Saia-Burgess Controls AG
Bahnhofstrasse 18 I CH 3280 Murten I Schweiz

T +41 (0)26 672 71 11 I F +41 (0)26 672 74 99 I www.sbc-support.ch I www.saia-pcd.ch

PCD2/3: IO Signals in the Device Configurator

saia-burgess
Control Systems and Components

Projekt History

Date	Author	Modification
23.06.2009	TCS	Creation of project and documentation (version 1)

1. Summary

1.1 Functional description

This sample project intended to show how IO modules are configured in device configurator and how to use IO handling functionality in device configurator to read/write IO signals.

To read and write digital/analogue values using the IO modules and device configurator, it is essential to have a basic understanding of Device configurator. This topic is dealt with in section 2.1 (Device configurator).

1.2 Quick Steps

In general following easy steps in device configurator will allow you to configure and read/write IO values to respective IO modules.

- Enable IO handling (By default its enabled when new device is created)
- Place Input/Output modules in respective IO slots in device configurator
- Enable media mapping for each IO module
- Define media address
- Define PG5 symbol Names for each IO channels (Or keep Default)
- In case of analog modules select suitable scaling
- Save the configuration
- Device must have program with at least one COB
- Mapped media/PG5 public symbols can now be used in programs.
- Re-build All and download program to target controller

1.3 Possible application

The device configuration for various IO modules described in this example can be used in any project with digital and/or analogue IO signals.

1.4 Hardware and software used

Hardware:

- PCD3.M5540, PCD3.C200
- One or several I/O modules, depending on the requirement
- PCD8.K111 programming cable or USB cable (for PCD3 or PCD2.Mxxx0)
- Where input modules are used, a signal transmitter is required.

To use these examples with a controller type other than a PCD3.M5540, the relevant device type should be selected in the device configurator.

Minimum software version:

SAIA PG5 2.0.110 or higher

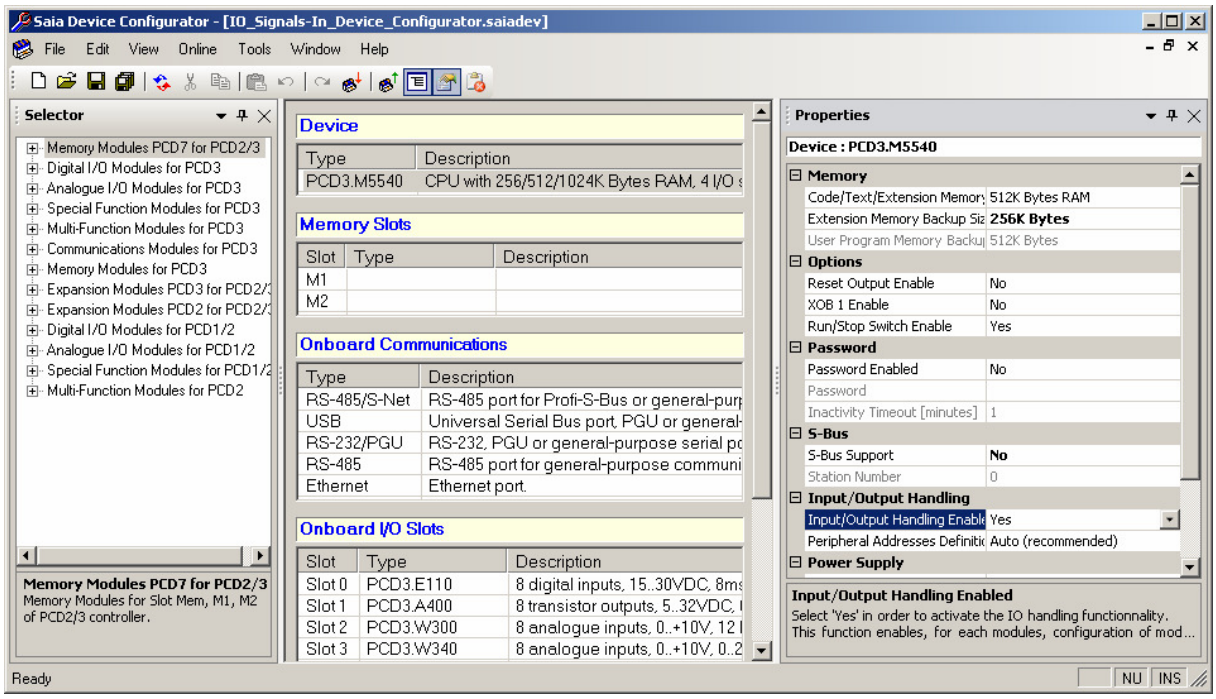
PCD3: minimal FW 1.08.23, PCD2.M5: minimal FW 1.08.19

2. Device configurator

2.1 Introduction

The Saia Device Configurator is used to configure the hardware settings of Saia PCD. It also offers the possibility to configure the IO modules with the IO handling functionality. We will discuss configuring IO modules with the IO handling functionality using device configurator.

Detail Online help on device configurator is available from Help menu.



2.2 IO handling in device configurator

The IO handling functionality defines peripheral memory for storing IO values. It defines one range for input values and one range for output values. Within those peripheral memory ranges (input and output), a range of address are reserved for each configured module for its input and/or output values.

The media mapping functionality enables a mapping between the peripheral memory values and the device resources (registers and flags). When media mapping is enabled input values from peripheral memory will be copied to respective PCD resources (Registers or Flags) at the beginning of a cycle, it means before the first COB is executed.

For Output modules values from PLC resources will be copied to output peripheral memory at the end of program cycle that is at the end of last COB.

