Hardware and Engineering

XIOC Signal Modules

04/03 AWB2725-1452GB

MOELLER

Think future. Switch to green.

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3rd edition 04/2003
See revision protocol in the "About this manual" chapter

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Translator: Patrick Chadwick

Warning!
Dangerous electrical voltage!

Before commencing the installation

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

Contents

About this Manual

List of revisions

The following major changes have been made to the earlier editions::

Edition date	Page	Description	New	Modification
10/02	21	"Counter module"		×
	41	"Digital input/ output modules"	×	
04/03	11	"Terminal capacity of the terminal block"		×
	37, 38, 39, 40, 41	„Technical data"		×
	41	"Konfiguration und Programmierung der Digital-Ein-/ Ausgänge"	×	

This manual describes the XIOC signal module for the expandable PLC types XC-CPU100/200/400/600. In Chapter 1 you will find information on mounting and wiring, which is applicable to all the signal modules. Chapter 4 provides comprehensive technical data. This chapter also starts with a general section. Specific features are then dealt with separately or, there where it is more useful, combined in groups. Chapter 2 and Chapter 3 include further detailed information on the temperature acquisition module and the counter module.

Additional manuals

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

PLC type	Manual no.
XC-CPU100	AWB2724-1453GB
XC-CPU600	AWB2700-1428GB

These manuals are also available online as PDF files, under "www.moeller.net → support". Enter the manual number here as the search text.

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.

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 Chapter 3 "Counter module" there is an "*n*" in the designation for several function block inputs and outputs. This "*n*" is a wildcard. For example, the designation "Counter*n*Enable" 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

Important!
Indicates the risk of minor material damage.

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

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

For greater clarity, the chapter title is shown at the top left of the page, and the current section at top right. Exceptions are the first page of each chapter, and empty pages at the end.

1 Signal modules

Overview

The signal modules for the expandable PLC types XC-CPU100/600 are divided into:

- Digital input/output modules
- Analogue input/output modules
- Function modules, such as counter and network modules

The following table provides an overview of the modules.

Table 1: List of signal modules

Designation	Type	Technical data
Module rack	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
Digital input module	XIOC-8DI	8 channels, 24 V DC
	XIOC-16DI	16 channels, 24 V DC
	XIOC-16DI-AC	16 channels, 200 to 240 V AC
Digital output module	XIOC-8DO	8 channels, transistor output 12/24 V DC (source type)
	XIOC-16DO	16 channels, transistor output 12/24 V DC (source type)
	XIOC-16DO-S[1)]	16 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, 12 output channels, transistor output 24 V DC (source type)
Analogue 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
Analogue output module	XIOC-2AO-U1-2AO-I2	Voltage output (channel 0 + 1) 0 to 10 V DC, current (channel 2 + 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 4) –10 to 10 V DC
	XIOC-4AO-U1	Voltage output (channels 0 to 4) 0 to 10 V DC
Counter module	XIOC-1CNT-100kHz	Input for fast counter, maximum frequency 100 kHz, 1 channel, switchable 1/2-phase, 2 open-collector outputs
	XIOC-2CNT-100kHz	Input for fast counter, maximum frequency 100 kHz, 2 channels, switchable 1/2-phase, 2 open-collector outputs per channel

1) With short-circuit protection

Accessories

Designation	Type	Comments
Spring-loaded terminal	XIOC-TERM-18T	For digital and analogue I/O modules
Screw terminals	XIOC-TERM-18S	

Assembly

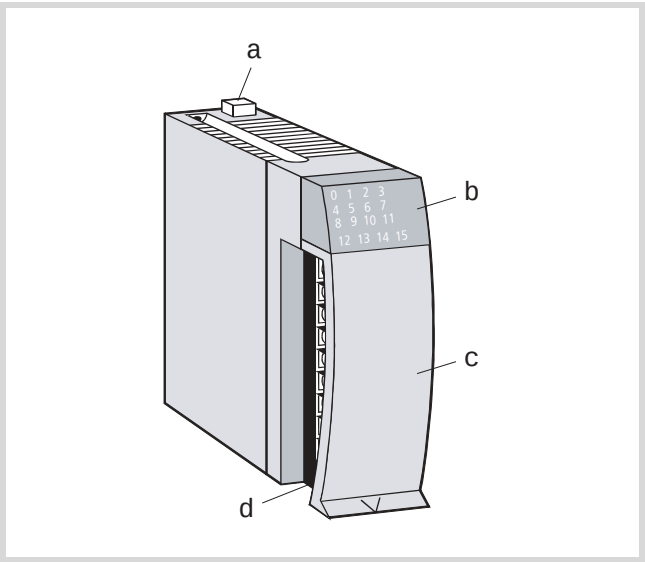


Figure 1: Assembly of a signal module

a Catch
b LED display
c I/O cover
d Terminal block

PLC connection

The XIOC modules are the I/O modules for the PLC types XC-CPU100/200/600. The following diagrams show the assembly of XIOC modules connected to a PLC.

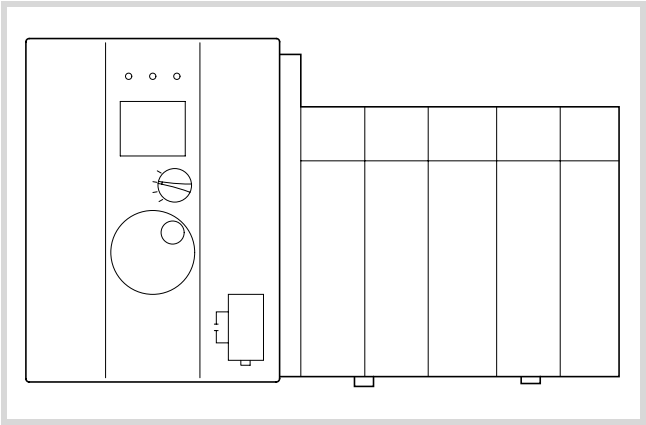


Figure 2: XC-CPU600 with XIOC signal modules

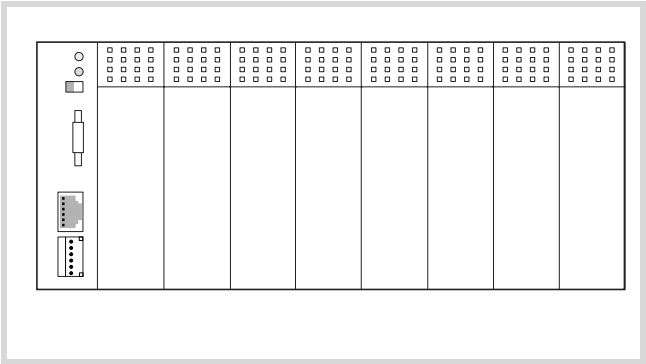


Figure 3: XC-CPU100/200 with XIOC signal modules

Slot assignment in the module racks

The XIOC modules are plugged onto module racks that provide the connection to the PLC. The modules are also interconnected through the module rack.

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.

Four different module racks are available:

Table 2: Slot assignment in the module racks

Module rack	Slots		
	1	2	3
XIOC-BP-XC (Basic module rack)	CPU with power supply		–
XIOC-BP-XC1 (Basic module rack)	CPU with power supply		I/O module
XIOC-BP-2 (Expansion module rack)	I/O module		–
XIOC-BP-3 (Expansion module rack)	I/O module		

As a rule, the first module rack, which is used to take the CPU type XC-CPU100/200, is a basic module rack. You can add on several expansion module racks to the right side. The module racks must be arranged so that one CPU module and a maximum of 7 XIOC signal modules can be planned (→ fig. 4).

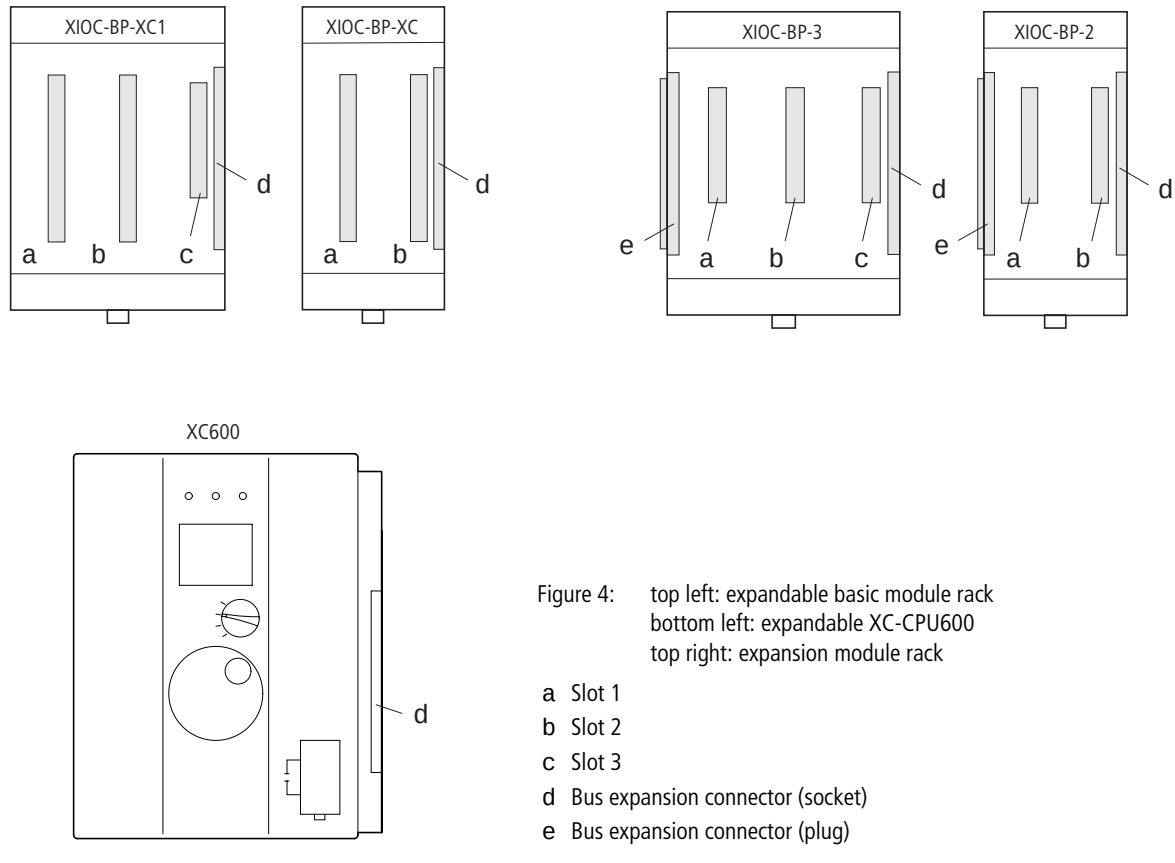


Figure 4: top left: expandable basic module rack
bottom left: expandable XC-CPU600
top right: expansion module rack

a Slot 1
b Slot 2
c Slot 3
d Bus expansion connector (socket)
e Bus expansion connector (plug)

Mounting the module rack

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

Caution!
The expansion module rack 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 module rack. Discharge yourself from any electrostatic charge before touching electronic modules. Voltage peaks on the bus connector may cause malfunction or damage to the modules.

→ Read the manual AWB2700-1428GB for information on mounting the XC-CPU600, and manual AWB2724-1453GB for the XC-CPU100.

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 module rack on the top hat mounting rail so that the top edge of the rail fits into the slot, and then slide the module rack 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 module rack is firmly seated [3].
- ▶ If you want to fit an expansion module rack: push it to the left, until the bus connector of the expansion module rack can be plugged into the bus connector socket of the XC-CPU600 or the basic rack or expansion module rack. Take care that the bus connectors of the module racks are completely engaged, in order to ensure reliable electrical contact.

