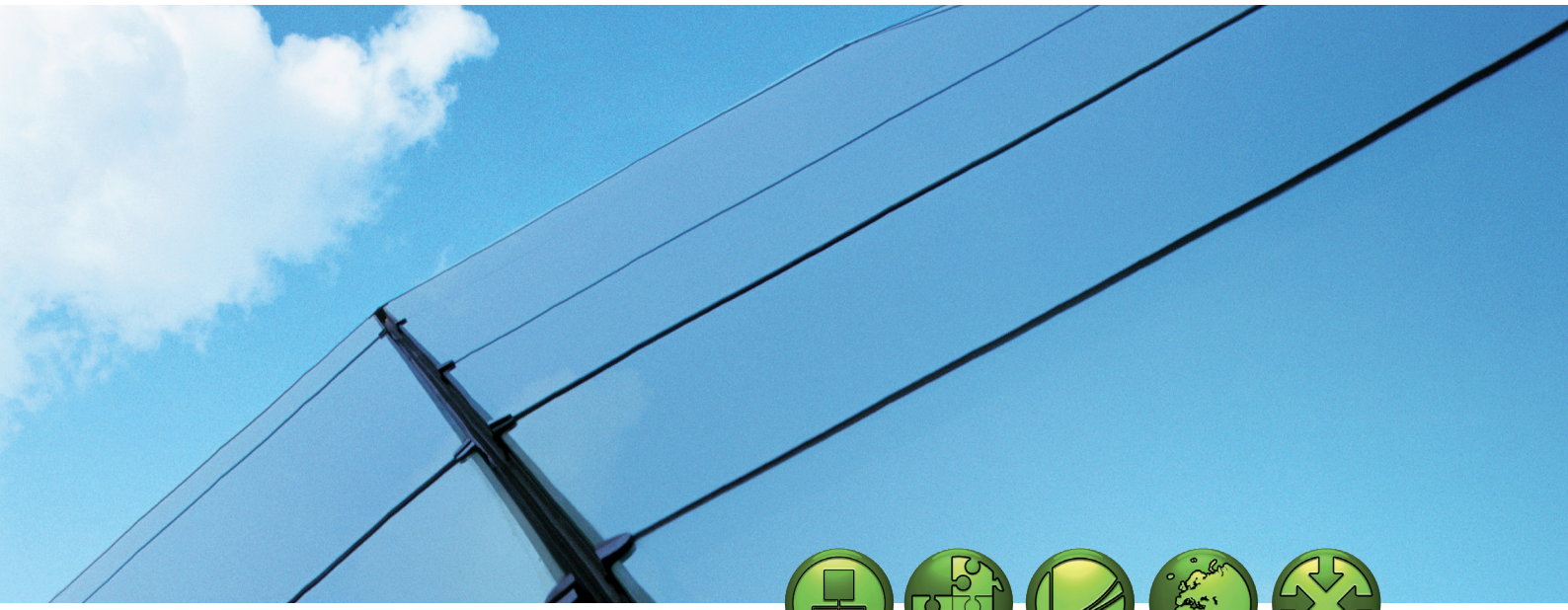

EXO System 2008

MANUAL

REGIN

THE CHALLENGER IN BUILDING AUTOMATION

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Contents at a Glance

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Part I Introduction

Chapter 1 What is EXO?

Control systems

EXO is the brand name for Regin's system products for building automation. EXO supplies powerful controllers for control and automation. It also supplies software for superior systems. All controllers from Regin can be used stand-alone, some of them can also be integrated into large communication systems together with other EXO products.

Distributed

EXO is based on distributed processor power. Advanced control systems are run locally on the controllers where alarms, data, event logging, time control, etc. are managed. All important data is also stored locally on the controller before they perhaps are transferred to the superior system. This provides a very high operation reliability. The control process is not affected by an error in the main computer or by a broken communication line. Not even the logging of historic data is affected.

Communication

The distributed system design guarantees a low load on the communication network.

The controllers and the superior system communicate via, e.g. TCP/IP network or cable (EXOline, LON, etc.). EXOflex and EXOcompact can also communicate via radio and telephony. Existing communication infrastructure can often be used.

Compatibility

In order to achieve the greatest flexibility, the EXO system is based on modular design. All our products, from software for superior systems to sensors, are universal building blocks that can be combined into automation systems of very different properties.

Openness

The EXO openness facilitates the use of big parts of the existing plant together with EXO products. Third party communication paths, sensors, software for superior systems, etc. can easily be integrated.

Chapter 2 Functions

Control and Automation

Control and monitor Regin's controllers for control and automation provide high operation reliability, and are characterized by a great openness to the surrounding environment. They are used, e.g. to control and monitor heating, cooling and ventilation in buildings.

Freely programmable Some controllers are freely programmable while others are programmed with complete programs for a given field of application.

Monitoring

Superior system The automation system is monitored via a local display and/or a superior system. We offer the superior systems EXO4. EXO4 Web Server can be used for Internet connection to EXO4 and EXOopc Driver can be used for connection to other manufacturer's superior systems. Dynamic values are displayed, setpoints and parameters can be changed, and alarms can be displayed or managed.

Logged values Logged historic values are gathered on the controller and are uploaded to the superior system for database storage. Historic values can be displayed and printed in EXO4 or EXOreport.

Communication

Media types Most media types for communication are supported, e.g. computer networks, radio, telephony, GSM, cable and satellite. These communication paths can be used for communication between controllers as well as between the controllers and the superior system. Some controllers can also send alarms as SMS messages to mobile phones, etc.

Protocol The controllers can communicate with the superior system with the EXO protocol EXOline or TCP/IP. In addition, field busses, like e.g. LON and Modbus, are supported.

Chapter 3 **Products**

Overview

This chapter gives only an overview of products that can be used in an EXO system. For more information about communication devices that can be used in EXO systems, please see the document ***Communication Devices***.

Hardware

Controllers

A controller is a process computer that is used for controlling processes within, e.g. building automation.

The controllers from Regin that can be built into EXO systems, can be classified into two main groups, pre-programmed and freely programmable.

Pre-programmed

Pre-programmed controllers from Regin:

- **Corrigo E**, which can be configured with E-Tool or display.
- **Regio Maxi** and **Regio Midi**, which can be configured with Regio Tool or display.

Regio Maxi is also freely programmable.

Free programmable

Freely programmable controllers from Regin:

- **EXOflex**
- **EXOcompact**
- **Regio Maxi** (which is pre-programmed on delivery).

Programming is made in the PC program EXOdesigner

EXOcompact

Usage

EXOcompact is primarily used in applications with a limited number of I/O points, but where the possibility to program the controller freely is important. EXOcompact is easily integrated with e.g. EXOflex and EXO4 in large automation systems.

Models

EXOcompact is available in different models with 8, 15 or 28 I/Os and with or without internal display. External displays are optional for models without internal display. There are also models with two communication ports. These are called EXOcompact Dual Port.

Communication

Communication can be made via RS485 (EXOline, Modbus) or modem (dial-up telephony or GSM). There are also models of EXOcompact with communication ports for TCP/IP or LON.

EXOflex

Usage

EXOflex has its primary range of application in systems with a large number of I/O points, and high demands on communication and expansion possibilities.

House

The EXOflex concept is based on a house holding different so-called PIFA units. Each EXOflex house may include 1-4 sections, i.e. 2-8 PIFA slots.

Flexibility This modular design of EXOflex offers great flexibility as well as the option of a large number of I/Os.

Communication EXOflex supports most communication protocols and field busses that are used in building automation, TCP/IP, EXOline, LON, Modbus, EIB, Mbus, etc. Communication media that can be used are e.g. computer networks, cable, GSM, telephony, radio and satellite.

EXOflex Open Web

Internet EXOflex Open Web is an EXOflex unit including a built-in web server and a web-based superior system, which makes it possible to control the controllers directly via Internet and a common web browser.

Usage The primary range of application for EXOflex Open Web is in smaller systems, typically one or a few buildings. In larger systems, EXO4 Web Server is a better option when Internet connection is required.

Regio Maxi and Regio Midi

Pre-programmed Both Regio Maxi and Regio Midi are pre-programmed zone controllers for handling functions like temperature, humidity, change-over and occupancy.

Regio Tool The functions can be configured with the PC program Regio Tool or display. Regio Tool is not included in the installation of EXOdesigner and it works on Windows Vista.

Freely programmable Regio Maxi (but not Regio Midi) is also entirely freely programmable. Desired functions are programmed in EXOdesigner in this case.

Models Regio Maxi and Midi are available in different models intended for functions of different kinds, with various sets of I/O points, with or without display, etc.

Communication Regio Maxi and Midi can be used stand-alone or integrated in an EXO system. They can communicate via EXOline or Modbus in integrated systems. Connection can also be made to TCP/IP Gateway EX8282.

Corrigo E

Pre-programmed Corrigo E is delivered with pre-installed software for different applications (heating or ventilation).

E-Tool Configuration is made with the PC program E-Tool or display. E-Tool must be installed separately, and it does not work on Windows Vista.

Models Corrigo E is available in different models with various sets of I/O points and with or without display. External displays are optional for models without internal display.

Communication Corrigo E can be used stand-alone or integrated in an EXO system. Communication can be made via EXOline, TCP/IP, Modbus or LON.

Sensors and Actuators

Installation level Regin offers a complete range of products on installation level that covers the most common tasks in building automation. The EXO system also manages sensors, actuators, etc. from all the mayor suppliers on the market.

Computers

Computers

Ordinary Windows computers that are available on the market can be used.

System requirements

The EXO system PC programs typically require:

- A PC running one of the following Microsoft Windows:
  - Windows 2000 Server SP4
  - Windows XP Professional SP2 or x64 SP1
  - Windows Server 2003 Server SP1 or R2, all editions
  - Windows Vista, all editions
  - Windows XP Home SP2 works for EXO4 Client. (A small number of advanced functions are not supported).

  We strongly recommend Windows XP Professional since it handles external products best.

  Terminal Services, Services, and VMWare are not supported.

  It is important to log off a session of EXO4 or EXOdesigner since only one user can run these on a computer at a time. This means that if one user has logged in and runs e.g. EXOdesigner, this session will continue to run if another user logs in, which could be the case if Windows goes to stand-by mode or the second user logs in with the command Switch User. The second user can not run EXOdesigner in this case.

  If another database than MSDE 2000 is used, you might not be able to use any Web edition of Windows 2003 Server.
- A Pentium III processor, or higher. As a rule, the main computer should have 150 MHz per EXOline communication path (modem, serial port, TCP/IP station, etc.). Work computers typically have no performance issues.
- 128–512 MB RAM depending on the size of the project. 1 GB is required for Windows Vista.
- 20 GB hard disk will be sufficient unless you are running very large SQL Server projects. A more detailed formula for estimating database sizes can be found in the document ***EXO4 Advanced Configuration***.
- A USB port for EXOkey hardware keys (only for EXO4).
- EXO4 requires a screen resolution of at least 1024x768, True Color (24 or 32 bits). This is recommended even for EXOdesigner, although it only requires a screen resolution of 800x600, 32768 colors.

Multi-processor systems or systems with HT processors are supported but will bring neither advantages nor disadvantages.

Serial ports

The EXO programs are designed to work with all types of serial ports, supported by Windows. The standard serial ports **`COM1:`** and **`COM2:`** based on the circuit NS16550 will provide the best performance. Unfortunately, not all modern PCs have a built-in serial port, if so, as this is a critical issue, you might consider changing supplier.

Number of serial ports

The number of serial ports required on the PC is determined by the following:

- One serial port is required for serial communication paths, i.e. for communication with stations that are permanently connected by cable.
- One serial port is required for each modem that is used for communication with the stations of the project.
- One serial port is required for each modem used in a dial-up network if it is connecting from a service computer.
- One serial port on the main computer is required for Nimbus Alarm Server, if alarms are to be sent to mobile phones as SMS messages.

Groups of serial ports

Comtrol RocketPort and **Digi Accelleport** are two intelligent serial ports with high quality drivers for Windows. These are add-on cards with 8 or more serial ports that work excellently with EXO.

Comtrol and Digi also provide products where the serial ports are positioned in a separate unit connected to the PC via TCP/IP-Ethernet. If there is an existing network connection between buildings, using these products you may not need to install a long cable.

Comtrol (**www.comtrol.com**) are represented in Sweden by, among others, Antonica AB (**www.antonica.se**). Digi (**www.digi.com**) is represented in Sweden by Scribona (**www.partner.scribona.se**). The products are also sold in general by e.g. Dustin.

Up to 4 serial ports

If up to 4 serial ports are needed, an ordinary PCI card that uses only one interrupt, will be sufficient.

Hardware Key for EXO4 2008 (EXOkey version 7)

New series

There is a new series of hardware keys for EXO4 2008: EXOkey XS7, S7, M7, L7, XL7 and XXL7. The new keys will only be obtainable as USB or PC Card (not for parallel ports).

I/O points

These keys give the right to a number of so-called **I/O points** (instead of a number of controllers as the old keys). I/O points are the physical inputs and outputs of the controllers for which the computer is the main computer. It does not matter how many inputs and outputs are actually used or how many other variables on the controllers are used. All Regio controllers will count as 3 I/O points each for EXOkey, no matter the number of physical I/O points of the controllers.

Work computers

There is no particular hardware key for work computers. All the keys give full main computer functionality. Still, EXOkey XS is appropriate for work computers, since these can communicate with all the controllers via the main computer. EXOkey XXL offers another possibility. With this key on the main computer, the work computers do not need hardware keys.

No hardware key

EXO4 can also be run without any hardware keys at all, with a very small number of I/O points, but without network support. This can be used in extremely small projects with a few controllers and one computer.

Summary

A summary is presented in the table below:

Harware key	Number of I/O points	Network	Main computer (collection of alarms, events, logs, etc)
No	≤ 75	No*	Yes
EXOkey XS	≤ 300	Yes	Yes
EXOkey S	≤ 500	Yes	Yes
EXOkey M	≤ 1 000	Yes	Yes
EXOkey L	≤ 3 000	Yes	Yes
EXOkey XL	Unlimited	Yes	Yes
EXOkey XXL	Unlimited	Yes *	Yes

*) If EXOkey XXL is used on the main computer, the work computers can communicate with the main computer without any hardware keys.

Network Equipment

Adapted for networks The EXO system is completely adapted for networks and works in most standard networks. More information about network communication can be found in ***EXOdesigner's Help*** (in the topic *Communication – Networks*).

Computers The computers can be permanently connected to the network or connected via a dial-up connection. The main computer must either have a fixed IP address or be on the same subnet as the work computers.

Controllers TCP/IP connected controllers must have a TCP/IP port, which means that a communication PIFA with a TCP/IP port is required for EXOflex. For EXOcompact it is necessary to use a model that includes a TCP/IP port.

E-mail To send E-mails with Nimbus Alarm Server, an Internet connection and an E-mail Server are required.

TCP/IP Gateway EX8282

Gateway EX8282 is used as a gateway between EXOline RS485 and a TCP/IP network.

Use Two examples where TCP/IP Gateway EX8282 can be used:

- EXOflex, EXOcompact, Corrigo E and old installed EXO controllers can all be connected to EX8282 to make it possible to communicate via a TCP/IP network.
- EX8282 is useful to connect Regio Maxi and/or Regio Midi to a TCP/IP network.

Example Example: In a hotel, there are 10 levels with 25 rooms at each floor. Each room has one Regio Maxi or Midi. On each floor, one EX8282 is installed and connected to the Regio controllers with RS485. TCP/IP is used as a backbone between the floors to the PC with the superior system.

Modems

Telephone Modems

Models The following modem models can be used for communication to and from controllers:

- **X 9011** is for internal mounting and is quite sufficient for most applications. It fits EXOflex, and stands very well against lightning disturbances on the telephone line. It can communicate at 2 400 bps (max). If you require a higher communication speed or communication over GSM, other modems will have to be used. See the following section.
- **Westermo TD-32B/RS485** can be used with EXOcompact.
- **Westermo TD-35/RS232** can be used with EXOflex. This modem can also be used with the computer, and then also for communication with GSM modems.

Speed Modems from Westermo can be used for communication at 2400 bps or faster, e.g. 9600 bps.

Purchase Westermo modems can be purchased correctly configured for EXO systems from Regin.

Modems for Use between Computers and for Nimbus Alarm Server

Separate modems In order to connect a service computer to the main computer via the telephone network, separate modems are needed. In these cases, "ordinary" modems (v.90 or v.92) can be a better choice than industrial modems from Westermo.

Nimbus

For some Nimbus services a modem is needed, e.g. when sending alarm information as SMS messages to mobile phones. Other Nimbus services such as sending alarm information by E-mail do not require a modem.

If a modem is needed, it can not be the same modem that is being used to connect to the controllers or between computers. Regin offers the modem GSMAlarm for this purpose.

To send E-mails with Nimbus Alarm Server, an Internet connection and an E-mail Server are required. Please refer to the document M2186, Nimbus Alarm Server.

GSM Modems

Regin

Regin offers the following GSM modems:

- GSMGDW11 for EXOflex.
- GSMCorr/EXOcom for Corrigo E and EXOcompact.
- GSMEXOflex for EXOflex.
- GSMAlarm to be used with Nimbus Alarm Server.

GSM subscription

The GSM modem uses the same type of so-called SIM cards as ordinary mobile phones to link it to a certain GSM subscription.

SIM cards

SIM cards can be configured to require a “password” in order to be used, a so-called PIN code. At present, this function is not supported.

Permanently Connected Modems

Leased lines

For communication over so-called leased lines, permanently connected modems are needed. In most cases multi-drop is required, i.e. one master and several slaves connected on the same line. This requires a communication speed of 1 200 bps is needed.

The **Westermo TD-23** modem can be used. Please refer to: **http://www.westermo.se/** for more information.

Modems for Optic Fibre Cable

RiTex

Regin has tried two modems from RiTex for **point-to-point communication** via optic fibre cable:

- **RiTex D-1F** is designed for serial ports with the interface RS232.
- **RiTex D5-F** is designed for serial ports with the interface RS485 or RS422.

Both types can be used with EXO controllers. Data transfers can be sent up to 30 km using a suitable fibre cable type. For cable choice and technical information, please contact RiTex Elektronik AB, **http://www.ritex.se/**.

Ethernet

The optic fibre cable can also be used as part of an Ethernet network.

Radio Modems

Satel

For radio communication, you can use radio modems from Satel, a company with several different models in their product range. We recommend a **Sateline-3AS** with the transfer speed 2400, 4800 or 9600 bps. This modem can be adapted to connect to RS232 or RS485.

More information is available on: **http://www.pro4wireless.com/produkter/modem/**.

Repeater

REPEAT485

To be able to connect more controllers or to be able to use a longer cable in EXO projects, the repeater REPEAT485 is suitable.

Communication Converter

RS232 to RS485 To convert from RS232 (in the serial port of a computer) to RS485 for communication with EXO controllers, Regin offers **CONV232-485**.

hlEXOline **X1171A** is used to convert from EXOline to hlEXOline. hlEXOline can be used to handle longer distances, or if unshielded cables are used.

USB to RS485 To convert the PC's USB port, from USB to RS485, for communication with EXO controllers, we recommend the E-Cable-USB that is sold by Regin. Maximum cable length is three meters.

USB to RS232 To convert the PC's USB port, from USB to RS232, the USB 2.0 Cable from Z-TEK can be used. For more information, please see: **http://www.z-tek.com.cn**.

Software

PC Products

GUI EXO offers a Windows standard Graphical User Interface (GUI) for configuration and programming of application programs.

PC programs The EXO system comprises, among others, the following PC products:

- **EXOdesigner:** EXOdesigner is the EXO configuration environment.
- **EXO4:** EXO4 is a Regin program for superior systems. It is used, among other things, to display windows for controlling and monitoring on work computers and for gathering and storing analog values in a database on the main computer.
- **EXOreport:** EXOreport is an add-on program for EXO4 intended for processing, displaying and printing reports and charts on runtime and measured values. EXOreport also includes functions for designing reports with the option to decide the look and data content of the reports freely.
- **EXO4 Web Server:** EXO4 Web Server is an add-on program for EXO4 that provides access to the entire EXO system from a computer over the Internet using a standard web browser.
- **EXOopc Driver:** EXOopc Driver is a general driver for Regin's control system that enables the use of all software supporting the OPC standard together with all Regin hardware.

MSDE and SQL Server

Database types EXO4 manages the databases via a general interface from Microsoft called ADO. EXO4 is designed for use with the following database types: Access 2, Access 97, Access 2000, MSDE 1.0, MSDE 2000, SQL Server 7.0 and SQL Server 2000.

MSDE The database manager MSDE 2000 from Microsoft is automatically installed when installing EXO4.

SQL Server In large projects where many historical values are to be stored in the database, this may be insufficient. In those cases, you can use an SQL Server database from Microsoft. This database manager must be purchased separately.

MSDE

Normal database type MSDE is the normal database type for EXO4.

Limitation MSDE is a limited variant of SQL Server. It has no administration tool and its size limit is 2 GB per database.

Database size It is important to be able to calculate the size of the databases in a project, so that you can judge the required size of the hard disk, and to be able to determine if MSDE, with its 2 GB limitation, can be used.

75-150 bytes MSDE and SQL Server use approximately 75-150 bytes per value on the hard disk, but for alarms and digital events, this depends on the length of the texts, etc. The amount of values that will be present in the database at any one time can be calculated by studying the configuration as concerns the number of signals, the log size in the tool Logging, and the purging for analog signals in the tool EXO4 Action Categories. It is also important that purging and defragmentation are performed regularly to prevent the database from growing indefinitely. See the chapter ***Database Maintenance***.

Administration EXO4 handles all the administration such as MSDE configuration, backups, defragmentation, etc. Some tasks, e.g. creating the databases, can be done manually using the tool Databases.

SQL Server

License SQL Server is a very advanced database manager from Microsoft. A license will have to be purchased prior to any installation. EXO4 can use SQL Server 7.0 and SQL Server 2000.

Clients SQL Server is available in different variants that mainly differ in the number of clients being managed. The smallest variant (5 clients) is sufficient for EXO4, as EXO4 never has more than one client connection to SQL Server, even if there are many EXO4 computers in the project.

Management in EXO4 EXO4 can manage SQL Server databases in two different ways, either **automatically** or **manually**.

It is not possible to use SQL Server (of any version) for EXO4 on computers with Windows Vista. It works only with MSDE 2000, which is installed automatically with EXO4.

Automatic Management

Managed as MSDE The automatic management of an SQL Server database is practical to use in projects where you want to install SQL Server directly on an EXO4 main computer to avoid having to configure all the settings in SQL Server. The EXO4 database will then be managed in the same way as an MSDE database.

Local hard disk An automatically managed SQL Server database must reside on the local hard disk of the computer that reads and writes to it.

Manual Management

Advanced The manual management of an SQL Server database is intended for advanced applications, i.e. when SQL Server is installed on a separate computer, and when full control of security and maintenance is required. It is appropriate to use manual management for clients with an existing IT department that has previous knowledge of SQL Server.

Not described Manual management of SQL Server databases is described in the document ***EXO4 Advanced Configuration***.

Nimbus Alarm Server

Alarms Nimbus Alarm Server is, among other things, used to send alarms from an EXO4 main computer to e.g. a mobile phone using Short Message Service (SMS). Alarm events are forwarded to the correct receiver depending of for instance date and time.

License Nimbus Alarm Server is included on the EXO4-CD and is installed separately. It may be evaluated for 30 minutes without a license, which thereafter can be purchased from Regin.

Windows Vista The new revision of Nimbus Alarm Server that is included on the EXO4 2008 CD works on Windows Vista.

Chapter 4 Installation

System Requirements

Please see the chapter ***Products*** for system requirements.

Installation

Installation order

In general, the following order of installation should be applied.

1. Install any RAID drives and any other special equipment and make sure you have a functioning Windows environment. Run Windows Update and install all updates, but not necessarily new functions, such as the Windows Media Player.
2. Connect the computer to the company network (if there is one), and let the network administrator add the computer to the domain or equivalent.
3. Install the EXO software. Restart Windows when prompted to do so.
4. Connect the hardware, E-cable, modem, EXOkey, etc. This can be done directly or later.

Description

Some of the steps are described below.

Installation of EXO Software

To install EXO software you need to log on as an **administrator** on the local computer.

You will also need administrator rights the first time you run EXO4 in runtime. Thereafter limited rights users will suffice.

To use EXOdesigner and to configure EXO4 you need to log on as either a **power user** or an **administrator**.

Windows Vista

Special considerations for Windows Vista can be found below in the section ***Windows Vista***.

EXOsys

EXOsys is a software common for several Regin products, such as EXOdesigner and EXO4. **EXOsys** is always installed first when you install for the first time. EXOsys is installed separately and has its own revision number. If e.g. EXOdesigner and EXO4 were purchased at different occasions, you could have two different versions of EXOsys. If this is the case, it is always recommended to use the latest revision.

If you already have installed a newer version of EXOsys than the CD version, you should not install the CD version on top of the existing version.

Automatic CD launch The CD automatically launches the Setup program, which will guide you through the installation, display the documentation, provide troubleshooting information, etc.

Install The software is installed by clicking on **Setup**.

Upgrade Older Versions

Install as above If you already has an older version of the software on your computer, you can install a newer version the same way as described above.

EXO4 Installation Types

Three types When installing EXO4 there are three different installation types:

- **Full installation** is intended for normal EXO4 servers and stand-alone EXO4 computers. The database manager MSDE from Microsoft will be installed.
- **Full installation except MSDE** results in a complete EXO4 installation, but without the database manager MSDE. This installation can be used for EXO4 computers without a database, or when you want to use a different database manager e.g. SQL Server.
- **Work Computer installation** is intended for computers that are going to be used as strict EXO4 client computers (work computers). No server or configuration functions will be installed and neither will the database manager MSDE.

MSDE When a **Full installation** (with MSDE) is selected during the installation of EXO4, the installation program will search the local hard disk for MSDE 1, SQL Server 7, MSDE 2000 (default instance or the instance EXO), and SQL Server 7 (default instance or the instance EXO). If any of these are found, the installation program continues without installing MSDE. MSDE is never upgraded automatically.

During the installation of MSDE 2000 the user password is set to **ReginEXO4**. This password should be changed to protect the EXO4 databases from unauthorized network access. This is done in a dialog that is opened with the menu command **Tools - Change MSDE Password** in the tool EXO4 Databases

Nimbus Alarm Server If Nimbus Alarm Server is required for e.g. sending alarms to mobile phones as SMS or E-mail messages, it will have to be installed separately. Nimbus Alarm Server is included on the CD, but if you want to use it for more than the allowed 30 minutes evaluation time, a license needs to be purchased from Regin.

SQL Server

SQL Server package The SQL Server package containing a database manager and administration tools, can be installed on the same computer as EXO4, or on any computer in the network. If the database is to be automatically handled, it must however be installed on the same computer as EXO4. On Windows computers not running server operating systems, the SQL Server Desktop Edition, which is included in the SQL Server package, must be installed.

Managing The Hardware (Plug & Play)

E-cable-USB, etc.

Installation CD When connecting an E-cable-USB for the first time, a found-new-hardware dialog is displayed on the screen. Insert the installation CD or floppy provided with the E-cable and install the driver.

Copy This only needs to be done once. Windows will thereafter find a copy of the driver on the hard disk.

Modems for Communication with Controllers and Nimbus

Disable At restart, Windows will detect the modems intended for the communication between the controllers and Nimbus Alarm Server and prompt for drivers. Neither EXO nor Nimbus uses the modem settings in Windows. Instead they use a separate configuration of the serial port from Windows point of view. It is therefore best to disable the modems.

Restart After disabling the modems, you will not be prompted again at restart.

Dial-up Modems for Dial-up Networks

Driver Modems that are to be used for communication between e.g. a main computer and a service computer in a dial-up network need the correct drivers. If Windows does not find the correct driver, you should use the floppy or CD provided with the modem.

EXOkey

Drivers Drivers for EXOkey are installed automatically at the installation of EXOsys. Please contact the Regin Support if EXOsys is installed but Windows cannot find an appropriate driver when EXOkey USB or EXOkey PC Card is connected for the first time.

Windows Vista

EXO 2008 EXOdesigner 2008 and EXO4 2008 work on Microsoft Windows Vista. They can also still be used on Windows 2000, Windows XP and Windows Server 2003.

Security plicies

Almost all changes in the EXO 2008 software regarding Windows Vista concern the new security policies in Windows. Because of this, the EXO software uses a different internal architecture when saving settings on the hard disk of Windows Vista computers. Theoretically this is only internal changes, but in many cases it may be necessary to understand the architecture.

Windows folder

Traditionally the EXO software saves a lot of settings in files in the Windows folder (typically **`C:\Windows\`**). This is however normally not allowed for Windows Vista. EXO 2008 still uses the old architecture on computers with Windows XP (and older). On computers with Windows Vista, EXO 2008 however uses a new architecture, where two different folders are used:

Folder (typically)	**Description**
`C:\ProgramData\Regin\`	Settings that should be common for all users, like: ❑ Installed revisions. ❑ Communication settings. ❑ MSDE settings. ❑ Crashed dump files. ❑ Etc...
`C:\Users\`*`User`***`\AppData\Local\Regin\`**	Settings that should be individual for each user, like: ❑ Sizes of tool windows. ❑ Visual settings. ❑ Tool options. ❑ Current project, current controller, etc. ❑ Etc...

Access rights

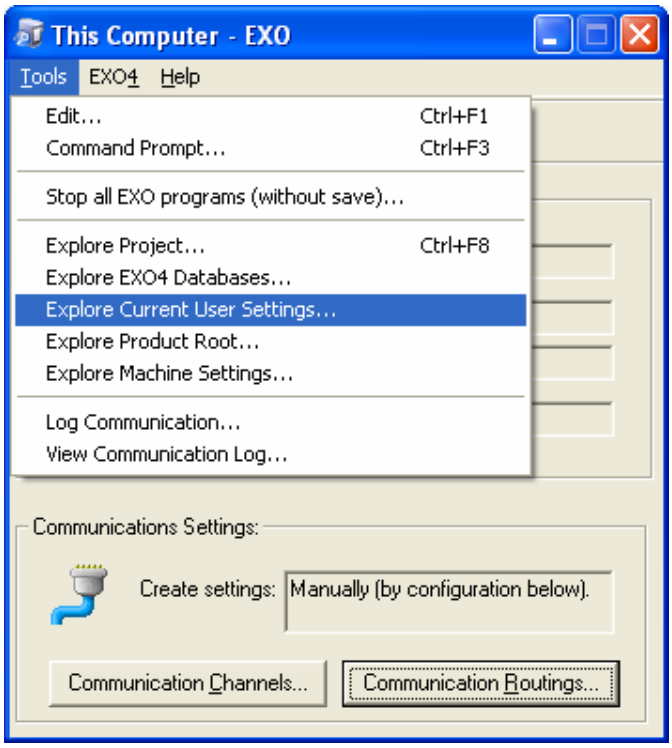
These folders are created automatically during setup (of EXOsys) and you are assigned suitable access rights to the files in these folders.

Setup

During setup, the *project root* folder (normally **`C:\EXO Projects\`**) and the *database root* folder (**`C:\EXO4Db`**) are also created as in previous versions of EXO. On Windows Vista computers, suitable access rights to the files in these folders are also assigned. The access rights to your hard disk are normally limited by Windows Vista. You can not place project folders anywhere on the hard disk (without changing your access rights).

This Computer

This Computer tool has a number of new commands to explore all these folders: **Explore current user settings**, **Explore Machine settings**, etc.



Users and security in Windows Vista

Local administrator

The EXO system on computers with Windows XP requires *Users* group privileges to run EXO4 runtime and *Power Users* privileges to configure EXO4 and controllers, i.e. run EXOdesigner. Most customers and integrators, however, choose to log in as a *local administrator*, and thus override all security features in the file system and elsewhere in Windows.

UAC

Windows Vista has a feature, *UAC* (*User Account Control*). It is active by default and it is not supposed to be turned off. When the UAC is active, even if the current user belongs to the *local administrators* group, most programs is run without administrator privileges. UAC recognizes some programs as requiring administrative privileges and then asks the user for permission to continue. This is done in a way that requires a physically present user to allow the program to continue.

Special folders

UAC also intervenes when any program (except installation programs) tries to write to files in some special folders, including the Windows folder. Such writes are intercepted and the changes are saved in copies of the files, individually for each user. Thus the system itself can not be compromised by such a write. Microsoft's intent is that old software should not notice the difference. Unfortunately, this was not the case for EXO software.

Turn off

UAC can be turned off by an *administrator* (after confirming his intentions with the special UAC message box). However, we have decided that such a solution would not be satisfactory.

Installing EXO software

Warning message

The EXO installation program is a program that UAC recognizes as requiring administrative privileges. However, since it is not a signed application, you will get the UAC warning messages and an *unrecognized publisher* warning. Please accept these warnings. Some further warnings are given during the installation process. Just accept these as well with OK.

Access rights

The EXO installation program changes the access rights to the *project root* and *database root* folders, to allow *Power Users* and `NETWORK_SERVICE` *Users* to write to these folders. Although Microsoft plays down the role of Power Users in Windows Vista, the group still remains and has the same role in EXO 2008 on Windows XP computers as it has in EXO 2005 and previous versions.

Access rights to some EXO folders after installation on computers with Windows Vista.

Folder with subfolders	Description	
Product root folder (typically **`C:\Program Files\EXO\`**)	*Users* `SYSTEM` *Administrators*	Read-only Read / Write Read / Write
Project root and *database root* folder (typically **`C:\EXO Projects\`** and **`C:\EXO4Db\`**)	*Users* `SYSTEM` *Administrators* *Power Users* NETWORK_SERVICE	Read-only Read / Write Read / Write Read / Write Read / Write

Regio Tool

Regio Tool is included in the installation of EXOdesigner and works on Windows Vista.

E-Tool

E-Tool is not included in the installation of EXOdesigner, and its separate installation does not work on Windows Vista.

Patching EXO software

Patches

We distribute patches in two ways:

- As packages with installation programs, in which case everything works as described above.

- As individual files with the same folder structure as in the *product root* folder, in which case you have to copy the files manually. Since this folder is controlled by UAC, you will get confirmation prompts when you try to overwrite the files with the upgrades.

Warnings

We do not recommend you to take any warnings lightly, but unfortunately the amount of UAC messages you get during patching means that the real ones are in risk of getting lost in the general noise.

MSDE and SQL Server

It is not possible to use SQL Server (of any version) for EXO4 on computers with Windows Vista. It works only with MSDE 2000, which is installed automatically with EXO4.

Some computers have SQL Express 2005 preinstalled. To use EXO4 on such computers, you have to uninstall SQL Express first.

Services

MSDE 1, MSDE 2000, SQL Server 7 and SQL Server 2000 all run as *services* under the built-in user account **`SYSTEM`**. SQL Server Express 2005 and SQL Server 2005 run under the user account **`NETWORK_SERVICE`**. It is in preparation for SQL Server 2005 that we add **`NETWORK_SERVICE`** to the access lists for the folders as above.

MSDE

Note that MSDE not only must have access to the database under the *database root* folder, but also to the folder where it stores backup files.

Moving projects and databases

Access

When you move a project or a database outside the *project root* or *the database root* folders, make sure the users have appropriate access to the folders and files.

E-Cable USB

Driver

You can use the old enclosed mini CD to install the driver for E-Cable USB on Windows Vista. Once installed, it will upgrade itself through Windows Update.

Advanced serial port devices

Drivers

There are device drivers available for the advanced serial port devices Comtrol RocketPort and DeviceMaster RTS. Make sure that you use the latest device drivers for these kinds of devices. You can download the device drivers from **`http://www.comtrol.com/`**.

Chapter 5 Basic Project Design

Project

Project

An EXO project is a plant consisting of a number of controllers that often are organized into stations, main computers, and a number of work computers. It all comes together in a communication system.

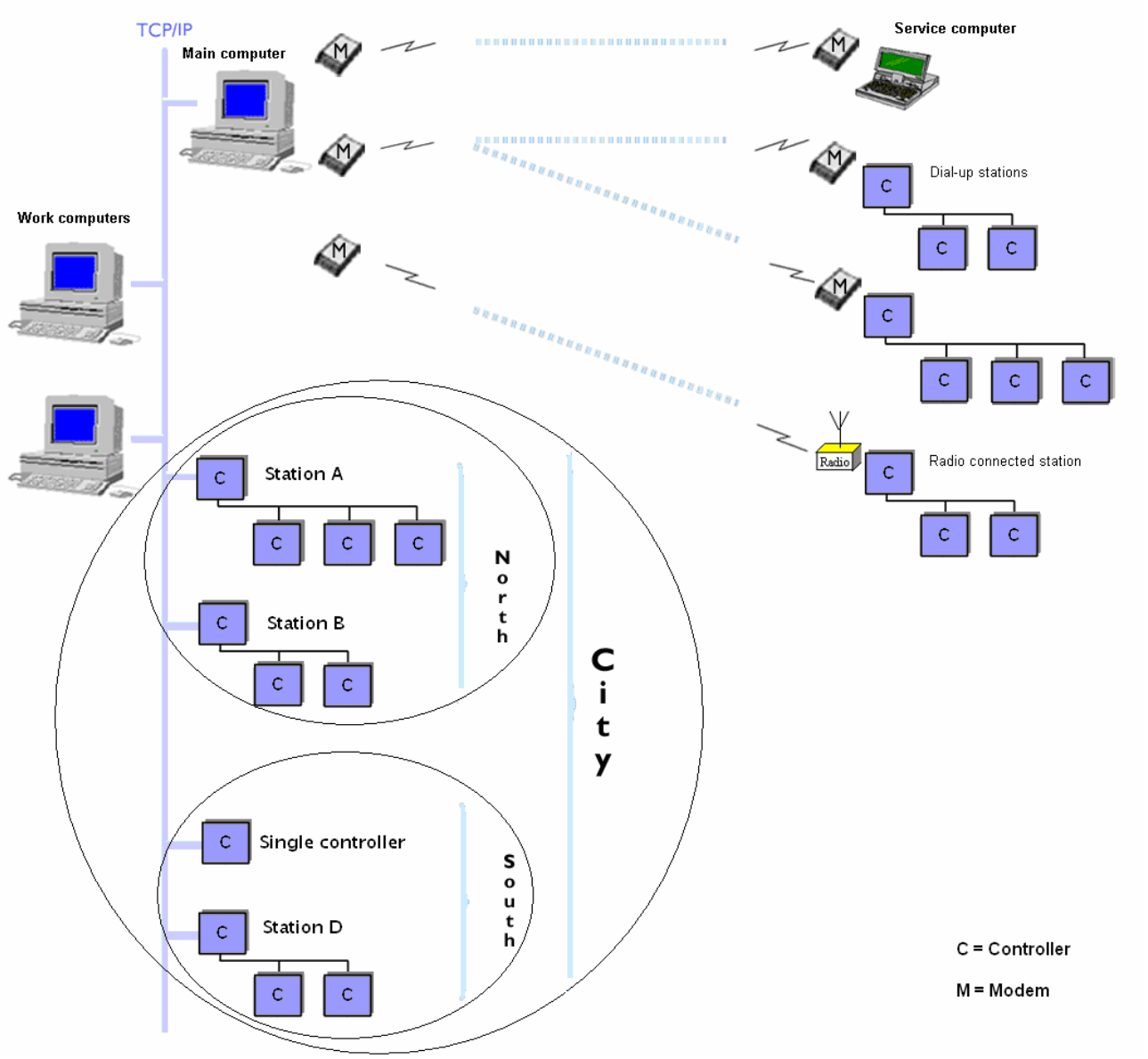
Folder

The entire project configuration is stored in a project folder with subfolders on the hard disk. This makes it easy to move a project from one PC to another without affecting other projects.

Hierarchical structure

Projects are organized in a hierarchical structure.

- The project is the top level and can contain areas, stations, controllers and computers.
- A project normally contains a main computer and a number of work computers that all have EXO4 installed.
- A controller has a number of I/O points and up to three communication ports. The controllers control processes, collect data and generate alarms on errors, etc.
- The controllers can be organized in stations. Normally, a station consists of several controllers in a master/slave system. The master controller is generally connected to a main computer via e.g. a fixed cable, a TCP/IP network, a dial-up modem or a radio modem.
- Areas can be used to e.g. group the project's stations and controllers into geographical areas. The image below displays the areas **South** and **North**. These areas are part of an even larger area, **City**.



Communication

Protocol

For the communication between controllers and between the main computer and the controllers, the protocol EXOline is normally used. EXOline may be used to read and write variable values, downloading programs to the controllers etc.

Media

A cable with an RS485 interface is normally used for the communication within a station, i.e. between the controllers in one EXOline line.

For the communication between the main computer and the controllers, several different media types may be used, e.g. cables with RS485 (or RS232), fixed TCP/IP networks, dial-up modems and radio modems.

A TCP/IP network is used for the communication between the main computer and the work computers. Service computers can also connect to the main computer using a dial-up modem (dial-up network).

Data Flow

Distributed

The EXO system is a distributed system, which means that control and automation programs are run locally on the controllers where alarms, data, event logging, time control, etc. are managed.

Real-time values

Real-time values are transferred to the superior system when required, for example, when the operator opens a process window. The operator can change the values of parameters, setpoints, etc., using either the superior system or the controller's display. All changes are immediately transferred to the controller.

Alarms

Each alarm can be configured for transfer at activation. If not, the alarm will be stored on the controller and transferred at synchronization, which occurs at least once every 24 hours.

The alarms are stored in a database on the superior system and can also be sent to mobile phones, using SMS via Nimbus Alarm Server. The operator can view the alarms in different report windows, and also acknowledge, block and unblock the alarms.

The alarms can also be displayed, acknowledged, blocked and unblocked on the display of the controller.

Historical data

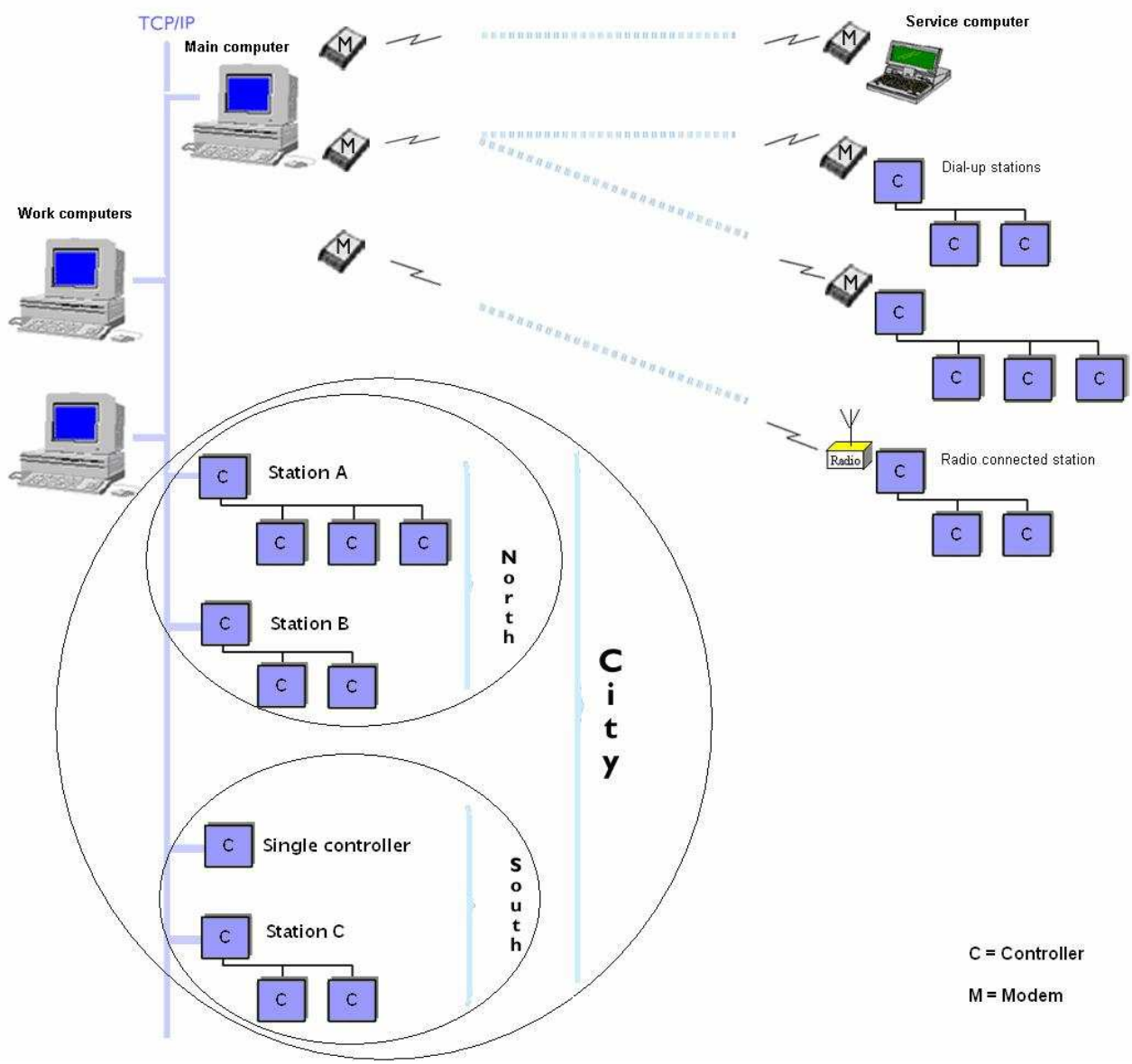
Logged data is stored on the controller and is normally transferred to the superior system at synchronization, once every 24 hours. The superior system stores the values in a database. The operator can view the values in charts and other types of reports.

Part II Planning and Designing Projects

Table of contents

Part II Planning and Designing Projects

Chapter 6 **Physical and Logical Design**



Physical Design

Controllers

Process connections Each controller has a number of I/O points. The controllers control processes, collect data and activate alarms on errors. The data is forwarded to the main computer and may then be displayed on the work computers.

Serial ports Each controller has up to three communication ports. On EXOflex and EXOcompact Dual Port, these are flexible and can operate in optional modes, e.g. as Master or Slave. It is also possible to configure the communication speed, parity, etc.

Real-time clock All EXO controllers have a real-time clock. The real-time clock is set during the setup of the controller and is continuously updated by EXO4. The real-time clock is managed by a hardware clock for accuracy (on all controllers except the Regio controllers).

Battery All EXO controllers have a battery that secures the configuration and runtime data in the event of a power failure. The battery will also ensure that the real-time clock is not affected by a power failure.

Ranges of controllers

Two types In Regin's range of controllers, there are controllers that are pre-programmed with certain functions and controllers that freely can be programmed to the desired functionality. Both ranges of controllers can be connected to an EXO system, i.e. they can be part of an EXO project.

Free programmable The following models of controllers are freely programmable:

- EXOflex
- EXOcompact
- Regio Maxi (which is pre-programmed on delivery).

Pre-programmed The following models of controllers are pre-programmed:

- Corrigo E
- Regio Midi
- Regio Maxi (which also is freely programmable).

EXOflex

PIFA units

The EXOflex concept is based on a house holding different so-called PIFA units. This provides maximum performance and flexibility as it enables the system designer to choose the communication and I/O equipment needed.

Houses

There are houses with slots for 2, 4, 6 or 8 PIFA units.

Various types

There are various types of PIFA units:

- **I/O PIFA** has a number of I/O points. These inputs and outputs are either analog or digital.
- **Power PIFA** supplies power to the internal parts and has a serial port (RS232 or RS485). The power PIFA is powered with 24 V DC.
- **Communication PIFA** is delivered with the following communication port alternatives:
  - One serial port (RS232 or RS485). The type is selected on the PIFA unit.
  - Two serial ports with the option to use either RS485 or RS232. The selection is performed on the PIFA unit.
  - One TCP /IP port for connecting the controller to a TCP/IP network.
  - One LON port. Several communication PIFA units of this type can be connected in an EXOflex house with one processor.
- External **display** with keypad. The unit is connected with a 200 meters cable or shorter.

Process connections

EXOflex inputs and outputs on I/O-PIFA units:

Analog inputs:	0(4)-20 mA, 0-10 V DC, 0-200 mV, 0-2000 Ω, PT1000, Pt100, DIN Ni1000, LGNi1000, 12 bit A/D
Analog outputs:	0-10 V DC, short circuit protected, 11 bit D/A
Digital inputs:	For potential free connector, 24 V DC, configurable for pulse input
Digital outputs:	24 V DC, 0.5 A, configurable for pulse output

Galvanic insulation

The external parts of the PIFA units are separated from the internal electronics by an isolation barrier that is bridged by an opto coupler. This optimizes the potential for handling complex electrical environments.

Consequently, the external parts of each PIFA unit needs an external power supply, which can be the very same that powers the entire EXOflex unit.

Battery backup

EXOflex provides the possibility of using an add-on card for battery charging and spare power (Option 9035) that can be connected to an external lead battery. In these cases one or more EXOflex units are continuously powered even in the event of a main power failure.

Positions (slots) of the EXOflex House

32 PIFA units

Each EXOflex processor unit with a main processor can handle 32 PIFA units at the most.

Unique address

Each PIFA unit must have a unique address in the range from 0 to 31.

Slots

A PIFA unit that is mounted in an EXOflex processor unit receives its address according to its position in the house. The slot at the top left has the address 1, the slot below has the address 2, and so on.

1	3	5	7
2	4	6	8

Display

An external display unit always has the PIFA address 0.

Default

In an EXOflex house, these PIFA addresses are default on delivery.

Expansion unit

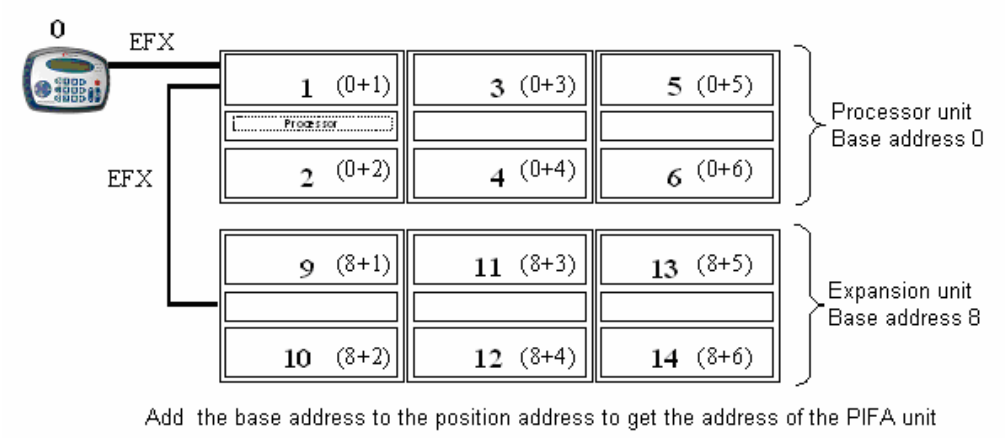
An expansion unit can be used exclusively to increase the number of I/O points. It has neither a main processor nor serial ports. The base address is set in an expansion unit by configuring jumpers on the Power PIFA unit.

PIFA unit address

The address of a PIFA in an expansion unit is generated by adding the base address to the PIFA unit's slot in the EXOflex house.

Example

Below is an example of addresses in a system with one processor unit and one expansion unit:



The Positioning of the PIFA Units

Rules

There are rules for which slots the various types of PIFA units can hold.

- The power PIFA must always be positioned in slot 1.
- Communication PIFA units with one or two serial ports are normally positioned in slot 2 and can never be positioned in an expansion unit.
- I/O PIFA units may be positioned in any slot except slot 1.

External display External display units are connected to the EFX channel of the main power PIFA. The connection should be made either in the front of the main power PIFA, or as a fixed connection using screw connectors. External displays cannot be connected to expansion units.

EXOcompact

Usage EXOcompact is primarily used in applications where the number of I/O points is limited. EXOcompact is easily integrated with e.g. EXOflex and EXO4 in large automation systems.

Models EXOcompact is available in different models with a varying number of I/O points, and with or without display. External displays (with 3 or 10 meter cables) are optional for models without internal display.

Communication EXOcompact is delivered with one of the following alternatives of communication ports:

- One RS485 port for serial communication.
- One TCP/IP port for TCP/IP network connection.
- One RS485 port and one LON port.
- Two RS485 ports (EXOcompact Dual Port).
- One RS485 port and one TCP/IP-port (EXOcompact Dual Port).

Power supply An EXOcompact is powered with 24 V AC, 6 VA.

Process connections EXOcompact inputs/outputs:

Analog inputs:	0-10 V, 0-200 mV, PT1000, DIN Ni1000 LGNi1000, 12 bit A/D
Analog outputs:	0-10 V, 5 mA, 8 bit D/A, short circuit protected
Digital inputs:	For potential free connector, 24 V DC, configurable for pulse input
Digital outputs:	Triac outputs 24 V AC, 0.5 A continuous, configurable for pulse output
24 V DC output:	0.1 A, short circuit protected

EXOcompact Dual Port

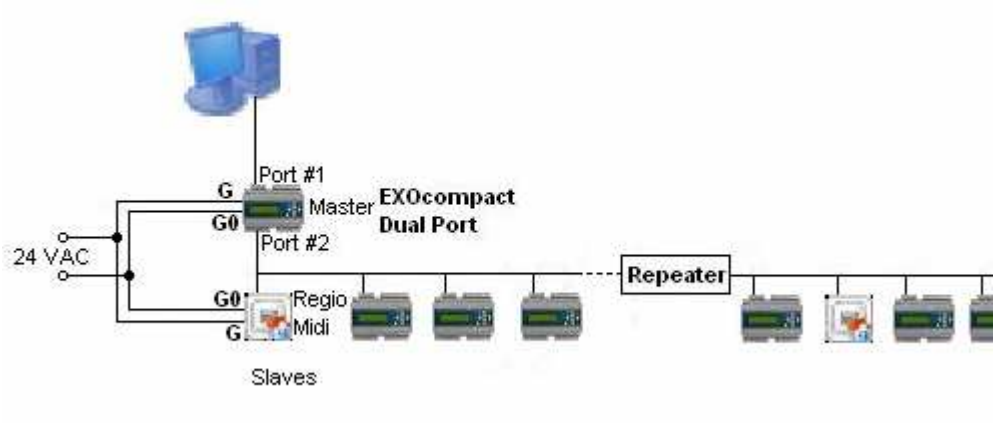
Two ports

EXOcompact Dual Port are EXOcompact models with two communications ports.

Port #2

The second port (Port #2) is a general-purpose port handled by EXOreal and can be used as master, slave or for binary communication. It can not handle dial-up modems. Only port #1 is able to handle dial-up modems.

Low Level EXOline



Un-isolated

EXOcompact Dual Port C152D and 128D have an un-isolated communication port (Port #2), Low Level EXOline. Except for the isolation, all other characteristics are compatible with EXOline, and the two types could be mixed in a network without any problem.

Demands

If you connect two controllers (master – slave) with un-isolated communication ports, please observe the following demands:

- When using the same power supply for two controllers connected with un-isolated communication ports, you must connect G0 to G0 and G to G. They must **not** be cross-connected! See an example with EXOcompact Dual Port and Regio Midi in the above figure.
- The longest communication cable length is 300 m between un-isolated master/slave ports.
- A maximum of 32 controllers is allowed.
- The communication cable must be well separated from power cables and other possible interfering (EMI) cables.
- A repeater with isolated power supply (e.g. REPEAT485 from Regin) is recommended to prolong the communication distance and number of controllers.

Project Builder

When you add an EXOcompact Dual Port in Project Builder you must use the correct model name (i.e. C152D, C152DT, C282D or C282DT). For EXOcompact controller models with only <u>one</u> communication port, the generic names EXOcompact 8, 15 and 28 respectively.

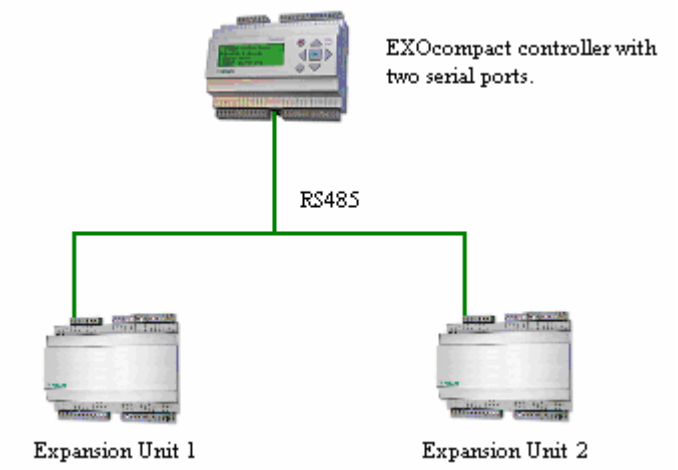
EXOcompact Expansion Units

Max 2

Any EXOcompact controllers can be used as expansion units, but normally C80, C150 or C280, is used because it is most economical. Max two expansion units can be handled.

Configuration

Expansion units are configured in the tool Inputs and Outputs, which is described in the chapter *Inputs and Outputs*.



Port #2 Expansion units are connected to serial port #2 of the EXOcompact controller with RS485 cables. Note that because port 2 is a non-isolated serial port, it is best to place the controller and its expansion units relatively close to each other.

Connect You can connect expansion units to *single* and *station slave* controllers. You can however not connect expansion units to *station master* controllers (with *slaves*).

Properties The inputs and outputs on the expansion units have the same properties and can be used in the same way as if they were built-in into the controller.

Corrigo E

Pre-programmed Corrigo E is a series of comprehensive controllers that are pre-programmed with applications either for air handling (ventilation) or for heating system.

Models Corrigo E is available in different models with a varying number of I/O points, and with or without display. External displays (with 3 or 10 meter cables) are optional for models without internal display.

Corrigo E-tool Corrigo E-tool is a PC software that makes it possible to configure and supervise a facility via a graphical interface.

Communication A Corrigo E with a communication port is easily integrated with e.g. EXOflex and EXO4 in large automation systems. There are models of Corrigo E with one of the following communication ports:

- One RS485 port for serial communication (EXOline, LON or Modbus).
- One TCP/IP port for TCP/IP network connection.

Power supply A Corrigo E is powered with 24 V AC, 4 VA.

Process connections Corrigo E inputs/outputs:

Analog inputs:	PT1000 or 0-10 V
Analog outputs:	0-10 V DC, 1 mA, short circuit protected
Digital inputs:	For potential free connector
Digital outputs:	Triac outputs 24 V AC, 0.5 A (1 A peak)

Regio

Three series The Regio system has three series of controllers: Mini, Midi and Maxi. The controllers of the Midi and Maxi series support the EXOline protocol and can be handled by EXOdesigner, EXO4, etc., as other types of EXO controllers.

- Maxi controllers are based on EXOreal. The application program is written in EXOL, but the source code is not distributed. It has to be used exactly as it is, but you can upgrade the program with Regio Tool. Regio Maxi is freely programmable, which means that you can program it in exactly the same way as EXOflex and EXOcompact.
- Midi controllers are not based on EXOreal. The application program is built into the firmware and can not be upgraded. Midi controllers support a subset of the EXOline protocol, enough to be able to use EXOtest, EXO4, etc. Regio Midi is not freely programmable.

Midi controllers have an un-isolated RS485 port. This means that you must use shorter cable lengths, make sure to use isolated RS485 ports on the computer, not mix the power supply cables G & G0 between Midi controllers, etc. Please study the wiring examples in the manual **Regio in EXO 2008 Projects** carefully!

Functions The functions and the application programming interface of Maxi and Midi controllers are the same, but the Midi controllers only have a subset of the Maxi controllers' functions. For further information, please see the Regio documentation.

Mix controllers You can mix all controller models in a project: EXOflex, EXOcompact, Corrigo E, Regio Midi, and Regio Maxi.

EXOkey All Regio controllers count as 3 I/O points each for EXOkey, no matter the number of physical I/O points of the controllers.

Documentation The document Regio in EXO 2008 Projects describes how to use Regio controllers in EXO systems. It will be installed to your hard disk by EXOdesigner.

On Regin's homepage www.regin.se you can find manuals and other documentation that thoroughly describes all three types of Regio controllers.

Communication

Communication port The Midi and Maxi controllers have one communication port (RS485 or TCP/IP), and can be used in the same project topologies as any other controller with one communication port.

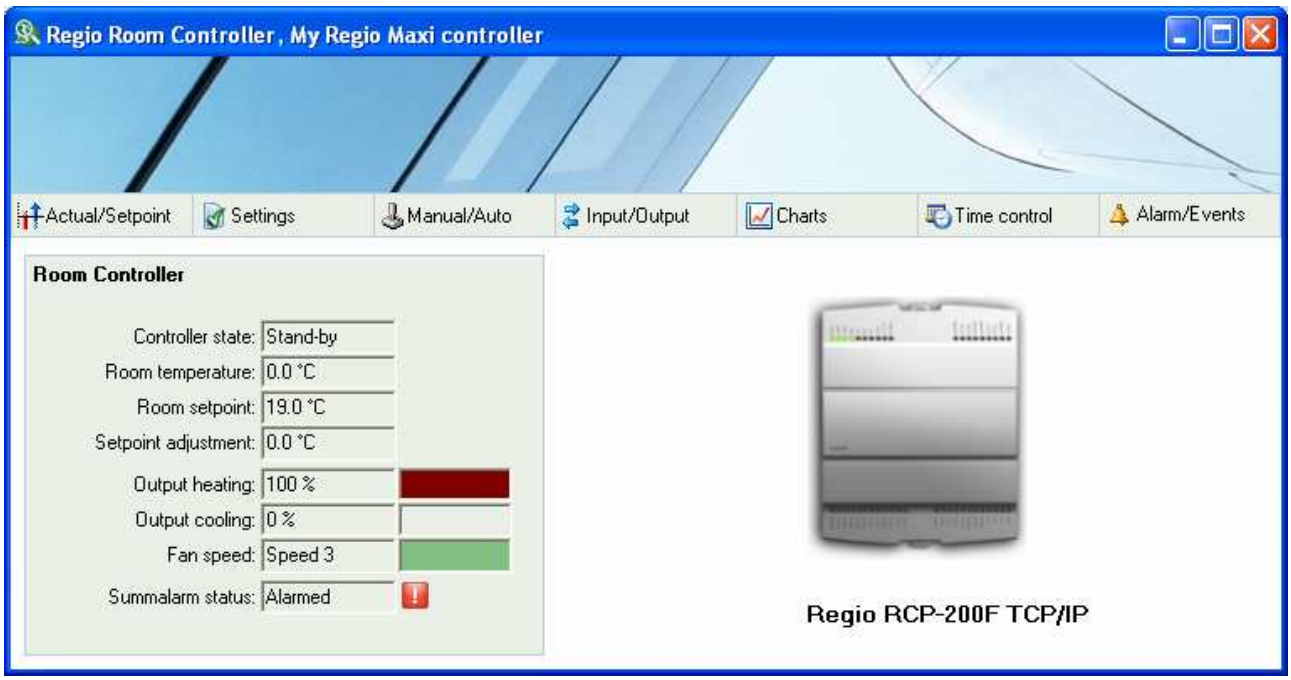
TCP/IP For Regio controllers it is often best to use TCP/IP Gateways. Regio controllers are often installed in buildings with existing TCP/IP networks, so by using gateways the serial cables can be shorter.

EXOline address Each Regio controller is delivered with a unique EXOline address, which is written on a label on the controller. The purpose of this is to eliminate the need of a software setup, before deploying the controller. This is however only possible to use for controllers connected directly to the main computer (as station master controllers without slaves).

EXO4

Regio controllers EXO4 is able to handle Regio controllers similar to other EXO controller models, with process windows, alarms & events, logging, etc.

Process windows EXO4 is delivered with complete ready-made EXO4 window classes for Regio controllers. These windows are designed similar to Regio Tool. The user can see all parameters, execute commands, change setpoints, etc. It is however <u>not</u> possible to configure the controller from the EXO4 windows. For configuration purposes, the user has to use Regio Tool that is included in EXOdesigner.



EXO4 window class The EXO4 window class is the same for all Regio controller models and configurations. It adapts itself at runtime to the actual controller model.

Design It is possible to design your own EXO4 windows, as you can do with other EXO controller models, but it is a lot of work.

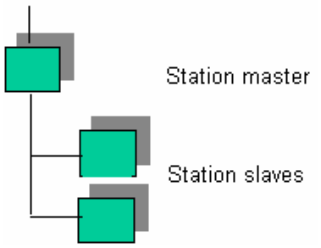
Alarms, logging, etc. The Maxi controllers have a number of pre-configured alarms, events and log points. These will be sent to EXO4 automatically and stored in the database. From the ready-made Regio window, the user can easily open the alarms, events and historical chart windows, showing the points from the current controller.

Group controlling It is possible to design your own group control functions. This is used to e.g. setting mode or changing setpoint in a number of controllers with one command from the EXO4 runtime. There are however <u>no</u> ready-made functions for this. You can accomplish it yourself with EXO4 signals, EXObasic programming, etc.

Stations

Structure

A station is a structure of controllers on one communication line. The top controller is the **station master**, the other controllers are **station slaves**.



Purpose

There can be several reasons for grouping the controllers into a station:

- The controllers in a station are physically close. Only **one** line is used from the computer to all controllers in the station, via cable, TCP/IP, modem or radio, and is managed by the station master.
- Controllers of the same functionality that communicate intensively with one another can form a station.
- All controllers in a station form a unit for the operator. The operator can view values and alarms from all the controllers in the station on the display of the station master.

Two ports

A station master must have at least two communication ports. One of the ports (the slave port) is connected for communication with the main computer of the project, and the other (the master port) is connected for communication with the station slaves.

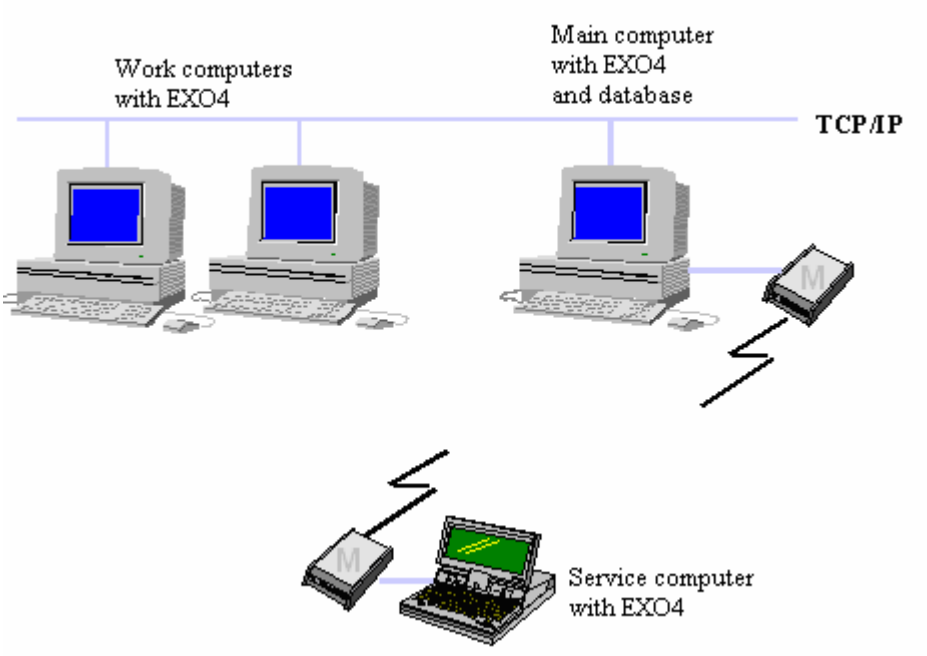
Single controller

If a plant only needs one controller in a certain place, it can be organized as a single controller. As such a controller requires only one port. Corrigo E, Regio Maxi and Regio Midi can operate as single controllers.

Computers

Network

A project generally consists of a TCP/IP network with one main computer and a number of work computers running EXO4. Service computers that connect via dial-up modems can also be added to the network.



System status All computers can be used to display the system status graphically to operators. In general, there is a window for each station and single controller, where you quickly and easily can get its status.

Communication The main computer manages the communication with all the controllers. Thus, the work computers communicate with the controllers via the main computer. The main computer can also transfer values between the various stations and single controllers via itself.

Database The main computer has, by default, an MSDE database for storing, e.g. alarms and logged values. An MSDE database has a storage limit of 2 GB. If this limit is insufficient, an SQL Server can be purchased separately. (Please see the document ***EXO4 Advanced Configuration***).

Installation Installation of EXO4, please see the chapter ***Installation***.

More information More information about computers in networks can be found in ***EXOdesigner's Help*** (in the topic *Communication – Networks – Computers in Networks*).

Logical Design

Areas

Geographical The controllers are grouped geographically in areas, which provide a better overview of the system.

Areas Both controllers and stations can be geographical areas independently. It is also possible to form a geographical structure of areas freely.

Structure The geographical areas structure the project and facilitate, e.g. report searching.

Signal Types

Signal types Signal types are a way to structure the signals of a project in order to assist the operator in his choice of selection for display in, e.g. reports.

Default In EXO4 there is, by default, various signal types, e.g. temperature, energy, power, runtime and pulse counting.

Chapter 7 Communication

EXOline Protocol

Protocol

A protocol defines a language and the rules for communication. The language consists of a number of commands that can be performed in one communication line, e.g. read/set variable values, query the controller's status, and download programs.

EXOline

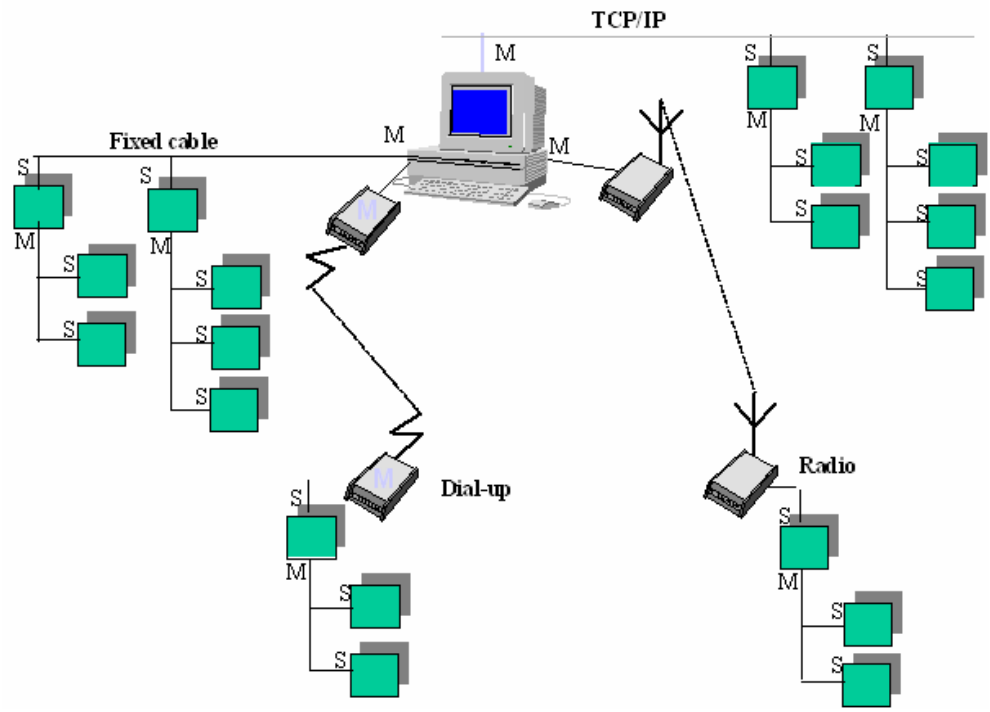
The protocol **EXOline** is the protocol most commonly used by EXO controllers. It contains commands for all normal communication tasks that can be performed on a controller.

Communication lines

The EXOline protocol requires no more than one master port and one or several slave ports on each communication line. Stations with multiple controllers constitute a communication line with one station master and a number of stations slaves. A separate communication line exists between the stations and their main computer, in which the main computer is master and the stations are slaves.

Routing functions

Units in various communication lines can communicate with each other through routing functions on the master controllers and on the main computer.



Master/Slave

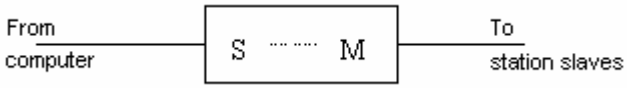
The master/slave communication is performed as such: A master performs a task in one of the subordinated slaves using a communication command. The command is performed in the slave controller, which will respond with an acknowledgement. The acknowledgement is received by the master and the communication is finished. If there is no response from the slave within a specified time, a few more attempts to reach the slave controller will be made. In the case the slave still does not respond, the communication is considered failed and the slave controller will be listed as unreachable.

Communication The master controller can communicate with all its slaves and transfer information between them. Consequently, it also has the possibility to transfer information between the slaves via itself.

Addressing Communication with a controller is only possible if it has an address. The address specifies the receiver of the communication command so that all other controllers on the same line may ignore the command.

PLA and ELA The addressing components used to address controllers are PLA and ELA. All controllers within one station have the same PLA, but different ELA. The master controller has the lowest ELA value and the slave controllers have the subsequent values in ascending order (single values may be skipped).

Routing Within a station compounded by more than one controller, the station master needs at least two serial ports for communication. One port will act as slave to the main computer of the station, while the other port is permanently fixed to the station slaves and acts as master. While all communication with EXOline protocol has to go from a master port to a slave port, a so-called **routing** between the ports on the master controller needs to be configured in order for the information to be transferred from the slave port to the master port. If the controller has three ports, routing can be connected from two slave ports to the same master port.



Filter Routing can also contain filters to allow only certain EXOline telegrams to be sent through the controller. The filter is defined with the lowest and the highest PLA address, and the lowest and the highest ELA addresses to be let through the routing of the master controller.

Expansion units EXOcompact expansion units should not be configured to route the communication to them. These units have always the addresses 241:1 and 241:2.

Communication Lines

Communication within a Station

Fixed cables A fixed cable with an RS485 interface is used for EXOline communication between controllers within a station.

Communication between a Main Computer and its Stations and Single Controllers

Media Different media types can be used for communication between a station and its main computer. Some examples follow below:

- Fixed cable with RS485 or RS232.
- Permanently connected TCP/IP network.
- Radio
- Dial-up modem, that dials-up and disconnects when required.

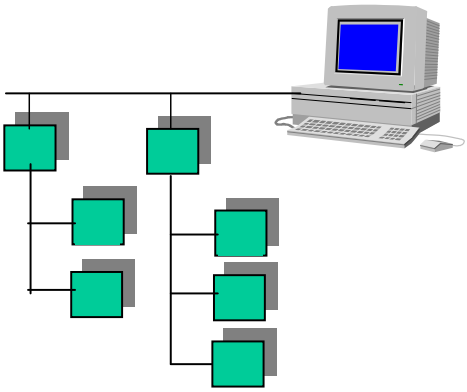
Communication between Computers

TCP/IP The communication between main computers and work computers takes place in a common TCP/IP network.

Service computers Service computers can also be used to connect to the network using common dial-up modems.

Communication Media

Fixed Cable



Fixed cables RS485 is the default interface for communication via fixed cables between controllers within stations as well as between a main computer and its stations and single controllers.

Distance A communication distance of 1 km can be reached without problems. Further considerations should be made for longer distances.

Multi-drop RS485 allows multi-drop, i.e. one master and several slaves connected on the same line. In order to be able to design communication networks as required, each serial port on a controller can be individually configured as master or slave.

Parallel connections The controllers are connected in parallel on the line. See also the below section ***Communication Connections***.

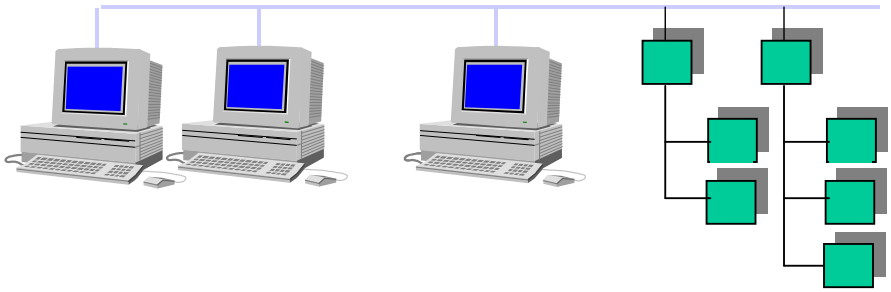
hlEXOline

Enhanced hlEXOline is an enhanced RS485 port on EXOflex units that is capable of providing more power to the line. As a result, extended communication distances (6-8 km at the most) may be achieved by using hlEXOline.

Jumper hlEXOline is configured by moving a jumper on the EXOflex main power PIFA (port 1) or the communication PIFA (port 2-3). EXOcompact and Regio controllers do not support hlEXOline.

Please note that it is not possible to mix hlEXOline and RS485 on the same communication line.

TCP/IP Network



Computer network TCP/IP is a technology used for designing computer networks. The technology itself is not bound to a specific media or transfer speed and is used to design, among other things, local networks, dial-up networks, radio networks and fibre networks, with very high transfer speeds.

Public IP address The main computer must have a public (white), fixed IP address or be located on the same subnet as its work computers.

A public IP address is the address that is registered as the company's connection to the Internet. Black IP addresses (the opposite of white IP addresses) are private addresses that are used internally in, for example, a company network.

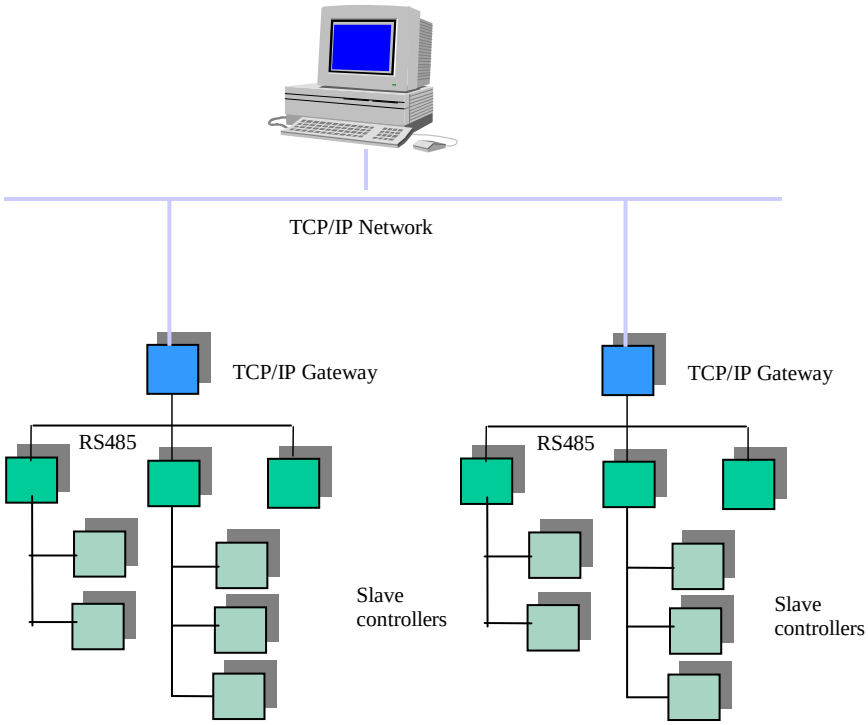
Performance Ethernet is one of the more common standards for local networks. Ethernet provides different speeds from 10 to 1000 Mbps. Modern switches can connect Ethernet segments with different speeds into a seamless local network without disturbances to individual equipments. See also the below section ***Communication – Dimensioning***.

Connection For connections, please see the below section ***Communication Connections***.

EXOflex A special TCP/IP PIFA (EP8282) is used to connect an EXOflex directly to a TCP/IP network.

EXOcompact Corrigo E There are specific models of EXOcompact and Corrigo E with a TCP/IP port.

TCP/IP Gateway All EXO controllers that have a communication port of the type RS485 (or RS232) can be connected to the TCP/IP Gateway EX8282. This is true also for Regio Maxi and Regio Midi.



Two ports EX8282 has two communication ports:

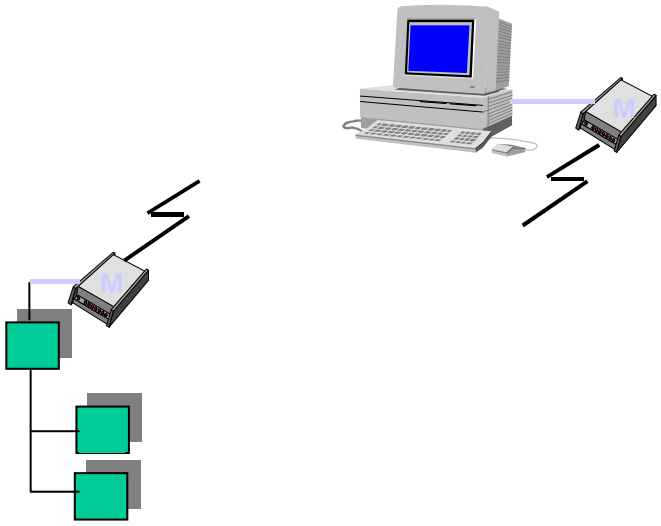
- ❑ A TCP/IP port that is intended to be connected to the main computer through a TCP/IP network.
- ❑ A serial port with an RS485 connector <u>and</u> an RS232 connector.

Connection You can make one of the following connections to the serial port:

- ❑ A number of controllers can be connected directly to the RS485 connector
- ❑ <u>One</u> controller (with station slaves if any) can be connected to the RS232 connector.

More information More information about TCP/IP networks can be found in ***EXOdesigner's Help*** (the topics *Communication – Communication Media—TCP/IP*, *Communication – Networks*, and *Communication – Connections*).

Dial-up Modem (EXOflex and EXOcompact)



Several dial-up modems A main computer that is connected to dial-up stations and/or single controllers can communicate with only one station/controller at the time for each modem in use. If there are multiple dial-up stations/controllers connected to the main computer it is not unusual to have several dial-up modems connected to it. In general, at least two dial-up modems are needed, one for outgoing calls and one for incoming calls. However, the number of dial-up modems must be determined by the number of connected dial-up stations and single controllers.

Dial-up group If there are many dial-up modems connected to the main computer, they can be organized into a group of equal parallel options.

EXOcompact EXOcompact requires a modem of the type **Westermo TD-32B/RS485,** connected to the RS485 port. It is also necessary to use EXOdesigner and EXO4 2005 or 2008 with directly connected modems.

EXOflex For EXOflex, modems are connected with RS232 to port #3. This port has to be positioned below the processor in the EXOflex house.

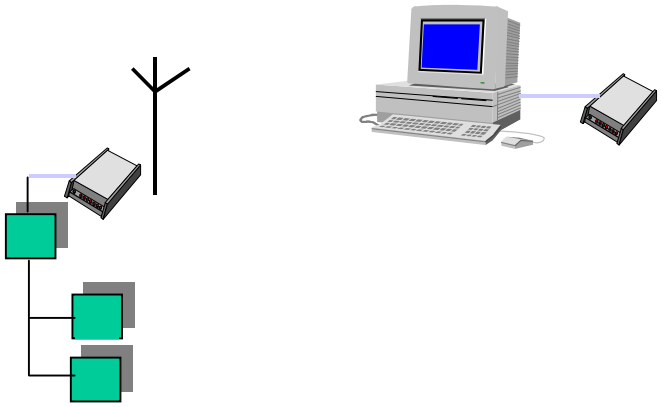
We recommend:

- **EXO 9010/9011**, which is an add-on modem from Regin. This modem communicates with a max speed of 2400 bps.
- **Westermo TD-35/RS232** can be used with EXO controllers for communication with 2400 bps. It can also be used for communication at higher speeds, e.g. 9600 bps.

Computer **Westermo TD-35** is used with the main computer. The communication speed must be the same as the speed of the controller's modems. This means that if you have controllers with modems of different communication speeds, you will need at least one modem for each speed connected to the computer.

More information More information about dial-up connections can be found in ***EXOdesigner's Help*** (the topic *Communication – Communication Media – Dial-up*).

Radio (EXOflex only)



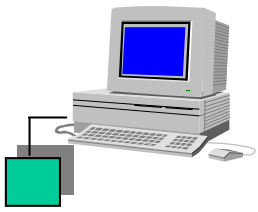
EXOflex RS232 is normally used for connection to radio modems.

Low-power band By operating in the low-power band (0.5W, 420-470MHz) this type of modem may be used in most European countries without an operating license.

Distance The communication distance for radio communication is 5-10 km depending on the type of antenna and the features of the landscape.

Satel A radio modem from Satel can be used for radio communication. We recommend **Sateline-3AS** with a transfer speed of 2400, 4800 or 9600 bps.

Port-to-port (EXOflex only)



Port-to-port Port-to-port communication is primarily used in training when you typically only communicate with one controller.

RS232 RS232 is used for communication between a computer and an EXOflex unit, port to port.

Cable A shielded cable must be used for permanent installations. The area should be 0.25 mm^2 or more, as dictated by the mechanical considerations, and the length should not exceed 3 m. The RS232 port on the EXOflex unit is normally isolated from the internal circuits, but the RS232 cable should nonetheless be separated from heavy disturbances.

LON (not Regio Controllers)

EXOflex A special communication PIFA is required for connections to LON.

EXOcompact, Corrigo E EXOcompact and Corrigo E provide the option of a communication port of the type LON.

Communication Connections

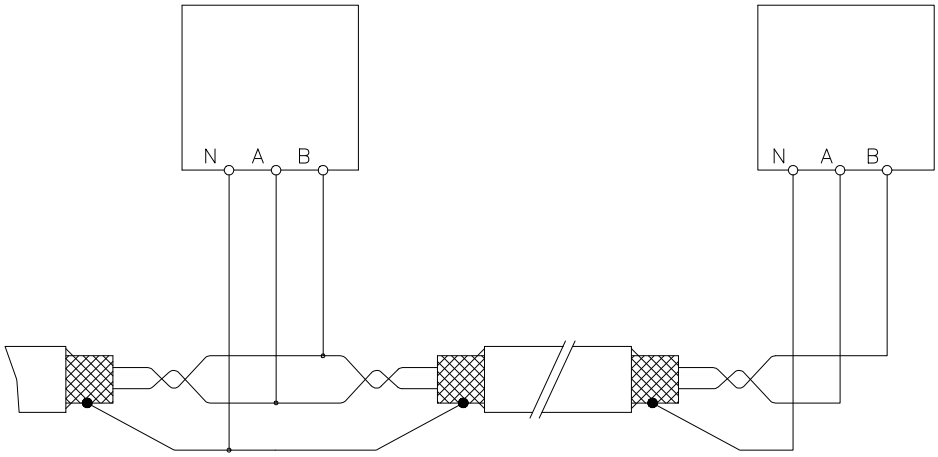
EXOline (RS485)

Standard

EXOline is the standard means for communication via fixed cables.

Parallel connections

The controllers are connected in parallel on the line. Please see the figure below.



Cables

Shielded and twisted cables should be used. The area of the cable should be 0.25 mm^2 or more, as dictated by mechanical conditions, and the capacitance should be less than 100 pF/m. The line should normally be terminated at both ends (the last controller at each end) with a resistor value of 100 Ω/0.5 W.

Branch off

The line may branch off in several lines into a tree structure. If one branch exceeds 200 m it is recommended that the line is terminated with a *n**100 Ω resistor at the last controller in each branch (*n* = number of branches). Up to 50 controllers may be connected on the same line without amplification. The shield should normally be grounded in at least one point, normally the **N** terminal on the station master.

RS485

To connect controllers with serial ports of the type RS485 to the computer, you can use serial ports on the computer of the same interface, or a communication adapter that connects to the RS232 port of the computer. See the chapter ***Products*** for more information.

E-signal

EXOline carries messages in both directions on the same pair of conductors. A special signal is used to control the communication direction when converting to RS232 and EXOloop. This signal is called the E-signal.

hlEXOline

Enhanced

hlEXOline is an enhanced EXOline port on EXOflex units that is capable of supplying more power to the line and handling line receivers with higher sensitivity than the standard EXOline port. As a result, extended communication distances (6-8 km at the most) may be achieved by using hlEXOline.

Cable

The cable area should be 0.5 mm^2 or more, as dictated by mechanical considerations. The line should be terminated as for EXOline, but the resistor should be able to dissipate 2 Watts (100Ω/2W) due to higher line power.

Jumper switch

hlEXOline is obtained by moving a jumper switch on the EXOflex main power PIFA (port 1) or on the communication PIFA (Port 2–3). EXOcompact and Regio controllers do not support hlEXOline.

Note that hlEXOline and EXOline must not be mixed on the same communication loop.

RS232 Interface

Port to port RS232 is used for communication between two devices, port to port, normally on fixed cables.

Cable A shielded cable must be used. The area should be 0.25 mm^2 or more, as dictated by mechanical considerations, and the length should not exceed 15 meters, unless otherwise specified in the data sheet.

EXOflex The RS232 port on EXOflex-units is normally insulated from the internal circuits, but the RS232 cable should nonetheless be separated from heavy disturbances.

Ethernet Interface

Networks Ethernet is an interface used for constructing computer networks. Ethernet is not specific for any particular media or communication speed and it is used often for creating local area networks (LANs), radio networks and fibre optic networks using very high speeds.

10 MB One of the most common standards for Ethernet in a LAN is IEEE 802.3, which is Ethernet with a transfer speed of 10 MB. The usual way to connect to a 10MB Ethernet network is via 10Base-T, which is the technical term for twisted-pair Ethernet. Other connection methods used for 10 MB Ethernet are 10Base-2/BNC (thin-wire Ethernet) and AUI (thick-wire Ethernet).

Cable When connecting equipment to a twisted pair Ethernet network, a so-called TP cable is used. The TP cable is an 8-pole twisted pair cable with an impedance of 100 Ohms and RJ45 connectors at both ends. The TP cable is either shielded (STP) or unshielded (UTP). To avoid disturbances to network traffic, the cable should not be spliced or pass a plinth.

EXOflex EXOflex units that are connected to Ethernet have a shielded RJ45 connector and should therefore be connected by shielded TP cable (STP).

Communication - Dimensioning

Performance The choice of communication media and the number of lines is the single most important factor for the operator's perception of the system's speed and performance.

EXO4 EXO4 is designed to work well even during long periods of high load. However, our recommendations below normally result in a good response on, e.g. operator commands and alarms.

Station Size

15 controllers More than 15 controllers per station should be avoided, unless there are particular reasons to exceed this number. Especially the alarm response time can be affected by a larger number of controllers.

TCP/IP Networks

TCP/IP The superior choice of media is a TCP/IP network, as the main computer can communicate with several stations in parallel. This choice is equivalent to a connection with a separate serial port and a fixed cable to each station and single controller.

Station A 10 MB Ethernet connection is more than adequate for communication with a TCP/IP connected station or controller. However, a main computer can communicate with practically all TCP/IP connected controllers in parallel. If you have more than 25 TCP/IP connected controllers, the computer should be connected with a 100 MB Ethernet connection and use a switched network of 100 Mbps or more until there is a branch off so that less than 25 controllers use the same path.

EXO4 computers

For communication between computers an even lower performance is sufficient, even GSM data modems work but with a lower performance. However, this requires that all the computers maintain a copy of the project. If the project is located only on the main computer and file sharing is being used, 100 Mbps is preferred between all computers.

Fixed Cable

15 stations

15 stations (and single controllers) can easily be connected to each serial port with an RS485 cable and a communication speed of 2400 bps or more. It is, in fact, possible to connect considerably more stations, especially if there are only a few controllers in each station.

Slow lines

If a specific EXOline segment is considerably slower than, e.g. a 300 bps base band modem or a radio modem with a long switching time, the communication speed can be affected. The time needed for alarm transfers from other stations and other traffic to the station may increase if there is a window open to the station. If possible, such communication lines should be isolated to a separate serial port (or even better, to several serial ports) on the main computer, and allow the fast stations to use another serial port.

Several serial ports

If several serial ports are needed on a computer (more than 6 ports at 9600 bps or more than 10 ports at 2400 bps), passive add-on cards or USB serial ports should not be used. Cards with their own processor that relieve the CPU, e.g. Comtrol Rocketport (but not Rocketport 550) should be used instead. But basic 16550 based cards with up to 4 ports, if they can share an interrupt!, can be used. If a very large number of serial ports are needed, 16 or more, please contact Regin Support for advice.

Dial-up Modems

Number of modems

The one and same modem on the computer cannot be used to communicate with controllers connected with GSM modems, 9600 bps modems, or 2400 bps modems. Nor can these modems be used for communication via a dial-up TCP/IP network, nor for sending alarms using Nimbus Alarm Server. If the project includes several different modem speeds, or both GSM connected and traditional dial-up connections, the needs have to be analyzed individually.

In the information below, we assume that only one type exists. If there are other types, these will have to be added to get the total number of modems and telephone lines on the computer. Incoming telephone numbers also need to be different for different kinds of connections.

Small projects

In small projects, where the only workplace is the main computer, one modem is normally sufficient. The modem must be accessible externally, i.e. if the modem is behind a switchboard there must be a direct number to the modem.

Two modems

As the project grows and alarms risk not getting through, it is time to start using two modems, one for outgoing traffic, and one for incoming traffic. The modems should be connected to traditional telephone subscriptions (not group numbers). The modem for incoming calls needs to have a known telephone number, the modem for outgoing calls does not.

More information

Please see ***EXOdesigner's Help*** (the topic *Communication – Communication Media – Dial-up*) for more information.

Data Flow

Two station types

In general, the EXO system differentiates between two types of stations (and single controllers), depending on the organization of the communication with the main computer. The two types differ in when, e.g. alarm events are transferred to the main computer.

- **Permanently connected**: Permanently connected stations/controllers are connected to a main computer via a serial port, radio or TCP/IP. As a result, there is a continuous contact with all the controllers in the stations.
- **Dial-up**: Dial-up modems are used for communication with the main computer in dial-up stations/controllers. As a result, the computer is **not** in continuous contact with the controllers of the station. First, a connection needs to be established by a so-called **dial-up connection**, prior to communication.

Synchronization

Synchronization is performed at configurable times, usually at night every 24 hours, or manually by an operator command.

The reasons for the synchronization are primarily to check the main computer's connection to the dial-up stations, collect stored alarms and logged values, to synchronize the real time clocks and to update EXO4 signals.

Within a Station

Polling

A station master is usually connected to several station slaves that are being polled periodically by the station master according to the master/slave method. This way the master periodically polls variables and checks any alarm states.

Master controller

Alarms, dynamic values and parameters from all controllers in a station can be viewed on the display of the station master. Some values may also be maneuverable (changeable). The integrator decides the values that are only to be inspected, and the ones that also should be maneuverable.

Between Computer and Station/Single Controller

Actual Values, Setpoints and Parameters

EXO4 window

The actual values, setpoints and parameters of a station/single controller are transferred when the operator has selected an EXO4 window, e.g. a process window, for displaying values.

Dial-up

For dial-up stations, the main computer first performs a commanded connection, i.e. the main computer dials the controller whose values are to be displayed.

Main computer

The controller's main computer requests the values from the controller.

Work computers

If the process window was selected in a work computer (not the main computer) the collected values are forwarded to the work computer.

Alarms

Immediate transfer

All alarm events (including switch-offs, acknowledgements, etc.) are always immediately transferred (by notification) from permanently connected stations and single controllers to the main computer. This is also the case with dial-up stations and single controllers while they are connected.

Dial-up

Dial-up connected controllers normally creates a spontaneous connection when an alarm is activated (but can be configured to connect at all types of alarm events).

Synchronization

At synchronization, all stored alarm events are collected from the controllers.

Database All alarm events are stored in the database of the main computer. In EXO4, there are ready-made windows for displaying sum alarms, alarm reports and event reports. The reports collect their values from the database.

Nimbus Alarms can be sent to mobile phones as SMS messages or as E-mails using Nimbus Alarm Server.

Logs

Synchronization Logs are transferred from the controllers to the main computer during synchronization. The operator can also order a manual synchronization when needed. The synchronization can be configured to run at all dial-up connections.

Spontaneous If the automatic synchronization for some reason fails, the station/single controller will connect spontaneously and start synchronization when a log is 80% full.

Database The logged values are stored in the database of the main computer.

Visualization In EXO4, logged values can be displayed in historical charts or be used in reports created in EXOreport.

Clock Synchronization

Synchronization At synchronization, the master and single controllers' clocks are set. In stations, the time is then distributed to the slave controllers.

The computer clock All clocks are also updated when the computer clock is changed. In permanently connected controllers, this is performed instantly. In dial-up controllers, the change will take place at the next connection.

Between Stations (EXO4 signals)

EXO4 signals EXO4 signals are used to transfer variable values between stations and single controllers via the EXO4 main computer.

Dial-up EXO4 signals cannot be used for dial-up controllers.

Cycle time EXO4 continuously polls the values of the EXO4 signals on the controllers, with configured cycle times. When a value has been changed, it is printed to optional variables in other controllers.

Synchronization All EXO4 signals are updated at synchronization.

Statistics

Communication Statistics

Information The communication statistics for stations, controllers and communication channels are maintained by EXO4 and contain the following information:

- Number of successful connections.
- Number of communications with error code from the controller.
- Number of failed communications (at transport level).

Unreachable Stations and Controllers

Unreachable

A station or a controller will be considered unreachable if it does not answer a communication command within a certain time (the time is determined by the communication protocol).

Reasons

When the communication does not work it might be due to faulty controllers, modems, cables, power failure, etc.

Lists

The main computer manages lists of unreachable stations and single controllers. The station master controllers manage lists of their unreachable slave controllers. The communication between all controllers and stations in a project is checked continuously. This way, the lists are updated automatically when the communication stops working or is resumed.

Purposes

The lists of the unreachable controllers and stations have the following purposes.

- The ability to generate alarms (to the operator) when the communication stops working.
- To quickly update alarm status databases after a power failure.

Connection Statistics

Connection

Connection is a concept used when dialing-up. It means that contact is established between a station or single controller and its main computer or between a work computer and a main computer.

Disconnection

When the computer ends the communication with a controller, it will automatically disconnect.

Modem

EXO4 generates connection statistics for each station, single controller and communication channel (i.e. per modem and modem group). The connection statistics consist of information about the number of successful or failed connections in seconds.

Connection status

The connection status holds information on the progress of the current connection, i.e. the current phase of the connection, e.g. “Contact established” or “No lines are available”.

Three different ways

Main computers and dial-up stations/single controllers can connect in three different ways:

- **Commanded connection:**

  Commanded connections are mainly used when the operator has selected a process window displaying values in a dial-up controller. The main computer then connects to the controller and requests the values. While you are connected, all alarm events are also transferred to the main computer. Once the connection is no longer needed, disconnection is automatic with a few seconds delay (if someone wants to call the same station again).

- **Spontaneous connection:**

  Spontaneous connections are normally executed when an alarm has been activated in a single controller or in any of a station’s controllers. The station master will then connect to its main computer.

- **Synchronization connection:**

  Synchronization connections are automatically executed at configurable times, usually at night, once every 24 hours.

Part III Configuring Project Design and Communication

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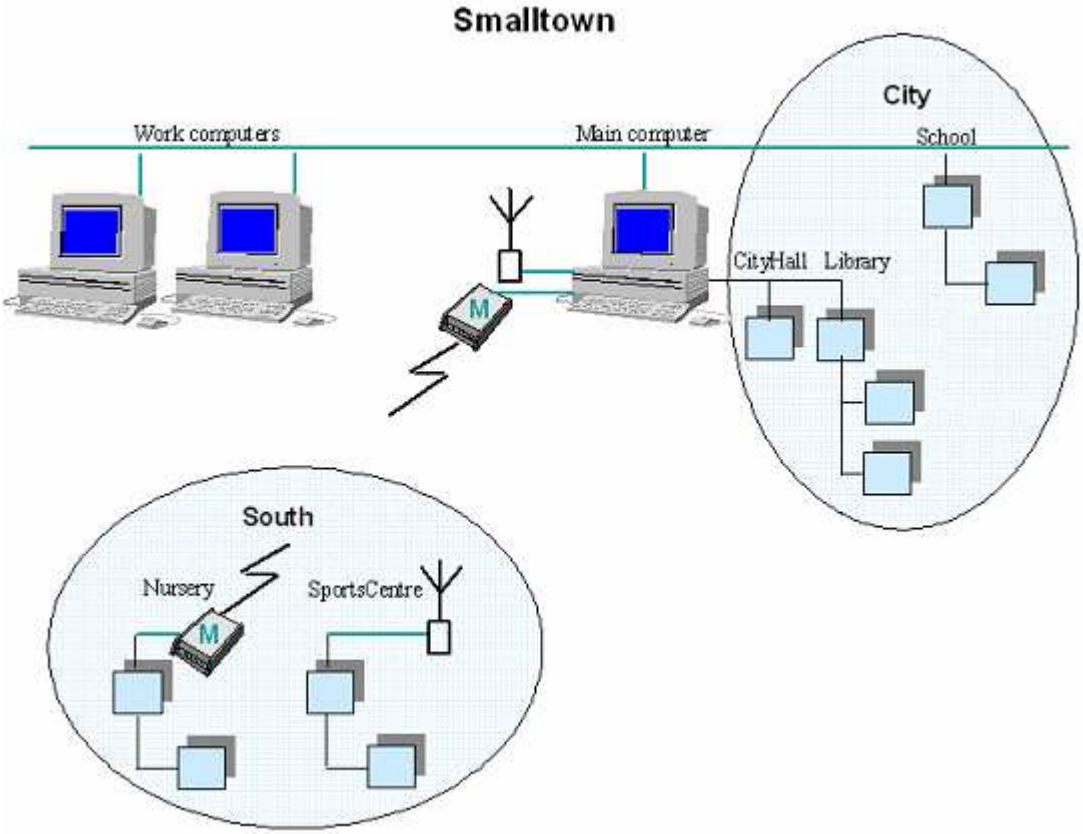
Part III Configuring Project Design and Communication

Chapter 8 Configuring Project Design

Example Project



Contents

The example project Smalltown contains the following:

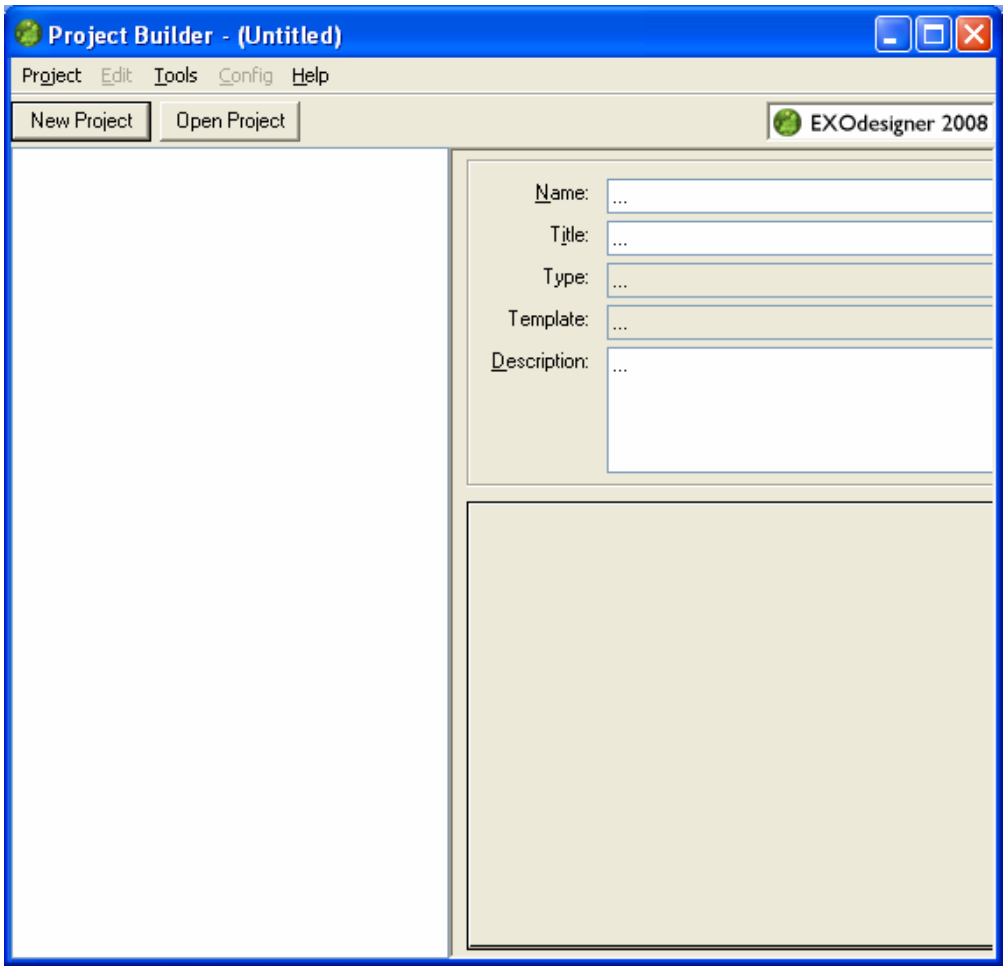
- Main computer with EXO4 and EXO4 database.
- 2 work computers running EXO4.
- 3 areas – City, South and ExampleArea.
  - The area City contains the controller CityHall and the station Library, which both are serially connected. It also contains the TCP/IP connected station School.
  - The area South contains the dial-up station Nursery and the radio connected station SportsCentre.
  - The area ExampleArea is created when the project is created. It contains three single controllers (EXOcompact, Corrigo E and Regio Maxi).

Project

Project Builder

Project Builder is the configuration environment of the EXO system and is used to e.g. create new projects, open and change existing projects. It is also used for opening windows for configuration of the controllers' functions, EXO4 windows etc.

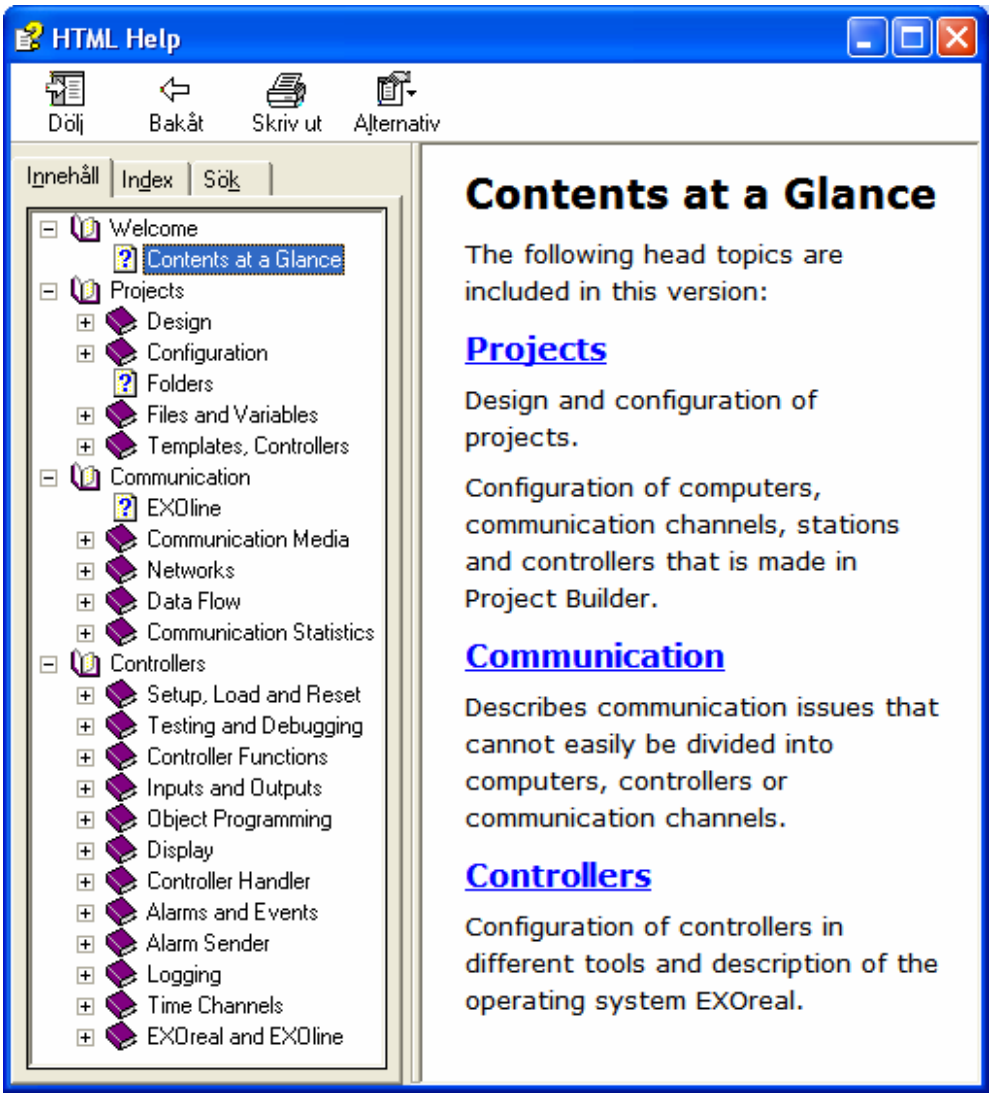
Open Project Builder by clicking on **EXO – Project Builder** on the Windows start menu.



EXOhelp

Reference

EXOhelp is a true help system with reference documentation for the EXO system.



Projects and controllers

EXOhelp 2008 contains help about designing projects and controllers (but not EXOL programming). More help, including EXO4, will be included in the future.

Search

You can open EXOhelp from Windows' start menu and search for desired topics manually. There are three ways to find the topics: by content browsing, index keywords or by searching for any words in the topic texts.

Open

You can also open EXOhelp from the different tools in EXOdesigner, by pressing the key F1. In this case, the topic for the current function or tool is automatically opened. In EXO 2008 you can open a suitable help topic from, among others, the following tools: Project Builder, Alarms & Events, Controller Handler, Display, EXOflex I/O, Controller Functions, Inputs & Outputs, Logging, Objects, PIFA I/O and Time Channels.

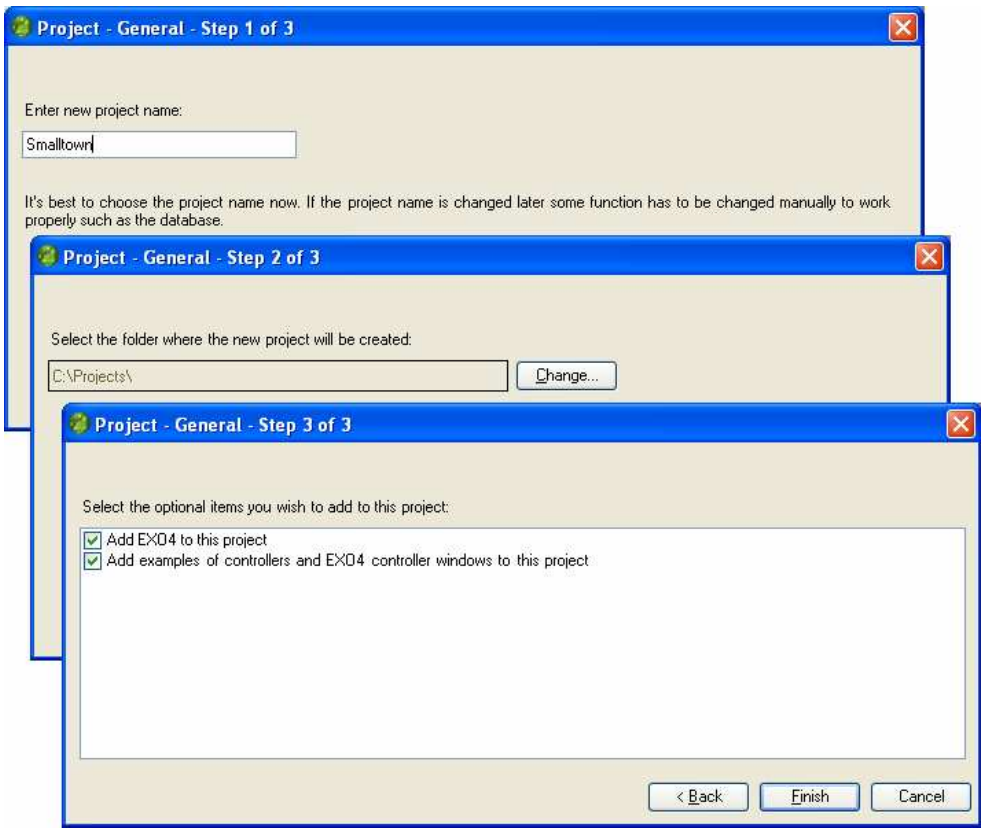
Creating a New Project

Start

Start by creating a new project.

Open the wizard that helps you to create a new project in one of the following ways:

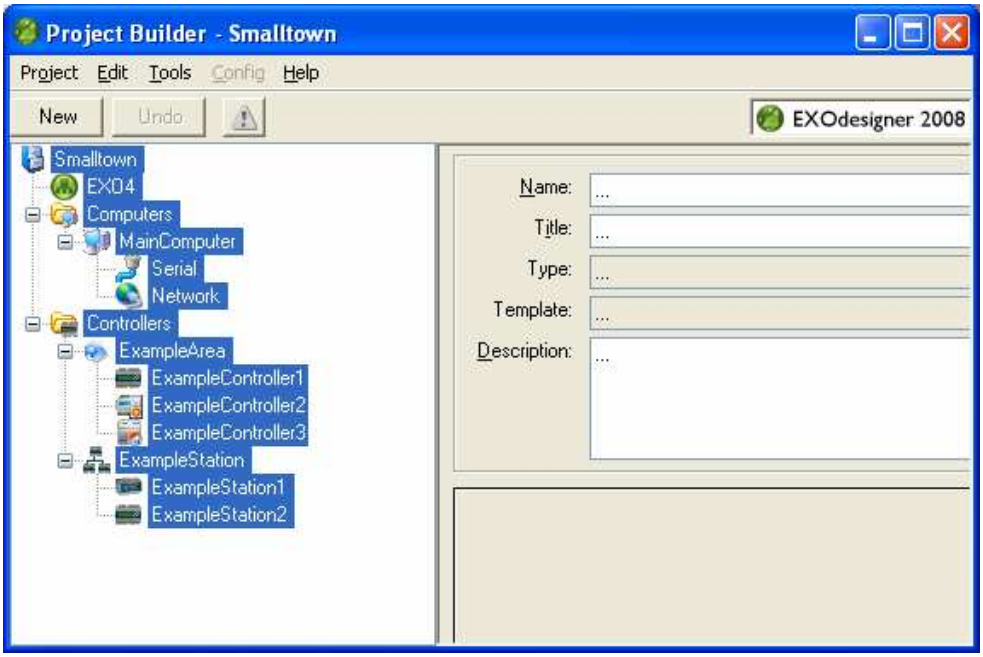
- Click on the **New Project** button.
- Select **Project – New Project**.
- Simultaneously press the **Ctrl+N** keys.



1. Enter the project name, in this case **Smalltown**, in the first dialog box. The name may contain the letters (a-z), the Swedish extended characters (å,ä,ö), the digits (0-9), and underscore (_). Other characters, e.g. space, are not allowed. EXOdesigner is not case-sensitive.
2. Select the folder on the computer's hard disk where the project should be saved. Usually the default folder `C:\Projects` is selected. A subfolder, the so-called project folder for the new project, is created in the folder `Projects`.
3. If EXO4 is installed on the computer, a third and last dialog is displayed on the screen. This dialog lets you choose if you want EXO4 and examples of controllers and EXO4 windows in your project. Click on the button **Finish**.

After a while, Project Builder will display the new project.

Project Builder



Contents

Initially, if the default options have been accepted and EXO4 is installed on the computer, the project contains the following:

- The folder **EXO4**. This folder contains the entire EXO4 configuration that is common to all computers in the project, e.g. windows.
- The folder **Computers.** This folder contains the server computer **MainComputer** in which there are two communication channels: **Serial** for communication via fixed cable, and **Network** for communication with controllers via a TCP/IP network.
- The folder **Controllers** contains the area **ExampleArea** and the station **ExampleStation**.

  The area contains three single controllers:

  - **ExampleController1:** EXOcompact with standard program for air handling.
  - **ExampleController2:** Corrigo E with standard program for heating.
  - **ExampleController3:** Regio Maxi with standard program for room control.

