

ADAM 5510 Series

**PC-based Programmable Controller
User's Manual**

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**4 Edition
May 2008**

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1

System Overview

Chapter 1 System Overview

1.1 Introduction

Standalone Data Acquisition and Control System

As the growth of PC-based technology, Advantech PC-based Programmable Controllers have been widely applied in variety of industrial automation applications. Enhanced from the original ADAM-5510 controller, the ADAM-5510 Series Controller is a new series of stand-alone programmable controller features high memory capacity, user-friendly configuration tool, rich serial communication interfaces, and also Ethernet port available on specific models. Applying the ADAM-5510 Series Controller, the C programmers would be able to handle any complex task easily.

The ADAM-5510 Series Controller includes four models as following:

- **ADAM-5510M** 4-slot PC-based Programmable Controller
- **ADAM-5510E** 8-slot PC-based Programmable Controller
- **ADAM-5510/TCP** 4-slot Ethernet-enabled Programmable Controller
- **ADAM-5510E/TCP** 8-slot Ethernet-enabled Programmable Controller

Note: the model number ADAM-5510 is not included in the ADAM-5510 Series Controller. It's because all above ADAM-5510 Series Controller share the same hardware specifications and software function libraries. However, the model of ADAM-5510 has it's own hardware specification and software library.

1.2 Features

The system of ADAM-5510 Series Controller consists of two major components: the main unit and I/O modules. The main unit includes a CPU card, a power regulator, a 4-slot or 8-slot base, three serial communication ports and one programming port. Some models also embed one Ethernet port. They has the following major features:

1.2.1 Control flexibility with C programming

The ADAM-5510 Series Controller is a compact PC in its own right and includes an 80188 CPU and a built-in ROM-DOS operating system. It can be used in a way similar to how one uses an x86 PC in the office. Programmers in C can write and compile applications in Borland C 3.0 and download to the ADAM-5510 Series Controller. Given the prevalence of C language programming tools, this is a distinct advantage for many users

and can result in a very short learning curve and very modest training expense requirements.

1.2.2 RS-232/485 communication ability

The ADAM-5510 Series Controller has four serial communication ports, giving it excellent communication abilities. This facilitates its ability to control networked devices. The communication ports of different models are listed as below table.

	ADAM-5510M	ADAM-5510E	ADAM-5510/TCP	ADAM-5510E/TCP
COM1	RS-232	RS-232/485	RS-232	RS-232/485
COM2	RS-485	RS-485	RS-485	RS-485
COM3	RS-232	RS-232	RS-232	RS-232
COM4	RS-232/485	RS-232/485	RS-232/485	RS-232/485

Table 1-1 Communication Ports of ADAM-5510 Series Controller

For example, ADAM-5510M COM1 is a dedicated RS-232 port, COM2 is a dedicated RS-485 port, and COM4 is a RS-232/485 selectable port. These three ports allowed the ADAM-5510M to satisfy diverse communication and integration demands. COM3 is a spare programming port for downloading or transferring executable programs from a host PC. It can also be used as an RS-232 communication port. Please refer to following figure and check the location of COM ports.

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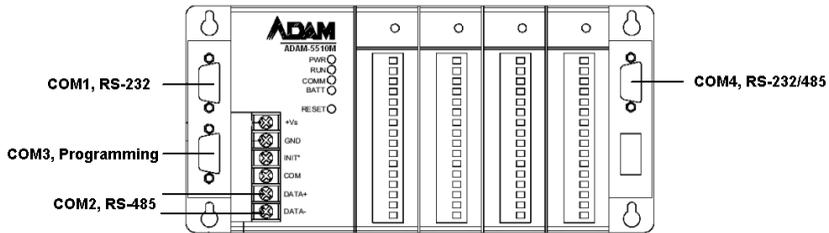


Figure 1-1 ADAM-5510M Communication Ports

1.2.3 Versatile Protocols of Communication Function Libraries

The communication protocol of the ADAM-5510 is user-defined and there are library functions of MODBUS/RTU protocol and MODBUS/TCP protocol (ADAM-5510/TCP and ADAM-

5510E/TCP only), available for users. Of course, users can implement ASCII-based command and response protocol by themselves. The function libraries include following protocols.

- MODBUS/RTU Master Function for connecting to remote I/O modules via RS-485 port
- MODBUS/RTU Slave Function for connecting to HMI/SCADA software via RS-485 port
- MODBUS/TCP Server Function for connecting to HMI/SCADA software via Ethernet port (ADAM-5510/TCP and ADAM-5510E/TCP only)
- MODBUS/TCP Client Function for connecting to Ethernet-enabled remote I/O modules via Ethernet port (ADAM-5510/TCP and ADAM-5510E/TCP only)

1.2.4 Complete set of I/O modules for total solutions

The ADAM-5510 Series Controller uses a convenient backplane system for supporting versatile I/O modules. Advantech's complete line of ADAM-5000 I/O modules integrates with the ADAM-5510 Series Controller to support your applications. Following table is the I/O module support list we provided for user's choice.

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Module	Name	Specification	Reference
Analog I/O	ADAM-5013	3-ch. RTD input	Isolated
	ADAM-5017	8-ch. AI	Isolated
	ADAM-5017H	8-ch. High speed AI	Isolated
	ADAM-5018	7-ch. Thermocouple input	Isolated
	ADAM-5024	4-ch. AO	Isolated
Digital I/O	ADAM-5050	7-ch. D I/O	Non-isolated
	ADAM-5051	16-ch. DI	Non-isolated
	ADAM-5051D	16-ch. DI w/LED	Non-isolated
	ADAM-5051S	16-ch. Isolated DI w/LED	Isolated
	ADAM-5052	8-ch. DI	Isolated
	ADAM-5055S	16-ch. Isolated DI/O w/LED	Isolated
	ADAM-5056	16-ch. DO	Non-isolated
	ADAM-5056D	16-ch. DO w/LED	Non-isolated
	ADAM-5056S	16-ch. Isolated DO w/LED	Isolated
ADAM-5056SO	16-ch. Iso. DO w/LED (source)	Isolated	
Relay Output	ADAM-5060	6-ch. Relay output	Isolated
	ADAM-5068	8-ch. Relay output	Isolated
	ADAM-5069	8-ch. Power Relay output	Isolated
Counter/Frequency	ADAM-5080	4-ch. Counter/Frequency	Isolated
Serial I/O	ADAM-5090	4-port RS232	Non-isolated

Table 1-2 I/O Module Support List

- A full range of digital modules support +10 to +30VDC I/O and relay outputs.
- A set of analog modules provide up to 16-bit resolution and programmable input and output (including bipolar) signal ranges. For details, refer to ADAM-5000 Series I/O Module User's Manual.
- A complete set of C language I/O subroutines are included in the ADAM-5510 Series Controller function library to reduce programming efforts. Users can easily call these subroutines to execute the ADAM-5510 Series Controller's I/O functions while programming in Borland C 3.0 languages. For a detailed description, refer to Chapter 5: Programming and Function Library.

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1.2.5 Built-in ROM and RAM disk for programming

The ADAM-5510 Series Controller has built-in Flash Memory and SRAM for file downloading, system operation and data storage. It provides 1MB file system, 960 KB free for users to download programs. There are also 640KB SRAM to provide the memory needed for efficient application operation and file transfer. Moreover, users are allowed to decide the battery backup memory size up to 384KB in the SRAM.

1.2.6 Built-in real-time clock and watchdog timer

The micro-controller also includes a real-time clock and watchdog timer. The real-time clock records events while they occur. The watchdog timer is designed to automatically reset the microprocessor if the system fails. This feature greatly reduces the level of maintenance required and makes the ADAM-5510 Series Controller ideal for use in applications which required a high level of system stability.

1.2.7 Built-in Ethernet Port (ADAM-5510/TCP and ADAM-5510E/TCP only)

The Ethernet port on ADAM-5510/TCP and ADAM-5510E/TCP can perform powerful function as following.

- FTP Server and Client Function
- Web Server Function
- Send Mail Function
- TCP and UDP Connection by Sockets

1.3 ADAM-5510 Series Controllers Specification

1.3.1 System

- CPU: 80188 microprocessor
- Memory:
 - 1.5MB flash memory:
 - 256KB system Disk (Drive C: Read Only)
 - 256KB flash memory (Accessed by Function LIB)
 - 1024KB file system, 960KB for user applications (Drive D: Read/Write)
 - 640KB SRAM
 - up to 384KB with battery backup (Accessed by Function LIB)
- Operating System: ROM-DOS (MS-DOS 6.22 Compatible)
- Real-time Clock: yes
- Watchdog Timer: yes
- COM1: RS-232 (ADAM-5510M, ADAM-5510/TCP)
RS-232/485 (ADAM-5510E, ADAM-5510E/TCP)
- COM2: RS-485
- Programming Port/COM3: TX, RX, GND (RS-232 Interface)
- COM 4: RS-232/485
- I/O Capacity: 4 Slots (ADAM-5510M, ADAM-5510/TCP)
8 Slots (ADAM-5510E, ADAM-5510E/TCP)

1.3.2.1 RS-232 interface (COM1) for ADAM-5510M and ADAM-5510/TCP

- Signals: TxD, RxD, RTS, CTS, DTR, DSR, DCD, RI, GND
- Mode: Asynchronous full duplex, point to point
- Connector: DB-9 pin
- Transmission speed: Up to 115.2 Kbps

- Max transmission distance: 50 feet (15.2 m)

1.3.2.2 RS-232/485 interface (COM1) for ADAM-5510E and ADAM-5510E/TCP

- RS-232/485 Mode Selectable (Select by jumper setting, refer to Figure 1-2)
- RS-232 Mode: Asynchronous full duplex, point to point
Signals: TxD, RxD, RTS, CTS, DTR, DSR, DCD, RI, GND

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- RS-485 Mode: Half duplex, multi-drop
Signal: DATA+, DATA-
- Connector: DB-9 pin
- Transmission speed: Up to 115.2 Kbps
- Max transmission distance:
RS-232: 50 feet (15.2 m)
RS-485: 4,000 feet (1220 m)

1.3.3 RS-485 interface (COM2)

- Signals: DATA+, DATA-
- Mode: Half duplex, multi-drop

- Connector: Screw terminal
- Transmission speed: Up to 115.2 Kbps
- Max transmission distance: 4000 feet (1220 m)

1.3.4 RS-232 programming port (COM3)

- Signals: Tx, Rx, GND
- Mode: Asynchronous, point to point
- Connector: DB-9 pin
- Transmission speed: Up to 115.2 Kbps
- Max transmission distance: 50 feet (15.2 m)

1.3.5 RS-232/485 interface (COM4)

- RS-232/485 Mode Selectable (Select by jumper setting, refer to Figure 1-2)
- RS-232 Mode: Asynchronous full duplex, point to point
Signals: TxD, RxD, RTS, CTS, DTR, DSR, DCD, RI, GND
- RS-485 Mode: Half duplex, multi-drop
Signals: DATA+, DATA-
- Connector: DB-9 pin
- Transmission speed: Up to 115.2 Kbps
- Max transmission distance:
RS-232: 50 feet (15.2 m)
RS-485: 4000 feet (1220 m)

1.3.6 Isolation

- Power: 3000 VDC
- Input/Output: 3000 VDC
- Communication: 2500 VDC (COM2 only)

Chapter 1 System Overview

1.3.7 Power

- Unregulated +10 to +30 VDC
- Protected against power reversal
- Power consumption: 2.0 W

1.3.8 Mechanical

- Case: ABS with captive mounting hardware
- Plug-in screw terminal block:
 - Accepts 0.5 mm² to 2.5 mm², 1 - #12 or 2 - #14 to #22 AWG

1.3.9 Environment

- Operating temperature: -10° to 70° C (14° to 158° F)
- Storage temperature: -25° to 85° C (-13° to 185° 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.

1.3.10 Dimensions

The following diagrams show the dimensions of the system unit and an I/O unit. All dimensions are in millimeters.

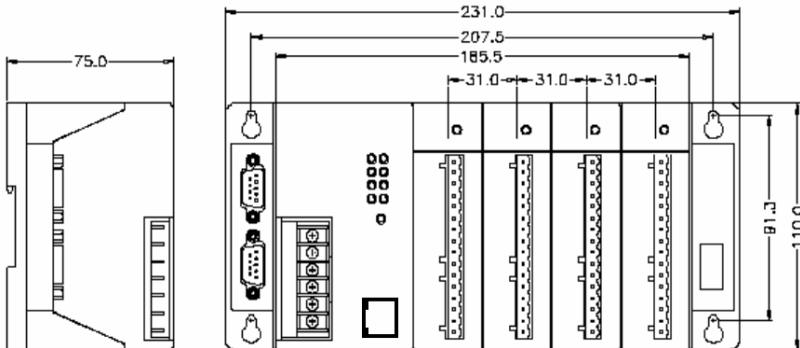


Figure 1-2 ADAM-5510M and ADAM-5510/TCP Dimension

Chapter 1 System Overview

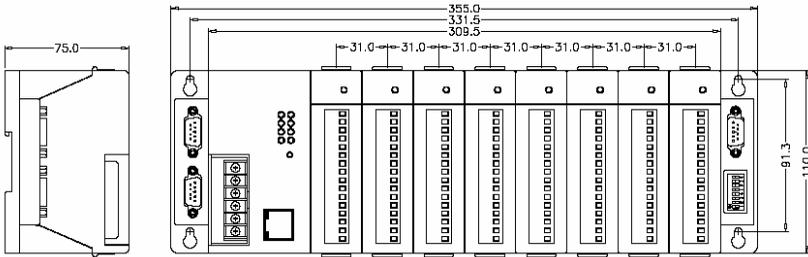


Figure 1-3 ADAM-5510E and ADAM-5510E/TCP Dimension

1.3.11 LED Status

ADAM-5510M and ADAM-5510E:

There are four LEDs on the ADAM-5510M and ADAM-5510E front panel. The LED's indicate ADAM-5510M and ADAM-5510E's operating status, as explained below:

- (1) **PWR**: power indicator. This LED is on whenever the ADAM-5510M or ADAM-5510E is powered on.
- (2) **RUN**: program execution indicator. This LED is regularly blinks whenever the ADAM-5510M or ADAM-5510E is executing a program.
- (3) **COMM**: communication indicator. This LED blinks whenever the host PC and the ADAM-5510M or ADAM-5510E is communicating. Please notice: if the host COM port is connected to the ADAM-5510M or ADAM-5510E's COM1, this LED will normally be off. On the other hand, if the host COM port is connected to the ADAM-5510M and ADAM-5510E's COM2, this LED will normally be on.
- (4) **BATT**: battery status indicator. This LED will be on whenever the SRAM backup battery is low.

ADAM-5510/TCP and ADAM-5510E/TCP:

There are eight LEDs on the ADAM-5510/TCP and ADAM-5510E/TCP front panel. The LED's indicate operating status, as explained below:

Chapter 1 System Overview

- (1) **PWR**: power indicator. This LED is on whenever the ADAM-5510/TCP or ADAM-5510E/TCP is powered on.
- (2) **RUN**: program execution indicator. This LED is regularly blinks whenever the ADAM-5510/TCP or ADAM-5510E/TCP is executing a program.
- (3) **COMM**: communication indicator. This LED blinks whenever the host PC and the ADAM-5510/TCP or ADAM-5510E/TCP is communicating. Please notice: if the host COM port is connected to the ADAM-5510/TCP or ADAM-5510E/TCP COM1, this LED will normally be off. On the other hand, if the host COM port is connected to the ADAM-5510/TCP or ADAM-5510E/TCP's COM2, this LED will normally be on.

- (4) **BATT**: battery status indicator. This LED will be on whenever the SRAM backup battery is low.
- (5) **Speed**: This LED is on when the Ethernet communication speed is 100 Mbps.
- (6) **Link**: This LED is normal on whenever the Green indicator. This LED is on when the ADAM-5510/TCP or ADAM-5510E/TCP's Ethernet wiring is connected.
- (7) **TX**: This LED blinks whenever the ADAM-5510/TCP or ADAM-5510E/TCP transmitting data to Ethernet.
- (8) **RX**: This LED blinks whenever the ADAM-5510/TCP or ADAM-5510E/TCP receiving data from Ethernet.

2

Installation Guidelines

Chapter 2 Installation Guidelines

This chapter explains how to install an ADAM-5510 Series Controllers. A quick hookup schemes including both 4-slot and 8-slot models are provided that let you easily configure your system before implementing it into your application.

2.1 System Requirements

Before you start installing the ADAM-5510 Series Controller, make sure the system requirements are met:

2.1.1 Host Computer Requirements

1. IBM PC compatible computer with 486 CPU (Pentium is recommended).
2. Microsoft 95/98/NT 4.0 (SP3 or SP4) or higher versions.
3. DOS version 3.31 or higher.
3. Borland C 3.0 for DOS
4. At least 32 MB RAM.
5. 20 MB of hard disk space available
6. VGA color monitor.
7. 2x or higher speed CD-ROM.
8. Mouse or other pointing devices.
9. At least one standard RS-232 port (e.g. COM1, COM2).
10. One RS-485 card or RS-232 to RS-485 converter (e. g. ADAM-4520) for system communication.

2.1.2 ADAM-5510M Requirements

1. One ADAM-5510 Series Controller main unit.
2. One ADAM-5510 Series Controller Startup Manual
3. One core clamp for power supply connection.
4. One ADAM Products Utilities CD.
5. Power supply for ADAM-5510 Series Controller (+10 to +30 VDC unregulated)
6. One RS-232 straight through DB-9 cable

2.1.3 I/O Module Requirements

At least one I/O module is needed to use the system. A variety of I/O modules are available to meet different application requirements. Table 2-1 gives a current listing of these modules for your reference.

Module	Name	Specification	Reference
Analog I/O	ADAM-5013	3-ch. RTD input	Isolated
	ADAM-5017	8-ch. AI	Isolated
	ADAM-5017H	8-ch. High speed AI	Isolated
	ADAM-5018	7-ch. Thermocouple input	Isolated
	ADAM-5024	4-ch. AO	Isolated
Digital I/O	ADAM-5050	7-ch. D I/O	Non-isolated
	ADAM-5051	16-ch. DI	Non-isolated
	ADAM-5051D	16-ch. DI W/ LED	Non-isolated
	ADAM-5052	8-ch. DI	Isolated
	ADAM-5056	16-ch. DO	Non-isolated
	ADAM-5056D	16-ch. DO W/LED	Non-isolated
Relay Output	ADAM-5060	6-ch. Relay output	Isolated
	ADAM-5068	8-ch. Relay output	Isolated
	ADAM-5069	8-ch. Power Relay output	Isolated
Counter/Frequency	ADAM-5080	4-ch. Counter/Frequency	Isolated
Serial I/O	ADAM-5090	4-port RS232	Non-isolated

Table 2-1 I/O Module Support List

2.2 Hardware Installation

2.2.1 Selecting I/O Module

To organize an ADAM-5510 Series Controller data acquisition & control system, you need to select I/O modules to interface the main unit 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 many I/O is required to your system?

How will you place the controller for concentrate the I/O points of an entire process?

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 2-2 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 signals can be either ac or dc.
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. Discrete signals can be either AC or DC.
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 ADAM-5510M
Analog output module	Analog valves, actuators, chart recorders, electric motor drives, analog meters	Interpret ADAM-5510M output to analog signals (generally through transducers) for field devices.

Table 2-2 I/O Selection Guidelines

Advantech provides 19 types of ADAM-5000 I/O modules for various applications so far. The Figure 2-1 and table 2-3 will help you to select the ADAM-5000 I/O modules quickly and easily.

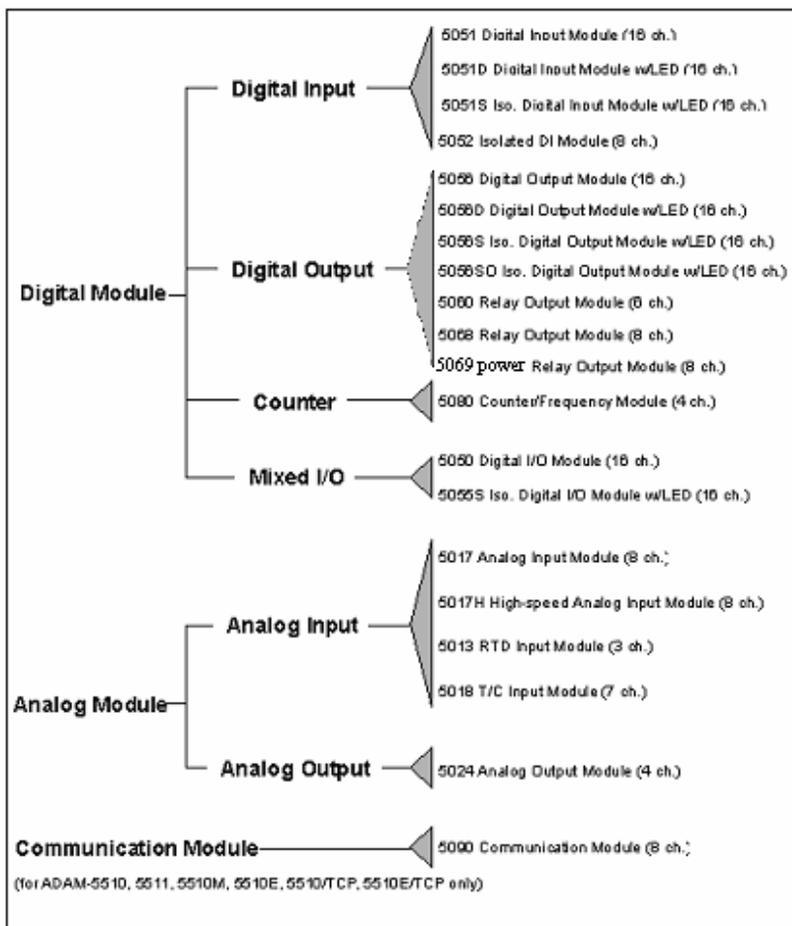


Figure 2-1 ADAM-5000 I/O Module Selection Chart

Chapter 2 Installation Guidelines

Module		ADAM-5013	ADAM-5017	ADAM-5017H	ADAM-5018	ADAM-5024
Analog Input	Resolution	16 bit	16 bit	12 bit	16 bit	-
	Input Channel	3	8	8	7	-
	Sampling Rate	10	10	8K	10	-
	Voltage Input	-	$\pm 150 \text{ mV} \pm 500 \text{ mV} \pm 1 \text{ V} \pm 5 \text{ V} \pm 10 \text{ V}$	$\pm 250 \text{ mV} \pm 500 \text{ mV} \pm 1 \text{ V} \pm 5 \text{ V} \pm 10 \text{ V}$	$\pm 15 \text{ mV} \pm 50 \text{ mV} \pm 100 \text{ mV} \pm 500 \text{ mV} \pm 1 \text{ V} \pm 2.5 \text{ V}$	-
	Current Input	-	$\pm 20 \text{ mA}^*$	$\pm 20 \text{ mA}^*$	$\pm 20 \text{ mA}^*$	-
	Direct Sensor Input	Pt or Ni RTD	-	-	J, K, T, E, R, S, B	-
Analog Output	Resolution	-	-	-	-	12 bit
	Voltage Output	-	-	-	-	0~10 V
	Current Output	-	-	-	-	0~20 mA 4~20 mA
Digital Input and Digital Output	Digital Input Channels	-	-	-	-	-
	Digital Output Channels	-	-	-	-	-
Count-er (32-bit)	Channels	-	-	-	-	-
	Input Frequency	-	-	-	-	-
	Mode	-	-	-	-	-
COM-M	Channels	-	-	-	-	-
	Type	-	-	-	-	-
Isolation		3000 VDC	3000 VDC	3000 VDC	3000 VDC	3000 VDC

Module		ADAM-5050	ADAM-5051	ADAM-5051D	ADAM-5051S
Analog Input	Resolution	-	-	-	-
	Input Channel	-	-	-	-
	Sampling Rate	-	-	-	-
	Voltage Input	-	-	-	-
	Current Input	-	-	-	-
	Direct Sensor Input	-	-	-	-
Analog Output	Resolution	-	-	-	-
	Voltage Output	-	-	-	-
	Current Output	-	-	-	-
Digital Input and Digital Output	Digital Input Channels	16 DIO (bit-wise selectable-e)	16	16 W/LED	16 W/LED
	Digital Output Channels		-	-	-
Count-er (32-bit)	Channels	-	-	-	-
	Input Frequency	-	-	-	-
	Mode	-	-	-	-
COM-M	Channels	-	-	-	-
	Type	-	-	-	-
Isolation		-	-	-	2500 VDC

Notice: ADAM-5510E can support ADAM-5024 x 8(Max).

Chapter 2 Installation Guidelines

Module		ADAM-5052	ADAM-5055S	ADAM-5056	ADAM-5056D	ADAM-5056S /5056SO
Analog Input	Resolution	-	-	-	-	-
	Input Channel	-	-	-	-	-
	Sampling Rate	-	-	-	-	-
	Voltage Input	-	-	-	-	-
	Current Input	-	-	-	-	-
	Direct Sensor Input	-	-	-	-	-
Analog Output	Resolution	-	-	-	-	-
	Voltage Output	-	-	-	-	-
	Current Output	-	-	-	-	-
Digital Input and Digital Output	Digital Input Channels	8	8 W/LED	-	-	-
	Digital Output Channels	-	8 W/LED	16	16 W/LED	16 W/LED
Count-er (32-bit)	Channels	-	-	-	-	-
	Input Frequency	-	-	-	-	-
	Mode	-	-	-	-	-
COM-M	Channels	-	-	-	-	-
	Type	-	-	-	-	-
Isolation		5000 VRMS	2500 VDC	-	-	2500 VDC

Module		ADAM-5060	ADAM-5068	ADAM-5069	ADAM-5080	ADAM-5090
Analog Input	Resolution	-	-	-	-	-
	Input Channel	-	-	-	-	-
	Sampling Rate	-	-	-	-	-
	Voltage Input	-	-	-	-	-
	Current Input	-	-	-	-	-
	Direct Sensor Input	-	-	-	-	-
Analog Output	Resolution	-	-	-	-	-
	Voltage Output	-	-	-	-	-
	Current Output	-	-	-	-	-
Digital Input and Digital Output	Digital Input Channels	-	-	-	-	-
	Digital Output Channels	6 relay (2 form A/ 4 form C)	8 relay (8 form A)	8 relay (8 form A)	-	-
Count-er (32-bit)	Channels	-	-	-	4	-
	Input Frequency	-	-	-	5000 Hz (max)	-
	Mode	-	-	-	Frequency, Up/Down Counter, Bi-direction Counter	-
COM-M	Channels	-	-	-	-	4
	Type	-	-	-	-	RS-232
Isolation		-	-	-	1000 VRMS	-

Table 2-3 I/O Selection Guidelines

Chapter 2 Installation Guidelines

2.2.2 Selecting Power Supply Module

ADAM-5510 Series Controller works under unregulated power source between +10 and +30 VDC. When you arrange different I/O modules on ADAM-5510 Series Controller's backplane, it may require comparable power supply. Use the following steps as guidelines for selecting a power supply for your ADAM-5510 Series control system.

Refer to table 2.4 to check the power consumption of ADAM-5510 Series Controller and each I/O module.

Main Units	Description	Power Consumption
ADAM-5000/485	Distributed Data Acquisition and Control System based on RS-485	1.0 W
ADAM-5000E	Distributed Data Acquisition and Control System based on RS-485	4.0 W
ADAM-5000/TCP	Distributed Data Acquisition and Control System based on Ethernet	5.0 W
ADAM-5510	PC-Based Programmable Controller (With Battery Backup)	1.0 W
ADAM-5510M	Enhanced PC-Based Programmable Controller (With Battery Backup)	1.2 W
ADAM-5511	PC-Based Programmable Controller with Modbus	1.0 W
ADAM-5510E	8-clot PC-Based Programmable Controller	1.2W
ADAM-5510/TCP	Ethernet-enabled PC-Based Programmable Controller	2.0W
ADAM-5510E/TCP	8-clot Ethernet-enabled PC-Based Programmable Controller	2.0W
I/O Modules	Description	Power Consumption
ADAM-5013	3-Channel RTD Input Module	1.1 W
ADAM-5017	8-Channel Analog Input Module (mV, mA or High Voltage)	1.25 W
ADAM-5017H	8-Channel High speed Analog Input Module (mV, mA or High Voltage)	2.2 W
ADAM-5018	7-Channel Thermocouple Input Module (mV, V, mA, Thermocouple)	0.63 W
ADAM-5024	4-Channel Analog Output Module (V, mA)	2.9 W
ADAM-5050	16-Channel Universal DIO	1.2 W
ADAM-5051	16-Channel Digital Input Module	0.53 W
ADAM-5051D	16-Channel Digital Input w/LED Module	0.84 W
ADAM-5056S	16-Channel Isolated Digital Input w/LED Module	0.8 W
ADAM-5056SO	16-Channel Digital Input w/LED Module	0.84 W
ADAM-5052	8-Channel Isolated DI	0.27W
ADAM-5055S	16-Channel Isolated DIO w/LED Module	0.68 W
ADAM-5056	16-Channel Digital Output Module	0.53 W
ADAM-5056D	16-Channel Digital Output w/LED Module	0.84 W
ADAM-5056S	16-Channel Isolated Digital Output w/LED Module	0.6 W
ADAM-5060	6-Channel Relay Output Module (2 of Form A, 4 of Form C)	1.8 W
ADAM-5068	8-Channel Relay Output Module (8 of Form A)	1.8 W
ADAM-5069	8-Channel Power Relay Output Module (8 of Form A)	2.2 W
ADAM-5080	4-Channel Counter/ Frequency Input Module	1.5 W
ADAM-5090	4-Port RS232 Module	0.6 W

Table 2.4 Power Consumption of ADAM-5000 series

Calculate the Summary of the whole system's power consumption. For example, there are following items in your system.

ADAM-5510M * 3 & ADAM-5024 * 2 & ADAM-5017 * 4 & ADAM-5068 * 2 & ADAM-5080 * 2

The power consumption is:

$$1.2W * 3 + 2.9W * 2 + 1.25 * 4 + 1.8W * 2 + 1.5W * 2 = 21W$$

Chapter 2 Installation Guidelines

Select a suitable power supply from Table 2.5 or other comparable power resource for system operation.

Specification	PWR-242	PWR-243	PWR-244
Input			
Input Voltage	90~264 V _{AC}	85~132 V _{AC} 170~264V _{AC}	100~240 V _{AC}
Input Frequency	47~63 Hz	47~63 Hz	47~63 Hz
Input Current	1.2 A max.	1.4 A max	25 A/110 V _{AC} 50A/220 V _{AC} (Inrush current)
Short Protection	Yes	Yes	Yes
Output			
Output Voltage	+24V _{DC}	+24V _{DC}	+24V _{DC}
Output Current	2.1 A	3 A	4.2 A
Overload Protection	Yes	Yes	Yes
General			
Dimension	181mm x 113 mm x 60 mm (L x W x H)	181mm x 113 mm x 60 mm (L x W x H)	181mm x 113 mm x 60 mm (L x W x H)
Operating Temperature	0~50°C (32~122°F)	0~50°C (32~122°F)	0~50°C (32~122°F)
DIN-rail Mountable	Yes	No	No

Table 2.5 Power Supply Specification Table

2.2.3 Install Main Unit and Modules

When inserting modules into the system, align the PC board of the module with the grooves on the top and bottom of the system. Push the module straight into the system until it is firmly seated in the backplane connector. Once the module is inserted into the system, push in the retaining clips (located at the top and bottom of the module) to firmly secure the module to the system.

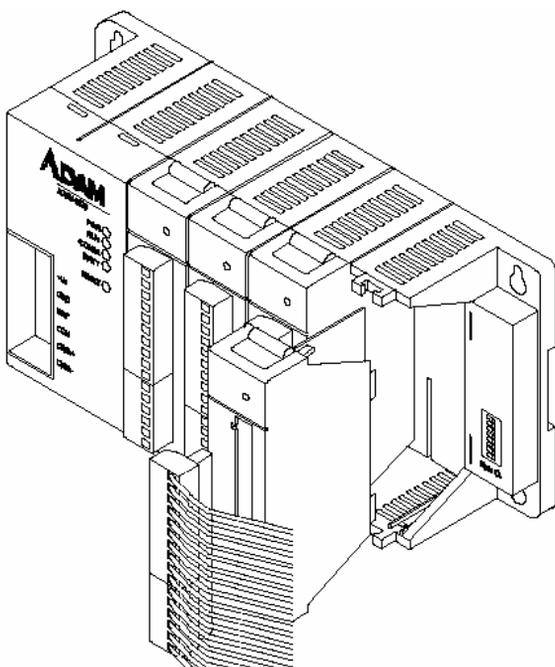


Figure 2-2 Module alignment and installation for 4-slot models (ADAM-5510M and ADAM-5510/TCP)

2.2.5 Mounting

The ADAM-5510 Series Controller can be installed on a panel or on a DIN rail.

Panel mounting

Mount the system on the panel horizontally to provide proper ventilation. You cannot mount the system vertically, upside down or on a flat horizontal surface. A standard #7 tapping screw (4 mm diameter) should be used.

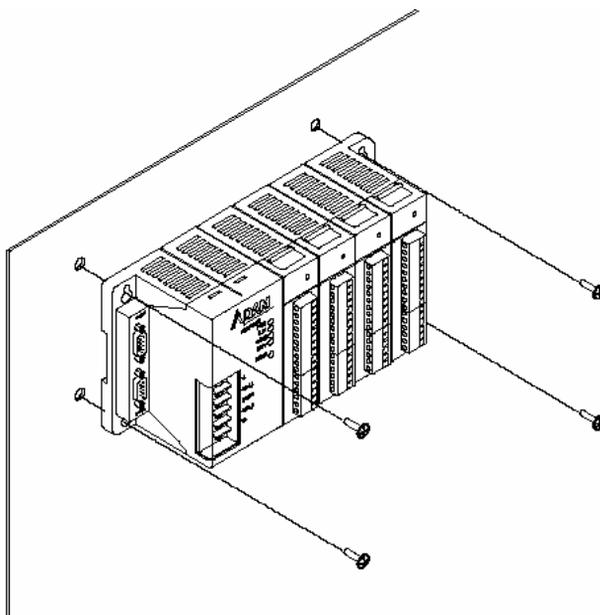


Figure 2-4: Panel mounting screw placement for (ADAM-5510M and ADAM-5510/TCP)

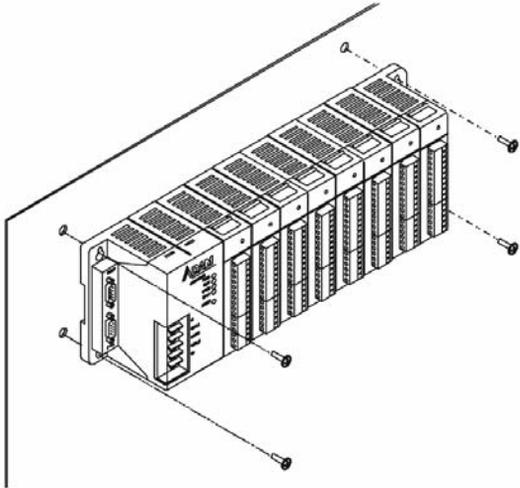


Figure 2-5: Panel mounting screw placement for 8-slot models (ADAM-5510E and ADAM-5510E/TCP)

DIN rail mounting

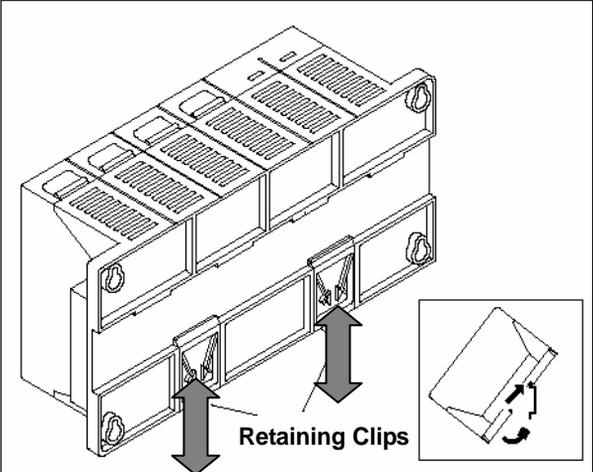


Figure 2-6: Rail mounting for 4-slot models (ADAM-5510M and ADAM-5510/TCP)

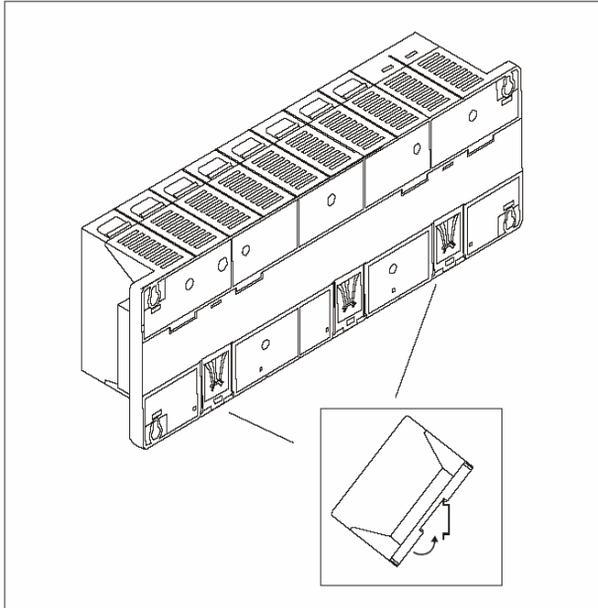


Figure 2-7: Rail mounting for 8-slot models
(ADAM-5510E and ADAM-5510E/TCP)

The system can also be secured to the cabinet by using mounting rails. If you mount the system on a rail, you should also consider using end brackets at each end of the rail. The ended brackets help keep the system from sliding horizontally along the rail. This minimizes the possibility of accidentally pulling the wiring loose. If you examine the bottom of the system, you will notice two small retaining clips. To secure the system to a DIN rail, place the system on to the rail and gently push up on the retaining clips. The clips lock the system on the rail. To remove the system, pull down on the retaining clips, lift up on the base slightly, and pull it away from the rail.

2.2.6 Jumper Settings and DIP Switch Settings

This section tells you how to set the jumpers and DIP switches to configure your ADAM-5510 Series Controller. It gives the system default configuration and your options for each jumper and dip switch. There are three jumpers (JP2~JP4) on the CPU card, and one 8-pin DIP switch on backplane.

JP2 is for the watchdog timer setting
 JP3 is for COM2 port RS-485 setting (ADAM-5510M and ADAM-5510E only.)
 JP4 is for battery power ON/OFF setting
 The following figure shows the location of the jumpers:

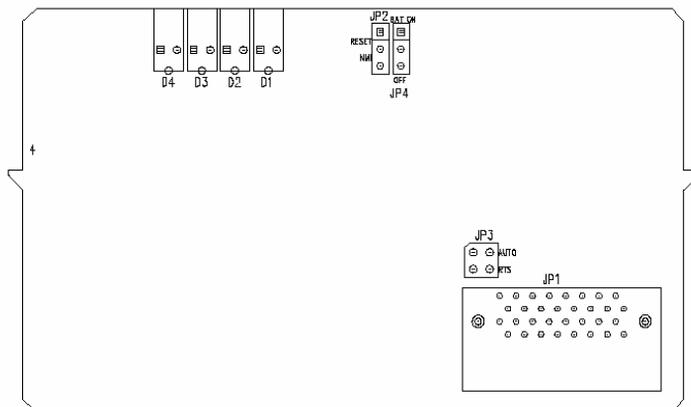


Figure 2-8: Jumper locations on the CPU card

2.2.6.1 COM2 port RS-485 control mode setting

The COM2 port is dedicated as an RS-485 interface. In an RS-485 network, handshaking signals such as RTS (Request to Send), normally control the direction of the data flow. A special I/O circuit in the ADAM-5510 Series Controller CPU module senses the data flow direction and automatically switches the transmission direction, making handshaking signals unnecessary. Jumper JP3 gives users the option of configuring the COM2 port for automatic control or RTS control. Jumper settings are shown in Figure 2-5:

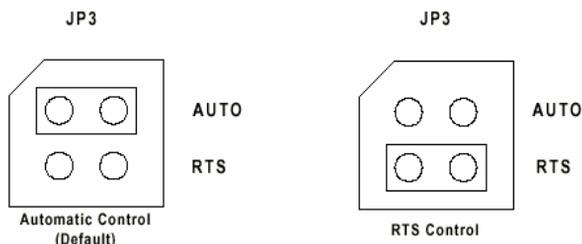


Figure 2-9: COM2 port RS-485 control mode setting (JP3)

Chapter 2 Installation Guidelines

Note: ADAM-5510/TCP and ADAM-5510E/TCP CPU module is set to Auto Mode by default and there is no more JP3 available.

2.2.6.2 Watchdog timer setting

Jumper JP2 on the CPU card lets you configure the watchdog timer to disable mode, reset mode or NMI (Non-maskable interrupt) mode.

Jumper settings are shown below:

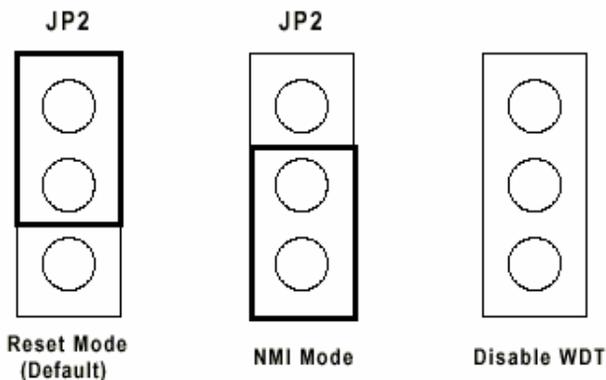


Figure 2-10: Watchdog timer setting

2.2.6.3 Battery backup setting

Jumper JP4 on CPU card lets you configure the battery backup for SRAM is ON or OFF. Jumper settings are shown below:

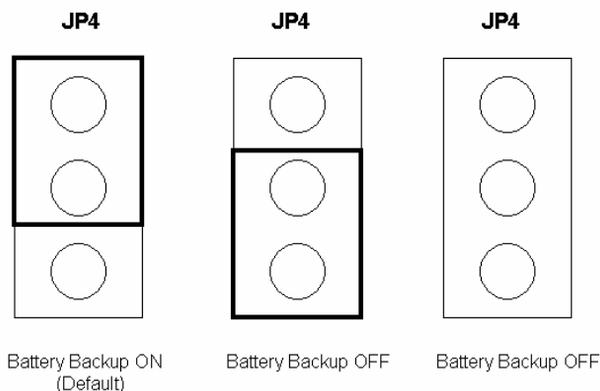


Figure 2-11: Watchdog timer setting

2.2.6.4 RS-232/485 selectable jumper setting

For ADAM-5510M and ADAM-5510/TCP:

The communication mode of COM4 is setting by the Jumper 1 on the backplane. Please refer to Figure 2-12 to set the communication interface you prefer to. **The default setting of COM4 is RS-485 mode.**

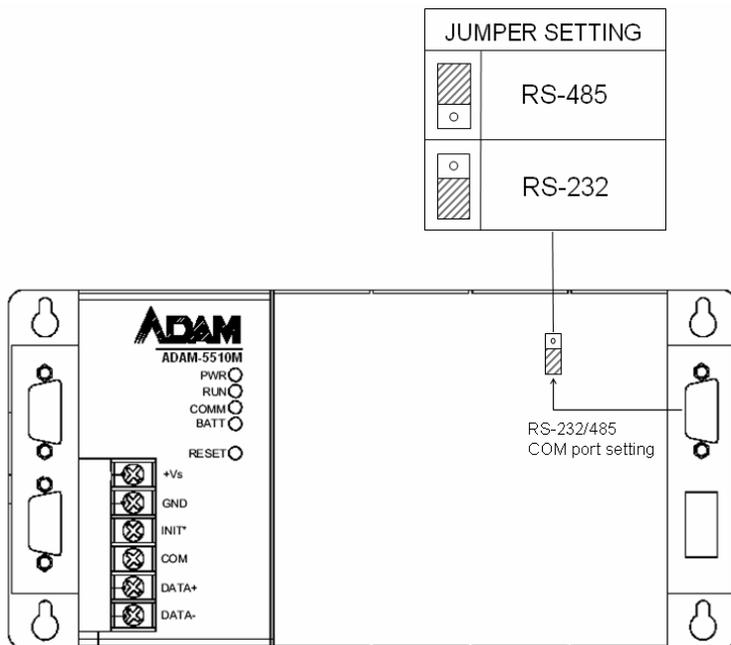


Figure 2-12 COM4 RS-232/485 Setting

For ADAM-5510E and ADAM-5510E/TCP:

The Communication mode of COM1 and COM4 are set by JP3 and JP1 on the backplane. Please refer to Figure 2-13 to set the communication interface. **The default setting of COM1 is RS-232 mode and the default setting of COM4 is RS-485 mode.**

Chapter 2 Installation Guidelines

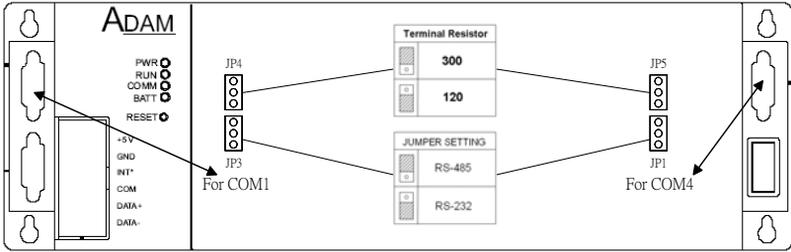


Figure 2-13 COM1/COM4 RS-232/485 Setting

2.2.6.5 DIP Switch Setting

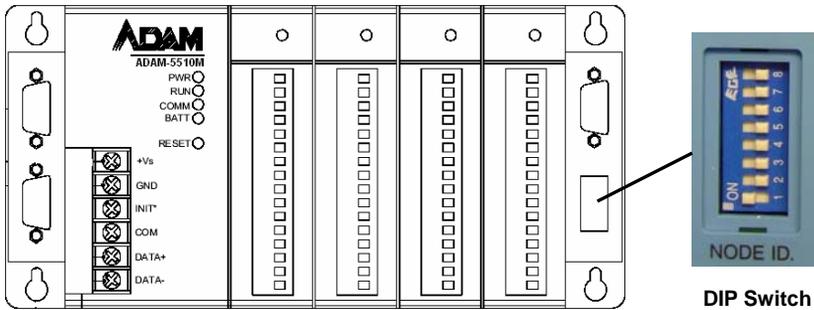


Figure 2-14: ADAM-5510 Series DIP Switch

DIP 1-5	DIP 6	DIP 7,8
Device ID Setting	Configuration Tool via COM1/COM2	Reserved

Table 2.6 DIP Switch Function Table

Device ID Setting:

You can set up your device ID by changing DIP Switch 1-5. The available ID for ADAM-5510 Series Controller is from 1 to 31.

Please refer to the Fig 2.7 Device ID DIP Switch Table to set up your Device ID.

Chapter 2 Installation Guidelines

DIP 1	DIP 2	DIP 3	DIP 4	DIP 5	Device ID
On	Off	Off	Off	Off	1
Off	On	Off	Off	Off	2
On	On	Off	Off	Off	3
Off	Off	On	Off	Off	4
On	Off	On	Off	Off	5
Off	On	On	Off	Off	6
On	On	On	Off	Off	7
Off	Off	Off	On	Off	8
On	Off	Off	On	Off	9
Off	On	Off	On	Off	10
On	On	Off	On	Off	11
Off	Off	On	On	Off	12
On	Off	On	On	Off	13
Off	On	On	On	Off	14
On	On	On	On	Off	15
Off	Off	Off	Off	On	16
On	Off	Off	Off	On	17
Off	On	Off	Off	On	18
On	On	Off	Off	On	19
Off	Off	On	Off	On	20
On	Off	On	Off	On	21
Off	On	On	Off	On	22
On	On	On	Off	On	23
Off	Off	Off	On	On	24
On	Off	Off	On	On	25
Off	On	Off	On	On	26
On	On	Off	On	On	27
Off	Off	On	On	On	28
On	Off	On	On	On	29
Off	On	On	On	On	30
On	On	On	On	On	31

Table 2.7 Device ID DIP Switch Table

Note: DIP switch 0 is reserved by system configuration. Please leave this ID available.

Chapter 2 Installation Guidelines

Selecting COM port for configuration tool

You can swap the connection for configuration tool SIMU5KE.EXE via COM1 or COM2 by changing DIP switch 6 status. Please refer to Chapter 3.4 for further information.

DIP 6	Configuration Tool
OFF	Via COM2 RS-485
ON	Via COM1 RS-232

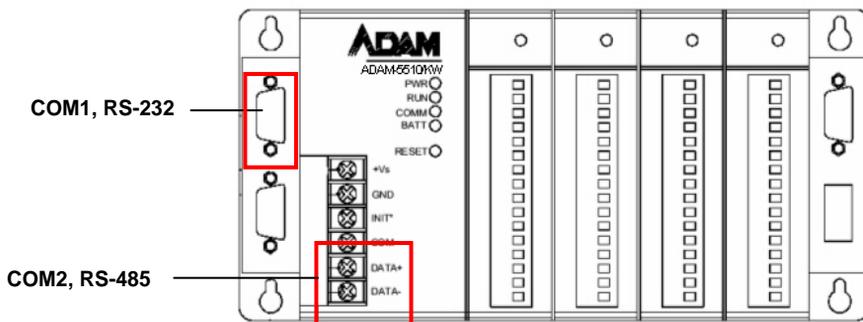


Figure 2-15: ADAM-5510 Series COM1 and COM2

2.2.7 Pin assignment of COM port

Pin No.	Description
Pin 1	DCD
Pin 2	Rx
Pin 3	Tx
Pin 4	DTR
Pin 5	GND
Pin 6	DSR
Pin 7	RTS
Pin 8	CTS
Pin 9	RI

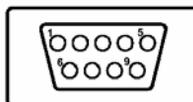


Table 2.8 RS-232 Port Pin Assignment

Pin No.	Description
Pin 1	DATA-
Pin 2	No Connection
Pin 3	No Connection
Pin 4	DATA+
Pin 5	No Connection
Pin 6	No Connection
Pin 7	No Connection
Pin 8	No Connection
Pin 9	No Connection

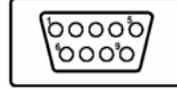


Table 2.9 RS-485 Port Pin Assignment

2.3 System Wiring and Connections

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

2.3.1 Power supply wiring

Although the ADAM-5510 Series Controller is 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 VDC . 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 VDC. Screw terminals +Vs and GND are for power supply wiring.

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

Chapter 2 Installation Guidelines

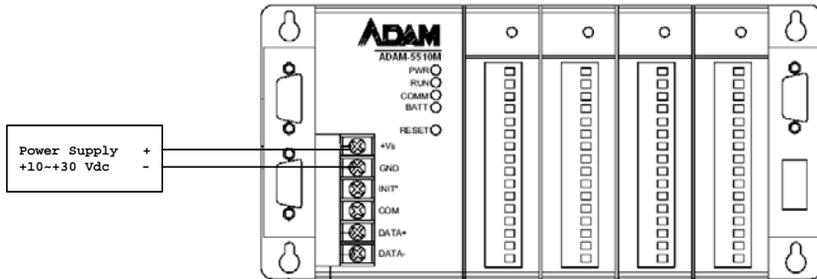


Figure 2-16: ADAM-5510 Series Controller power wiring

2.3.2 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 2 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.

2.3.3 System Network Connection

The ADAM-5510 Series Controller has four communication ports. These ports allowed you to program, configure, monitor, and integrate the remote devices.

Network Connection for System Configuration and Download

The ADAM-5510 Series Controller has a programming port with a DB-9 connection. This port (COM3) allows you to program, configure, and troubleshoot the ADAM-5510 Series Controller from your host computer. The programming port has an RS-232 interface and only uses TX, RX, and GND signals. The cable connection and the pin assignment are as follows:

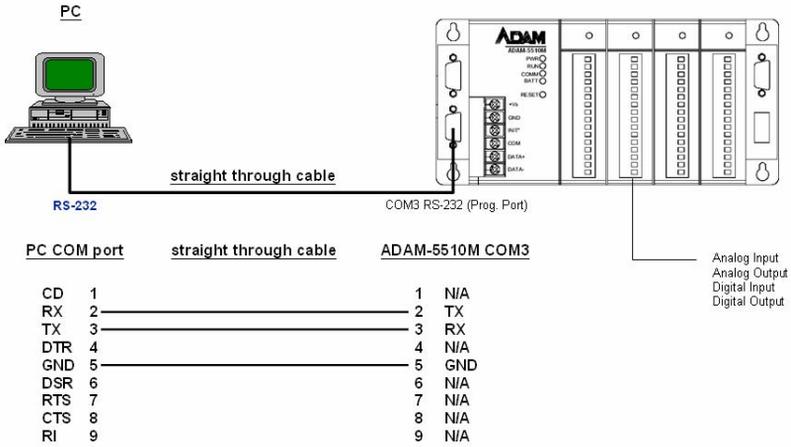


Figure 2-17 System Configuration Wiring

RS-232 Network Connection for System Monitoring and Integration

Since the connection for an RS-232 interface is not standardized, different devices implement the RS-232 connection in different ways. If you are having problems with a serial device, be sure to check the pin assignments for the connector. The following table shows the pin assignments for the ADAM-5510 Series Controller COM1 RS-232 port.

Note: The COM1 of ADAM-5510M and ADAM-5510/TCP is dedicated as an RS-232 interface. However, the COM1 of ADAM-5510E and ADAM-5510E/TCP is RS-232/RS-485 selectable. All models of ADAM-5510 Series Controllers' COM4 is RS-232/485 selectable.

Chapter 2 Installation Guidelines

RS-485 Network Connection for System Monitoring and Integration

The ADAM-5510 Series Controller provides RS-485 interfaces for multi-drop network integration. The COM2 is a dedicated RS-485 interface (Screw terminals DATA- and DATA+ are used for making the COM2 RS-485 connections). The COM4 is an RS-232/485 selectable DB-9 connector. Usually, you will need to prepare an ADAM-4520 RS232 to RS-485 converter to link with host PC for data monitoring. See Figure 2-18.

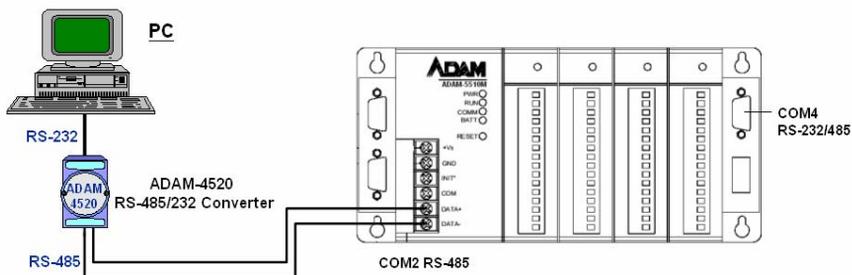


Figure 2-18 System Monitoring Wiring

Ethernet Network Connection

The ADAM-5510/TCP and ADAM-5510E/TCP provide Ethernet interface for network integration. Usually, you will need to prepare an ADAM-6520 Ethernet switch or hub for connecting to other network devices as following figure.

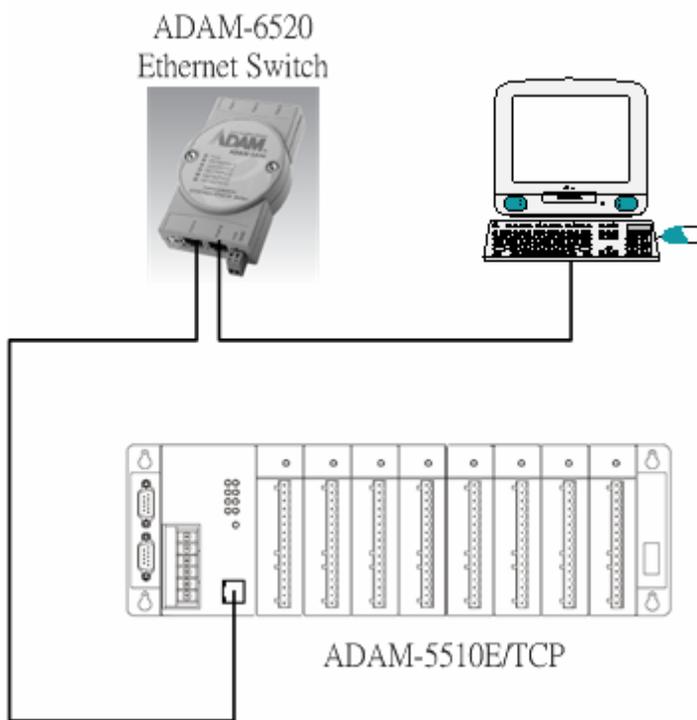


Figure 2-19 Ethernet Connection

2.4 Software Installation

When main unit installation is completed, you may begin to configure the I/O modules and download program to the ADAM-5510 Series Controller. ADAM-5510 Series Controller comes packaged with a Utility CD, containing ADAM Product series Utilities as system configuration tool. While you Insert the CD into the CD drive (e.g. D:) of the host PC, the Utility software setup menu will start up automatically. Click the ADAM-5510 Series icon to execute the setup program, and there will be a Utility executive program installed in your host PC. See chapter 3 I/O Configuration and Program Download for the detail operation.

3

I/O Configuration and Program Download

Chapter 3 I/O Configuration and Program Download

This chapter explains how to use the ADAM-5510 Series Utility to configure the I/O modules and download application programs into the ADAM-5510 Series system.

Two more utilities will be used to finish the configuration. The first one is “SIMU5KE.EXE” which needs to be run on ADAM-5510 Series system for simulating ADAM-5000E system. The other one is “ADAM-4000-5000.EXE” which needs to be run on host computer for configuring the I/O modules.

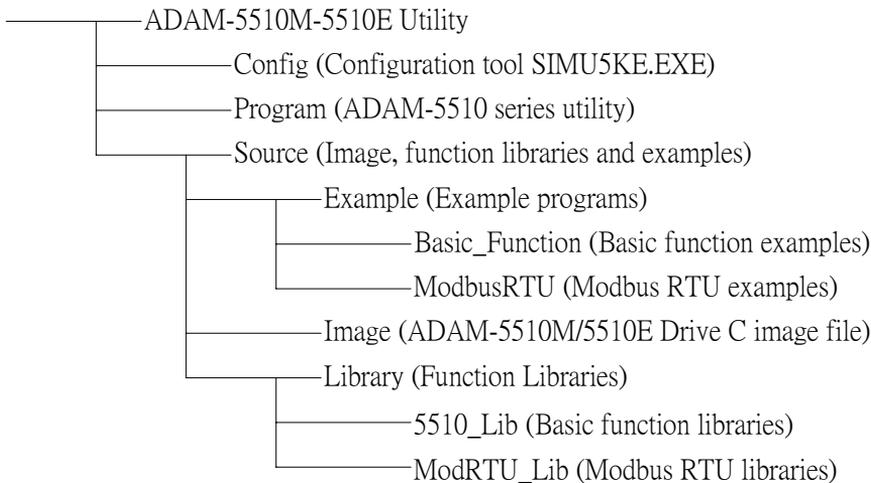
3.1 System Hardware Configuration

Before the system configuration, you will need to setup the environment as we mentioned in Chapter 2.1: System Requirements.

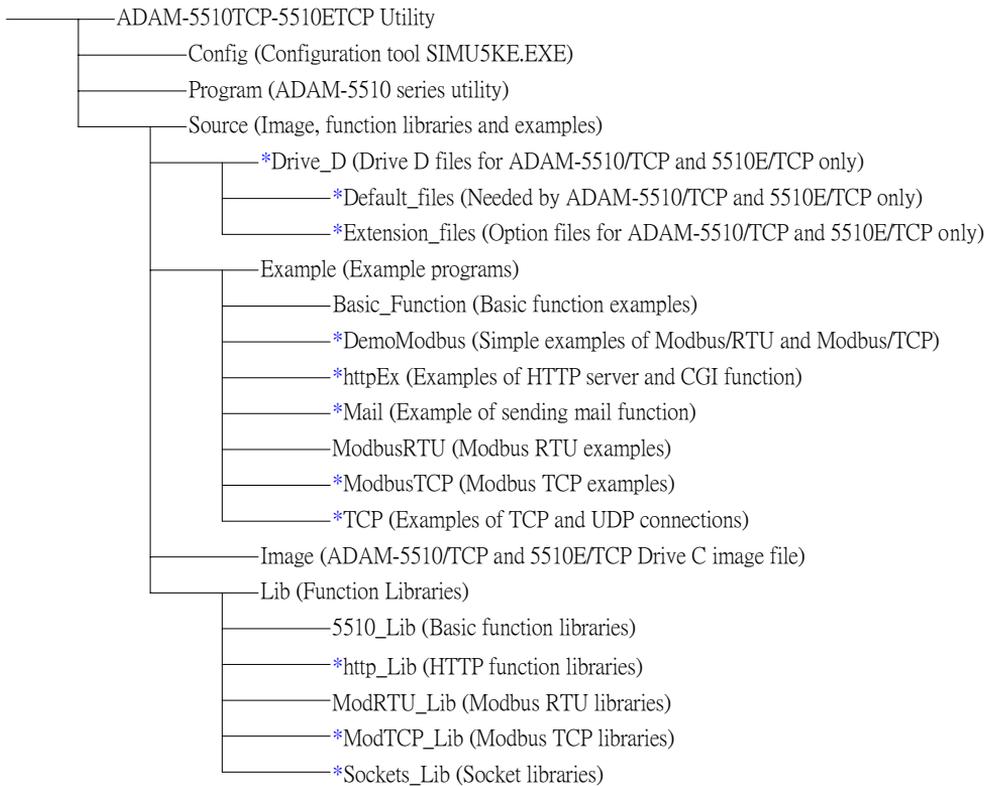
3.2 Install Utility Software on Host PC

ADAM-5510 Series systems packaged with a Utility CD, containing ADAM Product Series Utilities as system configuration tools. While you insert the CD into the CD drive (e.g. D:) of the host PC, the Utility software setup menu will start up automatically.

Click the ADAM-5510 Series icon to execute the setup program. After installation, you will find related directories under “ADAM-5510 Series Utility” directory as following.



Chapter 3 I/O Configuration and Program Download

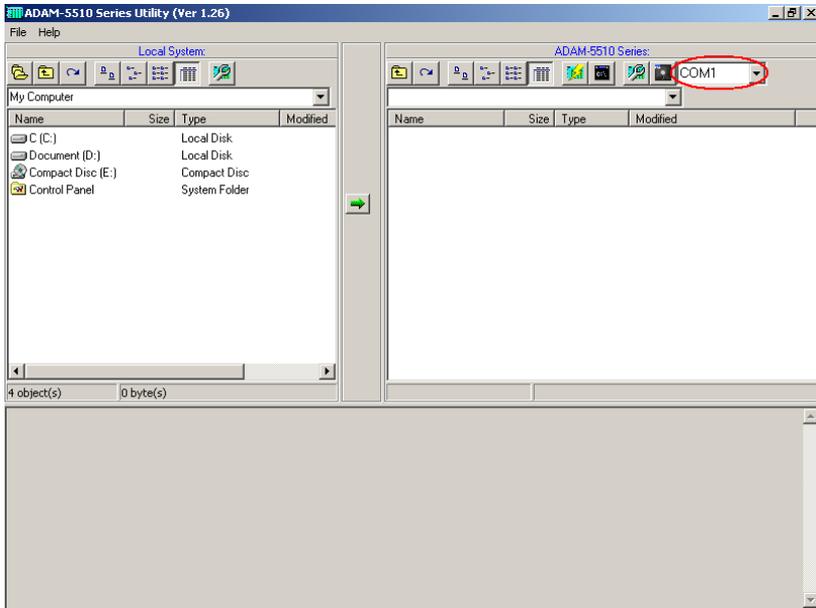


* For ADAM-5510/TCP and ADAM-5510E/TCP only

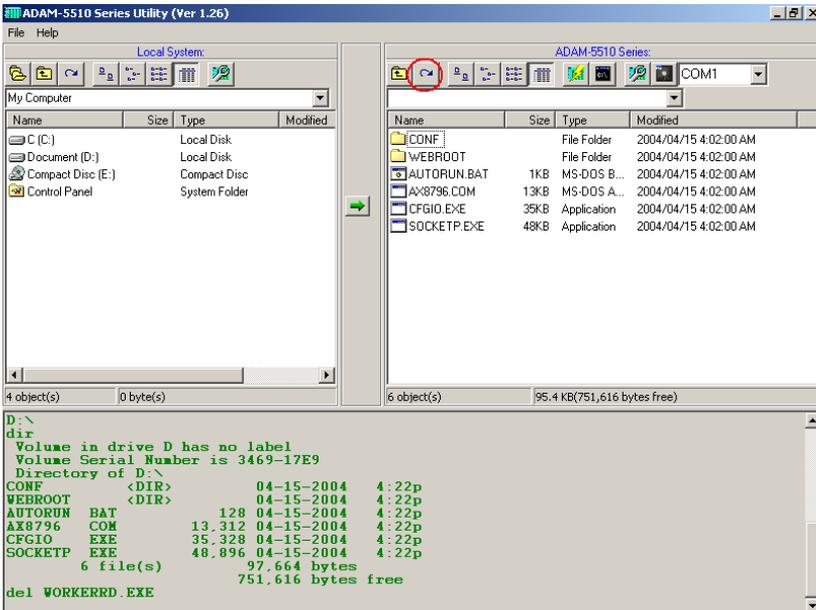
Chapter 3 I/O Configuration and Program Download

3.3 ADAM-5510 Series Utility Overview

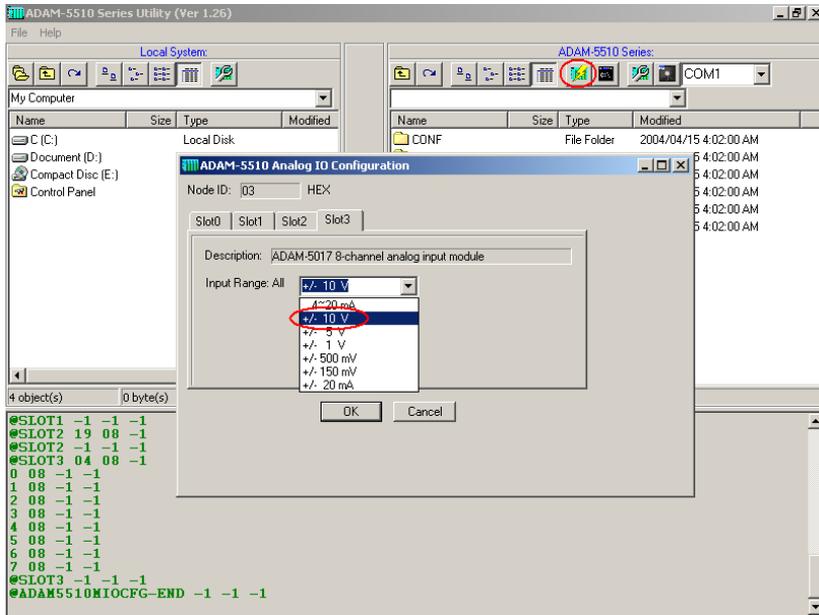
3.3.1 COM port selection for host PC.



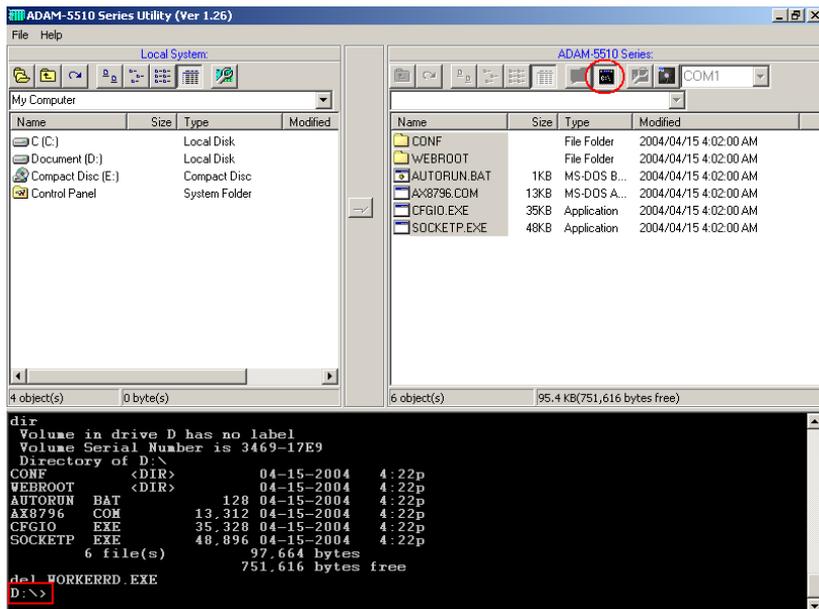
3.3.2 “Refresh Folder” button for displaying the files and directories on drive D: of ADAM-5510 Series system.



