10/10 MN05003004Z-EN
replaces 01/08 AWB2724-1453GB

Modular PLC
XC-CPU101...(-XV)

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Original Operating Instructions
The German-language edition of this document is the original operating manual.

Translation of the original operating manual
All editions of this document other than those in German language are translations of the original German manual.

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see revision protocol in the "About this manual" chapter

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Editor: Thomas Kracht, Barbara Petrick
Translator: globaldocs GmbH

Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

Contents

About this manual

List of revisions

Edition date	Page	Keyword	New	Modification	Omitted
10/02	70	"External filter: If required"			✓
04/03	20	„Warm start"		✓	
	29	„Direct peripheral access"	✓		
	22	„Updating the operating system (OS)"	✓		
	34	„Interrupt processing"	✓		
	11	„Data access to the multimedia card"	✓		
	40	„Browser commands"	✓		
	51	"Routing"	✓		
08/03	All	Baud rate modified from 57600 to 38400		✓	
	20	„Status indication, easySoft-CoDeSys"	✓		
	32	"Communication interrupted" message	✓		
	39	„System events"	✓		
	45	„Communication fault(#0): Logging off"	✓		
	69	Battery life		✓	
08/03 (Reprint)	10, 69	XC-CPU-101-C256k-8DI-6DO (-XV)	✓		
12/03		Completely revised			
12/03 (Reprint)	41	„Data remanence", 1st paragraph		✓	
04/04	42	„Limit values for memory usage"	✓		
06/04	18, 68, 72	"External 24 V DC line filter for the XC100 power supply"	✓	✓	
11/04	11	MMC		✓	
	19	„Startup behaviour"		✓	
	21	„Full reset"		✓	
	21	„Creating and transferring a boot project"		✓	
	22	„Updating the operating system (OS)"		✓	
03/05	42	„Segment size of the XC-CPU101-C256k"	✓		
	43	„Addressing inputs/outputs and markers"	✓		
	44	„Diagnostics"	✓		
	55	„Programming via CANopen network (Routing)"		✓	
01/08	21	„Create boot project after online change"	✓		
	41	„Data remanence"		✓	
	55	„Programming via CANopen network (Routing)"		✓	
10/10	All	Change to Eaton terminology	✓		

Abbreviations and symbols

Symbols used in this manual have the following meanings:

MWS	Menu selector switch
BAS	Operating mode switch
CPU	Central processing unit
CRC	Cyclic redundancy check
MMC	Multimedia card
I/O	Inputs/outputs

▶ indicates instructions to be followed

Select ‹File → New› means: activate the instruction "New" in the "File" menu.

Attention!
Warns of the risk of material damage

Caution!
Warns of the possibility of serious damage and slight injury

Warning!
Indicates the risk of major damage to property, or serious or fatal injury.

For clarity of layout, we adhere to the following conventions in this manual: at the top of left-hand pages you will find the Chapter heading, at the top of right-hand pages the current Section heading; exceptions are the first pages of Chapters and empty pages at the end of Chapters.

Additional documentation

At different points in this manual, references are made to more detailed descriptions in other manuals. These are described with their title and documentation number (e.g. MN04802001Z-EN). All manuals are available in PDF format. If for some reason the manual is not supplied on the product CD, it is available for download as a PDF file.

Go to http://www.eaton.com/moeller → **Support** and enter the document number in the Quick Search field.

1 Design of the XC100

The XC-CPU101-... controllers – referred to below simply as XC100 – have been designed for application in machinery and plant control systems. These controllers are fitted with interfaces for connecting to a programming device (RS232) and for linking to decentralized CANopen expansion units, so they can form the core of a comprehensive automation system.

The XC100 controller has a compact design, and can be fitted with either local or decentralized expansion. The basic unit consists of:

- Rack,
- A CPU for control or visualisation, with integral power supply and local inputs/outputs,
- XIOC signal modules.

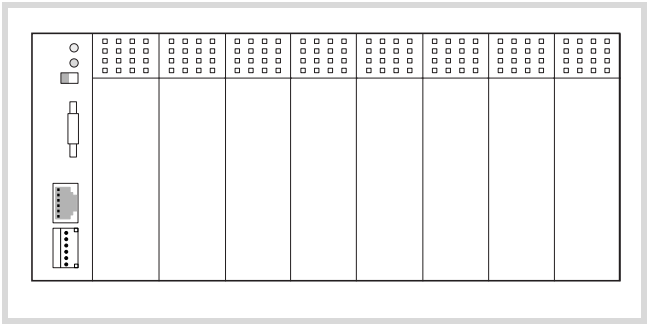


Figure 1: Layout of the XC-CPU101 with XIOC modules

→ Further details about the CPU can be found in the next section.

Detailed information about the module racks and XIOC modules can be found in the manual "Hardware and Engineering, XIOC Signal modules". This manual is provided as a PDF file (h1452g.pdf) on the CD.

The latest versions of specific manuals can be found at http://www.eaton.com/moeller → **Support**.
Search item: MN05002002Z-EN

CPU with PSU and local inputs/outputs

The CPU module of the XC100 has a compact design that is divided into two functional units:

- Processor unit with interfaces
- 24 V PSU with integral digital inputs (eight) and digital outputs (six).

Figure 2: Assembly of the CPU module XC-CPU101

① Processor unit

② 24 V PSU with local inputs/outputs

24 V PSU with local inputs/outputs

The power supply unit provides the operating voltages required by the processor unit and the inputs/outputs (local and decentralized).

Task

The power supply transforms the 24 V DC supply voltage into the voltages required by the system. These voltages are fed to the bus on the basic rack unit and any expansion rack units that are present.

The special feature of connection to the 24 V supply voltage is that the processor unit and the local inputs/outputs can be fed separately. One 24 V connection is provided for the processor unit (labelled: 24V/0V) and another 24 V connection for the local inputs/outputs (labelled: 24VQ/0VQ).

Surface mounting

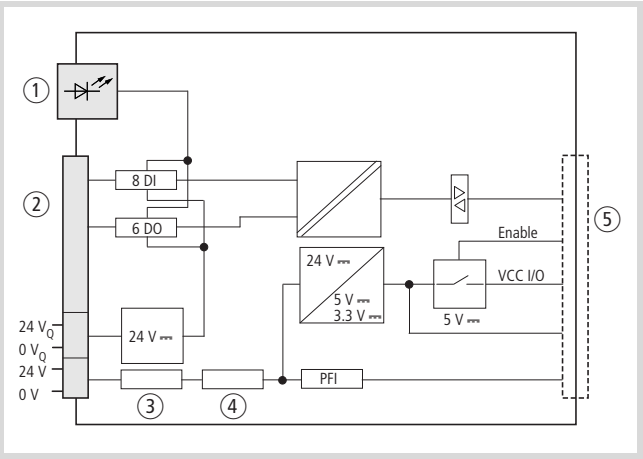


Figure 3: Block diagram: power supply unit

① Status indicator for I/Os
② Front connection terminals
③ Internal filter
④ Buffer
⑤ XIOC I/O-bus, module rack
PFI = Power Fail Interrupt

The voltage connection $0V_Q/24V_Q$ is only for the supply voltage to the integral local inputs (8) and outputs (6), and is electrically isolated from the bus.

The 0V/24V voltage connection is internally filtered and buffered and fed to a voltage transformer which generates the required system voltages. The internal power supply for the 5 V system voltage is designed so that the processor unit is supplied with the required current.

⚠ **Caution!**
When using the XC100-CPU and the XIOC-Signal modules in an ABS plastic enclosure, the limitations stated in table 1apply. ABS enclosures are identified with "ABS" on the surface which faces the backplane.

Table 1: Limitations which apply when using the XC100-CPU and the XIOC-Signal modules in an ABS plastic enclosure

Fitted in:	Installation location internal temperature:	Current rating of the 5 V system voltage of the I/O bus
CI enclosure	> 40 °C	Use of the XC100 not permissible
	0 to 40 °C	max. 1.5 A[1]
Distribution fuse-board	0 to 55 °C	max. 1.5 A[1]
Control panel	> 40 °C	max. 1.5 A[1]
	0 to 40 °C	max. 3.2 A

1) On the outputs of the CPU made of ABS enclosure material, a utilization factor g of 0.5 applies

→ Limitations in performance for the digital I/O modules with ABS enclosures are described in the documentation for the XIOC signal modules (MN05002002Z-EN; previously AWB2725-1452GB).

If there is an interruption break or collapse of the 24 V supply (threshold is about 10 V) then a power-down logic switches of the 5 V supply to the signal modules (central I/O). The sequence is initiated by the PFI signal and leads to a power-down through the CPU.

Local digital inputs

The 18-pole terminal block which has the power supply to the CPU, the local I/Os and the physical connection to the local inputs/outputs is located on the right half of the CPU behind the front enclosure.

The eight digital inputs and six semiconductor outputs are designed for 24 V signals and have a common 0VQ/24VQ power supply which is potentially isolated right up to the bus.

Local digital inputs/outputs

The outputs Q0.0 to Q0.5 can be loaded with 500 mA, a duty factor (ED) of 100% and a utilization factor (g) of "1".

▽ **Attention!** Please observe the limitations of performance for the outputs with ABS enclosures in → table 1.

The outputs are short-circuit proof. A short-circuit state should, however, not be permitted to exist over a longer period.

Terminal assignments

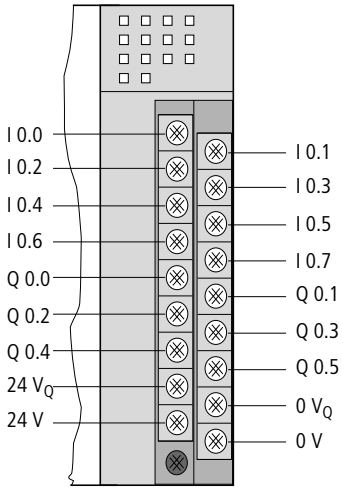


Figure 4: Connections for PSU and local I/O

I0.0 to I0.7: local digital inputs
Q0.0 to Q0.5: local digital outputs
$0V_Q/+24V_Q$: supply voltage for the local inputs/outputs
0V/+24V: supply voltage to the processor unit

LED displays

The LEDs indicate the signal status for the inputs and outputs. An LED that is ON indicates a H-level signal on the corresponding terminal.

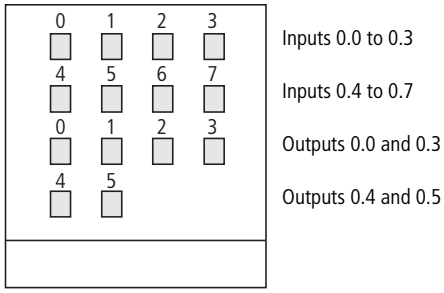


Figure 5: LEDs for the integral inputs/outputs

The two upper rows of LEDs show the signal status for the eight digital inputs of the CPU module (I0.0 to I0.7), and the two lower rows show the signal status for the six digital outputs (Q0.0 to Q0.5).

Connecting interrupt inputs

The inputs I0.0, I0.1, I0.2, I0.3 can be used as interrupt inputs.

The L/H edges are evaluated. The interrupt inputs act immediately and independently of the cycle time for the application and they start the programmed Interrupt routines. The program section which has been processed up to the arrival of the Interrupt signal is interrupted immediately. All further Interrupt processes should be application related programmed.

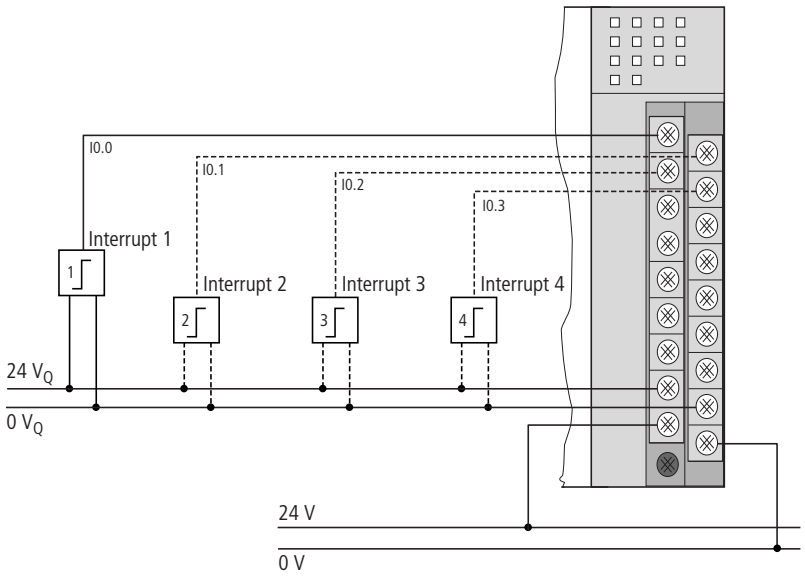


Figure 6: Interrupt input connections

→ If an XC100 PLC is replaced by an XC200 PLC, the interrupt inputs are connected to other physical input addresses!

Local bus expansion with XIOC-BP-EXT

The XIOC-BP-EXT backplane enables expansion of local system busses from a max. of 7 to a max. of 15 slots.

The intelligent modules such as network and gateway modules can only be inserted into I/O slots 1 to 3. All other modules can be connected to any slot.

The possible arrangement of the backplane is described in the documentation of the XIOC signal modules (MN05002002Z-EN; previously AWB2725-1452GB). Please pay attention to the current requirements, particularly the current supplied by the power supply and the current requirement of the signal modules.

Further information can be found in the "XIOC signal modules" (MN05002002Z-EN; previously AWB2725-1452GB) documentation. Integration of the bus expansion via the software is explained in the "Expansion of the XIOC bus" section.

CPU

The XC-CPU101...(-XV) types of CPU are based on a processor with an integrated CAN interface, and include battery-buffered flash and SRAM memories. The CAN fieldbus interface is electrically isolated. A battery is required for the operation of the data-saving function.

The monitoring of the system voltage ensures that the data-saving routine will be initiated if the voltage goes below a fixed preselected level. In order to ensure that the stored energy required for the data-saving routine is not used up by I/O activities, the 5 V system voltage for the I/O modules is switched off.

The internal real-time clock facilitates time and date dependent control functions.

The available operating and interface control devices are:

- LED display for RUN/Stop and general error
- Operating-mode selector switch RUN/Stop
- RS232 interface, e.g. for programming device interfacing
- CANopen interface as a fieldbus interface
- Interface for a multimedia memory card (MMC).

The CPUs for XC100 controllers are available in various different versions:

- XC-CPU101-C64K-8DI-6DO (-XV)
- XC-CPU101-C128K-8DI-6DO (-XV)
- XC-CPU101-C256K-8DI-6DO (-XV)

C64K, C128K and C256K are a measure for the size of the user memory.

"XV" designates a visualisation CPU, and permits the direct connection to and control of a text display (XV-101).

In accordance with the size of the application program, the following memory values apply:

	XC-CPU101-…(-XV)		
	C64K-8DI-6DO	C128K-8DI-6DO	C256K-8DI-6DO
Program code	64 kByte	128 Kbyte	256 kByte
Program data, of which:	64 kByte	128 Kbyte	256 kByte
Markers	4 kByte	8 kByte	16 kByte
Retain data	4 kByte	8 kByte	16 kByte

The XC-CPU...-XV types have an additional 64 kByte flash memory for text

Task

The task of the CPU is to generate output signals from the incoming local and central/decentralized signal, in accordance with the application program.

Input/output signal can be, for instance:

- digital or analog signals
- commands from the text display[1)]
- output to the text display[1)]
- connections to the programming system
- connections to the CANopen bus interface
- connections to fieldbus modules, if present
- connections to intelligent signal modules, if present.

1) Only with XC-CPU...-XV

Use of the CPU types

CPU types	XC100	Text display XV-101-…	
		K42	K84
XC-CPU101...	✓	–	–
XC-CPU101…(-XV)	✓	✓	✓

Surface mounting

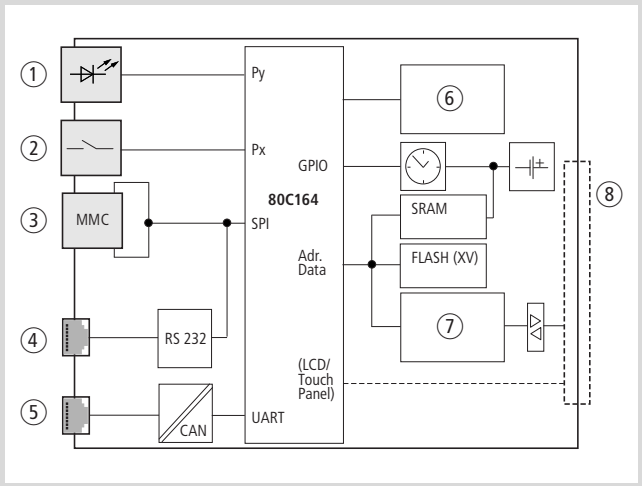


Figure 7: Block diagram of the XC-CPU101

① State indication RUN, Stop, SF
② Operating mode selector switch
③ Multimedia card
④ Programming device interface: RS232 on XC-CPU101
⑤ CANopen fieldbus interface
⑥ Voltage monitoring
⑦ I/O bus interface
⑧ XIOC I/O bus (on module rack)

LED status indicator

→ chapter "Operating states" on page 41.

Operating mode selector switch

The operating modes "Stop" and "Run" are selected by a rocker switch at the front of the CPU module. Please note that the position of the operating mode selector switch sets the behaviour of the CPU. The effectiveness of the software settings depends on the position of the operating mode selector switch. If the selector switch is changed to the "Stop" position while the equipment is in the "Run" mode, then the CPU will switch from the operating mode "Run" to the "Stop" state at the end of the cycle that is currently running. The position of the operating mode selector switch is polled at the end of each cycle, and the controller switches to the selected state, → chapter "CPU operation".

Multimedia Card (MMC)/Memory card

The multimedia card is used as an optional backup medium for the (boot) project and to save recipe data. The operating system supports memory capacities up to a maximum of 128 MByte. At present, Eaton offers MMCs in the sizes 16 and 32 MByte, with the type designations XT-MEM-MM16M and XT-MEM-MM32M. To write data to the multimedia card, just plug it into the corresponding MEM CARD slot in the CPU. Use the command "create boot project" to transfer the project to the MMC.

→ From operating system (OS) version 03.03 it is possible to transfer the operating system to the memory card and to transfer it from there to other PLCs, → section "Updating the operating system (OS)" on page 22.

Erasing functions

Use the browser "Format" command in order to erase the entire content on the MMC. You can delete the boot project and the operating system on the MMC using the "Reset (Original)" command.

Data access to the multimedia card

The "XC100_File" library is contained in the "Lib_CPU101". It provides the elements for access to the MMC. It is necessary to add the respective library to the "Library manager":

- ▶ Change to the library manager and position the mouse pointer on the field for the libraries. Then press the right-hand mouse button.
- ▶ Select the "Additional library insert" command in the new opened information window.
- ▶ Select the "Lib_CPU101" library and then the "XC100_File" file. Open this file.

The module is integrated into the library manager with the "Open" command. The following functions are now available:

- FileClose
- FileDelete
- FileGetSize
- FileOpen
- FileRead
- FileRename
- FileSetPos
- FileWrite.

Further information about these modules can be found in the "Libraries of the XC100_File.lib" section and the in the manual "Function Blocks for easySoft-CoDeSys" (MN05010002Z-EN; previously AWB2786-1456GB).

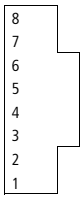
▽ **Attention!**

- The "FAT16 file system" is not transaction-safe.
- The control voltage/control may not be switched off when a File service is still open.
- A voltage failure or shut down of the supply voltage with an open File service can lead to destruction of the multimedia card.

Programming device interface

The CPU is fitted with an RS232 interface. This serial interface enables a point-to-point connection. The handshake lines are not available. Communication between the controller and the programming device takes place through this RS232 interface. Physically, the interface is an RJ45 socket. Use the programming cable XT-SUB-D/RJ45 for connecting XC100. The interface is not electrically isolated.

Interface assignment



	RS232
8	RxD
7	GND
6	–
5	TxD
4	GND
3	–
2	–
1	–

Data transfer rate modification

- ▶ Open the ‹Resources → PLC Configuration› dialog field.
- ▶ Activate the "Other parameters" tab.
- ▶ Select the required data transfer rate in the "Baudrate" list field. In the example, this is 38400 kBit/s.

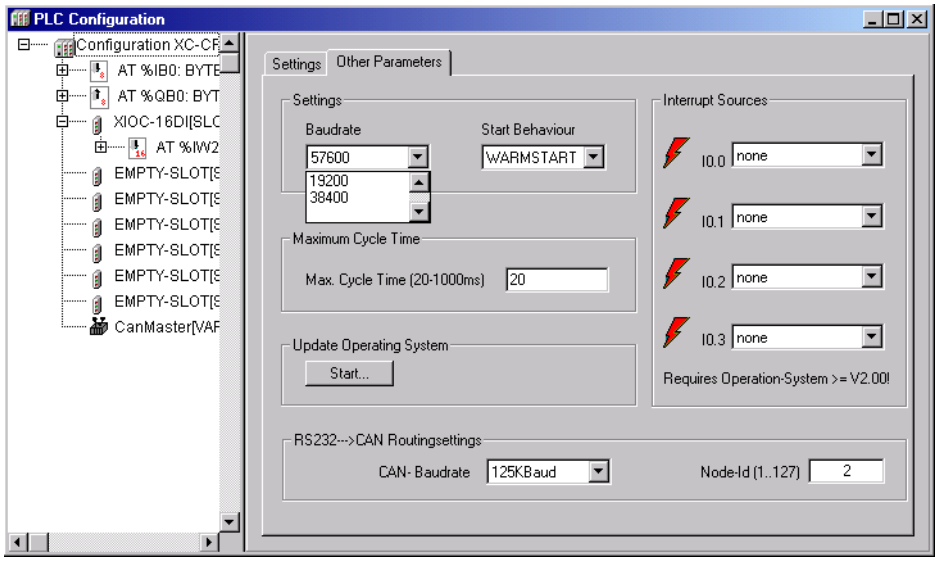


Figure 8: Controller configuration – "Other parameters"

- ▶ Close the "Other Parameters" window.
- ▶ Select the menu ‹Online → Login›.

Figure 9: Menu "Online"

The query as illustrated in (→ figure 10) appears:

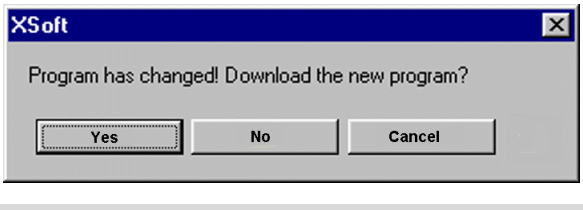


Figure 10: Query concerning program change

▶ Use a double-click to select the field with the preset baud rate.

This field now has a grey background.

▶ Double-click this field once more to choose the Baud rate, e.g. 38400 Bit/s Confirm with "OK".
▶ Select the menu ‹Online → Log-in› again.

Once again, you will see the following message:

▶ If you answer this query with "Yes", and you see the following error message shown below for a communication error, the baud rates for XC100 and XSoft do not match. The next steps show you how to set the baud rate.

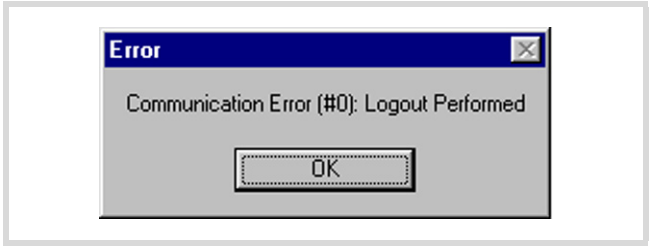


Figure 11: Communication fault

▶ Acknowledge the error message, with "OK".
▶ Select the menu ‹Online → Communication parameters› (→ figure 9).

Now you will see the "Communication window", as shown in the next diagram.

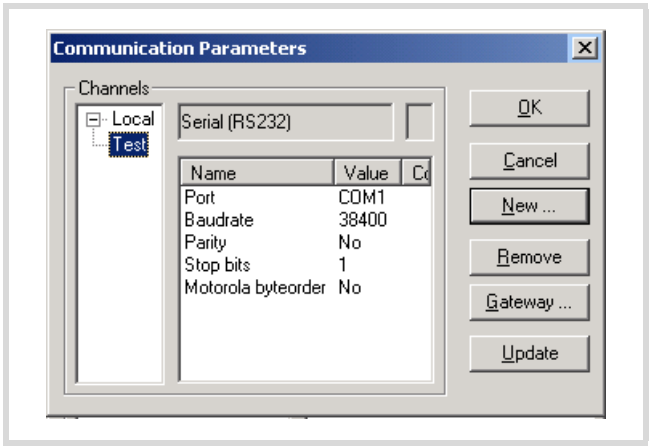


Figure 12: Communication parameters

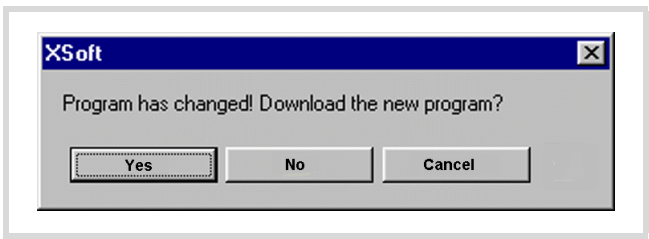


Figure 13: Confirmation request after program change

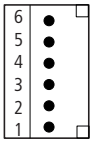
▶ Again, answer this query with "Yes".
▶ Select the menu ‹Online → Start› (→ figure 9). This puts the controller into the RUN mode.