  The station contains two controllers:

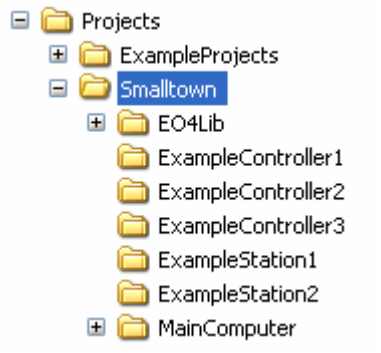
  - **ExampleStation1:** One EXOflex controller that functions as the station's master controller. At this stage, the controller only contains general functions, but it can be configured and programmed as required.
  - **ExampleStation2:** One EXOcompact that functions as the station's slave controller with standard program for a heating system.

Hard Disk

Project folder

When a project is created, a project folder is created on the computer's hard disk. The project folder contains everything concerning the project, which makes it easy to copy and move it. The project folder on the hard disk contains:

- ❑ One folder for each controller in the project.
- ❑ One folder for each computer in the project.
- ❑ The folder **EO4Lib**, which contains all EXO4 configuration that is common to all the computers in the project.



Areas and stations

The organization of the project in areas and stations is not shown on the hard disk.

Main computer

When a main computer is created in a project, normally when a project is created, an MSDE database by the name **`Database`** is created on the local hard disk. It will be included in the file

`C:\EXO4Db\`*`Project`***`\Database.Mdf`**.

This means that the database will not be copied together with a project. This is however not normally desired. See also the chapter ***Commissioning***.

Modify

Modify

The project structure can of course be modified. You can delete and add controllers, stations, areas, etc. to correspond to the requirements of the new project. You can add more functionality, e.g. time control, to the controllers that initially contains examples on ready-made applications.

Changing the title

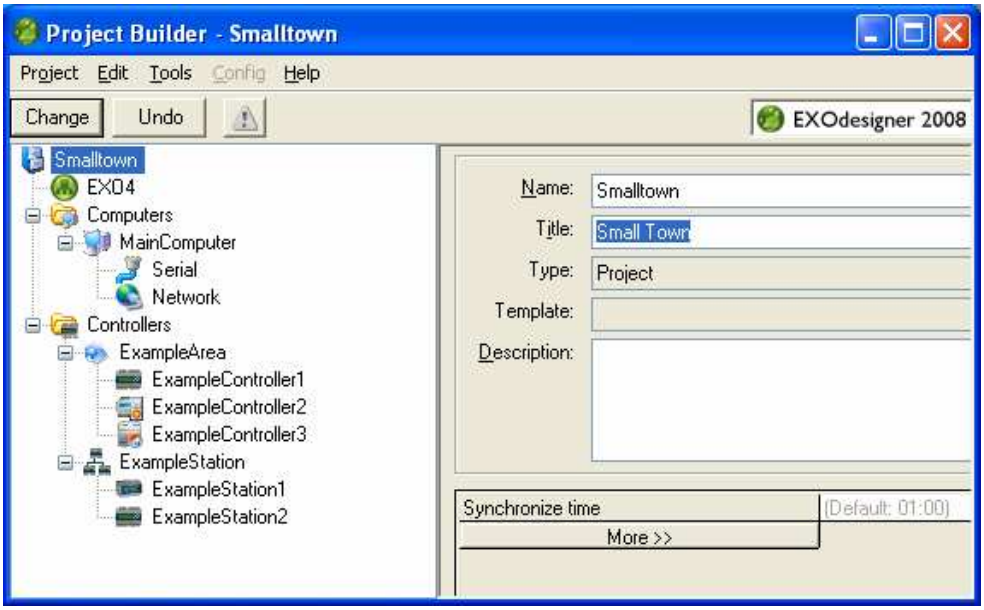
The title is the text that the operator can see in applications. If it remains unchanged, it will be the same as the project name. As the project name cannot contain spaces, a different title name is sometimes preferred.

Select the project in Project Builder, i.e. in this case **Smalltown**.

Enter a different title, e.g. **Small Town**, in the attribute **Title**.

Accept the change by pressing the Enter key or by clicking on the **Change** button.

To undo the change, click on the **Undo** button.



Areas

Organizing

It is common, although not necessary, to organize the project in areas to get a better overview of the system. Organizing the project into areas will allow the operator to use these when searching for alarms and logged signals, etc. in EXO4.

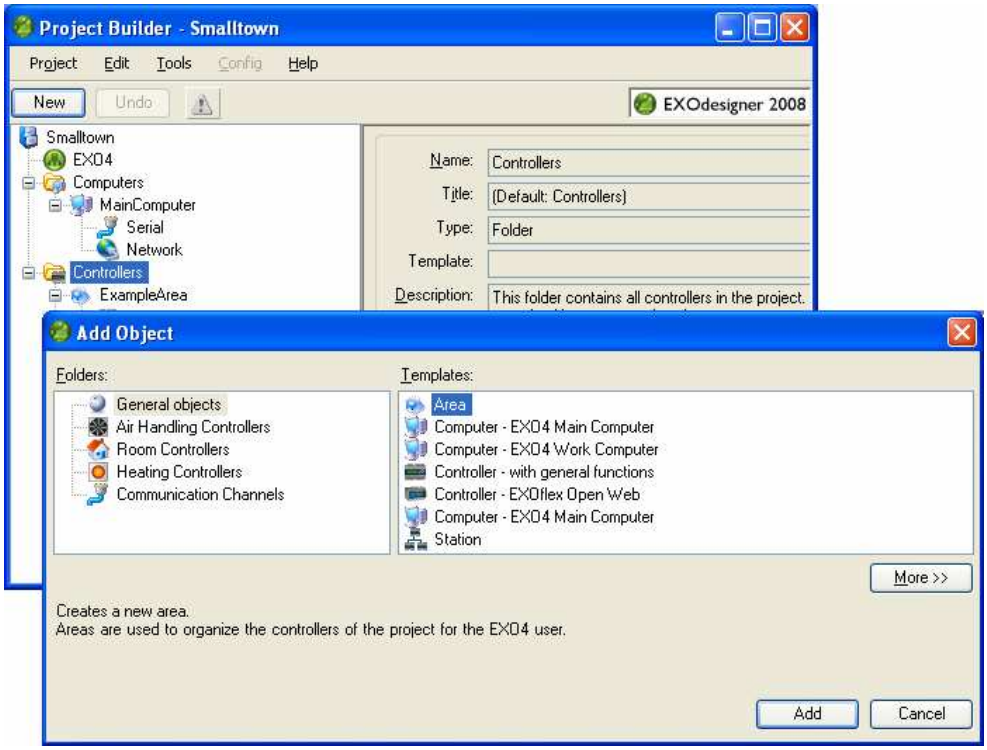
Several levels

The folder **Controllers** and the station folders in Project Builder may contain areas at different levels. New areas will be located in the Project Builder folder that is highlighted when you click on the **New** button or when you press the Enter key. The location of the areas in the folder structure can be changed at a later stage.

Creating New Areas

Create a new area in the folder **Controllers** in the following way:

- Select **Controllers** in Project Builder.
- Click on the **New** button or the Enter key.
- Select **Area** in the dialog box Add Object.
- Click on the **Add** button.

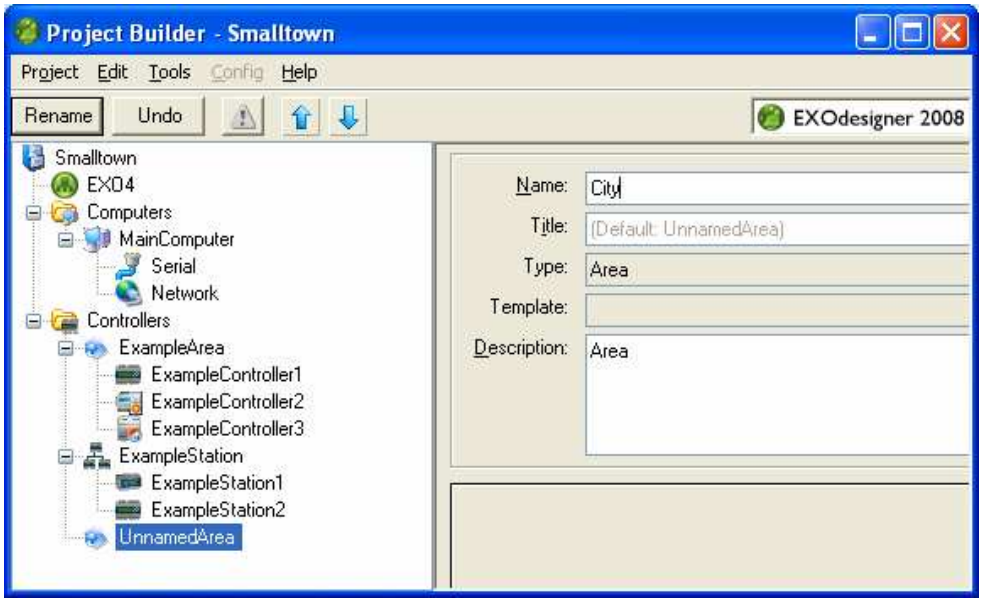


Name

A new area with the name **UnnamedArea** is displayed in Project Builder. It is good practice to use a descriptive name in the attribute **Name**. This name may not contain spaces. If you want a different name to be displayed to the operator during runtime, enter this name in the attribute **Title.**

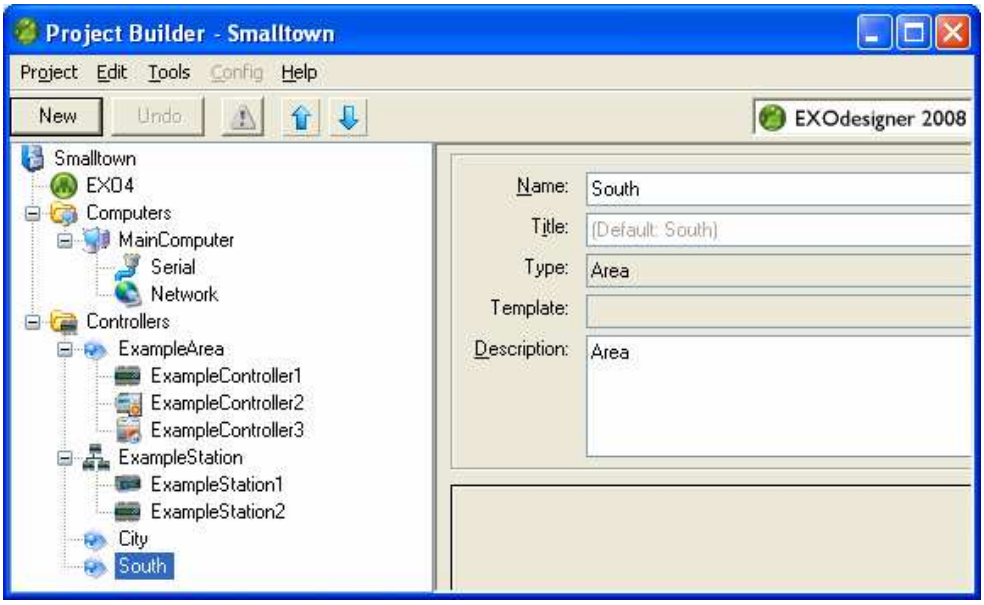
In this example, the new area should have the name **City**.

- Select the new area.
- Enter the name **City** in the attribute **Name**.
- Press the Enter key or click on the **Rename** button.



Create yet another area in the folder **Controllers**.

The name of the new area should be **South**.



Controllers

New controller

New controllers are created in Project Builder with the help of templates.

Templates

The following templates are included in EXOdesigner:

- **EXOflex or EXOcompact with general functions:** An EXOflex or EXOcompact controller with general functions has no control functions but can be programmed for the required functionality, e.g. with the help of controller objects. The controller's model is selected, and also if you want the functions Display, Alarms and Events, Logging and Time Channels.
- **EXOflex or EXOcompact with heating system or air handling function:** For air handling or heating systems in EXOflex or EXOcompact a ready-made basic application is created that, besides the control functions, also has the functions alarms, logging and display. More functionality can be added and configured for specific needs.
- **Corrigo E with heating system or air handling function:** Corrigo E with standard heating system or air handling function is used for pre-programmed Corrigo E controllers. Their programs can not be changed but can be configured with E-Tool that is opened from Project Builder with e.g. a button when a Corrigo E controller is selected.
- **Room control:** There are five templates for room controllers:
  - Regio Maxi with example of a room control program with fan coils. The controller is freely programmable, which means that you can change and add functions to the program yourself.
  - Regio Maxi with example of a room control program without fan coils. The controller is freely programmable.
  - Regio Maxi with standard room control function. The standard room function can not be changed, but it can be configured with Regio Tool that is opened from Project Builder with e.g. a button when a Regio controller is selected.

- Regio Maxi with standard extendable room control function. The standard room function can not be changed, but it can be configured with Regio Tool. It is also possible to add your own application program with objects, log signals, alarms and time channels.
- Regio Midi with standard room control function. The program can not be changed, but you can configure it with Regio Tool.

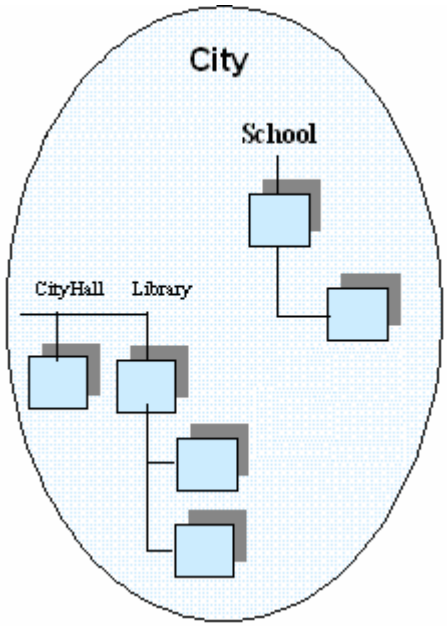
Expansion units Expansion units are not created as objects in Project Builder.

Unique name Each controller in a project must have a unique name. As usual, the name may not include e.g. spaces.

Title If you want another designation of the controller than the name to be shown to the operator, you configure that in the attribute **Title** with any signs.

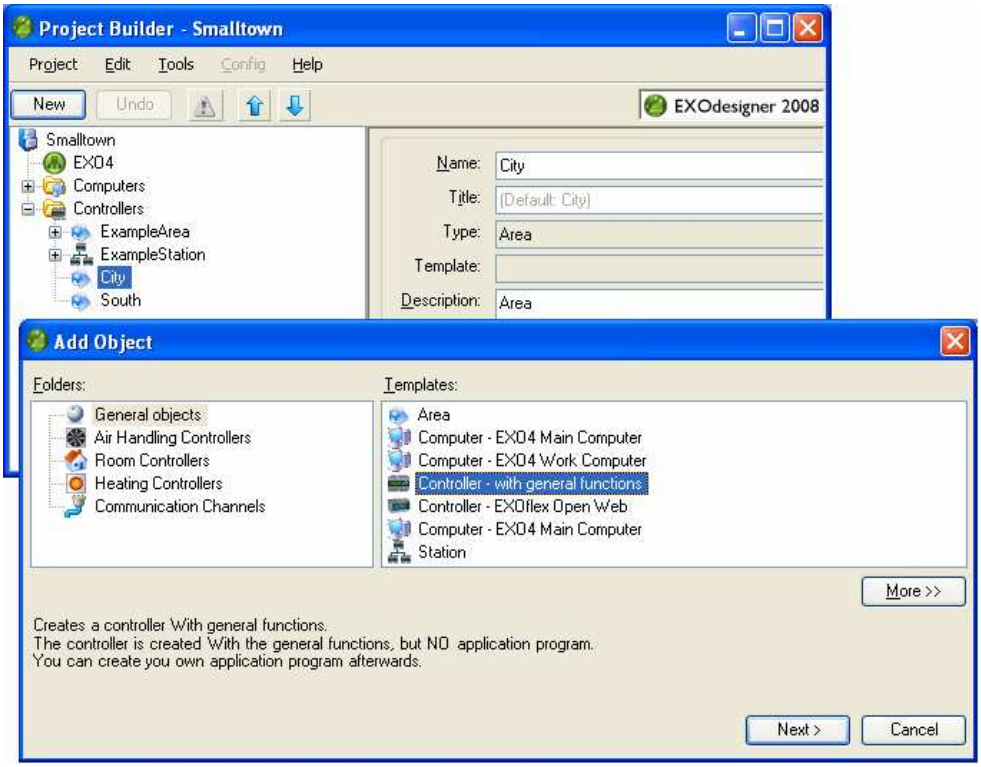
Creating a Controller using General Functions

Example In order to demonstrate how to create a controller using general functions, we will create the controller CityHall in the area City.



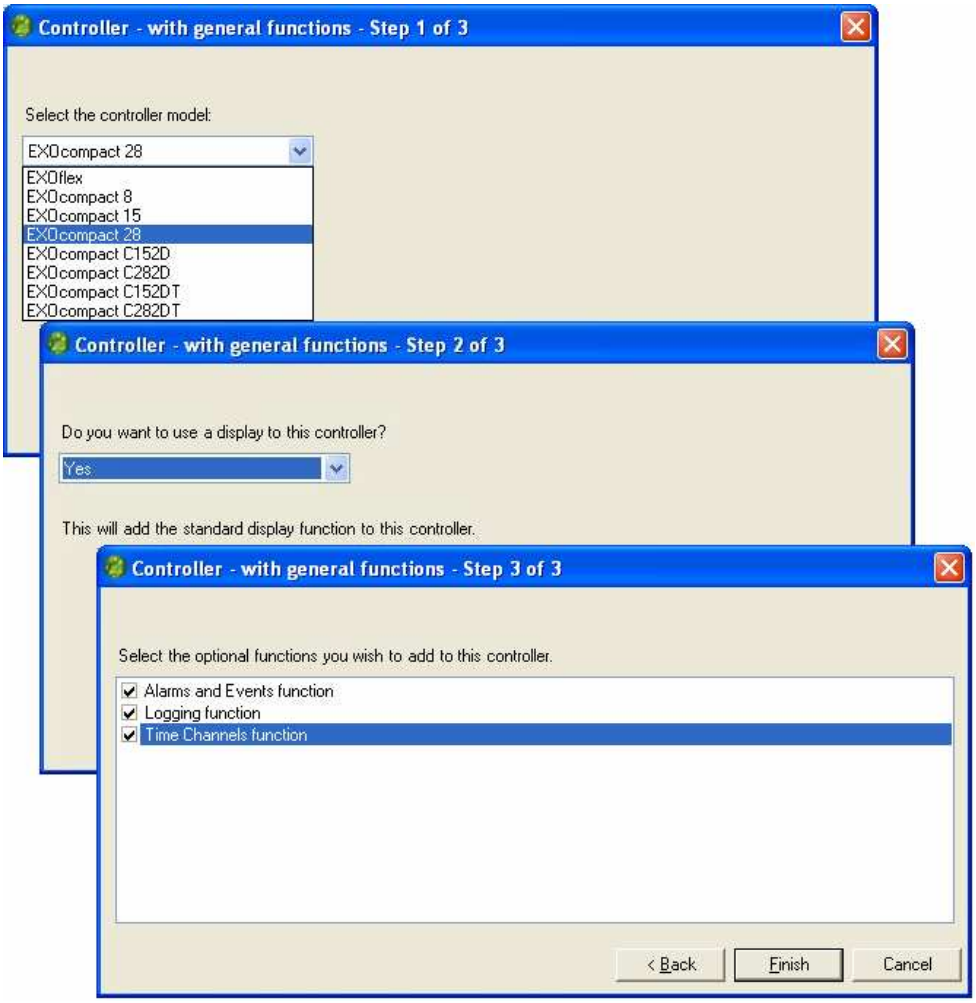
Create a new controller in the area City in the following way:

- Select the area **City** in Project Builder.
- Click on the **New** button or the Enter key.
- Select **Controller – with general functions** in the dialog box Add Object.
- Click on **Next**.



Wizard

When a controller is created using the template **Controller – with general functions** a wizard is displayed, which allows you to select the controller model and controller functions, e.g. display, handling of alarms and events, logging, and time channels.



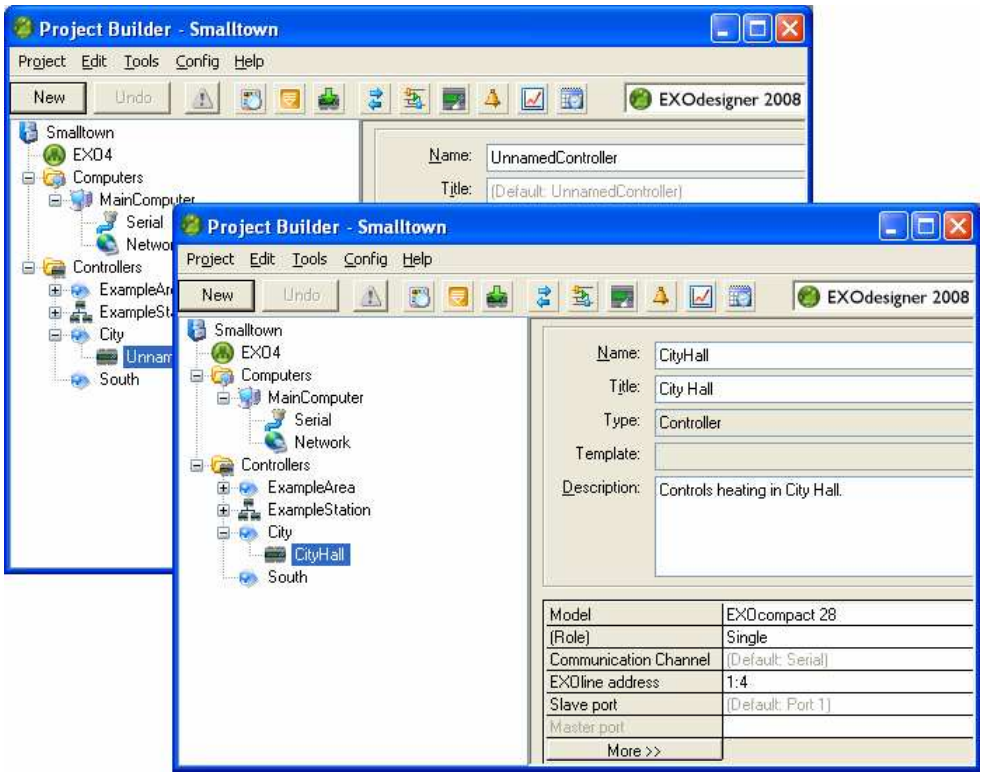
Select the following in the wizard **Controller – with standard functions**:

1. In this case, select **EXOcompact 28**, i.e. EXOcompact with 28 I/O points, in the first dialog box. Click **Next**.
2. Click **Yes** for the function Display and click **Next**.
3. **Alarms and Events function** and **Logging function** are selected by default. Add **Time Channels function** and click **Finish**.

Project Builder

After a short while a new controller, **UnnamedController**, is displayed.

- Give the controller the name **CityHall** (without spaces) in the attribute **Name**.
- Type **City Hall** (with spaces) in the attribute **Title**.
- You can give a description of the controller's function in the project in the attribute **Description**.
- Confirm with the button **Rename** or with the Enter key.



Stations

Stations

A station can consist of one or more controllers. A station always has exactly one master controller with a communication port to the main computer. If the station contains more than one controller, the other controllers are connected as slave controllers to the station master.

Two ports

In a station that has one or more slave controllers, the station master requires at least two communication ports – one for the superior system and one for the slave controllers.

New station

First you create a station. Then you give it a name and create the controllers that are to be included in the station. It is also possible to move earlier created controllers into a station.

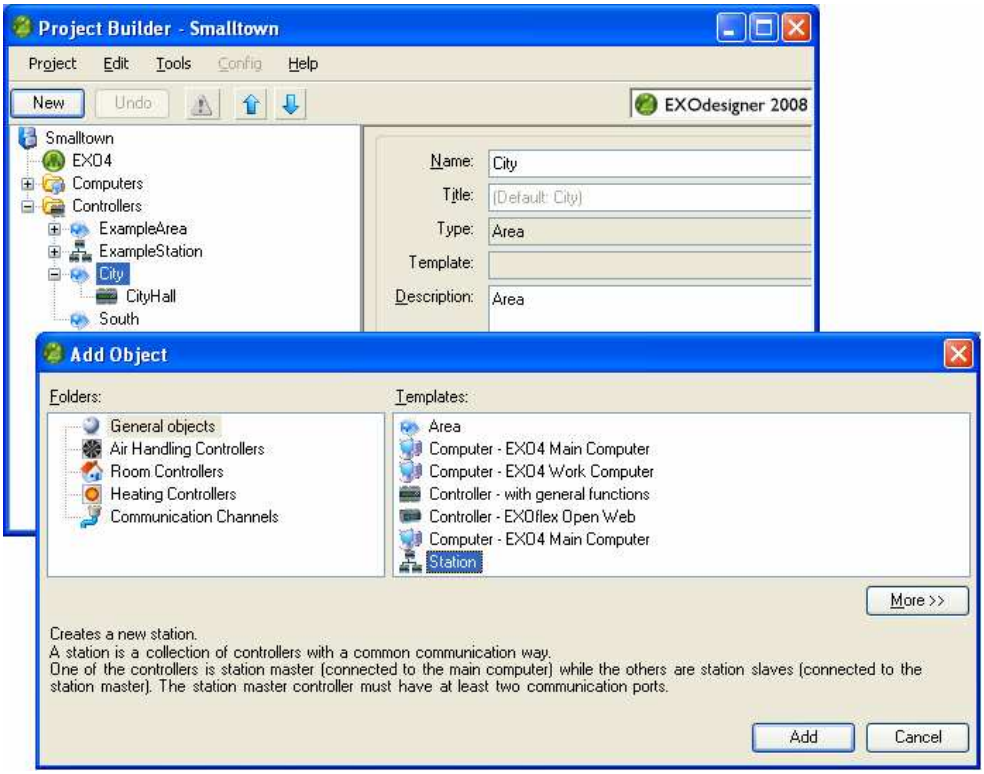
Name

Each controller in a project must have a unique name. By default, all controllers in a station are given the same name as the station name, followed by a digit. The station master is normally given the number 1, and this number is incremented for each subsequent controller. As usual, the name may not include e.g. spaces.

Creating a Station

Create a new station in the area City in the following way:

- Select the area **City** in Project Builder.
- Click on the **New** button or the Enter key.
- Select **Station** in the dialog Add Object.
- Click the button **Add**.



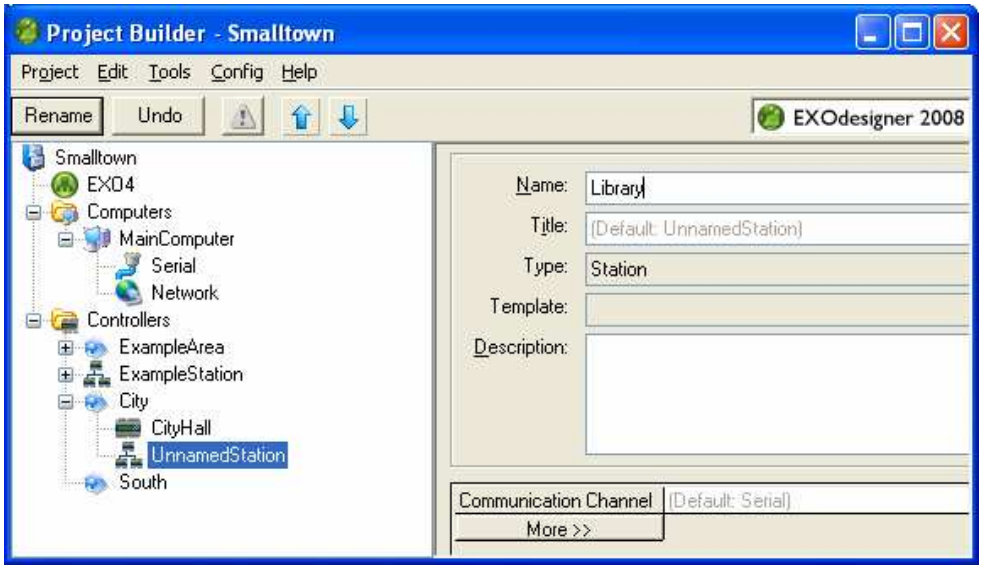
Name

A new station with the name UnnamedStation is created in Project Builder. Give the new station an appropriate name.

In this case, give the new station the name **Library**.

- Select the new station (UnnamedStation).
- Enter **Library** in the attribute **Name**.
- Click on the button **Rename** or the Enter key.

The attribute **Title** changes automatically to **Library**.



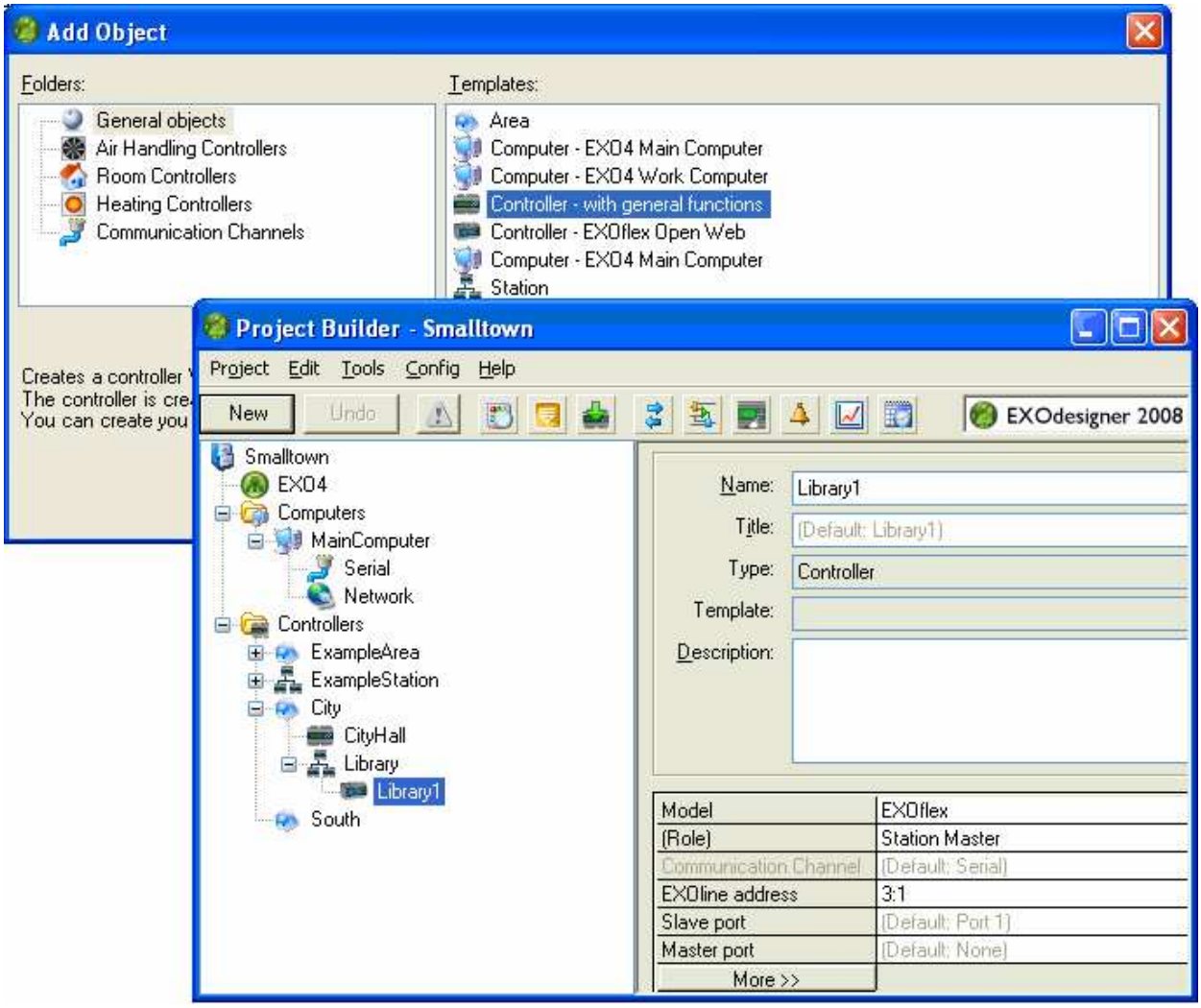
Creating Controllers in the Station Library

Library1

Create a new controller in the station Library in the following way:

- Select the station **Library** in Project Builder
- Click the **New** button or the Enter key.
- Select **Controller – with general functions** in the folder **General objects** in the dialog Add Object and click on **Next**.
    1. Select **EXOflex** in Step 1.
    2. Select **Yes** for the function Display in Step 2.
    3. Select the functions **Alarms and Events**, **Logging** and **Time Channels** in Step 3.
- Click the button **Finish**.

A controller with the name **Library1** is created in the station Library.



Library2

Create another controller in the station Library in the following way:

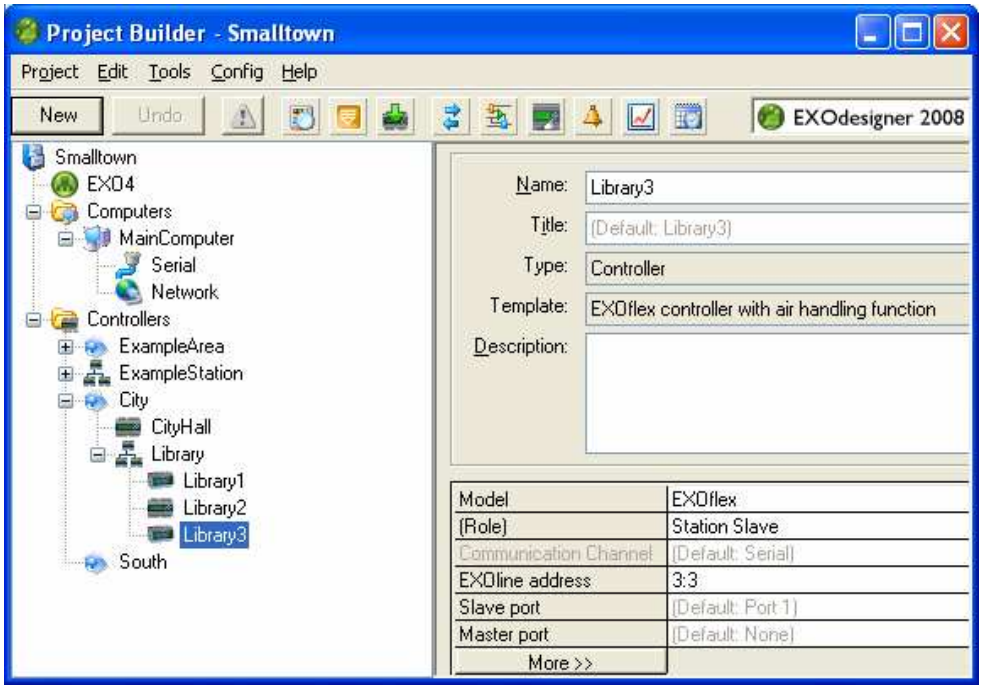
- Select the station **Library** and click the **New** button or the Enter key.
- Select **Heating Controllers** and thereafter **Controller – EXOcompact with example of a heating program** in the dialog box Add Object and click on **Next**.
- Accept the default **EXOcompact 28** and click on **Finish**.

A controller with the name **Library2** is created as a slave in.

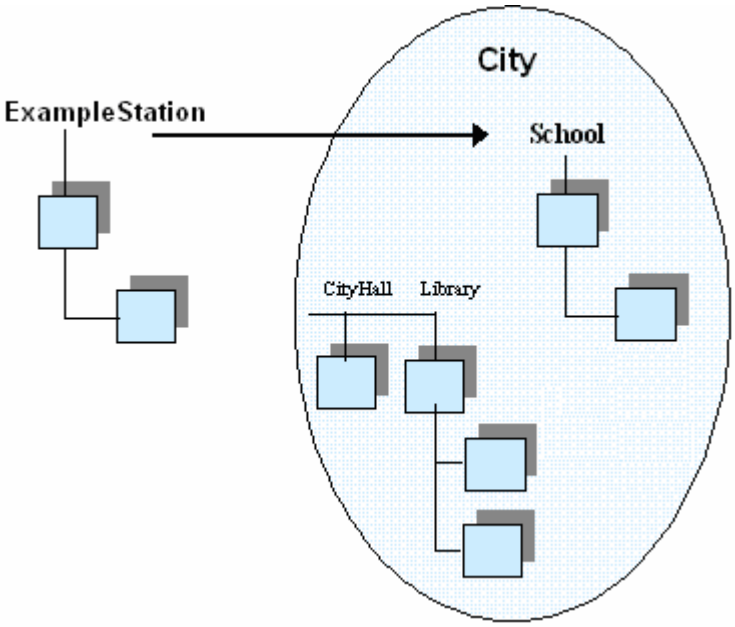
Library3

Create yet another controller in the station **Library**, but now select the template **Controller – EXOflex with example of an air handling function**.

A new slave controller by the name **Library3** is created in the station.



The ExampleStation is Converted into the Station School



Template examples

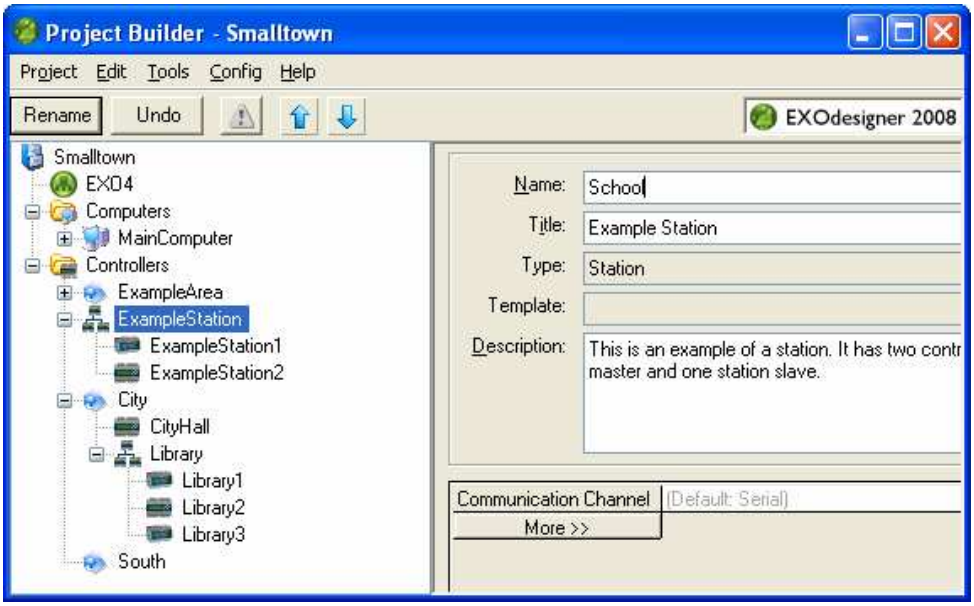
When we created our project, we accepted to get examples of controllers in the project. The station **ExampleStation** that contains two controllers was created. This station was not assigned to an area. We are going to change this station into the station **School** and place it in the area **City**.

Name

The first step will be to rename the station.

Change the name of the station by selecting the station **ExampleStation** in Project Builder and give it the name **School**.

When you push the Enter key (or the Rename button), you are asked if you want to rename the controllers according to the name standard. If you accept, the controllers in the station will automatically be given the names School1 – School2.

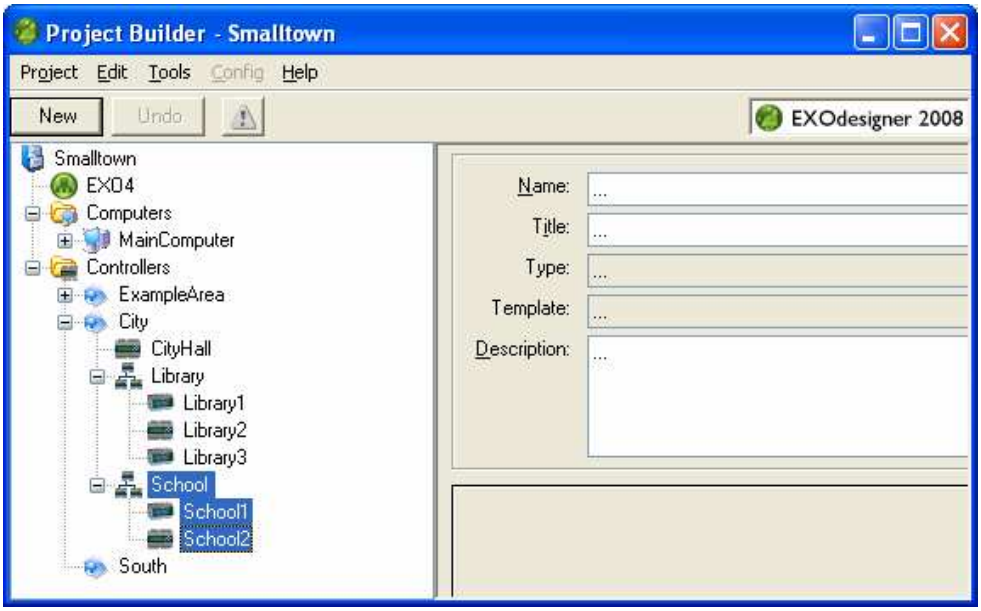


Move The station should be moved into the area City.

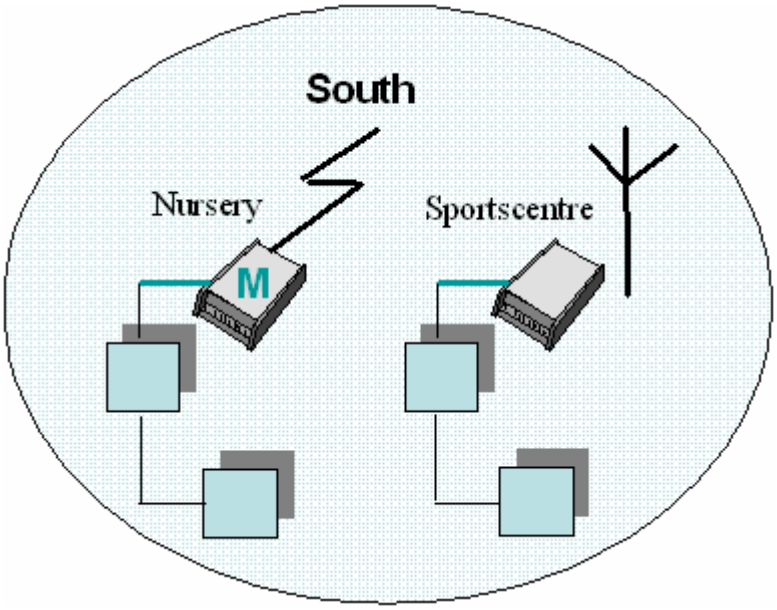
Move the station into the area City in the following way:

- Select the station **School** and click **Edit – Cut** or simultaneously press the **Ctrl+X** keys.
- Select the area **City** and click **Edit – Paste** or simultaneously press the **Ctrl+V** keys.

Result The result is displayed in Project Builder:



Stations and Controllers in the Area South

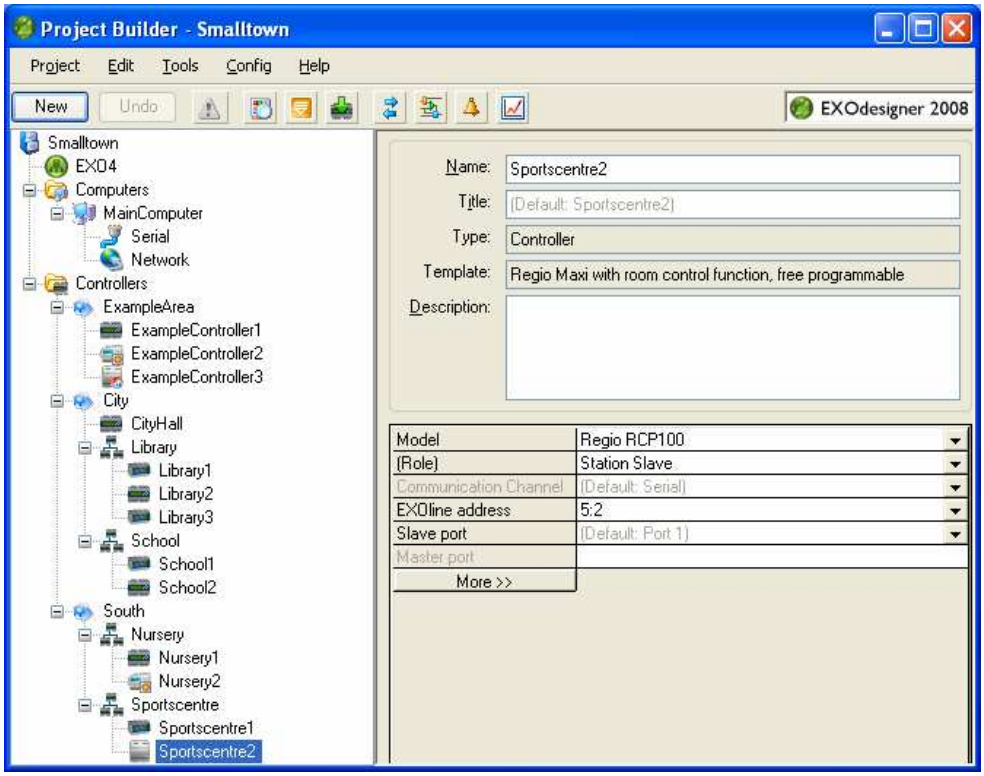


Create the new stations **Nursery** and **Sportscentre** in the area **South**.

The new stations should contain two controllers each, created from templates of choice.

Result

The example project should now have the structure illustrated below.



Communication Channels

Communication

Communication channels are objects containing the configuration for the communication between a main computer and its controllers. Communication channels are always associated with a computer.

EXO4 computer

If you have accepted that the project should contain EXO4 when it was first created in Project Builder, a main computer with the name **MainCompter** is created in the folder **Computers**.

Main Computer

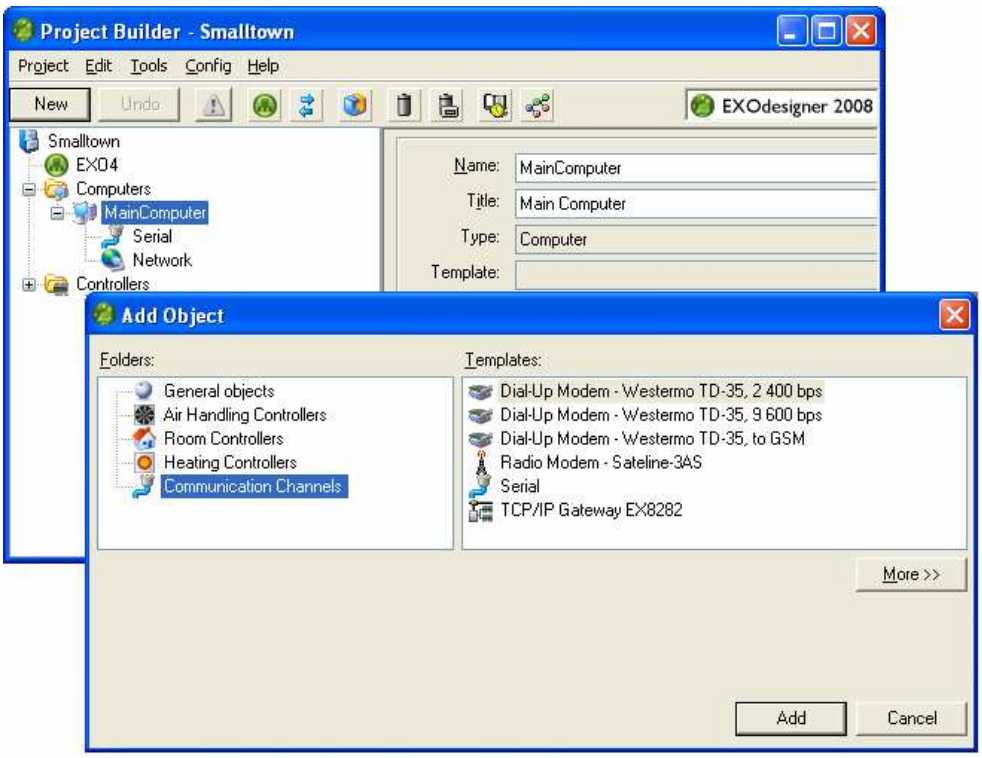
The main computer is a server that initially contains a database.

It also contains two communication channels:

- **Serial** for serial communication with controllers via a fixed cable.
- **Network** for TCP/IP communication with the controllers.

New

A new communication channel for the computer is created by selecting the object **MainComputer** in Project Builder and clicking on the button **New**. Select the required communication channel type in the dialog box Add Object.



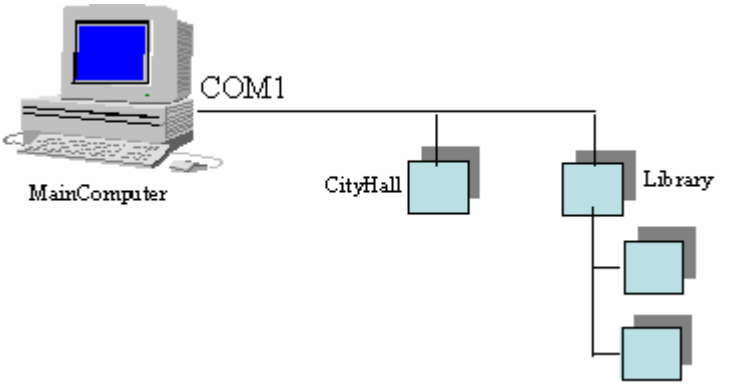
Templates

There are different templates for communication channels. They contain different basic configurations that have been customized for the various communication types. There are only a few configurations to be done by the integrator.

The available templates are:

- Serial for serial communication via a fixed cable between a serial port on the computer and controllers.
- Dial-Up Modem for communication with dial-up controllers.
- Radio Modem for communication with controllers via radio.
- TCP/IP Gateway EX8282 that is used when the connection is made via such a unit.

Serial Communication Channel



Fixed cable

When a new project has been created in Project Builder using the standard template, the main computer will contain a serial communication channel for communication with stations and single controllers via a fixed cable. This communication channel has been given the name Serial.

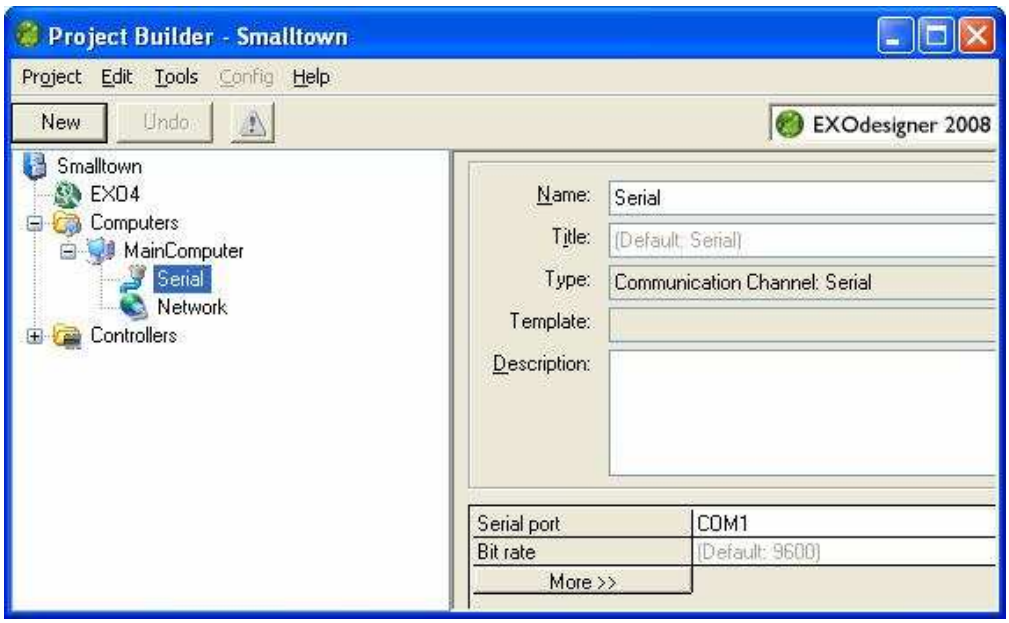
Several serial ports

If the EXO system is required to use multiple serial ports on the computer, a communication channel will have to be created for each such serial port.

Computer

By default, the serial communication path is set to use the physical port COM1 of the computer.

If any other port than COM1 is being used on the computer, this must be entered in the communication channel's attribute **Serial port**.

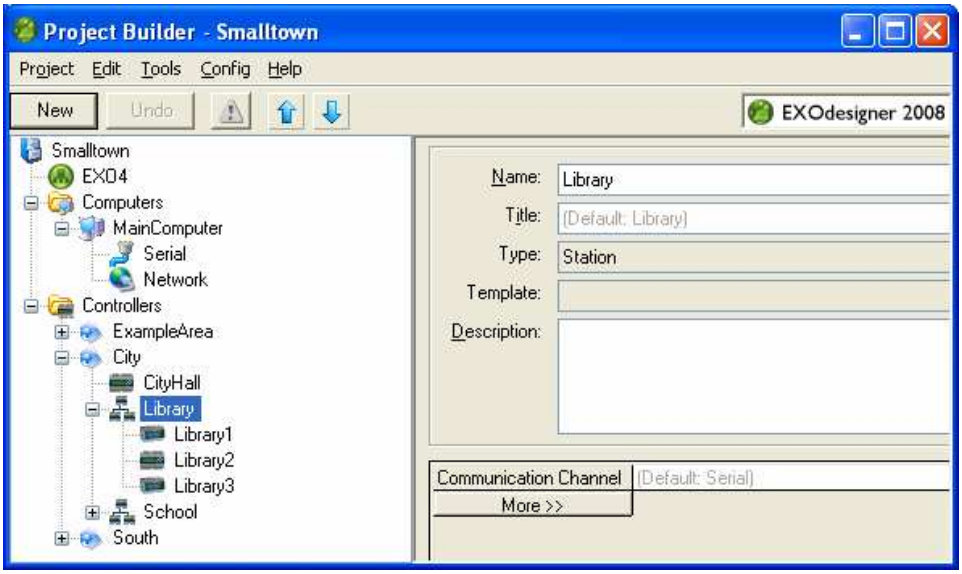


Stations/controllers

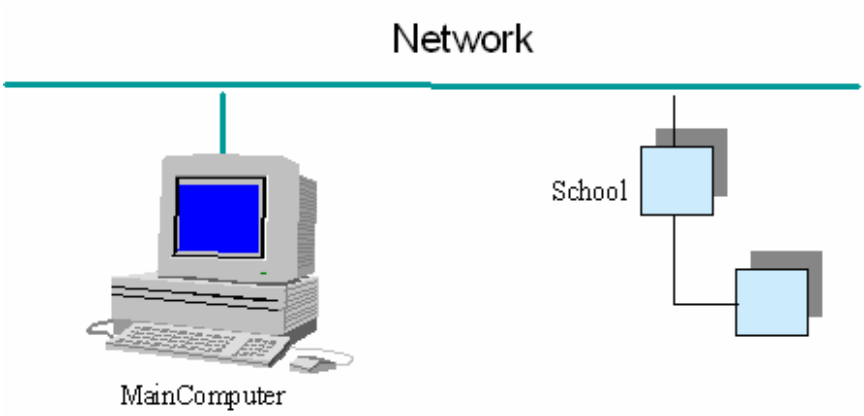
Stations and single controllers are connected to a serial communication channel by selecting the serial communication channel to which it is connected.

If a station or a single controller is to communicate serially with the main computer via a fixed cable, you accept the default setting **Serial** in the attribute **Communication Channel**.

This applies to the station **Library** and the controller **CityHall** in our example.



TCP/IP

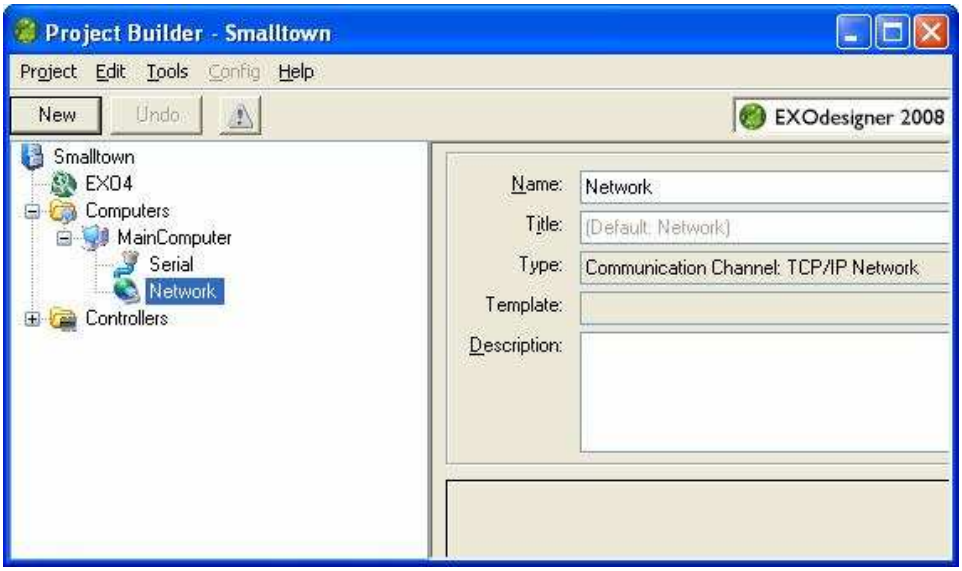


Network

TCP/IP can be used for communication with stations and controllers via a network. Controllers that shall be connected to a TCP/IP network, must either be equipped with a TCP/IP port or be connected to a TCP/IP Gateway EX8282.

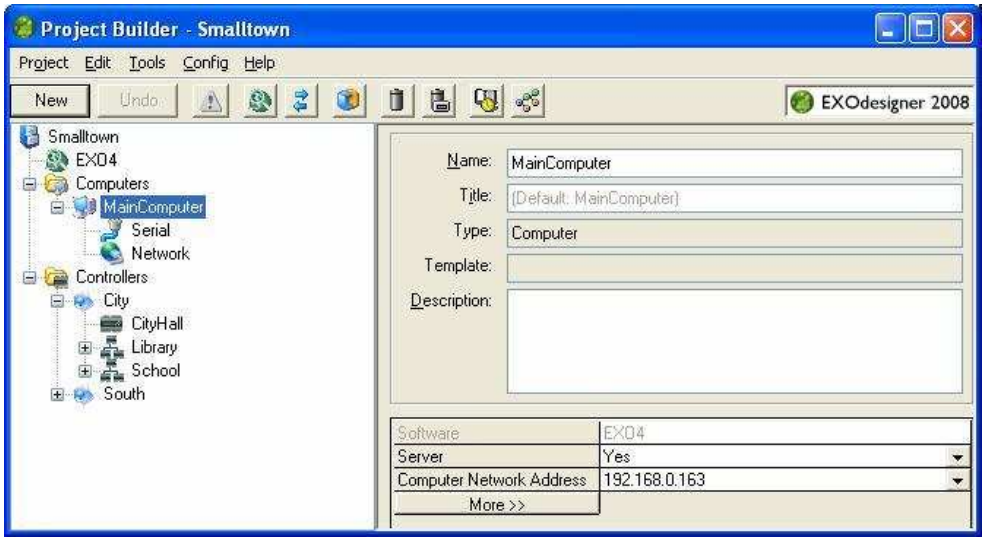
Main computer

When a project has been created in Project Builder using the standard template, the main computer will contain a communication channel for TCP/IP communication with stations and single controllers. This communication channel has been given the name Network.



Computer

No configuration is needed for the communication channel Network but the computer's network address has to be specified in its attribute **Computer Network Address**.



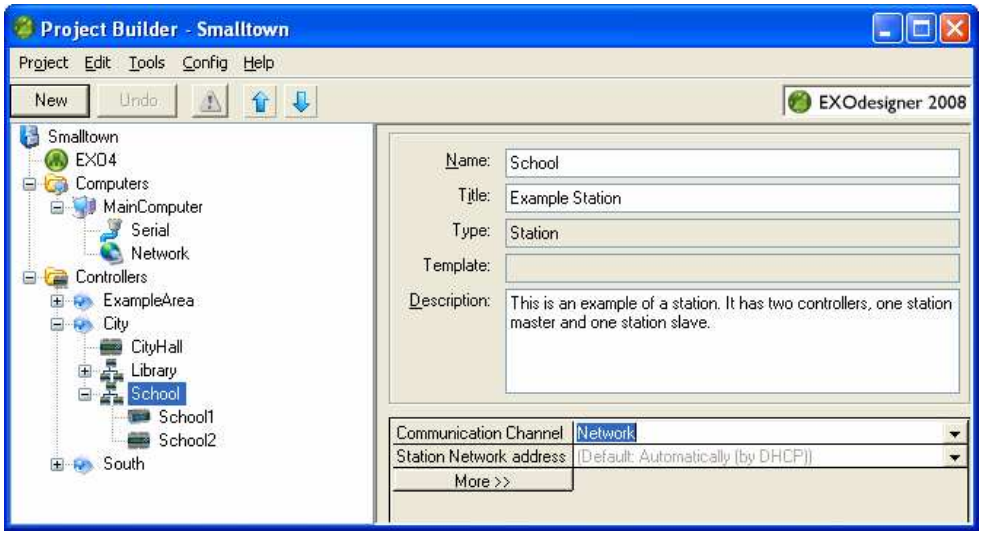
Stations/controllers

Units, such as stations, single controllers and TCP/IP Gateway EX8282, that are going to communicate with the main computer via the network also need to be configured.

Connect a station or controller to a TCP/IP communication channel in the following way:

- Select the station or controller to be connected to the main computer via the network, e.g. the station School.
- Select **Network** in the attribute **Communication Channel**.

  Click on the **Change** button or press the Enter key. The attribute **Station Network address** or **Controller Network address** will be displayed. In this attribute, you can enter the network address**.** In this case, we accept the default setting **Automatically by DHCP**.



Configuration of TCP/IP port

EP8280

Configuration of the older TCP/IP PIFA, EP8280, must be done with the TCP/IP Tool that is opened from the tool EXOflex I/O when this type of PIFA is selected. This tool can not be used for configuring the new TCP/IP PIFA EP8282. Configuration and setup of EP8280 are not described in this manual.

Automatic Configuration of the TCP/IP PIFA EP8282 and the TCP/IP port on EXOcompact, Regio Maxi and Corrigo E are identical. Normally you can use the automatic configuration in Project Builder.

Advanced In more advanced configuration cases, you can select manual configuration of System Function for the controller in Project Builder and use the tool TCP/IP Settings.

Connection methods Project Builder and the TCP/IP port supports three standard connection methods:

- **Automatically (by DHCP)**: The controller gets the IP settings automatically from a DHCP server. The main computer will be able to communicate with the controller, because the controller will use its network address to initiate connection to the main computer.
- **Static IP address**: You select a static IP address for the controller. The address must be appropriate for the subnet where the controller is located. The Subnet Mask and Default Gateway settings must be configured manually with the tool TCP/IP Settings. You get the IP settings from your network administrator. The main computer will communicate with the controller using the configured IP address.
- **DNS Name**: You select a host name and a domain for the controller that together become a DNS Name (`Host.Domain`). The host name should normally be **`EXO`**`_ControllerName`. You get the domain from your network administrator. The controller will get the IP settings automatically from a DHCP Server. The DNS name will be registered in the DNS Server automatically. It requires that the DHCP and DNS servers are able to co-operate. The main computer will communicate with the controller using the DNS name.

Address The connection method that will be used depends on how you configure the network address of the station or controller in Project Builder. You can view the generated settings of the TCP/IP port in the tool TCP/IP Settings, which is accessible from the **Config** menu in Project Builder.

More information More information about controllers in TCP/IP networks can be found in ***EXOdesigner's Help*** (the topic *Communication – Networks*).

Setup

Load The settings of the TCP/IP PIFA EP8282 and the TCP/IP port on EXOcompact, Regio Maxi and Corrigo E must be loaded to the controller as a part of the setup with the tool Setup Controller. When using the tool, a physical controller to setup will be selected automatically or manually. When an EXOflex with the PIFA EP8282 is selected in the tool, the LED marked ID on the PIFA will flash with green color. When an EXOcompact with TCP/IP port is selected in the tool, the LED marked *LAN/Serv* on the controller will flash with orange color.

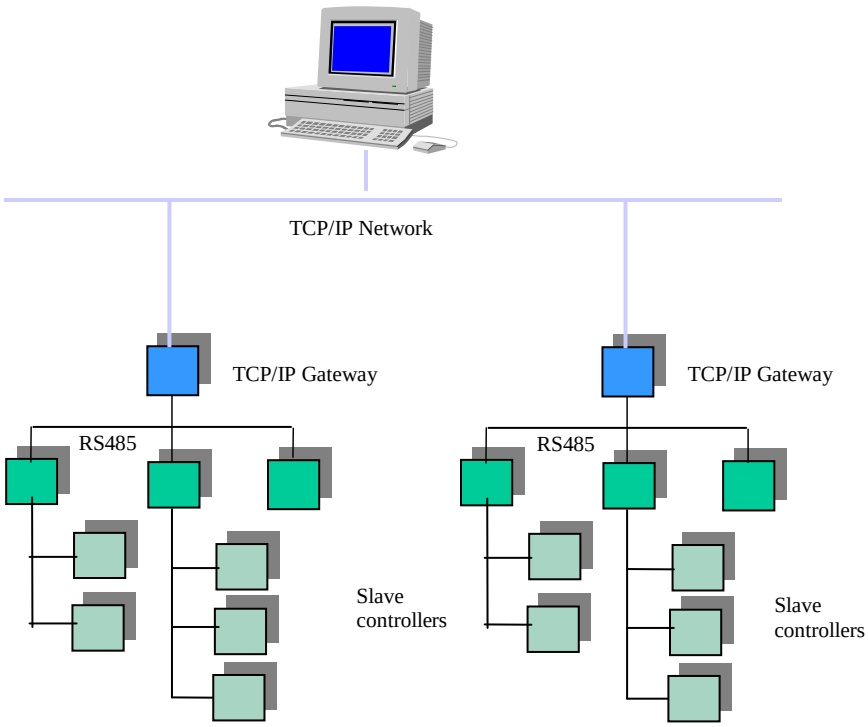
Methods There are two different communication methods to use, when setting up a TCP/IP connected controller:

- On the TCP/IP network. Both the computer and the controller must be configured for the subnet where they are connected.
- With a direct crossover network cable connected between the computer and the controller. The computer must be removed from the network.

Crossover cable By using a direct crossover network cable it is possible to setup the controller regardless of the TCP/IP settings of the computer. The tool will use temporary TCP/IP settings in the computer and/or the controller. In this case the temporary connection can be kept also after the setup has finished (including loading the programs), which makes it possible to check the programs with EXOtest, etc.

TCP/IP Gateway EX8282

Function TCP/IP Gateway EX8282 is normally used to connect a number of controllers to a TCP/IP network. It has the same functions as the TCP/IP port on EP8282, EXOcompact, Regio Maxi and Corrigo E.



Two ports

EX8282 has two communication ports:

- ❑ A TCP/IP port that is intended to be connected to the main computer through a TCP/IP network.
- ❑ A serial port with an RS485 connector and an RS232 connector.

Connections

You can make one of the following connections to the serial port:

- ❑ A number of controllers can be connected directly to the RS485 connector.
- ❑ One controller (with station slaves if any) can be connected to the RS232 connector.

Station

If a station that consists of a number of controllers is connected to the TCP/IP Gateway unit, the slave controllers must be connected "underneath" the master controller.

Compatible

The TCP/IP Gateway EX8282 supports all features of (and is compatible with) the TCP/IP ports of EP8282, EXOcompact, Regio Maxi and Corrigo E.

Connections

For instructions of connections etc., please see the product sheet: http://www.regin.se/pub/filer/product_sheets_gb/ex8282_gb.pdf.

Configuration

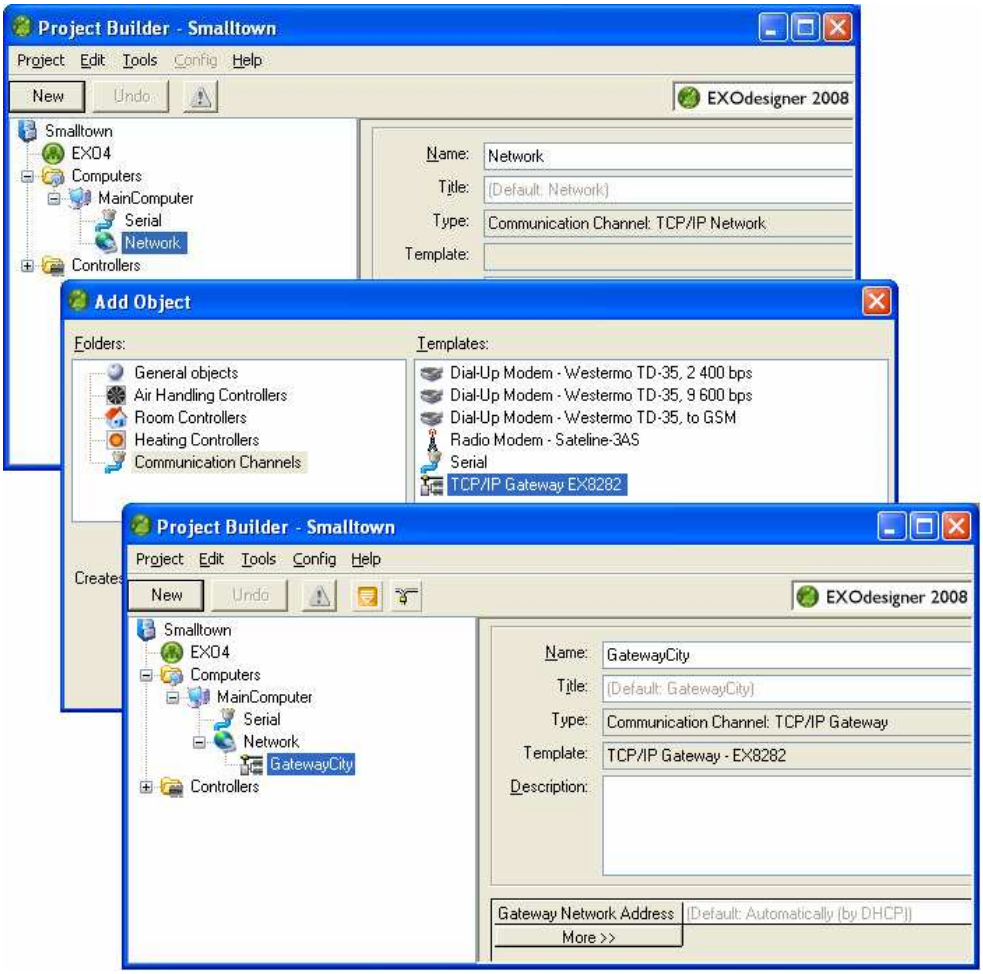
Project Builder

New TCP/IP Gateway objects are created as sub objects to the Network object of the main computer in Project Builder. You can find the TCP/IP Gateway object among the Communication Channels in the Add Object dialog box.

A communication channel for a TCP/IP Gateway object is created in the following way:

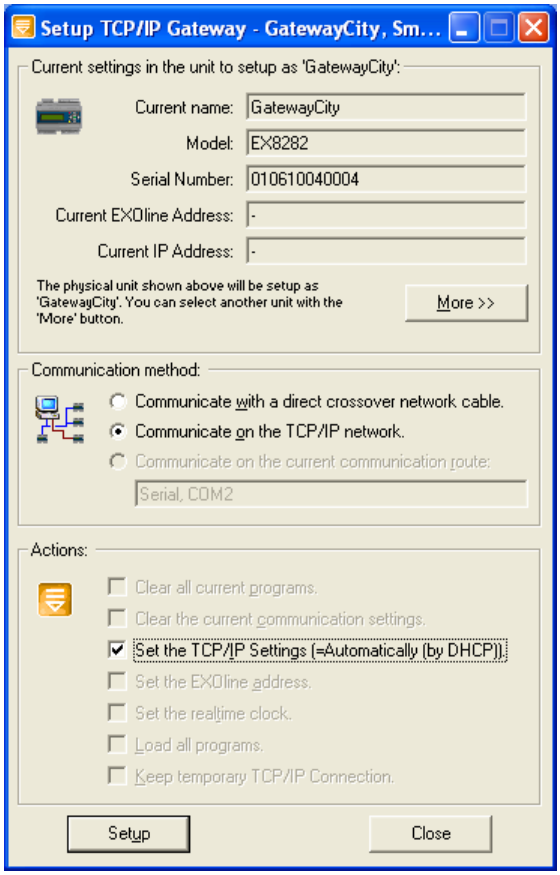
- Select the communication channel **Network** in Project Builder.
- Click on the **New** button to create a new communication channel.
- Select **Communication Channels** in the left part of the dialog box Add Objects.
- Select **TCP/IP Gateway EX8282** in the right part of the dialog and click on **Add**.

  A TCP/IP Gateway object is added below the Network communication channel. You can give it a suitable name.



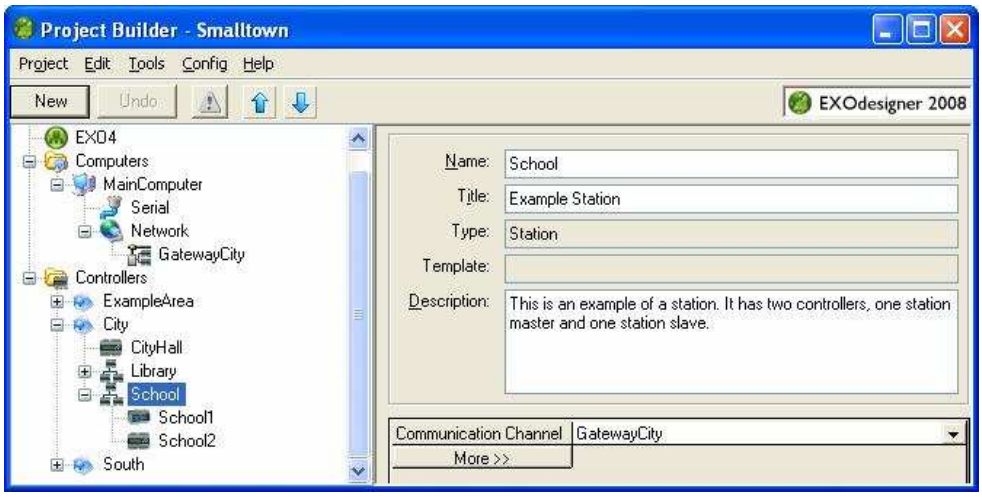
Network address For each gateway, you can configure a name, a title and a network address. The gateway network address can be configured in the same way as that of controllers, i.e. *Automatically (by DHCP)*, *Static IP Address* or *DNS Name*.

Setup When these parameters are configured, you must download the TCP/IP settings to EX8282. You do that with the command **Setup TCP/IP Gateway**. It is similar to the command **Setup Controller**.



Stations/controllers

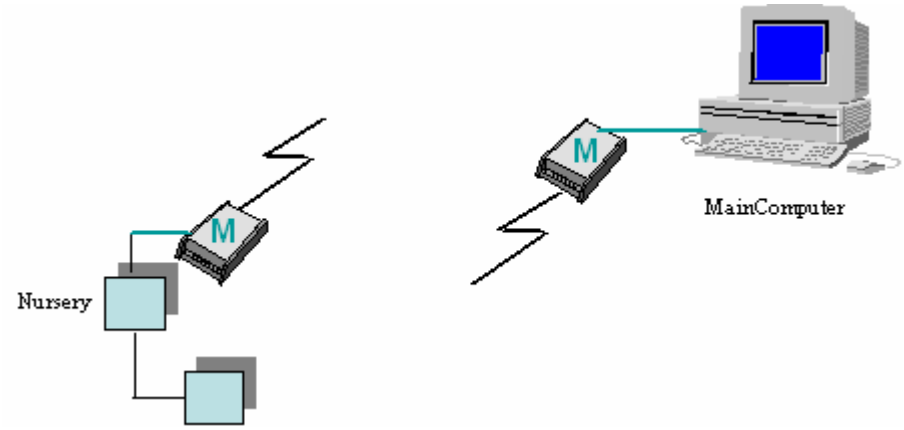
For stations and controllers that are connected to a TCP/IP Gateway, you select the gateway as communication channel.



Advanced

Both TCP/IP Gateways and controllers can be configured manually for advanced purposes.

Dial-Up

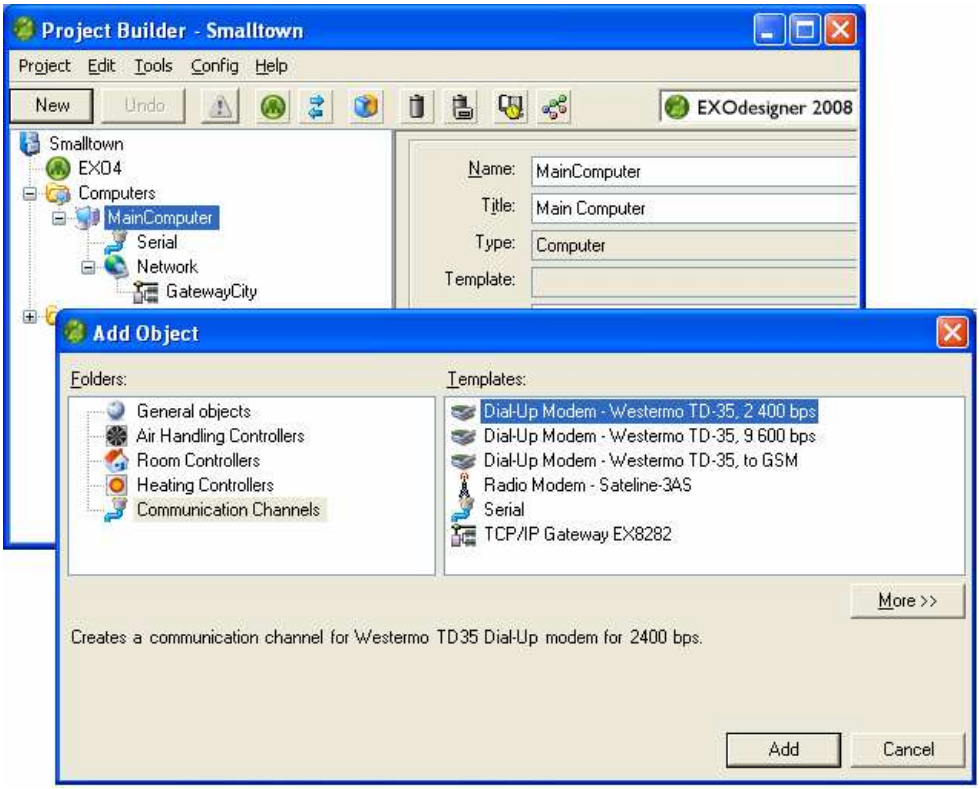


Dial-up modem A communication channel of the type Dial-Up Modem is used for communication between the main computer and dial-up stations/single controllers.

New When a communication channel of the type Dial-Up Modem is created in Project Builder, you select one of a number of pre-configured modem types at different speeds to simplify the configuration. By modem type, we mean the type of the modem that is connected to the computer.

A communication channel for a dial-up connection is created in the following way:

- Select the computer to which the modem is connected.
- Click on the **New** button to create a new communication channel.
- Select **Communication Channels** in the dialog box Add Object and select modem type (2 400 bps, 9 600 bps or GSM).
- Click on the **Add** button to add the communication channel.



Modem group

When the first modem communication channel is added to a computer, a modem group is automatically created.

Multiple modems

If there are several modems connected to the computer a group telephone number can be used to ensure that all incoming calls are received when there is a modem available.

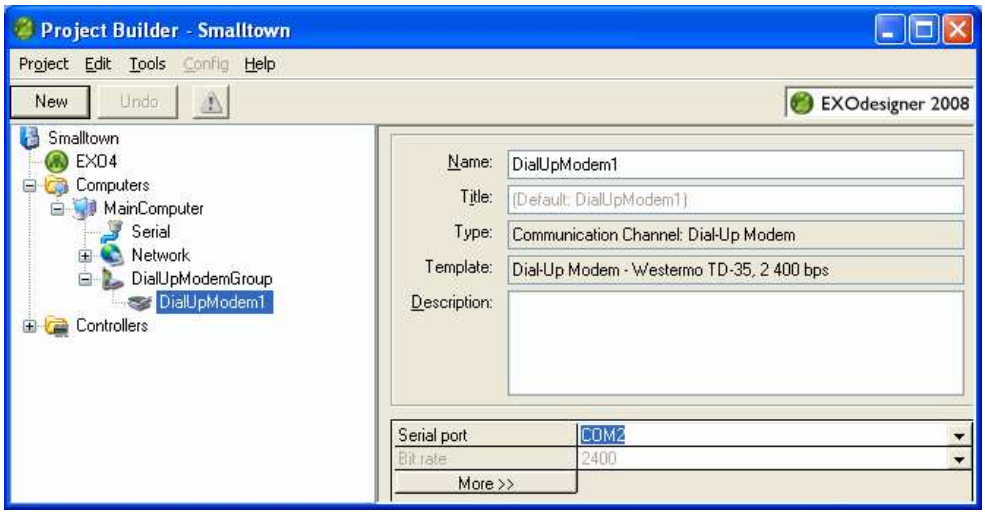
If there is no group number, two modem groups can be created, one for incoming calls and one for outgoing calls.

Physical port

In Project Builder you configure to which physical port on the computer each modem is connected.

Configure to which communication port on the computer the modem is connected.

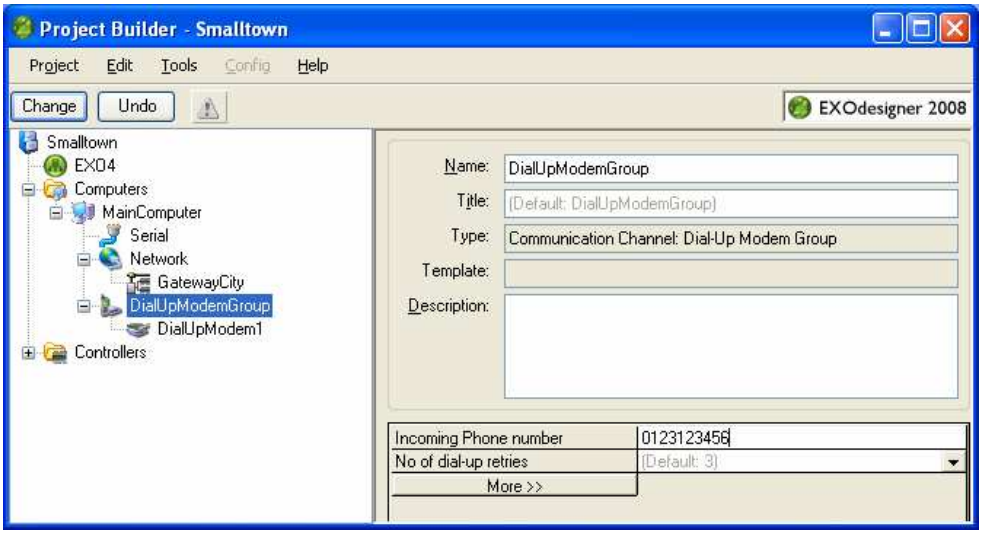
- Select the modem in Project Builder.
- Select the serial port in the attribute **Serial port**.
- Click on **Change** or press the Enter key.



Telephone number

Configure the telephone number of the modem or the modem group.

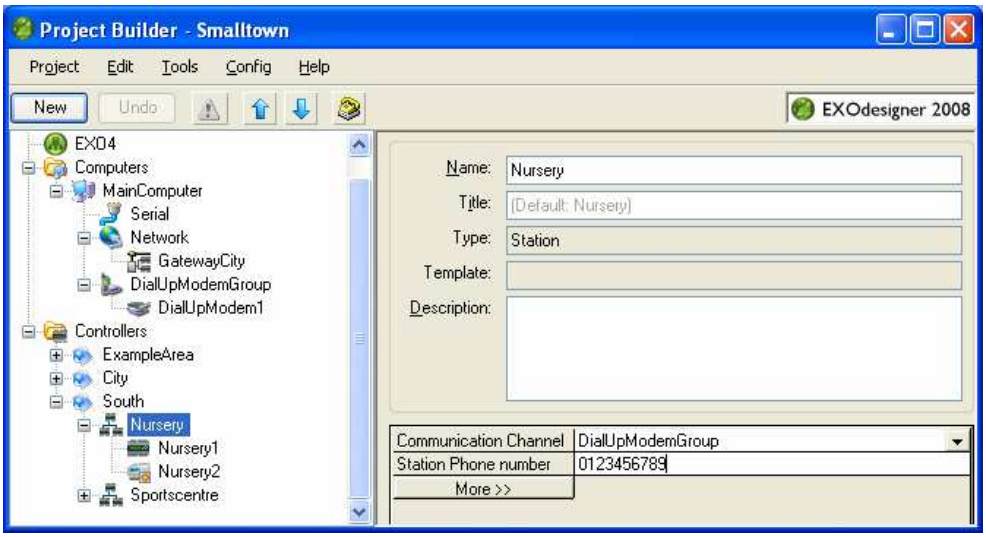
- Select the modem's modem group in Project Builder.
- Enter the telephone number of the modem in the attribute **Incoming Phone number**.
- Click on **Change** or press the Enter key.



Station/controller A dial-up station or single controller has to be configured with its telephone number.

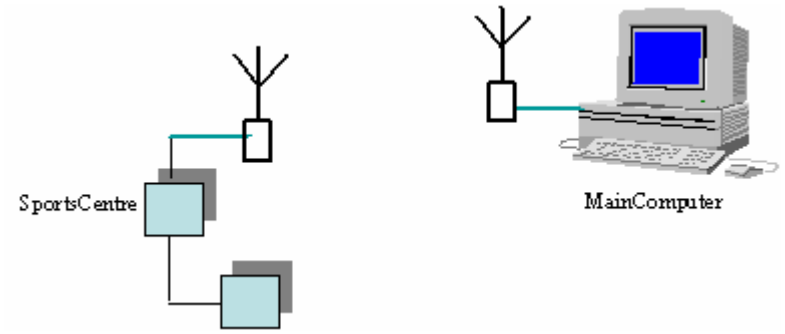
A dial-up station or single controller is configured for communication in the following way:

- Select the dial-up station Nursery in Project Builder.
- Select **DialUpModemGroup** in the attribute **Communication Channel**.
- Click on **Change** or press the Enter key. The attribute **Station Phone number** is displayed.
- Enter the telephone number of the station in the attribute **Station Phone number**. (For single controllers, this attribute is called **Controller Phone number**).



More information A more detailed description of dial-up stations can be found in ***EXOdesigner's Help*** (the topic *Communication – Communication Media – Dial-up*).

Radio



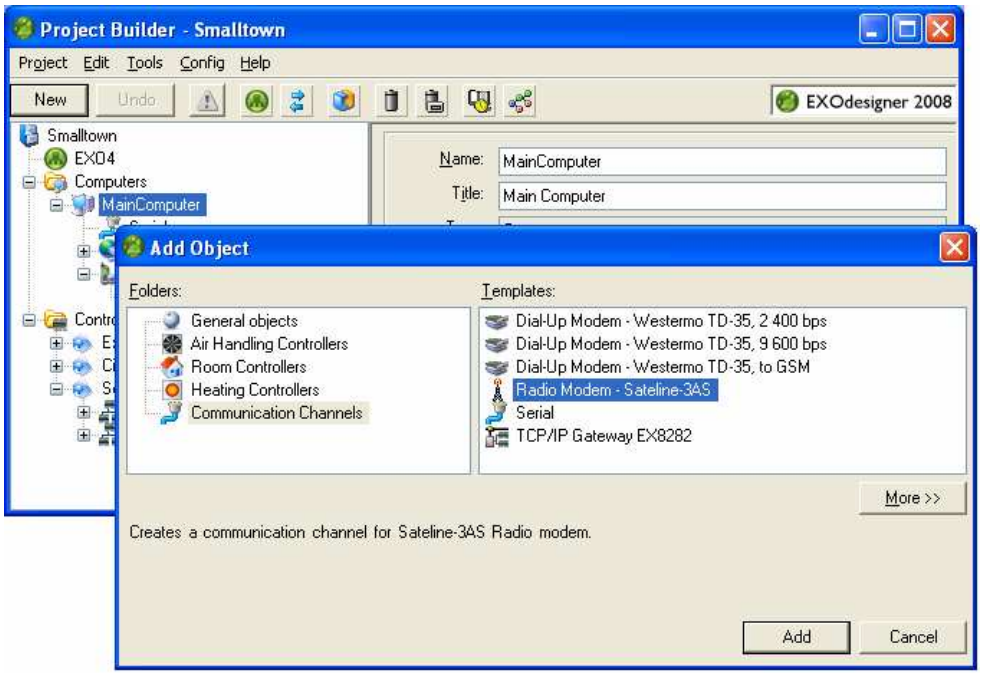
Modem

For communication via radio the modem model Sateline-3AS with the transfer speeds 2400, 4800 or 9600 bps is used.

New

A radio communication channel created in the following way:

- Select the computer to which the radio modem is connected.
- Click on **New** to create a new communication channel.
- Select **Communication Channels** in the dialog Add Object and select the radio modem.
- Click on **Add** to add the communication channel.

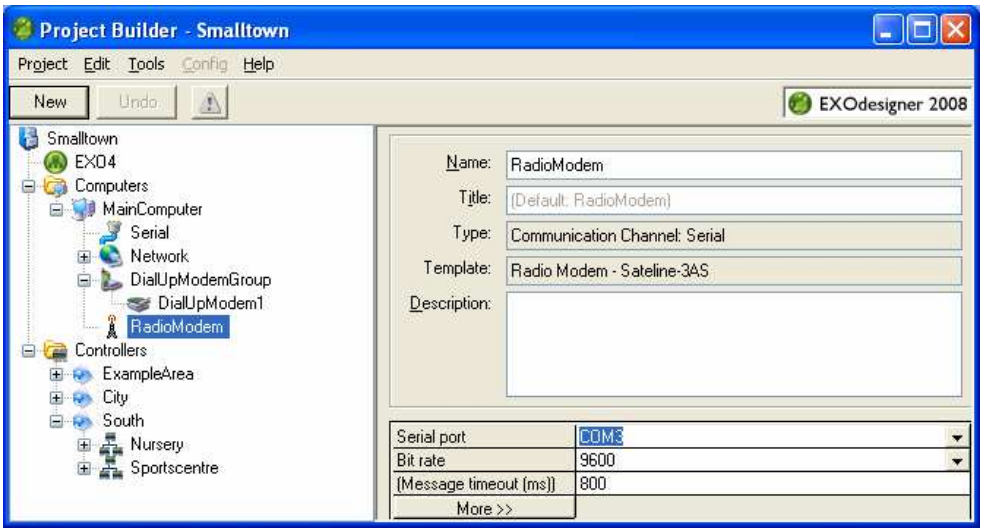


Physical port

The physical port that connects to the computer's radio modem, and the transfer speed and time out of the radio modem, are configured in Project Builder.

Configure the radio communication channel.

- Select the radio modem in Project Builder.
- Select the serial port in the attribute **Serial port**.
- If needed, change the communication speed in the attribute **Bit rate** and the value for timeout in **Message timeout (ms)**.
- Click the **Change** button, or press the Enter key to accept the configuration.

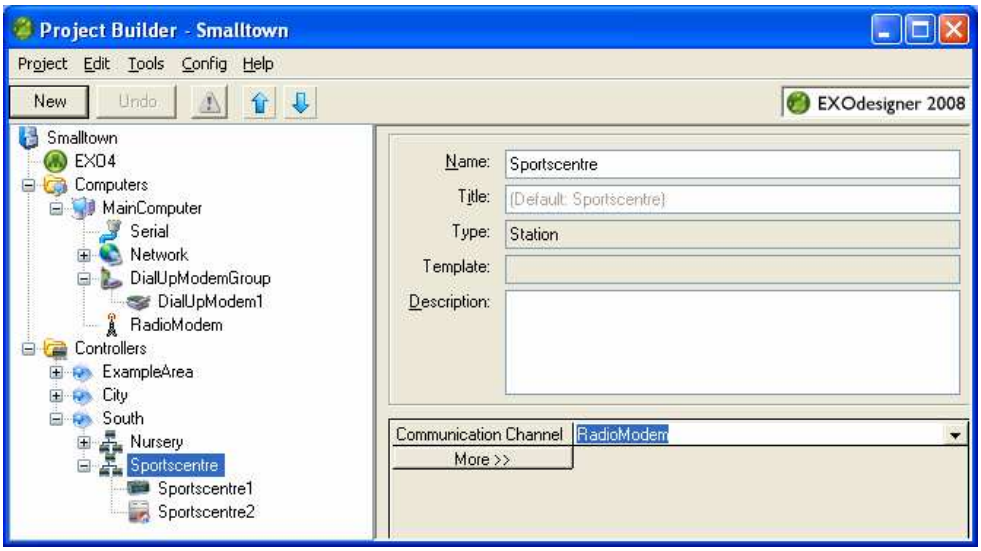


Stations/controllers

Stations and controllers that communicate via radio must be linked to the radio modem communication channel.

Configure a station or a controller with a communication channel for radio modems.

- Select the station that communicates via radio.
- Select **RadioModem** in the attribute **Communication Channel**.
- Click on the **Change** button or press the Enter key.



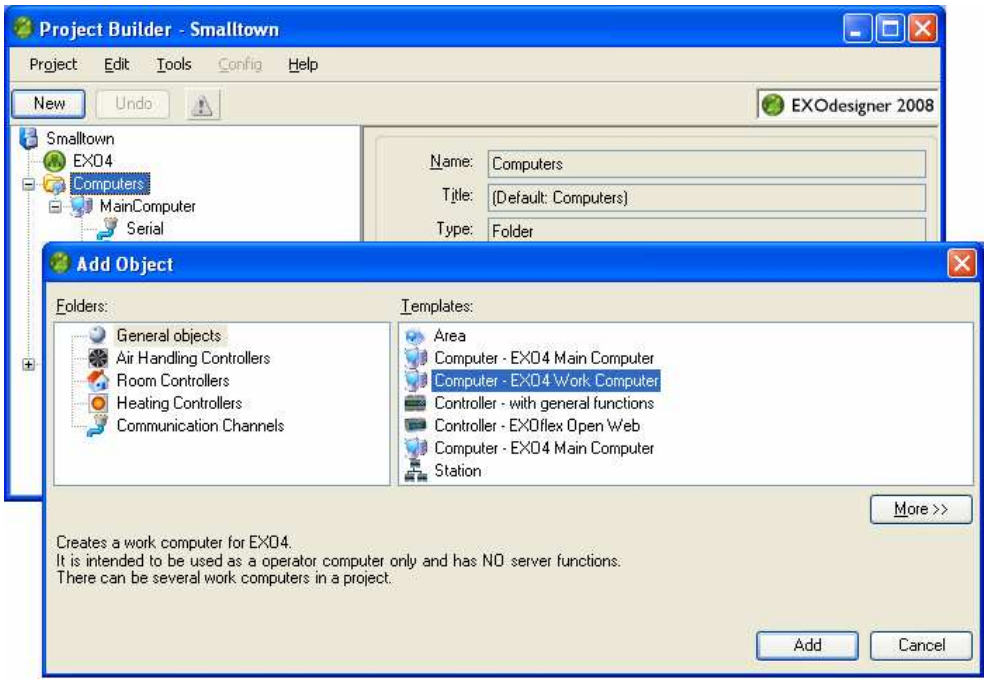
Computers

New computer

New computers can be created in Project Builder. Usually a project has one or several work computers, besides the main computer.

Create the new computer **WorkComputer** in the following way:

- Select the folder **Computers** in Project Builder and click on **New**.
- Select **General objects** in the left box, and then **Computer – EXO4 Work Computer** in the right box in the dialog Add Object.
- Click on **Add**.



Templates

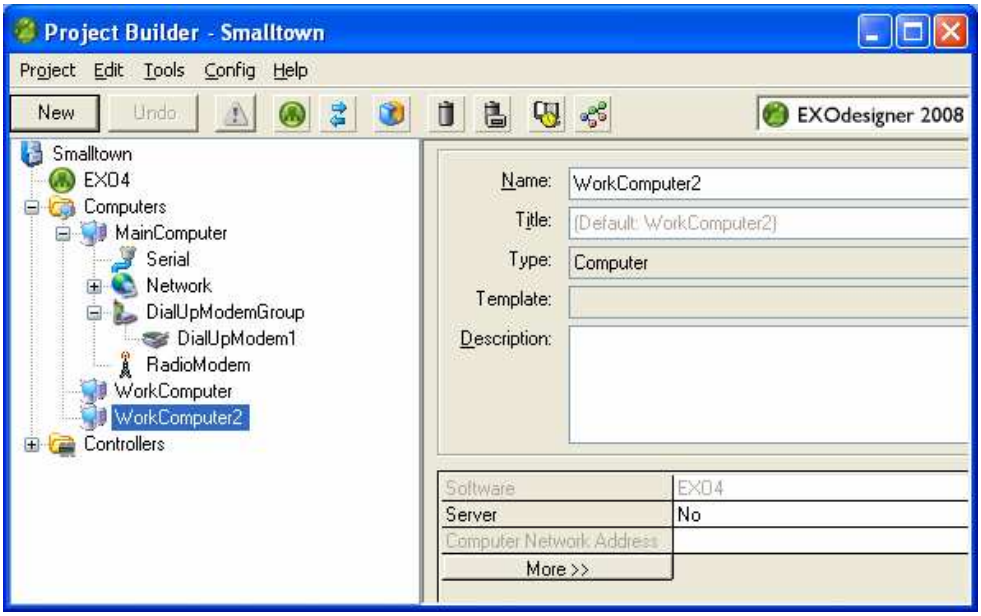
There are two templates for creating a new computer.

- ❑ If you choose to use EXO4 in the project, an EXO4 Main Computer is automatically created when the project is created. This computer is a server and has by default an MSDE database and two communication channels for communication with controller stations, one for serial communication and one for communication via a network.
- ❑ EXO4 Work Computer is a work computer with EXO4. It is not a server and therefore it has no database. Work computers can communicate with all controllers in the project via the main computer. They can also gather and display information from the database of the main computer.

Name

Usually you give the work computers names that associate to their physical location or to their function in the project. Generally, the main computer keeps the name MainComputer. As usual, the name may not contain e.g. spaces.

Also create the new computer **WorkComputer2** in the same way.

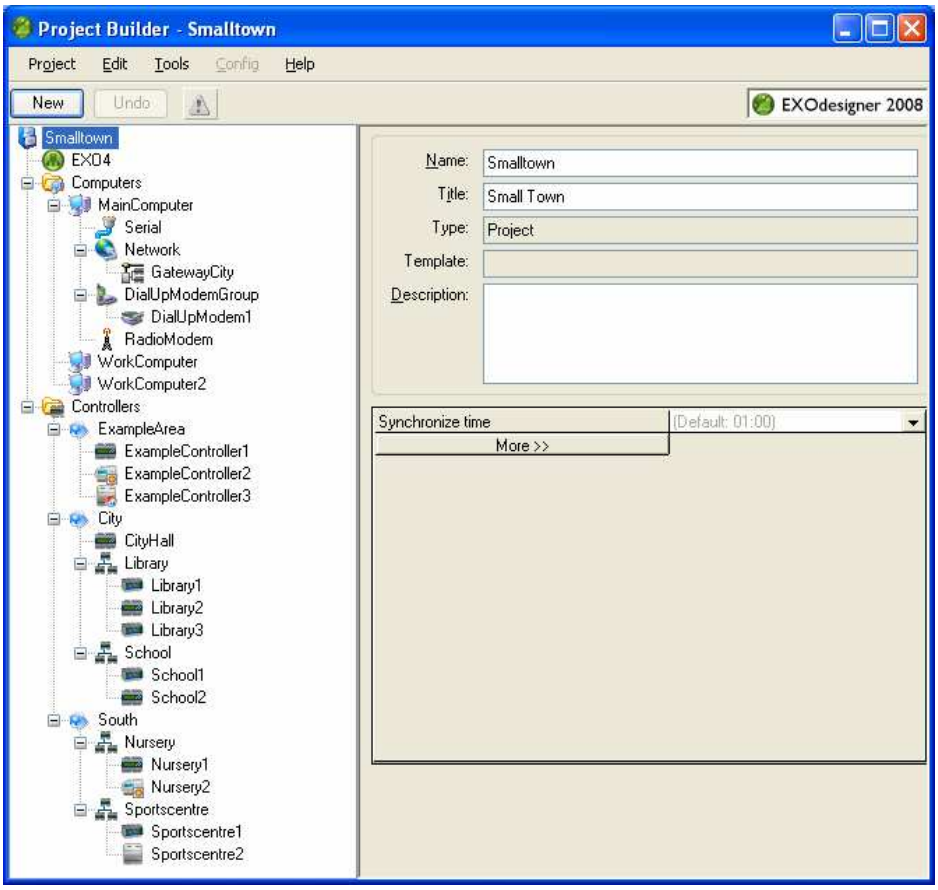


Network Address

Main computer

For the network communication to work between the main computer and the work computers in a project with one or more work computers, the IP address or the DNS name of the main computer must be entered in the attribute **Network address**.

- Select the computer that is to communicate with work computers via the network.
- Enter the IP address or the DNS name of the computer in the attribute **Network address**.



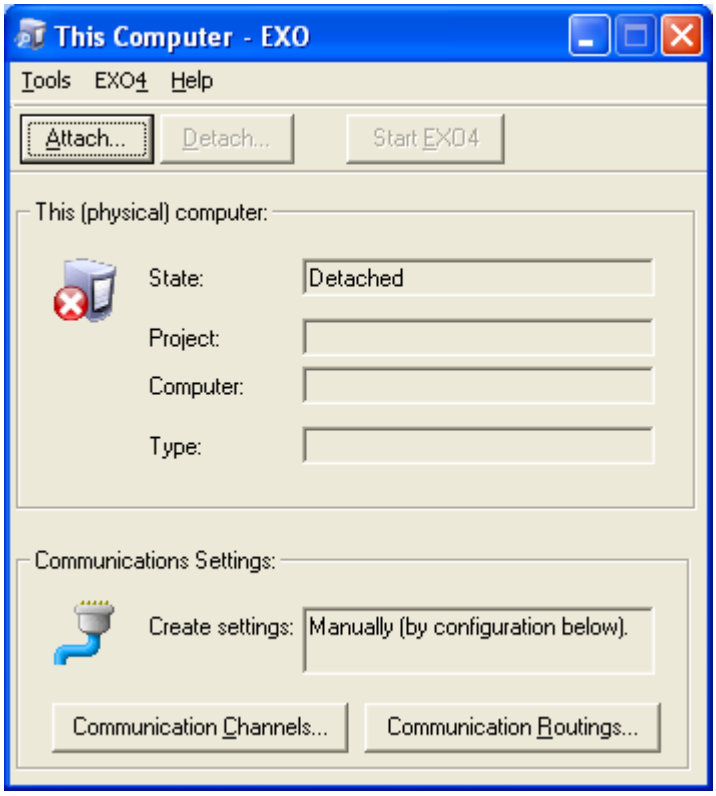
Whole project The above picture shows the whole project. The project now corresponds to the first figure of this chapter, except that the project also includes the area ExampleArea with its three single controllers.

Attach and Detach

Detach Any computers created in Project Builder will be detached by default. This means that the settings made in Project Builder for communication with stations are not activated.

Attach When the project has been copied to the **customer's** computers, you use the tool This Computer to attach each physical computer to a computer that has been created in Project Builder. Thereafter, the communication settings made in Project Builder are active. The tool This Computer is described in the chapter ***Commissioning***.

Integrator mode The integrator should use the mode **Detach** (except in rare circumstances). If any communication configuration is needed, it should be done using the Communication Tool, which is described in ***EXOdesigner's Help***.



Chapter 9 Configuring Controllers

Procedure

The programming and configuration of a controller is typically performed in the following steps:

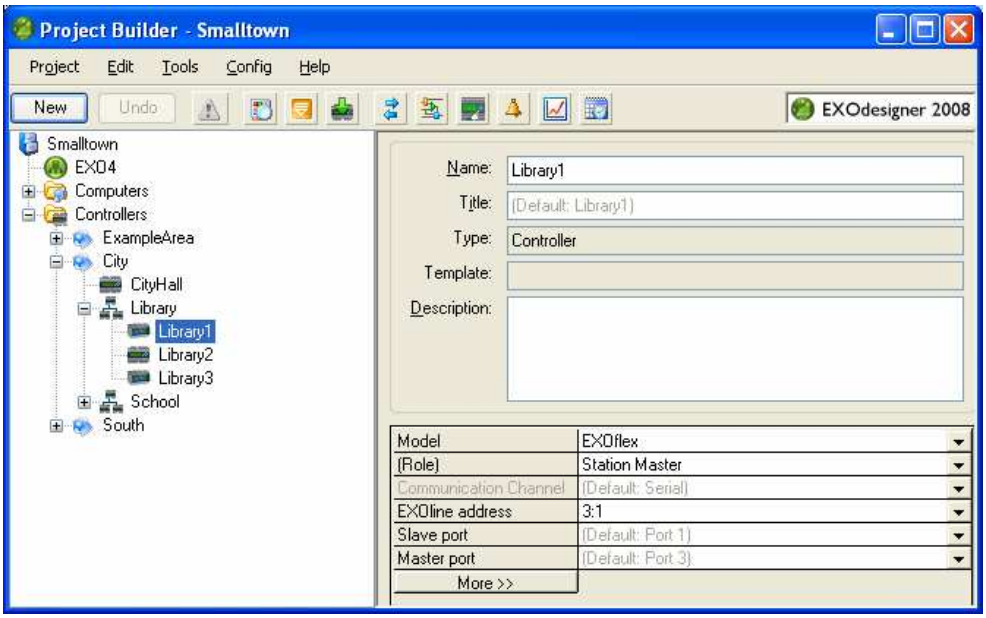
- ❑ Programming and configuration of the controller's functions using EXOdesigner.
- ❑ Connect a computer to the controller and set its address.
- ❑ Load the programs to the controller.
- ❑ Check that the controller is working appropriately. If this is not the case, you need to troubleshoot, correct the error and redo the loading and testing.

Communication Ports

Station master

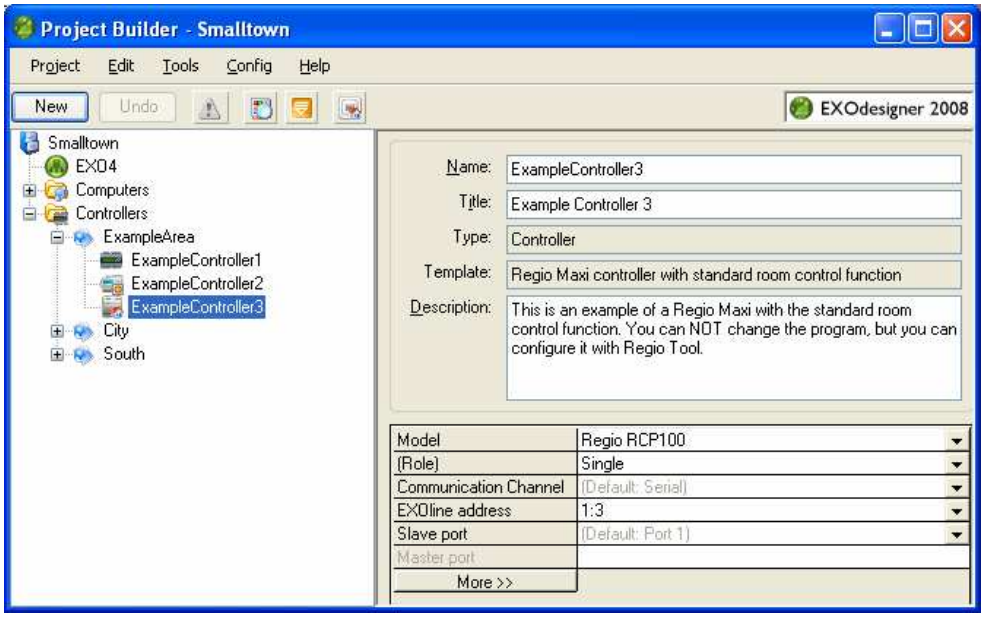
The communication ports on a station master controller have the attributes **Slave port** and **Master port** in Project Builder.

- ❑ **Slave port**: The controller's communication port to its main computer. The default setting depends on the type of communication channel it is connected to.
- ❑ **Master port**: The controller's communication port to its slave controllers, i.e. all other controllers on the same EXOline line. The default setting is **None** if there are no slave controllers.



Others

A controller that is a station slave or a controller with the role single (i.e. a controller that is not included in a station) has only one communication port (port #1), which is the controller's port to its master (the station master or the computer). Normally, no configuration of this communication port is needed.



Check the configuration of the communication ports of the controller, i.e. the attributes **Slave port** and **Master port.**

Controllers

Setting the Address of the Controller

Unique address

Each controller in a project must have a unique EXOline address. The address consists of two numbers, PLA and ELA, which normally is written PLA:ELA.

PLA:ELA

All controllers in a station have the same PLA address, but different ELA addresses. The station master must have the lowest ELA address, often 1 (one), and the station slaves have the subsequent ELA numbers in ascending order.

Automatically

The address of the controller is automatically generated by Project Builder and is displayed in the attribute **EXOline address**.

Default address

On delivery from the factory, the default address of the controller is always 254:30. It is only possible to load a program to a controller using the address that was configured in Project Builder. This is why the physical address of the controller first has to be set with the command **Setup Controller**.

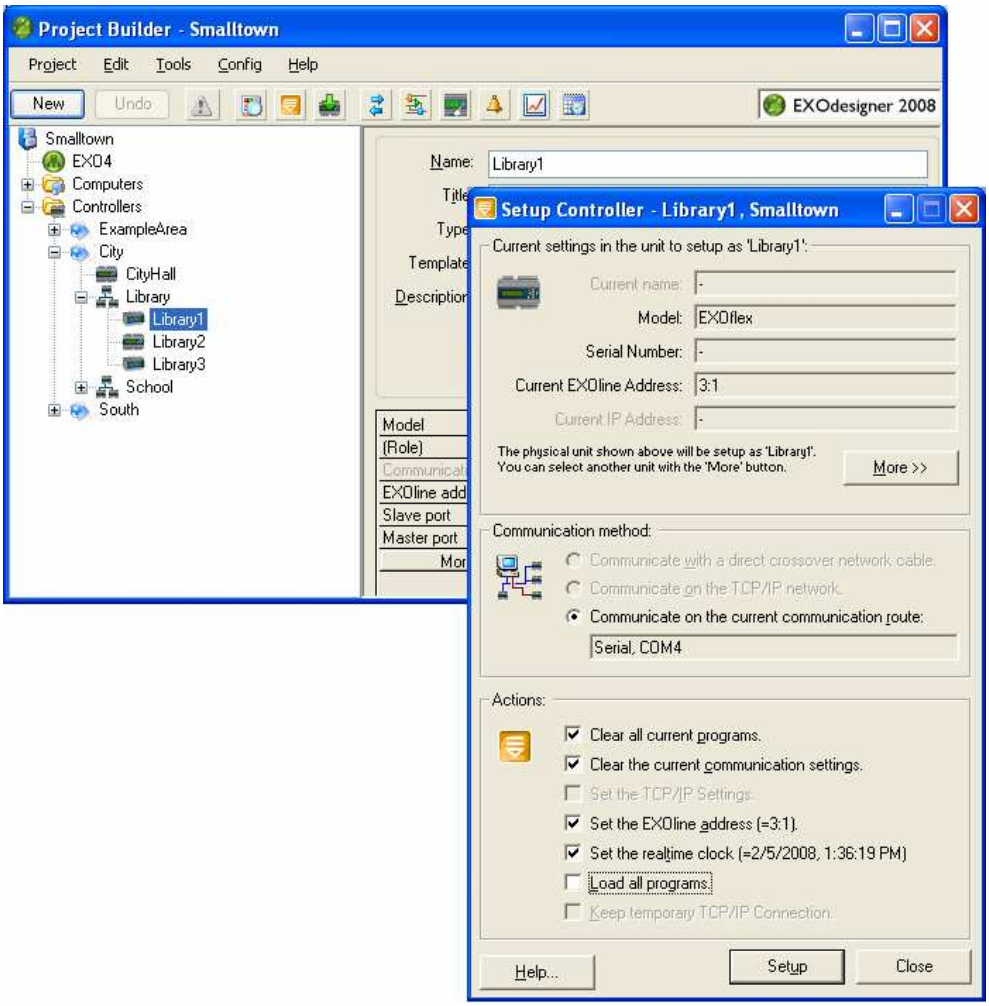
During **Setup** there must be only **one** controller with the same address, e.g. the factory default address, connected to the computer.

Setup

Setting the address using the command **Setup Controller**.

- Select the controller whose address is to be set in Project Builder, that is **Library1** (EXOflex) or **CityHall** (EXOcompact) depending on which type of controller you have serially connected to your computer.
- Click on the **Setup Controller** button, select **Tools – Setup Controller**, or press the keys **Shift+F5**.
- Unselect the command **Load all programs** and click the button **Setup** at

the bottom of the window to set the controller's address and real-time clock.



Setup The command **Setup Controller** will execute within a few seconds.

Set an address In the chapter ***Commissioning*** there is a description of what to think of when setting addresses for different kinds of controllers. There is also a description of how to reset the configuration for ports during runtime using objects and display, which may be necessary.

Restore Occasionally, e.g. when a controller has been replaced, it may be necessary to restore the factory default settings of the old controller. This can be done with the menu command **Tool - Reset (to factory settings)**. All application programs will be deleted on the controller, the communication ports will resume their default settings and the controller's address will be restored to 254:30.

Configuring the Controller's Functionality

Templates There are some templates with ready-made applications that can be used to create new controllers. There are e.g. templates for creating EXOflex and EXOcompact controllers with air handling and heating systems. If required, more functionality can be added to these applications.

An outline describing the functions of air handling and heating systems, process windows in EXO4, etc. can be found in ***Part VI Controller Templates***.

General functions There are also templates for creating EXOflex, EXOcompact or Regio Maxi controllers with general functions. These are used for manual programming and configuration of the controller.

Empty controller

The template Empty controller when no functions or programs should be added to the EXOflex, EXOcompact or Regio Maxi controller. This is normally used when you want to create your own special programs. (This template appears in the dialog Add Object when General Objects is selected and the button More is clicked).

Controller Functions

Controller functions

Controller functions are used to provide EXOflex, EXOcompact, and Regio Maxi controllers' functionality, such as display, alarm management and logging.

Toolbar

When a controller has been created in Project Builder, buttons are displayed on the toolbar. These buttons are used to open various configuration tools (windows for configuration of the functions' properties). These windows can also be opened from the **Config** menu or by using hotkeys.

Button	Text	Description
	EXOflex I/O **Inputs and Outputs**	Configuration tool for the controller's inputs and outputs. Inputs and Outputs is used for other controller models than EXOflex.
	Objects	Tool for adding, deleting and configuring controller objects.
	Display	Tool for adding, deleting and configuring menu items and dialog boxes for the display of the controller.
	Alarms and Events	Tool for adding, deleting and configuring the alarm points and digital event points of the controller.
	Logging	Tool for adding, deleting and configuring analog signals on the controller for storing in a database on the main computer.
	Time Channels	Tool for adding, deleting and configuring time channels.

Inputs and Outputs

EXOflex

The tool EXOflex I/O is used to define the PIFA units of the EXOflex unit. Thereafter, the inputs and outputs of the PIFA units are configured with the required functionality using the tool PIFA I/O.

EXOcompact

For EXOcompact and Regio Maxi, the tool Inputs and Outputs is used to configure the inputs and outputs.

Description

The configuration of the controller's inputs and outputs is described in the chapter ***Inputs and Outputs***.

Control and Automation

Freely programmable

EXOflex, EXOcompact and Regio Maxi are freely programmable, which makes them easy to adjust to each specific application. The programming of the control and automation functions of the controller can be performed by the use of objects or by using the high level programming language EXOL.

Objects

The quickest and simplest way to program the control and automation functions is to use the objects in EXOdesigner. Objects can be added and configured using the tool Objects.

Description

The chapter ***Control and Automation*** provides a description of control and automation using controller objects. EXOL programming is not included in this manual.

Display

Description Configuration and operation of the controller's display are described in the chapter ***Display***.

Alarms and Events

Description The chapter ***Alarms and Events*** provides a description of the configuration of alarm points and digital events using the tool Alarms and Events.

Logging

Description The chapter ***Logging*** provides a description of the configuration of logged analog signals using the tool Logging.

