X67BC8331

1 General information

The bus controller makes it possible to connect X2X Link I/O nodes to POWERLINK. It is also possible to operate the X2X Link cycle synchronously 1:1 or synchronous to POWERLINK using a prescaler.

Additional X2X Link I/O nodes (X67 modules or other modules based on X2X Link) can be connected using the integrated X2X Link connection. Mechanically, POWERLINK is connected via an IP67-rated standard D-coded M12 Ethernet connector.

POWERLINK is a standard protocol for Fast Ethernet with hard real-time characteristics. The POWERLINK Standardization Group (EPSG) ensures openness and continuous advancement. www.ethernet-powerlink.org

- POWERLINK V1/V2
- 8 digital channels, configurable as inputs or outputs
- I/O configuration and firmware update via the fieldbus
- Integrated connection to the local expansion via X2X Link for up to 250 additional modules
- Configurable I/O cycle (starting at 200 µs)

2 Order data

Model number	Short description	Figure
	Bus controller modules	
X67BC8331	X67 bus controller, 1 POWERLINK interface, X2X Link power supply 3 W, 8 digital channels configurable as inputs or outputs, 24 VDC, 2 A, configurable input filter	

Table 1: X67BC8331 - Order data

Required accessories
See "Required cables and connectors" on page 8. For a general overview, see section "Accessories - General overview" of the X67 system user's manual.

3 Technical data

Model number	X67BC8331
Short description	
Bus controller	POWERLINK (V1/V2) controlled node
General information	
Inputs/Outputs	8 digital channels, configurable as inputs or outputs using the software, inputs with additional functions
Isolation voltage between channel and bus	500 V_{eff}
Nominal voltage	24 VDC
B&R ID code	
Bus controller	0xA7A5
Internal I/O module	0x1311
Sensor/Actuator power supply	0.5 A summation current
Status indicators	I/O function per channel, supply voltage, bus function
Diagnostics	
Outputs	Yes, using LED status indicator and software
I/O power supply	Yes, using LED status indicator and software
Connection type	
Fieldbus	M12, D-coded
X2X Link	M12, B-coded
Inputs/Outputs	8x M8, 3-pin
I/O power supply	M8, 4-pin
Power output	3 W X2X Link power supply for I/O modules
Power consumption	
Fieldbus	3.5 W
Internal I/O	3.8 W
X2X Link power supply	4.2 W at maximum power output for connected I/O modules
Certifications	
CE	Yes
KC	Yes
EAC	Yes
UL	cULus E115267 Industrial control equipment
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5
ATEX	Zone 2, II 3G Ex nA IIA T5 Gc IP67, Ta = 0 - Max. 60°C TÜV 05 ATEX 7201X
Interfaces	
Fieldbus	POWERLINK (V1/V2) controlled node
Type	Type 2 [1)]
Variant	M12 interface (female connector on module)
Line length	Max. 100 m between 2 stations (segment length)
Transfer rate	100 Mbit/s
Transfer	
Physical layer	100BASE-TX
Half-duplex	Yes
Full-duplex	No
Autonegotiation	Yes
Auto-MDI / MDIX	Yes
Min. cycle time [2)]	
Fieldbus	200 µs
X2X Link	200 µs
Synchronization between bus systems possible	Yes
I/O power supply	
Nominal voltage	24 VDC
Voltage range	18 to 30 VDC
Integrated protection	Reverse polarity protection
Power consumption	
Sensor/Actuator power supply	Max. 12 W [3)]
Sensor/Actuator power supply	
Voltage	I/O power supply minus voltage drop for short-circuit protection
Voltage drop for short-circuit protection at 0.5 A	Max. 2 VDC
Summation current	Max. 0.5 A
Short-circuit proof	Yes
Digital inputs	
Input voltage	18 to 30 VDC
Input current at 24 VDC	Typ. 4 mA
Input characteristics per EN 61131-2	Type 1
Input filter	
Hardware	≤10 µs (channels 1 to 4) / ≤70 µs (channels 5 to 8)
Software	Default 0 ms, configurable between 0 and 25 ms in 0.2 ms intervals

