BUCHER automation

User Manual



60883467_04

JXM-IO-E30

Expansion module

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Translation of the german original User Manual

Revision	2.31.1
Date of issue	11/4/2024

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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 it. 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.

Start | www.bucherautomation.com

For further information refer to the following information 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 Information

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 module is for adding multifunctional inputs and 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 Usage other than intended

This device must not be used in technical systems which to a high degree have to be fail-safe.

Machinery Directive

This device is no safety-related part as per Machinery Directive 2006/42/EC, and must, therefore, not be used for safety-relevant applications. This device is NOT intended for the purpose of personal safety, and must, therefore, not be used to protect persons.

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 JXM-IO-E30 expansion module is a cost-effective and universally applicable I/O extension for self-propelled machines. For use in the industrial sector, additional requirements must be met:

– Measures for use in the industrial sector [▶ 31]

3.1 Variants

Some information in this document distinguishes between the following variants:

Variant	Item number
JXM-IO-E30-G20-K00	10001687
JXM-IO-E30-G20-K00-O01 *Model with CAN IN/OUT and AI10V*	10002046

Observe the relevant information in the following chapters:

– Inputs [▶ 21]

– MOLEX connector [▶ 29]

3.2 Design

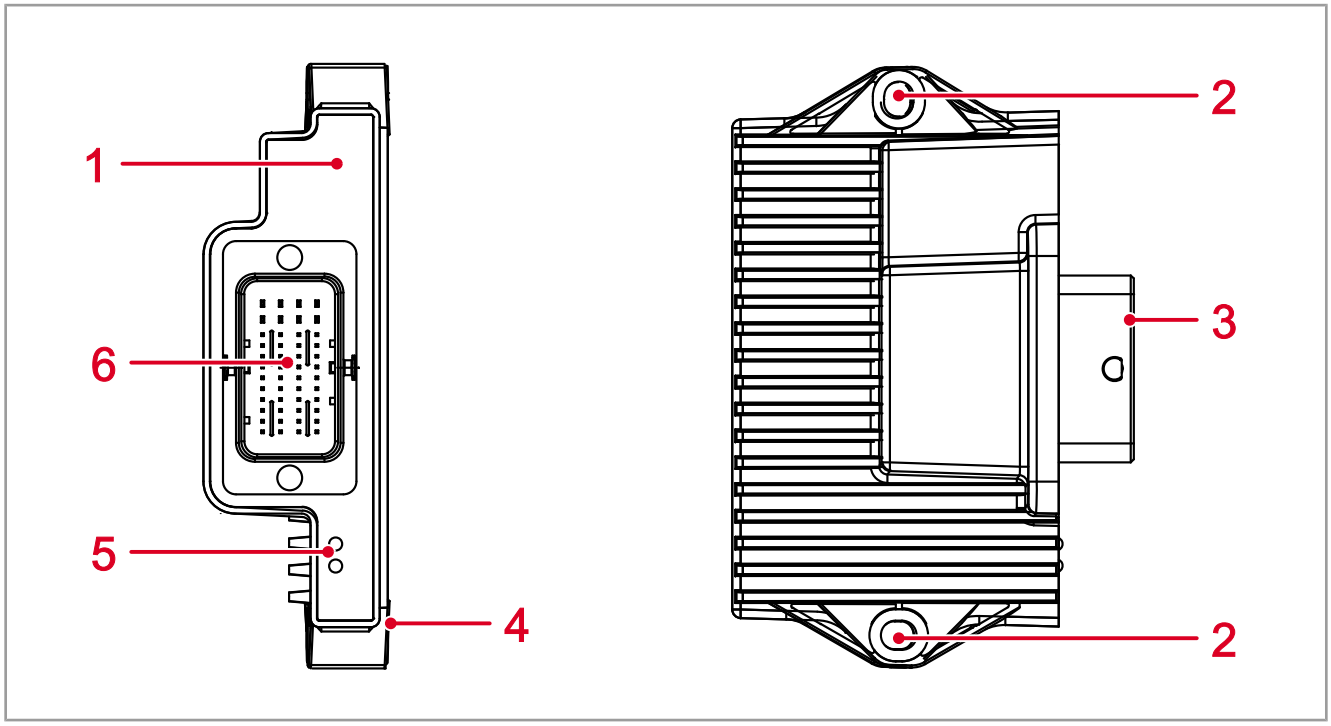


Fig. 1: Design

1	Housing
2	Fastening lugs
3	MOLEX connector
4	Mounting surface
5	LED indicators
6	Contact pins

3.3 Product features

- 1 CAN port with optional terminating resistor
- Communication via CANopen protocol
- 8 analog inputs for current or voltage measurement
- 4 digital inputs for use as digital, frequency, period time or counter inputs
- 4 digital outputs with current monitoring. 3 A maximum load per channel. The total current must not exceed 6 A. These outputs can also be used as digital inputs.
- 6 PWM outputs, 7 A max., with current monitoring. These outputs can also be used as digital inputs.
- 4 PWM outputs, 3 A max., with precision current measurement and PID current control. These outputs can also be used as digital inputs.
- 3 outputs with monitored supply voltages for sensors (battery voltage)
- Separate connections for logic and output driver supply
- Total current output of up to 25 A

3.4 Diagnostic capability via LEDs

The JXM-IO-E30 is equipped with 2 LEDs indicating various states and errors.

Red LED	Green LED	Description
●	○	– Operating voltage is present (VBAT_ECU). – The bootloader is not being executed.
ON	OFF	
✷	○	– The bootloader is being executed. – The device has no firmware.
ON/OFF: 200 ms	OFF	
✷	○	– The start process was completed without errors. – The device is in the **Stopped** state.
ON/OFF: 400 ms	OFF	
○	✷	– The start process was completed without errors. – The device is in the **Pre-Operational** state.
OFF	ON/OFF: 200 ms	

Red LED	Green LED	Description
○		– The start process was completed without errors. – The device is in the **Operational** state.
OFF	ON: 200 ms	
	OFF: 600 ms	
○	3x 	– The start process was completed without errors. – The device is in calibration mode.
OFF	3x ON/ OFF: 200 ms	
	Pause: 400 ms	
		– The device is in the **Bus Off** state. – Bus communication is not possible. – There is a wiring error.
ON: 200 ms OFF: 400 ms		
3x 		Measured values are outside their specified ranges. The following errors may have occurred: – The PCB temperature is too high. – The CPU temperature is too high.
3x ON/OFF: 200 ms	ON/OFF: 400 ms	

3.5 Nameplate

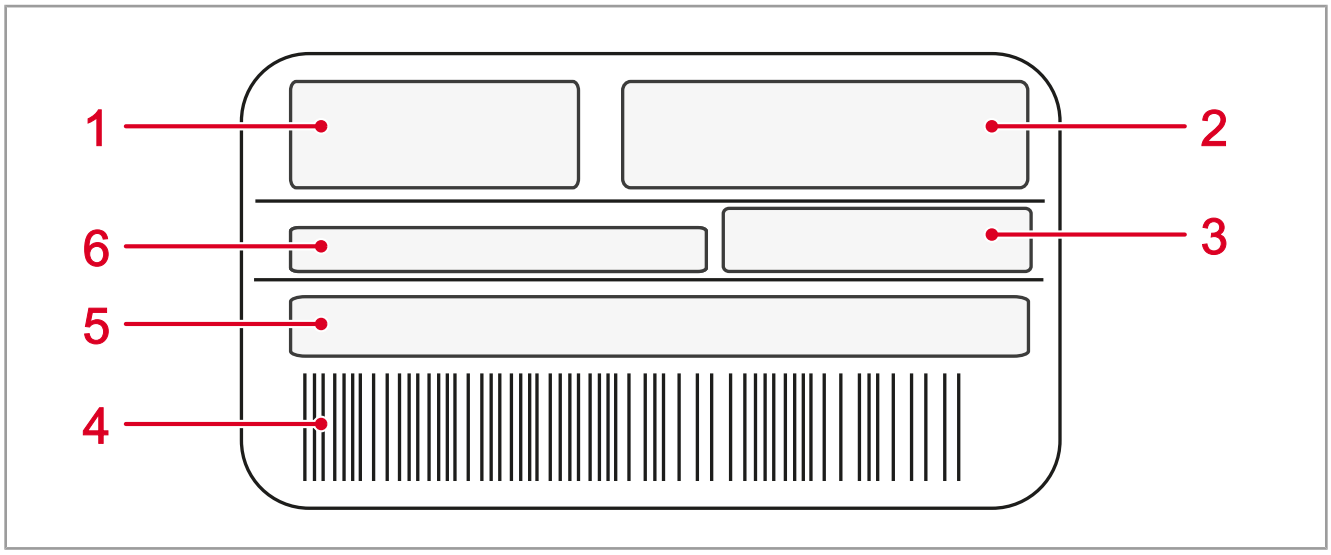


Fig. 2: Nameplate

1	Logo
2	Certification mark
3	Registration number and hardware revision
4	Barcode
5	Serial number
6	Model code number

3.6 Scope of Delivery

Scope of delivery	Item number	Quantity
JXM-IO-E30-G20-K00	10001687	1
OR		
JXM-IO-E30-G20-K00-O01 *Model with CAN IN/OUT and AI10V*	10002046	1

4 Technical Specifications

This chapter contains information on both electrical and mechanical data as well as on operating data of the JXM-IO-E30 device.

4.1 Dimensions

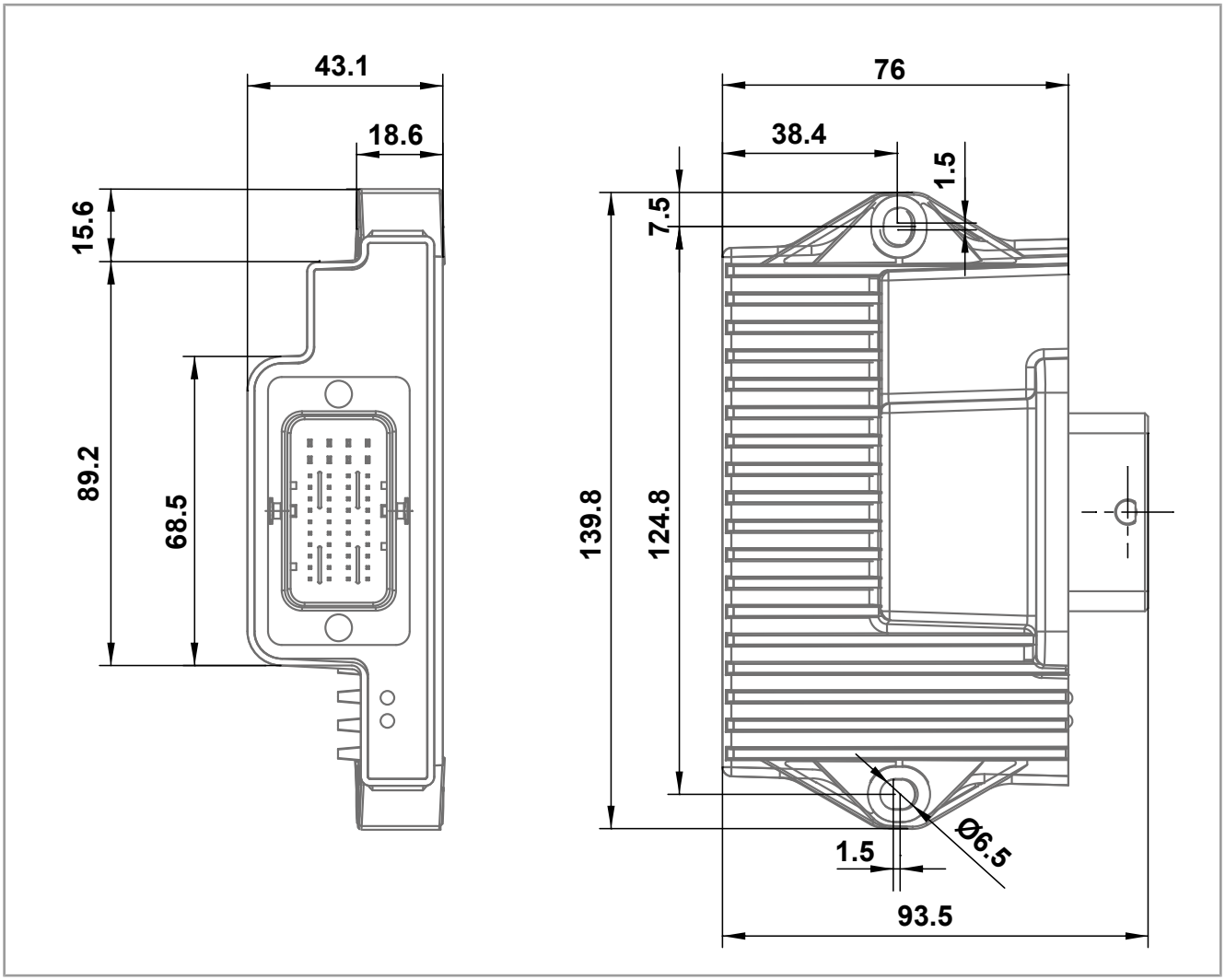


Fig. 3: Dimension in mm

Info

CAD data

For CAD data go to www.bucherautomation.com and navigate to the product page *JXM-IO-E30 > Downloads*.

4.2 Mechanical specifications

Parameter	Description	Standards
Weight	325 g	
Enclosure specifications		
Material	Polyamide	
Enclosure potential	Isolated	
Vibration resistance	10 Hz ... 150 Hz, 6 h	ISO 16750-3
Shock resistance		
Type of shock	Half-sine wave	ISO 16750-3
Intensity and duration	50 g for 11 ms	
Number and direction	10 shocks in the directions of all 3 spatial axes	
Free fall		
Height of fall	From 1 m height on solid ground	ISO 16750-3

Tab. 1: Mechanical specifications

4.3 Electrical properties

Output driver supply

Parameter	Description
Abbreviation	VBAT_PWR
Total current	Max. 25 A
Operating voltage	DC 8 V … 32 V
Protection against polarity reversal	There is the danger of a short circuit if the polarity is reversed. Protect the circuit by an external 25 A fuse.
Voltage protection	+36 V for 1 h at T_{max} -20 °C, function state C

Tab. 2: Output driver supply

ECU power supply

Parameter	Description	
Abbreviation	VBAT_ECU	
Operating voltage	DC 8 V … 32 V	
Protection against polarity reversal	Max. 32 V	
	There is the danger of a short circuit if the polarity is reversed. Protect the circuit by an external 2 A fuse.	
Current consumption	At 12 V	approx. 49 mA + total current at VEXT_SEN
	At 24 V	approx. 34 mA + total current at VEXT_SEN

Tab. 3: ECU power supply

Ground reference

Pin	Purpose
GND_PWR	Ground for VBAT_PWR and VBAT_ECU
GND_SEN	Ground for VEXT_SEN

Tab. 4: Ground reference

4.4 Environmental conditions

Parameter	Description	Standards
Operating temperature	-40 °C … +85 °C	ISO 16750-4
Storage temperature	-40 °C … +85 °C	
Relative humidity	5 % … 95 %	
Weather resistance	The device is designed for use in all weather conditions and is suitable for outdoor use.	
Salt water resistance	The device is not designed for maritime applications.	
Degree of protection	IP65 with mating connector plugged in	

Tab. 5: Environmental conditions

4.5 EMI values

The device has E1 approval according to ECE R10 Rev. 5 and CE conformity according to ISO 14982.

