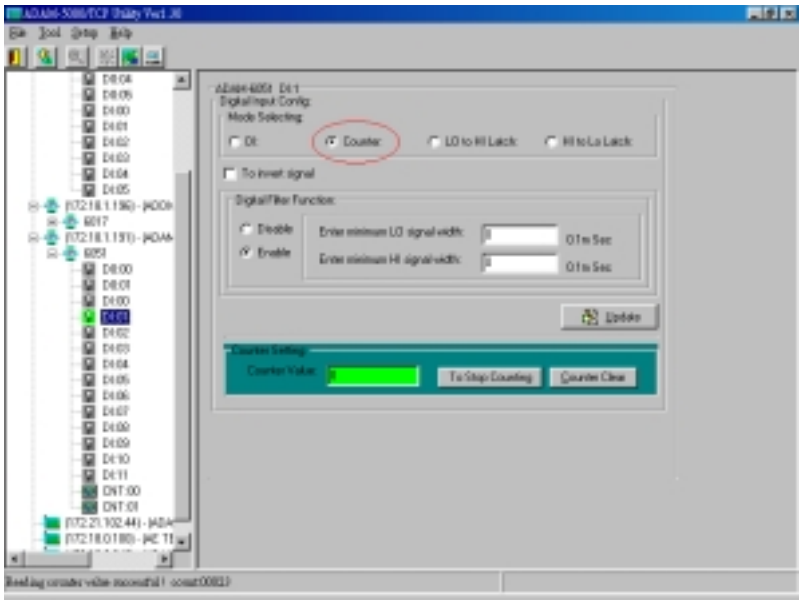


Figure 5-12 Counter Input Mode

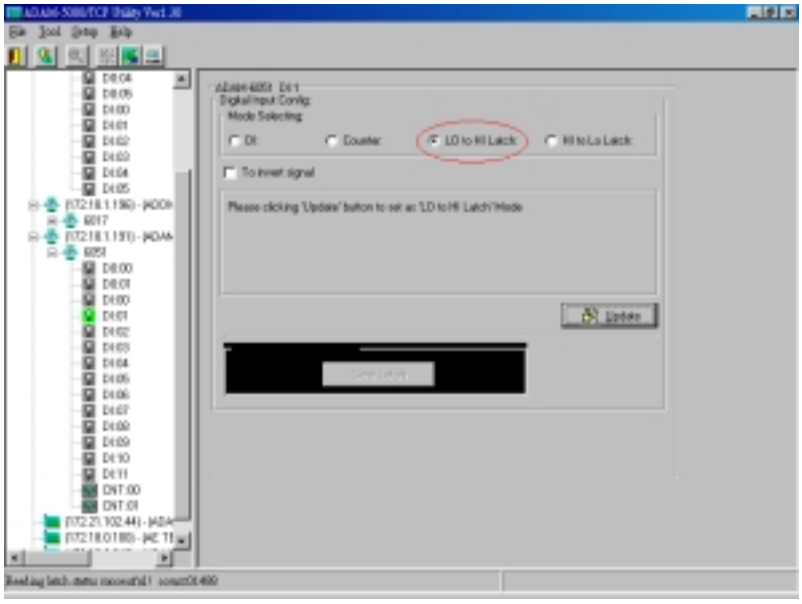


Figure 5-13 Latch Input Mode

Note:

1) The new working mode setting will take effective after click the “Update” button.

2) If necessary, users could invert the original single for flexible operation needs.

The digital output channels support pulse output and delay output functions. Click the specific channel, there will be four working modes for choosing.

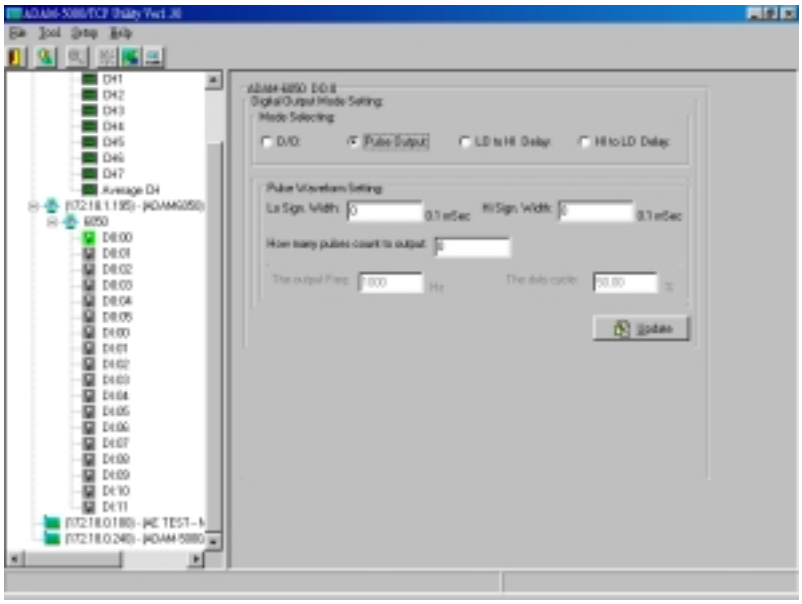


Figure 5-14 Pulse Output Mode Setting

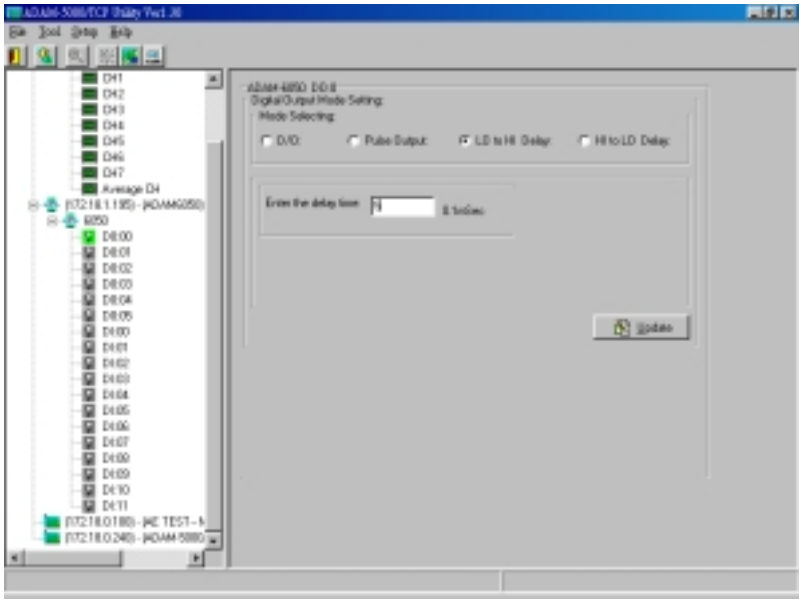


Figure 5-15 Delay Output Mode Setting

Analog Input Module

Selecting ADAM-6000 Analog Input Modules includes ADAM-6017, users can read following information from the Utility.

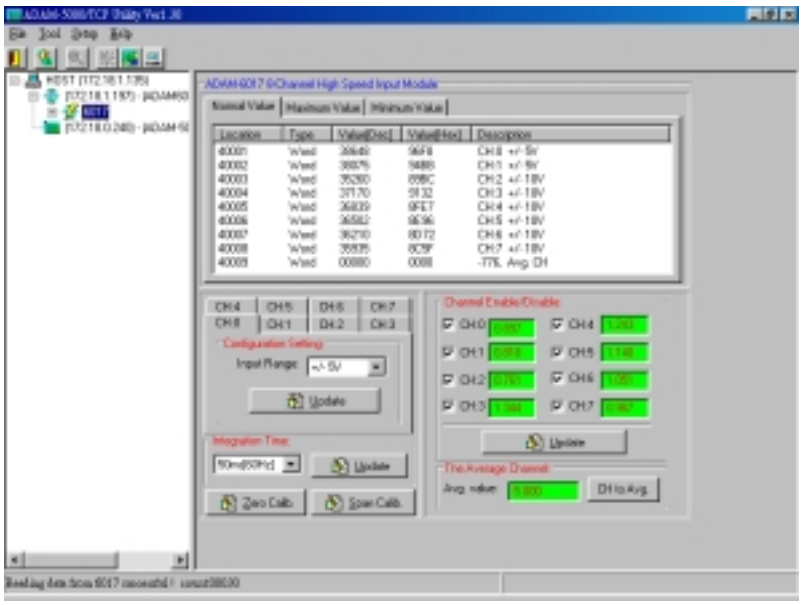


Figure 5-16 Current Analog Input Status

Location：Standard Modbus address. (Refer to Assigning address for I/O module in Chapter 4)

Type：Data type of the I/O channel. The data type of analog Input modules is always “word”.

Value：The current status on each channel of I/O modules. Windows Utility provides both decimal and hexadecimal values used for different applications.

Description：Describes the channel numbers, sensor types, and measurement range of the specified module.

Before acquiring the current data of an analog input module, you have to select the input range and integration time. Then the input data will be scaled as the specified range with engineer unit.

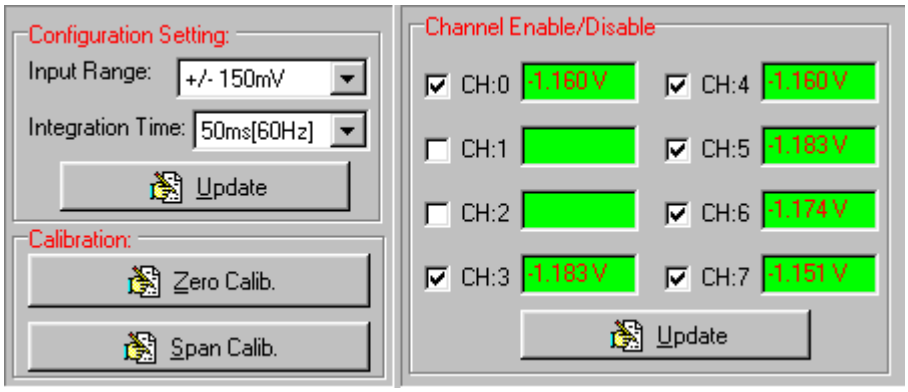


Figure 5-17 setting range and integration time

Note：Windows Utility allows user to Enable / Disable the current status display.

To provide users more valuable information, the ADAM-6000 analog modules have designed with calculation functions, includes Maximum, Minimum, and Average values of individual channels. Click the Maximum value tab, you will see the historical maximum values in each channel unless to press the against “Reset” buttons.

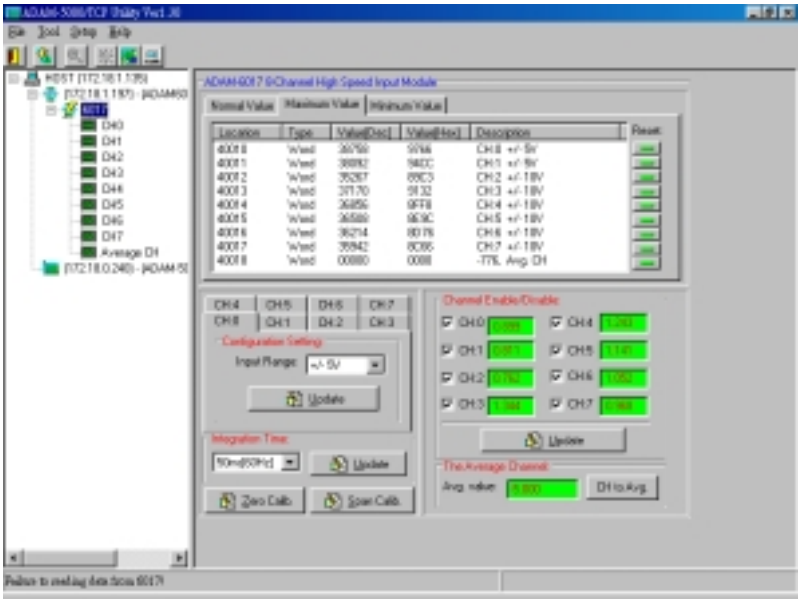


Figure 5-18 Maximum Value Recording

Click the Minimum value tab, you will see the historical minimum values in each channel unless to press the against “Reset” buttons.

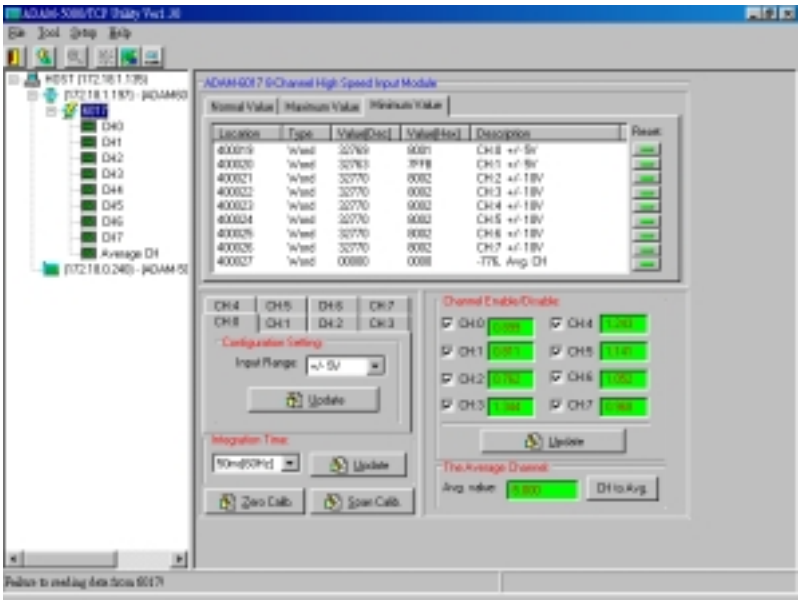


Figure 5-19 Minimum Value Recording

Moreover, all of the analog channels are allowed to configure the High/Low limitation for alarm trigger function. Once the value of the specific channel over or under the limitation, the alarm status could trigger a digital output channel in the ADM-6017.

