

# XIOC Signal Modules

**Hardware and Engineering**

04/08 AWB2725-1452GB

**MOELLER** 

Think future. Switch to green.

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See revision protocol in the "About this manual" chapter

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## 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

|  |  |    |
|--|--|----|
| <b>About this manual</b>                 |  | 5  |
|  | List of revisions  | 5  |
|  | Additional manuals   | 5  |
|  | Intended users   | 5  |
|  | Abbreviations and symbols  | 6  |
| <b>1 Signal modules</b>                  |  | 7  |
|  | Overview of the signal modules for XC-CPU100/200                     | 7  |
|  | Accessories  | 8  |
|  | Assembly   | 8  |
|  | PLC connection   | 8  |
|  | Engineering notes  | 8  |
|  | – Arrangement of the modules according to current consumption        | 8  |
|  | – Arrangement of the modules with increased ambient temperature      | 8  |
|  | Slot assignment in the backplanes                                    | 9  |
|  | Mounting the backplane   | 10 |
|  | – Mounting on the top hat rail                                       | 10 |
|  | – Mounting on the mounting plate                                     | 10 |
|  | Detaching the backplane  | 10 |
|  | Mounting the signal modules  | 12 |
|  | Detaching the signal modules   | 12 |
|  | Fixing the terminal block  | 12 |
|  | Wiring up the I/O signals  | 13 |
|  | – Wiring up the screw terminal block                                 | 13 |
|  | – Wiring up the spring-loaded terminal block                         | 13 |
|  | – Terminal capacities of the terminal blocks                         | 13 |
|  | Wiring the digital input module (24 V DC)                            | 13 |
|  | Wiring up the digital output module (24 V DC)                        | 14 |
|  | – Wiring up the relay output module                                  | 14 |
|  | – Wiring up the transistor output module                             | 14 |
|  | Wiring of the XIOC-32DI input module and the XIOC-32DO output module | 15 |
|  | Wiring of the analog modules   | 16 |
|  | – Signal selector with the analog modules                            | 16 |
|  | Connecting signal cables   | 17 |
|  | Expansion of the XI/OC bus in the easySoft-CoDeSys                   | 18 |
|  | Dimensions   | 19 |
|  | – Signal modules   | 19 |
|  | – Backplane  | 19 |
| <b>2 Temperature acquisition modules</b> |  | 21 |
|  | XIOC-4T-PT   | 21 |
|  | – Features   | 21 |
|  | – Wiring   | 22 |
|  | – Data evaluation  | 23 |
|  | Conversion tables  | 24 |
|  | – Fault-finding  | 26 |
|  | XIOC-4AI-T   | 27 |
|  | – Characteristics  | 27 |
|  | – Configuration and Parameterisation                                 | 27 |
|  | – Diagnosis  | 28 |

|  |   |    |
|--|---|----|
| <b>3 Counter modules XIOC-...CNT100kHz</b>       |   | 29 |
|  | Assembly  | 29 |
|  | – RESET button on the module                                      | 29 |
|  | – LED display   | 29 |
|  | Programming   | 29 |
|  | – Mode (operating mode) switch                                    | 30 |
|  | Connecting an incremental encoder to the counter input            | 31 |
|  | – Two incremental encoders  | 31 |
|  | – Incremental encoder with differential output                    | 34 |
|  | – Incremental encoder with NPN transistor output                  | 34 |
|  | – Incremental encoder with NPN transistor output (open-collector) | 34 |
|  | Connecting devices to the Y outputs                               | 34 |
|  | Function summary  | 35 |
|  | – Linear counter  | 35 |
|  | – Ring counter  | 36 |
|  | – Additional functions for linear and ring counters               | 37 |
|  | Configure counter features  | 38 |
|  | Processing of commands  | 39 |
|  | State display in the controller configuration                     | 43 |
|  | – FLAG summary  | 43 |
|  | – Functional sequence for pulse processing (example)              | 44 |
| <b>4 Counter analog module XIOC-2CNT-2AO-INC</b> |   | 45 |
|  | Features  | 45 |
|  | LEDs  | 46 |
|  | Programming and configuration                                     | 46 |
|  | – Information exchange via the input/output map                   | 46 |
|  | Configuration of the base parameters                              | 49 |
| <b>5 Serial interface module XIOC-SER</b>        |   | 51 |
|  | Features  | 51 |
|  | LED display   | 52 |
|  | Design of the RS-422-/RS-485 interface                            | 52 |
|  | Select the module in the configurator of the easySoft-CoDeSys     | 52 |
|  | Configuration of the interface                                    | 53 |
|  | – “Transparent mode” mode of operation                            | 53 |
|  | – “Suconet-K mode (slave)” operating mode                         | 53 |
|  | Access to the receive and send data                               | 54 |
| <b>6 Suconet K module (master) XIOC-NET-SK-M</b> |   | 55 |
|  | Features  | 55 |
|  | LED display   | 55 |
|  | Design of the Suconet K (RS 485-)interface                        | 55 |
|  | Select the module in the configurator of the easySoft-CoDeSys     | 56 |
|  | Configuration of the interface                                    | 56 |
|  | Access to the receive and send data                               | 56 |

|  |           |
|--|-----------|
| <b>7 PROFIBUS-DP module XIOC-NET-DP-M / XIOC-NET-DP-S</b>                                | <b>57</b> |
| Hardware and software prerequisites  | 57        |
| Features   | 58        |
| – PROFIBUS-DP interface  | 58        |
| – Switches for bus termination resistors   | 58        |
| – Status and diagnostics display (LEDs)  | 58        |
| DP module operation  | 59        |
| – Download behaviour   | 59        |
| – Behaviour after switch on of the supply voltage  | 59        |
| – Behaviour after RUN → STOP transition  | 59        |
| – Behaviour after interruption of the DP line  | 59        |
| Process analysis   | 59        |
| Configuration XIOC-NET-DP-S/M  | 59        |
| Data exchange  | 60        |
| – PROFIBUS-DP module (master) ↔ slaves   | 60        |
| – PROFIBUS-DP master ↔ DP-S module   | 60        |
| – XC100/XC200 ↔ DP-M module  | 60        |
| XC100: status indication of the PROFIBUS-DP slave  | 63        |
| Example: Data transfer XC200 (master) ↔ XC100 (slave)                                    | 63        |
| Diagnostics of the PROFIBUS-DP slaves  | 65        |
| – Implement diagnostics  | 65        |
| – Diagnostics data evaluation  | 66        |
| – Coarse diagnostics with variable from GETBUSSTATE type                                 | 66        |
| – Detailed diagnostics with DIAGGETSTATE function block                                  | 67        |
| Diagnostics in the slave control   | 70        |
| – Query master and connection status   | 70        |
| – Diagnostic module “xDPS_SendDiag”  | 70        |
| Application example for sending diagnostics data (with the xDPS_SendDiag function block) | 71        |
| Program example for diagnostics in the master control                                    | 73        |
| – Create configuration   | 73        |
| – Structure of the program example with a master   | 74        |
| – Function of the program example  | 75        |
| – Function of the diagnostics program  | 75        |
| – Function of the data exchange (monitoring)   | 75        |
| – Program example for diagnostics with a master  | 76        |
| Parametric programming of the LE4 with analog inputs/outputs                             | 78        |

|                         |  |    |
|-------------------------|--|----|
| <b>8 Technical data</b> |  | 79 |
|                         | XControl   | 79 |
|                         | Digital input modules  | 80 |
|                         | Digital output modules   | 82 |
|                         | – Transistor output modules                                      | 82 |
|                         | – Relay output module  | 83 |
|                         | Digital input/output modules                                     | 84 |
|                         | – Configuration and programming of the<br>digital inputs/outputs | 84 |
|                         | Analog input modules   | 86 |
|                         | Analog output module   | 87 |
|                         | Analog input/output modules                                      | 89 |
|                         | Temperature acquisition module XIOC-4T-PT                        | 91 |
|                         | Temperature acquisition module XIOC-4AI-T                        | 92 |
|                         | Counter module   | 93 |
|                         | Counter analog module  | 94 |
|                         | PROFIBUS-DP module   | 94 |
|                         | Serial interface module  | 95 |
|                         | Suconet-K module (master)  | 95 |
| <b>Index</b>            |  | 97 |

## About this manual

### List of revisions

The following significant amendments have been introduced since previous issues:

| Edition date                           | Page                             | Subject   | New                                      | Modification |
|--|----------------------------------|---|--|--------------|
| 10/02                                  | 29                               | Counter modules<br>XIOC-...CNT100kHz                        |  | ✓            |
|  | 84                               | Digital input/output modules                                | ✓  |              |
| 04/03                                  | 13                               | Terminal capacities of the terminal blocks                  |  | ✓            |
|  | 79, 80, 82, 83, 84               | Technical data  |  | ✓            |
|  | 84                               | Configuration and programming of the digital inputs/outputs | ✓  |              |
| 10/03                                  | 7, 89                            | Analog input/output modules                                 | ✓  |              |
|  | 81                               | XIOC-16DI-110VAC  |  |              |
|  | 89                               | Notes   |  |              |
| 12/03                                  | 7, 8, 13, 14, 15, 19, 80, 82, 89 | XIOC-32DI/<br>XIOC-32DO                                     | ✓  |              |
|  | 9, 10                            | XIOC-BP-EXT   | ✓  |              |
|  | 45, 94                           | XIOC-2CNT-2AO-INC   |  |              |
|  | 51, 95                           | XIOC-SER  | ✓  |              |
|  | 04/04                            | 7, 16, 90   | XIOC-2AI-1AO-U1-I1<br>XIOC-4AI-2AO-U1-I1 | ✓            |
| 04/04                                  | 29                               | Programming   | ✓  |              |
|  | 46                               | Programming and configuration                               | ✓  |              |
|  | 53                               | Gap-Time  | ✓  |              |
| 07/04                                  | 57, 94                           | PROFIBUS-DP module<br>XIOC-NET-DP-M /<br>XIOC-NET-DP-S      | ✓  |              |
| 09/04                                  | 51                               | XIOC-SER module<br>Suconet-K mode (Slave)                   | ✓  |              |
| 02/05                                  | 15                               | Wiring XIOC-32DI/DO,<br>conductor colour                    | ✓  |              |
|  | 55, 95                           | Suconet K module<br>(master)<br>XIOC-NET-SK-M               | ✓  |              |
|  | 57, 94                           | XIOC-NET-DP-S   | ✓  |              |
| 11/06                                  | 27, 92                           | XIOC-4AI-T  | ✓  |              |
| 11/06,<br>unchanged<br>editing<br>date | 27                               | Note  | ✓  |              |
|  | 28                               | Assignment of the diagnostics information                   |  |              |
|  | 92                               | Technical data  |  | ✓            |

| Edition date | Page | Subject                                    | New | Modification |
|--------------|------|--|-----|--------------|
| 04/08        | 53   | "Suconet-K mode<br>(slave)" operating mode |     | ✓            |
|              | 54   | Configuration in the<br>Sucosoft S40       |     | ✓            |

This manual describes the XIOC signal module for the XC-CPU100/200 expandable PLC types. In chapter1 you will find information on mounting and wiring, which is applicable to all the signal modules. chapter8 provides comprehensive technical data. This chapter also starts with a general section. Specific features are then dealt with separately or where it proves to be more useful, combined in groups. The other chapters contain product specific information which applies to the modules.

### Additional manuals

The PLC types used in conjunction with the signal modules are described in the following manuals:

| PLC type  | Manual No.     |
|-----------|----------------|
| XC-CPU100 | AWB2724-1453GB |
| XC-CPU200 | AWB2724-1491GB |

The manuals are also available online as PDF files at <http://www.moeller.net/support>. Enter the above mentioned manual number in order to find it quickly.

### Intended users

Read this manual carefully, before you install the signal module and start using it. We assume that you are familiar with basic physical concepts and are experienced in reading technical drawings and dealing with electrical equipment.

**About this manual****Abbreviations and symbols**

The abbreviations and symbols used in this manual have the following meanings:

|       |                               |
|-------|-------------------------------|
| I/O   | Input/Output                  |
| PLC   | Programmable Logic Controller |
| $I_o$ | Input current                 |
| $I_1$ | Output current                |
| $U_o$ | Input voltage                 |
| $U_1$ | Output voltage                |

In chapter3 Counter modules XIOC-...CNT100kHz there is an "n" in the designation for several function block inputs and outputs. This "n" is a wildcard. For example, the designation "CounterEnable" for the inputs "Counter1Enable" and "Counter2Enable" of the "CounterControl" function block.

All dimensions are in millimetres, unless otherwise specified.

► Indicates instructions on what to do



Draws your attention to interesting tips and supplementary information

**Caution!**

Warns of a hazardous situation that could result in damage to the product or components.

**Warning!**

Indicates the risk of major damage to property, or slight injury.

**Danger!**

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

For greater clarity, the name of the current chapter is shown in the header of the left-hand page and the name of the current section in the header of the right-hand page. Exceptions are the first page of each chapter, and empty pages at the end.

# 1 Signal modules

## Overview of the signal modules for XC-CPU100/200

| Designation                 | Type                      | Technical data   |
|-----------------------------|---------------------------|--|
| Backplane                   | XIOC-BP-XC                | For CPU with power supply  |
|                             | XIOC-BP-XC1               | For CPU with power supply, 1 signal module   |
|                             | XIOC-BP-2                 | For 2 signal modules   |
|                             | XIOC-BP-3                 | For 3 signal modules   |
|                             | XIOC-BP-EXT               | I/O module for expansion   |
| Digital input module        | XIOC-8DI/-16DI/-32DI      | 8 channels/16 channels, 32 channels 24 V DC  |
|                             | XIOC-16DI-110VAC          | 16 channels, 110 to 120 V AC   |
|                             | XIOC-16DI-AC              | 16 channels, 200 to 240 V AC   |
| Digital output module       | XIOC-8DO/16DO             | 8 channels/16 channels, transistor output 12/24 V DC (source type)   |
|                             | XIOC-16DO-S <sup>1)</sup> | 16 channels, transistor output 12/24 V DC (source type)  |
|                             | XIOC-32DO                 | 32 channels, transistor output 12/24 V DC (source type)  |
|                             | XIOC-12DO-R               | 12 channels, relay output  |
| Digital input/output module | XIOC-16DX                 | 16 input channels, 24 V DC<br>12 output channels, transistor output 24 V DC (source type)  |
| Analog input module         | XIOC-8AI-I2               | Current input (channels 0 to 7) 4 to 20 mA, 12 bit   |
|                             | XIOC-8AI-U1               | Voltage input (channels 0 to 7) 0 to 10 V DC, 12 bit   |
|                             | XIOC-8AI-U2               | Voltage input (channels 0 to 7) -10 to +10 V DC, 12 bit  |
|                             | XIOC-4T-PT                | PT100/1000 input (channels 0 to 3) 15 bit, signed  |
|                             | XIOC-4AI-T                | 4 Analogue inputs for thermal elements (channels 0 to 3) 15 bit, signed  |
| Analog output module        | XIOC-2AO-U1-2AO-I2        | Voltage output (channels 0 to 1) 0 to 10 V DC,<br>Current output (channels 2 to 3) 4 to 20 mA, 12 bit  |
|                             | XIOC-2AO-U2               | Voltage output (channel 0 + 1) -10 to 10 V DC  |
|                             | XIOC-4AO-U2               | Voltage output (channels 0 to 3) -10 to 10 V DC  |
|                             | XIOC-4AO-U1               | Voltage output (channels 0 to 3) 0 to 10 V DC  |
| Analog input/output module  | XIOC-4AI-2AO-U1           | Voltage input (channels 0 to 3) 0 to 10 V DC, 14 bit<br>Voltage output (channels 0 to 1) 0 to 10 V DC, 12 bit  |
|                             | XIOC-2AI-1AO-U1           | Voltage input (channels 0 to 1) 0 to 10 V DC, 14 bit<br>Voltage output (channel 0) 0 to 10 V DC, 12 bit  |
|                             | XIOC-4AI-2AO-U1-I1        | Voltage input (channels 0 to 3) 0 to 10 V DC, 14 bit<br>or current input (channels 0 to 3) 0 to 20 mA, 14 bit<br>Voltage output (channels 0 to 1) 0 to 10 V DC, 12 bit<br>or current output (channels 0 to 1) 0 to 20 mA, 12 bit |
|                             | XIOC-2AI-1AO-U1-I1        | Voltage input (channels 0 to 1) 0 to 10 V DC, 14 bit<br>or current input (channels 0 to 1) 0 to 20 mA, 14 bit<br>Voltage output (channel 0) 0 to 10 V DC, 12 bit<br>or current output (channel 0) 0 to 20 mA, 12 bit             |
| Counter module              | XIOC-1CNT-100kHz          | 1 channel, Input for fast counter, maximum frequency 100 kHz, switchable 1/2-phase,<br>2 open-collector outputs  |
|                             | XIOC-2CNT-100 kHz         | 2 channels, Input for fast counter, maximum frequency 100 kHz, switchable 1/2-phase,<br>2 open-collector outputs per channel   |
| Counter analog module       | XIOC-2CNT-2AO-INC         | Input for fast counters, maximum frequency of 400 kHz; 2 channels, output -10 to +10 V   |
| Serial interface module     | XIOC-SER                  | Serial interface, selectable: RS 232, RS 422, RS 485, SUCONET K mode (slave)   |

1) With short-circuit protection

**Accessories**

| Designation            | Type          | Comments                                 |
|------------------------|---------------|--|
| Spring-loaded terminal | XIOC-TERM-18T | For digital and analog I/O modules       |
| Screw terminals        | XIOC-TERM-18S |  |
| Plug/cable             | XIOC-TERM32   | For 32-pole digital input/output modules |

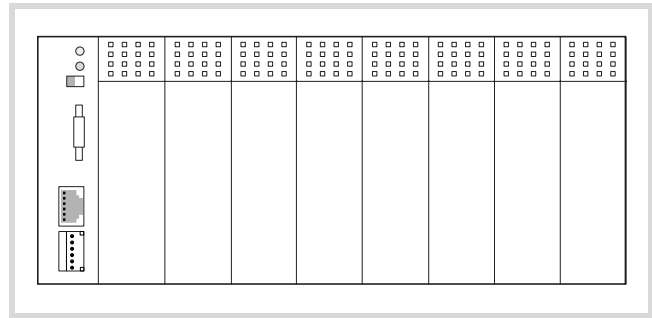


Figure 2: XC-CPU100/200 with XI/OC signal modules

**Assembly**

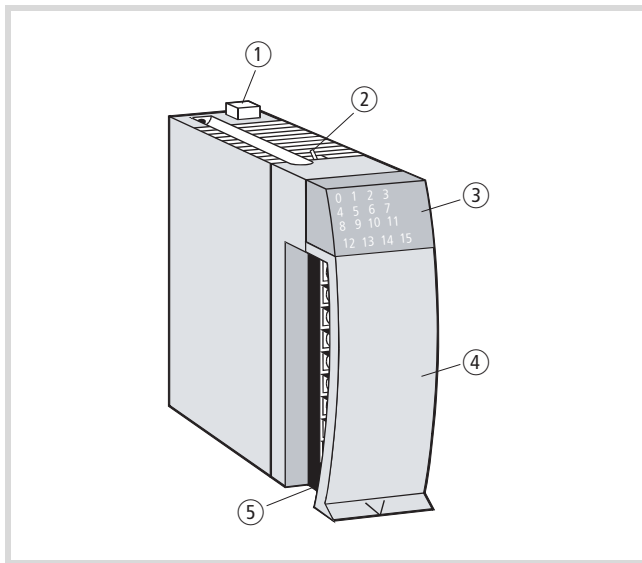


Figure 1: Assembly of a signal module

- ① Catch
- ② LED selector for XIOC-32DI/XIOC-32DO; the modules are equipped with 16 LEDs for displaying the input/output (I/O) display state. Depending on the position of the selector, the LEDs indicate the I/O's 0 – 15 (switch at front) or 16 – 31 (switch at rear). The LED designated with "+" lights up when I/O 16 – 31 are displayed.
- ③ LED display
- ④ I/O cover
- ⑤ Terminal block

**PLC connection**

The XI/OC modules are the I/O modules for the XC-CPU100/200 PLC types. The following diagrams show the assembly of XI/OC modules which are connected to a PLC.

**Engineering notes**

**Arrangement of the modules according to current consumption**

The CPU supplies other XI/OC modules from its integrated power supply unit. Generally, these modules should be arranged so that the modules with the higher internal current consumption (e.g. XIOC 2CNT-...) are connected first to the CPU. The modules with a lower current consumption should then follow.

**Arrangement of the modules with increased ambient temperature**

If the modules are used in ambient temperature > 40° C or with limited convection (e.g. enclosed CI enclosure), measures should be implemented to prevent excessive rises in heat dissipation. This can be achieved by derating certain modules.

| Module type  | Technical features                          | Limit value at ... |         |
|--------------|---|--------------------|---------|
|              |   | < 40 °C            | > 40 °C |
| XIOC-16DI-AC | Simultaneity factor                         | 1                  | 0,75    |
| XIOC-16DO    | Rated current per common potential terminal | 4A                 | 3,4A    |
| XIOC-16DO-S  |   | 5A                 | 4,3A    |
| XIOC-16DX    | Simultaneity factor                         | 1                  | 0,5     |
|              | Module arrangement                          | any                | 1)      |

1) Locate not directly beside CPU and not directly beside further XIOC-16DX

Further details concerning engineering can be found in the manuals:

- XC-CPU100: AWB2724-1453GB
- XC-CPU200: AWB2724-1491GB

### Slot assignment in the backplanes

The XI/OC modules are plugged onto backplanes that provide the connection to the PLC. The modules are also interconnected through the backplane.

The integrated bus system ensures interference-free transmission between the individual slots on the bus. In addition, the bus system supplies the individual modules with the voltage that is required for internal signal processing.

The supply voltage for the I/O electronics is applied directly to the corresponding I/O modules.

Five different backplanes are available:

As a rule, the first backplane, which is used to take the XC-CPU100/200 CPU type is a basic backplane. You can add on several expansion backplanes to the right side. The backplanes must be arranged so that one CPU module for basic expansion and a maximum of seven XI/OC signal modules can be planned (→ fig. 4).

Through the use of bus expansion, you can add further backplanes consisting of CPU and 5, 6 or 7 I/O modules to the basic expansion. The bus expansion has the same design and the same dimensions as the XI/OC-BP-3 expansion rack. However, it is equipped with additional components for amplification of the bus signals. The arrangement of the bus expansion with the basic expansion is fixed (→ fig. 4). The maximum expansion stage can accept 15 XI/OC I/O modules.

- If you wish to expand existing basic expansion with 6 or 7 I/O modules, you will need to replace an existing rack (backplane) (XI/OC-BP-2/XI/OC-BP-3) by a bus expansion (XI/OC-BP-EXT). The bus expansion may only be positioned at the position indicated in Figure 4.
- In the PLC Configuration, the 7th element "EXTENSION-SLOT[SLOT]" with the "Replace element" function is to be replaced by the "EXTENSION-SLOT" element. A total of up to 15 slots are indicated.

Table 1: Slot assignment in the backplanes

| Backplane                         | Slots                    |   |            |
|-----------------------------------|--------------------------|---|------------|
|                                   | 1                        | 2 | 3          |
| XI/OC-BP-XC<br>(Basic backplane)  | CPU with power supply    |   | –          |
| XI/OC-BP-XC1<br>(Basic backplane) | CPU with power supply    |   | I/O module |
| XI/OC-BP-2<br>(ExpansionRack)     | I/O module               |   | –          |
| XI/OC-BP-3<br>(ExpansionRack)     | I/O module               |   |            |
| XI/OC-BP-EXT (bus expansion)      | I/O module for expansion |   |            |

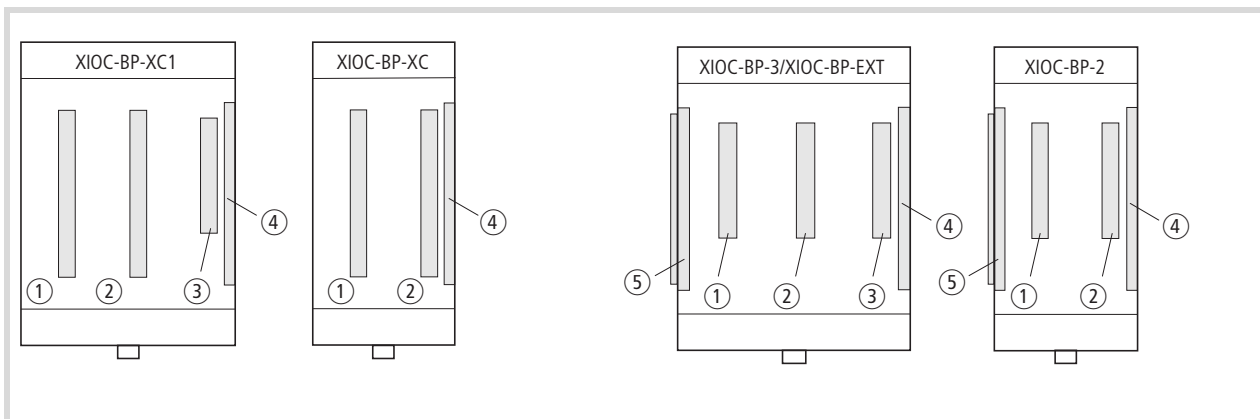


Figure 3: Top left: expandable backplane  
Top right: expandable backplane

- ① Slot 1
- ② Slot 2
- ③ Slot 3
- ④ Bus expansion connector (socket)
- ⑤ Bus expansion connector (plug)

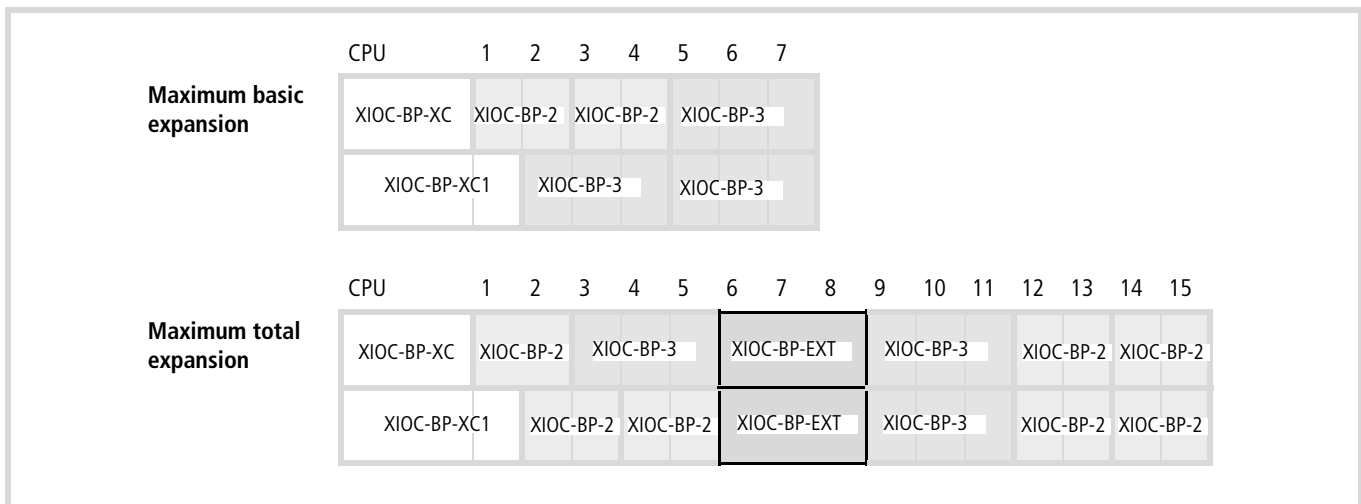


Figure 4: Maximum expansion of the I/O modules without and with XI/OC bus expansion

How to implement the software bus expansion in the PLC configurator of the easySoft-CoDeSys is described from page 18.

expansion backplane. Take care that the bus connectors of the backplanes are completely engaged, in order to ensure reliable electrical contact.

### Mounting the backplane

The backplane can either be snapped onto a top hat (DIN) rail, or screwed directly onto the mounting plate.



#### Warning!

The expansion backplane must only be plugged in or pulled out when the power is switched off. First detach the CPU or I/O modules that were plugged into the backplane. Discharge yourself from any electrostatic charge before touching electronic modules. Voltage peaks on the bus connector may cause malfunction or damage to the modules.

### Mounting on the mounting plate

The spring contacts that protrude from the back of the backplane are intended to provide a ground for the modules. They must have a reliable electrical contact with the mounting plate.

Take care that the contact areas are protected from corrosion and – if you are using painted mounting plates – that the paint layer is removed from the contact areas.

- ▶ Plug the bus connector of the expansion backplane into the bus connector of the basic rack or expansion backplane. Take care that the bus connectors of the backplanes are completely engaged, in order to ensure reliable electrical contact.

→ Mounting of the controls is described in:

- AWB2724-1453GB for XC-CPU100
- AWB2724-1491GB for XC-CPU200

### Detaching the backplane

- ▶ Use a screwdriver to pull out the locking bar until the catch snaps into position. The locking bar is then held in this position **1**.
- ▶ Only with expansion backplanes: Slide the expansion backplane along the top hat rail to the right until the bus connectors are disengaged.
- ▶ Take the backplane off the rail.

### Mounting on the top hat rail

- ▶ Use a screwdriver to pull out the locking bar until the catch snaps into position. The locking bar is then held in this position **1**.
- ▶ Place the backplane on the top hat mounting rail so that the top edge of the rail fits into the slot, and then slide the backplane into the correct position **2**.
- ▶ Press down the catch of the locking bar. The bar snaps in behind the edge of the mounting rail. Check that the backplane is firmly seated **3**.
- ▶ If you want to fit an expansion backplane: push it to the left, until the bus connector of the expansion backplane can be plugged into the bus connector socket of the basic rack or

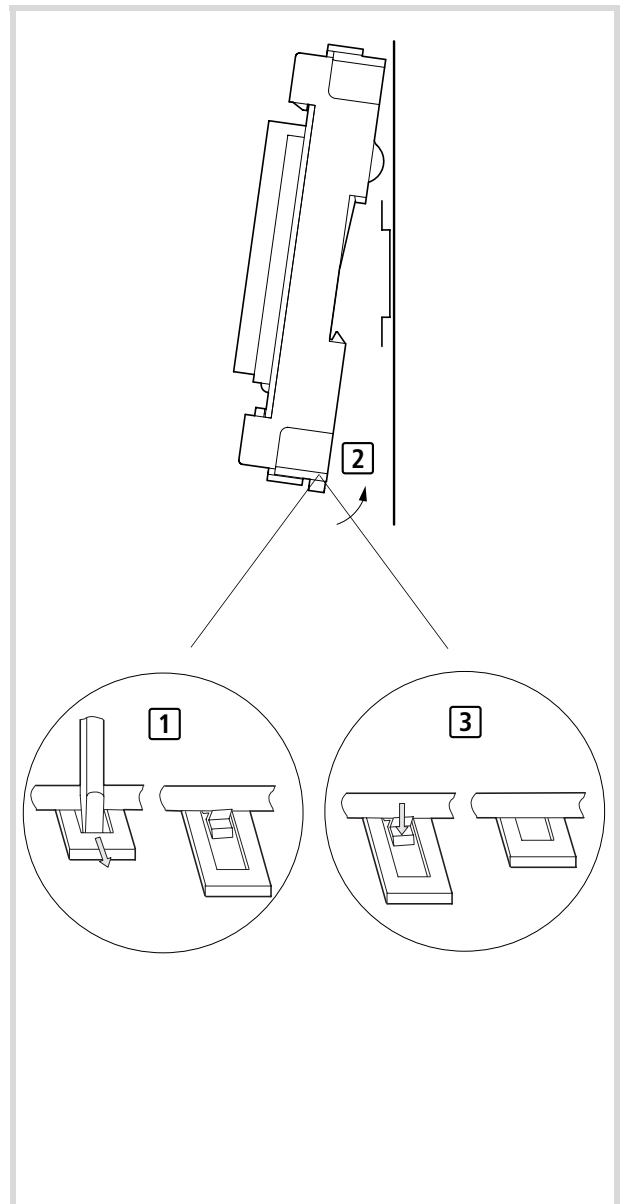
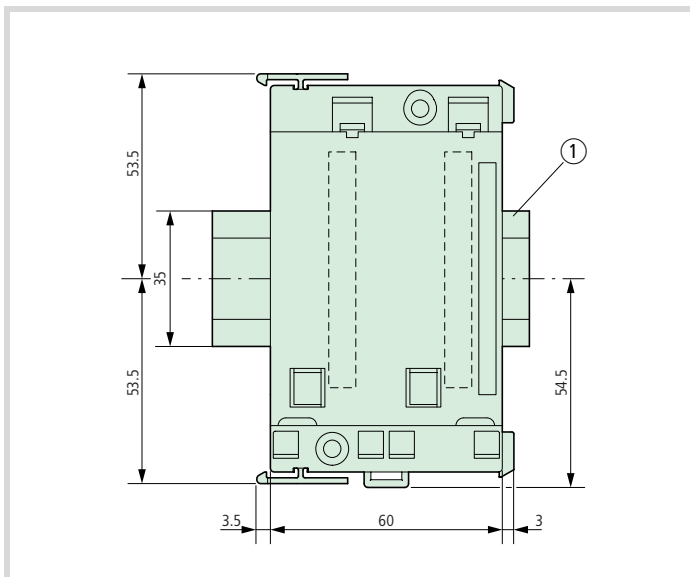
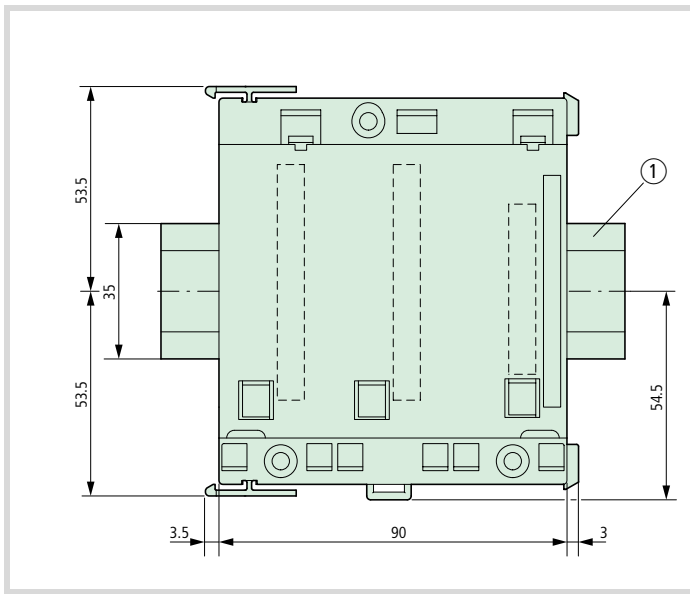


Figure 5: Mounting on a 35 mm top hat (DIN) rail,  
 top left: XIOC-BP-XC1, (XIOC-BP-3)  
 bottom left: XIOC-BP-XC, (XIOC-BP-2)

① 35 mm top hat rail

See also dimensions on page 19.

### Mounting the signal modules

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

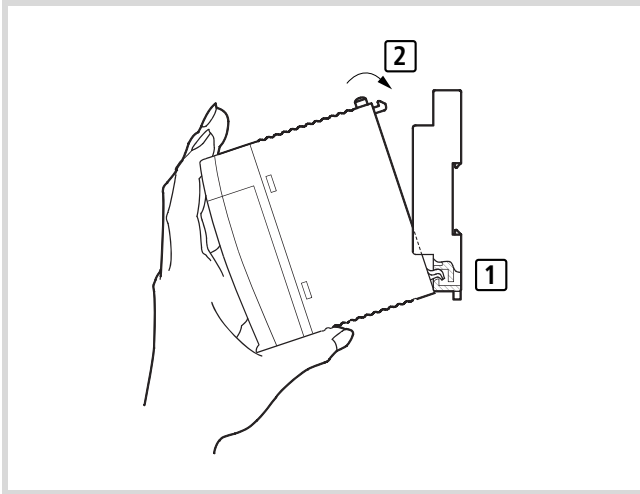


Figure 6: Mounting the signal modules

### Detaching the signal modules

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

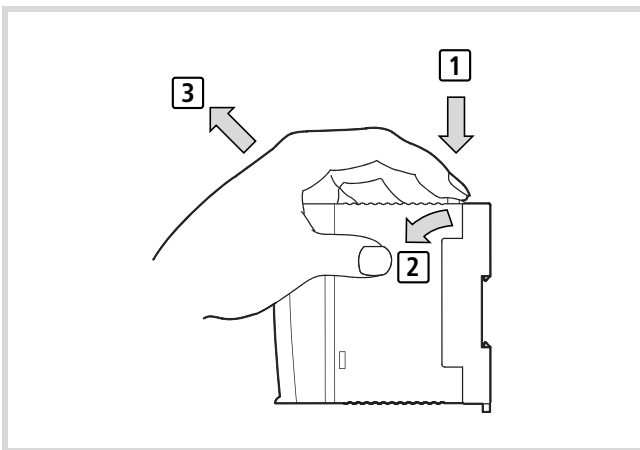


Figure 7: Detaching the modules

### Fixing the terminal block

- ▶ Plug the lower end of the terminal block onto the module board. Screw in the fixing screw a short way **1**.
- ▶ Push the top end of the terminal block onto the module until you hear it snap into position **2**.
- ▶ Hold the top end of the terminal block firmly, and tighten up the fixing screw **3**.
- ▶ Tug on the top end of the terminal block, to check that it is firmly seated and cant come loose **4**.

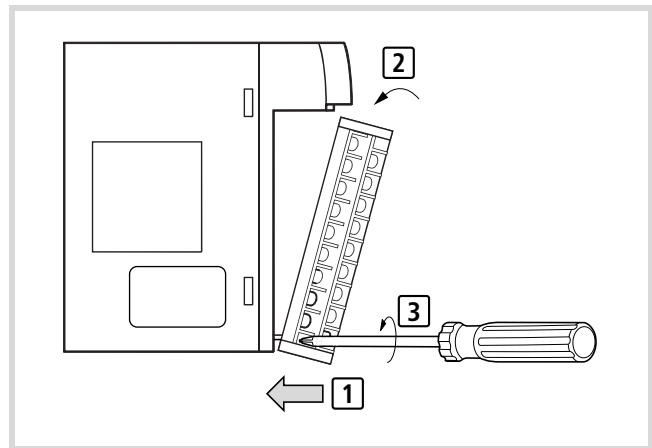


Figure 8: Fixing the terminal block

## Wiring up the I/O signals

### Wiring up the screw terminal block

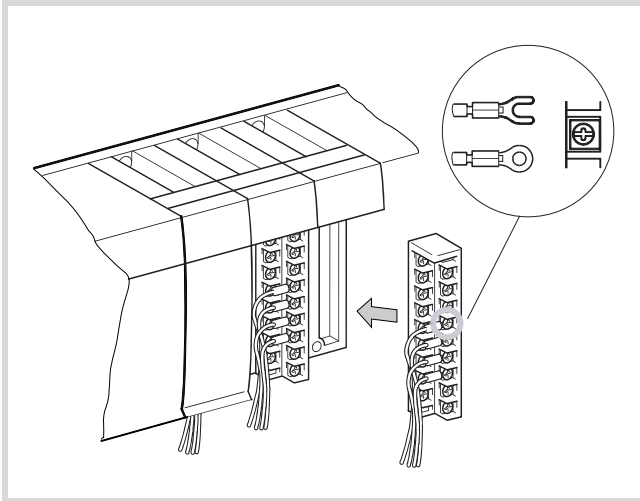


Figure 9: Wiring up the screw terminal block

→ Please observe the following notes:

- All terminals have M3 screws.
- Tighten up the screws to a torque of 0.49 to 0.78 Nm.
- If cable lugs are to be used they may have a maximum external diameter of 6 mm.
- Do not attach more than 2 cable lugs to one terminal.
- Use a cable with a maximum conductor cross-section of 0.75 mm<sup>2</sup>, or 0.5 mm<sup>2</sup> if two cable lugs are going to be fixed to the same terminal.

### Wiring up the spring-loaded terminal block

The spring-loaded terminal block has the same basic design as the screw terminal block. The difference lies in the way the cable is connected.

**Caution!**  
The cables are to be inserted into the terminals with out the use of ferrules or cable lugs.

## Terminal capacities of the terminal blocks

**Caution!**  
For UL applications, the power supply lines to the XIOC-8DO, -16DO, -12DO-R, -16DX modules must have a cross-section of AWG16 (1.3 mm<sup>2</sup>).

Table 2: Cable connection

| Conductor                       | Screw connection           | Spring-loaded connection   |
|---------------------------------|----------------------------|--|
| solid core                      | 0.5 to 2.5 mm <sup>2</sup> | 0.14 to 1.0 mm <sup>2</sup>  |
| stranded, with bootlace ferrule | 0.5 to 1.5 mm <sup>2</sup> | The cables are to be inserted into the terminals with out the use of ferrules or cable lugs. |
| stranded                        | –                          | 0.34 to 1.0 mm <sup>2</sup>  |

## Wiring the digital input module (24 V DC)

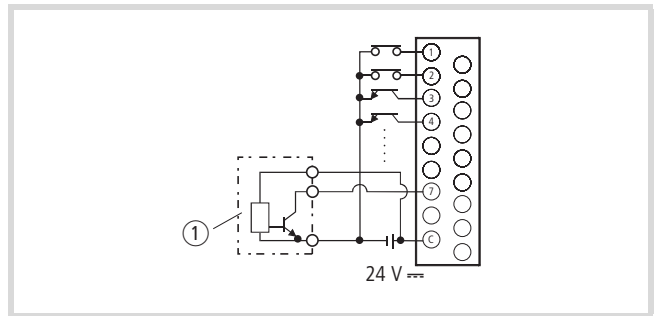


Figure 10: Example of external wiring for the DC input XIOC-8DI/16DI/32DI (here 16 DI)

① Proximity switch

- The diodes that are connected inverse-parallel to the input circuits of the module enable operation of the inputs from either +24 V DC or –24 V DC (see Connection example on page 80).
- When an ON signal is applied to all inputs, the current drawn via the input contacts is typically 6.9 mA (XIOC-8DI) or 4 mA (XIOC-16DI).
- Sensors, such as proximity sensors or photoelectric switches, can be directly attached, provided that they are current-sinking types (open-collector). Sensors that have a voltage output must be connected to the inputs via transistors.
- Use cables with a maximum length of 30 meters.