In addition, the device has CE conformity according to EN 61000-6-1 and EN 61000-6-2 in the industrial sector as of hardware revision 02. To comply with CE conformity requirements, additional measures are necessary (see Measures for use in the industrial sector [▶ 31]).

Pulses ISO 7637-2

Test pulse	Values	Functional class
1	-450 V	C
2 a	+37 V	B
2b	+20 V	C
3 a	-150 V	A
3b	+150 V	A

Tab. 6: Pulses ISO 7637-2

Pulses ISO 16750-2

Test pulse	Values	Functional class
4	Ua1: -12 V / 50 ms Ua2: -5 V / 500 ms	B (24 V systems)
4		C (12 V systems, E1)
5b	Load dump 70 V / 2 Ω / 350 ms	C

Tab. 7: Pulses ISO 16750-2

Irradiation ISO 11452

Parameter	Values	Functional class
Protection against RF noise	20 MHz ... 2 GHz 60 V/m	A
	20 MHz ... 2 GHz 75 V/m	B
	20 MHz ... 57 MHz and 82 MHz ... 2 GHz 100 V/m	B

Tab. 8: Irradiation ISO 11452

Emission CISPR 25

Parameter	Values	
Narrowband emission	30 MHz ... 1,000 MHz	Min. 1 dB below limit
Wideband emission	30 MHz ... 1,000 MHz	Min. 1 dB below limit

Tab. 9: Emission CISPR 25

ESD EN 61000-4-2

ESD EN 61000-4-2	Values	Functional class
Contact discharge	±4 kV	A
Discharge through air	±8 kV	A

Tab. 10: ESD EN 61000-4-2

Tests for use in industrial applications

Burst

Parameter	Values	Criterion	Standards
Burst	2 kV	B	EN 61000-6-2
	1 kV	B	EN 61000-6-1

Tab. 11: Burst

RF induction

Parameter	Values	Criterion	Standards
RF induction	10 V	A	EN 61000-6-2
	3 V	A	EN 61000-6-1

Tab. 12: RF induction

Impulse voltages

Parameter	Values	Criterion	Standards
Impulse voltages	±1 kV	B	EN 61000-6-2
	±0.5 kV	B	EN 61000-6-1

Tab. 13: Impulse voltages

4.6 Outputs

Output PWMi_H3

Parameter	Description	
High-side PWM output with precise current diagnostics		
Abbreviation	PWMi_H3	
Quantity	4	
Peak Current	3 A per channel	
Load range	0.02 A … 3 A per channel	
Properties	No-load detection	Compatible with inductive load
	Overcurrent detection, precise current measurement	
Pulse width modulation		
PWM frequency	1,500 Hz max	
Resolution	0.1 %	
Dithering frequency	50 Hz … 800 Hz	
Dither amplitude	0% … 20%	
Current control	PID controller with configurable control parameters	
Control period	≥ 5 ms, adjustable	
Current diagnostics		
Resolution	12 bits	
Measuring range	0.2 A … 4 A	
Measuring accuracy	±2.5 % of 3 A	
Use as input		
NPN and PNP input	**Switching the interface to NPN or PNP affects the entire PWMi_H3_x group!**	
	L level ≤ 1.6 V	H level ≥ 4.6 V
Input resistance	PNP 94 kΩ	NPN 10 kΩ

Tab. 14: Outputs PWMi_H3_1 ... PWMi_H3_4

Output PWM_H7

Parameter	Description	
High-side PWM output with current diagnostics		
Abbreviation	PWM_H7	
Quantity	6	
Peak Current	7 A per channel	
Load range	0.2 A … 7 A per channel	
Properties	No-load detection	Compatible with inductive load
	Overcurrent detection	

Parameter	Description	
Current diagnostics	Diagnostics value	Measuring accuracy
Referenced to 7 A	< 0.2 A	±45 %
	≤ 1.5 A	±35 %
	> 1.5 A ... 7 A	±25 %
Pulse width modulation		
PWM frequency	5 Hz min	1,500 Hz max
Resolution	0.1 %	
Dithering frequency	25 Hz … 800 Hz	
Dither amplitude	0% … 20%	
Use as input		
NPN or PNP input	**Switching the interface to NPN or PNP affects the entire PWM_H7_x group!**	
	L level ≤ 1.6 V	H level ≥ 4.6 V
Input resistance	PNP 94 kΩ	NPN 10 kΩ

Tab. 15: Outputs PWM_H7_1 ... PWM_H7_6

ⓘ Info

Measurability of very short pulses

The resolution of the duty cycle at the PWM output is 0.1 %. Due to the limited edge steepness, very short pulses may not be measured.

– Example - high frequency pulses:
  At 10 kHz output frequency, 0.1 % or 99.9 % duty cycle and low impedance load, a signal can no longer be measured.
– Example - low frequency pulses:
  1 Hz output frequency allows for a 0.1 % duty cycle to be measured.

Output DO_H3

Parameter	Description	
Digital output with current diagnostics		
Abbreviation	DO_H3	
Quantity	4	
Peak Current	3 A per channel	
Total current	6 A max for all 4 DO_HR channels collectively	
Load range	0.02 A … 3 A	
On-Off switching frequency	50 Hz max	
Properties	No-load detection	Compatible with inductive load
	Overcurrent detection	
Current diagnostics	Current	Measuring accuracy
Referenced to 3 A	< 0.2 A	±45 %
	≤ 1.5 A	±35 %
	> 1.5 A ... 3 A	±25 %

Parameter	Description	
Use as input		
NPN and PNP input	**Switching the interface to NPN or PNP affects the entire DO_H3_x group!**	
	L level ≤ 1.6 V	H level ≥ 4.6 V
Input resistance	PNP 94 kΩ	NPN 10 kΩ

Tab. 16: Outputs DO_H3_1 ... DO_H3_4

Sensor output VEXT_SEN

Parameter	Description
Sensor supply output: VBAT_ECU is looped through to VEXT_SEN via a PTC resistor. An overcurrent or short circuit at the sensor supply can be detected.	
Abbreviation	VEXT_SEN
Quantity	3
Peak Current	100 mA min per channel at 85 °C
	Approx. 500 mA per channel at 25 °C

Tab. 17: Sensor output VEXT_SEN

4.6.1 Current diagnostics at the outputs

The limit values vary for each output (see Outputs [▶ 17]).

All outputs are calibrated at the factory to achieve the highest possible accuracy. For low current values, the measurement is not linear. The measurement is therefore linearized by the firmware:

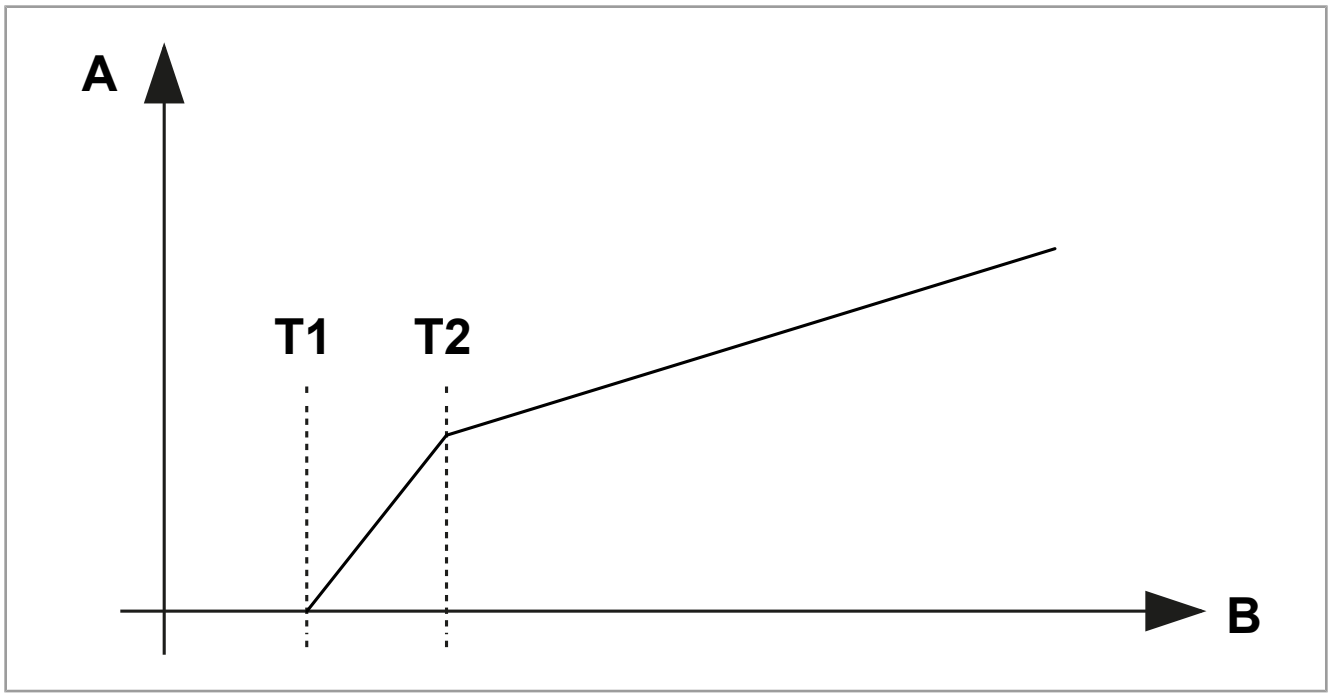


Fig. 4: Graph: Principle of linearization

A	Current value
B	ADC value

– T2 is 200 mA, lower current levels are displayed as 0.
– T2 is 500 mA. From 200 mA to 500 mA the measured current value is linearized.

4.6.2 Overcurrent trip at outputs

If overcurrent flows through an output for 500 ms (default value), the overcurrent shutdown becomes active. This value can be changed using the parameter OVERCURRENT_TIME. If an overcurrent event is detected, the output shuts down and the overcurrent bit is set for 10 seconds. During this time the port cannot be switched on again.

Re-enabling the port

✓ The JXM-IO-E30 is in the **Operational** state.
✓ 10 s have passed since the output was shut down.
► Set the output value (digital or PWM) of the respective port again.

4.7 Inputs

All inputs in the operating voltage range are surge-proof and overcurrent-proof. The JXM-IO-E30 has 3 separate VEXT_SEN ports used to supply the sensors. The connector pins output the battery voltage via a PTC thermistor. The output voltage can be read back in the device so that a failure of the sensor supply can be detected.

Alternatively, the analog inputs can also be used as digital inputs (DI_PNP).

Analog inputs

Parameter	Description	
Analog inputs		
Abbreviation	AI	
Quantity	8	
Resolution	12 bits	
Voltage measuring	JXM-IO-E30	JXM-IO-E30-O01
Rated measuring range	0 V … 5 V	0 V … 10 V
Overvoltage measurement	5 V … 7 V	10 V … 12 V
Input resistance	≥ 35 kΩ	
Maximum voltage	+32 V	
Measuring accuracy	±2 % across the rated measuring range	
Moving average filter		
Filter depth range	1 ... 32	
	If set to 1 no filtering is active.	
Measuring cycle	1 ms	
Current measurement		
Measuring range	0 mA … 20 mA	
Overcurrent range	21 mA … 24 mA	
Load resistor	120 Ω	
Measuring accuracy	±1.5 % of 20 mA	
Behavior in case of overcurrent detection	In case of overcurrent, the current measurement is interrupted. At the end of the overcurrent event, the current measurement is automatically resumed.	
As DI_PNP		
H level	≥ 4.6 V	
L level	≤ 1.6 V	
Input frequency	10 Hz max	
Input resistance	≥ 35 kΩ	

Tab. 18: Analog inputs

Digital inputs

All digital inputs are PNP inputs. From HW revision 02.00 onwards, digital input DI_P_1 can also be configured as NPN input.

All outputs can also be used as simple digital NPN or PNP inputs with restrictions.

Parameter	Description
Digital inputs with frequency measurement	
Abbreviation	DI_P
Quantity	4
Pull-down resistor	5.6 kΩ
H level	≥ 4.6 V
L level	≤ 1.6 V
Input frequency	0.1 Hz … 10 kHz
Dielectric strength	+32 V max

Tab. 19: Digital inputs DI_P_1 ... DI_P_4

Configuration inputs

Configuration inputs are tristate inputs and are used to set the node ID. The base address can be set by the user and has the default value 0x30. The node ID can be shifted by connecting the configuration inputs with VBAT_ECU or GND via an offset.

Parameter	Description	
Configuration inputs for configuring the node ID		
Abbreviation	CFG1	CFG2
Quantity	2	

Tab. 20: Configuration inputs CFG1 … CFG2

For more information, refer to chapter Setting the node ID [▶ 49].

5 Mechanical installation

⚠ WARNING



Risk of burns

Contact with hot surface may cause burns.

- ► Take protective measures to prevent inadvertent contact with the device.
- ► Allow the device to cool down for some time before you start working on it.

NOTICE



Damages to material or functional impairment due to welding

Welding on the chassis may damage the device material, or impair device functions.

- ► Before you start welding, disconnect all connections between the device and the electric system of the vehicle.
- ► Protect the device from flying sparks and welding beads (splatter).
- ► Do not touch the device with the welding electrode or earth clamp.

NOTICE



Dirt and moisture can affect the electrical connections

- ► Protect unused pins using blanking plugs.
- ► Protect all electrical connections with appropriate single wire seals.
- ► Clean the area around a connector prior to removing the mating connector.

NOTICE



Functional impairment due to magnets or motors with coil

Using magnets or motors with a coil in the vicinity of the JXM-IO-E30 may adversely affect current readings of the inputs and outputs.

- ► Ensure that there is sufficient clearance or shield the JXM-IO-E30.

5.1 Requirements for installation location and mounting surface

Requirements for the mounting surface

Parameter	Description
Suitable materials	No special material requirements
Shape / quality	The contact surface must be plane.
Fastening lugs	All existing fastening lugs must be screwed down. The device can directly be fastened to the vehicle or to a mounting plate.

Tab. 21: Requirements for the mounting surface

Requirements for the installation space

– Sufficient air circulation
– Sufficient space between the device and parts that may become very hot
– The device must be accessible for service work at all times.