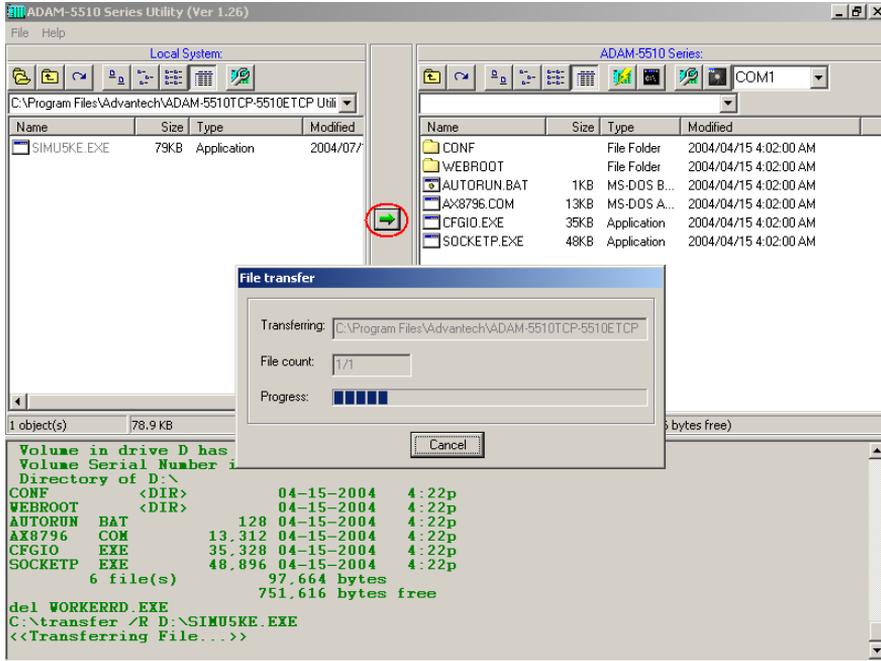
3.3.3 “Config ADAM” button for configuring analog input/output modules.



3.3.4 “Launch Terminal” button for launching terminal emulation function.



3.3.7 “Download” button for copying files to ADAM-5510 Series system.

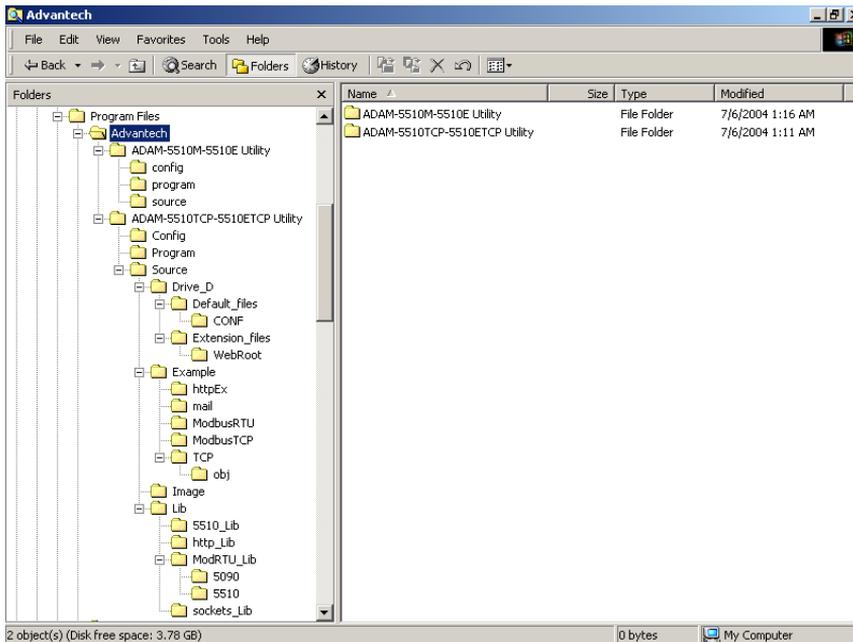


Chapter 3 I/O Configuration and Program Download

3.4 Example of I/O Module Configuration

3.4.1 Install ADAM-5510 Series Utility

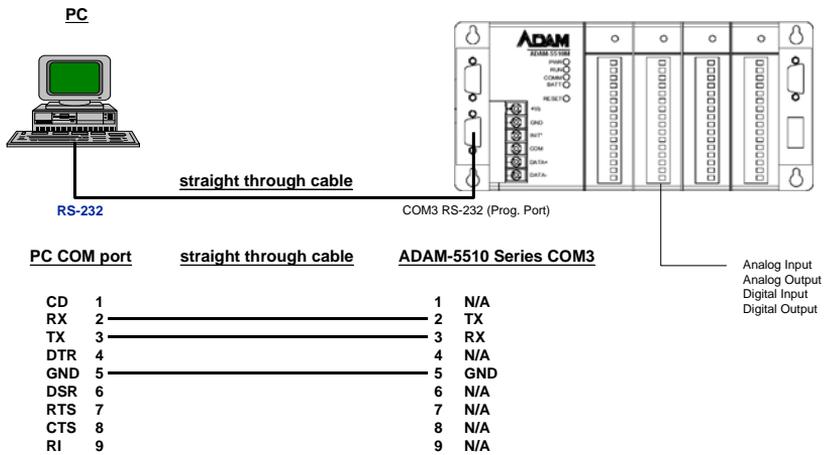
1. Insert the ADAM Products CD and setup ADAM-5510 Series Utility.
2. After the ADAM-5510 Series Utility has been installed, you will find two directories under “C:\Program Files\Advantech\ADAM-5510 Series Utility” directory. They are named “ADAM-5510M-5510E Utility” and “ADAM-5510TCP-5510ETCP Utility”. So if you are using ADAM-5510M or ADAM-5510E, you have to use the files under “ADAM-5510M-5510E Utility” directory. If you are using ADAM-5510/TCP or ADAM-5510E/TCP, you have to use the files under “ADAM-5510TCP-5510ETCP Utility” directory.



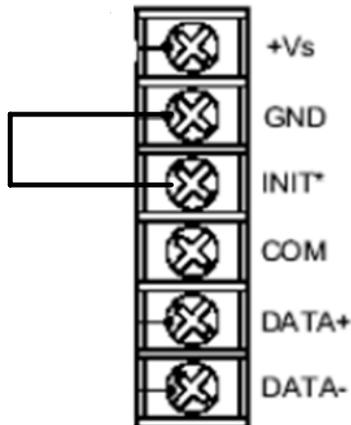
3.4.2 Configure the I/O Modules by ADAM-5510 Series Utility

Following steps will use ADAM-5510/TCP as an example to demonstrate how to configure the ADAM-5017 Analog Input Module.

1. Programming Port Wiring for configuration.

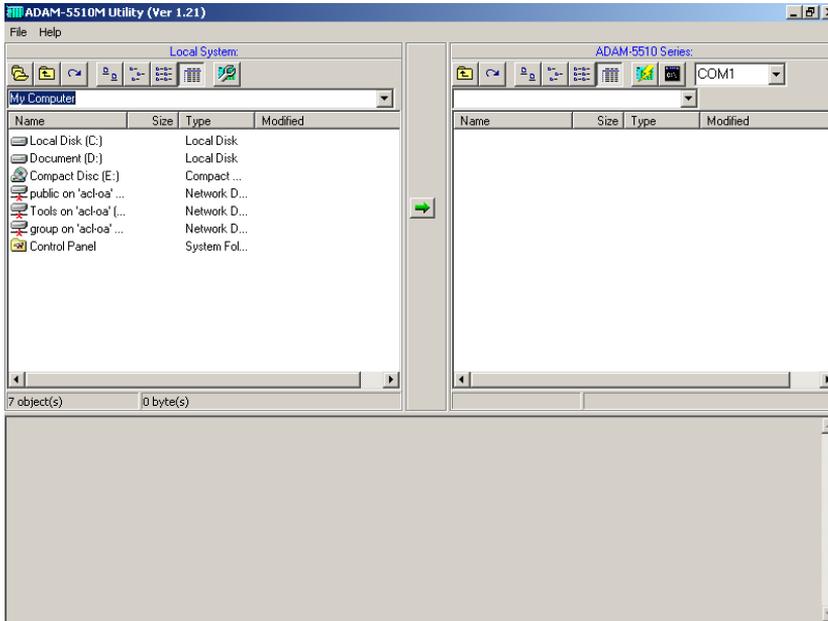


2. Connect INIT* pin to power GND pin and then reboot.

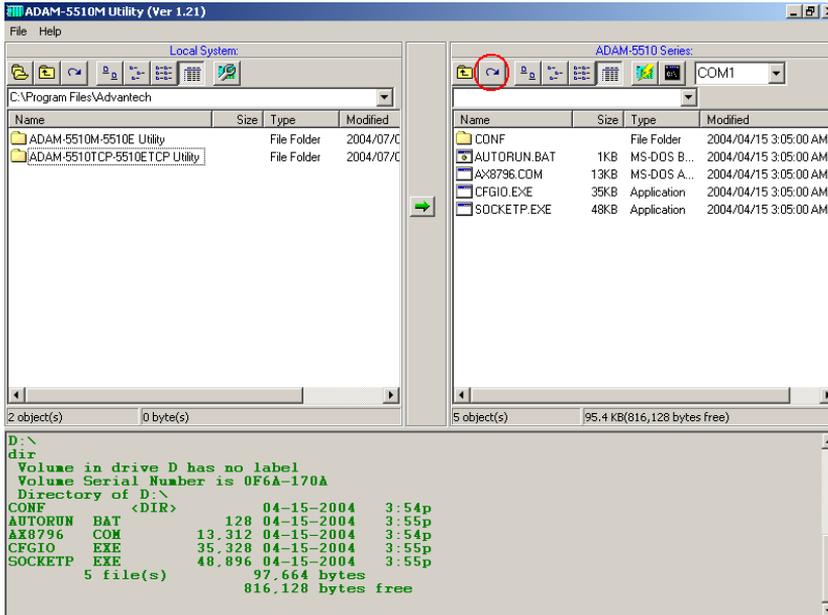


Chapter 3 I/O Configuration and Program Download

3. Please click “Program” directory under “ADAM-5510TCP-5510ETCP Utility” and run “ADAM5510.EXE”, which is so called ADAM-5510 Series Utility. You will find following figure.

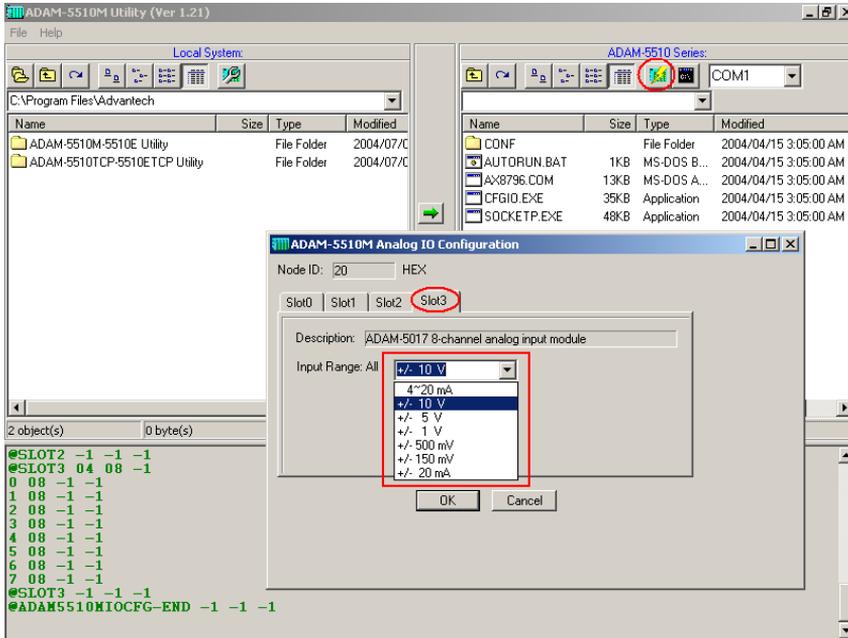


4. Click Refresh button to check if the drive D: of ADAM-5510TCP is detected correctly.

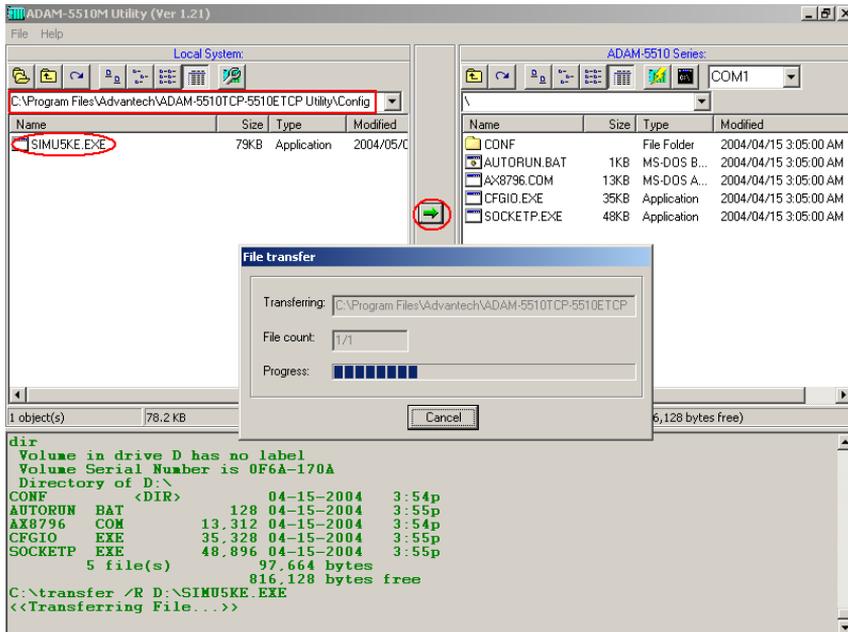


Chapter 3 I/O Configuration and Program Download

5. Click “Config ADAM” button. Select Slot3 and configure the input range.



6. Download I/O Module Configuration Tool “SIMU5KE.EXE” under “Config” directory onto Drive D: of ADAM-5510/TCP.



Chapter 3 I/O Configuration and Program Download

7. Set DIP SW6 as ON.

COM Port Selection for Configuration Tool:

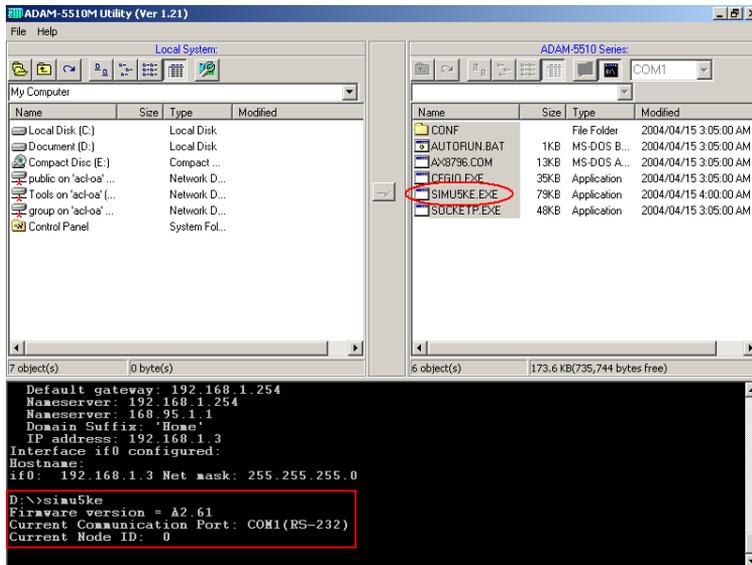
DIP	SW6
ON	COM1/RS-232

8. Set DIP SW1 to SW5 as OFF.

ID Address = 0

DIP	SW1	SW2	SW3	SW4	SW5
OFF	0	0	0	0	0

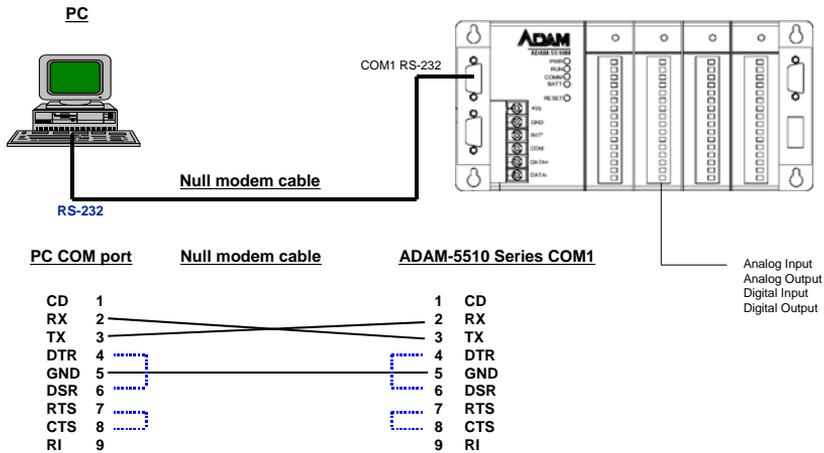
9. Run “SIMU5KE.EXE” and check the Communication Tool does use COM1/RS-232 port.



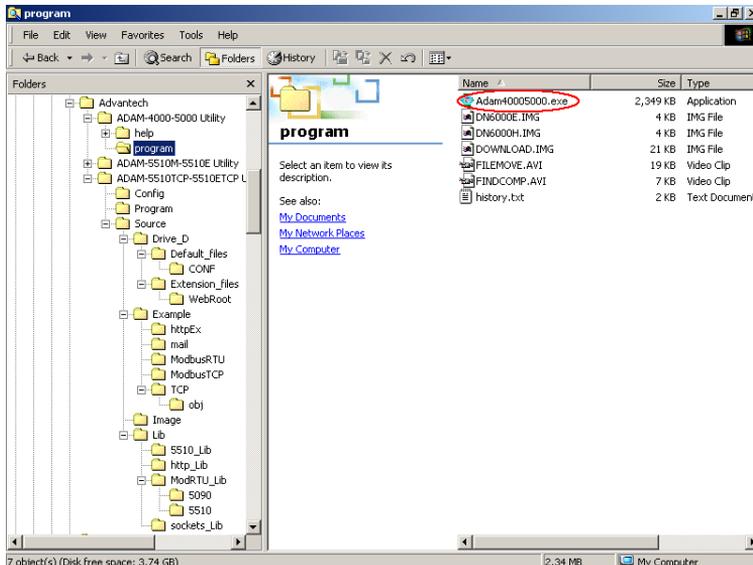
Note: If you use a new version of “SIMU5KE.EXE” above V1.21, please let the SW7 and SW8 be “On”.

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10. Connect Host PC to COM1/RS-232 on ADAM-5510/TCP by null modem cable.

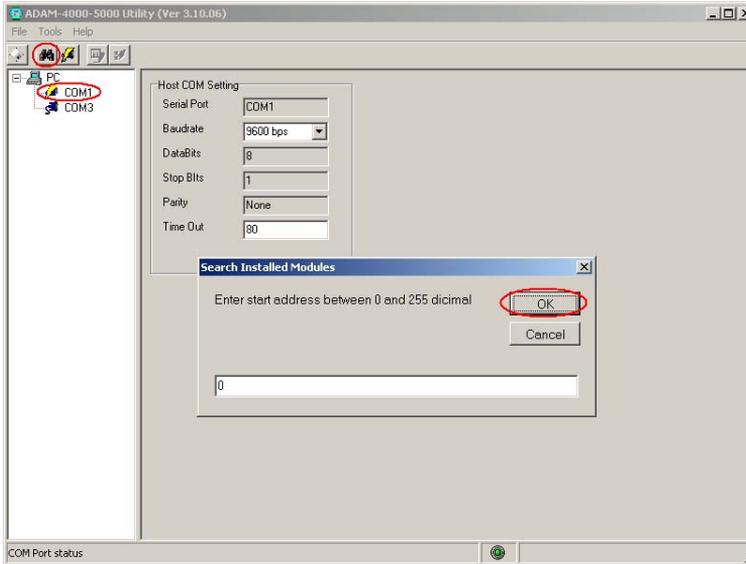


11. Insert the ADAM Products CD and setup ADAM-4000-5000 Utility.

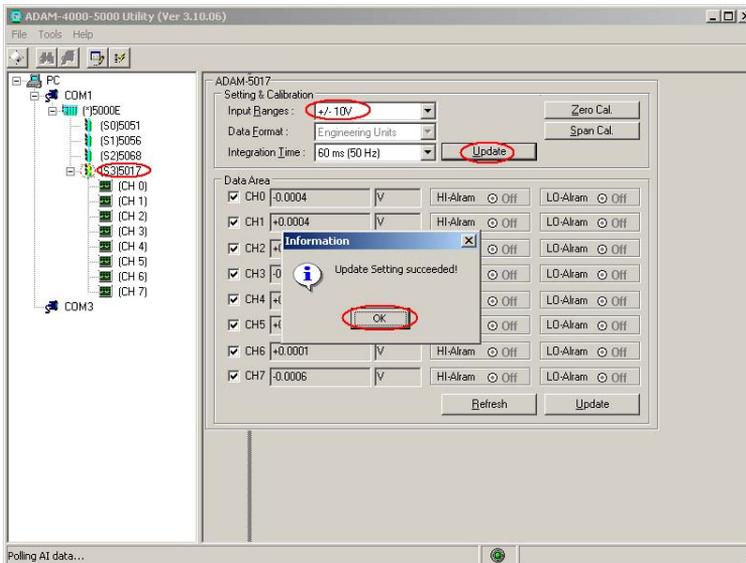


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12. Close ADAM-5510 Series Utility and run ADAM-4000-5000 Utility “ADAM40005000.EXE”.



13. Search the ADAM-5510/TCP Module and configure the input range of ADAM-5017 Analog Input Module.

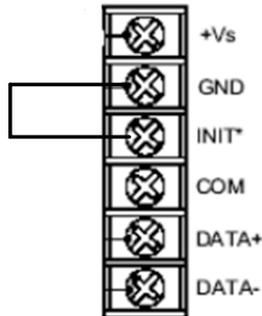


14. Close the ADAM-4000-5000 Utility. Disconnect INIT* pin to power GND pin and then reboot ADAM-5510/TCP.

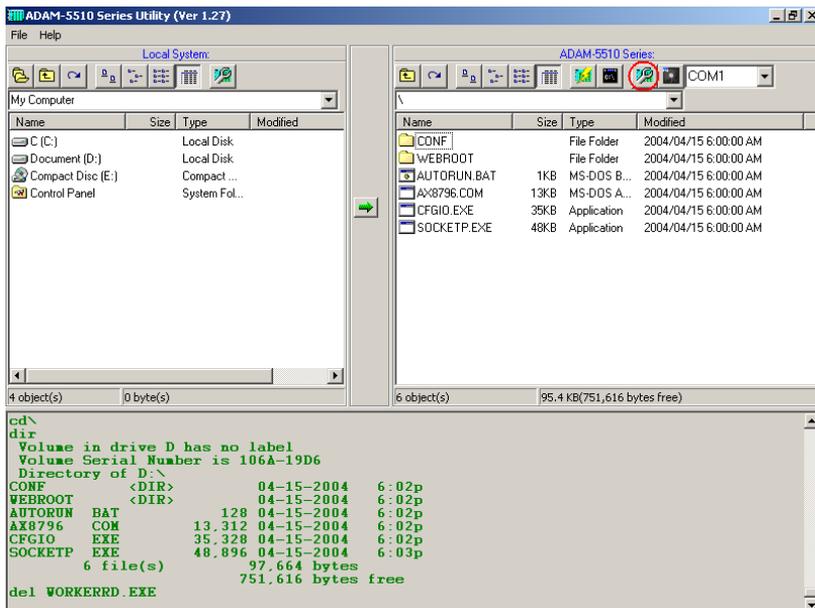
3.5 Initialize the drive D: to default settings. (For ADAM-5510/TCP and ADAM-5510E/TCP only)

Following steps will show you how to initialize the drive D: to default settings for ADAM-5510/TCP. The drive D: of ADAM-5510/TCP will return to initial files and settings after this function is performed. You will get the same result when you perform the same steps for ADAM-5510E/TCP. As there is no system files on drive D: of ADAM-5510M and ADAM-5510E, you can simply neglect this section and go to section 3.7.

1. Connect INIT* pin to power GND pin and then reboot.

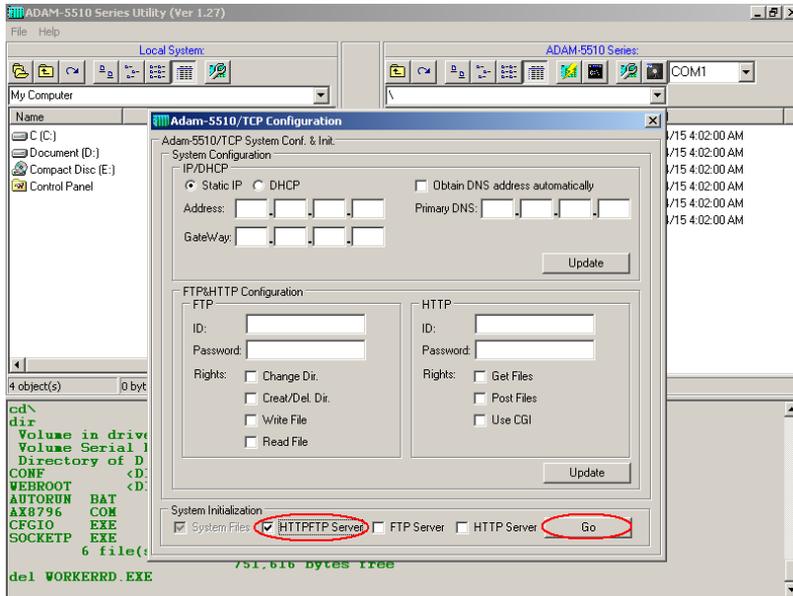


2. Click on “ADAM-5510/TCP Configuration” button.

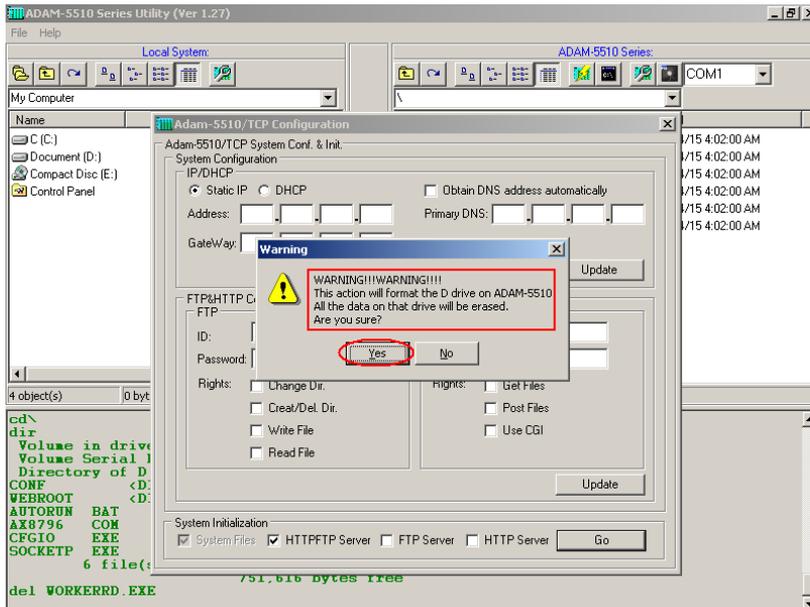


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3. Select “HTTPFTP Server” item and click “Go” button.

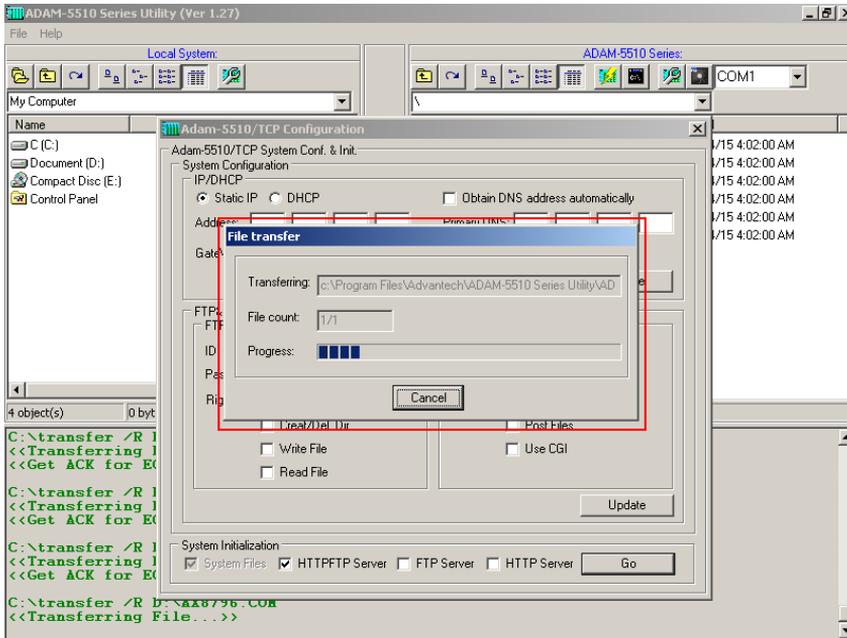


4. Click “Yes” to initialize drive D and it will be formatted and all the files on drive D will be lost. If you would like to keep the drive contents, please go to section 3.8.

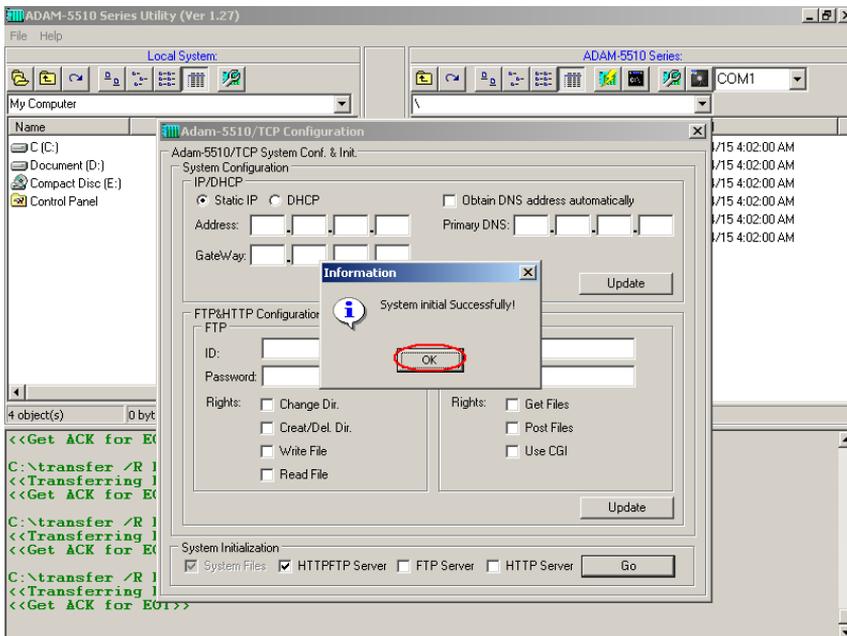


Chapter 3 I/O Configuration and Program Download

5. You will find the initialization process is performing.

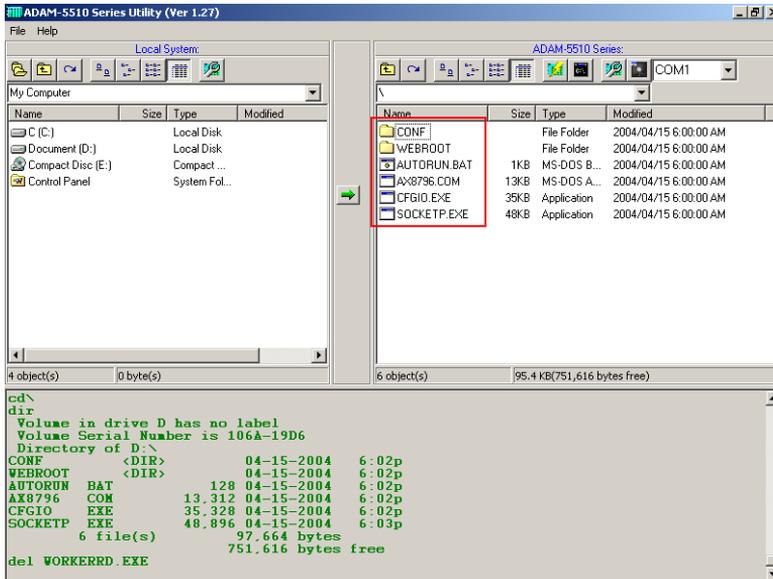


6. Click "OK" to finish the initialization procedures.

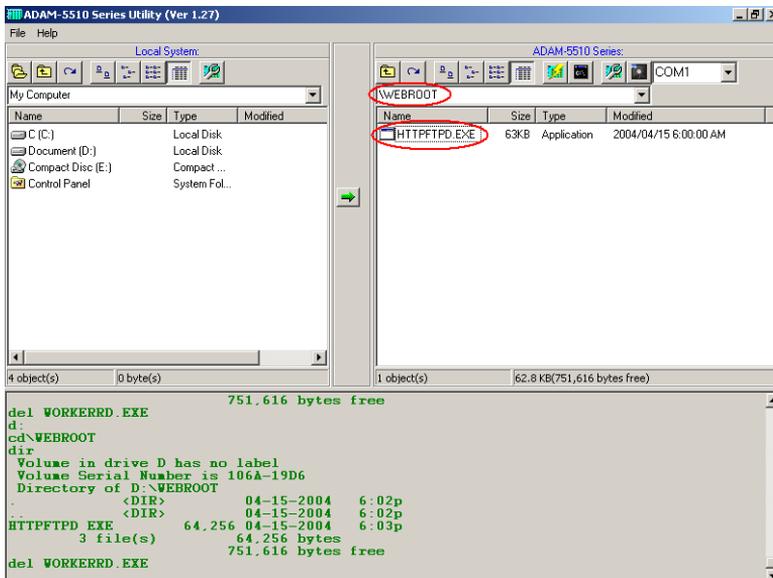


Chapter 3 I/O Configuration and Program Download

- The directory of drive D will be refreshed as following picture.



- In this demonstration, you will find the FTP & HTTP Server file is under "WEBROOT" directory.

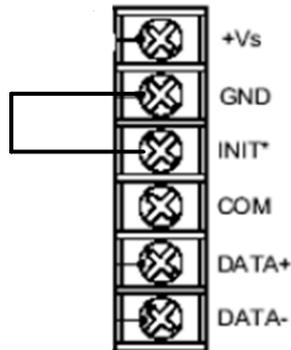


- Disconnect INIT* pin to power GND pin and then reboot ADAM-5510/TCP.

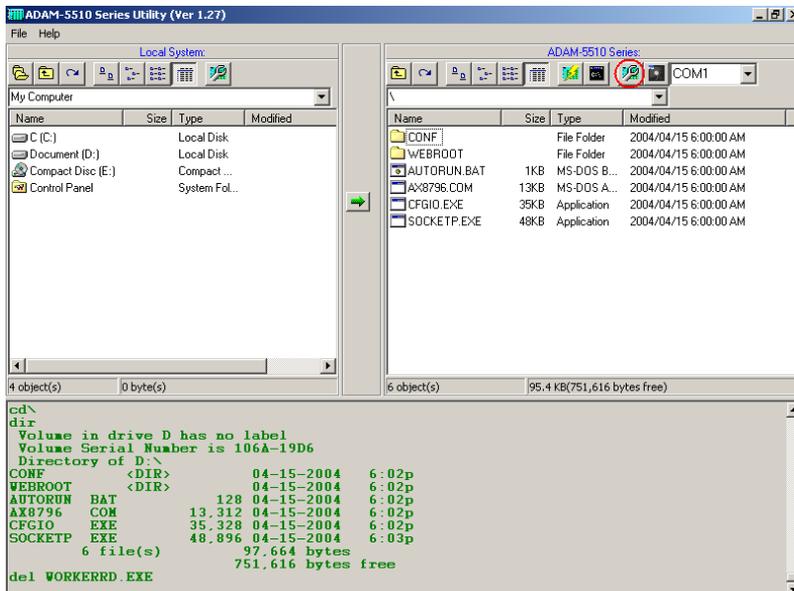
3.6 Configure IP address and ftp/http user/password settings. (For ADAM-5510/TCP and ADAM-5510E/TCP only)

Following steps will show you how to configure IP address and users/password of FTP server and HTTP server for ADAM-5510/TCP. **Please note the default IP address is “10.0.0.1”.** You will get the same result when you perform the same steps for ADAM-5510E/TCP. As the Ethernet port is not supported by ADAM-5510M and ADAM-5510E, you can simply neglect this section and go to section 3.7.

1. Connect INIT* pin to power GND pin and then reboot.

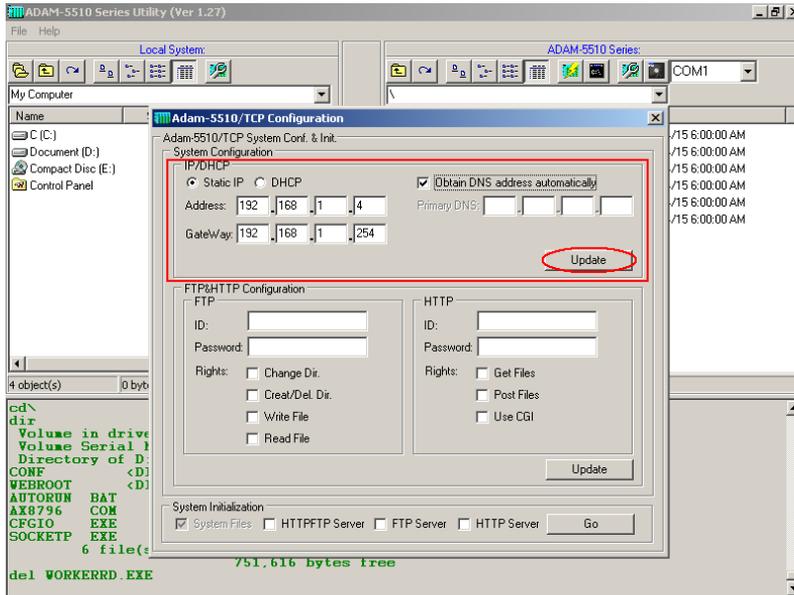


2. Click on “ADAM-5510/TCP Configuration” button.



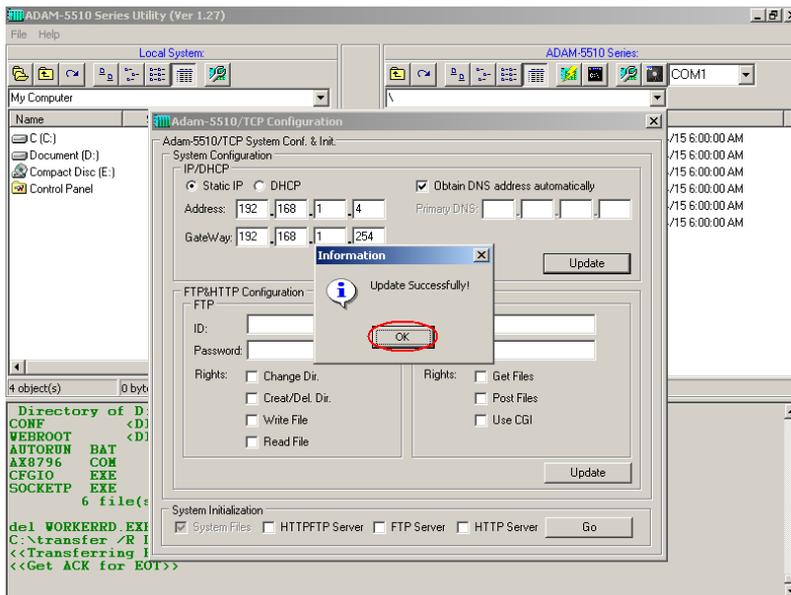
Chapter 3 I/O Configuration and Program Download

3. Select “Static IP” and fill in the IP address and Gateway IP. Select “Obtain DNS address automatically” item. Click “Update” button to perform the configuration.



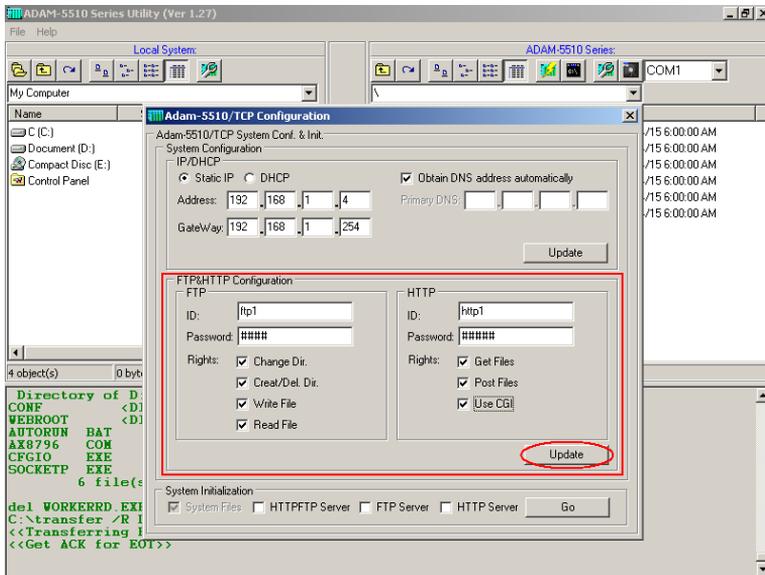
Note: Above settings is only an example. You have to configure the network settings by your network environment.

4. Click “OK” to finish the network configuration.



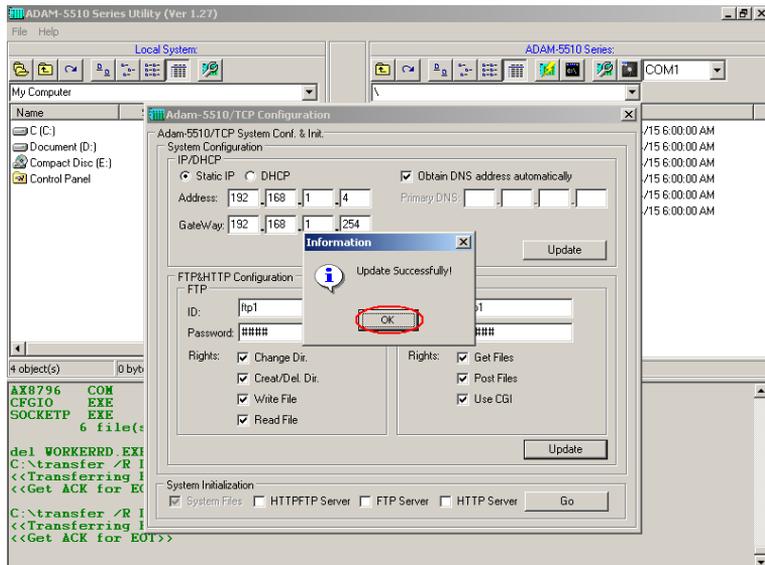
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5. Fill in the user name, password and access right for FTP server and HTTP server. Click “Update” button to perform the configuration.



Note: This utility can only let you configure one user for FTP server and one user for HTTP server. If you would like to configure multi-users for FTP server and HTTP server, please refer to chapter 4.

6. Click “OK” to finish the configuration.



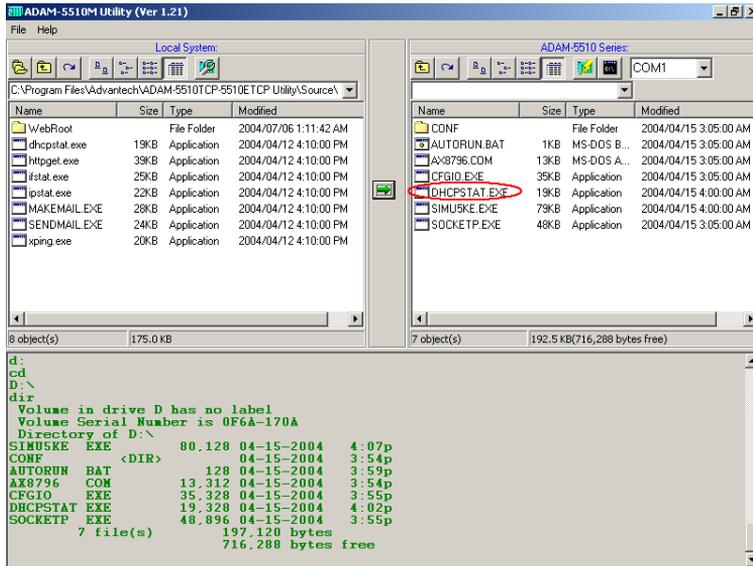
7. Disconnect INIT* pin to power GND pin and then reboot ADAM-5510/TCP.

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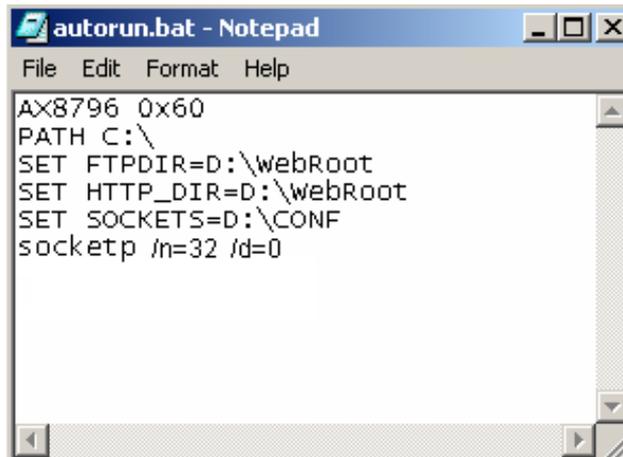
3.7 Download and run the application program automatically after boot up

Following steps will demonstrate the function by updating “AUTORUN.BAT” and run “DHCPSTAT.EXE” automatically after boot up.

1. Download the “DHCPSTAT.EXE” onto ADAM-5510/TCP.

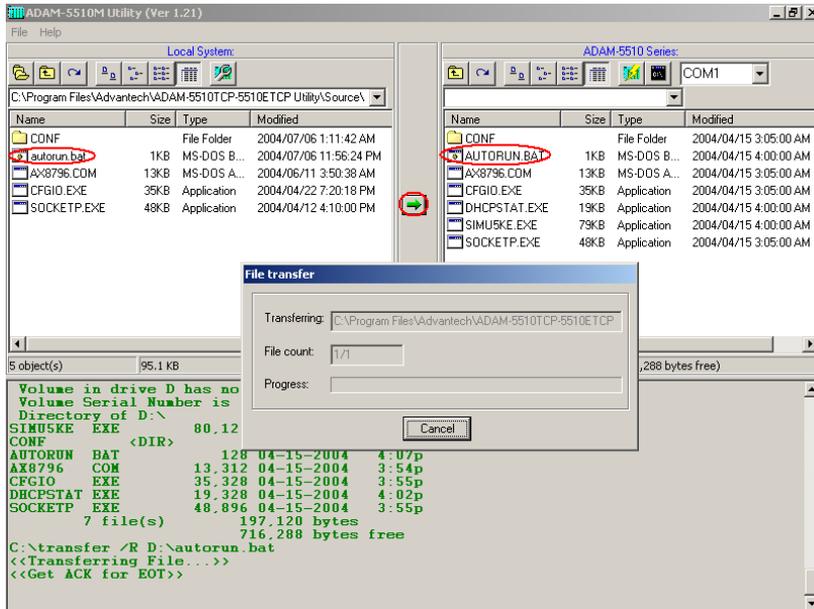


2. Edit “AUTORUN.BAT” under “Source\Drive_D\Default_Files” directory.

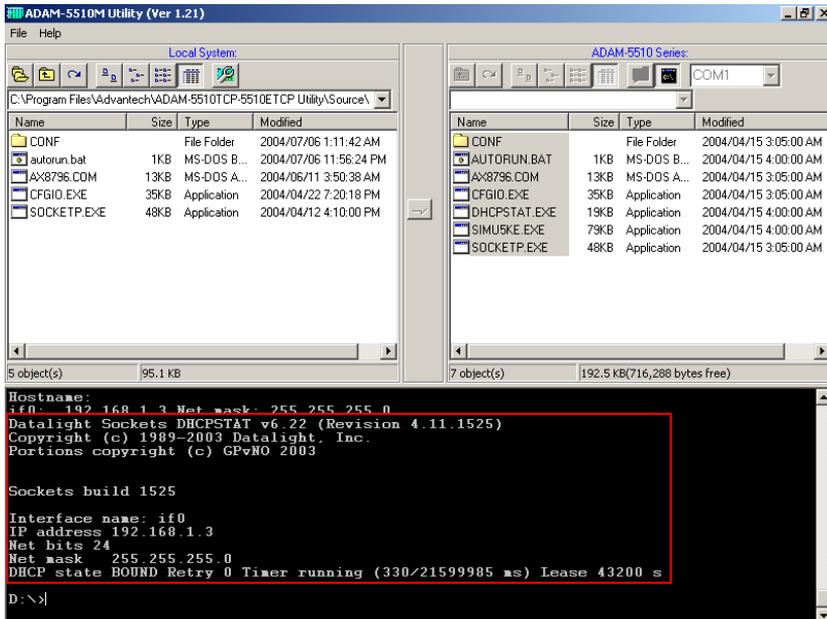


Chapter 3 I/O Configuration and Program Download

3. Update "AUTORUN.BAT" to ADAM-5510/TCP in the utility.



4. Reset the ADAM-5510/TCP and check if the "DHCPSTAT.EXE" has been executed correctly.

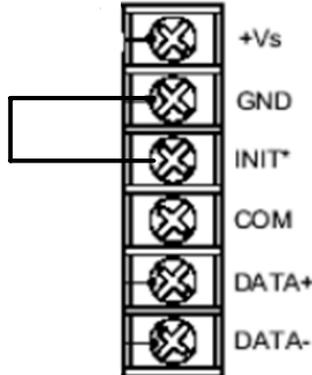


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3.8 Backup drive D as image file.

Following steps will use ADAM-5510/TCP as an example to demonstrate how to backup drive D as image file.

1. Connect INIT* pin to power GND pin and then reboot.



2. Click "Refresh" button.

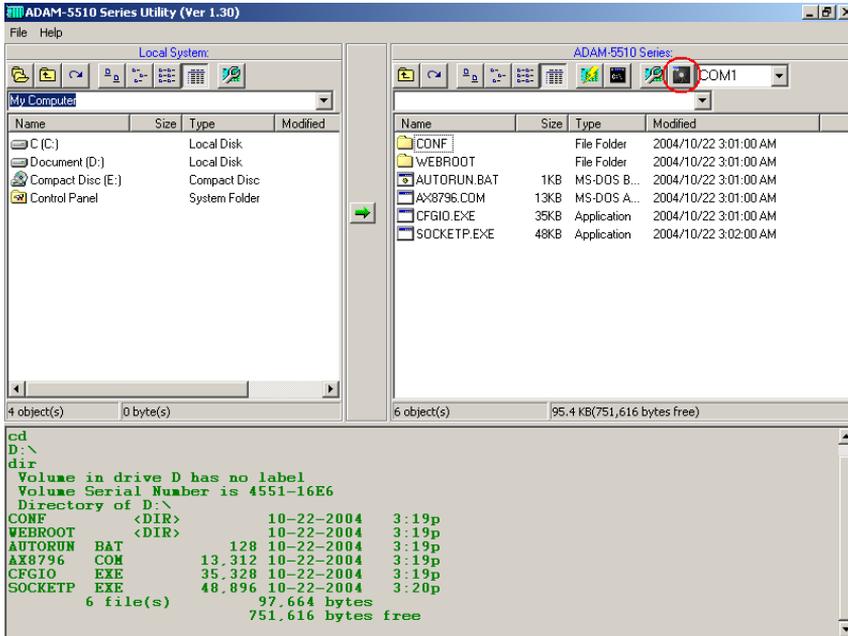
The screenshot shows the ADAM-5510 Series Utility (Ver 1.30) interface. The 'Local System' pane on the left shows drive D. The 'ADAM-5510 Series' pane on the right shows the contents of drive D, including folders CONF and WEBROOT, and files AUTORUN.BAT, AX8796.COM, CFGIO.EXE, and SOCKETP.EXE. The 'Refresh' button is highlighted with a red box.

Name	Size	Type	Modified
CONF		File Folder	2004/10/22 3:01:00 AM
WEBROOT		File Folder	2004/10/22 3:01:00 AM
AUTORUN.BAT	1KB	MS-DOS B...	2004/10/22 3:01:00 AM
AX8796.COM	13KB	MS-DOS A...	2004/10/22 3:01:00 AM
CFGIO.EXE	35KB	Application	2004/10/22 3:01:00 AM
SOCKETP.EXE	48KB	Application	2004/10/22 3:02:00 AM

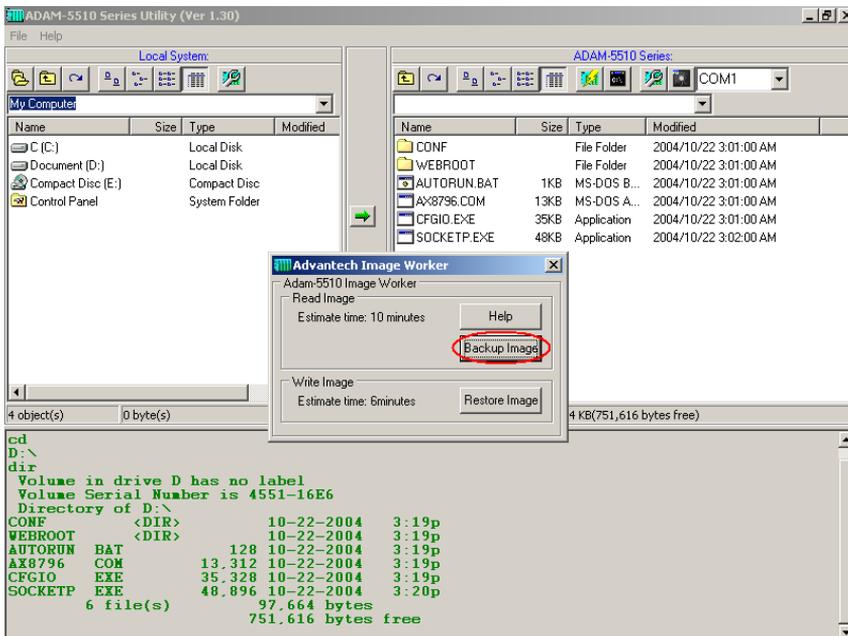
```
cd
D:\
dir
Volume in drive D has no label
Volume Serial Number is 4551-16E6
Directory of D:\
CONF          <DIR>          10-22-2004   3:19p
WEBROOT      <DIR>          10-22-2004   3:19p
AUTORUN  BAT          128  10-22-2004   3:19p
AX8796  COM          13,312  10-22-2004   3:19p
CFGIO   EXE          35,328  10-22-2004   3:19p
SOCKETP EXE          48,896  10-22-2004   3:20p
6 file(s)          97,664 bytes
751,616 bytes free
```

Chapter 3 I/O Configuration and Program Download

3. Click “Image Worker” button and perform the backup function.

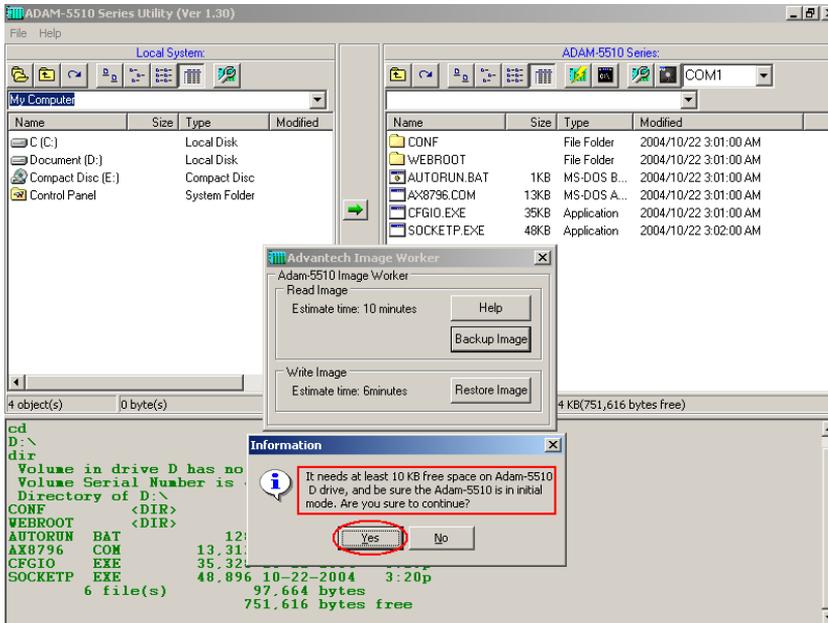


4. Click “Backup Image” button.

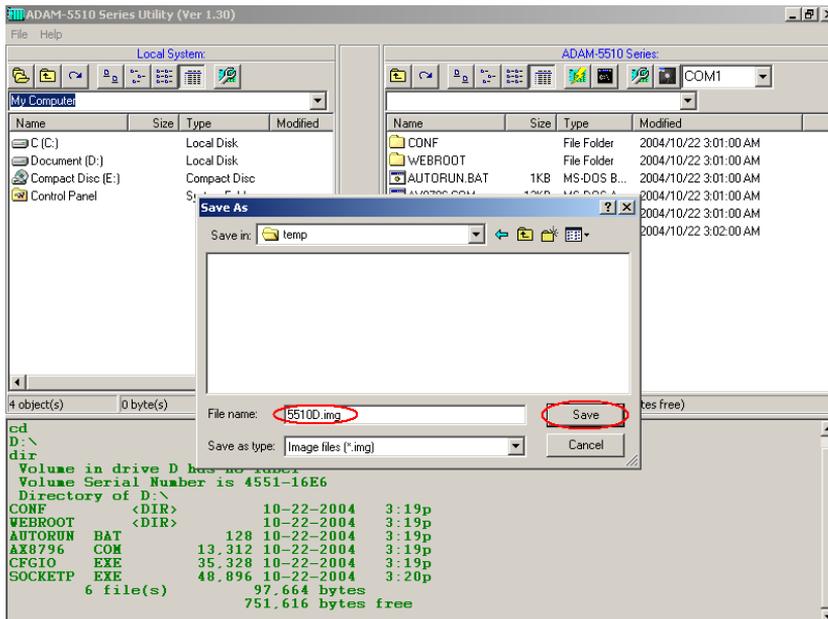


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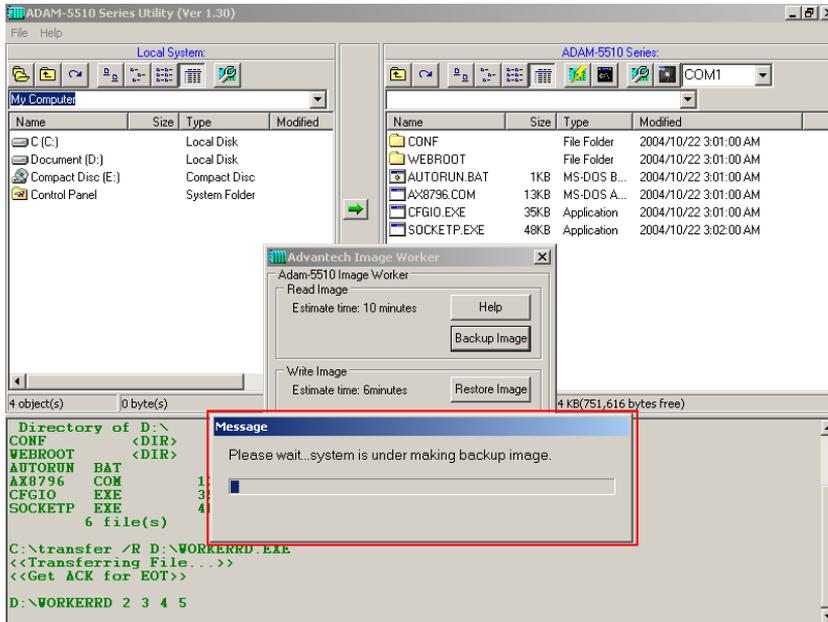
5. Check if there is 10KB free space on drive D and ADAM-5510/TCP is in initial mode. Click “Yes” to start the backup.



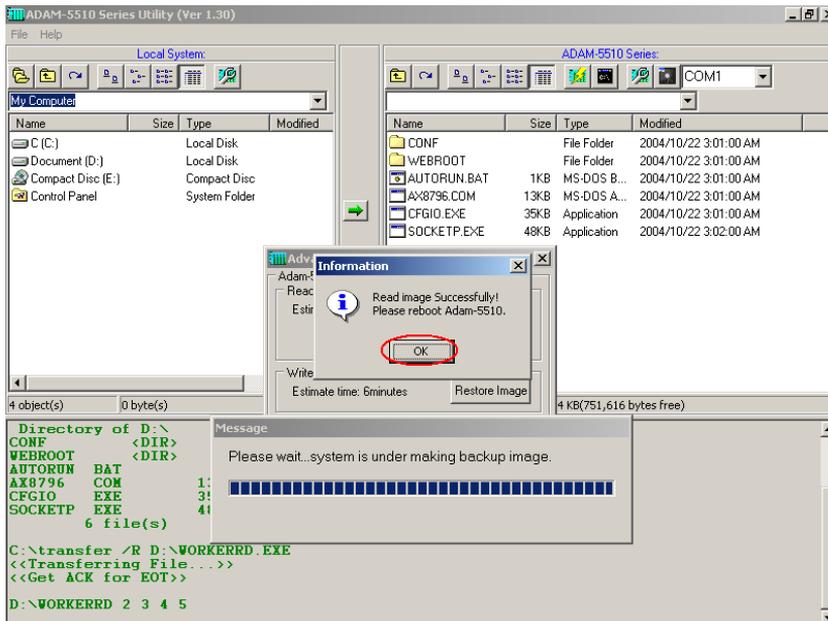
6. Type the file name and click “Save”.



7. Backup function is processing.



8. Click "OK" to finish the backup process. Disconnect INIT* pin to power GND pin and then reboot ADAM-5510/TCP.

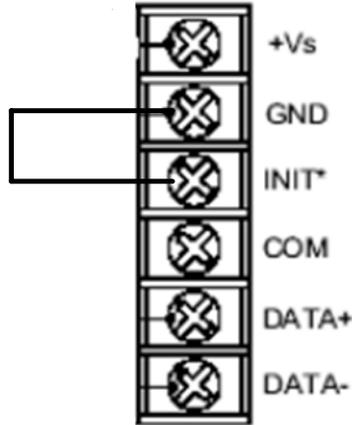


Chapter 3 I/O Configuration and Program Download

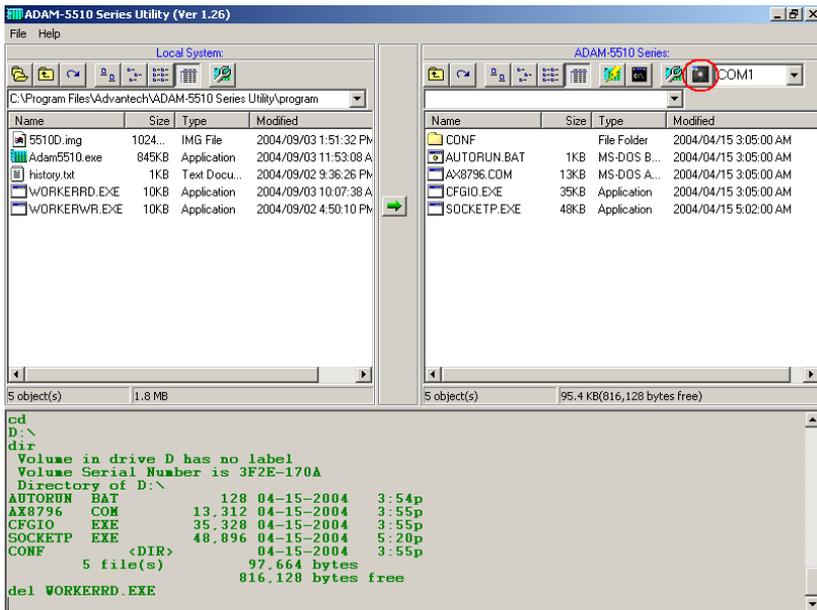
3.9 Restore the drive D from image file.

Following steps will use ADAM-5510/TCP as an example to demonstrate how to restore image file to drive D.

1. Connect INIT* pin to power GND pin and then reboot.

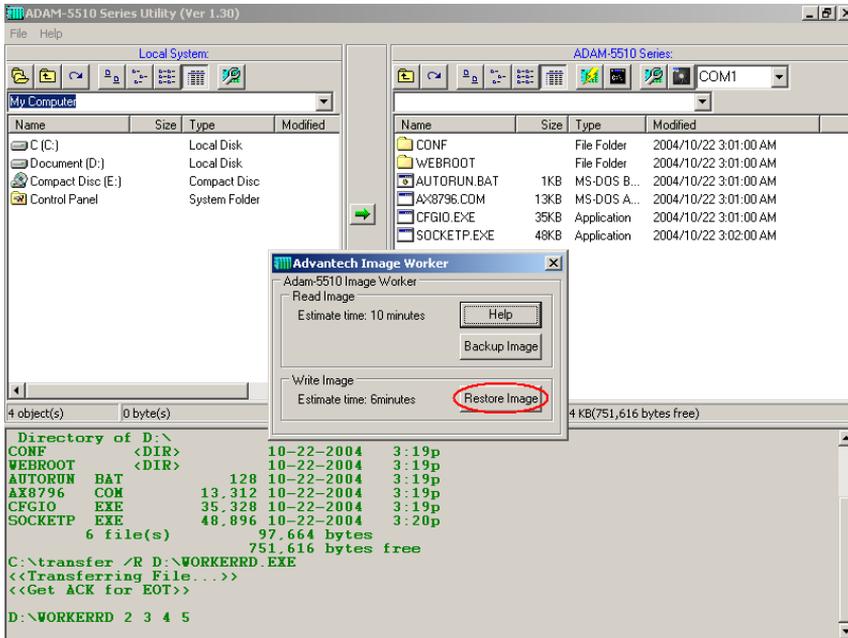


2. Click “Image Worker” button and perform the restore function.

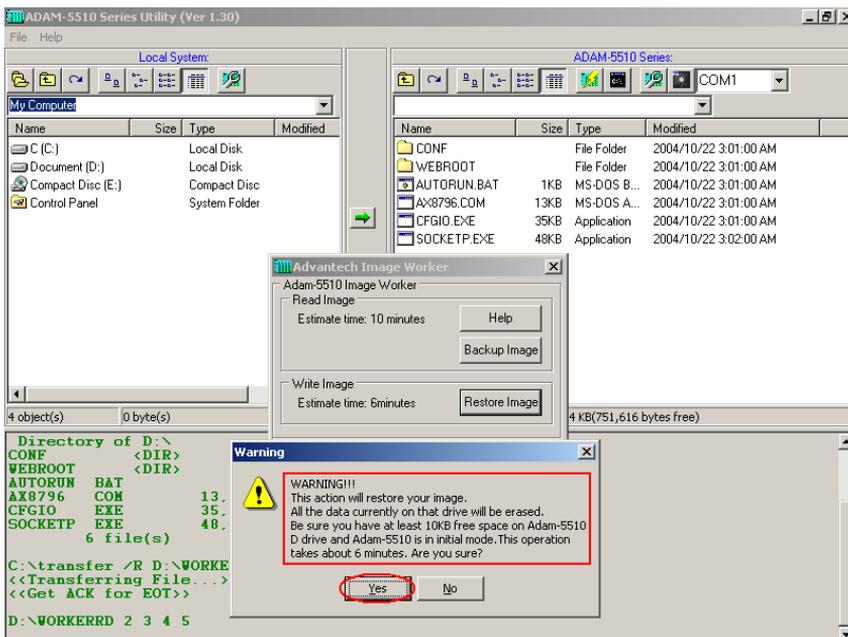


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3. Click “Restore Image” button.