The subsequent communication between the XC100 and the PC (as the programming device) will be made at the selected transmission rate.

CANopen interface

The CPUs can be connected to the CANopen bus via the electrically isolated ISO-11898 interface.

The connector has the following assignment:



Terminal	Signal
6	GND
5	CAN_L
4	CAN_H
3	GND
2	CAN_L
1	CAN_H

Connector type: 6-pole, plug-in spring-loaded terminal block, conductor cross-section up to 0.5 mm^2

The CPUs can be operated on the CAN bus either as the network (NMT) master or as the NMT slave.

The CPU can be used to send/receive CAN telegrams directly to/from the user program. An interruption on the CAN Bus will only be recognised when the respective CAN slave is monitored by the PLC (Nodeguarding function).

Power supply

The sequence in which the power supply of the individual CAN slaves is connected does not have an effect on the functionality of the CAN bus. Depending on the parametric programming, the PLC "waits" for the non-existent slave or starts it at the time at which the slave is interfaced to the CAN network.

Start/Stop behaviour

If you set the operating mode selector to the "Stop" position, all outputs of the decentralized devices will be set to the "0" level.

Bus terminating resistors

The ends of the network link must be terminated with 120 Ω bus termination resistors:

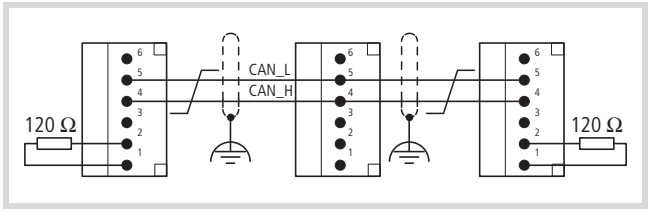


Figure 14: Possible configuration of a CANopen bus with bus termination resistors

Terminals 1 and 4, 2 and 5, 3 and 6 are internally connected.

Properties of the CANopen cable

Use only cable approved for CANopen applications and with the following characteristics:

- Characteristic impedance 100 to 120 Ω
- Capacitance < 60 pF/m

The demands placed on the cable, connectors and bus termination resistors are specified in ISO 11898. Following you will find some demands and stipulations listed for the CANopen network.

In the following table, standard parameters for the CANopen network with less than 64 CANopen slaves are listed (table complies with the stipulations of the ISO 11898).

Table 2: Standard parameters for CANopen network cable according to the ISO 11898

Bus length [m]	Loop resistance [mΩ/m]	Conductor cross-section [mm^2]	Bus termination resistor [Ω]	Transfer rate with cable length [kBit/s]
0 – 40	70	0.25 – 0.34	124	1000 at 40 m
40 – 300	< 60	0.34 – 0.6	150 – 300	> 500 at 100 m
300 – 600	< 40	0.5 – 0.6	150 – 300	> 100 at 500 m
600 – 1000	< 26	0.75 – 0.8	150 – 300	> 50 at 1000 m

The length of the CANopen bus cable is dependant on the conductor cross-section and the number of bus users connected. The following table includes values for the bus length in dependance on the cross-section and the connected bus users, which guarantee a secure bus connection (table corresponds with the stipulations of the ISO 11898).

Table 3: Cable cross-section, bus length and number of bus slaves conform to ISO 11898

Cable cross-section [mm]	Maximum length [m]		
	n = 32	n = 64	n = 100
0.25	200	170	150
0.5	360	310	270
0.75	550	470	410

n = number of connected bus users

If the bus length is greater than 250 m and/or are more than 64 slaves connected, the ISO 11898 demands a residual ripple of the supply voltage of ≦ 5%.

As the bus cable is connected directly to the COMBICON connector of the CPU, additional details concerning stub lines are not required.

The bus users are configured in the "PLC Configuration" window of the CPU in the programming software.

Cable recommendation:
LAPP cable
UNITRONIC-BUS LD

Real-time clock

The XC100 features a real-time clock, which can be referenced in the user program via the functions from the "SysLibRTC" library.

The following functions are possible:

- Display of the battery charge state
- Display mode for hours (12/24 hour display)
- Reading and setting of the real-time clock.

A description of the functions can be found in the "SysLibRTC.pdf" file.

→ For the XC100 the "GetRealTimeClock" (evaluation of the real-time clock) and "SetRealTimeClock" (setting of the real-time clock) function blocks can continue to be used. However, they are not supported by the XC200 and XN-PLC-CANopen controls.

More information about the function blocks can be found in the separate "Function blocks for easySoft CoDeSys" (MN05010002Z-EN; previously AWB2786-1456GB) manual.

XC-CPU101-…-XV

The XC-CPU101-...-8DI-6DO- XV units are equipped with an expandable operating system. The functionality of the system permits operation of these CPUs with text displays from the XV-101-..

→ The text displays are described in the separate manual "Hardware and Engineering" (MN04802001Z-EN; previously AWB2726-1461GB).

Battery

A lithium battery, type 1/2 AA (3.6 V) is used for data-saving. The battery compartment can be found on the left side of the CPU unit, behind a cover plate. The charge level of the battery is monitored. If the battery voltage falls below a fixed preset level, then a general error message will be generated.

The battery buffer times are:

- Worst-case: 3 years continuous buffering
- Typical: 5 years of continuous buffering

▽ **Attention!** To avoid loss of data, the battery must be changed when the low threshold level has been reached.

Ordering designation of the battery: XT-CPU-BAT-1

CPU installation

→ Detailed information about the installation of the backplanes and XI/OC modules can be found in the manual "Hardware and Engineering XI/OC Signal Modules" (MN05002002Z-EN; previously AWB2725-1452GB). Here you can also find further information on the various types of module rack and the individual slot assignments for the CPU and the XI/OC signal modules.

- ▶ Insert the loop on the bottom of the CPU module into the hole in the module rack [1].
- ▶ Press the top of the CPU module onto the module rack, until you hear it click into position [2].

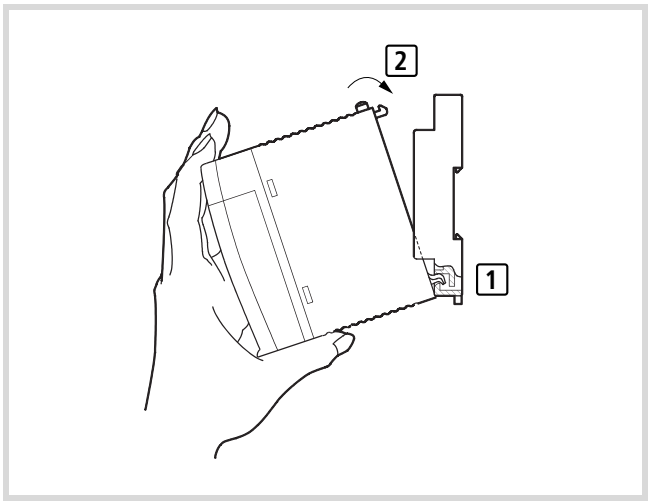


Figure 15: CPU installation

Detaching the CPU

- ▶ Press in the catch [1].
- ▶ Keep the catch pressed in, and pull the top of the CPU module forwards [2].
- ▶ Lift up the CPU module and remove it [3].

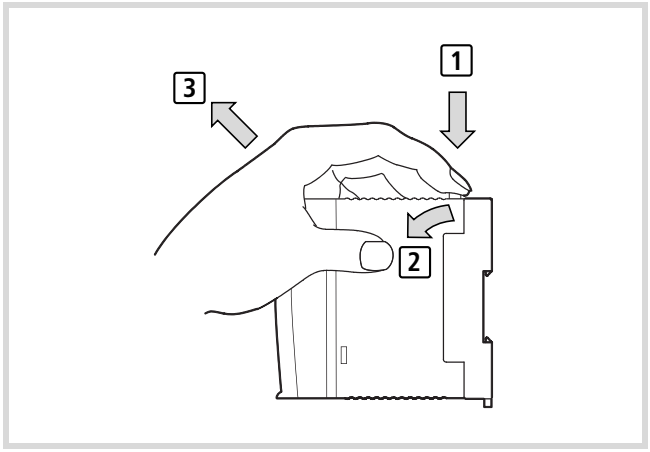


Figure 16: Detaching the modules

2 Engineering

Control panel layout

The layout of the components inside the control panel is a major factor for achieving interference-free functioning of the plant or machinery. During the project planning and design phase, as well as its implementation, care must be taken that the power and control sections are separated. The power section includes:

- Contactors,
- Coupling/interfacing components,
- Transformers,
- Frequency inverters,
- Converters.

In order to effectively exclude any electromagnetic contamination, it is a good idea to divide the system into sections, according to their power and interference levels. In small switchgear cabinets it is often enough to provide a sheet steel dividing wall, to reduce interference factors.

Ventilation

In order to ensure sufficient ventilation a minimum clearance of 50 mm to passive components must be observed. If the neighbouring components are active elements, such as power supplies or transformers, then the minimum spacing should be 75 mm. The values that are given in the technical data must be observed.

Layout of units

Build the module racks and the controls into the switchgear cabinet in a horizontal position:

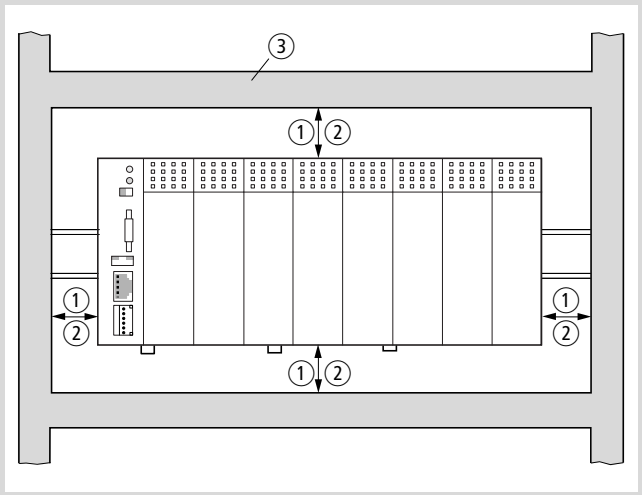


Figure 17: Control panel layout

① Spacing > 50 mm
② Spacing > 75 mm to active elements
③ Cable duct

Preventing interference

Cable routing and wiring

Cables are divided into the following categories:

- Electric power lines (e.g. power lines carrying high currents, or lines to converters, contactors, solenoid valves)
- Control and signal cables: (e.g. digital input lines)
- Measurement and signal cables (e.g. fieldbus connections)

→ Always route power cables and control cables as far apart as possible. This avoids capacitive and inductive coupling. If separate routing is not possible, then the first priority must be to shield the cable responsible for the interference.

Take care to implement proper cable routing both inside and outside the control panel, to keep interference as low as possible:

▶ Avoid parallel routing of sections of cable in different power categories.
▶ As a basis rule, keep AC cable separated from DC cables.
▶ Keep to the following minimum spacing:
  – at least 10 cm between power cables and signal cables;
  – at least 30 cm between power cables and data or analog cables.
  – When routing cables, make sure that the outgoing and return leads of a circuit pair are routed together: The currents flowing in opposite directions thus cancel each other out as a summation. The generated electromagnetic fields cancel each other out.

Suppressor circuitry for interference sources

▶ All suppressor circuitry should be wired in as close to the source of interference (contactors, relays, solenoids) as possible.

→ Switched inductors should always have suppressor circuitry fitted.

Shielding

▶ Use shielded cables for the connections to the data interfaces. The general rule is: the lower the coupling impedance, the better the shielding effect.

Lighting protection

External lightning protection

All cables that go outside buildings must be shielded. Metal conduit is the best solution to this problem. For signal cables, use overvoltage protection devices, such as varistors or other similar devices. Install the protection devices as close as possible to the cable entry into the building, at the latest there were the cable enters the switchgear cabinet.

Internal lightning protection

Internal lightning protection covers all those measures taken to reduce the effects of a lightning strike and the resulting electrical and magnetic fields on metallic installation and electrical plant. These measures are:

- equipotential bonding/earthing
- shielding
- using overvoltage protection devices

Please consult the following manuals for advice on cable routing and shielding measures:

- AWB27-1287 "EMC Engineering Guidelines for Automation Systems"
- TB27-001-GB "Electromagnetic Compatibility (EMC) for Automation systems"
- TB02-022-GB "Electromagnetic Compatibility (EMC) for Machinery and Plant"

Wiring examples

→ You can find wiring examples for the XI/OC modules in the manual "Hardware and Engineering, XI/OC signal Modules" (MN05002002Z-EN; previously AWB2725-1452GB).

PSU

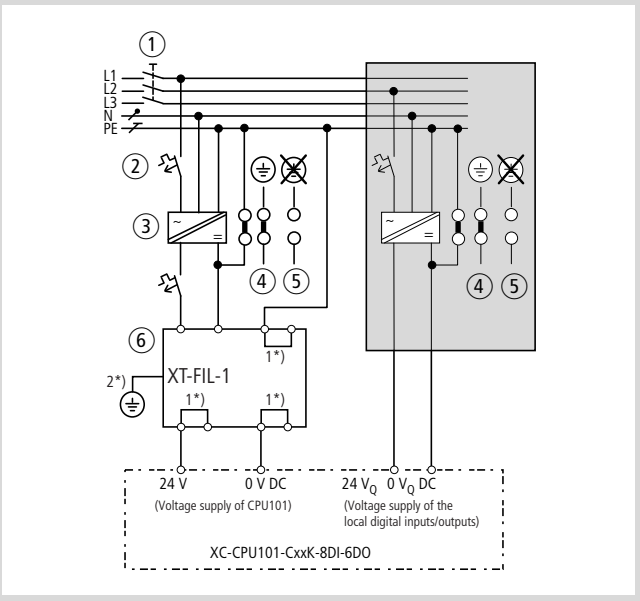


Figure 18: Wiring example for the supply section

① Main switches
② Circuit protection device
③ 24 V DC supply voltage
④ Earthed operation
⑤ In floating (i.e. unearthed) operation, an isolation monitor must be used (IEC 204-1, EN 60204-1, DIN EN 60204-1).
⑥ 24 V DC line filter; ensures that a current of up to 2.2 A (maximum) is available at a rated voltage of 24 V DC. Ensures that the EMC stipulations for devices are fulfilled when the filter is used.
The filter is not a component of the CPU and must therefore be ordered separately: Type: XT-FIL-1, Article no.: 285316
(Supplier: Eaton Industries GmbH)
→ „Dimensions" on page 72
→ „Technical data" on page 76

1*) Internal jumper

2*) Additional PE connection via contact spring on rear

Power supply of the digital inputs/outputs

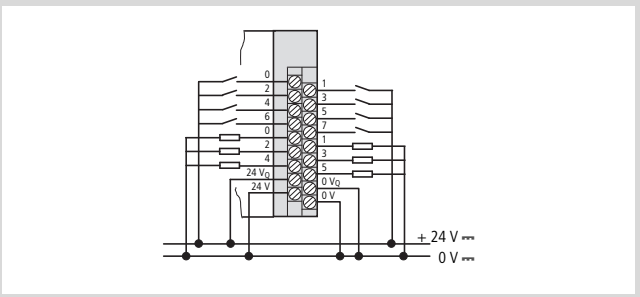


Figure 19: Example for wiring the terminal block

The wiring example indicates the wiring of a separate voltage supply for inputs/outputs.

3 CPU operation

Startup behaviour

After the supply voltage is switched on the CPU will carry out a self-test and several CRC checks. If a fault is detected, it will remain in the "Switch-on not OK" state, → chapter "Operating states" on page 41. After the tests have been successfully completed, the operating system (OS) takes over the communication with the programming system as well as execution and debugging of the application program. It only supports one application program.

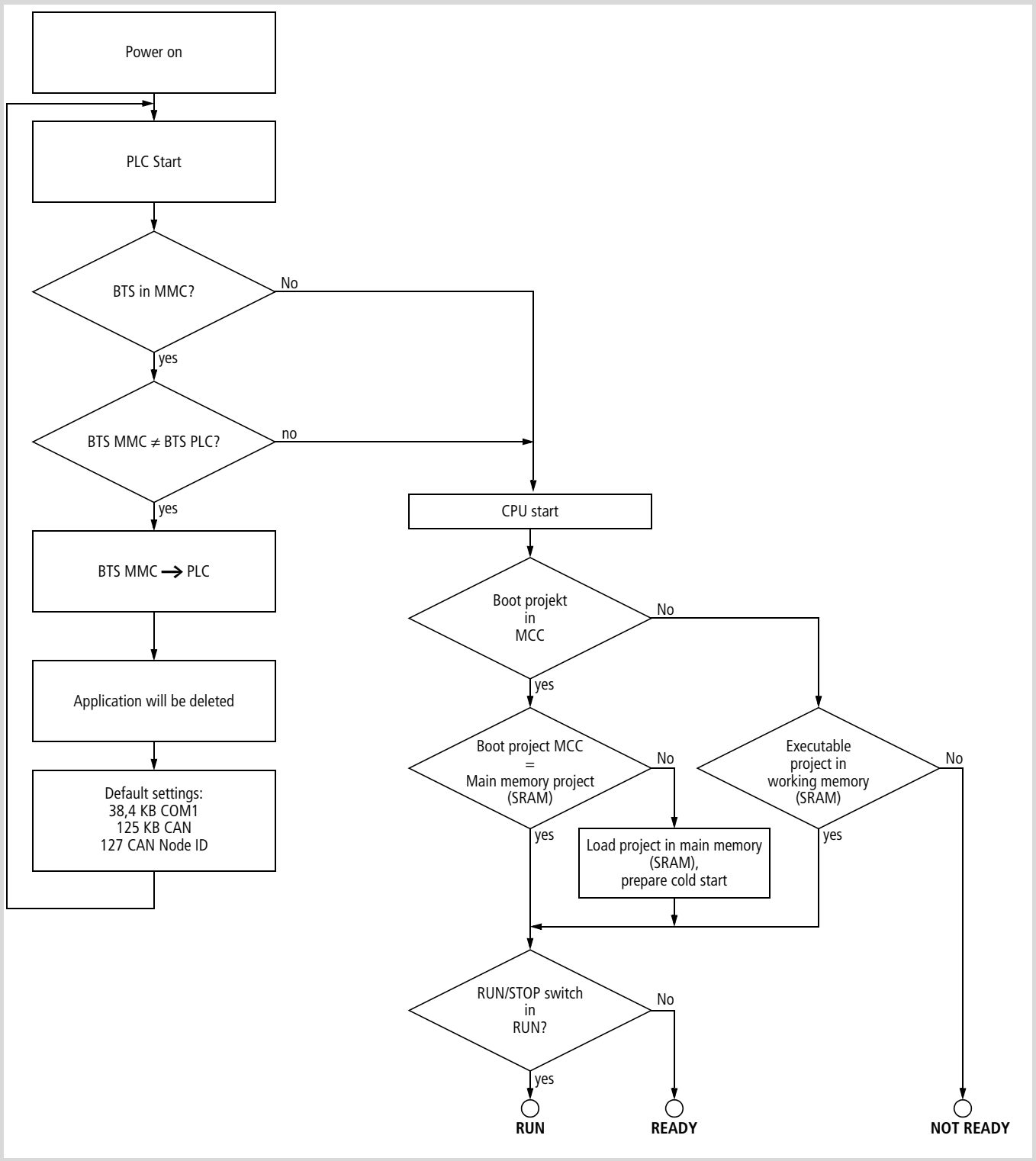


Figure 20: Startup behaviour

Switch-off behaviour

Switch-off (operating mode selector switch: Run → Stop) leads to an interruption of the program run the end of the cycle. Running of the program is ended immediately with a voltage dip (switching via the PFI signal). The outputs are switched off at the same time. When the supply voltage returns, the controller carries out a restart (see section "Startup behaviour").

Start behaviour

The start behaviour of the controller depends on:

- the position of the local operating mode selector switch
- the parameter settings for start behaviour that were set in the programming system.

(With the CPU version "XV" (visualisation CPU), it is basically possible to operate the system from the system menu in the display).

The position of the operating mode switch determines whether the operating states changes from "Stop" to"Run".This change cant be forced by a corresponding choice within the programming system.

When a program starts, a check is made whether the configured inputs and outputs match those that are actually present. A check is also made whether the module that was parameterized is physically present, or a different module. A module that is not present will not have any effect on the start of the application program, but if the module is a different type, the start will be prevented.

When the application program starts, a distinction is made between (see also the following sections):

- Cold start
- Warm start

Stop behaviour

The processing of the application program always halts at the end of a program cycle.

Cold start

A cold start is initiated during the initial start, after loading a program to the PLC and after every "Cold reset". During this start, all the program variables are set to their initialisation values and the program is started.

Warm start

All further starts of the loaded program as well as after "Warm resets" are warm starts. The variables that were declared with "RETAIN" retain their values, the other variables are set to their initialisation values and program is started.

Test and commissioning

The PLC supports the following test and commissioning features:

- Breakpoint/single-step mode
- Single cycle mode
- Forcing
- Online modification
- Status indication (Power Flow).

Breakpoint/single-step mode

Breakpoints can be set within the application program. If an instruction has a breakpoint attached, then the program will halt at this point. The following instructions can be executed in single-step mode. The cycle-time monitoring is deactivated.

Caution!
At this moment any outputs set will remain set!

Single-cycle mode

In single-cycle operation, one program cycle is performed in real time. The outputs are enabled during the cycle. At the end of the cycle, the output states are cancelled and the outputs are switched off. The cycle-time monitoring is active.

Forcing

All the variables in an application program can be forced to a given setting. If variables for physical outputs of the local I/Os are forced, they will only be connected through to the peripherals in the "Run" state.

Status indication, easySoft-CoDeSys

- The signal state of the physical, Boolean inputs are displayed in "Start" and "Stop" mode.
- The signal state of the physical, Boolean outputs are only displayed in "Start" (RUN) mode.
- The display for a low signal is displayed with "FALSE" and has a black background.
- The display for a high signal is displayed with "TRUE" and has a blue background.
- All other variables are only displayed in "Start" mode with the current respective variable value.

Programreset

The application program can be reset to one of the following levels:

- Warm reset
- Cold reset
- Full reset

Warm reset

This correspond to the initialisation during a warm start, see section "Warm start"on page 20.

Cold reset

This correspond to the initialisation during a cold start, see section "Cold start"on page 20.

Full reset

The application program in the controller is completely deleted. After this, the controller is in the "NOT READY" state.
The boot project and the operating system on the MMC will also be deleted.

Program parameterization

An application program has various parameters that can be set or adjusted in the programming system:

- Maximum program cycle time
- Start behaviour at Power-On
- Parameters for CAN Routing.

Maximum program cycle time

The maximum cycle time for the application program can be set, in the range from 20 ms to 1000 ms.
The default value is 20 ms.

Start behaviour at Power-On

This setting defines how the controller should respond after switch-on, if an application program is present and the operating mode selector switch is in the "Run" position.

The following settings are available:

- WARMSTART (default setting),
- COLDSTART,
- STOP.

Creating and transferring a boot project

A boot project is generated by a loaded user program and saved on the MMC.

The following steps are necessary in order to create a boot project:

▶ Insert an MMC into the "MEM Card" slot of the CPU.
▶ Change over to the "Online" folder.
▶ Select the "Login" command.
▶ Select the "Create boot project" command.

→ The boot project is dependent to the operating system version with which it was generated. If you wish to transfer the boot project on a PLC into a further PLC, remove the MMC (with boot project) from the source PLC and insert it into the target PLC. Then switch the PLC off and on.

The target PLC can only operate with the new boot project when the source PLC has the same operating system as that which has generated the boot project, → section "Updating the operating system (OS)"on page 22.

Create boot project after online change

After an online change has been carried out, you can create a new boot project.

Please note the following information:

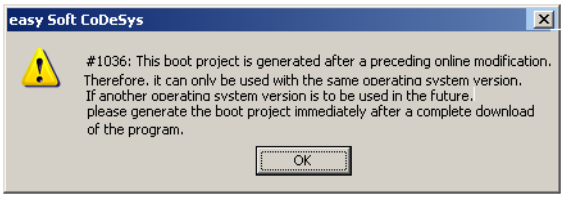


Figure 21: Download: Selection and information

Updating the operating system (OS)

With the XC100, you have the possibility of replacing the operating system (OS) supplied with the PLC by a more recent one. Eaton offers the most recent operating system version for download on the Internet.