Time Control

Description The chapter ***Time Control*** provides a description of the configuration of time control using the tool Time Channels and the EXO4 objects EXO4 Time Channels and EXO4 Calendars.

Other Controller Functions

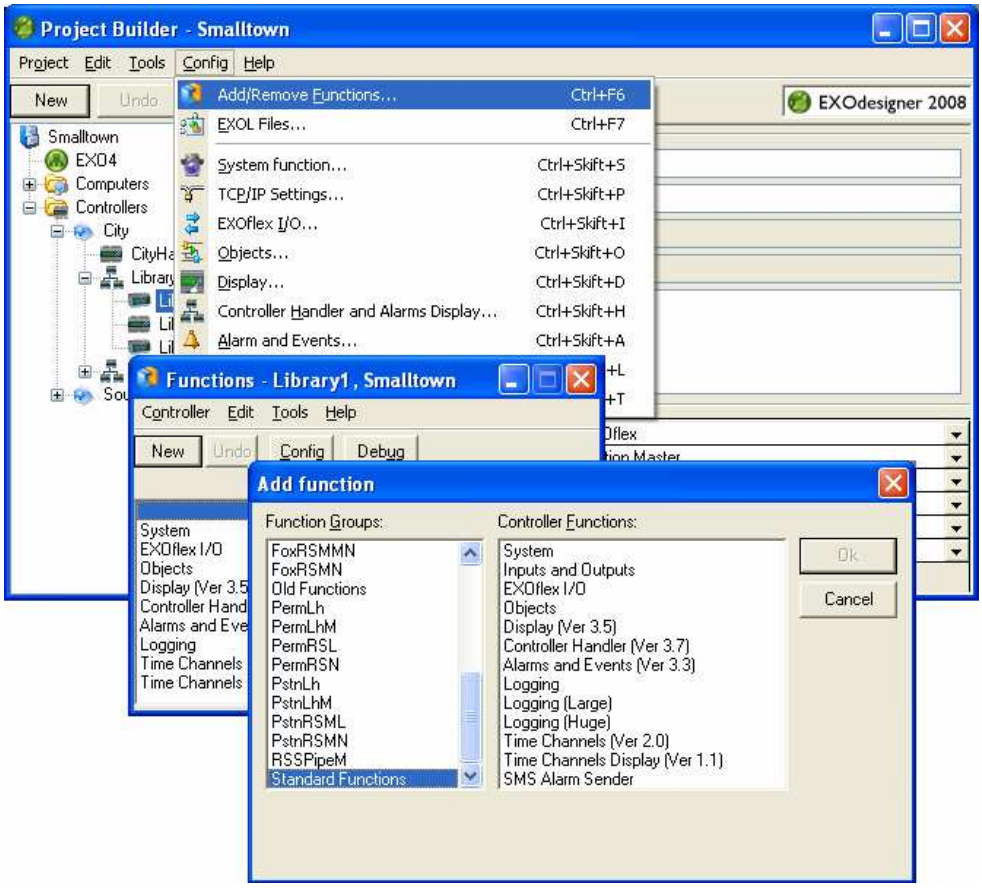
Description Other controller functions are not included in this manual. Please refer to ***EXOdesigner's Help***.

Adding More Controller Functions

Adding It is possible to add more controller functions than the ones that initially were added to a controller, e.g. if you discover that you need time control.

Add controller functions, that were not automatically added by Project Builder, in the following way:

- Select the controller that is to contain one or more functions that were not added automatically.
- Click on **Config – Add/Remove Functions**.
- Click on the **New** button in the dialog box Functions.
- Select the controller functions to be added in the dialog box Add Function and click on the **OK** button.
  - To select multiple consecutive controller functions, select the first required function, press and hold the **Shift** key, and select the last required function in the list.
  - Select multiple single controller functions by pressing and holding the **Ctrl** key while you select the various functions.



Loading Programs to the Controller

Modifications

When application programs have been added or modified, either by programming of control functions or by configuration of controller functions, the controller needs to be loaded with the new programs.

First time

The first time a controller is loaded with the newly developed programs, it must be cleared, i.e. it should not contain any user-defined data, configurations or programs. The command **Setup Controller** clears the controller and sets its address according to the configuration in Project Builder. This is described in the above section ***Setting the Address of the Controller***.

Synchronize

When the controller has been in operation for some time, the operator might have made changes in parameter values that affect the operation, e.g. alarm limit settings. In this case, it is advisable to first upload the values of the physical controller and compare them with the values of the configuration tool. This can be done using the command **Synchronize Parameters** in tools with this option.

Loading programs

All application programs that have been configured and programmed in the computer are loaded to the physical controller by selecting the controller in Project Builder and clicking the **Load Controller** button on the toolbar.

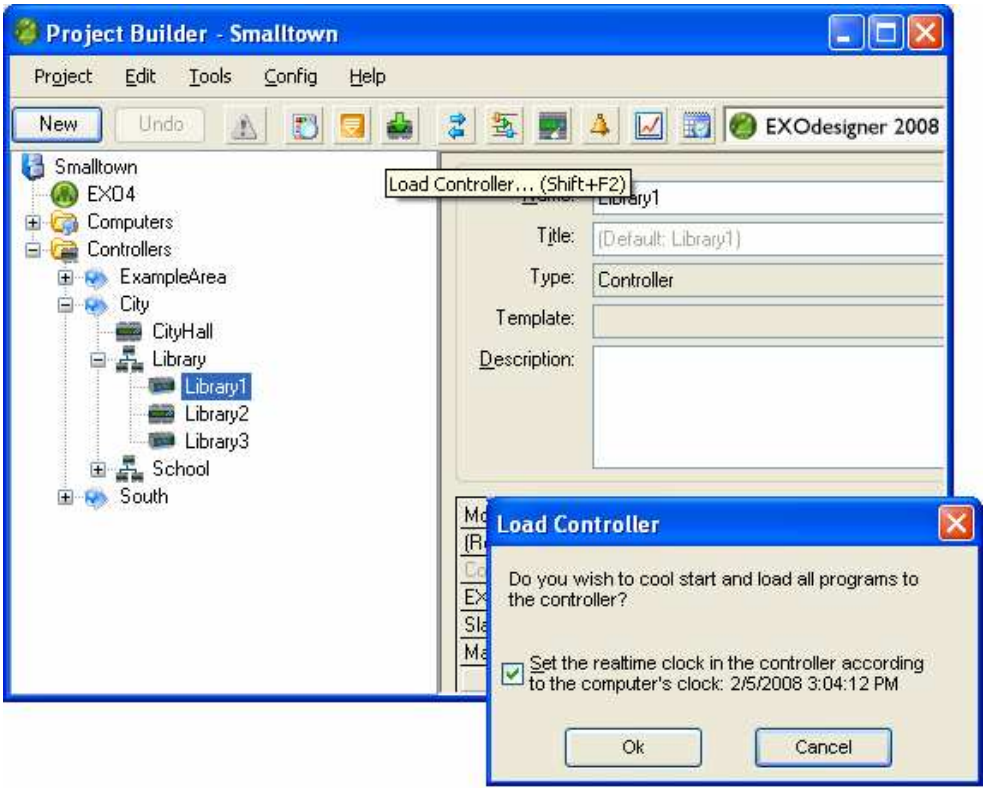
 **Load Controller** (or select the menu command **Tools – Load Controller**).

The following takes place when the controller is loading:

- The controller is cleared, but its address and its communication port settings are kept, which means you will not loose contact with the controller. This is a so-called controller cool-start.
- The application programs are converted (translated) into a language that can be understood by the operating system, and thereafter they are loaded to the controller. Some errors, e.g. typing mistakes, are checked during the file conversion.

- Select the controller to be loaded with the application programs (for instance **Library1** or **CityHall** depending of which controller you use).
- Click the **Load Controller** button.
- Click the **Ok** button in the dialog box Load Controller to confirm the cool start (i.e. to keep settings that are vital for the communication) , and to load the computer time together with the programs that are stored for the controller on the hard disk.

The dialog box EXOload is displayed.

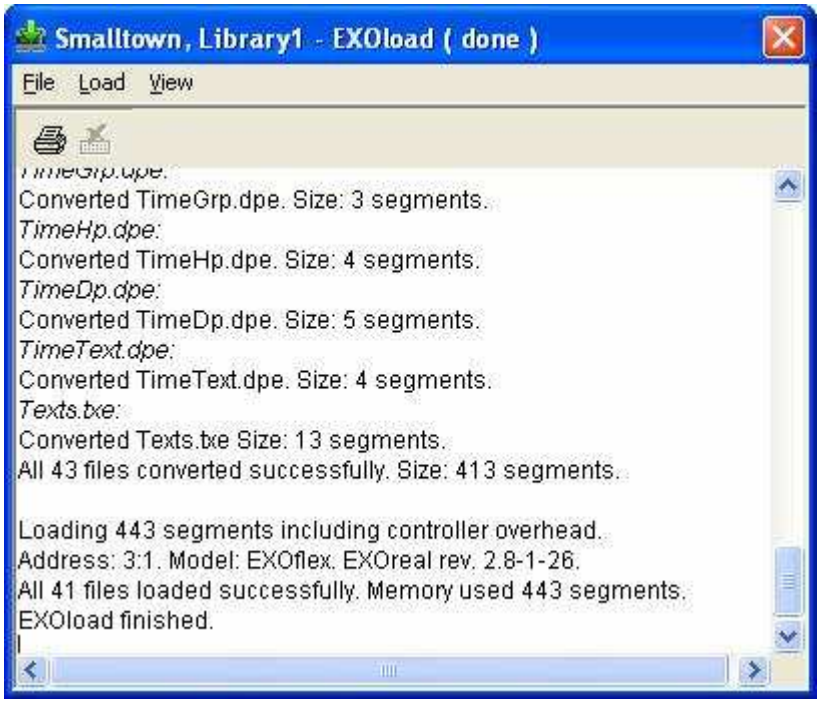


EXOload

The dialog box EXOload displays the progress of the program loading process. At the end of the process, a message will appear to let you know whether it was successful or if errors were found.

Execute

If the program loading was successful the application programs will execute (run) automatically in the controller.



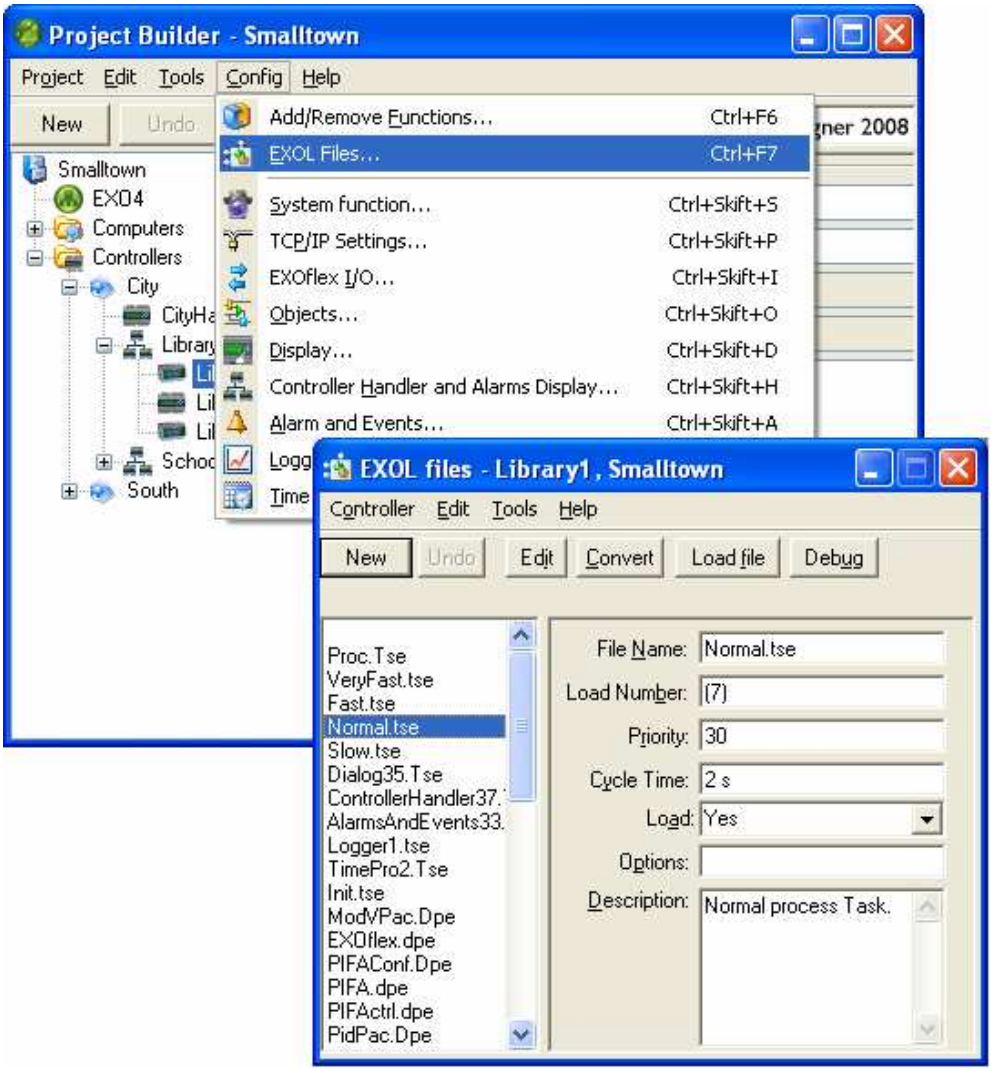
Reload

Often the controller does not perform as expected after the initial loading, even if you did not receive any error message during the loading. This is mostly due to logical errors while programming, so-called **bugs** (errors in the program). This means you have to edit the program and reload the parts that were wrong. The safest way is to always reload the entire controller.

> The safest way is to always reload the entire controller when changes have been made to its configuration.

Files

The project files can be audited, edited and reloaded with the tool EXOL Files. Open the tool by clicking **Config – EXOL files** in Project Builder.



Debugging Controllers

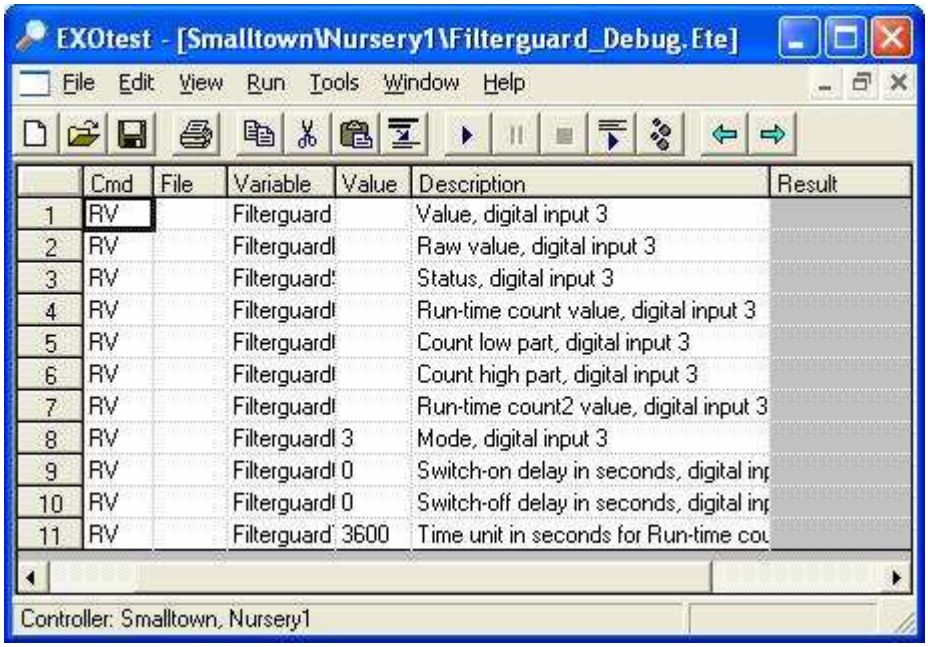
EXOtest

The tool EXOtest is used to test and debug the programs that have been loaded to the controller.

Starting

EXOtest may be started from several different tools by clicking the **Debug** button. The content will be determined by the selection of object/objects, e.g.:

- When EXOtest is opened from PIFA I/O or Inputs and Outputs, all variables of the selected inputs and/or outputs are displayed.
- When EXOtest is opened from Display, the variables of the selected dialog boxes are displayed.
- When EXOtest is opened from Objects, the variables of the selected objects are displayed.
- When EXOtest is opened from EXOL Files, all variables of the selected files are opened.



The tool bar

The tool bar in EXOtest includes some special buttons, among others:

All commands of all lines are performed in order until the execution is stopped.

Commands of the selected lines are performed in order until the execution is stopped.

Stops the execution.

The commands are performed step-by-step.

Commands

Each line in EXOtest is a communication message, a command (the column **Cmd**).

Read variable

The command **RV** (Read Value) is used to read the value of a variable. The result is displayed in the column **Result**.

Set variable value

A variable value can be set (i.e. changed) in the controller by entering the command **SV** (Set Value) in the column **Cmd,** and then enter the required value in the column **Value**.

- Enter the EXOtest command **SV** in the column **Cmd** for the variable value you wish to change.
- Enter the required value of the variable in the column **Value**.
- Press the Enter key to run the command, i.e. change the value of the variable in the controller.
- Change the EXOtest command in the column **Cmd** back to **RV**.

Empty EXOtest file

An empty EXOtest file can be opened in Project Builder with the menu command **Tools – EXOtest**. In this file, you can enter EXOtest commands. A number of commands can be put together and saved in an EXOtest file for later use.

Load

The EXOtest command **TStat** can be used to read the load on Task files and the controller's processor:

- ❑ **Lost Cycles** is increased if a Task does not perform its task within the configured cycle time.
- ❑ **Idle** specifies for how long the processor is idle.

(Task files are explained in the section ***The Controller's Application Programs*** below)

Overview

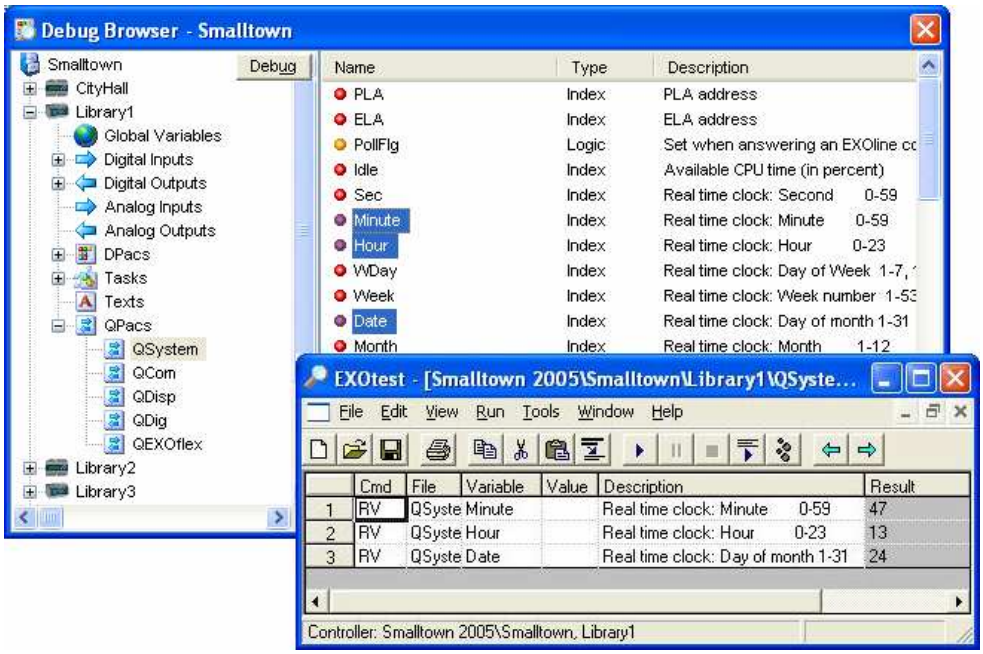
An overview of EXOtest commands is available in ***EXOdesigner's Help***.

Debug Browser

Debug Browser

In Project Builder, EXOtest can also be opened via Debug Browser. Debug Browser is a window similar to the Windows Explorer, where you can easily select the variables you would like to investigate or change with EXOtest.

- Select the controller Library1 (or CityHall) in Project Builder.
- Click on the button , select the menu item **Tools – Debug**, or press the hotkeys **[Ctrl]+[F2]**.
- Browse to the selected variables. In the example below the folder **Library1** has been expanded first and thereafter the folder **QPacs**. By pressing and holding the **Ctrl** key the file **QSystem** and the variables **Date**, **Hour** and **Minute** have been selected.
- Click the button **Debug** to open EXOtest with the selected variables.



Cold-start, Cool-start and Warm-start Controllers

Cold-start

Cold-start

During a cold-start the controller re-starts in the initial mode it once had on delivery from the factory. This means, among other things, the following:

- ❑ All application programs are cleared.
- ❑ The controller's address is set to 254:30.
- ❑ All communication port parameters are reset to their default values (slave with the communication speed 9600 bits/s).

Perform a cold-start

A cold-start is performed with the menu command **Tools – Reset Controller** in Project Builder, or the EXOtest command **ColdS**. A cold-start is also performed before the address of the controller is set when selecting the command **Setup Controller** in Project Builder.

Cool-start

Cool-start

Also during a cool-start all application programs are cleared, but the address of the controller and the communication port settings are kept. This means that the operating system is re-started without losing contact with the controller.

Perform a cool start

Use the EXOtest command **CoolS** to perform a cool-start. A cool start is also performed before program loading when you select the command **Load Controller** in Project Builder.

Warm-start

Power-up

A warm-start is automatically performed at power-up or when the security system detects a critical error. It is not possible to perform a manual warm-start.

Warm-start

During a warm-start all hardware resources and dynamic functions are re-started for normal operation. Application programs and variable values are kept.

The Controller's Application Programs

Reference document

The following is a brief description of different file types and variable types in the application programs of the controller. A more detailed description can be found in the documents ***EXOL Programming*** and ***EXOL Reference***.

EXOL

The controller's application programs are written in the programming language EXOL. When, for example, controller functions and objects are created, the programming code is changed in one or several files on the computer's hard disk. These files are later loaded to the controller.

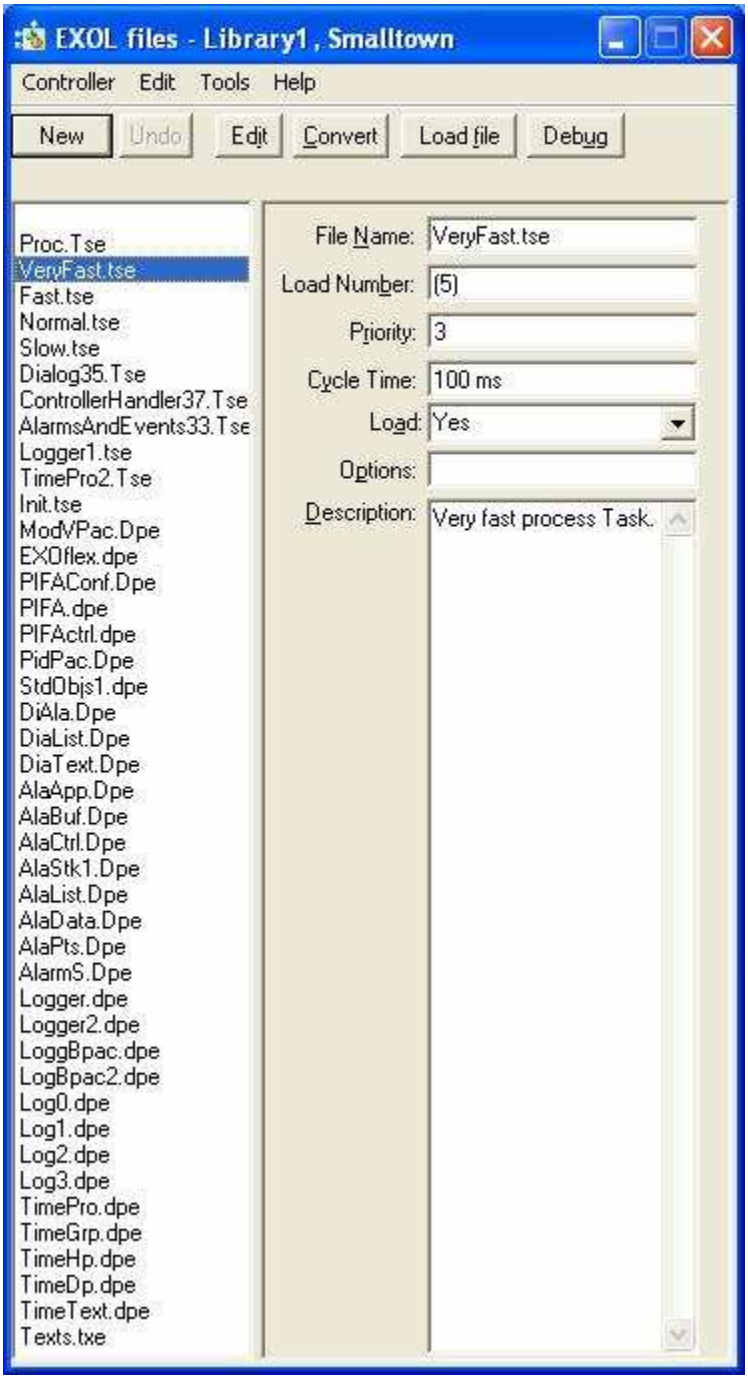
Files

There are three different types of files in EXO:

- **Tasks** with the file extension `.Tse`. These files contain instructions for the controller's tasks.
- **DPacs** (Data Packages) with the file extension `.Dpe`. These files contain data, i.e. lists with variable declarations.
- **Text** contains declarations of text strings. There can only be one text file with a maximum of 239 text strings in a controller. Each text string can contain a maximum of 110 ASCII-characters. The file is usually named `Texts.Txe`.

EXOL Files

The files that have been created on the computer's hard disk for a controller are listed in the tool EXOL Files. In this tool you can open a file for editing with the **Edit** button and debug the file with EXOtest with the **Debug** button.



Tasks

Max. 15

A maximum of 15 user defined Tasks can be executed in parallel in the controller. Each Task has its own cycle time and priority.

Executing

When executing a Task, the instructions are carried out sequentially within the Task, one at a time. The whole Task is executed periodically with a given **cycle time,** and when you reach the end of the Task, it becomes passive until it is time to start the next cycle.

Parallel

When several Tasks, apparently, execute in parallel it is called **multitasking.** The EXOreal operating system handles so-called **pre-emptive multitasking.** This means that a Task with higher **priority** always may execute when required. If a low priority Task executes and it is time for a higher priority Task to start a new cycle, it may do so. After that, the Task with lower priority may continue executing.

Starvation

Because high-prioritized Tasks are able to interrupt low-prioritized Tasks when they want, there is a risk "to starve" the low-prioritized Tasks. This means that they never get access to the processor, and they may thus never execute. In such cases you must change cycle times and priority on your Tasks.

> Note that if a Task has high priority and it has a lot to do the whole time, there is a risk that it prevents other Tasks from executing. In general, high prioritized Tasks should be short and fast enough to manage what they should in their cycle time. Then also lower prioritized Tasks can get access to the processor in between.

Too short cycle

It may happen that a Task does not manage what it is supposed to do, i.e. the cycle time has run out before the instructions in the Task have finished executing. Then the Task's error counter increases by one (1). This counter can be read with the EXOtest command **`TSTAT`**.

CPU capacity

The processor has a limited capacity to share between the operating system and all the Tasks that are executed in the controller. Sometimes it may happen that the capacity is not enough, which can be established by reading the variable **`Idle`** in the controller using the EXOtest command **`MStat`**. The variable states the part of the time (%) that the processor is idle.

> If the Idle calculator is zero or very close to zero, the controller's processor is used to the fullest. If you wish to have more functions, you must add these in another controller, e.g. an underlying controller.

DPacs

Numeric data

A DPac is a package of numerical data, so-called variables. The variables in DPacs can be made available from all Tasks in the controller.

Max. 62

A controller can contain a maximum of 62 user defined DPacs.

Generic name

DPac is a generic name for three different types of data packages:

- **VPac**: A list of **user defined** variable declarations, e.g. outdoor temperature. The maximum length of a VPac is 15300 cells (5000-15000 variables depending on the data type). (With EXOreal 2.7 or older: max 960 cells).
- **QPac**: A list of pre-defined system variables, e.g. for port settings and the real time clock. The QPacs are not loaded to the controller; they are a part of the operating system EXOreal and are stored in the RAM of the controller. The QPacs are the programmer's interface to the operating system.
- **BPac** (BitPac): In BPacs, values are stored in bytes and are compressed in a way that is very unlike all other DPacs. In BPacs you can read and write data incorrectly, e.g. a part of a floating-point number can be read as an integer.

Variable

When a DPac is loaded to the controller, space for its variables are reserved in the RAM of the controller. A variable is thus a location in the memory that during runtime may contain different values at different times. For example, the operator can change the value via the controller's display.

Data types

When a variable is declared, its data type must be defined. The data type determines the size (in cells) of the memory space that is to be reserved for the variable. This means that the data type determines the interval of the stored value, i.e. the size of values that can be stored in the reserved location.

Data Types

Simple data types

There are four basic simple data types in EXOL:

Data type	Interval	Cells	Bytes in BPac	Description
L	0,1	1	1	Logic variable. Zero (0) is equivalent to false and one (1) is equivalent to true.
X	0..255	1	1	Short positive integer (Index).
I	-32768..+32767	2	2	Integer variable (Integer).
R	-3.3E38.. +3.3E38	3	4	Real variable (Real). Usually floating point numbers, but also manages to store integers with full accuracy up to 2^{23} (=8 388 608).

String

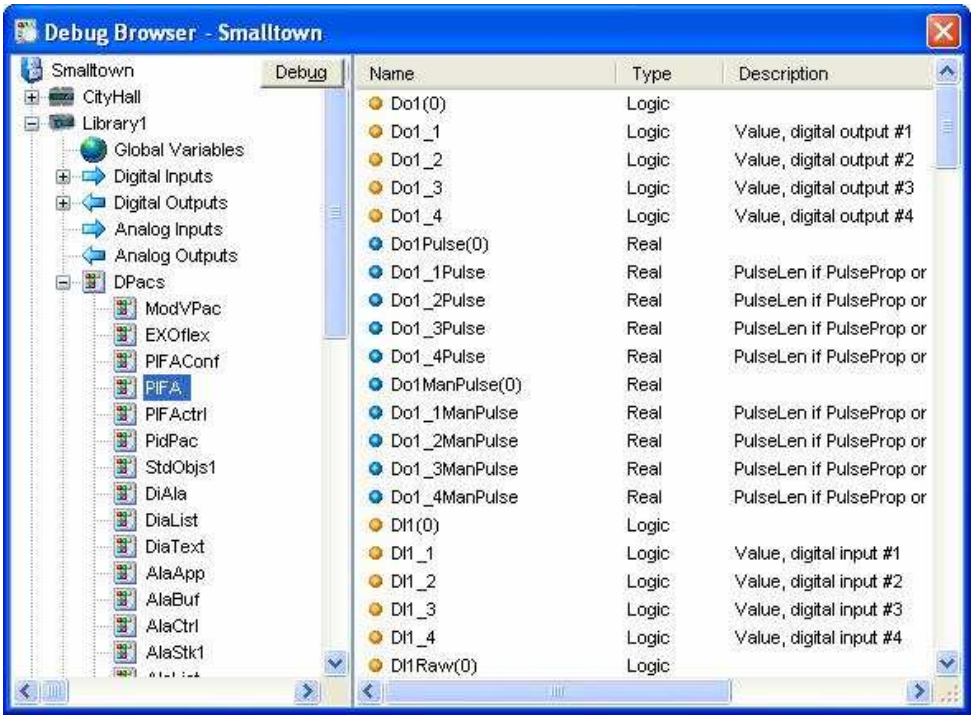
There is also a data type for strings, represented by the character **$**. A string is a sequence of ASCII characters that form a continuous entity, e.g. a text for the display. Strings can only be defined in a special text file.

Referring to a variable

In general, the EXOL Browser is used to select a variable to be entered in an attribute of a configuration tool. By using the EXOL Browser, you minimize the risk of typing mistakes and syntax errors. EXOL Browser can also be used in EXO4 Window Designer.

EXOL Browser

An example of the EXOL Browser:



EXOL syntax

Sometimes it is not possible to use the EXOL Browser to refer to variables (mainly when entering the programming code in a Task file). In such cases, we recommend the following EXOL syntax:

```
VPac:
VariableName        ; The VPac name should be declared

BPac:
ModVar(BPacFile.Records(RecordNumber).ColumnName)
ModVar(BpacFile.RecordName.ColumnName)
```

Chapter 10 Configuring Computers

Projects with EXO4

Creating projects

When a new project that uses EXO4 is created in Project Builder, the following is added to the project:

- ❑ A main computer with a database and two communication channels, one for serial communication and one for communication via a TCP/IP network.
- ❑ Standard templates for EXO4 windows, e.g. alarm status reports, alarm events report, and real-time charts.
- ❑ Standard templates for system windows, which provide an overview of the project and contain buttons and menus for opening other standard windows.
- ❑ Standard templates for overview windows, to help you create windows in the specific application.
- ❑ If controllers were created on the templates for air handling or heating systems, process windows will be available for these applications.

Configuring Computers

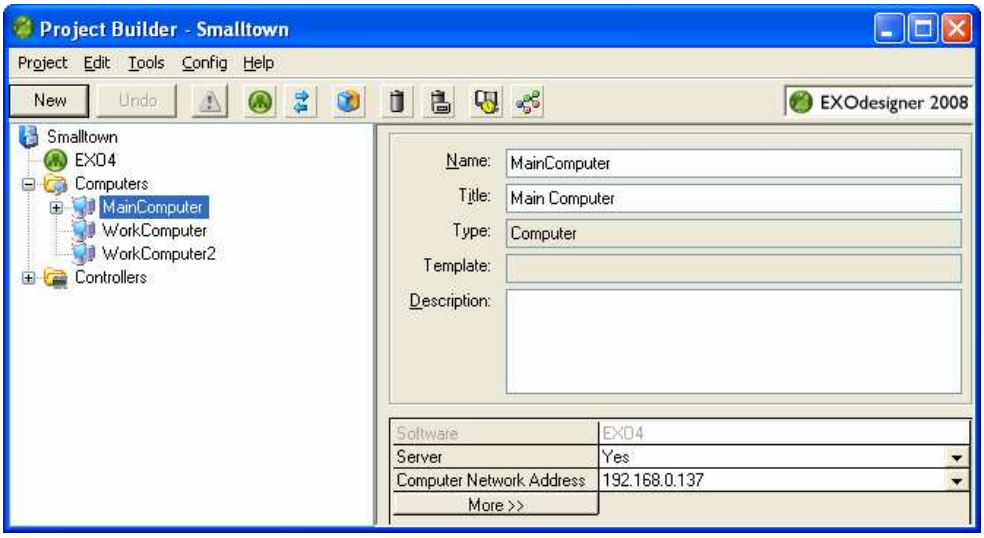
Name and Network Address

Project Builder

The following configurations have to be done in Project Builder for each computer in the project.

- ❑ Each computer in the project must have a unique name specified in the attribute **Name.** Normally, the computer is named in accordance with its role in the EXO project. We recommend that the main computer keeps the default name **MainComputer**.
- ❑ The network address of the computer must be specified in the attribute **Network address**, with either its IP address (e.g. 192.168.0.123) or its full DNS name. The full DNS name is generally provided by the IT department.

- Select the computer to be configured in Project Builder.
- Specify the computer name in the attribute **Name**. (The main computer is a server and is given the name **MainComputer** by default. Other computers can be given names according to, e.g. their location). The computer name may not contain, e.g. spaces.
- A designation to be displayed to the operator can be specified in the attribute **Title**.
- The computer's IP address or its full DNS name is specified in the attribute **Network address**.



Installation When the project has been installed on the customer's computers, each physical computer is attached to the corresponding computer that has been configured in Project Builder. This is described in the chapter ***Commissioning.***

Important About Names

Global objects The following object types are exposed globally to EXO4:

- Computers
- Stations
- Controllers
- EXO4 windows
- Databases

Unique names Objects that are exposed globally to EXO4 can be referred to from anywhere, without specifying the full path. This means that all global objects must have unique names. It is therefore not possible to use the same name, as an example, both for a controller and an EXO4 window.

Running EXO4

Detached During configuration and testing of EXO4 the computer needs to be detached.

Testing While the computer is still detached, the EXO4 functionality can be tested using the command **Tools – Run EXO4** or by clicking the button **Run EXO4** on the toolbar in Project Builder.

Without database If you only need to test process windows, EXO4 can be run without server functions using the menu command **Tools – Run EXO4 (without server functions)** in Project Builder.

The Computer Toolbar

The toolbar

When a computer in Project Builder is selected, buttons with the following functions are displayed on the toolbar.

Button	Text	Description
	Run EXO4	While the computer still is detached (i.e. while the project is being configured and tested), this button will start EXO4.
	Show number of I/O points	Displays the number of I/O points and which hardware key is required to run EXO4.
	Add/Remove EXO4 Functions	Used to add and/or remove EXO4 functions.
	EXO4 Databases	Opens the configuration tool for the project's databases. A description follows in the chapter ***Commissioning.***
	Database Backup Script	Opens an editor with a script file that controls the copying of the database backup file to another media, e.g. to another computer in the network where backups are run regularly. Also see the chapter ***Database Maintenance***.
	Nimbus Explorer	Opens the configuration tool for Nimbus Alarm Server. See the chapter ***Alarms and Events***.
	EXO4 Computer Signals	Opens the configuration tool for EXO4 Signals. EXO4 signals facilitate the transfer of variable values between controllers in different stations via EXO4.

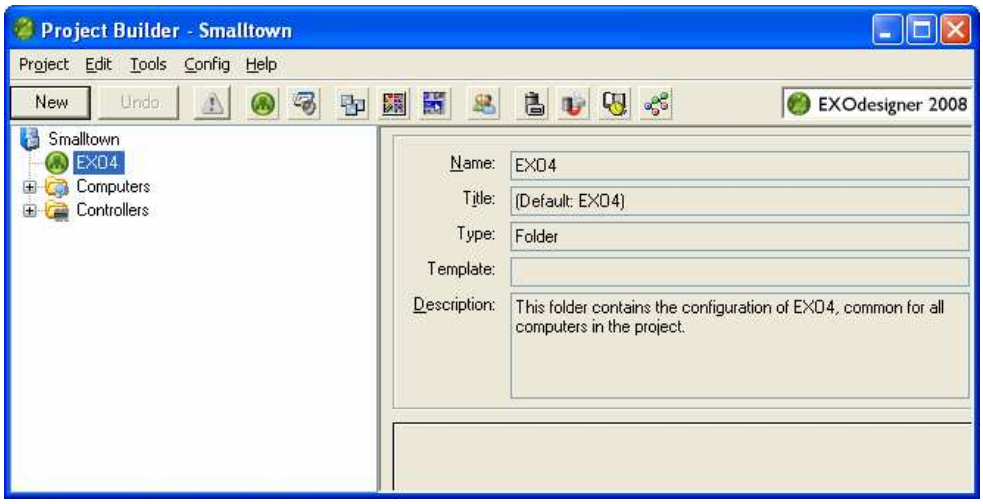
Configuring EXO4

Operator program

EXO4 is the operator program of the EXO system. EXO4 allows an operator to, e.g. monitor and control the system processes, monitor alarms and perform alarm maneuvers, display historical values in reports and charts, from a computer.

Configuration

EXO4 is configured in windows (so-called configuration tools) that are opened from Project Builder. The tools are normally opened by clicking on the buttons of the toolbar or by using the menu **Config**.



The toolbar

When EXO4 is selected in Project Builder, buttons with the following functions are displayed on the toolbar:

Button	Text	Description
	Run EXO4	While the computer still is detached (i.e. while the project is being configured and tested), this button will start EXO4.
	View Run-time Messages	Run-time Messages is used to debug EXO4 on this physical computer.
	EXO4 Windows	Displays a list of the windows that are defined in the project. From this window, you can start EXO4 Window Designer for the selected window.
	EXO4 Window Designer	Opens the configuration tool for EXO4 windows.
	EXO4 Menu Designer	Opens the configuration tool for menus for EXO4 windows.
	EXO4 Users	EXO4 Users is used to define users.
	Database Backup Script (of Main Computer)	Opens an editor with a script file that controls the copying of the database backup file to another media, e.g. to another computer in the network where backups are run regularly. Also see the chapter ***Database Maintenance***.
	EXO4 Action Categories	EXO4 Action Categories is used to configure actions (e.g. print outs) at different events.
	Nimbus Explorer (of Main Computer)	Opens the configuration tool for Nimbus Alarm Server. See the chapter ***Alarms and Events.***
	EXO4 Signals (of Main Computer)	The configuration tool for EXO4 Signals. EXO4 signals facilitate the transfer of variable values between controllers in different stations via EXO4.

Designing and Configuring EXO4 Windows

Description

The chapter ***EXO4 Window Design*** contains a description of, e.g. the design of windows and window classes, and how to use the window templates that are included in EXO4.

Alarms and Events

Description

The chapter ***Alarms and Events*** contains a description of configuration of alarm points and digital events for EXO4, display of alarms in EXO4 windows, alarm events reports, alarm status reports and event reports.

Logging

Description

The chapter ***Logging*** contains a description of logged signals, historical charts and real-time charts.

Time Control

Description

The chapter ***Time Control*** contains a description of the EXO4 window templates for time channels.

Configuring Database Maintenance

Database maintenance By database maintenance we mean purging old data, defragmenting, and backing up. It is important to purge and defrag the database regularly in order to prevent it from growing indefinitely.

Description Database maintenance is described in the chapter ***Database Maintenance***.

Defining Operators

Access to EXO4 The operator's EXO4 runtime access controls, not only the information that is displayed to him in the EXO4 windows, but also the selection of commands he can execute. The operator commands can be stored in an operator log.

Description The configuration of users, the window template User Log Report and the configuration of access to windows and window elements are described in the chapter ***EXO4 Window Design***.

Part IV Configuring Functionality

Table of contents

Part IV Configuring Functionality

Chapter 11 **Examples**

Examples in this Manual

Examples In the examples that are given in the rest of this manual, we only display configuration of EXOflex. However, configuration of EXOflex and EXOcompact are exactly the same, except that EXOflex requires that you specify which PIFA units you have inserted in the current EXOflex house.

Carry out This means that you can carry out the examples if you have Training Kit 1971 (an EXOflex with EP7416) or Evaluation Tool Kit (an EXOcompact with 28 I/O).

Library1 If you have an EXOflex with EP7416, all configurations is made in the controller **Library1** (as in the examples).

CityHall If you have an EXOcompact with 28 I/O, all configurations is made in the controller **CityHall**. In this case, please select appropriate names and texts instead of the ones that are given in the examples.

Regio and Corrigo E

Regio Regio controllers are described in the ***Regio Manuals***.

Configuration with Regio Tool is described in the document ***Regio Tool Manual***.

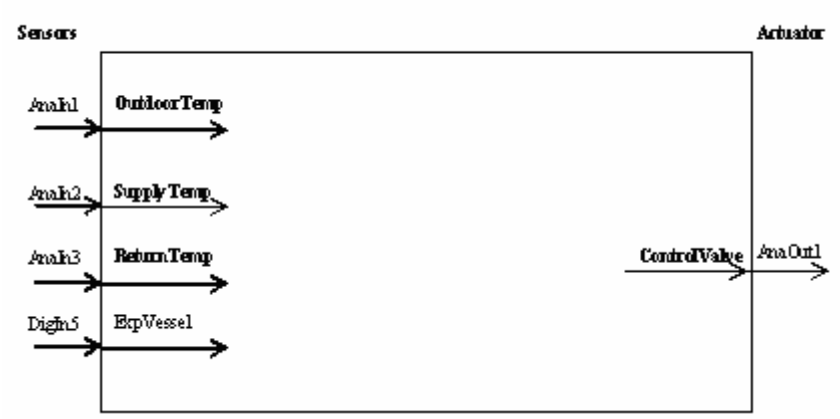
Regio in EXO projects is described in the document Regio in EXO Projects.

Corrigo E Corrigo E controllers are described in the ***Corrigo E Manuals***.

Configuration with E-tool is described in the document ***Manual E-tool***.

Chapter 12 Inputs and Outputs

EXOcompact



Functions

When an EXOcompact controller is created in Project Builder, objects for inputs and outputs that can handle, e.g. the following functions, are added:

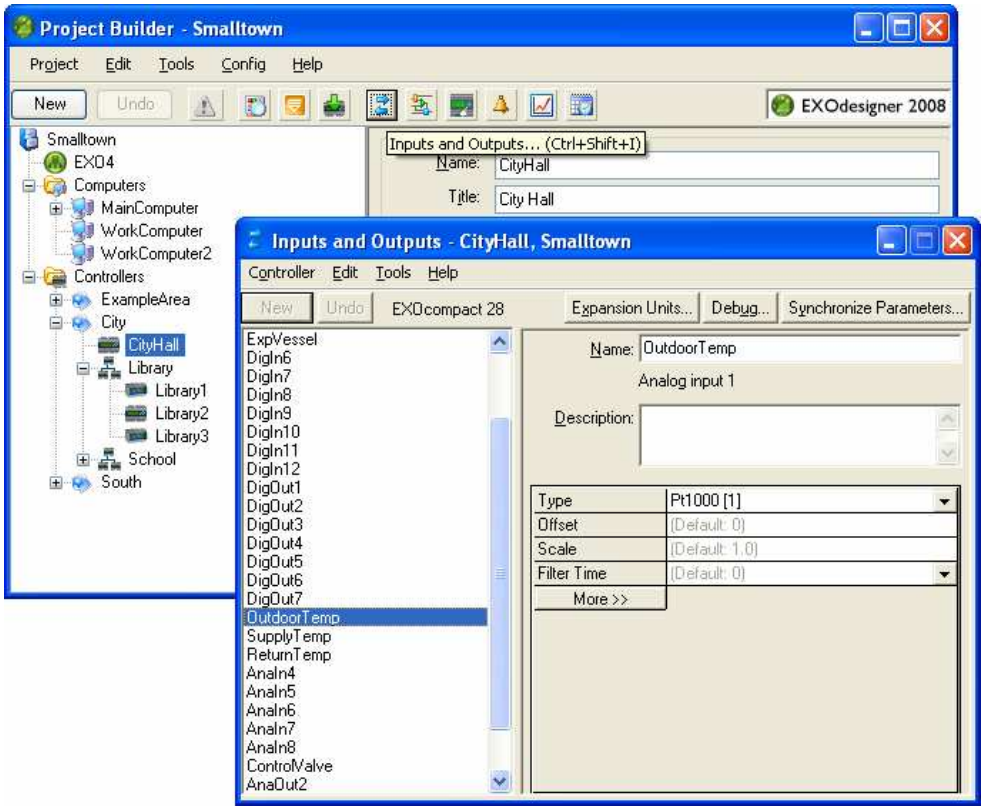
- runtime logging
- pulse counting
- pulse rate measuring
- pulse proportioning
- on/off delay
- ramping (gradual rise of the analog output)
- manual / automatic control of outputs
- conversion of analog values to application units.

Analog inputs

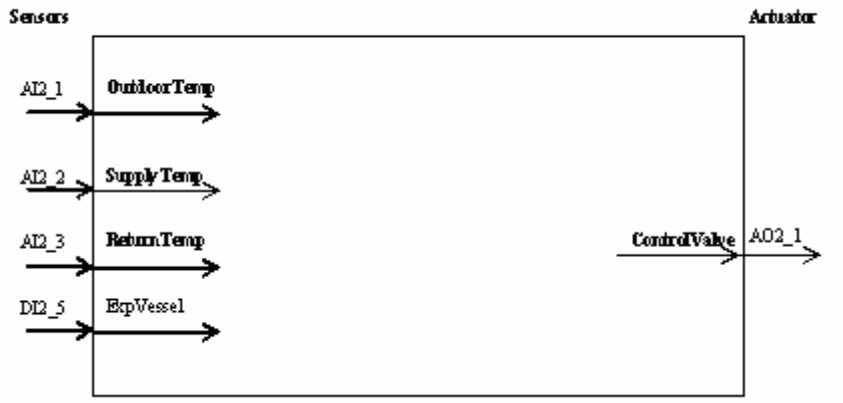
For analog inputs you can choose the operating mode that applies for the sensor in question, e.g. 0-10V, Pt1000 or Ni1000.

Inputs and Outputs

Functions of the inputs and outputs, and the operating modes of the analog inputs are configured with the tool Inputs and Outputs:



EXOflex



Two steps

The configuration of inputs and outputs in EXOflex is performed in two steps:

- The tool **EXOflex I/O** is used to configure which PIFA units that are included in the EXOflex house, and the slots the PIFAs are occupying.
- The tool **PIFA I/O** is used to configure the inputs and outputs of the I/O PIFA units. Each I/O PIFA (PIFA unit with inputs and/or outputs, but not the main power PIFA), has its own processor that can perform certain calculations of signals to accomplish some functions, and thereby relieve the main processor. Therefore, it is important to configure the inputs and outputs in PIFA I/O when these functions are used.

Power PIFA

The digital inputs and outputs on the power-PIFA (EP1011) are handled by the main processor (EXOreal). They can be configured with a tool that looks the same as PIFA I/O. They have the same functions and properties as those on EXOcompact and Regio Maxi.

Functions

The functions that can be managed by the inputs and outputs are, e.g.:

- runtime logging
- pulse counting (not I/O-PIFA's in software respect normal digital inputs)

- pulse rate measuring (not I/O-PIFA's in software respect normal digital inputs)
- pulse proportioning
- frequency generation (not power-PIFA units)
- on/off delay
- ramping (gradual rise of analog output)
- manual / automatic control of outputs
- conversion of analog values to application units.

Analog inputs

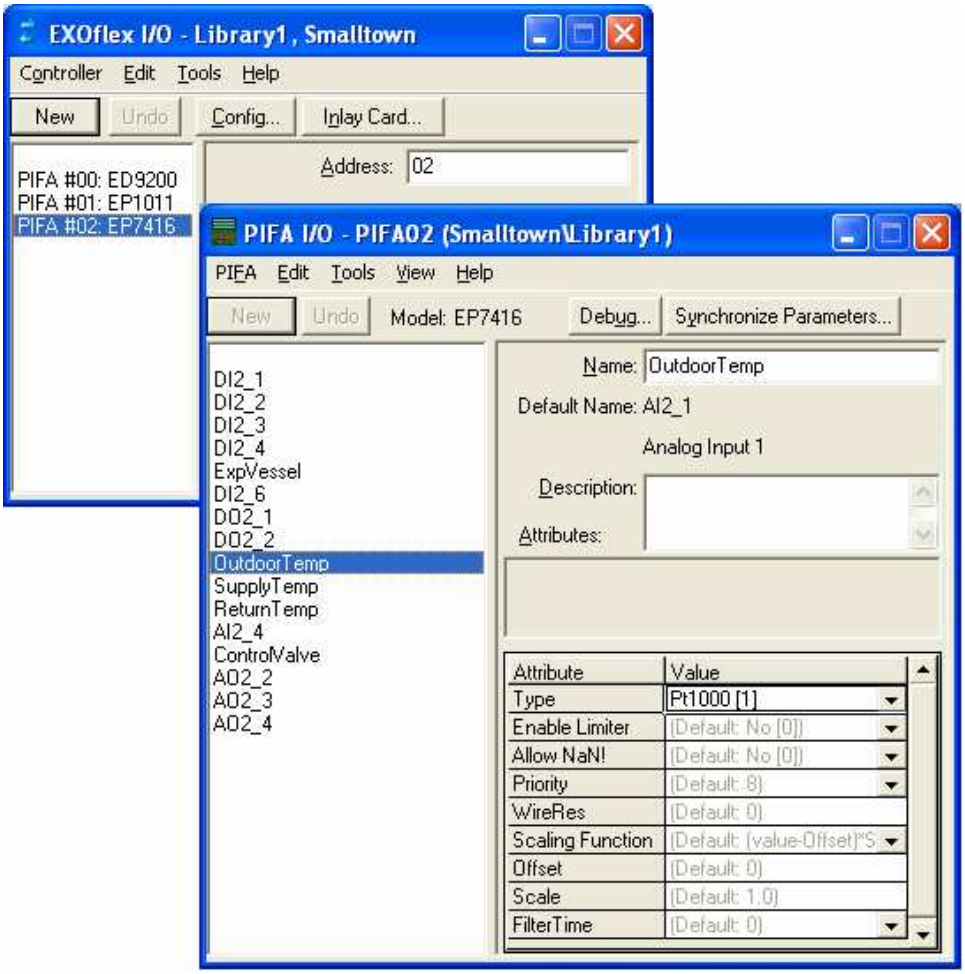
For the analog inputs you can choose the operating mode that applies to the sensor in question, e.g. 0-10V, 0-200 mV, 0(4)-20 mA, PT1000, PT100, Ni1000 or 0-2000 Ω.

Advanced DI

Some I/O-PIFA units have, in software respects, advanced digital inputs that have faster digital filter and can be configured to handle more functions (pulse counting and pulse rate measuring) than the normal ones.

Tools

EXOflex I/O (for defining the PIFA units of the EXOflex housing) and PIFA I/O (for configuring the functions of the inputs and outputs and the operating modes of the analog inputs.):



Variables, Names and Description

Variables

Each input and output has a number of variables, i.e. storing areas in the memory, where measured values, configuration values etc. are stored. These variables can be found in the file **`InputOutput.Dpe`** for EXOcompact and Regio Maxi, and in the file **`PIFA.Dpe`** for EXOflex. After loading the controller, it is possible to troubleshoot all variables of an input or output. Select an input or output and click on the button **Debug** to open a window for troubleshooting the variables.

References Henceforth references will sometimes be made to particular variables for the various inputs and outputs, e.g. *AI* refers to the calculated value (after selected functions) of an analog input, and ***AI*Raw** refers to the real value before calculations.

Unique name Each input and output of a controller must have a unique name. The standard name is a compound of the I/O type and its position in the controller:

- **AnaIn1** and **DigOut3** are examples of standard names in InputOutput.Dpe.
- **AI2_1** and **DO2_3** are examples of standard names in PIFA.Dpe (the inputs and outputs position in EXOflex is a compound of the position of the PIFA unit in the EXOflex house and the I/O's position on the PIFA unit).

This means that the standard names for the variables above will be, e.g.:

- **AnaIn1** and **AnaIn1Raw** in InputOutput.Dpe.
- **AI2_1** and **AI2_1Raw** in PIFA.Dpe.

Descriptive names Usually you wish to use more descriptive names on the various inputs and outputs. The integrator has the possibility to use the configuration tool to assign a unique name (unique to the controller in question) to each input and output, which then is used instead of the default name. The name may not contain spaces and the first character cannot be a digit.

If the inputs **AnaIn1** (InputOutput.Dpe) and **AI2_1** (PIFA.Dpe), e.g. has been given the name **OutdoorTemp**, the names of the above-mentioned variables will be **OutdoorTemp** and **OutdoorTemp*Raw*,** respectively.

Description A description of the input's and output's function can be specified in the attribute **Description**.

Other configuration The configuration that can be made depends on the I/O type. When selecting an input or an output in PIFA I/O or in Inputs and Outputs, its configurable settings will be displayed to the right in the tool. Descriptions of the various functions of the inputs and outputs will be given later in this chapter.

Saving and Loading the Configuration

Saving The input and output configuration is saved with the menu command **Controller – Save** or by pressing the **Ctrl + S** keys.

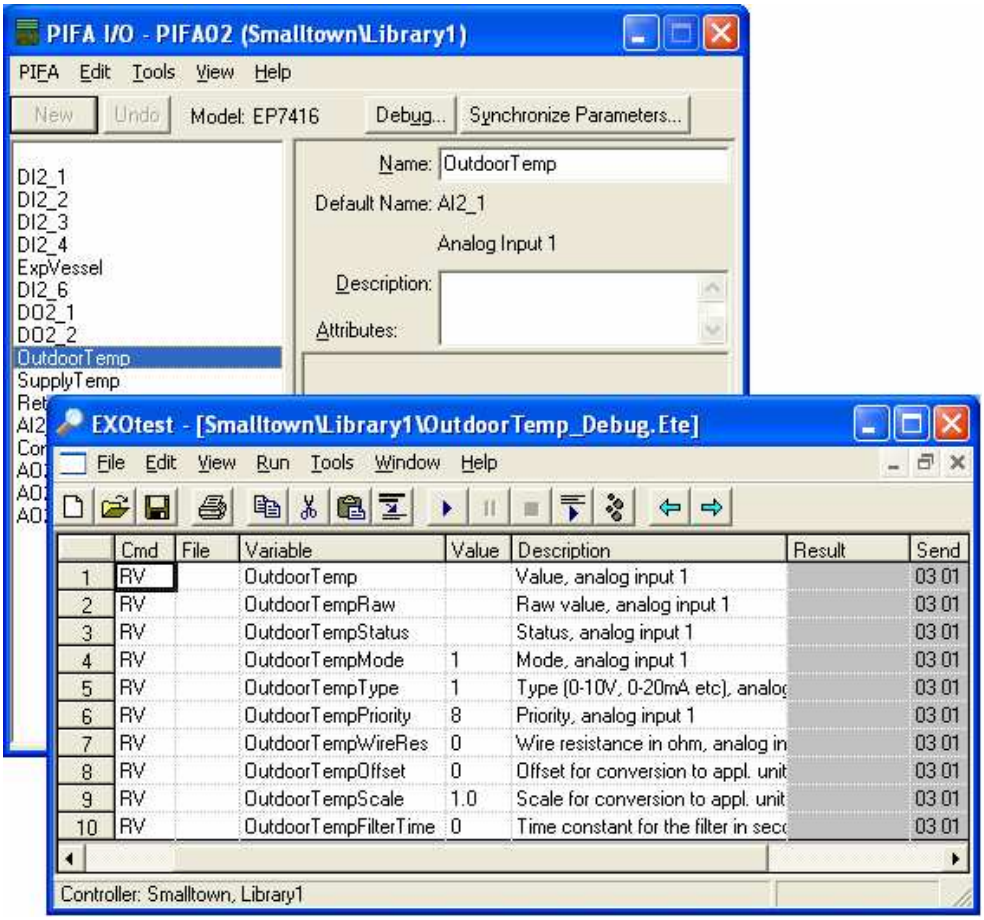
Reloading When the configuration of an input or an output has been changed in the tool, the entire controller needs to be reloaded (i.e. it needs a cold start or a cool start).

Change during runtime The application can change the values of parameter variables during runtime without changing the configuration. When the controller is reloaded, all variables will be set according to the configuration.

Reading configuration By clicking on the button **Synchronize Parameters** you can display the settings that have been made in the controller. This allows you to compare the settings of the configuration tool with the settings in the controller, and gives you the option to replace the settings of the configuration tool with the settings of the controller.

Troubleshooting Inputs and Outputs

Debug For troubleshooting and testing all variables of a specific input or output, select the input/output in PIFA I/O or Inputs and Outputs. Then click on **Debug**, and EXOtest will open a window for troubleshooting the variables.



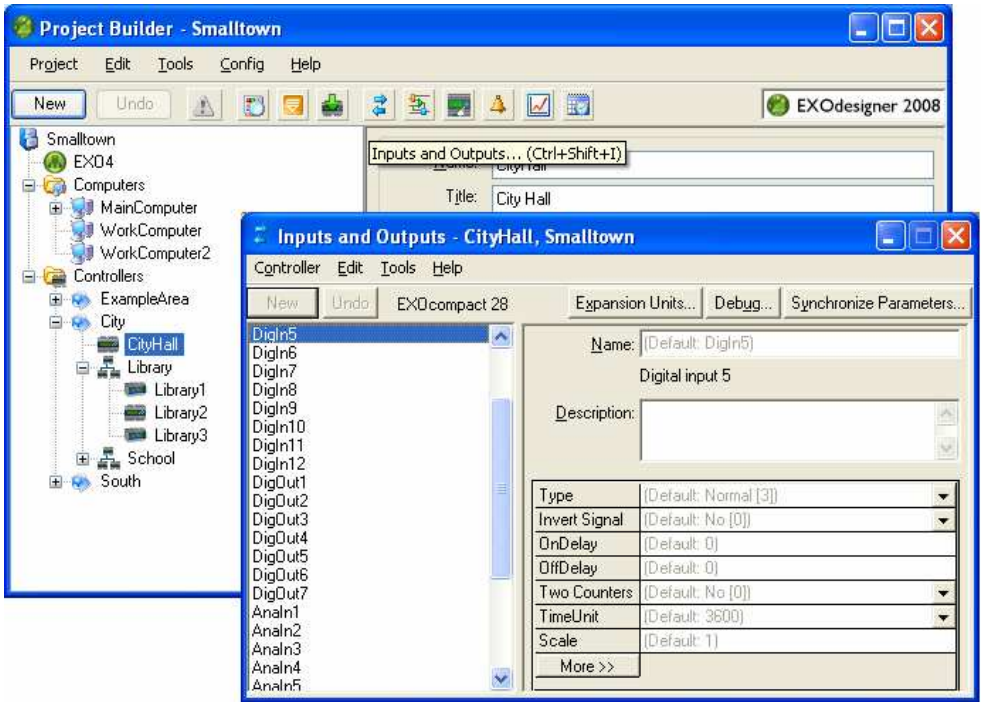
Configuring I/O

EXOcompact

Inputs and Outputs

Inputs and outputs on EXOcompact controllers are configured with the tool Inputs and Outputs.

- In Project Builder, you select the EXOcompact which inputs and outputs should be configured, in this case **CityHall**.
- Click on the button  to open the tool Inputs and Outputs.
- Select the input or output that should be configured.



Only the configuration of inputs and outputs on EXOflex, i.e. PIFA I/O, is shown in the following examples. Inputs and outputs on EXOcompact and Regio Maxi are configured similarly in the tool Inputs and Outputs.

EXOcompact Expansion Units

Max 2

You can have max two expansion units for each controller. The units must always have the EXOline addresses 241:1 and 241:2 respectively. You configure the expansion units in the tool Inputs and Outputs.

Expansion units are not created as objects in Project Builder.

Objects

Push the button Expansion Units... in the tool Inputs and Outputs to open a dialog box, where you can select which expansion units you have connected to the controller. When you click on the Ok button, input and output objects for the selected expansion units will be created in the tool.

Default names

You can use the input and output objects for the expansion units in the same way as the built-in inputs and outputs. The default names of the objects are the following: `Exp1igDigIn1`, `Exp1DigIn2`, `Exp1DigOut1`, `Exp1DigOut2`, `Exp2DigIn1`, `Exp2DigIn2`, `Exp2DigOut1`, `DigOut2Exp2`, etc.

Configure

You can configure the settings of the input and output objects directly in the tool Inputs and Outputs tool.

Setup

Expansion units

The controllers used as expansion units need to be setup to work properly. The setup command will set the EXOline address and load an application program.

The application program is needed to interact with the function Inputs and Outputs in the EXOcompact controller, with an acceptable performance. The application program is included in EXOdesigner and can not be modified by the project designer.

Detached mode

To setup the expansion units, you must set the computer in *detached* mode, with the tool This Computer. You connect the expansion units, one at a time, to the default serial port of the computer. Then you perform the setup command, by clicking the setup buttons in the dialog box Expansion Units (that is opened in the tool Inputs and Outputs). When the units are setup, you can deploy them into the project.

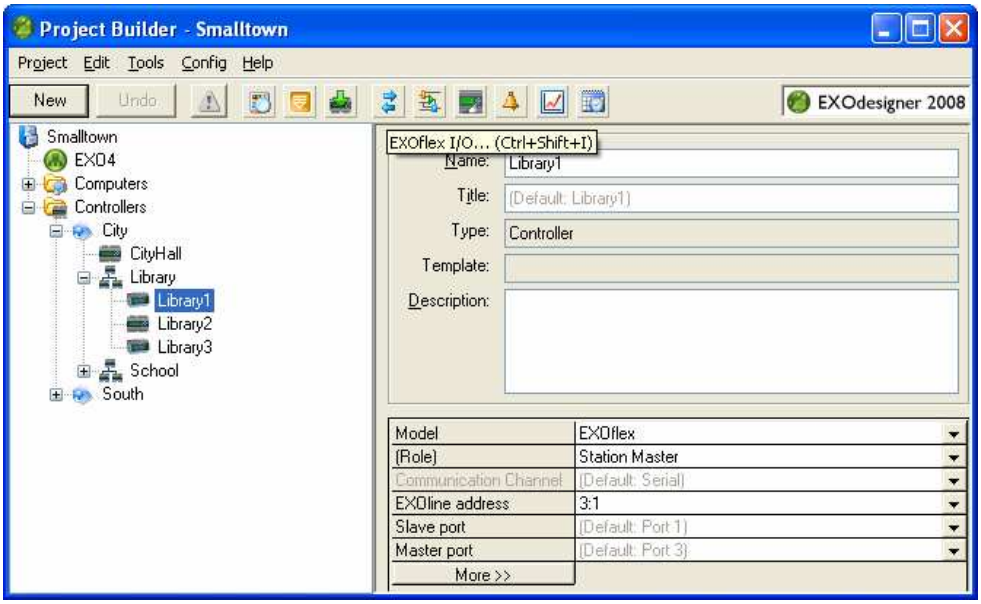
EXOflex

Defining PIFA Units with EXOflex I/O

Specify

The tool EXOflex I/O is used to specify which PIFA type has been mounted in which slot of the EXOflex housing.

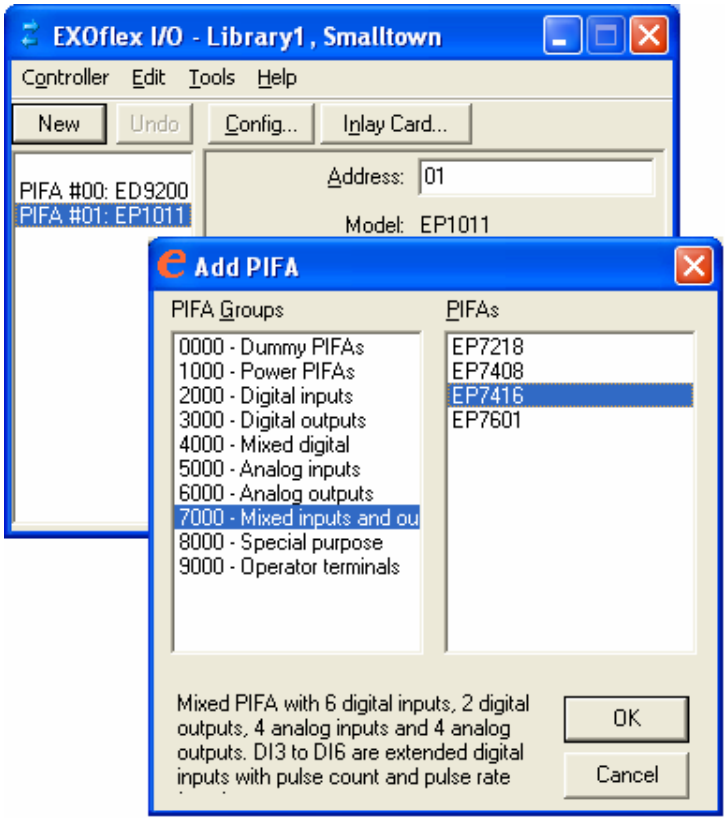
- Select an EXOflex controller in Project Builder. In this example, we have chosen the controller **Library1**, which is an EXOflex controller with general functions (including display, alarms and events, logging and time channels).
- Open EXOflex I/O by clicking on the button in the toolbar.



Add PIFA

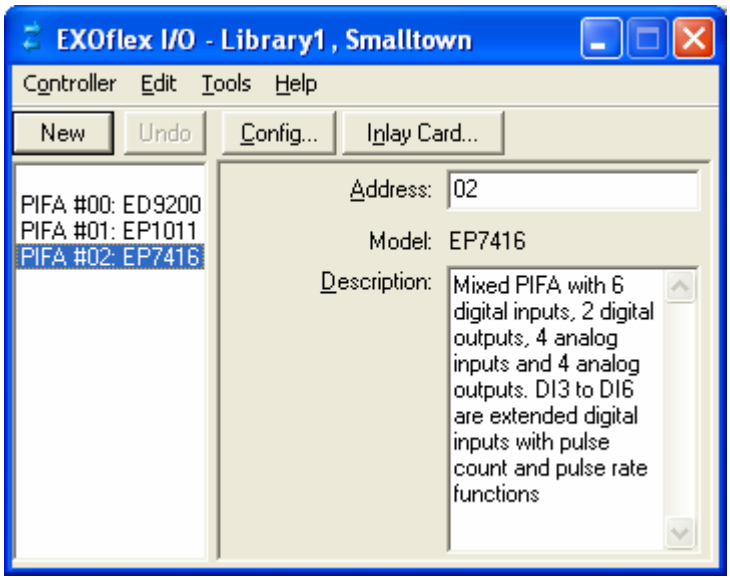
Library1 already contains a display (ED9200) and a power PIFA unit. We will add the I/O PIFA unit that has been mounted in the EXOflex housing.

- Click on the button **New** in the tool EXOflex I/O to open the dialog box **Add PIFA**.
- Select the PIFA group **7000 – Mixed inputs and outputs** and thereafter the PIFA unit **7416**.



List box

The list to the left in EXOflex I/O displays all the PIFA units that have been added. In the controls to the right, the settings for the PIFA are shown. Normally, you would only check that the attribute **Address** is correct.

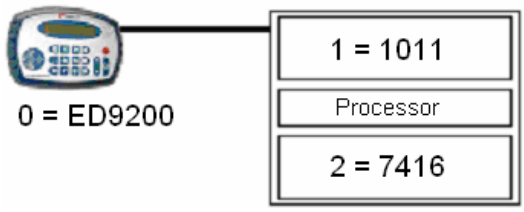


Address

The attribute **Address** displays the PIFA unit's position in the EXOflex house. The addresses will automatically be set correctly if the PIFA units are added in ascending order according to their physical location. If the address of a PIFA is incorrect, it will not be possible to communicate with it. An incorrect address can be changed in the tool.

Training Kit 1971

The Training Kit 1971 is equipped as follows:



PIFA-Position	PIFA type	Descripiton
0	ED9200	External display connected by cable to the power PIFA unit.
1	EP1011	Power PIFA unit for power supply, also contains e.g. port #1.
2	EP7416	I/O-PIFA unit with 6 digital inputs, 2 digital outputs, 4 analog inputs and 4 analog outputs.

Please check that the attribute **Address** for PIFA unit **7416** is **02**.

Configuring functionality with PIFA I/O

Configure

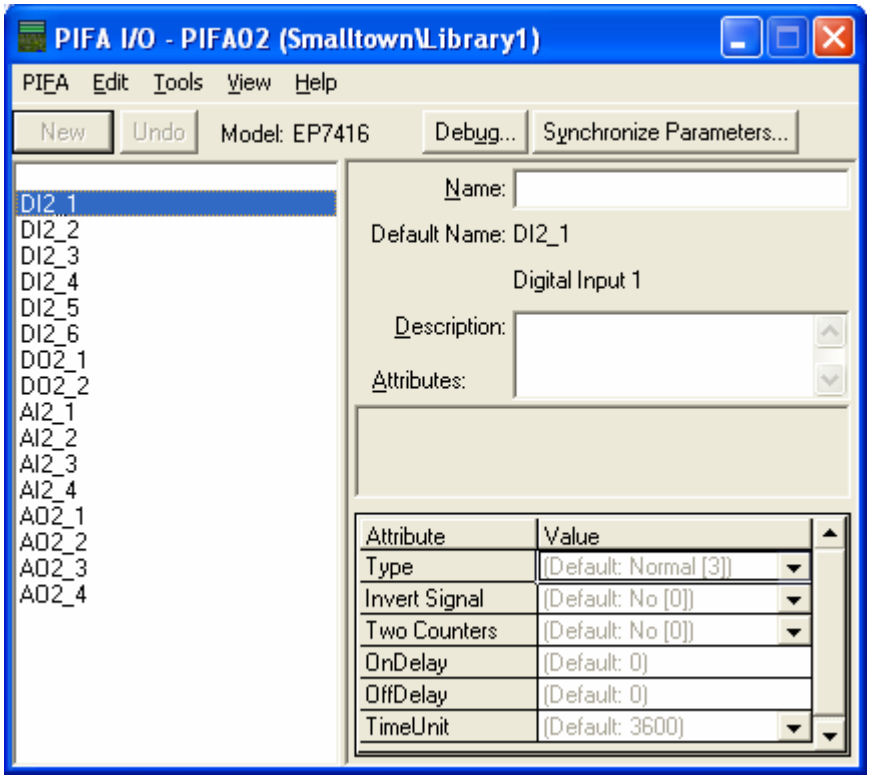
The PIFA I/O Tool contains a list of all inputs and outputs of the PIFA unit and provides the possibility to configure their functionality.

Please note that it is important that the configuration of inputs and outputs for I/O-PIFA units that can be done using the PIFA I/O Tool must be done in this tool in order to relieve the main processor.

Open

The tool PIFA I/O is opened in the EXOflex I/O Tool by clicking on **Config**.

- Select the PIFA unit **7416** in the EXOflex I/O.
- Click on the button **Config** to open PIFA I/O.
- Select the input or output that you want to configure.



You can perform the following configurations in PIFA I/O, even if you do not have an EXOflex with EP7416, but of course you cannot load the configurations to the controller in that case.

Analog Inputs (AI)

Configuring AI

We will use the first three analog inputs (AI2_1 – AI2_3) of the PIFA unit 7416 in the EXOflex controller Library1 (AnaIn1 – AnaIn3 on the EXOcompact controller CityHall).

Select the first three analog inputs in turn and give them the following names by entering them in the attribute **Name**:

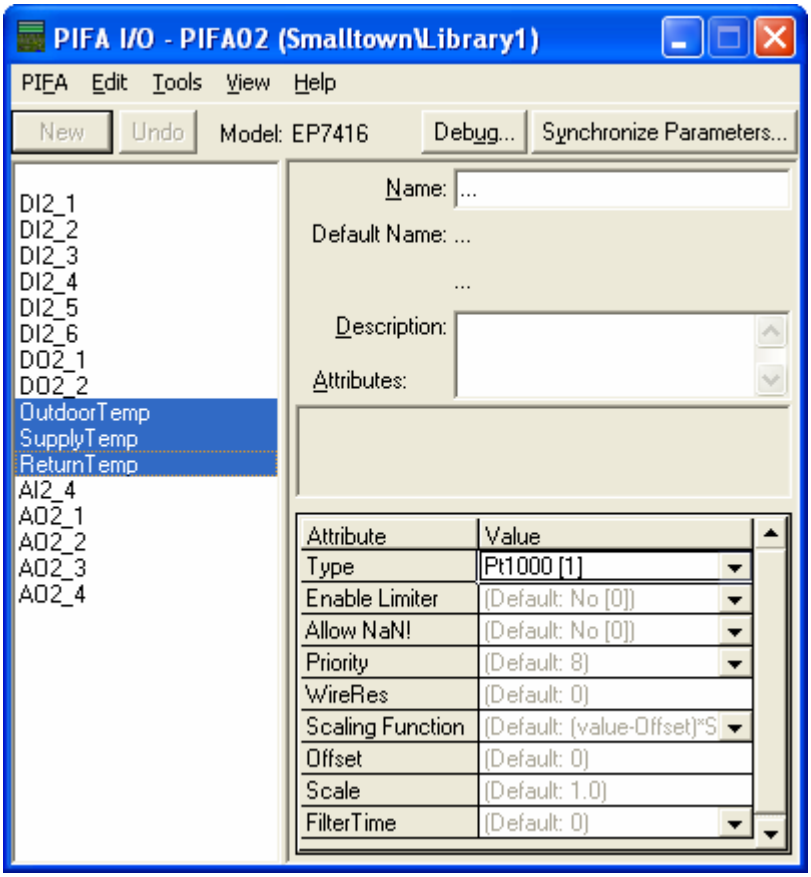
- **AI2_1: OutdoorTemp**
- **AI2_2: SupplyTemp**
- **AI2_3: ReturnTemp**

Accept each name change by clicking the button **Change** or by pressing the Enter key.

The three inputs should have the operating mode Pt1000.

- Multi-select the three inputs by selecting the first one, pressing and holding the **Shift** key while clicking on the third one.
- Check that the operating mode **Pt1000** is selected in the attribute **Type**.

Save the changes by clicking on the menu item **PIFA – Save** or by pressing the hotkeys **Ctrl + S**.



Integration filter The measured value always first passes a fast integration filter to filter out noise and hum. This filter cannot be configured.

Integration filter The update times for the variables of the analog inputs are approximately the following:

- EXOflex: Less than 0.4 seconds (in the file PIFA.Dpe).
- EXOcompact: Less than 2.5 seconds (in the file InputOutput.Dpe).

Variable The input's level (after passing the integration filter) is continually indicated in the variable *AI*.

Troubleshooting To facilitate troubleshooting, the instantaneous value (i.e. the value before any exponential filter, limitation, scaling etc.) of the input is indicated in the variable *AI***Raw**.

Configuration The configuration of analog inputs for different functions is described in the following.

Exponential Filter

FilterTime The measured value can also be filtered trough an exponential filter. The time constant of the filter is configured with the attribute **FilterTime** (the variable *AI***FilterTime**). The time constant equals the time it takes the value, after filtering, to reach 63% of the final value when the input is changed in steps.

Operating Modes

Type The operating mode of the analog input is selected with the configuration attribute **Type**. There are several options for different magnitudes and measurement ranges, e.g.:

- **0–10V**
- **0–20mA** (in EXOcompact an external resistance is required)
- **0–2000Ω**, only EXOflex
- **Pt100 -50** till **+150°C**, only EXOflex

- **Pt100 0** till **+600°C**, only EXOflex
- **Pt1000**
- **Ni1000**
- **Ni1000 L&G**

The value is presented directly in engineering units (according to **Type**) in the variables *AI* and *AI***Raw**.

Application unit

The analog input can automatically convert the measured value to the required application unit in the variable *AI*.

Select the scaling function in the attribute **Scaling Function** to do this. There are two functions to choose from:

AI = (Measured value - **OffSet**) * **Scale**

AI = (Measured value * **Scale**) + **OffSet**

Configure the attributes **Scale** (*AI***Scale**) and **Offset** (*AI***Offset**) with the required values.

Signal Outside the Measurement Range

Measurement range

Each function mode (as set in the configuration in **Type**) has a defined measurement range (e.g. 0-10 Volt). Each physical input also has an actual measurement range that is somewhat greater, at both ends of the range.

Unit

The actual measurement range differs from unit to unit, depending on what the electronics in the analog input can handle. For example, a particular analog input with the function mode 0–10 volt has an actual measurement range of –0.13 to +10.47 Volt.

Indication

That a signal is outside the measurement range is always indicated in the variable *AI***Status**, as follows:

- The signal is outside the defined measurement range if *AI***Status** = 4 or 12 (4 = below defined measurement range, 12 = above defined measurement range).
- The signal is outside the actual measurement range if *AI***Status** = 5 or 15 (5 = below actual measurement range, 15 = above actual measurement range).

These values can be connected to, e.g. alarm points.

Attributes

With the attributes **Enable Limiter** and **Allow NaN!,** you can decide how the value will be indicated in the variable *AI*, when the signal goes outside the measurement range.

Limit the signal to the defined measurement range

Enable Limiter

If **Enable Limiter** is active, the signal is limited to the defined measurement range, even if the signal goes outside this.

If the input signal e.g. is 10.21 Volt, the analog input will still give the value 10. If the function is not active, the value is indicated up to the limit of the actual measurement range.

This limitation is performed before the value is sent to the exponential filter. The variable *AI***Raw** always shows the actual measured value.

Outside actual measurement range

Allow NaN!

By using **Allow NaN!**, you can decide what will be indicated when the signal goes outside the actual measurement range.

If the function is active, the variable *AI* is set to **NaN!** (Not-a-Number) when the signal is outside the actual measurement range.

If the function is not active, the actual measurement range's limit is indicated instead.

Compensation for Wire Resistance (EXOflex only)

WireRes

In EXOflex, analog inputs can automatically be compensated for resistance in wires to temperature sensors. This is achieved by measuring the total resistance in both conductors from the controller to the sensor and configuring the measured value directly in Ohm (Ω) in the attribute **WireRes** (the variable *AI***WireRes**).

Priority (EXOflex only)

Priority

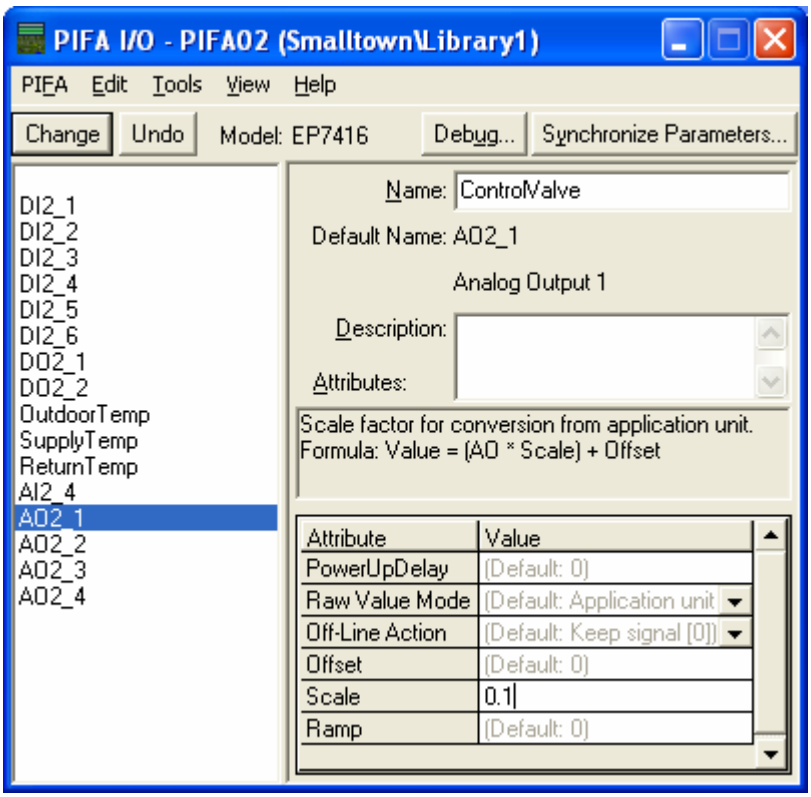
Each analog input on an EXOflex can be given its own priority. If the interval between measured values is too long for the application, you can increase the priority for some inputs on the PIFA, and decrease it for others. 1 (one) is the highest priority.

Analog Outputs (AO)

Configuring AO

The analog output AO2_1 (AnaOut1) will be used to control a valve.

- Select the analog output **AO2_1** (Library1) or **AnaOut1** (CityHall) depending on which controller you use.
- Give the output the name **ControlValve** in the attribute **Name**.
- Scale the output signal by entering **0.1** in the attribute **Scale**. This is done because the result of the controller's process will be in percent, and the analog output is always 0-10 V.
- The standard configuration is accepted for other attributes.
- Accept the changes and save them.



Controlling

The value of the output is directly controlled with the variable *AO* or manually with the variables *AO***ManAutoSelect** and *AO***Man** (in application units).

Troubleshooting

For troubleshooting purposes, the output's momentary status (raw value) is indicated in the variable *AO***Raw**, normally in application units.

Manual control

The mode of the output can be controlled manually with the variable *AO*`ManAutoSelect`

- *AO*`ManAutoSelect` = **2** is **automatic** mode, i.e. the signal is controlled by the variable *AO*.
- When *AO*`ManAutoSelect` = **0** the output has the value **0** in application units.
- When *AO*`ManAutoSelect` = **1** the signal is instead controlled by the variable *AO*`Man` in application units.

Configuration

The configuration of analog outputs for different functions is described in the following.

Application Units

Scale and Offset

You can choose to control the signal in the desired application unit. This is done with the attributes **Scale** and **Offset** (the variables *AO*`Scale` and *AO*`Offset`) in the following way:

Output signal = (*AO* * **Scale**) + **Offset**

Gradual Rise (Ramping)

Ramping

With the configuration attribute **Ramp** (the variable *AO*`Ramp`) you can configure an automatic, gradual rise of the output signal. You specify how fast the output signal changes per second, always in engineering units.

Power-up Action

Delay

Normally, the outputs are kept low for the time specified for each output by the attribute **PowerUpDelay** (the variable *AO*`PowerUpDelay`). When that time has elapsed, the output is set to the value of the variable *AO*. If **Ramp** is configured the signal rises gradually to that level. Thereafter, it will function as usual.

EXOflex

In EXOflex, it is possible to configure that the behavior at power-up shall be controlled manually. This is configured for each PIFA unit with the attribute **Type of Activation = Manual** in the tool EXOflex I/O.

Off-line Action (EXOflex only)

Losing contact

In EXOflex, the PIFA units may loose contact with the main processor, e.g. if the cable between an expansion unit and the processor unit is damaged, or if the processor unit loses power. Using the attribute **Off-line Action**, you can specify what will happen to the output if this occurs.

Keep signal

Normally you would use the configuration **Off-line Action = Keep Signal.** The output signal will remain on the output, as it was when the contact was lost

Set signal low

With the configuration **Off-line Action = Set Signal Low** the output is set low as soon as the contact is lost.

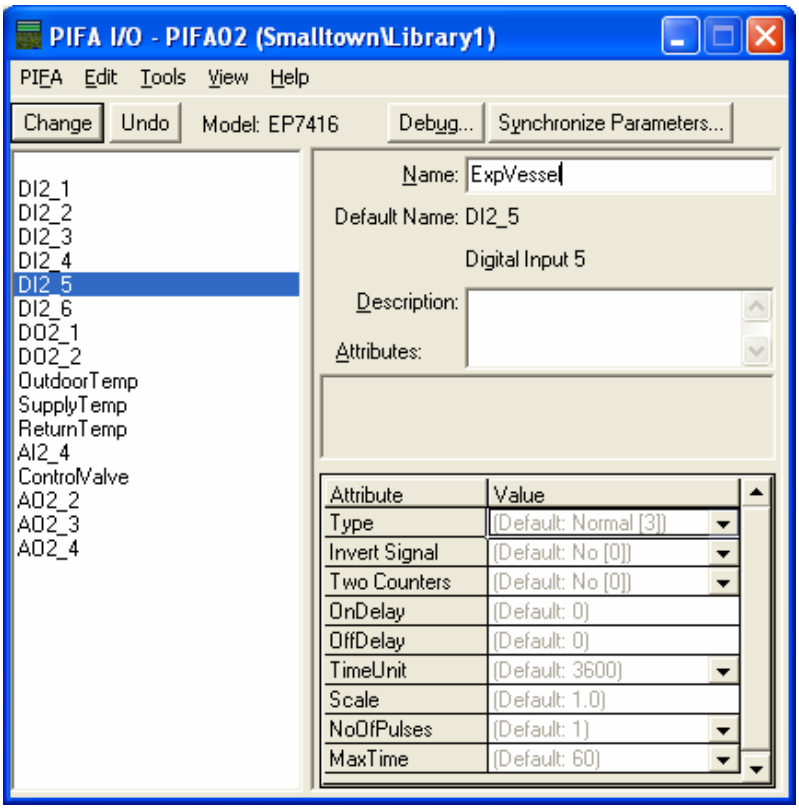
Re-established

When contact is re-established, much the same will occur as during power-up, as described above.

Digital Inputs (DI)

Configuring DI

Keep the standard configuration for the digital inputs, but give the more describing name **ExpVessel** (expansion vessel) to the **Di2_5** (or **DigIn5**).



Digital filter

A digital input has a filter that always filters out very short pulses. The following pulses are always detected:

- EXOflex:
  - Normal DI on I/O-PIFA units: Longer than 9 ms.
  - Advanced DI on I/O PIFA units: Longer than 4.5 ms.
  - DI on power-PIFA units: Longer than 8 ms.
- EXOcompact: Longer than 8 ms.

Update times

The update times for the variables of the digital inputs are approximately the following:

- EXOflex:
  - DI on I/O-PIFA units: 50 ms (in the file PIFA.Dpe).
  - DI on power-PIFA units: 1.6 seconds.
- EXOcompact: 1.6 seconds (in the file InputOutput.Dpe).

Variable

The registered value can be found in the variable *DI*.

Troubleshooting

For troubleshooting (or other purposes), the inputs momentary value (the raw value) is indicated in the variable *DI*Raw.

Configuration

The configuration of digital inputs for different functions is described in the following.

On/off Delay

On delay

On delay is configured with the required number of seconds in the attribute **OnDelay**. This value is stored in the variable *DI*`OnDelay`.

Off delay

Off delay is configured with the required number of seconds in the attribute **OffDelay**. This value is stored in the variable *DI*`OffDelay`.

Signal Inversion

Invert signals

Signal inversion, i.e. if a low signal should be considered ranked as high level in the software and vice versa, is specified by selecting **Yes** in the attribute **Invert Signal**.

Runtime Measuring

Run-time counter

Runtime measuring means measuring the time the input is high, with the resolution 1 second. This function is activated by selecting **Run-Time Counter** in the attribute **Type**.

Time unit

The required unit can be specified in seconds in the attribute **TimeUnit**, and is stored in the variable *DI*`TimeUnit`. Runtime is calculated in hours, i.e. 3600 seconds, by default.

DI`Count`

The time being measured is enumerated in the variable *DI*`Count`. *DI*`Count` has high resolution with approximately 12 figures accuracy, which corresponds to >30 000 years. The application program can change the value of this variable at any time if required. The inputs will then continue to enumerate from the entered value.

Two counters

You can choose to have two counters for runtime measuring by selecting **Two Counters = Yes**. In addition to the variable *DI*`Count`, the variable *DI*`Count2` is added.

DI`Count2`

DI`Count2` has a resolution of approximately 6 figures accuracy, which corresponds to approximately 11 days.

Reset

The application program can set/reset both variables independently of each other.

Logging

DI`Count2` can advantageously be used for data assimilation to the function Logging, for e.g. logging runtime/24h. Logging can be configured to log *DI*`Count2` directly to achieve this function.

Pulse Counting

EXOcompact, power-PIFA units and DI with advanced pulse management on I/O-PIFA units

Pulse counter

EXOcompact, power-PIFA units and, in software respect, advanced digital inputs on I/O-PIFA units has a built-in function for pulse counting. The function is activated if **Type = Pulse Counter** or **Type = Pulse Counter+Rate**.

The function counts the following pulses:

- ❑ EXOflex:
  - ❑ I/O-PIFA units: Pulses longer than 4.5 ms that occur with a periodicity as low as 9 ms.
  - ❑ Power-PIFA units: Pulses longer than 8 ms that occur with a periodicity as low as 400 ms.
- ❑ EXOcompact: Pulses longer than 8 ms that occur with a periodicity as low as 400 ms.

Application unit

The function can automatically convert the value to application unit by using a conversion value that is specified in the attribute **Scale**. This value is stored in the variable *DI*`Scale`. The value in *DI*`Scale` is then multiplied by the number of pulses before the variable *DI*`Count` is updated.

DICount The value of the pulse counting is stored in the variable **DICount** which is updated regularly. **DICount** has high resolution, with approximately 12 figures accuracy, i.e. 1 trillion (1 billion) pulses. The application program can, at any time, set the value of **DICount** to a required value. The input will then continue to count from the entered value.

Two counters You can also choose to have two counters for pulse counting by selecting **Two Counters = Yes**. In addition to the value **DICount,** the variable **DICount2** is added.

DICount2 **DICount2** has a resolution of approximately 6 figures accuracy, i.e. 1 million pulses.

Resetting The application program can set/reset both variables, independently of each other.

Logging **DICount2** can be used advantageously for data assimilation to the function Logging, for e.g. logging the number of pulses/24h. Logging can be configured to log **DICount2** directly to achieve this function.

No status values When pulse counting is activated, the input's status is not indicated in *DI* and **DIRaw**. If this is required, you must configure **Type** with a numerical value that activates the function. Note, however, if the pulse speed is high, this will put a great load on the EXOreal processor.

Normal DI on PIFA Units

Controller objects To achieve pulse counting on, in software respect, normal digital inputs on PIFA units, the controller object **Pulse Counting** can be used. The object is added and configured in the tool Objects, which is described in the chapter ***Control and Automation***.

Pulse Rate Measuring

EXOcompact, power-PIFA units and DI with advanced pulse management on I/O-PIFA units

Pulse rate EXOcompact, power-PIFA units and, in software respect, advanced digital inputs on I/O-PIFA units, have a built-in function for pulse rate measuring (i.e. frequency measuring). The function is activated if **Type = Pulse Counter+Rate**.

The function counts the following pulses:

- EXOflex:
  - I/O-PIFA units: Pulses longer than 4.5 ms that occur with a periodicity as low as 9 ms, i.e. max 110 pulses per second.
  - Power-PIFA units: Pulses longer than 8 ms that occur with a periodicity as low as 400 ms, i.e. max 2.5 pulses per second.
- EXOcompact: Pulses longer than 8 ms that occur with a periodicity as low as 400 ms, i.e. max 2.5 pulses per second.

Time unit The required time unit can be specified in seconds in the attribute **TimeUnit** and it can be stored in the variable **DITimeUnit**. With e.g. **TimeUnit = 60**, the pulse speed is calculated as pulses/minute.

Application unit This function can automatically convert the values to application units by specifying a conversion value in the attribute **Scale**. This value is stored in the variable **DIScale**. The value of **DIScale** is then multiplied by the number of pulses before the **DIRate** is updated.

DIRate The pulse speed is indicated continuously in the variable **DIRate**.

Calculation The pulse speed is calculated in the following instances:

- When the input has received **NoOfPulses** number of pulses.
- If an insufficient number of pulses have been received during the time **MaxTime** (normally 1 minute) the speed will be calculated at any rate.

No status values

When pulse counting is activated, the input's status is not indicated in *DI* and *DI***Raw**. If this is required, you will have to configure **Type** with a numerical value that activates this function. Note however, that this will put a great load on the EXOreal processor.

Normal DI on I/O PIFA units

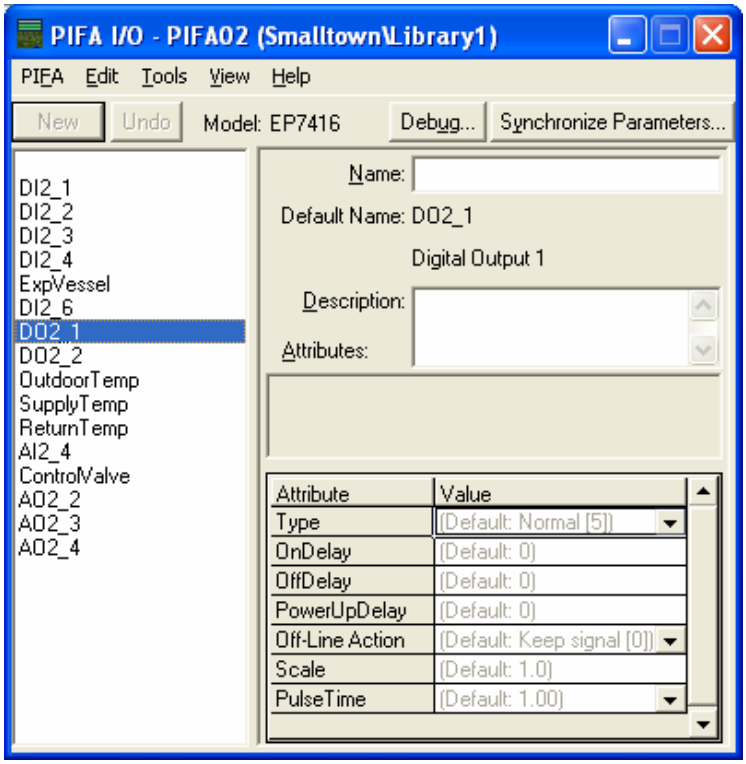
Controller objects

To achieve pulse rate measuring (i.e. frequency measuring) on, in software respect, normal digital inputs on PIFA units, the controller object **Pulse Counting** can be used. The object is added and configured in the tool Objects, which is described in the chapter ***Control and Automation***.

Digital Outputs (DO)

Configuring DO

Keep the standard configuration for the digital outputs.



Control

Digital outputs are controlled directly by the variable *DO* or manually by the variable *DO***ManAutoSelect**.

Troubleshooting

For troubleshooting purposes, the output's momentary value (the raw value) is indicated in the variable *DO***Raw**.

Manual control

The output's mode can be controlled manually with the variable *DO***ManAutoSelect**.

- *DO***ManAutoSelect** = **2** is **automatic** mode, i.e. the output's mode is controlled by the variable *DO*.
- When *DO***ManAutoSelect** = **0** or **1** the output is low or high, respectively, regardless of the value of *DO*.

Physical hand control

For PIFA units with physical hand control switches the output's mode can also be controlled manually. The function of the hand control switch is superior to its correspondence in software, the variable *DO*`ManAutoSelect`. In these PIFA units, there is a variable, *DO*`ManAutoStatus`, that specifies status for the digital output's hand control mode, from both a software and a hardware point of view.

- If the switch is in **Auto** mode, the configuration of *DO*`ManAutoSelect` is displayed (see above).
- If not, the mode of the switch is displayed. When *DO*`ManAutoStatus` = **3** or **4** the output is low and high, respectively.

Configuration

The configuration of digital outputs for different functions is described in the following.

On/Off Delay

On delay

On delay is configured with the required number of seconds in the attribute **OnDelay**. This value is stored in the variable *DO*`OnDelay`.

Off delay

Off delay is configured with the required number of seconds in the attribute **OffDelay**. This value is stored in the variable *DO*`OffDelay`.

Pulse Proportioning

Pulse proportion

A digital output can generate a pulse-proportioning signal automatically. This is achieved by selecting **Type = Pulse Proportion**.

A pulse-proportioning signal means that a signal is generated with a constant frequency, but with varying pulse lengths (the time when the output is high). The resolution of the signal is 10 ms in EXOflex I/O-PIFA units and 200 ms in EXOcompact and power-PIFA units.

The proportion

The pulse proportion is controlled in automatic mode with the variable *DO*`Pulse` in percent (i.e. with a value in the interval 0–100). Alternatively, it is possible to control the proportion with an application unit by specifying a conversion value in the attribute **Scale** (*DO*`Scale`). The pulse proportion (in percent) will then be controlled by *DO*`Pulse` * **Scale**.

Period

The period (the time between the pulses) is configured in the attribute **PulseTime** (the variable *DO*`PulseTime`), in seconds, in the interval 0.01 - 300 seconds in EXOflex I/O-PIFA units and 0.2 – 200 ms in EXOcompact and power-PIFA units.

No momentary value

When the pulse-proportioning function is in use, the momentary value of the output is **not** indicated in *DO*`Raw`. If this is required, you must configure **Type** with a numerical value that will activate this function. Note, however, if the pulse speed is too high, this will put a great load on the EXOreal processor.

Manual control

The signal can also be manually controlled:

- *DO*`ManAutoSelect` = **2** is **automatic** mode, i.e. the signal is controlled by the variable *DO*`Pulse` as described above.
- When *DO*`ManAutoSelect` = **0** the output will have the value **0** in application unit.
- When *DO*`ManAutoSelect` = **1** the signal is controlled by the variable *DO*`ManPulse` in application unit.

Frequency Generation (EXOflex only)

Pulse Rate

A digital output on a PIFA unit can automatically generate a frequency signal. This is achieved by selecting **Type = Pulse Rate**.

Frequency generation means that a signal with a constant pulse length (the time when the output is high), but with varying frequency, is generated. The resolution of the signal is 10 ms.

Frequency The pulse rate is controlled with the variable *DO*`Pulse` in pulses/second (Hz). Alternatively, it is possible to control the pulse rate with an application unit by specifying a conversion value in the attribute **Scale** (*DO*`Scale`). The pulse rate is then controlled by *DO*`Pulse` * **Scale**.

Pulse length The pulse length (the time when the output is high) can be configured with the attribute **PulseTime** (the variable *DO*`PulseTime`), in seconds, in the interval 0.01 to 300 seconds.

No momentary value During frequency generation, the output's momentary status is **not** indicated in *DO*`Raw`. If this is required, you must configure **Type** with a numerical value that activates the function. Note however, that if the pulse speed is high, this will put a great load on the EXOreal processor.

Manual control The signal can also be controlled manually, according to the following:

- When *DO*`ManAutoSelect` = **2**, the mode will be **automatic**, i.e. the signal is controlled by the variable *DO*`Pulse` , as described above.
- When *DO*`ManAutoSelect` = **0**, the output will have the value **0** in application units.
- When *DO*`ManAutoSelect` = **1**, the signal will be controlled by the variable *DO*`ManPulse` in application units.

Power-up Action

Delay Normally, the outputs are kept low for the time that is specified for each output in the attribute **PowerUpDelay** (the variable *DO*`PowerUpDelay`). When that time has elapsed the output is immediately set according to the value of the variable *DO* (disregarding **OnDelay)** or *DO*`Pulse`, depending on the type of function. Thereafter, it will function normally.

EXOflex The behavior at power-up can be configured for manual control in EXOflex I/O. This is configured for each I/O-PIFA unit using the attribute **Type of Activation = Manual**.

Off-line Action (EXOflex only)

Losing contact In EXOflex, PIFA units in expansion units may lose contact with the EXOreal processor, e.g. the cable between an expansion unit and the processor unit is damaged, or if the processor unit loses power. With the attribute **Off-line Action** you can decide what will happen to the output if this occurs.

Keep signal Normally you would use the configuration **Off-line Action = Keep Signal**. The output signal will remain on the output, as it was when the contact was lost. For pulse proportioning or frequency outputs, this means that the output will continue to generate pulses on its own.

Set signal low With the configuration **Off-line Action = Set Signal Low** the output is set low as soon as the contact is lost.

Contact re-established When contact is re-established, much the same will occur as during power-up, as described above.

Save, Close and Reload

Save Save the configuration in PIFA I/O or Inputs and Outputs with the keys **Ctrl+S** or the menu command **Controller – Save**.

Close Close PIFA I/O or Inputs and Outputs. If you forgot to save the configuration you will be asked if you want to save it.

EXOflex I/O Save and close the window EXOflex I/O in the same way.

Reload If you want to test the configuration at runtime, you have to reload the controller and test the behavior with EXOtest.

Chapter 13 Control and Automation

Freely programmable

Regin's range of controllers provides both freely programmable and pre-programmed controllers. The high-level language EXOL or controller objects can be used for programming the freely programmable controllers to obtain the required functionality. The most efficient is however to use controller objects. This description will only include programming by means of controller objects.

Purpose

The purpose of the programming is usually to process the controller's input signals from sensors into output signals to actuators. In addition, you often want to get alarms when something is not working properly.

Controller objects

Controller objects can be used to program most applications. An object performs one or several tasks. There are general objects as well as custom-made objects for a certain application. Objects are created from the available types, and connections are made between the objects, to system variables, and to alarm points. Furthermore, you can adjust the application program by configuring parameters.

Programming

Programming with controller objects usually means that you create a chain of tasks (objects) to be executed, from on or several of the controller's inputs, to one or several of its outputs and alarm points.

Example

For example, for a heating system, the program can be configured to read the outdoor temperature, and then calculate the desired inlet temperature (setpoint). This value is then compared with the real value (actual value) and the result can be configured to operate a valve.

Object names

Objects should be given descriptive names. The name may not contain, e.g. spaces.

Object variables

The interface between objects and the objects' interface to other programs are so-called **object variables**.

Data types

Each object variable has a data type, e.g. real, logic, or index. An object variable of a specific data type must be connected to a variable of the same type.

Variable names

When an object variable is created, it gets its name according to the following rule: The name of the object is followed by an underscore and the ID of the signal (which can be obtained from the documentation of the object type).

Example

Example: If an object has been created and given the name **OutdoorTemp**, and the signal ID is **`Output`**, the name of the object variable will be **`OutdoorTemp_Output`**.

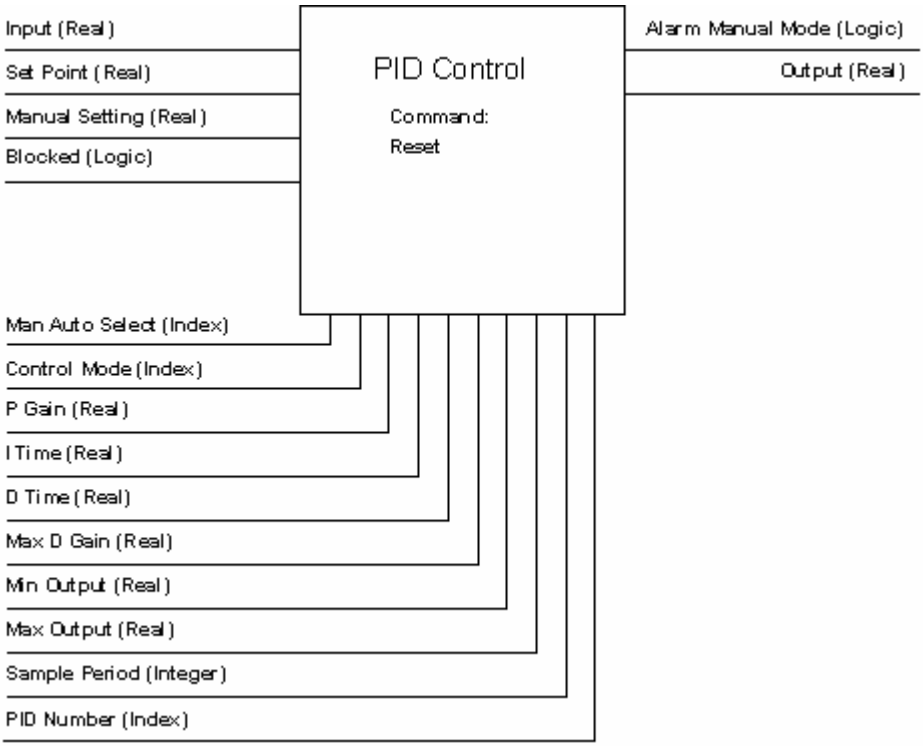
Global VPacs

Normally the object variables are created in the file **`StdObjs1.Dpe`**. This is a global file (with the switch **`/Ms`**), which means that other programs can refer to the variables without the file name.

Description

Description Descriptions of the different available objects can be found in ***EXOdesigner's Help***.

Figure An object's description is usually illustrated by figure. As an example, the figure below shows the object PID Control.



Variables The figure displays all the variables of the object and their data types.

Function The functions of the object's variables are illustrated in the figure in the following way:

- Input signals to the object, are shown to the left of the object. Input signals can be inputs on controllers or output signals from other objects.
- Output signals from the object are shown to the right of the object. Output signals can be outputs on controllers, alarm points, or an input signal to another object.
- The parameters are shown below the object. Parameters are used to control the functionality of the object. Parameters have standard values that can be replaced by other values. On the PID Control you can for instance configure its P, I and D parameters, limit its control signal and allow it to function as a cooling controller. You may allow the operator to change the parameters' values on the display or on a superior system.
- Commands, if any, are stored within the object itself.

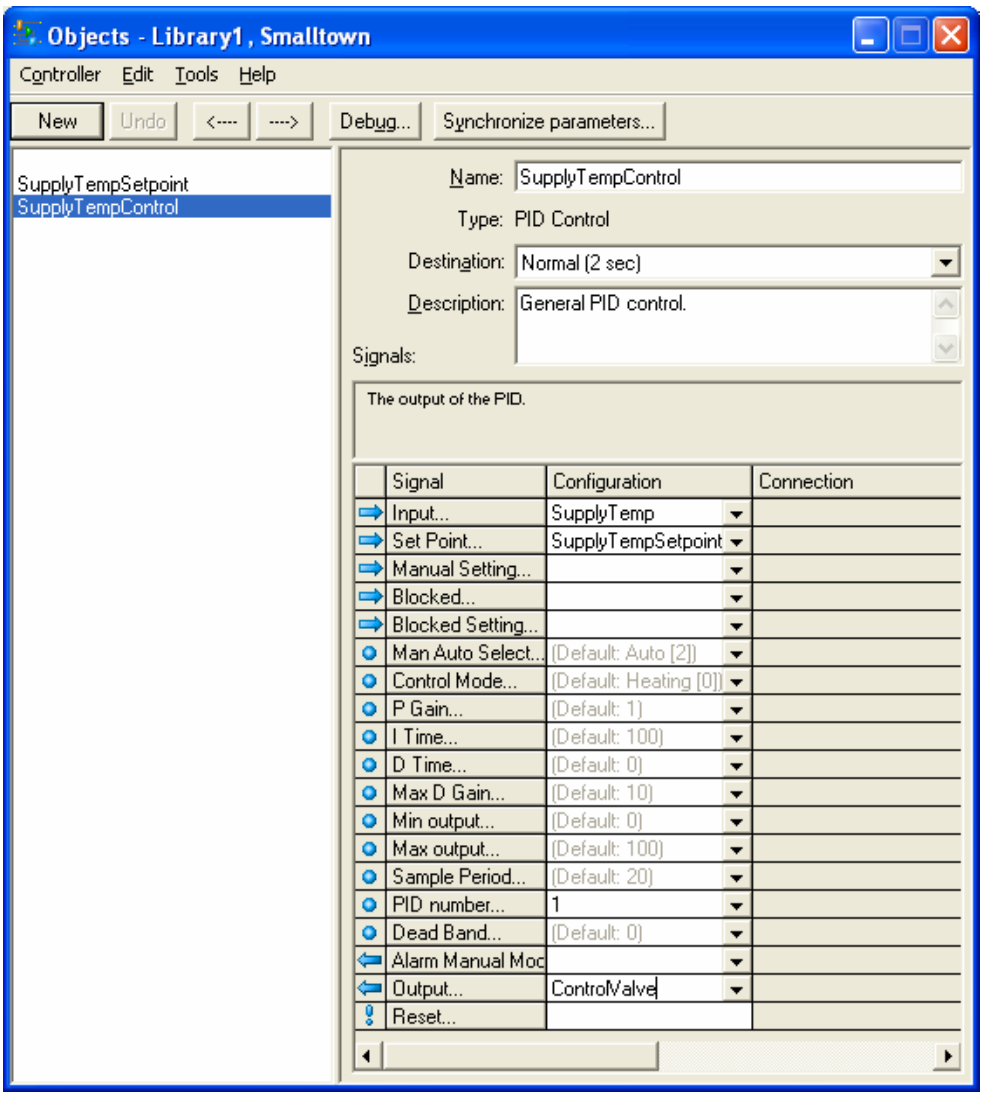
The Tool Objects

Configuration

The objects are added and configured with the tool Objects, which you can open from Project Builder with the button .

Objects

The figure below displays the tool Objects with the object type PID Control.



Destination

The Task file, within which the object's task is to be performed, is selected in the attribute **Destination**. Normally, one of the files **`Slow.tse`** (with the periodicity 5 s.), **`Normal.tse`** (2 s.), **`Fast.tse`** (500 ms.), or **`VeryFast.tse`** (100 ms.) is selected. The tasks that can be performed in Task files with longer cycle time, should be performed such a one in order to avoid a too high load on the processor of the controller.

Icons

The function of each signal (variable) is represented by the following symbols in the tool:

Input signal to the object.

Output signal from the object.

Parameter.

Command.

Configuration

The object variables are configured in the column Configuration.

Connection

Any connections to subsequent objects are displayed in the column Connection.

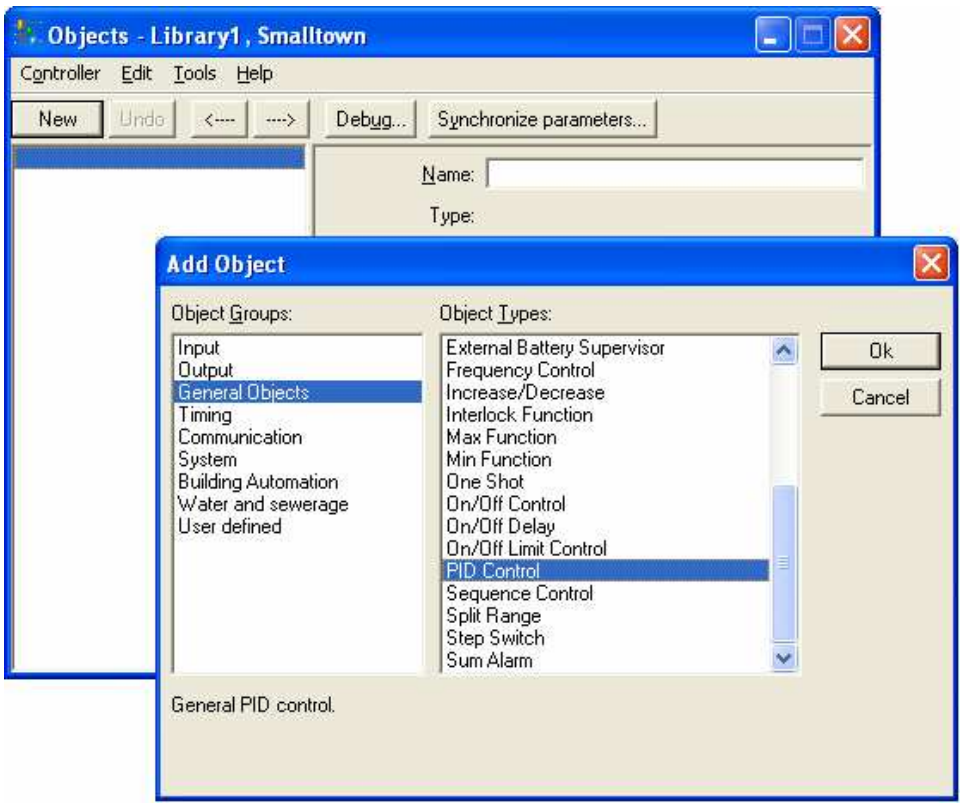
New Objects

New objects

New objects are added by clicking on the button **New** in the tool Objects, and then selecting the object type in the dialog Add Object.

Object search

In the dialog Add Object, the object types are divided into object groups in order to facilitate searching.



Object configuration

Select the required object group and thereafter the object type, click on the button **Ok.** The object will be added in the tool Objects, where it can be configured.

Loading the Program to the Controller

Reload

When an object has been added, the entire controller must be reloaded using the command **Load Controller** in Project Builder.

Runtime changes

The application can change the values of parameter variables in runtime without changing the configuration in the tool. However, after reloading the controller, all variables will be set according to the configuration in the tool.

Reading configuration

By clicking on the button **Synchronize Parameters**, you can display the configuration made on the controller. Thereafter, you will be able to compare the configuration of the configuration tool with the corresponding configuration on the controller. This gives you the opportunity to replace the configuration of the tool with the configuration of the controller.

Troubleshooting Objects

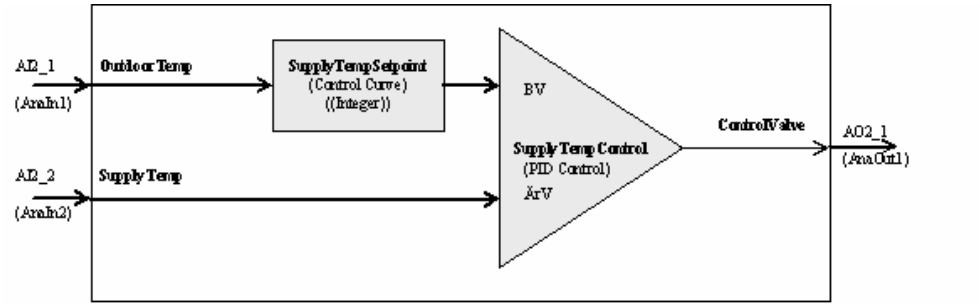
Troubleshooting

By clicking on **Debug** in Objects**,** EXOtest is opened for troubleshooting and testing, displaying all variables of the selected object.

Programming with Objects

Example

In order to illustrate the connection between objects, we will create an application on the controller Library1, for controlling a heating system with an outdoor-compensated setpoint. (The controller CityHall can be programmed in the same way).



Inputs and outputs

In the chapter ***Inputs and Outputs***, the tools PIFA I/O and Inputs and Outputs were used to give descriptive names to the analog inputs and outputs. The analog inputs were set to be of the type Pt1000 and the analog output was scaled with 0.1.

Names

The inputs and outputs were given the descriptive names that appear in the figure above. These names will be used when connecting the inputs and outputs to objects.

