

**BAS-2000 series**

**User Manual**

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## **Packing List**

In the whole set of BAS-2000 seriesBAS-2000 series there are items as listed below:

1. BAS-2000 Module Assembly
2. Accessory kit which includes
  - (1) BAS-2000 Support CD (BAS-2514 & BAS-2520 package only)
  - (2) Local Bus Ribbon Cable (BAS-2514/BAS-2520 : 1 pc,  
BAS-2014/BAS-2020 : 2 pcs)

## **FCC Class A**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy. If not installed and used in accordance with this user's manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

## **Safety Instructions**

1. Read these safety instructions carefully.
2. Keep this installation reference guide for later reference.
3. Disconnect this equipment from any AC outlet before cleaning. Do not use liquid or spray detergents for cleaning. Use a damp cloth.
4. For pluggable equipment, the power outlet must be installed near the equipment and must be easily accessible.
5. Keep this equipment away from humidity.
6. Put this equipment on a reliable surface during installation. Dropping it or letting it fall could cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. **DO NOT COVER THE OPENINGS.**
8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
9. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient over-voltage.
12. Never pour any liquid into an opening. This could cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If any of the following situations arises, get the equipment checked by service personnel:
  - a. The power cord or plug is damaged.
  - b. Liquid has penetrated into the equipment.
  - c. The equipment has been exposed to moisture.
  - d. The equipment does not work well, or you cannot get it to work according to the installation reference guide.
  - e. The equipment has been dropped and damaged.
  - f. The equipment has obvious signs of breakage.
15. **DO NOT LEAVE THIS EQUIPMENT IN AN UNCONTROLLED ENVIRONMENT WHERE THE STORAGE TEMPERATURE IS BELOW -20° C (-4° F) OR ABOVE 60° C (140° F). IT MAY DAMAGE THE EQUIPMENT.**

The sound pressure level at the operator's position according to IEC 704-1:1982 is equal to or less than 70 dB(A).

## **Wichtige Sicherheitshinweise**

1. Bitte lesen Sie sich diese Hinweise sorgfältig durch.
2. Heben Sie diese Anleitung für den späteren Gebrauch auf.
3. Vor jedem Reinigen ist das Gerät vom Stromnetz zu trennen.  
Verwenden Sie keine Flüssig- oder Aerosolreiniger. Am besten dient ein angefeuchtetes Tuch zur Reinigung.
4. Die Netzanschlußsteckdose soll nahe dem Gerät angebracht und leicht zugänglich sein.
5. Das Gerät ist vor Feuchtigkeit zu schützen.
6. Bei der Aufstellung des Gerätes ist auf sicheren Stand zu achten. Ein Kippen oder Fallen könnte Verletzungen hervorrufen.
7. Die Belüftungsöffnungen dienen zur Luftzirkulation die das Gerät vor Überhitzung schützt. Sorgen Sie dafür, daß diese Öffnungen nicht abgedeckt werden.
8. Beachten Sie beim Anschluß an das Stromnetz die Anschlußwerte.
9. Verlegen Sie die Netzanschlußleitung so, daß niemand darüber fallen kann. Es sollte auch nichts auf der Leitung abgestellt werden.
10. Alle Hinweise und Warnungen die sich an den Geräten befinden sind zu beachten.
11. Wird das Gerät über einen längeren Zeitraum nicht benutzt, sollten Sie es vom Stromnetz trennen. Somit wird im Falle einer Überspannung eine Beschädigung vermieden.
12. Durch die Lüftungsöffnungen dürfen niemals Gegenstände oder Flüssigkeiten in das Gerät gelangen. Dies könnte einen Brand bzw. elektrischen Schlag auslösen.
13. Öffnen Sie niemals das Gerät. Das Gerät darf aus Gründen der elektrischen Sicherheit nur von autorisiertem Servicepersonal geöffnet werden.
14. Wenn folgende Situationen auftreten ist das Gerät vom Stromnetz zu trennen und von einer qualifizierten Servicestelle zu überprüfen:
  - a. Netzkabel oder Netzstecker sind beschädigt.
  - b. Flüssigkeit ist in das Gerät eingedrungen.
  - c. Das Gerät war Feuchtigkeit ausgesetzt.
  - d. Wenn das Gerät nicht der Bedienungsanleitung entsprechend funktioniert oder Sie mit Hilfe dieser Anleitung keine Verbesserung erzielen.
  - e. Das Gerät ist gefallen und/oder das Gehäuse ist beschädigt.
  - f. Wenn das Gerät deutliche Anzeichen eines Defektes aufweist.

15. Bitte lassen Sie das Gerät nicht unbehehrt hinten unter  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) oder oben  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ), weil diesen Temperaturen das Gerät zerstören könnten.

Der arbeitsplatzbezogene Schalldruckpegel nach DIN 45 635 Teil 1000 beträgt  $70\text{dB(A)}$  oder weiger.

DISCLAIMER: This set of instructions is provided according to IEC704-1. Advantech disclaims all responsibility for the accuracy of any statements contained therein.





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CHAPTER  
**1**

**System Overview**

# Chapter 1 System Overview

## 1.1 Introduction

---

### **BAS-2000 series Softlogic Digital Controller BAS-2514 & BAS-2520**

The Advantech BAS-2000 series is the control system for Building Automation Control Application. BAS-2520 series controller is a stand-alone controller with the concept of typical DDC (Direct Digital Controller) in BA system. For examples, it is designed with universal I/O, wall mounting thin case and it is also embedded BA control algorithm for HVAC, lighting, security ..... Applications.

This powerful, stand-alone controller is very easy to learn and use. BAS-2000 series controllers use the KW softlogic as its control center. It is fully compatible with IEC61131-3 standard. User can use multiple languages such as the Function Block Diagram (FBD), Sequential Flow Chart (SFC), Ladder Diagram (LD), Structure Text (ST) and Instruction List (IL) for control function configuration. It would reduce engineer efforts to learn proprietary programming tool and save the investment cost and schedule in proprietary system.

The BAS-2000 series controllers adopt MODBUS/RTU protocol which is the most popular and cost effective solution for field data communicating, and the transmission speed is up to 115.2Kbps. By using MODBUS/RTU protocol, it will be much easier to integrate the control data between BAS-2000 series controller and field machinery such as compressor, chiller, inverter and power panel. And the BACnet MS/TP protocol will be the optional protocol in nearly future.

## 1.2 Features

---

- Process IEC-61131 standard with rich development environment
- Cross-Language programming
- Large memory size for programming and storage
- Real time multi-task engine
- Free pre-defined function library
- Powerful debug / diagnostic / simulation / force tools
- Open Standard connection - Modbus standard Interface
- Online editing & partial download
- RS-232/485 communication ability
- Built-in ROM and RAM disk for programming
- Built-in real-time clock and watchdog timer

### 1.2.1 Process IEC 61131-3 standard with rich development environment

The standard IEC 61131-3 has been established to standardize the multiple languages, sets of instructions and different concepts existing in the field of automation systems. The great variety of control concepts has led to an incompatibility between the different control platforms and manufacturers. The result was a great effort to be made for training, hard- and software investments.

IEC 61131-3 defines the syntax of 5 programming languages, defines a certain representation and describes the different elements which can be used in the language.

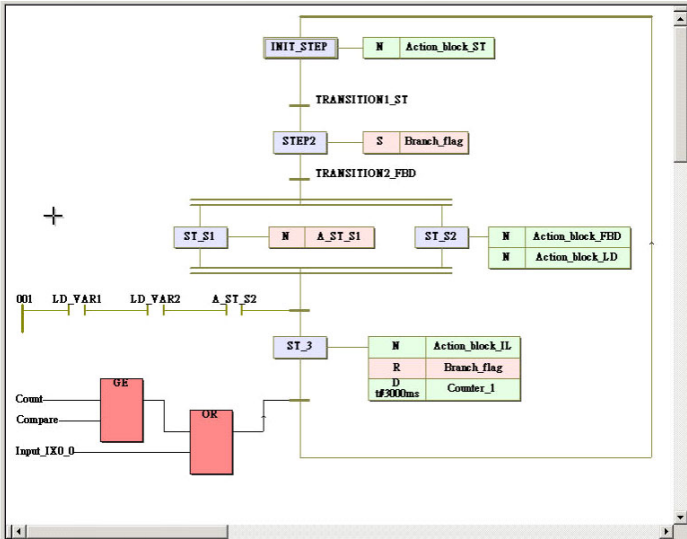
The programming languages can be differentiated by the physical appearance into 2 textual languages and 3 graphical languages.

**Table 1.1: Programming Languages Table**

Textual Languages	Graphical Languages
Instruction List (IL) Structured Text (ST)	Function Block Diagram (FBD) Ladder Diagram (LD) Sequential Function Chart (SFC)

## 1.2.2 Cross-Language Programming

For some project integrate and scalable issues, cross-language can help you to choose the different language for your project. For example, you can use ladder (LD) on the simple I/O module control or simple logical expression and use Function Block (FB) on process control for more advanced expression and use Sequential Function Chart (SFC) for system configuration in hybrid control system such as Water Treatment.



## 1.2.3 Large memory size for programming and storage

BAS-2000 series controllers - BAS-2514 and BAS-2520 support 640KB system memory and 1MB flash memory for programming use. It is large than traditional pc based controller. With this large memory, you can expand your program size for more tags and expressions. Beside, the storage size is also growing up with this large memory size.

### For System Use

256 KB system ROM

256 KB flash memory

512 KB SRAM, up to 32 KB with battery backup

### **1.2.4 Real time multi-task engine**

BAS-2514/BAS-2520 provides the multi-task and multi-program environment. BAS-2514/BAS-2520 communication, data process and I/O access tasks are working independent, so the system can work with higher performance and efficiency.

### **1.2.5 Pre-defined function library**

Advantech MULTIPROG provides many pre-defined function library such as maximum of strings as string function block, Convert REAL to INT as type convert function block. It helps you to build up your program more conveniently. It is more convenient than the traditional control programming tools. With this pre-defined function, you can make your project easier in timer control, variable type convert or strings convert, etc.

In addition, user can define their own function block for common use function or special domain know how.

### **1.2.6 Powerful debug/diagnostic/simulation/force tools**

Advantech MULTIPROG provides lots of powerful tools for debug, diagnostic, simulation and force function. It shows friendly interfaces when you use these tools. With debug / diagnostic tools, you can make it easier on trouble shooting. Advantech MULTIPROG simulator supports program verification offline directly on your PC. This is great in case you are developing logic and you do not have access to a controller. To activate an I/O simply click on the LED you want to energize and your logic executes as if it was a real I/O. The result? The program operation is the same as if you actually were connected to the controller, so all the debug tools are fully functional: power and logic flow, I/O force and overwriting.. With force tools, you can check more exception situations and check if the project handling right or wrong. It prevents the damage for you.

## 1.2.7 Open Standard connection - Modbus standard Interface



*Figure 1.1: Communication with HMI Station*

With Modbus protocol, you can integrate your system thru most of HMI SCADA system or OPC Server and even HMI SCADA with OPC Server. It helps you to integrate control I/O system and plant system easier.



*Figure 1.2: Communication with Configuration Station*

The configuration & control application program can be downloaded through PORT1 RS-232.



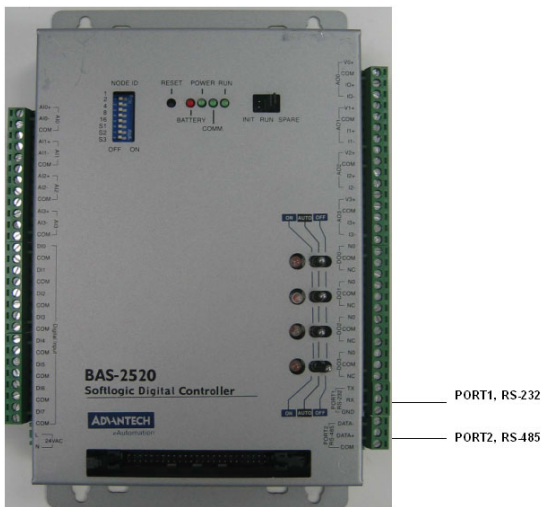
## 1.2.8 Online editing & partial download

Online editing is a MUST even though many packages do not support it. It is unacceptable to shut down the machine or process to perform maintenance, not to mention how difficult it is to debug when you have to switch back and forth from program to run mode. MULTIPROG supports online editing so you can make changes and then download the changes to the controller WITHOUT stopping the machine or process. It helps you to maintain your system easier and save the cost for your system process.

## 1.2.9 RS-232/485 communication ability

The BAS-2514/BAS-2520 has two serial communication ports, giving it excellent communication abilities. This facilitates its ability to control networked devices. Refer to Figure 1-1, COM1 is a dedicated RS-232 port (configuration port), COM2 is a dedicated RS-485 port. These two ports allowed the BAS-2514/BAS-2520 to satisfy diverse communication and integration demands.

With this communication ports, you should not to buy more I/O communication device and save more costs. You can also extend your system structure by using these communication ports.



**Figure 1.3: BAS-2514/BAS-2520 Communication Ports**

### **1.2.10 Built-in ROM and RAM disk for programming**

The BAS-2514/BAS-2520 has built-in Flash Memory and SRAM for file downloading, system operation and data storage. It provides 1 MB file system, 384 KB free for users to download programs. There are also 512KB SRAM to provide the memory needed for efficient application operation and file transfer. Moreover, users are allowed to decide the battery backup memory size up to 384KB in the SRAM.

### **1.2.11 Built-in real-time clock and watchdog timer**

The BAS-2514/BAS-2520 also includes a real-time clock and watchdog timer. The real-time clock records events while they occur. The watchdog timer is designed to automatically reset the microprocessor if the system fails. BAS-2514/BAS-2520 provides three kinds of watchdog time for Operating System Watchdog, KW application watchdog, Modbus server communication watchdog. It will shift up the reliability of system. And makes the BAS-2514/BAS-2520 ideal for use in applications which required a high level of system stability.

## 1.3 BAS-2514/BAS-2520 Specification

---

### 1.3.1 System

- CPU: 80188-40, 16-bit microprocessor
- Operating system: Boot ROM-DOS
- 1 MB files system for users' application
- 256 KB system ROM (for system use)
- 256 KB flash memory (for system use)
- SRAM: 512 KB
- Battery backup: 32 KB (16 KB for data, 16 KB for KW retain data)
- Timer BIOS: Yes
- Real-time clock: Yes
- Watchdog timer: Yes

#### **Operating System Watchdog**

#### **KW application watchdog**

#### **Modbus server communication watchdog**

- COM1: RS-232, 3 Wires (configuration port)
- COM2: RS-485, Terminal
- I/O capacity for BAS-2514: 14 onboard I/O (4AI/8DI/4AO/4DO), up to 74 I/O point (expanded by BAS-2020/BAS-2014 I/O Expansion Module)  
I/O capacity for BAS-2520: 20 onboard I/O (4AI/8DI/4AO/4DO), up to 80 I/O point (expanded by BAS-2020/BAS-2014 I/O Expansion Module)
- Analog Input type:
  - 2,3 wired Pt-100, Pt-1000
  - 3K, 10K Thermistor
  - 0 to 10V<sub>DC</sub> signal
  - 4 to 20 mA signal
  - A/D resolution: 16-bit
  - Selectable input type by Software
- Digital Input type:
  - Dry contact
    - Logic level 1 : Close
    - Logic level 0 : Open
  - Wet Contact (Check external power voltage 15Vdc)

Logic level 1 : +10 to 30Vdc

Logic level 0 : +3Vmax

support 1KHz pulse input (Check frequency )

- Analog output : (please be noticed that BAS-2000 analog output channel cannot be used by common ground wiring)  
0 to 10Vdc output  
4 to 20 mA output  
D/A resolution: 8-bit  
Selectable input type by Software
- Digital output:  
Relay output : AC240V<sub>AC</sub> @ 3A, with LED indicator
- CPU power consumption: 2.5 W
- Status display: Power, RUN, Communication, Battery

### **1.3.2 RS-485 interface (COM2) (Connect to host PC)**

- Signals: DATA+, DATA-
- Mode : Half duplex, multi-drop
- Connector: Screw terminal
- Transmission speed: Up to 38400 bps
- Max transmission distance: 4000 feet (1220 m)

### **1.3.3 Power**

- Power Requirement : 24 VAC or 17 ~ 35 Vdc ("L" : +Vdc, "N" : -Vdc)
- Power consumption: 2.5 W

### **1.3.4 Environment**

- Operating temperature: -10° to 60° C (14° to 140° F)
- Storage temperature: -25° to 85° C (-13° to 185° F)
- Humidity: 5 to 95 %, non-condensing
- Atmosphere: No corrosive gases

### 1.3.5 Dimensions : 171mm X 242 mm X 35 mm

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

### 1.3.6 Software Specification

- Real Time O.S: KW PROCONOS (Up to 16 tasks)
- Programmable Code/Data Size: up to 64 KB

### 1.3.7 LED Status of the BAS-2514/BAS-2520

There are four LEDs on the BAS-2514/BAS-2520 front panel. The LED's indicate BAS-2514/BAS-2520's operating status, as explained below:

- (4) **PWR:** power indicator. This LED is on whenever the BAS-2514/BAS-2520 is powered on.  
If BAS-2514/BAS-2520 system fails, the power indicator will be regular blinking per 500ms. You should stop your program and click on the error message, the system will return to normal power indicator mode.
- (2) **COMM:** COM2 communication indicator. This LED blinks whenever the host PC and the BAS-2514/BAS-2520 are communicating.
- (3) **RUN:** CPU operation indicator, this LED shall blink in normal condition. If the CPU fails, the LED will be latched.
- (4) **Battery:** battery status indicator. This LED will be on whenever the SRAM backup battery is low. If battery low, please contact with Advantech support.



**Figure 1.4: BAS-2514/2520 LED and Jumper**

## 1.4 Limitation

### 1.4.1 I/O Quantity

BAS-2520 provides 20 onboard I/O and BAS-2514 provides 14 onboard I/O, the I/O can also expanded with BAS-2020/BAS-2014 I/O Expansion Module through local bus (the max. length of local bus cable is up to 2.0 meters). The I/O capacity of BAS-2520 is up to 80 points and the I/O capacity of BAS-2514 is up to 74 points.



**Figure 1.5: BAS-2000 Controller with I/O Expansion Module Connection**

### 1.4.2 Memory size

BAS-2514/BAS-2520 enlarges the memory size for programming use and system unit.

It contain system ROM, flash memory, SRAM and files system memory for user's application,

- 256 KB system ROM (for system use)
- 256 KB flash memory (for system use)
- SRAM: 512 KB
- Battery backup: 32 KB (16 KB for data, 16 KB for KW retain data)

CHAPTER  
**2**

**Installation Guidelines**

# Chapter 2 Installation Guidelines

## 2.1 System Requirements

---

### 2.1.1 Host Computer Requirements

1. IBM PC compatible computer with 486 CPU (Pentium is recommended).
2. Microsoft 98/2000/XP/NT 4.0 (SP3 or SP4) or higher versions.
3. At least 32 MB RAM.
4. 20 MB of hard disk space available
5. VGA color monitor.
6. 2x or higher speed CD-ROM.
7. Mouse or other pointing devices.
8. At least one standard RS-232 port (e.g. COM1, COM2).
9. One RS-485 card or RS-232 to RS-485 converter (e. g. ADAM-4520) for system communication.

### 2.1.2 BAS-2514/BAS-2520 Requirements

1. One BAS-2520 (or BAS-2514) main unit.
2. One BAS-2000 User Manual
3. BAS-2020 (or BAS-2014) with Local Bus Cable (Optional)
4. 24VAC Power supply for BAS-2514/BAS-2520 (the BAS-2020/ BAS-2014 will be powered by BAS-2514/BAS-2520, the additional power supply is unnecessary)
5. One RS-232 straight through DB-9 cable

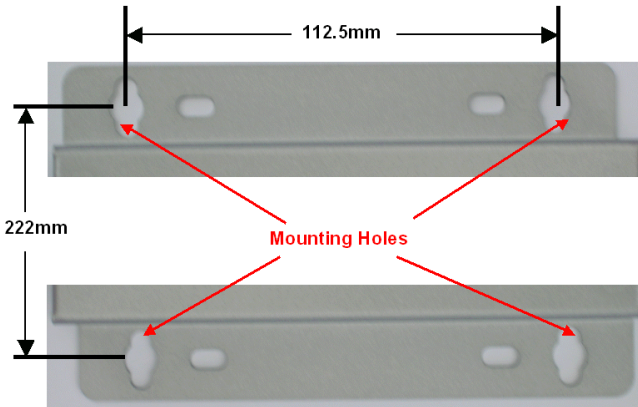


## 2.2 Hardware Installation

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### 2.2.1 Mounting

The BAS-2514/BAS-2520 controller can be installed on a panel or Wall

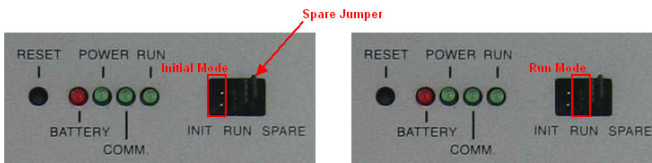


*Figure 2.1: BAS-2000 Modules Wall Mounting Holes*

### 2.2.2 Jumper Settings and DIP Switch Settings

This section tells you how to set the jumpers and DIP switches to configure your BAS-2514/BAS-2520 controller. It gives the system default configuration and your options for each jumper and dip switch. There is one 8-pin DIP switch on backplane board. In this section, the BAS-2520 will be the example for this tutorial case (all of the jumper and DIP switch setting is the same for both of BAS-2514 and BAS-2520).

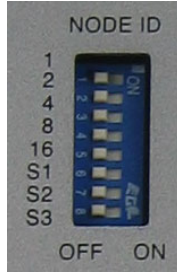
#### System Mode Setting : RUN/Initial



*Figure 2.2: CPU Jumper Setting*

**Device ID Setting:**

You can set up your device ID by change the DIP Switch 1-5 beside BAS-2514/BAS-2520.



*Figure 2.3: DIP switch for Device ID*

**ID Setting :**

Please refer the following example for ID setting.

ID 1 : 1 ON only

ID 2 : 2 ON only

ID 3 : 1 & 2 ON (1+2=3)

ID 4 : 4 On only

ID 10 : 2 and 8 ON (2+8=10)

ID 15 : 1, 2, 4, 8 ON (1+2+4+8=15)

**COM Port Setting :**

S1 ON : COM Port 2 RS-485 Enabled

S1 OFF : COM Port 1 RS-232 Enabled

Note : COM1 and COM2 cannot be used in the same time.

**Baud Rate Setting**

Baud Rate	S2	S3
9600 bps	OFF	OFF
19200 bps	OFF	ON
38400 bps	ON	OFF
115.2K bps	ON	ON

## 2.3 BAS-2514/BAS-2520 System Wiring and Connections

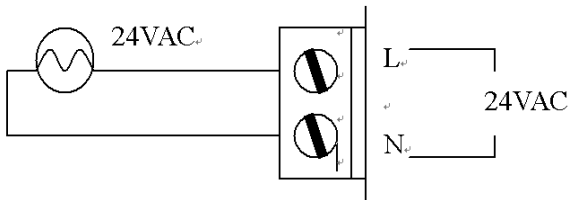
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This section provides basic information on wiring the power supply, I/O units, communication port connection and programming port connection.

### 2.3.1 Power supply wiring

The BAS-2514/BAS-2520 was designed with using power supply 24VAC, the typical power requirement in Building Automation device. Please refer the following power wiring drawing .

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



**Figure 2.4: BAS-2514/BAS-2520 Power Wiring**

### 2.3.2 I/O modules wiring

The system uses a plug-in screw terminal block for the interface between I/O modules and field devices. The following information must be considered when connecting electrical devices to I/O modules.

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

### 2.3.3 System Network Connection

The BAS-2514/BAS-2520 has two communication ports. These ports allowed you to program, configure, monitor, and integrate the remote devices.

#### Network Connection for System Configuration and Download

The BAS-2514/BAS-2520 has a programming port with a 3 wires terminal connection. This port (PORT1) allows you to program, configure, and troubleshoot the BAS-2514/BAS-2520 from your host computer. The programming port has an RS-232 interface and only uses TX, RX, and GND signals. The cable connection and the pin assignment are as follows:



#### PC COM Port

#### BAS-2514/BAS-2520 Port1

CD	1		
RX	2		RX
TX	3		TX
DTR	4		GND
GND	5		
DSR	6		
RTS	7		

*Note: The diagram shows red lines indicating the wiring connections between the PC COM port and the BAS-2514/BAS-2520 Port1. The connections are: CD (1) to TX (3), RX (2) to RX (3), and DTR (4) to GND (3).*

**Figure 2.5: System Configuration Wiring**

### Simulation Mode Setting for BAS Utility connection

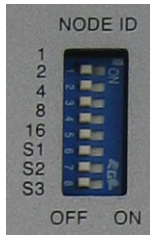
The BAS-2000 I/O can be configured and be calibrated by BAS utility. Before using BAS utility, the BAS-2000 controller must be set as simulation mode. For the detail steps, please refer the following descriptions.

Step 1: Set the Controller mode as "RUN"



*Figure 2.6: CPU jumper setting for simulation mode*

Step 2: Set all of the DIP switch of "NODE ID" to be "OFF"



*Figure 2.7: CPU DIP switch setting for simulation mode*

Step 3: Connect the RS-232 cable to Port 1

Step 4: Run BAS Utility software

## RS-485 Network Connection for System Monitoring and Integration

The BAS-2514/BAS-2520 provides RS-485 interfaces for multi-drop network integration. The PORT2 is a dedicate RS-485 interface (Screw terminals DATA- and DATA+ are used for making the PORT2 RS-485 connections). Usually, you will need to prepare an ADAM-4520 RS232/485 converter to link with host PC for data monitoring See Figure 2-11.