→ Not all of the functions of the new operating system (OS) are supported by the older XC100 versions.

You have two choices available to transfer the operating system (OS).

- Directly from the PC to the PLC
- From the PC into the MMC.

A transfer of the OS from the PC to the MMC of the PLC is possible only when the PLC has an OS from version 03.03 or higher.

Transferring the operating system from the PC to the PLC

If an operating system (OS) is loaded into the PLC, the existing operating system (OS) as well as the user program are deleted.

Procedure:

▶ Insert an MMC into the "MEM Card" slot of the CPU.
▶ Establish a serial connection via the RS232 interface of the PC with the XC100, see → page 45.
▶ Activate the "Other Parameters" tap in the "PLC Configuration" window.

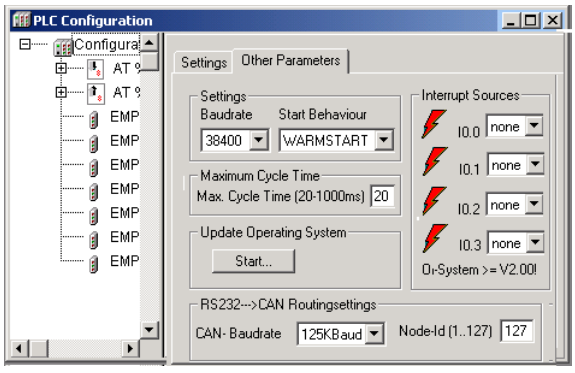


Figure 22: Start the download of the XC100 operating system

▶ Click on the "Start" button.

The "Download" window opens.

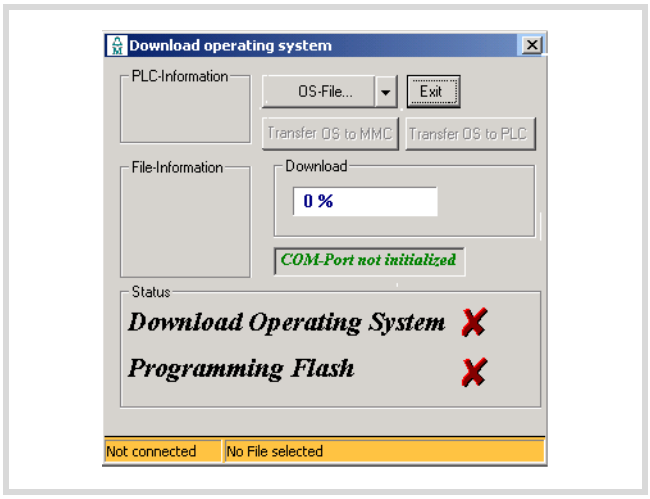


Figure 23: Download: Selection and information

▶ Press the "Operating System File" button and select the required operating system file (*.hex).

→ The files opened last can be selected via the drop-down menu.

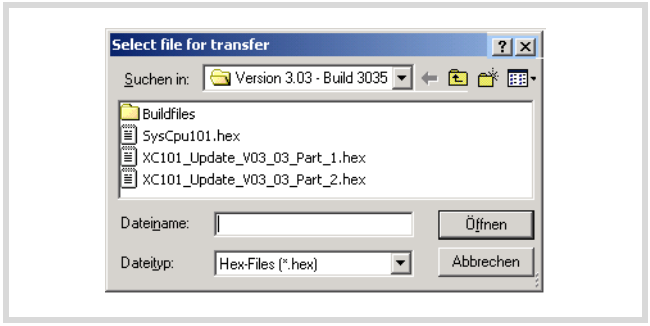


Figure 24: Operating system file selection

After the operating system file has been selected (from version V03.03) you receive information concerning the target type and file version.

▶ Click the Transfer Device button.

Transfer commences.

→ If a warning symbol appears in the "Download operating system - Status" field, the supply voltage may not be switched off!

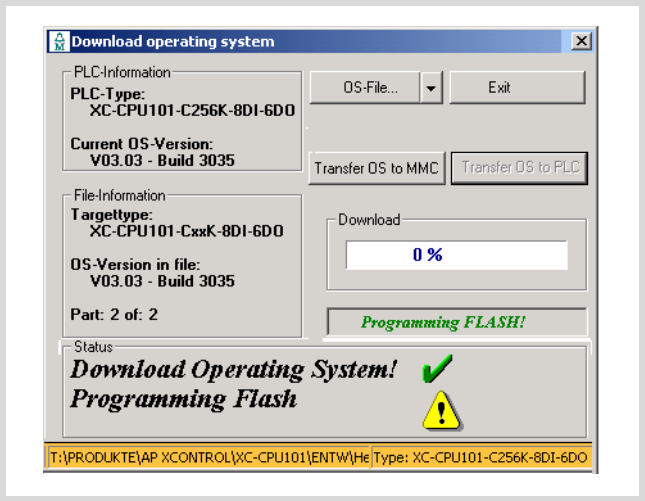


Figure 25: Warning during download

Wait for the following display.

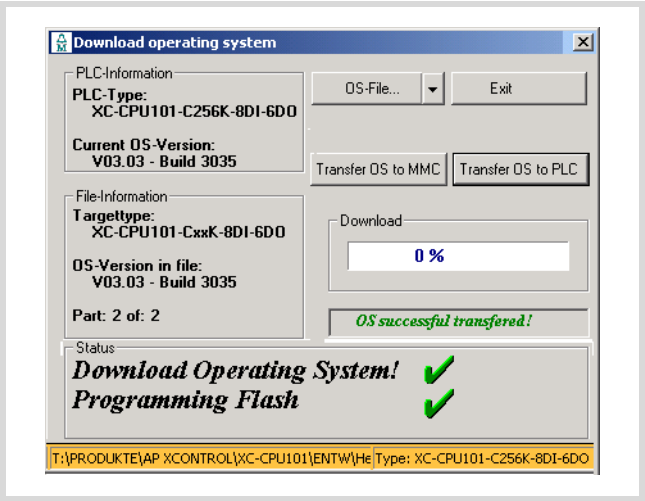


Figure 26: OS successfully transferred to the PLC

► In this window click the Exit button.

After download of the OS into the PLC the "Communication interrupted" message may appear as the PLC is rebooted after every download of the OS. Renewed login is required after each reboot.

As soon as you have logged on, the following message appears: "No program on the PLC! Should the new program be loaded?

The program is loaded after you have acknowledged the question with "Yes". You can then create the boot project.

Transferring the operating system from the PC into the MMC

If an OS is loaded into the MMC, the OS and the boot project on the MMC and the user program in the PLC are deleted. The procedure is similar to the description in section "Transferring the operating system from the PC to the PLC" on page 22.

Transferring the operating system from the MMC into the PLC

Switch the PLC off and on. The transfer can take more than 30 seconds as the CPU must be booted several times.

Do not interrupt the process, e.g. by switching off the supply voltage!

Update of further XC100 PLCs

If you wish to transfer the new operating system to further PLCs, insert the MMC into the PLC, which also features an OS from V03.03 or higher. The OS of the PLC is updated during the switch on process and a boot project is loaded into the PLC.

4 Program processing and system time

The application program is processed cyclically. The states of the inputs are read before the start of each program cycle, and the output states are written to the physical outputs at the end of the cycle. In addition, all system activities carried out before or after the processing cycle.

Among these are:

- Communication with easySoft-CoDeSys
- Online modifications
- Processing of the CANopen protocol stack, etc.

As a result of the software architecture of the run-time system, timing jitter may occur between individual processing cycles.

Cycle-time monitoring

The cycle-time monitoring monitors the cyclic task of the application program using a hardware timer. If the time exceeds the parameterized time, the outputs of the controller will be disconnected and the XC100 is put into the "Stop" state.

System libraries, function blocks and functions

You can use various system libraries with the respective functions and function blocks for your application.

Generally, the following libraries are available after the target system selection:

- Standard.lib
- RTCLib.lib
- Counter.lib
- SYSLIBCALLBACK.LIB

In these libraries, general IEC modules and functions for the XC PLCs are included. You will find the above mentioned libraries in the easySoft-CoDeSys under ‹Resources → Library manager›. Further libraries which are subsequently installed are also displayed in the library manager.

The description of the function blocks and functions can be found in the Library/Online help of the programming system:

▶ Start the easySoft-CoDeSys, click on the "Help" button and select "Contents". In this window you can choose between "Contents", "Index", and "Search".

Library manager

The installed libraries are placed in the Library Manager.

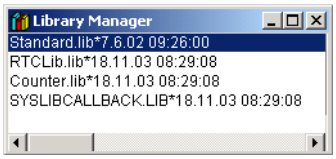


Figure 27: Standard libraries in the library manager

Target system specific libraries

For the XC100 target system, the "Lib_Common" and "Lib_CPU101" libraries are required.

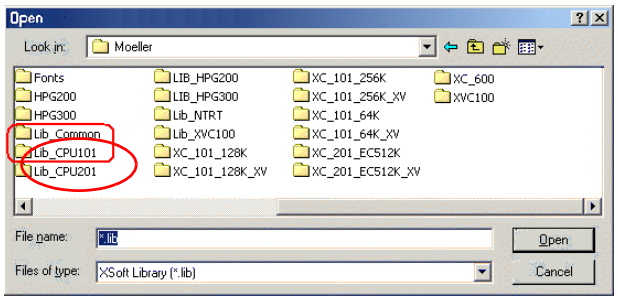


Figure 28: Target system specific libraries

Lib_Common

The basic functions which are required for the entire XC target systems are contained in the "Lib_Common". Furthermore, this library contains the S40 typical function blocks which have been adopted from the PS40 system to the easySoft-CoDeSys system.

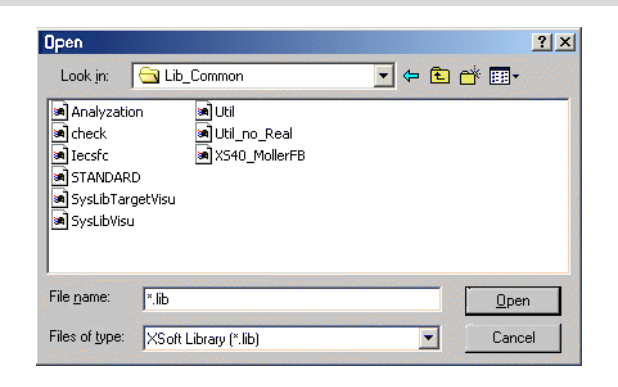


Figure 29: Files of the "Lib_Common"

Further information concerning the "STANDARD.lib" and "XS40_MoellerFB.lib" libraries can be found following this paragraph. More detailed explanations of the other libraries are not undertaken; they are explained in the (MN05010003Z-EN; previously AWB2700-1437GB) programming software manual and/or in the Library/Online help of the programming system.

Standard.lib

The IEC function blocks and standard functions are contained in the Standard.lib.

The description of the function blocks and functions can be found in the programming software manual (MN05010003Z-EN; previously AWB2700-1437GB) and in the Library/Online help of the programming system.

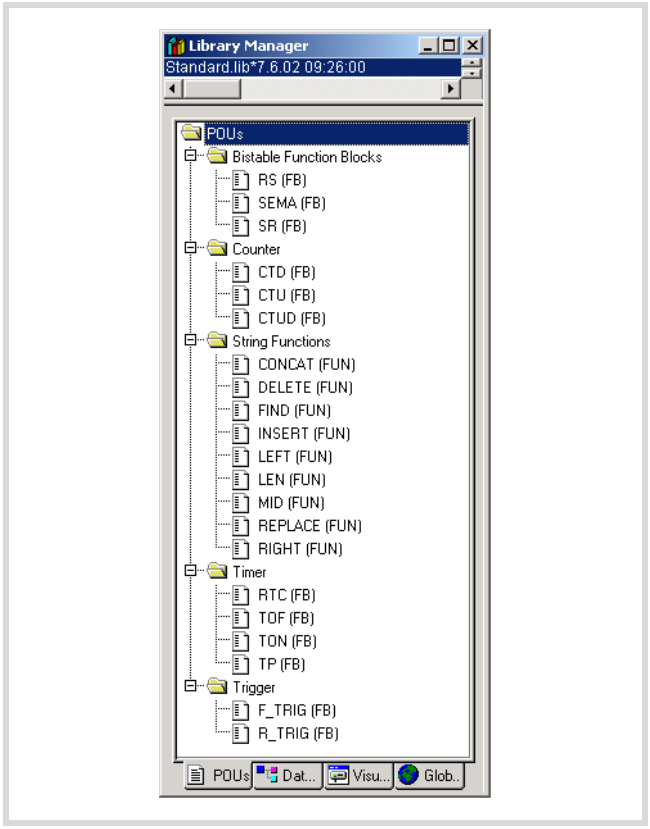


Figure 30: Function blocks and functions of the "Standard.lib"

XS40_MoellerFB.lib

You can find the descriptions of the "XS40_MoellerFB" in the "Function Blocks for easySoft CoDeSys" manual (MN05010002Z-EN; previously AWB2786-1456GB).

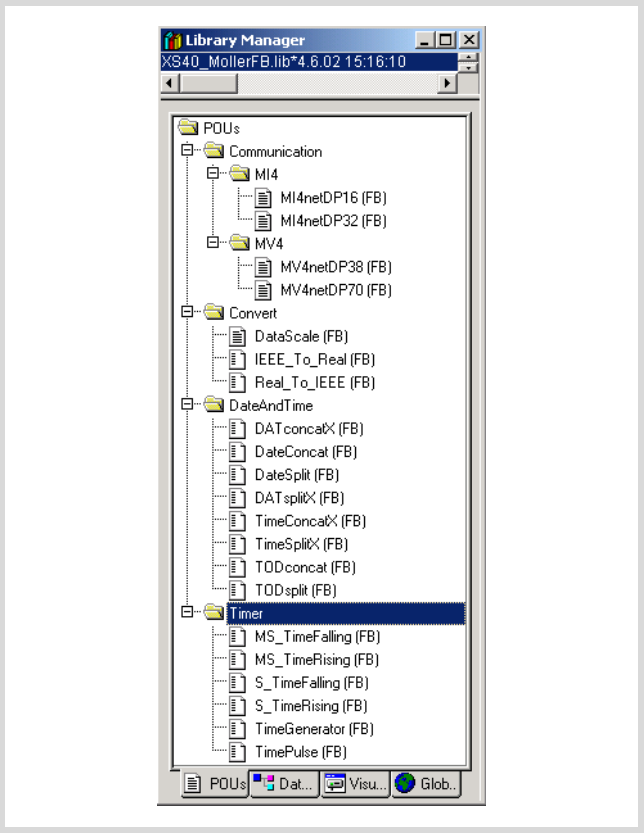


Figure 31: Function blocks of the "XS40_MoellerFB.lib"

Libraries of the "Lib_CPU101"

Libraries which are required for the XC100 target system are compiled together in the "Lib_CPU101" library.

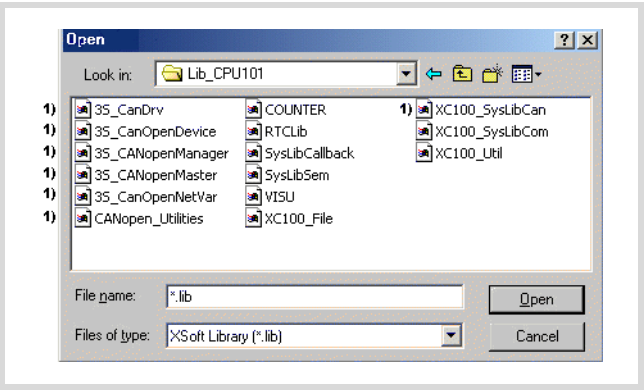


Figure 32: Function blocks of the "Lib_CPU101"

The libraries designated with "1)" include functions for the CANopen fieldbus. The CANopen bus expansion is described in the application notes regarding the CANopen bus. The application notes provide information concerning the following topics:

- XC-...-XION: Connection of the XION products (AN2700K18GB)
- XC-...-XC: Network variables (AN2700K19GB)
- Coupling multiple autonomous controls (CAN-Device) via CANopen (AN2700K20GB).
- Engineering of CAN stations (AN2700K27GB).

"Counter.lib" library:

The COUNTER library provides functions in order to integrate the XIOC-1CNT-100KHZ and XIOC-2CNT-100KHZ counter modules in the XC100 system.

The description of the COUNTER library can be found in the "Function blocks for easySoft-CoDeSys " manual (MN05010002Z-EN; previously AWB2786-1456GB) in the "Counter modules: counter.lib" section.

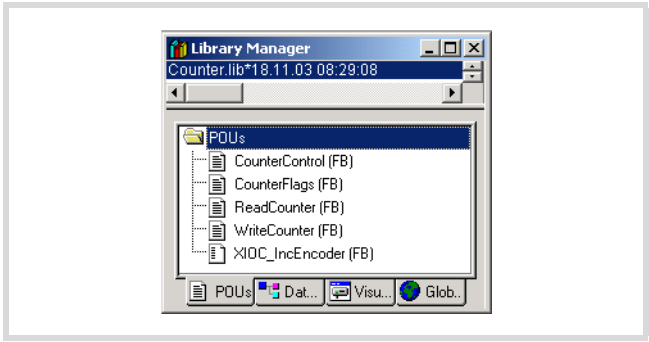


Figure 33: Function blocks of the "Counter.lib"

"RTCLib" library

The "RTCLib" library provides read and write functions for access to the real-time clock.

The description of the "RTCLib" library can be found in the "Function blocks for easySoft-CoDeSys" manual (MN05010002Z-EN; previously AWB2786-1456GB) in the "Clock modules: RTCLib.lib" section.

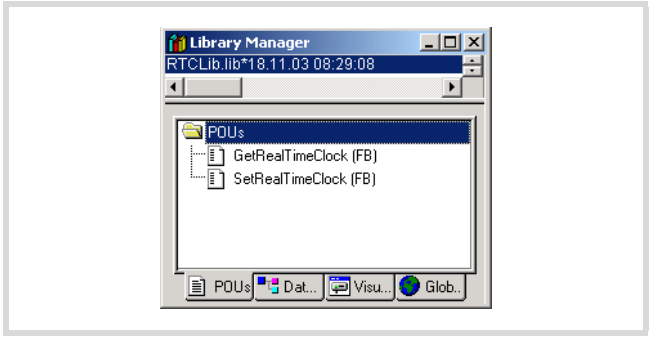


Figure 34: Function blocks of the "RTCLib.lib"

SYSLIBCALLBACK.LIB library

The SYSLIBCALLBACK.LIB provides defined callback functions for activation of run-time events (e.g. logon and logoff of the event functions).

The description of the library can be found in the programming software manual (MN05010003Z-EN; previously AWB2700-1437GB) and in the Library/Online help of the programming system.

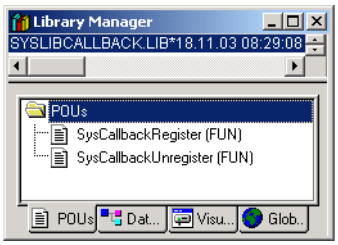


Figure 35: Functions of the "SysLibCallBack.lib"

"SysLibSem" library

The "SysLibSem" library provides functions to generate and use Semaphore (an enclosed information medium which cant be interrupted) for the synchronisation of tasks. Semaphore prevents simultaneous access to critical data which is used by multiple tasks. If a task accesses a certain area, the mechanism prevents that other tasks access the same area simultaneously. Only after the task authorised for access has ended access, is it possible for another task to access this area.

The description of the functions can be found in the programming software manual (MN05010003Z-EN; previously AWB2700-1437GB) manual and in the Library/Online help of the programming system.

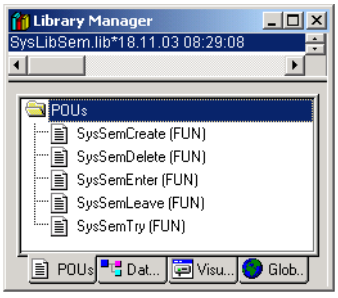


Figure 36: Functions of the "SysLibSem.lib"

"VISU" library

The "VISU" library provides functions with which process visualisation can be implemented in the easySoft-CoDeSys.

The description of the "VISU" library can be found in the "Function blocks for easySoft-CoDeSys" manual (MN05010003Z-EN; previously AWB2786-1456GB) in the "Visualisation modules: VISU.lib" section.

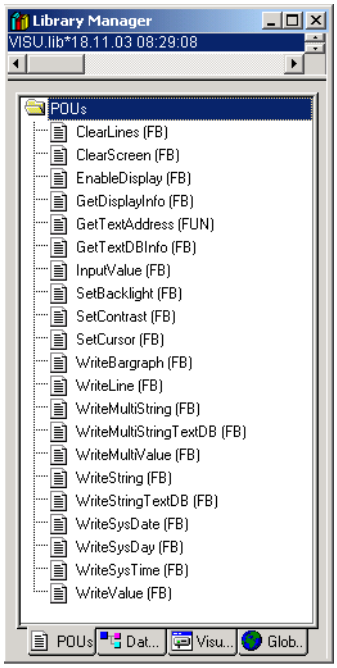


Figure 37: Functions of the "VISU.lib"

XC100_File.lib library

The "XC100_File.lib" library provides functions with which the easySoft-CoDeSys can access the file system of the Multimedia Card "MMC".

The description of the "XC100_File.lib" library can be found in the "Function blocks for easySoft-CoDeSys" manual (MN05010002Z-EN; previously AWB2786-1456GB) in the "File access block: XC100_File.lib" section.

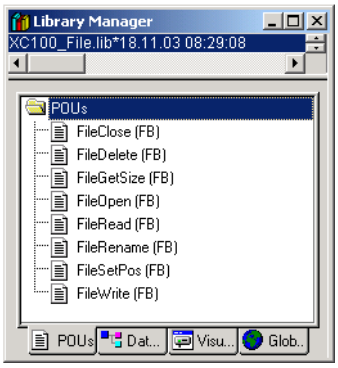


Figure 38: Functions of the "XC100_File.lib"

XC100_SysLibCom.lib library

The "XC100_SysLibCom.lib" library provides functions to operate the RS232 interface in transparent mode.

The description of the "XC100_SysLibCom.lib" library can be found in the manual in the "RS232 interface in transparent mode" section.

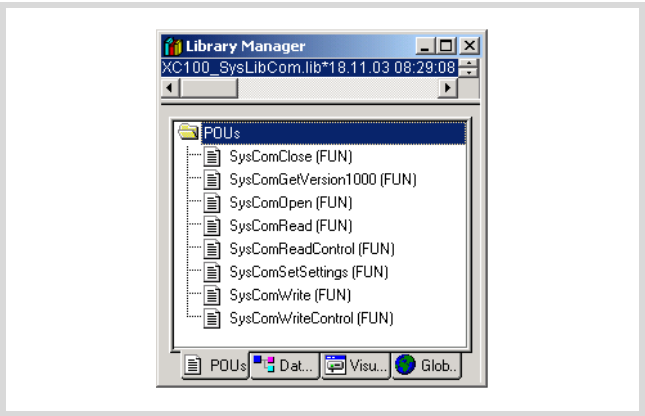


Figure 39: Functions of the "XC100_SysLibCom.lib"

"Library XC100_Util.lib"

The "XC100_Util.lib" library also provides various function blocks e.g., in order to integrate the following functionality's in the application:

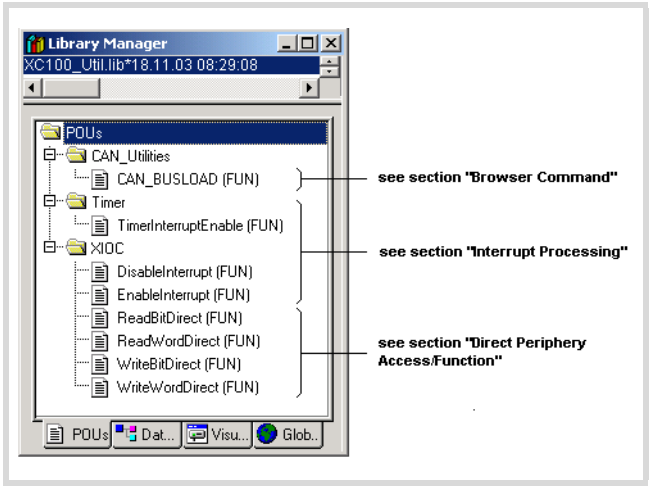


Figure 40: Functions of the "XC100_Util.lib"

You can find the descriptions of the function blocks in the manual "Function Blocks for easySoft-CoDeSys" (MN05010002Z-EN; previously AWB2786-1456GB).

Direct peripheral access

The "Direct peripheral access" function enables access directly to the local and central input and output signals of the control. The I/O access does not occur via the input/output image. The local and central input and output signals you can find the input and output signals of the CPU and the centrally expanded XC-100 control with the XIOC signal modules. XIOC signal modules which can be integrated via a bus system can't be accessed via the "Direct peripheral access".

