# Saia® Software
PG5

1.1 Saia® PG5 Controls Suite: Engineering & programming

1.1.1 Saia® PG5 Core – everything you need available at all times

The Saia® PG5 Core is a central key element of the Saia® PG5 Controls Suite. This is used to create Saia® PCD projects. The Saia® PG5 Core is included in every software package and is identical throughout.

1.1.1.1 Saia® PG5 Core | Basic properties

❯ Wide range with large projects and high complexity

Small projects   Large projects
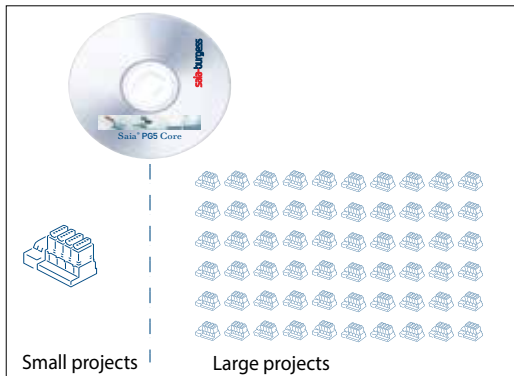
With the Saia® PG5 Project Manager, projects can be managed with just one individual controller or with very large networks.
It is used at OEM manufacturers with just one Saia® PCD per machine, and equally well in large properties such as tunnels with over a thousand installed Saia® PCD controllers.
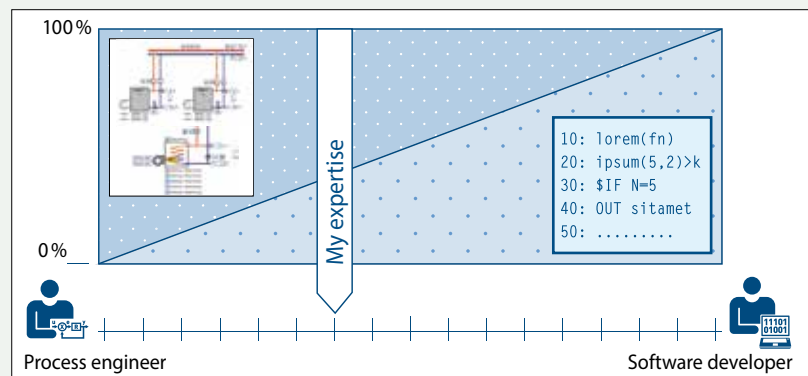
◀ The Saia® PG5 Project Manager for individual devices just as for large control networks.

❯ Software tool with broad user profile – everyone can get used to it quickly

Saia® PG5 Core offers all groups of people involved in ICA and automation technology suitable functions for mastering their tasks reliably and well.
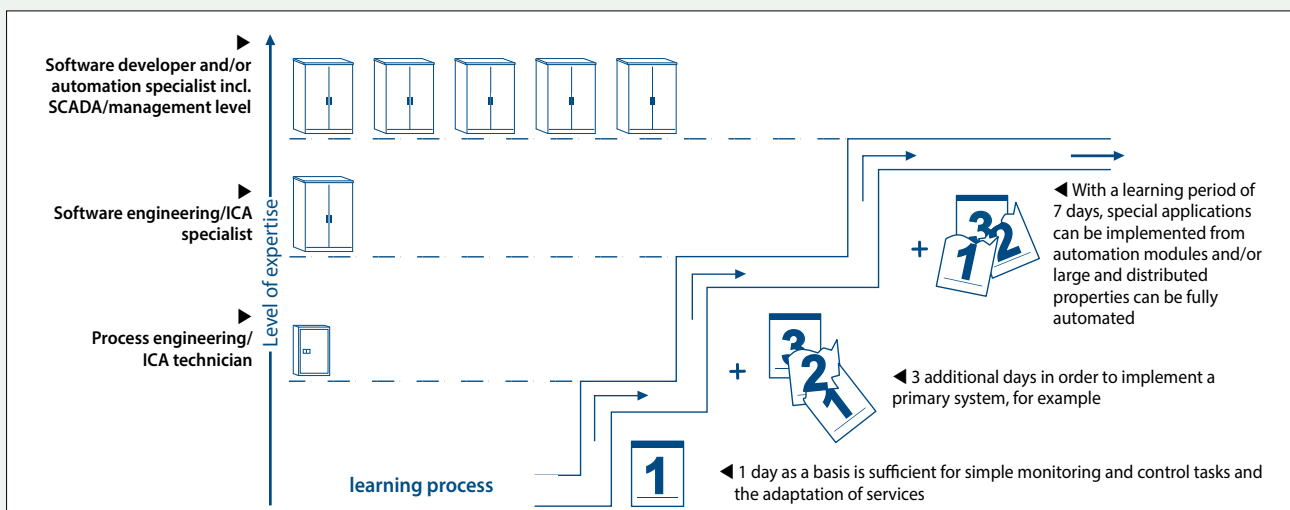As an application engineering tool, users can also implement the most demanding automation projects using graphical application modules in the FUPLA Editor without them having to program in IL, Graftec or Kopla, etc.
As a development tool, dedicated control and logic functions, communication drivers and IT functions can be programmed in the Saia® Instructions List.


```
10: lorem(fn)
20: ipsum(5,2)>k
30: $IF N=5
40: OUT sitamet
50: .........
```

My expertise

Process engineer   Software developer

▲ Saia® PG5 offers a large variety of solutions – there is one to suit everyone

Saia-Burgess training program 1+3+3

Software developer and/or automation specialist incl. SCADA/management level

Software engineering/ICA specialist

Process engineering/ICA technician

Level of expertise

learning process

◀ With a learning period of 7 days, special applications can be implemented from automation modules and/or large and distributed properties can be fully automated

◀ 3 additional days in order to implement a primary system, for example

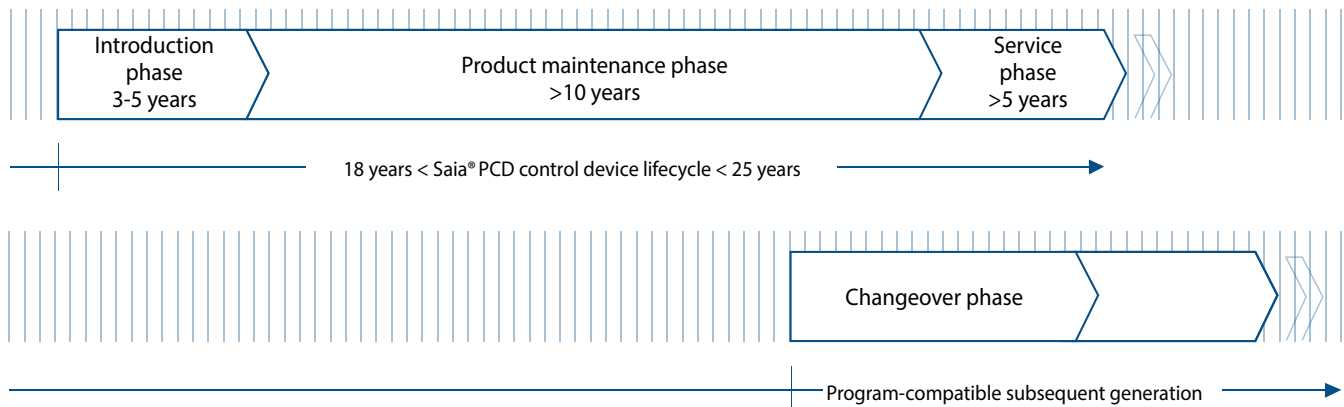◀ 1 day as a basis is sufficient for simple monitoring and control tasks and the adaptation of services

▲ The time up to which solution competence is achieved

❯ A standard software – for all device types – now and in the future

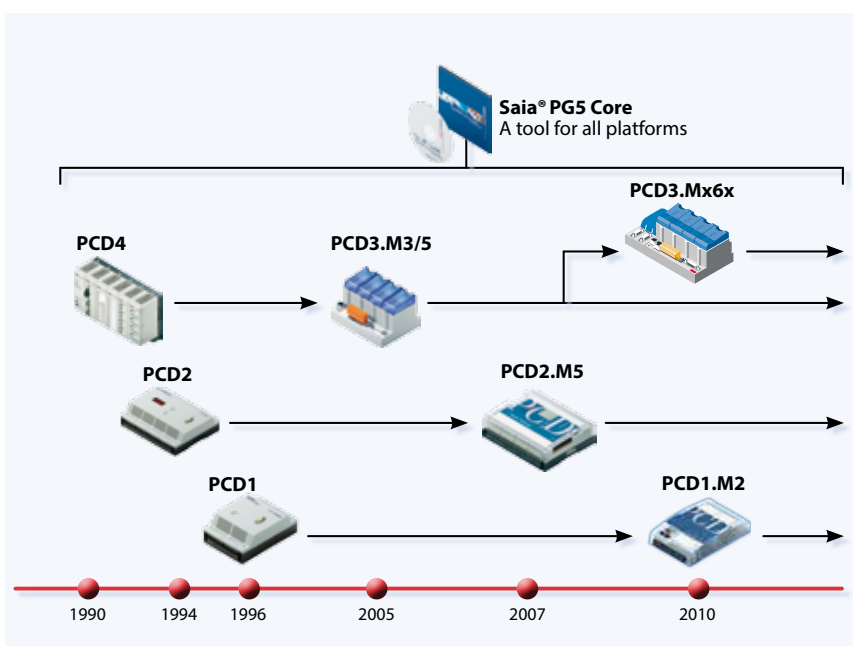Programming tool/software development tool

Java Bytecode	Saia® Instructions List	Common Intermedia Language
Java Virtual Machine	Saia® Virtual Machine	Common Language Runtime .NET
ORACLE®	saia-burgess	Microsoft®

CPU hardware level

▲ We supply our devices with a virtual ICA machine. This "machine" always remains the same even if the hardware on it changes. Your application will always run on all device platforms – now and in the future.

Applications can be ported over long periods of time and across all product lines.
Virtualization is the key to reusable program code. Java and Microsoft.Net work in the same way. Hardware-dependent compilation of applications, e.g. as is normal for soft PLC systems, is obsolete.

Introduction phase 3-5 years	Product maintenance phase >10 years	Service phase >5 years

18 years < Saia® PCD control device lifecycle < 25 years

Changeover phase

Program-compatible subsequent generation

▲ Lifecycle planning of Saia®PCD control devices. Enables maximum profitability of your investment in know-how and systems. Long usage phase without expensive reinvestment and no high service costs.

Saia® PG5 Core
A tool for all platforms

PCD3.Mx6x

PCD4 → PCD3.M3/5

PCD2 → PCD2.M5

PCD1 → PCD1.M2

1990	1994	1996	2005	2007	2010

▲ Old application programs can be taken over for new Saia® PCD controllers and further processed with the Saia® PG5 Core

The control electronics should have the same lifecycle as the systems technology. It must be possible to adapt and extend at any point in this cycle.
The compatibility and free portability of systems/machine software is ensured by an overall product generation of 18-25 years. This only works if engineering software is developed fully in-house and thus relies on "interpreted program code". This requires more hardware resources but enables the portability of user software across multiple generations of controllers.

1 Saia® Software

2 Communication & Interaction

3 Saia® S-Web technology

License policy for maximum security, flexibility and independence

➤ In principle, any company can apply for the Saia® PG5 license. There are no market-related exclusions as with other providers. The only requirement is the ability to use the products professionally.

➤ With the acquisition of a Saia® PG5 license, a company can register any number of its employees as users. There are no costs per space or per user. However, a company must at least have one proven qualified Saia® PG5 programmer. The qualification can be obtained via training by Saia-Burgess Controls.

➤ There is a special end user license for operators of Saia® PCD automation systems. This includes all Saia® software tools and Saia® application libraries which an external service provider or OEM has used in a system/property to create an automation system. The end user license only applies to the Saia® PCD devices installed at the operator and cannot be used for the creation of automation solutions for third parties.

◄ This certification as a Saia® PCD system integrator shows that a company has proven its ability to implement automation solutions reliably and professionally with Saia® PCD. We recommend that operators, investors and planners take into account the certification when selecting the service provider.

Saia® PG5 Controls Suite test license

90-day test license: All Saia® PG5 Controls Suite components can be tested for 90 days free of charge. There are no functional limitations and all the applications developed during the trial period can be used 1:1 in the licensed version.

Make sure that your systems are created with the correct licenses in order to guarantee the warranty and support as well.
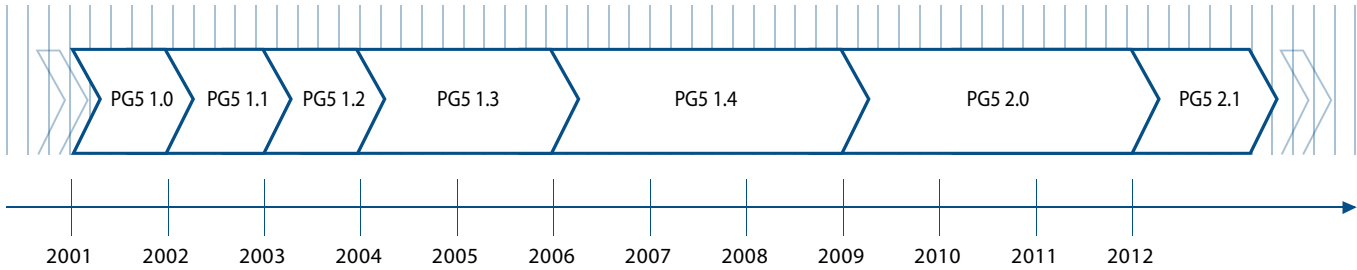

License as a "user key"

Licensing procedures

The Saia® PG5 license mechanism offers better flexibility and more simplicity when installing license extensions. The license is distributed as a "user key" file which defines the user permissions for the software applications. A license extension can be quickly distributed by sending the customer an e-mail with a "user key" file or a password.
Saia-Burgess Controls AG can create customer-specific user keys using the license manager.
The keys can be tailored to any request. It is possible to define the editors or libraries which the customer is permitted to use. The scope, number and size of the projects are irrelevant here.

Software maintenance

We are continually further developing our software in sensible and easy-to-manage innovation steps. The following diagram shows the major version changes over the past 10 years. Known errors are dealt with via patches without a version change. New functions are first tested in beta versions before the sum of all new functions is made official in a major new version. A moderate fee is charged for major version steps with substantial additional functions. This occurs in a cycle of 2–3 years.

| PG5 1.0 | PG5 1.1 | PG5 1.2 | PG5 1.3 | PG5 1.4 | PG5 2.0 | PG5 2.1 |

2001　2002　2003　2004　2005　2006　2007　2008　2009　2010　2011　2012

▲ Milestones in software development and maintenance

The QR code tells you the current progress made in software development. Web Code scen13145

1.1.1.2 Saia® PG5 Core | Components

On the following pages, the Saia® PG5 Core is presented and the components are explained in more detail.
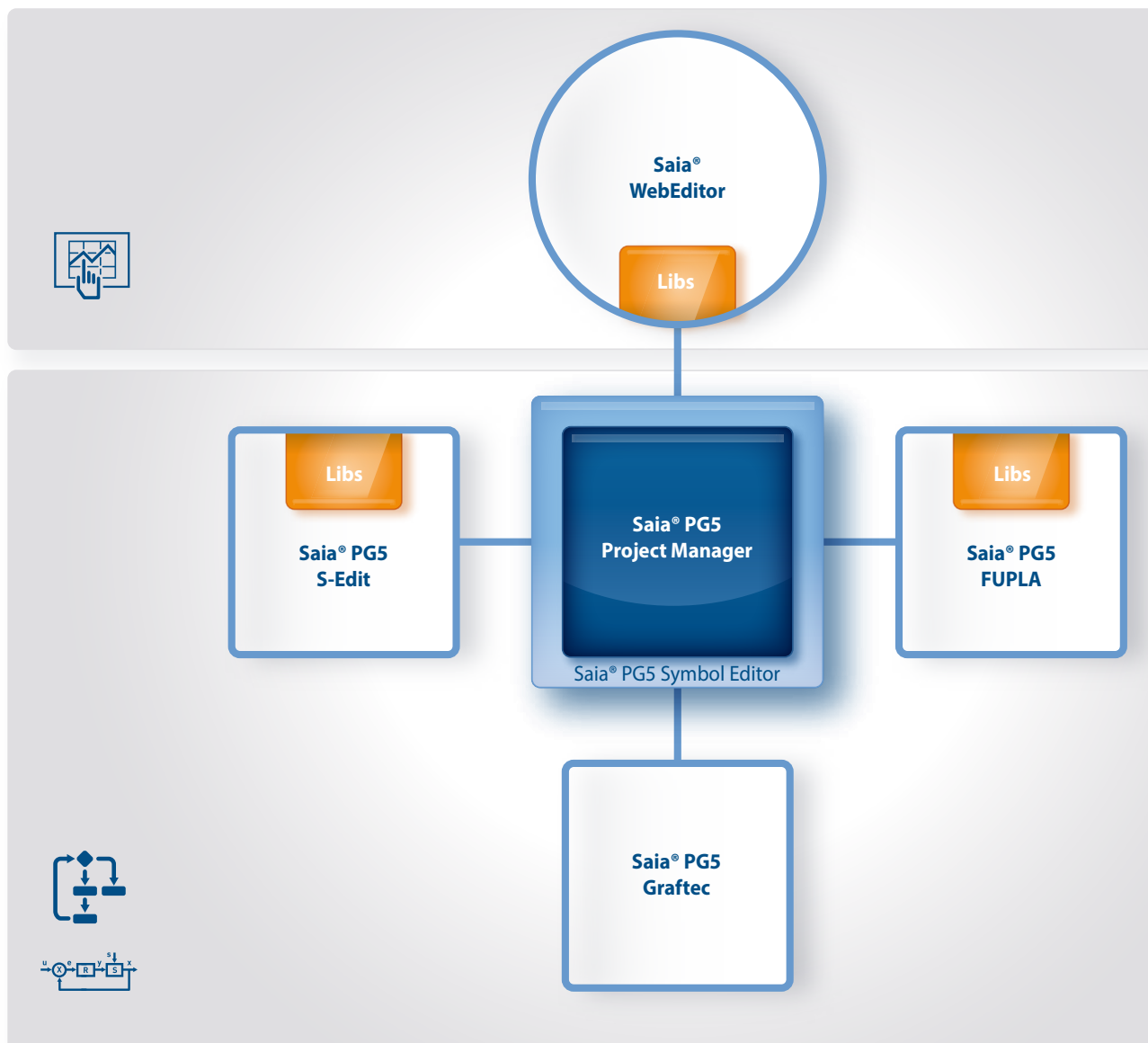
▲ Saia® PG5 Core at a glance

The Saia® PG5 Core contains the following components:

➤ Project Manager (administers complex installations of networked PCD controllers, including documentation)

   ➤ Network Configurator (integrated network editors for the configuration of devices and communications networks)

   ➤ Device Configurator (configuration of hardware parameters on the controller)

➤ Symbol Editor (administers all local, global and network symbols and symbol groups. Auto-allocation largely dispenses with the need for fixed addressing)

➤ Programming methods (integrated programming environments: FUPLA [function block diagram], S-Edit [instruction list IL] and Graftec [sequential function chart])

➤ Libs (standard libraries which quickly and easily enable all the core functions of the ICA/automation technology)

➤ WebEditor (for WebSCADA functions in every controller)

Saia® PG5 Project Manager

The configurations and applications are created, changed and managed in the Saia® PG5 Project Manager. The Saia® PG5 Project Manager is the central linchpin for all work with Saia® PCD controllers.