Object

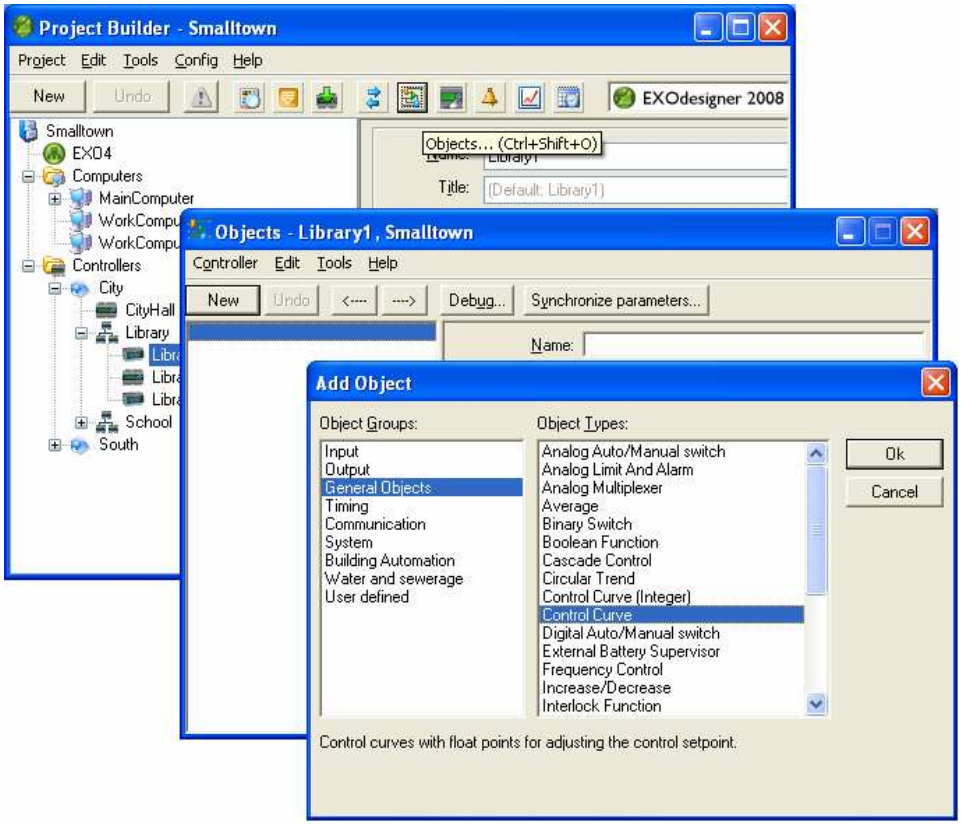
The adding and the configuration of the objects SupplyTempSetpoint and SupplyTempControl are described in the following:

SupplyTempSetpoint

New object

We will start by adding an object of the type **Control Curve**.

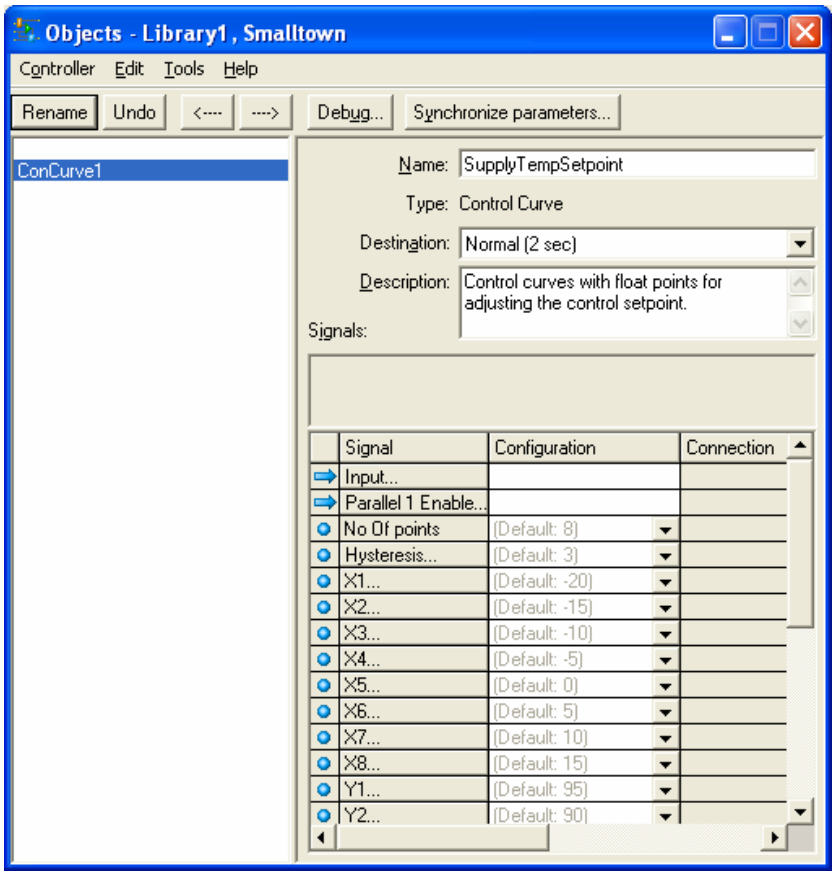
- Select the desired controller in Project Builder and click on the button  in order to open the tool Objects.
- Click on **New** to open the dialog Add Object.
- Select the object group **General Objects** in the left list box and thereafter **Control Curve** in the right list box. Click on **Ok** to add the object.



Control Curve

Control Curve uses a curve (the parameters x1-x8 and y1-y8) to increase the setpoint for the inlet temperature at decreasing outdoor temperatures.

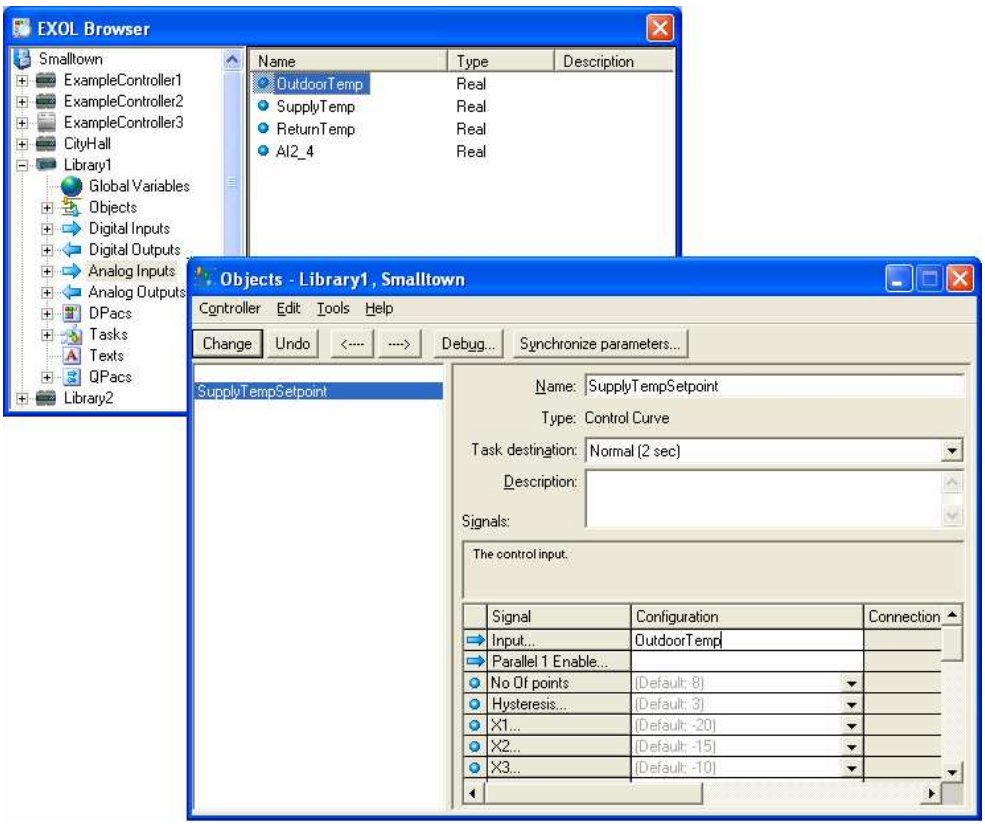
Give the new object the name **SupplyTempSetpoint** in the attribute **Name** and accept the change by clicking **Rename** or by pressing the Enter key.



Input signal

The analog input **OutdoorTemp** should be the object's input signal. The easiest way to select variables is by opening EXOL Browser.

- Click on the signal **Input...** in Objects to open EXOL Browser.
- Select **Analog Inputs** in the left list and thereafter **OutdoorTemp** in the right list.
- The tool Objects will display the selected variable in the column Configuration. Accept the configuration by clicking on **Change** or pressing the Enter key.

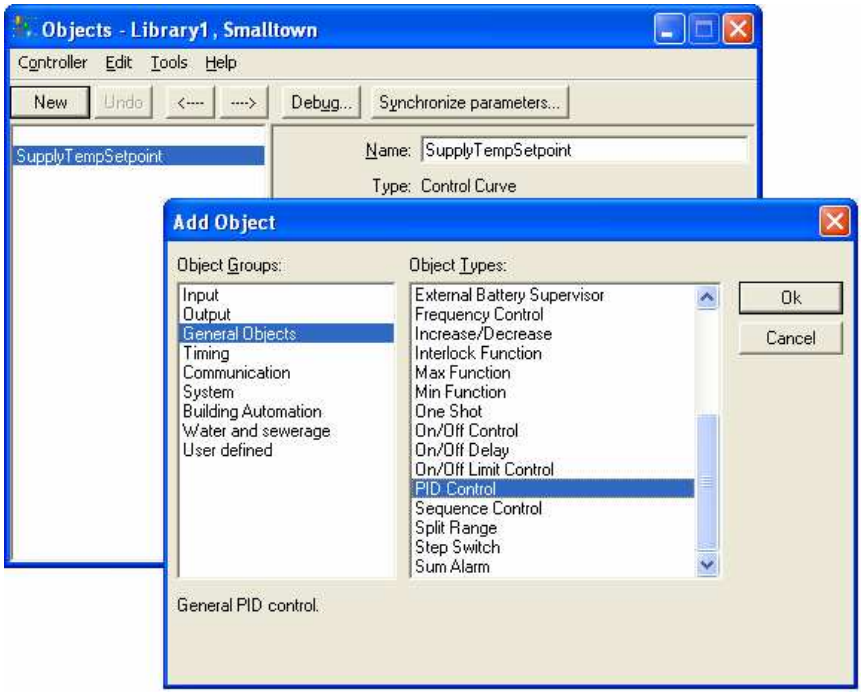


SupplyTempControl

Adding

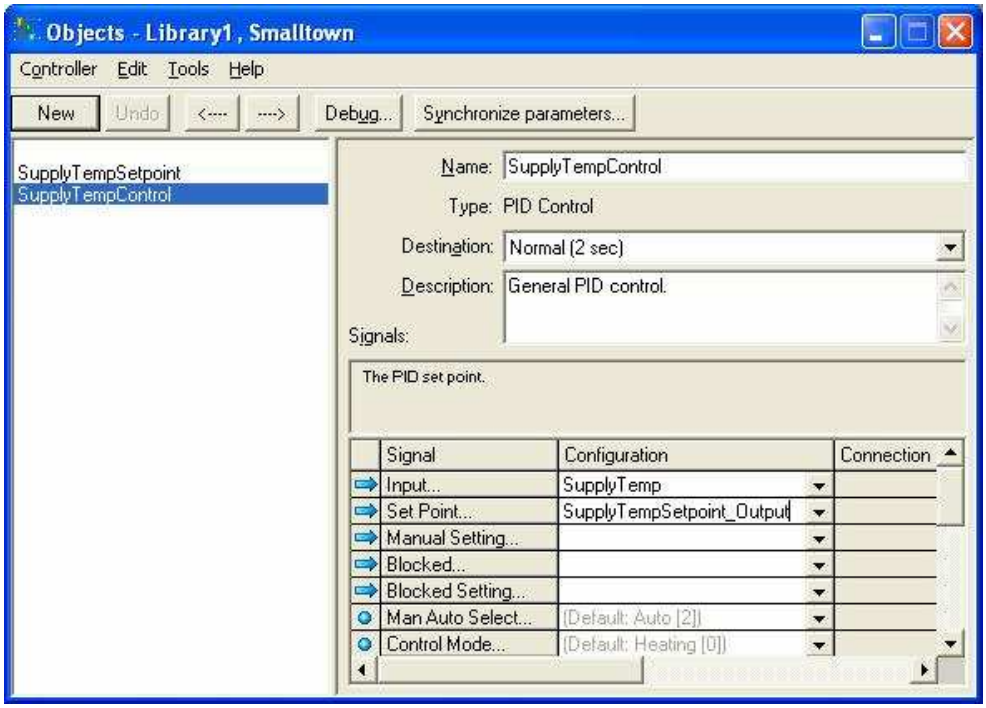
We are going to create an object of the type **PID Control**. PID Control works the same way as a traditional analog PID control. The output signal will be given in percent.

- Make sure that the object **SupplyTempSetpoint** is selected in Objects because the PID control object should come after SupplyTempSetpoint in the event chain.
- Click the **New** button to open the dialog box Add Object
- Select the object type **PID Control** in the object group **General Objects** and click on **Ok**.



Input signals

- Give the new object the name **SupplyTempControl**.
- The signal **Input** for this object should be the actual value, i.e. the analog input **SupplyTemp**. Select this variable in EXOL Browser after selecting **Analog Inputs** in the left list box.
- The setpoint value, **Set Point**, should be the output signal from the object SupplyTempSetpoint, i.e. the variable **SupplyTempSetpoint_Output**. Select this variable in the list box that will be displayed when clicking on the button to the right in the column Configuration for the signal Set Point.
- Confirm the configuration.

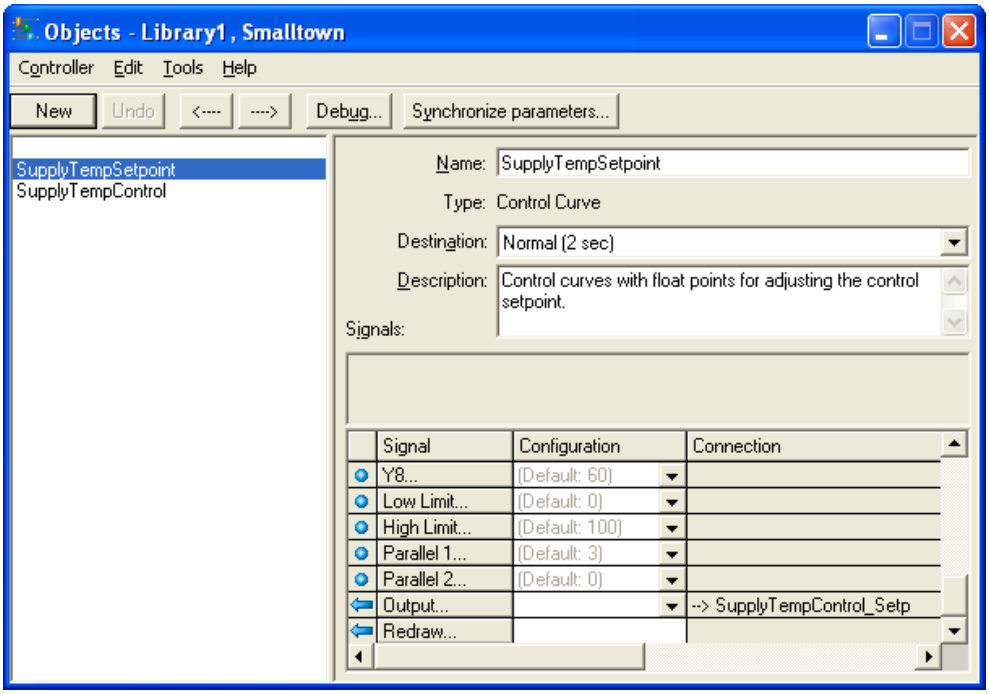


Connection

Output signals from an object that are going to be connected to subsequent objects are never configured. It is sufficient to configure the input signals to the subsequent objects. The first object we created, SupplyTempSetpoint, now automatically displays the connection to the variable SupplyTempControl_Setp in the column Connection.

Controller's outputs

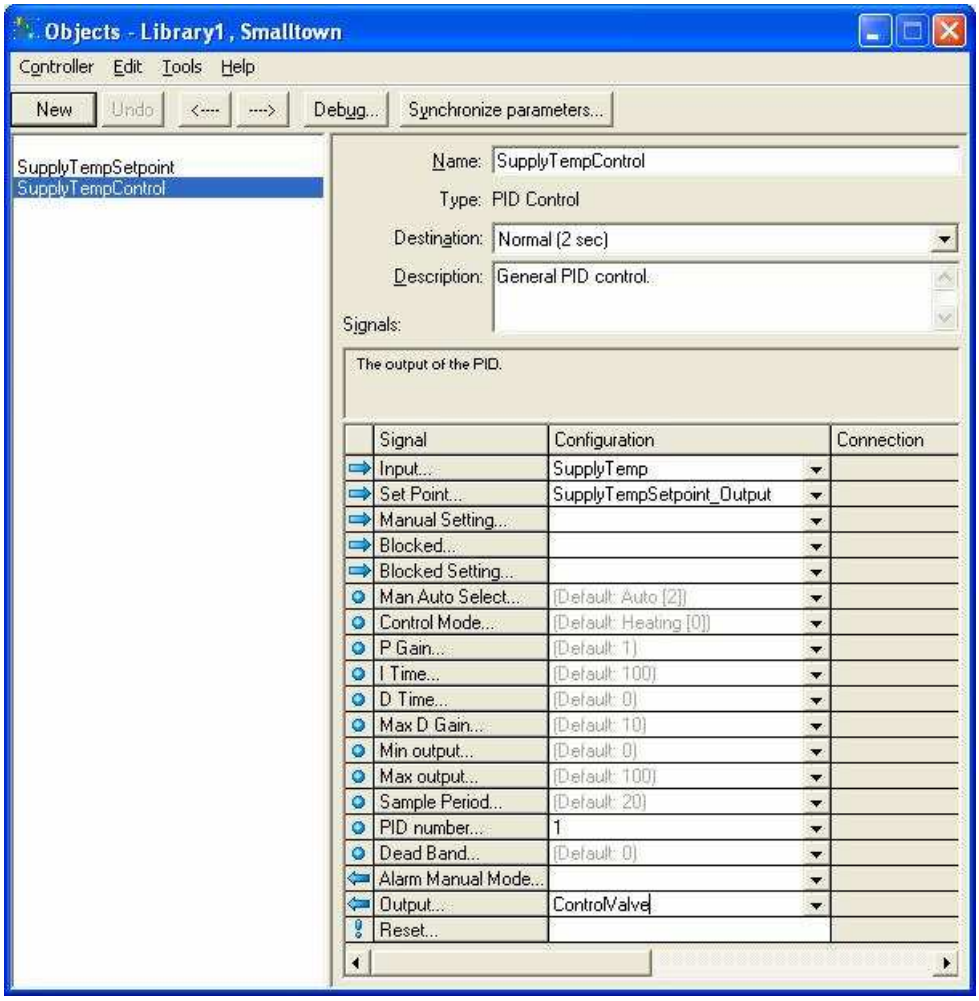
The only output signals from objects that should be configured in the tool Objects are those that are to be sent to the controller's outputs. (Connections to alarm points can be configured in the tool Objects or in the tool Alarms and Events).



Output signals

The output signal from SupplyTempControl should be connected to the physical output **ControlValve**. The analog outputs have the output range 0-10V and the output signal from PID Control is specified in percent. Therefore, the value is scaled with 0.1 before it is transmitted on the physical output. This configuration was made in the tool PIFA I/O or Inputs and Outputs and is described in the chapter ***Inputs and outputs***.

- Select the object **SupplyTempControl**.
- Click on **Output...** in the column Signal to open EXOL Browser.
- Select the variable **ControlValve** in EXOL Browser after selecting **Analog Outputs** in the left list box.
- Confirm the configuration.



Saving, Loading and Testing

Saving

All configurations must be saved before closing Objects.

- Save the configuration of Objects by clicking on the menu command **Controller – Save** or by pressing the **Ctrl + S** keys.
- Close Objects. If you have not saved the changes, a message will be displayed, prompting you to save the changes.

Reload

The functionality of the objects can be tested by first reloading the controller and then selecting an object and click on the button Debug in the tool Objects.

Chapter 14 **Display**

Concepts

Display

The controller function Display manages the user interface of a controller using either a built-in display or an external display. The physical display consists of a text display for presenting values, a keypad and LEDs.

Master controller

Normally the display is only used in the master controller of the stations and in single controllers. A station master can display values from all its station slaves.

Tree structure

The design of the user interface is based on a number of menus and dialog boxes that are organized in a tree structure.

Figures

In this chapter, English texts are used to illustrate the configuration and the display functions. However, other languages, e.g. German or French, can be used.

Menus

Scrollable lists

Menus are scrollable lists where each line corresponds to a navigation to a submenu or a series of dialog boxes. 4 menu items can be displayed simultaneously.

```
 Actual/Setpoint
>Settings
 Manual/Auto
 Access Rights
```

Selected menu item

One of the menu items is selected with a right-arrow displayed in front of the line. By pressing the keypad's up and down arrow keys (▲ and ▼), the selection can be moved up or down.

Navigation

Press the right arrow key (▶) to navigate to the selected menu item and the left arrow key (◀) to navigate to a superior menu (or dialog box).

Dialog Boxes

Contents

Only one dialog box can be shown on the display at a time. Each dialog box can contain static texts, 8 dynamic values at most, and arrows (↓↑).

```
Outdoortemp:12.3 °C
Supply temp
Act.: 62.1 °C    Setp->
Setp:62.3 °C
```

Dynamic values

The dynamic values are real-time values that are retrieved from variables. Dynamic values are updated continuously, normally with an interval of 2 seconds. Operators with sufficient access level can be allowed to change the value of, e.g. setpoints and parameters.

Arrows

The occurrence of arrows in dialog boxes indicates that there are dialog boxes above and/or below the dialog box that currently is displayed. These arrows will be displayed at the top right and the bottom right corner, respectively, of the dialog box.

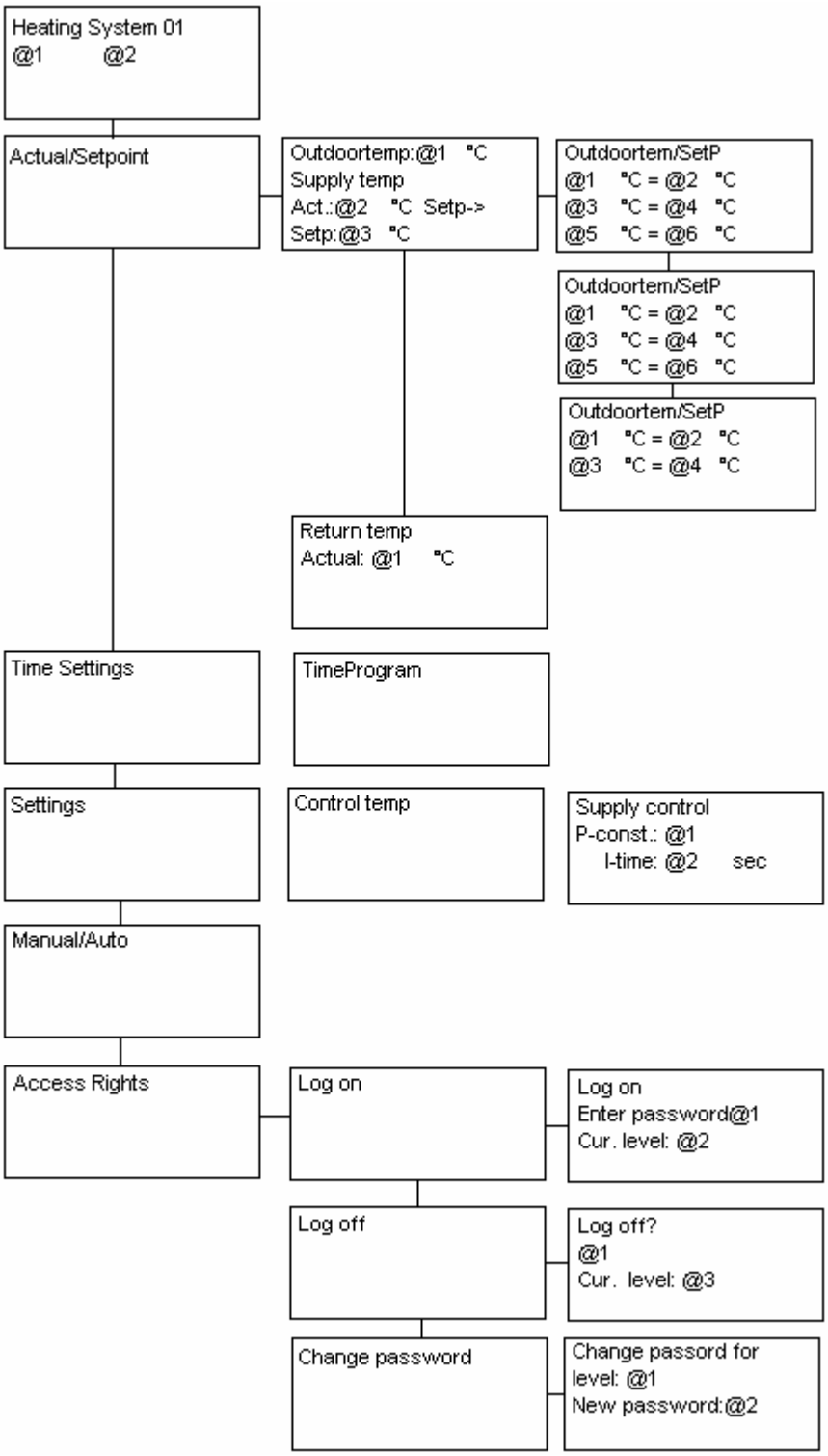
Navigation

Navigation between dialog boxes in the same series is done using the up and down arrow keys (▲ and ▼) on the keypad. By pressing the left arrow key (◀) you normally navigate to the superior menu, i.e. the menu where the current series of dialog boxes was selected.

Tree Structure

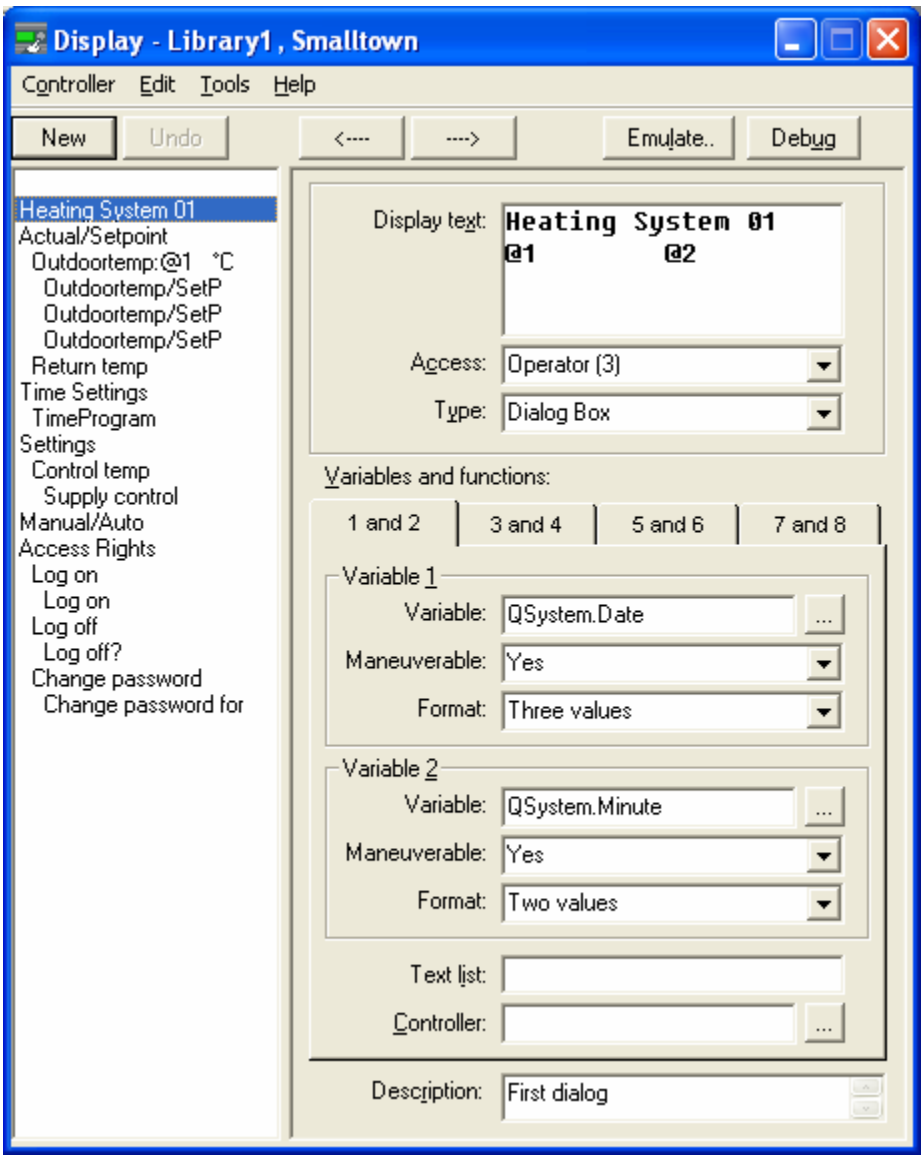
Figure

The figure below displays part of an example of a tree structure with menus and dialog boxes. Navigations that are possible are shown with solid lines. Later in this chapter we will configure this tree structure.



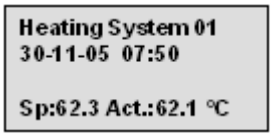
The tool Display

The corresponding tree structure in the tool Display has the following appearance:



System box

The top dialog box in the tree structure is called the **system box**. Normally, it displays the date and time, and sometimes also other information.



Standby mode

2.5 minutes after a key was last pressed on the keypad, the display will automatically return to its standby mode. This means that the operator will be logged off and the system box will be displayed.

Access Levels

Access

The integrator may limit the operator's permission to change values in a dialog box by configuring an access level for it. The navigation from menu items to subordinated dialog boxes or submenus can also be limited this way.

Access levels

There are five access levels: Admin (1), Service (2), Operator (3), Guest (4), and Everyone (5). The access level Admin is the highest access one, and Everyone, which gives access to for everyone, is the lowest.

Password

Each access level has **one** password, which normally is a 4-digit number.

Initial password

The five access levels will initially hold the following passwords:

Access level	Password
Admin (1)	1111
Service (2)	2222
Operator (3)	3333
Guest (4)	4444
Everyone (5)	5555

In order to avoid unauthorized access to the system, these passwords should be changed. Changing the passwords will be described later in this chapter.

Logging on

By logging on using a password, the operator is granted an access level. Logging on will be described later in this chapter.

No access

When the operator performs a maneuver, e.g. changes the value in a dialog box, his access level is compared with the access level that was configured for the dialog box. If the operator does not have sufficient access level to perform the maneuver, it will not be permitted and the log on dialog box will be displayed. The operator may then log on and perform the required maneuver.

Logging off

When you have logged off, or when the display has returned automatically to stand-by mode, the access level is set to **Everyone**, or to the highest level for the password 0.

Unlocking the system

By changing the password for a certain level to 0, the system will automatically log on to this level (instead of logging on to **Everyone**). The system will "unlock" to this level.

If the password 0 is given to more than one level, the system will unlock to the level with the highest access level.

Note that if the password 0 is set to the highest level (Admin), then the display will be accessible to everyone, and anyone will be able to change any password.

Operating

Two types

There are presently two types of displays in the Regin range of products: one with 7 keys, and one with 18 keys.

7 key display

The built-in display in EXOcompact and the external display for Corrigo E have 7 keys:

- The navigation keys (◀ ▶ ▲ ▼) are used, among other things, to navigate in the tree structure, to move the cursor to required position in the text display, and to increase/decrease the value on the cursor's current position.
- OK is used, among other things, to confirm a changed value, whereupon the displayed value is fed to the controller. The value in the controller will not change unless the change has been confirmed with this key.

- C is used, among other things, to undo a change in progress by pressing this key until the original value is restored in the display and the maneuver is terminated.
- The alarm button is used to inspect and navigate between alarms.

18 key display

The external display that can be used with both EXOflex and EXOcompact has 18 keys. In addition to the keys on the 7 key display, it has the following keys that facilitate the input of new values:

- The digits **0-9**
- Decimal point (**.**)

Do not push more than one key simultaneously as this will not be registered!

Changing Values

Maneuver LED

When a dialog box is displayed with one or several changeable (maneuverable) values, and when the operator that is currently logged on has sufficient access level to make changes, the maneuver LED (the LED by the pen symbol) will flash.

Maneuver mode

There are two ways to start maneuver mode:

- **OK** starts maneuver mode for editing of the currently displayed value.
- **C** starts maneuver mode for entering an entirely new value. The existing value is erased from the display.

A cursor will flash in both cases.

Change

When a value has been changed, the change has to be confirmed by pressing the **OK** key.

The variable in the controller will change, only if the entered value is confirmed. If the value is not confirmed, the value will only change in the display.

Undo

Undo an entered value and terminate the maneuver mode by pressing the **C** key for a few seconds**.**

By pressing the **C** key when the currently displayed variable value is empty, the maneuver mode will be terminated for this value and the cursor will move to the next changeable variable and delete its value in the display.

Move the cursor

The cursor is moved from left to right within the existing value using the navigation keys ▸ and ◂ .

Delete

By pressing the **C** key, the digit or character in the cursor position will be deleted.

Increase/decrease values

The up and down arrow keys (▲ and ▼) increase/decrease the value of the digit or the character in the curser position by 1 (one). This is repeated automatically when pressing and holding the key. (The ASCII value is the value that will be changed for characters).

If the character in the cursor position is a decimal point, its value cannot be changed this way. However, the decimal point can be deleted by pressing the **C** key.

Text select

Using the keys ▲ and ▼ you can browse up or down in the texts for text select, i.e. the format for displaying numerical values as texts.

Negative numbers

An initial minus sign is obtained by first placing the cursor in the leftmost character position with the key ◂ and then pressing the key ▼.

The subsequent digits can then be changed to the required value.

Cursor on space

If the cursor is positioned to the right of the value, i.e. on a space, there are different ways to enter a digit or a decimal point, depending on what keys your display type provides.

On an **18 key** display, the easiest way to enter an optional digit or a decimal point is to use the digit or decimal point keys.

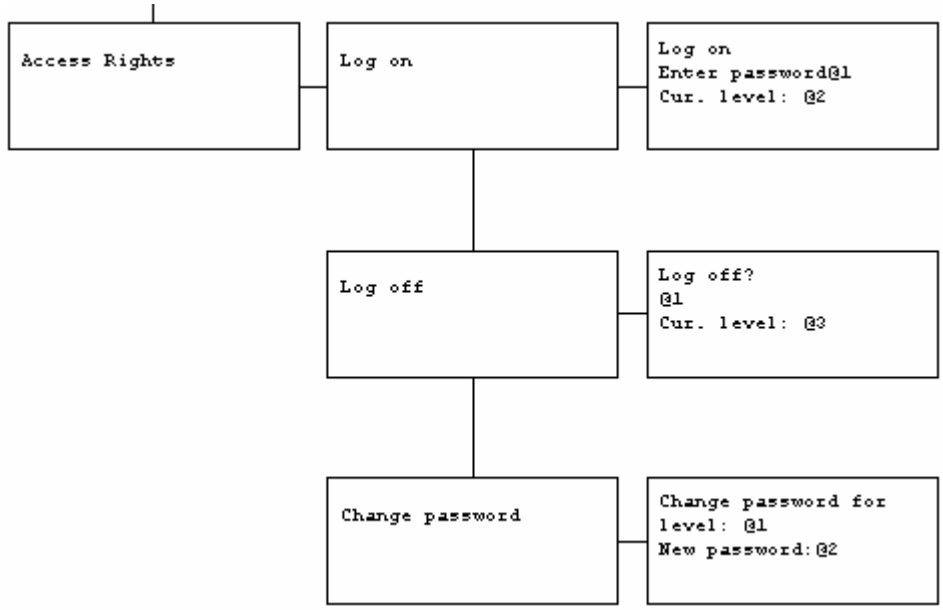
On a **7 key** display, the up and down arrow keys (▲ and ▼) are used:

- The digit 0 (zero) is obtained by pressing the key ▲. Thereafter the value can be increased/decreased as described above.
- A decimal point is obtained by pressing the key ▼.

Logging on, Logging off and Changing Password

Managing access

The function Display has the following menus and dialog boxes for managing access levels.



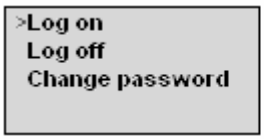
The menu item *Access Rights* is accessible from the menu directly under the system box.

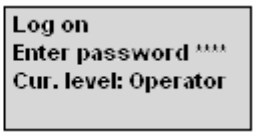
Logging on

- Navigate from the system box with the key ▼ and select **Access Rights** by pressing the key ▶ **.**
- In the menu Access Rights, select **Log on** with the key ▶ (see the left figure below).
- Log on by first pressing the **OK** key in the log on dialog and then entering your password. You do not have to enter any initial zeros. If the password is set to ”0001”, you only need to enter ”1”.
- Press the **OK** key to confirm the password.

The password is now being verified.

- If the password is correct, the access level will be changed.
- If the password is incorrect, a warning will be displayed for a short while.





Automatically

The log on dialog box will be displayed automatically if the operator attempts to make a maneuver he does not have access to perform, e.g. acknowledge an alarm. In this case, the log on dialog box has a time-out function that makes the display return to the previously displayed dialog box after about 4 seconds if no key is pressed. The operator can also choose to return to the previously displayed dialog box by pressing the **C** key.

Unlocking the system

The log in dialog box can be used to unlock the system to another access level than “*Everyone*”. First, log in with the highest access level (*Admin*). Then enter the password “**0**” in the log in box and select the level on which you want the system to be unlocked.

Logging off

- Navigate from the system box with the key ▼ and select **Access Rights** by pressing ▶.
- Browse to **Log off** with ▼ and select **Log off** with ▶.
- Press the **OK** key to start the maneuver mode.
- The text of the second line displays one of the two options “No” and “Yes”. Press ▼ to switch to “Yes” and **OK** to confirm.

The system box is displayed and the current access level is set to **Everyone** or to the highest level with the password ”0”.

Automatically

If logging off is not performed manually, it will be performed automatically a certain time after the last time a key was pressed.

Changing Password

- Navigate from the system box with the key ▼ and select **Access Rights** with ▶.
- Browse to **Change password** with ▼ and select the item with ▶.
- Press **OK** to start the maneuver mode.
- Select the access level to be used for the password change with ▼ and confirm with **OK**.
- Enter a new password and confirm with **OK**.

The program will verify whether the operator has permission to change the password on the selected access level. If the operator has the same access level or higher, the password will be changed. If not, a warning will be displayed on the last line.

Alarm Management

Display

The controller function Display contains an alarm function for inspecting and, if you have sufficient access level, maneuver alarms. Alarms can be acknowledged, blocked and unblocked on the display.

Alarm LED

When an alarm is triggered, the alarm LED, the LED next to the bell symbol, will start to flash. When all alarms have been acknowledged, but there still is any alarm that have not yet been returned, the alarm LED will provide a fixed light.

Configuration

When alarms are configured in the tool Alarms and Events, the integrator determines for each alarm individually, among other things, its alarm class and its display text. The tool Alarms and Events is described in the chapter ***Alarms and Events***.

Inspecting Alarms

- Navigate to the alarm function of the display by pressing the alarm button.
- If there are several alarms that have been triggered, you can browse them by using the navigation keys (▼ and ▲).
- By navigating left with the key ◀ you can leave the alarm management and return to the dialog box that was displayed before you pressed the alarm button.
- By pressing the alarm button you always get to the first alarm.

Display text

Alarms are displayed with alarm text, alarm status, class, date, and time.

```
Supply temp control
error
30 nov 17:26 Class:A
Acknowledged
```

Performing Alarm Maneuver

- Browse to the required alarm (see above).
- Press **OK** to display a menu with the alarm maneuvers available for the alarm in question. (see figure below).
- Select the required maneuver using the keys ▼ and ▲.
- Press **OK** to perform the required maneuver.

```
Supply temp control
error
>Unblock
 Cancel
```

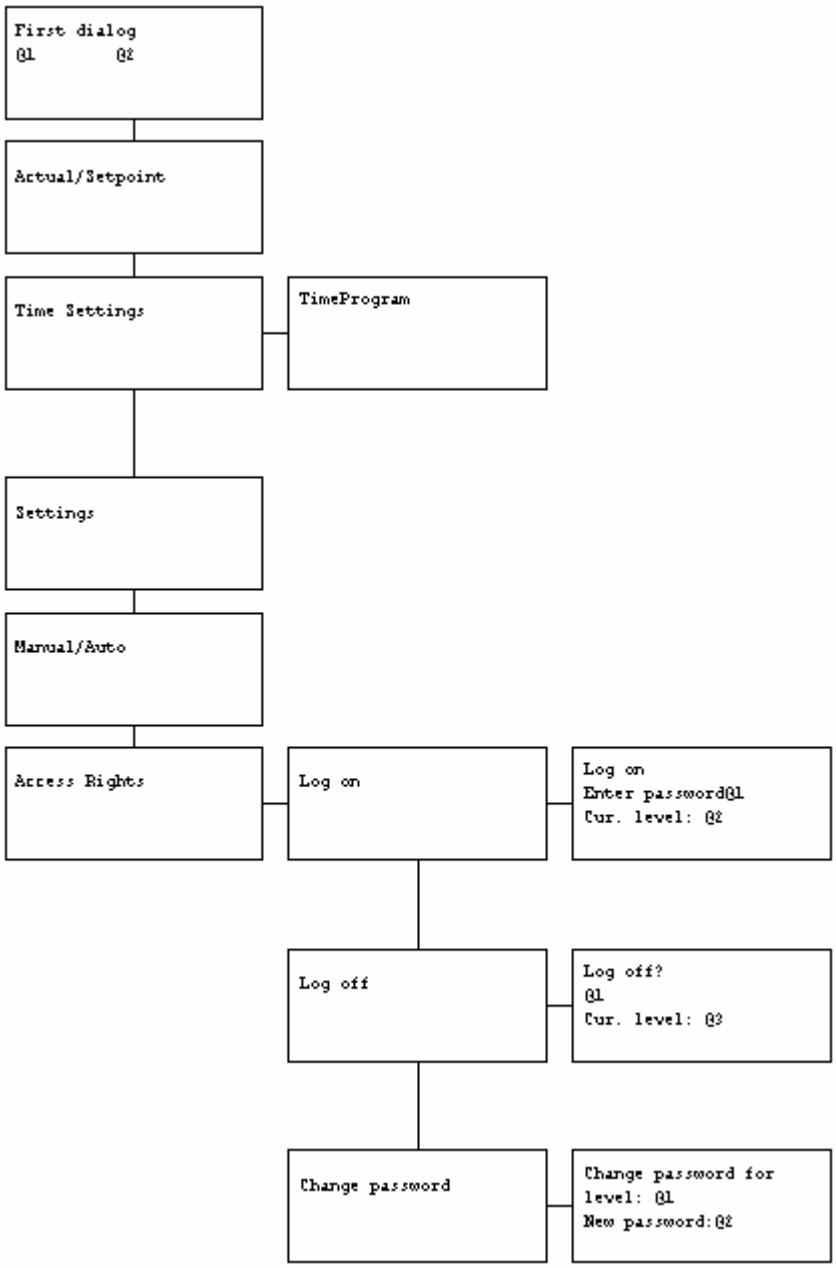
Configuration

Display function

When a controller is created in Project Builder, you can choose to add the controller function Display. If this has not been done, and you would like to add it at a later time, it can be added in the dialog box Functions that can be opened using the menu command **Config – Add/Remove Functions** in Project Builder.

Initial display

When the Display function is first added it will have a basic tree structure, which, depending on the language settings of the computer, will be in English, Swedish or some other language. The tree structure will contain the following:



Alarms

Any alarms that have been configured for local alarm management in the tool Alarms and Events will automatically be displayed on the display.

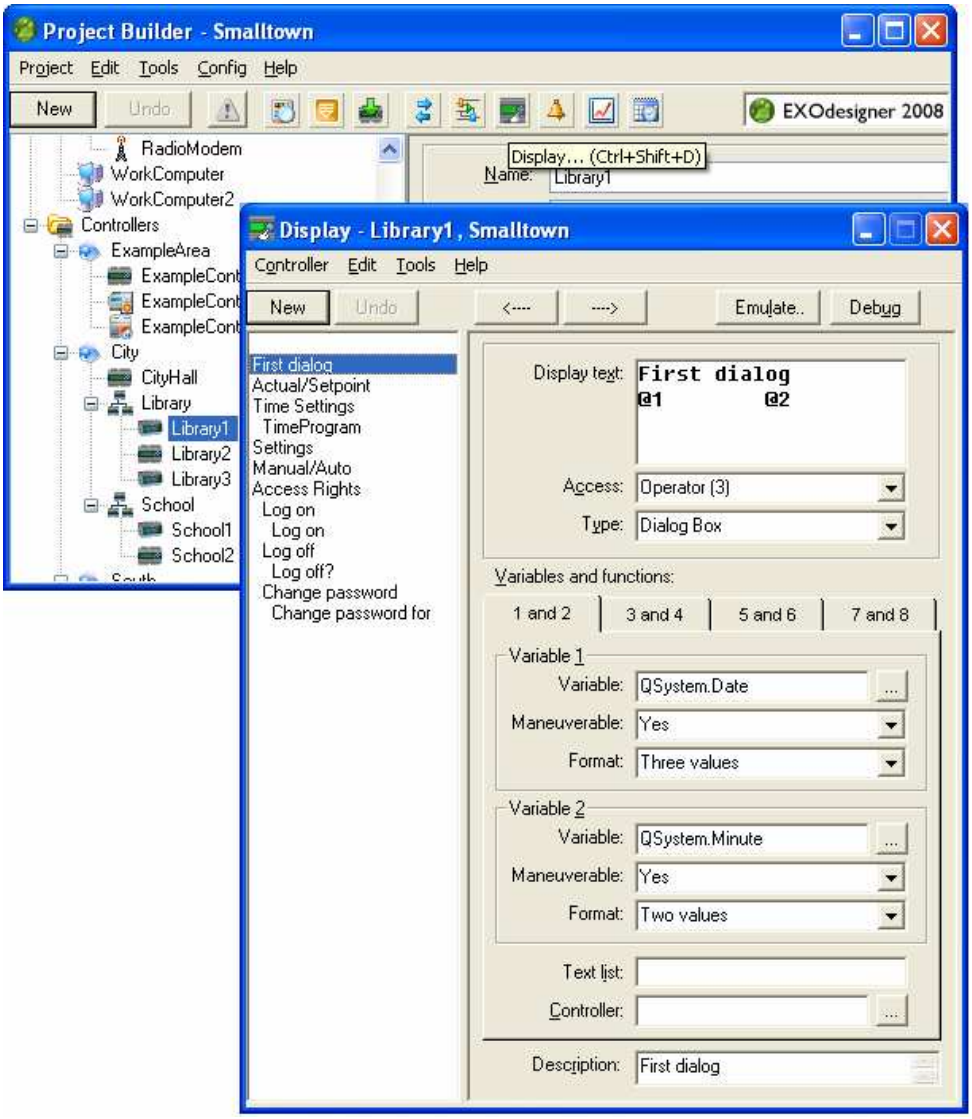
Display Tool

The tool Display

Configuration of the Display function is done in the tool Display.

Opening Display

Open Display Tool by selecting a controller in Project Builder and pressing the button . In this example, we will select **Library1** (you can select **CityHall** instead).



The list box

The list box to the left in Display Tool displays the text of each menu item, as well as each dialog box' static text for the first line.

Tree structure

The up-or-down positioning, (▲ and ▼), of the menus and the dialog boxes is concluded from their mutual order. The various levels of the tree structure, (▶ and ◀), is set by using indents, which are configured with the arrow buttons (---> and <---) on the toolbar.

.

Changing the static text in the system box to **Heating System 01**.

- Select **First dialog** in the left list.
- Delete the text on the first line of the attribute **Display text** and enter the text **Heating System 01**.
- Confirm the change by clicking on **Change** or by pressing the Enter key.
- The text in the list to the left will change.

Emulator

Testing

Display has a so-called emulator that you can use to test the appearance and function of the current configuration before it is loaded to the controller. The emulator consists of a window with a 4 line display and 4 navigation keys. The keys function in the same way as when the program is running in a physical controller.

Open the emulator by clicking on the button **Emulate** or by pressing the keys **Ctrl+E**.

Appearance

The images below illustrate the emulator and how it may appear. The top image illustrates a dialog box and the bottom image illustrates a menu:

Work in parallel

You can use the emulator and the main window in parallel. If you change the configuration in the main window, the same changes will instantly be made in the emulator.

Values displayed

The display of dynamic values in the emulator is exclusively for estimating their extension to the right. The dynamic display in the emulator corresponds to the value zero (0). For the format text change though, the text with most characters will be displayed.

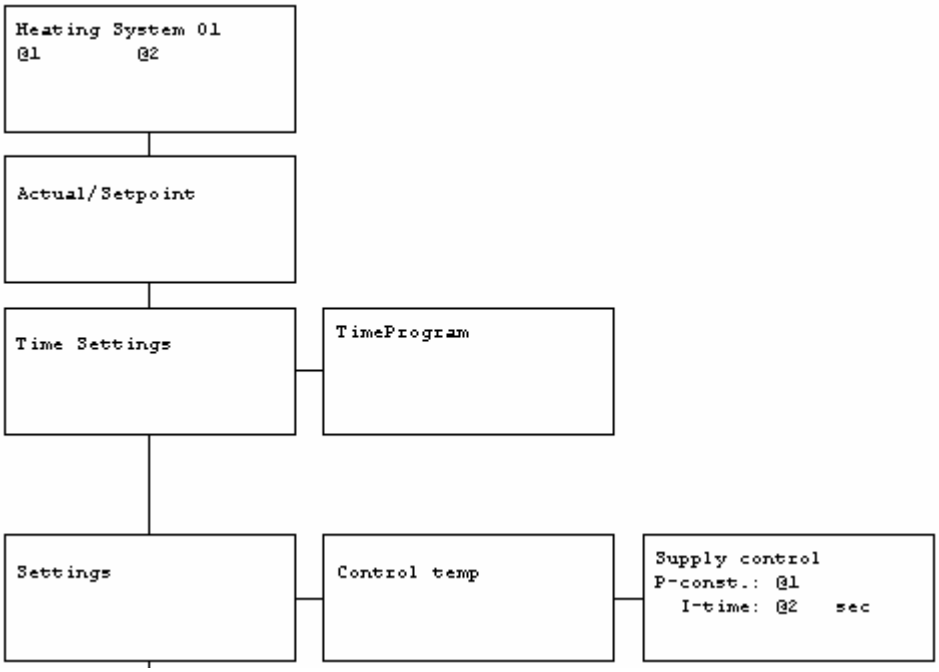
Creating a Menu Item and a Dialog Box

Menu item

First, we will create the menu item **Control temp**, which will be part of a submenu to **Settings**.

Dialog box

Secondly, we will create the dialog box **Supply control** that will display the P and I parameters of the PID regulator. These parameters will also be modifiable.

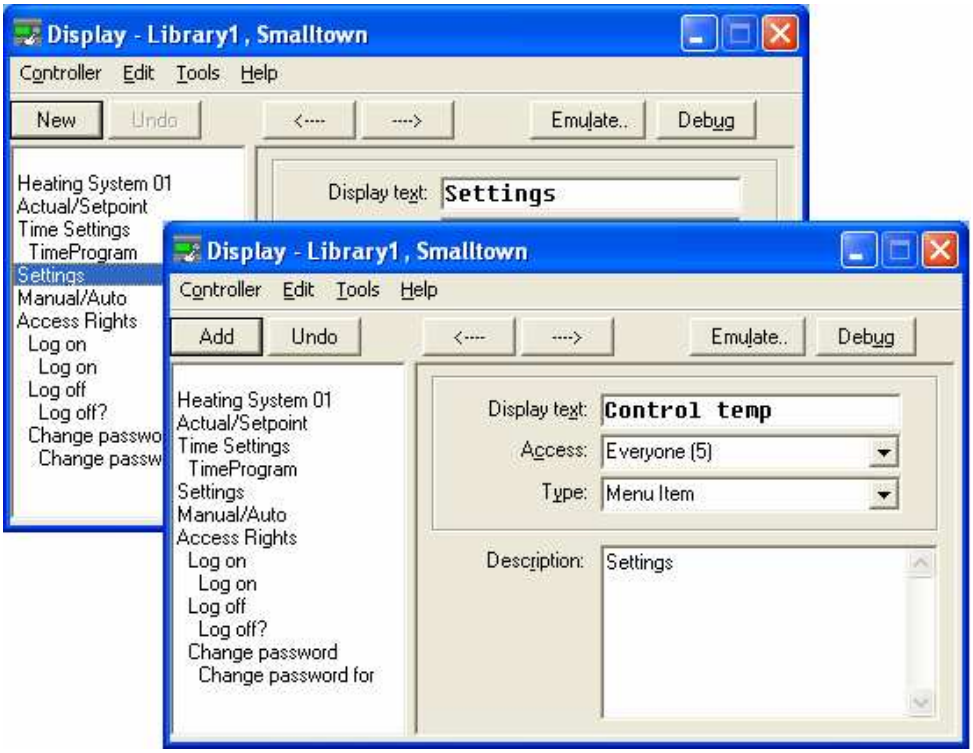


The Menu Item Control Temp

Adding

- Select **Settings** in the left list in Display.
- Click on the button **New** and check that the attribute **Type** is **Menu Item**.
- Enter the text **Control temp** in the attribute **Display text**. Further configurations will not be necessary as we want to accept the lowest access level (Everyone).
- Click on the button **Add** (or press the Enter key) to add the menu item.

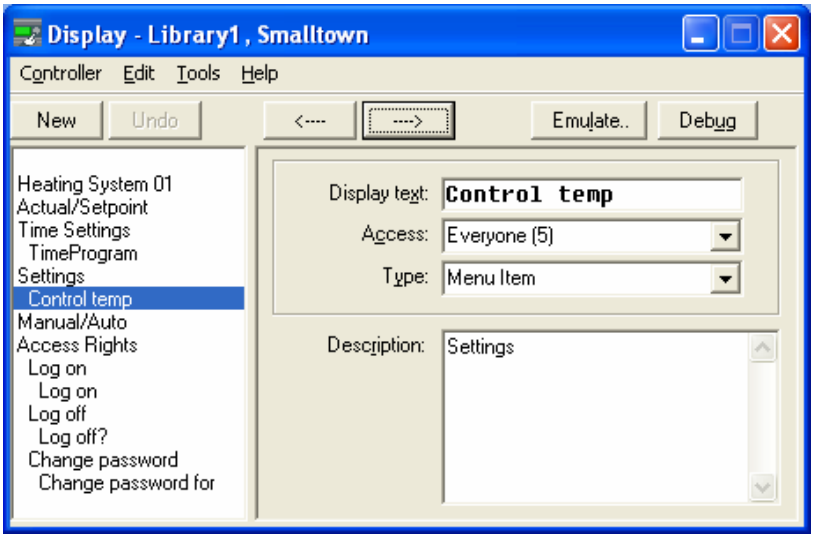
The new menu item is added at the same level as Settings.



Changing the level

We are going to change the level of **Control temp** and make it a submenu to **Settings**.

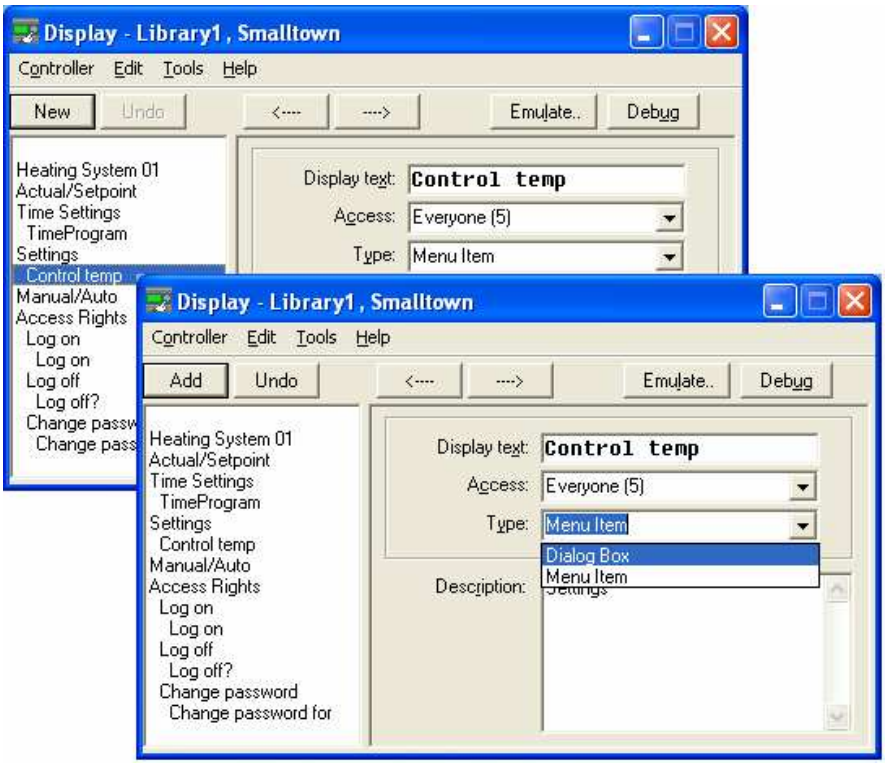
- Select **Control temp** in the left list.
- Move the menu item one step to the right by clicking on the button with the right arrow ---> on the toolbar or the right arrow key on the keyboard.
- Open the emulator by clicking on the button **Emulate** and verify the navigation.



The Dialog Box Supply Control

Adding

- Select **Control temp** in the left list in Display.
- Click on the button **New**.
- Select **Dialog Box** in the attribute **Type**.
- Click on the button **Add** (or press the Enter key) to add the dialog box.



Configuring Dialog Boxes

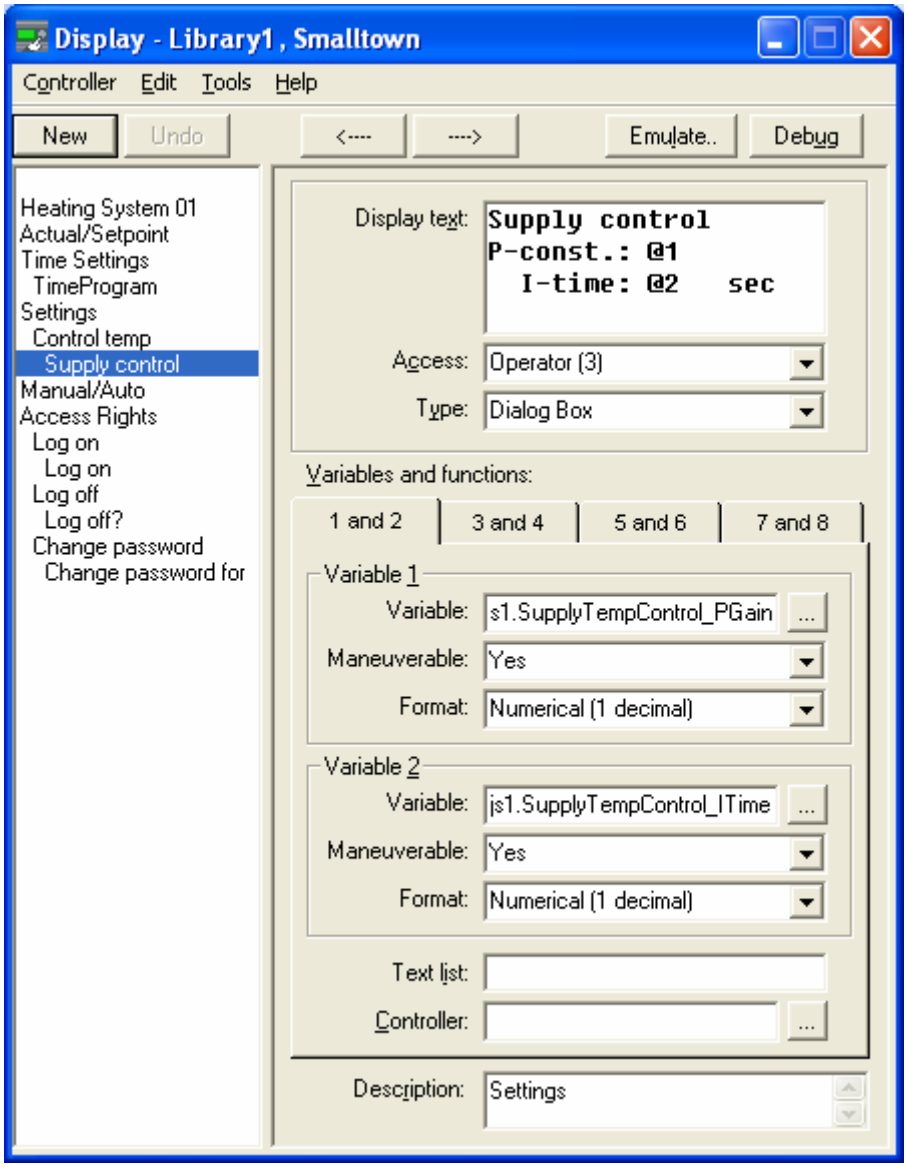
Configuration

Now the new dialog box, Supply control, should be configured. (The attributes' configuration alternatives are described in the text that follows).

- Make sure that the new dialog box is selected.
- Enter the following text in the attribute **Display text.** Use the Tab key on the keyboard or the mouse to move the cursor to the next line.

```
Supply control
P-const.: @1
  I-time: @2      sec
```

  @1 and @2 are placeholders on the display for the dynamic values, i.e. they decide where the dynamic values will be displayed. Note that we have left space for the value of **I-time** before its unit **sec**.
- EXOL Browser can be used for finding the variables to use by clicking on the button with the three points to the right of the attribute **Variable**. The following variables can be found in the **DPac file StdObjs1** or in the folder **Global Variables**:
  Select the variable **SupplyTempControl_PGain** for the first dynamic value (**Variable 1**, i.e. for the placeholder @1).
  Select the variable **SupplyTempControl_ITime** for the second dynamic value (**Variable 2**, i.e. for the placeholder @2).
- The attribute **Format** should be configured with **Numerical (1 decimal)**. The format determines how the dynamic value will be displayed.
- Both dynamic values should be maneuverable (modifiable). To configure this, select **Yes** in the attribute **Maneuverable.**
- If a dialog box has one or several maneuverable dynamic values, you can configure the access level required to change the values. Change the access level for the maneuverable values by selecting **Operator (3)** in the attribute **Access.**
- Click on the button **Change** to accept the configuration.
- Change the level of the dialog box to be subordinated the menu item Control temp by clicking on the button with the right arrow ---> twice.
- Test the configuration with the emulator that opens when you press the button **Emulate**.



Attributes of Dialog Boxes

Description

Possible configuration attributes are described below.

Display Text

Display text

The attribute **Display text** in a dialog box can contain 4 text lines. Each line can contain a maximum of 20 characters, and consists of static text and dynamic values.

Static text

The static text can be entered in other languages besides English, e.g. Swedish or German.

Dynamic values

Each dialog box can besides the static text contain up to 8 dynamic values. The positioning of the dynamic values in the dialog box is marked with the placeholder **@n**, where **n** is the number of the variable, i.e. 1-8. Spaces are used to reserve place for the value to the right, if there is a following text, e.g. a unit.

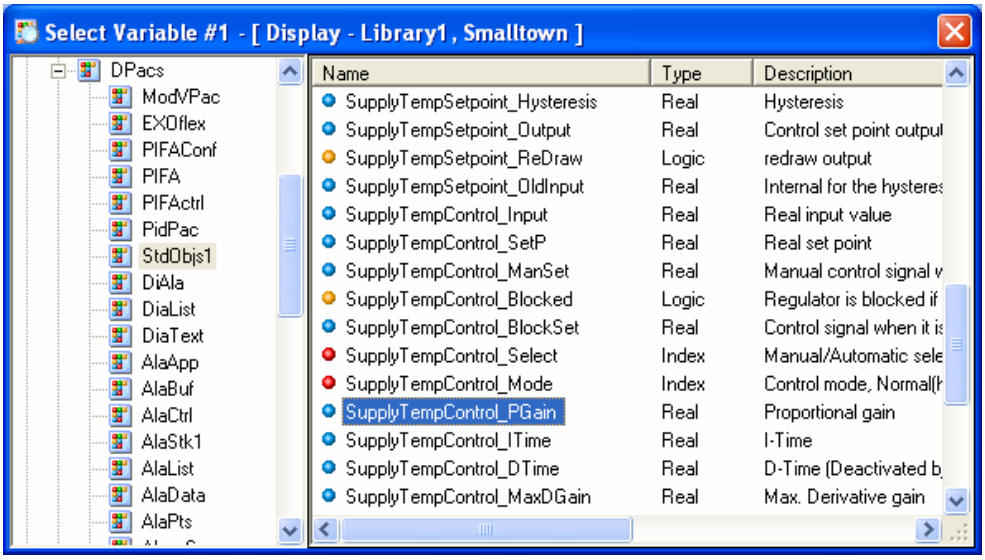
Variables and Functions

Placeholder

In the lower part of the window, you specify, which variable is to be displayed in each position. The number of the placeholder (@1 - @8) must correspond to the number of the variable (Variable 1 – Variable 8).

EXOL Browser

You can select the variables in EXOL Browser, which is opened by pressing the button to the left of the attribute **Variable**.



Two or three values

For display formats that display the values of two or three numerical values, the **first** variable should be specified. The selected variable and the following variable(s) will then be displayed in reverse order, i.e. from right to left. For example, to display the time format hh:mm you select the variable **`QSystem.Minute`** as the variable **`Minute`** is declared before the variable **`Hour`** in the file **`QSystem`**. An example is displayed in the predefined system box.

Maneuverable

With **Maneuverable** you can choose, for each variable, whether it should be maneuverable (i.e. modifiable by the operator (**Yes**)), or only be readable (**No**).

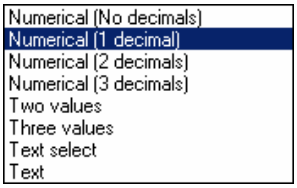
When a variable in the dialog box is maneuverable, you can change the required access level for changing the values of the variables at runtime with the attribute **Access**. All maneuverable variables in the dialog box will have the same access level.

Display format

Format specifies how the variable should be displayed. The dynamic display is, in most cases, a numerical value, but may in some cases be two or three numerical values (e.g. for displaying time and date) or a text (e.g. a telephone number).

For numerical values, the accuracy level for displaying the value (number of decimals) can be configured.

Integer values can be displayed with static texts, so-called text select (e.g. Off, On, Auto).

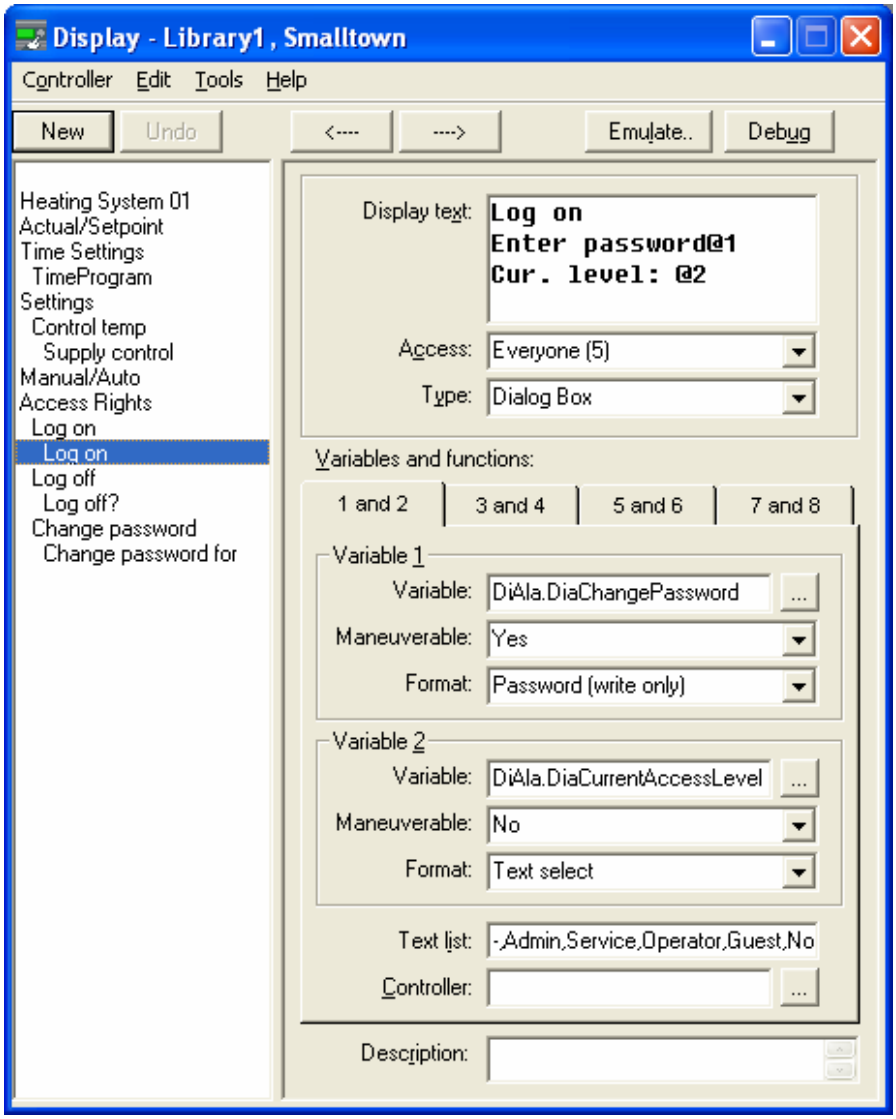


Text select

Text select (text change) is used to display the value of an integer variable as text. When the format **Text select** has been selected, the texts to be used have to be specified in a comma-separated list, without spaces, in the attribute **Text list**. The first text is used for the value 0, the second for the value 1, etc. **Off,On,Auto** can, for example, be used to represent the values, **0**, **1**, and **2**. If a value should not be displayed to the operator during maneuver, it should be specified with a dash (-).

If two variables belonging to the same variable pair (1 and 2, 3 and 4 etc.) both have text select, they must also use the same set of texts. If this is not the case, variable numbers may be skipped. You can for instance skip Variable 2 (and placeholder @2) and use Variable 1 and Variable 3 (and the placeholders @1 and @3).

The example below shows the text select format as it is configured for the predefined log on dialog box.



A Different Controller

A different controller

If the variables that are to be displayed dynamically are located in a different controller than the one being configured, the address of this controller must be specified in the attribute **Controller.** The address is specified with the name of the controller or its numerical address (comma-separated PLA and ELA, e.g. 1,3).

Serial ports

The controller's serial ports must be configured for Display to be able to display variables in other controllers. This is not done by configuring Display, but by configuring System Function. Then System Function works out where the other controllers are connected, which is used by Display.

Browse Arrows

Generate

The browse arrows that indicate that there are dialog boxes or menu items above and/or below in the same series are generated automatically by selecting the menu command **Tools - Generate Browse Arrows**. Text, if any, in position 20 is overwritten.

Dialog boxes

The arrows are placed to the very right on the top or bottom line of the dialog box.

Menus

In menus, the arrows appear only at the first and at the last menu item in the series.

Saving and Printing

Saving the configuration

Before the controller is reloaded with the configuration in Display, the configuration has to be saved with the menu command **Controller - Save** or by pressing the keys **Ctrl+S.**

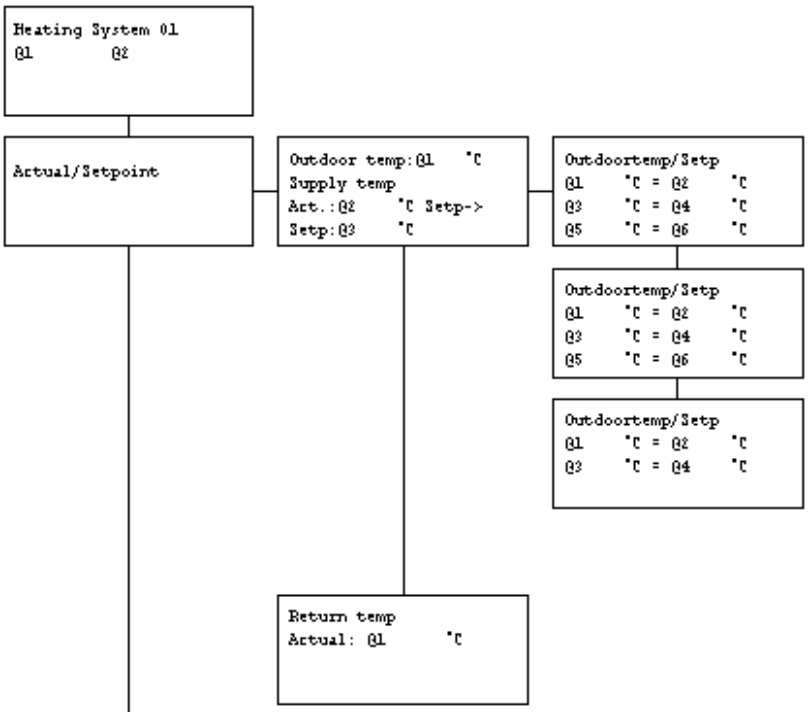
Printing

The configuration in Display can be printed in the following ways:

- The configured tree structure can be previewed on the screen by using the menu command **Controller – Print Documentation Preview.**
- The documentation of the configured tree structure can be printed on a printer by using the menu command **Controller - Print Documentation**.
- The configuration can be printed on a printer by using the command **Controller – Print Configuration**.
- The command **Copy Image** on the **Tools** menu, copies an image of the tree structure for the selected dialog boxes and menus to the Clipboard. The image can then be copied into a document or a drawing program. The copied image has always the same size as the screen of the computer, so images of too large tree structures cannot be created.

More Dialog Boxes

We will provide another example of how to create dialog boxes in Display.



The Dialog Box Outdoortemp

- Select **Actual/Setpoint** in the left list in Display and click on the button **New**.
- Select **Dialog Box** in the attribute **Type** and click on the button **Add**.
- Select the new dialog box and change its level to be subordinate to the menu item Actual/Setpoint by clicking on the right arrow ---> on the toolbar.
- Enter the following text in the attribute **Display text**:

  Outdoor temp:@1 °C
  Supply temp
  Act.:@2 °C Setp->
  Setp:@3 °C

  Remember to use the Tab key to move the cursor to the next line and make space for the display of the values.

  In some countries, e.g. Sweden, the degree character (°) is obtained by pressing and holding the **[Alt]** key while typing the ASCII code **248** on the numerical keyboard. Other countries may use a different ASCII code for this character.

  The arrow (**->**) after the text **Setp** on the third line should indicate that there is an additional level with a series of dialog boxes below this dialog box. The arrow is typed using the keys for the characters **–** and **>** on the keyboard.
- The following variables should be used:

  Variable 1: OutdoorTemp
  Variable 2: SupplyTemp
  Variable 3: SupplyTempControl_SetP (Variable 3 is located on the other tab, **3 and 4**)
- Moreover, the following configurations are made for all three variables:

  Maneuverable: No
  Format: Numerical (1 decimal)
- Confirm the configuration.

The Dialog Boxes Outdoortemp/Setpoint

Three boxes

The three dialog boxes Outdoortemp/Setpoint are used to configure the 8 dots in the curve of the object SupplyTempSetpoint, which is of the type Control Curve.

- Select the dialog box **Outdoortemp** in the left list in Display and click on **New** and thereafter on **Add**.
- Change the level of the new dialog to be subordinated the dialog box Outdoortemp.
- Enter the following text in the attribute **Display text**:

  Outdoortemp/SetP
  @1 °C =@2 °C
  @3 °C =@4 °C
  @5 °C =@6 °C

- All variables should have the format **Numerical (no decimals)**

  Moreover, the following configurations are made for the variables:

  Variable 1: SupplyTempSetpoint_X1, Maneuverable: No
  Variable 2: SupplyTempSetpoint_Y1, Maneuverable: Yes
  Variable 3: SupplyTempSetpoint_X2, Maneuverable: No
  Variable 4: SupplyTempSetpoint_Y2, Maneuverable: Yes

Variable 5: SupplyTempSetpoint_X3, Maneuverable: No
Variable 6: SupplyTempSetpoint_Y3, Maneuverable: Yes

- Accept the configuration and change the access level to **Operator (3)** in the attribute **Access**.
- Confirm this configuration.

When the first dialog box in the series on the same level has been created, you should make sure that it is selected. When the next dialog box is added, it will be added after the selected dialog box and the only attributes that need to be changed are the ones that are different, i.e. the variables.

This means that, in the second dialog box, the variables should be changed to **SupplyTempSetpoint_X4 – X6** and **SupplyTempSetpoint_Y4 – Y6**, respectively.

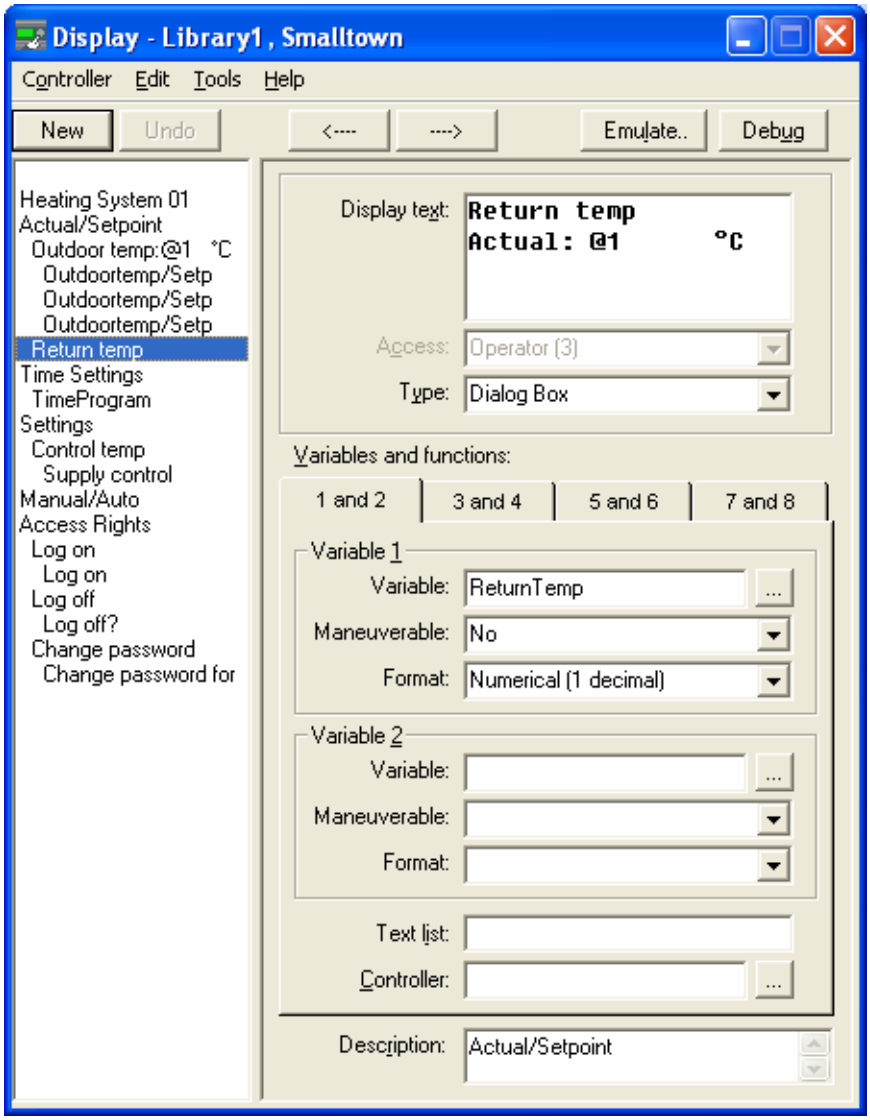
In the third dialog box, the variables should be changed to **SupplyTempSetpoint_X7 – X8** and **SupplyTempSetpoint_Y7 – Y8**, respectively, and the last line in the attribute **Display text** should be deleted by deleting the variables 5 and 6.

The Dialog Box Returntemp

- Select the last created dialog box **Outdoortemp/SetP** to insert a new dialog box below that one and click on **New**.
- Make sure that **Dialog Box** is selected in the attribute **Type** and click on **Add**.
- Move the new dialog box one level up with the left arrow (<---) on the toolbar to make it subordinated to the menu item **Actual/Setpoint** (i.e. the same level as the dialog box Outdoortemp). by using the left arrow (<---) on the toolbar.
- Enter the following text in the attribute **Display text**:

  ```
  Return temp
  Actual:@1     °C
  ```

  The dynamical value to be displayed is the variable **ReturnTemp** and it should, of course not be maneuverable, since it is a measured value. The value should be displayed with one decimal.
- Accept the configuration.
- Test the configuration in the emulator.
- Save the configuration, reload the controller and test the function on the display of the controller.



Save, Close and Reload

Save Save the configurations that you have made in Display with the keys **Ctrl+S** or the menu command **Controller – Save.**

Close Close the tool Dialog. If you forgot to save the configuration, you will be asked if you want to save it.

Reload If you want to test how it works at runtime, you have to reload the controller.

Chapter 15 EXO4 Window Design

What is EXO4?

Operator

From the operator's point of view, EXO4 is a ready-made program that, among other things, contains:

- Windows for monitoring and controlling the processes.
- The windows also contain buttons, click areas and popup menus to open other windows.
- Gathering, storing and presentation of alarms.
- Gathering, storing and presentation of historical data

Windows

An EXO4 application contains a number of windows with process pictures, popup menus, and dynamic elements for displaying, and if required, changing values in the controllers, etc. Dynamic values in an open window are updated continuously when you have a connection to the controller whose values you are displaying.

Design

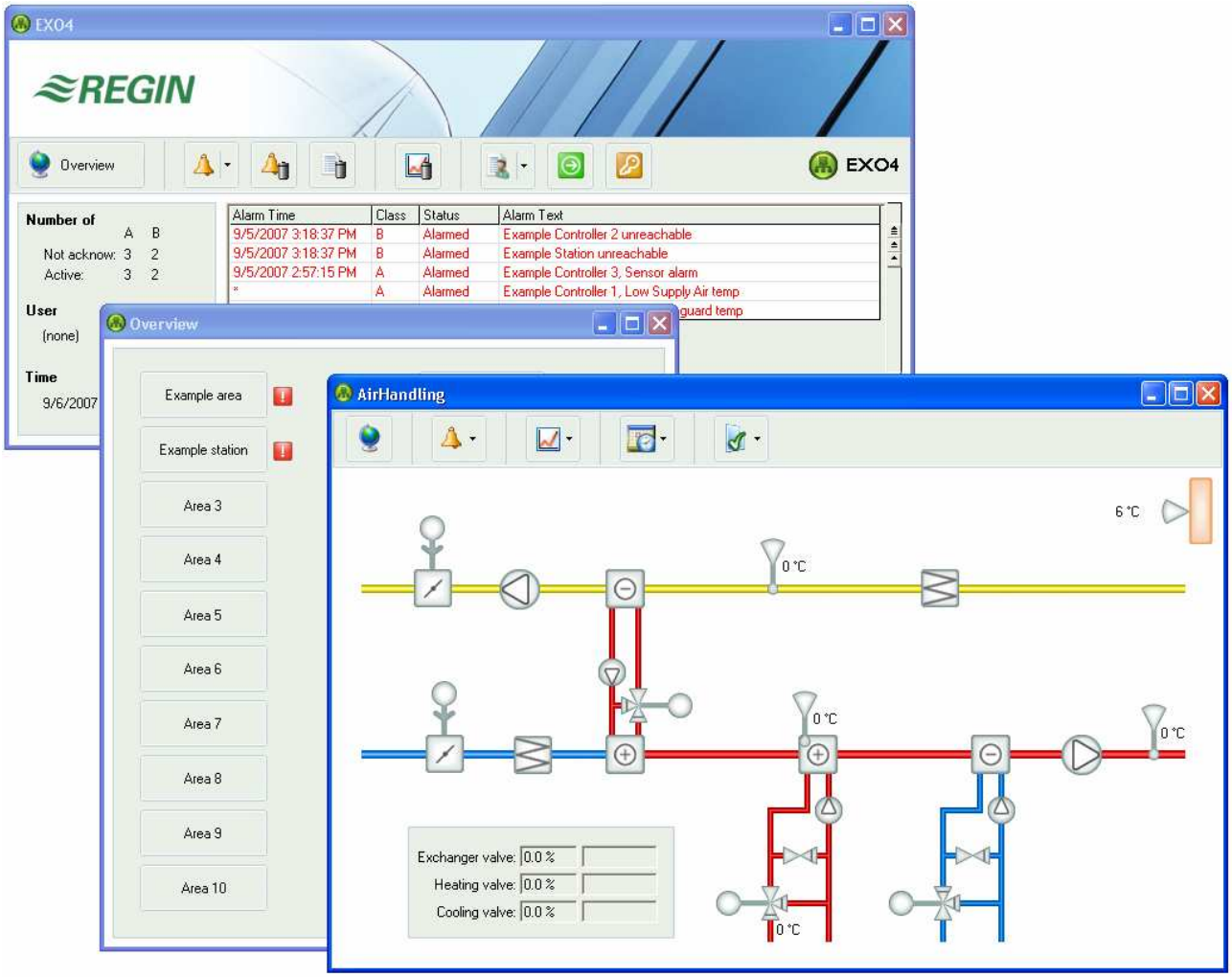
EXO4 2008 includes new standard window templates for, among others, system window, overview window and process windows (controller windows). It is recommended to use this graphic design for the windows you design yourself as well.

Clip arts and symbols

Libraries with clip arts and symbols are included in EXO4. These are described in the document ***EXO4 Libraries***.

Dial-up

To display or change dynamic values in dial-up stations and controllers, connection and disconnection are normally performed when a window for such a station/controller is opened and closed, respectively. See the section ***Designing Windows – Configuring the Window's Properties - Dial-up Controllers***.



Windows

Background

The EXO4 windows may have an unchangeable background composed of a process flow diagram or similar. To design these background pictures, we recommend using Paint.Net, which is a free third-party tool. It is included on the EXO4 CD.

Window elements

The dynamic display, e.g. the display of variable values in the controller, is presented in so-called window elements that can be placed on top of the static background. Some dynamic values can by modified by an operator providing he has sufficient access level.

Maneuver

Some window elements can be controlled by different maneuvers, e.g. by direct entry into the element, or by dialog box confirmation. The changed value is transferred to the controller, unless you press the key **Esc** to undo the maneuver.

Toolbar

Many windows have a toolbar with popup menus.

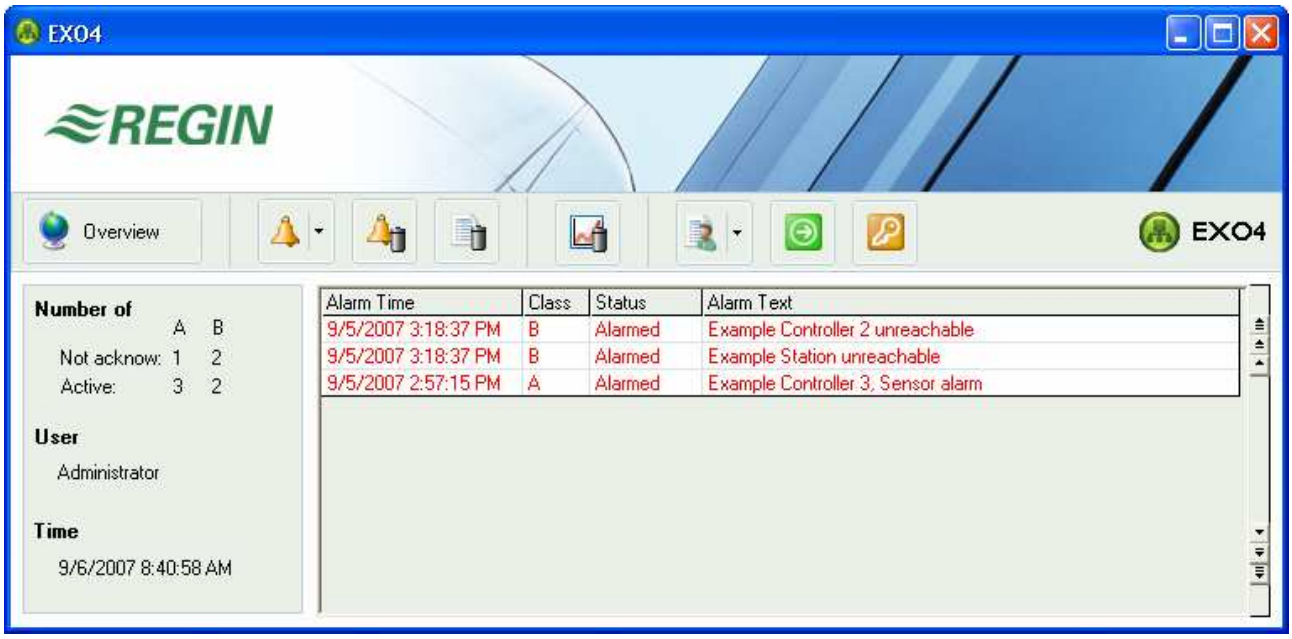
EXO4 System Window

Starting EXO4

The EXO4 system window is opened when EXO4 Run is started. The system window must be active or minimized when EXO4 is running. If the system window is closed, EXO4 will also close.

Summary overview

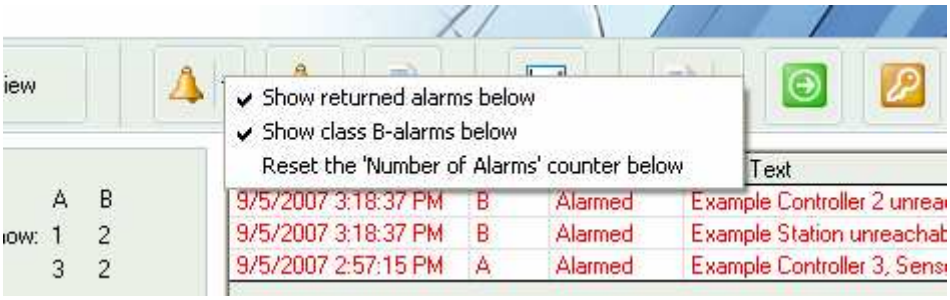
The system window provides an overview of the alarms of the system and it has also buttons to open the overview window, alarm status report, alarm events report, historical chart and user log report.



Latest alarms

The frame with *Latest alarms* is a small alarm status report that shows 10 active alarms. The user has limited possibilities to select which alarms should be shown with the *Alarm Filtration* menu:

- ❑ Alarm points class A only <u>or</u> both class A and B.
- ❑ Alarm points with status *alarmed* <u>or</u> both statuses *alarmed* and *returned*.



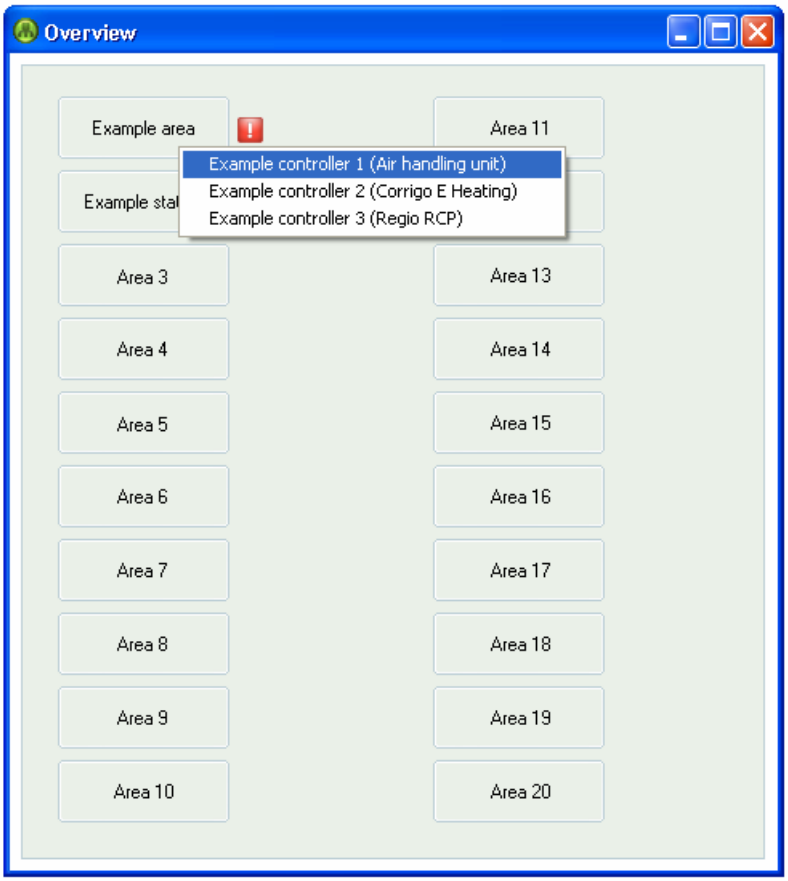
Overview Windows

System window

The system window contains the button **Overview**, which opens a window that displays the overview window of the project.

Overview window

The most important functions of the overview window is to provide a comprehensive picture of the plant, to offer access to process windows and display sum alarms.



Buttons

The window contains a number of "buttons" that open popup menus when clicked. Each button represents an area, and each command in the menus opens a corresponding controller window.

Alarm status

To the right of each button, there is an alarm status symbol that shows the sum alarm status of the area. When the user clicks the alarm status symbol, an alarm status report window for that area is opened.

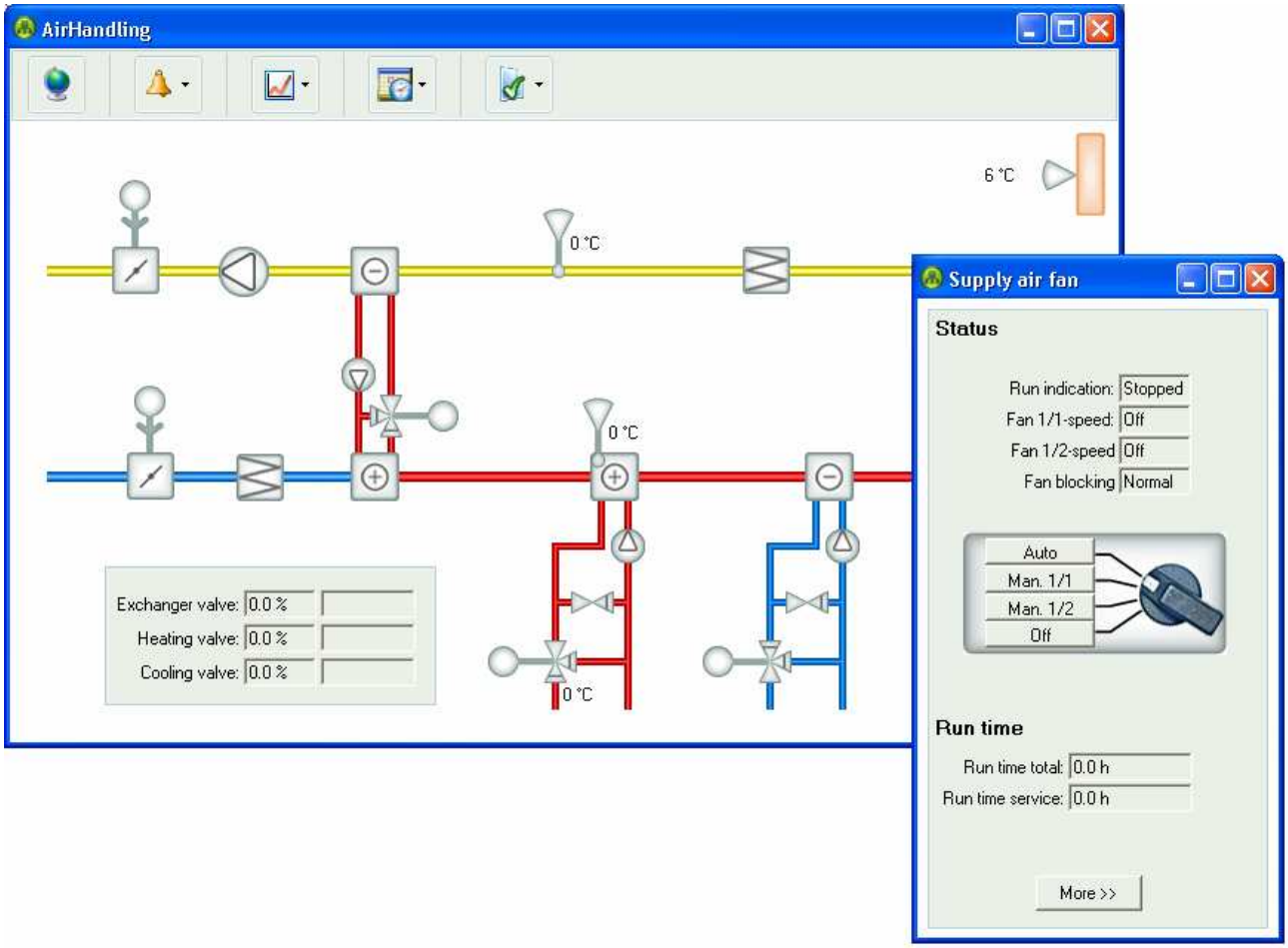
Designing

The Overview Window template is just semi-ready. It must be completed by the project designer for each project. See the section ***Designing Windows*** below.

Process Windows

Technical parts Many windows in a project display an outline of the technical parts of the plant and its dynamical values.

Example windows EXO4 2008 includes heating and air unit example windows. Below you can see the Air Unit example window.



Window templates The heating and air unit example windows are just semi-ready. They must be completed by the project designer for each project. See the section ***Designing Windows*** below.

Reports

Window templates In the EXO4 library there are ready-made templates for windows with reports and charts that can easily be added to the project.

Reports The following window templates for reports are available in the EXO4 library:

- Reports for alarm events and alarm status. Described in the chapter ***Alarms and Events***.
- Event reports for digital events. Described in the chapter ***Alarms and Events***.
- Historical charts. Described in the chapter ***Logging***.
- Real-time charts. Described in the chapter ***Logging***.
- User log report.

User log report How to use EXO4 window templates and the user log report is described in the section ***Using a Window Template*** later in this chapter.

Viewers for Time Channels and Calendars

Two types

There are two types of Time Channel Viewers and Calendar Viewers in EXO4:

- ❑ Viewer applications that show the objects EXO4 Time Channels and EXO4 Calendars graphically for the EXO4 operator. The objects are created in the tool EXO4 Signals.
- ❑ Viewer applications that show the time channels and calendars in a controller graphically for the EXO4 operator. The time channels are created in the controller's tool Time Channels.

Descriptions

The viewers are described in the chapter ***Time Control***

Window Classes

Blueprint

In a project, there is often a great number of windows with identical appearance, e.g. windows in which the operator can change the minimum and maximum values for alarms. To avoid having to create a new window for each appliance, a window class can be created. A window class is created in the same way as an ordinary window, but serves as a blueprint for a window and can be used to display different values depending on from where it is opened (instantiated).

National Languages

Language setting

EXO4 run-time, the EXO4 window templates, the controller templates, Regio Tool and E-Tool are delivered with all texts in Swedish and English. EXO4, Regio Tool and E-Tool select the language automatically depending on the current language setting in the Control Panel. The window templates and controller templates also select the language automatically, but they check the language setting when the controller or window template is added to the project. This language will be used even if you change the language setting afterwards.

Text files

It is possible to translate all texts into any language. All texts are placed in special text files with a different file extension for each language. If no files are found for the current language setting, American English will be used.

Description

In the document ***EXO4 Libraries***, you can find the files that are easy to translate to facilitate for the users of the EXO4 windows that are included in EXOdesigner. It also describes requirements for the texts to be translated into Chinese.

Operating

Starting EXO4

Automatic start

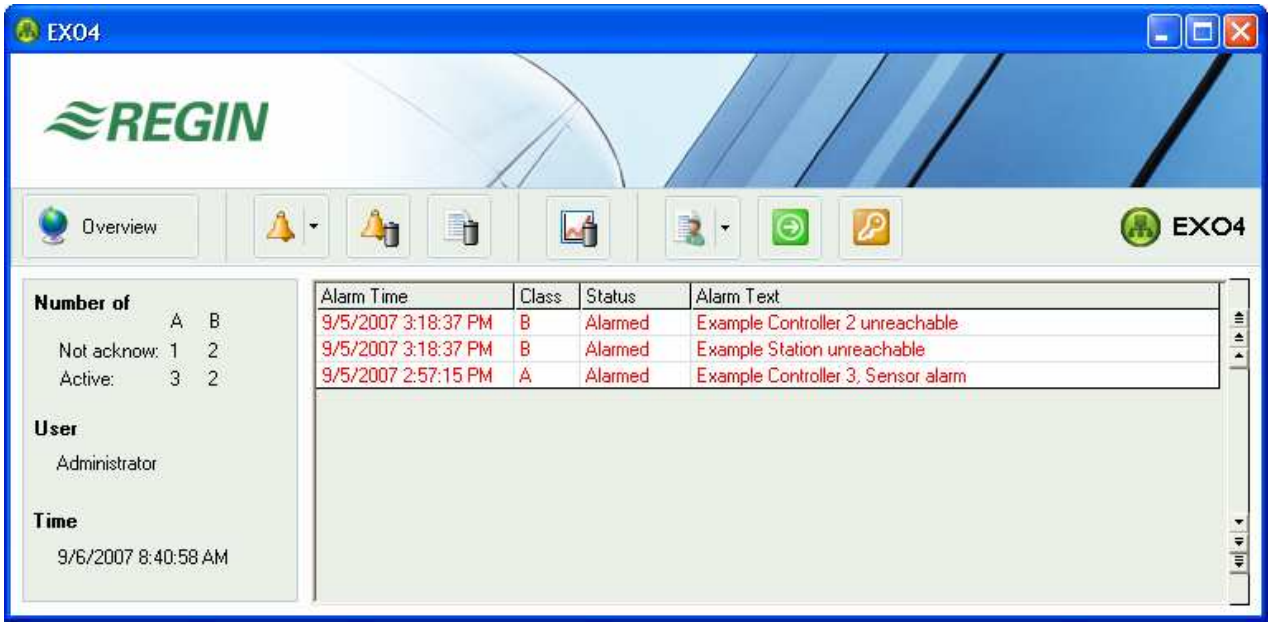
Normally, EXO4 is configured to start automatically when Windows starts. This is necessary in order for the program to restart automatically after a power failure. A description of how this is configured is given in the chapter ***Windows Settings***.

Manual start

When the system is in operation mode, EXO4 is started by clicking on the desktop shortcut **Start EXO4**. This shortcut was created when the computer was attached using the command **Attach** in This Computer. However, during the time the project is being developed and tested, the button **Run EXO4** in Project Builder is used to start EXO4.

> During the time the project is being developed and tested, the button **Run EXO4** in Project Builder is used to start EXO4.

System window The EXO4 System window opens when EXO4 has started.



Closing EXO4

System window EXO4 is closed by clicking the button to the right on the title bar (which will also close the system window) in the system window.

EXO4 functions When the program is closed, all functions that are managed by EXO4 are stopped. Functions that are being performed in the controllers are not affected, e.g. control and automation functions, alarm management and temporary storing of historical data. Normally, closing EXO4 does not cause any problems, the function for sending alarms will however be discontinued.

Computer shut down If the computer has to be shut down, EXO4 must always be closed, as described above, before closing Windows.

Logging On/Off

Logging on The system window has a toolbar at the top including the buttons **Log in** and **Log out**.

 Log in

 Log out

When you click on the button **Log in**, the dialog Log On EXO4 is opened.

Password Select your User ID in the Log On dialog box and enter your password. An error message will appear if the password is incorrect. Only one person at a time may be logged on to the same computer.

Initially After installing EXO4, there will be one initial user with the access level Admin (see below), **Adm,** with the password **exo**. To prevent unauthorized access to the system this password should be changed as soon as possible.

Access level After logging on, the operator will get access to EXO4 according to his access level.

Logging off When you have finished your work, you should log off. Click on the **Log out** button in the system window. You have to confirm that you want to log off.

Not logging off If you neglect to log off, the system will be vulnerable to unauthorized access. If the user log is used, the logged on operator will be held responsible for that particular maneuver.

Automatically When the computer has been idle for a certain time, normally 10 minutes, the user will be logged off automatically.

Access Levels in EXO4

EXO4 access The operator's access level to use EXO4 determines which windows can be displayed, which commands can be performed, and how much information should be displayed in a window.

Level based EXO4 2008 has support for a level based access control. A level based system will be created in new projects by the EXO4 template.

Levels The levels in the level based access control system are:

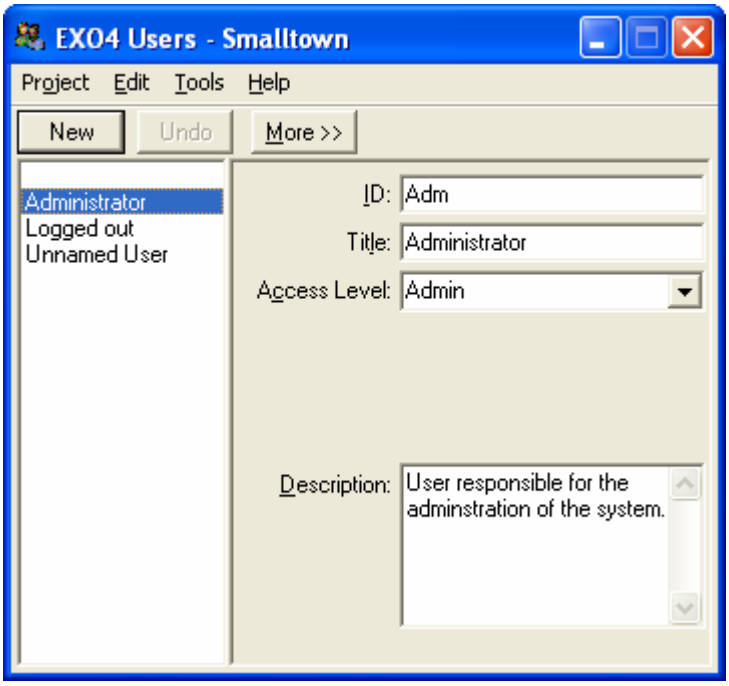
- (Everyone)
- Guest
- Operator
- Service
- Admin

Standard windows All standard EXO4 windows are designed to require access level *operator* for all maneuvers.

Users The project's EXO4 users are defined in the tool EXO4 Users, where you also select the access level for each user.

Open EXO4 users can be opened in EXO4 run by selecting the popup menu command **Users…** in the System window toolbar.

It can also be opened from Project Builder by first selecting EXO4 and then using the button  on the toolbar or the menu command **Config – EXO4 Users**.



Initial users

The EXO4 template contains two initial users:

- **Administrator** (Admin) with user ID Adm and password exo.
- **Unnamed User** (Operator) with user ID UU and password exo.
- **Logged out** (None) is used when no user has logged on.

Administrator

It is important to change the password for the user Administrator to prevent unauthorized access to the system. This is done in the dialog Log On EXO4 when EXO4 is running.

Unnamed User

You are supposed to remove (or rename) the Unnamed User and create your own.

Logged out

For the virtual user Logged out, you can select which access level the user is granted when nobody is logged on. This means that you can use all standard EXO4 windows as they are without forcing the user to log in.

Old EXO4 Projects

Use new windows

To be able to use the new windows in EXO4 2008 in a project created with a previous version of EXO4, you must add the access categories for the level based system to the project manually.

Procedure

Create a new project and open the tool EXO4 Access Categories in both projects. Copy all access categories in the new project and paste them into the old one (the **Admin** category will be overwritten). If you have not used the old access categories in the project you can remove them. Configure the access level for each user with the tool EXO4 Users.

Access categories

Although the old system with access categories still exists, you normally do not have to make any configurations in the tool EXO4 Access Categories.

EXO4 Window Properties

EXO4 Windows

EXO4 Windows

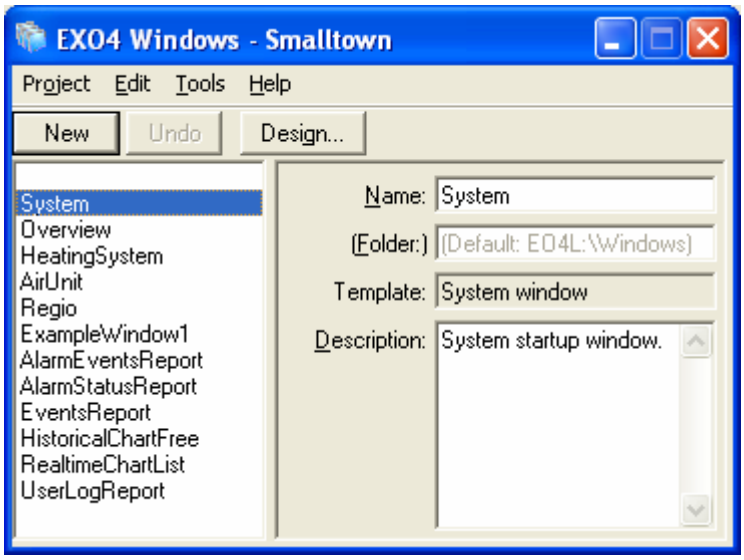
The tool EXO4 Windows includes a list of windows in the selected project. In this list, you can add or delete windows, or select a window for designing.

Path

Most windows are common to all or several of the computers in the project. This is why new windows are located in the common folder **`EO4L:\Window`** by default.

Opening

EXO4 Windows is opened by selecting EXO4 in Project Builder and clicking on the button  .



Window Design

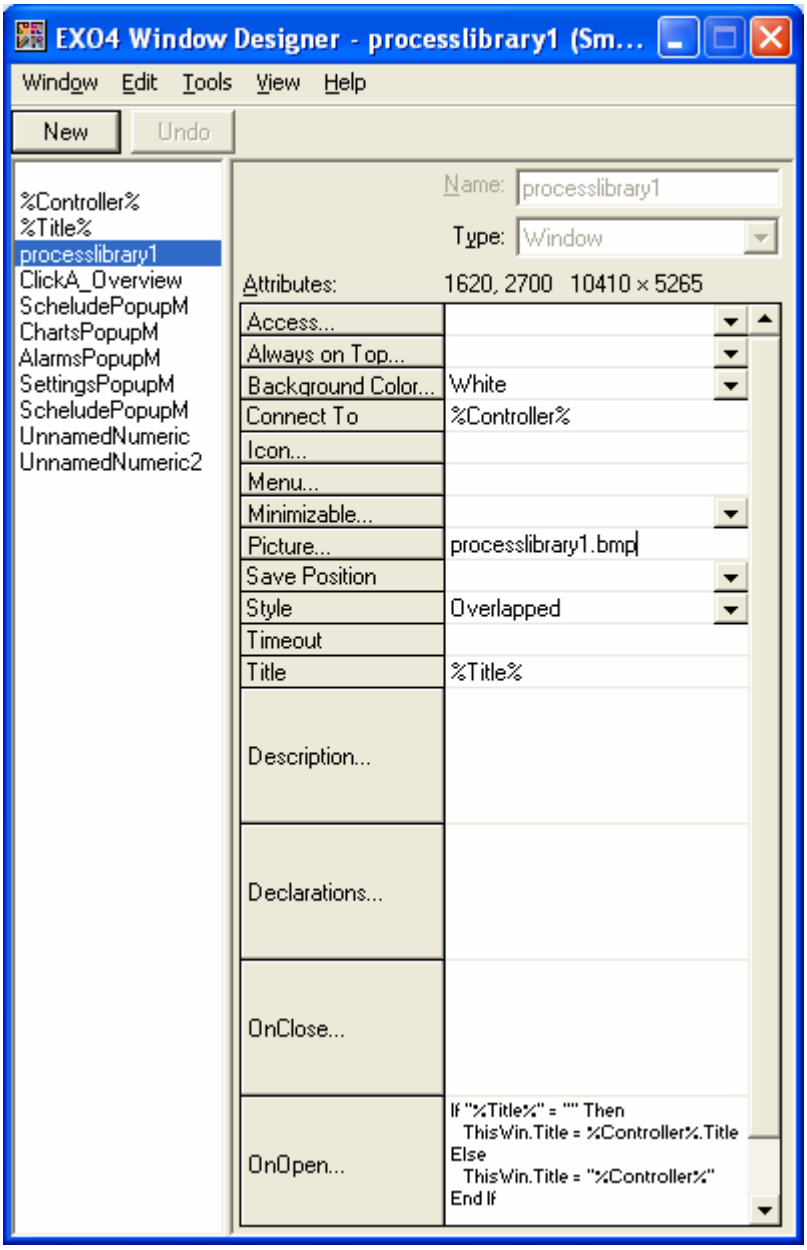
Graphic design

To design controller windows (process windows) you can use the heating or air unit example windows, and modify them. You can also create your own windows from scratch. In any case, we recommend using the same graphic design as the standard EXO4 windows, which is:

- ❑ Process pictures with a soft semi-three-dimensional look on white background. Just a few values are displayed inside the pictures.
- ❑ Most process values are shown within *frames* with Regin's green-grey background color.
- ❑ Toolbars with popup menus are used instead of standard Windows menus.

Open

The EXO4 windows are designed in the tool EXO4 Window Designer, which can be opened from EXO4 Windows by selecting a window and clicking on the button **Design**.



Properties

In the tool EXO4 Window Designer you can configure the properties of the window, e.g. the access level that should have access to the window, the title that is to be displayed in the title bar and which background picture to use if any. If the window will display values from dial-up controllers, you can enter the controller that is being used for the connection.

Style

In **Style** you can decide the style of the window. The most common options are:

- **Overlapped** is a window has to be closed expressly by the operator. This window type is normally used for process windows.
- A **DaughterWindow** is always displayed inside its mother window. Daughter windows are normally used for parameter settings that can be made in relatively small windows. A daughter window cannot have menus. The mother window used is usually the window from which the daughter window was opened, i.e. **`ThisWin`**.
- **Popup** windows must belong to a mother window**,** just like daughter windows. The only difference between the two is that a popup window can be moved outside of its mother window, and is therefore a better choice when the window, due to its size, covers large parts of its mother window.

ConnectTo

For dial-up connected controllers, you can specify which controller to connect to when the window is opened in the attribute **ConnectTo**.

Background Picture

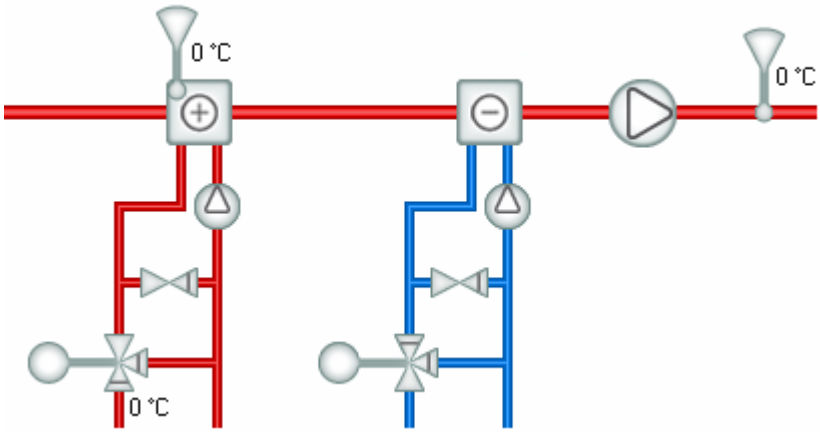
Static Process windows often have a static background picture illustrating an outline of the process. On top of this background, dynamic window elements are placed.

Paint.Net We recommend Paint.Net for designing background pictures. Paint.Net is a free third-party tool, which is supposed to be similar to Microsoft Paint, but far more advanced. It is included on the EXO4 CD.

BMP The background picture can be created using any drawing program, but has to be saved as a bitmap, i.e. with the file extension .BMP.

Saving Backgrounds are normally saved in the project folder **`EO4Lib:\Pictures`** (i.e. usually in **`C:\Projects\`***`Project folder`***`\EO4Lib\Pictures`**).

