BUCHER automation

User Manual



60874420_01

JX3-DO16

Digital Output Module

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Translation of the german original User Manual

Revision	2.35.5
Date of issue	8/25/2025

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1 Introduction

1.1 Information on this document

This document forms an integral part of the product and must be read and understood prior to using the device. It contains important and safety-related information for the proper use of the product as intended.

Target Groups

This document is intended for specialists with appropriate qualifications.
Only competent and trained personnel are allowed to put this device into operation.
During the whole product life cycle, safe handling and operation of the device must be ensured. In the case of missing or inadequate technical knowledge or knowledge of this document any liability is excluded.

Availability of Information

Make sure this document is kept at the ready in the vicinity of the product throughout its service life.
For information on new revisions of this document, visit the download area on our website. This document is not subject to any updating service.

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For further information refer to the following information products:

– User manuals
  Information on commissioning Bucher Automation products
– Online help for the JetSym software
  Functions of software products with application examples
– Application-oriented manuals
  Product-independent documentation
– Version updates
  Information about changes to the software products and operating system of your device

ⓘ Info

Further information

For further information on the noise immunity of a system, please refer to the Application Note 016 *EMC-Compatible Installation of the Electric Cabinet* available for download on www.bucherautomation.com.

1.2 Typographical conventions

This manual uses different typographical effects to support you in finding and classifying information. Below, there is an example of a step-by-step instruction:

✓ This symbol indicates requirements which have to be met before executing the following action.

► This sign or a numbering at the beginning of a paragraph marks an action instruction that must be executed by the user. Execute the instructions one after the other.

⇨ The target after a list of instructions indicates reactions to, or results of these actions.

ⓘ Info

Further information and practical tips

In the info box you will find helpful information and practical tips about your product.

2 Safety

2.1 General

The product corresponds to the current state of science and technology when placed on the market.
In addition to this user manual, the laws, regulations and directives of the country of operation or the EU apply to the operation of the product. The operator is responsible for compliance with the relevant accident prevention regulations and generally recognized safety rules.

2.2 Purpose

2.2.1 Intended use

This expansion module is for adding digital outputs to controllers.

Operate the device only in accordance with the intended conditions of use and within the limits set forth in the technical specifications.
Intended use of the product includes its operation in accordance with this manual.

SELV

The operating voltage of this device is classified as Safety Extra Low Voltage and is, therefore, not subject to the EU Low Voltage Directive. The device may only be operated from a SELV source.

2.2.2 Non-intended use

Do not use the device in technical systems for which a high level of failure safety is specified.

Machinery Directive

This device is not a safety-related part as per Machinery Directive 2006/42/EC and must, therefore, not be used for safety-relevant applications.

2.3 Warnings used in this document

⚠ DANGER



High risk

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING



Medium risk

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION



Low risk

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE



Material damage

Indicates a situation which, if not avoided, could result in malfunctions or material damage.

3 Product description

The JX3-DO16 is an expansion module for the connection of digital actuators. The module is equipped with 16 digital outputs and is short-circuit-protected.

3.1 Design

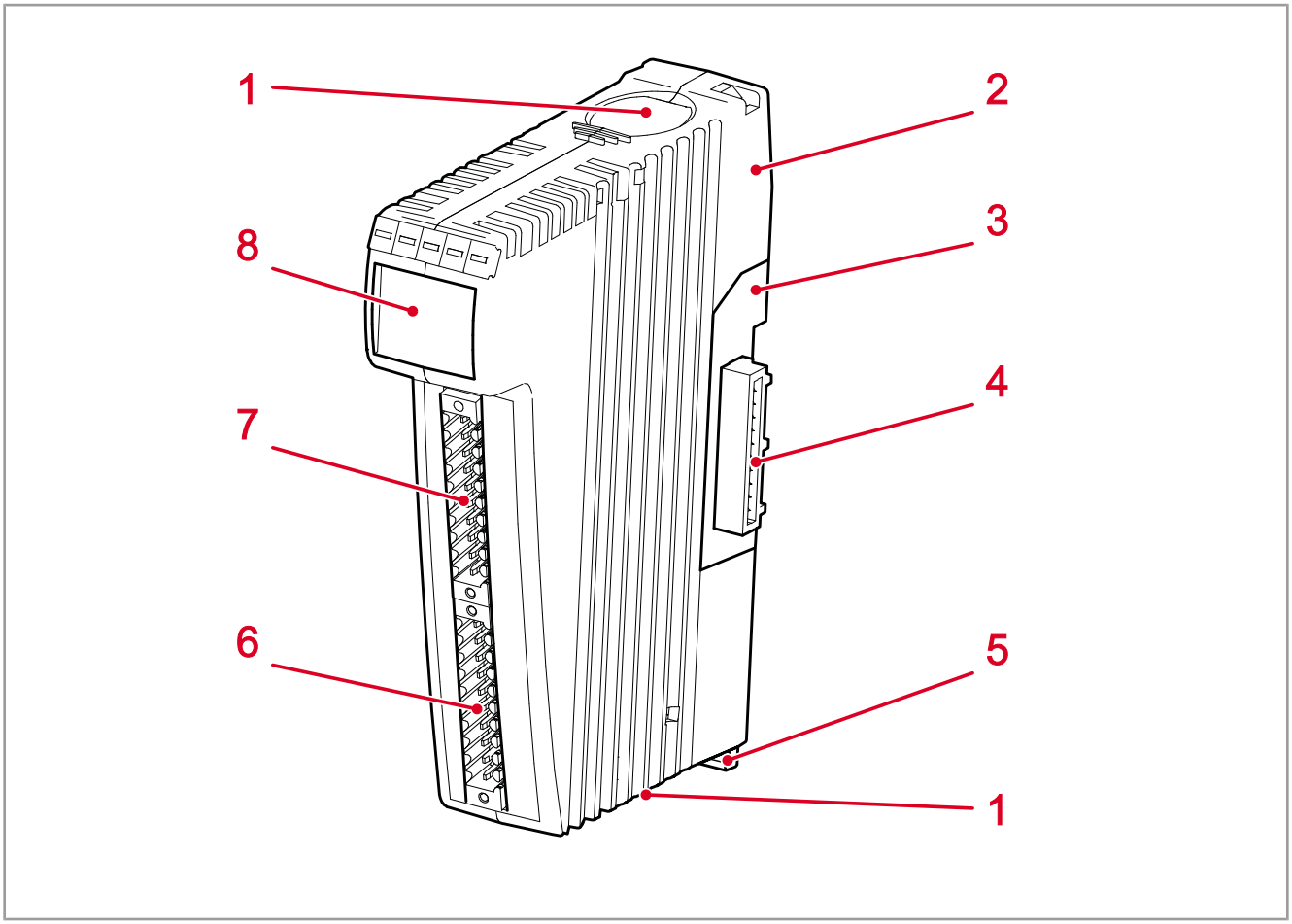


Fig. 1: Design

1	Latch
2	Housing
3	Backplane module
4	Connector for expansion modules
5	DIN rail release latch
6	Digital outputs 1 ... 8
7	Digital outputs 9 ... 16
8	Status indication

3.2 Product features

- Pulse-width modulation PWM
- Short-circuit detection
- Configurable module states in case of a failure

3.3 Status indication

LEDs indicate the communication status of the module as well as the status of the power supply.

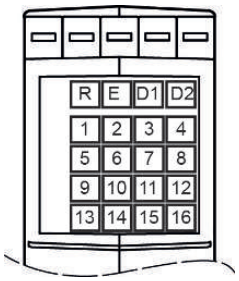


Fig. 2: Status indication

LED	Description
R	Logic circuit supply
E	Communication with controller or bus node
D1	Diagnostic function 1
D2	Diagnostic function 2
1 … 16	Digital level

Tab. 1: Description of the LEDs

3.3.1 Diagnostics capabilities by means of status indication

The expansion module is equipped with 20 LEDs which indicate states and errors. The LED colors indicate different states for simple diagnostics. The amber LEDs indicate the digital level of the connected hardware.

The amber LEDs 1 through 16 refer to digital outputs OUT 1 through OUT 16.

Diagnostics capabilities are also offered in the Setup window of the JetSym software.