*Figure 2.8: System Monitoring Wiring*

## 2.4 BAS-2514/BAS-2520 System Configuration

### 2.4.1 Standalone Controller Wiring

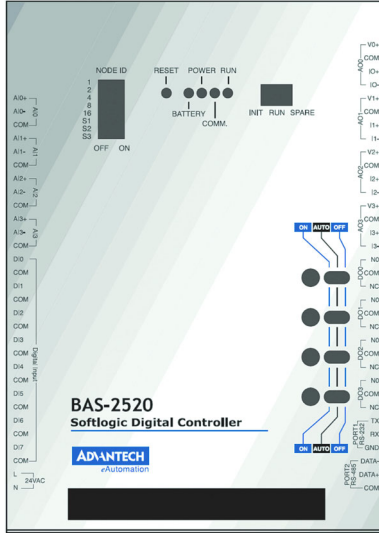


Figure 2.9: BAS-2000 SoftLogic Digital Controller

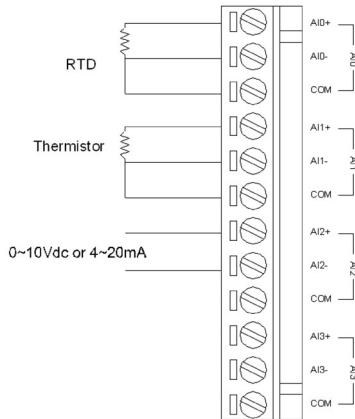
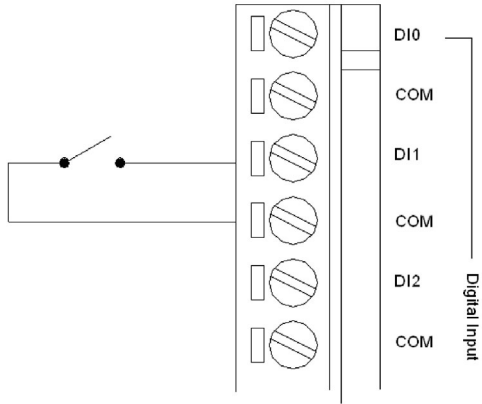
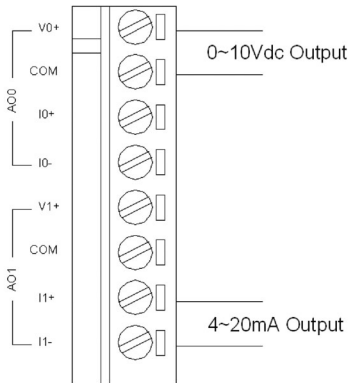


Figure 2.10: BAS-2000 Analog Input Channel Wiring

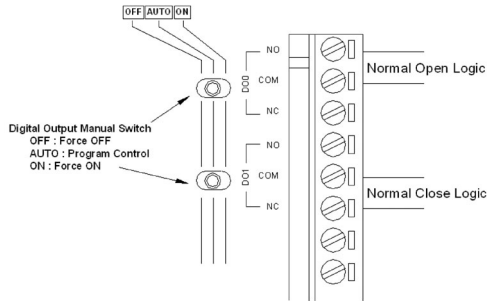


**Figure 2.11: BAS-2000 Digital Input Channel Wiring**



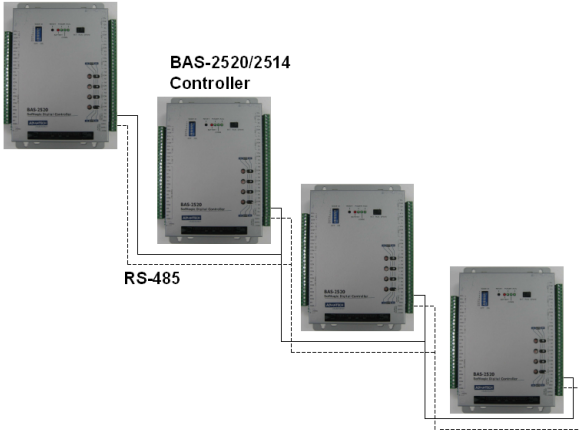
**Figure 2.12: BAS-2000 Analog Output Channel Wiring**



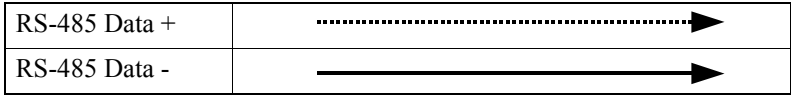


**Figure 2.13: BAS-2000 Digital Output Channel Wiring**

## 2.4.2 System Multi-Connection Wiring



*Figure 2.14: BAS-2000 System Connection*



In multi-connection, you should adjust device ID by change DIP switch, please refer to chapter 2.2.2 Device ID DIP switch setting.

### 2.4.3 MULTIPRO Programming Wiring



**PC COM Port**

**BAS-2514/BAS-2520 Port1**

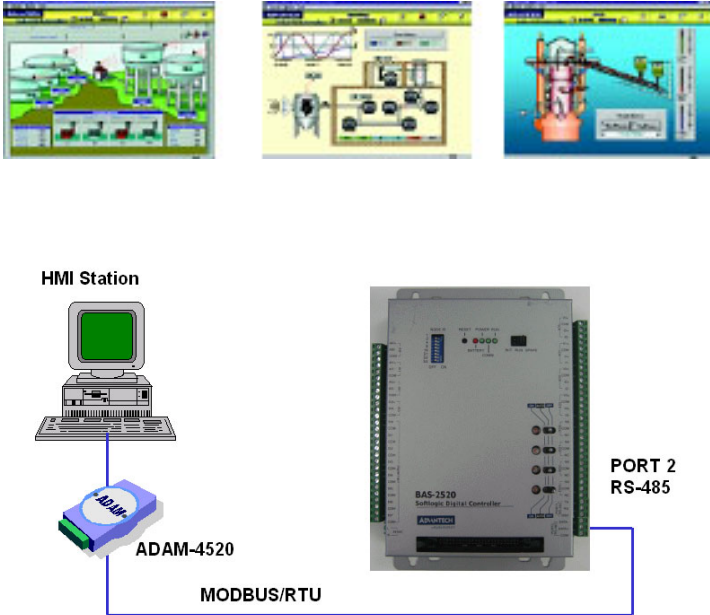
CD	1		
RX	2		RX
TX	3		TX
DTR	4		GND
GND	5		
DSR	6		
RTS	7		

*Note: Red lines in the original diagram indicate a cross-connection: PC RX (2) to Controller TX (3), PC TX (3) to Controller RX (2), and PC GND (5) to Controller GND (4).*

**Figure 2.15: BAS-2000 MULTIPROG programming station wiring**

You can run the MULTIPROG from your Host PC and make some program or procedure in it and download the program to BAS-2514/ BAS-2520 thru COM1. After the program is downloading into system, BAS-2514/BAS-2520 will start running the program automatically.

## 2.4.4 HMI SCADA System Wiring



**Figure 2.16: HMI SCADA System**

You can connect BAS-2514/BAS-2520 to the HMI SCADA System thru MODBUS protocol from COM 2 RS-485. If the HMI SCADA is not including MODBUS OPC Server, you have to install an individual MODBUS OPC Server in your system such as ADAMView, GeniDAQ. If the MODBUS OPC Server is included, you can active the function to get connection with BAS-2514/BAS-2520, such as ASTUDIO.

CHAPTER  
**3**

**Software Installation**

# Chapter 3 Software Installation

## 3.1 Introduction

---

KW MULTIPROG IEC 61131 programming system supports all IEC 61131-3 programming languages. According to the task to be handled, programmer experience level, and your company standards, you may choose one of the five standardized programming languages.

KW MULTIPROG runs as a 32 bit application on all standard PC Windows systems and allows intuitive programming with a clear structure:

- User interface and use are strictly oriented to the Windows standard.
- The Edit Wizard displays the available elements in all editors while programming.
- An extensive context-sensitive HTML help system supports you on all levels: from questions about the general use, via information about function, up to the back-ground of the IEC 61131-3 standards.
- Cross-References automatically create an overview of the used data.
- Self-definable and dockable toolbars.
- In a few minutes, you will learn the basic steps to create a control program by the online help video sequences.

### **Fully Support IEC 61131-3 Programming Languages**

- Instruction List (IL)
- Structured Text (ST)
- Function Block Diagram (FBD)
- Ladder Diagram (LD)
- Sequential Function Chart (SFC)

\*All programming languages can be mixed within one project.

### **Cross-compiling**

The basic languages of the IEC 61131-3 standard; i.e., FBD, LD and IL, can be cross-compiled to each other including their comments. Program code, which has been written in ST, can be compiled to any of the three basic languages.

## **On-line Language Switching for True International Support**

The software, including help systems and documentation, is available in English, German, French, Japanese and Chinese. Online, even the user generated project documentation, can be switched into any language as well.

## **Graphic Editor**

The fully graphic editor allows a completely free placing of objects as well as a network-oriented handling. You may choose the method which best suits your application, and use the functions of the editor by which you can quickly create your programs in LD/FBD or SFC. The editor supports:

- Mixing of LD, FBD and SFC in a single worksheet.
- Placing of objects at a sizeable grid.
- Insertion of new elements into existing networks without any limitations.
- Moving of single objects or networks.
- Auto routing for an automatic connection.
- Display of graphics in the functions and function blocks to visualize their purpose.
- Opening of the code by a double click on the appropriate user defined functions and function blocks.
- Different colors for functions and function blocks from the firmware library, the user library and the project.

## **Textual Languages**

The text editor allows you to create your programs fast and easily. You are supported by various functions:

- Syntax highlighting indicates the keywords of the program.
- IntelliSense automatically completes your variable names, structure elements and function block perimeters.
- The Edit Wizard eases the editing by displaying the available elements and function blocks.
- The menu adapts itself context-sensitively.

## Reliability by Experience

KW MULTIPROG is based on an embedded softlogic controller that has been applied in the automation industry since 1991. With over 250,000 runtime installations worldwide, a sophisticated and reliable product is available which is continuously adapted to new technologies.

## Preemptive Multitasking

KW MULTIPROG is based on a standard multi-tasking operating system and supports pre-emptive scheduling. This allows the exact prediction of the time behavior of user tasks, down to 1 millisecond resolution. A watchdog is assigned to each user task and will activate the appropriate system tasks to realize corrective action if a real-time violation arises. In this way, supervision is guaranteed. The programming of system tasks allows a differentiated reaction from the application towards runtime errors (exception handling: watchdog, division by zero, etc.) and changes in the operational mode (e.g., stop to run, boot sequence). Highly efficient communication functions support OPC, remote maintenance and programming.

## Hardware Requirements

Device	Minimum	Recommended
IBM compatible PC with Pentium Processor	200 MHz	350 MHz
System RAM	64 MB	128 MB
Hard Disk Space	60 MB free space	
CD ROM Drive	Required	
VGA Monitor Color Settings Resolution	256 Colors 800 x 600	True Color 1024 x 768
RS-232 Interface	1 Port	
Mouse	Recommended	

## Software Requirements

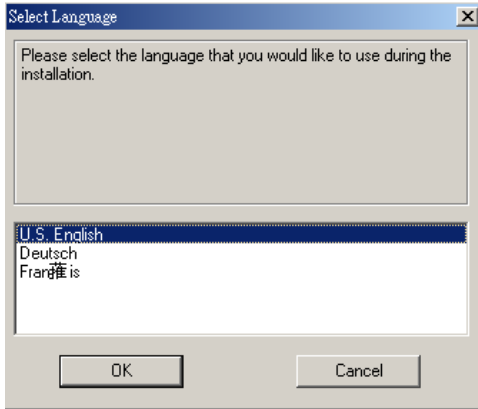
- Microsoft Windows 98
- Microsoft Windows NT 4.0 SP5 or Windows 2000/XP
- Microsoft Internet Explorer 4.02 and above



## 3.2 MULTIPROG Installation

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- (1) Insert the Advantech MULTIPROG Software CD into CD-ROM, system will auto launch the install program. After launching install program, system will pop up "Select Language" dialog box. Choose the suitable language for your system. (In this example, we choose U.S. English)



*Figure 3.1: Language selection page*

- (2) After select the language option, the next dialog box will be shown up. All components of KW Software will show in this screen.



*Figure 3.2: MULTIPROG software installation start screen*

### **MULTIPROG 3.3**

The IEC 61131 programming system MULTIPROG supports all IEC 61131-3 programming languages. According to the task to be handled, the experience and the company standard, you may choose one of the five standardized programming languages. The use of MULTIPROG offers you many advantages. Our long-term experience in the automation industry guarantees you a sophisticated software product.

#### **ProConOS**

Programmable Controller Operating System is a real time, multitasking IEC- 61131 compliant PLC operating system designed to be embedded in almost any hardware. Since it is easily integrated with existing runtime programs and firmware packages, the control suppliers can offer an IEC compliant system maintaining their own individual unique features and capabilities.

√ Reliability due to expertise

ProConOS, has been applied in the automation industry since 1991. Thus a sophisticated and reliable product is available, which matches current requirements and which are continuously adapted to new technologies.

√ Advantages due to a clear structure

The modular software structure offers:

- Multiple interfaces for system development engineers
- Easy realization of manufacturer-specific features
- Fast integration into existing systems such as CNC, robotics or motion control

Standard real time operating systems by well-known manufacturers form the basis of ProConOS.

#### **OPC Server**

The ProConOS OPC Server provides the gateway to the standard Windows world and to Windows CE. ProConOS OPC Server handles the data exchange between Windows applications (e.g. visualization, data base, ...) and ProConOS PLCs via the manufacturer independent client/server interface OPC (OLE for Process Control). The OPC Server can be applied for the communication with a PLC or in distributed PLC networks.

- (3) Click on MULTIPROG 3.3 and bring out the installation wizard.

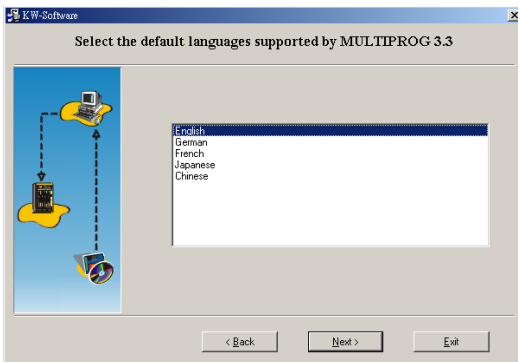


*Figure 3.3: MULTIPROG software installation wizard*

- (4) In this step, the installation wizard will show the welcome message and other notes for installation.



*Figure 3.4: MULTIPROG software setup program start screen*

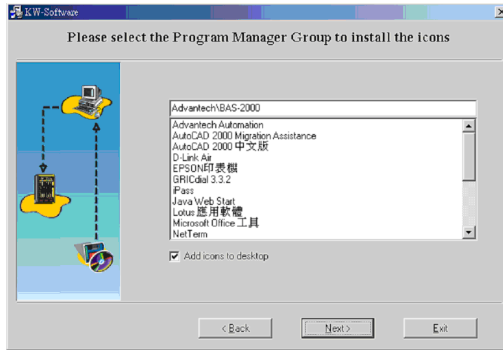


*Figure 3.5: MULTIPROG software setup program language selection page*

- (5) Select the default language supported by MULTIPROG and click "Next" button to continue installation.

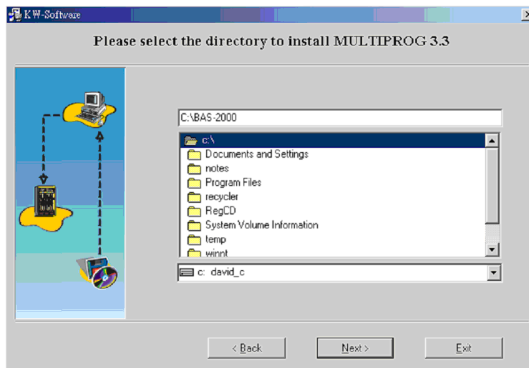
**Note:** *MULTIPROG supports English, German, French, Japanese language mode.*

- (6) Select the program manager group for yourself. We suggest you to set the Groups name to "Advantech\BAS-2000".



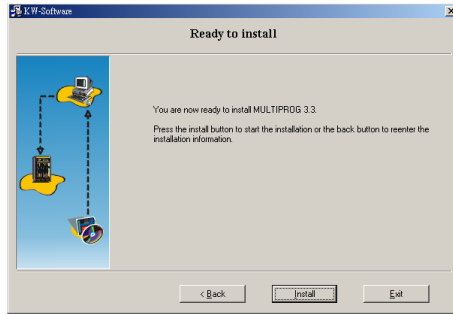
**Figure 3.6: MULTIPROG software Program Manager Group setup page**

- (7) Select the destination folder to install MULTIPROG. You can choose the folder yourself or use the default install path for "C:\KWSOft ". It is recommended that you install the MULTIPROG on the path for "C:\BAS-2000". Make sure your setting and click on "Next" to go to next step.



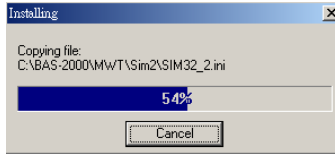
**Figure 3.7: MULTIPROG software installing directory setup page**

- (8) Make sure if those setting before are correct; please click on "Install" to begin installing. Otherwise click on "Back" to check the setting for previous steps.



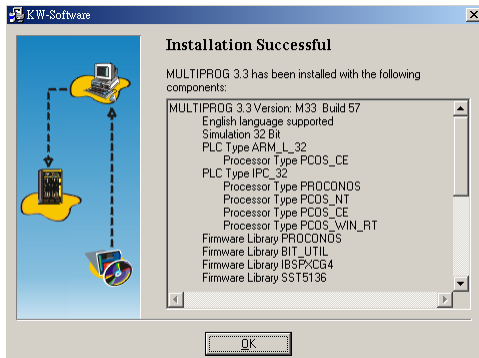
**Figure 3.8: MULTIPROG software ready to install**

- (9) System will enter installing process after clicking Install button. After the status slide bar reach 100%, the installation is finished.



**Figure 3.9: MULTIPROG software installing percentage**

- (10) After finishing the installation, system will show you the message of "Installation Successful" and the installed components.



**Figure 3.10: MULTIPROG software install successfully**

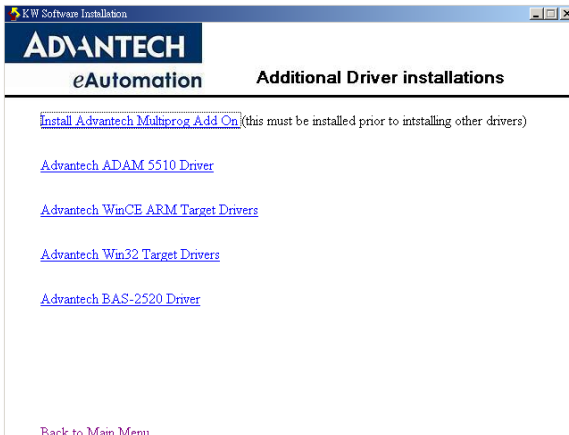
### 3.3 MULTIPRO Add-ons Installation

- (1) After finishing install MULTIPRO program, we need to install the other Add-On program. Please click on "Multiprog Add-Ons" to process the installation.



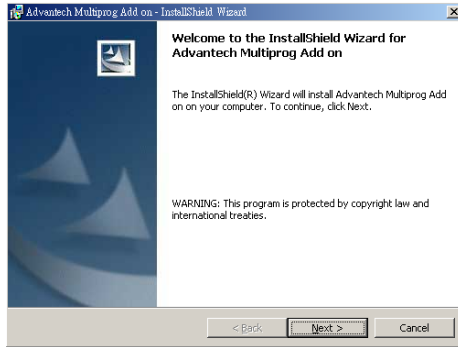
*Figure 3.11: MULTIPROG Add-on component installation selection*

- (2) There are 5 components in Add-on for selection. Please be noticed the "Advantech Multiprog Add-on" must be installed first.



*Figure 3.12: Add-on components selection page*

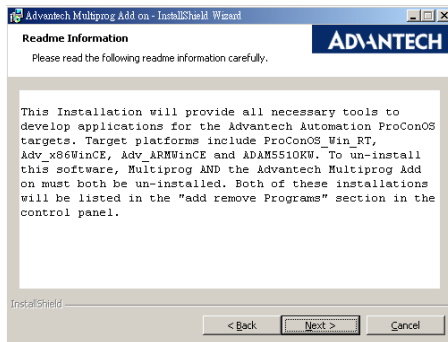
- (3) The software InstallShield Wizard will help you to install step by step.



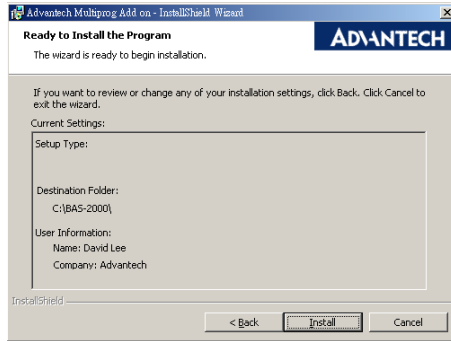
**Figure 3.13: MULTIPROG software Add-on installation welcome page**



**Figure 3.14: License acceptance page**

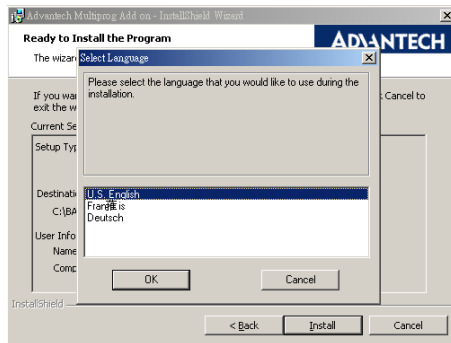


**Figure 3.15: Installation warning page**

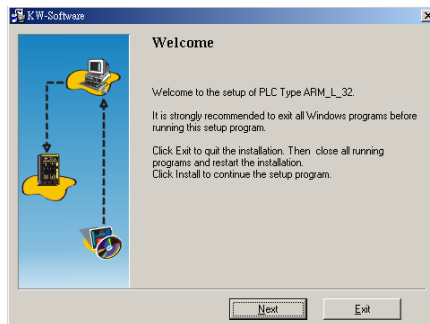


**Figure 3.16: MULTIPROG software Add-on ready to install**

(4) Please select the language

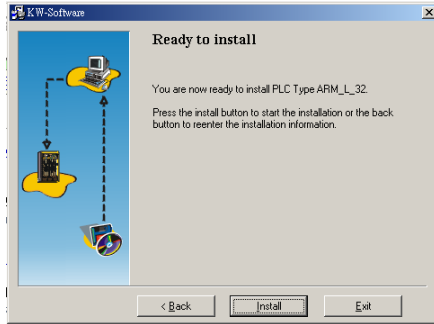


**Figure 3.17: MULTIPROG software Add-on installation language selection page**



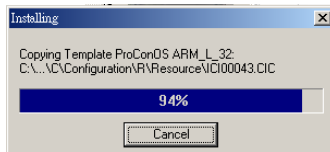
**Figure 3.18: PLC Type ARM\_L\_32 Add-on installation welcome page**



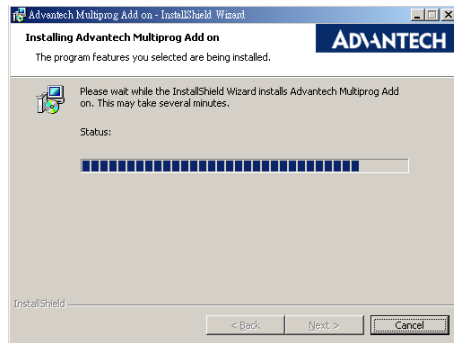


**Figure 3.19: PLC Type ARM\_L\_32 component ready to install**

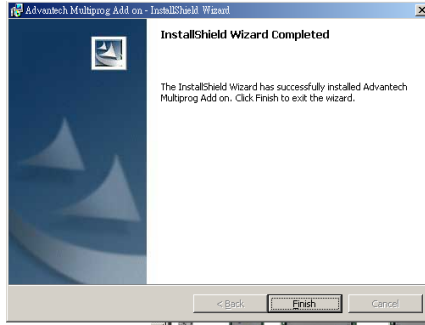
- (5) Installation wizard will initialize the process of installing "Advantech MULTIPROG Add on".



**Figure 3.20: PLC Type ARM\_L\_32 installation wizard**

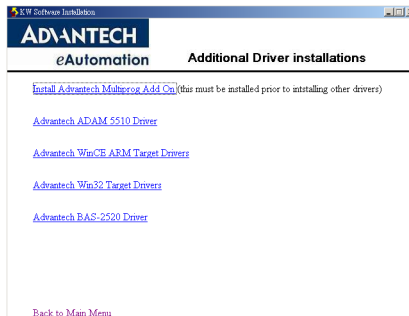


**Figure 3.21: Installation percentage of PLC Type ARM\_L\_32 Add-on**



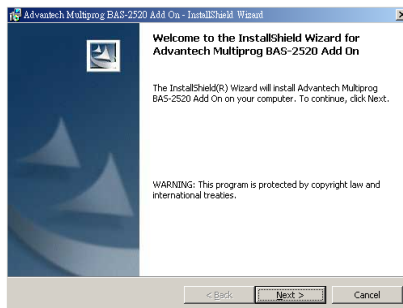
**Figure 3.22: PLC Type ARM\_L\_32 Add-on component install successfully**

- (6) Please go back to Multiprog Add-on main manu to select the "Advantech BAS-2000 Driver" component to install it.