5.2 Mounting orientation

When mounting, observe the permitted and prohibited mounting orientations.

ⓘ Info

Overheating due to incorrect mounting orientation

If the device switches itself off, check whether the device has overheated due to an unfavorable mounting orientation.

5.2.1 Allowed mounting orientations

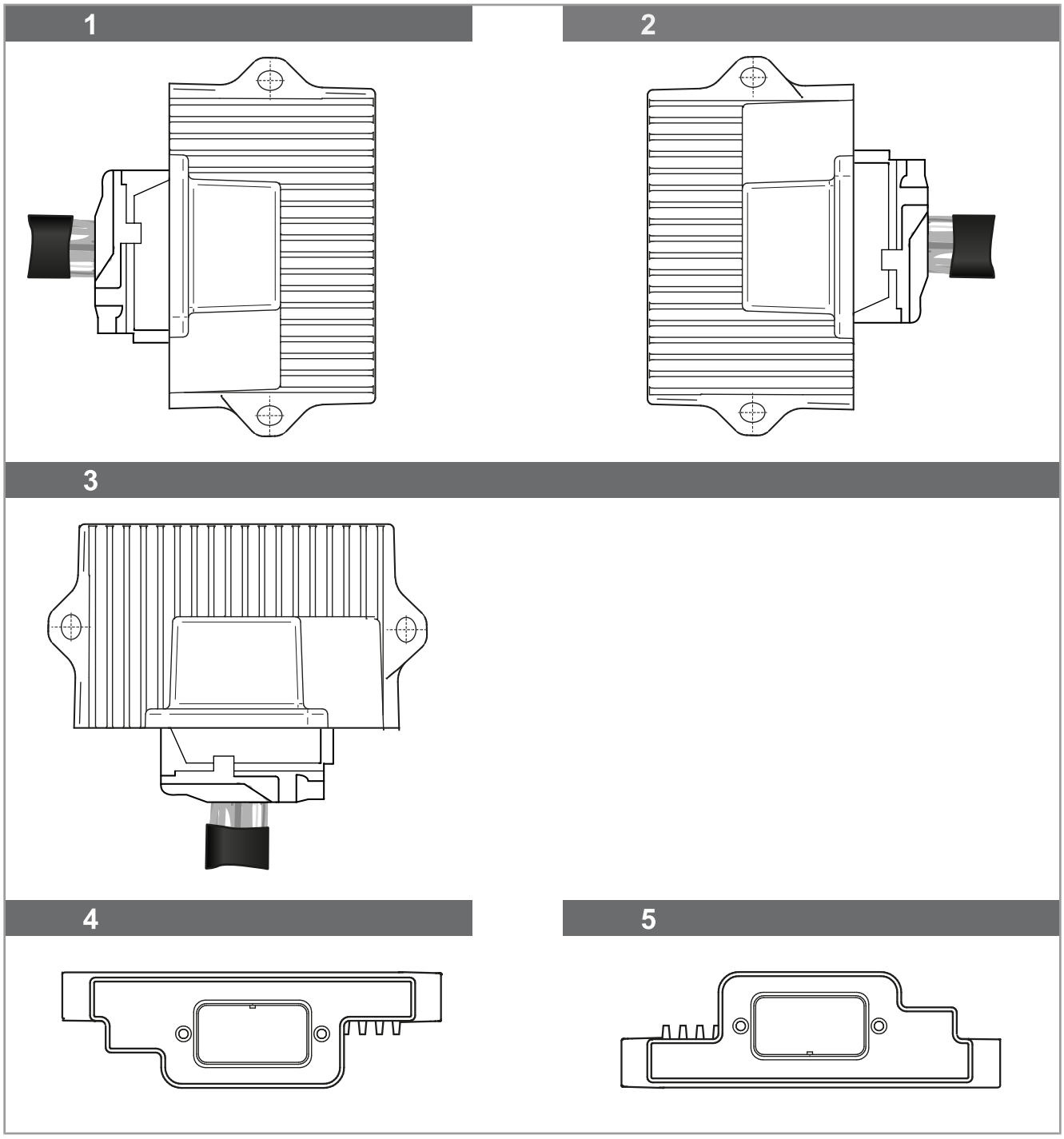


Fig. 5: Allowed mounting orientations

5.2.2 Forbidden mounting orientations

NOTICE

Ingress of moisture in the case of incorrect mounting orientation

- ► Protect the device from splash and condensate.
- ► Do not route the connector plug vertically upwards.
- ► Do not use a steam jet near the unprotected device.

Any orientation where the connector plug is not protected against splash water or condensation is prohibited.

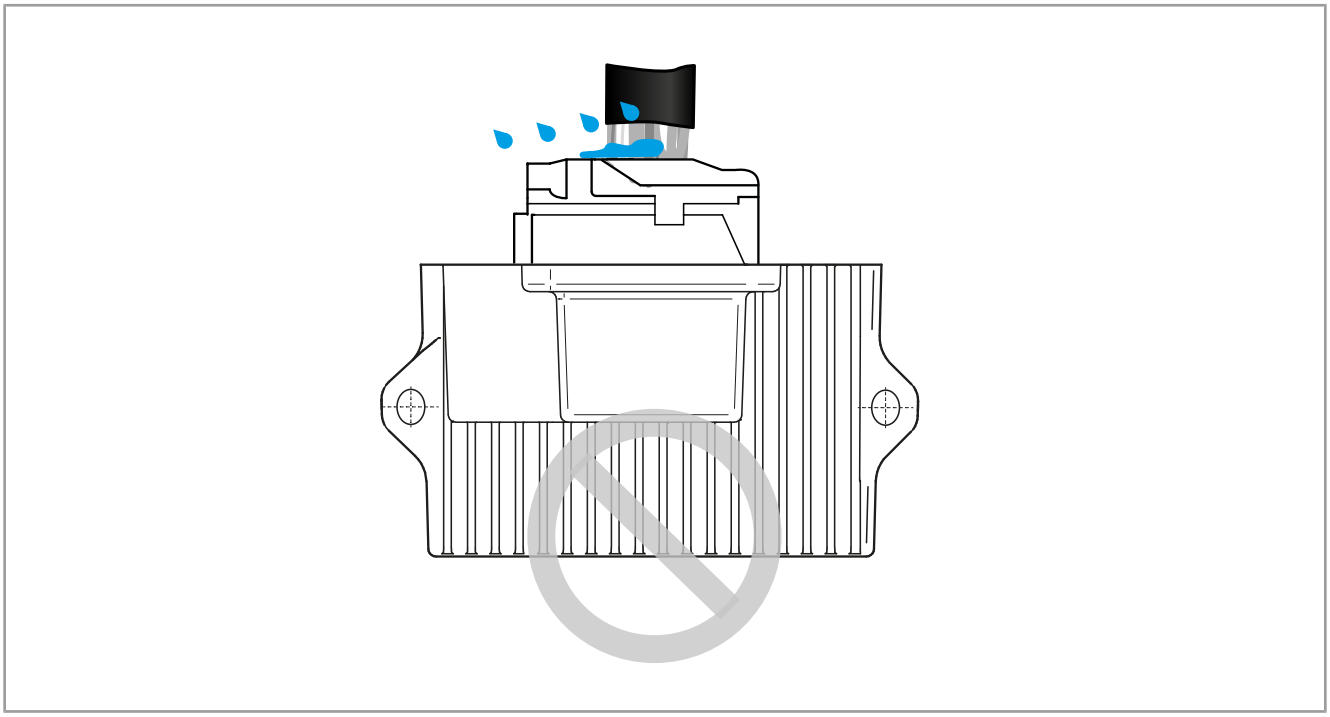


Fig. 6: Forbidden mounting orientation

5.3 Installing the expansion module

Mounting hardware

Installation hardware is not included in the scope of delivery. Bucher Automation AG recommends the following mounting hardware:

Material	Type	Quantity
Screws/bolts	M6	2
Washers	DIN 125-1	2

Tab. 22: Mounting hardware

Mechanical installation

- ► Install the JXM-IO-E30 using both fastening lugs. Torque down to 4 Nm max.

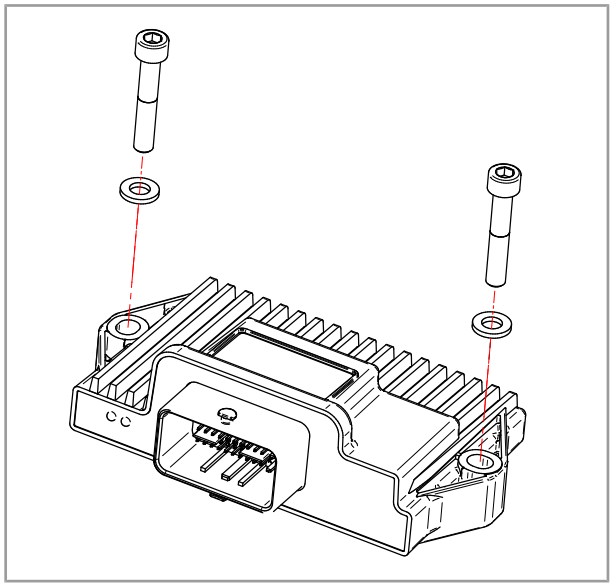


Fig. 7: Installation drawing

6 Electrical connection

⚠ WARNING



Signal disruption due to incorrect CAN wiring

Unshielded or incorrectly twisted CAN lines may cause communication faults. In the worst case, a malfunction of the device can lead to subsequent physical injury.

- ► Connect 120 Ω termination resistors to both ends of the CAN bus.
- ► Alternatively, connect the internal terminating resistor (see pinout).

NOTICE



Improving electromagnetic compatibility

Improper implementation of the wiring harness may impair electromagnetic compatibility.

- ► Keep the cables as short as possible.
- ► Lay power lines and signal lines separated from each other.

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.

NOTICE



Surges resulting from missing protection or fusing

Surges may cause malfunctions or damage to the product.

- ► Protect the voltage inputs from surges according to the requirements.
- ► Ensure that the device is handled in accordance with ESD regulations.

NOTICE



Interferences due to differences in potential

Differences in potential can lead to interferences.

- ► Wire sensors and actuators including their supply lines in star configuration to prevent differences in potential.

6.1 Pin assignment

6.1.1 MOLEX connector

⚠ WARNING

Risk of short circuit if battery polarity is reversed

Inadequate fuse protection can lead to a short circuit if the polarity of the battery is reversed.

- ► Protect VBAT_PWR with an external 25 A fuse.
- ► Protect VBAT_ECU with an external 2 A fuse.

The pins in the lines A to K drive up to 6 A; the pins in the lines L to M drive up to 12 A.

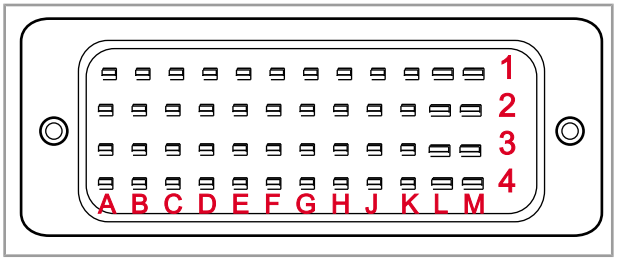


Fig. 8: MOLEX connector – pin assignment

Pin assignment

	4	3	2	1
A	PWM_H7_5	n.c.	CAN1_TERM2 / CAN_H_OUT*	CAN_H
B	PWM_H7_5	AI_1	CAN1_TERM1 / CAN_L_OUT*	CAN_L
C	PWM_H7_6	AI_2	DI_P_1	PWMi_H3_4
D	PWM_H7_6	AI_3	DI_P_2	PWMi_H3_3
E	PWM_H7_4	AI_4	DI_P_3	PWMi_H3_2
F	PWM_H7_4	AI_5	DI_P_4	PWMi_H3_1
G	PWM_H7_3	AI_6	GND_SEN	DO_H3_4
H	PWM_H7_3	AI_7	VEXT_SEN_3	DO_H3_3
J	CFG1	AI_8	VEXT_SEN_2	DO_H3_2
K	CFG2	VBAT_ECU	VEXT_SEN_1	DO_H3_1
L	**GND_PWR**	**GND_PWR**	**VBAT_PWR**	**VBAT_PWR**
M	**GND_PWR**	**PWM_H7_2**	**PWM_H7_1**	**VBAT_PWR**

* JXM-IO-E30 / JXM-IO-E30-O01

Abbreviations used in this document

Abbreviation	Description
AI	Analog input, current/voltage
CAN1_TERM	These two pins must be jumpered to enable the 120 Ω terminating resistor.
CFG	Configuration pin for setting the CAN node ID
DI_P	Digital and frequency input
DI_P_1	Digital and frequency input which can also be used as NPN input as of HW Rev. 02.00.
DO_H3	Digital high-side output
GND_PWR	Ground – power outputs
GND_SEN	Ground – sensor power supply
n.c.	Reserved pin that must not be connected. **NOTICE! Seal unused pins with pin plugs.**
PWM_H7	High-side PWM output up to 7 A
PWMi_H3	High-side PWM output up to 3 A with precise current measurement
VBAT_ECU	Power supply for logic unit and sensors
VBAT_PWR	Power supply for output driver
VEXT_SEN	Sensor supply protected by PTC resistor each.

Tab. 23: Abbreviations used in this document

MOLEX mating connector – Specification

Parameter	Description	
Designation	MOLEX plug-in connector	
Type	48-pin	
Series production	64320	
Manufacturer part number	0643201311	
Crimp contacts		
For 0.75 mm² lines	Quantity	40
	Manufacturer part number	0643221029
For 1.5 mm² lines	Quantity	8
	Manufacturer part number	0643231039
Protective cap		
Manufacturer part number	0643201301	

Tab. 24: MOLEX mating connector specification

6.2 Measures for use in the industrial sector

The JXM-IO-E30 was developed for the automotive industry. In order to be able to use the device also in the industrial sector in conformity with CE, you must implement the measures of one of the following options:

Option 1 – Limitation of the maximum cable length to 3 m

1. Limit the maximum cable length to 3 m.
2. Use a transil diode of type BZW06-33 at each DI_P input and at the outputs PWM_H7, PWMi_H3 and DO_H3.
3. Shield all 8 analog inputs (shield 1).
4. Shield the CAN bus (shield 2).