Mounting on the mounting plate

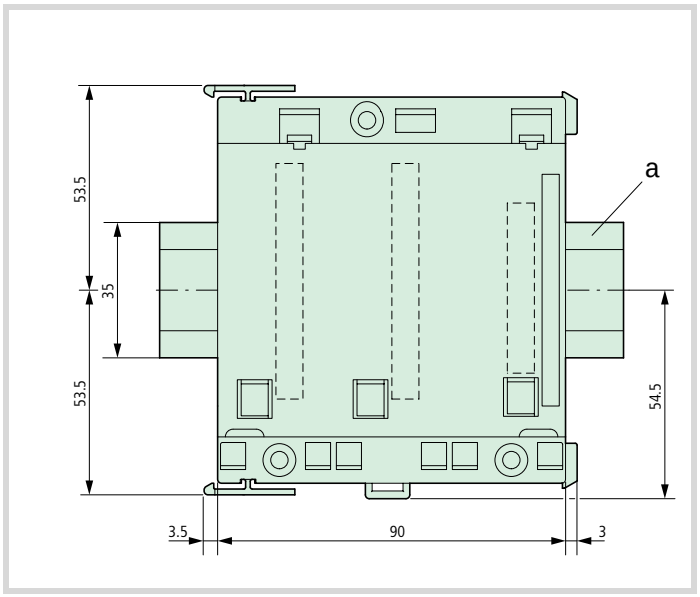
The spring contacts that protrude from the back of the module rack are intended to provide a ground for the modules. They must have a reliable electrical contact with the mounting plate.

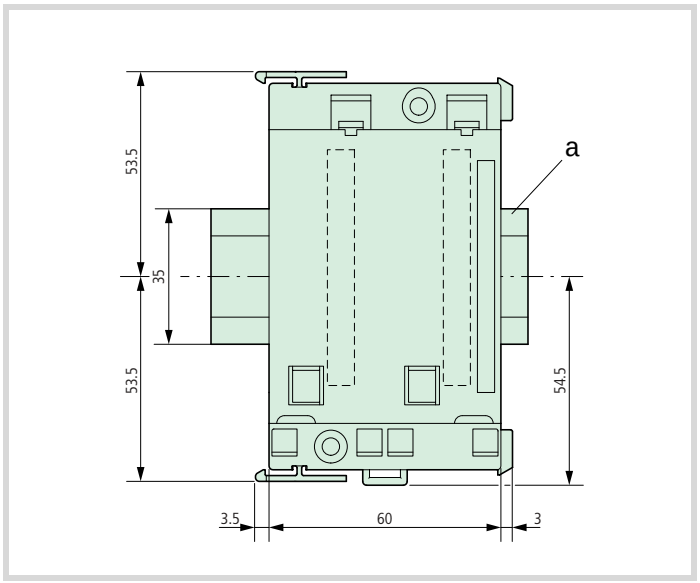
Take care that the contact areas are protected from corrosion and – if you are using painted mounting plates – that the paint layer is removed from the contact areas.

- ▶ Plug the bus connector of the expansion module rack into the bus connector of the XC-CPU600 or the basic rack or expansion module rack. Take care that the bus connectors of the module racks are completely engaged, in order to ensure reliable electrical contact.

Detaching the module rack

- ▶ 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 module racks: Slide the expansion module rack along the top hat rail to the right, until the bus connectors are disengaged.
- ▶ Take the module rack off the rail.





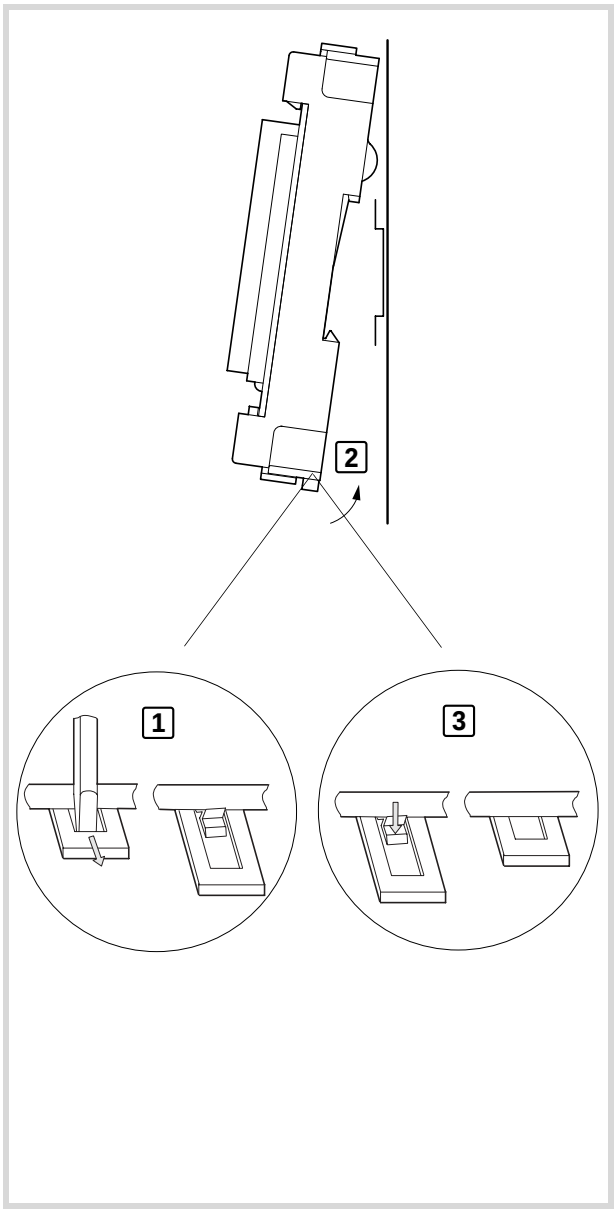


Figure 5: Mounting on a 35 mm top hat (DIN) rail,
top left: XIOC-BP-XC1, (XIOC-BP-3)
bottom left: XIOC-BP-XC, (XIOC-BP-2)

a 35 mm top hat rail

See also dimensions on Page 14.

Mounting the signal modules

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

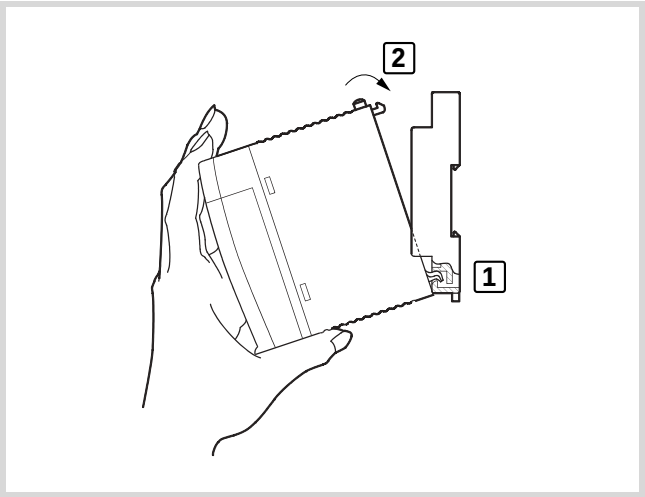


Figure 6: Mounting the signal modules

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].

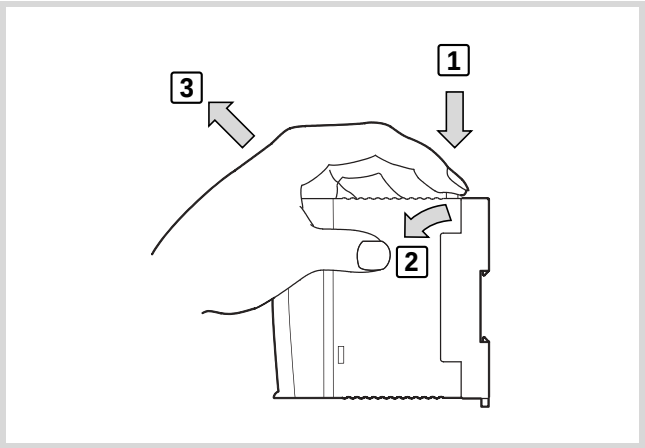


Figure 7: Detaching the modules

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 cannot come loose [4].

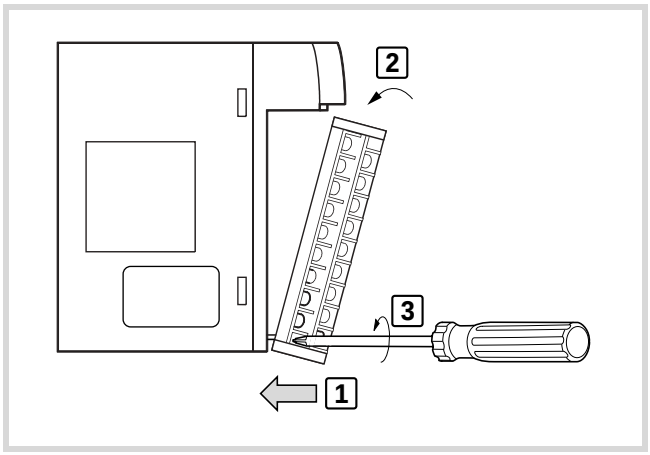


Figure 8: Fixing the terminal block

Wiring up the I/O signals

Wiring up the screw terminal block

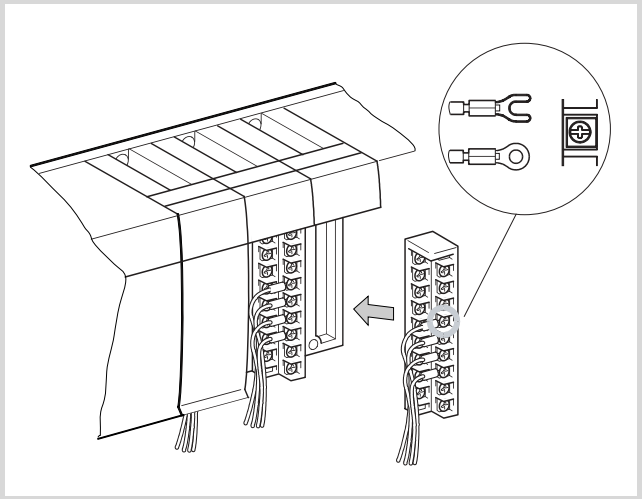


Figure 9: Wiring up the screw terminal block

→ 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, then they must have a maximum outside 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^2 , or 0.5 mm^2 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.

Terminal capacity of the terminal block

▽ **Important!**
With UL-conform applications, the supply cables to the XIOC-8DO, -16DO, -12DO-R, -16DX modules must have a cross-section of AWG16 (1.3 mm^2).

Table 3: Cable connection

Conductor	Screw connection	Spring-loaded connection
solid core	0.5 to 2.5 mm^2	0.14 to 1.0 mm^2
stranded, with bootlace ferrule	0.5 to 1.5 mm^2	0.34 to 1.0 mm^2

Wiring the digital input module (24 V DC)

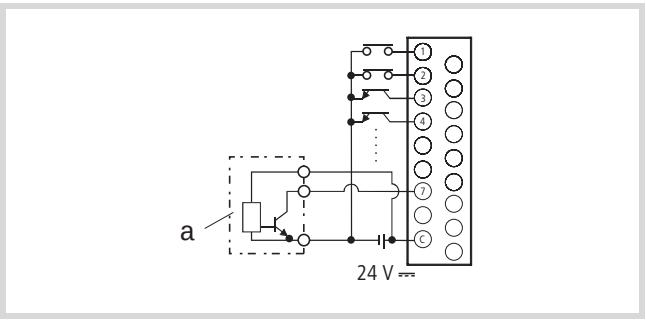


Figure 10: Example of external wiring for the DC input XIOC-8DI/ 16DI (here 16 DI)

a Proximity switch

- The diodes that are connected in antiparallel to the input circuits of the module enable operation of the inputs from either +24 V DC or
  –24 V DC (see "Internal circuit" on Page 38).
- 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.

Wiring up the digital output module (24 V DC)

Wiring up the relay output module

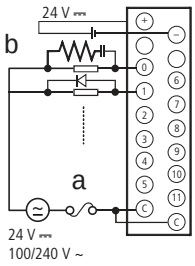


Figure 11: External wiring of the relay output XIOC-12DO-R

a Fuse

b 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 µF and resistor about 100 Ω) 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.