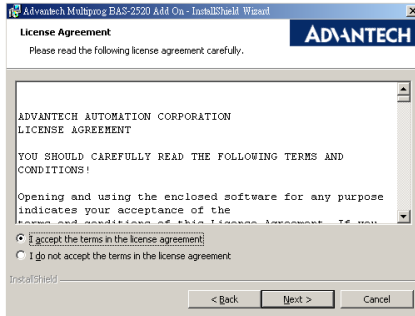


**Figure 3.23: Add-on components selection page**

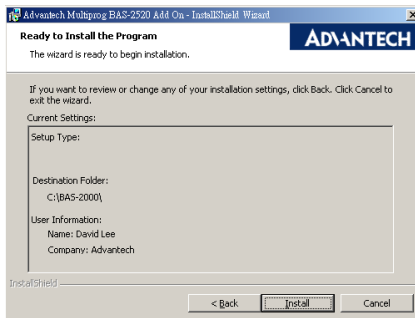
- (7) The software InstallShield Wizard will help you to install step by step.



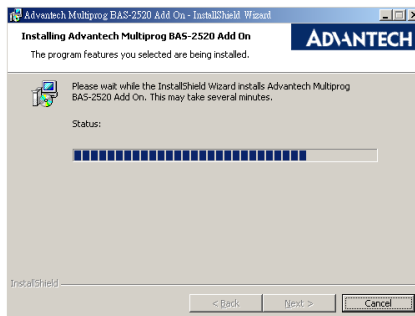
**Figure 3.24: Bas-2520 Driver Add-on installation welcome page**



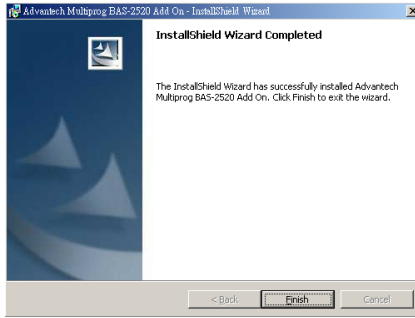
**Figure 3.25: License acceptance page**



**Figure 3.26: BAS-2520 Driver Installation information**



**Figure 3.27: BAS-2520 Driver Installation percentage**



*Figure 3.28: BAS-2520 Driver Installation completely*

### **3.4 MULTIPROG Registration**

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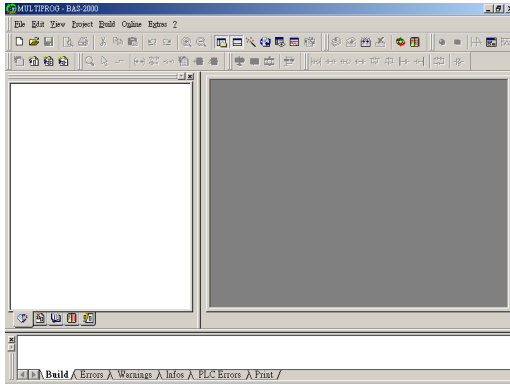
After finishing the installation step, you can run MULTIPROG from Start Menu --> All Program --> Advantech-->BAS-2000-->MULTIPROG

The program will be launch after you click on the icon for MULTIPROG and show the following welcome screen.



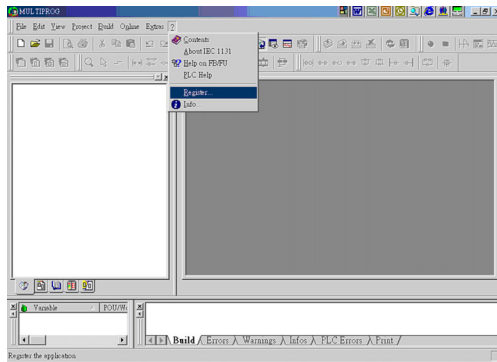
*Figure 3.29: MULTIPROG software start screen*

After showing the welcome screen, it will enter the main program.



**Figure 3.30: MULTIPROG software main program**

Choose "-->Register" of menu bar to open the Registration dialog box.



**Figure 3.31: MULTIPROG software for choosing license register function**

Enter the registration code from the key in the license agreement come with the software package.



**Figure 3.32: License code register block**

If you enter the correct registration code, the dialog box will close.



**Figure 3.33: License register successfully**

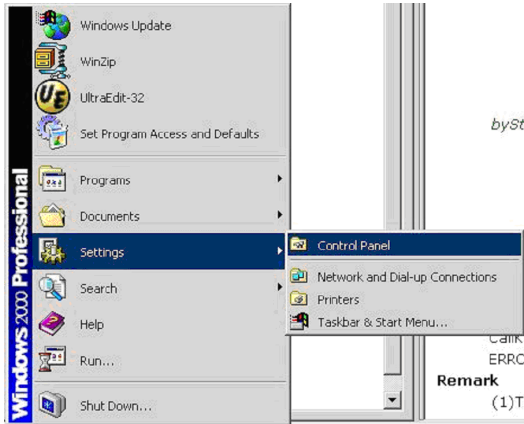
You can check the license status from "?-->Info" of menu bar.



**Figure 3.34: MULTIPROG software "about" information**

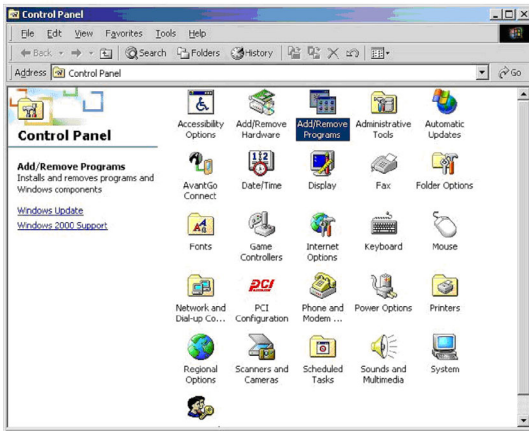
### 3.5 Uninstall MULTIPROG

To uninstall MULTIPROG, please remove it from Control Panel. You can just open the control panel by clicking on Start --> Settings --> Control Panel.



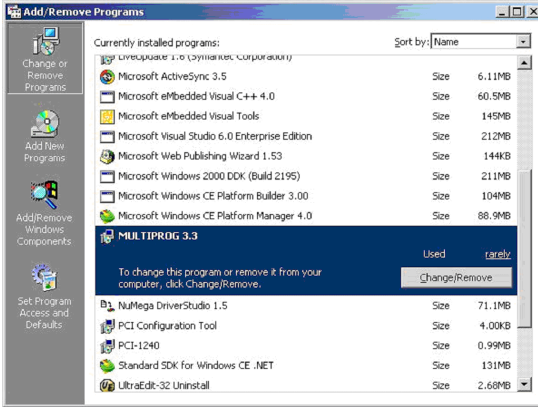
*Figure 3.35: Windows Program manual for "Control Panel"*

Click on "Add/Remove Programs" icon to enter the uninstall process



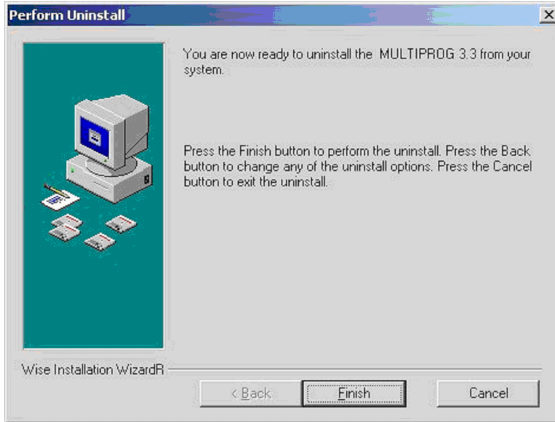
*Figure 3.36: Select "Add/Remove Programs" in Microsoft Windows Control Panel*

Find the MULTIPROG 3.3 of currently installed programs, click on the Change/Remove button to start the uninstall process.



**Figure 3.37: Select MULTIPROG software to remove it from Windows**

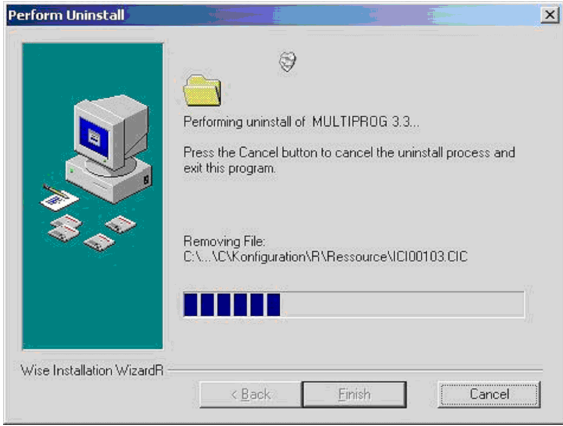
Press the Finish button to perform the uninstall.



**Figure 3.38: Windows ready to remove MULTIPROG software**



After click on Finish button, the uninstall process will start. After installation step is finished. The dialog box will be closed.



**Figure 3.39: MULTIPROG software un-installation proceeding**



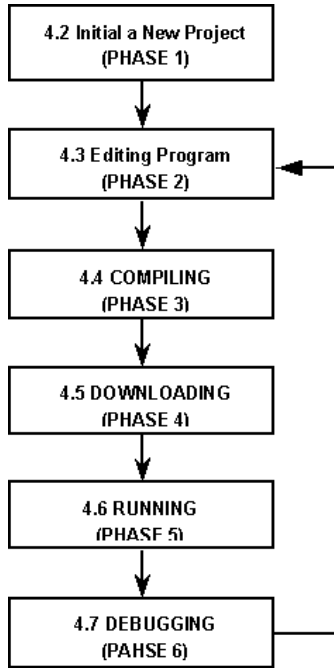
CHAPTER  
**4**

**Getting Started**

# Chapter 4 Getting Started

## 4.1 Project Development Flow Chart

---



*Figure 4.1: Project Development Flow Chart*

## 4.1.1 RUN MULTIPROG

Before starting to create a new project, it is necessary to run the MULTIPROG program. You can run the program from **Start menu --> Advantech --> BAS-2000 --> MULTIPROG**

After click on MULTIPROG icon, system will come out the welcome screen of MULTIPROG.



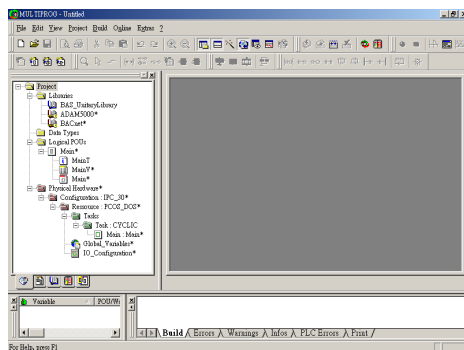
*Figure 4.2: MULTIPROG software start screen*

## 4.2 Initial Project

---

Before starting a new project, you must to open a new project and select the suitable template file for BAS-2520. After open a new project you can configure the system and I/O modules for this system.

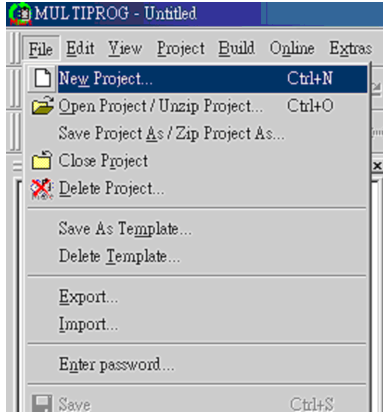
### 4.2.1 Create a new project



*Figure 4.3: Project windows in MULTIPROG main program*

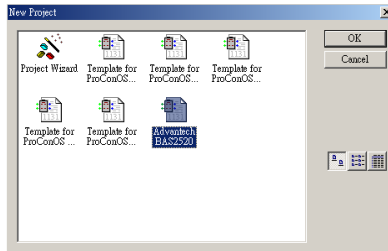
After the welcome message, you can see the main screen for MULTIPROG. You can create a new project by several ways, open with file menu, click on the new project icon from tools bar or press hot key (Ctrl + N), In this example, you can try to create a new project with opening the file menu.

**File --> New Project**



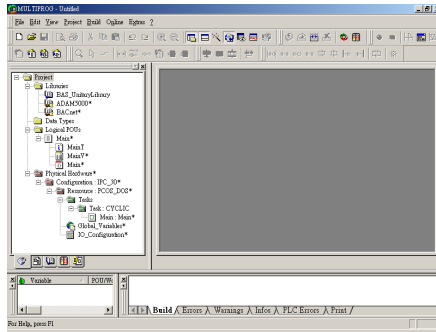
*Figure 4.4: Selection manual for creating new project*

**4.2.2 Select a Template File**



*Figure 4.5: Project Template selection page*

After a new project is created, the template dialog box will show up, choose the "Template for BAS-2520" and click on "OK" to start a new project. After Choosing the template file the system will go back to main program area as follow:



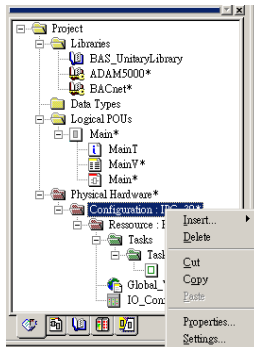
*Figure 4.6: MULTIPROG main program page for BAS-2520 template*

### 4.2.3 Resource Setting

Resource setting is used to specify the target for downloading. With the PLC type IPC you can use 2 simulations at the same time. You can also specify the real communication port for real device on BAS-2520 for programming.

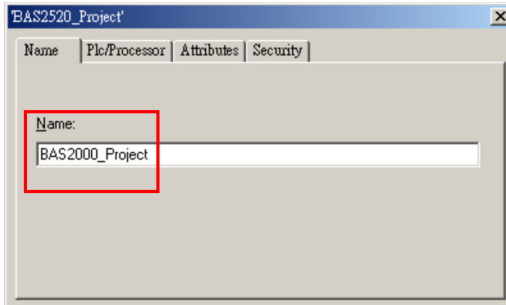
#### **Step 1. Modify the Configuration Name & Resource Name**

1. Expand the Physical Hardware tree menu to go on setting process
2. Modify Configuration Name  
Right click on Configuration: IPC\_30 option and click on Properties to set the configuration name. For example, you can change the property name for what you want.



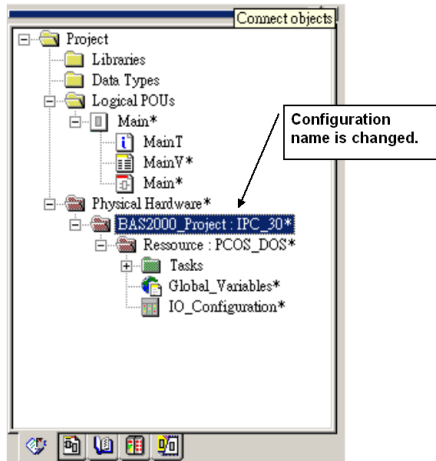
*Figure 4.7: Selection manu for "Configuration : IPC\_30"*

3. Fill in the wanted name (for example : 'BAS2000\_Project') and click on OK button.



**Figure 4.8: Property page of "Configuration : IPC\_30"**

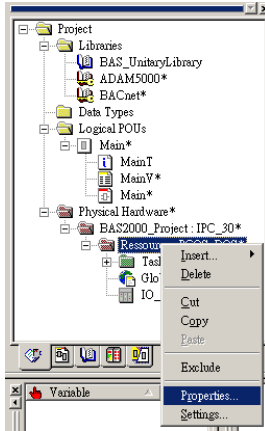
4. After clicking on ok, the modification is finished. The configuration name is changed to 'BAS2000\_Project : IPC\_30'. Please note "IPC\_30" is attached to your project name by system automatically.



**Figure 4.9: Worksheet of BAS-2520 after renaming the project**

5. Modify Resource Name  
You can just right click on 'Resource : PCOS\_DOS' and click on sub-menu of 'Properties...'. Please change the resource name to "'BAS2520' and click on OK button.

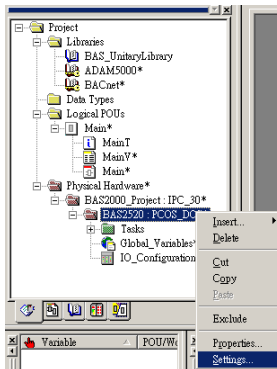




*Figure 4.10: Property selection for "Resource : PCOS\_DOS"*

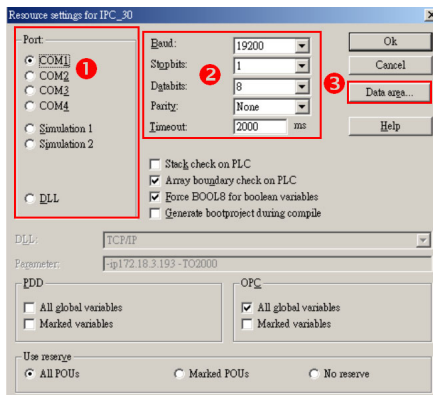
**Step 2. Start to Set Resource**

1. Right click on BAS-2520: PCOS\_DOS option and click on "Settings..." option in popup dialog to set the resource.



*Figure 4.11: Setting selection for "BAS2520 : PCOS\_DOS"*

2. You can see the BAS2520 :PCOS\_DOS dialog box will popup as below



**Figure 4.12: Setting page for "BAS2520 : PCOS\_DOS"**

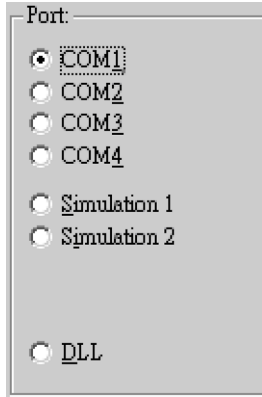
## Filed Description

COM	Indicates to which serial port the program is sent.
Simulation	Indicates to which simulation the program is sent.
DLL	Indicates that the program is sent to a communication DLL. A communication DLL is necessary, if the communication interface between the programming system and the PLC and/or the processor type does not fit together. Only available if a communication DLL is found in the path <code>mwtexe\plcname</code> .
Baud	Specifies the baud rate for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Stopbits	Specifies the number of stopbits for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Databits	Specifies the number of the databits for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Parity	Indicates the use of a parity bit for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Timeout	Specifies the interval in ms for timeout. During this time interval the programming system tries to establish the connection to the hardware. If the time interval is exceeded timeout is displayed.
Stack-Check on PLC	Activates the Stack-Check on the PLC. The Stack-Check checks if there are stack overflows. Activating this checkbox means a loss of performance but more security.
Array boundary check on PLC	Activates the array boundary check on the PLC. The array boundary check checks if all used array elements are included in the array. If an array e.g. has 23 elements, it is checked whether more than 23 elements are used in the PLC application. Activating this checkbox means a loss of performance but more security.

Force BOOL8 for Boolean variables	Stores all Boolean variables without direct location as a byte. Activating this checkbox means a much higher performance. The resulting code is changed. If it is not checked the variables are stored as one bit.
Generate bootproject during compile	Generates a bootproject during the compilation process and not while downloading. This checkbox can be used to generate a bootproject offline. The file for the bootproject is called bootfile.pro and is stored in the resource directory.
DLL:	Specifies the name of the communication DLL. Only available if DLL is activated.
Parameter:	Specifies the string passed to the DLL. Only available if DLL is activated.
PDD	Specifies if variables are written to the PDD on the PLC i.e. the variables can be used with IEC 61131-5 communication function blocks.
OPC	Specifies if variables are written to the *.csv file in the resource directory. The OPC Server processes these variables and transfers their actual values to an OPC Client.
Use reserve	Uses the memory reserve for Patch POU which has been entered in the dialog 'Data Area'. 'All POUs' means that the reserve is used for all POUs. 'Marked POUs' means that the reserve is used for all POUs which have been marked in the dialog 'Insert' while inserting the POU or in the POU properties dialog (tab 'Type'). 'No reserve' means that the reserve is not used. Recommended setting: 'All POUs'.
Data area...	Calls the dialog 'Data Area' for setting the memory areas for user and system flags and the reserve for POUs.

### 3. Port Setting and Baud Rate Setting

Before setting the port and baud rate, you should make sure the related setting of your host PC is fit to your choice. In the example, you can just set the three area of 'Port', 'Baud rate' and 'Data area...'. Please leave the other setting as default value.



**Figure 4.13: COM Port setting**

#### Filed Description

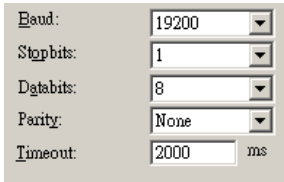
COM	Indicates to which serial port the program is sent.
Simulation	Indicates to which simulation the program is sent.
DLL	Indicates that the program is sent to a communication DLL. A communication DLL is necessary, if the communication interface between the programming system and the PLC and/or the processor type does not fit together. Only available if a communication DLL is found in the path mwtxe\plcname.

#### Port setting:

You can set up the port setting between your local port and BAS-2520. For example, if you connect your BAS-2520 to your COM 1, please choose COM1 option in this Port setting.

**Note:** (1) You can also choose Simulation option for 32 bits simulation program if there is not any real device on BAS-2520.

## 4. Baud Rate Setting



Baud: 19200  
Stopbits: 1  
Databits: 8  
Parity: None  
Timeout: 2000 ms

**Figure 4.14: Baud Rate setting**

### Filed Description

Baud	Specifies the baud rate for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Stopbits	Specifies the number of stopbits for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Databits	Specifies the number of the databits for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Parity	Indicates the use of a parity bit for the communication via the selected port. This entry has only to be changed if your hardware needs a different value.
Timeout	Specifies the interval in ms for timeout. During this time interval the programming system tries to establish the connection to the hardware. If the time interval is exceeded timeout is displayed.

### Baud Rate Setting

For the hardware specification, please follow the limitation for connecting BAS-2520 programming port.

Baud rate: 19200

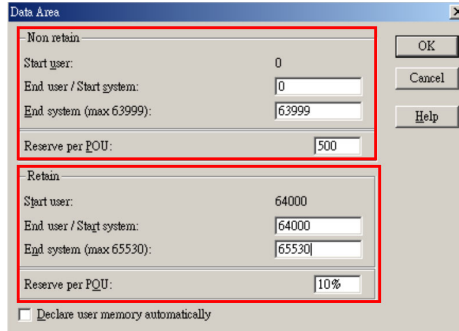
Stop bits: 1

Data bits: 8

Parity: None

## 5. Data area setting

The purpose of setting "Data Area" is setting the memory areas for user and system flags and the reserve for POU's.



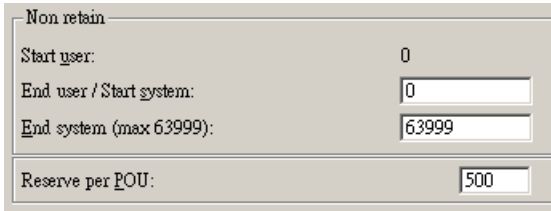
**Figure 4.15: Data Area setting**

### Field Description of Non retain area

Start user:	Specifies the address where the memory area for user flags starts.
End user / Start system:	It specifies the address where the memory area for the programming system flags starts. These flags are internally used by the programming system.
End system:	It specifies the address where the memory area for programming system flags ends. These flags are internally used by the programming system .
Reserve per POU:	It specifies the default memory reserve for a POU used for Patch POU. If no reserve is used it is not possible to use Patch POU if retain or non-retain variables have been added. The reserve can be entered in % or in bytes.
Declare user memory in I/O configuration automatically	Creates automatically a hidden entry (VAR_CONF) in the I/O configuration containing the memory areas set in this dialog. This checkbox should normally be activated for using the settings done in this dialog. Only for old projects or special I/O configurations this checkbox should be unchecked.

**Note:** *Please follow the setting of tutorial, otherwise BAS-2520 will not work correctly.*

### Non-retain area setting:



The image shows a dialog box titled "Non retain" with a light gray background. It contains four rows of settings, each with a label on the left and a value on the right. The first row is "Start user:" with the value "0". The second row is "End user / Start system:" with a text input field containing "0". The third row is "End system (max 63999):" with a text input field containing "63999". The fourth row is "Reserve per POU:" with a text input field containing "500".

Non retain	
Start user:	0
End user / Start system:	<input type="text" value="0"/>
End system (max 63999):	<input type="text" value="63999"/>
Reserve per POU:	<input type="text" value="500"/>

*Figure 4.16: Non-retain setting*

#### **Start user:**

System default Start user value for non-retain is '0', you can't modify this value.

#### **End user / Start system:**

Start system value should follow the Start user value. Please fill '0' here.

#### **End system (max 63999):**

System will automatically calculate the system flags end as max value of End system value. In this tutorial, please fill in the max value '63999'.

#### **Reserve per POU:**

Default memory reserve for a POU is used for Patch POU. Please leave this value as default. The default value is '500'.



### Retain area setting:

Retain	
Start user:	64000
End user / Start system:	<input type="text" value="64000"/>
End system (max 65530):	<input type="text" value="65530"/>
Reserve per POU:	
	<input type="text" value="10%"/>

*Figure 4.17: Retain Area setting*

### Field Description of retain area

Start user:	Specifies the address where the memory area for user flags starts.
End user / Start system:	It specifies the address where the memory area for the programming system flags starts. These flags are internally used by the programming system.
End system:	It specifies the address where the memory area for programming system flags ends. These flags are internally used by the programming system .
Reserve per POU:	It specifies the default memory reserve for a POU used for Patch POU. If no reserve is used it is not possible to use Patch POU if retain or non-retain variables have been added. The reserve can be entered in % or in bytes.
Declare user memory in I/O configuration automatically	Creates automatically a hidden entry (VAR_CONF) in the I/O configuration containing the memory areas set in this dialog. This checkbox should normally be activated for using the settings done in this dialog. Only for old projects or special I/O configurations this checkbox should be unchecked.

#### **Start user:**

System default Start user value for retain is '64000', the value is follow the End system value.