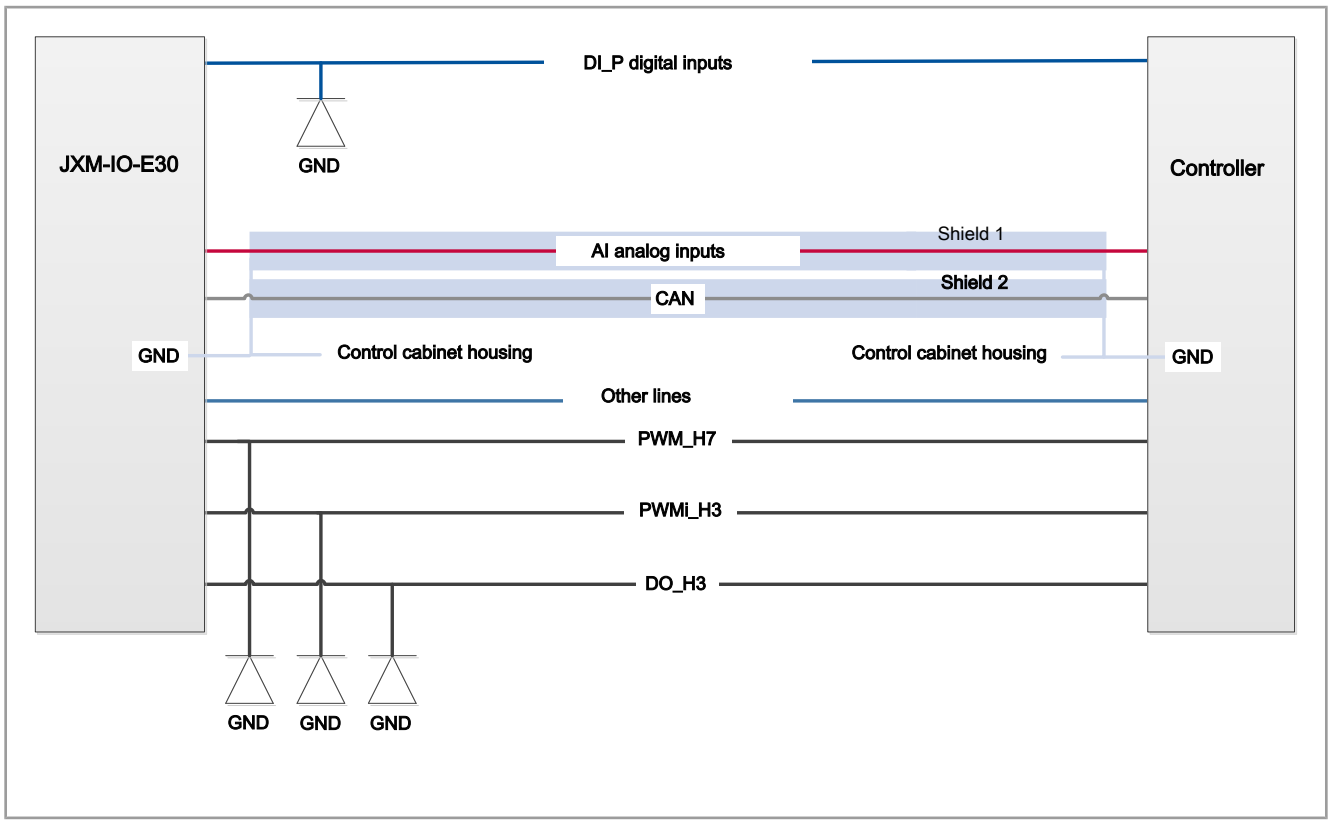


Fig. 9: Block diagram: Limitation of the maximum cable length

Option 2 – Overall shielding

1. Shield all cables with an overall shielding grounded on both sides.
2. Use a transil diode of type BZW06-33 at each DI_P input and at the outputs PWM_H7, PWMi_H3 and DO_H3.

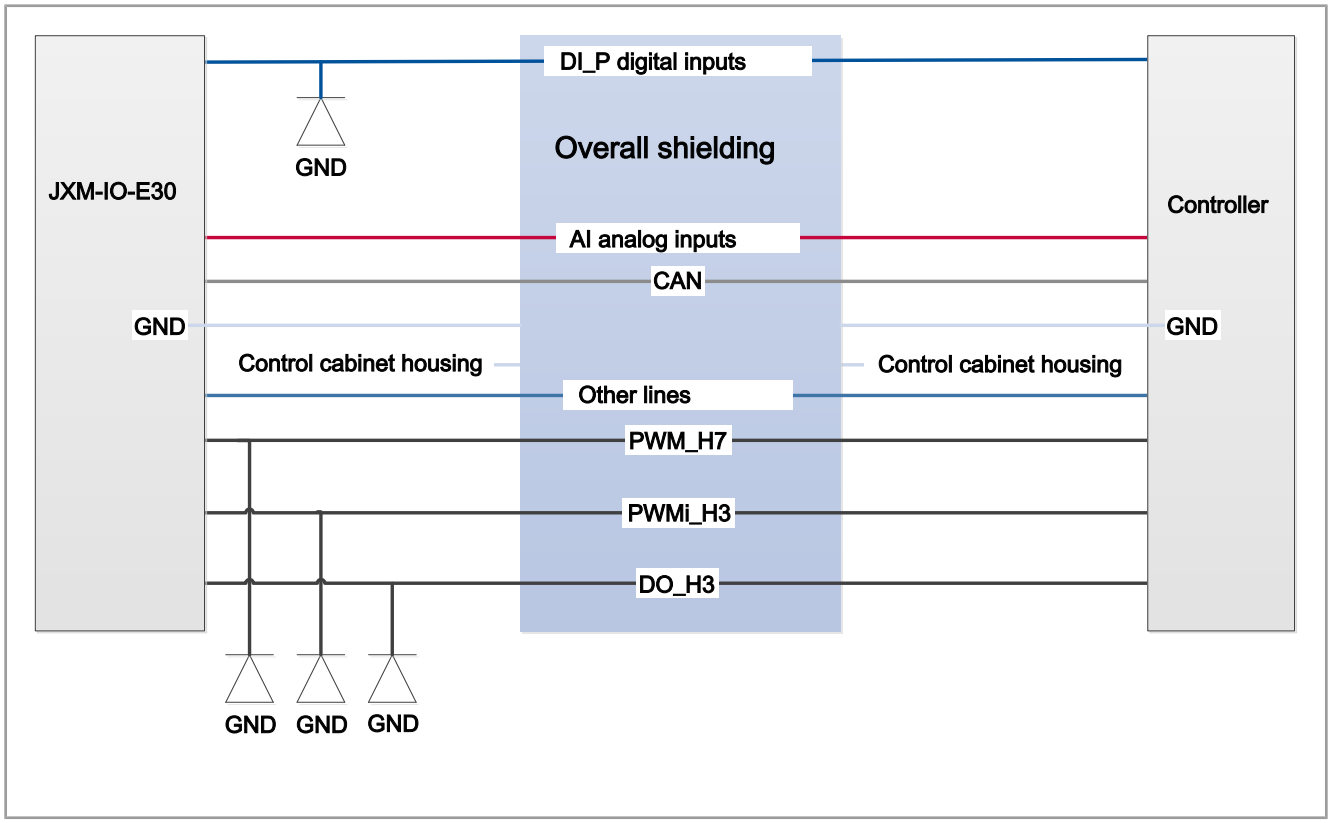


Fig. 10: Block diagram: Overall shielding

7 Identification and Configuration

7.1 Identification

This chapter describes how to identify the JXM-IO-E30 device:

– Determining the hardware revision

– Retrieving Electronic Data Sheet (EDS) information. The EDS holds numerous non-volatile production-relevant data.

– Determining the OS version of the device and its software components

7.1.1 Device information

Device information

Index	Subindex	Description	Type	Types of access	Default value
0x1018	0	Number of supported entries	U8	R	
	1	Manufacturer ID	U32	R	0x000000B3
	2	Product code	U32	R	
	3	Revision number	U32	R	
	4	Serial number	U32	R	
0x1000	0	Type of device	U32	R	
0x1008	0	Device Name	String	R	
0x1009	0	Hardware revision	String	R	
0x100A	0	Software version	String	R	

Tab. 25: Device information

7.1.2 Electronic Data Sheet (EDS)

Each JXM-IO-E30 features an Electronic Data Sheet (EDS). Production-specific data is stored in the CANopen object indexes 0x4555 and 0x4565.

EDS information

Index	Subindex	Description	Type	Types of access
0x4555	0	Number of supported entries	U8	R
	1	Reserved		
	2	Reserved		
	3	Reserved		
	4	Module code	U16	R
	5	Product name	String	R
	6	PCB revision number	I16	R
	7	PCB options	I16	R
	8	Reserved		
	9	Serial number	String	R
	10	Production time stamp: Day	U8	R
	11	Production time stamp: Month	U8	R
	12	Production time stamp: Year	U16	R
	13	Reserved		
	14	Reserved		
	15	Minimum OS version	U32	R
	16	Minimum bootloader version	U32	R

Tab. 26: EDS information

Electronic nameplate

Index	Subindex	Description	Type	Default
0x4565	0	Number of supported entries	U32	5
	1	Version number of the electronic name plate	U32	0
	2	Command	U32	0
	3	Product serial number	String	0
	4	Item number	String	0
	5	Product revision	String	0

Tab. 27: Electronic nameplate

7.2 Operating system

We are continuously striving to enhance the operating systems of our products. Enhancing means adding new features, and upgrading existing functions. Current OS files are available for download from our website on the pages of the respective product.

Info

Further information

More information on this subject is available on our website.

Start | www.bucherautomation.com

7.2.1 Operating System Update of the Expansion Module

This chapter describes how to carry out an operating system update on the JXM-IO-E30 expansion module. You have got several options to transfer the OS file to the expansion module:

– By means of the controller
– By means of the command line tool JetEasyDownload (version 1.00.0.15 or higher) from Bucher Automation

OS update via JetEasyDownload

To update the operating system of a device, use a PEAK CAN dongle and the Bucher Automation command line tool JetEasyDownload (version 1.00.0.15 or higher).

Info

Required OS version

Model type JXM-IO-E30-K00-O01 does not support OS file versions previous to 2.16.0.00. Any attempt to import an OS file version previous to 2.16.0.00, will cause the following:

– JetEasyDownload aborts with a timeout error.
– The previous OS is deleted.
– The device is waiting in bootloader mode for a valid OS file.

When the OS upload failed, reset the JXM-IO-E30-K00-O01. You can then repeat the update attempt with an OS version ≥ 2.16.0.00.

JetEasyDownload parameters

Calling JetEasyDownload requires the applicable specifications parameters.

Parameter	Description	Values	
-H<Num>	Hardware	0 =	PCAN_ISA1CH
		1 =	PCAN_ISA2CH
		2 =	PCAN_PCI_1CH
		3 =	PCAN_PCI_2CH
		4 =	PCAN_PCC_1CH
		5 =	PCAN_PCC_2CH
		6 =	PCAN_USB_1CH
		7 =	PCAN_USB_2CH
		8 =	PCAN_Dongle Pro
		9 =	PCAN_Dongle
		10 =	PCAN_NET Bucher Automation
		11 =	PCAN_DEV default device
		20 =	IXXAT V2.18
		22 =	IXXAT V3
		100 =	CAN hardware detected first
-T<nodeID>	Target node ID	The Node ID is given as a decimal.	
-B<Num>	Baud rate **Mind the permissible baud rates of your device!**	0 =	10 kB
		1 =	20 kB
		2 =	50 kB
		3 =	100 kB
		4 =	125 kB
		5 =	250 kB
		6 =	500 kB
		7 =	1 MB
-S<Num>	SDO timeout	Default	300 ms
-L<name>	OS file name	e.g. JXM-IO-E30_Vx.xx.x.xx.os	

Tab. 28: JetEasyDownload parameters

Performing the update

```
JetEasyDownload -H100 -T48 -B5 -S8000 -LJXM-IO-E30_Vx.xx.x.xx.os
```

ⓘ Info

Selecting the CAN dongle

When selecting the CAN hardware, the –H100 parameter gives priority to the hardware detected as connected to the PC. Ensure that the PEAK CAN dongle is the only CAN device connected to the PC, to prevent the selection of the wrong CAN dongle.

✓ The JXM-IO-E30 and the controller are disconnected.

✓ JetEasyDownload and the PEAK CAN dongle are ready for use.

✓ A CAN connection is established between the PEAK CAN dongle and the JXM-IO-E30.

1. Call up JetEasyDownload with the above parameters and a valid OS file.

   ⇨ The device carries out a reset.

   ⇨ The device starts in boot loader mode with a single heartbeat in init state (data = 0x00).

2. Wait for approx. 7 seconds while the device formats the flash memory.

   ⇨ The device initiates the download process.

⇨ The device starts automatically with the new firmware.

8 Parameterization

8.1 Concept and control

The concept of the JXM-IO-E30 device is based on the assignment of interfaces to the inputs and outputs of the device. Each input and output of the device is called a port and can be configured. The function of a port is determined by assigning an interface to it. Any interface contains parameters, value types and a state:

– Parameters can be assigned to each interface.
– Information can be transmitted and set via values to any interface.
– The status provides information about the status of the interface.

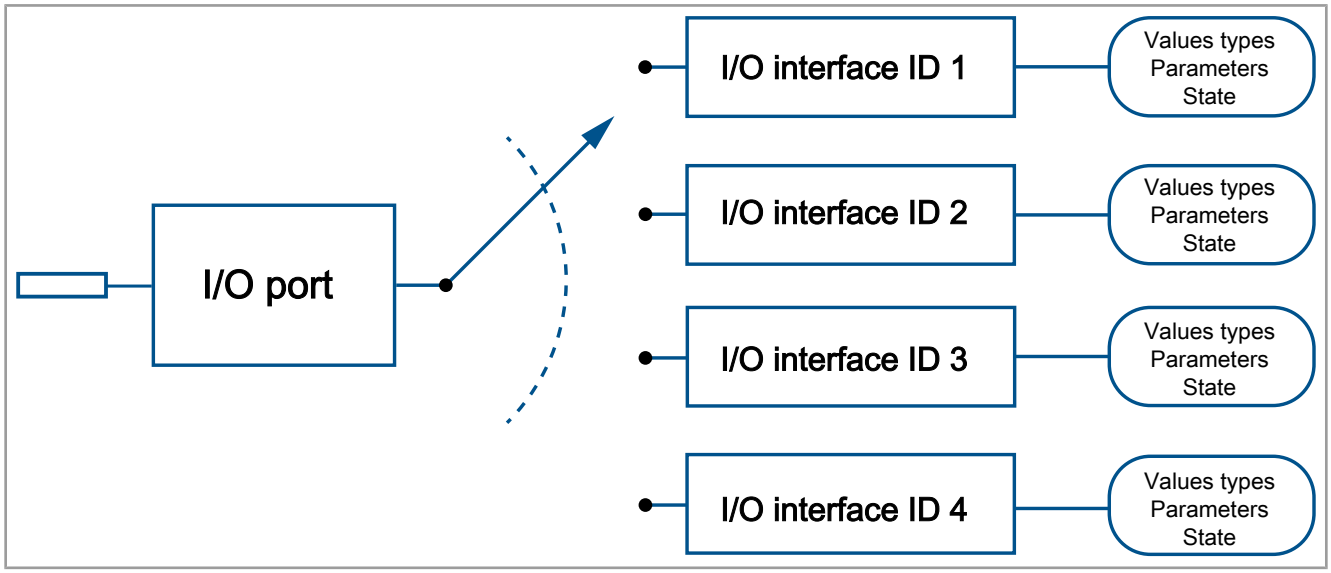


Fig. 11: Concept and control

8.1.1 Configuration options of connections

The table below shows an overview of the ports and the respective interfaces:

Ports	Description	Supported interfaces
AI_1 … AI_8	Analog inputs	AI_VOLTAGE AI_CURRENT DI_PNP
DI_P_1 … DI_P_4	Digital inputs	DI_PNP (DI_NPN only for DI_P_1) FI_PNP (FI_NPN only for DI_P_1) ENCI_PNP (each for DI_P_1 and DI_P_2 as well as for DI_P_3 and DI_P_4)
PWMi_H3_1 … PWMi_H3_4	PWM outputs	PWMO_HS3, CPWMO_HS3, DO_HS3 DI_NPN, DI_PNP

Ports	Description	Supported interfaces
PWM_H7_1 … PWM_H7_6	PWM outputs	PWMO_HS7, PWMO_HS3, DO_HS3, DO_HS7 DI_NPN, DI_PNP
DO_H3_1 … DO_H3_4	Digital outputs	DO_HS3 DI_NPN, DI_PNP

Tab. 29: Supported ports and interfaces - Overview

When configuring the outputs, observe the information in chapter Outputs [▶ 17].

