Allowances made for Millennium Bug

We assert that the ADAM-5510/P31 will not initiate any millennium bug problems (so-called Y2K problems). Although ADAM-5510/P31 contains a real time clock, Advantech has taken action to make the ADAM-5510/P31 immune to the Y2K problem.

Copyright Notice

Acknowledgments

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CE Notification

The ADAM-5510/P31 developed by Advantech Co., Ltd. has passed the CE test for environmental specifications. Test conditions for passing included the equipment being operated within an industrial enclosure, using shielded twisted-pair RS-485 cables and having SFC-6 sleeve core clamps added to the power cable (see Figure 0-1 in Chapter 0). In order to protect the ADAM-5510/P31 system from being damaged by ESD (Electrostatic Discharge) and EMI leakage, we strongly recommend the use of CE-compliant industrial enclosure products, shielded twisted-pair RS-485 cables, and core clamps.

FM Notification

Advantech's ADAM-5510/P31 series has passed the FM certification. According to National Fire Protection Association, work sites are classified into different classes, divisions and groups based on hazard considerations. ADAM-5510/P31 series is compliant with the specifications of Class I, Division 2, Groups A, B, C, and D indoor hazardous. The FM approval report Job ID is 3000008.

A Message to the Customer...

Advantech Customer Services

Each and every Advantech product is built to the most exacting specifications to ensure reliable performance in the unusual and demanding conditions typical of industrial environments. Whether your new Advantech equipment is destined for the laboratory or the factory floor, you can be assured that your product will provide the reliability and ease of operation for which the name Advantech has come to be known.

Your satisfaction is our number one concern. Here is a guide to Advantech's customer services. To ensure you get the full benefit of our services, please follow the instructions below carefully.

Technical Support

We want you to get the maximum performance from your products. So if you run into technical difficulties, we are here to help. For most frequently asked questions you can easily find answers in your product documentation. These answers are normally a lot more detailed than the ones we can give over the phone.

So please consult this manual first. If you still cannot find the answer, gather all the information or questions that apply to your problem and, with the product close at hand, call your dealer. Our dealers are well trained and ready to give you the support you need to get the most from your Advantech products. In fact, most problems reported are minor and are able to be easily solved over the phone.

In addition, free technical support is available from Advantech engineers every business day. We are always ready to give advice on application requirements or specific information on the installation and operation of any of our products.

Website information:

You can access the most current support on our website:

http://www.advantech.com

Product Warranty

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two year from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability as a consequence of such events under the terms of this Warranty.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product ever does prove defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered (e.g. type of PC, CPU speed, Advantech products used, other hardware and software used etc.). Note anything abnormal and list any on-screen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, you have to request an RAM number. When requesting an RMA (Return Material Authorization) number, please access ADVANTECH's RMA website: http://www.advantech.com.tw/rma. If the web sever is shut down, please contact our office directly. You should fill in the "Problem Repair Form", describing in detail the application environment, configuration, and problems encountered. Note that error descriptions such as "does not work" and "failure" are so general that we are then required to apply our internal standard repair process.

4. Carefully pack the defective product, a completely filled-out Repair and Replacement Order Card and a photocopy of dated proof of purchase (such as your sales receipt) in a shippable container. A product returned without dated proof of purchase is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

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Quick Start

Quick Start

Welcome & Preview

Welcome to the Advantech ADAM-5510/P31 user's guide. This chapter was written to provide users with a fast and easy installation guide and with the basic operating skills necessary to use the ADAM-5510/P31's core capabilities.

This Quick Start chapter contains the following sections:

- System requirements
- Installation guide
- Utility application program
- A training example

0.1 System Requirements

0.1.1 Host computer

1. IBM PC compatible computer with 486 CPU(Pentium is recommended).
2. Microsoft NT 4.0 (SP3 or SP4) or higher versions.
3. Advantech Paradym-31 v4.1.
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-232 DB-9 straight through cable for downloading/programming.
11. One RS-485 card or RS-232 to RS-485 converter (e. g. ADAM-4520) for configuring ADAM-4000 modules.

0.1.2 ADAM-5510/P31

1. One ADAM-5510/P31 main unit with two blank slot covers.
2. One ADAM-5510/P31 user's manual.
3. One Advantech Paradym-31 user's manual.
4. One core clamp for power supply connection.
5. Three ADAM-5510/P31 utility diskettes.
6. Power supply for ADAM-5510/P31 (+10 to +30 V_{DC} unregulated)
7. One cross-over DB-9 cable

0.1.3 I/O modules

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 0-1 gives a current listing of these modules as of this printing:

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
Counter/Frequency	ADAM-5080	4-ch. Counter/Frequency	Isolated

Table 0-1: *ADAM-5000 I/O modules*

0.1.4 Remote I/O Function for ADAM-4000 Modules

ADAM-5510/P31 provides additional Remote I/O Function applicable to ADAM-4000 modules (except ADAM-4016 and ADAM-4018M). You can select among different ADAM-4000 modules according to their application purposes. Refer to Table 0-2 for the ADAM-4000 modules that can be used for ADAM-5510/P31 Remote I/O function.

Module	Name	Specification	Reference
Analog I/O	ADAM-4011	Thermocouple input	Isolated
	ADAM-4011D	Thermocouple input	Isolated
	ADAM-4012	Analog input	Isolated
	ADAM-4013	RTD input	Isolated
	ADAM-4017	8-ch. AI	Isolated
	ADAM-4018	8-ch. Thermocouple input	Isolated
	ADAM-4021	Analog Output	Isolated
Digital I/O	ADAM-4050	7-ch. D I/O	Non-isolated
	ADAM-4052	8-ch. DI	Isolated
	ADAM-4053	16-ch. DI	Non-isolated
Relay Output	ADAM-4060	6-ch. Relay output	Isolated
Counter/Frequency	ADAM-4080	2-ch. Counter/Frequency	Isolated
	ADAM-4080D	2-ch. Counter/Frequency	Isolated

Table 0-2: *Remote I/O Function for ADAM-4000 Modules*

0.2 Installation Guide

1. Open the ADAM-5510/P31 package and make sure that the following items are present:
   1- One ADAM-5510/P31 main unit with two blank slot covers.
   2- One ADAM-5510/P31 user's manual.
   3- Three ADAM-5510/P31 diskettes.
   4- One RS-232 DB-9 crossover cable for COM1 use.
2. Make sure that everything described in Section 0.1 is ready.
3. Connect the ADAM-5510/P31 power cable between the power supply and the ADAM-5510/P31 screw terminals (+Vs and GND).

Make sure that the power source is between +10 to +30 V_{DC}.

4. Connect the download cable between the host computer and the ADAM-5510/P31. They you can configure ADAM-5000 modules on ADAM-5510/P31. A standard DB-9 pin cable (straight-through type) can be used to connect the ADAM-5510/P31 (programming port) and the host PC RS-232 port.

Note: *When you download the program into ADAM-5510/P31, you have to make sure that the memory capacity will not exceed over 128K byte.*

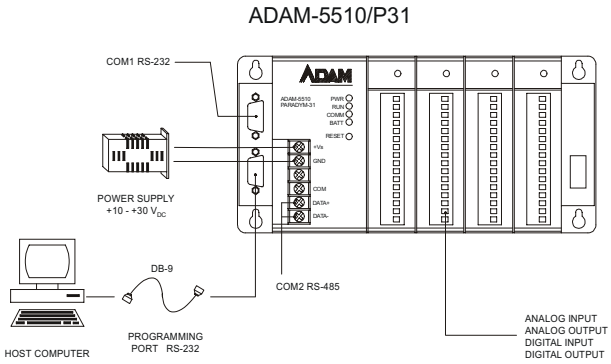


Figure 0-1: *Installation wiring of the ADAM-5510 and host PC*

5. Install Advantech Paradym-31 on your host PC. Please refer to the Advantech Paradym-31 user's manual for installation process.

Note: *If you have only one COM port, make sure you use an RS-232 DB-9 straight-through cable to connect the host PC and the ADAM-5510/P31 during downloading/programming.*

0.3 Utility Application Program: ADAM5510.EXE

0.3.1 Installation

1. Insert ADAM-5510/P31 utility diskette 1 into the floppy disk drive (e.g. A:) in the host PC. Change the host computer default drive from C: to A:

2. Key in **install <Enter>**. The install program on the diskette will automatically complete the installation. When installation is completed, the default working directory will be automatically changed to c:\5510.
3. Key in **adam5510 <Enter>**.
4. This starts the utility program for ADAM-5510/P31. The highlighted cursor will be at its default location at "**COMport**" on the menu bar.
5. Press **<Enter>**; a pop-up window will appear. Use the arrow keys to move the highlighted cursor to select a COM port on the host PC, then press **<Enter>** to confirm the selection. Press **<ESC>** to return to the menu bar.

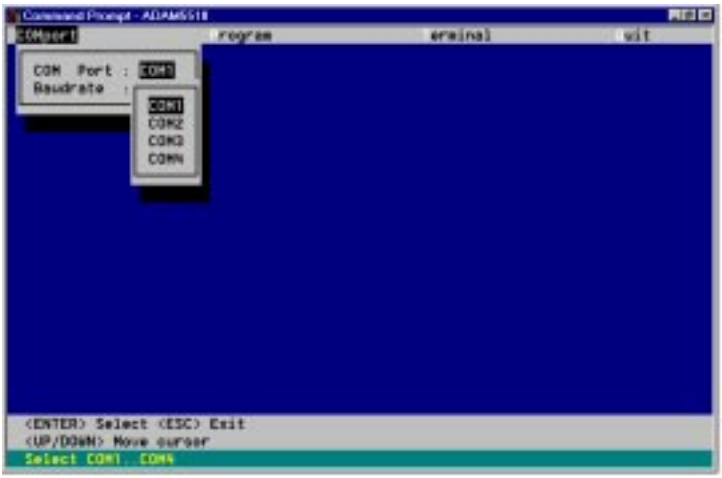


Figure 0-2: *Menu for setting up compiler working paths*

0.3.2 I/O modules configuration

1. Move the cursor to **"Terminal"** and press **<Enter>**.
2. Press **"Ctrl-X"**; the operating environment will be changed to DOS and the active drive to the "D" drive.
3. Set the network address of the ADAM-5510/P31 as "1" (All bits of the DIP switch except bit 0 are "OFF").

4. Run the execution file **"SIMU5000"** on the "D" drive. The ADAM-5510/P31 will be simulated as an ADAM-5000/485.
5. Press **"Alt-X"**, and then move the cursor to **"Quit"**, select **"Yes"** and press **<Enter>**. The active directory will be changed to the directory C:\5510.
6. Run the execution file **"ADAM"** in the directory C:\5510.
7. After displaying some processing messages, the screen shown in Figure 0-3 will appear. This screen can be used for configuring and calibrating ADAM-5000 I/O modules.

Figure 0-3: *Utility/Configure menu screen*

8. This menu screen consists of a menu bar at the top of the screen and a status field that displays information about the connected modules. When you first start the program, it automatically scans for any attached modules and displays their data. Module characteristics, module configuration parameters and input or output values will be displayed in the status field.

Menu Item	Description	Reference
COMport	Select host PC COM port (e.g. COM1) and configure other parameters.	
Search	Search for ADAM-5000 series plug-in modules.	
Setup	Specify module types & I/O range values, including three options: ✓ System setting ✓ Module setting ✓ Output data	
Run	Get current I/O values & module status.	
Calibrate	Calibrate modules. Parameters are stored in each module's onboard EEPROM.	
Terminal	Change to ADAM-5510 terminal mode allowing key-in of commands, then return to main menu.	
File	Save module setup values in the host PC.	
Quit	Exit main menu. Return to last operating status.	

Table 0-3: *Functions of items on the menu bar*

Table 0-3 describes the functions in the utility program which you could use to configure I/O modules. For more detailed information on I/O module configuration and calibration, please refer to **Chapter 4 I/O Modules**.

0.3.3 Reboot ADAM-5510/P31

After I/O module configuration, you have to exit the ADAM utility and then run "ADAM5510.exe" again.

1. Select the correct COM port.
2. Move the cursor to **"Terminal"** and press **<Enter>**.
3. Press the **"RESET"** button on the ADAM-5510/P31 front panel.
4. After ADAM-5510/P31 resets and reboots, the welcome screen shown in Figure 0-4 will appear. Now you can operate the ADAM-5510/P31 remotely through Advantech Paradym-31 on your host PC.

Figure 0-4: *Opening screen; operating ADAM-5510/P31 remotely*

0.3.4 ADAM-5510/P31 I/O Driver Installation

If you want to use ADAM-5080 module, you have to install ADAM-5080 I/O Driver at first.

1. Insert ADAM-5510/P31 I/O Driver diskette into your floppy drive(e.g.A:) in the host PC. Change the host computer default drive from C: to A:
2. Use your Windows Explorer or the Windows Run command to execute the Setup Program on the ADAM-5510/P31 I/O Driver installation diskette. (The path of the Setup program on diskette should be A:\setup.exe, if your default floppy drive is A:).
3. The Setup program will specify for you a default installation path, *C:\PARADYM*. If you are not satisfied with the default installation path, just click the Browse button to change to another path (Be aware that you have to install this ADAM-5510/P31 I/O Driver into the folder that Advantech Paradym-31 is in). After you have specified the installation path, just click the Next button.

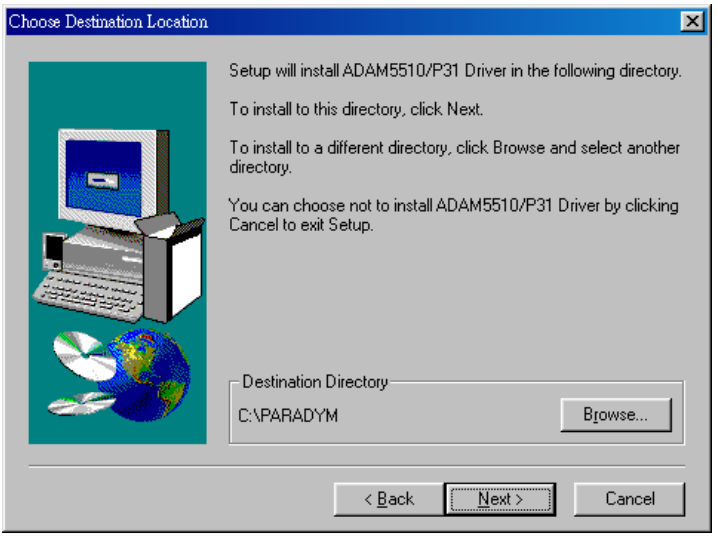


Figure 0-5: *Selecting Installation Path*

4. After Selecting *LONG* type, you can choose ADAM-5080 to write your program.

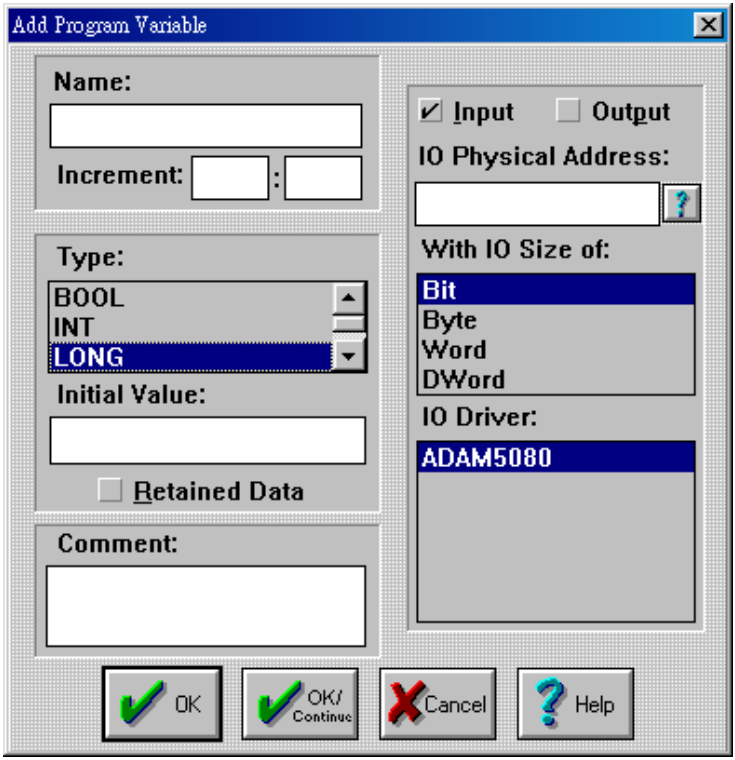


Figure 0-6: *Selecting ADAM-5080 module*

0.4 Installation Example

Let's follow the instructions below to integrate an Advantech Paradym-31 demonstration and the ADAM-5510/P31.

1. Connect the host PC and the ADAM-5510/P31 as described in section 0.2. Note that the COM port of the host PC and the COM1 port of the ADAM-5510/P31 must be connected by a cross-over DB-9 cable. You may also connect the host PC and the COM2 (RS-485) port of the ADAM-5510/P31 if the host PC has an RS-485 port.
2. Install one ADAM-5056 module in the ADAM-5510/P31
3. Run Advantech Paradym-31 under Windows NT 4.0.
4. Open the project file and select **"DEMO"**. The screen shown in Figure 0-5 will appear.
5. Select **"Build All and Run"**. The ladder diagram demonstration will be compiled and downloaded to the ADAM-5510/P31. The control program will automatically execute on the ADAM-5510/P31.
6. You may select **"Monitor"** to monitor the execution of the control program on the ADAM-5510/P31. See Figure 0-6.
7. This example project written in ladder diagram directs the ADAM-5060 to turn on relays one by one. Appendix A gives a more detailed explanation of this example.

Note: Please plug the Key pro of Paradym-31 on COM port of host PC

0.5 ADAM-5510/P31 Remote I/O Function

0.5.1 Remote I/O Module Configuration

Before using Remote I/O Function, you have to configure ADAM-4000 as following steps.

1. Connect ADAM-4000 modules to computer
2. Run ADAM utility to configure every ADAM-4000 module individually

3. Connect ADAM-4000 modules to ADAM-5510/P31 through RS-232 or RS-485 port.
4. Please read ADAM-4000 manual for detail installation.

0.5.2 ADAM-5510/P31 Remote I/O Function Block Installation

Please follow the steps below to install ADAM-5510/P31 Remote I/O Function Block:

1. Insert ADAM-5510/P31 Remote I/O Function Block diskette into your floppy drive(e.g.A:) in the host PC. Change the host computer default drive from C: to A:
2. Use your Windows Explorer or the Windows Run command to execute the Setup Program on the ADAM-5510/P31 Remote I/O Function Block installation diskette. (The path of the Setup program on diskette should be A:\setup.exe, if your default floppy drive is A:).

Figure 0-7: *Setup Option*

3. The ADAM-5510/P31 Remote I/O Function Block installation program will launch. Just follow the Installation Wizard to proceed with your Setup.

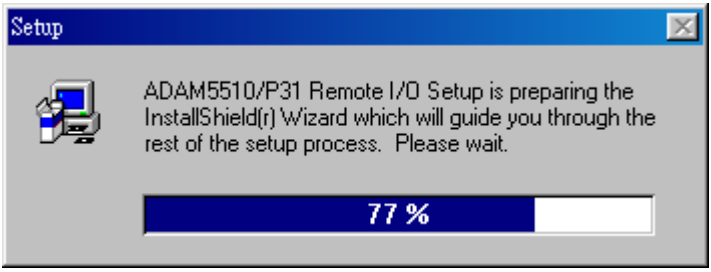


Figure 0-8: *Installation Program*

4. The Setup program will specify for you a default installation path, C:\Program Files\Advantech\P31_RIO. If you are not satisfied with the default installation path, just click the Browse button to change to another path. After you have specified the installation path, just click the Next button.

Figure 0-9: *Selectting Installation Path*

5. The Setup Program will create a “P31_RIO” program folder in your Start menu if unspecified.

Figure 0-10: *Adding Program Icons*

6. The Setup program will now copy the required files to the destination folder. A progress bar will display the percentage of your files being copied.

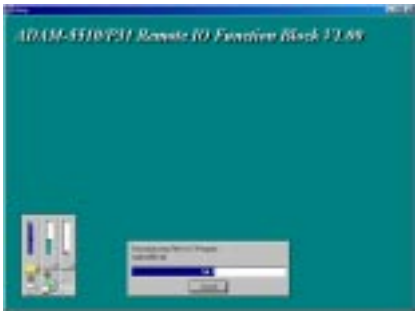


Figure 0-11: *Copying files to folder*

0.5.3 Running the Function Block Import/Export Utility

Before using the ADAM-5510/P31Remote I/O function, you must run the Function Block Import/Export Utility to install the ADAM-5510/P31 Remote I/O Function Block file to your Advantech Paradym-31 software. Please follow the steps below to install ADAM-5510/P31 Remote I/O Function Block:

1. Access Start menu/The Advantech Paradym-31/Function Block Import/Export Utility

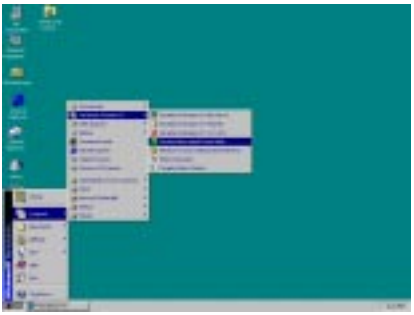


Figure 0-12: *Access Start Menu*

2. The Function Block Import/Export Utility dialog box appears. Just click the Import Function Block button to proceed.

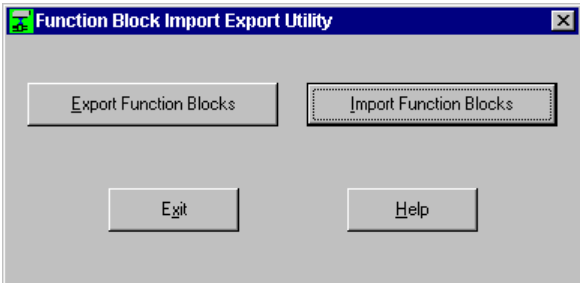


Figure 0-13: *Function Block Import/Export Utility*

3. The Import Function Blocks dialog box appears. You can see the source directory from which you will copy the ADAM-5510/P31 Remote I/O Function Block program files (i.e. Path to root of Export Data, which is default to C:\Program Files\Advantech\P31_RIO), and also the destination directory, to which you copy the program files (i.e. Path to Paradym Root Directory, which is default to C:\Paradym). We suggest you use the default paths, unless you want to specify otherwise. Click the Ok button to begin importing ADAM-5510/P31 Remote I/O Function Block files into Advantech Paradym-31. The installation is completed.

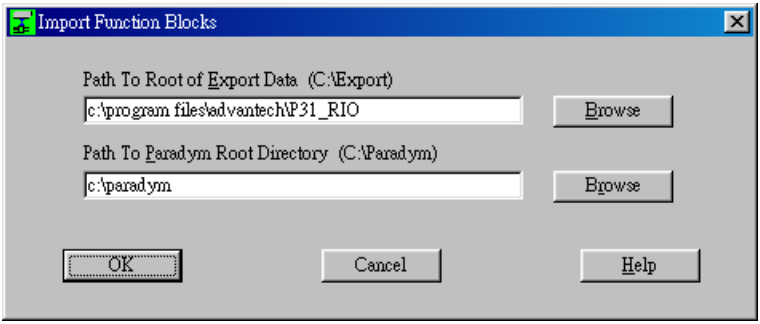


Figure 0-14: *Selecting the Path*

0.5.4 Builder the Ladder Program

Please follow the steps below to build your own Ladder program

1. Run the Advantech Paradym-31 program by double-clicking the Paradym.exe in your imported folder. Or just access *Start /Program/ Advantech Paradym-P31/Advantech Paradym-P31 V4.1-ADV*

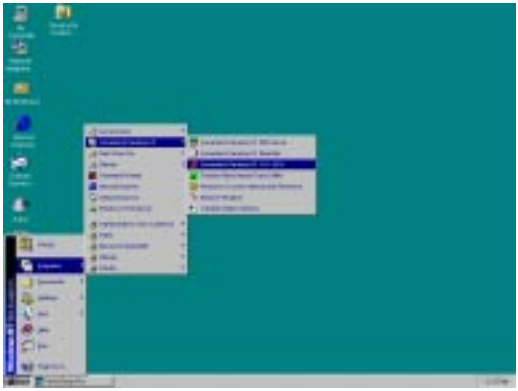


Figure 0-15: *Run the Advantech Paradym-31 program*

2. Before you download control programs into ADAM-5510/P31 controller, you have to make sure that ADAM-5510 resource configuration is correct. Click *Edit/Resource* menu command to pop up ADAM-5510 *Resource Configuration* dialog box as below:

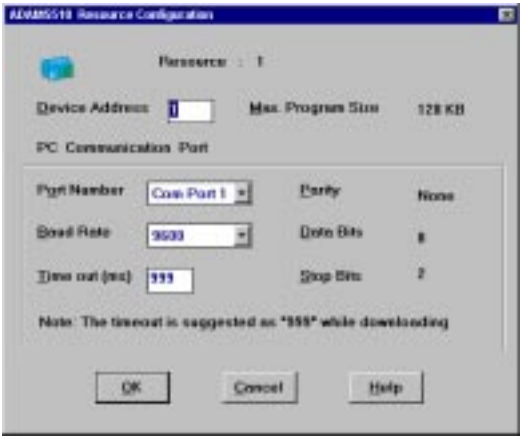


Figure 0-16: *Resource Configuration*

Note: Please refer to ADAM-5510/P31 controller user guide for NodeID and Baud rate setting.

Program Size: the maximum size of available ROM to download control program.