2.3 Working with Device configurator

Device configurator has various views namely Main window, Selector window, Properties window and message window. Main view has context menu and actions like Device type change are performed from context menu. Each component is selected in main view and properties window at right shows all parameters. The editable parameters are adjusted from here. For example select the Device say PCD3.M5540 in main window, all hardware settings properties are displayed in properties window.

All possible modules which can be placed in one of the slots are available in selector window. These include digital and analog IO modules, communication modules, IO extension modules etc. Modules from selector window are placed in device slots by selecting the respective slot and double mouse click on module in the selector window. Once the module from selector window is placed in device slot, properties of module are configured from properties window.

2.4 Configuring IO modules

IO handling needs to be enabled to use the IO handling functionality with media mapping for IO modules. It is only available for PCD3 and PCD2.M5. Select the appropriate device type in main view and by default IO handling is enabled for newly created device in device configurator. The peripheral addresses definition should be “Auto”(recommended and default), when user defined is selected it is possible to configure input/output peripheral memory address manually.

Next step is to place the required IO modules in desired slot. When these modules are selected in main view its properties are displayed in properties window. Select Media mapping Enabled as YES and provide the base media addresses. PG5 Symbol names for each input/output are defined from symbol definition property, by default symbol Names appear like *IO.Slot**x**.DigitalInput**x*** or *IO.Slot**2.**AnalogueInput**x.***

In case of analogue modules scaling is done for each channel in properties window. Predefined or user defined minimum and maximum values are selected for minimum and maximum physical signals. More about configuring and using IO modules is described in next chapter.

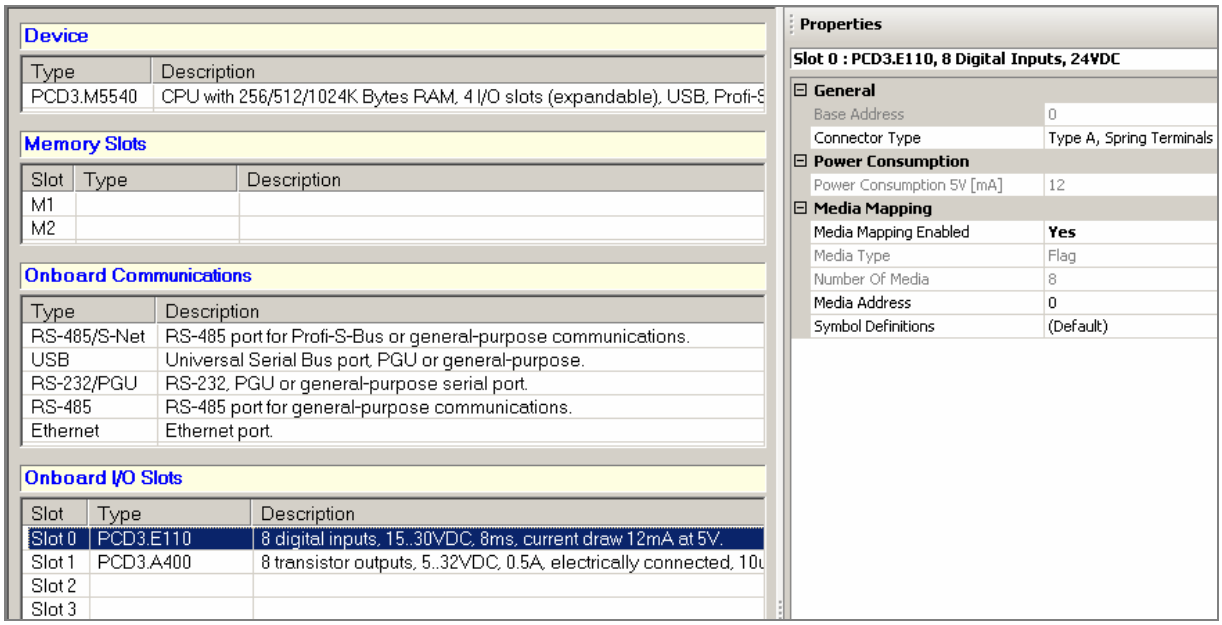
3. Functional description and settings

3.1 Principles of reading/writing I/O modules

When media mapping is enabled SAIA PCD works with a process map. Inputs are read at the start of the cycle and outputs are updated at the end of cycle.