#### **End user / Start system:**

Start system value should follow the Start user value. Please fill '64000' here.

**End system (max 65530):**

System will automatically calculate the system flags end as max value of End system value. In this tutorial, please fill in the max value '65530'.

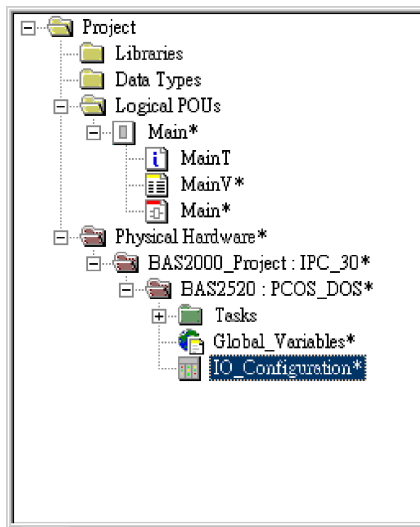
**Reserve per POU:**

Default memory reserve for a POU is used for Patch POU. Please leave this value as default. The default value is '10%'.

**4.2.4 Set I/O Configuration**

The dialog 'I/O Configuration' is used to edit the I/O configuration worksheet. The I/O configuration normally contains declarations of the I/O modules, for example the logical addresses of a module (start and end address), device declarations (driver name or memory address), etc.

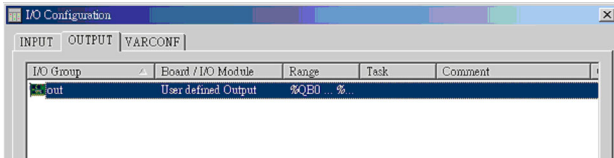
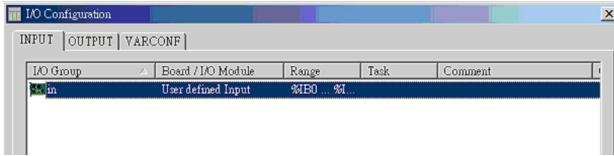
After finishing the resource setting, you can go on setting the I/O module on your system. Double click on the IO\_Configuration option and system will bring out a dialog box of I/O Configuration.



*Figure 4.18: IO\_Configuration selection*

**Step 1. Delete the default I/O module setting:**

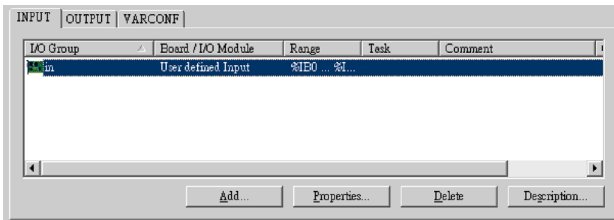
There will be two I/O modules for system default I/O module setting for your reference, one for Input module named "in" and the other one for output module named "out". Please delete the default module from system to release the memory address setting.



**Figure 4.19: I/O configuration page**

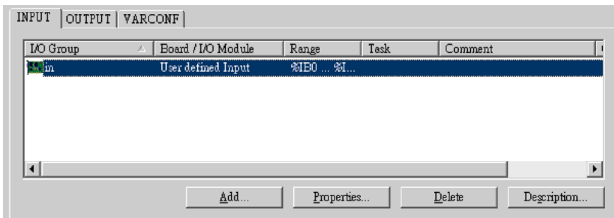
You can delete default I/O module configuration by simply choose the module and click on delete as following step.

1. Select I/O module



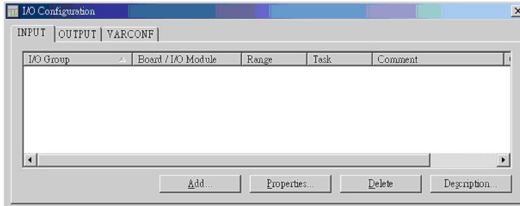
**Figure 4.20: I/O Selection**

2. Click on Delete button



**Figure 4.21: Delete I/O**

### 3. I/O module is deleted



**Figure 4.22: Empty I/O Configuration page**

#### **Step 2. Add I/O module**

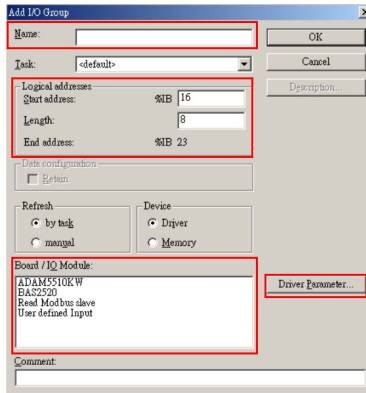
While the connected process is running, the PLC receives input signals via the I/O modules. These input signals are processed according to the PLC program. After a working cycle the PLC transmits the output signals to the I/O modules. The way the PLC handles these signals are set up via the I/O configuration.

If necessary also the data configuration of the memory area for non-retentive and retentive variables can be edited.

In this example, you will learn to add a Digital Input and Digital Output module of BAS-2520.

It is easy to add a new input / output module as following steps:

- 2.1. Select INPUT tag of I/O Configuration dialog box (Please refer Fig. 4-21)**
- 2.2. Click on "Add..." button (Please refer Fig. 4-21)**
- 2.3. The Properties dialog box pop up**



**Figure 4.23: "Add I/O Group" Property dialog box**

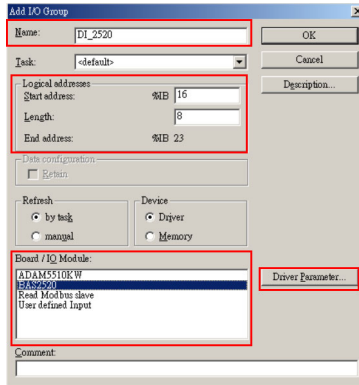
## Field Description of I/O Configuration

'OK'	Confirms the dialog. The settings are entered in the corresponding page ('INPUT' or 'OUTPUT') of the dialog 'I/O Configuration'.
'Description'	Calls a description concerning the selected board / I/O module (see below). If no board is selected, clicking on this button has no effect.
Name	Specifies the name of the I/O module. The user can define any name.
Task	Specifies the task, to which the module is assigned (i.e. which processes the signals for/from the module). The list box contains all tasks which are used in the PLC program.
Start address	Specifies the start address of the module. The location prefix (I for inputs and Q for outputs) is entered automatically. The size prefix for I/O modules is always set to B (byte). If a new module is added, the system automatically enters the first free address. Important: When changing the (proposed) start address, ensure that it does not overlap with an already declared module!
Length	Specifies the number of address bytes. Important: If several groups are to be declared, ensure that their address ranges do not overlap!
End address	The end address is calculated automatically by the system (end address = start address + length).
Refresh'by task' or 'manual'	Specifies, whether the values at the inputs/outputs are refreshed by the assigned task or have to be refreshed manually. In the most cases 'by task' should be selected.
Device'Driver' or 'Memory'	Specifies the device. Different dialog areas are visible, depending on this setting: If 'Driver' is selected, the dialog area 'Board/ I/O Module' is visible, where you can select a driver. In this case the fieldbus card is accessed using the specified driver. To get direct or buffered memory access, select 'Memory'. Then, the dialog area 'Memory' is visible. In the most cases 'Driver' should be selected. For detailed information about these areas, see below.

Board / I/O Module:	This dialog area is only visible, if 'Device' is set to 'Driver'. The area is used to specify the used I/O module. The list box contains all drivers installed on your system. Select the required driver by double clicking on the corresponding entry. To define driver settings click on the button 'Driver Parameter...'
Driver Parameter...	This button is only visible, if 'Device' is set to 'Driver'. If a board / I/O module is selected, pressing this button calls the dialog 'Driver information of device device_name'. The contents of this dialog depends on the selected board/module. For detailed information about the data please refer to your module documentation.
'Comment'	Text field for entering a short description text.

### Step 3. Input Module Setting

Fill the name field. For some rules on Name and Logical address, please refer to table of named rule and Logical address rule.



**Figure 4.24: Editing I/O property**

In this step, you should only modify the I/O module for "Name", "Logical addressed", "Board / IO Module" and "Driver Parameter".

Name:

You can assign the name of your I/O module under system rules.

- (1) Only 8 digits for name.

- (2) Must be start with alpha character, not numeric character.
- (3) Can not use special character for example, !@#\$%^&\*(). The under line symbol is allowed for the name rule.

### 3.1 Name Setting

In this tutorial, you can assign the DI\_2520 for DI in BAS-2520 module.



*Figure 4.25: I/O name setting*

### 3.2 Logical address setting

#### Logical address:

You should assign the logical address for different I/O module. There are three parameters for this setting.

#### Start address:

System will detect the free logical address for your start address.

#### Length for BAS-2514 I/O modules:

Module Type	Number of Channel	Length
Analog Input	4	8 bytes
Analog Output	3	4 bytes
Digital Input	4	1 bytes
Digital Output	3	0.5 bytes

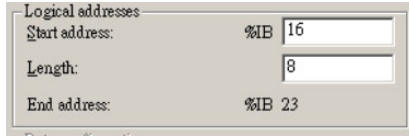
#### Length for BAS-2520 I/O modules:

Module Type	Number of Channel	Length
Analog Input	4	8 bytes
Analog Output	4	4 bytes
Digital Input	8	1 bytes
Digital Output	4	0.5 bytes

#### End address:

System will calculate the end address automatically.

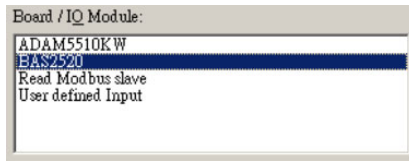
In this tutorial, as the DI in BAS-2520, the value of start address field is '8' (system default value) and the value of length field is '8'.



**Figure 4.26: I/O address length setting**

### 3.3 Board I/O Module Setting

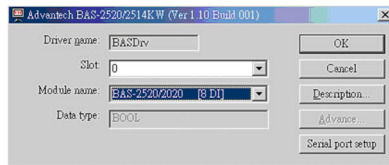
Select BAS2520 for Board / IO Module for supporting BAS-2520 onboard I/O.



**Figure 4.27: Board I/O module selection**

### 3.4 Driver Parameter Setting

After selecting BAS2520 as your Board / IO Module, please click on Driver Parameter button to make a advance setting of ADAM-5000 I/O Modules.



**Figure 4.28: Driver parameter setting**

#### Driver Name

When you select the BAS2520 for Board / IO Module, please note, the default Driver name is setting to BASDrv, It can't change under this Board I/O Module.

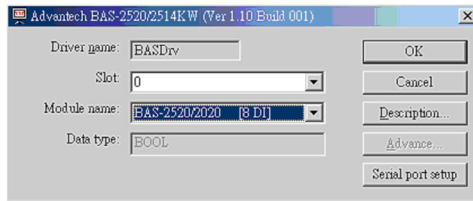


### Device ID:

You can set up the device ID refers to hardware setting in chapter 2.

### Module name

With the BAS-2520 Board I/O Module setting, we provide the BAS-2000 series I/O module for selecting. You can select the correct module of your system. In this tutorial, please select 'BAS-2520/2020 [8 DI]' here.



*Figure 4.29: Selection for BAS-2520/2514 Board I/O*

### Data type

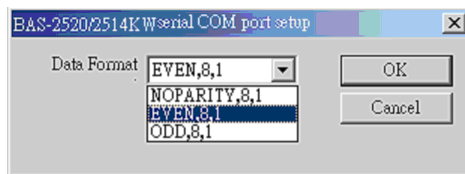
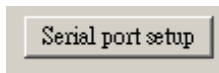
After selecting the module name, system will select the Data type for you automatically. There are four types of data type for I/O module as follow.



*Figure 4.30: Data type selection*

### Serial Port Setup

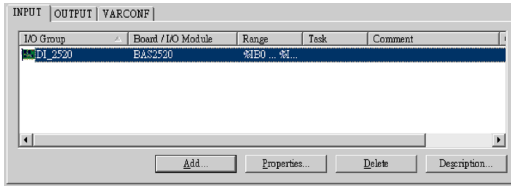
Select the Date format for your I/O module by clicking on Serial port setup button, system supports three kinds of data format. In this tutorial, please select 'EVEN,8,1'.



*Figure 4.31: Series Port setting*

## Get Online Help

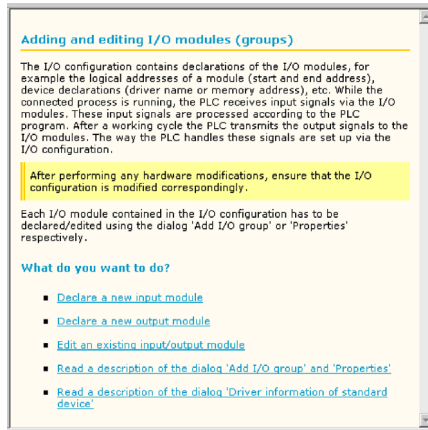
After finishing the setting above, you can click on OK to finish the I/O module setting. The I/O Configuration will update as follow.



**Figure 4.32: Digital Input for BAS-2520 setting**

If you still need more information about this setting, you can click on the "Description..." button to get more information.

After clicking on the "Description..." button, the online help system will start and give you the related information.



**Figure 4.33: On-line Help for I/O module setting**

## Step 4. Output Module Setting

### 4.1. Select OUTPUT tag of I/O Configuration dialog box

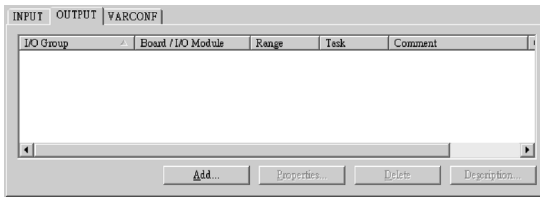


Figure 4.34: Output I/O Configuration dialog

### 4.2. Click on "Add..." button

### 4.3. The Properties dialog box pop up (Please refer Fig. 4-22)

Fill the name field. For some rules on Name and Logical address, please refer to table of named rule and Logical address rule.

In this step, you should only modify the I/O module for "Name", "Logical addressed", "Board / IO Module" and "Driver Parameter".

Name:

You can assign the name of your I/O module under system rules.

- (1) Only 8 digits for name.
- (2) Must be start with alpha character, not numeric character.
- (3) Can not use special character for example, !@#\$%^&\*(). The under line symbol is allowed for the name rule.

### 4.4 Name Setting

In this tutorial, you can assign the DO\_2520 for DO in BAS-2520 Controller.

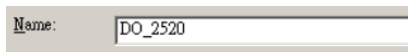


Figure 4.35: DO Name setting

### 4.5 Logical address setting

#### Logical address:

You should assign the logical address for different I/O module. There are three parameters for this setting.

**Start address:**

System will detect the free logical address for your start address.

**Length for BAS-2014 I/O modules:**

Module Type	Number of Channel	Length
Analog Input	4	8 bytes
Analog Output	3	4 bytes
Digital Input	4	1 bytes
Digital Output	3	0.5 bytes

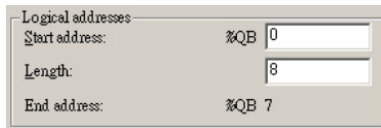
**Length for BAS-2020 I/O modules:**

Module Type	Number of Channel	Length
Analog Input	4	8 bytes
Analog Output	4	4 bytes
Digital Input	8	1 bytes
Digital Output	4	0.5 bytes

**End address:**

System will calculate the end address automatically.

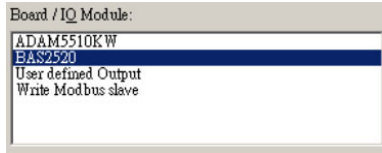
In this tutorial, as the BAS-2520 is the Controller with 20 channels Digital Output module, the value of start address field is '0' (system default value) and the value of length field is '8'.



**Figure 4.36: Output address length setting**

## 4.6 Board I/O Module Setting

Select BAS2520 for Board / IO Module for supporting BAS-2000 I/O Modules.



*Figure 4.37: Output module selection*

## 4.7 Driver Parameter Setting

After selecting BAS2520 as your Board / IO Module, please click on Driver Parameter button to make a advance setting of BAS-2000 I/O Modules. (Please refer Fig. 4-27)

### Driver Name

When you select the BAS2520 for Board / IO Module, please note, the default Driver name is setting to BASDrv, It can't change under this Board I/O Module.

### Device ID:

You can set up the device ID refers to hardware setting in chapter 2.

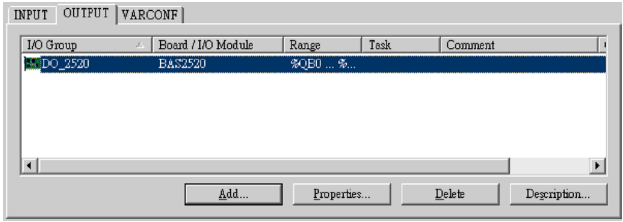
### Module name

With the BAS2520 Board I/O Module setting, we provide the BAS-2000 series I/O module for selecting. You can select the correct module of your system. In this tutorial, please select 'BAS-2520/2020 [4 DO]' here. (Please refer Fig. 4-28)

### Serial Port Setup

Select the Date format for your I/O module by clicking on Serial port setup button, system supports three kinds of data format. In this tutorial, please select 'EVEN,8,1'. (Please refer Fig. 4-30)

After you finish the step, ADAM-5056 will be added on OUTPUT module.



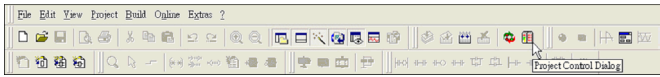
**Figure 4.38: DO Module selection**

### 4.2.5 Download Hardware Setting

After finishing the I/O Configuration, you can download the hardware setting into BAS-2520.

#### *Step 1 Download the I/O Configuration into System*

There will be two components to download to the system, one for I/O Configuration file and project code for another. After making your project, you should download the setting to your system. You can click on the tools bar icon of Project Control Dialog.



**Figure 4.39: Menu/Tool bar of MULTIPROG main program**

#### *Step 2 Click on Download button to download the file into system*



**Figure 4.40: Project Control Dialog**

## 4.3 EDIT Program

### 4.3.1 User interface

The program user interface consists basically of six parts:

Menu, toolbars, main screen, message window, cross reference window and status bar.

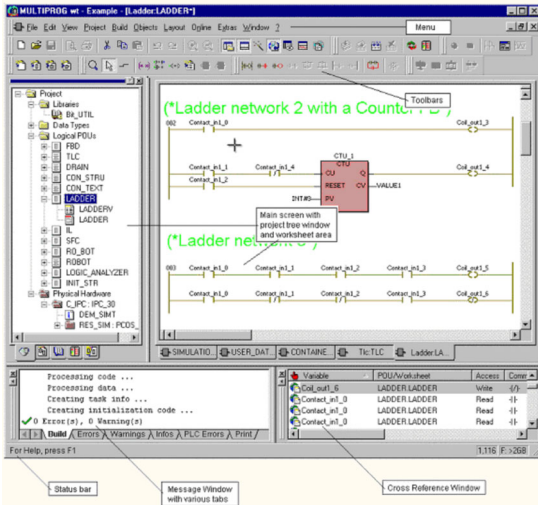


Figure 4.41: MULTIPROG software user interface

#### Step 1. Create a New Program

Expand the Main of Logical POUs, double click on Main program as follow.

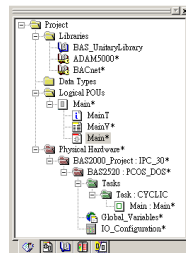
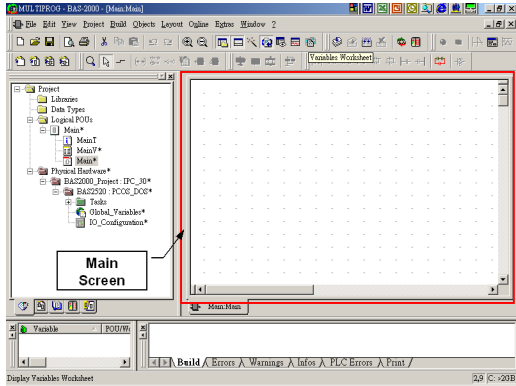


Figure 4.42: Create New Program

**Step 4. System will open the main screen area in center area.**



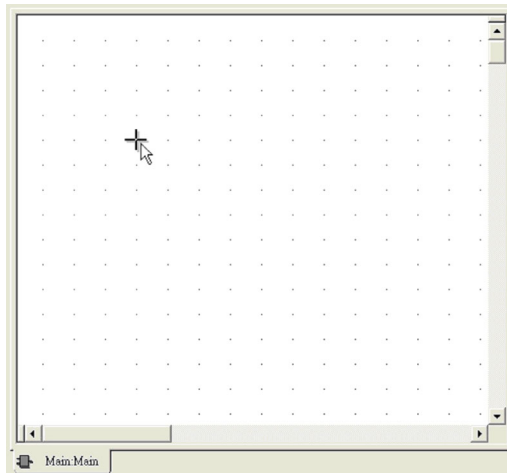
**Figure 4.43: Program editing worksheet**

### **4.3.2 Create a Contact Network**

In this tutorial, you can learn how to create a contact network between DI & DO point in BAS-2520 controller.

**Step 1. Click on main screen**

Move your mouse to the main screen and click on a location of main screen. A cross-type of locator will show on the main screen.

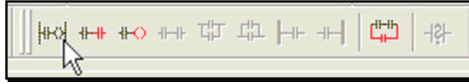


**Figure 4.44: Program editing window**



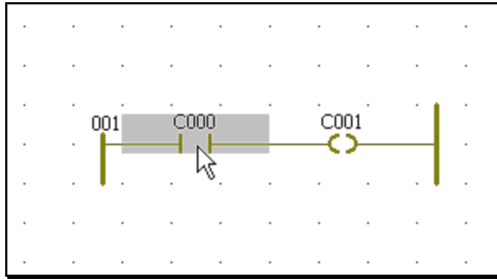
**Step 2. Click on Contact Network Icon.**

Move the cursor on the Ladder Tool Bar and click on the Contact Network icon to create a ladder contact network.



**Figure 4.45: Ladder Tool Bar**

After clicking on the icon of contact network, there comes a closed structure contact network ladder.

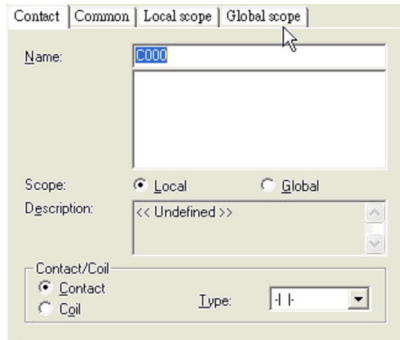


**Figure 4.46: Ladder Diagram Example**

**Step 3. BAS-2520 Digital Input Channel 0 Setting**

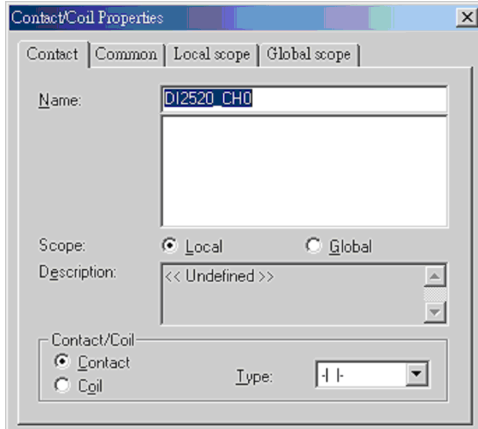
**3.1 Configure the Contact/Coil Properties**

Double click on the element C000. It will pop up the property dialog box. In this tutorial, we will configure this contact/coil for BAS-2520 DI channel 0.



**Figure 4.47: Default setting of C000**

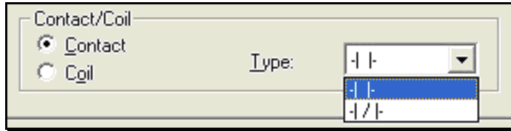
Change the name from C000 to DI2520\_CH0 and click on OK, the contact name will be set to DI2520\_CH0. Please note in this tutorial the 'Scope' field is set to be 'Local'.



**Figure 4.48: Contact/Coil Property editing example**

### 3.2 Select the Contact/Coil Type

There are two types of Contact for output, Normal Open and Normal Close.



**Figure 4.49: Contact/Coil type selection**

Select the contact and select contact type to normal open symbol. After finishing this setting, click on OK to finish the Contact setting.

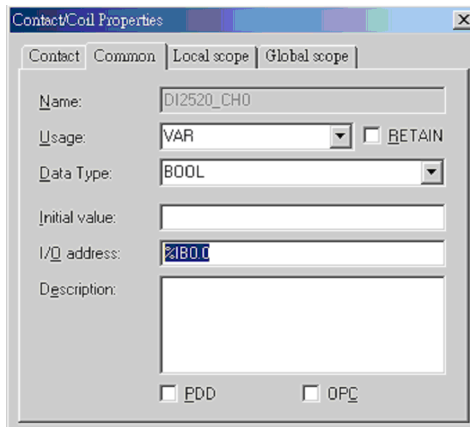
### Contact Type

Contacts are basic elements of an LD network. A contact copies the Boolean value from its left to its right according to the state of the associated variable. The name of the variable is indicated above the contact. The type of the contact is represented with the symbol of its qualifier. The following types of contacts can be used:

Symbol	Name	Description
--     --	Normally open contact	The Boolean value is copied from the left to the right if the state of the associated variable is ON.
--   /   --	Normally closed contact	The Boolean value is copied from the left to the right if the state of the associated variable is OFF.

### 3.3 Setting the Common Value for BAS-2520 DI Channel 0

In this step, you can set up the common value of Usage, Data Type, Initial Value, I/O address and Description of the contact object.