The following window appears on the left-hand side of the screen as soon as the Saia® PG5 Project Manager is opened. Thanks to desktop docking, there is still enough space on the right-hand side of the screen for further windows.
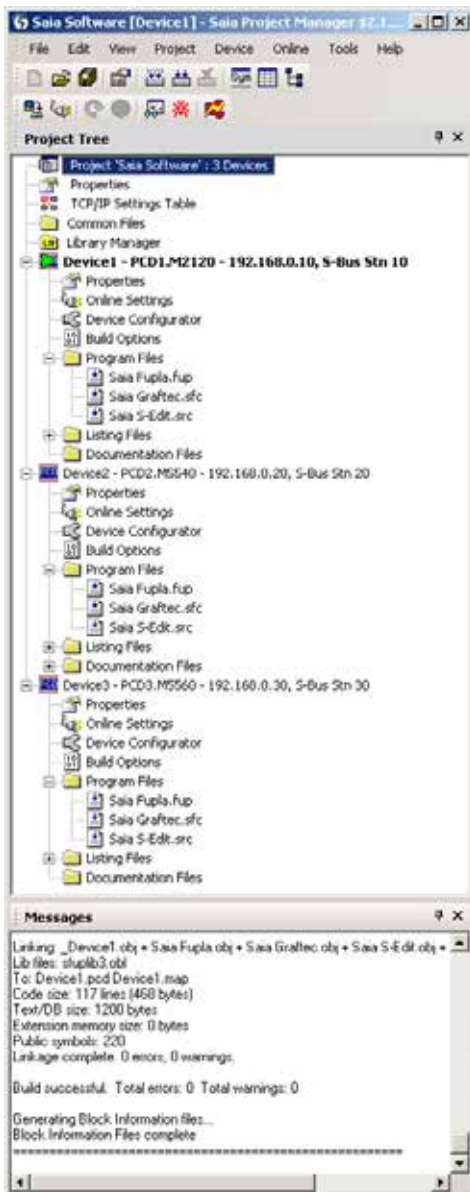
Project Tree

The layout and structure largely correspond to Windows Explorer. The "Project Tree" window allows direct access to all PCDs used in the project, their settings and the program files and documents that go with them. Program organization by files (containing one or more program blocks) simplifies the shared use of program files in multiple Saia® PCDs.

The "Program Files" folder may also comprise different data types. It is therefore possible to save all types of programming in one folder.

Messages and Error List

Displays the build log, error and status messages. Errors in the program code are listed here after the build, and can be located directly by clicking.

Window of the Saia® PG5 Project Manager

Network Configuration
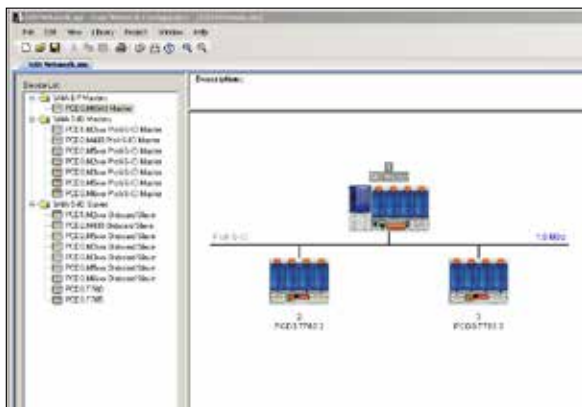
Network configurator in use – Profi-S-IO Network

Network configuration is used for the configuration of devices and communications networks. Three different configurations generally exist:

1.) Ethernet RIO Network Configurator
➤ Smart RIO – PCD3.T665 and PCD3.T666.

2.) BACnet Network Configurator
➤ BACnet Configuration Files (*.bnt)

3.) S-Net Network Configurator
➤ Profibus-DP Network File (*.dp)
➤ Profi-S-IO Network File (*.sio)
➤ LON Network File (*.lon)

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Device Configurator

The hardware and physical functions of the controller are defined in the Device Configurator; e.g. device type, memory modules, communication channels, associated modules and I/Os. The I/O configuration, parameterization and designation, as well as the configuration of the Ethernet protocols, e.g. DNS, DHCP etc., takes place here. The Device Configurator also controls the use of input/output modules in the internal power supply of PCDs and prints the labels which are adhered to the I/O modules.
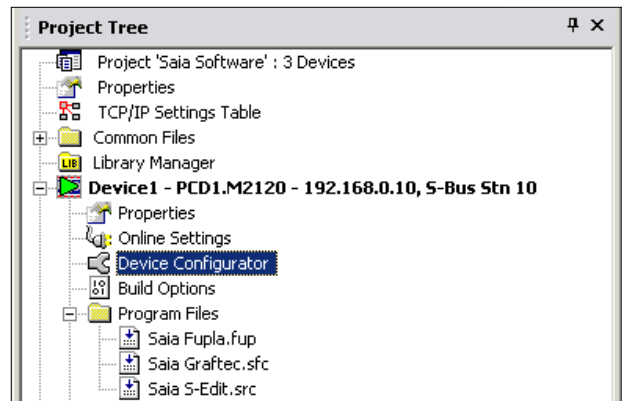
Selecting Device Configurator in the Saia® PG5 Project Manager
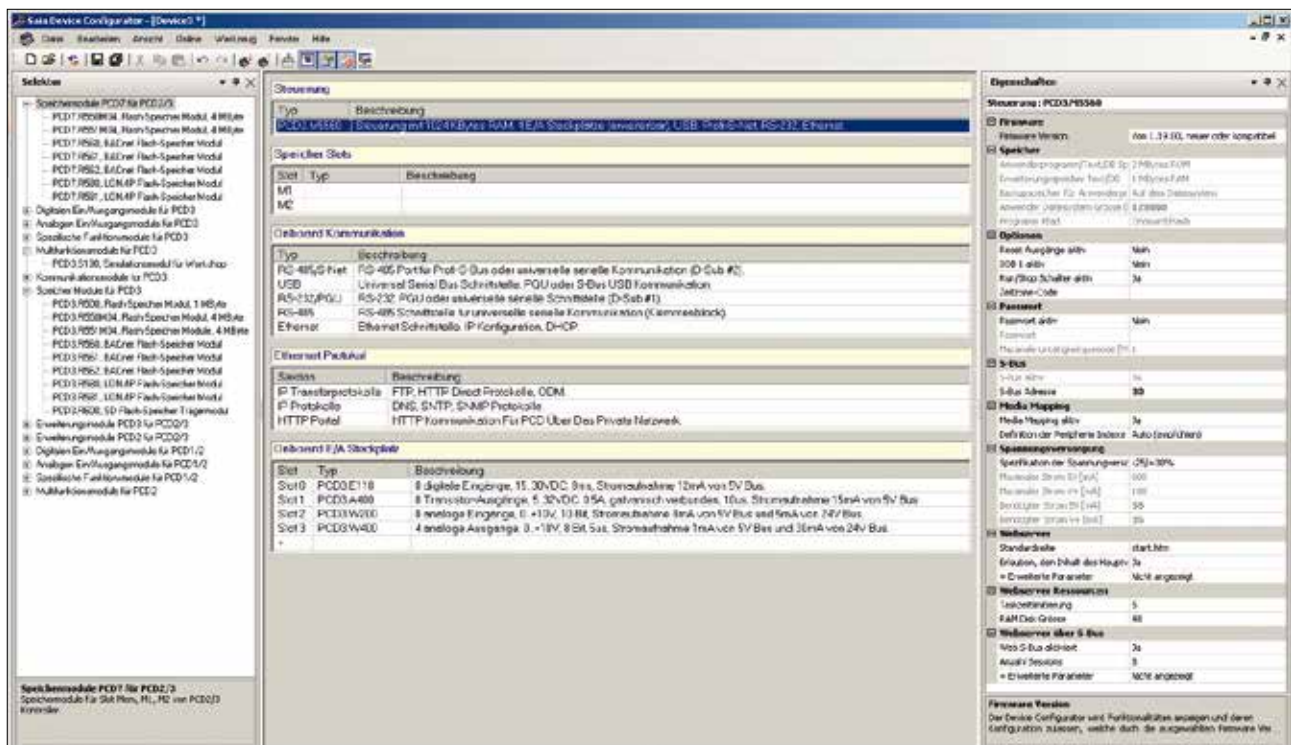
All parameters and modules can be viewed at a glance and printed out as system documentation in the Device Configurator.

Symbol Editor

The Symbol Editor is the heart of the Saia® PG5 Core. It defines and documents all symbols used by the program.
The various editors are connected by the Symbol Editor. New symbols used in the program code are taken over directly by the Symbol Editor.

➤ The import/export function allows the reuse of pre-defined I/O lists in electrical diagrams and visualization tools.

➤ Symbols can be grouped together. All the symbols required for a function form one group. This makes it easier to use functions and recognize symbols in the program code, and also gives a clearer overview in the Symbol Editor.
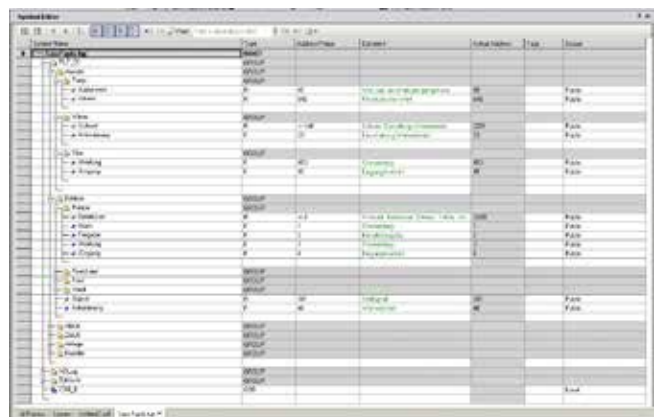

Overview of all symbols used in the Symbol Editor

Programming methods in the Saia® PG5 Core

Saia® FUPLA (function block diagram)

FUPLA is Saia®'s own function block diagram editor. It differs in many respects from other graphical programming interfaces:

➤ One FUPLA file can contain several program blocks. This means that one file can encompass an entire machine function. In symbolic programming, each program block is given an individual symbol name. This prevents collisions during the build.

➤ FUPLA blocks are organized into pages. Each page can produce several outputs so that entire functions can be seen at a glance on one page.

➤ Graphical functions (FBoxes) not only have inputs and outputs, but also parameter windows for configuring and online modification.
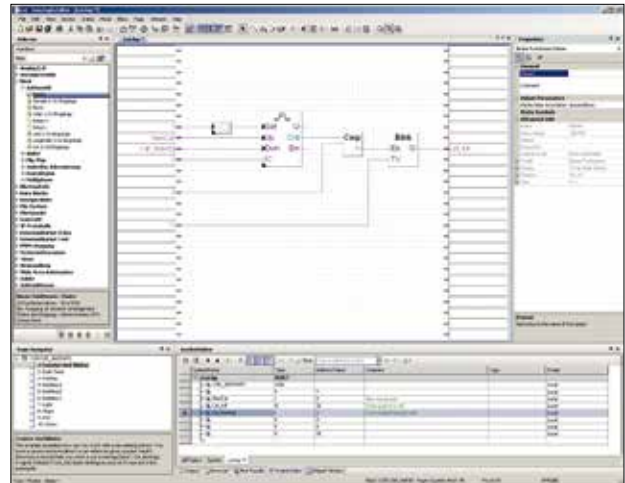
Saia® FUPLA (function block diagram)

Comment: The Kopla Editor (contact plan) is an integral part of the Saia® PG5 FUPLA Editor. Unlike conventional graphical programming environments, FBoxes and contact plan elements can be freely mixed in one and the same graphic.

Saia® Graftec (sequential function chart)

Graftec (sequential function chart) is particularly suited to sequential processes. Sequential blocks are a fixed component of the PCD firmware and are processed by it efficiently.

➤ Steps and transitions can be programmed in IL and graphically in FUPLA.

➤ In order to ensure a good overview with extensive sequential processes as well, the division into sub-pages is possible.

➤ In online mode, the active transition is permanently displayed.

➤ Option to process the code step-by-step in step mode.
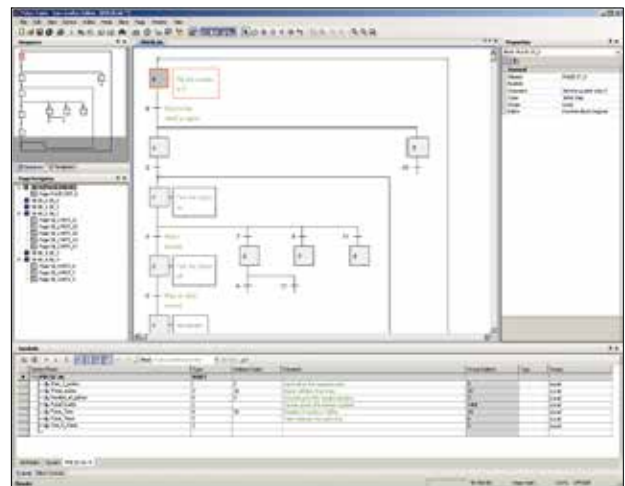
Saia® Graftec (sequential function chart)

Saia® S-Edit (instruction list IL)

The editor for the strong instruction set of Saia® PCD. S-Edit combines an editor and online debugger in one interface.

➤ The color syntax function detects valid instructions and applies a color to them. The program code is thus much easier to read and typographical errors are detected immediately.

➤ The "Bookmarks", "Goto Line", "Find and Replace" editor functions make it easier to navigate through extensive programs.

➤ The code built can be shown directly in the original code. The function is also used by the integrated debugger.

➤ Complete functions can be copied from the library using drag-and-drop.

Saia® S-Edit (instruction list IL)

1 Saia® Software

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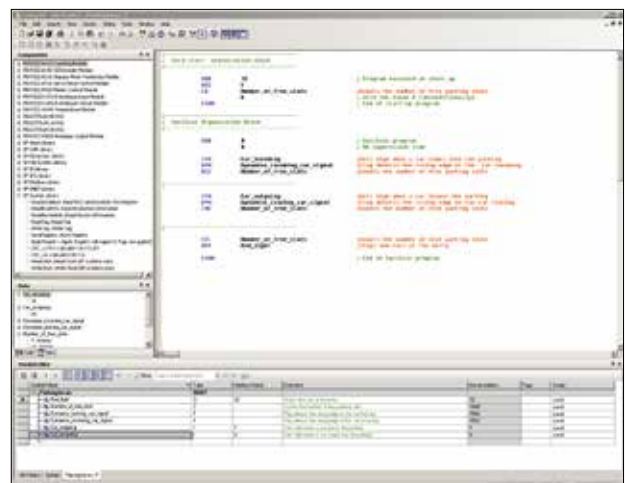
Saia® FUPLA

The Saia® FUPLA Editor is the quickest and most reliable method of implementing applications. This editor can also be easily used by those with no software programming experience. It is the right tool for optimizing and modifying systems. All complex functions have been implemented by specialists in Saia® S-Edit or Saia® Graftec and packaged into graphical function blocks (FBoxes). "Ready and simple to use" also by service technicians and process engineers.
In the automation of infrastructure, > 95% of all applications are implemented purely by engineering with Saia® FUPLA. Not one line of code is written here.