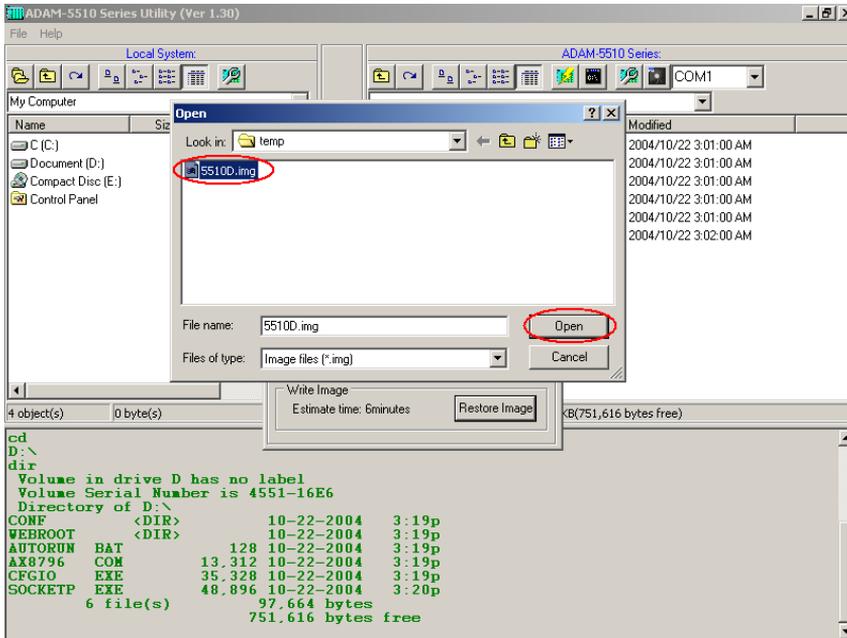


4. Check the warning message. Make sure all files on drive D can be deleted and then click “Yes”.

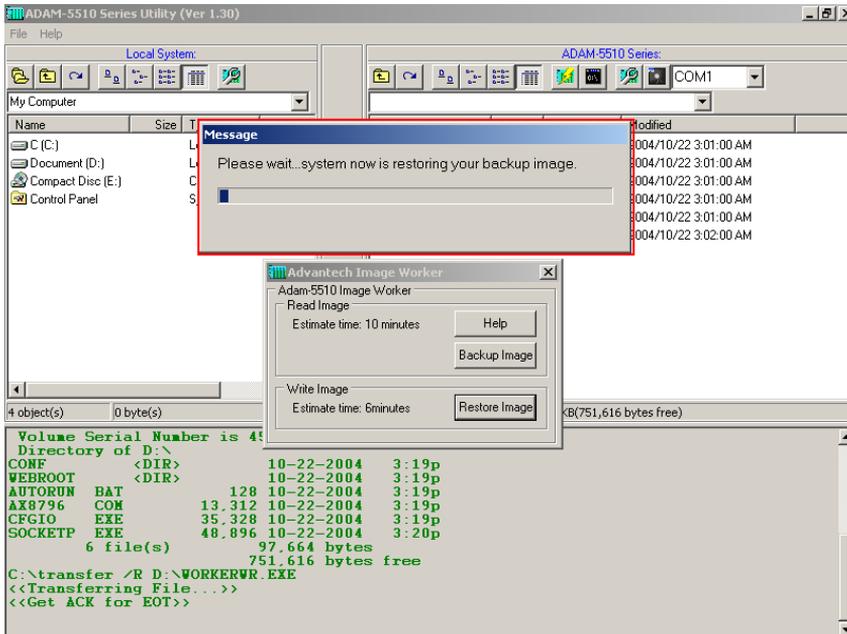


Chapter 3 I/O Configuration and Program Download

5. Select the image file and click “Open”.

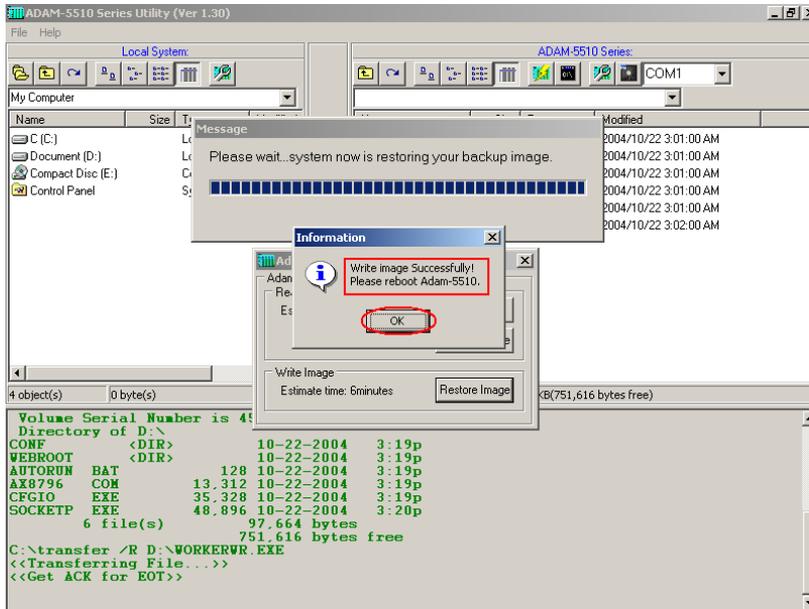


6. The restore function is processing.

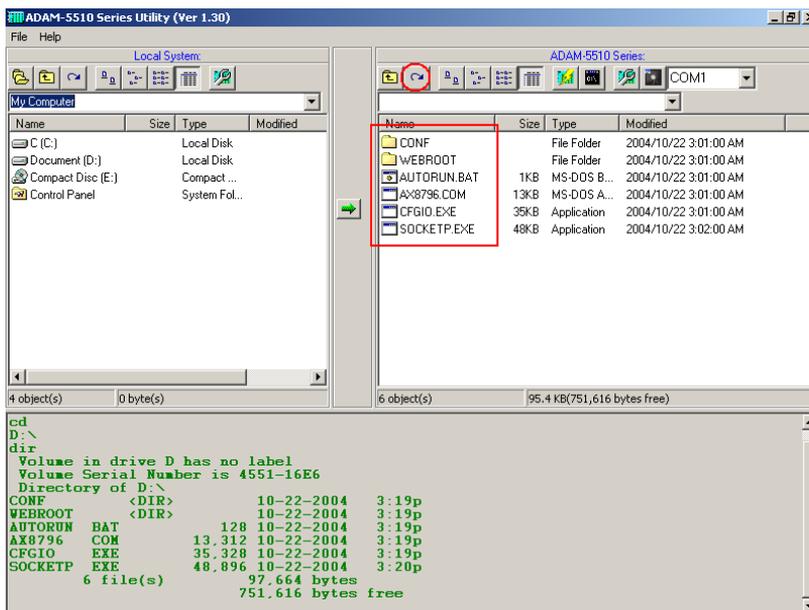


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7. Click "OK" to finish the restore process. Disconnect INIT* pin to power GND pin and then reboot ADAM-5510/TCP.



8. Check the drive D has been restored from the backup image file.



4

Guidelines for Network Functions

The network features of ADAM-5510 Series Controller are very rich especially on Ethernet-enabled models such as ADAM-5510/TCP and ADAM-5510E/TCP. In order to speed up the learning curve about versatile network features, the network functions will be present by step-by-step demonstration in this chapter. The detail information of related functions, utilities and applications are shown on later chapters. The sample programs can also be found after ADAM-5510 Series Controller utility on ADAM CD is installed.

Before you start to test the network functions, you have to configure two files as following.

SOCKET.CFG: Text file contains related configuration command.

SOCKET.UPW: Text file contains user name and password.

SOCKETS Configuration Files: SOCKET.CFG, HOSTS

SOCKETS uses two files in the D:\CFG directory (default), or any other directory specified by the SOCKETS environment variable. These files are SOCKET.CFG, the default start-up file, and HOSTS, the host names file. If not found, SOCKETS uses the default SOCKET.CFG in the D:\CFG directory.

SOCKET.CFG is a text file containing configuration commands. Empty lines and lines starting with # are ignored. Commands are used to specify protocol parameters like the IP address of the stack, interface parameters like Packet Driver or Asynchronous Serial lines, routes and various other parameters. Here is a simple example:

```
ip address demo
    Set the IP address of this host to 192.6.1.1.
interface pdr if0 dix 1500 5
    Use Packet Driver, naming the interface 'if0', MTU=1500,
    Receive buffers = 5
route add default if0 router
    Route all traffic to unknown destinations via 'if0' using 'router'
    as a gateway
tcp mss 1460
    TCP Maximum Segment Size = 1460.
tcp window 2920
    TCP Maximum window = 2920.
start prntsrv
```

Start printer server on PRN using default port of 10.

HOSTS is an optional file containing mappings of IP addresses in dotted decimal notation to names.

Sample HOSTS file:

```
192.6.1.1 demo
192.6.1.2 router
192.6.1.3 server
```

SOCKET.CFG Samples

The following configuration file contains the minimum possible commands for a valid configuration file: just one. This is to specify that the interface should use a Packet Driver, the interrupt vector, which must be searched for. It should use DIX encapsulation, have an MTU of 1500 and have a maximum of 5 receive buffers. Since no IP address is specified, BOOTP will be used and the required operating parameters will be retrieved from a BOOTP server, which must be available on the network.

SOCKET.CFG:

```
interface pdr if0 dix 1500 5
```

The following is a more typical example specifying a static IP address, a Packet Driver interface, a default route, the TCP MSS and WINDOW.

SOCKET.CFG:

```
# Sample configuration file
ip address 192.6.1.1
interface pdr if0 dix 1500 5
route add default if0 192.6.1.2
tcp mss 1460
tcp window 2920
```

Format of "SOCKET.UPW"

This is the same file used for the HTTP and FTP server's (*FTPD.EXE*) permissions. This file consists of lines where each line contains a user's information. A line starting with a # is considered a comment and is ignored. Each line consists of four fields:

```
<Username> <Password> <Working Directory> <Permissions> [# comment]
```

Username: The name of this user. If it is *, it will be used when the client does not specify a username.

Password: This user's password. If it is *, no password is required

Working Directory: The user will only have access to this directory and its subdirectories. If it is '/', this user has access to the whole system. HTTP_DIR can be referred to as '\'. If a relative path is specified, it is appended to HTTP_DIR.

Permissions: IMPORTANT when a user is granted both FTP and HTTP permissions, the FTP permissions must appear **first**, otherwise they will be ignored.

Operations allowed. May contain any combination of the following tokens:

- e** - User may 'get' files
- p** - User may 'post' files
- g** - User may use cgi

Fields should be separated by single spaces. If any field is missing the entry is ignored. A comment may follow the last field (permissions) of the line.

Note: If a default user is supplied, it should always appear first in the list of users. Only users below the default user will be considered.

Example configuration files, which are used by following demonstrations:

SOCKET.CFG:

```
# Packet driver settings
ip address 192.168.1.4
interface pdr if0 dix 1500 10 0x60

# The following will cause SOCKETS to display IP status
ip address

# The following lines set TCP parameters
ip ttl 64
tcp mss 1460
tcp window 2920
```

SOCKET.UPW:

```
su su \WebRoot drwcepgm # su may do everything on whole system.
* * \guest rg # default user may read (FTP) and get (HTTP)
# from %HTTP_DIR%\guest
test1 test1 \drep # test1 can change directories and read files (FTP)
# test1 get and post files (HTTP) in %HTTP_DIR%\
ftp1 ftp1 \WebRoot rd # ftp1 can read files and change directories (FTP)
# in %HTTP_DIR%\guest and has no HTTP rights
http1 http1 /epgm # http1 can get and post files, use CGI,
# and use remote console.
# http1 has no FTP rights
user1 user1 \guest\user1 rdcw # user1 has full FTP access rights to the
# directory %HTTP_DIR%\user\user1
```

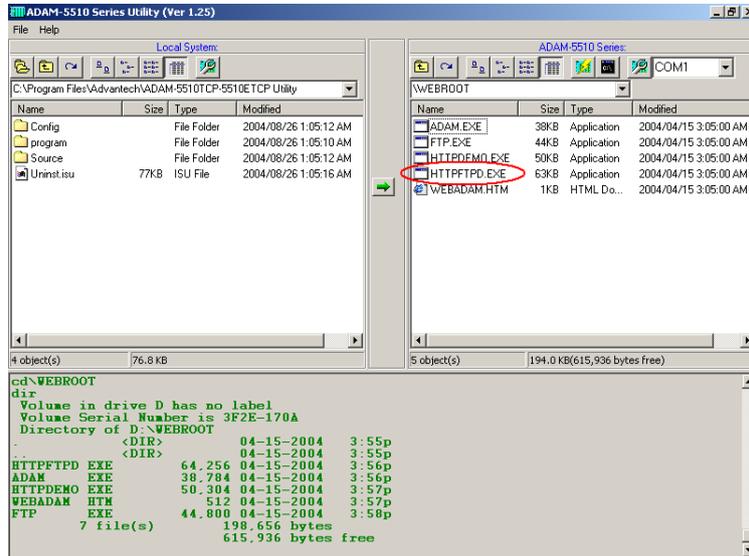
4.1 FTP Server

Application: FTPD.EXE or HTTPFTPD.EXE

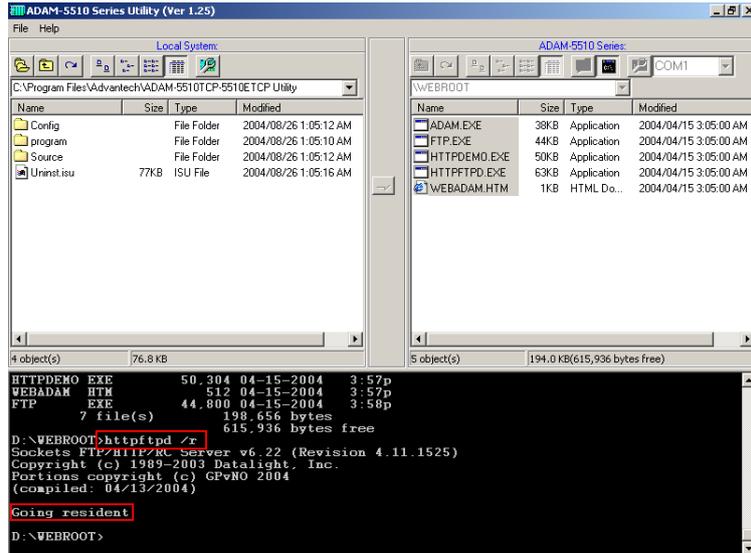
System configuration:

- ADAM-5510/TCP main unit
- FTP Client program on host PC

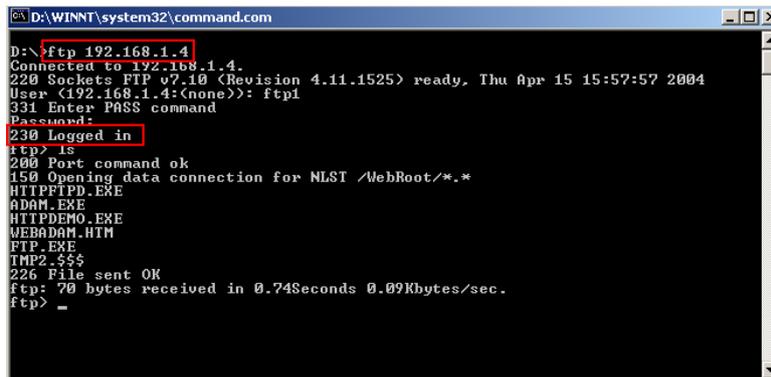
1. Download FTPD.EXE or HTTPFTPD.EXE onto drive D under "Webroot" directory.



- Run FTPD.EXE or HTTPFTPD.EXE at resident.

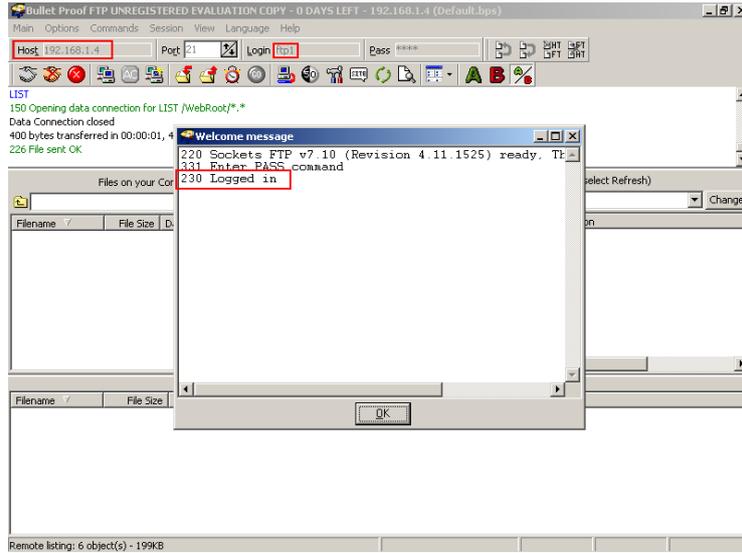


- Check the FTP function by FTP client application.

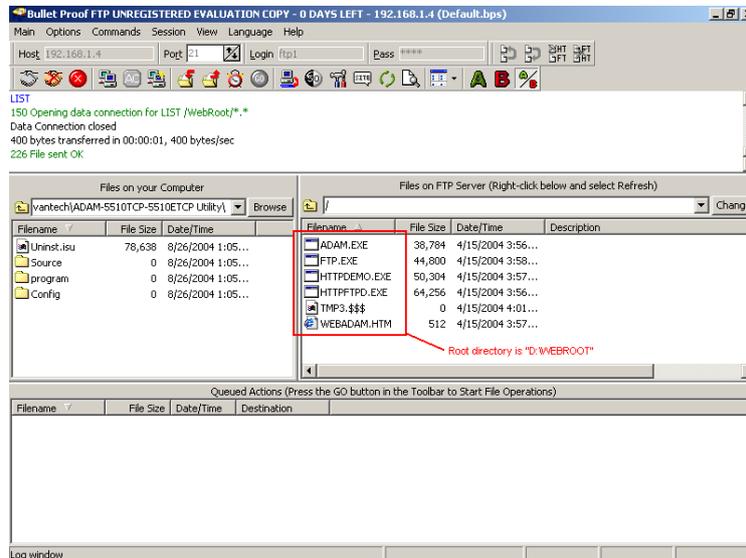


Chapter 4 Guidelines for Network Functions

4. Login FTP server by another FTP client application.



5. Check the files under "WEBROOT" directory are correctly.



4.2 HTTP Server

Example program: HTTPDEMO.EXE (without CGI function)

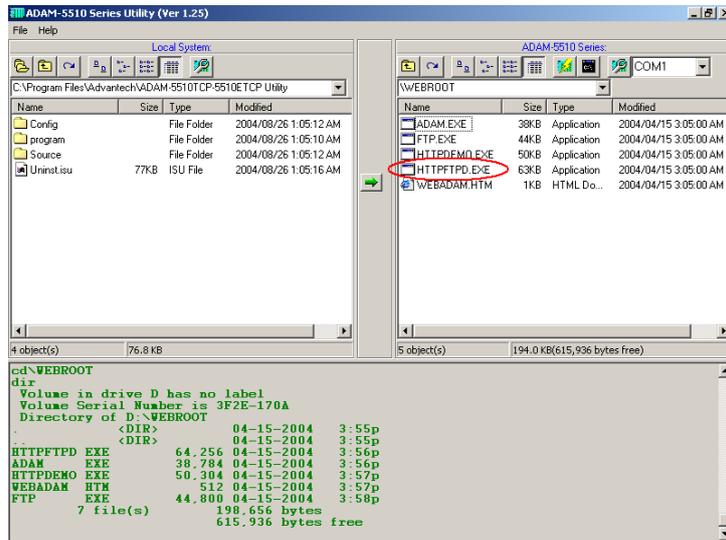
Source file: HTTPDEMO.C under "Source\Example\httpEx" directory

Application: HTTPD.EXE or HTTPFTPD.EXE

ADAM-5510/TCP configuration:

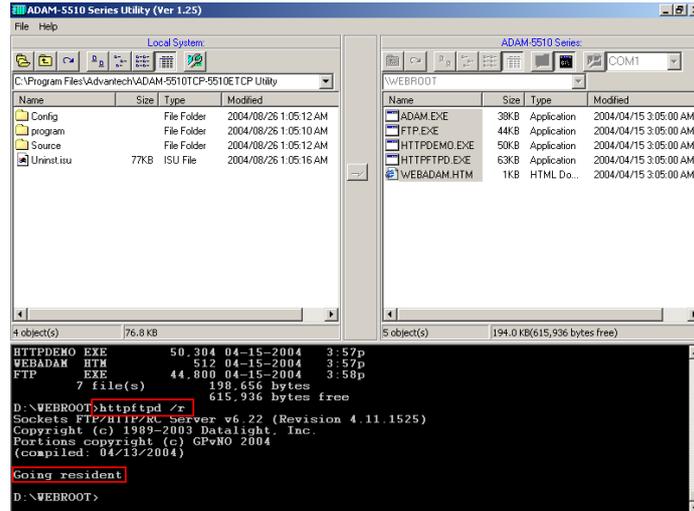
- ADAM-5510/TCP main unit
- ADAM-5051D at slot 0
- ADAM-5056D at slot 1
- ADAM-5068 at slot 2
- ADAM-5017 at slot 3
- Short ADAM-5051D DI0 to ADAM-5056D DO0, DI1 to DO1, ..., DI15 to DO15

1. Download HTTPD.EXE or HTTPFTPD.EXE onto drive D under "WEBROOT" directory.

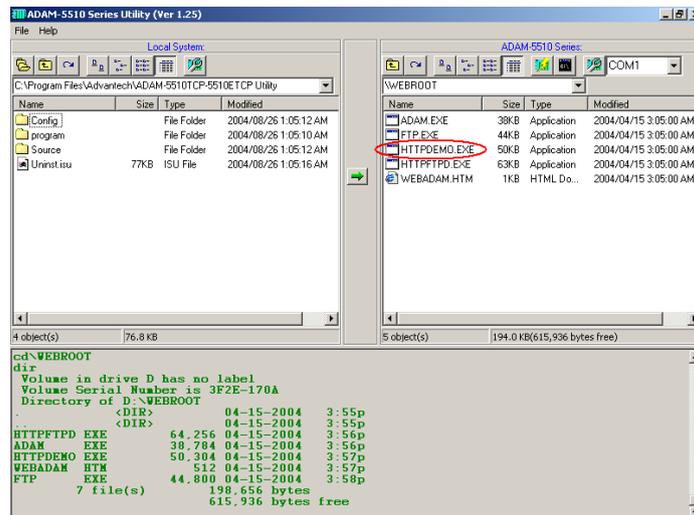


Chapter 4 Guidelines for Network Functions

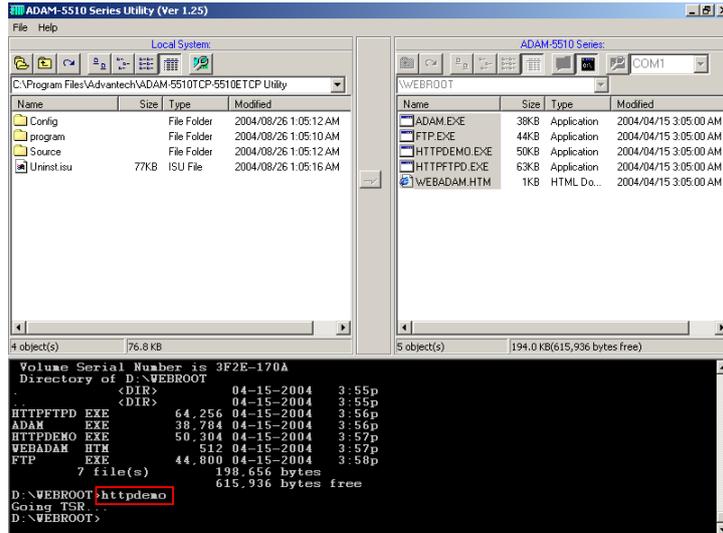
2. Run HTTPD.EXE or HTTPFTPD.EXE at resident.



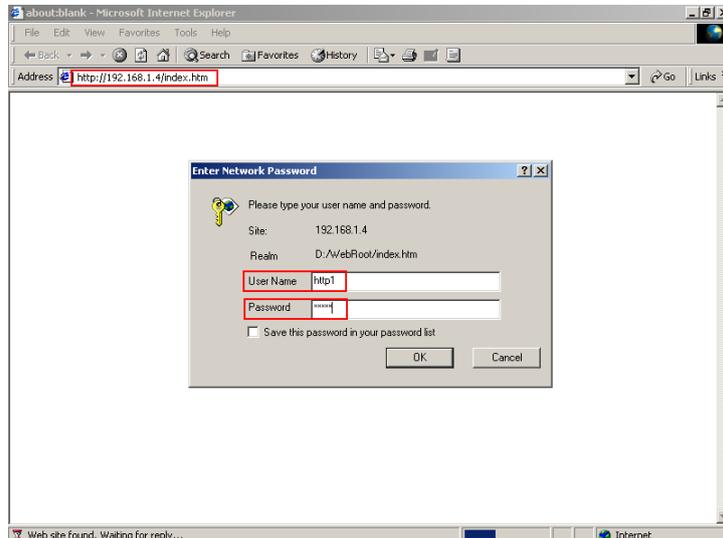
3. Build HTTPDEMO.EXE from HTTPDEMO.PRJ under "Source\Example\httpEx" directory and download HTTPDEMO.EXE onto drive D under "WEBROOT" directory.



4. Run HTTPDEMO.EXE.

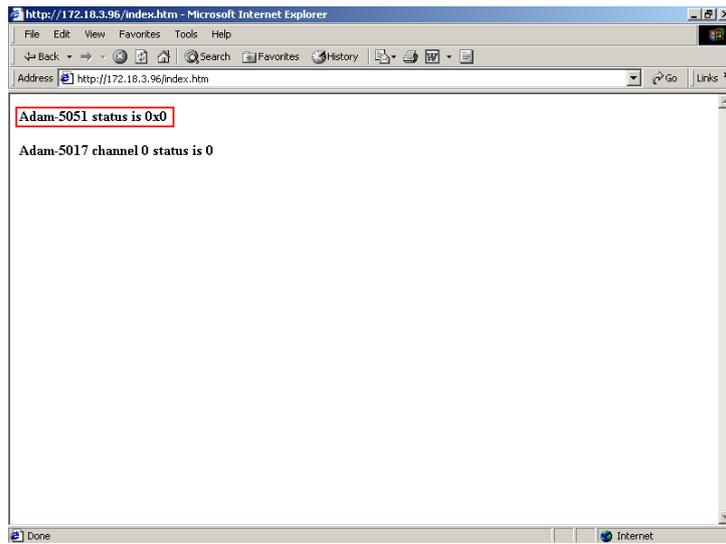


5. Run IE, type URL "http://192.168.1.4/index.htm" and login.

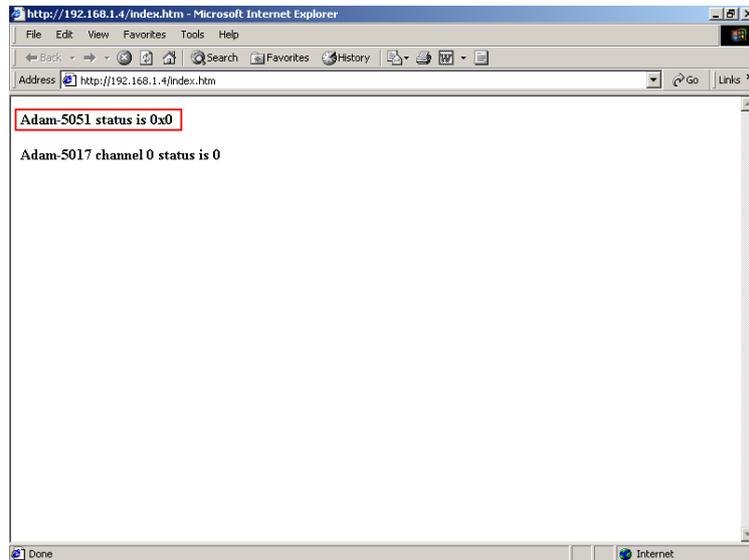


Chapter 4 Guidelines for Network Functions

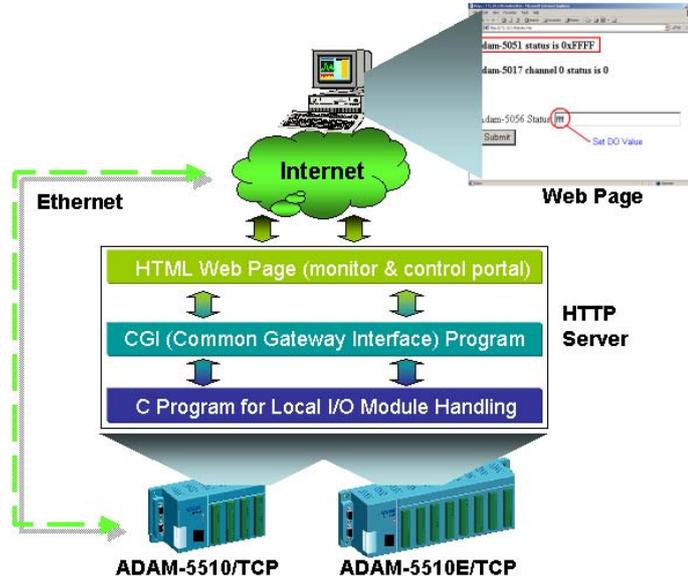
6. Check the DO channels on ADAM-5056D switching ON/OFF periodically and check the DI channels' status is shown on IE.



7. Check the DI channels' status is switching ON/OFF periodically.



The following figure is the software architecture of HTTP Server function. The HTTP Server has built-in the ADAM-5510/TCP (or ADAM-5510E/TCP) Ethernet Controller. Whenever users open the IE Browser to acquire data from ADAM-5510/TCP controller through Internet or Intranet, it will call up the existed web pages to provide a monitor and control portal. All of the commands from the web page must be linked via a CGI program to the C control program which handle the real read/write action in ADAM-5000 I/O modules.



Basically, there are three steps in the process of Web Monitoring & Control.

1. Registration: Register a HTML name for the web page you designed
2. User login and invoke control program: After registration, users can invoke local control program by login Server
3. Local I/O activated by local control program

HTTPDEMO.C

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <process.h>

#include "5510drv.h"
#include "CGI_Lib.h"

FILE *fp;
int number = 0;
int count = 1;

unsigned LocalDIO(void);
unsigned int LocalAIO(void);
void ReplaceStr(char *ptr_str1, char *ptr_str2, int len_str);

void main(void)
{
    char * homepage_name = "index.htm";

    Init501718(3);

    if(!Http_Server_Reg(homepage_name)) // registration
        return;

    adv_printf("Program exiting...");
    HttpDeRegister("index.htm");
}

int far Callback(HTTP_PARAMS far* psParams)
// implement your program in this function
{
    static char *ptr_XX = 0;
    static char *ptr_OO = 0;
    char *tmpStr = 0;
    static char Htm_Content[] = "HTTP/1.0 200 OK\r\n"
// content of html page, content=1
```

```
"Content-type: text/html\r\n\r\n"  
// means refreshes every 1 second  
"<html><META HTTP-EQUIV=""Refresh"" content=1>"  
"<b>Adam-5051 status is OOOOOOO</b><p>"  
"<b>Adam-5017 channel 0 status is XXXXXXX</b>"  
"</html>";  
  
number++;  
adv_printf("Refresh %d times...\n", number);  
  
if (!ptr_OO)  
    ptr_OO = strstr(Htm_Content, "OOO");  
  
sprintf(tmpStr, "0x%X", LocalDIO());  
ReplaceStr(ptr_OO, tmpStr, 7);  
tmpStr = 0;  
if (!ptr_XX)  
    ptr_XX = strstr(Htm_Content, "XXX");  
sprintf(tmpStr, "%d", LocalAIO());  
ReplaceStr(ptr_XX, tmpStr, 7);  
HttpSendData(psParams->iHandle, Htm_Content, strlen(Htm_Content));  
return RET_DONE;  
}  
  
unsigned LocalDIO(void)  
// set Adam-5056&5068 and return Adam-5051 Status  
{  
    unsigned div, dov;  
    char dov1;  
  
    if(count%2==0)  
    {  
        dov = 0xffff;  
        dov1 = 0x0;  
    }  
    else  
    {  
        dov = 0x0000;  
        dov1 = 0xff;  
    }  
}
```

Chapter 4 Guidelines for Network Functions

```
count++;
if(count>100)
    count = 1;
Set5068(&dov1,2,0,AByte); //slot 2
Set5056(&dov,1,0,AWord); //slot 1

Get5051(0,0,AWord,&div); //slot 0
return ~div;
}

unsigned int LocalAIO(void) //return Adam-5017 channel 0 status
{

    unsigned int aiv;
    int ch, tmpcnt;

    tmpcnt=0;
    while(1)
    {
        if(AiUpdate(3,0)==0)
        {
            tmpcnt++;
            Get501718(3, 0, &aiv);
            if(tmpcnt>=8)
                break;
        }
    }
    return aiv;
}

void ReplaceStr(char *ptr_str1, char *ptr_str2, int len_str) // replace string
{
    int i;
    for(i=0; i<len_str; i++)
        ptr_str1[i] = 32;

    for(i=0; i<strlen(ptr_str2); i++)
        ptr_str1[i] = ptr_str2[i];
}
```

Example program: ADAM.EXE (with CGI function)

Source file: ADAM.C and WEBADAM.htm under

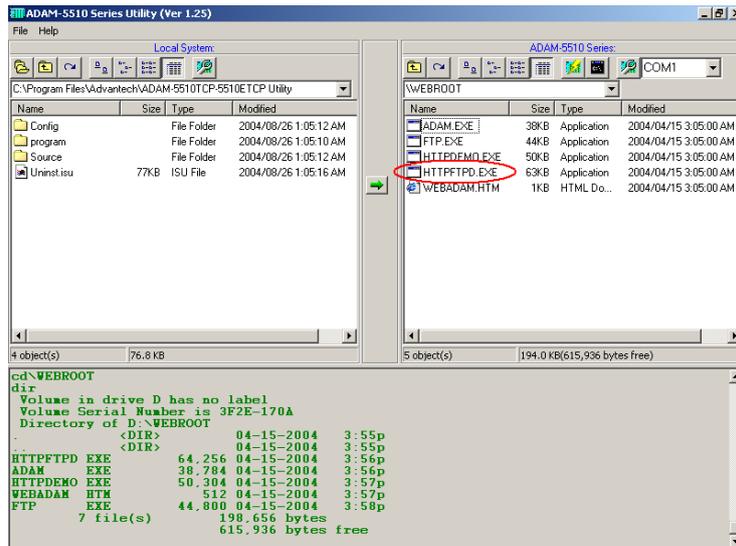
“Source\Example\httpEx” directory

Application: HTTPD.EXE or HTTPFTPD.EXE

ADAM-5510/TCP configuration:

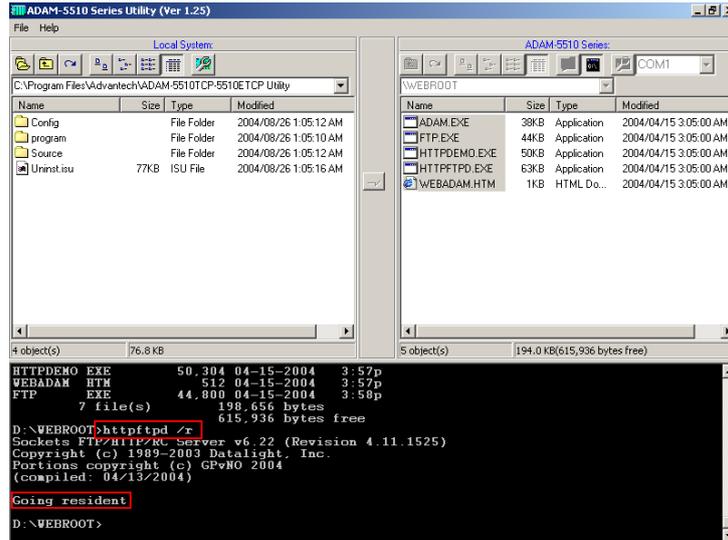
- ADAM-5510/TCP main unit
- ADAM-5051D at slot 0
- ADAM-5056D at slot 1
- ADAM-5068 at slot 2
- ADAM-5017 at slot 3
- Short ADAM-5051D DI0 to ADAM-5056D DO0, DI1 to DO1, ..., DI15 to DO15

1. Download HTTPD.EXE or HTTPFTPD.EXE onto drive D under “WEBROOT” directory.

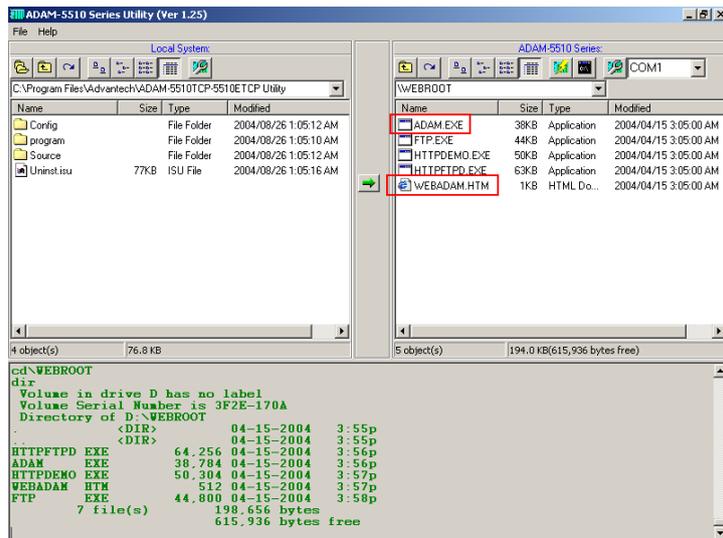


Chapter 4 Guidelines for Network Functions

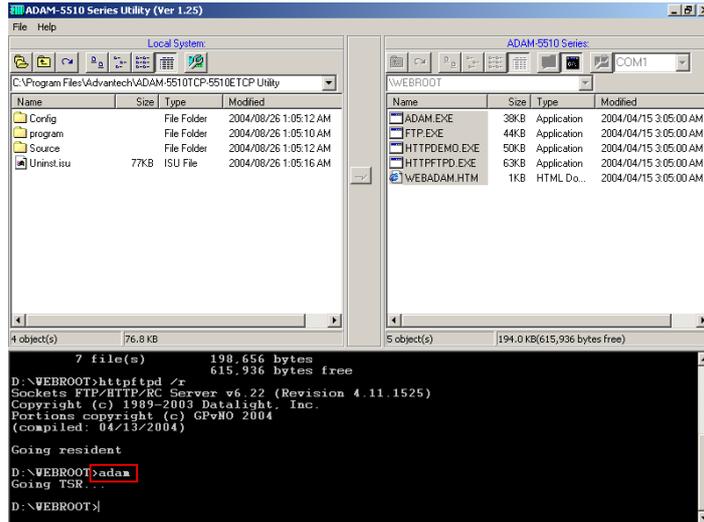
2. Run HTTPD.EXE or HTTPFTP.DEXE at resident.



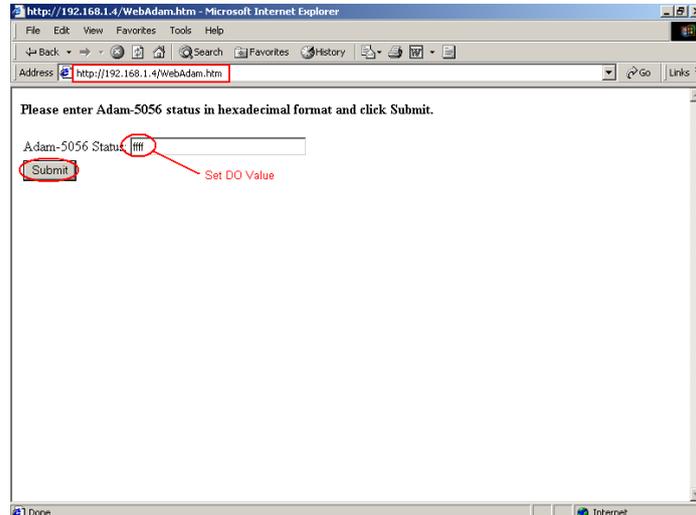
3. Build ADAM.EXE from ADAM.PRJ under "Source\Example\httpEx" directory and download ADAM.EXE and WEBADAM.htm onto drive D under "WEBROOT" directory.



4. Run ADAM.EXE.



5. Run IE, type the URL as “http://192.168.1.4/webadam.htm” and input the value for DO channels then click “Submit” button.



6. Check the DO channels' status on ADAM-5056D is changed correctly.

ADAM.C

```
#include <stdio.h>
#include <io.h>
#include <process.h>
#include <stdlib.h>
#include <string.h>

#include "5510drv.h"
#include "CGI_Lib.h"

extern unsigned _stklen = 3000;
extern unsigned _heaplen = 2000;

int far Callback(HTTP_PARAMS far* psParams);
int returnVal(char *ptr_name, char *ptr_end);
void LocalDIO(int DO_val);
int count = 1;

void main(void)
{
    char * homepage_name = "Adam.htm";

    if(!Http_Server_Reg(homepage_name))
        return;

    adv_printf("Program exiting\n");
    HttpDeRegister("Adam.htm");
}

int far Callback(HTTP_PARAMS far* psParams) //implement your
program in this function
{
    char buf[200], *p, *ptr_val, *ppass;
    int iQueryLen;
    char Re_Htm_Content[400];
    char *ptr_Re = Re_Htm_Content;
    int numberbytes;
    int DoVal, DVal;
```

```

*buf = 0;

iQueryLen = _fstrlen(psParams->szQuery);
if (iQueryLen)
    _fmemcpy (buf,psParams->szQuery, iQueryLen);

numberbytes = HttpGetData(psParams->iHandle, buf + iQueryLen, 200 -
iQueryLen);

if (numberbytes < 0)
{
    if (numberbytes == (-WOULDBLK))
        return RET_OK;
    else
        adv_printf("wrong input value\n");
}

iQueryLen += numberbytes;

ptr_Re += sprintf(ptr_Re, "HTTP/1.0 200 OK\r\nContent-type:
text/html\r\n\r\n<html><h1>");
if (strncmp(buf,"DOValues=", 9) == 0) {
    ptr_val = buf + 9;
    if ((p = strchr(ptr_val, '&')) == NULL)
        adv_printf("Please click Submit button..\n");

    adv_printf("the DO val is 0x%x\n", returnVal(ptr_val, p));
    LocalDIO(returnVal(ptr_val, p));
}
ptr_Re += sprintf(ptr_Re, "<P><P><A
href=\"/WebAdam.htm\">Back</A>.</html>\n");
HttpSendData(psParams->iHandle, Re_Htm_Content, ptr_Re -
Re_Htm_Content);
return RET_DONE;
}

int returnVal(char *ptr_name, char *ptr_end)
{
    int r_Val, buf_idx;
    char buf_val[10];

```

Chapter 4 Guidelines for Network Functions

```
memset(buf_val, 0, 10);

for(buf_idx=0; buf_idx<10; buf_idx++)
{
    if(ptr_name == ptr_end)
        break;
    buf_val[buf_idx] = ptr_name[buf_idx];
}

sscanf(buf_val, "%X", &r_Val);
return r_Val;
}

void LocalDIO(int DO_val)
{
    unsigned div, dov;
    char dov1;

    if(count%2==0)
    {
        dov = ~DO_val;
        dov1 = 0x0;
    }
    else
    {
        dov = ~DO_val;
        dov1 = 0xff;
    }

    count++;
    if(count>100)
        count = 1;
    Set5068(&dov1,2,0,AByte);
    Set5056(&dov,1,0,AWord);

    return;
}
```

WEBADAM.htm

```
<html>
<head>
</head>

<body>
  <b>
    <p><p><p><p>
    Please enter Adam-5056 status in hexadecimal format and click Submit.
    </b>

    <form action="Adam.htm" method=post name="login1">

      <table>
        <tr>
          <td>Adam-5056 Status:</td>
          <td align=right><input name="DOValues" type=text size=30
maxlength=50></td>
        </tr>
        <tr>
          <td>
            <input name="submit" type=submit value="Submit">
          </td>
        </tr>
      </table>

    </body>
</html>
```

4.3 Send Mail

Example program: AMAIL.EXE, MAIL.TXT

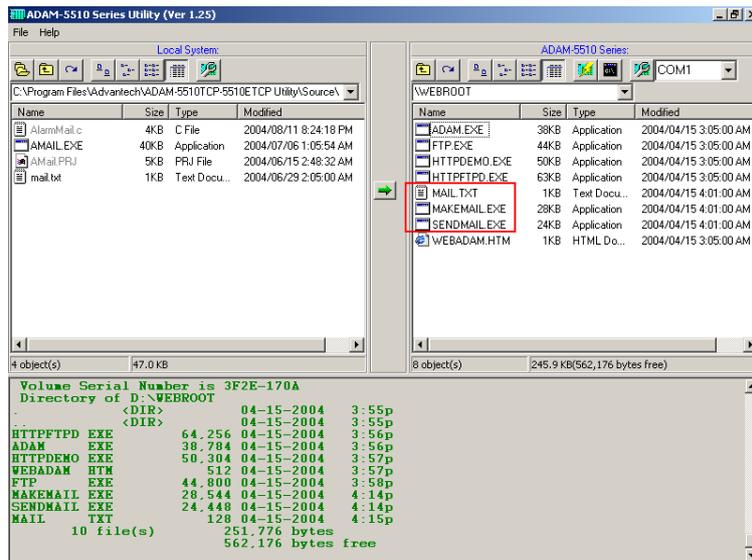
Source file: ALARMMAIL.C under "Source\Example\mail" directory

Utility: SENDMAIL.EXE, MAKEMAIL.EXE

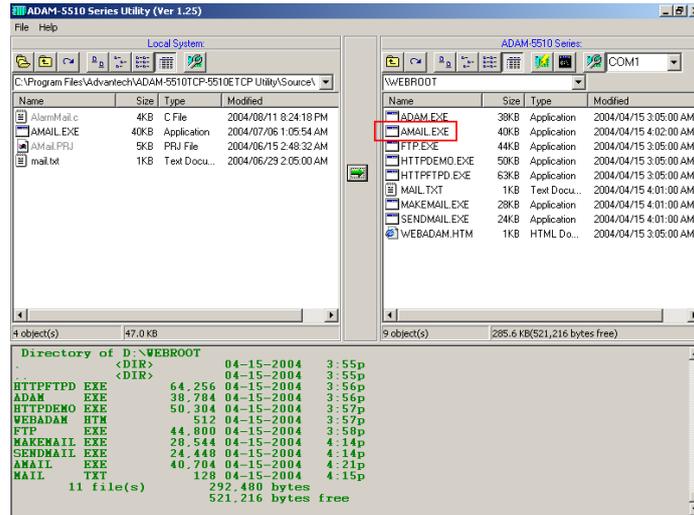
ADAM-5510/TCP configuration:

- ADAM-5510/TCP main unit
- ADAM-5051D at slot 0
- ADAM-5056D at slot 1
- ADAM-5068 at slot 2
- ADAM-5017 at slot 3
- Short ADAM-5051D DI0 to ADAM-5056D DO0, DI1 to DO1, ..., DI15 to DO15

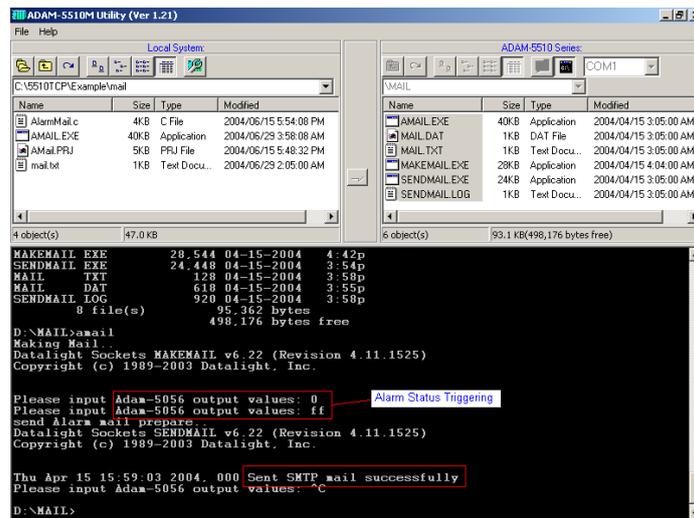
1. Download SENDMAIL.EXE, MAKEMAIL.EXE and MAIL.TXT onto drive D under "WEBROOT" directory.



- Build AMAIL.EXE from AMAIL.PRJ under "Source\Example\mail" directory and download AMAIL.EXE onto drive D under "WEBROOT" directory.

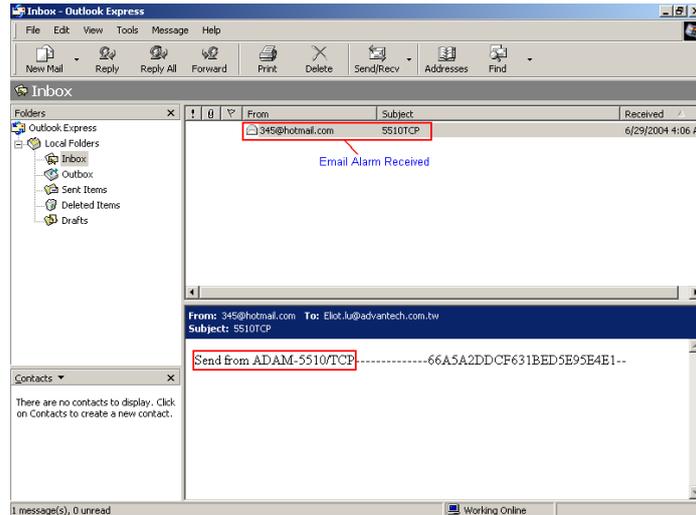


- Run AMAIL.EXE and change the value for DO channels from 0 to FF for triggering the alarm email.



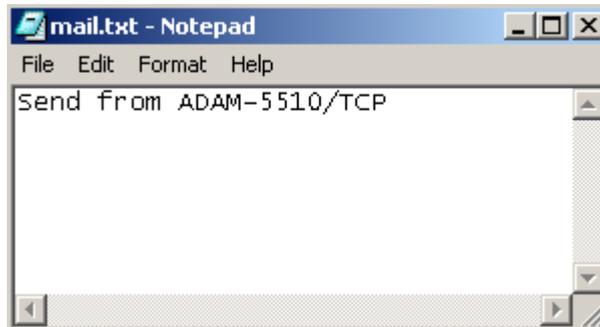
Chapter 4 Guidelines for Network Functions

4. Check the mailbox and it receives the email correctly.



Note: The IP address of ADAM-5510/TCP should be at the same domain with the IP address of mail server, which will help you to send out the email from ADAM-5510/TCP. If you ask another mail server whose IP address is not at the same domain, the mail server will verify the IP address of the email sending from and then stop to provide service for sending out the email for ADAM-5510/TCP.

MAIL.TXT:



ALARMMAIL.C

```
#include <stdio.h>
#include <process.h>
#include <errno.h>
#include "5510drv.h"

int SendAlarmMail(void);
int MakeAlarmMail(void);

int count = 1;

void main(void)
{
    unsigned div, dov;
    char dov1;

    if(!MakeAlarmMail())
    {
        adv_printf("make mail fail..");
        return;
    }

    while(1)
    {
        adv_printf("Please input Adam-5056 output values: ");
        scanf("%X", &dov);
        if(count%2==0)
        {
            dov1 = 0x0;
        }
        else
        {
            dov1 = 0xff;
        }

        if(dov == 0x33)
            return;

        count++;
    }
    if(count>100)
```

Chapter 4 Guidelines for Network Functions

```
        count = 1;

        Set5068(&dov1,2,0,AByte);
        Set5056(&dov,1,0,AWord);

        Get5051(0,0,AWord,&div);

        if(div == 0x00ff)
        {
            if(!SendAlarmMail())
            {
                adv_printf("send mail error..");
                return;
            }
        }
    }

}

int MakeAlarmMail(void)
{
    char * arg_To = "-t567@123.com";
    char * arg_From = "-f345@hotmail.com";
    char * arg_subject = "-s5510TCP";
    char * arg_MailContent = "-bmail.txt";
    char * arg_O_mail = "-omail.dat";

    adv_printf("Making Mail..\n");
    if(spawnlp(P_WAIT,
               "d:\\mail\\makemail.exe",
               "d:\\mail\\makemail.exe",
               arg_To,
               arg_From,
               arg_subject,
               arg_MailContent,
               arg_O_mail,
               NULL)==-1)
    {
        return 0;
    }

    return 1;
}
```

```
}  
  
int SendAlarmMail(void)  
{  
    char * arg1 = "smtp.123.com";  
    char * arg2 = "mail.dat";  
  
    adv_printf("send Alarm mail prepare.\n");  
    if(spawnlp(P_WAIT, "d:\\mail\\sendmail.exe", "d:\\mail\\sendmail.  
exe", arg1, arg2, NULL) == -1)  
    {  
        return 0;  
    }  
  
    return 1;  
}
```

4.4 Modbus/TCP Server

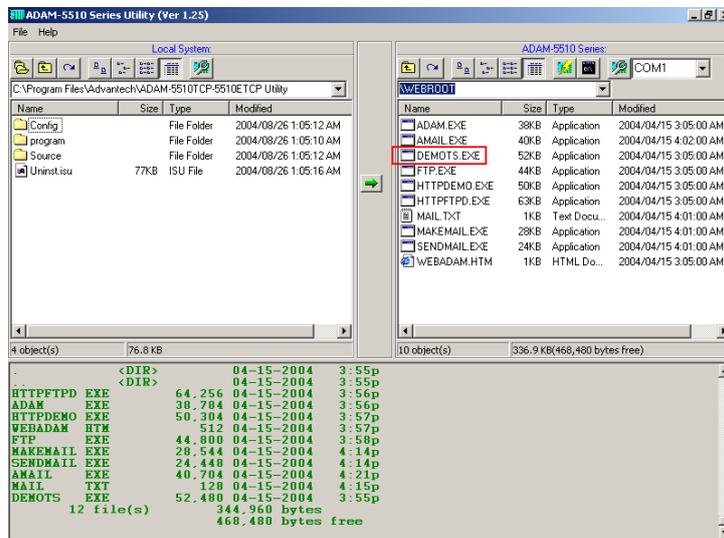
Example program: DEMOTS.EXE

Source file: DEMOTS.C under "Source\Example\DEMOMODBUS" directory

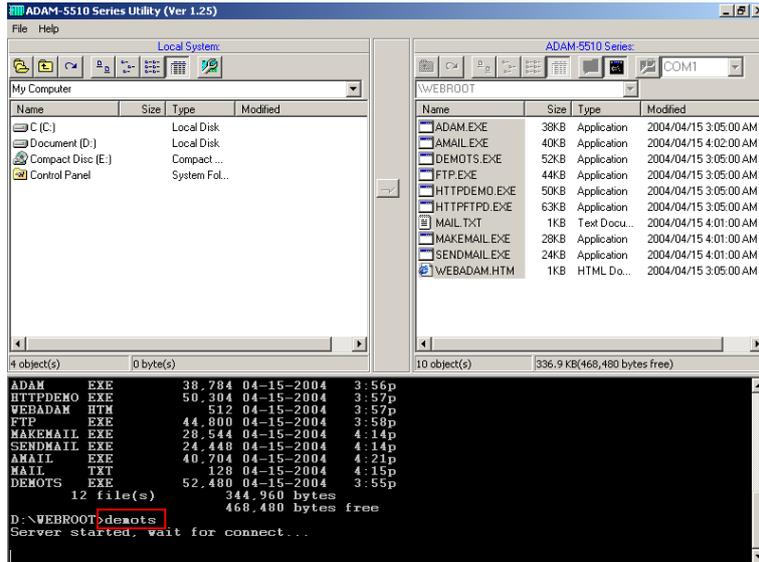
ADAM-5510/TCP configuration:

- ADAM-5510/TCP main unit
- ADAM-5051D at slot 0
- ADAM-5056D at slot 1
- ADAM-5068 at slot 2
- ADAM-5017 at slot 3
- Short ADAM-5051D DI0 to ADAM-5056D DO0, DI1 to DO1, ..., DI15 to DO15

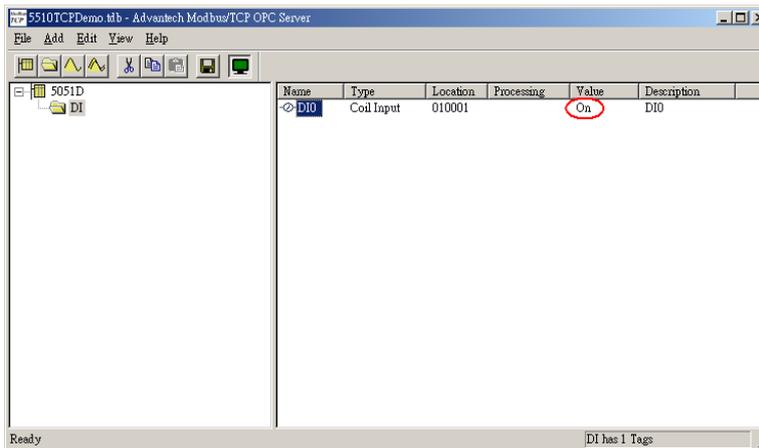
1. Build DEMOTS.EXE from DEMOTS.PRJ under "Source\Example\DemoModbus" directory and download DEMOTS.EXE onto drive D under "WEBROOT" directory.



2. Run DEMOTS.EXE

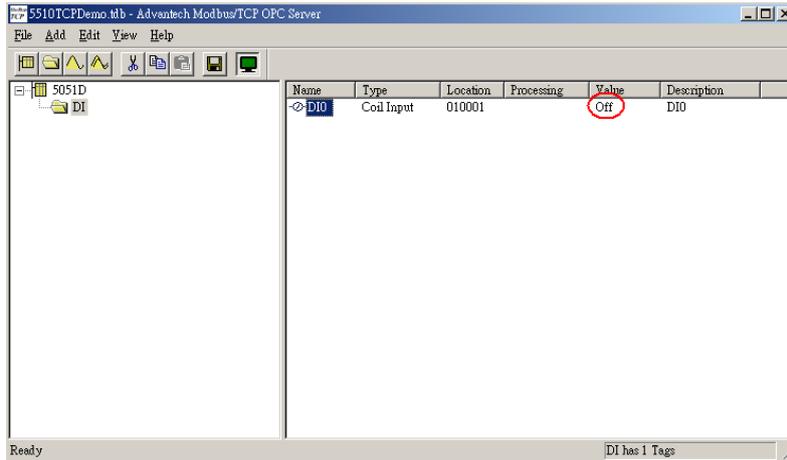


3. Run Advantech Modbus/TCP OPC Server and connect to ADAM-5051D DI0.

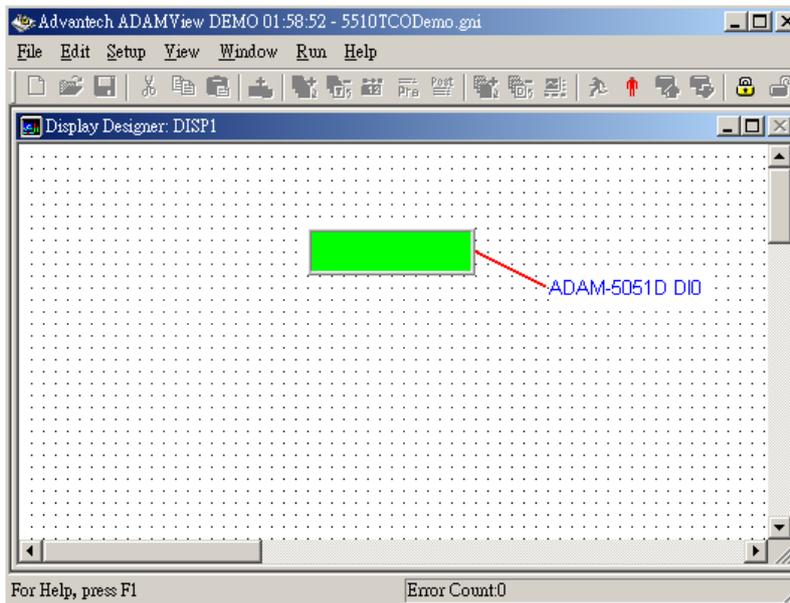


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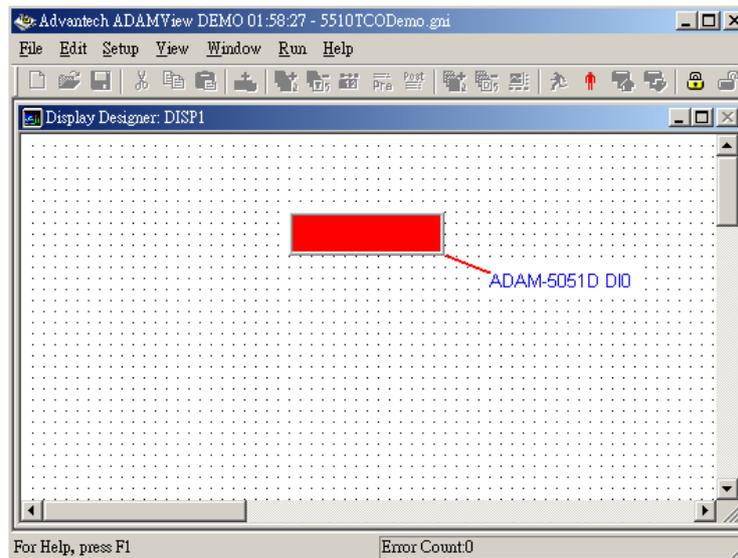
- The DEMOTS.EXE will periodically switch ON/OFF to ADAM_5056D DO channels so Modbus/TCP OPC Server will update the ADAM-5051D DI0 status correctly.



- Run ADAMView Software to monitor the ADAM-5051D DI0 status.



- The ADAM-5051D DIO status will be updated correctly in ADAMView.



DEMOTS.C

```
#include "mod.h"
#include "5510drv.h"

#define DATASIZE 250
#define sizeofShareMem 4000

int count=0;
unsigned int LocalDIO(void);

int main(void)
{
    SOCKET Sock_5510;
    int err_code;
    unsigned int Share_Mem[sizeofShareMem];
    unsigned int tmpcnt=0;
    int tmpidx;
```

Chapter 4 Guidelines for Network Functions

```
        memset(Share_Mem, 0, sizeof(Share_Mem));

    if((err_code=ADAMTCP_ModServer_Create(502, 5000, 7,
        (unsigned char *)Share_Mem,
        sizeof(Share_Mem)))!=0)    //first step
    {
        adv_printf("error code is %d\n", err_code);
    }

    Timer_Init();
    tmpidx = Timer_Set(1000);
    adv_printf("Server started, wait for connect...\n");
    while(1)
    {
        ADAMTCP_ModServer_Update(); //second step: return 0
        NO packet, return 1 has packet

        if(tmArriveCnt[tmpidx])
        {
            Timer_Reset(tmpidx);
            disable();
            Share_Mem[0] = LocalDIO();    //write 5051
            status to address 40001
            enable();
        }
    }

    ADAMTCP_ModServer_Release();

    return 0;
}

unsigned int LocalDIO(void)    //set Adam-5056&5068 and return Adam-
5051 Status
{
    unsigned div, dov;
    char dov1;

    if(count%2==0)
    {
        dov = 0xffff;
        dov1 = 0x0;
    }
}
```

```
}  
else  
  
{  
    dov = 0x0000;  
    dov1 = 0xff;  
}  
  
count++;  
if(count>100)  
    count = 1;  
Set5068(&dov1,2,0,AByte); //slot 2  
Set5056(&dov,1,0,AWord); //slot 1  
  
Get5051(0,0,AWord,&div); //slot 0  
return (unsigned int)~div;  
}
```

4.5 Modbus/TCP Client

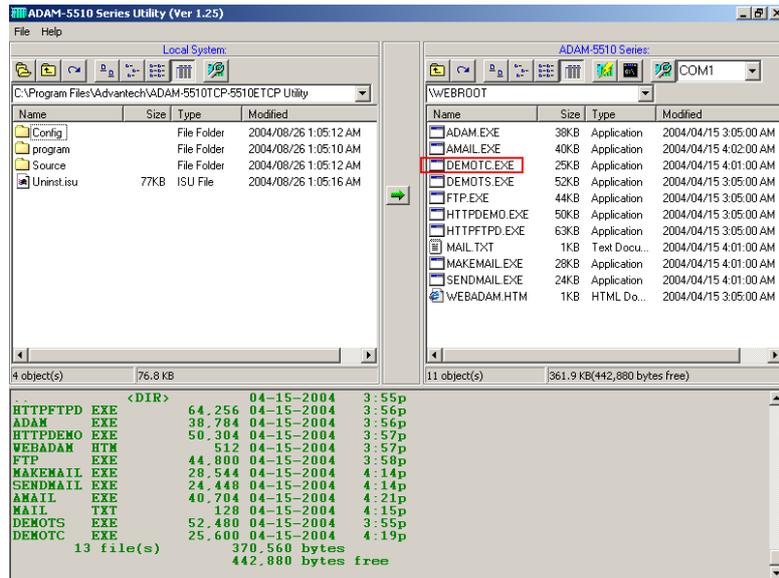
Example program: DEMOTC.EXE

Source file: DEMOTC.C under "Source\Example\DEMOMODBUS" directory

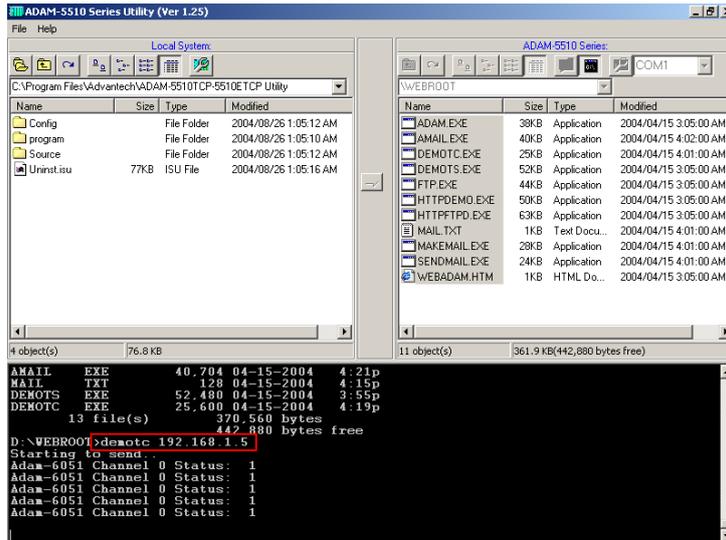
System configuration:

- ADAM-5510/TCP main unit
- ADAM-6051 with a switch connected to DI0

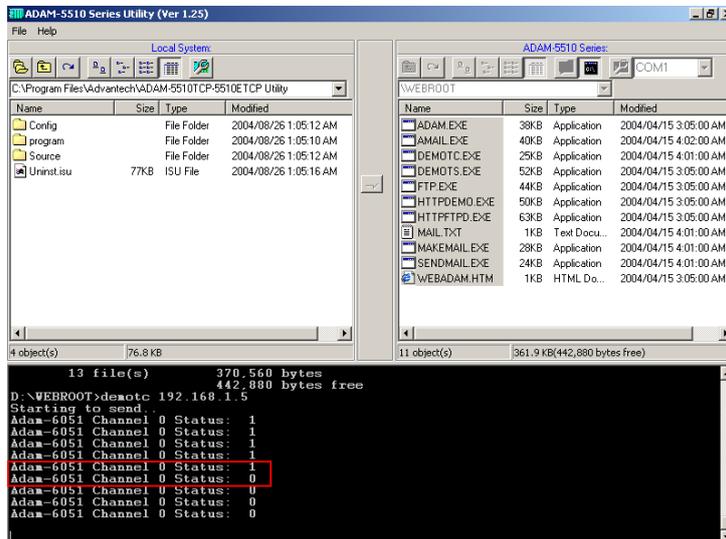
1. Build DEMOTC.EXE from DEMOTC.PRJ under "Source\Example\DemoModbus" directory and download DEMOTC.EXE onto drive D under "WEBROOT" directory.



- Run DEMOTC.EXE and you can find the ADAM-6051 DI0 status.



- Turn off the switch which is connected to ADAM-6051 DI0 and check the ADAM-5510/TCP can update the DI0 status correctly.



DEMOTC.C

```
#include "mod.h"

#define Server_Port 502
#define MAXDATASIZE 100

int main(int argc, char *argv[])
{
    char * ServerIP;
    SOCKET SO_5510;
    unsigned char HostData[MAXDATASIZE];
    int DataByteCount = 0;
    int tmp;
    unsigned int tmpcnt=0, tmpcnt1=0;
    int errcode;

    memset(HostData, MAXDATASIZE, 0);

    if(argc==2)
    {
        ServerIP = argv[1];
    }
    else
    {
        adv_printf("Please input Server IP.\n");
        return 0;
    }

    if(ADAMTCP_Connect(&SO_5510, ServerIP, Server_Port)<=0)
    {
        perror("ADAMTCP_Connect()\n");
        ADAMTCP_Disconnect(&SO_5510);
        return 0;
    }

    adv_printf("Starting to send.\n");
    while(1)
    {
        //Query Adam-6051 Server
        if((errcode=ADAMTCP_ReadCoilStatus(&SO_5510, 50, 0x01,
0x01, 0x01, &DataByteCount, HostData))<=0)
```

```
{
    if(errcode==TCPTimeOut_Err)
        perror("Time Out.\n");
    else
        adv_printf("Error: Error Code is %d\n", errcode);
    ADAMTCP_Disconnect(&SO_5510);
    return 0;
}
else
{
    adv_printf("Adam-6051 Channel 0 Status: ");
    for(tmp=0; tmp<DataByteCount; tmp++)
    {
        adv_printf("%2X", HostData[tmp]&0x01);
    }
    adv_printf("\n");
}

for(tmpcnt=0; tmpcnt<50000; tmpcnt++) //delay
{for(tmpcnt1=0; tmpcnt1<4; tmpcnt1++){}}
```