LED	Lighting pattern	Color	Description
R	OFF	---	No logic circuit supply
	ON	Green	Logic voltage supply is OK
E	OFF	---	Communication with controller or bus node is active
	ON	Red	Communication with controller or bus node is Inactive
D1	ON	Red	Short circuit/overload of outputs 1 … 8
D2	ON	Red	Short circuit/overload of outputs 9 … 16
1 … 16	OFF	---	State of output 1 … 16 = OFF, output 1 … 16 has low level, voltage level of the terminal < +11 V
	ON	Yellow	State of output 1 … 16 = ON, output 1 … 16 has high level, voltage level of the terminal > +11 V

3.4 Nameplate

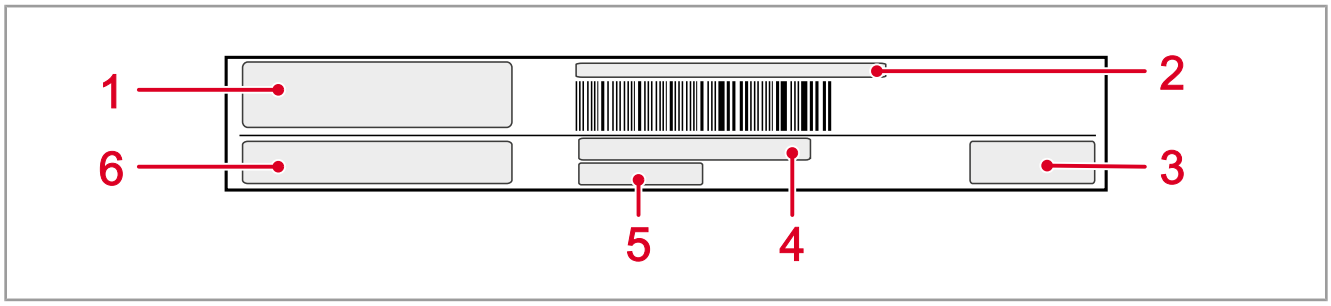


Fig. 3: Sample nameplate

1	Company logo
2	Serial number
3	Certification mark
4	Item number
5	Hardware revision
6	Item name

3.5 Scope of delivery

Scope of delivery	Item number	Quantity
JX3-DO16	10000595	1
OR		
JX3-DO16_PI	10001482	1
Male connector with PUSH-IN connection, 10-pin	60869254	2
AND		
Terminal labels	60870411	10
Keying pins	60870410	1
Product Documentation Note	60888123	1

4 Technical specifications

This chapter contains information on both electrical and mechanical data as well as on operating data of the JX3-DO16 device.

4.1 Dimensions

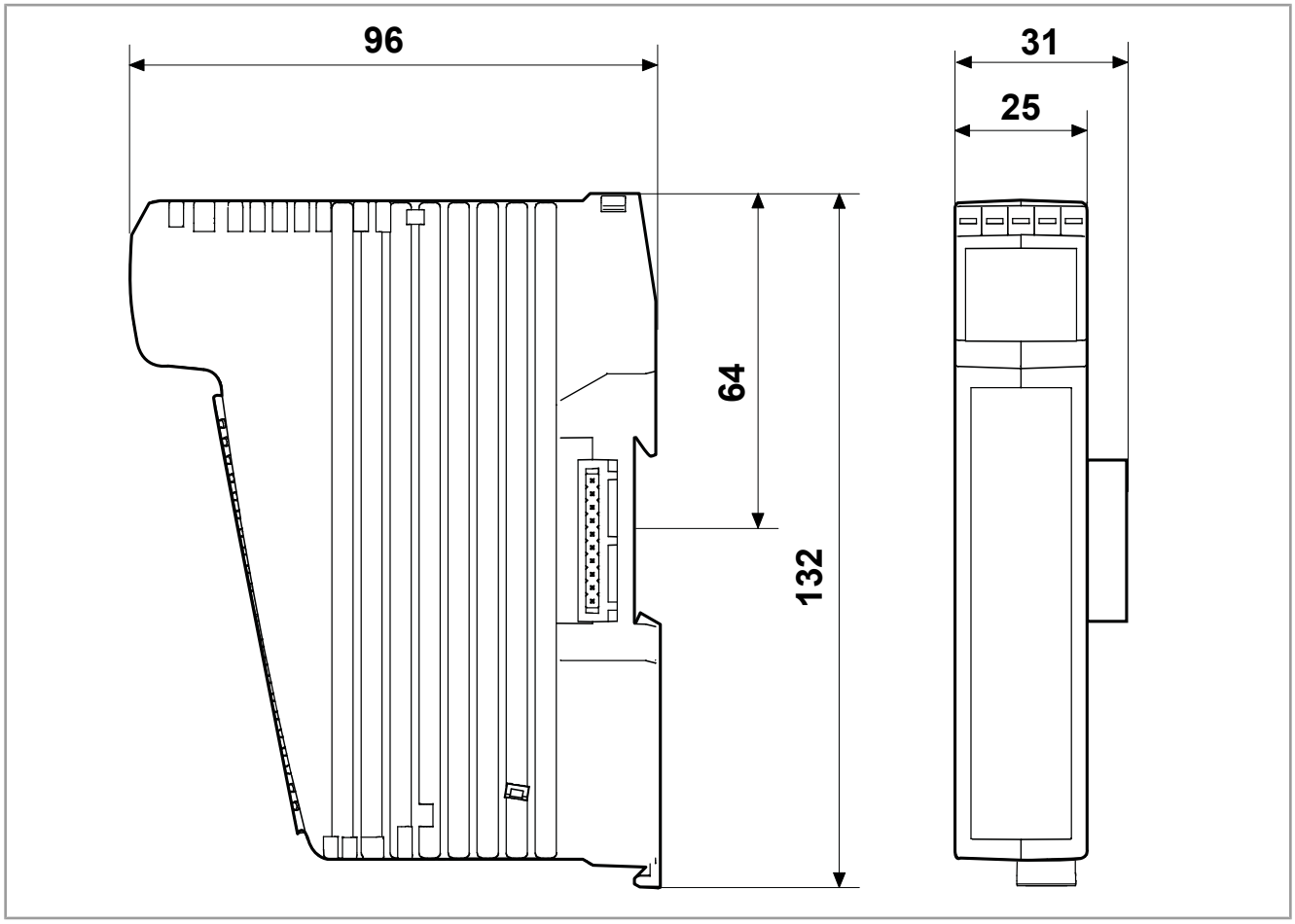


Fig. 4: Dimensions in mm

4.2 Mechanical specifications

Parameter	Description	Standards
Mounting orientation	Vertically mounted on DIN rail	
Weight	160 g	
Housing specifications		
Material	Plastic	
Maximum drop height		
with shipping packaging	1 m	DIN EN 61131-2 DIN EN 60068-2-31
with product packaging	0.3 m	
Vibration resistance		

Parameter	Description	Standards
Frequency sweeps	1 octave/minute, sinusoidal	DIN EN 61131-2 DIN EN 60068-2-6
Constant amplitude	3.5 mm	5 Hz ≤ f ≤ 9 Hz
Constant acceleration	1 g	9 Hz ≤ f ≤ 150 Hz
Number and direction	10 sweeps for all 3 spatial axes	
Shock resistance		
Type of shock	Half-sine wave	DIN EN 61131-2 DIN EN 60068-2-27
Intensity and duration	15 g for 11 ms	
Number and direction	3 shocks in the directions of all 3 spatial axes	
Degree of protection		
Degree of protection	IP20	DIN EN 60529

Tab. 2: Mechanical specifications

4.3 Electrical properties

Category	Description	
Rated voltage	DC 24 V	
Permissible voltage range	-15 % ... +20 %	
Rated power	96 W	
Type	3, pnp	IEC 61131-2
Electrical isolation	None	
Protective circuits	Short-circuit, overload, open-circuited grounding cable, overtemperature	
Protection against polarity reversal	Is ensured when the module is installed on a grounded DIN rail	
Protection against inductive loads	Yes	
Voltage in OFF state	3.0 V max.	
Voltage in ON state	Maximum voltage - 1.0 V	
Load current per output	0.5 A max.	
Total current of all 16 outputs	4.0 A max.	

Tab. 3: Digital outputs

Category	Description	
Logic voltage of the JX3 system bus	DC +5 V (-15 % … +10 %)	
Current consumption - Logic voltage	80 mA	
Additional voltage	DC +24 V (+15 % … +20 %)	
Current consumption - Additional voltage	0 mA	
Nominal power consumption	40 mW	

Tab. 4: JX3 system bus

4.4 Environmental Conditions

Parameter	Description	Standards
Operating temperature	0 °C … +50 °C	DIN EN 61131-2
Storage temperature	-40 °C … +70 °C	DIN EN 60068-2-1
Humidity	10 % … 95 %, non-condensing	DIN EN 60068-2-2
Max. operating altitude	2,000 m above sea level	DIN EN 61131-2
Corrosion immunity and chemical resistance	No special protection against corrosion. Ambient air must be free from higher concentrations of acids, alkaline solutions, corrosive agents, salts, metal vapors and other corrosive or electroconductive contaminants.	
Degree of pollution – Electronics	Level 2	DIN EN 61131-2
	Usually, the pollution is non-conductive. However, temporary conductivity due to condensation may occur.	