Benefits of using the FUPLA Editor

➤ Programming is made much easier with pre-programmed function blocks (FBoxes) for all standard functions
➤ Creation of complex user programs by simply positioning and linking function blocks. This does not require extensive programming knowledge.
➤ Extensive and high-performance FBox families for communication and building automation tasks

➤ Detailed context-sensitive FBox information, clear parameter descriptions and graphical presentation in the function block diagram editor (FUPLA) make user programs easy to read and understand
➤ Online display of process values and parameter adjustment makes commissioning considerably easier and saves maintenance costs

Selecting the library

Process input values

Page overview

Process output values

Process values used
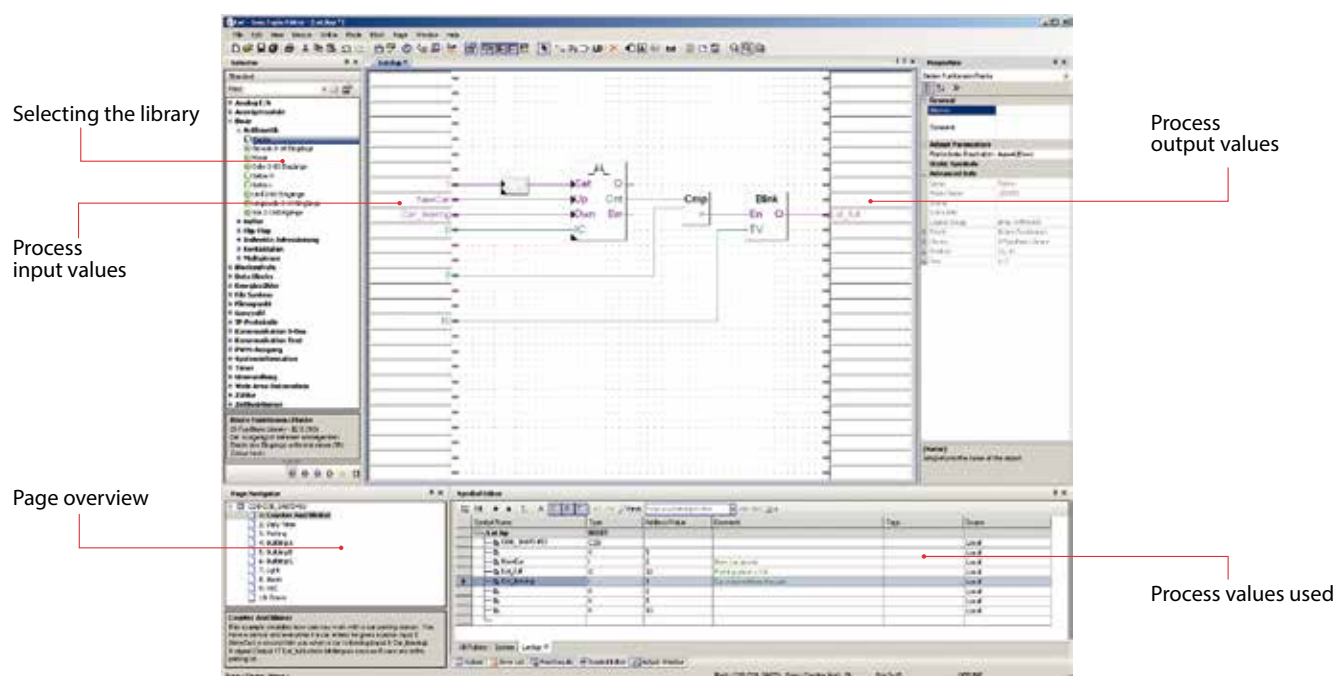
Structure of the FUPLA Editor

Features of the libraries

➤ Clearly set out in a tree structure, making FBox selection very easy
➤ Parameters are conveniently entered via adjust windows in the FUPLA editor, without losing program clarity

➤ Obvious differentiation between data types through use of different colors

Each data type is identified by a different color. This makes programs easier to read.

Binary data	**Purple**
Integer data	**Blue**
Floating-point data	**Yellow**
Texts (TX) and data blocks (DB)	**Green**

Clear grouping into families

All FBoxes (function boxes) are grouped into families. This provides a better overview and makes it easier to find individual FBoxes. A distinction is also made between a standard, application and user FBox:

Standard: Shows the FBox libraries of the basic application components

Application: Shows the FBox libraries of the engineering application components

User: Only shows the FBox libraries which the user himself has created

All: Shows all available FBox libraries

★ **Favorite:** On this page the user can group together the most frequently used FBoxes (from all libraries). This means that it is no longer necessary to search for FBoxes or to switch between library tabs.

FBoxes in the Saia® PG5 Core

Standard and application FBoxes are already available to the user in the Saia® PG5 Core.

The standard FBox libraries are basic families which offer normal logical and arithmetic operations as well as numerous useful system functions. The "Standard FBox libraries" diagram shows the FBox families available.

In addition to the standard FBoxes, the Saia® PG5 Core contains further FBoxes. These include application FBox libraries which comprise engineering families. These are listed in the "Application FBox libraries" diagram to the right.

The search function (Filter) in the Selector enables a specific FBox to be found quickly.

Standard FBox libraries
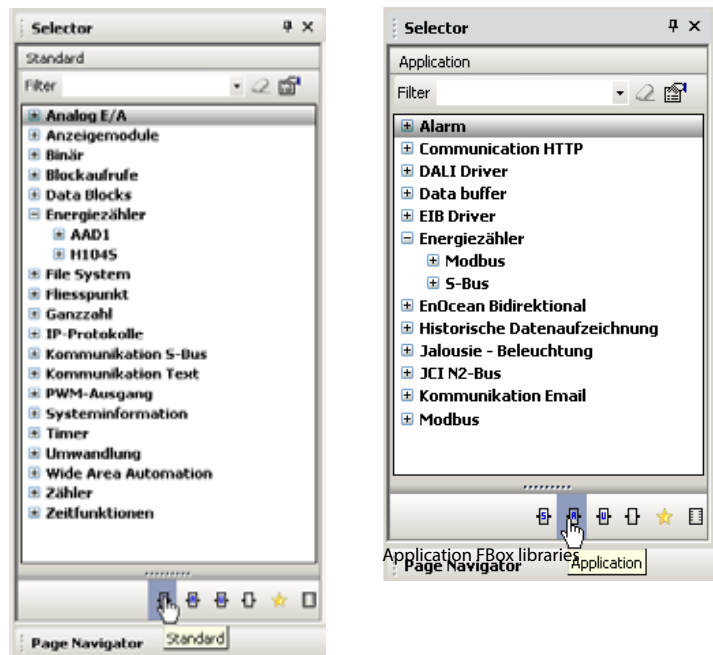
Application FBox libraries

So that Engineering can access the correct FBoxes, their function and parameters must be known. The online user manual integrated into the PG5 Core is the ideal way to get a quick overview of the relevant FBoxes.
Clicking on the FBox makes information such as a brief description of the FBox, an explanation of inputs and outputs, information on the parameter settings and a function description of the FBox accessible to all.
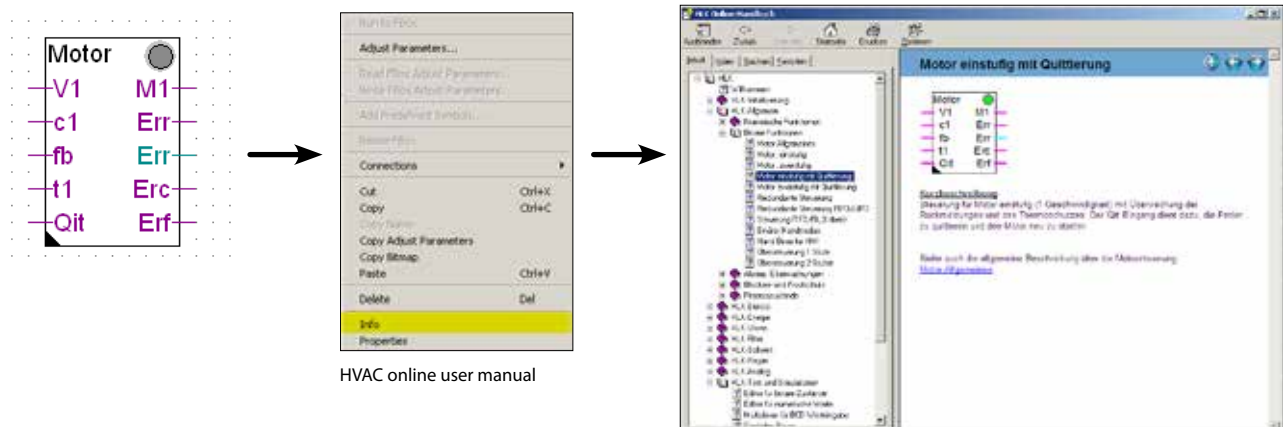
HVAC online user manual

Selecting a FBox from the FBox Selector

The functions required to write a program can be selected in the FBox Selector and then added to the FUPLA program using drag-and-drop. This makes it quick and easy to put together a program.
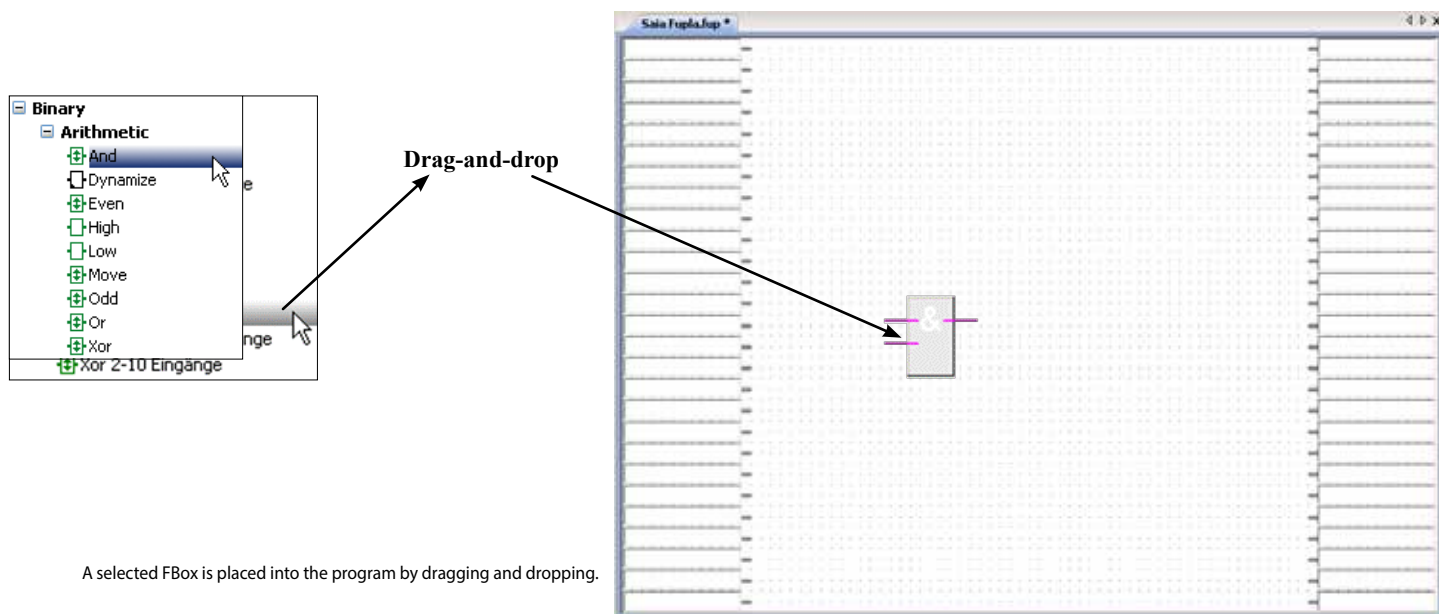
Drag-and-drop

A selected FBox is placed into the program by dragging and dropping.

Every FBox in the FBox Selector has a symbol. The meaning of this symbol is explained below:
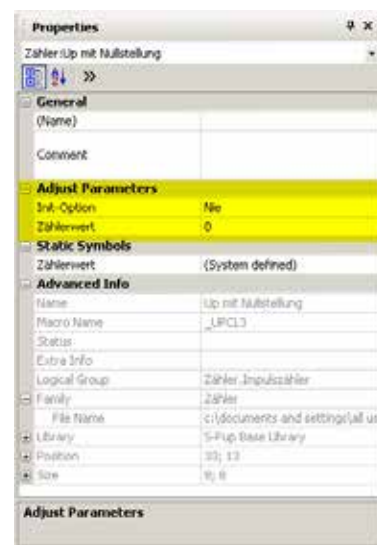
FBox with adjust functions
Some FBoxes have additional "Adjust Parameters". These are shown by a black triangle in the bottom left-hand corner. Particular properties of the FBox can be configured using these parameters.

Offline processing of Adjust Parameters
Adjust Parameters can be processed offline via the Properties window. The values of the parameters are saved in the FUPLA file. Before the PCD uses the new parameters, the program must be downloaded.

Online processing of Adjust Parameters
Adjust Parameters can be processed online via the "View, Adjust Window" instruction, which opens the window for online adjustment whereby both the actual and the processed values are shown. The processed values are written directly to the memory of the PCD and not updated in the FUPLA output file.

Adjust Parameters

Adjust Window

FBox with stretch function
Various FBoxes can be extended, i.e. the number of input or output connections for the FBox can be defined by moving the mouse vertically. Extendable FBoxes can be pushed back together or stretched further at any time.

FBox without additional function
There are no additional functionalities for these FBoxes.

Download in run mode
These FBoxes can be downloaded during run mode. The PCD does not therefore need to be set to HALT mode first.

WebEditor – powerful software tool

The production of web-based visualization and control interfaces is an essential element of engineering effort. Appealing, functionally designed web pages are the public face of the system, supporting operational efficiency and safety. A powerful tool for generating the web pages is therefore crucial.
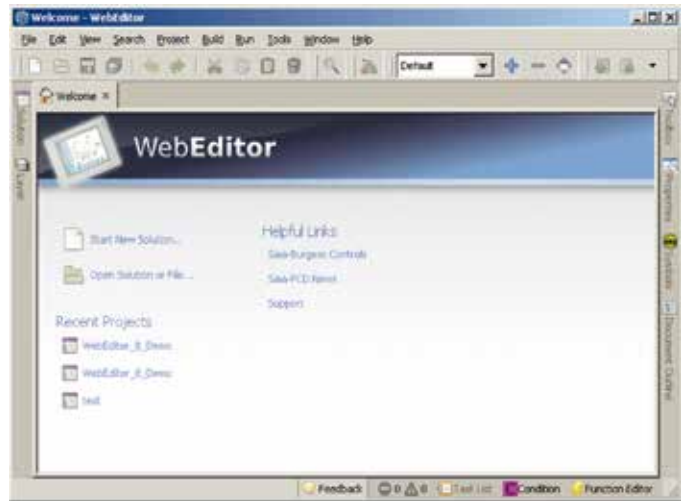
Start screen for WebEditor 8

Saia® WebEditor: Simple, intuitive and efficient

Designing dynamic web pages with a normal HTML editor is laborious and requires specific know-how (in-depth HTML and Java programming knowledge). To ensure that this innovative technology does not remain the preserve of a small circle of specialists, with the Saia® WebEditor, Saia-Burgess provides the user with a simple-to-use software tool for generating web pages. The WebEditor is used to create Java-based web-pages simply and efficiently by placing and parameterizing objects specially tailored to the PCD web server. The use of the Editor is intuitive, and requires no HTML or Java programming knowledge. With optimum integration into the Saia® PG5 Controls Suite and the associated direct access to all symbols, powerful macro management to generate your own reusable macros and many other useful functions for efficient generation of web pages, the engineering costs are significantly reduced compared to other editors.

The tool is based on the automation environment. Areas of use include system visualizations, alarming and trending functions, or just one service page. The full integration into the Saia® PG5 Core, in conjunction with Saia® PCD controllers, guarantees a particularly efficient working method.
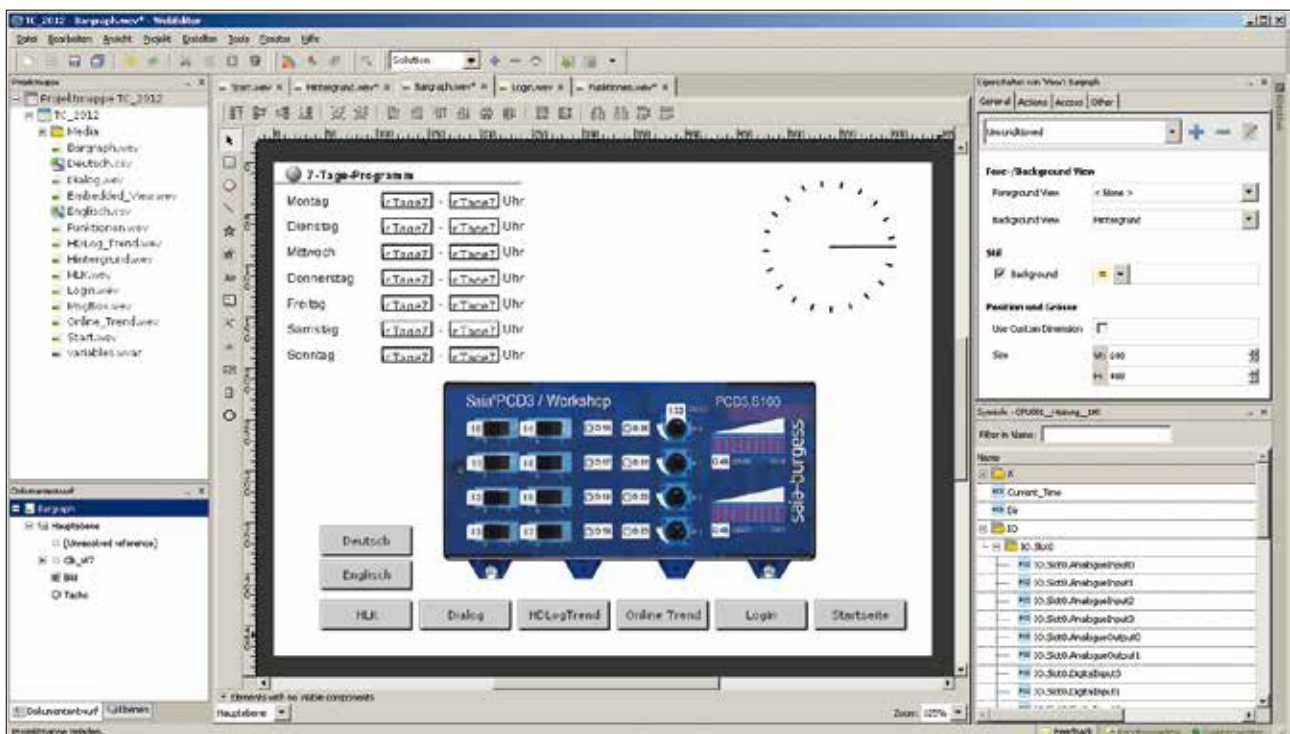
The Saia® WebEditor produces appealing web visualizations without any web designer skills.

The WebEditor includes a transparent and adjustable workspace for efficient operation. The workspace essentially comprises the menu/instruction bar, the View Editor (drawing area) and windows. Thanks to docking window technology, the user can freely position and show/hide the windows as he requires.

