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Prerequisites

The products described in this manual should be installed, operated and maintained only by qualified application programmers and software engineers who are familiar with EN 61131-3 concepts of PLC programming, automation safety topics and applicable national standards.

This quick guide gives the first principles of use for the Ascon Tecnologic **microPAC** system.

To start programming, you need this guide, a PC, the OpenPCS programming suite and at least the **microPAC** Basic Unit.

There are three possibilities regarding the hardware and software in use:

1. Use the **microPAC** demo box. In this case you have all the things you need. Just install OpenPCS on your PC and connect it to the demo box.
2. Use **microPAC** Basic Unit alone. In this case you should provide:
 - An adequate power supply;
 - An Ethernet CAT 5 cross cable (e.g. Ascon Tecnologic part #: AP-S2/CABLE-CUPROG);
 - When requested (the serial ports are optional), the service port serial cable (e.g. Ascon Tecnologic part #: AP-S2/CANBLECUCONF).
3. Use **microPAC** Basic Unit with some I/O modules. In this case you should provide:
 - An adequate power supply;
 - An Ethernet CAT 5 cross cable (e.g. Ascon Tecnologic part #: AP-S2/CABLE-CUPROG);
 - When requested (the serial ports are optional), the service port serial cable (e.g. Ascon Tecnologic part #: AP-S2/CANBLECUCONF);
 - When the external I/O modules are specific to the **microPAC** series, it is only necessary to connect the modules and the I/Os, as the modules are ready to be installed.

Using this manual

Specifications within the text of this manual are given in the International System of Units (SI), with non SI equivalents in parentheses.

Fully Capitalized words within the text indicate markings found on the equipment.

Words **in bold** style within the text indicate markings found in the Configuration Tools.

Warnings, Cautions and Notes are used to emphasize critical instructions:



DANGER!

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Caution

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Note: Highlights important information about an operating procedure or the equipment.

Current Documentation on the Internet

Make sure you are always working with the latest version of this document.

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<http://www.ascontecnologic.com>

Chapter 1

Hardware Installation

1-1 Mechanical installation

The **sigmadue microPAC** and the expansion modules are installed on standard DIN rail. In a normal cabinet layout the first slot on the left must be reserved for the Basic Unit because the connector for the expansion modules is on the right end. Up to two I/O modules can be connected to each Basic Unit.

1-1-1 Installing and Removing modules

A complete description on how the modules can be mounted on or removed from a DIN Rail can be found in the “MP-02 Installation Manual” [9].

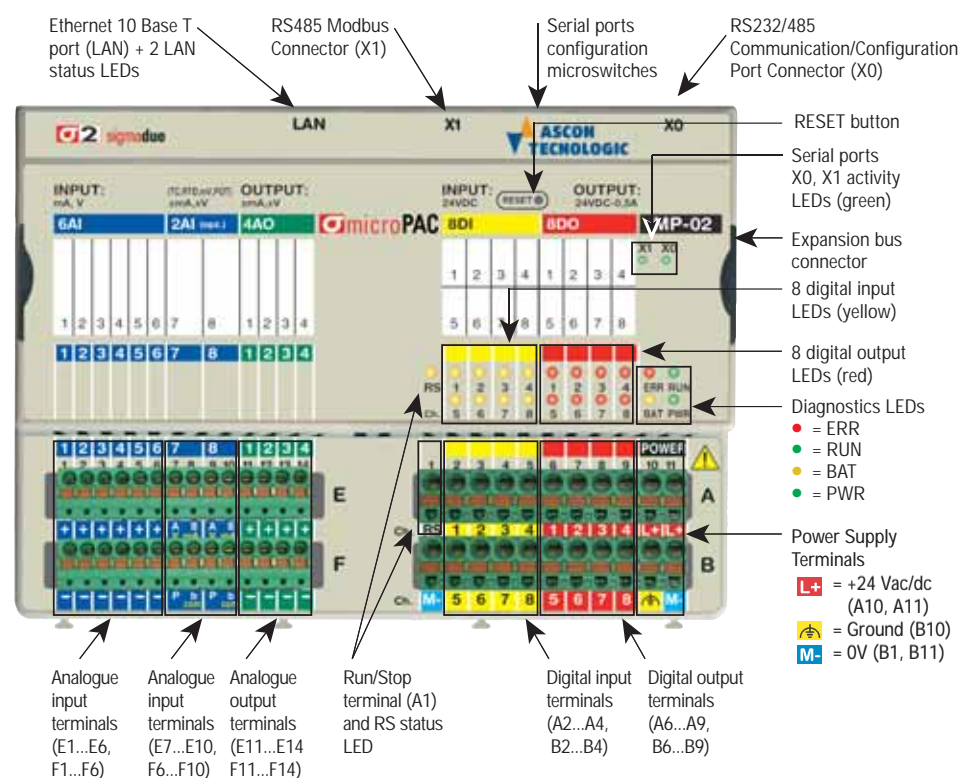


Figure 1.1 - Basic Unit I/O and Communication Ports.