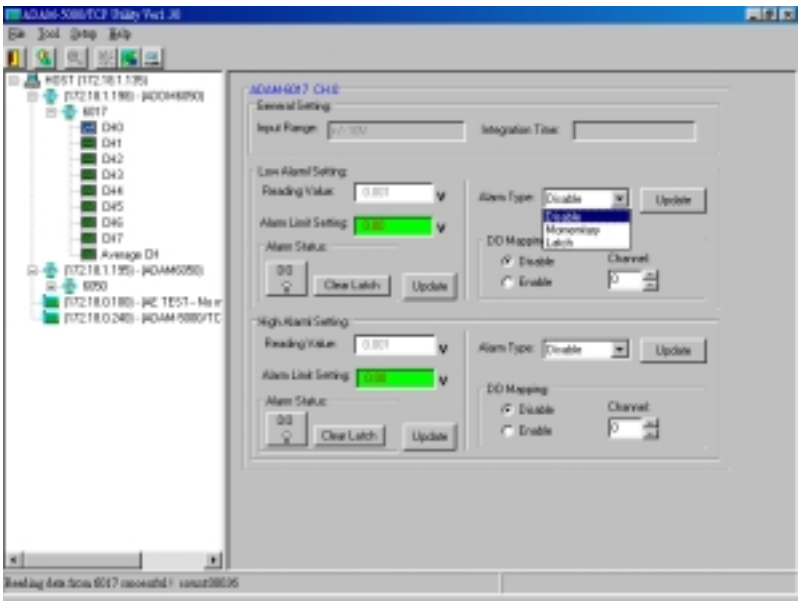


Figure 5-20 Alarm Setting

5-3-5 I/O Module Calibrations

Calibration is to adjust the accuracy of ADAM module. There are several modes for module's calibration: Zero calibration, Span calibration, CJC calibration, and Analog Output calibration. Only analog input and output modules can be calibrated, and the ADAM-6017 is the first released analog module.

Zero Calibration

1. Apply power to the module and let it warm up for 30 minutes.
2. Make sure the module is correctly installed and properly configured for the input range you want to calibrate.
3. Use a precision voltage source to apply a calibration voltage to the V+ and V- terminals of the ADAM-6017 module.
4. Click the Execute button.

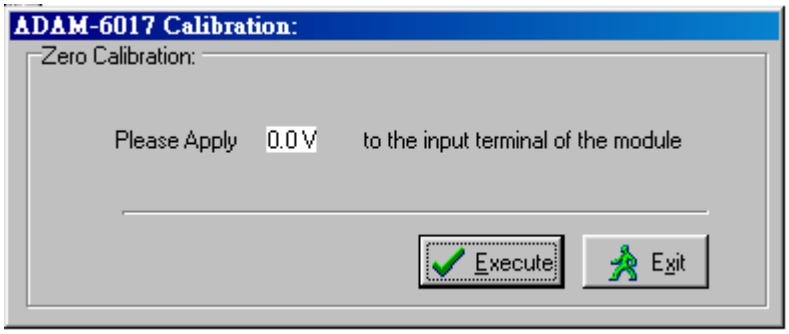


Figure 5-21 Zero Calibration

Span Calibration

Follow the same procedure of zero calibration and click the Execute button.

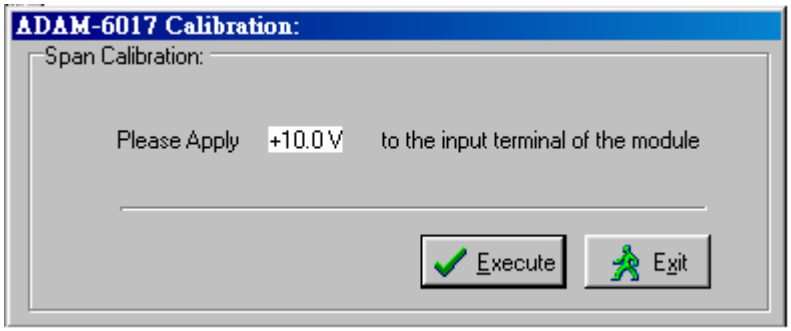


Figure 5-22 Span Calibration

5-3-6 Security Setting

Though the technology of Ethernet discovered with great benefits in speed and integration, there also exist risk about network invading form anywhere. For the reason, the security protection design has built-in ADAM-6000 I/O modules. Once user setting the password into the ADAM-6000 firmware, the important system configurations (Network, Firmware, Password) are only allowed to be changed by password verification.

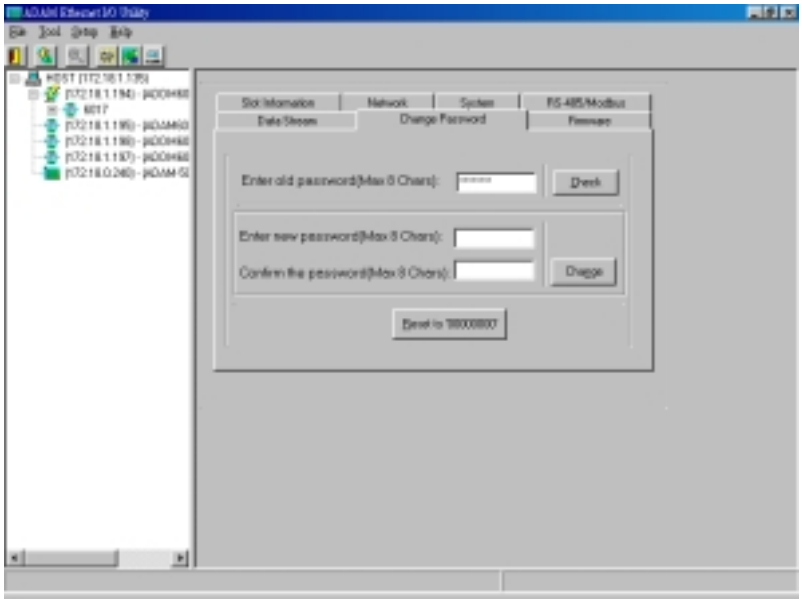


Figure 5-23 Password Setting

Note: The default password of ADAM-6000 is "**00000000**". Please make sure to keep the correct password by yourself. If you lose it, please contact to Advantech's technical support center for help.

5-3-7 Terminal Emulations

You can issue commands and receive response by clicking the Terminal button on the tool bar. There are two kinds of command format supported by this emulating function. Users can choose ASCII or Hexadecimal mode as their communication base. If the ASCII mode has been selected, the Windows Utility will translate the request and response string both in Modbus and ASCII format. Please refer Chapter 6-2 to use Modbus Command; and refer Chapter 6-4 to apply ASCII command.

For example, select ASCII mode and key-in the ASCII command “$01M” (read module name), then click Send. The response will show as figure 5-24.

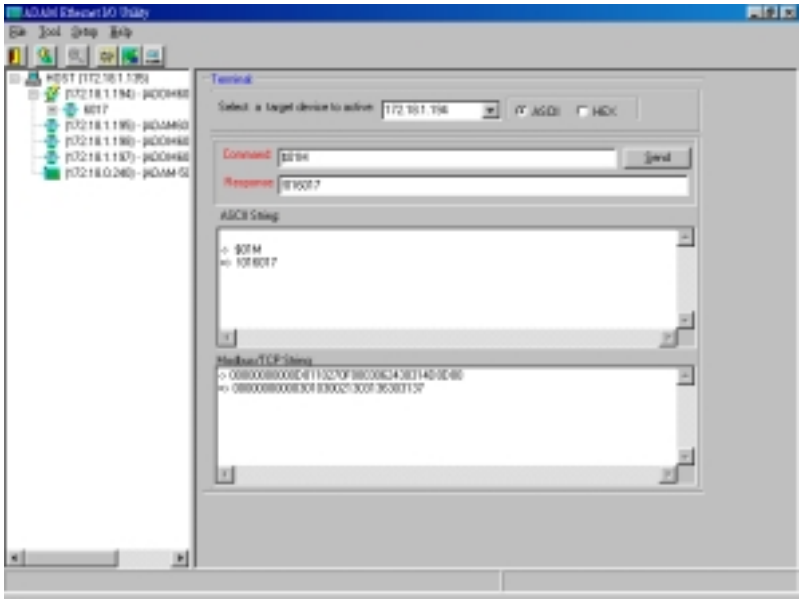


Figure 5-24 Command Emulation

5-3-8 Data Stream

Data Stream Configuration

In addition to TCP/IP communication protocol, ADAM-6000 supports UDP communication protocol to regularly broadcast data to specific host PCs.

Click the tab of Data Stream, then configure the broadcasting interval and the specific IP addresses which need to receive data from the specific ADAM-6000 I/O module. This UDP Data Stream function broadcasts up to 8 host PCs simultaneously, and the interval is user-defined from 50ms to 7 Days.

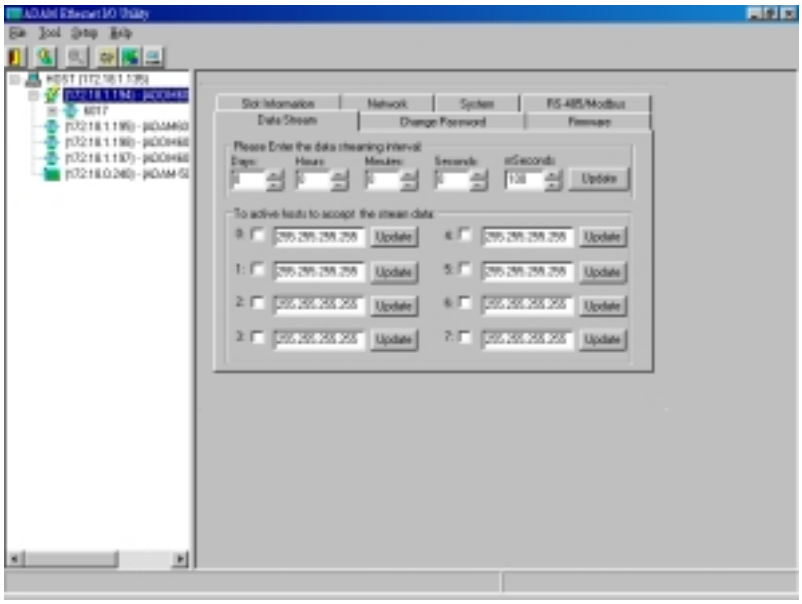


Figure 5-25 Data Stream Configuration

Data Stream Monitoring

After finishing the configuration of Data Stream, you can select the item “Monitor Data Stream” in the function bar or click icon to call up operation display as Figure 5-26.

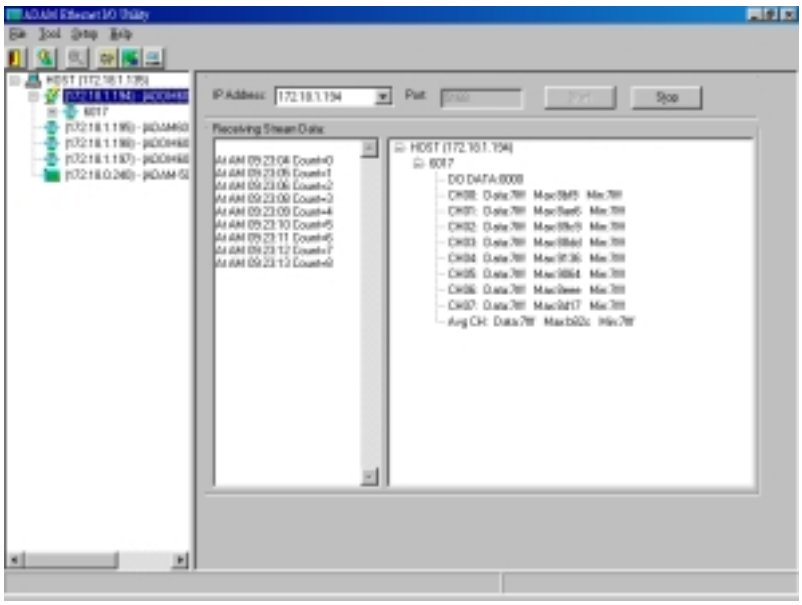


Figure 5-26 Data Stream Monitoring

Select the IP address of the ADAM-6000 you want to read data, then click “Start ” button. The Utility software will begin to receive the stream data on this operation display.

5-3-9 Firmware and Web Page Update

ADAM-6000 I/O modules are available to remote download firmware for customization web pages or new functions upgrade. Select the Firmware Upgrade tab and click the “Browsing” button to find the specific firmware (*.bin) for upgrade.

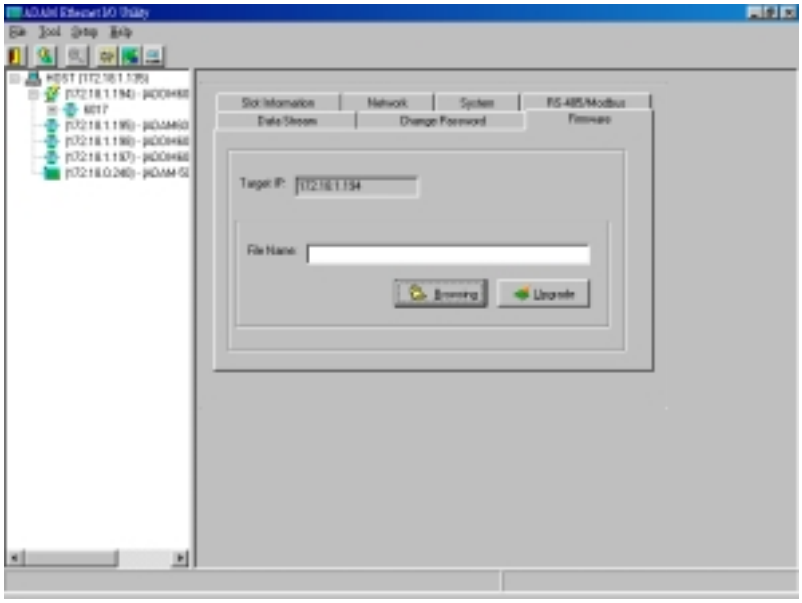


Figure 5-27 Firmware Upgrade

Click the upgrade button, then the new firmware will be downloaded into the specific ADAM-6000 module.