Addressing is dependent on the slot number "0 to 15" of the signal modules. Further differentiation within the slot exists and relates to bit number "0 to max. 63" of the Inputs/Outputs.

Depending on the functionality of the XIOC signal modules, access occurs as a bit/word or read/write operation. The access parameter indicates the table 4.

The inputs/outputs which are required for "Direct peripheral access" are physically connected in the same manner as normal inputs/outputs.

Table 4: "Direct peripheral access" overview

Module	I/O bit access			I/O word access			I/O slot
	Read	Write	Param./Module	Read	Write	Param./Module	Param.
XC-CPU101-C256K-8DI-6DO	✓	✓	DI: 0 to 7; DO: 0 to 5	✓	✓	0	0
XC-CPU101-C256K-8DI-6DO-XV	✓	✓	DI: 0 to 7; DO: 0 to 5	✓	✓	0	0
XC-CPU101-C128K-8DI-6DO	✓	✓	DI: 0 to 7, DO: 0 to 5	✓	✓	0	0
XC-CPU101-C128K-8DI-6DO-XV	✓	✓	DI: 0 to 7, DO: 0 to 5	✓	✓	0	0
XC-CPU101-C64K-8DI-6DO	✓	✓	DI: 0 to 7, DO: 0 to 5	✓	✓	0	0
XC-CPU101-C64K-8DI-6DO-XV	✓	✓	DI: 0 to 7, DO: 0 to 5	✓	✓	0	0
XIOC-8DI	✓	–	0 to 7	✓	–	0	1 to 15
XIOC-16DI	✓	–	0 to 15	✓	–	0	1 to 15
XIOC-16DI-AC	✓	–	0 to 15	✓	–	0	1 to 15

Module	I/O bit access			I/O word access			I/O slot
	Read	Write	Param./Module	Read	Write	Param./Module	Param.
XIOC-8DO	–	✓	0 to 7	–	✓	0	1 to 15
XIOC-16DO	–	✓	0 to 15	–	✓	0	1 to 15
XIOC-16DO-S	–	✓	0 to 15	–	✓	0	1 to 15
XIOC-12DO-R	–	✓	0 to 11	–	✓	0	1 to 15
XIOC-16DX	–	✓	0 to 15	✓	✓	0	1 to 15
XIOC-8AI-I2	–	–	–	✓	–	0 to 7	1 to 15
XIOC-8AI-U1	–	–	–	✓	–	0 to 7	1 to 15
XIOC-8AI-U2	–	–	–	✓	–	0 to 7	1 to 15
XIOC-4T-PT	–	–	–	✓	–	0 to 3	1 to 15
XIOC-2AO-U1-2AO-I2	–	–	–	–	✓	0 to 3	1 to 15
XIOC-4AO-U1	–	–	–	–	✓	0 to 3	1 to 15
XIOC-4AO-U2	–	–	–	–	✓	0 to 3	1 to 15
XIOC-2AO-U2	–	–	–	–	✓	0 to 1	1 to 15
XIOC-4AI-2AO-U1	–	–	–	✓	✓	AI: 0 to 3, AO: 0 to 1	1 to 15
XIOC-2AI-1AO-U1	–	–	–	✓	✓	AI: 0 to 1, AO: 0	1 to 15
XIOC-1CNT-100KHZ	–	–	–	–	–	–	1 to 15
XIOC-2CNT-100KHZ	–	–	–	–	–	–	1 to 15
XIOC-2CNT-2AO-INC	–	–	–	✓	✓		1 to 15
XIOC-SER	–	–	–	–	–	COM2, COM3	1 to 15
XIOC-NET-DP-M	–	–	–	–	–	–	1 to 3

Functions

ReadBitDirect

A bit of an input module can be read directly with this function. The state of an input bit is stored in the variables, which indicate to the parameterized pointer "ptr_xValue". The pointer variable will not be changed when a fault occurs during processing.

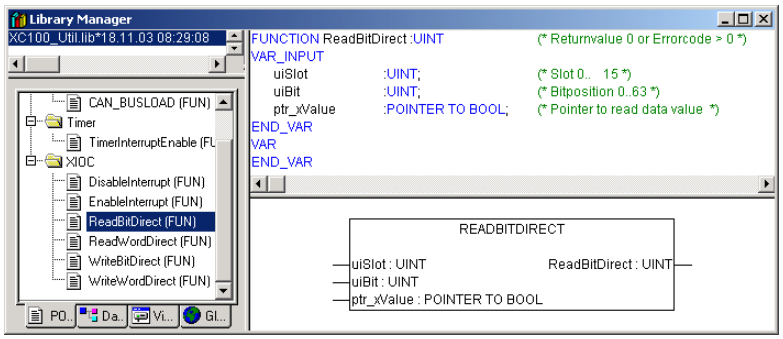


Figure 41: ReadBitDirect function

Table 5: Parameters of the "ReadBitDirect" function

uiSlot:	Slot number of the signal module. For possible parameters see table 4 on page 29
uiBit:	Bit position within the input value of the signal module. For possible parameters see table 4 on page 29
ptr_xValue:	Pointer to the variable value
ReadBitDirect:	Display of the fault code, see table 9 on page 33

ReadWordDirect

A word of an input module can be read directly with this function. The state of an input word is stored in the variables, which indicate to the parameterized pointer "ptr_wValue".

The pointer variable will not be changed when a fault occurs during processing.

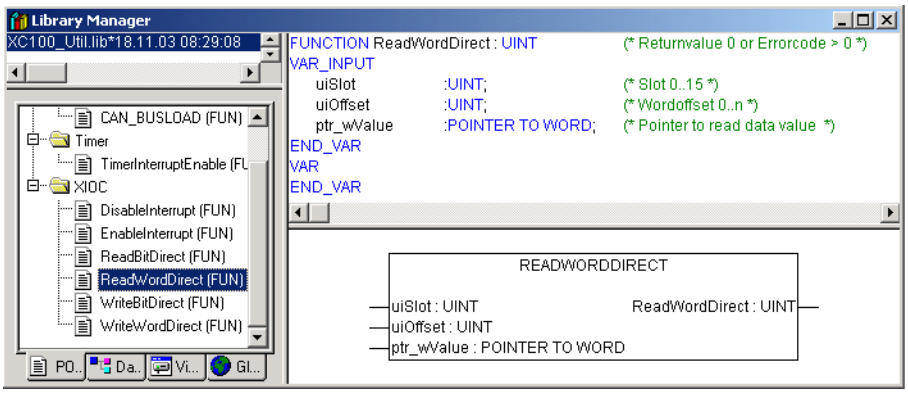


Figure 42: ReadWordDirect function

Table 6: Parameters of the "ReadWordDirect" function

uiSlot:	Slot number of the signal module. For possible parameters see table 4 on page 29
uiOffset:	Word offset within a signal module. For possible parameters see table 4 on page 29
ptr_wValue:	Pointer to the variable value
ReadWordDirect:	Display of the fault code, see table 9 on page 33

WriteBitDirect

A bit of an output module can be controlled directly with this function. The respective output image is refreshed in addition to the physical output. Writing to the output is possible and not subject to limitation, for only the local 6 outputs of the XC100-CPU with slot "0".

The following limitations apply to slots "1" and above:

An individual output cant be written with a "direct peripheral access". Writing of an entire output word is always the case. This means that the output image which is active at the time of the "direct access" will be output with the modified output bit. Thus, an output from other outputs within the output word occurs at the point of time when it is accessed and not at the end of the cycle.

For this reason, with a "direct peripheral access" to an output bit within a program cycle, the remaining outputs of the output word should not be used and evaluated.

A further refresh of the output word occurs at the end of the cycle.

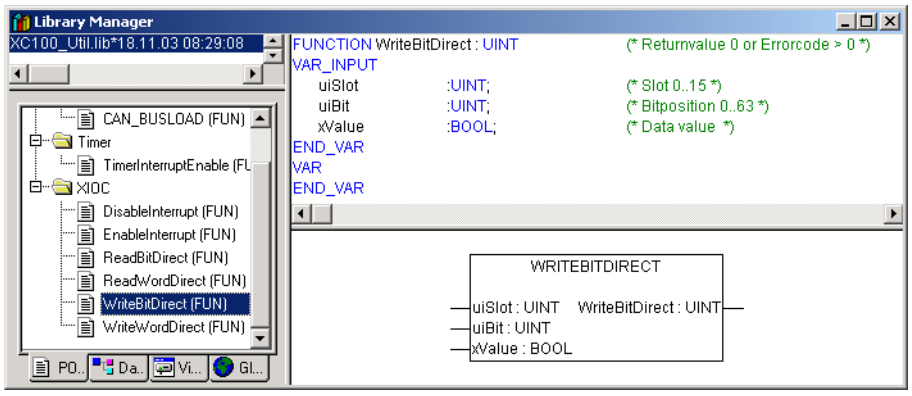


Figure 43: WriteBitDirect function

Table 7: Parameters of the "WriteBitDirect" function

uiSlot:	Slot number of the signal module. For possible parameters see table 4 on page 29
uiBit:	Output bit within the signal module. For possible parameters see table 4 on page 29
xValue:	Input parameter from "Bit" type
WriteBitDirect	Display of the fault code, see table 9 on page 33

WriteWordDirect

A word of an output module can be written directly with this function. At the time of access, the respective output image is also refreshed in addition to the physical output.

A further refresh of the output word occurs at the end of the cycle.

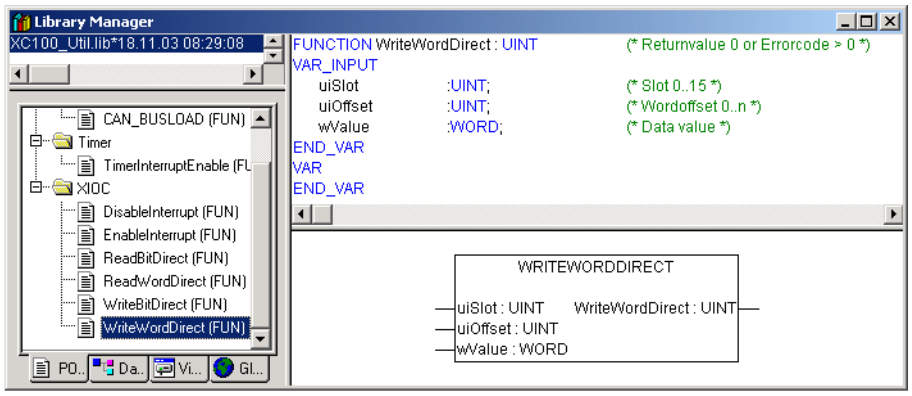


Figure 44: WriteWordDirect function

Table 8: Parameters of the "WriteWordDirect" function

uiSlot:	Slot number of the signal module. For possible parameters see table 4 on page 29
uiOffset:	Output word within a signal module. For possible parameters see table 4 on page 29
wValue:	Input parameter from "Word" type
WriteWordDirect	Display of the fault code, see table 9 on page 33

Error code with "direct peripheral access"

All functions verify as far as possible for the validity of the call parameters. Verification is undertaken to determine if the access occurs in dependance on the parameterized signal module and the physical existence of the signal module. If a fault is determined, access is not undertaken and an error code is output → table 9 The data fields for the value transfer remain unchanged.

Table 9: Error code with direct peripheral access IO_ACCESS_NO_ERROR data type

IO_ACCESS_NO_ERROR:	0:	No error
IO_ACCESS_INVALID_ SLOTNUMBER	1:	Slot = 0 or greater than 7
IO_ACCESS_INVALID_OFFSET	2:	BitWord offset is too large
IO_ACCESS_DENIED	3:	Invalid access, e.g. write access to input module, read access to output module or access to non-available address range (offset too large)
IO_ACCESS_NO_MODULE	4:	No module available at the parameterized slot
IO_ACCESS_INVALID_VALUE	4:	Result is not "0" or "1" with "WriteBitDirect"
IO_ACCESS_ INVALID _BUFFER	5:	No or incorrect pointer to the output variables

Interrupt processing

In the XC100 it is possible to program and parameterize up to seven interrupt events. Interrupts can be activated by:

- physical inputs I0.0 to I0.3 of the XC-CPU101
- XIOC signal modules with interrupt features
- TIMER_Interrupt.

The interrupt events listed in figure 45 are available:

If an interrupt occurs, the runtime module executes the program organisational unit (POU) which is linked to the interrupt source. Execution of the POU is time-monitored. The parameterized cycle time is used for this cycle time. The interrupts are enabled when changed to the RUN state and inhibited when changed to the STOP state. Interrupt sources which are not enabled in the configuration do not initiate an interrupt. If a POU is not assigned to an enabled interrupt source, the interrupt is recognised and executed but without running a POU.

Frequent occurrence of an interrupt during a cycle can cause the cycle time to time-out and result in a reset being initiated by the Watchdog.

User interrupts can be inhibited and re-enabled from the program. The functions "DisableInterrup" and "EnableInterrupt" are provided for this purpose. A call parameter in the easySoft CoDeSys determines if an individual interrupt or all interrupts are enabled or inhibited. Enabling of an inhibited interrupt must be performed with the same parameter used to inhibit it.

Both the "DisableInterrupt" and "EnableInterrupt" functions are components of the "XC100_Util.lib" library. This library must – if not already done so – be integrated into the library manager of the easySoft CoDeSys.

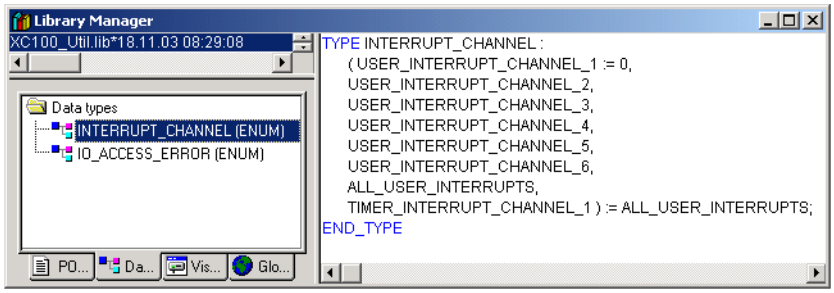


Figure 45: User events

Interrupt prioritising

In task configuration you can assign a physical interrupt input I0.0, I0.1, I0.2 or I0.3 to an interuppt channel. Three channels are available. Channels 1 to 3 have a high priority, channels 4 to 6 have a low priority.

Lower priority interrupts can be interrupted by those with higher priority.

Timer interrupt

An interrupt channel for a timer interrupt is available in addition to the six different interrupt channels for inputs with interrupt capability. The start condition and the setpoint value definition are application related in the easySoft-CoDeSys.

The following illustration indicates the function and the parametric programming for the "Timer Interrupt". This function is contained in the "XC101_Util.lib".

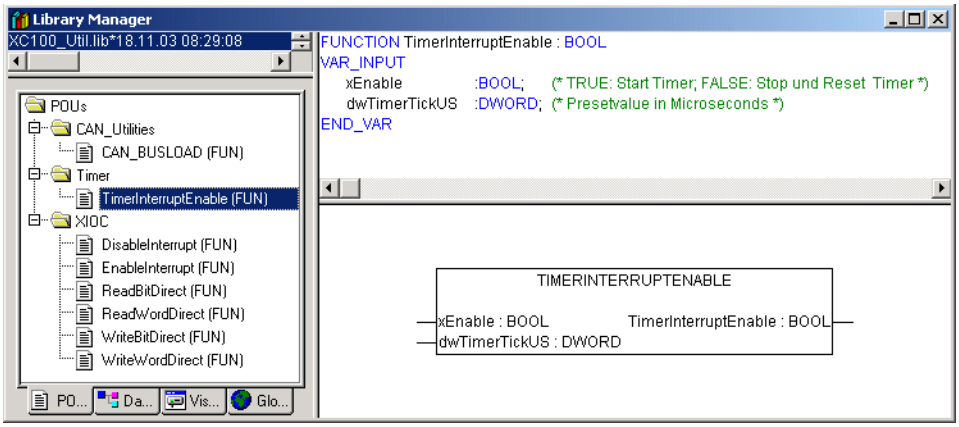


Figure 46: Function "Timer Interrupt"

The setpoint value setting occurs on the "dwTimerTickUS" input. The minimum value is 500, the maximum value is 2500000 microseconds. If the upper or lower limit value is exceeded on the "dwTimerTickUS" function module input, the function call returns FALSE as the feedback value and the timer is not started. The setpoint value is accepted with the start of the timer and can not be modified for the run time.

The linking of the timer interrupt with the respective IEC program occurs as with the IO interrupts via ‹Task configuration → System events›.

The entered interrupt function is executed immediately as soon as the interrupt occurs. The running IEC program cycle can be interrupted at any point.

The timer interrupt can also itself be interrupted by higher priority system interrupts, e.g. as with CAN. Cycle time monitoring is active during execution of the timer interrupt. Cycle time monitoring is orientated exclusively to the value entered for the maximum program cycle time. If very frequent timer and IO interrupts occur, they can lead to the program cycle time being exceeded. If the program cycle time is exceeded the XC-CPU101 changes from the RUN to the STOP operating status.

The Timer interrupts can be inhibited and enabled from the user program. Use the "DisableInterrupt" and "EnableInterrupt" functions for this case.

DisableInterrupt

With this function, you disable (deactivate) a parameterized physical interrupt by accessing it from the user program.

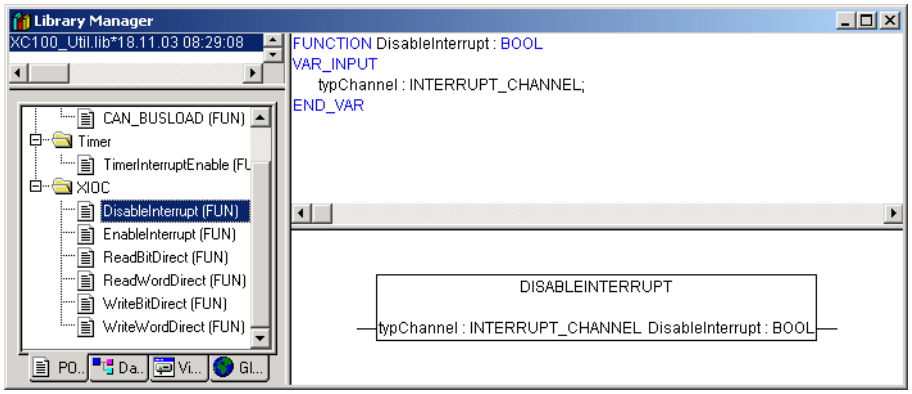


Figure 47: DisableInterrupt function

EnableInterrupt

With this function, the physical interrupt which was deactivated beforehand can now be re-enabled as an active interrupt.

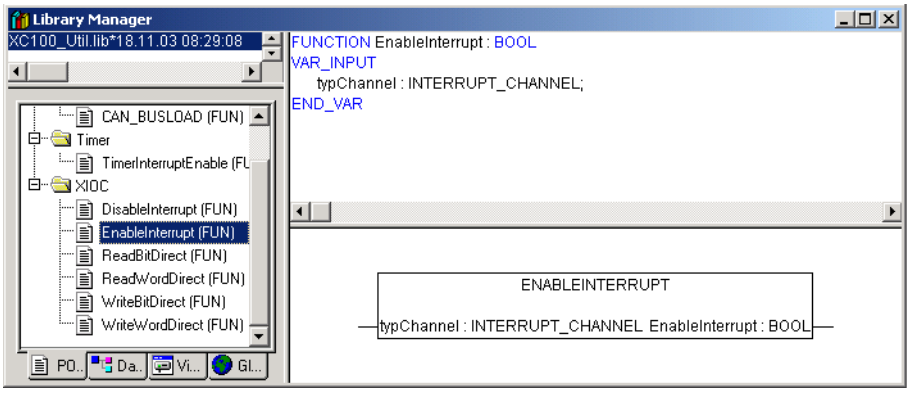


Figure 48: EnableInterrupt function

Creating and integrating an interrupt function

The formal procedure for the provision and integration of an interrupt function is described in individual steps in the following.

In the example, a H-signal on input I0.0 should branch into an interrupt module and execute it.

▶ Create a program module for the normal application ("PLC-PRG") for this purpose and a further module with the interrupt functionality "Interrupt1".

The following figure shows you both modules:

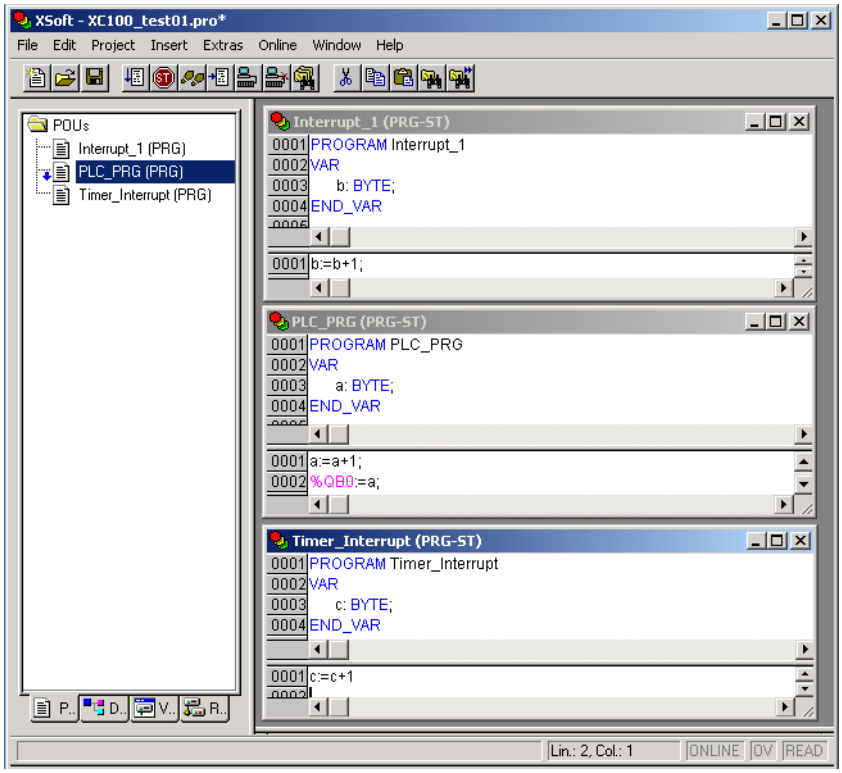


Figure 49: "PLC_PRG" and "Interrupt_1" modules

▶ Changeover to the PLC Configuration and assign Interrupt_0.0 from the list field to input I1.

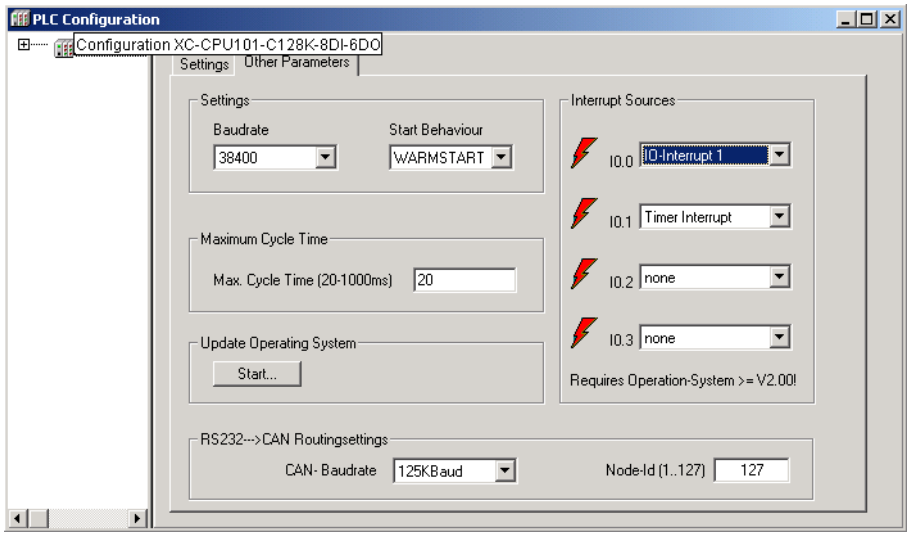


Figure 50: Assign input I0.0 with interrupt 4

- ▶ Changeover to the "Task configuration" and tick the box in the "System events" input field for "IO-Interrupt1".
- ▶ Now stay on the same row and mark the "called POU" field with the left-hand mouse key and press function key "F2".