Tab. 5: Environmental conditions

4.5 EMC Values

4.5.1 Housing

Emitted interference

Parameter	Values	Standards
Frequency band	**30 MHz … 230 MHz**	DIN EN 61000-6-3 DIN EN 61131-2 DIN EN 55011
Limit value	30 dB (µV/m) at 10 m distance	
Frequency band	**230 MHz … 1,000 MHz**	
Limit value	37 dB (µV/m) at 10 m distance	
	Class B	

Tab. 6: Emitted interference

Immunity to interference

Parameter	Values	Standards
Magnetic field with mains frequency		
Frequency	50 Hz	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-8
Magnetic field	30 A/m	
RF field, amplitude-modulated		
Frequency band	80 MHz … 2 GHz	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-3
Test field strength	10 V/m	
	AM 80 % with 1 kHz	
	Criterion A	
ESD		

Parameter	Values	Standards
Discharge through air Test peak voltage	8 kV	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-2
Discharge through air Test peak voltage	4 kV	
	Criterion A	

Tab. 7: Immunity to interference

4.5.2 DC Power Supply Inputs and Outputs

Emitted interference

Parameter	Values	Standards
Signal and control line connections, DC voltage supply inputs and outputs		
Frequency band	0.15 … 0.5 MHz	DIN EN 61000-6-3
Limit value	40 to 30 dB	
Frequency band	0.5 … 30 MHz	
Limit value	30 dB	
	Class B	

Tab. 8: Emitted interference of the DC power supply inputs and outputs

Immunity to interference

Parameter	Values	Standards
RF field, asymmetric, amplitude-modulated		
Frequency band	0.15 … 80 MHz	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Test voltage	3 V	
	AM 80 % with 1 kHz	
Source impedance	150 Ω	
	Criterion A	
Bursts		
Test voltage	2 kV	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4
	tr/tn 5/50 ns	
Repetition frequency	5 kHz	
	Criterion A	
Surge voltages, symmetric, line-to-line		
Differential-mode coupling	tr/th 1.2/50 µs	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5
	0.5 kV	
Surge voltages, asymmetric, line-to-ground		
Common-mode coupling	tr/th 1.2/50 µs	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5
	1 kV	

Tab. 9: Immunity to interference of the DC power supply inputs and outputs

4.5.3 Shielded Data and I/O Lines

Immunity to interference

Parameter	Values	Standards
RF field, asymmetric, amplitude-modulated		
Frequency band	0.15 MHz … 80 MHz	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Test voltage	3 V	
	AM 80 % with 1 kHz	
Source impedance	150 Ω	
Criterion	A	
Bursts		
Test voltage	1 kV	DIN EN 61000-6-2 DIN EN 61000-6-2 DIN EN 61000-4-4
	tr/tn 5/50 ns	
Repetition frequency	5 kHz	
Criterion	A	
Surge voltages, asymmetric, line-to-ground		
Common-mode coupling	tr/th 1.2/50 µs	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5
	1 kV	

Tab. 10: Immunity of shielded data lines and I/O lines

5 Mechanical installation

This chapter describes how to install and replace the device.

NOTICE

Damaged devices

Damaged devices may cause considerable physical damage.

- ► Check the device for external damage and faulty connections.
- ► Ensure to install only fully functional devices.

5.1 Installing the device on the DIN rail

NOTICE

Functional impairment caused by unfavorable installation

- ► Install the device only in vertical position on the DIN rail (DIN EN 60715).
- ► Keep a minimum distance of 30 mm to surrounding parts.

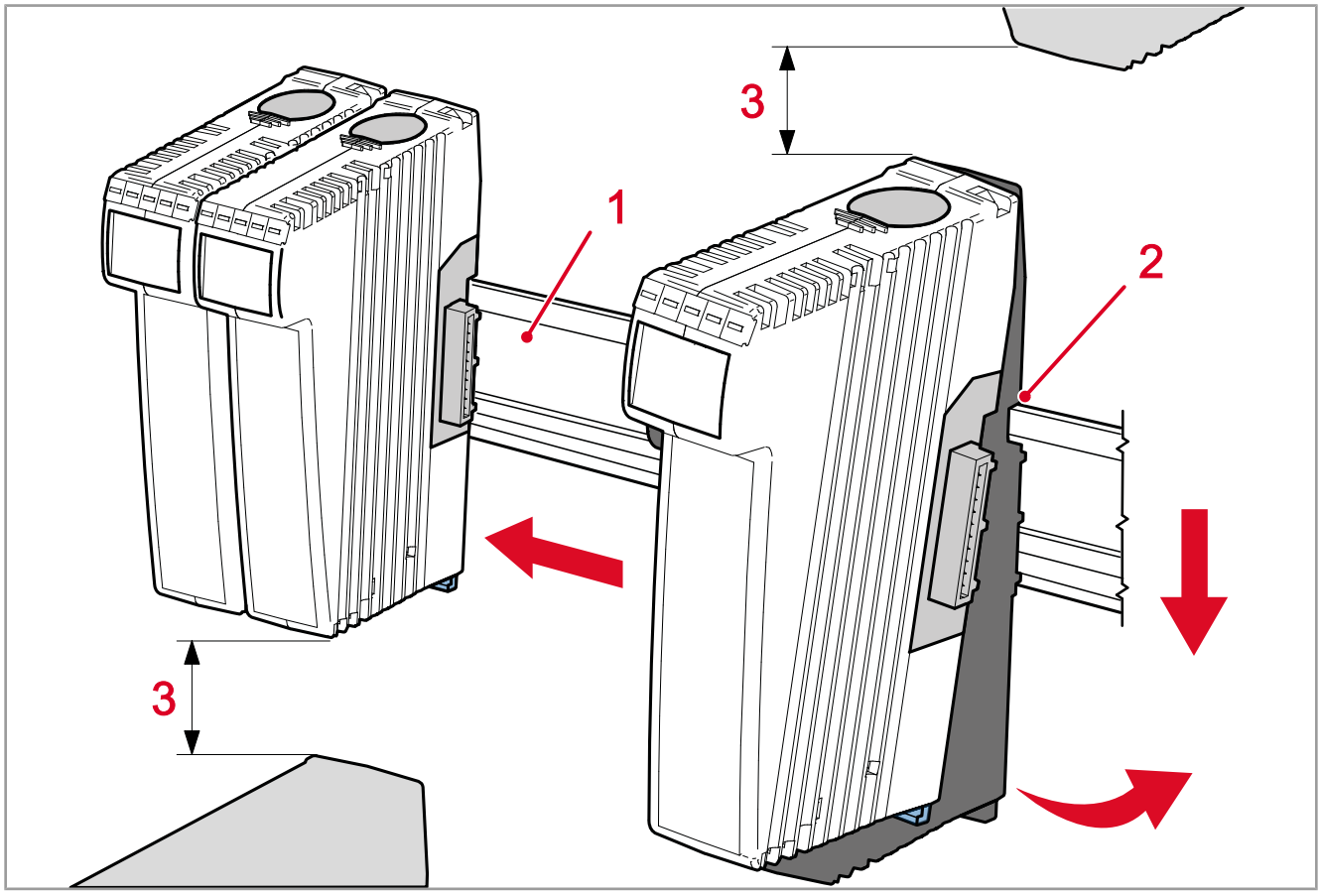


Fig. 5: Installing the device on the DIN rail

1	DIN rail
2	Upper latch
3	Minimum distance to surrounding parts (30 mm min.)

1. De-energize the system.
2. Place the upper latch (2) in an angled position on the DIN rail (1).
3. Snap the lower latch of the device onto the DIN rail.
4. Slide the device on the DIN rail to its intended position.

5.2 Removing Device from DIN Rail

Applying force to the release latch disengages the device from the DIN rail.