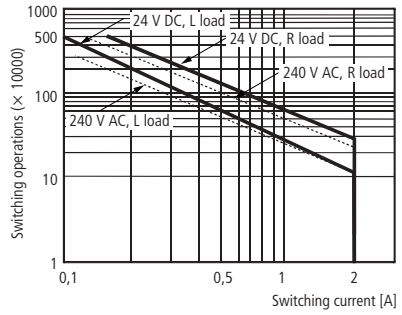


Figure 12: Operating life diagram for the relay contacts

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

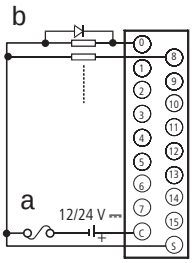


Figure 13: External wiring of the transistor output XIOC-8DO/-16DO (positive logic, source type)

a Fuse

b 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 cannot 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 cannot 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.

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

Wiring up the analogue module

- ▶ Short-circuit any unused channels on the analogue input module.
- ▶ Short-circuit any unused current outputs on the analogue output module (2 to 3 channels).
- ▶ 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.

Project planning

Details on project planning can be found in the following manuals

XC-CPU600: AWB2700-1428

XC-CPU100: AWB2724-1453

Dimensions

Signal modules

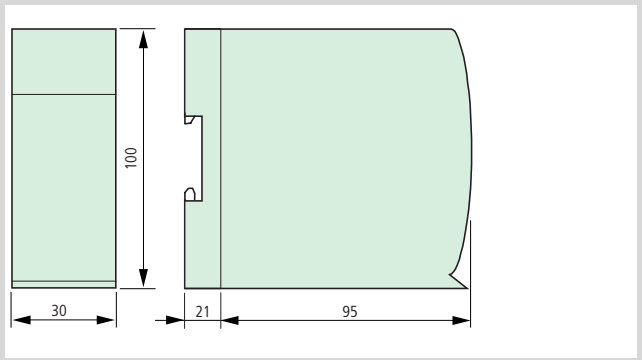


Figure 14: Dimensions of the signal modules

Module rack

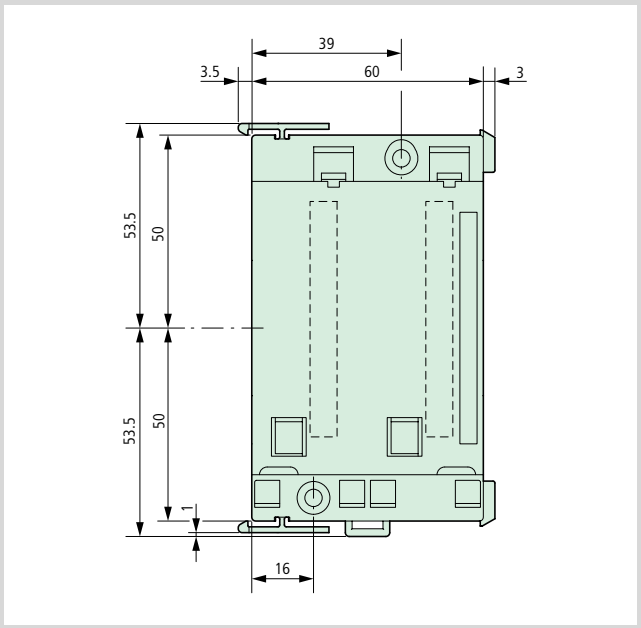


Figure 15: Dimension of the module racks XIOC-BP-XC, XIOC-BP-2

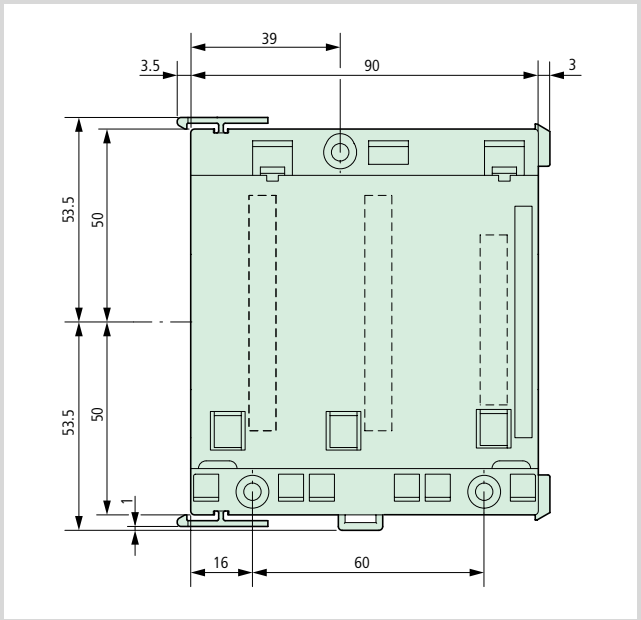


Figure 16: Dimensions of the module rack XIOC-BP-XC1, XIOC-BP-3

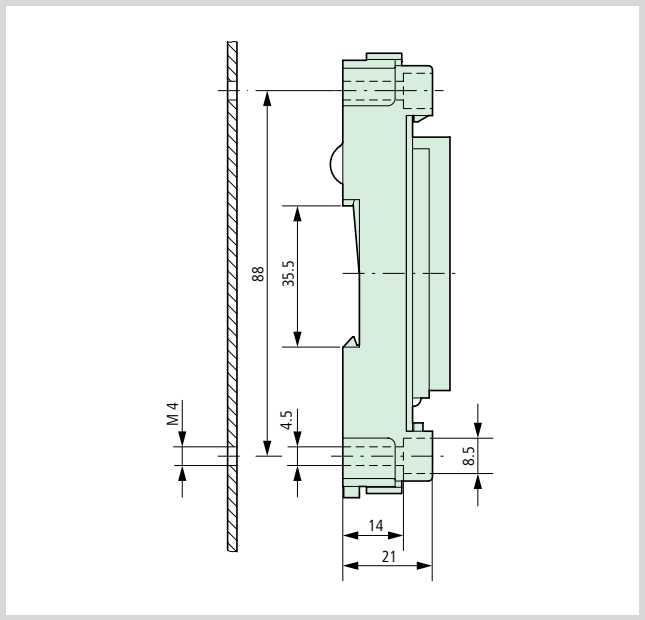


Figure 17: Dimensions of the module racks

2 Temperature acquisition module XIOC-4T-PT

Features

Pt100 (IEC751) and Pt1000 resistance thermometers can be connected to the XIOC1000T-PT temperature acquisition module.

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

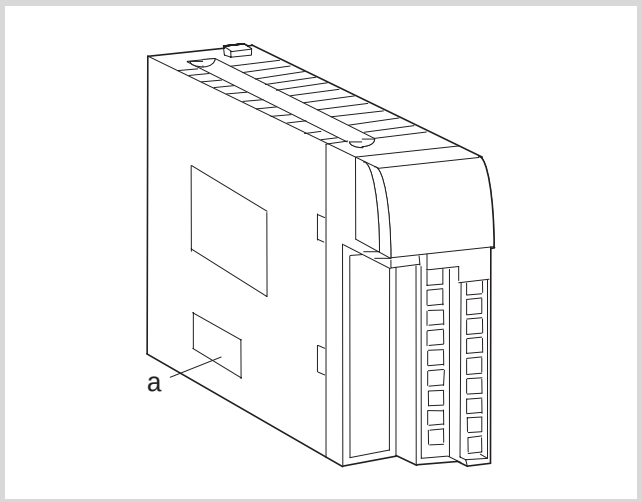
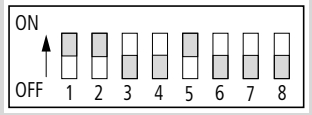
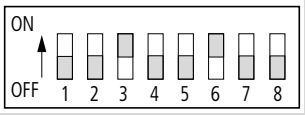
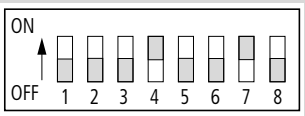


Figure 18: DIP switch position for temperature setting

a DIP switch

Table 4: Setting the temperature range

Type of resistance thermometer	Temperature meas. range (°C)	Accuracy (°C)	DIP switch
Pt100	–20 to + 40	± 0.5	 1, 2, 5 = ON
Pt100	–50 to + 400	± 3	 3, 6 = ON
Pt1000	–50 to + 400	± 6	 4, 7 = ON

Wiring

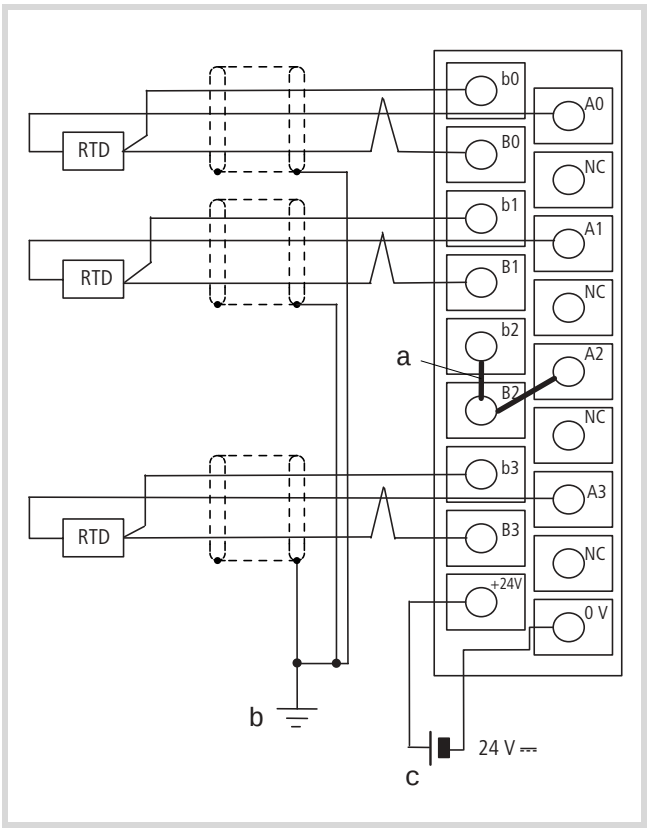


Figure 19: Wiring example

a Join the terminals of unused inputs (b2-B2-A2 in the diagram). Unused inputs have an indefinite status. The value is $7FFF_{hex}$.

b The shielding of the cable can be grounded at one or both ends, depending on the interference situation.

c External supply voltage, 24 V DC

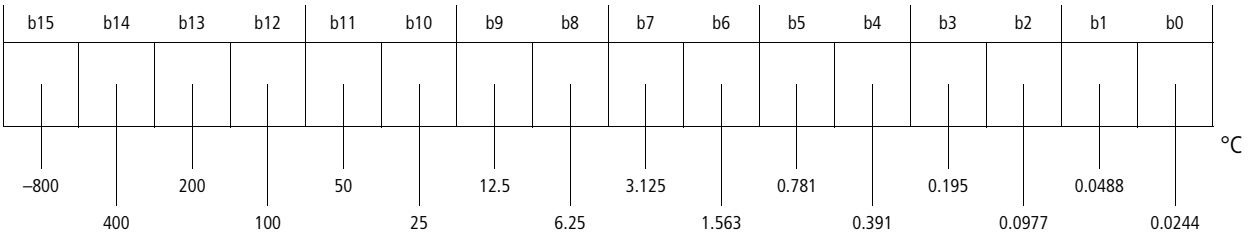
RTD = Resistance Temperature Detector

NC = Not connected/unused

Data evaluation

1. Range: –50 to +400 °C (Pt100/Pt1000)

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



Example 1

$F800_{hex}$ = 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0

F_{hex} 8_{hex} 0_{hex} 0_{hex}

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

–800 + 400 + 200 + 100 + 50 = –50 °C

Example 2

0600_{hex} = 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0

0_{hex} 6_{hex} 0_{hex} 0_{hex}

25 + 12.5 = 37.5 °C

If the measured value for the temperature lies outside the range (< –51 °C or > 410 °C), then the data value is displayed as $7FFF_{hex}$.