Port Number: the assigned communication port from which to download program.

Baud rate: the data transfer rate of communication port. ADAM-5510/P31 supports four kinds of baud rate: 9600, 19200, 38400, 115200. The default value is 9600.

Parity: the parity checking setting value of communication port. The default value is None.

3. Select the *Tools/Language/LD-Ladder* menu command from the menu bar. Click the *Function Block* button on the button row of the right side of your program window.

Figure 0-17: *Selecting Language*

3. The *Function Block* dialog box will appear. Select the *Vendor Provided* option, and you'll see a list of ADAM-4000 modules.

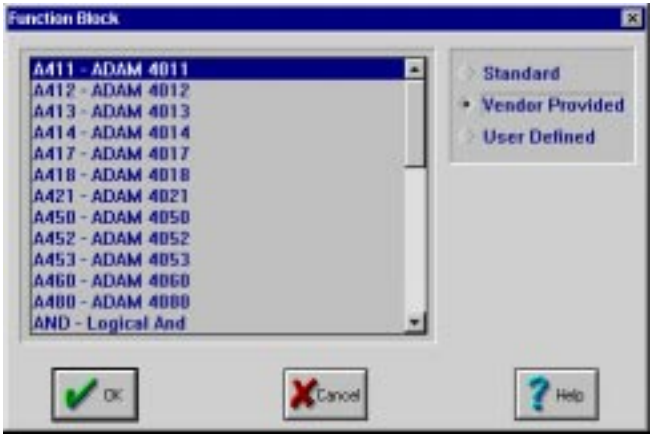


Figure 0-18: *Selecting Modules*

4. Select the modules by double-clicking the module name in the list of ADAM-4000 modules.
5. You can add a User Defined Function Block of ADAM-4011 simply by clicking the left button.

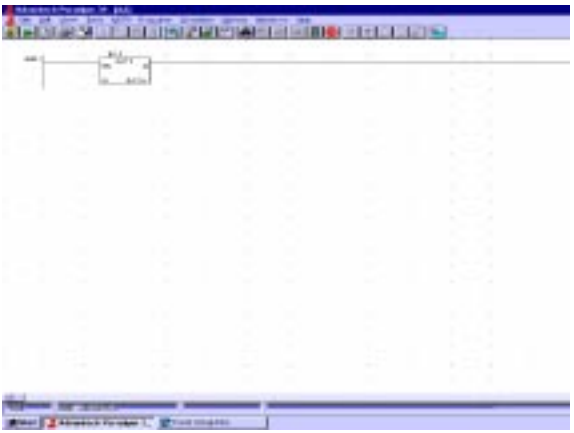


Figure 0-19: *Writing Program*

0.6 Conclusion

After carefully walking through all the installation and operating instructions described above, you will have been exposed to the ordinary procedures for using ADAM-5510/P31. For more sophisticated utilization or programming skills, please refer to following chapters.

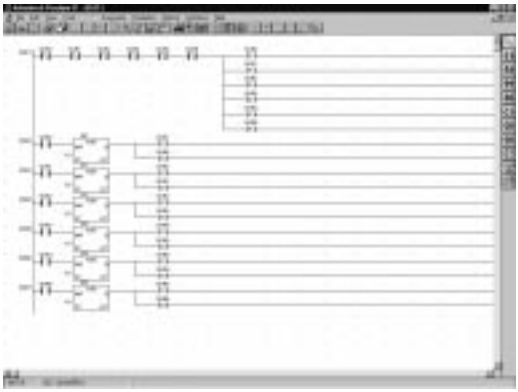


Figure 0-20: *Example project on controlling ADAM-5060*

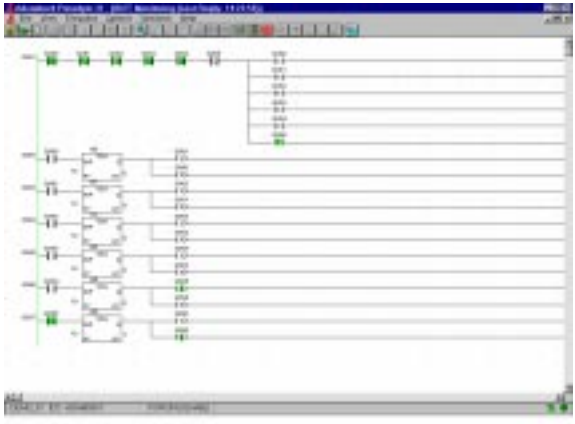


Figure 0-21: *Example project showing monitoring function*

1

Introduction

Introduction

1.1 Standalone Data Acquisition and Control System

The task of monitoring and controlling a process in a laboratory in an industrial plant can be extremely complex. As the number of data collection points and process control actuators in the network increases, this task becomes more challenging. PC-based DA&C systems provide a high value alternative to older, more expensive technology in the control industry, since they only require a desktop PC or equivalent at their core. Now Advantech's ADAM-5510/P31 can operate a process control network independently, without a connection to a desktop PC. Integrated with Advantech Paradym-31, ADAM-5510/P31 offers an IEC-1131-3 compliant run time engine that meets every need you might have expected: simple structure, ease of use and plenty of power.

1.2 Features

1.2.1 Open structure PC-based controller

In contrast to traditional proprietary PLCs, Advantech ADAM-5510/P31 adapts the structure of a PC. Given the prevalence of PCs in our offices and in our daily lives, it is advantageous to use the structure of a PC since a large number of people will be acquainted with it. Using PC-based technology will shorten training times and increase overall profits.

1.2.2 A choice of programming languages

ADAM-5510/P31 offers a choice of programming languages since it can be used with Advantech Paradym-31, a graphical development tool, which offers three time-proven programming languages. These languages are: Ladder Diagram, Sequential Function Chart and Function Block Diagram. You can choose the language that best fits your application or skills, and can even switch between languages or combine them within a single program. This makes development fastand easy.

1.2.3 Data storage for versatile applications

ADAM-5510/P31 is equipped with plenty of storage space for developing complex logic or for data storage applications. It has 256 KB of

flash ROM for the operating system and 256 KB of SRAM and 512 KB of flash disk for your application and for storage. Furthermore, part of the SRAM is backed up by a battery. This provides dependable protection during power outages.

1.2.4 RS-232/485 communication ability

ADAM-5510/P31 has three serial communication ports. This gives ADAM-5510 excellent ability to communicate with other devices, as well as aiding the construction of networks in the field. Of these three serial ports, COM1 is an RS-232 port while COM2 is an RS-485 port. These two ports should satisfy the demand for communications having different characteristics. COM3 is a programming port through which you can download or transfer executable programs from the host PC. (TX, RX, GND Supported, See Page 2-12)

1.2.5 Built-in real-time clock and watchdog timer

ADAM-5510/P31's microcontroller includes a real-time clock and a 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/P31 ideal for use in applications which require a high level of system stability.

1.2.6 ADAM-5510/P31 Remote I/O Function

ADAM-5510/P31 Remote I/O Function offers more flexibility for your ADAM series product applications. More I/O points are available for use, and you can flexibly combine ADAM-4000 and ADAM-5000 products, according to your application, to meet your centralized/ distributed I/O points requirements. This feature reduces your efforts in cabling layout and maintenance. Furthermore, you can take advantage of the flexibility for future I/O points expansion.

1.3 System Configuration

The following diagram shows a possible ADAM-5510/P31 system configuration:

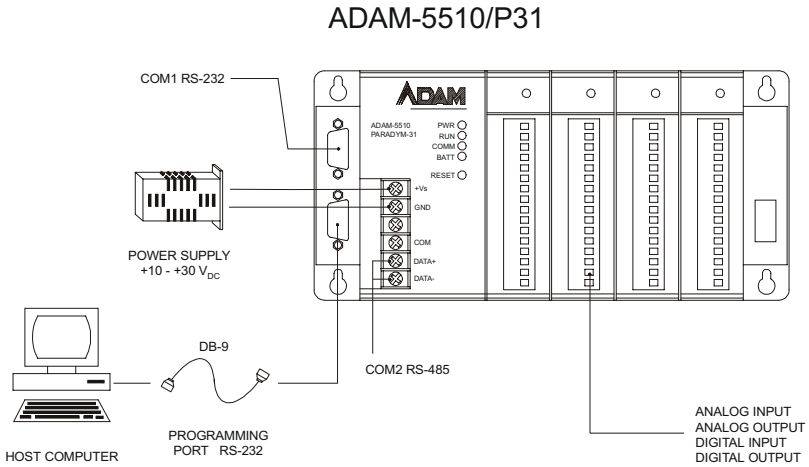


Figure 1-1: *ADAM-5510/P31 system configuration*

1.3.1 LED Display

There are four LEDs on the ADAM-5510/P31 front panel. The LED's indicate ADAM-5510/P31's operating status, as explained below:

(1) **PWR**: power indicator. This LED is on whenever the ADAM-5510/P31 is powered on.

(2) **RUN**: program execution indicator. This LED is requlary blinks whenever the ADAM-5510/P31 is executing a program.

(3) **COMM**: communication indicator. This LED blinks whenever the host PC and the ADAM-5510/P31 are communicating. Please notice: if the host COM port is connected to the ADAM-5510/P31's RS-232 port, this LED will normally be off. On the other hand, if the host COM port is connected to the ADAM-5510/P31's RS-485 port, this LED will normally be on.

(4) **BATT**: battery status indicator. This LED will be on whenever the SRAM backup battery is low.

2

Installation Guidelines

Installation Guideline

This chapter explains how to install an ADAM-5510/P31 controller. A quick hookup scheme is provided that lets you easily configure your system before connecting it to your application.

2.1 Starting up ADAM-5510/P31

Step 1: Review system requirements

Before you start installing the ADAM-5510/P31, make sure the system requirements are met:

Host computer

1. IBM PC compatible computer with 486 CPU (Pentium is recommended).
2. Microsoft NT 4.0 (SP3 or SP4) or higher versions.
3. Advantech Paradym-31 v4.1.
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-232 DB-9 straight cable for downloading/programming.

ADAM-5510/P31

1. One ADAM-5510/P31 main unit with two blank slot covers.
2. One ADAM-5510/P31 user's manual.
3. One core clamp for power supply connection.
4. Three ADAM-5510/P31 diskettes
5. Power supply for the ADAM-5510/P31 (+10 to +30 V_{DC}) with power cable.

I/O modules

1. At least one ADAM-5000 series I/O module.

Step 2: Wiring the power cable and download cable

Connect the power cable between the power supply and the ADAM-5510/P31. Make sure the power source is between +10 to +30 V_{DC}. Screw terminals +Vs and GND are for power supply wiring.

Connect the download cable between the host computer and the ADAM-5510/P31. A standard DB-9 pin cable (straight-through type) can be used to connect the ADAM-5510/P31 (programming port) and the host-PC (RS-232 port).

The following figure shows how to connect the cables:

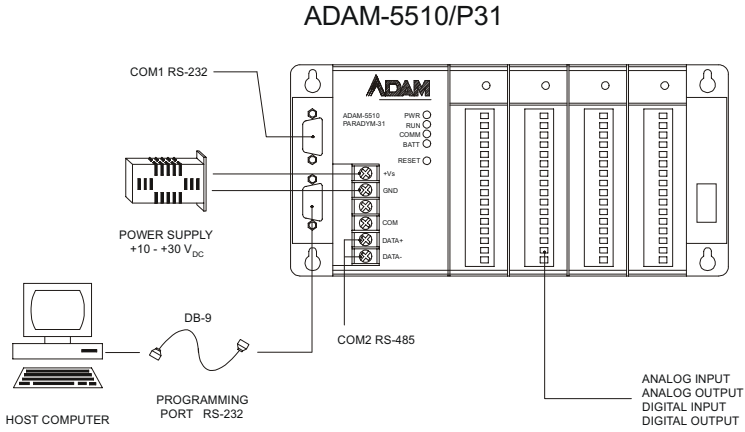


Figure 2-1: *ADAM-5510/P31 wiring and connections*

Step 3: Run utility software in host computer

After installing the ADAM-5510/P31 utility program (refer to section 0.3), you will find ADAM5510.EXE in the directory **c:\5510. This** file is a menu-driven software utility provided for downloading user's programs. When the file is executed, the main screen appears, as shown in Figure 2-2.

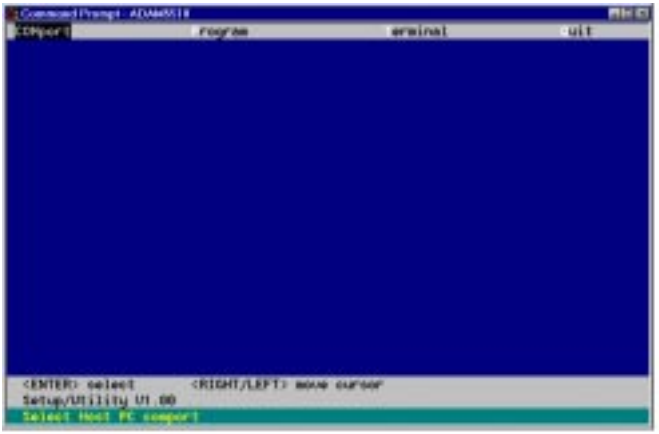


Figure 2-2: *ADAM-5510/P31 software utility*

Select COM port

First, highlight the "**COMport**" option on the menu bar and press <**Enter**>. The status field (shown below) will appear. Second, highlight the COM port on the PC that you connected the ADAM-5510/P31 to, then press <**Enter**>. The baud rate is set to a default value of 57600 bps and cannot be changed. The screen is as shown in Figure 2-3:

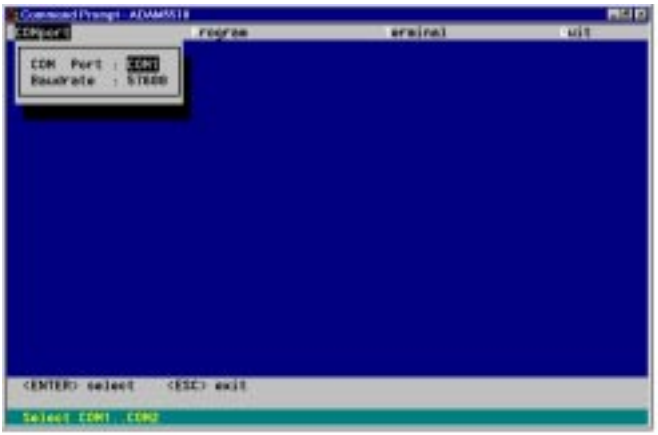


Figure 2-3: *Communication port selection*

2.2 Module Installation

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.

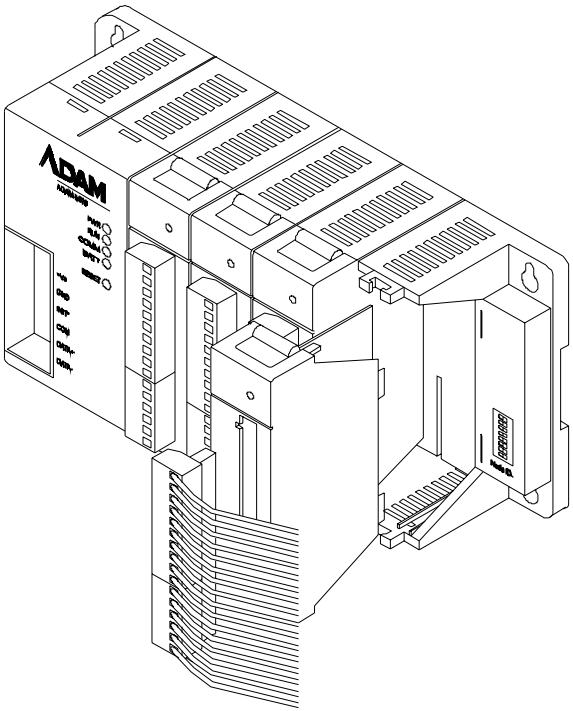


Figure 2-4: *Module alignment and installation*

2.3 I/O Slots and I/O Channel Numbering

The ADAM-5510/P31 system provides 4 slots for use with I/O modules. The I/O slots are numbered 0 through 3, and the channel numbering of any I/O module in any slot starts from 0. For example, the ADAM-5017 is an 8-channel analog input module. Its input channel numbering is 0 through 7.

2.4 Mounting

The ADAM-5510/P31 system 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 tating screw (4 mm diameter)

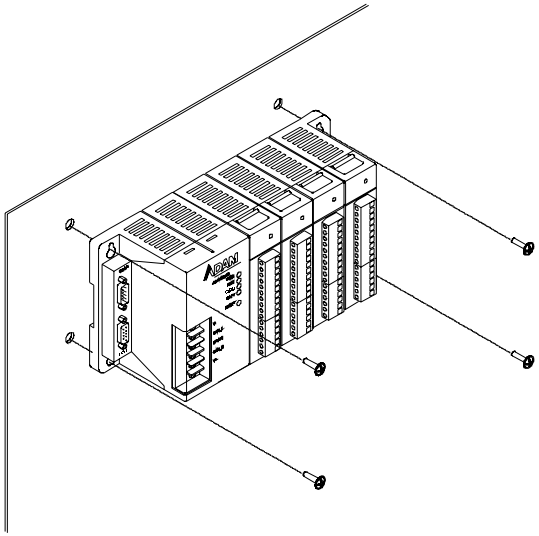


Figure 2-5: *ADAM-5510/P31 panel mounting screw placement*

should be used.

DIN rail mounting

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 end 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 onto 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.

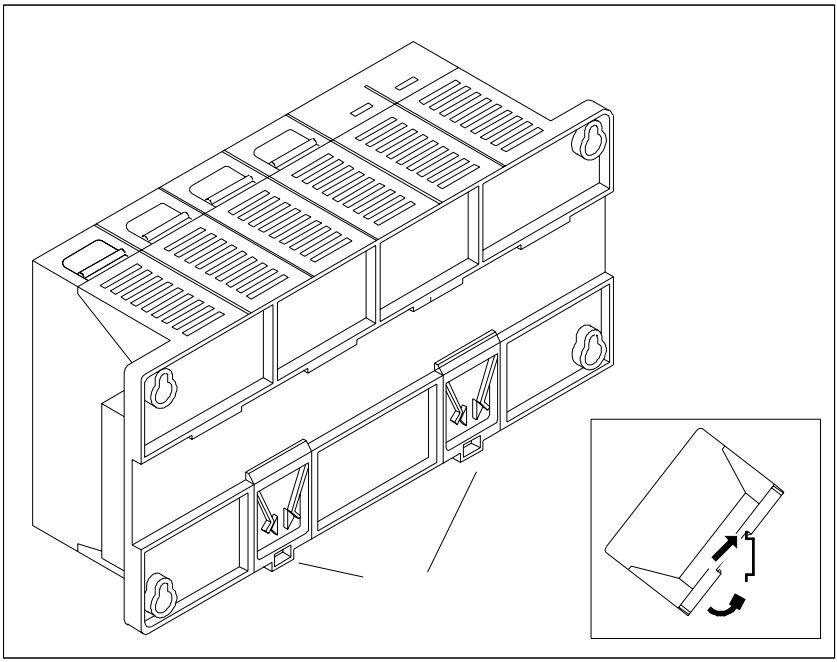


Figure 2-6: *ADAM-5510/P31 rail mounting*

2.5 Jumper Settings and DIP Switch Settings

This section tells you how to set the jumpers and DIP switches to configure your ADAM-5510/P31 system. 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 board. Note that JP1 is actually a connector.

The following figure shows the location of the jumpers:

* JP4 is for battery power ON/OFF

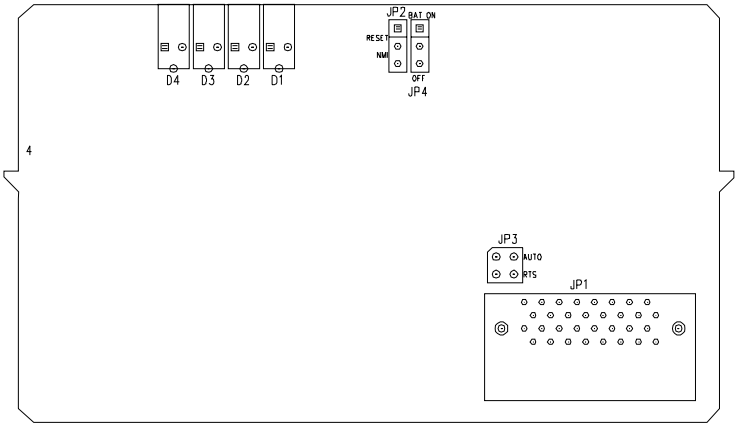


Figure 2-7: *Jumper locations on the CPU card*

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/P31 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 2-8:

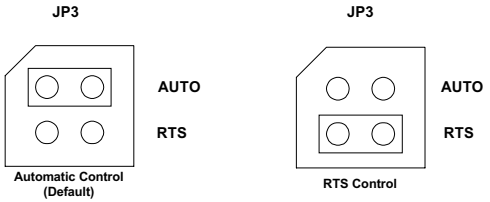


Figure 2-8: *COM2 port RS-485 control mode setting (JP3)*

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:

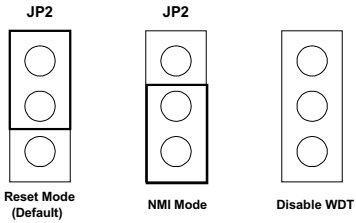


Figure 2-9: *Watchdog timer setting*

Network address/baudrate setting

Set the network address/baudrate using the 8-pin DIP switch located on the lower right-hand face of the ADAM-5510/P31 front cover. Valid address settings range from 0 to 63 (00h to 3Fh) where ON in any of the 6 DIP switch positions bits 1 through 6 equates to a binary 1, and OFF equates to a binary 0. For example, if the Node ID is 03h, the DIP switch settings for switches 1 and 2 (representing bits 1 and 2) would both be ON while the switches 3, 4, 5, and 6 would be OFF. The default Node ID is 01h.

The two DIP switch positions bit 7 and bit 8 are for baudrate setting, as shown in the following table:

Baudrate (bps)	9600	19200	38400	115200
Bit 7	OFF	ON	OFF	ON
Bit 8	OFF	OFF	ON	ON

Table 2-1: *DIP switch baudrate settings*

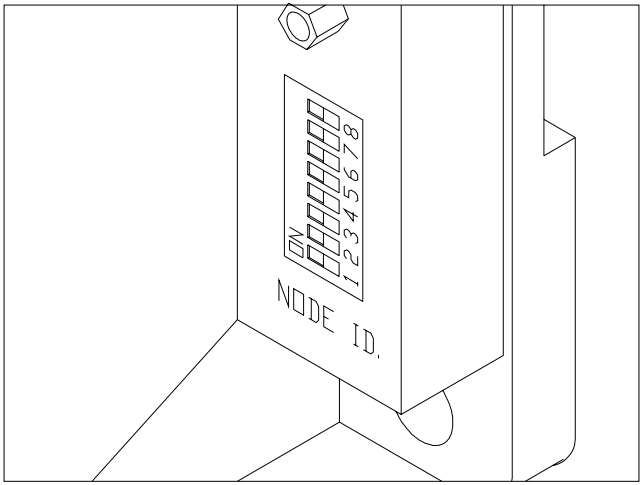


Figure 2-10: *ADAM-5510/P31 network address DIP switch*

2.6 Wiring and Connections

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

Power supply wiring

Although the ADAM-5510/P31 systems are designed for a standard industrial unregulated 24 V_{DC} power supply, they accept any power unit that supplies within the range of +10 to +30 V_{DC}. The power supply ripple must be limited to 200 mV peak-to-peak, and the immediate ripple voltage should be maintained between +10 and +30 V_{DC}. Screw terminals +Vs and GND are for power supply wiring.

Note: The wires used should be sized at least 2 mm².

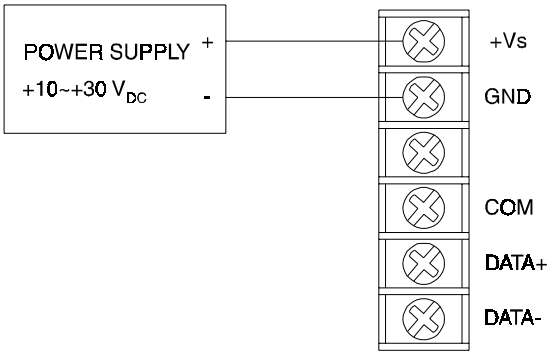


Figure 2-11: *ADAM-5510/P31 power wiring*

I/O modules wiring

The system uses a plug-in screw terminal block for the interface between an I/O module 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 mm² to 2.5 mm².
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.

Programming port connection

The ADAM-5510/P31 has a programming port with a DB-9 connection. This port allows you to program, configure, and troubleshoot the ADAM-5510/P31 from your host computer. The programming port has an RS-232 interface and only uses TX, RX, and GND signals. The pin assignment of the port is as follows:

Pin No.	Description
Pin 1	Not Used
Pin 2	Tx
Pin 3	Rx
Pin 4	Not Used
Pin 5	GND
Pin 6	Not Used
Pin 7	Not Used
Pin 8	Not Used
Pin 9	Not Used

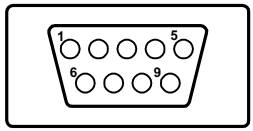


Table 2-2: *DB-9 programming port pin assignments*

RS-232 port connection

The COM1(3F8) port is dedicated as an RS-232 interface and has a DB-9 connector. 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 COM1 port.

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

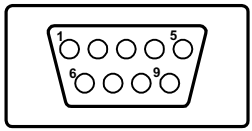


Table 2-3: *RS-232 port pin assignments*

RS-485 port connection

The COM2 (2F8) port is dedicated as an RS-485 interface. Screw terminals DATA- and DATA+ are used for making the COM2 RS-485 connections.