*Figure 4.50: Data type, initial value, I/O address setting in Contact/Coil property*

You should specify the I/O address of the contact. The location prefix must be assigned I for input here. The size prefix for I/O modules is always set to B (byte). In this tutorial, the I/O address of DI2520\_Ch0 will be "%IB0.0".

Prefix	Memory Mapping Address
%IB	0.0

Prefix: %IB means Input Byte

I for Input Location Prefix

B for Size Prefix

Memory Mapping Address: 0.0

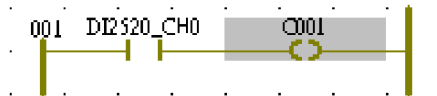
According to the logical address setting of BAS-2520 (refer to I/O Configuration Step 4), the start address is 0, the length is 1 bytes. BAS-2520 is with 8 channels digital input module. The memory mapping address table will be as following table.

Channel	Ch0	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7
Address	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7

After setting the common value for DI5051\_Ch0, click on ok and finish the setting.

#### Step 4. BAS-2520 Digital Output Channel 0 Setting

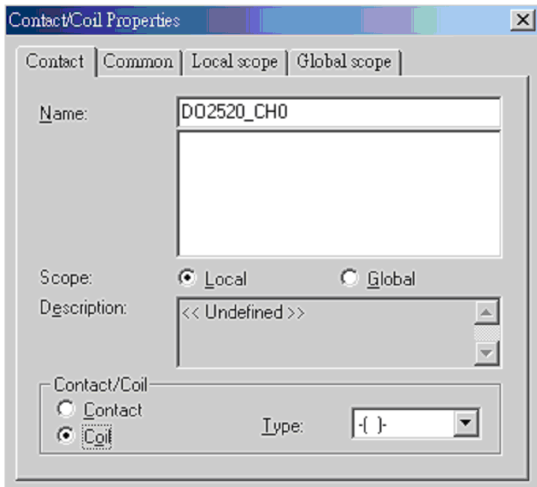
##### 4.1 Configure the Contact/Coil Properties



**Figure 4.51: Contact/Coil Ladder example**

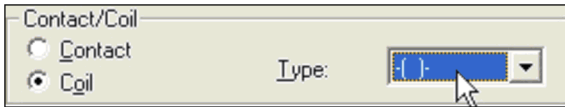
Double click on the element C001. It will pop up the property dialog box. In this tutorial, we will configure this contact/coil for BAS-2520 DO channel 0.

Change the name from C000 to DO2520\_Ch0 and click on OK, the contact name will be set to DO2520\_Ch0. Please note in this tutorial the 'Scope' field is set to be 'Local'.



**Figure 4.52: Contact/Coil name editing**

#### 4.2 Select the Contact/Coil Type



**Figure 4.53: Contact/Coil type selection**

Select the Coil and select Coil type to Coil symbol. After finishing this setting, click on OK to finish the Contact setting.

#### Coil Type

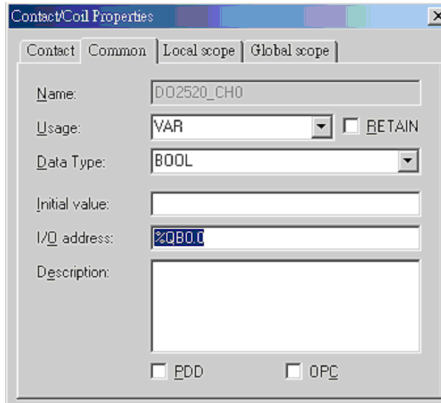
Coils are basic elements of an LD network. A coil copies the state of the element on its left to the element on its right without modification. It stores an appropriate function of the state or transition of the left link into the associated Boolean variable. The name of the variable is indicated above the coil. The type of the coil is represented with the symbol of its qualifier.

The following types of coils can be used:

Symbol	Name	Description
-- ( ) --	Coil	The Boolean value is copied from the left to the right and to the associated variable.
-- ( / ) --	Negated coil	The Boolean value is copied from the left to the right. The negated Boolean value is copied to the associated variable.
-- ( S ) --	SET coil	The Boolean value is copied from the left to the right. The associated variable is set if the left link is TRUE.
-- ( R ) --	RESET coil	The Boolean value is copied from the left to the right. The associated variable is reset if the left link is TRUE.

### 4.3 Setting the Common Value for BAS-2520 DO Channel 0

In this step, you can set up the common value of Usage, Data Type, Initial Value, I/O address and Description of the contact object.



**Figure 4.54: Contact/Coil Common property setting**

You should specify the I/O address of the contact. The location prefix must be assigned to Q for output here. The size prefix for I/O modules is always set to B (byte). In this tutorial, the I/O address of DO2520\_Ch0 will be "%QB0.0".

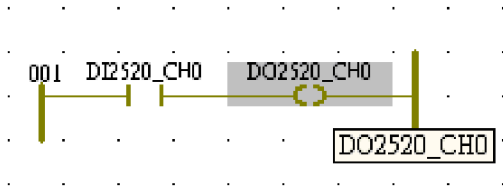
Prefix	Memory Mapping Address
%QB	0.0

Prefix: %IB means Input Byte  
 Q for Output Location Prefix  
 B for Size Prefix  
 Memory Mapping Address: 0.0

According to the logical address setting of BAS-2520 (refer to I/O Configuration Step 7), the start address is 0, the length is 0.5 bytes. BAS-2520 is with 4 channels digital output. The memory mapping address table will be as following table.

Channel	Ch0	Ch1	Ch2	Ch3
Address	0.0	0.1	0.2	0.3

After setting the common value for DO2520\_Ch0, click on ok and finish the setting. The contact network will be done after this step; you can see the ladder of contact network is finished as follow.

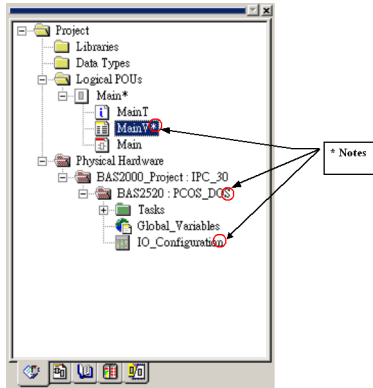


**Figure 4.55: Contact/Coil Ladder example with edited name**

## 4.4 Make / Compile your Project

---

After checking the contact network, you should make / compile your project in this section. If any change made, there will have the "\*" note show up in project menu. Please compiler your project by click on Make button.



*Figure 4.56: Project windows in main program*

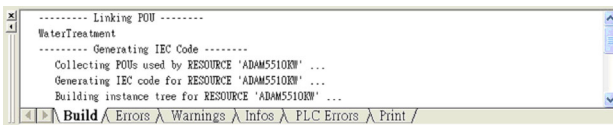
### Step 1. Make Your Project

Click on the tools bar of Compiler/Debug.



*Figure 4.57: Compiler/Debug tool bar*

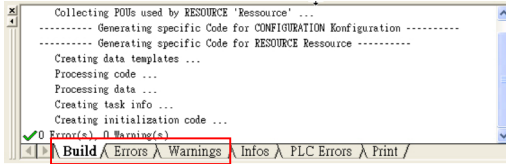
You can see the process for compiling your project in cross reference windows below.



*Figure 4.58: Compiler/Debug message window*

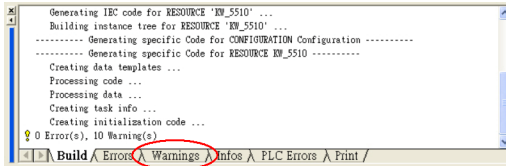


If there is not any error message or warning message shows up, you can download the project into BAS-2520.



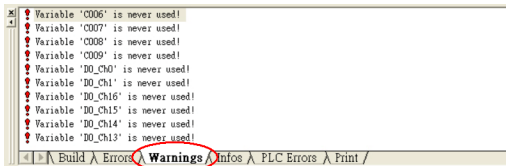
**Figure 4.59: Build/Errors/Warning pages selection in Compiler/Debug message window**

Otherwise, if there comes some error or warning message. You have to click on the Errors or Warnings Tag below the cross reference windows to correct some errors from system check. For detail error message, please refer to online help.



**Figure 4.60: Warning page selection in Compiler/Debug message window**

For example, if system show 10 warnings after compiling your project. You can click on the Warnings Tag under the message dialog box to find the warning message and correct them.



**Figure 4.61: Warning page in Compiler/Debug message window**

## 4.5 Download your Project

---

After checking the compiler step is ok, you have to download the project to your BAS-2520 system. Please follow the step to finish the downloading process.

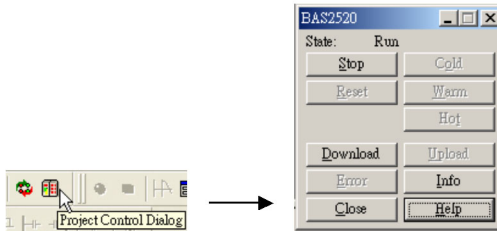
### ***Step 1. Download the program into System***

After downloading the I/O configuration setting to BAS-2520, you should download your project into BAS-2520. You can follow the step to download and active your system. After making your project, you should download the setting to your system. You can click on the tools bar icon of Project Control Dialog.



***Figure 4.62: Project Control Dialog selection in main program tool bar***

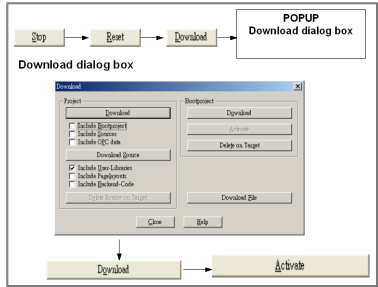
### ***Step 2. Click on Download button to download the file into system***



***Figure 4.63: Project Control Dialog***

### Download Process Flow Chart

When the dialog box shows up, please follow the following step to download and active your project.



**Figure 4.64: Configuration program download process flow chart**

**Step 3. Click the Stop button to Stops the PLC or simulation**



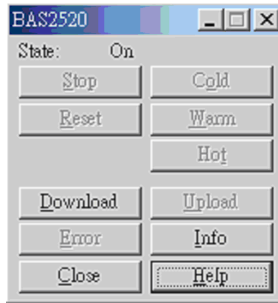
**Figure 4.65: Stop PLC CPU via Project Control Dialog**

**Step 4. Click the Reset button to Resets the PLC**



**Figure 4.66: Reset PLC CPU via Project Control Dialog**

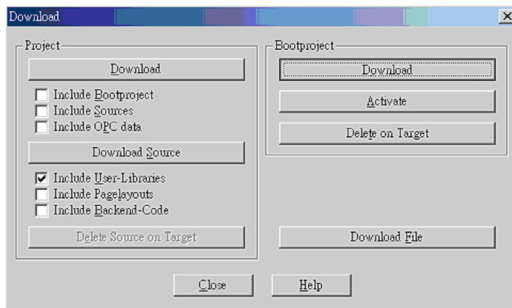
**Step 5. Click on Download button to recall the download dialog box**



**Figure 4.67: Download program into PLC CPU via Project Control Dialog**

**Step 6. Send a Bootproject to the Target**

After clicking on download button, the download dialog box will show up. Click on Download button in Bootproject.



**Figure 4.68: Bootproject download function selection in Download dialog**

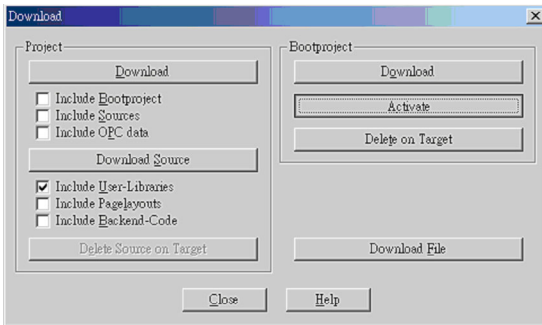
During the downloading process, the status bar below will show the downloading status and the percentage of downloading.



**Figure 4.69: Bootproject download percentage**

### Step 7. Active Your Project

After download and active your project and no error show on the control dialog box, you can run your project now.



**Figure 4.70: Bootproject activate function selection in Download dialog**

#### Fields Description:

Title bar	The title bar of the dialog shows the name of the resource, which is controlled by this dialog.
State	Indicates the state of the PLC or simulation. If [Debug] is added to the state it means that variables have been forced or breakpoints have been set.
Stop	Stops the PLC or simulation.
Cold	Executes a cold start. During a cold start all data are initialized.
Warm	Executes a warm start. During a warm start only non-retentive data are initialized.
Hot	Executes a hot start. During a hot start no data are initialized.
Restart	Restarts the program execution after a breakpoint has been reached. Only available if a breakpoint has been set.
Go	Continues the program execution after a breakpoint has been reached. Only available if a breakpoint has been set.

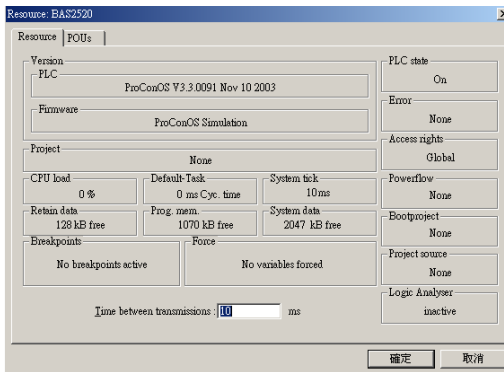
Step	Steps over. Continues the program execution line by line after a breakpoint. If a function or a function block is reached it is stepped over. The code body of the function or function block is not debugged. Only available if a breakpoint has been set.
Trace	Traces into. Continues the program execution line by line after a breakpoint. If a user function or a function block is reached it traces into the code body of the function or function block. Only available if a breakpoint has been set.
Error	Opens the message window with the PLC errors. Only available if errors were detected.
Download	Calls the dialog 'Download Resource_name' to send a project or bootproject to the target.
Upload	Starts uploading the zipped project source from the PLC which has been downloaded before. Click here for information how to upload the project source.
Reset	Resets the PLC.
Info	Calls the dialog 'Resource: resource name' for information about the current PLC state.
Close	Closes the control dialog.

## 4.6 Run Your Project

After finishing in download project, you can run your project with Cold start, Warm start or Hot start, the different between these three modes are list as following table:

<p>Cold Start</p> <p><b>C</b>old</p>	Executes a cold start. During a cold start all data are initialized.
<p>Warm Start</p> <p><b>W</b>arm</p>	Executes a warm start. During a warm start only non-retentive data are initialized.
<p>Hot Start</p> <p><b>H</b>ot</p>	Executes a hot start. During a hot start no data are initialized.

If you want to check the system status before running the project, you can click on the info button in control dialog box. You can get some information about your system such as ProConOS Version, Firmware version, Project Name, CPU load, Memory Usage, etc.



**Figure 4.71: Software Information Dialog**

## 4.7 Online Debug Mode and Force Tools

After the step of section 4.7, It seems nothing happen from your system and you don't know if the system is running. In this section, you can learn how to use the debug mode and force tools to check if the system is running.

### Step 1. Open the Debug Mode

Click on the Debug on/off icon from Compiler/Debug tools bar. The ladder of your project will go into online debug mode in Main Screen.

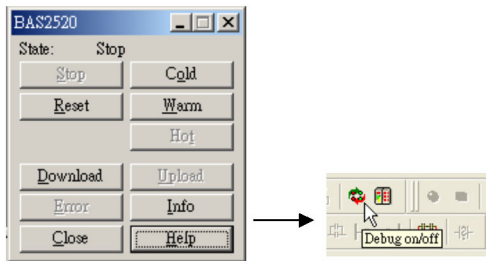


Figure 4.72: Open Debug Mode in Compiler/Debug tool bar

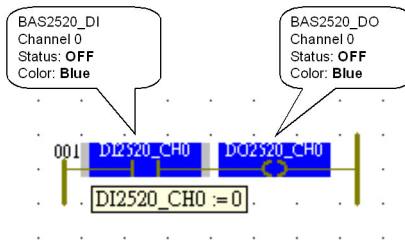


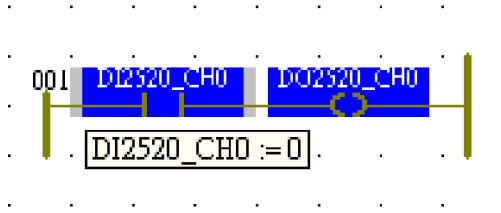
Figure 4.73: Online Debug Mode

After entering the debug mode, your I/O contact will show Blue if your I/O status is OFF. If the status of I/O contact is on, the icon will turn to Red.

### Step 2. Checks I/O Status with Force Tools

In this step, you can try to turn on the I/O contact manually with force tools to check the real status of I/O contact.

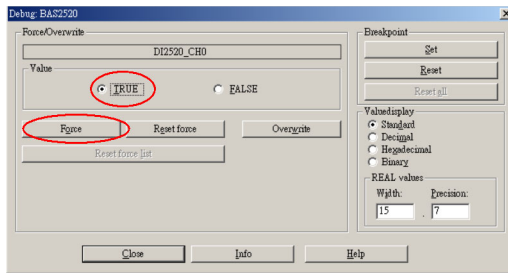




**Figure 4.74: Debug Mode result in ladder diagram**

Double click on DI2520\_Ch0 I/O contact, the Force/Overwrite dialog box will popup and you can assign the value to TRUE or FALSE with Force or Overwrite command.

In this step, please select the TRUE Value and click on Force button to active the DI2520\_Ch0



**Figure 4.75: "Force" True setting in Debug Dialog**

### Field Description of Debug Dialog Box:

Dialog area Force/Overwrite

Value	Specifies the variable value if you have called the dialog for a non-Boolean variable. For a Boolean variable the radio buttons 'TRUE' and 'FALSE' are available.
Force	Forces the marked variable.
Reset force	Resets the marked forced variable.
Reset force list	Resets all forced variables.
Overwrite	Overwrites the marked variable. Note: The dialog remembers the overwrite value which was entered formerly for a variable. If you call the dialog for the same variable again, this formerly entered value is displayed automatically in the text field.

### Dialog area Breakpoint

Set	Sets a breakpoint.
Reset	Resets a breakpoint. Only available if a breakpoint has been set before.
Reset all	Resets all set breakpoints.

### Dialog area Value display

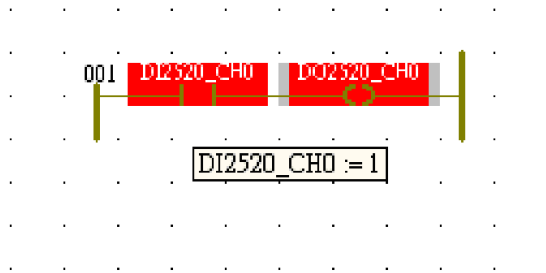
'Standard', 'Decimal', 'Hexadecimal' or 'Binary'	Determines the notation in which the online values are displayed in the worksheets. The selected option is applied to all worksheets.
REAL values 'Width' and Precision'	Allows to set the decimal point representation of REAL variables in online mode individually. 'Width' determines the number of digits before the decimal point, 'Precision' the number of positions after the decimal point. Default setting is 15.7E (e.g. 3.1234567E005).

Close	closes the dialog.
Info	calls the dialog of resource.

### ***Step 3. Online Monitoring***

When you click on the Force button, DI2520\_Ch0 will turn on and the color will change to Red. Because the workflow of ladder of contact network is from left to right side, after the DI2520\_Ch0 is turning on, DO2520\_Ch0 is going to turn on after his left side. As you see in your main screen, both of DI2520\_Ch0 and DO2520\_Ch0 are turning on and became red status.

**Note:**        *Only physical inputs and outputs can be forced.*



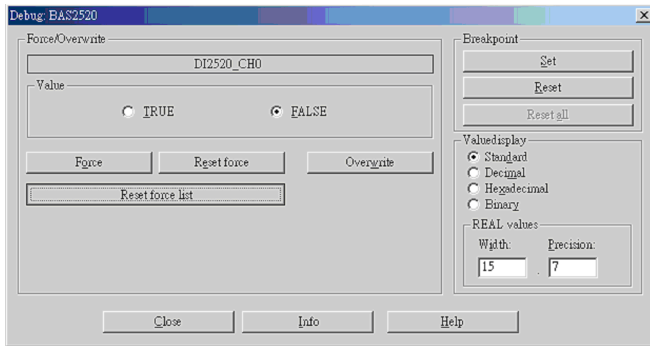
**Figure 4.76: Contact/Coil "Force ON" status**

### Overwrite

Overwrite means that a variable is overwritten with a new value only for one working cycle. After this cycle the normal value is used automatically.

### Force

Having forced a variable the new value is used until it is reset to the normal value by the user.



**Figure 4.77: Reset the normal value by resetting force**

## 4.8 Tutorial 2. Make a cross-compiling project

The key feature of BAS-2520 MULTIPROG is fully support IEC61131-3 language. In order to make sure that the workflow is going normally and the powerful feature. You can learn to make a timer for cross-compiler project in this section.

### Step 1. Drag the Contact Network

Cross select the contact network and drag out the contact network.

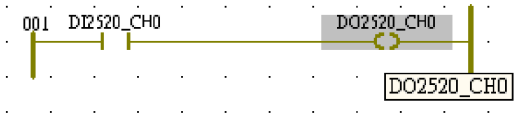


Figure 4.78: Drag out the network length in ladder

### Step 2. Click on the contact network line

Move your mouse to the contact network line and click on the line to reserve the space of function block.

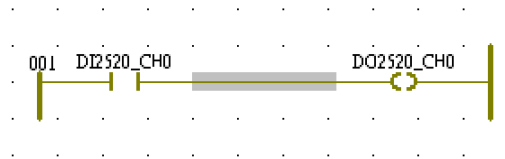


Figure 4.79: Network line in ladder

### Step 3. Enable the Edit Wizard

Enable the edit wizard by clicking on the Edit Wizard icon.

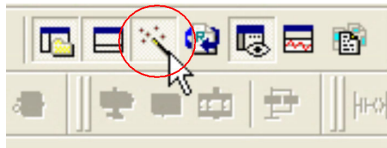


Figure 4.80: Edit Wizard tool bar

#### Step 4. Select the Required Function Block

For example, a Timer On-Delay logic will be used in application in tutorial case. Double click on TON (Timer On-Delay) Function blocks, system will popup the Variable Properties dialog box. Fill in "Timer\_01" for the function blocks variable name and click on OK.

Double click on the function blocks

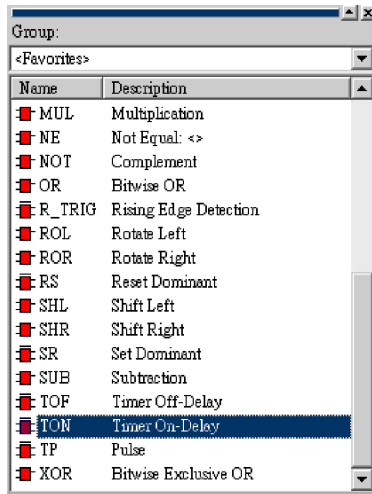


Figure 4.81: Function Block Windows

Modify the default variable name from TON\_1 to Timer\_01

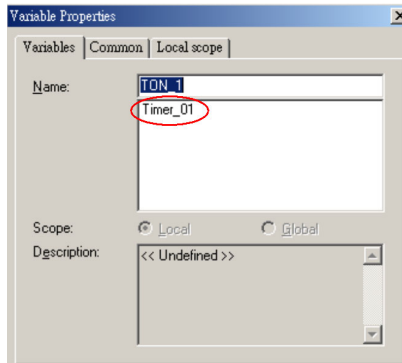
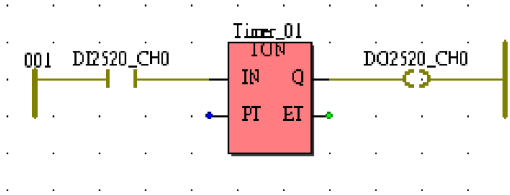


Figure 4.82: Timer On-Delay function block property setting dialog

Timer On-Delay is adding to the contact network.

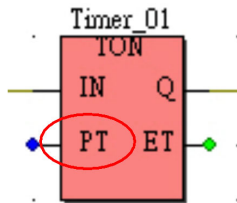


**Figure 4.83: Timer On-Delay program example**

**Note:** There are four parameters for TON function block, set up this parameter individually.

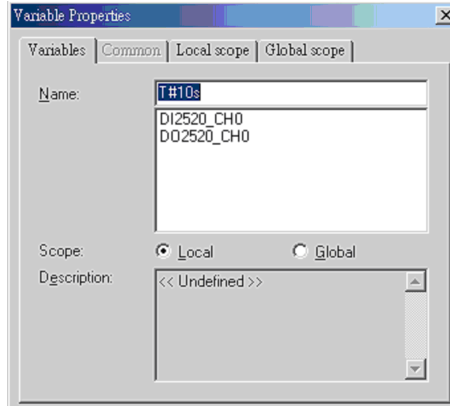
Parameter	Data types	Description
IN	BOOL	If a rising edge is detected, the on-delay timing is started.
PT	TIME	preset time interval for the delay
Q	BOOL	TRUE if IN = TRUE and ET < PT FALSE if IN = FALSE and ET >= PT
ET	TIME	elapsed time interval

**Step 5. Set up Present Time of Timer On-Delay Function Block**



PT: Present Time

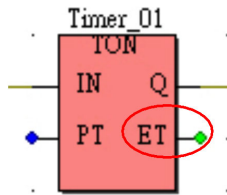
**Figure 4.84: Present Time input pin in Timer On-Delay block**



**Figure 4.85: Variable Properties setting dialog for variable name of "present time" input**

Enter the value of "T#10s" in Name field. It means the delay timer is setting to 10 seconds.