Table 2: X67BC8331 - Technical data

Model number	X67BC8331
Input circuit	Sink
Input resistance	Typ. 6 kΩ
Switching threshold	
Low	<5 VDC
High	>15 VDC
Digital outputs	
Variant	FET positive switching
Switching voltage	I/O power supply minus residual voltage
Nominal output current	2 A
Total nominal current	8 A
Output circuit	Source
Output protection	Thermal shutdown in the event of overcurrent or short circuit, integrated protection for switching inductive loads, reverse polarity protection of the output power supply
Diagnostic status	Output monitoring with 10 ms delay
Leakage current when switched off	5 µA
Switching on after overload shutdown	Approx. 10 ms (depends on the module temperature)
Residual voltage	<0.5 V at 2 A nominal current
Peak short-circuit current	<21 A
Switching delay	
0 → 1	<250 µs
1 → 0	<270 µs
Switching frequency	
Resistive load	Max. 100 Hz
Inductive load	See section "Switching inductive loads"
Braking voltage when switching off inductive loads	50 VDC
Electrical properties	
Electrical isolation	Bus to POWERLINK and channel disconnected Channel to channel connected
Operating conditions	
Mounting orientation	
Any	Yes
Installation elevation above sea level	
0 to 2000 m	No limitation
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m
Degree of protection per EN 60529	IP67
Ambient conditions	
Temperature	
Operation	-25 to 60°C
Derating	See section "Derating".
Storage	-40 to 85°C
Transport	-40 to 85°C
Mechanical properties	
Dimensions	
Width	53 mm
Height	85 mm
Depth	42 mm
Weight	200 g
Torque for connections	
M8	Max. 0.4 Nm
M12	Max. 0.6 Nm

Table 2: X67BC8331 - Technical data

1) See Automation Help under "Communication / POWERLINK / General information / Hardware - CN" for more information.
2) The minimum cycle time specifies the time up to which the bus cycle can be reduced without communication errors occurring.
3) The power consumption of the sensors and actuators connected to the module is not permitted to exceed 12 W.

4 LED status indicators

Figure	LED	Color	Status	Description
Status indicator 1: Left: Green, Right: Red  Status indicator 2: Left: Green, Right: Red	**Status indicator 1**: Status indicator for POWERLINK bus controller			
	L/A IF1	Green	On	A link to the peer station has been established.
			Blinking	A link to the peer station has been established. Indicates Ethernet activity is taking place on the bus.
	S/E[1)]	Green/Red		Status/Error LED. The statuses of this LED are described in section "Status/Error LED "S/E"" on page 4.
	I/O LEDs			
	1 - 8	Orange	-	Input/Output status of the corresponding channel
	Status indicator 2: Status indicator for module function			
	Left	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	Right	Red	Off	No power to module or everything OK
			On	Error or reset status
			Single flash	Warning/Error on an I/O channel. Level monitoring for digital outputs has been triggered.
			Double flash	Supply voltage not in the valid range

1) The Status/Error LED is a green/red dual LED.

4.1 Status/Error LED "S/E"

The Status/Error LED is a green/red dual LED. The color green (status) is superimposed on the color red (error).

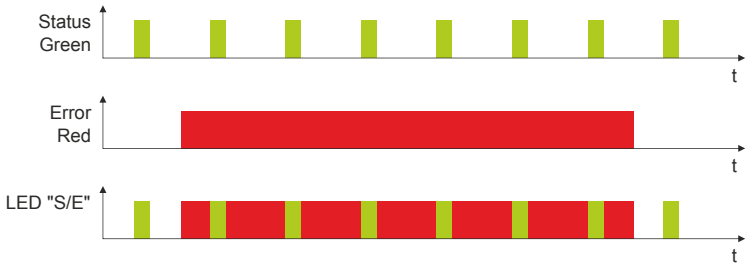
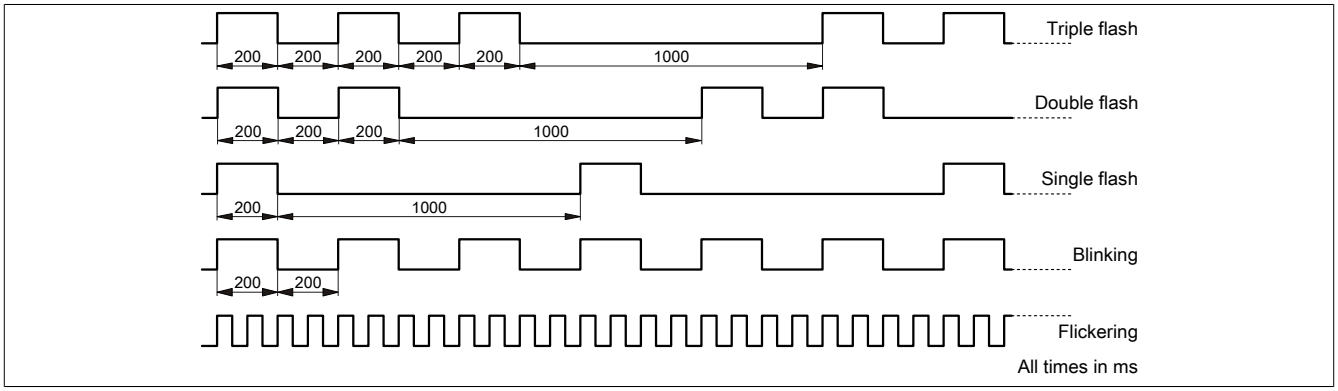
Red - Error	Description
On	The controlled node (CN) is in an error state (failed Ethernet frames, increased number of collisions on the network, etc.). If an error occurs in the following states, then the green LED blinks over the red LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE  Note: • Several red blinking signals are displayed immediately after the device is switched on. This is not an error, however. • The LED is lit red for CNs with configured physical node number 0 but that have not yet been assigned a node number via dynamic node allocation (DNA).