2.7 LED Status of the ADAM-5510/P31 Unit

The ADAM-5510/P31 unit front panel cover has four LEDs which indicate operating statuses. Please refer to **Section 1.3.1** for details.

2.8 I/O Modules Configuration

When main unit installation is completed, you may still need to configure or calibrate the I/O modules inserted in the ADAM-5510/P31 slots. The utility program **ADAM5510.EXE** can help you do this. See **Section 0.3.2 I/O modules configuration** in **Chapter 0**. Greater detail is provided in **Chapter 4**.

2.9 Remote I/O Wiring

This section provides two ways of Remote I/O function wiring . You should connect the host PC and ADAM modules on following ways.

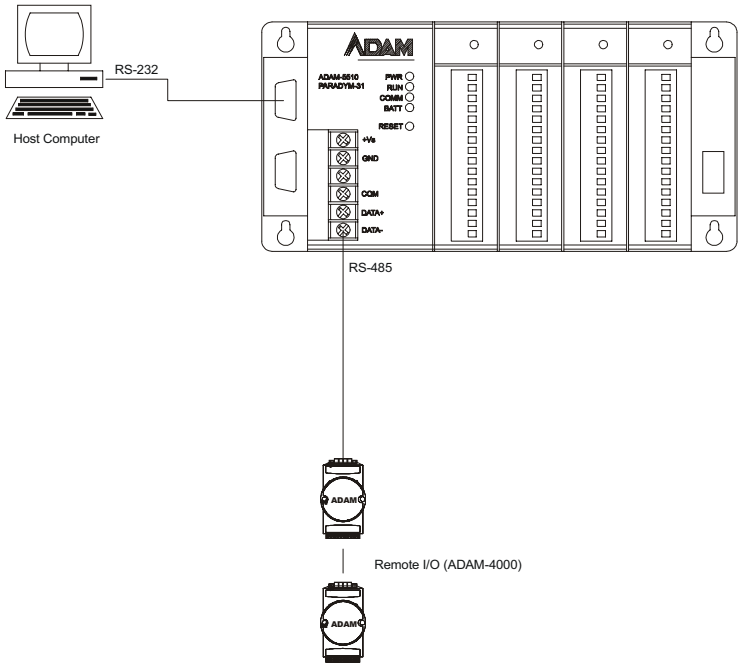


Figure 2-12: *Remote I/O Wiring (RS-485)*

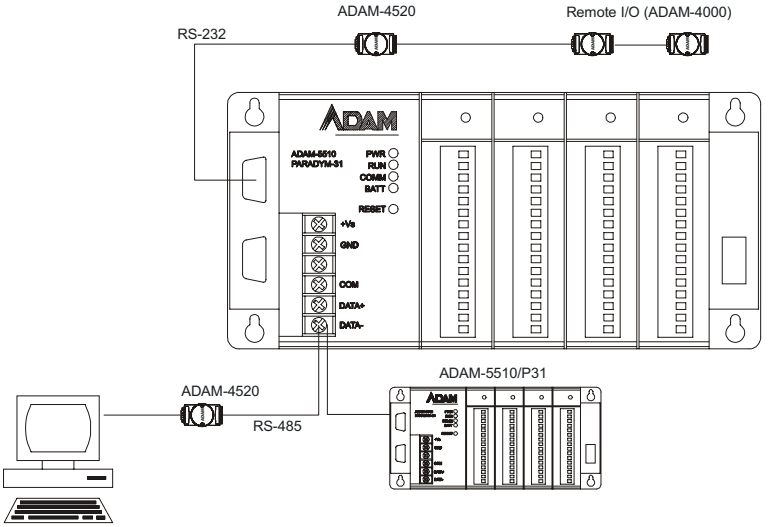


Figure 2-13: *Remote I/O Wiring (RS-232)*

Note: When you intened to change the connection, you have to stop the program and reset ADAM-5510/P31.

3

System Specifications

System Specifications

3.1 Overview

The ADAM-5510/P31 is a PC-based programmable microcontroller for standalone data acquisition and control which can control, monitor and acquire data through multichannel I/O modules. Its IBM-PC compatible hardware and bundled IEC 1131-3 compliant Advantech Paradym-31 software provides a fast and easy combination for implementing your applications. Each system can handle up to 4 I/O modules (up to 64 I/O points). The system also provides serial communication ports (RS-232/485), allowing the system to communicate with other devices for versatile applications.

3.2 Major Features

The ADAM-5510/P31 system hardware 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 base, two serial communication ports and a programming port. It has the following major features:

Built-in 80188 CPU and ROM-DOS operating system

ADAM-5510/P31's CPU card includes an 80188 microprocessor. Its ROM-DOS operating system is an MS-DOS compatible system. It provides all the basic functions of MS-DOS except the BIOS. Users can run control programs written using ladder diagram, SFC or FBD under this ROM-DOS environment.

Built-in ROM and flash disk for programming

The ADAM-5510/P31 has a built-in flash ROM, SRAM and flash disk. The system provides 400 KB of free flash disk to allow users to download programs. There are also 12 KB of free SRAM with battery backup to provide the memory needed for temporary variable storage in user's programs.

Built-in RS-232/485 communication ports

The ADAM-5510/P31 has two serial communication ports to enable the controller to communicate with other devices in your applications. The COM1 port is dedicated as an RS-232 interface. The COM2 port is dedicated as the RS-485 port. This unique design makes the controller suitable for use in a variety of applications.

3-way isolation and watchdog timer

Electrical noise can enter a system in many different ways. It may enter through an I/O module, a power supply connection or the communication ground connection. The ADAM-5510/P31 system provides isolation for I/O modules (3000 V_{DC}), communication connections (2500 V_{DC}), and communication power connections (3000 V_{DC}). The 3-way isolation design prevents ground loops and reduces the effect of electrical noise on the system. It also offers better surge protection to prevent dangerous voltages or spikes from harming your system. The system also has a watchdog timer to monitor the microprocessor. The watchdog timer automatically resets the microprocessor in the ADAM-5510/P31 system if the system fails.

3.3 Technical Specifications of the ADAM-5510/P31 System

System

- CPU: 80188-40, 16-bit microprocessor
- Flash ROM: 256 KB (system use only)
- Operating system: ROM-DOS
- Flash disk: 512 KB (400 KB free space for users)
- SRAM: 12 KB battery backup free memory for users
- Timer BIOS: Yes
- Real-time clock: Yes
- Watchdog timer: Yes
- COM1(3F8): RS-232
- COM2(2F8): RS-485
- Programming port (RS-232 interface, DB-9 connector): Tx, Rx, GND
- I/O capacity: 4 modules (limitation: only one ADAM-5024 is allowed in one ADAM-5510/P31 main unit)
- CPU power consumption: 1.0 W
- LED Status display: Power, CPU, Communication, Battery

RS-232 interface (COM1)

- 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)

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)

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)

Remote I/O Modules

- Nodes: 32 (At most 16 AI/O modules allowed to be installed)

Isolation

- Communication Power: 3000 V_{DC}
- Input/Output: 3000 V_{DC}
- Communication: 2500 V_{DC} (COM2 only)

Power

- Unregulated +10 to +30 V_{DC}
- Protected against power reversal
- Power consumption: 2.0 W

Mechanical

- Case: KJW with captive mounting hardware
- Plug-in screw terminal block:

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

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.

Dimensions

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

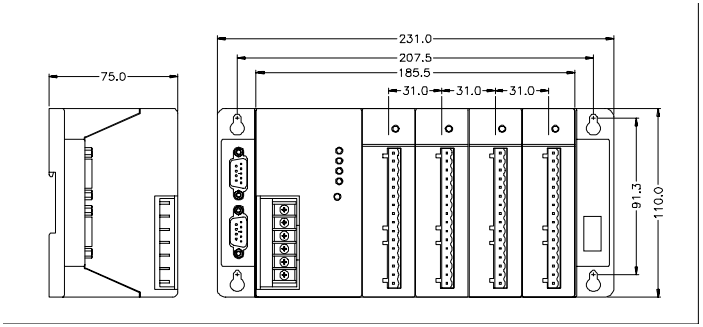


Figure 3-1: *ADAM-5510/P31 system & I/O module dimensions*

3.4 Basic Function Block Diagram

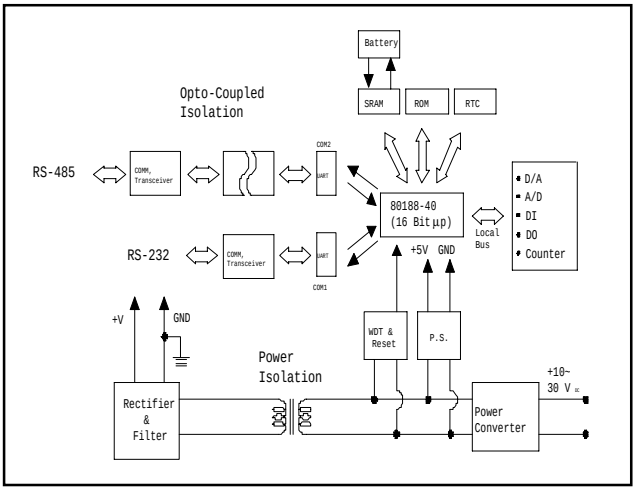


Figure 3-2: *Function block diagram*

4

I/O Modules

I/O Modules

4.1 RTD Input Module

ADAM-5013 3-channel RTD input module

The ADAM-5013 is a 16-bit, 3-channel RTD input module that features programmable input ranges on all channels. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. Its opto-isolated inputs provide 3,000 V_{DC} of isolation between the analog input and the module, protecting the module and peripherals from damage due to high input line voltage.

Note: *Owing to the conversion time required by the A/D converter, the initialization time of each ADAM-5013 module is 5 seconds. Thus the total initialization time will be about 20 seconds if all 4 I/O slots in an ADAM-5510/P31 main unit contain ADAM-5013 modules.*

ADAM-5013

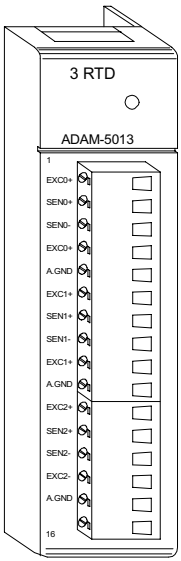


Figure 4-1: *ADAM-5013 module frontal view*

Application wiring

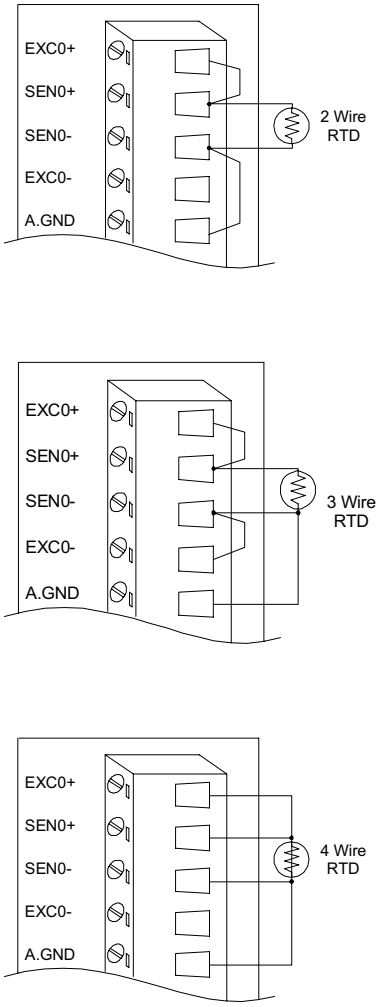


Figure 4-2: *RTD inputs*

Technical specifications of ADAM-5013

Analog input channels	three
Input type	Pt or Ni RTD
RTD type and temperature range	Pt -100 to 100° C a=0.00385 Pt 0 to 100° C a=0.00385 Pt 0 to 200° C a=0.00385 Pt 0 to 600° C a=0.00385 Pt -100 to 100° C a=0.00392 Pt 0 to 100° C a=0.00392 Pt 0 to 200° C a=0.00392 Pt 0 to 600° C a=0.00392 Ni -80 to 100° C Ni 0 to 100° C
Isolation voltage	3000 V_{DC}
Sampling rate	10 samples/sec (total)
Input impedance	2 MΩ
Bandwidth	13.1 Hz @ 50 Hz, 15.72 Hz @ 60 Hz
Input connections	2, 3 or 4 wire
Accuracy	± 0.1% or better
Zero drift	± 0.015 °C/°C
Span drift	± 0.01 °C/°C
CMR@50/60 Hz	150 dB
NMR@50/60 Hz	100 dB
Power consumption	1.2 W

Table 4-1: *Technical specifications of ADAM-5013*

4.2 ADAM-5013 RTD Input Resistance Calibration

1. Apply power to the ADAM-5510/P31 system that the RTD input module is plugged into and let it warm up for about 30 minutes
2. Make sure that the module is correctly installed and is properly configured for the input range you want to calibrate. You can use the ADAM utility software to help in this.
3. Connect the correct reference self resistance between the screw terminals of the ADAM-5013 as shown in the following wiring diagram. Table 4-2 below shows the correct values of the span and zero calibration resistances to be connected. Reference resistances used can be from a precision resistance decade box or from discrete resistors with the values 60 Ω, 140 Ω, 200 Ω and 440 Ω.

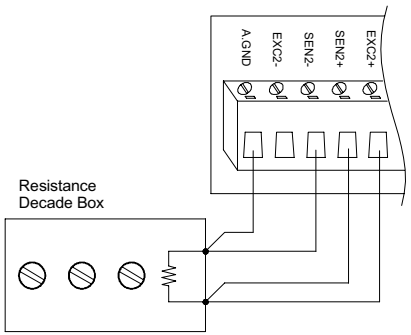


Figure 4-3: *Applying calibration resistance*

4. First, with the correct zero (offset) calibration resistance connected as shown above, issue a Zero Calibration command to the module using the Calibrate option in the ADAM utility software.
5. Second, with the correct span resistance connected as shown above, issue a Span Calibration command to the module using the Calibrate option in the ADAM utility software. Note that the module zero calibration must be completed prior to the span calibration.

Note: *If the above procedure is ineffective, the user must first issue an RTD Self Calibration command $aaSi2 to the module and then complete steps 4 and 5 after self calibration is complete.*

Calibration resistances (ADAM-5013)

Input Range Code (Hex)	Input Range	Span Calibration Resistance	Zero Calibration Resistance
20	Pt, -100 to 100° C A = 0.00385	140 Ohms	60 Ohms
21	Pt, 0 to 100° C A = 0.00385	140 Ohms	60 Ohms
22	Pt, 0 to 200° C A = 0.00385	200 Ohms	60 Ohms
23	Pt, 0 to 600° C A = 0.00385	440 Ohms	60 Ohms
24	Pt, -100 to 100° C A = 0.00392	140 Ohms	60 Ohms
25	Pt, 0 to 100° C A = 0.00392	140 Ohms	60 Ohms
26	Pt, 0 to 200° C A = 0.00392	200 Ohms	60 Ohms
27	Pt, 0 to 600° C A = 0.00392	440 Ohms	60 Ohms
28	Ni, -80 to 100° C	200 Ohms	60 Ohms
29	Ni, 0 to 100° C	200 Ohms	60 Ohms

Table 4-2: *Calibration resistances of ADAM-5013*

4.3 Analog Input Modules

ADAM-5017 8-channel analog input module

The ADAM-5017 is a 16-bit, 8-channel analog differential input module that provides programmable input ranges on all channels. It accepts millivolt inputs (±150mV, ±500mV), voltage inputs (±1V, ±5V and ±10V) and current input (±20 mA, requires 125Ω resistor). The module provides data to the host computer in engineering units (mV, V or mA). This module is an extremely cost-effective solution for industrial measurement and monitoring applications. Its opto-isolated inputs provide 3,000 V_{DC} of isolation between the analog input and the module, protecting the module and peripherals from damage due to high input line voltage. Additionally, the module uses analog multiplexers with active overvoltage protection. The active protection circuitry assures that signal fidelity is maintained even under fault conditions that would destroy other multiplexers. This module can withstand an input voltage surge of 70 Vp-p with ±15 V supplies.

ADAM-5017

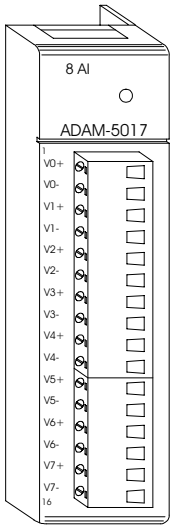


Figure 4-4: *ADAM-5017 module frontal view*

Application wiring

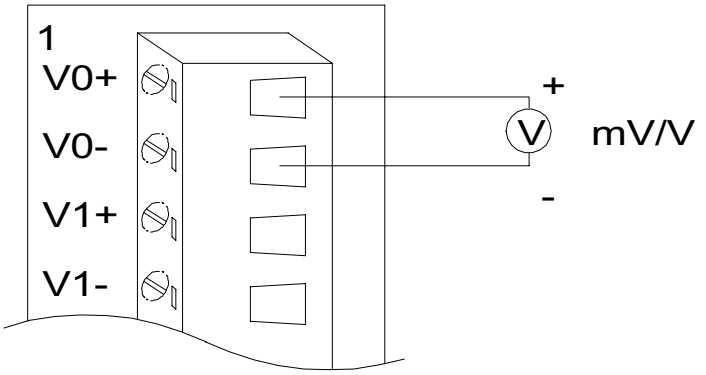


Figure 4-5: *Millivolt and volt input*

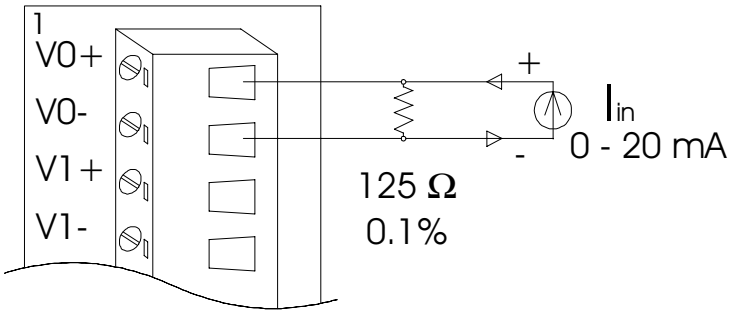


Figure 4-6: *Process current input*

Note: *To keep measurement accuracy please short the channels that are not in use.*

Technical specifications of ADAM-5017

Analog input channels	Eight differential
Input type	mV, V, mA
Input range	± 150 mV, ± 500 mV, ± 1V, ±5V, ±10V and ±20 mA
Isolation voltage	3000 V_{DC}
Sampling rate	10 samples/sec (total)
Analog input signal limit	15 V max.
Max. allowable voltage difference between two connectors in a module	15 V max.
Input impedance	2 Mohms
Bandwidth	13.1 Hz @ 50 Hz, 15.72 Hz @ 60 Hz
Accuracy	± 0.1%
Zero drift	± 1.5 μV/°C
Span drift	± 25 PPM/°C
CMR@50/60 Hz	92 dB min.
Power requirements	+10 to +30 V_{DC} (non-regulated)
Power consumption	1.2 W

Table 4-3: *Technical specifications of ADAM-5017*

ADAM-5017H 8-channel high speed analog input module

The ADAM-5017H is a 12-bit plus sign bit, 8-channel analog differential input module that provides programmable input ranges on each channel. It accepts millivolt inputs (± 500 mV, 0-500 mV), voltage inputs (±1 V, 0-1 V, ±2.5 V, 0-2.5 V, ±5 V, 0-5 V, ±10 V and 0-10 V) and current inputs (0-20 mA and 4-20 mA; requires a 125 ohms resistor). The module provides data to the host microprocessor in engineering units (mV, V or mA) or two's complement format. Its sampling rate depends on the data format received: up to 1,000 Hz (total) in two's complement or 600 Hz (total) in engineering units. Space is reserved for 125-ohm, 0.1%, 10 ppm resistors (See Figure 4-10). Each input channel has 3000 V_{DC} of optical isolation between the outside analog input line and the module, protecting the module and peripherals from high input line voltages. Additionally, the module uses analog multiplexers with active overvoltage protection. The active protection circuitry assures that signal fidelity is maintained even under fault conditions that would destroy other multiplexers. The analog inputs can withstand a constant 70 Vp-p input with ±15 V supplies.

ADAM-5017H

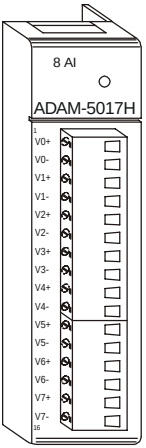


Figure 4-7: *ADAM-5017H module frontal view*

Application wiring

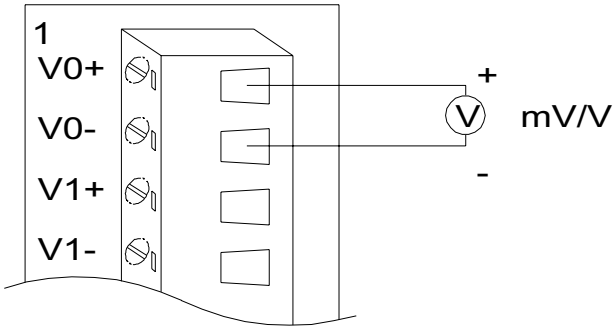


Figure 4-8: *Millivolt and volt input*

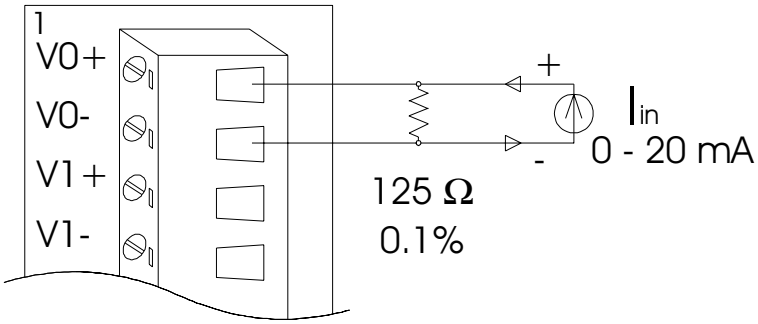


Figure 4-9: *Process current input*

Technical specifications of ADAM-5017H

Analog Input Channels	8 differential
ADC Resolution	12 bits, plus sign bit
Type of ADC	Successive approximation
Isolation Voltage	3000 V_{DC}
Sampling Rate	1,000 Hz/module no. (total) in two's complement data format; 600 Hz/module no. (total) in engineering unit data format
Input Impedance	20 Mohms (voltage inputs); 125 ohms (current inputs)
Signal Input Bandwidth	1000 Hz for both voltage inputs and current inputs
Analog Signal Range	±15 V max.
Analog Signal Range for any two measured Pins	±15 V max.
Power Requirements	+10 to +30 V_{DC} (non-regulated)
Power Consumption	1.8 W

Table 4-4: *Technical specifications of ADAM-5017H*

	Input Range	With Overranging	Offset Error @ 25° C	Offset Error @ -10 to +70° C	Gain Error @ 25° C	Gain Error @ -10 to +70° C	Offset Drift	Gain Drift	Display Resolution
Voltage Inputs	0 ~ 10 V	0 ~ 11 V	±1 LSB	±2 LSB	±1 LSB	±2 LSB	17 μV/°C	50 ppm/°C	2.7 mV
	0 ~ 5 V	0 ~ 5.5 V	±1 LSB	±2 LSB	±1.5 LSB	±2 LSB	16 μV/°C	50 ppm/°C	1.3 mV
	0 ~ 2.5 V	0 ~ 2.75 V	±1 LSB	±2 LSB	±1.5 LSB	±2 LSB	20 μV/°C	55 ppm/°C	0.67 mV
	0 ~ 1 V	0 ~ 1.375 V	±1 LSB	±2.5 LSB	±2 LSB	±2.5 LSB	20 μV/°C	60 ppm/°C	0.34 mV
	0 ~ 500 mV	0 ~ 687.5 mV	-	±5 LSB	±3 LSB	±3.5 LSB	20 μV/°C	67 ppm/°C	0.16 mV
	± 10 V	±11 V	±1 LSB	±2 LSB	±1 LSB	±2 LSB	17 μV/°C	50 ppm/°C	2.7 mV
	± 5 V	±0 ~ 5.5 V	±1 LSB	±2 LSB	±1.5 LSB	±2 LSB	17 μV/°C	50 ppm/°C	1.3 mV
	± 2.5 V	±0 ~ 2.75 V	±1 LSB	±2 LSB	±1.5 LSB	±2 LSB	20 μV/°C	55 ppm/°C	0.67 mV
	± 1 V	±0 ~ 1.375 V	±1 LSB	±2.5 LSB	±2 LSB	±2.5 LSB	20 μV/°C	60 ppm/°C	0.34 mV
	± 500 mV	±0 ~ 687.5 mV	-	±5 LSB	±3 LSB	±3.5 LSB	20 μV/°C	67 ppm/°C	0.16 mV
Current Inputs	0 ~ 20 mA	22 mA	±1 LSB	±1 LSB	±1.5 LSB	±2 LSB	nA/°C	ppm/°C	5.3 μA
	4 ~ 20 mA	22 mA	±1 LSB	±1 LSB	±1.5 LSB	±2 LSB	nA/°C	ppm/°C	5.3 μA

Table 4-5: *ADAM-5017H input signal ranges*

ADAM-5018 7-channel thermocouple input module

The ADAM-5018 is a 16-bit, 7-channel thermocouple input module that features programmable input ranges on all channels. It accepts millivolt inputs (±15 mV, ±50 mV, ±100 mV, ±500 mV), voltage inputs (±1 V, ±2.5 V), current inputs (±20 mA, requires 125 Ω resistor) and thermocouple inputs (J, K, T, R, S, E, B).