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

$$\text{Temperature (°C)} = \frac{\text{Decimal value, e.g. 256 } (0100_{hex})}{40.96} = 6.26\ (°C)$$

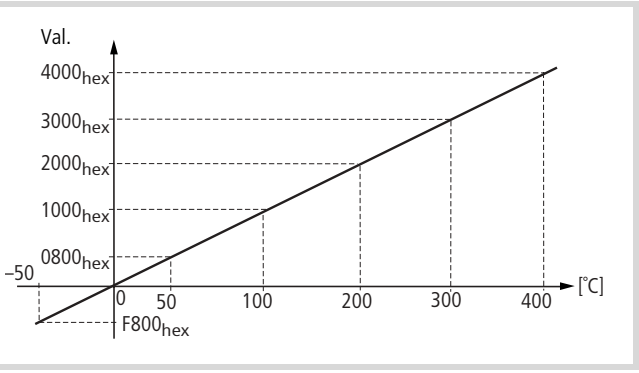
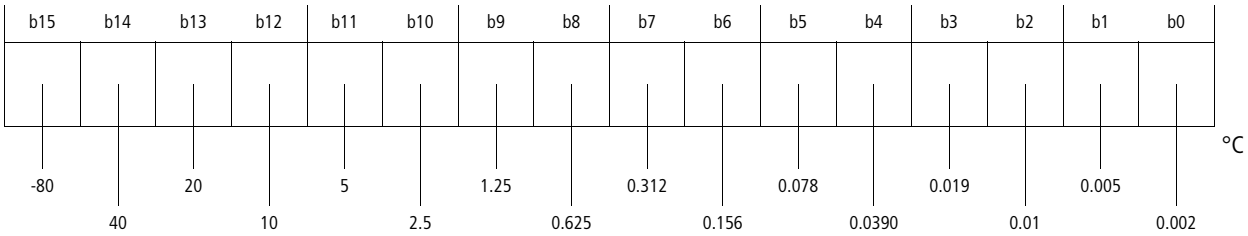


Figure 20: Temperature/measurement diagram

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

$E000_{hex}$ = 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0

E_{hex} 0_{hex} 0_{hex} 0_{hex}

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

–80 + 40 + 20 = –20 °C

Example 2

0600_{hex} = 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0

0_{hex} 6_{hex} 0_{hex} 0_{hex}

2.5 + 1.25 = 3.75 °C

If the measured value for the temperature lies outside the range (< –25 °C or > 45 °C), then the data value is displayed as $7FFF_{hex}$.

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

$$\text{Temperature (°C)} = \frac{\text{Decimal value, e.g. 256 } (0100_{hex})}{409.6} = 0.626\ (°C)$$

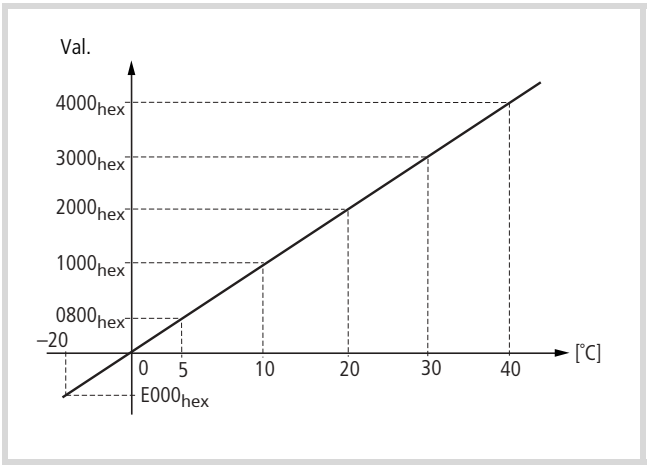


Figure 21: Temperature/measurement diagram

Conversion tables

Table 5: Conversion table for Pt100 (–20 to +40 °C)

Temperature (°C) 1)	Decimal value	Hexadecimal value	Pt100 resistance (O)
-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 6: Conversion table for Pt100/Pt1000 (–50 to +400 °C)

Temperature (°C)[1]	Decimal value	Hexadecimal value	Pt100 resistance (O)[2]
-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
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

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 $7FFF_{hex}$:

- ▶ 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 ($< 400\ \Omega$)
- ▶ 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 $7FFF_{hex}$:

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

3 Counter module

Assembly

The counter module 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.

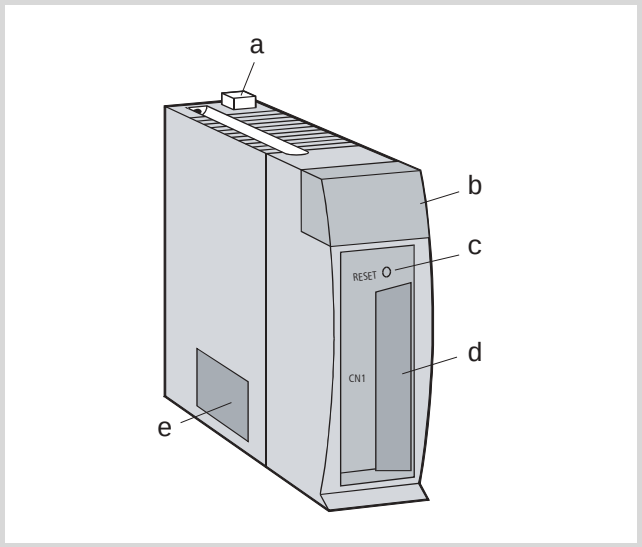


Figure 22: Assembly of the counter module

No.	Designation	Comments
a	Catch	
b	LED display	→ page 21
c	RESET button	Sets the parameters to "0". → page 21
d	Connection for pulse generator	30-pole connection (15 pins × 2) for the XIOC-TERM30-CNT4 connector. → page 24, 25
e	Mode switch (DIP)	This switch is used to set the operating mode. → page 22

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

1 A	1B	1M	PW
			ER
0	1		
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 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:	
	on:	OK
	blinking:	• After incorrect parameter entry • 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.
	OFF	Hardware error
ER	Error	
	ON:	• After operating the RESET button on the module • Hardware error
0, 1, 2, 3	Outputs Y	

Mode (operating mode) switch

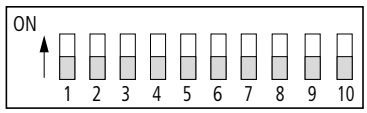


Figure 23: Mode (operating mode) switch, settings as delivered

→ 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.
Type of counter input				
Mode 1	1	OFF	2-phase counter, max. 100 kHz	1 + 2
	2	OFF		
Mode 2	1	ON	1-phase counter, (pulse-change)	1 + 2
	2	OFF		
Mode 3	1	OFF	1-phase counter, (polarity reversal)	1 + 2
	2	ON		
Mode 4	1	ON	2-phase counter with 4x evaluation, max. 25 kHz	1 + 2
	2	ON		
Polarity of the reference input (marker input)				
	3/4	OFF	A voltage on the input produces a "0" signal	1/2
		ON	A voltage on the input produces a "1" signal	
CPU-stop counter				
	5/6	OFF	CPU-STOP → Counter STOP	1/2
		ON	CPU-STOP → Counter RUN	
Linear/ring counter				
	7/8	OFF	Linear counter	1/2
		ON	Ring counter	
	9/10	OFF	not used	–

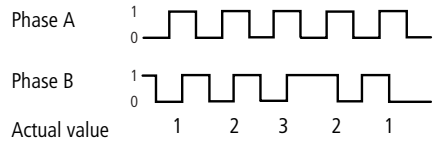


Figure 24: Mode 1 (2-phase)

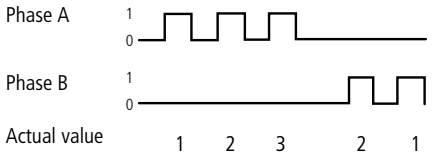


Figure 25: Mode 2 (1-phase)

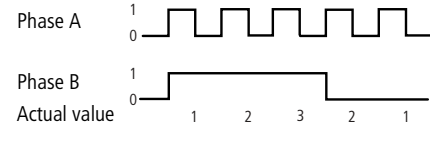


Figure 26: Mode 3 (1-phase)

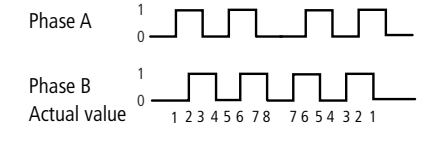


Figure 27: Mode 4 (2-phase, with quadruple evaluation)

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. The encoder that is connected can have a differential output or an open-collector output. The following examples illustrate the various connection options.

Two incremental encoders

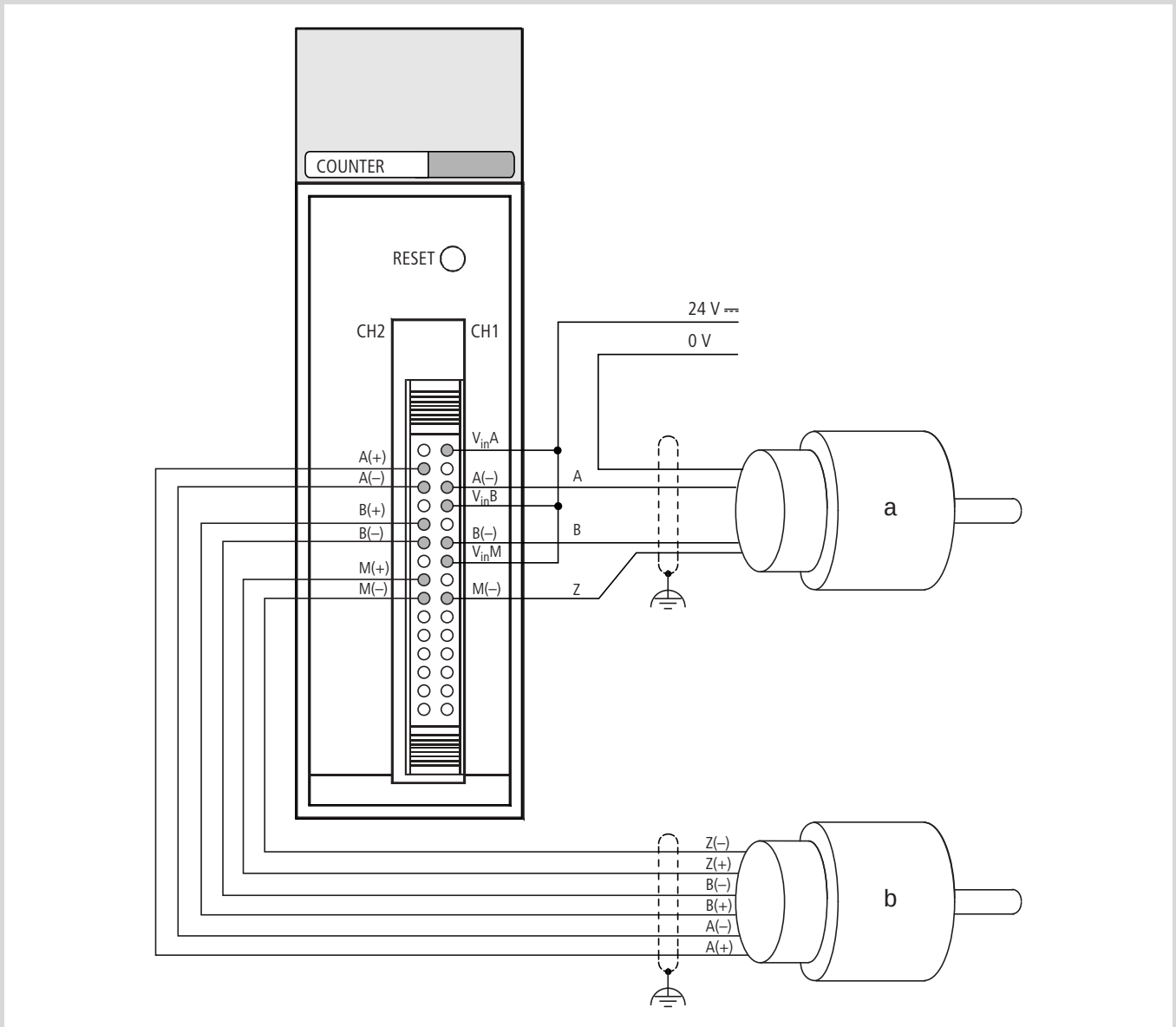
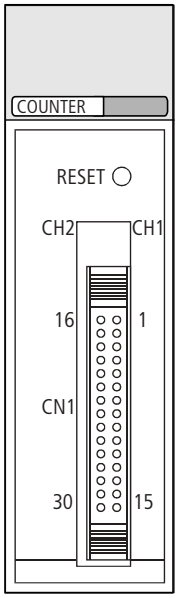


Figure 28: Connection for 2 incremental encoders (example)

a Encoder with open-collector outputs

b Encoder with differential outputs

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

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.