Instructions to Java Applet Customization

Introduction

In this section, we will tell you the way to create an applet web page to monitor the status of ADAM-6060 through the Web browser. To write an input processing applet, you need to know how to define a class with multiple methods. To understand how an applet processes input data, you must learn what events are and how events are handled in Java programs. We don't intend to teach you how to write the applet because it is beyond the scope of our discussion here. Instead, we will provide you with a small-but-useful example as well as the relevant class, methods and suggested template. We refer the interested user who is intended to know more details to the following web site http://java.sun.com/docs/books/tutorial/.

To write an applet that is capable of processing ADAM-6060 input data in a very short time, we provide you with a class which includes all necessary methods. The kernel functions/methods to communicate with our product and display the current, updated status has been fine-tuned for any signal it can process. Four major methods are developed for the purpose, listed in table 1.

♦ boolean ForceCoil(int CoilAddr, boolean IsTrunOn) This method is used for digital output of module channels. The parameter CoilAddr is integer data type and the coil address of the channel. IsTrueOn is the parameter used to indicate ON or OFF. If the method is successful, it will return true.
♦ boolean ReadCoil(int StartingAddr, int NoOfPoint, byte ModBusRTU[]) This method is used for digital input of module channels. The parameter StartingAddr is the starting address of desired channel. NoOfPoint is to indicate how many desired channels to be monitored. Both of the parameters are of integer data type. The third parameter, ModBusRTU is an array with data type of byte, which is used to carry digital inputs of the desired channels. The default size is 128.
♦ boolean ReadRegister(int StartingAddr, int NoOfPoint, byte ModBusRTU[]) This method is used for analog input of module channels. The parameter StartingAddr is the starting address of desired channel. NoOfPoint is to indicate how many desired channels to be monitored. Both of the parameters are of integer data type. The third parameter, ModBusRTU is an array with data type of byte, which is used to carry analog inputs of the desired channels. The default size is 128.

Table 1. Useful Methods to Communicate ADAM-6000 I/O Series Modules for Digital I/O and Analog I/O

Employing these four methods, you can customize your applet and focus solely on the user interface you intend to create and the number of channels you want to monitor.

An Example

To process ADAM-6060 input and display the result/status on an applet, we will use objects from the standard java class library and the class we develop. Specifically, we provide Modbus class to handle the communication with ADAM-6000 I/O modules. Now we're going to teach you step by step how to customize your Web page.

Java Applet Programming

To create your own Web page, you have to follow some rules. There are two parts in this section. We start from the HTML file. Please refer to table 2 below for the default HTML source code.

```
<HTML>
<HEAD>
<TITLE>
ADAM-6000 Ethernet-Enabled DA&C Modules
</TITLE>
</HEAD>
<BODY>
<APPLET
   CODEBASE = "."
   CODE        = "Adam6060.class"
   ARCHIVE = "Adam6060.jar"
   NAME        = "Adam6060 Relay Module"
   WIDTH       = 500
   HEIGHT     = 400
   HSPACE      = 0
   VSPACE     = 0
   ALIGN       = middle
>
<PARAM NAME = "HostIP" VALUE = "010.000.000.000">
</APPLET>
</BODY>
</HTML>
```

Table 2. Overview of index.html

Firstly, the HTML file must be named “index.html.” The name of parameter in <APPLET…> cannot change. The lines “CODE = "Adam6060.class"” and “ARCHIVE = "Adam6060.jar"” indicate where the class and jar files (your Java Applet program) are for ADAM-6060 module. WIDTH and HEIGHT are parameters to set the visible screen size of your Java Applet Web page. The HTML is a good template for you to create your own embedded Web page; however, the parameter names and most of their values cannot be modified, or it will not work. You can only change the value of WIDTH and HEIGHT parameters, e.g. WIDTH = 640 and HEIGHT = 480. However, you must change the value of CODE and ARCHIVE when you try to write it for another module, say ADAM-6017, and thus you should use “Adam6017.class” and “Adam6017.jar” instead of “Adam6060.class” and “Adam6060.jar.”

Some Instructions When Writing Java Applet for ADAM-6000 I/O Series

To enable your java applet to communicate with ADAM-6000 I/O modules, you have to include the following code in the very beginning of your program:

```
import Adam.ModBus.*;
```

In constructor it is suggested to add the following fragment in your exception handler:

```
Try {
     HostIP  = getParameter("HostIP");
     Adam6060Connection = new ModBus(HostIP);
     if (HostIP == "")
        labAdamStatusForDIO.setText("Get Host IP is null !!");
     else
        labAdamStatusForDIO.setText("Get Host IP :" +
        Adam6060Connection.GetHostIP() + " Ver 1.00");

     ……..

}
```

The fragment is used to obtain the host IP value and check if it is null. To acquire the necessary parameter information from the index.html, you need to add the fragment below.

```
public String[][] getParameterInfo() {
  String[][] pinfo =
    {
    {"HostIP", "String", ""},
    };
  return pinfo;
}
```

As for mouse/keyboard events and graphical user interface, they are beyond the scope of our discussion here and we will leave them to users.

After you finish your program and compile, it should generate a couple of classes, e.g. ADAM6060.class, ADAM6060$1.class, ADAM6060$2, and myFramPanel.class in our example. Then, follow the standard way to combine the generated classes with ModBus.class which must be placed in the directory path “Adam/ModBus/” into a jar file. In this case, the name for the file should be ADAM6060.jar. The figure below shows the structure to make the jar file.

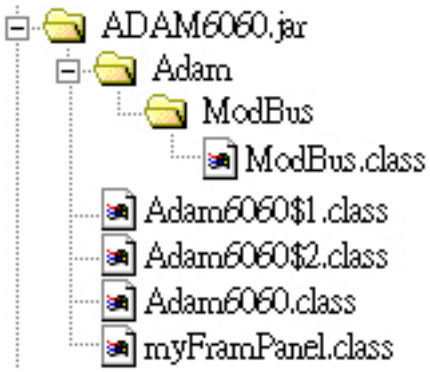


Figure 5-28 The structure of ADAM6060.jar file

Start your ADAM utility, and open the tab “Firmware/Web” as shown below. Then, tell the utility where the path is for the JAR and HTML files. In this case, they are ADAM-6060.jar and index.html. Push

button, and a confirmation window pops up. After you confirm, it will start processing.

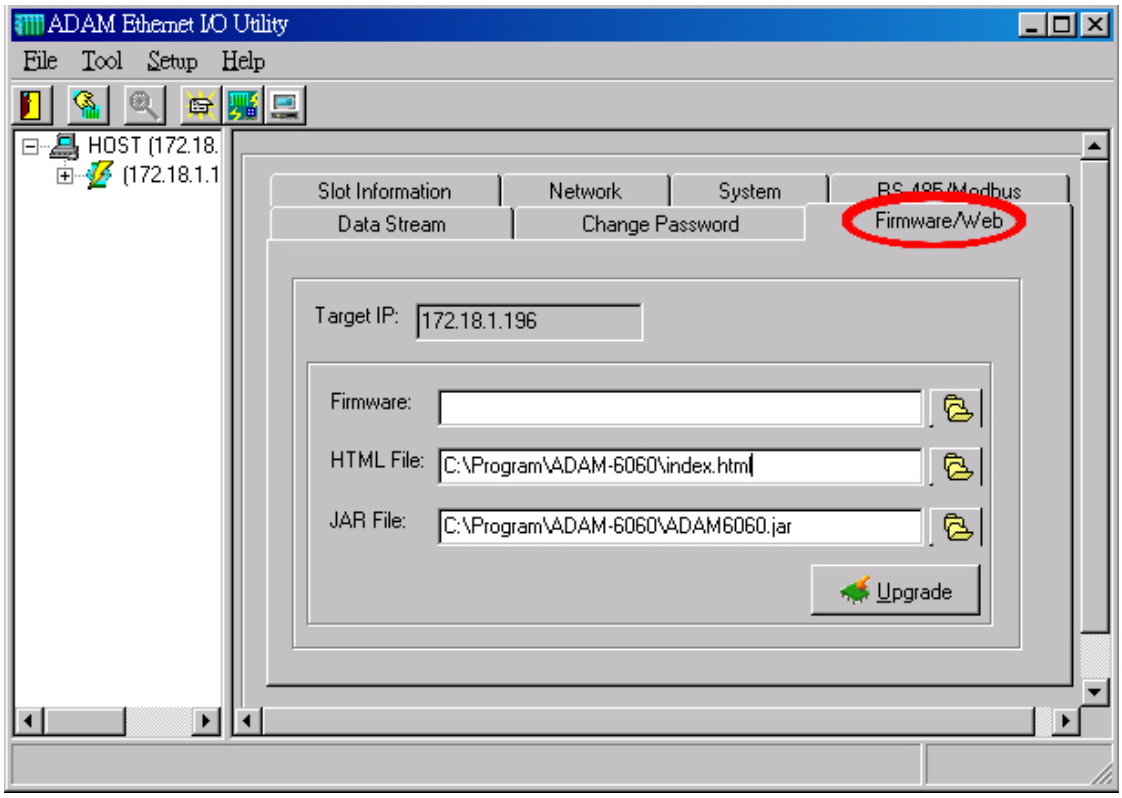


Figure 5-29 Firmware Upgrade for ADAM-6000 I/O Series Modules

Appendix A

Source Code of Java Applet Example

```
import Adam.ModBus.*;
import java.awt.*;
import java.awt.event.*;
import java.applet.*;
import java.io.*;
import java.lang.*;


public class Adam6060 extends Applet {
  boolean isStandalone = false;
  String var0;
  Thread AdamPoilThread;
  String HostIP;
  long ErrCnt = 0;
  boolean IsAdamRuning = false;
  ModBus Adam6060Connection;

  Label Label1 = new Label();

  myFramPanel palStatus = new myFramPanel(2);
  myFramPanel pal1 = new myFramPanel(3);
  myFramPanel pal2 = new myFramPanel(3);
  myFramPanel palAdamStatus = new myFramPanel(1);

  Label labStartAddress = new Label("Start Address:");
  TextField txtStartAddress = new TextField("1");
  Label labCount = new Label("No. of coils to read(Max 128):");
  TextField txtCount = new TextField("1");
  Button btAdam6060 = new Button("Read Coils");
  TextArea txtMsg = new TextArea("", 1, 10, 1);

  Label labAdamStatusForDIO = new Label("Status : ");

  /**Get a parameter value*/
  public String getParameter(String key, String def) {
    return isStandalone ? System.getProperty(key, def) :
```

```
      (getParameter(key) != null ? getParameter(key) : def);
  }

  /**Constructor*/
  public Adam6060() {
  }
  /**Applet Initialization*/
  public void init() {
    try {
         HostIP  = getParameter("HostIP");
         Adam6060Connection = new ModBus(HostIP);    //create ADAM-6060
module object
         if (HostIP == "")    //check the Host IP
             labAdamStatusForDIO.setText("Get Host IP is null !!");
         else
             labAdamStatusForDIO.setText("Get    Host    IP    :"    +
Adam6060Connection.GetHostIP() + " Ver 1.00");

         jbInit();
    }
    catch(Exception e) {
      e.printStackTrace();
    }
  }

  /**Component initialization and displayed screen*/

  private void jbInit() throws Exception {
    this.setLayout(null);

    palStatus.setBackground(Color.lightGray);
    palAdamStatus.setBackground(Color.lightGray);

    palStatus.setBounds(new Rectangle(42, 50, 409, 15 *2 + 0 * 2 + 77 +
152 + 33 ));
    pal1.setBounds(new Rectangle(12, 15 , 385, 77));
    pal2.setBounds(new Rectangle(12, 15 + 77 + 0 , 385, 152));
    palAdamStatus.setBounds(new Rectangle(12, 15 + 77 + 0 * 2 + 152, 385,
```

```
33));

    palStatus.setLayout(null);
    pal1.setLayout(null);
      pal1.add(labStartAddress, null);
      pal1.add(txtStartAddress, null);
      pal1.add(labCount, null);
      pal1.add(txtCount, null);
      pal1.add(btAdam6060, null);

    labStartAddress.setBounds(new Rectangle(20, 15, 85, 20));
    txtStartAddress.setBounds(new Rectangle(205, 15, 60, 20));
    labCount.setBounds(new Rectangle(20, 40, 180, 20));
    txtCount.setBounds(new Rectangle(205, 40, 60, 20));
    btAdam6060.setBounds(new Rectangle(275, 40, 80, 22));

    btAdam6060.addMouseListener(new java.awt.event.MouseAdapter() {
    public void mousePressed(MouseEvent e) {     //mouse event handling
         int i, j;
         long  lAddress, lCount;
         byte ModBusRTU[] = new byte[128];

         if
(Adam6060Connection.ReadCoil((int)Long.parseLong(txtStartAddress.getT
ext()), (int)Long.parseLong(txtCount.getText()), ModBusRTU))
         {
             lAddress = Long.parseLong(txtStartAddress.getText());
             for( i = 0; i < Long.parseLong(txtCount.getText()); i++)
             {
                 txtMsg.append("Address:" + String.valueOf(lAddress) +
"   ->  " + String.valueOf((int)ModBusRTU[i]) + "\n");
                 lAddress++;
             }
         }
         else
         {
             try
             {
```

```
                Adam6060Connection = new ModBus(HostIP);
            }
            catch(Exception eNet) { eNet.printStackTrace(); }
        }
    }
  });

  palAdamStatus.setLayout(null);
  pal2.setLayout(null);
    pal2.add(txtMsg, null);
  txtMsg.setBounds(new Rectangle(15, 15, 355, 120));

  Label1.setFont(new java.awt.Font("DialogInput", 3, 26));
  Label1.setForeground(Color.blue);
  Label1.setText("ADAM-6060 DIO Module");
  Label1.setBounds(new Rectangle(83, 17, 326, 29));
  this.add(Label1, null);
  this.add(palStatus, null);
  palStatus.add(pal1, null);
  palStatus.add(pal2, null);

  palStatus.add(palAdamStatus, null);

  labAdamStatusForDIO.setBounds(new Rectangle(10, 8, 350, 12));
  palAdamStatus.add(labAdamStatusForDIO, null);
}

/**Applet Information Acquisition*/
public String getAppletInfo() {
  return "Applet Information";
}
/**Get parameter info*/
public String[][] getParameterInfo() {
  String[][] pinfo =
    {
    {"HostIP", "String", ""},
    };
  return pinfo;
```