The most important windows are explained here:

WebEditor window: Solution
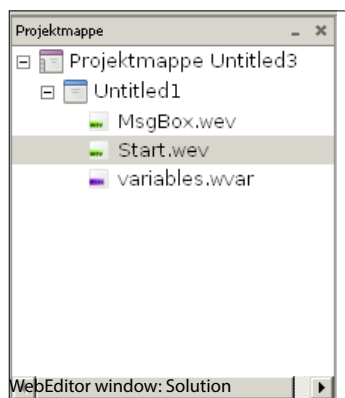
The Solution shows the project and file structure. This folder can contain multiple WebEditor projects with various data types. The file types are shown clearly in an orderly tree structure.

WebEditor window: Symbols
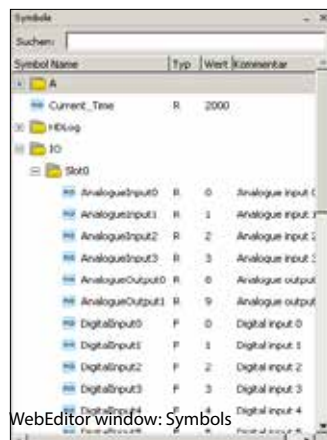
Symbols are taken over from the configured PG5 project path and updated automatically.

To find symbols quickly, the window has a search function.

WebEditor window: Document Outline
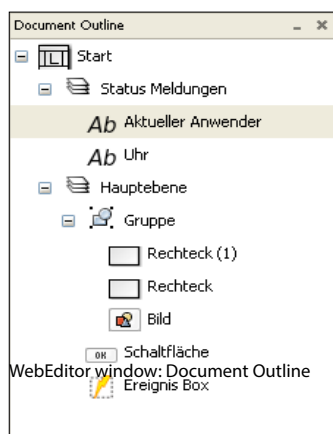
The Document Outline window provides an overview of the structure of the current view.

With this window, an element can be selected directly, regardless of its group or level.

WebEditor window: Layers

This window provides an overview of all layers in the view currently open. Layers can be created, moved or deleted. All layers, including the background and foreground view, can be hidden for additional clarity.

WebEditor window: Properties

In the "Properties" window, the properties and behavior of objects at runtime are quickly and easily configured with just a few clicks.

The window is subdivided into four areas:

➤ **General**
  – View settings (depending on conditions)

➤ **Actions**
  – Configuration of results (when holding down, when releasing)
  – Function key

➤ **Access**
  – Settings for access control

➤ **Other**
  – Element name and comments
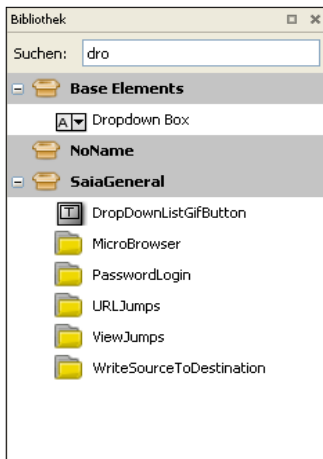
WebEditor window: Libraries

All available elements, images and templates are listed in the Library window.

Like the Symbols window, a search can be conducted in the Library window.

Double-clicking on an element adds it to the open view.

The library in the WebEditor includes the following library groups:

➤ **Base Elements**
Templates for bar graphs, buttons, images, etc.

➤ **NoName**
CheckBox Template

➤ **Saia® General**
View Jumps, URL Jumps, PasswordLogin, etc.

➤ **Alarming**
Objects template for alarming

➤ **Trending**
Objects template for showing trends

➤ **Application Library**
Template objects for HVAC and DDC Suite FBoxes

➤ **Icon Gallery**
Image gallery of Controls AG
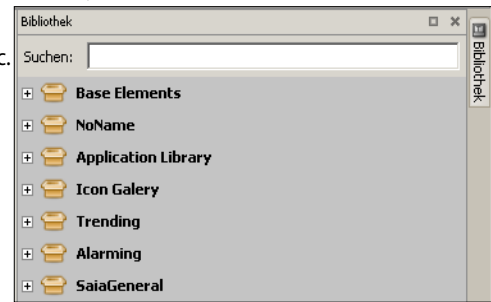
Library groups

The macros for the Trending and Alarming library groups are described below.
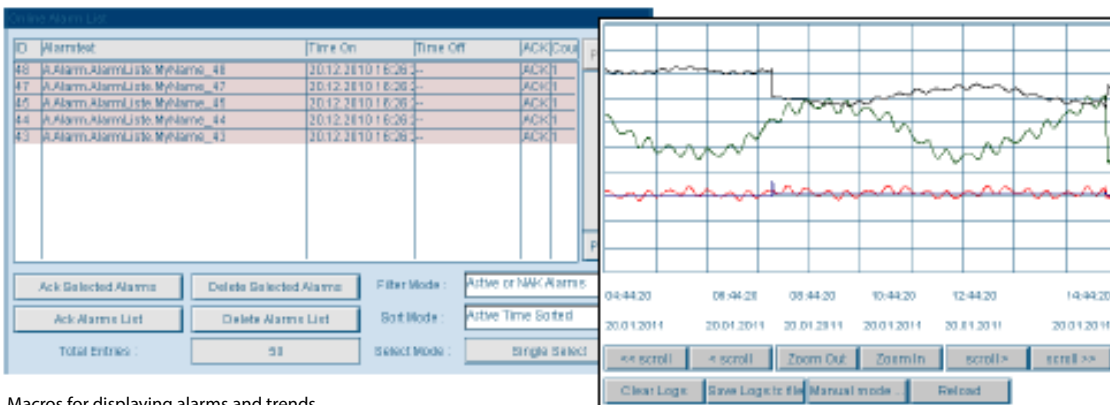
Macros for displaying alarms and trends

Alarm macro

The system signals are monitored and alarms detected independently of the web browser in the PCD. The actual alarm function is implemented in the firmware (COSinus) of the PCD. Its activation and parameter setting take place with the FUPLA FBox library. The alarms are stored in alarm lists in the non-volatile internal memory of the PCD.

Trend macro

Historical trending is defined as the capture, display and long-term storage of time-stamped system values. Two types of trending are supported – online and offline. With online trending, the client (PC, panel) captures the data and saves it temporarily. The PLC program does not have to be modified. With offline trending, data capture and interim storage take place in the PLC system. This requires special program code (e.g. via FUPLA FBoxes) to be created. The offline trend can either be saved in databases or on the PCD's file system.

### 1.1.1.3 Saia® PG5 Core | Example application

With the Saia® PG5 Core, all types of ICA tasks can be initiated on machines and systems. The graphical application components supplied support the use of the Saia® AutomationServer (web + IT) and calculation/logic functions. The basic functions of the Saia® PG5 Core are shown below using a simple logic.
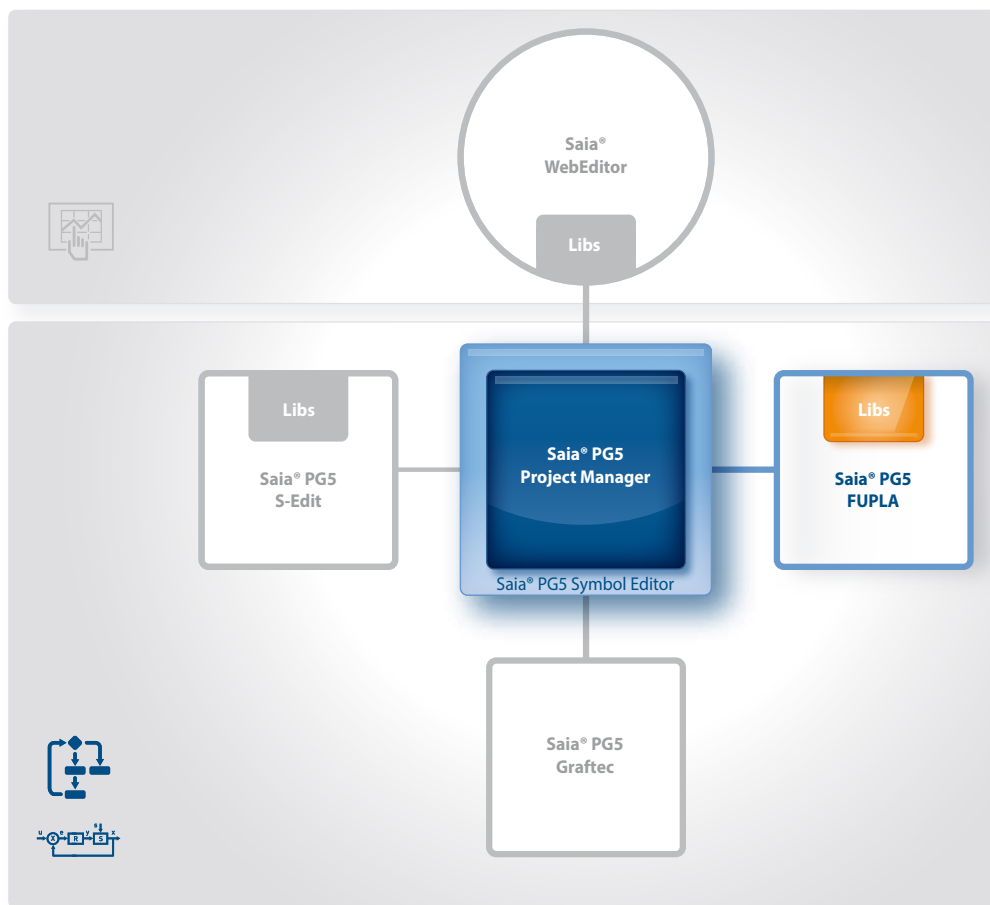
In following example application, only the Saia® PG5 Core tools shown in color are used.

To start, a new project with a name and a description must be created in the Saia® Project Manager. In this newly created project, one of the first steps must be to configure the communication (PC ↔ PCD).

The Online Settings must be configured in order to create a communication (PC ↔ PCD).

Online Settings: Selection of the communication channel
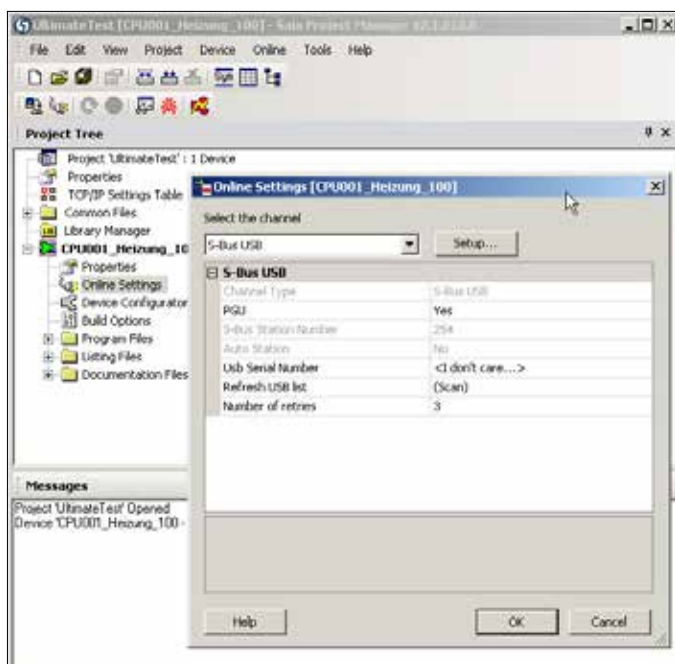
Online Settings

Select the channel: Select a transmission channel between the PC and the Saia® PCD controller. Here it is possible to choose between the following channels:

➤ PGU channel (RS-232)
➤ S-Bus channel (serial)
➤ S-Bus modem channel
➤ SOCKET channel (TCP / IP)
➤ S-Bus USB channel
➤ Profi-S-Bus channel

Setup: Channel configuration

The controller selection and the associated configuration are performed in the Device Configurator. The Device Configurator has multiple windows: "Device View", "Selector", "Properties" and "Media Mapping". The "Device View" window has a context menu. The menu features various options, such as Device, memory slots, Monitoring, Onboard communication, Ethernet protocols and Onboard I/O slots.

The relevant components are selected in the "Device View" window and all the associated parameters displayed on the right in the "Properties" window. Parameters which can be edited can be modified from here. If, for example, the PCD3.M5540 device was selected in the "Device View" window, the hardware settings are displayed in the "Properties" window. All modules which can be inserted into one of the slots are listed in the "Selector" window. This includes digital and analogue I/O modules, communications modules, expansion modules, etc. Modules can be taken from the "Selector" window and placed in the device slots, whereby the relevant slot is selected and then the module double-clicked in the "Selector" window. The module properties are configured via the "Properties" window.
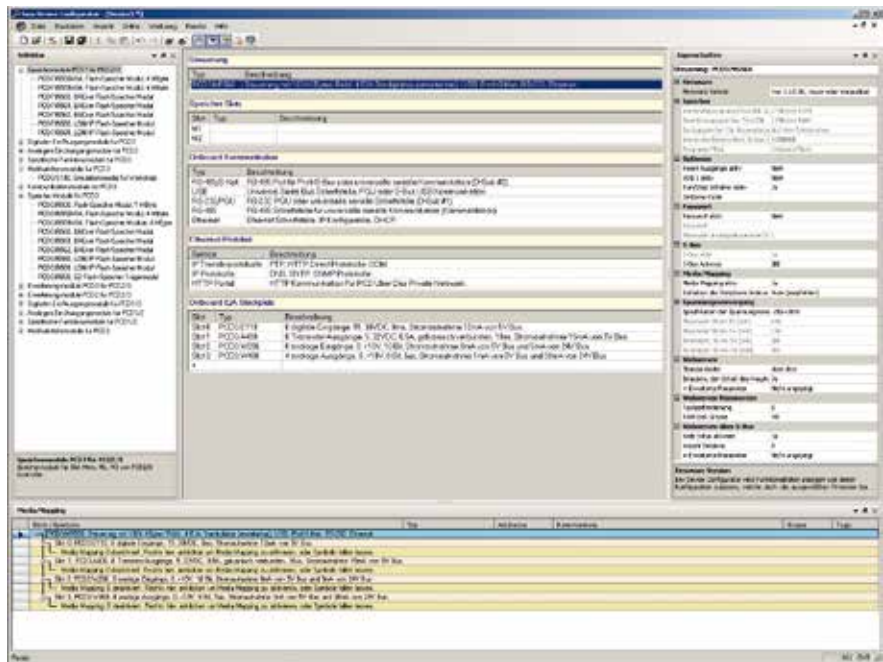
Device Configurator with the most important windows

The "Media Mapping" window shows the symbol names for all inputs and outputs. The configuration of analog signals takes place here. This window can be shown and/or hidden via the menu view → Media Mapping. After the settings have been performed, the configuration must be loaded into the controller.
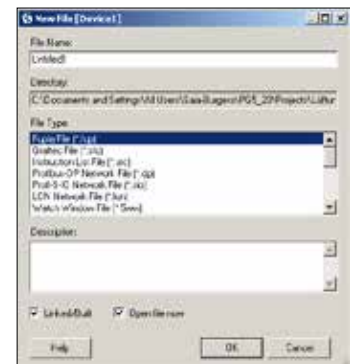
After the hardware settings, a new program file can be created. Right-click on Program Files and then New in the following selection menu.
The New File dialog opens. Enter a file name. Make sure that FUPLA Files (*.fup) is selected as the File Type and close the dialog with OK.

→ FUPLA file was created, now the user program can be created with FBoxes.


Creating a FUPLA file

Intuitive display as a function block diagram

User programs can be created from various FBoxes without any extensive knowledge of programming. They can be displayed as desired in the function block diagram editor (FUPLA).

In this example, the performance values of individual energy meters are continually monitored and the maximum and minimum values captured over days, weeks or even years. The voltage and power is compared with variable limit values. If exceeded, a relay output is activated which can be used, e.g., to control a signal lamp or to introduce a peak load cut-out. In addition, an e-mail can be sent to notify a specialist.
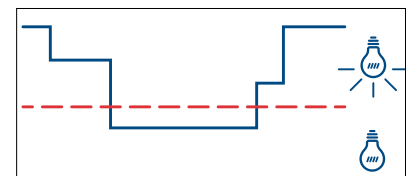

Monitoring performance values
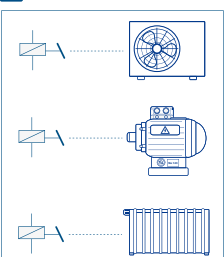
An extract from the load cut-out is explained and presented below. Only the most important FBoxes are dealt with here.

It should be made clear that a simple logic can be implemented with the FBoxes already in the Saia® PG5 Core.
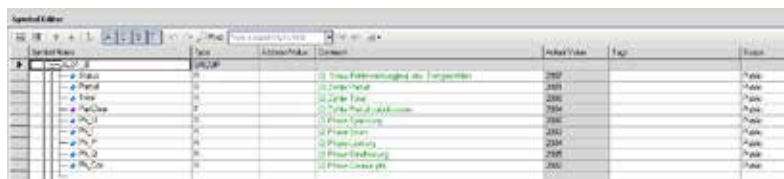

Load cut-out

S-Bus energy meters

This FBox is used to read the energy meter using the S-Bus interface.

The energy meter supplies the current power consumption values of the consumers connected. For the example above, the power and voltage are used.
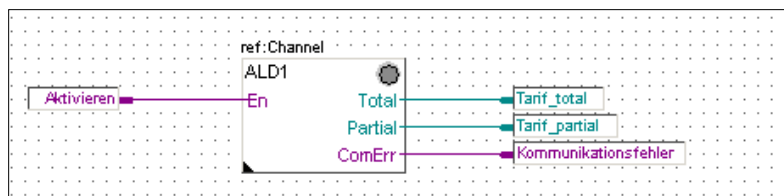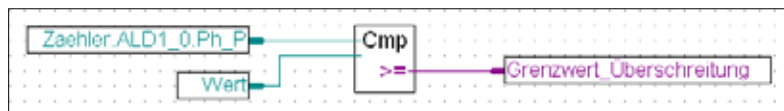

FBox – Energy Meter S-Bus

In the Symbol Editor it can be seen which tabs and flags can be used.