The module forwards the data to the host computer in engineering units (mV, V, mA or temperature °C). An external CJC on the plug-in terminal is designed for accurate temperature measurement.

ADAM-5018

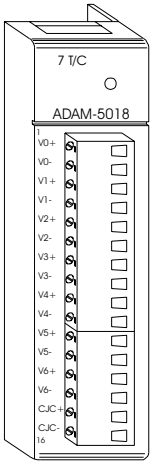


Figure 4-10: *ADAM-5018 module frontal view*

Application wiring

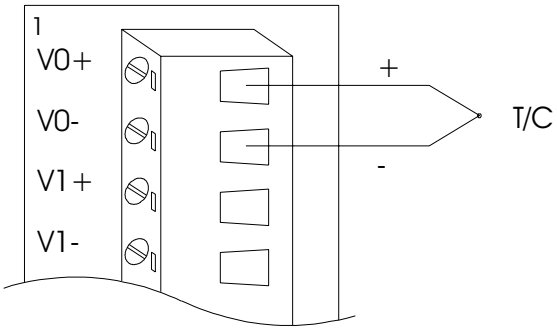


Figure 4-11: *Thermocouple input*

Technical specifications of ADAM-5018

Analog Input Channels	Seven differential
Input Type	mV, V, mA, Thermocouple
Input Range	± 15 mV, ± 50 mV, ± 100 mV, ± 500 mV, ± 1 V, ± 2.5 V and ± 20 mA
T/C Type and Temperature Range	J 0 to 760 °C K 0 to 1370 °C T -100 to 400 °C E 0 to 1400 °C R 500 to 1750 °C S 500 to 1750 °C B 500 to 1800 °C
Isolation Voltage	3000 V_{DC}
Sampling Rate	10 samples/sec (total)
Input Impedance	2 Mohms
Bandwidth	13.1 Hz @ 50 Hz, 15.72 Hz @ 60 Hz
Accuracy	± 0.1% or better
Zero Drift	± 0.3 μV/°C
Span Drift	± 25 PPM/°C
CMR @ 50/60 Hz	92 dB min.
Power Consumption	1.2 W

Table 4-6: *Technical specifications of ADAM-5018*

4.4 Analog Output Modules

ADAM-5024 4-channel analog output module

The ADAM-5024 is a 4-channel analog output module. It receives its digital input from the host computer, via the RS-485 interface of the ADAM-5510/P31 main unit. The format of the data is engineering units. It then uses the D/A converter controlled by the main unit to convert the digital data into output signals.

You can specify slew rates and start up currents through the configuration software. The analog output can also be configured as current or voltage output through the software utility. The module protects your equipment from ground loops and power surges by providing opto-isolation of the D/A output and transformer based isolation up to 500 V_{DC}.

Slew rate

The slew rate is defined as the slope (the ascending or descending rate per second) of the analog output from the present to the required value.

ADAM-5024

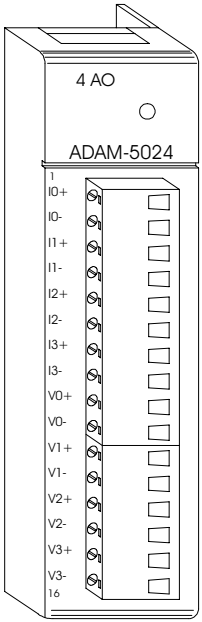


Figure 4-12: *ADAM-5024 module frontal view*

Application wiring

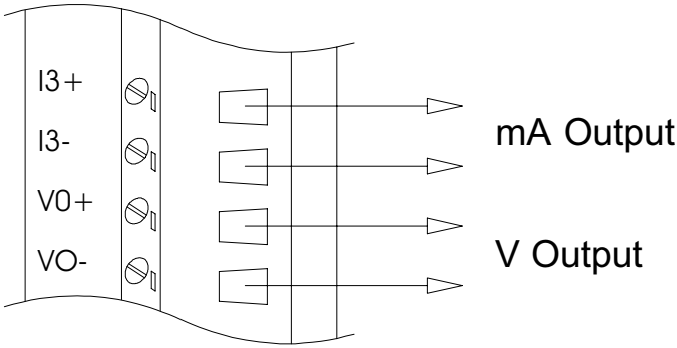


Figure 4-13: *Analog output*

Technical specifications of ADAM-5024

Analog Output Channels	Four
Output Type	V, mA
Output Range	0-20mA, 4-20mA, 0-10V
Isolation Voltage	3000 Vdc
Output Impedance	0.5 Ohms
Accuracy	±0.1% of FSR for current output ±0.2% of FSR for voltage output
Zero Drift	Voltage output: ±30 μV/ºC Current output: ±0.2 μA/ºC
Resolution	±0.015% of FSR
Span Temperature Coefficient	±25 PPM/ºC
Programmable Output Slope	0.125-128.0 mA/sec 0.0625-64.0 V/sec
Current Load Resistor	0-500 Ohms (source)
Power Consumption	2.5W (Max.)

Table 4-7: *Technical specifications of ADAM-5024*

4.5 Analog I/O Modules Calibration

Analog input/output modules are calibrated when you receive them. However, calibration is sometimes required. No screwdriver is necessary because calibration is done in software with calibration parameters stored in the ADAM-5000 analog I/O module's onboard EEPROM.

The ADAM-5510/P31 system comes with the ADAM utility software that supports calibration of analog input and analog output. Besides the calibration that is carried out using the utility software, the modules incorporate automatic Zero Calibration and automatic Span Calibration at bootup or reset.

Analog input module calibration

Modules: ADAM-5017, 5017H, 5018

1. Apply power to the ADAM-5510/P31 system that the analog input module is plugged into and let it warm up for about 30 minutes
2. Assure that the module is correctly installed and is properly configured for the input range you want to calibrate. You can do this by using the ADAM utility software. (Refer to Chapter 5)
3. Use a precision voltage source to apply a span calibration voltage to the module's V0+ and V0- terminals. (See Tables 4-8 and 4-9 for reference voltages for each range.)

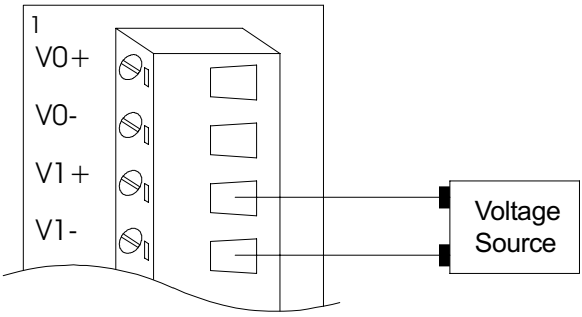


Figure 4-14: *Applying calibration voltage*

4. Execute the Zero Calibration command (also called the Offset Calibration command). This is also done with the ADAM utility software. (See the "Zero Calibration" option in the Calibration sub-menu of the ADAM utility software.)

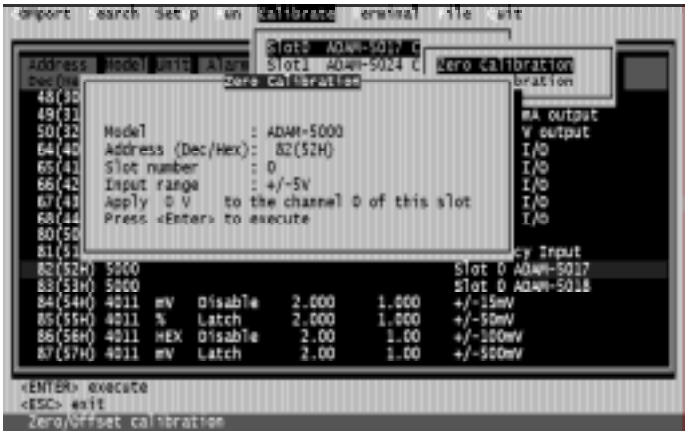


Figure 4-15: *Zero calibration*

5. Execute the Span Calibration command. This can be done with the ADAM utility software. (See the "Span Calibration" option in the Calibration sub-menu of the ADAM utility software.)

Figure 4-16: *Span calibration*

6. Only for ADAM-5018: Execute the CJC (cold junction sensor) Calibration command. This can be done with the ADAM utility software. (See the “CJC Calibration” option in the Calibration submenu of the ADAM utility software.)

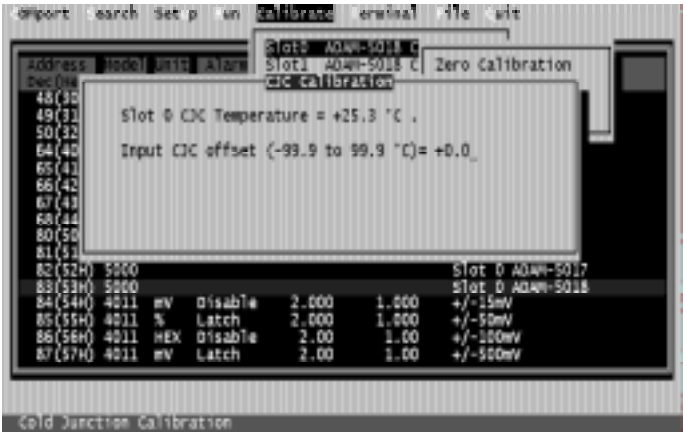


Figure 4-17: *Cold junction calibration*

** Note:* *Zero calibration and span calibration must be completed before CJC calibration. To calibrate CJC, the thermocouple attached to ADAM-5018 and a standard thermometer should be used to measure a standard known temperature, such as the freezing point of pure water. The amount of offset between the ADAM-5018 and the standard thermometer is then used in the ADAM utility to complete CJC calibration.*

Calibration voltage (ADAM-5017/5018)

Module	Input Range Code (Hex)	Input Range	Span Calibration Voltage
5018	00h	±15 mV	+15 mV
	01h	±50 mV	+50 mV
	02h	±100 mV	+100 mV
	03h	±500 mV	+500 mV
	04h	±1V	+1 V
	05h	±2.5V	+2.5 V
	06h	±20 mA	+20 mA (1)
	0Eh	J thermocouple 0 to 760 ºC	+50 mV
	0Fh	K thermocouple 0 to 1000 ºC	+50 mV
	10h	T thermocouple -100 to 400 ºC	+22 mV
	11h	E thermocouple 0 to 1000 ºC	+80 mV
	12h	R thermocouple 500 to 1750 ºC	+22 mV
	13h	S thermocouple 500 to 1750 ºC	+22 mV
	14h	B thermocouple 500 to 1800 ºC	+15 mV
5017	07h	Not used	
	08h	±10 V	+10 V
	09h	±5 V	+5 V
	0Ah	±1 V	+1 V
	0Bh	±500 mV	+500 mV
	0Ch	±150 mV	+150 mV
	0Dh	±20 mA	+20 mV (1)

Table 4-8: *Calibration voltage of ADAM-5017/5018*

Calibration voltage (ADAM-5017H)

Module	Input Range Code (Hex)	Input Range	Span Calibration Voltage
5017H	00h	±10 V	+10 V
	01h	0 ~ 10 V	+10 V
	02h	±5 V	+5 V
	03h	0 ~ 5 V	+5 V
	04h	±2.5 V	+2.5 V
	05h	0 ~ 2.5 V	+2.5 V
	06h	±1 V	+1 V
	07h	0 ~ 1 V	+1 V
	08h	±500 mV	+500 mV
	09h	0 ~ 500 mV	+500 mV
	0ah	4 ~ 20 mA	*(1)
	0bh	0 ~ 20 mA	*(1)

Table 4-9: *Calibration voltage of ADAM-5017H*

(1) Note: *You can substitute 2.5 V for 20 mA if you remove the current conversion resistor for that channel. However, the calibration accuracy will be limited to 0.1% due to the resistor's tolerance.*

Analog output module calibration

The output current of analog output modules can be calibrated by using a low calibration value and a high calibration value. The analog output modules can be configured for one of two ranges: 0-20 mA and 4-20 mA. Since the low limit of the 0-20 mA range (0 mA) is internally an absolute reference (no power or immeasurably small power), just two levels are needed for calibration: 4 mA and 20 mA.

1. Apply power to the ADAM-5510/P31 system including the analog output module for about 30 minutes.
2. Assure that the module is correctly installed and that its configuration is according to your specifications and that it matches the output range you want to calibrate. You can do this by using the ADAM utility software. (Refer to Chapter 5, Utility Software)
3. Connect either a 5-digit mA meter or voltmeter with a shunt resistor (250 Ω, .01 % and 10 ppm) to the screw terminals of the module.

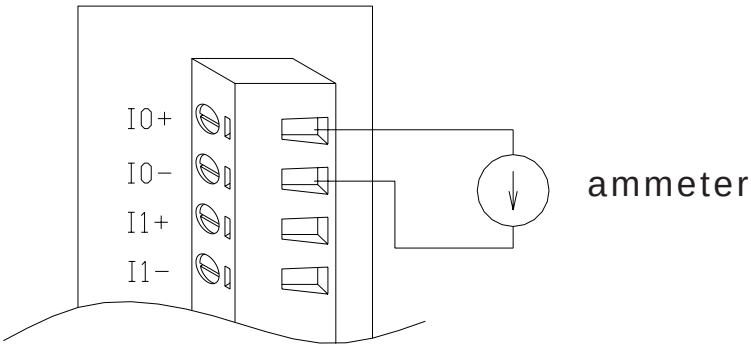


Figure 4-18: *Output module calibration*

4. Issue the Analog Data Out command to the module with an output

value of 4 mA.

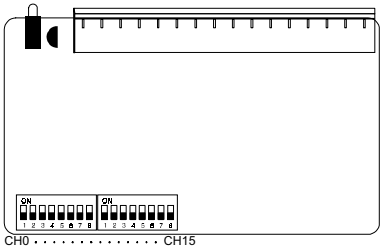
5. Check the actual output value at the modules terminals. If this does not equal 4 mA, use the "Trim" option in the "Calibrate"sub-menu to change the actual output. Trim the module until the mA meter indicates exactly **4 mA**, or in the case of the voltmeter with shunt resistor, trim until the meter indicates exactly **1 V**. (When calibrating for **20 mA** using a voltmeter and shunt resistor, the correct voltage should be **5 V**.)
6. Issue the 4 mA Calibration command to indicate that the output is calibrated and to store the calibration parameters in the module's EEPROM.
7. Execute an Analog Data Out command with an output value of 20 mA. The module's output will be approximately 20 mA.
8. Execute the Trim Calibration command as often as necessary until the output current is equal to exactly 20 mA.
9. Execute the 20 mA Calibration command to indicate that the present output is exactly 20 mA. The analog output module will store its calibration parameters in the unit's EEPROM.

4.6 Digital Input/Output Modules

ADAM-5050 16-channel universal digital I/O module

The ADAM-5050 features sixteen digital input/output channels. Each channel can be independently configured to be an input or an output channel by the setting of its DIP switch. The digital outputs are open-collector transistor switches that can be controlled from the ADAM-5510/P31. The switches can also be used to control solid-state relays, which in turn can control heaters, pumps and power equipment. The ADAM-5510/P31 can use the module's digital inputs to determine the state of limit or safety switches, or to receive remote digital signals.

Warning! *A channel may be destroyed if it is subjected to an input signal while it is configured to be an output channel.*



Dip Switch Key
ON = Digital Output
OFF = Digital Input

Figure 4-19: *Dip switch setting for digital I/O channel*

ADAM-5050

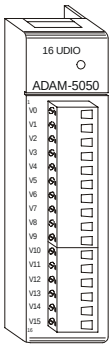


Figure 4-20: *ADAM-5050 module frontal view*

Application wiring

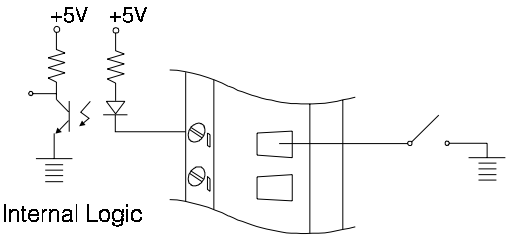


Figure 4-21: *Dry contact signal input (ADAM-5050)*

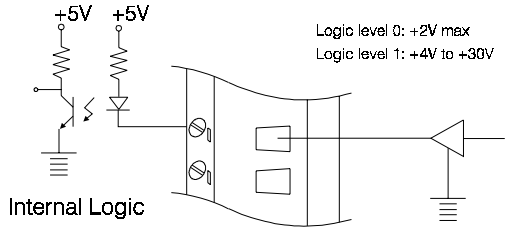


Figure 4-22: *Wet contact signal input (ADAM-5050)*

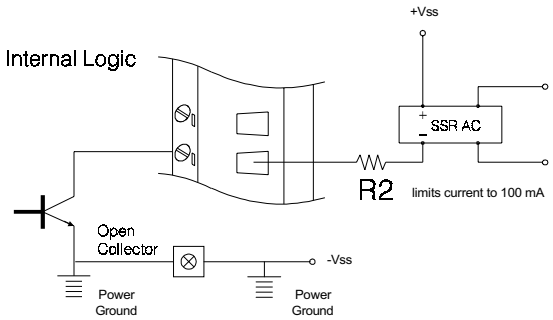


Figure 4-23: *Digital output used with SSR (ADAM-5050/5056)*

Technical specifications of ADAM-5050

Points	16
Channel Setting	Bitwise selectable by DIP switch
Digital Input	Dry Contact Logic Level 0: close to GND Logic Level 1: open Wet Contact Logic Level 0: +2 V max Logic Level 1: +4 V to 30 V
Digital Output	Open collector to 30 V, 100mA max load
Power Dissipation	450 mW
Power Consumption	0.4 W

Table 4-10: *Technical specifications of ADAM-5050*

ADAM-5051 16-channel digital input module

The ADAM-5051 provides sixteen digital input channels. The ADAM-5510/P31 can use the module's digital inputs to determine the state of limit or safety switches or to receive remote digital signals.

ADAM-5051

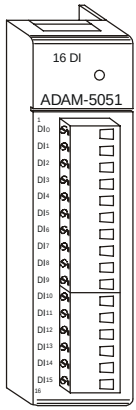


Figure 4-24: *ADAM-5051 module frontal view*

Application wiring

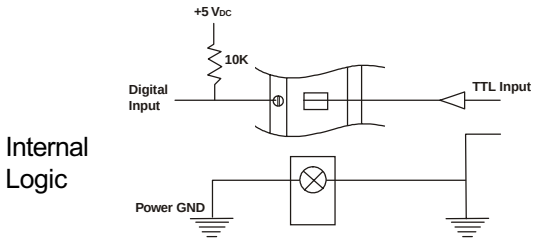


Figure 4-25: *TTL input (ADAM-5051)*

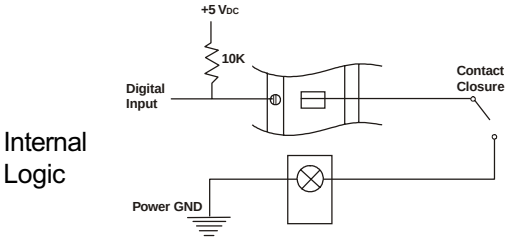


Figure 4-26: *Contact closure input (ADAM-5051)*

Technical specifications of ADAM-5051

Points	16
Digital input	Logic level 0: + 1 V max Logic level 1: + 3.5 to 30 V Pull up current: 0.5 mA 10 kΩ resistor to + 5 V
Power consumption	0.3 W

Table 4-11: *Technical specifications of ADAM-5051*

Overview

Compatible ADAM-5000 Series Main Units

ADAM-5051D is designed to be implemented with the following Advantech ADAM-5000 series main units:

ADAM-5000/485
ADAM-5000E
ADAM-5510
ADAM-5510/P31

ADAM-5051D 16-channel Digital Input W/ LED Module

The ADAM-5051D has all of the same features as the ADAM-5051, except that it is also equipped with sixteen LEDs. These are located beside the module's panel.The purpose of an LED is to tell the user the state in which the channel is in at the time. If the LED lights up, it means that the channel is in Logic Level "1". If the LED remains dark, it means that the channel is in Logic Level "0". This is illustrated in the table on the following page.

ADAM-5051D Module Diagram

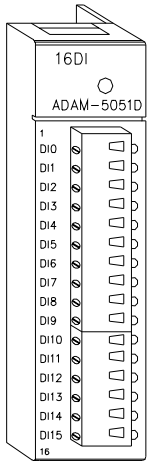


Figure 4-27: *ADAM-5051D Module*

ADAM-5051D Application Wiring

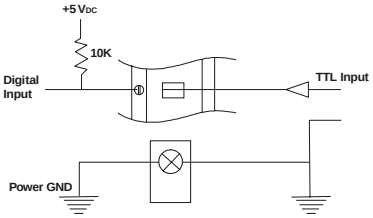


Figure 4-28: *TTL Input (ADAM-5051D)*

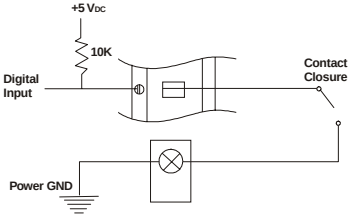


Figure 4-29: *Contact Closure Input (ADAM-5051D)*

Technical Specification of ADAM-5051/5051D

	ADAM-5051	ADAM-5051D
Number of Channels	16	16
Input Voltage	30 Vmax	30 Vmax
Logic Level	Logic Level 0 : 0~1V Logic Level 1 : 3.5 ~30V	Logic Level 0 : 0~1V Logic Level 1 : 3.5 ~30V
LED Indicator	No	Indicate Input State of each channel On: Input logic level "1" : Input Floating Off: Input logic level "0"
Circuit Type	Pull-Up current = 0.5mA (Source Type)	Pull-Up current = 0.5mA (Source Type)
Power Consumption	0.4 W (max.)	0.8 W (max.)

Table 4-12: *Comparison between ADAM-5051 and ADAM-5051D*

ADAM-5052 8-channel isolated digital input module

The ADAM-5052 provides eight fully independent isolated channels. All have 5000 V_{RMS} isolation to prevent ground loop effects and to prevent damage from power surges on the input lines.

ADAM-5052

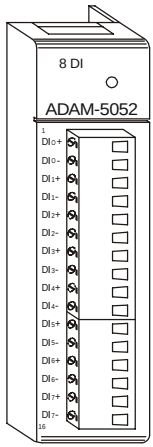


Figure 4-30: *ADAM-5052 module frontal view*

Application wiring

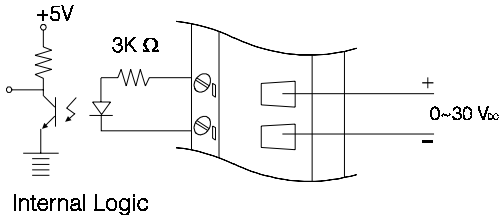


Figure 4-31: *Isolated digital input (ADAM-5052)*

Technical specifications of ADAM-5052

Points	8 Differential
Digital input	Logic level 0: + 1 V max Logic level 1: + 3.5 to 30 V Isolation voltage: 5000 V_{RMS} Resistance: 3 kΩ / 0.5 W
Power consumption	0.4 W

Table 4-13: *Technical specifications of ADAM-5052*

ADAM-5056 16-channel digital output module

The ADAM-5056 features sixteen digital output channels. The digital outputs are open-collector transistor switches that you can control from the ADAM-5510/P31. You also can use the switches to control solid-state relays.

ADAM-5056

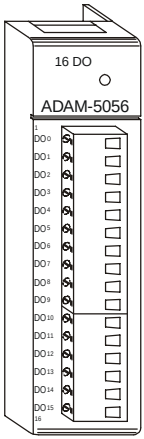


Figure 4-32: *ADAM-5056 module frontal view*

Application wiring

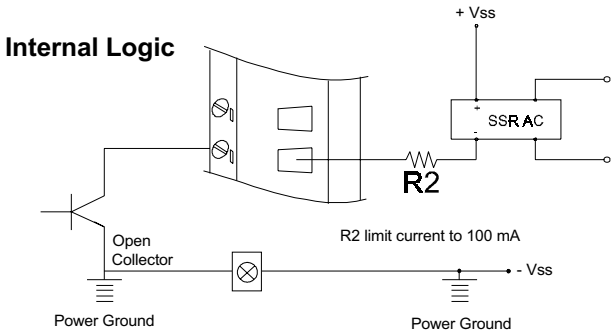


Figure 4-33: *Digital output used with SSR (ADAM-5050/5056)*

Technical specifications of ADAM-5056

There are 16-point digital input and 16-point digital output modules in the ADAM-5000 series. The addition of these solid state digital I/O devices allows these modules to control or monitor the interfaces between high power DC or AC lines and TTL logic signals. A command from the host converts these signals into logic levels suitable for the solid-state I/O devices.

Points	16
Digital output	Open collector to 30 V 100 mA max load
Power dissipation	450 mW
Power consumption	0.25 W

Table 4-14: *Technical specifications of ADAM-5056*

Compatible ADAM-5000 Series Main Units

ADAM-5056D is designed to be implemented within the following Advantech ADAM-5000 series main units:

ADAM-5000/485
ADAM-5000E
ADAM-5510
ADAM-5510/P31

ADAM-5056D 16-channel Digital Output W/ LED Module

ADAM-5056D is a 16-channel digital output W/ LED module, which is based on ADAM-5056. In addition to the original functions inherited from its predecessor, the ADAM-5056D is further enhanced with the following features:

LED display

16 LED indicators are added to the panel. Users can monitor the status of each channel at a glance. When a LED indicator is on, it means that this channel is now in *logic level "1"* status. When a LED indicator is off, it means this channel is in *logic level "0"* status.