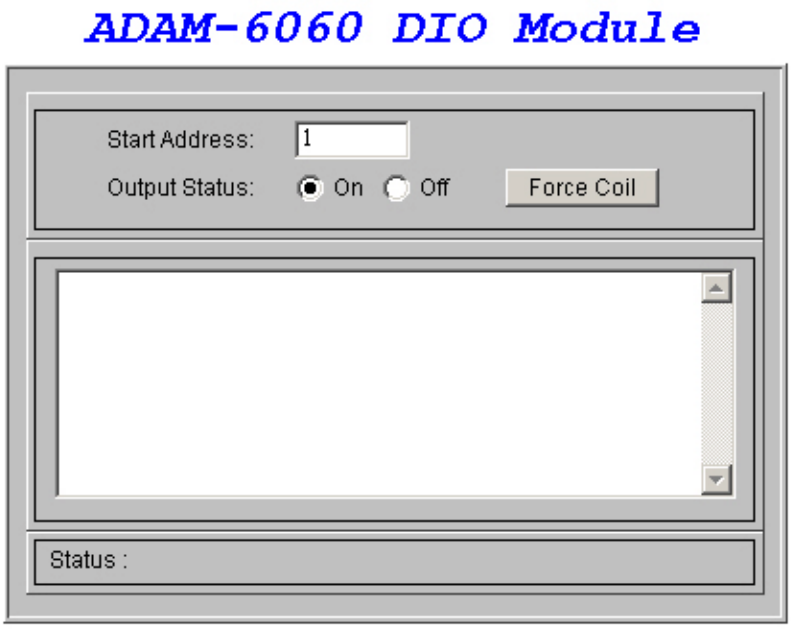
```
  }


  /**Main method: for the purpose of laying out the screen in local PC*/

  public static void main(String[] args) {
    Adam6060 applet = new Adam6060();
    applet.isStandalone = true;
    Frame frame;
    frame = new Frame() {
      protected void processWindowEvent(WindowEvent e) {
        super.processWindowEvent(e);
        if (e.getID() == WindowEvent.WINDOW_CLOSING) {
          System.exit(0);
        }
      }
      public synchronized void setTitle(String title) {
        super.setTitle(title);
        enableEvents(AWTEvent.WINDOW_EVENT_MASK);
      }
    };
    frame.setTitle("Applet Frame");
    frame.add(applet, BorderLayout.CENTER);
    applet.init();
    applet.start();
    frame.setSize(500,620);
    Dimension d = Toolkit.getDefaultToolkit().getScreenSize();
    frame.setLocation((d.width - frame.getSize().width) / 2, (d.height
- frame.getSize().height) / 2);
    frame.setVisible(true);
  }

}

  /**Displayed Screen*/
class myFramPanel extends Panel
{
    int panelType;
```

```
    Label labMassage = new Label("");

    public myFramPanel() {
        //super();
    }

    public myFramPanel(int myType) {
        //super();
        panelType = myType;
    }

    public myFramPanel(int myType, String Msg, int msgTextLength) {
        //super();
        panelType = myType;
        if (Msg != "") {
            labMassage.setText(Msg);
            this.setLayout(null);
            labMassage.setBounds(new Rectangle(20, 3, msgTextLength,
15));
            this.add(labMassage);
        }
    }

    public void paint(Graphics g) {
        Dimension size = getSize();

        if (panelType == 1) {
            int off;

            off = 4;
            g.setColor(Color.white);
            g.drawRect(0, 0, size.width - 1, size.height - 1);

            g.setColor(Color.darkGray);
            g.drawLine(size.width - 1, 0, size.width - 1, size.height -
1);
            g.drawLine(0, size.height - 1, size.width - 1, size.height
- 1);g.setColor(Color.black);
```

```
            g.setColor(Color.black);
            g.drawRect(off, off, size.width - 2 - off * 2, size.height
- 2 - off * 2);
        }
        else if (panelType == 2)    {
            g.setColor(Color.white);
            g.drawRect(0, 0, size.width - 1, size.height - 1);

            g.drawLine(size.width - 4, 2, size.width - 4, size.height -
4);
            g.drawLine(2, size.height - 4, size.width - 4, size.height
- 4);

            g.setColor(Color.darkGray);
            g.drawLine(2, 2, size.width - 4, 2);
            g.drawLine(2, 2, 2, size.height - 4);

            g.drawLine(size.width - 1, 0, size.width - 1, size.height -
1);
            g.drawLine(0, size.height - 1, size.width - 1, size.height
- 1);g.setColor(Color.black);
        }
        else if (panelType == 3) {
            int off;

            off = 4;
            g.setColor(Color.white);
            g.drawRect(0, 0, size.width - 1, size.height - 1);

            g.setColor(Color.darkGray);
            g.drawLine(size.width - 1, 0, size.width - 1, size.height -
1);
            g.drawLine(0, size.height - 1, size.width - 1, size.height
- 1);

            g.setColor(Color.black);
            g.drawRect(off, off + 5, size.width - 2 - off * 2, size.height
```

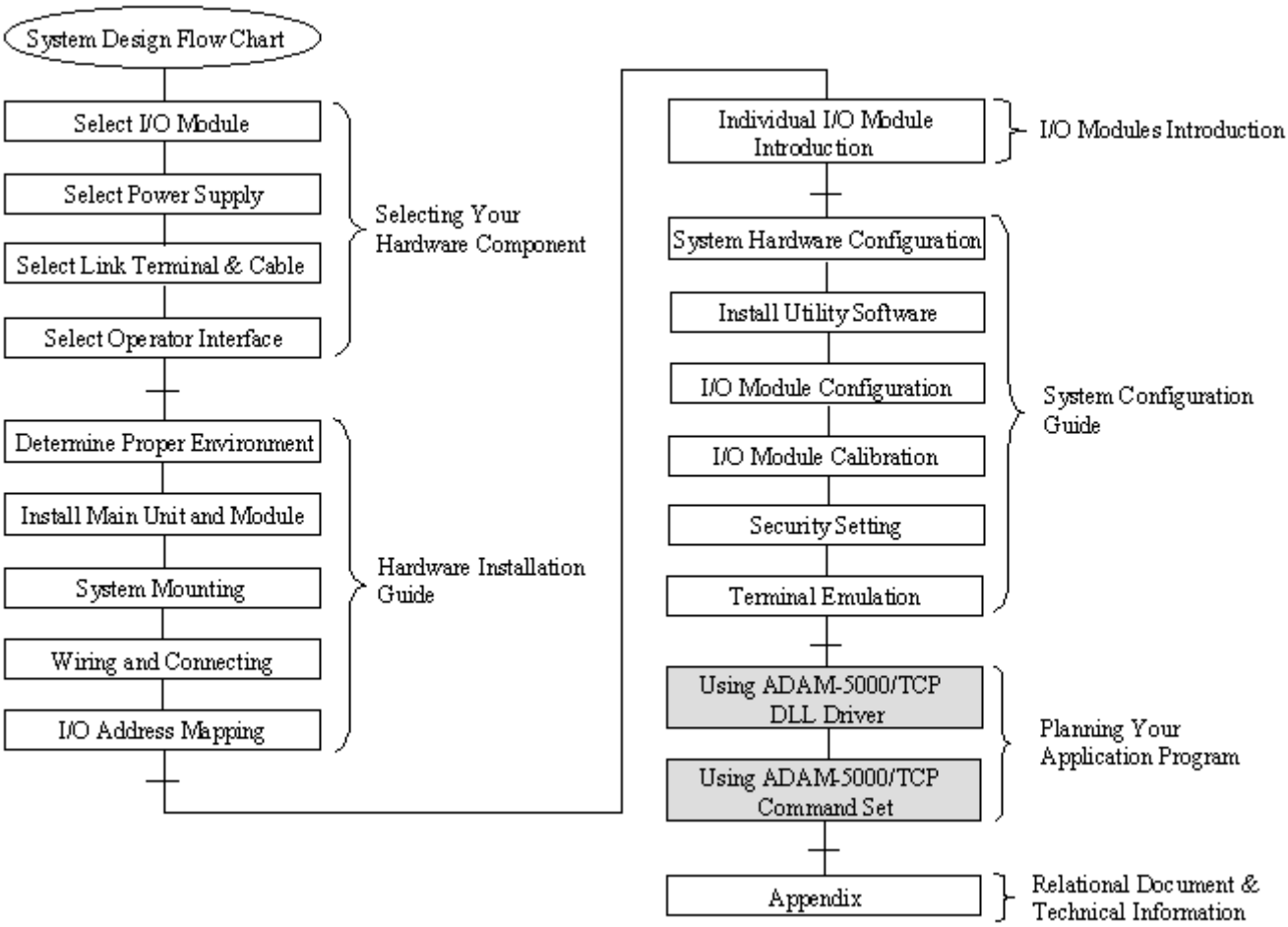
```
- 2 - off * 2 -5 );
        }
        else {
            g.setColor(Color.darkGray);
            g.drawRect(0, 0, size.width - 1, size.height - 1);
        }
    }
};
```

Snapshot of the Running Applet



Chapter 6

Planning Your Application Program



Using this Chapter

6-1 Introduction

After completing the system configuration, you can begin to plan the application program. This chapter introduces two programming tools for users to execute system data acquisition and control. The DLL drivers and command sets provide a friendly interface between your applications and ADAM-6000 I/O modules.

6-2 DLL (Dynamic Link Library) Driver

The Dynamic Link Library (DLL) enables you to quickly and easily to write Windows applications for ADAM-6000 modules. The library supports Borland C, Delphi, Visual C++, and Visual Basic. Since ADAM-6000 modules communicate with a host computer through Ethernet, no additional driver needs to be installed. The DLL includes all necessary function calls to utilize the ADAM-6000 modules to their fullest extent.

In the same path with “ADAM Ethernet I/O”, you‘ll find the relational example files for each kind of programming languages after setup the Windows Utility program. You can customize the source code to create your own tailor-made ADAM-6000 setup program or monitoring system.

6-2-1 Index

There are eight function libraries common used by ADAM-6000 and ADAM-5000/TCP list as follow:

ADAMTCP_Connect

ADAMTCP_Disconnection

ADAMTCP_GetDLLVersion

ADAMTCP_ReadReg

ADAMTCP_WriteReg

ADAMTCP_ReadCoil

ADAMTCP_WriteCoil

ADAMTCP_SendReceive5KTCPCmd

In addition, Advantech offers more function libraries especially for various ADAM-6000 applications.

ADAMTCP_SendReceive6KTCPCmd

ADAMTCP_Read6KDIO

ADAMTCP_Write6KDO

ADAMTCP_Read6KAI

ADAMTCP_Read6KDIOMode

ADAMTCP_Write6KDIOMode

ADAMTCP_Read6KSignalWidth

ADAMTCP_Write6KsignalWidth

ADAMTCP_Read6KCounter

ADAMTCP_Clear6KCounter

ADAMTCP_Start6KCounter

ADAMTCP_Stop6KCounter

ADAMTCP_Clear6KDILatch

6-2-2 Function Descriptions

ADAMTCP_Connect

Description:

Establish a Windows Sockets connection in a specified ADAM-6000 I/O module.

Syntax:

int ADAMTCP_Connect(int socket_type, char *szIP, unsigned short port, SOCKET *conn_socket,
int iConnectionTimeout, int iSendTimeout, int iReceiveTimeout);

Parameter:

socket_type[in]: to specify the connection type that is UDP or TCP.

szIP[in]: the IP address for ADAM-6000 that to be connected.

port[in]: the connection port

conn_socket[out]: the handle that represent a socket

iConnectionTimeout[in]: the specified timeout interval for connecting to the ADAM-6000

iSendTimeout[in]: the specified timeout interval for sending a command to the ADAM-6000

iReceiveTimeout[in]: the specified timeout interval for receiving response from the ADAM-6000

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

ADAMTCP_Disconnect

Description:

Disconnect the Windows Sockets connection of the specified ADAM-6000 I/O module.

Syntax:

void ADAMTCP_Disconnect(void);

Parameter:

void

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

ADAMTCP_GetDLLVersion

Description:

Read the version of ADAM-6000 DLL driver

Syntax:

int ADAMTCP_GetDLLVersion(void);

Parameter:

void

Return:

0x100 -> Version 1.10

ADAMTCP_ReadReg

Description:

Read the holding register value at a specified range described in parameters.