Symbol Editor

Arithmetic FBoxes – Comparison

Is greater or equal to: Binary output is set if the top input is greater than or the same as the bottom input. Otherwise the binary output is not activated. Signal if limit value is exceeded

FBox – Integer Comparison

Data capture

The HDLog FBox records up to 10 values for a historical data evaluation. The values are first saved in a buffer (RAM DB) and written to a CSV file depending on the parameterization. The resulting files can therefore, for example, be forwarded via an e-mail (see below, FBox family communication e-mail), read via FTP access or read and displayed via a web application.

In our example application, the energy data evaluation is performed with this FBox.
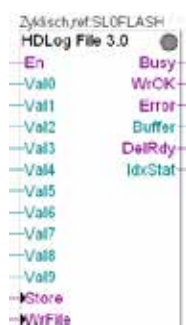

HDLog FBox

E-mail

The e-mail function and integral SMTP (Simple Mail Transfer Protocol) client enable PCD controllers to send process and system information to an e-mail server via the Ethernet interface. Alarm, service and status messages – or any process information required – can therefore be sent by e-mail to a management center and/or to service personnel. The data saved previously is sent as an attachment. Convenient FUPLA FBoxes are provided in order to use the e-mail functions.

Thus in our example, a limit value being exceeded can be reported directly to the responsible member of staff.
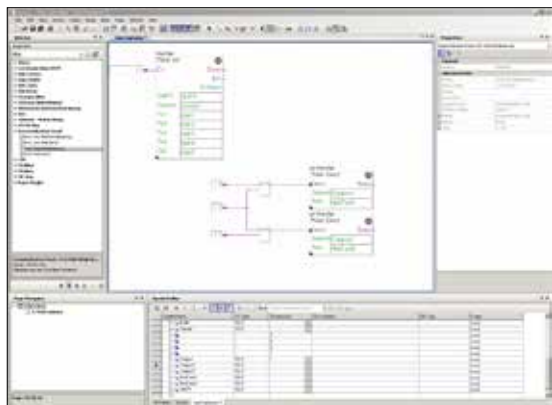
Sending e-mails with the PCD
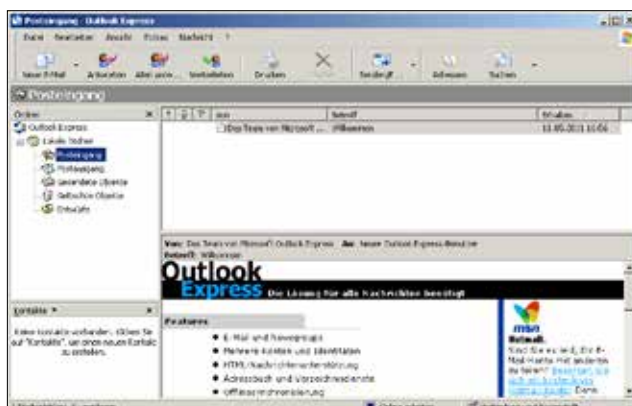
The FBoxes named above must now be positioned in the FUPLA program, described and linked with each other.

→ We therefore have a finished FUPLA program.

Generating a program (Build)

So that the finished edited program can be read and run by the PCD, it must be generated in the Project Manager via Menu → Device → Rebuild All Files or using the Rebuild All Files button in the FUPLA Editor or in the Project Manager.

The results of the various program preparation steps (Compiler, Assembler, Linker) are shown in the Messages window.

If the program has been edited correctly, the build function is completed with the message: Build successful. Total errors 0 Total warnings 0

Any errors which have occurred are shown as error messages. By double-clicking on the error message, the error concerned can easily be localized in the user program.

Rebuild All Files

Transferring the program to the PCD (Download)

The user program is now ready and just needs to be transferred from the PC to the Saia® PCD. This is done using the Download Program button or the Online "Download Program" menu command in the Project Manager.

Should any communications problems arise, the configuration settings (Online Settings) and the PC ↔ PCD connection with the USB cable must be checked.

Download Program

As soon as a system function is implemented with FBoxes and has been downloaded to the controller, the current project values can be displayed using "Go online/offline".
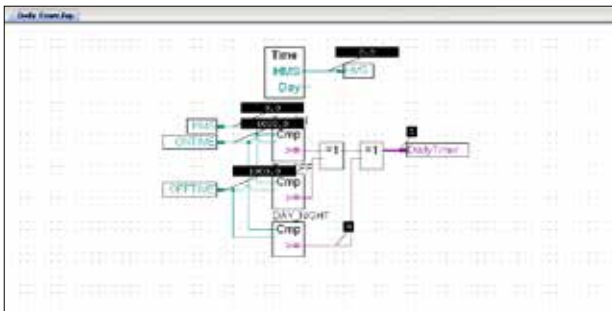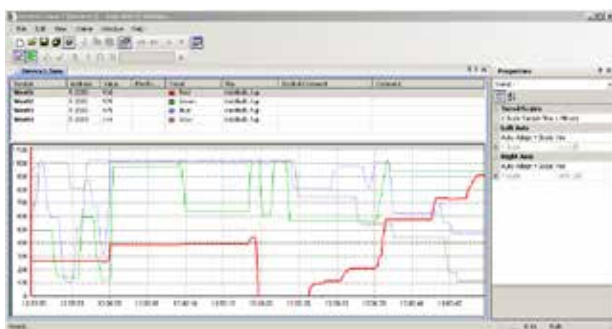
FUPLA program – "Go online"

"Go online" causes the current project values to be displayed.

If "Go online" is activated, all binary connections show the current status by means of the line thickness:

Thin "purple" line: Status = 0
Thick "purple" line: Status = 1

By clicking on the line the current value can also be displayed. This also applies to analog values.

Watch Window

Via the Watch window, it is possible to show selected online data such as the status of inputs/outputs or the content of variables of various FUPLA pages over a specific time. Data can be displayed and changed here.

Data can be entered manually or imported using copy/paste and drag-and-drop. A successful build of the PG5 program automatically updates the symbols with their new address. This also works with the Watch Window open.

## 1.1.2 Saia® HVAC modules and use

1.1.2.1 HVAC modules
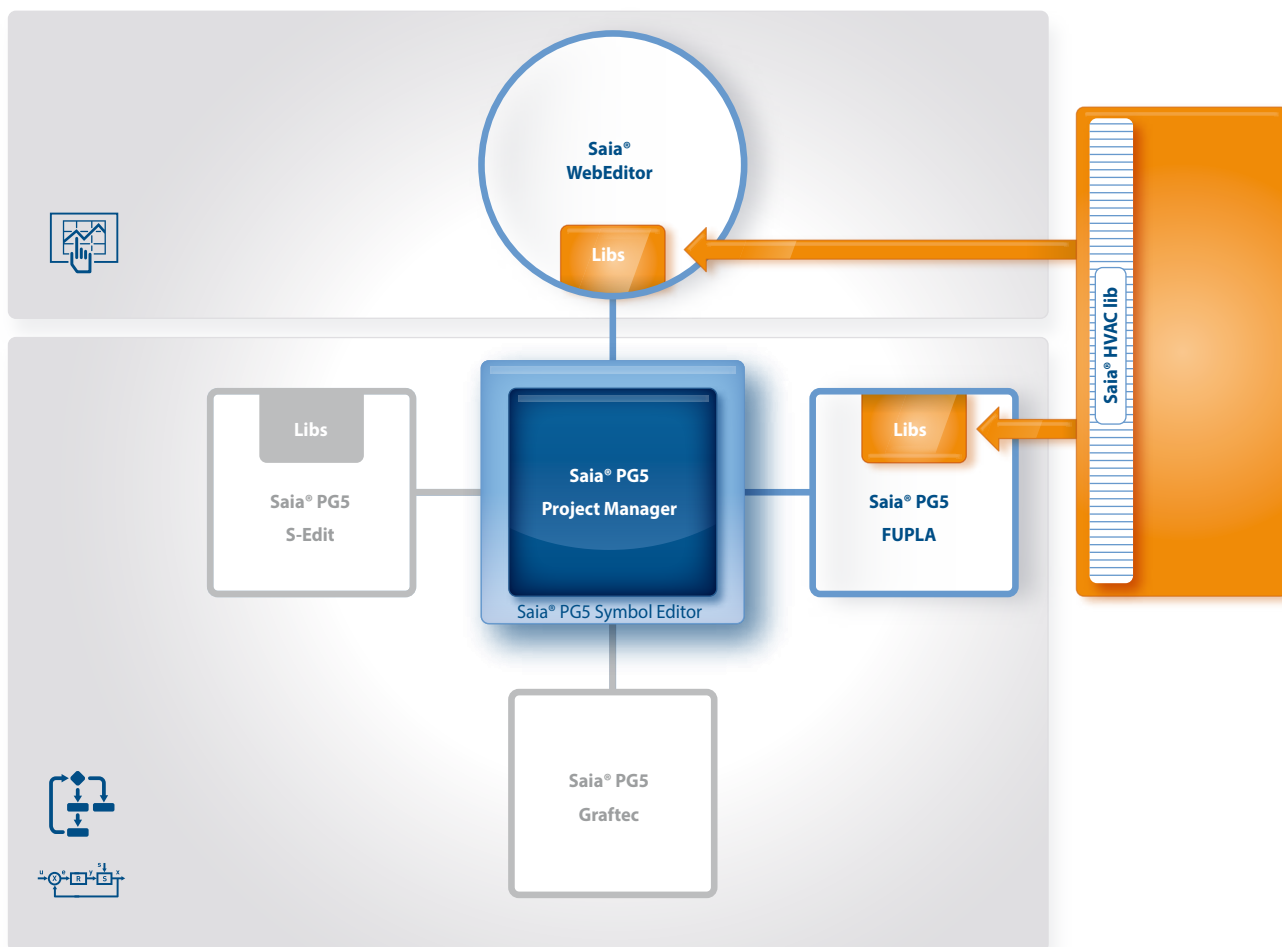
Saia® PG5 Core + HVAC library. The visualization is created using the WebEditor.

With the FBoxes included in the Saia® PG5 Core package, the majority of the program functions can already be implemented. In addition, other libraries for special areas of use are available. The HVAC library, for example, has an efficient collection of complex control modules (FBoxes) for the heating, ventilation and air conditioning systems area. These functions simplify the engineering of the technical systems of buildings.

The HVAC library contains the following FBox groups

➤ **Analogue:** Function blocks for individual scaling of each individual analog input or output

➤ **Clocks:** Daily program, weekly program, annual program, clock with multiple switching periods in one FBox, national holidays, monthly switch-offs or switching periods one after the other on the same day, as well as FBoxes for reading and writing clock data

➤ **Controllers:** Two-point controller, three-point controller, boiler loading, P, PZ, PI, PID, P-PI, P-PID controllers, incoming air mixers, controller sequences, mixer sequences

➤ **Electric:** FBoxes for lighting control, window blind control and step switches

➤ **Energy:** Energy meters, pulse counters, monthly statement, enthalpy, switching heating on/off, load cut-out

➤ **Filters:** Filter, limitation, ramp limitation, average of measurement values, dead zone, dead range with delay, zero zone, hysteresis

➤ **General:** FBoxes for numeric functions, binary functions, alarms, monitoring, motor, blocking and frost protection, process states, switches and the conversion of data types

➤ **Init:** Initialization of the subfunctions for the HVAC library

➤ **Set-Points:** Heat curve, heating demand, setpoint device, setpoint ramp, setpoint adjustment

➤ **Test:** Simulation of values and states
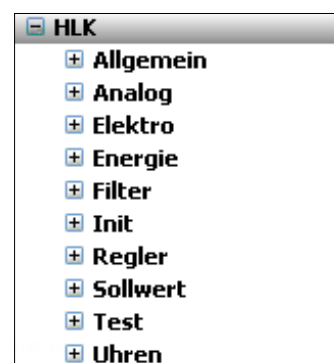
## 1.1.2.2 Example application of the HVAC library

The HVAC FBox library is used in order to implement an HVAC system in the following example. The following system should be controlled and regulated by a PCD. The implementation of the FUPLA program is shown clearly on the next few pages in step-by-step instructions.
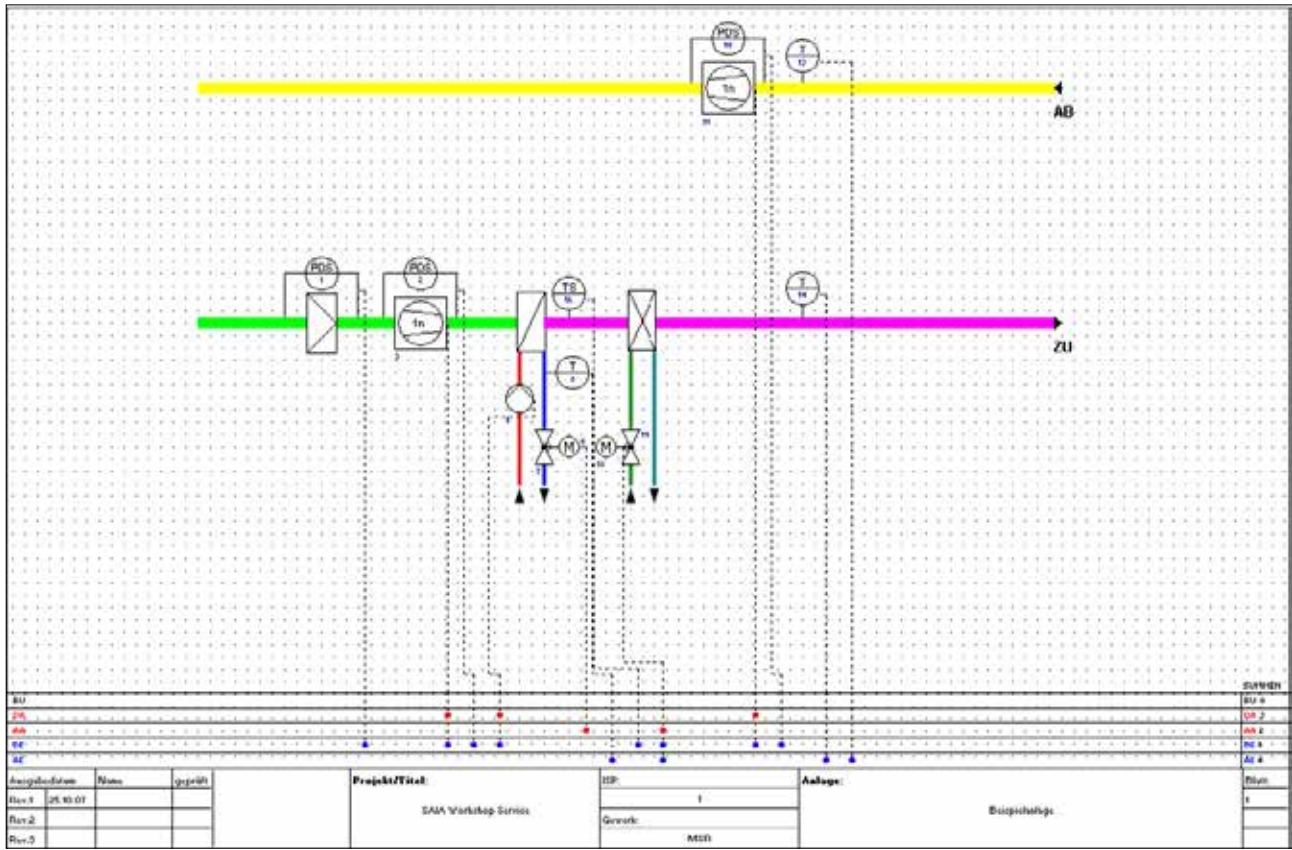
Example application of the HVAC modules – HVAC system

To start, a new project must be created in the Saia® Project Manager. No adjustment is made on the Device Configurator in this example. This example is merely intended to show the use and application of HVAC FBoxes.

An appropriate name and a description is assigned to the project.
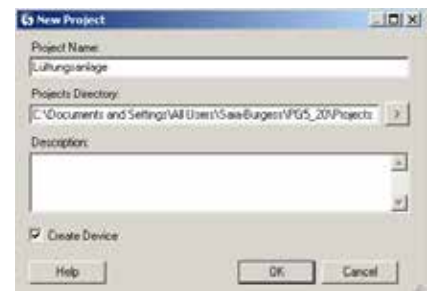
Entering a project name

After creating the project, a new program file must be created.

To do this, right-click on Program Files and then New in the following selection menu.

The New File dialog opens. Enter Ventilation as the file name, for example. Make sure that FUPLA Files (*.fup) is selected as the File Type and close the dialog with OK.
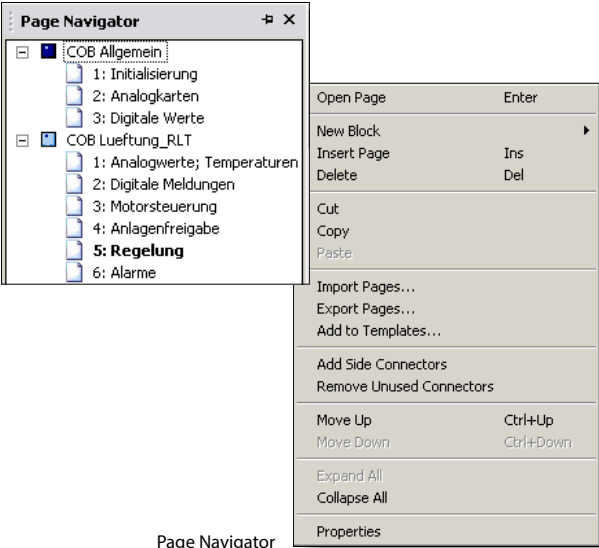
Now open the FUPLA program by double-clicking on the file created.
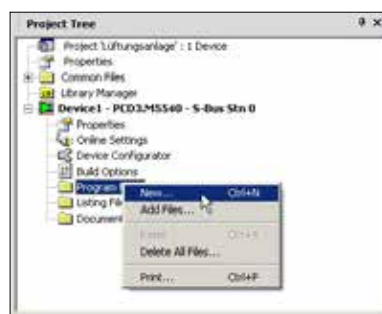
Creating a FUPLA file and assigning a name

The project requires 2 COBs with a total of 9 FUPLA pages.