The "Help Manager" window opens in which all predefined programs are listed:

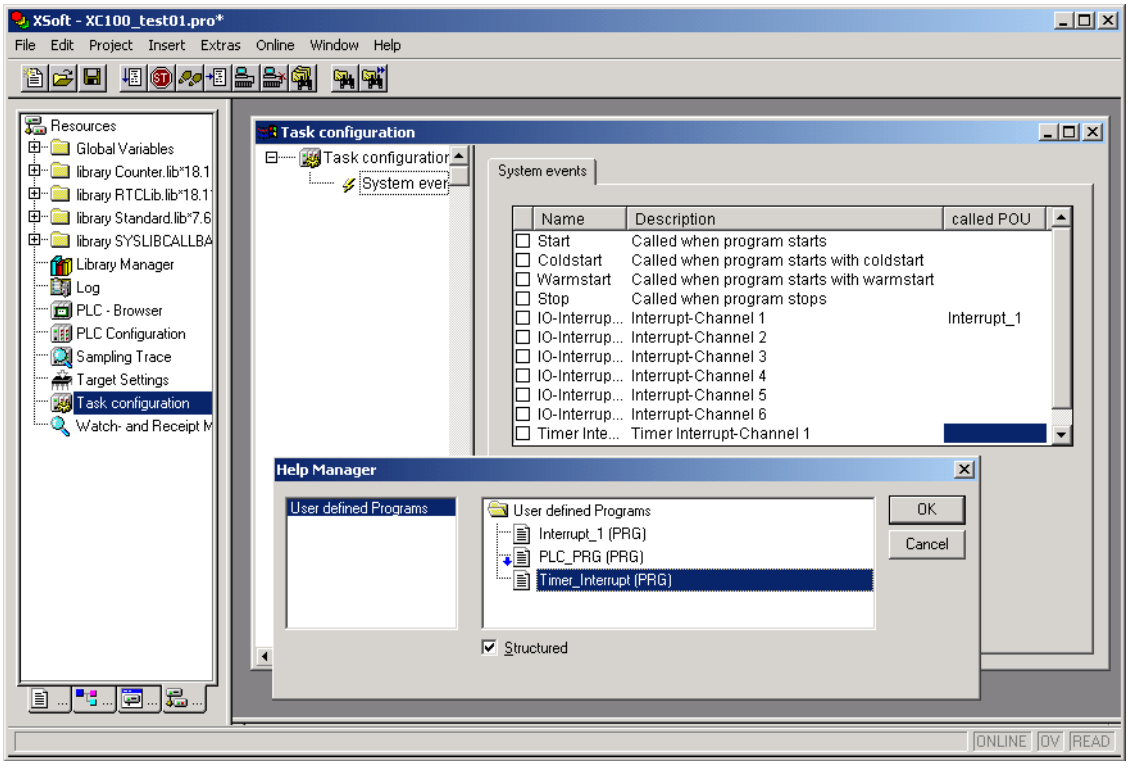


Figure 51: Parameterization of the interrupt source

▶ Select the "Interrupt_1 (PRG)" POU with a double click and then the POU "Timer_Interrupt (PRG)".

The following window appears:

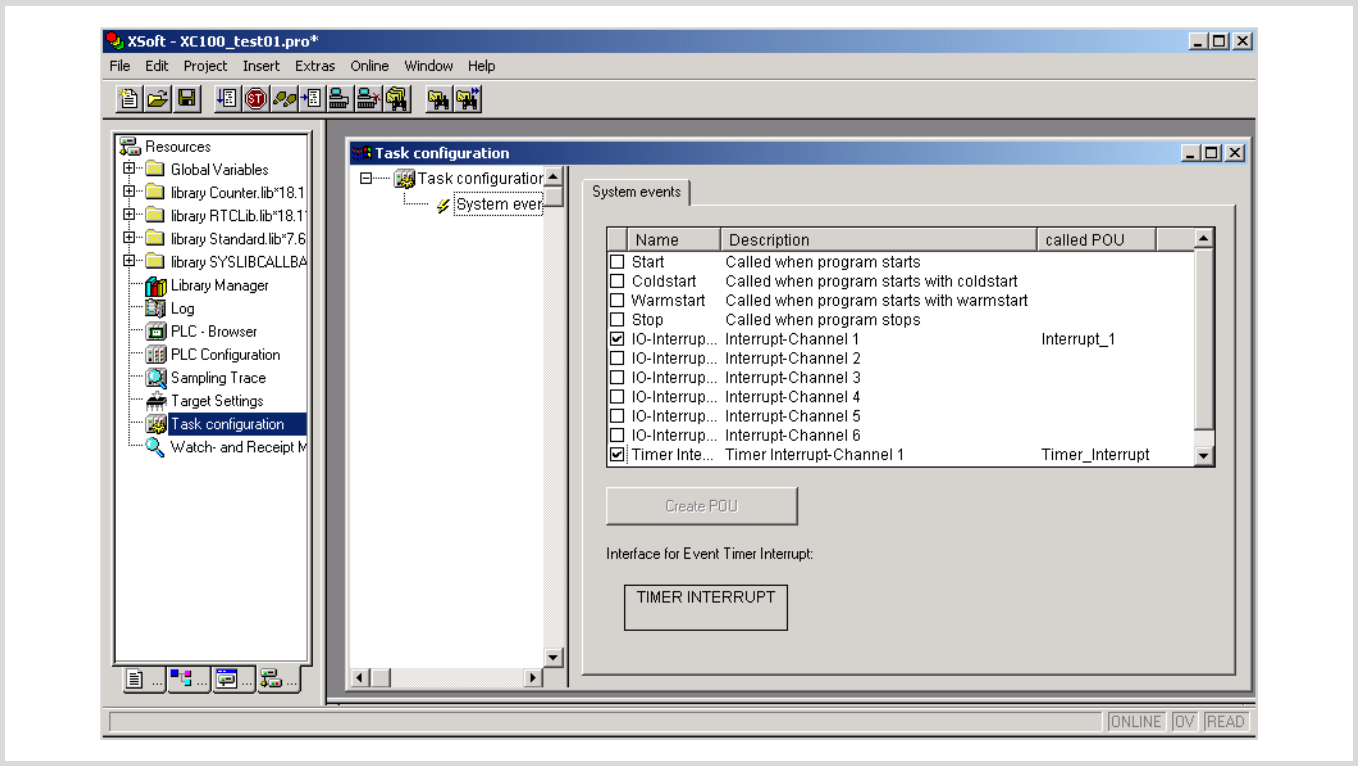


Figure 52: Interrupt module completed task configuration

▶ Save the program created, compile it and logon to the PLC and test the functions of the program modules which you have created.

System events

Not only can a task call up a project module for processing, a system event (event) can also call it up. The system events which can be used for the purpose are target system dependant. They are comprised of the standard system and the target system dependant events. Possible events are e.g.:

- Stop
- Start
- Coldstart
- Warm start
- IO interrupt
- Timer interrupt
- Online modification

See also figure 52.

→ The single step mode is not possible with program modules of the system events.

Browser commands

You can directly access the states/events in the XC100 with the Browser commands. The Online description in the easySoft-CoDeSys can be found at: ‹Resources → PLC-Browser›.

Command	Description
?	Get a list of implemented commands.
reflect	Mirror current command line for test purposes.
mem	Memory-dump, Syntax: mem <start-addr> <end-addr>
memc	As mem, addresses are added to the start address of the code range.
memd	As mem, addresses are added to the start address of the data range.
pinf	Output project information
ppt	Output module pointer table
dpt	Output data pointer table
pid	Output project ID
cycle	Output cycle time

Command	Description
GetNodeId	Output CANopen Node ID
SetNodeId	Set CANopen Node ID
metrics	Output PLC information
reload	Load boot project from the MMC on the PLC
remove	Erase boot project from the MMC
format	Formatting of the MMC
getswitchpos	Output switch position
getbattery	Output battery status
getrtc	Read-out real-time clock [HH:MM:SS]
setrtc	Set real-time clock [HH:MM:SS]
canload	Displays the load of the CANopen fieldbus.

"canload" browser command

The "canload" function is contained in the "XC100_Util.lib". They can be called up as browser commands. With this command, the current utilization of the CANopen bus is determined. The data utilization of the bus is determined via and integration time and determined in relation to the CAN baud rate.

You will receive the following information after the browser command is called:

CAN Busload = 51 Percent

Baud rate: 125 Kbaud

Integration Time: 504 ms.

With a bus loading of 75 percent or higher, a warning appears - ATTENTION: HIGH BUSLOAD.

Caution!
Overload of the local CAN bus in conjunction with further short term load peaks can lead to CAN data loss.

In addition to the browser command, a function call for the CAN_BUSLOAD function block to determine the CAN bus loading from the user program is available.

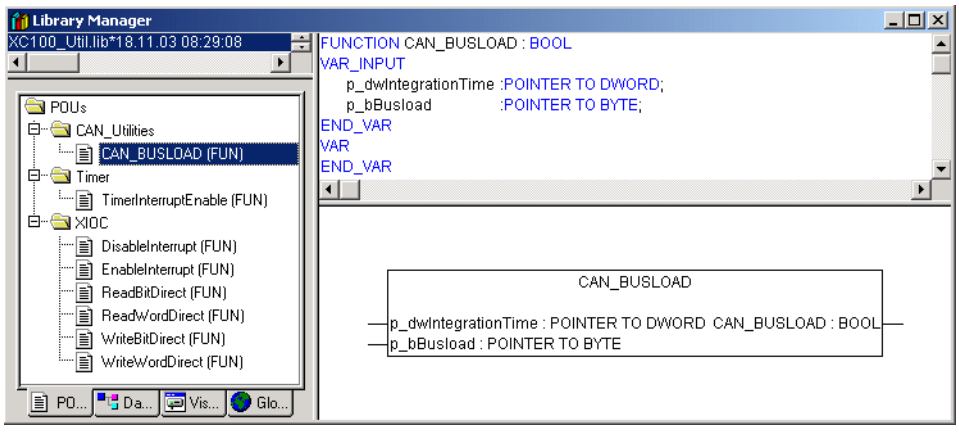


Figure 53: Function "Can_Busload"

Data remanence

The controller has a memory area for remanent data → page 10. The variables declared with "VAR_RETAIN" are saved in this area and are thus retentive during a warm start of the application program (Caution: This does not apply for I, Q and M variables!). Data that are remanent for a cold start – "VAR_RETAIN Persistent" are not supported. Remanence (non-volatility) of the data is guaranteed when the PLC is switched off if a battery is inserted.

If it was not possible to finish a cycle that was being processed, because of a supply interruption, then the data will not be consistent, since the interruption could have occurred at any point of the cycle. When the voltage supply recovers, the residual-cycle will not be completed. The control starts according to the set start behaviour.

If this is to be prevented, appropriate measures must be taken as part of the engineering. One solution for this problem is an uninterruptible power supply with additional accumulator buffering.

Program transfer

The transfer of an application program always takes place via the battery-buffered SRAM area in the controller. Afterwards, a backup can be created on the multimedia card by using the "Create boot project" command. A program backup can only be created while the system is in the "HALT" state. The internal FLASH memory of the CPU cant be used as storage for a program backup.

Operating states

In the following overview you will find the state definitions of XC100. The LED-displays of the corresponding states are also detailed..

State	Display		Definition
	RUN/STOP	SF	
System test	off	off	System test in progress
System update	on	on	System update in progress
Switch-on OK	off	off	System test finished without error
Switch-on not OK	blinks	blinks	System test generated an error
NOT READY	off	on	No application program present
STOP	blinks	off	Application program loaded, PLC in "STOP" state
RUN	on	off	Application program loaded, PLC in "RUN" state
STOP/RUN with general error, diagnosis message	on	on	General error/ diagnosis message available

Limit values for memory usage

The data memory of the XC100 is divided into memory segments. The segment sizes are shown in figure 54. The global data utilises multiple segments. The required amount can be specified to suit the size of the loaded program.

The segment size for the different control types can be found under ‹Target Settings → Memory Layout›:

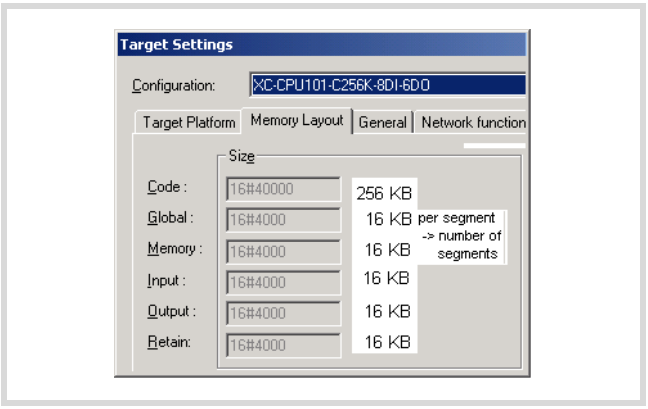


Figure 54: Segment size of the XC-CPU101-C256k

The hexadecimal values of the other PLC types must be converted to decimal values.

In order to ensure that you use the available memory for the global data in an optimum and efficient manner, we recommend that you make the following settings when a new project is being created:

PLC type	Number of data segments (global)
XC-CPU101-C64K-8DI-6DO	16
XC-CPU101-C128K-8DI-6DO	12
XC-CPU101-C256K-8DI-6DO	14

The number of segments is set to 1 by default.

The number of segments is changed as follows:

▶ Select ‹Project → Options → Compile options›; select the data segments field and enter the number of segments listed above for the respective control type.

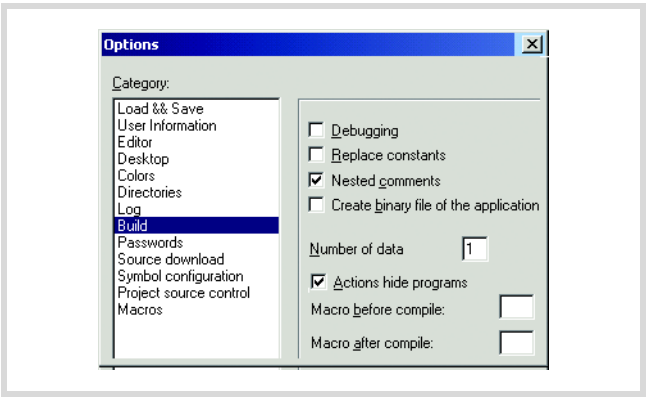


Figure 55: Memory management: Change the number of data segments

Addressing inputs/outputs and markers

If you open the PLC configuration of a new project, you will receive the current view of the default settings of the addressing. In this setting the addresses are automatically assigned and address conflicts (overlaps) are reported.

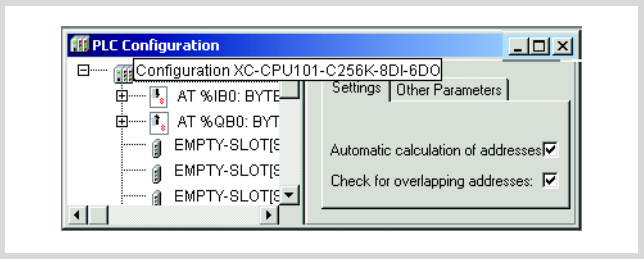


Figure 56: Default setting of the addressing

If you add a module to the PLC in the configurator, the configurator will assign this module with an address. Further modules are assigned with the next addresses in ascending order. You can also assign the addresses freely. However, if you access the "Automatic calculation of addresses" function later, the addresses are shown in reassigned ascending order.

"Activate Automatic addresses"

The addresses are automatically assigned or modified if a module is changed or added. This can occur with a centrally assigned module as well as a module which is a component of a decentral PROFIBUS-DP slave or CAN station.

If you add a module, the addresses of all the subsequent modules (independently of the line) are offset by the address value of the added module, and the added module is assigned with an address. Modules which are located in the configuration before the added module are not changed. If you remove the tick in the "Automatic calculation of addresses" checkbox, the addresses remain unchanged with modifications/expansions.

Check for overlapping addresses

If the check for overlapping addresses is activated, addresses which are assigned twice will be detected and an error message is generated during compilation. This setting should not be modified.

Uneven word addresses

(Independent of the "Check for overlapping addresses" setting)

If you assign an uneven address to a word addressable module in the entry field address e.g. IB3, the PLC configurator automatically shows the following even word address (IW4).

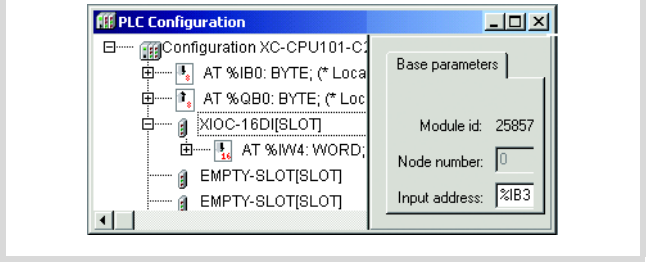


Figure 57: Uneven address

Address range

Addresses can only be assigned within the valid ranges. The range details can be found under ‹Target Settings → Memory Layout → Size›.

The addresses are checked during compilation. It is essential to ensure that the addresses of the configured module are used (referenced) in the program. If the address exceeds the range, a fault is signalled.

Table 10: Address ranges

PLC	Input			Output			Markers		
	Size	Max. Byte address	Max. Word address	Size	Max. Byte address	Max. Word address	Size	Max. Byte address	Max. Word address
XC100-64k	2k	2047	2046	2k	2047	2046	4k	4095	4094
XC100-128k	4k	4095	4094	4k	4095	4094	8k	8191	8190
XC100-256k	16k	16383	16382	16k	16383	16382	16k	16383	16382
XC200-256k	4k	4095	4094	4k	4095	4094	16k	16383	16382
XC200-512k	4k	4095	4094	4k	4095	4094	16k	16383	16382

Free assignment or modification of addresses of input/ output modules and diagnostic addresses

Depending on the module, you can assign/modify the input, output and the diagnostics(marker) addresses:

In order to make the modifications visible in the PLC configurator it is necessary to click once on the PLC Configurator or to select another module after the address has been edited. They will be accepted in all cases during compilation.

Run "Automatic calculation of addresses"

With the "Automatic calculation of addresses" function which you can run either via the context menu or the menu bar, all the respective addresses are recalculated. If you are dealing with a bus master module, the calculation is also carried out for the modules which are constituents of the slave on the bus line. The freely entered addresses of subordinate modules are overwritten when the address of a higher level module is calculated. If the addresses have changed and you wish to implement the "Automatic calculation of addresses", you must first of all activate the change. Click first of all on the nodes to drop down the structure or set the cursor in the PLC Configuration field and press the left mouse button.

If you mark the "Configuration XC-CPU..." text and call the "Automatic calculation of addresses", all the addresses are recalculated

→ Enter the addresses in an ascending order and in continuous blocks.

Diagnostics

You can run diagnostics with the help of the diagnostics function block. The following possibilities are available:

Type of diagnostics	Function block	Library	Documentation
Inspection of the XI/OC modules: • Does the configuration of the hardware correspond with the configurator? • Is the module function ok? Note: These tests are undertaken once during switch on or after loading/start of the program	XDiag_SystemDiag	xSysDiagLib	MN05010002Z-EN; previously AWB2786-1456GB
Inspection of the XIOC-NET-DP-M module and the stations on the DP line	XDiag_SystemDiag XDiag_ModuleDiag	XSysDiagLib	MN05010002Z-EN; previously AWB2786-1456GB
	DiagGetState	BusDiag	MN05002002Z-EN; previously AWB2725-1452GB
Inspection of the XIOC-NET-DP-S module	XDiag_SystemDiag XDiag_ModuleDiag	xSysDiagLib	MN05010002Z-EN; previously AWB2786-1456GB
DP slave provides the master with additional diagnostics data	XDPS_SendDiag	xSysNetDPSDiag	MN05002002Z-EN; previously AWB2725-1452GB

5 Establishing a PC – XC100 connection

This section describes the measures that are required to link a PC to the XC100, so that the PC can be used as a programming device (hardware and software).

Establishing a connection via the RS232 interface

Communication is implemented via the non-optocoupled serial RS232 interface. You can use either the COM1 or the COM2 port for the PC interface. Please use the XT-SUB-D/RJ45 programming cable to make the physical connection.

Programming cable

The programming cable is made up as shown below:

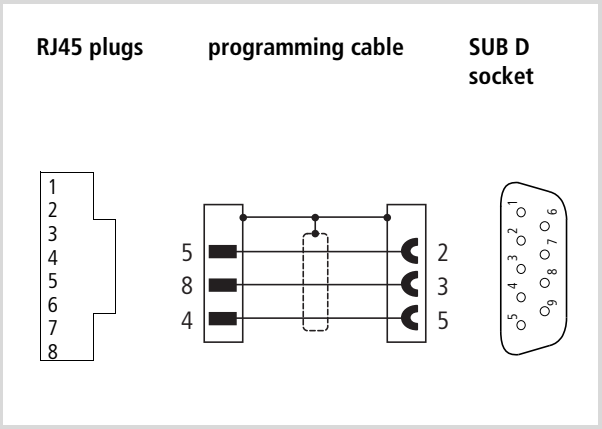


Figure 58: Pin assignment RS232 programming cable

Software easySoft-CoDeSys

The communication parameters are determined by means of easySoft-CoDeSys.

- ▶ Call up the menu item ‹Online → Communication Parameters› in easySoft CoDeSys, and select the COM1 or COM2 interface.
- ▶ Preselect the values indicated in Figure 59.

You can alter the default values by making a double-click on the entered value.

→ Further notes on the communication parameters can be found in the programming software manual (MN05010003Z-EN; previously AWB2700-1437GB).

Communication fault(#0): Logging off

A connection can not be established between the programming PC and the XC100, please check:

- the physical connection
- the baud rate of the communication parameters in the easySoft CoDeSys
- the baud rate in the XC100 (set as default to 38400 kBit/s)
- the baud rate of the CAN connection if the CAN fieldbus is used.
- that the interface parameters in the easySoft CoDeSys and in the XC100 correspond!

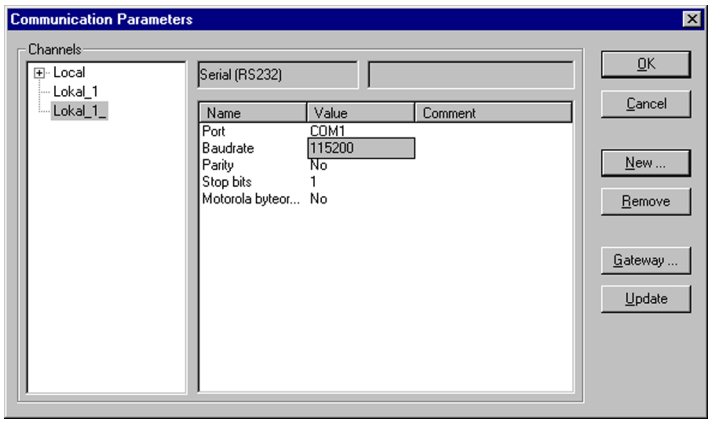


Figure 59: Select communication parameters

6 Creating a sample project

The following example aims to help you learn how to use the easySoft CoDeSys software. You create a project by creating a configuration and a program. You can then test out the project after it has been downloaded.

The configuration is created in the easySoft CoDeSys configuration editor. A distinction is made between local and central I/Os:

The local (digital) inputs and outputs are integral parts of the CPU module, implemented on the power supply board. They are already pre-configured in the configuration editor.

The central inputs/outputs are implemented in the signal modules, which can be joined up via the module rack. Configure them to suit the requirements of the application. The available XI/OC signal modules can be used.

Connect appropriate CANopen fieldbus participants to the CANopen interface.

The basis for the configuration is the following hardware layout.

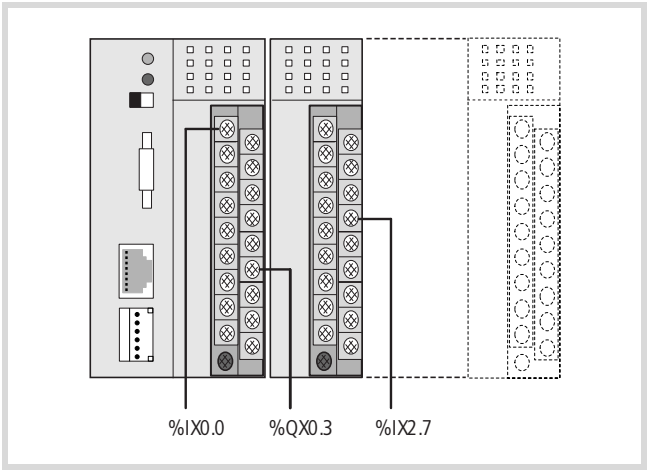


Figure 60: Hardware layout for the sample project

Task

Make a logical AND linkage of inputs I0.0 and I2.7 on the XC100. The result of this logical operation should be presented at output Q0.3.

The second step is to read in the inputs/generate the outputs, using a CAN Master.

Activate the appropriate CAN libraries before linking the CAN Master [VAR] module into the controller configuration. This sequence will not take place automatically, but must be explicitly carried out by the user.

Procedure

Setting up a target system

After starting easySoft CoDeSys, create a new file:

- ▶ Select the menu item ‹File → New›.
- ▶ Answer the query about saving the old project.

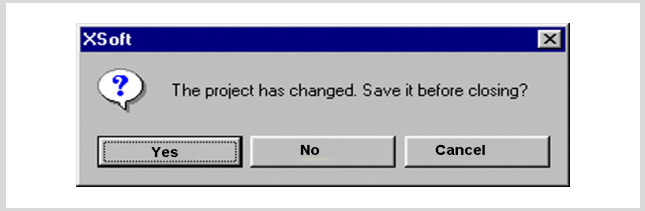


Figure 61: Save old project?