WARNING

The **RESET** button **does not restart** the CPU or the 1131 application. The RESET button **resets all the stored setup parameters and restores the default parameters** (as well as those set by the user).

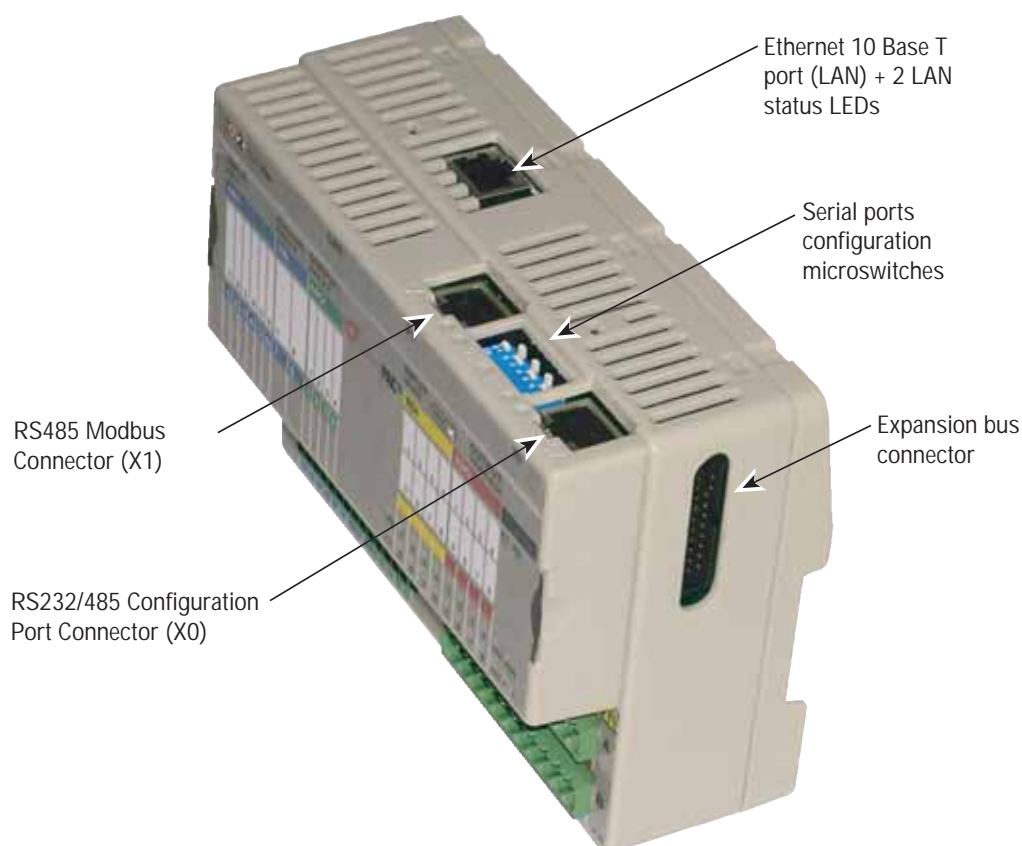


Figure 1.2 - Communications and expansion bus connectors.

For pin-outs and electrical characteristics see “MP-02 Installation Manual” [9].

1-2 Electrical installation

Referring to “Figure 1.1 - Basic Unit I/O and Communication Ports.” and “Figure 1.2 - Communications and expansion bus connectors.”.

1-2-1 Connect the communication cables

RS232/485
Serial Service/
ModBus Port

X0 connector

The connector X0 on the MP-02 unit is an RJ45 type, with the following pinout:

Pin	1	2	3	4	5	6	7	8
Signal	D+ (RS485)	D- (RS485)	GND (RS485)	GND (RS232)	RX (RS232)	TX (RS232)	NC	NC

RS485
Modbus Port

X1 connector

The connector X1 on the MP-02 unit is an RJ45 type, with the following pinout:

Pin	1	2	3	4	5	6	7	8
Signal	D+ (RS485)	D- (RS485)	GND (RS485)	NC	NC	NC	NC	NC

LAN Ethernet
10baseT

LAN connector

The connector on the CPU module is an RJ45 type, with the following pinout:

Pin	1	2	3	4	5	6	7	8
Signal	TX+	TX-	RX+	NC	NC	RX-	NC	NC

1-2-2 Connector “A” connections

The “A” terminal block allows the connection of the +24V Power Supply, Run/Stop, 4 Digital Inputs and 4 Digital Outputs Signals.