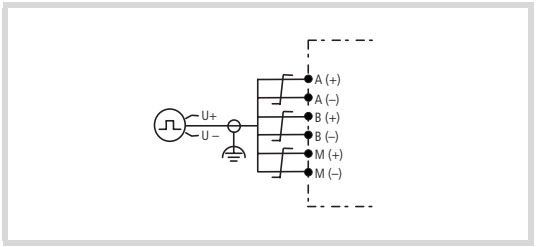


Figure 29: Encoder with differential outputs

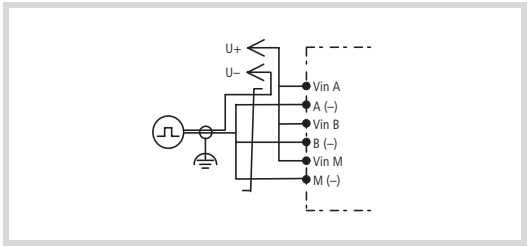


Figure 30: Encoder with voltage outputs

Cable with attached connector for the counter module

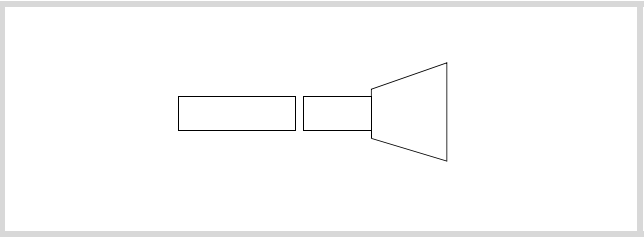


Figure 31: Cable with connector (XIOC-TERM30-CNT4)

No.	Chan. 2	Colour	No.	Chan. 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

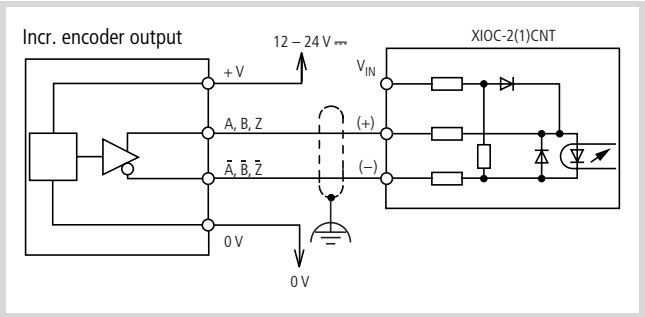


Figure 32: Connection for an incremental encoder with a differential output (example)

Incremental encoder with NPN transistor output

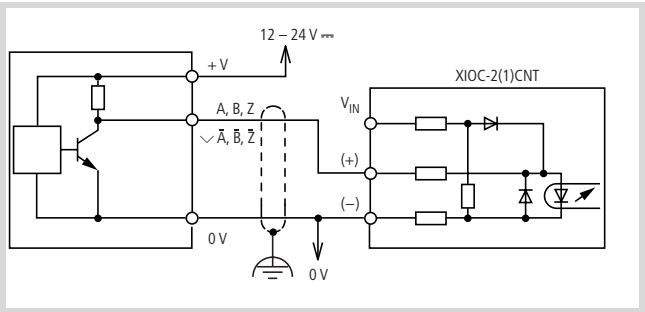


Figure 33: Connection for an incremental encoder with an NPN transistor output (example)

Incremental encoder with NPN transistor output (open-collector)

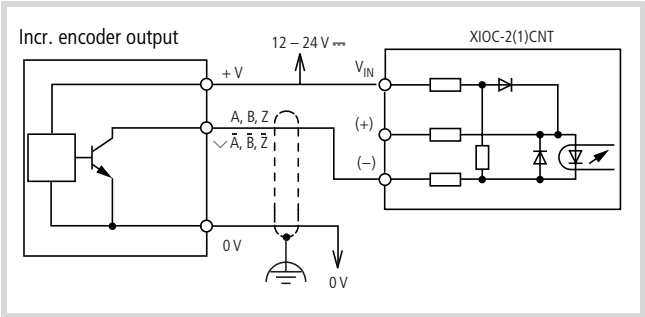


Figure 34: Connection for an incremental encoder with an open-collector NPN transistor output (example)

Incremental encoder with PNP transistor output (open-collector)

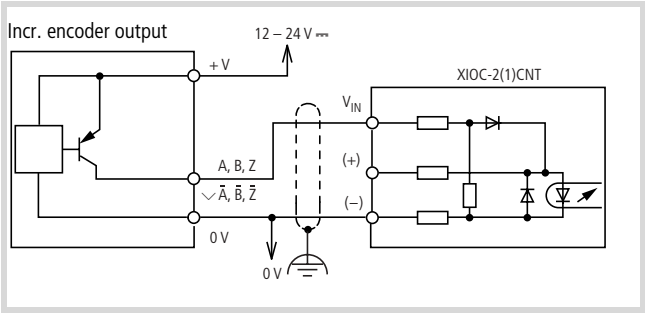


Figure 35: Connection for an incremental encoder with an open-collector PNP transistor output (example)

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.

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

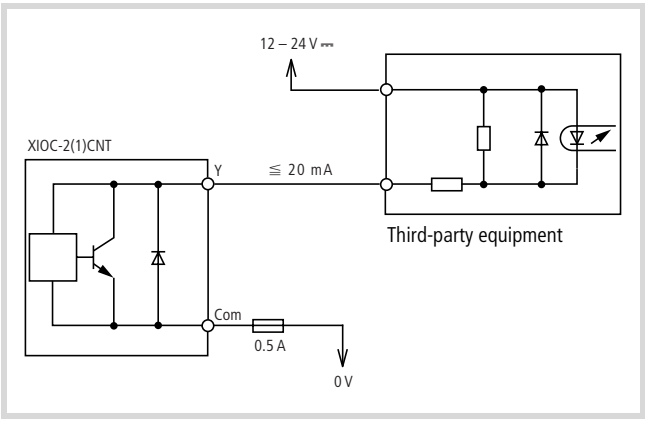


Figure 36: Connecting third-party equipment to the counter module

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 ($FFFFFFFF_{hex}$). 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.

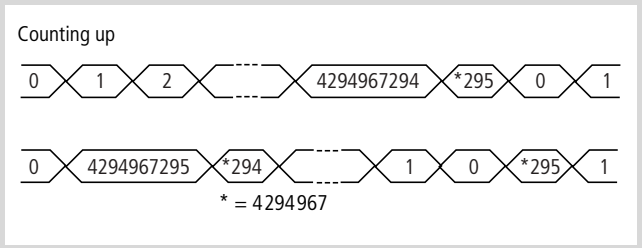


Figure 37: Counting range of the linear counter

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. The actual value of the count is continuously compared with the comparison 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 "Counter*n*Enable" input, either at the start or during operation. This does not depend on the counter being enabled.

Example

- Count direction: up
- Comparison value: 4294967200

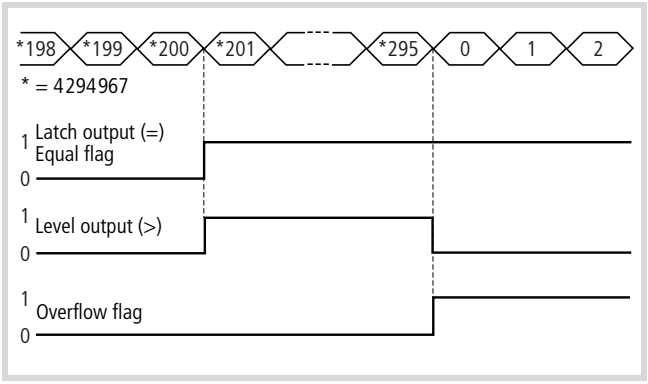


Figure 38: Setting module outputs

Overflow flag

The Overflow flag is set when the actual value changes from $FFFFFFFF_{hex}$ 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

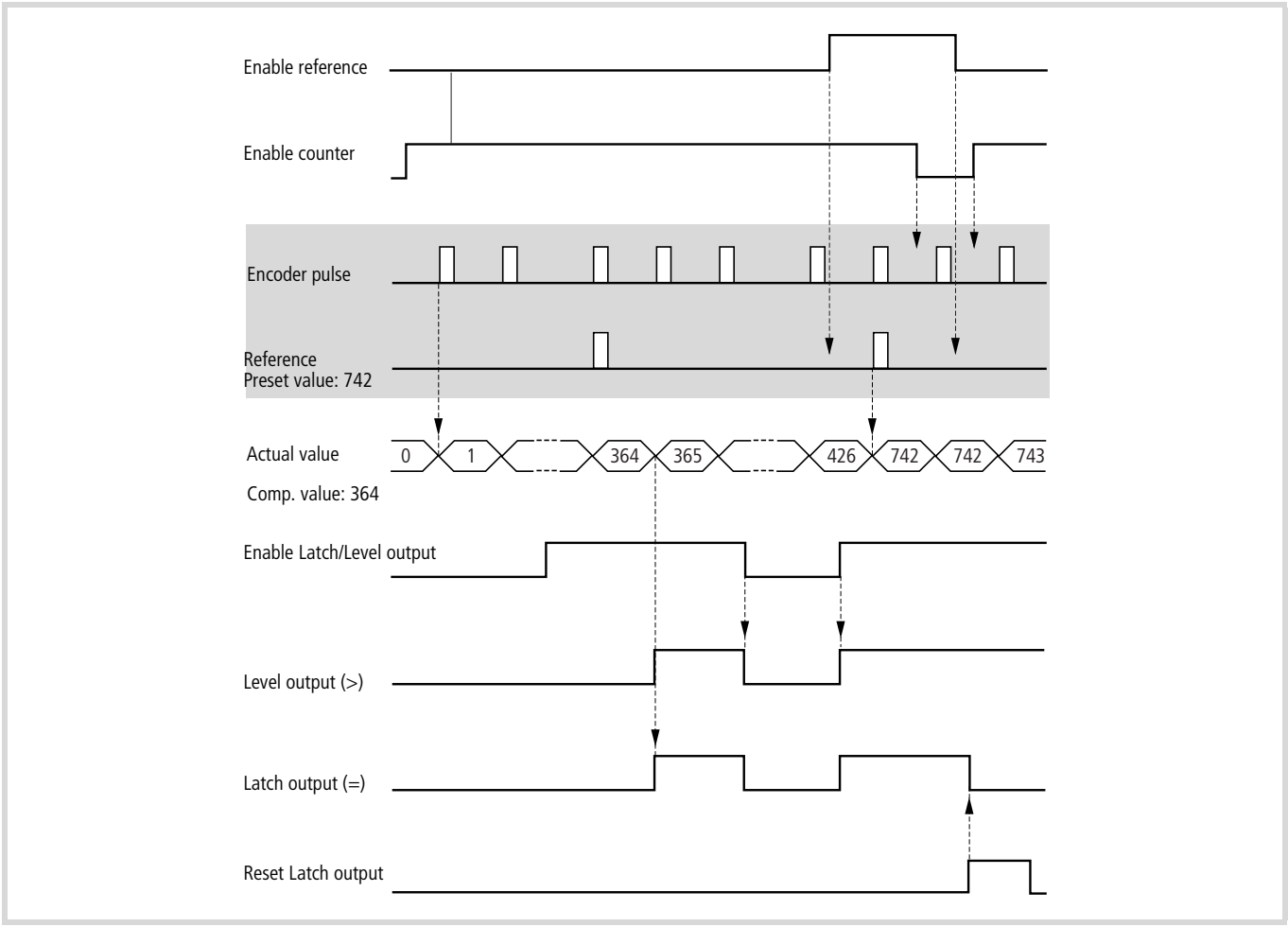


Figure 39: Example of a linear counter, with the functions "interrogate comparison value and reference signal" and "reset outputs"

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

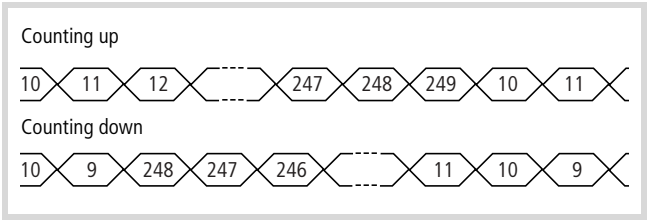


Figure 40: Counting range of the ring counter

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 = $FFFFFFFF_{hex}$.