Syntax:

int ADAMTCP_ReadReg(SOCKET conn_socket, WORD wStartAddress, WORD wCount, WORD wData[ ])

Parameter:

conn_socket[in]:	the handle that represent the connection socket
wStartAddress[in]:	the starting address that to be read
wCount[in]:	how many holdings register to be read
wData[out]:	a unsigned 16 bits array that stored the read holding register

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

Example:

```
// Read input registers demo program
//--- In this demo program, reading 16 register starting at register 0(address 1)
//--- The IP address for ADAM-6000 module is 172.16.2.200 in this demo program.
//--- Change the IP Address to match your ADAM-6000 module

#include <windows.h>
#include <winsock2.h>
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include "adv5ktcp.h"
#define DEFAULT_PORT 502
```

```
//-------- default timeout -----
int        iConnectionTimeout=2000;
int        iSendTimeout=2000;
int        iReceiveTimeout=2000;

int main(int argc, char **argv)
{
           int     i,j;
           SOCKET   conn_socket;
           int        iRetVal,iVersion;
           WORD                wStartAddress=1;
           WORD                wCount=16;
           WORD                wData[16];
         char line[80];

           printf("In this demo, the IP Address of 6000 module is assumed as 172.16.2.200\n");
           printf("Please make sure the IP Address for your 6000 module is 172.16.2.200 (Y/N)? ");
         gets(line);
           if( toupper( line[0])!='Y' )
                    return 0;

           for(i=0; i<wCount; i++)
             wData[i]=0xffff;

           iVersion=ADAMTCP_GetDLLVersion();
           printf("The Version=%04x\n",iVersion);

           //--- Firstly, try to create a connection to ADAM-6000 ---
           //--- Please change the following IP address to match your ADAM-6000 module ---
           iRetVal=ADAMTCP_Connect(SOCK_STREAM,"172.16.2.200",502,&conn_socket,
                                    iConnectionTimeout, iSendTimeout, iReceiveTimeout);

           if( iRetVal<0 )
           {
               printf("Connect Failure !!!     code=%d\n",iRetVal);
               exit(0);
           }
```

```
    //--- reading input register ---
    iRetVal=ADAMTCP_ReadReg(conn_socket, wStartAddress, wCount,wData);
    if( iRetVal )
    {
        printf("ADAMTCP_ReadReg() Fail !!!     code=%d\n",iRetVal);
        ADAMTCP_Disconnect();
        exit(0);
    }

    for(i=0,j=wStartAddress; i<wCount; i++,j++)
    {
      printf("Addr:[%d] -> %04x\n",j,wData[i]);
    }
  printf("\n");

    //--- Lastly, disconnection to 6000 I/O Modules ---
    ADAMTCP_Disconnect();
  printf("ADAMTCP_Discennect() successful !\n");
}
```

ADAMTCP_WriteReg

Description:

Write the holding register value at a specified range described in parameters.

Syntax:

int ADAMTCP_WriteReg(SOCKET conn_socket, WORD wStartAddress, WORD wCount, WORD wData[ ])

Parameter:

conn_socket[in]:	the handle that represent the connection socket
wStartAddress[in]:	the starting address that to be read
wCount[in]:	how many holdings register to be read
wData[out]:	a unsigned 16 bits array that stored the value write to holding value

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

ADAMTCP_ReadCoil

Description:

Read the coils value at a specified range described in parameters.

Syntax:

int ADAMTCP_ReadCoil(SOCKET conn_socket, WORD wStartAddress, WORD wCount, BYTE byData[ ])

Parameter:

conn_socket[in]:	the handle that represent the connection socket
wStartAddress[in]:	the starting address that to be read
wCount[in]:	how many coils to be read
byData[out]:	a 8 bit array that stored the read coil

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

ADAMTCP_WriteCoil

Description:

Write the coils value at a specified range described in parameters.

Syntax:

int ADAMTCP_WriteCoil(SOCKET conn_socket, WORD wStartAddress, WORD wCount, BYTE byData[ ])

Parameter:

conn_socket[in]: the handle that represent the connection socket

wStartAddress[in]: the starting address that to be read

wCount[in]: how many coils to be read

byData[out]: a 8-bit array that stored the read coil

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

ADAMTCP_SendReceive5KTCPCmd

Description:

This function is just for user's convenience, accepting the ASCII format string as a command. Then transform it to meet the Modbus/TCP specification.

Syntax:

int ADAMTCP_SendReceive5KTCPCmd(SOCKET conn_socket, char szSendToTCP[ ], char szReceiveFromTCP[ ], char szModbusSend[ ], char szModbusReceive[ ])

Parameter:

conn_socket[in]: the handle that represent the connection socket

szSendToTCP[in]: the ASCII format string that send to a ADAM-6000 module

szReceiveFromTCP[out]: the ASCII format string that response from a ADAM-6000 module

szModbusSend[out]: the Modbus/TCP format string that send to a ADAM-6000 module

szModbusReceive[out]: the Modbus/TCP format string that response from a ADAM-6000 module

Return:

Please refer to Chapter 6-2-3 “Return Codes” for more detail information

ADAMTCP_SendReceive6KTCPCmd

Description:

This function is specific for 6000 series. It accepts the command in ASCII format string. Then transform it to follow the Modbus/TCP communication protocol.

Syntax:

int ADAMTCP_SendReceive6KTCPCmd(char szIP[], char szSendToTCP[], char szReceiveFromTCP[]
char szModbusSend[], char szModbusReceive[])

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

szSendToTCP[in]: the ASCII format string that send to the ADAM-6000.

szReceiveFromTCP[out]: the ASCII format string that response from the ADAM-6000.

szModbusSend[out]: the Modbus/TCP format string that send to the ADAM-6000.

szModbusReceive[out]: the Modbus/TCP format string that response from the ADAM-6000.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information

ADAMTCP_Read6KDIO

Description:

To read the DI/DO status in the specific ADAM-6000 module.

Syntax:

int ADAMTCP_Read6KDIO(char szIP[], WORD wModule, WORD wIDAddr, BYTE byDI[], BYTE byDO[])

Parameter:

szIP[in]:	the IP Address of the target ADAM-6000 module to be connected.
wModule[in]:	the module name of the ADAM-6000 module to be connected. (For example, 6050, 6051, or 6060)
wIDAddr[in]:	the Modbus device ID for an ADAM-6000 module. (Always 1)
byDI[out]:	an 8-bit array that stored the DI status of the specific ADAM-6000.
byDO[out]:	an 8-bit array that stored the DO status of the specific ADAM-6000.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Write6KDO

Description:

Set D/O status to an specific ADAM-6000 module.

Syntax:

int CALLBACK ADAMTCP_Write6KDO(char szIP[], WORD wModule, WORD wIDAddr, WORD wStartDO, WORD wCount, BYTE byDO[])

Parameter:

szIP[in]:	the IP Address of the target ADAM-6000 module to be connected.
wModule[in]:	the module name of the ADAM-6000 module to be connected. (For example, 6050, 6051, or 6060)
wIDAddr[in]:	the Modbus device ID for an ADAM-6000 module. (Always 1)
wStartDO[in]:	the starting channel to be written.
wCount[in]:	the total channels to be written.
byDO[out]:	an 8-bit array that stored the DO status of the specific ADAM-6000.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Read6KAI

Description:

To read analog input channel's value for an ADAM-6000 module.

Syntax:

int ADAMTCP_Read6KAI(char szIP[], WORD wModule, WORD wIDAddr, WORD wGain[], WORD wHex[], double dlValue[])

Parameter:

szIP[in]:	the IP Address of the target ADAM-6000 module to be connected.
wModule[in]:	the module name of the ADAM-6000 module to be connected. (For example, 6050, 6051, or 6060)
wIDAddr[in]:	the Modbus device ID for an ADAM-6000 module. (Always 1)
wGain[in]:	the range code against analog input range for individual channels stored in this array.
wHex[out]:	an unsigned 16-bit array that stored the value reading from AI channels.
dlValue[out]:	an array that stored the values in engineer unit format that reading from AI channels.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Read6KDIOMode

Description:

To read the working mode of each DI/O channels in a specific ADAM-6000 module.

Syntax:

int ADAMTCP_Read6KDIOMode(char szIP[], WORD wModule, WORD wIDAddr, BYTE byDIMode[], BYTE byDOMode[])

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wModule[in]: the module name of the ADAM-6000 module to be connected.
(For example, 6050, 6051, or 6060)

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

byDIMode[out]: an 8-bit array that stored DI channels' working modes which represent in numeric format as follows:
0: this channel is in 'DI' mode
1: this channel is in 'Counter' mode
2: this channel is in 'Lo to Hi latch' mode
3: this channel is in 'Hi to Lo latch' mode

byDOMode[out]: an 8-bits array that stored DO channels' working modes which represent in numeric format as follows:
0: this channel is in 'DO' mode
1: this channel is in 'Pulse Output' mode
2: this channel is in 'Lo to Hi Delay' mode
3: this channel is in 'Hi to Lo Delay' mode

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Write6KDIOMode

Description:

To set the working modes for each DI/O channels in a specific ADAM-6000 module.

Syntax:

int ADAMTCP_Wirte6KDIOMode(char szIP[], WORD wModule, WORD wIDAddr, BYTE byDIMode[], BYTE byDOMode[])

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wModule[in]: the module name of the ADAM-6000 module to be connected. (For example, 6050, 6051, or 6060)

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

byDIMode[in]: an 8-bit array that stored DI channels' working modes which represent in numeric format as follows:

0: this channel is in 'DI' mode

1: this channel is in 'Counter' mode

2: this channel is in 'Lo to Hi latch' mode

3: this channel is in 'Hi to Lo latch' mode

byDOMode[in]: an 8-bit array that stored D/O channels' working modes which represent in numeric format as follows:

0: this channel is in 'DO' mode

1: this channel is in 'Pulse Output' mode

2: this channel is in 'Lo to Hi Delay' mode

3: this channel is in 'Hi to Lo Delay' mode

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Read6KSignalWidth

Description:

To read the minimal high/low signal width of each D/I channel in a specific ADAM-6000 module.

Syntax:

int ADAMTCP_Read6KSignalWidth(char szIP[], WORD wModule, WORD wIDAddr, unsigned long ulLoWidth[], unsigned long ulHiWidth[])

Parameter:

szIP[in]:	the IP Address of the target ADAM-6000 module to be connected.
wModule[in]:	the module name of the ADAM-6000 module to be connected. (For example, 6050, 6051, or 6060)
wIDAddr[in]:	the Modbus device ID for an ADAM-6000 module. (Always 1)
ulLoWidth[out]:	an unsigned 32-bit array that stored the minimal low signal width of each DI channel. The unit is 0.1 msec.
ulHiWidth[out]:	an unsigned 32-bit array that stored the minimal high signal width of each DI channel. The unit is 0.1 msec.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Write6KSignalWidth

Description:

To set the minimal high/low signal width of each DI channel in a specific ADAM-6000 module.

Syntax:

int ADAMTCP_Write6KSignalWidth(char szIP[], WORD wModule, WORD wIDAddr, unsigned long ulLoWidth[], unsigned long ulHiWidth[])

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wModule[in]: the module name of the ADAM-6000 module to be connected. (For example, 6050, 6051, or 6060)

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

ulLoWidth[out]: an unsigned 32-bit array that stored the minimal low signal width of each DI channel. The unit is 0.1 msec.

ulHiWidth[out]: an unsigned 32-bit array that stored the minimal high signal width of each DI channel. The unit is 0.1 msec.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Read6KCounter

Description:

To read the counter value when a DI channel configured in 'Counter' mode.

Syntax:

int ADAMTCP_Read6KCounter(char szIP[], WORD wModule, WORD wIDAddr,
unsigned long ulCounterValue[]);

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wModule[in]: the module name of the ADAM-6000 module to be connected.
(For example, 6050, 6051, or 6060)

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

ulCounterValue[out]: an unsigned 32-bit array that stored the counter value of each DI channel.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Clear6KCounter

Description:

To clear the counter value when a DI channel configured in 'Counter' mode.

Syntax:

int ADAMTCP_Clear6KCounter(char szIP[], WORD wIDAdd, WORD wChIndex, WORD wData)

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

wChIndex[in]: the specific DI channel need to be cleared the counter value.

wData[in]: always 1.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Start6KCounter

Description:

Start counting when a DI channel configured as 'Counter' mode.

Syntax:

int ADAMTCP_Start6KCounter(char szIP[], WORD wAddress, WORD wChIndex)

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

wChIndex[in]: the specific DI channel need to start or stop counting.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Stop6KCounter

Description:

Stop counting when a DI channel configured as 'Counter' mode.

Syntax:

int ADAMTCP_Stop6KCounter(char szIP[], WORD wAddress, WORD wChIndex)

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

wChIndex[in]: the specific DI channel need to start or stop counting.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

ADAMTCP_Clear6KDILatch

Description:

To clear the latch when a DI channel configured as 'Lo to Hi Latch' or 'Hi to Lo Latch'.

Syntax:

int ADAMTCP_Clear6KDILatch(char szIP[], WORD wIDAddr, WORD wChIndex)

Parameter:

szIP[in]: the IP Address of the target ADAM-6000 module to be connected.

wIDAddr[in]: the Modbus device ID for an ADAM-6000 module. (Always 1)

wChIndex[in]: the specific DI channel need to be cleared the latch status.

Return:

Please refer to Chapter 6-2-3 "Return Codes" for more detail information.

6-2-3 Return Codes

Using these function libraries, you can read the error message from the returning codes.

ADAM5KTCP_NoError	(0)
ADAM5KTCP_StartupFailure	(-1)
ADAM5KTCP_SocketFailure	(-2)
ADAM5KTCP_UdpSocketFailure	(-3)
ADAM5KTCP_SetTimeoutFailure	(-4)
ADAM5KTCP_SendFailure	(-5)
ADAM5KTCP_ReceiveFailure	(-6)
ADAM5KTCP_ExceedMaxFailure	(-7)
ADAM5KTCP_CreateWsaEventFailure	(-8)
ADAM5KTCP_ReadStreamDataFailure	(-9)
ADAM5KTCP_InvalidIP	(-10)
ADAM5KTCP_ThisIPNotConnected	(-11)
ADAM5KTCP_AlarmInfoEmpty	(-12)
ADAM5KTCP_NotSupportModule	(-13)
ADAM5KTCP_ExceedDONo	(-14)
ADAM5KTCP_InvalidRange	(-15)

6-3 ADAM-6000 Commands

ADAM-6000 and ADAM-5000/TCP system accept a command/response form with the host computer. When systems are not transmitting they are in listen mode. The host issues a command to a system with a specified address and waits a certain amount of time for the system to respond. If no response arrives, a time-out aborts the sequence and returns control to the host. This chapter explains the structure of the commands with Modbus/TCP protocol, and guides to use these command sets to implement user's programs.