The terminals are positioned as follows:

Pin	1	2	3	4	5	6	7	8	9	10	11
Label	RS	1	2	3	4	1	2	3	4	L+	L+
Function	Run/Stop	DI1	DI2	DI3	DI4	DO1	DO2	DO3	DO4	POWER	
Signal	INPUT	INPUT	INPUT	INPUT	INPUT	OUT	OUT	OUT	OUT	+24V	+24V




- 1 **RS** Run/Stop terminal, connecting this terminal to a 24V source, it is possible to launch or stop the execution of the 1131 program loaded in the CPU;
- 2...5 **1...4** 4 Digital Inputs terminals, connecting this terminal to a 24V source, it is possible to change the status of the input;
- 6...9 **1...4** 4 Digital Outputs terminals. Each source type (PNP) digital output can manage a 24V 0.5A load;
- 10...11 **L+** 24Vdc power supply terminals.


1-2-3 Connector “B” connections

The “B” terminal block allows the connection of the 0V Power Supply, 4 Digital Inputs, 4 Digital Outputs Signals and the system hearth.

The terminals are positioned as follows:

Pin	1	2	3	4	5	6	7	8	9	10	11
Label	M-	5	6	7	8	5	6	7	8		M-
Function	POWER	DI1	DI2	DI3	DI4	DO1	DO2	DO3	DO4	Ground	POWER
Signal	0V	INPUT	INPUT	INPUT	INPUT	OUT	OUT	OUT	OUT	Ground	0V



- 1 **M-** 0V power supply terminal.
- 2...5 **5...8** 4 Digital Inputs terminals, connecting this terminal to a 24V source, it is possible to change the status of the input
- 6...9 **5...8** 4 Digital Outputs terminals. Each source type (PNP) digital output can manage a 24V 0.5A load.
- 10  Frame ground.
- 11 **M-** 0V power supply terminal.

1-2-4 Connector “E” connections

The “E” terminal block allows the connection of 6 Analogue Inputs, 2 optional Analogue Inputs and 4 Analogue Outputs.

The terminals are positioned as follows:

Pin	1	2	3	4	5	6	7	8	9	10	11	9	10	11
Label	+1	+	+	+	+	+	A V	B mA	A V	B mA	+	+	+	+
Function	AI1	AI2	AI3	AI4	AI5	AI6	Univ. AI1		Univ. AI2		AO1	AO2	AO3	AO4
Signal	IN	IN	IN	IN	IN	IN	IN		IN		OUT	OUT	OUT	OUT

Analogue input (mA, V)

Analogue input (\pm mA, \pm V) Analogue output (\pm mA, \pm V)

- 1...6 + 6 configurable analogue (linear) input plus (+) poles. These inputs can be configured as mA or V. The minus (-) poles are on connector “F”;
- 7...10 A...B 2 optional universal/high level analogue (linear) inputs (No. 7, 8) (see the “MP-02 Installation Manual” for details). The number (0... 2) and type of input can be identified with the order code. The other terminals of these 2 inputs are on connector “F”;
- 11...14 + 4 optional analogue output plus (+) poles. The number of output (0... 4) is specified in the order code, the type of output is set during the **CPU setup phase** (see the “MP-02 Installation Manual” for details). The minus (-) poles are on connector “F”.

1-2-5 Connector “F” connections

The connector labelled “F” has 14 terminals:

Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Name	-	-	-	-	-	-	P	b com	P	b com	-	-	-	-
Function	AI1	AI2	AI3	AI4	AI5	AI6	Univ. AI1		Univ. AI2		AO1	AO2	AO3	AO4
Signal	IN	IN	IN	IN	IN	IN	IN		IN		OUT	OUT	OUT	OUT

Analogue input (mA, V)

Analogue input (\pm mA, \pm V) Analogue output (\pm mA, \pm V)

- 1...6 - 6 configurable analogue (linear) input minus (-) poles;
- 7...10 P...b 2 optional universal/high level analogue (linear) inputs (No. 7, 8) (see the “MP-02 Installation Manual” for details);
- 11...14 - 4 optional analogue output minus (-) poles.

Chapter 2

OpenPCS Programming Suite Installation

The OpenPCS programming suite from Infoteam is provided on CD-ROM. It is also available online at: www.infoteam.de.

2-1 Installing OpenPCS

2-1-1 Hardware and Software Requirements

OpenPCS requires a PC with at least:

- Pentium II, 1GHz;
- 512 MB RAM;
- 16 GB of free disk space;
- CD-ROM and 1024*768 resolution;
- Windows 2003 Server, Windows XP SP11 or Windows Vista 32bit.

2-1-2 Installation

OpenPCS is provided on CD-ROM. The CD auto-starts a screen where you can select the software you want to install. If auto-start is not activated or does not work, please start the last distributed OpenPCS programming tool version (e.g.