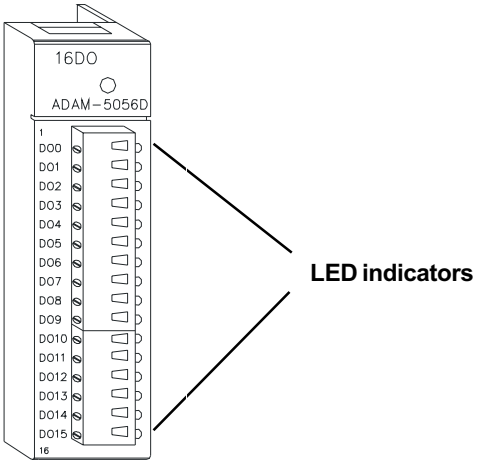


Figure 4-34: *ADAM-5056D Module*

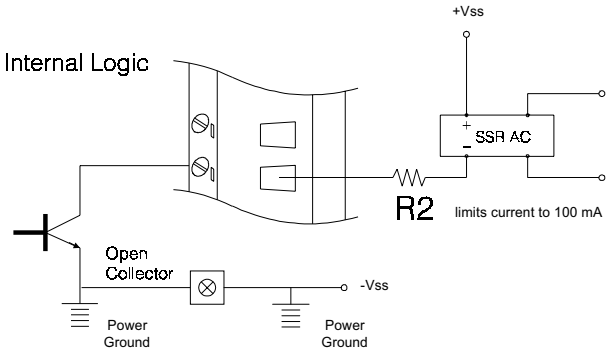


Figure 4-35: *ADAM-5056D Application Wiring*

Digital Output Holding Function

A yellow mini jumper is added to the PCB, the major function of which is to hold the digital output value at its last status so that it won't be erased when the RESET button of your system is pressed or your system software going into reset.

To enble your *Digital Output Holding* Funciton, you must first set the yellow mini jumper on. When the *Digital Output Holding* Function is enabled, the digital output value of ADAM-5060D will first be cleared during system power-on. When the RESET button is pressed or when a system software reset occurs, its digital output value will be held at the last value.

To disable your *Digital Output Holding* Funciton, you must set the mini jumper off. When the jumper is off, it's functions just like an ADAM-5056.

Main Units Supporting Digital Output Holding Function

The *Digital Output Holding* Function is applicable only to ADAM-5510 and ADAM-5511. Other main units, such as ADAM-5000/485, ADAM-5000/CAN and ADAM-5000E, do not support this function, since their firmwares will automatically clear the digital output. Although the firmware of ADAM-5510 and ADAM-5511 will not automatically clear the digital output value, it is nevertheless left as user's free choice to write a program either to clear the digital output or to set the initial value for the system.

The digital output behaviors during power-on and reset are summarized in the following table:

ADAM-5056D Digital Output during Power-on and Reset

	Power-on	Reset
ADAM-5000/485	DO. clear	DO. clear
ADAM-5000/CAN	DO. clear	DO. clear
ADAM-5000E	DO. clear	DO. clear
ADAM-5510	DO. clear	DO. hold
ADAM-5511	DO. clear	DO. hold

Table 4-15: *Main Units Supporting Digital Output Holding Funciton*

Technical Specification of ADAM-5056/5056D

	ADAM-5056	ADAM-5056D
Number of Channels	16	16
Operating Voltage	30 Vmax	30 Vmax
Digital Output	Open Collector to 30V 100mA max load	Open Collector to 30V 100mA max load
LED indicator	No	On: Output logic 1 Off: Output logic 0
Power Dissipation	450 mW for each channel	450 mW for each channel
Power Consumption	0.25 W	0.8 W

Table 4-16: *Comparison between ADAM-5056 and ADAM-5056D*

4.7 Relay Output Modules

ADAM-5060 relay output module

The ADAM-5060 relay output module is a low-cost alternative to SSR modules. It provides 6 relay channels, two of Form A and four of Form C.

ADAM-5060

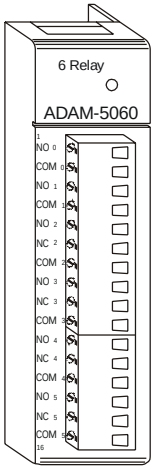


Figure 4-36: *ADAM-5060 module frontal view*

Application wiring

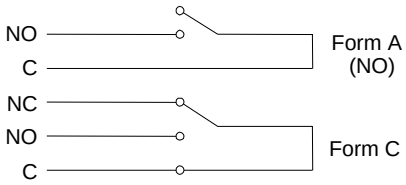


Figure 4-37: *Relay output*

Technical specifications of ADAM-5060

Points	6, two Form A and four Form C
Contact rating	AC: 125 V @ 0.6A; 250 V @ 0.3 A DC: 30 V @ 2 A; 110 V @ 0.6 A
Breakdown voltage	500 V_{AC} (50/60 Hz)
Relay on time (typical)	3 ms
Relay off time (typical)	1 ms
Total switching time	10 ms
Insulation resistance	1000 MΩ min. @ 500 V_{DC}
Power consumption	0.7 W

Table 4-17: *Technical specifications of ADAM-5060*

ADAM-5068 relay output module

The ADAM-5068 relay output module provides 8 relay channels of Form A. Switches can be used to control the solid-state relays.

ADAM-5068

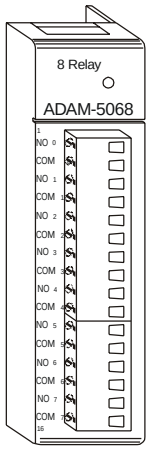


Figure 4-38: *ADAM-5068 module frontal view*

Application wiring

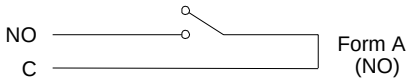


Figure 4-39: *Relay output*

Technical specifications of ADAM-5068

Points	8 Form A
Contact Rating	AC: 120 V @ 0.5 A DC: 30 V @ 1 A
Breakdown Voltage	500 V_{AC} (50/60 Hz)
Relay On Time (typical)	7 msec.
Relay Off Time (typical)	3 msec.
Total Switching Time	10 msec.
Power Consumption	2.0 W

Table 4-18: *Technical specifications of ADAM-5068*

4.8 Counter/Frequency Module

Overview

Compatible ADAM-5000 Series Main Units

ADAM-5080 is a 4-channel counter/frequency module designed to be implemented within the following Advantech ADAM-5000 series main units:

ADAM-5000/485 (with firmware Version A2.3 or above)
ADAM-5510 (with library Version V1.00 or above)
ADAM-5510/P31 (with I/O driver Version V1.00 or above)

Please make sure that the ADAM-5080 counter/frequency module is properly inserted into the compatible main units.

ADAM-5080 4-channel Counter/Frequency Module

With ADAM-5080 4-Channel Counter/Frequency Module, users can select either counter or frequency mode for data output. ADAM-5080 offers users a variety of very flexible and versatile applications such as below:

Counter Mode or Frenquency Mode

If you want to measure the number of input signals for totalizer function, you may use counter mode to measure quantities such as movement and flow quantity. Alternatively, you can also select frequency mode to calculate the instantaneous differential of quantities such as rotating speed, frequency or flow rate, and present them in specific engineering formats.

Up/Down or Bi-direction Function

When operating in counter mode, you can choose either the Up/Down function or the Bi-direction function for different application purposes. The counter will count up or down according to your applications. This counting function helps users obtain the most accurate data.

Alarm Setting Function

While in counter mode, you can set alarm status--Disable and Latch. If you want to disable it, you can select Disable.If Latch status is

selected, it means the Alarm status will be "latched" whenever the alarm being triggered. Once the alarm status being "latched," it will thereafter stay in that triggered state. Users will have to issue a "Clear Alarm Status" command to return the "latched" alarm status back to normal. Users can designate the high-limit value and low-limit value to regulate your alarm behavior through the utility program.

Digital Output Mapping

Users can either run the utility program or issue a "Set Alarm Connetion" command to designate a specific digital output module for the alarm signal to be sent through.

ADAM-5080 Module Diagram

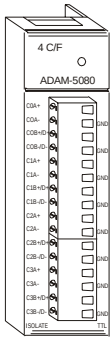


Figure 4-40: *ADAM-5080 Module*

ADAM-5080 Application Wiring

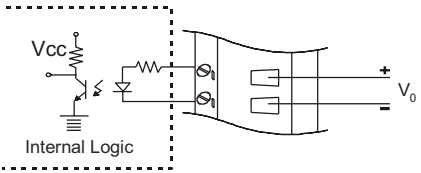


Figure 4-41: *Isolated Input Level*

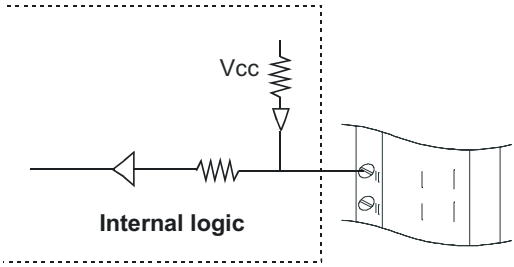


Figure 4-42: *TTL Input Level*

ADAM-5080 Counter/Frequency Mode Selection

Users can select Bi-direction, Up/Down Counter or Frequency option as shown in Figure 4.

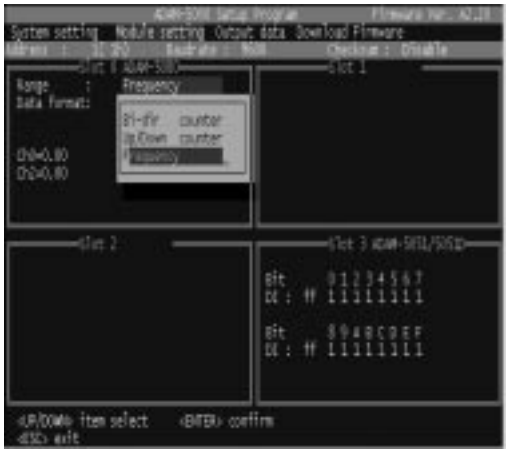


Figure 4-43: *Counter / Frequency Mode*

Note: *All four channels of ADAM-5080 will operate simultaneously in the mode you have selected. i.e. If you switch the ADAM-5080 to Counter Mode, all four channels will operate in Counter Mode.*

Features -- Counter Mode

Up/Down Counting

The Up/Down Counter Function offers two types of counting: Up Couting (increasingly) and Down Counting (decreasingly).

Up Counting : when C0A+ and C0A- sense any input signals, the counter counts up.

Down Counting : when C0B+ and C0B- sense any input signals, the counter counts down.

On receiving Up and Down signal simultaneously, the counter will not perform each specific counting accordingly, but will remain at the previous counting value, since these simultaneous signals won't have any effect on counting values.

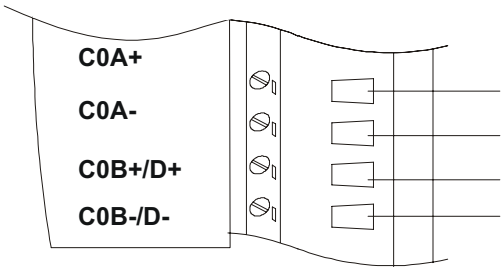


Figure 4-44: *Wiring for Up/Down Counting*

Note: *If you need only one type of counting, connect C0A+ and C0A- for Up Counting only; or connect C0B+ and C0B- for Down Counting only.*

Bi-direction Counting

For implementing Bi-derection Counting, you need to connect C0B+/D+ and C0B-/D- to implement the control function for Up/Down Counting.

Up Counting : when the input signal is within logic level "1", the counter value increases.

Down Counting : when the input signal is within logic level "0", the counter value decreases.

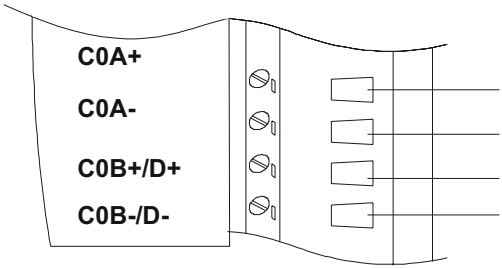


Figure 4-45: *Wiring for Bi-direction Counting*

Note: *If users select TTL mode and don't connect C0B+ C0B-, the counter value will increase. If users select Isolated mode and don't connect C0B+ C0B-, the counter value will decrease.*

Features -- Frequency Mode

If users want to select frequency mode, they can only utilize Up Counting type, and can only connect to C0A+ and C0A-.

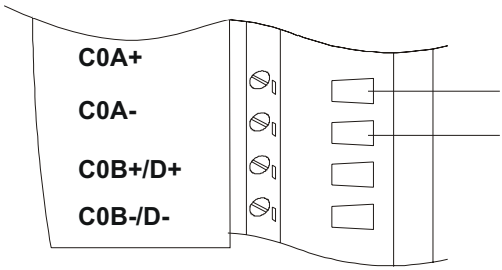


Figure 4-46: *Wiring for Frequency Mode*

Features -- Alarm Setting

According to your application purposes, you can run the utility program to set different limit values for High/Low Alarm.

Figure 4-47 *Setting Alarm Limit*

Setting Initial Counter Value

In oder to utilize the alarm function, users have to set a high-alarm limit value and/or a low alarm limit value, and a initial value to fulfill the requirements for a basic alarm setting.

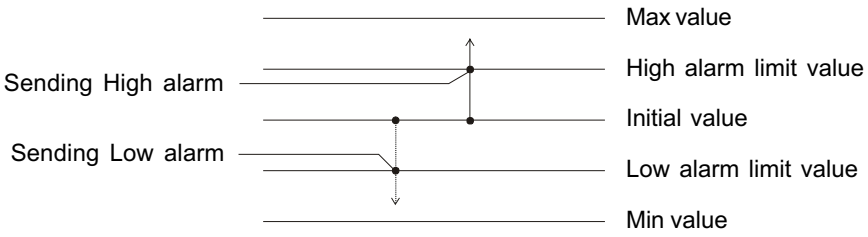


Figure 4-48: *Sending Alarm Signal (recommended settings)*

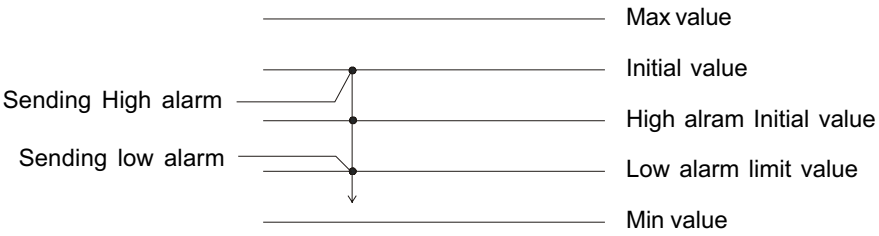


Figure 4-49: *Sending Alarm Signal (settings not recommended)*

Overflow Value

Overflow value is the number of times the counter value exceeds the Max/Min values you specified. When the counter value exceeds Maximum value, the overflow value increases; When the counter value goes under Minimum value, the overflow value decreases. Besides, when the counter value runs beyond the range of Max/Min value, it will continue counting from the initial value. Furthermore, if users want to check the counter value to see if it is higher or lower than the Max/ Min value, they can run the "$aaSi7" command to gain a readout of the overflow value.

Getting the Totalizer Value

If users want to get the actual counter value, a formula such as follows can facilitate an easy calculation from the initial counter value, overflow value and current counter value:

$$V_{tol} = \{|V_{ini} - V_{min\ (or\ } V_{max)}| + 1\} \times |V_{vf}| + |V_{ini} - V_{cur}|$$

V_{tol} : totalizer value

V_{ini} : initial counter value

V_{min} : min. couner value = 0 (fixed value)

V_{max} : max. counter value = 2^{32} = 4,294,967,295 (fixed value)

V_{vf} : overflow value

V_{cur} : current counter value

Example:

If the initial value =10, overflow value =4, min. value = 0, current counter value = 3, the totalizer value could be calculated as

totalizer value = {|10 - 0| + 1} x| 4 |+ |10 -3| = 51

Features--Digital Output Mapping

If users want to use Digital Output function, ADAM utility is available for setting specifically which module, channel or slot to receive the alarm signals.

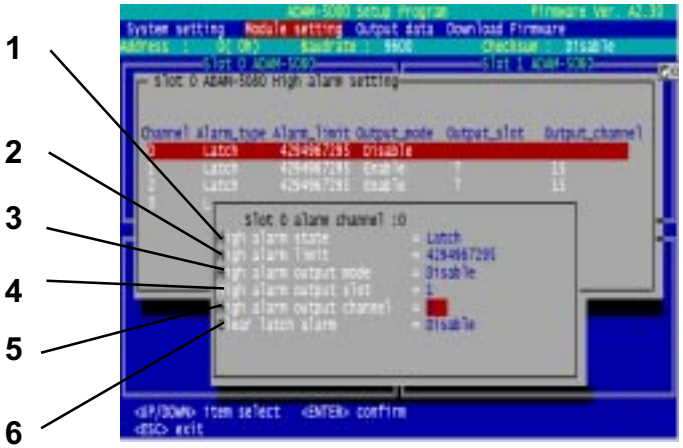


Figure 4-50: *Digital Output Mapping*

1: **High Alarm State**--Set Alarm state to "Latch" or "Disable".

2: **High Alarm Limt**--Set Alarm limit from 0 to 4,294,967,295.

3: **High Alarm Output Mode**--Enable or Disable D.O. Mapping.

4: **High Alarm Output Slot**--Users can select D.O Modules such as ADAM-5050, ADAM-5056, ADAM-5060, ADAM-5068 for the alarm signal to be sent through.

5: **High Alarm Output Channel**--Select Alarm Output Channel

6: **Clear Latch Alarm**--Users can Select "Enable" or "Disable" option. When selecting "Enable", the latch will be relieved and the alarm state will return to normal. Once the alarm state returns to normal, the **Clear Latch Alarm** will return to "Disable".

TTL/Isolated Input Level

According to your need, you can select either TTL or Isolated Input Level by setting the configuration for the jumpers. Select the proper jumper settings for either TTL or Isolated Input according to Figure Figure 10. Please note that you must configure all six jumpers to the correct configuration for proper function.

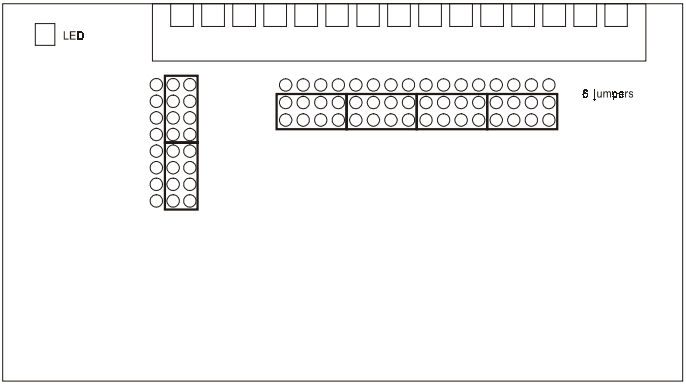
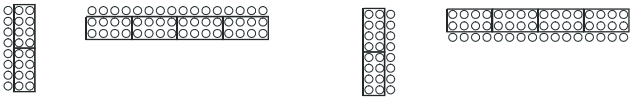


Figure 4-51: *Jumper Location on the ADAM-5080 Module*



TTL Input Level Isolated Input Level

Figure 4-52: *TTL/Isolated Input Level Selectting*

ADAM-5080 Technical Specifications

Channel	4
Input Frequency	0.3 ~ 1000 Hz max. (Frequency mode) 5000 Hz max. (Counter mode)
Input Level	Isolated or TTL level
Minimum Pulse Width	500 μ sec. (Frequency mode) 100 μ sec. (Counter mode)
Minimum Input Current	2mA (Isolated)
Isolated Input Level	Logic Level 0 : +1 V_{MAX} Logic Level 1 : + 3.5 V to 30 V
TTL Input Level	Logic Level 0 : 0 V to 0.8 V Logic Level 1 : 2.3 to 5 V
Isolated Voltage	1000 V_{RMS}
Mode	Counter (Up/Down, Bi-direction) Frequency
Programmable Digital Noise Filter	8 ~ 65000 μ sec

Table 4-19: *ADAM-5080 technical specifications*

5

Troubleshooting

Troubleshooting

This chapter provides a standard group of troubleshooting procedures for some of the more commonly encountered questions.

5.1 ADAM-5510/P31 and Advantech FX

5.1.1 No Fastlink when you are downloading programs

If you install Advantech FX in your system as the HMI (Human-Machine Interface) to monitor your system's operation, please keep this in mind: disable the Fastlink linkage between Advantech FX and Advantech Paradym-31 when downloading a program from the host PC to the ADAM-5510/P31. An attempt by Fastlink to convey information between Advantech FX and Advantech Paradym-31 may cause downloading failure.

5.1.2 No concurrent monitoring with Advantech Paradym-31

Advantech FX is a useful tool for monitoring system operations. Advantech Paradym-31 also has monitoring functions. However, simultaneous monitoring by Advantech Paradym-31 will substantially slow down the Advantech FX monitoring functions. The majority of the host PC resources will be allocated to the Advantech Paradym-31 monitor, so Advantech FX looks like it has come to a halt. Therefore, we recommend that you turn off Advantech Paradym-31 monitoring if you are using the Advantech FX monitoring functions.

5.2 Communication

5.2.1 Failure to communicate (host to ADAM-5510/P31)

If you have connected all wiring and cabling correctly, but the communication between the host and the ADAM-5510/P31 still fails, please check that the baud rate setting on ADAM-5510/P31 is correct. In ADAM-5510/P31, bit 7 and bit 8 of the DIP switch beside slot 3 are used to set the communication baud rate. This setting must be consistent with the setting in the Advantech Paradym-31 software on the host PC, otherwise communication will fail.

5.2.2 Failure to communicate (with ADAM-4520)

If the ADAM-4520 RS-232 to RS-422/485 converter is used to connect your host computer and ADAM-5510/P31, correct and consistent baud rate settings are required to allow the system to communicate normally. Please refer to Section 5.2.1.

5.2.3 Incorrect cable connections

In normal operation, you may use either the RS-232 port or the RS-485 port on the ADAM-5510/P31 to download programs from the host. A cross-over DB-9 cable is required for this operation. The downloading will not work if you use a straight-through DB-9 cable.

5.3 ADAM-5510/P31 kernel program

5.3.1 System doesn't work even when installation is correct

If you have correctly installed Advantech Paradym-31 on the host PC, connected the host and the ADAM-5510/P31, and made all necessary hardware settings, but you still cannot download programs, please check the system kernel using the following steps:

(1) Connect another host PC and the **programming port** of the ADAM-5510/P31 using a straight-through DB-9 cable. You can keep the previous connection unchanged.

(2) Execute the ADAM-5510/P31 utility program on this second host PC. Enter the **Terminal** option, and push "Reset" of ADAM-5510/P31.

(3) If the reset processes run normally, try to download the program from the first host PC with Advantech Paradym-31 again. It should work.

(4) If downloading still fails, or the reset of the ADAM-5510/P31 is abnormal, you have to re-write the kernel program to the ADAM-5510/P31 as described below.

(5) To re-write the kernel program to the ADAM-5510/P31, keep the connection as mentioned in (1) above. Execute the ADAM-5510/P31 utility program. Run the **Program** option.

(6) When the utility completes re-writing the kernel program to the ADAM-5510/P31, you can restart your work.

5.4 System Indicators

While the ADAM-5510/P31 system is in operation, the indicators on the front panel can help you diagnose problems with the system. The table below gives a quick reference of the ADAM-5510/P31's status associated with each status indicator.

State	PWR	RUN	COMM	Status of ADAM-5510/P31
1	ON	ON	ON	Powered on, but not running
2	ON	OFF	Regular Blinking	Searching the COM port for data transmission
3	ON	OFF	OFF	COM 1 is selected for data transmission
4	ON	OFF	ON	COM 2 is selected for data transmission
5	ON	OFF	Blinking	Under data transmission
6	ON	Regular Blinking	ON/OFF	Running; "ON means COM2 is selected, "OFF" means COM1 is selected.
7	ON	Regular Blinking	Blinking	Running and starting monitoring functions in Advantech Paradym-31

Table 5-1: *Diagnostics with LED system indicators*

5.5 Troubleshooting for Remote Download

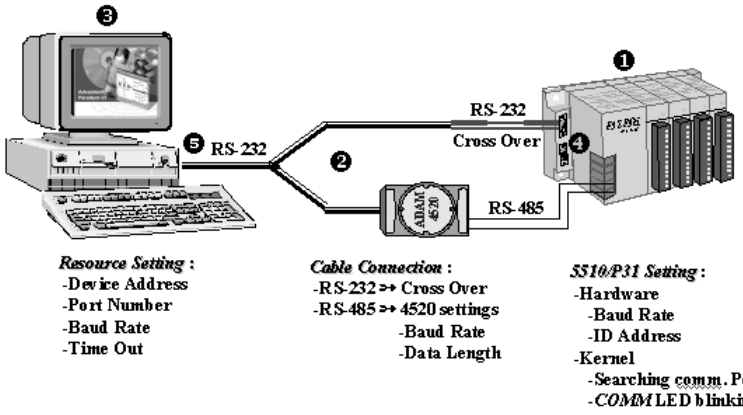


Figure 5-1: *Problem sources during downloading*

As the above diagram shows, problems during downloading can arise from five separate sources. These include

(1) ADAM-5510/P31 I/O settings and kernel (main unit) status

(2) Cable connections between ADAM-5510/P31 and ADAM-4520 and the host computer

(3) Paradym-31 resource settings

(4) Com Port of ADAM-5510/P31

(5) Com Port of the Host PC (Paradym-31)

The procedure to troubleshoot downloading errors follows the above sequence, and is presented below, step by step.