Clip arts There are some clip arts for building automation available in the EXO4 library that can be used to paste into the background picture. The clip arts specific for building automation are stored in the folder **`Alib:\Pictures\CLIPART\Building Automation Symbols\`** **(`Alib = C:\Program\Exo\Alib`)**.



3D and animated EXO4 also includes a limited set of clip art and symbols for creating three dimensional (3D) and animated pictures for building automation. EXO4 2008 has support for animated GIF pictures. The clip art objects are located in the folder **`Alib:\Pictures\CLIPART\3D Building Automation Symbols\`** and the animated symbols in **`Alib:\Pictures\CLIPART\3D Animations\`**.

Documentation Lists of available clip arts and symbols can be found in the document ***EXO4 Libraries***.

Texts Headings can be written directly in the background picture. Use black text with the font MS Sans Serif, bold, size 8 or 10. Other texts in the picture should be written with black text, font MS Sans Serif, non-bold, size 8.

Window Elements

Variable values Dynamic window elements are often placed on top of a static background picture to display variable values or to perform commands.

Variable values There are various types of window elements for displaying and, if required, changing variable values in the controller. The most common types are:

- **Numeric** displays a numerical value with digits. The value may be displayed with a title text.

- **Text Change**, **Symbol Change** and **Color Change** display various integer values with different texts, symbols (pictures) and colors respectively. **Color Change** elements can not be used in process pictures since they do not have solid background color. Instead, you use Symbol Change elements.
- **Bar Graph** displays a numerical value illustrated in a horizontal or vertical bar graph.
- **Check Box** displays a logical value in a check box.
- **Text** displays a text variable in a text field, which may have an introductory title text. It is used for, e.g. telephone numbers.

Commands

There are also window elements that are used to perform commands, e.g. opening another window or starting and stopping a machine. The following window elements are used for commands:

- **Button**, i.e. a push button. A button can also be used for dynamic display.
- **Click Area** is an invisible element that can be added to e.g. a symbol or a text. The mouse cursor will change its appearance when it is being passed over the click area.
- **PopUp Menu** is, as the click area, an invisible element that can be added to a symbol or a text. When clicking the popup menu, a menu of various commands is displayed.

Descriptions

All EXO4 window elements are described shortly below.

Numeric

Numerical value

Numeric displays a numerical value. The element consists of a title text to the left and a value, with or without a unit, to the right. The unit is configured in the attribute **Unit**.

Border

If **Border = Yes,** the dynamic value is displayed in an input field. This is used if the value is maneuverable.

Number of decimals

In the attribute **Format**, you can specify the number of decimals to be displayed.

Limit

To limit the maneuver possibilities for the operator you can specify values for **Max Value** and **Min Value**.

Suggestions

In **Suggests**, you can enter suggestions for values in a comma-separated list, the values will then be displayed in a combo box and the operator may choose between the various values.

Bar Graph

Numerical values

Bar graph displays numerical values in a bar that changes size. The window element consists of a title text to the left and a rectangular area where different values are displayed by change of color.

Bar type

Use the attribute **Style** to determine whether the bar is to be displayed horizontally or vertically.

Scale

If **Scale = Yes,** scale values and scale lines are displayed. If **Border = Yes,** the bar will be framed.

Bottom Value

The lowest value of the bar, that is, the lowest value the variable can have, is specified in the attribute **Bottom Value.** Normally, this option is configured with the same value as **Min Value. Bottom Value** must be within the interval **Min Value** and **Max Value.** It must also be lower than the dynamic value (i.e. **Value**).

If **Value** at runtime gets the same value as **Bottom Value**, the bar graph will be replaced by a line indicating the current value.

Colors

The colors of the bar graph are determined by the following attributes:

- The background color of the bar graph is determined with the attribute **Background Color**.
- **Colors** defines the colors that should be used when the bar is drawn. If multiple colors are being used, these have to be specified in a comma-separated list.

- **Color Limits** defines the limit values for colors used when the bar is drawn. The attribute can be configured with a number of comma-separated values. The attribute **Colors** must always be configured with one more color than the number of limit values in **Color Limits**. The first color is used in the interval **Bottom Value** up to the first limit value, and the second color is used between the first and the second limit value, etc.

Maneuver

If **Maneuver Style** is **Dialog Box** you can specify a list of suggestions of values to be assigned to the variable. A combo box will then be displayed in the maneuver window.

Text Change

Numerical values

The text change element is used to display and change numerical values by means of texts. The element consists of a title to the left and a value in text format to the right.

Texts

The texts that should correspond to the different numerical values are stated in the attribute **Texts** with list syntax (se below).

Style

If the text change element has maneuver possibility, the attribute **Style** is used to specify whether the element is to be displayed as a combo box or as a list box. The default value is **Combo Box**.

Symbol Change

Numerical values

The symbol change element is used to display numerical values with different pictures.

Pictures

The file names of the static pictures that should correspond to various numerical values are specified in the attribute **Pictures** with list syntax (see below). The file names must include the file extensions, which may be .BMP or .ICO. It is not necessary to specify the path if the picture files are placed in the folder **`EO4L\Pictures`**.

Symbols

For symbol change elements, a number of symbols for building automation are included in EXO4. All symbols are placed in the folder: **`ALib:\Pictures\Symbols\`**. The symbols are listed in the document ***EXO4 Libraries***.

Color change

Most symbols are the same as the clip art objects intended for the process pictures, but with various color indications. They are supposed to be used on top of the static symbols in the background pictures to accomplish dynamic color change.

Other symbols

Other symbols (like alarm status and switches) are not dependent on a process picture. They can be used in parameter frames or other places.

Size Mode

The pictures should be of the same size. If and how the window elements and the pictures should adjust their sizes to each other is specified in the attribute **Size Mode.**

The following options are available:

- ❑ **Clip** means that no adjustment is made. This is also the default.
- ❑ **Stretch** adjusts the size of the picture to the size of the element.
- ❑ **AutoSize** adjusts the size of the element to the size of the displayed picture.

Maneuver

The symbol change element can have the maneuver possibility **Dialog Box**. In this case, a title text for the dialog can be specified in the attribute **Title,** and a list with texts that correspond to various numerical values can be specified in the attribute **Texts**.

Color Change

Numerical values

The color change element is used to display numerical values in different colors.

Area

The color changes in the area (within the solid line) in which it is placed. In EXO4 Window Designer, the element is a point displayed with a cross-hair.

Process pictures You can not use Color Change elements in the process pictures' clip arts because they do not have solid background color. Instead, you use Symbol Change elements.

Colors The colors that should correspond to various numerical values are specified in the attribute **Colors** with list syntax (se below).

The following color names are supported:

`Black, Blue, Green, Cyan, Red, Magenta, Brown, LtGray, Gray, LtBlue, LtGreen, LtCyan, LtRed, LtMagenta, Yellow, White`

Flashing Flashing colors can be defined by indicating 2 colors separated by a vertical line (|). The element will then continuously change between these 2 colors when the variable has the corresponding value.

No maneuver The color change element has no maneuver possibility.

Text

String Text displays a text variable, i.e. the attribute **Value** refers to a string variable (data type $) or to texts in a text file on the hard disk. The element consists of a title text to the left and a text value to the right.

Border If **Border = Yes**, the dynamic value is displayed in an input field. This is used when the text should be maneuverable.

Editable If the text element is maneuverable (i.e. if **Maneuver Style** is not set to **None**), the integrator can reduce the operators choice of text values, by configuring **Editable = No** and specifying the various texts in a comma-separated list in the attribute **Suggests**. These choices will then be displayed in a combo box. If the text value is maneuverable and **Editable** has not been configured, the operator will be able to enter a text of his choice.

Multiline The element can display multi-line texts if **Multiline = Yes**.

Check Box

Digital signal The check box is used to display and control a digital signal. The window element consists of a title and a check box.

Value If the check box is empty, the value of the variable is 0 (false), otherwise it is 1 (true).

Button

Push button Normally, the push button is used to perform a command, e.g. to open a window, but it can also be used to display and control digital signals.

Reaction code The reaction code, i.e. what should happen when the operator clicks on the button, is specified in the attribute **OnManeuver**.

Texts The text that is to be displayed on the button is specified in the attribute **Texts**.

Click Area

Invisible The click area is invisible during runtime and is used to activate an event, e.g. to open a window. Often, a click area is placed on top of a symbol or a text.

Reaction code The reaction code, i.e. what should happen when the operator clicks on the area, is specified in the attribute **OnClick**.

PopUp Menu

Activate event The popup menu is invisible during runtime. When the operator clicks within the area of the window element, a popup menu opens next to the mouse cursor. The operator may then choose an option from the popup menu to activate an event.

Menu The menu that is going to be used (the file extension can be omitted) is specified in the attribute **Menu**. The menu is defined in the tool EXO4 Menu Designer.

Chart and Query

Chart Chart is used to display stored measured values in curves as functions of time.

Query Query is used to display tables with values and texts retrieved from a database.

Window templates Normally, one of the window templates included in EXO4 for display of these types of window elements is used. Therefore, these elements are not described in this document.

Common Attributes

Attributes The following attributes are configured for most types of window elements:

- **Name**: The name of the window element must be unique within the window and may not contain e.g. spaces.
- **Access** specifies the access level needed to perform maneuvers, e.g. changing the value of a variable. When an operator tries to perform a maneuver, EXO4 performs a check to see if the operator has sufficient access level for that particular element. If this is not the case, the Log On dialog box will be displayed and the maneuver can be performed only if the operator logs on without delay.
- **Title** is the text that, in most cases, is displayed to the left of the window element. The title may contain an ampersand (&), which will underline the succeeding character and create a shortcut key for the element. Font, font size and text color are specified in the attribute **Title Font Scheme**.
- **Font Schemes** specifies the font, font size and text color of the dynamic value. Available font schemes can be inspected and you can also add your own font schemes in EXO4 Font Schemes. EXO4 Font Schemes is opened by clicking the button **Font Schemes...**

  We recommend the following font schemes for Numeric, Text and Text Change elements:

  - **ViewOnly** (and **ViewNotified**) for elements with maneuver style **None**.
  - **Editable** for elements with maneuver style **Immediately**.
  - **Clickable** for elements with maneuver style **NumericDialogBox** or **OnManeuver** code.

  The document ***Designing EXO4 Windows*** describes the available fonts and when to use them.
- **Value** specifies which variable (normally in the controller) that is to be displayed in the window element for dynamic display and maneuvers. The variable is specified in the following way:

  `ControllerName.VariableName` (if the variable exists in a global VPac).

  `ControllerName.FileName.VariableName`

  In order to avoid typing mistakes, the variable can usually be specified by selecting it in EXOL Browser. Click on the button **Value…** to open EXOL Browser**.**
- **Border** specifies if a value is to be displayed with a frame. The window element should be displayed in a frame if its value can be changed by the operator directly in a Numeric, Text or Text Change element.

- **Maneuver Style** specifies if the window element is to have maneuver possibility, i.e. if the value is to be modifiable. The following options are available:
  - **None**: The window element has no maneuver possibility.
  - **Directly**: Maneuvers are performed directly in the window element. For most types of window elements, the value is set in the controller when you press the **Enter** key. The value in e.g. a check box is set in the controller when the mouse button is released.
  - **Immediately**: This maneuver style works in the same way as **Directly**. The difference is that when you click elsewhere, the maneuver is carried out instead of undone. Hence, it is not necessary to press the **Enter** key to perform the maneuver. An initiated maneuver can be cancelled by pressing the **Esc** key**.**
  - **Prompt**: This maneuver style works in the same way as **Directly**. The difference is that, just before the value of the variable is updated, a message box is opened where the operator confirms the maneuver by clicking on **Ok** or cancels it by clicking on **Cancel**.
  - **NumericDialogBox**: When the maneuver is initiated, a dialog box opens to allow the operator to change the value. When the operator clicks on **Ok** the dialog box is closed and the value of the variable is updated. When the operator clicks on **Cancel** or any other place in the mother window, the dialog box is shut down but the value of the variable is not updated.
- **Tool Tip Text** is the text being displayed when the mouse cursor points at the window element

Old EXO4 Projects

Font schemes

The new EXO4 Windows in EXO 2008 need a set of new font schemes. To be able to use the new windows in a project created with a previous version of EXO4, you must add these font schemes to the project manually.

Create a new project and open the tool EXO4 Font Schemes in both projects. Copy all font schemes in the new project and paste them into the old one (some font schemes will be overwritten). Do not remove any of the old font schemes.

List Syntax

List syntax

Attributes that can be configured in the form of a list share the same syntax. Examples of such attributes are **Texts**, **Pictures**, **Colors**, **Suggests,** etc.

A few examples of the syntax are shown below:

```
Text0, Text1, Text2, Text3
Text0, "Text 1", Text2, "Text 3", "//Text 4"
"", Text1, Text2, "", "Text 3", ""
No, Yes
```

Different values

The different values in the list correspond to various numerical values. The first alternative corresponds to the value 0, the next alternative corresponds to the value 1, etc. For logical data types, the first alternative corresponds to the value **false** and the second alternative to the value **true.**

Quotation marks

If an alternative consists of more than one word, it must be enclosed by quotation marks. An empty alternative must be stated with two quotation marks or with nothing between two comma signs (**,,**).

Default

If a value begins with 2 slashes (//) it is considered to be a default alternative and is used if no alternative for the current value exists.

Multi-selection

The commands **Select Existing** and **Pick from Application Library**, which are used for choosing pictures, menus, etc., handle multi-selection and result in correct syntax.

Menus

Popup menus Menus are used in window elements of the type popup menu.

Independent Menus are used as independent units in EXO4. Which menu to use for a specific popup menu is stated in EXO4 Window Designer in the attribute **Menu**. This makes it possible to have the same menu in many popup menus.

Tool Menus are configured in the tool EXO4 Menu Designer. The texts (i.e. menu items) that should be displayed in the menu and what should happen when the menu item is selected are always configured. You can also choose an access level (or access category) for each menu item that you do not want everyone to have access to.

Toolbars

Background The toolbar should be painted entirely in the background picture. The bar itself is a frame similar to a *parameter frame*. The buttons with their symbols are also painted directly in the background picture. Buttons that open popup menus should be designed with a small arrow to the right of the picture.

Clip art objects To design the tool bar buttons, there are a number of clip art objects in the folder **`Prod:\ALib\Pictures\ClipArt\ToolBar\`** that you can use.

Text It is also possible to create buttons with text. You can have buttons with text only or with symbol and text (with the text to the right of the symbol as the *Overview* button above). Use black text with the font MS Sans Serif, non-bold, size 8.

Adding Add click area and popup menu elements for the "buttons" with EXO4 Window Designer. Create new popup menus or use existing ones.

Events and Reaction Codes

Events By events we mean, among other things:

- ❑ Opening and closing windows.
- ❑ Clicking on a button or on a click area.
- ❑ Changing the value of a dynamic window element.

Initiating Events can be initiated by an operator or by the system. The system initiates an event e.g. when the value of an input that is connected to the attribute **Value** in a window element is changed.

Reaction code A reaction code can be activated when an event has been triggered. By reaction code, we mean what should be performed when a certain type of event occurs. An example of a reaction code is to open a window or print a window on a printer. In most cases, it is sufficient to enter a single line to achieve the required function. However, it is possible to write several lines, and even entire programs if required.

EXObasic The reaction code is written in the programming language EXObasic. Description of EXObasic can be found in the reference documents ***EXObasic for EXO4*** and ***EXObasic Reference***.

Events

Summary A summary of the events that are available to windows and window elements in EXO4:

Event	Description
`OnChange( Value As` *`Type`***`, Reason As Integer )`**	This event is activated every time the value that is connected to the attribute **Value** of the window element has been changed. This can be due to, e.g. a maneuver, changes of measured values or assignment in EXObasic code. The new value is specified in the variable **`Value`**. The way a value has been changed is specified in the variable **`Reason`**: **`0 = OnChangeManeuver`** **`1 = OnChangePoke`** **`2 = OnChangeAdvise`**
`OnManeuver( Value As` *`Type`***`, Cancel as Integer )`**	This event is activated every time the value that is connected to the attribute **Value** in the window element is changed due to a maneuver. The event is also activated for controls with the maneuver style **None**. The maneuver can be stopped by configuring **`Cancel = True`**. It is also possible to modify the maneuver value by assignment to the variable **`Value`**.
`OnClick()`	This event is activated every time an operator has clicked on a click area or a menu command.
`OnOpen()`	This event is activated when the window is opened. The EXObasic code is executed **after** all the window elements have been assigned there initial values, but **before** the values of the bound variables has been received.
`OnClose()`	This event is activated when the window is closed.

Reaction Codes

Attribute

The configuration tool for windows, window elements, and menus have space for EXObasic code with headings like **OnManeuver, OnOpen, OnClose, OnClick, Declarations**, etc.

Reaction code

The reaction code (if there is one) is performed when an event is triggered during runtime, e.g.:

- Opening another window. See the below section ***Opening Windows***.
- Printing the current window on a printer with the command **`ThisWin.Print`**. The picture will cover the size of the paper. It is not possible to change size or color on the print jobs.

Variable Declarations

Declarations

Variables and procedures can be declared in the attribute **Declarations** in the window. This is not a program in the sense that they are executed, but they function as a kind of “library” for data and code that can be used by other code.

Lifetíme

EXO4 can use EXObasic code in different places. The code’s lifetime will depend on, among other things, where it belongs.

- Variables that are declared in the attribute **Declarations** exist as long as the window in which they are declared exists (i.e. is open at runtime).
- If reaction code creates its own variables, these will only exist during the execution of the reaction code.

Opening Windows

Windows can be opened with two different commands, depending on whether it is an ordinary window or a window class. Window classes are shortly described in the below section ***Window Classes***.

Opening Ordinary Window

Syntax

The EXObasic syntax for opening an ordinary window:

```
OpenWindow "file.ewd"
```

Daughter window

A daughter window, or a popup window, must have a mother window, which usually is the window from where the new window is opened. The following syntax is then used:

```
thisWin.OpenWindow "file.ewd"
```

Opening Window Class

Open window class

A window class is opened with the command **OpenWindowInstance** followed by the file name of the window class, an instance name and arguments.

Instance name

To be able to have several instances (windows) of one window class open simultaneously with different contents, each instance must have a unique name. Therefore, it is appropriate to use different instance names when they are opened, preferably a name that represents the specific context where the window is opened, e.g., the controller's name, a compound of the controller's name and the object's name, or the area's name.

Syntax

The EXObasic syntax for opening a window class instance:

```
OpenWindowInstance "file.ewd","instancename","Arg1","Arg2"
```

Daughter window

A daughter window, or a popup window, must have a mother window, which usually is the window from where the new window is opened. The following syntax is then used:

```
thisWin.OpenWindowInstance "file.ewd", "instancename","Arg1"…
```

Window Classes

Window class

A window class has one or several arguments that can be given different values depending on from where it is opened. This makes it possible to re-use the one and same window class in various places in the project. Two common examples of when it is appropriate to use window classes are to set alarm limits and for manual/automatic switches.

Re-use

For example, if you have created a window class for manual/automatic switch, you can use it anywhere required in the project. You can also copy the window class to other projects. This will reduce the required work effort as well as the risk of errors.

Arguments

A window class can, for example, display various texts in the title bar of the window, refer to different controllers and different variables depending on what is to be displayed in the window when it is opened. To achieve this, so-called arguments are used. The arguments are specified in the code that opens (instantiates) the window.

Standard Window Templates

Window classes

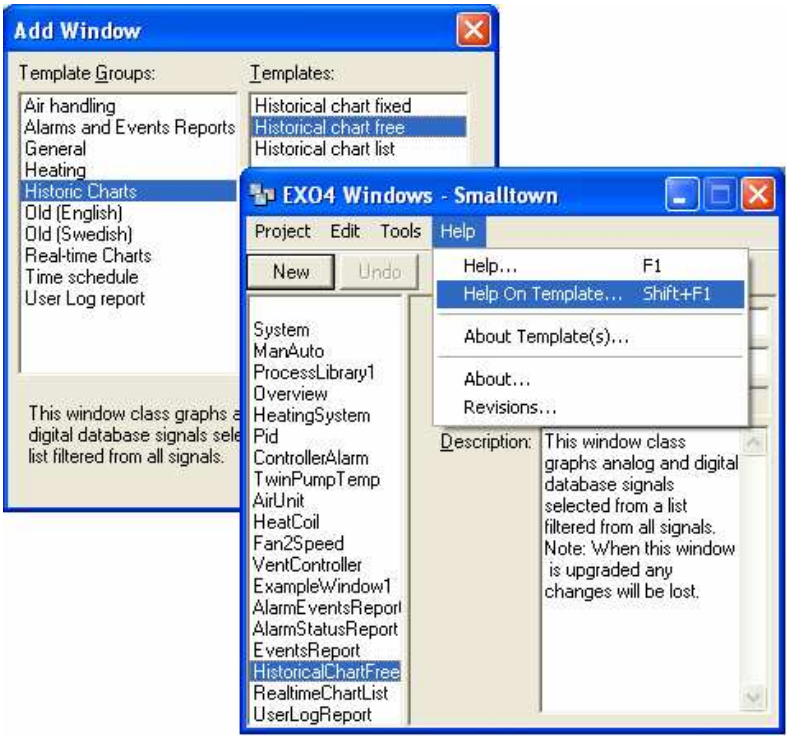
A number of window templates are included in EXO4. Most of these are window classes. There are window classes for, i.e. historical charts, real-time charts and alarm reports.

Language

The language of the templates depends on the national settings in Windows.

Adding

Window classes that are included in EXO4 are added to the project in EXO4 Windows.



Syntax help

In EXO4 Windows, you can get help with the EXObasic syntax for a specific template, i.e. how to open an instance of the window. Select a window that was created from a template and click on the menu command **Help - Help on Template.**

Optional arguments

Many of the window elements have several optional arguments which are enclosed by brackets ([ ]) in the help file. The optional arguments receive default values if no values are specified. If you do not want to specify all optional arguments, you can either exclude them or specify a so-called empty string **""** depending on which argument(s) you want to exclude.

Example

We will assume that a window class has 5 arguments. The first is compulsory and the rest are optional. If you do not want to use any of the optional arguments, they can be excluded.

```
OpenWindowIntstance  "Window.ewd", "InstanceName", "Compulsory"
```

If you, in addition, want to use the 4th optional argument, the 2nd and 3rd arguments have to be stated with an empty string, but the 5th argument can be excluded, e.g.:

```
OpenWindowIntstance "Window.ewd", "InstanceName", "Compulsory", "",
"","Optional4"
```

See also

In the section ***Using a Window Template*** later in this chapter, we will use the User Log Report to demonstrate how to use a standard window template.

Designing Windows

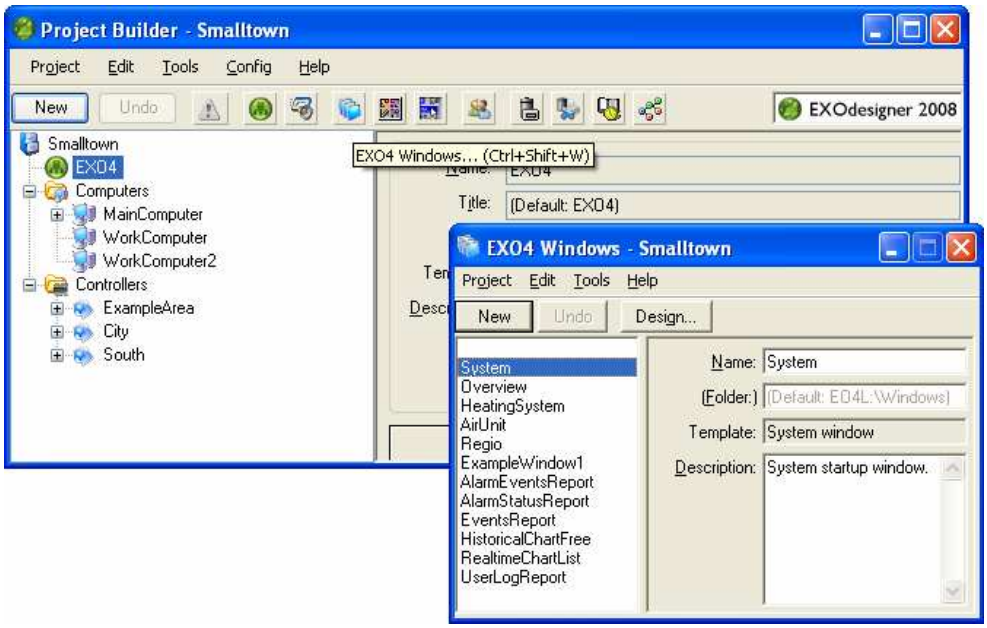
Adding Windows in EXO4 Windows

EXO4 Windows

The tool EXO4 Windows includes a list of windows in the selected project. In this list, you can add or delete windows, or select a window for designing.

Open

Open EXO4 Windows by selecting **EXO4** in Project Builder and clicking on the button .



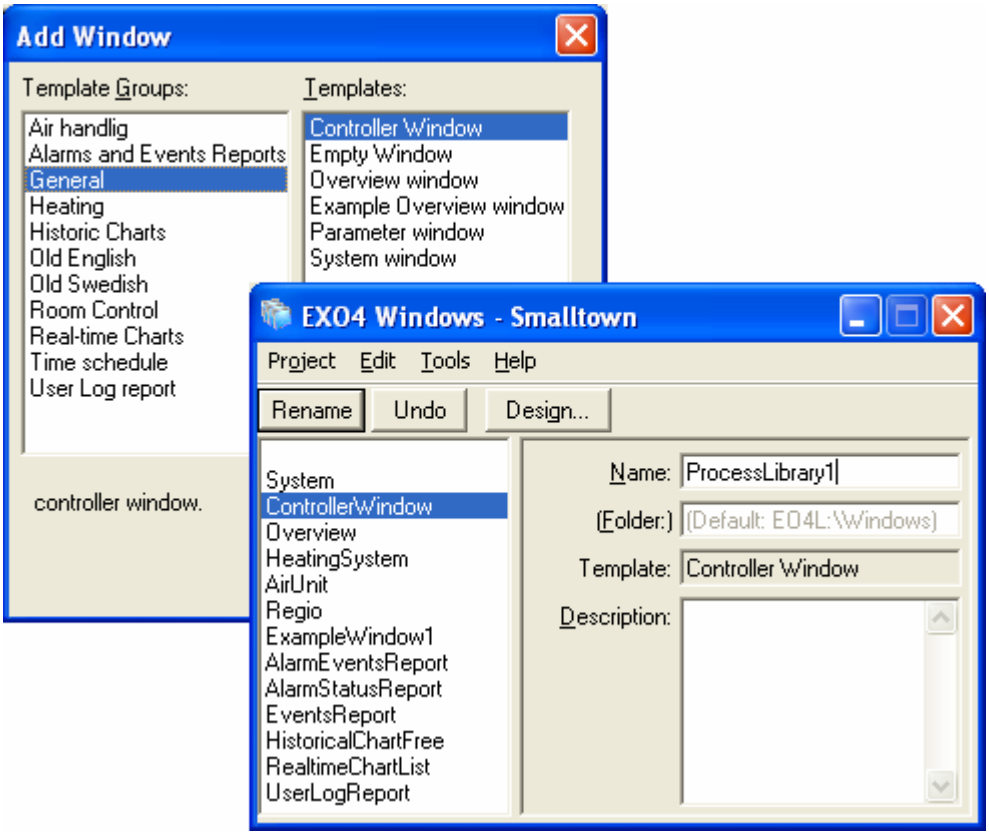
New window

First we will create a process window for the controller Library1 (or CityHall).

Example windows

To design process windows you can use the heating or air handling example windows and modify them. In this example, we will however use the template Controller Window.

- Click on the button **New** to add a new window.
- Select a window template in the dialog box **Add Window**. The template **Controller Window** in the template group **General** is selected for this example.
- Click on **OK** to add the new window.
- The new window has been given the name **ControllerWindow**. Change the name to **ProcessLibrary1** (or ProcessCityHall) in the attribute **Name**.
- Confirm by clicking on **Rename**.



Name The name of the window may not contain spaces, and it cannot have the same name as any of the computers, stations, controllers, other EXO4 windows or databases.

Configuring the Window's Properties

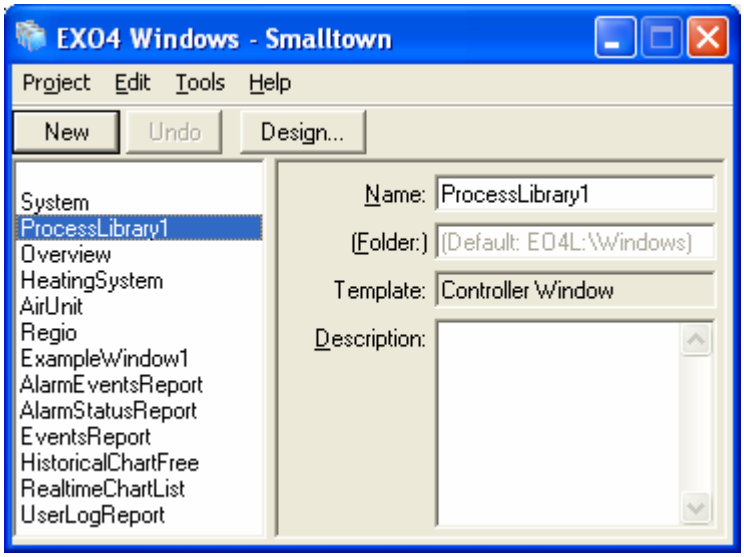
EXO4 windows Most EXO4 windows have a static background (e.g. a process picture) and a toolbar with buttons and popup menus to open other windows. They have also dynamic window elements to display and, if required, change values in the controller.

Window Designer Each window and dynamic window element has configurable properties, so-called attributes, that are configured in EXO4 Window Designer. The attributes have, to large extent, default values, and only a few need to be redefined.

Open

Open EXO4 Window Designer from EXO4 Windows in one of the following ways:

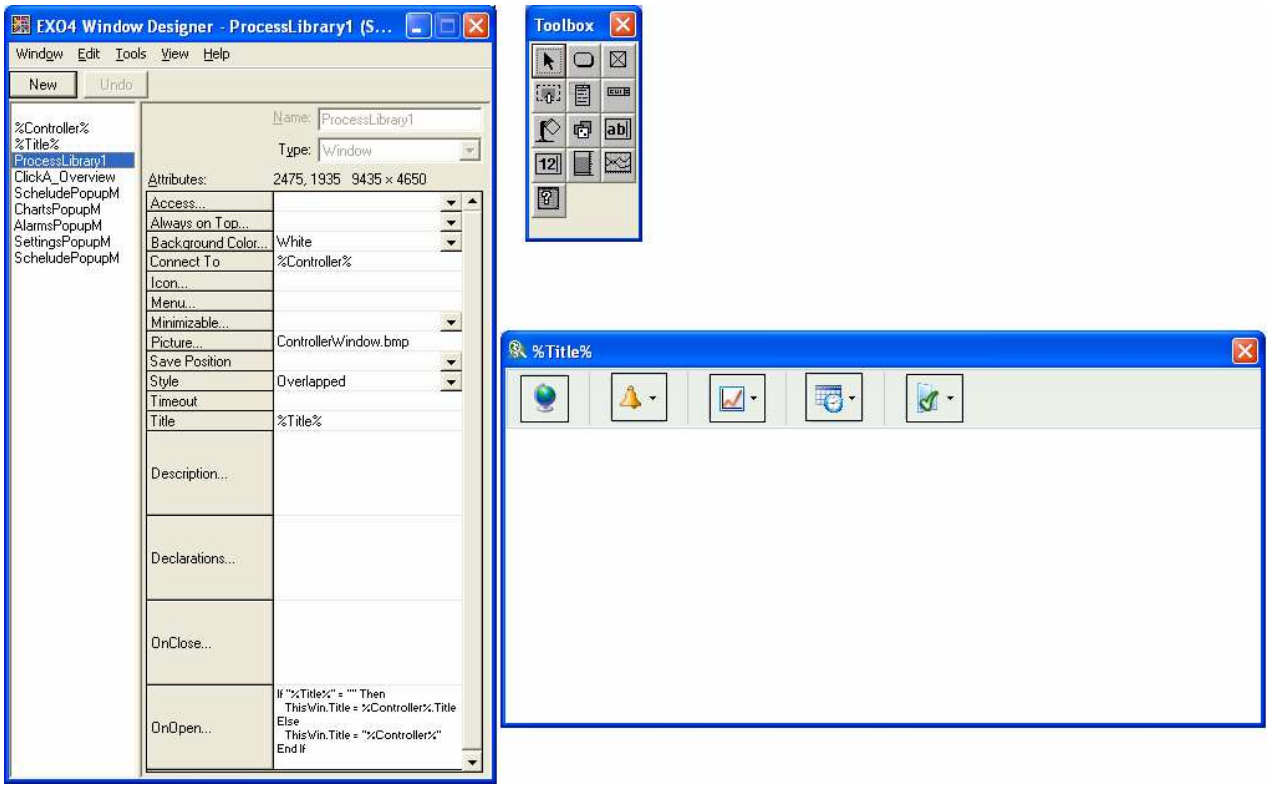
- Select the new window **ProcessLibrary1** and click on **Design**.
- Double click the new window in the left list box.



Three windows

EXO4 Window Designer consists of three windows. The windows are:

- The configuration window (the leftmost window in the picture below), in which the window and the window elements are configured.
- The toolbox in which window elements can be selected.
- The design window into which the window elements are inserted. Since we created the window with the template Controller Window, the design window has a toolbar with buttons. Some of these buttons have popup menus.



Left list

The first two lines in the list to the left in the configuration window are arguments. When a window has one or more arguments, it is a window class. A window class is a type of template that makes it possible to use the same window in different places in the project. What an argument is assigned to be depends on what is sent to it when the window is opened.

%Controller% To the first argument, %Controller%, we will send the name of the controller for which the process window is displayed.

%Title% To the second argument, %Title%, we will send what we want to be displayed in the title-bar of the window. If nothing is sent to this argument, the title will be the same as %Controller%.

Window name The next line in the left list is the window itself. When you select this name, you can see the attributes (properties) of the window to the right.

Toolbar The following lines in the left list are window elements for the toolbar, i.e. click areas and popup menus.

Close To close EXO4 Window Designer, you have to close the configuration window.

View In the menu **View**, you can reopen the toolbar and the design window if you have closed them.

Window Attributes??

Selecting The properties of the window are configured by selecting the window's name, i.e. in this case ProcessLibrary1, in the left list in the configuration window. The configurable attributes will be displayed to the right.

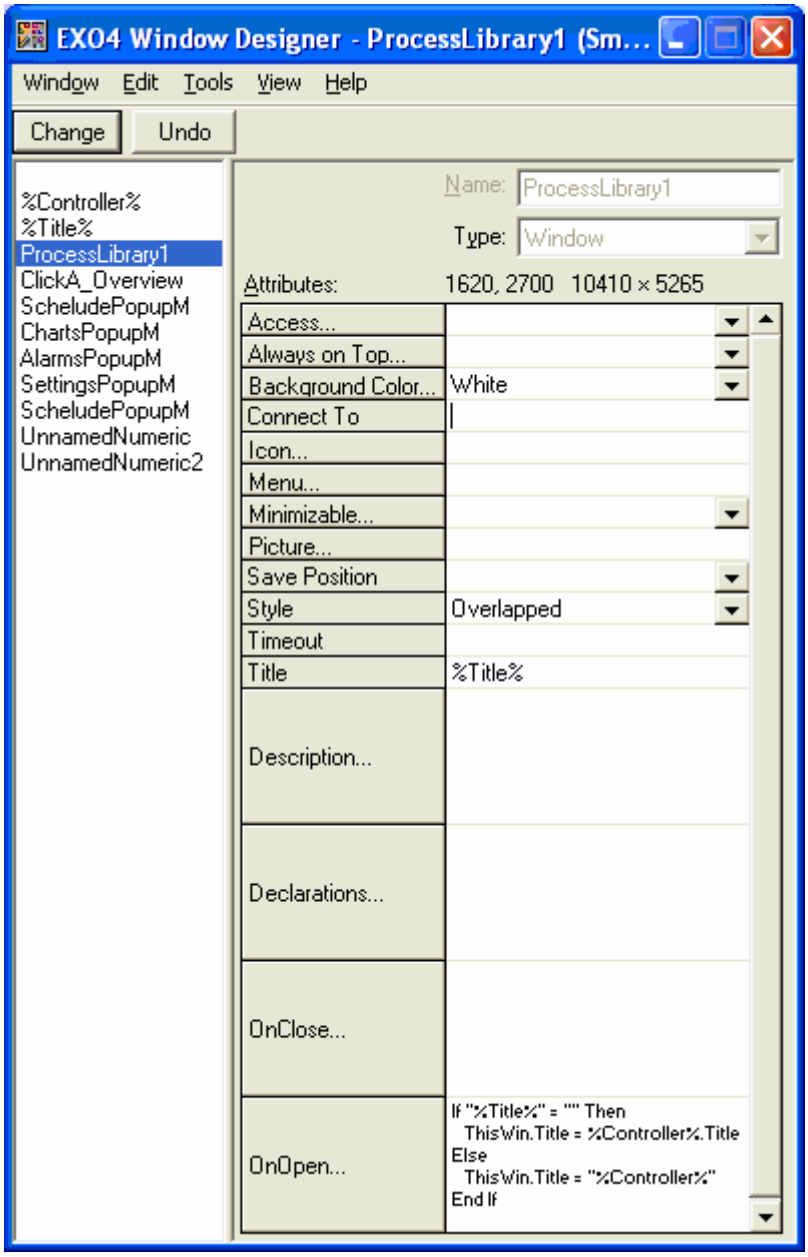
Attributes Normally, the following attributes are configured for a window:

- In **Access** a user level (or an access category) can be chosen for the window, unless everyone should have access.
- For windows that display values from dial-up controllers, you can enter the controller that is being used for the connection in the attribute **ConnectTo**. This is described below.
- In **Picture** you can, if required, choose a static background (usually a process picture) for the window. See further information in the section ***Static Background*** below.
- In **Style**, you can decide the style of the window. Further information can be found in the section ***EXO4 Window Properties*** earlier in this chapter.

Configuration

Select the window name, ProcessLibrary1, in the configuration window of EXO4 Window Designer and perform the following configuration:

- In the attribute **Connect To**, delete the text **%Controller%**, as the controller is not dial-up connected.
- Click on the button **Change**.



Style

The style of the window is **Overlapped**. This window type is normally used for process windows. It means that the window has to be closed expressly by the operator.

Dial-up Controllers

Automatically

You would typically want to connect automatically when opening a window that displays variable values from a dial-up controller. This is achieved by entering the name of the controller to connect to in the attribute **Connect To**, e.g. Nursery1.

Established

EXO4 keeps track of whether the connection is already established, or should be kept open, when opening and closing windows.

Connect status

The connect status indicates what is happening with a dial-up connection between a modem on the main computer and a station. It is suitable to show the connect status in process windows of dial-up stations.

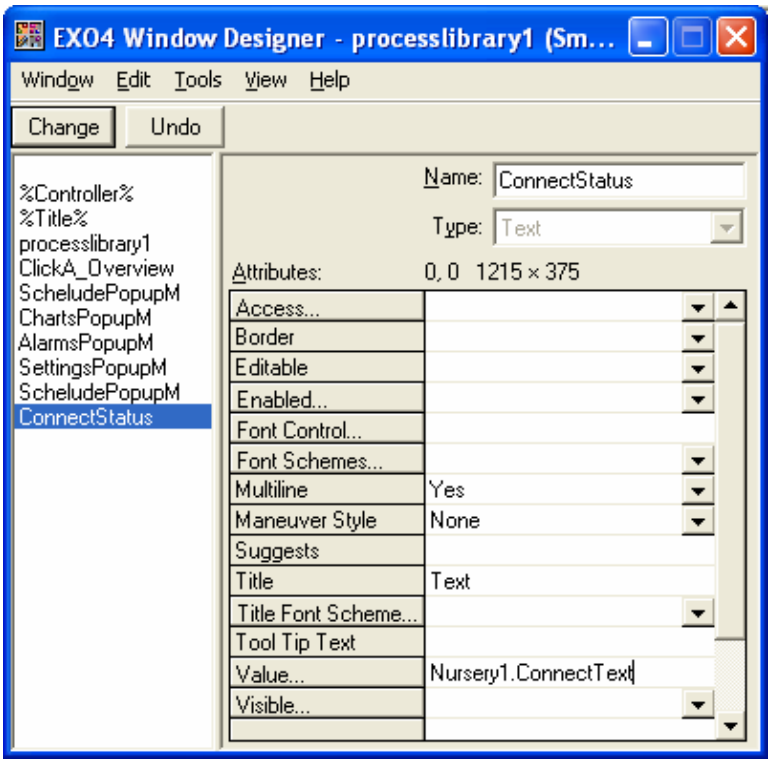
ConnectText

The connect status can be shown in EXO4 windows as scrolling text (in national language) in a window element. The window element should be of the type multiple line textbox. The connect status text can be found in the variable `ControllerName.ConnectText`.

That is, the window element is configured with the following attributes:

Value = *`ControllerName`*`.ConnectText`, e.g. `Nursery1.ConnectText`

Multiline = `Yes`



Static Background

Static

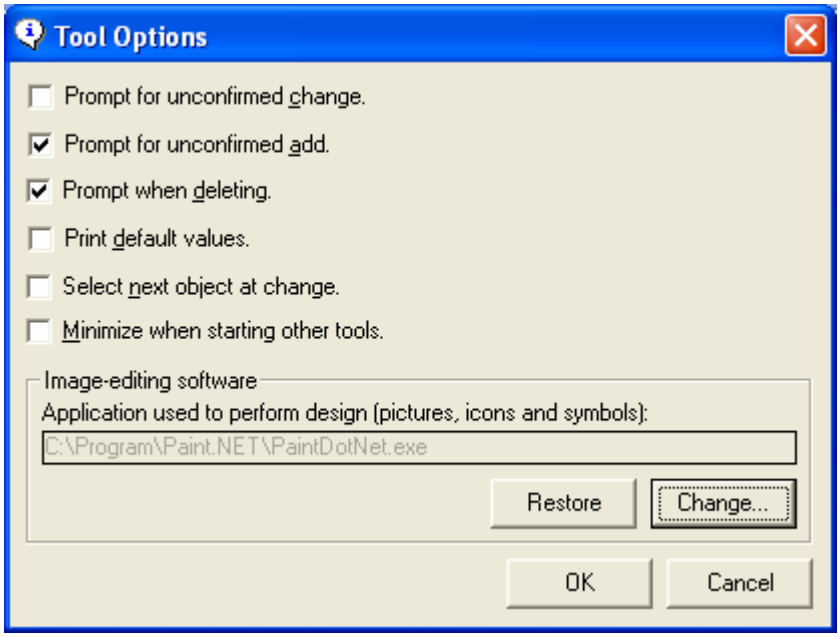
Process windows often have a static background picture illustrating an outline of the process. On top of this background, dynamic window elements are placed.

Paint.Net

We recommend Paint.Net for designing background pictures. Paint.Net is a free third-party tool, which is supposed to be similar to Microsoft Paint, but far more advanced. It is included on the EXO4 CD.

Default

As default, the tool Window Designer uses Paint.Net in EXO4 2008 if it is installed. Otherwise, it uses Microsoft Paint (included in Microsoft Windows). You can also manually select which image-editing tool to use. This is done by clicking on the button **Change** in the Tool Options dialog box and selecting the desired tool. Tool Options is opened with the menu command **Tools – Tool Options** in EXO4 Window Designer tool.



BMP

The background picture has to be saved as a bitmap, i.e. with the file extension .BMP.

Saving

If you use the button **Picture...** to design the picture and save it with an appropriate name, the background picture is automatically stored in the project folder **`EO4Lib:\Pictures`** (i.e. usually in **`C:\Projects\`***`Project folder`***`\EO4Lib\Pictures`**)

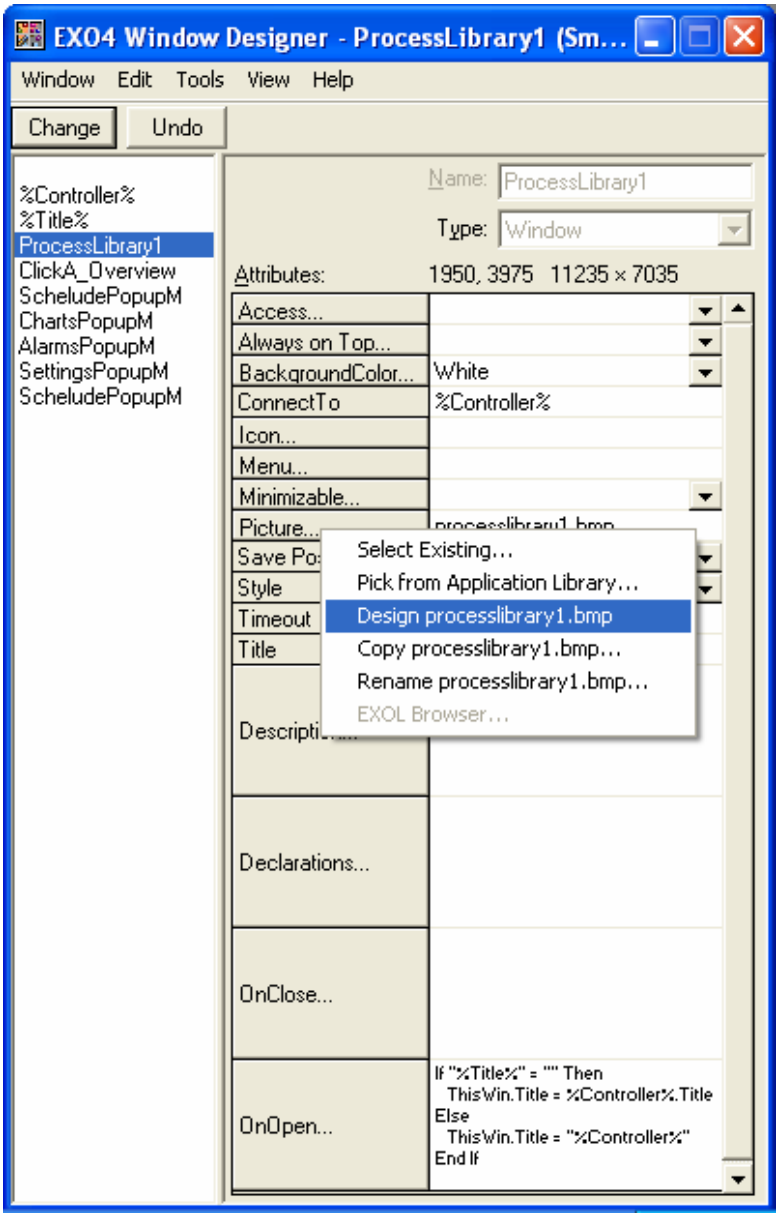
Clip art

There are some clip arts for building automation available in the EXO4 library that can be used to paste into the background picture. A list of available clip arts can be found in the document ***EXO4 Libraries***.

Texts Headings can be written directly in the background picture. Use black text with the font MS Sans Serif, bold, size 8 or 10. Other texts in the picture should be written with black text, font MS Sans Serif, non-bold, size 8.

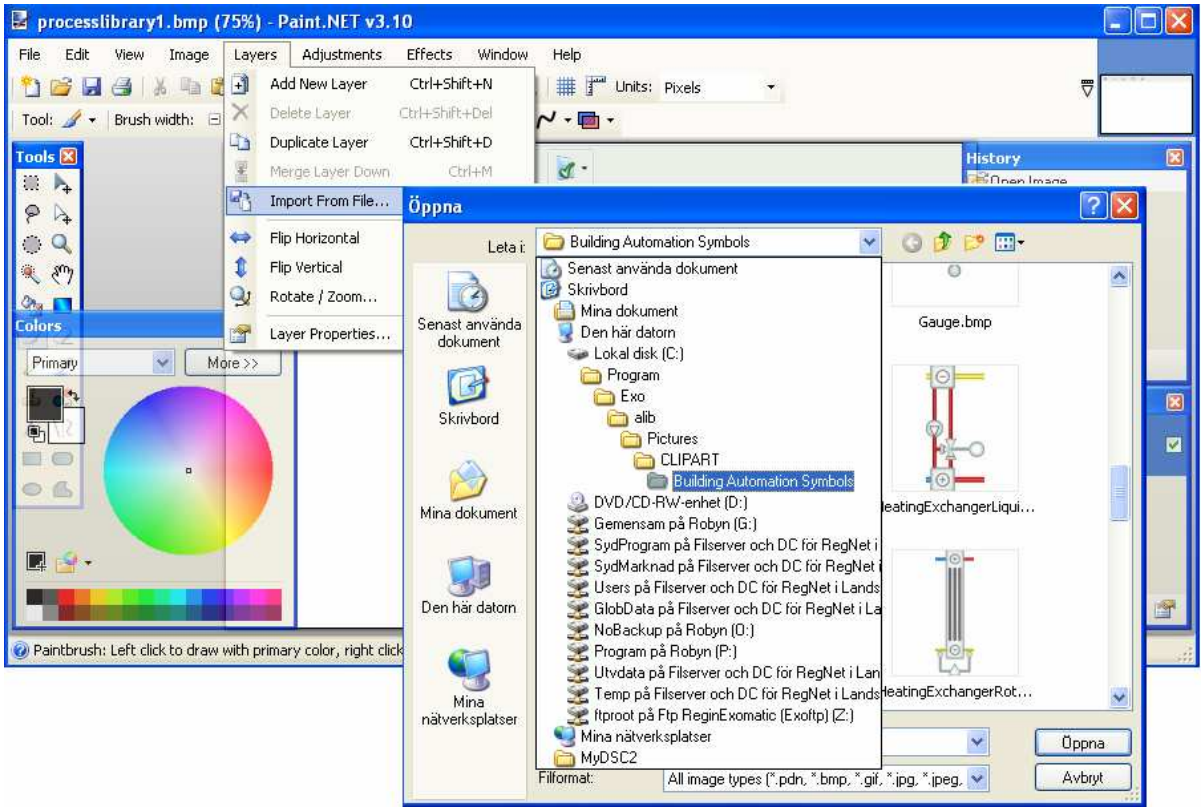
Picture file

- Select the window name, Library1Process, in EXO4 Window Designer.
- Click on the button **Picture…** to open a popup menu.
- Select **Copy ControllerWindow.bmp** in the menu. (The picture is copied in order to leave the original picture for the template window unchanged.)
- Give the new window the name **ProcessLibrary1.bmp** and click on **Save**.
- Open the picture file for editing by clicking the button **Picture...** again.
- Select **Design processlibrary1.bmp** on the menu to open the image-editing tool.

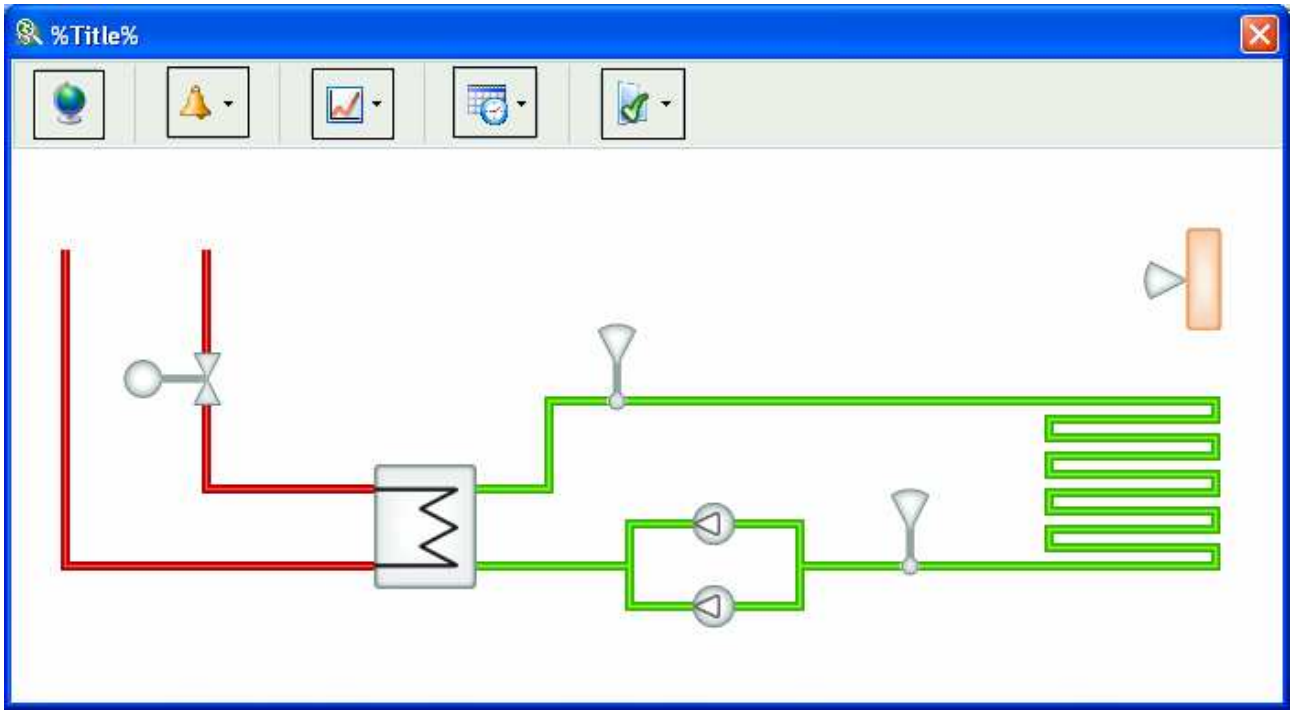


Drawing a picture

- Click on the menu command **Layers – Import from file** in Paint.Net and open the picture folder. The path is usually: **`C:\Program\EXO\alib\Pictures\CLIPART\Building Automation Symbols`**.
- Select a symbol and click on **Open**. The symbol will be pasted into the top left section of Paint.Net. Move it to the side and select the next symbol. Repeat this for all symbols you wish to use in the background and arrange them to visualize the process.
- Save the file and close Paint.Net.
- Click on the button Change in EXO4 Window Designer.
- Save the configuration with the keys **Ctrl+S** or the menu command **Window – Save**.
- Close EXO4 Window Designer by closing the configuration window and reopen it
- Now the picture should be displayed in the design window.
- If necessary, change the size of the design window to fit the picture by pulling its frames.



Example The background `HeatingSystem.bmp`, which is used for EXOdesigner's example controllers with heating systems uses the below picture:



Dynamic Window Elements

Dynamic

Dynamic window elements are often placed on top of a static background in the window. The elements have two areas of use:

- To display and, if required, change the values of variables in a controller. Examples of such elements are numerical fields and symbol change.
- Perform commands, i.e. opening a different window or starting and stopping a machine. The elements push buttons, click areas and popup menus are primarily used in these cases.

Window elements

The available window element types are displayed in the toolbox of EXO4 Window Designer. When the cursor points at a button in the toolbox, a so-called tool tip is displayed.

Descriptions

Short descriptions of the available window element types with corresponding attributes can be found in the section ***EXO4 Window Properties*** earlier in this chapter.

Attributes

Each window element can be configured with a number of properties (attributes) to achieve the required appearance and function. Some attributes are available for almost all types of window elements, others are specific to certain types of window elements.

Activating

A window element is activated either by selecting it in the configuration window, or in the design window by using the pointer tool at the top left of the toolbox.

Moving elements

An element can be moved by selecting it, pressing and holding the left mouse button, and dragging it to the desired position. The arrow keys of the keyboard can also be used to move an element.

Changing size

Once the element is in place and selected, it will have handles that can be used to change its size.

Adjusting

By using some simple commands, you can change sizes, positions or spaces for a group of window elements. Select the required elements by simultaneously pressing and holding the keys **Ctrl** or **Shift** and clicking on the elements. Thereafter, use the commands on the menu **Tools - Align**.

Configuring Window Elements

OutdoorTemp

Numeric

We are going to add a numeric window element in order to display the value of the outdoor temperature in the controller Library1. It will be placed to the right of the outdoor sensor in the process window of the design window.

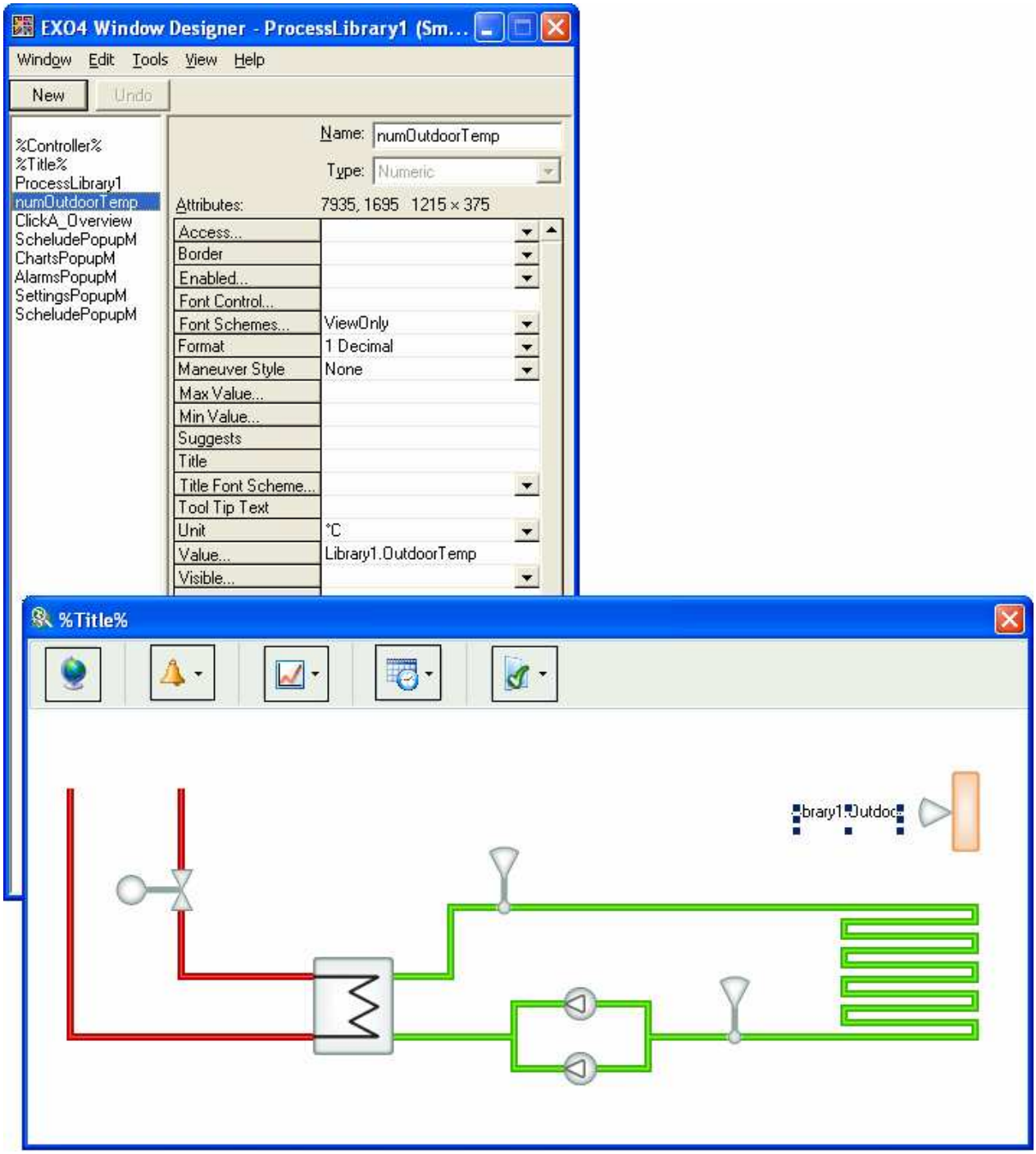
- Add a window element of the type **Numeric** in one of the following ways:

  1. Select the element type **Numeric** in the toolbox and draw a rectangle of the required size of the new element to the left of the outdoor sensor in the design window.

  2. Click on **New** in the configuration window. Select the type **Numeric** in the attribute **Type** and click on **Add**. Place the new element to the right of the outdoor sensor by using the mouse to drag it, or use the arrow keys on the keyboard.
- If needed, adjust the size of the window element by pulling its handles.
- In the configuration window, enter the name **numOutdoorTemp** in the attribute **Name**. We recommend indicating the type of the window element with the first letters in the name.
- Select the standard font scheme **ViewOnly** in the attribute **Font Schemes**.
- Select **1 Decimal** in the attribute **Format**.
- The standard configuration in the attribute **Maneuver Style** is **None**. As the operator cannot change the outdoor temperature, we will accept this.
- Delete the text **Numeric** in the attribute **Title**. The text in front of the element will disappear.
- Select the unit **°C** in the attribute **Unit**.
- The attribute **Value** decides which variable's that should be displayed in the window element. Click on **Value…** to open EXOL Browser and select the variable for the analog input **OutdoorTemp** in the controller, i.e. **Library1.OutdoorTemp**.
- Click on **Rename** or **Change** (the text on the button may differ) to confirm the configuration.

Since we have the argument %Controller%, you can change the controller name Library1 to %Controller%, i.e. the variable will be **`%Controller%.OutdoorTemp`**.

This is however explained in the section ***Window Classes*** later in this chapter.



SupplyTemp and ReturnTemp

Add two more numeric window elements and configure them for the two other temperature variables, **SupplyTemp** and **ReturnTemp** in the controller **Library1**.

Tip: If a window element already has been configured for a certain purpose, e.g. to display values from a temperature sensor, the configuration of this element can be done in the following ways:

1. Select the configured window element in the design window and copy it with the commands **Edit – Copy** and **Edit – Paste**, or by using the keys **Ctrl+C** and **Ctrl+V.**
2. Select the configured window element in the configuration window. Click the button **New**, and then **Add**.

This way, you normally only have to move the element and change the configuration of the attributes **Name** and **Value**.

Name: numSupplyTemp **Value: Library1.SupplyTemp**

Name: numReturnTemp **Value: Library1.ReturnTemp**

SupplyTempControl

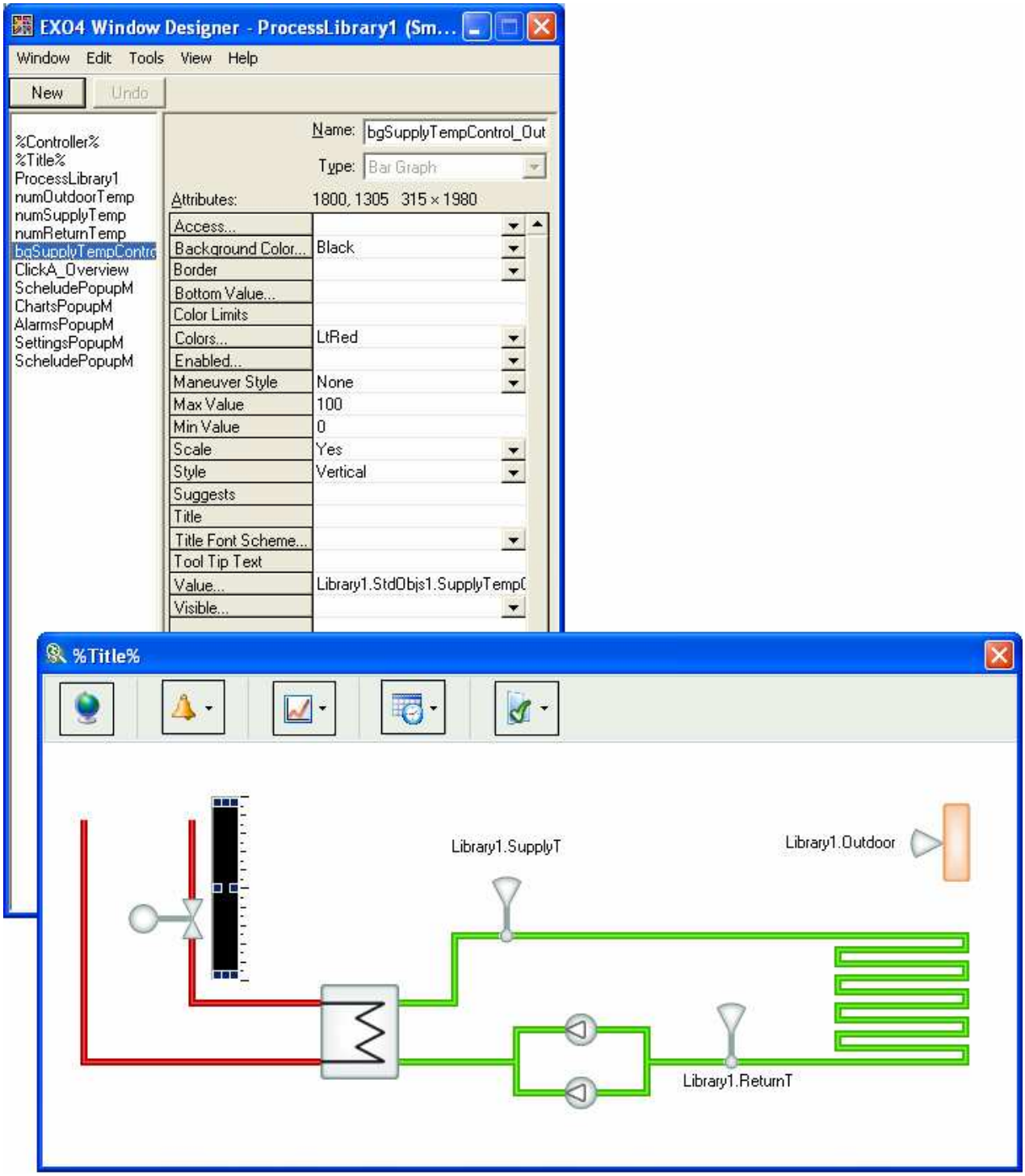
Bar Graph

We will display the output value from the object **SupplyTempControl** (which is of the type **PID Control**) with a window element of the type Bar Graph. The output value from SupplyTempControl controls a valve that is connected to the analog output ControlValve.

Add a window element of the type **Bar Graph** and place it to the right of the valve in the process window. Pull the handles to make the element a rectangular, vertical meter (see picture below).

Configure the following attributes:

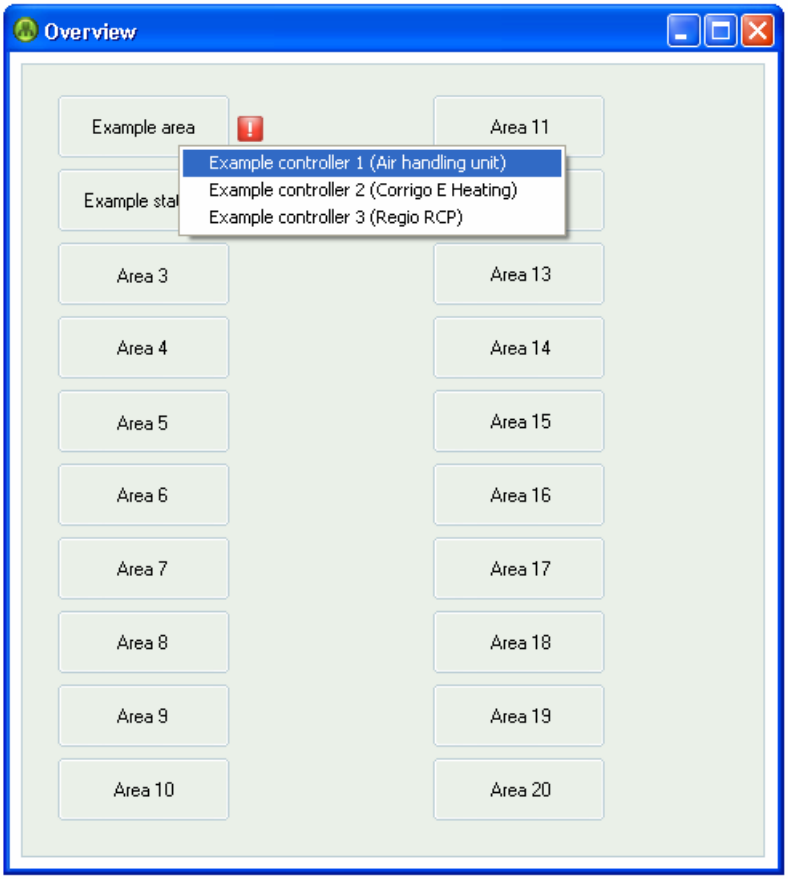
- **Name: bgSupplyTempControl_Output**
- **Background Color: Black**
- **Colors: LtRed**
- **Maneuver Style: None** (default configuration)
- Accept the default values for **Max Value** and **Min Value**, **100** and **0**, respectively
- **Scale: Yes** (default configuration)
- **Style: Vertical** (default configuration)
- **Title**: Delete the title text - text to the left of the element is not necessary in this case.
- **Value**: In EXOL Browser, select the variable **SupplyTempControl_Output** in the controller's. DPac file StdObjs1.
- Confirm the configuration and save it with the menu command **Window – Save** or the keys **Ctrl+S**.
- Close the configuration window to close all three windows of EXO4 Window Designer. If you have forgotten to save the configuration, you will be asked if you want to do it.


EXO4 Window Designer - ProcessLibrary1 (Sm...
Window Edit Tools View Help
New
Undo
%Controller%
%Title%
ProcessLibrary1
numOutdoorTemp
numSupplyTemp
numReturnTemp
bgSupplyTempContro
ClickA_Overview
SchedulePopupM
ChartsPopupM
AlarmsPopupM
SettingsPopupM
SchedulePopupM
Name: bgSupplyTempControl_Out
Type: Bar Graph
Attributes: 1800, 1305 315 × 1980
Access...
Background Color... Black
Border
Bottom Value...
Color Limits
Colors... LtRed
Enabled...
Maneuver Style None
Max Value 100
Min Value 0
Scale Yes
Style Vertical
Suggests
Title
Title Font Scheme...
Tool Tip Text
Value... Library1.StdObjs1.SupplyTempC
Visible...
%Title%
Library1.SupplyT
Library1.Outdoor
Library1.ReturnT

Overview Window

Testing

To be able to test the functionality of the window elements and their properties during runtime, we will configure the window Overview.



Buttons and menus

The overview window contains a number of "buttons" that open popup menus when clicked. Each button represents an area, and each command in the menus opens a corresponding controller window. To the right of each button, there is an alarm status symbol that shows the sum alarm status of the area. When the user clicks the alarm status symbol, an alarm status report window for that area is opened.

Picture

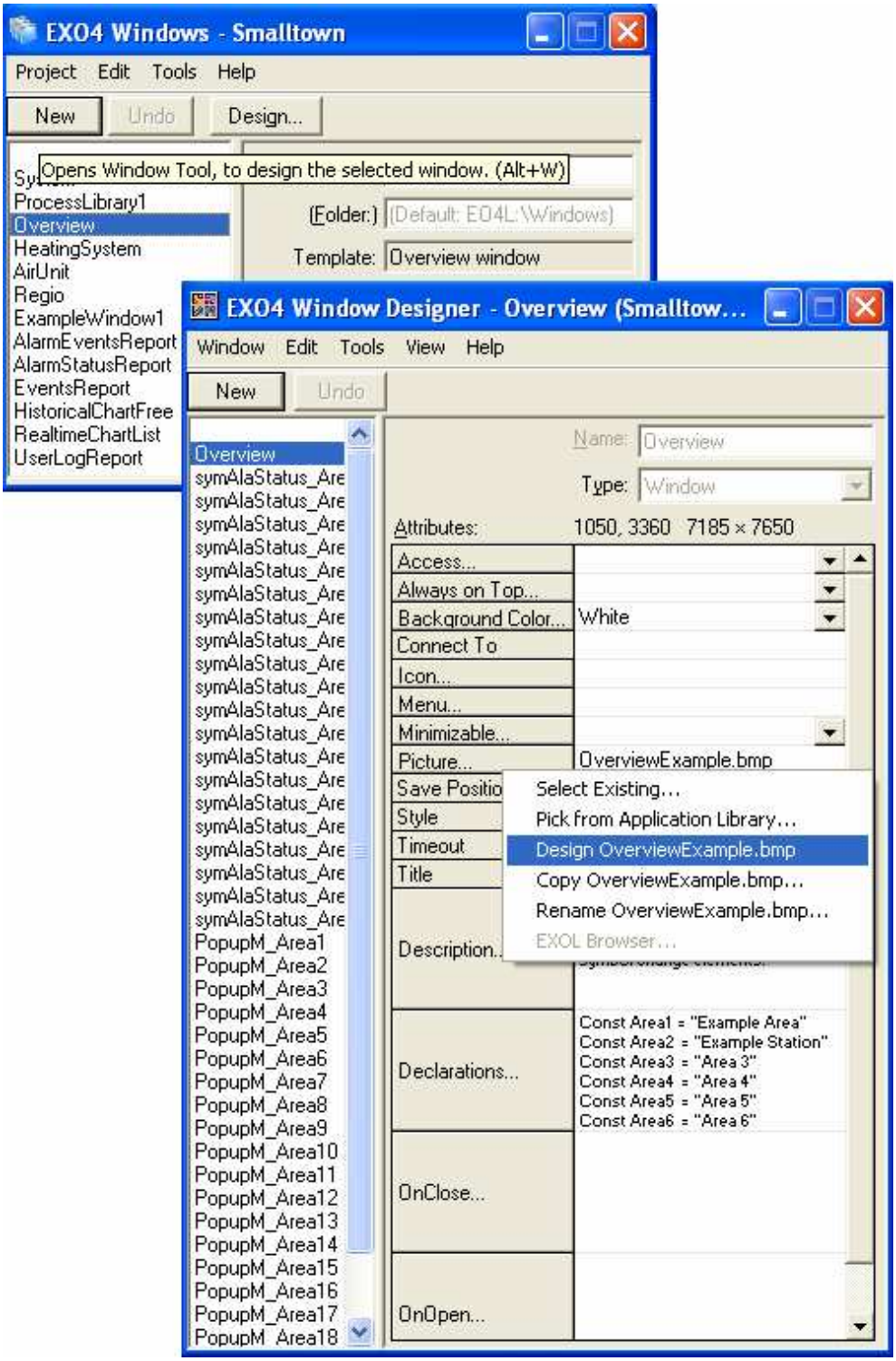
The boxes with the area names are painted in Paint.Net.

Large projects

If you have very large projects, you can design the popup menus to open regional overview windows instead of opening the controller windows directly.

Open the window Overview to design it in Paint.Net:

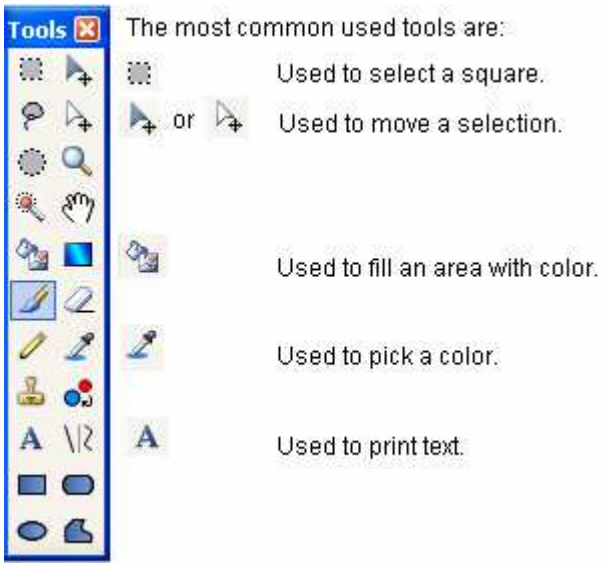
- Open EXO4 Windows in Project Builder (if it is not already open).
- Select the window **Overview** and click on **Config** (or double click on the name).
- Select the window name **Overview** in the configuration window of EXO4 Window Designer.
- Click on the button **Picture** and select **Design OverviewExample.bmp** in the popup menu. (We do not have to copy this picture as the project will only have one overview window, so it does not matter if we change its picture.)


EXO4 Windows - Smalltown
Project Edit Tools Help
New Undo Design...
Opens Window Tool, to design the selected window. (Alt+W)
ProcessLibrary1
Overview
HeatingSystem
AirUnit
Regio
ExampleWindow1
AlarmEventsReport
AlarmStatusReport
EventsReport
HistoricalChartFree
RealtimeChartList
UserLogReport
(Folder:) (Default: EO4L:\Windows)
Template: Overview window
EXO4 Window Designer - Overview (Smalltow...
Window Edit Tools View Help
New Undo
Name: Overview
Type: Window
Attributes: 1050, 3360 7185 × 7650
Access...
Always on Top...
Background Color... White
Connect To
Icon...
Menu...
Minimizable...
Picture... OverviewExample.bmp
Save Positio
Style
Timeout
Title
Description...
Declarations...
OnClose...
OnOpen...
Select Existing...
Pick from Application Library...
Design OverviewExample.bmp
Copy OverviewExample.bmp...
Rename OverviewExample.bmp...
EXOL Browser...
Const Area1 = "Example Area"
Const Area2 = "Example Station"
Const Area3 = "Area 3"
Const Area4 = "Area 4"
Const Area5 = "Area 5"
Const Area6 = "Area 6"
PopupM_Area1
PopupM_Area2
PopupM_Area3
PopupM_Area4
PopupM_Area5
PopupM_Area6
PopupM_Area7
PopupM_Area8
PopupM_Area9
PopupM_Area10
PopupM_Area11
PopupM_Area12
PopupM_Area13
PopupM_Area14
PopupM_Area15
PopupM_Area16
PopupM_Area17
PopupM_Area18

Designing the Picture in Paint.Net

Tools

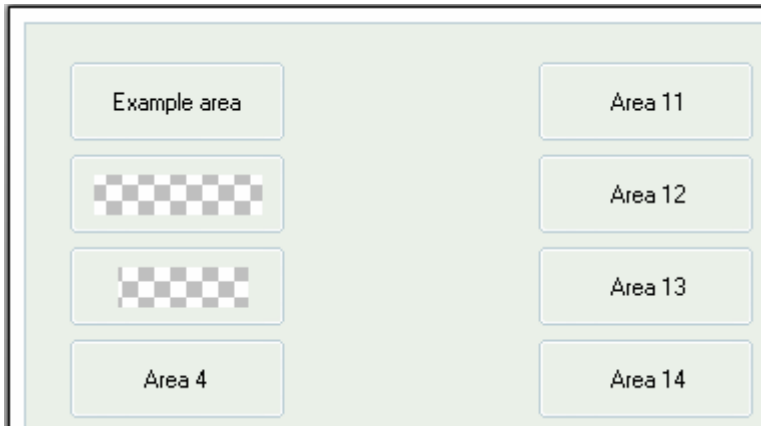
Paint.Net has a toolbox:



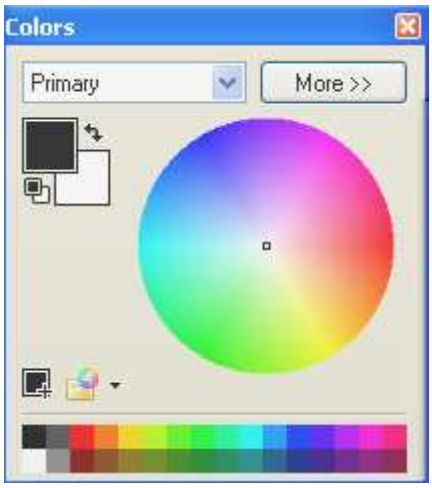
Design picture

Design the picture in Paint.Net. (This is one way to do it.)

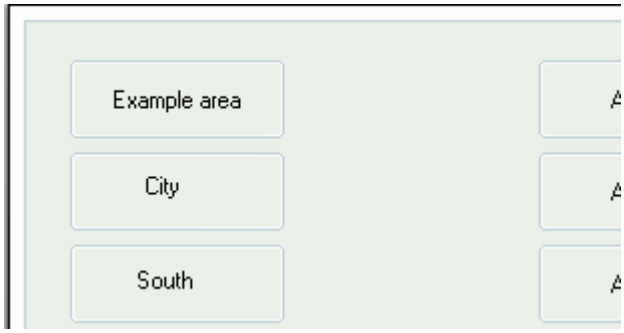
- ❑ Select the names in the second and third box to the left, one at a time, and delete them. Use the key Esc to unselect an area and the keys Ctrl+Z to undo a deletion.



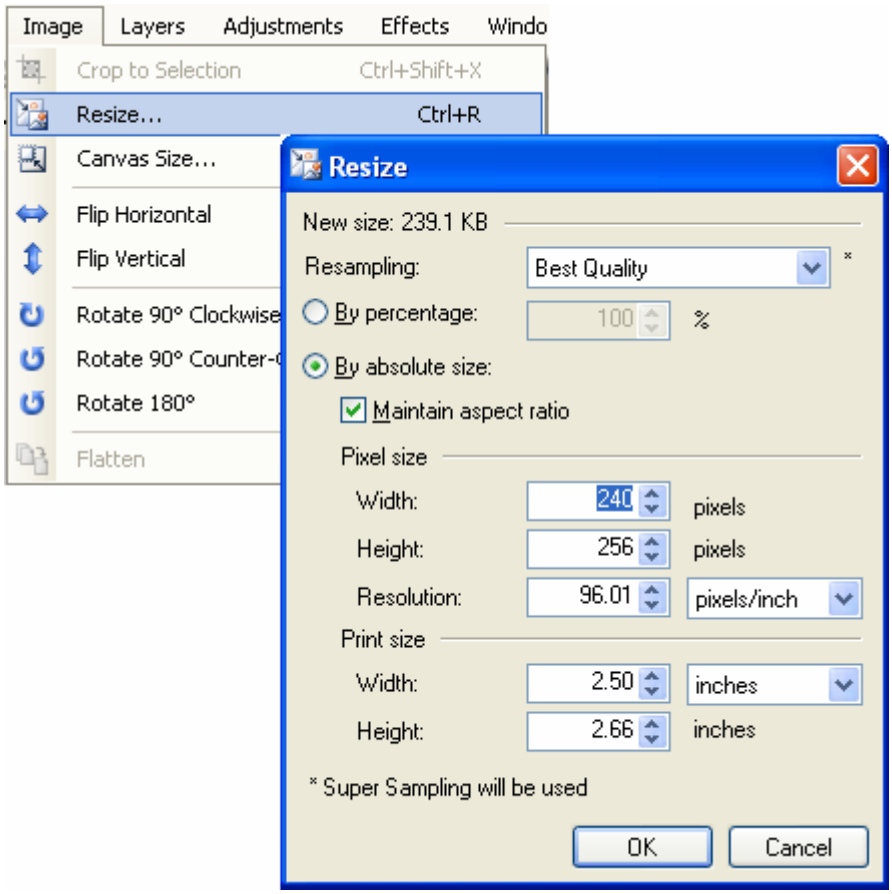
- ❑ Pick the background color and fill the removed areas with the color. You can choose the tolerance in the toolbar. 50% tolerance is suitable.
- ❑ Select black color in the Colors tool.



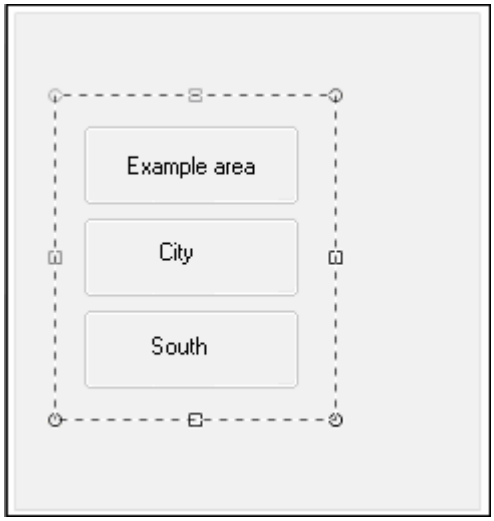
- Select the Text tool and print **City** in the second box and **South** in the third box. The font is chosen in the toolbar. It should be Microsoft Sans Serif, size 8 and Sharp.
- Select the texts one at a time and move them so that they are centered in the box. Probably you have to pick the background color again and fill the missing areas of the boxes.



- Select first the boxes **Area 4-10** and then **Area 11-20** and delete them as they are not needed. Fill the deleted areas with the background color.
- Select the remaining three boxes and cut them (**Ctrl+X**). Fill the background area.
- Select the menu command **Image – Resize**, change the width to **240** and click on **OK**.



- Paste the previously cut boxes with the keys **Ctrl+V** and move them so that they are placed a little to the left but centered vertically in the drawing canvas.

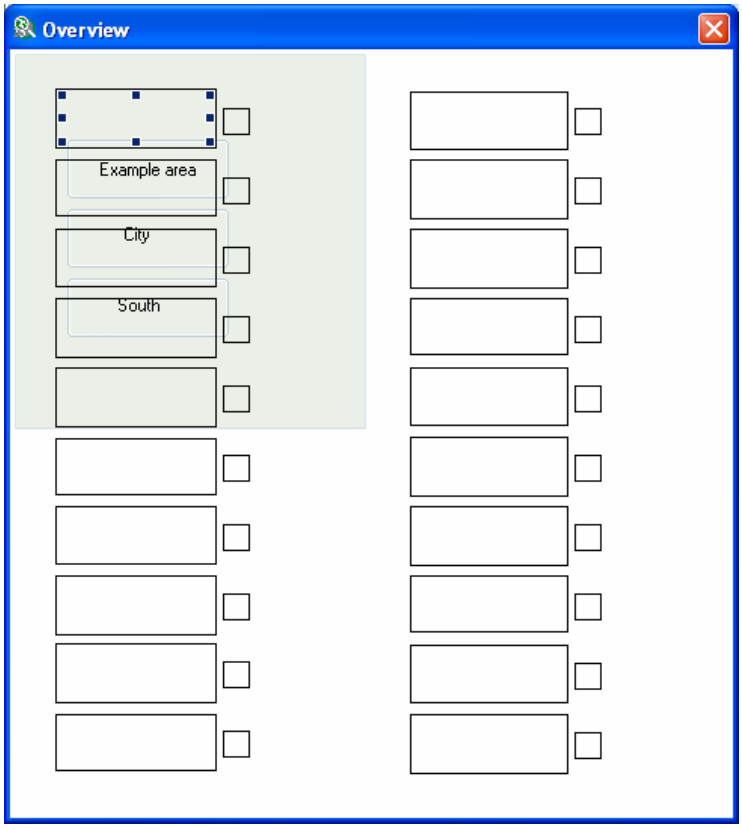


- Save and close Paint.Net.
- Click on the button **Change** in EXO4 Window Designer.

Configuring the Overview Window

Design window

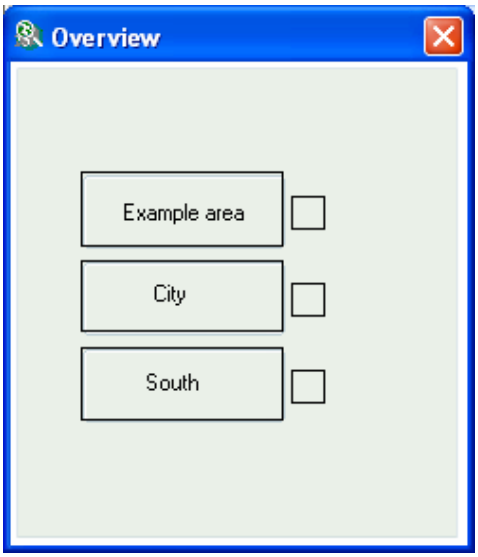
The design window in EXO4 Window Designer should look something like this:



Design

The first thing to do is to design the window elements to suit our project.

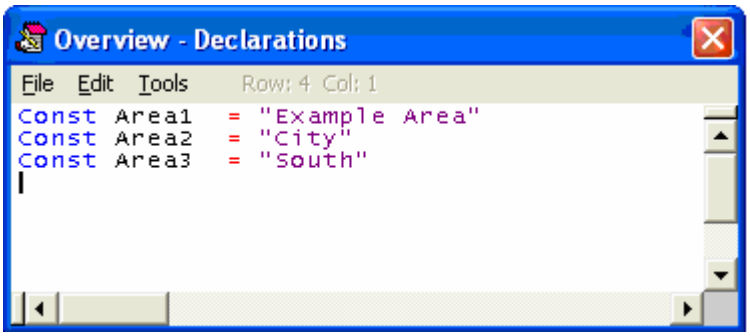
- Make sure that EXO4 Window Designer is open with the window Overview.
- Remove the window elements that are not needed, i.e. **SymAla_Status**4-20 and **PopupM_Area**4-20. In the configuration window, you can multi-select elements by clicking on the first one, pressing the Shift key and selecting the last one.
- In the design window, select all the six remaining window elements by selecting the pointer tool in the toolbox and “draw” a rectangle around them all. (Or else you can press the Ctrl key and select them one at a time.) Then you use the arrow keys to move them so that they fit on the background.
- The last thing to do is to make the size of the design window suitable for the background by pulling the frames of the window. Make sure that there is a small white frame around the background green-gray area.



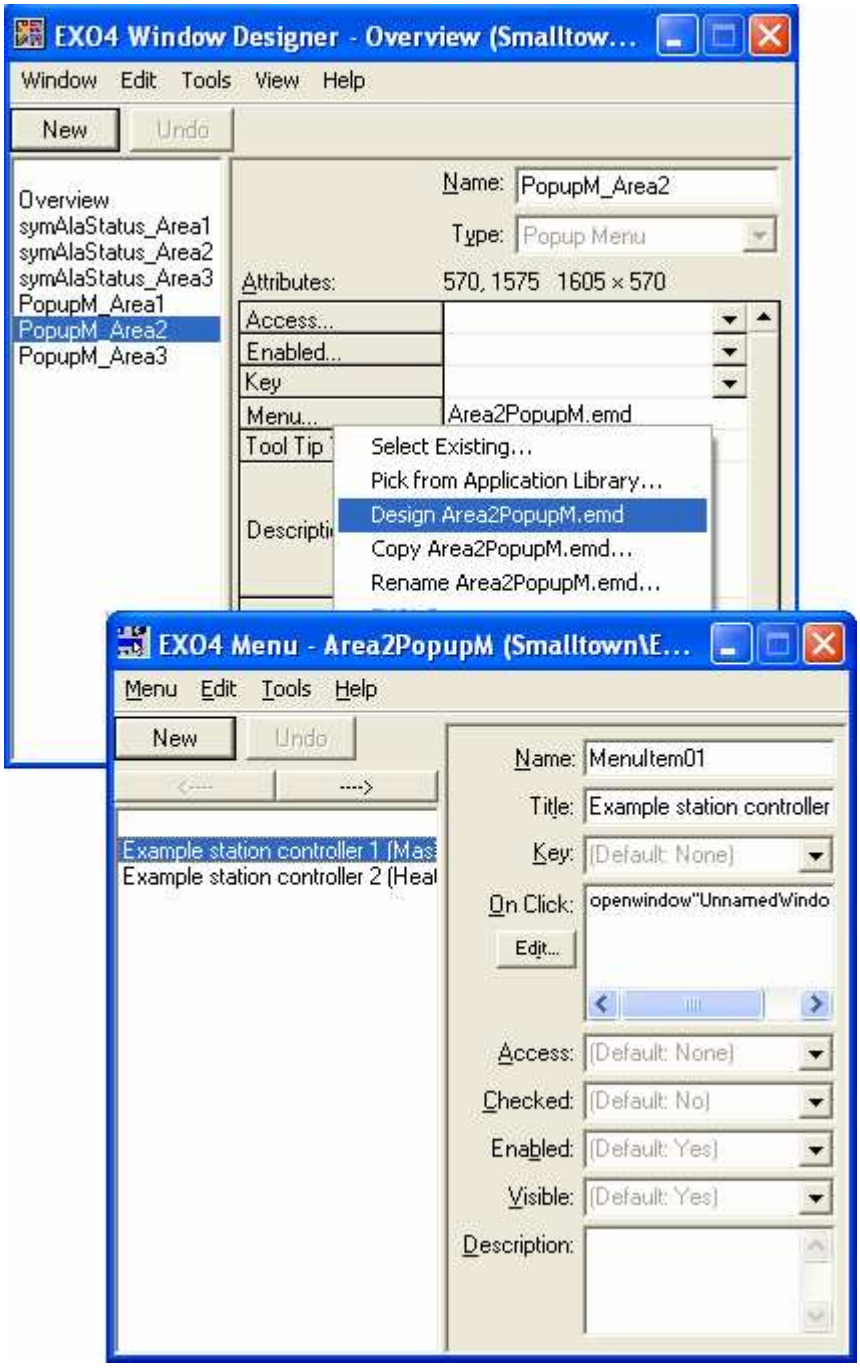
Configuring

The window elements are configured to open process windows.

- Select the window, i.e. **Overview**, in the configuration window.
- Open an edit window by clicking on the attribute button **Declarations…**.
- Change the code as follows:
  `Const Area1 = “ExampleArea”` (i.e. the same as before).
  `Const Area2 = “City”`
  `Const Area3 = “Soth”`
- Remove the rest of the code and close the edit window.
- Confirm the configuration by clicking on **Change**.

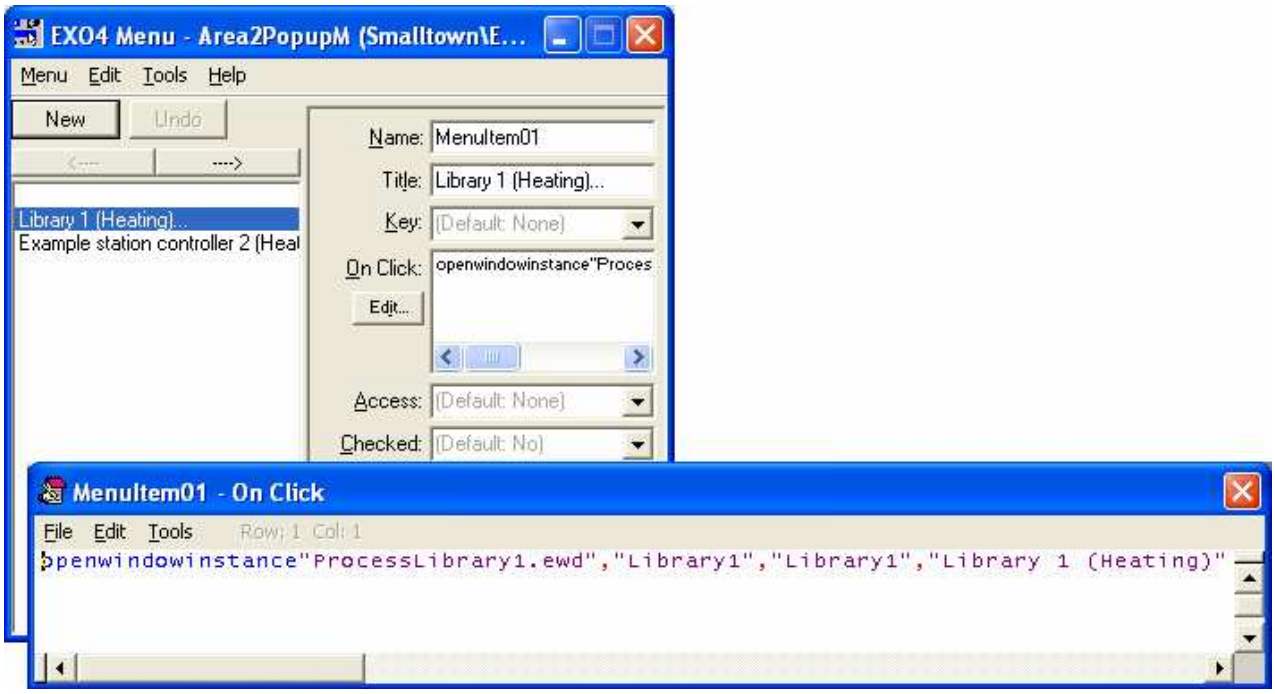


- Select the window element **PopupM_Area2** in the configuration window.
- Click on the button **Menu…** in the attributes list.
- Select **Design Area2PopupM.emd** in the attributes to open the tool EXO4 Menu Designer.



- Select the first line to the left in EXO4 Menu Designer: **Example station controller 1 (Master controller)…**
- Change the text in the attribute **Title** to **Library 1 (Heating)…**, as this is the text that will be displayed in the popup menu. The three dots implies that a window or dialog will open.
- Click on the button **Edit…** below the attribute **On Click** to open an edit window.

- Replace the line in the edit window with the following code on one line:
  `openWindowInstance “ProcessLibrary1.ewd”, ”Library1”,”Library1”,”Library 1 (Heating)”`
- Close the edit window and confirm the configuration with the button **Change**.
- Save the configuration with the menu command **Menu – Save** or **Ctrl+S** and close EXO4 Menu Designer.



The code

As the window we created is a window class (it has two arguments), the EXObasic command **`openwindowinstance`** is used to open it. Thereafter follows arguments:

`“ProcessLibrary1.ewd”` is the window’s filename.

`“Library1”` is an instance name that must be unique to make it possible to open the window from different places at the same time. It could be whatever you like, but we recommend using the name of the controller for which the window will be opened.

The next **`“Library1”`** is the controller’s name, which is the first argument that is sent to the window’s first argument **%Controller%**.

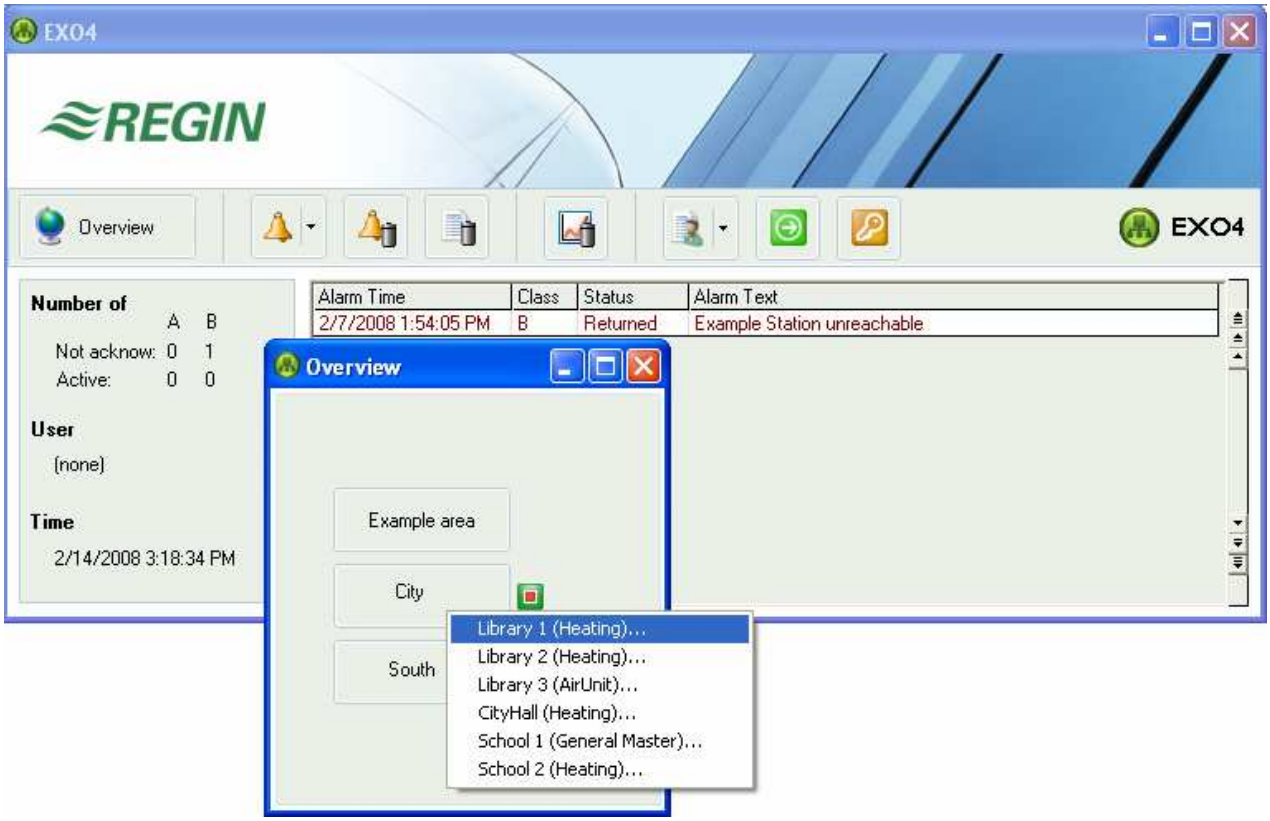
`“Library 1 (Heating)”` is the second argument that is sent to the window, i.e. what will be displayed in the title bar of the window.

Run EXO4

Now you can start EXO4 Run to test the overview window and the performance of the window elements in the controller window.

Open

During design and configuration of EXO4 windows, EXO4 is opened in run mode by clicking on Run EXO4 in the toolbar in Project Builder. 



From now on you can allow EXO4 to run and test the functions as new window elements are added or other changes to the configuration are made:

- After a change of the configuration in a window, save it with **Window – Save** or **Ctrl+S**.
- Close the window in question in EXO4 and re-open it to allow the window to be updated with the new configuration.

If you, contrary to all expectation, make changes in the System Window, EXO4 must be restarted.

Other controllers

It is a good idea to make it possible to open controller windows for the other controllers in the project as well.

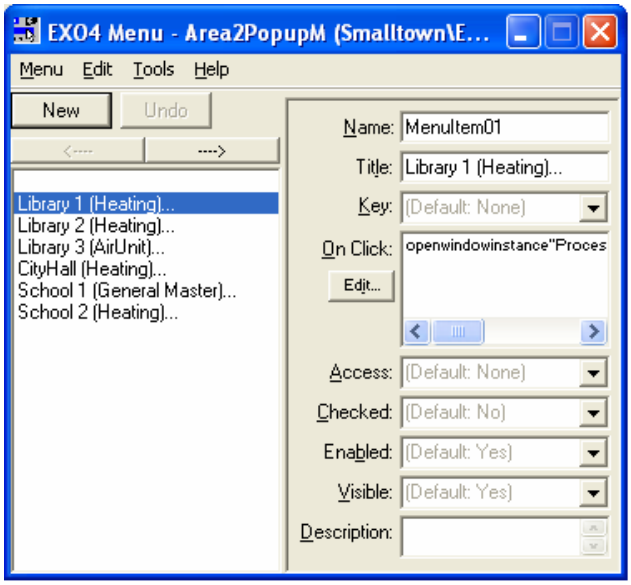
When more menu items are needed in a popup menu, click on the button **New** in the tool EXO4 Menu Designer and configure it as needed. Menu items get their names automatically and they need not be changed.

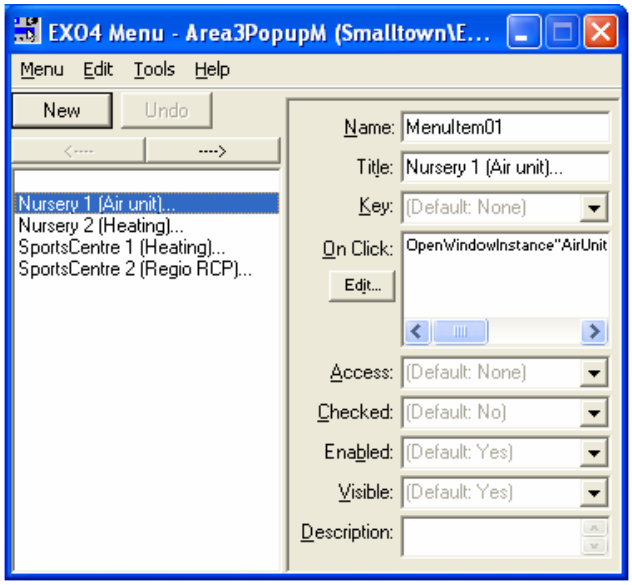
The following window classes can be used:

`HeatingSystem.ewd` *"windowFile","instanceName","controller","title"*
`AirUnit.ewd` *"windowFile","instanceName","controller","title"*
`Regio.ewd` *"windowFile","instanceName","title"*

The following ordinary window can also be used:

`ExampleWindow1.ewd`
It is opened with the command **`openwindow "ExampleWindow1.ewd"`**





Parameter Frames

Process values

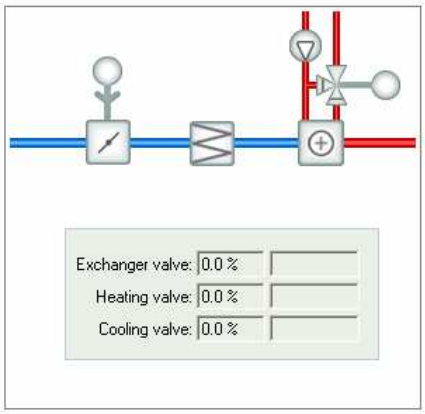
Most process values should be shown in *parameter frames*. These frames can be put into a large window with toolbar, process picture, etc. You can also create parameter windows with one (or a few) parameter frames only.

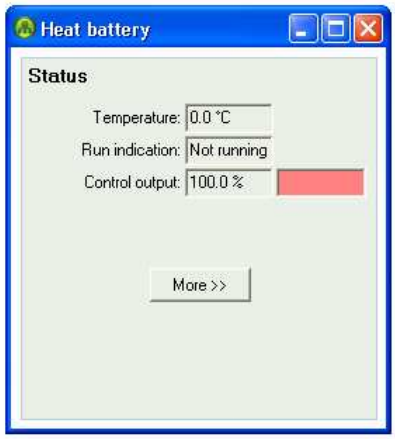
Frame color

The frames are painted directly in the background picture. A parameter frame is a simple box with a single pixel border. The background color of the frame should be Regin's green grey (RGB: 234,240,232), and the border should be Regin's border color (RGB: 189,207,214).

Headings

Headings can be written directly in the background picture. Use black text with the font MS Sans Serif, bold, size 8 or 10.





Dynamic elements

Add dynamic elements into the frames with EXO4 Window Designer. In frames you mostly use Numeric, Text and Text Change elements, but sometimes also symbol change and bar graph elements. The elements are normally organized into "tables".

Configure

Configure Numeric, Text and Text Change elements as below:

Type	Font scheme	Border	Maneuver Style
View-only values	`ViewOnlyInFrame` (and `ViewNotifiedInFrame`)	**Yes**	**None**
Editable values	`EditableInFrame`	**Yes**	**Immediately**
Clickable values	`ClickableInFrame`	**Yes**	*Xxxx***DialogBox** or **OnManeuver** code.

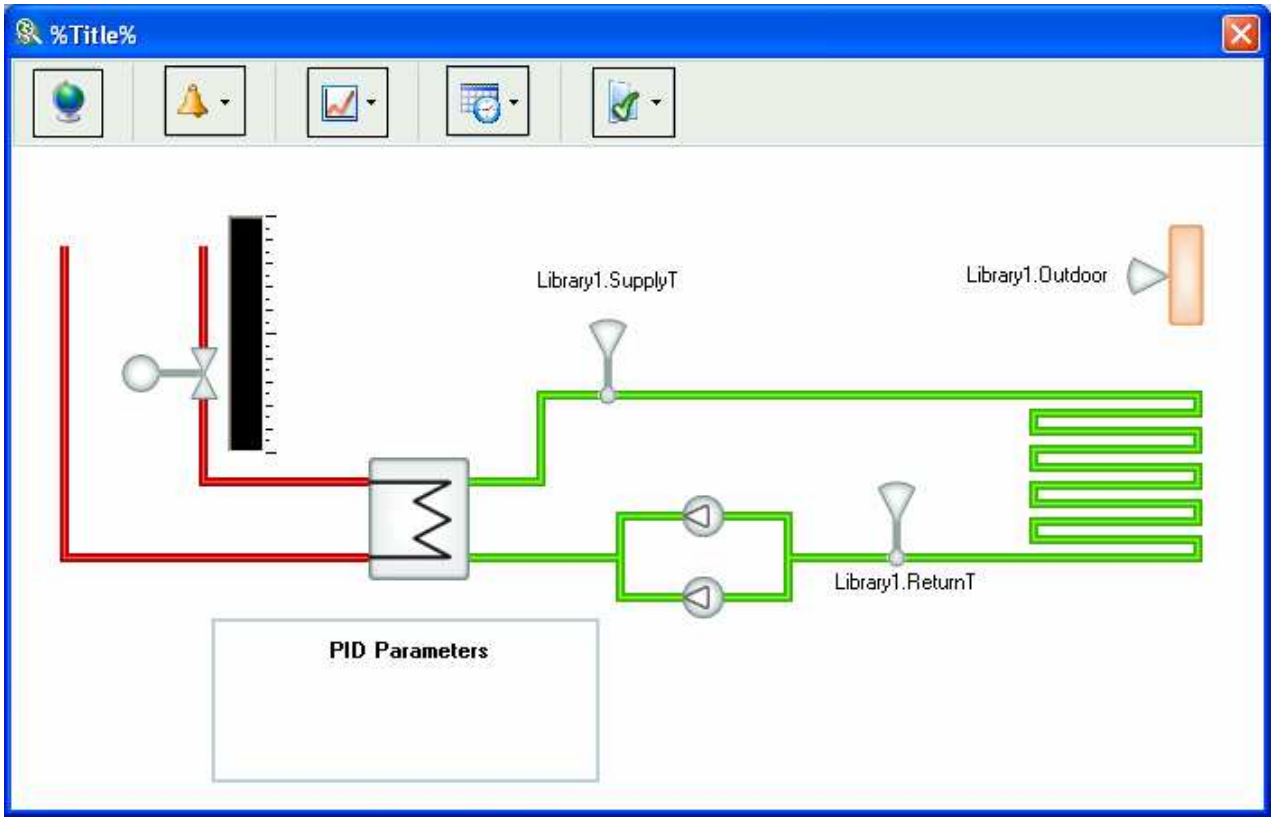
Maneuverable

We will make sure that we can change the PID control parameters P and I in the object SupplyTempControl. This will be done within a frame in the window ProcessLibrary1.

Design

First you have to edit the background picture, ProcessLibrary1.

- Open the window ProcessLibrary1 in EXO4 Window Designer and select the window name in the left list.
- Select **Design ProcessLibrary1.ewd** in the popup menu that opens when you click on the button **Picture…**
- Create a new layer for the parameter frame by clicking on the + sign to the left in the Layers window in Paint.Net.
- Change the colors in the Colors Window in Paint.Net. Click on Primary and then the button **More** and choose the border color, RGB: 189,207,214 in the RGB fields. Click on Secondary and choose the background color RGB: 234,240,232.
- Insert a rectangle below the process picture with the Rectangle tool .
- Change the primary color to black and use the text tool to print the heading **PID Parameters** in the rectangle. The font should be MS Sans Serif, bold, size 8 or 10.
- Save the file and close Paint.net.
- Save the configuration, close and re-open EXO4 Window Designer to display the parameter frame.
- If needed, resize the design window so that the parameter frame is displayed.



Parameters

Now it is time to insert the numeric window elements in the parameter frame to make it possible for the operator to change the P and I parameters of the PID control.

Start with the P parameter.

- Enhance the area of the window so the new parameter frame appears in the designer window of EXO4 Window Designer.
- Add a window element of the type **Numeric** and place it in the parameter frame.

Configure the following attributes:

- **Name: numSupplyTempControl_PGain**
- **Access: Operator**
- **Border: Yes**
- **Font Schemes: Editable**
- **Format: No Decimals**
- **Maneuver Style: Immediately**
- **Title: P-const**
- Value: In EXOL Browser, select the variable **Library1.SupplyTempControl_PGain**

Continue with the I parameter.

Add another window element of the type **Numeric** and place it directly below the element for the P parameter. (Select both and use the menu commands in **Tools – Align** to align them).

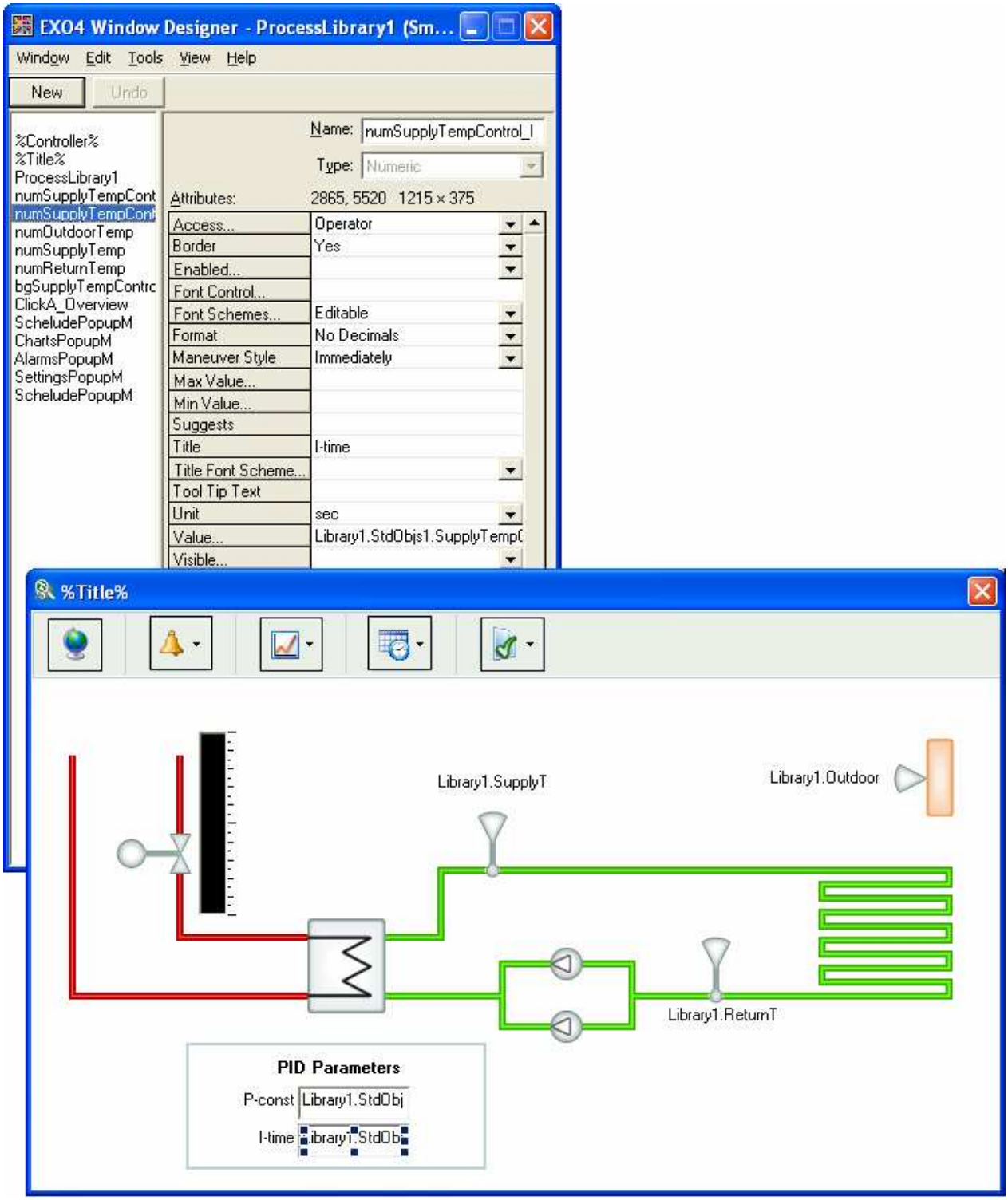
This window element should have the same configuration as the previous, with the exception of the following attributes:

- **Name: numSupplyTempControl_ITime**
- **Title: I-time**
- **Unit: sec**
- **Value: Library1.SupplyTempControl_ITime**

Confirm and save the configuration.

Appearance

The configuration and the design window in EXO4 Window Designer should now have, more or less, the following appearance:



Log on

Keep in mind that you have to log on as an operator to be able to change the values when the configuration is tested in EXO4.

Events and Reaction Codes

During runtime Events occur constantly when EXO4 is running. Below are a few examples

OnChange EXO4 has a system window that always has to be open when EXO4 is running. Normally, the system window displays an overview of alarm events in window elements. When such an element is updated due to an alarm event, an **OnChange** event is triggered.

OnManeuver When an operator clicks on **Overview** in the system window it will execute the reaction code that was written for the button event **OnManeuver**, namely:

```
OpenWindow "Overview.Ewd".
```

This code opens the window **Overview**.

OnOpen When the window **Overview** is opened, its event **OnOpen** is triggered, and if the integrator has written a code for the event, it will be performed.