About this manual

Wiring up the digital output module (24 V DC)

Wiring up the relay output module

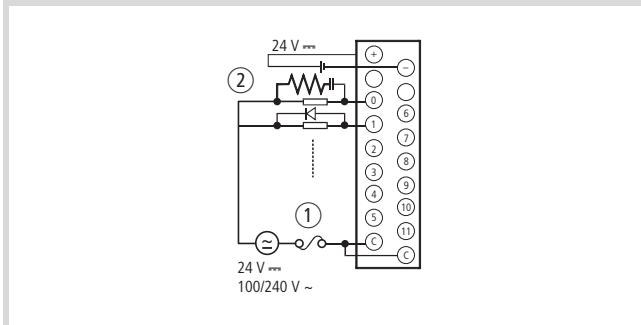


Figure 11: External wiring of the relay output XIOC-12DO-R

- ① Fuse
- ② RC peak-suppression filter or diode

RC peak-suppression filter

► When an inductive load is present, wire an RC peak-suppression filter (capacitor 0.1  $\mu\text{F}$  and resistor about 100  $\Omega$ ) parallel to the load. For DC loads, freewheel diodes must be used.

Fuse

► There is no fuse inside the module. Fit a 6 A fuse in the circuit (common) to protect the external wiring from being burnt out.

Supply voltage for relay operation

► Observe the polarity of the 24 V DC connection. Incorrect wiring can damage the internal circuitry.

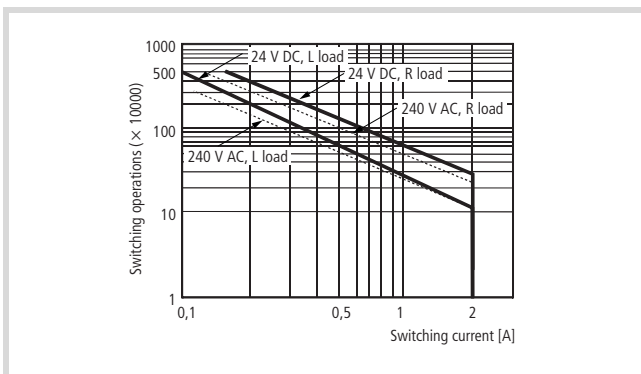


Figure 12: Operating life diagram for the relay contacts

The operating life of a contact is inversely proportional to the square of the current. Any overload currents that occur, or directly connected capacitive loads, can therefore drastically reduce the operating life of a relay.

The transistor output module is to be preferred for high-frequency switching operations.

Wiring up the transistor output module

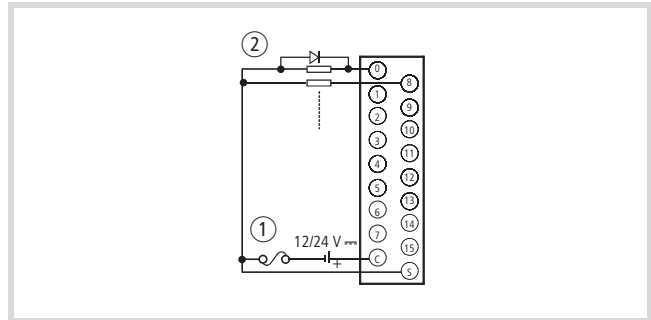


Figure 13: External wiring of the transistor output XIOC-8DO/-16DO/32DO, here: 16DO (positive logic, source type)

- ① Fuse
- ② Diode

Freewheel diode

► When using inductive loads, connect a freewheel diode in parallel.

S and C terminals

Always connect up the S and C terminals. If the module is operated without these terminals being connected, then the freewheel diodes cant carry out their function, and there is a danger that the module will not function correctly, or may even be damaged.

Fuse

A fuse is wired into the common current path, to prevent the external wiring from being burnt out, but it cant protect the transistors. The transistors can, therefore, be destroyed by a short-circuit of the external load.

If the fuse has blown, then no output signals can be produced, even though the LED is lit up.



Warning!

When the blown fuse has been replaced, do not switch on the power to the module again, until you have found and removed the source of the fault.

**Wiring of the XIOC-32DI input module and the XIOC-32DO output module**

The modules have a 40-pole plug connector. Connect the module with external terminals via the plug with connected cable (XIOC-TERM32). The number of the connector pin can be seen in the following diagram. Verify the assignment of conductor – connector pin (number). The cross-section of the conductors is 0.4 mm.

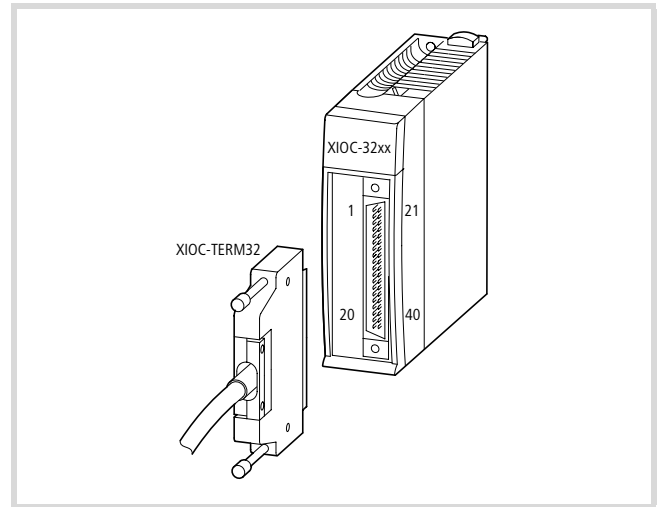


Figure 14: Cable with connector (XIOC-TERM32)

| No. | Conductor colour | Signal name<br>XIOC-32DI | Signal name<br>XIOC-32DO |
|-----|------------------|--------------------------|--------------------------|
| 1   | white            | 0                        | 0                        |
| 2   | brown            | 1                        | 1                        |
| 3   | green            | 2                        | 2                        |
| 4   | yellow           | 3                        | 3                        |
| 5   | grey             | 4                        | 4                        |
| 6   | pink             | 5                        | 5                        |
| 7   | blue             | 6                        | 6                        |
| 8   | red              | 7                        | 7                        |
| 9   | black            | C                        | C                        |
| 10  | purple           | 8                        | S                        |
| 11  | grey/pink        | 9                        | 8                        |
| 12  | blue/red         | 10                       | 9                        |
| 13  | white/green      | 11                       | 10                       |
| 14  | brown/green      | 12                       | 11                       |
| 15  | white/yellow     | 13                       | 12                       |
| 16  | yellow/brown     | 14                       | 13                       |
| 17  | white/grey       | 15                       | 14                       |
| 18  | grey/brown       | C                        | 15                       |
| 19  | white/pink       | ---                      | C                        |
| 20  | pink/brown       | ---                      | S                        |

| No. | Conductor colour | Signal name<br>XIOC-32DI | Signal name<br>XIOC-32DO |
|-----|------------------|--------------------------|--------------------------|
| 21  | white/blue       | 16                       | 16                       |
| 22  | brown/blue       | 17                       | 17                       |
| 23  | white/red        | 18                       | 18                       |
| 24  | brown/red        | 19                       | 19                       |
| 25  | white/black      | 20                       | 20                       |
| 26  | brown/black      | 21                       | 21                       |
| 27  | grey/green       | 22                       | 22                       |
| 28  | yellow/grey      | 23                       | 23                       |
| 29  | pink/green       | C                        | C                        |
| 30  | yellow/pink      | 24                       | S                        |
| 31  | green/blue       | 25                       | 24                       |
| 32  | yellow/blue      | 26                       | 25                       |
| 33  | green/red        | 27                       | 26                       |
| 34  | yellow/red       | 28                       | 27                       |
| 35  | green/black      | 29                       | 28                       |
| 36  | yellow/black     | 30                       | 29                       |
| 37  | grey/blue        | 31                       | 30                       |
| 38  | pink/blue        | C                        | 31                       |
| 39  | grey/red         | ---                      | C                        |
| 40  | pink/red         | ---                      | S                        |

## About this manual

### Wiring of the analog modules

- ▶ Only use shielded cables for connection to external equipment.
- ▶ Route the cables separately from power leads or signal cables that carry differential voltages.
- ▶ Depending on the prevailing electromagnetic environment, one or both ends of the shielding should be grounded.
- ▶ Lay the AC supply power cables in separate ducts to those used for signal or data cables.
- ▶ Lay signal and data cables as close as possible to the grounded surfaces of the switchgear cabinet.

### Signal selector with the analog modules

You can set the "voltage" or "current" signal types for each input and output with the XIOC-2AI-1AO-U1-I1 and XIOC-4AI-1AO-U1-I1 analog modules. The setting is implemented via the 6-pole DIP switch. In the factory default state all input and output switches are set to facilitate the processing of voltage signals. The characteristics of the inputs and outputs can be viewed in the technical data, → page 90.

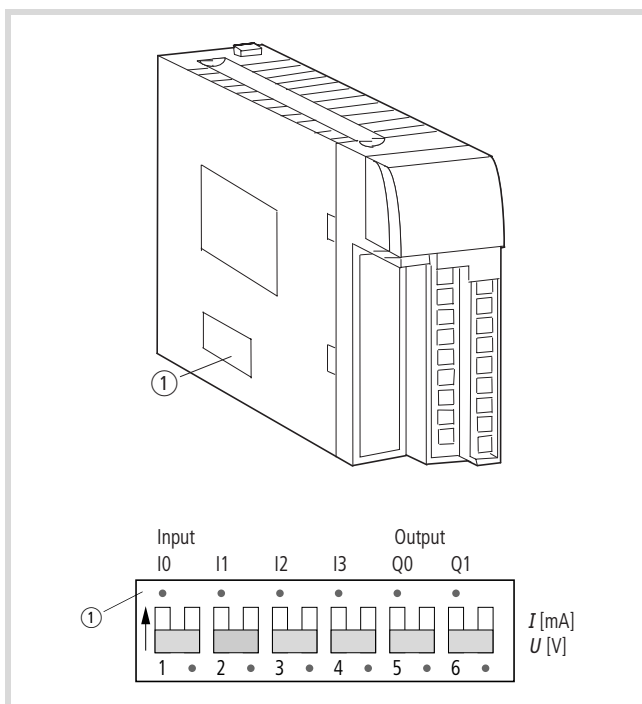
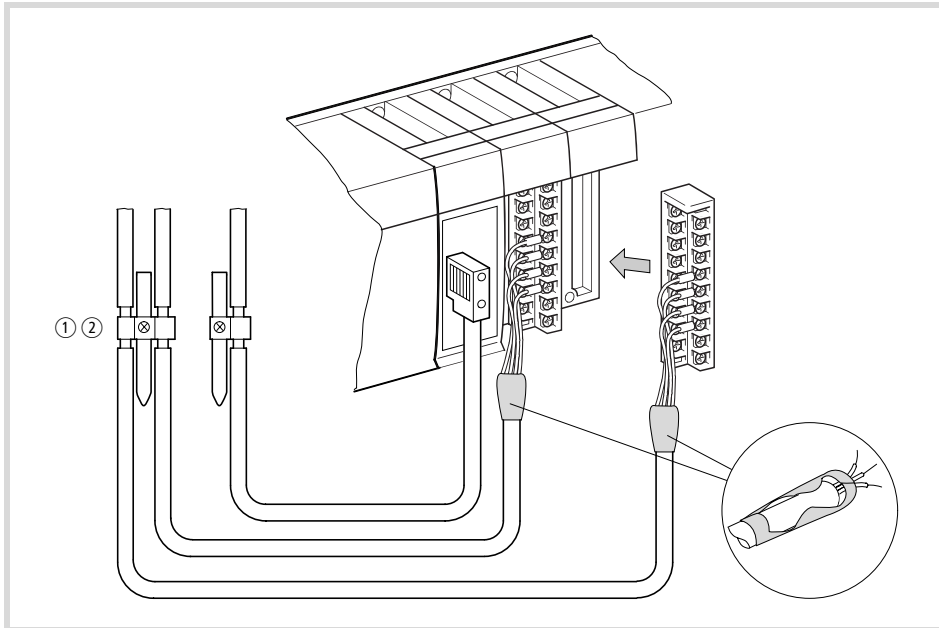


Figure 15: DIP switch for setting the "voltage" (U) or "current" (I) signal type

The "voltage" factory default state is set in the figure.

Connecting signal cables

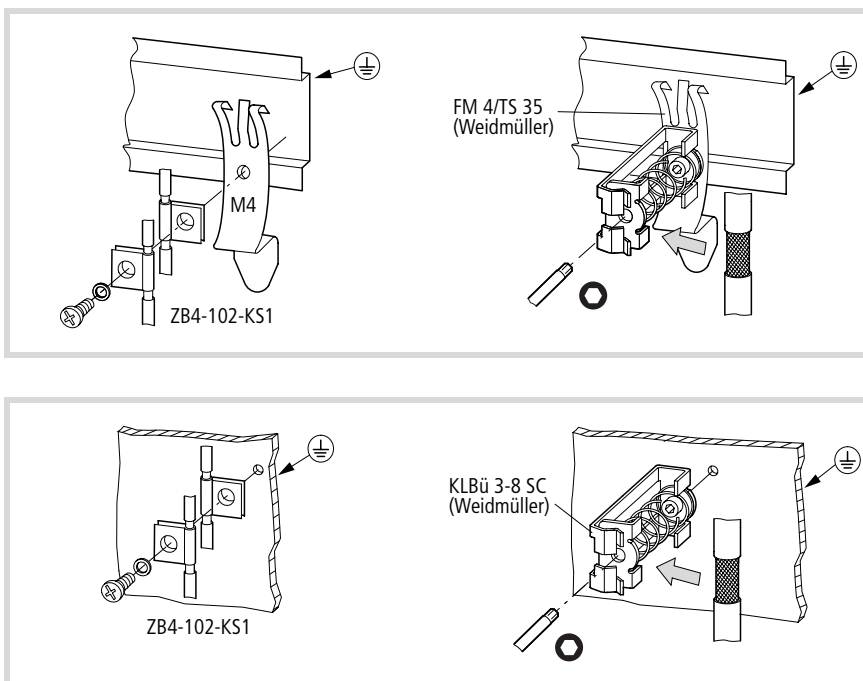


End of the screened cables:

- ▶ Strip back the screen at the end of the cables and insulate it, e.g with heat shrink.

Figure 16: Shielding of signal cables, overview

- ① Screen earthing for top-hat rail
- ② Screen earthing for mounting plate
- Detailed view in Figure17



- ▶ Remove the cable sheath in the contact clamp area.
- ▶ Place one contact clamp on each stripped section of the signal cables or press the stripped section into the snap fastener of the clamp strap.
- ▶ Connect the contact clamp or the clamp strap with a low-impedance connection to the top-hat rail or mounting plate.
- ▶ Attach the top-hat rail to the mounting plate.
- ▶ Ensure that all the contact areas are protected from corrosion and – if you are using painted mounting plates – that the paint layer is removed from the contact areas.
- ▶ Earth the mounting rail using as large a surface as possible.

Figure 17: Screen earthing for top-hat rail (top) or mounting plate (bottom) with contact clamp or clamp strap, detailed view

## Expansion of the XI/OC bus in the easySoft-CoDeSys

The bus expansion with the XI/OC-BP-EXT backplane to a maximum of 15 slots is implemented on the software side in the PLC configuration of the easySoft-CoDeSys.

→ In total, a maximum of 15 slots are possible with an XC100/XC200 PLC, → figure 4 on page 10.

When creating a new configuration, the first 7 slots are created as EMPTY-SLOTS. Slot 7 can be replaced by an EXTENSION-SLOT. This allows the creation of a new node which enables expansion of up to 15 EMPTY-SLOTS.

The expansion backplane can be integrated as follows:

- ▶ Open the PLC Configurator
- ▶ Click with the right mouse button in the last EMPTY-SLOT.
- ▶ Select the "Replace element" command.
- ▶ Select EXTENSION-SLOT with a double-click in a new window.

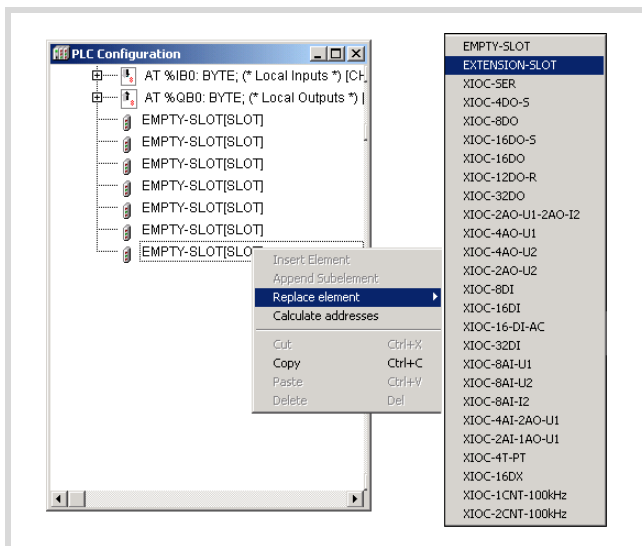


Figure 18: Expansion backplane configuration

The following illustration indicates the maximum configuration of the I/O slot.

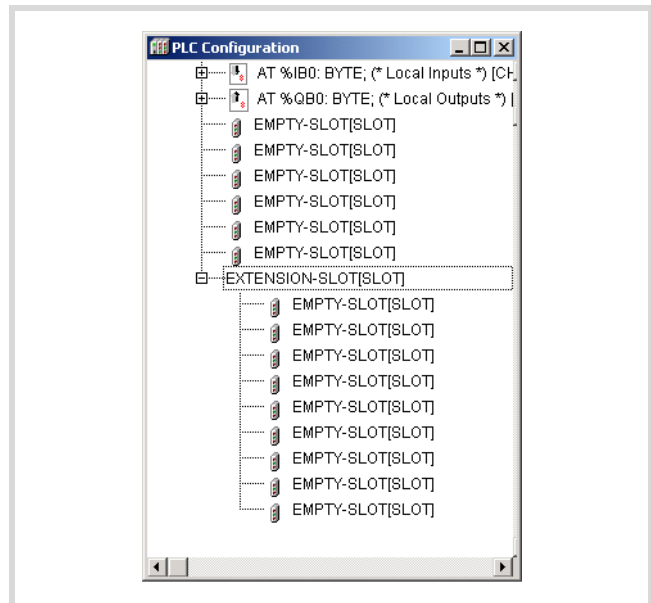


Figure 19: Maximal configuration XC100

**Dimensions**

**Signal modules**

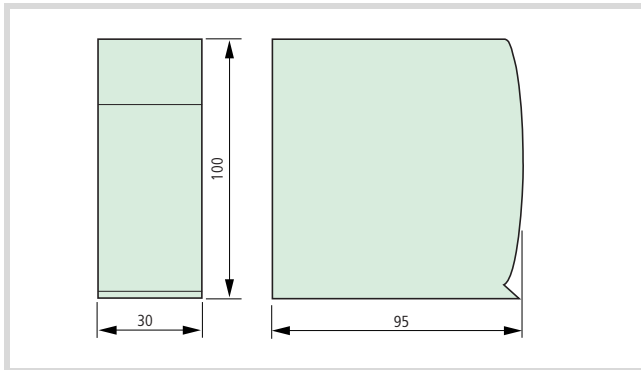


Figure 20: Signal modules

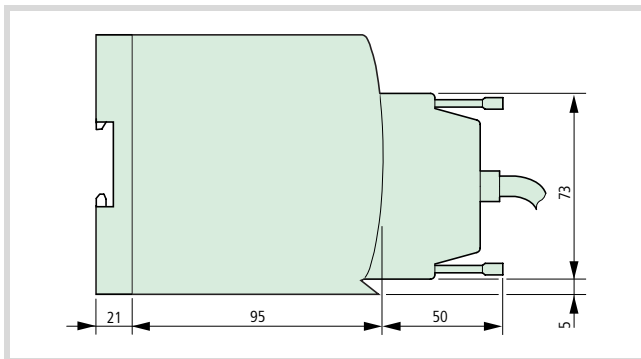


Figure 21: XIOC-32DI, XIOC-32DO with XIOC-TERM32 connector

**Backplane**

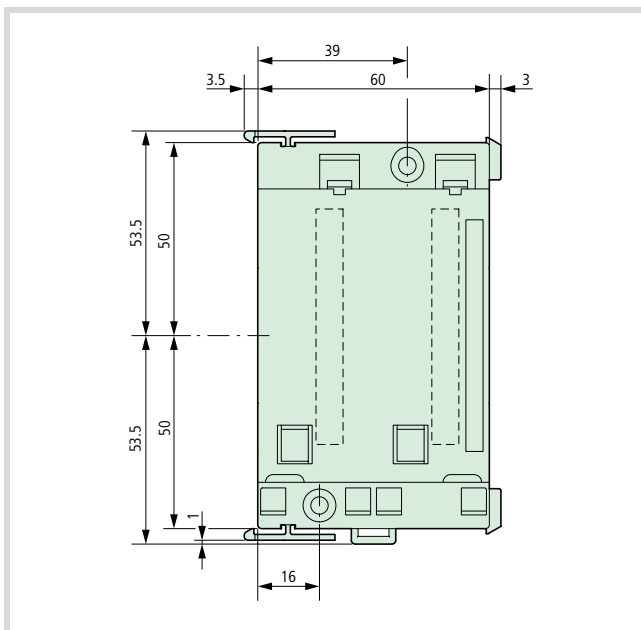


Figure 22: Dimension of the backplanes XIOC-BP-XC, XIOC-BP-2

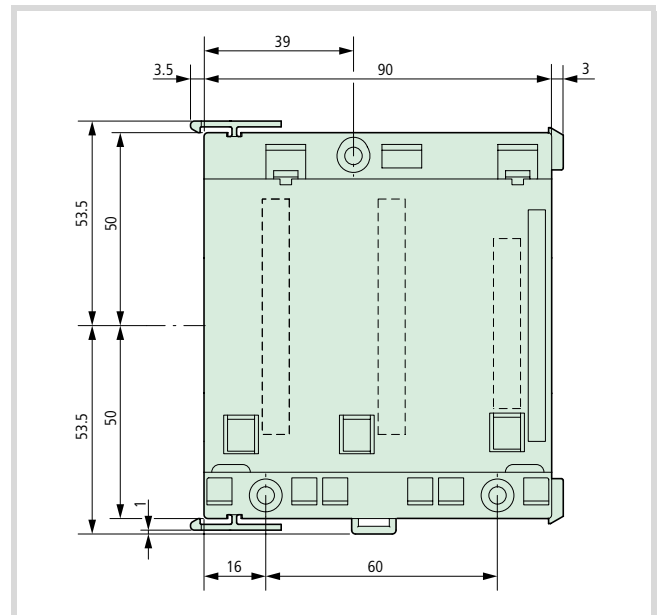


Figure 23: XIOC-BP-XC1, XIOC-BP-3, XIOC-BP-EXT backplane (rack)

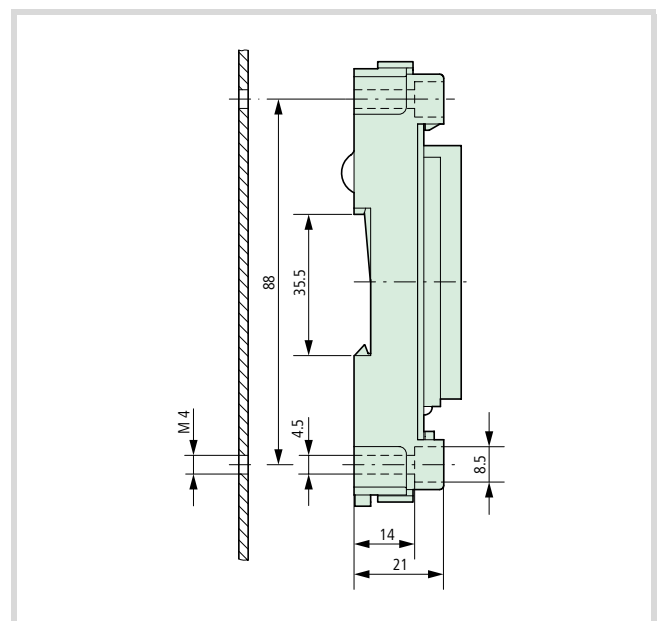


Figure 24: Dimensions of the backplanes



## 2 Temperature acquisition modules

### XIOC-4T-PT

#### Features

Pt100 (IEC751) and Pt1000 resistance thermometers can be connected to the XIOC-4T-PT temperature acquisition module.

Three temperature ranges are available, that can be selected via DIP switches.

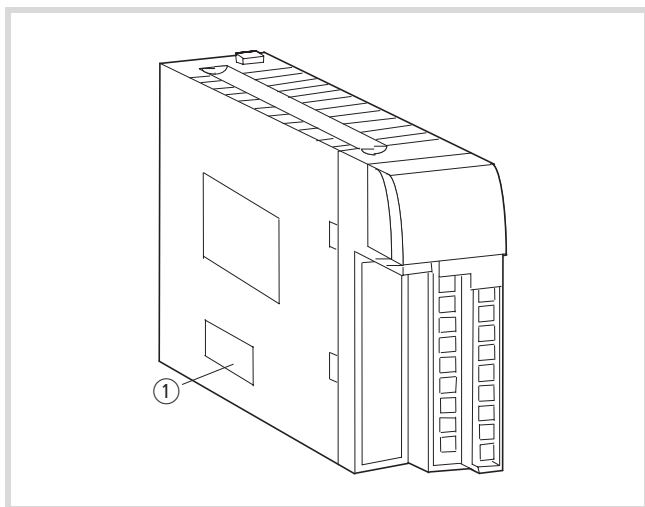


Figure 25: DIP switch position for temperature setting

① DIP switch

Table 3: Setting the temperature range

| Type of resistance thermometer | Temperature measurement range (°C) | Accuracy (°C) | DIP switch  |
|--------------------------------|------------------------------------|---------------|---|
| Pt100                          | -20 to + 40                        | ± 0.5         | <p>ON<br/>OFF ↑<br/>1 2 3 4 5 6 7 8</p> <p>1, 2, 5 = ON</p> |
| Pt100                          | -50 to + 400                       | ± 3           | <p>ON<br/>OFF ↑<br/>1 2 3 4 5 6 7 8</p> <p>3, 6 = ON</p>    |
| Pt1000                         | -50 to + 400                       | ± 6           | <p>ON<br/>OFF ↑<br/>1 2 3 4 5 6 7 8</p> <p>4, 7 = ON</p>    |

## Temperature acquisition modules

### Wiring

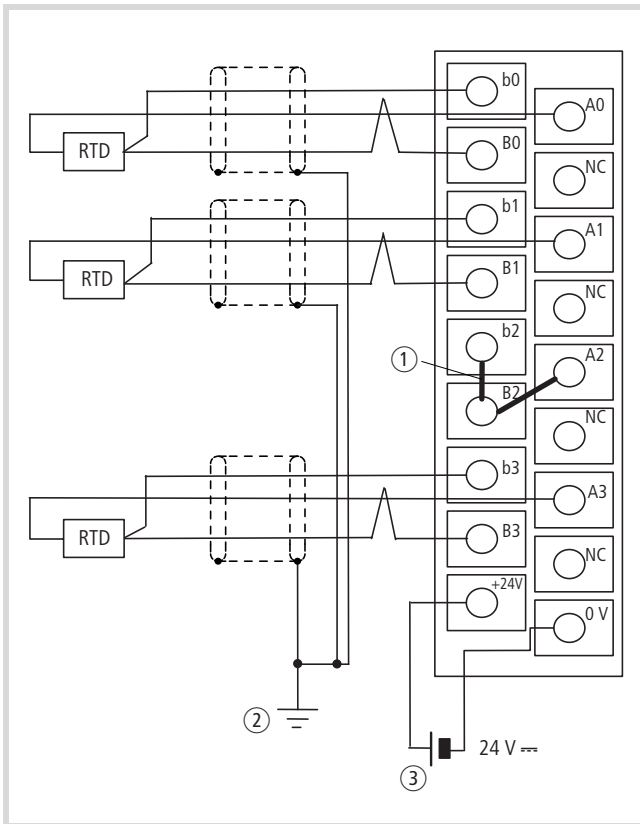


Figure 26: Wiring example

- ① Join the terminals of unused inputs (b2-B2-A2 in the diagram).  
Unused inputs have an indefinite status. The value is  $7FFF_{hex}$ .
- ② The shielding of the cable can be grounded at one or both ends, depending on the interference situation.
- ③ External supply voltage, 24 V DC

RTD = Resistance Temperature Detector

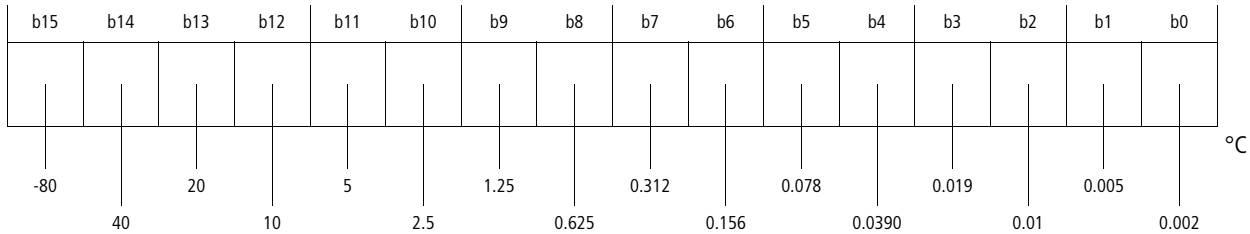
NC = Not connected/unused



Temperature acquisition modules

2. Range: -20 to +40 °C (Pt100)

The temperature is converted into a signed 15 bit value. The weighting of the bits can be seen in the following diagram.



Example 1

$$E000_{hex} = \begin{matrix} 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ E_{hex} & & 0_{hex} & & 0_{hex} & & 0_{hex} & & 0_{hex} & & & & & & \end{matrix}$$

If you enter these bit values in the table above, the result is the following value:

$$-80 + 40 + 20 = -20 \text{ °C}$$

Example 2

$$0600_{hex} = \begin{matrix} 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0_{hex} & & 6_{hex} & & 0_{hex} & & 0_{hex} & & 0_{hex} & & & & & & \end{matrix}$$

$$2.5 + 1.25 = 3.75 \text{ °C}$$

If the measured value for the temperature lies outside the range (< -25 °C or > 45 °C), then the data value is displayed as 7FFF<sub>hex</sub>.

The relationship between temperature and the measured value is shown by the following equation and the diagram.

$$\text{Temperature (°C)} = \frac{\text{Decimal value, e.g. } 256 \text{ (0100}_{hex})}{409,6} = 0.626 \text{ (°C)}$$

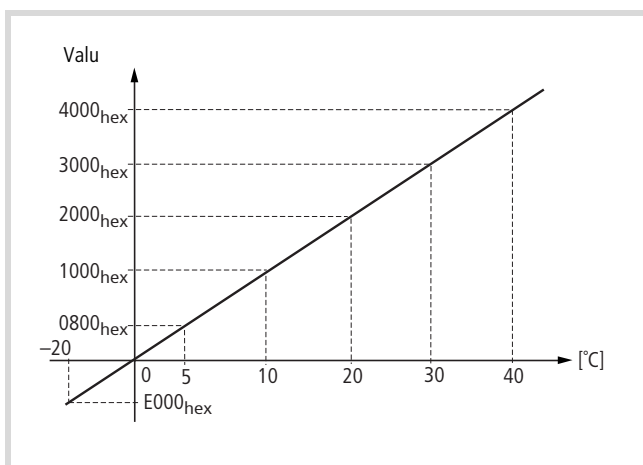


Figure 28: Temperature/measurement diagram

Conversion tables

Table 4: Conversion table for Pt100 (-20 to +40 °C)

| Temperature (°C) 1) | Decimal value | Hexadecimal value | Pt100 resistance (Ω) |
|---------------------|---------------|-------------------|----------------------|
| -25                 | 55296         | D800              | 90.19                |
| -20                 | 57344         | E000              | 92.16                |
| -15                 | 59392         | E800              | 94.12                |
| -10                 | 61440         | F000              | 96.09                |
| -5                  | 63488         | F800              | 98.04                |
| 0                   | 0             | 0000              | 100.00               |
| 5                   | 2048          | 0800              | 101.95               |
| 10                  | 4096          | 1000              | 103.90               |
| 15                  | 6144          | 1800              | 105.85               |
| 20                  | 8192          | 2000              | 107.79               |
| 25                  | 10240         | 2800              | 109.73               |
| 30                  | 12288         | 3000              | 111.67               |
| 35                  | 14336         | 3800              | 113.61               |
| 40                  | 16384         | 4000              | 115.54               |
| 45                  | 18432         | 4800              | 117.47               |

1) The technical data refer to the range from -20 to 40 °C.

Table 5: Conversion table for Pt100/Pt1000 (-50 to +400 °C)

| Temperature (°C) <sup>1)</sup> | Decimal value | Hexadecimal value | Pt100 resistance (Ω) <sup>2)</sup> |
|--------------------------------|---------------|-------------------|------------------------------------|
| -60                            | 63078         | F666              | 72.33                              |
| -55                            | 63283         | F733              | 78.32                              |
| -50                            | 63488         | F800              | 80.31                              |
| -45                            | 63693         | F8CC              | 82.29                              |
| -40                            | 63898         | F999              | 84.27                              |
| -35                            | 64102         | FA66              | 86.25                              |
| -30                            | 64307         | FB33              | 88.22                              |
| -25                            | 64512         | FC00              | 90.19                              |
| -20                            | 64717         | FCCC              | 92.16                              |
| -15                            | 64922         | FD99              | 94.12                              |
| -10                            | 65126         | FE66              | 96.09                              |
| -5                             | 65331         | FF33              | 98.04                              |
| 0                              | 0             | 0000              | 100.00                             |
| 5                              | 205           | 00CC              | 101.95                             |
| 10                             | 410           | 0199              | 103.90                             |
| 15                             | 614           | 0266              | 105.85                             |
| 20                             | 819           | 0333              | 107.79                             |
| 25                             | 1024          | 0400              | 109.73                             |
| 30                             | 1229          | 04CC              | 111.67                             |
| 35                             | 1434          | 0599              | 113.61                             |
| 40                             | 1638          | 0666              | 115.54                             |
| 45                             | 1843          | 0733              | 117.47                             |
| 50                             | 2048          | 0800              | 119.40                             |
| 55                             | 2253          | 08CC              | 121.32                             |
| 60                             | 2458          | 0999              | 123.24                             |
| 65                             | 2662          | 0A66              | 125.16                             |
| 70                             | 2867          | 0B33              | 127.07                             |
| 75                             | 3072          | 0C00              | 128.98                             |
| 80                             | 3277          | 0CCC              | 130.89                             |
| 85                             | 3482          | 0D99              | 132.80                             |
| 90                             | 3686          | 0E66              | 134.70                             |
| 95                             | 3891          | 0F33              | 136.60                             |
| 100                            | 4096          | 1000              | 138.50                             |

| Temperature (°C) <sup>1)</sup> | Decimal value | Hexadecimal value | Pt100 resistance (Ω) <sup>2)</sup> |
|--------------------------------|---------------|-------------------|------------------------------------|
| 110                            | 4506          | 1199              | 142.29                             |
| 120                            | 4915          | 1333              | 146.06                             |
| 130                            | 5325          | 14CC              | 149.82                             |
| 140                            | 5734          | 1666              | 153.58                             |
| 150                            | 6144          | 1800              | 157.31                             |
| 160                            | 6554          | 1999              | 161.04                             |
| 170                            | 6963          | 1B33              | 164.76                             |
| 180                            | 7373          | 1CCC              | 168.46                             |
| 190                            | 7782          | 1E66              | 172.16                             |
| 200                            | 8192          | 2000              | 175.84                             |
| 210                            | 8602          | 2199              | 179.51                             |
| 220                            | 9011          | 2333              | 183.17                             |
| 230                            | 9421          | 24CC              | 186.82                             |
| 240                            | 9830          | 2666              | 190.45                             |
| 250                            | 10240         | 2800              | 194.07                             |
| 260                            | 10650         | 2999              | 197.69                             |
| 270                            | 11059         | 2B33              | 201.29                             |
| 280                            | 11469         | 2CCC              | 204.88                             |
| 290                            | 11878         | 2E66              | 208.45                             |
| 300                            | 12288         | 3000              | 212.02                             |
| 310                            | 12698         | 3199              | 215.57                             |
| 320                            | 13107         | 3333              | 219.12                             |
| 330                            | 13517         | 34CC              | 222.65                             |
| 340                            | 13926         | 3666              | 226.17                             |
| 350                            | 14336         | 3800              | 229.67                             |
| 360                            | 14746         | 3999              | 233.17                             |
| 370                            | 15155         | 3B33              | 236.65                             |
| 380                            | 15565         | 3CCC              | 240.13                             |
| 390                            | 15974         | 3E66              | 243.59                             |
| 400                            | 16384         | 4000              | 247.04                             |
| 410                            | 16794         | 4199              | 250.48                             |

1) The technical data refer to the range from -50 to +400 °C for the Pt100

2) Resistance value Pt1000 = 10 × resistance value Pt100

## Temperature acquisition modules

### Fault-finding

The following list describes some types of fault and advice on removing them.

#### Faults that affect a single channel

If the measurement is unstable, does not meet the specified accuracy, or indicates the value 7FFF<sub>hex</sub>:

- ▶ check that the wiring is correct for the channel that shows the error
- ▶ check whether the cable from the sensor to the module runs close to mains power supply cables
- ▶ check that the terminal connection is firmly seated
- ▶ check that the data for the Pt100/1000 that is used conform to IEC751
- ▶ check the resistance of the external wiring (< 400 Ω)
- ▶ check that the temperature to be measured lies within the range of the XIOC-4T-PT.

#### Faults that affect more than one channel

All channels indicate the value 7FFF<sub>hex</sub>:

- ▶ check that the external supply voltage is properly connected
- ▶ check whether the load capability of the external supply is adequate ( $\geq 1$  A).

**XIOC-4AI-T**

**Characteristics**

The temperature acquisition module XIOC-4AI-T is used for the switching on of thermal elements and for voltage measurement.

For temperature measurement the connection of thermal elements of type B, E, J, K, N, R, S, T is possible. The display is carried out in in 1/10 °C or 1/10 °F. The module recognises when the temperature falls below or is above the range and also recognises a wire break to the temperature sensor. The module has an integrated cold position compensation and interference voltage suppression.

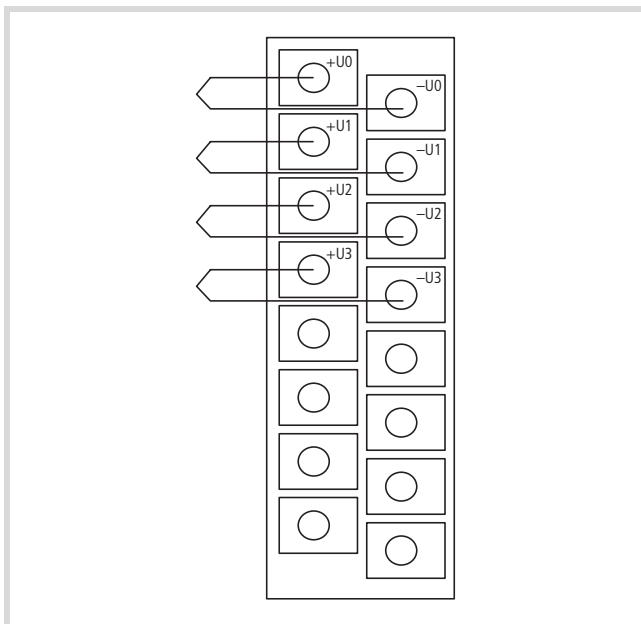


Figure 29: Connection of module

→ Terminals not identified may not be used!

**Configuration and Parameterisation**

The configuration and parameterisation takes place, as usual in the device configuration of the programming system. After selecting the module an integer value is available for every channel that can be used in the user programme. A diagnostic word which contains the display of measurement range errors is available for the assessment of diagnostic information.

**Defining Measurement Parameters**

For each measurement channel the following parameters can be defined:

- Thermal element type
- Scaling
- Channel active/inactive
- Interference voltage suppression 50/60 Hz.

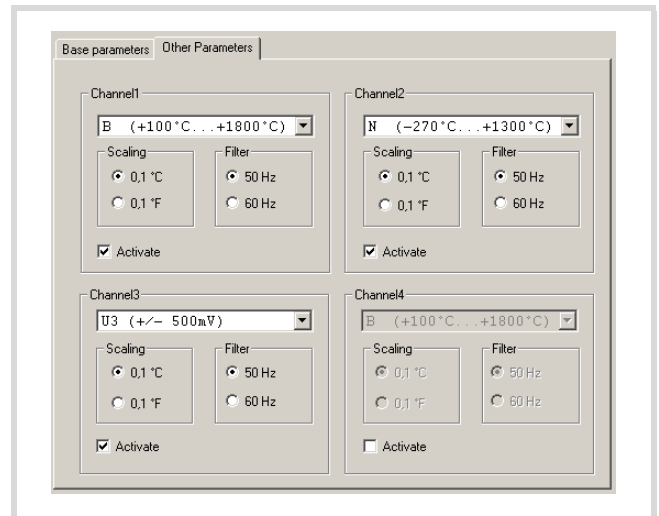


Figure 30: Parameter dialogue

→ In the operation mode "Voltage" the parameter "Scaling" has no relevance.