6-3-1 Command Structure

It is important to understand the encapsulation of a Modbus request or response carried on the Modbus/TCP network. A complete command is consisted of command head and command body. The command head is prefixed by six bytes and responded to pack Modbus format; the command body defines target device and requested action. Following example will help you to realize this structure quickly.

Example:

If you want to read the first two values of ADAM-6017 (address: 40001~40002), the request command should be:

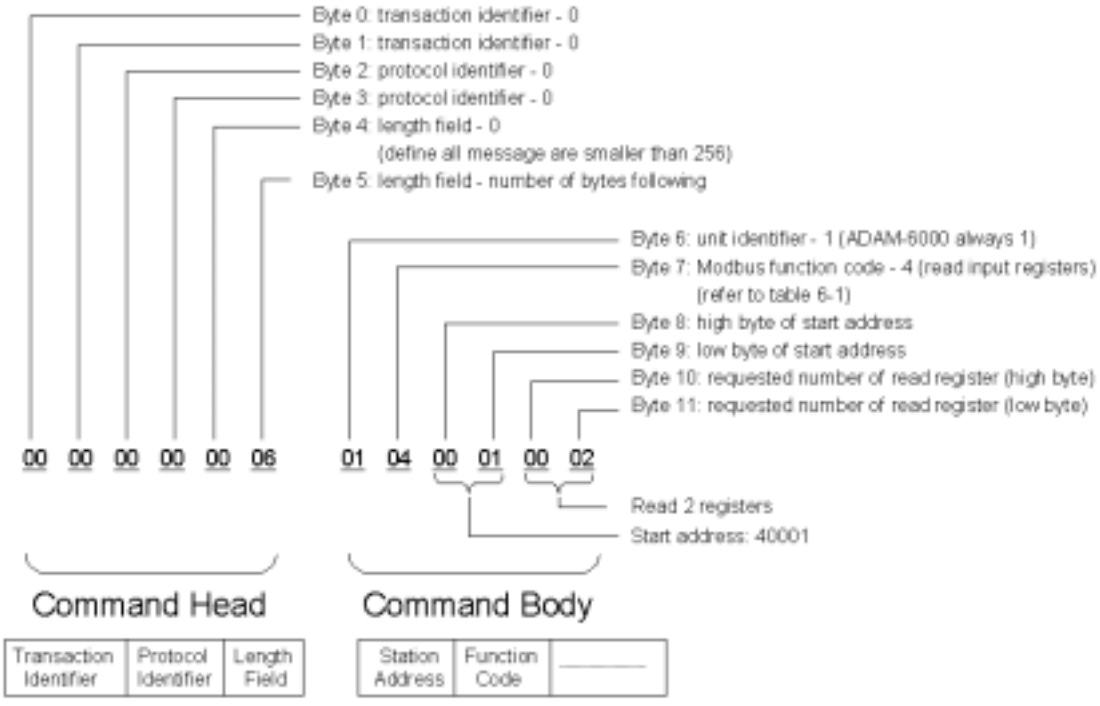


Figure 6-1 Request Comment Structure

And the response should be:

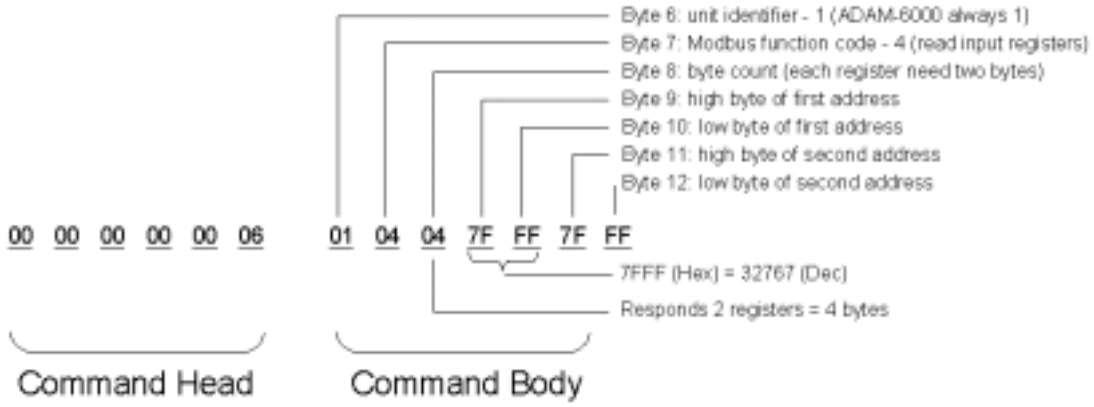


Figure 6-2 Response Comment Structure

6-3-2 Modbus Function Code Introductions

To full-fill the programming requirement, there is a series of function code standard for user's reference…

Code (Hex)	Name	Usage
01	Read Coil Status	Read Discrete Output Bit
02	Read Input Status	Read Discrete Input Bit
03	Read Holding Registers	Read 16-bit register. Used to read integer or floating point process data.
04	Read Input Registers	
05	Force Single Coil	Write data to force coil ON/OFF
06	Preset Single Register	Write data in 16-bit integer format
08	Loopback Diagnosis	Diagnostic testing of the communication port
15	Force Multiple Coils	Write multiple data to force coil ON/OFF
16	Preset Multiple Registers	Write multiple data in 16-bit integer format

Table 6-1 Response Comment Structure

Function Code 01

The function code 01 is used to read the discrete output's ON/OFF status of ADAM-6000 modules in a binary data format.

Request message format for function code 01:

Command Body					
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Coil High Byte	Requested Number of Coil Low Byte

Example: Read coil number 1 to 8 (address number 00017 to 00024) from ADAM-6000 Modules

01 01 00 17 00 08

Response message format for function code 01:

Command Body					
Station Address	Function Code	Byte Count	Data	Data	…

Example: Coils number 2 and 7 are on, all others are off.

01 01 01 42

In the response the status of coils 1 to 8 is shown as the byte value 42 hex, equal to 0100 0010 binary.

Function Code 02

The function code 02 is used to read the discrete input's ON/OFF status of ADAM-6000 in a binary data format.

Request message format for function code 02:

Command Body					
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Input High Byte	Requested Number of Input Low Byte

Example: Read coil number 1 to 8 (address number 00001 to 00008) from ADAM-6000 modules

01 01 00 01 00 08

Response message format for function code 02:

Command Body					
Station Address	Function Code	Byte Count	Data	Data	…

Example: input number 2 and 3 are on, all others are off.

01 01 01 60

In the response the status of input 1 to 8 is shown as the byte value 60 hex, equal to 0110 0000 binary.

Function Code 03/04

The function code 03 or 04 is used to read the binary contents of input registers

Request message format for function code 03 or 04:

Command Body					
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Register High Byte	Requested Number of Register Low Byte

Example: Read Analog inputs #1 and #2 in addresses 40001 to 40002 as floating point value from ADAM-6017 module

01 04 00 01 00 02

Response message format for function code 03 or 04:

Command Body					
Station Address	Function Code	Byte Count	Data	Data	…

Example: Analog input #1 and #2 as floating point values where AI#1=100.0 and AI#2=55.32

01 04 08 42 C8 00 00 47 AE 42 5D

Function Code 05

Force a single coil to either ON or OFF. The requested ON/OFF state is specified by a constant in the query data field. A value of FF 00 hex requests it to be ON. A value of 00 00 hex requests it to be OFF. And a value of FF FF hex requests it to release the force.

Request message format for function code 05:

Command Body					
Station Address	Function Code	Coil Address High Byte	Coil Address Low Byte	Force Data High Byte	Force Data Low Byte

Example: Force coil 3 (address 00003) ON in ADAM-6000 module

01 05 00 03 FF 00

Response message format for function code 05:

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

Command Body					
Station Address	Function Code	Coil Address High Byte	Coil Address Low Byte	Force Data High Byte	Force Data Low Byte

Function Code 06

Presets integer value into a single register.

Request message format for function code 06:

Command Body					
Station Address	Function Code	Register Address High Byte	Register Address Low Byte	Preset Data High Byte	Preset Data Low Byte

Example: Preset register 40002 to 00 04 hex in ADAM-6000 module

01 06 00 02 00 04

Response message format for function code 06:

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

Command Body					
Station Address	Function Code	Register Address High Byte	Register Address Low Byte	Preset Data High Byte	Preset Data Low Byte

Function Code 08

Echoes received query message. Message can be any length up to half the length of the data buffer minus 8 bytes.

Request message format for function code 08:

Command Body		
Station Address	Function Code	Any data, length limited to approximately half the length of the data buffer

Example: 01 08 00 02 00 04

Response message format for function code 08:

Command Body		
Station Address	Function Code	Data bytes received

Example: 01 08 00 02 00 04

Function Code 15 (0F hex)

Forces each coil in a sequence of coils to either ON or OFF.

Request message format for function code 15:

Command Body								
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Coil High Byte	Requested Number of Coil Low Byte	Byte Count	Force Data High Byte	Force Data Low Byte

Example: Request to force a series of 10 coils starting at address 00017 (11 hex) in ADAM-6000 module.

01 0F 00 11 00 0A 02 CD 01

The query data contents are two bytes: CD 01 hex, equal to 1100 1101 0000 0001 binary. The binary bits are mapped to the addresses in the following way.

Bit: 1 1 0 0 1 1 0 1 0 0 0 0 0 0 0 1

Address (000XX): 24 23 22 21 20 19 18 17 - - - - - - 26 25

Response message format for function code 08:

The normal responses return the station address, function code, start address, and requested number of coil forced.

Command Body					
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Coil High Byte	Requested Number of Coil Low Byte

Example: 01 0F 00 11 00 0A

Function Code 16 (10 hex)

Preset values into a sequence of holding registers.

Request message format for function code 16:

Command Body							
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Register High Byte	Requested Number of Register Low Byte	Byte Count	Data

Example: Preset constant #1 (address 40009) to 100.0 in ADAM-6000 module.

01 10 00 09 00 02 04 42 C8 00 00

Response message format for function code 08:

The normal responses return the station address, function code, start address, and requested number of registers preset.

Command Body					
Station Address	Function Code	Start Address High Byte	Start Address Low Byte	Requested Number of Register High Byte	Requested Number of Register Low Byte

Example: 01 10 00 09 00 02

6-4 Apply with ASCII Command for ADAM-6000 Modules

For users do not familiar to Modbus protocol, Advantech offers a function library as a protocol translator, integrating ASCII command into Modbus/TCP structure. Therefore, users familiar to ASCII command can access ADAM-6000 easily. Before explaining the structure of ASCII command packed with Modbus/TCP format. Let's see how to use an ASCII command and how many commands are available for your program.

TCP Format	Modbus Format	ASCII Command

Figure 6-3 ASCII Command Structure in ADAM-6000

6-4-1 Syntax of ASCII

Command Syntax:

[delimiter character][address][slot][channel][command][data][checksum][carriage return]

Every command begins with a delimiter character. There are two valid characters:

$ and #

The delimiter character is followed by a two-character address (hex-decimal) that specifies the target system. The two characters following the address specified the module and channel.

Depending on the command, an optional data segment may follow the command string. An optional two-character checksum may also be appended to the command string. Every command is terminated with a carriage return (cr).

Note: All commands should be issued in UPPERCASE characters only!

The command set is divided into the following three categories:

System Command Set

· Analog Input Command Set

Analog Input Alarm Command Set

· Digital I/O Modules Command Set

Every command set category starts with a command summary of the particular type of module, followed by datasheets that give detailed information about individual commands.

Although commands in different subsections sometime share the same format, the effect they have on a certain module can be completely different than that of another. Therefore, the full command sets for each type of modules are listed along with a description of the effect the command has on the given module.

6-4-2 I/O Module Command Set Searching Tables

ADAM-6017 Command Table

Command Syntax	Command Name	Description
$aaAff	Set Integration Time	Sets the integration time for a specified module
$aaB	Get Integration Time	Get the integration time from a specified module
$aaAnntt	Set Input Range	Set the input range to the specified channel in the analog input module
$aaBnn	Read Input Range	Read the input range of the specified channel in the analog input module
#aan	Read Analog Input from Channel N	Return the input value from the specified channel in the analog input module
#aa	Read Analog Input from all channels	Return the input values from all channels of the specified analog input module
$aa0	Span Calibration	Calibrate the analog input module to correct the gain error
$aa1	Offset Calibration	Calibrate the analog input module to correct the offset error
$aa6	Read Channels Status	Asks a specified input module to return the status of all channels
$aa5mm	Enable/Disable multiplexing	Enables/Disables multiplexing simultaneously for separate channels of the specified input module

#aaMH	Read all Max. Data	Read the maximum data from all channels in the specified module
#aaMHn	Read single Max. Data	Read the maximum date from a specified channel in the module
#aaML	Read all Min. Data	Read the minimum data from all channels in the specified module
#aaMLn	Read single Min. Data	Read the minimum data from a specified channel in the module
$aaEmm	Enable/Disable Channels to Average	Enables/Disables the specified channels for data average function
$aaE	Read Ave. Channels	Identify which channels are included in average function
#aaDnd	Set Digital Output	Set the status of the specified digital output in the ADAM-6017 module
$aaCjAhs	Set Alarm Mode	Set the High/Low alarm in either Momentary or Latching mode
$aaCjAh	Read Alarm Mode	Returns the alarm mode for the specified channels
$aaCjAhEs	Enable/Disable Alarm	Enables/Disables the high/low alarm of the specified channels
$aaCjCh	Clear Latch Alarm	Resets a latched alarm
$aaCjAhCCn	Set Alarm Connection	Connects the High/Low alarm of a specified input channel to interlock with a specified output channel
$aaCjRhC	Read Alarm Connection	Returns the alarm configuration of a specified input channel
$aaCjAhU	Set Alarm Limit	Set the High/Low alarm limit value to a specified channel
$aaCjRhU	Read Alarm Limit	Returns the High/Low alarm limit value of the specified channel
$aaCjS	Read Alarm Status	Reads whether an alarm occurred in the specified channel
$aaF	Read Firmware Version	Return the firmware version code from the specified ADAM-6000 module.
$aaM	Read Module Name	Return the module name from the specified module