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 "Counter*n*Enable" input.

Example:

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

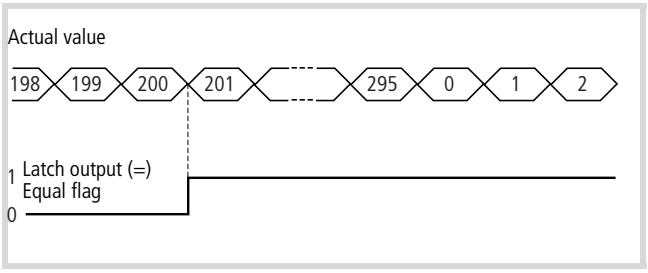


Figure 41: Set module output (Latch)

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 42

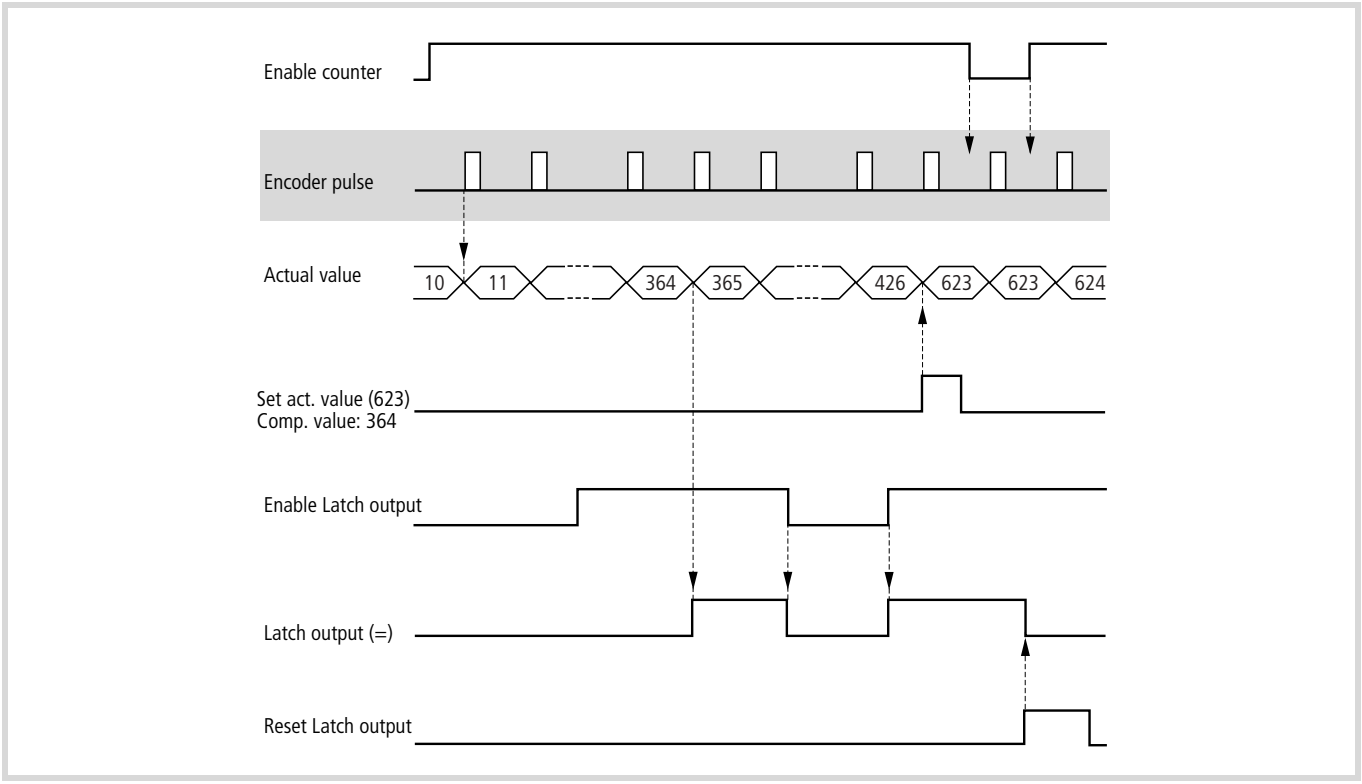


Figure 42: Example of a linear counter, with the functions "interrogate comparison value and reference signal" and "reset outputs"

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 22. 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 7: Configuration options

	Feature	Linear counter	Ring counter
Interrogation option for the counter	Start value	0	any
	End value	$FFFFFFFF_{hex}$	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 Counter*n*Enable	
	Inhibit counter	FALSE at input Counter*n*Enable	
Comparison value	Output (=)/ Equal flag	TRUE if actual value = comparison value → figure 43	
	Output (>)	TRUE if actual value > comparison value → figure 44	–
	Output (=)/ clear Equal flag	Set Output (=) and Equal flag "0"	
	Output (=) enable/inhibit	Input CompareOutput*n*Enable	
Reference input	Reference input = 1	Preset value overwrites actual value → figure 44	–
	Reference input: enable/inhibit	Input "ReferenceMarker*n*Enable"	–
	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:

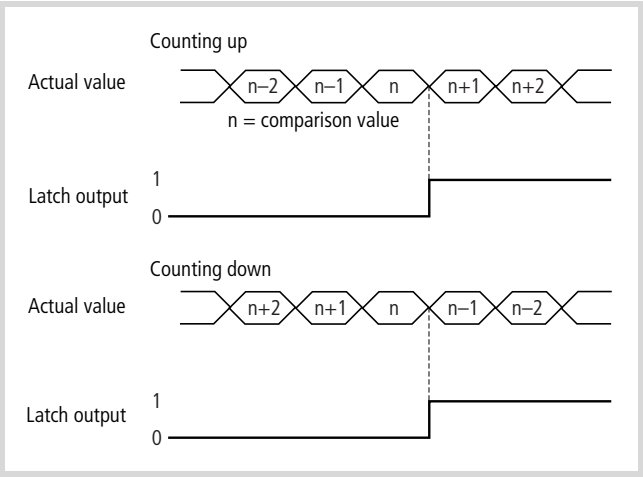


Figure 43: Interrogate comparison value

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.

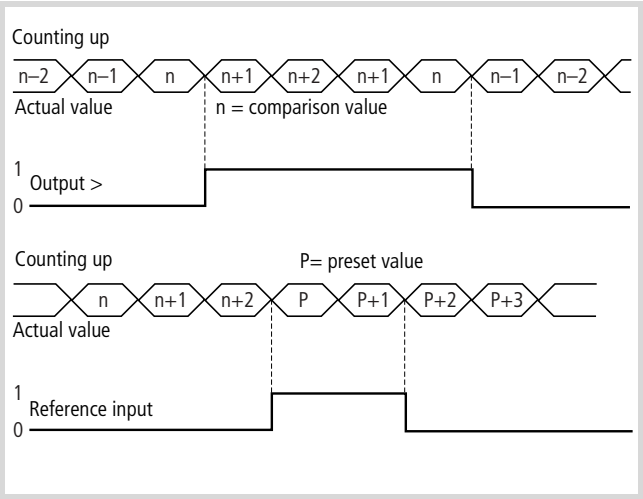


Figure 44: Interrogation of comparison and reference signals

Processing of commands

The following table describes the commands and illustrates the sequence in 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 "$FFFFFFFF_{hex}$".

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

→ A detailed description of the function blocks "CounterControl", "ReadCounter", "WriteCounter" and "CounterFlags" with all their inputs/ outputs and commands can be found in the manual "Function blocks for XSoft". This manual is also available as a PDF file (h1456g.pdf).

The latest edition of the manual can be found at
http://www.moeller.net/support
Search text: "AWB2725-1456GB".

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 "Counter*n*Enable" 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*n*, 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_{hex}, 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 XSoft", 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*n*" 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 "CompareOutput*n*Enable" of the "CounterControl" block.

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

Set "preset" value

Only for linear counters:

The command is carried out if there is a "0" signal applied to the "Counter*n*Enable" input of the "CounterControl" function block.

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

If the encoder transmits a reference signal, the preset value overwrites the actual value.

Enable reference input

Only for linear counters:

▶ Apply a "1" signal to the "ReferenceMarker*n*Enable" (n = 1, 2) input of the "CounterControl" function block, so that the reference signal can be received from the encoder.

Enable counter input

▶ Apply a "1" signal to the "Counter*n*Enable" input of the "CounterControl" function block, so that the signals can be received from the encoder.

When using a ring counter, the enable can only be implemented after you have set the start and end values.

Set new actual value

▶ Enter the command WRITECURRENTVALUE at the "Command" input of the "WriteCounter" block, and the actual value at the "Data" input.

Reset Latch output and Equal flag (EQ)

▶ Apply a "1" signal to the "ClearEqual*n*" input of the "CounterControl" function block to set the output and the Equal flag to "0".

The output and flag can only be set again if you apply a "0" signal to this input.

Read out start value

Only for ring counters:

▶ Enter the command READPRESETVALUE at the "Command" input of the "ReadCounter" block.

As soon as you have entered this command, the values will be shown at the outputs: "DataLowChannel*n*" and "DataHighChannel*n*", as well as "Output*n*_UDINT" and "Output*n*_DINT".

The command applies to both channels.

Read out end value

Only for ring counters:

▶ Enter the command READSETTINGVALUE at the "Command" input of the "ReadCounter" block.

As soon as you have entered this command, the values will be shown at the outputs: "DataLowChannel*n*" and "DataHighChannel*n*", as well as "Output*n*_UDINT" and "Output*n*_DINT".

The command applies to both channels.

Read out comparison value

▶ Enter the command READSETTINGVALUE*n* at the "Command" input of the "ReadCounter" block.

As soon as you have entered this command, the values will be shown at the outputs: "DataLowChannel*n*" and "DataHighChannel*n*", as well as " Output*n*_UDINT" and "Output*n*_DINT".

The command applies to both channels.

Read out preset value

Only for linear counters:

▶ Enter the command READPRESETVALUE at the "Command" input of the "ReadCounter" block.

As soon as you have entered this command, the values will be shown at the outputs: "DataLowChannel*n*" and "DataHighChannel*n*", as well as " Output*n*_UDINT" and "Output*n*_DINT".

The command applies to both channels.

Read actual (=current) values

▶ Enter the command READCURRENVALUE at the "Command" input of the "ReadCounter" block.

As soon as you have entered this command, the actual value will be shown continuously at the outputs: "DataLowChannel*n*" and "DataHighChannel*n*", as well as " Output*n*_UDINT" and "Output*n*_DINT".

The command applies to both channels.

Read out flags

This command is described in detail on Page 34!

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 $FFFFFFFF_{hex}$ to 00000000_{hex}.

You can interrogate the flag state by using the command READFLAGS for the "CounterFlags" block. 16 bits are shown at the "StatusChannel*n*" 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_{hex} to $FFFFFFFF_{hex}$.

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

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

Read out flags

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

These states are frozen until a new positive edge occurs.

The states of "StatusChannel*n*" and "OutputsChannel*n*" 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

- StatusChannel*n*

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Val.	0	0	0	0	0	U/D	0F	UF	0	0	0	EQ	EC	OE	ME	CE

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) 0: no enable 1: enabled
ME	Reference input state (default value = 0) 0: no enable 1: enabled
OE	Output Y state (default value = 0) 0: no enable 1: enabled
EC	Equal Flag clear active (default value = 0) If the "ClearEqual*n*" input function of the "CounterControl" block is set to TRUE, then EC = FALSE. If it is set to FALSE, then EC = TRUE.
EQ	State of Equal flag It is set of actual value = comparison value. It will remain set until a "1" signal is applied to the "ClearEqual*n*" input of the "CounterControl" block.
UF	State of Underflow flag It is set if the actual value changes from 0 to 4294967295 ($FFFFFFFF_{hex}$). It will remain set until the CLEARUNDERFLOW command is applied to the "Command" input of the "CounterFlags" function block. The output words "Outputs", "StatusChannel*n*" and "OutputsChannel*n*" will be set to "0".
OF	State of Overflow flag It is set if the actual value changes from 4294967295 ($FFFFFFFF_{hex}$) 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", "StatusChannel*n*" and "OutputsChannel*n*" will be set to "0".
U/D	State of Up/Down 0: if the actual value has changed from "n" to "n – 1". 1: if the actual value has changed from "n" to "n + 1".