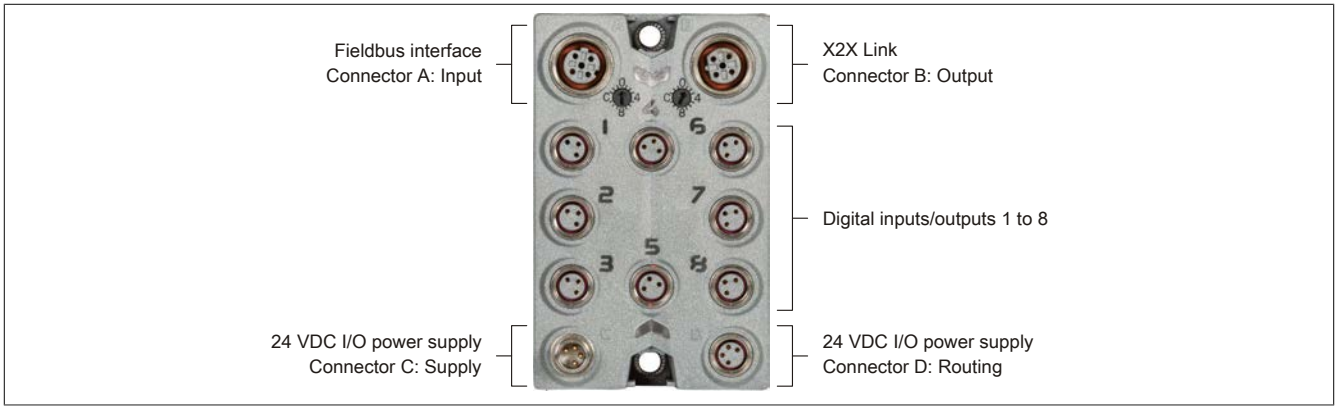
Table 3: Red Status/Error LED: LED indicates an error

Green - Status	Description
Off	No power supply or mode NOT_ACTIVE. The controlled node (CN) is either not supplied with power, or it is in state NOT_ACTIVE. The CN waits in this state for about 5 seconds after a restart. Communication is not possible with the CN. If no POWERLINK communication is detected during these 5 seconds, the CN enters state BASIC_ETHERNET (flickering). If POWERLINK communication is detected before this time expires, however, the CN immediately enters state PRE_OPERATIONAL_1.
Flickering green (approx. 10 Hz)	Mode BASIC_ETHERNET. The CN has not detected any POWERLINK communication. In this state, it is possible to communicate directly with the CN (e.g. with UDP, IP, etc.) If communication POWERLINK is detected in this state, the CN switches to PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Mode PRE_OPERATIONAL_1. When operating on a POWERLINK V1 manager, the CN switches directly to PRE_OPERATIONAL_2. When operated on a POWERLINK V2 manager, the CN waits until an SoC frame is received and then switches to the PRE_OPERATIONAL_2 state.
Double flash (approx. 1 Hz)	Mode PRE_OPERATIONAL_2. The CN is normally configured by the manager in this state. It is then switched to state READY_TO_OPERATE by command (POWERLINK V2) or by setting the "data valid" flag in the output data (POWERLINK V1).
Triple flash (approx. 1 Hz)	Mode READY_TO_OPERATE. In network POWERLINK V1, the CN switches automatically to OPERATIONAL as soon as input data is present. In a POWERLINK V2 network, the manager switches to the OPERATIONAL state by issuing a command.
On	Mode OPERATIONAL. The PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Mode STOPPED. Output data is not being output, and no input data is being provided. It is only possible to switch to or leave this state after the manager has given the appropriate command.

Table 4: Green Status/Error LED: LED indicates operation

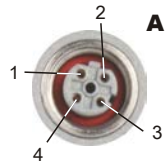


5 Operating and connection elements



6 Fieldbus interface

The module is connected to the network using pre-assembled cables. The connection is made using M12 circular connectors.

Connection	Pinout		
	Pin	Description	
	1	TXD	Transmit data
	2	RXD	Receive data
	3	TXD\	Transmit data\
	4	RXD\	Receive data\
	Shield connection made via threaded insert in the module A → D-keyed (female), input		

Information:

The color of the wires used in field-assembled cables for connecting to the fieldbus interface may deviate from the standard.

It is extremely important to make sure that the pinout is correct (see X67 section "Accessories - POWERLINK cables" in the X67 user's manual).

6.1 Cabling guidelines for bus controllers with Ethernet cables

Some X67 system bus controllers are based on Ethernet technology. POWERLINK cables supplied by B&R can be used for wiring.

Model number	Connection type
X67CA0E41.xxxx	Attachment cables - RJ45 to M12
X67CA0E61.xxxx	Connection cables - M12 to M12

The following cabling guidelines must be observed:

- Use Cat 5 SFTP cables.
- Observe the minimum cable bend radius (see data sheet for the cable).