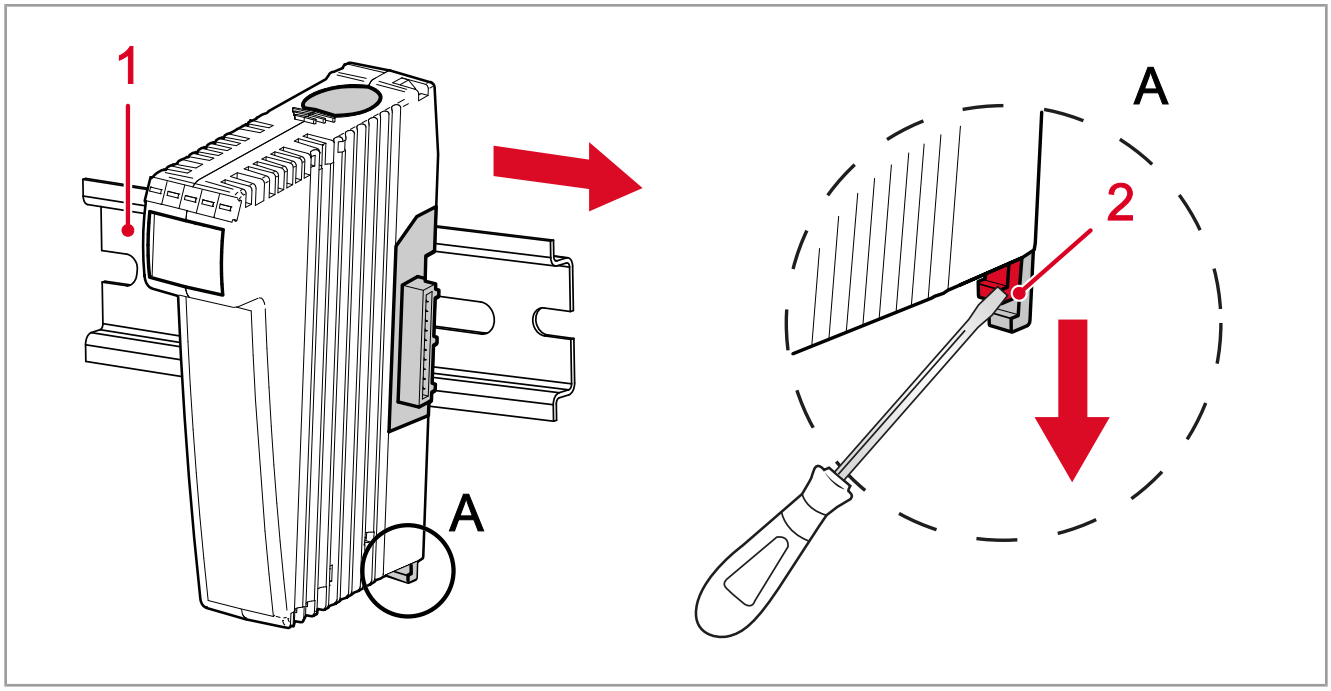


Fig. 6: Removing the device from the DIN rail

1	DIN rail
2	DIN rail release latch
A	Detail view

1. Disconnect the system from the power supply.
2. Pull the device off the overall assembly.
3. Pry the release latch (2) downwards and pull the device off the DIN rail (1).

5.3 Removing the enclosure from the backplane module

Pressing down on the upper and the lower backplane latches of the device allows you to remove the enclosure from the backplane module.

NOTICE

Mechanical damage and reduced EMC noise immunity

If devices are replaced, degree of protection IP20 is not ensured. Touching the EMC clip may lead to mechanical damage to the device and reduced EMC noise immunity.

► Do not touch any electronic components once the enclosure has been removed from the backplane module.

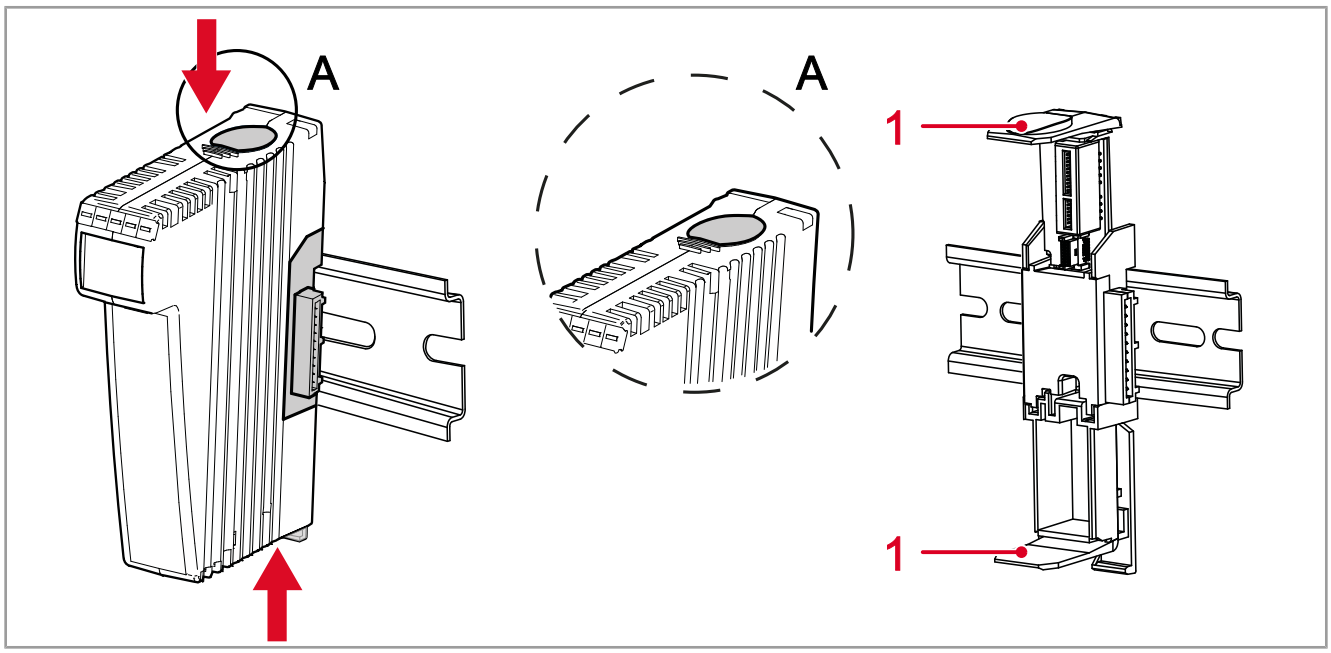


Fig. 7: Removing the enclosure from the backplane module

A	Detail view
1	Latch

1. De-energize the system.
2. Simultaneously, press and hold the upper and lower latches (1) of the device.
3. Keep the latches pressed and pull off the enclosure.

6 Electrical Connection

NOTICE

Damages to material or functional impairment

Improper implementation of the wiring harness may cause mechanical stress.

- ► Protect the cables from bending, twisting or chafing.
- ► Install strain reliefs for the connecting cables.

6.1 Block diagram

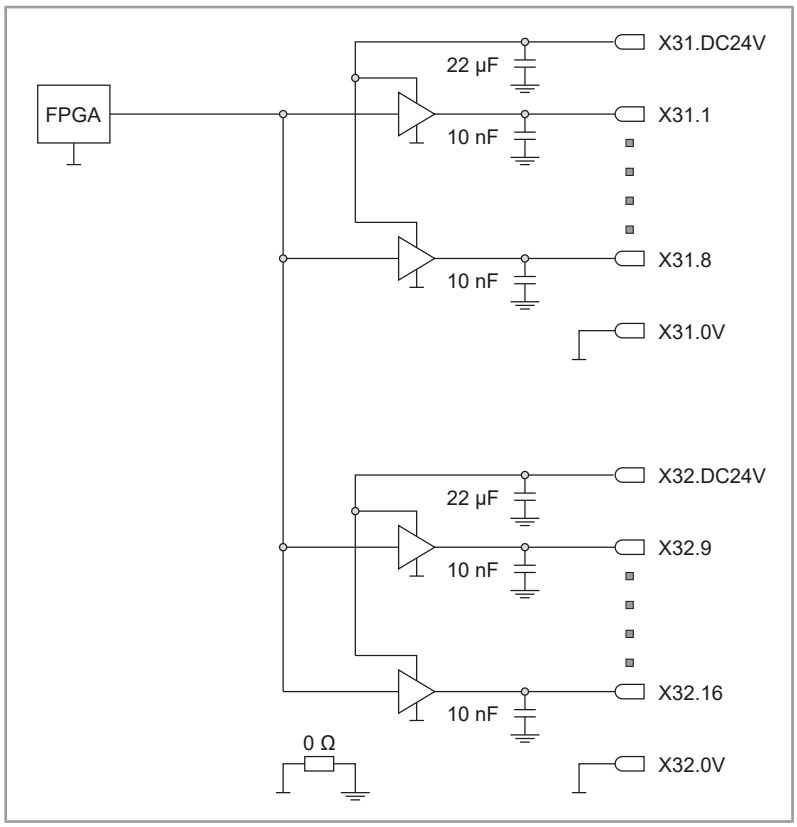
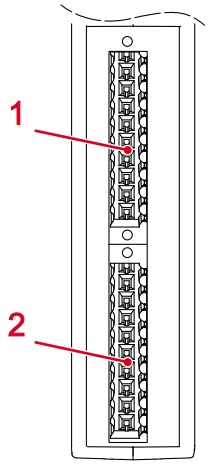