ADAM-6050 Command Table

Command Syntax	Command Name	Description
$aaAff	Configuration	Sets the integration time for a specified module
$aa6	Read Channels Status	Asks a specified input module to return the status of all channels
#aabb	Write Digital Output	Writes specified values to either a single channel or all channels simultaneously
$aa5	Reset Status	Indicates whether a specified digital I/O module was reset after the last time the $aa5 command was issued
$aaF	Read Firmware Version	Return the firmware version code from the specified ADAM-6000 module.
$aaM	Read Module Name	Return the module name from the specified module

ADAM-6051 Command Table

Command Syntax	Command Name	Description
$aaAff	Configuration	Sets the integration time for a specified module
$aa6	Read Channels Status	Asks a specified input module to return the status of all channels
#aabb	Write Digital Output	Writes specified values to either a single channel or all channels simultaneously
$aa5	Reset Status	Indicates whether a specified digital I/O module was reset after the last time the $aa5 command was issued
$aaF	Read Firmware Version	Return the firmware version code from the specified ADAM-6000 module.
$aaM	Read Module Name	Return the module name from the specified module

ADAM-6060 Command Table

Command Syntax	Command Name	Description
$aaAff	Configuration	Sets the integration time for a specified module
$aa6	Read Channels Status	Asks a specified input module to return the status of all channels
#aabb	Write Digital Output	Writes specified values to either a single channel or all channels simultaneously
$aa5	Reset Status	Indicates whether a specified digital I/O module was reset after the last time the $aa5 command was issued
$aaF	Read Firmware Version	Return the firmware version code from the specified ADAM-6000 module.
$aaM	Read Module Name	Return the module name from the specified module

6-4-3 System Command Set

$aaAff

Name Set Integration Time

Description Sets an integration time to a specified ADAM-6000 module.

Syntax **$aaAff(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to configure. (Always 01)

A is I/O module configuration command.

ff represents the integration time.

50 means 50ms (Operation Under 60 Hz power)

60 means 60ms (Operation Under 50 Hz power)

(cr) is the terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01A50(cr)**

response: **!01(cr)**

The ADAM-6000 module at address 01h is configured to an integration time 50ms (60Hz). The response indicates that the command has been received.

Note: An analog input module requires a maximum of 7 seconds to perform auto calibration and ranging after it is reconfigured. During this time span, the module cannot be addressed to perform any other actions.

$aaB

Name Read Integration Time Setting

Description Read the integration time setting of a specified ADAM-6000 module.

Syntax **$aaB(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to configure. (Always 01)

B is I/O module configuration reading command.

51 means 50ms (Operation Under 60 Hz power)

60 means 60ms (Operation Under 50 Hz power)

(cr) is the terminating character, carriage return (0Dh)

Response **!aaff(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal address of an ADAM-6000 module.

ff represents the integration time.

50 means 50ms (Operation Under 60 Hz power)

60 means 60ms (Operation Under 50 Hz power)

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01B(cr)**

response: **!0150(cr)**

The ADAM-6000 module at address 01h is configured to an integration time 50ms (60Hz).

$aaM

Name Read Module Name

Description Returns the module name from a specified ADAM-6000 module.

Syntax **$aaM(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to interrogate. (Always 01)

M is the Module Name command.

(cr) is the terminating character, carriage return (0Dh).

Response **!aa60bb(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error, communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was in-valid.

aa (range 00-FF) represents the 2-character hexadecimal address of an ADAM-6000 module.

bb (range 00-FF) represents the 2-character model number of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh).

Example command: **$01M(cr)**

response: **!0150(cr)**

The command requests the system at address 01h to send its module name. The system at address 01h responds with module name **6050** indicating that there is an ADAM-6050 at address 01h.

$aaF

Name Read Firmware Version

Description Returns the firmware version code from a specified ADAM-6000 module.

Syntax **$aaF(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to interrogate. (Always 01)

F is the Firmware Version command.

(cr) is the terminating character, carriage return (0Dh).

Response **!aa(version)(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error, communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal address of an ADAM-6000 module.

(version) represents the firmware version of the ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh).

Example command: **$01F(cr)**

response: **!01A1.01(cr)**

The command requests the system at address 01h to send its firmware version.

The system responds with firmware version **A1.01**.

6-4-4 Analog Input Command Set

Command Syntax	Command Name	Description
$aaAnntt	Set Input Range	Set the input range to the specified channel in the analog input module
$aaBnn	Read Input Range	Read the input range of the specified channel in the analog input module
#aan	Read Analog Input from Channel N	Return the input value from the specified channel in the analog input module
#aa	Read Analog Input from all channels	Return the input values from all channels of the specified analog input module
$aa0	Span Calibration	Calibrate the analog input module to correct the gain error
$aa1	Offset Calibration	Calibrate the analog input module to correct the offset error
$aa6	Read Channels Status	Asks a specified input module to return the status of all channels
$aa5mm	Enable/Disable multiplexing	Enables/Disables multiplexing simultaneously for separate channels of the specified input module
#aaMH	Read all Max. Data	Read the maximum data from all channels in the specified module
#aaMHn	Read single Max. Data	Read the maximum date from a specified channel in the module
#aaML	Read all Min. Data	Read the minimum data from all channels in the specified module
#aaMLn	Read single Min. Data	Read the minimum data from a specified channel in the module
$aaEmm	Enable/Disable Channels to Average	Enables/Disables the specified channels for data average function
$aaE	Read Ave. Channels	Identify which channels are included in average function
#aaDnd	Set Digital Output	Set the status of the specified digital output in the ADAM-6017 module

$aaAnntt

Name Set Input Range

Description Sets the input range for a specified channel of a specified analog input module.

Syntax **$aaAnntt**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to configure. (Always 01)

A represents the set input range command.

nn (range 00-07) represents the specific channel you want to set the input range.

tt (range 0x07-0x0D) represents the 2-character code of the input type. (Refer to the table below)

(cr) is the terminating character, carriage return (0Dh).

Signal Type and Range	Against Code
4 ~ 20mA	07
-10V ~ 10V	08
0V ~ 5V	09
-1V ~ 1V	0A
0mV ~ 500mV	0B
-100mV ~ 100mV	0C
0 ~ 20mA	0D

Table 6-4 ADAM-6017 Analog Input Range mapping Table

Response **!aa(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh).

Example command: **$01A0107(cr)**

response: **!01(cr)**

Channel 1 of the ADAM-6017 module at address 01h is set to the input range 4-20 mA. The response indicates that the command has been received as a valid command.

$aaBnn

Name Read Input Range

Description Returns the input range for a specified channel of a specified analog input module.

Syntax **$aaBnn**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to interrogate. (Always 01)

B represents the read input range command.

nn (range 00-07) represents the specific channel you want to read the input range.

(cr) is the terminating character, carriage return (0Dh).

Response **!aatt(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

tt (range 0x07-0x0D) represents the 2-character code of the input type. (Refer to the Table 6-4)

(cr) is the terminating character, carriage return (0Dh).

Example command: **$01B01(cr)**

response: **!0107(cr)**

Channel 1 of the ADAM-6017 module at address 01h responds with an input range 4-20 mA.

$aan

Name Read Analog Input from Channel N

Description Returns the input data from a specified channel in a specified analog input module.

Syntax **$aan**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to interrogate. (Always 01)

n (range 0-8) represents the specific channel you want to read the input data.

(cr) is the terminating character, carriage return (0Dh).

Response **>(data)(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

(cr) is the terminating character, carriage return (0Dh).

Example command: **$012(cr)**

response: **>+10.000**

Channel 2 of the ADAM-6017 module at address 01h responds with an input value +10.000.

$aa

Name Read Analog Input from All Channels

Description Returns the input data from all channels in a specified analog input module.

Syntax **$aa**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to interrogate. (Always 01)

(cr) is the terminating character, carriage return (0Dh).

Response **>(data)(data)(data)(data)(data)(data)(data)(data)(data)(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

(cr) is the terminating character, carriage return (0Dh).

Note: The latest data returned is the Average value of the preset channels in this module.

Example command: **$01(cr)**

response:

>+10.000+10.000+10.000+10.000+10.000+10.000+10.000+10.000+10.000

$aa0

Name Span Calibration

Description Calibrates a specified analog input module to correct for gain errors

Syntax **$aa0(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module which is to be calibrated. (Always 01)

0 represents the span calibration command.

(cr) is the terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Note: In order to successfully calibrate an analog input module's input range, a proper calibration input signal should be connected to the analog input module before and during the calibration process.

$aa1

Name Zero Calibration

Description Calibrates a specified analog input module to correct for offset errors

Syntax **$aa1(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module which is to be calibrated. (Always 01)

1 represents the zero calibration command.

(cr) is the terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Note: In order to successfully calibrate an analog input module's input range, a proper calibration input signal should be connected to the analog input module before and during the calibration process.

$aa6

Name Read Channels Status

Description Asks a specified input module to return the status of all channels

Syntax **$aa6(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module you want to interrogate. (Always 01)

6 is the read channels status command.

(cr) is the terminating character, carriage return (0Dh)

Response **!aamm(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

mm are two hexadecimal values. Each value is interpreted as 4 bits. The first 4-bit value represents the status of channels 4-7, the second 4 bits represents the status of channels 0-3. A value of 0 means the channel is disabled, while a value of 1 means the channel is enabled.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$016(cr)**

response: **!01FF(cr)**

The command asks the analog input module in slot 1 of the system at address 01h to send the status of its input channels. The analog input module responds that all its multiplex channels are enabling (FF equals 1111 and 1111).

$aa5mm

Name Enable/Disable Channels for multiplexing

Description Enables/Disables multiplexing for separate channels of the specified input module

Syntax **$aa5mm(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module. (Always 01)

5 identifies the enable/disable channels command.

mm (range 00-FF) are two hexadecimal characters. Each character is interpreted as 4 bits. The first 4-bit value represents the status of channels 4-7; the second 4-bit value represents the status of channels 0-3. A value of 0 means the channel is disabled, while a value of 1 means the channel is enabled.

(cr) is the terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01581(cr)**

response: **!01(cr)**

The command enables/disables channels of the analog input module at address 01h. Hexadecimal 8 equals binary 1000, which enables channel 7 and disables channels 4, 5 and 6. Hexadecimal 1 equals binary 0001, which enables channel 0 and disables channels 1, 2 and 3.

#aaMH

Name Read Maximum Value

Description Read the Maximum values from all channels in a specified analog input module

Syntax **$aaMH(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01)

MH represents the read maximum value command.

(cr) is the terminating character, carriage return (0Dh)

Response **>(data)…(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01MH(cr)**

response:

>+10.000+10.000+10.000+10.000+10.000+10.000+10.000+10.000+10.000

Note: The latest data returned is the Average value of the preset channels in this module.

#aaMHn

Name Read Maximum Value from channel N

Description Read the Maximum values from a specific channel in a specified analog input module

Syntax **$aaMHn(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01)

MH represents the read maximum value command.

n (range 0-8) represents the specific channel you want to read the input data.

Note: The latest data returned is the Average value of the preset channels in this module.

(cr) is the terminating character, carriage return (0Dh)

Response **>(data)(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01MH2(cr)**

response: **>+10.000**

#aaML

Name Read Minimum Value

Description Read the Minimum values from all channels in a specified analog input module

Syntax **$aaML(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01)

ML represents the read minimum value command.

(cr) is the terminating character, carriage return (0Dh)

Response **>(data)…(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01ML(cr)**

response:

>+10.000+10.000+10.000+10.000+10.000+10.000+10.000+10.000+10.000

Note: The latest data returned is the Average value of the preset channels in this module.

#aaMLn

Name Read Minimum Value from channel N

Description Read the Minimum values from a specific channel in a specified analog input module

Syntax **$aaMLn(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01)

ML represents the read minimum value command.

n (range 0-8) represents the specific channel you want to read the input data.

Note: The latest data returned is the Average value of the preset channels in this module.

(cr) is the terminating character, carriage return (0Dh)

Response **>(data)(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01ML3(cr)**

response: **>+10.000**

#aaEmm

Name Enable/Disable Channels for Average

Description Enables/Disables the specific channels in the analog input module for the average function.

Syntax **$aaEmm(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01)

E represents the enable/disable channel for average command.

mm (range 00-FF) are two hexadecimal characters. Each character is interpreted as 4 bits. The first 4-bit value represents the status of channels 4-7; the second 4-bit value represents the status of channels 0-3. A value of 0 means the channel is disabled, while a value of 1 means the channel is enabled.

(cr) is the terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01E03(cr)**

response: **!01**

The command enables/disables channels for average function in the analog input module at address 01h. Hexadecimal 03 equals binary 00000011, which enables channel 0, 1 and disables the rest of other channels.

#aaE

Name Read the Average Enable/Disable Status

Description Read the average enable/disable status of all channels in the specific analog input module.

Syntax **$aaE(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01)

E represents the enable/disable channel for average command.

(cr) is the terminating character, carriage return (0Dh)

Response **!aamm(cr)** if the command is valid.

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module.

mm (range 00-FF) are two hexadecimal characters. Each character is interpreted as 4 bits. The first 4-bit value represents the status of channels 4-7; the second 4-bit value represents the status of channels 0-3. A value of 0 means the channel is disabled, while a value of 1 means the channel is enabled.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$01E(cr)**

response: **!0103**

The command set “ON” status to the channel 0 in the analog input module at address 01h.