8.1.2 I/O ports and SDO map

Each I/O port is mapped with an SDO index.:

I/O ports	SDO index
AI_1 … AI_8	0x2100 … 0x2107
DI_P_1 … DI_P_4	0x2108 … 0x210B
PWMi_H3_1 … PWMi_H3_4	0x210C … 0x210F
PWM_H7_1 … PWM_H7_6	0x2110 ... 0x2115
DO_H3_1 … DO_H3_4	0x2116 … 0x2119

Tab. 30: SDO mappings of the I/O ports

Use subindex 1 to assign a specific interface (Overview – I/O interfaces [▶ 40]) to a port. Use the other subindices to access the parameters, values and statuses.

ⓘ Info

Assigning interfaces

You can only assign an interface in the **Pre-Operational** state during the start process. There is no parameter check in **Pre-Operational** state.

Index	Subindex	Description	Type	Access	Default value
0x2100 … 0x2119	0	Number of supported entries	U8	R	
	1	Interface ID	U32	R/W	0 (disabled)
	2	I/O state	U32	R	(Disabled) Bit is set
	10 … 29	Input values		R	
	30 … 49	Output values		R/W	0
		When switching to **Operational** state, the setpoints are set to 0. A previously set value is lost when switching from **Operational** to **Pre-Operational** state. Only possible in the **Operational** state, otherwise an error occurs (SDO abort).			
	50 … 199	Parameter		R/W	

Tab. 31: Subindices for accessing parameters, values and statuses

8.1.3 Overview – I/O interfaces

The following table lists the I/O interfaces along with respective Parameters, values and statuses [▶ 44].

ⓘ Info

Restrictions

The following restrictions must be observed in the **Operational** and **Pre-Operational** states:

- You can only assign an interface during the start process while the system is **Pre-Operational** state.
- You can only configure output values while the system is in **Operational** state.
  You can configure parameters in both states.
- If you leave the **Pre-Operational** state, all values are set to 0.
- All outputs are inactive in the **Pre-Operational** state.
  The inputs remain active in the **Pre-Operational** state.

ID dec/hex	Interface	Parameter	Values	Status
0	**INACTIVE IO**			Disabled
1	**AI_VOLTAGE** Analog voltage input	SENSOR_SUPPLY FILTER_DEEP MIN_DEVIATION	I_VOLTAGE I_RATIO	INACTIVE ERROR OVERVOLTAGE SUPPLY_FAULT
2	**AI_CURRENT** Analog current input (0 … 24 mA)	SENSOR_SUPPLY FILTER_DEEP MIN_DEVIATION	I_CURRENT	INACTIVE ERROR OVERCURRENT SUPPLY_FAULT
3	**DI_PNP** Digital input (active-high with pull-down)	SENSOR_SUPPLY	I_DIGITAL I_COUNTER	INACTIVE ERROR SUPPLY_FAULT

ID dec/hex	Interface	Parameter	Values	Status
4	**FI_PNP** Frequency input (active-high with pull-down)	SENSOR_SUPPLY TIMEOUT_TIME GATE_TIME	I_FREQUENCY I_DUTY_CYCLE I_DIGITAL I_COUNTER I_PERIODIC_TIME I_H_PULSE_TIME I_L_PULSE_TIME	INACTIVE ERROR SUPPLY_FAULT TIMEOUT
5	**DI_NPN** Digital input (active-low with pull-up)	SENSOR_SUPPLY	I_DIGITAL I_COUNTER	INACTIVE ERROR SUPPLY_FAULT
6	**PWMO_HS3** High-side PWM output (up to 3 A , with precise current measurement)	PWM_FRQ DITHER_FRQ DITHER_AMP MAX_CURRENT OVERCURRENT_TIME FILTER_DEEP MIN_DEVIATION MIN_CURRENT OPENCIRCUIT_DETECTION	I_HCURRENT O_DUTY_CYCLE	INACTIVE ERROR OVERCURRENT OPEN_CIRCUIT
7	**DO_HS3** High-side digital output (up to 3 A)	MAX_CURRENT OVERCURRENT_TIME FILTER_DEEP MIN_DEVIATION MIN_CURRENT OPENCIRCUIT_DETECTION	I_HCURRENT O_DIGITAL	INACTIVE ERROR OVERCURRENT OPEN_CIRCUIT

ID dec/hex	Interface	Parameter	Values	Status
8	**Reserved**			
9	**Reserved**			
10/a	**CPWMO_HS3** High-side output (up to 3 A , with current control)	PWM_FRQ DITHER_FRQ DITHER_AMP CURRENT_CONTROL_P CURRENT_CONTROL_I CURRENT_CONTROL_D MAX_CURRENT OVERCURRENT_TIME CURRENT_CONTROL_TIME FILTER_DEEP MIN_DEVIATION MIN_CURRENT OPENCIRCUIT_DETECTION	I_HCURRENT O_HCURRENT	INACTIVE ERROR OVERCURRENT OPEN_CIRCUIT CC_UNLOCK
11/b	**PWMO_HS7** High-side PWM output (up to 7 A)	PWM_FRQ DITHER_FRQ DITHER_AMP MAX_CURRENT OVERCURRENT_TIME FILTER_DEEP MIN_DEVIATION MIN_CURRENT OPENCIRCUIT_DETECTION	I_HCURRENT O_DUTY_CYCLE	INACTIVE ERROR OVERCURRENT OPEN_CIRCUIT

ID dec/hex	Interface	Parameter	Values	Status
12/c	**DO_HS7** High-side digital output (up to 7 A)	MAX_CURRENT OVERCURRENT_TIME FILTER_DEEP MIN_DEVIATION MIN_CURRENT OPENCIRCUIT_DETECTION	I_HCURRENT O_DIGITAL	INACTIVE ERROR OVERCURRENT OPEN_CIRCUIT
13/d	**FI_NPN** Frequency input (active-low with pull-up)	SENSOR_SUPPLY TIMEOUT_TIME GATE_TIME	I_FREQUENCY I_DUTY_CYCLE I_DIGITAL I_COUNTER I_PERIODIC_TIME I_H_PULSE_TIME I_L_PULSE_TIME	INACTIVE ERROR SUPPLY_FAULT TIMEOUT
26/1 a	**ENCI_PNP** Incremental encoder input	SENSOR_SUPPLY TIMEOUT_TIME RESOLUTION	I_COUNTER I_DIRECTION	INACTIVE ERROR SUPPLY_FAULT

Tab. 32: Summary of I/O interfaces

8.1.4 Parameters, values and statuses

Input values

Subindex		Description	Type	Access	Unit/ value range
10	I_VOLTAGE	Voltage value	U16	R	1 mV
11	I_RATIO	Ratio to VBAT_ECU	U16	R	1 ‰
12	I_CURRENT	Current value (small measuring range)	U16	R	1 µA
13	I_HCURRENT	Current value (large measuring range)	U16	R	1 mA
14	I_FREQUENCY	Frequency value	U32	R	0.1 Hz
15	I_DUTY_CYCLE	PWM duty cycle	U16	R	1 ‰
16	I_DIGITAL	Digital value	BOOL	R	0 … 1
17	I_COUNTER	Count value (free-running counter)	U32	R	0 … 4294967295
18	I_PERIODIC_TIME	Periodic time; reads the period duration	U32	R	1 µs
19	I_HPULS_TIME	High-pulse time, reads the high-pulse duration	U32	R	1 µs
20	I_LPULS_TIME	Low-pulse time, reads the low-pulse duration	U32	R	1 µs
22	I_DIRECTION	Actual direction of rotation	U8	R	0 … 2 0 = No movement 1 = Forward 2 = Backward

Tab. 33: Input values

Output values

Subindex		Description	Type	Unit/ value range
30	O_DIGITAL	Digital value	BOOL	0 … 1
31	O_DUTY_CYCLE	PWM duty cycle	U16	1 ‰
32	O_HCURRENT	Current value setting (large measuring range)	U16	1 mA

Tab. 34: Output values

Parameter

Subindex type		Description	Type	Access	Unit/ value range
50	SENSOR_SUPPLY	Associated sensor supply, which is also monitored.	U16	R/W	0 = OFF 1 = VEXT_SEN_1 2 = VEXT_SEN_2 3 = VEXT_SEN_3 Default: 0
51	PWM_FRQ	PWM frequency	U32	R/W	0.1 Hz Default: 1 kHz
52	DITHER_FRQ	Dithering frequency	U32	R/W	0.1 Hz Default: 1,000
53	DITHER_AMP	Dither amplitude	U16	R/W	0.1 % Default: 0
54	CURRENT_CONTROL_P	Current control: P term x1000000	U32	R/W	0 … 4294967295 Default: 100,000
55	CURRENT_CONTROL_I	Current control: I term x1000000	U32	R/W	0 … 4294967295 Default: 10,000
56	CURRENT_CONTROL_D	Current control: D term x1000000	U32	R/W	0 … 4294967295 Default: 400

Subindex type		Description	Type	Access	Unit/ value range
57	MAX_CURRENT	Maximum current that cannot exceed the specified value in the interface type.	U16	R/W	1 mA Default: – 3 A for PWMi_H3 – 7 A for PWM_H7
58	OVERCURRENT_TIME	In the event of overcurrent, the unit is switched off after the corresponding time.	U32	R/W	1 ms Default: 500 ms
59	TIMEOUT_TIME	Sets the TIMEOUT bit in the status during frequency measurement, if no signal change is present. Defines the point where I_DIRECTION signals no movement.	U32	R/W	0 … 4294967295 Default: 1,000 ms
60	CURRENT_ CONTROL_TIME	Cycle time of current control	U32	R/W	1 ms Default: 5 ms
61	FILTER_DEEP	Moving average calculation depth	U32	R/W	1 … 32 Default: 1
62	GATE_TIME	Measuring time of the frequency measurement	U32	R/W	1 ms Default: 1,000
63	MIN_DEVIATION	Minimum deviation for input values (as of OS 2.04.0.00)	U16	R/W	µA or mV Default for AI: 10
64	MIN_CURRENT	If less current flows at the output than the set threshold, this is detected as a cable break and the OPEN_LOAD status is set (as of OS 2.05.0.00).	U16	R/W	1 mA Default value is the lowest possible value: – PWMi_H3 outputs: 200 mA min – Other outputs: 500 mA min

Subindex type		Description	Type	Access	Unit/ value range
65	OPENCIRCUIT_DETECTION	Enables/disables cable break detection of a port. Once during bootup, **mode 1** checks for any load pulling the output towards GND (without reset). In powered-up state, **mode 2** additionally checks if the current level falls short of MIN_CURRENT (with reset). In powered-up state only, **mode 3** checks if the current level exceeds MIN_CURRENT (with reset). **NOTICE! Do NOT use modes 2 and 3 with PWM outputs and current-controlled outputs as this may cause the system to detect a cable break where there is none.**	U16	R/W	0 =No cable break detection 1 = Cable break detection only in **Pre-Operational** state 2 = Cable break detection in the **Pre-Operational** and **Operational** states 3 = Cable break detection only in **Operational** state Default: 0
68	RESOLUTION	Resolution, e.g. At the encoder input	U8	R/W	0 … 2 0 = 1/4 resolution 1 = 1/2 resolution 2 = Full resolution Default: 0

Tab. 35: Parameter

Status

Bit	Status	Description
0x00000001	INACTIVE	This port is disabled.
0x00000002	ERROR	An undefined error has occurred.
0x00000008	OVERVOLTAGE	Overvoltage is present at the input.
0x00000010	OVERCURRENT	Overcurrent is present at the input/output.
0x00000020	SUPPLY_FAULT	The supply voltage VEXT_SEN is not correct.
0x00000080	OPEN_CIRCUIT	There is no load at the output, e.g. in case of cable breakage. This status entry is only checked while the device is booting!
0x00000100	TIMEOUT	The time for frequency measurement has been exceeded.
0x00000200	CC_UNLOCK	The current control is not within the control range.

Tab. 36: Status

8.2 Setting the node ID

The base node ID can be set in the System parameters [▶ 52]. The default value is 0x30.