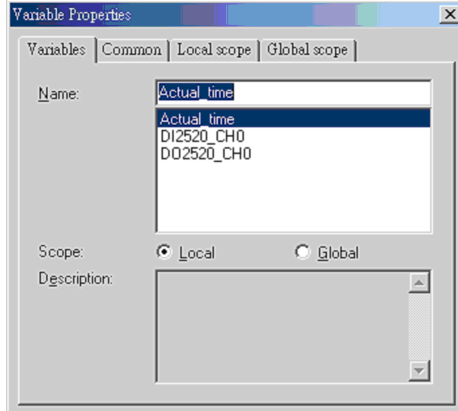
**Step 6. Set up Elapsed Time of Timer On-Delay Function Block**



ET: Elapsed Time

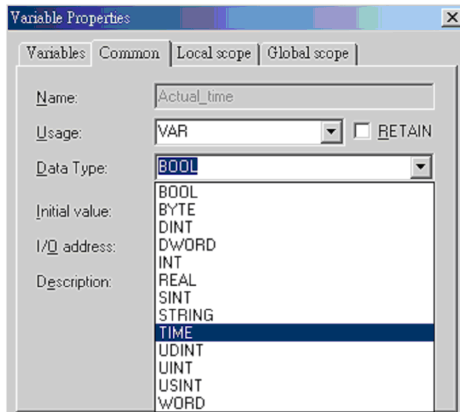
**Figure 4.86: Elapsed Time output pin in Timer On-Delay block**

Modify the name to Actual\_Time. The purpose for ET is to show the real actual timer when system is running.



**Figure 4.87: Variable Properties setting dialog for variable name for "elapsed time" output**

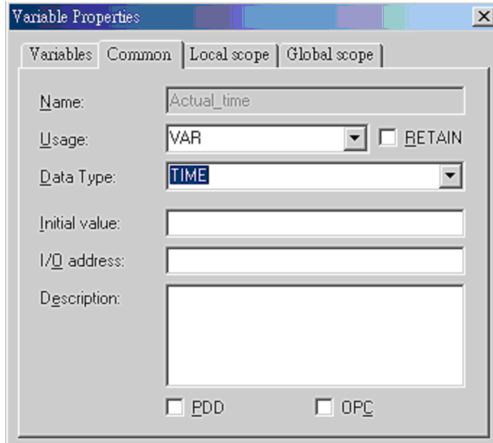
Change the data type in Common tag to TIME.



**Figure 4.88: Data Type selection for "Elapsed Time"**

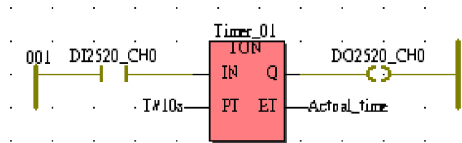


After finishing the setting of data type, click on OK to close the dialog box



**Figure 4.89: Data Type correct setting for "Elapsed Time"**

You just finish a cross-compiling contact network which is mixed with ladder and Timer On-Delay function block. The next step is to make the project again and monitor online by using debug tools. Please refer to section 4.5 to section 4.9



**Figure 4.90: Complete Timer On-Delay program**

## 4.9 Online Debug for Cross-Compiling Language Project.

After making the cross-compiling language project, you can enable the online debug mode and check with force tools again.

### Step 1. Enable the Debug Mode

Cross select the contact network and drag out the contact network.

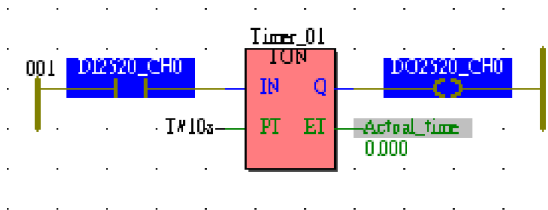


Figure 4.91: Timer On-Delay program debug

### Step 2. Send Force True to DI5051\_Ch0

Force the Value to TRUE.

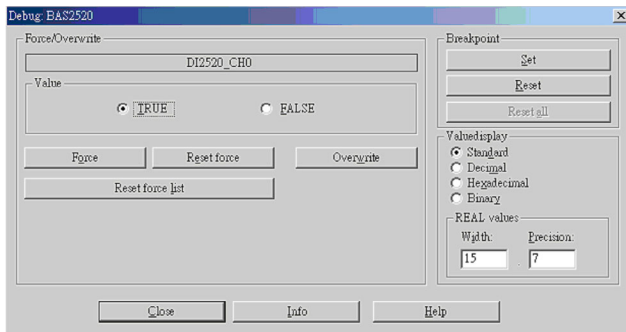


Figure 4.92: Digital Input force on to trigger Timer On-Delay function

### Step 3. Project is Running

After the DI2520\_Ch0 is active, The Timer On-Delay function block is active at the same time. You can see the Actual\_Time is running as the real timer.

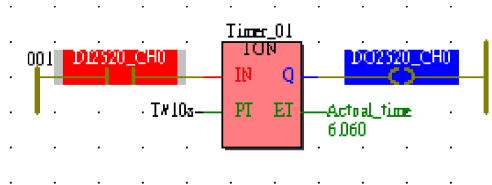


Figure 4.93: Timer is during count down

### Step 4. Timer On Delay Time Out

After 10 seconds when the PT value is time out. DO2520\_Ch0 will be turned on to red status.

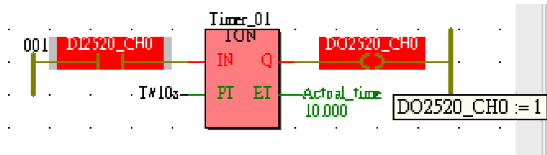


Figure 4.94: On-Delay Time up and output coil is triggered to be on

After you finish the tutorial, you can start up your BAS-2520 trips. If there still have many problems for programming or developing your project.

You can get the online help information from MULTIPROG. It provides a friendly and powerful online help interface. Almost anytime you can get the help by click on "Description" or "Help". For more detail, please refer to the next section.



APPENDIX  
**A**

**User Interface**

# Appendix A User Interface

## Menu Bar



*Figure A.1: Menu Bar*

The menu contains a set of submenus with all commands you need to develop your project and to work with the program. Below you find a short description of these submenus. A short description of each menu item is displayed in the status bar. The usage of the menu items are explained in the corresponding procedures.

File	The submenu 'File' can be used to create, save and zip/unzip projects, to save a project as a template and to delete templates. It also contains commands for printing, print setup and print preview. Additionally this submenu contains a menu item for exporting and importing. Using this menu items it is possible to export a translation file (*.csv) which contains all comments within the worksheets as well as the contents of the description worksheets. This csv-file can be translated into any language, e.g by using a translation software. After (re)importing the translated file you can switch the project language by selecting the language in the project properties dialog. Another useful feature accessible via this menu is protecting a project using a password. For that purpose the menu contains the item 'Enter password...'. For detailed information please refer to the topic Protecting a project using a password.
Edit	The submenu 'Edit' contains all commands which are necessary for editing such as marking, choosing different working modes or cutting and pasting. Additionally it provides functionality for searching and replacing text strings used to edit textual worksheets (e. g. description worksheets, variables worksheets; ST worksheets or IL worksheets) and graphical worksheets. Depending on the active editor the menu contains as well commands for handling objects (e. g. selecting, moving, enabling branch modes, creating pictures, etc.).
View	The submenu 'View' can be used to hide or show the different windows of the user interface (project tree window, message window, cross reference window, watch window, Logic Analyzer, Edit Wizard) and the status bar.

Project	The submenu 'Project' can be used to insert data type worksheets and POU's and to announce libraries. It further provides a command to compare the POU's of the current project with another project and to display the detected differences in the message window.
Build	The submenu 'Build' consists of different commands for starting the compilation after editing, for displaying the errors detected while compiling and for building the cross references. Additionally the submenu 'Build' provides the command 'Source conversion' for cross compiling POU's. Detailed information are provided in the topic Source conversion for IL, FBD and LD
Objects	The submenu 'Objects' is available if you are using an editor. The menu item 'Variable' can be used to insert a new variable into the variable list of the current POU. When editing a graphical worksheet, the submenu provides additional menu items to insert and edit graphical objects, such as connectors, jumps, contacts, coils, etc. Depending on the graphical language you are using, some items may be grayed (i.e. inactive).
Layout	The submenu 'Layout' is available if you are using the graphic editor. It contains several designing utilities. You can display e.g. page borders or a grid for better organizing the content of your worksheets. Furthermore you can zoom into and out of the worksheet, modify the worksheet size, the autscroll speed and the object size.
Online	The submenu 'Online' provides commands for debugging a project, calling the Resource Control and activating the Powerflow. In addition the command 'Online Layout' allows to set the appearance of graphical worksheets in online mode and a second submenu named 'Logic Analyzer' is available, containing the commands for controlling the Logic Analyzer.
Extras	The submenu 'Extras' can be used to call the dialogs 'Shortcut Keys' and 'Options' as well as other optional tools, such as the pagelayout editor. The dialog 'Shortcut Keys' (also known as Shortcut Manager) allows you to define your own keyboard shortcuts or customize the default shortcuts. The dialog 'Options' provides the facility to customize the menus, toolbars, text editors and text colors.

Window	The submenu 'Window' can be used to arrange the windows and symbols on your screen and to close all open windows in one step.
?	The submenu '?' contains all commands for calling help.

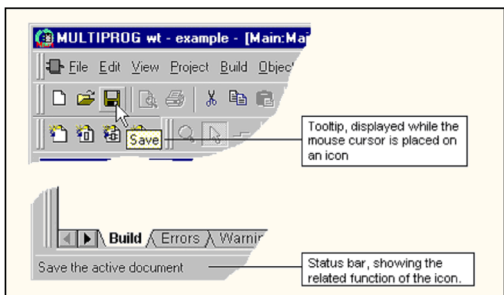
**Tools Bar**

The program provides several toolbars which contain different icons to access often used operations more rapidly. These operations can also be performed using the menu items or pre-defined shortcuts.

The toolbars are located below the menu bar. By default all toolbars are visible. To hide or show a certain toolbar, please use the dialog 'Options'.

If you place the mouse cursor on any icon (without clicking it), a short description text, the so called tooltip appears. These tooltips contain the name of the current icon. If the tooltips do not appear, please enable them in the dialog 'Options'.

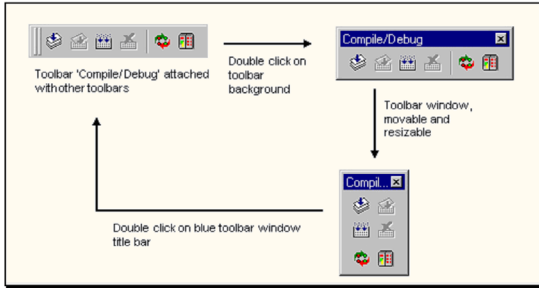
Additionally the status bar displays the function of the desired icon. The following figure shows an example:



**Figure A.2: Tool Bar operation guide**

You can detach every toolbar from the other toolbar by double clicking on the gray toolbar background. The toolbar is then displayed in a window, which can be resized and moved to any position on your screen. To reinsert the toolbar window, just double click on the blue toolbar window title bar.





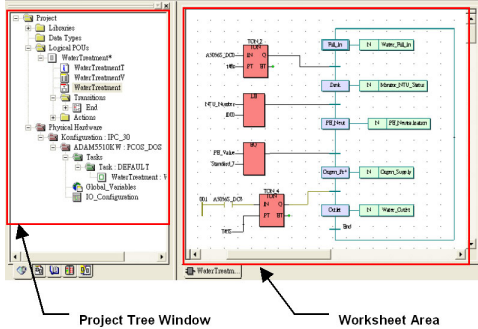
**Figure A.3: Move/Resize Tool Bar**

## Toolbars



**Figure A.4: Tool Bar in main program**

## Main Screen



**Figure A.5: Main Screen in main program**

## Status bar



**Figure A.6: Status Bar**

## Project tree - overview

The project manager is a comfortable and powerful tool for program organization and project management. It includes the project tree editor and the instance tree.

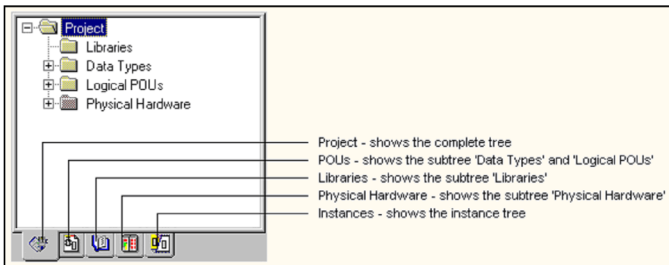
The project tree editor allows you to edit the structure of your project. You can edit your project within four subtrees.

- In the subtree 'Library' libraries can be announced.
- In the subtree 'Data Types' worksheets can be added for editing data types.
- In the subtree 'Logical POU's' new POU's and worksheets can be added for editing variable and code body worksheets.
- In the subtree 'Physical Hardware' all configuration elements can be inserted, global variables and network variables can be declared and programs can be associated to tasks.

The instance tree displays the project structure in the PLC.

It is possible to display the complete project tree or only particular subtrees. For this purpose the project tree window provides several tabs at its bottom. They can be used to switch between the various views. If you place your mouse cursor on a tab (without clicking it) a tooltip appears, which shows the name of the subtree.

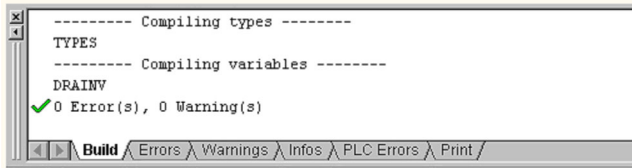
Which tabs are visible at the bottom of the project tree window can be defined by the user. For that purpose open the submenu 'Extras' and select the menu item 'Options'. In the dialog 'Options' open the page 'General' and mark the tabs to be displayed in the page area 'Project tree'.



**Figure A.7: Project Tree pages**

## Message Windows

The message window is located below the main screen. It contains several pages, which are activated by clicking on the corresponding tab.



*Figure A.8: Message Window*

The message window is a dockable window. 'Dockable' means, that you can detach the window from the desktop by double clicking on the gray window border. It is then displayed as a usual window, i.e. you can change the size and move the window to any position on the screen. To reattach it into the desk, just double click into the blue window title bar.

The message window allows to display different steps during compiling, the compiler errors and warnings and some other information, e.g. the number of compiled POU instances in the project.

You can toggle between hidden and visible message window.

### **How to display/hide the message window:**

- Click on the icon 'Messages'. "pic158.TIF"

Depending on its previous state, the message window is now visible or hidden. If the message window is closed when starting the compilation it appears automatically. One of the main benefits of the message window is the possibility of direct accessing the worksheets in which the compiler detected errors.



APPENDIX **B**

**Building Automation  
function block libraries**

# Appendix B Building Automation function block libraries

## Introduction

This document presents the design for a new Function Block Library to be created in the KW Multiprog Environment. The library will present the functions necessary to control most unitary HVAC systems, as outlined in the following sections.

## Including BAS function block libraries into main program

Step 1: Click on the "Edit Wizard" in Tool Bar to open the Function Block Window

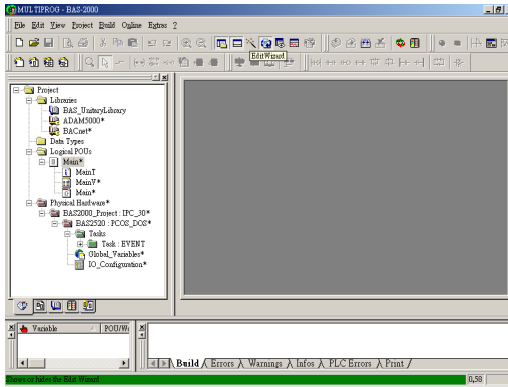


Figure B.1: "Edit Wizard" in Tool Bar

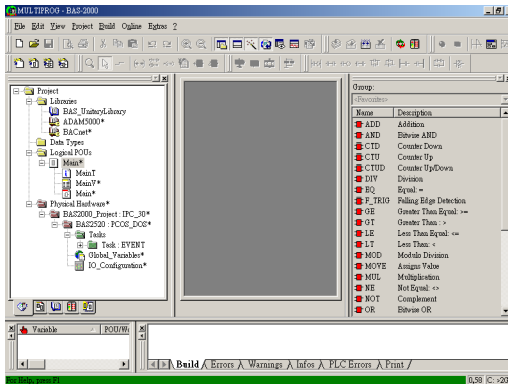
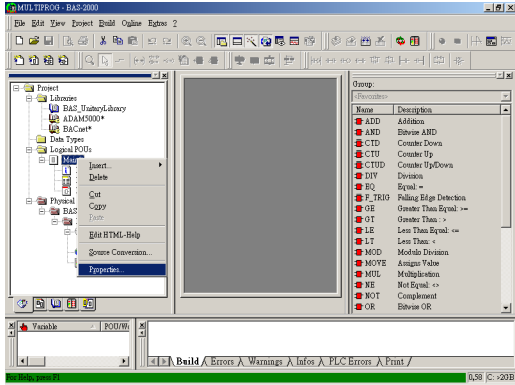


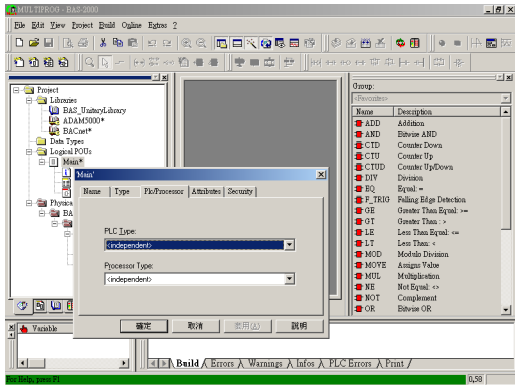
Figure B.2: Function Block Window

Step 2: Move the mouse to the "Main\*" under "Logic POUs" then click the right bottom in mouse. Select the "Properties"

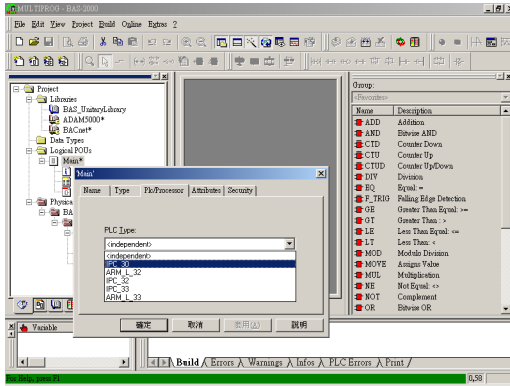


**Figure B.3: "Properties" in "Main\*"**

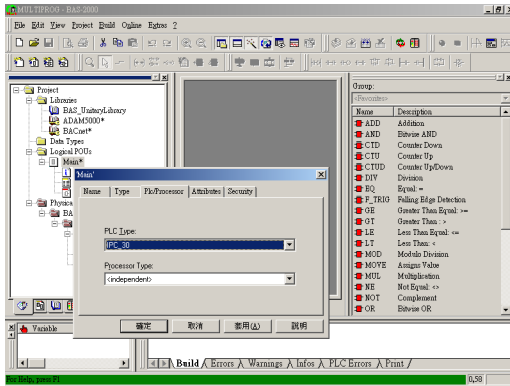
Step 3: Go to the "Plc/Processor" page. Go to "PLC Type" to select "IPC 30" then click "OK".



**Figure B.4: "Plc/Processor" page of "Properties" in "Main\*"**



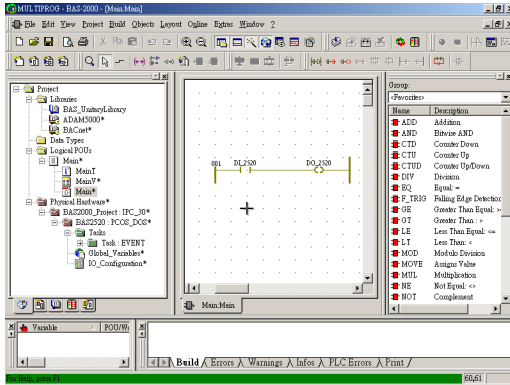
**Figure B.5: Select list of "PLC Type"**



**Figure B.6: Select "IPC 30" for "PLC Type"**

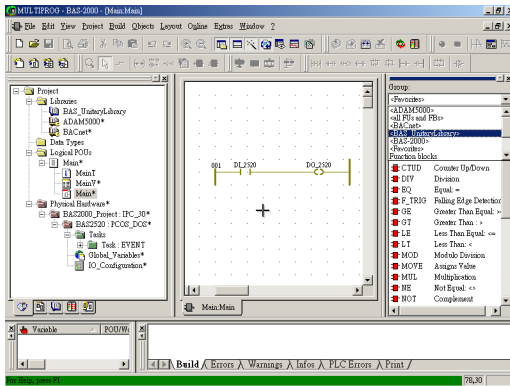
Step 4: Click on the "Main\*" Edit function to open the work sheet. Move mouse to work sheet then click on the left bottom.



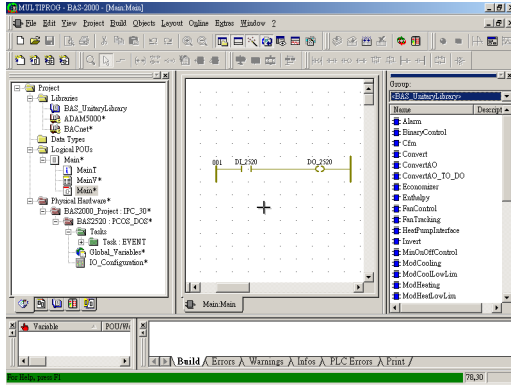


**Figure B.7: Program edit work sheet**

Step 5: Go to function block window then select "BAS\_UnitaryLibrary" group to open the BAS function block library list.



**Figure B.8: Function Block groups list**



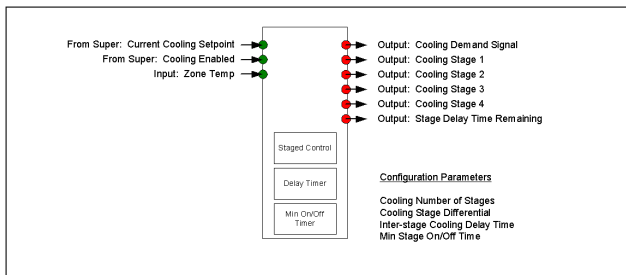
**Figure B.9: BAS Function Block list**

## Unitary Zone Temperature-Based Function Blocks

The function blocks in this section are specifically tailored to zone temperature based control, which will be used by all single-zone unitary controllers. By creating the blocks in this manner, the correct nomenclature and logic can be pre-assigned to the inputs, outputs and parameters, rather than more generic terms, making them easier to use.

Generic function blocks, found In Section 3 of this document, will be more appropriate for built-up and other Air Handling units serving more than one zone (e.g. Discharge Temperature based control) and employing other sequences such as exhaust pressure control, etc.

## Staged Cooling Control (Zone based)



**Figure B.10: Stage Cooling Control Function Block**

**Description:** Provides control of up to four mechanical cooling stages based on the HVAC unit's zone temperature. The Device Supervisor block enables or disables the Mechanical cooling section.

Once enabled, this block will cycle cooling stages on and off based on the Zone Temperature, Current Cooling Setpoint, and the parameters Cooling Stage Differential, Inter-stage Cooling Delay Time, and Min Stage On/Off Time.

**Usage Example:** Two stage cooling with 1.0 degree differential, 10 minute Inter-stage Cooling Delay Time, and 3 minute Min Stage On/Off Time.

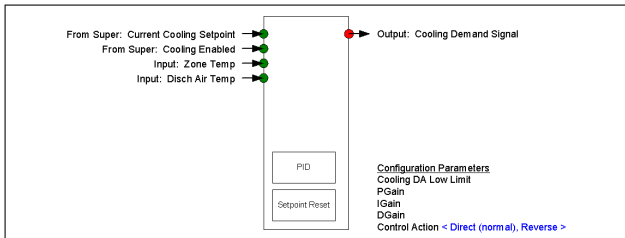
If the Zone Temperature is above the Current Cooling Setpoint, the first cooling stage will start. Ten minutes later, when the Inter-stage Delay is satisfied, if the Zone Temperature is at least 1.0 degree above setpoint (the Cooling Stage Differential), the second stage will start.

Each stage must run at least the amount of time specified in Min Stage On/Off Time. Once the minimum on time is satisfied, a stage may shut down when the Setpoint minus differential for that stage is satisfied.

In the above example, with a Current Zone Cooling Setpoint of 73 degrees, Cooling stages 1 & 2 will come on and off at the following temperatures:

STAGE	ON Setpoint	OFF Setpoint
Cool 1	73 (current zone cooling stpt)	72 (on setpoint - differential)
Cool 2	74 (Cool 1 stpt + differential)	73 (on setpoint - differential)

### Modulating Cooling Control (Zone Based)

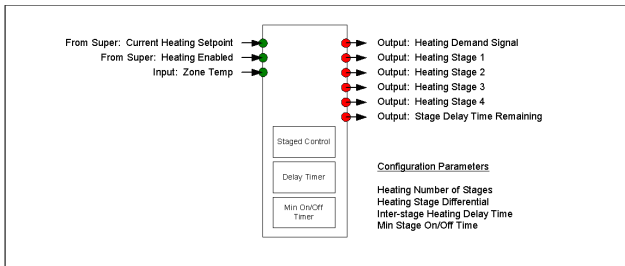


**Figure B.11: Modulating Cooling Control Function Block**

**Description:** Provides control of any modulating cooling device such as a valve or damper based on the HVAC unit's zone temperature. The Device Supervisor block enables or disables the Mechanical cooling section.

Once enabled, this block will modulate Cooling Demand (damper or valve position 0 - 100%) based on the Zone Temperature and the Current Cooling Setpoint. The value of Cooling DA Low Limit will be used as the lowest allowable DA temperature.