Information:

Using POWERLINK cables supplied by B&R (X67CA0E61.xxxx and X67CA0E41.xxxx) satisfies product standard EN 61131-2.

The customer must implement additional measures in the event of further requirements.

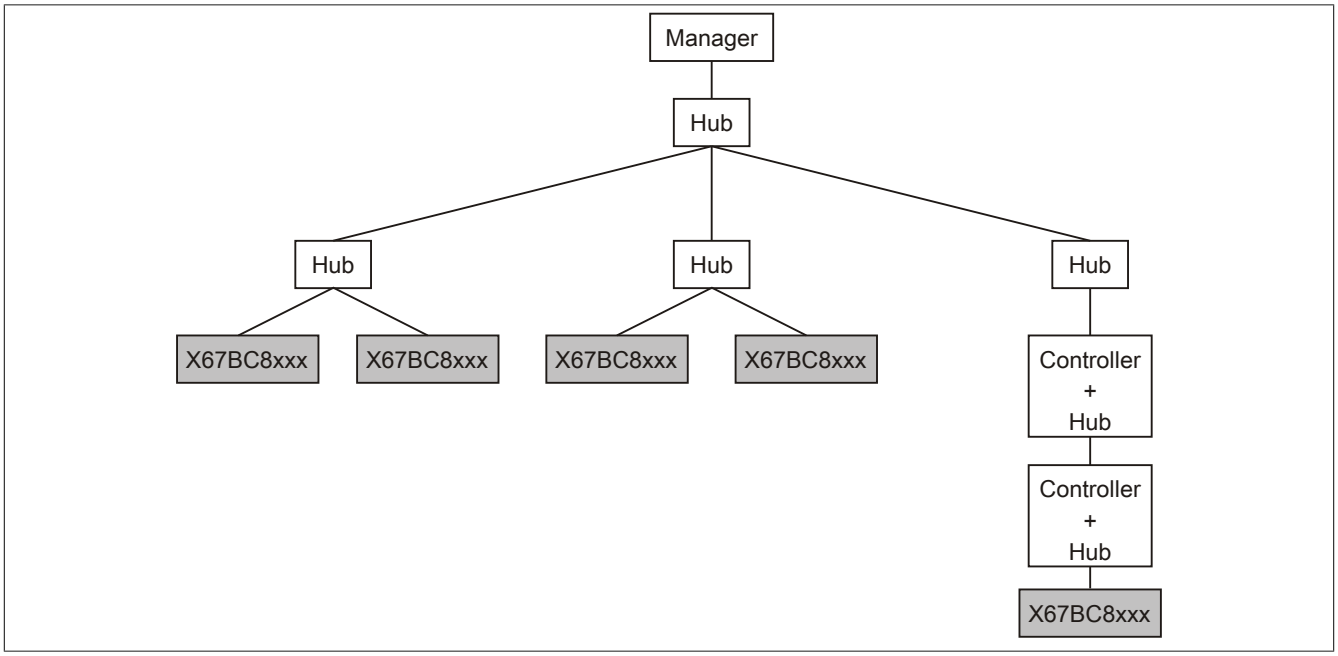
6.2 POWERLINK node number

The node number for the POWERLINK node is set using the two number switches.

Switch position	Description
0x00	Only permitted when operating the POWERLINK node in DNA mode.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node.
0xF0 - 0xFF	Reserved, switch position not permitted.

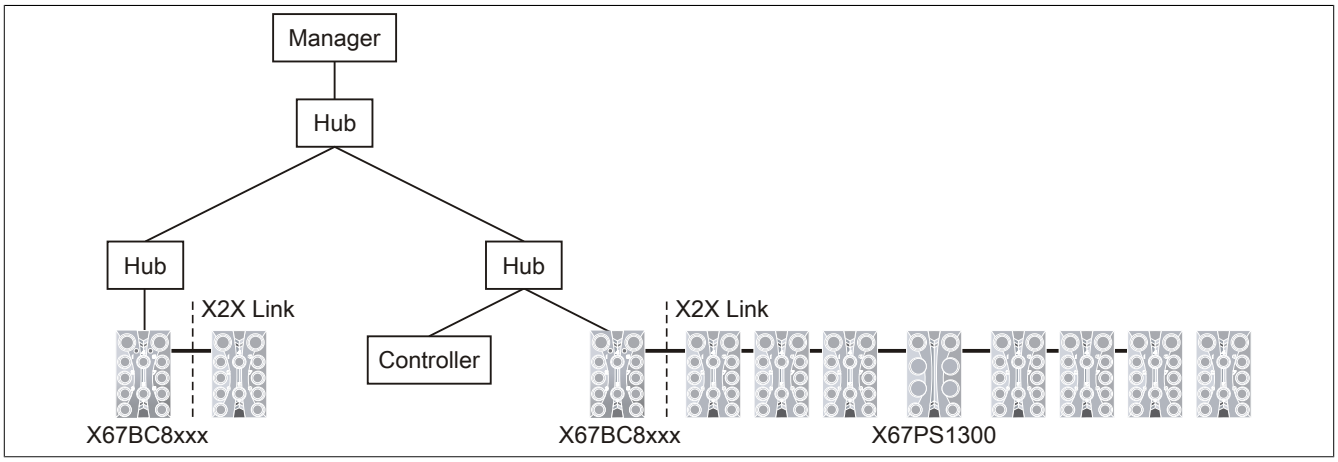
6.3 Integration in a POWERLINK network

This bus controller is used as the last controller in both a tree or line structure.