```
    }

return 1;
}
```

4.6 Modbus/RTU Slave

Example program: DEMORS.EXE

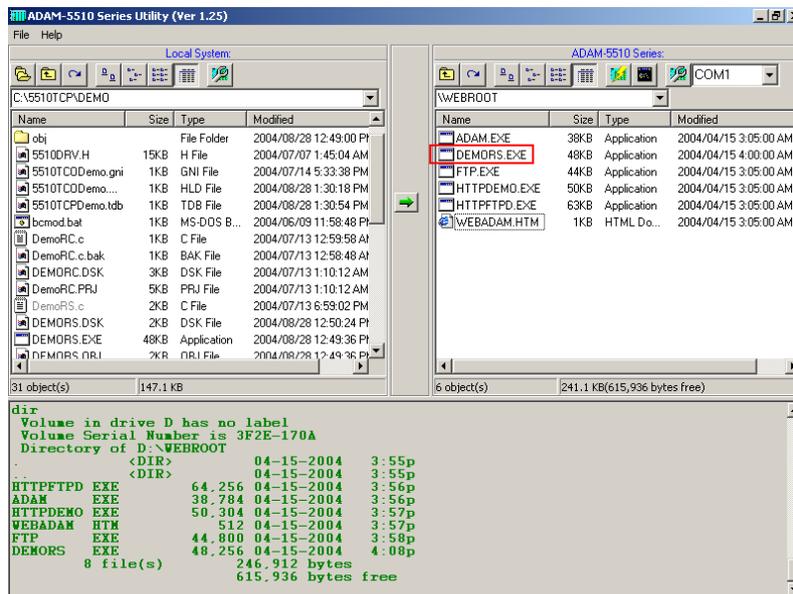
Source file: DEMORS.C under "Source\Example\DEMOMODBUS" directory

Utility: Modbus/RTU OPC Server and HMI Software on host PC.

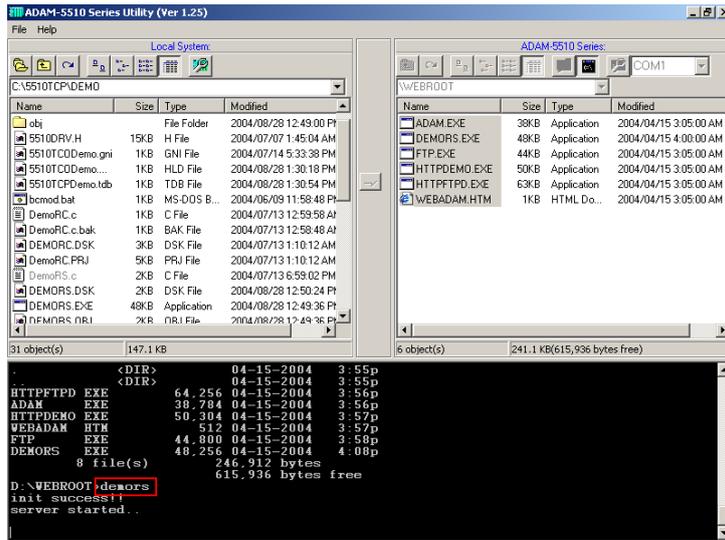
ADAM-5510/TCP configuration:

- ADAM-5510/TCP main unit
- ADAM-5051D at slot 0
- ADAM-5056D at slot 1
- ADAM-5068 at slot 2
- ADAM-5017 at slot 3
- Short ADAM-5051D DI0 to ADAM-5056D DO0, DI1 to DO1, ..., DI15 to DO15

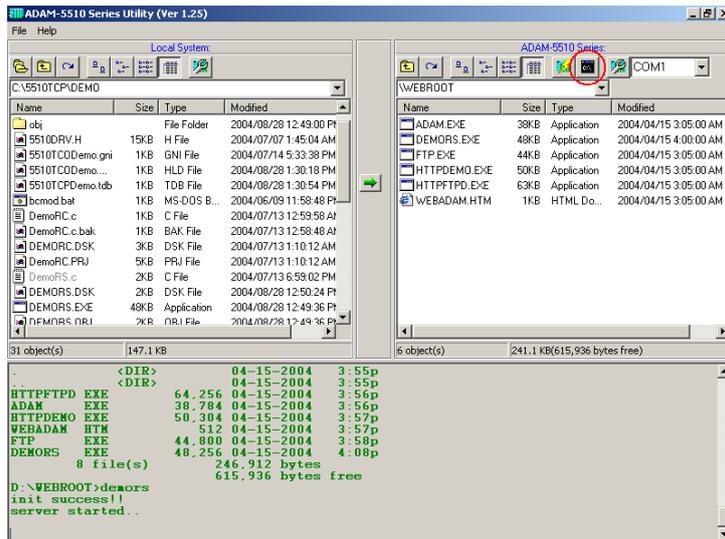
1. Build DEMORS.EXE from DEMORS.PRJ under "Source\Example\DemoModbus" directory and download DEMORS.EXE onto drive D under "WEBROOT" directory.



- Run DEMORS.EXE and ADAM-5056D DO channels will switch ON/OFF periodically.

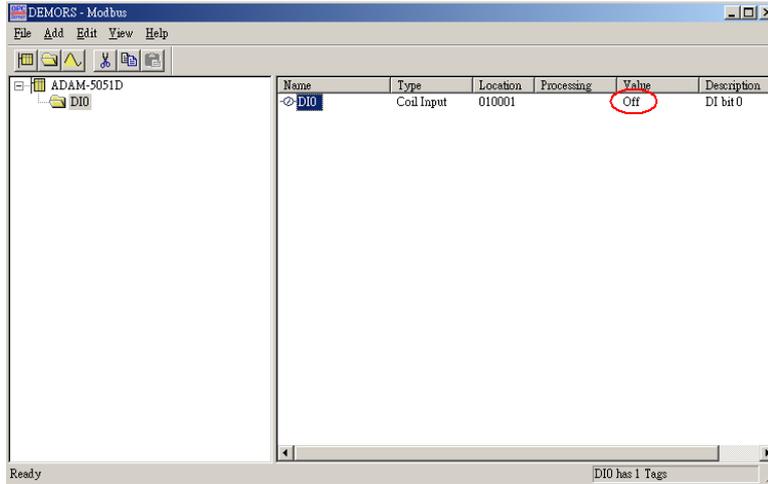


- Click "Launch Terminal" button and ensure COM1 has been released.

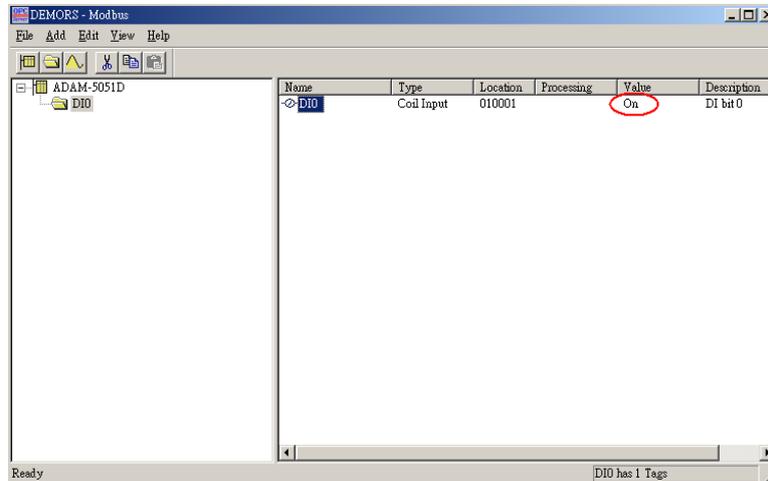


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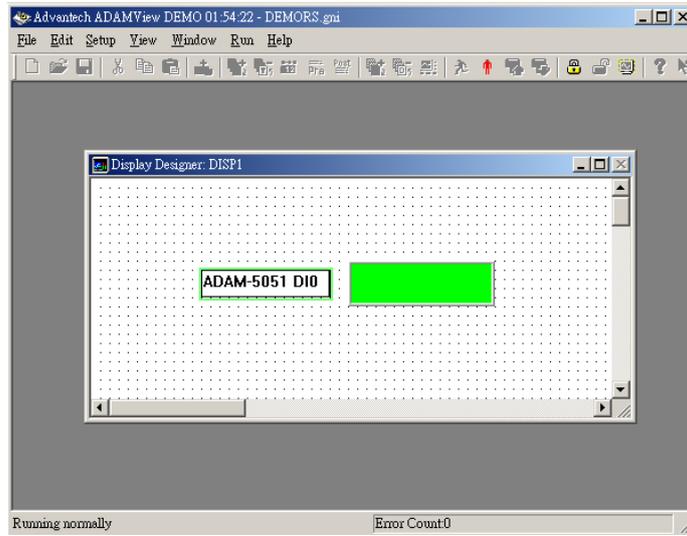
4. Run Modbus/RTU OPC Server on host PC and check ADAM-5051D DI0 status.



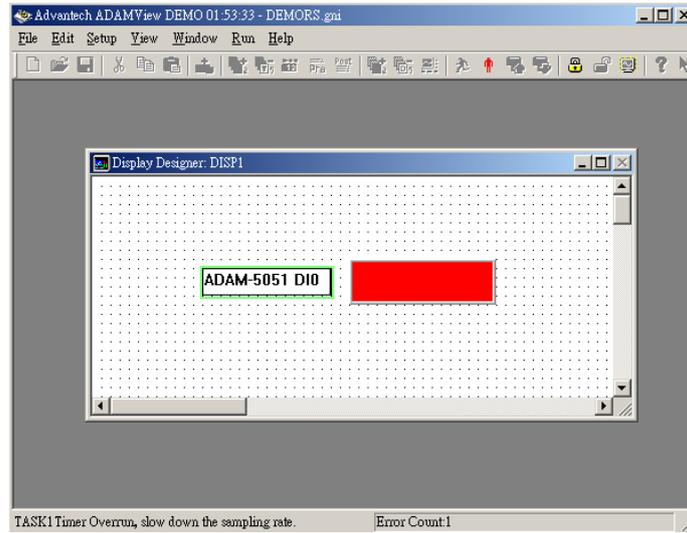
5. Check ADAM-5051D DI0 status is switching correctly.



- Run HMI Software on host PC, link to Modbus OPC Server and check the ADAM-5051D DI0 status.



- Check ADAM-5051D DI0 status is switching correctly.



DEMORS.C

```
#include <stdio.h>
#include <dos.h>
#include <time.h>
#include <conio.h>
#include "5510drv.h"
#include "RTU.h"

#define MAXDATASIZE 100
#define sizeofShareMem 10

int count;
unsigned int LocalDIO(void);

void main()
{
    unsigned int Share_Mem[sizeofShareMem];
    char cCh;
    char LSR_State;
    unsigned int tmpcnt, tmpcnt1;

    if(!Modbus_COM_Init(COM1, Slave, (unsigned long)9600,
NO_PARITY, DATA8, STOP1)!=0)
    {
        adv_printf("error\n");
        return;
    }

    adv_printf("init success!!\n");

    if(!ADAMRTU_ModServer_Create(3, (unsigned char *)Share_Mem,
sizeof(Share_Mem)))
    {
        adv_printf("err code is %d\n", Error_Code());
        return;
    }

    adv_printf("server started..\n");

    while(1)
    {
```

```
        disable();
        Share_Mem[0] = LocalDIO();    //write 5051 status to
address 40001
        enable();

        for(tmpcnt=0; tmpcnt<50000; tmpcnt++) //delay
        {for(tmpcnt1=0; tmpcnt1<8; tmpcnt1++){}}

    }

}

unsigned int LocalDIO(void) //set Adam-5056&5068 and return Adam-
5051 Status
{
    unsigned div, dov;
    char dov1;

    if(count%2==0)
    {
        dov = 0xffff;
        dov1 = 0x0;
    }
    else
    {
        dov = 0x0000;
        dov1 = 0xff;
    }

    count++;
    if(count>100)
        count = 1;
    Set5068(&dov1,2,0,AByte); //slot 2
    Set5056(&dov,1,0,AWord); //slot 1

    Get5051(0,0,AWord,&div); //slot 0
    return (unsigned int)~div;
}
```

4.7 Modbus/RTU Master

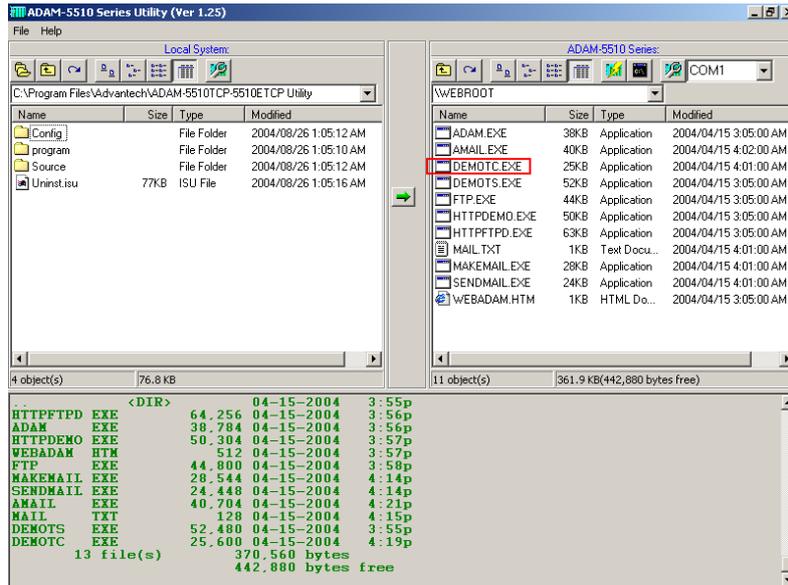
Example program: DEMORC.EXE

Source file: DEMORC.C under "Source\Example\DEMOMODBUS" directory

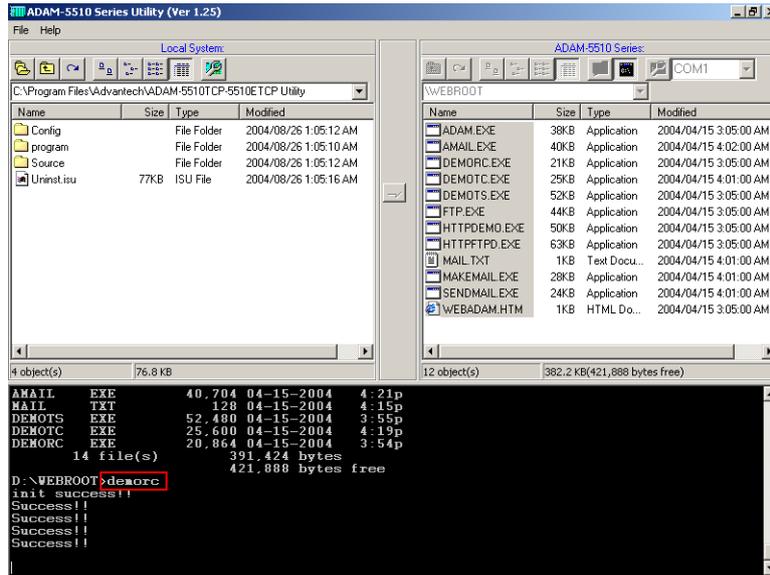
System configuration:

- ADAM-5510/TCP main unit
- ADAM-4056S

1. Build DEMORC.EXE from DEMORC.PRJ under "Source\Example\DemoModbus" directory and download DEMORC.EXE onto drive D under "WEBROOT" directory.



- Run DEMORC.EXE and you will find the connection is successful as following figure. You will also find the LEDs of ADAM-4056S periodically switch ON/OFF by the command from DEMORC.EXE



DEMORC.C

```
#include <stdio.h>
#include <dos.h>
#include <time.h>
#include "RTU.h"

#define MAXDATASIZE 100

void main()
{
    unsigned char HostData[MAXDATASIZE];
    int cnt=0;
    unsigned int tpcnt=0, tpcnt1=0;
```

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```
    if(Modbus_COM_Init(COM2, Master, (unsigned long)9600,  
NO_PARITY, DATA8, STOP1)!=0)  
  
    {  
        adv_printf("error\n");  
        return;  
    }  
  
    adv_printf("init success!!\n");  
  
    while(1)  
    {  
  
        cnt++;  
        if(cnt%2==0)  
        {  
            HostData[1]=0x0f;  
            HostData[0]=0xff;  
        }  
        else  
        {  
            HostData[1]=0x00;  
            HostData[0]=0x00;  
        }  
        if(cnt==10)  
            cnt = 0;  
  
        //Set 4056S status  
        if(!ADAMRTU_ForceMultiCoils(COM2, 0x01, 0x11, 0x0C,  
0x02, HostData))  
        {  
            adv_printf("err code is %d\n", Error_Code());  
            adv_printf("fail send..");  
        }  
        else  
            adv_printf("Success!!\n");  
  
        for(tmpcnt=0; tmpcnt<50000; tmpcnt++) //delay  
        {for(tmpcnt1=0; tmpcnt1<4; tmpcnt1++){}}  
    }  
}
```

4.8 TCP Server

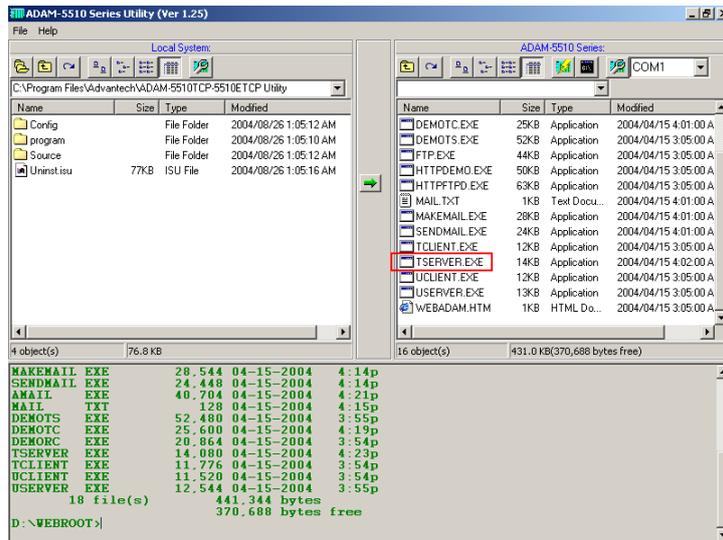
Example program: TSERVER.EXE

Source file: TCP_SERVER.C under "Source\Example\TCP" directory

System configuration:

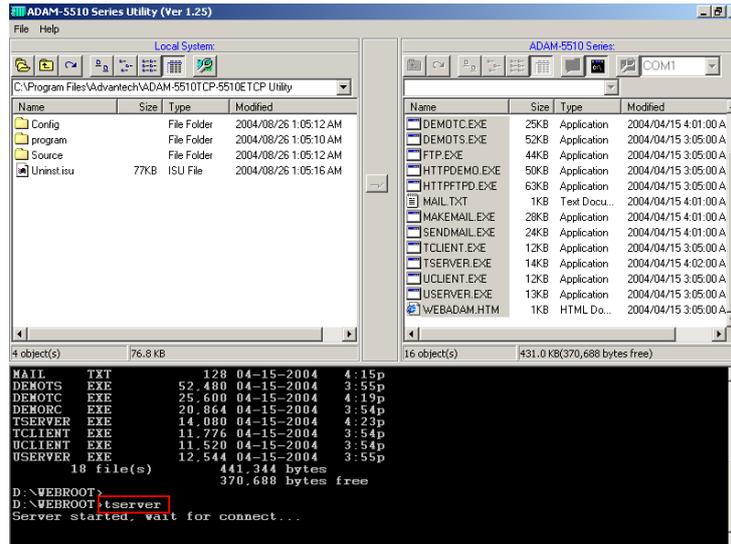
- ADAM-5510/TCP main unit
- TCP Client program on host PC

1. Build TSERVER.EXE from TSERVER.PRJ under "Source\Example\TCP" directory and download TSERVER.EXE onto drive D under "WEBROOT" directory.

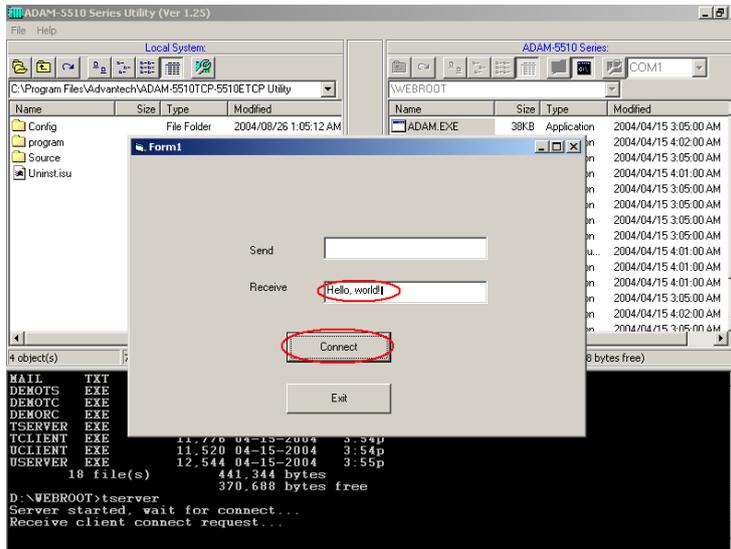


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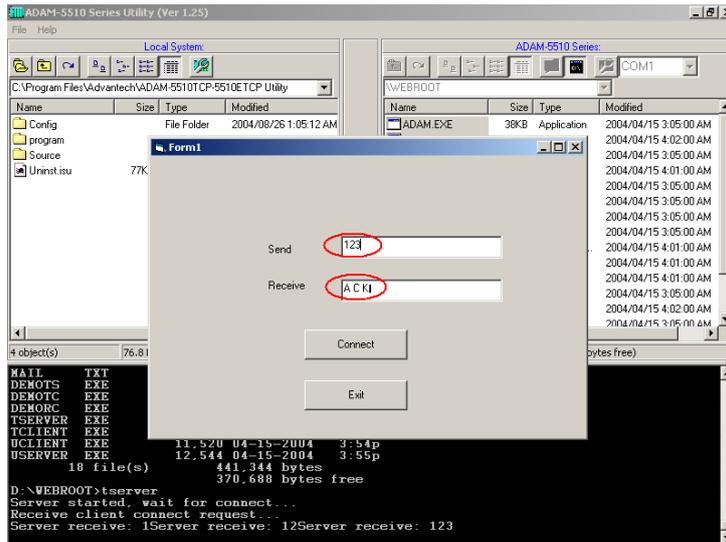
2. Run TSERVER.EXE



3. Run TCP Client program and connect to TSERVER.EXE. The TSERVER.EXE will response "Hello Word!" to TCP Client program.



4. Type characters and send them out from TCP Client program to test the TCP connection.



TCP SERVER.C

```

#include <stdio.h>
#include <stdlib.h>
#ifdef _MSC_VER
#include <malloc.h>
#else
#include <mem.h>
#endif
#include <string.h>
#include <conio.h>
#include <errno.h>
#include "socket.h"
#define Erno errno

#define FALSE 0
#define TRUE 1
#define Host_Port 5510
#define Max_Conn 40
    
```

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```
#define MAXDATASIZE 100
```

```
SOCKET remoteSocket[Max_Conn];  
int WaitSocketCount[Max_Conn];  
int socketTotal = 0;  
int timeoutRelease = FALSE;
```

```
void ReleaseClient(int idx_so);
```

```
int main(void)
```

```
{  
    SOCKET Sock_5510, New_Conn;  
    struct sockaddr_in Host_addr;  
    struct sockaddr_in Client_addr;  
    int sin_size;  
    int hasConnect, hasMessage;  
    int maxSocket, sidx, New_Sidx, numbytes, sidx2;  
    char buff[MAXDATASIZE];  
    unsigned long pulArgp;  
    char *str;  
    int tmpcount=1;
```

```
    if ((Sock_5510 = socket(AF_INET, SOCK_STREAM, 0)) ==  
INVALID_SOCKET)  
    {  
        perror("socket");  
        exit(1);  
    }
```

```
    Host_addr.sin_family = AF_INET;  
    Host_addr.sin_port = htons(Host_Port);  
    Host_addr.sin_addr.s_addr = INADDR_ANY;  
    memset(&(Host_addr.sin_zero), 0, 8);
```

```
    if (bind(Sock_5510, (struct sockaddr *)&Host_addr, sizeof(struct  
sockaddr)) == SOCKET_ERROR)  
    {  
        perror("bind");  
        exit(1);  
    }
```

```
pulArgp = 1;
if(ioctlsocket(Sock_5510, FIONBIO, &pulArgp))

{
    perror("ioctlsocket");
    exit(1);
}

if(listen(Sock_5510, 5) == SOCKET_ERROR)
{
    perror("listen");
    exit(1);
}

hasMessage = FALSE;
memset(WaitSocketCount, 0, sizeof(WaitSocketCount));
adv_printf("Server started, wait for connect...\n");
while(1)
{
    if (socketTotal > 0)
        hasConnect = Host_WaitForClient(Sock_5510, 0);
    else
        hasConnect = Host_WaitForClient(Sock_5510, 5);

    if(hasConnect)
    {
        adv_printf("Receive client connect request...\n");
        sin_size = sizeof(struct sockaddr_in);
        if((New_Conn = accept(Sock_5510, (struct sockaddr *)&Client_addr,
            &sin_size)) == INVALID_SOCKET)
        {
            perror("accept");
            continue;
        }

        if (New_Conn != INVALID_SOCKET)
        {
            if (socketTotal < Max_Conn)
            {
                remoteSocket[socketTotal] = New_Conn;
                New_Sidx = socketTotal;
            }
        }
    }
}
```

```
        socketTotal++;
    }
    else
    {

        if (send(New_Conn, "Connetion full, you are going to be
disconnected!\n", 50, 0) == SOCKET_ERROR)
            perror("send");
        closesocket(New_Conn);
        adv_printf("Connetion full, disconnect client!\n");
    }
}
else
    adv_printf("(TCP) Invalid incoming socket!\n");

    str = "Hello, world!\n";
    if (send(remoteSocket[New_Sidx], str, strlen(str), 0) ==
SOCKET_ERROR)
        perror("send");

}

if(socketTotal>0)
{
    for(sidx=0; sidx<socketTotal; sidx++)
    {
        hasMessage = Host_WaitForClient(remoteSocket[sidx], 0);
        if(hasMessage)
        {
            if((numbytes=recv(remoteSocket[sidx], buf, sizeof(buf), 0)) ==
SOCKET_ERROR)
            {
                ReleaseClient(sidx);
            }
            else
            {

                if(numbytes>0)
                    adv_printf("Server receive: %s", buf);

                if(tmpcount%2==0)
```

```
        str = "ACK\n";
    else
        str = "A C K\n";

    if(numbytes==0)

        {
            ReleaseClient(sidx);
        }
    else if(send(remoteSocket[sidx], str, strlen(str), 0) ==
SOCKET_ERROR)
        {
            ReleaseClient(sidx);
        }

        memset(buf, 0, sizeof(buf));
        tmpcount++;
        if(tmpcount>100)
            tmpcount = 1;

        WaitSocketCount[sidx] = 0;
    }
}
else
    WaitSocketCount[sidx]++;

if(WaitSocketCount[sidx]>10000)
{
    timeoutRelease = TRUE;
    ReleaseClient(sidx);
}
}
}
}

return 0;
}

int Host_WaitForClient(int WaitSocket, int i_iWaitMilliSec)
{
```

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```
fd_set FdSet;
struct timeval waitTime;

FD_ZERO(&FdSet);
FD_SET(WaitSocket, &FdSet);
waitTime.tv_sec = i_iWaitMilliSec / 1000;
waitTime.tv_usec = (i_iWaitMilliSec % 1000)*1000L;

if (select(0, &FdSet, NULL, NULL, &waitTime) > 0)
    return TRUE;
return FALSE;
}

void ReleaseClient(int idx_so)
{
    int sidx, sidx2;

    sidx = idx_so;

    if(timeoutRelease)
    {
        if (send(remoteSocket[sidx], "Connetion timeout, you are going to be
disconnected!\n", 53, 0) == -1)
            perror("send");
    }

    if(remoteSocket[sidx]!=INVALID_SOCKET)
    {
        if(closesocket(remoteSocket[sidx])!=0)
            adv_printf("Release client resource fail!");
    }

    for(sidx2 = sidx; sidx2<= socketTotal-1; sidx2++)
    {
        if(sidx2<socketTotal-1)
        {
            WaitSocketCount[sidx2] = WaitSocketCount[sidx2+1];
            remoteSocket[sidx2] = remoteSocket[sidx2+1];
        }
        else if(sidx2==socketTotal-1)
        {

```

```
        WaitSocketCount[sidx2] = 0;
        remoteSocket[sidx2] = NULL;
    }

}

socketTotal--;

if(timeoutRelease)
    adv_printf("Connetion timeout, disconnect client %d!\n", sidx);
else
    adv_printf("Socket error, disconnect client %d!\n", sidx);

if(socketTotal==0)
    adv_printf("Wait for client connect...\n");

timeoutRelease = FALSE;

}
```

TCP Client program on host PC

```
Private Sub Command1_Click()
' Invoke the Connect method to initiate a
' connection.
tcpClient.Connect
End Sub

Private Sub Command2_Click()
End
End Sub

Private Sub Form_Load()
' The name of the Winsock control is tcpClient.
' Note: to specify a remote host, you can use
' either the IP address (ex: "121.111.1.1") or
' the computer's "friendly" name, as shown here.
tcpClient.RemoteHost = "192.168.1.4"
tcpClient.RemotePort = 5510

End Sub
```

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```
Private Sub Text1_Change()  
tcpClient.SendData Text1.Text
```

```
End Sub  
Private Sub tcpClient_DataArrival _  
(ByVal bytesTotal As Long)  
Dim strData As String  
tcpClient.GetData strData  
Text2.Text = strData  
End Sub
```

4.9 TCP Client

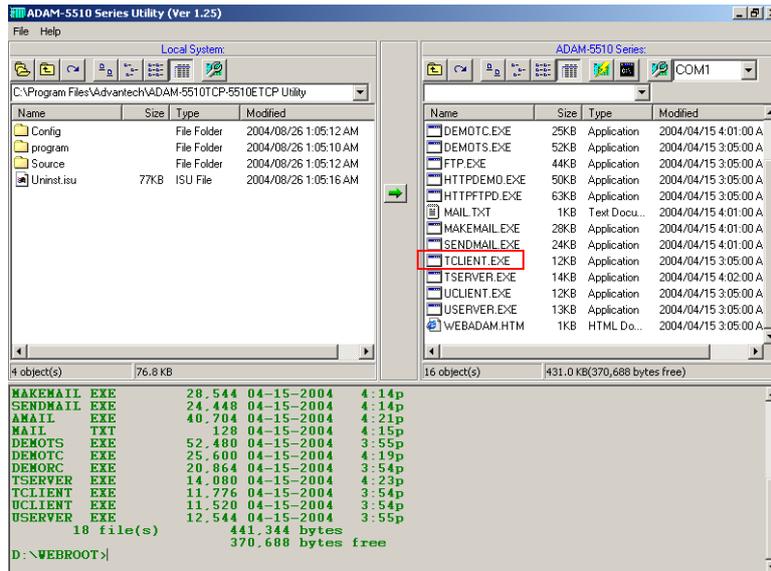
Example program: TCLIENT.EXE

Source file: TCP_CLIENT.C under "Source\Example\TCP" directory

System configuration:

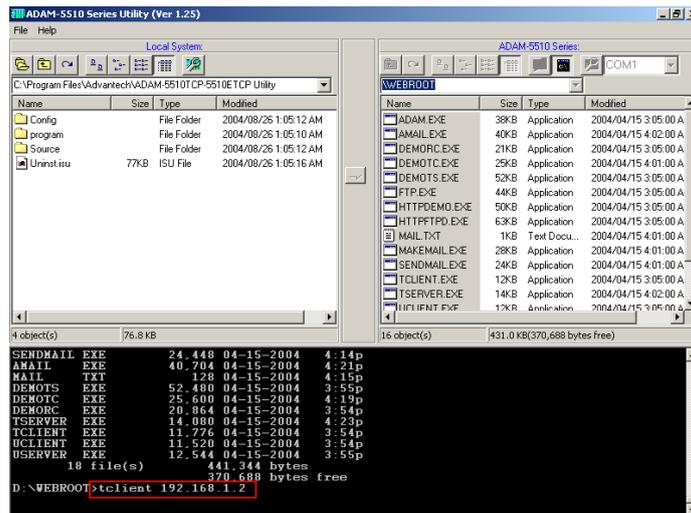
- ADAM-5510/TCP main unit
- TCP Server program on host PC

1. Build TCLIENT.EXE from TCLIENT.PRJ under "Source\Example\TCP" directory and download TCLIENT.EXE onto drive D under "WEBROOT" directory.

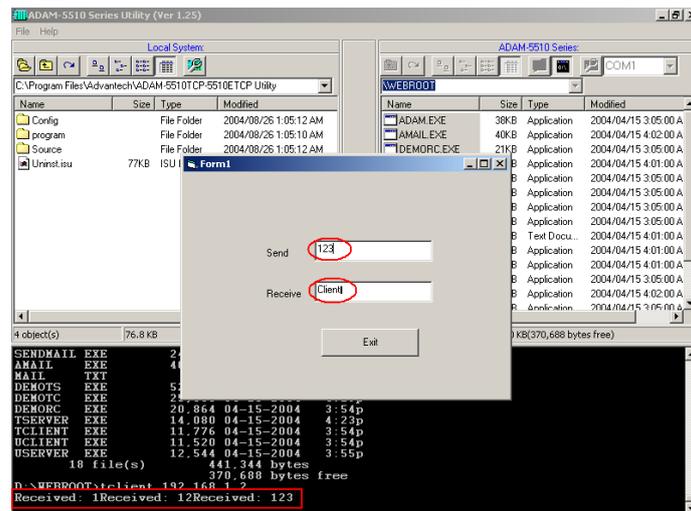


Chapter 4 Guidelines for Network Functions

2. Run TCP Server program on host PC and then run TCLIENT.EXE to connect to TCP Server program.



3. Type characters and send them out from TCP Server program to test the TCP connection. You will find TCLIENT.EXE receive the characters and reply ACK message.



TCP_CLIENT.C

```
#include <stdio.h>
#include <stdlib.h>
#ifdef _MSC_VER
#include <malloc.h>
#else
#include <mem.h>
#endif
#include <string.h>
#include <conio.h>
#include <errno.h>
#include "socket.h"
#define Errno errno

#define Server_Port 5510
#define MAXDATASIZE 100

int main(int argc, char *argv[])
{
    SOCKET SO_5510;
    int numbytes=0;
    char buf[MAXDATASIZE];
    struct hostent *he;
    struct sockaddr_in Server_addr;
    char *str1, *str2, *str;
    int tmpcount=1;

    str1 = "TCP\n";
    str2 = "Client\n";

    if (argc != 2)
    {
        fprintf(stderr, "usage: server hostname\n");
        exit(1);
    }

    if ((he=gethostbyname(argv[1])) == NULL)
    {
        perror("gethostbyname");
        exit(1);
    }
}
```

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```
if ((SO_5510 = socket(AF_INET, SOCK_STREAM, IPPROTO_TCP)) ==  
INVALID_SOCKET)  
{  
    perror("socket");  
    exit(1);  
}
```

```
Server_addr.sin_family = AF_INET;  
Server_addr.sin_port = htons(Server_Port);  
Server_addr.sin_addr = *((struct in_addr *)he->h_addr);  
memset(&(Server_addr.sin_zero), 0, 8);
```

```
if (connect(SO_5510, (struct sockaddr *)&Server_addr,  
sizeof(struct sockaddr)) == SOCKET_ERROR)  
{  
    perror("connect");  
    exit(1);  
}  
  
while(1)  
{  
    if ((numbytes=recv(SO_5510, buf, MAXDATASIZE-1, 0)) ==  
SOCKET_ERROR)  
    {  
        perror("recv");  
        exit(1);  
    }  
  
    if(numbytes>0)  
    {  
        adv_printf("Received: %s",buf);  
  
        memset(buf, 0, sizeof(buf));  
        if(tmpcount%2==0)  
            str = str1;  
        else  
            str = str2;  
  
        sleep(1);  
        if (send(SO_5510, str, strlen(str), 0) == SOCKET_ERROR)
```

```
    {
        perror("send");
        exit(1);
    }
    tmpcount++;
    if(tmpcount>100)
        tmpcount=1;
}
else
{
    closesocket(SO_5510);
    break;
}
}
return 0;
}
```

TCP Server program on host PC

```
Private Sub Command1_Click()
End
End Sub
```

```
Private Sub Form_Load()
' Set the LocalPort property to an integer.
' Then invoke the Listen method.
tcpServer.LocalPort = 5510
tcpServer.Listen
Form1.Show ' Show the client form.
End Sub
```

```
Private Sub tcpServer_ConnectionRequest _
(ByVal requestID As Long)
' Check if the control's State is closed. If not,
' close the connection before accepting the new
' connection.
If tcpServer.State <> sckClosed Then _
tcpServer.Close
' Accept the request with the requestID
' parameter.
tcpServer.Accept requestID
End Sub
```

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```
Private Sub Text1_Change()  
' The TextBox control named txtSendData  
' contains the data to be sent. Whenever the user  
' types into the textbox, the string is sent  
' using the SendData method.  
tcpServer.SendData Text1.Text  
End Sub
```

```
Private Sub tcpServer_DataArrival _  
(ByVal bytesTotal As Long)  
' Declare a variable for the incoming data.  
' Invoke the GetData method and set the Text  
' property of a TextBox named txtOutput to  
' the data.  
Dim strData As String  
tcpServer.GetData strData  
Text2.Text = strData  
End Sub
```

4.10 UDP Connection

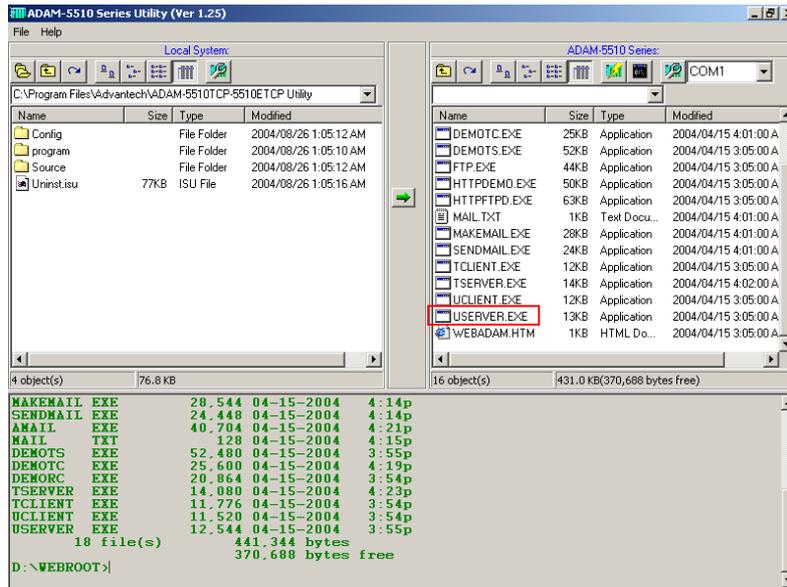
Example program: USERVER.EXE

Source file: UDP_SERVER.C under "Source\Example\TCP" directory

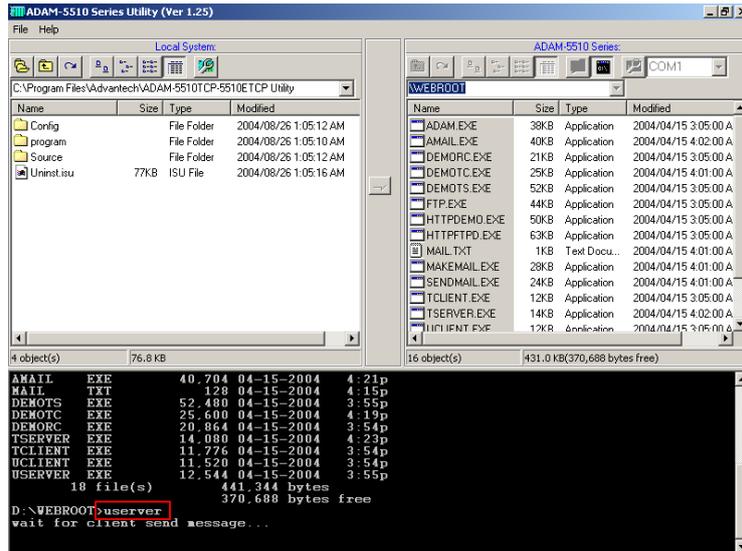
System configuration:

- ADAM-5510/TCP main unit
- UDP program on host PC

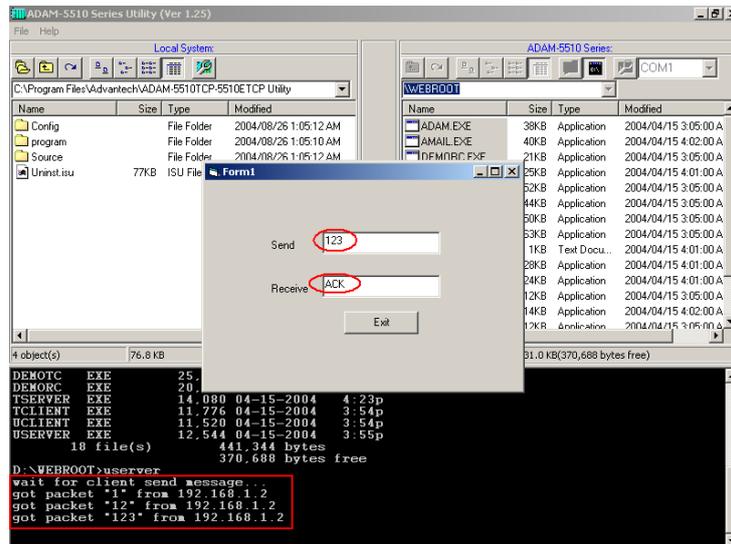
1. Build USERVER.EXE from USERVER.PRJ under "Source\Example\TCP" directory and download USERVER.EXE onto drive D under "WEBROOT" directory.



2. Run USERVER.EXE



3. Run UDP program on host PC. Type characters and send them out to test the UDP connection. You will find USERVER.EXE receive the characters and reply ACK message.



UDP_SERVER.C

```
#include <stdio.h>
#include <stdlib.h>
#ifdef _MSC_VER
#include <malloc.h>
#else
#include <mem.h>
#endif
#include <string.h>
#include <conio.h>
#include <errno.h>
#include "socket.h"

#define Errno errno

#define FALSE 0
#define TRUE 1
#define Host_Port 5510
#define MAXBUFLen 100

int main(void)
{
    SOCKET Host_Sock;
    struct sockaddr_in Host_addr;
    struct sockaddr_in Client_addr;
    int hasMessage = FALSE;
    unsigned long pulArgp;
    char buf[MAXBUFLen];
    int addr_len, numbytes;
    char* ackmsg = "ACK";

    if ((Host_Sock = socket(PF_INET, SOCK_DGRAM, IPPROTO_UDP))
    == INVALID_SOCKET)
    {
        perror("socket");
        exit(1);
    }

    Host_addr.sin_family = AF_INET;
    Host_addr.sin_port = htons(Host_Port);
```

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```
Host_addr.sin_addr.s_addr = INADDR_ANY;
memset(&(Host_addr.sin_zero), 0, 8);

if (bind(Host_Sock, (struct sockaddr *)&Host_addr, sizeof(struct
sockaddr)) == SOCKET_ERROR)
{
    perror("bind");
    exit(1);
}

pulArgp = 1;
if(ioctlsocket(Host_Sock, FIONBIO, &pulArgp))
{
    perror("ioctlsocket");
    exit(1);
}

adv_printf("wait for client send message...\n");

while(1)
{

    hasMessage = Host_WaitForMessage(Host_Sock, 0);

    if(hasMessage)
    {
        addr_len = sizeof(struct sockaddr);
        if ((numbytes = recvfrom( Host_Sock, buf, sizeof(buf), 0,
(struct sockaddr *)&Client_addr, &addr_len)) ==
SOCKET_ERROR)
        {
            perror("recvfrom");
            if (errno == EWOULDBLOCK)
                adv_printf("EWOULDBLOCK");
            break;
        }
        buf[numbytes] = 0;
        adv_printf("got packet \"%s\" from %s\n", buf,
inet_ntoa(Client_addr.sin_addr));
```

```
if((numbytes=sendto(Host_Sock, ackmsg, strlen(ackmsg), 0,
    (struct sockaddr *)&Client_addr, sizeof(struct sockaddr))) ==
SOCKET_ERROR)
    {
        perror("sendto");
        break;
    }
}

closesocket(Host_Sock);
return 0;
}

int Host_WaitForMessage(int serverSocket, int i_iWaitMilliSec)
{
    fd_set FdSet;
    struct timeval waitTime;

    FD_ZERO(&FdSet);
    FD_SET(serverSocket, &FdSet);
    waitTime.tv_sec = i_iWaitMilliSec / 1000;
    waitTime.tv_usec = (i_iWaitMilliSec % 1000)*1000L;

    if (select(0, &FdSet, NULL, NULL, &waitTime) > 0)
        return TRUE;
    return FALSE;
}
```

UDP program on host PC

```
Private Sub Command1_Click()
End
End Sub

Private Sub Form_Load()
' The control's name is udpPeerA
With udpPeerA
' IMPORTANT: be sure to change the RemoteHost
' value to the name of your computer.
.RemoteHost = "192.168.1.4"
.RemotePort = 5510 ' Port to connect to.
```

Chapter 4 Guidelines for Network Functions

```
.Bind 5510          ' Bind to the local port.  
End With  
Form1.Show        ' Show the second form.  
End Sub
```

```
Private Sub Text1_Change()  
' Send text as soon as it's typed.  
udpPeerA.SendData Text1.Text  
End Sub
```

```
Private Sub udpPeerA_DataArrival _  
(ByVal bytesTotal As Long)  
Dim strData As String  
udpPeerA.GetData strData  
Text2.Text = strData  
End Sub
```

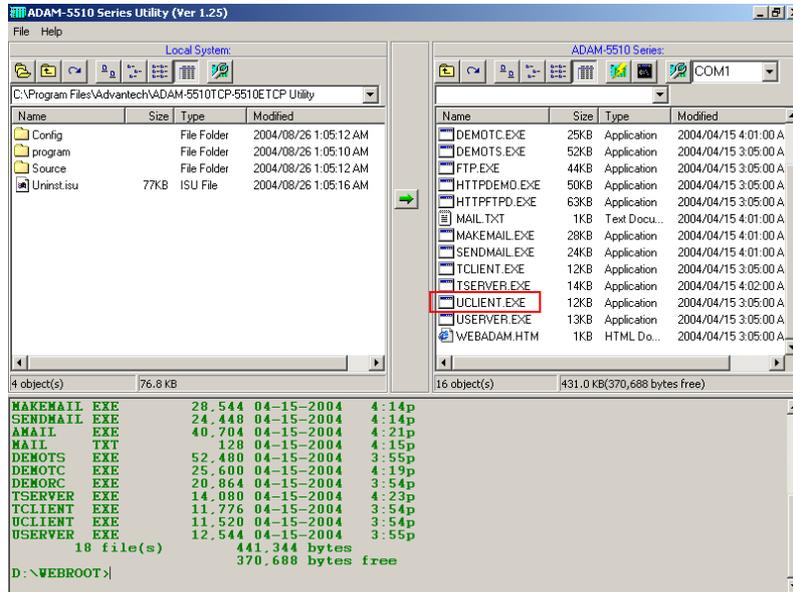
Example program: UCLIENT.EXE

Source file: UDP_CLIENT.C under "Source\Example\TCP" directory

System configuration:

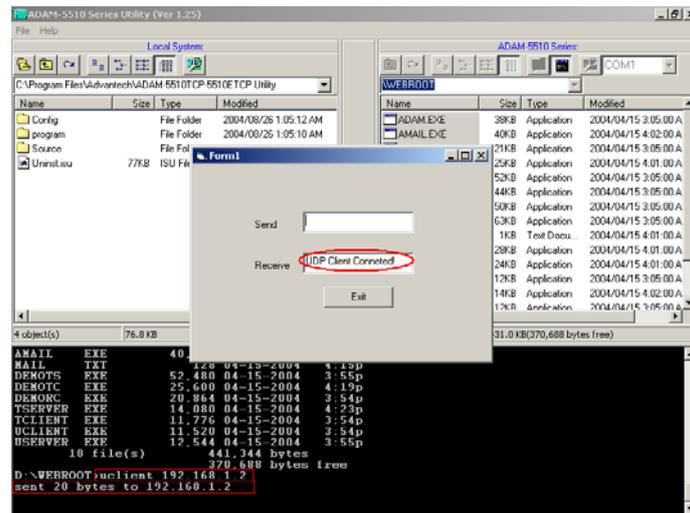
- ADAM-5510/TCP main unit
- UDP program on host PC

1. Build UCLIENT.EXE from UCLIENT.PRJ under "Source\Example\TCP" directory and download UCLIENT.EXE onto drive D under "WEBROOT" directory.

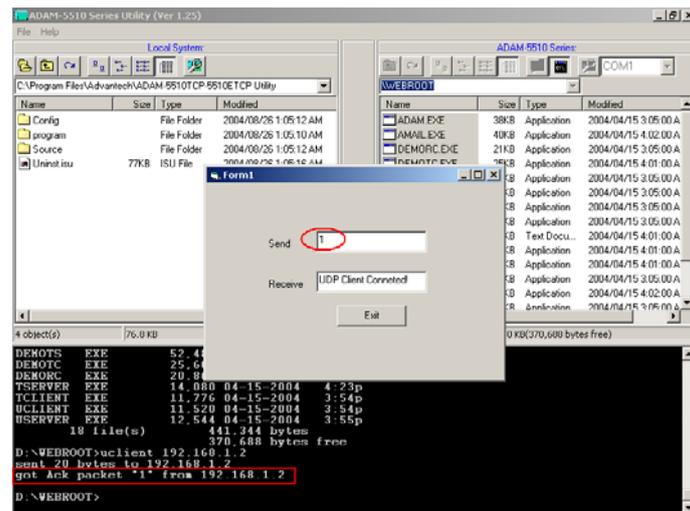


Chapter 4 Guidelines for Network Functions

- Run UDP program on host PC and then run UCLIENT.EXE to connect to the UDP program. You will find the UDP program receives "UDP Client Connected!" from UCLIENT.EXE



- Type a character and send it out from UDP program to test the UDP connection. You will find UCLIENT.EXE receive the character correctly.



UDP_CLIENT.C

```
#include <stdio.h>
#include <stdlib.h>
#ifdef _MSC_VER
#include <malloc.h>
#else
#include <mem.h>
#endif
#include <string.h>
#include <conio.h>
#include <errno.h>
#include "socket.h"
#define Errno errno
#define BufferSize 100
#define Host_Port 5510

int main(int argc, char *argv[])
{
    SOCKET SO_5510;
    struct sockaddr_in Server_addr;
    struct sockaddr_in From_Addr;
    struct hostent *he;
    char buf[BufferSize];
    int numbytes;
    unsigned int From_Size;
    char* msg = "UDP Client Conneted!";

    if (argc != 2)
    {
        fprintf(stderr, "usage: uclient xxx.xxx.xxx.xxx\n");
        exit(1);
    }

    if ((he=gethostbyname(argv[1])) == NULL)
    {
        perror("gethostbyname");
        exit(1);
    }
}
```

Chapter 4 Guidelines for Network Functions

```
if ((SO_5510 = socket(AF_INET, SOCK_DGRAM, IPPROTO_UDP)) ==
INVALID_SOCKET)

{
    perror("socket");
    exit(1);
}

Server_addr.sin_family = AF_INET;
Server_addr.sin_port = htons(Host_Port);
Server_addr.sin_addr = *((struct in_addr *)he->h_addr);
memset(&(Server_addr.sin_zero), 0, 8);

if ((numbytes=sendto(SO_5510, msg, strlen(msg), 0,
(struct sockaddr *)&Server_addr, sizeof(struct sockaddr))) ==
SOCKET_ERROR)
{
    perror("sendto");
    exit(1);
}

adv_printf("sent %d bytes to %s\n", numbytes,
inet_ntoa(Server_addr.sin_addr));

From_Size = sizeof(From_Addr);
if ((numbytes = recvfrom( SO_5510, buf, sizeof(buf), 0,
(struct sockaddr *)&From_Addr, &From_Size)) == -1)
{
    perror("recvfrom");
    exit(1);
}
buf[numbytes] = 0;
adv_printf("got Ack packet \"%s\" from %s\n", buf,
inet_ntoa(From_Addr.sin_addr));

closesocket(SO_5510);

return 0;
}
```

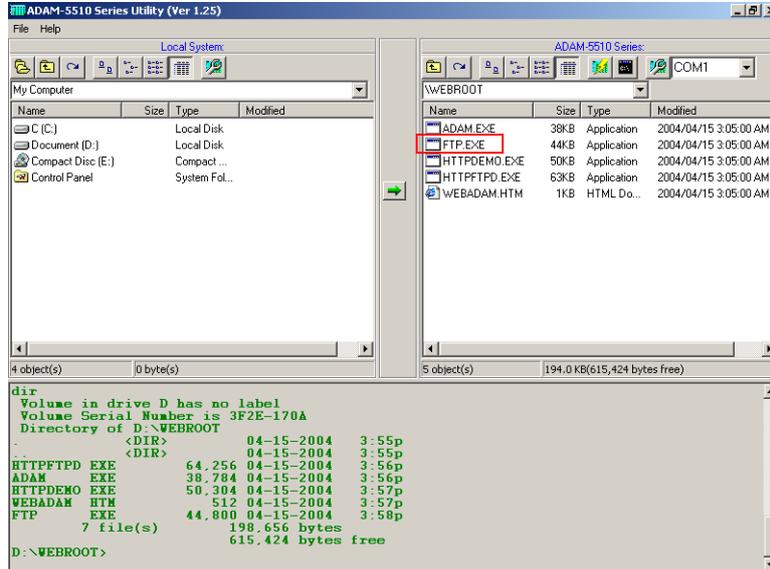
4.11 FTP Client

Utility: FTP.EXE

System configuration:

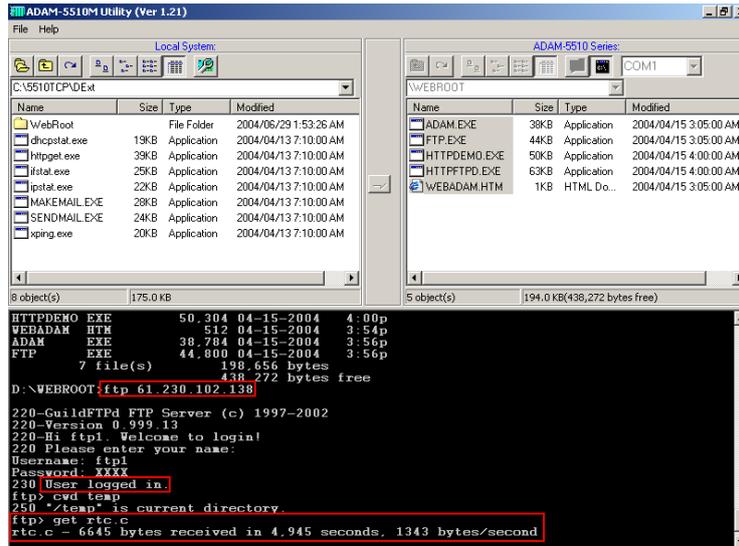
- ADAM-5510/TCP main unit

1. Download FTP.EXE onto drive D under "WEBROOT" directory.

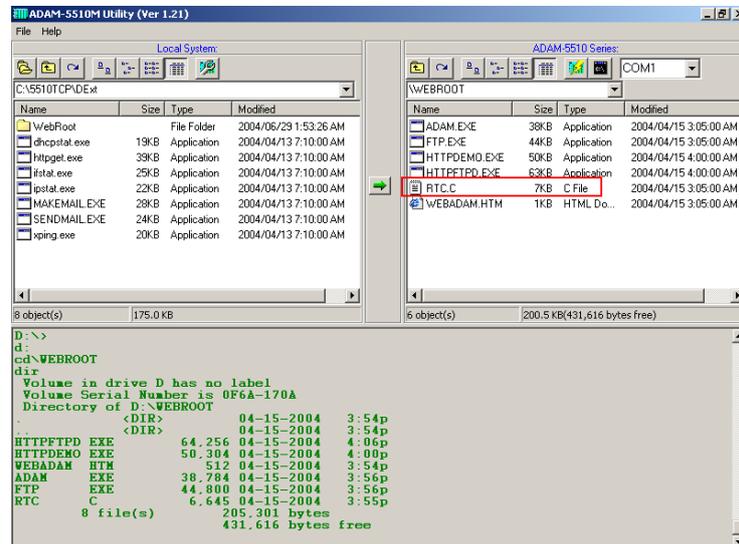


Chapter 4 Guidelines for Network Functions

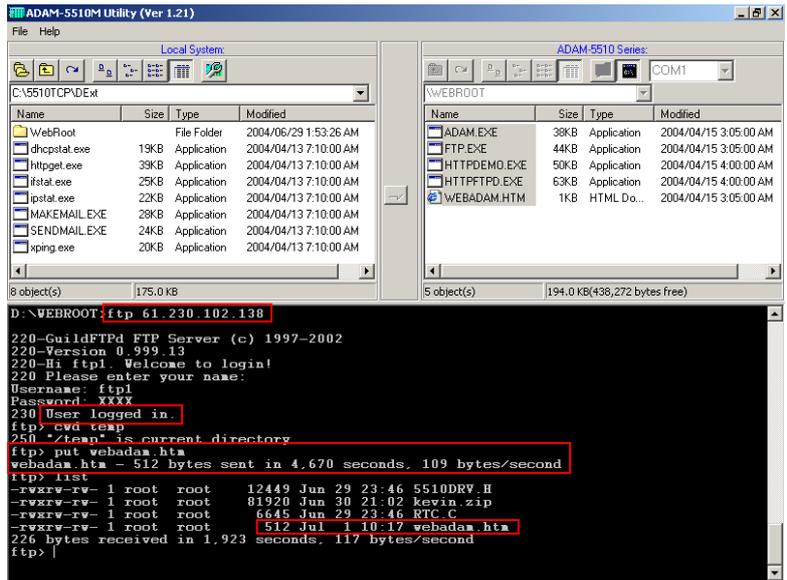
2. Run FTP.EXE, login to FTP Server and get file from FTP Server.



3. Check the file is under "WEBROOT" directory.



- Run FTP.EXE, login to FTP Server and put the file "WEBADAM.HTM" under "WEBROOT" directory onto FTP Server.



5

Programming and Function Library

5.1 Introduction

User-designed ADAM-5510 Series application programs make use of ADAM-5510 Series library functions. To make the most efficient use of ADAM-5510 Series' memory space, the ADAM-5510 Series function library has been separated into 10 smaller libraries. Therefore, a user can link only those libraries needed to run his application, and only those libraries will be included in the compiled executable. The smaller the linked libraries, the smaller the compiled executable will be.

5.1.1 Programming detail about the ADAM-5510 Series Controller

The operating system of ADAM-5510 Series Controller is ROM-DOS, which is a MS-DOS equivalent system. It allows users to run application programs written in assembly language as well as high-level languages such as C or C++. Certainly, there will be some limitations when running application programs in the ADAM-5510 Series Controller. In order to build successful applications, please keep the following limitations and concerns in mind.

5.1.2 Mini BIOS functions

The ADAM-5510 Series Controller provides up to four serial communication ports including programming port for connecting peripherals, so the mini BIOS of ADAM-5510 Series Controller only provides 10 function calls. Since the user's program cannot use other BIOS function calls, the ADAM-5510 Series Controller may not work as intended. Additionally, certain language compilers such as QBASIC directly call BIOS functions that are not executable in ADAM-5510 Series Controller. The ADAM-5510 Series Controller mini BIOS function calls are listed in the following table.

Function	Sub-function	Task
07h		186 or greater cd-processor esc instruct
10h	0eh	TTY Clear output
11h		Get equipment
12h		Get memory size
15h	87h	Extended memory read
	88h	Extended memory size
	c0h	PS/2 or AT style A20 Gate table
16h	0	Read TTY char
	1	Get TTY status
	2	Get TTY flags
18h		Print "Failed to BOOT ROM-DOS" message
19h		Reboot system
1ah	0	Get tick count
	1	Set tick count
	2	Get real time clock
	3	Set real time clock
	4	Get data
	5	Set data
1ch		Timer tick

Table 5-1: ADAM-5510 Series Controller mini BIOS function calls

5.1.3 Converting program codes

The ADAM-5510 Series Controller has an 80188 CPU. Therefore, programs downloaded into its flash ROM must be converted into 80186 or 80188 compatible codes firstly, and the floating point operation must be set to Emulation Mode". For example, if you develop the application program in Borland C, you will compile the program as following picture.

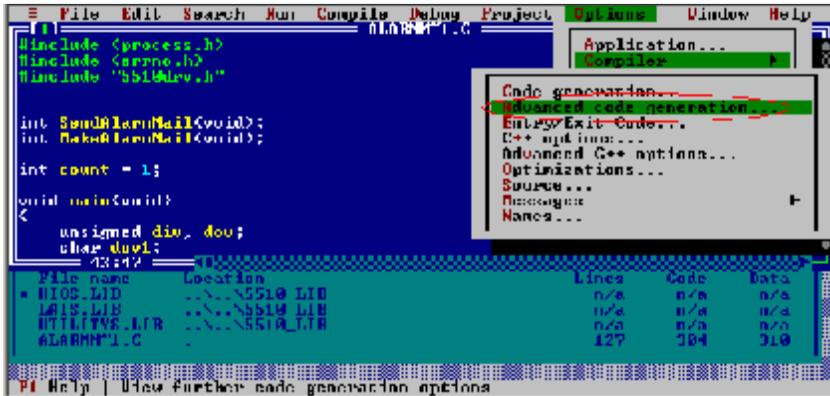


Figure 5-1: Select “Advanced code generation”

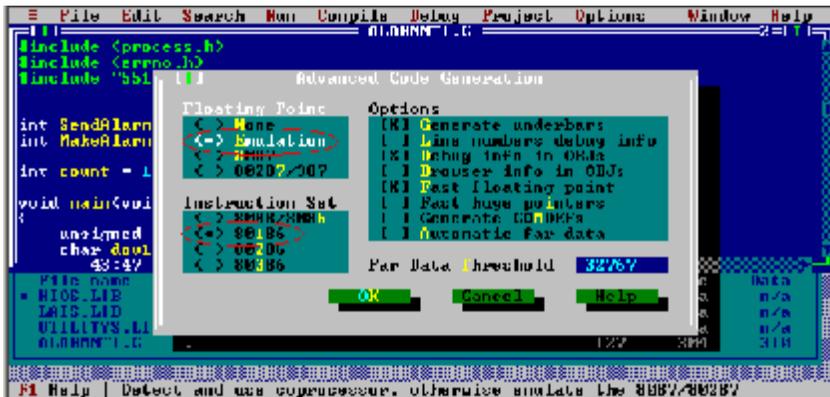


Figure 5-2: Select “Emulation” and “80186” settings

5.1.4 Libraries Sized for Different Memory Modes

The ADAM-5510 Series function libraries support four memory models: SMALL, MEDIUM, COMPACT and LARGE. You can use library files sized according to your memory model. For example, if you use **small** model you can link UTILITYS.LIB and LIOS.LIB to implement system and low speed I/O module access functions. On the other hand, if you use **large** model, you can link UTILITYL.LIB and LIOL.LIB.

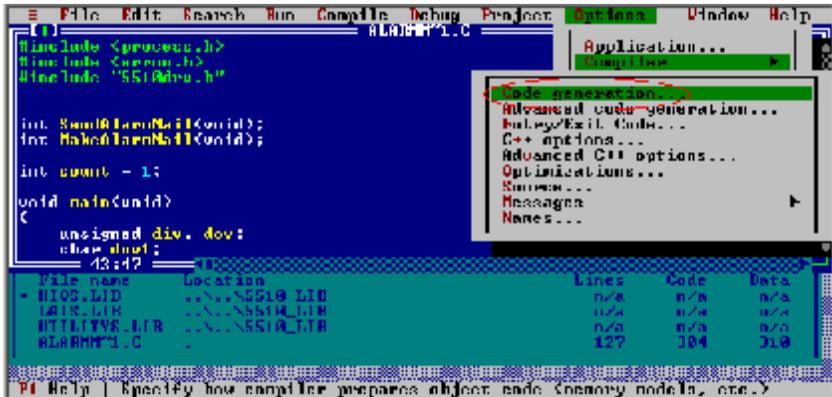


Figure 5-3: Select “Code generation”

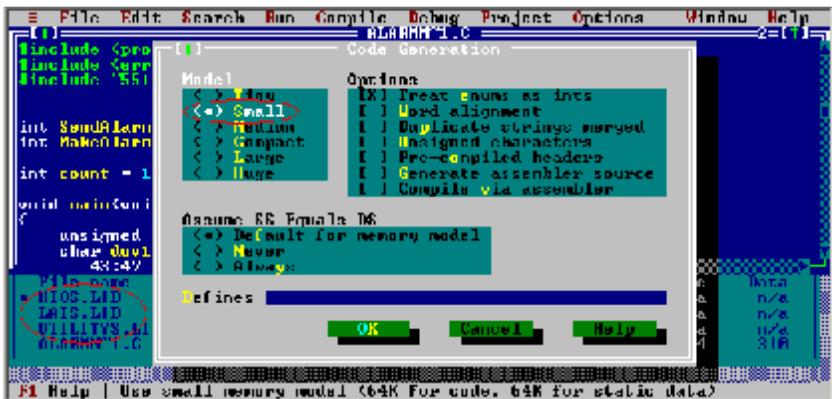


Figure 5-4: Select “Small” Model while using *S.LIB

5.1.5 Limitations

Certain critical files are always kept in flash ROM, such as operating system, BIOS, and monitoring files. The ADAM-5510 Series Controller provides an additional 1MB flash disk as drive D. There is up to 960KB free space for user’s application program. As some additional system files and network utilities for ADAM-5510/TCP and ADAM-5510E/TCP are distributed on drive D, the free space for user’s application program should be less than 960KB. Besides, there are 256KB flash memory and up to 384KB battery backup SRAM for user’s applications which can be accessed by function library.

Warning:  The free space of flash disk is not suitable for frequently creating and deleting files such as periodic data logging application because the DOS FAT file system is probably destroyed by critical operations while the disk is almost full. The better way is to take the operations on battery backup SRAM.

5.1.6 Programming the watchdog timer

The ADAM-5510 Series Controller is equipped with a watchdog timer function that resets the CPU or generates an interrupt if processing comes to a standstill for any reason. This feature increases system reliability in industrial standalone and unmanned environments.

If you decide to use the watchdog timer, you must write a function call to enable it. When the watchdog timer is enabled, it must be cleared by the application program at intervals of less than 1.6 seconds. If it is not cleared at the required time intervals, it will activate and reset the CPU, or generate a NMI (Non-Maskable Interrupt). You can use a function call in your application program to clear the watchdog timer. At the end of your program, you still need a function call to disable the watchdog timer.

5.2 Category of Function Libraries

ADAM-5510 Series Controller has 10 categories of function libraries as following:

- Category A. System Functions (UTILITY*.LIB)
- Category B. Low Speed AI Module Functions (LAI*.LIB)
- Category C. High Speed I/O and Counter/Frequency Module Functions (HIO*.LIB)
- Category D. Communication Functions (COMM*.LIB)
- Category E. Serial Module Functions (A5090*.LIB)
- Category F. MODBUS/RTU Functions (MBRTU*.LIB and MBRTU9*.LIB)
- Category G. MODBUS/TCP Functions (MBTCP*.LIB)
- Category H. Socket Functions (SOCKET*.LIB)
- Category I. HTTP Functions (CGI_LIB*.LIB)

Note 1: These function libraries support Borland C 3.0 for DOS only.

Note 2: Please include all necessary ADAM-5510 Series function libraries in your project file.

Note 3: The ADAM-5510 Series function libraries, which come with ADAM CD version 2.20 or later, support 8 slot and 4 slot main units, i.e., ADAM-5510E, ADAM-5510E/TCP, ADAM-5510M and ADAM-5510/TCP simultaneously. So if you have already used ADAM-5510M and would like to use 8 slot main unit such as ADAM-5510E in your system, it is strongly recommended that you build your projects for both ADAM-5510M and ADAM-5510E by linking latest function libraries on ADAM CD version 2.20 or later. Just keep one version of function libraries for all ADAM-5510 Series Controllers will simplify the maintenance.

5.3 Library Index

5.3.1 Category A. System Functions: (UTILITY*.LIB)

[ADAMdelay](#)

[Get_BoardID](#)

[Get_NodeID](#)

[GetRTctime](#)

[SetRTctime](#)

[LED_init](#)

[LED_OFF](#)

[LED_ON](#)

[ProgramByte](#)

[ProgramSector](#)

[EraseSector](#)

[Get_SysMem](#)

[Set_SysMem](#)

[read_mem](#)

[Get_NVRAM_Size](#)

[Set_NVRAM_Size](#)

[Timer_Init](#)

[Timer_Reset](#)

[Timer_Set](#)

[Release_All](#)

[tmArriveCnt](#)

[WDT_clear](#)

[WDT_disable](#)

[WDT_enable](#)

[write_backup_ram](#)

[read_backup_ram](#)

[adv_printf\(\)](#)

Chapter 5 Programming and Function Library

5.3.2 Category B. Low Speed AI Module Functions (LAI*.LIB)

[AiUpdate\(\)](#)
[Init5013\(\)](#)
[Get5013\(\)](#)
[GetRange5013\(\)](#)
[Init501718\(\)](#)
[Get501718\(\)](#)
[GetRange501718\(\)](#)

5.3.3 Category C. High Speed I/O and Counter/Frequency Module Functions (HIO*.LIB)

[Init5017H\(\)](#)
[GetRange5017H\(\)](#)
[Get5017H\(\)](#)
[Init5017UH\(\)](#)
[SetRange5017UH_Advanced_Setting\(\)](#)
[SetRange5017UHTriVal\(\)](#)
[GetRange5017UHTriVal\(\)](#)
[GetRange5017UHTriData\(\)](#)
[SetRange5017UH\(\)](#)
[GetRange5017UH\(\)](#)
[Get5017UH\(\)](#)
[Get5017UH_CyclicData\(\)](#)
[Init5024\(\)](#)
[Set5024\(\)](#)
[GetRange5024\(\)](#)
[Get5050\(\)](#)
[Get5051\(\)](#)
[Get5052\(\)](#)
[Get5055\(\)](#)
[Set5050\(\)](#)
[Set5055\(\)](#)
[Set5056\(\)](#)
[Set5060\(\)](#)
[Set5068\(\)](#)
[Set5069\(\)](#)
[InitDIFilter\(\)](#)
[Init5080\(\)](#)
[Get5080\(\)](#)
[Init5081\(\)](#)

[Get5081\(\)](#)
[Clear_Counter\(\)](#)
[Start_Stop_Counter\(\)](#)
[ReadOverflowFlag\(\)](#)
[SetInitCounterVal\(\)](#)
[GetRange5080\(\)](#)
[SetRange5080\(\)](#)
[GetRange5081\(\)](#)
[SetRange5081\(\)](#)

5.3.4 Category D. Communication Functions: (COMM*.LIB)

[checksum\(\)](#)

RS-485 Port (COM2) Functions

[com_485_install\(\)](#)
[com_485_deinstall\(\)](#)
[com_485_set_format\(\)](#)
[com_485_set_speed\(\)](#)
[com_485_flush_rx\(\)](#)
[com_485_flush_tx\(\)](#)
[com_485_rx\(\)](#)
[com_485_rx_empty\(\)](#)
[com_485_tx\(\)](#)
[com_485_tx_string\(\)](#)
[com_485_tx_empty\(\)](#)

Program Port (COM3) Functions

[com_pgm_install\(\)](#)
[com_pgm_deinstall\(\)](#)
[com_pgm_flush_rx\(\)](#)
[com_pgm_flush_tx\(\)](#)
[com_pgm_rx\(\)](#)
[com_pgm_rx_empty\(\)](#)
[com_pgm_set_format\(\)](#)
[com_pgm_set_speed\(\)](#)
[com_pgm_tx\(\)](#)
[com_pgm_tx_empty\(\)](#)
[com_pgm_tx_string\(\)](#)

RS-232/485 Port (COM1) Functions

Note: For ADAM-5510M and ADAM-5510/TCP, COM1 supports RS-232 only.