OpenPCS_Ver_631e.exe file) available in X:\SETUP\ folder ("x": is the letter assigned to the CD-ROM drive in your PC).

At the end of the installation, you will be asked if you want to install hardware drivers. If drivers were provided with your PLC, enter the path to the hardware driver, otherwise click "**Exit**". If drivers were received for your PLC, a license key for OpenPCS was also included. See Licence Editor for how to insert a licence key. If you did not receive a hardware driver nor a licence key, OpenPCS is still fully functional, but restricted to 'SIMULATION'.

Note: Installations to substitute drives are not supported by Windows XP.

2-1-3 Starting OpenPCS

With Windows started choose:

Start → Programs → infoteam OpenPCS 2008 → infoteam OpenPCS 2008
this will open the Framework.

Chapter 3

AT target .cab file Installation

3-1 Configuring OpenPCS

In order to work with the Ascon Tecnologic CPU target, you must install in OpenPCS a **.cab** file. The file **AT_sigmadue_Lxx_Hyy_zzzz.cab** contains all the files describing Ascon Tecnologic **sigmadue** Hardware, drivers, examples and utilities (**xx**, **yy** and **zzzz** are digits to identify the software version). In the OpenPCS “Extras” menu, select “tools – Driver install...”. “Select” the desired cabinet (e.g. AT_sigmadue_L13_H7_2009.cab), then “Install”.

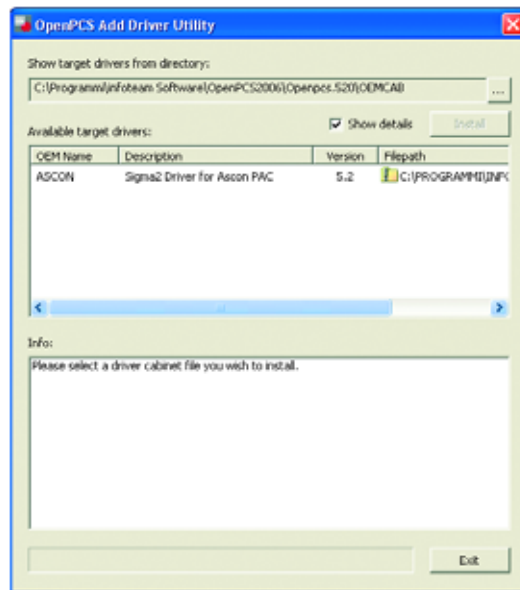


Figure 3.1 - OpenPCS OEM Driver Installation

Chapter 4

PC Ethernet port configuration

In order to communicate with the Ascon Tecnologic MP-02 you must set the IP address and subnet mask of your PC.

To do this, go to the:

Start → Control Panel → Network Connection → LAN

right-click it with your mouse to show the context menu, and select “Properties”.

In the “General” sheet select “Internet Protocol” and chose “Properties”.

In the “General” sheet now you can set:

IP address	192.168.5.xx	xx: all except 11
subnet mask	255.255.255.0	

Chapter 5

OpenPCS Set-up

5-1 OpenPCS Setup

To connect the OpenPCS development system to the Ascon Tecnologic target, a new connection must be defined.

Select “Connections...” item in the “PLC” menu. In the window of *Figure 5.1 - OpenPCS Connection Setup* select “New”.

Now in the window “Edit connection” it is possible to set the new connection. In the field “Name” you can name the new connection.

By pushing the “Select” button you can pick the driver that manages the communication with the target: for Ascon Tecnologic CPU is TCP52.

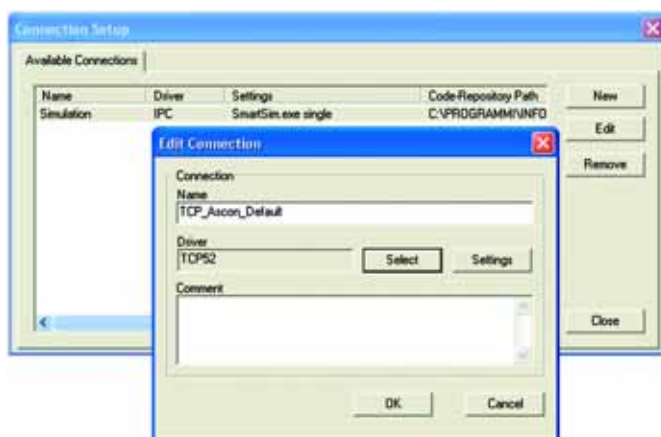


Figure 5.1 - OpenPCS Connection Setup

By clicking the “Settings” button you can set the communication parameters.