Select the target system. In the example, the system XC-CPU101-C64K-8DI-6DO has been selected.

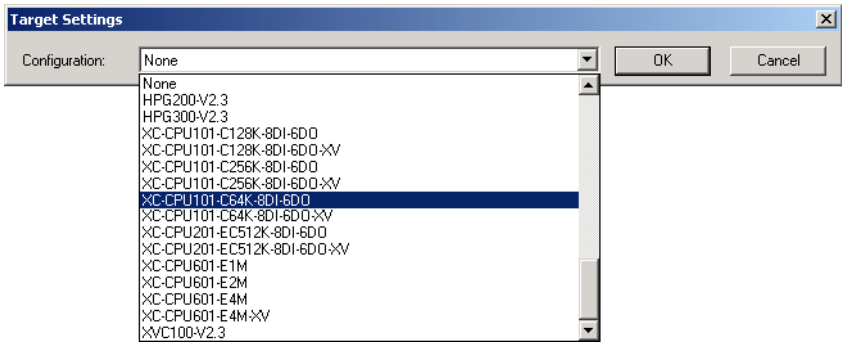


Figure 62: Select target system

A double click on the target system leads to the following (see figures). The register tabs "Target platform", Memory layout" and "General" just present information about the target system. No settings can be made in these tabbed screens.

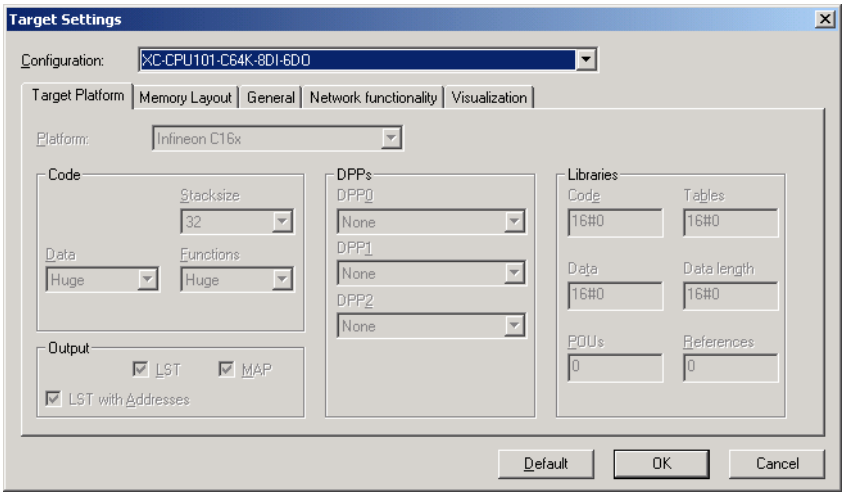


Figure 63: Target system settings – target platform

▶ If a CANopen slave is to be integrated into the configuration, click the "Networkfunctionality" tab and tick the "Support network variables" check box.

You will get a message that this target system supports the CAN network.

The "Support network variables" control box must only be activated if you wish to work with network variables. When activated, the libraries required for operation of network variables are added automatically. This function is not required if you use a CAN Master/CAN Device.

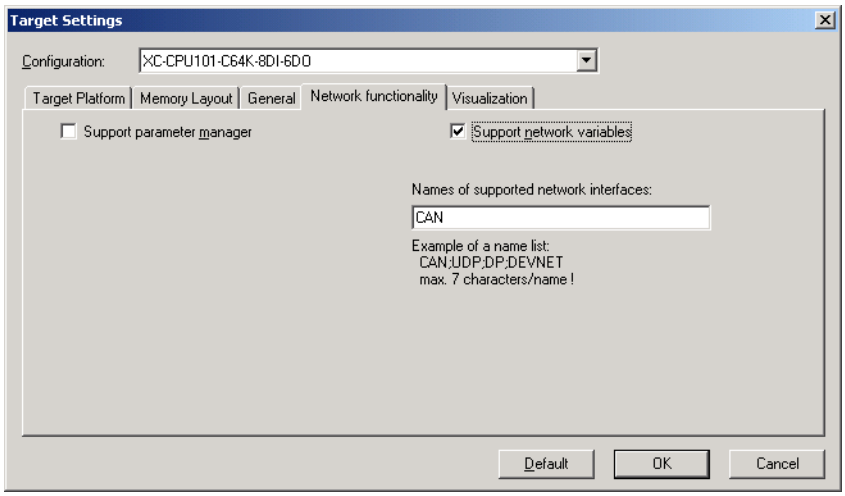


Figure 64: Target system settings – CAN network functions (1)

▶ Activate the "Support parameter manager" check box in order to view additional information concerning the index ranges.

The CAN relevant Parameter manager is only required for a CAN device. Standard settings are available for this purpose, which means that no modifications must be made.

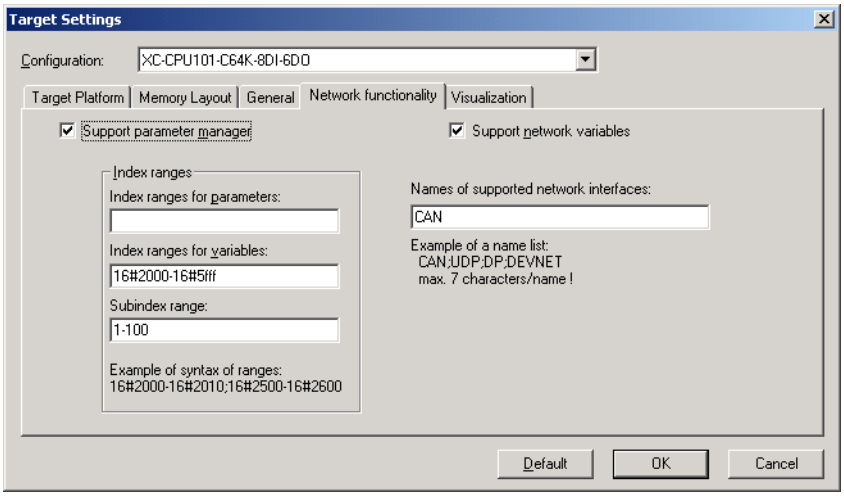


Figure 65: Target system settings – CAN network functions (2)

▶ Close this selection with "OK".
▶ Select the POU type "Program" and the programming language "IL":

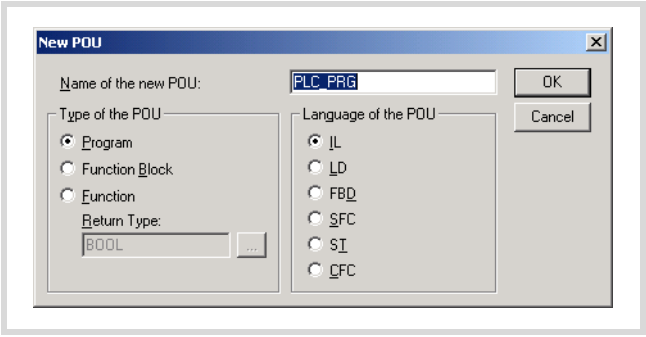


Figure 66: Select POU type

▶ Confirm with "OK" and save the file under "sample-1".

A window will now appear, in which you can continue with the programming or configuration:

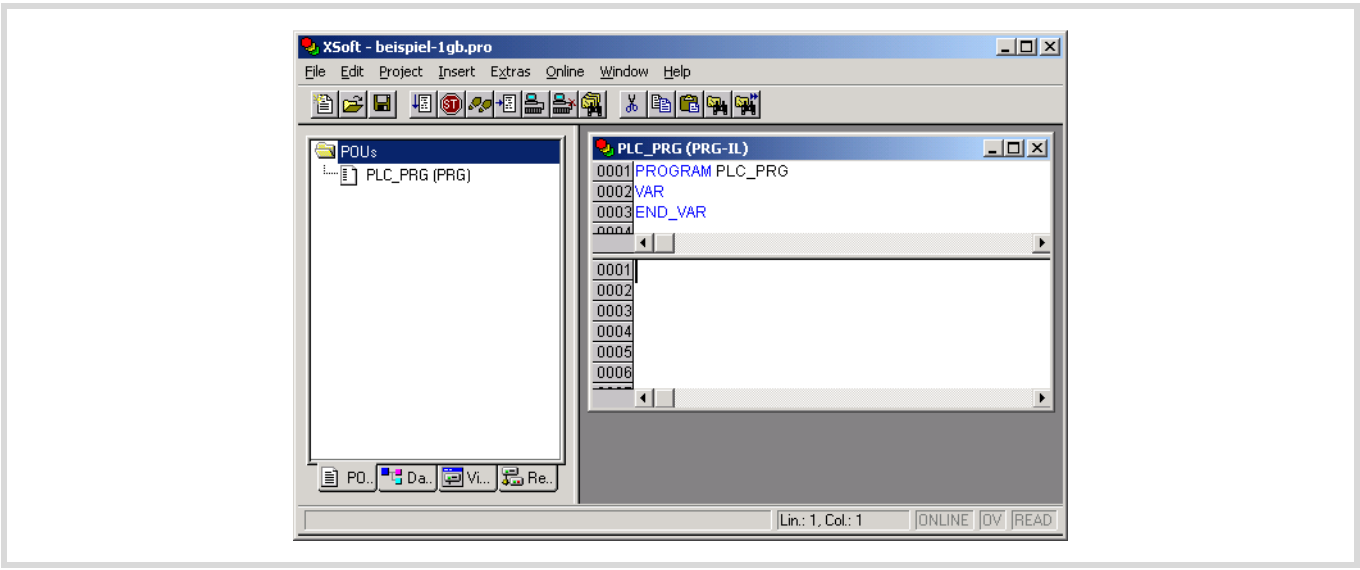


Figure 67: POU type "Program" in IL representation

Configure XC100 controller

The example makes use of the "XC-CPU101-C64K-8DI-6DO".

▶ Select the "Resources" register (left half of window, at bottom), to configure the XC100 with the local and central inputs and outputs.

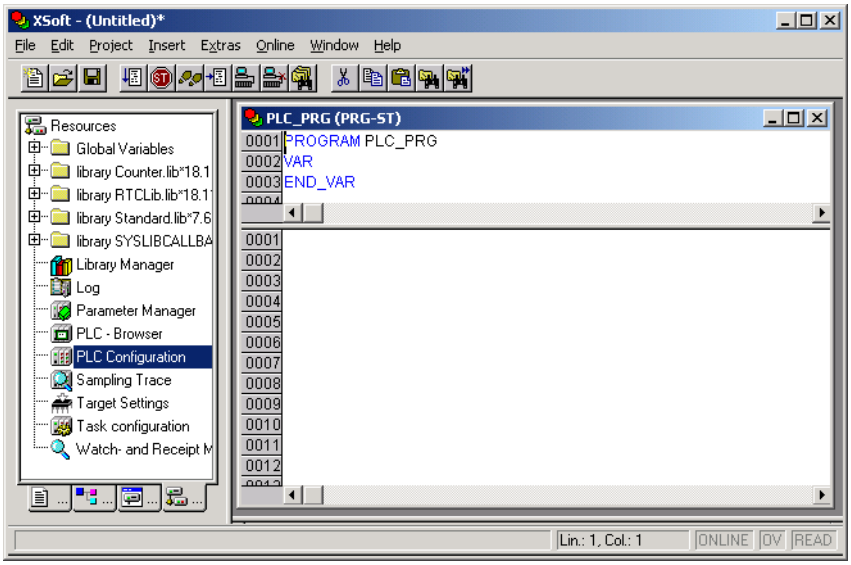


Figure 68: Configure XC100 controller

▶ Double-click on the directory "Controller configuration".

Another window is opened: "PLC configuration":

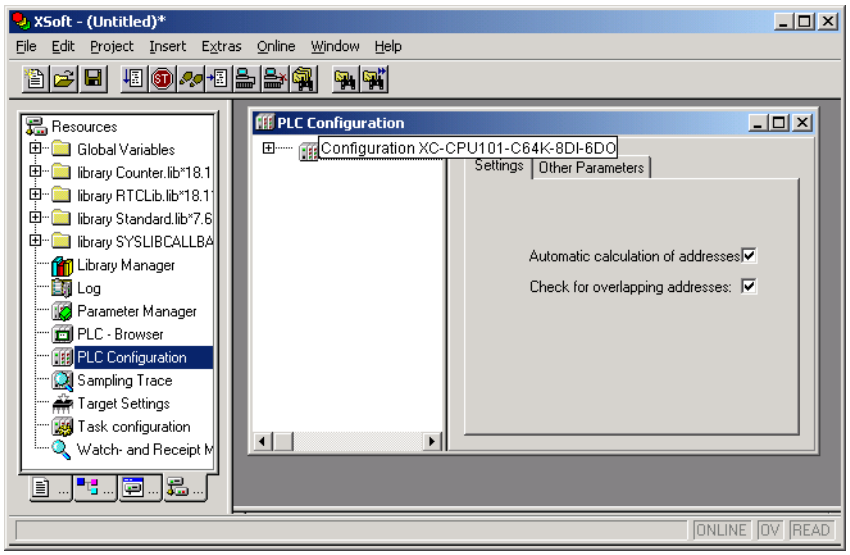


Figure 69: Basic configuration of the XC100 – settings

▶ Click on the register card "Additional parameters".

A window appears with the default values for the "XC-CPU101-C64K-8DI-6DO".

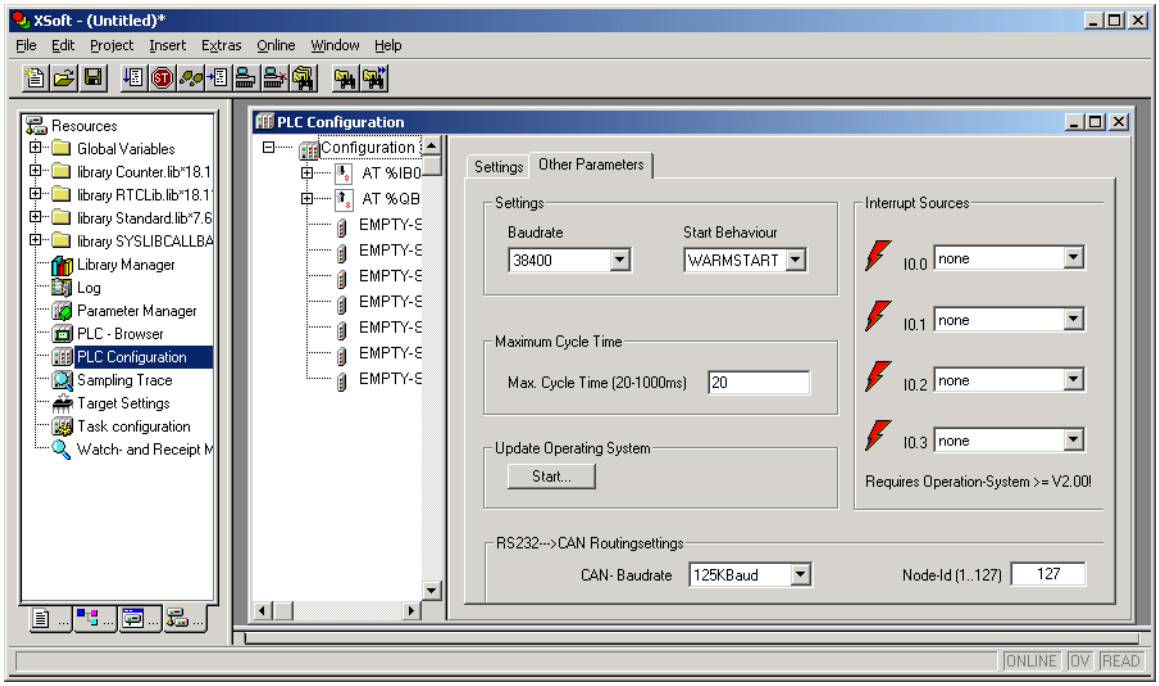


Figure 70: Basic configuration of the XC100 – additional parameters

▶ To display the I/O configuration, click on the plus sign in front of the directory "XC-CPU101-C64K-8DI-6DO".

The local inputs and outputs (integral parts of the CPU) are already configured:

- "AT %IB0;Byte; (*Local Inputs*)"
- "AT %QB0;Byte; (*Local Outputs*)"

You can also set the parameters for up to 15 central signal modules. The slots "EMPTY-SLOT" are wildcards for central expansion of the signal modules.

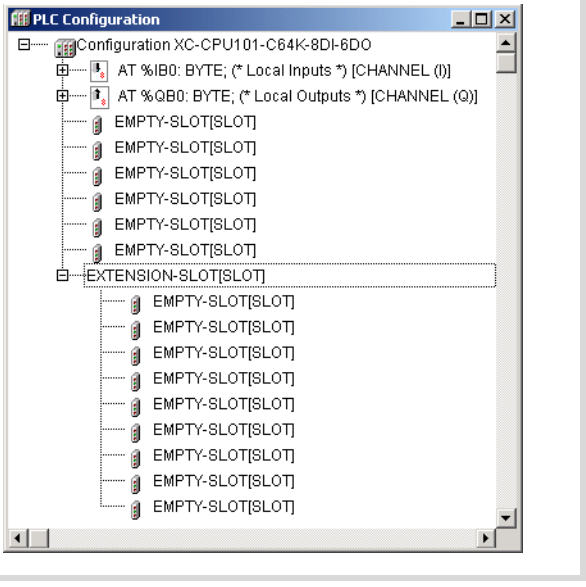


Figure 71: Basic configuration of the XC100 – local I/Os

If you want to join up a central digital input module with 16 inputs, right next to the CPU, then carry out the following steps:

▶ Mark the first "EMPTY-SLOT" and then click the right mouse button.

A window is opened

▶ Select the field "Replace element".

The window that is now opened lists the signal modules which are available.

▶ Select the module "XIOC-16DI".

The configuration now looks as follows:

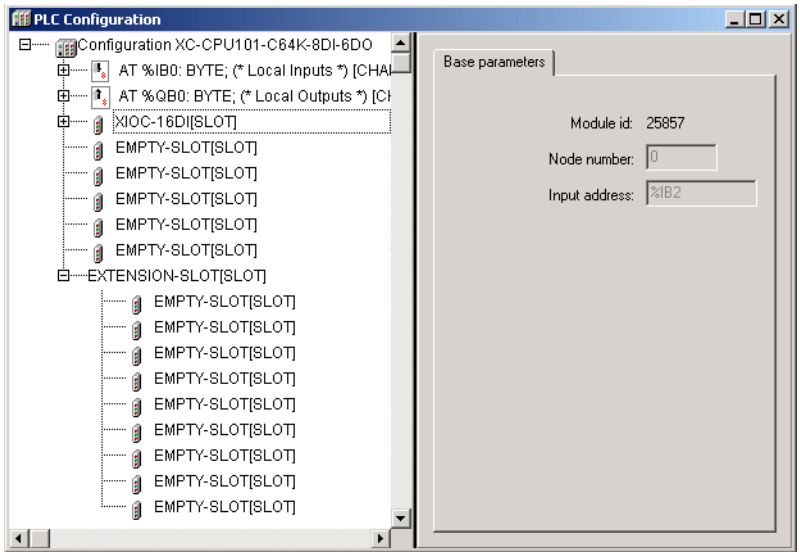


Figure 72: Configuration XC-CPU101-C64K-8DI-6DO

▶ In addition, click on the plus sign in front of the modules
- "AT %IB0;Byte; (*Local Inputs*)"
- "AT %QB0;Byte; (*Local Outputs*)"
- XIOC-16DI (SLOT).

You will now get detailed information, with the physical address area of the inputs and outputs.

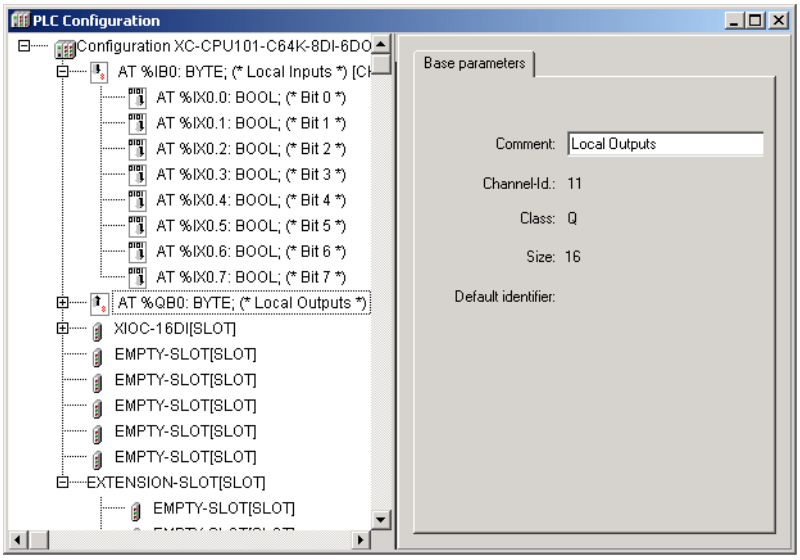
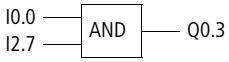


Figure 73: Address area of the configuration

Writing a program

As described in the description of the task on Page 47, a logical AND combination is to be made between input I0.0 and input I2.7. The result of this logical operation is to be presented at output Q0.3.



▶ Select the "POUs" tab and double click on the "PLC-PRG" element. The declaration and program window will be opened.

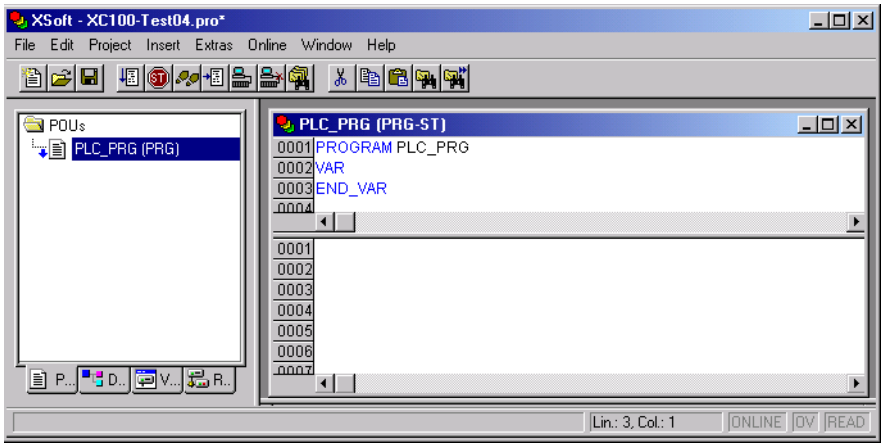


Figure 74: Program and declaration window

▶ Create the declaration and the program, as shown in the following diagram, and then compile the project.

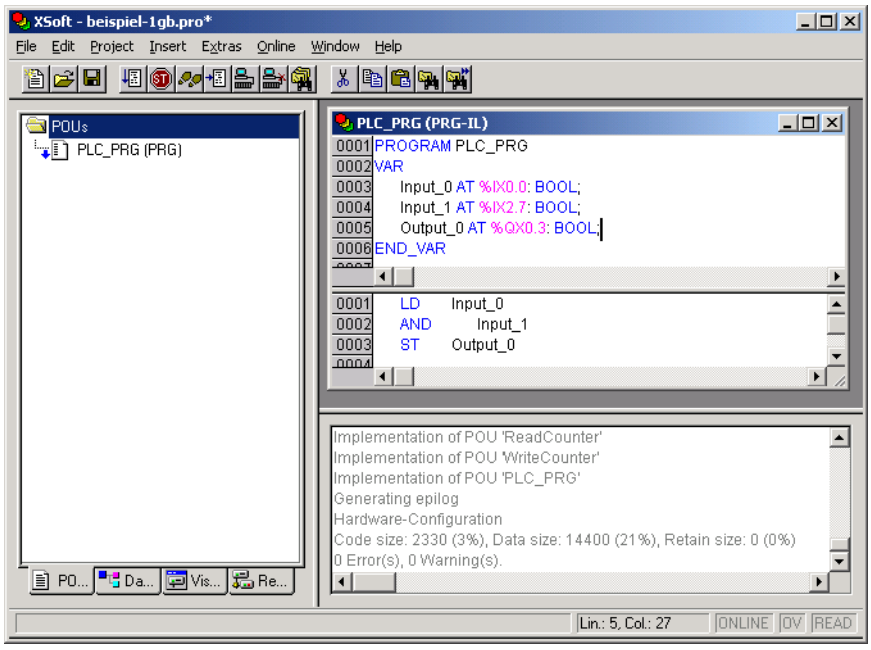


Figure 75: Compiled program

▶ Load the project into the controller.
▶ Test the project.