The following library functions support RS-485 automatic data flow control. So it is not necessary for users to take care of the control of data flow direction.

[com install\(\)](#)

[com deinstall\(\)](#)

[com set format\(\)](#)

[com set parity\(\)](#)

[com set speed\(\)](#)

[com rx\(\)](#)

[com tx\(\)](#)

[com rx empty\(\), com tx empty\(\)](#)

[com tx ready\(\)](#)

[com tx string\(\)](#)

[com flush rx\(\), com flush tx\(\)](#)

[com carrier\(\)](#)

[com clear break\(\), com set break\(\)](#)

[com clear local loopback\(\), com set local loopback\(\)](#)

[com disable fifo\(\), com enable fifo\(\)](#)

[com get line status\(\), com set line params\(\),](#)

[com lower dtr\(\), com raise dtr\(\)](#)

[com lower rts\(\), com raise rts\(\)](#)

[com read scratch register\(\), com write scratch register\(\)](#)

[CRC16\(\)](#)

[com get modem status\(\)](#)

[modem autoanswer\(\)](#)

[modem command state\(\)](#)

[modem command\(\)](#)

[modem dial\(\)](#)

[modem handup\(\)](#)

[modem initial\(\)](#)

RS-232/485 Port (COM4) Functions

[com 232 485 install\(\)](#)

[com 232 485 deinstall\(\)](#)

[com 232 485 set format\(\)](#)

[com 232 485 set speed\(\)](#)

[com 232 485 flush rx\(\)](#)

[com 232 485 flush tx\(\)](#)

[com 232 485 rx\(\)](#)
[com 232 485 rx_empty\(\)](#)
[com 232 485 tx\(\)](#)
[com 232 485 tx_string\(\)](#)
[com 232 485 tx_empty\(\)](#)

5.3.5 Category E. Serial Module Functions (A5090*.LIB)

For ADAM-5090 Serial COM Ports:

[port install\(\)](#)

[port deinstalled\(\)](#)
[port select\(\)](#)
[reset slot\(\)](#)
[port reset\(\)](#)
[which has been installed\(\)](#)
[port set speed\(\)](#)
[port set format\(\)](#)
[port disable fifo\(\)](#)
[port enable fifo\(\)](#)
[port carrier\(\)](#)
[port clear break\(\)](#)
[port set break\(\)](#)
[port clear local loopback\(\)](#)
[port set local loopback\(\)](#)
[port get line status\(\)](#)
[port set line params\(\)](#)
[port get modem status\(\)](#)
[port get modem control status\(\)](#)
[port set modem control params\(\)](#)
[port lower dtr\(\)](#)
[port raise dtr\(\)](#)
[port raise rts\(\)](#)
[port lower rts\(\)](#)
[modem initial 90\(\)](#)
[modem command 90\(\)](#)
[modem command state 90\(\)](#)
[modem autoanswer 90\(\)](#)
[modem dial 90\(\)](#)
[modem handup 90\(\)](#)
[port flush rx\(\)](#)
[port flush tx\(\)](#)
[port rx error\(\)](#)

[port_rx_ready\(\)](#)
[char port_rx\(\)](#)
[port_tx_empty\(\)](#)
[port_tx\(\)](#)
[port_tx_string\(\)](#)

5.3.6 Category F. MODBUS/RTU Functions (MBRTU*.LIB and MBRTU9*.LIB)

For ADAM-5510 Series COM Ports:

[Modbus_COM_Init\(\)](#)

[Modbus_COM_Release\(\)](#)

[Error_Code\(\)](#)

[ADAMRTU_ForceMultiCoils\(\)](#)

[ADAMRTU_ForceSingleCoil\(\)](#)

[ADAMRTU_PresetMultiRegs\(\)](#)

[ADAMRTU_PresetSingleReg\(\)](#)

[ADAMRTU_ReadCoilStatus\(\)](#)

[ADAMRTU_ReadHoldingRegs\(\)](#)

[ADAMRTU_ReadInputRegs\(\)](#)

[ADAMRTU_ReadInputStatus\(\)](#)

[ADAMRTU_ModServer_Create\(\)](#)

[Ver_RTU_Mod\(\)](#)

For ADAM-5090 Serial COM Ports:

[Error_Code\(\)](#)

[Modbus_5090_Init\(\)](#)

[Modbus_5090_Release\(\)](#)

[A5090_RTU_ForceMultiCoils\(\)](#)

[A5090_RTU_ForceSingleCoil\(\)](#)

[A5090_RTU_PresetMultiRegs\(\)](#)

[A5090_RTU_PresetSingleReg\(\)](#)

[A5090_RTU_ReadCoilStatus\(\)](#)

[A5090_RTU_ReadHoldingRegs\(\)](#)

[A5090_RTU_ReadInputRegs\(\)](#)

[A5090_RTU_ReadInputStatus\(\)](#)

5.3.7 Category G. MODBUS/TCP Functions (MBTCP*.LIB)

[Ver TCP Mod\(\)](#)

Modbus TCP Client Functions:

[ReturnErr_code\(\)](#)

[ADAMTCP_Connect\(\)](#)

[ADAMTCP_Disconnect\(\)](#)

[ADAMTCP_ForceMultiCoils\(\)](#)

[ADAMTCP_ForceSingleCoil\(\)](#)

[ADAMTCP_PresetMultiRegs\(\)](#)

[ADAMTCP_PresetSingleReg\(\)](#)

[ADAMTCP_ReadCoilStatus\(\)](#)

[ADAMTCP_ReadHoldingRegs\(\)](#)

[ADAMTCP_ReadInputRegs\(\)](#)

[ADAMTCP_ReadInputStatus\(\)](#)

Modbus TCP Server Functions:

[ADAMTCP_ModServer_Create\(\)](#)

[ADAMTCP_ModServer_Update\(\)](#)

[ADAMTCP_ModServer_Release\(\)](#)

5.3.8 Category H. Socket Functions (SOCKET*.LIB)

Socket function:

[accept \(\)](#)

[bind \(\)](#)

[closesocket \(\)](#)

[connect \(\)](#)

[ioctlsocket \(\)](#)

[getpeername \(\)](#)

[getsockname \(\)](#)

[getsockopt \(\)](#)

[htonl \(\)](#)

[htons \(\)](#)

[inet_addr \(\)](#)

[inet_ntoa \(\)](#)

[listen \(\)](#)

[ntohl \(\)](#)

[ntohs \(\)](#)

[recv \(\)](#)

[recvfrom \(\)](#)

[select \(\)](#)

[send \(\)](#)
[sendto \(\)](#)
[setsockopt \(\)](#)
[shutdown \(\)](#)
[socket \(\)](#)

Database function:

[gethostbyaddr\(\)](#)
[gethostbyname\(\)](#)
[gethostname \(\)](#)
[getservbyport\(\)](#)
[getservbyname\(\)](#)
[getprotobynumber\(\)](#)
[getprotobyname\(\)](#)

5.3.9 Category I. HTTP Functions (CGI_LIB*.LIB)

Socket function:

[HttpRegister\(\)](#)
[HttpDeRegister\(\)](#)
[HttpGetData\(\)](#)
[HttpSendData\(\)](#)
[HttpSubmitFile\(\)](#)
[HttpGetStatus\(\)](#)
[HttpGetVersion\(\)](#)
[GetStackPointer\(\)](#)
[GetStackSegment\(\)](#)
[SetStackPointer\(\)](#)
[SetStackSegment\(\)](#)

5.4 Function Library Description

5.4.1 System Functions (UTILITY*.LIB)

ADAMdelay

Syntax:

void ADAMdelay(unsigned short msec)

Description:

Delays program operation by a specified number of milliseconds.

Parameter

msec

Description

From 0 to 65535.

Return value:

None.

Example:

```
#include "5510drv.h"
void main(void)
{
    /* codes placed here by user */
    ADAMdelay(1000); /* delay 1 sec. */
    /* codes placed here by user */
}
```

Remarks:

ADAMDelay will possibly decrease the performance so it is recommended to use for loop instead.

Get_BoardID

Syntax:

unsigned char Get_BoardID(int Board)

Description:

Gets the type identification of the I/O module in a controller slot.

Parameter

Int Board

Description

The slot number of an ADAM-5510 SERIES, from 0 to 7.

Return value:

The return values are:

I/O Module name	Return Value
ADAM-5017	ADAM5017_ID
ADAM-5018	ADAM5018_ID
ADAM-5017H	ADAM5017H_ID
ADAM-5013	ADAM5013_ID
ADAM-5080	ADAM5080_ID
ADAM-5081	ADAM5081_ID
ADAM-5052	ADAM5052_ID
ADAM-5050	ADAM5050_ID
ADAM-5051	ADAM5051_ID
ADAM-5056	ADAM5056_ID
ADAM-5060	ADAM5060_ID
ADAM-5068	ADAM5068_ID
ADAM-5069	ADAM5069_ID
ADAM-5024	ADAM5024_ID

Remarks:

None

Get_NodeID

Syntax:

unsigned char Get_NodeID(void)

Description:

Gets the DIP switches number of the ADAM-5510 SERIES Controller.

Parameter**Description**

None.

Return value:

The DIP switches number of the ADAM-5510 SERIES Controller.

Example:

```
#include "5510drv.h"
unsigned char SystemNodeNumber;
unsigned char IOModuleName, SlotNumber;
void main(void)
{
    SystemNodeNumber = Get_NodeID();
    if( SystemNodeNumber == 0x15)
    {
        /* Read IO module name in Slot 0*/
        SlotNumber = 0;
        IOModuleName = Get_BoardID(SlotNumber);
        if( IOModuleName == ADAM5051_ID)
        {
            /* IO Board is current, put your code in Here*/
        }
        else
        {
            adv_printf("\nThe IO Board is NOT ADAM5051");
            adv_printf("\nPlease Check your system setup");
        }
    }
    else
        adv_printf("\nNode number Error!");
}
```

Remarks :

None

GetRTctime SetRTctime

Syntax:

```
unsigned char GetRTctime(unsigned char Time)
void SetRTctime(unsigned char Time,unsigned char data)
```

Description:

GetRTctime: Reads Real-Time Clock chip timer. A user can activate a program on the date desired.

SetRTctime: Sets date and time of the real-time clock.

Parameter	Description
Time	RTC_sec the second
	RTC_min the minute
	RTC_hour the hour
	RTC_day the day
	RTC_week day of the week
	RTC_month the month
	RTC_year the year
	data New contents.

Return value:

The value requested by the user.

Example:

```
#include "5510drv.h"
void main(void)
{unsigned char sec=0,min=0,hour=12;
  adv_printf("Time %02d:%02d:%02d\n",GetRTctime(RTC_hour),
  GetRTctime(RTC_min), GetRTctime(RTC_sec));
  adv_printf("Set current time 12:00:00\n");
  SetRTctime(RTC_sec,sec);
  SetRTctime(RTC_min,min);
  SetRTctime(RTC_hour,hour);
  adv_printf("Time %02d:%02d:%02d\n",GetRTctime(RTC_hour),
  GetRTctime(RTC_min), GetRTctime(RTC_sec));
}
```

Remarks:

None.

LED_init LED_OFF LED_ON

Syntax:

```
void LED_init(void)
void LED_OFF(int which_led)
void LED_ON(int which_led)
```

Description:

Turns LED lights on and off. The LED I/O port must be initialized first. It will take a little time for the light to stabilize following the signal for the turning on and turning off of the light.

Parameter	Description
which_led	PWR RUN COMM

Return value:

None.

Example:

```
#include "5510drv.h"
void main(void)
{
    LED_init();
    /* flash COMM led */
    while(1)
    {
        LED_ON(COMM);
        ADAMdelay(500);
        LED_OFF(COMM);
    }
}
```

Remarks:

None.

ProgramByte **ProgramSector** **EraseSector**

Syntax:

```
BOOL EraseSector( unsigned long ulBase )  
BOOL ProgramByte( unsigned long ulAddress, BYTE byte )  
BOOL ProgramSector( unsigned long ulAddress_s, unsigned char far  
* SECTOR_DATA)
```

Description:

EraseSector : Erases a 64 KB sector of data in the 256 KB Flash memory

ProgramByte : Programs a byte of information into the 256 KB Flash memory.
This feature supports data-logging or mass information storage.

ProgramSector : Programs an entire 32 KB sector of data of the global variable, SECTOR_DATA[], into 256 KB Flash memory.

Parameter	Description
ulBase	User-determined address range to be erased, taken from addresses in the range 0x80000L to 0xB0000L.
ulAddress	User-determined destination address for byte transfer, taken from the range 0x80000L to 0xBFFFFL.
ulAddress_s	User-determined destination address in the Flash memory, taken from addresses in the range 0x80000L to 0xB8000L.
SECTOR_DATA	Pointer at the starting address in the origin memory of the user's data array.

Return value:

TRUE Successful transfer to Flash memory.

FALSE Error (destination already occupied, excess address range, or program error).

read_mem

Syntax:

unsigned char read_mem (int memory_segment , unsigned int i)

Description:

Reads far memory data, 256 KB Flash memory, from 0x80000L to 0xBFFFFL, where (the Absolute Address) = (SEG*16 + OFFSET). For example, (0x800FFL) = (0x8000*16 + 0x00FF).

Parameter	Description
memory_segment	User-determined address taken from the range 0x8000 to 0xBF00.
i	Offset for use in location of memory taken from the range 0x0000 to 0x0FFF.

Return value:

The value in memory storage at the indicated address.

Example:

```
#include "5510drv.h"
void main(void)
{
    unsigned char sector[32768];
    unsigned char data;
    unsigned long addr,sector_num;
    unsigned int i;

    adv_printf("erase sector 0x80000L\n");
    if(EraseSector(0x80000L))
        adv_printf("erase succeed \n");
    adv_printf("Write data(55) to 0x80000~0x80001\n");
    data=55;
    ProgramByte(0x80000L,data);
    ProgramByte(0x80000L+1,data);
    ProgramByte(0x80000L+2,data);
    for(i=0;i<3;i++)
    {
        adv_printf("read%d data=%d\n",i,read_mem(0x8000,0x0000+i));
    }
}
```

```
}
adv_printf("erase sector 0x80000L\n");
if(EraseSector(0x80000L))
    adv_printf("erase succeed \n");
data = 1;
for(i=0;i<32768;i++)
    *(sector+i)=data;
adv_printf("Write data(0x01) to 0x80000~0x87FFF\n");
ProgramSector(0x80000,&sector);
for(i=0;i<100;i++)
{
    adv_printf("read%d data=%d\n",i,read_mem(0x8000,0x0000+i));
}
}
```

Remarks:

None.

Get_SysMem Set_SysMem

Syntax:

```
unsigned char Get_SysMem(unsigned char which_byte)
void Set_SysMem(unsigned char which_byte, unsigned char data)
```

Description:

Get_SysMem: Reads a byte from security SRAM.

Set_SysMem: Writes a byte to security SRAM. Security SRAM supports 113 bytes for user storage of important information.

Parameter Description

which_byte	From 0 to 112, user-determined.
data	Value to be saved.

Return value:

The value in a byte of security SRAM.

Example:

```
#include "5510drv.h"
void main(void)
{
    unsigned char data[4] = {1,2,3,4};
    int i;
    /* save current value */
    for(i=10;i < 14;i++)
    {
        Set_SysMem(i, data[i-10]);
        adv_printf("data=%d\n",Get_SysMem(i));
    }
}
```

Remarks:

None

Get_NVRAM_Size **Set_NVRAM_Size**

Syntax:

```
unsigned char Get_NVRAM_Size(void)
void Set_NVRAM_Size(unsigned char sector)
```

Description:

Gets the size of battery backup RAM.

Sets the size of battery backup RAM.

(The unit is sectors, each sector is 4KB in size. Maximum size is 384 KB theoretically.)

Parameter Description

sector NVRAM size in 4 KB sectors, from 1 to 96 sectors.

Return value:

Get_NVRAM_Size: sector Number of sectors NVRAM size is set to, from 1 to 96.

Example:

```
#include "5510drv.h"
void main()
{
    unsigned char sector;
    sector = Get_NVRAM_Size();
    adv_printf("Backup ram=%dKbyte\n",sector*4);
    /*Set Bacup ram 40Kbyte*/
    Set_NVRAM_Size(10);
}
```

Remarks:

None.

write_backup_ram **read_backup_ram**

Syntax:

void write_backup_ram(unsigned long index, BYTE data)
unsigned char read_backup_ram(unsigned long index)

Description:

Writes a byte to battery backup memory.

Reads the value in backup RAM at index address, maximum 384 KB total backup RAM, index = 0 – 393214;

Parameter	Description
index	An index for data in the battery backup RAM, from 0 to 393214; maximum 384 KB battery backup SRAM
in total.	
data	A byte of data that the programmer wants to write to battery-protected SRAM.

Return value:

The single-byte value in backup RAM at address index.

Example:

```
#include "5510drv.h"
void main()
{
    unsigned long addr;
    unsigned char data;
    /*write the data 0x55 into battery backup memory, index=10*/
    data=0x55;
    write_backup_ram(10,data);
    adv_printf("data=%x\n",read_backup_ram(10));
}
```

Remarks:

None

Timer_Init()

Syntax:

```
int Timer_Init()
```

Description:

Initializes the timer built into the 80188 microprocessor. The return value "0" means the initialization of the time was successful. The return value "1" means the timer had already been initialized.

Parameter Description

None.

Return value:

0: Initialization was successful.

1: The timer had already been initialized.

Remarks:

None.

Timer_Reset

Syntax:

void Timer_Reset(int idx)

Description:

Resets the timer identified by the integer idx to its initial state.

Parameter Description

idx Timer index.

Return value:

None.

Remarks:

None.

Timer_Set

Syntax:

```
int Timer_Set(unsigned int msec)
```

Description:

Requests a timer function from the microprocessor and then sets the time interval of the function. Timer intervals are set in 5 millisecond increments. The function return value is an integer representing the ID of the timer function when it is successful.

A return value “-1” means the request failed. Programmers should consider whether an assigned timer has timed-out when programming for timer functions. The value of the variable [tmArriveCnt\[idx\]](#) can be checked to verify timer status.

A value of 0 indicates that the timer is still counting. Values other than 0 mean the timer has timed-out.

Parameter	Description
-----------	-------------

msec	Time interval set, max. value is 65536.
------	-----------------------------------------

Return value:

Integer Function success, value represents function timer ID. Max. value of 100.

-1 Function failure.

Remarks:

Timer function calls in the ADAM-5510 SERIES are emulated as timer functions in a PLC. Applications using timer functions will run less efficiently the more timer functions are running simultaneously in a program. Please refer to [Example 9](#) on the utility diskettes for details.

Release_All

Syntax:

```
void Release_All()
```

Description:

Releases all timer resources of the ADAM-5510 SERIES system.

Parameter Description

None.

Return value:

None.

Remarks:

None.

Example:

```
#include "5510drv.h"
void main()
{
    int idx;
    /* Initializes the timer built into the 80188 microprocessor */
    Timer_Init();
    /* Sets time interval of the timer to 1 second.          */
    idx=Timer_Set(1000);
    /* Checks whether the timer has timed out                */
    while(tmArriveCnt[idx]==0)
    {
        /* user can attend to other tasks...                */
        adv_printf("test");
    }

    /* Resets the current timer to its initial state.        */
    Timer_Reset(idx);
    /* Releases all timer resources                          */
    Release_All();
}
```

WDT_clear,WDT_disable,WDT_enable

Syntax:

```
void WDT_clear(void)
void WDT_disable(void)
void WDT_enable(void)
```

Description:

Clear watchdog timer.

Disable watchdog timer.

Enable watchdog timer.

When the watchdog timer is enabled, it will have to be cleared at least once every 1.5 seconds. The watchdog timer default value is "disable".

Parameter Description

None.

Return value:

None.

Example:

```
#include "5510drv.h"
void main(void)
{
    int i;
    WDT_enable();
    for(i=0;i<100;i++)
    {
        /*put your code in Here*/
        WDT_clear();
        /*put your code in Here*/
    }
    WDT_disable();
}
```

Remarks:

None

adv_printf

Syntax:

```
void adv_printf(char *pFormat, ...);
```

Description:

Print string to console. This function has the same usage as printf() function. However, it has lower priority to be executed.

Parameter Description

The same as printf() of standard Borland C 3.0 library function.

Return value:

None.

Example:

```
for(i=0;i<4;i++)
{
    type[i]=Get_BoardID(i);
    if( type[i] > 0x18)
        type[i]=0;
}

for(i=0;i<4;i++)
{
    adv_printf("IO slot %d is %s \n",i+1,s_type[type[i]]);
}
adv_printf("press any key to continue...\n");

getch();
```

Remarks:

If printf() function is put within while loop such as Modbus/RTU server function, it will decrease the performance of server function due to higher priority of printf(). So it is strongly recommended that uses adv_printf() instead, which has lower priority than printf().

5.4.2 Low Speed AI Module Functions (LAI*.LIB)

AiUpdate

Syntax:

```
int AiUpdate(int Board, int *channel)
```

Description:

Checks whether the data of a low-speed analog input module, such as ADAM-5017, ADAM-5018 and ADAM-5013, is ready to be accessed.

Parameter Description

int Board	The slot number of an ADAM-5510 Series, from 0 to 7.
int *channel	The return value indicates the channel for which data is ready.

Valid value 0 to 7 for ADAM-5017.
Valid value 0 to 6 for ADAM-5018.
Valid value 0 to 2 for ADAM-5013.

Return value:

int status; 0 : Ready
-1 : Not ready
-2 : The hardware of the module failed

Example:

Please refer to the [ADAM-5017/5018 Example](#)

Remarks:

None.

Get5013

Syntax:

void Get5013(int Board, int Channel, void *pValue)

Description:

Reads the data value in an ADAM-5013 module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
Channel	0 – 2 for ADAM-5013.
*pValue	The value returned.

Note: The *pValue for ADAM-5013 must be interpreted in reference to the input range that was set during module configuration.

Return Value:

None.

Example:

Please refer to the [ADAM-5013 Example](#)

Remarks:

None.

Get501718

Syntax:

void Get501718(int Board, int Channel, void *pValue)

Description:

Reads the data value in an I/O module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
Channel	0 - 6 for ADAM-5018; 0 - 7 for ADAM-5017
*pValue	The value returned.

Note: The *pValue for ADAM-5017 and ADAM-5018 must be interpreted in reference to the range input that was set during module configuration.

Return value:

None.

Example:

Please refer to the [ADAM-5017/5018 Example](#)

Remarks:

None.

GetRange5013

Syntax:

```
void GetRange5013(int Board, int Channel, void *pRange)
```

Description:

Reads the input range in an ADAM-5013 module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
Channel	0 – 2 for ADAM-5013.
*pRange	The input range code returned. (See Appendix B.)

Return Value:

None.

Example:

Please refer to the [ADAM-5013 Example](#)

Remarks:

None.

GetRange501718

Syntax:

```
void GetRange501718(int Board, int Channel, void *pRange)
```

Description:

Reads the input range in an ADAM-501718 module.

Parameter Description

Board 0 – 7 for Slot0 ...Slot7.

Channel 0 – 7 for ADAM-5017, 0-6 for ADAM-5018.

*pRange The input range code returned (See [Appendix B.](#))

Return Value:

*pRange The input range code returned.

Example:

Please refer to the [ADAM-5017/5018 Example](#)

Remarks:

None.

Init5013

Syntax:

void Init5013(int Slot)

Description:

Initializes ADAM-5013. Note that ADAM-5013 must be initialized before other commands are issued to it.

Parameter	Description
Slot	From 0 to 7.

Return Value:

None.

Example:

Please refer to the ADAM-5013 Example

Remarks:

None.

Init501718

Syntax:

void Init501718(int Slot)

Description:

Initializes ADAM-5017 or ADAM-5018. Note that ADAM-5017 or ADAM-5018 must be initialized prior to other commands being issued to them.

Parameter	Description
Slot	From 0 to 7.

Return value:

None.

Example:

Please refer to the ADAM-5017/5018 Example

Remarks:

None.

ADAM-5013 Example

```
#include "5510drv.h"
void main()
{
    char ch;
    unsigned char Range;
    int *pRange,*pVaule;
    int i,j;
    int channel,slot;

    /*Initial ADAM-5013*/
        /*One ADAM-5013 module on slot 2*/
    slot=2;
        Init5013(slot);
    GetRange5013(slot,0,pRange);

    Range=*pRange & 0xff;
    adv_printf("range is 0x%x \n",Range);

    for(i=0;i<100;)
    {
        while(AiUpdate(slot, &channel)==0)
        {
            Get5013(slot,channel,pVaule);
            adv_printf("\n channel= %d ADAM-5013=%04d
\n",channel,*pVaule);
            i++;
        }
    }
        Release_All();
}
```

ADAM-5017/5018 Example

```
#include "5510drv.h"
void main()
{
    unsigned char Range,Format;
    int *pRange,*pVaule;
    int i;
    int channel,slot;

    char *RangeArray[6]={"+/-10V","+/-5V","+/-1V","+/-500mv","+/-
150mV","+/-20mv"};
    /*Initial ADAM-5017(ADAM-5018)*/
        /*One ADAM-5017 module on slot 0*/
    slot=0;
    Init501718(slot);
    GetRange501718(slot,0,pRange);

    Range=*pRange & 0xff;
    Format>(*pRange & 0xff00)>>8;
    adv_printf("with range is %s format is 0x%x\n",RangeArray[Range-
8],Format);

    for(i=0;i<100;)
    {
        while(AiUpdate(slot, &channel)==0)
        {
            Get501718(slot,channel,pVaule);
            adv_printf("\n channel= %d ADAM-5017=%04d
mV\n",channel,*pVaule);
            i++;
        }
    }
}
```

5.4.3 High Speed I/O and Counter/Frequency Module Functions (HIO*.LIB)

Get5017H

Syntax:

```
void Get5017H(int Board, int Channel, void *pValue)
```

Description:

Reads the data value in an ADAM-5017H module.

Parameter	Description
------------------	--------------------

Board	0 – 7 for Slot0 ...Slot7.
-------	---------------------------

Channel	0 – 7 for ADAM-5017H.
---------	-----------------------

*pValue	The value returned.
---------	---------------------

Note: The pValue for ADAM-5017H must be interpreted in reference to the input range that be setup in the module configuration

Return Value:

None.

Example:

Please refer to the [ADAM-5017H Example](#)

Remarks:

None.

GetRange5017H

Syntax:

void GetRange5017H(int Board, int Channel, void *pRange)

Description:

Reads the input range in an ADAM-5017H module.

Parameter Description

Board 0 – 7 for Slot0 ...Slot7.

Chanel 0 – 7 for ADAM-5017H.

*pRange The input range code returned. (See [Appendix B](#).)

Return Value:

None.

Example:

Please refer to the [ADAM-5017H Example](#)

Remarks:

None.

Init5017H

Syntax:

void Init5017(int Slot)

Description:

Initializes ADAM-5017H. Note that ADAM-5017H must be initialized before other commands are issued to it.

Parameter Description

Slot	From 0 to 7.
------	--------------

Return Value:

None.

Example:

Please refer to the [ADAM-5017H Example](#)

Remarks:

None.

ADAM-5017H Example

```
#include "5510drv.h"
void main()
{
    int channel,*pRange;
    int Format,Range;
    int slot;
    int *pValue[8];
    char *RangeArray[12]={"+/-10V","0~10V","+/-5V","0~5V",
        "+/-2.5v","0-2.5V","+/-1V","0-1V",
        "+/-500mV","0~500mV","4~20mA","0~20mA"};

    slot=1;
    Init5017H(slot);
    channel=0;
    GetRange5017H(slot,channel,pRange);
    Format=(*pRange & 0xff00)>>8;
    Range=*pRange & 0xff;
    adv_printf("\n(with range is %s format is
0x%x)",RangeArray[Range],Format);
    Init5017H(slot);
    for(channel=0;channel<8;channel++)
    {
        Get5017H(slot,channel,pValue+channel);
        adv_printf("\n adam5017h channel:%d =
%d",channel,*(pValue+channel));
    }
}
```

Init5017UH

Syntax:

void Init5017UH(int Slot, unsigned long AcqMode, unsigned long DataFormat, unsigned char ChannelMask);

Description:

Initializes ADAM-5017UH. Note that ADAM-5017UH must be initialized before other commands are issued to it.

Parameter	Description
Slot	From 0 to 7.
AcqMode	Cyclic mode , Non Cyclic mode
DataFormat:	EngineeringUnit , RawData
ChannelMask	Enable/Disable Channel: 0x0~0xff

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

Set5017UH_Advanced_Setting

Syntax:

```
void Init5017UH (int Slot, unsigned int Acq_Num, unsigned long Freq,  
                unsigned long Trig_Mode, unsigned long FilterMode);
```

Description:

Sets the advanced setting in ADAM-5017UH.

Note that ADAM-5017UH must be setting before other commands are issued to it.

Parameter Description

Slot	From 0 to 7.
Acq_Num	when Eng. Units=>128 (Max), when Raw Data=>512
Freq	when single channel=> 2~200K when multi-channel=> 2~100K when trigger ON=>2~50K
Trig_Mode	Conf_Trigger Conf_PreTrigger Conf_PostTrigger Conf_Trigger_OFF (this term is useless when Acq_Num==1)
FilterMode	ON , OFF (this term is useless when Trig_Mode=Conf_Trigger_OFF)

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

Set5017UHTriVal

Syntax:

```
void Set5017UHTriVal(int Slot, int Channel, int TriggerVal);
```

Description:

Stes the setting triggle value in ADAM-5017UH.

Parameter Description

Slot From 0 to 7.

Channel

TriggerVal

10<TriggerVal<10 (In_Range_mi10V_10)

4<TriggerVal<20 (In_Range_4_20mA)

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

Get5017UHTriVal

Syntax:

```
void Get5017UHTriVal(int Slot, int Channel, int *TriggerVal);
```

Description:

Get the trigger value from Adam-5017UH. Use this function after turn on the trigger mode. The pValue must be an int array of 128-byte size (int array[64]; 64 int = 128 bytes).

Parameter Description

Slot	From 0 to 7.
Channel	
*TriggerVal	The Value returned

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

Get5017UH_TriData

Syntax:

```
void Get5017UH_TriData(int Slot, int Channel, int *pValue);
```

Description:

Get the trigger data value from Adam-5017UH. Use this function after turn on the trigger mode. The pValue must be an int array of 128-byte size (int array[64]; 64 int = 128 bytes).

Parameter Description

Slot	From 0 to 7.
Channel	
*TriggerVal	The Value returned

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

SetRange5017UH

Syntax:

```
void SetRange5017UH(int Slot, int Channel, unsigned char Range);
```

Description:

Sets the input range in ADAM-5017UH.

Parameter Description

Slot From 0 to 7.

Channel

Input range code:

In_Range_0_500mV	0x43	//000.00
n_Range_0_20mA	0x46	//00.000
In_Range_0_10V	0x48	//00.000
In_Range_mi10V_10V	0x08	//00.000 //mi: minus
In_Range_4_20mA	0x07	//00.000

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

GetRange5017UH

Syntax:

```
void GetRange5017UH(int Slot, int Channel, void *pRange);
```

Description:

Reads the input range value from ADAM-5017UH.

Parameter	Description
Slot	From 0 to 7.
Channel	
*pRange	The Value returned

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

Get5017UH_CyclicData

Syntax:

```
void Get5017UH_CyclicData(int Slot, unsigned int *pValue);
```

Description:

Get the cyclic status data from ADAM-5017UH.

Parameter	Description
Slot	From 0 to 7.
*pValue	The Value returned

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

Get5017UH

Syntax:

void Get5017UH(int Board, int Channel, void *pValue)

Description:

Reads the data value in an ADAM-5017UH module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
Channel	0 – 7 for ADAM-5017UH.
*pValue	The value returned.

Note: The pValue for ADAM-5017UH must be interpreted in reference to the input range that be setup in the module configuration

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

GetRange5017UH

Syntax:

void GetRange5017H(int Board, int Channel, void *pRange)

Description:

Reads the input range in an ADAM-5017UH module.

Parameter Description

Board 0 – 7 for Slot0 ...Slot7.

Chanel 0 – 7 for ADAM-5017UH.

*pRange The input range code returned. (See [Appendix B.](#))

Return Value:

None.

Example:

Please refer to the [ADAM-5017UH Example](#)

Remarks:

None.

ADAM-5017UH Example

```
#include "5510drv.h"

void main(void)
{
    int iSlot=0;
    int iChannel=0;
    unsigned char ChannelMask;
    unsigned long Conf_Setting;
    unsigned long Freq=100000;
    unsigned int AcquisitionNum=1;
    float Data;

    ChannelMask=0x0F; /*enable ch0~ch3, disable ch4~ch7*/
    if(!Init5017UH(iSlot, Conf_NonCyclic, Conf_EngineeringUnit,
ChannelMask))
    {
        adv_printf("Init Error!\n");
    }

    if(!Set5017UH_Advanced_Setting(iSlot, AcquisitionNum, Freq,
Conf_Trigger_OFF, Conf_Filter_OFF))
    {
        adv_printf("Advanced Setting Error!\n");
    }

    if(Get5017UH(iSlot, iChannel, &Data))
    {
        adv_printf("Data: %f\n", Data);
    }
    else
    {
        adv_printf("Get Adam-5017UH value Error!\n");
        adv_printf("Error code %d\n", ErrCode);
    }
}
}
```


Init5024

Syntax:

```
void Init5024(int Slot, int ch0_val, int ch1_val, int ch2_val, int ch3_val)
```

Description:

Initializes ADAM-5024 module in the slot indicated, loading user-specified analog output values into each of the modules' four channels.

Parameter Description

ch0_val	The initial value output by channel 0.
ch1_val	The initial value output by channel 1.
ch2_val	The initial value output by channel 2.
ch3_val	The initial value output by channel 3.

Return Value:

None.

Example:

Please refer to the [ADAM-5024 Example](#)

Remarks:

None.

Set5024

Syntax:

void Set5024(void *pValue, int Board, int Channel)

Description:

Specifies the output of a channel of a selected ADAM-5024.

Parameter Description

*pValue	The value set for analog output.
Board	Slot number = 0 - 7.
Channel	AO channel = 0 - 3.

Return Value:

None.

Example:

Please refer to the [ADAM-5024 Example](#)

Remarks:

None.

ADAM-5024 Example

```
#include "5510drv.h"
void main()
{
    unsigned long *pValue;
    int channel,slot;
    slot=3;
    /*initializes outputs of all channels
    of the ADAM-5024 in slot 3 to output a
    value of 0 */
    Init5024(slot,0,0,0,0);
    /*Value set 2000mV*/
    *pValue=2000;
    for(channel=0;channel<4;channel++)
    {
        Set5024(pValue,slot,channel);
        adv_printf("\n channel %d = %d mV",channel,*pValue);
    }
}
```

Get5050, Get5051, Get5052, Get5055

Syntax:

```
void Get5050(int Board, int Bit, int Size, void *pValue)
void Get5051(int Board, int Bit, int Size, void *pValue)
void Get5052(int Board, int Bit, int Size, void *pValue)
void Get5055(int Board, int Bit, int Size, void *pValue)
```

Description:

Reads the data value in an I/O module.

Parameter Description

Board	ADAM-5510 Series slot number, from 0 to 7.
Bit	See "Size" parameter below.
Size	ABit, AByte, AWord If Size= ABit, Bit=0..15 (pin0..pin15) If Size=AByte, Bit=0 for Low Byte data; Bit=8 for High Byte data If Size=AWord, Bit does not care. Always word data.
pValue	The value returned.

Return value:

None.

Example:

```
void main(void)
{
  unsigned char Bdata;
  unsigned int Wdata;
  /* Slot0, pin13, data=0 or 1 */
  Get5051(0, 13, ABit, &Bdata);
  /* Slot2, pin0~pin7, Bdata=Low Byte data */
  Get5051(2, 0, AByte, &Bdata);
  /* Slot3, pin0~pin15, Wdata=Word data */
  Get5051(3, 0, AWord, &Wdata);
```

Remarks:

Digital filter function is available. Please refer to InitDIFilter() function.

Set5050, Set5055, Set5056, Set5060, Set5068, Set5069

Syntax:

```
void Set5050(void *pValue, int Board, int Bit, int Size)
void Set5055(void *pValue, int Board, int Bit, int Size)
void Set5056(void *pValue, int Board, int Bit, int Size)
void Set5060(void *pValue, int Board, int Bit, int Size)
void Set5068(void *pValue, int Board, int Bit, int Size)
void Set5069(void *pValue, int Board, int Bit, int Size)
```

Description:

Sets the digital output for ADAM-5050, ADAM-5055, ADAM-5056, ADAM-5060, ADAM-5068 and ADAM-5069 modules to the specified values.

Parameter Description

pValue	The digital value specified by the user to be output.
Board	0 to 7 (Slot0 .. Slot7).
Bit	See "Size" parameter below.
Size	ABit, AByte, AWord If Size = ABit, Bit = 0 ... 15 (pin0 ... pin15) If Size = AByte, Bit = 0 is Low Byte data Bit = 8 is High Byte data If Size = AWord, Bit does not care, always word data.

Return Value:

None.

Example:

```
void main(void)
{
    unsigned char Bitdata = 1;
    Set5056( &Bitdata, 0, 13, ABit);
    /* Output 1 to slot 0, pin 13 */
}
```

Remarks:

None

InitDIFilter

Syntax:

```
void InitDIFilter(int iSlot, int iCh, unsigned int MIN_Lo_Width, unsigned int MIN_High_Width);
```

Description:

Set time interval of digital filter for DI channel.

Parameter	Description
iSlot	Slot no. from 0 to 7
iCh	Channel no. 0 –15 depends on DI module
MIN_Lo_Width	Time interval of DI filter for Low state (5 ~ 65535 msec)
MIN_High_Width	Time interval of DI filter for High state (5 ~ 65535 msec)

Return Value:

None.

Example:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "5510DRV.H"
#define MaxSlot 8
char *s_type[0x1f]={
    "",
    "",
    "",
    "",
    "",
    "",
    "ADAM5017 ", /*0x4*/
    "ADAM5018 ",
    "",
    "",
    "",
    "ADAM5013 ", /*0x9*/
    "",
    "",
    "ADAM5017H", /*0xc*/
    "ADAM5018H",
    "",
    "ADAM5052 ",
```

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```
"ADAM5050 ", /*0x10*/
"ADAM5051 ",
"ADAM5056 ",
"" ,
"ADAM5060 ", /*0x14*/
"ADAM5055",
"" ,
"" ,
"" ,
"ADAM5024 " /*0x18*/
"" ,
"" ,
"" ,
"" ,
"" ,
"" ,
"ADAM5080 ", /*0x1e*/
"ADAM5081 ", /*0x1e*/

};

void main()
{
    unsigned char type[MaxSlot];
    unsigned DI_Value, DO_Value;
    unsigned Pre_DI_Value;
    unsigned Pre_DI_Value1;
    unsigned DI_Value1;
    unsigned Pre_DI_Value2;
    unsigned DI_Value2;
    char c;
    int i;
    int Slot5051, Slot5056, Slot5052, Slot5050, Slot5055;
    int inputdelay;

    for(i=0;i<MaxSlot;i++)
    {
        type[i]=Get_BoardID(i);
        type[i] &= 0x1f;
        if( type[i] > 0x18)
            type[i]=0;
    }

    for(i=0;i<MaxSlot;i++)
    //print module slot positions
    {
        adv_printf("IO slot %d is %s \n",i,s_type[type[i]]);
    }
    adv_printf("press any key to continue...\n");getch();
}
```

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```
for(i=0; i<MaxSlot; i++)

{
    if(type[i]==0x11)
        Slot5051 = i;
        //5051 Slot position

    if(type[i]==0x12)
        Slot5056 = i;
        //5056 Slot position

    if(type[i]==0x0F)
        Slot5052 = i;

    if(type[i]==0x10)
        Slot5050 = i;

    if(type[i]==0x15)
        Slot5055 = i;
}

adv_printf("press '1' to turn on filter, the other key to turn off..\n");
c=getch();
if(c=='1')
{
    adv_printf("Desired time interval (up to 5 msec): ");
    scanf("%d", &inputdelay);
    InitDIFilter(Slot5051, 0, inputdelay, inputdelay);
    InitDIFilter(Slot5051, 1, inputdelay, inputdelay);
    InitDIFilter(Slot5051, 2, inputdelay, inputdelay);
    InitDIFilter(Slot5055, 8, inputdelay, inputdelay);
    InitDIFilter(Slot5055, 15, inputdelay, inputdelay);
}

while(1)
{
    Get5055(Slot5055,0,AByte, &DI_Value);
    Get5051(Slot5051,0,AWord,&DI_Value1);
    //get 5051 status

    if(Pre_DI_Value!=DI_Value)
    //if data changed, print new status
    {
        Pre_DI_Value=DI_Value;
        adv_printf("5055 status =%02X \n ",DI_Value);
    }
}
```

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```
if(Pre_DI_Value1!=DI_Value1)
//if data changed, print new status

{
    Pre_DI_Value1=DI_Value1;
    adv_printf("5051 status =%4x \n ",~DI_Value1);
}
}
```

Remarks:

Reference Data:

Time Interval	Cut-off Frequency
15 ms	50 Hz
30 ms	20 Hz
50 ms	12 Hz

Init5080

Description:

Initiate ADAM-5080 Module

Syntax:

```
void Init5080(int slotno)
```

Parameter Description

slotno	The specific slot inserted with ADAM-5080 0-7 or slot0-slot7
--------	-----------------------------------------------------------------

Return Value:

None

Example:

Please refer to the [ADAM-5080 Example](#)

Get5080

Description:

Get Value from specific channel in ADAM-5080

Syntax:

```
void Get5080(int slotno, int channel, long *pValue)
```

Parameter Description

slotno	The specific slot inserted with ADAM-5080 0-7 or slot0-slot7
channel	The specific channel in ADAM-5080, 0-3
*pValue	The Value returned

Return Value:

The Value from the specific channel

Example:

Please refer to the [ADAM-5080 Example](#)

Init5081

Description:

Initiate ADAM-5081 Module

Syntax:

```
void Init5081(int slotno)
```

Parameter Description

Parameter	Description
slotno	The specific slot inserted with ADAM-5081 0-7 or slot0-slot7

Return Value:

None

Example:

Please refer to the [ADAM-5081 Example](#)

Get5081

Description:

Get Value from specific channel in ADAM-5081

Syntax:

```
void Get5081(int slotno, int channel, long *pValue)
```

Parameter Description

slotno	The specific slot inserted with ADAM-5081 0-7 or slot0-slot7
channel	The specific channel in ADAM-5081, 0-3
*pValue	The Value returned

Return Value:

The Value from the specific channel

Example:

Please refer to the [ADAM-5081 Example](#)

Clear_Counter

Description:

Reset the current counter value to its initial value

Syntax:

```
int Clear_Counter(int slotno, int channel)
```

Parameter Description

slotno	The specific slot inserted with ADAM-5080/5081 0-7 or slot0-slot7
channel	The specific channel in ADAM-5080/5081, 0-3

Return Value:

None

Example:

Please refer to the [ADAM-5080/5081 Example](#)

Start_Stop_Counter

Description:

Start or stop the specific counter

Syntax:

```
int Stop_Start_Counter(int Board, int Channel, int StartOrStop);  
/* StartOrStop=1 -> Start ; StartOrStop=0 -> Stop */
```

Parameter	Description
Board	The specific slot inserted with ADAM-5080/5081
channel	The specific channel in ADAM-5080/5081, 0-3
	Start 1
	Stop 0

Return Value:

None

Example:

Please refer to the [ADAM-5080/5081 Example](#)

ReadOverflowFlag

Description:

Check if counter value reach max. count limit

Syntax:

```
void ReadOverflowFlag(int Board, int Channel, void *pValue)
```

Parameter Description

slotno	The specific slot inserted with ADAM-5080/5081, 0-7 or slot0-slot7
Channel	0~3
*pValue	The value returned

Return Value:

The overflow value returned

Example:

Please refer to the [ADAM-5080/5081 Example](#)

SetInitCounterVal

Description:

Set initial counter value (between 0 to 4,294,967,295)

Syntax:

int SetInitCounterVal(int slotno, int channel, unsigned long Value)

Parameter Description

slotno	The specific slot inserted with ADAM-5080/5081, 0-7 or slot0-slot7
channel	The specific channel in ADAM-5080/5081, 0-3

Return Value:

None

Example:

Please refer to the [ADAM-5080/5081 Example](#)

GetRange5080

Syntax:

```
void GetRange5080(int Board, void *pValue)
```

Description:

Reads the input range in an ADAM-5080 module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
*pValue	Input Range Code

Return Value:

*pValue	The input range code returned.
1	Counter input
2	Frequency input

Example:

Please refer to the [ADAM-5080 Example](#)

Remarks:

None.

SetRange5080

Syntax:

void SetRange5080(int Board, void *pValue)

Description:

Set the input range in an ADAM-5080 module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
*pValue	Input Range Code

Return Value:

*pValue	The input range code to be set.
1	Counter input
2	Frequency input

Example:

None

Remarks:

None.

GetRange5081

Syntax:

void GetRange5081(int Board, void *pValue)

Description:

Reads the input range in an ADAM-5081 module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
*pValue	Input Range Code

Return Value:

*pValue	The input range code returned.
3	Counter input
4	Frequency input

Example:

Please refer to the [ADAM-5081 Example](#)

Remarks:

None.

SetRange5081

Syntax:

void SetRange5081(int Board, void *pValue)

Description:

Set the input range in an ADAM-5081 module.

Parameter Description

Board	0 – 7 for Slot0 ...Slot7.
*pValue	Input Range Code

Return Value:

*pValue	The input range code to be set.
3	Counter input
4	Frequency input

Example:

None

Remarks:

None.

ADAM-5080 Example

```
#include "5510drv.h"

char *s_type[0x1f]={
    "",
    "",
    "",
    "",
    "",
    "ADAM5017_ID ", /*0x4*/
    "ADAM5018_ID ",
    "ADAM5080_ID ", /*0x06*/
    "",
    "ADAM5013A_ID ", /*0x8*/
    "ADAM5013B_ID ", /*0x9*/
    "",
    "",
    "ADAM5017H_ID", /*0xc*/
    "ADAM5018H_ID",
    "",
    "ADAM5052_ID ",
    "ADAM5050_ID ", /*0x10*/
    "ADAM5051_ID ",
    "ADAM5056_ID ",
    "ADAM5068_ID ", /*0x13*/
    "ADAM5060_ID ", /*0x14*/
    "",
    "",
    "",
    "",
    "ADAM5024_ID " /*0x18*/
    "",
    "",
    "",
    "",
    "",
    "",
    "",
    ""
};
```

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```
void main()

{
    unsigned char range;
    unsigned char type[4];
    unsigned long counter_value;
    char overflag_value[4];
    char c;
    int ch,i;

    /* ---- first scan IO module -----*/
    for(i=0;i<4;i++)
    {
        type[i]=Get_BoardID(i);
        if( type[i] > 0x18)
            type[i]=0;
    }

    /*----show on the screen ---*/
    for(i=0;i<4;i++)
    {
        adv_printf("IO slot %d is %s \n",i+1,s_type[type[i]]);
    }

    /*--- Initialize counter module ----- */
    adv_printf("Initialize ADAM-5080\n");
    Init5080(0);

    /* Get ADAM-5080 range */
    GetRange5080(0,&range);
    if (range==1)
        adv_printf("Range is counter\n");
    if (range==2)
        adv_printf("Range is frequency\n");

    /* Start all of counter */

    for (i=0;i<4;i++)
    {
        if (Start_Stop_Counter(0,i,1)==0)
```

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```
        adv_printf("Board %d Channel %d Start failure!!\n",0,i);
    }

    /*--- Set initial counter value      ---*/
    for (i=0;i<4;i++)
    {
        if (SetNnitCounterVal(0,i,4294967290)==0)
            adv_printf("Board %d Channel %d Setting failure!!\n",0,i);
    }

    /*--- Clear all      of counter ---*/
    for (i=0;i<4;i++)
    {
        if (Clear_Counter(0,i)==0)
            adv_printf("Board %d Channel %d Clear failure!!\n",0,i);
    }

    /*---- Forever loop until user press the "Q" key */
    while(1)
    {
        ReadOverflowFlag(0,&(overflag_value[0]));
        for (i=0;i<4;i++)
            adv_printf("Channel %d
                over_flag_value=%d\n",i,overflag_value[i]);

        for (i=0;i<4;i++)
        {
            Get5080(0,i,&(counter_value));
            adv_printf("Channel %d counter_value=%lu
                \n",i,counter_value);
        }
        adv_printf("press 'Q' to quit, the other key to continue.\n");
        c=getch();
        if ( c == 'q' ||      c == 'Q') /* Quit from      this program */
            break;
    }

    /*--- Release all allocated timers to reload the control programs */
    Release_All();
}
```

5.4.4 Communication Functions (COMM*.LIB)

checksum

Syntax:

unsigned int checksum(void *buffer, int len, unsigned int seed)

Description:

Calculates the checksum of the string or data array in the string buffer.

Parameter**Description**

buffer

The string for which a user wants to calculate the checksum.

len

The length of the data array in the buffer.
seed A seed value added into the checksum for the purpose of calculation or security.

Return value:

The checksum of the data array buffer.

Example:

```
unsigned char String[]="this is a test CheckSum";  
void main(void)  
{  
    unsigned int code;  
    code = checksum(String, strlen(String),0);  
}
```

Remarks:

None.

com_carrier

Syntax:

int com_carrier(void)

Description:

Detects the carrier signal of COM port.

Parameter Description

None.

Return value:

TRUE If a carrier is present.

FALSE No carrier.

Example:

```
void main(void)
{
if( com_carrier() == TRUE ) {
/* Telephone carrier signal present at COM
port, put your associate program here */
}
}
```

Remarks:

None.

com_clear_break, com_set_break

Syntax:

void com_clear_break(unsigned baseaddr)

void com_set_break(unsigned baseaddr)

Description:

Sets COM port to clear BREAK signal.

Sets COM port to send BREAK signal.

Parameter Description

baseaddr The UART address, COM1=0x3F8,
COM2=0x2F8.

Return value:

None.

Example:

None.

Remarks:

Please refer to the 16C550 UART register document (Appendix B).

com_clear_local_loopback, com_set_local_loopback

Syntax:

void com_clear_local_loopback(unsigned baseaddr)

void com_set_local_loopback(unsigned baseaddr)

Description:

Sets COM port to disable loopback function for diagnostic.

Sets COM port to enable loopback function for diagnostic.

Parameter Description

baseaddr The UART address, COM1=0x3F8,

COM2=0x2F8.

Return value:

None.

Example:

None.

Remarks:

Please refer to the 16C550 UART register document (**Appendix B**).

com_deinstall

Syntax:

void com_deinstall(void)

Description:

Uninstalls the communications drivers completely, without changing the baud rate or DTR.

Parameter Description

None.

Return value:

None.

Example:

```
void main(void)
{
/* codes placed here by user */
com_deinstall();
}
```

Remarks:

This function **MUST** be called before returning to DOS, so the interrupt vector will not point to our driver anymore.

com_disable_fifo, com_enable_fifo

Syntax:

```
void com_disable_fifo(unsigned baseaddr)  
int com_enable_fifo(unsigned baseaddr, unsigned triggerlevel)
```

Description:

Sets COM port to disable fifo receiving trigger level 1, 4, 8, 14.
Sets COM port to enable fifo receiving trigger level 1, 4, 8, 14.

Parameter Description

Baseaddr The UART address, COM1=0x3F8,
COM2=0x2F8.
Triggerlevel 1, 4, 8, 14.

Return value:

0: Success.
-1: Fifo not available.
-10: Failure to enable.

Example:

None.

Remarks:

Please refer to the 16C550 UART register document (**Appendix B**).

com_flush_rx, com_flush_tx

Syntax:

```
void com_flush_rx(void)
void com_flush_tx(void)
```

Description:

Buffer flushers. Initializes the transmit and receive queues (respectively) to their empty state.

Parameter Description

None.

Return value:

None.

Example:

```
void main(void)
{
  com_flush_tx();
  com_flush_rx();
}
```

Remarks:

None.

com_get_line_status, com_set_line_params, com_get_modem_status

Syntax:

```
int com_get_line_status(unsigned baseaddr)
int com_set_line_params(unsigned baseaddr, unsigned lineparams)
int com_get_modem_status(unsigned baseaddr)
```

Description:

Reads from COM port line control register.
Writes to COM port line control register.
Reads from COM port modem status register.

Parameter Description

baseaddr The UART address, COM1=0x3F8,
COM2=0x2F8.
lineparams Please refer to the UART specifications.

Return value:

Please refer to the 16C550 UART register document (Appendix B).

Example:

None.

Remarks:

Please refer to the 16C550 UART register document (Appendix B).

com_install

Syntax:

```
int com_install(int portnum);
```

Description:

Installs the communications drivers.

Parameter Description

int portnum; Desired port number, always 1 for ADAM-5510.

Return value:

int status; 0 = Successful installation.

1 = Drivers already installed.

2 = Invalid port number.

3 = No UART for specified port.

Example:

```
void main(void)
{
status = com_install(1); /* COM1 */
if( status == 0 ) adv_printf("\n COM1 install OK!");
else exit(0);
}
```

Remarks:

None.

com_lower_dtr, com_raise_dtr

Syntax:

void com_lower_dtr(void)

void com_raise_dtr(void)

Description:

Sets COM port to DTR for low signal.

Sets COM port to DTR for high signal.

Parameter Description

None.

Return value:

None.

Example:

None.

Remarks:

Please refer to the 16C550 UART register document (Appendix B).

com_lower_rts, com_raise_rts

Syntax:

void com_lower_rts(unsigned baseaddr)

void com_raise_rts(unsigned baseaddr)

Description:

Sets COM port to RTS for low signal.

Sets COM port to RTS for high signal.

Parameter Description

baseaddr The UART address, COM1=0x3F8,
COM2=0x2F8.

Return value:

None.

Example:

```
#define COM1 0x3F8
#define COM2 0x2F8
void main(void)
{
    com_lower_rts(COM1); /* handshaking with
external serial device */
    ADAMdelay(500);
    com_raise_rts(COM1); /* generates a signal of
500 ms low trigger */
}
```

Remarks:

Please refer to the 16C550 UART register document (Appendix B).

com_read_scratch_register, com_write_scratch_register

Syntax:

int com_read_scratch_register(unsigned baseaddr)

void com_write_scratch_register(unsigned baseaddr, int value)

Description:

Reads from COM port scratch register.

Writes to COM port scratch register.

Parameter Description

baseaddr The UART address, COM1=0x3F8,
COM2=0x2F8.

value Integer value one byte in length, assigned by
user from the range 0 to FF.

Return value:

Please refer to the 16C550 UART register document (Appendix B).

Example:

None.

Remarks:

This byte is reserved for the user. Please refer to the 16C550 UART register document (Appendix B).

com_set_format

Syntax:

```
void com_set_format(int data_length, int parity, int stop_bit)
```

Description:

Sets the parameters for data length, parity and stop bits for the COM1 port.

Parameter Description

data_length Valid range 5 to 8 bits for 1 character.

parity 0: no parity

1: odd parity

2: even parity

stop_bit 1: 1 stop bit

2: 2 stop bits

Return value:

None.

Example

```
void main()
{
/* Sets data format of the COM1 port to 8-bit data length, no
parity, 1 stop bit*/
com_set_format(8, 0, 1);
}
```

Remarks:

None.

com_set_parity

Syntax:

```
void com_set_parity(enum par_code parity, int stop_bits);
```

Description:

Sets the parity and stop bits.

Parameter Description

int code; COM_NONE = 8 data bits, no parity

COM_EVEN = 7 data bits, even parity

COM_ODD = 7 data bits, odd parity

COM_ZERO = 7 data bits, parity bit = zero

COM_ONE = 7 data bits, parity bit = one

int stop_bits; Must be 1 or 2.

Return value:

None.

Example:

```
void main(void)
{
  com_set_parity(COM_NONE, 1); /* set N, 8, 1 */
}
```

Remarks:

None.

com_set_speed

Syntax:

```
void com_set_speed(unsigned long speed);
```

Description:

Sets the baud rate of the COM port.

Parameter Description

speed The baud rate value.

Return value:

None.

Example:

```
void main(void)
{
  com_set_speed(9600L);
  /* set baud rate = 9600 bps */
}
```

Remarks:

None.

com_rx

Syntax:

char com_rx(void)

Description:

Returns the next character from the receive buffer, or a NULL character (`^0`) if the buffer is empty.

Parameter Description

None.

Return value:

c The returned character.

Example:

```
void main(void)
{
  unsigned char COMdata;
  COMdata = com_rx();
}
```

Remarks:

None.

com_tx

Syntax:

```
void com_tx(char c)
```

Description:

com_tx() sends a single character by waiting until the transmit buffer isn't full, then putting the character into it. The interrupt driver will then send the character once it is at the head of the transmit queue and a transmit interrupt occurs.

Parameter Description

c The value you would like to send.

Return value:

None.

Example:

```
void main(void)
{
  com_tx(0x02);
  com_tx(0x03);
}
```

Remarks:

None.

com_rx_empty, com_tx_empty

Syntax:

```
int com_rx_empty(void)
```

```
int com_tx_empty(void)
```

Description:

Small routines to return status of the transmit and receive queues.

Parameter Description

None.

Return value:

Com_rx_empty(void) returns TRUE if the receive queue is empty.

Com_tx_empty(void) returns TRUE if the transmit queue is empty.

Example:

```
void main(void)
{
    unsigned char data;
    if( com_rx_empty() == FALSE) data=com_rx();
}
```

Remarks:

None.

com_tx_string

Syntax:

```
void com_tx_string(char *s)
```

Description:

com_tx_string() sends a string by repeatedly calling com_tx().

Parameter Description

s The string you would like to send.

Return value:

None.

Example:

```
unsigned char name[]="ADAM5510";  
void main(void)  
{  
  com_tx_string(name);  
}
```

Remarks:

None.

com_485_deinstall

Syntax:

```
void com_485_deinstall(void)
```

Description:

Releases the interrupt register of the microprocessor for use by the RS-485 port without changing the baud rate or DTR.

Parameter Description

None.

Return value:

None.

Example:

```
void main()
{
/* Releases the interrupt register for use by the
RS-485 port */
com_485_deinstall();
}
```

Remarks:

This function **MUST** be called before returning to DOS. The interrupt vector will not be pointed to the interrupt service routine again.

com_485_flush_rx(), com_485_flush_tx()

Syntax:

void com_485_flush_rx(void)

void com_485_flush_tx(void)

Description:

COM2 (RS-485) buffer flusher. Initializes the transmitting and receiving queues to their empty states.

Parameter Description

None.

Return value:

None.

Example:

```
void main()
{
  com_485_flush_rx();
  com_485_flush_tx();
}
```

Remarks:

The COM2 (RS-485) transmitter uses polling-action (not interrupt-action). Its buffer is always flushed.

com_485_install

Syntax:

```
int com_485_install(void)
```

Description:

Allocates the interrupt registers of the microprocessor for use by the RS-485 port and sets the interrupt vector to the interrupt service routine.

Parameter Description

None.

Return value:

integer; Installation status.

0 = Successful installation

1 = Drivers are already installed

Example:

```
void main()
{
int status;
status = com_485_install();
if( status ==0)
adv_printf("\n The allocation of COM2 port (RS-485) is
OK !");
else
exit(0);
}
```

Remarks

None.

com_485_rx

Syntax:

```
char com_485_rx(void)
```

Description:

Returns the next character from the receiving buffer, or a NULL character('\0') if the buffer is empty.

Parameter Description

None.

Return value:

c The return character.

Example:

```
void main()  
{  
char C485data;  
C485data=com_485_rx();  
}
```

Remarks:

None.

com_485_set_format

Syntax:

```
void com_485_set_format(int data_length, int parity, int stop_bit)
```

Description:

Sets the parameters data length, parity and stop bits of the RS-485 port.

Parameter Description

data_length Valid range 5 to 8 bits for one character.

parity 0: no parity

1: odd parity

2: even parity

stop_bit 1: 1 stop bit

2: 2 stop bits

Return value:

None.

Example:

```
void main()
{
/* Sets the data format of the RS-485 port to 8-bit
data length, no parity, 1 stop bit*/
com_485_set_format(8, 0, 1);
}
```

Remarks:

None.

com_485_set_speed

Syntax:

```
void com_485_set_speed(unsigned long speed)
```

Description:

Sets the baud rate of the RS-485 port.

Parameter Description

speed The baud rate value.

Return value:

None.

Example:

```
void main()
{
  com_485_set_speed(9600L);/*Sets the baud rate of
the RS-485 port to 9600 bps */
}
```

Remarks:

None.

**com_485_rx_empty(),
com_485_tx_empty()**

Syntax:

```
int com_485_rx_empty(void)
int com_485_tx_empty(void)
```

Description:

Returns the status of the COM2 (RS-485) transmitting and receiving queues.

Parameter Description

None.

Return value:

Com_485_rx_empty() returns "TRUE" if the receiving queue is empty.
Com_485_tx_empty() returns "TRUE" if the transmitting queue is empty.

Example:

```
void main()
{
  unsigned char data;
  if( com_485_rx_empty()== FALSE)
  data =com_485_rx();
}
```

Remarks:

The COM2 (RS-485) transmitter uses polling-action (not interrupt-action). Its queue is always empty.

com_485_tx

Syntax:

```
void com_485_tx(char c)
```

Description:

This function sends a single character to the Tx pin of the RS-485 port, waits until the last bit is sent to the remote terminal, and then sets the RTS pin to OFF.

Parameter Description

c The character you would like to send.

Return value:

None.

Example:

```
void main()
{
  com_485_tx(0x03);
  com_485_tx('$');
}
```

Remarks:

None.

com_485_tx_string

Syntax:

```
void com_485_tx_string(char *s)
```

Description:

com_485_tx_string() sends a string by calling com_485_tx() repeatedly.

Parameter Description

s The string you would like to send.

Return value:

None.

Example:

```
void main()
{
  com_485_tx_string("This is a string test.");
}
```

Remarks:

None.

com_pgm_deinstall

Syntax:

```
void com_pgm_deinstall(void)
```

Description:

Releases the interrupt registers of the microprocessor for use by the programming port without changing the baud rate or DTR.

Parameter Description

None.

Return value:

None.

Example:

```
void main()
{
—
—
/* There are some codes before such a function call
*/
com_pgm_deinstall();
}
```

Remarks:

The programming port is normally used for downloading control programs to the ADAM-5510 using the ADAM-5510 utility. The programming port can be used as an additional communication port if the users have such a requirement. NOTE: The user MUST reset the ADAM-5510 before he uses the port for program downloading again.

com_pgm_flush_rx(), com_pgm_flush_tx()

Syntax:

```
void com_pgm_flush_rx()  
void com_pgm_flush_tx()
```

Description:

COM3 (Programming port) buffer flusher. Initializes the transmit and receive queues to their empty states.

Parameter Description

None.

Return value:

None.

Example:

```
void main()  
{  
  com_pgm_flush_rx();  
  com_pgm_flush_tx();  
}
```

Remarks:

The COM3 (programming port) transmitter uses polling-action (not interrupt-action). Its buffer is always flushed.

com_pgm_install

Syntax:

```
int com_pgm_install(void)
```

Description:

Allocates the interrupt registers of the microprocessor for use by the programming port (COM3) and sets the interrupt vector to the interrupt service routine.

Parameter Description

None.

Return value:

int status: 0 = Successful installation

1 = Drivers are already installed

Example:

```
void main()
{
int status;
status = com_pgm_install();
if( status ==0)
adv_printf("\n Programming port has been installed
successfully !");
else
exit(0);
}
```

Remarks:

None.

com_pgm_rx

Syntax:

```
char com_pgm_rx(void)
```

Description:

Returns the next character from the receiving buffer, or a NULL character ('\0') if the buffer is empty.

Parameter Description

None.

Return value:

c The return character.

Example:

```
void main()
{
char CPGMdata;
CPGMdata=com_pgm_rx();
}
```

Remarks:

None.

com_pgm_rx_empty(), com_pgm_tx_empty()

Syntax:

```
int com_pgm_rx_empty(void)
int com_pgm_tx_empty(void)
```

Description:

Returns the status of the COM3 (Programming port) transmitting and receiving queues.

Parameter Description

None.

Return value:

Com_pgm_rx_empty() returns "TRUE" if the receiving queue is empty.
Com_pgm_tx_empty() returns "TRUE" if the transmitting queue is empty.

Example:

```
void main()
{
    unsigned char data;
    if( com_pgm_rx_empty() == FALSE)
        data = com_pgm_rx();
}
```

Remarks:

The COM3 (programming port) transmitter uses polling-action (not interrupt-action). Its queue is always empty.

com_pgm_set_format

Syntax:

```
void com_pgm_set_format(int data_length, int parity, int stop_bit)
```

Description:

Sets the parameters data length, parity and stop bits of the programming port.

Parameter Description

data_length Valid ranges: 7 or 8 bits for one character.

parity 0: no parity

1: odd parity

2: even parity

stop_bit 1: 1 stop bit

2: 2 stop bits

Return value:

None.

Example:

```
void main()
{
/* Sets the data format of the programming port to
8-bit data length, no parity, 1 stop bit*/
com_pgm_set_format(8, 0, 1);
}
```

Remarks:

None.

com_pgm_set_speed

Syntax:

```
void com_pgm_set_speed(unsigned long speed)
```

Description:

Sets the baud rate of the programming port (COM3).

Parameter Description

speed The baud rate value.

Return value:

None.

Example:

```
void main()
{
  com_pgm_set_speed(9600L);
  /* Sets the baud rate of the programming port to
  9600 bps */
}
```

Remarks:

We suggest that users set the baud rate of the programming port below 57600 bps (included) because the programming port UART chip is not a standard UART chip.

com_pgm_tx

Syntax:

```
void com_pgm_tx(char c)
```

Description:

This function sends a single character to the Tx pin of the programming port, waits until the last bit is sent to the remote terminal, and then sets the RTS pin to OFF.

Parameter Description

c The character you would like to send.

Return value:

None.

Example:

```
void main()
{
  com_pgm_tx(0x03);
  com_pgm_tx('$');
}
```

Remarks:

None.

com_pgm_tx_string

Syntax:

```
void com_pgm_tx_string(char *s)
```

Description:

com_pgm_tx_string() sends a string by calling com_pgm_tx() repeatedly.

Parameter Description

s The string you would like to send.

Return value:

None.

Example:

```
void main()
{
com_pgm_tx_string("This is a string test.");
}
```

Remarks:

None.

com_232_485_deinstall

Syntax:

```
void com_232_485_deinstall(void)
```

Description:

Releases the interrupt register of the microprocessor for use by the RS-232/485 port (COM4) without changing the baud rate or DTR.

Parameter Description

None.

Return value:

None.

Example:

```
void main()
{
/* Releases the interrupt register for use by the COM4 RS-232/485
port */
com_232_485_deinstall();
}
```

Remarks:

This function **MUST** be called before returning to DOS. The interrupt vector will not be pointed to the interrupt service routine again.

com_232_485_flush_rx(), com_232_485_flush_tx()

Syntax:

```
void com_232_485_flush_rx(void)
void com_232_485_flush_tx(void)
```

Description:

COM4 (RS-232/485) buffer flusher. Initializes the transmitting and receiving queues to their empty states.

Parameter Description

None.

Return value:

None.

Example:

```
void main()
{
  com_232_485_flush_rx();
  com_232_485_flush_tx();
}
```

Remarks:

The COM4 (RS-232/485) transmitter uses polling-action (not interrupt-action). Its buffer is always flushed.

com_232_485_install

Syntax:

```
int com_232_485_install(void)
```

Description:

Allocates the interrupt registers of the microprocessor for use by the COM4 RS-232/485 port and sets the interrupt vector to the interrupt service routine.

Parameter Description

None.

Return value:

integer; Installation status.

0 = Successful installation

1 = Drivers are already installed

Example:

```
void main()
{
int status;
status = com_232_485_install();
if( status ==0)
adv_printf("\n The allocation of COM4 port (RS-232/485) is
OK !");
else
exit(0);
}
```

Remarks

None.

com_232_485_rx

Syntax:

```
char com_232_485_rx(void)
```

Description:

Returns the next character from the receiving buffer, or a NULL character(^0) if the buffer is empty.

Parameter Description

None.

Return value:

c The return character.

Example:

```
void main()
{
char C232485data;
C232485data=com_232_485_rx();
}
```

Remarks:

None.

com_232_485_set_format

Syntax:

```
void com_232_485_set_format(int data_length, int parity, int stop_bit)
```

Description:

Sets the parameters data length, parity and stop bits of the COM4 RS-232/485 port.

Parameter Description

data_length Valid range 5 to 8 bits for one character.

parity 0: no parity

1: odd parity

2: even parity

stop_bit 1: 1 stop bit

2: 2 stop bits

Return value:

None.

Example:

```
void main()
{
/* Sets the data format of the COM4 RS-232/485 port to 8-bit
data length, no parity, 1 stop bit*/
com_232_485_set_format(8, 0, 1);
}
```

Remarks:

None.

com_232_485_set_speed

Syntax:

```
void com_232_485_set_speed(unsigned long speed)
```

Description:

Sets the baud rate of the COM4 RS-232/485 port.

Parameter Description

speed The baud rate value.

Return value:

None.

Example:

```
void main()
{
  com_232_485_set_speed(9600L);
  /*Sets the baud rate of the COM4 RS-232/485 port to 9600 bps */
}
```

Remarks:

None.