**Staged Heating Control (Zone Based)**



**Figure B.12: Stage Heating Control Function Block**

**Description:** Provides control of up to four heating stages based on the HVAC unit's zone temperature. The Device Supervisor block enables or disables the heating section.

Once enabled, this block will cycle heating stages on and off based on the Zone Temperature, Current Heating Setpoint, and the parameters Heating Stage Differential, Inter-stage Heating Delay Time, and Min Stage On/Off Time.

**Usage Example:** Two stage heating with 1.0 degree differential, 5 minute Inter-stage Heating Delay Time, and 1 minute Min Stage On/Off Time.

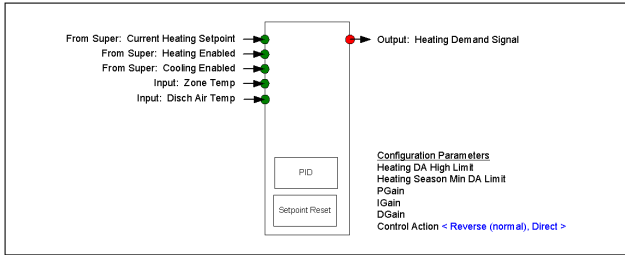
If the Zone Temperature is below the Current Heating Setpoint, the first heating stage will start. Five minutes later, when the Inter-stage Delay is satisfied, if the Zone Temperature is at least 1.0 degree below setpoint (the Heating Stage Differential), the second stage will start.

Each stage must run at least the amount of time specified in Min Stage On/Off Time. Once the minimum on time is satisfied, a stage will shut down when the Setpoint plus differential for that stage is satisfied.

In the above example, with a Current Zone Heating Setpoint of 70 degrees, Heating stages 1 & 2 will come on and off at the following temperatures:

STAGE	ON Setpoint	OFF Setpoint
Heat 1	70 (current zone heating stpt)	71 (on setpoint + differential)
Heat 2	69 (Heat 1 stpt - differential)	70 (on setpoint + differential)

### Modulating Heating Control (Zone Based)

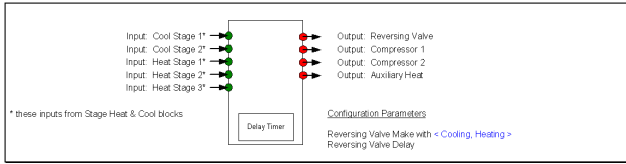


**Figure B.13: Modulating Heating Control Function Block**

**Description:** Provides control of any modulating heating device such as a valve or damper based on the HVAC unit's zone temperature. The Device Supervisor block enables or disables the heating section.

Once enabled, this block will modulate Heating Demand (damper or valve position 0 - 100%) based on the Zone Temperature and the Current Heating Setpoint. The value of Heating DA High Limit will be used as the highest allowable DA temperature. The value of Heating Season Min DA Limit will be used as the lowest allowable DA temperature during the strict Heating Season (Heating is Enabled while mechanical cooling is not). This feature may be used to preheat cold ventilation air during the heating season.

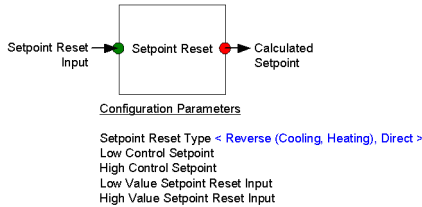
# Heat Pump Reserving Valve Control



**Figure B.14: Heat Pump Reversing Valve Control Function Block**

**Description:** Provides control of Heat Pump points based on outputs from Staged Cooling and Heating Control Blocks and the values of the listed configuration parameters.

## Setpoint Reset Calculation



**Figure B.15: Setpoint Reset Calculation Function Block**

**Description:** Calculates a setpoint based on a linear reset schedule derived from user entered inputs for the endpoints of both the Setpoint and Reset ranges.

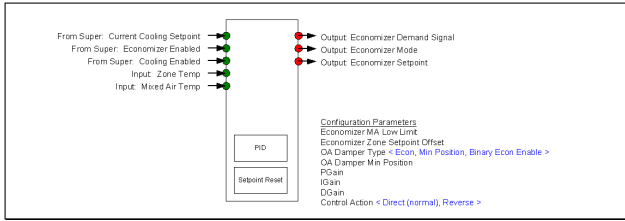
Setpoint Reset Type = Reverse

The Calculated Setpoint will increase as the Setpoint Reset Input Decreases.

Setpoint Reset Type = Direct

The Calculated Setpoint will increase as the Setpoint Reset Input Increases.

## Economizer Control



**Figure B.16: Economizer Control Function Block**

**Description:** Provides either:

Direct control of a Modulating Outside Air Damper, or

A Binary Enable circuit for enabling a local Economizer control loop

Control is based on the HVAC unit's zone temperature. The Device Supervisor block enables or disables the economizer section.

OA Damper Type = Econ

Once enabled, this block will modulate Economizer Demand (damper position 0 - 100%) based on the Zone Temperature and the Current Cooling Setpoint - Economizer Zone Setpoint Offset. The value of Economizer MA Low Limit will be used as the lowest allowable MA Temperature during economizer operation (except that during Occupied Mode, the OA Damper will not be allowed to close more than OA Damper Min Position, regardless of the resulting MA Temperature).

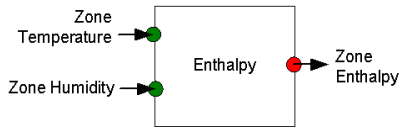
OA Damper Type = Binary Econ Enable

Whenever the Economizer is Enabled, this Output will come on if Zone Temperature rises above Current Cooling Setpoint - Economizer Zone Setpoint Offset. The Output will go off when Zone Temperature falls below Current Cooling Setpoint - (2\* Economizer Zone Setpoint Offset).

OA Damper Type = Min Position

The Economizer Demand output will be set to the user-defined OA Damper Min Position during the Occupied period and to 0.0% (fully closed) at all other times.

## Enthalpy Calculation

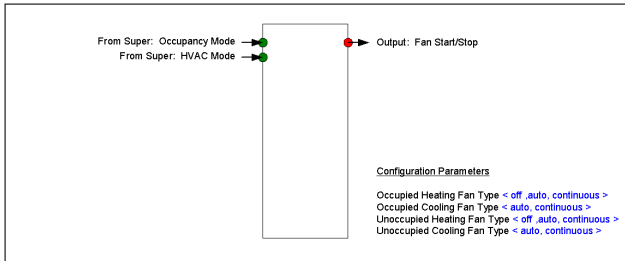


**Figure B.17: Enthalpy Calculation Function Block**

**Description:** Calculates the Total Heat Content for one zone or air stream. Typically two zones or air streams are compared and the air stream with the least total heat content is identified as the lowest cost cooling source.

In the case of the Economizer control block, if Outside Air is the lowest cost source of cooling, the Device Supervisor block will set the Economizer Enabled value ON.

## Single Speed Fan Control



**Figure B.18: Single Speed Fan Control Function Block**

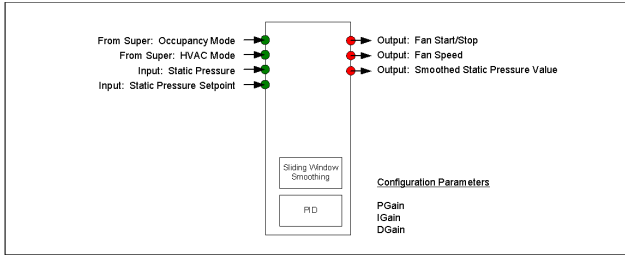
**Description:** Provides On/Off control of a single speed fan. The Device Supervisor block sets the Occupancy Mode and HVAC Mode.

**Usage Example:** If the Occupied Heating Fan Type is Auto, and the HVAC Mode is Heat, and the Occupancy Mode is Occupied, this block will cycle the fan on and off as the heating stages cycle on and off.

Similarly, using the above example, if the Occupied Heating Fan Type is Continuous, this block will maintain the fan on during all Occupied periods.



## VFD Fan Control



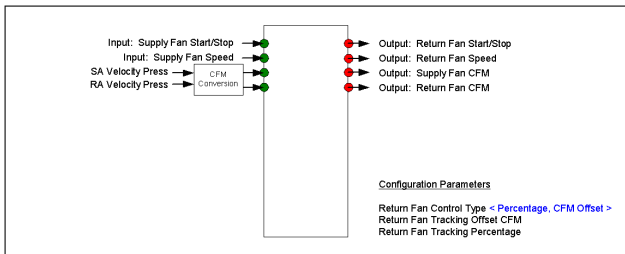
**Figure B.19: VFD Fan Control Function Block**

**Description:** Provides control of a Fan Start/Stop point and Fan Speed based on the HVAC unit's Supply Air Static Pressure. The Device Supervisor block sets the Occupancy Mode and HVAC Mode.

This block will maintain the fan on during all Occupied periods and all other periods where the HVAC Mode is either Heat or Cool. The Fan Speed will be modulated to maintain the Static Pressure Setpoint.

The Static Pressure Input will be averaged over time using the Sliding Window Smoothing function to obtain a more stable input value to control to.

## Return Fan Tracking



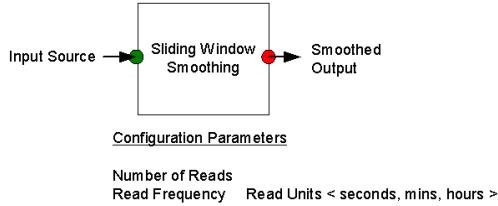
**Figure B.20: Return Fan Tracking Function Block**

**Description:** Provides control of Return Fan Start/Stop and Return Fan Speed based on either a percentage of Supply Fan speed, or a fixed CFM offset in the Return Air-stream versus that of the Supply Air-stream.

**Usage Example:** If the Return Fan Control Type is Percentage, and the value of Return Fan Tracking Percentage is 90%, the Return Fan Speed will always equal 90% of the Supply Fan Speed.

If the Return Fan Control Type is CFM Offset, and the value of Return Fan Tracking Offset CFM is 500 CFM, the Return Fan Speed will always be maintained such that the airflow in the Return Air-stream is 500 CFM lower than the airflow in the Supply Air-stream. This would indicate that 500 CFM of Outside Air is being introduced into the Supply Air-stream.

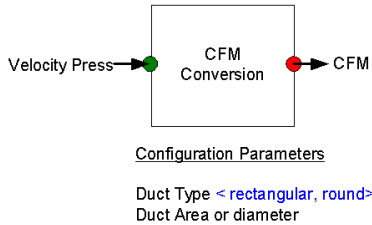
**Sliding Window Smoothing**



**Figure B.21: Sliding Window Smoothing Function Block**

**Description:** Smooths out fluctuating values by performing a sliding window average of a number of separate readings of the same value using the parameters list.

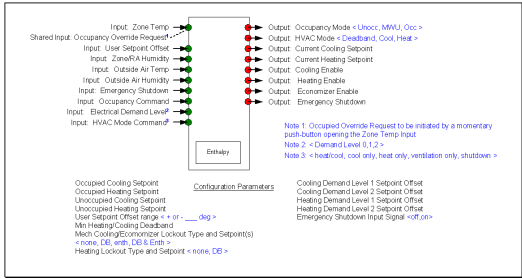
**CFM Calculation**



**Figure B.22: Sliding Window Smoothing Function Block**

**Description:** Converts measured Velocity Pressure into CFM airflow, using the parameters listed.

# Device Supervisor Control "Super"

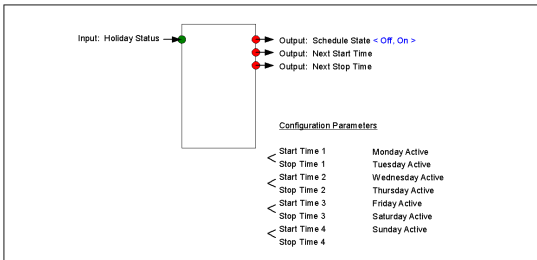


**Figure B.23: Device Supervisor Control Function Block**

**Description:** The Device Supervisor reads in all building-wide information pertaining to the status of Schedules, Holidays, Free Cooling, Electrical Demand, Emergency and other conditions. It also contains all zone-specific setpoints and settings for how to respond to changes in the building-wide values.

Integrating building-wide and local information, it coordinates all function areas of the unitary controller (occupancy, heating, cooling, fan control, etc) enabling other control functions as needed.

## Schedule

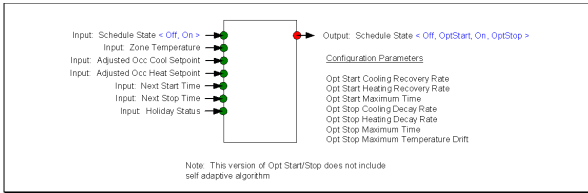


**Figure B.24: Schedule Control Function Block**

**Description:** Provides scheduling capabilities within the unitary controller. The user may enter up to 4 start and stop time pairs, and identify which days of the week those times apply to. Multiple schedules may be used to handle different start and stop times on different days of the week.

Schedules have the ability to be linked to global holiday status values, and will output their Next Start Time and Next Stop Time for use in Optimum Start and Stop calculations.

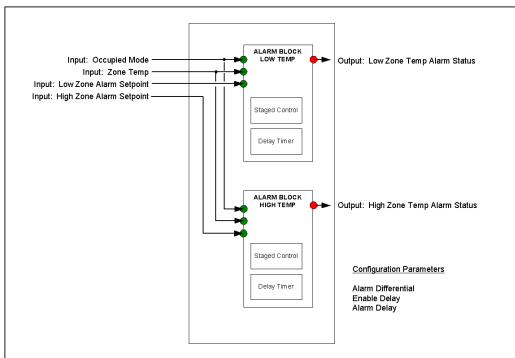
### Optimum Start/Optimum Stop



**Figure B.25: Optimum Start/Optimum Stop Control Function Block**

**Description:** Calculates the amount of Early Start Time required to achieve Adjusted Occupied Cooling or Heating zone setpoint at the Next Start Time (from schedule), and the amount of Early Stop Time permissible (which will result in no more temperature drift from setpoint than that specified in Opt Stop Maximum Temperature Drift) by the Next Stop Time. The Schedule State Output will take the Schedule and Optimum Start/Stop times into account and set the integrated Schedule State accordingly.

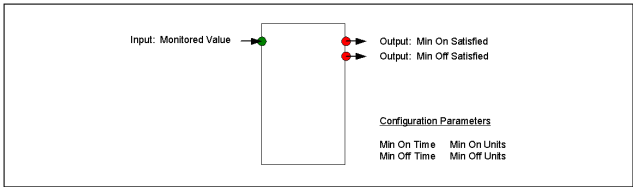
### Alarming



**Figure B.26: Alarm Function Block**

**Description:** Provides High and Low Zone temperature Alarming capabilities during Occupied periods, based on user entries. Enable Delay sets the amount of time to hold off alarms upon first transitioning to Occupied for the day (this will allow for warm-up, etc.). Alarm Delay sets the amount of time the Zone Temperature may be outside of the safe range before an Alarm is generated. This type of delay is helpful to reduce nuisance alarms, etc.

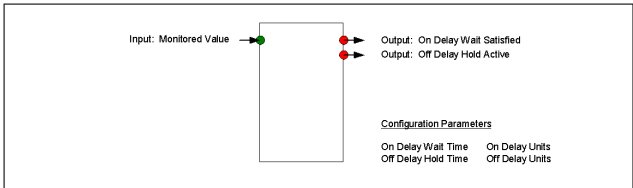
**Minimum On/Off Timers**



*Figure B.27: Minimum On/Off Timer Function Block*

**Description:** Minimum On Satisfied will be set on once the Monitored Value has been on at least the amount of time specified in Min On Time. Similarly, the Minimum Off Satisfied will be set on once the Monitored Value has been off at least the amount of time specified in Min Off Time.

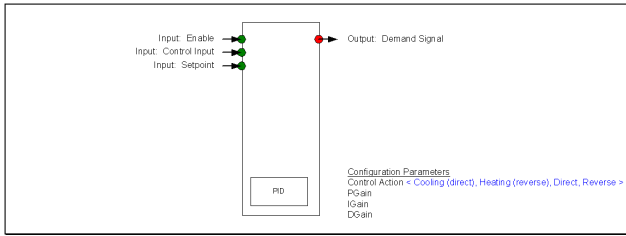
**Delay Timer**



*Figure B.28: Delay Timer Function Block*

**Description:** On Delay Wait Satisfied will be set on once the Monitored Value has been on at least the amount of time specified in On Delay Wait Time. Off Delay Hold Active will be set on when the Monitored Value goes on. It will stay on until the Monitored Value has transitioned to off, and has been off at least the amount of time specified in Off Delay Hold Time.

## Modulating Control (Generic)

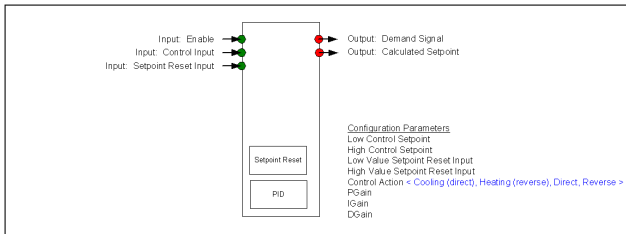


**Figure B.29: Modulating Control Function Block**

**Description:** Provides control of any modulating device such as a cooling or heating valve or damper, or a pressure controlled VFD, based on the Control Input. The Enable Input enables or disables the block. When disabled, the Demand Signal Output will be set to 0.0%

When enabled, the block will modulate the Demand Signal Output (0 - 100%) based on the Control Input and the Setpoint.

## Modulating Control with Reset (Generic)

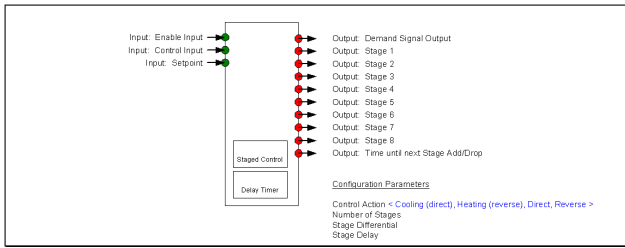


**Figure B.30: Modulating Control with Reset (Generic) Function Block**

**Description:** Provides control of any modulating device such as a cooling or heating valve or damper, or a pressure controlled VFD, based on the Control Input. The Enable Input enables or disables the block. When disabled, the Demand Signal output will be set to 0.0%

When enabled, the block will modulate the Demand Signal Output (0 - 100%) based on the Control Input and the Calculated Setpoint. The Setpoint is calculated using the listed reset parameters.

## Staged Control (Generic)

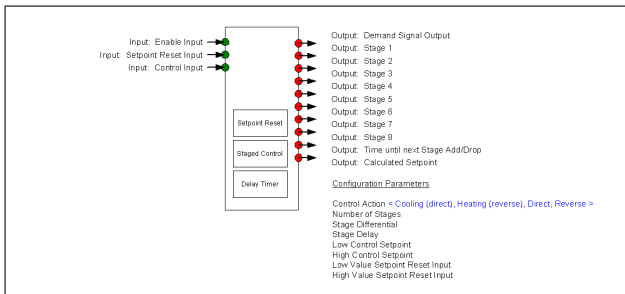


**Figure B.31: Staged Control (Generic) Function Block**

**Description:** Provides control of up to eight stages of heating, cooling, pressure, etc., based on the Control Input. The Enable Input enables or disables the block. When disabled, the Demand Signal output will be set to 0.0% and all stages will be set off.

When enabled, this block will cycle stages on and off based on the Control Input and Setpoint, and the parameters Stage Differential and Stage Delay.

## Staged Control with Reset (Generic)



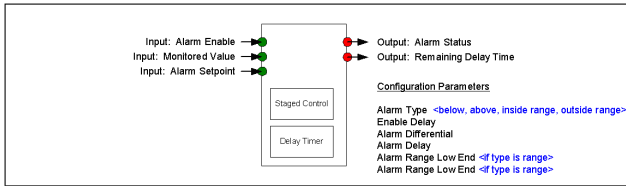
**Figure B.32: Staged Control with Reset (Generic) Function Block**

**Description:** Provides control of up to eight stages of heating, cooling, pressure, etc., based on the Control Input. The Enable Input enables or disables the block. When disabled, the Demand Signal output will be set to 0.0% and all stages will be set off.

When enabled, this block will cycle stages on and off based on the Control Input and Calculated Setpoint, and the parameters Stage Differential and Stage Delay.

The Setpoint is calculated using the listed reset parameters.

### Generic Alarming

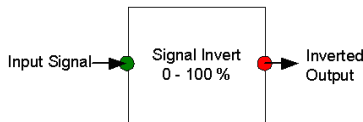


**Figure B.33: Generic Alarm Function Block**

**Description:** Provides Alarming such that any value may be monitored to test if it is below or above a given Alarm Setpoint, or if it is inside or outside of an identified range. Further, it may be configured such that Alarms may only be generated during certain time periods, or linked to certain events or values in the system (Occupied for example), based upon user entries.

Enable Delay sets the amount of time to hold off alarms upon first transitioning to the enabled state (this will allow for warm-up, etc.). Alarm Delay sets the amount of time the Monitored Value may be outside of the safe range before an Alarm is generated, which may be helpful to reduce nuisance alarms, etc

### Signal Inversion



**Figure B.34: Signal Inversion Function Block**

**Description:** Provides the inverse signal in the 0 - 100% range.

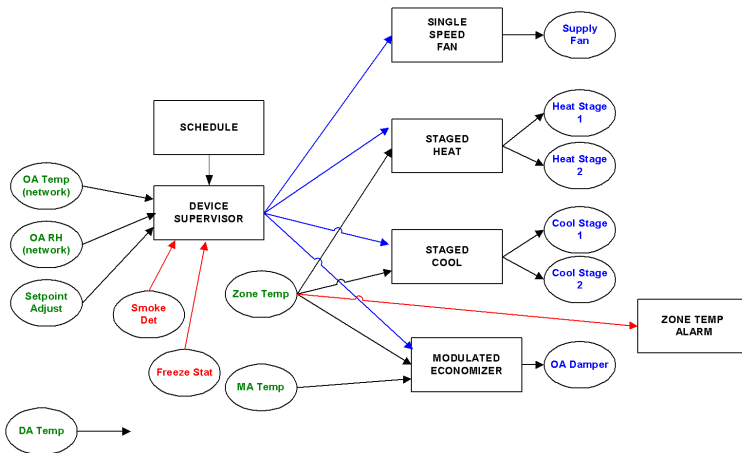


## Examples of Complete Sequences

On the following pages are examples of complete unitary sequences built from the library function blocks. These specific configurations are examples only; many different configurations are possible using these function blocks.

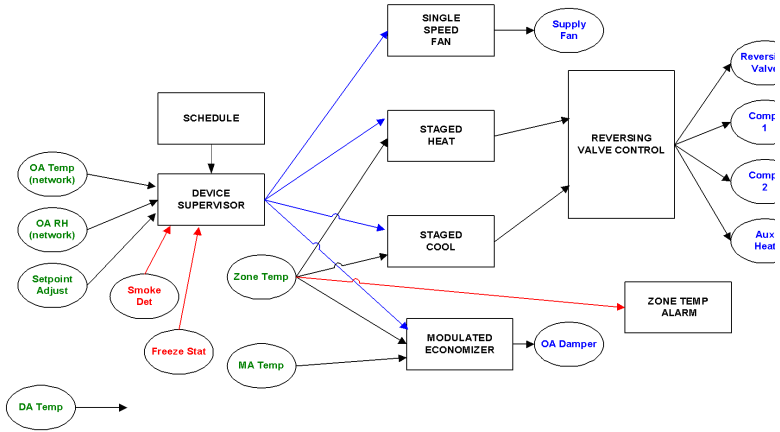
1. Staged Rooftop HVAC Unit (example)
2. Heat Pump HVAC Unit w/ Auxiliary Heat (example)
3. Fan Coil HVAC Unit (example)
4. Built up Air Handling HVAC Unit w/ VFDs (example)

### 4.1 STAGED ROOFTOP HVAC UNIT (example)



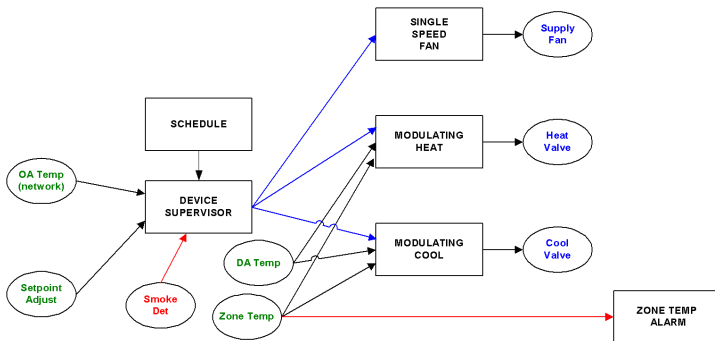
*Figure B.35: Staged Rooftop HVAC Unit Example*

#### 4.2 HEAT PUMP HVAC UNIT w/ AUX HEAT (example)



*Figure B.36: Heat Pump HVAC Unit w/ Auxiliary Heat Example*

#### 4.3 FAN COIL HVAC UNIT (example)



*Figure B.37: Fan Coil HVAC Unit Example*

4.4 BUILT UP AIR HANDLING HVAC UNIT w/ VFDs (example)

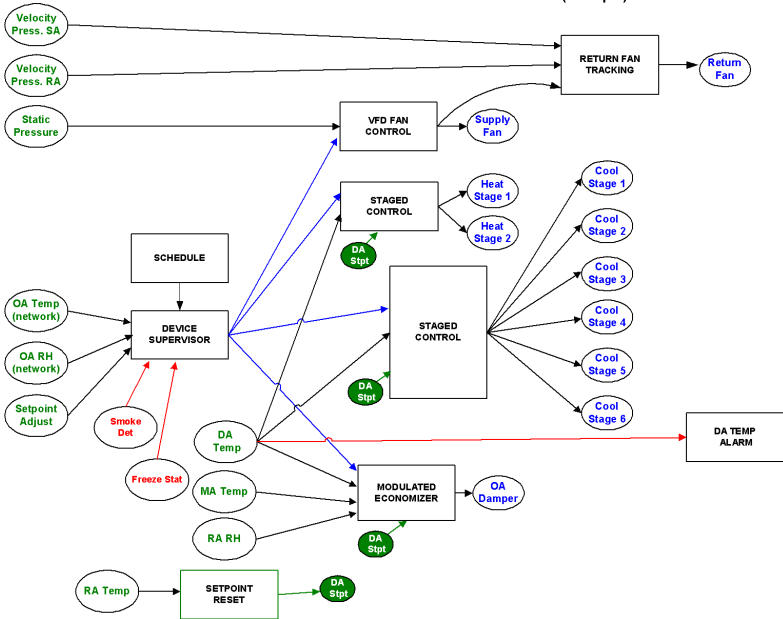


Figure B.38: Built up Air Handling HVAC Unit w/ VFDs Example



APPENDIX

C

**BAS-2000 Utility  
Operation Guide**

# Appendix C BAS-2000 Utility Operation Guide

## Introduction

Advantech offers the BAS-2000 utility software inside the packing of BAS-2514/2520 for Input/Output channel configuration. User can follow the following operation guide to finish the channel setting for BAS-2000 series modules.