Figure 5.2 - TCP Settings

The Port number and IP address must be the same as those configured at the initial CPU configuration session. See the Ethernet setup menu, items 7 and 2. OpenPCS environment is now ready to communicate with the AT target. The project must be set up in order to use the CPU.

Select the “*Resource Properties*” item in the PLC menu, select “*Ascon Tecnologic...*” in the “*Hardware Module*” field, then select the newly created TCP connection in the “*Network Connection*” field.

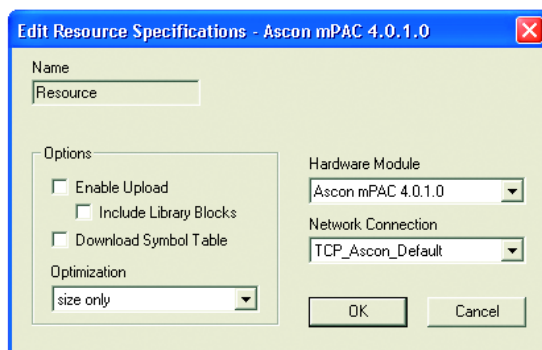


Figure 5.3 - *OpenPCS resource Specifications*

The code “*Optimization*” menu allows for three choices of compilation: “*Normal*” and “*Speed only*” refers to the NCC: Native Code Compilation, while “*Size only*” refers to the standard code.

Please note that the use of NCC does not permit the user to insert break points in debugging projects.

Setup Communication Timeout

There are several conditions that could make it necessary to set the Ethernet Port communication timeout to a value higher than the default value. This timeout checks the dialogue between OpenPCS and the target CPU. When dealing with large programs, it may be necessary to set a longer driver timeout. The default value of 20000ms can be increased by using the following register key:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\infoteam Software GmbH\
OpenPCS\6.x.x\Online\TcpDriverTimeout_ms]
```

Value = "20000" means a timeout of 20 seconds.

Chapter 6

Getting started: the first project

To introduce you to OpenPCS, we will use a simple example shown below. The rest of this chapter will then implement the solution with OpenPCS.

Problem: A blinker shall blink when a button `button` is pressed with an interval of 2 seconds. If the button is released, the blinker should immediately turn off.

Solution: might look like this:

```
PROGRAM ❶ blinker_st ❷
VAR ❸
button ❹    AT %I0.0 :    BOOL; (*input ❺*)
blinker      AT %Q0.0 :    BOOL; (*output*)
timer        :          TON; (*timer functionblock*)
END_VAR
(* call 2s-timer ❺*)
timer(in:= button,pt:=T#2s); ❻
(* if 2s are over... *)
if (timer.q) then
    (* ... toggle blinker *)
    blinker := not blinker;

    (* and reset timer! *)
    timer (in:= false);
end_if;