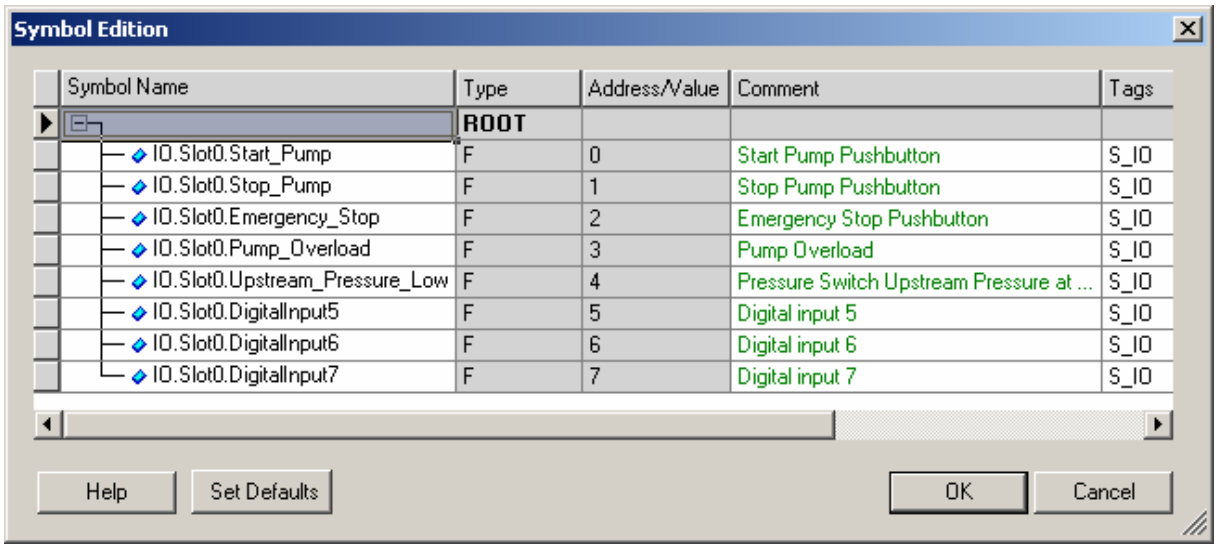
3.1.1 Digital I/O modules

For digital IO modules Flags are used for media mapping and these mapped flags can then be used in user program for reading/writing values to IO modules. In following example digital input module PCD3.E110 is placed in Slot0 and Media mapping is enabled from properties window. Media Address is defined as 0 which means flag 0 to 7 are mapped with Input 0 to 7 of PCD3.E110 module



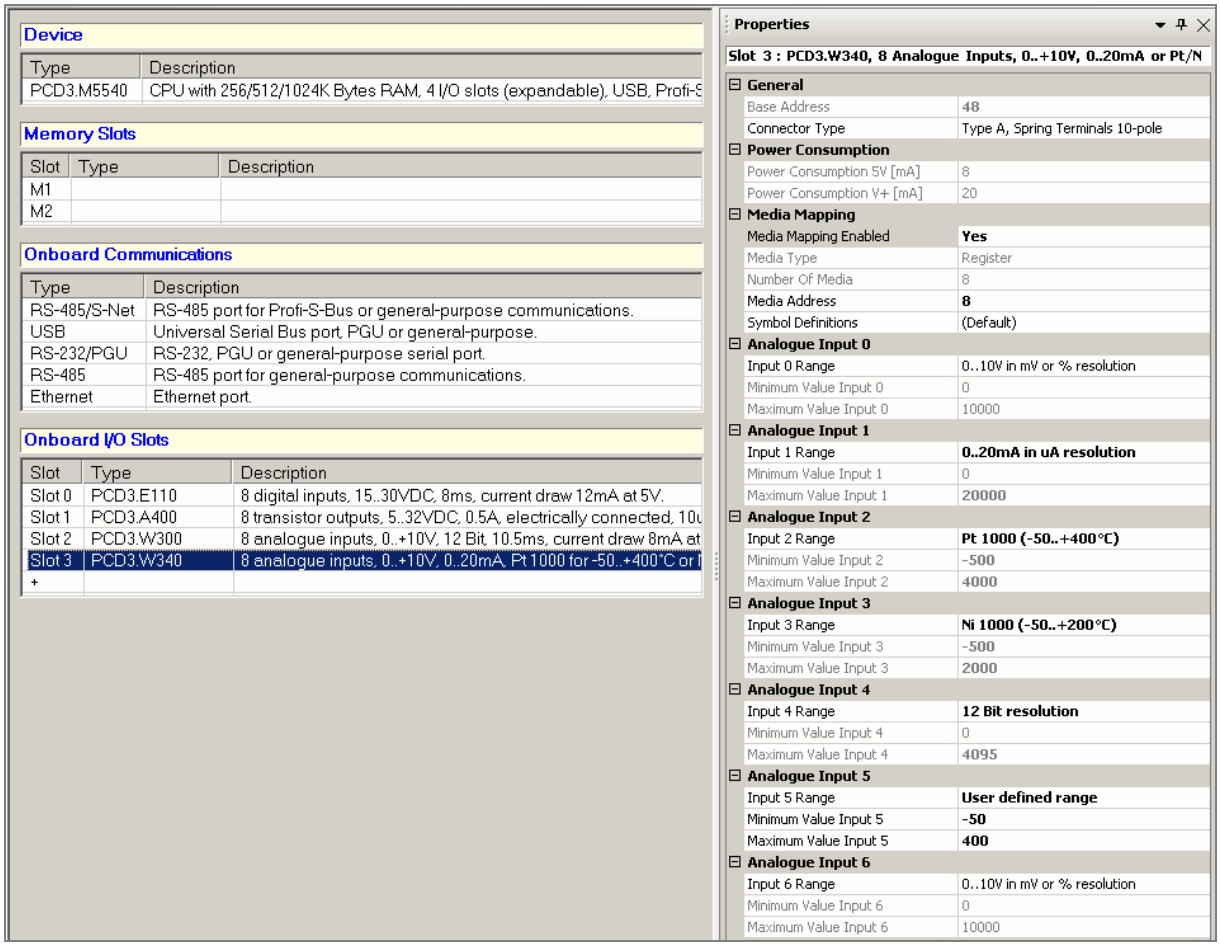
Similarly for digital output modules, values written to the mapped flags will be written to respective outputs. In above example flags 8 to 15 are mapped to PCD3.A400 module's Output0 to Output7.

Symbol definitions for mapped flags are modified from the properties window. Below example shows the example of defining symbols for digital inputs module PCD3.E110. Following dialog is opened from Properties window by selecting Symbol definition property. These symbols are available in program editors and they are then used in user program.