#aaDnd

Name	Set Digital Output
Description	Set the digital output status in ADAM-6000 analog input module.
Syntax	**$aaDnd(cr)** **$** is a delimiter character. **aa** (range 00-FF) represents the 2-character hexadecimal Modbus address of the ADAM-6000 module to be read. (Always 01) **D** represents the digital output setting command. **n** (range 0-1) represents the specific channel you want to set the output status. **d** (range 0-1) represents the status you want to set to the specific channel **(cr)** is the terminating character, carriage return (0Dh)
Response	**!aa(cr)** if the command is valid. **?aa(cr)** if an invalid operation was entered. There is no response if the module detects a syntax error or communication error or if the specified address does not exist. **!** delimiter character indicating a valid command was received. **?** delimiter character indicating the command was invalid. **aa** (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module. **(cr)** is the terminating character, carriage return (0Dh)
Example	command: **$01D01(cr)** response: **!01** The command set “ON” status to the channel 0 in the analog input module at address 01h.

6-4-5 Analog Input Alarm Command Set

$aaCjAhs	Set Alarm Mode	Set the High/Low alarm in either Momentary or Latching mode
$aaCjAh	Read Alarm Mode	Returns the alarm mode for the specified channels
$aaCjAhEs	Enable/Disable Alarm	Enables/Disables the high/low alarm of the specified channels
$aaCjCh	Clear Latch Alarm	Resets a latched alarm
$aaCjAhCCn	Set Alarm Connection	Connects the High/Low alarm of a specified input channel to interlock with a specified output channel
$aaCjRhC	Read Alarm Connection	Returns the alarm configuration of a specified input channel
$aaCjAhU	Set Alarm Limit	Set the High/Low alarm limit value to a specified channel
$aaCjRhU	Read Alarm Limit	Returns the High/Low alarm limit value of the specified channel
$aaCjS	Read Alarm Status	Reads whether an alarm occurred in the specified channel

$aaCjAhs

Name Set Alarm Mode

Description Sets the High/Low alarm of the specified input channel in the addressed ADAM-6000 module to either Latching or Momentary mode.

Syntax **$aaCjAhs(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired channel j (j : 0 to 7).

A is the Set Alarm Mode command.

h indicates alarm types (H = High alarm, L = Low alarm)

s indicates alarm modes (M = Momentary mode, L = Latching mode)

(cr) represents terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal address of the corresponding ADAM-6000 module.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1AHL(cr)**

response: **!01(cr)**

Channel 1 of the ADAM-6000 module at address 01h is instructed to set its High alarm in Latching mode.

The module confirms that the command has been received.

$aaCjAh

Name Read Alarm Mode

Description Returns the alarm mode for the specified channel in the specified ADAM-6000 module.

Syntax **$aaCjAh(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired channel j (j : 0 to 7).

A is the Read Alarm Mode command.

h indicates the alarm types (H = High alarm, L = Low alarm)

(cr) represents terminating character, carriage return (0Dh)

Response **!aas(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal address of the corresponding ADAM-6000 module.

s indicates alarm modes (M = Momentary mode, L = Latching mode)

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1AL(cr)**

response: **!01M(cr)**

Channel 1 of the ADAM-6000 module at address 01h is instructed to return its Low alarm mode.

The system responds that it is in Momentary mode.

$aaCjAhEs

Name Enable/Disable Alarm

Description Enables/Disables the High/Low alarm of the specified input channel in the addressed ADAM-6000 module

Syntax **$aaCjAhEs(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired channel j (j : 0 to 7).

AhEs is the Set Alarm Mode command.

h indicates alarm type (H = High alarm, L = Low alarm)

s indicates alarm enable/disable (E = Enable, D = Disable)

(cr) represents terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal address of the corresponding ADAM-6000 module.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1ALEE(cr)**

response: **!01(cr)**

Channel 1 of the ADAM-6000 module at address 01h is instructed to enable its Low alarm function.

The module confirms that its Low alarm function has been enabled.

Note: An analog input module requires a maximum of 2 seconds after it receives an Enable/Disable Alarm command to let the setting take effect. During this interval, the module cannot be addressed to perform any other actions.

$aaCjCh

Name Clear Latch Alarm

Description Sets the High/Low alarm to OFF (no alarm) for the specified input channel in the addressed ADAM-6000 module

Syntax **$aaCjCh(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired channel j (j : 0 to 7).

Ch is the Clear Latch Alarm command.

h indicates alarm type (H = High alarm, L = Low alarm)

(cr) represents terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal Modbus network address of the corresponding ADAM-6000 module.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1CL(cr)**

response: **!01(cr)**

Channel 1 of the ADAM-6000 module at address 01h is instructed to set its Low alarm state to OFF.

The system confirms it has done so accordingly.

$aaCjAhCCn

Name Set Alarm Connection

Description Connects the High/Low alarm of the specified input channel to interlock the specified digital output in the addressed ADAM-6000 module

Syntax **$aaCjAhCCn(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000/TCP module. (Always 01)

Cj identifies the desired analog input channel j (j : 0 to 7).

AhC is the Set Alarm Connection command.

h indicates alarm type (H = High alarm, L = Low alarm)

Cn identifies the desired digital output channel n (n : 0 to 1). To disconnect the digital output, n should be set as '*'.

(cr) represents terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal Modbus network address of the corresponding ADAM-6000 module.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1ALCC0(cr)**

response: **!01(cr)**

Channel 1 of the ADAM-6000 module at address 01h is instructed to connect its Low alarm to the digital output of channel 0 in the specific ADAM-6000 module.

The system confirms it has done so accordingly.

$aaCjRhC

Name Read Alarm Connection

Description Returns the High/Low alarm limit output connection of a specified input channel in the addressed ADAM-6000 module

Syntax **$aaCjRhC(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus address of an ADAM-6000 module. (Always 01)

Cj identifies the desired analog input channel j (j : 0 to 7).

RhC is the Read Alarm Connection command.

h indicates alarm type (H = High alarm, L = Low alarm)

(cr) represents terminating character, carriage return (0Dh)

Response **!aaCn(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal Modbus network address of the corresponding ADAM-6000 module.

Cn identifies the desired digital output channel n (n : 0 to 1) whether interlock with the alarm of the specific analog input channel. If the values of n are '*', the analog input has no connection with a digital output point.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1RLC(cr)**

response: **!01C0(cr)**

Channel 1 of the ADAM-6000 module at address 01h is instructed to read its Low alarm output connection.

The system responds that the Low alarm output connects to the digital output at channel 0 in the specific ADAM-6000 module.

$aaCjAhU

Name Set Alarm Limit

Description Sets the High/Low alarm limit value for the specified input channel of a specified ADAM-6000 module.

Syntax **$aaCjAhU(data)(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired analog input channel j (j : 0 to 7).

AhU is the Set Alarm Limit command.

h indicates alarm type (H = High alarm, L = Low alarm)

(data) represents the desired alarm limit setting. The format is always in engineering units.

(cr) represents terminating character, carriage return (0Dh)

Response **!aa(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal Modbus network address of the corresponding ADAM-6000 module.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1AHU+080.00(cr)**

response: **!01(cr)**

The high alarm limit of the channel 1 in the specific ADAM-6000 module at address 01h is been set +80.

The system confirms the command has been received.

Note: An analog input module requires a maximum of 2 seconds after it receives a Set Alarm Limit command to let the settings take effect. During this interval, the module cannot be addressed to perform any other actions.

$aaCjRhU

Name Read Alarm Limit

Description Returns the High/Low alarm limit value for the specified input channel in the addressed ADAM-6000 module

Syntax **$aaCjRhU(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired analog input channel j (j : 0 to 7).

RhU is the Read Alarm Limit command.

h indicates alarm type (H = High alarm, L = Low alarm)

(cr) represents terminating character, carriage return (0Dh)

Response **!aa(data)(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal Modbus network address of the corresponding ADAM-6000 module.

(data) represents the desired alarm limit setting. The format is always in engineering units.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1RHU(cr)**

response: **!01+2.0500(cr)**

Channel 1 of the ADAM-6000 module at address 01h is configured to accept 5V input. The command instructs the system to return the High alarm limit value for that channel.

The system responds that the High alarm limit value in the desired channel is 2.0500 V.

$aaCjS

Name Read Alarm Status

Description Reads whether an alarm occurred to the specified input channel in the specified ADAM-6000 module

Syntax **$aaCjS(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module. (Always 01)

Cj identifies the desired analog input channel j (j : 0 to 7).

S is the Read Alarm Status command.

(cr) represents terminating character, carriage return (0Dh)

Response **!aahl(cr)** if the command was valid

?aa(cr) if an invalid operation was entered.

There is no response if the system detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

aa represents the 2-character hexadecimal address Modbus of the corresponding ADAM-6000 module.

h represents the status of High alarm. '1' means the High alarm occurred, '0' means it did not occur.

l represents the status of Low alarm. '1' means the Low alarm occurred, '0' means it did not occur.

(cr) represents terminating character, carriage return (0Dh)

Example command: **$01C1S(cr)**

response: **!0101(cr)**

The command asks the module at address 01h to return its alarm status for channel 1.

The system responds that a High alarm has not occurred, but the Low alarm has occurred.

6-4-6 Digital Input/Output Command Set

Command Syntax	Command Name	Description
$aa6	Read Channels Status	Asks a specified input module to return the status of all channels

#aabb	Write Digital Output	Writes specified values to either a single channel or all channels simultaneously

$aa6

Name Read Channel Status

Description This command requests that the specified ADAM-6000 module return the status of its digital input channels and a read-back value of its digital output channels.

Syntax **$aa6(cr)**

$ is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of the ADAM-6000 module. (Always 01)

6 is the Digital Data In command.

(cr) is the terminating character, carriage return (0Dh)

Response **!aa(data)(data)00(cr)** if the command is valid. (ADAM-6050/6051/6060)

?aa(cr) if an invalid operation was entered.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

! delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module.

(data) a 2-character hexadecimal value representing the values of the digital input module.

(cr) is the terminating character, carriage return (0Dh)

Example command: **$016(cr)**

response: **!01112200(cr)**

The command asks the specific ADAM-6000 module at address 01h to return the values of all channels.

The first 2-character portion of the response indicates the address of the ADAM-6000

module. The second 2-character portion of the response, value 11h (00010001), indicates that digital input channels 8 and 12 are ‘ON’, channels 9, 10, 11, 13, 14 and 15 are ‘OFF’. The third 2-character portion of the response, value 22h (00100010), indicates that digital input channels 1 and 5 are ON, and channels 0, 2, 3, 4, 6 and 7 are OFF.

#aabb(data)

Name Write Digital Output

Description This command sets a single or all digital output channels to the specific ADAM-6000 module.

Syntax **#aabb(data)(cr)**

is a delimiter character.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of the ADAM-6000 module. (Always 01)

bb is used to indicate which channel(s) you want to set.

Writing to all channels (write a byte): both characters should be equal to zero **(BB=00)**.

Writing to a single channel (write a bit): first character is 1, second character indicates channel number which can range from 0h to Fh.

(data) is the hexadecimal representation of the digital output value(s).

When writing to a single channel (bit) the first character is always 0. The value of the second character is either 0 or 1.

When writing to all channels (byte) 2 or 4-characters are significant. The digital equivalent of these hexadecimal characters represent the channels' values.

Response **>(cr)** if the command was valid.

?aa(cr) if an invalid command has been issued.

There is no response if the module detects a syntax error or communication error or if the specified address does not exist.

> delimiter character indicating a valid command was received.

? delimiter character indicating the command was invalid.

aa (range 00-FF) represents the 2-character hexadecimal Modbus network address of an ADAM-6000 module that is responding.

(cr) is the terminating character, carriage return (0Dh)

Example command: **#151201(cr)**

response: **>(cr)**

An output bit with value 1 is sent to channel 2 of a digital output module at address 01h. Channel 2 of the digital output module is set to ‘ON’.

command: **#010012(cr)**

response: **>(cr)**

An output byte with value 12h (00010010) is sent to the digital output module at address 01h. Channels 1and 4 will be set to ‘ON’, and all other channels will be set to ‘OFF’.

Note: If any channel of the digital output module is configured as the output for an analog input alarm, it cannot be reconfigured via digital output commands. Channels used for analog input alarms always have a higher priority.

Appendix A

Design Worksheets

An organized system configuration will lead to efficient performance and reduce engineer effort. This Appendix provides the necessary worksheet, helping users to configure their DA&C system in order. Follow these working steps to build up your system relational document:

Step 1. Asking questions and getting answers for your control strategy.

1) What will be monitored and controlled? (List the equipment)

2) What will be monitored and controlled separately? (Divide the function area)

3) What will be monitored and controlled by ADAM-6000 I/O? (List the target equipment in different function areas)

Step 2. Identify the I/O types of each equipment and full-fill Table A-1 to establish the I/O data base.

Function Area	Equipment	Input or Output	I/O Module Type	I/O Module Product No.	Voltage of Range	Current of Range	Special Requirements

Table A-1 I/O Data Base

Step 3. Mapping the I/O data base into ADAM-6000 I/O modules.

1) In column A, note the ADAM-6000/TCP IP addresses mapped for individual function areas.

2) In column B, list the I/O module's product number.

3) In column C, enter the maximum number of I/O points available per module.

4) In column D, total the number of the I/O point you need.

5) In column E, calculate the total number of these modules that you will need.

6) In column F, enter the number of spare modules that you may need for future expansion in your systems.

7) In column G, enter the total number (Required + Spare) of these modules that you need for these systems.

<A>	<B>	<C>	<D>	<E>	<F>	<G>
ADAM-6000 IP Address	I/O Module Product No.	I/O Points per Module	Total I/O Points Required	I/O Module Required	Spare I/O Modules	Total I/O Modules

Table A-2 Summary Required Modules

Step 4. Implement the Modbus address in to the I/O table.

ADAM-6000 IP Address	I/O Type	Channel Number	I/O Address	Tag Name	Equipment & Description

Table A-3 Table for Programming

These several worksheets are very useful to hardware wiring and software integration, please make copies to establish your own system configuration documentation.