Step 1 : ADAM-5510/P31

➢ Hardware settings:

Please make sure that the hardware settings in the ADAM-5510/P31 are correct, including the ***ID address*** and the ***baud rate setting***. The ID

address is set using DIP1 to DIP6 on the DIP switch at the right side of ADAM-5510/P31's front panel. 'ON' equates to logic 1 and 'OFF' equates to logic 0. DIP7 and DIP8 are used for Baud Rate setting, as detailed in the following table.

Baudrate (bps)	9600	19200	38400	115200
Bit 7	OFF	ON	OFF	ON
Bit 8	OFF	OFF	ON	ON

The same settings must be set in the ADAM-5510/P31 and in the Paradym-31 software, otherwise the system will not work. Please see Step 3 below for instructions on setting the Paradym-31 software.

➢ Kernel programs:

The program ***ADAM_P31.COM*** must be running in ADAM-5510/P31 before downloading. First, make sure that:

1. ADAM_P31.COM is executing in Drive D.
2. There is enough space for downloading in Drive D.

The message "Searching communication port", as shown in the screen below (Figure 5-2) indicates that the ADAM-5510/P31 is ready to receive a command from Paradym-31.

Figure 5-2: *Opening screen, ADAM_P31.COM executing*

If any difficulties are encountered during this step, including unsuccessful booting, garbage code appearing on screen, or other obvious problems, please re-***program*** the ADAM-5510/P31 using its utility, then see whether the program will boot. After that, see whether ADAM_P31.COM or your own program will run.

➢ LED indicators :

Check the 'COMM' LED on the ADAM-5510/P31 front panel. If the COMM LED is blinking, the program ADAM_P31.COM is running and is searching for the Com Port on the ADAM-5510/P31 which will receive commands from Paradym-31 on the host computer. If a command enters COM1 (RS-232), the 'COMM' LED will be dark unless communication between ADAM-5510/P31 and Paradym-31 is in progress. If a command enters COM2 (RS-485) the 'COMM' LED will remain lit.

Step 2 : Cable connections

➢ COM1 (RS-232) : cross over

If you use COM1 to communicate between the ADAM-5510/P31 and Paradym-31 on the host computer, the cable wires must connect between the computer port and the ADAM-5510/P31 port as shown::

	Pin-2 (Rx) ⟷ Pin-3 (Tx)		
Paradym-31	Pin-3 (Tx) ⟷ Pin-2 (Rx)		*ADAM-5510/P31*
	Pin-5 (Gnd) ⟷ Pin-5 (Gnd)		

Of course, you can use a ***Null Modem Cable*** to connect the ADAM-5510/P31 and host computer (Paradym-31) directly via the RS-232 interface.

➢ COM2 (RS-485) :

If you adopt this connection scheme:

(host computer (Paradym-31) ⟷ ADAM-4520 ⟷ ADAM-5510/P31), you must check the baud rate and data length on the ADAM-4520. Please open the ADAM-4520 plastic shell and set the proper baud rate. Set the data length to 10.

Step 3 : Paradym-31 resource settings :

Use the command sequence below to open the Resource Configuration screen:

Paradym-31 ➔ [Edit] ➔ [Attributes] ➔ [Resource…]
In this screen, fill in values which match your hardware settings. We recommend you use the default value for the 'Time out' setting (999 ms).

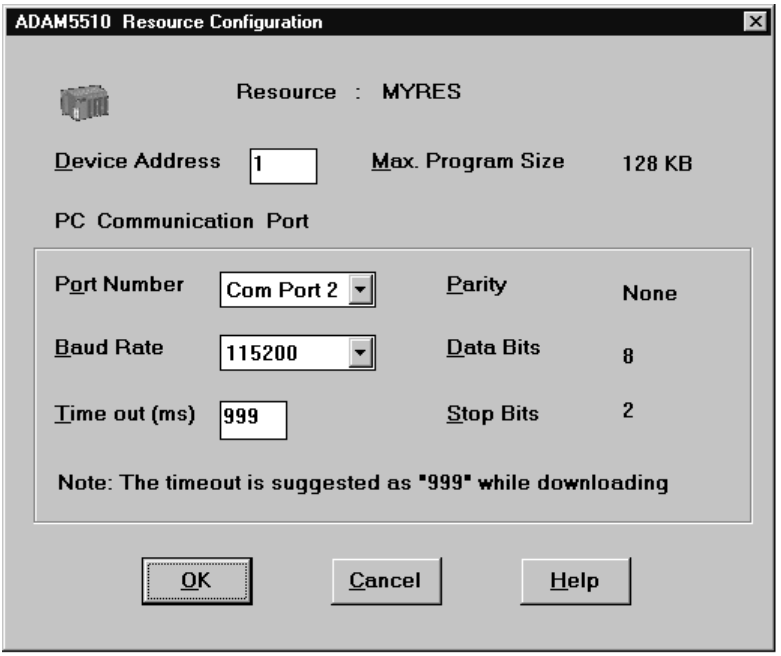


Figure 5-3: *Advantech Paradym-31 resource configuration screen*

Step 4 : Check com port of ADAM-5510/P31

Normally, one of the previous 3 steps will solve whatever problem you have downloading files from Paradym-31 to ADAM-5510/P31. However, it is possible that your trouble is caused by defective hardware. Check the hardware communication ports by executing ***CHECKCOM.EXE*** and follow the hints on the screen.

Step 5 : Check com port of host PC (Paradym-31)

After checking the communication ports on the ADAM-5510/P31, check the communication ports on the host PC. Use the program ***Hyperterminal*** (accessed by the following command sequence)

[Start] ➔ [Programs] ➔ [Accessories] ➔ [Hyperterminal])
Hyperterminal will check your RS-232 port via external loopback test (it will connect Pin-2 and Pin-3 together).

This concludes our troubleshooting procedure. What follows are some error messages and reference for using ADAM-5510/P31 and Paradym-31.

☞ **Download failed; error occurred while sending file name**

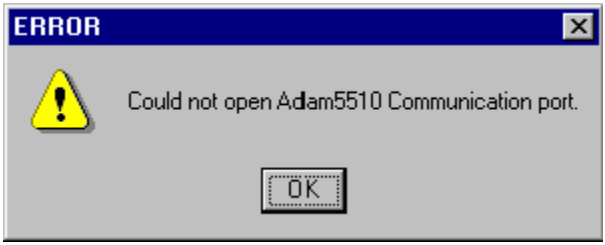
This message appears when it is impossible to build the communication link between the ADAM-5510/P31 and Paradym-31. It may be due to a wrong Com Port setting, improper ID and baud rate configurations, or an incorrect cable connection. Please follow Step1 to Step3 to correct the problem.

☞ **Download failed; error occurred while sending file size**

This error message implies that there is not enough space in Drive D of the ADAM-5510/P31 to receive and save your file. If you enter the terminal mode of ADAM-5510/P31's utility program, ADAM5510.EXE, you should see a corresponding message for your reference. Press [Ctrl] + [X] to terminate the kernel ADAM_P31 and try to free more space on Drive D by clearing unneeded files.

```
Set communication port to COM1.
Enable ADAM-5510/P31 WDT function.
ADAM-5510 P31 enter command mode.
Disk full !!!
```

☞ **Unable to download, start or stop the program from Paradym-31**



You may encounter one of the above error messages while trying to send messages from Paradym-31 to the ADAM-5510/P31. The cause of the problem could be a conflict at the Com Port. For example, if you are executing ADAM5510.EXE, and select a COM port, and at the same time select the same Com Port with Paradym-31, then you will get this kind of error message when you run the "Download', 'Start' or 'Stop' functions. You need to close other relevant programs if this problem occurs.

☞ **Unable to stop the program from Paradym-31**

This problem may result from a defective UDFB (User Defined Function Block). The defect will probably be in a UDFB you developed, and may be an infinite loop or something else that disables you from terminating the program under Paradym-31. Please follow the hints below.

Method 1:

1. Please remark or remove the ADAM_P31 command in autoexec.bat
2. Re-program the ADAM-5510/P31.
3. Enter terminal mode and delete the defective program
4. Run ADAM_P31 under Drive D

Method 2:

During booting of the ADAM-5510/P31, the boot program detects whether [Ctrl] + [X] key is pressed or not. That is to say, before AUTORUN executes, the ADAM-5510/P31 will check [Ctrl] + [X] first. If yes, then the original program will not be executed automatically and you will enter the ROM-DOS environment. You can take advantage of this fact to terminate the faulty program.

☞ **How to delete a program in ADAM-5510/P31 using Paradym-31**

Due to limited space, sometimes you will need to delete some files in the ADAM-5510/P31 to clear more space. Paradym-31 doesn't provide a function to do this directly, but we can use an indirect method to achieve this goal. Here is a tip to delete the program indirectly using Paradym-31:

1. Make sure that ADAM_P31 is waiting for a command from Paradym-31
2. Open the program targeted for deletion under Paradym-31. Please note that this is the program you want to delete inside the ADAM-5510/P31
3. Click the '*Download and Run'* icon to re-download this program
4. While downloading, click **[Cancel]** to stop downloading
5. Following this, the program inside the ADAM-5510/P31 will be deleted

Paradym-31 will completely clear the target program in ADAM-5510/P31 when you press the [Cancel] button during downloading.

A

Quick Start Example

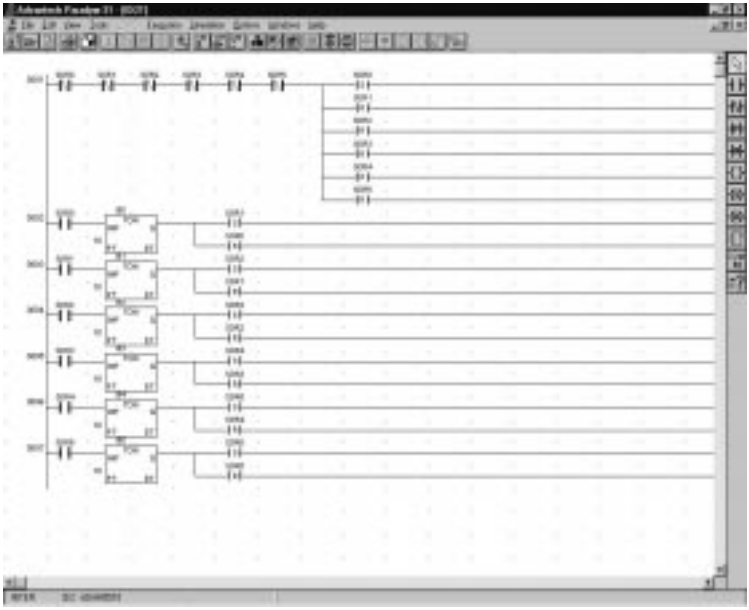


Figure A-1: *Example project to control ADAM-5060*

This chapter provides a description of the example project mentioned in Chapter 0.

A.1 Example: Relay Output

Figure A-1 is the screen demonstration of this example. This is a control program written in the ladder diagram control language.

1. When this program is started, only line 0001 is logically true (All 6 relays on ADAM-5060 have the same normal-close initial state). So relay 0 is set (to 1) and the other relays are reset (to 0).
2. Once the logic states of the 6 relays are re-adjusted according to the initial state, line 0001 turns false but line 0002 becomes true. The logic state of lines 0003 to 0007 remain unchanged.
3. Line 0001 will delay 10 seconds before changing logic states to be in accordance with the function block logic (S0R1 resets to 0)

4. Now relay 1 is closed and the others are open. So again the logic states change. Line 0002 is true and the others are false.
5. Following a 10-second delay, relay 2 is set and relay 1 is reset by itself.
6. The operation of this example is easily grasped: after the initial state, these six relays are turned on and off one by one, only one at a time. Each relay turns on in turn at 10-second intervals. This example demonstrates a sequential and cyclic switching process.

Quick Start Example

B

COM Port Register Structure

Register Structure

This appendix gives a short description of each of the module's registers. For more information please refer to the data book for the STARTECH 16C550 UART chip.

All registers are one byte in length. 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 a write.
BASE+0 Divisor latch bits 0 - 7 when DLAB=1
BASE+1 Divisor latch bits 8-15 when DLAB=1.
The two 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

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

bit 2: Number of stop bits
bit 3: Parity enable
bit 4: Even parity select
bit 5: Stick parity
bit 6: Set break
bit 7: Divisor Latch Access Bit (DLAB)