6.4 System configuration

A digital mixed module is already integrated in the bus controller. Up to 250 I/O modules can be connected to the bus controller.

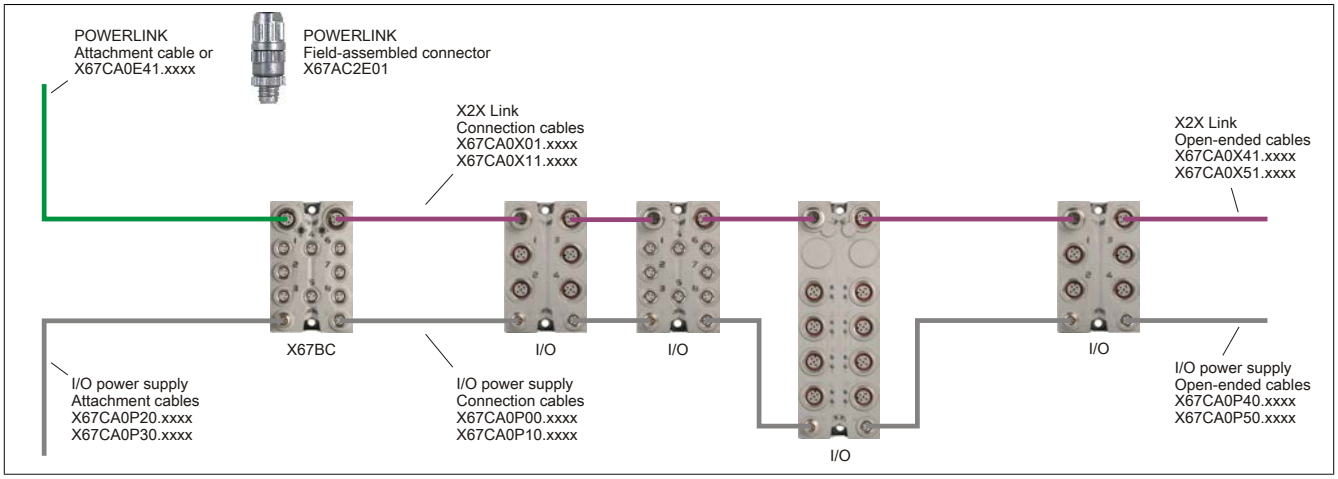


Information:

3 W are provided by the bus controller for additional X67 modules or other X2X Link-based modules.

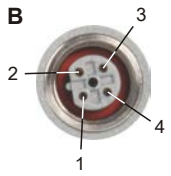
System supply module X67PS1300 is needed for additional power. This supply module provides 15 W for additional modules. It should be mounted in the middle of the modules that are to be supplied with power.

6.5 Required cables and connectors



7 X2X Link

Additional modules are connected to the bus controller via X2X Link using pre-assembled cables. The connection is made using M12 circular connectors.

Connection	Pinout	
	Pin	**Name**
	1	X2X+
	2	X2X
	3	X2X⊥
	4	X2X\
	Shield provided by threaded insert in the module	
	B → B-keyed (female), output	

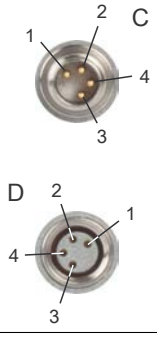
8 24 VDC I/O power supply

The I/O power supply is connected via M8 connectors C and D. The power supply is connected via connection C (male). Connector D (female) is used to route the power supply to other modules.

The fieldbus / X2X Link power supply and I/O power supply are supplied separately via pins 1 and 2.

Information:

The maximum permissible current for the I/O power supply is 8 A (4 A per pin).

Connection	Pinout		
	Pin	**Connector C (male)**	**Connector D (female)**
	1	24 VDC fieldbus / X2X Link	24 VDC I/O
	2	24 VDC I/O	24 VDC I/O
	3	GND	GND
	4	GND	GND
	C → Connector (male) in module, feed for I/O power supply D → Connector (female) in module, routing of I/O power supply		

9 Integrated digital mixed module

1 additional mixed module can be saved by the digital mixed module integrated in the bus controller.