**Measurement range**

- Thermal elements

Depending on the thermal element used various temperature ranges can be measured. The measured value display is carried out as signed integer decimal value in 1/10 Grad C or 1/10 Grad F resolution.

The decimal value 545 corresponds to 54.5 Grad at 1/10 °C setting.

Tabelle 6: Thermal elements with temperature ranges

| Element | Temperature range |        |     |         |          |
|---------|-------------------|--------|-----|---------|----------|
| B       | +100°C            | +212°F | ... | +1800°C | + 3272°F |
| E       | -270°C            | -454°F | ... | +1000°C | +1832°F  |
| J       | -210°C            | -346°F | ... | +1200°C | +2192°F  |
| K       | -270°C            | -454°F | ... | +1370°C | +2498°F  |
| N       | -270°C            | -454°F | ... | +1300°C | +2372°F  |
| R       | -50°C             | -58°F  | ... | +1760°C | +3200°F  |
| S       | -50°C             | -58°F  | ... | +1540°C | +2804°F  |
| T       | -200°C            | -328°F | ... | +400°C  | +752°F   |

- Voltage measurement

When a voltage range (U1 = ±50 mV, U2 = ±100 mV, U3 = ±500 mV ), U4 = ±1000 mV) is selected the measurement value corresponds to the signed integer value (16 Bit). The parameterisation of the unit °C/°F and the measurement of the cold position remains without relevance in this measurement.

**Temperature acquisition modules**

Table 7: Transformation of the voltage measurement (16 Bit signed Integer)

| Measurement value [mV] with voltage range ... |          |          |           | Transformed value |        |
|---|----------|----------|-----------|-------------------|--------|
| ±50 mV  | ±100 mV  | ±500 mV  | ±1000 mV  | dec.              | hex.   |
| -50.000                                       | -100.000 | -500.000 | -1000.000 | -32768            | 0x8000 |
| -49.998                                       | -99.997  | -499.985 | -999.969  | -32767            | 0x8001 |
| -0.002  | -0.003   | -0.015   | -0.031    | -1                | 0xFFFF |
| 0.000   | 0.000    | 0.000    | 0.000     | 0                 | 0x0000 |
| 0.002   | 0.003    | 0.015    | 0.031     | 1                 | 0x0001 |
| 49.998  | 99.997   | 499.985  | 999.969   | 32766             | 0x7FFE |
| 50.000  | 100.000  | 500.000  | 1000.000  | 32767             | 0x7FFF |

Table 8: Resolution for voltage measurement

| Resolution[µV] with voltage range... |          |           |           |
|--------------------------------------|----------|-----------|-----------|
| ±50 mV                               | ±100 mV  | ±500 mV   | ±1000 mV  |
| 1.526 µV                             | 3.052 µV | 15.259 µV | 30.519 µV |

**Diagnosis**

The status word contains the diagnosis information for all 4 channels.

For every channel exceeding and shortfall of the measurement value is displayed as well as a wire break. With an error the corresponding ERROR-LED on the module is also lit.

|           |        |        |        |           |        |       |       |           |       |       |       |           |       |       |       |
|-----------|--------|--------|--------|-----------|--------|-------|-------|-----------|-------|-------|-------|-----------|-------|-------|-------|
| Bit 15    | Bit 14 | Bit 13 | Bit 12 | Bit 11    | Bit 10 | Bit 9 | Bit 8 | Bit 7     | Bit 6 | Bit 5 | Bit 4 | Bit 3     | Bit 2 | Bit 1 | Bit 0 |
| Channel 3 |        |        |        | Channel 2 |        |       |       | Channel 1 |       |       |       | Channel 0 |       |       |       |
| D33       | D32    | D31    | D30    | D23       | D22    | D21   | D20   | D13       | D12   | D11   | D10   | D03       | D02   | D01   | D00   |

Table 9: Allocation of diagnosis information

|     |   |
|-----|---|
| Dx0 | Range shortfall: Measurement value < Measurement start value - (1 % ±0.5 %) × Measurement range)<br>The following applies for elements with a temperature range from -270 °C: Measurement value < Measurement start value |
| Dx1 | Range exceeded<br>(Measurement value > Measurement range end value + (1% ± 0.5%) × Measurement range)   |
| Dx2 | Wire break (only with temperature measurement)  |
| Dx3 | Reserved  |

x = Channel 0 ... 3

### 3 Counter modules XIOC-...CNT100kHz

#### Assembly

The counter module XIOC-1CNT-100kHz provides one channel, the module XIOC-2CNT-100kHz provides two channels, each with one input for pulse frequencies up to 100 kHz, a reference input and two digital outputs.

You can connect single-phase or 2-phase incremental encoders (with/without quadruple evaluation for the 2-phase). The type of counter (linear or ring counter) is set with the aid of DIP switches.

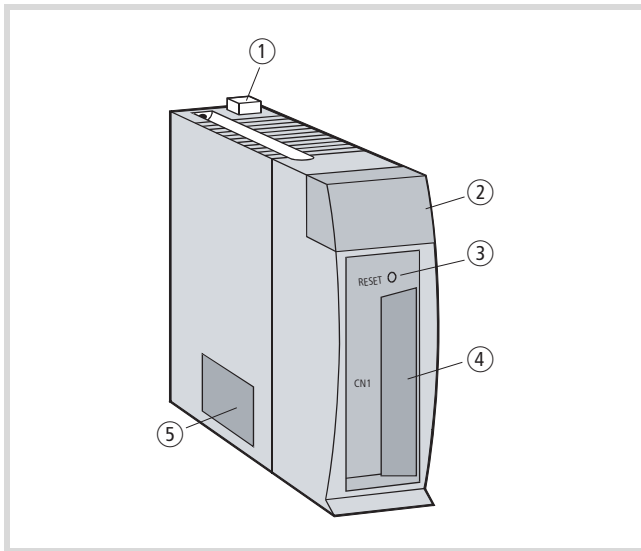


Figure 31: Assembly of the counter module

| No. | Designation                    | Comments   |
|-----|--------------------------------|--|
| ①   | Catch                          |  |
| ②   | LED display                    | → page 29  |
| ③   | RESET button                   | Sets the parameters to "0". → page 29  |
| ④   | Connection for pulse generator | 30-pole connection (15 pins × 2) for the XIOC-TERM30-CNT4 connector. → page 32, 33 |
| ⑤   | Mode switch (DIP)              | This switch is used to set the operating mode. → page 30                           |

#### RESET button on the module

You operate the RESET button (by using a pointed object) to reset the parameters to their initial (default) setting. When the button is pushed, the ERROR-LED in the LED display lights up red.

#### LED display

The LEDs have the following designations:

|                  |     |     |    |                  |     |     |    |
|------------------|-----|-----|----|------------------|-----|-----|----|
| 1 A              | 1 B | 1 M | PW | 1 A              | 1 B | 1 M | PW |
| 2A               | 2B  | 2M  | ER |                  |     |     | ER |
| 0                | 1   | 2   | 3  | 0                | 1   |     |    |
| XIOC-2CNT-100KHZ |     |     |    | XIOC-1CNT-100KHZ |     |     |    |

| LED        | Meaning  |
|------------|--|
| 1A, 1B     | Encoder signal, phase A, B; channel 1  |
| 2A, 2B     | Encoder signal, phase A, B; channel 2  |
| 1M, 2M     | Encoder reference signal (marker signal); channel 1, 2<br>The LED lights up when a voltage is present at the input, regardless of whether the signals are inverted or not.   |
| PW         | Indicates the supply voltage for the module:<br>on: OK<br>blinking: <ul style="list-style-type: none"> <li>After incorrect parameter entry</li> <li>With the counter type "Ring counter", the LED blinks if voltage has been applied to the PLC. After you have set the preset value (WRITEPRESETVALUE) and the comparison value (WRITESETTINGVALUE2), the LED lights up continuously.</li> </ul> OFF Hardware error |
| ER         | Error<br>on: <ul style="list-style-type: none"> <li>After operating the RESET button on the module</li> <li>Hardware error</li> </ul>  |
| 0, 1, 2, 3 | Outputs Y  |

#### Programming

Programming was implemented using the following function blocks:

- CounterControl
- ReadCounter
- WriteCounter
- CounterControl
- XIOC\_IncEncoder.

A detailed description can be found in the "Function blocks for easySoft-CoDeSys" manual. This manual is available as a PDF file and can be downloaded at <http://www.moeller.net/support>. Use "h1456d.pdf" as a search keyword to find it as quickly as possible.

The function blocks are contained in the "Counter.lib" (XC100) and "XC200\_Counter.lib" library files.

**Mode (operating mode) switch**

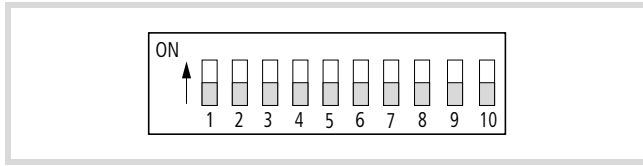


Figure 32: Mode (operating mode) switch, settings as delivered

→ In order to set the DIP-switches you will first have to take out the module. But switch off the supply voltage first!

|                              | Switch | Position | Function  | Chan<br>nel |
|------------------------------|--------|----------|---|-------------|
| <b>Type of counter input</b> |        |          |   |             |
| Mode 1                       | 1      | OFF      | 2-phase counter,<br>max. 100 kHz                      | 1 + 2       |
|                              | 2      | OFF      |   |             |
| Mode 2                       | 1      | ON       | 1-phase counter,<br>(pulse-change)                    | 1 + 2       |
|                              | 2      | OFF      |   |             |
| Mode 3                       | 1      | OFF      | 1-phase counter,<br>(polarity reversal)               | 1 + 2       |
|                              | 2      | ON       |   |             |
| Mode 4                       | 1      | ON       | 2-phase counter with<br>4x evaluation, max.<br>25 kHz | 1 + 2       |
|                              | 2      | ON       |   |             |

| <b>Polarity of the reference input (marker input)</b> |  |     |   |     |
|---|--|-----|---|-----|
| 3/4   |  | OFF | A voltage on the input<br>produces a "0" signal | 1/2 |
|   |  | ON  | A voltage on the input<br>produces a "1" signal |     |

| <b>CPU-stop r counter</b> |  |     |                            |     |
|---------------------------|--|-----|----------------------------|-----|
| 5/6                       |  | OFF | CPU-STOP →<br>Counter STOP | 1/2 |
|                           |  | ON  | CPU-STOP →<br>Counter RUN  |     |

| <b>Linear/ring counter</b> |  |     |                |     |
|----------------------------|--|-----|----------------|-----|
| 7/8                        |  | OFF | Linear counter | 1/2 |
|                            |  | ON  | Ring counter   |     |
| 9/10                       |  | OFF | not used       | —   |

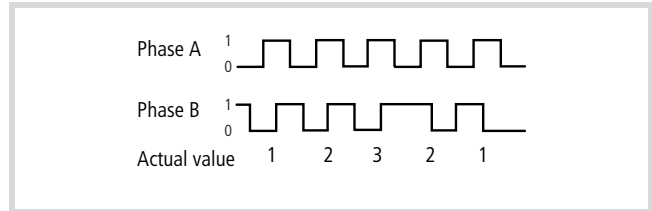


Figure 33: Mode 1 (2-phase)

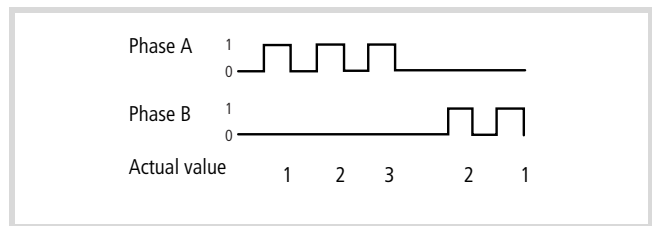


Figure 34: Mode 2 (1-phase)

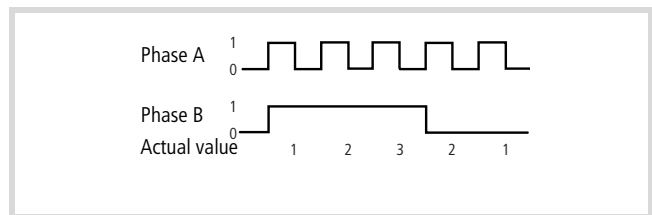


Figure 35: Mode 3 (1-phase)

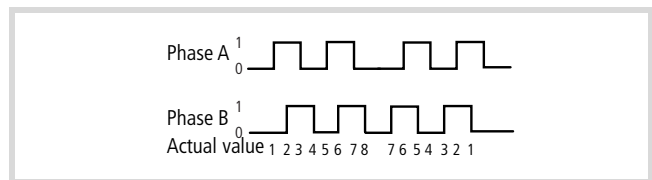


Figure 36: Mode 4 (2-phase, with quadruple evaluation)

### Connecting an incremental encoder to the counter input

The counter module has an input circuit that permits the connection of various types of incremental encoder. An encoder with a differential output (+/- 5 V DC) or an open collector output (12 to 24 V DC) can be connected. The following examples illustrate the various connection options.

### Two incremental encoders

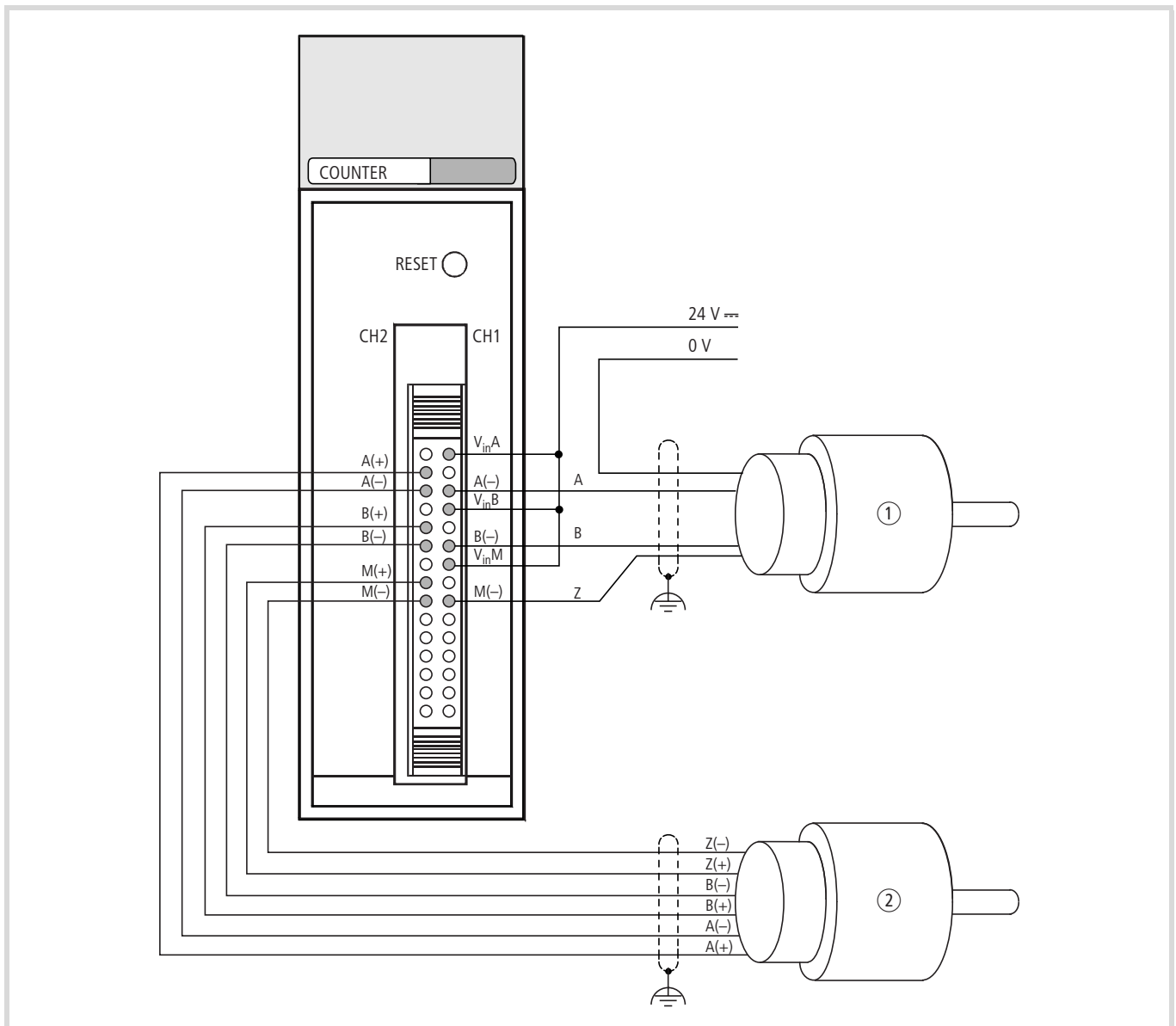


Figure 37: Connection for 2 incremental encoders (example)

- ① Encoder with **12 to 24 V DC** open collector outputs
- ② Encoder with **+/- 5 V DC** differential outputs

| Terminal arrangement | No. CH2          | No. CH1           | Meaning of the signals          |                   |   |
|----------------------|------------------|-------------------|---------------------------------|-------------------|---|
|                      | <b>XIOC-2CNT</b> |                   | <b>XIOC-2CNT/<br/>XIOC-1CNT</b> |                   |   |
|                      | 16               | V <sub>IN</sub> A | 1                               | V <sub>IN</sub> A | Phase A<br>If voltage input is used, connect to 12 to 24 V DC supply.<br>If the differential input is used: connect to the positive polarity.<br>If the voltage input is used, connect to the open-collector signal.<br>If the differential input is used, connect to the negative polarity.            |
|                      | 17               | A (+)             | 2                               | A (+)             |   |
|                      | 18               | A (-)             | 3                               | A (-)             |   |
|                      | 19               | V <sub>IN</sub> B | 4                               | V <sub>IN</sub> B | Phase B<br>If voltage input is used, connect to 12 to 24 V DC supply.<br>If the differential input is used: connect to the positive polarity.<br>If the voltage input is used, connect to the open-collector signal.<br>If the differential input is used, connect to the negative polarity.            |
|                      | 20               | B (+)             | 5                               | B (+)             |   |
|                      | 21               | B (-)             | 6                               | B (-)             |   |
|                      | 22               | V <sub>IN</sub> M | 7                               | V <sub>IN</sub> M | Marker (reference)<br>If voltage input is used, connect to 12 to 24 V DC supply.<br>If the differential input is used: connect to the positive polarity.<br>If the voltage input is used, connect to the open-collector signal.<br>If the differential input is used, connect to the negative polarity. |
|                      | 23               | M (+)             | 8                               | M (+)             |   |
|                      | 24               | M (-)             | 9                               | M (-)             |   |
|                      | 25 to 27         | not used          | 10 to 12                        | not used          | Do not connect anything to these terminals.   |
|                      | 28               | Y2                | 13                              | Y0                | Output<br>Comparator output<br><br>(-) reference potential for the Y outputs. The following applies for XIOC-2CNT: reference potential 1 and 2 are independent of each other.   |
|                      | 29               | Y3                | 14                              | Y1                |   |
|                      | 30               | Com2              | 15                              | Com1              |   |

Note: The pin numbers defined for the XIOC-1CNT-100 kHz and XIOC-2CNT-100 kHz do not match those given by the connector manufacturer.

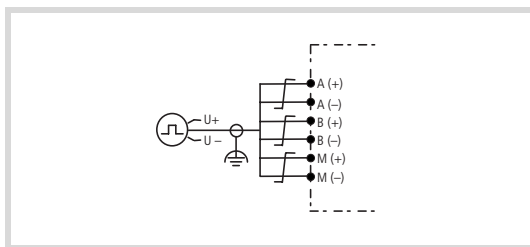


Figure 38: Encoder with differential outputs

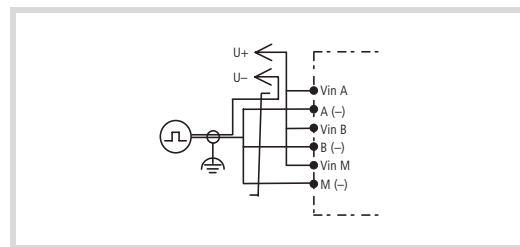


Figure 39: Encoder with voltage outputs

## Cable with attached connector for the counter module

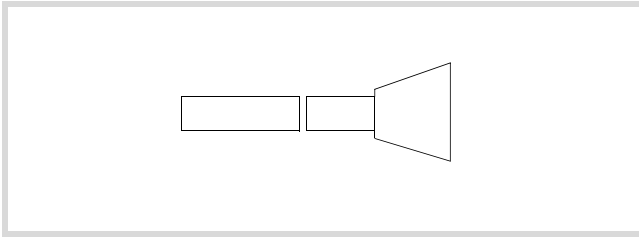


Figure 40: Cable with connector (XIOC-TERM30-CNT4)

| No. | Channel 2 | Colour       | No. | Channel 1 | Colour      | Meaning of the signals                            |
|-----|-----------|--------------|-----|-----------|-------------|---|
| 16  | VIN A     | red/white    | 1   | VIN A     | black       | 12 to 24 V DC (open-collector)                    |
| 17  | A (+)     | orange/black | 2   | A (+)     | brown       | (+) differential output                           |
| 18  | A (-)     | green/white  | 3   | A (-)     | red         | (-) differential-output (open-collector)          |
| 19  | VIN B     | blue/white   | 4   | VIN B     | orange      | Phase B 12 to 24 V DC (open-collector)            |
| 20  | B (+)     | yellow/black | 5   | B (+)     | yellow      | (+) differential output                           |
| 21  | B (-)     | violet/white | 6   | B (-)     | green       | (-) differential-output (open-collector)          |
| 22  | VIN M     | grey/black   | 7   | VIN M     | blue        | reference (marker) 12 to 24 V DC (open-collector) |
| 23  | M (+)     | pink/black   | 8   | M (+)     | violet      | (+) differential output                           |
| 24  | M (-)     | blue/black   | 9   | M (-)     | grey        | (-) differential-output (open-collector)          |
| 25  | -         | green/black  | 10  | -         | white       | -   |
| 26  | -         | pink/red     | 11  | -         | pink        |   |
| 27  | -         | pink/blue    | 12  | -         | blue        |   |
| 28  | Y2        | pink/green   | 13  | Y2        | light green | Output open-collector                             |
| 29  | Y3        | red/black    | 14  | Y3        | black/white | open-collector                                    |
| 30  | Com2      | orange/white | 15  | Com2      | brown/white | 0 V (open-collector)                              |

**Incremental encoder with differential output**

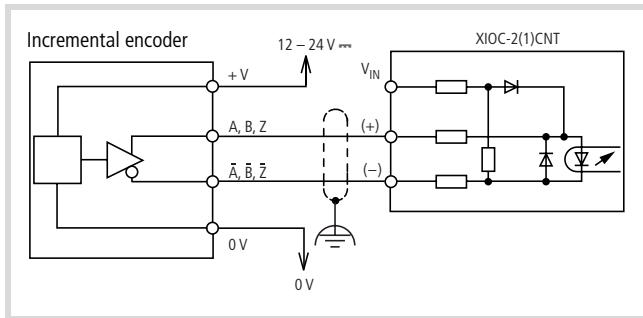


Figure 41: Connection for an incremental encoder with a differential output (example)

**Incremental encoder with NPN transistor output (open-collector)**

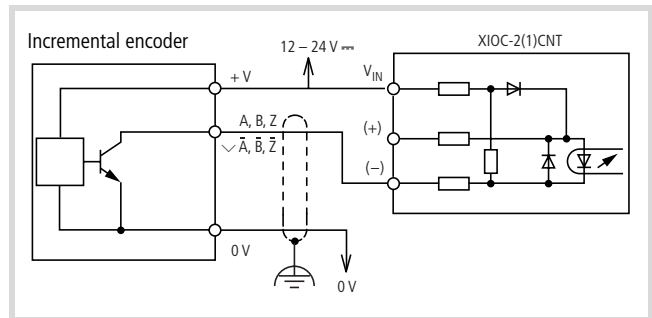


Figure 43: Connection for an incremental encoder with an open-collector NPN transistor output (example)

**Incremental encoder with NPN transistor output**

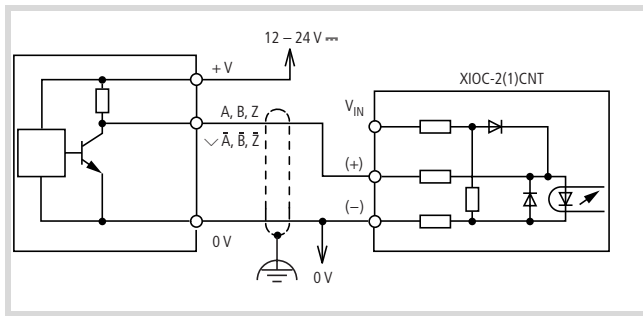


Figure 42: Connection for an incremental encoder with an NPN transistor output (example)

**Incremental encoder with PNP transistor output (open-collector)**

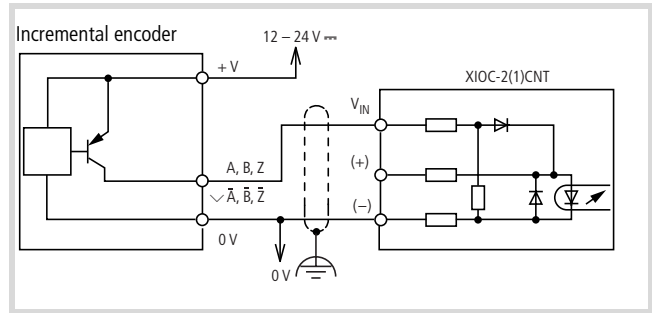


Figure 44: Connection for an incremental encoder with an open-collector PNP transistor output (example)

**Connecting devices to the Y outputs**

The counter module has 2 open-collector transistor outputs per channel. The diagram shows how to connect it to another device.



**Caution!**

Wire in an 0.5 A fuse, as shown in the diagram, to protect the internal circuitry

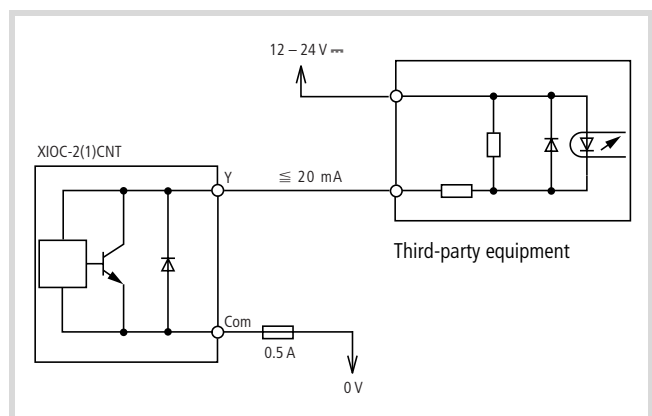


Figure 45: Connecting third-party equipment to the counter module

## Function summary

A counter channel has the function of either a linear counter or a ring counter, depending on the setting of the operating mode switch on the module.

## Linear counter

The counting range of the linear counter starts at the value 0 and ends at the value 4294967295 (FFFFFFFF<sub>hex</sub>). If the counter is enabled, it starts at 0 and counts all incoming pulses up or down – depending on the count direction. If the count reaches the end value it starts again at 0.

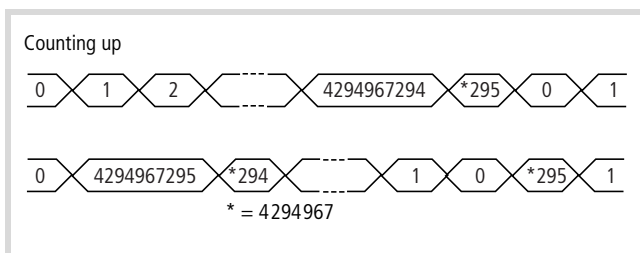


Figure 46: Counting range of the linear counter

## Parameterizing the comparison value, setting module outputs

You can set a comparison value, so that an action can be performed when a defined count value has been reached. It is continuously compared with the actual value. If they are identical, two types of output can be activated. The outputs are led out directly from the module, for a fast response.

The "Latch" output (=), Equal flag:

The "Latch" output is set when equality is achieved. It is indicated by the "=" symbol. The Equal flag serves as the internal marker for the "Latch" output. The output and flag remain set until you reset them.

The "Level" output (>):

The "Level" output is set to "1" if the actual value is larger than the comparison value. If the actual value falls below the comparison value, then it is reset to "0". The "Level" output is indicated by the ">" symbol.

You can set the comparison value at the "CounterEnable" input, either at the start or during operation. This does not depend on the counter being enabled.

Example:

- Count direction: up
- Comparison value: 4294967200

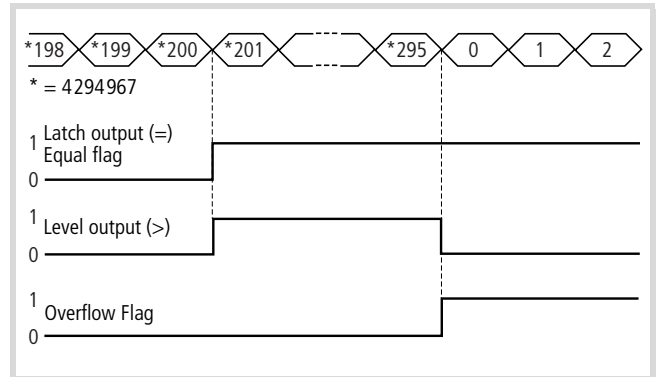


Figure 47: Setting module outputs

## Overflow flag

The Overflow flag is set when the actual value changes from FFFFFFFF<sub>hex</sub> to 0. You can reset it by using the CLEAROVERFLOW command.

## Change actual value

You can change the actual value during counting. This does not depend on the counter being enabled.

## Use of the reference input

Incremental encoders send a reference marker signal once per turn. This can be used to overwrite the actual value by a preset value that was defined as part of the parameter settings. In order to be able to process the reference signal, the reference input must be enabled.

**Example of a linear counter, with the functions:**

- interrogate comparison value and reference signal
- reset outputs

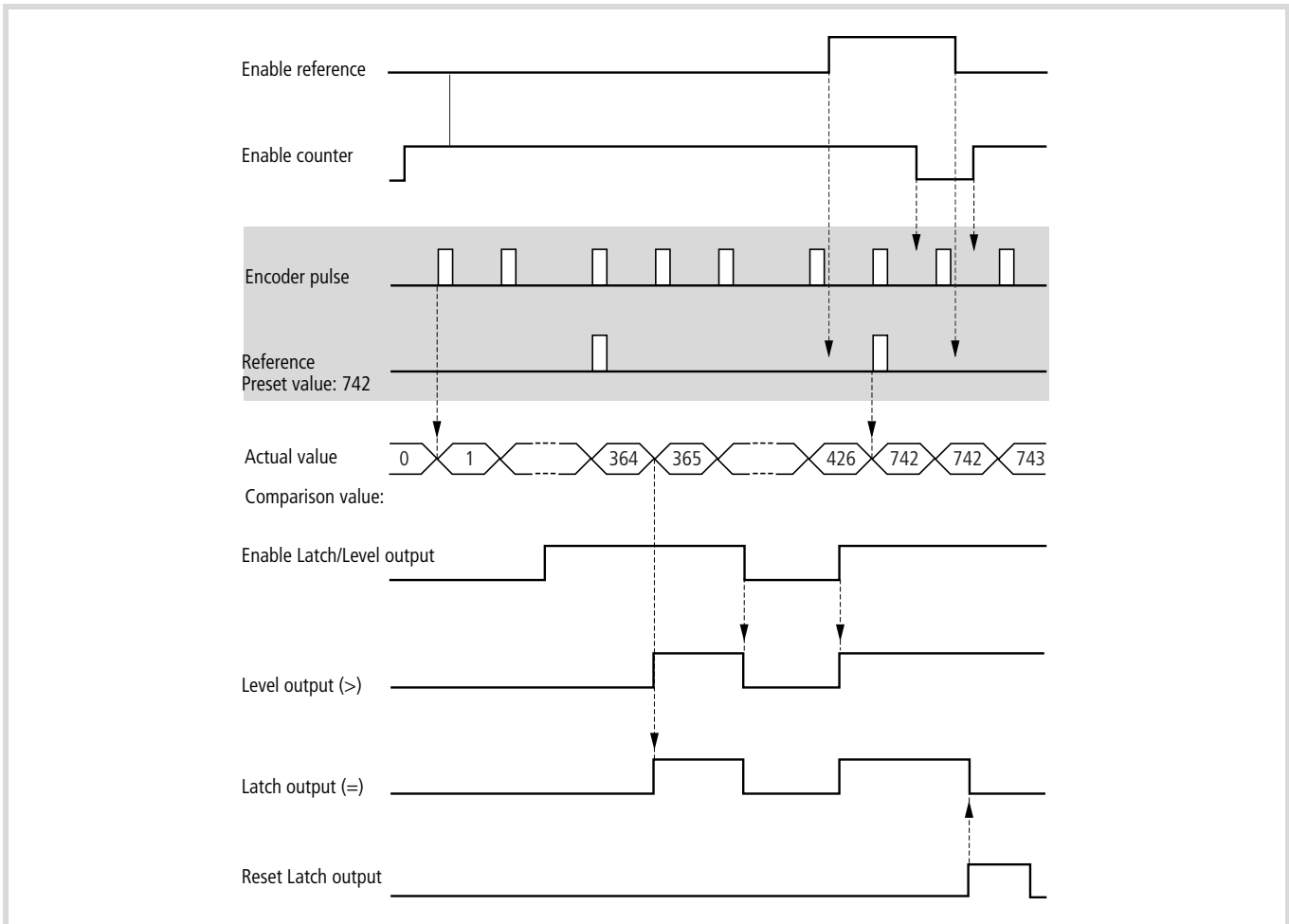


Figure 48: Example of a linear counter, with the functions "interrogate comparison value and reference signal" and "reset outputs"

**Ring counter**

The counting range is defined by the start and end values, whereby the start value must be lower than the end value.

As soon as the counter has been enabled, the start value is set and all incoming pulses will be counted. The following actual values will be shown, depending on the count direction (up or down).

Example:

- Start value = 10
- End value = 248

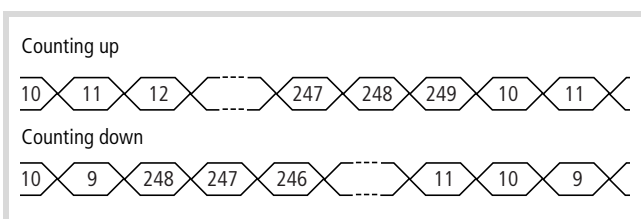


Figure 49: Counting range of the ring counter

An up counter counts up to the end value + 1, and then restarts from the start value. For a down counter, the next value is the start value - 1, carrying on to the end value.

As a rule: minimum start value = 0; maximum end value = FFFFFFFF<sub>hex</sub>.

**Parameterizing the comparison value, setting module outputs**

You can set a comparison value, so that an action can be performed when a defined count value has been reached. The comparison value must lie between the parameter settings for start value and end value. It is continuously compared with the actual value. When equality is achieved, a "Latch" output (=) can be set. This output is led out directly from the module, for a fast response. The Equal flag serves as the internal marker for the "Latch" output. The output and flag remain set until you reset them.

You can set the comparison value either at the start or during operation. This does not depend on the counter being enabled at the "CounterEnable" input.

Example:

- Count direction: up
- Parameters: start value: 0, end value: 294, comparison value: 200

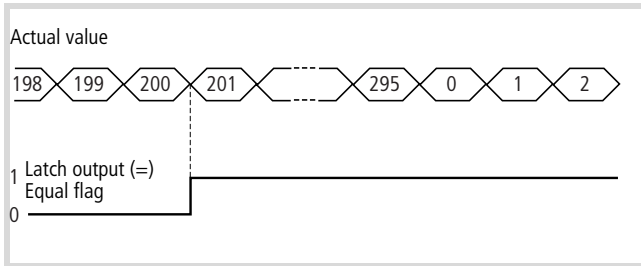


Figure 50: Set module output (Latch)

**Change actual value**

You can change the actual value during counting. This does not depend on the counter being enabled.

Requirement: start value ≤ actual value ≤ end value.

**Example of a ring counter, with the functions:**

- interrogate comparison value and reference signal
- reset outputs
- Set actual value

→ figure 51

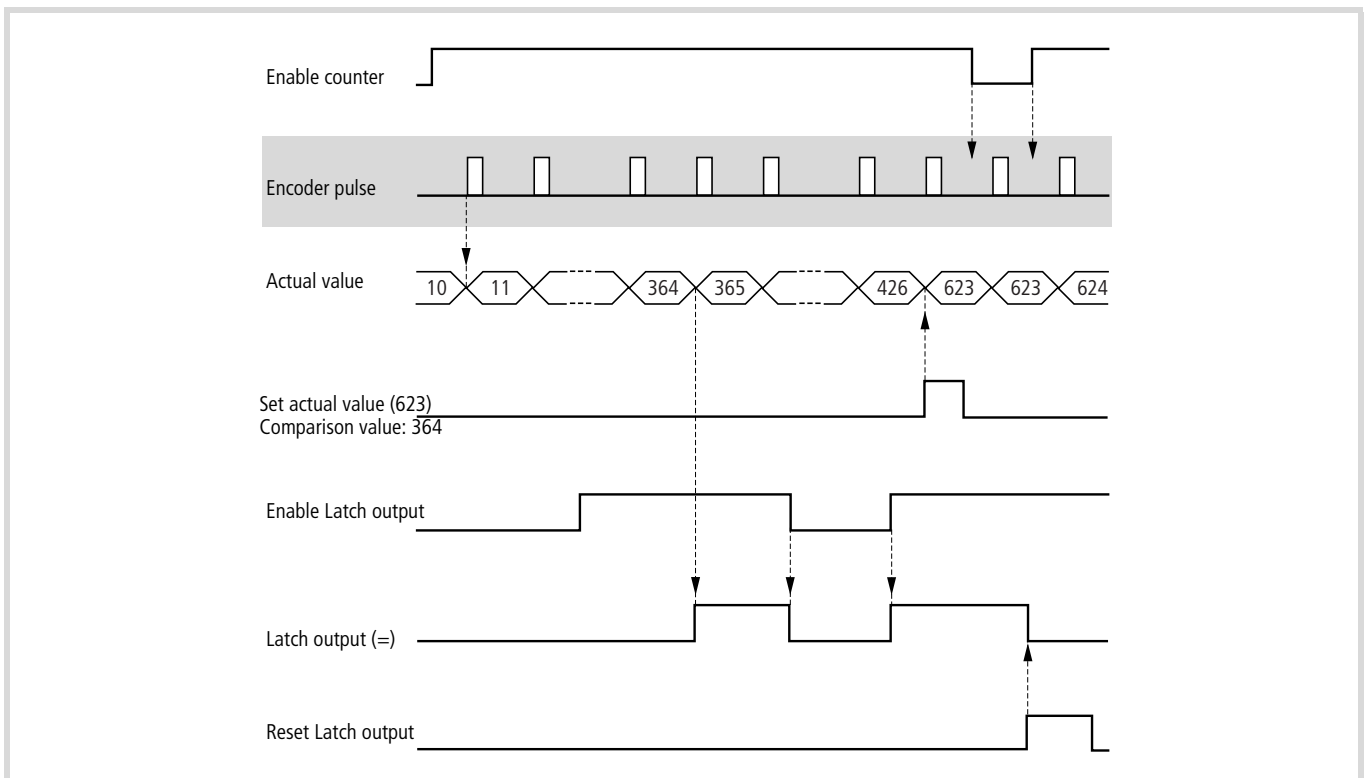


Figure 51: Example of a linear counter, with the functions "interrogate comparison value and reference signal" and "reset outputs"

**Additional functions for linear and ring counters**

Regardless of the type of counter input (mode 1 to 4), you can set the counter type (linear or ring counter) for each channel on the operating mode switch of the module → page 30. You can also assign other functions to the counter type, making the settings via the switch:

**Counter RUN/STOP when CPU has STOP state**

Counter RUN: If the CPU is in the STOP state, the encoder pulses continue to be counted.

Counter STOP: If the CPU is in the STOP state, no pulses are counted

**Polarity of the reference input**

This function is only activated with a linear counter.

- Switch OFF: voltage at the input produces a "0" signal.
- Switch ON: voltage at the input produces a "1" signal.

**Configure counter features**

Table 10: Configuration options

|   | Feature                         | Linear counter                                      | Ring counter |
|---|---------------------------------|---|--------------|
| <b>Interrogation option for the counter</b> | Start value                     | 0   | any          |
|   | End value                       | FFFFFFF <sub>hex</sub>                              | any          |
|   | Overflow Flag                   | "1" if actual value changes from FFFFFFFF → 0       | 0            |
|   | Underflow Flag                  | "1" if actual value changes from 0 → FFFFFFFF       | 0            |
|   | Clear Overflow flag             | Set Overflow flag "0"                               | –            |
|   | Clear Underflow flag            | Set Underflow flag "0"                              | –            |
|   | Enable counter                  | TRUE at input CounternEnable                        |              |
|   | Inhibit counter                 | FALSE at input CounternEnable                       |              |
| <b>Comparison value</b>                     | Output (=)/ Equal flag          | TRUE if actual value = comparison value → figure 52 |              |
|   | Output (>)                      | TRUE if actual value > comparison value → figure 53 | –            |
|   | Output (=) / clear Equal flag   | Set Output (=) and Equal flag "0"                   |              |
|   | Output (=) enable/inhibit       | Input CompareOutputnEnable                          |              |
| <b>Reference input</b>                      | Reference input = 1             | Preset value overwrites actual value → figure 53    | –            |
|   | Reference input: enable/inhibit | Input "ReferenceMarkernEnable"                      | –            |
|   | Invert reference input signal   | By DIP-switch                                       | –            |

The diagram, shows the state of the Latch output (=) for linear and ring counters, depending on the count sequence:

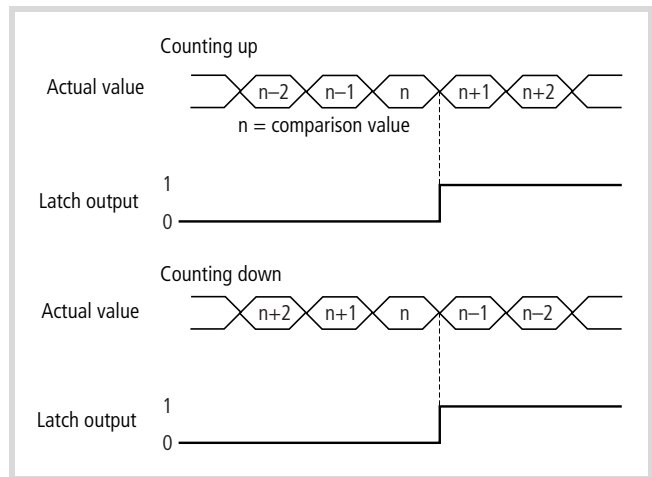


Figure 52: Interrogate comparison value

The diagram shows (for the linear counter

- the state of the Level output (>), depending on the count sequence
- the acceptance of the preset value P, in response to the reference signal.