3.1.2 Analogue Input modules

All analogue modules can be configured and used using device configurator. Similar to digital modules they are placed in respective slots and needs to be configured from properties window. In below example Configuration for PCD3.W340 module is shown. Register 8 to 15 are mapped with analogue input 0 to 7 of PCD3.W340 module. Registers 8 to 15 then are used in programs. Symbol definition for register 0 to 7 can be edited from Symbol definition property. Scaling for analogue IOs can be configured in device configurator. In below example first analogue input is configured as 0 to 10 Volts that means values in the Register 8 will vary from 0 to 10000 for 0 to 10 Volts respectively. The other inputs work in the same way.



Device

Type	Description
PCD3.M5540	CPU with 256/512/1024K Bytes RAM, 4 I/O slots (expandable), USB, Profi-S

Memory Slots

Slot	Type	Description
M1		
M2		

Onboard Communications

Type	Description
RS-485/S-Net	RS-485 port for Profi-S-Bus or general-purpose communications.
USB	Universal Serial Bus port, PGU or general-purpose.
RS-232/PGU	RS-232, PGU or general-purpose serial port.
RS-485	RS-485 port for general-purpose communications.
Ethernet	Ethernet port.

Onboard I/O Slots

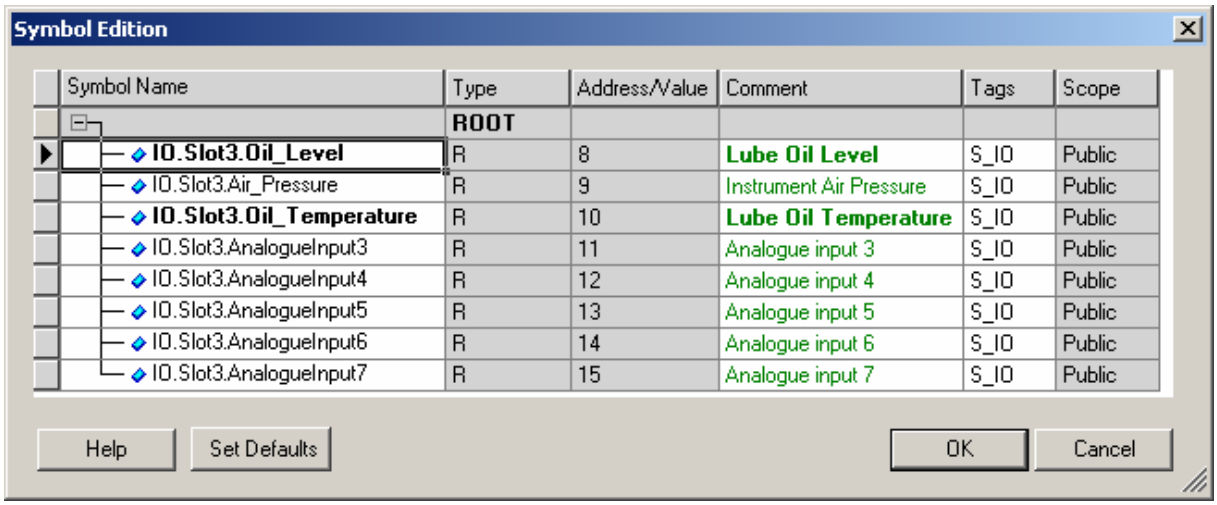
Slot	Type	Description
Slot 0	PCD3.E110	8 digital inputs, 15..30VDC, 8ms, current draw 12mA at 5V.
Slot 1	PCD3.A400	8 transistor outputs, 5..32VDC, 0.5A, electrically connected, 10u
Slot 2	PCD3.W300	8 analogue inputs, 0..+10V, 12 Bit, 10.5ms, current draw 8mA at
Slot 3	PCD3.W340	8 analogue inputs, 0..+10V, 0..20mA, Pt1000 for -50..+400°C or I
+		

Properties

Slot 3 : PCD3.W340, 8 Analogue Inputs, 0..+10V, 0..20mA or Pt/N

General	
Base Address	48
Connector Type	Type A, Spring Terminals 10-pole
Power Consumption	
Power Consumption 5V [mA]	8
Power Consumption V+ [mA]	20
Media Mapping	
Media Mapping Enabled	**Yes**
Media Type	Register
Number Of Media	8
Media Address	**8**
Symbol Definitions	(Default)
Analogue Input 0	
Input 0 Range	0..10V in mV or % resolution
Minimum Value Input 0	0
Maximum Value Input 0	10000
Analogue Input 1	
Input 1 Range	**0..20mA in uA resolution**
Minimum Value Input 1	0
Maximum Value Input 1	**20000**
Analogue Input 2	
Input 2 Range	**Pt 1000 (-50..+400°C)**
Minimum Value Input 2	**-500**
Maximum Value Input 2	**4000**
Analogue Input 3	
Input 3 Range	**Ni 1000 (-50..+200°C)**
Minimum Value Input 3	**-500**
Maximum Value Input 3	**2000**
Analogue Input 4	
Input 4 Range	**12 Bit resolution**
Minimum Value Input 4	0
Maximum Value Input 4	**4095**
Analogue Input 5	
Input 5 Range	**User defined range**
Minimum Value Input 5	**-50**
Maximum Value Input 5	**400**
Analogue Input 6	
Input 6 Range	0..10V in mV or % resolution
Minimum Value Input 6	0
Maximum Value Input 6	10000

Scaling properties of analogue modules varies for different types of modules. Symbol definitions for mapped registers are modified from the properties window. These symbols will be available in program editors and can be used in the user program. Below example shows the example of defining symbols for analogue inputs module PCD3.W340. This dialog is opened from Properties window by selecting Symbol definition property.