**com_232_485_rx_empty(),
com_232_485_tx_empty()**

Syntax:

```
int com_232_485_rx_empty(void)  
int com_232_485_tx_empty(void)
```

Description:

Returns the status of the COM4 (RS-232/485) transmitting and receiving queues.

Parameter Description

None.

Return value:

Com_232_485_rx_empty() returns "TRUE" if the receiving queue is empty.

Com_232_485_tx_empty() returns "TRUE" if the transmitting queue is empty.

Example:

```
void main()  
{  
  unsigned char data;  
  if( com_232_485_rx_empty() == FALSE)  
    data = com_232_485_rx();  
}
```

Remarks:

The COM4 (RS-232/485) transmitter uses polling-action (not interrupt-action). Its queue is always empty.

com_232_485_tx

Syntax:

```
void com_232_485_tx(char c)
```

Description:

This function sends a single character to the Tx pin of the COM4 RS-232/485 port, waits until the last bit is sent to the remote terminal, and then sets the RTS pin to OFF.

Parameter Description

c The character you would like to send.

Return value:

None.

Example:

```
void main()
{
com_232_485_tx(0x03);
com_232_485_tx('$');
}
```

Remarks:

None.

com_232_485_tx_string

Syntax:

```
void com_232_485_tx_string(char *s)
```

Description:

com_232_485_tx_string() sends a string by calling com_232_485_tx() repeatedly.

Parameter Description

s The string you would like to send.

Return value:

None.

Example:

```
void main()
{
  com_232_485_tx_string("This is a string test.");
}
```

Remarks:

None.

CRC16

Syntax:

unsigned int CRC16(char *data_p, unsigned int length)

Description:

Calculates the CRC 16-bit value of the string *data_p.

Parameter Description

*data_p The string which you want to calculate CRC code.

length The length of string *data_p.

Return value:

The CRC16 code.

Example:

```
unsigned char String[]="this is a test CRC16";
void main(void)
{
    unsigned int code;
    code = CRC16(String, strlen(String));
    adv_printf("\n The string %s CRC16 code = %d", String,
    Code);
}
```

Remarks:

None.

modem_autoanswer

Syntax:

```
void modem_autoanswer(void)
```

Description:

Sets up modem to auto answer phone calls.

Parameter Description

None.

Return value:

None.

Example:

```
void main(void)
{
  modem_autoanswer();
  /* waiting phone call */
}
```

Remarks:

None.

modem_command

Syntax:

```
void modem_command(char *cmdstr)
```

Description:

Sends an AT command string to the modem. For details, refer to the AT command document provided by the manufacturer.

Parameter Description

cmdstr Specifies command string; refer to AT command string.

Return value:

None.

Example:

```
void main(void)
{
    modem_command("atz"); /* initialize modem */
}
```

Remarks:

None.

modem_command_state

Syntax:

```
void modem_command_state(void)
```

Description:

Sets modem to command mode. In other words, this causes the modem to escape from data mode to command mode. The modem will delay at least 3 seconds before switching back to command mode. This command has the same effect as sending the ASCII command “+++” to the modem.

Parameter Description

None.

Return value:

None.

Example:

```
void main(void)
{
/* receiving data from modem, so modem is in transfer
data mode. */
modem_command_state();
/* now, you can send an AT command string to modem
*/
}
```

Remarks:

None.

modem_dial

Syntax:

```
void modem_dial(char *telenum)
```

Description:

Directs modem to connect to the specified telephone number.

Parameter Description

telenum The phone number you would like modem to dial.

Return value:

None.

Example:

```
void main(void)
{
/* COM port and modem initial OK */
modem_dial("886222184567");
/* waiting to link */
}
```

Remarks:

None.

modem_handup

Syntax:

```
void modem_handup(void)
```

Description:

Sets the modem to hand up the telephone. The command has the same effect as sending the ASCII command “atho” to the modem.

Parameter Description

None.

Return value:

None.

Example:

```
void main(void)
{
  modem_handup(); /* close phone */
}
```

Remarks:

None.

modem_initial

Syntax:

void modem_initial(void)

Description:

Sets modem to initial status. Due to the ADAM5510 system's construction, the modem can only be connected to COM1. This resets the modem to the initial state. The command has the same effect as sending the ASCII command "atZ" to the modem.

Parameter Description

None.

Return value:

None.

Example:

```
void main(void)
{
/* you need to initialize COM1 */
modem_initial();
/* put your modem function... */
}
```

Remarks:

None.

Example Program:

```
#include "5510drv.h"
void main()
{
    unsigned long speed=9600L;
    unsigned char data,ch;
    int status,com,sp;
    unsigned int i,j;
    while(1)
    {
        adv_printf("\n com1: com232");
        adv_printf("\n com2: com485");
        adv_printf("\n com3: com232485");
        adv_printf("\n Input the coummunction at com : ");
        scanf("%d",&com);
        adv_printf("\n Select baud rate 9600L ");
        adv_printf("\n [1] 9600L ");
        adv_printf("\n [2] 19200L ");
        adv_printf("\n [3] 38400L ");
        adv_printf("\n [4] 57600L ");
        adv_printf("\n [5]115200L ");
        adv_printf("\n baudrate=");
        scanf("%d",&sp);

        //com2 port (RS-485) install
        switch(sp)
        {
            case 1:
                speed=9600L;break;
            case 2:
                speed=19200L;break;
            case 3:
                speed=38400L;break;
            case 4:
                speed=57600L;break;
            case 5:
                speed=115200L;break;
            default:
                speed=115200L;break;
        }
    }
}
```

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```
    }
    switch(com)
    {
        case 1:

            status=com_install(1);
            if(status==0)
                adv_printf("\n The allocation of com%d port is ok\n ",com);
                else if (status==1)
                {
                    adv_printf("\ncom%d port is already
                    installed\n ",com);
                }
            else
            {
                adv_printf("\n The allocation of com%d port is not ok\n ",com);
                adv_printf("status=%d\n",status);
                exit(0);
            }

            //Format and Speed Setting
            com_set_format(8,0,1);
            com_set_speed(speed);
            //Transfer data
            adv_printf("Stop transfer data <ESC>");
            for(i=0;i<1000;i++)
            {
                for(j=0;j<1000;j++)
                {
                    com_tx_string(" com232 test ");
                    if(kbhit())
                    {
                        ch=getch();
                        if(ch==0x1b){ i=1000;j=1000 ;}
                    }
                }
            }
            //Receive data
            adv_printf("\n\n Please transfer data from server or <ESC> to
            exit\n");
```

```
while(1)
{
    if(com_rx_empty()==0)
    {
        data=com_rx();
        adv_printf("\n %c",data);

    }
    if(kbhit())
    {
        ch=getch();
        if(ch==0x1b){ break; }
    }
}
break;
case 2:
status=com_485_install();
if(status==0)
    adv_printf("\n The allocation of com%d port is ok\n ",com);
    else if (status==1)
    {
        adv_printf("\ncom%d port is
already installed\n ",com);
    }
else
{
    adv_printf("\n The allocation of com%d port is not ok\n ",com);
    adv_printf("status=%d\n",status);
    exit(0);
}

//Format and Speed Setting
com_485_set_format(8,0,1);
com_485_set_speed(speed);
//Transfer data
adv_printf("Stop transfer data <ESC>");
for(i=0;i<1000;i++)
{
    for(j=0;j<1000;j++)
    {
```

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```
    com_485_tx_string(" com485 test ");
    if(kbhit())
    {
        ch=getch();
        if(ch==0x1b){ i=1000;j=1000 ;}
    }
}
//Receive data

adv_printf("\nPlease transfer data from server or input<ESC> to
exit\n");
while(1)
{
    if(com_485_rx_empty()==0)
    {
        data=com_485_rx();
        adv_printf("\n %c",data);
    }
    if(kbhit())
    {
        ch=getch();
        if(ch==0x1b){ break; }
    }
}
break;
case 3:
status=com_232_485_install();
if(status==0)
    adv_printf("\n The allocation of com%d port is ok\n ",com);
    else if (status==1)
    {
        adv_printf("\ncom%d port is
already installed\n ",com);
    }
else
{
    adv_printf("\n The allocation of com%d port is not ok\n ",com);
    adv_printf("status=%d\n",status);
    exit(0);
}
```

```
//Format and Speed Setting
com_232_485_set_format(8,0,1);
com_232_485_set_speed(speed);
//Transfer data
adv_printf("Stop transfer data <ESC>");
for(i=0;i<1000;i++){
  for(j=0;j<1000;j++){
    com_232_485_tx_string(" com232485 test ");
    if(kbhit())
      {
        ch=getch();
        if(ch==0x1b){ i=1000;j=1000 ;}
      }
  }
}
//Receive data
adv_printf("\n\n Please transfer data from server or <ESC> to
exit\n");
while(1)
{
  if(com_232_485_rx_empty()==0)
  {
    data=com_232_485_rx();
    adv_printf("\n %c",data);
  }
  if(kbhit())
  {
    ch=getch();
    if(ch==0x1b){ break; }
  }
}
break;
default:
break;
}
adv_printf("\n <ESC> to exit or anykey to continue\n ");
  ch=getch();
  if(ch==0x1b){ break;}
}
}
```

5.4.5 Serial Module Functions (A5090*.LIB)

Port\Slot	Slot0	Slot 1	Slot2	Slot 3	Slot4	Slot5	Slot6	Slot7
Port 1	1	11	21	31	41	51	61	71
Port 2	2	12	22	32	42	52	62	72
Port 3	3	13	23	33	43	53	63	73
Port 4	4	14	24	34	44	54	64	74

Table 5-2: ADAM-5090 Port No. Definition

Install Port

Syntax:

```
int port_install(int portno)
```

Description:

Install the communication drivers

Parameter

portno

Description

The specified port number

Return Value:

- 0 first time install and install completely!
- 4 not first time install but install completely!
- 5 portno error
- 6 no ADAM5090 Module in this slot

Deinstalled Port

Syntax:

```
int port_deinstalled(int portno)
```

Description:

Uninstalled the communication drivers completely

Parameter

portno

Description

The specified port number

Return Value:

0	deinstall success
-1	deinstall fail

Select Working Port

Syntax:

```
void port_select(int portno)
```

Description:

Select a specified port for work

Parameter

portno

Description

The specified port number

Return Value:

None

Reset Slot

Syntax:

```
int reset_slot(int slotno)
```

Description:

Reset specified slot

Parameter

slotno

Description

The slot you would like to reset
0~3

Return Value:

None

Example:

```
void main ()  
{  
//reset all port in the slot 0  
reset_slot(0);  
}
```

Reset Port

Syntax:

```
void port_reset(int portno)
```

Description:

Reset specified port

Parameter

portno

Description

The specified port number

Return Value:

None

Detect Installed Port

Syntax:

```
int which_has_been_installed(void)
```

Description:

Detects which ports have been installed

Parameter	Description
portno	The specified port number

Return Value:

Port mask which has been installed

EX.

```
0x2353 (0010-0011-0101-0011B)
The port01,02,11,13,21,22,32 have been installed
```

```
0x0082 (0000-0000-1000-0010B)
The port02,14 have been installed
```

Example:

```
void main ()
{
    int Flag;

    //here we install port1, 12, 23

    port_install(1);
    port_install(12);
    port_install(23);

    //set flat as the return value

    Flag=which_has_been_install();

    //Flag must be 0000-0100-0010-0001B

}
```

Set Port Baud Rate

Syntax:

```
void port_set_speed(int portno, long speed)
```

Description:

Set the baud rate of specified port

Parameter	Description
portno	The specified port number
long speed	4800L, 9600L, 19200L, 38400L, 115200L

Return Value:

None

Example:

```
void main ()  
  
{  
//here we install port1, 2  
port_install(1);  
port_install(2);  
  
//select working port1, and set the communication rate to 38400bps  
port_select(1);  
  
port_speed(1, 38400L)  
  
//select working port2, and set the communication rate to 9600bps  
port_select(2);  
  
port_speed(2, 9600L)  
}
```

Set Port Data Format

Syntax:

```
void port_set_format(int portno, int data_length, int parity, int stop_bit)
```

Description:

Set the parameters for data length, parity and stop bits for specified port

Parameter	Description
portno	The specified port number
data length	5 - 8
parity	0x00 no parity 0x01 odd parity 0x02 even parity
stop bit	0x01 1 stop bit 0x02 2 stop bits

Return Value:

None

Example:

```
void main ()  
{  
port_install(1); port_select(1); port_speed(1, 9600L);  
  
//set data format(Data Length=8; Parity=None; Stop Bit=1)  
  
port_set_format(1, 8, 0, 1);  
  
}
```

Disable Port FIFO (FIFO Size=1, for Tx and Rx) Enable Port FIFO (FIFO Size=128, for Tx and Rx)

Syntax:

```
void port_disable_fifo(int portno)
int port_enable_fifo(int portno)
```

Description:

Set specified port to disable FIFO
Set specified port to enable FIFO

Parameter	Description
portno	The specified port number

Return Value:

Disable FIFO	: None	
Enable FIFO	: 0x00	FIFO enable success
	0x01	FIFO not available
	0x04	portno error

Example:

```
void main ()
{
port_install(1);
:
:
port_set_format(1, 8, 0, 1)
//enable port1 FIFO to 128 byte port_enable_fifo(1);
}
```

Detect Port Carrier

Syntax:

```
int port_carrier(int portno)
```

Description:

Detect the carrier signal of specified port

Parameter	Description
portno	The specified port number

Return Value:

```
0          : no carrier been detected or bad command or parameter
1          : detect carrier
```

Example:

```
void main ()
{
port_install(1);
:
:
port_enable_fifo(1);
//if port1 detected carrier, print out the message if(port_carrier(1));
{
adv_printf("\n port1 detect carrier");
{
}
```

Clear Port Break Set Port Break

Description:

Set specified port to clear BREAK signal

Set specified port to send BREAK signal

Syntax:

```
void port_clear_break(int portno)
```

```
void port_set_break(int portno)
```

Parameter	Description
portno	The specified port number

Return Value:

None

Example:

```
void main ()  
  
{  
  
port_install(1);  
  
:  
  
:  
  
port_enable_fifo(1);  
  
    //set port1 to clear break signal port_clear_break(1);  
  
    //or "port_set_break(1)"  
  
}
```

Clear Local Loopback Set Local Loopback

Syntax:

```
void port_clear_local_loopback(int portno)  
void port_set_local_loopback(int portno)
```

Description:

Set specified port to disable loopback function for diagnostic
Set specified port to enable loopback function for diagnostic

Parameter	Description
portno	The specified port number

Return Value:

None

Example:

```
void main ()  
  
{  
  
port_install(1);  
  
:  
  
:  
  
port_enable_fifo(1);  
  
//set port1 to enable loopback function for diagnostic  
port_set_local_loopback(1);  
  
//or "port_clear_local_loopback(1)"  
  
}
```

Read LSR Set LCR

Syntax:

```
int port_get_line_status(int portno)
int port_set_line_params(int portno, int lineparams)
```

Description:

Read from specified port line status register (LSR)
Write to specific port line control register (LCR)

Parameter	Description
portno	The specified port number
lineparams	Line control register parameter (see UART Register Description Table)

Return Value:

```
port_get_line_status :
    0x00XX : LSR value
    0xFF00 : bad command or parameter
port_set_line_params :
    0x00 : write success
    0x01 : LCR read back error
    0xFE00 : LCR write not able
    0xFF00 : bad command or parameter
```

Example:

```
void main ()
{
int LSR_Value, LCR_Params;
port_install(1);
:
:
port_enable_fifo(1);

//get LSR value
LSR_Value=port_get_line_status(1);

//set LCR value=0x03
LCR_Params=0x03;
port_set_line_status(1, LCR_Params);
```

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Register Name	Description	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LSR	Line Status Register	Data Error	Tx Empty	THR Empty	Rx Break	Framing Error	Parity Error	Overrun Error	RxRDY
LCR	Line Control Register	divisor latch access	Tx Break	Force parity	odd/even parity	Parity enable	Number of stop bit	data length bits[1:0]	

UART Register Description Table

Read Modem Status (MSR)

Syntax:

```
int port_get_modem_status(int portno)
```

Description:

Read from specified port modem status register

Parameter

portno

Description

The specified port number

Return Value:

```
0x00XX      :    modem status
0xFF00      :    bad command or parameter
```

Example:

```
void main ()

{
int MSR_Value;
port_install(1);
:
:
port_enable_fifo(1);

//get MSR value
MSR_Value=port_get_modem_status(1);
}
```

Register Name	Description	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LSR	Line Status Register	Data Error	Tx Empty	THR Empty	Rx Break	Framing Error	Parity Error	Overrun Error	RxRDY
LCR	Line Control Register	divisor latch access	Tx Break	Force parity	odd/even parity	Parity enable	Number of stop bit	data length bits[1:0]	

UART Register Description Table

Read Modem Control Register (MCR) Set Modem Control Register (MCR)

Syntax:

```
int port_get_modem_control_status(int portno)  
int port_set_modem_control_params(int portno, int MCRparams)
```

Description:

Read from specified port modem control register
Set from specified port modem control register

Parameter	Description
portno	The specified port number
MCRparams	Modem control register parameter (see UART Register Description Table)

Return Value:

Read MCR:

```
0x00XX : modem status  
0xFF00 : bad command or parameter
```

Write MCR:

```
0x0000 : write MCR success  
0x0001 : read back error  
0xFF00 : bad command or parameter
```

Example: void main ()

```
{  
  
int MCR_Value, MCR_Params;  
  
port_install(1);  
  
:  
  
:  
  
port_enable_fifo(1);
```

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```
//set MCR value=3 (RTS=1; DTR=1) MCR_Params=3  
port_set_modem_control_params(1, MCR_Params);
```

```
//get MCR value
```

```
MCR_Value=port_get_modem_control_status(1);
```

```
// MCR value must be 3
```

```
}
```

Register Name	Description	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LSR	Line Status Register	Data Error	Tx Empty	THR Empty	Rx Break	Framing Error	Parity Error	Overrun Error	RxRDY
LCR	Line Control Register	divisor latch access	Tx Break	Force parity	odd/even parity	Parity enable	Number of stop bit	data length bits[1:0]	

UART Register Description Table

Set DTR Low Set DTR High

Syntax:

```
void port_lower_dtr(int portno)  
void port_raise_dtr(int portno)
```

Description:

Set specified port DTR low
Set specified port DTR high

Parameter	Description
portno	The specified port number

Return Value:

None

Example:

```
void main ()  
  
{  
  
port_install(1);  
  
:  
  
:  
//set port1 DTR low port_lower_dtr(1);  
  
//set port1 DTR high port_raise_dtr(1);  
  
}
```

Set RTS High Set RTS Low

Syntax:

```
void port_raise_rts(int portno)
void port_lower_rts(int portno)
```

Description:

Set specified port RTS high
Set specified port RTS low

Parameter	Description
portno	The specified port number

Return Value:

None

Example:

```
void main ()
{
port_install(1);

:

:
//set port1 RTS low port_lower_rts(1);

//set port1 RTS high port_raise_rts(1);
}
```

Modem Initial

Syntax:

modem_initial_90(int portno)

Description:

Set modem to initial status

parameter	Description
portno	The specified port number

Return Value:

None

Send Modem AT Command

Syntax:

modem_command_90(int portno, char *cmdstr)

Description:

Send AT command string to the modem

parameter	Description
portno	The specified port number
*cmdstr	AT command string

Return Value:

None

Set Modem Command Mode

Syntax:

```
void modem_command_state_90(int portno)
```

Description:

Set modem to command mode

parameter	Description
portno	The specified port number

Return Value:

None

Set Modem Autoanswer

Syntax:

```
void modem_autoanswer_90(int portno)
```

Description:

Set up modem to auto answer phone calls

parameter	Description
portno	The specified port number

Return Value:

None

Modem Dial Out

Syntax:

```
void modem_dial_90(int portno, char *telnumber)
```

Description:

Direct modem to dial the specified telephone number

parameter	Description
portno	The specified port number
*telnumber	The telephone number you would like to dial out

Return Value:

None

Example: void main ()

```
{  
  
port_install(1);  
  
:  
  
:  
  
//initial modem for port1  
  
modem_initial_90(1);  
  
  
//set the dial out number as "1234-5678"  
  
modem_dial_90(1, "12345678");  
  
}
```

Han up Modem

Syntax:

```
void modem_handup_90(int portno)
```

Description:

Set modem to hand up the telephone

parameter	Description
portno	The specified port number

Return Value:

None

Rx Flush Tx Flush

Syntax:

```
void port_flush_rx(int portno) void port_flush_tx(int portno)
```

Description:

Flush Rx or Tx FIFO

parameter	Description
portno	The specified port number

Return Value:

None

Receive Error Check

Syntax:

```
int port_rx_error(int portno)
```

Description:

Check whether receive error or not

Parameter

portno

Description

The specified port number

Return Value:

0 : no error

0x00XX : receive error and return LSR value

Example:

```
void main ()
{
int Err_Value;

port_install(1);

:

:

//get error check value; if error, print out the message
Err_Value=port_rx_error(1); if(Err_Value)

{

adv_printf("\n Rx Error, The LSR value=%X", Err_Value);

}

}
```

Ready Check

Syntax:

```
int port_rx_ready(int portno)
```

Description:

Check received data in port FIFO already

Parameter

portno

Description

The specified port number

Return Value:

0 : data not ready

1 : data ready

Receive Character

Syntax:

```
char port_rx(int portno)
```

Description:

Receive a character from specific port

Parameter

portno

Description

The specified port number

Return Value:

Character

Example:

```
void main ()  
  
{  
  
char C;  
  
port_install(1);  
  
:  
  
:  
  
//if port1 FIFO receive data, read a character and print it out  
  
if(port_rx_ready(1));  
  { C=port_rx(1);  
  
adv_printf("\n %C", C);  
  
  }  
  
}
```

Empty Check

Syntax:

```
int port_tx_empty(int portno)
```

Description:

Return the status of the specified port transmit queues

Parameter

portno

Description

The specified port number

Return Value:

0 : not empty

1 : FIFO empty

2 : FIFO and Transmitting empty

Send Character

Syntax:

```
void port_tx(int portno, char c)
```

Description:

Send a character to the THR of the specified port

Parameter	Description
portno	The specified port number
c	The character you would like to send

Return Value:

None

Example:

```
main()

{
char character
port_installed(1)

:

:
//check whether FIFO empty or not, if empty, send a character
if(port_tx_empty(1);

{

character='a'

port_tx(1, character)

{

}
```

Send String

Syntax:

```
void port_tx_string(int portno, char *s)
```

Description:

Sends a string by calling port_tx() repeatedly

Parameter

portno

*s

Description

The specified port number

the string you would like to send

Return Value:

None

Example:

```
main()

{
char string port_installed(1)

:

:
//check whether FIFO empty or not, if empty, send a string
if(port_tx_empty(1);

{

string="abcde"

port_tx_string(1, string)

{

}
```

5.4.6 MODBUS/RTU Functions (MBRTU*.LIB and MBRTU9*.LIB)

For ADAM-5510 Series COM Ports:

Modbus_COM_Init

Syntax:

```
int Modbus_COM_Init(int Port, int iMode, unsigned long iBaud, int iParity, int iFormat, int iStopBits);
```

Description:

Initial a COM port for Modbus/RTU connection.

Parameters	Value	Description
Port:	COM1	Initial COM1
	COM2	Initial COM2
	COM4	Initial COM4
iMode:	Slave	Modbus/RTU slave mode
	Master	Modbus/RTU master mode
iBaud:	9600, etc ...	The value of baud rate
iparity:	NO_PARITY	No parity
	ODD_PARITY	Odd parity
	EVEN_PARITY	Even parity
	ONE_PARITY	Parity=1
	ZERO_PARITY	Parity=0
iFormat:	DATA5	5 data bit
	DATA6	6 data bit
	DATA7	7 data bit
	DATA8	8 data bit
iStopBits:	STOP1	One stop bit
	STOP2	Two stop bits

Return value:

- 0 No error occurs
- 1 COM_already_installed: COM port has been installed before.
- 2 Err_Access_COM: Error occurs when try to access COM port.

Example:

```
if(Modbus_COM_Init(COM2, Master, (unsigned long)9600, NO_PARITY,  
DATA8, STOP1)!=0)  
{  
    adv_printf("error\n");  
    return;  
}  
  
adv_printf("init success!!\n");
```

Modbus_COM_Release

Syntax:

```
void Modbus_COM_Release(int Port);
```

Description:

Release the COM port of Modbus connection

Parameters	Value	Description
Port	1	COM1
	2	COM2
	4	COM4

Return value:

None

Error_Code

Syntax:

```
int Error_Code(void);
```

Description:

When following function call gets error return, this function can get the exact error code for user.

ADAMRTU_ForceMultiCoils(), ADAMRTU_ForceSingleCoil(),
ADAMRTU_PresetMultiRegs(), ADAMRTU_PresetSingleReg(),
ADAMRTU_ReadCoilStatus(), ADAMRTU_ReadHoldingRegs(),
ADAMRTU_ReadInputRegs(), ADAMRTU_ReadInputStatus()

Parameters	Description
------------	-------------

None	
------	--

Return value:

NULL	No exception error returned
Erro Code	Exception error returned

Error code:

91	Invalid Response
92	COM Port Initial or Mode Error
93	COM Port Time Out

Example:

```
if(!ADAMRTU_ForceMultiCoils(COM2, 0x01, 0x11, 0x0C, 0x02, HostData)){  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
    adv_printf("Success!!\n");
```

ADAMRTU_ForceMultiCoils

Syntax:

```
bool ADAMRTU_ForceMultiCoils(int iPort, int Slave_Addr,  
    int CoillIndex, int TotalPoint, int TotalByte,  
    unsigned char szData[]);
```

Description:

“0F HEX” command of Modbus/RTU function code

Parameter

Parameter	Description
iPort	COM port number
Slave_Addr	Slave address
CoillIndex	Coil address
TotalPoint	Quantity of coils
TotalByte	Byte count
szData[]	Force Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
HostData[0]=0xf0;
```

```
if(!ADAMRTU_ForceMultiCoils(COM1, 0x02, 0x64, 0x08, 0x01, HostData))  
    {  
        adv_printf("err code is %d\n", Error_Code());  
        adv_printf("fail send..");  
    }  
else  
    adv_printf("Success!!");
```

ADAMRTU_ForceSingleCoil

Syntax:

```
bool ADAMRTU_ForceSingleCoil(int iPort, int i_iAddr, int i_iCoilIndex,  
                             int i_iData);
```

Description:

“05 HEX” command of Modbus/RTU function code.

Parameter	Description
iPort	COM port number
i_iAddr	Slave address
i_iCoilIndex	Coil address
int i_iData	Force Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
if(!ADAMRTU_ForceSingleCoil(COM1, 0x02, 0x65, 0))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
    adv_printf("Success!!");
```

ADAMRTU_PresetMultiRegs

Syntax:

```
bool ADAMRTU_PresetMultiRegs(int iPort, int i_iAddr, int i_iStartReg,  
    int i_iTotalReg, int i_iTotalByte, unsigned char i_szData[]);
```

Description:

“10 HEX” command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave address
i_iStartReg	Starting Address
i_iTotalReg	No. of Registers Hi
i_iTotalByte	Byte Count
i_szData[]	Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
HostData[0]=0x12;  
HostData[1]=0x56;  
HostData[2]=0x38;  
HostData[3]=0x09;
```

```
if(!ADAMRTU_PresetMultiRegs(COM1, 0x02, 0x64, 2, 4, HostData))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
    return;  
}  
else  
    adv_printf("Success!!");
```

ADAMRTU_PresetSingleReg

Syntax:

```
bool ADAMRTU_PresetSingleReg(int iPort, int i_iAddr, int i_iRegIndex,  
                             int i_iData);
```

Description:

“06 HEX” command of Modbus RTU function code

Parameter	Description
IPort	COM port number
i_iAddr	Slave Address
i_iRegIndex	Register Address
i_iData	Preset Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
if(!ADAMRTU_PresetSingleReg(COM1, 0x02, 0x68, 0x1234))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
    return;  
}  
else  
    adv_printf("Success!!");
```

ADAMRTU_ReadCoilStatus

Syntax:

```
bool ADAMRTU_ReadCoilStatus(int iPort, int i_iAddr, int i_iStartIndex,  
    int i_iTotalPoint, int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

“01HEX” command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Coil Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
if(!ADAMRTU_ReadCoilStatus(COM1, 0x02, 0x6E, 0x01, &DataByteCount,  
    HostData))  
    {  
        adv_printf("err code is %d\n", Error_Code());  
        adv_printf("fail send..");  
    }  
else  
    {  
        adv_printf("Status: ");  
        for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
            {  
                adv_printf("%02X", HostData[tmpcnt]);  
            }  
        adv_printf("\n");  
    }  
}
```

ADAMRTU_ReadHoldingRegs

Syntax:

```
bool ADAMRTU_ReadHoldingRegs(int iPort, int i_iAddr,  
                             int i_iStartIndex, int i_iTotalPoint,  
                             int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

"03 HEX" command of Modbus RTU function code.

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Register Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
if(!ADAMRTU_ReadHoldingRegs(COM1, 0x02, 0x65, 0x01, &DataByteCount,  
    HostData))  
    {  
        adv_printf("err code is %d\n", Error_Code());  
        adv_printf("fail send..");  
    }  
else  
    {  
        adv_printf("Status: ");  
        for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
            {  
                adv_printf("%02X", HostData[tmpcnt]);  
            }  
        adv_printf("\n");  
    }  
}
```

ADAMRTU_ReadInputRegs

Syntax:

```
bool ADAMRTU_ReadInputRegs(int iPort, int i_iAddr, int i_iStartIndex,  
                           int i_iTotalPoint, int *o_iTotalByte,  
                           unsigned char o_szData[]);
```

Description:

“04 HEX” command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Register Data

Return value:

TRUE No error occurs
FALSE Error occurs, call Error_Code() for exact error codes

Example:

```
if(!ADAMRTU_ReadInputRegs(COM1, 0x02, 0x65, 0x01, &DataByteCount,  
    HostData))  
    {  
        adv_printf("err code is %d\n", Error_Code());  
        adv_printf("fail send..");  
    }  
else  
    {  
        adv_printf("Status: ");  
        for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
            {  
                adv_printf("%02X", HostData[tmpcnt]);  
            }  
        adv_printf("\n");  
    }
```

ADAMRTU_ReadInputStatus

Syntax:

```
bool ADAMRTU_ReadInputStatus(int iPort, int i_iAddr,  
                             int i_iStartIndex, int i_iTotalPoint,  
                             int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

"02 HEX" command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Inputs Data

Return value:

TRUE No error occurs
FALSE Error occurs, call Error_Code() for exact error codes

Example:

```
if(!ADAMRTU_ReadInputStatus(COM1, 0x02, 0x64, 0x08, &DataByteCount,  
    HostData))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
{  
    adv_printf("Status: ");  
    for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
    {  
        adv_printf("%02X", HostData[tmpcnt]);  
    }  
    adv_printf("\n");  
}
```

ADAMRTU_ModServer_Create

Syntax:

```
void ADAMRTU_ModServer_Create(int slave_addr, unsigned char *  
                               ptr_mem, unsigned int size_of_mem);
```

Description:

Create Modbus/RTU Server function

Parameter	Description
slave_addr	Slave address of Modbus/RTU Server
ptr_mem	Share memory
size_of_mem	Size of share memory

Return value:

None

Example:

```
ADAMRTU_ModServer_Create(3, (unsigned char *)Share_Mem,  
                          sizeof(Share_Mem));  
  
    adv_printf("server started..\n");  
  
    while(1)  
    {  
        if(predate != Share_Mem[0])  
        {  
            adv_printf("40001 is %X\n", Share_Mem[0]);  
            //strongly recommend use adv_printf() instead of printf()  
            predate = Share_Mem[0];  
        }  
    }
```

Ver_RTU_Mod

Syntax:

```
void Ver_RTU_Mod(char *vstr);
```

Description:

Check Modbus/RTU library version

Parameter	Description
vstr	Pointer to array of library version information

Return value:

None

Example:

```
char library_ver[20];

void main(void)
{
    Ver_RTU_Mod(library_ver);

    adv_printf("The version of library is %s\n", library_ver);
}
```

For ADAM-5090 Serial COM Ports:

Error_Code

Syntax:

```
int Error_Code(void);
```

Description:

When following function call gets error return, this function can get the exact error code for user.

A5090_RTU_ForceMultiCoils(), A5090_RTU_ForceSingleCoil(),
A5090_RTU_PresetMultiRegs(), A5090_RTU_PresetSingleReg(),
A5090_RTU_ReadCoilStatus(), A5090_RTU_ReadHoldingRegs(),
A5090_RTU_ReadInputRegs(), A5090_RTU_ReadInputStatus()

Parameters	Description
------------	-------------

None

Return value:

NULL	No exception error returned
Erro Code	Exception error returned

Error code:

91	Invalid Response
92	COM Port Initial or Mode Error
93	COM Port Time Out

Example:

```
iport = 74;           //slot7, port 4

...

if(!A5090_RTU_ReadCoilStatus(iport, 0x02, 0x6E, 0x01,
    &DataByteCount, HostData))
    {
        adv_printf("err code is %d\n", Error_Code());
        adv_printf("fail send..");
    }
```

Modbus_5090_Init

Syntax:

```
int Modbus_5090_Init(int Port, unsigned long iBaud, int iParity,
                    int iFormat, int iStopBits);
```

Description:

Initial a COM port on ADAM-5090 for Modbus/RTU connection.

Parameters:	Value	Description
Port:	See below	
iBaud:	9600, etc ...	The value of baud rate
iparity:	NO_P	No parity
	ODD_P	Odd parity
	EVEN_P	Even parity
	ONE_P	Parity=1
	ZERO_P	Parity=0
iFormat:	D5	5 data bit
	D6	6 data bit
	D7	7 data bit
	D8	8 data bit
iStopBits:	S1	One stop bit
	S2	Two stop bits

Port\Slot	Slot0	Slot 1	Slot2	Slot 3	Slot4	Slot5	Slot6	Slot7
Port 1	1	11	21	31	41	51	61	71
Port 2	2	12	22	32	42	52	62	72
Port 3	3	13	23	33	43	53	63	73
Port 4	4	14	24	34	44	54	64	74

Table 5-2: ADAM-5090 Port No. Definition

Return value:

0x00 It's the first time installed and install OK !
 0x04 It's not the first time installed and install OK !
 0x05 The port number is incorrect
 0x06 It's not ADAM5090 module in this slot
 0x07 Fail to create Rx buffer

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Example:

```
iport = 74; //slot7, port 4

if(Modbus_5090_Init(iport, 9600L, NO_P, D8, S1)!=0)
    {
        adv_printf("error\n");
        return;
    }
```

Modbus_5090_Release

Syntax:

```
int Modbus_5090_Release(int Port);
```

Description:

Release the ADAM-5090 COM port of Modbus connection

Parameters:

Port See Table 5-2 on Modbus_5090_Init()

Return value:

0	No error occurs
-1	Error occurs

A5090_RTU_ForceMultiCoils

Syntax:

```
bool A5090_RTU_ForceMultiCoils(int iPort, int Slave_Addr,  
                               int CoillIndex, int TotalPoint,  
                               int TotalByte, unsigned char szData[]);
```

Description:

"0F HEX" command of Modbus/RTU function code

Parameter	Description
iPort	COM port number
Slave_Addr	Slave address
CoillIndex	Coil address
TotalPoint	Quantity of coils
TotalByte	Byte count
szData[]	Force Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;           //slot7, port 4  
...  
  
HostData[0]=0xf0;  
...  
  
if(!A5090_RTU_ForceMultiCoils(iport, 0x02, 0x64, 0x08, 0x01, HostData))  
    {  
        adv_printf("err code is %d\n", Error_Code());  
        adv_printf("fail send..");  
    }  
    else  
        adv_printf("Success!!");
```

A5090_RTU_ForceSingleCoil

Syntax:

```
bool A5090_RTU_ForceSingleCoil(int iPort, int i_iAddr, int i_iCoilIndex,  
                               int i_iData);
```

Description:

“05 HEX” command of Modbus/RTU function code.

Parameter	Description
iPort	COM port number
i_iAddr	Slave address
i_iCoilIndex	Coil address
int i_iData	Force Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;                //slot7, port 4  
  
if(!A5090_RTU_ForceSingleCoil(iport, 0x02, 0x65, 1))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
    adv_printf("Success!!");
```

A5090_RTU_PresetMultiRegs

Syntax:

```
bool A5090_RTU_PresetMultiRegs(int iPort, int i_iAddr, int i_iStartReg,  
                                int i_iTotalReg, int i_iTotalByte, unsigned char i_szData[]);
```

Description:

“10 HEX” command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave address
i_iStartReg	Starting Address
i_iTotalReg	No. of Registers Hi
i_iTotalByte	Byte Count
i_szData[]	Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;           //slot7, port 4  
  
HostData[0]=0x12;  
HostData[1]=0x56;  
HostData[2]=0x38;  
HostData[3]=0x09;  
  
if(!A5090_RTU_PresetMultiRegs(iport, 0x02, 0x64, 2, 4, HostData))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
    return;  
}  
else  
    adv_printf("Success!!");
```

A5090_RTU_PresetSingleReg

Syntax:

```
bool A5090_RTU_PresetSingleReg(int iPort, int i_iAddr,  
                               int i_iRegIndex, int i_iData);
```

Description:

“06 HEX” command of Modbus RTU function code

Parameter	Description
IPort	COM port number
i_iAddr	Slave Address
i_iRegIndex	Register Address
i_iData	Preset Data

Return value:

TRUE No error occurs
FALSE Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;            //slot7, port 4  
  
if(!A5090_RTU_PresetSingleReg(iport, 0x02, 0x68, 0x1234))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
    return;  
}  
else  
    adv_printf("Success!!");
```

A5090_RTU_ReadCoilStatus

Syntax:

```
bool A5090_RTU_ReadCoilStatus(int iPort, int i_iAddr,  
                               int i_iStartIndex, int i_iTotalPoint,  
                               int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

"01HEX" command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Coil Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;           //slot7, port 4  
  
if(!A5090_RTU_ReadCoilStatus(iport, 0x02, 0x6E, 0x01, &DataByteCount,  
                               HostData))  
    {  
        adv_printf("err code is %d\n", Error_Code());  
        adv_printf("fail send..");  
    }  
else  
    {  
        adv_printf("Status: ");  
        for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
            {  
                adv_printf("%02X", HostData[tmpcnt]);  
            }  
        adv_printf("\n");  
    }  
}
```

A5090_RTU_ReadHoldingRegs

Syntax:

```
bool A5090_RTU_ReadHoldingRegs(int iPort, int i_iAddr,  
                               int i_iStartIndex, int i_iTotalPoint,  
                               int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

"03 HEX" command of Modbus RTU function code.

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Register Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;           //slot7, port 4  
  
if(!A5090_RTU_ReadHoldingRegs(iport, 0x02, 0x65, 0x01, &DataByteCount,  
                               HostData))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
{  
    adv_printf("Status: ");  
    for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
    {  
        adv_printf("%02X", HostData[tmpcnt]);  
    }  
    adv_printf("\n");  
}
```

A5090_RTU_ReadInputRegs

Syntax:

```
bool A5090_RTU_ReadInputRegs(int iPort, int i_iAddr,  
                             int i_iStartIndex, int i_iTotalPoint,  
                             int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

"04 HEX" command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Register Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;           //slot7, port 4  
  
if(!A5090_RTU_ReadInputRegs(iport, 0x02, 0x65, 0x01, &DataByteCount,  
HostData))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
{  
    adv_printf("Status: ");  
    for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
    {  
        adv_printf("%02X", HostData[tmpcnt]);  
    }  
    adv_printf("\n");  
}
```

A5090_RTU_ReadInputStatus

Syntax:

```
bool A5090_RTU_ReadInputStatus(int iPort, int i_iAddr,  
                               int i_iStartIndex, int i_iTotalPoint,  
                               int *o_iTotalByte, unsigned char o_szData[]);
```

Description:

"02 HEX" command of Modbus RTU function code

Parameter	Description
iPort	COM port number
i_iAddr	Slave Address
i_iStartIndex	Starting Address
i_iTotalPoint	No. of Points
o_iTotalByte	Byte Count
o_szData[]	Inputs Data

Return value:

TRUE	No error occurs
FALSE	Error occurs, call Error_Code() for exact error codes

Example:

```
iport = 74;           //slot7, port 4  
  
if(!A5090_RTU_ReadInputStatus(iport, 0x02, 0x64, 0x08, &DataByteCount,  
                               HostData))  
{  
    adv_printf("err code is %d\n", Error_Code());  
    adv_printf("fail send..");  
}  
else  
{  
    adv_printf("Status: ");  
    for(tmpcnt=0; tmpcnt<DataByteCount; tmpcnt++)  
    {  
        adv_printf("%02X", HostData[tmpcnt]);  
    }  
    adv_printf("\n");  
}
```

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5.4.7 MODBUS/TCP Functions (MBTCP*.LIB)

Ver_TCP_Mod

Syntax:

```
void Ver_TCP_Mod(char *vstr);
```

Description:

Check Modbus/TCP library version.

Parameter

vstr

Description

Pointer to array of library version information

Return value:

None

Example:

```
char library_ver[20];
```

```
void main(void)
```

```
{
```

```
    Ver_TCP_Mod(library_ver);
```

```
    adv_printf("The version of library is %s\n", library_ver);
```

```
}
```

Modbus TCP Client Functions:

ReturnErr_code

Syntax:

```
int ReturnErr_code(void);
```

Description:

When following function call gets error return, this function can get the exact error code for user.

ADAMTCP_ForceMultiCoils(), ADAMTCP_ForceSingleCoil(),
ADAMTCP_PresetMultiRegs(), ADAMTCP_PresetSingleReg(),
ADAMTCP_ReadCoilStatus(), ADAMTCP_ReadHoldingRegs(),
ADAMTCP_ReadInputRegs(), ADAMTCP_ReadInputStatus()

Parameter	Description
-----------	-------------

None	
------	--

Return value:

NULL	No error occurs
Erro Code	Exception error returned

Error code:

01	ILLEGAL FUNCTION
02	ILLEGAL DATA ADDRESS
03	ILLEGAL DATA VALUE
04	SLAVE DEVICE FAILURE
05	ACKNOWLEDGE
06	SLAVE DEVICE BUSY
07	NEGATIVE ACKNOWLEDGE
08	MEMORY PARITY ERROR

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Example:

```
SOCKET SO_5510;
```

```
...
```

```
if(ADAMTCP_ReadCoilStatus(&SO_5510, 50, 0x01, 0x11, 0x10,  
    &DataByteCount, HostData)<=0)  
{  
    perror("ADAMTCP_ReadCoilStatus()\n");  
    adv_printf("err code is %d\n", ReturnErr_code());  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}
```

ADAMTCP_Connect

Syntax:

```
int ADAMTCP_Connect(SOCKET * SO, char * Target_IP, int Target_Port);
```

Decription:

Connect to Modbus/TCP Server

Parameter	Description
SO	A descriptor identifying an unconnected socket
Target_IP	Modbus/TCP server IP
Target_Port	Server port for the connection

Return value:

TRUE	No error occurs
-1	Error occurs when gets the host name
-2	The socket is invalid when initializes the socket
-3	Error occurs when connects to Modbus/TCP server

Example:

```
if(ADAMTCP_Connect(&SO_5510, ServerIP, Server_Port)<=0)
{
    perror("ADAMTCP_Connect()\n");
    ADAMTCP_Disconnect(&SO_5510);
    return 0;
}
```

ADAMTCP_Disconnect

Syntax:

```
bool ADAMTCP_Disconnect(SOCKET * SO);
```

Description:

Disconnect to Modbus/TCP Server

Parameter

SO A descriptor identifying the connected socket to Modbus/TCP server

Return value:

TRUE No error occurs
FALSE There is error occurs

Example:

```
if(ADAMTCP_Connect(&SO_5510, ServerIP, Server_Port)<=0)
{
    perror("ADAMTCP_Connect()\n");
    ADAMTCP_Disconnect(&SO_5510);
    return 0;
}
```

ADAMTCP_ForceMultiCoils

Syntax:

```
int ADAMTCP_ForceMultiCoils(SOCKET * SO, int WaitMilliSec,  
                             int Slave_Addr, int CoillIndex, int TotalPoint,  
                             int TotalByte, unsigned char szData[]);
```

Description:

“0F HEX” command of Modbus TCP function code

Parameter	Description
SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
CoillIndex	Coil address
TotalPoint	Quantity of coils
TotalByte	Byte count
szData[]	Force Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
HostData[1]=~0x33;  
//Query Adam-5000/TCP Server, Adam5056 in Slot 2, Adam5051 is Slot 1,  
//force channel status to 0x3333  
if(ADAMTCP_ForceMultiCoils(&SO_5510, 50, 0x01, 0x21, 0x10, 0x02,  
    HostData)<=0)  
{  
    perror("ADAMTCP_ForceMultiCoils()\n");  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}
```

ADAMTCP_ForceSingleCoil

Syntax:

```
int ADAMTCP_ForceSingleCoil(SOCKET * SO, int WaitMilliSec,  
                             int Slave_Addr, int CoillIndex, int Data);
```

Description:

“05 HEX” command of Modbus TCP function code

Parameter	Description
SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
CoillIndex	Coil address
Data	Force Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
//Query Adam-5000/TCP Server, Adam5056 in Slot 2, Adam5051 is Slot 1,  
    force channel 5 to 1  
if(ADAMTCP_ForceSingleCoil(&SO_5510, 50, 0x01, 0x25, 1)<=0)  
{  
    perror("ADAMTCP_ForceSingleCoil()\n");  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}
```

ADAMTCP_PresetMultiRegs

Syntax:

```
int ADAMTCP_PresetMultiRegs(SOCKET * SO, int WaitMilliSec,  
                             int Slave_Addr, int StartReg, int TotalReg,  
                             int TotalByte, unsigned char Data[]);
```

Description:

“10 HEX” command of Modbus TCP function code

Parameter	Description
SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
StartReg	Starting address
TotalReg	No. of registers
TotalByte	Byte count
szData[]	Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
HostData[0]=0x07;  
HostData[1]=0x00;  
HostData[2]=0x07;  
HostData[3]=0x00;
```

```
//5024 slot 3, force channel 1&2(type 0~10V) to 4.376V  
if(ADAMTCP_PresetMultiRegs(&SO_5510, 50, 0x01, 0x19, 0x02, 4,  
    HostData)<=0)  
{  
    perror("ADAMTCP_PresetMultiRegs()\n");  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}
```

ADAMTCP_PresetSingleReg

Syntax:

```
int ADAMTCP_PresetSingleReg(SOCKET * SO, int WaitMilliSec,  
                             int Slave_Addr, int RegIndex, int Data);
```

Description:

“06 HEX” command Modbus TCP function code

Parameter	Description
SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
RegIndex	Register address
Data	Preset Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
//Query Adam-5000/TCP, Adam-5024 in slot 4, force channel 1(type 0~10V)  
to 5V  
if(ADAMTCP_PresetSingleReg(&SO_5510, 50, 0x01, 0x19, 0x07ff)<=0)  
{  
    perror("ADAMTCP_PresetSingleReg()\n");  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}
```

ADAMTCP_ReadCoilStatus

Syntax:

```
int ADAMTCP_ReadCoilStatus(SOCKET * SO, int WaitMilliSec,  
                           int Slave_Addr, int StartIndex, int TotalPoint,  
                           int * ByteCount, char * wData);
```

Description:

“01 HEX” command of Modbus TCP function code

Parameter

SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
StartIndex	Starting address
TotalPoint	No. of points
ByteCount	Byte count
wData	Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
//Query Adam-5000/TCP Server, Adam5051 in Slot 1  
if(ADAMTCP_ReadCoilStatus(&SO_5510, 50, 0x01, 0x11, 0x10,  
    &DataByteCount, HostData)<=0)  
{  
    perror("ADAMTCP_ReadCoilStatus()\n");  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}  
else  
{  
    adv_printf("Adam-5051 Status: ");  
    for(tmp=0; tmp<DataByteCount; tmp++)
```

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```
{
    adv_printf("%2X", HostData[tmp]);
}
adv_printf("\n");
}
```

ADAMTCP_ReadHoldingRegs

Syntax:

```
int ADAMTCP_ReadHoldingRegs(SOCKET * SO, int WaitMilliSec,  
                             int Slave_Addr, int StartIndex, int TotalPoint,  
                             int * ByteCount, char * wData);
```

Description:

“03 HEX” command of Modbus TCP function code

Parameter

SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
StartIndex	Starting address
TotalPoint	No. of points
ByteCount	Byte count
wData	Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
//Query Adam-5000/TCP Server, Adam5024 in Slot 3, query all channels  
//using readholdingregs to read status  
if((errno=ADAMTCP_ReadHoldingRegs(&SO_5510, 50, 0x01, 0x19, 0x08,  
    &DataByteCount, HostData))<=0)  
{  
    perror("ADAMTCP_ReadHoldingRegs()\n");  
    adv_printf("errno is %d\n", errno);  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}  
else  
{
```

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```
adv_printf("Adam-5024 Status: ");
for(tmp=0; tmp<DataByteCount; tmp++)
{
    adv_printf("%02X", HostData[tmp]);
}
adv_printf("\n");
}
```

ADAMTCP_ReadInputRegs

Syntax:

```
int ADAMTCP_ReadInputRegs(SOCKET * SO, int WaitMilliSec,  
                           int Slave_Addr, int StartIndex, int TotalPoint,  
                           int * ByteCount, char * wData);
```

Description:

"04 HEX" command of Modbus TCP function code

Parameter

SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
StartIndex	Starting address
TotalPoint	No. of points
ByteCount	Byte count
wData	Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
//Query Adam-5000/TCP Server, Adam5024 in Slot 3, query all channels  
//using ADAMTCP_ReadInputRegs to read status
```

```
if((errno=ADAMTCP_ReadInputRegs(&SO_5510, 50, 0x01, 0x19, 0x08,  
                                &DataByteCount, HostData))<=0)  
{  
    perror("ADAMTCP_ReadInputRegs()\n");  
    adv_printf("errno is %d\n", errno);  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}  
else  
{
```

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```
adv_printf("Adam-5024 Status: ");
for(tmp=0; tmp<DataByteCount; tmp++)
{
    adv_printf("%02X", HostData[tmp]);
}
adv_printf("\n");
}
```

ADAMTCP_ReadInputStatus

Syntax:

```
int ADAMTCP_ReadInputStatus(SOCKET * SO, int WaitMilliSec,  
                             int Slave_Addr, int StartIndex, int TotalPoint,  
                             int * ByteCount, char * wData);
```

Description:

“02 HEX” command Modbus TCP function code

Parameter

SO	The socket connected to Modbus/TCP server
WaitMilliSec	Set duration(msec unit) for the response from Modbus/TCP server
Slave_Addr	Slave address
StartIndex	Starting address
TotalPoint	No. of points
ByteCount	Byte count
wData	Data

Return value:

TRUE	No error occurs
0	Time out error when receive modbus query message from Modbus/TCP server
-1	Error occurs when send modbus query message to Modbus/TCP server
-2	Error occurs when receive modbus query message from Modbus/TCP server

Example:

```
//Query Adam-5000/TCP Server, Adam5051 in Slot 1  
if(ADAMTCP_ReadInputStatus(&SO_5510, 50, 0x01, 0x11, 0x10,  
    &DataByteCount, HostData)<=0)  
{  
    perror("ADAMTCP_ReadInputStatus()\n");  
    ADAMTCP_Disconnect(&SO_5510);  
    return 0;  
}  
else  
{  
    adv_printf("Adam-5051 Status: ");  
    for(tmp=0; tmp<DataByteCount; tmp++)
```

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```
{
    adv_printf("%2X", HostData[tmp]);
}
adv_printf("\n");
}
```

Modbus TCP Server Functions:

ADAMTCP_ModServer_Create

Syntax:

```
int ADAMTCP_ModServer_Create(int Host_Port, unsigned long  
                             waittimeout, unsigned int numberConns,  
                             unsigned char * ptr_mem, int size_mem);
```

Description:

Create a Modbus/TCP Server

Parameter	Description
Host_Port	The port for Modbus/TCP server
Waittimeout	Time out value, 0~0xffffffff milli-second
NumberConns	Maximum connections for client
ptr_mem	Share memory
size_mem	The size of share memory

Return value:

- 0 No error occurs
- 91 Invalid socket
- 92 Error occurs when associates a local socket address with a socket
- 93. Error occurs when sets up the socket mode
- 94 Error occurs when listens to the incoming socket

Example:

```
if((err_code=ADAMTCP_ModServer_Create(502, 5000, 20,  
   (unsigned char *)Share_Mem, sizeof(Share_Mem)))!=0)  
    {  
        adv_printf("error code is %d/n", err_code);  
    }  
adv_printf("Server started, wait for connect...\n");
```

ADAMTCP_ModServer_Update

Syntax:

```
int ADAMTCP_ModServer_Update(void);
```

Description:

Update the Modbus/TCP Server. The Modbus/TCP server needs to be updated by calling ADAMTCP_ModServer_Update() function continuously to keep server alive.

Parameter

None

Return value:

1 New message has come in
0 No new message comes in

Example:

```
while(1)
{
    iState = ADAMTCP_ModServer_Update(); //second step
    if(iState)//if has message, show the data at address 40001
    {
        if(pre_data != Share_Mem[0])
        {
            adv_printf("40001 is %X\n", Share_Mem[0]);
            //notice: printf() will decrease server performance
            pre_data = Share_Mem[0];
        }
    }
}
```

ADAMTCP_ModServer_Release

Syntax:

```
void ADAMTCP_ModServer_Release(void);
```

Description:

Release Modbus/TCP Server

Parameter

None

Returned value:

None

Example:

```
ADAMTCP_ModServer_Release();
```

5.4.8 Socket Functions (SOCKET*.LIB)

TCP/IP SOCKETS API Overview

This section describes the SOCKETS API, which is compatible with the BSD Sockets API and also the Winsock API. The definitions and prototypes for the C environment are supplied in SOCKET.H, while the implementation of the C interface is in SOCKET.C.

The SOCKETS API is implemented as a layer on top of the Compatible API (CAPI) and provides an interface to the socket and name resolution facilities provided by the Datalight DOS SOCKETS product. It also provides the database functions of BSD Sockets and Winsock.

A *socket* is an end-point for a connection and is defined by the combination of a host address (also known as an IP address), a port number (or communicating process ID), and a transport protocol, such as UDP or TCP. Two connected SOCKETS using the same transport protocol define a connection. The API uses a socket handle, sometimes referred to as simply a socket. The socket handle is required by most function calls in order to access a connection. The socket handle used is the same as a normal socket as used in CAPI. A socket handle is obtained by calling the **socket()** function. A socket handle can only be used for a single connection. When no longer required, such as when a connection has been closed, the socket handle must be released by calling **closesocket()**. Socket handles are positive numbers greater than 63.

Types of Service

SOCKETS can be used with one of two service types:

- . SOCK_STREAM (using TCP).
- . SOCK_DGRAM (using UDP).

A stream connection provides for the bi-directional, reliable, sequenced, and unduplicated flow of data without record boundaries. No broadcast facilities can be used with a stream connection.

A datagram connection supports bi-directional flow of data that is not guaranteed to be sequenced, reliable, or unduplicated. That is, a process receiving messages on a datagram socket may find messages duplicated, and, possibly, in an order different from the order in which it was sent. An important characteristic of a datagram

connection is that record boundaries in data are preserved.

Datagram connections closely model the facilities found in many contemporary packet switched networks such as Ethernet. Broadcast messages may be sent and received.

Establishing Remote Connections

To establish a connection, one side (the server) must execute a **listen()** and subsequent **accept()** and the other side (the client) a **connect()**. A connection consists of the local socket / remote socket pair. It is therefore possible to have a connection within a single host as long as the local and remote *port* values differ. Each host in an IP network must have at least one host address also known as an IP address. When a host has more than one physical connection to an IP network, it may have more than one IP address. An IP address must be unique within a network. An IP address is 32 bits in length, a port number 16 bits. A value of zero means “any” while a binary value of all 1s means “all.” The latter value is used for broadcasting purposes. Using the **sockaddr** structure conveys the addresses (host/port) to be used in a connection. A local association is performed by the **bind()** function.

Using SOCK_STREAM and SOCK_DGRAM Services

When using the SOCK_STREAM service (TCP), bi-directional data can be sent using the **send()** or **sendto()** functions and received using the **recv()** or **recvfrom()** functions until one side performs a **shutdown(1)** or **shutdown(2)** after which that side cannot send any more data, but can still receive data until the other side performs a **shutdown(1)**, **shutdown(2)** or **closesocket()**.

When using the SOCK_DGRAM service, datagrams can be sent without first establishing a “connection”. In fact UDP provides a “connectionless” service although the connection paradigm is used.

Blocking and Non-blocking Operations

The default behavior of socket functions is to block on an operation and only return when the operation has completed. For example, the **connect()** function only returns after the connection has been performed or an error is encountered. This behavior applies to most socket function calls, such as **recv()** and even **send()**, and especially

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on SOCK_STREAM connections.

In many, if not most applications, this behavior is unacceptable in the single-threaded DOS environment and must be modified. This modification can be accomplished by making all operations on a socket non-blocking by calling **ioctlsocket()** with the FIONBIO option. If a non-blocking operation is performed, the function always returns immediately. If the function could not complete without blocking, an error is returned with *errno* containing EWOULDBLOCK. This error should be regarded as a recoverable error and the operation should be retried, preferably at some later time.

Out of band data

TCP “out of band” or urgent data is not implemented. Setting the MSG_OOB flag has no effect in **recv()**, **recvfrom()**, **send()** or **sendto()**; it will simply be ignored. The SO_OOBINLINE option will also be ignored and **ioctlsocket()** with the SIOCATMARK command, will always return an argument value of 1.

Error Reporting

In general, the C functions implementing the SOCKETS API return a value of SOCKET_ERROR if the return type is **int** and an error is encountered, in which case, the actual error code is returned in a common variable *errno*. ERR_RE_ENTRY is returned when the SOCKETS kernel has been interrupted. This condition can occur only when the API is called from an interrupt service routine. Programs designed for this type of operation, such as TSR programs activated by a real time clock interrupt, should be coded to handle this error by re-trying the function at a later stage.

Other sources of Information

Many good books have been written on the Sockets API. Here are a few:

Pocket Guide to TCP/IP Sockets (C Version) by Michael J. Donahoo, Kenneth L. Calvert

Windows Sockets Network Programming (Addison-Wesley Advanced Windows Series) by Bob Quinn, et al; Hardcover

Internetworking with TCP/IP Vol. III Client-Server Programming and Applications-Windows Sockets Version by Douglas E. Comer, David L. Stevens (Contributor) ;Hardcover.

The Winsock 1.1 help file (WINSOCK.HLP) is also a very useful source of information.

Porting Issues

When porting an application from another BSD Sockets environment like Unix, Linux or Windows (Winsock), a number of issues must be kept in mind. The most important one is that ROM-DOS is a single-user, single-task, single-thread operating system. The use of blocking calls will suspend the system until completion, which may imply an indefinite time under abnormal or even normal conditions. In addition no completion event such as a WSAAsyncSelect windows message for Winsock or a Signal for Unix/Linux is available. Only applications either using nonblocking operations or the **select()** function may be ported successfully. Other applications must be adapted to follow these guidelines.

Unlike Winsock and like BSD Sockets, an error number is returned in the *errno* variable and is only valid directly after an API call. When writing portable code to run on both SAPI and Winsock, a simple `#define` can normally be used i.e.