The configuration inputs (CFG1 and CFG2) generate an offset to the set base node ID.
CFG1 and CFG2 may have one of the following 3 states:

– Jumpered to GND → Low (L)
– Jumpered to VBAT → High (H)
– Open → O

The offset corresponds to the values in the following table:

CFG1	CFG2	Offset of module ID
O	O	0
L	O	1
H	O	2
O	L	3
L	L	4
H	L	5
O	H	6
L	H	7
H	H	8

Tab. 37: Offset for set base node ID

8.3 Diagnostic information

Diagnostic information

Index	Subindex	Description	Type	Types of access	Unit
0x2000	0	Number of supported entries	U8	R	
	2	VBAT_PWR	U16	R	mV
	3	7V IO	U16	R	mV
	4	3V3	U16	R	mV
	6	PCB temperature	I16	R	0.1 °C
	7	CPU temperature	I16	R	0.1 °C
	9	CPU VRef	U16	R	mV
	10	SPWR1	U16	R	mV
	11	SPWR2	U16	R	mV
	12	SPWR3	U16	R	mV
	13	VBAT_ECU	U16	R	mV
	14	CFG1	U16	R	mV
	15	CFG2	U16	R	mV
	20	Total current ±50 %	U32	R	mA

Tab. 38: Diagnostic information

Status information

Index	Subindex	Description	Type	Types of access
0x1001	0	Error register	U8	R
	Bit 0	General error		R
	Bit 1	Total overcurrent		R
	Bit 3	Temperature		R
	Bit 4	Communication error		R
	Bit 7	CI error (invalid input)		R

Tab. 39: Status information

8.4 Saving settings permanently and resetting to default values

The following parameters are permanently stored in the EEPROM:

– PDO Mapping
– All I/O interface assignments and parameters
– Producer heartbeat time

Saving the settings

Index	Subindex	Description	Type	Access	Default value
0x1010	0	Number of supported entries	U8	R	1
	1	Saving all parameters	U32	R/W	
		When the specific signature 0x65766173 ("save") is written, the parameters are saved. **NOTICE! When using CodeSys, write the signature in reverse order: 0x73617665 („evas“).**			

Tab. 40: Saving settings to EEPROM

Resetting the settings to their default values

Index	Subindex	Description	Type	Access	Default value
0x1011	0	Number of supported entries	U8	R	1
	1	Command register	U32	R/W	1
		Writing the specific signature 0x64616F6C (“load”) resets all settings to default. **NOTICE! When using CodeSys, write the signature in reverse order: 0x6C6F6164 („daol“).**			

Tab. 41: Resetting the settings to their default values

ⓘ Info

Loading the settings from the EEPROM

During bootup, the last saved settings are automatically loaded.
During a firmware update, the settings may be reset to the default values.

Setting parameters

The parameters are set as follows:

1. The vehicle controller configures the parameters of the JXM-IO-E30.
2. The vehicle controller stores the settings in the EEPROM via index 0x1010.
3. The vehicle controller reads the CRC via index 0x4556 subindex 1 and saves this value locally in a remanent memory.
4. Following JXM-IO-E30 reboot, the vehicle controller checks the CRC value in the local memory against the value in index 0x4556 subindex 1. If the values do not match, parameterization must be restarted.

ⓘ Info

Activating the Changes

The changes to the indexes 0x1010 and 0x1011 only become active after a restart.

8.5 System parameters

Index	Subindex	Description	Type	Access	Default value
0x4556	0	Number of supported entries	U8	R	4
	1	CRC of the currently applying parameter settings* The CRC checks whether the settings need to be transferred to the device again.	U32	R	
	3	CAN baud rate	U8	R/W	1
		0: 125 kBd			
		1: 250 kBd (default)			
		2: 500 kBd			
		3: 1 MBd			
	4	CANopen node ID to be used in the future (without config pins)	U8	R/W	0x30
	5	CANopen node ID being used currently (without config pins)	U8	R	0x30
	6	Offset to base node ID (config pins)	U8	R	0

Tab. 42: System parameters

*The CRC is calculated using the current parameter values described in chapter Saving settings permanently and resetting to default values [▶ 51].

Info

Activating the set system parameters

You can only use the set system parameters after restarting the system.

8.6 Mapping of Process Data Objects (PDOs)

The following parameters let you set the transmit PDOs (TPDO 1 ... 4) and receive PDOs (RPDO 1 ... 4).

ⓘ Info

Further information

For in-depth information, see the *CANopen STX API* application-oriented manual.

For application-oriented manuals open www.bucherautomation.com and go to *product page JXM-IO-E30 > Product-independent documentation*.

Validity of a PDO

The MSB (most significant bit) of the COB ID lets you determine the validity of a PDO. To map a PDO, first set the PDO to invalid (bit 31 = 1) and then to valid (bit 31 = 0).

Bit	Value	Description
31 (MSB)	0	PDO exists/is valid
	1	PDO does not exist/is invalid
30	0	RTR (Remote Transmission Request) permitted for this PDO
	1	No RTR allowed for this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 … 11	0	If bit 29 = 0
	X	If bit 29 = 1: Bits 28 ... 11 of the 29-bit COB ID
10 … 0 (LSB)	X	Bits 10 ... 0 of the COB ID

Tab. 43: Validity of a PDO

8.6.1 RPDO communication parameters

Index	Sub-index	Description	Type	Types of access	Unit	Default value	
0x1400 … 0x1403	0	Number of supported entries	U8	R		0	
	1	COB ID (user-configurable value for PDOs)	U32	R/W		RPDO 1: Index 0x1400	0x200 + Node-ID
						RPDO 2: Index 0x1401	0x300 + Node-ID
						RPDO 3: Index 0x1402	0x400 + Node-ID
						RPDO 4: Index 0x1403	0x500 + Node-ID
	2	Transmission Type	U8	R		Acyclic type = 0	
	3	Inhibit Time	U16	R/W	0.1 ms	100 (10 ms)	
	5	Event Time	U16	R/W	1 ms	500 (500 ms)	

Tab. 44: RPDO communication parameters

Info

Writing communication parameters

To write communication parameters, the JXM-IO-E30 device must be in **Pre-Operational** state.

8.6.2 TPDO communication parameters

Index	Sub-index	Description	Type	Types of access	Unit	Default value	
0x1800 … 0x1803	0	Number of supported entries	U8	R		0	
	1	COB ID (user-configurable value for PDOs)	U32	R/W		TPDO 1: Index 0x1800	0x180 + Node-ID
						TPDO 2: Index 0x1801	0x280 + Node-ID
						TPDO 3: Index 0x1802	0x380 + Node-ID
						TPDO 4: Index 0x1803	0x480 + Node-ID
	2	Transmission Type	U8	R		Acyclic type = 0	
	3	Inhibit Time	U16	R/W	0.1 ms	100 (10 ms)	
	5	Event Time	U16	R/W	1 ms	500 (500 ms)	

Tab. 45: TPDO communication parameters

Info

Writing communication parameters

To write communication parameters, the JXM-IO-E30 device must be in **Pre-Operational** state.

For a configuration example, refer to chapter Sending interface input values via TPDO [▶ 56].

8.6.3 Mapping tables

RPDO mapping table

Index	Sub-index	Description	Type	Access	Default value
0x1600 … 0x1603	0	Number of supported entries	U8	R/W	0
	1	1st object being mapped	U32	R/W	
	2	2nd object being mapped	U32	R/W	
	…	…	U32	R/W	
	64	64th object being mapped	U32	R/W	

Tab. 46: RPDO mapping table

TPDO mapping table

Index	Subindex	Description	Type	Access	Default value
0x1A00 … 0x1A03	0	Number of supported entries	U8	R/W	0
	1	1st object being mapped	U32	R/W	
	2	2nd object being mapped	U32	R/W	
	…	…	U32	R/W	
	64	64th object being mapped	U32	R/W	

Tab. 47: TPDO mapping table

Mapping entry U32

Byte	0	1	2 and 3
Content	Bit length	Subindex	Index

Tab. 48: Mapping entry U32

8.6.4 Mapping of digital values

As an alternative to bit-wise mapping of digital values to PDOs, you can also use object 0x6000 for mapping digital values.

Index	Subindex	Description	Type	Types of access	Default value
0x6000	0	Number of supported entries	U8	R	4
	1	Read access to inputs DIP and PWMi_H3	U8	R	
		Bits 0 ... 3 represent index 0x2108 ... 0x210b, subindex 16.			
		Bits 4 ... 7 represent index 0x210c ... 0x210f, subindex 16.			
	2	Read access to inputs DIP and DO_H3	U8	R	
		Bits 0 ... 3 represent index 0x2108 ... 0x210b, subindex 16.			
		Bits 4 ... 7 represent index 0x2116 ... 0x2119, subindex 16.			
	3	Read access to inputs PWMi_H3 and DO_H3	U8	R	
		Bits 0 ... 3 represent index 0x210c ... 0x210f, subindex 16.			
		Bits 4 ... 7 represent index 0x2116 ... 0x2119, subindex 16.			
	4	Read access to inputs PWM_H7	U8	R	
		Bits 0 ... 5 represent index 0x2110 ... 0x2115, subindex 16.			

Tab. 49: Mapping of digital values

Displaying digital values

The SDO shows the value I_DIGITAL for selected values. If you have not previously configured the corresponding port for digital values, then no error message is issued and the value in this bit is not defined.

Enabling byte-wise mapping

To switch from the default bitwise mapping to the bytewise mapping after system startup, 2 SDO commands must be sent to the node:

Index	Subindex	Description	Data length	Value
0x2001	2	Enabling byte-wise mapping	4 bytes	0xb4c0ffee
	3		4 bytes	1

Tab. 50: SDO commands, activation of byte-wise mapping

8.6.5 Sending interface input values via TPDO

To send interface input values via TPDO, proceed as follows:

1. Switch the JXM-IO-E30 to **Pre-Operational** state.
2. Assign the desired interface.
3. Invalidate the TxPDO object.
4. Disable the mapping.
5. Enter the mapping value.
6. Enable the mapping.
7. Validate the TxPDO object.
8. Switch the JXM-IO-E30 to **Operational** state.

STX example

The following STX example shows you in part how you can output the value AI1 Voltage on TPDO1.

```
//Switch JXM-IO-E30 to Pre-Operational state
CanOpenSetCommand(
cCanChannel,CAN_CMD_NMT,CAN_CMD_NMT_Value(
cJXMNodeId,CAN_NMT_PREOPERATIONAL));

//AI_1 port type to AI_VOLTAGE (=1)
iTemp := 1;
CanOpenDownloadSDO(
cCanChannel, cJXMNodeId, 0x2100, 1, CANOPEN_DWORD, 4, iTemp, iBusy);
when SDOACCESS_FINISHED(iBusy) continue;

//Invalidating TxPDO object, setting uppermost bit to 1
dTemp := 0x80000000+0x180+0x30;
CanOpenDownloadSDO(
cCanChannel, cJXMNodeId, 0x1800, 1, CANOPEN_DWORD, 4, dTemp, iBusy);
when SDOACCESS_FINISHED(iBusy) continue;

//Disabling mapping
dTemp := 0;
CanOpenDownloadSDO(
cCanChannel, cJXMNodeId, 0x1a00, 0, CANOPEN_BYTE, 1, dTemp, iBusy);
when SDOACCESS_FINISHED(iBusy) continue;
```

```
//Entering value for AI1 voltage
dTemp := 0x21000a10; // Index: 0x2100, subindex 0x0a = 10, length 0x10 = 16
bits
CanOpenDownloadSDO(
cCanChannel, cJXMNodeId, 0x1a00, 1, CANOPEN_DWORD, 4, dTemp, iBusy);
when SDOACCESS_FINISHED(iBusy) continue;

//Enabling mapping
dTemp := 1; // Number of mapping entries
CanOpenDownloadSDO(
cCanChannel, cJXMNodeId, 0x1a00, 0, CANOPEN_BYTE, 1, dTemp, iBusy);
when SDOACCESS_FINISHED(iBusy) continue;

//Validating object, setting uppermost bit to 0, specifying PDO COB
dTemp := 0x180+0x30;
CanOpenDownloadSDO(
cCanChannel, cJXMNodeId, 0x1800, 1, CANOPEN_DWORD, 4, dTemp, iBusy);
when SDOACCESS_FINISHED(iBusy) continue;

//Switch JXM-IO-E30 to Operational state
CanOpenSetCommand(
cCanChannel,CAN_CMD_NMT,CAN_CMD_NMT_Value(
cJXMNodeId,CAN_NMT_OPERATIONAL));
```

8.7 Frequency measurement at the digital inputs

For the frequency measurement at the digital inputs 2 measuring methods are available:

– Gating measurement

– Pulse length measurement

Gating measurement

The gate time (GATE_TIME) is the time period during which pulses are counted. Measurements of high-frequency signals can thus be easily recorded. The values I_FREQUENCY and I_PERIODIC_TIME are determined using this method.

In order to achieve the resolution of 0.1 Hz for low frequency signals, the gate time must be adjusted accordingly. The maximum gate time is 10 seconds.

ⓘ Info **Gate time and update rate**

A gate time of 10 s means that the update rate is also 10 s.

Pulse length measurement

This method is suitable for the resolution of low frequencies. It is based on the time between the edge changes. To do this, it is necessary to calculate the values I_HPULSE_TIME and I_LPULSE_TIME externally:

f [mHz] = 10^9 / (I_HPULSE_TIME + I_LPULSE_TIME)

ⓘ Info **Decrease of resolution**

In pulse length measurement, the resolution decreases with increasing frequency.

8.8 Acquisition of encoder signals

The ENCI_PNP interface lets you acquire encoder signals. The encoder inputs do not feature debouncing.

Info

Automatic Configuration of the Inputs as ENCI_PNP

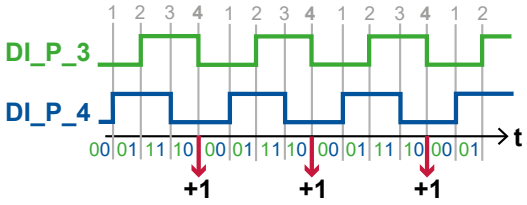
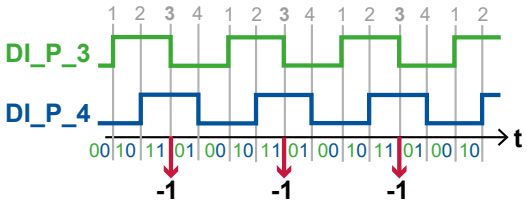
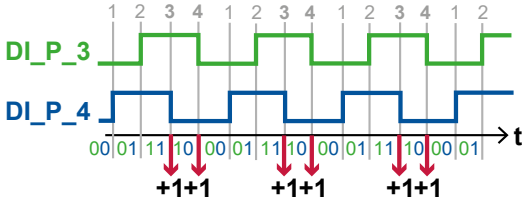
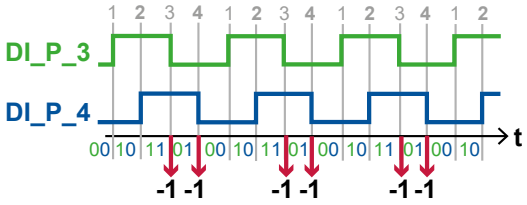
For the acquisition of encoder signals always 2 inputs are required.

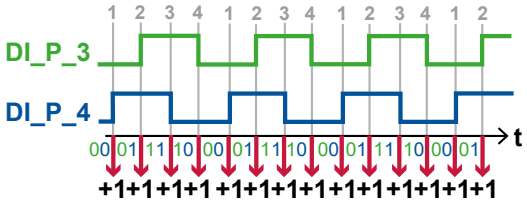
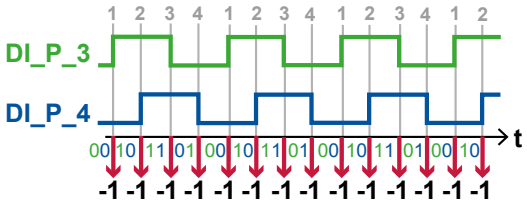
If, for example, you configure input DI_P_3 as ENCI_PNP, the adjacent input DI_P_4 is automatically configured as ENCI_PNP.