7 Programming via CANopen network (Routing)

"Routing" is the capability to establish an Online connection from a programming device (PC) to any desired (routing capable) control in a CAN network, without having to directly connect the programming device directly with the target PLC. It can instead be connected to any other PLC in the network. All actions that are available through a direct PC–PLC connection can also be implemented through the routing connection:

- Program download
- Online modifications
- Program test (Debugging)
- Generation of boot projects
- Writing files in the PLC
- Reading files from the PLC

Routing has the advantage that a PLC connected to the programming PC can access all routing capable PLCs on the CAN bus. You can determine in the project selection which controller you wish to communicate with. This provides an easy way of controlling remote PLCs.

However, the data transfer rate with routing connections is considerably slower than with direct connections (serial or TCP/IP). This results, for example, in slower display refresh rates of variables and longer download times.

Prerequisites

The following prerequisites must be fulfilled to use routing:

- The routing PLC and the target PLC must both support routing.
- Both PLCs must be connected via the CAN bus.
- The PLCs must both have the same active CAN baud rate.
- The valid routing node ID must be set on both PLCs.

Routing through XC200

To perform a program transfer or routing using TCP/IP through a connection between XC200 and PC, you must first set the block size for the transferred data. The packet size (4 KByte or 128 KByte) depends on the transfer type (program transfer or routing) and the operating system, → table 11.

Table 11: Block size for data transfer

	Program/file transfer		Routing	
	OS < V1.03.02	**OS ≧ V1.03.02**	**OS < V1.03.02**	**OS ≧ V1.03.02**
Block size Default: 128 kByte	128 kByte	128/4 kByte	Routing not possible	4 kByte

Attention!
The program download with a block size of 4 KByte to a PLC with an operating system version earlier than V1.03.02 will cause faulty behaviour!

If a program download is performed, the progress bar on the programming device monitor will only change erratically (about every 10 seconds).

Routing with the XC200 is possible from BTS version 1.03.02.

The setting of the block size (change of the value in the registry) is explained as follows.

→ You can change this setting only if you have administrator rights on your PC.

Changing the block size

▶ Close all easySoft-CoDeSys applications.
▶ Close the CoDeSys gateway server.

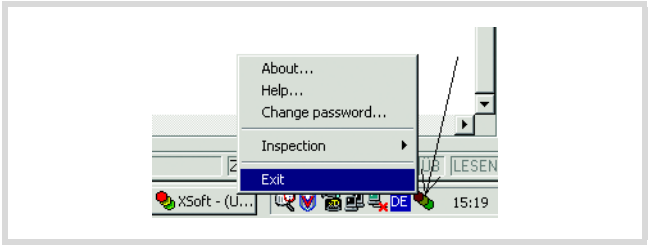


Figure 76: Closing the CoDeSys gateway server

▶ Change the block size to the required value.

The following *.reg files are available in the easySoft CoDeSys installation directory to enter the block size in the registry:

BlockSizeDefault.reg	Enters a block size of 20000_{hex} =128 Kbyte (default value) in the Registry.
BlockSizeRout.reg	Enters a block size of 1000_{hex} = 4 KByte in the Registry.

Alternatively, you can use the BlockSizeEditor application to change the block size.

The download block size is defined in the following registry key:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\3S-Smart Software Solutions
GmbH\Gateway Server\Drivers\Standard\Settings\Tcp/Ip (Level 2
Route)]
"Blocksize"=dword:00020000
```

The default block size is 20000_{hex} (=128 Kbyte), the block size for routing is 1000_{hex} (= 4 Kbyte).

Notes

- If large files are written to the target PLC or read from the PLC, it is possible that the online connection will be interrupted after the transfer process has been completed. Renewed connection is possible.
- If a program with a modified routing node ID is loaded into the target PLC, the target PLC accepts the modified routing node ID; however, the communication connection will be interrupted. Reconnection with a corrected routing Node ID is possible.
- If a PLC receives a program without valid routing parameters (Baud rate / Node ID), this PLC cannot be connected via a routing connection.
- The routing is independent of the configuration (master/slave): a target PLC that has not been configured as a master or as a slave can be accessed. It must only receive the basic parameters such as Node ID and baud rate, as well as a simple program.

Addressing

PLCs on the CAN-Bus can be configured as a master or as a slave. The PLCs are assigned with a Node ID/node number (address) in order to uniquely identify them (with the basis communication). To use the routing function to access a target PLC, you must assign a further routing ID to the routing and target PLC. An RS200 or Ethernet interface can be used as a connection between the PC and XC232 .

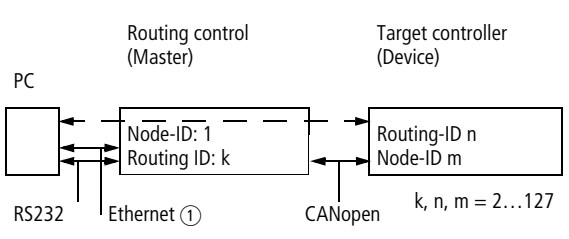


Figure 77: Routing via XC…, EC4-200

① Ethernet connection only possible with XC200

Table 12: Example for setting the Node Id, Baud rate

PLC	Function	Node ID	Routing ID	Baud rates	★↑ ↑ ＃.
Routing controller	Master	1	127	125 KB	79
Target controller	Device	3	54	125 KB	80

→ The following applies for device PLCs: The Routing-ID must **not be equal** to the Node-ID (Basis communication)!

The exception is the XC100 with operating system ≧ V2.0: the Routing-ID **must be equal** to the Node-ID!

The Routing-ID of the master (XC100, XC200) can be set in the PLC configurator under the "Other parameters" tab:

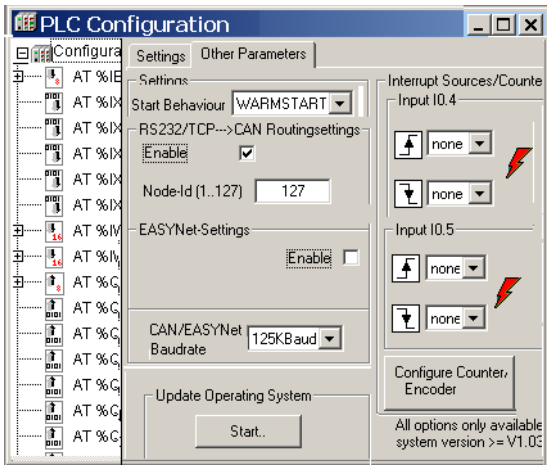


Figure 78: CAN Master routing settings (XC200)

The ID for basis communication is defined in the "CanMaster" folder in the "CAN parameters" tab (Figure 79).

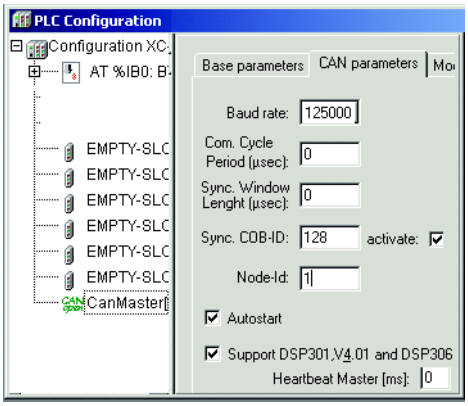


Figure 79: CAN Master: Node ID for basis communication

Communication with the target PLC

- ▶ Connect the PC to the routing PLC.
- ▶ Select the target PLC with which you want to communicate for the project.
- ▶ Determine the communication settings for the PC and the PLC connected to the PC.
- ▶ Enter the target ID (Target ID = Node ID!) of the target PLC, as in the example, and log on.

You can run the following functions:

- Program download
- ONLINE modification
- Program test (Debugging)
- Create bootable project
- Filing source code.

Note for project creation

Assign two Node-IDs to the target PLC:

- ▶ One ID for basic communication
- ▶ One ID for routing

If you are using an XC100, enter the same number for both IDs. The routing ID and the baud rate of the target PLC (XC 100) to the routing function can be defined in the "Additional parameters" window in the PLC Configuration. Enter the baud rate and the node ID in the "RS232 → CAN routing settings" field.

The CAN baud rate depends on the operating system version:

Table 13: Baud rates for CAN connection

	Operating System Version	
Baud rates	**< V. 2.0**	**≧ V 2.0**
10000	✓	✓
20000	✓	✓
50000	✓	✓
100000	✓	✓
125000	✓	✓
250000	✓	✓
500000	–	✓
800000	–	✓
1000000	–	✓

→ To guarantee a fast data transfer, the routing should be performed only with a CAN baud rate of at least 125 KBit/s.

The ID for basis communication is defined in the "CanDevice" in the "CAN setting" tab → figure 80.

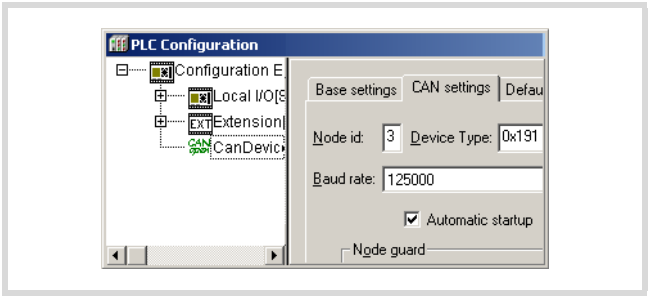


Figure 80: CAN device parameters

ID and baud rate are transferred with the project download.

Example

In the following example which is based on Figure 81 the procedure for access to a PLC program is explained.

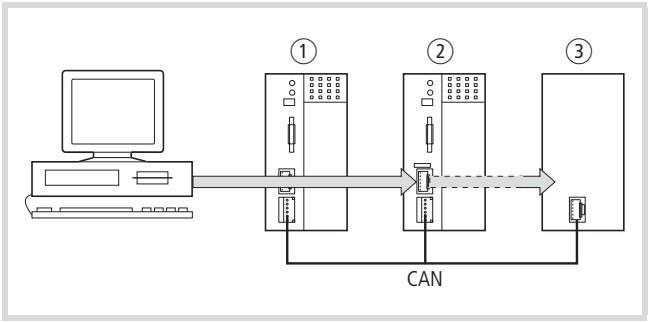


Figure 81: Diagnostics possibilities

① XC100 with Node ID 1
② XC200 with node ID 2, routing ID 127
③ PLC (e.g . XC100) with node ID 3 and routing ID 3

You have connected the PC to the PLC with node ID "2" and want to access the target PLC with routing ID "3".

- ▶ Open the project of the target PLC whose program you wish to edit or test.
- ▶ First configure the parameters for the hardware connection PC ↔ PLC (Node ID 2).
- ▶ From the Online menu select Communication Parameters…
- ▶ Click the New button under "local" channels.

The "New Channel" window appears.

- ▶ Select the channel in the "Device" window: Serial [RS232] [Level 2 Route] or TCP/IP [Level 2 Route].
- ▶ You can assign a new name in the Name field, e.g. "Rout_232".
- ▶ Confirm with OK and return to the original window.

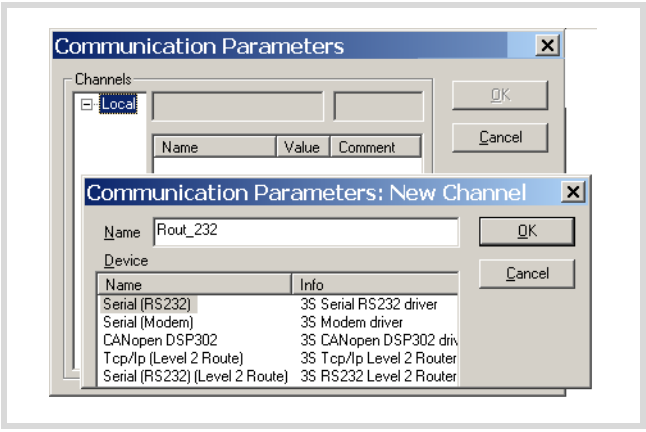


Figure 82: Channel parameter setting

You have now determined the parameters for the hardware connection between the PC and the PLC (node ID 2).

- ▶ Call up the communications parameters in the "Online" menu once again and select the control which you want to program/test.
- ▶ Enter the number 3 as the target ID in the example. The target ID is identical to the routing ID!
  To enter the target ID, click on the field in the Value column, to the right of the term Target ID. Enter the number 3 there and confirm with OK.
- ▶ Log on and carry out the action.

PLC combinations for routing

The following PLC support routing:

From → / To ↓	XC100 XC121	XC200[1)]	EC4-200
XC100, XC121	×	×	×
XC200[1)]	×	×	×
EC4-200	x	×	×

1) XC200 from version V2001-03-01

Number of communication channels

Several communication channels can be opened, e.g. PC ↔ PLC 2, PC ↔ PLC 3 in dependence on the PLC (communication channel) which is connected to the PC. The status display of control 2 and 3 can be implemented simultaneously.

Table 14: Type and number of communication channels

Communications channel	PLC	Max. channel count
TCP/IP Level2Route	XC200	5
Serial RS 232 Level2Route	XC…/EC4-200	1

8 RS232 interface in transparent mode (COM 1/2/3)

The transparent mode serves data exchange with data terminals (e.g. terminals, printers, PCs, measurement devices etc.) via the RS232 serial interface connection. The data transfer is transparent; i.e. the data is transferred without it being interpreted further.

This functionality is provided on the XC100 by the "XC100_SysLibCom" library. The library must be integrated into the "Library Manager". The library contains functions for opening and closing the interface, for sending and receiving data and for setting the interface parameters and control cables.

If control lines of the integrated XC100 interfaces on the RS232 are contacted in the function module, they will not function as the control lines do not physically exist. However, these "XC100_SysLibCom functions" are implemented for reasons of compatibility.

With the XIOC-SER hardware interface module, the control lines are available and are operated via the "SysComReadControl" and "SysComWriteControl" function calls.

If transparent mode is active, no communication is possible with the programming system. Transparent mode must first be disabled. When Transparent mode is closed, the original communication parameters are reinitialised. The transparent mode is forcibly deactivated when the PLC changes to the STOP mode.

A prerequisite for operating the RS232 interface in transparent mode is hardware version 02 and operating system version V02.00 or higher.

Demands placed on the functionality of the transparent mode

"SysComOpen" function

The function opens the RS232 interface for transparent mode. After the interface has been successfully opened, the function returns a value greater than 0.

▶ Enter this value with the following functions as the "dwHandle" parameter.

If a fault has occurred, the feedback value is equal to "0". Transparent mode of the interface will not be enabled.

For operation of the serial interface, the following parameters (ENUMERATION types/List types) are available:

Baud rate for COM 1, COM 2, COM 3

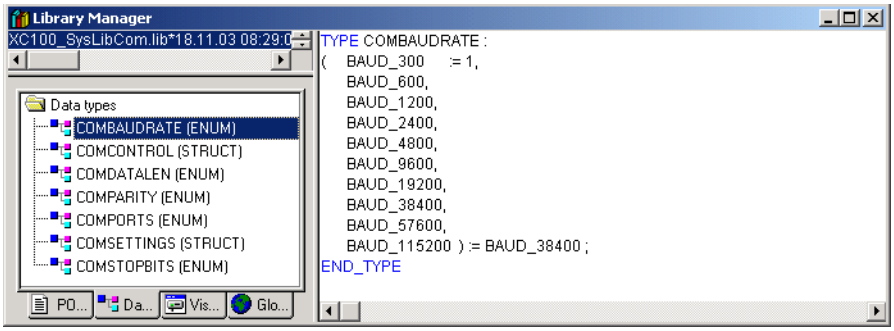


Figure 83: Baud rate selection

Number of data bits

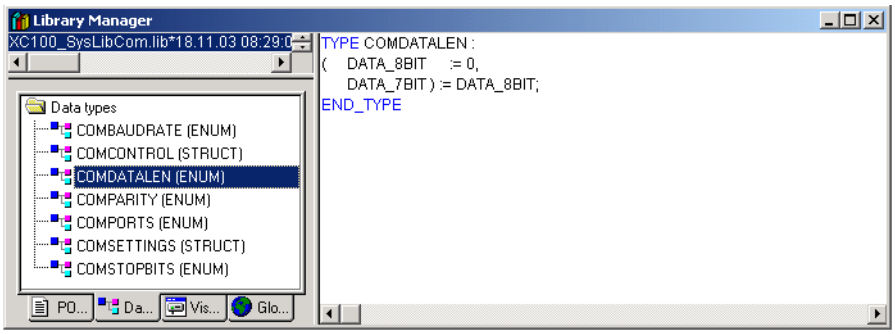


Figure 84: Number of data bits

Selection of the parity

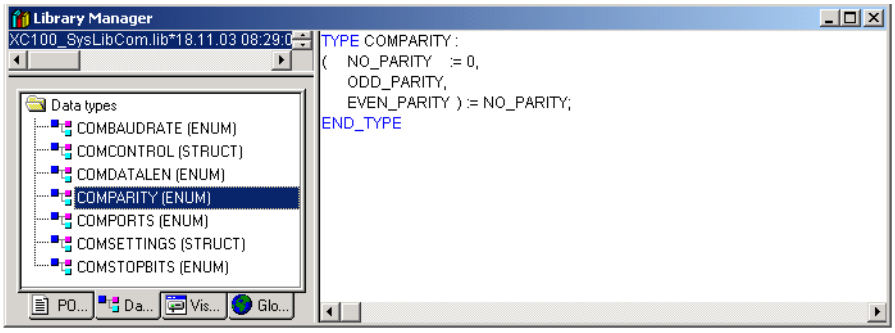


Figure 85: Even/uneven parity

Selection of the COM interface

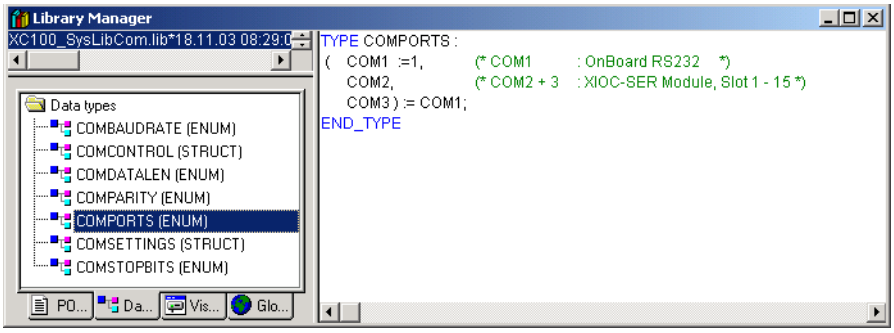


Figure 86: Selection of the COM interface

Number of stop bits

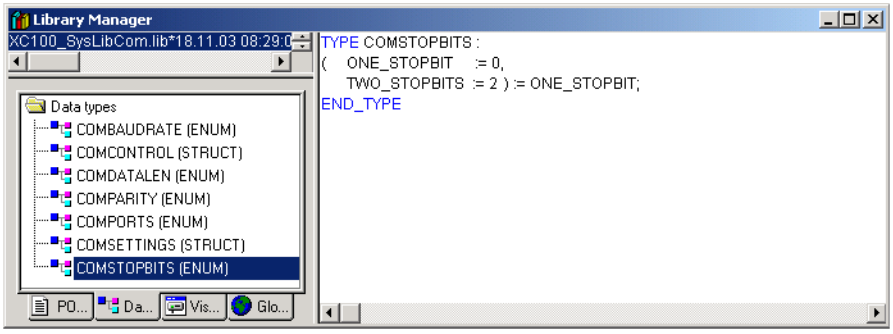


Figure 87: Stop bits

Parametric programming of the control lines/cables of the COM 2/COM 3 interface

The operation of the control lines/cables is implemented with the "ComControl" module. This function only serves the DTR, DSR and DCD interface lines of the XIOC-SER hardware interface module. The ERROR LED available on the module is also operated via this module and controlled with the TRUE command. If the respective interface lines are parameterized with TRUE, read/write access is possible.

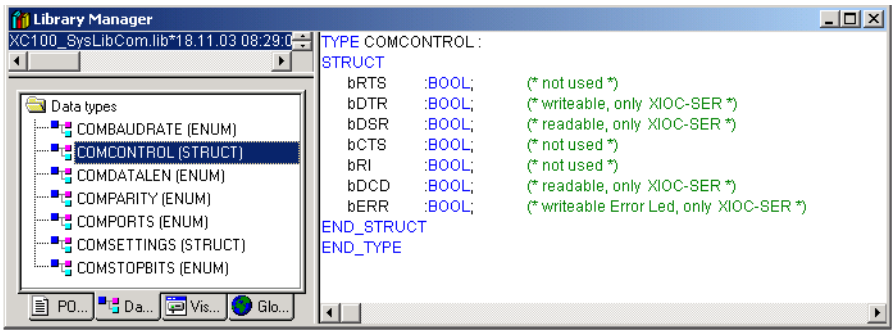


Figure 88: Parametric programming of the control lines of the COM 2 and COM 3 interfaces and the ERR-LED

Parametric programming of the interface

In the "ComSettings" module the complete interface parameters of the COM 2 or COM3 interface are deposited and stored. These parameters are activated by the call up of the module and assigned to the respective hardware interface.

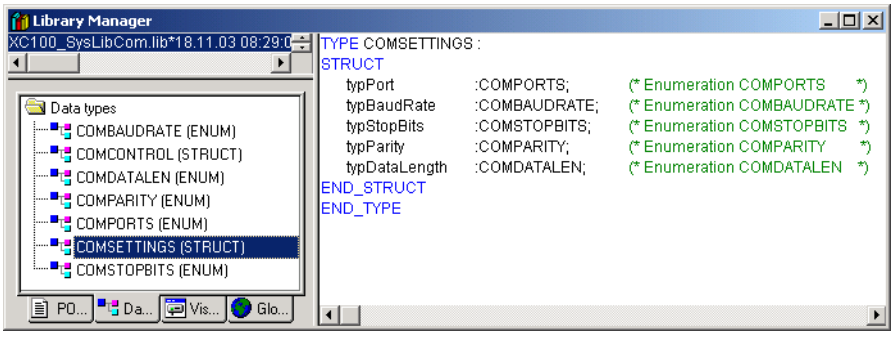


Figure 89: Interface parameter of the COM 2 or COM 3 interface

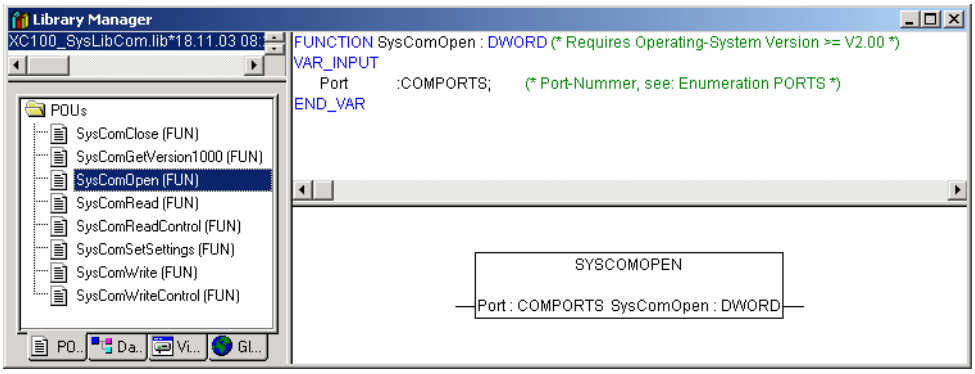


Figure 90: "SysComOpen" function

Table 15: Parameters of the "SysComOpen" function

Port	Selection of the interface	
	Parameter:	Specify the interface to be opened.
SysComOpen	Return value 0: Return value > 0:	Opening of the RS232 interface was **not** successful. Opening of the RS232 interface was successful.

"SysComClose" function

The function closes any RS232 interface opened in transparent mode. During closing, the communication parameters which were set last are restored. The function returns the TRUE return value when the action has been completed successfully.

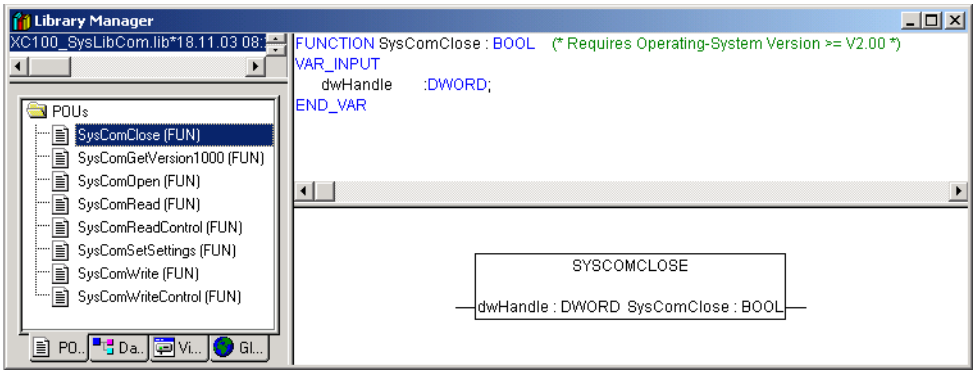


Figure 91: SysComClose function

Table 16: Parameters of the "SysComClose" function

dwHandle	Return value of the "SysComOpen" function
SysComClose	Return value TRUE: Closing of the RS232 interface was successful

"SysComRead" function

Data received via the RS232 interface in transparent mode can be read with this function.

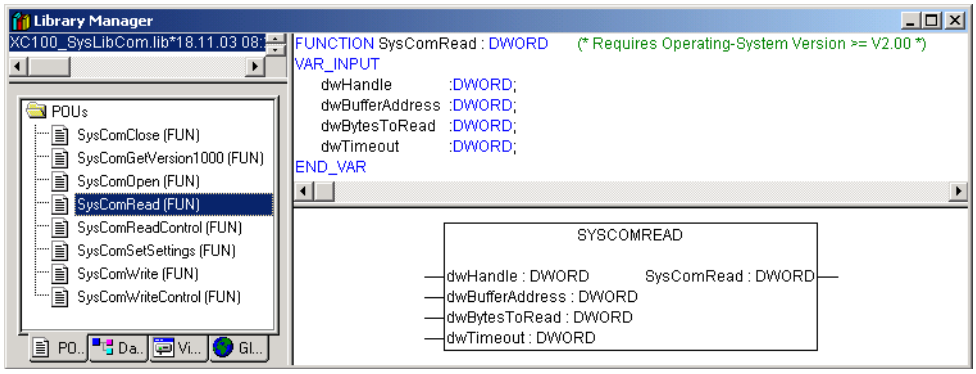


Figure 92: SysComRead function

Table 17: Parameters of the "SysComRead" function

dwHandle	Return value of the "SysComOpen" function
SysComClose	Return value TRUE: Closing of the RS232 interface was successful
dwBufferAddress	Address under which the read data is stored
dwBytesToRead	Limitation of the max. number of data bytes (COM 1: max. 190 bytes; COM 2 + 3: max. 250 bytes)
dwTimeout	Parameter without meaning
SysComRead	Return value: Informs you about the number of read data bytes.

Caution!
Test of the buffer address or the buffer size does not occur!

"SysComWrite" function

This function allows output of the data via the RS232 interface.

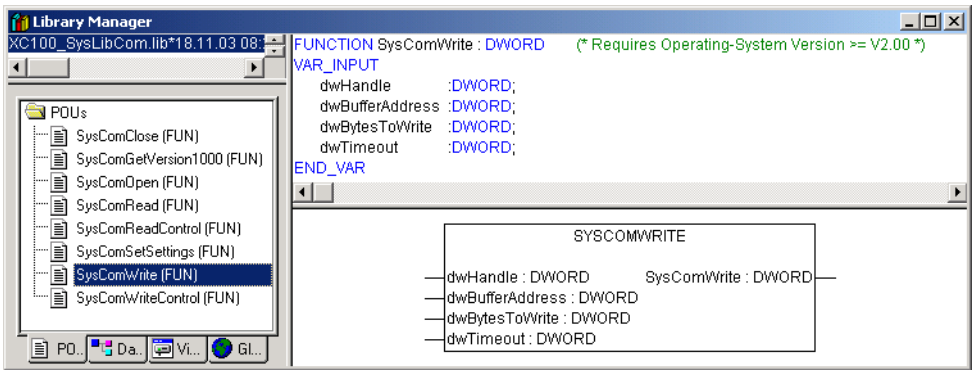


Figure 93: SysComWrite function

Table 18: Parameters of the "SysComWrite" function

dwHandle	Return value of the "SysComOpen" function
dwBufferAddress	Address under which the output data is stored
dwBytesToWrite	Number of data bytes to be sent (COM 1: max. 190 bytes; COM 2, 3: max. 250 bytes)
dwTimeout	Parameter without meaning
SysComWrite	Return value: Informs you about the amount of sent data.

Caution!
Test of the buffer address or the buffer size does not occur!

"SysComSetSettings" functions

Interface parameters of the RS232 interface for the transparent mode can be set with this function.

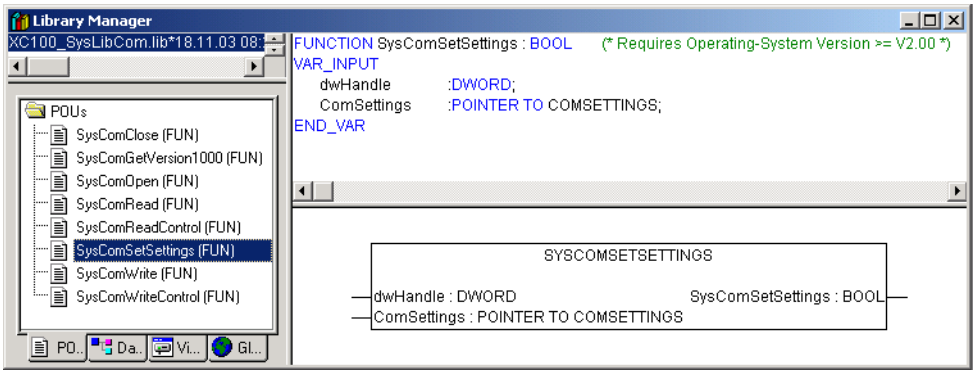


Figure 94: SysComSettings function

Table 19: Parameters of the "SysComSettings" function

dwHandle	Return value of the "SysComOpen" function
ComSettings	Pointer which points to the memory range in which the interface parameter is stored
SysComSetSettings	Return value TRUE, if the interface has been parameterized successfully, otherwise FALSE

Example

The example opening, a text output and closing of the RS232 interface with the XC100.

PLC_PRG (PRG-ST)