Fig. 8: Block diagram

Part	Description
FPGA	Communication chip
22 µF	Capacitance on the power supply for outputs
10 nF	Capacitance at digital output
X31. DC24V	Power supply of digital outputs OUT 1 ... 8
X32. DC24V	Power supply of digital outputs OUT 9 ... 16

Tab. 11: Legend Block diagram

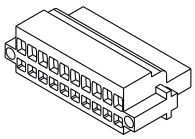
6.2 Digital outputs X31, X32



	Position 1		Position 2
Pin	X31	Pin	X32
DC24V	Power supply 1- 8	DC24V	Power supply 9- 16
1	Digital output OUT 1	9	Digital output OUT 9
2	Digital output OUT 2	10	Digital output OUT 10
3	Digital output OUT 3	11	Digital output OUT 11
4	Digital output OUT 4	12	Digital output OUT 12
5	Digital output OUT 5	13	Digital output OUT 13
6	Digital output OUT 6	14	Digital output OUT 14
7	Digital output OUT 7	15	Digital output OUT 15
8	Digital output OUT 8	16	Digital output OUT 16
0 V	Reference potential	0 V	Reference potential

6.3 Connector specification

6.3.1 10-pin connector, spring-cage technology

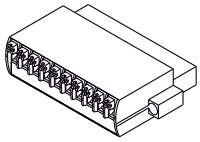


Parameter	Description	Standards
Connector		
Designation	BU_10_E_BLZF_GE_RM3.5	
Item number	60869252	
Connector technology	Spring-cage connection	
Type	10-pin, 3.5 mm pitch	
Connectible conductors		
Outer diameter of the isolation	2.90 mm max	
AWG	16 … 28	
Terminal range	0.13 … 1.5 mm²	
Stripping length	10 mm	
Specification without wire end ferrules		
Solid conductor	H05(07) V-U	
	0.2 … 1.5 mm²	
Flexible conductor	H05(07) V-K	
	0.2 … 1.5 mm²	

Parameter	Description	Standards
Specification with wire end ferrules		
Wire end ferrule without sleeve	0.2 … 1.5 mm²	DIN 46228/1
Wire end ferrule with sleeve	0.2 … 1.5 mm²	DIN 46228/4
Crimping tool	PZ 4, PZ 6 ROTO, PZ 6/5	DIN 46228

Tab. 12: Connector specification, 10-pin connector, spring-cage technology

6.3.2 10-pin male connector with PUSH-IN connection



Parameter	Description	Standards
Connector		
Designation	BU_10_E_BL-I/O_GE_RM3.5	
Item number	60869254	
Connector technology	Spring connection, push-in	
Type	10-pin, 3.5 mm pitch	
Connectible conductors		
Outer diameter of the isolation	2.90 mm max	
AWG	16 … 24	
Terminal range	0.2 mm² … 1.5 mm²	
Stripping length	10 mm	
Specification without wire end ferrules		
Solid conductor	H05(07) V-U	
	0.2 mm² … 1.5 mm²	
Flexible conductor	H05(07) V-K	
	0.2 mm² … 1.5 mm²	
Specification with wire end ferrules		
Wire end ferrule without sleeve	0.25 mm² … 1.0 mm²	DIN 46228/1
Wire end ferrule with sleeve	0.25 mm² … 0.75 mm²	DIN 46228/4
Crimping tool	PZ 4, PZ 6 ROTO, PZ 6/5	DIN 46228

Tab. 13: Connector specification, 10-pin, PUSH-IN connection

6.4 Connecting digital actuators

The way of connecting digital actors is identical for all 16 outputs. Usage of shielded cables is not required. Each of the 16 digital outputs of the expansion module can be loaded with a maximum of 0.5 A. The total current of all 16 digital outputs must not exceed 4.0 A.

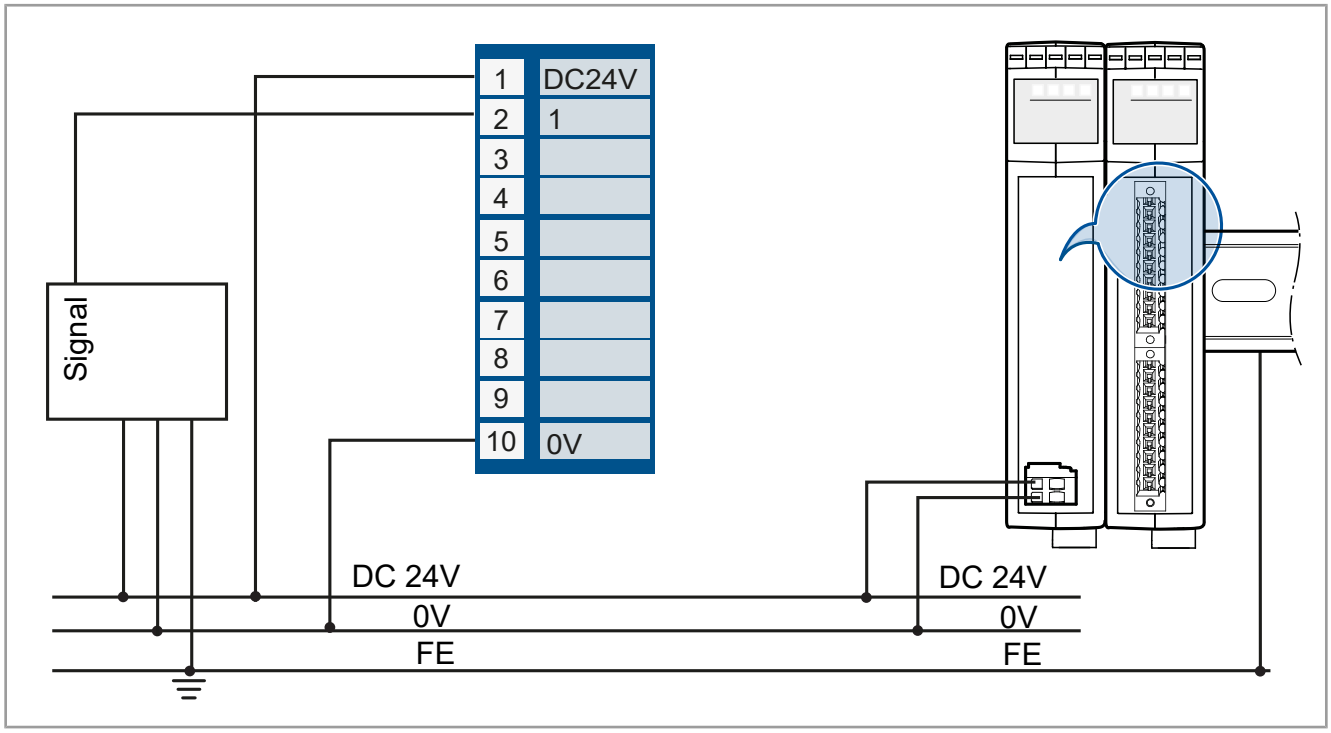


Fig. 9: Connection example: Digital actuator

1. Ensure that the cross section of the conductor is apt for conducting the maximum current to the actuator.
2. Separate load and logic voltage: Connect the load voltage of the digital outputs and the logic voltage to separate power supply units. This way, communication with the expansion module is still possible, even if the load voltage supply is switched off.
3. Connect the actuators to the outputs and to the power supply unit. The following example shows the connection of a digital actuator to output OUT 1. Make sure that the total current of all digital outputs does not exceed 4.0 A.

6.5 Functional test

For switching digital outputs the expansion module needs not be configured after it has been powered up. After switching-on, all 16 digital outputs are in OFF state. A voltage of 0 V is applied.

✓ The digital actuators have been connected.

✓ The module has been connected to a JX3 node.

► Power up the JX3 node.

⇨ Following correct commissioning, LED R is lit green.