If you reconfigure one of the two inputs, the adjacent input automatically becomes INACTIVE - no encoder signals are acquired any more.

Resolution

You can set the resolution using the RESOLUTION parameter.

RESOLUTION	Direction	Resolution
0 (Default)	Forward	
	Reverse	
1	Forward	
	Reverse	

RESOLUTION	Direction	Resolution
2	Forward	
	Reverse	

Tab. 51: Resolution of the encoder signals

Input values for ENCI_PNP

You can query the following Input values:

Input value	Description	PDO send condition
I_COUNTER	32-bit counter running forward and backward	Event Time
I_DIRECTION	Current direction	In case of change

Tab. 52: Input values for ENCI_PNP

Signaling standstill

The TIMEOUT_TIME parameter allows you to specify the time required to elapse before a standstill is signaled. The default value is 1,000 ms, i.e. if no more pulses are received for 1,000 ms, then I_DIRECTION = 0.

8.9 NMT commands

The JXM-IO-E30 supports the following NMT commands:

NMT commands	Description
RESET	Resets the JXM-IO-E30
PREOPERATIONAL	Switches to **Pre-Operational** state
OPERATIONAL	Switches to **Operational** state
START	Starts the JXM-IO-E30
STOP	Stops the JXM-IO-E30, the JXM-IO-E30 continues to send heartbeat signals and process NMT commands.

Tab. 53: Supported NMT commands

8.10 Troubleshooting

Emergency object telegrams (EMCY telegrams)

EMCY telegrams are sent at startup or after any changes at an inhibit time of 50 ms.

Byte	Contents	
0 … 1 =	Emergency Error Code	
2 =	Error register	Object 0x1001
3 =	I/O offset 0x21nn, where nn is the offset	
4 … 7 =	Manufacturer-specific „error field“ entry	
	Always 0 is sent.	

Tab. 54: Byte values of Emergency objects

Error memory (error history)

The EMCY errors are stored in a stacked memory. Subindex 1 provides access to the latest error.

Byte	Contents	
0 … 1 =	Emergency Error Code	
2 =	Error register	Object 0x1001
3 =	I/O offset 0x21nn, where nn is the offset	

Tab. 55: Byte values of the error memory

The error memory can be accessed via index 0x1003.

Index	Subindex	Description	Type	Types of access	Default value
0x1003	0	Number of errors	U8	R/W	0
		Entering 0 clears the entire memory. Values > 0 are not allowed.			
	1	Latest „Error Field“ entry	U32	R	
	2 … 254	Other current "Error Field" entries	U32	R	

Tab. 56: Subindexes of the error memory

Emergency Error Codes

Code	Description
0x0000	No error or error reset
0x1000	Generic error
0x2300	Total current is too high
0x3100	Voltage exceeding the required tolerance range
0x4200	Device temperature is too high
0x8110	CAN data overrun (lost objects)
0x8130	Life guard error or heartbeat error
0x8140	Recovered from **Bus-Off** state
0x8210	Processing errors due to incorrect length of PDOs

Code	Description
0x8220	PDO length exceeded
0xff00	Configuration error on the device
0xff01	I/O-Port OVERVOLTAGE
0xff02	I/O-Port OVERCURRENT
0xff03	I/O-Port SUPPLYFAULT
0xff05	I/O-Port OPEN_CIRCUIT
0xff06	I/O-Port TIMEOUT
0xff07	I/O-Port CC_UNLOCK

Tab. 57: Emergency Error Codes

8.10.1 Heartbeat

The device sends a heartbeat message cyclically as soon as it is in the **Pre-Operational** state.

Index	Subindex	Description	Type	Types of access	Default value
0x1017	0	Producer heartbeat time in ms	U16	R/W	1000

Tab. 58: Index of the heartbeat message

Heartbeat monitoring

The number of heartbeats to be monitored can be set via the controller with the corresponding master node ID and corresponding timeout. If the device does not detect a heartbeat within the specified timeout period (e.g. in the event of a communication interruption), the device switches to the **Stopped** state and the outputs are de-energized.

Index	Subindex	Description				Type	Types of access	Default value
0x1016	0	Number of heartbeats to be monitored				U8	R/W	0
	1 … 4	Node ID to be monitored and timeout				U32	R/W	
			MSB		**LSB**			
		Bits	31 … 24	23 … 16	15 … 0			
		Value	Reserved (Value: 00h)	Node ID	Heartbeat time-out			
		Type	-	U8	U16			

Tab. 59: Heartbeat monitoring

Value ranges

– Node ID: 0 … 127

– Heartbeat timeout: 0 … 65535 (in ms)

Example

Command	Description
`r 0x1016 0`	Read number of node IDs that can be monitored.
`w 0x1016 1 4 0x007F03e8` – `1` = first entry – `4` = 4 bytes (U32) – `00` = reserved – `7F` = 127 (node ID) – `3e8` = 1000 (timeout in ms)	Set first node ID to be monitored to 127 with timeout 1000 ms.
`r 0x1016 1`	Read first configuration in first entry.

Tab. 60: Heartbeat Monitoring - Example

8.11 Current control with PID controller

The individual P, I and D controllers usually have the following characteristics:

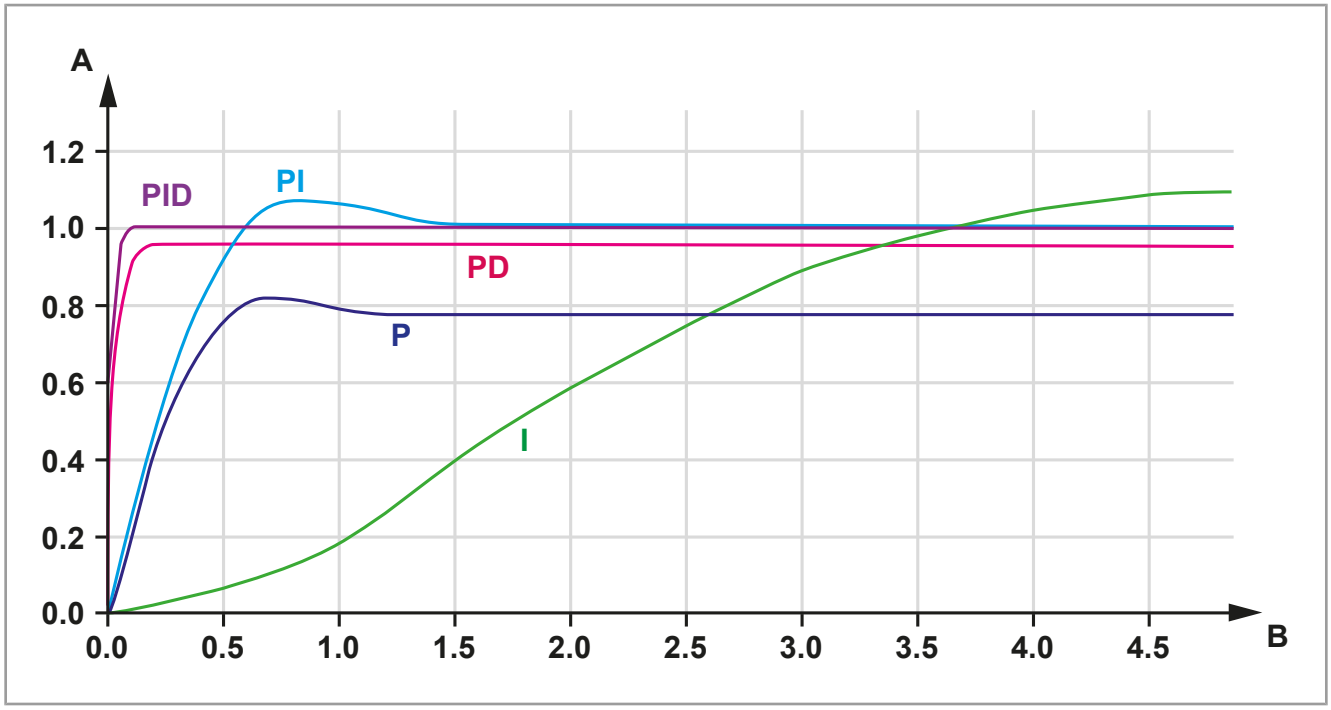


Fig. 12: Comparison of controller types in a control loop

A	Step response
B	Time

8.11.1 Test scenario

The PID controller was tested on the JXM-IO-E30 under the following conditions:

Condition	Description	
Output	1 kHz PWM	
Control period	10 ms	
Load	Inductive	An unspecified valve solenoid
VBAT	24 V	In case of a short circuit 4.8 A ~5 Ω

Tab. 61: General conditions of the test scenario

JetSym was used to set up a test scenario in which the setpoint switches back and forth between 0.3 A and 0.7 A.

Closed-loop control parameters: P = 100,000, I = 0, D = 0, Measurements: blue = setpoint, red = actual value

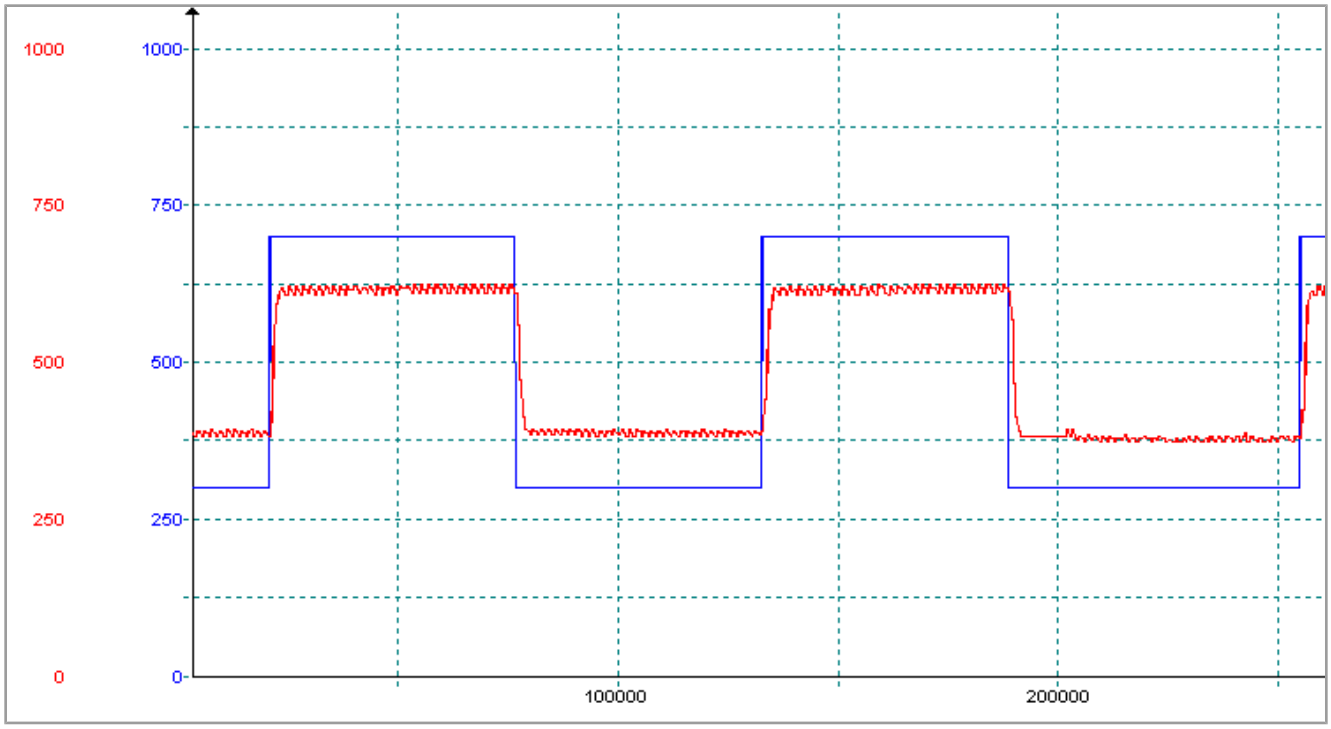


Fig. 13: Test scenario with the control parameters P = 100,000, I = 0, D = 0

The P controller works well with this value. However, the setpoint is not reached, which corresponds to the typical behavior of a P controller (see Current control with PID controller [▶ 62]).

Closed-loop control parameters: P = 100,000, I = 5,000, D = 0, Measurements: blue = setpoint, red = actual value

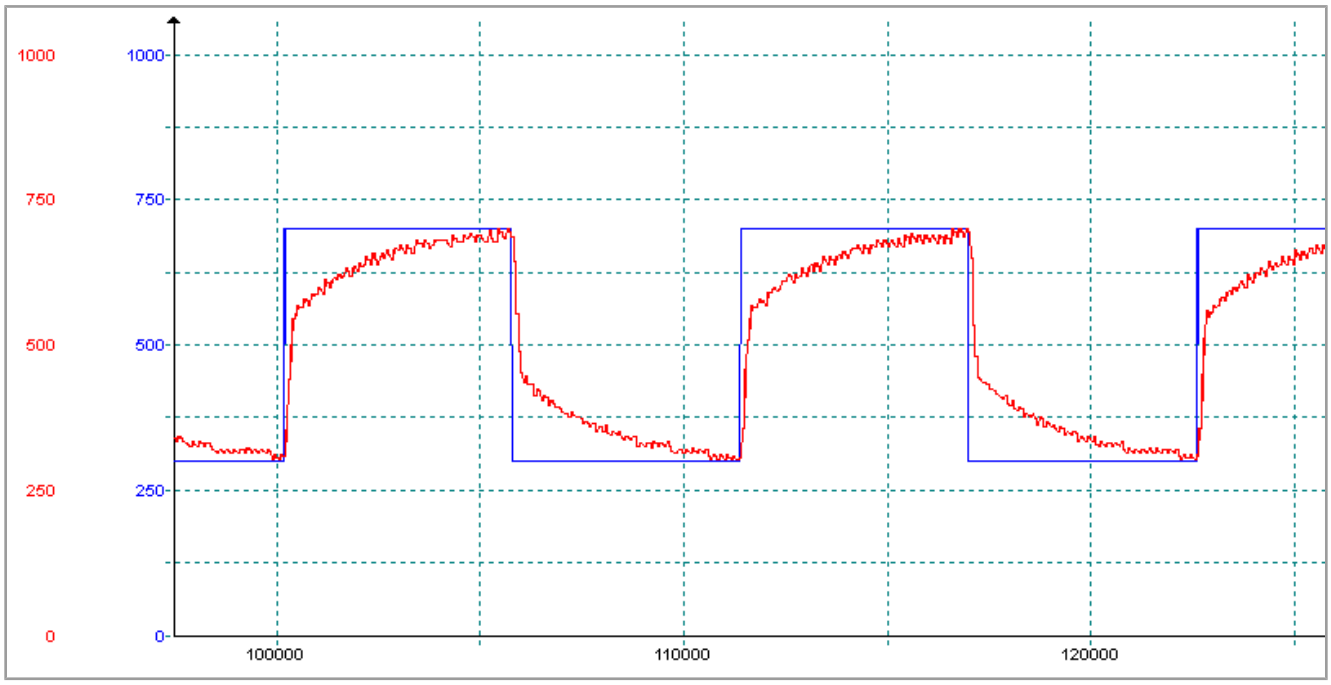


Fig. 14: Test scenario with the control parameters P = 100,000, I = 5,000, D = 0

The I controller also works satisfactorily, the setpoint is reached with this setting.