```
0001 PROGRAM PLC_PRG
0002 VAR
0003     dwSioHandle          :DWORD;
0004     OpenTrigger          :F_TRIG;
0005     CloseTrigger         :F_TRIG;
0006     WriteBuffer          :STRING(26);
0007     nWriteLength         :DWORD;
0008     typComSettings       :COMSETTINGS;
0009     Input 0              : BOOL;
0010     Input 1              : BOOL;
0011     typComSetSettings    : BOOL;
0012 END_VAR
```

```
0001 (* Opening of the interface for transparent mode and setting of the interface parameters *)
0002     OpenTrigger( CLK: = Input 0 );
0003         IF   (OpenTrigger.Q=TRUE) THEN
0004             dwSioHandle:=SysComOpen(Port:=COM1);
0005                 IF (dwSioHandle > 0) THEN
0006                     typComSettings.typBaudRate     :=Baud_19200;    (*  4800; 9600; 19200; ... *)
0007                                                                     (* ... 38400; 57600 Bit/s *)
0008                     typComSettings.typDataLength   :=Data_8BIT;     (*  7; 8 Bit *)
0009                     typComSettings.typPARITY       :=NO_PARITY;     (*  NO; ODD; EVEN - Parity *)
0010                     typComSettings.typPORT         :=COM1;          (*  COM1 (XC100) *)
0011                     typComSettings.typStopBits     :=ONE_STOPBIT;   (*  1; 2 StopBit *)
0012                     SysComSetSettings(dwHandle :=dwSioHandle,
0013                         ComSettings :=ADR(typComSettings));
0014                 END_IF
0015                 WriteBuffer:=  ' End of the transmission text ',
0016         END_IF
0017 (* Closing of the interface *)
0018     CloseTrigger( CLK: = Input 1 );
0019         IF   (CloseTrigger.Q=TRUE) THEN
0020             SysComClose(dwHandle:= dwSioHandle); dwSioHandle:=0;
0021         END_IF
0022 (* Output of the text via the transparent mode of the XC100 RS232 interface *)
0023     IF ( (* Timer.Q=TRUE AND *) dwSioHandle > 0) THEN
0024         nWriteLength:=SysComWrite(dwHandle:=dwSioHandle, dwBufferAddress:=ADR(WriteBuffer),
0025             dwBytesToWrite:=LEN(WriteBuffer), dwTimeOut:=0);
0026     END_IF
```

Figure 95: Programming example for Transparent mode

"SysComReadControl" function

With the onboard RS232 interface of the CPU101 the control cables/lines are not available. Therefore, the "SysComReadControl" module is not to be used for this interface.

The XIOC-SER hardware interface module has control/interface lines available. This allows the "SysComReadControl" module read access to the control/interface lines of the COM 2 and COM 3 interface.

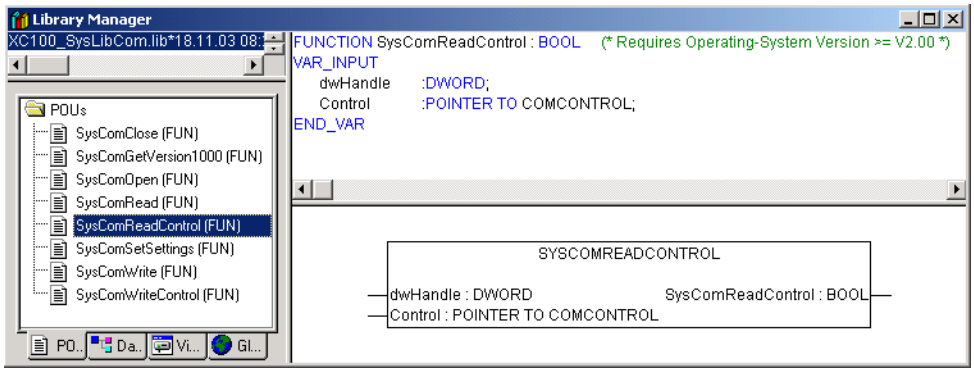


Figure 96: Read access to the control/interface lines of the COM 2 or COM 3 interface

Table 20: Parameters of the "SysComReadContro" function

dwHandle	Return value of the "SysComOpen" function	
Control	COM 1:	Function discontinued
	COM 2, COM 3:	TRUE = read command on the control lines/cables of the hardware interface
SysComReadControl	COM 1:	Function discontinued
	COM 2, COM 3:	TRUE = read command was successful; FALSE = read command was not successful

"SysComWriteControl" function

With the integrated RS232 interface of the CPU101 the control cables/lines are not available. Therefore, the "SysComWriteControl" module is not to be used for this interface.

The XIOC-SER hardware interface module has control/interface lines available. This allows the "SysComWriteControl" module write access to the control/interface lines of the COM 2 and COM 3 interface.

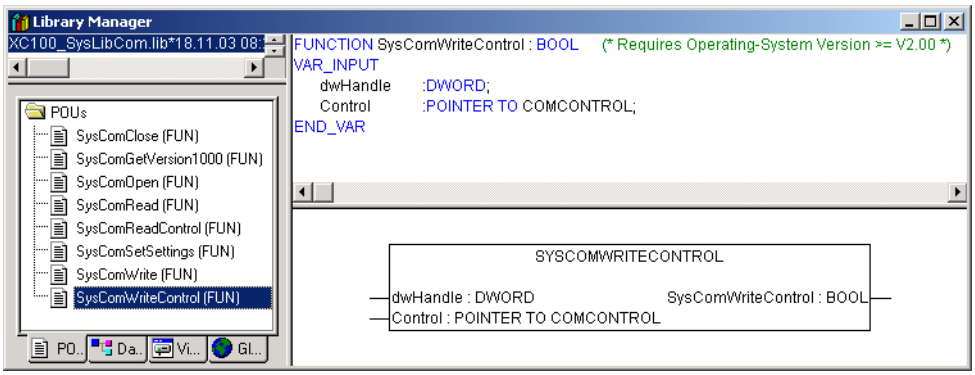


Figure 97: Write access to the control/interface lines of the COM 2 or COM 3 interface

Table 21: Parameters of the "SysComWriteControl" function

dwHandle	Return value of the "SysComOpen" function	
Control	COM 1:	Function discontinued
	COM 2, COM 3:	TRUE = write command on the control lines/cables of the hardware interface
SysComReadControl	COM 1:	Function discontinued
	COM 2, COM 3:	Feedback: TRUE = read command was successful; FALSE = read command was not successful

Automatic closing of the interface

The transparent mode is automatically ended by the operating system with a PLC state change of the XC100 to STOP. The interface is reinitialised with the interface parameters last used.

Appendix

Compatibility

The functional range of the XC-CPU101 is dependant on the hardware (HW), the installed operating system (BTS) and the version of the programming software.

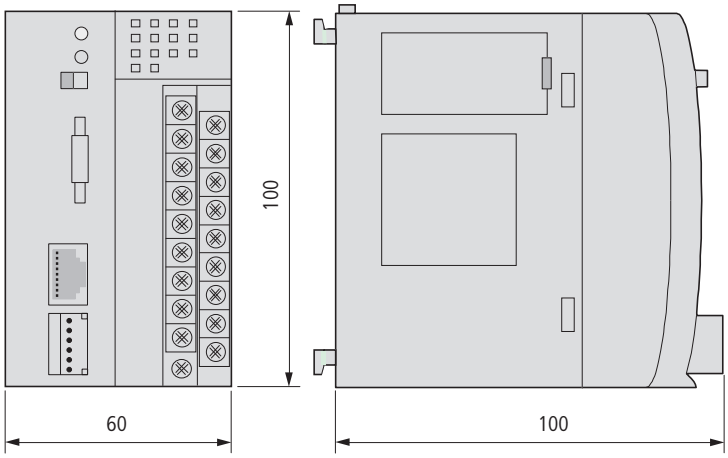
The following overview informs you about the functionality in dependence on the hardware, BTS and easySoft-CoDeSys versions:

→
- The compatibility for older operating systems of the XC101 is guaranteed.
- Due to the modified control configuration with existing projects, it might be necessary that the control configuration may need to be re-entered.
- If a project with a new control configuration is loaded onto an XC101 with an older operating system version, only the functions of the older operating system are available for use.

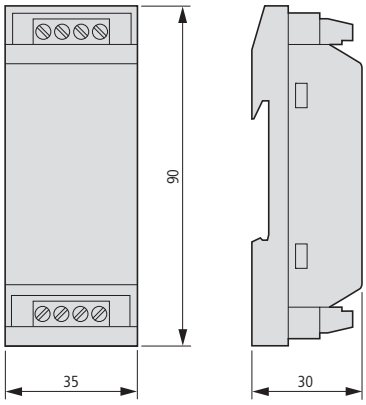
Functionality	**Hardware version:**			
	V01	**V02**	**V04**	
	From operating system version:			**easySoft-CoDeSys-Version:**
Basic functionality	V1.2	–	–	≦ V2.2.5.+Rev. B
PRG default baud rate 57.6 kBit/s	Only V1.2	–	–	V2.3.1
PRG default baud rate 38.4 kBit/s	V1.3	–	–	V2.3.1
Multiple CAN users	V1.3	–	–	V2.3.1
CAN Device	V1.3	–	–	V2.3.1
Programming via CANopen (Routing)	V1.3	–	–	V2.3.1
MMC access	–	V2.0	–	V2.3.1
Interrupt functionality	–	V2.0	–	V2.3.1
RS232 interface in Transparent mode	–	V2.0	–	V2.3.1
Peripheral direct access	–	V2.0	–	V2.3.1
CAN direct access	–	V2.0	–	V2.3.1
CAN baud rate up to 500 kBit/s	–	V2.0	–	V2.3.1
XI/OC bus expansion with XIOC-BP-EXT	V1.3	–	–	V2.3.2
Introduction of the CAN bus load "canload"	V1.3	–	–	V2.3.2
Storage of text data bank on the MMC	V1.3	–	–	V2.3.2
Storage of project information on the MMC	V1.3	–	–	V2.3.2
System events warm and cold start	V1.3	–	–	V2.3.2
Timer interrupt	V1.3	–	–	V2.3.2
Serial interface module XIOC-SER	V1.3	–	–	V2.3.2
PROFIBUS-DP M module	–	–	V3.01	V2.3.2
SUCONET K slave	–	–	V3.02	V2.3.2
Update of the MMC's operating system	–	–	V3.03	V2.3.2
PROFIBUS-DP S module	–	–	V3.10	V2.3.2
Suconet K master module	–	–	V3.10	V2.3.2
Diagnostics	–	–	V3.10	V2.3.2
Free address specification DP	–	–	V3.10	V2.3.2

Dimensions

XC-CPU101...

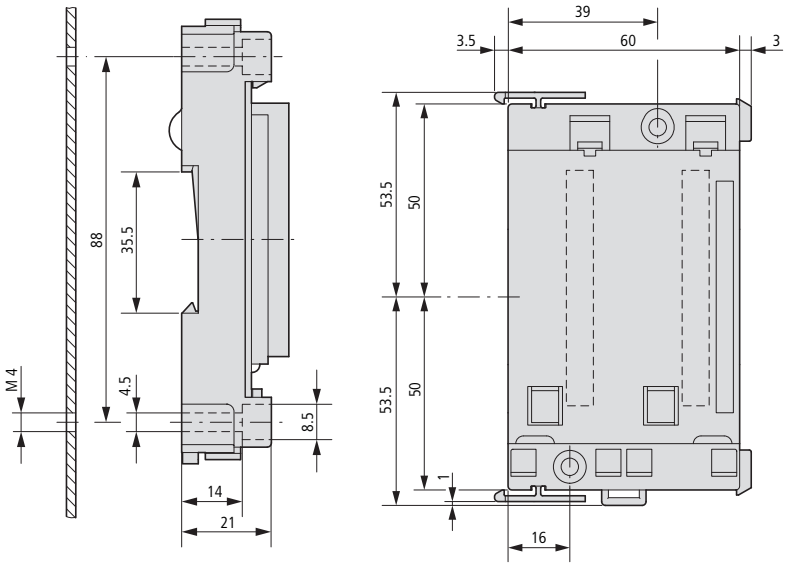


XT-FIL-1 line filter

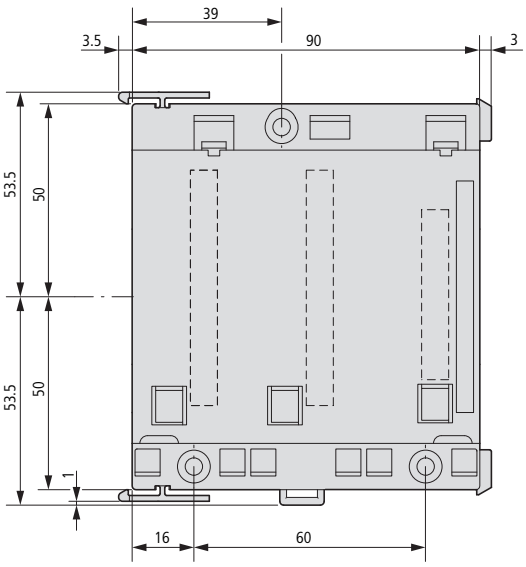


Racks

XIOC-BP-XC



XIOC-BP-XC1



Technical data

			XC-CPU101-C…K-8DI-6DO(-XV)
General			
Standards			IEC/EN 61131-2 EN 50178
Ambient temperature		°C	0 to +55
Storage		°C	–25 to +70
Mounting position			horizontal
Relative humidity, non-condensing (IEC/EN 60068-2-30)		%	10 to 95
Air pressure (operation)		hPa	795 to 1080
Vibration resistance			10 to 57 Hz ±0.075 mm 57 to 150 Hz ±1.0 g
Mechanical shock resistance			15 g/11 ms
Overvoltage category			II
Pollution degree			2
Degree of protection			IP20
Rated insulation voltage		V	500
Emitted interference			EN 50081-2, Class A
Interference immunity			EN 50082-2
Battery (service life)			Worst case 3 years, typ.5 years
Weight		kg	0.23
Dimensions (W × H × D)		mm	90 × 100 × 100
Terminations			Plug-in terminal block
Terminal capacity			
Screw terminals			
Flexible with ferrule		mm^2	0.5 to 1.5
solid		mm^2	0.5 to 2.5
Spring-loaded terminals			
Flexible		mm^2	0.14 to 1.0
solid		mm^2	0.34 to 1.0
Electromagnetic compatibility (EMC)			
Electrostatic discharge (IEC/EN 61000-4-2, Level 3, ESD)			
Contact discharge		kV	4
Electro-magnetic fields (IEC/EN 61000-4-3, RFI)		V/m	10
Burst pulses (IEC/EN 61000-4-4, level 3)			
Power cables		kV	2
Signal cables		kV	1
High-energy pulses (surge) (IEC/EN 61000-4-5)		kV	0.5
Conducted (IEC/EN 1 1-1-1)		V	10

			XC-CPU101-C…K-8DI-6DO(-XV)
Supply voltage for the CPU (24 V/0 V)			
Hold-up time on supply drop-out			
Duration of brownout		ms	10
Repeat rate		s	1
Input voltage		V DC	24
Permissible range		V DC	20.4 to 28.8
Power consumption		W	max. 26
Residual ripple		%	≦ 5
Maximum power dissipated (without local I/O)	*P*v	W	6
Overvoltage protection			Yes
Protection against polarity reversal			Yes
External supply filter			Type: XT-FIL-1, see the technical data on Page 76
Internal supply filter			Yes
Inrush current		× *I*n	Not limited, (limiting only by a supply-side 24 V DC PSU)
Output voltage for the signal modules			
Rated value		V DC	5
Output current		A	3.2
Off-load stable			Yes
Short-circuit rating			Yes
Electrically isolated from supply voltage			No
CPU			
Microprocessor			Infineon C164
Memory			
Program code (C64K/C128K/C256K) program code (C64K/C128K/C256K)		kByte	64/128/256
Program data (C64K/C128K/C256K)		kByte	64/128/256
Marker and / or retain data (C64K/C128K/C256K)		kByte	4/8/16
Cycle time for 1 k of instructions (Bit, Byte)		ms	0.5
Interfaces			
Multimedia card			Yes, optional, 16 MB or 32 MB, to be ordered separately
Serial interface (RS232) without handshake line			
Transfer rate		kBit/s	38.4
Connection types			RJ45
Electrical isolation			No
In the "transparent mode":			
Data transfer rate			300, 600, 1200, 2400, 4800, 9600, 19200, 38400,57600 Bit/s
Character formats			8E1, 8O1, 8N1, 8N2, 7E2, 7O2, 7N2, 7E1
Number of transmission bytes in a block			190 bytes
Number of received bytes in a block			190 bytes

			XC-CPU101-C…K-8DI-6DO(-XV)
CANopen			
Maximum data transmission rate		bit/s	Operating system version < 2.0: maximum 250000 Operating system version = 2.0: maximum 1000000
Potential isolation			Yes
Device profile			According to DS 301 V4
PDO type			asyn., cyc., acyc.
Connection			Plug-in spring-loaded terminal block, 6-pole
Bus terminating resistors			External
Station		Quantity	max. 126
Watchdog			Yes
RTC (Real-Time Clock)			Yes
Power supply of local inputs/outputs ((24 V_Q/0 V_Q)			
Input voltage		V DC	24
Voltage range		V DC	19.2 to 30, observe polarity
Potential isolation			
Power supply against CPU voltage			Yes
Overvoltage protection			Yes
Protection against polarity reversal			Yes
Digital inputs			
Input current per channel at nominal voltage		mA	type. 3.5
Power loss per channel			type 85 mW
Switching levels as per EN 61131-2			
Limit values type "1"			low < 5 V DC, high > 15 V DC
Input delay			
Off → On		ms	type 0.1
On → Off		ms	type 0.1
Inputs		Quantity	8
Channels with the same reference potential		Quantity	8
Status indication			LED
Digital outputs[1]			
Power loss per channel			
QX0.0 and QX0.5		W	0.08
Load circuits			
QX0.0 and QX0.5		A	0.5
Output delay			
Off → On			type 0.1 ms
On → Off			type 0.1 ms
Channels		Quantity	6
Channels with the same reference potential		Quantity	6
Status indication			LED
Duty factor		% ED	100
Utilization factor		g	1

1) Observe the limitations with use of the XC-CPU101 in an ABS enclosure, → table 1 on Page 8.

			24-V-DC-Filter XT-FIL-1
General			
Standards			IEC/EN 61131-2 EN 50178
Ambient temperature		°C	0 to +55
Storage		°C	–25 to +70
Mounting position			Horizontal/vertical
Relative humidity, non-condensing (IEC/EN 60068-2-30)		%	10 to 95
Air pressure (operation)		hPa	795 to 1080
Vibration resistance			10 to 57 Hz ±0.075 mm 57 to 150 Hz ±1.0 g
Mechanical shock resistance			15 g/11 ms
Impact resistance			500 g/∅ 50 mm ± 25 g
Overvoltage category			II
Pollution degree			2
Degree of protection			IP20
Rated impulse voltage		V	850
Emitted interference			EN 50081-2, Class A
Interference immunity			EN 50082-2
Weight		g	95
Dimensions (W × H × D)		mm	35 × 90 × 30
Terminations			Screw terminal
Terminal capacity			
Screw terminals			
Flexible with ferrule		mm^2	0.2 to 2.5 (AWG22-12)
solid		mm^2	0.2 to 2.5 (AWG22-12)
Power supply			
Input voltage		V DC	24
Permissible range		V DC	20.4 to 28.8
Residual ripple		%	≦ 5
Overvoltage protection			Yes
Potential isolation			
Input voltage against PE			Yes
Input voltage against output voltage			No
Output voltage to PE			Yes
Output voltage		V DC	24
Output current		A	2.2

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