Right-clicking on the COB opens the Properties window opposite. Here there are instructions with which new pages are created ("Insert Page") or a name assigned ("Properties").
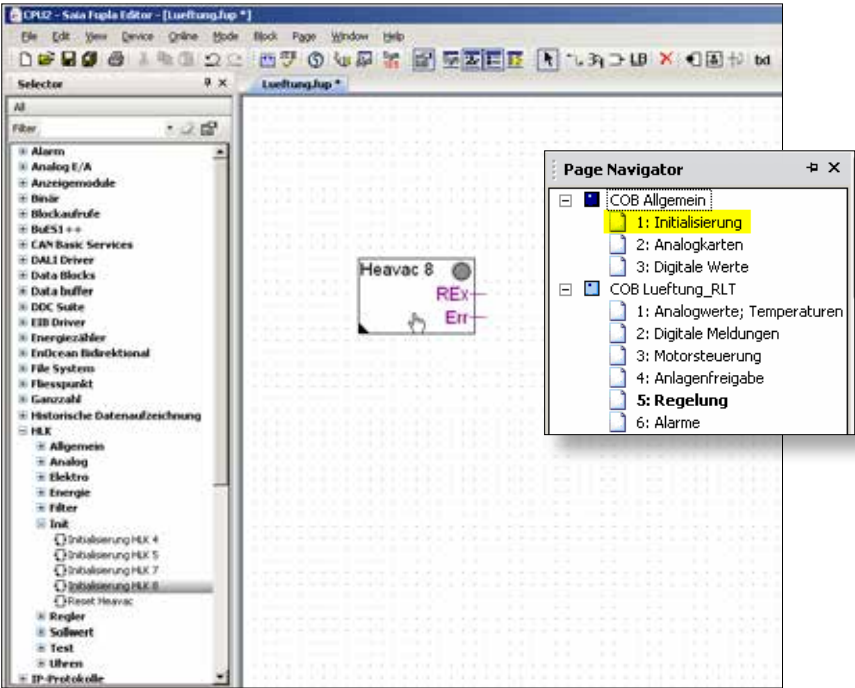

Page Navigator

Initialization

If the user wishes to use FBoxes from the HVAC library, he must place an HVAC initialization FBox at the start of the FUPLA file.

Various common properties of the HVAC FBoxes, such as the behavior of the FBox after loading or the start-up behavior when switching on the PCD, are set with this initialization FBox.
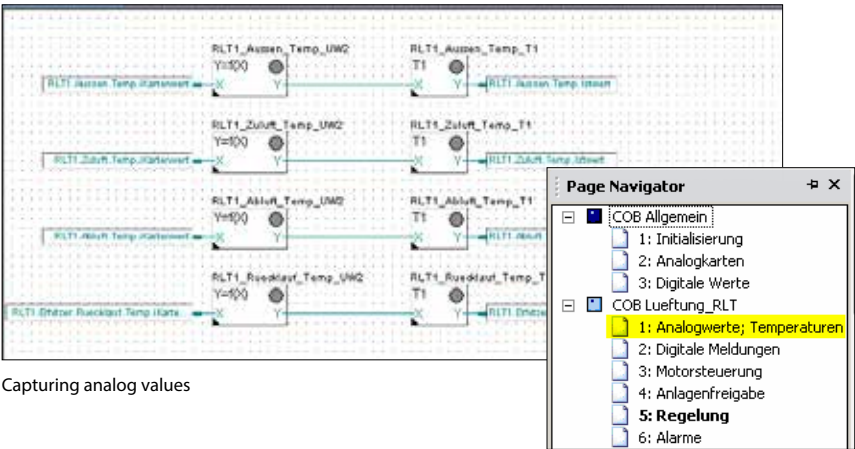

Initializing FBoxes

Capturing analog values

The temperature values for outside, supply and exhaust air and the return flow are to be captured. To do this, the Conversion FBox from the HVAC General FBox family is placed on the page four times, then the Filter T1 FBox from the HVAC Filters FBox family placed next to each one.

The FBoxes and Connector must be connected.

Assign the FBoxes a name. (Right click on FBox – Properties ➝ Name).

Create symbols in the Symbol Editor and move them to Connector using drag-and-drop.

Capturing analog values

Symbol Editor

Capturing reports

The seven reports for filter, frost protection and motors are to be captured.

Place the Digital Reference FBox from the HVAC Test FBox family (Application tab) on the page as shown, then the Xor FBox from the Binary Arithmetic FBox family (Standard tab) and move them to two inputs.

Add symbols from Symbol Editor as before.

Digital messages

Motor controllers

Place the Motor 1 speed+Ack FBox from the HVAC General FBox family (Application tab) on the page three times as shown.

Place the inputs/outputs on the FBox using the button from the Connector menu as shown.

Display the Symbol Editor using F5.

Create a new sub-group. We can now create symbols in the sub-group. Then move the symbols just created to Connector on the FUPLA page via drag-and-drop.

Motor controller

System release

The system should be connected via a clock and the pump via the external temperature.

Place the Clock 7 days FBox from the HVAC Clocks FBox family (Application tab) and the Override 1 Stage FBox from the HVAC General FBox family on the page four times as shown. Place the Anti-blocking pump FBox from the HVAC General FBox family and the Controller 2 points and sequence 2 points FBoxes from the HVAC Controllers FBox family as shown on the page.

Place the Or FBox and the And FBox from the Binary Arithmetic FBox family on the page as shown. Set the Connector as shown opposite on the page and connect the elements.


System release

Control

The system should receive a supply/exhaust air temperature cascade as a control.

Place the W/Ambient temperature FBox from the HVAC Set-Points FBox family and the Controller PI and Sequence Master HC FBox from the HVAC Controllers FBox family on the page as shown. Place the Maximum FBox from the Integer Arithmetics FBox family on the page as shown. Connect the elements. Now a few basic settings still need to be made in the FBoxes. The Properties window opens by clicking on the FBox. All values are experience values which can be used to control temperature as a basis for adjustment. Obviously these values must be adjusted according to the control behavior during operation.
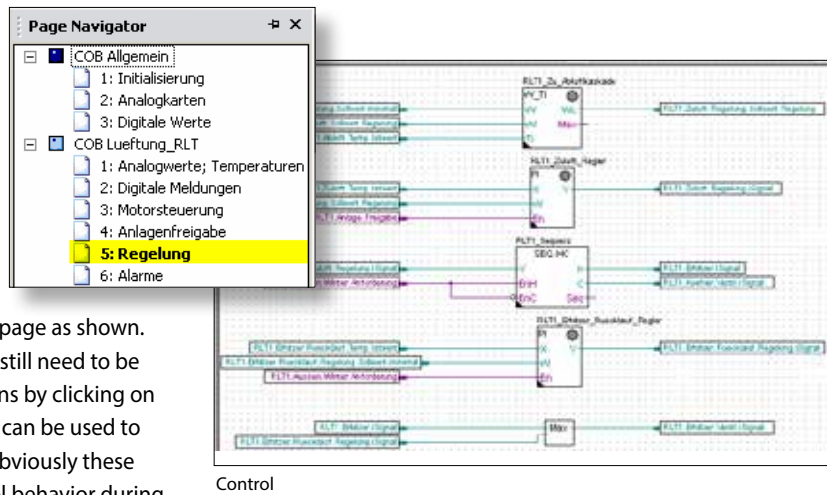
Control

Alarm processing

We still need to process messages as alarms. Place the Alarm inhibit 1–10 FBox from the HVAC General FBox family with two inputs and the Alarm FBox on the page as shown. Then position the Or FBox from the Binary Arithmetic FBox family with four inputs, set the Connector and connect all the elements as shown. The FBox with the name VS_01_alarm saves the alarm until it is acknowledged. Since the motor alarms are already saved in the Motor FBox, this can be connected via the Or FBox to the VS_01_alarm_ssm FBox. This FBox is designed to provide a visual and audible alarm notification. The s1 output is reset once acknowledged and the s2 output switches from flashing to being permanently on. Only once the alarm is cleared does s2 also go out.
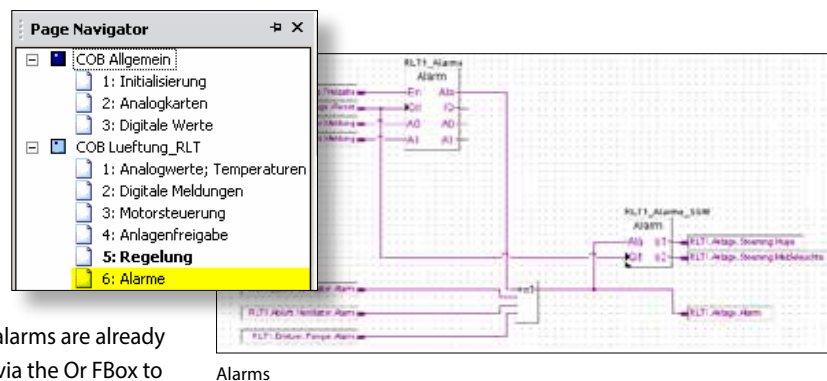
Alarms

## Physical inputs and outputs for the test

Position the PCD2.W4 FBox from the HVAC Analog family and move this to two inputs. Position the PCD2.W2 FBox and move this to four outputs. Connect all FBox inputs and outputs with connectours. Enter O 112 in the PCD2.W4 FBox. There must be a space behind O so that the exact output can be identified. The same applies to I,F,R, etc. Enter I 96 in the PCD2.W2 FBox. Move the associated symbols via drag-and-drop from the Symbol Editor to the Connector to the FBoxes.

Position the Override digital FBox from the HVAC General FBox family on the page as shown. Set the connectors and connect all elements as shown. In the Symbol Editor, add the symbol name I0 and 0 as the address.

Return to the symbol name and enter ..7 next to the address I0 and click Enter. The Symbol Editor automatically creates the symbols I1 to I7 with the relevant address for you. Repeat this for the digital outputs O16 ..23 with address 112 to 119. Now move the symbols just created to Connector on the FUPLA page via drag-and-drop.

The symbols are now linked to the inputs and outputs and can be tested.

The FUPLA program shown is a summary of a possible exercise from the basic course on building automation workshop.
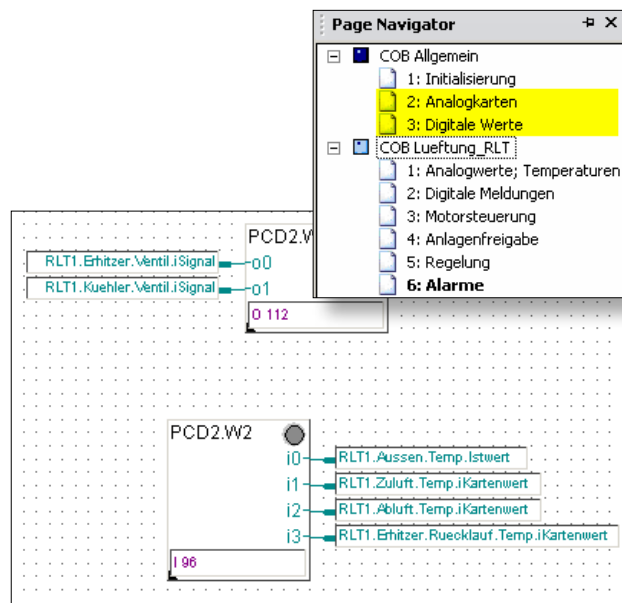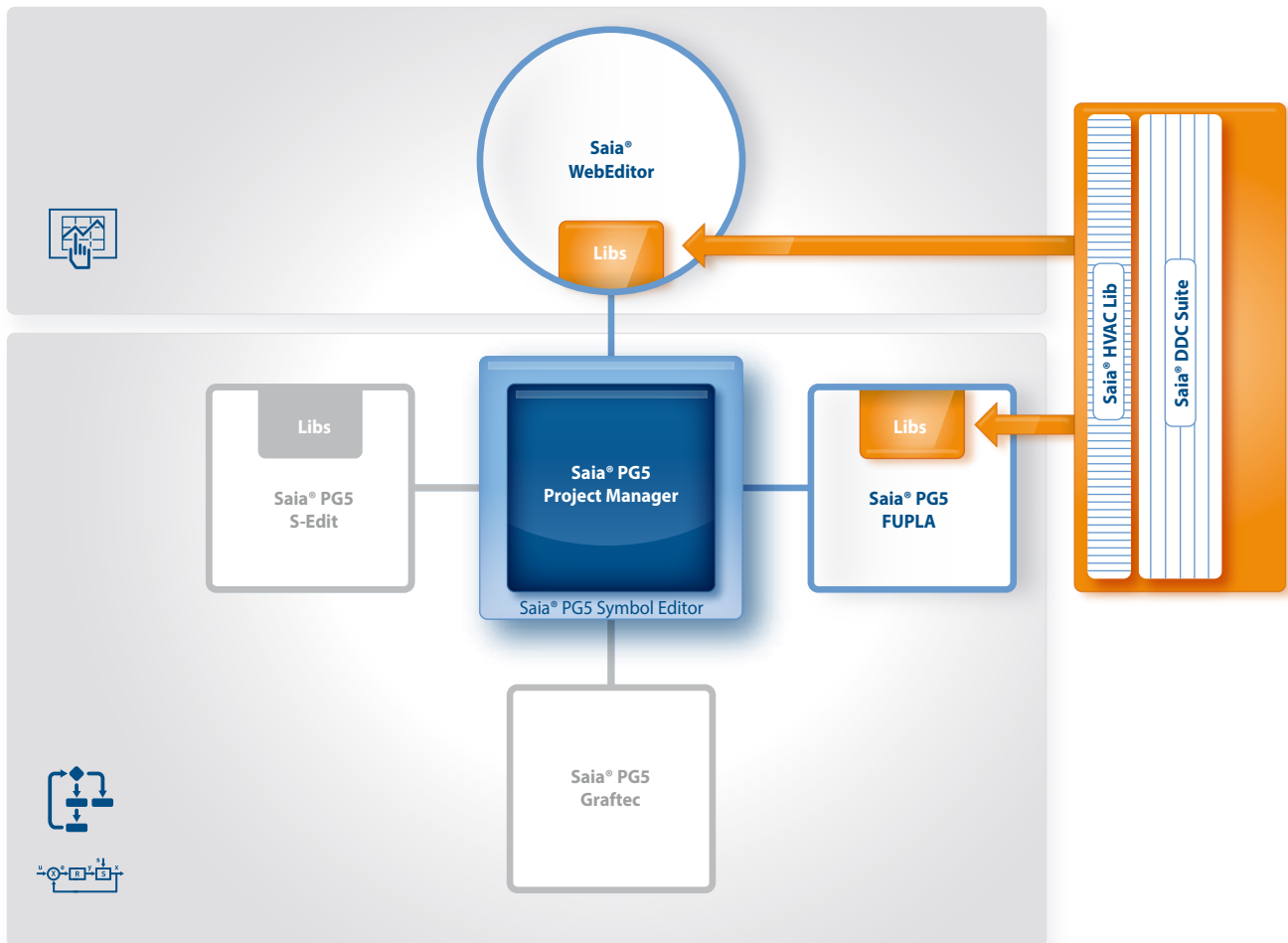

Analog board
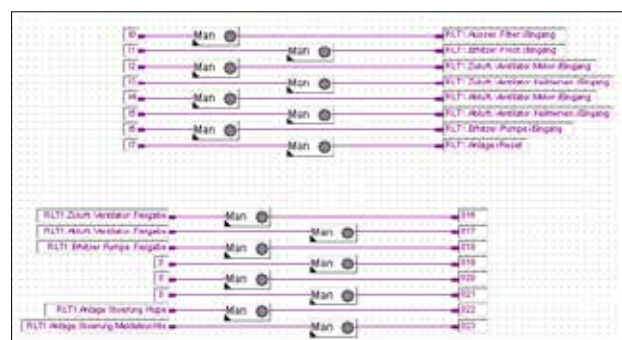
Digital values

1.1.3 **Increasing engineering efficiency through Saia® installation templates**

1.1.3.1 **DDC Suite**

Saia® PG5 Core + DDC Suite library

Using the Saia® PG5 DDC Suite library and templates makes the creation of HVAC applications even simpler. Complex program structures and application elements such as complete pump controllers, incl. hour meters or entire control tasks for ventilation systems are grouped together as templates in individual function boxes and optimally add to the current HVAC library. This means that projects can be implemented efficiently.
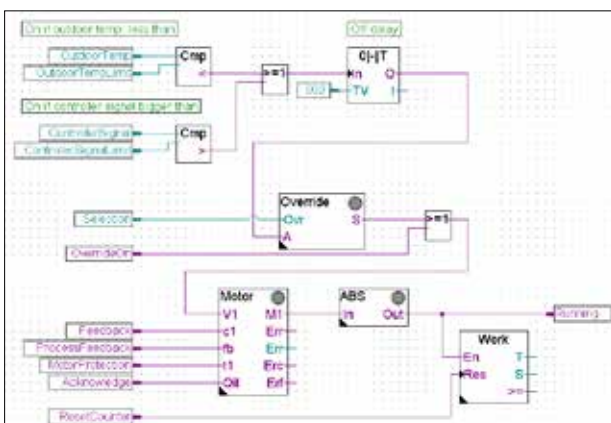
Complete pump control with HVAC library
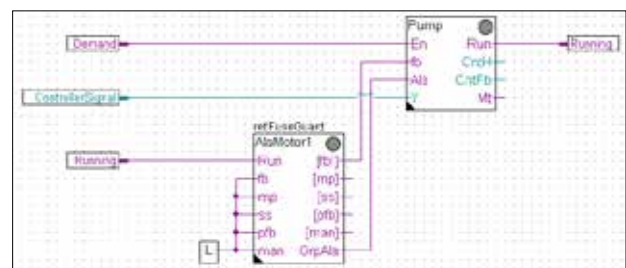
Complete pump control with DDC Suite library

We can already see a number of benefits when comparing the two FUPLA pages (HVAC and DDC Suite).
➤ It is easier to read and understand the FUPLA program – fewer FBoxes and links on one page.
➤ Arranged clearly and transparently – easier to handle, e.g. for new colleagues in the developer or service team
➤ Easy to maintain

The following FBox families are available to the DDC Suite library user:

➤ **DDC Alarming:** Fault modules for motors, fire protection and various components

➤ **DDC Analogue values:** FBoxes for capturing measurement values

➤ **DDC Controller:** Control modules for components such as cooler, heat recovery system and heater

➤ **DDC Controls:** Triggering of motors, pumps, flaps and drives

➤ **DDC General:** General FBoxes such as manual information, media access

➤ **DDC Initialisation:** Modules which must be inserted once into a FUPLA and which provide basic functions.