9.1 Pinout

X1 to X8
M8 ①

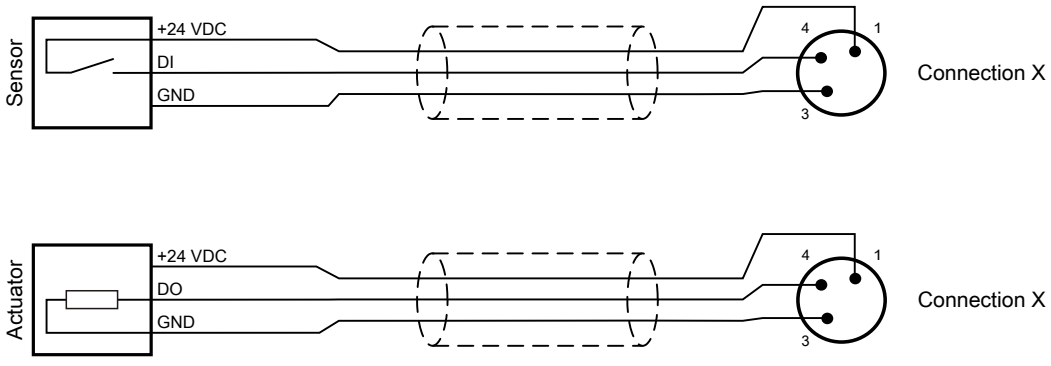
1	+24 VDC
3	GND
4	DI/DO x

① X67CA0D40.xxxx: M8 sensor cable, straight
X67CA0D50.xxxx: M8 sensor cable, angled

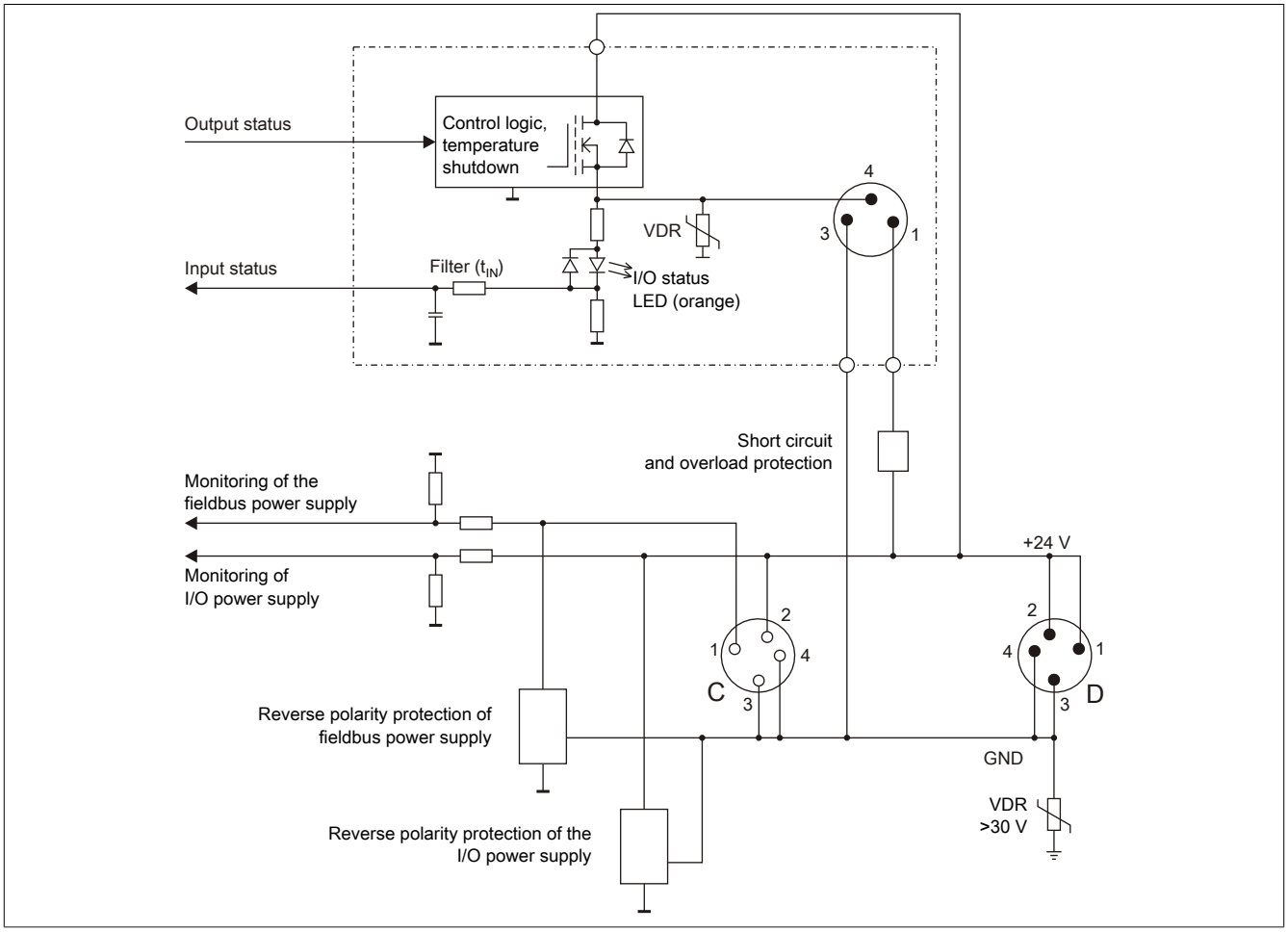
9.2 Connections X1 to X8

M8, 3-pin	Pinout	
	**Pin**	**Name**
	1	24 VDC sensor/actuator power supply[1)]
	3	GND
	4	Inputs/Outputs
	1) Sensors/Actuators are not permitted to be supplied externally.	
	Connections (female), input/output	