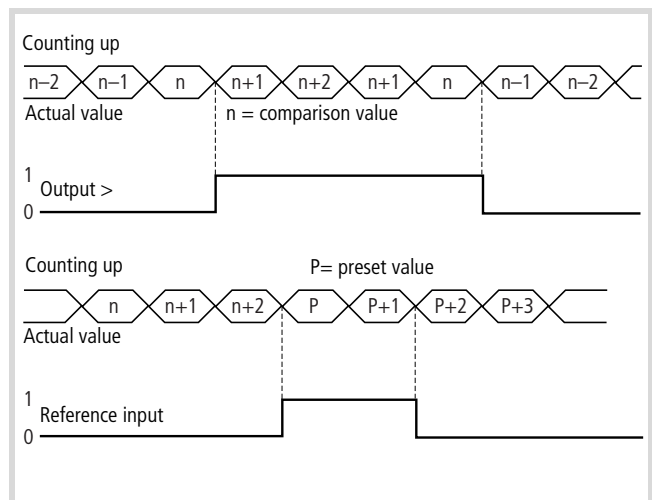


Figure 53: Interrogation of comparison and reference signals

## Processing of commands

The following table describes the commands and illustrates the sequence which they are processed after the controller is switched on. You should also keep to this sequence during programming. Some of the commands may not be necessary, depending on the application. Where commands only apply to the linear counter of the ring counter, this is also mentioned. The counting range for the linear counter lies between the start value 0 and the end value "FFFFFF<sub>hex</sub>".

→ The input values to the function blocks "CounterControl", "WriteCounter" and "CounterFlags" are accepted when a positive edge appears at the "Strobe" input.

**Set start value** Only for ring counter:

- ▶ Enter the command WRITEPRESETVALUE at the "Command" input of the block "WriteCounter" and the start value at the "Data" input.

Take care that the condition "Start value < End value" is fulfilled.

**Set end value** Only for ring counter:

- ▶ Enter the command WRITESETTINGVALUE at the "Command" input of the block "WriteCounter" and the end value at the "Data" input.

**Set comparison value**

- ▶ Enter the command WRITESETTINGVALUE1 (for linear counter) or WRITESETTINGVALUE2 (for ring counter) at the "Command" input of the block "WriteCounter" and the comparison value at the "Data" input.

You can access the channels individually or together.

You can set the comparison value either at the start or during operation. This does not depend on the counter being enabled at the "CounterEnable" input of the function block "CounterControl".

When the actual value matches the comparison value, the module outputs will be set. The Equal flag associated with the output is also set at the same time. You can interrogate the flag by using the command READFLAGS for the "CounterFlags" block.

The Equal flag retains its state if the state of the CPU changes from RUN → STOP or STOP → RUN.

**Assign module outputs to the comparison value 1 or 2**

Comparison value 1 (linear counter) or comparison value 2 (ring counter) can be assigned to several module outputs (Y<sub>n</sub>, n = 1, 2, 3, 4) and the conditions "=" and/or ">" for setting the outputs (only the "=" condition can be used with a ring counter).

- ▶ To achieve this, set up a bit combination (16 bits), e.g. 0021<sub>hex</sub>, that is applied to the "OutputSpecification" input of the "CounterFlags" block (further information can be found in the description of the function block "CounterFlags" in the manual "Function blocks for easySoft-CoDeSys", AWB2786-1456GB).
- ▶ Apply the SPECIFYOUTPUT command to the "Command" input and a "1" signal to the "Strobe" input.

The "CounterEnable" input (flag) must not be set. When the condition "Actual value = preset value" is met, the (Latch) output Y0 is set to "1" by the bit combination "0021". It will remain set until you reset it by using the "ClearEqual" input of the "CounterControl" block.

Only for linear counters:

The (Level) output Y1 will be set to "1" if the condition "Actual value > Preset value" is fulfilled. If the actual value falls below the comparison value 2, then the output is automatically reset to "0".

**Enable module output**

The module outputs are the "Latch" output (=) and the "Level" output (>). The Level output is only available for the linear counter.

- ▶ To enable the outputs, apply a "1" signal to the "CompareOutputnEnable" of the "CounterControl" block.

An inhibit applied to the output does not affect the Equal flag.

|   |  |
|---|--|
| <b>Set "preset" value</b>                     | <p>Only for linear counters:</p> <p>The command is carried out if there is a "0" signal applied to the "CounterEnable" input of the "CounterControl" function block.</p> <ul style="list-style-type: none"> <li>▶ Enter the command WRITEPRESETVALUE at the "Command" input of the block "WriteCounter" and the preset value at the "Data" input.</li> </ul> <p>If the encoder transmits a reference signal, the preset value overwrites the actual value.</p> |
| <b>Enable reference input</b>                 | <p>Only for linear counters:</p> <ul style="list-style-type: none"> <li>▶ Apply a "1" signal to the "ReferenceMarkernEnable" (n = 1, 1) input of the "CounterControl" function block, so that the reference signal can be received from the encoder.</li> </ul>  |
| <b>Enable counter input</b>                   | <ul style="list-style-type: none"> <li>▶ Apply a "1" signal to the "CounterEnable" input of the "CounterControl" function block, so that the signals can be received from the encoder.</li> </ul> <p>When using a ring counter, the enable can only be implemented after you have set the start and end values.</p>  |
| <b>Set new actual value</b>                   | <ul style="list-style-type: none"> <li>▶ Enter the command WRITECURRENTVALUE at the "Command" input of the "WriteCounter" block, and the actual value at the "Data" input.</li> </ul>  |
| <b>Reset Latch output and Equal flag (EQ)</b> | <ul style="list-style-type: none"> <li>▶ Apply a "1" signal to the "ClearEqualn" input of the "CounterControl" function block to set the output and the Equal flag to "1".</li> </ul> <p>The output and flag can only be set again if you apply a "0" signal to this input.</p>  |
| <b>Read out start value</b>                   | <p>Only for ring counter:</p> <ul style="list-style-type: none"> <li>▶ Enter the command READPRESETVALUE at the "Command" input of the "ReadCounter" block.</li> </ul> <p>As soon as you have entered this command, the values will be shown at the outputs: "DataLowChanneln" and "DataHighChanneln", as well as "Outputn_UDINT" and "Outputn_DINT".</p> <p>The command applies to both channels.</p>   |
| <b>Read out end value</b>                     | <p>Only for ring counter:</p> <ul style="list-style-type: none"> <li>▶ Enter the command READSETTINGVALUE at the "Command" input of the "ReadCounter" block.</li> </ul> <p>As soon as you have entered this command, the values will be shown at the outputs: "DataLowChanneln" and "DataHighChanneln", as well as "Outputn_UDINT" and "Outputn_DINT".</p> <p>The command applies to both channels.</p>  |
| <b>Read out comparison value</b>              | <ul style="list-style-type: none"> <li>▶ Enter the command READSETTINGVALUEn at the "Command" input of the "ReadCounter" block.</li> </ul> <p>As soon as you have entered this command, the values will be shown at the outputs: "DataLowChanneln" and "DataHighChanneln", as well as "Outputn_UDINT" and "Outputn_DINT".</p> <p>The command applies to both channels.</p>   |
| <b>Read out preset value</b>                  | <p>Only for linear counters:</p> <ul style="list-style-type: none"> <li>▶ Enter the command READPRESETVALUE at the "Command" input of the "ReadCounter" block.</li> </ul> <p>As soon as you have entered this command, the values will be shown at the outputs: "DataLowChanneln" and "DataHighChanneln", as well as "Outputn_UDINT" and "Outputn_DINT".</p> <p>The command applies to both channels.</p>  |
| <b>Read actual (=current) values</b>          | <ul style="list-style-type: none"> <li>▶ Enter the command READCURRENTVALUE at the "Command" input of the "ReadCounter" block.</li> </ul> <p>As soon as you have entered this command, the actual value will be shown continuously at the outputs: "DataLowChanneln" and "DataHighChanneln", as well as "Outputn_UDINT" and "Outputn_DINT".</p> <p>The command applies to both channels.</p>   |

**Read out flags** This command is described in detail on page 42!

**Clear Overflow flag** Only for linear counters:

- ▶ Enter the command CLEAROVERFLOW at the "Command" input of the "CounterFlags" function block to clear the flag.

The flag is set when the actual value changes from FFFFFFFF<sub>hex</sub> to 00000000<sub>hex</sub>.

You can interrogate the flag state by using the command READFLAGS for the "CounterFlags" block. 16 bits are shown at the "StatusChanneln" output of the "CounterControl" block.

Bit 9 (OF) indicates the state of the Overflow flag.

**Clear Underflow flag** Only for linear counters:

- ▶ Enter the command CLEARUNDERFLOW at the "Command" input of the "CounterFlags" function block to clear the flag.

The flag is set when the actual value changes from 00000000<sub>hex</sub> to FFFFFFFF<sub>hex</sub>.

You can interrogate the flag state by using the command READFLAGS for the "CounterFlags" block. 16 bits are shown at the "StatusChanneln" output of the "CounterControl" block.

Bit 8 (UF) indicates the state of the Underflow flag.

**Counter modules**  
**XIOC-...CNT100kHz**

**Read out flags**

Apply the command READFLAGS to the "Command" input of the "CounterFlags" block, in order to update the function block outputs: "Outputs", "StatusChanneln", "OutputsChanneln". A positive edge must be applied to the "Strobe" input in order to execute the command.

Their states are held until another transition edge occurs.

The states of "StatusChanneln" and "OutputsChanneln" are shown for channels 1 and 2.

- Outputs: only Bits 0 to 3 of the 16 bits have a meaning:

|       |    |    |    |    |    |    |   |   |   |   |   |   |    |    |    |    |
|-------|----|----|----|----|----|----|---|---|---|---|---|---|----|----|----|----|
| Bit   | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3  | 2  | 1  | 0  |
| Value | 0  | 0  | 0  | 0  | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | Y3 | Y2 | Y1 | Y0 |

Significance of the bit: Y0 to Y3:

- 0: output "0" signal
- 1: output "1" signal

- StatusChanneln

|       |    |    |    |    |    |     |   |     |   |   |   |     |     |     |     |     |
|-------|----|----|----|----|----|-----|---|-----|---|---|---|-----|-----|-----|-----|-----|
| Bit   | 15 | 14 | 13 | 12 | 11 | 10  | 9 | 8   | 7 | 6 | 5 | 4   | 3   | 2   | 1   | 0   |
| Value | 0  | 0  | 0  | 0  | 0  | U/D | 0 | U/F | 0 | 0 | 0 | E/Q | E/C | O/E | M/E | C/E |

Significance of the bit:

Apart from EC, the bit states are retained if the CPU changes state, from RUN → STOP or STOP → RUN.

|     |  |
|-----|--|
| CE  | Counter state (default value = 0)<br>0: no enable<br>1: enabled  |
| ME  | Reference input state (default value = 0)<br>0: no enable<br>1: enabled  |
| OE  | Output Y state (default value = 0)<br>0: no enable<br>1: enabled   |
| EC  | Equal Flag clear active (default value = 0)<br>If the "ClearEqualn" input function of the "CounterControl" block is set to TRUE, then EC = FALSE.<br>If it is set to FALSE, then EC = TRUE.  |
| EQ  | State of Equal flag<br>It is set of actual value = comparison value. It will remain set until a "1" signal is applied to the "ClearEqualn" input of the "CounterControl" block.  |
| UF  | State of Underflow flag<br>It is set if the actual value changes from 0 to 4294967296 (FFFFFFFF <sub>hex</sub> ). It will remain set until the CLEARUNDERFLOW command is applied to the "Command" input of the "CounterFlags" function block. The output words "Outputs", "StatusChanneln" and "OutputsChanneln" will be set to "0". |
| OF  | State of Overflow flag<br>It is set if the actual value changes from 4294967296 (FFFFFFFF <sub>hex</sub> ) to 0. It will remain set until the CLEAROVERFLOW command is applied to the "Command" input of the "CounterFlags" function block. The output words "Outputs", "StatusChanneln" and "OutputsChanneln" will be set to "0".   |
| U/D | State of Up/Down<br>0: if the actual value has changed from "n" to "n - 1".<br>1: if the actual value has changed from "n" to "n + 1".   |

- OutputsChanneln

The bits contained in the word indicate the conditions on which an output depends.

Meaning of the bits

|        |    |    |    |    |    |    |   |   |    |   |   |   |    |   |   |   |
|--------|----|----|----|----|----|----|---|---|----|---|---|---|----|---|---|---|
| Bit    | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7  | 6 | 5 | 4 | 3  | 2 | 1 | 0 |
| Value  | 0  | 0  | >  | =  | 0  | 0  | > | = | 0  | 0 | > | = | 0  | 0 | > | = |
| Output | Y3 |    |    |    | Y2 |    |   |   | Y1 |   |   |   | Y0 |   |   |   |

Example:

0021<sub>hex</sub> (0000 0000 0010 0001) shows that:

- output Y1 is set if the actual value > preset (target) value
- output Y0 is set if the actual value = preset (target) value.

### State display in the controller configuration

The counter module indicates its status in 5 words, within the controller configuration:

1st word: status

2nd word: input data, Low word, channel 1

3rd word: input data, High word, channel 1

4th word: input data, Low word, channel 2

5th word: input data, High word, channel 2

The status word is composed of the following bits:

| Channel |    |    |    |    | Channel 2 |     | Channel 1 |     | Channel 2 |     | Channel 1 |     | Channel 2 |     | Channel 1 |     |
|---------|----|----|----|----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|
| Bit     | 15 | 14 | 13 | 12 | 11        | 10  | 9         | 8   | 7         | 6   | 5         | 4   | 3         | 2   | 1         | 0   |
| Meaning | 0  | 0  | 0  | 0  | OF2       | UF2 | OF1       | UF1 | EQ2       | OE2 | ME2       | CE2 | EQ1       | OE1 | ME1       | CE1 |

Significance of the bit:

Apart from EC, the bit states are retained if the CPU changes state, from RUN → STOP or STOP → RUN.

|    |  |
|----|--|
| CE | Counter state (default value = 0)<br>0: no enable<br>1: enabled  |
| ME | Reference input state (default value = 0)<br>0: no enable<br>1: enabled  |
| OE | Output Y state (default value = 0)<br>0: no enable<br>1: enabled   |
| EQ | State of Equal flag<br>0: no action<br>1: if actual value = comparison value<br>It remains set until a "0" signal is applied to the "CompareOutputn Enable" input of the "CounterControl" block.   |
| UF | State of Underflow flag<br>It is set if the actual value changes from 0 to 4294967296 (FFFFFFFF <sub>hex</sub> ). It will remain set until the CLEARUNDERFLOW command is applied to the "Command" input of the "CounterFlags" function block. The output words "Outputs", "StatusChanneln" and "OutputsChanneln" will be set to "0". |
| OF | State of Overflow flag<br>It is set if the actual value changes from 4294967296 (FFFFFFFF <sub>hex</sub> ) to 0. It will remain set until the CLEARUNDERFLOW command is applied to the "Command" input of the "CounterFlags" function block. The output words "Outputs", "StatusChanneln" and "OutputsChanneln" will be set to "0".  |

### FLAG summary

All the flags and their meanings are listed below

| Flag | Designation            | Meaning  |
|------|------------------------|--|
| CE   | CounterEnable          | Pulse inputs are enabled (1) or inhibited (0) <sup>1)</sup>  |
| ME   | ReferenceMarker Enable | Reference input is enabled (1) or inhibited (0) <sup>1)</sup>  |
| OE   | OutputEnable           | Latch output (=) input is enabled (1) or inhibited (0) <sup>1)</sup>   |
| EQ   | Equal Flag             | The Equal flag is set if actual value = comparison value. <sup>1)</sup>  |
| EC   | ClearEqual             | Clear Equal flag: after being set ("1" signal) it sets the Latch output (=) to a "0" signal. The EC flag must be reset ("0" signal).   |
| UF   | Underflow              | It is set if the actual value changes from 0 to 4294967296 (FFFFFFFF <sub>hex</sub> ). It will remain set until the CLEAROVERFLOW command is applied to the "CounterFlags" function block. |
| OF   | Overflow               | It is set if the actual value changes from 4294967296 (FFFFFFFF <sub>hex</sub> ) to 0. It will remain set until the CLEAROVERFLOW command is applied to the "CounterFlags" function block. |

1) Default value = 0

All flags (apart from EC) retain their states if the state of the CPU changes from RUN → STOP or STOP → RUN.

**Counter modules**  
**XIOC-...CNT100kHz**
**Functional sequence for pulse processing (example)**

The following examples illustrate the functional sequence for processing pulses.

Actions that you can perform yourself are marked by the ► symbol. The functions are executed by commands that you can enter at the function block inputs, or by applying "0" or "1" signals to the inputs of the "CounterControl" block. Commands are shown in capital (upper case) letters, inputs are shown in lower case letters. The values shown in brackets represent the initial state.

**Linear counter**

| Function   | Command or input           |
|--|----------------------------|
| ► Set comparison value 1   | WRITESETTINGVALUE1         |
| ► Set the output specification (the module outputs must be assigned to the comparison value 1 in order to set the specification) | SPECIFYOUTPUT              |
| ► Set the preset value (when using referencing)  | WRITEPRESETVALUE           |
| ► Enable counter inputs <sup>1)</sup>  | CounternEnable (1)         |
| ► Enable Latch/Level outputs <sup>1)</sup>   | CompareOutputnEnable (1)   |
| <b>For referencing</b>   |                            |
| ► Enable reference inputs <sup>1)</sup>  | ReferenceMarkernEnable (1) |
| <b>Initiate referencing</b>  |                            |

**When the reference signal is received, the preset value will overwrite the actual value, e.g. actual value = 0.**

|                            |                            |
|----------------------------|----------------------------|
| ► Inhibit reference inputs | ReferenceMarkernEnable (0) |
|----------------------------|----------------------------|

**Start counting (pulses are counted)**

- If actual value = comparison value 1:
  - Latch output (=) is set to a "1" signal
  - Equal flag is set to a "1" signal
  - Stop counting
- If actual value > comparison value 1:
  - Level output (>) is set to "1"

|   |                    |
|---|--------------------|
| ► Reset Latch output and Equal flag<br>– Set the ClearEqual flag (Equal flag is set to "0", Latch output (=) is set to "0") | Clear Equaln (1)   |
| ► Reset the ClearEqual flag   | ClearEqualn (0)    |
| ► Set new comparison value  | WRITESETTINGVALUE1 |
| ...   |                    |
| The Overflow flag is set when the count changes from FFFFFFFF <sub>hex</sub> → 0:   |                    |
| ► Reset Overflow flag   | CLEAROVERFLOW      |
| The Underflow flag is set when the count changes from 0 → FFFFFFFF <sub>hex</sub>   |                    |
| ► Reset Underflow flag  | CLEARUNDERFLOW     |

- 1) Can be performed simultaneously, by using a pulse at the "Strobe" input of the "CounterControl" block.

**Ring counter**

| Function   | Command or input         |
|--|--------------------------|
| ► Set start value  | WRITEPRESETVALUE         |
| ► Set end value  | WRITESETTINGVALUE1       |
| ► Set comparison value 2   | WRITESETTINGVALUE2       |
| ► Set the output specification (the module outputs must be assigned to the comparison value 2 in order to set the specification) | SPECIFYOUTPUT            |
| ► Enable counter inputs <sup>1)</sup>  | CounternEnable (1)       |
| ► Enable Latch output <sup>1)</sup>  | CompareOutputnEnable (1) |

**Start counting (pulses are counted)**

- If actual value = comparison value 2:
  - Latch output (=) is set to a "1" signal
  - Equal flag is set to a "1" signal
  - Stop counting

|   |                    |
|---|--------------------|
| ► Reset Latch output and Equal flag<br>– Set the ClearEqual flag (Equal flag is set to "0", Latch output (=) is set to "0") | Clear Equaln (1)   |
| ► Reset the ClearEqual flag   | ClearEqualn (0)    |
| ► Set new comparison value 2  | WRITESETTINGVALUE2 |
| ...   |                    |

- 1) Can be performed simultaneously, by using a pulse at the "Strobe" input of the "CounterControl" block.

## 4 Counter analog module XIOC-2CNT-2AO-INC

### Features

The counter analog module provides two channels for counting up and down, each with a reference input and an analog output ( $\pm 10$  V).

The counter inputs and the reference input can process 5 V DC differential signals (RS 422) of an incremental encoder. The incremental encoder is connected via the XIOC-TERM-18T or XIOC-TERM-18S clamp terminals with the module. The encoder can receive its power supply from the module. The power supply is provided by the power supply unit of the CPU.

→ Verify the current consumption of all modules.

The module is a standard I/O module. It can be used on all I/O slots.

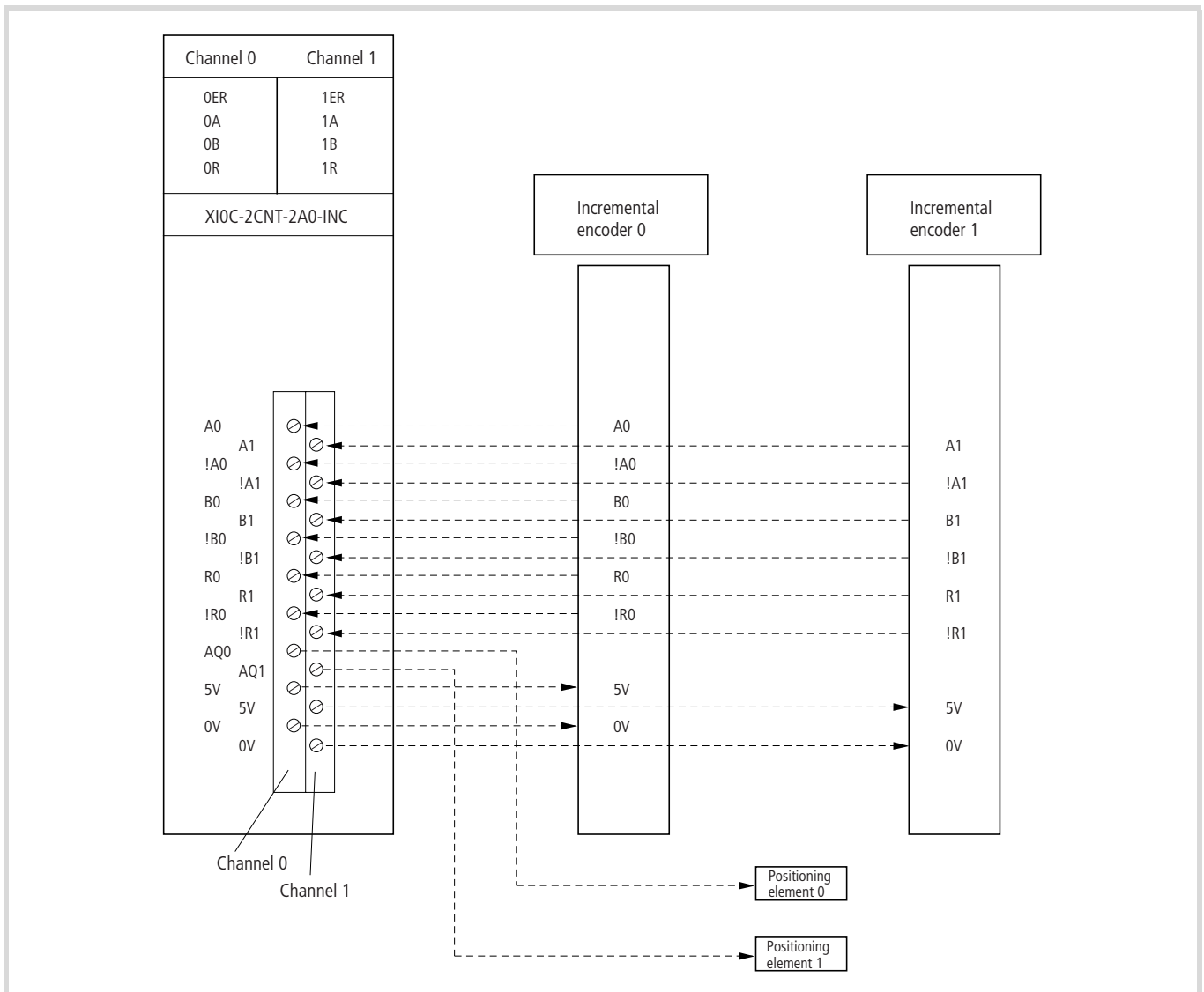


Figure 54: Connections of the counter module

## LEDs

The XIOC-2CNT-2AO-INC has eight LEDs for the status display. They are assigned as follows:

| Designation | Meaning          | Colour |
|-------------|------------------|--------|
| ER          | Error            | red    |
| A           | Signal A         | green  |
| B           | Signal B         | green  |
| R           | Reference signal | green  |

The error LED lights when the edges of the A and B signals rise or fall simultaneously.

## Programming and configuration

In order to access the module inputs and for actuation of the analog inputs, you can choose between:

- Direct access via the input/output map
- Access via the function blocks.

The function blocks are contained in the "Counter\_Analog.lib" library file and have the following function:

XIOC\_2CNT2AO\_INCreferencing and detecting counter values

XIOC\_2CNT2AO\_ANALOGsetting the analog outputs

Furthermore, you must define the following parameters in the configurator of the easySoft-CoDeSys:

- Reference value
- 1, 2, 4 signal edge evaluation
- Number of homing reference checks (once, permanent)

## Information exchange via the input/output map

You receive the following information via the input map:

- States of signals A, B, R
- Error messages (Error)
- Reference status (Referenced)
- Zero-crossing recognition (Zero Crossing)
- Feedback "Referencing activated"
- Counter status.

You can control the following information via the output map:

- Inhibit the count impulse (Hold)
- Activation of referencing (Activate Referencing)
- Perform a reset (Reset)
- Acknowledgement of zero crossing (Zero Crossing Acknowledge)
- Acknowledge error message (Error Acknowledge)
- Write an analog value.

## Input map

A channel occupies the following input bit and words which you can query:

IWn: Signal states for channels 0 and 1, → table 11

IWn+2: Counter value, lower Word, channel 0

IWn+4: Counter value, higher Word, channel 0

IWn+6: Counter value, lower Word, channel 1

IWn+8: Counter value, higher Word, channel 1

("n" results from the configuration/slot)

Table 11: Iwn: Channel 0 and 1 status signals

| Channel | Channel 1 |        |     |      |        |    |    |    | Channel 0 |        |     |      |        |    |    |    |
|---------|-----------|--------|-----|------|--------|----|----|----|-----------|--------|-----|------|--------|----|----|----|
| Bit     | 15        | 14     | 13  | 12   | 11     | 10 | 9  | 8  | 7         | 6      | 5   | 4    | 3      | 2  | 1  | 0  |
| Meaning | tbd       | RefAc1 | ZC1 | Ref1 | Error1 | R1 | b1 | A1 | tdb       | RefAc0 | ZC0 | Ref0 | Error0 | R0 | b0 | A0 |

## Meaning of the bits

| Bit  | Designation                   | State | Condition   |
|------|-------------------------------|-------|---|
| 0/8  | Signal A                      | 1     | A = "1" and !A = "0"                                |
|      |                               | 0     | A = "0" and !A = "1"                                |
| 1/9  | Signal B                      | 1     | B = "1" and !B = "0"                                |
|      |                               | 0     | B = "0" and !B = "1"                                |
| 2/10 | Signal R                      | 1     | R = "1" and !R = "0"                                |
|      |                               | 0     | R = "0" and !R = "1"                                |
| 3/11 | Error                         | 1     | Internal error (A and B edges occur simultaneously) |
|      |                               | 0     | o.k.  |
| 4/12 | Ref (Referenced)              | 1     | Referenced  |
|      |                               | 0     | Not referenced                                      |
| 5/13 | ZC (Zero Crossing)            | 1     | Counter value = 0                                   |
|      |                               | 0     | Counter value ≠ 0                                   |
| 6/14 | RefAc (Referencing Activated) | 1     | Referencing activated (set with AcRef)              |
|      |                               | 0     | Referencing not activated                           |
| 7    | tbd                           | x     | Not defined   |

1) ZC = Zero Crossing (zero crossing bit)

The zero crossing bit is set if the counter value = 0.

If the output bit ZCA is set to "1" in the program, the ZC bit is reset.

### Output map

Every channel has the following output bit and word that you can set:

QWn: Control functions, channel 0 and 1, → table 12

QWn+2: Bit 0 to 11: Analog output, channel 0

QWn+4: Bit 0 to 11: Analog output, channel 1

("n" results from the configuration/slot)

Table 12: Control functions, channel 0 and 1,

| Channel | Channel 1 |     |     |        |      |        |        |       | Channel 0 |     |     |        |      |        |        |       |
|---------|-----------|-----|-----|--------|------|--------|--------|-------|-----------|-----|-----|--------|------|--------|--------|-------|
|         | 15        | 14  | 13  | 12     | 11   | 10     | 9      | 8     | 7         | 6   | 5   | 4      | 3    | 2      | 1      | 0     |
| Meaning | tbd       | tbd | tbd | ErAck1 | ZCA1 | Reset1 | AcRef1 | Hold1 | tbd       | tbd | tbd | ErAck0 | ZCA0 | Reset0 | AcRef0 | Hold0 |

Table 13: Meaning of the bits

| Bit   | Designation                                | State | Condition   |
|-------|--|-------|---|
| 0/8   | Hold                                       | 0     | Enable of the input count impulse (Signals A +B)                              |
|       |  | 1     | Inhibit of the input count impulse  |
| 1/9   | AcRef <sup>1)</sup> (Activate referencing) | 1     | Activate referencing  |
|       |  | 0     | Do not activate referencing   |
| 02/10 | Reset                                      | 0 → 1 | Asynchronous reset (counter value is set to the reference value) (L → H edge) |
|       |  | 0     | –   |
| 03/11 | ZCA (Zero Crossing Acknowledge)            | 0 → 1 | Reset of the zero crossover bit (L → H edge)                                  |
|       |  | 0     | –   |
| 04/12 | ErAck (Error Acknowledge)                  | 0 → 1 | Reset of the error bit (L → H edge)   |
|       |  | 0     | –   |
|       | tbd  | x     | Not defined   |

1) Activate Referencing (AcRef): Activate/deactivate referencing for the reference signal of the encoder

### Configuration of the base parameters

- ▶ Open the easySoft-CoDeSys and generate the configuration with the XI0C-2CNT-2AO-INC module.
- ▶ Click on the module in the "PLC Configuration".
- ▶ Open the "Other Parameters" tab and enter the values for:
  - Edge evaluation
  - Number of reference checks
  - Reference value.

### Edge evaluation of the count impulse, 1x, 2x or 4x

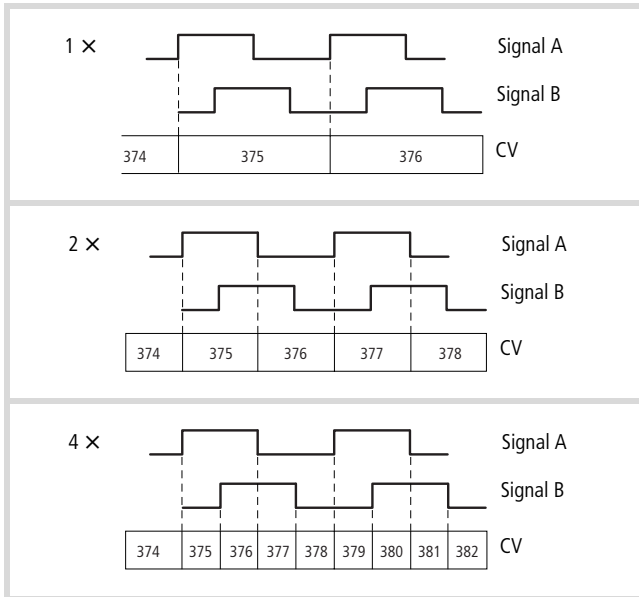


Figure 55: Edge evaluation

- ① CV = Counter value
- ② 1 × = single, 2 × = double, 4 × = quadruple

### Number of reference verifications (once, permanent)

After the "Activate Referencing" module has been set, the reference pulses of the encoder will be processed by the module. If a reference pulse is detected (signal R: 0 → 1), the counter value is overwritten with the reference value. This occurs once or with every new reference pulse (permanent).

**Reference value:** A value from 0 to 4294967295 is possible.

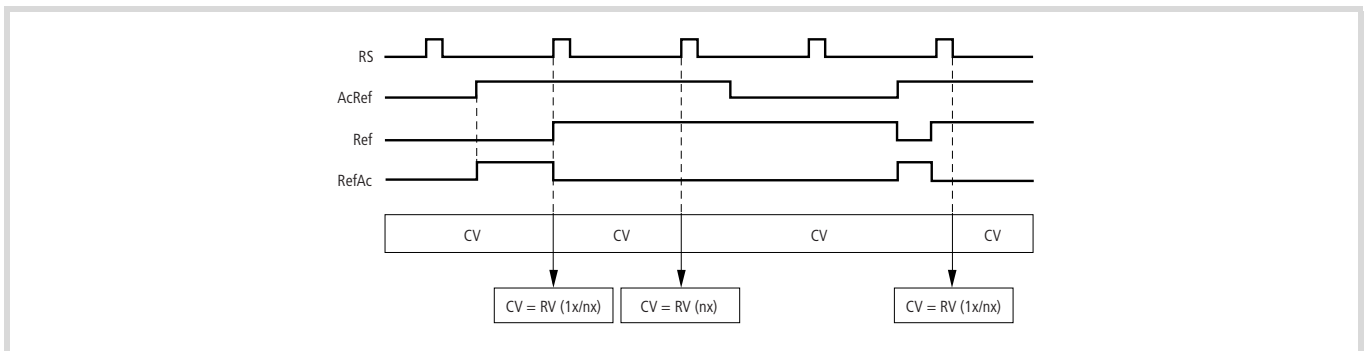


Figure 56: Referencing

Meaning of the signals → table

**Counter analog module  
XIOC-2CNT-2AO-INC**

Table 14: Meaning of the signals

|       |  |                               |
|-------|--|-------------------------------|
| RS    | Reference encoder signal   | Reference signal from encoder |
| AcRef | Activate Referencing   | Activate referencing          |
| Ref   | Referenced   | Referenced                    |
| RefAc | Referencing activated  | Referencing activated         |
| CV    | Counter value  | Counter value                 |
| RV    | Reference value  | Reference value               |
| CV=RV | The reference value overwrites the count value when setting (1x/nx): once or permanent (nx): permanent |                               |

Explanation:

It is possible to perform referencing once or permanently. The "Activate Referencing (AcRef)" output bit should be set in order to detect the reference signal. The module reacts by setting the "Referencing Activated (RefAc)" input bit. You can query (scan) this bit. When a reference impulse is detected, the "RefAc" input bit is set to a "0" signal and the counter value is overwritten by the reference value. If a further reference impulse is detected, the counter value will be overwritten by the reference value only if you have undertaken the "permanent" setting in the PLC Configuration at <Number of references → Other parameters>.

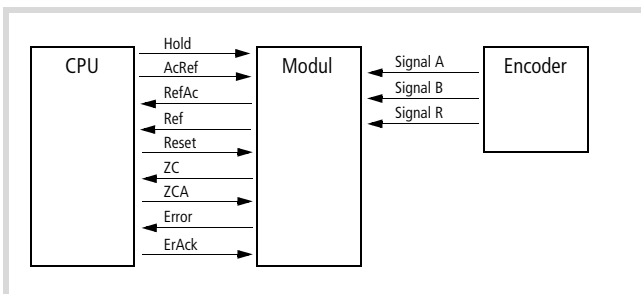


Figure 57: Signal overview

**Output of the analog value**

The digital value of the output word QWn (n can be seen in the configuration) is converted to an analog voltage. The value range is represented in the following illustration:

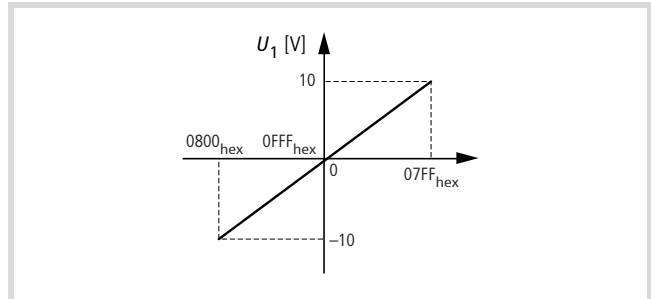


Figure 58: Value range of the analog outputs

Table 15: Value range

| Digital value (hex.) | Digital value (dec.) |
|----------------------|----------------------|
| 0                    | 0                    |
| 7FF                  | 2047                 |
| 800                  | 2048                 |
| FFF                  | 4095                 |

**Behaviour of the module with CPU RUN/STOP**

The CPU transfers the parameters with each STOP → RUN change to the module.

With a "RUN → STOP change" counters are reset to "0". Furthermore, all parameters are erased and the analog outputs are shut down (0 V DC). The module no longer counts further pulses if the CPU is in the "STOP" state.

## 5 Serial interface module XIOC-SER

### Features

The module is used in conjunction with the XC100 or XC200 CPU. It has two operating modes available:

- Transparent mode  
For communication with other devices which feature a serial interface. For this purpose an interface is made available in the RS 232, RS 422 and RS 485 versions.
- Suconet-K mode (slave)  
As a Suconet-K slave for communication with the PS4 control system (from XIOC-SER version 02).

On an XC100 a maximum of two modules (COM interfaces) and on a XC200 a maximum of four modules (COM interfaces) can be operated. As the modules XIOC-SER and XIOC-NET-SK-M are addressed via the COM interfaces, the details of the number of modules (COM interfaces) in the PLC refers to both modules.