7 Programming

7.1 Abbreviations, Module Register Properties and Formats

Abbreviations

The abbreviations used in this document are listed in the table below:

Abbreviation	Meaning
R 100	Register 100
MR 150	Module register 150

Tab. 14: Abbreviations

Module register properties

Each module register is characterized by certain properties. Most properties are identical for many module registers. In the following description, module register properties are mentioned only if a property deviates from the default properties listed below.

Property	Default
Access	Read/write
Value after reset	0 or undefined (e.g. revision/version number)
Takes effect	Immediately
Write access	Always
Data type	Integer

Tab. 15: Module register properties

Numerical formats

The numerical formats used in this document are listed in the table below:

Notation	Format of numerical values
100	Decimal
0x100	Hexadecimal
0b100	Binary

Tab. 16: Numerical formats

7.2 Addressing I/O Expansion Modules

The JX3 I/O module connects to sensors and actuators. The data are either sent directly to the controller via the JX3 system bus or, if the JX3 modules are located remotely, via Ethernet bus nodes or EtherCAT® bus nodes.

Each JX3 I/O module provides 10,000 module registers.

These module registers are mapped to registers in the controller. The only way of writing and reading process, configuration and diagnostic data to and from an expansion module is via controller registers. Controller registers can be accessed in the application program of the controller, in a setup pane of JetSym or via a visualization application.

The number of a controller register or I/O being mapped to a module register depends on the following parameters:

- Controller model
- Type of connection between controller and expansion module
  - Local direct connection
  - Remote connection via Ethernet
  - Remote connection via EtherCAT®
- Position and number of expansion modules in the system
  The number of expansion modules that can be connected to a controller depends on the model of the expansion module. After max. 8 expansion modules, a power supply module must be inserted.

Example system overview

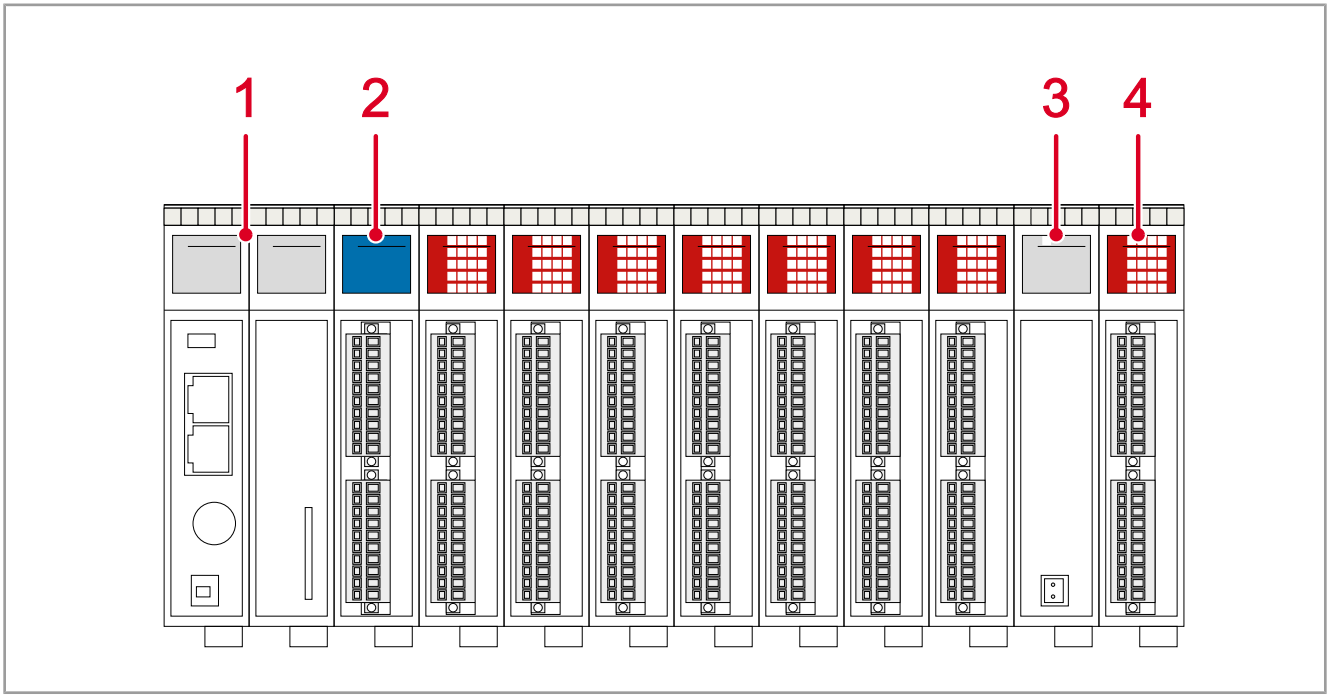


Fig. 10: Example: System overview of a controller together with various expansion modules

1	Controller
2	First expansion module
3	Power supply module
4	Further expansion modules

ⓘ Info

Number of connectible expansion modules

You can calculate the exact amount of connectible expansion modules by means of the
system bus configurator, JX3-sysbus_configurator_xxx_e.
The configurator is available for download. Go to www.bucherautomation.com and navigate to the *JX3Modules* product page > *Downloads*.

ⓘ Info

Further information

For in-depth information, see the *JX3 System* application-oriented manual.

For application-oriented manuals open www.bucherautomation.com and go to *product page JX3-DO16 > Product-independent documentation*.

7.3 Fixing a short circuit/overload at the output driver

The expansion module permanently checks the output driver for short-circuit or overload. A short-circuit or overload is caused by too high a current at one of the connected actuators. If there is a malfunction (short-circuit, overload), the state of the faulty output starts to alternate between OFF and ON. LED D1, or D2 indicates an error and one of the bits in module register 0000 is set.

Response of the module	Description
LED D1 is lit.	There is a short circuit at one of the outputs OUT 1 ... 8.
Bit 0 = 1 in MR 0000	
LED D2 is lit.	There is a short circuit at one of the outputs OUT 9 ... 16.
Bit 1 = 1 in MR 0000	

To eliminate the problem, proceed as follows:

1. Check the line to the actuator for a short-circuit to 0 V.
2. Reduce the current consumed by the actuator.

⇨ LED D1, or D2 goes out.

⇨ Bit 0, or bit 1 in module register 0000 is cleared.

7.4 Diagnostics of error messages

The expansion module signals error messages. If an error is detected, the module sets the respective error bit in the module register. The module activates the red LED D1 or D2. The controller and the bus node, if any, respond to the error.

The application program detects in certain registers on the controller that the expansion module is signaling an error. The application program responds to this error. Once the root cause has been eliminated by the user, the expansion module sets error bit 0 in the module register. LEDs D1 and D2 on the module go off. The application program acknowledges the error message in the controller and bus node, if any.

7.4.1 Module register

Module register	0000
Description	Module state
	Signaling error messages
Value range	2 bits, bit-coded
Access	Read access
Value after reset	Depending on error messages of the module
Bit values	Description
Bit 0	**Short circuit/overload of outputs OUT 1 ... OUT 8 (X31)**
1	There is a short circuit/overload
Bit 1	**Short circuit/overload of outputs OUT 9 ... OUT 16 (X32)**
1	There is a short circuit/overload

7.5 How to identify the module

Module register	0009
Description	Displaying the OS version
	JetSym lets you transfer another operating system to the expansion module.
Values	Released OS version: IP#1.0.0.0 … IP#254.255.0.0
	Bootloader version: IP#255.1.0.0 … IP#255.255.0.0
Access	Read access
Value after reset	OS version

Module register	0032
Description	Displaying the FPGA revision
	The FPGA version number cannot be changed by the user.
Values	IP#1.0.0.0 … IP#255.255.0.0
Access	Read access
Value after reset	OS version

7.6 Writing values to all outputs

Module register	0512
Description	Writing values to all outputs in one go
Value range	16 bits, bit-coded
Outputs	OUT 1 ... OUT 16

7.7 Error states

For each digital output the user may specify a default value or a certain behavior in the event of an error. A fault condition exists if cyclic data exchange with the bus node or controller is interrupted. Should this case occur, the digital output of the expansion module issues the defined default value: If in case of a fault condition the present state is to be output, the state which is output remains unchanged. If the error value is to be output, the value of the bit in module register 0514 is output as state.

In this document a variable name is assigned to each module register. The JetSym HW Manager uses these variable names.