```
#ifdef _Windows
#define Errno WSAGetLastError()
#else
#define Errno errno
#endif
.
.

if (Errno == WSAEWOULDBLOCK)
{
.
.
}
.
.
```

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Like in Winsock both the WSAE... of Winsock and the E... error definitions of BSD may be used e.g. WSAEWOULDBLOCK and EWOULDBLOCK. The actual error numbers are the same as that of Winsock, except in cases of DOS error code conflicts e.g. WSAEINVAL has the same value as the DOS EINVAL. Always using the symbolic value and not numeric values, will avoid potential problems.

The function `gethostbyaddr()` will always fail with `errno == WSANO_DATA`.

All the file/socket operations of BSD Sockets must be translated to the `*socket()` versions as used in Winsock e.g. `closesocket()` instead of just `close()`.

In Linux/Unix a socket descriptor can be treated the same as a file descriptor; not so for SAPI or Winsock.

For Winsock the `WSAStartup()` and `WSACleanup()` functions must be called; make it conditional for portable code.

The "socket set" is defined differently for SAPI/Winsock on the one hand and LINUX/UNIX on the other. Always use the `FD_*` macros for portable code.

Function Reference

The following sections describe the individual functions of the SOCKETS API.

accept

Syntax:

```
SOCKET accept ( SOCKET so, struct sockaddr *psAddress, int *p  
iAddressLen );
```

Description:

Accepts a connection on a socket.

Parameters

<i>so</i>	A descriptor identifying a socket which is listening for connections after a listen() .
<i>psAddress</i>	An optional pointer to a buffer which receives the socket address of the connecting peer.
<i>piAddrLen</i>	An optional pointer to an integer which contains the length of the address <i>psAddress</i> .

Return Value

If no error occurs, **accept()** returns a value of type SOCKET which is a descriptor for the accepted packet. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code is returned in **errno**.

The integer referred to by *iAddressLen* initially contains the amount of space pointed to by *psAddress*. On return it will contain the actual length in bytes of the socket address returned.

Error Codes

ENETDOWN	The network subsystem has failed.
EFAULT	The * <i>piAddressLen</i> argument is too small (less than the sizeof a struct sockaddr).
EINVAL	listen() was not invoked prior to accept().
EMFILE	The queue is empty upon entry to accept() and there are no descriptors available.
ENOBUFS	No buffer space is available.
ENOTSOCK	The descriptor is not a socket.
EOPNOTSUPP	The referenced socket is not a type that supports connection-oriented service.
EWOULDBLOCK	The socket is marked as non-blocking and no

Remarks

This function extracts the first connection on the queue of pending connections on listening socket *so*, creates a new socket with the same properties as *so* and returns a handle to the new socket. If no pending connections are present on the queue, and the socket is not marked as non-blocking, **accept()** blocks the caller until a connection is present. If the socket is marked non-blocking and no pending connections are present on the queue, **accept()** returns an error as described below. Socket *so* remains listening.

The argument *psAddress* is a result parameter that is filled in with the socket address of the connecting peer. The *piAddressLen* is a value-result parameter; it should initially contain the amount of space pointed to by *psAddress*; on return it will contain the actual length (in bytes) of the socket address returned. This call is used with the connectionbased SOCK_STREAM socket type. If *psAddress* and/or *piAddressLen* are equal to NULL, then no information about the remote peer socket address of the accepted socket is returned.

See Also

bind(), connect(), listen(), select(), socket()

bind

Syntax:

```
int bind ( SOCKET so, const struct sockaddr * psAddress, int
iAddressLen );
```

Description:

Associates a local socket address with a socket.

Parameters

so A descriptor identifying an unbound socket.
psAddress The socket address to assign to the socket. The `sockaddr` structure is defined as follows:

```
struct sockaddr {
    u_short sa_family;
    char sa_data[14];
};
```

iAddressLen The length of the name *psAddress*.

Return Value

If no error occurs, **bind()** returns 0. Otherwise, it returns `SOCKET_ERROR`, and a specific error code is returned in **errno**.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EADDRINUSE	The specified address is already in use. (See the <code>SO_REUSEADDR</code> socket option under <code>setsockopt()</code> .)
EFAULT	The <i>iAddressLen</i> argument is too small (less than the size of a <code>struct sockaddr</code>).
EAFNOSUPPORT	The specified address family is not supported by this protocol.
EINVAL	The socket is already bound to an address.
ENOBUFS	Not enough buffers available, too many connections.
ENOTSOCK	The descriptor is not a socket.

Remarks

This routine is used on an unconnected datagram or stream socket, before subsequent **connect()**s or **listen()**s. When a socket is created with **socket()**, it exists in a name space (address family), but it has no socket address assigned. **bind()** establishes the local association (host address/port number) of the socket by assigning a local address to an unnamed socket.

In the Internet address family, an address consists of several components. For `SOCK_DGRAM` and `SOCK_STREAM`, the address consists of three parts: a host address, the protocol number (set implicitly to UDP or TCP, respectively), and a port number which identifies the application. If an application does not care what address is assigned to it, it may specify an Internet address equal to `INADDR_ANY`, a port equal to 0, or both. If the Internet address is equal to `INADDR_ANY`, any appropriate network interface will be used; this simplifies application programming in the presence of multihomed hosts. If the port is specified as 0, `SOCKETS` will assign a unique port to the application. The application may use **getsockname()** after **bind()** to learn the address that has been assigned to it, but note that **getsockname()** will not necessarily fill in the Internet address until the socket is connected, since several Internet addresses may be valid if the host is multi-homed.

See Also

`connect()`, `listen()`, `getsockname()`, `setsockopt()`, `socket()`.

closesocket

Syntax:

```
int closesocket ( SOCKET so );
```

Description:

Closes a socket.

Parameters

so

Description

A descriptor identifying a socket.

Return Value

If no error occurs, **closesocket()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code is returned in errno.

Error Codes

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

ENOTSOCK

The descriptor is not a socket.

EWOULDBLOCK

The socket is marked as nonblocking and SO_LINGER is set to a nonzero timeout value.

Remarks

This function closes a socket. More precisely, it releases the socket descriptor so, so that further references to so will fail with the error ENOTSOCK. If this is the last reference to the underlying socket, the associated naming information and queued data are discarded.

The semantics of **closesocket()** are affected by the socket options SO_LINGER and SO_DONTLINGER as follows:

Option	Interval	Type of close	Wait for close?
SO_DONTLINGER	Don't care	Graceful	No
SO_LINGER	Zero	Hard	No
SO_LINGER	Non-zero	Graceful	Yes

If `SO_LINGER` is set (i.e. the `L_onoff` field of the `linger` structure is non-zero) with a zero timeout interval (`L_linger` is zero), **`closesocket()`** is not blocked even if queued data has not yet been sent or acknowledged. This is called a "hard" or "abortive" close, because the socket's virtual circuit is reset immediately, and any unsent data is lost. Any **`recv()`** call on the remote side of the circuit will fail with `ECONNRESET`.

If `SO_LINGER` is set with a non-zero timeout interval, the **`closesocket()`** call blocks until the remaining data has been sent or until the timeout expires. This is called a graceful disconnect. Note that if the socket is set to non-blocking and `SO_LINGER` is set to a non-zero timeout, the call to **`closesocket()`** will fail with an error of `EWOULDBLOCK`.

If `SO_DONTLINGER` is set on a stream socket (i.e. the `L_onoff` field of the `linger` structure is zero), the **`closesocket()`** call will return immediately. However, any data queued for transmission will be sent if possible before the underlying socket is closed. This is also called a graceful disconnect. Note that in this case `SOCKETS` may not release the socket and other resources for an arbitrary period, which may affect applications which expect to use all available sockets.

See Also

`accept()`, `socket()`, `ioctlsocket()`, `setsockopt()`.

connect

Syntax:

```
int connect ( SOCKET so, const struct sockaddr * psAddress,  
int iAddressLen );
```

Description:

Establishes a connection to a peer.

Parameters

so

Description

A descriptor identifying an unconnected socket.

psAddress

The socket address of the peer to which the socket is to be connected.

iAddressLen

The length of *psAddress*.

Return Value

If no error occurs, **connect()** returns 0. Otherwise, it returns `SOCKET_ERROR`, and a specific error code is returned in `errno`.

On a blocking socket, the return value indicates success or failure of the connection attempt.

On a non-blocking socket, if the return value is `SOCKET_ERROR` and **errno** indicates an error code of `EWOULDBLOCK`, then your application can either:

1. Use **select()** to determine the completion of the connection request by checking if the socket is writeable, or
2. Use **recv()** until either no error or an error of `EWOULDBLOCK` is returned.

Error Codes

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

EADDRINUSE

The specified address is already in use.

EADDRNOTAVAIL

The specified address is not available from the local machine.

EAFNOSUPPORT

Addresses in the specified family cannot be used with this socket.

ECONNREFUSED

The attempt to connect was forcefully rejected.

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EDESTADDRQ	A destination address is required.
EFAULT	The <i>iAddressLen</i> argument is incorrect.
EINVAL	The socket is not already bound to an address.
EISCONN	The socket is already connected.
EMFILE	No more file descriptors are available.
ENETUNREACH	The network can't be reached from this host at this time.
ENOBUFS	No buffer space is available. The socket cannot be connected.
ENOTSOCK	The descriptor is not a socket.
ETIMEDOUT	Attempt to connect timed out without establishing a connection
EWouldBLOCK	The socket is marked as non-blocking and the connection cannot be completed immediately. It is possible to select() the socket while it is connecting by select()ing it for writing.

Remarks

This function is used to create a connection to the specified foreign socket address. The parameter *so* specifies an unconnected datagram or stream socket. If the socket is unbound, unique values are assigned to the local association by the system, and the socket is marked as bound. Note that if the address field of the *psAddress* structure is all zeroes, **connect()** will return the error EADDRNOTAVAIL.

For stream sockets (type SOCK_STREAM), an active connection is initiated to the foreign host using *psAddress* (an address in the name space of the socket). When the socket call completes successfully, the socket is ready to send/receive data.

For a datagram socket (type SOCK_DGRAM), a default destination is set, which will be used on subsequent **send()** and **recv()** calls.

See Also

accept(), bind(), getsockname(), socket() and select().

getpeername

Syntax:

```
int getpeername ( SOCKET so, struct sockaddr * psAddress, int * piAddressLen );
```

Description:

Gets the socket address of the peer to which a socket is connected.

Parameters

so

psAddress

piAddressLen

Description

A descriptor identifying a connected socket.

The structure which is to receive the socket address of the peer.

A pointer to the size of the *psAddress* structure.

Return Value

If no error occurs, **getpeername()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code is returned in **errno**.

Error Codes

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

EFAULT

The **piAddressLen* argument is not large enough.

ENOTCONN

The socket is not connected.

ENOTSOCK

The descriptor is not a socket.

Remarks

getpeername() retrieves the socket address of the peer connected to the socket *so* and stores it in the struct sockaddr identified by *psAddress*. It is used on a connected datagram or stream socket.

On return, the *piAddressLen* argument contains the actual size of the socket address returned in bytes.

See Also

bind(), socket(), getsockname().

getsockname

Syntax:

```
int getsockname ( SOCKET so, struct sockaddr * psAddress,  
int * piAddressLen );
```

Description:

Gets the local socket address for a socket.

Parameters

so

psAddress

piAddressLen

Description

A descriptor identifying a bound socket.

Receives the socket address (name) of the socket.

A pointer to the size of the *psAddress* buffer.

Return Value

If no error occurs, **getsockname()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code is returned in **errno**.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EFAULT	The * <i>piAddressLen</i> argument is not large enough.
ENOTSOCK	The descriptor is not a socket.
EINVAL	The socket has not been bound to an address with bind() .

Remarks

getsockname() retrieves the current socket address for the specified socket descriptor in *psAddress*. It is used on a bound and/or connected socket specified by the *so* parameter. The local association is returned. This call is especially useful when a **connect()** call has been made without doing a **bind()** first; this call provides the only means by which you can determine the local association which has been set by the system.

On return, the *piAddressLen* argument contains the actual size of the socket address returned in bytes.

If a socket was bound to INADDR_ANY, indicating that any of the host's IP addresses should be used for the socket, **getsockname()**

will not necessarily return information about the host IP address, unless the socket has been connected with **connect()** or **accept()**. A SOCKETS application must not assume that the IP address will be changed from INADDR_ANY unless the socket is connected. This is because for a multi-homed host the IP address that will be used for the socket is unknown unless the socket is connected.

See Also

`bind()`, `socket()`, `getpeername()`.

getsockopt

Syntax:

```
int getsockopt ( SOCKET so, int iLevel, int iOptname,  
char * pcOptval, int * piOptlen );
```

Description:

Retrieves a socket option.

Parameters

<i>so</i>	A descriptor identifying a socket.
<i>iLevel</i>	The level at which the option is defined; the only supported levels are SOL_SOCKET and IPPROTO_TCP.
<i>iOptname</i>	The socket option for which the value is to be retrieved.
<i>pcOptval</i>	A pointer to the buffer in which the value for the requested option is to be returned.
<i>piOptlen</i>	A pointer to the size of the <i>pcOptval</i> buffer.

Return Value

If no error occurs, **getsockopt()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code is returned in *errno*.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EFAULT	The <i>piOptlen</i> argument was invalid.
ENOPROTOOPT	The option is unknown or unsupported. In particular, SO_BROADCAST is not supported on sockets of type SOCK_STREAM, while SO_ACCEPTCONN, SO_DONTLINGER, SO_KEEPALIVE, SO_LINGER and SO_OOBINLINE are not supported on sockets of type SOCK_DGRAM.
ENOTSOCK	The descriptor is not a socket.

Remarks

getsockopt() retrieves the current value for a socket option associated with a socket of any type, in any state, and stores the result in *pcOptval*. Options may exist at multiple protocol levels, but they are always present at the uppermost "socket" level. Options affect socket operations, such as whether an operation blocks or not, the routing of packets, out-of-band data transfer, etc.

The value associated with the selected option is returned in the buffer *pcOptval*. The integer pointed to by *piOptlen* should originally contain the size of this buffer; on return, it will be set to the size of the value returned. For `SO_LINGER`, this will be the size of a struct `linger`; for all other options it will be the size of an integer.

If the option was never set with **setsockopt()**, then **getsockopt()** returns the default value for the option.

The following options are supported for **getsockopt()**. The Type identifies the type of data addressed by *optval*. The `TCP_NODELAY` option uses *level* `IPPROTO_TCP`; all other options use *level* `SOL_SOCKET`.

Value	Type	Meaning	Default
<code>SO_ACCEPTCONN</code>	BOOL	Socket is listen()ing.	FALSE
<code>SO_BROADCAST</code>	BOOL	Socket is configured for the transmission of broadcast messages.	FALSE
<code>SO_DEBUG</code>	BOOL	Debugging is enabled.	FALSE
<code>SO_DONTLINGER</code>	BOOL	If true, the <code>SO_LINGER</code> option is disabled.	TRUE
<code>SO_DONTROUTE</code>	BOOL	Routing is disabled.	FALSE
<code>SO_ERROR</code>	int	Retrieve error status and clear.	0
<code>SO_KEEPAIVE</code>	BOOL	Keepalives are being sent.	FALSE
<code>SO_LINGER</code>	struct <code>linger</code> *	Returns the current linger options.	<code>l_onoff</code> is 0
<code>SO_OOINLINE</code>	BOOL	Out-of-band data is being received in the normal data stream.	FALSE
<code>SO_RCVBUF</code>	int	Buffer size for receives	1460
<code>SO_REUSEADDR</code>	BOOL	The socket may be bound to an address which is already in use.	FALSE
<code>SO_SNDBUF</code>	int	Buffer size for sends	1460
<code>SO_TYPE</code>	int	The type of the socket (e.g. <code>SOCK_STREAM</code>).	As created

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TCP_NODELAY BOOL Disables the Nagle algorithm FALSE
for send coalescing.

Calling **getsockopt()** with an unsupported option will result in an error code of ENOPROTOOPT being returned from **WSAGetLastError()**.

See Also

setsockopt(), socket().

htonl

Syntax:

`u_long htonl (u_long ulHostlong);`

Description:

Converts a **u_long** from host to network byte order.

Parameters**Description**

ulHostlong A 32-bit number in host byte order.

Return Value

htonl() returns the value in network byte order.

Remarks

This routine takes a 32-bit number in host byte order and returns a 32-bit number in network byte order.

See Also

`htons()`, `ntohl()`, `ntohs()`.

htons

Syntax

```
u_short htons ( u_short usHostshort );
```

Description:

Converts a **u_short** from host to network byte order.

Parameters

sHostshort

Description

A 16-bit number in host byte order.

Return Value

htons() returns the value in network byte order.

Remarks

This routine takes a 16-bit number in host byte order and returns a 16-bit number in network byte order.

See Also

htonl(), ntohl(), ntohs().

inet_addr

Syntax:

unsigned long inet_addr (const char * *pc*);

Description:

Converts a string containing a dotted address into an **in_addr**.

Parameters

Description

pc

A character string representing a number expressed in the Internet standard "." notation.

Return Value

If no error occurs, **inet_addr()** returns an unsigned long containing a suitable binary representation of the Internet address given. If the passed-in string does not contain a legitimate Internet address, for example if a portion of an "a.b.c.d" address exceeds 255, **inet_addr()** returns the value INADDR_NONE.

Remarks

This function interprets the character string specified by the *pc* parameter. This string represents a numeric Internet address expressed in the Internet standard "." notation. The value returned is a number suitable for use as an Internet address. All Internet addresses are returned in network order (bytes ordered from left to right).

Internet Addresses

Values specified using the "." notation take one of the following forms:

a.b.c.d a.b.c a.b a

When four parts are specified, each is interpreted as a byte of data and assigned, from left to right, to the four bytes of an Internet address. Note that when an Internet address is viewed as a 32-bit integer quantity on the Intel architecture, the bytes referred to above appear as "d.c.b.a". That is, the bytes on an Intel processor are ordered from right to left.

Note: The following notations are only used by Berkeley, and nowhere else on the Internet. In the interests of compatibility with their software, they are supported as specified.

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When a three part address is specified, the last part is interpreted as a 16-bit quantity and placed in the right most two bytes of the network address. This makes the three part address format convenient for specifying Class B network addresses as "128.net.host".

When a two part address is specified, the last part is interpreted as a 24-bit quantity and placed in the right most three bytes of the network address. This makes the two part address format convenient for specifying Class A network addresses as "net.host".

When only one part is given, the value is stored directly in the network address without any byte rearrangement.

See Also

`inet_ntoa()`

ioctlsocket

Syntax:

```
int ioctlsocket ( SOCKET so, long ICmd, u_long * pulArgp );
```

Description:

Controls the mode of a socket.

Parameters

Description

<i>so</i>	A descriptor identifying a socket.
<i>ICmd</i>	The command to perform on the socket <i>so</i> .
<i>pulArgp</i>	A pointer to a parameter for <i>ICmd</i> .

Return Value

Upon successful completion, the **ioctlsocket()** returns 0. Otherwise, a value of `SOCKET_ERROR` is returned, and a specific error code is returned in `errno`.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EINVAL	<i>ICmd</i> is not a valid command, or <i>pulArgp</i> is not an acceptable parameter for <i>ICmd</i> , or the command is not applicable to the type of socket supplied
ENOTSOCK	The descriptor <i>so</i> is not a socket.

Remarks

This routine may be used on any socket in any state. It is used to get or retrieve operating parameters associated with the socket, independent of the protocol and communications subsystem. The following commands are supported:

Command

Semantics

FIONBIO	Enable or disable non-blocking mode on the socket <i>so</i> . <i>pulArgp</i> points at an unsigned long , which is non-zero if non-blocking mode is to be enabled and zero if it is to be disabled. When a socket is created, it operates in blocking mode (i.e. non-blocking mode is disabled). This is consistent with BSD sockets.
FIONREAD	Determine the amount of data which can be read

atomically from socket *so*. *puArgp* points at an **unsigned long** in which **ioctlsocket()** stores the result. If *so* is of type SOCK_STREAM, FIONREAD returns the total amount of data which may be read in a single **recv()**; this is normally the same as the total amount of data queued on the socket. If *so* is of type SOCK_DGRAM, FIONREAD returns the size of the first datagram queued on the socket.

SIOCATMARK Determine whether or not all out-of-band data has been read. This applies only to a socket of type SOCK_STREAM which has been configured for in-line reception of any out-of-band data (SO_OOBINLINE). If no out-of-band data is waiting to be read, the operation returns TRUE. Otherwise it returns FALSE, and the next **recv()** or **recvfrom()** performed on the socket will retrieve some or all of the data preceding the "mark"; the application should use the SIOCATMARK operation to determine whether any remains. If there is any normal data preceding the "urgent" (out of band) data, it will be received in order. (Note that a **recv()** or **recvfrom()** will never mix out-of-band and normal data in the same call.) *argp* points at a **BOOL** in which **ioctlsocket()** stores the result.

Compatibility

This function is a subset of **ioctl()** as used in Berkeley sockets. In particular, there is no command which is equivalent to FIOASYNC, while SIOCATMARK is the only socketlevel command which is supported.

See Also

socket(), setsockopt(), getsockopt().

listen

Syntax:

```
int listen ( SOCKET so, int iBacklog );
```

Description:

Establishes a socket to listen for incoming connection.

Parameters

Description

<i>so</i>	A descriptor identifying a bound, unconnected socket.
<i>iBacklog</i>	The maximum length to which the queue of pending connections may grow.

Return Value

If no error occurs, **listen()** returns 0. Otherwise, a value of `SOCKET_ERROR` is returned, and a specific error code is returned in `errno`.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EADDRINUSE	An attempt has been made to listen() on an address in use.
EINVAL	The socket has not been bound with bind() or is already connected.
EISCONN	The socket is already connected.
EMFILE	No more file descriptors are available.
ENOBUFS	No buffer space is available.
ENOTSOCK	The descriptor is not a socket.
EOPNOTSUPP	The referenced socket is not of a type that supports the listen() operation.

Remarks

To accept connections, a socket is first created with **socket()**, a backlog for incoming connections is specified with **listen()**, and then the connections are accepted with **accept()**. **listen()** applies only to sockets that support connections, i.e. those of type `SOCK_STREAM`. The socket *so* is put into "passive" mode where incoming connections are acknowledged and queued pending acceptance by the process.

This function is typically used by servers that could have more than

one connection request at a time: if a connection request arrives with the queue full, the client will receive an error with an indication of `ECONNREFUSED`.

Compatibility

iBacklog is limited (silently) to 5. As in 4.3BSD, illegal values (less than 1 or greater than 5) are replaced by the nearest legal value.

See Also

`accept()`, `connect()`, `socket()`.

ntohl

Syntax:

`u_long ntohl (u_long ulNetlong);`

Description:

Converts a **u_long** from network to host byte order.

Parameters**Description**

ulNetlong

A 32-bit number in network byte order.

Return Value

ntohl() returns the value in host byte order.

Remarks

This routine takes a 32-bit number in network byte order and returns a 32-bit number in host byte order.

See Also

`htonl()`, `htons()`, `ntohs()`.

ntohs

Syntax

```
u_short ntohs ( u_short usNetshort );
```

Description:

Converts a **u_short** from network to host byte order.

Return Value

ntohs() returns the value in host byte order.

Parameters

usNetshort

Description

A 16-bit number in network byte order.

Remarks

This routine takes a 16-bit number in network byte order and returns a 16-bit number in host byte order.

See Also

htonl(), htons(), ntohl().

recv

Syntax:

```
int recv ( SOCKET so, char * pobuf, int iLen, int iFlags );
```

Description:

Receives data from a socket.

Parameters

Description

<i>so</i>	A descriptor identifying a connected socket.
<i>pcBuf</i>	A buffer for the incoming data.
<i>iLen</i>	The length of <i>pcBuf</i> .
<i>iFlags</i>	Specifies the way in which the call is made.

Return Value

If no error occurs, **recv()** returns the number of bytes received. If the connection has been closed, it returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code is returned in *errno*.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
ENOTCONN	The socket is not connected.
ENOTSOCK	The descriptor is not a socket.
EOPNOTSUPP	MSG_OOB was specified, but the socket is not of type SOCK_STREAM.
ESHUTDOWN	The socket has been shutdown; it is not possible to <i>recv()</i> on a socket after <i>shutdown()</i> has been invoked with <i>how</i> set to 0 or 2.
EWOULDBLOCK	The socket is marked as non-blocking and the receive operation would block.
EMSGSIZE	The datagram was too large to fit into the specified buffer and was truncated.
EINVAL	The socket has not been bound with <i>bind()</i> .
ECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
ECONNRESET	The virtual circuit was reset by the remote side.

Remarks

This function is used on connected datagram or stream sockets specified by the `so` parameter and is used to read incoming data.

For sockets of type `SOCK_STREAM`, as much information as is currently available up to the size of the buffer supplied is returned. If the socket has been configured for in-line reception of out-of-band data (socket option `SO_OOBINLINE`) and out-of-band data is unread, only out-of-band data will be returned. The application may use the **ioctlsocket()** `SIOCATMARK` to determine whether any more out-of-band data remains to be read.

For datagram sockets, data is extracted from the first enqueued datagram, up to the size of the buffer supplied. If the datagram is larger than the buffer supplied, the buffer is filled with the first part of the datagram, the excess data is lost, and **recv()** returns the error `EMSGSIZE`.

If no incoming data is available at the socket, the **recv()** call waits for data to arrive unless the socket is non-blocking. In this case a value of `SOCKET_ERROR` is returned with the error code set to `EWOULDBLOCK`. The **select()** call may be used to determine when more data arrives.

If the socket is of type `SOCK_STREAM` and the remote side has shut down the connection gracefully, a **recv()** will complete immediately with 0 bytes received. If the connection has been reset, a **recv()** will fail with the error `ECONNRESET`.

iFlags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *iFlags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
<code>MSG_</code>	<code>PEEK</code> Peek at the incoming data. The data is copied into the buffer but is not removed from the input queue.
<code>MSG_OOB</code>	Process out-of-band data.

See Also

`recvfrom()`, `,recv()`, `send()`, `select()`, `socket()`

recvfrom

Syntax

```
int recvfrom ( SOCKET so, char * pcBuf, int iLen, int iFlags,  
struct sockaddr * psFrom, int * piFromlen );
```

Description:

Receives a datagram and store the source address.

Parameters

Description

<i>so</i>	A descriptor identifying a bound socket.
<i>pcBuf</i>	A buffer for the incoming data.
<i>iLen</i>	The length of <i>pcBuf</i> .
<i>iFlags</i>	Specifies the way in which the call is made.
<i>psFrom</i>	An optional pointer to a buffer which will hold the source address upon return.
<i>piFromlen</i>	An optional pointer to the size of the <i>psFrom</i> buffer.

Return Value

If no error occurs, **recvfrom()** returns the number of bytes received. If the connection has been closed, it returns 0. Otherwise, a value of `SOCKET_ERROR` is returned, and a specific error code is returned in `errno`.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EFAULT	The <i>piFromlen</i> argument was invalid: the <i>psFrom</i> buffer was too small to accommodate the peer address.
EINVAL	The socket has not been bound with <code>bind()</code> .
ENOTCONN	The socket is not connected (<code>SOCK_STREAM</code> only).
ENOTSOCK	The descriptor is not a socket.
EOPNOTSUPP	<code>MSG_OOB</code> was specified, but the socket is not of type <code>SOCK_STREAM</code> .
ESHUTDOWN	The socket has been shutdown; it is not possible to <code>recvfrom()</code> on a socket after <code>shutdown()</code> has been invoked with <i>how</i> set to 0 or 2.
EWOULDBLOCK	The socket is marked as non-blocking and

EMSGSIZE	the <code>recvfrom()</code> operation would block. The datagram was too large to fit into the specified buffer and was truncated.
ECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
ECONNRESET	The virtual circuit was reset by the remote side.

Remarks

This function is used to read incoming data on a (possibly connected) socket and capture the address from which the data was sent.

For sockets of type `SOCK_STREAM`, as much information as is currently available up to the size of the buffer supplied is returned. If the socket has been configured for in-line reception of out-of-band data (socket option `SO_OOBINLINE`) and out-of-band data is unread, only out-of-band data will be returned. The application may use the **`ioctlsocket()`** `SIOCATMARK` to determine whether any more out-of-band data remains to be read. The `psFrom` and `piFromlen` parameters are ignored for `SOCK_STREAM` sockets.

For datagram sockets, data is extracted from the first enqueued datagram, up to the size of the buffer supplied. If the datagram is larger than the buffer supplied, the buffer is filled with the first part of the message, the excess data is lost, and **`recvfrom()`** returns the error code `EMSGSIZE`.

If `psFrom` is non-zero, and the socket is of type `SOCK_DGRAM`, the network address of the peer which sent the data is copied to the corresponding struct `sockaddr`. The value pointed to by `piFromlen` is initialized to the size of this structure, and is modified on return to indicate the actual size of the address stored there.

If no incoming data is available at the socket, the **`recvfrom()`** call waits for data to arrive unless the socket is non-blocking. In this case a value of `SOCKET_ERROR` is returned with the error code set to `EWOULDBLOCK`. The **`select()`** call may be used to determine when more data arrives.

If the socket is of type `SOCK_STREAM` and the remote side has shut down the connection gracefully, a **`recvfrom()`** will complete immediately with 0 bytes received. If the connection has been reset **`recv()`** will fail with the error `ECONNRESET`.

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iFlags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *iFlags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_PEEK	Peek at the incoming data. The data is copied into the buffer but is not removed from the input queue.
MSG_OOB	Process out-of-band data.

See Also

recv(), send(), socket().

select

Syntax:

```
int select ( int iNfds, fd_set * psReadfds, fd_set * psWritefds,  
fd_set * psExceptfds, const struct timeval * psTimeout );
```

Description:

Determines the status of one or more sockets, waiting if necessary.

Parameters

Description

<i>iNfds</i>	This argument is ignored and included only for the sake of compatibility.
<i>psRadfds</i>	An optional pointer to a set of sockets to be checked for readability.
<i>psWritefds</i>	An optional pointer to a set of sockets to be checked for writability.
<i>psExceptfds</i>	An optional pointer to a set of sockets to be checked for errors.
<i>psTimeout</i>	The maximum time for select() to wait, or NULL for blocking operation.

Return Value

select() returns the total number of descriptors which are ready and contained in the *fd_set* structures, 0 if the time limit expired, or `SOCKET_ERROR` if an error occurred. If the return value is `SOCKET_ERROR`, **errno** contains the specific error code.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EINVAL	The <i>psTimeout</i> value is not valid.
ENOTSOCK	One of the descriptor sets contains an entry which is not a socket.

Remarks

This function is used to determine the status of one or more sockets. For each socket, the caller may request information on read, write or error status. The set of sockets for which a given status is requested is indicated by an *fd_set* structure. Upon return, the structure is updated to reflect the subset of these sockets which meet the specified condition, and **select()** returns the number of sockets meeting the conditions. A set of macros is provided for manipulating

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an `fd_set`. These macros are compatible with those used in the Berkeley software, but the underlying representation is completely different and the same as that used in Winsock.

The parameter `psReadfds` identifies those sockets which are to be checked for readability. If the socket is currently **listen()**ing, it will be marked as readable if an incoming connection request has been received, so that an **accept()** is guaranteed to complete without blocking. For other sockets, readability means that queued data is available for reading or, for sockets of type `SOCK_STREAM`, that the virtual socket corresponding to the socket has been closed, so that a **recv()** or **recvfrom()** is guaranteed to complete without blocking. If the virtual circuit was closed gracefully, then a **recv()** will return immediately with 0 bytes read; if the virtual circuit was reset, then a **recv()** will complete immediately with the error code `ECONNRESET`. The presence of out-of-band data will be checked if the socket option `SO_OOBINLINE` has been enabled (see **setsockopt()**).

The parameter `psWritfds` identifies those sockets which are to be checked for writability. If a socket is **connect()**ing (non-blocking), writability means that the connection establishment successfully completed. If the socket is not in the process of **connect()**ing, writability means that a **send()** or **sendto()** will complete without blocking.

The parameter `psExceptfds` identifies those sockets which are to be checked for the presence of out-of-band data or any exceptional error conditions. Note that out -of-band data will only be reported in this way if the option `SO_OOBINLINE` is `FALSE`. For a `SOCK_STREAM`, the breaking of the connection by the peer or due to `KEEPALIVE` failure will be indicated as an exception. If a socket is **connect()**ing (non-blocking), failure of the connect attempt is indicated in `psExceptfds`.

Any of `psReadfds`, `psWritfds`, or `psExceptfds` may be given as `NULL` if no descriptors are of interest.

Four macros are defined in the header file **socket.h** for manipulating the descriptor sets. The variable `FD_SETSIZE` determines the maximum number of descriptors in a set. (The default value of `FD_SETSIZE` is 16, which may be modified by #defining `FD_SETSIZE` to another value before #including **socket.h**.) Internally, an `fd_set` is represented as an array of `SOCKETs`. The macros are:

FD_CLR(so, *psSet) Removes the descriptor so from set.
FD_ISSET(so, *pSset) Nonzero if so is a member of the set, zero otherwise.
FD_SET(so, *psSet) Adds descriptor so to set.
FD_ZERO(*psSet) Initializes the set to the NULL set.

The parameter *psTimeout* controls how long the **select()** may take to complete. If *psTimeout* is a null pointer, **select()** will block indefinitely until at least one descriptor meets the specified criteria. Otherwise, *psTimeout* points to a struct *timeval* which specifies the maximum time that **select()** should wait before returning. If the *timeval* is initialized to {0, 0}, **select()** will return immediately; this is used to "poll" the state of the selected sockets.

See Also

accept(), connect(), recv(), recvfrom(), send().

send

Syntax:

```
int send ( SOCKET so, const char * pcBuf, int iLen, int iFlags );
```

Description:

Sends data on a connected socket.

Parameters

Description

<i>so</i>	A descriptor identifying a connected socket.
<i>pcBuf</i>	A buffer containing the data to be transmitted.
<i>iLen</i>	The length of the data in <i>pcBuf</i> .
<i>iFlags</i>	Specifies the way in which the call is made.

Return Value

If no error occurs, **send()** returns the total number of characters sent. (Note that this may be less than the number indicated by *len*.) Otherwise, a value of `SOCKET_ERROR` is returned, and a specific error code is returned in `errno`.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EACCES	The requested address is a broadcast address, but the appropriate flag was not set.
EFAULT	The <i>pcBuf</i> argument is not in a valid part of the user address space.
ENETRESET	The connection must be reset because SOCKETS dropped it.
ENOBUFS	SOCKETS reports a buffer deadlock.
ENOTCONN	The socket is not connected.
ENOTSOCK	The descriptor is not a socket.
EOPNOTSUPP	MSG_OOB was specified, but the socket is not of type <code>SOCK_STREAM</code> .
ESHUTDOWN	The socket has been shutdown; it is not possible to <code>send()</code> on a socket after <code>shutdown()</code> has been invoked with <code>how</code> set to 1 or 2.
EWOULDBLOCK	The socket is marked as non-blocking and the requested operation would block.

EMSGSIZE	The socket is of type SOCK_DGRAM, and the datagram is larger than the maximum supported by SOCKETS.
EINVAL	The socket has not been bound with bind().
ECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
ECONNRESET	The virtual circuit was reset by the remote side.

Remarks

send() is used on connected datagram or stream sockets and is used to write outgoing data on a socket. For datagram sockets, care must be taken not to exceed the maximum IP packet size of the underlying subnets. If the data is too long to pass atomically through the underlying protocol the error EMSGSIZE is returned, and no data is transmitted.

Note that the successful completion of a **send()** does not indicate that the data was successfully delivered.

If no buffer space is available within the transport system to hold the data to be transmitted, **send()** will block unless the socket has been placed in a non-blocking I/O mode. On non-blocking SOCK_STREAM sockets, the number of bytes written may be between 1 and the requested length, depending on buffer availability on both the local and foreign hosts. The **select()** call may be used to determine when it is possible to send more data.

iflags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by oring any of the following values:

Value	Meaning
MSG_DONTROUTE	Specifies that the data should not be subject to routing
MSG_OOB	Send out-of-band data (SOCK_STREAM only)

See Also

recv(), recvfrom(), socket(), sendto().

sendto

Syntax:

```
int sendto ( SOCKET so, const char * pcBuf, int iLen, int iFlags,
const struct sockaddr * psTo, int iTolen );
```

Description:

Sends data to a specific destination.

Parameters

<i>so</i>	A descriptor identifying a socket.
<i>pcBuf</i>	A buffer containing the data to be transmitted.
<i>iLen</i>	The length of the data in <i>pcBuf</i> .
<i>iFlags</i>	Specifies the way in which the call is made.
<i>PsTo</i>	An optional pointer to the address of the target socket.
<i>iTolen</i>	The size of the address in <i>to</i> .

Return Value

If no error occurs, **sendto()** returns the total number of characters sent. (Note that this may be less than the number indicated by *len*.) Otherwise, a value of `SOCKET_ERROR` is returned, and a specific error code is returned in `errno`.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EACCES	The requested address is a broadcast address, but the appropriate flag was not set.
EFAULT	The <i>pcBuf</i> or <i>psTo</i> parameters are not part of the user address space, or the <i>psTo</i> argument is too small (less than the size of a <code>struct sockaddr</code>).
ENETRESET	The connection must be reset because SOCKETS dropped it.
ENOBUFS	SOCKETS reports a buffer deadlock.
ENOTCONN	The socket is not connected (<code>SOCK_STREAM</code> only).
ENOTSOCK	The descriptor is not a socket.
EOPNOTSUPP	<code>MSG_OOB</code> was specified, but the socket is not of type <code>SOCK_STREAM</code> .

ESHUTDOWN	The socket has been shutdown; it is not possible to <code>sendto()</code> on a socket after <code>shutdown()</code> has been invoked with <code>how</code> set to 1 or 2.
EWOULDBLOCK	The socket is marked as non-blocking and the requested operation would block.
EMSGSIZE	The socket is of type <code>SOCK_DGRAM</code> , and the datagram is larger than the maximum supported by <code>SOCKETS</code> .
ECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
ECONNRESET	The virtual circuit was reset by the remote side.
EADDRNOTAVAIL	The specified address is not available from the local machine.
EAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
EDESTADDRREQ	A destination address is required.
ENETUNREACH	The network can't be reached from this host at this time.

Remarks

sendto() is used on datagram or stream sockets and is used to write outgoing data on a socket. For datagram sockets, care must be taken not to exceed the maximum IP packet size of the underlying subnets. If the data is too long to pass atomically through the underlying protocol the error `EMSGSIZE` is returned, and no data is transmitted.

Note that the successful completion of a **sendto()** does not indicate that the data was successfully delivered.

sendto() is normally used on a `SOCK_DGRAM` socket to send a datagram to a specific peer socket identified by the `psTo` parameter. On a `SOCK_STREAM` socket, the `psTo` and `iToLen` parameters are ignored; in this case the **sendto()** is equivalent to **send()**.

To send a broadcast (on a `SOCK_DGRAM` only), the address in the `to` parameter should be constructed using the special IP address `INADDR_BROADCAST` (defined in **socket.h**) together with the intended port number. It is generally inadvisable for a broadcast datagram to exceed the size at which fragmentation may occur, which

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implies that the data portion of the datagram (excluding headers) should not exceed 512 bytes.

If no buffer space is available within the transport system to hold the data to be transmitted, **sendto()** will block unless the socket has been placed in a non-blocking I/O mode. On non-blocking SOCK_STREAM sockets, the number of bytes written may be between 1 and the requested length, depending on buffer availability on both the local and foreign hosts. The **select()** call may be used to determine when it is possible to send more data.

iFlags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *iFlags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_DONTROUTE	Specifies that the data should not be subject to routing.
MSG_OOB	Send out-of-band data (SOCK_STREAM only Out of band data)

See Also

recv(), recvfrom(), socket(), send().

setsockopt

Syntax:

```
int setsockopt ( SOCKET so, int level, int optname,  
const char * optval, int optlen );
```

Description:

Sets a socket option.

Parameters	Description
<i>so</i>	A descriptor identifying a socket.
<i>level</i>	The level at which the option is defined; the only supported levels are SOL_SOCKET and IPPROTO_TCP.
<i>optname</i>	The socket option for which the value is to be set.
<i>optval</i>	A pointer to the buffer in which the value for the requested option is supplied.
<i>optlen</i>	The size of the <i>optval</i> buffer.

Return Value

If no error occurs, **setsockopt()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code is returned in *errno*.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EFAULT	<i>optval</i> is not in a valid part of the process address space.
EINVAL	<i>level</i> is not valid, or the information in <i>optval</i> is not valid.
ENETRESET	Connection has timed out when SO_KEEPALIVE is set.
ENOPROTOOPT	The option is unknown or unsupported. In particular, SO_BROADCAST is not supported on sockets of type SOCK_STREAM, while SO_DONTLINGER, SO_KEEPALIVE, SO_LINGER and SO_OOBINLINE are not supported on sockets of type SOCK_DGRAM.
ENOTCONN	Connection has been reset when SO_KEEPALIVE is set.
ENOTSOCK	The descriptor is not a socket.

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Remarks

setsockopt() sets the current value for a socket option associated with a socket of any type, in any state. Although options may exist at multiple protocol levels, this specification only defines options that exist at the uppermost "socket" level. Options affect socket operations, such as whether expedited data is received in the normal data stream, whether broadcast messages may be sent on the socket, etc.

There are two types of socket options: Boolean options that enable or disable a feature or behavior, and options which require an integer value or structure. To enable a Boolean option, *optval* points to a nonzero integer. To disable the option *optval* points to an integer equal to zero. *optlen* should be equal to `sizeof(int)` for Boolean options. For other options, *optval* points to the an integer or structure that contains the desired value for the option, and *optlen* is the length of the integer or structure.

SO_LINGER controls the action taken when unsent data is queued on a socket and a **closesocket()** is performed. See **closesocket()** for a description of the way in which the SO_LINGER settings affect the semantics of **closesocket()**. The application sets the desired behavior by creating a *struct linger* (pointed to by the *optval* argument) with the following elements:

```
struct linger {
    int l_onoff;
    int l_linger;
}
```

To enable SO_LINGER, the application should set *l_onoff* to a non-zero value, set *l_linger* to 0 or the desired timeout (in seconds), and call **setsockopt()**. To enable SO_DONTLINGER (i.e. disable SO_LINGER) *l_onoff* should be set to zero and **setsockopt()** should be called.

By default, a socket may not be bound (see **bind()**) to a local address which is already in use. On occasions, however, it may be desirable to "re-use" an address in this way. Since every connection is uniquely identified by the combination of local and remote addresses, there is no problem with having two sockets bound to the same local address as long as the remote addresses are different. To inform SOCKETS that a **bind()** on a socket should not be disallowed because the desired address is already in use by another socket, the application

should set the `SO_REUSEADDR` socket option for the socket before issuing the `bind()`. Note that the option is interpreted only at the time of the `bind()`: it is therefore unnecessary (but harmless) to set the option on a socket which is not to be bound to an existing address, and setting or resetting the option after the `bind()` has no effect on this or any other socket.

An application may request that SOCKETS enable the use of "keep-alive" packets on TCP connections by turning on the `SO_KEEPALIVE` socket option. If a connection is dropped as the result of "keep-alives" the error code `ENETRESET` is returned to any calls in progress on the socket, and any subsequent calls will fail with `ENOTCONN`.

The `TCP_NODELAY` option disables the Nagle algorithm. The Nagle algorithm is used to reduce the number of small packets sent by a host by buffering unacknowledged send data until a full-size packet can be sent. However, for some applications this algorithm can impede performance, and `TCP_NODELAY` may be used to turn it off. Application writers should not set `TCP_NODELAY` unless the impact of doing so is well-understood and desired, since setting `TCP_NODELAY` can have a significant negative impact of network performance. `TCP_NODELAY` is the only supported socket option which uses `level/ IPPROTO_TCP`; all other options use level `SOL_SOCKET`.

The following options are supported for `setsockopt()`. The Type identifies the type of data addressed by *optval*.

Value	Type	Meaning
<code>SO_BROADCAST</code>	<code>BOOL</code>	Allow transmission of broadcast messages on the socket.
<code>SO_DEBUG</code>	<code>BOOL</code>	Record debugging information.
<code>SO_DONTLINGER</code>	<code>BOOL</code>	Don't block close waiting for unsent data to be sent. Setting this option is equivalent to setting <code>SO_LINGER</code> with <code>L_onoff</code> set to zero.
<code>SO_DONTROUTE</code>	<code>BOOL</code>	Don't route: send directly to interface.
<code>SO_KEEPALIVE</code>	<code>BOOL</code>	Send keepalives
<code>SO_LINGER</code>	<code>struct linger *</code>	Linger on close if unsent data is present
<code>SO_OOINLINE</code>	<code>BOOL</code>	Receive out-of-band data in the normal data stream.
<code>SO_RCVBUF</code>	<code>Int</code>	Specify buffer size for receives
<code>SO_REUSEADDR</code>	<code>BOOL</code>	Allow the socket to be bound to an address which is already in use. (See <code>bind()</code> .)

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SO_SNDBUF	Int	Specify buffer size for sends.
TCP_NODELAY	BOOL	Disables the Nagle algorithm for send coalescing.

BSD options not supported for **setsockopt()** are:

Value	Type	Meaning
SO_ACCEPTCONN	BOOL	Socket is listening
SO_ERROR	Int	Get error status and clear
SO_RCVLOWAT	Int	Receive low water mark
SO_RCVTIMEO	Int	Receive timeout
SO_SNDLOWAT	Int	Send low water mark
SO_SNDTIMEO	Int	Send timeout
SO_TYPE	Int	Type of the socket
IP_OPTIONS		Set options field in IP header.

See Also

`bind()`, `getsockopt()`, `ioctlsocket()`, `socket()`.

shutdown

Syntax:

```
int shutdown ( SOCKET so, int how );
```

Description:

Disables sends and/or receives on a socket.

Parameters

Description

so

A descriptor identifying a socket.

how

A flag that describes what types of operation will no longer be allowed.

Return Value

If no error occurs, **shutdown()** returns 0. Otherwise, a value of `SOCKET_ERROR` is returned, and a specific error code is returned in `errno`.

Error Codes

`ENETDOWN` `SOCKET`s has detected that the network subsystem has failed.

`EINVAL` *how* is not valid.

`ENOTCONN` The socket is not connected (`SOCK_STREAM` only).

`ENOTSOCK` The descriptor is not a socket.

Remarks

shutdown() is used on all types of sockets to disable reception, transmission, or both.

If *how* is 0, subsequent receives on the socket will be disallowed. This has no effect on the lower protocol layers. For TCP, the TCP window is not changed and incoming data will be accepted (but not acknowledged) until the window is exhausted. For UDP, incoming datagrams are accepted and queued. In no case will an ICMP error packet be generated.

If *how* is 1, subsequent sends are disallowed. For TCP sockets, a FIN will be sent.

Setting *how* to 2 disables both sends and receives as described above.

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Note that **shutdown()** does not close the socket, and resources attached to the socket will not be freed until **closesocket()** is invoked.

Comments

shutdown() does not block regardless of the `SO_LINGER` setting on the socket. An application should not re-use a socket after it has been shut down.

See Also

`connect()`, `socket()`.

socket

Syntax:

SOCKET socket (int *af*, int *type*, int *protocol*);

Description:

Creates a socket.

Parameters

af An address format specification. The only format currently supported is PF_INET, which is the ARPA Internet address format.

type A type specification for the new socket.

Protocol A particular protocol to be used with the socket, or 0 if the caller does not wish to specify a protocol.

Return Value

If no error occurs, **socket()** returns a descriptor referencing the new socket. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code is returned in errno.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
EAFNOSUPPORT	The specified address family is not supported.
EMFILE	No more file descriptors are available.
ENOBUFS	No buffer space is available. The socket cannot be created.
EPROTONOSUPPORT	The specified protocol is not supported.
EPROTOTYPE	The specified protocol is the wrong type for this socket.
ESOCKTNOSUPPORT	The specified socket type is not supported in this address family.

Remarks

socket() allocates a socket descriptor of the specified address family, data type and protocol, as well as related resources. If a protocol is not specified (i.e. equal to 0), the default for the specified connection mode is used.

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Only a single protocol exists to support a particular socket type using a given address format. However, the address family may be given as `AF_UNSPEC` (unspecified), in which case the *protocol* parameter must be specified. The protocol number to use is particular to the "communication domain" in which communication is to take place.

The following *type* specifications are supported:

Type Explanation

<code>SOCK_STREAM</code>	Provides sequenced, reliable, two-way, connection-based byte streams with an out-of-band data transmission mechanism. Uses TCP for the Internet address family.
<code>SOCK_DGRAM</code>	Supports datagrams, which are connectionless, unreliable buffers of a fixed (typically small) maximum length. Uses UDP for the Internet address family.

Sockets of type `SOCK_STREAM` are full-duplex byte streams. A stream socket must be in a connected state before any data may be sent or received on it. A connection to another socket is created with a **connect()** call. Once connected, data may be transferred using **send()** and **recv()** calls. When a session has been completed, a **closesocket()** must be performed. Out-of-band data may also be transmitted as described in **send()** and received as described in **recv()**.

The communications protocols used to implement a `SOCK_STREAM` ensure that data is not lost or duplicated. If data for which the peer protocol has buffer space cannot be successfully transmitted within a reasonable length of time, the connection is considered broken and subsequent calls will fail with the error code set to `ETIMEDOUT`.

`SOCK_DGRAM` sockets allow sending and receiving of datagrams to and from arbitrary peers using **sendto()** and **recvfrom()**. If such a socket is **connect()**ed to a specific peer, datagrams may be send to that peer **send()** and may be received from (only) this peer using **recv()**.

See Also

`accept()`, `bind()`, `connect()`, `getsockname()`, `getsockopt()`, `setsockopt()`, `listen()`, `recv()`, `recvfrom()`, `select()`, `send()`, `sendto()`, `shutdown()`,

octlsocket()).

gethostbyaddr

Syntax:

```
struct hostent * gethostbyaddr ( const char * pcAddr, int len, int type );
```

Description:

Gets host information corresponding to an address.

Parameters

Description

pcAddr

A pointer to an address in network byte order.

len

The length of the address, which must be 4 for PF_INET addresses.

type

The type of the address, which must be PF_INET.

Return Value

If no error occurs, **gethostbyaddr()** returns a pointer to the hostent structure described above. Otherwise it returns a NULL pointer and a specific error number is returned in *errno*.

Error Codes

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

WSAHOST_NOT_FOUND

Authoritative Answer Host not found.

WSATRY_AGAIN

Non-Authoritative Host not found, or SERVERFAIL.

WSANO_RECOVERY

Non-recoverable errors, FORMERR, REFUSED, NOTIMP.

WSANO_DATA

Valid name, no data record of requested type.

Remarks

gethostbyaddr() returns a pointer to the following structure which contains the name(s) and address which correspond to the given address.

```
struct hostent {  
    char * h_name;  
    char ** h_aliases;  
    short h_addrtype;
```

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```
        short h_length;  
        char ** h_addr_list;  
};
```

The members of this structure are:

Element	Usage
h_name	Official name of the host (PC).
h_aliases	A NULL-terminated array of alternate names.
h_addrtype	The type of address being returned; for SOCKETS this is always PF_INET.
h_length	The length, in bytes, of each address; for PF_INET, this is always 4.
h_addr_list	A NULL-terminated list of addresses for the host. Addresses are returned in network byte order.

The macro `h_addr` is defined to be `h_addr_list[0]` for compatibility with older software. The pointer which is returned points to a structure which is allocated by SOCKETS. The application must never attempt to modify this structure or to free any of its components. The application should copy any information which it needs before issuing any other SOCKETS API calls.

See Also

`gethostbyname()`,

gethostbyname

Syntax:

```
struct hostent * gethostbyname ( const char * pszName );
```

Description:

Gets host information corresponding to a hostname.

Parameters

Description

PszName A pointer to the name of the host.

Return Value

If no error occurs, **gethostbyname()** returns a pointer to the hostent structure described above. Otherwise it returns a NULL pointer and a specific error number is returned in *errno*.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

Remarks

gethostbyname() returns a pointer to a hostent structure as described under **gethostbyaddr()**. The contents of this structure correspond to the hostname *pszName*.

The pointer which is returned points to a structure which is allocated by SOCKETS. The application must never attempt to modify this structure or to free any of its components. The application should copy any information which it needs before issuing any other SOCKETS API calls.

A **gethostbyname()** implementation must not resolve IP address strings passed to it. Such a request should be treated exactly as if an unknown host name were passed. An application with an IP address string to resolve should use **inet_addr()** to convert the string to an IP address, then **gethostbyaddr()** to obtain the hostent structure.

See Also

gethostbyaddr()

gethostname

Syntax:

```
int gethostname ( char * pszName, int iAddressLen );
```

Description:

Return the standard host name for the local machine.

Parameters

pszName

Description

A pointer to a buffer that will receive the host name.

iAddressLen

The length of the buffer.

Return Value

If no error occurs, **gethostname()** returns 0, otherwise it returns SOCKET_ERROR and a specific error code is returned in *errno*.

Error Codes

EFAULT

The *iAddressLen* parameter is too small

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

Remarks

This routine returns the name of the local host into the buffer specified by the *pszName* parameter. The host name is returned as a null-terminated string. The form of the host name is dependent on the SOCKETS configuration file. However, it is guaranteed that the name returned will be successfully parsed by **gethostbyname()**.

See Also

gethostbyname().

getprotobyname

Syntax:

```
struct protoent * getprotobyname ( const char * pszName );
```

Description:

Gets protocol information corresponding to a protocol name.

Parameters	Description
<i>pszName</i>	A pointer to a protocol name.

Return Value

If no error occurs, **getprotobyname()** returns a pointer to the protoent structure described above. Otherwise it returns a NULL pointer and a specific error number is returned in *errno*.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

Remarks

getprotobyname() returns a pointer to the following structure which contains the name(s) and protocol number which correspond to the given protocol *pszName*.

```
struct protoent {  
    char * p_name;  
    char ** p_aliases;  
    short p_proto;  
};
```

The members of this structure are:

Element	Usage
<i>p_name</i>	Official name of the protocol.
<i>p_aliases</i>	A NULL-terminated array of alternate names.
<i>p_proto</i>	The protocol number, in host byte order.

The pointer which is returned points to a structure which is allocated by the SOCKETS library. The application must never attempt to modify this structure or to free any of its components. The application should copy any information which it needs before issuing any other SOCKETS API calls.

See Also

getprotobynumber()

getprotobynumber

Syntax:

```
struct protoent * getprotobynumber ( int number );
```

Description:

Gets protocol information corresponding to a protocol number.

Parameters

number

Description

A protocol number, in host byte order.

Return Value

If no error occurs, **getprotobynumber()** returns a pointer to the protoent structure described above. Otherwise it returns a NULL pointer and a specific error number is returned in errno.

Error Codes

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

WSANO_RECOVERY

Non recoverable errors, FORMERR, REFUSED, NOTIMP.

WSANO_DATA

Valid name, no data record of requested type.

Remarks

This function returns a pointer to a protoent structure as described above in **getprotobyname()**. The contents of the structure correspond to the given protocol number.

The pointer which is returned points to a structure which is allocated by SOCKETS. The application must never attempt to modify this structure or to free any of its components. The application should copy any information which it needs before issuing any other SOCKETS API calls.

See Also

getprotobyname()

getservbyname

Syntax:

Gets service information corresponding to a service name and protocol.

Description:

```
struct servent * getservbyname ( const char * pszName,  
const char * proto );
```

Parameters

pszName

proto

Description

A pointer to a service name.

An optional pointer to a protocol name. If this is NULL, **getservbyname()** returns the first service entry for which the *pszName* matches the *s_name* or one of the *s_aliases*. Otherwise **getservbyname()** matches both the *pszName* and the *proto*.

Return Value

If no error occurs, **getservbyname()** returns a pointer to the servent structure described above. Otherwise it returns a NULL pointer and a specific error number is returned in *errno*.

Error Codes

ENETDOWN

SOCKETS has detected that the network subsystem has failed.

WSANO_RECOVERY

Non recoverable errors, FORMERR, REFUSED, NOTIMP.

WSANO_DATA

Valid name, no data record of requested type.

Remarks

getservbyname() returns a pointer to the following structure which contains the name(s) and service number which correspond to the given service *pszName*.

```
struct servent {  
    char * s_name;  
    char ** s_aliases;  
    short s_port;  
    char * s_proto;  
};
```

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The members of this structure are:

Element	Usage
s_name	Official name of the service.
s_aliases	A NULL-terminated array of alternate names.
s_port	The port number at which the service may be contacted. Port numbers are returned in network byte order.
s_proto	The name of the protocol to use when contacting the service.

The pointer which is returned points to a structure which is allocated by the SOCKETS library. The application must never attempt to modify this structure or to free any of its components. The application should copy any information which it needs before issuing any other SOCKETS API calls.

See Also

getservbyport()

getservbyport

Syntax

```
struct servent * getservbyport ( int port, const char * proto );
```

Description:

Gets service information corresponding to a port and protocol.

Parameters

port The port for a service, in network byte order.
proto An optional pointer to a protocol name. If this is NULL, **getservbyport()** returns the first service entry for which the *port* matches the *s_port*. Otherwise **getservbyport()** matches both the *port* and the *proto*.

Return Value

If no error occurs, **getservbyport()** returns a pointer to the servent structure described above. Otherwise it returns a NULL pointer and a specific error number is returned in *errno*.

Error Codes

ENETDOWN	SOCKETS has detected that the network subsystem has failed.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

Remarks

getservbyport() returns a pointer a servent structure as described above for **getservbyname()**.

The pointer which is returned points to a structure which is allocated by SOCKETS. The application must never attempt to modify this structure or to free any of its components. The application should copy any information which it needs before issuing any other SOCKETS API calls.

See Also

getservbyname()

5.4.9 HTTP Functions (CGI_LIB*.LIB)

CGI Application API (Server API)

Introduction

The SOCKETS web servers, HTTPD.EXE and HTTPFTPD.EXE, provide both a Spawning Common Gateway Interface (CGI) and an Extension API with the ability to extend the server to create dynamic web pages, perform specialized tasks, etc. One of the extensions provided is a Server Side Includes (SSI) interface using the CGI interface, enabling a user to create web pages using HTML templates with variable names, which is substituted in-time with specific values. The HTTPD Extension CGI works as follows: The extension has to implement one function called the *callback function*. The server has a number of functions that the extension may use, e.g. *HttpSendData*. They are designed to give the extension sufficient control over any http request.

Spawning CGI

An external program, indicated by the requested URL, is spawned. All relevant information is passed as environment variables. The program gets all input (e.g. posted data) from *standard in* and sends all response through *standard out*.

This type of CGI is discouraged in favor of the *Extension API*. The following CGI environment variables are supported:

CONTENT_TYPE
CONTENT_LENGTH
PATH, COMSPEC
REQUEST_METHOD

Enough free memory must be available when spawning a CGI program, or no swapping or overlaying will be attempted. Since COMMAND.COM uses all free memory, it follows that no CGI program will be spawned if COMMAND.COM is the current foreground program.

CGI programs must be small and must execute reasonably quickly. While a CGI program is executing, the HTTP server is effectively

blocked and cannot service any other requests. No console input or output should be used. A CGI program is invoked by a URL containing a path of /cgi-bin/<cgi-program> where <cgi-program> is the name of an executable program which must be in the HTTP root directory or in the path. Note that the "/cgi-bin/" part is stripped off and does not represent a real directory. <Cgi-program> may be followed by a "?" and a command line. On entry to the CGI program, the environment variables listed above are set up and can be accessed.

If a command line is given, it can also be accessed in the normal way. The CGI program generates a dynamic page by writing to STDOUT. When the CGI program terminates, this output is sent to the remote client (browser). The output can consist of a header and a body part separated by an empty line. If the header contains a "Content-type:" line, the content type will be set to that type and only the body will be sent to the client. Otherwise all the output will be sent to the client using content type "text/plain". COMMAND.COM can be invoked as a CGI program to perform simple DOS functions e.g. directory listings. The following example performs a directory listing:

<http://www.embedded-server.com/cgi-bin/command?cdir>

The next one performs a wide directory listing using a wild-card specification:

http://www.embedded-server.com/cgi-bin/command?cdir%20*.htm%20/w

Note the use of %20 to specify a space character.

Refer to the INDEX.HTM web page for an example of various ways of calling CGI programs. The NUM.EXE program with source code NUM.C, demonstrates the use of a header and body part building a simple "page visited" web page: `printf("Content-type: text/html\n\n"
"<html>\n<h1>\nThis page has been visited %d times\n</h1>\n",
number); printf("<P><P>Back.</html>\n");`

Forms programming can be performed using either the GET or POST methods. When GET is used, form data is copied to the command line and is limited to 128 characters including the URL part. When the POST method is used, the command line is also built. In addition, form data are available from STDIN and is limited by disk space only. See the forms programming example consisting of FORM.HTM,

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FORM.EXE and FORM.C for examples of using both the GET and POST methods.

So that you may fully understand CGI programming, this detailed explanation of the server operation is provided.

Whenever HTTPD receives a URL containing “/cgi-bin/”, it interprets the rest of the URL as a DOS program to spawn and run to completion. The full path parsed from the URL is used, implying that the program should be in physical directory called “/cgi-bin/” or a subdirectory thereof. E.g. “program.exe” should be in “%HTTP_DIR%\cgi-bin\” if the request is “GET /cgibin/program.exe”.

While this “CGI program” is executing, the server can accept new server connections, but will not respond to them before the CGI program terminates. The CGI program can be any DOS program that is small enough to fit into available memory. Since HTTPD is blocked while the CGI program executes, user interaction should not be used and the CGI program should complete in a reasonable time. Operation on receiving a CGI URL:

If the CGI program name is followed by a “?”, the rest of the line is sent as a command line to the CGI program after converting all %n combinations.

If a “Content-Type” header is encountered, the CONTENT_TYPE environment variable is set to the given value and if a “Content-Length” header is encountered, the CONTENT_LENGTH environment variable is set to the given value. The PATH and COMSPEC environment variables are copied to the new environment and the REQUEST_METHOD environment variable is set to either GET or POST.

If the POST method is used, the rest of the HTTP message is copied to a temporary file that is then re-directed to stdin. The stdout stream is redirected to another temporary file. After completion of the request, the temporary files are deleted. They will be created in the %HTTPTMP% directory.

The CGI program is now invoked. This program can check the environment variables, access the command line and in the case of a POST, read from stdin.

All output that should be passed back to the HTTP client (Browser) is written to stdout. A single header line followed by an empty line, containing "Contenttype":

content_type" may be pre-pended to the data. This line will be used to set the content-type of the data being sent back. If such a header is not found, the content type will be set to "text/plain".

Overview of the Extention API

The SOCKETS HTTP servers (HTTPD/HTTPFPD) provide a facility to call functions in other modules which may be TSR or transient programs. These functions are referred to as "HTTPD extensions". HTTPD or HTTPFPD must be loaded as a TSR using the /r switch. It provides an API via software Interrupt 63Hex. The API can be located by searching for a signature containing SockHTTPD starting 10 bytes before the interrupt entry point and terminated by a 0 byte.

A **CGI adapter** is provided that simplifies the communication with the server. It is located in a file called CGIADAP.C. The adapter finds the signature and provides a C interface. It also intercepts the callback function and performs a stack and context switch, which makes implementing an extension much easier.

An HTTPD extension registers interest in a specific URL by calling the **HttpRegister()** API specifying a "path". Note that this path has nothing to do with an actual file path on the server and will override any real path that may be used for serving static pages. The **HttpRegister()** function also specifies a Callback function to be called when the actual request is received by HTTPD, a DWORD User ID to be used in callbacks and whether requests should be allowed to overlap, i.e. a new request can be received while still servicing a previous request or requests.

The Callback function will be called when a request for the registered path is received and as many times afterwards as is necessary to complete the request. It is called with a parameter structure specifying the reason for the request, the User ID, an HTTPD handle and values specific to the reason for the callback, e.g. a pointer to the command line on the initial callback. Other reasons for calling the Callback function are to notify of new received data, connection closure by the peer, readiness to accept more data and connection errors.

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The callback must return a value to indicate that it is still busy handling the request, has completed the request or wants to abort the request with an error. The HTTPD handle will be constant and unique from the first callback to the completion of the request.

While in the Callback function, data can be read from the peer or sent to the peer and a file can be submitted to be sent to the peer.

Note: Extensions are responsible for sending all HTTP header fields to clients.

The following extensions have been developed for functional and demonstrational purposes.

SSI Interface

If you want to display the current date and time, or a certain CGI environment variable in your otherwise static document, you can go through the trouble of writing a CGI program that outputs this small amount of virtual data. Or better yet, you can use a powerful feature called Server Side Includes (or SSI).

Server Side Includes are directives which you can place into your HTML documents to output such data as environment variables and file statistics.

For a detailed introduction, please visit <http://www.ora.com/info/cgi/ch05.html>

A simple yet powerful interface is provided to perform Server Side Includes (SSI) tasks. A user only has to implement one predefined function and make use of only four API functions to unlock the power of SSI.

The working of the interface is described at the top of the header file *ssi.h*.

To use, include *ssicgi.c* in your project and include *ssi.h* in your source files. Take a look at *ssi.c* for a simple example.

Extention API Examples

Five very simple examples are included to demonstrate the usage of the Extention API. Source code is included, as well as make files. Put all *.htm* and *.exe* files in the %HTTP_DIR% directory and start *HTTPD*. Load all the cgi programs (you may use *cgi.bat*). All is in place now and the examples may be accessed through *index.htm*.

The first four examples may operate in one of two modes:

As a TSR (resident) program: this is the default behavior. At this stage unloading of the TSR is not supported. De-registration is possible by loading the program again. This routine may be repeated.

As a transient program: use */t* command line switch to activate. This option will immediately spawn 'command.com'. From this prompt other cgi programs may be loaded. The program exits when 'command.com' is exited by typing 'exit' at the prompt.

These programs are:

1. ***cgiecho*** A very simple program that accepts data from a user and echoes it back nicely formatted. Get *echoform.htm* from the browser.
2. ***cgicount*** A page visit counter. Only updates between sessions if transient (*cgicount /t*). Get *num.htm* from the browser.
3. ***cgiform*** Does the same as the old 'fill out the form and submit' utility. Get *caform.htm* from the browser.

SSI A very simple SSI implementation that demonstrates the SSI interfaces. *Template.htm* is filled by some variables. Get *ssi.htm* from the browser.

The fifth example, ***FFUR***, (Form-base File Upload Receiver) is only a transient program, but can easily be adapted to be similar to the rest. It handles the upload of a file as a POST command by filling out *ffur.htm*.

HTTPD Function Reference

CGIADAP.C is an interface program a user may utilize to implement external extension CGI programs. This interface performs stack and context switches, and provides ordinary C functions to access the http server (*HTTPD.exe*).

The header file to use is *CGIADAP.H*.

The API may be used without using *CGIADAP* by making low level calls which are detailed below. In this case the user must perform the required stack and context switches if required.

HttpRegister

Syntax:

```
int HttpRegister(far char *pfszPath,  
                int (far *pfCallback) (HTTP_PARAMS far *pfsHttpParams),  
                int iFlags, DWORD dwUserID);
```

Description:

The **HttpRegister()** function registers an interest in a URL, providing a callback function. The callback is guaranteed to only be called when DOS can be called. The DOS critical handler will be disabled and all critical errors will result in an access error without any user intervention. Since the callback happens at interrupt time, it should execute for as short a time as possible. After a done or error return, no further callbacks will be generated for the current request.

Only one callback will be active at any time. Calling an API function while executing the callback function will not result in another callback before the current callback has returned.

Parameter

Description

pfszPath

far pointer to the string identifying a URL. It should be an exact match of the `abs_path` part of the URI minus the leading '/'. For instance, If you want to capture all <http://myserver.com/cgi-bin/getpage.exe>, you should register 'cgibin/getpage.exe'.

pfCallback

Address of callback function.
Return values when returning from callback:
RET_OK not done, give me more upcalls
RET_DONE done, no more upcalls please
RET_ERR done, error

PfsHttpParams

Far pointer to HTTP parameter block.

`pfsHttpParams->iReason`

Reason for callback:

R_NEWREQ - New HTTP request. `pszCommandLine` points to the command line passed in the URL. The number contained in `iValue` specifies the HTTP operation; RQ_GET for GET and RQ_POST for POST.

R_INDATA - Input data available, `iValue` contains count.

R_OUTDATA - Can send output data, `iValue` contains count.

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R_ENDDATA - Peer closed connection i.e. "end of input data"

R_CLOSED - Connection closed.

pfsHttpParams->iHandle

HTTPD handle, used in subsequent API calls for this request. The user should not modify it.

See HTAPIC.H for the other definitions

iflags F_OVERLAP - Overlapped request (1),
non-overlapped request (0).
All other bits are reserved.

dwUserID Value passed to HttpRegister(); this value is for use by the extension, HTTPD does not modify it.

Return value

0: OK

< 0: One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH APIF_REGISTER (0)

DS:SI pfszPath

ES:DI pfCallback

BX iFlags

CX:DX dwUserID

Low level return parameters

Return code in AX.

Note that the stack and the data segment on entry will be that of HTTPD. Depending on the memory model used for the extension and the amount of stack space required, it may be required to switch stacks during the callback.

HttpDeRegister

Syntax:

```
int HttpDeRegister(char far *pfszPath);
```

Description:

The **HttpDeRegister()** function removes the interest in a URL. After this call no more callbacks will be generated for this URL. Any requests in progress will be terminated with an error to the peer. This function must be called for all registrations made by a program before terminating that program; otherwise the system will inevitably crash on any subsequent request.

Parameter	Description
<i>pfszPath</i>	Far pointer to URL to de-register.

Return value

0: OK

< 0: One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH	APIF_DEREGISTER (1)
DS:SI	pfszPath

Low level return parameters

Return code in AX.

HttpGetData

Syntax

```
int HttpGetData(int iHandle, char far *pfcBuf, int iCount);
```

Description:

The **HttpGetData()** function can be called when a POST operation has been indicated by the callback to get data sent to the server by the client. If more data is expected and the extension is busy executing the callback function, a 0 return should be made from the callback indicating it is still busy and getting more data should be attempted at the next callback.

return:

>= 0 - ok, bytes received

< 0: One of the error messages (see htapic.h)

Parameter	Description
<i>iHandle</i>	Handle passed in pfsHttpParams.
<i>pfcBuf</i>	Far pointer to buffer to receive data.
<i>iCount</i>	Length of buffer.

Return value

>=0: OK, number of bytes received.

< 0: One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH	APIF_GETDATA (2)
BX	<i>iHandle</i>
DS:SI	<i>pfcBuf</i>
CX	<i>iCount</i>

Low level return parameters

Return code in AX.

HttpSendData

Syntax

```
int HttpSendData(int iHandle, char far *pcBuf, int iCount);
```

Description:

The **HttpSendData()** function is used to send data to the client.

If the return indicates that less than the requested number of bytes has been sent and the extension is busy executing the callback function, a 0 return should be made from the callback indicating it is still busy. Then an attempt to send more data should be made at the next callback.

All the required data should be sent to the client before an **HttpSubmitFile()** function is used. After **HttpSubmitFile()**, **HttpSendData()** should not be called again.

Parameter	Description
<i>iHandle</i>	Handle passed in pfsHttpParams.
<i>pcBuf</i>	Far pointer to buffer with data to send.
<i>iCount</i>	Length of buffer.

Return value

>= 0: number of bytes actually sent
< 0: One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH	APIF_SENDDATA (3)
BX	<i>iHandle</i>
DS:SI	<i>pcBuf</i>
CX	<i>iCount</i>

Low level return parameters

Return code in AX.

HttpSubmitFile

Syntax:

```
int HttpSubmitFile(int iHandle, char far *pfszFileName);
```

Description:

The **HttpSubmitFile()** function is used to submit a file to be sent to the client in response to a request. The file will be logically appended to any data already sent using **HttpSendData()**. The file should not be exclusively opened when it is submitted. After it is transmitted, transmit upcalls will be issued normally. This gives the user the ability to send any number of files on the connection with arbitrary data in between.

Parameter

iHandle
pfszFileName

Description

Handle passed in pfsHttpParams.
Far pointer to name of file to submit.

Return value

0: OK
< 0: One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH	APIF_SENDFILE (4)
BX	<i>iHandle</i>
DS:SI	<i>pfszFileName</i>

HttpGetStatus

Syntax

```
int HttpGetStatus(void);
```

Description:

The **HttpGetStatus()** function gets the number of connections to the server. It must also be used as a polling function when the server is running in passive mode to dequeue and handle pending requests.

Parameter	Description
-----------	-------------

None	
------	--

Return value

>=0: Number of connections to server.

< 0: One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH APIF_GETSTATUS(6)

Low level return parameters

Return code in AX.

HttpGetVersion

Syntax

```
int HttpDeRegister(void);
```

Description:

The **HttpGetVersion()** function gets the version of the running HTTP server.

Parameter	Description
None	

Return value

≥ 0 : Version number.

< 0 : One of the error messages (SEE HTAPIC.H)

Low level calling parameters

AH APIF_GETVERSION (5)

Low level return parameters

Return code in AX.

GetStackPointer/GetStackSegment

Syntax

```
int SetStackPointer (void);  
int SetStackSegment (void);
```

Description:

The **GetStackPointer()/GetStackSegment()** functions get the current Stack Pointer/Segment.

Parameter	Description
None	

Return value

Current value of Stack Pointer/Segment.

SetStackPointer/SetStackSegment

Syntax:

```
void SetStackPointer (int iPointer);  
void SetStackSegment (int iSegment);
```

Description:

The **SetStackPointer()/SetStackSegment()** functions set the Stack Pointer/Segment.

The stack pointer for callbacks is by default set to `_SP - 1000`, the first time the HTTP API is called. If you would need space on the stack, or for some reason want to make it tighter, set the stack pointer for callbacks manually. Be careful not to overwrite used memory.

Parameter	Description
<i>iPointer</i>	Value to set Stack Pointer to.

Return value

None

Constants and Definitions used by CGI API

Refer to HTAPIC.H.

SSI Definitions and functions

Refer to SSI.H.

New COM Port API

Syntax:

```
void Ver_COMLib(char *vstr);  
CHAR SIO_Open(UCHAR i_ucPort);
```

Return Value:

On success, return 0
On error, return -1

Syntax:

```
CHAR SIO_Close(UCHAR i_ucPort);
```

Return Value:

On success, return 0
On error, return -1

Syntax:

```
CHAR SIO_SetState(UCHAR i_ucPort, ULONG i_ulBaudRate,  
UCHAR i_ucParity, UCHAR i_ucDataBits, UCHAR i_ucStopBits);
```

Argument:

i_ulBaudRate COM baudrate setting
i_ucParity NO_PARITY(0x00), ODD_PARITY(0x08),

EVEN_PARITY(0x18)

i_ucDataBits COM format setting
Items: DATA5(0x00), DATA6(0x01), DATA7(0x02), DATA8(0x03)
i_ucStopBits COM stop bits setting
Items: STOP1(0x00), STOP2(0x04)

Return Value:

On success, return 0
On error, return -1

Syntax:

```
INT SIO_RecvBytes(UCHAR i_ucPort, UCHAR i_ucMode, UINT  
i_uinBytes, UCHAR * o_ucDataBuf);
```

Description:

When Block_Mode, program will block here until nBytes data is received

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When UnBlock_Mode, program will not block and return the total number of bytes data have been received.

Argument:

i_ucMode Block_Mode(0x01), UnBlock_Mode(0x02)
i_uinBytes number of bytes to be read
o_ucDataBuf Buffer for received data

Return Value:

On success, return the number of bytes data return
On error, return -1

Syntax:

```
INT SIO_GetAvaiRecvBytes(UCHAR i_ucPort);
```

Return Value:

On success, return the number of bytes data in input buffer
On error, return -1

Syntax:

```
INT SIO_SendBytes(UCHAR i_ucPort, UINT i_uinBytes, UCHAR *  
i_ucDataBuf);
```

Argument:

i_uinBytes number of bytes to be sent
i_ucDataBuf A buffer for data to be sent

Return Value:

On success, return the number of bytes data have been sent
On error, return -1

Syntax:

```
CHAR SIO_PurgeBuf(UCHAR i_ucPort, UCHAR i_ucFlag);
```

Argument:

i_ucFlag
Clear_RXBuffer(0x01): Clear input buffer and receive FIFO
Clear_TXBuffer(0x02): Clear output buffer and send FIFO

Remarks

User can clear input buffer and output buffer together with argument

Syntax:

Clear_RXBuffer|Clear_TXBuffer

Return Value:

None

Syntax:

INT SIO_GetAvaiSendBuf(UCHAR i_ucPort);

Return Value:

On success, return the number of remaining available bytes space in output buffer

On error, return -1

6

Sockets Utility

Chapter 6 Sockets Utility

SOCKETS utilities make use of command-line parameters and/or configuration files. Please be careful to note the name and location of the configuration file used by the application you are working with. All SOCKETS applications require that the kernel be loaded before the application is run in order to function properly.

DHCPSTAT

DHCPSTAT displays the DHCP information for the machine.

Syntax

DHCPSTAT [r | v]

Options

The r option is for forcing a renewal of the DHCP lease.

The v option displays the SOCKETS version information.

Example

```
DHCPSTAT
```

This will display all the DHCP information, such as IP address and lease time.

FTP

FTP is a file transmitting and retrieving client that runs in interactive or batch mode.

Syntax

FTP server [options]

Options

/n

/v

/p=Port

/f=ScriptFile [ScriptParameters]

Remarks

Server

The name or ip address of a server to connect to.

/n

Suppress progress indicator.

/v

Verbose output for troubleshooting.

/p=Port

Connect to a server port other than the standard FTP port number of 21.

/f=ScriptFile

A file containing commands for the client to send to the server upon connection. Simple parameter substitution is performed, with the first element of *ScriptParameters* accessible as "%1," etc.

ScriptParameters

Parameters to pass into the *ScriptFile*.

Return Codes

0 Success

1 Parameter error

2 SOCKETS not loaded

3 User aborted

4 Transfer aborted

5 Error writing local file

6 Error reading local file

Other Server returned error response code; to find that error code, add 390 to the response code returned by FTP. The result will always be greater than or equal to 400 in this case.

Chapter 6 Sockets Utility

Example

```
FTP /n FTP.cdrom.com /f=getfile.scr /.2/simtelnet/msdos DIRS.TXT
(The file GETFILE.SCR):
user anonymous
pass root@
cd %1
binary
get %2
quit
```

FTP Commands

The commands entered at the FTP client can be interpreted and translated to standard FTP commands to be sent to the server. The FTP server might recognise more, or less, commands than the standard list of commands as specified in RFC 959. The **site** command is always server dependent. Some of the standard commands are implemented differently in various servers. Useful things to note are:

1. The **put** and **get** commands allow multiple file transfers by usage of wild card characters. When **getting** files with paths or long names, no translation of foreign file names are done. Specify a valid DOS **local_file** name.
2. A short directory list (NLST) is obtained by **ls** and the long list with **dir**.
3. Some of the commands can be abbreviated.
4. Some commands are aliases added for user comfort like **bye**, **exit** and **quit**; **get** and **mget**; and **put** and **mput**.
5. The optional [**local_file**] parameter will, when specified, cause the output of that command to be logged to a file. By specifying the file as PRN you can get immediate printouts.
6. On some servers you might specify the optional [**remote_file**] parameter as PRN or the printer output device to do remote printing. (See also the **site nopath** command for the SOCKETS FTP server.)
7. The **F3** key and **spacebar** can be used to recall the last command word by word. Below is a list of commands recognised by the SOCKETS FTP client (some FTP servers might not offer all the facilities):

Chapter 6 Sockets Utility

Command	Description
abort	Cancel an incomplete transfer
append	"Put" a file at the server but append it if the file exists
ascii	Synonym for type a
binary	Synonym for type i
bye	Synonym for quit
cd directory	Synonym for cwd
cwd directory	Change server directory
delete file	Delete a server file
dir [file directory [local_file]]	Synonym for list
exit	Synonym for quit
get remote_file(s) [local_file]	Transfer a file from the server in the current mode (type)
image	Synonym for type i
ls [file directory [local_file]]	Synonym for nlst
lcd directory	Perform a local change directory
ltdir [file directory]	Give a local directory listing
list [file directory [local_file]]	Give a long directory listing
mget remote_file(s) [local_file]	Synonym for get
mkdir remote_directory	Create a server directory
mput local_file(s) [remote_file]	Synonym for put
nlst [file directory [local_file]]	Give a short names-only directory listing
pass [password]	Password for username
pasv [on off]	Report or change the status of the passive transfer mode to enable firewall friendly file transfers. (The SOCKETS FTP client always tries to switch passive mode on at the start of a session.)
put local_file(s) [remote_file]	Transfer a file to the server in the current mode (type)
Pwd	Print working directory at server
quit	Terminate FTP session
quote remote_command [args ...]	Send a command to the server without any interpretation
rmdir remote_directory	Remove (delete) a server directory
rnfr existing_filename	Rename a file, command 1 of 2
rnto new_filename	Rename a file, command 2 of 2
site sub-command	Send server specific commands
size file	Report the file size in bytes as a 213 message
shell	Shell to DOS for IFTP.EXE
stat	Report the status of a transfer or active connections
System	Return operating system information from the server
type [i a]	Report or select the file transfer mode: image (binary) or ASCII
user [username]	Username to logon
verbose [on off]	Verbose mode reports more of the FTP negotiations

Chapter 6 Sockets Utility

IFSTAT

IFSTAT displays the status of the Interface and the version information for SOCKETS.