- OutputsChannel*n*

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_{hex} (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			
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) 0: no enable 1: enabled
ME	Reference input state (default value = 0) 0: no enable 1: enabled
OE	Output Y state (default value = 0) 0: no enable 1: enabled
EQ	State of Equal flag 0: no action 1: if actual value = comparison value It remains set until a "0" signal is applied to the "CompareOutput*n*Enable" input of the "CounterControl" block.
UF	State of Underflow flag It is set if the actual value changes from 0 to 4294967295 ($FFFFFFFF_{hex}$). It will remain set until the CLEARUNDERFLOW command is applied to the "Command" input of the "CounterFlags" function block. The output words "Outputs", "StatusChannel*n*" and "OutputsChannel*n*" will be set to "0".
OF	State of Overflow flag It is set if the actual value changes from 4294967295 ($FFFFFFFF_{hex}$) 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", "StatusChannel*n*" and "OutputsChannel*n*" 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)[1)]
ME	ReferenceMarker Enable	Reference input is enabled (1) or inhibited (0)[1)]
OE	OutputEnable	Latch output (=) is enabled (1) or inhibited (0)[1)]
EQ	Equal Flag	The Equal flag is set if actual value = comparison value.[1)]
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 4294967295 ($FFFFFFFF_{hex}$). 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 "4294967295" ($FFFFFFFF_{hex}$) 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.

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[1)]	Counter*n*Enable (1)
▶ Enable Latch/Level outputs[1)]	CompareOutput*n*Enable (1)
For referencing	
▶ Enable reference inputs[1)]	ReferenceMarker*n*Enable (1)
Initiate referencing	
When the reference signal is received, the preset value will overwrite the actual value, e.g. actual value = 0.	
▶ Inhibit reference inputs	ReferenceMarker*n*Enable (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 – Set the ClearEqual flag (Equal flag is set to "0", Latch output (=) is set to "0")	Clear Equal*n* (1)
▶ Reset the ClearEqual flag	ClearEqual*n* (0)
▶ Set new comparison value	WRITESETTINGVALUE1
...	
The Overflow flag is set when the count changes from $FFFFFFFF_{hex} \rightarrow 0$:	
▶ Reset Overflow flag	CLEAROVERFLOW
The Underflow flag is set when the count changes from $0 \rightarrow FFFFFFFF_{hex}$	
▶ 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[1)]	Counter*n*Enable (1)
▶ Enable Latch output[1)]	CompareOutput*n*Enable (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 – Set the ClearEqual flag (Equal flag is set to "0", Latch output (=) is set to "0")	Clear Equal*n* (1)
▶ Reset the ClearEqual flag	ClearEqual*n* (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 Technical data

XControl

General	
Standards and regulations	IEC/EN 61 131-2, EN 50 178
Ambient temperature	0 to +55 °C
Storage temperature	–25 to +70 °C
Vibration resistance	10 – 57 Hz ±0.075 mm, 57 – 150 Hz ±1.0 g
Mechanical shock resistance	15 g/11 ms
Impact resistance	500 g/∅ 50 mm ±25 g
Overvoltage category	II
Pollution degree	2
Protection class	1
Enclosure protection	IP20
Interference emission	DIN/EN 55 011/22, Class A
Electromagnetic compatibility	
Electrostatic discharge (IEC/EN 61 000-4-2)	
Contact discharge	4 kV
Radiated (IEC/EN 61 000-4-3, RFI)	
AM/PM	10 V/m
Burst (IEC/EN 61 000-4-4)	
Supply cables	2 kV
Signal cables	1 kV
Surge (IEC/EN 61 000-4-5)	
Supply cables, asymmetrical	0.5 kV
Conducted (IEC/EN 61 000-4-6)	
AM	10 V
External supply voltage	
Rated voltage U_e	24 V DC (12 V DC)
Permissible range	20.4 to 28.8 V DC (11.8 to 14.4 V DC)
Input voltage ripple	< 5 %
Hold-up capability on brownouts	
Duration of brownout	10 ms
Repetition rate	1 s

Digital input modules

Type	XIOC-8DI	XIOC-16DI	XIOC-16DI-AC
Input type	DC input	DC input	AC input
Number of input channels	8	16	16
Number of channels with common reference potential[1)]	8	16	16
Input voltage	24 V DC	24 V DC	200 to 40 V AC
Input voltage range	20.4 to 28.8 V DC	20.4 to 28.8 V DC	170 to 264 V AC
Input resistance	Typ. 3.5 kΩ	Typ. 5.9 kΩ	Typ. 32 kΩ (50 Hz) Typ. 27 kΩ (60 Hz)
Input current	Typ. 6.9 mA	Typ. 4.0 mA	4. to 8.0 mA (200 V AC/50 Hz)
Voltage level			
ON	≧ 15V	≧ 15V	≧ 164 V AC
OFF	≦ 5V	≦ 5V	≦ 40 V AC
Input signal delay			
OFF→ ON	≦ 5 ms (4 ms typ.)	≦ 5 ms (4 ms typ.)	≦ 15 ms
ON → OFF	≦ 5 ms (4 ms typ.)	≦ 5 ms (4 ms typ.)	≦ 25 ms
Electrical isolation			
Between inputs and the I/O bus	Through optocouplers	Through optocouplers	Through optocouplers
Input indication	By LED (green)	By LED (green)	By LED (green)
External connection	Plug-in terminal block	Plug-in terminal block	Plug-in terminal block
Internal current consumption (5 V DC)	Typ. 26 mA	Typ. 51 mA	Typ. 51 mA
Weight	0.16 kg	0.16 kg	0.18 kg

1) The terminals for the reference potential are internally connected.

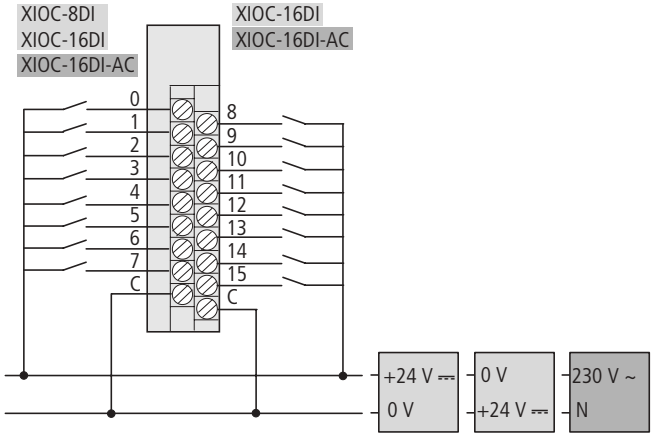


Figure 46: Terminal assignment

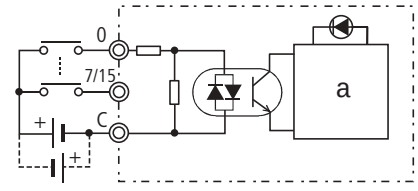


Figure 45: Internal circuit

a Internal circuitry

Digital output modules

Transistor output modules

Type	XIOC-8DO	XIOC-16DO	XIOC-16DO-S
Output type	Transistor output (source type)	Transistor output (source type)	Transistor output (source type)
Number of output channels	8	16	16
Number of channels with common reference potential	8	16	16
Output voltage	12/24 V DC	12/24 V DC	12/24 V DC
Switching current, minimum	1 mA	1 mA	1 mA
Residual current for a "0" signal	0.1 mA	0.1 mA	0.1 mA
Rated current			
for "1" signal	0.3 A	0.3 A	0.8 A
Per common potential terminal	2.4 A	4 A	5 A
Output signal delay			
OFF→ ON	≦ 0.3 ms	≦ 0.3 ms	≦ 0.3 ms
ON → OFF	≦ 1 ms	≦ 1 ms	≦ 1 ms
Overvoltage protection	Diode	Diode	Integrated
Fuse[1)]	4 A	8 A	None
Electrical isolation			
Between outputs and the I/O bus	Through optocouplers	Through optocouplers	Through optocouplers
Short-circuit protection	–	–	Yes
Output indication	By LED (green)	By LED (green)	By LED (green)
External connection	Plug-in terminal block	Plug-in terminal block	Plug-in terminal block
Internal current consumption (5 V DC)	Typ. 30 mA	Typ. 50 mA	Typ. 50 mA
External supply voltage[2)]	12/24 V DC, → page 37	12/24 V DC, → page 37	12/24 V DC, → page 37
Weight	0.16 kg	0.16 kg	0.16 kg

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

2) Attach the external supply voltage (12/24 V DC) to the "C" and "S" terminals.
Important! With UL-conform applications the supply cables must have a cross-section of AWG16 (1.3 mm²).

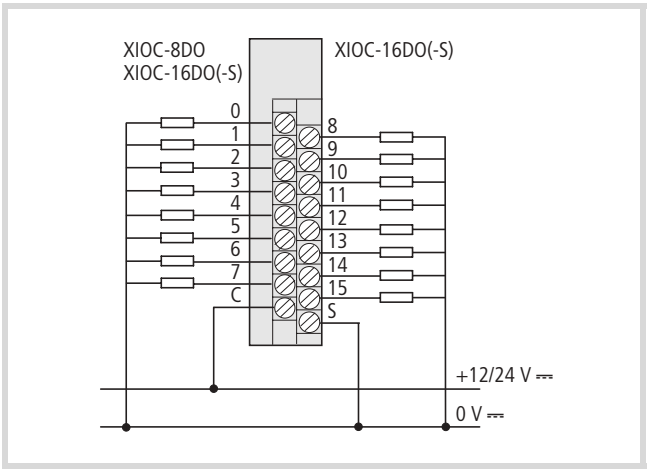


Figure 47: Terminal assignment

Relay output module

Type	XIOC-12DO-R
Output type	Relay output
Number of output channels	12
Number of channels with common reference potential[1)]	12
Output voltage	100/240 V AC, 24 V DC
Switching current, minimum	1 mA
Rated current	
for "1" signal	2 A
Per common potential terminal	5 A
Output signal delay	
OFF→ ON	≦ 10 ms
ON → OFF	≦ 10 ms
Overvoltage protection	External
Fuse	External
Electrical isolation	
Between relay and the I/O bus	Through optocouplers
Output indication	By LED (green)
General	
External connection	Plug-in terminal block
Internal current consumption (5 V DC)	Typ. 40 mA
External supply voltage[2)]	24 V DC, → page 37
Weight	0.2 kg

1) The reference potential terminals are internally connected.

2) An external 24 V DC voltage must applied.
Important! With UL-conform applications the supply cables must have a cross-section of AWG16 (1.3 mm²).

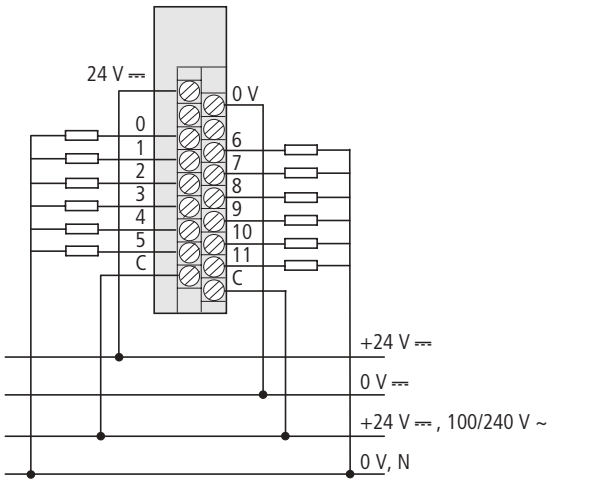


Figure 48: Terminal assignment for the XIOC-12DO-R module

Digital input/output modules

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

Type	XIOC-16DX
Inputs	
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	typ. 100 µs
ON → OFF	typ. 1 ms
Electrical isolation	
Between inputs and the I/O bus	Through optocouplers
Input indication	By LED (green)
Outputs	
Output type	Transistor (source type)
Number of output channels	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_N = 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 – 3, 4 – 7, 8 – 11. Actuation of the outputs within a group only in the same program cycle.
Number of outputs	max. 3
Maximum total current	2A per group
Minimum total current	250 mA
Output signal delay	typ. 100 µs
Overvoltage protection	Diode
Electrical 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)
General	
External connection	Plug-in terminal block
Internal current consumption (5 V DC)	Typ. 50 mA
External supply voltage[1)]	24 V DC, → page 37
Weight	0.16 kg

1) Important! With UL-conform applications the supply cables must have a cross-section of AWG16 (1.3 mm²).