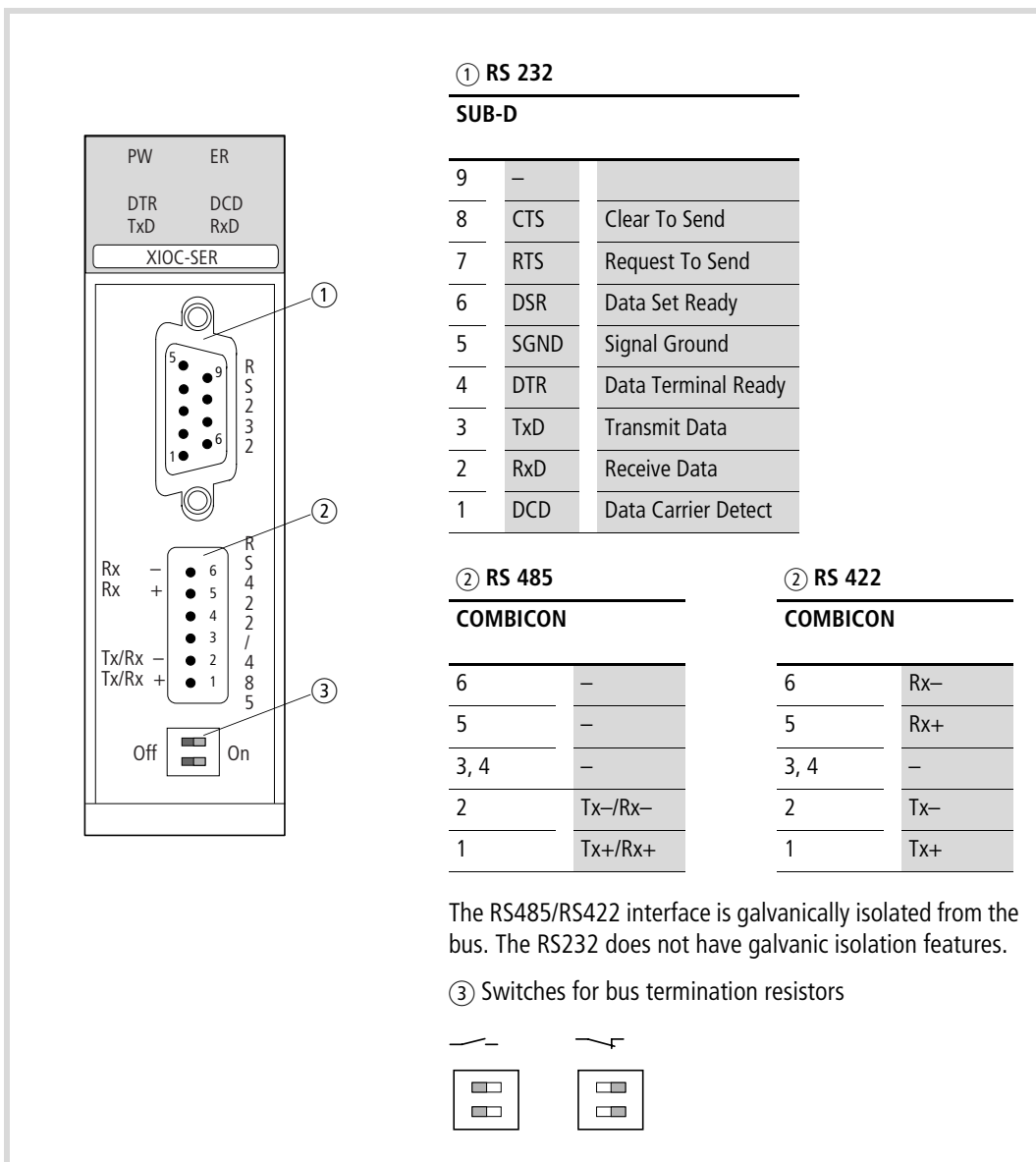


Figure 59: RS232, RS422, RS485 interfaces

**LED display**

| LED display | LED function | Module                 |
|-------------|--------------|------------------------|
| PW (Power)  | ON           | Switched on            |
| ER (Error)  | On/Off       | Application specific   |
| DTR         | ON           | Data Terminal Ready    |
| DCD         | ON           | Data Carrier Detect    |
| TxD         | Flashing     | Data is being sent     |
| RxD         | Flashing     | Data is being received |

**Design of the RS-422-/RS-485 interface**

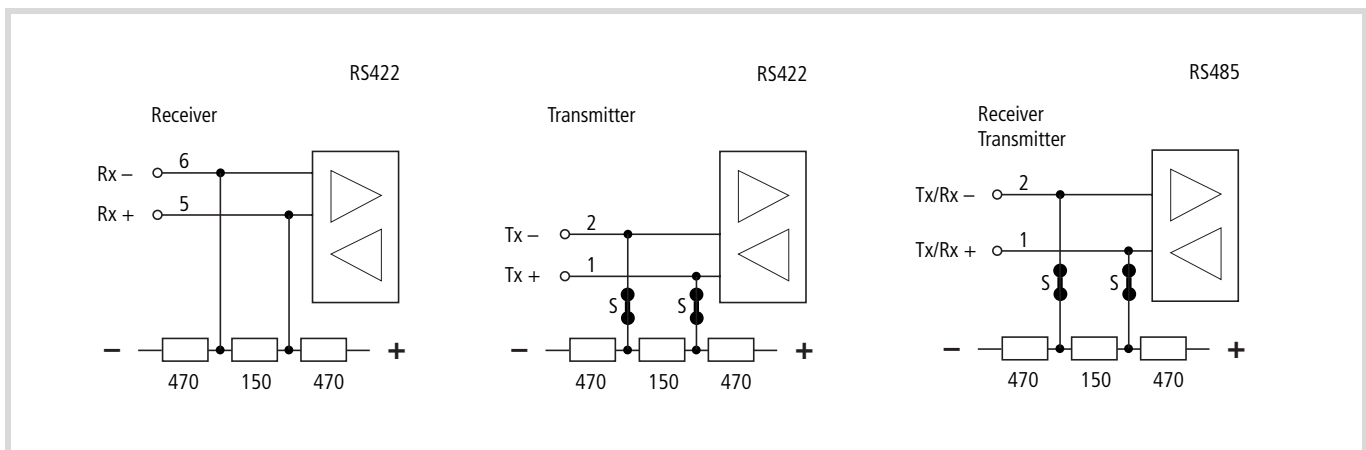


Figure 60: RS-422-/RS-485 interface  
S = switch for bus termination resistor

**Select the module in the configurator of the easySoft-CoDeSys**

- ▶ Open the PLC Configurator
- ▶ Click with the right mouse button on the required slot.
- ▶ Select the "Replace element" command.
- ▶ Select XIOC-SER with a double-click in a new window.

→ The assignment between the slot of the module and the COM... programming language in the configurator: Activate the "Other Parameters" tab and select COM2, 3, 4 or 5 from the "Serial interface" list field, → figure 62.

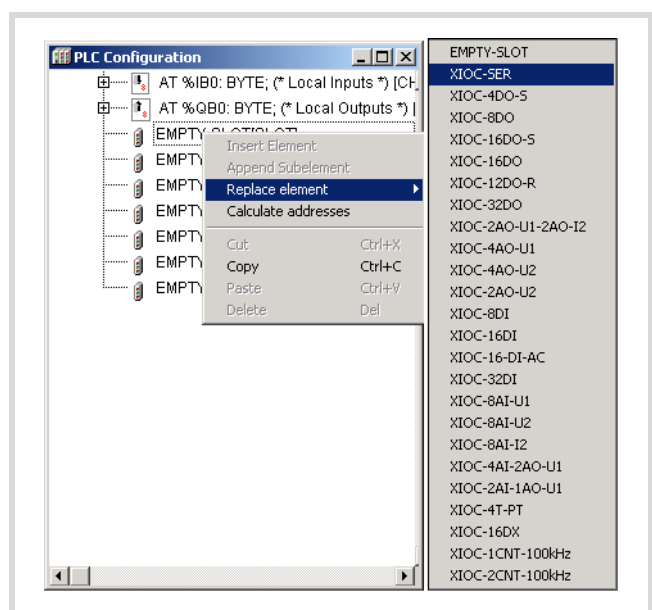


Figure 61: Integrate the module, here: XIOC-SER

## Configuration of the interface

After selection of the module, "Transparent" or "Suconet K" (slave) operating mode (bus status) can be clicked in the "Other parameters" tab. The operating mode becomes active after the CPU is switched on. The power supply must be switched off and back on after a selection change.

### "Transparent mode" mode of operation

In this operating mode the RS-232, RS-485 or RS-422 interface can be used for sending and receiving data.

The RS232 interface is available externally for connection via a 9-pole SUB-D plug (pins); the RS422/RS485 interface can be accessed via a 6-pole springloaded terminal block (COMBICON).

If you select the RS-422 or RS-485 interfaces, the position of the bus termination resistor switch is important (→ figure 60).

The resistors are integrated into the receive line (Rx-/Rx+) of the RS-422 interface. They can be switched in (default setting) or out on the send line of the RS-422 as well as the RS-485 interface.

Both switches must be in the same setting position to guarantee perfect communication.

An example for parameter settings in transparent mode is shown in Figure 62. The parameters can be modified by a click on the arrow button.

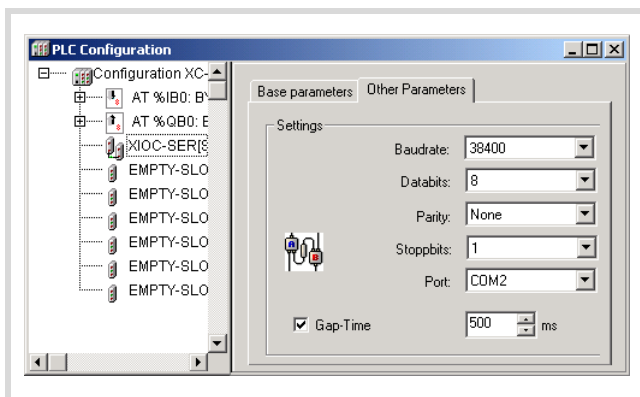


Figure 62: Default parameter in transparent mode

#### Serial interface:

Here you select the logical name of your interface. The serial interface module can be addressed by this name in the user program

#### Setting gap time:

This function is not activated in the basic setting. The gap time is used to tolerate possible intervals when receiving telegram characters (gaps in telegrams).

### "Suconet-K mode (slave)" operating mode

In this mode of operation, the variable length data blocks are transferred between the XIOC-SER (Suconet K slave) module and a Suconet-K master of the PS4 system.

- ▶ Set the mode of operation (bus status) to "Suconet K" in the "Other Parameters" tab of the easySoft-CoDeSys configurator and match the parameters accordingly.
  - Define the slave address which is displayed in the configurator of the SucoSoft S40 for the slave, in the "Suconet K address" field.
  - Define the send and receive data count (maximum 120 bytes). The send data count of the slave (XIOC-SER) must correspond with the receive data of the master. The same applies for the send data (master) → receive data (slave).
  - Serial interface: Here you select the logical name of your interface. The serial interface module can be addressed by this name in the user program.
  - Specify the Suconet-K device type. Each station on the Suconet-K rung is uniquely identified by a device type. By default, the device type for the XIOC-SER is set to SIS-TYP-A0EF, but you can change this to any other type. An XIOC-SER can therefore also be configured as a replacement for a previous Suconet-K station (for example a PS4-341-MM1). You do not have to modify the PS40 program for this purpose.

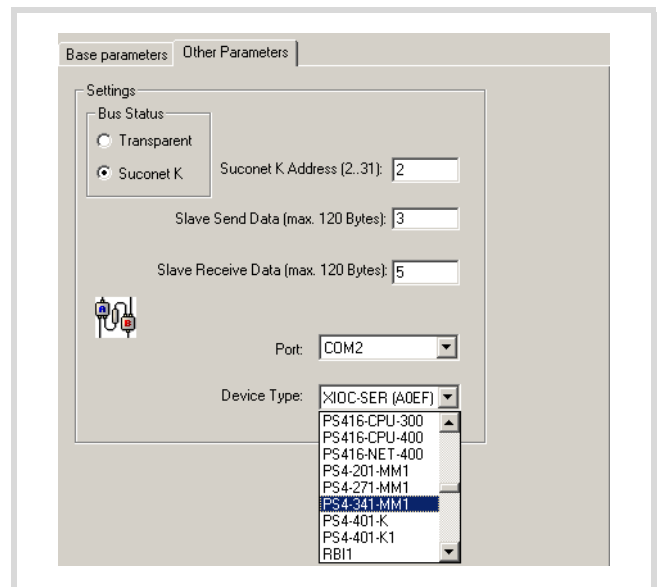


Figure 63: Communications parameters for the Suconet K operating mode

## Serial interface module XIOC-SER

### Master connection ↔ XIOC-SER

The RS-485 interface is active in the Suconet K mode of operation.

```
Master  TA/RA----- Tx/Rx+  XIOC-SER
        TB/RB ----- Tx/Rx-
```

### Setting the bus termination resistors

Set the bus termination resistors. If the module is physically the first or last module on the end of a line, set both of the S switches (→ fig. 60 ) to the "ON" setting (default setting). Both of the switches must be set to "OFF" at all other positions on the line. Both switches must be in the same setting position to guarantee perfect communication.

### Configuration in the SucoSoft S40

In the configurator of the SucoSoft S40, extend the master with the XIOC-SER module by selecting the module from a list. Use the same device type that you have selected in the list field "Device type" in the configuration dialog of the XIOC-SER. The address is then displayed in the parameter window. Enter the data count in the "send data" and "receive data" fields.

### Diagnostics on the master

The diagnostics byte of the slave (XIOC-SER) can be read in the master program. The method for reading the diagnostics byte can be found in the documentation of the master. The diagnostics byte of the master has the following structure:

| Bit | Meaning                               |
|-----|---------------------------------------|
| 0   | Reserved                              |
| 1   | 0 = Station in "RUN"                  |
|     | 1 = Station in "Halt"                 |
| 2   | 0 = ok                                |
|     | 1 = Length fault of the received data |
| 3   | Reserved                              |
| 4   | Reserved                              |
| 5   | Reserved                              |
| 6   | 0 = ok                                |
|     | 1 = No connection                     |
| 7   | 0 = ok                                |
|     | 1 = Incorrect device type             |

### Diagnostics on the slave

The diagnostics is performed by the "Suconet K-Slave" function block. You can query both of the "xMasterDiscon" and "xMasterStop" outputs on the module. You receive the following messages:

The "Suconet K-Slave" function block can be found in the "Suconet K.lib" library. It is described in the AWB2786-1456 (Function blocks for easySoft-CoDeSys).

|               |                         |
|---------------|-------------------------|
| xMasterDiscon | 0 = Master connected    |
|               | 1 = Master disconnected |
| xMasterStop   | 0 = Master in RUN       |
|               | 1 = Master in STOP      |

### Access to the receive and send data

Access from the user program to the data of the XIOC-SER module is implemented in transparent mode with the aid of functions from the xSysCom100.lib library, from the SysLibCom.lib or xSysCom200.lib. The functions are described in the AWB2724-1453 (XC100) and AWB2724-1491 (XC200)

In the Suconet K mode of operation you implement the "Suconet K-Slave" function block.

The "Suconet K-Slave" function block can be found in the "Suconet K.lib" library. It is described in the AWB2786-1456 (Function blocks for easySoft-CoDeSys).

## 6 Suconet K module (master) XIOC-NET-SK-M

### Features

The module is used in conjunction with the XC100 or XC200 CPU. It has the function of the master on the Suconet K line and can control up to 16 slaves. Suconet K and Suconet K1 slaves are possible.

On an XC100 a maximum of two modules (COM interfaces) and on a XC200 a maximum of four modules (COM interfaces) can be operated. As the modules XIOC-SER and XIOC-NET-SK-M are addressed via the COM interfaces, the details of the number of modules (COM interfaces) in the PLC refers to both modules.

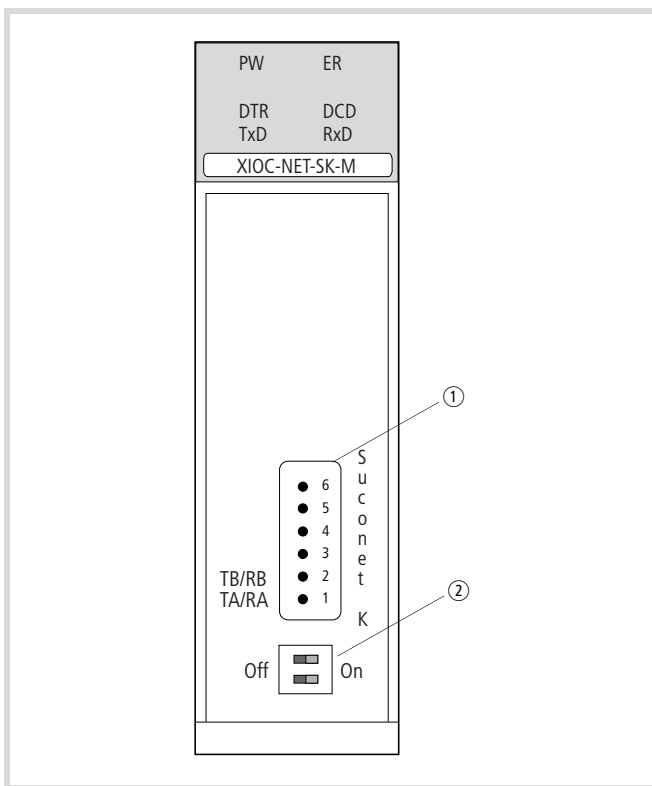


Figure 64: Suconet K interface RS 485

| ① | RS 485 (COMBICON) | b | Switches for bus termination resistors |
|---|-------------------|---|--|
| 6 | –                 |   |  |
| 5 | –                 |   |  |
| 4 | –                 |   |  |
| 3 | –                 |   |  |
| 2 | TB/RB             |   |  |
| 1 | TA/RA             |   |  |

The RS485 interface is galvanically isolated from the bus.

### LED display

| LED display | LED function | Module                 |
|-------------|--------------|------------------------|
| PW (Power)  | ON           | Switched on            |
| ER (Error)  | On/Off       | Application specific   |
| DTR         | ON           | Ready for operation    |
| DCD         | ON           | All stations connected |
| TxD         | ON           | Data is being sent     |
| RxD         | ON           | Data is being received |

### Design of the Suconet K (RS 485-)interface

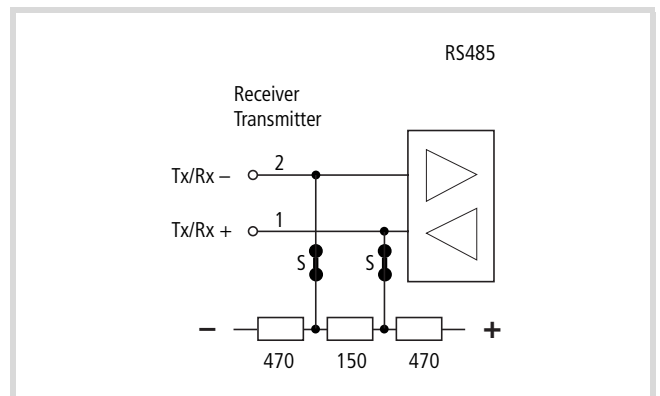


Figure 65: Suconet K interface/ RS485 interface

S = switch for bus termination resistor

### Select the module in the configurator of the easySoft-CoDeSys

- ▶ Open the PLC Configurator
- ▶ Click with the right mouse button on the required slot.
- ▶ Select the "Replace element" command.
- ▶ Select the module with a double-click in a new window.

→ The assignment between the slot of the module and the COM... programming language in the configurator: Activate the "Other Parameters" tab and select COM2, 3, 4 or 5 from the "Serial interface" list field, → figure 67.

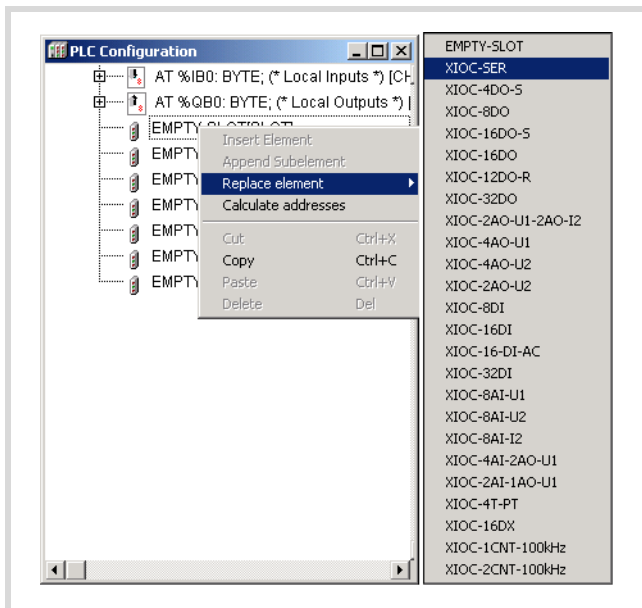


Figure 66: Integrate the module, here: XIOC-SER

### Configuration of the interface

After selection of the module the baud rate and the serial interface COM2, 3, 4 or 5 can be set in the "Other Parameters" tab.

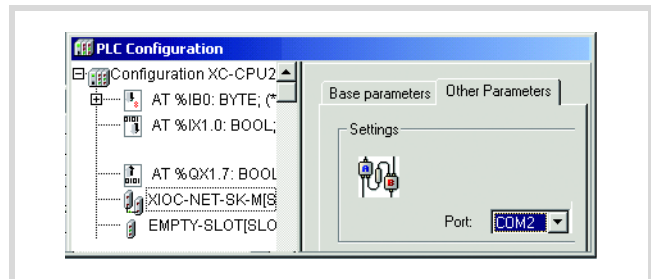


Figure 67: Parameters for Suconet K master

### Setting the bus termination resistors

Set the bus termination resistors. If the module is physically the first or last module on the end of a line, set both of the S switches (→ figure 65 ) to the ON setting (default setting). Both of the switches must be set to "OFF" at all other positions on the line. Both switches must be in the same setting position to guarantee perfect communication.

### Access to the receive and send data

Access from the user program to the data of the XIOC-NET-SK-M is implemented with the aid of the function blocks from the "SuconetK\_Master.lib" library. The function blocks are described in the AWB2786-1456 (Function blocks for easySoft-CoDeSys).

## 7 PROFIBUS-DP module XIOC-NET-DP-M / XIOC-NET-DP-S

The PROFIBUS-DP module XIOC-NET-DP-M (M = master and XIOC-NET-DP-S (S = slave) forms the interface between the XC100-/XC200-CPU and the PROFIBUS-DP, which corresponds to the standard EN 50170 Vol. 2.

→ The master module is referred to in the following with the abbreviation DP-M module; the slave module is referred to as the DP-S module. If the description applies to both modules, they are simply referred to as the DP module.

A DP module can be inserted into one of the first three slots beside the CPU. This must also be taken into consideration with the configuration in the easySoft-CoDeSys PLC configuration.

Table 16: Maximum quantity and slots for DP modules dependant on the control type

| XC    | Slot       | Max. quantity   | Comment                                |
|-------|------------|-----------------|--|
| XC100 | 1, 2 or 3  | 2 <sup>1)</sup> | → table 20                             |
| XC200 | 1, 2 and 3 | 3               | No gaps between DP modules! → table 21 |

1) From operating system version 3.10 or higher, a DP-M and a DP-S module are possible.

The DP-M module organises and operates the data transfer between the user program and the connected slaves. Up to 31 slaves can be addressed on one bus section. Several sections can be coupled together using repeaters, thus allowing up to 124 slaves to be connected.

The DP-S module can send and receive up to 244 bytes.

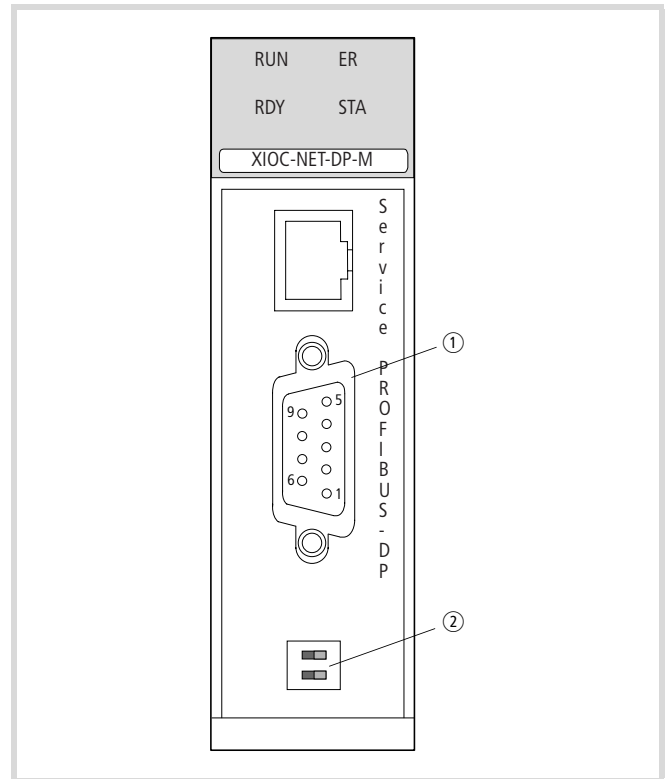


Figure 68: XIOC-NET-DP-M front view  
(XIOC-NET-DP-S is identical except for the type designation)

- ① PROFIBUS-DP interface
- ② Bus termination resistors

### Hardware and software prerequisites

The following prerequisites must be fulfilled for use of a DP module:

Table 17: Hardware and software prerequisites

| Hardware    | Software DP-M  | Software DP-S  |
|-------------|----------------|----------------|
| XC100 ≥ V04 | BTS ≥ V3.0     | BTS ≥ V3.10    |
| XC200 ≥ V04 | BTS ≥ V1.02.00 | BTS ≥ V1.03.02 |

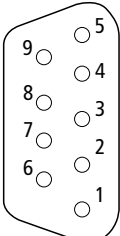
BTS = operating system

**PROFIBUS-DP module**  
**XIOC-NET-DP-M /**  
**XIOC-NET-DP-S**

**Features**

**PROFIBUS-DP interface**

In order to connect the PROFIBUS-DP cable to the galvanically isolated RS485 interface, you will require the special PROFIBUS-DP connector ZB4-209-DS2. It features the required wiring for malfunction free operation up to 12 Mbit/s.

| PROFIBUS-DP   | Pin | Meaning      |
|---|-----|--------------|
|  | 3   | RxD/TxD-P    |
|   | 4   | CNTR-P       |
|   | 5   | DGND         |
|   | 6   | VP (+5 V DC) |
|   | 8   | RxD/TxD-N    |

**Switches for bus termination resistors**

Termination resistors must be present on both ends of the cable. The DP module features switch-in bus termination resistors and can be placed at the end of a line.

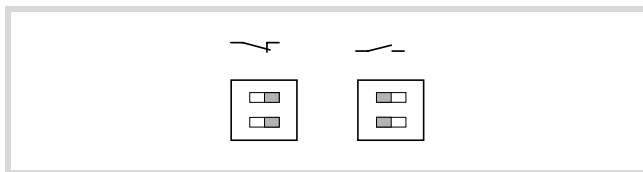


Figure 69: Bus termination resistor on the DP module (left switched on, right switched off)

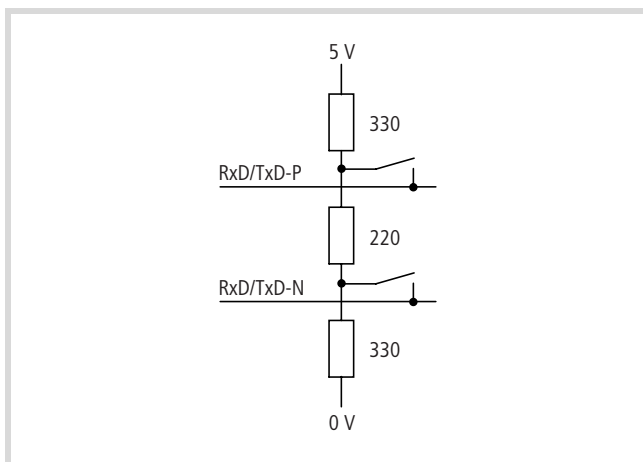


Figure 70: Bus termination resistors on the DP module

→ On modules which do not feature bus termination resistors the ZB4-209-DS2 PROFIBUS-DP connector can be used. It features a sliding switch which can be used to switch the resistors in or out.

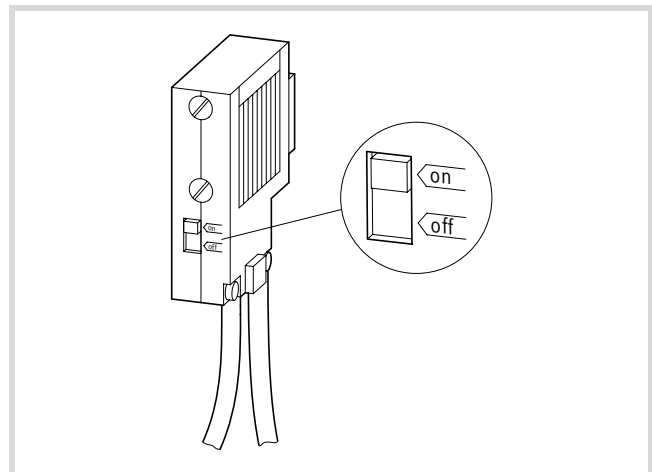


Figure 71: Bus termination resistors on PROFIBUS-DP connector

**Status and diagnostics display (LEDs)**

The four LEDs on the DP modules provide information concerning their status. They can occur in the following combinations:

| LED combination | Master status  |
|-----------------|--|
| RUN ● ○ ER      | Communication o.k.                                   |
| RDY ● ● STA     |  |
| RUN ○ ○ ER      | Hardware error                                       |
| RDY ⊗ ○ STA     |  |
| RUN ● ● ER      | All slaves are missing or there is no bus connection |
| RDY ● ● STA     |  |
| RUN ● ● ER      | At least one slave is missing                        |
| RDY ● ● STA     |  |

| LED-combination | Slave Status                                      |
|-----------------|---|
| RUN ● ○ ER      | Communication o.k.                                |
| RDY ● ● STA     |   |
| RUN ● ● ER      | Connection to master interrupted or wrong address |
| RDY ● ○ STA     |   |
| RUN ⊗ ○ ER      | Not configured                                    |
| RDY ● ○ STA     |   |

○ ON ● cyclic flash ⊗ irregular flash ○ OFF

## DP module operation

### Download behaviour

In a configuration with one or more DP modules the CPU will require a few seconds for the warm start after a project download. During this time the easySoft-CoDeSys user interface will not indicate any parameter changes or allow any data input. A "?" will appear in the configuration behind the inputs

### Behaviour after switch on of the supply voltage

An error message appears when the supply voltage is applied and the CPU does not contain a user program. The following LEDs of the DP module are displayed: ER, RDY and STA LEDs light up and the RUN LED flashes. As soon as a program is loaded, the "Error" message will disappear and the bus communication is active. As the CPU is in the STOP state, the RUN/STOP LED will flash on the CPU. A transition from STOP → RUN means the data is transferred via the bus. The LEDs now have these states: RUN, RDY and STA LED light up and the ER LED is off.

### Behaviour after RUN | STOP transition

- With configuration of the XC200 with DP-M module  
When the CPU switches from RUN to STOP, the master sets the content of all data to be sent to "0". The bus communication remains active. However, no application data is transferred.

In slaves without a user program, such as e.g. in an XI/ON-I/O unit, the outputs are set to "0" as a result. The slaves with a user program receive the "0" information in the receive data. A reaction to the "0" data must be programmed by the user.

- With configuration: XC200 with DP S module  
After the RUN → STOP transition, the slave sets the data content which is sent to the master to "0". A reaction in the master to the "0" data must be programmed by you. The communication with the master is retained. The slave receives the current data from the master as was the case beforehand.

### Behaviour after interruption of the DP line

→ section "Configuration XIOC-NET-DP-S/M", "Auto Clear Mode" function

- With configuration of the XC200 with DP-M module  
The master detects when the connection is interrupted to some slaves. In this case it sets the received data which the decoupled slaves send to "0".
- With configuration of the XC200 with DP-S module
  - Prerequisite: Watchdog active  
If the slave is decoupled, the slave sets the data sent by the master to "0" after the watchdog time has timed out. The data to the master continues to be updated by the slave.
  - Prerequisite: Watchdog not active  
After the slave is decoupled, the data last received from the master remains.

## Process analysis

The following browser commands are available for tracing the causes of malfunctions.

|              |  |
|--------------|--|
| geteventlist | Event list   |
| geterrorlist | Error list   |
| plcload      | Display of the CPU loading in %. Should be under 70 %. |

## Configuration XIOC-NET-DP-S/M

The basic configuration is described in the manual for programming software (AWB2700-1437GB).

In the master's configuration, you can change the "Auto Clear Mode" function in the DP Parameter tab:

- Not active (default): If a slave is disconnected from the bus, the master continues to communicate with the other slaves.
- Active: If a slave is disconnected from the bus, the master sets the outputs of all slaves on the bus to the safe state and stops all communication. To restart communication, switch the CPU power of and on again.

The "Autostart" function on the DP Parameter tab has no effect.

The configuration of the XIOC-NET-DP-M can be seen in the example on page 73.

A few peculiarities must be observed for configuration of the XIOC-NET-DP-S. The data to be transferred is packed into data blocks, which you can select in the "Inputs/Outputs" tab. There for example, you will find blocks available such as "2 Byte input con (0x91)" for inputs (data receive) as well as "2 Byte output con (0x91)" for the outputs (data send). The designation "con" stands for consistent. This means that the data, such a two bytes are consistent. This ensures that the master will process the two bytes simultaneously.

The same data blocks must be configured in the same sequence for the master PLC as well as for the slave PLC. In the configuration of the slave PLC the data direction is defined by the suffix "IEC-Input" (data receive) or "IEC-Output" (data send) (→ figure 83).

The quantity of transferred data in one direction is limited to:

- Data blocks: max. 24
- Byte: max. 244

In the program, the send and receive data are accessed with the directly represented variables in the configurator.

**Data exchange**

**PROFIBUS-DP module (master) t slaves**

The PROFIBUS-DP master (XIOC-NET-DP-M) supports two protocol types:

- Cyclic data exchange (DP-V0 services)  
The data exchange between the master and slaves is implemented cyclically with the PROFIBUS-DP bus. As a result the master copies the data in the input/output image of the CPU. The user program accesses this data.
- Asynchronous data exchange (DP-V1 services)  
The asynchronous data exchange serves acyclic reading and writing of data; e. g. for parametric programming of a drive. Function blocks are used for this task (see AWB278-1456GB: Acyclic data access modules for PROFIBUS-DP).

**PROFIBUS-DP master t DP-S module**

The DP master implements a cyclic data exchange (DP-V0 services) with the DP-S module. The configuration, parametric programming and programming of the PLCs is explained in section "Example: Data transfer XC200 (master) n XC100 (slave)" on page 63

**XC100/XC200 t DP-M module**

The received and transmitted data of the slave are collected in the memory of the PROFIBUS-DP module (XIOC-NET-DP-M) and exchanged with the input/output image of the control. The timing of the exchange depends on the control type and the mode of operation.

Table 18: Operating modes of the XC100/XC200

| Operating mode |                         |                         |
|----------------|-------------------------|-------------------------|
| <b>XC100</b>   | Without task management | Cyclic                  |
| <b>XC200</b>   | With task management    | periodic (monotasking)  |
|                |                         | periodic (multitasking) |

**XC100: cyclic data exchange**

On the XC100 the data exchange between the CPU and the DP-M module is determined by the program cycle.

Before the program start commences, the slave data is copied from the DP-M module into the input image of the CPU. Then the user program and the PROFIBUS-DP cycle (data exchange DP master ↔ slave) start simultaneously. At the end of the program cycle the data of the output image is copied into the DP-M module. The bus cycle time should be less than the program cycle time. If it is longer (→ figure 72), no data exchange occurs at the end of the program cycle; the bus cycle continues. This means that the next programming cycle will be performed with the "old" data from the previous bus cycle.

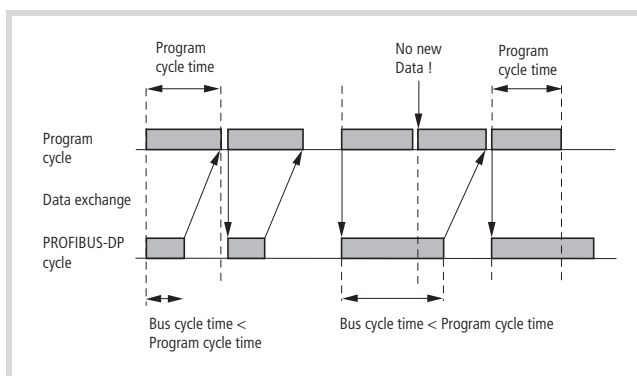


Figure 72: Data exchange between XC100 and DP-M module

**XC200: Periodic data exchange (monotasking)**

The XC200 always performs the user program periodically.

Without task management the default program PLC\_PRG is processed with a cycle time (task interval) of 10 ms. This corresponds to a program which is managed by a single task and which is accessed with a task interval of 10 ms.

The data exchange between the CPU and the DP-M module is determined by the task interval. At the end of the task interval, the data exchange between the input/output image of the CPU and the DP module occurs.

The program start is initiated with the start of the next task interval and the DP-BUS cycle (data exchange DP-Master ↔ Slaves).

The task interval must be longer than the bus cycle time in order to guarantee a refresh of the inputs/outputs in every program cycle. If the task interval is less than the bus cycle time (→ fig. 73), data exchange will not take place at the start of the following task. The bus cycle continues and a refresh of the inputs/outputs occurs in the next cycle.

In order to derive the time required for the task interval, determine the bus cycle time in dependence on the baud rate.

Select the time for the task interval to be 5 % longer than the bus cycle time.

In general, the time for the task interval is in a range from 2 ms to 500 ms.

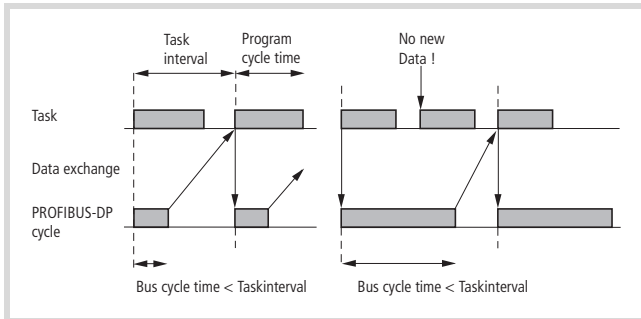


Figure 73: Data exchange with periodic operation

**Determination of the bus cycle time:**

In order to determine the bus cycle time you must access the Target Rotation Time (TTR) of the PROFIBUS-DP. It is a little longer than the bus cycle time.

The TTR can be taken from the bus parameters of the easySoft-CoDeSys configurator time

It is defined in "tBit" = "Bit times":

- ▶ Click on the XIOC-NET-DP-M folder in the PLC configuration.
- ▶ Open the "Bus Parameters" tab and set the baud rate.

The target rotation time is displayed in accordance with the baud rate, e. g. at a baud rate of 12 Mbit/s = 6647 tBit.

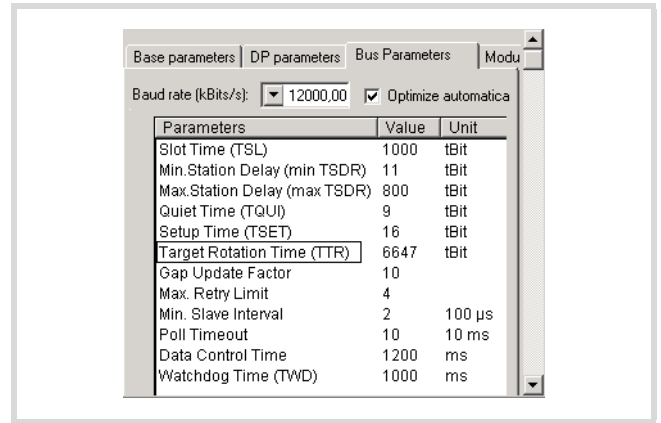


Figure 74: Setting the bus parameters

In order to ascertain the TTR in ms, determine the bit time [ns] for an individual bit using the following formula:

$$\text{Bit time [ns]} = \frac{1\,000\,000\,000}{\text{Baud rate [Bit/s]}}$$

Multiply the bit time with the TTR [tBit] which is defined in the configurator (→ fig. 74), you will receive a target rotation time in ms.

Example for a configuration comprised of a PROFIBUS-DP line with 2 stations:

The bus should be operated with a baud rate of 12 000 000 Bit/s. How long is the TTR?

$$\frac{1\,000\,000\,000}{12\,000\,000} = 83,33 \text{ ns (time for one bit)}$$

$$83 \times 6647 \text{ (tBit config.)} = 0.55 \text{ ms (TTR)}$$

Add 5 % and you receive the time for the task interval = approx. 0.60 ms. In this case however, 2 ms should be entered as the smallest task interval is 2 ms!

If you select this configuration with 2 stations having different baud rates, the following TTR results

**PROFIBUS-DP module**  
**XIOC-NET-DP-M /**  
**XIOC-NET-DP-S**

Table 19: Target Rotation Time, dependent on the baud rate

| Baud rate    | 1 tBit [ns] | Config. [tBit] | TTR [ms] |
|--------------|-------------|----------------|----------|
| 12 Mbit/s    | 83          | 6647           | 0,5539   |
| 6 MBit/s     | 166         | 5143           | 0,8572   |
| 3 MBit/s     | 333         | 4449           | 1,4830   |
| 1,5 MBit/s   | 666         | 4449           | 2,9660   |
| 500 Kbit/s   | 2000        | 3416           | 6,8320   |
| 187,5 Kbit/s | 5333        | 2994           | 15,9680  |
| 93,75 Kbit/s | 10666       | 2994           | 31,9360  |
| 19,2 Kbit/s  | 52038       | 2994           | 155,9375 |
| 9,6 Kbit/s   | 104167      | 2994           | 311,8750 |

A change of the station count or the transmitted data would result from another TTR!

**Task control in online operation**

In online mode the status of a task is defined in the configuration tree. The timing of a task can be monitored with the aid of a graphic representation. A prerequisite for this function is that the "SysTaskInfo.lib" and "SysLibTime.lib" library functions are appended into the easySoft-CoDeSys (↔ AWB2700-1437GB, Section "Resources", "Task configuration"). When "SysTaskInfo.lib" is appended, the "SysLibTime.lib" is automatically appended.

**Reaction time on PROFIBUS-DP**

Figure75 indicates the course of an input on a PROFIBUS-DP slave from processing until a slave output is set.

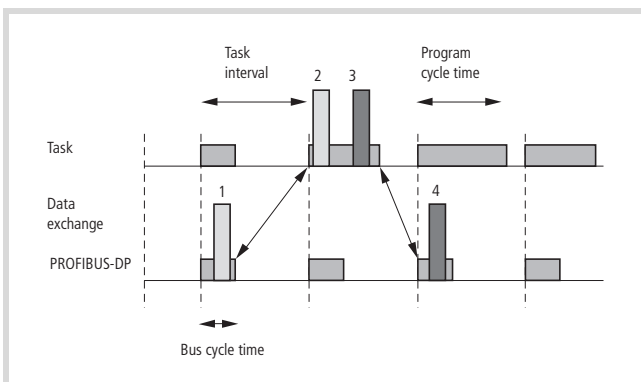


Figure 75: Reaction time on PROFIBUS-DP

**Procedure:**

Prerequisite: the bus run time is less than the task interval.

- ① The voltage is applied to a slave input. The "1" signal is detected during the bus cycle.
- ②, ③ The input data of the slave is copied into the input image of the CPU at the beginning of the following task interval. The input is processed ② and the result is presented to the output ③. The outputs are copied to the output image at the end of the task interval.
- ④ The output of the slave is set in the following bus cycle.

**XC200: multitasking mode**

The multitasking mode is described in the XC200 manual (AWB2724-1491G). Here are a few notes for use of the DP module.

The data exchange between the CPU and the DP-M module is determined by the task interval. Verify that the following conditions have been fulfilled when you have assigned each configured DP-M module with a TASK:

- The tasks must have differing priorities!
- The inputs and outputs of the slave which have been coupled to a line have also been referenced!
- The set the time for a task interval is in a range from 2 ms to 500 ms.

**XC100/XC200**

If differing tasks operate on the inputs/outputs of a DP-line, the first configured task in which a slave output is used initiates the PROFIBUS-DP cycle.