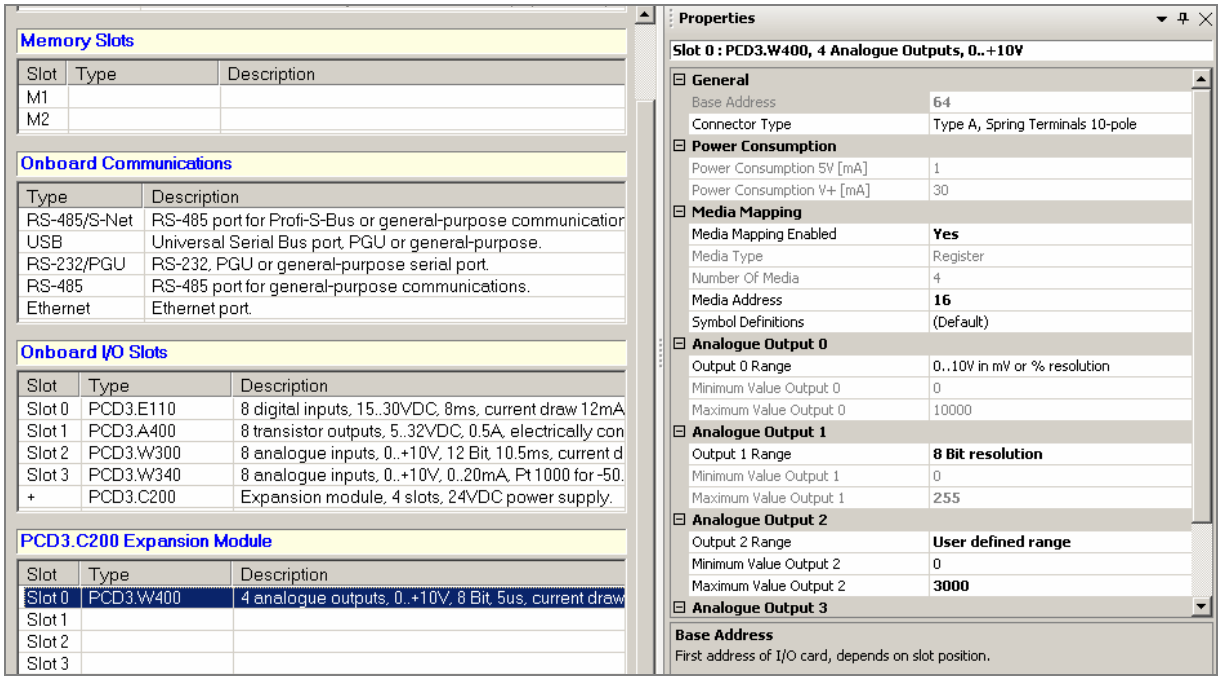
Symbol Edition

Symbol Name	Type	Address/Value	Comment	Tags	Scope
ROOT					
IO.Slot3.Oil_Level	R	8	**Lube Oil Level**	S_IO	Public
IO.Slot3.Air_Pressure	R	9	Instrument Air Pressure	S_IO	Public
IO.Slot3.Oil_Temperature	R	10	**Lube Oil Temperature**	S_IO	Public
IO.Slot3.AnalogueInput3	R	11	Analogue input 3	S_IO	Public
IO.Slot3.AnalogueInput4	R	12	Analogue input 4	S_IO	Public
IO.Slot3.AnalogueInput5	R	13	Analogue input 5	S_IO	Public
IO.Slot3.AnalogueInput6	R	14	Analogue input 6	S_IO	Public
IO.Slot3.AnalogueInput7	R	15	Analogue input 7	S_IO	Public

Help | Set Defaults | OK | Cancel

3.1.3 Analogue Output modules

In below example output module PCD3.W400 is configured using device configurator. Values from the register 16 to 19 are written to output module PCD3.W400. Output0 is configured as 0 to 10 volts with corresponding minimum and maximum values 0 and 10000 respectively. Writing values 0 to 10000 to register 16 will output 0 to 10 volts at the first output. Similarly for next outputs it will output 0 to 10 Volts based on the corresponding values in the range of minimum and maximum values. It is also possible to configure user defined minimum and maximum values (Output 2).



Memory Slots

Slot	Type	Description
M1		
M2		

Onboard Communications

Type	Description
RS-485/S-Net	RS-485 port for Profi-S-Bus or general-purpose communicatior
USB	Universal Serial Bus port, PGU or general-purpose.
RS-232/PGU	RS-232, PGU or general-purpose serial port.
RS-485	RS-485 port for general-purpose communications.
Ethernet	Ethernet port.

Onboard I/O Slots

Slot	Type	Description
Slot 0	PCD3.E110	8 digital inputs, 15..30VDC, 8ms, current draw 12mA
Slot 1	PCD3.A400	8 transistor outputs, 5..32VDC, 0.5A, electrically con
Slot 2	PCD3.W300	8 analogue inputs, 0..+10V, 12 Bit, 10.5ms, current d
Slot 3	PCD3.W340	8 analogue inputs, 0..+10V, 0..20mA, Pt1000 for -50.
+	PCD3.C200	Expansion module, 4 slots, 24VDC power supply.