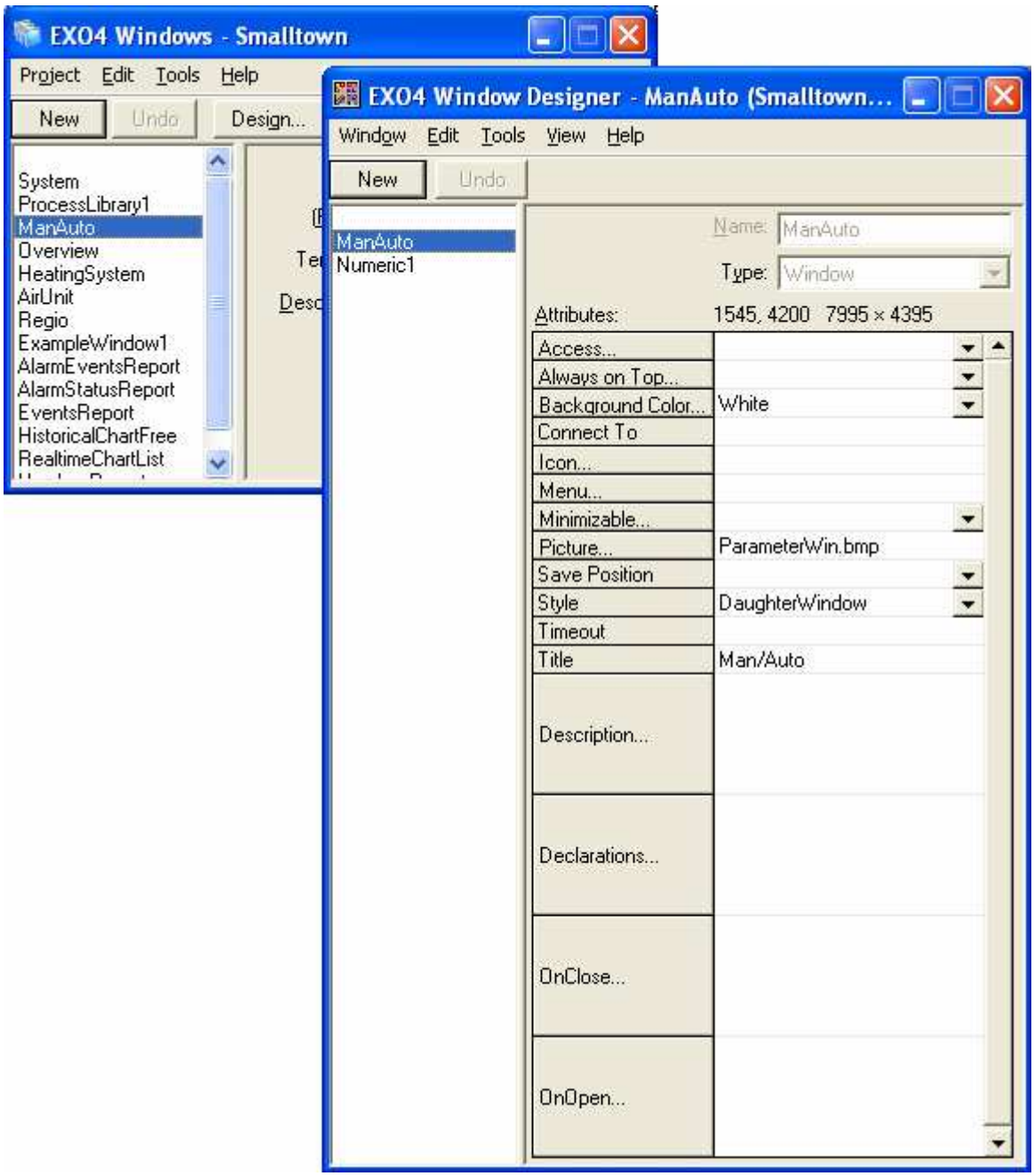
OnClose When the window **Overview** is closed, the event **OnClose** is triggered.

Creating the Window ManAuto

Example In order to be able to control if the object **SupplyControl** (of the type PID control) should have the operating mode automatic, manual or be switched off, we are going to create a daughter window. When manual control is selected, you should be able to enter the value of the analog output in percent.

Adding the window

- Open the tool EXO4 Windows and click on **New**.
- Select the template group **General** and the template **Parameter window** and click on **Ok**.
- Name the new window **ManAuto** and click on **Rename**.
- Open the tool EXO4 Window Designer by clicking on **Design** or by double clicking on the window name in the list to the left.
- In EXO4 Window Designer, select the option **Daughter Window** in the attribute **Style**.
- Enter the title text of the window **Man/Auto** in the attribute **Title**.
- Delete four of the five numeric window elements since they are not needed. Move the remaining one to the bottom of the window.

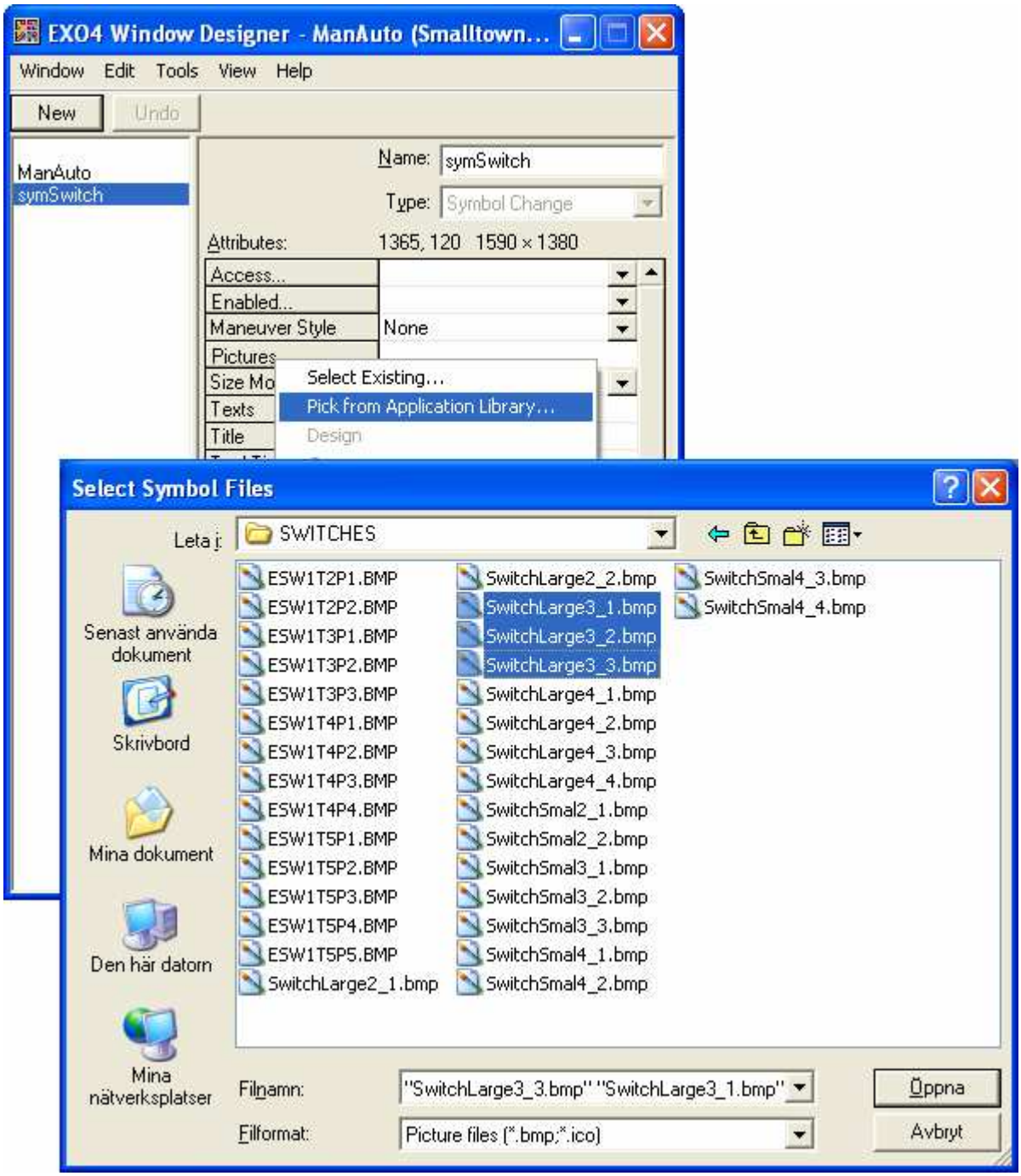


Symbol change

Add a symbol change element and select the symbol files.

- Add a window element of the type **Symbol Change** and name it **symSwitch**.
- Click on the button **Pictures** and select **Pick from Application Library**. (Choose **Select Existing,** if the pictures already have been inserted in the project. The pictures will then be in the project folder EO4Lib\Pictures).
- If **Pick from Application Library** was selected, you should browse for the folder SWITCHES in the dialog box Select Symbol Files. The path is usually **`C:\Program\EXO\ALib\Pictures\Symbols\SWITCHES`**. If the pictures already have been added to the project, an error message will appear. You can choose either to overwrite or to cancel.
- Multi-select the 3 BMP files SwitchLarge3_1, SwitchLarge3_2 and SwitchLarge3_3 (select the first file, press and hold the **[Shift]** key and select the last file, see picture below) and click on **Open**. The files appear in a comma-separated list in the attribute **Picture**. The order should be from 1

to 3, if not, you have to change the order. The first picture will be used when the variable's value is 0, the second for the value 1 and the third for the value 2.



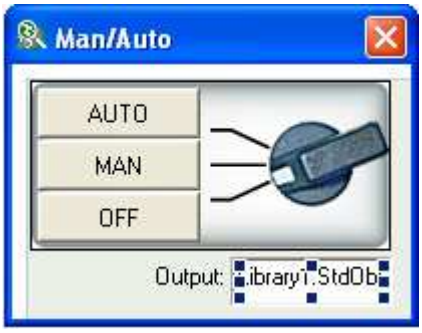
Size

To be able to design the placement of the symbol change element we have to see its appearance and size. This can be accomplished in the following way:

- The variable whose value is to be displayed is usually selected in the attribute **Value**. To make the symbol appear, enter the digit **0** in the attribute **Value** and click on **Change**.
- Adjust the positioning of the symbol change element to the left top of the window

The other elements

- Add three buttons with the names **btnAuto**, **btnMan** and **btnOff**. Place them to the left in the symbol change element.
- Give the numeric window element the name **numManValue** and place it below the symbol change element.
- Decrease the size of the window by pulling its frames, until the elements have just enough space to fit in the window.



Configuration

The three buttons are configured in the following way:

- **Maneuver Style: Directly**
- **Texts: AUTO**, **MAN** and **OFF** respectively.
- Click on the button **OnManeuver…** for the buttons and enter the following reaction codes:
  btnAuto: `Library1.SupplyTempControl_Select = 2`
  btnMan: `Library1.SupplyTempControl_Select = 1`
  btnOff: `Library1.SupplyTempControl_Select = 0`

The numerical window element **numManValue** is configured as follows:

- **Border: Yes**
- **Font Schemes: Editable**
- **Maneuver Style: Immediately**
- **Title: Output:**
- **Unit: %**
- **Value: Library1.SupplyTempControl_ManSet** (use EXOL Browser)

The symbol change element **symSwitch** is configured as follows:

- **Value:** Select the variable **Library1.SupplyTempControl_Select**.

Save the configuration.

Menus

Independent

Menus are used as independent units in EXO4. Which menu to use for a specific window element of the type popup menu is stated in the attribute **Menu** in EXO4 Window Designer. This makes it possible to have a number of standard menus in the project.

EXO4 Menu Designer

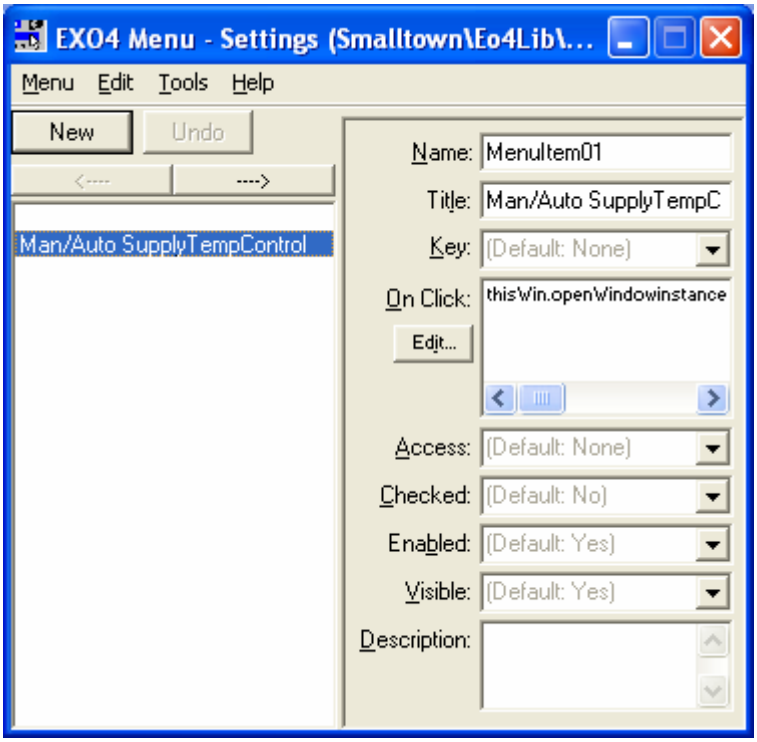
Menus are added and configured with the tool EXO4 Menu Designer, which can be opened in the following ways.

- ❑ In Project Builder, with the menu command **Config – EXO4 Menu Designer** or the button . This method is normally used when new menus are created.

- Click on a popup menu window element's attribute button **Menu..** in the configuration window of EXO4 Window Designer. Select a menu that has already been added to the project, or select one from the application library. Then you will be able to choose **Design**, **Copy** or **Rename** in the popup menu at the button **Menu...**.

Appearance

EXO4 Menu Designer:



Menu item

Each line in the left list in EXO4 Menu Designer is one menu item (menu command).

Attributes

Usually, the following attributes are configured in the tool Menu Designer:

- If you do not want to grant access to the menu item for everyone, you can choose an access category for the command in **Access.**
- The text of the menu item that is to be displayed in the menu is entered in **Title.**
- In the attribute **On Click,** you specify in EXObasic code what will happen when the operator clicks on the menu command. Usually the command will open a window with the reaction code `OpenWindow...` or `OpenWindowInstance...` (Reaction codes are described in the section ***Events and Reaction Codes*** earlier in this chapter).

Saving

Save the menu with the menu command **Menu – Save**. The menu will be saved in a file with the file extension *.Emd* in the project folder **EO4Lib\Menus**.

Menu Configuration

Popup menu

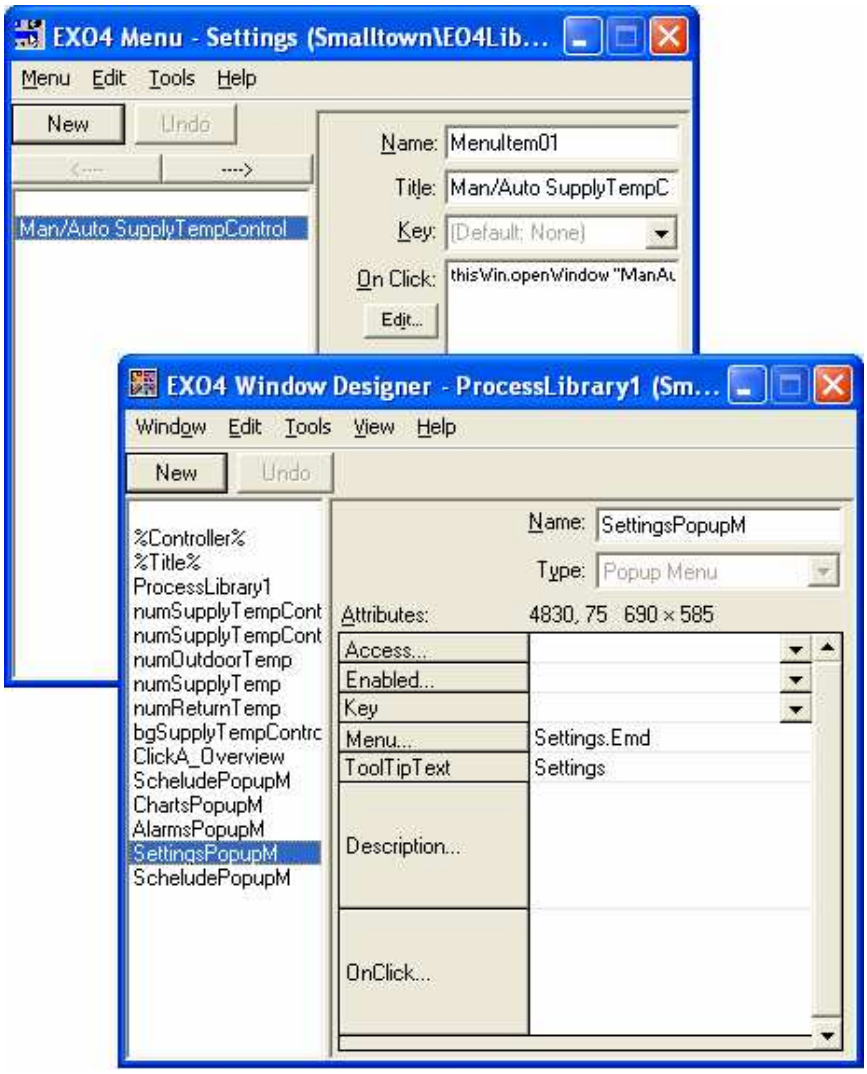
In the window ProcessLibrary1, we will make a popup menu that opens the window ManAuto.

Toolbar

The toolbar in the window ProcessLibrary1 has a "button" that is intended for settings.

The "button" should open a popup menu, but no menu is associated with the window element. Therefore, we will create one.

- Select EXO4 in Project Builder and click on the button EXO4 Menu Designer .
- Click on **New** to create a new menu item.
- Print **Man/Auto SupplyTempControl** in the attribute **Title**.
- Enter the following reaction code in the attribute **OnClick**
  `ThisWin.OpenWindow "ManAuto.Ewd"`
  ThisWin means that the daughter window will belong to the current window.
- Click on **Change**.
- Save the new menu with the name **Settings.Emd**.
- Open the window **ProcessLibrary1** in EXO4 Window Designer.
- Select the window element **SettingsPopupM**.
- Click on the attribute button **Menu…**, select **Select Existing** in the popup menu and select the new menu in the dialog Select Menu File
- Save the configuration and test the function of the daughter window ManAuto.



Window Classes

Window class

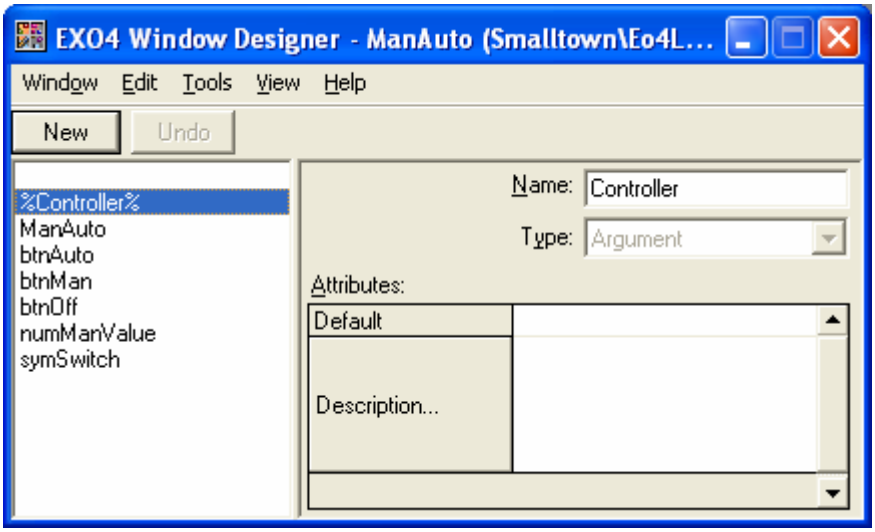
A window class has one or several arguments that can be given different values depending on from where it is opened. This makes it possible to re-use the one and same window class in various places in the project.

Arguments

A window class can, for example, display various texts in the title bar of the window, refer to different controllers and different variables depending on what is to be displayed in the window when it is opened. To achieve this, so-called arguments are used. The arguments are specified in the code that opens (instantiates) the window.

Adding arguments

Arguments are added in the configuration window of EXO4 Window Designer by clicking on **New** and selecting **Type=Argument**. The argument should be given an appropriate name, e.g. *Controller*. Click on the button **Add**. The argument is displayed at the top of the left list and is enclosed by percent signs (*%Controller%*). The argument *%Controller%* may now be used in all places, where you for an ordinary window would specify the name of the controller.



Default value

A default value, i.e. a value that will be used if no value is sent to the argument when the window is instantiated, can be configured in the attribute **Default.**

Open window class

A window class is opened with the command **OpenWindowInstance** followed by the file name of the window class, instance name and arguments.

Instance name

To be able to have several instances (windows) of one window class open simultaneously with different contents, each instance must have a unique name. Preferably, the instance name should represent the specific context where the window is opened, e.g., the controller's name, a compound of the controller's name and the object's name, or the area's name.

Syntax

The EXObasic syntax for opening a window class instance:

```
OpenWindowInstance "file.ewd","instancename","Arg1","Arg2"
```

Daughter window

A daughter window, or a popup window, must have a mother window, which usually is the window from where the new window is opened. The following syntax is then used:

```
thisWin.OpenWindowInstance "file.ewd", "instancename","Arg1"…
```

Creating the Window Class ManAuto

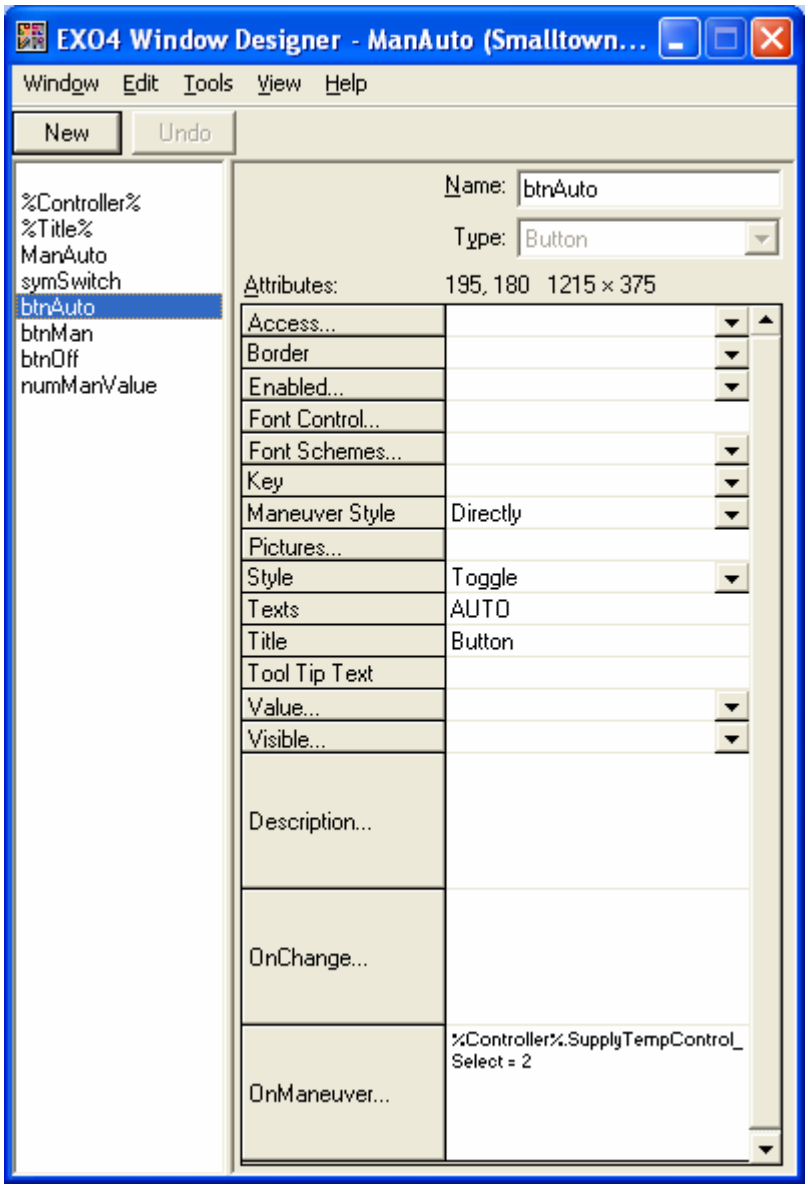
Example

We are going to change the window **ManAuto** into a window class by adding arguments. After this, we will be able to use it anywhere we need it in the project.

Arguments

- Open EXO4 Window Designer for the window **ManAuto**.
- Click on **New** in the configuration window.
- Select the type **Argument** in **Type**.

- Give the argument an appropriate name. Here, we will use **Controller**.
- Click on **Add**. The argument is inserted at the top of the left list and is displayed as **%Controller%**.
- Select **%Controller%** in the left list and insert another argument with the name **Title**, this will be used in the title bar text of the window.
- Replace all occurrences of the controller name **Library1** (or **CityHall**) with the argument **%Controller%** in all window elements,
  e.g. for the window element **SymSwitch**, the attribute **Value** will be:
  `%Controller%.SupplyTempControl_Select`
  Be careful not to remove the dot between the controller name and the name of the variable.
- Add **%Title%** in the attribute **Title** of the window, i.e. it should read:
  `Man/Auto %Title%`
- Save the configuration.



Opening the window

- Open EXO4 Window Designer for the window **ProcessLibrary1** and select to design the menu **Settings.emd** for the window element **SettingsPopupM**.
- Change the reaction code in **OnClick** for the menu item Man/Auto SupplyTempControl to the following (written in one line):

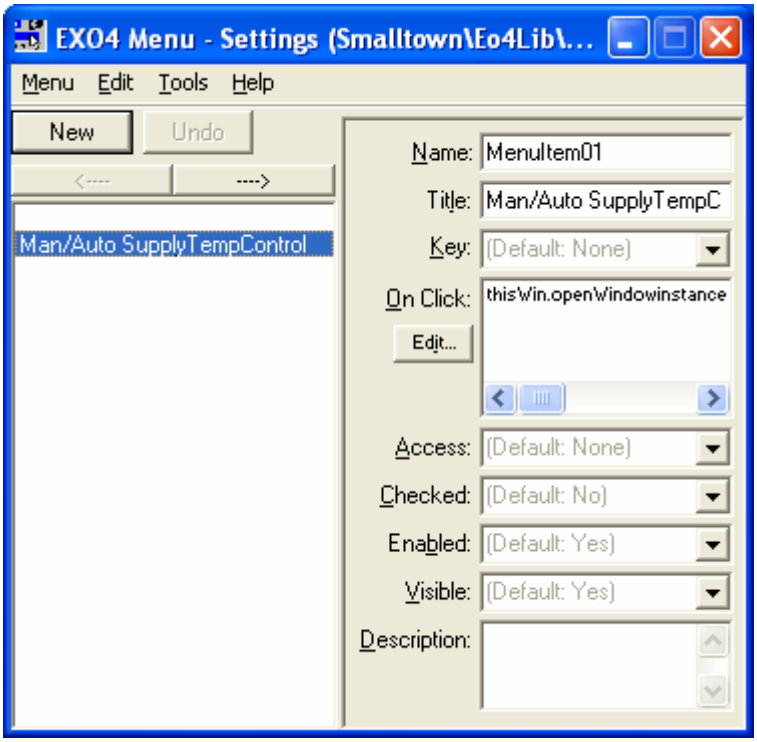
```
ThisWin.OpenWindowInstance "ManAuto.Ewd",
"Library1_SupplyTempControl","Library1",
"SupplyTempControl"
```

- Save and test the function.

Explanation

- **`ThisWin`** because it is a daughter window that should be connected to the current window.
- **`OpenWindowInstance`** - the command that opens an instance of a window class.
- **`"ManAuto.Ewd"`** – the file name of the window class.
- **`"Library1_SupplyTempControl"`** – a unique instance name for the window class that is to be opened.

  We have chosen to use a compound of the controller's name and the object's name to be able to use this window class to control more objects in the same controller simultaneously.
- **`"Library1"`** – the first argument, %Controller%, in the list box in EXO4 Window Designer for the window ManAuto.
- **`"SupplyTempControl"`** – the second argument, %Title%, in the list box.



Toolbar – Adding Button

User log report

We will use the User Log Report as an example of how to add, open and use a window template that is included in EXO4.

Adding a button

The user log report will be opened with a button on the toolbar in the window ProcessLibrary1. This button has to be added first.

Clip arts

Clip arts for toolbars can be found in **`Prod:\ALib\Pictures\Clipart\Toolbar\`**. In this case, the clip art **`Userlog.bmp`** will be used. It has an arrow to the right side that implies that a popup menu is associated with it, so we have to edit it before using it.

Edit the picture

- Find the picture **`Prod:\ALib\Pictures\Clipart\Toolbar\Userlog.bmp`** and open it in **Paint.Net**. (Right-click on the file and select Open with Paint.Net). **`Prod:`** is normally **`C:\Program\EXO\`**.
- Select the left part of the picture with the Rectangle Select tool and copy it with **Ctrl+C**.

  The whole picture:  The copied picture: 
- Open the picture **`EmptyButtonSmall.bmp`** in Paint.Net.
- Paste the copied picture with **Ctrl.V** and center it on the drawing canvas. 
- If you want to, you can save the picture with a suitable name before proceeding. Otherwise, you can leave Paint.Net open.

Add the button

- Copy the button picture in Paint.Net by first selecting the whole picture with **Ctrl+A** and then copying it with **Ctrl+C**.
- Open the window ProcessLibrary1 in EXO4 Window Designer.
- Open the background picture of ProcessLibrary1 in Paint.Net by clicking on the attribute button **Picture…** and selecting **Design ProcessLibrary1.bmp** in the popup menu.
- Paste the toolbar picture into ProcessLibrary1.bmp with **Ctrl+V** and move it to a suitable place on the toolbar.
- Save the picture file and close Paint.Net.
- Save and close EXO4 Window Designer. EXO4 Window Designer has to be reopened to display the new “button”.

Using a Window Template

User Log Report The window template User Log Report that is included in EXO4 is a window class.

Database The user log report (UserLogReport.Ewd) displays system events and maneuvers performed in EXO4. The information is retrieved from the system's database table User Log, which contains all user operations.

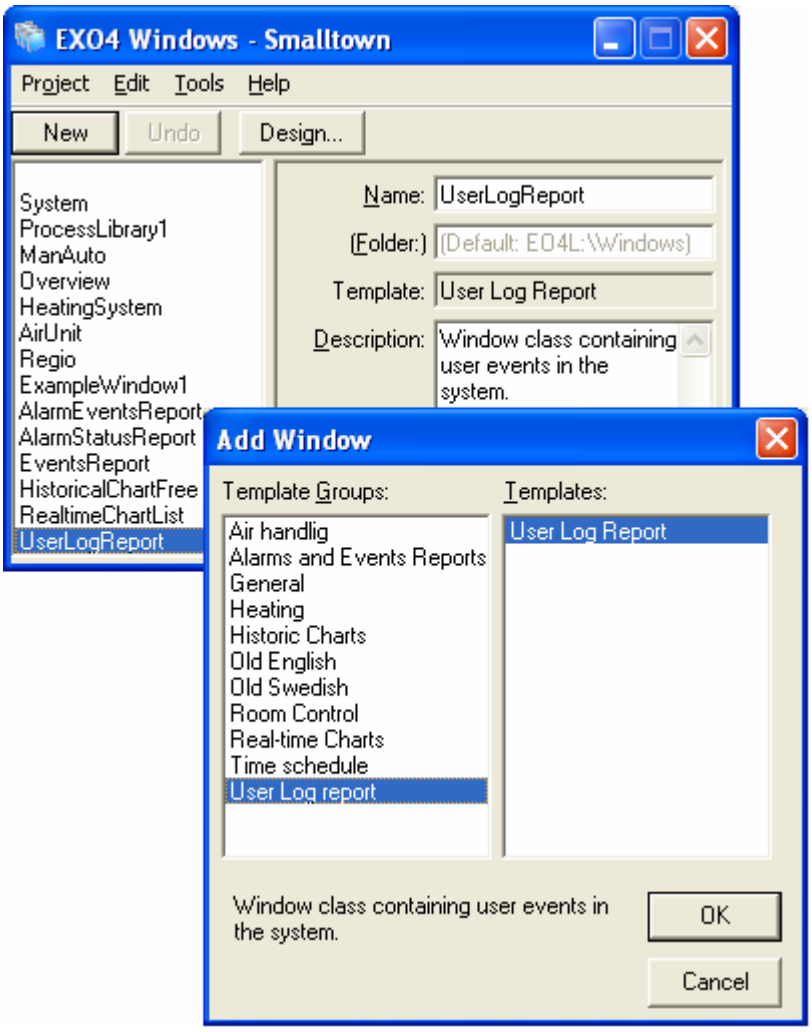
System events System events are for instance start-up and shutdown of EXO4, log on and log off.

Maneuvers All maneuvers on window elements that are bound to variables are stored by default.

Operator The operator can limit the range of selection from the database by specifying signal, value, operator and time span.

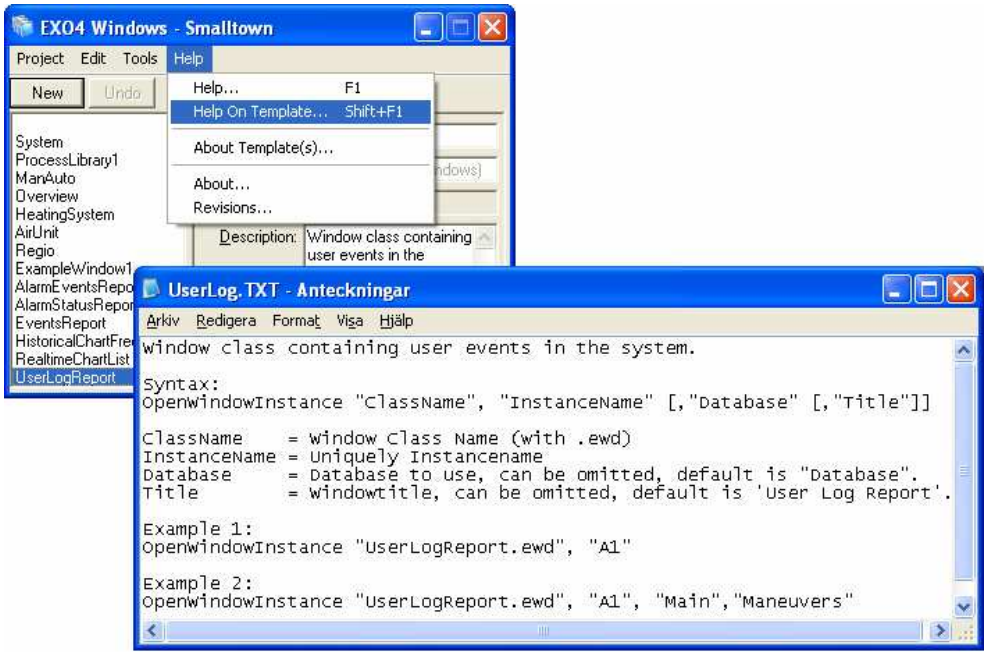
Adding

- Open EXO4 Windows.
- As you can see, the window **UserLogReport** has already been added to the project. If not, click on **New** in the tool EXO4 Windows and add **User Log Report**.



Syntax help

Select the window **UserLogReport** in EXO4 Windows and click on the menu command **Help – Help on Template** to open the syntax help file.



Reaction code

The reaction code to open the user log report is **`OpenWindowInstance`** followed by the class name and an instance name. Sometimes you also state the database name and/or title bar texts:

`"ClassName"` is the file name of the window class, in this case, **`"UserLogReport.Ewd"`**.

`"InstanceName"` is the unique name of the instance that can be chosen at random. In both examples in the help file the instance name is **`"A1"`**. A better choice is to use a name that implies from where the instance window is opened.

`"Database"` is an optional argument that specifies the database from which the user log is to be retrieved. If no database is specified, the default database with the name Database will be used.

`"Title"` is an optional argument that specifies the title bar text of the window. If the title is not specified, the title bar text will be **User Log Report**, or corresponding term for the language set in Windows.

Opening windows

A user log can be opened in one of the following ways:

- Only compulsory arguments, which means that the optional arguments can be omitted entirely:

```
OpenWindowIntstance "UserLogReport.Ewd", "A1"
```

- Compulsory arguments and the first optional argument, which means that the second optional argument can be omitted:

```
OpenWindowIntstance "UserLogReport.Ewd", "A1", "Database2"
```

- Compulsory arguments and both optional arguments:

```
OpenWindowIntstance "UserLogReport.Ewd", "A1", "Database2", "Maneuvers"
```

- Compulsory arguments and the last optional argument, which means that the first optional argument must be specified with an empty string (**`""`**)

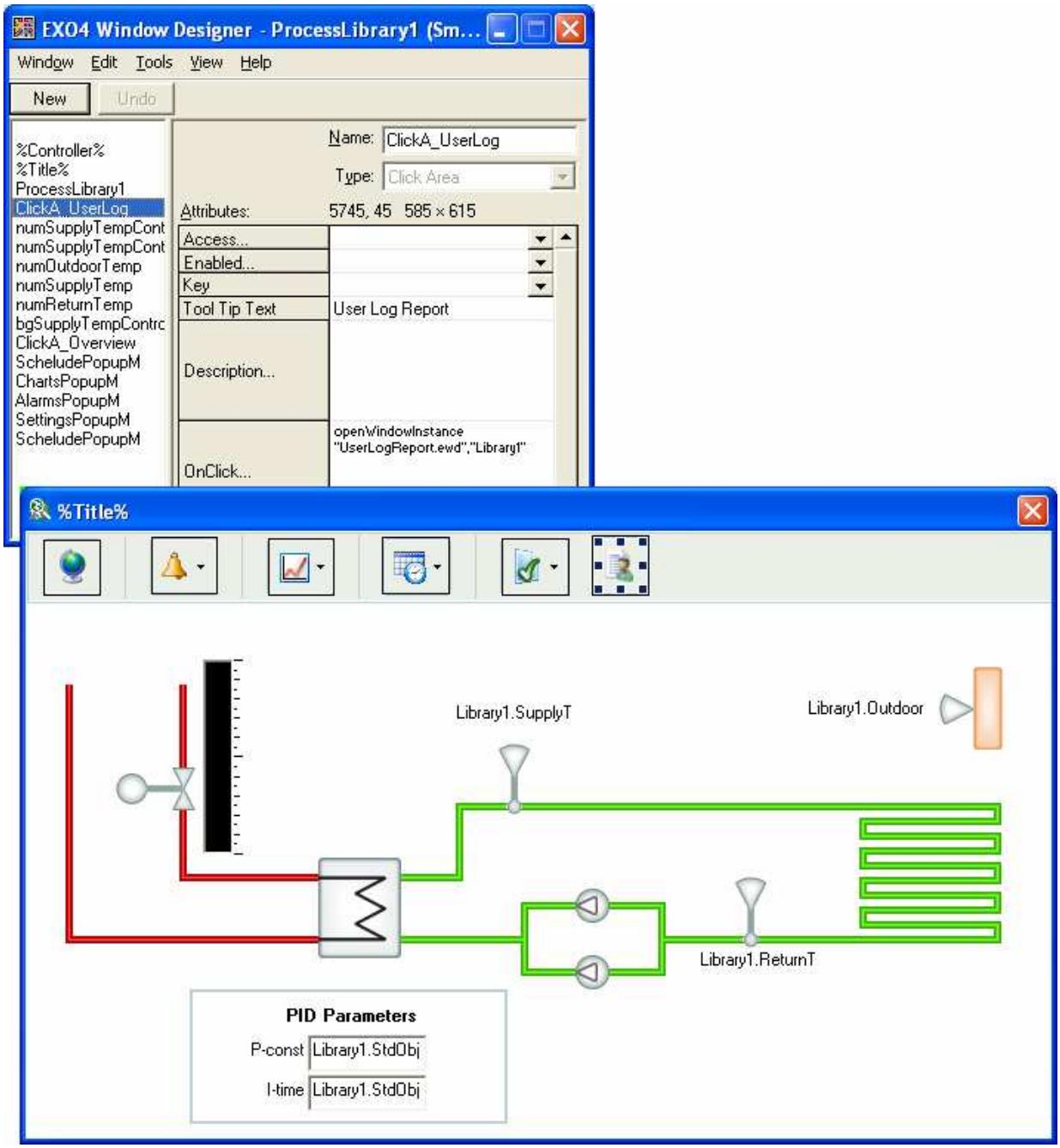
```
OpenWindowIntstance "UserLogReport.Ewd", "A1", "", "Maneuvers"
```

Reaction code

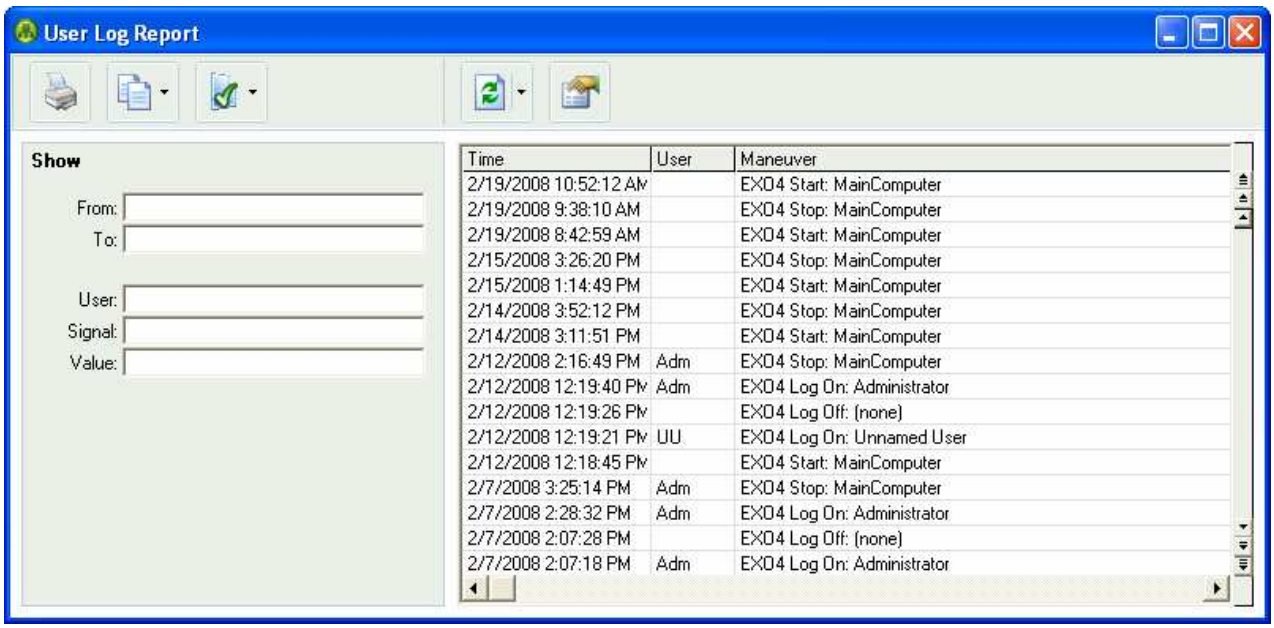
The button that we added in the above section ***Toolbar - Adding Button*** should open the user log report.

- Open the window ProcessLibrary1 in EXO4 Window Designer.
- Add a new click area to the window. Resize it and place it on top of the new "button".
- Give the click area the name **ClickA_UserLog**.
- Print **User Log Report** in the attribute **Tool Tip Text**.
- Print the following reaction code in **OnClick**:

  `openWindowInstance "UserLogReport.ewd", "Library1"`
- Confirm the configuration and save EXO4 Window Designer.
- Test the function of the new button in EXO4 Run.



User Log Report The User Log Report:



Limit selection The operator can limit the selection from the database by specifying signal, value, operator and time span.

Date/time The syntax for input of date/time is the same as the syntax for the time indications in the Time column (which corresponds to the settings in the Windows Control Panel).

Wildcards The input fields signal, value and operator allow the use of so-called wildcards '*'. If you for example want to view all maneuvers done in the controller Library1, you enter Library1* in the input field Signal.

Refresh If the range is changed, the operator must click on **Refresh** to update the search result.

Auto refresh If the popup menu item **Auto Refresh** is activated, the search result will automatically be updated when the database is changed (due to changed values), when new maneuvers occur or when the filter criteria are changed. It is not advisable to use Auto update if you have chosen to store all maneuvers in EXO4.

Properties The button **Properties** opens a window with detailed information about the selected maneuver.

Curves Viewer

Curve points

Control Curves Viewer is a program for changing and displaying curve points in EXO4. The program is designed to work together with objects of the type **Control Curve** in EXOdesigner.

Starting

It is a standalone program that is started with the EXObasic command **`Shell`**. To the operator, it looks as an integrated part of EXO4.

In the example below, the code to open the program has been entered in multiple lines to make the arguments more clear. This code must be entered in one line and all comma signs are necessary.

```
Shell "Prod:\EXOop4\Curve1.exe
      ModName=ControllerName
      ObjectName=Curve1,Curve2,,,,,,
      CurveName=Curve1,Curve2,,,,,,
      NoOfPoints=8,8,8,6,,,,,
      Unit=°C,A,Volt,,,,,
      Title=Windowtitle"
```

- **`ModName`** is the name of the controller.
- **`ObjectName`** is the name of the objects in the controller.
- **`CurveName`** is the name of the curves, as displayed to the operator. Default: **`Curve1,,,Curve8`**.
- **`NoOfPoints`** is the number of curve points for each curve. Default: **`8`**.
- **`Unit`** is each curve's unit. Default: **`°C`**.
- **`Title`** is the text displayed in the title bar of the window.

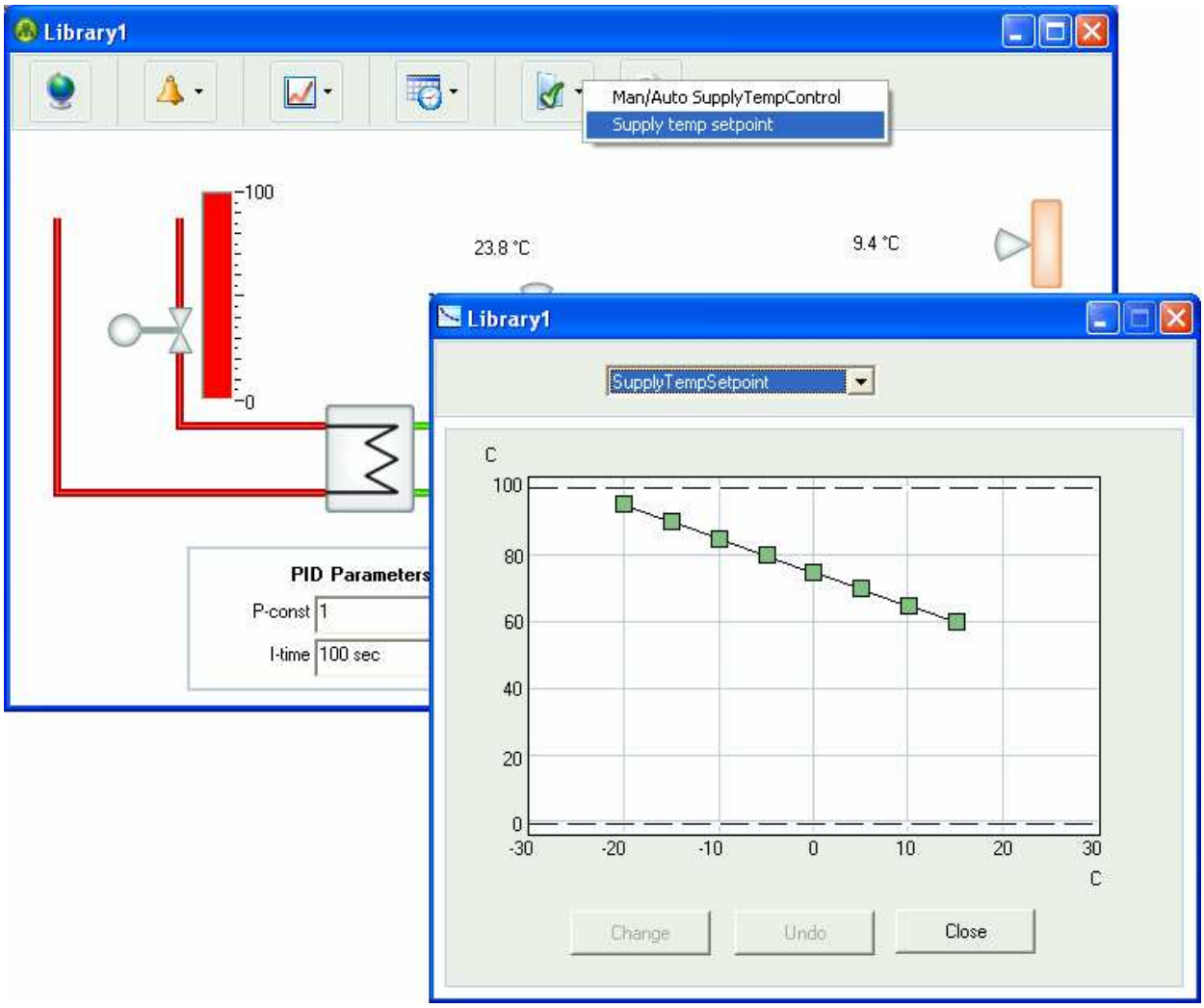
Menu item

We will insert a new menu item in the menu Settings.emd that was created earlier in this chapter. This menu item will open the window Control Curves Viewer for the object SupplyTempSetpoint, which is of the type Control Curve.

- Open the window ProcessLibrary1 in EXO4 Window Designer
- Select the window element **SettingsPopupM**, click on the button **Menu..** and open the menu Settings.emd for design.
- In EXO4 Menu Designer, click on **New** or press Enter to add a new menu item.
- Enter the text **Supply temp setpoint** in the attribute **Title**.
- Enter the following reaction code in one line in **OnClick**.

```
shell "Prod:\exoop4\curve1.exe
ModName=%Controller%
Objectname=SupplyTempSetpoint
CurveName=SupplyTempSetpoint,,,,,,,
NoOfPoints=8,8,,,,,, Unit=°C,°C,,,,,,
Title=Supply temp setpoint %Controller%”
```

- Confirm the configuration, save and close EXO4 Menu Designer
- Check the functionality.

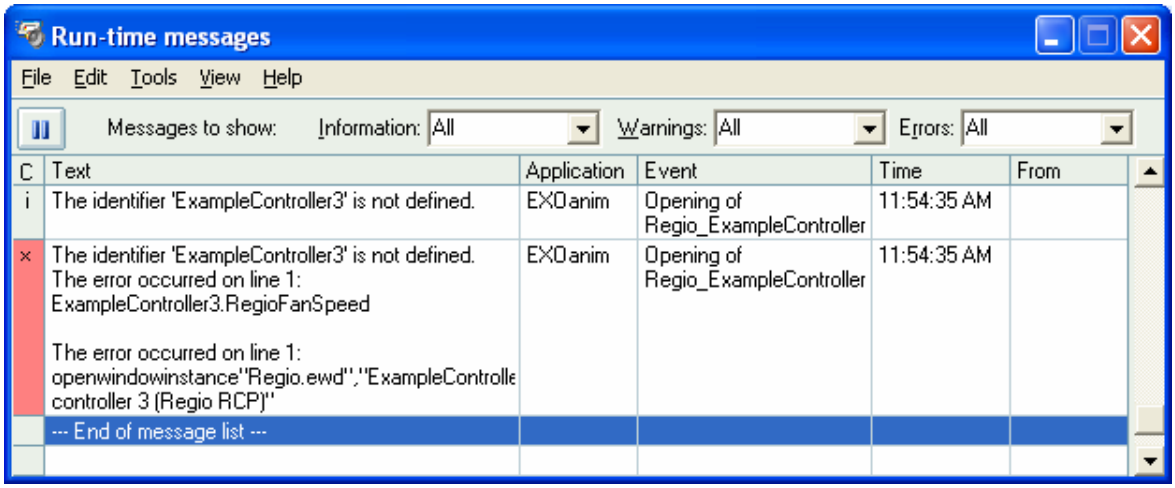


Troubleshooting

Input arguments

When problems occur during configuration, and a window does not work as expected, there is usually a fault in one ore more of the window's input arguments. Troubleshooting is done in the following way:

- Start **Runtime messages** with the menu command **Tools – View Runtime Messages** or the button  in Project Builder.
- Then run the offending code in EXO4.
- When the window in question is opened, it will type its instance name and the contents of all arguments to EXO4 Messages. From here, it is easy to see if the arguments actually contain what was intended.



Database

If no data from the database can be seen in the window, Microsoft Access can be used to check that the data actually exists. This is described in the document ***Troubleshooting EXO4***.

Regio

EXO4

EXO4 is able to handle Regio controllers similar to other EXO controller models, with process windows, alarms & events, logging, etc.

Process Windows

Window classes

Regio is delivered with complete ready-made EXO4 window classes for Regio controllers.

Design

These windows are designed similar to Regio Tool. The user can see all parameters, execute commands, change set-points, etc. It is however not possible to configure the controller from the EXO4 windows. For configuration purposes, the user has to use Regio Tool.

Runtime

The EXO4 window class is the same for all Regio controller models and configurations. It adapts itself at runtime to the actual controller model.

Design yourself

It is possible to design your own EXO4 Windows, as you can do for other EXO controller models, but it is a lot of work.

Alarms, Events and Logging

Pre-configured

The Maxi controllers have a number of pre-configured alarms, events and log points. These will automatically be sent to EXO4 and stored in the database. The user is able to see and use them in EXO4. The user can easily open the alarms, events and historical chart windows from the ready-made Regio window class, to view the points from that controller only.

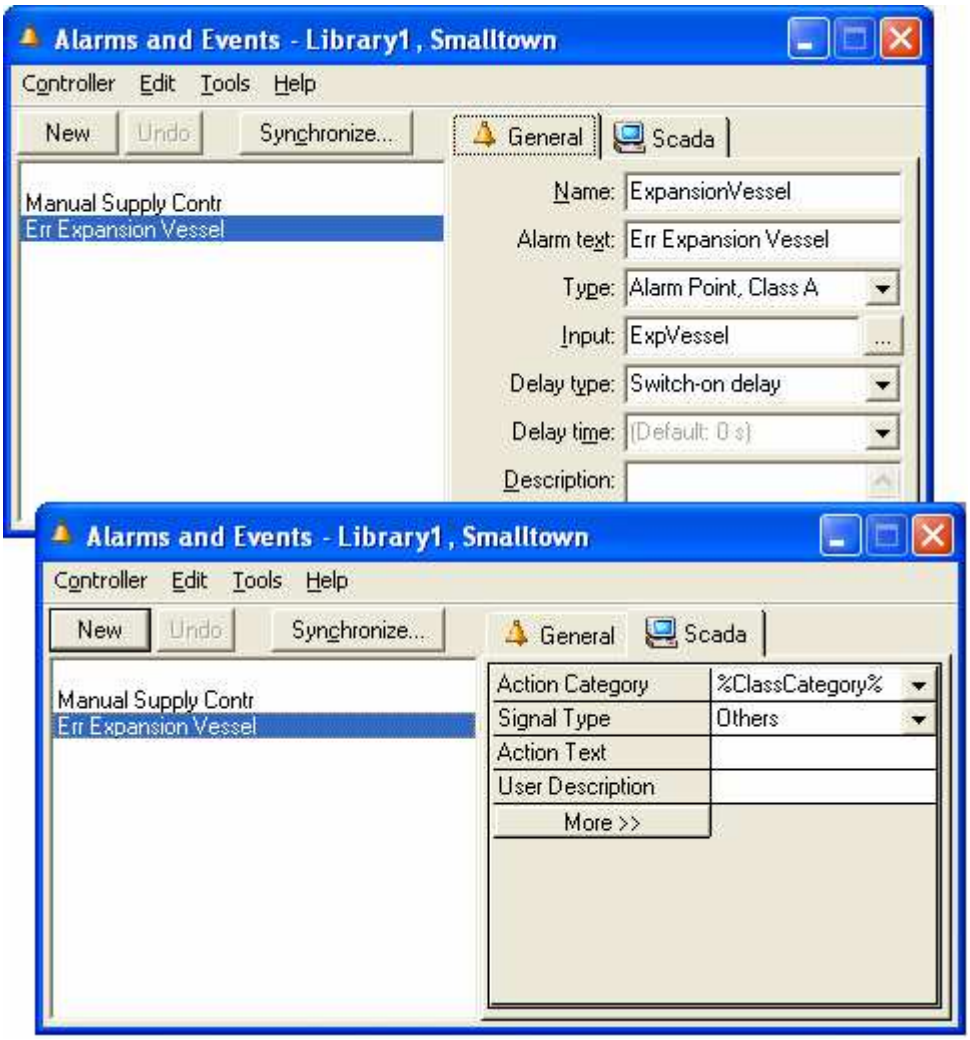
Chapter 16 Alarms and Events

Concepts

Alarm Points and Event Points

Alarms and Events

Alarm points and event points are defined and configured with the Alarms and Events tool.



Alarm points

Alarm points are configured with an expression or a variable that generates the alarm's switch-on and switch-off.

- An expression is usually a comparison that generates a logical value that is **true** when the alarm is switched on, e.g. **`SupplyTemp > 87`**.
- A variable is usually an alarm output from an object or a digital input signal from a sensor (e.g. **`SupplyTempControl_AlaManual`** or **`ExpVessel`**). In both cases, the alarm must be switched on when the logical variable has the value 1 (one).

Event points Event points are used to register switch-on and switch-off of digital signals, i.e. switch-on is registered when the value of the signal has changed from 0 to 1, and switch-off is registered when the value is changed from 1 to 0.

Delay Both alarm points and event points can be configured with On and/or Off Delay. They can also be assigned to a specific alarm type (e.g. Motor protection, Sensor error, High temp) and/or a signal type that can be used for selection in the main computer and to determine the response of the main computer in different situations.

Max 250 A controller can be configured with a maximum of 250 alarm points and event points. A maximum of 240 texts can be entered into the file `Texts.txe`. This file has to be shared by all programs that use texts. This means that the number of alarm points that can be configured with alarm texts for the controller's display is less than 250.

Storing Information about alarm events and digital events are temporarily stored in a list in the controller. This list can normally store 48 events. The main computer of the project empties the list at appropriate times, normally during station synchronization, and saves the information in a database on the hard disk of the computer. See the section ***Transferring to the Main Computer*** later in this chapter.

Alarm Classes

Alarm points Each alarm point is configured with a so-called alarm class, class A, B or C.

Degree of importance The class is primarily used to indicate the degree of importance of the alarm to the operator. The alarm class A is the most important alarm, while class C is the least important alarm.

Differences There are also functional differences:

- The alarm classes A and B require that the alarm has returned **and** is acknowledged to return to the status **Normal** again. The alarm class C does not require acknowledgement, but can be acknowledged all the same.
- When alarms of the alarm class A are triggered, they are sent as SMS text messages via Nimbus Alarm Server by default.

Alarm Status and Alarm Events

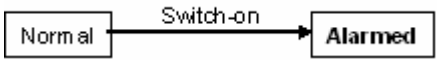
Alarm status Alarm status denotes the current status of the alarm. There are five different statuses:

- **Normal**: The initial state of the alarm point, i.e. the alarm condition is false or the logical variable has the value 0.
- **Alarmed**: The status of the alarm point when the alarm has been triggered, i.e. when the alarm condition becomes true or when the logical variable has the value 1.
- **Returned**: A class A or B alarm that has returned (the alarm condition is false again), but has not been acknowledged.
- **Acknowledged**: An alarm point that is still switched-on, but has been acknowledged.
- **Blocked**: A temporarily blocked alarm point. Switch-on and switch-off are not registered.

Alarm event An alarm event is a change of an alarm point's status.

Switch-on/off The most basic alarm events are switch-on and switch-off:

- **Switch-on**: An alarm is triggered, i.e. the alarm condition is switched on (becomes true or 1), and the status of the alarm point becomes **Alarmed**.

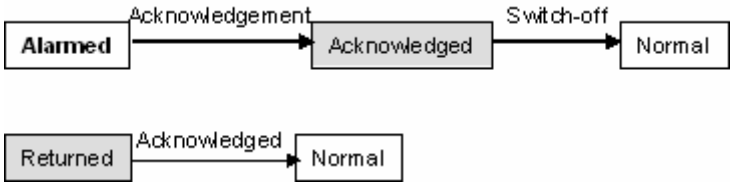


- **Switch-off**: An alarm is returned, i.e. the alarm condition is switched off (becomes false or 0). When an alarm is switched off, the class of the alarm point determines what will happen:
  - Class C alarm points gets the status **Normal** as do acknowledged alarms of the classes A and B.
  - Unacknowledged alarms of class A or B get the status **Returned**.

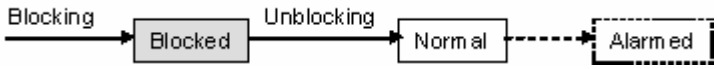
Alarm maneuvers

There are three different types of alarm maneuvers: acknowledgement, blocking and unblocking. All three maneuvers are performed by the operator, either from the controller's display or from a work computer. These three different maneuver types are also considered to be alarm events.

- **Acknowledgement**: When an alarm is acknowledged, the following will happen:
  - Not yet returned alarms get the status **Acknowledged**.
  - Returned alarms get the status **Normal**.



- **Blocking**: When an alarm is blocked, it will get the status **Blocked**. Switch-on, switch-off and acknowledgements will be ignored. The only alarm event that will be registered is unblocking.
- **Unblocking**: When a blocked alarm is unblocked it will get the status **Normal**. If the alarm is still switched on, it will get the status **Alarmed** (after the configured alarm delay time).



Current status

Each alarm point in a controller has a variable (*Alarmname*_`Status`) that indicates its current status. The variable is located in the file **AlaData.Dpe**.

Sum alarm status

Sum alarm status is the status of the alarm point that has the most severe alarm status. The sum alarm status is registered on three different levels: each controller, each station, and each area.

Transferring to the Main Computer

Immediately All alarm events are always "immediately" transferred by notification from permanently connected stations to the main computer. This is also the same with dial-up stations while they are connected.

Spontaneous connection Normally, dial-up stations connect spontaneously when an alarm is triggered. This can however be configured for all types of alarm events.

Station synchronization During a station synchronization, which normally takes place once every night, all events (alarm events and digital events) that are stored in the event list of the controller are transferred to the main computer.

Alarm database When transferring alarm events to the main computer, these are stored in an alarm database. The alarm database contains information about all alarm events and digital events that have occurred, as well as the current status of all alarm points.

Tables An EXO4 database has the following tables for alarms and events:

Table Name	Description
Alarm Register	Contains a register of all the alarm points in the project. The table contains one record for each alarm point.
Alarm Values	Contains all alarm events of all alarm points in the project. One record contains one event for an alarm point.
Digital Register	Contains a register of all logged digital signals in the project. The table contains one record for each signal.
Digital Values	Contains logged digital values for all logged signals. One record contains one change for one signal.

Record A row in the database table is called a record. Each time data is stored, a new record is created in the table.

Presentation

Display on Controllers

Automatic The Display program contains an alarm function that is automatically activated on controllers with a display. The Display program has an alarm function for inspecting and, if you are logged on with sufficient access level, maneuvering alarms. Alarms can be acknowledged, blocked and unblocked on the display.

Station master With the tool Controller Handler and Alarms Display on the tab Alarms Display, you can configure the display of the station's master controller to display alarms from all controllers in the station (including its slave controllers). In that case, for the operator to know from which controller the alarm originated, it should be specified in the attribute **Alarm text** in Alarms and Events. Controller Handler and Alarms Display can be opened from Project Builder with the menu command **Config – Controller Handler and Alarms Display** when the station master is selected.

The Alarm LED When an alarm is triggered, the alarm LED, the LED next to the bell symbol, will start to flash. When all alarms have been acknowledged, but there still are one or more alarms that have not yet been returned, the alarm LED will provide a fixed light.

Description The chapter ***Display*** provides a description of how to navigate to the alarm function of the display, and how to browse between different alarms and perform alarm maneuvers.

Window Elements in EXO4

Symbols In order to display the current alarm status for each alarm point, it is common to insert symbols in EXO4 process windows. EXO4 provides standard symbols in picture format for this purpose.

Sum alarm status Another common practice for EXO4 windows is to display the sum alarm status for areas in an overview window.

Reports and Charts in EXO4

Reports In EXO4 there are window templates for the display of alarm status, alarm events and digital events. The information in the reports is retrieved from the alarm database.

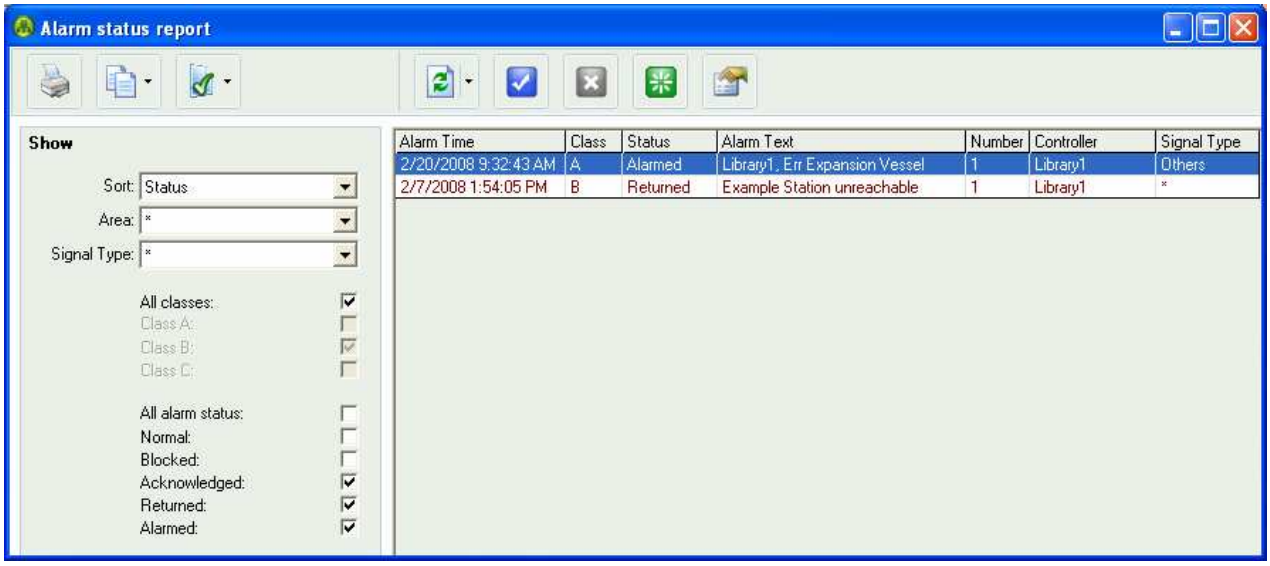
Printing All reports can, besides being displayed on the monitor, also be printed on a printer.

Selection The operator can limit the selection from the database by specifying, e.g. area and type of signal. When the selection has been changed, the operator must click on the button **Update** in order to update the search result. If the check box **Auto Update** is ticked, an automatic update of the search result will occur, either when the database has been changed due to events in the controllers, or because the filtration has been changed.

Signal name The naming convention for alarm points and event points in reports is a compound of the controller's title (the controller's name if it has no title), and the alarm or signal text, e.g. *Library1.Manual Supply Control*.

Alarm Status Report

Current status The alarm status report (AlarmStatusReport.Ewd) displays the current status of the system's alarm points as they are registered in the alarm database.



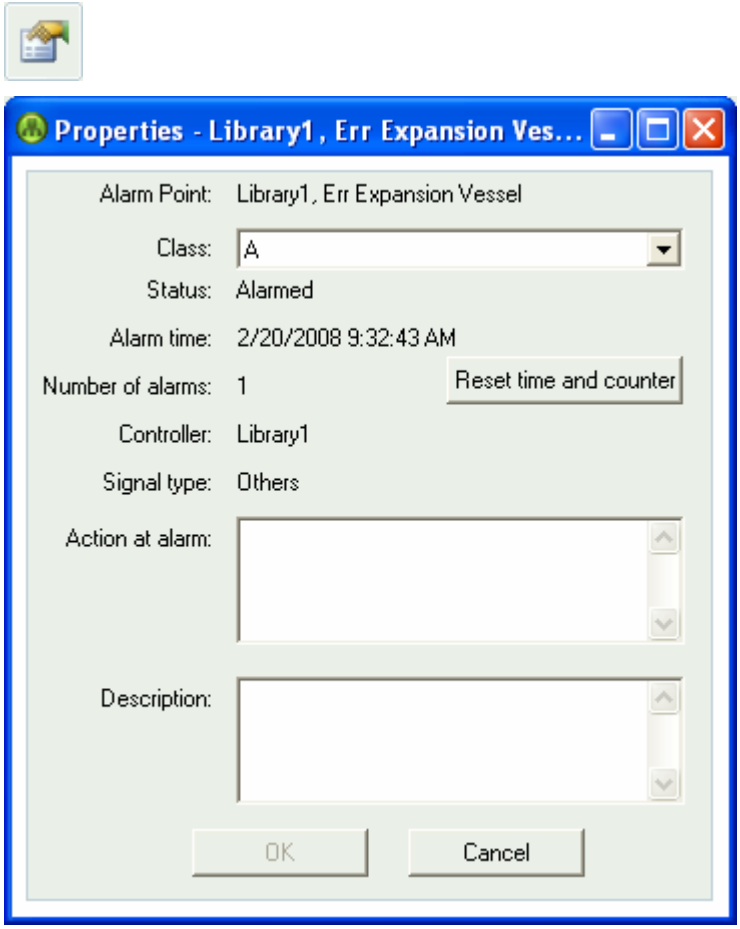
The integrator The integrator can determine, among other things, which area and signal types should be available to the operator for searching. In that case, this is done in the reaction code that opens the window.

The operator The operator can limit the range of selection from the database by specifying alarm class, alarm status, area and signal type.

Alarm maneuvers The operator can perform different maneuvers on an alarm point by first selecting it, and then clicking on one of the buttons **Acknowledge, Block, or Unblock**.

Properties

The button **Properties** opens a new window with more detailed information about the selected alarm point.



Change alarm class

The user can change the class of an alarm point in the Properties dialog by just changing it and clicking on **OK**.

To make it work, the following requirements must be fulfilled:

- The attribute **Action Category** must be configured with the macro **`%ClassCategory%`** for all points in the **Alarms & Events** tool. New alarm points will be configured in this way automatically.
- The **Alarms & Events** function version 3.3 must be used in the controller
- The **Controller Handler** function version 3.7 must be used in the controller.
- If the controller is a *station slave*, it also requires **Controller Handler** function version 3.7 in the *station master*.
- The project must include the following *EXO4 action categories*: **`AlarmsClassA`**, **`AlarmsClassB`** and **`AlarmsClassC`**.

To upgrade existing controllers, you first have to add the new functions and then remove the old functions manually. At last you must open the **Alarms & Events** tool, set **Action Category** = **`%ClassCategory%`** for all points and save the new configuration.

If the main computer is created with EXO4 2003 (or older) you must add the new *action categories* manually. Create a new project and open the EXO4 Action Categories tool in both projects. Copy all action categories in the new project and paste them into the old one

If you wish to implement your own commands to change the alarm class you can do that with EXObasic code.

Reset

The button **Reset time and counter** resets the number of switch-ons for the selected alarm point.

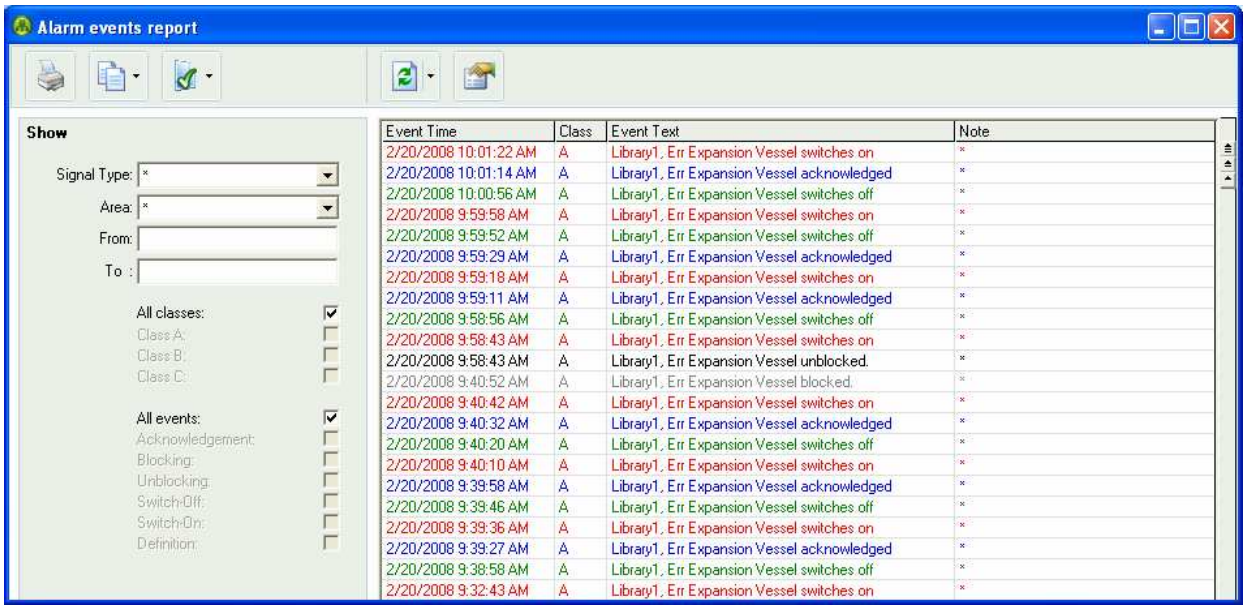
Text boxes

The text boxes Action at alarm and Description are editable and are saved in the database if they are not configured in the tool Alarms and Events.

Alarm Events Report

History

The alarm events report (AlarmEventsReport.Ewd) displays the history of the alarm points in the system. The information is retrieved from the alarm database of the system.



The integrator

The integrator can determine, among other things, which area and signal types should be available to the operator for searching. In that case, this is done in the reaction code that opens the window.

The operator

The operator can limit the range of selection from the database by specifying alarm class, alarm status, area, signal type and time.

More information

For more information, see the section ***Alarm Events Report and Events Report*** below.

Events Report

Digital events

The events report (EventsReport.Ewd) displays the history of events for digital points in the system and looks just about the same as Alarm Events Report. The information is retrieved from the database of the system.

The integrator

The integrator can determine, among other things, which area and signal types should be available to the operator for searching. In that case, this is done in the reaction code that opens the window.

The operator

The operator can limit the range of selection by specifying digital event, area, signal type and time.

More information

For more information, see the sections ***Alarm Events Report and Events Report*** below.

Alarm Events Report and Events Report

Time

The syntax for entering date/time corresponds to the default settings of the Windows Control Panel and is the same as the time indication in the column **Event Time**.

Follow a certain signal

The events of a particular signal can be followed by first selecting the signal and thereafter clicking on the menu item **Show selected signal only** at the button **Settings**. This method can be combined with other selections to limit the amount of information. Select the same menu item to return to normal display of events.

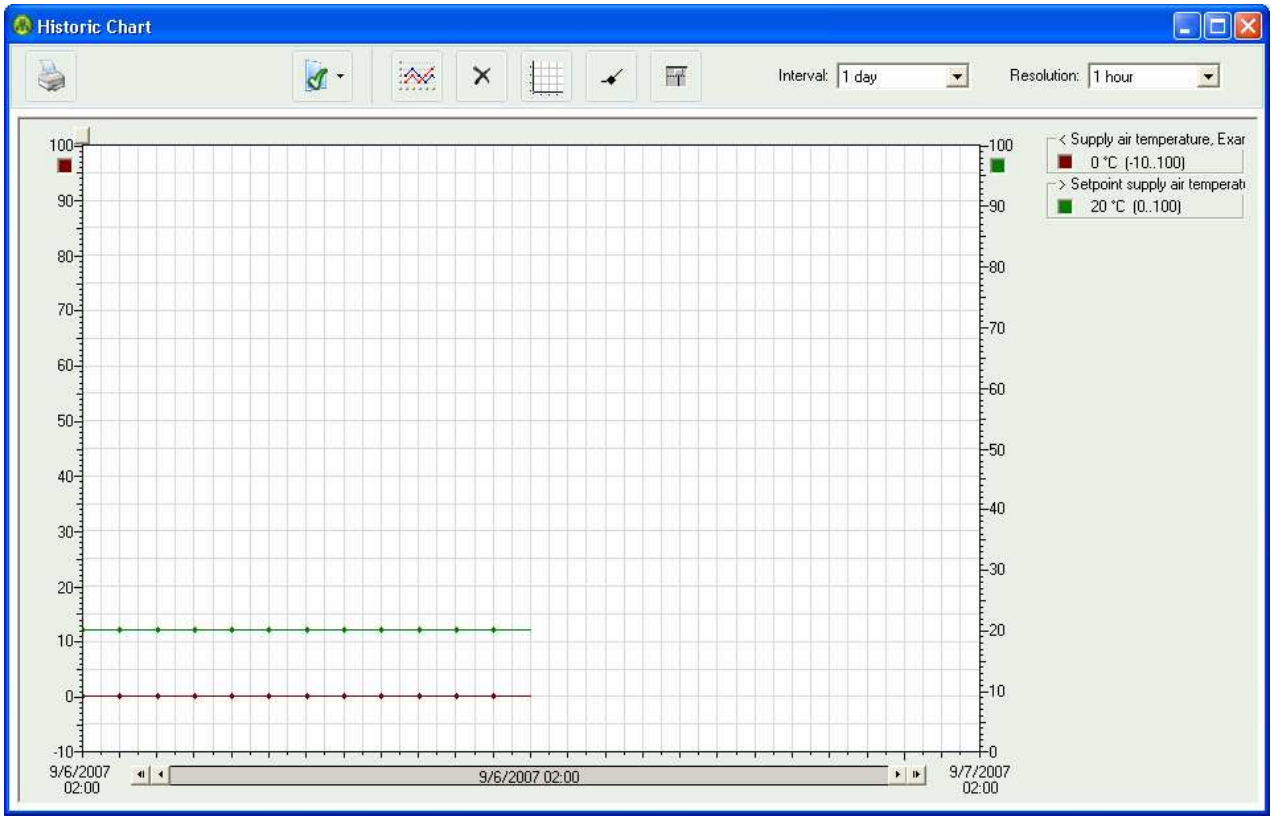
Event notation

The button **Event Notation** opens a new window that allows editing of any notation for the selected event. This is stored in the database.

Charts

Historical curves Window templates for display of historical curves can be used for digital signals.

Description A description of the three available types of historical charts can be found in the chapter ***Logging***.



SMS Messages and E-mails

Nimbus Alarm Server Nimbus Alarm Server can be used in the main computer, e.g. for sending SMS messages or e-mails when an alarm is triggered. It is possible, among other things, to configure that the alarm notifications should be sent to different destinations at different times. Nimbus Alarm Server can also be used for acknowledgements with re-calls.

GSM modem Normally, a GSM modem connected to the main computer is used to send SMS messages. This modem must be dedicated for this purpose, which means that this modem cannot be used for other communication.

E-mail To send e-mails, an Internet connection and an e-mail server are required.

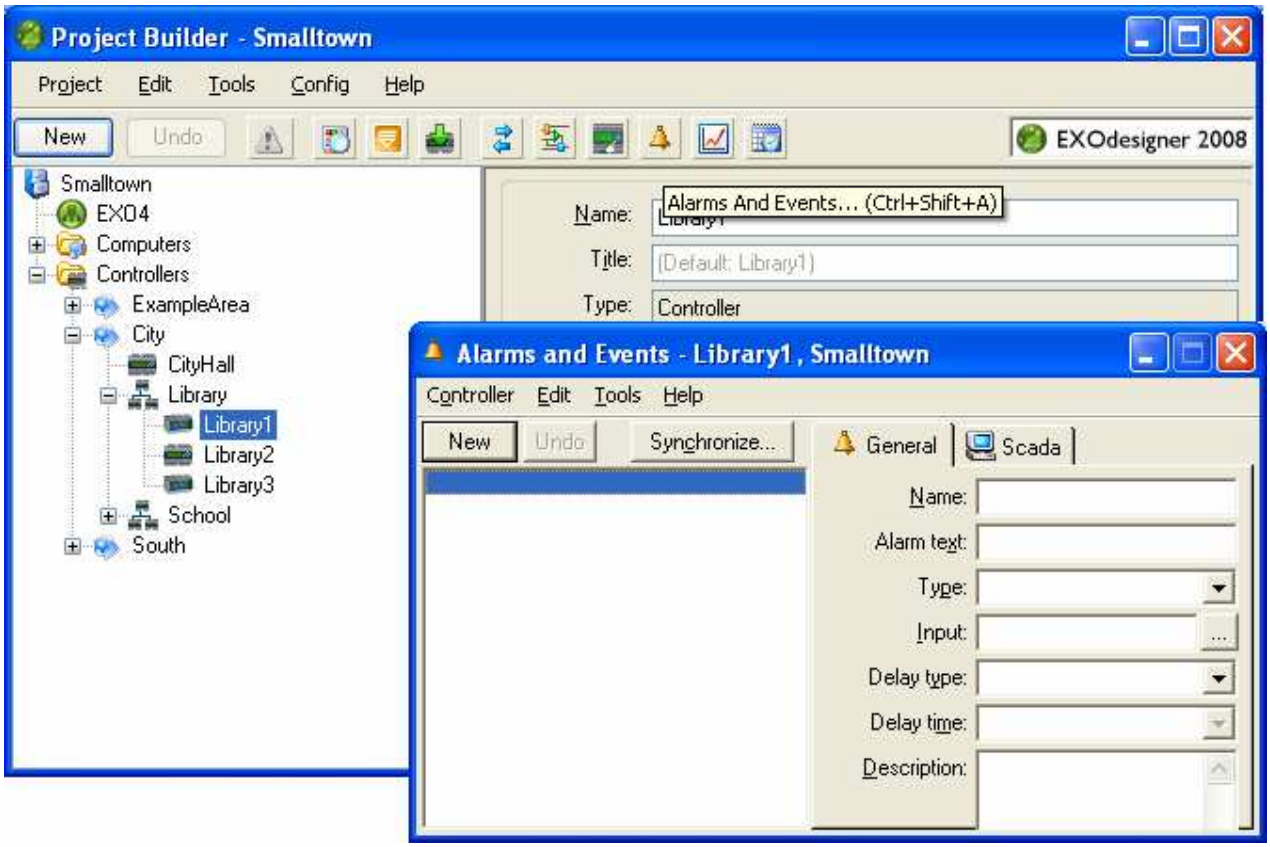
Configuration in Alarms and Events

Alarm Points and Event Points

Alarms and Events Alarm points and event points are configured using the tool Alarms and Events.

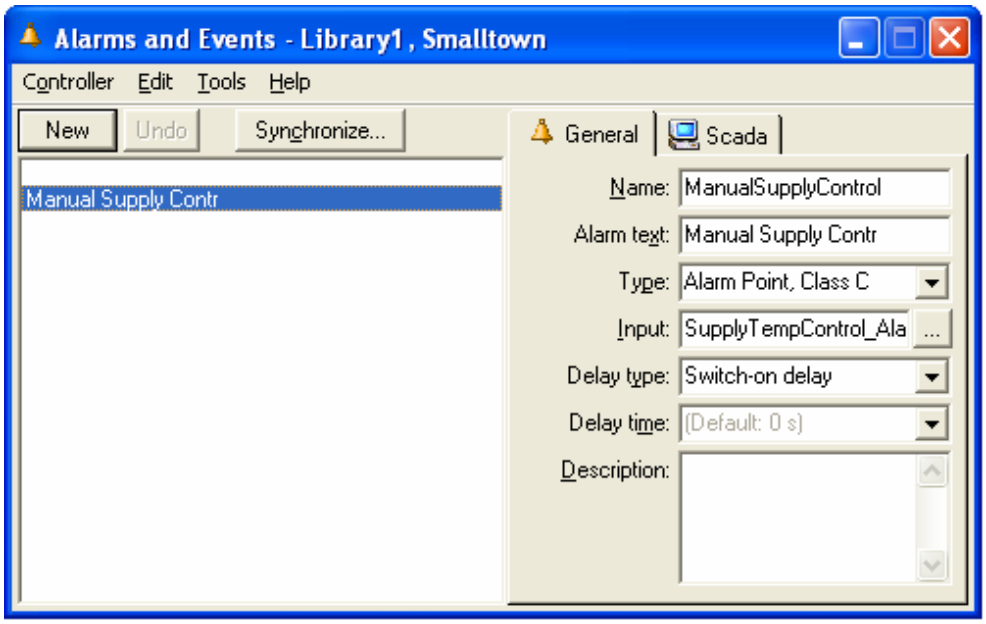
Opening

Open Alarms and Events for the controller Library1 (or CityHall) by selecting the controller in Project Builder and clicking on the button .



Configuring an Alarm Point

- Create an alarm point by clicking on the button **New** and then on the button **Add**.
- Enter a name for the alarm point in the attribute **Name** (Note: Do not use spaces). This name must be unique within the controller. In this example we will name it **ManualSupplyControl**.
- **Alarm text** for alarm points and **Signal text** for event points are the texts that will be displayed to the operator on the display. It can therefore not be more than 20 characters. In this example, we will enter **Manual Supply Contr**. In EXO4, this text will be combined with the title of the controller, e.g. **Library1.Manual Supply Contr**.
- Use **Type** to determine whether this is an alarm point or an event point. For alarm points, you also need to determine its class (A, B, or C). We will choose **Alarm Point, Class C**.
- A condition (e.g. `SupplyTemp > 87`) or a variable of the data type logic (e.g. a digital input) is entered in the field **Input.** Objects often have alarm outputs and the easiest way to connect to these outputs is to click on the button to the right of the field and select the alarm output in EXOL Browser. In this example, we will select the variable **SupplyTempControl_AlaManual**, which can be found among the Global variables or in the DPac file StdObjs1 in EXOL Browser.
- You can choose to have on-delay, off-delay, both, or no delay at all, in the attribute **Delay type**. The delay is configured in **Delay Time** in the interval 5 seconds to 6 hours. The unit is specified with **s, min**, or **h** (for seconds, minutes and hours).
- Confirm the configuration of the alarm point by clicking on the button **Rename** (or **Change**).



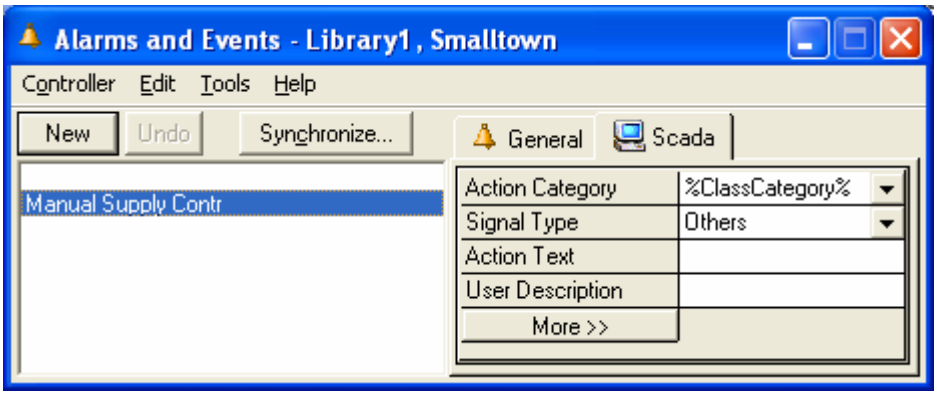
EXO4 configuration

In the tab **Scada** in Alarms and Events, there are some configurations that are specific to EXO4.

- Open the tab **Scada**.
- To allow the operator to make a selection of the EXO4 reports, each point can be associated with a signal type in the attribute **Signal Type**, e.g. Temperature, Pressure, Flow. Select **Others** in this attribute.

- For alarm points an action text can be specified in the attribute **Action Text** in order to inform the operator about what action to take in the event of an alarm.

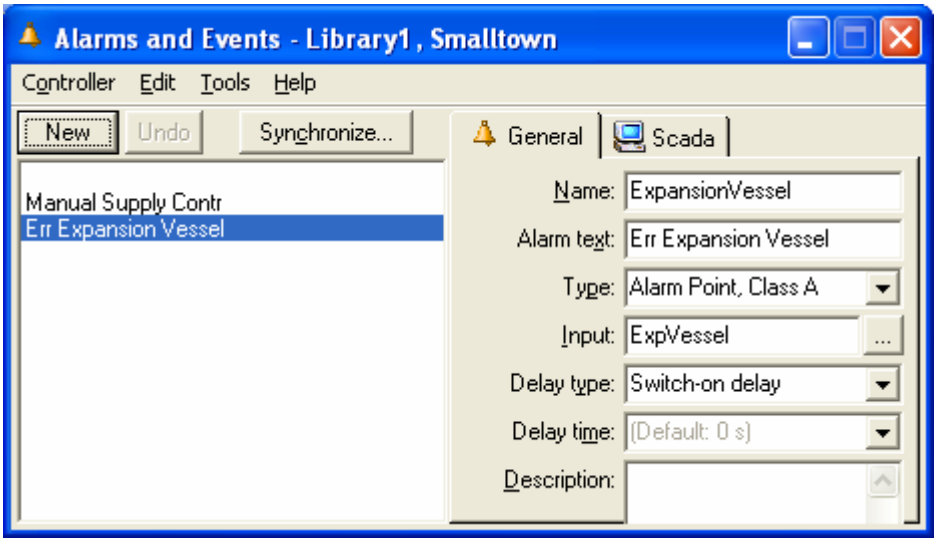
  Alarm points can also be given a description in **User Description**.
- The action text and the description will be displayed in the window that opens when clicking on the button **Properties** in the alarm status report.

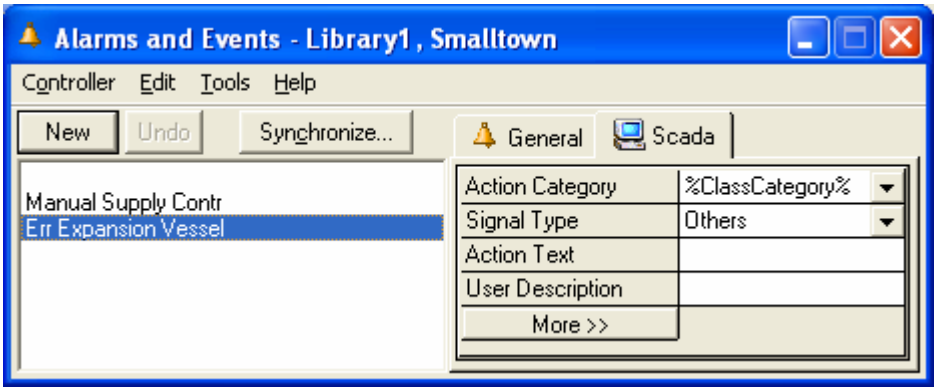


Configuring one more Alarm Point

Create an alarm point for the expansion vessel, the digital input **ExpVessel**, on basis of the configuration in the pictures below.

Remember to click on the button **New** before a new alarm point is configured, and use the button **Add** to add the alarm point.





Saving and Loading

Saving

Before closing Alarms and Events, the configuration needs to be saved.

Reloading

The controller needs to be reloaded in the following cases:

- After adding or deleting alarms and/or events.
- When a change has been made to the configuration of the tab **General**.

A reload is not necessary if changes have been made exclusively on the tab **Scada**.

Synchronization

The menu command **Tools - Synchronize Parameters** and the button **Synchronize** can be used to display the settings in the controller. This command also allows you to compare and replace these settings with the settings in the configuration tool.

EXO4

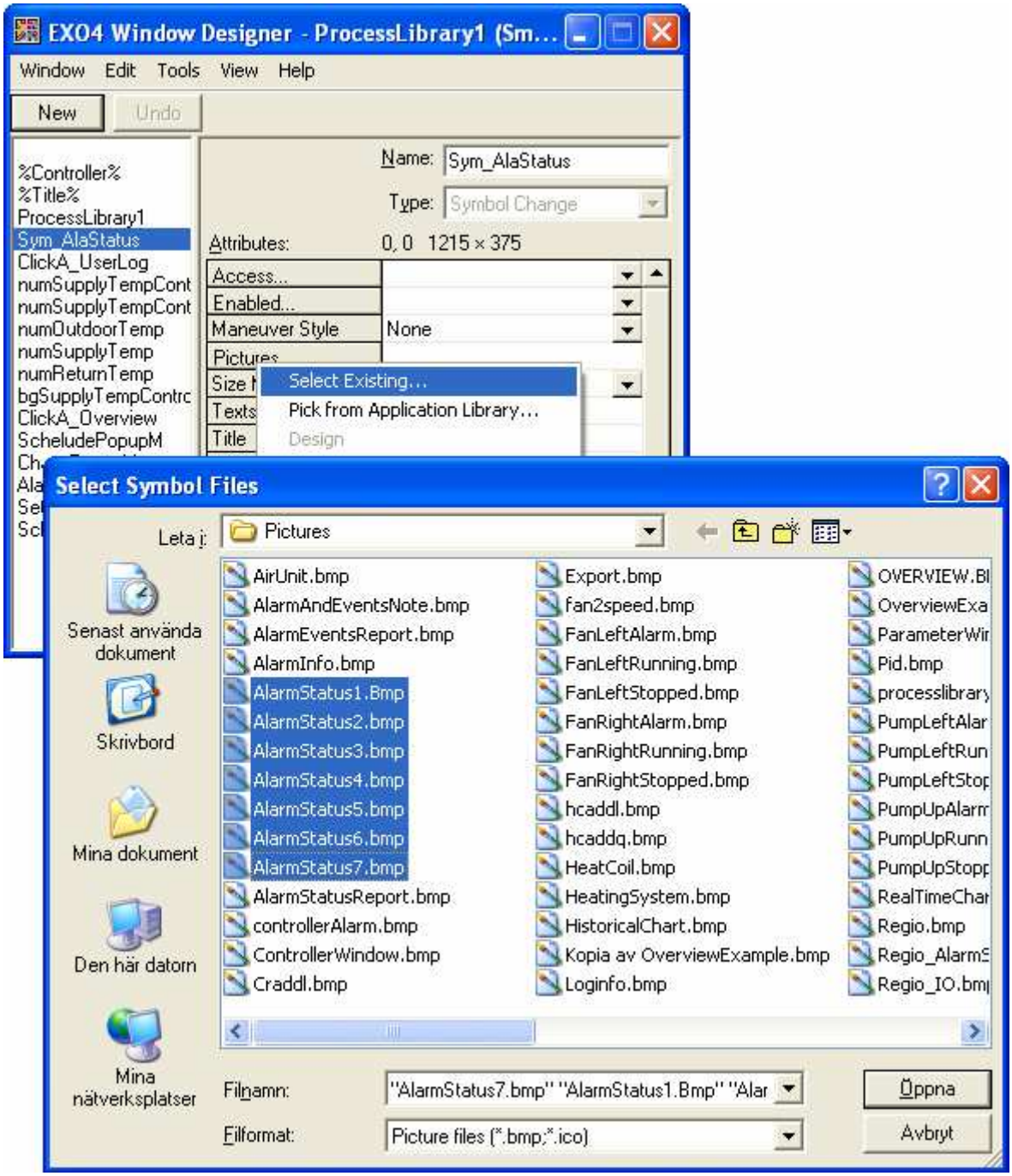
Symbol for Displaying the Status of an Alarm Point

Window element

We will create a window element to display the current alarm status of an alarm point with a symbol (picture).

- Open EXO4 Window Designer for e.g. the controller window ProcessLibrary1.
- Create a new window element of the type **Symbol Change** and give it a descriptive name, e.g. **Sym_AlaStatus**.
- Print **Alarm status** in the attribute **Tool Tip Text**.
- Click on the button **Pictures…** and select **Select Existing** (since the Overview window already uses these symbols).
- Select the seven pictures **AlarmStatus1 – AlarmStatus 7**. Click on **Open**. The picture files are now inserted in the attribute **Pictures**.
- Since there is no picture for the value 0, a comma (`,`) has to be added in the front of the text in the text box Pictures. Check also that the order of the picture files goes from 1 to 7.
- Enter the value 1 in the attribute **Value** to be able give the window element a suitable size and place it in the design window. Then delete the value 1.
- Enter the name of the alarm variable in the text box **Value**. The variable's name is a compound of the controller's name, the alarm point's name and the variable's name (which is `Status`).

  Example:`%Controller%.ExpansionVessel.Status`
- Check the performance of the alarm status symbol by running EXO4.



Symbol for Sum Alarm Status

Sum Alarm Status

To display symbols for sum alarm status, window elements are created in the same way as to display the status of an alarm point (see the above section). The level for which you want to show sum alarm status, determines the text to be entered in the text box **Value.**

- .**Area:** An area's sum alarm status (**`SumStatus`**) and the text of the sum alarm status (**`SumStatusText`**) are retrieved from the database by specifying the classes and the area of interest. Area must be stated with its title (not with its name).

  Example:

  ```
  DefaultDb.Alarms.SumStatus("AB","City")
  DefaultDb.Alarms.SumStatusText("AB","City")
  ```

- **Station:** A station's sum alarm status is indicated in the variable **`AlaStnStat`** in the file **`AlaApp`** of the station master.

Example: **`Library.AlaApp.AlaStnStat`**

- **Controller:** A controller's sum alarm status is indicated in the variable **`AlaModStat`** in the file **`AlarmS`** in the controller.

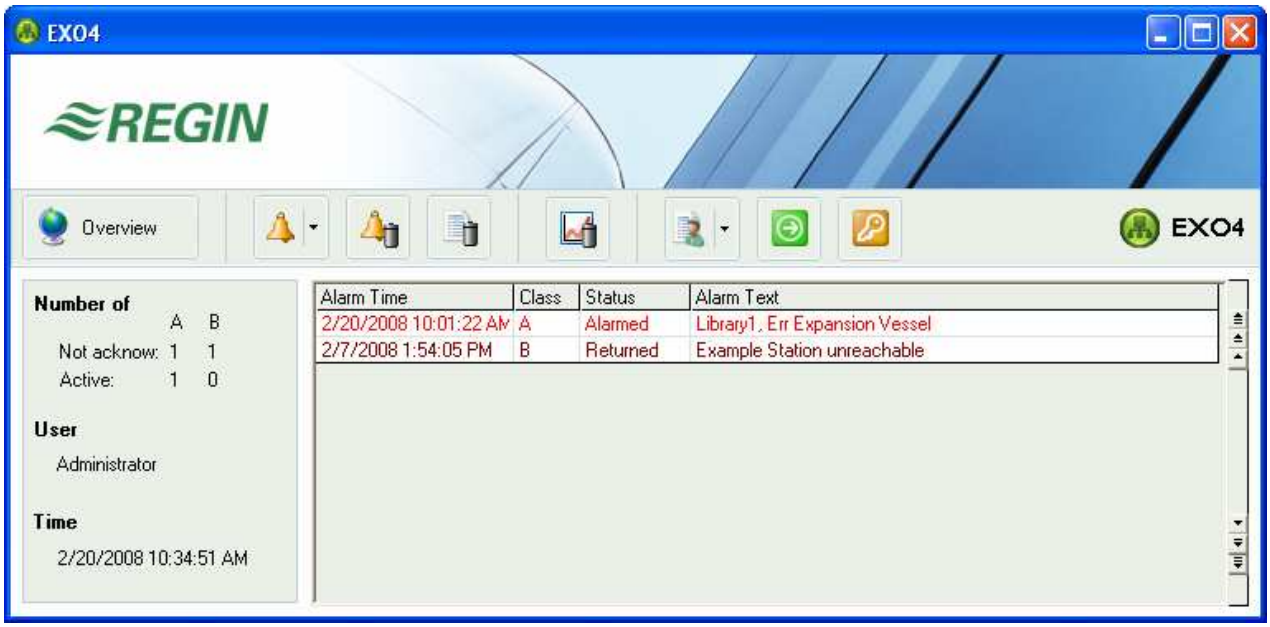
  Example: **`Library1.Alarms.AlaModStat`**

Opening Reports

Standard

When the standard template for creating a new computer in Project Builder has been used, the following, among other things, is added to the project:

- Window templates for alarm status reports, alarm event reports and event reports:
- A system window displaying an overview of the alarms of the system, and buttons and menu commands for opening an alarm status report, an alarm events report and an events report.



Opening a window

Usually, the operator opens a report window by clicking on a button or a popup menu command. The code for opening the window is specified in the text box **OnManeuver** for buttons (in EXO4 Window Designer) and in **On Click** for popup menu commands (in EXO4 Menu).

Opening reports

Examples on how to open the various reports are given below.

```
OpenWindowInstance "AlarmStatusReport.Ewd", "instancename"
OpenWindowInstance "AlarmEventsReport.Ewd", "instancename"
OpenWindowInstance "EventsReport.Ewd", "instancename"
```

Instance name

To be able to have several instances (windows) with different contents of one window class open simultaneously, each instance must have a unique name. Therefore, it is appropriate to use different instance names when they are opened, preferably a name that represents the specific context where the window is opened.

Selection

The integrator can limit the selection displayed in the report to a certain area, certain signal types, and a certain database. This is done by means of an extra argument when opening the instance window with the command **`OpenWindowInstance`**.

Syntax help

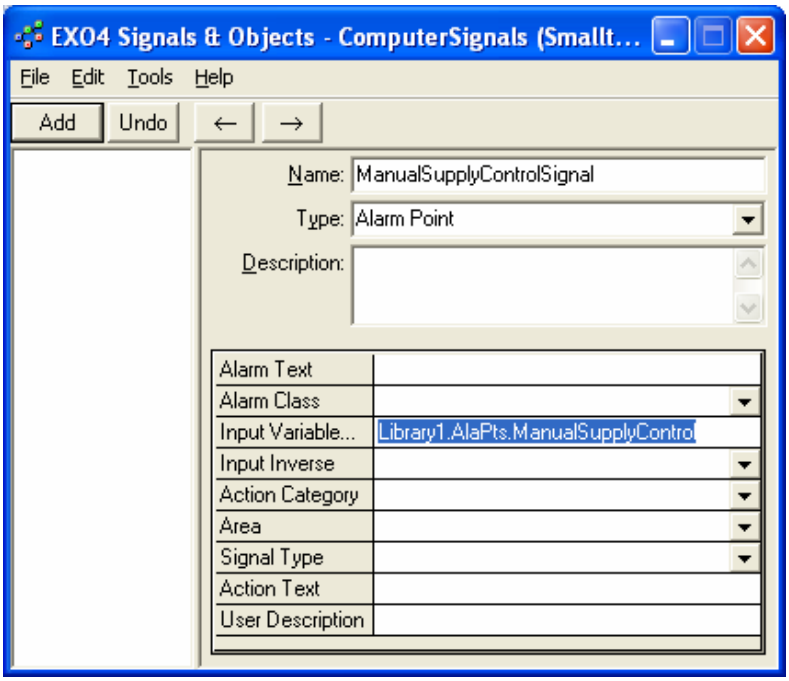
Syntax help for a certain template can be retrieved by selecting a window created from the template and clicking on the menu command **Help – Help on Template** in the tool EXO4 Windows.

More information Overview of the window templates and description of window classes can be found in the chapter ***EXO4 Window Design***.

Alarm Signals as EXO4 Signals

EXO4 Signals An alarm point that has been defined in the tool EXO4 Signals, lives and is maintained in the PC. This means that it keeps its value when EXO4 is restarted. If, for example, an alarm point has the status alarmed when EXO4 is closed, it will keep this status, even if the alarm has been reset. The status of an alarm point that has not been defined in EXO4 Signals, has in this case, been returned.

Alarm Point An alarm point is defined in EXO4 Signals using the type **Alarm Point**. A logic variable, that receives the value **1** (true) when an alarm is triggered and the value **0** (false) when the alarm has returned, is specified as **Input Variable**.



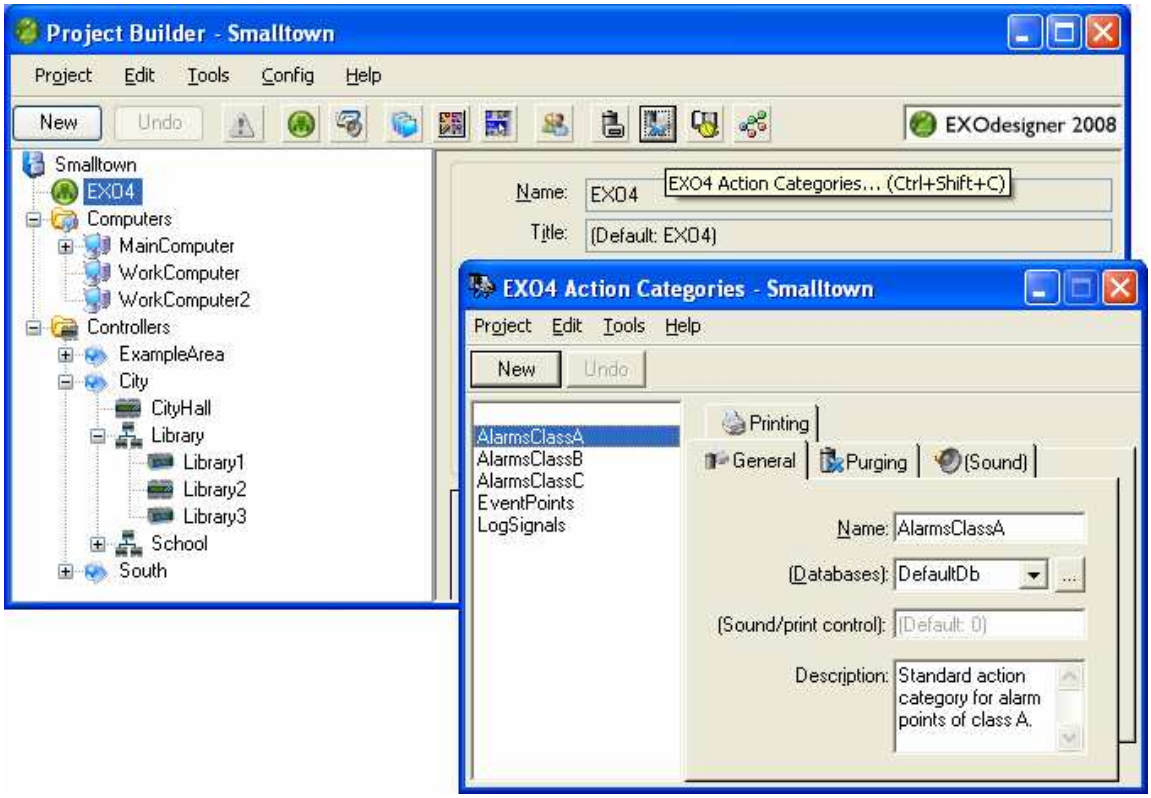
Actions for Alarms and Events

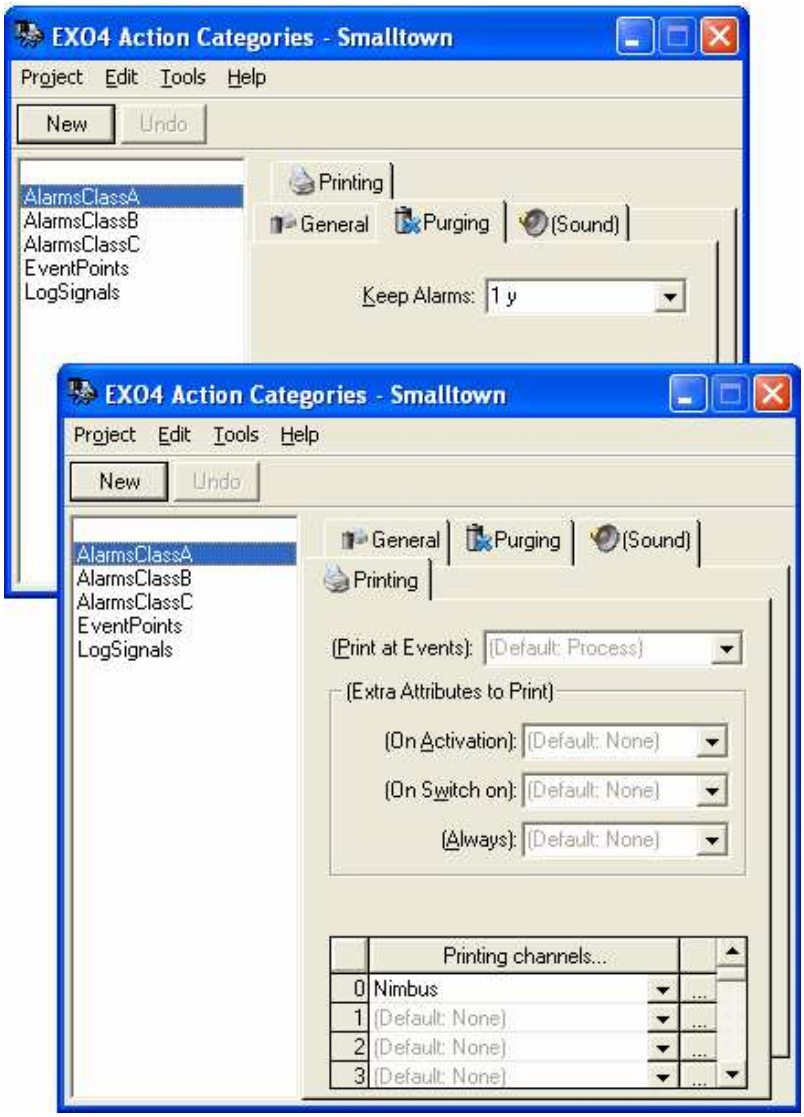
Alarms and Events The type of each alarm point (class) and event point is configured in Alarms and Events.

Storage time The database storage times for the various signal types can be configured in EXO4 Action Categories. In most cases, the default configuration will be adequate.

Action You can also configure what action should take place when an alarm is triggered, e.g. sending an alarm via the Nimbus Alarm Server. Default is that class A alarms is configured to be sent via Nimbus Alarms Server, as Nimbus is configured as a printing channel for this type of alarms.

Action categories EXO4 Action Categories tool is opened with the menu command **Config – EXO4 Action Categories** or with the button .


Project Builder - Smalltown
Project Edit Tools Config Help
New Undo
EXOdesigner 2008
Smalltown
EX04
Computers
MainComputer
WorkComputer
WorkComputer2
Controllers
ExampleArea
City
CityHall
Library
Library1
Library2
Library3
School
South
Name: EX04
EX04 Action Categories... (Ctrl+Shift+C)
Title: (Default: EX04)
EX04 Action Categories - Smalltown
Project Edit Tools Help
New Undo
AlarmsClassA
AlarmsClassB
AlarmsClassC
EventPoints
LogSignals
Printing
General
Purging
(Sound)
Name: AlarmsClassA
(Databases): DefaultDb
(Sound/print control): (Default: 0)
Description: Standard action category for alarm points of class A.


EX04 Action Categories - Smalltown
Project Edit Tools Help
New Undo
AlarmsClassA
AlarmsClassB
AlarmsClassC
EventPoints
LogSignals
Printing
General
Purging
(Sound)
Keep Alarms: 1 y
EX04 Action Categories - Smalltown
Project Edit Tools Help
New Undo
AlarmsClassA
AlarmsClassB
AlarmsClassC
EventPoints
LogSignals
General
Purging
(Sound)
Printing
(Print at Events): (Default: Process)
(Extra Attributes to Print)
(On Activation): (Default: None)
(On Switch on): (Default: None)
(Always): (Default: None)
Printing channels...
0 Nimbus
1 (Default: None)
2 (Default: None)
3 (Default: None)

Nimbus Alarm Server

Function Nimbus Alarm Server can be used to send e.g. SMS messages from the main computer when an alarm has been triggered. In the configuration tool for Nimbus, you can configure among other things users and weekly schedules.

Activating By default, class A alarms are sent via Nimbus. If you want other alarm classes to be sent by Nimbus as well, you have to configure Nimbus as a printing channel in EXO4 Action Categories tool. See the above section ***Actions for Alarms and Events***.

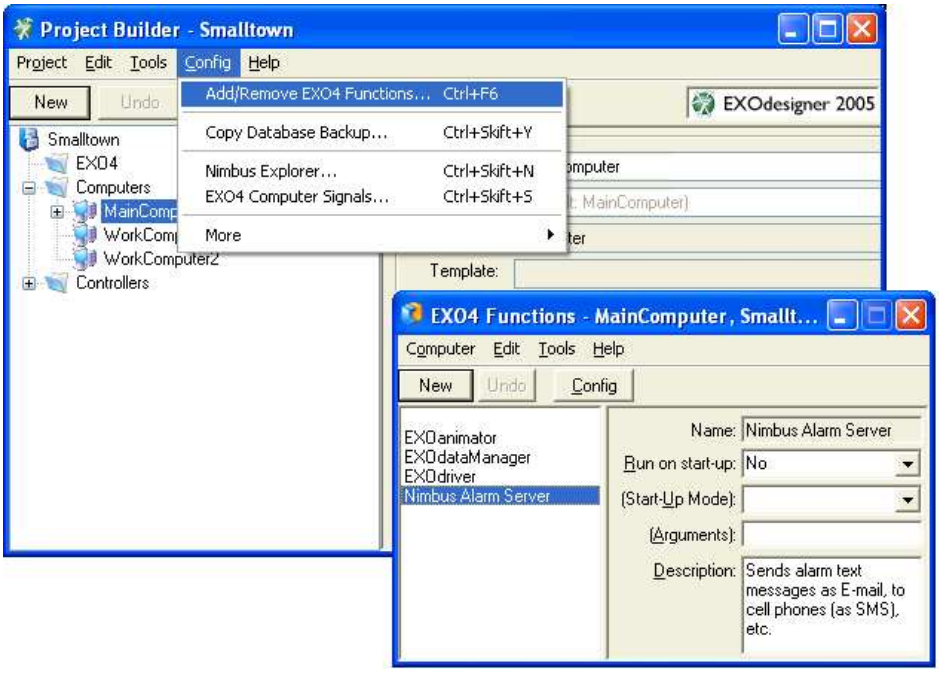
Installation Nimbus Alarm Server can be found on the CD and must be installed separately.

License Nimbus Alarm Server may be evaluated for 30 minutes without a license. After this, the program requires an unlocking code to unlock the product that can be purchased from Regin.

Main computer If a computer has been created from the main computer template, Nimbus will be added to the EXO4 Functions.

Configuration If Nimbus is part of the EXO4 Functions, a Nimbus printer is automatically added in the EXO4 Printing Channels Tool.

Auto start If Nimbus is to start automatically when EXO4 is started, this has to be selected in EXO4 Functions – Run on start-up.

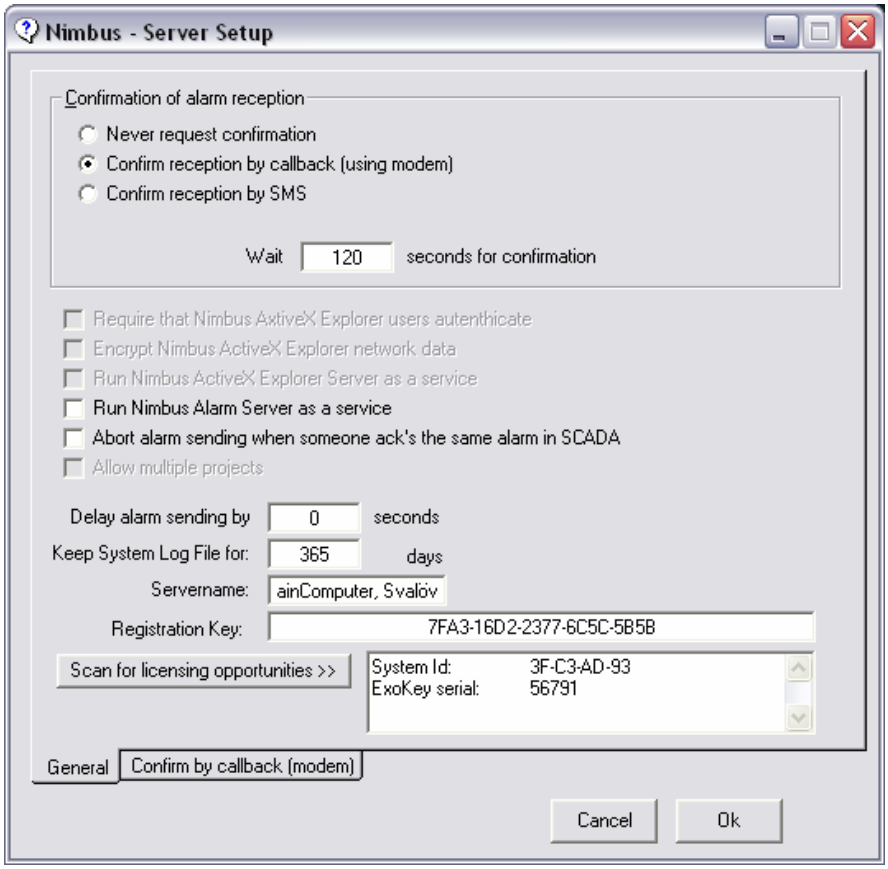


Unlocking code

Registration key Unlocking the Nimbus Alarm Server requires a registration key which is supplied by our resellers.