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

C

Data Formats and I/O Ranges

Data Formats and I/O Ranges

C.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 scientific 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 µV (three decimal places)
±100 mV, ±150 mV, ±500 mV	10 µV (two decimal places)
±1 V, ±2.5 V, ±5 V	100 µV (four decimal places)
±10 V	1 mV (three decimal places)
±20 mA	1 µA (three decimal places)
Type J and T thermocouple	0.01ºC (two decimal places)
Type K, E, R, S, and B thermocouple	0.1ºC (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 305.5ºC. The analog input module is configured for a Type J thermocouple whose range is 0ºC to 760ºC. 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)
```

C.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	±00.000	-10.000	1 mV	Reading/ 1000
	09h	±5 V	Engineering Units	+5.0000	±0.0000	-5.0000	100.00 µV	Reading/ 1000
	0Ah	±1 V	Engineering Units	+1.0000	±0.0000	-1.0000	100.00 µV	Reading/ 10000
	0Bh	±500 mV	Engineering Units	+500.00	±000.00	-500.00	10 µV	Reading/ 10
	0Ch	±150 mV	Engineering Units	+150.00	±000.00	-150.00	10 µV	Reading/ 100
	0Dh	±20 mA	Engineering Units	+20.000	±00.000	-20.000	1 µV	Reading/ 1000

C.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
	01h	±50 mV	Engineering Units	+50.000	±00.000	-50.000	1 µV	Reading/ 100
	02h	±100 mV	Engineering Units	+100.00	±000.00	-100.00	10 µV	Reading/ 100
	03h	±500 mV	Engineering Units	+500.00	±000.00	-500.00	10 µV	Reading/ 10
	04h	±1 V	Engineering Units	+1.0000	±0.0000	-1.0000	100 µV	Reading/ 10000
	05h	±2.5 V	Engineering Units	+2.5000	±0.0000	-2.5000	100 µV	Reading/ 10000
	06h	±20 mA	Engineering Units	+20.000	±00.000	-20.000	1 µA	Reading/ 1000
	07h	Not Used						

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
	0Fh	Type K Thermocouple 0° C to 1000° C	Engineering Units	+1000.0	+0000.0	0.1° C	Reading/ 10
	10h	Type T Thermocouple -100° C to 400° C	Engineering Units	+400.00	-100.00	0.1° C	Reading/ 10
	11h	Type E Thermocouple 0° C to 1000° C	Engineering Units	+1000.00	+0000.0	0.1° C	Reading/ 10
	12h	Type R Thermocouple 500° C to 1750° C	Engineering Units	+1750.0	+0500.0	0.1° C	Reading/ 10
	13h	Type S Thermocouple 500° C to 1750° C	Engineering Units	+1750.0	+0500.00	0.1° C	Reading/ 10
	14h	Type B Thermocouple 500° C to 1800° C	Engineering Units	+1800.0	+0500.0	0.1° C	Reading/ 10

C.4 Analog Input Ranges - ADAM-5017H

Range Code	Input Range	Data Formats	+Full Scale	Zero	-Full Scale	Displayed Resolution	Actual Value
00h	±10 V	Engineering	11	0	-11	2.7 mV	Reading/ 1000
		Two's Comp	0FFF	0	EFFF	1	
01h	0 ~ 10 V	Engineering	11	0	Don't care	2.7 mV	Reading/ 1000
		Two's Comp	0FFF	0	Don't care	1	
02h	±5 V	Engineering	5.5	0	-5.5	1.3 mV	Reading/ 1000
		Two's Comp	0FFF	0	EFFF	1	
03h	0 ~ 5 V	Engineering	5.5	0	Don't care	1.3 mV	Reading/ 1000
		Two's Comp	0FFF	0	Don't care	1	
04h	±2.5 V	Engineering	2.75	0	-2.75	0.67 mV	Reading/ 10000
		Two's Comp	0FFF	0	EFFF	1	
05h	0 ~ 2.5 V	Engineering	2.75	0	Don't care	0.67 mV	Reading/ 10000
		Two's Comp	0FFF	0	Don't care	1	
06h	±1 V	Engineering	1.375	0	-1.375	0.34 mV	Reading/ 10000
		Two's Comp	0FFF	0	EFFF	1	
07h	0 ~ 1 V	Engineering	1.375	0	Don't care	0.34 mV	Reading/ 10000
		Two's Comp	0FFF	0	Don't care	1	
08h	±500 mV	Engineering	687.5	0	-687.5	0.16 mV	Reading/ 10
		Two's Comp	0FFF	0	EFFF	1	
09h	0 ~ 500 mV	Engineering	687.5	0	Don't care	0.16 mV	Reading/ 10
		Two's Comp	0FFF	0	Don't care	1	
0ah	4 ~ 20 mA	Engineering	22	4.0	Don't care	5.3 µA	Reading/ 1000
		Two's Comp	0FFF	02E9	Don't care	1	
0bh	0 ~ 20 mA	Engineering	22	0	Don't care	5.3 µA	Reading/ 1000
		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.*

C.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 μA.

Example:

An analog output module on channel 1 of slot 0 in an ADAM-5000/P31 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>

C.6 Analog Output Ranges

Range Code (hex)	Output Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution
30h	0 to 20 mA	Engineering Units	20.000	00.000	5 μA
		% of Span	+100.00	+000.00	5 μA
		Hexadecimal Binary	FFF	000	5 μA
31h	4 to 20 mA	Engineering Units	20.000	04.000	5 μA
		% of Span	+100.00	+000.00	5 μA
		Hexadecimal Binary	FFF	000	5 μA
32h	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

C.7 ADAM-5013 RTD Input Format and Ranges

Range Code (hex)	Input Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution	Actual Value
20	100 Ohms Platinum RTD -100 to 100° C a=0.00385	Engineering Units	+100.00	-100.00	±0.1° C	Reading/ 100
21	100 Ohms Platinum RTD 0 to 100° C a=0.00385	Engineering Units	+100.00	+000.00	±0.1° C	Reading/ 100
22	100 Ohms Platinum RTD 0 to 200° C a=0.00385	Engineering Units	+200.00	+000.00	±0.2° C	Reading/ 100
23	100 Ohms Platinum RTD 0 to 600° C a=0.00385	Engineering Units	+600.00	+000.00	±0.6° C	Reading/ 100
24	100 Ohms Platinum RTD -100 to 100° C a=0.00392	Engineering Units	+100.00	-100.00	±0.1° C	Reading/ 100
25	100 Ohms Platinum RTD 0 to 100° C a=0.00392	Engineering Units	+100.00	+000.00	±0.1° C	Reading/ 100
26	100 Ohms Platinum RTD 0 to 200° C a=0.00392	Engineering Units	+200.00	+000.00	±0.2° C	Reading/ 100

Table C-1: *Resolution according to input range*

Note: *See next page for table continuation.*

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	Reading/ 100
28	120 Ohms Nickel RTD -80 to 100° C	Engineering Units	+100.00	-80.00	±0.1° C	Reading/ 100
29	120 Ohms Nickel RTD 0 to 100° C	Engineering Units	+100.00	+000.00	±0.1° C	Reading/ 100

D

Performance

Performance

D.1 Performance

The ADAM-5510/P31 system hardware is designed to work with Advantech Paradym-31 software to provide system solutions. The interactive operation between ADAM-5510/P31 hardware and Advantech Paradym-31 software is sophisticated. Performance evaluation results are presented below for your reference. These may be useful to you in planning your use of ADAM-5510/P31 in your applications.

D.1.1 ADAM-5510/P31 standalone

When ADAM-5510/P31 is used alone, its performance is determined by how fast the ADAM-5510/P31 and the installed I/O modules interact with Advantech Paradym-31. The following subsections show representative operational statistics of different I/O modules recorded under test conditions.

To measure the throughput performance of each ADAM I/O module, we used the digital outputs of an ADAM-5056 module as an input trigger and as an input end-point signal to the module to be tested. The test function block diagrams for each I/O module were as follows.

D.1.1.1 ADAM-5013

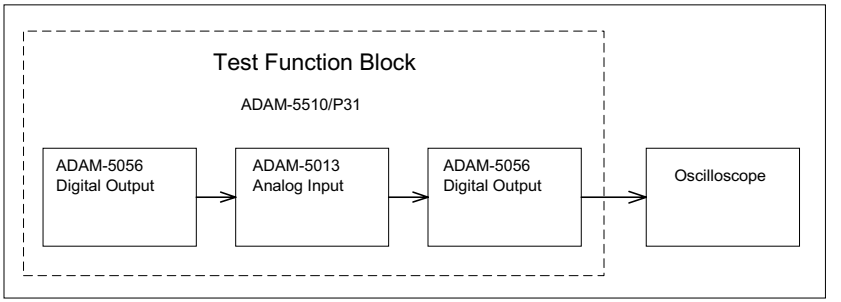
Input channels	Response time(ms)	Remark
1	0.379	
2	0.447	
3	0.515	
4	0.583	
5	0.657	
6	0.759	
7	0.795	
8	0.867	
9	0.931	

Table D-1: *ADAM-5013 channel response time*

Note 1: *Response times increase for greater numbers of channels in a given network. If nine channels are active in a network, the average response time of each channel can be approximately 0.931 ms.*

Note 2: *Each ADAM-5013 module updates all of its active channels concurrently every 100 ms. This updating process takes 5.51 ms for the entire module.*

ADAM-5013 Test Function Block Diagram



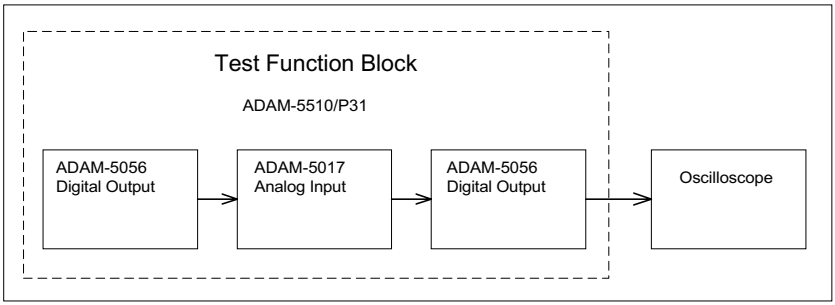
D.1.1.2 ADAM-5017

Input channels	Response time(ms)	Remark
1	0.368	
2	0.429	
3	0.463	
4	0.563	
5	0.631	
6	0.699	
7	0.771	
8	0.831	
9	0.919	
10	0.985	
11	1.059	
16	1.389	
17	1.449	
18	1.517	
24	1.939	

Table D-2: *ADAM-5017 channel response time*

Note 1: Each ADAM-5017 module updates all of its active channels concurrently every 100 ms. This updating process takes 4.8 ms for the entire module.

ADAM-5017 Test Function Block Diagram



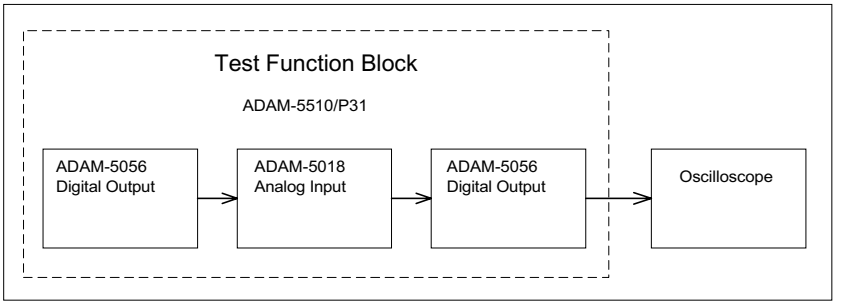
D.1.1.3 ADAM-5018

Input channels	Response time(ms)	Remark
1	0.395	
2	0.458	
3	0.534	
4	0.611	
5	0.679	
6	0.747	
7	0.815	
8	0.889	
14	1.308	
15	1.378	
21	1.838	

Table D-3: *ADAM-5018 channel response time*

Note 1: Each ADAM-5018 module updates all of its active channels concurrently every 100 ms. This updating process takes 4.7 ms for the entire module. In addition, the CJC of each ADAM-5018 is updated every 30 seconds. This updating process takes 370 ms.

ADAM-5018 Test Function Block Diagram

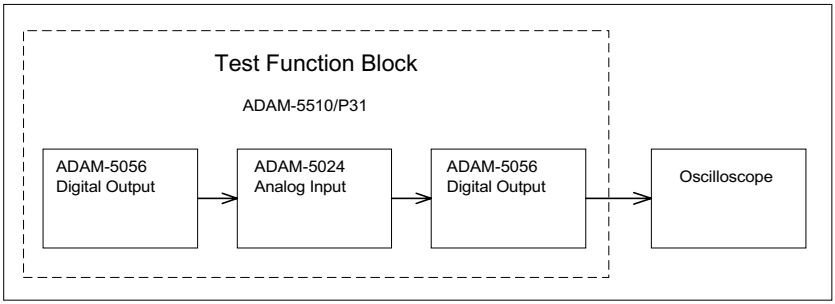


D.1.1.4 ADAM-5024

Input channels	Response time(ms)	Remark
1	1.146	
2	2.056	
3	2.956	
4	3.855	
5	4.637	
6	5.347	
7	6.109	
8	6.832	
9	7.572	
10	8.388	
11	9.175	
12	9.881	

Table D-4: *ADAM-5024 channel response time*

ADAM-5024 Test Function Block Diagram



D.1.1.5 ADAM-5050

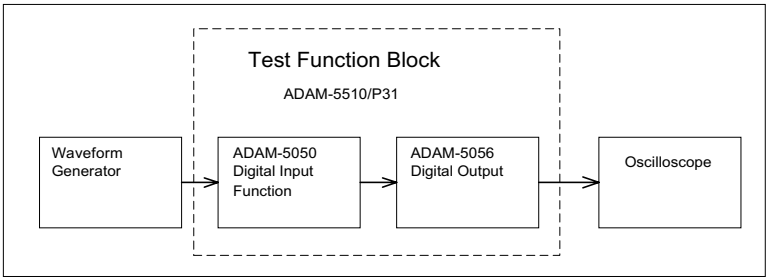
Input channels	Response time(ms)	Remark
1	0.389	
2	0.423	
3	0.515	
4	0.602	
5	0.694	
6	0.785	
7	0.874	
8	0.966	
9	1.561	
10	1.146	
16	1.673	
17	1.774	
32	3.13	

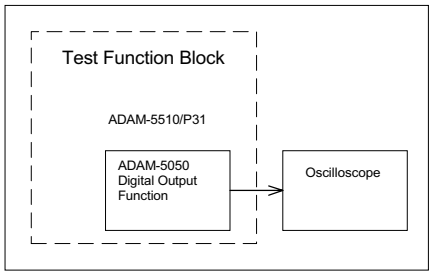
Table D-5: *ADAM-5050 channel response time (input)*

Input channels	Response time(ms)	Remark
1	0.2271	
2	0.2660	
3	0.3143	
4	0.3722	
5	0.4134	
6	0.4728	
7	0.5336	
8	0.5727	
9	0.6335	
10	0.6998	
16	1.006	
32	1.832	
48	2.693	
64	3.535	

Table D-6: *ADAM-5050 channel response time (output)*

ADAM-5050 Test Function Block Diagram



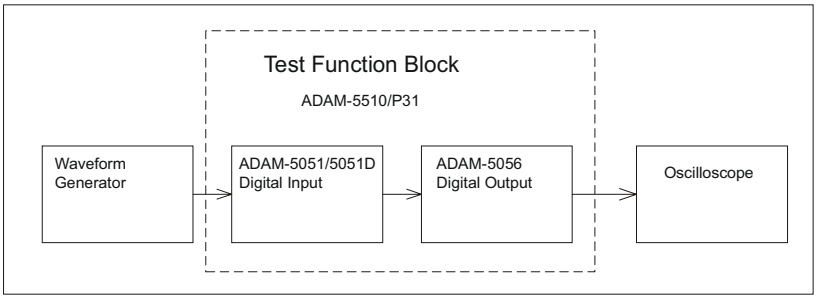


D.1.1.6 ADAM-5051/5051D

Input channels	Response time(ms)	Remark
1	0.309	
2	0.399	
3	0.489	
4	0.577	
5	0.667	
6	0.756	
7	0.846	
8	0.936	
9	1.132	
10	1.116	
16	1.582	
17	1.686	
32	3.068	

Table D-7: *ADAM-5051/5051D channel response time*

ADAM-5051/5051D Test Function Block Diagram

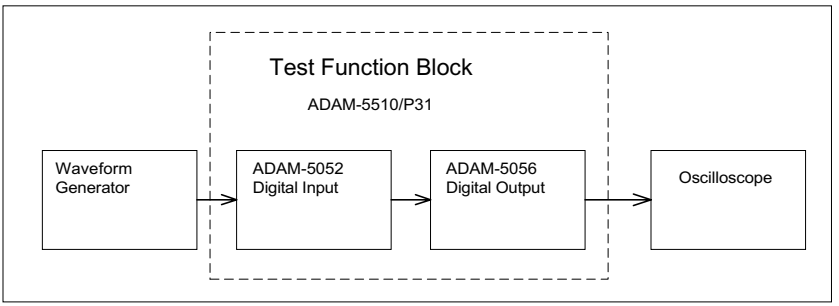


D.1.1.7 ADAM-5052

Input channels	Response time(ms)	Remark
1	0.303	
2	0.392	
3	0.483	
4	0.570	
5	0.662	
6	0.755	
7	0.843	
8	0.930	
9	1.016	
15	1.556	
16	1.646	

Table D-8: *ADAM-5052 channel response time*

ADAM-5052 Test Function Block Diagram

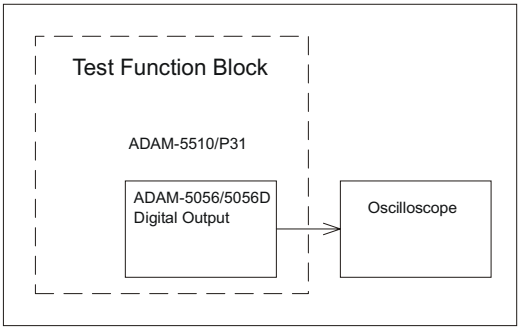


D.1.1.8 ADAM-5056/5056D

Input channels	Response time(ms)	Remark
1	0.2351	
2	0.2738	
3	0.3355	
4	0.3723	
5	0.4355	
6	0.4926	
7	0.5345	
8	0.5947	
9	0.6525	
10	0.6930	
16	0.9735	
32	1.836	
48	2.696	
64	3.532	

Table D-9: *ADAM-5056/5056D channel response time*

ADAM-5056/5056D Test Function Block Diagram

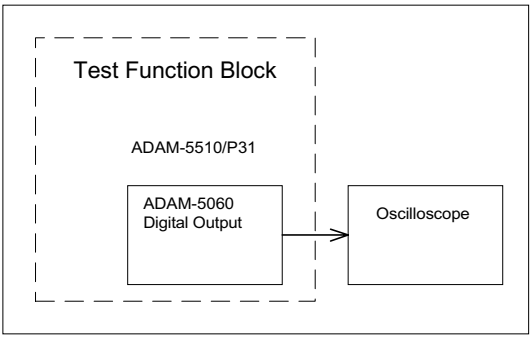


D.1.1.9 ADAM-5060

Input channels	Response time(ms)	Remark
1	0.192	
2	0.243	
3	0.293	
4	0.343	
5	0.395	
6	0.445	
7	0.497	
12	0.751	
13	0.799	
18	1.055	
24	1.357	

Table D-10: *ADAM-5060 channel response time*

ADAM-5060 Test Function Block Diagram

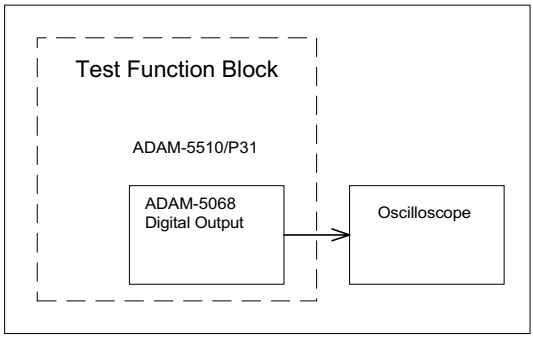


D.1.1.10 ADAM-5068

Input channels	Response time(ms)	Remark
1	0.192	
2	0.243	
3	0.294	
4	0.345	
5	0.395	
6	0.445	
7	0.497	
8	0.546	
16	0.913	
24	1.351	
32	1.748	

Table D-11: *ADAM-5068 channel response time*

ADAM-5068 Test Function Block Diagram

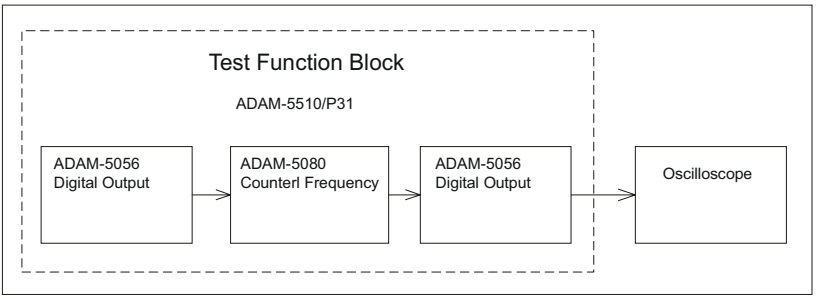


D.1.1.11 ADAM-5080

Input channels	Response time(ms)	Remark
1	0.376	
2	0.448	
3	0.521	
4	0.594	
5	0.658	
6	0.736	
7	0.805	
8	0.883	
12	1.160	
16	1.472	
32	1.748	

Table D-12: *ADAM-5080 channel response time*

ADAM-5080 Test Function Block Diagram



D.1.2 ADAM-5510/P31 in network

ADAM-5510/P31 can be used in multidrop networks, such as the example network shown in Figure 3-3.

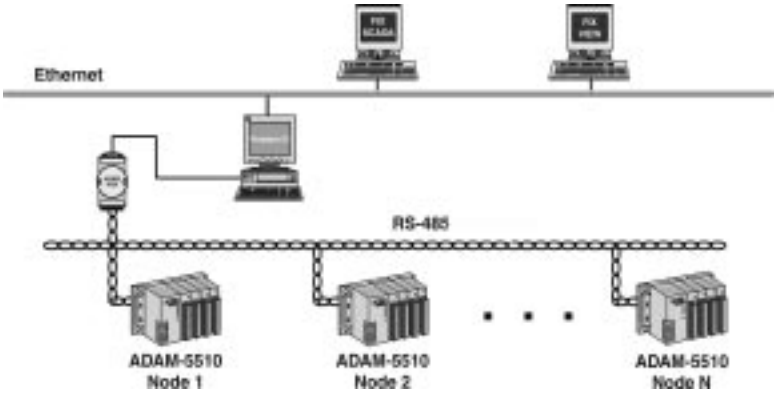


Figure D-1: *ADAM-5510/P31 Networking*

D.1.2.1 Analog input modules

Testing conditions:

(1) ADAM-5510/P31: 3 pieces

(2) ADAM-5018: 4 pieces in each ADAM-5510/P31

(3) Advantech Paradym-31 v4.1

Testing results:

Response time for each measured signal:

731.75 ms +/- 32.70 ms (95% confidence interval)

maximum response time: 1232 ms

D.1.2.2 Digital input modules

Testing conditions:

(1) ADAM-5510/P31: 5 pieces

(2) ADAM-5050: 4 pieces in each ADAM-5510/P31

(3) Advantech Paradym-31 v4.1

Testing results:

Response time for each measured signal:

191.61 ms +/- 12.25 ms (95% confidence interval)

maximum response time: 361 ms

D.2 Remote I/O Modules Performance

ADAM-5510/P31 Remote I/O function provides network expansion capability with many alternatives. In order for you to know more precisely our superior performances in many aspects, we have here listed four performance indicators for your reference:

- Each ADAM-4000 module performance
- Memory performance
- Connecting 16 A I/O Modules performance
- Connecting 32 Modules performance

D.2.1 Each ADAM-4000 Module Performance

When used a standalone device, ADAM-5510/P31's performance depends solely on how fast itself and the installed I/O modules interact with Advantech Paradym-31. The AI/O Module Performance can be judged by the response time required for a specific Function Block to complete its execution. The following subsections show representative operational statistics of different I/O modules recorded under testing conditions. The test function block diagrams are provided as following.

A ladder is written as below:

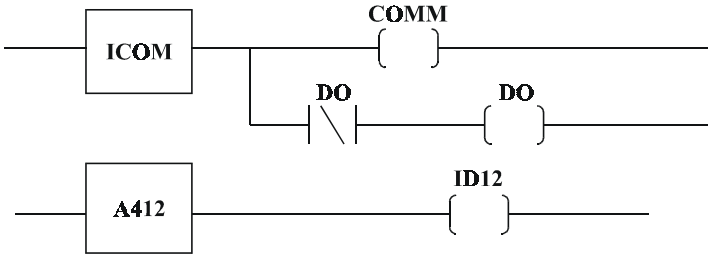


Figure D-2: *Testing Ladder Flow Chart*

When ID12 is true, the communication is successful.

The coil DO flash ON and OFF in each scan.

The memory for the 1st rung occupies 41300 bytes.

Use an oscillator to detect the scanning time between each pulse.

D.2.2 Memory Performance

Memory performance can be judged by the memory left after compiling a ADAM-5510/P31 Remote I/O Function Block executable. Its purpose is to let users know how much memory is still available for the purpose of managing the whole system. The ADAM-5510/P31 is equipped with 128 K bytes memory space for executing your application program. If the memory requirement for the application surpasses the memory still available, the program is unable to execute. The testing results are the following.

Block: The number of Function Blocks.

Block 0: There is no function block but signal input and signal output only.

Block 3: There are three function blocks.

Scan (ms) : The time for executing function blocks

Memory byte: The memory left after the function block being compiled.

Mem. Increas: The memory increases after adding an additional function block.

D.2.2.1 ADAM-4011/4011D

Block	Scan (ms)	Memory byte	Mem. increas
0	1.33	41300	
1	5.6	58158	16858
2	13.4	58238	80
3	19.7	58814	576
4	26.1	58894	80
Average	5.66		

Table D-13: *ADAM-4011/4011D Function Block Response Time*

D.2.2.2 ADAM-4012

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	5.5	58092	16792
2	13.2	58172	80
3	19.5	58748	576
4	26.0	58844	96
Average	5.58		

Table D-14: *ADAM-4012 Function Block Response Time*

D.2.2.3 ADAM-4013

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	5.95	58236	16936
2	11.75	58316	80
3	17.4	58892	576
4	23	58988	96
Average	5.15		

Table D-15: *ADAM-4013 Function Block Response Time*

D.2.2.4 ADAM-4017

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	6.65	58188	16888
2	13	58252	64
3	20.45	58844	592
4	26.8	58924	80
Average	5.97		

Table D-16: *ADAM-4017 Function Block Response Time*

D.2.2.5 ADAM-4018

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	7.265	58188	16888
2	14	58252	64
3	21.35	58844	592
4	28.35	58924	80
Average	6.42		

Table D-17: *ADAM-4018 Function Block Response Time*

D.2.2.6 ADAM-4021

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	9.00	58554	17254
2	17.65	58650	96
3	26.40	59226	576
4	34.35	59322	96
Average	8.11		

Table D-18: *ADAM-4021 Function Block Response Time*

D.2.2.7 ADAM-4050

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	5.80	43138	1838
2	11.40	43254	116
3	16.85	43370	116
4	22.05	43948	578
Average	4.96		

Table D-19: *ADAM-4050 Function Block Response Time*

D.2.2.8 ADAM-4052

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	7.80	42716	1416
2	14.40	42784	68
3	21.00	42900	116
4	27.35	42984	84
Average	6.52		

Table D-20: *ADAM-4052 Function Block Response Time*

D.2.2.9 ADAM-4053

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	7.85	42914	1614
2	14.5	43014	100
3	21	43082	68
4	27.8	43182	100
Average	6.57		

Table D-21: *ADAM-4053 Function Block Response Time*

D.2.2.10 ADAM-4060

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	5.85	42672	1372
2	12.95	42756	84
3	16.65	42840	84
4	22.35	42940	100
Average	5.17		

Table D-22: *ADAM-4060 Function Block Response Time*

D.2.2.11 ADAM-4080/4080D

Block	Scan (ms)	Memory byte	Mem. increase
0	1.33	41300	
1	7.265	43694	2394
2	14	43810	116
3	21.35	44438	628
4	28.35	44538	100
Average	6.42		

Table D-23: *ADAM-4080/4080D Function Block Response Time*

D.2.3 Connecting 16 AI/O Modules Performance

Since ADAM-5510/P31 Remote I/O function can simultaneously be connected to a maximum of 16 Analog Input/Output ADAM-4000 modules, you can select among them for performance testing.

The following example illustrates the performance for connecting 16 AI/O modules.

ADAM-4013
ADAM-4017 * 2
ADAM-4018 * 12
ADAM-4021

We configure functional blocks for all channels.

Result

The memory performance: 81,678 byte.

The scanning time: 0.822 second.

D.2.4 Connecting 32 Modules Performance