Module register		0513
		Applying the settings defined in module register 0514
Description		This module register lets you define whether, in case of a fault condition, the state at the output is to remain unchanged or whether the settings defined in module register 0514 are to be applied.
Value range		16 bits, bit-coded
Bit values	**Enabling fault condition indication**	
Bit 0	**Output OUT 1**	
0 =	The state of the output remains the same.	
1 =	Output assumes the state set in MR 514.	
Bit 1	**Output OUT 2**	

Module register	**0513**
0 =	The state of the output remains the same.
1 =	Output assumes the state set in MR 514.
Bit 2	**Output OUT 3**
0 =	The state of the output remains the same.
1 =	Output assumes the state set in MR 514.
Bit x	**Output OUT (x+1)**
0 =	The state of the output remains the same.
1 =	Output assumes the state set in MR 514.
Bit 15	**Output OUT 16**
0 =	The state of the output remains the same.
1 =	Output assumes the state set in MR 514.
Module register	0514
Description	Lets you define the response of the output in the event of a fault condition
Value range	16 bits, bit-coded
Bit values	Output state in a fault condition
Bit 0	**Output OUT 1**
0 =	Output assumes the state OFF.
1 =	Output assumes the state ON.
Bit 1	**Output OUT 2**
0 =	Output assumes the state OFF.
1 =	Output assumes the state ON.
Bit 2	**Output OUT 3**
0 =	Output assumes the state OFF.
1 =	Output assumes the state ON.
Bit x	**Output OUT (x+1)**
0 =	Output assumes the state OFF.
1 =	Output assumes the state ON.
Bit 15	**Output OUT 16**
0 =	Output assumes the state OFF.
1 =	Output assumes the state ON.

7.7.1 Configuring the response in the event of errors

Once the module has been powered up, all digital outputs first signal their present state in the case of a fault condition.

► To configure the response to fault conditions, set the corresponding bit in module register 0513 or 0514.

Description	
The state is to remain unchanged in case of a fault condition	Bit x = 0 in MR 0513
The state to be returned is OFF	Bit x = 1 in MR 0513, and bit x = 0 in MR 0514
The state to be returned is ON	Bit x = 1 in MR 0513, and bit x = 1 in MR 0514

Tab. 17: Configuration in module register

x: 0 … 15 (output number - 1)

7.8 Pulse-width modulation PWM

7.8.1 Description

Pulse width modulation can be used:

– for controlling a variable speed DC motor,
– for connecting a proportional valve with variable flow or
– for the flashing frequency of a lamp.

With pulse-width modulation, the expansion module independently issues periodic signals at the output.

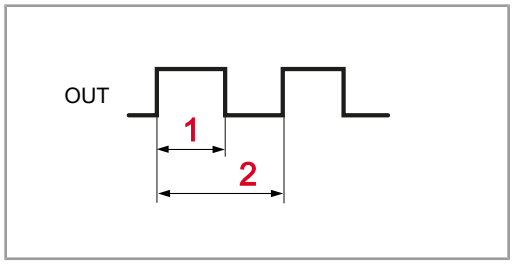


Fig. 11: PWM signal

1	ON time
2	Period duration

Module registers let you configure PWM frequency and duty cycle. When configuring PWM, the following interdependencies exist between digital outputs:

– A common PWM frequency is configured for four digital outputs each
– For each digital output a separate PWM duty cycle is configured
– The PWM function is activated for each digital output separately

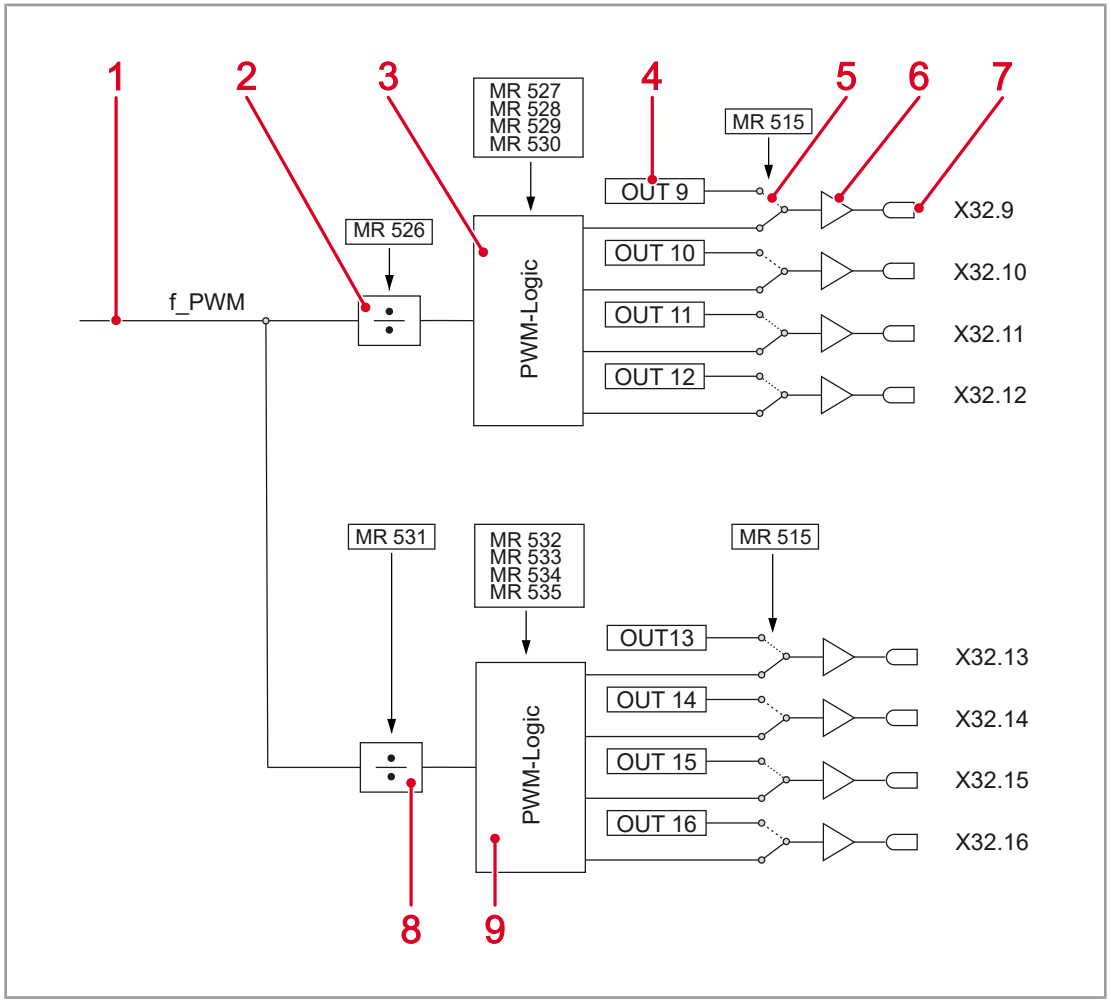


Fig. 12: Principle of a PWM logic circuit

1	PWM basic frequency
2	Frequency divider 1 for PWM of the digital outputs 9 ... 12
3	PWM logic circuit for digital outputs 9 … 12
4	Digital output value
5	Switch for activating the PWM function
6	Output driver
7	Terminal point of the digital output
8	Frequency divider 1 for PWM of the digital outputs 13 ... 16
9	PWM logic circuit for digital outputs 13 … 16

If PWM has been activated for a digital output, the following functions of this output are disabled:

– Switching the digital output, e.g. from the controller or from JetSym

– Reading the state of the digital output, e.g. from the controller or from JetSym

7.8.2 Configuration

Calculation

PWM frequency with frequency divider 1

$$f_{OUT9_12} = \frac{31250\ Hz}{MR[526] + 1}$$

The PWM frequency is generated from a basic frequency of 31,250 Hz. The PWM frequency for outputs 9 … 12 is calculated based on the basic frequency.

PWM frequency with frequency divider 2

$$f_{OUT13_16} = \frac{31250\ Hz}{MR[531] + 1}$$

The PWM frequency is generated from a basic frequency of 31,250 Hz. The PWM frequency for outputs 13 … 16 is calculated based on the basic frequency.

Module-specific PWM register 526

$$MR[526] = \frac{31250\ Hz}{f_{OUT9_12}} - 1$$

If you know the desired output frequency f_{OUT9_12}, you can calculate the value of module-specific register 526.

Module-specific PWM register 531

$$MR[531] = \frac{31250\ Hz}{f_{OUT13_16}} - 1$$

If you know the desired output frequency f_{OUT13_16}, you can calculate the value of module-specific register 531.

PWM duty cycle

$$t = \frac{1}{f_{OUTX_X}}$$

$$t = \frac{MR[527...530,532...535] + 1}{256}$$

The duty cycle defines the duration of the ON state of the digital output. The ON duration is calculated by the given formula.