Procedure The unlocking procedure:

- Select the menu command **Config – Server Setup** in Nimbus Explorer.

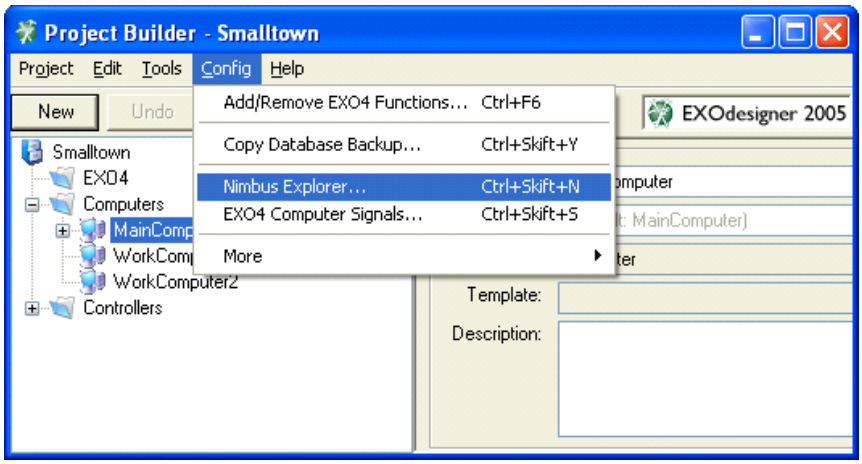


- Click on the button **Scan for licensing opportunities** >>. The number for **ExoKey serial** should be provided to the reseller.
- The reseller sends a registration key to be entered in the field **Registration key**.

Configuration of Nimbus Alarm Server

Start

Open the configuration tool **Nimbus Explorer** by clicking on this item in the menu **Config** in Project Builder.

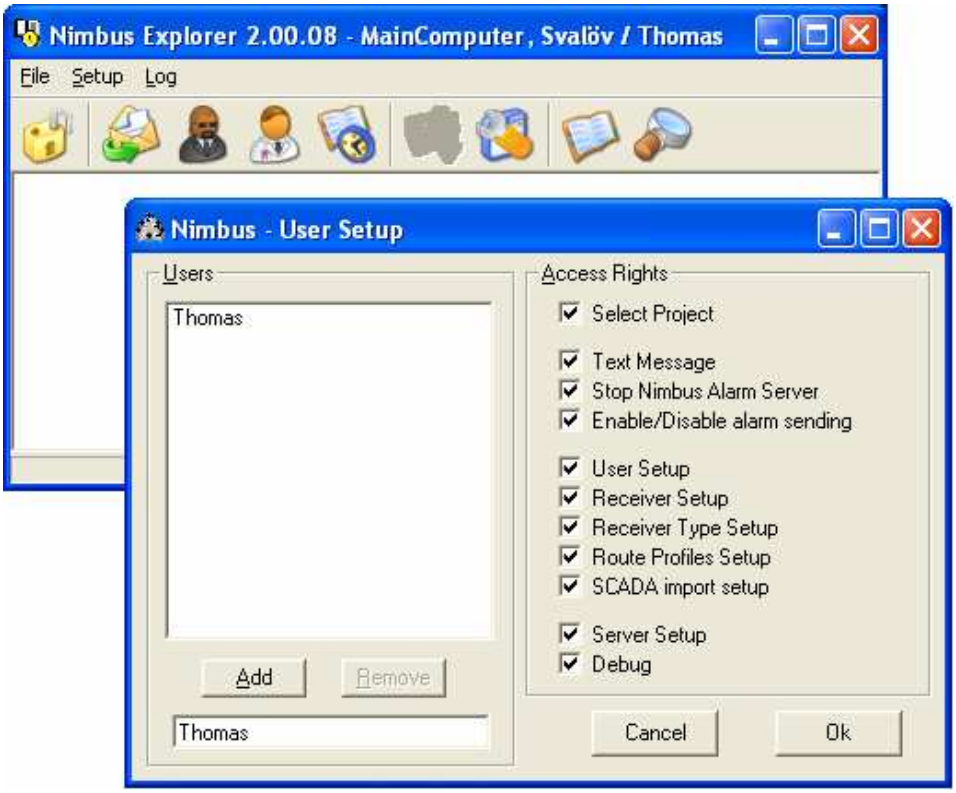


Logging on

It is not necessary to log on the first time Nimbus Explorer is launched. However, when a user has been added, log on will be necessary to administrate Nimbus.

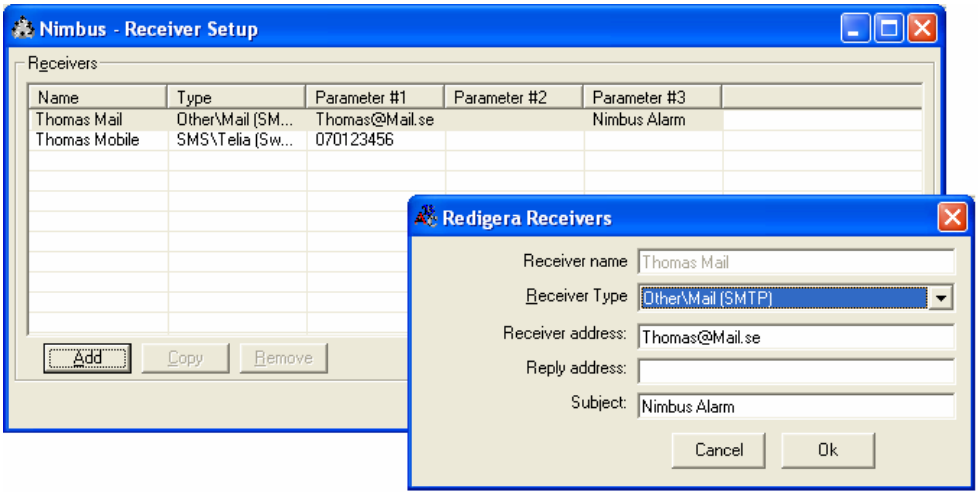
Users

Click on the menu command **Setup – User Setup** in Nimbus Explorer to add a new administrator of Nimbus.



Receivers

Alarm receivers are added in the dialog that opens with the menu command **Setup – Receiver Setup** in Nimbus Explorer. Whether the alarm is to be sent via SMS message or via e-mail is specified in receiver type. The telephone number or the e-mail address needs to be entered.



Receiver types

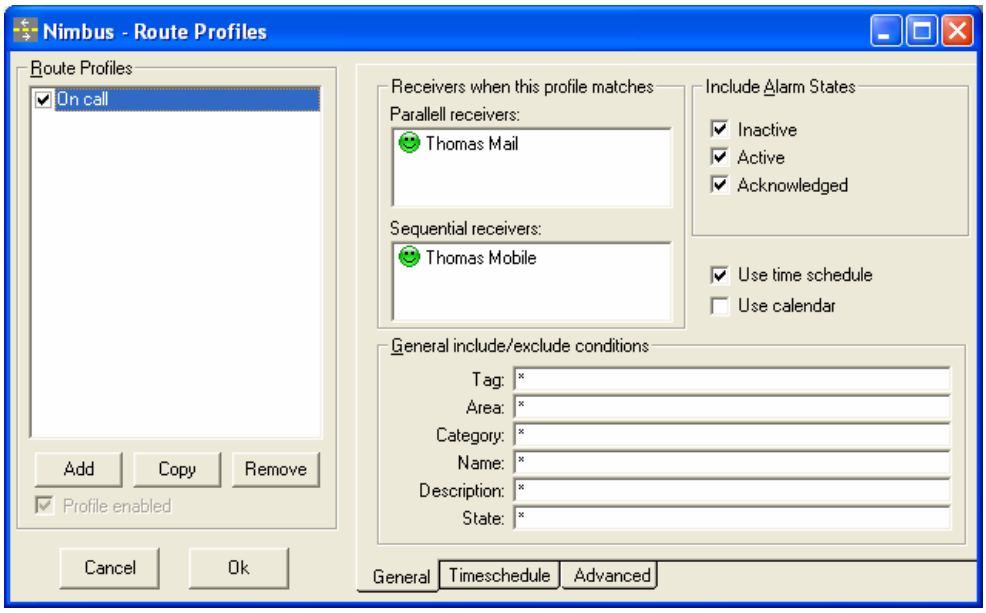
Some configuration is needed for each receiver type that is to be used, e.g. port settings and IP address for the SMTP server. More information about this can be found in the Nimbus documentation.

Route profiles

The alarm receivers are specified in the dialog Route Profiles.

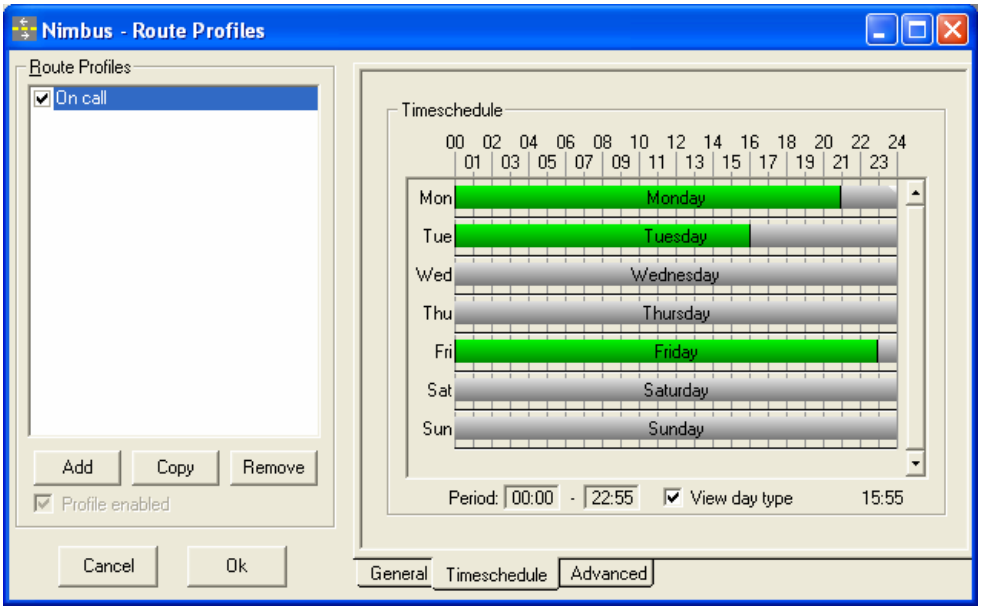
There are two types of receivers for alarm route profiles:

- **Parallel receivers**: Alarms are sent to the specified receivers simultaneously.
- **Sequential receivers**: If none of the parallel receivers confirm, the alarm will be sent to the sequential receivers, in the order they are specified.



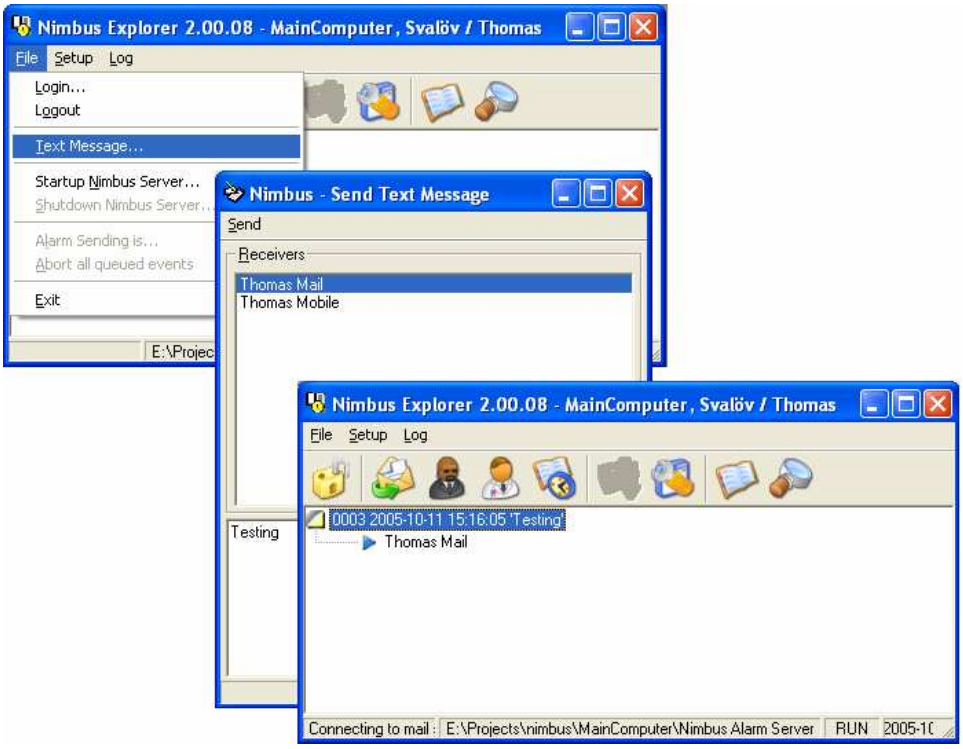
Time schedule

A time schedule or calendar can be used by ticking these options in the dialog Route Profiles. The settings are made in the tabs **Timeschedule** and **Global calendar,** respectively.



Testing

The receiver configuration can be tested by clicking on the menu command **File – Text Message** and sending a message to a receiver. The picture below shows an example.



More information

Further information about Nimbus Alarm Server can be found in the document ***Nimbus Alarm Server Manual*** that is included on the CD.

Chapter 17 Logging

Concepts

Polled Signals

Real-time charts Polled signals are measured values in the controller that EXO4 reads in real-time. The values are drawn directly into a real-time chart.

Logged Signals

Database Logged signals are analog measured values that are saved in special logs in the controller in certain period times. The main computer empties the logs on appropriate times to save the information in a historical database on the hard disk. See the section ***The Main Computer*** below.

Logging The signals that are to be logged are defined in the tool Logging.

Logging occasion The values of the signals that are to be logged are measured continuously. However, only one measured value is entered in the log at each logging occasion. A logging occasion is a measurement made over a certain period of time. A logging is time-stamped with the time of the beginning of the period.

Measured value function Each signal is connected to a measured value function that determines what is to be written at the logging occasion. Average value, max value and value at the end of the time period are examples of measured value functions.

Period time A log is characterized by a certain period time, i.e. all signals in a log have the same period time. When the configuration is saved, signals with the same period time (and reference time, usually 00:00) are placed in the same log.

Number of signals Each log can contain a maximum of eight signals.

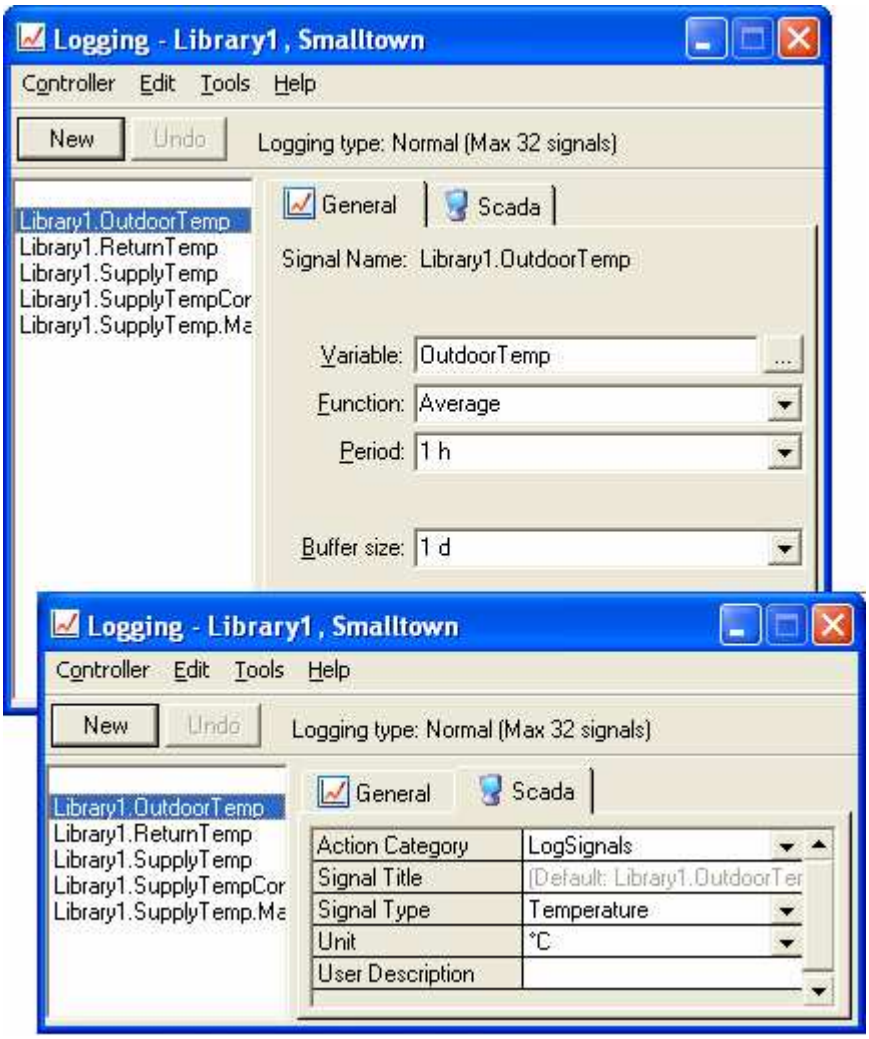
Number of logs There are three different kinds of Logging that differ in the number of logs that can be handled and consequently the maximum amount of signals that can be measured:

- **Logging** handles a maximum of 4 logs (32 signals).
- **Logging Large** handles a maximum of 8 logs (64 signals).
- **Logging Huge** handles a maximum of 12 logs (96 signals).

Default Logging (with max. 4 logs) is added when you create a controller and select to use Logging in it. If additional logs are required, the larger function will have to be added using the tool Functions (which opens with the menu command **Config – Add/Remove Functions**) in Project Builder.

Log size The size of the logs, and consequently the amount of data that can be stored, is configured by specifying a buffer size for each signal.

Logging The configuration tool Logging:



The Main Computer

Transferring to the Main Computer

Synchronization Logged data is normally transferred to the main computer during synchronization. Synchronization is usually made once every night. The operator can also order a manual synchronization if needed. Furthermore, it is possible to configure an automatic synchronization for all dial-up connections.

Spontaneous connection If, for some reason, the automatic synchronization fails, the station will make a spontaneous connection when a log is 80% full. The main computer will then empty the log.

Manual A manual synchronization can be done with the EXObasic method `ControllerName.Synchronize`. This code can be added for instance as reaction code in a button's event **OnManeuver**. When the operator clicks on the button, a synchronization connection (that includes the dial-up connection to a dial-up controller) will be performed by EXO4, and the logs of the controller will be emptied.

Database

Main computer The logged values from the controllers are stored in a database in the main computer.

Configuration The database storage time for the values can be set during the configuration. You can also determine in what way they should be compiled.

Compilation The standard setting for compilation is minute values to 1 hour, hour values to 1 day, and day values to 1 month.

Saving By default, minute values are saved for 1 month, hour values for 3 months and month values forever.

Purging The original values are not removed during compilation, which means that the size of the database will increase. As a result, purging and defragmentation of the database is sometimes necessary. This is described in the chapter ***Database Maintenance.***

Tables An EXO4 database has the following tables for logged analog signals:

Table Name	Description
Analog Register	Contains a register of all the logged analog signals in the project. The table contains one record for each signal.
Analog Values	Contains logged values for all logged analog signals. One record contains one measured value for a signal.
CompactConfig	Contains time interval for compacting.
Purge Time	Contains purging times.

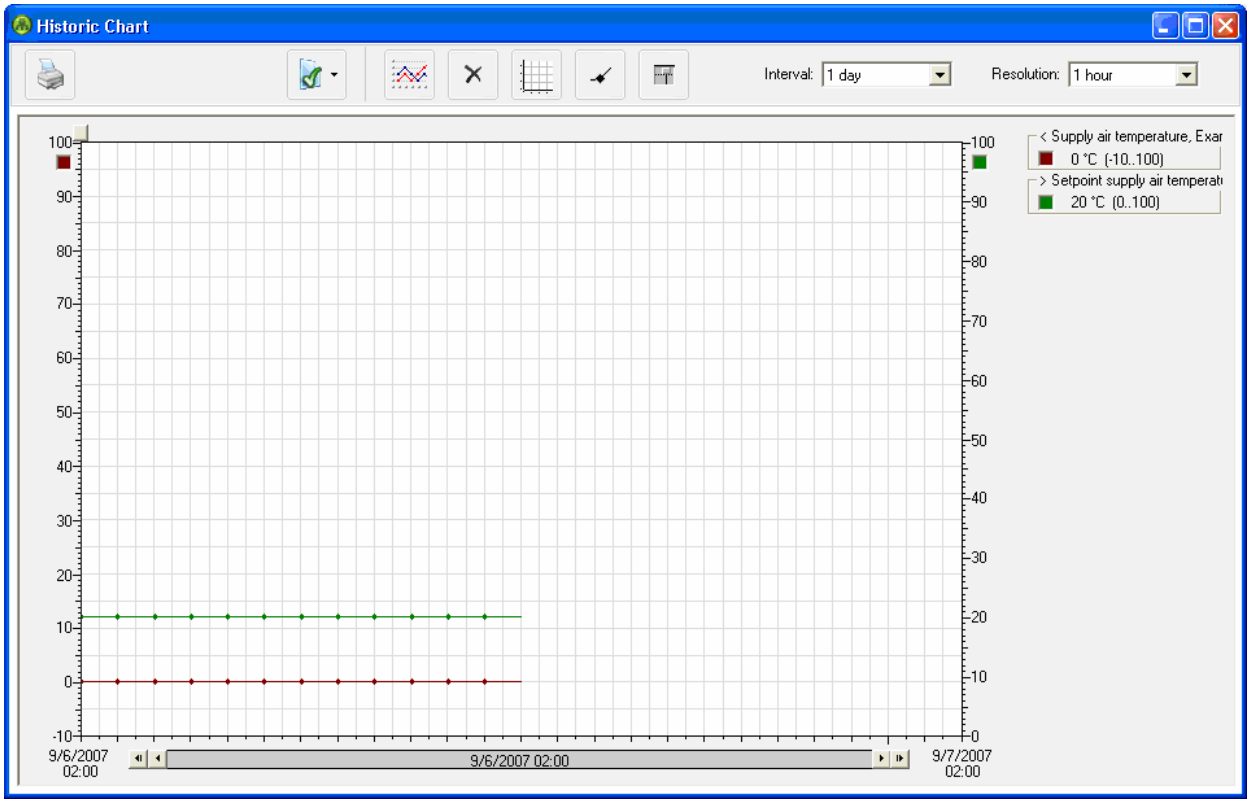
A row in the database table is called a record. Each time data is stored, a new record is created in the table.

Presentation

Historical charts In EXO4 there are window templates for displaying historical curves that retrieve values from the database.

Real-time charts In EXO4 there are also window templates for real-time charts that display polled signals.

Printing Besides being displayed on the monitor, all reports can be printed on a printer.



Reports

EXOreport EXOreport can be used to create, display and print reports with logged historical values from the database.

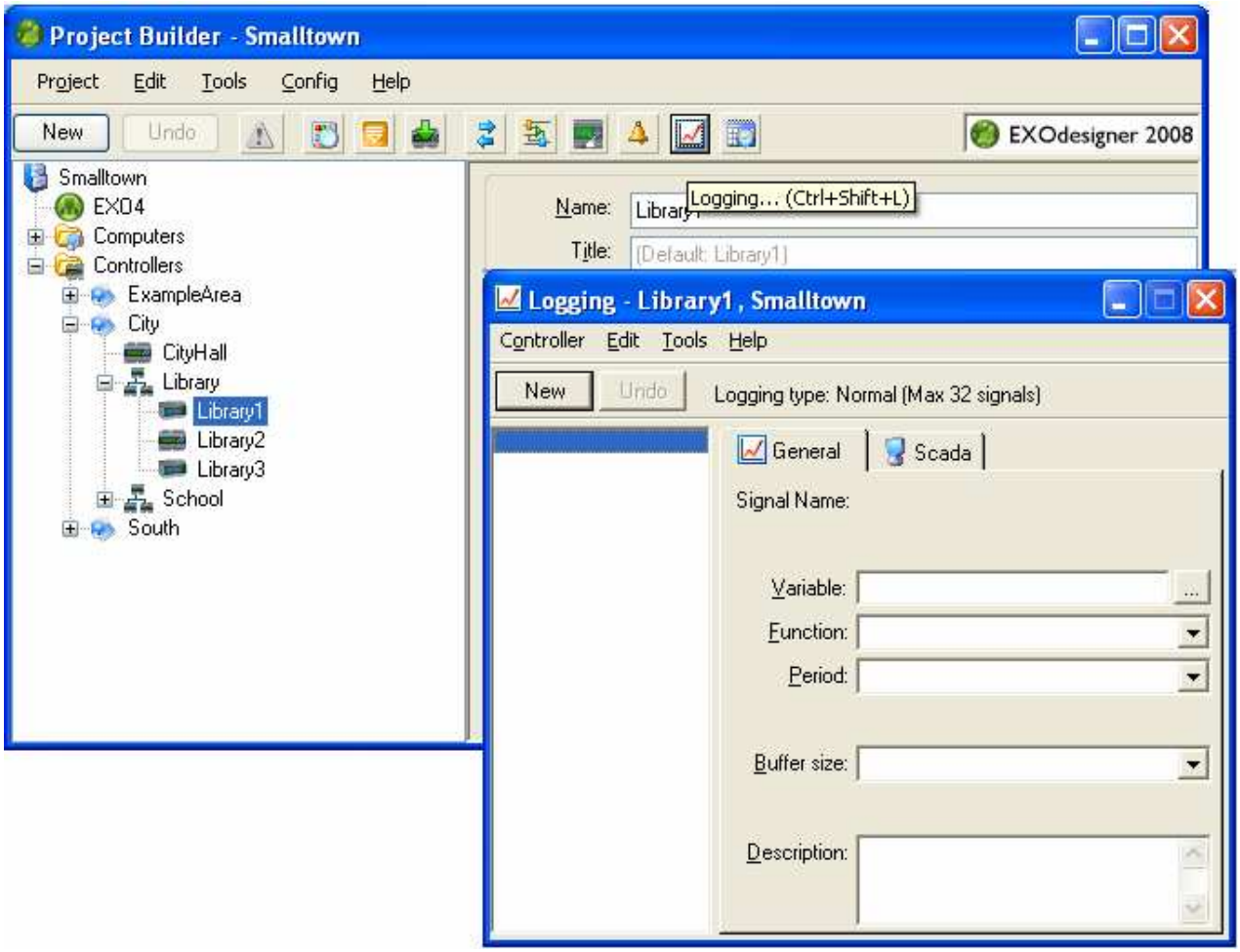
Description EXOreport is described in the document ***EXOreport Manual***.

Configuration

Analog Signals

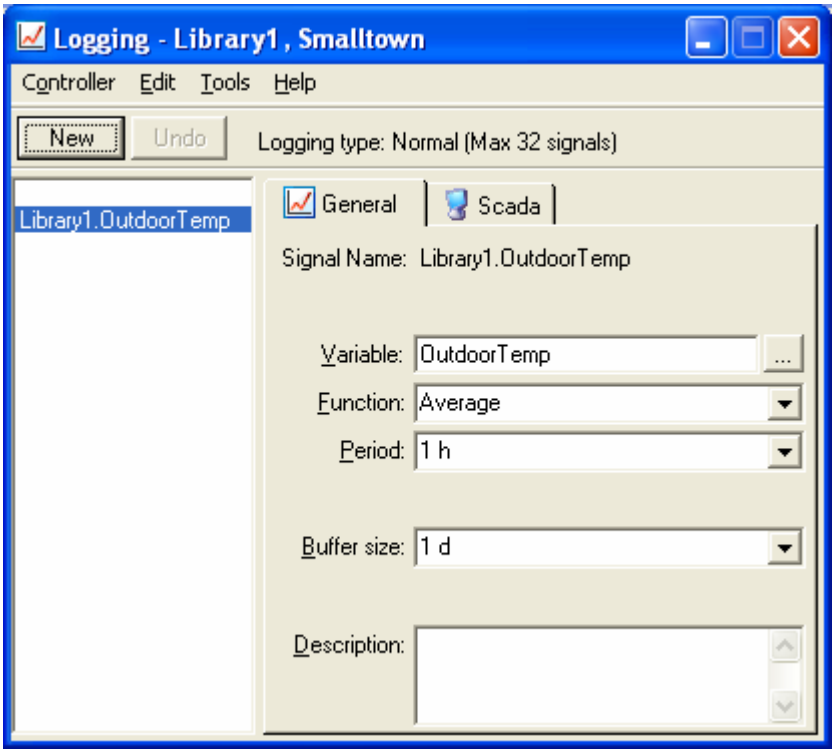
Logging

Open the Logging tool by selecting the controller **Library1** (or **CityHall**) in Project Builder and clicking on the button .



A new signal

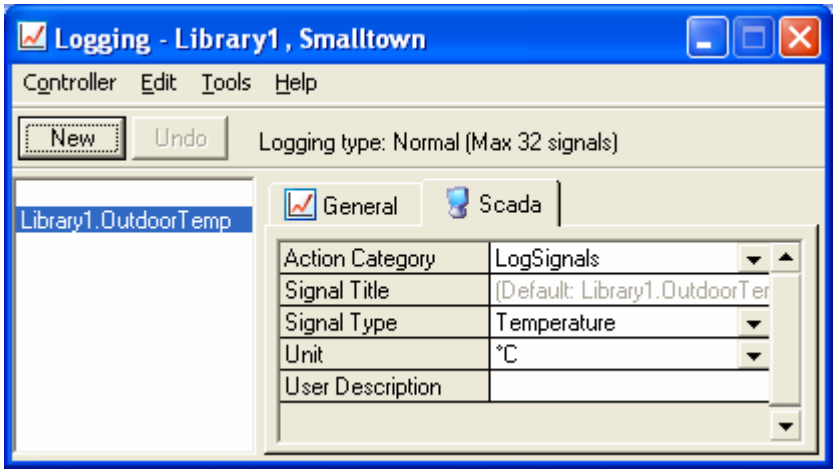
- Click on the button **New** to create a new signal and perform the following configurations. The attributes Function, Period and Buffer size will be described below.
- Select the analog input variable **OutdoorTemp** in the controller Library1 in EXOL Browser, which is opened by clicking on the button with three dots to the right of the attribute **Variable**.
- Select the function **Average** in the attribute **Function**.
- Select the period **1 h** in **Period.**
- Select **1 d** in **Buffer size**.



EXO4 configuration

Configurations that are exclusive to EXO4 can be made on the tab **Scada** in Logging.

- Open the tab **Scada**.
- The signal is associated with the **Action Category – LogSignals**. The action category decides the handling of the signal. For logged values, this means setting the time for purging of old values. See the section ***Actions for Logged Signals*** at the end of this chapter.
- The signal title to be used in EXO4 charts and EXOreport reports is set in the attribute **Signal Title.** If no title has been entered, the default title will be a compound of the controller and the variable name, e.g. **`Library1.OutdoorTemp`**.
- To allow the operator to make selections in the reports of EXO4, each signal can be associated with a signal type in the attribute **Signal Type**. Select **Temperature**.
- The unit of the signal (**°C**) is selected in the attribute **Unit**. The unit will then be displayed in charts and reports.
- Text entered in **User Description** is displayed in EXO4 reports when the operator opens the information box for a logged signal.



Function

Function

The measured value function of the signal is selected in **Function.** The following options are available:

- **Average**: Logging continuously reads the value of the variable during the period, and calculates an average value, which is added to the log.
- **Max**: Logging continuously reads the value of the variable during the period, and adds the highest value to the log.
- **Min**: Logging continuously reads the value of the variable during the period, and adds the lowest value to the log.
- **Counting (Sum)**: Logging reads and resets the value of the variable. The total of the measured values during the period is added to the log. This function is used to measure pulses and runtimes during the period. This function cannot be used to log functions that have not been prepared for this. There are special **Count** variables for the digital inputs.
- **Single Sample (Start of period)**: Logging reads the value of the variable at the start of the period and adds it to the log. This function is appropriate for meter readings.
- **Single Sample (End of period)**: Logging reads the value at the end of the period and adds it to the log. This function is appropriate for meter readings. The value in the log is time stamped with the time of the start of the period.

Period

Period

One measured value for each signal is written to the log at the interval determined by the **Period**. The period times can be in the interval 1 minute to 1 day, and the only period times allowed are those which add up to exactly one day. The following units are supported: **`min`**, **`h`** and **`d`**, for minutes, hours, and days, respectively. All measured values in the log are time stamped with the start time of the period (this is also valid for Single Sample (End of period)).

Number of periods

The number of different period times (logs) and consequently the number of signals that can be configured is restricted as follows:

- Logging (standard), max 4 different period times and max 32 signals.
- Logging Large, max 8 different period times and max 64 signals.
- Logging Huge, max 12 different period times and max 96 signals.

Buffer Size

Buffer size

For each signal a place in the log is reserved by specifying a space of time in **Buffer Size.** If, for example, the period time of the signal is 1 hour, and its buffer size is 2 days, place is reserved for 48 values for this signal. The most common buffer size is at least 2 days.

The space of time can be specified in the units **`min`**, **`h`**, **`d`**, **`w`**, **`m`** and **`y`** for minutes, hours, days, weeks, months, and years, respectively.

Saving and Loading

Saving and loading

Before Logging is shut down, the configuration must be saved. The controller needs to be reloaded in the following cases:

- After adding or deleting signals.
- When a configuration change has been made on the tab **General**. A reload is not necessary if the changes were made exclusively on the tab **Scada**.

More Examples

It may also be appropriate to log the other temperatures with the measured value function average, with the **Period 1 h** (1 hour) and the **Buffer size 1 d** (1 day). That is, the signals:

- **`ReturnTemp`**
- **`SupplyTemp`**
- **`SupplyTempControl_SetP`**

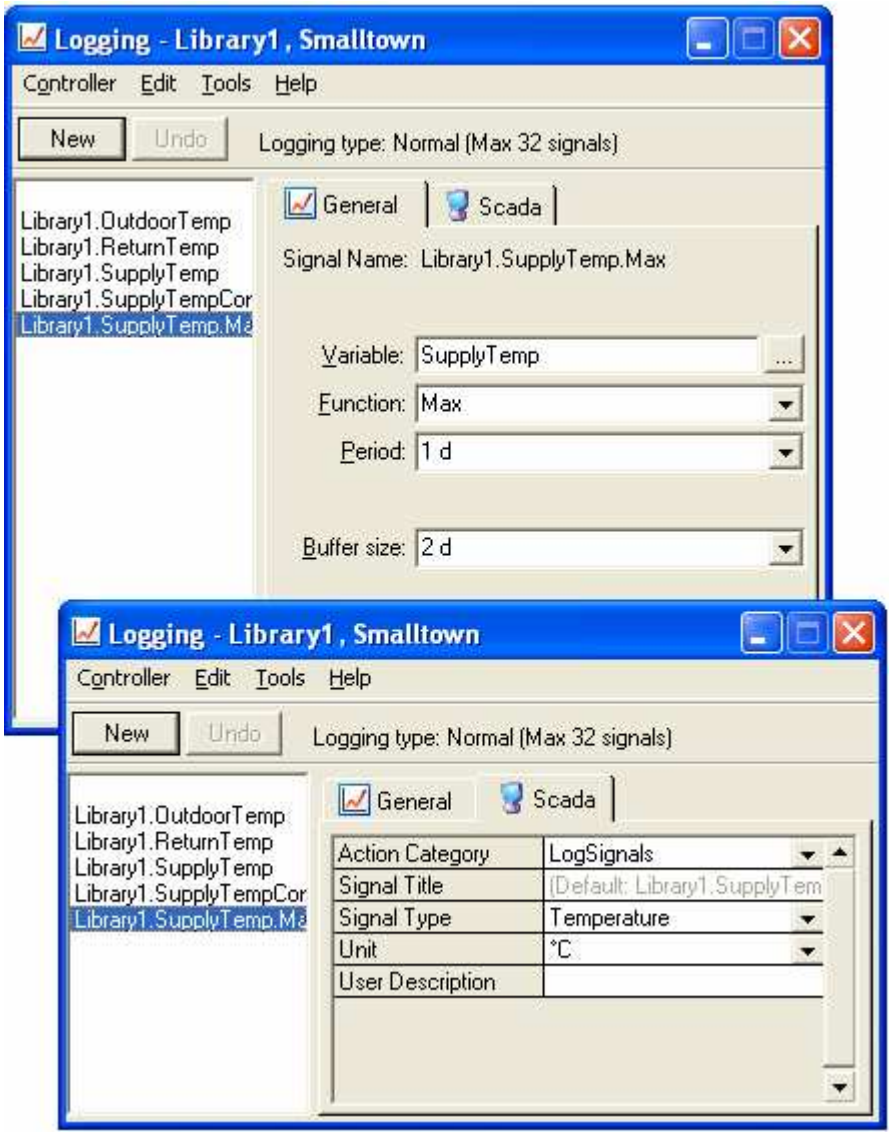
These signals are stored in the same log as **`OutdoorTemp`**.

Remember to click on the button **New** before configuring, and to add the new log signal with the button **Add.**

Also, configure these signals with appropriate values for EXO4 on the tab **Scada**.

Also, add a log point for the signal **`SupplyTemp`** that registers the highest value during 1 day, i.e. use the function **Max**, the **Period 24 h** (1 d), and the **Buffer size 2 d**.

This signal will be stored in a different log than the rest as the period and the function are different.



Charts

Standard charts

In EXO4 there are a number of standard templates for windows with historical charts and real-time charts.

Adding

A window template is added to the project with the EXO4 Windows tool. This procedure is described in the chapter ***EXO4 Window Design***.

Historical Charts

Use

Historical charts are used to display historical curves whose analog or digital values are retrieved from the database. There are three types of historical charts with different restriction levels, depending on how much liberty the integrator want to grant the operator to choose the signals in the specific application.

Historical charts

The following window templates for display of historical charts are included in EXO4:

- **Fixed** (HistoricalChartFixed.Ewd): The integrator determines entirely which signals will be displayed by specifying them as arguments in the reaction code that opens the window.
- **List** (HistoricalChartList.Ewd): The integrator creates a list of signals, from which the operator may choose a maximum of 10 signals at a time.

- **Database query** (HistoricalChartFree.Ewd): The database query grants the operator the greatest freedom to choose signals from the system database. The operator can select area, signal type and digital or analog. However, the integrator can limit the searches to a certain sub area or to certain signal types. In the signal option box, the texts of analog signals are blue, and the texts of digital signals are black.

Emptying logs

The logs of the controller are automatically emptied during a daily synchronization connection. Therefore, values that have been gathered after the latest synchronization are not yet in the database. A manual synchronization can be done with the method `Controllername.Synchronize`, which preferably can be added as reaction code in a button's **OnManeuver** event. When the operator clicks on the button, EXO4 performs a synchronization connection and empties the logs of the controller. If it is a dial-up controller, the synchronization connection includes the dial-up connection to the specified controller.

Real-time Charts

Use

Real-time charts are used to display real-time curves. There are two types of real-time charts with different restriction levels, depending on how much liberty the integrator want to grant the operator to choose the signals in the specific application.

Real-time charts

The following window templates for real-time charts that retrieve values directly from the controller are included in EXO4:

- **Fixed** (RealtimeChartFixed.Ewd): The integrator determines entirely which signals are to be displayed by specifying them as arguments in the reaction code that opens the window.
- **List** (RealtimeChartFixed.Ewd): The integrator creates a list of signals, from which the operator may select up to 10 signals to display at a time.

Opening Charts

Opening windows

Normally, the operator opens a chart window by clicking on a button or selecting a popup menu item. The code to open the window is entered in the text box **OnManeuver** for buttons (in EXO4 Window Designer) and in **OnClick** for popup menu items (in EXO4 Menu Designer).

Opening charts

An example of how to open a historical chart is shown below.

```
OpenWindowInstance "HistoricalChartFree.Ewd", "instancename"
```

Instance name

To be able to have several instances (windows) with different contents of one window class open simultaneously, each instance must have a unique name. Therefore, it is appropriate to use different instance names when they are opened, preferably a name that represents the specific context where the window is opened.

Selection

The integrator can limit the selection of signals to be displayed in the chart by using extra arguments when the instance window is opened with the command OpenWindowInstance.

Syntax help

Syntax help is displayed by selecting a window that has been created from the template and clicking on **Help – Help on Template** in the tool EXO4 Windows.

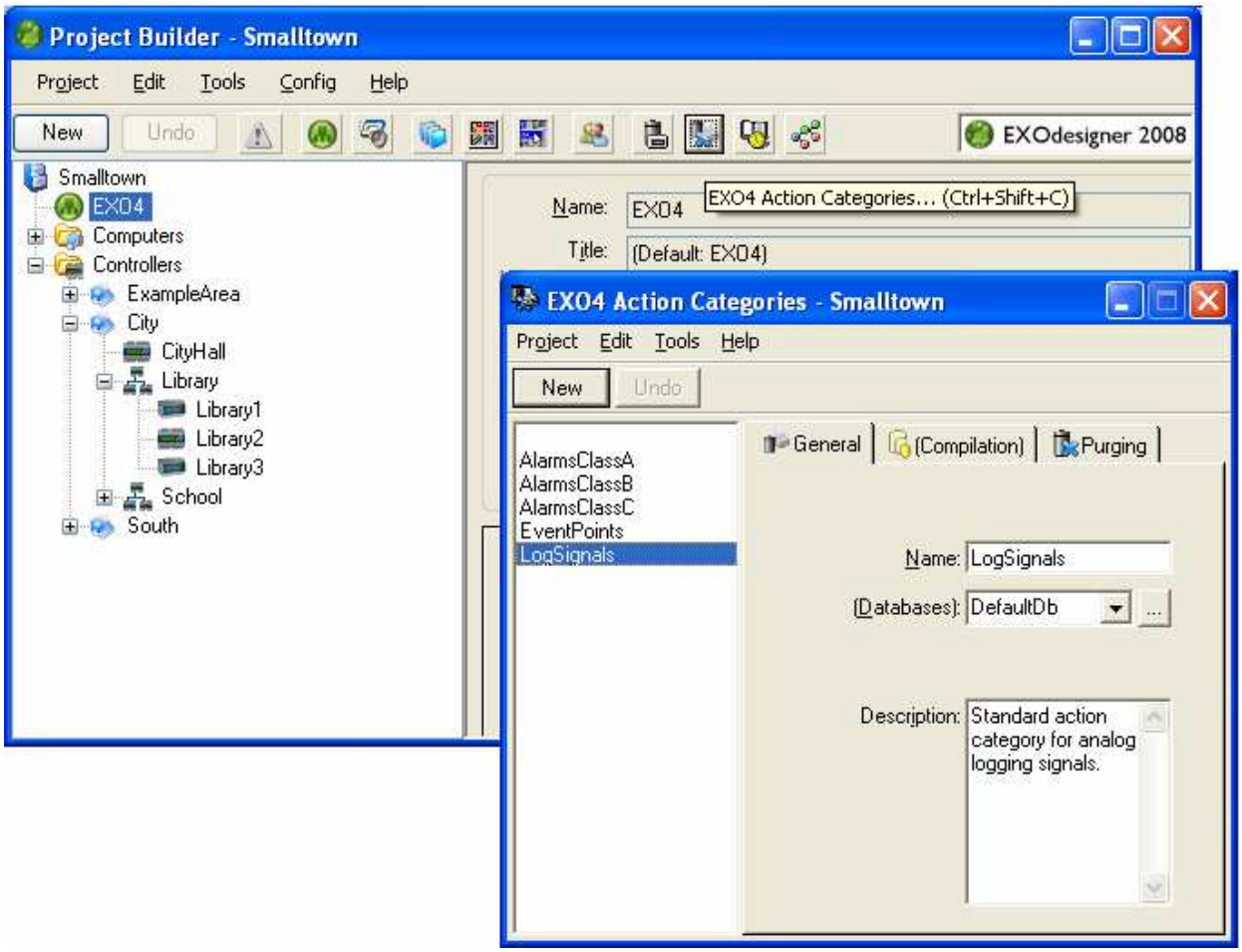
More information

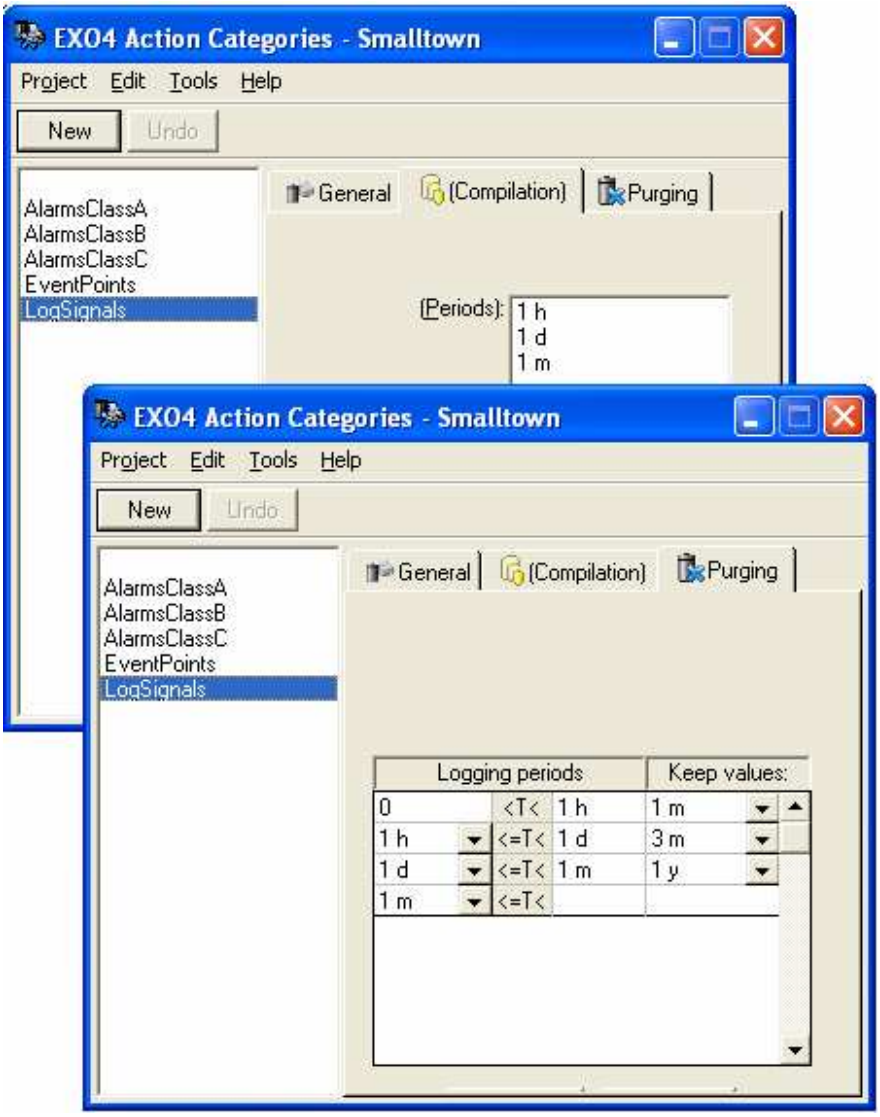
An overview of window templates and description of window classes is provided in the chapter ***EXO4 Window Design***.

Actions for Logged Values

Database In EXO4 Action Categories you can configure the database storage time and database compilation for the analog signals.

EXO4 Action Categories EXO4 Action Categories is opened from Project Builder with the menu command **Config – EXO4 Action Categories** or with the button .




EXO4 Action Categories - Smalltown
Project Edit Tools Help
New
Undo
AlarmsClassA
AlarmsClassB
AlarmsClassC
EventPoints
LogSignals
General
(Compilation)
Purging
(Periods):
1 h
1 d
1 m
EXO4 Action Categories - Smalltown
Project Edit Tools Help
New
Undo
AlarmsClassA
AlarmsClassB
AlarmsClassC
EventPoints
LogSignals
General
(Compilation)
Purging
Logging periods
Keep values:
0 <T< 1 h 1 m
1 h <=T< 1 d 3 m
1 d <=T< 1 m 1 y
1 m <=T<

Chapter 18 Time Control

Time Channels

Time control

Time channels can be used for time control, i.e. switch-on/off of pumps, fans and lighting.

Time channel

A time channel consists of a number of switch-on/off times for the various days of the week and holidays (calendar):

- A time channel is associated with a time schedule.
- The time schedule specifies the day plan that is valid for each day of the week and for holidays.
- The day plans specifies the switch-on/off times.
- Calendar periods normally defines holidays.

Tool

Time channels in the controllers are created and configured with the tool Time Channels.

EXO4

In EXO4, the objects EXO4 Time Channels and EXO4 Calendars can be created in the tool EXO4 Signals

Presentation

The time control can be inspected and modified on the display. The operator can change run mode, start/stop times, etc.

In EXO4 windows, e.g. process windows, you can add window elements to make it possible for the operator to inspect and modify the time control.

The applications Controller Time Channel Viewer and Controller Calendar Viewer display windows showing time channels that have been added to the controller with the tool Time Channels. They can be used to change start/stop times, run modes, etc.

The applications EXO4 Time Channel Viewer and EXO4 Calendar Viewer display windows showing the state of the objects EXO4 Time Channels and EXO4 Calendars. They can be used to change start/stop times, run modes, etc.

Time channels

Time channels are added and configured with the tool Time Channels.

A time channel is created and configured in the following way:

- A time channel is created. For each time channel, a time schedule is selected.
- A time schedule is created. In the time schedule you specify the day plan valid for each day of the week, and the day plan valid for holidays.
- One or more day plans are created.

Calendar periods

You can also create and configure calendar periods, normally for holidays.

Presentation

Controller Display

Menu for time channels On the display, the time control program shows a menu for the time channels that have been configured in the tool Time Channels.

Example: An example of a menu in the time control program:

```
>Normal Speed
 Reduced Speed
 Holidays
```

Selection Each menu item corresponds to a time channel. The last menu item is always a time schedule for holidays. One menu item is always marked with the sign > at the beginning of the line.

Scrolling Use the navigation keys ▼ and ▲ to scroll between the various menu items.

Displaying time channel The right arrow key (▶), opens the first dialog box for the selected time channel.

Time Channels

Example An example of the text of a dialog box for a time channel:

```
Normal Speed
Mon: NormalTime
Func.: Always On
Current mode: On
```

Run mode The run mode of the time channel is displayed with its function. The following functions are available:

- ❑ Always off
- ❑ Always on
- ❑ Forc. Off (The time channel is deactivated and is set to Auto mode at next switch-off)
- ❑ Forc. On (The time channel is activated and is set to Auto mode at next switch-on)
- ❑ Auto

Changing run mode The run mode of the time channel can be changed. First, press **OK,** then scroll to the required run mode using the keys ▼ or ▲**,** confirm by pressing **[OK].**

Current mode The current mode of the time channel is indicated with **On** or **Off**.

Day of the week When the required time channel is displayed, use ▲ or ▼ to scroll between the days. Use the key ▶ to access the settings for each day of the week.

```
Mon=Monday, Tue=Tuesday, Wed=Wednesday, Thu=Thursday, Fri=Friday,
Sat=Saturday, Sun=Sunday, Hol=Holiday
```

Day Plans

Three types There are three types of day plans:

- ❑ Start/stop plans (Day Plan (Start/Stop)).
- ❑ Runtime plans (Day Plan (Run-Time)).
- ❑ Interval plans (Day Plan (Interval)).

Description The three types of day plans are described in the following.

Start/stop plan

A start/stop plan can have up to 4 periods, each with individual start and stop times.

An example of a start/stop plan with a configured period:

```
NormalTime
0800-1600 0000-0000
0000-0000 0000-0000
```

Runtime plan

A runtime plan can have up to 4 periods, each with individual start and run times.

An example of a runtime plan with two configured periods:

```
RunTime 2
0700-0010 1730-0020
0000-0000 0000-0000
```

Interval plan

In an interval plan, an interval, a runtime and a reference time is set.

An example of an interval plan where each interval is 2 hours, the runtime is 10 minutes at each interval, and the first interval starts at 00:00:

```
Interval 2
Interval : 02:00
Run Time : 00:10
Reference: 00:00
```

Non-defined

Non-defined periods are displayed with 00:00. You can add new times to change these periods.

Changing Day Plan

Change day plan

Day plan for required day in a time channel is changed in the following way:

- Select the required day in the time channel and press **OK.**
- Select a new day plan with the keys ▲ or ▼ and confirm with **OK**.

Changing Times

Change times

Times and periods in a day plan is changed in the following way:

- Select the required day in the time channel and press **OK** to start editing mode**.**
- The key **OK** moves the cursor to the next value in the display. The key ▶ moves the cursor within the value. Use the keys ▲ and ▼ to increase decrease the digit at the cursor position.

Holidays

Selecting a holiday

To change the start/stop date for holiday periods (Calendar Period), press ▼ on the menu with the time channels until **Holidays** is selected on the display. Thereafter, press ▶ to access the settings. To scroll between the various holiday periods, press ▲ or ▼**.**

Changing the date

Thereafter, change the start and stop date for the holiday periods, in the same way as described above for changing the start and stop times for day plans.

It is not possible to add more holiday periods than has been defined in the tool Time Channels.

Process Windows

Process Windows

Window elements that indicate whether the various time channels are in run mode or not can be added in, for example, process windows in EXO4. It is also possible to add elements that allow the operator to change the run mode.

Time Channel Viewers and Calendar Viewers

Controllers

Time channels that have been loaded to the controller after configuring them in the tool Time Channels, can be inspected and modified with the applications *Controller Time Channel Viewer* and *Controller Calendar Viewer*. The general heating and air unit EXO4 window templates use the viewer applications for the time channels and calendar in the controller.

EXO4

The objects EXO4 Time Channels and EXO4 Calendars are new types of EXO4 objects in EXO 2008 that are configured in the tool EXO4 Signals. These objects can be inspected and modified with the applications *EXO4 Time Channel Viewer* and *EXO4 Calendar Viewer*.

Three views

The Time Channels Viewers and Calendar Viewers have three views:

- Time Channel Viewer
- Calendar Viewer
- The tab Standard Schedule.

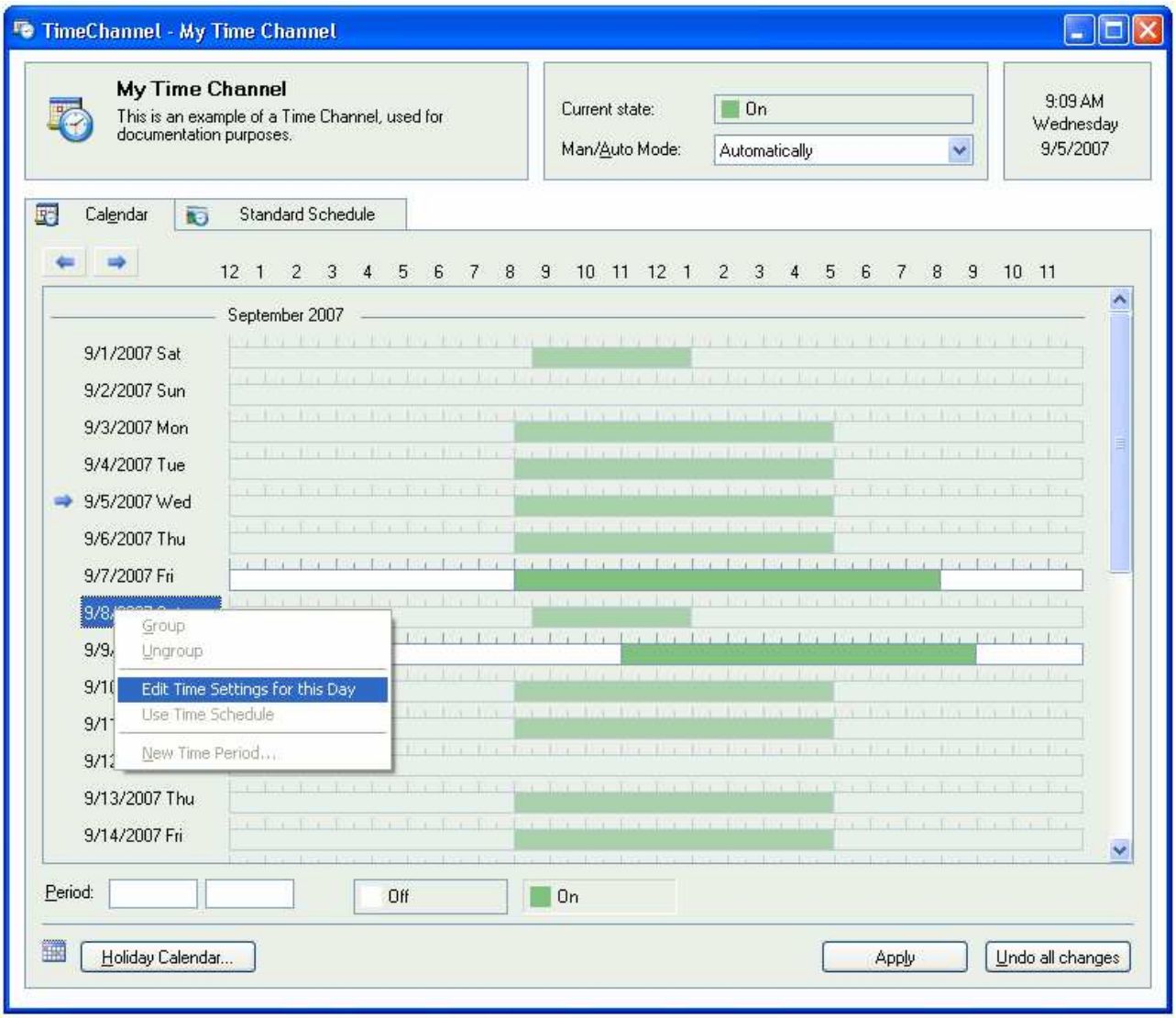
Appearance

The three views for EXO4 and controllers look just about the same for the applications and are shown below.

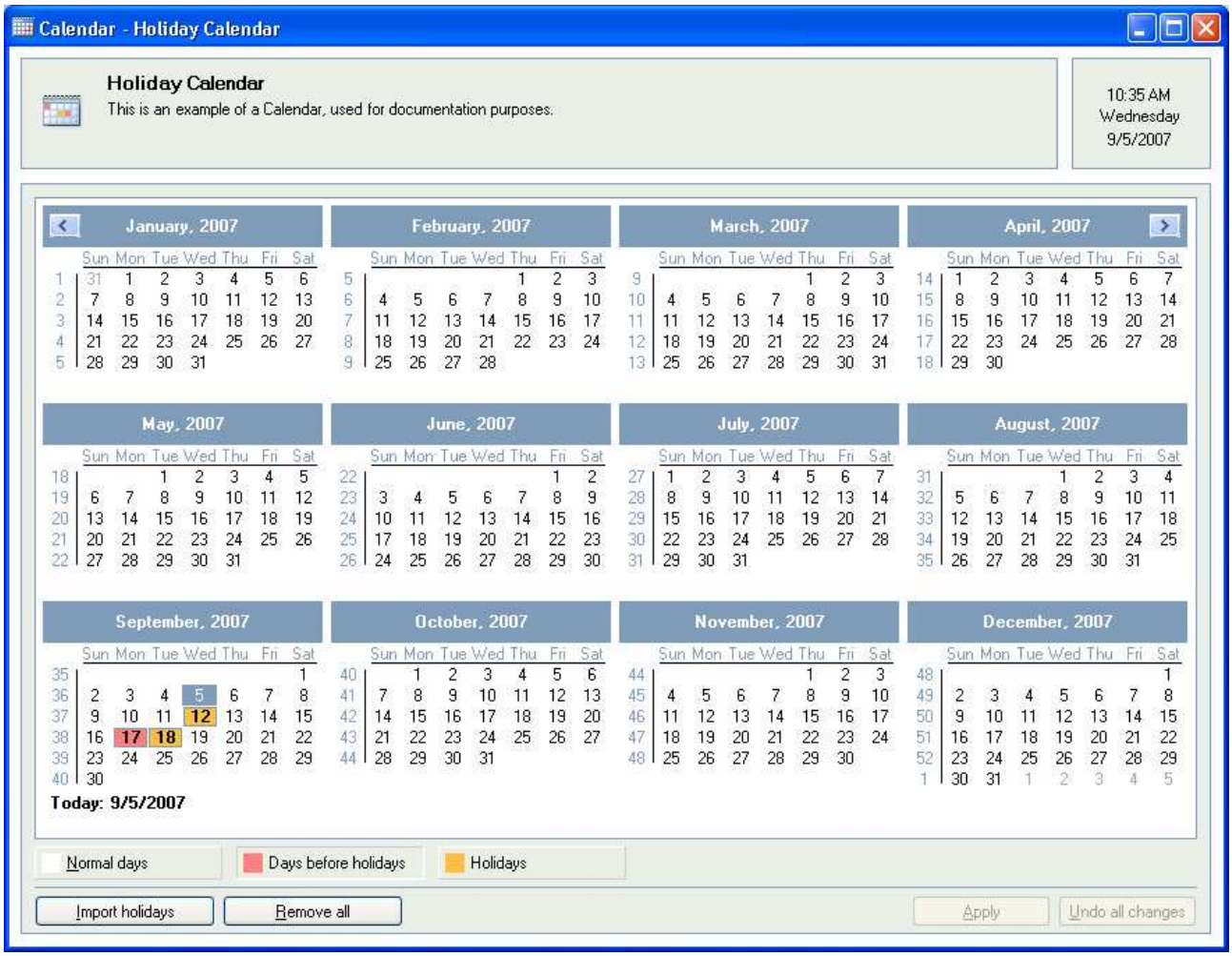
Functions

The functions of the Time Channel Viewer and Calendar Viewer of EXO4 and controllers do however differ somewhat. The functions of are described in the below sections ***EXO4 Time Channel Viewer***, ***EXO4 Calendar Viewer***, ***Controller Time Channel Viewer*** and ***Controller Calendar Viewer***.

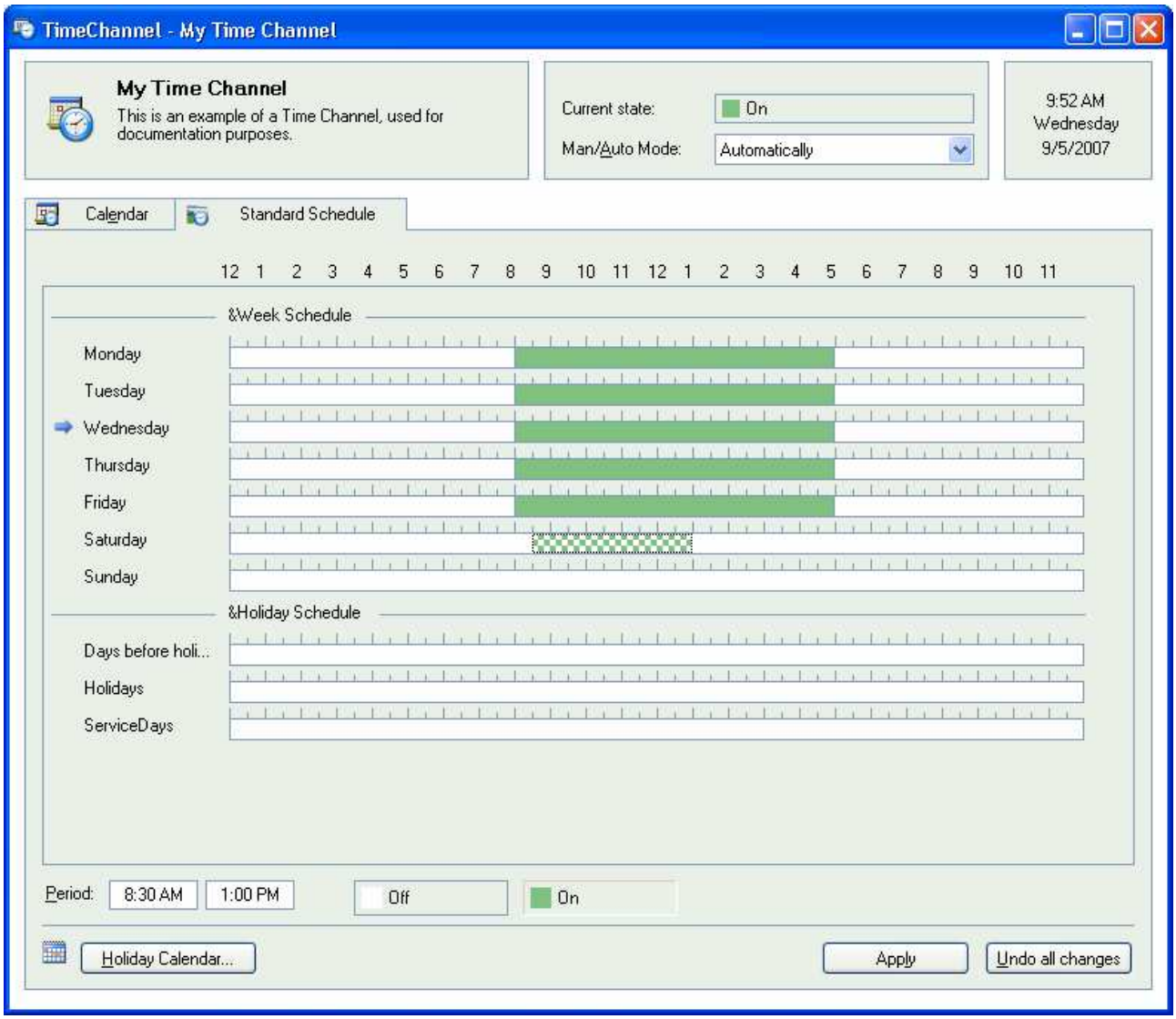
Time Channel Viewer



Calendar Viewer



Standard Schedule Tab



EXO4 Time Channel Viewer

Use

EXO4 Time Channel Viewer is an application that shows one EXO4 Time Channel graphically for the EXO4 operator. The operator can change the time period settings, create new special days, change the man/auto mode, etc. EXO4 Time Channels are configured in the tool EXO4 signals.

Upper part

The upper part of the application window shows the title, a description, the *current state* and the *man/auto mode* of the time channel. It also shows the current time and date of the main computer.

Man/auto mode

The user can change the man/auto mode directly, either by selecting a state manually or by selecting automatic mode. The state of the time channel will change immediately when the man/auto mode is changed.

Lower part

The lower part of the window contains two tabs: **Calendar** and **Standard Schedule**. You can open the EXO4 Calendar Viewer with the button **Holiday Calendar**. See the section ***EXO4 Calendar Viewer*** below.

Calendar tab

The calendar tab shows day plans for all days, according to the standard time schedule and the holiday calendar. You can view different months with the arrow buttons.

Disabled

The day plans are normally disabled, but by right-clicking on the title for a day and selecting Edit Time Setting for this Day, the day plan becomes enabled (which corresponds to creating a *special day plan* in the configuration). When the day plan is enabled, it is possible to create, delete and move time periods with the mouse.

Remove To remove a special day plan, right-click on the day and select Use the Time Schedule for this Day. Old special day plans will be removed automatically after 1 year.

Standard schedule tab The standard schedule tab shows day plans for all days of the week (the *week schedule*) and all day types in the holiday calendar (the *holiday schedule*).

Group The user can create, delete and move time periods with the mouse in the day plans. It is possible to group and ungroup the day plans by right-clicking the titles of the day plans. You can multi-select time periods and/or day plans by pressing the Shift or Ctrl key and then use the mouse.

Apply To apply changes to the main computer you must press the button **Apply**.

EXO4 Calendar Viewer

Use EXO4 Calendar Viewer is an application that shows an EXO4 Calendar graphically for the EXO4 operator. The operator can create and delete calendar days. Normally the viewer is used for holiday calendars. EXO4 Calendars are configured in the tool EXO4 signals.

Open Normally the viewer is opened from the EXO4 Time Channel Viewer.

Upper part The upper part of the application window shows the title and a description of the time channel. It also shows the current time and date of the main computer.

Create and delete The user can create and delete calendar days with the mouse. Select a day type with one of the **day type** buttons below the calendar, and click on the days that should belong to that day type. Old calendar days will be removed automatically after 1 year.

Apply To apply the changes to the main computer you must press the button **Apply**.

Import You can also import all holidays with the button B. Select your country and press **Import**. All official holidays several years ahead will be created in the calendar.

Controller Time Channel Viewer

Use Controller Time Channel Viewer is an application that shows <u>one</u> time channel in a controller graphically for the EXO4 operator. The operator can change the time period settings, the man/auto mode, etc. The controller's time channels are configured in the tool Time Channels.

Upper part The upper part of the application window shows the title, a description, the *current state* and the *man/auto mode* of the time channel. It also show the current time and date in the controller.

Man/auto mode The user can change the *man/auto mode* directly, by selecting either a state manually, a temporarily forced state or automatic mode. The *temporarily forced* mode means that the time channel will return to the automatic mode by itself the next time the schedule of the time channel changes state. When the man/auto mode is changed, it might take up to one minute until the state of the time channel is changed.

Lower part The lower part of the window contains two tabs: Calendar and Standard Schedule. You can open the Controller Calendar Viewer with the button Holiday Calendar. See the section ***Controller Calendar Viewer*** below.

Calendar tab The calendar tab shows day plans for all days according to the standard time schedule and the holiday calendar. You can view different months with the arrow buttons. You can <u>not</u> do any changes on this tab.

Standard schedule tab The standard schedule tab shows day plans for all days of the week (the *week schedule*) and for holidays (the *holiday schedule*).

Group The user can create, delete and move time periods with the mouse in the day plans. The user can <u>not</u> group and ungroup the day plans. Days might however be grouped in the controller (by using the same day plan in the configuration).

Apply To apply the changes to the controller you must press the button **Apply**. It might take up to one minute until the state of the time channel is changed.

Controller Calendar Viewer

Use

Controller Calendar Viewer is an application that shows the holiday calendar in a controller for the EXO4 operator. The operator can create and delete calendar days. The controller's holiday calendar is configured in the tool Time Channels.

Open

The viewer is normally opened from the Controller Time Channel Viewer.

Upper part

The upper part of the application window shows the title and a description of the time channel. It also shows the current time and date in the controller.

Create and delete

The user can create and delete calendar days with the mouse. Select a day type with one of the **day type** buttons below the calendar, and click on the days that should belong to that day type. The calendar in the controller does handle years. This means that the days configured as holidays, will be holidays every year. To apply the changes to the controller you must press the button **Apply**.

Import

You can also import all holidays with the button **Import holidays**. Select your country and press **Import**. All official holidays the current year will be created in the calendar.

Configuration

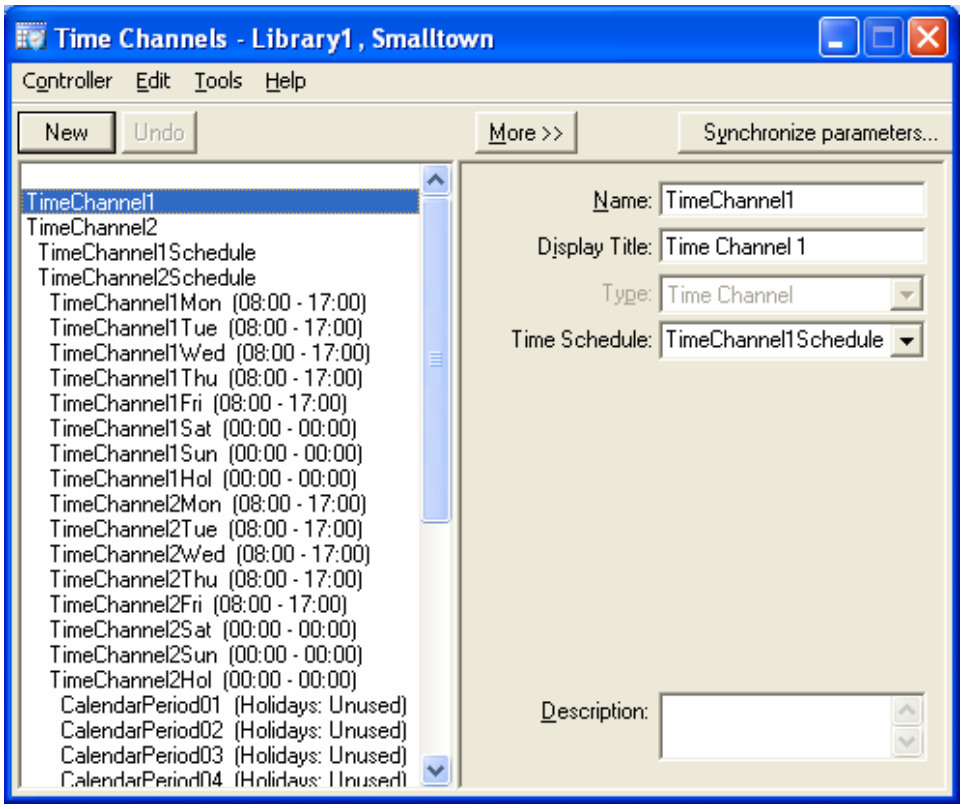
Controller

Controller template

When a controller is added from the standard template in Project Builder, and use time control has been selected, an initial configuration of time channels, time schedules, day plans and calendar periods is created.

Tool

Time channels in controllers are added and configured with the tool Time Channels.



List box

The names of the time plans that have been created **are** shown in the left list box. The different plans' levels in the list box indicate their types. Time channels are placed to the very left, the time schedules one step to the right, day plans yet another step to the right, and calendar periods one more step to the right.

Create and Configure

Create and configure

A time channel is created and configured in the following way:

- A time channel is created. For each time channel, a time schedule is selected.
- A time schedule is created. In the time schedule, you specify the day plan valid for each day of the week, and the day plan valid for holidays.
- One or more day plans are created.

Opposite order

The best way to create time channels is by working in the opposite order of the above. That is, first define the required day plans, then add time schedules and configure the time channel last.

Calendar periods

You can also create and configure calendar periods, normally for holidays.

Configuration Example

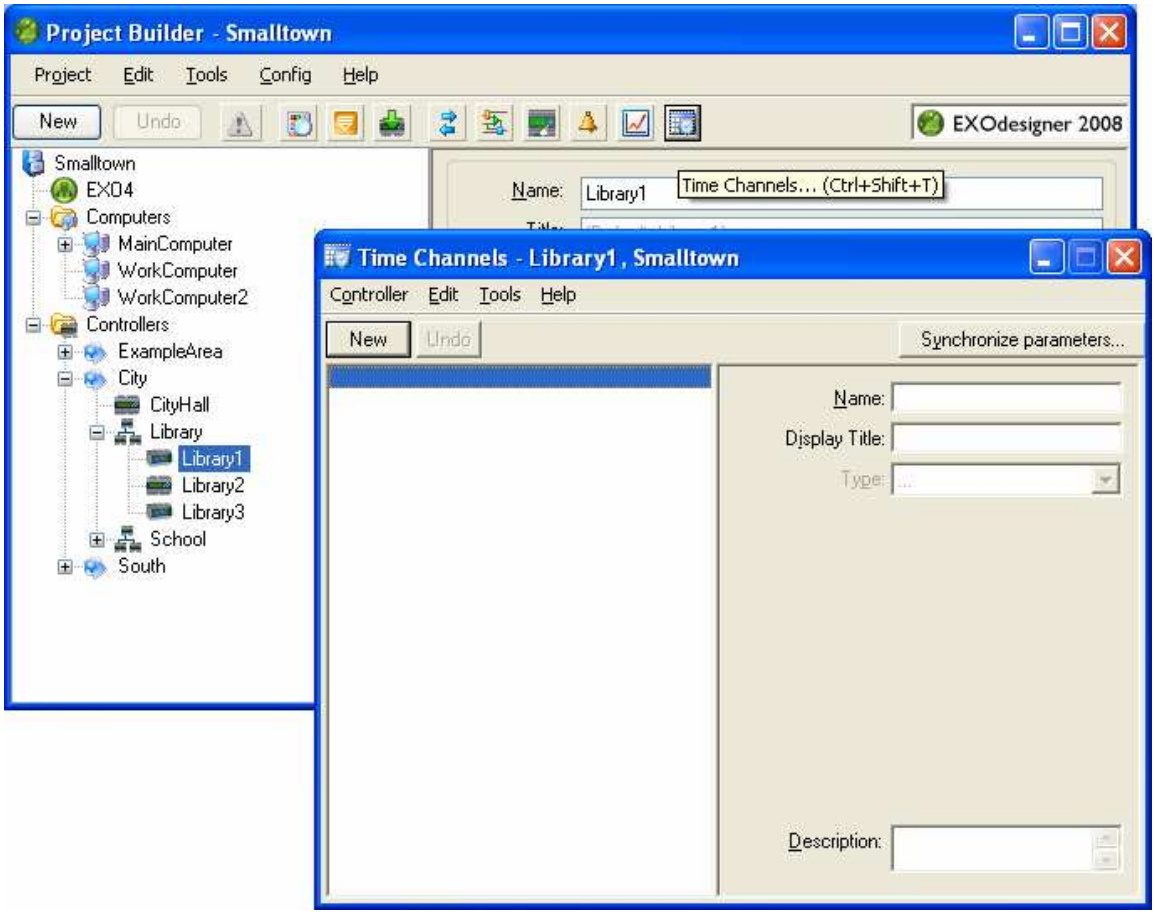
Example

We will create a time channel to control the lighting.

Open the tool

First, open the tool Time Channels.

- Select the controller **Library1** (or **CityHall**) in Project Builder and click on the button to open the tool Time Channels.
- A number of examples of time channels, time schedules, day plans and calendar periods are pre-configured. Remove all of these.



Day Plans

Time settings

Day plans are used to define switch-on/off times of the time channel.

If different time settings for all the days of the week are required, 8 separate day plans (for Monday to Sunday, and holidays) should be created.

If the time settings for certain days should be the same, a common day plan should be created for these days.

Options

A day plan is created by selecting one of the following options in the attribute **Type** in the tool Times Channel:

- ❑ Day Plan (Start/Stop)
- ❑ Day Plan (Run-Time)
- ❑ Day Plan (Interval)

Max 254

A maximum of 254 day plans can be configured for a controller.

Naming

A good practice is to give the day plan the same name as the time channel with an addition indicating which day(s) of the week should be used. A few examples:

- Various day plans for all days of the week:

  NormalSpeedMon, NormalSpeedTue,…, NormalSpeedSun, NormalSpeedHolidays.

- Day plans for several successive days:

  NormalSpeedMonToFri, NormalSpeedMonToThu.

- Day plans for several non-successive days:

  NormalSpeedMonWedFri.

Day Plan (Start/Stop)

4 periods

Day Plan (Start/Stop) provides the possibility to configure up to 4 periods, each with individual start and stop times.

Not over midnight

The time period must be between 00:00 and 24:00. If e.g. a time period from 21:00 to 08:00 the following day is required, two time periods must be defined. The first period would start at 21:00 and stop at 24:00, the second period would start at 00:00 and stop at 08:00.

Never activated

If you want to define a day plan which is never activated, you define a day plan with the same stop time and start time, for example 00:00 to 00:00.

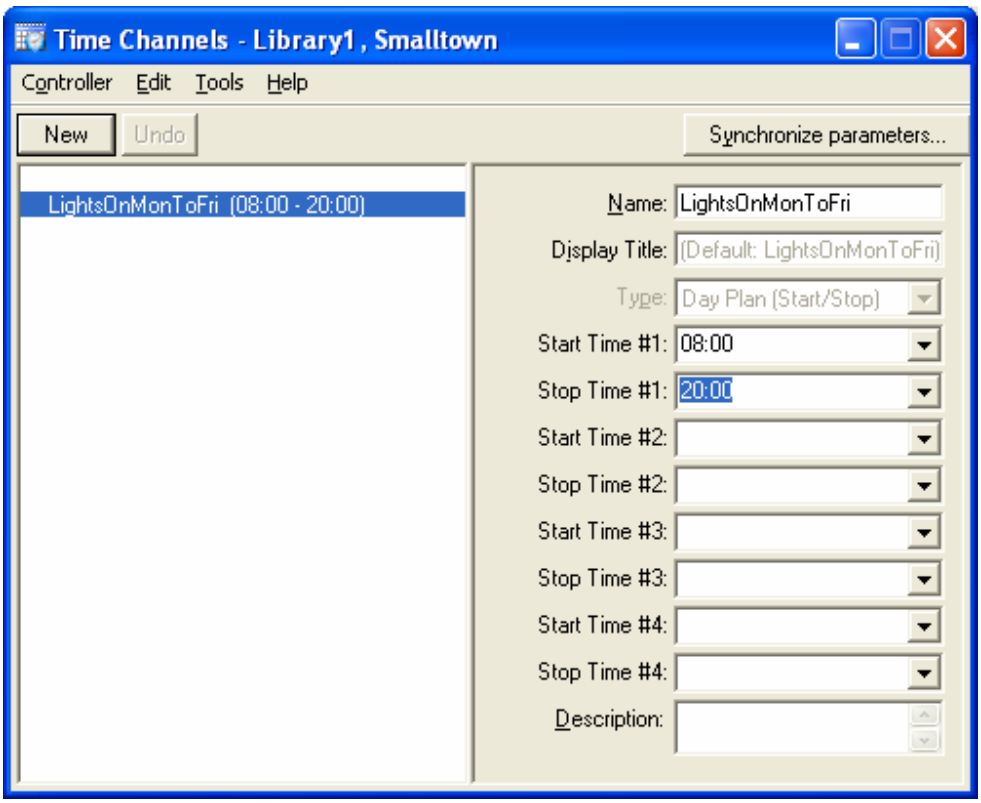
Always activated

If you want to define a day plan that stays active all the time, you state 00:00 to 24:00.

Create and configure

Define a day plan of the type Day Plan (Start/Stop).

- Click on the button **New** in Time Channels and select **Day Plan (Start/Stop)** in the attribute **Type**.
- Enter the name **LightsOnMonToFri** in the attribute **Name** and click on the button **Add**.
- Specify the time **08:00** in the attribute **Start Time #1** and **20:00** in **Stop Time #1** and click on the button **Change**.



Day Plan (Run-Time)

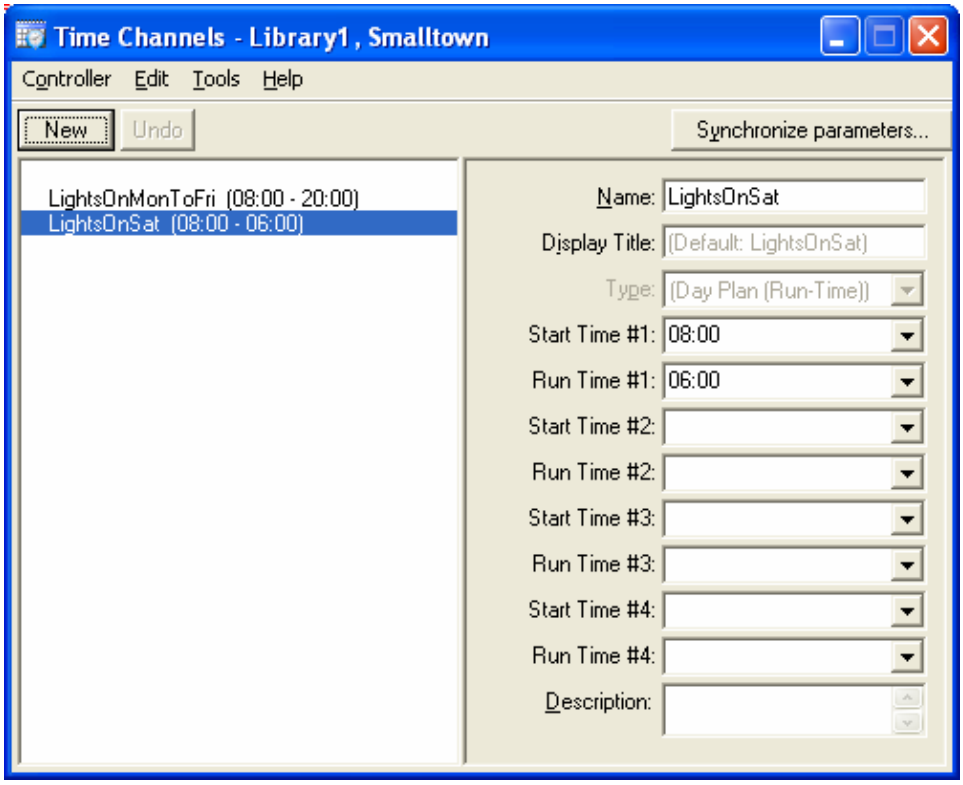
4 periods

Day Plan (Run-Time) provides the possibility to configure 4 periods, each with individual start and run times.

Create and configure

Define a day plan of the type Day Plan (Run-Time).

- Click on the button **New** in Time Channels and select **Day Plan (Run-Time)** in the attribute **Type**.
- Enter the name **LightsOnSat** in the attribute **Name** and click on the button **Add**.
- Specify the time **08:00** in the attribute **Start Time #1** and **06:00** in **Run Time #1** (i.e. the same as from 08:00 to 14:00) and click on the button **Change**.



Day Plan (Interval)

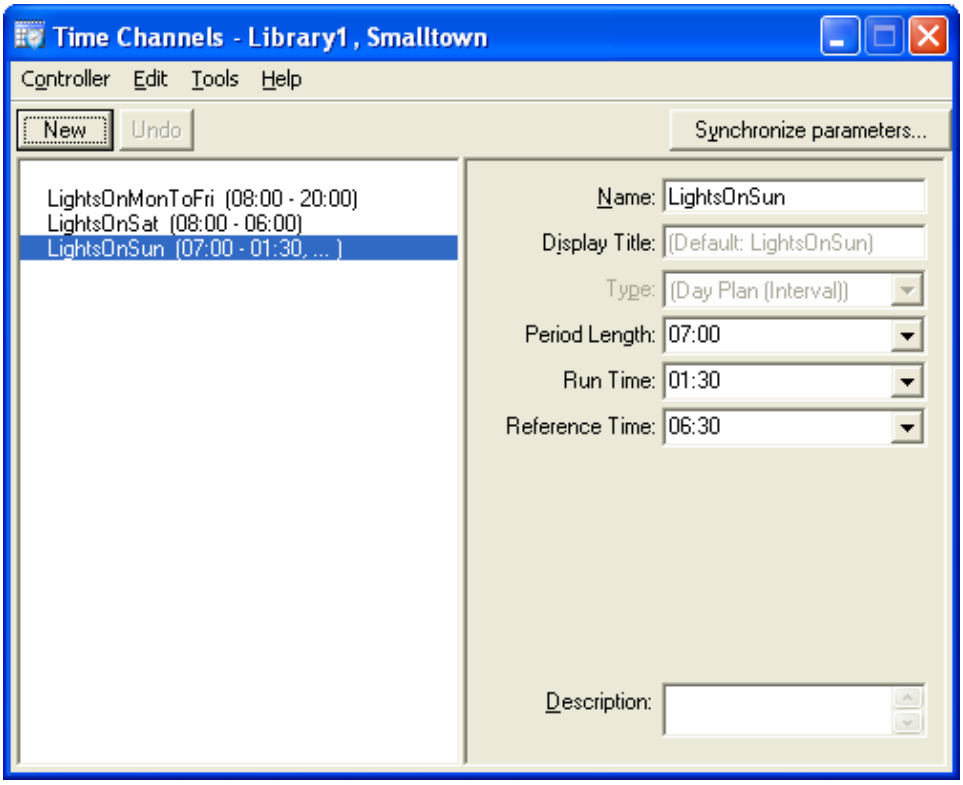
Interval

For Day Plan (Interval) the interval between the periods, the run time for each period and a reference time that specifies the time the first interval should start (normally at 00:00) are configured.

Create and configure

Define a day plan of the type Day Plan (Interval).

- Click on the button **New** in Time Channels and select **Day Plan (Interval)** in the attribute **Type**.
- Enter the name **LightsOnSun** in the attribute **Name** and click on the button **Add**.
- Specify the period length **07:00**, the run time 1**:30** and the reference time **06:30** and click on the button **Change**.



Time Schedule

Use

Time schedules are used to define which day plan that is to be used on the different days of the week and on holidays.

Max 30

A time schedule is created by selecting **Time Schedule** in the attribute **Type**. Normally one time schedule is created for each time channel. A maximum of 30 time schedules can be created in a controller.

Naming

A good practice is to give the time schedule the same name as the time channel with the addition Schedule, e.g. NormalSpeedSchedule.

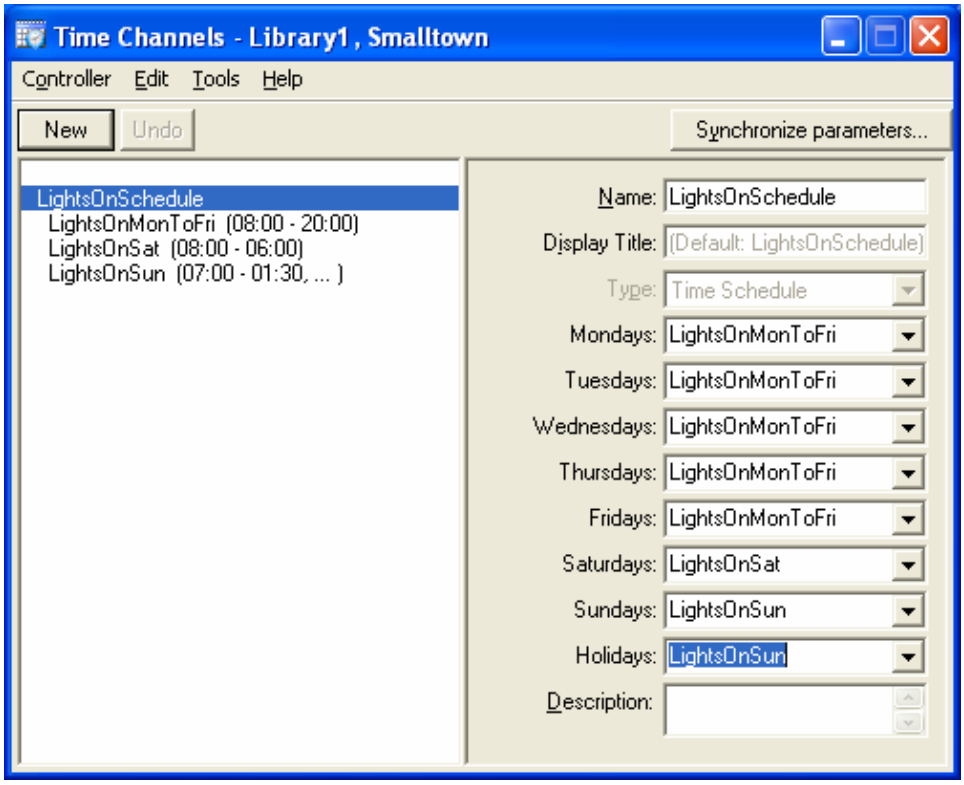
Holidays

Holidays can be unlinked from a time schedule by deleting the text in **Holidays**.

Create and configure

A time schedule can now be defined.

- Select the first empty line above the day plans in the list box to the left (to insert the time schedule above the day plans). Click on the button **New**, select **Time Schedule** in the attribute **Type** and click on **Add**.
- Give the new time schedule the name **LightsOnSchedule**.
- Select the day plan **LightsOnMonToFri** in the attributes **Mondays – Fridays**.
- Select the day plan **LightsOnSat** in the attribute **Saturdays**.
- Select the day plan **LightsOnSun** in the attributes **Sundays** and **Holidays**.



Time Channel

Use

Time channels are used to control switch-on and switch-offs of one or more logical variables in a controller. How this is done is described below in the section ***Binding Time Channels to Variables***.

Max 30

A time channel is created by selecting **Time Channel** in the attribute **Type**. A maximum of 30 time channels can be created in a controller.

Name and title

The attribute **Name** is the internal technical name for the time channel and it may not contain spaces. The text that is to be displayed to the operator, on the display and in EXO4, is specified in **Display Title**. It is appropriate to give the time channel a name that describes its function in the application, e.g. NormalSpeed.

Time schedule

Each time channel must refer to a time schedule. The time schedule that is to be used for the time channel is specified in the attribute **Time Schedule**.

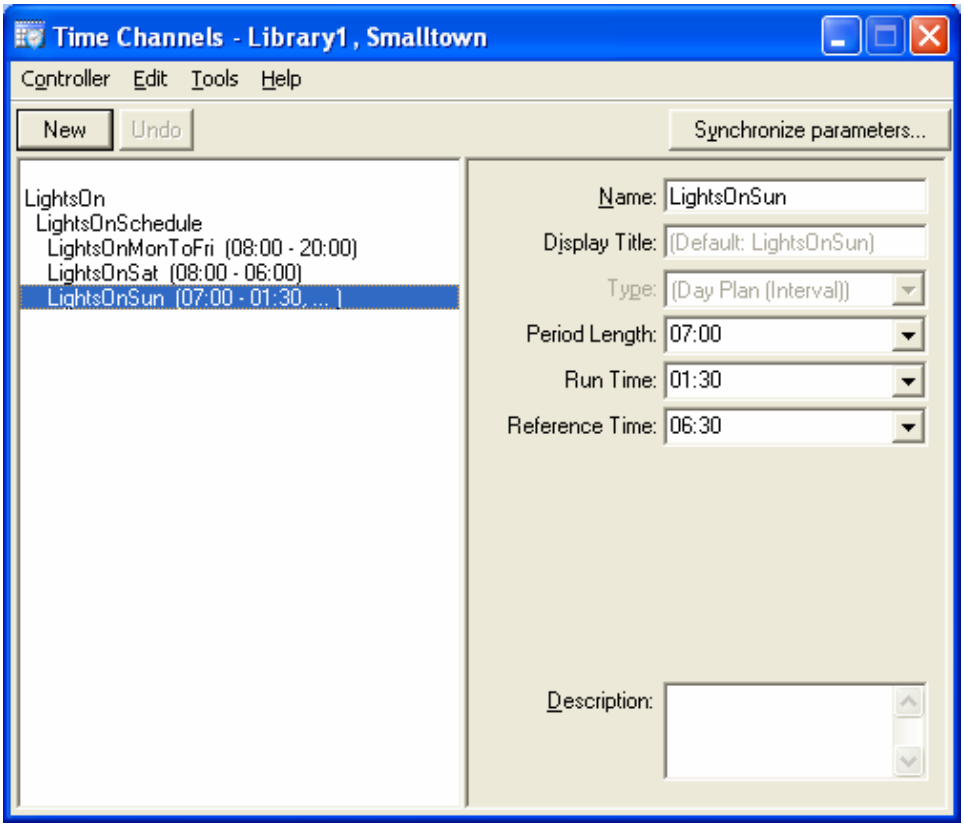
Empty

The attributes **Special Calendar 1-3** that are displayed when you press the button **More**>> should always be left empty for time channels.

Create and configure

Now, defining the time channel remains.

- Select the first empty line in the list box to the left again. Click on the button **New**, select **Time Channel** in the attribute **Type** and click on **Add**.
- Give the new time channel the name **LightsOn**.
- The time schedule **LightsOnSchedule** will be selected in the attribute **Time Schedule**.



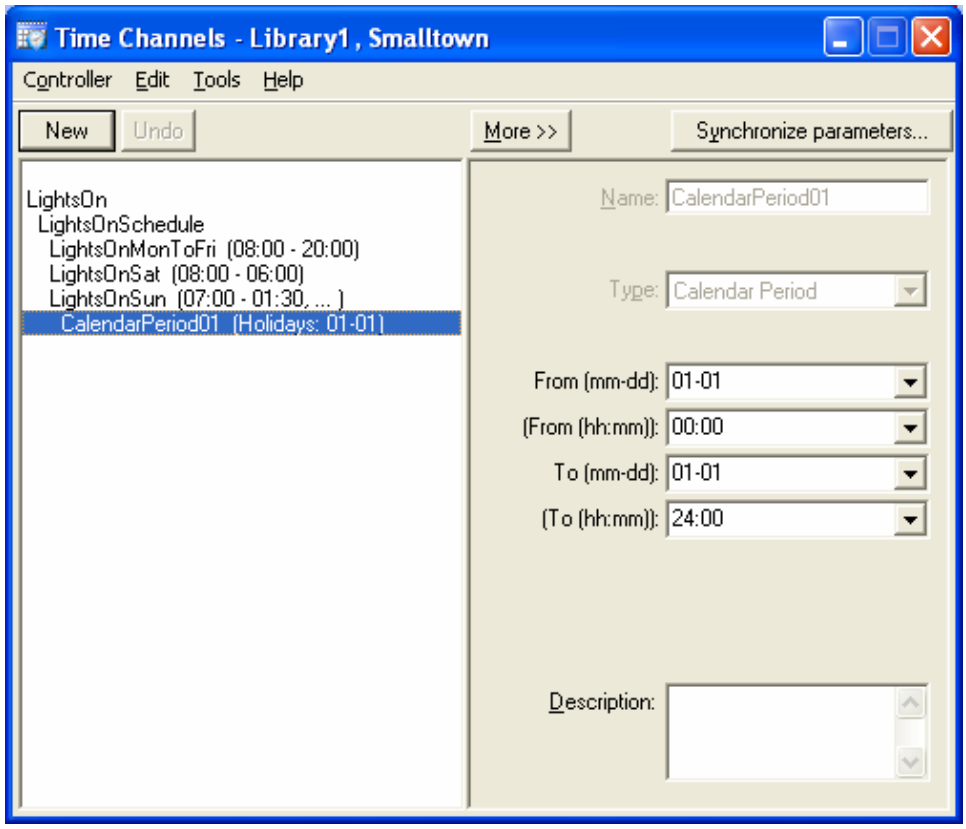
Calendar Periods

Use Calendar periods are normally used to define holidays.

From – To For each calendar period a start date, a start time, a stop date and a stop time are configured. A calendar period cannot extend over the turn of the year.

Create and configure Define two calendar periods below the day plans.

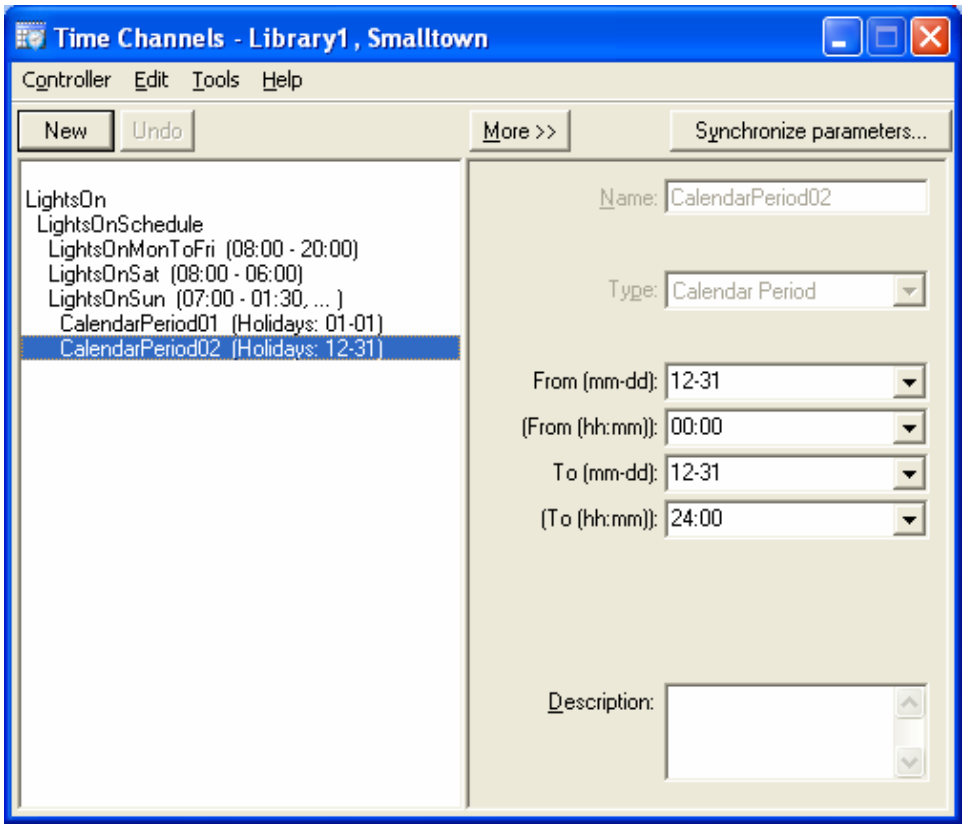
- Select the last day plan two add the calendar period below the day plans and click on **New**.
- Select **Calendar Period** in the attribute **Type** and click on **Add**.
- Print **24:00** in the attribute **(To (hh:mm))** and click on **Change**. This defines the calendar period January 1st.



Name

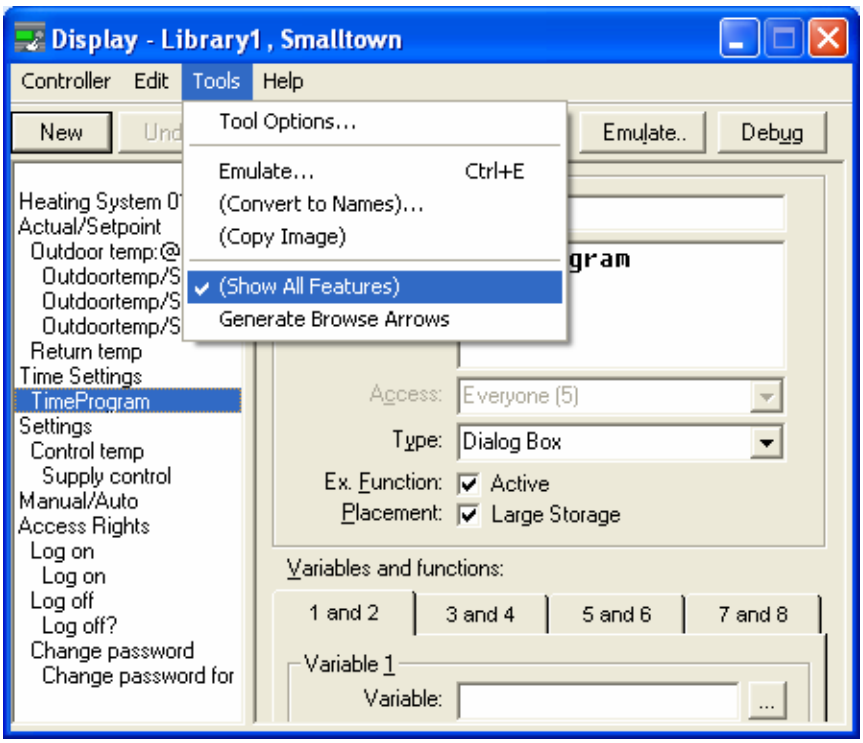
When you have configured an actual period of time (in this case To 24:00), the left list will display the date(s) of the calendar period.

Since a calendar period can not extend over the turn of a year, add a calendar period for 31st December.



Save Save all configurations that have been made with the menu command Controller – Save.

Reload When changes have been made to the time channels, the controller normally needs to be reloaded. As we are going to bind the time channel to a variable in the controller, we will wait until this is done.



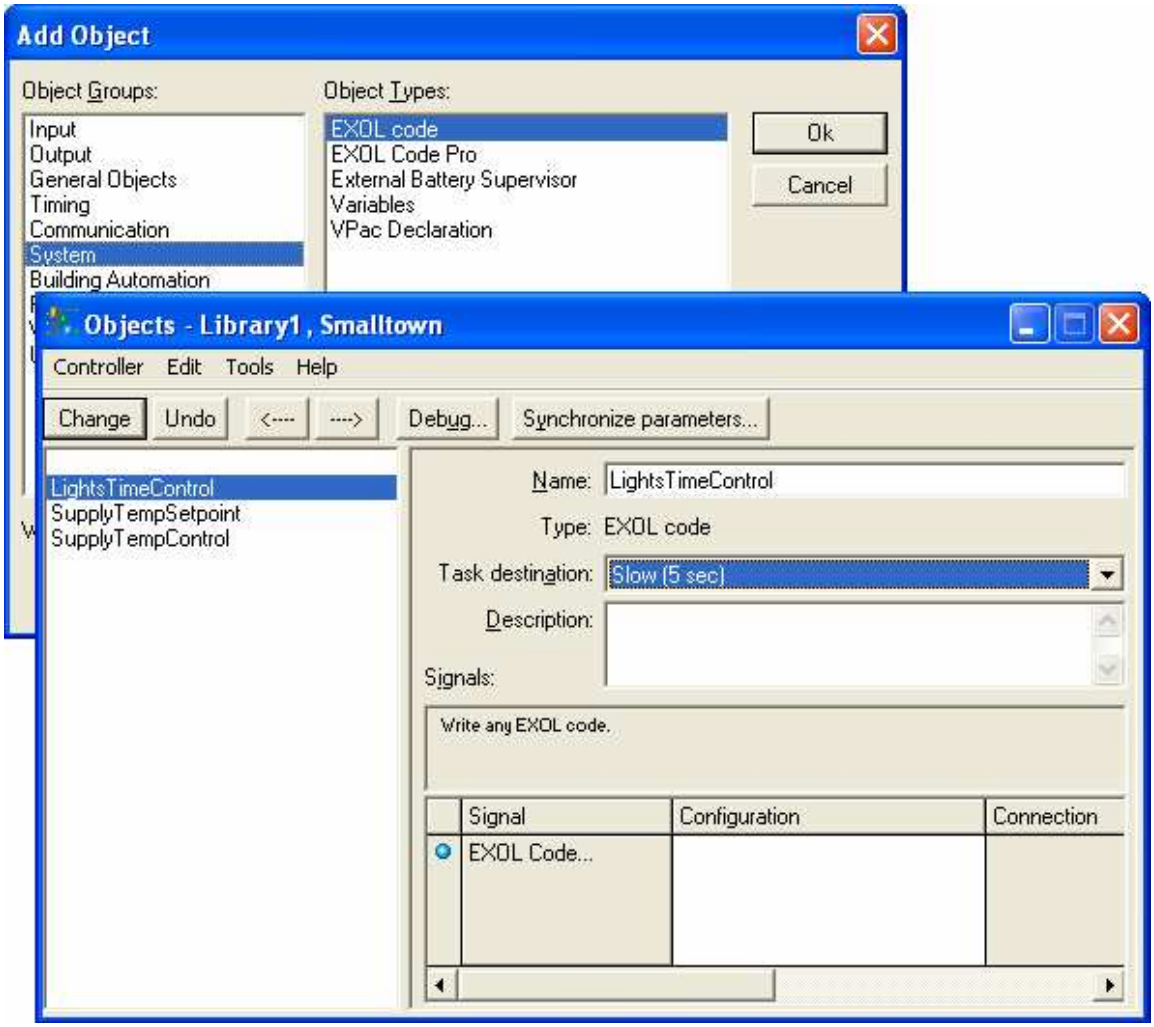
Binding Time Channels to Variables

Logic variable Each time channel has a logic interface variable that can be connected to, e.g. a digital output or to a logic variable in an object. The time control program generates a signal with the value 0 for off and the value 1 for on.

Name The interface variable of the time channel is named according to the principle **`TimeGroup`**, followed by the name of the time channel, e.g. **`TimeGroupLightsOn`**.

Example In the following example, an object of the type EXOL Code will be used to connect the time channel variable to a digital output.

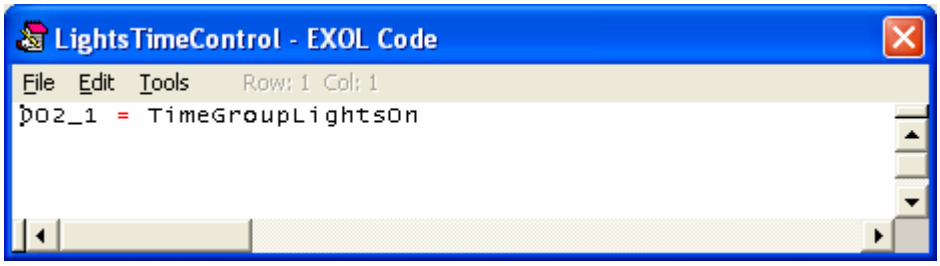
- Select the controller Library1 in Project Builder, and open the tool Objects.
- Add a new object by choosing the object group **System** and the object type **EXOL code** in the dialog **Add Object**.
- You can give the object a suitable name, e.g. LightsTimeControl.
- Select the object's destination file. In the example **Slow (5 sec)** has been selected, because the periodicity 5 seconds is sufficient.

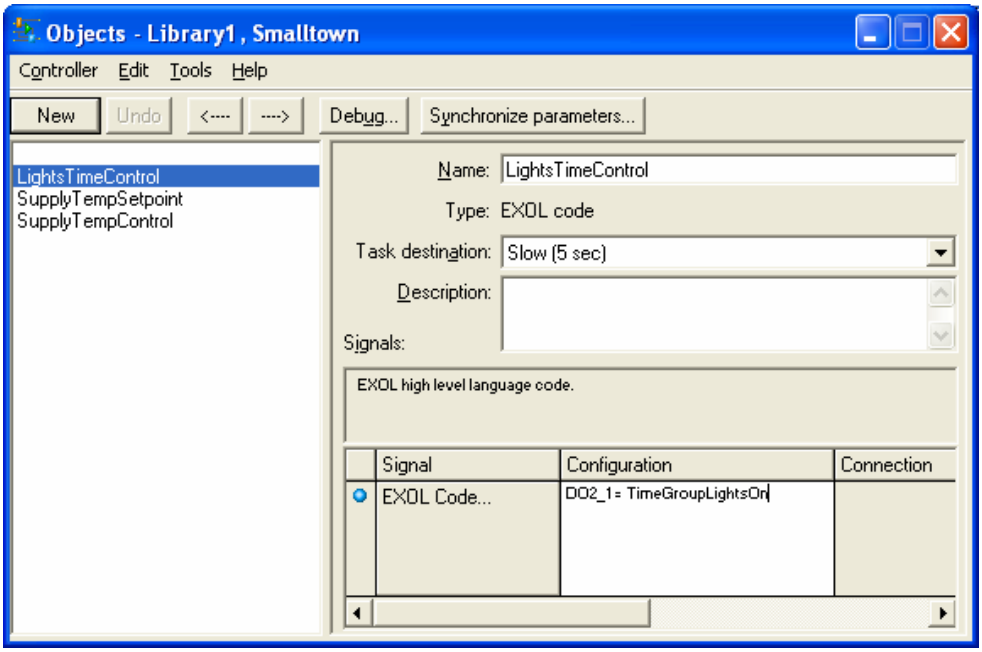


- Click on the button **EXOL Code…** to open an editor and enter the following code:

  `DO2_1 = TimeGroupLightsOn` (if you use Library1).
  In CityHall it will be: **`DigOut1 = TimeGroupLightsOn`**.

  This will update the digital output with the value of the interface variable in the time channel.
- Close the editor window and click the button **Change.** Save and exit Objects.





Reload and test Before you can test the time channel in the controller, it has to be reloaded.

EXO4

EXO4 Time Channels and EXO4 Calendars

Objects The objects EXO4 Time Channels and EXO4 Calendars are new types of objects for EXO4 in EXO 2008. They are created and configured in the tool EXO4 Signals.

Use Time channels and calendars in EXO4 are running (invisibly) on the main computer. They can be used for central time control of functions in the controllers and/or the computer. Each time channel has its own time schedule, special days and a common holiday calendar.

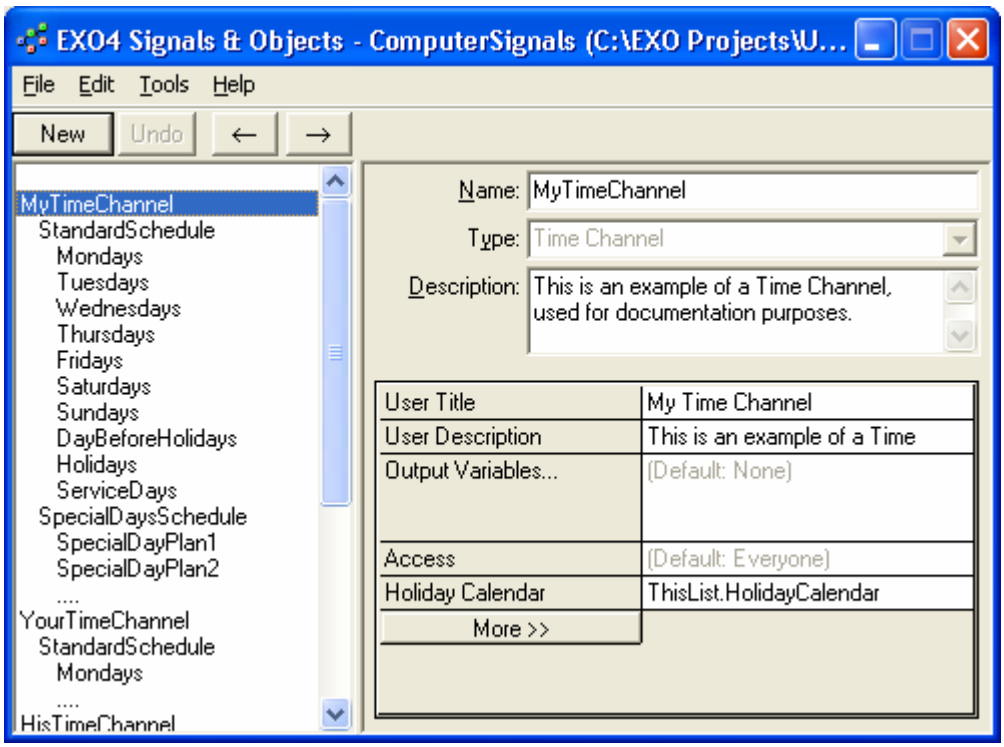
Viewer applications The viewer applications EXO4 Time Channel Viewer and EXO4 Calendar Viewer show the EXO4 time channels and calendars graphically for the EXO4 operator. The operator can change the time period settings, create new special days, select calendar days, etc. The changes made at runtime will be saved directly in the configurations files on the main computer.

In EXO4 2008 there is only a simple tool for creating and configuring EXO4 time channels and calendars. The documentation is also limited. It is possible to create and configure EXO4 time channels and calendars but it is difficult. Small configuration errors might cause EXO4 to crash.

EXO4 Signals & Objects Tool

Open

The tool EXO4 Signals & Objects can be opened in Project Builder by selecting the folder EXO4 in Project Builder and then the menu command **Config – EXO4 Signals (of Main Computer)**. It can also be opened with the button  .



ComputerSignals

The Main Computer template has a general signal list, called **`ComputerSignals`**. You can put any signals and objects in that file, including time channels and calendars. If you have a lot of signals & objects you can organize them into folders. You also have the possibility to create more signal lists to put signals and objects into. First you must add the signal list in the file **`Comp:\SigDir.Eo4`**, which you can open by selecting the main computer and execute the command **Config - More - EXO4 Signal Lists**. Then you must create the file manually, either by copying an existing file or by creating an empty text file. Signal list files must always have the file extension .Exo4SignalList.

Folder

A folder can be used as a container for other signals and objects both during configuration and at runtime (when exposing signals and objects for EXObasic). It has no functionality of its own. If you for example put a signal **`MySignal`** in a folder **`MyFolder`**, it will be exposed as **`ComputerSignals.MyFolder.MySignal`**.

EXO4 Time Channels

EXO4 object type

EXO4 Time Channels is an EXO4 object type that can be used for central time control of functions in the controllers and/or the computers. Each time channel has its own time schedule, special days and uses a common holiday calendar.