9.3 Connection examples



9.4 Input/Output circuit diagram



9.5 Derating / Operation with 2 A

The outputs of the module can handle up to 2 A. With a summation current of 8 A, no more than 4 channels are operable at full load. To ensure optimal use of the module, it is important to assign the channels properly, and to keep in mind a potential derating.

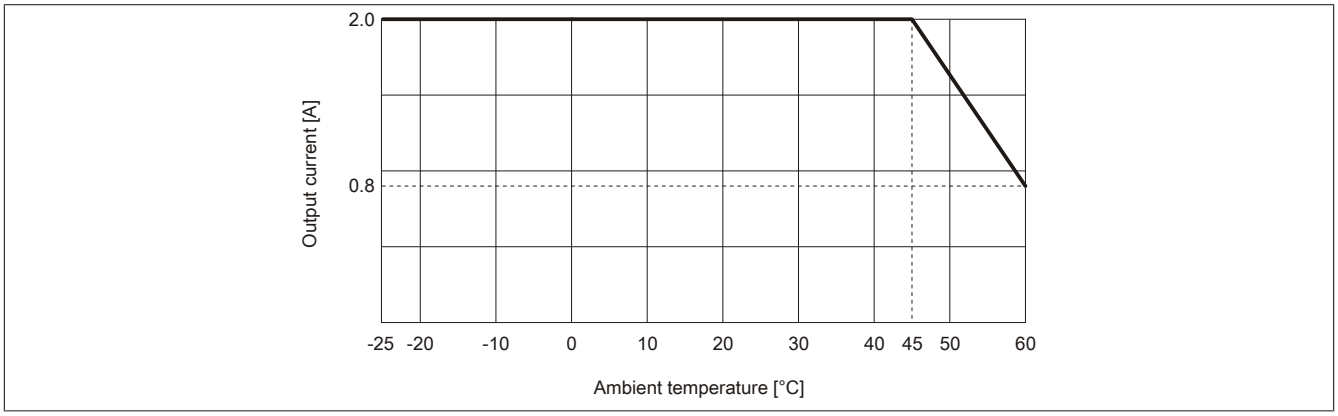
Correct channel assignment is important, since the 8 outputs are divided between 2 output drivers. The channels operated with 2 A must therefore be evenly divided between both output drivers.

Output driver 1: Channels 1 to 4
Output driver 2: Channels 5 to 8

The following table provides an overview of the number of fully used channels, the resulting best distribution, and a potential derating.

Number of channels using 2 A	Division	Derating
1	Any	No
2	1st channel with 2 A ... channel no. 1 to 4 2nd channel with 2 A ... channel no. 5 to 8	No
3	Assign all even or all odd channel numbers. Examples: 1, 3, 5 2, 4, 6 3, 5, 7 4, 6, 8	 Channels 1 and 3 Channels 2 and 4 Channels 5 and 7 Channels 6 and 8
4	Assign all even or all odd channel numbers. Possible divisions: 1, 3, 5, 7 2, 4, 6, 8	 On each channel On each channel

Derating when 3 or 4 channels are operated with 2 A:



10 SGx target systems

SG3

This module is not supported on SG3 target systems.

SG4

The module comes with preinstalled firmware. The firmware is also part of the Automation Runtime operating system for the PLC. With different versions, the Automation Runtime firmware is loaded onto the module.

The latest firmware is made available automatically when updating Automation Runtime.

11 Register description

11.1 General data points

In addition to the registers listed in the register description, the module also has other more general data points. These registers are not specific to the module but contain general information such as serial number and hardware version.

These general data points are listed in section "Additional information - General data points" of the X67 system user's manual.

11.2 Function model 0 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
16	ConfigIOMask01	USINT				•
18	ConfigOutput03 (input filter)	USINT				•
Communication						
0	Input state of digital inputs 1 to 8	USINT	•			
	DigitalInput01	Bit 0				
	...	...				
	DigitalInput08	Bit 7				
2	Switching state of digital outputs 1 to 8	USINT			•	
	DigitalOutput01	Bit 0				
	...	...				
	DigitalOutput08	Bit 7				
30	Status of digital outputs 1 to 8	USINT	•			
	StatusDigitalOutput01	Bit 0				
	...	...				
	StatusDigitalOutput08	Bit 7				

11.3 Configuration

11.3.1 I/O mask 1 to 8

Name:
ConfigIOMask01

Channels are configured as inputs/outputs in this register. It also determines whether output monitoring or filtering is applied to the channels. Outputs are monitored but not filtered.