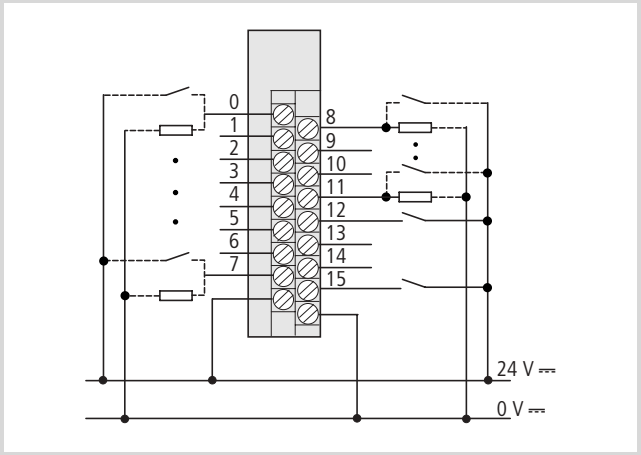


Figure 49: Terminal assignments for module XIOC-16DX

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 49.

The configuration of the module is performed in the "PLC Configuration" register. An "Empty slot" is inserted with "Set element". The following appears, for example:

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

After a double clock on the input word:

```
---AT%IW6:WORD;(*Inputs/Outputs*) [CHANNEL (I)]
  ---AT%IX6.0:BOOL;(*Bit 0*)
  ---AT%IX6.1:BOOL;(*Bit 1*)
  bis
  ---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 clock on the output word:

```
---AT%QW2: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 (Bits 4 to 7) cannot be used.

Example

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

- Programming the connection as an input.

Declaration:

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

Program (STL):

```
LD Start
ST Valve
```

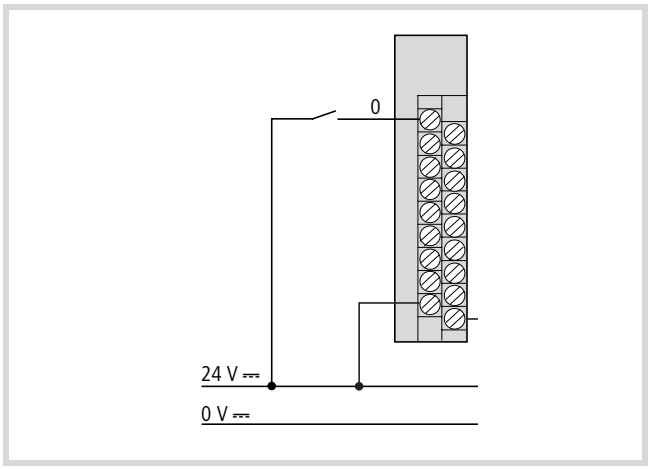


Figure 50: Wiring the connection as an input

- Programming the connection as an output.

Declaration:

```
Motor AT% QX2.0:   BOOL;
Start:             BOOL;
```

Program (STL):

```
LD Start
ST Motor
```

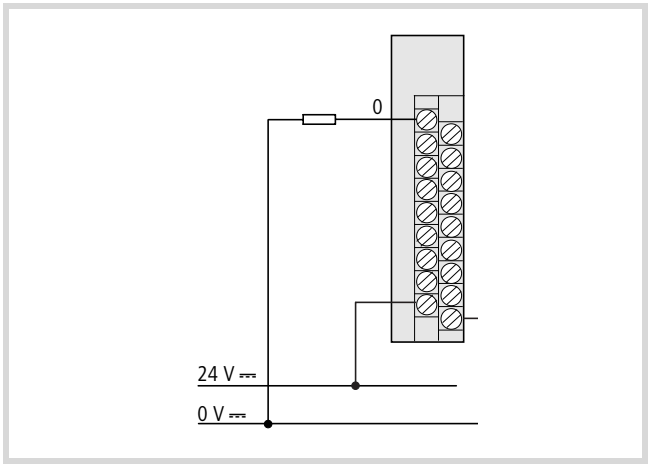


Figure 51: Wiring the connection as an output

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

Analogue input modules

Type	XIOC-8AI-I2	XIOC-8AI-U1	XIOC-8AI-U2
Input current range (0 to 7 channels)	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	Plug-in terminal block	Plug-in terminal block
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

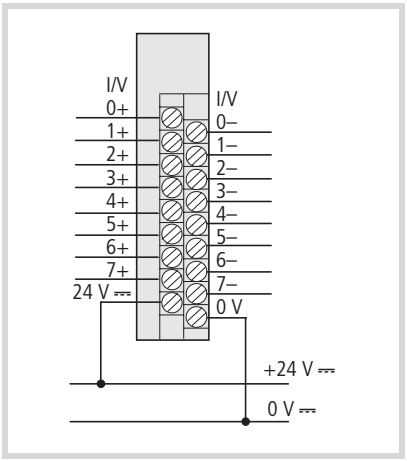


Figure 52: Terminal assignments for modules XIOC-8AI-I2 and XIOC-8AI-U1/-U2

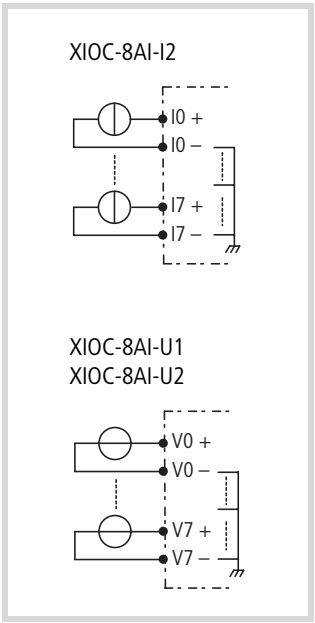


Figure 53: Module wiring

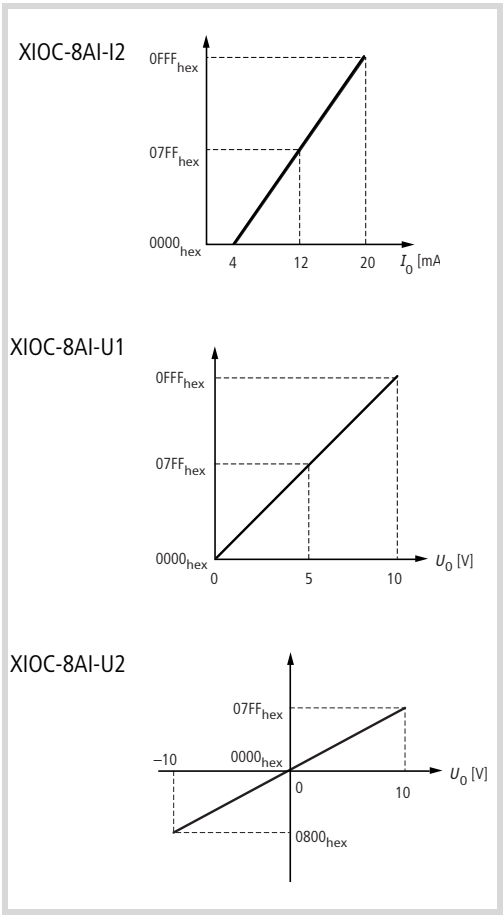


Figure 54: U/I diagram for the modules

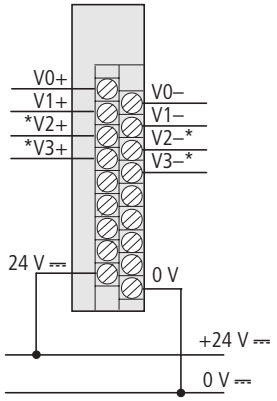
Analogue output modules

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[1)]	≦ 5 ms	≦ 5 ms	≦ 5 ms	≦ 5 ms
Overall accuracy	≦ ±1 % (of end of scale)			
External load resistance				
Voltage output	≧10k Ω	≧10k 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[2)]	2 channels (0 to 1)	2	4	4
Output current[2)]	2 channels (2 to 3)	–	–	–
External connection	Plug-in terminal block			
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.

XIOC-2AO-U2
XIOC-4AO-U1/-U2



XIOC-2AO-U1-2AO-I2

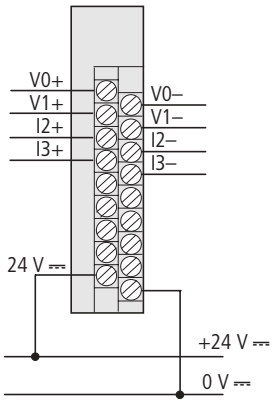
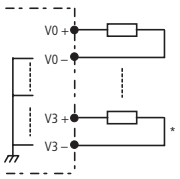


Figure 55: Terminal assignment

* not for XIOC-2AO-U2

XIOC-2AO-U2
XIOC-4AO-U1/-U2



* not for XIOC-2AO-U2

XIOC-2AO-U1-2A0-I2

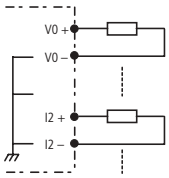
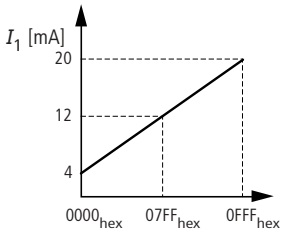
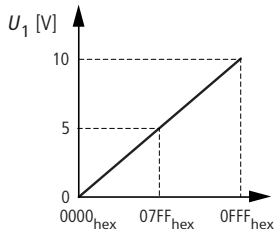


Figure 56: Module wiring

XIOC-2AO-U1-2A0-I2



XIOC-2AO-U1-2A0-I2
XIOC-4AO-U1



XIOC-2AO-U2
XIOC-4AO-U2

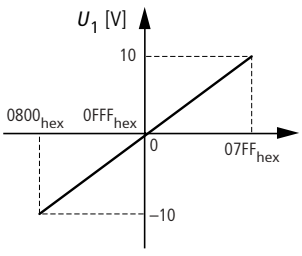


Figure 57: U/I diagram for the modules

Temperature acquisition module

→ More information on the temperature acquisition module can be found in Chapter 2 from Page 15 onwards.

Type	XIOC-4T-PT
Platinum RTD	Pt100 (IEC 751) / Pt1000
Temperature resolution	15 bit, with sign
Accuracy[1)]	
–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	–20 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	Shielded cable
Additional functions	Linearisation
Fault detection –20 to +40 °C –50 to +400 °C	The resistance value is $7FFF_{hex}$ at: ≦ –25 °C or ≧ 45 °C ≦ –60 °C or ≧ 410 °C
Response to cable break or unused inputs	In this case, the resistance is $7FFF_{hex}$.
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.

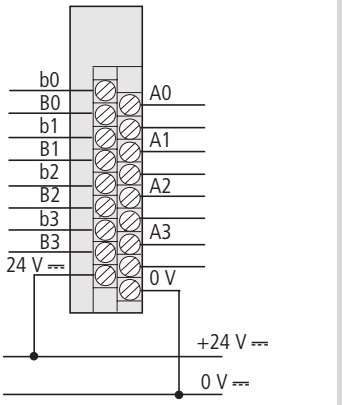


Figure 59: Terminal assignments for module XIOC-4T-PT

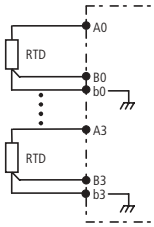


Figure 58: Module wiring

Counter module

→ More information on wiring up the counter module can be found in Chapter 3 from Page 21.

Type	XIOC-2CNT-100 kHz	XIOC-1CNT-100 kHz
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)	
Input		
Maximum count value	32 bit (0 to 4294967295)	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
Differential input current	≧ 4 mA	≧ 4 mA
Differential input voltage	12 to 24 V DC	12 to 24 V DC
Minimum ON voltage level	10 V DC	10 V DC
Maximum OFF voltage level	4 V DC	4 V DC
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	30-pole connector XIOC-TERM30-CNT4
External cabling	Twisted pair, shielded	Twisted pair, shielded
Output		
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

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