PCD3.C200 Expansion Module

Slot	Type	Description
Slot 0	PCD3.W400	4 analogue outputs, 0..+10V, 8 Bit, 5us, current draw
Slot 1		
Slot 2		
Slot 3		

Properties

Slot 0 : PCD3.W400, 4 Analogue Outputs, 0..+10V

General	
Base Address	64
Connector Type	Type A, Spring Terminals 10-pole
Power Consumption	
Power Consumption 5V [mA]	1
Power Consumption V+ [mA]	30
Media Mapping	
Media Mapping Enabled	**Yes**
Media Type	Register
Number Of Media	4
Media Address	**16**
Symbol Definitions	(Default)
Analogue Output 0	
Output 0 Range	0..10V in mV or % resolution
Minimum Value Output 0	0
Maximum Value Output 0	10000
Analogue Output 1	
Output 1 Range	**8 Bit resolution**
Minimum Value Output 1	0
Maximum Value Output 1	255
Analogue Output 2	
Output 2 Range	**User defined range**
Minimum Value Output 2	0
Maximum Value Output 2	**3000**
Analogue Output 3	

Base Address
First address of I/O card, depends on slot position.

3.1.4 Direct Access

It is also possible to read input values and write output values directly using IL instruction. Following instructions along with Address of input/output defined by device configurator are used for reading and writing IO values.

These instructions works independent of program cycle scan and they read or write inmmediately after execution. This means that you can read and write values several times in the same program scan cycle using these instructions.

Following instructions are available for reading and writing IO values.

For reading:

RDP address;

DWORD, per default.

RDPB address;

BYTE, LS byte of source, other bytes set to 0.

RDPW address;

WORD, LS word of source, MS bytes set to 0.

For writing:

WRP address;

DWORD, per default.

WRPB address;

BYTE, LS byte of source, other bytes set to 0.

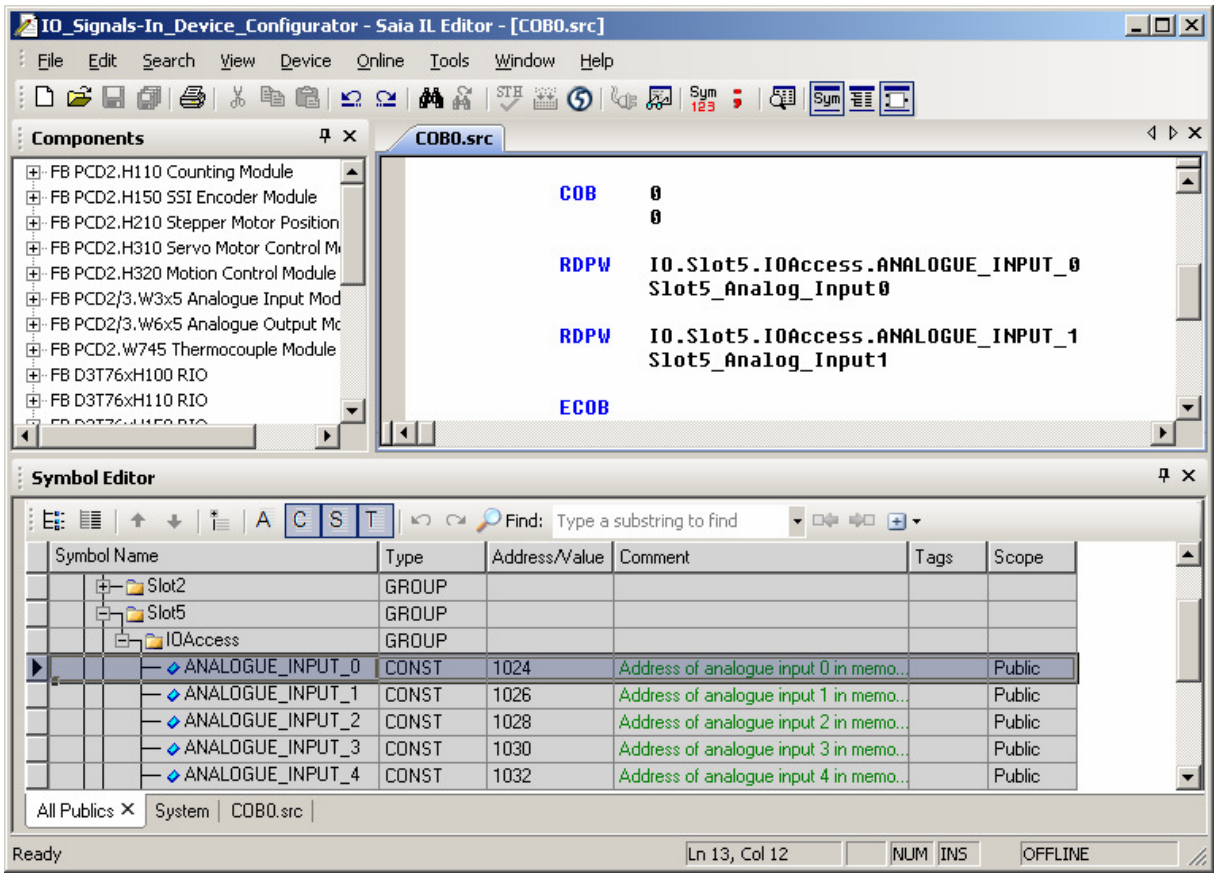
WRPW address;

WORD, LS word of source, MS bytes set to 0.

There is no bit access command and minimum access range is byte.

Example:

Device configurator generates constant symbol for ID/Address of the input/output values and these symbols are available in '*All public'* View. In below example for the module PCD3.W340 which is placed in slot 5, constant Symbols IO.Slot5.IOAccess.ANALOGUE_INPUT_0 to 7 are defined by Device configurator. These symbols are used along with above instruction to directly read/write values.



4. Device configurator vs Fbox Library for IO signals

Following sections describe the advantages and limitations of using device configurator for accessing IO signals compared to Fbox Library. This will help in choosing between Device configurator and Fbox library.