## BAS-2000 Utility Software Installation

Step 1 : Please insert the BAS-2000 CD into the CD-ROM of configuration computer.

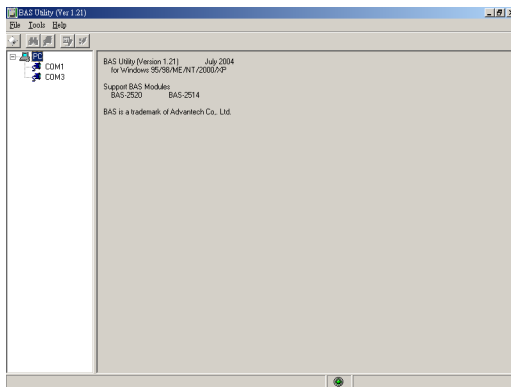
Step 2 : Go to directory "\\BAS-2000 Utility" in BAS-2000 CD to find "BASUtility" program.

Step 3 : Double click the "BASUtility" , the BAS-2000 utility setup program will be unpacked. The installation wizard will lead user to install the software step by step after the setup program being unpacked automatically.

## BAS-2000 Module Channel Configuration

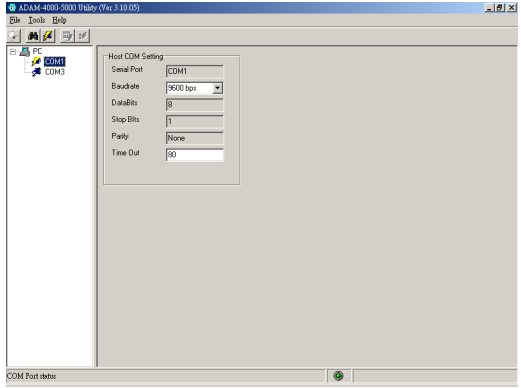
Step 1 : Connect the configured BAS-2000 controller with configuration computer (please refer section 2.3.3)

Step 2 : Open the BAS-2000 Utility Software after installing it.



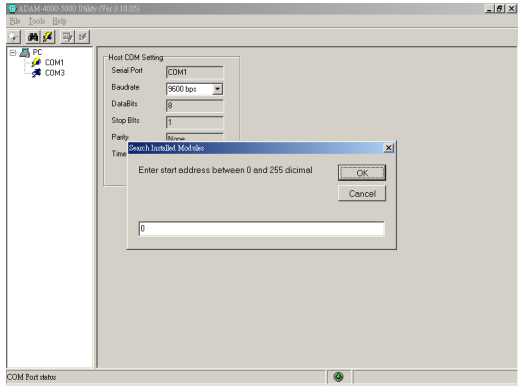
*Figure C.1: BAS-2000 utility software start screen*

Step 3 : Select the COM port connected with BAS-2000 controller then setup the communication parameters.



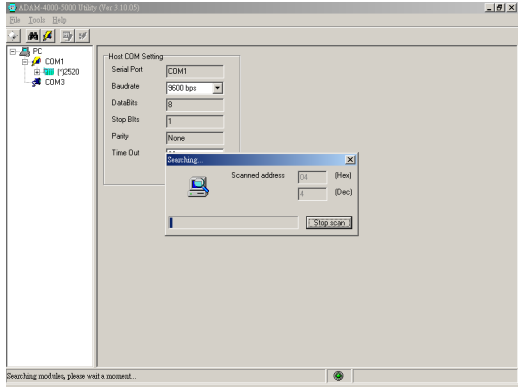
**Figure C.2: Configuration COM port setting**

Step 4 : Click the search bottom "Search.TIF". The module search dialog will pop out.



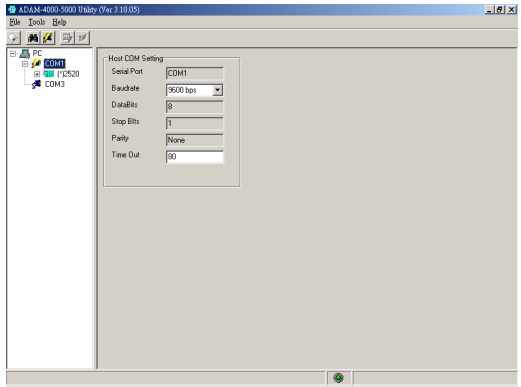
**Figure C.3: Module Search Dialog**

Step 5 : Click the "OK" bottom in search dialog to start up the module search function.



**Figure C.4: Searching BAS-2000 Module**

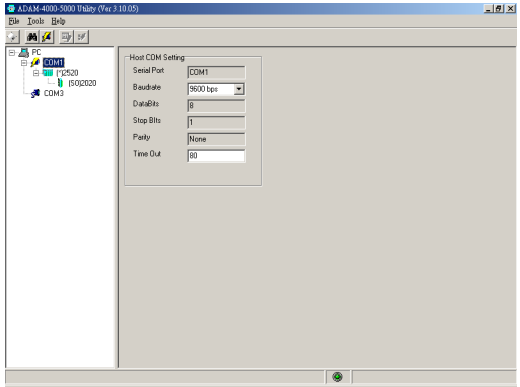
Step 6 : The BAS-2000 module being found. The BAS-2520 will be the example in this tutorial case.



**Figure C.5: The BAS-2520 being found by utility**

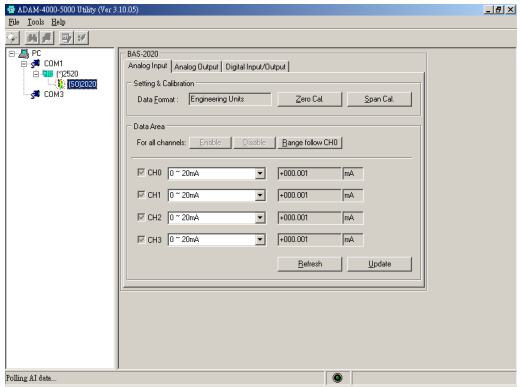


BAS-2520 equips with the BAS-2020 I/O module, so the "2020" (BAS-2020) can be found in the tree list under "2520" (BAS-2520).



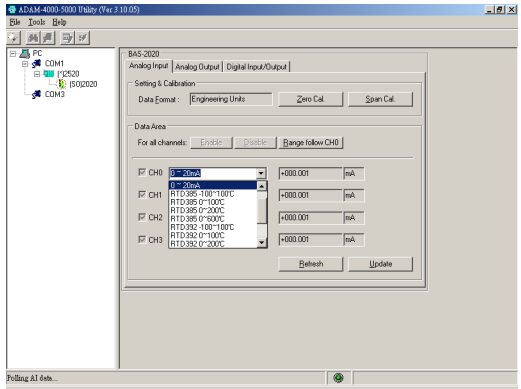
**Figure C.6:** The BAS-2020 I/O module under BAS-2520 tree list

Step 7 : Click on "2020" for I/O channels configuration. Click on "Analog Input" for analog input channels configuration.



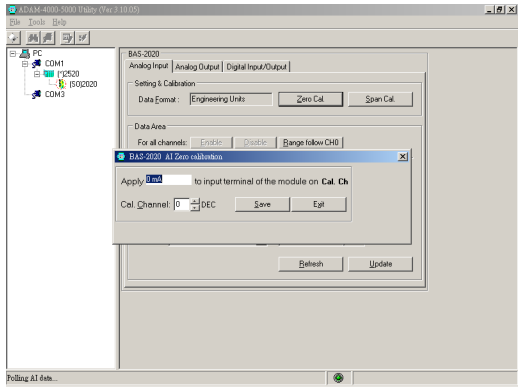
**Figure C.7:** The BAS-2020 I/O channels configuration pages

Step 8 :Select the analog input signal type for system requirement.



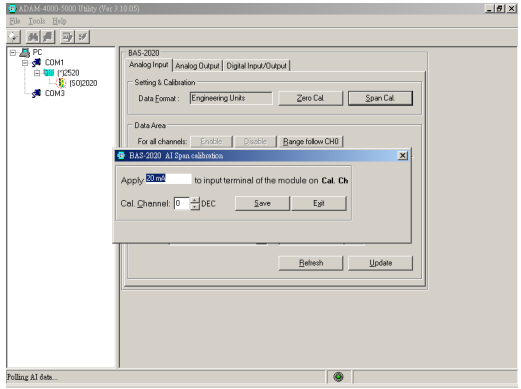
**Figure C.8: The analog input signal type selection**

If the zero calibration is required, please click on the "Zero Calibration.TIF" bottom. Please key in the zero point setting value and the zero reference channel in zero calibration dialog.



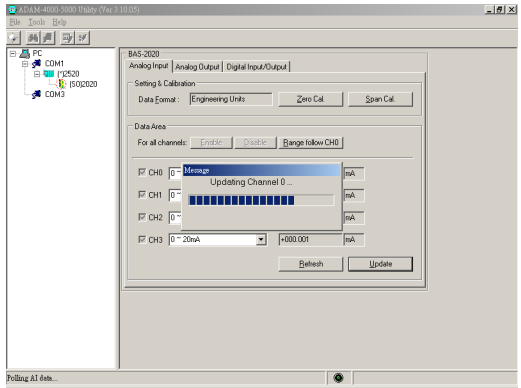
**Figure C.9: The analog input zero calibration dialog**

If the span calibration is required, please click on the "Span Calibration.TIF" bottom. Please key in the span point setting value and the span reference channel in span calibration dialog.



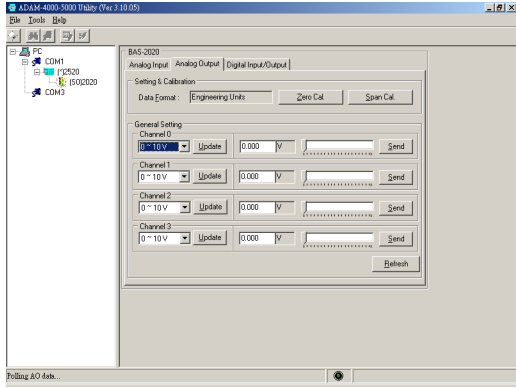
**Figure C.10: The analog input span calibration dialog**

Click on the "Update" bottom then the utility software will update the analog input configuration into configuration file.



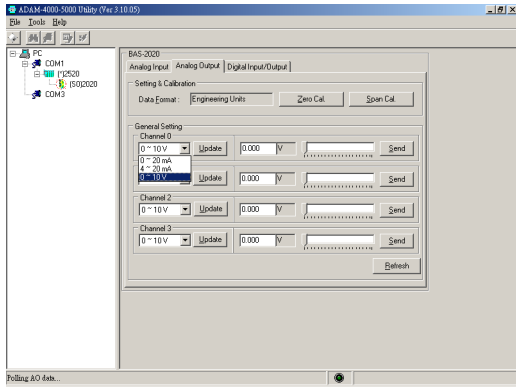
**Figure C.11: The analog input channels configuration being updating**

Step 9 : Click on "Analog Output" for analog output channels configuration.



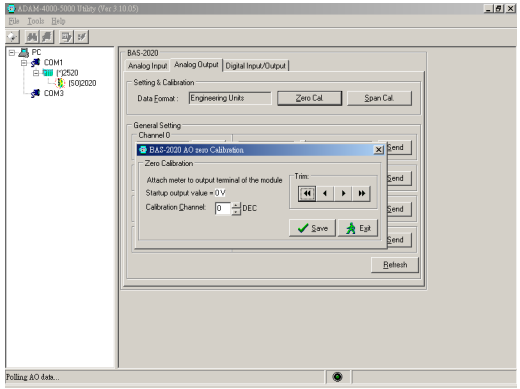
**Figure C.12: The analog output channels configuration pages**

Step 10 :Select the analog output signal type for system requirement.



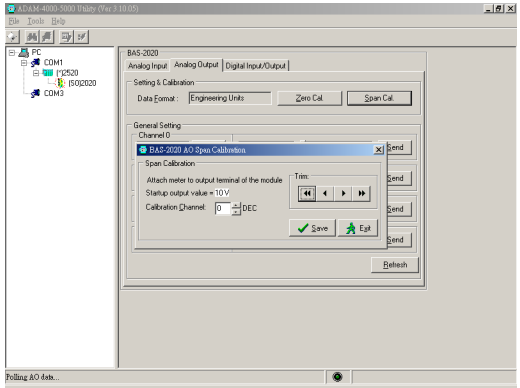
**Figure C.13: The analog output signal type selection**

If the zero calibration is required, please click on the "Zero Calibration.TIF" bottom. Please key in the zero point setting value and the zero reference channel in zero calibration dialog.



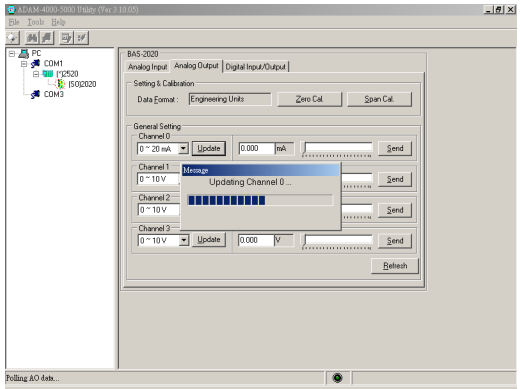
**Figure C.14: The analog output zero calibration dialog**

If the span calibration is required, please click on the "Span Calibration.TIF" bottom. Please key in the span point setting value and the span reference channel in span calibration dialog.



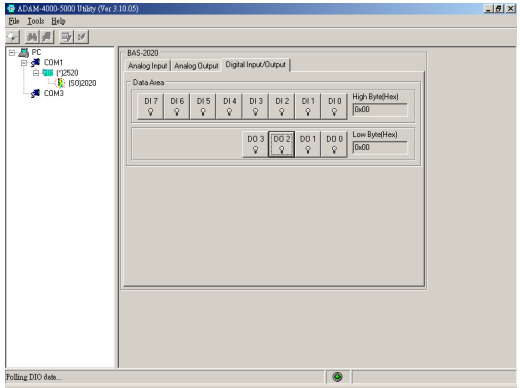
**Figure C.15: The analog output span calibration dialog**

Click on the "Update" button then the utility software will update the analog output configuration into configuration file.



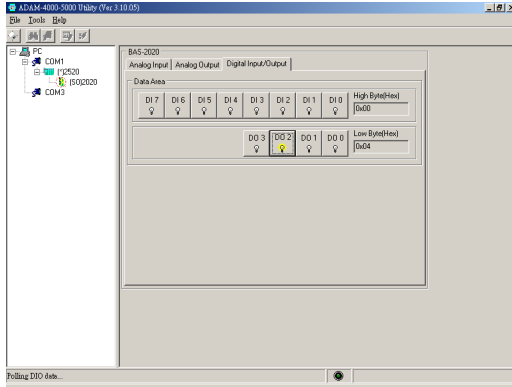
**Figure C.16: The analog output channels configuration being updating**

Step 11: Click on "Digital Input/Output" for digital input/output channels configuration.

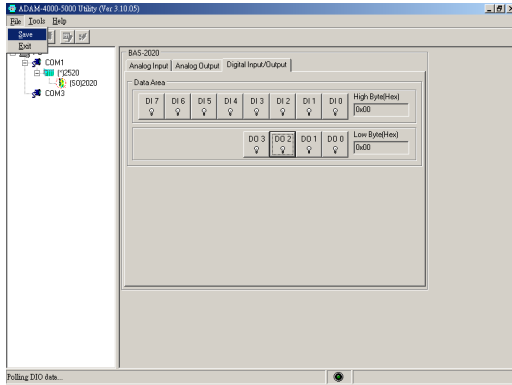


**Figure C.17: The digital input/output channels configuration pages**

The digital output channels can be controlled by the utility software for test or demonstration purpose. For example, please move the mouse to DO1 bottom "DO Off.TIF" then click it, the DO1 will be triggered as "ON" "DO Off.TIF".

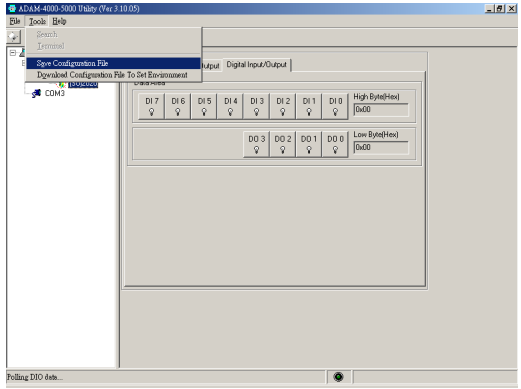


**Figure C.18:** The digital output channel 1 in "OFF" status



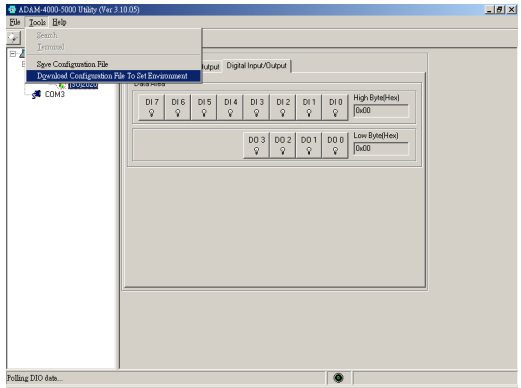
**Figure C.19:** The digital output channel 1 in "ON" status

Step 12: Move the mouse to "Tool" then save the configuration file for future requirement.



**Figure C.20: The configuration file save function**

Step 13: Move the mouse to "Tool" then download the configuration file to set environment to finish the configuration work.



**Figure C.21: The configuration file download function**



APPENDIX **D**

**I/O Address MODBUS  
Mapping Table**

# Appendix D I/O Address MODBUS Mapping Table

## For BAS-25XX Controller

Item	Point Type	BAS-2514	BAS-2520
1	Digital Input	Channel 0 ~ Channel 3 (00001 ~ 00004)	Channel 0 ~ Channel 7 (00001 ~ 00008)
2	Digital Output	Channel 0 ~ Channel 2 (00051 ~ 00053)	Channel 0 ~ Channel 3 (00051 ~ 00054)
3	Analog Input	Channel 0 ~ Channel 3 (40001 ~ 40004)	Channel 0 ~ Channel 3 (40001 ~ 40004)
4	Analog Output	Channel 0 ~ Channel 2 (40051 ~ 40053)	Channel 0 ~ Channel 3 (40051 ~ 40054)

## For 1st BAS-20XX I/O Expansion Module in Local Bus Connection

Item	Point Type	BAS-2514	BAS-2520
1	Digital Input	Channel 0 ~ Channel 3 (00101 ~ 00104)	Channel 0 ~ Channel 7 (00101 ~ 00108)
2	Digital Output	Channel 0 ~ Channel 2 (00151 ~ 00153)	Channel 0 ~ Channel 3 (00151 ~ 00154)
3	Analog Input	Channel 0 ~ Channel 3 (40101 ~ 40104)	Channel 0 ~ Channel 3 (40101 ~ 40104)
4	Analog Output	Channel 0 ~ Channel 2 (40151 ~ 40153)	Channel 0 ~ Channel 3 (40151 ~ 40154)

### For 2nd BAS-20XX I/O Expansion Module in Local Bus Connection

Item	Point Type	BAS-2514	BAS-2520
1	Digital Input	Channel 0 ~ Channel 3 (00201 ~ 00204)	Channel 0 ~ Channel 7 (00201 ~ 00208)
2	Digital Output	Channel 0 ~ Channel 2 (00251 ~ 00253)	Channel 0 ~ Channel 3 (00251 ~ 00254)
3	Analog Input	Channel 0 ~ Channel 3 (40201 ~ 40204)	Channel 0 ~ Channel 3 (40201 ~ 40204)
4	Analog Output	Channel 0 ~ Channel 2 (40251 ~ 40253)	Channel 0 ~ Channel 3 (40251 ~ 40254)

### For 3rd BAS-20XX I/O Expansion Module in Local Bus Connection

Item	Point Type	BAS-2514	BAS-2520
1	Digital Input	Channel 0 ~ Channel 3 (00301 ~ 00304)	Channel 0 ~ Channel 7 (00301 ~ 00308)
2	Digital Output	Channel 0 ~ Channel 2 (00351 ~ 00353)	Channel 0 ~ Channel 3 (00351 ~ 00354)
3	Analog Input	Channel 0 ~ Channel 3 (40301 ~ 40304)	Channel 0 ~ Channel 3 (40301 ~ 40304)
4	Analog Output	Channel 0 ~ Channel 2 (40351 ~ 40353)	Channel 0 ~ Channel 3 (40351 ~ 40354)



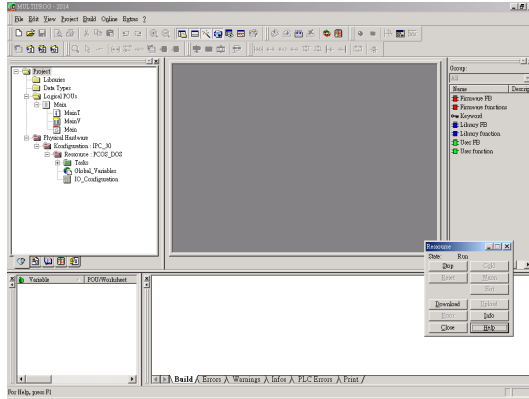
APPENDIX

# E

## **BAS-2514/BAS-2520 Controller Firmware Upgrade**

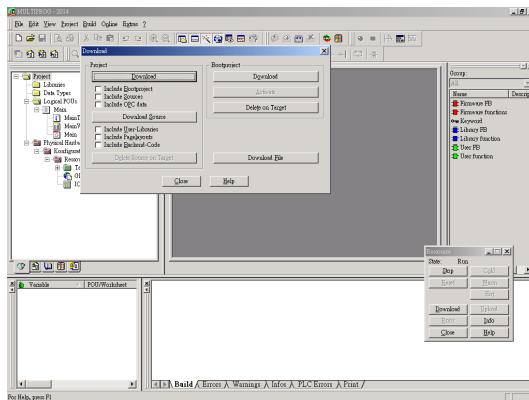
# Appendix E BAS-2514/BAS-2520 Controller Firmware Upgrade

- Step 1 : Connect the BAS-2514 or BAS-2520 with configuration computer (please refer Fig. 1.2)
- Step 2 : Run KW MULTIPROG software and open the "Ressource" dialog (please refer section 4.5)



*Figure E.1: KW "Ressource" dialog*

- Step 3 : Click the "Download" bottom in Ressource dialog to open download dialog



*Figure E.2: KW "Download" dialog*

Step 4 : Select "Download File" for firmware download

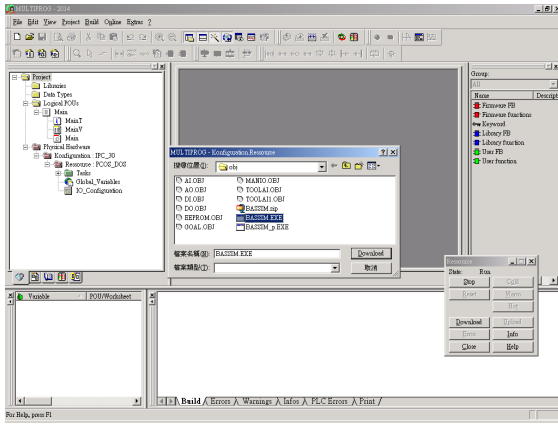


Figure E.3: Firmware file selection

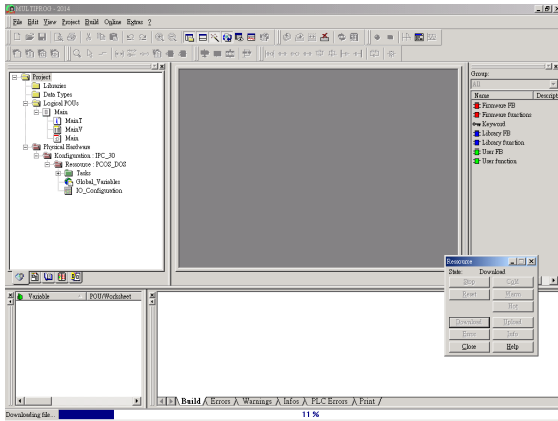


Figure E.4: Firmware downloading process

Step 5 : Re-boot BAS-2513/BAS-2520 controller