Enabling the PWM function

1. Configure the PWM frequency by setting the PWM frequency divider: To enable one of the outputs 9 ... 12, configure the PWM frequency in module register 0526. To enable one of the outputs 13 ... 16, configure the PWM frequency in module register 0531.
2. Configure the PWM duty cycle for this output in the corresponding module register.
3. Activate the PWM functionality of the output by setting the respective bit in module register 0515.

⇨ At the output, a PWM signal is issued.

Description	
Enabling PWM function for output OUT 9	Bit 8 = 1
Enabling PWM function for output OUT 10	Bit 9 = 1

Description	
etc.	
Enabling PWM function for output OUT 16	Bit 15 = 1

Tab. 18: Configuration in module register 0515

Disabling the PWM function

- ► If PWM is active, first of all, set the PWM duty cycle of the given output to 0 in the corresponding module register.
- ⇨ The expansion module completes the current PWM period. Then its output issues the state OFF.
- ⇨ Disable the PWM functionality of the output by clearing the respective bit in module register 0515.
- ⇨ At the output, a low level is output.

Description	
Disabling the PWM function for output OUT 9	Bit 8 = 0
Disabling the PWM function for output OUT 10	Bit 9 = 0
etc.	
Disabling the PWM function for output OUT 16	Bit 15 = 0

Tab. 19: Configuration in module register 0515

Making changes to the PWM duty cycle

- ► Make the change to the PWM duty cycle in module register “PWM duty cycle for output OUT X” by the controller.
- ⇨ The expansion module completes the current PWM period using the old PWM duty cycle setting.
- ⇨ The expansion module starts a new PWM period using the new PWM duty cycle setting.

Making changes to the PWM frequency

- ► Enter the new value into the PWM frequency divider in module register 0526 or module register 0531.
- ⇨ The expansion module immediately changes the PWM frequency.

7.8.3 Register of pulse width modulation

Module register	0515
Description	Enabling the PWM functionality for individual outputs
	Each output is assigned a bit in the module register.
Value range	8 bits, bit-coded
Bit value = 1	PWM functionality is enabled

Assigning inputs IN 1 … 16 to the bits:		
OUT 9 = BIT 8	OUT 12 = BIT 11	OUT 15 = BIT 14
OUT 10 = BIT 9	OUT 13 = BIT 12	OUT 16 = BIT 15
OUT 11 = BIT 10	OUT 14 = BIT 13	

Module register	0526
Description	PWM frequency divider for outputs OUT 9 ... 12
	This module register lets you configure the frequency divider for the PWM frequency of outputs OUT 9 ... 12.
Values	Reasonable values: 30 … 65535
Effectiveness	PWM function enabled

Module register	0527 … 0530
	Configuration of the PWM duty cycle.
Description	0527: PWM duty cycle for output OUT 9
	0528: PWM duty cycle for output OUT 10
	0529: PWM duty cycle for output OUT 11
	0530: PWM duty cycle for output OUT 12
Value range	0 … 255
Effectiveness	PWM function enabled

Module register	0531
	PWM frequency divider for outputs OUT 13 ... 16
Description	This module register lets you configure frequency divider 2 for the PWM frequency of outputs OUT 13 ... 16.
Values	Reasonable values: 30 … 65535
Effectiveness	PWM function enabled

Module register	0532 … 0535
	Configuration of the PWM duty cycle.
Description	0532: PWM duty cycle for output OUT 13
	0533: PWM duty cycle for output OUT 14
	0534: PWM duty cycle for output OUT 15
	0535: PWM duty cycle for output OUT 16
Value range	0 … 255
Effectiveness	PWM function enabled

8 Register overview

This register overview describes the registers of the JX3-DO16 device in operating system version in a highly summarized form.

Module code

Each module has a
unique module code for identification purposes (see module register
100601 *Module code*).

– Module code JX3-DO16: 302

General overview – registers

Register range	Description
0000	Module-specific status register
0009, 0032, 0257	Version registers
0512	All outputs OUT 1 ... OUT 16
0513 ... 0514	Error states
0515 ... 0535	Pulse-width modulation PWM

Module state

Registers	Description
0000	**Module-specific status register**
Bit 0 = 1	Short circuit/overload of OUT 1 ... 8
Bit 1 = 1	Short circuit/overload of OUT 9 ... 16

Revisions

Registers	Description
0009	OS version
0032	FPGA version
0257	Bootloader version

Error states

Register range	Description
0513	Activating the error state
0514	Error state of the outputs

PWM

Register range	Description
0515	Enabling the PWM function
0526	PWM frequency divider 1 for outputs OUT 9 ... 12
0527 … 0530	PWM duty cycle for output OUT 9 … 12
0531	PWM frequency divider 2 for outputs OUT 13 ... 16
0532 … 535	PWM duty cycle for output OUT 13… 9

Electronic Data Sheet (EDS)

This register range is located in the JX3 bus master (e.g. controller) and not on the JX3 I/O module.

Register range	Description
100500 … 100501	**EDS data selection**
100500	Interface: 1= Position of the expansion modules in the system
100501	Module number within the system
100600 … 100614	**Data of the EDS page 0 (identification)**
100600	Revision of EDS page 0
100601	Module code
100602 … 100612	Module name
100613	Hardware revision
100614	Hardware option
100700 … 100710	**Data of the EDS page 1 (production)**
100700	Revision of EDS page 1
100701 … 100707	Serial number of the module
100708	Production date: Day
100709	Production date: Month
100710	Production date: Year

9 Maintenance

This product is maintenance-free. The operation of the product does not required inspection or maintenance efforts.

9.1 Repairs

Defective components can cause dangerous malfunctions and compromise safety.
Only the manufacturer is authorized to perform repair work.
It is forbidden to open the product.

Product modifications

Modifications and alterations to the product and its functions are not allowed. The manufacturer exempts from liability for any modifications made to the product.

The original parts are specifically designed for the product. Parts and equipment from other manufacturers must not be used.

The manufacturer exempts from liability for any damage resulting from the use of non-original parts and equipment is excluded.

9.2 Storage and Shipment

Storage

When storing the product, observe the environmental conditions given in chapter “Technical specifications”.

Shipment and packaging

The product contains electrostatically sensitive components which can be damaged if not handled properly. Damages to the product can impair its reliability.

To protect the product from impact or shock, it must be shipped in its original packaging, or in an appropriate protective ESD packaging.
If the packaging is damaged, inspect the device for any visible damage, and immediately inform your freight forwarder and Bucher Automation AG of the damage caused during shipment. It is strictly forbidden to use a product that has been damaged or dropped.

9.3 Return and Disposal

The WEEE icon (crossed-out wheeled bin) says that end users must not dispose of waste electrical and electronic equipment together with household waste, but separately in an appropriate way. Applicable local environmental directives and regulations must be complied with.



Fig. 13: WEEE icon – crossed out wheeled bin

Disposal options

To do so, you may either resort to professional disposal service providers or return waste electronics to Bucher Automation AG.

Find detailed information along with the required Return Delivery Form on our website.

Batteries

Prior to disposing of waste electronics, remove any batteries where this is possible in a safe and non-destructive way. Dispose of batteries properly.

Personal data

It is the responsibility of the end user to delete any personal data stored on waste electric and electronic equipment prior to disposal.

Packaging material

The product's packaging materials must not be disposed of together with household waste. Find detailed information on how to return packaging material to Bucher Automation AG on our website.

10 Service

10.1 Technical Support

In case of questions, suggestions, or issues, please contact our experts from Technical Support. You may reach out by phone or through the contact form on our homepage:

Technical Support | www.bucherautomation.com

Or email us:

support@bucherautomation.com

Please supply the following information when contacting Technical Support:

– Hardware revision and serial number
  The hardware revision and serial number is printed on the nameplate of the product.
– OS version
  To determine the operating system version, use the functions of the development environment.

11 Spare parts and accessories

NOTICE



Inadequate accessories might cause damage to the product

Parts and equipment from other manufacturers might impede the function of the device and cause damage to the product.

► Only use accessories recommended by Bucher Automation AG.

11.1 Spare parts

Component	Item number
Terminal labels	60870411
Key	60870410
Male connector in spring-cage technology, 10-pin	60869252
Male connector with PUSH-IN connection, 10-pin	60869254

Tab. 20: Spare parts

11.2 Accessories

ⓘ Info

Ordering Accessories

The accessories are not part of the scope of delivery.

Suitable accessories can be obtained from Bucher Automation AG.

Component	Item number
Screwdriver	60871712
End clamp for DIN rail	60863970
Strain relief	60870963

Tab. 21: Accessories

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