blinker := blinker AND button;
END_PROGRAM ❶
```

- ❶ The program starts with the keyword PROGRAM, and ends with the other keyword END_PROGRAM. When working with OpenPCS, you will not type in these keywords, but rather the editor will create them automatically for you.
- ❷ OpenPCS will prompt you for the name of the program when you create a new program.
- ❸ In contrast to traditional PLC programming languages, IEC61131 requires that you declare all variables that you use.
- ❹ This line declares a variable of name 'button' of data type 'BOOL', to be mapped to hard ware address '%I0.0', i.e. this variable shall denote the lowest bit of the first input byte.
- ❺ Almost everywhere in IEC61131 you can use comments to describe your programs.
- ❻ The instruction part of the program starts with a call of a functionblock. As you will notice, most instructions are assignments and function(block) calls.

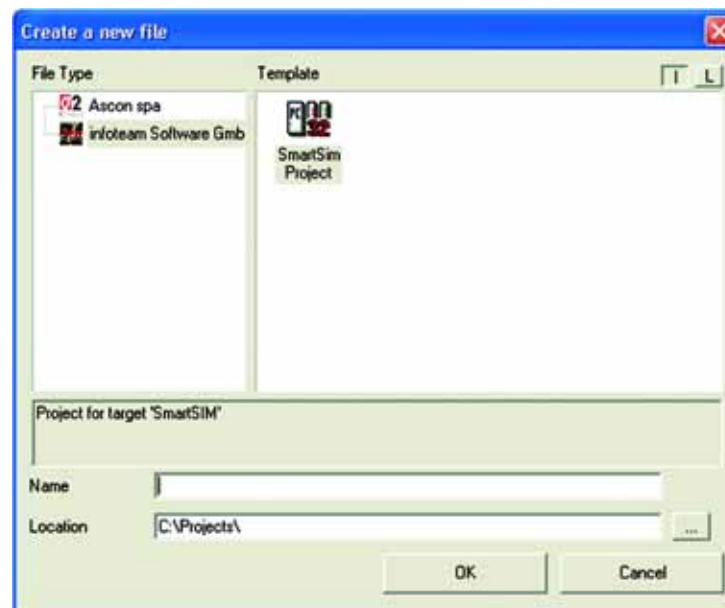
In this sample program, we have a functionblock **TON** (output is true after expiration of time), control structure **IF** (code of this block is only executed if its expression is satisfied), assignments **:=** (result of the right is assigned to variable on the left) and the operator **AND** (and-connect operand to current result).

Please note: which hardware addresses are valid is strongly dependent on the PLC you are using.

6-1 Creating a New project

For our first OpenPCS code, we will set up a new project.

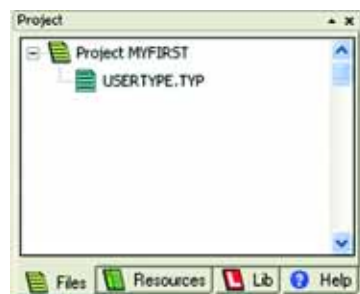
Start OpenPCS and select **File → Project → New**. A dialog box will prompt for the name and location of the new project.



Enter a name of your choice, e.g. "MyFirst".

Note: The name of an OpenPCS project should not contain blank (space) characters or special characters. Plus, for easy updates, it is recommended that you store your application separate from OpenPCS. To give an example, **C:\PROJECTS** is a good location to store your projects.

Now, the Browser contains the new project.

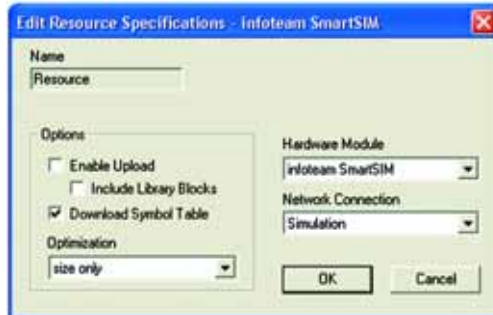


There are different views on your project:

1. The **Files-Pane** shows all files of the project;
2. The **Resource-Pane** displays the current configuration, with all defined Resources and their tasks;
3. The **Library-Pane** contains all installed libraries;
4. The **Help-Pane** shows the help topics.

OpenPCS has already created one (empty) file to contain your type definitions named **“usertype.typ”** and a default resource, named **“resource”**.

Typically, the default resource will need to be configured properly for your controller. We are not using any controller here, so the resource is quite ok, but to demonstrate breakpoints later we will need to set optimisation low enough to allow that. Find the **“resource”** entry in the Resource-Pane, right-click it with your mouse to show the context menu, and select **“Properties”**:



Under **“Optimization”**, **“Size only”** should be selected by default. If you use a sample project from your PLC manufacturer, other optimization settings can be set.



WARNING

For using breakpoints, optimization must be set to **“Size only”**!

6-2 Writing Code

To create a new program, choose **“File → New”**. A dialog-box will appear, where you must choose the programming language, a filename and the location where the file will be stored. As you can see there are plenty of programming languages that can be chosen, but we will only use ST in this introduction.

Enter **“blinker_st”** as the name and ST as language and press **“OK”**. Do not change the file location. Now you are asked if you want to link the new program to the active resource. Click **“Yes”** and a new task, named **“blinker_st”** will appear in the resource-pane under the active resource.

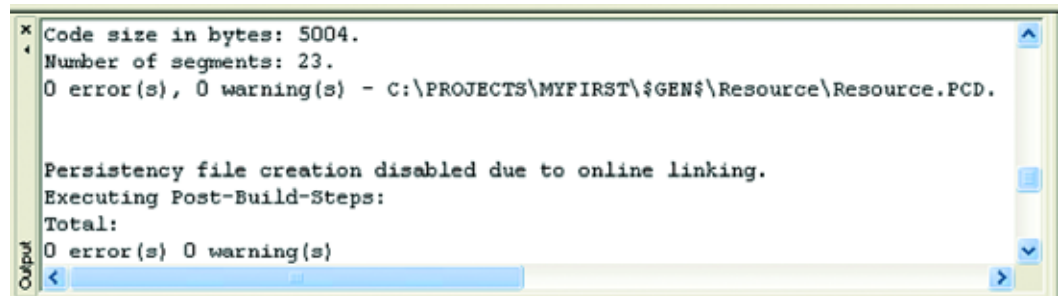
The Editor-Pane will open, displaying two different windows: At the top is the declaration window for your first program, at the bottom is the instruction window of your program. Enter the sample program like shown below:



Press **File → CheckSyntax** to invoke a syntax check. In the diagnostic output window, you should read “**0 errors, 0 warnings**”. If not, carefully check what you have entered.

6-3 Executing Code

To execute your small application, we need to compile it and transfer the code to the controller first. To build the code for the controller select **PLC → Build Active Resource** from the menu bar. In the output window, you will see the compilation proceed. The end of the output should look similar to the following:



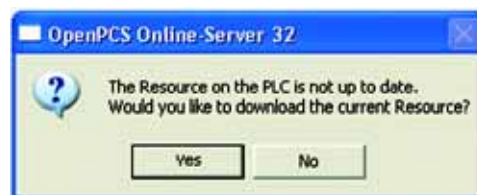
```

Code size in bytes: 5004.
Number of segments: 23.
0 error(s), 0 warning(s) - C:\PROJECTS\MYFIRST\GEN$\Resource\Resource.PCD.