4.1 Advantages of Device configurator

- **The complete system is visible in the same tool**
  Device configurator is designed to configure your overall system. Hardware settings and system components like communication modules and IO modules are configured in device configurator. When device configurator is used for configuring IO modules, it gives the overall picture of your complete system and its components. This is not possible when we use Fbox library to access IO modules.
- **Power consumption of the modules is automatically calculated**
  The Device Configurator makes check for power consumption of the input/output modules and issues warning if it exceeds available power supply from Device or expansion modules.
- **Less resources needed for the IO handling**
  Fboxes for accessing IO modules are part of user program and they use PCD resources. When IO modules are configured using Device configurator, processing of IO signals is handled by firmware and IO values are directly available in PCD media. It saves the user program memory and resources.
- **Working with a process image**
  With the device configurator when media mapping is used, SAIA PCD works with process image. Inputs are read at the start of program scan cycle and outputs are written at the end of program scan cycle. It is advantageous to have constant input process image throughout the one program cycle and updating outputs only once with final state after executing entire user program.[1]
- **IO symbols are all defined at the same place**
  Symbol definitions for Input/Output channels are edited from the symbol editor dialog opened within Device configurator from IO module properties window. In this way all input and output symbols are defined at one place in Device configurator near to respective IO modules. This is convenient to locate and manage all process input and output symbols.
- **Easier configuration of PCD3 Compact or counter/encoder modules**
  Apart from this device configurator offers the easy configuration for using special functions like counters/encoders. For example counter/encoder functions easily configured and used in case of PCD3 Compact or with special PCD3.H1xx modules.

[1] Please note that it is always possible to read/write IO signals many times in same program cycle using direct access instructions.

- **Warning in case of conflict**
  A warning or an error is also displayed when a module may have some conflict with the watchdog.
- **Label Editor**
  An extension application *Label editor* is useful to edit and print the labels for your IO modules. Label editor is available in Device configurator from menu Tools→Label Editor.

4.2 Note for special sensors

Although device configurator supports the all standard IO sensors, there are few special sensors (e. g. temperature sensors NTC 10) which are not supported in device configurator. We recommend in such special cases please use the existing Fbox libraries to access your process data. For more information on Analog signals using Fupla Fboxes please refer to Getting Started example 'Analogue_Signals_with_Fupla'

4.3 Precaution

Following care must be taken while using the Device configurator for analogue modules.

It is recommended to use Device configurator for accessing analogue I/O modules with PG5 2.0. However in order to compatible with programs from old PG5 versions it is still possible to use Fbox libraries which uses base addresses of I/O bus. When using the both methods in one program care must be taken that addresses do not interfere with each other. This means for example if Fbox in fupla program is using Base address 48 to read the analog values from Slot3 then Slot3 in Device configurator should be kept empty.

If the Programs from PG5 versions 1.4.xx or older are upgraded to PG 2.0 and if they were using the Fbox libraries to read the Analog I/O modules, they are still compatible with PG5 2.0.

5. Preparing Project

5.1 Preparing the PCD

The module to be used should be inserted into respective socket where it is configured in Device configured on the PCD3.M5540.

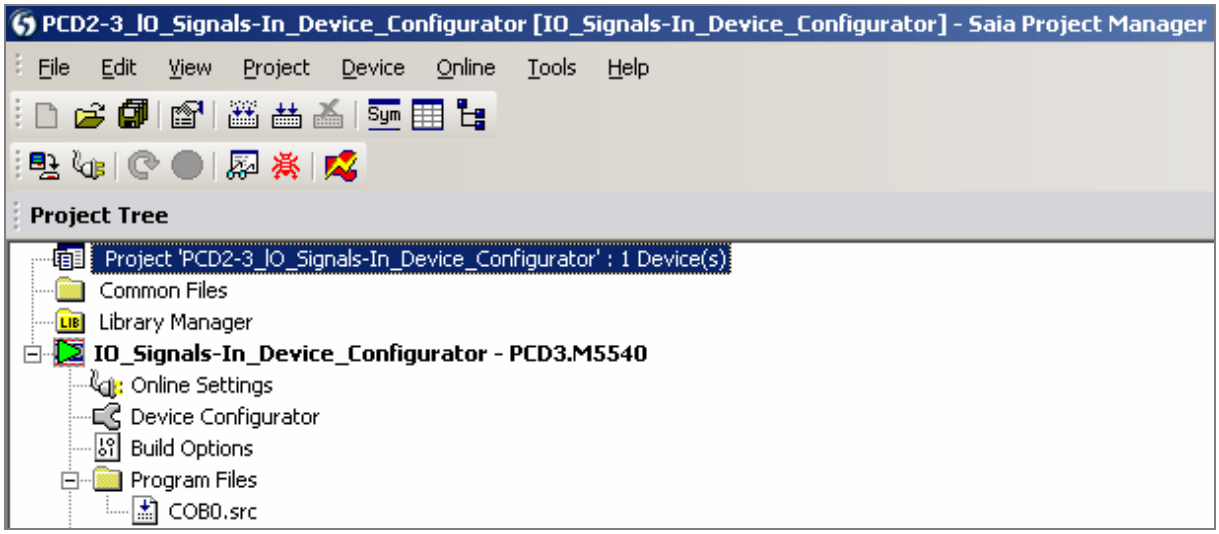
More information regarding the modules and the wiring information are available on our support site www.sbc-support.ch.

Analogue input modules are especially sensitive to earth loops. Please be sure to follow the wiring instructions.

The I/O bus on the SAIA PCD Classic controllers is not designed for “hot plugging”. Before inserting or removing I/O modules, the controller should be disconnected.