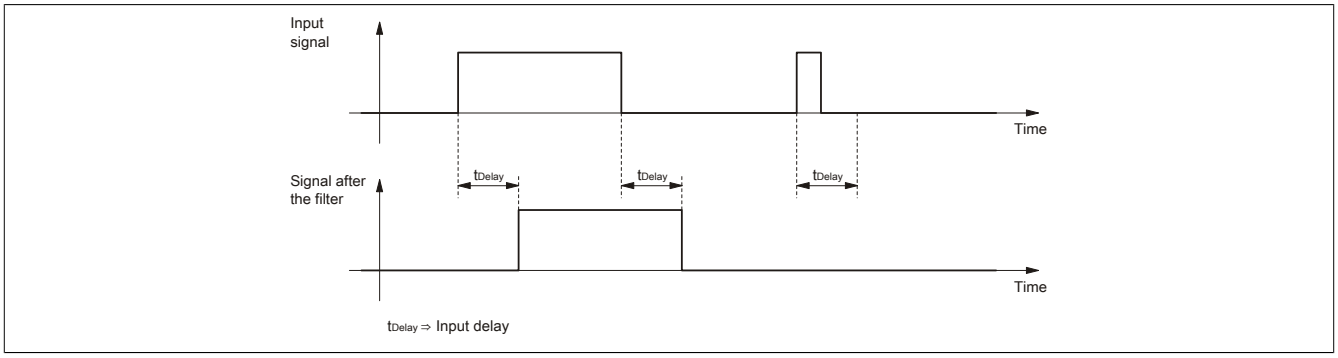
Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	Channel 1 configured as input/output	0	Configured as input
		1	Configured as output
...		...	
7	Channel 8 configured as input/output	0	Configured as input
		1	Configured as output

11.3.2 Input filter

An input filter is available for each input. The input delay can be set using register "ConfigOutput03" on page 13. Disturbance pulses which are shorter than the input delay are suppressed by the input filter.



11.3.2.1 Input filter

Name:
ConfigOutput03

This register can be used to specify the filter value for all digital inputs.

The filter value can be configured in steps of 100 µs. It makes sense to enter values in steps of 2, however, since the input signals are sampled every 200 µs.

Data type	Values	Filter
USINT	0	No software filter
	2	0.2 ms
	...	...
	250	25 ms - Higher values are limited to this value.

11.4 Communication

11.4.1 Digital inputs

Unfiltered

The input state is collected with a fixed offset to the network cycle and transferred in the same cycle.

Filtered

The filtered status is collected with a fixed offset to the network cycle and transferred in the same cycle. Filtering takes place asynchronously to the network in multiples of 200 µs with a network-related jitter of up to 50 µs.

11.4.1.1 Input state of digital inputs 1 to 8

Name:
DigitalInput01 to DigitalInput08

This register indicates the input state of digital inputs 1 to 8.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	DigitalInput01	0 or 1	Input state - Digital input 1
...		...	
7	DigitalInput08	0 or 1	Input state - Digital input 8

11.4.2 Digital outputs

The output status is transferred to the output channels with a fixed offset in relation to the network cycle (SyncOut).

11.4.2.1 Switching state of digital outputs 1 to 8

Name:
DigitalOutput01 to DigitalOutput08

This register is used to store the switching state of digital outputs 1 to 8.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	DigitalOutput01	0	Digital output 01 reset
		1	Digital output 01 set
...		...	
7	DigitalOutput08	0	Digital output 08 reset
		1	Digital output 08 set

11.4.3 Monitoring status of the digital outputs

On the module, the output states of the outputs are compared to the target states. The control of the output driver is used for the target state.

A change in the output state resets monitoring for that output. The status of each individual channel can be read. A change in the monitoring status generates an error message.

11.4.3.1 Status of digital outputs 1 to 8

Name:
StatusDigitalOutput01 to StatusDigitalOutput08

This register is used to indicate the status of digital outputs 1 to 8.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	StatusDigitalOutput01	0	Channel 01: No error
		1	Channel 01: Short circuit or overload
...		...	
7	StatusDigitalOutput08	0	Channel 08: No error
		1	Channel 08: Short circuit or overload

11.5 Minimum I/O update time

The minimum I/O update time defines how far the bus cycle can be reduced while still allowing an I/O update to take place in each cycle.

	Minimum I/O update time
Without filtering	150 µs
With filtering	200 µs

11.6 Minimum cycle time

The minimum cycle time specifies the time up to which the bus cycle can be reduced without communication errors occurring. It is important to note that very fast cycles reduce the idle time available for handling monitoring, diagnostics and acyclic commands.

	Minimum cycle time
Without filtering	150 µs
With filtering	200 µs