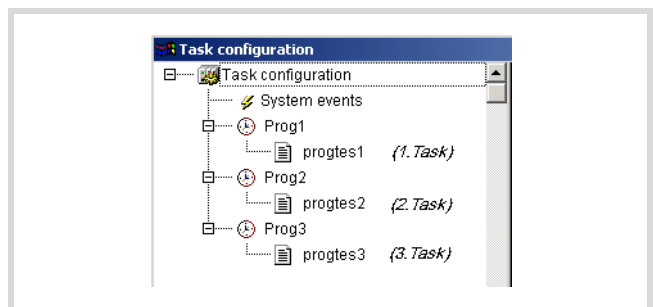


Figure 76: Configuration with three tasks

If for example, an output is not used in Task 1 but is used in Task 2 and 3, the PROFIBUS cycle will be started at the commencement of the second Task "Prog2". The data exchange occurs at the end of the task.

**XC100: status indication of the PROFIBUS-DP slave**

Analog and digital input and output states of the PROFIBUS-DP slave, which are connected via the DP-M module with the XC100 can be made visible in the status indication.

Prerequisites:

- A simple program (e.g.: a:=a) is loaded and the CPU is in STOP or RUN
- The inputs/outputs are configured
- Voltage/current is applied to the inputs.

The outputs of the PROFIBUS-DP slaves can be set in the configuration for test purposes if the following prerequisites are fulfilled:

- A simple program (e.g.: a:=a) is loaded and the CPU is in RUN
- The inputs/outputs are configured
- The outputs of the PLC configuration are clicked and a value is defined.

Neither a declaration or a program addressing the inputs/outputs is required.

**Example: Data transfer XC200 (master) n XC100 (slave)**

The example shows the configuration, parametric programming and programming of the both controls. Every PLC sends 2 bytes and receives 1 byte.

The design of the controls can be seen in Figure77.

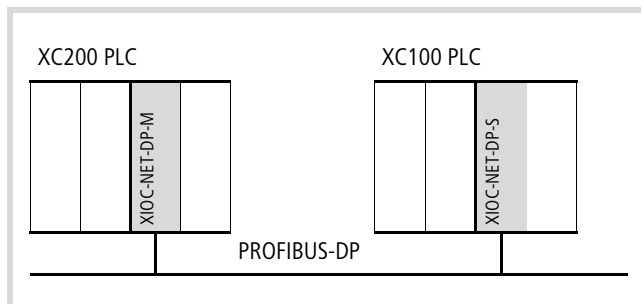


Figure 77: Design of the controls

- ▶ First of all configure the XC200 according to Figure78.

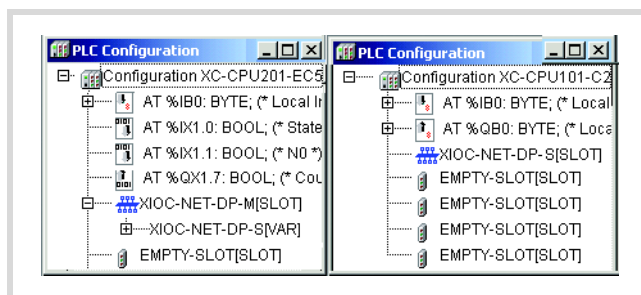


Figure 78: XC200 configuration

Define the parameters for the master in the XC200:

- ▶ Click on the "XIOC-NET-DP-M" and select the following settings:
  - in the DP Parameter tab: highest station address = 2
  - in the Bus Parameter tab: e.g. 1500.00
- ▶ Click on the "XIOC-NET-DP-S" folder.
- ▶ Select in the "Inputs/Outputs" tab (→ figure 79) the inputs/outputs for the slave, so that it corresponds to Figure80.

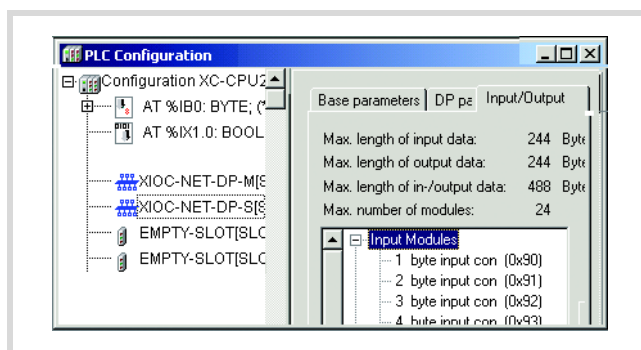


Figure 79: Selection of the inputs/outputs

→ Some input/output designations have the “con” suffix. This means that the data, such as two bytes are consistent. This ensures that the master will process the two bytes simultaneously.

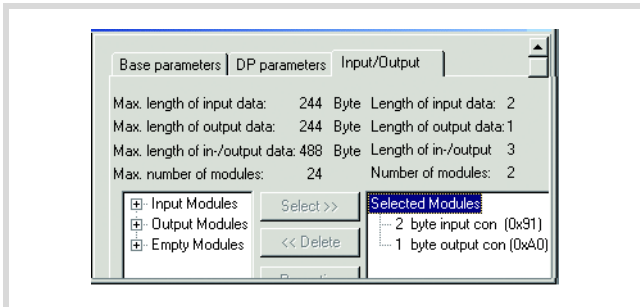


Figure 80: Parametric programming of the inputs/outputs

The direct I/O addresses are then displayed under XIOC-NET-DP-S in the XC200 control configuration, → figure 83.

► Create the program in accordance with Figure81.

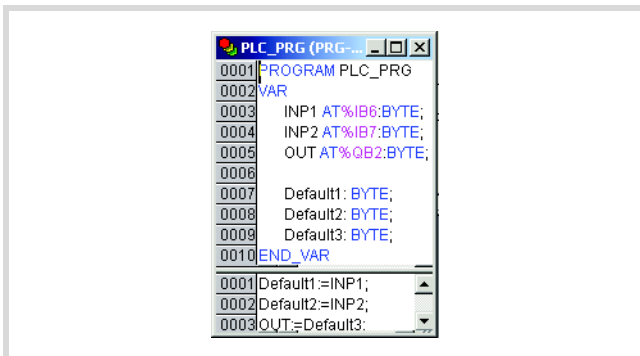


Figure 81: User program for XC200

Proceed in the same manner with the XC100 PLC.

Configure the XC100 according to Figure82:

- Enter the station address “2” in the “DP Parameter” tab.
- Select the inputs/outputs for the slave in the “Inputs/Outputs” tab.

The selection of the modules including their identity (e.g. 0x91) and their sequence must correspond with the selection in the DP-M/DP-S module, → figure 80.

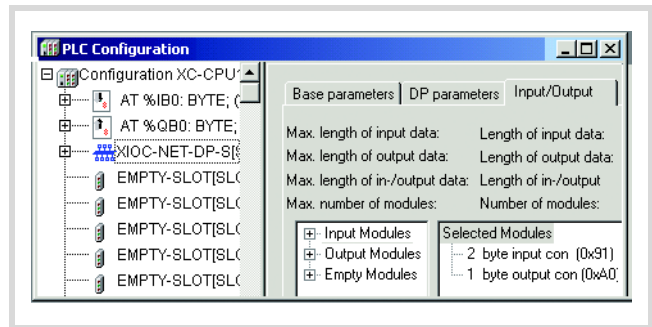


Figure 82: XC100 I/O configuration

Immediately afterwards the PLC configuration under XIOC-NET-DP-S displays the direct I/O addresses. If you compare the input/output details e.g. “2 Byte Input con” of the XC100 with the XC200, you will see that they are identical. The additional designation “IEC-Output” or “IEC-Input” provides information about the actual data direction. The details of the direct address such as IB/QB also provide the actual data direction. If for example a date in the XC100 is transferred from the QB2 (output byte ) to the IB6 (input byte) of the XC200.

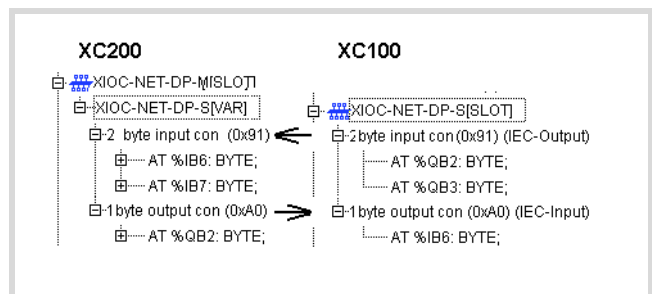


Figure 83: Display of the direct addresses and their data direction

► Create the program in accordance with Figure84.

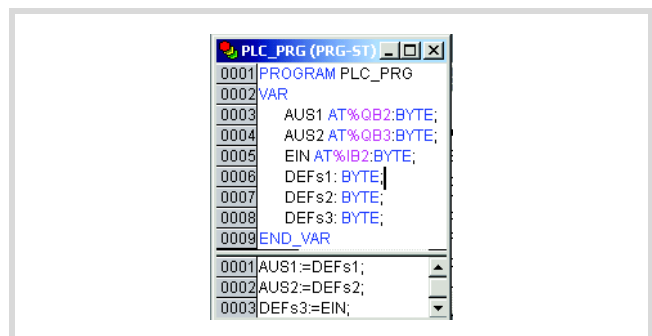


Figure 84: User program for XC100

### Diagnostics of the PROFIBUS-DP slaves

The diagnostics in the PROFIBUS-DP is organised so that the master collects the diagnostics data which has been provided by the slaves.

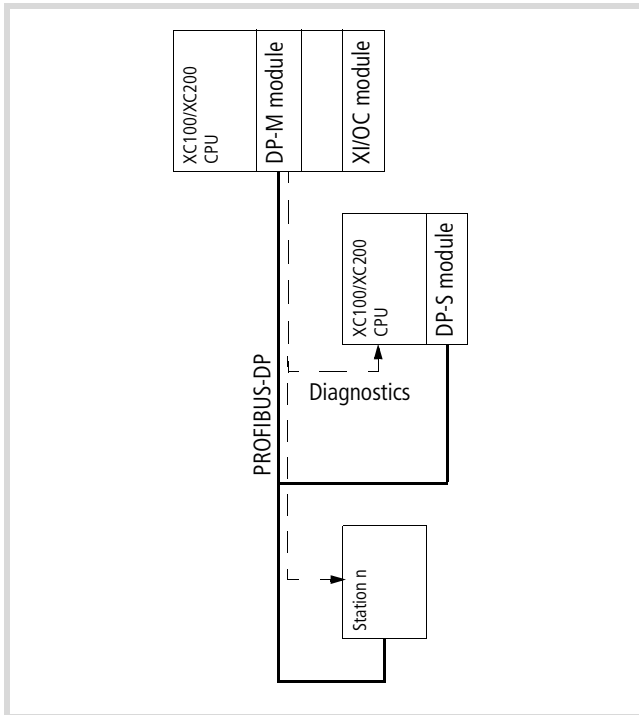


Figure 85: Diagnostics on the PROFIBUS-DP line

The evaluation of the diagnostics data can be programmed with the aid of function blocks. This can happen in two different methods. Both methods can continue to be used.

| Method for existing applications  | Method for new applications   |
|---|---|
| With the variables of the GETBUSSTATE type and the DIAGGETSTATE function block. | With the xDiag_SystemDiag and xDiag_ModuleDiag function blocks.<br>Software prerequisite (OS version):<br>XC100: 3.10<br>XC200: 1.03.02 |
| Library: BusDiag.lib  | Library: xSysDiagLib.lib  |
| The method is explained later   | The method is described in AWB2768-1456, chapter "Diagnostics module: xSysDiagLib".   |

Regardless of this, a slave can become active with the aid of the "xDPS\_SendDiag" function block, e.g. in order to inform the master of a RUN → STOP or STOP → RUN transition. In this case you must program the module with the START/STOP interrupt function. The information to be sent can be placed in an array which accesses the function block → section "Diagnostics in the slave control" on page 70.

### Implement diagnostics

The "BusDiag.lib" library file provides a GETBUSSTATE structure and the DIAGGETSTATE function block for implementation of the diagnostics. In section "Program example for diagnostics in the master control" from page 73 you will see how you can link the structure and the function block in the program with one another.

```

TYPE GETBUSSTATE;
STRUCT
    BOLDENABLE:    BOOL;
    ENABLE:        BOOL;
    DRIVERNAME:    POINTER TO STRING;
    DEVICENUMBER:  INT;
    READY:        BYTE;
    STATE:        INT;
    EXTENDEDINFO: ARRAY[0..129] OF BYTE;
END_STRUCT
END_TYPE
    
```

The assignment between DP module and diagnostics function block is implemented with the aid of a device number, which depends additionally on the module slot, → table 20 when the XC100 PLC or the → table 21 XC200 are used:

Table 20: Device number for XC100

| XIOC-Slot  | 1        | 2        | 3        |
|------------|----------|----------|----------|
| Module     | DP-M     | DP-S     | X-module |
| Device No. | 0        | 1        | –        |
| Module     | DP-S     | DP-M     | X-module |
| Device No. | 0        | 1        | –        |
| Module     | DP-M/S   | X-module | X-module |
| Device No. | 0        | –        | –        |
| Module     | X-module | DP-M     | DP-S     |
| Device No. | –        | 0        | 1        |
| Module     | X-module | DP-S     | DP-M     |
| Device No. | –        | 0        | 1        |
| Module     | X-module | DP-M/S   | X-module |
| Device No. | –        | 0        | –        |
| Module     | X-module | X-module | DP-M/S   |
| Device No. | –        | –        | 0        |

**PROFIBUS-DP module**  
**XIOC-NET-DP-M /**  
**XIOC-NET-DP-S**

Table 21: Device number for XC200

| XI/OC slot | 1        | 2        | 3        |  |
|------------|----------|----------|----------|--|
| Module     | DP-M/S   | DP-M/S   | DP-M/S   |  |
| Device No. | 0        | 1        | 2        |  |
| Module     | DP-M/S   | DP-M/S   | X-module |  |
| Device No. | 0        | 1        | –        |  |
| Module     | X-module | DP-M/S   | DP-M/S   |  |
| Device No. | –        | 0        | 1        |  |
| Module     | DP-M/S   | DP-M/S   | DP-M/S   | Configuration fault: Gaps are invalid! <sup>1)</sup> |
| Device No. | 0        | –        | 2        |  |
| Module     | X-module | X-module | DP-M     |  |
| Device No. | –        | –        | 0        |  |

X-module: no PROFIBUS-DP module

1) The configurator permits this design, but a fault is indicated during compilation.

**Diagnostics data evaluation**

You must create a variable of the GETBUSSTATE type (the procedure is described in section section "Coarse diagnostics with variable from GETBUSSTATE type") to evaluate the diagnostics data. With the EXTENDEDINFO array the variable provides each station with a (station) byte where the individual bits contain information concerning the status of the communication and the slave. The content of the byte is continually refreshed by the run time system (→ table 22 on page 67).

Query bit 2 of this station byte for coarse diagnostics. If the slave sends a diagnostics message, the assigned station byte will set bit 2 to the "1" signal state. In order to reset the signal (Bit 2 → "0" signal) call up the DIAGGETSTATE function block.

Query the EXTENDEDINFO output array of the DIAGGETSTATE function block for detailed diagnostics.

→ The EXTENDEDINFO output array from the DIAGGETSTATE function block is not identical with the EXTENDEDINFO array of the variables of the GETBUSSTATE type!

Further information can be found at section "Detailed diagnostics with DIAGGETSTATE function block" on page 67.

**Monitoring data exchange**

A station byte contains further information in the EXTENDEDINFO array GETBUSSTATE variable, e.g. the status of the data exchange between the master and the respective station. Query bit 1 for this purpose.

If data exchange functions bit 1 has the "1" signal state. A "0" signal indicates that the data exchange has been interrupted, e.g. by a cable break or device malfunction. In this case the slave cannot send diagnostics.

**Coarse diagnostics with variable from GETBUSSTATE type**

**Create variables of the GETBUSSTATE type**

A prerequisite for diagnostics is that the "BusDiag.LIB" file is integrated into the project. A directly addressable global variable of the GETBUSSTATE type must be created in order to access the diagnostics data. It is listed in the PLC Configuration under the "Diagnostic address" handle.

► Click on the "XIOC-NET-DP-M" folder in the PLC configuration.

The "Diagnostic address" is displayed on the "Base parameters" tab. The diagnostics address is called %MB4 for the XC100 and the first DP line of the XC200.

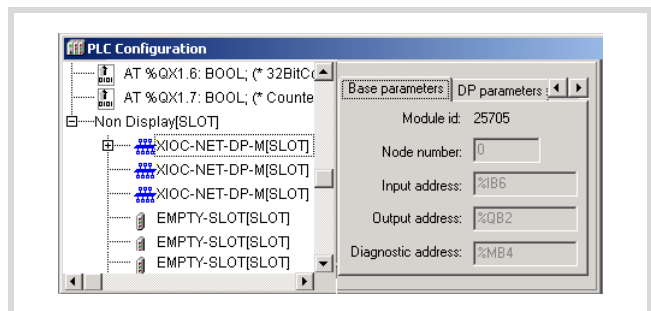


Figure 86: Diagnostic address

Declaration with XC100:

```
Var_Global
  DPSTAT AT%MB4 : GETBUSSTATE; (* MB4 diagnostics address of
  End_Var                                     the DP-master *)
```

Declaration with XC200 with 3 DP lines:

```
Var_Global
  DPSTAT_1 AT%MB4 : GETBUSSTATE; (* 1st master *)
  DPSTAT_2 AT%MBxx : GETBUSSTATE; (* 2nd master *)
  DPSTAT_3 AT%MByz : GETBUSSTATE; (* 3rd master *)
  End_Var
```

Query variables from the GETBUSSTATE type:  
The diagnostics data are written in an ARRAY OF BYTES with the EXTENDEDINFO structure names.

Evaluate the EXTENDEDINFO array:  
In principle the array has the following structure:

Table 22: Station byte

| Bit      | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Station address |
|----------|---|---|---|---|---|---|---|---|-----------------|
| Byte 0   |   |   |   |   |   | × | × | × | 0               |
| bytes1   |   |   |   |   |   | × | × | × | 1               |
| bytes2   |   |   |   |   |   | × | × | × | 2               |
| bytes3   |   |   |   |   |   | × | × | × | 3               |
| ...      |   |   |   |   |   |   |   |   |                 |
| bytes125 |   |   |   |   |   | × | × | × | 125             |

Each byte contains diagnostics information of a station. It is continuously refreshed by the run time system. Bit 0, 1 and 2 contain the following diagnostics data. Bit 3 to bit 7 are without significance.

Table 23: Diagnostics information

|            |   |
|------------|---|
| Bit 0 = 1: | A configuration exists for the address.   |
| Bit 1 = 1: | Data exchange ok<br>Bit 1 already indicates a "1" signal when data exchange for coupling of the slave has been successful. This means: the connection is o.k. and data exchange occurs. |
| Bit 2 = 1: | New diagnostics data exist.   |

For diagnostics, monitor the station byte for fault signals commencing with address 2 up to max. address 125. In the example it occurs with the query:

```
IF (xxx.EXTENDEDINFO[n] >=6) THEN
```

xxx = global variable of GETBUSSTATE type, e.g. DPSTAT  
n = address of the station

### Detailed diagnostics with DIAGGETSTATE function block

The DIAGGETSTATE function block must be accessed for each station/node (BUSMEMBERID).

```
FUNCTION_BLOCK DiagGetState
VAR_INPUT
    ENABLE:          BOOL;
    DRIVERNAME:     POINTER TO STRING ; (* XC100/XC200 = 0 *)
    DEVICENUMBER:   INT ; (*XC100: 0, 1/XC200: 0, 1, 2*)
    BUSMEMBERID:    DWORD ;
END_VAR

VAR_OUTPUT
    READY:          BOOL;
    STATE:          INT;
    EXTENDEDINFO:   ARRAY[0..99] OF BYTE ;
END_VAR
```

➔ The EXTENDEDINFO output of the "DiagGetState" function block is independent of the EXTENDEDINFO output of the GETBUSSTATE structure.

The program example for diagnostics indicates a line with an XI/ON station and an EM4/LE4 input/output combination (➔ from page 74).

After the parameters have been applied to the DRIVERNAME, DEVICENUMBER and BUSMEMBERID function inputs, a "1" must be applied to the ENABLE input.

If the READY function input is a "1" and the STATE output is a "2" (compare with the defined constants "NDSTATE\_DIAGINFO\_AVAILABLE = 2), the EXTENDEDINFO output array can be queried.

### Inputs/outputs of the DIAGGETSTATE function block

| Inputs       |   |
|--------------|---|
| ENABLE       | 1 = activate<br>0 = deactivate  |
| DRIVERNAME   | = 0 ( <b>always 0 with XC100/XC200</b> )  |
| DEVICENUMBER | XC100 = 0, 1/XC200 = 0, 1, 2  |
| BUSMEMBERID  | Address of the slaves   |
| Outputs      |   |
| READY        | 0 = module inactive<br>1 = module active  |
| STATE        | constants have been determined for the values<br>-1, 0, 1, 2, 3:<br>-1: NDSTATE_INVALID_INPUTPARAM<br>0: NDSTATE_NOTENABLED<br>1: NDSTATE_GETDIAG_INFO<br>2: NDSTATE_DIAGINFO_AVAILABLE<br>3: NDSTATE_DIAGINFO_NOTAVAILABLE |
| EXTENDEDINFO | Further diagnostic data is present in the 100 byte.   |

- Data content of DIAGGETSTATE.EXTENDEDINFO  
The data content of DIAGGETSTATE.EXTENDEDINFO is subdivided into:

- General diagnostics data (Byte 0 to 7)
- Standard diagnostics data (Byte 8 to 13)
- Device-specific diagnostics data (Byte 14 to 99)

The device-specific diagnostics data is described in the device documentation and in the respective GSD file.

The most important information has a grey background in the following table.

|   |   |
|---|---|
| EXTENDEDINFO[0]                             | //with PROFIBUS-DP: slave address               |
| EXTENDEDINFO[1..4]                          | //no meaning                                    |
| EXTENDEDINFO[5]                             | //length byte of the device diagnostic          |
| EXTENDEDINFO[6&7]                           | //no meaning                                    |
| EXTENDEDINFO[8]<br>(Standard byte 1)        | //Status_1                                      |
| Bit 0:                                      | Device does not respond (no valid IO data)      |
| Bit 1:                                      | Slave not ready                                 |
| Bit 2:                                      | Divergent configuration                         |
| Bit 3:                                      | Further diagnostics exist                       |
| Bit 4:                                      | Unknown command                                 |
| Bit 5:                                      | Invalid response                                |
| Bit 6:                                      | Incomplete parametric programming               |
| Bit 7:                                      | Parametric programming from another master      |
| EXTENDEDINFO[9]<br>(Standard byte 2)        | //Status_2                                      |
| Bit 0:                                      | Ready for new starting sequence                 |
| Bit 1:                                      | No parametric programming                       |
| Bit 2:                                      | "1"   |
| Bit 3:                                      | Watchdog activated                              |
| Bit 4:                                      | FREEZE command active                           |
| Bit 5:                                      | SYNC command active                             |
| Bit 6:                                      | Reserved  |
| Bit 7:                                      | Slave has not been engineered                   |
| EXTENDEDINFO[10]<br>(Standard byte 3)       | //no meaning                                    |
| EXTENDEDINFO[11]<br>(Standard byte 4)       | //for PROFIBUS-DP: master address               |
| EXTENDEDINFO[12&13]<br>(Standard byte 5, 6) | //Own identity number                           |
| EXTENDEDINFO[14]                            | //Length byte of the manufacturer-specific data |
| EXTENDEDINFO[15..99]                        | //device-specific diagnostics.                  |

• Diagnostics capable XI/ON modules

If you perform diagnostics with the DIAGGETSTATE function block on a XI/ON station, the EXTENDEDINFO output displays the diagnostics data for the entire station in bytes 15 and 16. The data originate from the GSD file of the central XI/ON gateway.

Byte 17 to 99 contains the fault code for the modules with diagnostics capability. This occurs in the module sequence. A byte will not exist for non-diagnostic capable modules.

|                        |    |   |                                   |
|------------------------|----|---|-----------------------------------|
| EXTENDEDINFO[15]       | // | Bit 0:  | Module diagnostics present        |
|                        |    | Bit 2:  | Parametric programming incomplete |
|                        |    | Bit 3:  | Divergent configuration           |
| EXTENDEDINFO[16]       | // | Bit 1:  | –                                 |
|                        |    | Bit 2:  | Module bus fault                  |
|                        |    | Bit 3:  | Master configuration fault        |
|                        |    | Bit 4:  | –                                 |
|                        |    | Bit 5:  | Station configuration fault       |
|                        |    | Bit 6:  | I/Oassistant force mode active    |
|                        |    | Bit 7:  | Module bus failure                |
| EXTENDEDINFO [17...99] | // | one or more bytes for each diagnostics capable module (→ following table; further information can be found in the "XI/ON PROFIBUS-DP" manual (AWB2700-1394G). |                                   |

The following excerpt from the "XI/ON Gateways for PROFIBUS-DP" (AWB2725-1529G) manual indicates the diagnostics bit of the XI/ON modules:

|                                 |        |                            |
|---------------------------------|--------|----------------------------|
| <b>e.g. power supply module</b> |        |                            |
| XN-BR-24VDC-D                   | Bit 0: | Module bus voltage warning |
|                                 | Bit 2: | Field voltage missing      |
| XN-PF-24VDC-D                   | Bit 2: | Field voltage missing      |
| XN-PF-120/230VAC-D              | Bit 2: | Field voltage missing      |
| <b>e.g. output modules</b>      |        |                            |
| XN-2DO-24VDC-0.5A-P             | Bit 0: | Overcurrent channel 1      |
| XN-2DO-24VDC-2A-P               | Bit 1: | Overcurrent channel 2      |
| XN-2DO-24VDC-0.5A-N             |        |                            |
| XN-16DO-24VDC-0.5A-P            |        |                            |
| <b>e.g. analog module</b>       |        |                            |
| XN-1AI-I                        | Bit 0: | Measured value range fault |
|                                 | Bit 1: | Wire breakage              |
| XN-1AI-U                        | Bit 0: | Measured value range fault |

|                  |          |  |
|------------------|----------|--|
| XN-2AI-PT/NI-2/3 | 1st BYTE |  |
|                  | Bit 0:   | Measured value range fault (channel 1) |
|                  | Bit 1:   | Wire breakage                          |
|                  | Bit 2:   | Short-circuit                          |
|                  | 2nd BYTE |  |
|                  | Bit 0:   | Measured value range fault (channel 2) |
|                  | Bit 1:   | Wire breakage                          |
|                  | Bit 2:   | Short-circuit                          |

**e.g. counter module**

|                   |        |                                      |
|-------------------|--------|--------------------------------------|
| XN-1CNT-24VDC (C) | Bit 0: | Short-circuit/wire breakage DO       |
|                   | Bit 1: | Short-circuit 24 V DC encoder supply |
|                   | Bit 2: | Count range end false                |
|                   | Bit 3: | Count range start false              |
|                   | Bit 4: | Invert DI with L ret. fault          |
|                   | Bit 5: | Main count direction false           |
|                   | Bit 6: | Operating mode false                 |
| XN-1CNT-24VDC (M) | Bit 0: | Short-circuit/wire breakage DO       |
|                   | Bit 1: | Short-circuit 24 V DC encoder supply |
|                   | Bit 2: | Encoder impulse false                |
|                   | Bit 3: | Integration time false               |
|                   | Bit 4: | Upper limit false                    |
|                   | Bit 5: | Lower limit false                    |
|                   | Bit 6: | Operating mode false                 |

**e.g. DOL starter module**

|         |        |                   |
|---------|--------|-------------------|
| XS1-XBM | Bit 0: | Ident fault       |
|         | Bit 1: | PKZ short-circuit |
|         | Bit 2: | PKZ overload      |
|         | Bit 4: | DIL1 defective    |
|         | Bit 5: | DIL2 defective    |

• Diagnostics byte of EM4/LE4 modules

→ Further information about the diagnostics is contained in the "EM4-204-DX1, expansion module for PROFIBUS-DP" module (AWB27-1315G).

The data content of DIAGGETSTATE.EXTENDEDINFO has the following meaning:

|                       |  |
|-----------------------|--|
| EXTENDEDINFO[0...13]  | as previously described                |
| EXTENDEDINFO[14]      | Length byte                            |
| EXTENDEDINFO[15]      | Group diagnostics byte for all modules |
| EXTENDEDINFO[16]      | Diagnostics byte for EM4               |
| EXTENDEDINFO[17...22] | Diagnostics byte for 1 ... 6 LE        |

PROFIBUS-DP module  
XIOC-NET-DP-M /  
XIOC-NET-DP-S

### Diagnostics in the slave control

Generally the master (DP-M module) queries the slave (DP-S module) if a diagnostics fault exists. In this case the master accesses the standard diagnostics data from the slave. Evaluation of this data is described in section "Diagnostics data evaluation" on page 66.

Furthermore, the slave can become active and send diagnostics data. Thus for example, the start/stop event can be evaluated and the master can be informed of application-specific data.

The slave activity is used to inform the master of the start/stop state as well as important user-specific data. Transfer of the data should not occur continuously as otherwise the load on the bus will be too high. The transfer is implemented with the Diagnostic module "xDPS\_SendDiag" (see section below) in the slave program. You can determine the content of the user-specific data and can copy it from the area defined in the module.

If the bus connection is interrupted after the start of the function block, the send job is performed as soon as the connection is re-established.

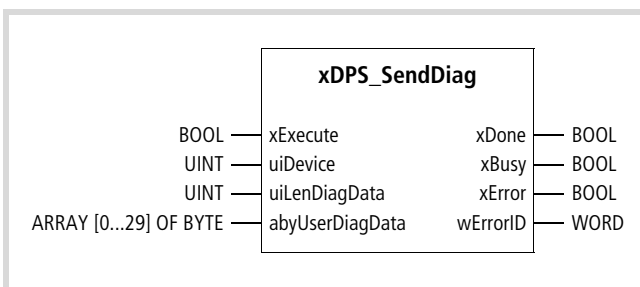
The assignment between the XIOC-NET-DP-S DP module and the diagnostics module is implemented with the aid of a device number, which is also dependent on the module slot. → table 20 Table 21

### Query master and connection status

If a query concerning the master state (RUN/STOP) or the connection state be necessary in the slave PLC, this function has to be programmed. More detailed information can be found here in the AWB2786-1456GB manual at "xDiag\_SystemDiag" and "xDiag\_ModuleDiag" function blocks.

### Diagnostic module "xDPS\_SendDiag"

This function block is located in the "xSysNetDPSDiag.lib" library



Function block prototype

### Meanings of the operands

|                 |   |
|-----------------|---|
| xExecute        | Start,<br>Prerequisite: xBusy output = L signal<br>xDone output = L signal<br><br>The input is to be set to an L signal, after the xDone-output = H signal.   |
| uiDevice        | DP slave device number  |
| uiLenDiagData   | Length of the diagnostics data (Byte 0 to 30)<br>The standard diagnostics data is sent with 0, → section "Data content of DIAGGETSTATE.EXTENDEDINFO" to page 68.  |
| abyUserDiagData | Diagnostics data of the user  |
| xDone           | H signal after the order has been processed<br><br>If "xExecute" changes from a H to L signal, the "xDone" output has an L signal   |
| xBusy           | H signal, after a valid job is present  |
| xError          | The outputs should be scanned after the xDone output changes from an L signal to a H signal.  |
| wErrorID        | If the xExecute input is set to an L signal, the Error output is also set to the L signal.<br><br>Error code<br>0: ok<br>1: incorrect device number<br>2: invalid length of the diagnostics data<br>3: no resources available<br>4: internal fault<br>5: error message of PROFIBUS-DP |

### Description

Access to the function block in the slave program has the effect than the master gets application-specific diagnostics data during the next access to the slave, and then exchanges the I/O data cyclically thereafter.

The CPU requires several cycles in order to process the function block!

As it can replace multiple master/slave modules, the device number must be entered on the "uiDevice" input. It represents the assignment between the function block and the module.

The following applies for the XC100: 0, 1 → table 20

The following applies for the XC200: 0, 1, 2 → table 21

**Application example for sending diagnostics data  
(with the xDPS\_SendDiag function block)**

The program example has been created as a function block, which includes the xDPS\_SendDiag module.

The transfer parameters are:

|                                   |   |
|-----------------------------------|---|
| uiDevice:UINT;                    | Device number                             |
| uiLenDiagData:UINT;               | Length of the diagnostics data to be sent |
| abyDiagData: ARRAY[0..29]OF BYTE; | Diagnostics data ByteArray                |

If processing of the function block is interrupted by a malfunction, the "DiagErrorWarning" variable is set. It should be declared as a global variable.

```

FUNCTION_BLOCK DP_SendDiag_Slave

VAR_INPUT                                (* Transfer parameter *)
    uiDevice:UINT;                        (* Device number*)
    uiLenDiagData:UINT;                  (* Length of the diagnostics data to be sent *)
    abyDiagData: ARRAY[0..29]OF BYTE;    (* Diagnostics data ByteArray *)
END_VAR

VAR_OUTPUT
    xError:BOOL;
    wErrorId:WORD;
END_VAR

VAR
    DpSndDiag : xDPS_SendDiag;
    Timer:TON;
    (*Test_Counter1: UINT;*)
    (*Test_Counter2: UINT;*)
END_VAR

Program:

IF NOT DpSndDiag.xBusy AND NOT DpSndDiag.xExecute THEN
    DpSndDiag.uiDevice:=uiDevice;
    DpSndDiag.uiLenDiagData:=uiLenDiagData;
    DpSndDiag.abyUserDiagData:=abyDiagData;
    DpSndDiag.xExecute:=TRUE;
END_IF

```

```
WHILE (NOT DpSndDiag.xDone )
DO
    Timer.PT:=T#2s;                                (* Avoid an endless loop if DpSndDiag.xDone has not been ended*)
    Timer.IN:=TRUE;
    Timer();

    IF Timer.Q =TRUE THEN
        DiagErrorWarning:=TRUE;

        EXIT;
    END_IF
    (*Test_Counter1:=Test_Counter1+1;*)
    DpSndDiag();
    xError:=DpSndDiag.xError;
    wErrorId:=DpSndDiag.wErrorId;
END_WHILE

DpSndDiag.xExecute:=FALSE;
DpSndDiag();

Timer.IN:=FALSE;
Timer();
(*Test_Counter2:=Test_Counter2+1;*)
```

**Program example for diagnostics in the master control**

The diagnostics will be explained using a program example which is based on the device design in figure 69. The diagnostics programs are also valid for other devices. In this example the XC100 assumes the control function.

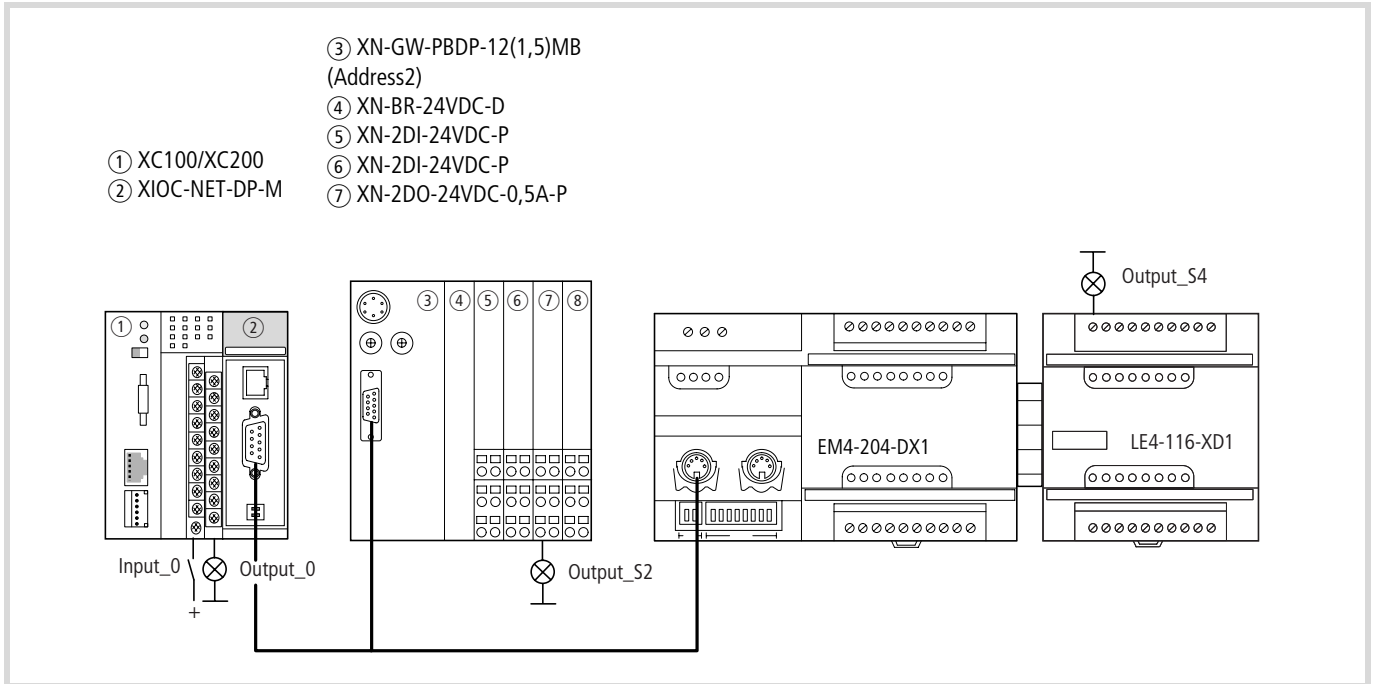


Figure 87: Configuration of the example project

**Create configuration**

The device configuration is implemented with the PLC Configuration of the programming software (→ AWB2700-1437, "PLC Configuration" section).

Create the configuration according to the following example:

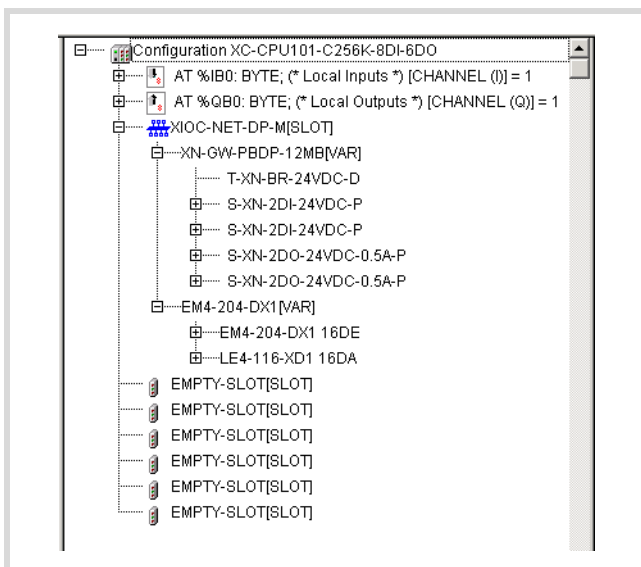


Figure 88: Device configuration in the easySoft-CoDeSys

**Configuration of the XIOC-NET-DP-M**

► Call up the "PLC Configuration" in the "Resources" tab.

The XC100 is displayed with inputs and outputs as well as several "Empty Slot" folders.

- Click with the right mouse button on one of the three EMPTY SLOT [Slot] folders under the QB0 output byte.
- Place the mouse pointer on the "replace element" and select the XIOC-NET-DP-M module from the list. It is added to the configuration and four tabs appear on the right hand window:

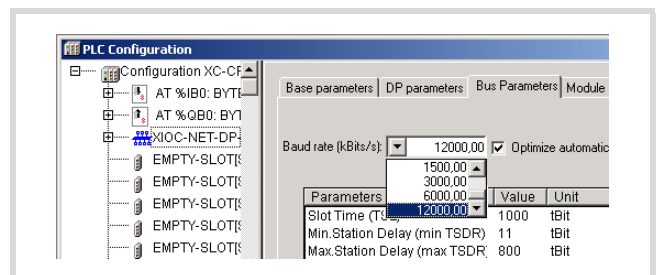


Figure 89: Configuration of the XIOC-NET-DP-M

**PROFIBUS-DP module**  
**XIOC-NET-DP-M /**  
**XIOC-NET-DP-S**

- ▶ Set the baud rate in the "Bus parameters" tab and verify if the "Optimize automatic" function is active.

### Configure XION station

- ▶ Click with the right mouse button on the XIOC-NET-DP-M[Slot] folder.
- ▶ Select "Append subelement" and click on a "Bus Refreshing module", e.g. XN-GW-PBDP-xxMB. It is added to the PLC configuration.
- ▶ Set the parameters in the various tabs for the XN-GW-PBDP:
  - Enter the station address in the "DP Parameter".
  - Modify the settings as follows in the "User parameters" tab (Set the cursor on the "Value" column and double click):
    - Diagnostics from modules: activate
    - Gateway diagnostics: device related diagnostics
- On the "Inputs/Outputs" tab:  
 Determine the I/O types of which the XION station is comprised:
  - ▶ Select the Bus Refreshing module first in all cases:
    - Mark the T-XN-BR-24VDC-D on the left window under "empty modules".
    - Press the "Select" button in order to transfer the module to the right hand window.

- ▶ Proceed in the same manner with other modules. After selection of all modules, the right hand window should include all the modules:

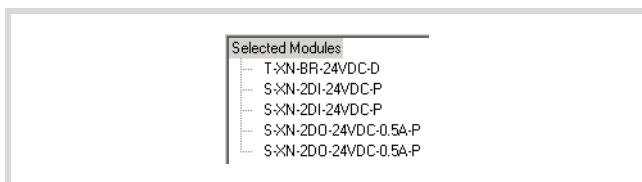


Figure 90: Configuration of the XION station

### Configuration of the EM4/LE4 module

- ▶ Set the cursor on the XIOC-NET-DP-M[SLOT] folder and confirm with the right hand mouse button.
- ▶ Set the cursor on the "Append subelement" point and select the EM4-204-DX1 module from the list. The device is added to the configuration.
- ▶ Set the parameters in the tabs:
  - Enter the station address in the "DP Parameter".
  - Select your modules in the "Input/Output" tab:
    - Mark the EM4-204-DX1 module on the left window under "Input Modules" and confirm with the "Select" button. The module is selected into the right "Selected modules" window.
    - Select the "LE4-116-XD1" under "Output modules".