5.1.1 Installation of the project

To install the project in your PG5 project directory, you should use the “Restore...” function from the “Project” menu in the PG5 2.0 Project Manager. This function will copy the project into your project directory.



This document can be found in the “Documents” folder in the project tree for the PG5 Project manager, and is opened directly from there by double-clicking on it.

5.1.2 Building and loading the project into the PCD

After making necessary configuration for module configurations in Device configurator, the device is loaded into the controller following a “Rebuild All” (Menu “Device→Rebuild All”….option, or Alt+F2 in Project manager).

If the controller is already in a “Run” state, the system will ask whether the controller can be stopped. This will be the case during testing. The message is displayed for safety reasons, as it may not be permissible to stop the controller while in use on an existing installation.

5.2 Viewing values online

Once the program is loaded into the controller, an online connection needs to be established to the controller, in order to view the values online. Clicking on the "Online" button (with the plug) connects the PC to the PCD. If the PCD is not yet in a Run state, it is started with the curved green arrow on the toolbar.

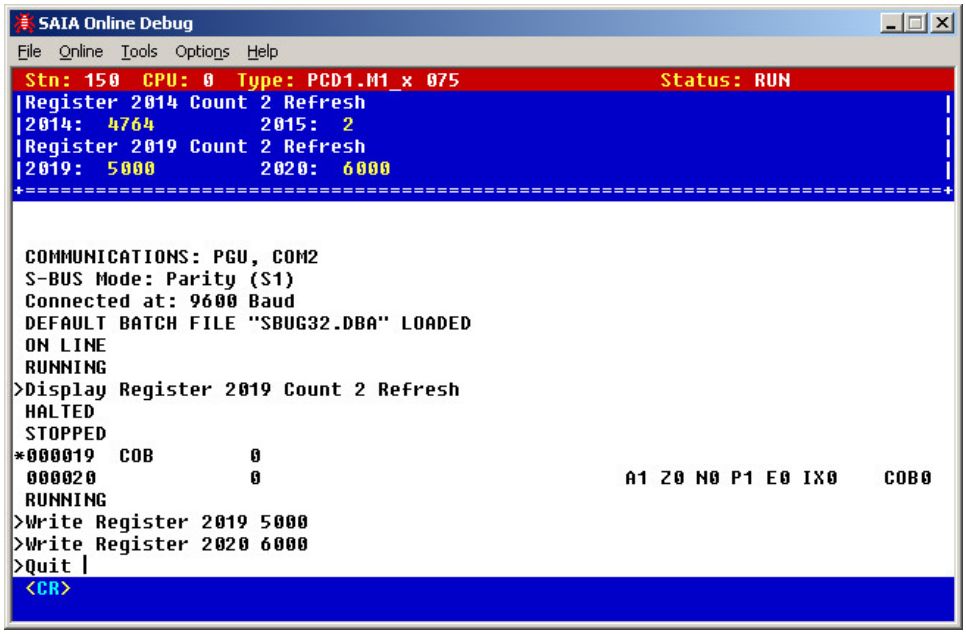
The Watch Window (see next section) can now be used to view the values online.

5.2.1 The SAIA Watch Window

To display and change the values from media on a screen, the Watch Window is used. Watch window is opened from the “View” menu in the PG5 Project Manager. The symbols to be displayed are “dragged and dropped” into the window.
As soon as PG5 is online, the relevant values will be displayed.

5.2.2 The PG5 Online Debugger

Another way of displaying values online is the Online Debugger (select “Tools”, “Online Debug” in the PG5 Project Manager, or press F11).



The Online Debugger is a very versatile tool, providing the following options:

- Controlling the PCD (stop, start etc.)
- Displaying PCD media (registers, flags, DBs etc. can also be refreshed)
- Writing to PCD media
- Modifying the program (if it is held in RAM)
- Displaying the CPU status (hardware and firmware version etc.)
- Reading the PCD history
- Displaying the current hardware configuration
- Program “trace” (step-by-step processing; not allowed when accessing analogue I/Os)
- Processing individual instructions
- Running the program up to a given event (e.g. change of specified media or to setting of Error Status Flag)

To display the values read in the Online Debugger, the following input is required (enter only the characters in bold):
> **D**isplay **R**egister <**address of register to be displayed**> **R**efresh <Enter>

The address of the register to be displayed can be seen e.g. in the “Data List View” within the PG5 Project Manager (select “View”, “Data List”).

6. Errors and debugging

To help to isolate and fix faults quickly, this section describes a number of frequently occurring errors.

6.1 Common errors

Here is a list of frequent causes of malfunction in the example described:

Error	Cause and resolution of error
The analogue output value is always =0 or maximum amplitude	May be caused by incorrect wiring of the module. Please check the wiring against the hardware manual for your PCD.
The analogue input value is always =0	
The value read from one or more analogue inputs jumps periodically and is not constant	This phenomenon could be caused by an “earth loop” in the system. Please check the earth of your system. The earth to the “-“ side of the module must have a short and massive connection to the “-“ terminal on the PCD (no looping of the earth wire around the PCD!)

6.2 Troubleshooting / debugging

When troubleshooting, it is advisable to start with device configuration and one empty COB. After downloading the configuration and program to PCD the IO values in respective media can be checked. The values in the PCD can be verified by means of the Watch Window or the Online Debugger.

To be sure that there is a signal at the input, the input signal should be verified with a Multimeter while commissioning.

6.3 Sources

The various procedures for operating the modules are specifically tailored to the hardware used in the modules concerned.

Hardware-specific details such as terminal assignments and wiring diagrams can be found in the hardware manual for the relevant controller.