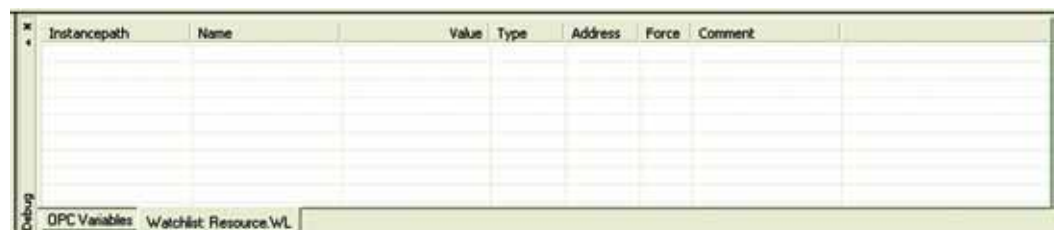
Persistency file creation disabled due to online linking.
Executing Post-Build-Steps:
Total:
0 error(s) 0 warning(s)

```

After compilation finished successfully, your code needs to be transferred to your controller. Now select **PLC → Online** to Connect to the resource. OpenPCS will detect, that your application needs to be downloaded and will prompt your permission to do so:



Accept that with “**yes**”. You will see a progress bar while the code is being transferred, but for this small example it should be finished very quickly. When download has finished, you will see that OpenPCS automatically opened another of its tools, the “**Test and Commissioning**”. This is proof that OpenPCS is online:

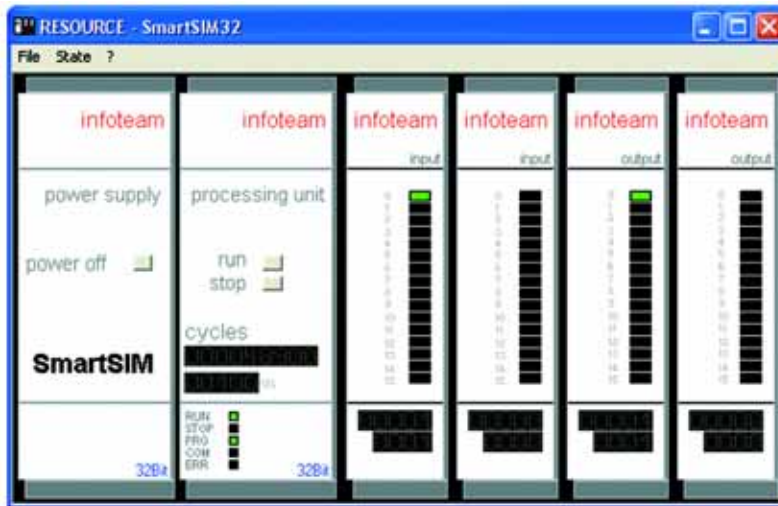


Note: In this introduction, we are not using a real hardware controller. Instead, we are using the “*Windows Simulation tool*” that comes with OpenPCS, named **SmartSIM**:

Use **PLC → Coldstart** (or press the red arrow in the toolbar) to start execution of your code.



Go to SmartSIM and activate the first input (“**button**”). This should activate the first output (“**blinker**”). After an expiration of three seconds it should go inactive switching back after another three seconds. De-activate the first input (“**button**”), and the first output (“**blinker**”) should be inactive.

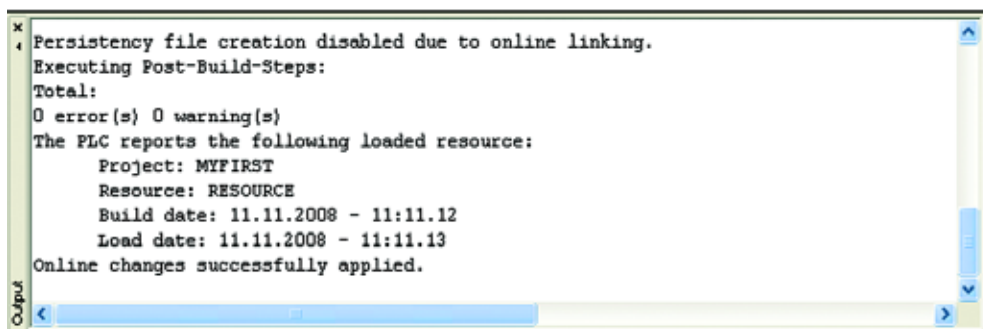


6-4 Monitoring Code

Now that your application is running, go back to the Browser and find the “**Resource**” in your project. Click all the small plus signs to open the entire tree under the resource entry. This will reveal the “**instance tree**”, showing all instances of programs and function blocks and all variables that you used in your program:



Double-click some of the variable entries (grey boxes with 0/1 shown), and see the corresponding variables added to the watch list in the Test&Commissioning:



Go back to SmartSIM and modify the inputs to see the effect in the watch list. The ST-Editor will also be in monitor mode. You should see a different cursor once you move the mouse onto the ST-Editor.

Move the mouse cursor to a variable in your code and after a short period, you will see a “**tooltip**” like display of online value display:



Move the mouse around and point at different variables to examine their values. If the variables are modified by the application, the display will be automatically refreshed.

If you need to analyse the logic of your code, value display alone may not be enough. Move the cursor to a line of your program that contains code, and single click the mouse. Now press **F9** to set a breakpoint to that line. You will see a red dot immediately, marking the breakpoint. Shortly after that, you will notice a yellow arrow, identifying the current instruction pointer.