➤ **DDC Set-Points:** Conversions, setpoints

➤ **DDC Systems and Clocks:** Clocks, systems and aggregate switches
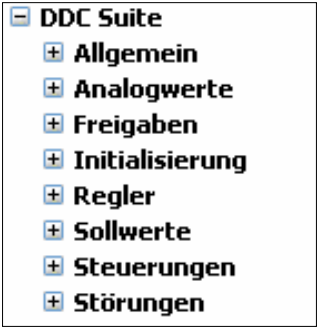
DDC Suite library

This FBox library with highly integrated FBoxes uses individual data points and creates groups and symbols automatically.

The unique features of the DDC suite are divided into 5 points:

Trending

Object parameter window

1. Integrated trending (offline history)
If, in addition to the actual control and regulation of a system, data is also to be recorded, this is easily done using the Saia® DDC Suite.
By defining the memory size in the object parameter window, the data capture for trending can be initiated. When the automation system is running, the data is now continually saved in the Saia® PCD and is available for evaluation.
In addition, a document (.txt) containing all parameterized historical data is saved in the Saia® Project Manager. A list of the trend settings can be seen in this file. There is one entry for each trend with all the details.

Alarming

2. Integrated alarming

The principle of the trend function also applies to alarm functions. By defining the alarm number in the object parameter window, the alarms are listed in a CSV file with numbers and text.

With Version 2.5 of the DDC Suite, the system identification key can be created completely freely directly from FUPLA. The aim is to create the system identification key for the S-Web alarm texts and BACnet® completely freely according to the specifications from the FUPLA program. The system identification key can have up to 12 levels. The general section (levels 1-10) is specified conveniently from a central FBox.

This FBox can be positioned multiple times. Within the FBox it can be selected what the key is to be used for. Thus, for example, various system identification keys can be created for S-Web alarming, the BACnet® Object Names and the BACnet® Description. If on certain FUPLA pages, for example for various systems, other levels are used, a further FBox is simply placed on the page. These FBoxes can also be used as often as desired and the changes to the system identification key are valid for the next FBox of this type. Thus a different name key can be used for each system.
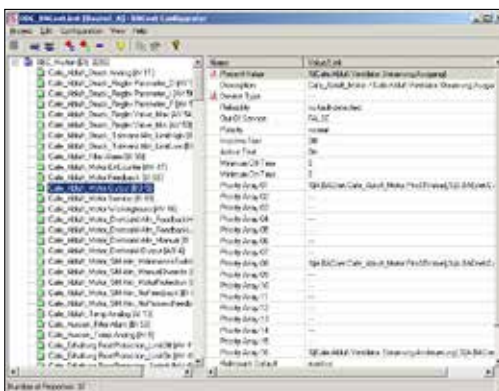

BACnet configurator

3. Automatic generation of the BACnet® configuration

For BACnet® projects, the BACnet® object list is created automatically, which saves a great deal of error-prone manual work. The automatic generation of the BACnet® objects is the main reason why so many customers use the DDC Suite. In building automation, it is normal for all systems to map relevant hardware and software data points to BACnet® objects. This may mean that multiple data points are used in a BACnet® object. Thus, for example, a binary output could receive exactly the same return message and be monitored via intrinsic alarming. The control templates for the DDC Suite already contain all BACnet® definitions which can be activated by clicking, thus BACnet® originates at the click of a button.

HTML document

4. Automatic documentation

The engineering documentation can be created quickly at the click of a button. The documentation on all DDC Suite FBoxes is created as an HTML file. This file contains a general description with all parameters and settings. The documentation can be saved in the PCD and, for example, be used for viewing via the web. It is, however, also possible to post-edit the documentation using a text processing tool and to add images from the SCADA/web application.
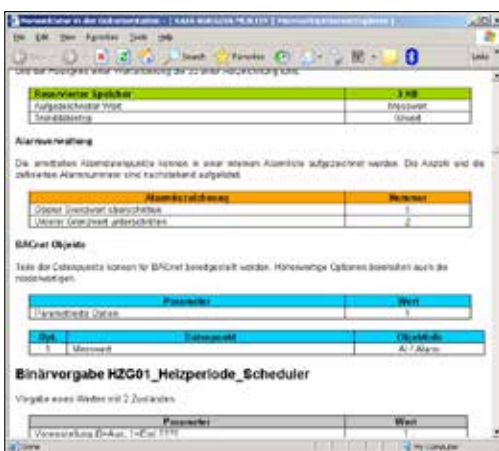
5. Templates for FUPLA, WebEditor and Visi.Plus

The Saia® DDC Suite largely comprises a highly integrated FBox library which is supplemented by a growing number of ready-made, tested and ready-to-use FUPLA pages which fully map the typical parts of the system in terms of function. The Saia® DDC Suite also provides the operating and visualization function for each FBox. Operation and visualization using the web browser or Visi.Plus is already integrated and ready for use.
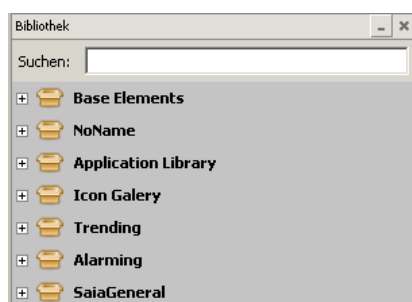
➤ FUPLA templates

In order to reduce the system programming time, entire applications (heating circuit, water heating, ventilation systems, etc.), including the calendar and control tasks, are fully integrated for free selection. Some suggestions for control settings and for system control can thus be freely added, changed or integrated.
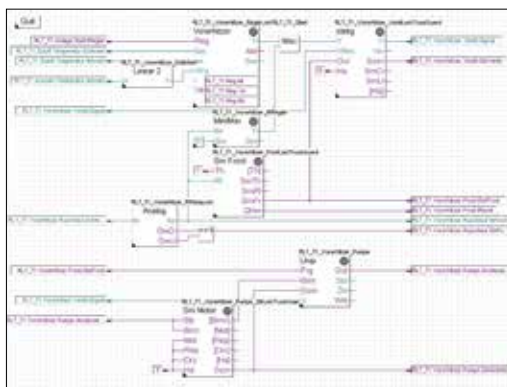
Template: Ventilation system

➤ WebEditor templates

The DDC Suite is also accompanied by template objects for S-Web applications. Graphical objects and control objects are available for each FBox. There are also S-Web system templates for predefined systems.

All official macros can be found in the "Library" WebEditor window.

➤ Visi.Plus templates

When importing data from FUPLA to Visi.Plus, FBoxes are identified and then handled by the Visi.Plus database as FBoxes. Not only are the data points imported, but the alarms and historical trends are automatically created upon import. In addition, the Visi.Plus user is provided with the same template objects as in WebEditor.
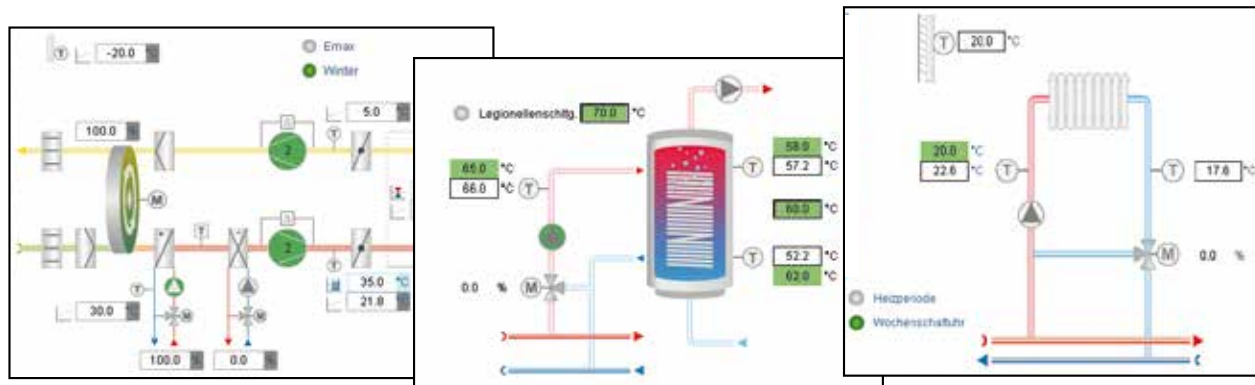

System schematic

1.1.3.2 **Example application of the DDC Suite**

In the previous example it was made clear how quickly and easily the implementation of an HVAC system can be performed with the correct engineering tool. The engineering time can, however, be further reduced using the DDC Suite.

Engineering start

After the hardware settings (Device Configurator), a new program file (FUPLA file) is created. The implementation of a system can now begin. Various templates are provided so that the creation of a new HVAC system does not have to start again from the very beginning.
After clicking on the "Template" symbol in the FUPLA Selector, the available templates are listed.

→ Selecting templates: In this example, the template AirCond_T1 is used.
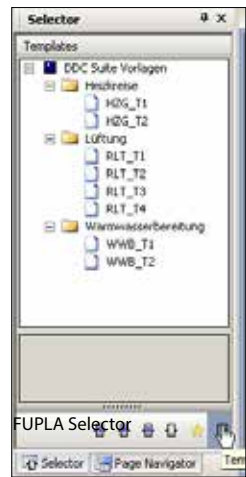
Adjusting the template pages

Most functions, settings and parameters can be set online. In the event of a function change, this means that the program is not normally recompiled and loaded into the controller. Thus, for example, the setpoint adjuster can easily be disabled if required the operator so desires or if the setpoint is to be used without any summer compensation. This reduces the commissioning time.

The template pages can also be adjusted with further FBoxes if required.
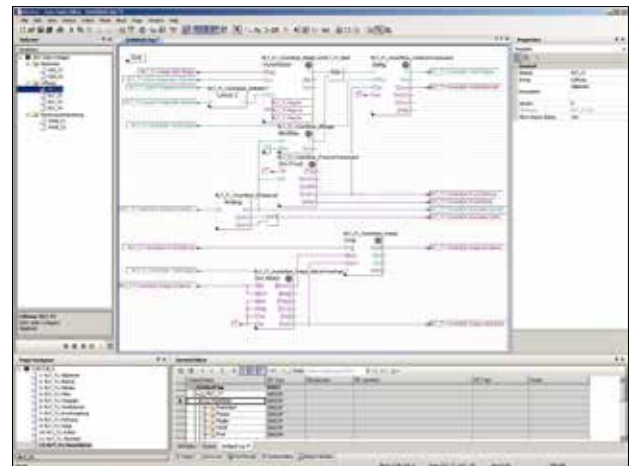
The AirCond_T1 template contains the FBoxes and links visible here.
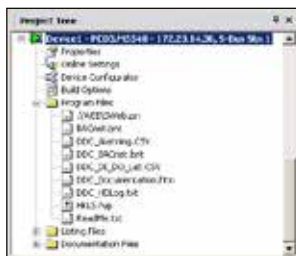
Project Tree with Program Files

Generating a program

As soon as the program is generated information is created automatically.
➤ BACnet configuration has been created (BACnet.bnt)
➤ Alarms with numbers and text are listed in a CSV file (DDC_Alarming.CSV)
➤ Documentation as an HTML file with settings is created (DDC_Dokumentation.htm)
➤ List of all parameterized historical data (DDC_HDLog.txt)
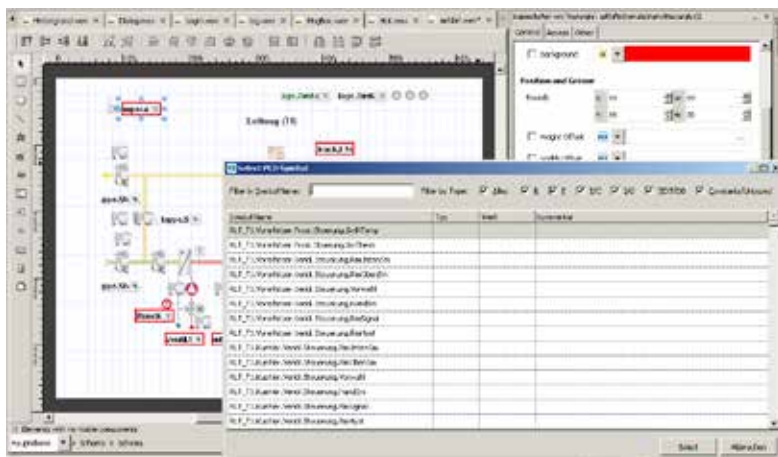
Linking symbols

Visualization

In the WebEditor, the template must be linked to the FUPLA page with just a few clicks.

Unlike the standard HVAC FBoxes, the symbolic parameter assignments in the FBoxes are not defined as arrays: Each individual parameter can and/or must be given its own symbolic assignment if a connection to a display or a building automation system is required. This assignment is no longer needed for the DDC Suite library since all parameters already contain symbolic assignments. Thus the assignment to an image in the WebEditor is very quick.

1.1.4 Saia® PG5 Controls Suite

1.1.4.1 My Controls Suite


Saia® PG5 Core – My Controls Suite
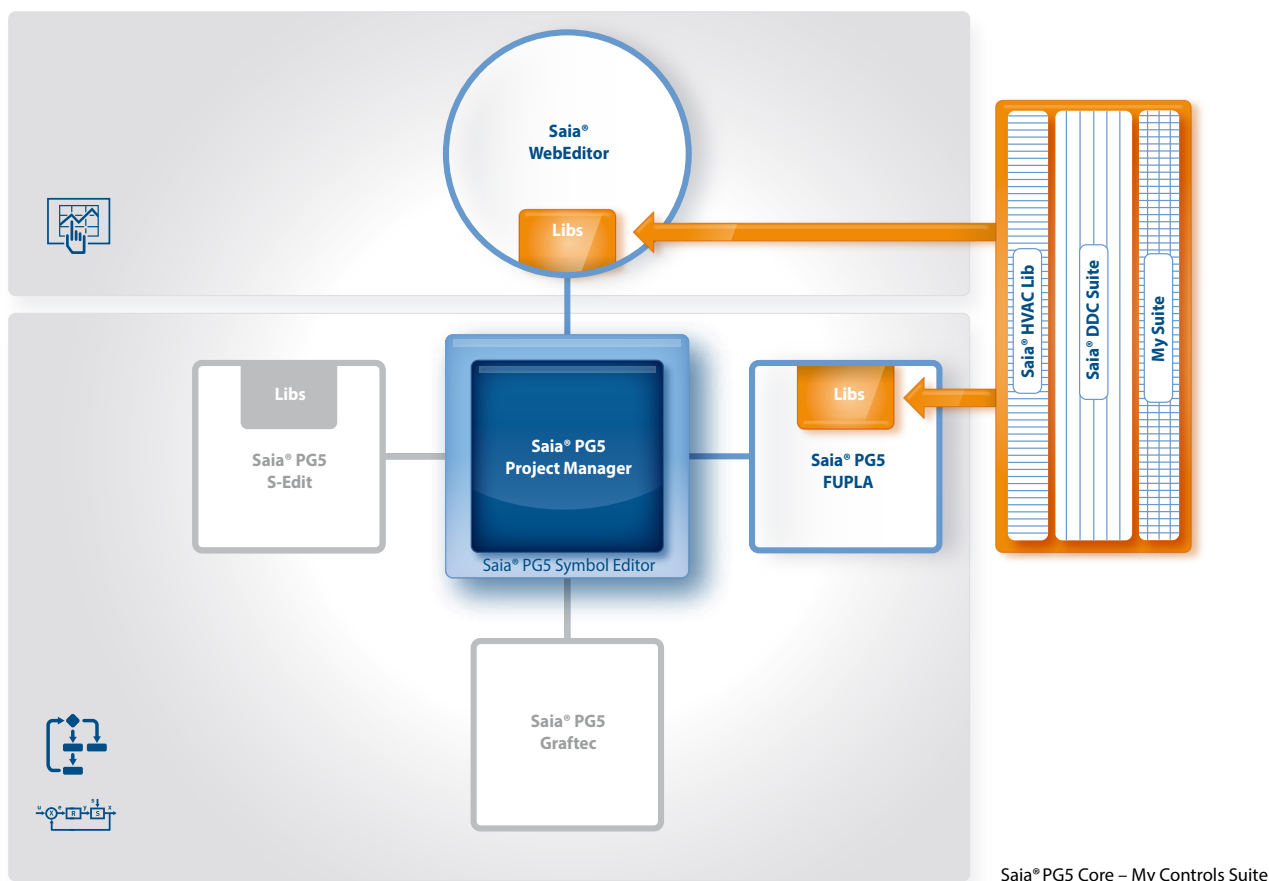
The use of predefined FBoxes and/or templates is not mandatory.

Saia® PG5 Core enables individual templates to be created and even offers the opportunity to define these templates with purely graphical engineering, without any IL programming.