Both modules are displayed on the right side window and are part of the configuration. This completes the configuration.

→ If you use the LE4 with analog inputs/outputs, also read the section "Parametric programming of the LE4 with analog inputs/outputs" on page 78.

### Structure of the program example with a master

The PLC\_PRG main program processes the inputs and outputs and calls the DP\_DIAG subprogram which contains the diagnostics in the first section and the communications query in the second section. The communication query is implemented for two stations. If you wish to add more slaves, copy a program section and add the parameters to the declaration section.

In general, the following programming measures should be implemented:

- ▶ Create a GETBUSSTATE global variable type:
 

```
DPSTAT AT%MB4: GETBUSSTATE
```
- ▶ Enter the maximum bus address in the declaration section:
 

```
Adr_max_DP: BYTE:=124;
```

→ In this example "3" is the maximum address. If a higher address is entered, e. g. 124, without the devices actually being physically connected, the time for processing the program is extended.

### Function of the program example

If a voltage is applied to input IX0.0 (Input\_0 = first input on the I/O module of the CPU) the following outputs should be set:

- QX0.0 (Output\_0) = first output on I/O module of the CPU,
- QX2.0 (Output\_S2) first output on XION module,
- QX4.0 (Output\_S4) = first output on LE4-116-XD1.

### Function of the diagnostics program

Bit 2 of all station bytes must be checked for querying the diagnostics messages. This occurs with the instruction:

```
IF DPSTAT.EXTENDEDINFO[n_DWORD] >=6 THEN
  DPSTAT is an instance name of GETBUSSTATE
  n_DWORD = address of the slave
```

Sends the slave a diagnostics message, e.g. a short-circuit, bit 2 of the station byte is set. The DIAGGETSTATE function block is accessed and the DIAGGETSTATE.EXTENDEDINFO output array is copied in a DIAGDATA\_DP dummy field. You can take the diagnostics data directly from the "DIAGSTATE.EXTENDEDINFO" output array or from the "DIAGDATA\_DP" output array.

If a fault has been recognised and processed, the GETBUSSTATE.EXTENDEDINFO output array recommences the query at the first station.

If a direct query is demanded, you can set an auxiliary marker which indicates when a fault indication is received (→ note in program example) and queries the fault code contained in it.

The content of the "DiagData\_DP" array corresponds with the content of the "DiagGetState.EXTENDEDINFO" array. The array is described in section "The data content of DIAGGETSTATE.EXTENDEDINFO is subdivided into:" on page 68.

If a short-circuit occurs on output QX2.0 (first output of the XION station) the fault is diagnosed.

In online mode the "DiagData\_DP" array contains the following details:

```

┌───DIAGSTATE_DP
├───DiagData_DP
│   ├───DiagData_DP[0] = 2
│   ├───DiagData_DP[1] = 0
│   ├───DiagData_DP[2] = 0
│   ├───DiagData_DP[3] = 0
│   ├───DiagData_DP[4] = 0
│   ├───DiagData_DP[5] = 12
│   ├───DiagData_DP[6] = 5
│   ├───DiagData_DP[7] = 1
│   ├───DiagData_DP[8] = 8
│   ├───DiagData_DP[9] = 12
│   ├───DiagData_DP[10] = 0
│   ├───DiagData_DP[11] = 1
│   ├───DiagData_DP[12] = 2
│   ├───DiagData_DP[13] = 179
│   ├───DiagData_DP[14] = 6
│   ├───DiagData_DP[15] = 1
│   ├───DiagData_DP[16] = 0
│   ├───DiagData_DP[17] = 0
│   └───DiagData_DP[18] = 1

```

- The "2" in the byte DiagData\_DP[0] = 2 indicates the address of the slave.
- Bit 3 is set in byte 8: Extended diagnostics exist (Bit 3 = 1 signal → 00001000 binary or 8 decimal)

This indicates that further information exists for example in byte 15 and 18:

- Bit 0 is set in byte 15: module diagnostics exist
- Bit 1 is set in byte 18: overcurrent channel 1

If the short-circuit is eliminated, the slave sends the diagnostics message again which causes the bit to reset.

### Function of the data exchange (monitoring)

Bit 1 of all stations should be queried to check the data exchange. This occurs with the instruction:

```
IF DPSTAT.EXTENDEDINFO[n].1 = TRUE THEN
  DPSTAT is an instance name of GETBUSSTATE
  n = address of the slave
```

With an existing connection the variables KOM2\_ok or KOM3\_ok are set to "1". If the connection to a slave is interrupted the variables are reset to "0".

The variables KOMx\_ok can be used again in the main program.

PROFIBUS-DP module  
XIOC-NET-DP-M /  
XIOC-NET-DP-S

## Program example for diagnostics with a master

### Global variable declaration

```
VAR_GLOBAL
  DPSTAT AT %MB4:           GetBusState;           (*Must be generally declared*)
(*See description "Create and query variables of the GETBUSSTATE type" *)
  KOM2_ok:                 BOOL;
  KOM3_ok:                 BOOL;
  Input_0 AT %IX0.0:       BOOL;
  Output_0 AT %QX0.0:      BOOL;
  Output_S2 AT %QX2.0:     BOOL;
  Output_S4 AT %QX4.0:     BOOL;
END_VAR
```

### PROGRAM PLC\_PRG

```
Declaration:
VAR
END_VAR

Program:
Output_0:=Input_0;
Output_S2:=Input_0;
Output_S4:=Input_0;

DIAG_DP;                               (*Diagnostics program*)

(* IF KOM2_ok =TRUE THEN                Data exchange query ok?
  Data transfer: Master <-> Slave 2     Run data exchange!
  END_IF*)

(* IF KOM3_ok =TRUE THEN                Data exchange query ok?
  Data transfer: Master <-> Slave 3     Run data exchange!
  END_IF*)
```

### PROGRAMM DIAG\_DP

```
Declaration:
VAR
  DIAGSTATE_DP :           DiagGetState;
  DiagData_DP:           ARRAY[0..99] OF BYTE ;
  wHelp_DP:             WORD;
  Adresse_DP:           DWORD;
  n_DWORD:             DWORD;
END_VAR
VAR CONSTANT
  Adr_max_DP:           BYTE:=124;           (*Enter max. bus address!*)
END_VAR
```

```

Program:
(*-----Diagnostics-----*)
IF DIAGSTATE_DP.ENABLE = FALSE THEN
  Adresse_DP:=0;
  FOR n_DWORD:=2 TO Adr_max_DP DO
    IF (DPSTAT.EXTENDEDINFO[n_DWORD] >=6) THEN
      Address_DP:=n_DWORD;
      EXIT;
    END_IF
  END_FOR

  IF DIAGSTATE_DP.ENABLE = FALSE THEN
    DIAGSTATE_DP.DRIVERNAME:=0;          (* always 0 *)
    DIAGSTATE_DP.DEVICENUMBER:=0;       (* DP master is the first device with DeviceNo = 0*)
    DIAGSTATE_DP.BUSMEMBERID:=Adresse_DP; (* Slave Address *)
    DIAGSTATE_DP.ENABLE:=TRUE;
    DIAGSTATE_DP();                      (* Call FB *)
  END_IF
END_IF
IF DIAGSTATE_DP.ENABLE = TRUE THEN
  IF DIAGSTATE_DP.READY THEN
    IF DIAGSTATE_DP.STATE=NDSTATE_DIAGINFO_AVAILABLE THEN
      (*Diaginfo:=TRUE;*)
      (*Set auxiliary marker: If diagnostics data query =0->1, the diagnostics data is valid and can be queried.
      The marker must be reset in the user program.*)
      FOR wHelp_DP:=0 TO (DIAGSTATE_DP.EXTENDEDINFO[14]+13) BY 1 DO
        DiagData_DP[wHelp_DP]:=DIAGSTATE_DP.EXTENDEDINFO[wHelp_DP];
      END_FOR
    END_IF
    DIAGSTATE_DP.ENABLE:=FALSE;
  END_IF
  DIAGSTATE_DP();
END_IF

(* Communication ok-- Slave 2 -----*)

IF DPSTAT.EXTENDEDINFO[2].1 = TRUE THEN
KOM2_ok:=FALSE;
ELSE
KOM2_ok:=TRUE;
END_IF

(* Communication ok-- Slave 3 -----*)

IF DPSTAT.EXTENDEDINFO[3].1 = TRUE THEN
KOM3_ok:=FALSE;
ELSE
KOM3_ok:=TRUE;
END_IF

(* End of ProfibusDP diagnostics *)

```

### Parametric programming of the LE4 with analog inputs/outputs

In this section you will discover how the LE4-206-AA1 and LE4-206-AA2 analog modules parameters are programmed with the aid of the easySoft-CoDeSys configurator:

- ▶ Add the EM4 -204-DX1 to the configuration and select the analog modules:

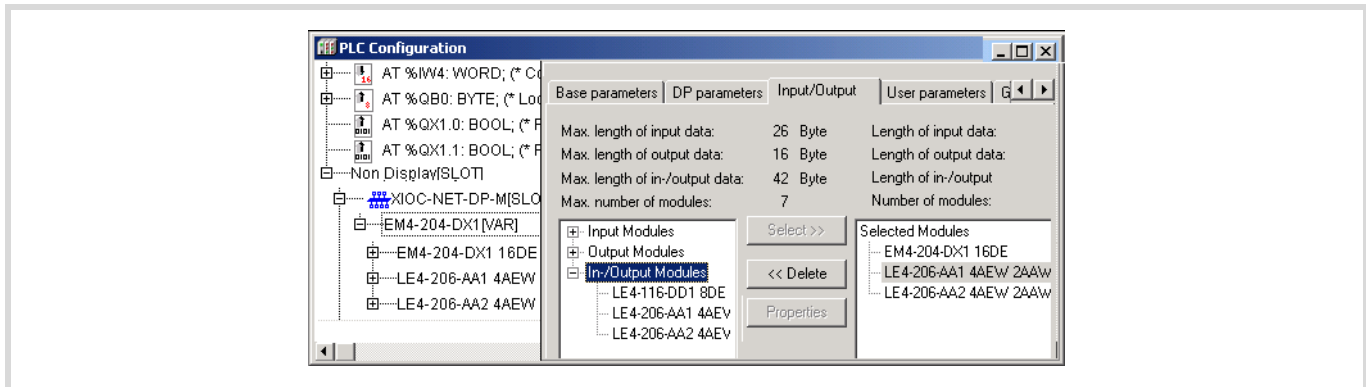


Figure 91: Adding analog modules to the configuration

- ▶ Mark a LE4 and click on the "Properties" button.

The "module properties" window opens.

- ▶ Click on the "IO count/Resolution/IOscan" text.

The following parameter setting properties are displayed

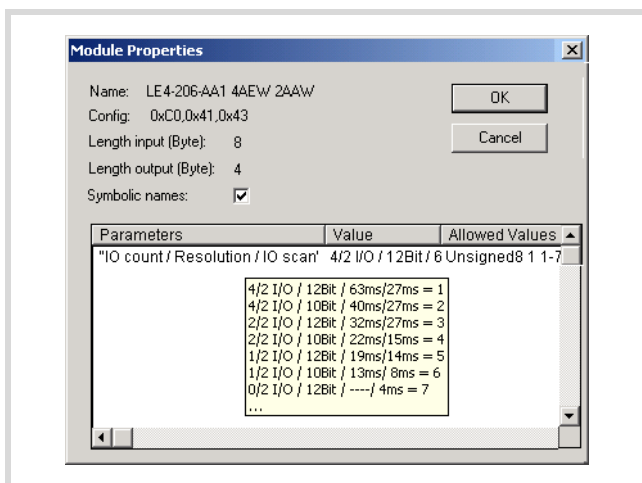


Figure 92: Analog module parameter module

The standard parameters are defined in the "value" field. You can change the setting by clicking on the first entry. The following value is displayed with each double click.

## 8 Technical data

### XControl

| <b>General</b>                                |   |
|---|---|
| Standards and regulations                     | IEC/EN 61131-2,<br>EN 50178                 |
| Ambient temperature                           | 0 to +55 °C                                 |
| Storage temperature                           | -25 to +70 °C                               |
| Vibration resistance                          | 10 – 57 Hz ±0.075 mm,<br>57 – 150 Hz ±1.0 g |
| Mechanical shock resistance                   | 15 g/11 ms                                  |
| Shock resistance                              | 500 g/∅ 50 mm ±25 g                         |
| Overvoltage category                          | II  |
| Pollution degree                              | 2   |
| Protection class                              | 1   |
| Enclosure protection                          | IP20  |
| Interference emission                         | DIN/EN 55011/22,<br>Class A                 |
| <b>Electromagnetic compatibility</b>          |   |
| Electrostatic discharge<br>(IEC/EN 61000-4-2) |   |
| Contact discharge                             | 4 kV  |
| Radiated<br>(IEC/EN 61000-4-3, RFI)           |   |
| AM/PM   | 10 V/m                                      |
| Burst (IEC/EN 61 000-4-4)                     |   |
| Supply cables                                 | 2 kV  |
| Signal cables                                 | 1 kV  |
| Surge (IEC/EN 61000-4-5)                      |   |
| Supply cables, asymmetrical                   | 0.5 kV                                      |
| Conducted (IEC/EN 61 000-4-6)                 |   |
| AM  | 10 V  |
| <b>External supply voltage</b>                |   |
| Rated voltage $U_e$                           | 24 V DC (12 V DC)                           |
| Permissible range                             | 20.4 to 28.8 V DC<br>(11.8 to 14.4)         |
| Input voltage ripple                          | < 5 %                                       |
| Bridging voltage dips                         |   |
| Drop-out duration                             | 10 ms                                       |
| Repeat rate                                   | 1 s   |

Technical data

Digital input modules

| Type   | XIOC-8DI                             | XIOC-16DI                            | XIOC-32DI                                   |
|--|--------------------------------------|--------------------------------------|---|
| Input type   | DC input                             | DC input                             | DC input                                    |
| Number of input channels   | 8                                    | 16                                   | 32  |
| Number of channels with common reference potential <sup>1)</sup> | 8                                    | 16                                   | 32, reference potential: 4 terminals        |
| Input voltage  | 24 V DC                              | 24 V DC                              | 24 V DC                                     |
| Input voltage range  | 20.4 to 28.8 V DC                    | 20.4 to 28.8 V DC                    | 20.4 to 28.8 V DC                           |
| Input resistance   | Typ. 3.5 kΩ                          | Typ. 5.9 kΩ                          | Typ. 5.6 kΩ                                 |
| Input current  | Typ. 6.9 mA                          | Typ. 4.0 mA                          | Typ. 4.3 mA                                 |
| Voltage level  |                                      |                                      |   |
| ON   | ≧ 15V                                | ≧ 15V                                | ≧ 15V                                       |
| OFF  | ≦ 5V                                 | ≦ 5V                                 | ≦ 5V  |
| Input signal delay   |                                      |                                      |   |
| OFF → ON   | ≦ 5 ms (4 ms normally)               | ≦ 5 ms (4 ms normally)               | 5 ms  |
| ON → OFF   | ≦ 5 ms (4 ms normally)               | ≦ 5 ms (4 ms normally)               | 5 ms  |
| Electrical isolation   |                                      |                                      |   |
| between inputs and the I/O bus                                   | Through optocouplers                 | Through optocouplers                 | Through optocouplers                        |
| Input indication   | By LED (green)                       | By LED (green)                       | With LED (green) <sup>2)</sup>              |
| External connection  | Plug-in terminal block <sup>3)</sup> | Plug-in terminal block <sup>3)</sup> | XIOC-TERM32 (connector/cable) <sup>3)</sup> |
| Internal current consumption (5 V DC)                            | Typ. 26 mA                           | Typ. 51 mA                           | Typ. 100 mA                                 |
| Weight   | 0.16 kg                              | 0.16 kg                              | 0.16 kg                                     |

- 1) The reference potential terminals are internally connected.
- 2) LED convertible 0 – 15, 16 – 31 (→ figure 1 on page 8)
- 3) Not supplied with the module

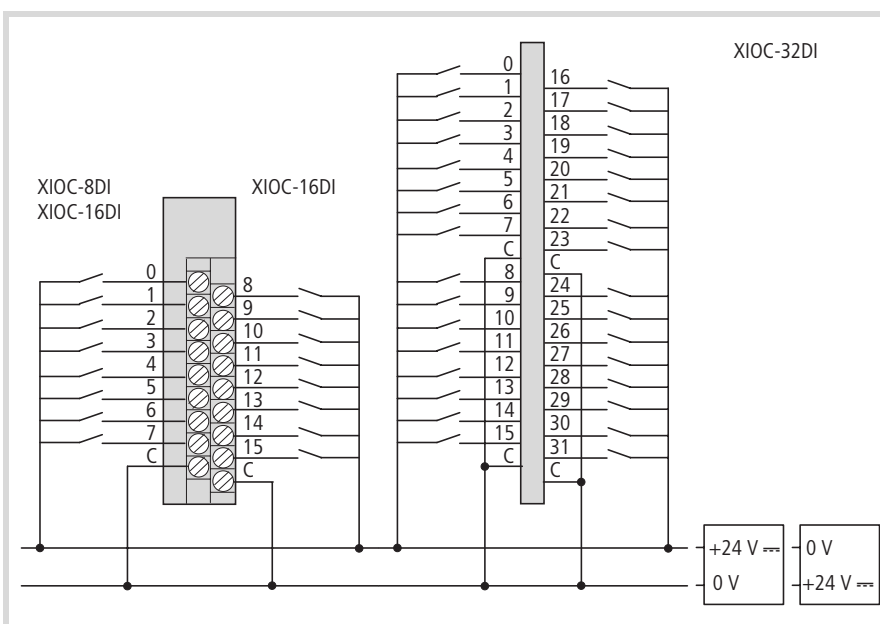


Figure 94: Terminal assignment

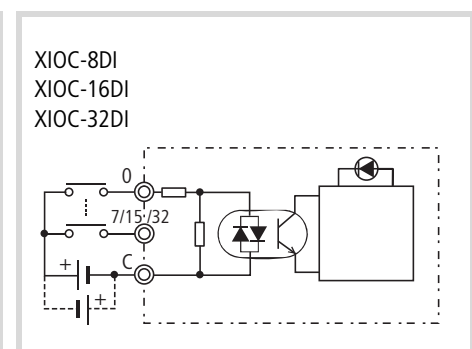


Figure 93: Connection example

| Type   | XIOC-16DI-110VAC                         | XIOC-16DI-AC                             |
|--|--|--|
| Input type   | AC input                                 | AC input                                 |
| Number of input channels   | 16                                       | 16                                       |
| Number of channels with common reference potential <sup>1)</sup> | 16                                       | 16                                       |
| Input voltage  | 100 to 40 V AC                           | 200 to 240 V AC                          |
| Input voltage range  | 85 to 132 V DC                           | 170 to 264 V DC                          |
| Input resistance   | Typ. 16 kΩ (50 Hz)<br>Typ. 13 kΩ (60 Hz) | Typ. 32 kΩ (50 Hz)<br>Typ. 27 kΩ (60 Hz) |
| Input current  | 4.8 to 7.6 mA (100 V AC/50 Hz)           | 4. to 8.0 mA (200 V AC/50 Hz)            |
| Voltage level  |  |  |
| ON   | ≧ 79 V AC                                | ≧ 164 V AC                               |
| OFF  | ≦ 20 V AC                                | ≦ 40 V AC                                |
| Input signal delay   |  |  |
| OFF → ON   | ≦ 15 ms                                  | ≦ 15 ms                                  |
| ON → OFF   | ≦ 25 ms                                  | ≦ 25 ms                                  |
| Electrical isolation   |  |  |
| between inputs and the I/O bus                                   | Through optocouplers                     | Through optocouplers                     |
| Input indication   | By LED (green)                           | By LED (green)                           |
| External connection  | Plug-in terminal block <sup>2)</sup>     | Plug-in terminal block <sup>2)</sup>     |
| Internal current consumption (5 V DC)                            | Typ. 51 mA                               | Typ. 51 mA                               |
| Weight   | 0.18 kg                                  | 0.18 kg                                  |

1) The reference potential terminals are internally connected.

2) Not supplied with the module

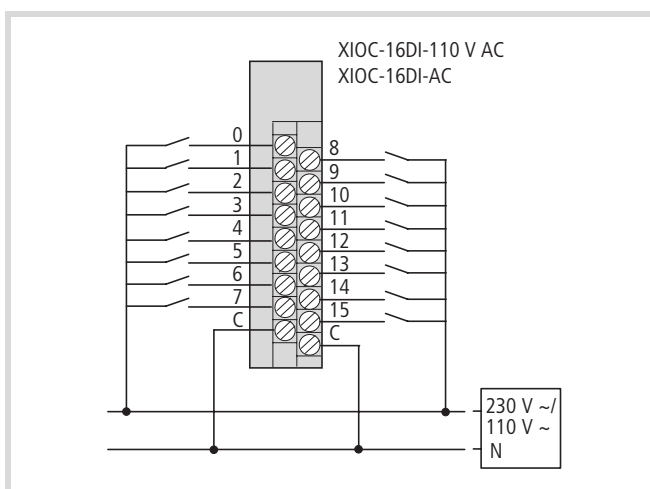


Figure 95: Terminal assignment

## Technical data

## Digital output modules

## Transistor output modules

| Type   | XIOC-8DO                             | XIOC-16DO                            | XIOC-16DO-S                          | XIOC-32DO                                       |
|--|--------------------------------------|--------------------------------------|--------------------------------------|---|
| Output type  | Transistor output (source type)      | Transistor output (source type)      | Transistor output (source type)      | Transistor output (source type)                 |
| Number of output channels                          | 8                                    | 16                                   | 16                                   | 32  |
| Number of channels with common reference potential | 8                                    | 16                                   | 16                                   | 32  |
| Output voltage                                     | 12/24 V DC                           | 12/24 V DC                           | 12/24 V DC                           | 12/24 V DC                                      |
| Switching current, minimum                         | 1 mA                                 | 1 mA                                 | 1 mA                                 | 1 mA  |
| Residual current for a "0" signal                  | 0.1 mA                               | 0.1 mA                               | 0.1 mA                               | 0.1 mA  |
| Rated current                                      |                                      |                                      |                                      |   |
| for "1" signal                                     | 0.3 A                                | 0.3 A                                | 0,8A                                 | 0,2A  |
| Per common potential terminal                      | 2,4A                                 | 4A                                   | 5A                                   | 3.2 A ( $\Sigma = 6.4 A$ )                      |
| Output signal delay                                |                                      |                                      |                                      |   |
| OFF → ON   | ≤ 0,3 ms                             | ≤ 0,3 ms                             | ≤ 0,3 ms                             | ≤ 0,3 ms  |
| ON → OFF   | ≤ 1 ms                               | ≤ 1 ms                               | ≤ 1 ms                               | ≤ 1 ms  |
| Overvoltage protection                             | Diode                                | Diode                                | Integrated                           | Diode   |
| Fuse <sup>1)</sup>                                 | 4A                                   | 8A                                   | None                                 | 8A  |
| Electrical isolation                               |                                      |                                      |                                      |   |
| between outputs and the I/O bus                    | Through optocouplers                 | Through optocouplers                 | Through optocouplers                 | Through optocouplers                            |
| Short-circuit protection                           | –                                    | –                                    | Yes                                  | –   |
| Output indication                                  | By LED (green)                       | By LED (green)                       | By LED (green)                       | With 16 LEDs (green) <sup>2)</sup>              |
| External connection                                | Plug-in terminal block <sup>3)</sup> | Plug-in terminal block <sup>3)</sup> | Plug-in terminal block <sup>3)</sup> | XIOC-TERM32 (connector and cable) <sup>3)</sup> |
| Internal current consumption (5 V DC)              | Typ. 30 mA                           | Typ. 50 mA                           | Typ. 50 mA                           | Typ. 250 mA                                     |
| External power supply <sup>4)</sup>                | 12/24 V DC (page 79)                 | 12/24 V DC (page 79)                 | 12/24 V DC (page 79)                 | 12/24 V DC (page 79)                            |
| Weight   | 0.16 kg                              | 0.16 kg                              | 0.16 kg                              | 0.16 kg   |

1) A blown fuse must not be replaced by the user.

2) LED convertible: 0 – 15, 16 – 31 (→ figure 1 on page 8)

3) Not supplied with the module

4) Important! For UL applications the power supply lines must have a cross-section of AWG16 (1.3 mm<sup>2</sup>).

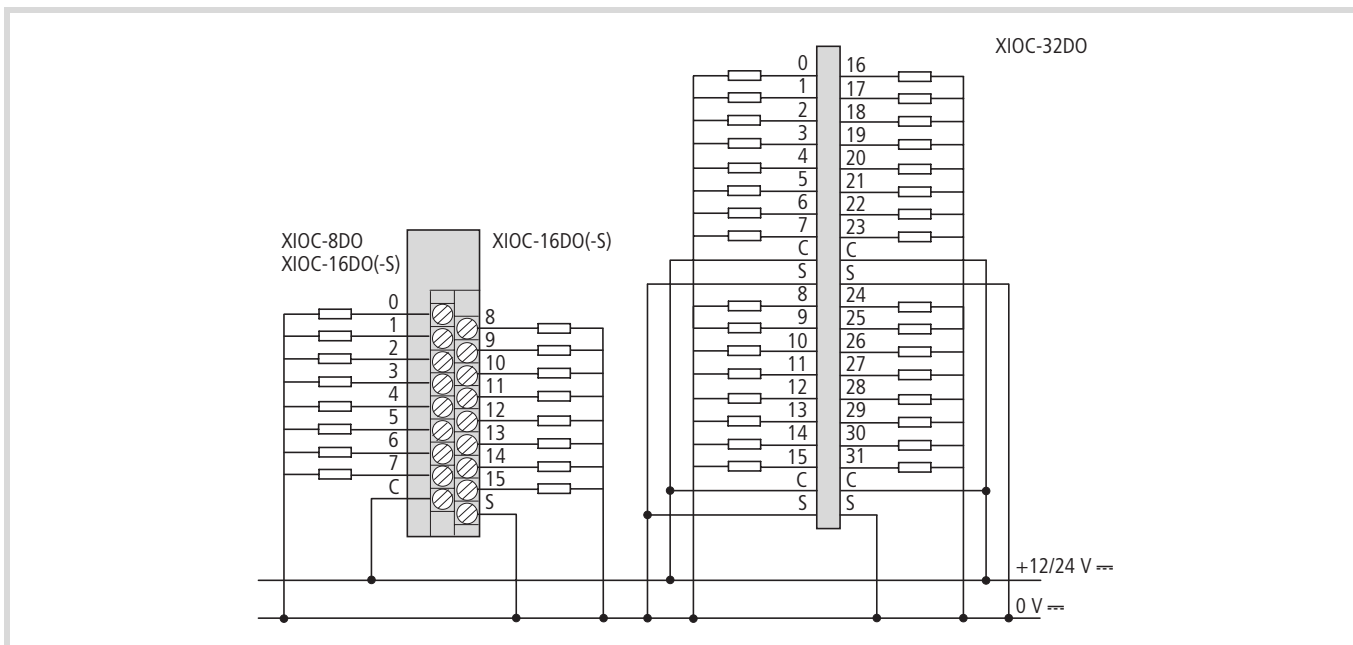


Figure 96: Assignment of the terminals and pins

### Relay output module

| Type   | XIOC-12DO-R                          |
|--|--------------------------------------|
| Output type  | Relay output                         |
| Number of output channels  | 12                                   |
| Number of channels with common reference potential <sup>1)</sup> | 12                                   |
| Output voltage   | 100/240 V AC, 24 V DC                |
| Switching current, minimum                                       | 1 mA                                 |
| Rated current  |                                      |
| for "1" signal   | 2A                                   |
| Per common potential terminal                                    | 5A                                   |
| Output signal delay  |                                      |
| OFF → ON   | ≤ 10 ms                              |
| ON → OFF   | ≤ 10 ms                              |
| Overvoltage protection   | External                             |
| Fuse   | External                             |
| Potential isolation between relay and the I/O bus                | Through optocouplers                 |
| Output indication  | By LED (green)                       |
| <b>General</b>   |                                      |
| External connection  | Plug-in terminal block <sup>2)</sup> |
| Internal current consumption (5 V DC)                            | Typ. 40 mA                           |
| External power supply <sup>3)</sup>                              | 24 V DC → page 79                    |
| Weight   | 0.2 kg                               |

Legend for the table:

- 1) The reference potential terminals are internally connected.
- 2) Not supplied with the module
- 3) An external 24 V DC voltage must be applied. Important! For UL applications the power supply lines must have a cross-section of AWG16 (1.3 mm<sup>2</sup>).

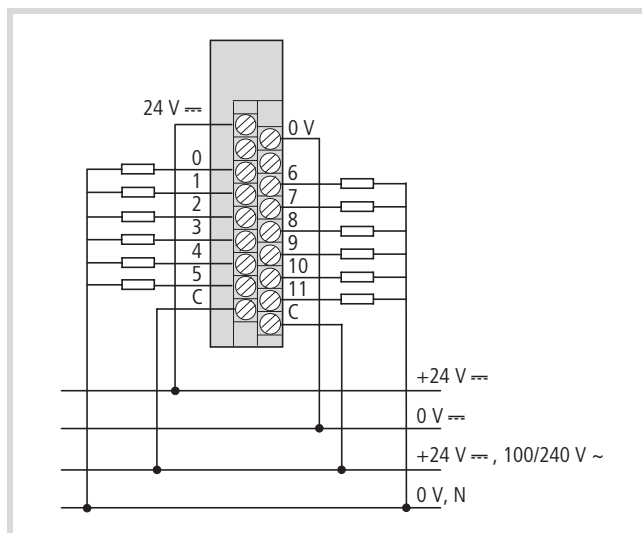


Figure 97: Terminal assignment for the XIOC-12DO-R module

→ Legends in the next column

**Technical data**

**Digital input/output modules**

**Caution!**  
The operating voltages for the inputs and outputs must come from the same source as those for the module.

| Type   | XIOC-16DX   |
|--|---|
| <b>Inputs</b>                                |   |
| Input type                                   | DC input  |
| Number of input channels                     | 16 (0 to 15)  |
| Input voltage                                | 24 V DC   |
| Range  | 20.4 to 28.8 V DC   |
| Input resistance                             | 5.6 kΩ  |
| Input current                                | Typ. 4 mA   |
| Voltage level                                |   |
| ON   | ≧ 15V   |
| OFF  | ≧ 5V  |
| Input signal delay                           |   |
| OFF → ON                                     | typically 100 μs  |
| ON → OFF                                     | typically 1 ms  |
| Electrical isolation                         |   |
| between inputs and the I/O bus               | Through optocouplers  |
| Input indication                             | By LED (green)  |
| <b>Outputs</b>                               |   |
| Output type                                  | Transistor (Source)   |
| Number of outputs                            | 12 (0 to 11)  |
| Output voltage                               | 24 V DC   |
| Residual current for a "0" signal            | approx. 140 μA  |
| Rated current                                |   |
| for "1" signal                               | 0.5 A DC at 24 V DC   |
| Lamp load                                    | 4 W, without series resistor  |
| Simultaneity factor g                        | 1   |
| Relative ON time (duty cycle)                | 100 %   |
| Limiting of switch-off voltage               |   |
| For inductive loads                          | yes, -21 V (for U <sub>N</sub> = 24 V DC)   |
| Switching repetition rate (actions per hour) |   |
| For time constant t ≤ 72 ms                  | 3600 (G = 1)  |
| Parallel wiring capability of outputs        | in groups 0 to 3, 4 to 7, 8 to 11; actuation of the outputs within a group only in the same program cycle |
| Number of outputs                            | max. 3  |
| Maximum total current                        | 2 A per group   |
| Minimum total current                        | 250 mA  |

| Type  | XIOC-16DX                      |
|---|--------------------------------|
| Output signal delay                                 | typ. 100 μs                    |
| Overvoltage protection                              | Diode                          |
| Potential isolation between outputs and the I/O bus | Through optocouplers           |
| Short-circuit protection                            | Yes                            |
| Short-circuit detection threshold                   | max. 1.2 A for 3 ms per output |
| Output indication                                   | By LED (green)                 |
| <b>General</b>                                      |                                |
| External connection <sup>1)</sup>                   | Plug-in terminal block         |
| Internal current sink                               | Typ. 50 mA                     |
| External supply voltage <sup>2)</sup>               | 24 V DC → page 79              |
| Weight  | 0.16 kg                        |

- 1) Not supplied with the module
- 2) Important! For UL applications the power supply lines must have a cross-section of AWG16 (1.3 mm<sup>2</sup>).

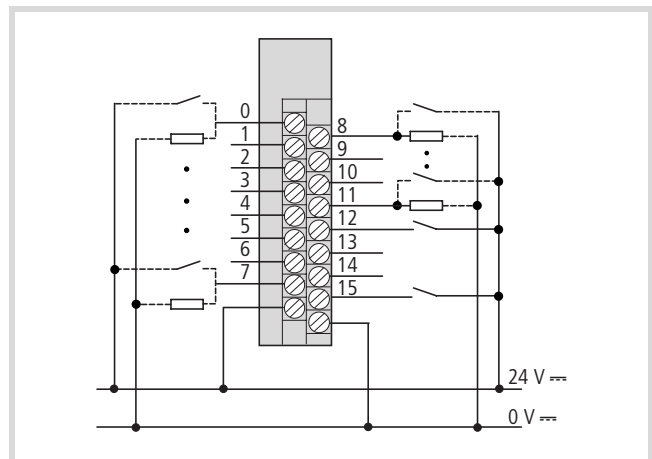


Figure 98: Terminal assignments for module XIOC-16DX

**Configuration and programming of the digital inputs/outputs**

The module has 16 connections. The first 12 connections (0 to 11) can be used as inputs and outputs, the connections 12 to 15 can only be used as inputs, → figure 98.

The configuration of the module is undertaken in the "PLC configuration" tab. It is inserted at an "Empty slot" with "Set element". For example, the following appears:

```

---XIOC-16DXISLOT
  --AT%IW6:WORD;(<*Inputs/Outputs*) [CHANNEL (I)]
  --AT%QW2:WORD;(<*Outputs/Inputs*) [CHANNEL (I)]
    
```

After a double click on the input word:

```

---AT%IX6:WORD!(*Inputs/Outputs*) [CHANNEL (I)]
---AT%IX6.0:BOOL!(*Bit 0*)
---AT%IX6.1:BOOL!(*Bit 1*)
to
---AT%IX6.7:BOOL!(*Bit 7*)
---AT%IX7.0:BOOL!(*Bit 0*)
---AT%IX7.1:BOOL!(*Bit 1*)
bis
---AT%IX7.7:BOOL!(*Bit 7*)
    
```

After a double click on the output word:

```

---AT%QX2:WORD!(*Outputs/Inputs*) [CHANNEL (I)]
---AT%QX2.0:BOOL!(*Bit 0*)
---AT%QX2.1:BOOL!(*Bit 1*)
bis
---AT%QX2.7:BOOL!(*Bit 7*)

---AT%QX3.0:BOOL!(*Bit 0*)
---AT%QX3.1:BOOL!(*Bit 1*)
---AT%QX3.2:BOOL!(*Bit 2*)
---AT%QX3.3:BOOL!(*Bit 3*)
---AT%QX3.4:BOOL!(*Bit 4*)
---AT%QX3.5:BOOL!(*Bit 5*)
---AT%QX3.6:BOOL!(*Bit 6*)
---AT%QX3.7:BOOL!(*Bit 7*)
    
```

➔ The marked outputs (Bit4 ... 7) can not be used!

**Example**

The connection "/I/Q0" of the XIOC-16DX should be programmed as an input or output. The connection should be wired corresponding to the program.

- Programming the connection as an input

Declaration:

```

Start AT% IX6.0:  B00L;
Valve:           B00L;
    
```

Program (IL):

```

LD Start
ST Valve
    
```

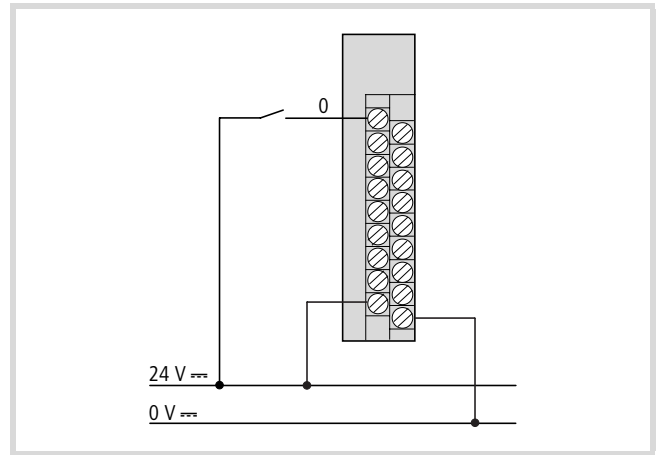


Figure 99: Wiring the connection as an input

- Programming the connection as an output

Declaration:

```

motor AT% QX2.0:  B00L;
Start:           B00L;
    
```

Program (IL):

```

LD Start
ST Motor
    
```

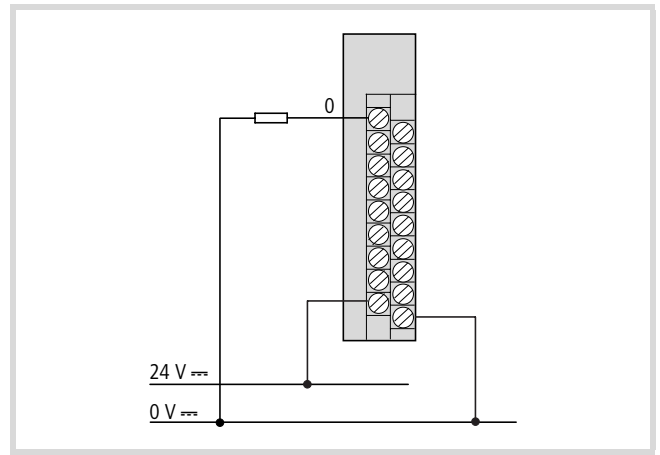


Figure 100:Wiring the connection as an output

You can proceed in the same manner with connections 1 to 11. The connections 12 to 15 can only be programmed as an input.

**Technical data**

**Analog input modules**

| Type                                  | XIOC-8AI-I2  | XIOC-8AI-U1              | XIOC-8AI-U2              |
|---------------------------------------|--|--------------------------|--------------------------|
| Input current range                   | 4 to 20 mA   | –                        | –                        |
| Input voltage range                   | –  | 0 to 10 V DC             | –10 to 10 V DC           |
| Resolution                            | 12 bit   | 12 bit                   | 12 bit                   |
| Conversion time                       | ≅ 5 ms   | ≅ 5 ms                   | ≅ 5 ms                   |
| Overall accuracy                      | ≅ ±1 % (of end of scale)   | ≅ ±1 % (of end of scale) | ≅ ±1 % (of end of scale) |
| Input resistance                      | –  | –                        | –                        |
| Voltage input                         | –  | 100 kΩ                   | 100 kΩ                   |
| Current input                         | Typ. 100 Ω   | –                        | –                        |
| Electrical isolation                  | –  | –                        | –                        |
| Channel to internal circuitry         | Through optocouplers   | Through optocouplers     | Through optocouplers     |
| Channel to channel                    | –  | –                        | –                        |
| Number of channels                    | 8  | 8                        | 8                        |
| External connection                   | Plug-in terminal block (not supplied with the module)                          |                          |                          |
| Internal current consumption (5 V DC) | 100 mA   | 100 mA                   | 100 mA                   |
| External supply voltage               | 24 V DC (+20 %, –15 %), approx. 0.15 A (approx. 0.4 A with supply switched on) |                          |                          |
| External cabling                      | 2-core shielded cable (≅ 20 m)   |                          |                          |
| Weight                                | 0.18 kg  | 0.18 kg                  | 0.18 kg                  |

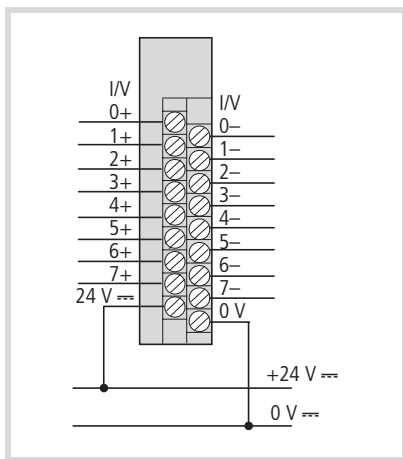


Figure 101: Terminal assignments for modules XIOC-8AI-I2 and XIOC-8AI-U1/U2

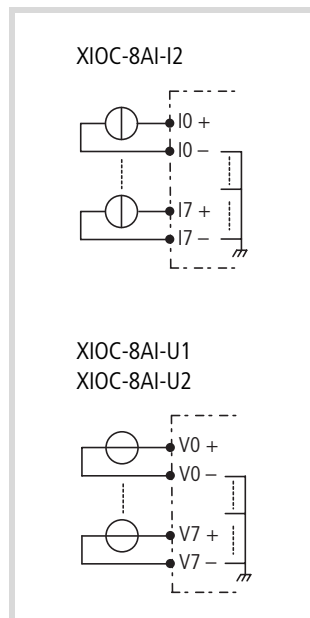


Figure 102: Module wiring

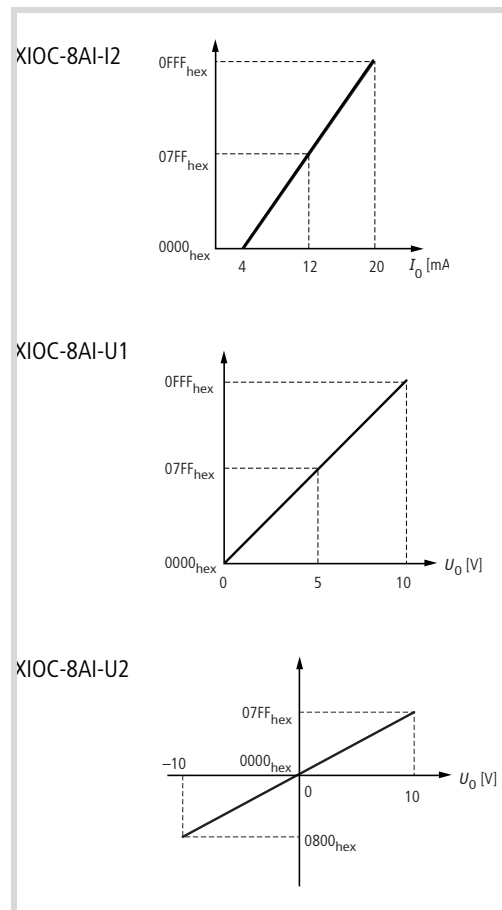


Figure 103: U/I diagram for the modules

## Analog output module

| Type                                  | XIOC-2AO-U1-2AO-I2   | XIOC-2AO-U2          | XIOC-4AO-U1          | XIOC-4AO-U2          |
|---------------------------------------|--|----------------------|----------------------|----------------------|
| Output voltage range                  | 0 to 10 V DC   | -10 to 10 V DC       | 0 to 10 V DC         | -10 to 10 V DC       |
| Output current range                  | 4 to 20 mA   | -                    | -                    | -                    |
| Resolution                            | 12 bit   | 12 bit               | 12 bit               | 12 bit               |
| Conversion time <sup>1)</sup>         | ≅ 5 ms   | ≅ 5 ms               | ≅ 5 ms               | ≅ 5 ms               |
| Overall accuracy                      | ≅ ±1 % (of end of scale)   |                      |                      |                      |
| External load resistance              |  |                      |                      |                      |
| Voltage output                        | ≅ 10k Ω  | f ≠ Ω                | ≅ 10 kΩ              | ≅ 10 kΩ              |
| Current output                        | 0 to 500 Ω   | -                    | -                    | -                    |
| Electrical isolation                  |  |                      |                      |                      |
| Channel to internal circuitry         | Through optocouplers   | Through optocouplers | Through optocouplers | Through optocouplers |
| Channel to channel                    | -  | -                    | -                    | -                    |
| Number of channels                    |  |                      |                      |                      |
| Output voltage <sup>2)</sup>          | 2 Channels (0 to 1)  | 2                    | 4                    | 4                    |
| Output current <sup>2)</sup>          | 2 channels (2 to 3)  | -                    | -                    | -                    |
| External connection                   | Plug-in terminal block <sup>3)</sup>   |                      |                      |                      |
| Internal current consumption (5 V DC) | Typ. 100 mA  | Typ. 100 mA          | Typ. 100 mA          | Typ. 100 mA          |
| External supply voltage               | 24 V DC (+20 %, -15 %), approx. 0.15 A (approx. 0.5 A with supply switched on) |                      |                      |                      |
| External cabling                      | 2-core shielded cable (≅ 20 m)   |                      |                      |                      |
| Weight                                | 0.18 kg  | 0.18 kg              | 0.18 kg              | 0.18 kg              |

1) The 5 ms refer to the conversion time of the ASIC. The nature of the output circuitry for the voltage outputs means that the settling time (to reach the final output value) varies according to the size of the voltage change. The longest time is required for a step voltage change from -10 V to +10 V:

-10 V → +10 V: 30 ms

0 V → +10 V: 5 ms

+10 V → 0 V: 14 ms

0 V → +1V: 1 ms

+1 V → 0 V: 3 ms

2) On the XIOC-2AO-U1-2AO-I2, the current and voltage outputs can be used at the same time.