Output value

Each time channel is an object with an output value that can be controlled automatically by the time channel or manually by the user. A time channel normally has two states (*off* and *on*) but it is possible to use up to four states. Each state corresponds to a value, which is the output value of the time channel. The output value can be connected (*bound*) to one or more variables in the controllers and/or the computers. It can not be bound to variables in dial-up connected controllers.

Standard schedule

Each time channel has a *standard schedule*. It has a separate day plan for each day of the week, with up to four time periods for each day.

Holiday calendar

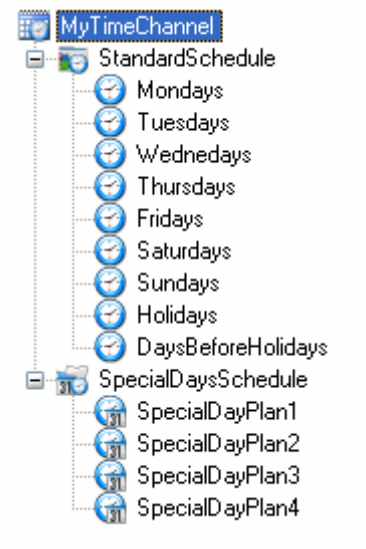
The time channel also has a reference to a holiday calendar, which (normally) is shared by all time channels. The holiday calendar specifies a number of *holiday periods*. Each period belongs to one (of several possible) *day types*, like *holidays*, *days before holidays*, etc. The standard schedule of the time channel also has a day plan for each day type in the holiday calendar. When the current day is specified in the holiday calendar, the day plan for the corresponding day type is used.

Special days schedule

Beside the standard schedule and the holiday calendar, each time channel has also a *special days schedule*. Each day in the special days schedule has its own day plan, with time periods valid for that day and that time schedule only.

Structure

The structure of a time channel is shown graphically below:



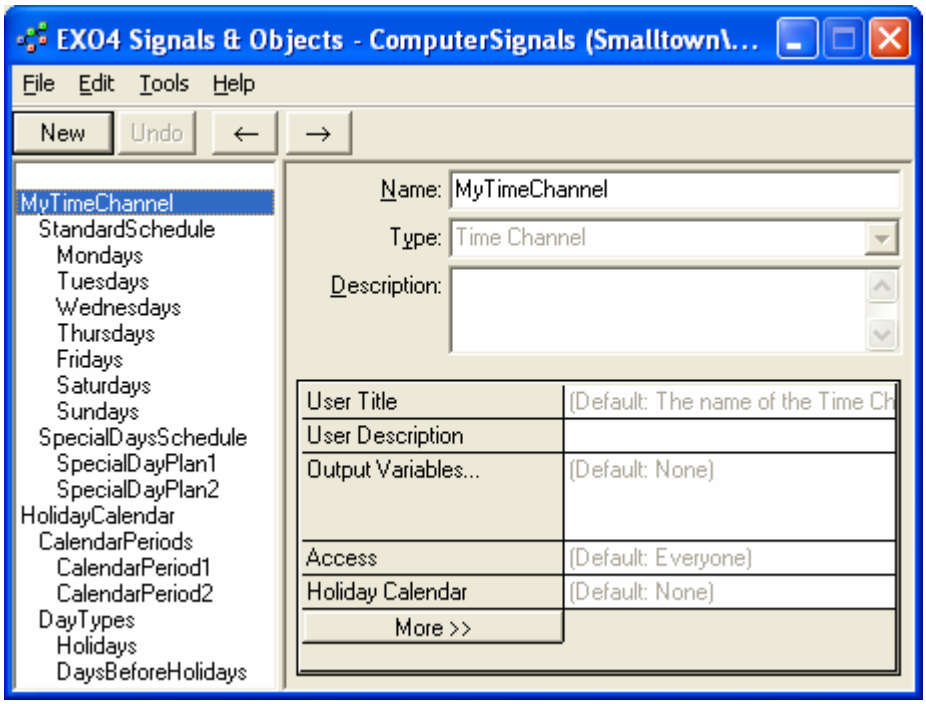
Create

To create time channels in the tool EXO4 Signals and Objects, you have to create a number of objects manually, and configure them correctly, as below:

- Each **Time Channel** must have a **Time Schedule** called **`StandardSchedule`**.
- The *standard schedule* must have one **Day Plan** for each day of the week, called **`Mondays`**, **`Tuesdays`**, **`Wednesdays`**, **`Thursdays`**, **`Fridays`**, **`Saturdays`** and **`Sundays`**.
- Each time channel can have a reference to a holiday **Calendar**. You configure the reference at the attribute **Holiday Calendar** (of the time channel object).
- The *standard schedule* must also have one day plan for each **Day Type** in the referenced *holiday calendar* (if any), with the same names as the corresponding *day types*.
- Each *time channel* must have a **Folder** called **`SpecialDaysSchedule`**.
- The *special days schedule folder* can contain any number of **Day Plans**, with the name **`SpecialDayPlan`***n*. The attribute **Date** must be configured for all these day plans.

You do not have to configure the *time periods* or create any *special day plans* in the Signals & Objects tool. The EXO4 operator (or you) can do it with the EXO4 Time Channel Viewer application. The changes made at runtime will be saved directly in the configuration files on the main computer.

Time Channel Objects



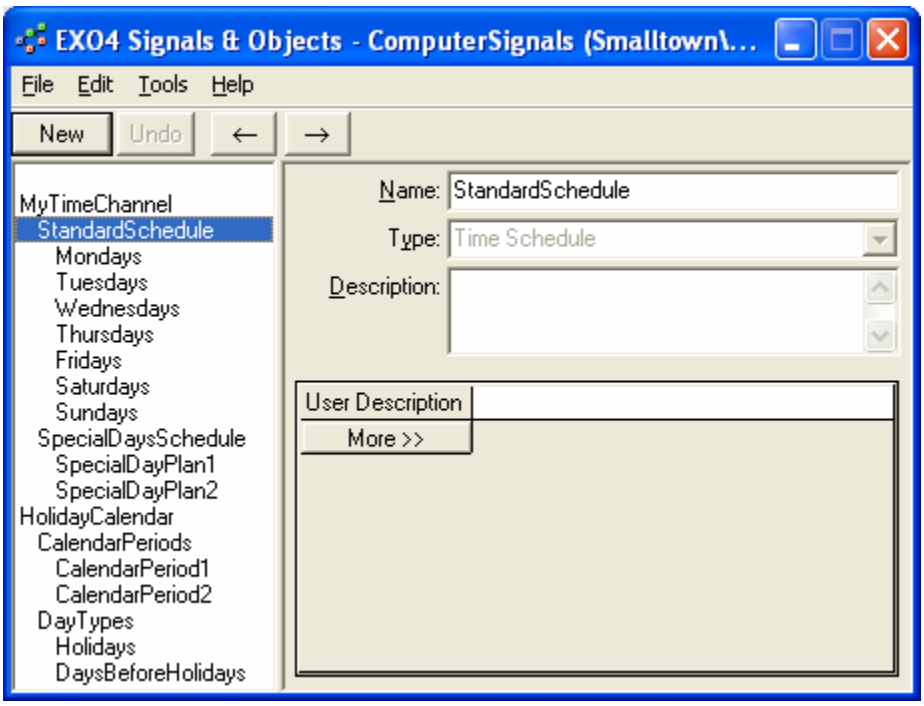
Attributes

Descriptions of the most useful attributes:

- **User Title** and **User Description**: Displayed in the EXO4 Time Channel Viewer applications.
- **Output Variables**: The variables that the output value of the time channel is bound to. Each time the time channel changes its state, these variables will be updated. They can be variables in the controllers and/or the computers.

  If you wish to bind the output value to more than one variable, they should be separated with commas.
- **Access**: The Access level (or access category) required to allow the EXO4 operator to change the settings of the time channel with the EXO4 Time Channel Viewer applications.
- **Holiday Calendar**: Reference to the holiday calendar. The reference is the fully exposed name (of the calendar) for EXObasic at runtime. If the calendar is placed in the same signal list as the time channel, the root object reference **`ThisList`** can be used e.g. **`ThisList.HolidayCalendar`**. Otherwise, the name of the signal list must be used as root object. Example: **`ThisSignalList.HolidayCalendar`**.

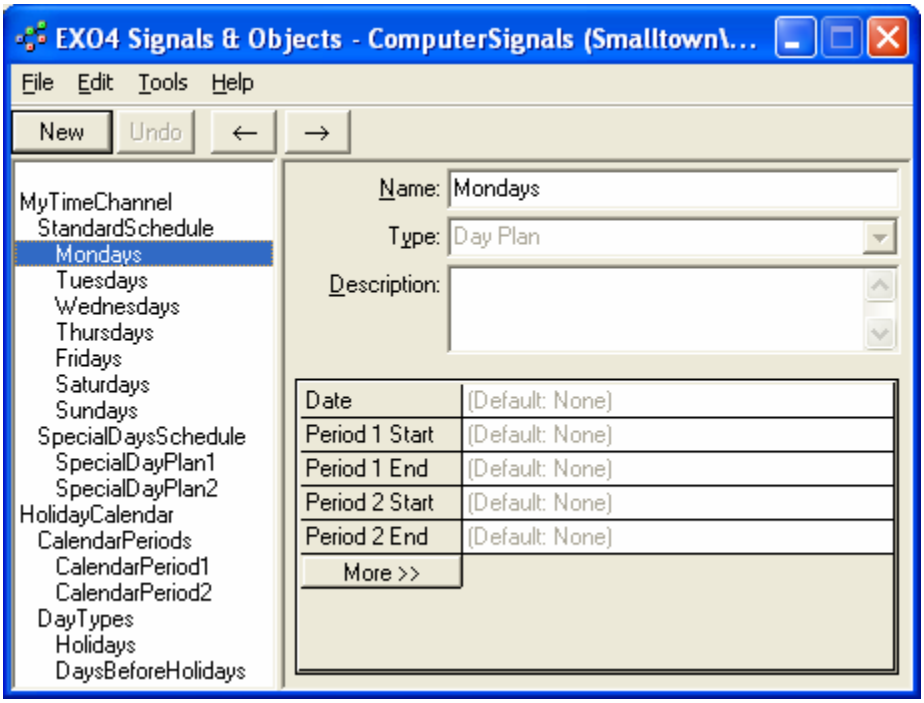
Time Schedule Objects



Attribute

The attribute **User Description** will be shown for the EXO4 operator in the EXO4 Time Channel Viewer application.

Day Plan Objects



Attributes

Descriptions of the most useful attributes:

- **Date**: The date for this day plan. Should be configured for *special day plans*. The format is always: *YYYY-MM-DD*. Example: **`2007-09-04`**.

- **Period** *n* **Start**: Start time for time period *n*. The format is always: `HH:MM`. Example: **`08:00`**.
- **Period** *n* **End**: End time for time period *n*. The format is always: `HH:MM`. Example: **`17:00`**.

EXO4 Calendars

EXO4 object type

EXO4 Calendars a general object type that can be used for any purpose of its own, but it is normally used as a holiday calendar for the time channels.

Share

All time channels normally share one holiday calendar.

Configure

Each calendar configures a number of day types, like holidays, days before holidays, service days. The calendar has a number of holiday periods. Each period belongs to one of the day types.

Output value

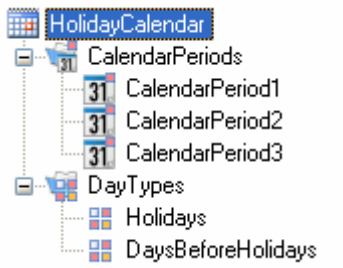
Each calendar is an object with an output value that is controlled automatically by the calendar. Each day type corresponds to a value, which is the output value of the time channel. The output value can be connected (bound) to one or more variables (similar to time channels).

Not bound

Calendars used as holiday calendars for time channels are however not bound in that way. Instead the time channels have a special reference to their holiday calendars.

Structure

The structure of a calendar is shown graphically below:



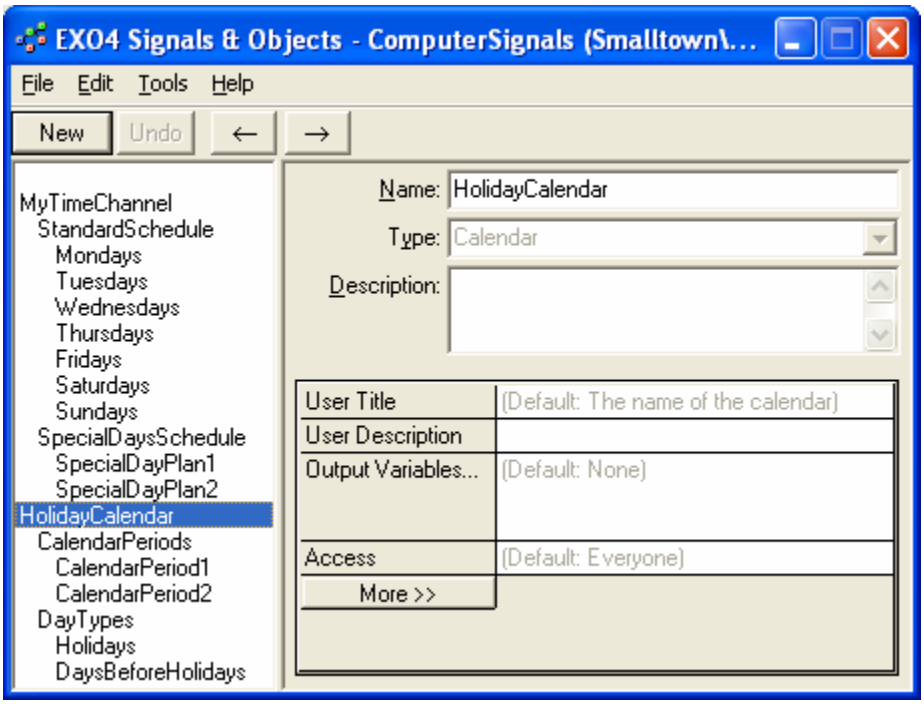
Create

To create a calendar in the tool EXO4 Signals and Objects, you have to create a number of objects manually, and configure them correctly, as below:

- Each **Calendar** <u>must</u> have a **Folder** called **`CalendarPeriods`**.
- The *calendar periods folder* <u>can</u> contain any number of **Calendar Periods**, called **`CalendarPeriod`***n*.
- Each *calendar period* <u>must</u> be configured with a **Start Date**, an **End Date** and belong to a **Day Type**.
- Each calendar <u>must</u> have a **Folder** called **`DayTypes`**.
- The *day types folder* must contain one or more **Day Type** objects.

You do <u>not</u> have to create any *calendar periods* in the Signals & Objects tool. The EXO4 operator (or you) can do it with the EXO4 Calendar Channel Viewer application. The changes made at runtime will be saved directly in the configuration files on the main computer.

Calendar Objects



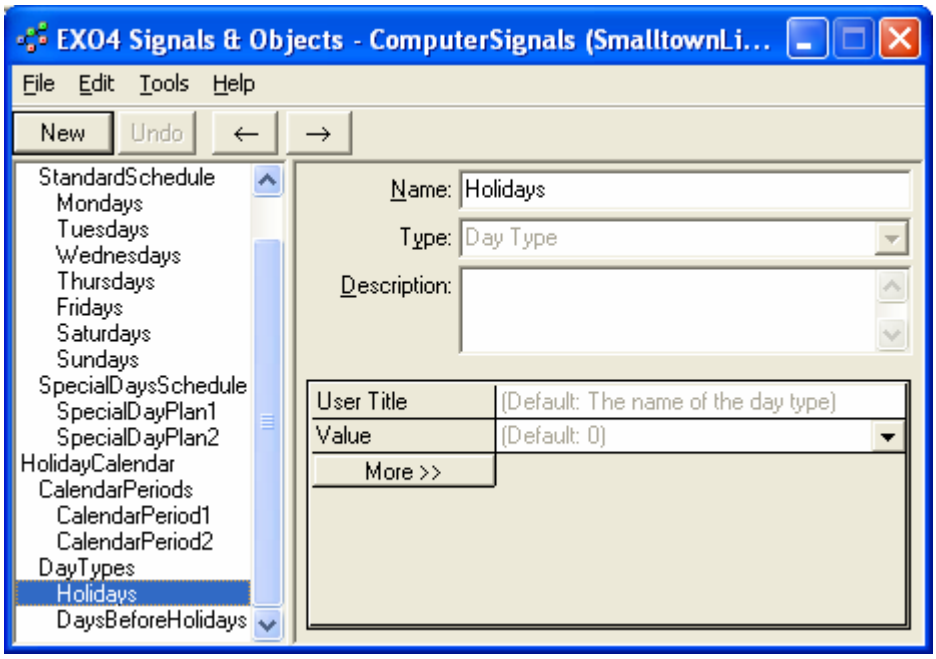
Attributes

Descriptions of the most useful attributes:

- **User Title** and **User Description**: Displayed in the EXO4 Calendar Viewer applications.
- **Output Variables**: The variables that the output value of the calendar is bound to. Each time the calendar changes day type, these variables will be updated. They can be variables in the controllers and/or the computers.

  This should not be used for calendars that are used as *holidays calendars* for time channels. Instead the time channels have a special reference to their holiday calendars.
- **Access**: The Access level (or access category) required to allow the EXO4 operator to change the settings of the calendar with the EXO4 Calendar Viewer applications.

Day Type Objects



Attributes

Descriptions of the most useful attributes:

- **User Title**: Displayed in the EXO4 Calendar Viewer applications.
- **Value**: The output value for this day type. This is not needed if the calendar is used as a *holiday calendar* for time channels only.

Presentation

Controller Display

Display

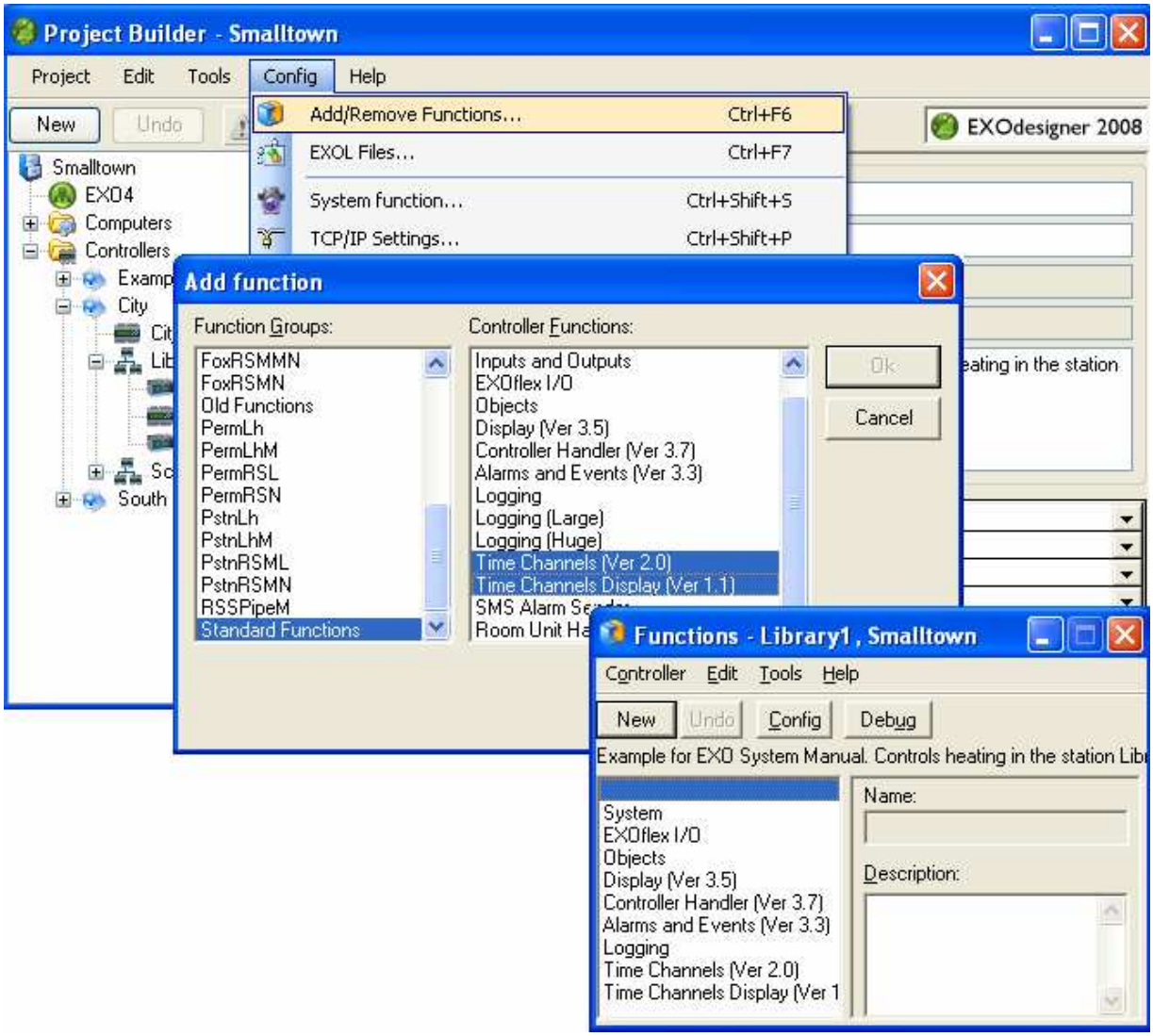
To be able to inspect and change the time settings on the display of the controller, a dialog box for this has to be added in the tool Display. If you choose to add Time Channels to the controller when it is created, this will be added automatically.

Adding Time Channels and Time Channels Display

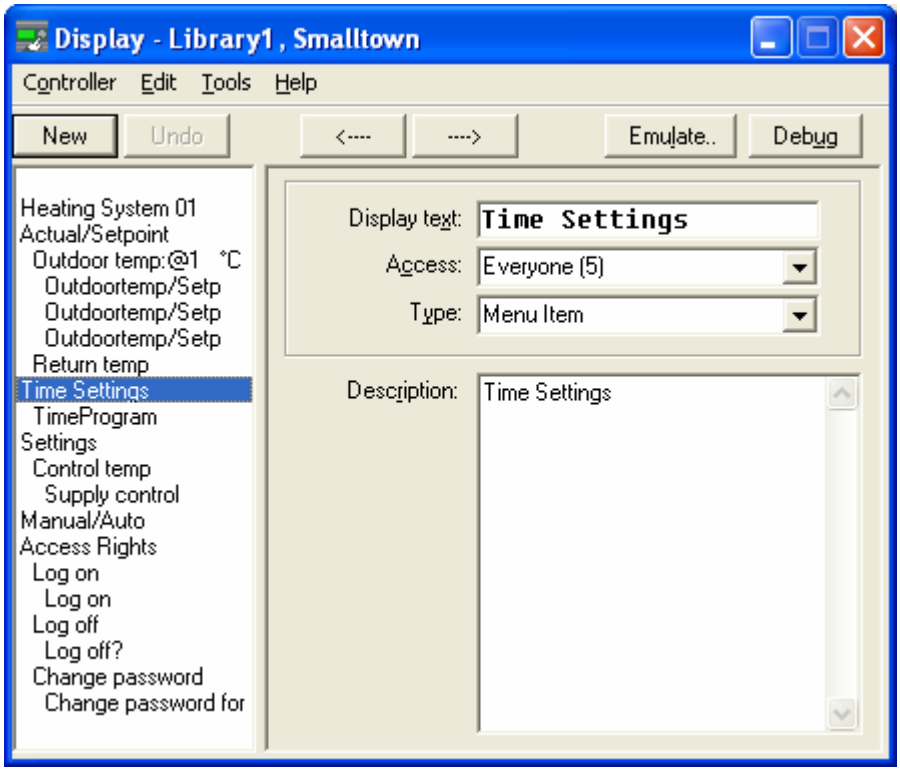
Adding afterwards

If Time Channels and Time Channels Display were not added when the controller was created, you can add them afterwards.

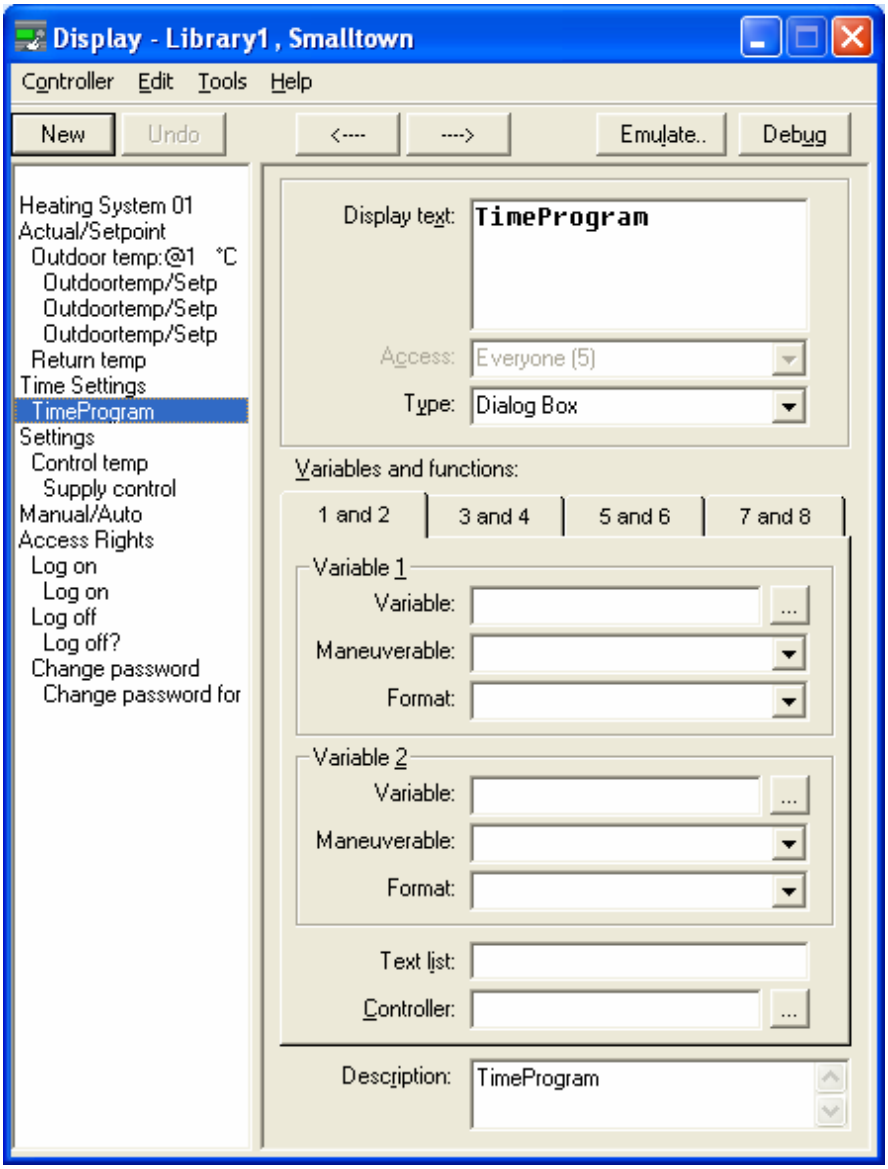
- Select the menu command **Config – Add/Remove Functions** in Project Builder.
- Click on **New** in the dialog Functions.
- Select the controller functions **Time Channels** and **Time Channels Display** and click on **Ok**.



- Open the Display tool for the controller you use.
- Select the line **Return temp** in the list box and click on **New**.
- Enter **Time Settings** in the attribute **Display text**, check that the type is **Menu Item** and click on **Add**.



- Select the line **Time Settings** in the left list, and add a dialog box by clicking on **New**.
- Select **Dialog Box** in the attribute **Type**.
- Enter **TimeProgram** (exactly in this way!) in the attribute **Display text**.
- Move the new item to the right to make a one-step indentation in proportion to the menu Time settings, using the button **--->.**



To make the Time Channels available from the display, one thing is left to do:

- Select the menu item **Tools – (Show All Features)**.
- Select the checkbox **Ex.function Active**.
- Click the button **Change**.
- Save the configuration.

EXO4

Presentation

In EXO4, presentation of the time channel's operating mode, and possibility to change it can be made with window elements or the Time Channel Viewers and Calendar Viewers of EXO4. Window Elements to Indicate Operating Mode

Run mode

A window element that indicates the current run mode for a time channel can be created in a process window as, e.g. a color change element. The variable **`TimeGroup`***`TimeChannel`* is specified in the attribute **Value** of the element, and the attribute **Colors** is specified with 2 colors, e.g. **`Grey,Yellow`**, to indicate on and off, respectively.

Changing run mode

The operator can also be given the possibility to change the function of the time channel in, e.g. a text change element. The variable **`TimeGroupStatus`***`TimeChannel`* is then connected to the element and the attribute **Texts** is given the following value:

`"Always off","Always on","Forced off","Forced on",Auto`

(when an option contains spaces, it must be enclosed by quotation marks (`"`)).

Time Channel Viewers and Calendar Viewers

Two applications

There are two types of Time Channel Viewers and Calendar Viewers in EXO4:

- Viewer applications that show the objects EXO4 Time Channels and EXO4 Calendars graphically for the EXO4 operator. The objects are created in the tool EXO4 Signals.
- Viewer applications that show the time channels and calendars in a controller graphically for the EXO4 operator. The time channels are created in the controller's tool Time Channels.

Descriptions

The user interface of the viewers is described in the section ***Presentation*** at the beginning of this chapter.

Open

To let the EXO4 user open the Time Channel Viewers, you should configure possibility to open them from the EXO4 windows, with buttons, click areas, menus, etc. The viewers are opened with the EXObasic command `Shell`.

The Calendar Viewers are normally opened from the Time Channel Viewers without any extra configuration.

Descriptions of how to open the viewers and compatibility with earlier versions of EXOdesigner (EXOapt) are described below.

EXO4 Time Channel Viewer

```
Shell "Prod:\Program\EXO4TimeChannelViewer.Exe TimeChannel=Computer-
Signals.MyTimeChannel"
```

Parameter

The parameter **`TimeChannel`** must be configured with the exposed name of the time channel, i.e. the (exposed) name of the signal list, a dot, and the name of the time channel.

EXO4 Calendar Viewer

Not open

The EXO4 Calendar Viewer is normally opened from the EXO4 Time Channel Viewer without any extra configuration.

Open

If you wish, it is possible to let the EXO4 user open the EXO4 Calendar Viewer directly from the EXO4 windows with buttons, click areas, menus, etc. The viewer is opened with the EXObasic command **`Shell.`** Example:

```
Shell "Prod:\Program\EXO4CalendarViewer.Exe Calendar=ComputerSignals.Holi-
dayCalendar"
```

Parameter

The parameter **`Calendar`** must be configured with the exposed name of the calendar, i.e. the (exposed) name of the signal list, a dot, and the name of the calendar.

Controller Time Channel Viewer:

```
Shell "Prod:\Program\ControllerTimeChannelViewer.Exe TimeChannel=My-
Controller.MyTimeChannel"
```

Parameters

The parameter **`TimeChannel`** must be configured with the name of the controller, a dot, and the name of the time channel. This works with controllers saved with the Time Channels tool in EXOdesigner 2008 only.

Controller Time Channel Viewer supports the following command line parameters:

Parameter	Default	Description
`Title`	*Time Channel Title*, ***Controller Title***	The title of the time channel for the EXO4 operator. Shown by the Controller Time Channel Viewer application.
`UserDescription`	None	The description of the time channel for the EXO4 operator. Shown by the Controller Time Channel Viewer application.
`EnableManAutoSelect`	`Yes`	Selects if the EXO4 user should be able to change the *man/auto mode*.
`Access`	Everyone	Access level (or access category) required to allow the EXO4 operator to change the settings of the time channel with the Controller Time Channel Viewer application.

Advanced configured

The Time Channels function for the controllers supports two advanced configuration possibilities that are not supported by the Controller Time Channel Viewer:

- Special calendars (called *Holiday Plan 1*, *2* and *3* in EXO 2005).
- Holiday periods limited to a part of a day (that is **From (hh:mm) ≠ 00:00** or **To (hh:mm) ≠ 24:00**).

The viewer will give an error message if the time channel uses any of these configurations.

Compatibility

Controllers saved with older versions of EXOdesigner (or EXOapt) can still be used. You have two choices:

- Open the Time Channels tool in EXOdesigner 2008 and resave the configuration. You do not have to upgrade the Time Schedules function (or the Time Program block) in the controller.
- Use the ordinal number of the time channel (instead of the name) to the parameter **`TimeChannel`**. The first time channel has number **`1`**, the next channel number **`2`**, etc. Example: **`TimeChannel=MyController.2`**.

Controller Calendar Viewer

Not open

The Controller Calendar Viewer is normally opened from the Controller Time Channel Viewer without any extra configuration.

Open

If you wish, it is possible to let the EXO4 user open the Controller Calendar Viewer directly from the EXO4 windows, with buttons, click areas, menus, etc. The viewer is opened with the EXObasic command **`Shell`**. Example:

```
Shell "Prod:\Program\ControllerCalendarViewer.Exe Calendar=MyController"
```

Parameters

The parameter **`Calendar`** must be configured with the name of the controller.

Controller Calendar Viewer supports the following command line parameters:

Parameter	Default	Description
`Title`	**Holiday Calendar,** ***Controller Title***	The title of the calendar for the EXO4 operator. Shown by the Controller Calendar Viewer application.
`UserDescription`	None	The description of the calendar for the EXO4 operator. Shown by the Controller Calendar Viewer application.
`Access`	Everyone	Access level (or access category) required to allow the EXO4 operator to change the settings of the calendar with the Controller Calendar Viewer application.

Regio Time Control

Preconfigured

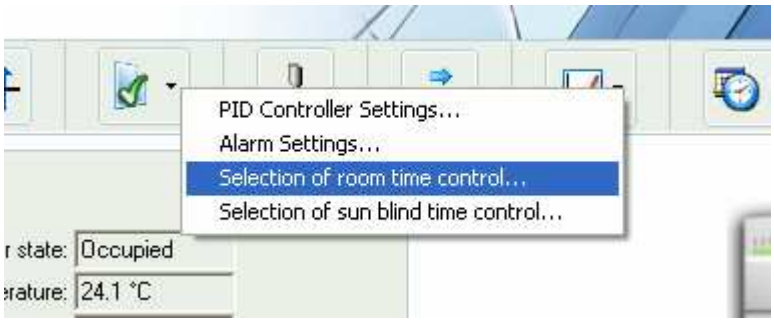
A new feature in EXO4 2008 is that the Regio window template includes preconfigured EXO4 Time Channels for Regio controllers. It is possible to use these time channels to control the Regio controller's controller state, the blind folders, and/or the lights.

EXO4 Time Channel

The EXO4 operator can bind each Regio controller to an EXO4 Time Channel directly in the Regio EXO4 window at runtime. When the controller is not bound to an EXO4 Time Channels, it is controlled by the built-in time channels in the controller (if it is a Regio Maxi).

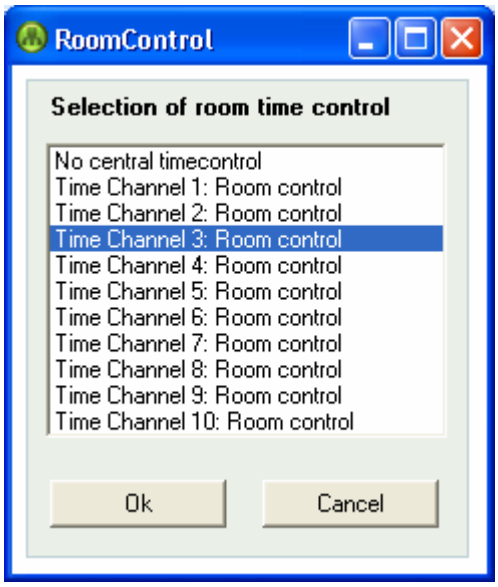
Setting menu

The user can bind the controller to a time channel from the **Settings** menu. See below:



Dialog box

The command opens a dialog box, where you can select which time channel to use. See below:



Bound

When a controller is bound to a time channel, the EXO4 user can open the EXO4 Time Channel Viewer for that time channel from the **Time Control** menu. See below:

Templates

The Regio Window templates include the following preconfigured objects:

- 10 time channels for room time control (controller state control).

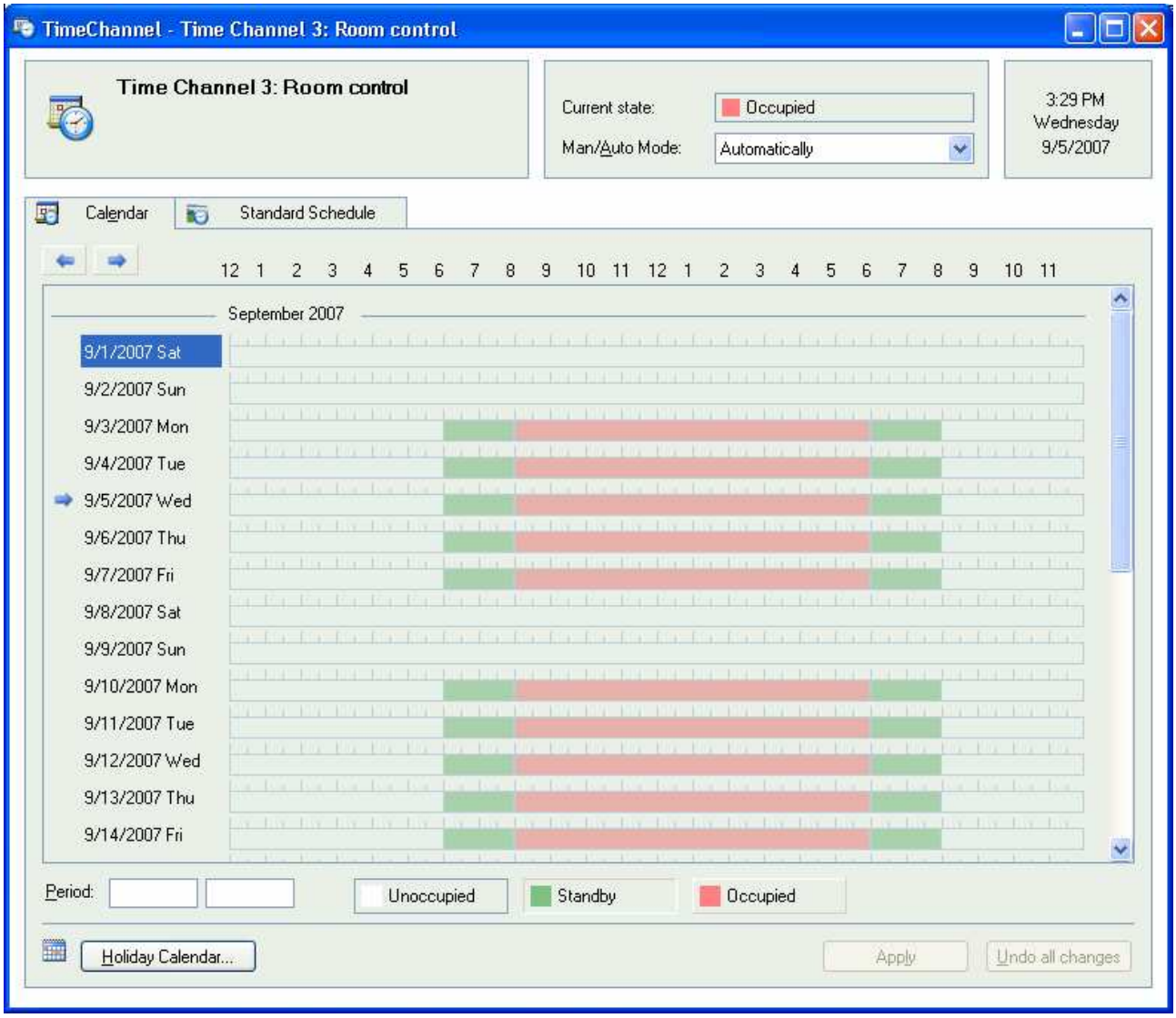
- 5 time channels for sun blind time control.
- 5 time channels for light time control.
- One holiday calendar

Signal list

All time channels are placed in a special signal list on the main computer, called **`RegioTimeChannels`**. You can open it with the EXO4 Signals & Objects tool, but it is not necessary. Everything is preconfigured to be used by the EXO4 operator without any further configuration.

Special

The time channels for room time control are special and can only be used to control Regio controller states. The time channels have three states: *Unoccupied*, *Standby* and *Occupied*. The EXO4 Time Channel Viewer looks like the below figure:

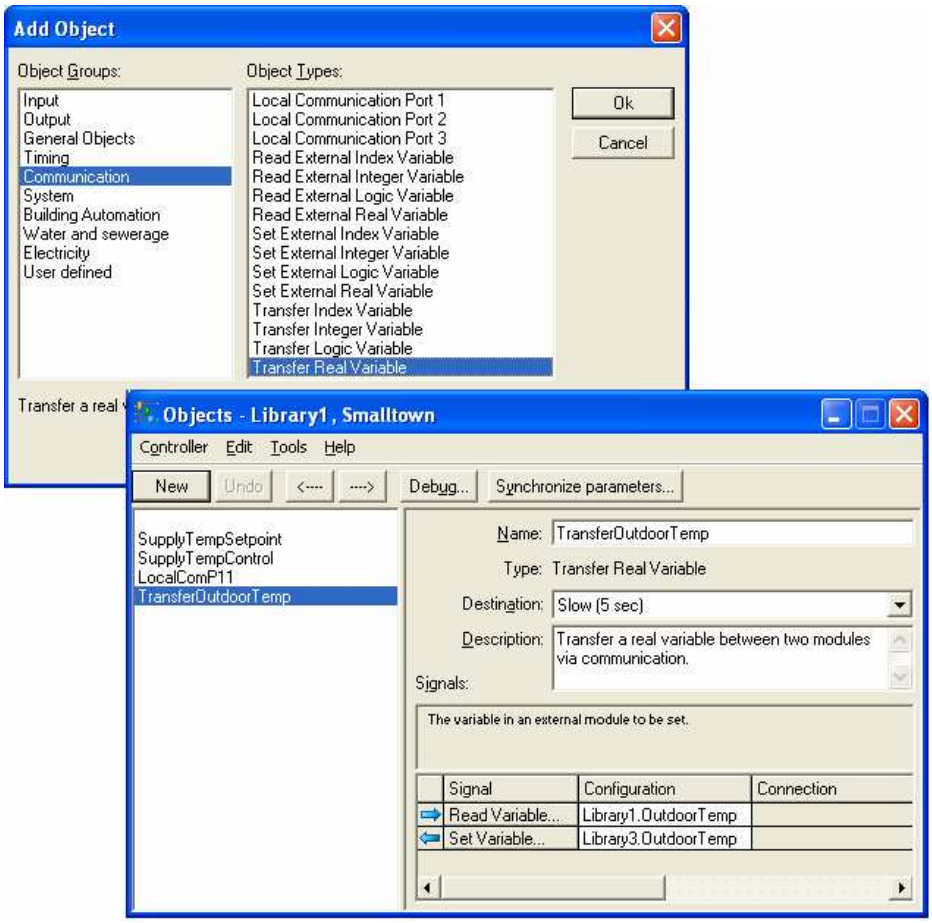


Chapter 19 **Data Transfer**

Data Transfer between Controllers within a Station

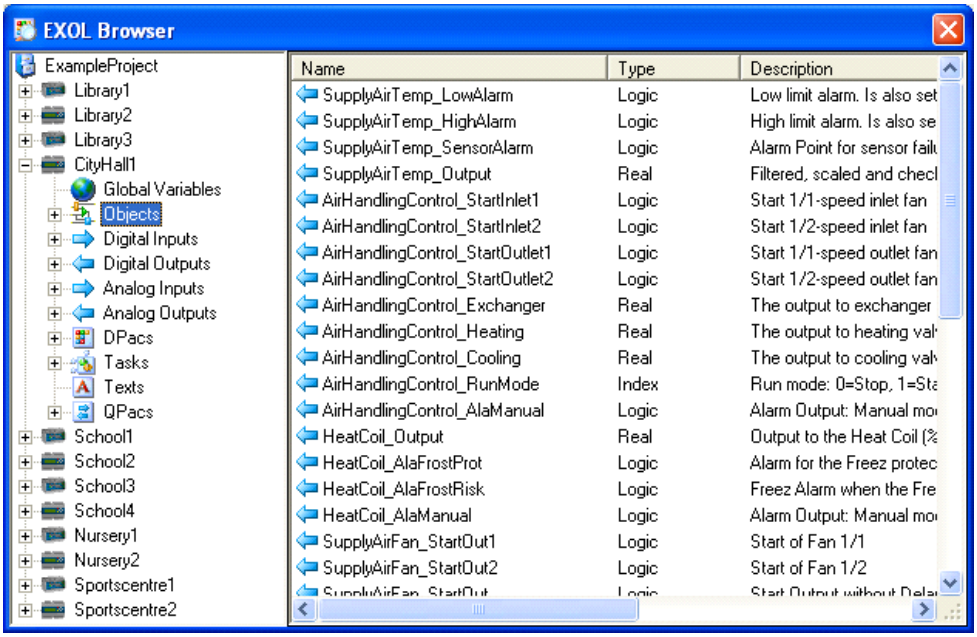
Object

Advantageously, the objects Transfer Variable, Read External Variable and Set External Variable are used for transferring variable values between controllers within a station.



Data type

These objects are available for each of the data types Logic, Index, Integer and Real. The data type of each variable is specified in the column **Type** in EXOL Browser.

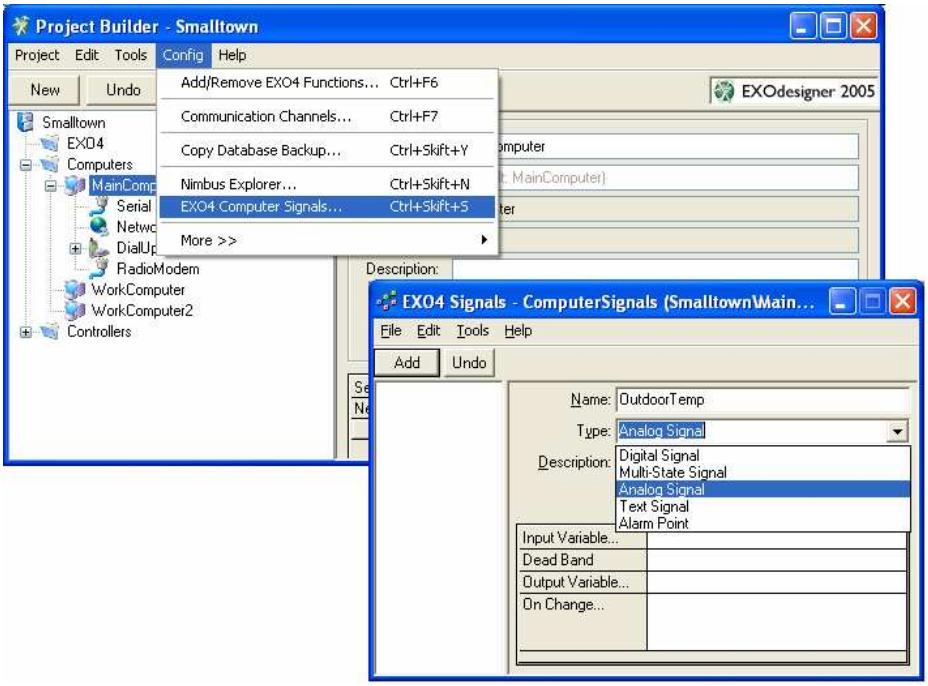


Data Transfer between Controllers in Different Stations

EXO4 signals EXO4 signals provide the possibility to transfer variable values between controllers in different stations via EXO4.

Except dial-up stations EXO4 signals do not work in dial-up stations.

Configuration EXO4 signals are configured in the window EXO4 Signals – Computer Signals.



Create an EXO4 signal in the following way:

- Open EXO4 Signals – Computer Signals by first selecting the main computer and then the menu command **Config – EXO4 Computer Signals...** in Project Builder.
- Click on the button **New**.
- Enter the signal name in the attribute **Name** and select its type in **Type**.
- Click on the button **Input Variable...** to open EXOL Browser and select the variable whose value is to be retrieved.
- Click on the button **Output Variable...** and select the variable to which the value is to be transferred.
- Enter any deadbands in the attribute **Deadband**. Deadbands should be specified primarily for analog values that are to be transferred between controllers. Using deadbands means that the receiving controller will not have to update all the time.
- If an action is to be activated when the value of the variable is changed, this is specified in the programming language EXObasic in the attribute **OnChange**

Part V Commissioning and Maintenance

Table of contents

Part V Commissioning and Maintenance

Chapter 20 Commissioning

Creating a project

An integrator typically creates the customer's project on his own computer, then he configures the controllers and performs certain tests of functionality, etc. The project is commissioned and final tests are made on-site in the customer's plant.

Commissioning

There are many considerations, mainly attributed to communication, involved in commissioning, e.g. addresses, communication ports and communication speeds.

Procedure

The commissioning procedure can be summarized in the following way:

- The commissioning of controllers on-site in the plant:
  - Setting the addresses of the controllers using the command **Setup Controller**.
  - Loading programs to the controllers using the command **Load Controller**.
  - Testing and troubleshooting.
- The commissioning of computers:
  - Installing the EXO software on the customer's computers.
  - Copying the project to the customer's main computer. Normally, work computers can run the project on the main computer using common file sharing.
  - Connecting the computers using the command **Attach** in This Computer.
  - Testing and troubleshooting. When the main computer and cables are fitted, the controllers can be accessed from the main computer. This can be tested using, e.g. EXOtest, possibly after having dialed the station from Project Builder.
- Database:
  - A database is created when the main computer is connected using the command **Attach** in This Computer.
  - The database is connected to the database manager by clicking on the button **Attach** in the tool EXO4 Databases.
  - Setting a maximum limit for the amount of memory MSDE or SQL Server may use. This is done using the command **MaxMemEXO4Db** from the command prompt.
  - Database maintenance is described in the chapter ***Databases***. Troubleshooting etc. is described in the document ***EXO4 Advanced Configuration***.

Controllers

240 V

Remember that a 240 V power outlet close to the installation is a good idea. Sometimes a 240 V outlet is placed inside the cabinet, but rarely more than one. The computer and e.g. a switch require two outlets, which means that a power strip containing several outlets is appropriate for the installation.

Connection

The Regin E-Cable is a communication converter that can be used between the computer and the EXOline port (RS485). The E-Cable is available for connections to the USB or the RS232 port of the computer. An appropriate RS232 cable may also be needed. The RS232 cable with connectors for EXOflex port #1 is sold by Regin. In some cases, a crossed TP cable (if the Ethernet port supports this), or a simple Ethernet switch and two straight TP cables are also needed.

Setting the Addresses of the Controllers

Setting addresses

When delivered from the factory, the controllers have the address 254:30. The first thing that you need to do in the customer's plant is to set the controllers' addresses to the ones in the project. This is made by selecting the required controller in Project Builder and clicking on the button **Setup Controller …**, either on the integrator's office computer before mounting the controllers, or directly on-site by means of a portable computer.

Detached mode

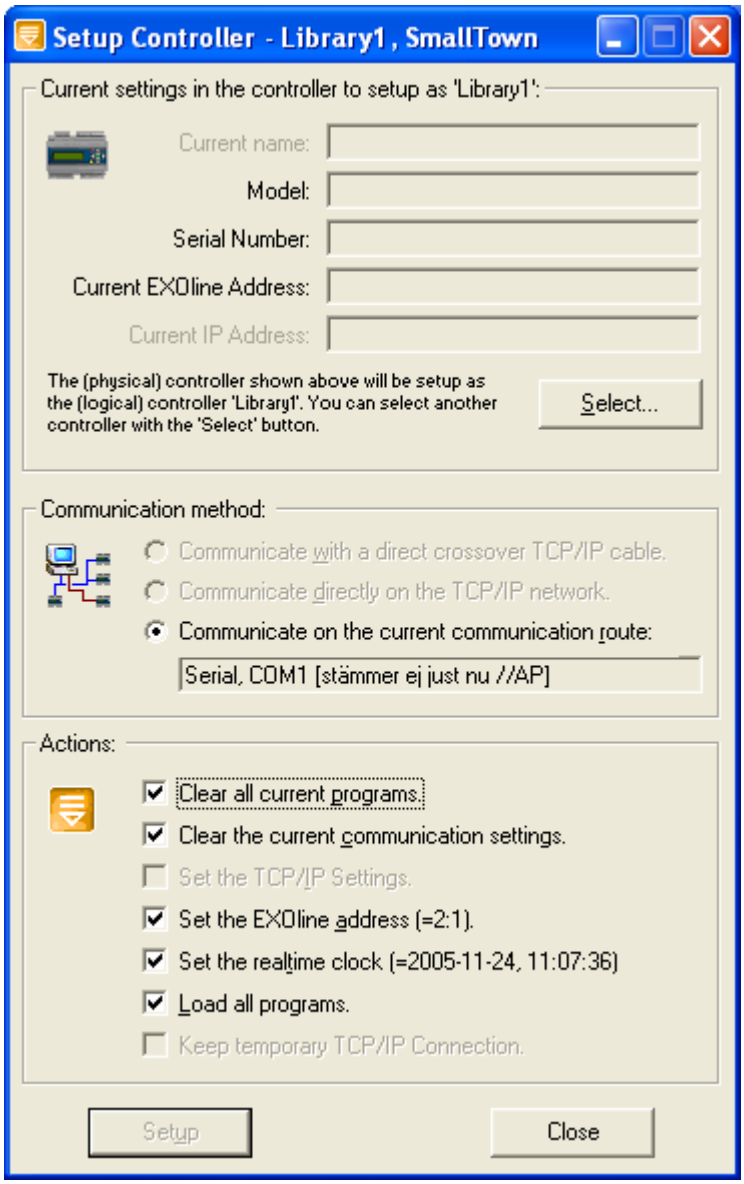
When addresses are changed in controllers, the computer must be in so-called detached mode. You can read about attached and detached mode in the section ***Computers - Attaching Computers*** later in this chapter.

Only one

When there is a direct connection between a computer and a controller, only one controller with the address 254:30 can be connected at a time. If not so, the computer will not be able to find any controller. Each controller in the project must have a unique address for the communication to work.

Setup Controller

With the tool Setup Controller, you can set the controllers' communication settings and real-time clock. You can also load all programs and configurations to the controllers.



Options

In the tool Setup Controller, you have the following options:

- ❑ You can manually select the physical controller to setup by using different methods, including searching and selecting from a list.
- ❑ You have the possibility to select different communication methods: The current communication route, TCP/IP Network and direct crossover Ethernet Cable.
- ❑ You can set the TCP/IP settings.
- ❑ You have the possibility to load the programs as a part of the setup.

Automatically

The tool selects an appropriate communication method and tries to find a suitable physical controller automatically. If it succeeds, this controller will be selected.

Select

If the tool could not find a suitable physical controller, you will get an error message, and the possibility to search and select a controller from a list. You can, at any moment, select another communication method and/or select another physical controller than the program has found.

Actions

When a physical controller has been selected, the tool suggests which actions to perform by automatically selecting the appropriate check boxes. You can change these selections as required.

Setup

To perform the setup you press the button **Setup**. The tool will show the progress of the setup by highlighting the corresponding actions. At last you will get a message that tells you if the setup was successful.

TCP/IP Port

Load configuration

You have to load the configuration of the TCP/IP port as a part of setting up the controller with the tool Setup Controller. When using the tool, a physical controller to setup will be selected automatically or manually. When a controller is selected in the tool, the controller's LED marked **LAN/ID** will flash with orange color.

Methods

There are two different communication methods to use, when setting up a TCP/IP-connected controller:

- ❑ On the TCP/IP network. In this case, the computer and the controller must be configured for the subnet where they are connected.
- ❑ With a crossover Ethernet cable connected directly between the computer and the controller. In this case, the computer must be removed from the network.

Ethernet cable

When setup is made using a crossover Ethernet cable, the tool Setup Controller will use temporary TCP/IP settings in the computer and/or in the controller. This makes it possible to setup the controller regardless of the TCP/IP settings of the computer. In this case it is also possible to keep the temporary connection after the setup has finished (including loading of programs),which also makes it possible to test the programs with EXOtest, etc.

Upgrade

You can upgrade the operating system of the TCP/IP port. This is done by first selecting the controller to upgrade then **More** and last **Upgrade TCP/IP OS**…

Loading Programs to the Controllers

Connecting

Programs can be loaded to the controllers when all controllers in a project have unique addresses. The computer is connected to the station master, which is loaded first with its program, followed by the loading of the station slaves with their programs.

Port settings

The port settings of the station master may have to be temporarily altered. See the next section ***Local Port Settings***.

TCP/IP

Information about controllers connected to a TCP/IP network can be found in ***EXOdesigner's Help*** (in the topic *Communication – Networks*). Information about setting addresses and loading TCP/IP connected controllers can be found in the above section.

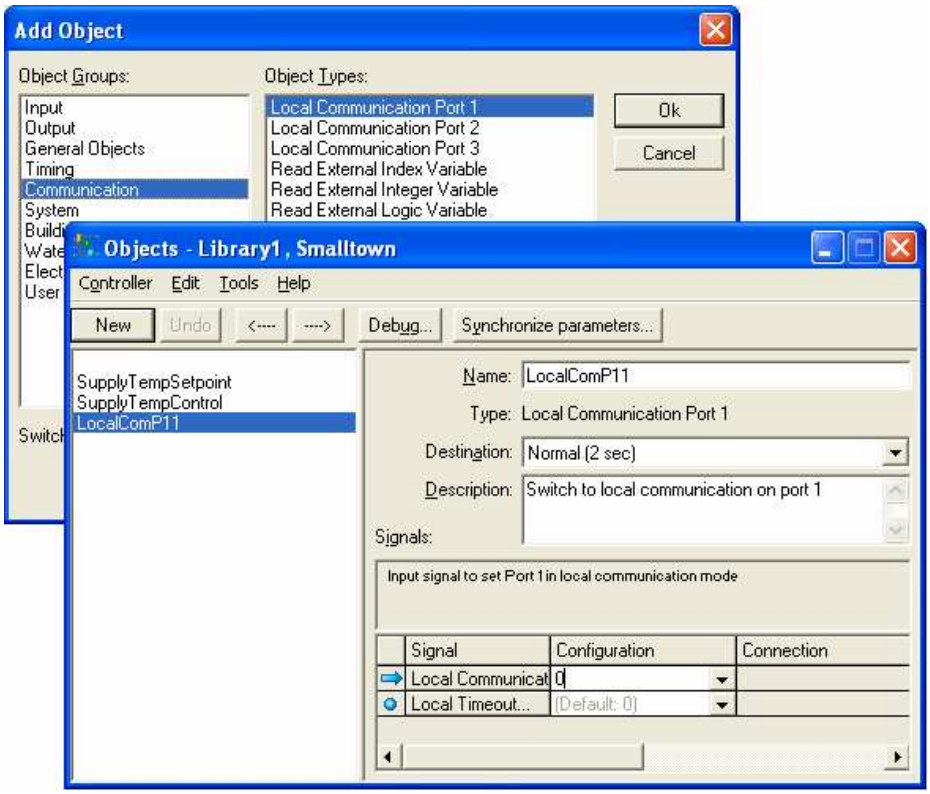
Local Port Settings

Port settings

If port #1 of the station master should not be connected to the main computer via a serial communication of the speed 9600 bps or via TCP/IP, this port needs to be re-configured temporarily, to be able to load programs and test the functionality on-site.

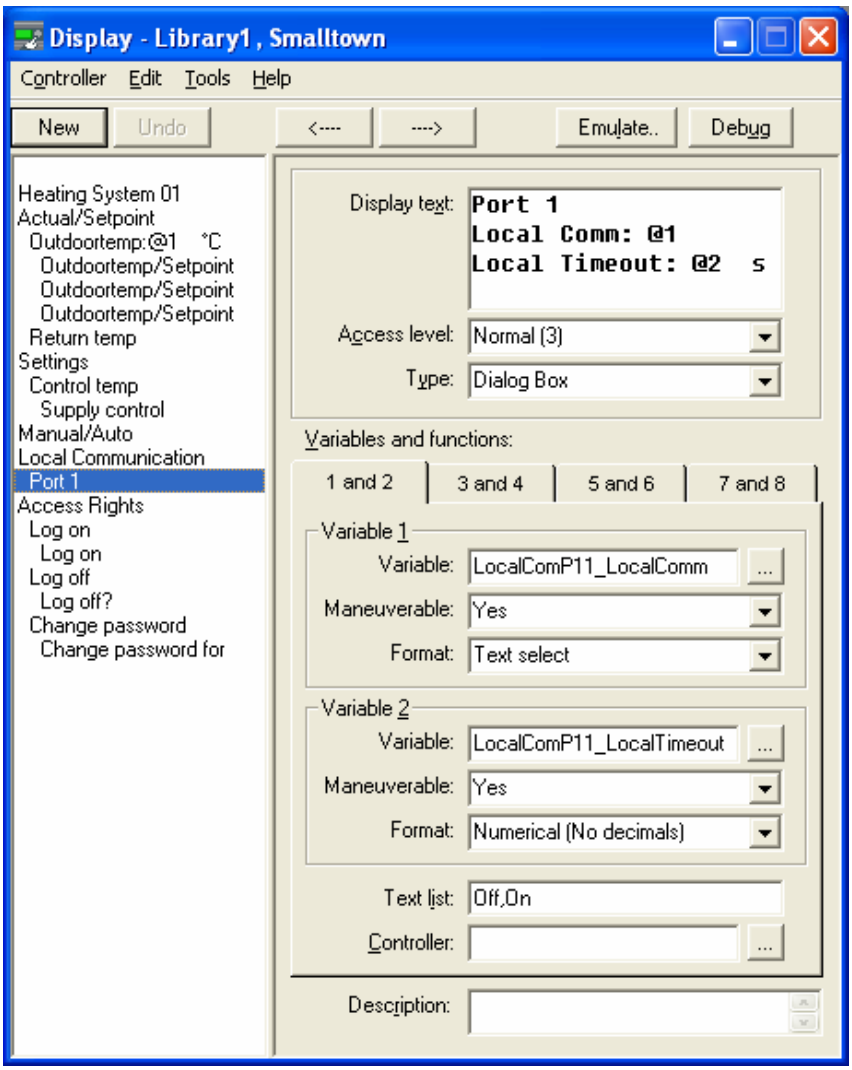
Local Communication

The object **Local Communication Port 1-3** can be used to temporarily change the settings of the ports 1-3. The object is added with the tool Objects.



Display

The variables of the object, the input signal (**`LocalComm`**), and the parameter (**`LocalTimeout`**), are made maneuverable in the display text of the Display tool.



The logical input signal (**`LocalComm`**) is activated when its value is set to 1 (one). Then the object sets the ports 1-3 for slave communication with 9600 bps. If any other port is set as master, slave with routing will be set for this port.

When the input returns, or after a set delay in a number of seconds in **Local Timeout**, the communication settings for port 1-3 are switched back to the original configuration.

By setting the time delay parameter **Local Timeout** to 0, the local communication will be active as long as the input **LocalComm** is active.

Testing and Troubleshooting

Testing

When the application programs have been loaded to all the controllers in a station, their functionality can be tested on-site. You can test, for example, that inputs and outputs receive reasonable values.

Parameter values

Sometimes, the parameter values of objects need to be changed in order to run pumps, dampers, etc. manually. This can be done in two different ways:

- ❑ Use EXOtest to change the value with the command SV.
- ❑ Change the parameter value temporarily using the tool Objects:

- Open Objects and change the required parameter value.
- Click on the button **Change** to change the value, but do not save.
- Click on the button **Synchronize Parameters** to change the value of the parameter in the controller.

Use the same procedure again to reset the parameter value.

Port settings The port settings of the station master may have to be temporarily altered. See the section ***Local Port Settings*** above.

Reloading It is a good practice to reload the controller with its programs after testing to restore all temporary changes of port settings, parameter values, etc.

Computers

Copying the Project

Installing If the EXO software is not already installed on the customer's computers, it will have to be done first. This goes for main computers as well as any existing work computers.

Copying the project The project is then copied to the customer's main computer. What is to be copied depends on whether it is an entirely new project or updates in an existing project:

- ❑ For a new project the entire project folder, including subfolders are copied to the customer's computers.
- ❑ For updates or changes in an existing project, only the new or updated subfolders are copied to the customer's project folder.

Work computers Normally, work computers can run the project on the main computer using common file sharing. However, for example if it is critical that alarms are printed on alarm printers that are connected to the work computer, a copy of the project should be kept locally on the work computer.

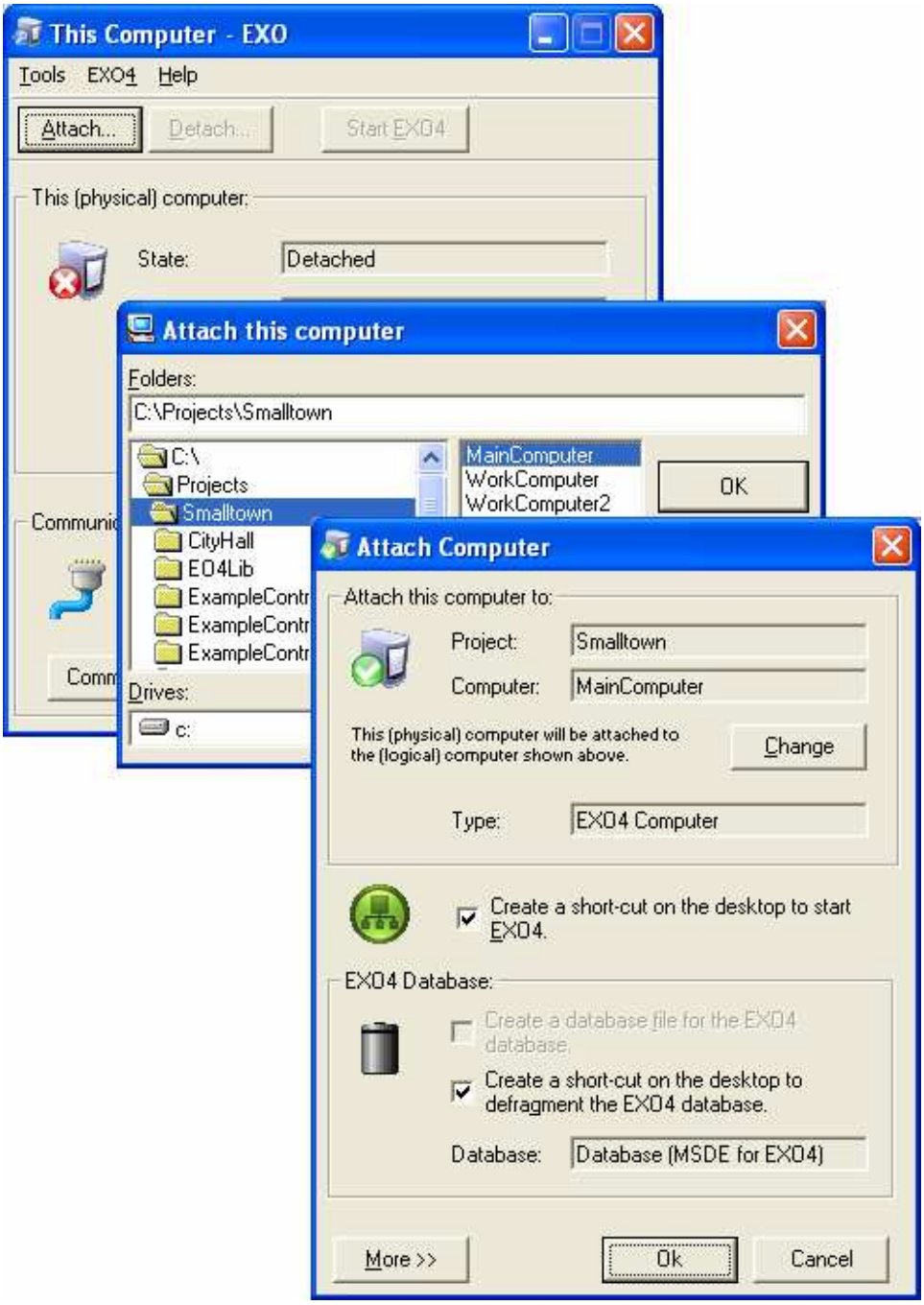
Attaching Computers

Detached When the project has been copied to the customer's computers, the physical computers are detached (not connected) to the logical computers. A logical computer is a computer in the project configuration in Project Builder.

Attach Each logical computer in Project Builder has to be attached to its corresponding physical computer using the tool This Computer. This creates two shortcuts on the desktop: one shortcut starts EXO4 in runtime and one is used for database defragmentation.

Attach the logical computer in Project Builder to the customer's physical computer in the following way:

- Select **EXO – This Computer** on the Windows Start Menu.
- Click on the button **Attach** in This Computer.
- Select the computer in the window Attach this computer and click on **OK**.
- Confirm the configuration in Attach Computer by clicking on **Ok**.



Attach

When the physical computer is connected, it will receive the communication settings that were configured in Project Builder.

Testing the Communication

Testing

It is a good practice to be at least two persons when testing the communication between the main computer and its controllers, one person should be placed next to the computer and the other one on-site in the plant.

The testing includes, among other things, checks to see if the computer can contact the controllers and if alarms are transferred to the computer.

Logging off a Session

One at a time

It is important to log off a session of EXO4 or EXOdesigner since only one user can run these on a computer at a time. This means that if one user has logged in and runs e.g. EXOdesigner, this session will continue to run if another user logs in, which could be the case if Windows goes to stand-by mode or the second user logs in with the command Switch User. The second user can not run EXOdesigner in this case.

Database

Copying a project

When the integrator copies a project from his own computer in order to copy it to the customer's computer, the database file is not copied. The best practice is to create a new database on the customer's computer. When you use the tool This Computer to attach the customer's main computer, a database will normally be created automatically.

Database file

A database of the type MSDE or an automatically handled SQL Server, must always be located on the local hard disk on the EXO4 computer that reads and writes in the database. Normally, the database is called **`Database.Mdf`** and is stored in **`C:\EXO4Db\`***`Project`***`\.`** The database file is thus not stored in the project folder.

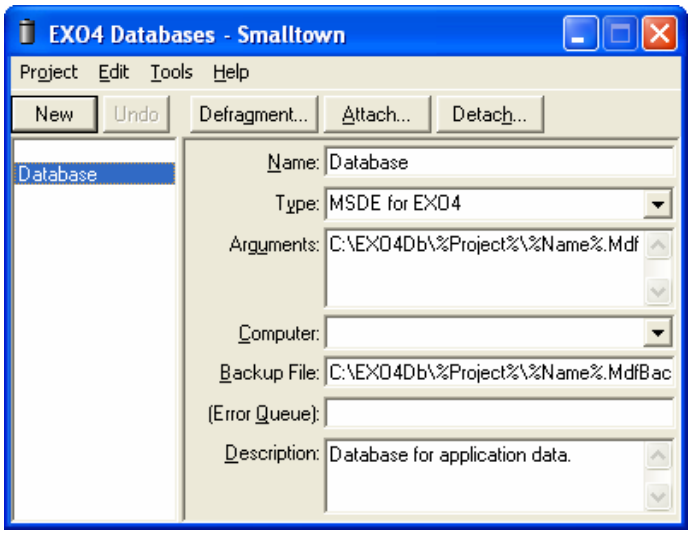
Copying projects

As the database file is not stored in the project folder, it is not copied when a project is copied from one computer to another, as for example, when copying it from the integrators computer to the customer's computer. Normally you do not want to copy the database when the project is copied. If you all the same have to copy, move or rename the database, you must follow the instructions in the below section ***Copying, Moving or Renaming the Database***.

Database Register

Databases

The databases of the EXO Project are registered and configured in the tool Databases. Normally, no configurations are necessary in Databases. If, on the other hand, a different database type, other than MSDE 2000 (or multiple databases), are required, configurations will have to be made in Databases.



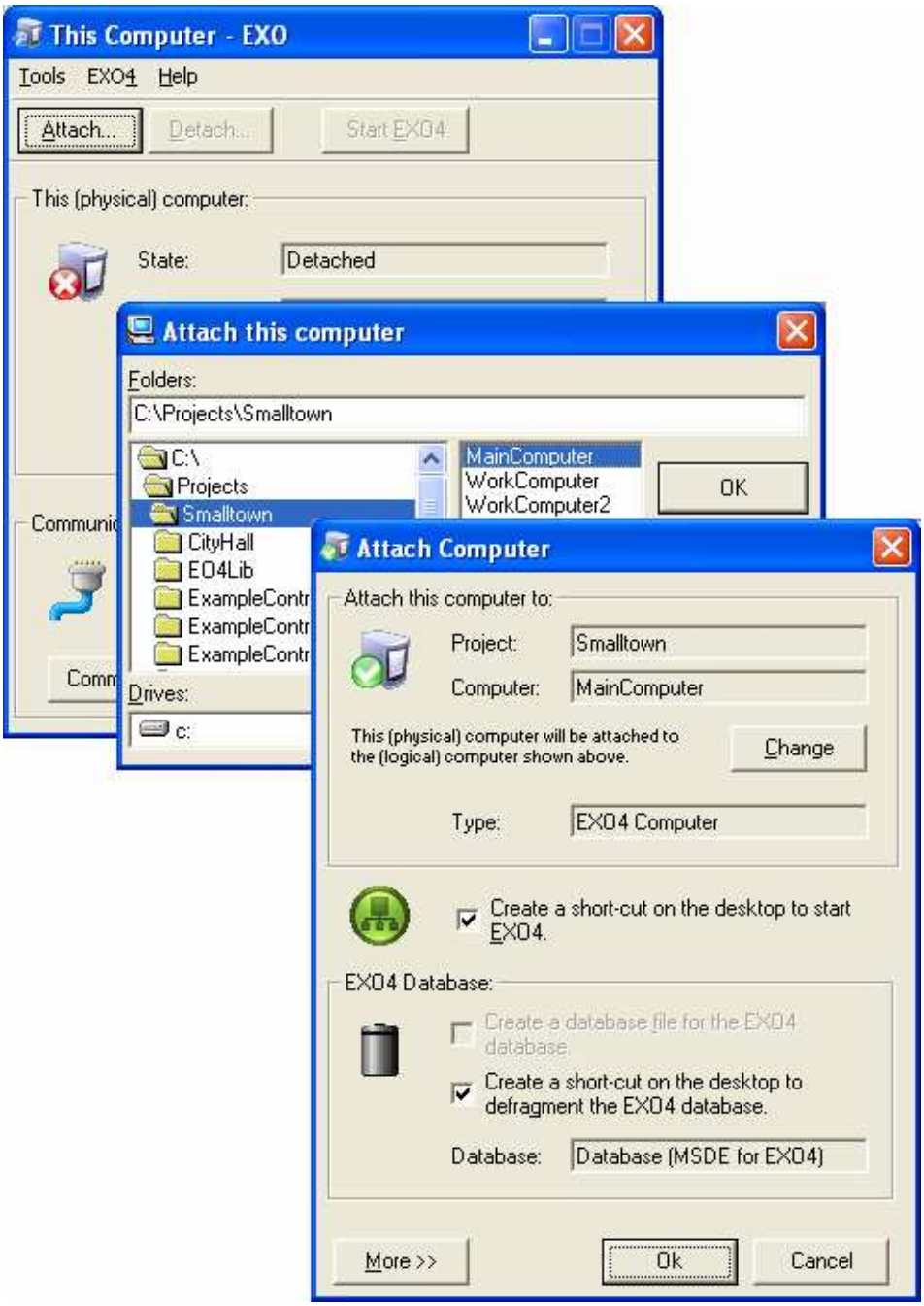
Password

During the installation of MSDE 2000 the user password is set to **ReginEXO4**. This password should be changed to protect the EXO4 databases from unauthorized network access. This is done in a dialog that is opened with the menu command **Tools - Change MSDE Password** in the tool EXO4 Databases

The Database is Created

Attach

When the customer's main computer for the EXO system is connected using the command **Attach** in This Computer, an MSDE database is created on the customer's computer (if this check box has not been unselected in the tool Attach Computer).

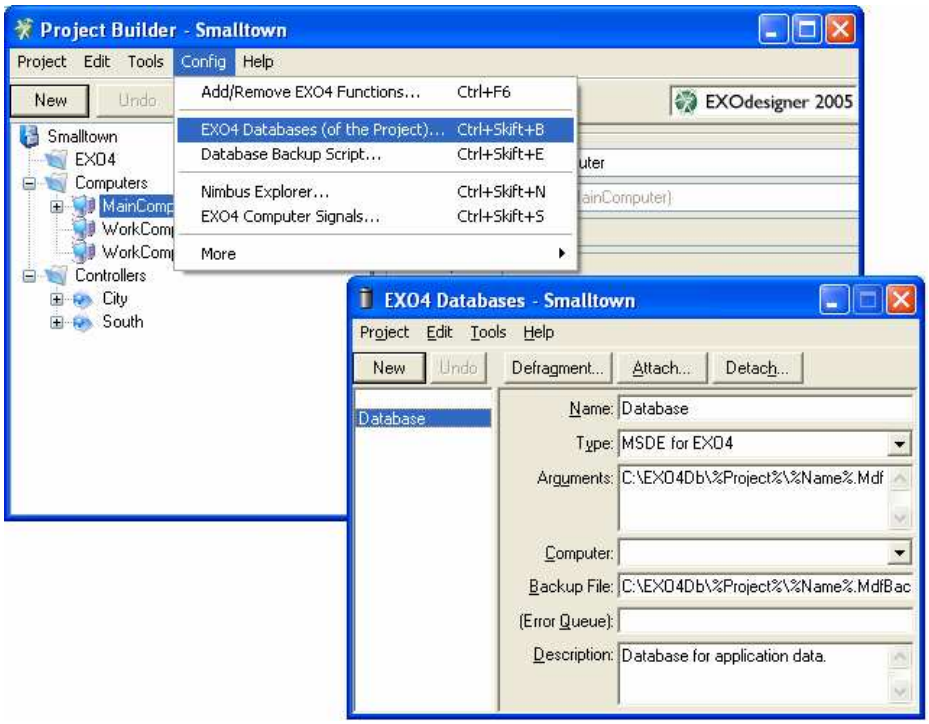


SQL Server

If an SQL Server database is required, it has to be created manually using the tool Databases. See the below section ***Creating a New Database***.

Connecting the Database to the Database Manager

The database The database is connected to the database manager by clicking on the button **Attach** in the tool EXO4 Databases.



Setting a Maximum Limit for the Memory

Max limit A max limit must be set for the amount of memory MSDE or SQL Server may use.

The Command Prompt This is done using the command **`MaxMemEXO4Db`** executed from the command prompt with the following syntax:

```
MaxMemEXO4Db [MaxMem] [Password] [InstanceName]
```

MaxMem **`MaxMem`** is the maximum amount of memory that can be used expressed in Mbytes.

A good practice is to set it to approximately half of the physical memory of the computer. If no value is specified or if it is marked with a hyphen (-), the current configuration will be displayed.

Password **`Password`** is the password for MSDE. It can be set using the command **`Change MSDE Password`** in the tool EXO4 Databases. If the password is omitted, the word **ReginEXO4** is used. Enter a hyphen (-) to leave the password empty.

InstanceName **`InstanceName`** is the MSDE instance to be used. If the instance name is omitted, the instance **EXO** will be used. Specify a hyphen (-) to use the MSDE standard instance.

Example **`MaxMemEXO4Db 128`**

Creating a New Database

Database register A new database is created in the database register by clicking on the button **New** in the tool Databases.

Database manager The type of database manager that will manage the database is selected in **Type**.

- MSDE database: MSDE for EXO4.

- Automatically managed SQL Server database: SQL Server for EXO4.
- Manually managed SQL Server database: SQLOLEDB (not described in this manual, but in the document ***EXO4 Advanced Configuration***).

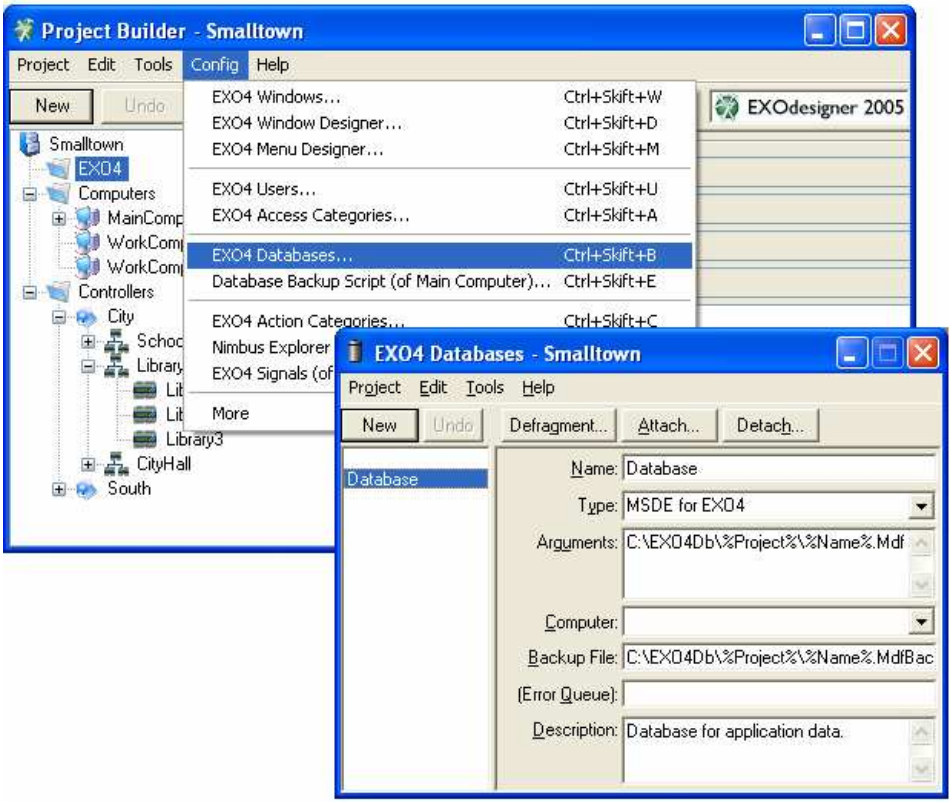
A new database Thereafter, you create a new, empty database with the menu command **Tools - Create Database**.

Attach Finally, the new database is attached to the database manager using **Tools – Attach Database**.

Copying, Moving or Renaming the Database

Copying To be able to copy, move, or rename the database file, e.g. to copy it from the customer's computer to the integrator's computer, the database must first be detached.

Detaching A database is detached from MSDE or SQL Server by first closing EXO4 and then detaching it using the menu command **Detach Database** in the tool EXO4 Databases.



When the database is copied, moved or renamed, it must first be detached. If you fail to do so, the database will be rendered unusable. This applies even if the computer is restarted.

Chapter 21 Database Maintenance

Database maintenance

Database maintenance includes the purging of old data, backup and defragmentation. Database maintenance should be performed regularly.

Times

By default, database maintenance is performed automatically at the following times:

- ❑ Purging of old data is performed on Saturdays at 23:00 hours.
- ❑ An automatic defragmentation is performed on Sundays at 23:00 hours. A manual defragmentation must be performed regularly. See the section ***Defragmentation*** below.
- ❑ A backup is performed every night at 03:00 hours.

Not valid

Backup and defragmentation is not valid for manually managed SQL Server databases.

Alarm 65% full

If an MSDE database is being used, a warning alarm is triggered when the size of the database reaches 65% of the maximum size. In these cases, the database should be defragmented manually.

Alarm 90% full

If an MSDE database is allowed to grow to 90% of the maximum size, a more serious alarm is triggered and the database storage will cease after approximately 5 minutes. However, data will be stored in temporary files that automatically will be read back to the database, when EXO4 is restarted after a manual defragmentation.

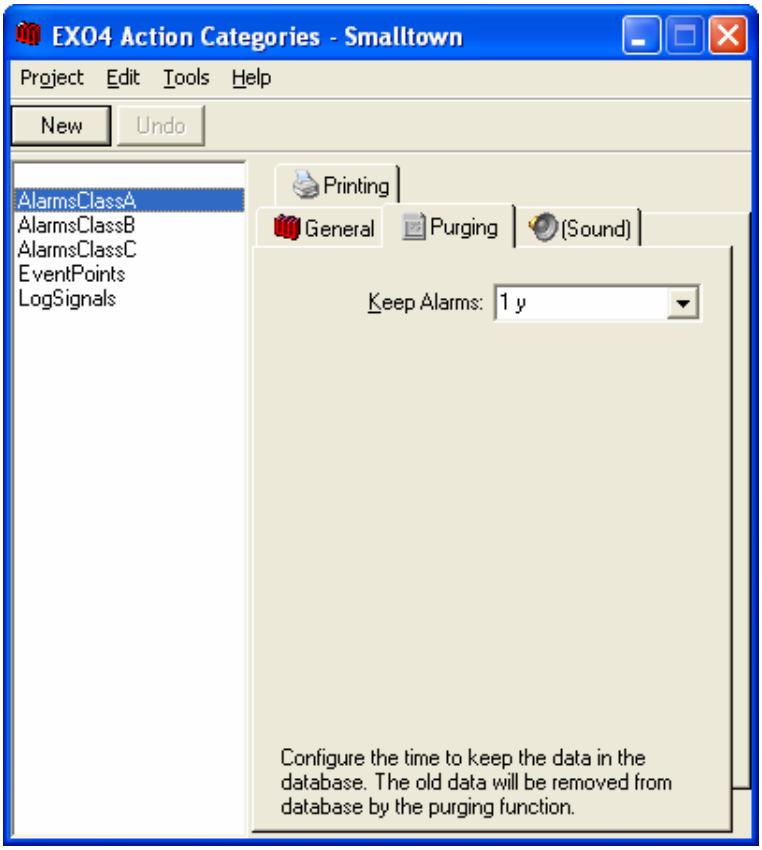
Purging Old Data

Compilation

Compilation of logged values and alarm events means that the data in the database is recalculated to a lower resolution, the minute values are recalculated to hour values, and hour values to day values, etc. As the original values do not disappear during compilation, the size of the database will grow. This is why it is important to purge the values in the database. By default, this is performed once a week.

Purging

The amount of time the values with different resolutions should be saved in the database is configured in the tool EXO4 Action Categories Tool per signal type.



Defragmentation

Regularly

If a database is continuously written to, its size will increase indefinitely, even if the amount of data is constant. To avoid this, the database must be defragmented regularly.

Automatic

By default, a limited defragmentation is performed once a week.

Manual

A more extensive defragmentation should be performed at least twice a year. This defragmentation is performed manually for MSDE and Automatically handled SQL Server databases in the following way:

- ❑ Close EXO4 Run.
- ❑ The defragmentation can be started in two different ways:
  - Using the shortcut **Defragment EXO4 Database** on the desktop. This shortcut was created by This Computer.
  - Opening the tool EXO4 Databases and clicking on the button **Defragment**.

  The defragmentation can take up to one hour depending on the size of the database but also on its level of fragmentation. The time needed decreases by performing the defragmentation often.
- ❑ Start EXO4 Run.

The database should be defragmented at least twice a year to decrease the size of the database.

Backup

Backup

Backing up the database means copying it to another media, e.g. tape or CD. This should be done regularly, preferably on a daily basis.

Automatic

EXO4 has a function that automatically backs up MSDE and automatically managed SQL Server databases. By default, this is performed once every 24 hours.

Database functions

The database functions as normal in EXO4, i.e. storing and reading can be done during the backup.

Local hard disk

The backup file must be located on the local hard disk, i.e. on the same computer as the database. This file may then be copied to, e.g. another regularly backed up computer in the network.

Copying

When the backup to a file on the local hard disk is finished, the file **`CopyDatabaseBackup.Bat`** in the computer folder is automatically started.

The script file

The file **`CopyDatabaseBackup.Bat`** contains instructions for how to copy the backup copy on the local hard disk to another computer's hard disk.

```
@echo off


Rem This is a script file that will run after the EXO4 database backup file
has been created.
Rem The script file is intended to copy the database backup file to another
media such as a network drive.

Rem You must change the following on the XCopy line below:
Rem * The ProjectName in the source path
(C:\EXO4db\ProjectName\*.MdfBackup)
Rem * The destination path (E:\BackupFolder\)
Rem * Remove the "Rem" command.

Echo ************************************************
Echo Copying EXO4 database backup file to backup media

Rem xcopy C:\EXO4db\ProjectName\*.MdfBackup E:\BackupFolder\ /F /Y

If %ErrorLevel% EQU 0 Goto End
Echo ************************************************

Pause

:End
```

Manually

Copying the backup copy of the database can be started manually in Project Builder by clicking the button  after selecting EXO4.

Restoring

A backup copy of a database can be restored (i.e. copied back into the project) in the following way:

- Close EXO4 Run.
- Open EXO4 Databases and select the database to be restored.
- Select the command **Restore Database** in the menu **Tools**.
- Select the backup copy of the database to be used in the dialog Restore MSDE Database. The backup will always have the file extension **`.MdfBackup`**.
- Click on the button **Start Restore** in the dialog MSDE Restore. All data in the existing database is overwritten by the content of the backup file.
- Start EXO4 Run after restoring the database.

Manually managed

EXO4 does not manage backups of manually managed SQL Server databases.

Chapter 22 Windows Settings

Windows is a large and complex operating system with many applications, besides EXO. As a result, some settings have to be changed in the operating system in order for it to function with EXO4.

Automatic Updates and Anti-virus Programs

Windows Update

Computers running Windows are sometimes subject to virus infections. In many cases, there are updates available from Microsoft that will prevent viruses from taking advantage of security holes, even before a virus is created. These updates are downloaded automatically with the Windows Update Service, which is integrated in the operating system.

Anti-Virus programs

There are also anti-virus programs that are updated via the Internet on a daily basis. These detect viruses.

EXO4 computers

A virus can incapacitate an EXO4 main computer, which has happened in reality. As a result, we recommend that the security updates are applied on the computers and that a good anti-virus program is used.

Restarting

Unfortunately, this contradicts the possibility to run EXO4 for months without restarting. Some of the security updates require a restart of Windows after installation. Before a restart is performed, the anti-virus program can only confirm a virus infection, not prevent their activation.

Solution

A solution for smaller plants could be to stop EXO4 once a month to install new security updates. This would also be a good time to perform a defragmentation of the database.

Higher demands

In larger plants with higher demands on a continuous runtime, this can be done every 6 months. The computer will then have to be placed behind a firewall, which has been configured for a higher security.

The updates should **not** be configured to install directly as the computer might restart automatically, which means that EXO4 is shutdown unsolicited!

The quality of anti-virus programs varies, and some do not work well in continuous runtime for long periods of time. We encourage a discussion with the customer's IT department in order to protect application servers from virus infections.

Service Pack

Upgrading?

Microsoft also corrects errors in the operating system with so-called Service Packs. If you do not experience any problems, there is generally no reason to upgrade. Regin resellers will be informed if there are errors in Windows that might affect the EXO software.

No Permanent Internet Connection

Less protection

There are both advantages and disadvantages with not having a permanent Internet connection. The risk for a virus infection is considerably lower, but the computer will generally be much less protected.

Twice a year

Service Packs and some other important updates can be downloaded in separate files from Microsoft. These should be installed during the periodical database maintenance, at least twice a year. Contact the customer's IT department!

Automatic Restart of EXO4 after a Power Failure

Auto Log on

Password

Windows allows automation of the log on process by storing passwords and other essential information in the registry.

> This means that others can start your computer using the account you created for automatic log on. Time conflicts may arise. If multiple network protocols are loaded, the automatic log on may cause Windows to attempt to connect to network resources before the protocols have finished loading.

Registry Editor

The Registry Editor (**`regedit`**) is used to add your log on information:

> Imprudent use of the Registry Editor may cause serious and extensive problems that might result in a necessity to reinstall Windows to correct the problems. The tool is used at your own risk.

Adding log on

Start `regedit` by using Run in Windows Start menu.

Search for the following sub-key in the registry:

`HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon`

Specify your domain name, account name and password with the values that are used during a normal log on. The following values should be specified:

- **`DefaultDomainName`**
- **`DefaultUserName`**
- **`DefaultPassword`**

If the value **`DefaultPassword`** does not exist, choose **Add Value** from the **Edit** menu. In the field **Value Name,** enter **`DefaultPassword`**. Select **`REG_SZ`** for datatype. Enter your password in the field **String** and save the changes.

If the string **`DefaultPassword`** is not specified, Windows will automatically change the value of the key **`AutoAdminLogon`** from **`1`** (true) to **`0`** (false), this will disable the function **`AutoAdminLogon`**.

Select **Add Value** from the **Edit** menu. Enter **`AutoAdminLogon`** in the field **Value Name**. Select **`REG_SZ`** for the data type. Enter **`1`** in the field **String**. Save the changes and exit **`regedit`**.

Shut down Windows and turn off the computer.

Restart the computer and Windows. You should now be logged on automatically.

> In order to evade the **`AutoAdminLogon`** process and/or to log on as a different user – press the **Shift** key after log off or restart.

More information

For more information, see Microsoft Knowledgebase article Q97597 How to Enable Automatic Logon in Windows NT:

http://support.microsoft.com/support/kb/articles/Q97/5/97.asp

Also see Q159969, Q167364 and Q114615.

Automatic Start of EXO4

Auto start A shortcut to EXO4 can be created on the desktop using the tool This Computer. By dragging and dropping the shortcut to the folder **Programs - Autostart** in Windows **Start** menu, EXO4 will start automatically after a restart of the computer or, for example, after a power failure.

Complex Programs Windows sometimes has problems starting complex programs such as, for example EXO4, directly during start-up. Instead, a shortcut to the program **`Prod:\EXOop4\EXO4RunD.exe`** that waits a minute before starting EXO4 can be created. **`Prod:`** stands for the folder in which the EXO programs are installed, usually **`C:\Program\EXO`** in a Swedish Windows installation, and **`C:\Program Files\EXO`** in an English Windows installation.

Users

Installing The user installing the EXO software must be logged on as local administrator.

Running In order to run EXOdesigner or an EXO4 main computer you must be logged on as local Power User.

EXO4 client To run an EXO4 client, you only need to be logged on as User.

The Control Panel By changing the user settings in Windows Control Panel a normal User on the network can be upgraded to a local Power User.

The Computer Clock

The controllers' clocks EXO periodically synchronizes the controller's clocks with the computer clock. The computer clock can of course be adjusted manually from time to time, if it is not off by much.

Internet There are systems for configuring the computer clock using, e.g. GPS. The cheapest option, however, would be to use a public Internet clock, such as, e.g. SP (Sveriges Provnings- och Forskningsinstitut) or NIST (National Institute for Standard and Technology):

http://www.sp.se/metrology/timefreq/eng/timesynch_ntp.htm

http://tf.nist.gov/service/its.htm

Client programs There are a number of client programs with ready-made lists for Internet clocks. One client is also built-in into Windows 2000 or later, however, it may be difficult to configure. The clients automatically adjust for time zones and summertime/wintertime, according to the settings in the Control Panel.

Firewall In larger networks, the firewall blocks this service when it is run directly from a standard computer to the Internet. Instead, the service may be run from a specific server in the network. Consult the customer's IT department!

Part VI Controller Templates

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Part VI Controller Templates

Chapter 23 Controller Templates

Controller Templates

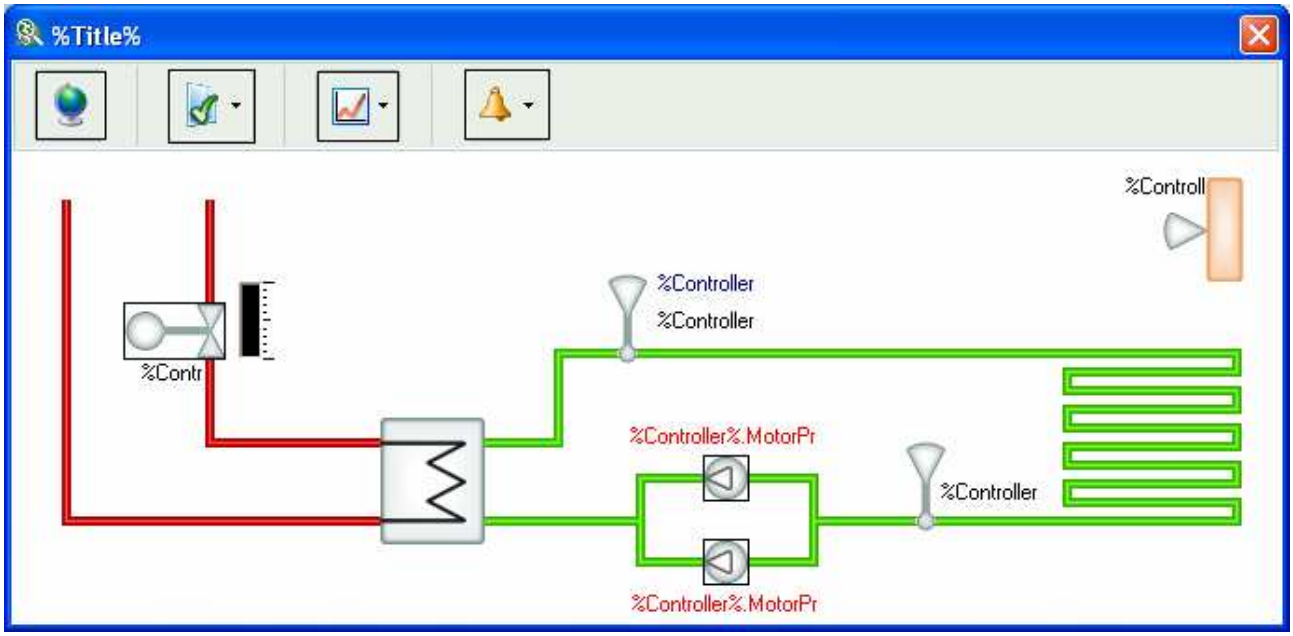
A number of templates, that facilitates the creation of controllers with basic functions for building automation, are included in EXOdesigner. The following templates, among others, are available:

- **Heating System in EXOcompact 28D:** Control of a heating system with twin pump control, heating control, alarms, display texts, and logging.
- **Heating System in EXOflex:** Control of a heating system with twin pump control, heating control, alarms, display texts and logging in a one-sectioned EXOflex equipped as follows: The PIFA units EP1011, EP7416, and an external display.
  - External display
  - EP1011: Power PIFA unit in position #1
  - EP7416: PIFA unit with 6 DI, 2DO, 4 AI and 4 AO in position #2
- **Air Unit in EXOcompact 28D:** Control of an air unit, time channel control for full/half speed, heating battery with frost protection, alarms, display texts, and logging.
- **Air Unit in EXOflex:** Control of an air unit, time channel control for full/half speed, heating battery with frost protection, alarms, display texts and logging in a two-sectioned EXOflex equipped as follows:
  - External display
  - EP1011: Power PIFA unit in position #1
  - EP0000: PIFA Slot Cover in position #2
  - EP4024: PIFA unit with 16 DI and 8 DO in position #3
  - EP7218: PIFA unit with 12 AI and 6 AO in position #4.

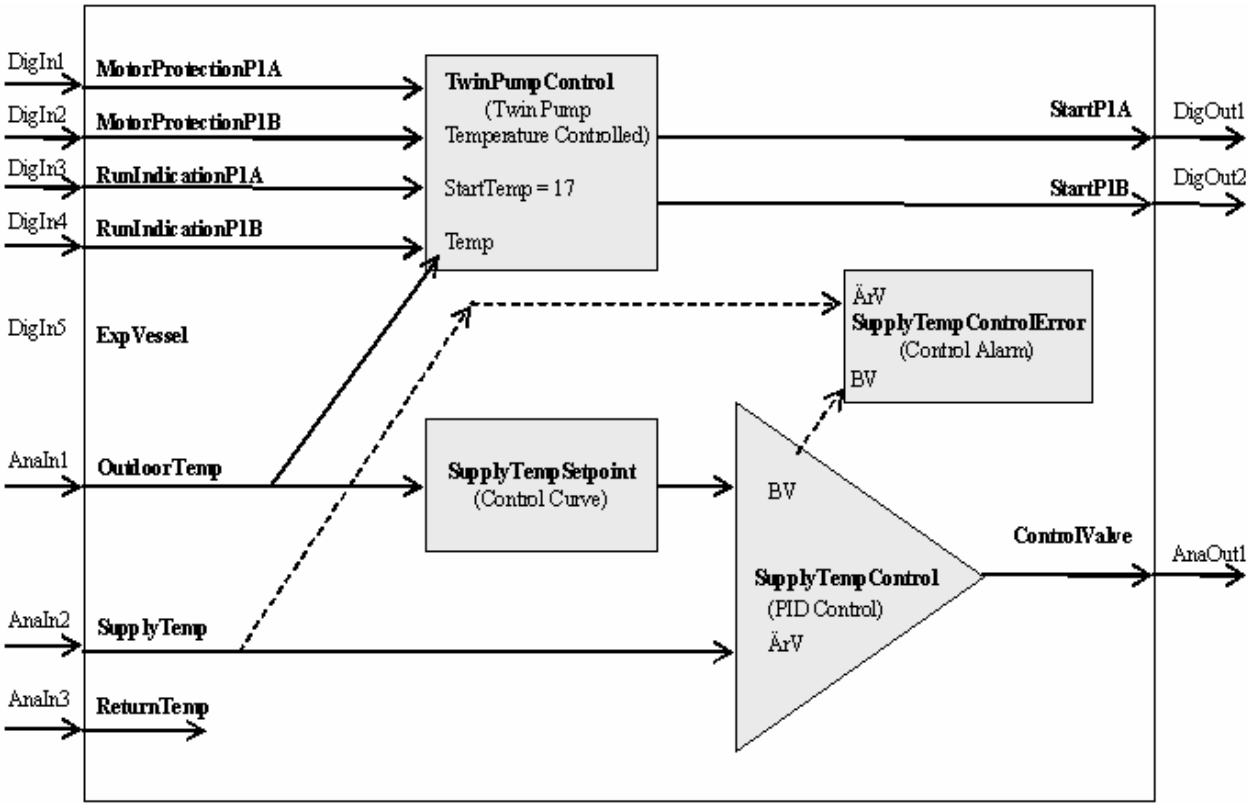
More functions

A controller that has been created from any of these templates can, if required, be expanded with additional functions in the current application, by, e.g. using controller objects.

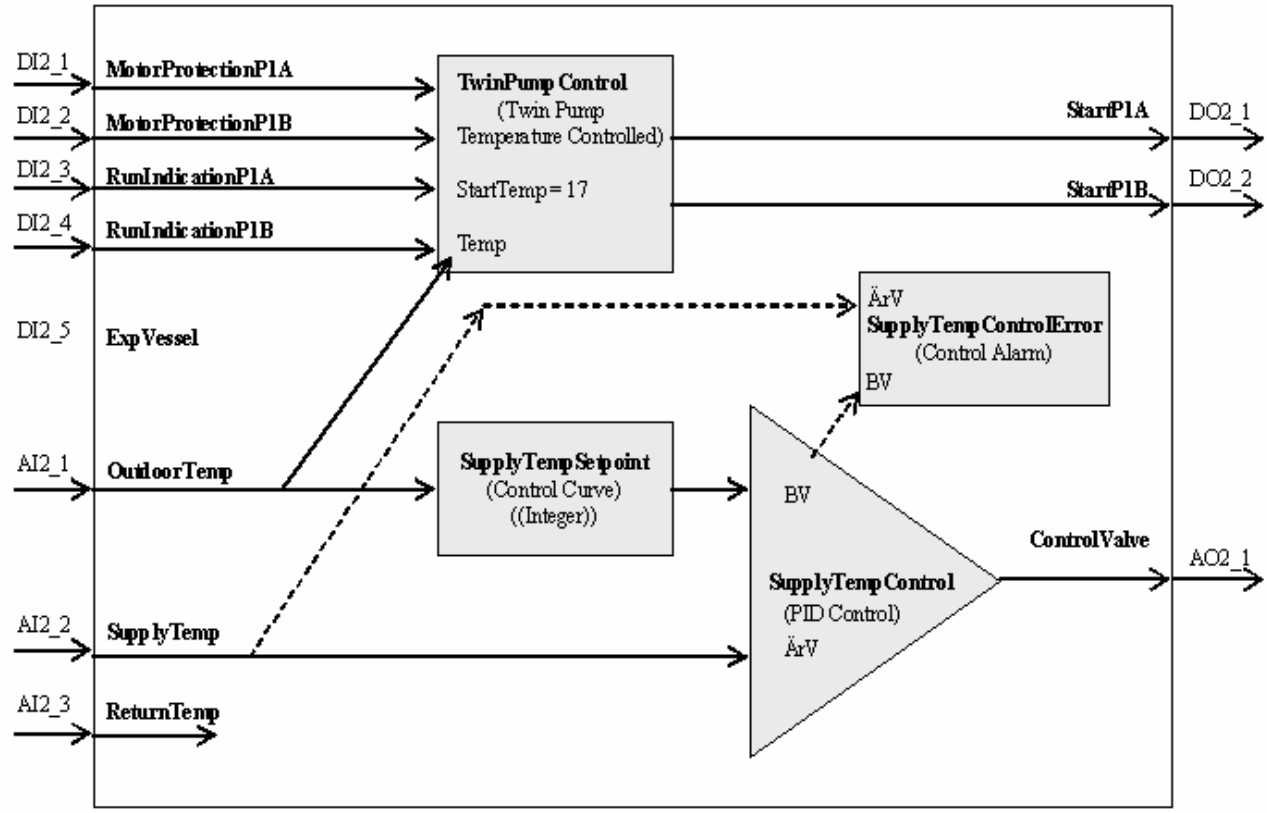
Heating System



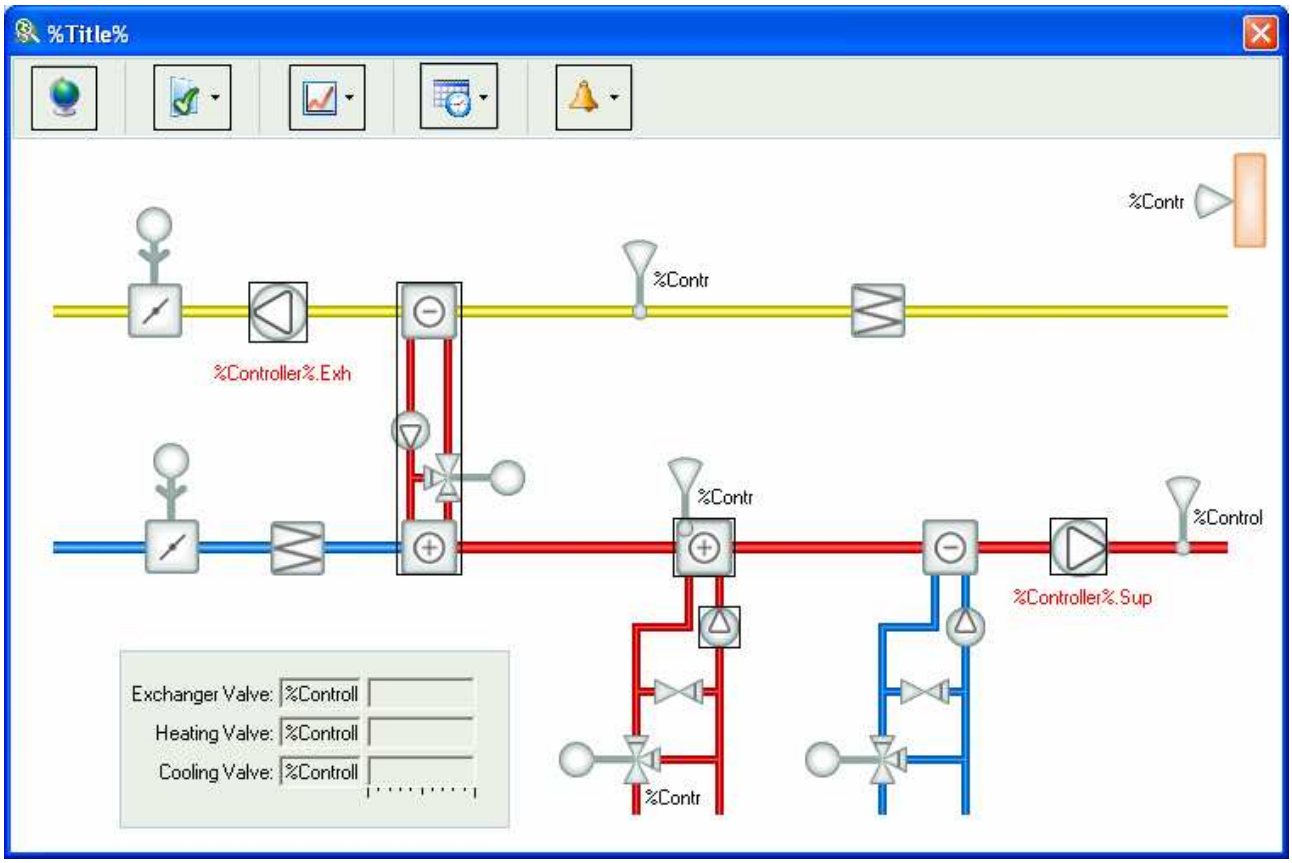
EXOcompact



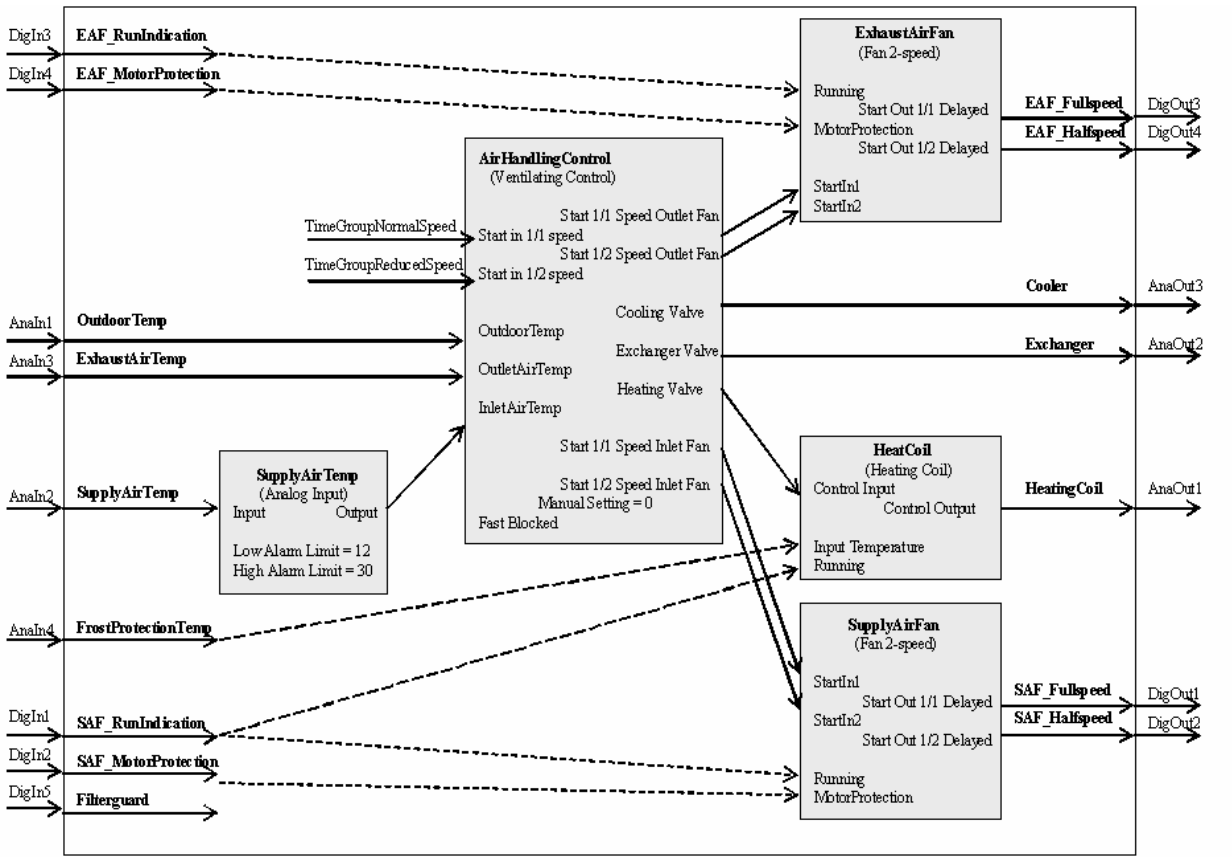
EXOflex



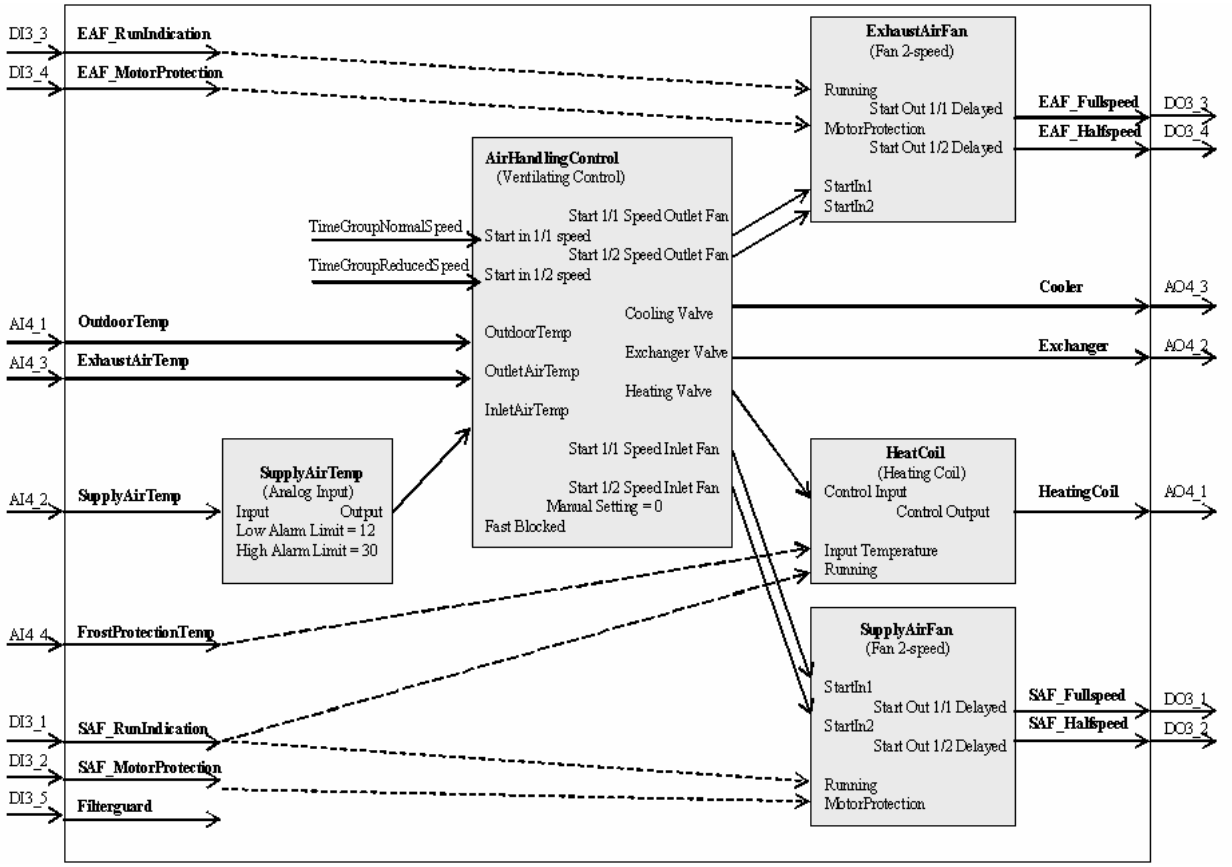
Air Unit



EXOcompact



EXOflex



Part VII License Agreement

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Part VII License Agreement

Chapter 24 **EXO4 2008**

License agreement for EXO4 2008:

-Including *EXO4 2008 XS7 PC-card* version

-Including *EXO4 2008 XS7 USB* version

-Including *EXO4 2008 S7 PC-card* version

-Including *EXO4 2008 S7 USB* version

-Including *EXO4 2008 M7 PC-card* version

-Including *EXO4 2008 M7 USB* version

-Including *EXO4 2008 L7 PC-card* version

-Including *EXO4 2008 L7 USB* version

-Including *EXO4 2008 XL7 PC-card* version

-Including *EXO4 2008 XL7 USB* version

-Including *EXO4 2008 XXL7 PC-card* version

-Including *EXO4 2008 XXL7 USB* version

-Including *EXO4 2008 Trial v*ersion

-Including *EXO4 2008* Upgrade

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Chapter 25 EXOdesigner 2008

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