Creating templates

Using templates significantly simplifies processes and reduces engineering time. In order to implement projects more efficiently, it is not only possible to use existing templates, but also user-specific engineering projects as templates. Users who have built their standard FUPLA pages can export and save them as .fxp files (a .fxp file includes any number of FUPLA pages). To reuse the pages, the .fxp files must be located and then imported.
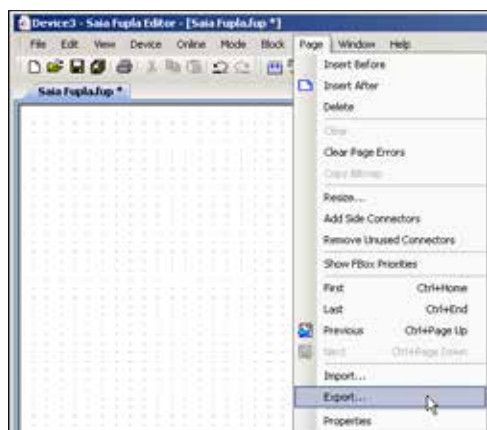
Creating templates
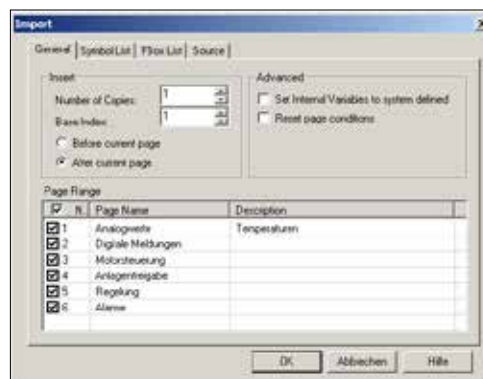
Using template pages

In addition to the templates which can be easily created and reused, it is also possible to create your own FBoxes and/or your own FBox library (My FBox Lib). The FBox Builder, which can be found in the Saia® PG5 Core, is used for this.

Creating FBoxes

The process of exporting FUPLA pages and then reimporting them is simplified by the Saia® FBox Builder. Users can import their .fxp files into the FBox Builder and then archive them as FBoxes.

This function (importing FUPLA export pages/files) enables a structured group of FBoxes to be grouped into one large macro FBox. The Saia® FBox Builder can then be used to document, maintain and export the new macro FBox as a new "product".

This capability allows custom libraries to be built up for any other use. The FBox Builder gives the user the chance to develop his own FBoxes without writing a single line of instruction list code.
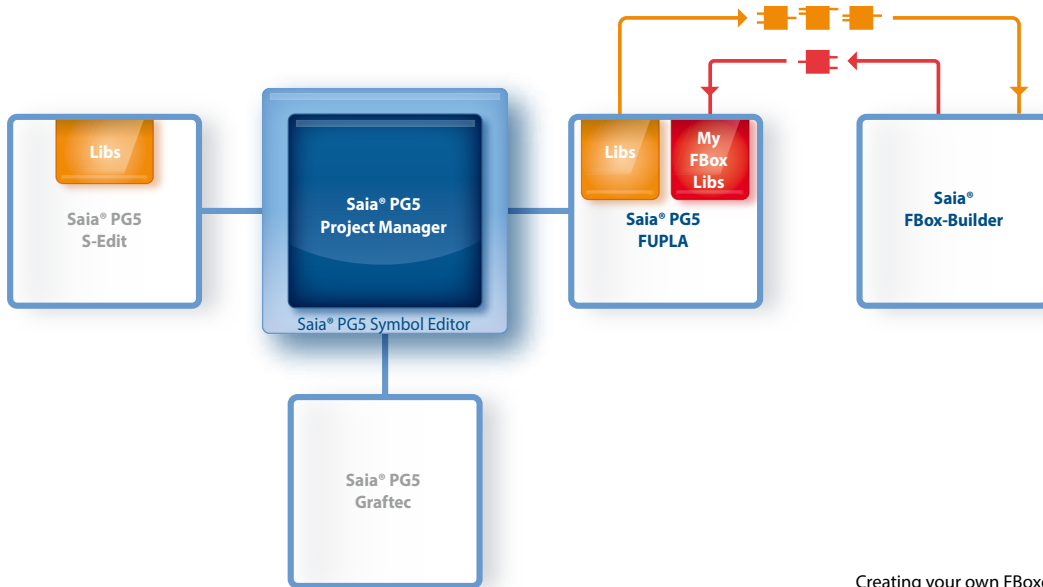

Creating your own FBoxes with the FBox Builder

The Saia® FBox Builder has further additional functions which enable programmers to develop completely new FBoxes and to maintain them in their own library. The FBox Builder advanced version is needed if the user wishes to integrate existing IL functions, or modify existing FBoxes, or even create completely new FBoxes. In addition to importing export pages (1), this version enables extensive functions such as:

➤ Importing existing FBoxes (2)
➤ Creating FBoxes "from scratch" (3)
➤ Importing IL code (4)

The advanced FBox Builder is suitable for experienced Saia® PG5-IL programmers who have attended a workshop and who have a license for the FBox Builder Advanced add-on tools.
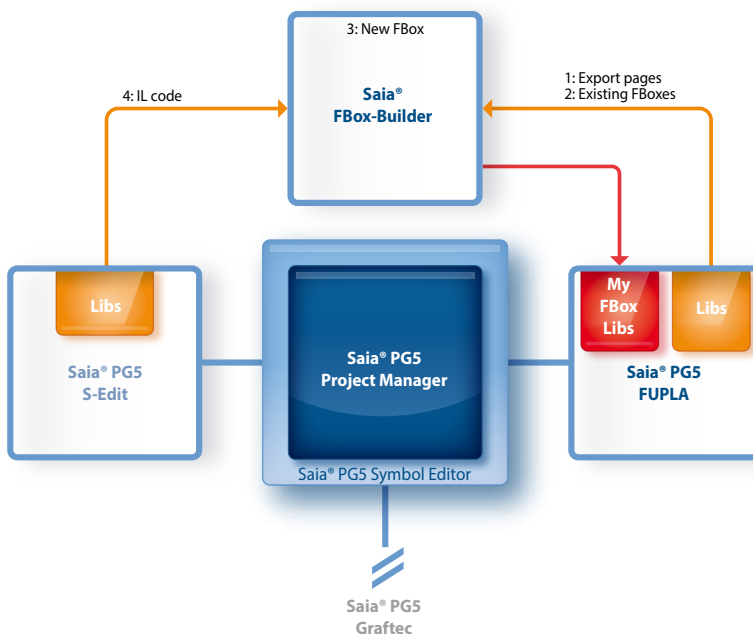
Using the Saia® FBox Builder in projects with the Saia® PG5 software technology

1.1.4.2 **WebEditor as a stand-alone tool**

Saia® WebEditor – Web visualization for automation

The Saia® WebEditor produces appealing web visualizations without any web designer skills.
The tool is based on the automation environment. Areas of use include system/machine visualizations, alarming and trending functions, or one service page. The full integration into the Saia® PG5 Core, in conjunction with Saia® PCD controllers, guarantees a particularly efficient working method.

➤ A stand-alone variant is also provided for applications independent of Saia® PCD controllers.

Stand-alone variant

The WebEditor is independent software which can be used without the Saia® PG5 Core.
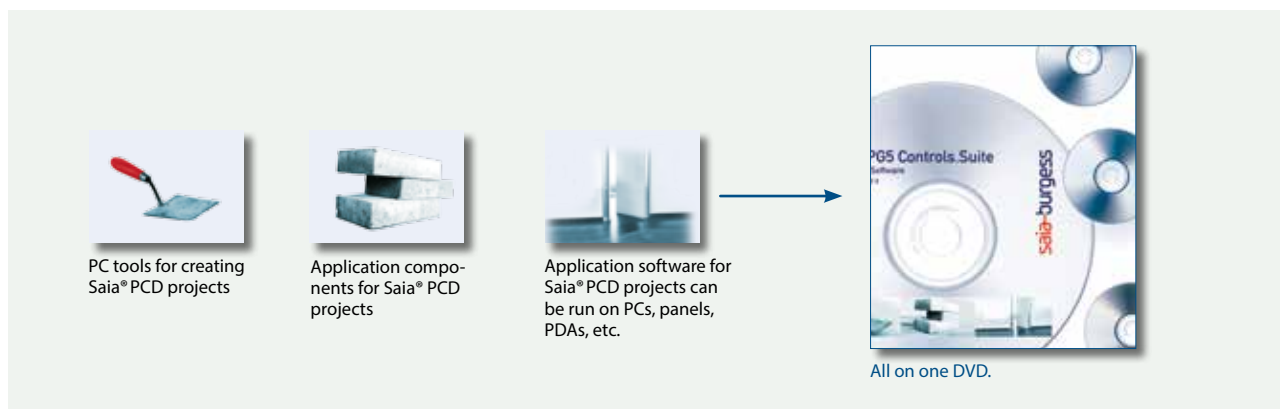

Using the stand-alone variant

The stand-alone variant of the WebEditor can, for example, be used to individually design the S-Energy Manager. The functionality of the off-the-shelf solution (S-Energy Manager) is based on standard Saia® technologies, in the form of a Saia® WebEditor project. In practical terms, the user interface for the S-Energy Manager can be flexibly customized using the Saia® WebEditor. The 'look and feel' and the functionality can then be tailored to the individual user, to include the company design/logo for example.

S-Energy Manager user interface – Predefined web pages, produced with Saia® WebEditor

1.1.4.3 Overview of the tools and license packages

The combined platform of the Saia® software is the Saia® PG5 Controls Suite DVD. This includes software tools for project configuration, engineering, programming and service. The DVD also includes application components with which you can increase your productivity when using Saia® PCD products. You will also find a wide range of system software on the Saia® PG5 Controls Suite DVD. This predominantly involves driver software which simply and reliably ensures the integration into a system environment.

PC tools for creating Saia® PCD projects

Application components for Saia® PCD projects

Application software for Saia® PCD projects can be run on PCs, panels, PDAs, etc.

All on one DVD.

Saia® PG5 Controls Suite contains everything you need for automation

PC tools

Saia® PG5 Core Project Manager
➤ Application Programming
➤ Application Engineering
➤ Network Management
➤ Service

Saia® WebEditor
Tool for creating web pages for the Saia® PCD WebServer

Saia® Visi.Plus
Visualization and management software for applications in infrastructure automation

Saia® HMI Editor
Tool for Saia® PCD Text Panels

Saia® FBox Builder
Tool for creating and managing Saia® FUPLA FBoxes

Saia® S-Service Online Tools
Downloading PG5 programs without installing the Saia® PG5 Core

Application components

Standard FBoxes
Program modules for Saia® FUPLA, the graphical engineering tool
➤ Arithmetic and logical FBoxes
➤ Analog FBoxes
➤ Communication FBoxes

Application FBoxes
Program modules for Saia® FUPLA, the graphical engineering tool.
FBoxes: Alarm, DALI, DDC Suite, EIB, Energy Meter, EnOcean, Historical Data Capture, HVAC, Blinds/Lighting, JCI N2-Bus, E-Mail Communication, LON, Modbus, Modem, MP-Bus, Room Controller

IL libraries
Function blocks for counter modules, drive modules and analog modules can be integrated into IL programs

Application software

Saia® Web-Connect
The PC program enables access to the PCD WebServer via any communication interface (RS232, RS485, Profibus, Ethernet, etc.)

SD Flash Explorer
With SD Flash Explorer, the content of the Saia® file system can be extracted to the PC.

Saia® .Net Suite
Simple integration of Saia® automation components into Windows applications

List of tools in the Saia® Controls Suite

License packages

We have defined three packages as a global standard out of the large variety of possible software combinations with the Saia® PG5 Controls Suite. The training programs, online training and documentation are based on these.

➤ **Saia® PG5 Core Package**

With this package, all types of ICA tasks can be initiated on machines and systems. The graphical application components supplied support the use of the Saia®AutomationServer (Web + IT) and simple calculation and logic functions.

➤ **Saia® PG5 HVAC Package**

In addition to the Saia® PG5 Core Package, further collections of graphical control modules (FBoxes) are included which are oriented to the needs of HVAC primary systems. Template pages can be created from the Saia® basic collection of HVAC ICA modules which map any kind of system configuration.

➤ **Saia® PG5 Extended Package**

In addition to the Saia® PG5 HVAC Package, highly integrated graphical modules (DDC Suite) are included as well as a collection of templates which map the current system design of the HVAC technology.

→ For details see order information

Saia® PG5 options – Add-on libraries: Tool is separated from libs. The FBox libraries can also be ordered.

The three standard packages can only be differentiated by the licensed application components (FBoxes, templates); the Saia® PG5 Core always remains identical.
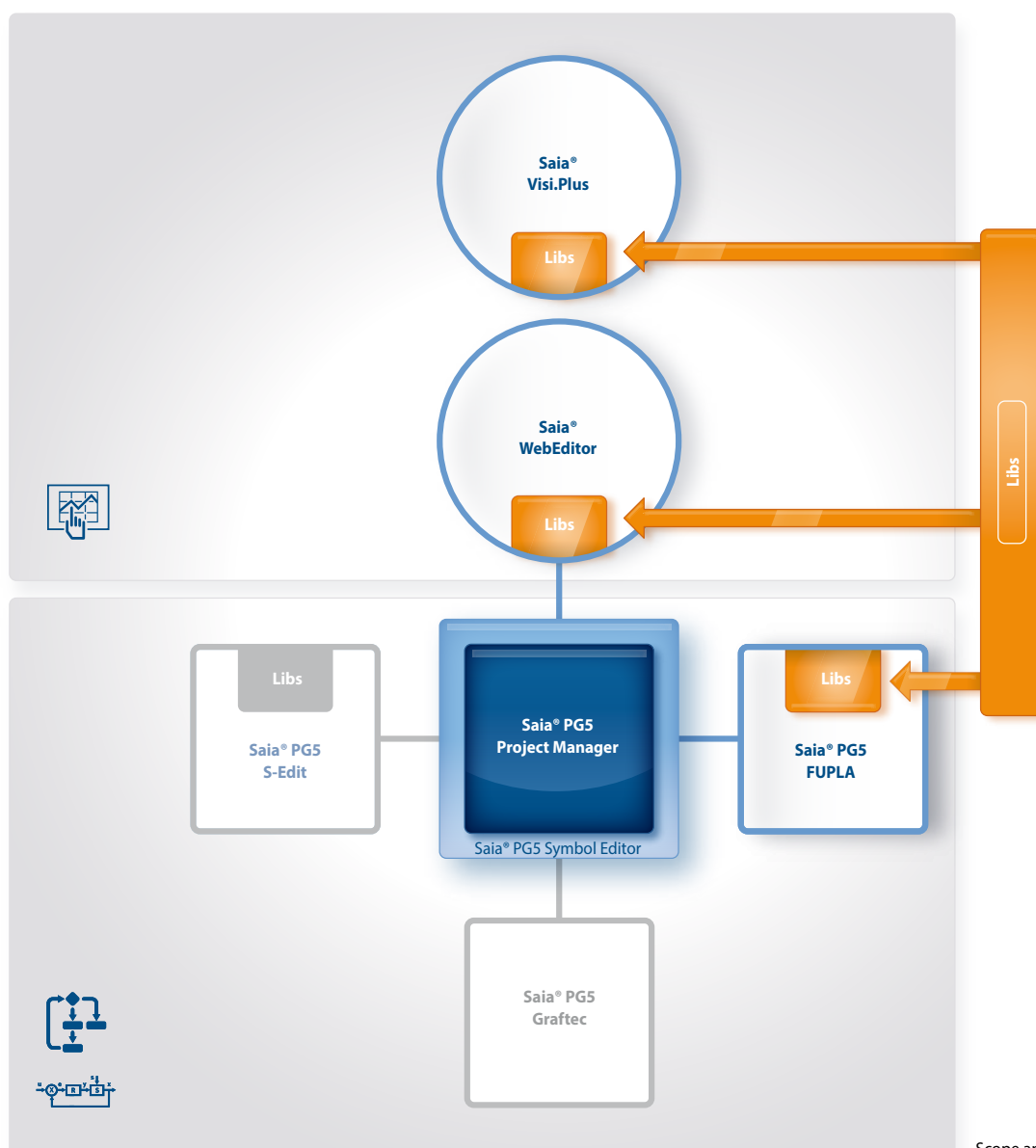
Scope and content of the Saia® PG5 packages

Order information| Saia® PG5 Controls Suite

Saia® PG5 programming tool

PG5 – Demo version with all functions. Runtime limited to 90 days	PG5 – Demo
Saia® PG5 Core Package[1] Programming software with editors (IL, FUPLA, Graftec), network configurators, standard libraries (Analog, Communication, Arithmetic & Logic), application libraries (Alarming, Blinds-Lighting, E-Mail, Trending [HDLog], Energy Meter, DALI, Modbus, EIB, EnOcean, JCI N2-Bus), WebEditor and FBox Builder (basic version)	PG5 – Core Package
Saia® PG5 HVAC Package[1] Same as Saia® PG5 Core Package and associated libraries (HVAC, Belimo MP-Bus, LonWorks, Room controllers and Modem), BACnet	PG5 – HVAC Package
Saia® PG5 Extended Package[1] Same as Saia® PG5 HVAC Package and associated DDC Suite library	PG5 – Extended Package
Software upgrade Upgrade – according to customer's key	PG5 – Upgrade
End customer license for Saia® PG5 End customer license for PG5. The customer is supported by the requisitioner (according to customer's key)	PG5 – End-User License

Saia® PG5 options – Add-on libraries

PG5 – Modem Library Modem base library incl. Data Buffer, DTMF, Pager & SMS libraries	PG5 – Modem
PG5 – HVAC Library HVAC Library for building automation	PG5 – HVAC
PG5 – DDC Suite Library DDC Suite Library for building automation (available in German/English/French)	PG5 – DDC Suite
PG5 – Belimo MP-Bus Library Library for Belimo MP-Bus	PG5 – MP-Bus
PG5 – Room Controller[1] Library for room control units	PG5 – Room Controller
PG5 – Lon[1] Library for LonWorks®	PG5 – Lon

Saia® PG5 options – Add-on tools

PG5 – WebEditor Software package for Saia® WebEditor as a stand-alone tool	PG5 – WebEditor
PG5 – FBox Builder ("advanced version") Software package for Saia® FBox Builder. IL knowledge needed and 1 day's training included	PG5 – FBox Builder

[1] Available from April 1, 2013