3) Not supplied with the module

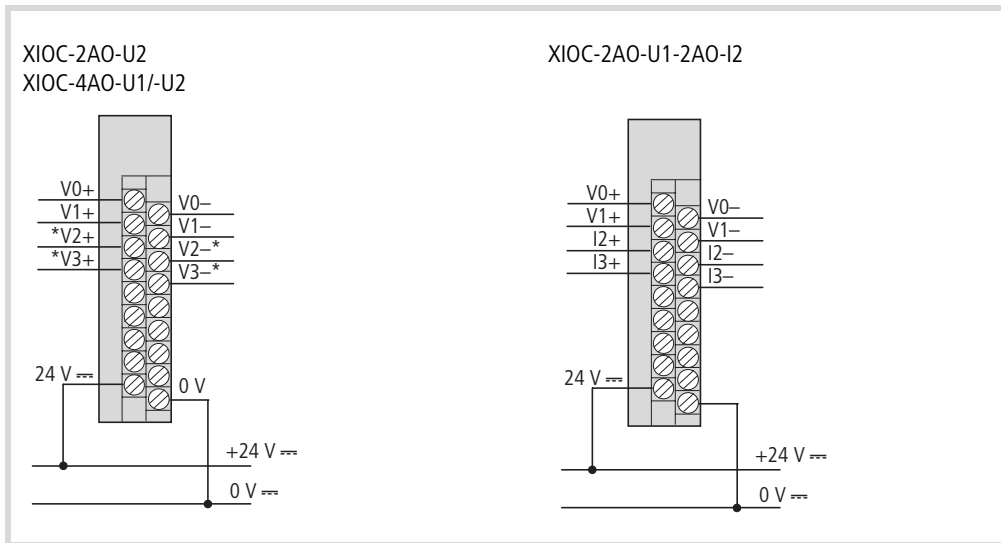


Figure 104: Terminal assignment

\* not for XIOC-2AO-U2

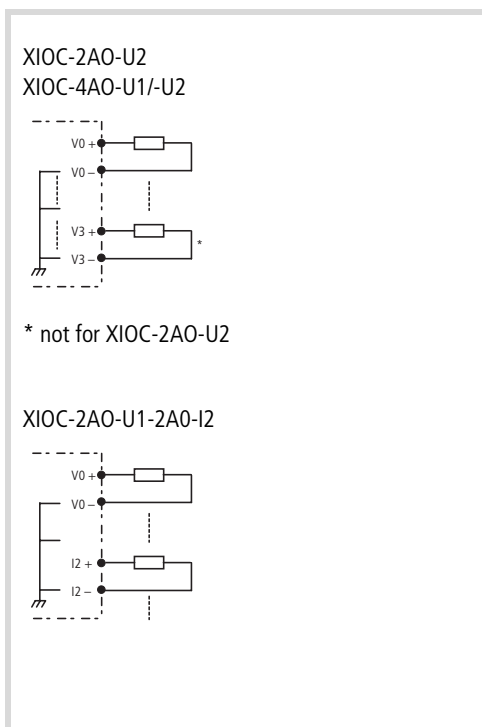


Figure 105: Module wiring

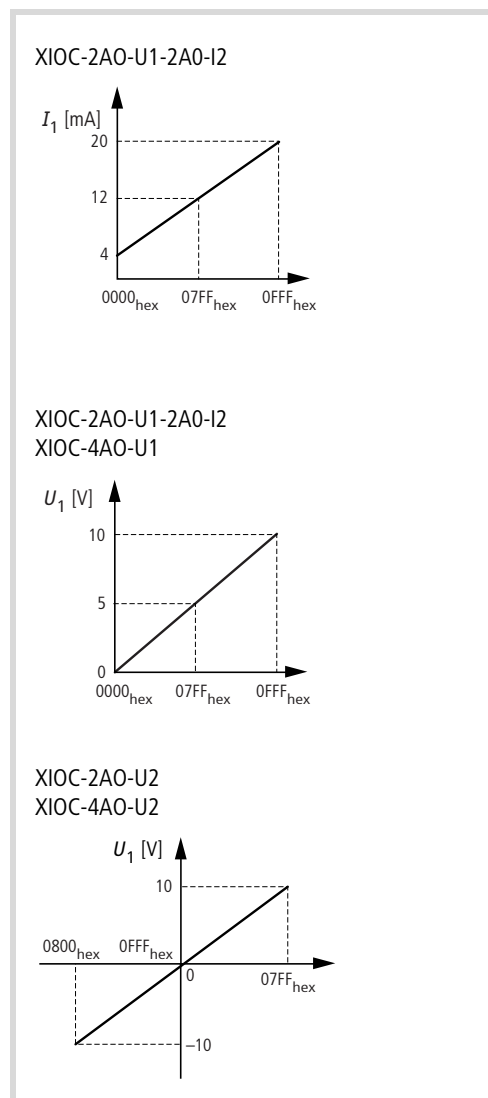


Figure 106: U/I diagram for the modules

**Analog input/output modules**

→ The modules can be operated with the CPUs XC-CPU101 from Version V02 and XC-CPU201.

| Type                                  | XIOC-4AI-2AO-U1                      | XIOC-2AI-1AO-U1                      |
|---------------------------------------|--------------------------------------|--------------------------------------|
| <b>General</b>                        |                                      |                                      |
| External connection                   | Plug-in terminal block <sup>1)</sup> | Plug-in terminal block <sup>1)</sup> |
| Internal current consumption (5 V DC) | 200 mA                               | 200 mA                               |
| Weight                                | 0.16 kg                              | 0.16 kg                              |
| <b>Inputs</b>                         |                                      |                                      |
| Input voltage range                   | 0 to 10 V DC                         | 0 to 10 V DC                         |
| Resolution                            | 14 bit                               | 14 bit                               |
| Conversion time                       | ≅ 1 ms                               | ≅ 1 ms                               |
| Overall accuracy                      | ≅ 0.4 % (of end of scale)            | ≅ 0.4 % (of end of scale)            |
| Input resistance                      | 40 kΩ                                | 40 kΩ                                |
| Electrical isolation                  |                                      |                                      |
| Channel to internal circuitry         | –                                    | –                                    |
| Channel to channel                    | –                                    | –                                    |
| Number of channels                    | 4                                    | 2                                    |
| <b>Outputs</b>                        |                                      |                                      |
| Output voltage range                  | 0 to 10 V DC                         | 0 to 10 V DC                         |
| Resolution                            | 12 bit                               | 12 bit                               |
| Conversion time                       | ≅ 1 ms                               | ≅ 1 ms                               |
| Overall accuracy                      | ≅ 0.4 % (of end of scale)            | ≅ 0.4 % (of end of scale)            |
| External load resistance              | ≅ 2 kΩ                               | ≅ 2 kΩ                               |
| Electrical isolation                  |                                      |                                      |
| Channel to internal circuitry         | –                                    | –                                    |
| Channel to channel                    | –                                    | –                                    |
| Number of channels                    | 2                                    | 1                                    |

1) Not supplied with the module

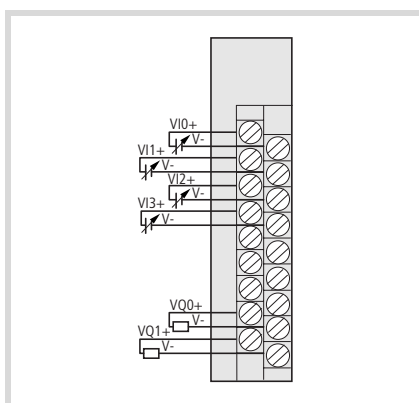
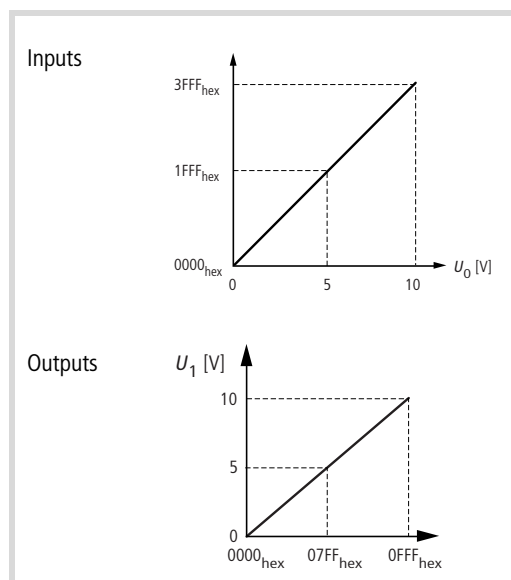


Figure 107: Terminal assignments for modules XIOC-4AI-2AO-U1 and XIOC-2AI-1AO-U1



Technical data

| Type   | XIOC-2AI-1AO-U1-I1                                    |            | XIOC-4AI-2AO-U1-I1        |            |
|--|---|------------|---------------------------|------------|
| For setting the "current" and "voltage" signal types → page 16 |   |            |                           |            |
| <b>General</b>   |   |            |                           |            |
| External connection  | Plug-in terminal block (not supplied with the module) |            |                           |            |
| Internal current consumption (5 V DC) with signal type:        |   |            |                           |            |
| <b>Input</b>   | <b>Output</b>   |            |                           |            |
| Voltage  | Voltage   | 220 mA     |                           | 270 mA     |
| Voltage  | Current   | 280 mA     |                           | 380 mA     |
| Current  | Voltage   | 220 mA     |                           | 270 mA     |
| Current  | Current   | 280 mA     |                           | 380 mA     |
| <b>Electrical isolation</b>                                    |   |            |                           |            |
| Channel to internal circuitry                                  | –   |            | –                         |            |
| Channel to channel   | –   |            | –                         |            |
| Weight   | 0.16 kg   |            | 0.16 kg                   |            |
| <b>Inputs</b>  |   |            |                           |            |
| Number of channels   | 2   |            | 4                         |            |
| Signal type  | Voltage   | Current    | Voltage                   | Current    |
| Input voltage range  | 0 to 10 V DC  | 0 to 20 mA | 0 to 10 V DC              | 0 to 20 mA |
| Resolution   | 14 bit  |            | 14 bit                    |            |
| Conversion time  | ≤ 1 ms  |            | ≤ 1 ms                    |            |
| Overall accuracy   | ≤ 0.4 % (of end of scale)                             |            | ≤ 0.4 % (of end of scale) |            |
| Input resistance   | 40 kΩ   | 125 Ω      | 40 kΩ                     | 125 Ω      |
| <b>Outputs</b>   |   |            |                           |            |
| Number of channels   | 1   |            | 2                         |            |
| Signal type  | Voltage   | Current    | Voltage                   | Current    |
| Output voltage range   | 0 to 10 V DC  | 0 to 20 mA | 0 to 10 V DC              | 0 to 20 mA |
| Resolution   | 12 bit  |            | 12 bit                    |            |
| Conversion time  | ≤ 1 ms  |            | ≤ 1 ms                    |            |
| Overall accuracy   | ≤ 0.4 % (of end of scale)                             |            | ≤ 0.4 % (of end of scale) |            |
| External load resistance                                       | ≥ 2 kΩ  | ≤ 0.5 kΩ   | ≥ 2 kΩ                    | ≤ 0.5 kΩ   |
| Short-circuit proof  | Yes   |            | Yes                       |            |

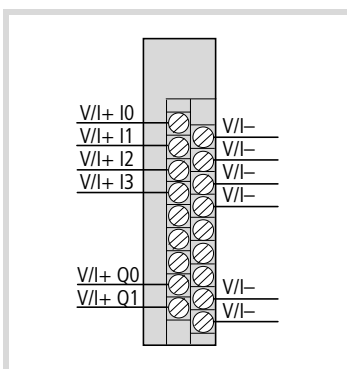
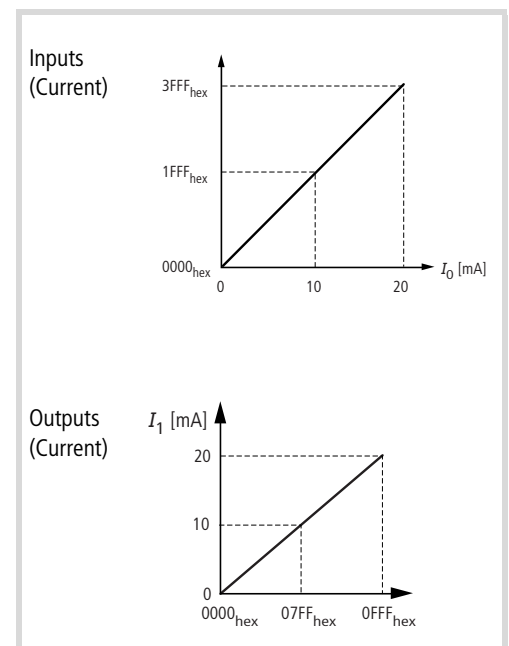
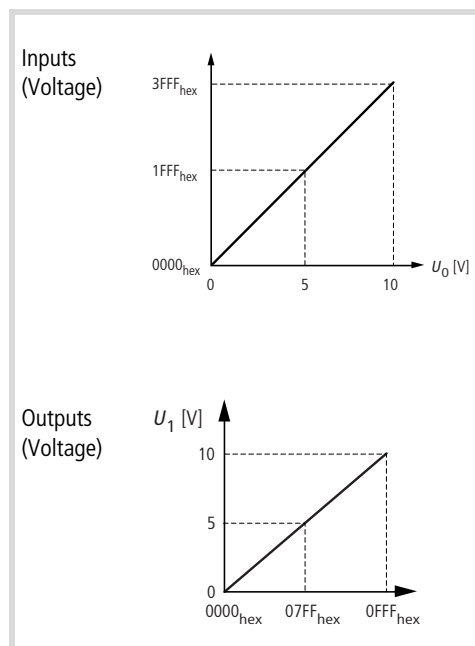


Figure 108: Terminal assignment of the XIOC-2AI-1AO-U1-I1 (I0, I1, Q0) and XIOC-4AI-2AO-U1-I1 (I0 to I3, Q0 to Q1) modules



**Temperature acquisition module XIOC-4T-PT**

→ More information on the temperature acquisition module can be found in chapter 2 from page 21 onwards.

| Type                                     | XIOC-4T-PT  |
|--|---|
| Platinum RTD                             | Pt100 (IEC 751) / Pt1000                              |
| Temperature resolution                   | 15 bit, with sign                                     |
| Accuracy <sup>1)</sup>                   |   |
| –20 to 40 °C (Pt100)                     | ±0.5 °C   |
| –50 to 400 °C (Pt100)                    | ±3 °C   |
| –50 to 400 °C (Pt1000)                   | ±6 °C   |
| Temperature measurement range            | –to +40 °C / –50 to +400 °C (constant current 2 mA)   |
| Number of inputs                         | 4   |
| Conversion time                          | Typ. 1 second for 4 channels                          |
| Electrical isolation                     |   |
| Between inputs and the I/O bus           | Through optocoupler                                   |
| Between inputs                           | –   |
| External supply voltage                  | 24 V DC   |
| Internal current consumption             | Max. 200 mA   |
| External resistance                      | Max. 400 Ω/channel                                    |
| External cabling                         | Screened cable <sup>2)</sup>                          |
| Additional functions                     | Linearisation   |
| Fault detection                          | The resistance value is 7FFF <sub>hex</sub> at:       |
| –20 to +40 °C                            | ≤ –25 °C or ≥ 45 °C                                   |
| –50 to +400 °C                           | ≤ –60 °C or ≥ 410 °C                                  |
| Response to cable break or unused inputs | In this case, the resistance is 7FFF <sub>hex</sub> . |
| Weight                                   | 0.18 kg   |

- 1) The quoted accuracy applies after 10 minutes of operation. The maximum temperature deviation can be somewhat larger just after the start. The characteristics of the RTD resistor must also be checked for correctness.
- 2) Not supplied with the module

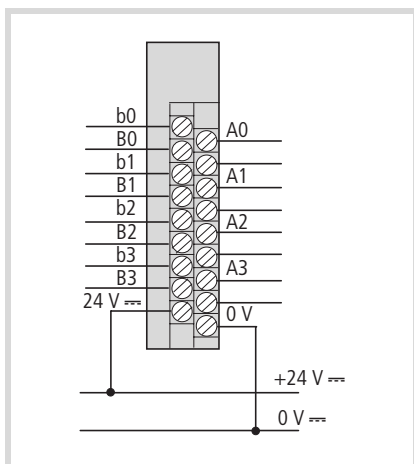


Figure 110: Terminal assignments for module XIOC-4T-PT

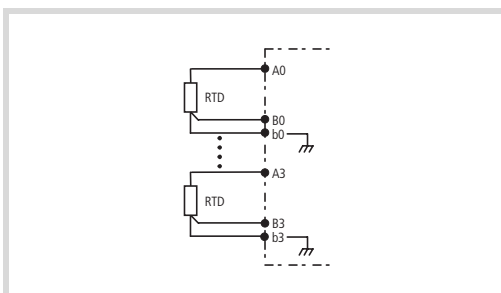


Figure 109: Module wiring

## Technical data

## Temperature acquisition module XIOC-4AI-T

→ More information on the temperature acquisition module can be found in chapter2 from page 27 onwards.

| Typ  | XIOC-4AI-T   |
|--|--|
| Channels                                   |  |
| Number                                     | 4  |
| Temperature measurement range              | K type: -270 – 1370<br>J type: -210 – 1200<br>B type: 100 – 1800<br>N type: -270 – 1300<br>E type: -270 – 1000<br>R type: -50 – 1760<br>T type: -200 – 400 |
| Voltage measurement                        | - 50 mV...50 mV<br>-100 mV...100 mV<br>-500 mV...500 mV<br>-1000 mV...1000 mV  |
| Cold position compensation                 | yes, integrated  |
| Interference voltage suppression           | 50 Hz, 60 Hz   |
| Unit                                       | 0.1 °C, 0.1 F  |
| Resolution                                 | 16 Bit   |
| Total error                                | ± 0.5 % of range<br>Element "E" from -270 °C to -180 °C ±2 % of measurement range  |
| Max. input voltage (destruction threshold) | 10 V DC  |
| Insulation voltage                         | 500 V <sub>rms</sub> between input cables and bus backplane  |
| Conversion time                            | < 1 s  |
| Temperature coefficient                    | < 200 ppm/°C from measurement range  |
| Weight                                     | 0.18 kg  |

## Counter module

→ More information on wiring up the counter module can be found in chapter3 from page 29.

| Type  | XIOC-2CNT-100 kHz  | XIOC-1CNT-100kHz                                 |
|---|--|--|
| Electrical isolation                        | 250 V DC between I/O signal and bus                          | 250 V DC between I/O signal and bus              |
| Internal current consumption (5 V DC)       | 200 mA   | 200 mA   |
| Ambient temperature + humidity in operation | 0 to 55 °C, 20 to 90 % relative humidity (no condensation)   |  |
| Ambient temperature + humidity in storage   | -10 to 75 °C, 10 to 90 % relative humidity (no condensation) |  |
| <b>Input</b>                                |  |  |
| Maximum count value                         | 32 bit (0 to 4,294,967,295)                                  | 32 bit (0 to 4,294,967,295)                      |
| Maximum frequency                           | 100 kHz (25 kHz with 4x resolution)                          | 100 kHz (25 kHz with 4x resolution)              |
| Number of channels                          | 2 channels   | 1 channel  |
| Input voltage                               | 12 to 24 V DC  | 12 to 24 V DC                                    |
| Voltage for ON                              | > 10 V DC  | > 10 V DC  |
| Voltage for OFF                             | < 4 V DC   | < 4 V DC   |
| Input current                               | ≥ 4 mA   | ≥ 4 mA   |
| Differential input voltage                  | +/- 5 V DC   | +/- 5 V DC                                       |
| Voltage for ON                              | 2 to 5 V DC  | 2 to 5 V DC                                      |
| Voltage for OFF                             | -5 to -0.8 V DC  | -5 to -0.8 V DC                                  |
| Differential input current                  | 35 mA  | 35 mA  |
| Electrical isolation                        | Through optocoupler  | Through optocoupler                              |
| Number of inputs per channel                | 3  | 3  |
| Minimum width of count pulse                | ON: ≥ 4 μs, OFF: ≥ 4 μs                                      | ON: ≥ 4 μs, OFF: ≥ 4 μs                          |
| Minimum width of marker                     | ≥ 10 μs (during an ON transition)                            | ≥ 10 μs (during an ON transition)                |
| Connection for external cabling             | 30-pole connector XIOC-TERM30-CNT4 <sup>1)</sup>             | 30-pole connector XIOC-TERM30-CNT4 <sup>1)</sup> |
| External cabling                            | Twisted pair, shielded <sup>1)</sup>                         | Twisted pair, shielded <sup>1)</sup>             |
| <b>Output</b>                               |  |  |
| Type of output                              | Transistor (open collector)                                  | Transistor (open collector)                      |
| External voltage                            | 12/24 V DC (max. 30 V DC)                                    | 12/24 V DC (max. 30 V DC)                        |
| Minimum load current                        | 1 mA   | 1 mA   |
| Maximum load current                        | 20 mA per output   | 20 mA per output                                 |
| Leakage current                             | Max. 0.5 mA  | Max. 0.5 mA                                      |
| Output delay time                           |  |  |
| ON → OFF                                    | ≤ 1 ms   | ≤ 1 ms   |
| OFF → ON                                    | ≤ 1 ms   | ≤ 1 ms   |
| Voltage drop in ON state                    | Max. 1.5 V   | Max. 1.5 V                                       |
| Number of external outputs                  | 4 outputs per module   | 2 outputs per module                             |
| Up/down counter                             | Actual (process) value ≥ setpoint 1                          | Actual (process) value ≥ setpoint 1              |
| Ring counter                                | Actual (process) value = setpoint 2                          | Actual (process) value = setpoint 2              |
| Electrical isolation                        | Through optocouplers   | Through optocouplers                             |

1) Not supplied with the unit

**Technical data**

**Counter analog module**

→ More information on wiring up the analog counter module can be found in chapter4 from page 45.

| Type                                       | XIOC-2CNT-2AO-INC                 |
|--|-----------------------------------|
| <b>General</b>                             |                                   |
| Channel count                              | 2                                 |
| Max. internal current consumption          | 450 mA                            |
| <b>Inputs</b>                              |                                   |
| Counter width                              | 32 bit                            |
| Signals to RS422                           | A, !A, B, !B, R, !R               |
| Input voltage differential                 | +/- 5 V DC                        |
| High                                       | 0.2 to +5 V DC                    |
| Low  | -5 to -0.2 V DC                   |
| Potential isolation                        |                                   |
| IO bus → inputs                            | No                                |
| Between inputs                             | No                                |
| Between inputs                             | No                                |
| Input frequency                            | 400 kHz                           |
| Operating modes                            | 1x, 2x, 4x signal edge evaluation |
| <b>Outputs (analog)</b>                    |                                   |
| Resolution                                 | 12 bit                            |
| Output voltage range                       | -10 to +10 V                      |
| Error                                      | typically 0.4 %                   |
| Potential isolation                        |                                   |
| IO bus → outputs                           | No                                |
| Between outputs                            | No                                |
| Conversion time                            | < 1 ms                            |
| Max. load current                          | 10 mA                             |
| Min. load resistance                       | 1 kOhm                            |
| Short-circuit proof                        | Yes                               |
| Max. output current (min. load resistance) | 10 mA<br>1 kΩ                     |
| <b>Power supply for encoder</b>            |                                   |
| Voltage                                    | 5 V DC                            |
| Current or channel <sup>1)</sup>           | Max. 300 mA                       |

1) Apply an external encoder supply if the current available is insufficient.

**PROFIBUS-DP module**

→ More information concerning the PROFIBUS-DP module can be found in chapter7 from page 57.

| Type                        | XIOC-NET-DP-M/S   |                                 |
|-----------------------------|---|---------------------------------|
| EMC                         | → page 79   |                                 |
| Function                    | XIOC-NET-DP-M:<br>PROFIBUS-DP interface, Master (class 1) | XIOC-NET-DP-S:<br>Slave         |
| Slave count                 | Max. 124 (30 without repeater)                            |                                 |
| Send/receive data           | for every 3.5 kByte for inputs and outputs                |                                 |
| Inputs/outputs              | XIOC-NET-DP-M:<br>Max. 244 bytes per slave                | XIOC-NET-DP-S:<br>Max. 244 Byte |
| Interface                   | RS485   |                                 |
| Connector type              | Sub-D, 9-pole, socket                                     |                                 |
| Electrical isolation        | Yes, for internal power supply                            |                                 |
| Current consumption         | 300 mA  |                                 |
| Baud rate/length            | kBits/s   | m                               |
|                             | 9,6   | 1200                            |
|                             | 19,2  | 1200                            |
|                             | 93,75   | 1200                            |
|                             | 187,5   | 1000                            |
|                             | 500   | 400                             |
|                             | 1500  | 200                             |
|                             | 3000  | 100                             |
|                             | 6000  | 100                             |
|                             | 12000   | 100                             |
| Bus termination resistors   | Switch-in   |                                 |
| Bus diagnostics             | LED   |                                 |
| Number of modules           | XC100: 1,<br>XC200: 3                                     |                                 |
| Slots, → table 20, Table 21 | 1, 2, 3   |                                 |

**Serial interface module**

→ More information on wiring up the interface module can be found in chapter 5 from page 51.

| Type  | XIOC-SER   |
|---|--|
| Number of modules (COM interface)                 |  |
| XC100   | 2  |
| XC200   | 4  |
| Active interface/module                           | 1  |
| Max. internal current consumption                 | 275 mA   |
| Electrical isolation                              |  |
| RS232   | No   |
| RS422/485   | Yes  |
| Connection  |  |
| RS232   | 9-pole SUB-D plug (pins)   |
| RS422/RS485                                       | 6-pole cage-clamp terminal block                                   |
| Transparent mode operation                        |  |
| Interface type                                    | RS 232, RS 422, RS 485   |
| Control and signal cables                         | RTS, CTS, DTR, DSR, DCD  |
| Data transfer rates                               | 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600 Bit/s |
| Character formats                                 | 8E1, 8O1, 8N1, 8N2, 7E2, 7O2, 7N2, 7E1                             |
| Number of send bytes in a block Com2, 3, 4, 5     | 250 bytes per COM  |
| Number of received bytes in a block Com2, 3, 4, 5 | 250 bytes per COM  |
| Suconet-K mode operating mode (Slave)             |  |
| Interface type                                    | RS485  |
| Data transfer rates                               | 187.5 or 375 kBit/s  |
| Number of slaves                                  | –  |
| Telegram  | Suconet K  |
| Address   | 2 to 31  |
| Max. send data                                    | 120 Byte   |
| Max. receive data                                 | 120 Byte   |

**Suconet-K module (master)**

| Type                              | XIOC-NET-SK-M                    |
|-----------------------------------|----------------------------------|
| Number of modules (COM interface) |                                  |
| XC100                             | 2                                |
| XC200                             | 4                                |
| Max. internal current consumption | 275 mA                           |
| Connection                        |                                  |
| RS485                             | 6-pole cage-clamp terminal block |
| Electrical isolation              | Yes                              |
| Suconet-K (master) mode           |                                  |
| Interface type                    | RS485                            |
| Data transfer rates               | 187.5 or 375 kBit/s              |
| Telegram                          | Suconet K/K1                     |
| Number of slaves                  | 16                               |
| Slave addresses                   | 2 to 31                          |
| Max. send data                    | 250 Byte                         |
| Max. receive data                 | 250 Byte                         |



## Index

|          |   |        |          |  |    |
|----------|---|--------|----------|--|----|
| <b>A</b> | Ambient temperature, enhanced                         | 8      | <b>D</b> | Data evaluation, temperature                     | 23 |
|          | Analog module parametric programming                  | 78     |          | Data exchange, DP module                         | 60 |
|          | Analog modules, overview                              | 7      |          | Data transfer, example for DP modules            | 63 |
|          | Arrangement of the modules                            | 8      |          | DC load  | 14 |
|          | Assembly  |        |          | Device number                                    | 65 |
|          | Counter module  | 29     |          | DIAGGETSTATE function block                      | 67 |
|          | Signal module   | 8      |          | Diagnostics                                      |    |
|          |   |        |          | DIAGGETSTATE (function block)                    | 67 |
|          |   |        |          | EXTENDEDINFO (Array)                             | 67 |
| <b>B</b> | Bus cycle time determination                          | 61     |          | GETBUSSTATE (Variable)                           | 66 |
|          | Bus expansion connector                               | 9      |          | Slaves in PROFIBUS-DP                            | 65 |
|          | Bus expansion with XIOC-BP-EXT                        |        |          | XIOC-SER   | 54 |
|          | Physical design                                       | 10     |          | Digital modules, overview                        | 7  |
|          | Settings in the easySoft-CoDeSys                      | 18     |          | Dimensions                                       |    |
|          | Bus termination resistors                             |        |          | Module rack                                      | 19 |
|          | XIOC-NET-DP-M   | 58     |          | Signal modules                                   | 19 |
|          | XIOC-NET-SK-M   | 55     |          |  |    |
|          | XIOC-SER  | 51     |          |  |    |
|          |   |        | <b>E</b> | End value (counter module)                       |    |
| <b>C</b> | C terminals   | 14     |          | – read out                                       | 40 |
|          | Cable with attached connector, for the counter module |        |          | Setting  | 39 |
|          | 15,   | 33     |          | Engineering                                      | 8  |
|          | Capacitive loads                                      | 14     |          | Example  |    |
|          | Catch   | 8      |          | Diagnostics in the master control (PROFIBUS-DP)  | 73 |
|          | Change actual value                                   | 35, 37 |          | Expansion backplane                              | 9  |
|          | Clear Underflow flag                                  | 41     |          | EXTENDEDINFO, Array                              | 67 |
|          | Command processing for counter module                 | 39     |          |  |    |
|          | Comparison value (counter module)                     |        | <b>F</b> | Fault-finding, for XIOC-4T-PT                    | 26 |
|          | – read out  | 40     |          | Filter for voltage-peak suppression              | 14 |
|          | Parameter setting                                     | 35, 36 |          | Freewheel diodes                                 | 14 |
|          | Setting   | 39     |          | Function block                                   |    |
|          | Configuration   |        |          | xDPS_SendDiag                                    | 70 |
|          | Counter analog module                                 | 49     |          | Fuse, to prevent burning out the external wiring | 14 |
|          | Counter properties                                    | 38     | <b>G</b> | GETBUSSTATE, Variable                            | 66 |
|          | Digital inputs/outputs                                | 84     |          |  |    |
|          | XIOC-NET-DP-M   | 73     | <b>I</b> | Inductive load                                   | 14 |
|          | Configuration example, DP module                      | 73     |          | Input map, counter analog module                 | 46 |
|          | Configuration, XIOC-NET-DP-S/M                        | 59     |          | Input/output status indication                   | 8  |
|          | Connecting devices to the Y outputs (counter module)  | 34     |          | Interface  |    |
|          | Connecting signal cables                              | 17     |          | PROFIBUS-DP                                      | 58 |
|          | Connecting the incremental value encoder              | 31     |          | XIOC-NET-SK-M                                    | 55 |
|          | Connection  |        |          | XIOC-SER   | 51 |
|          | Connecting devices to the Y outputs of the counter    |        |          |  |    |
|          | module  | 34     |          |  |    |
|          | Incremental encoder on the counter module             | 31     |          |  |    |
|          | Connections, counter module                           | 45     |          |  |    |
|          | Conversion tables, for Pt100/Pt1000                   | 24, 25 |          |  |    |
|          | Counter input (counter module)                        | 30     |          |  |    |
|          | – enable  | 40     |          |  |    |
|          | Current consumption, module arrangement               | 8      |          |  |    |
|          | Cyclic data exchange, DP module                       | 60     |          |  |    |

## Index

|          |  |            |          |  |            |
|----------|--|------------|----------|--|------------|
| <b>L</b> | Latch output . . . . .   | 35         | <b>R</b> | Reaction time, PROFIBUS-DP . . . . .             | 62         |
|          | – reset . . . . .  | 40         |          | Read actual (=current) value . . . . .           | 40         |
|          | LE4 . . . . .  | 78         |          | Read out flags (counter module) . . . . .        | 41         |
|          | LED display  |            |          | Receive data                                     |            |
|          | Counter analog module . . . . .  | 46         |          | XIOC-NET-SK-M . . . . .                          | 56         |
|          | Counter module . . . . .   | 29         |          | XIOC-SER . . . . .                               | 54         |
|          | XIOC-NET-SK-M . . . . .  | 55         |          | Reference input (counter module) . . . . .       | 30, 37     |
|          | XIOC-SER . . . . .   | 52         |          | – enable . . . . .                               | 40         |
|          | LED selector . . . . .   | 8          |          | Relay contacts, operating life . . . . .         | 14         |
|          | Level output . . . . .   | 35         |          | Repeater . . . . .                               | 57         |
|          | Level-Ausgang . . . . .  | 97         |          | RESET button (counter module) . . . . .          | 29         |
|          | Linear counter . . . . .   | 30, 35, 44 |          | Reset Equal flag (EQ) . . . . .                  | 40         |
|          |  |            |          | Resistance thermometer . . . . .                 | 21         |
|          |  |            |          | Ring counter . . . . .                           | 30, 36, 44 |
| <b>M</b> | Maximum basic expansion . . . . .  | 10         | <b>S</b> | S terminals . . . . .                            | 14         |
|          | Maximum total expansion . . . . .  | 10         |          | Send data  |            |
|          | Mode of operation, XIOC-SER  |            |          | XIOC-NET-SK-M . . . . .                          | 56         |
|          | Suconet K (slave) . . . . .  | 53         |          | XIOC-SER . . . . .                               | 54         |
|          | Transparent mode . . . . .   | 53         |          | Set new actual value . . . . .                   | 40         |
|          | Module arrangement . . . . .   | 8          |          | Shielding, signal cables . . . . .               | 17         |
|          | Module output (counter module)   |            |          | Short-circuit . . . . .                          | 14         |
|          | – assign to the comparison value 1 or 2 . . . . .                          | 39         |          | Signal modules                                   |            |
|          | – enable . . . . .   | 39         |          | Assembly . . . . .                               | 8          |
|          | Setting . . . . .  | 35, 36     |          | Max. number per CPU . . . . .                    | 9          |
|          | Module rack  |            |          | Overview . . . . .                               | 7          |
|          | Overview . . . . .   | 7, 9       |          | Start value (Counter module)                     |            |
|          | Slot assignment . . . . .  | 9          |          | – read out . . . . .                             | 40         |
|          | Monotasking . . . . .  | 61         |          | Setting . . . . .                                | 39         |
|          | Mounting   |            |          | Station byte . . . . .                           | 66         |
|          | Module rack . . . . .  | 10         |          | Status display                                   |            |
|          | Signal modules . . . . .   | 12         |          | Counter analog module . . . . .                  | 46         |
|          | Terminal block . . . . .   | 12         |          | Status display (counter module) . . . . .        | 43         |
|          | Multitasking mode . . . . .  | 62         |          | Status indication, PROFIBUS-DP slave . . . . .   | 63         |
|          |  |            |          | Suconet-K mode, XIOC-SER . . . . .               | 51         |
| <b>O</b> | Operating mode switch (counter module) . . . . .                           | 30         |          | Supply voltage                                   |            |
|          | Operation  |            |          | for relay operation . . . . .                    | 14         |
|          | DP module . . . . .  | 59         |          | I/O electronics . . . . .                        | 9          |
|          | Output map, counter analog module . . . . .                                | 48         |          | Signal modules . . . . .                         | 9          |
|          | Overflow flag (counter module) . . . . .                                   | 35         |          | Switching operations at high frequency . . . . . | 14         |
|          | – clear . . . . .  | 41         |          |  |            |
|          | Overload currents . . . . .  | 14         | <b>T</b> | Target Rotation Time . . . . .                   | 61         |
|          |  |            |          | Task control in online operation . . . . .       | 62         |
| <b>P</b> | Parametric programming of the LE4 with analog inputs/<br>outputs . . . . . | 78         |          | Technical data                                   |            |
|          | Periodic data exchange, DP module . . . . .                                | 61         |          | Analog input modules . . . . .                   | 86         |
|          | Polarity . . . . .   | 14         |          | Analog input/output modules . . . . .            | 89         |
|          | Preset value (counter module)  |            |          | Analog output module . . . . .                   | 87         |
|          | – read out . . . . .   | 40         |          | Counter analog module . . . . .                  | 94         |
|          | Setting . . . . .  | 40         |          | Counter module . . . . .                         | 93         |
|          | PROFIBUS-DP connector . . . . .  | 58         |          | Digital input modules . . . . .                  | 80         |
|          | PROFIBUS-DP module . . . . .   | 57         |          | PROFIBUS-DP module . . . . .                     | 94         |
|          | Programming  |            |          | Relay output module . . . . .                    | 83         |
|          | Counter analog module . . . . .  | 46         |          | Serial interface module . . . . .                | 95         |
|          | Counter module . . . . .   | 29         |          | Suconet-K module (master) . . . . .              | 95         |
|          | Digital inputs/outputs . . . . .   | 84         |          | Temperature acquisition module . . . . .         | 91         |
|          | Proximity switch . . . . .   | 13         |          | Transistor output modules . . . . .              | 82         |
|          | Pulse processing (example) . . . . .                                       | 44         |          |  |            |

|          |   |    |
|----------|---|----|
|          | Temperature setting (XIOC-4T-PT) .....          | 21 |
|          | Temperature/measurement diagram .....           | 24 |
|          | Terminal block .....                            | 8  |
|          | Mounting .....                                  | 12 |
|          | Terminal capacity, terminal block .....         | 13 |
|          | Transparent mode, XIOC-SER .....                | 51 |
| <hr/>    |   |    |
| <b>V</b> | Voltage peaks (filter) .....                    | 14 |
| <hr/>    |   |    |
| <b>W</b> | Wiring  |    |
|          | Analog modules .....                            | 16 |
|          | Counter module .....                            | 34 |
|          | Digital input module .....                      | 13 |
|          | Input module XIOC-32DI, output module XIOC-32DO |    |
|          | 15  |    |
|          | Relay output module .....                       | 14 |
|          | Screw terminal block .....                      | 13 |
|          | Spring-loaded terminal block .....              | 13 |
|          | Transistor output module .....                  | 14 |
|          | XIOC-4T-PT .....                                | 22 |
| <hr/>    |   |    |
| <b>X</b> | xDPS_SendDiag, function block .....             | 70 |