OpenPCS will display “**Breakpoint reached**” in the output window.



You may still move the mouse cursor around to examine variable values while the controller is stopped at the breakpoint. Press **F10** to single-step through your code, or press **F5** to continue execution. Within a line that contains a breakpoint, press **F9** again to delete the breakpoint. OpenPCS supports “**Online Edit**”, for further information see *Online Edit* in the user manual.

Note: If SmartSIM does not stop when you set a breakpoint, you probably did not set **optimisation settings** properly. Be sure your resource is configured for “**size only**”.

6-5 Online Edit

Online Edit (or Online Change) is a feature whereby program changes are applied to the PLC without the need to restart it. The following Steps need to be done in order to run Online Edit.

The program must be compiled and running on the PLC. The source is opened in an editor window.

The Editor can be switched from Monitor Mode (green colored symbol) to Edit Mode (red colored symbol) and back via **PLC → Online/ Edit** or the corresponding button of the toolbar



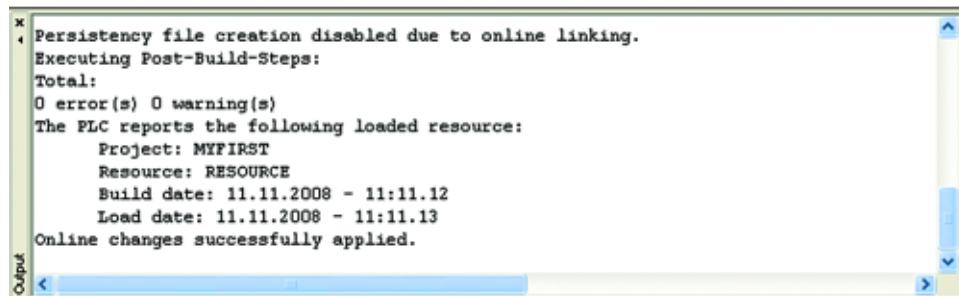
Implement the desired changes and close the Edit Mode via **PLC → Online/ Edit** again.

OpenPCS prints a dialogue to accept and download the changes:



If the changes are accepted, OpenPCS recompiles the necessary unit and downloads them to the PLC without stopping the running cycle. The changes have bearing on the next cycle.

OpenPCS prompts a message in the output window, if the update is finished:



Appendix A

Reference documents

- [1] “Infoteam OpenPCS programming system – user manual” – version 6.0 English
- [2] “IEC 61131-3: Programming Industrial Automation Systems” – Karl-Heinz John, Michael Tiegelkamp - Springer
- [3] “Ascon Tecnologic Firmware Function Block Library”
- [4] “IEC 61131-3 Function Block Library”.
- [5] “Estensioni per gestire porte di comunicazione dell’ambiente OpenPCS” V1.0 – Maurizio Grassi
- [6] “Modbus Messaging on TCP/IP implementation guide”
- <http://www.Modbus-IDA.org>
- [7] “MODBUS over Serial Line Specification & Implementation guide”
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- [8] “MODBUS APPLICATION PROTOCOL SPECIFICATION”
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- [9] “MP-02 Installation manual” (code: J30 - 658 - 1AMP-02 E).
- [10] “MP-02 User manual” (code: J30 - 478 - 1AMP-02 E).
- [11] “*micro***PAC** I/O modules Installation Manuals”.
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