Syntax

IFSTAT [i] [v]

Options

The i option shows the Interface status.

The v option shows the version information.

Example

IFSTAT v

This will display the SOCKETS version information

IPSTAT

The IPSTAT utility returns statistics on IP and memory. Use IPSTAT to check for error conditions and memory problems.

Syntax

IPSTAT

Example

IPSTAT

The following will be displayed (The values may differ):

IP stats at 160F:04C8:

Total Packets	2671
Smaller than minimum size	0
IP header length too small	0
Wrong IP version	0
Unsupported protocol	0
Memory available	9016
Memory allocation failures	0
Memory free errors	0
Minimum stack observed	886

Chapter 6 Sockets Utility

MAKEMAIL

MAKEMAIL packages the body text and any attachments for delivery using the **SENDMAIL** application.

Syntax

```
MAKEMAIL -tToAddress -fFromAddress -sSubject -bBodyTextFile -oOutputFileaAttachment
```

Options

ToAddress

The e-mail address of the recipient(s) of this mail. Additional recipients are specified by repeated use of the **-t** parameter. If the *ToAddress* is a name that can be resolved by either the DNS server or host file then the *@servername* is not necessary.

FromAddress

Used to identify the sender of the message.

Subject

The subject line of the e-mail message.

BodyTextFile

The local file containing the body text of the e-mail message to deliver.

OutputFile

The local file name in which to store the prepared file for delivery by **SENDMAIL**. This file is overwritten if it already exists!

Attachment

The name of a local file to be binary attached to this e-mail message. Multiple attachments are created by repeated use of the **-a** parameter. Files are attached as MIME parts, encoded with the application/x-uuencode content type.

Example

```
MAKEMAIL -tfred@yahoo.com -fmary@yahoo.com -sStatus -bmessage.txt -oemail.dat
```

```
MAKEMAIL -tfred -tbarney -fwilma -sDinner -bmenu.txt -oemail.dat
```

Chapter 6 Sockets Utility

```
MAKEMAIL -tfred -fwilma -sBowling -bbody.txt -aStone.jpg -  
aRock.jpg -omail.dat
```

Chapter 6 Sockets Utility

SENDMAIL

SENDMAIL delivers e-mail messages packaged by the **MAKEMAIL** application to an Internet mail server. **SENDMAIL** also creates a local log file to indicate successful send or failures.

Syntax

SENDMAIL server file

Options

Server

The IP address or DNS name of the Internet mail server to receive the message.

File

The file, created by the **MAKEMAIL** utility, to deliver.

Logging Format

Timestamp, Code String

Timestamp

Weekday Month Day Time Year

Code

Three digit integer. 000 means perfect success, 100-199 mean usage error and 200-299 means TCP/IP error from server.

String

Human-readable explanation of the error code.

Example

```
SENDMAIL mail.datalight.com mail.dat
```

XPING

XPING starts a continuous string of pings until stopped by a keystroke.

Syntax

XPING *ip address* [interval]

Remarks

ip address This may be a numeric address or a name address.

Options

interval The time to wait between pings in clock ticks.

Example

```
XPING 10.0.0.1 20
```

This will ping the address of 10.0.0.1 every 20 clock ticks.

7

HTTP and FTP Server Application

HTTP Server

Overview

The SOCKETS HTTP server, HTTPD.EXE, is a small, fast, reliable and extendable web server that can run as either an application or TSR. Apart from the minimum required file download capability, the following additional capabilities are provided:

1. Remote Console Server- ability to gain terminal-type access to the server system, using a standard browser, without the need to install any software on the browser computer
2. Authentication – Both system wide and directory wise
3. CGI Extensibility – The ability to extend the server to create dynamic web pages, perform specialized tasks, etc.
4. A Server Side Includes (SSI) interface is provided using the CGI interface, enabling a user to create web pages using HTML templates with variable names, which is substituted in- time with specific values
5. Ability to run as a background process
6. Flexibility to control physical parameters such as memory usage and number of connections

Server

The HTTP server is used to send static web pages existing as files on the server or dynamically generated web pages to a remote client (browser). Dynamic pages can be generated in two ways:

1. Extension CGI. By calling an external CGI handler, the server provides an API to external handlers. A Server Side Includes (SSI) interface is provided as well, which makes it very easy to create powerful interactive web pages.
2. Spawning CGI. By spawning programs with a relatively short execution time to generate the pages through a mechanism similar to CGI, the basic mechanism used by CGI is that arbitrary programs can be spawned from the web server

with input as received from the remote browser and output that can be sent to the browser.

The Remote Console Server accepts input from a remote client that is fed to the keyboard buffer for use by an arbitrary program using it. It also monitors the screen display buffer area and sends screen information to the remote client.

The SOCKETS password file controls authentication. Authentication is user specific and may also differ from directory to directory. It may also be put off for either some or all users. See the section on authentication.

The HTTP server can support multiple simultaneous sessions. The GET and POST request methods are implemented as well as the following MIME types:

text/html, text/plain, image/gif, image/jpeg, image/jpeg and application/octet-stream. The MIME type is determined by the file extension.

Remote Console Server

Initialization

The client (browser) will initialize a remote session. An HTTP connection will be made to the HTTP server. The downloaded page will contain the applet that will automatically connect to the RCS on TCP port 81. An example download page is supplied as REMCON.HTM.

Almost any application e.g. a text editor can be run on the server. The remote keyboard and display control the application as if they were locally attached.

On the remote side, the Java Applet acts as a simple terminal emulator that displays what it receives from the server and sends what is entered from the keyboard to the server.

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It is not required to have a real display adapter on the embedded system server, only to have display buffer memory.

When a new connection is made, all the screen data, as well as the cursor position, is sent to the client. Subsequently the RCS keeps a watch on the video memory and cursor position and

whenever a change is detected, the RCS sends the changed data to the Java applet.

Keyboard data received from the client is passed to the keyboard buffer making it available as keyboard input for use by any application executing on the server.

Remote Console Client

The remote console client exists as a Java 1.3.1 applet, supplied as RC.JAR, and will function on any Java 1.3.1 compliant browser. Please note that a security certificate has not been compiled into RC.JAR so it is not compliant with versions of the Netscape browser that require a security certificate to run Java applets. A DOS based client using SOCKETS is also supplied as RCCLI.EXE. For additional information about RC.JAR or RCCLI.EXE, please see the Utility Description Chapter.

Extension CGI

The SOCKETS HTTP servers (HTTPD/HTTPFTPD) provide a facility to call functions in other modules which may be TSR or transient programs. These functions are referred to as "HTTPD extensions." For more information please see the "ROM-DOS Developer's Guide" section "CGI Application API."

Extension CGI Examples

Five very simple examples are included to demonstrate the implementation of CGI. Source code is included.

Put all *.htm* and *.exe* files in the %HTTP_DIR% directory and start *HTTPD*. Load all the cgi programs (you may use *cgi.bat*). All is in place now and the examples may be accessed through *index.htm*.

The first four examples may operate in one of two modes:

As a TSR (resident) program: this is the default behavior. At this stage unloading of the TSR is not supported. De-registration is possible by loading the program again. This routine may be repeated.

As a transient program: use '/t' command line switch to activate. This option will immediately spawn 'command.com'. From this prompt other cgi programs may be loaded. The program exits when 'command.com' is exited by typing 'exit' at the prompt.

These programs are:

1. ***cgiecho*** A very simple program that accepts data from a user and echoes it back nicely formatted. Get *echoform.htm* from the browser.
2. ***cgicount*** A page visit counter. Only updates between sessions if transient (cgicount /t) Get *num.htm* from the browser.
3. ***cgiform*** Does the same as the old 'fill out the form and submit' utility. Get *caform.htm* from the browser.
4. ***SSI*** A very simple SSI implementation that demonstrates the SSI interfaces. *Template.htm* is filled by some variables. Get *ssi.htm* from the browser.

The fifth example, ***FFUR***, (Form-base File Upload Receiver) is only a transient program, but can easily be adapted to be similar to the rest. It handles the upload of a file as a POST command by filling out *ffur.htm*.

Passive Mode

The server may be run in passive mode by specifying a '/p' command line switch. When passive, the server will record network events but only handle them once it is triggered by a CGI user.

Server Memory

The server's memory usage may be controlled in two ways:

1. By specifying the amount of memory when going TSR.
2. By specifying the maximum number of connections the server will allow.

Option 1 is the recommended option. Use Option 2 if you have 'heavy' web pages – usually the type where pages consist of frames and many images, etc. Connections are generally reset when more connections are attempted than the defined maximum. The client then must retry to establish the lost connections, leading to a more distributed load on the server.

Spawning CGI

An external program, indicated by the requested URL, is spawned. All relevant information is passed as environment variables. The CGI program gets all input (e.g. posted data) from *standard in* and sends all response through *standard out*. Spawning CGI is discouraged in favor of Extension *CGI*. For more information please see the "ROM-DOS Developer's Guide" section "CGI Application API."

Authentication

Default authentication matches the capabilities of the FTP server as documented in the section "FTP Server" on page 217. A file called "SOCKET.UPW" should exist in the SOCKETS (environment variable) directory.

The default permission file controls remote console access. Each listed user has a single-letter privilege code set if he has privilege to use the Remote Console. The code should be missing if that user does not have Remote Console privilege.

An additional authentication feature is implemented - **htaccess**. This feature provides a per-directory permission override mechanism. It is enabled using '/t' as command line switch. If htaccess is enabled, the default mechanism may be skipped (but no default users or remote console access will be available).

A file called HTACCESS (typically hidden) contains authentication overrides to enable partial anonymous access or additional password security to subdirectories, etc. If this feature is activated, the server code will look for HTACCESS files in each directory starting from the requested path and continuing upward in the directory structure (assuming the root directory to be at the top) until an HTACCESS file is found. If no file is found, then the default settings are used. An anonymous access entry is available for the developer to specify that some subdirectory is authorized for any user, although its parent directory is password-protected. CGI scripts can also be controlled via the HTACCESS mechanism.

HTTPD Program

The syntax for HTTPD is:

```
HTTPD [options] [<http_port>] [<rc_port>]
```

Any combination of these switches may be used. They should be separated by at least one space.

Option	Description
/? /h	display help screen
/r	run server in TSR mode
/s	display server status
/t	enable htaccess directory level authentication
/u	unload if resident
/c	close listen
/d	do not start remote console

Chapter 7 HTTP and FTP Server Application

/g	allow old type (spawning) CGI
/p	Passive mode
/i=<InterruptNumber>	Interrupt number for cgi API
/m=<MemorySize>	set memory size
/n=<MaximumConnections>	number of simultaneous connections
/a=<ScreenX>, <ScreenY>	set screen aspect
/v=<ScreenBufferSegment>[:<ScreenBufferOffset>]	set video buffer address (hex)
/k	Unload and abort all active connections

Remarks

ScreenX, ScreenY

The width and height of the screen area to serve for the remote console session. These values default to 80 and 25, respectively.

ScreenBufferSegment, ScreenBufferOffset

Together, a pointer to the top-left corner of the display memory to serve for the remote console session. These values default to B000 and 0000 respectively, for monochrome display adapters and to B800 and 0000 respectively, for color display adapters.

MemorySize

The maximum amount of memory available to the server. The default value is 32K. The value of m can range from 8192 to 63472.

MaximumConnections

The maximum number of simultaneous connections allowed by the server.

InterruptNumber

The interrupt number to access the CGI API.

http_port

HTTP port to listen on. This parameter defaults to the standard HTTP port number of 80.

rc_port

Remote Console port to listen on. This parameter defaults to 81.

The "root" directory for web content is the current directory when HTTPD is started. This can be changed by setting an environment variable HTTP_DIR e.g.

```
SET HTTP_DIR=D:\SERVER\WEB
```

Format of "SOCKET.UPW"

This is the same file used for the FTP server's (*FTPD.EXE*) permissions. This file consists of lines where each line contains a user's information. A line starting with a # is considered a comment and is ignored. Each line consists of four fields:

```
<Username> <Password> <Working Directory>  
<Permissions> [# comment]
```

Username: The name of this user. If it is *, it will be used when the client does not specify a username.

Password: This user's password. If it is *, no password is required

Working Directory: The user will only have access to this directory and its subdirectories. If it is '/', this user has access to the whole system. HTTP_DIR can be referred to as '\'. If a relative path is specified, it is appended to HTTP_DIR.

Permissions: IMPORTANT when a user is granted both FTP and HTTP permissions, the FTP permissions must appear **first**, otherwise they will be ignored. Operations allowed. May contain any combination of the following tokens: **e** - User may 'get' files
p - User may 'post' files
g - User may use **cgi**
m - User may use **Remote Console**

Fields should be separated by single spaces. If any field is missing the entry is ignored. A comment may follow the last field (permissions) of the line.

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Note: If a default user is supplied, it should always appear first in the list of users. Only users below the default user will be considered.

Format of "htaccess"

Any directory may contain this file, and serve as overrides to the general permissions for the containing directory and all its subs until another htaccess is found. This file consists of lines where each line contains a user's information. A line starting with a # is considered a comment and is ignored. Each line consists of three fields:

<Username> <Password> <Permissions> [# comment]

username: The name of this user. If it is *, it will be used when the client didn't specify a username.

Password This user's password. If it is *, no password is required.

Permissions Operations allowed. may contain any combination of following tokens:
e - User may 'get' files
p - User may 'post' files
g - User may use **cgi**

Fields should be separated by single spaces. If any field is missing the entry is ignored. A comment may follow the last field (permissions) of the line.

Note: If a default user is supplied, it should always appear first in the list of users. Only users below the default user will be considered.

FTP Server

FTPD is a file server that can run either as an application or as a TSR. The name of the server as displayed in the banner is determined by the `HOSTNAME` environment variable. If the environment variable is not set, the name "Socket" is used. The user password file, `SOCKET.UPW`, in the `SOCKETS` directory (indicated by the `SOCKETS` environment variable) controls access.

A temporary file is created when a directory listing is requested. This file is created in the current directory, but can be created in any directory as specified in the `FTPDIR` environment variable.

FTPD Program

The syntax for FTPD is:

FTPD [options] [<ftp_port>]

Option	Description
/? /h	display help screen
/r	run server in TSR mode
/s	display server status
/u	unload if resident
/c	close listen
/m=<MemorySize>	set memory size
/n=<MaximumConnections>	number of simultaneous connections
/k	Abort all active connections and unload

Remarks

MemorySize

The number of bytes of memory available to the server. This value defaults to 32768.

MaximumConnections

The maximum number of simultaneous connections allowed by the server.

ftp_port

FTPD will listen on the listed port. This parameter defaults to the standard FTP port number of 21.

Configuration File

FTPD uses the standard SOCKET.UPW file for validating logins. The file is composed of text lines, each representing a login name, password, and the configuration to use for a session opened with those credentials. Space characters separate the parameters in the file, which are in the following format:

name password directory rights

The location of the username/password file to be used by the server is specified by the environment variable SOCKETS as follows:

%SOCKETS%\SOCKET.UPW

If the variable SOCKETS is not specified, the following file is used:

\\DL\SOCKETS\SOCKET.UPW

Configuration File Parameters

name

The login name of this record.

password

The password to authenticate a user trying to login as this name.

directory

The starting directory for this user.

rights

Up to four characters specifying which permissions this user is granted:

r means that this user has read access.

w means that this user has write access.

c means that this user has permission to make new directories.

d means that this user has permission to change to a directory other than his starting location and subdirectories from the starting location.

Example Socket.upw

Admin admin c:\drwc

Guest * c:\guest dr

Example Command Line

```
FTPD /m=40000 /r
```

FTP Server Commands

The following commands are recognised by the SOCKETS FTP server:

Command	Description
Abort	cancel an incomplete transfer
append	"put" a file at the server but append it if the file exists
<i>cwd directory</i>	change server directory
<i>dele file</i>	delete a server file
<i>list [file directory]</i>	give a long directory listing
<i>mkd remote_directory</i>	create a server directory
<i>nlst [file directory]</i>	gives a short names-only directory listing
<i>pass [password]</i>	password for username
<i>pasv [on off]</i>	report or change the status of the passive transfer mode to enable firewall friendly file transfers. (The SOCKETS FTP client always tries to switch passive mode on at the start of a session.)
<i>retr remote_file</i>	transfer a file from the server in the current mode
<i>stor local_file</i>	transfer a file to the server in the current mode
<i>pwd</i>	print working directory
<i>quit</i>	terminate FTP session
<i>rmd remote_directory</i>	remove (delete) directory
<i>rnfr existing_filename</i>	rename a file, command 1 of 2
<i>rnto new_filename</i>	rename a file, command 2 of 2
<i>site [path nopath]</i>	use full path description (see
<i>site raw [interface]</i>	open a session to a raw host using one of the raw lines (interfaces) specified
<i>site sub-command</i>	command to be passed on to raw host
<i>size file</i>	report the file size in bytes as a message prefixed with 213
<i>stat</i>	report the status of a transfer or active connections
<i>system</i>	return operating system information from the server
<i>type [i a]</i>	report or select the file transfer mode image (binary) or ASCII
<i>user [username]</i>	username to logon

Combined HTTP and FTP Server

HTTPFTPD is a combined HTTP and FTP server that can run either as an application or as a TSR. By default, it processes normal HTTP requests on port 80 and normal FTP requests on port 21. It also serves a proprietary session displaying the contents of text-mode display memory to the **RC.JAR** and **RCCLI** client applications. This feature is commonly called the "remote console." If the **HTTPFTPD** server is loaded as a DOS TSR program, set the environment variable, `HTTP_DIR`, to the location of the `INDEX.HTML` file; for example, `SET HTTP_DIR=C:\DL\SOCKETS\SERVER`

HTTPFTPD Program

The syntax for `FTTPD` is:

```
HTTPFTPD [options] [<http_port> [<ftp_port> [<rc_port>]]]
```

Any combination of these switches may be used. They should be separated by at least one space.

Option	Description
<code>/?</code> <code>/h</code>	display help screen
<code>/r</code>	run server in TSR mode
<code>/s</code>	display server status
<code>/t</code> authentication	enable <code>htaccess</code> directory level
<code>/u</code>	unload if resident
<code>/c</code>	close listen
<code>/d</code>	do not start remote console
<code>/g</code>	allow old type (spawning) CGI
<code>/p</code>	Passive mode
<code>/i=<InterruptNumber></code>	Interrupt number for cgi API
<code>/m=<MemorySize></code>	set memory size
<code>/n=<MaximumConnections></code>	number of simultaneous connections
<code>/a=<ScreenX>, <ScreenY></code>	set screen aspect
<code>/v=<ScreenBufferSegment>[:<ScreenBufferOffset>]</code>	set video buffer address (hex)
<code>/k</code>	Abort all active connections and unload

Remarks

ScreenX, ScreenY

The width and height of the screen area to serve for the remote console session. These values default to 80 and 25, respectively.

ScreenBufferSegment, ScreenBufferOffset

Together, a pointer to the top-left corner of the display memory to serve for the remote console session. These values default to B000 and 0000 respectively, for monochrome display adapters and to B800 and 0000 respectively, for color display adapters.

MemorySize

The maximum amount of memory available to the server. The default value is 32K. The value of m can range from 8192 to 63472.

MaximumConnections

The maximum number of simultaneous connections allowed by the server.

InterruptNumber

The interrupt number to access the CGI API.

http_port

HTTP port to listen on. This parameter defaults to the standard HTTP port number of 80.

ftp_port

FTP port to listen on. This parameter defaults to the standard FTP port number of 21

rc_port

Remote Console port to listen on. This parameter defaults to 81.

Configuration File

HTTPFTPD uses the standard SOCKET.UPW file for validating logins. The file is composed of text lines, each representing a login name, password, and the configuration to use for a session opened with those credentials.

Chapter 7 HTTP and FTP Server Application

Space characters separate the parameters in the file, which are in the following format:

name password directory rights

The location of the username/password file to be used by the server is specified by the environment variable SOCKETS as follows:

`%SOCKETS%\SOCKET.UPW`

If the variable SOCKETS is not specified, the following file is used:

`\DL\SOCKETS\SOCKET.UPW`

Configuration File Parameters

name

The login name of this record.

password

The password to authenticate a user trying to login as this name.

directory

The starting directory for this user.

w means that this user has write access.

c means that this user has permission to make new directories.

d means that this user has permission to change to a directory other than his starting location and subdirectories from the starting location.

e means that this user may 'get' files

p means that this user may 'post' files

g means that this user may use `cgi`

m means that this user may use Remote Console

Example Command Lines

```
HTTPFTPD /m=40000 /r
```

```
HTTPFTPD /a=80,25 /v=a000:0000 /r
```

Appendix A

COM Port Register Structure

Appendix A COM Port Register Structure

This appendix gives a short description of each module's registers. For more information, please refer to the STARTECH 16C550 UART chip data book. All registers are one byte. Bit 0 is the least significant bit, and bit 7 is the most significant bit. The address of each register is specified as an offset from the port base address (BASE), COM1 is 3F8h and COM2 is 2F8h.

- DLAB is the "Divisor Latch Access Bit", bit 7 of BASE+3.
- BASE+0 Receiver buffer register when DLAB=0 and the operation is a read.
- BASE+0 Transmitter holding register when DLAB=0 and the operation is write.
- BASE+0 Divisor latch bits 0 - 7 when DLAB=1
- BASE+1 Divisor latch bits 8-15 when DLAB=1.

Bytes BASE+0 and BASE+1 together form a 16-bit number, the divisor, which determines the baud rate. Set the divisor as follows:

Baud rate	Divisor	Baud rate	Divisor
50	2304	2400	48
75	1536	3600	32
110	1047	4800	24
133.5	857	7200	16
150	768	9600	12
300	384	19200	6
600	192	38400	3
1200	96	56000	2
1800	64	115200	1
2000	58	x	x

Appendix A COM Port Register Structure

BASE+1 Interrupt Status Register (ISR) when DLAB=0
bit 0: Enable received-data-available interrupt
bit 1: Enable transmitter-holding-register-empty interrupt
bit 2: Enable receiver-line-status interrupt
bit 3: Enable modem-status interrupt

BASE+2 FIFO Control Register (FCR)
bit 0: Enable transmit and receive FIFOs
bit 1: Clear contents of receive FIFO
bit 2: Clear contents of transmit FIFO
bits 6-7: Set trigger level for receiver FIFO interrupt

Bit 7	Bit 6	FIFO trigger level
0	0	01
0	1	04
1	0	08
1	1	14

BASE+3 Line Control Register (LCR)
bit 0: Word length select bit 0
bit 1: Word length select bit 1

Bit 1	Bit 0	Word length (bits)
0	0	5
0	1	6
1	0	7
1	1	8

Appendix A COM Port Register Structure

BASE+4	Modem Control Register (MCR) bit 0: DTR bit 1: RTS
BASE+5	Line Status Register (LSR) bit 0: Receiver data ready bit 1: Overrun error bit 2: Parity error bit 3: Framing error bit 4: Break interrupt bit 5: Transmitter holding register empty bit 6: Transmitter shift register empty bit 7: At least one parity error, framing error or break indication in the FIFO
BASE+6	Modem Status Register (MSR) bit 0: Delta CTS bit 1: Delta DSR bit 2: Trailing edge ring indicator bit 3: Delta received line signal detect bit 4: CTS bit 5: DSR bit 6: RI bit 7: Received line signal detect
BASE+7	Temporary data register

Appendix B

Data Formats and I/O Ranges

B.1 Analog Input Formats

The ADAM analog input modules can be configured to transmit data to the host in Engineering Units.

Engineering Units

Data can be represented in Engineering Units by setting bits 0 and 1 of the data format/checksum/integration time parameter to 0. This format presents data in natural units, such as degrees, volts, millivolts, and milliamps. The Engineering Units format is readily parsed by the majority of computer languages because the total data string length, including sign, digits and decimal point, does not exceed seven characters.

The data format is a plus (+) or minus (-) sign, followed by five decimal digits and a decimal point. The input range which is employed determines the resolution, or the number of decimal places used, as illustrated in the following table:

Input Range	Resolution
± 15 mV, ± 50 mV	1 μ V (three decimal places)
± 100 mV, ± 150 mV, ± 500 mV	10 μ V (two decimal places)
± 1 V, ± 2.5 V, ± 5 V	100 μ V (four decimal places)
± 10 V	1 mV (three decimal places)
± 20 mA	1 μ A (three decimal places)
Type J and T thermocouple	0.01°C (two decimal places)
Type K, E, R, S, and B thermocouple	0.1°C (one decimal place)

Example 1

The input value is -2.65 V and the corresponding analog input module is configured for a range of ± 5 V. The response to the Analog Data In command is:

-2.6500(cr)

Example 2

The input value is 305.5°C. The analog input module is configured for a Type J thermocouple whose range is 0°C to 760°C. The response to the Analog Data In command is:

+305.50(cr)

Example 3

The input value is +5.653 V. The analog input module is configured for a range of ± 5 V range. When the engineering units format is used, the ADAM Series analog input modules are configured so that they automatically provide an over range capability. The response to the Analog Data In command in this case is:

+5.6530(cr)

Appendix B Data Formats and I/O Ranges

B.2 Analog Input Ranges - ADAM-5017

Module	Range Code	Input Range Description	Data Formats	+F.S.	Zero	-F.S.	Displayed Resolution	Actual Value
ADAM-5017	08h	± 10 V	Engineering Units	+10.000	± 000.000	-10.000	1 mV	Reading/ 1000
			% of FSR	+100.00	± 000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	09h	± 5 V	Engineering Units	+5.0000	± 0.0000	-5.0000	100.00 μ V	Reading/ 1000
			% of FSR	+100.00	± 000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	0Ah	± 1 V	Engineering Units	+1.0000	± 0.0000	-1.0000	100.00 μ V	Reading/ 10000
			% of FSR	+100.00	± 000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	0Bh	± 500 mV	Engineering Units	+500.00	± 000.00	-500.00	10 μ V	Reading/ 10
			% of FSR	+100.00	± 000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	0Ch	± 150 mV	Engineering Units	+150.00	± 000.00	-150.00	10 μ V	Reading/ 100
			% of FSR	+100.00	± 000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	0Dh	± 20 mA	Engineering Units	+20.000	± 00.000	-20.000	1 μ V	Reading/ 1000
			% of FSR	+100.00	± 000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	

B.3 Analog Input Ranges - ADAM-5018

Module	Range Code	Input Range Description	Data Formats	+F.S.	Zero	-F.S.	Displayed Resolution	Actual Value
ADAM-5018	00h	±15 mV	Engineering Units	+15.000	±00.000	-15.000	1 μV	Reading/ 1000
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	01h	±50 mV	Engineering Units	+50.000	±00.000	-50.000	1 μV	Reading/ 100
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	02h	±100 mV	Engineering Units	+100.00	±000.00	-100.00	10 μV	Reading/ 100
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	03h	±500 mV	Engineering Units	+500.00	±000.00	-500.00	10 μV	Reading/ 10
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	04h	±1 V	Engineering Units	+1.0000	±0.0000	-1.0000	100 μV	Reading/ 10000
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	05h	±2.5 V	Engineering Units	+2.5000	±0.0000	-2.5000	100 μV	Reading/ 10000
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
	06h	±20 mA	Engineering Units	+20.000	±00.000	-20.000	1 μA	Reading/ 1000
			% of FSR	+100.00	±000.00	-100.00	0.01%	
			Two's Complement	7FFF	0000	8000	1 LSB	
07h	Not Used							

Appendix B Data Formats and I/O Ranges

Module	Range Code	Input Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution	Actual Value
ADAM-5018	0Eh	Type J Thermocouple 0°C to 760°C	Engineering Units	+760.00	+000.00	0.1°C	Reading/ 10
			% of FSR	+100.00	+000.00	0.01%	
			Two's Complement	7FFF	0000	1 LSB	
	0Fh	Type K Thermocouple 0°C to 1370°C	Engineering Units	+1370.0	+0000.0	0.1°C	Reading/ 10
			% of FSR	+100.00	+000.00	0.01%	
			Two's Complement	7FFF	0000	1 LSB	
	10h	Type T Thermocouple -100°C to 400°C	Engineering Units	+400.00	-100.00	0.1°C	Reading/ 10
			% of FSR	+100.00	-025.00	0.01%	
			Two's Complement	7FFF	E000	1 LSB	
	11h	Type E Thermocouple 0°C to 1000°C	Engineering Units	+1000.00	+0000.0	0.1°C	Reading/ 10
			% of FSR	+100.00	±000.00	0.01%	
			Two's Complement	7FFF	0000	1 LSB	
	12h	Type R Thermocouple 500°C to 1750°C	Engineering Units	+1750.0	+0500.0	0.1°C	Reading/ 10
			% of FSR	+100.00	+028.57	0.01%	
			Two's Complement	7FFF	2492	1 LSB	
	13h	Type S Thermocouple 500°C to 1750°C	Engineering Units	+1750.0	+0500.00	0.1°C	Reading/ 10
			% of FSR	+100.00	+028.57	0.01%	
			Two's Complement	7FFF	2492	1 LSB	
14h	Type B Thermocouple 500°C to 1800°C	Engineering Units	+1800.0	+0500.0	0.1°C	Reading/ 10	
		% of FSR	+100.00	+027.77	0.01%		
		Two's Complement	7FFF	2381	1 LSB		

B.4 Analog Input Ranges - ADAM-5017H

Range Code	Input Range	Data Formats	+Full Scale	Zero	Scale	-Full	Displayed Resolution
00h	±10 V	Engineering	11	0	-11		2.7 mV
		Two's Comp	0FFF	0	EFFF		1
01h	0 ~ 10 V	Engineering	11	0	Don't care		2.7 mV
		Two's Comp	0FFF	0	Don't care		1
02h	±5 V	Engineering	5.5	0	-5.5		1.3 mV
		Two's Comp	0FFF	0	EFFF		1
03h	0 ~ 5 V	Engineering	5.5	0	Don't care		1.3 mV
		Two's Comp	0FFF	0	Don't care		1
04h	±2.5 V	Engineering	2.75	0	-2.75		0.67 mV
		Two's Comp	0FFF	0	EFFF		1
05h	0 ~ 2.5 V	Engineering	2.75	0	Don't care		0.67 mV
		Two's Comp	0FFF	0	Don't care		1
06h	±1 V	Engineering	1.375	0	-1.375		0.34 mV
		Two's Comp	0FFF	0	EFFF		1
07h	0 ~ 1 V	Engineering	1.375	0	Don't care		0.34 mV
		Two's Comp	0FFF	0	Don't care		1
08h	±500 mV	Engineering	687.5	0	-687.5		0.16 mV
		Two's Comp	0FFF	0	EFFF		1
09h	0 ~ 500 mV	Engineering	687.5	0	Don't care		0.16 mV
		Two's Comp	0FFF	0	Don't care		1
0ah	4 ~ 20 mA	Engineering	22	4.0	Don't care		5.3 µA
		Two's Comp	0FFF	02E9	Don't care		1
0bh	0 ~ 20 mA	Engineering	22	0	Don't care		5.3 µA
		Two's Comp	0FFF	0	Don't care		1

Note: The full scale values in this table are theoretical values for your reference; actual values will vary.

B.5 Analog Output Formats

You can configure ADAM analog output modules to receive data from the host in Engineering Units.

Engineering Units

Data can be represented in engineering units by setting bits 0 and 1 of the data format/checksum/integration time parameter to 0. This format presents data in natural units, such as milliamps. The Engineering Units format is readily parsed by the majority of computer languages as the total data string length is fixed at six characters: two decimal digits, a decimal point and three decimal digits. The resolution is 5 μ A.

Example:

An analog output module on channel 1 of slot 0 in an ADAM-5000 system at address 01h is configured for a 0 to 20 mA range. If the output value is +4.762 mA, the format of the Analog Data Out command would be #01S0C14.762<cr>

B.6 Analog Output Ranges

Range Code	Output Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution
30	0 to 20 mA	Engineering Units	20.000	00.000	5 μ A
		% of Span	+100.00	+000.00	5 μ A
		Hexadecimal Binary	FFF	000	5 μ A
31	4 to 20 mA	Engineering Units	20.000	04.000	5 μ A
		% of Span	+100.00	+000.00	5 μ A
		Hexadecimal Binary	FFF	000	5 μ A
32	0 to 10 V	Engineering Units	10.000	00.000	2.442 mV
		% of Span	+100.00	+000.00	2.442 mV
		Hexadecimal Binary	FFF	000	2.442 mV

B.7 ADAM-5013 RTD Input Format and Ranges

Range Code (hex)	Input Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution
20	100 Ohms Platinum RTD -100 to 100 °C a=0.00385	Engineering Units	+100.00	-100.00	±0.1 °C
21	100 Ohms Platinum RTD 0 to 100 °C a=0.00385	Engineering Units	+100.00	+000.00	±0.1 °C
22	100 Ohms Platinum RTD 0 to 200 °C a=0.00385	Engineering Units	+200.00	+000.00	±0.2 °C
23	100 Ohms Platinum RTD 0 to 600 °C a=0.00385	Engineering Units	+600.00	+000.00	±0.6 °C
24	100 Ohms Platinum RTD -100 to 100 °C a=0.00392	Engineering Units	+100.00	-100.00	±0.1 °C
25	100 Ohms Platinum RTD 0 to 100 °C a=0.00392	Engineering Units	+100.00	+000.00	±0.1 °C
26	100 Ohms Platinum RTD 0 to 200 °C a=0.00392	Engineering Units	+200.00	+000.00	±0.2 °C

Note: See next page for table continuation.

Appendix B Data Formats and I/O Ranges

Note: This table continued from previous page.

27	100 Ohms Platinum RTD 0 to 600 °C a=0.00392	Engineering Units	+600.00	+000.00	±0.6 °C
28	120 Ohms Nickel RTD -80 to 100 °C	Engineering Units	+100.00	-80.00	±0.1 °C
29	120 Ohms Nickel RTD 0 to 100 °C	Engineering Units	+100.00	+000.00	±0.1 °C

Appendix B Data Formats and I/O Ranges

ADAM 5000 AI/AO Scaling

Module	Type	Range Low	Range High	Scale Low	Scale High	Data Format	
5013RTD	385(IEC)	-100	100	0	65535	U16B	
		0	100	0	65535	U16B	
		0	200	0	65535	U16B	
		0	600	0	65535	U16B	
	395(JIS)	-100	100	0	65535	U16B	
		0	100	0	65535	U16B	
		0	200	0	65535	U16B	
		0	600	0	65535	U16B	
	Ni	-80	100	0	65535	U16B	
		0	100	0	65535	U16B	
5017AI	mV	-150	150	0	65535	U16B	
	mV	-500	500	0	65535	U16B	
	V	-1	1	0	65535	U16B	
	V	-5	5	0	65535	U16B	
	V	-10	10	0	65535	U16B	
	mA	-20	20	0	65535	U16B	
5017H AI	mV	-500	500	0	4095	U12B	
	mV	0	500	0	4095	U12B	
	V	-10	10	0	4095	U12B	
	V	0	10	0	4095	U12B	
	V	-5	5	0	4095	U12B	
	V	0	5	0	4095	U12B	
	V	-2.5	2.5	0	4095	U12B	
	V	0	2.5	0	4095	U12B	
	V	-1	1	0	4095	U12B	
	V	0	1	0	4095	U12B	
	mA	4	20	0	4095	U12B	
	mA	0	20	0	4095	U12B	
	5018 AI	mV	-15	15	0	65535	U16B
		mV	-50	50	0	65535	U16B
mV		-100	100	0	65535	U16B	
mV		-500	500	0	65535	U16B	
V		-1	1	0	65535	U16B	
V		-2.5	2.5	0	65535	U16B	
mA		-20	20	0	65535	U16B	
T/C(J)		0	760	0	65535	U16B	
T/C(K)		0	1370	0	65535	U16B	
T/C(T)		-100	400	0	65535	U16B	
T/C(E)		0	1000	0	65535	U16B	
T/C(R)		500	1750	0	65535	U16B	
T/C(S)		500	1750	0	65535	U16B	
T/C(B)		500	1800	0	65535	U16B	
5024 AO	V	0	10	0	4095	U12B	
	mA	4	20	0	4095	U12B	
	mA	0	20	0	4095	U12B	

Appendix C

RS-485 Network

EIA RS-485 is the industry's most widely used bidirectional, balanced transmission line standard. It is specifically developed for industrial multi-drop systems that should be able to transmit and receive data at high rates or over long distances.

The specifications of the EIA RS-485 protocol are as follows:

- ♦ Maximum line length per segment: 1200 meters (4000 feet)
- ♦ Throughput of 10 Mbaud and beyond -Differential transmission (balanced lines) with high resistance against noise
- ♦ Maximum 32 nodes per segment
- ♦ Bi-directional master-slave communication over a single set of twisted-pair cables
- ♦ Parallel connected nodes, true multi-drop

ADAM-5510 Series Controller is fully isolated and use just a single set of twisted pair wires to send and receive! Since the nodes are connected in parallel they can be freely disconnected from the host without affecting the functioning of the remaining nodes. An industry standard, shielded twisted pair is preferable due to the high noise ratio of the environment. When nodes communicate through the network, no sending conflicts can occur since a simple command/response sequence is used. There is always one initiator (with no address) and many slaves (with addresses). In this case, the master is a personal computer that is connected with its serial, RS-232, port to an ADAM RS-232/RS-485 converter. The slaves are the ADAM-5510 Series Controller. When systems are not transmitting data, they are in listen mode. The host computer initiates a command/response sequence with one of the systems. Commands normally contain the address of the module the host wants to communicate with. The system with the matching address carries out the command and sends its response to the host.

C.1 Basic Network Layout

Multi-drop RS-485 implies that there are two main wires in a segment. The connected systems tap from these two lines with so called drop cables. Thus all connections are parallel and connecting or disconnecting of a node doesn't affect the network as a whole. Since ADAM-5510 Series Controller use the RS-485 standard, they can connect and communicate with the host PC. The basic layouts that can be used for an RS-485 network are:

Daisychain

The last module of a segment is a repeater. It is directly connected to the main-wires thereby ending the first segment and starting the next segment. Up to 32 addressable systems can be daisychained . This limitation is a physical one. When using more systems per segment the IC driver current rapidly decreases, causing communication errors. In total, the network can hold up to 64 addressable systems. The limitation on this number is the two-character hexadecimal address code that can address 64 combinations. The ADAM converter, ADAM repeaters and the host computer are non addressable units and therefore are not included in these numbers.

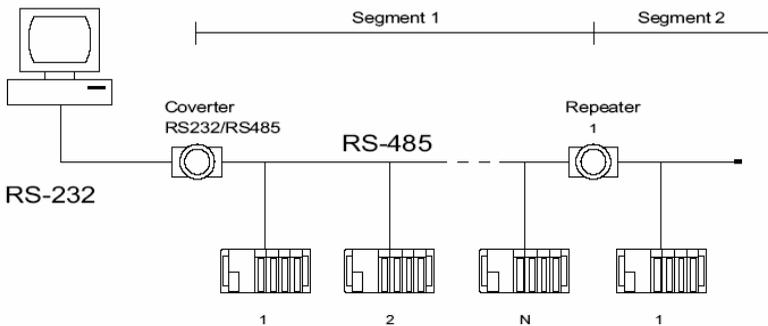


Figure C-1: Daisychaining

Star Layout

In this scheme the repeaters are connected to drop-down cables from the main wires of the first segment. A tree structure is the result. This scheme is not recommended when using long lines since it will cause a serious amount of signal distortion due to signal reflections in several line-endings.

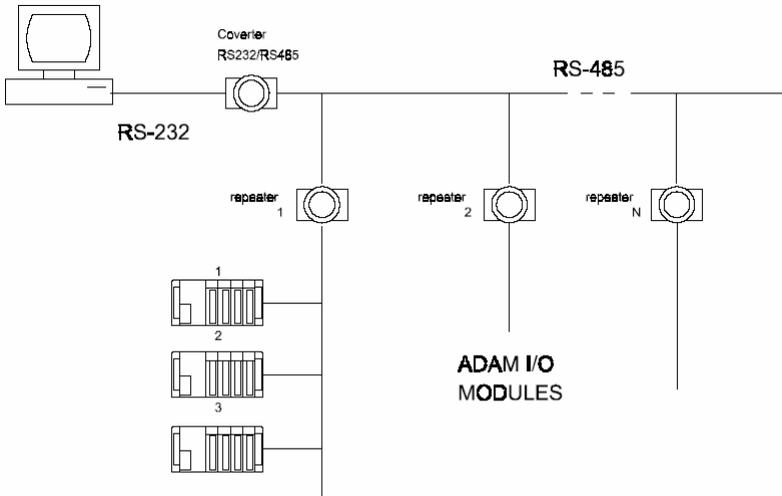


Figure C-2: Star structure

Random

This is a combination of daisychain and hierarchical structure.

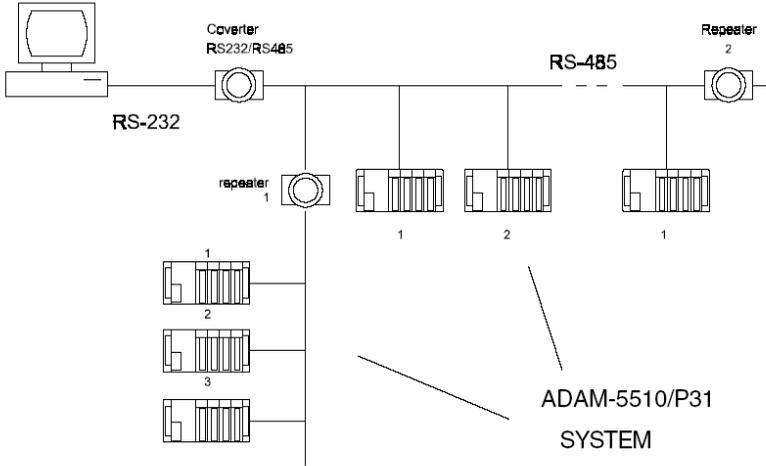


Figure C-3: *Random structure*

C.2 Line Termination

Each discontinuity in impedance causes reflections and distortion. When a impedance discontinuity occurs in the transmission line the immediate effect is signal reflection. This will lead to signal distortion. Specially at line ends this mismatch causes problems. To eliminate this discontinuity, terminate the line with a resistor.

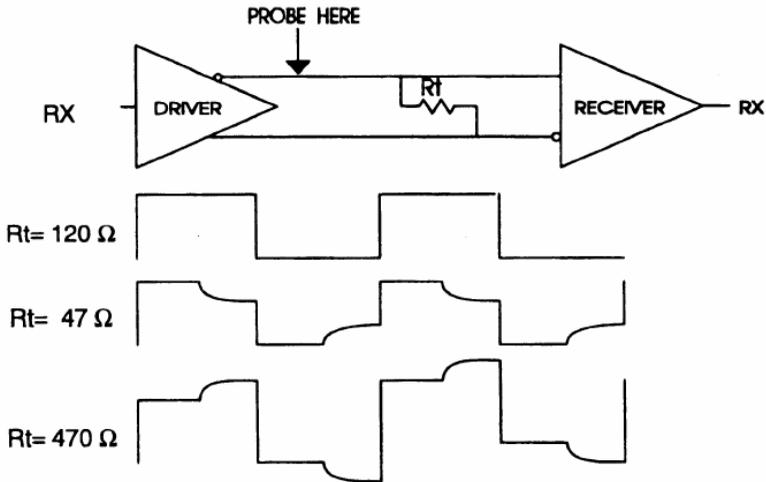


Figure C-4: Signal distortion

The value of the resistor should be as close as possible to the characteristic impedance of the line. Although receiver devices add some resistance to the whole of the transmission line, normally it is sufficient if the resistor impedance should equal the characteristic impedance of the line.

Example: Each input of the receivers has a nominal input impedance of 18 k Ω feeding into a diode transistor-resistor biasing network that is equivalent to an 18 k Ω input resistor tied to a common mode voltage of 2.4 V. It is this configuration, which provides the large common range of the receiver required for RS-485 systems! (See Figure D-5 below).

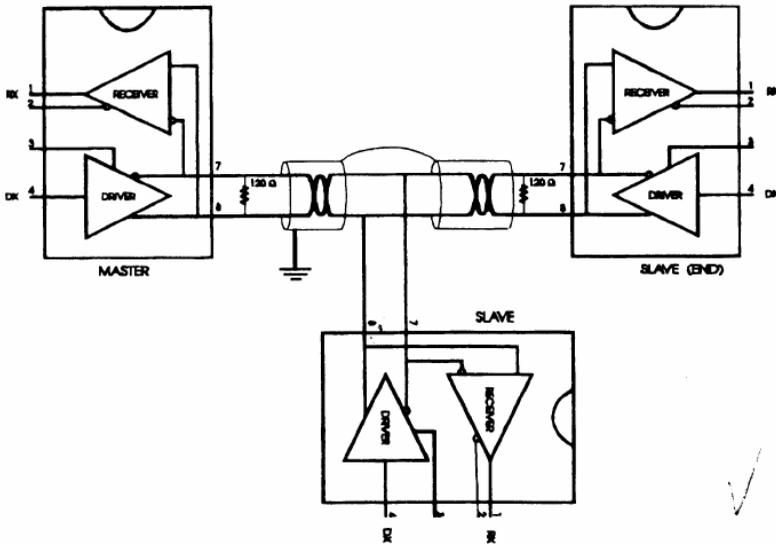


Figure C-5: Termination resistor locations

Because each input is biased to 2.4 V, the nominal common mode voltage of balanced RS-485 systems, the 18 k Ω on the input can be taken as being in series across the input of each individual receiver. If thirty of these receivers are put closely together at the end of the transmission line, they will tend to react as thirty 36k resistors in parallel with the termination resistor. The overall effective resistance will need to be close to the characteristics of the line. The effective parallel receiver resistance R_P will therefore be equal to:

$$R_P = 36 \times 10^3 / 30 = 1200 \Omega$$

While the termination receptor R_T will equal:

$$R_T = R_o / [1 - R_o / R_P]$$

Thus for a line with a characteristic impedance of 100 resistor $R_T = 100 / [1 - 100 / 1200] = 110 \Omega$

Since this value lies within 10% of the line characteristic impedance.

Thus as already stated above the line termination resistor R_T will normally equal the characteristic impedance Z_0 . The star connection causes a multitude of these discontinuities since there are several transmission lines and is therefore not recommend.

Note: The recommend method wiring method, that causes a minimum amount of reflection, is daisy chaining where all receivers tapped from one transmission line needs only to be terminated twice.

C.3 RS-485 Data Flow Control

The RS-485 standard uses a single pair of wires to send and receive data. This line sharing requires some method to control the direction of the data flow. RTS (Request To Send) and CTS (Clear To Send) are the most commonly used methods.

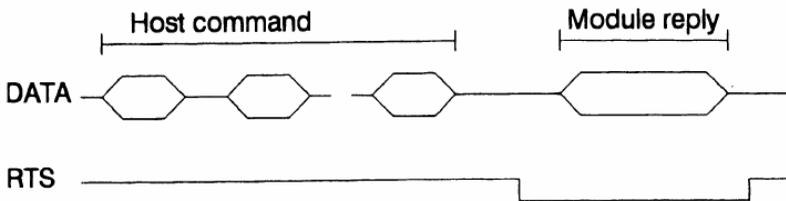


Figure C-6: RS-485 data flow control with RTS

Intelligent RS-485 Control

ADAM-4510 and ADAM-4520 are both equipped with an I/O circuit which can automatically sense the direction of the data flow. No handshaking with the host (like RTS, Request to Send) is necessary to receive data and forward it in the correct direction. You can use any software written for half-duplex RS-232 with an ADAM network without modification. The RS-485 control is completely transparent to the user.

Appendix D

Grounding Reference

Field Grounding and Shielding Application

Overview

Unfortunately, it's impossible to finish a system integration task at one time. We always meet some trouble in the field. A communication network or system isn't stable, induced noise or equipment is damaged or there are storms. However, the most usual issue is just simply improper wiring, ie, grounding and shielding. You know the 80/20 rule in our life: we spend 20% time for 80% work, but 80% time for the last 20% of the work. So is it with system integration: we pay 20% for Wire / Cable and 0% for Equipment. However, 80% of reliability depends on Grounding and Shielding. In other words, we need to invest more in that 20% and work on these two issues to make a highly reliable system. This application note brings you some concepts about field grounding and shielding. These topics will be illustrated in the following pages.

1. Grounding

- 1.1 The 'Earth' for reference
- 1.2 The 'Frame Ground' and 'Grounding Bar'
- 1.3 Normal Mode and Common Mode
- 1.4 Wire impedance
- 1.5 Single Point Grounding

2. Shielding

- 2.1 Cable Shield
- 2.2 System Shielding

3. Noise Reduction Techniques

4. Check Point List

D.1 Grounding

D-1.1 The 'Earth' for reference

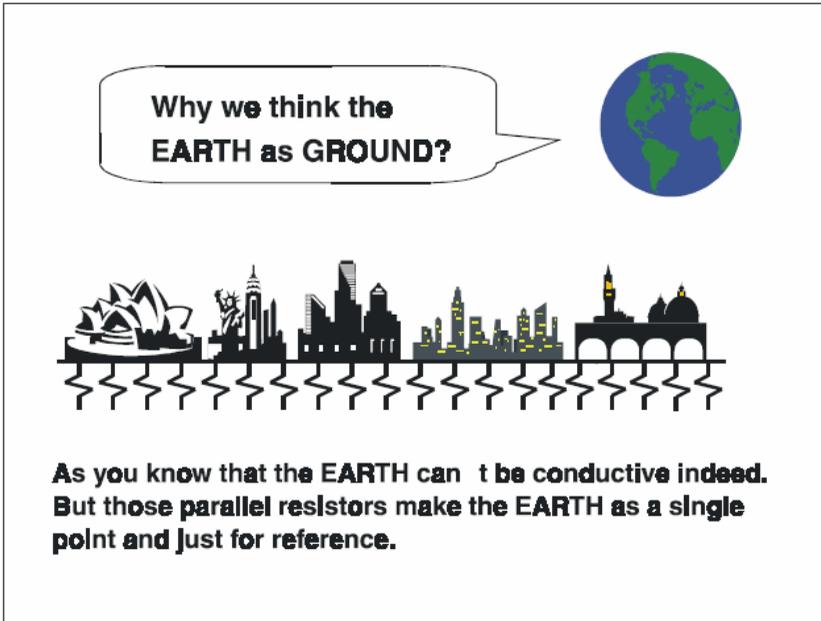


Figure D-1: Think the EARTH as GROUND.

As you know, the EARTH cannot be conductive. However, all buildings lie on, or in, the EARTH. Steel, concrete and associated cables (such as lightning arresters) and power system were connected to EARTH. Think of them as resistors. All of those infinite parallel resistors make the EARTH as a single reference point.

D-1.2 The 'Frame Ground' and 'Grounding Bar'

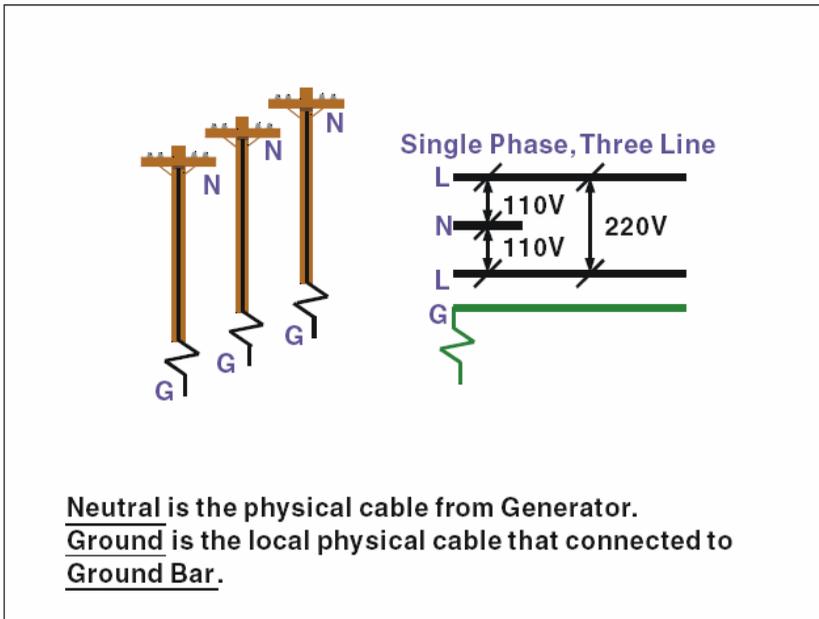
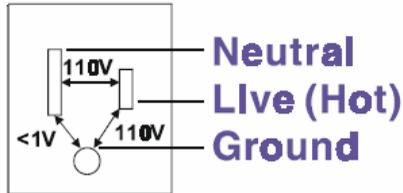


Figure D-2: Grounding Bar.

Grounding is one of the most important issues for our system. Just like Frame Ground of the computer, this signal offers a reference point of the electronic circuit inside the computer. If we want to communicate with this computer, both Signal Ground and Frame Ground should be connected to make a reference point of each other's electronic circuit. Generally speaking, it is necessary to install an individual grounding bar for each system, such as computer networks, power systems, telecommunication networks, etc. Those individual grounding bars not only provide the individual reference point, but also make the earth a our ground!

Normal Mode & Common Mode



Normal Mode: refers to defects occurring between the live and neutral conductors. Normal mode is sometimes abbreviated as NM, or L-N for live - to-neutral.

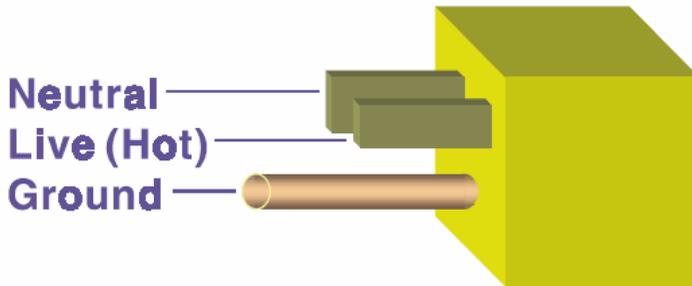
Common Mode: refers to defects occurring between either conductor and ground. It is sometimes abbreviated as CM, or N-G for neutral - to-ground.

Figure D-3: Normal mode and Common mode.

D-1.3 Normal Mode and Common Mode

Have you ever tried to measure the voltage between a live circuit and a concrete floor? How about the voltage between neutral and a concrete floor? You will get nonsense values. 'Hot' and 'Neutral' are just relational signals: you will get 110VAC or 220VAC by measuring these signals. Normal mode and common mode just show you that the Frame Ground is the most important reference signal for all the systems and equipments.

Normal Mode & Common Mode



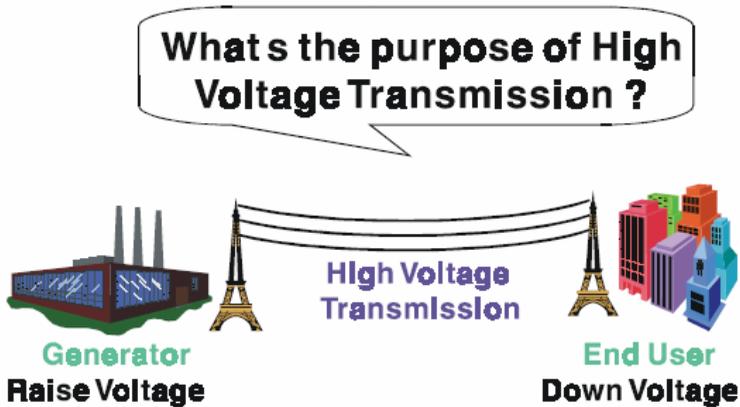
Ground-pin Is longer than others, for first contact to power system and noise bypass.

Neutral-pin Is broader than **Live-pin**, for reduce contacted Impedance.

Figure D-4: Normal mode and Common mode.

- Ground-pin is longer than others, for first contact to power system and noise bypass.
- Neutral-pin is broader than Live-pin, for reducing contact impedance.

D-1.4 Wire impedance

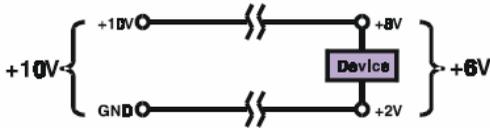


Referring to OHM rule, above diagram shows that how to reduce the power loss on cable.

Figure D-5: The purpose of high voltage transmission

- What's the purpose of high voltage transmission? We have all seen high voltage transmission towers. The power plant raises the voltage while generating the power, then a local power station steps down the voltage. What is the purpose of high voltage transmission wires? According to the energy formula, $P = V * I$, the current is reduced when the voltage is raised. As you know, each cable has impedance because of the metal it is made of. Referring to Ohm's Law, ($V = I * R$) this decreased current means lower power losses in the wire. So, high voltage lines are for reducing the cost of moving electrical power from one place to another.

Wire Impedance



The wire impedance will consume the power.

Figure D-6: wire impedance.

D-1.5 Single Point Grounding

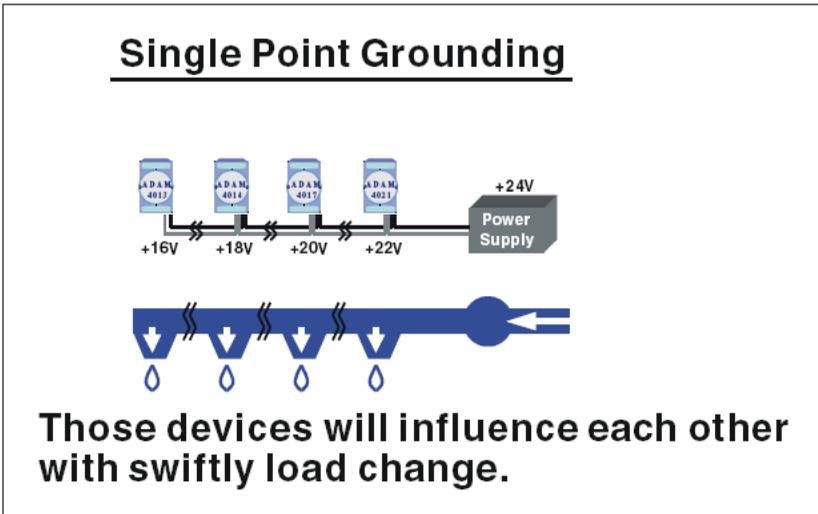


Figure D-7: Single point grounding. (1)

- What's Single Point Grounding? Maybe you have had an unpleasant experience while taking a hot shower in Winter. Someone turns on a hot water faucet somewhere else. You will be impressed with the cold water! The bottom diagram above shows an example of how devices will influence each other with swift load change. For example, normally we turn on all the four hydrants for testing. When you close the hydrant 3 and hydrant 4, the other two hydrants will get more flow. In other words, the hydrant cannot keep a constant flow rate.

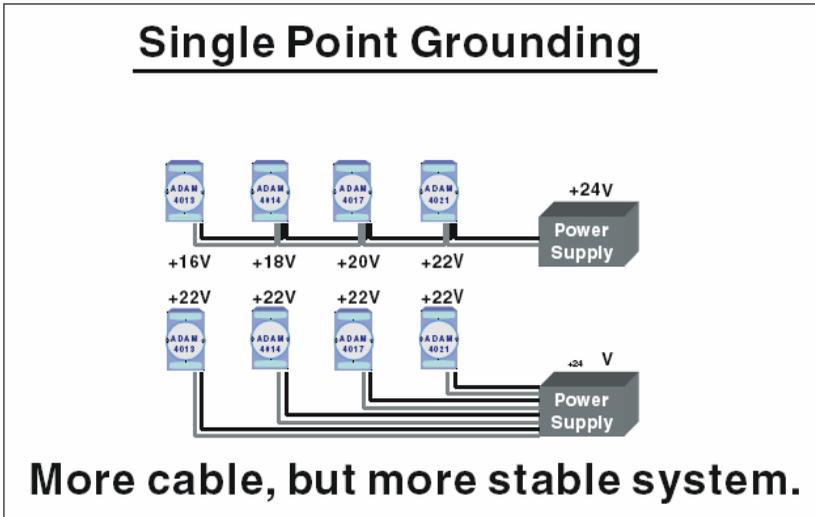


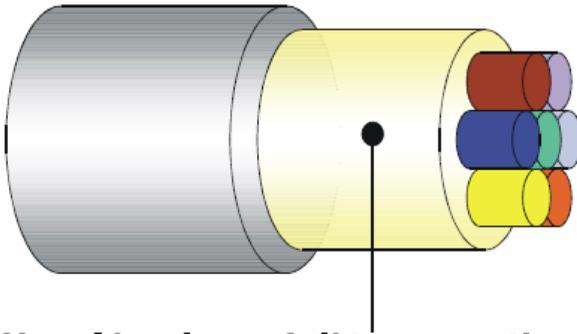
Figure D-8: Single point grounding. (2)

The above diagram shows you that a single point grounding system will be a more stable system. If you use thin cable for powering these devices, the end device will actually get lower power. The thin cable will consume the energy.

D.2 Shielding

D-2.1 Cable Shield

Single Isolated Cable



Use Aluminum foil to cover those wires, for isolating the external noise.

Figure D-9: Single isolated cable

- Single isolated cable The diagram shows the structure of an isolated cable. You see the isolated layer which is spiraled Aluminum foil to cover the wires. This spiraled structure makes a layer for shielding the cables from external noise.

Double Isolated Cable

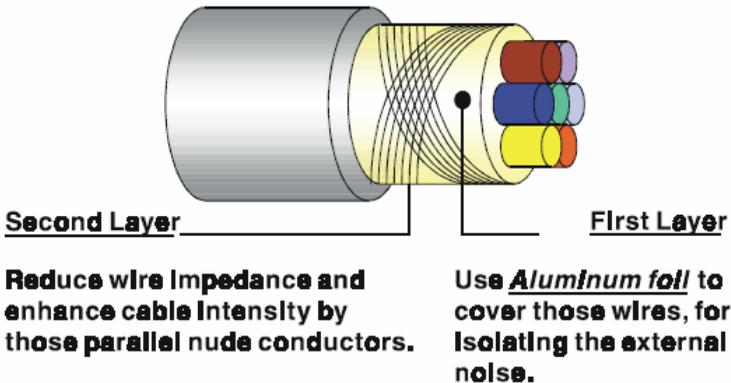


Figure D-10: Double isolated cable

- Double isolated cable Figure 10 is an example of a double isolated cable. The first isolating layer of spiraled aluminum foil covers the conductors. The second isolation layer is several bare conductors that spiral and cross over the first shield layer. This spiraled structure makes an isolated layer for reducing external noise. Additionally, follow these tips just for your reference.
- The shield of a cable cannot be used for signal ground. The shield is designed for carrying noise, so the environment noise will couple and interfere with your system when you use the shield as signal ground.
- The higher the density of the shield - the better, especially for communication network.
- Use double isolated cable for communication network / AI / AO.
- Both sides of shields should be connected to their frame while inside the device. (for EMI consideration)
- Don't strip off too long of plastic cover for soldering.

D-2.2 System Shielding

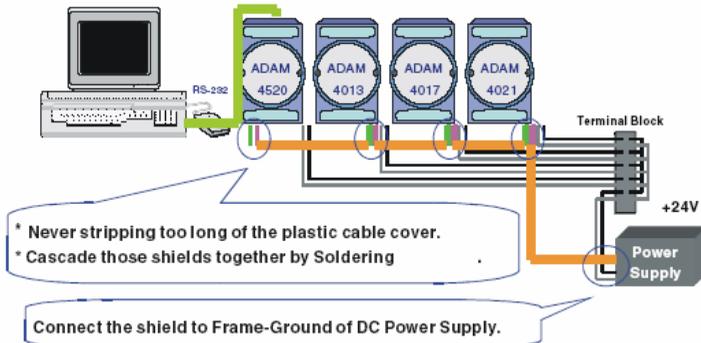
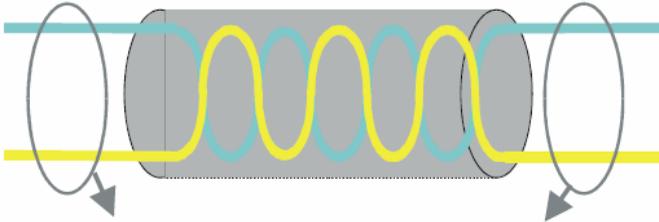


Figure D-11: System Shielding

- Never stripping too much of the plastic cable cover. This is improper and can destroy the characteristics of the Shielded-Twisted-Pair cable. Besides, the bare wire shield easily conducts the noise.
- Cascade these shields together by soldering. Please refer to following page for further detailed explanation.
- Connect the shield to Frame Ground of DC power supply to force the conducted noise to flow to the frame ground of the DC power supply. (The 'frame ground' of the DC power supply should be connected to the system ground)

Characteristic of Cable



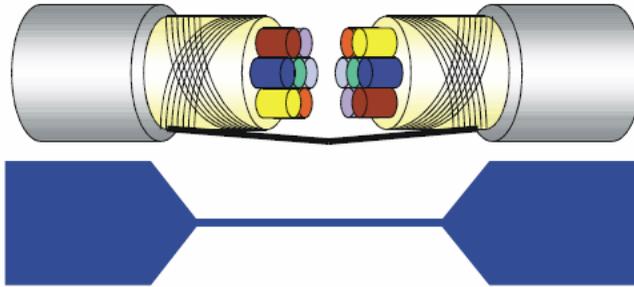
This will destroy the twist rule.

Don't strip off too long of plastic cover for soldering, or will influence the characteristic of twisted pair cable.

Figure D-12: The characteristic of the cable

- The characteristic of the cable Don't strip off too much insulation for soldering. This could change the effectiveness of the Shielded-Twisted-Pair cable and open a path to introduce unwanted noise.

System Shielding



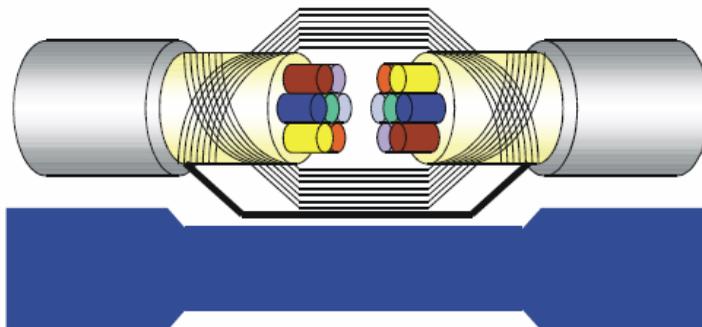
A difficult way for signal.

Figure D-13: System Shielding (1)

- Shield connection (1)

If you break into a cable, you might get in a hurry to achieve your goal. As in all electronic circuits, a signal will use the path of least resistance. If we make a poor connection between these two cables we will make a poor path for the signal. The noise will try to find another path for easier flow.

System Shielding



A more easy way for signal.

Figure D-14: System Shielding (2)

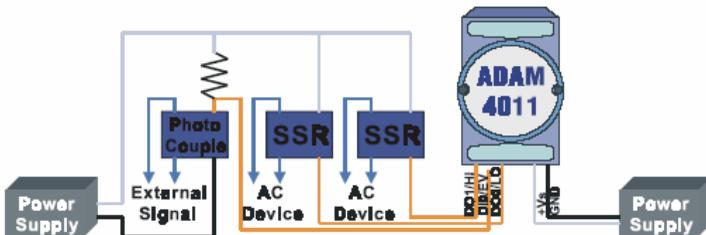
- Shield connection (2)

The previous diagram shows you that the fill soldering just makes an easier way for the signal.

D.3 Noise Reduction Techniques

- Isolate noise sources in shielded enclosures.
- Place sensitive equipment in shielded enclosure and away from computer equipment.
- Use separate grounds between noise sources and signals.
- Keep ground/signal leads as short as possible.
- Use Twisted and Shielded signal leads.
- Ground shields on one end ONLY while the reference grounds are not the same.
- Check for stability in communication lines.
- Add another Grounding Bar if necessary.
- The diameter of power cable must be over 2.0 mm².
- Independent grounding is needed for A/I, A/O, and communication network while using a jumper box.
- Use noise reduction filters if necessary. (TVS, etc)
- You can also refer to FIPS 94 Standard. FIPS 94 recommends that the computer system should be placed closer to its power source to eliminate load-induced common mode noise.

Noise Reduction Techniques



**Separate Load and Device power.
Cascade amplify/isolation circuit before
I/O channel.**

Figure D-15: Noise Reduction Techniques

D.4 Check Point List

- Follow the single point grounding rule?
- Normal mode and common mode voltage?
- Separate the DC and AC ground?
- Reject the noise factor?
- The shield is connected correctly?
- Wire size is correct?
- Soldered connections are good?
- The terminal screw are tight?