Since ADAM-5510/P31 Remote I/O function can simultaneously be connected to a maximum of 32 ADAM-4000 modules(At most 16AI/O modules), you can select among them for performance testing.

The following example illustrates the performance for connecting 32 modules.

ADAM-4011
ADAM-4012
ADAM-4013 * 3
ADAM-4017 * 2
ADAM-4018 * 15
ADAM-4021
ADAM-4050 * 2
ADAM-4052
ADAM-4053
ADAM-4060 * 2
ADAM-4080 * 3

We configure functional blocks for all channels.

Result

Memory performance: 106,676 byte.

Scanning time: 1.635 second.

D2.5 Other Performance

We also test the performance of other function blocks for your reference.

Testing Modules

ADAM-5510/P31 * 1

ADAM-5056 * 1

Baud Rate: 38400 bps

D2.5.1 Element Performance

Element	RAM (bytes)	Response time(ms)
( )	16	0.0384
| |	32	0.0225
| \ |	32	0.0213
(S)	16	0.0379
(R)	16	.00376

D2.5.2 Function Block Performance

Block	RAM (bytes)	Response time(ms)
CTU	116 (2nd : 100)	0.1142
TON	68	0.1249
EQ	244 (2nd : 84)	0.0809
GT	244 (2nd : 84)	0.0878
RGT	14250 (2nd : 96)	0.2987
ADD	516 (2nd : 106)	0.0988
RADD	14316 (2nd : 96)	0.3539
MOVE	20	0.0831
ITOR	14260 (2nd : 96)	0.2137
SQRT	16584 (2nd : 96)	0.8861
AND	180 (2nd : 52)	0.0489
CALC	15332 (2nd : 592)	0.2134
CMP	680 (2nd : 88)	0.0966
SCL	14312 (2nd : 128)	0.8398
PID	16196 (2nd : 240)	4.604

Note: (2nd: 100) means that memory will increase 100 byte when you add second block.

E

RS-485 Network

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/P31 systems are 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/P31 systems. 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.

E.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/P31 systems 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.

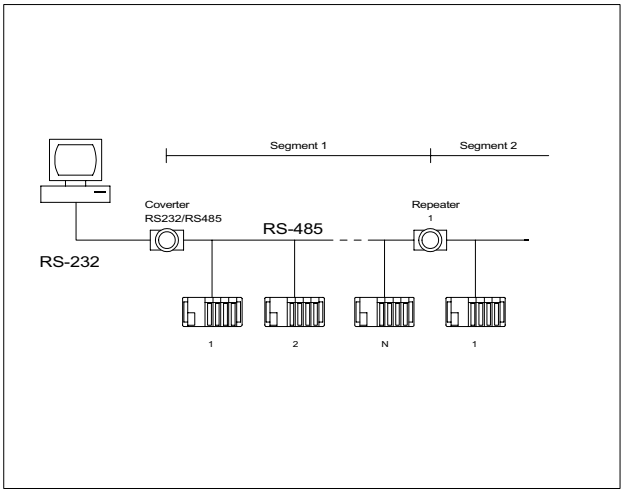


Figure E-1: *Daisychaining*

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.

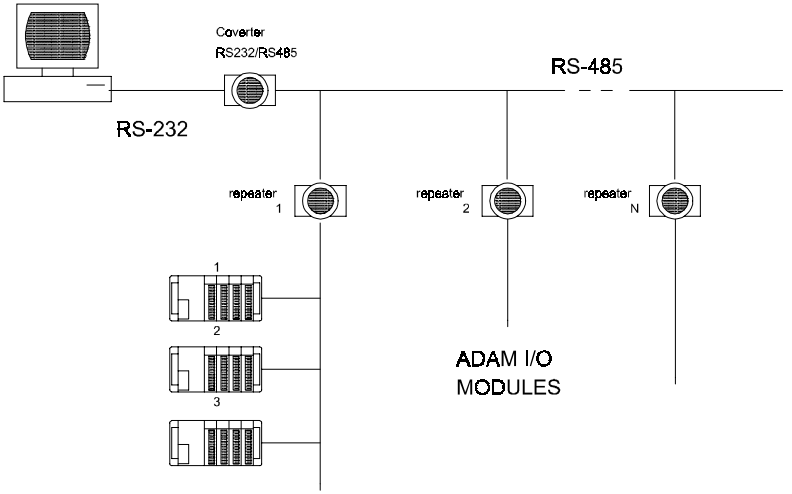


Figure E-2: *Star structure*

Random

This is a combination of daisychain and hierarchical structure.

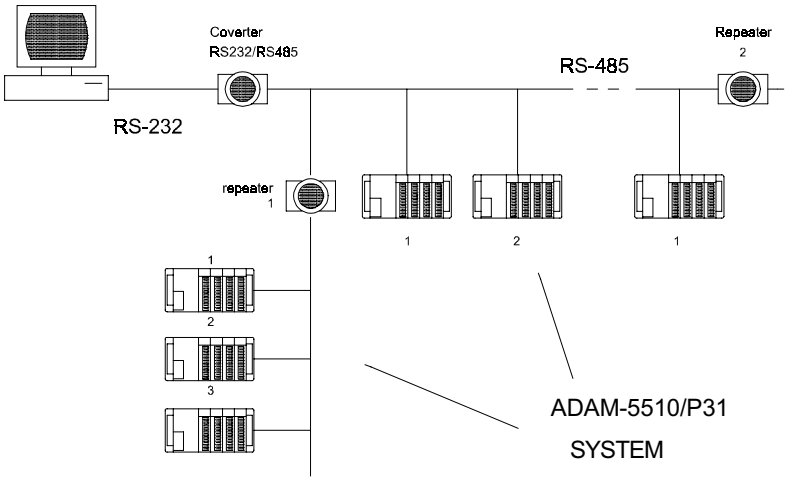


Figure E-3: *Random structure*

E.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.

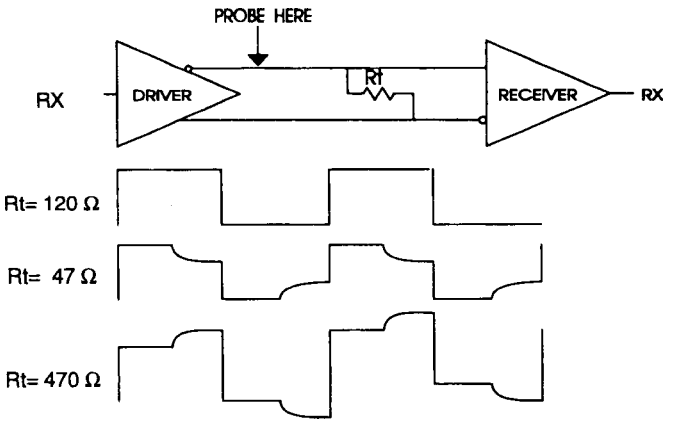


Figure E-4: *Signal distortion*

The value of the resistor should be a 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 to the resistor impedance should equal the characteristic impedance of the line.

Example:

Each input of the receivers has a nominal input impedance of 18 kΩ feeding into a diode transistor- resistor biasing network that is equivalent to an 18 kΩ 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 E-5 below).

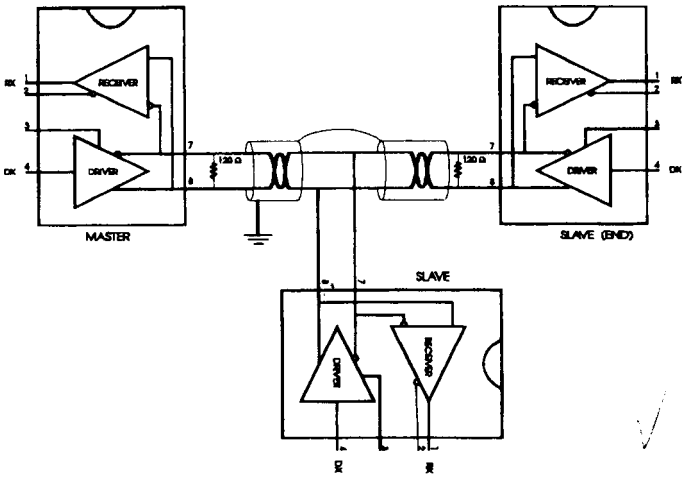


Figure E-5: *Termination resistor locations*

Because each input is biased to 2.4 V, the nominal common mode voltage of balanced RS-485 systems, the 18 kΩ 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 36kΩ 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 Ω 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_o.

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.

E.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.

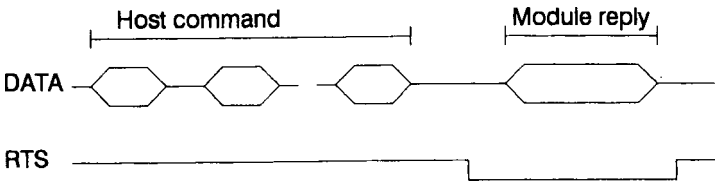


Figure E-6: *RS-485 data flow control with RTS*

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.

F

ADAM-4000/5000 System Grounding Installation

F. 1 Power Supplies For relevant wiring issues, please refer to the following scheme :

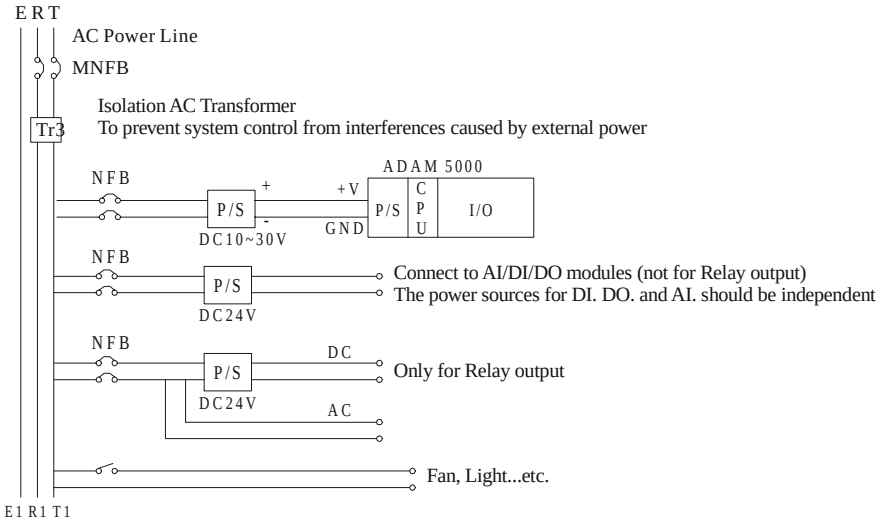


Figure F-1: Grounding Scheme

F.2 Grounding Installation

- The outer case for the module is made of iron and fitted with a fan and convection holes with filters.
- If possible, wiring should be connected to the module through an external terminal block (T/B) to avoid external wires directly getting into the inside of the module. Its advantages are (1) a clear demarcation for external/internal wiring responsibility, (2) wire numbering can be arranged in an explicit and concise manner, and (3) an easy diagnostics for the wiring problems and a more aesthetical layout plan.

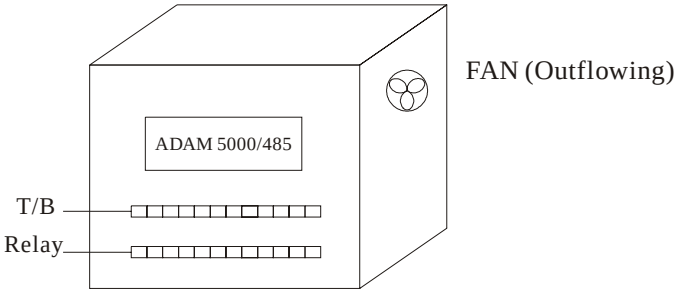


Figure F-2: External Terminal Block and Fan

F.3 External DI, DO, AI, AO Wiring Reference

- The common end of some D.I. and D.O. modules is connected with the GND of ADAM-5000/4000 system. Therefore, the common end of external DI and DO signal wiring should not be grounded with those on-site machineries.
- Within an environment that is subject to multiple interferences, it is advised that a higher voltage level, e.g. a voltage above 12 V_{DC}, should be used to ward off possible interferences.
- The signal wire for AI and AO must be of a shielded type, i.e. with surrounding copper mesh and aluminum foil for proper shielding. For the specification of the signal wires, please refer to User's Manual.

F.4 Requirements for RS-485 signal wires

- Use RS-485 twisted-pair as signal wire. The quality of signal transmission can be improved in proportion with the number of twists per foot of the wire. If the wire has more twists per foot, the signal quality could be better.
- Twisted -pair wire compliant with EIA-422 or EIA-485 standards, which contains 24AWG thin copper conductor with copper mesh and aluminum foil for shielding.

- The shielding material of the wires should only be grounded on one end as illustrated in the following diagram. This is to avoid ground loop.

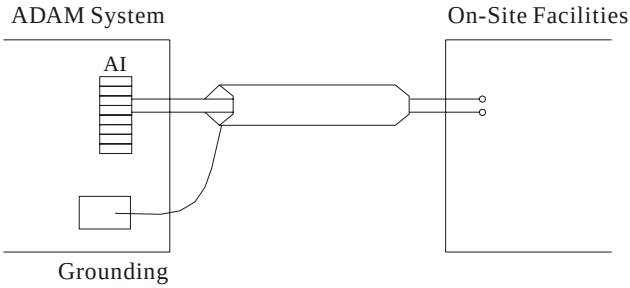


Figure F-3: Grounding for on-site facilities and ADAM-5000/4000 Systems

- Since shielded twisted-pair has been adopted for signal wires, only DATA+ and DATA- of ADAM-5000 system should be connected. And the shielding materials should be treated in the same manner as with AI and AO signal wires, i.e. it should be connected to Ground on only one end through the COM port on computer or on ADAM-5000 system such as illustrated in the following diagram:

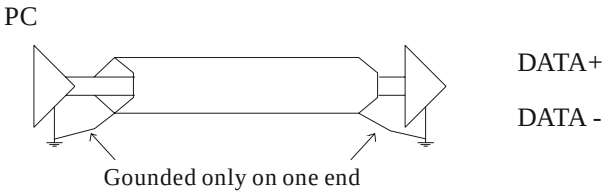


Figure F-4: Grounding for signal wires

F.5 Grounding reference (Ground bar for the factory environment should have a standard resistance below 5 Ω)

Since ADAM-4000 / 5000 system comes with a plastic outer case with DC power supply, its grounding procedure should be done according to the following points:

- Power supply : The E terminal of the external power supply should be connected with the panel.
- The outer case of panel should be fixed with two grounding bus. Connect the ground of power (E-terminal) to the grounding bus with shortest path. Use single contact for connection.
- Another grounding bus is for connection with AI and AO shielded signal wires. While AI and AO signal wires enter inside the panel, the shielding materials is stripped off and its copper mesh should be entangled together (There is no effect leaving alone any single wire strand). Connect to grounding bus in the shortest path, and then connect the two grounding buses in a way such as the following illustration: (Please note that wire length should not be too long, otherwise it will compromise the quality of the twisted-pair wires)

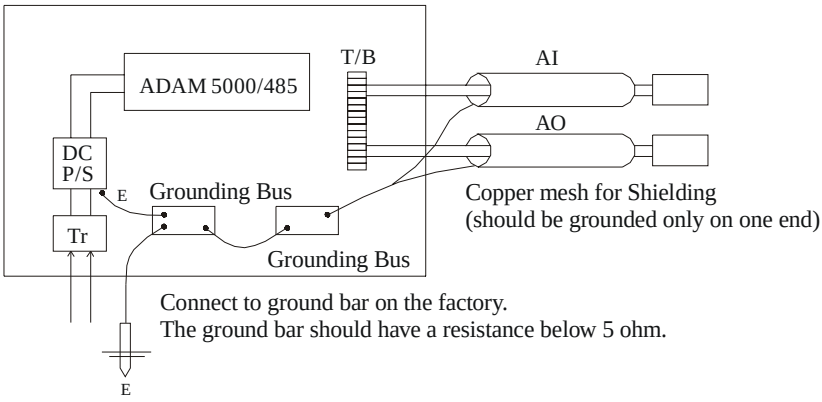


Figure F-5 : Grounding Reference

F.6 Some Suggestions on Wiring Layout

- Since communication is carried through high-frequency signals, it is advisable that the wiring layout should be paid due attention to. Any wire should best remain as a single integral wire. Nevertheless, if you should need another wire for extended connection, it is suggested that you use soldering iron to connect the disparate wires together. The parts of copper mesh should be soldered together too.
- Generally, factories will layout the power lines, control lines, signal lines and communication lines within separate conduits. Since communication lines and signal lines are most susceptible to interference, you should consider avoid laying them parallel with any power line in close distance. Nevertheless, if they should remain parallel with the power line, just keep a proper distance between them. Basically, an AC current up to 2A should require a distance of 50 cm. The bigger the current or voltage, the longer the distance is required.
- For communication lines and AI/O signal lines, it is suggested that they should be carried within Zinc-gilded tube for crush resistance. Meanwhile, one end of the zinc-gilded tube should be connected to factory facilities and grounded together.
- While planning your wire layouts, you should consider layouts that can save wire length.

G

Grounding Reference

Grounding Reference

Field Grounding and Shielding Application

Overview

Unfortunately, it's impossible to finish the system integration task at a time. We always meet some troubles in field. Such as communication network or system isn't stable, noise influence, and equipment is damaged or hungs up by thunders. However, the most possible issue is just the improper wiring; ie, grounding and shielding. As you know the 80/20 rule in our life: we spend 20% time for 80% works, but 80% time for left 20% works. So to system integration, we paid 20% cost for Wire / Cable and 80% cost for Equipment. However, 80% reliability depends on Grounding and Shielding. In a word, we just need to pay 20% investment and work on those two issues to get a high reliable system.

This application note will bring you some concepts about field grounding and shielding. Below topics will be illustrated in 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

G.1 Grounding

1.1 The 'Earth' for reference

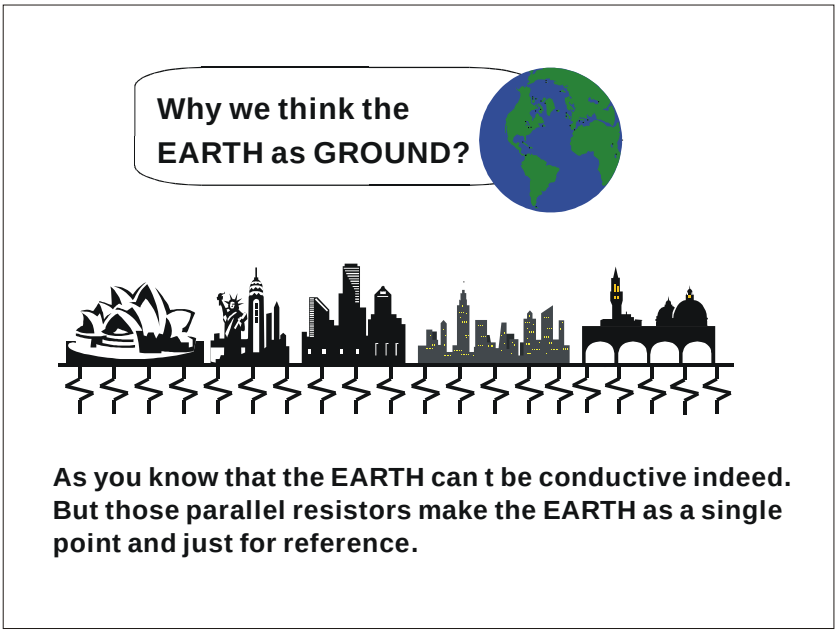
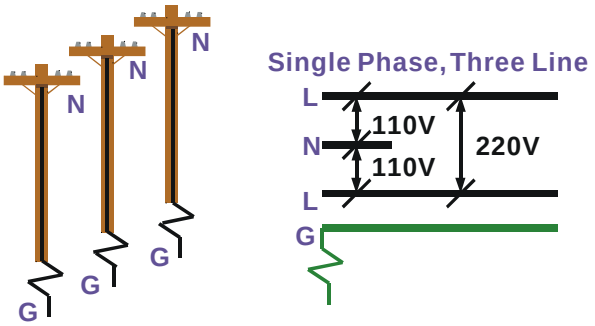


Figure G-1: Think the EARTH as GROUND.

- Why we think the EARTH as GROUND?

As you know that the EARTH can not be conductive indeed. But all buildings base on EARTH. Steels, concretion and relational cables such as Lighting Arrester and power system were connected to EARTH. Think them as resistors, then those infinite parallel resistors make the EARTH as a single point and just for reference.

1.2 The 'Frame Ground' and 'Grounding Bar'



Neutral is the physical cable from Generator.
Ground is the local physical cable that connected to Ground Bar.

Figure G-2: Grounding Bar.

According to previous description, the grounding is the most important issue for our system. Just like 'Frame Ground' of the computer, this signal offers a reference point of the electronic circuit inside the computer. When we want to communicate with this computer, not only 'signal ground', but also 'frame ground' should be connected to make a reference point of each other's electronic circuit. Generally speaking, it's necessary to build a individual grounding bar for each system, such as computer networks, telecommunication networks, power system, . . . , etc. Those individual grounding bars not only provide the individual reference point, but also make the earth as a real ground!

1.3 Normal Mode and Common Mode

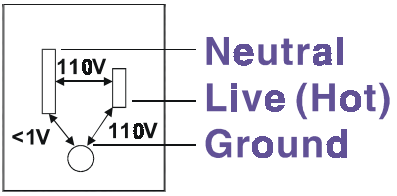


Figure G-3: Normal mode and Common mode.

Have you ever tried to measure the voltage between 'Hot' and concrete floor, or measure the voltage between 'Neutral' and concrete floor? You will get nonsense value with above testing. 'Hot' and 'Neutral' were just a relational signal, so you will get the AC110V or AC220V by measure those two signal. Normal mode and common mode just show you that the 'frame ground' is the most important reference signal for all the systems and equipments.

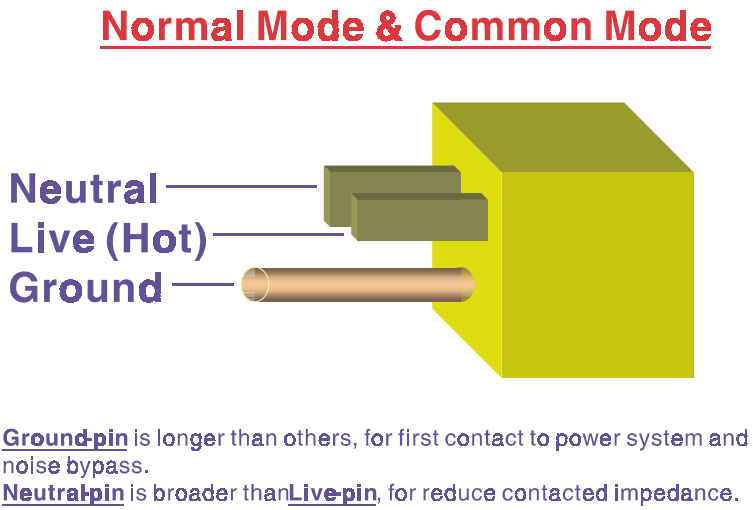


Figure G-4: Normal mode and Common mode.

- Ground-pin is longer than others, for first contact to power system and noise bypass.
- Neutral-pin is broader than Live-pin, for reduce contact impedance.

1.4 Wire impedance

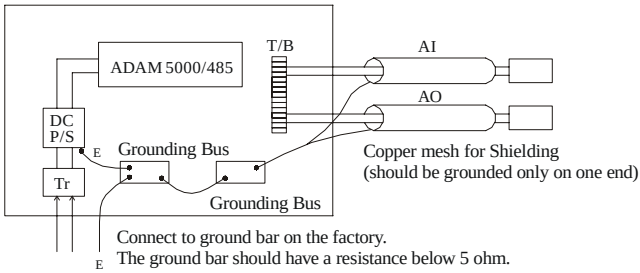


Figure G-5: The purpose of high voltage transmission

- What's the purpose of high voltage transmission?

We can see the high voltage tower stand at suburban. The power plant raises the voltage while generating the power, then downs the voltage when transmits the power to power station. What's the purpose of high voltage transmission do you think? According to the energy formula, P = V * I, so the current will be reduced while raising the voltage. Besides, as you know that each cable has the wire impedance. So, referring to Ohm rule (V = I * R), this decreased current makes the low power consumption. So the high voltage transmission just for reducing the power consumption.

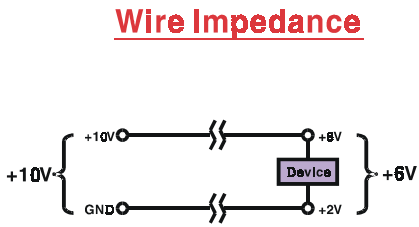


Figure G-6: wire impedance.

Above diagram just shows you that the wire impedance will consume the power.

1.5 Single Point Grounding

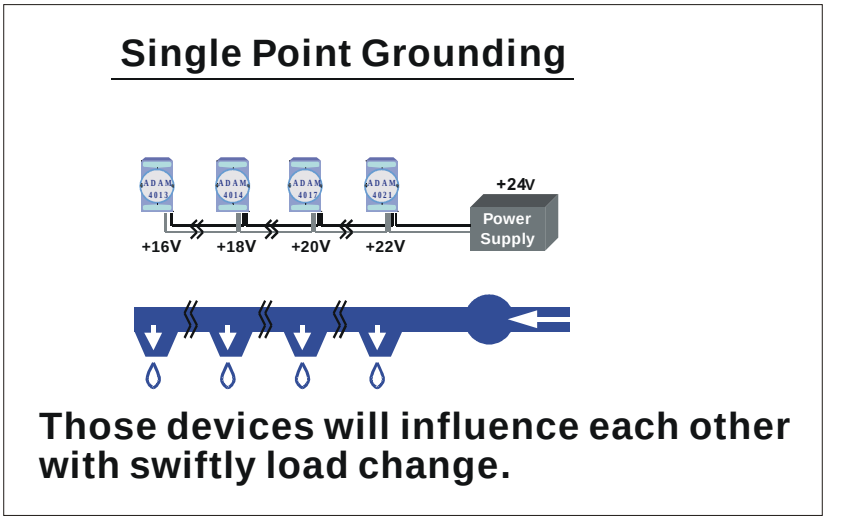


Figure G-7: Single point grounding. (1)

- What's Single Point Grounding?

Maybe you had some displease experiences just like take hot water shower in Winter. When someone turns on another hot water hydrant near the Heater, you'll be impressed with the cold water!

The bottom diagram of above figure just shows that those devices will influence each other with swiftly 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 a more flow. In other words, the hydrant can not keep a constant flow rate.

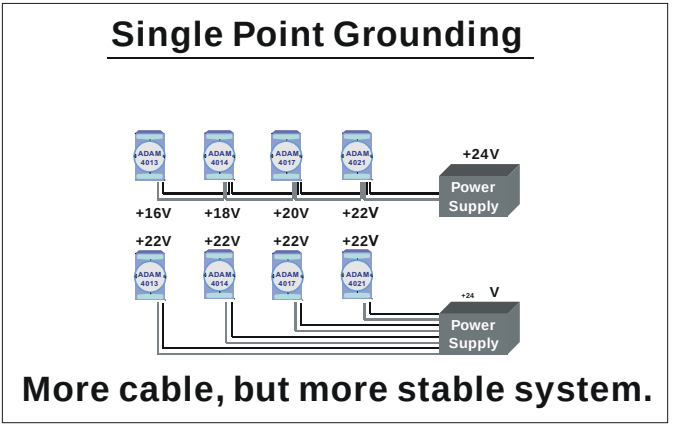


Figure G-8: Single point grounding. (2)

Above diagram shows you that single point grounding system will be a more stable system. Actually, when you use the thin cable powering those devices, the end device will get lower power. The thin cable will consume the energy.

G.2 Shielding

2.1 Cable Shield

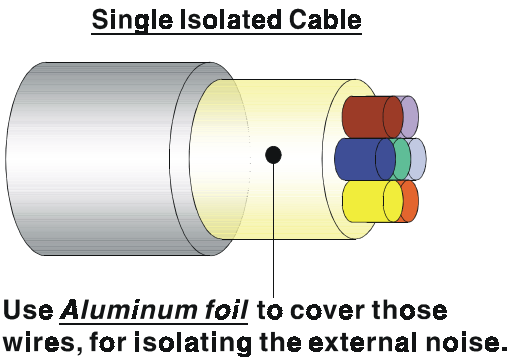


Figure G-9: Single isolated cable

- Single isolated cable

Above diagram shows you the structure of the isolated cable. You can see the isolated layer spiraling Aluminum foil to cover those wires. This spiraled structure makes an isolated layer for isolating the cables from the external noise.

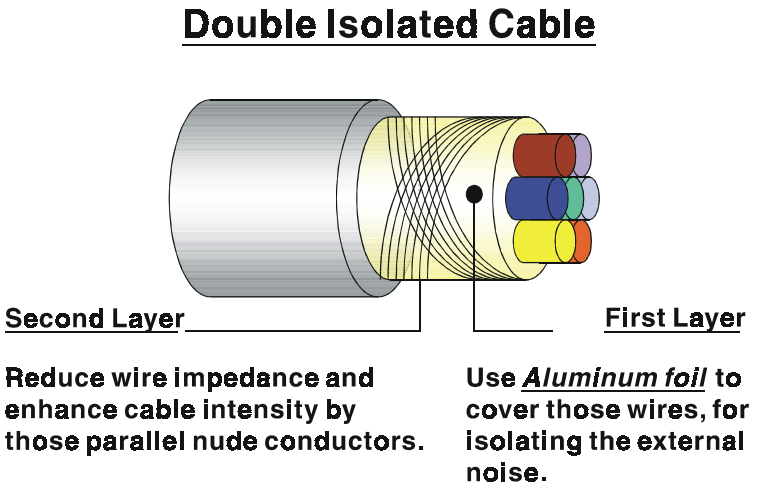


Figure G-10: Double isolated cable

- Double isolated cable

You can see the double isolated cable structure as figure 10. The first isolated layer spiraling Aluminum foil covers those wires. The second isolated layer spiraling and crossing several nude conductors cover the first layer shielding and those wires. This spiraled structure makes an isolated layer for isolating those external noise.

Besides, following tips just for your reference.

- The shield of cable can't be used for signal ground.

The shield is just designed for adhering noise, so the environment noise will couple and interfere your system when you use the shield as signal ground.

- The density of shield is the higher 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.

2.2 System Shielding

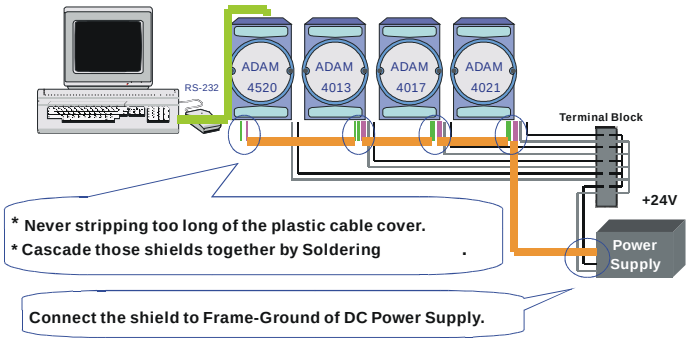


Figure G-11: System Shielding

- Never stripping too long of the plastic cable cover. Otherwise, this improper status will destroy the characteristic of the Shielded-Twisted-Pair cable. Besides, those nude wires are easy to adhere the noise.
- Cascade those shields together by “Soldering”. Please refer to following page for further detail explanation.
- Connect the shield to Frame-Ground of DC power supply to force those adhered noise 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)

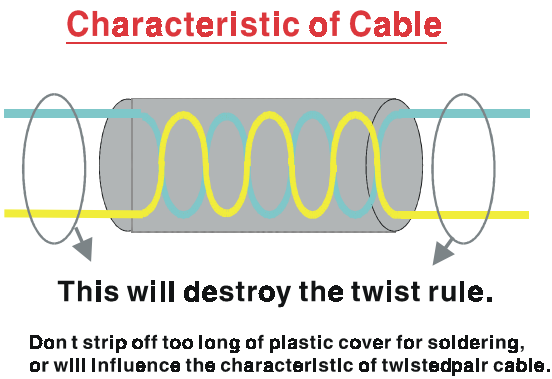
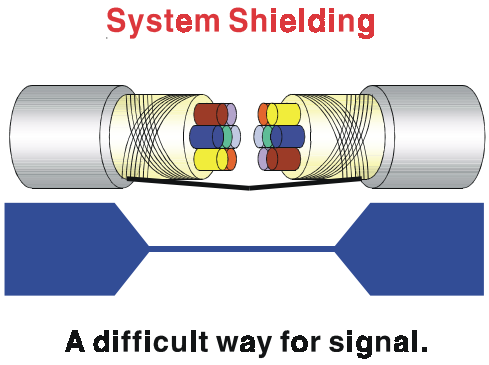


Figure G-12: The characteristic of the cable

- The characteristic of the cable

Don’t strip off too long of plastic cover for soldering. Otherwise will influence the characteristic of the Shielded-Twisted-Pair cable, and will make an easy way to adhere noise.



FigureG-13: System Shielding (1)

- Shield connection (1)

When you want to visit somewhere, you must like to find out an easiest way to achieve your goal, aren't you? So as electronic circuit, all signals use the easiest way. If we connected those two cables just with few wires, it is a difficult way for signal. So the noise will try to find out another path for easier way for flow.

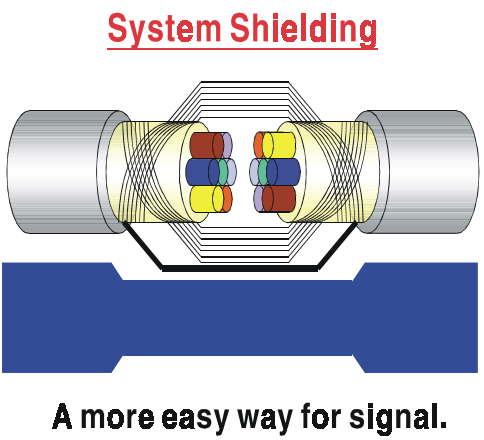


Figure G-14:System Shielding (2)

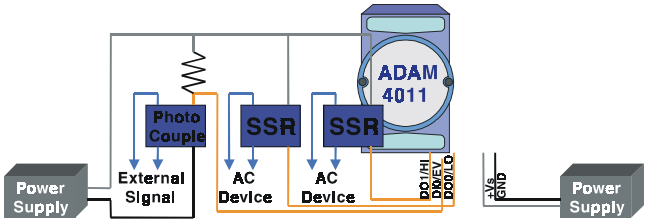
- Shield connection (2)

Above diagram shows you that the fill soldering just makes a easier way for the signal.

G.3 Noise Reduction Techniques

- Enclose noise sources in shield 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.
- It's almost communication problem while system unstable.
- Add another Grounding Bar if necessary.
- The diameter of power apply cable must be over 2.0 mm2.
- Independent grounding is needed for A/I, A/O, and communication network while using the 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



eparate Load and Device power.

ascade amplify/isolation circuit before I/O channel.

Figure G-15: Noise Reduction Techniques

G.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 suitable?
- The diameter of wire thick enough?
- How about the soldering of connection?
- The terminal screw tightly?

Grounding Reference