Closed-loop control parameters: P = 100,000, I = 5,000, D = 400, Measurements: blue = setpoint, red = actual value

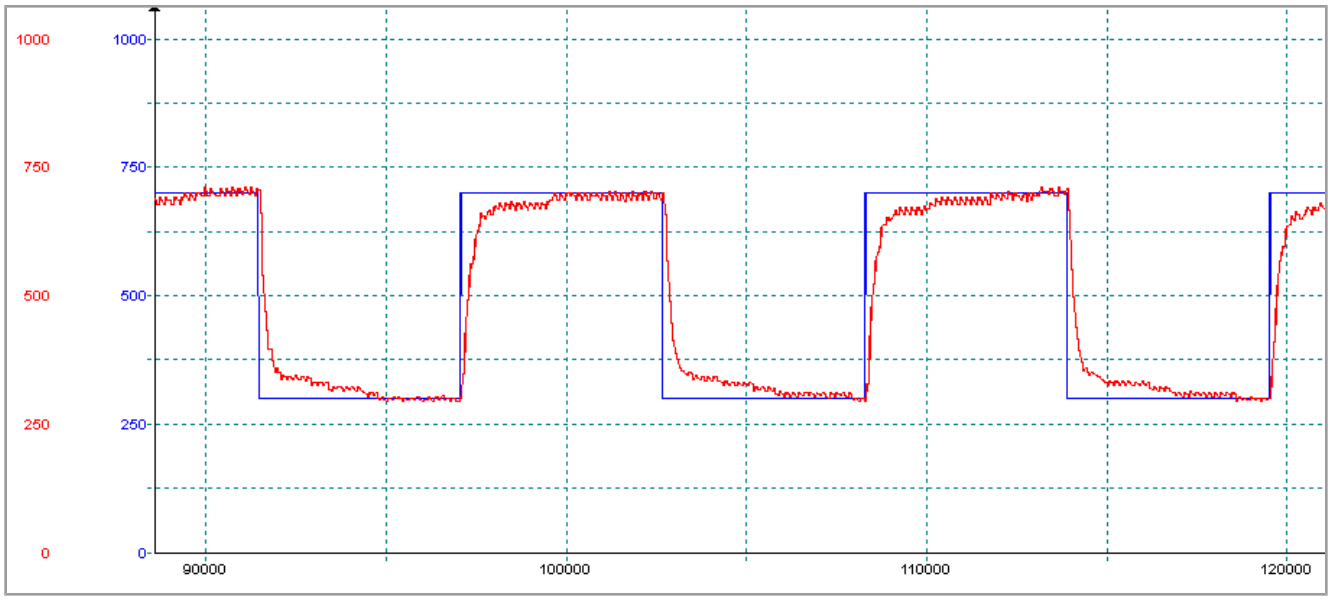


Fig. 15: Test scenario with the control parameters P = 100,000, I = 5,000, D = 400

The D controller causes the actual value to approach the setpoint more quickly.

Closed-loop control parameters: P = 100,000, I = 10,000, D = 400, Measurements: blue = setpoint, red = actual value

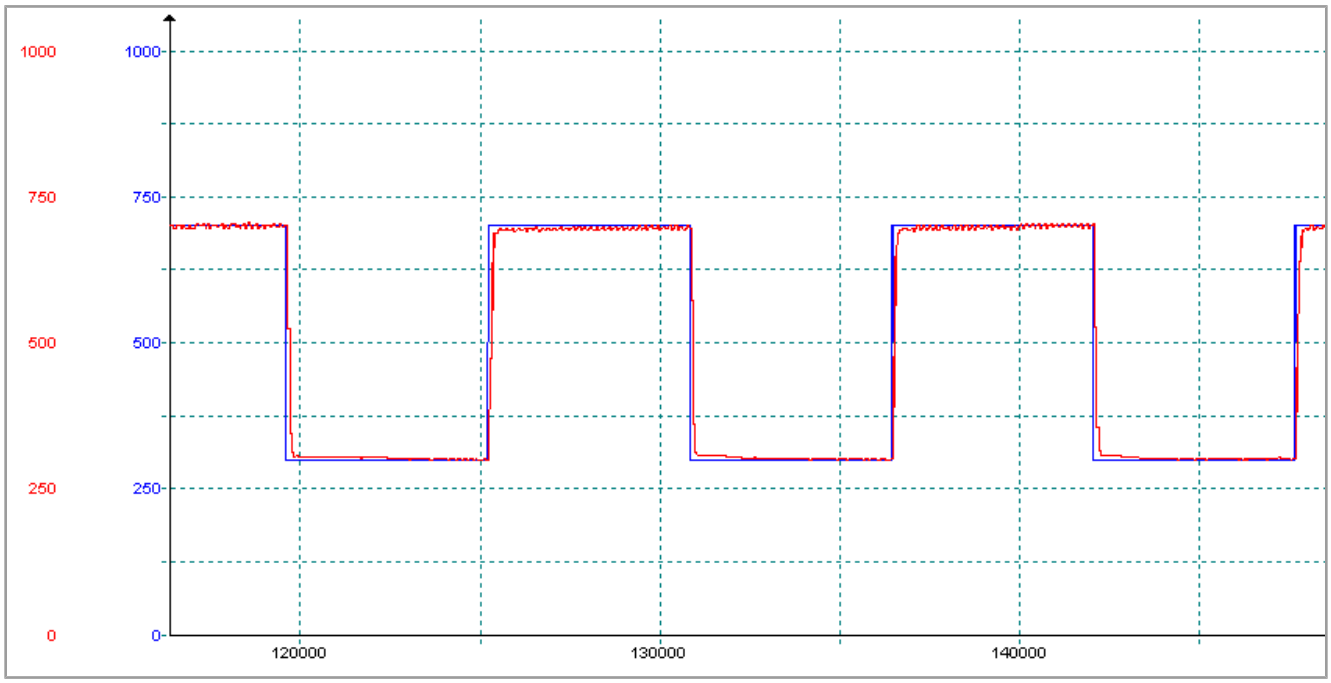


Fig. 16: Test scenario with the control parameters P = 100,000, I = 10,000, D = 400

In this example, the period of the setpoint signal was selected with approx. 10 ms for illustrative purposes. For fast control, the P value should be increased and the sampling time reduced to 5 ms. Settling times < 50 ms can be achieved.

8.11.2 Current measurement at the PWMi_H3_X outputs

The current measurement at the PWMi_H3_X outputs is implemented via shunt resistor. The measuring amplifier has a low-pass filter with R * C = 1 ms. This low-pass filter provides an integral component.

The arithmetic mean is measured. The CPU measures the current only midway through the turn-on time of the PWM signal. Since there is no calculation of the ratio between turn-on time and turn-off time, an integral component is necessary to ensure maximum reading correctness.

Usually valves already have a good average of the load current due to their self-inductance. Purely resistive loads can be operated on the controller if the PWM frequency is set to 1 kHz. The low-pass filter mentioned above is provided for this purpose. For lower frequencies (e.g. 100 Hz) the current measurement at purely resistive loads is too inaccurate.

8.12 Dither technology for controlling hydraulic valves

Typically, PWM signals of 100 Hz ... 200 Hz are used to control proportional hydraulic valves. The low frequency prevents the valve needle from coming to a complete stop and the control works without major hysteresis effects.

If valve control requires higher frequencies (1 kHz), the PWM signal can be modulated. This is known as dithering and prevents the needle from coming to a rest. You can set the frequency and amplitude of this dither signal in the JXM-IO-E30:

– The dither amplitude determines the change of the pulse length of the output signal (max. 20 % of the period length).
– The dither frequency determines how often the change occurs (100 Hz ... 200 Hz).

Examples

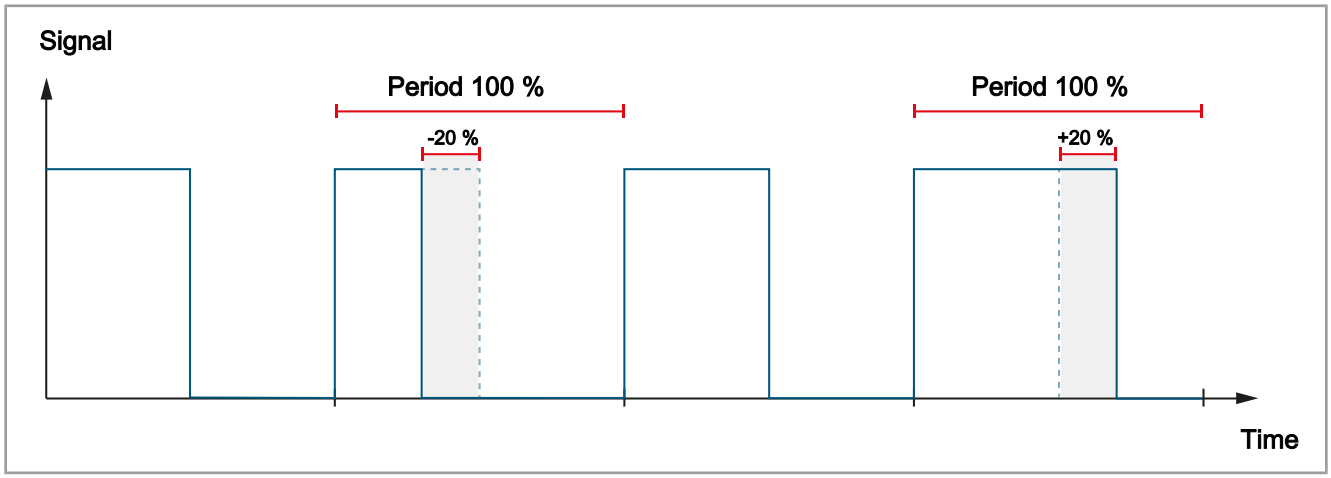


Fig. 17: Dithering example with 50 % O_DUTY_CYCLE and 20 % DITHER_AMP

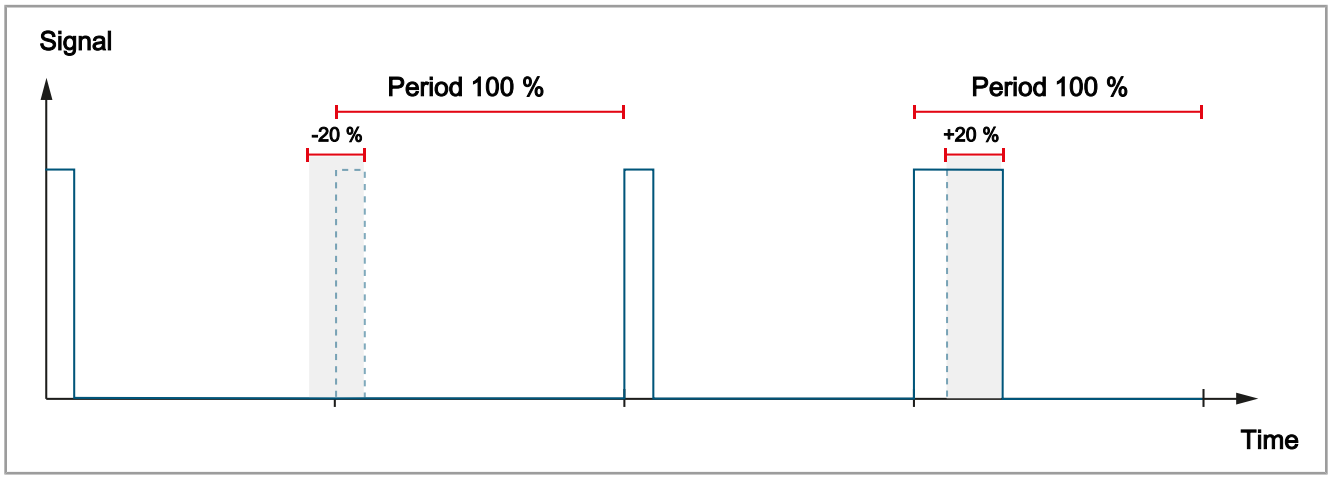


Fig. 18: Dithering example with 10 % O_DUTY_CYCLE and 20 % DITHER_AMP

Automatic adjustment of the dither amplitude

The DITHER_AMP parameter auto adjusts if the O_DUTY_CYCLE and O_HCURRENT output values near the margins of their range.

The margins are:

– For O_DUTY_CYCLE: 0 ‰ ≤ x ≤ 200 ‰ and 801 ‰ ≤ x ≤ 1,000 ‰
– For O_HCURRENT: 0 mA ≤ x ≤ 200 mA and 2,801 mA ≤ x ≤ 3,000 mA

The resulting distance range is 0 ... 20 %.

If DITHER_AMP exceeds the distance to the respective margin value, DITHER_AMP is limited to respective distance.

ⓘ Info

If you want to use the dither technology in conjunction with the PID controller, then test the control behavior thoroughly beforehand. The modulation continuously changes the actual value of the controller. If the control does not work satisfactorily, you can try the following:

– Decrease the amplitude of the dither signal.
– Use the averaging filter on the current feedback of the output.
– Adjust the PID parameters.

9 Maintenance

This device is maintenance free. Therefore, for the operation of the device, no inspection or maintenance is required.

9.1 Repairs

Defective components could cause dangerous malfunctions and could compromise safety.
Only the manufacturer is allowed to repair the device.
It is forbidden to open the device.

Modifications to the device

Modifications and alterations to the device and its functions are not allowed. In the case of modifications to the device, any liability is excluded.

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

Any liability for any damages resulting from the use of non-original parts and equipment is excluded.

9.2 Storage and Shipment

Storage

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

Shipment and packaging

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

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

9.3 Return and Disposal

Disposal options

Return your Bucher Automation AG product to us for proper disposal. Find detailed information along with the required Return Delivery Form on our website.

Meaning of WEEE icon



Fig. 19: WEEE icon – crossed out trash can

The product is waste electronic equipment and must be disposed of by a certified waste management facility. Do not dispose of the product with normal household waste. Applicable local environmental directives and regulations must be complied with.

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 customers to delete any personal data stored on waste electric and electronic equipment prior to disposal.

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
  For the operating system version, see index 0x100A.

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 Accessories

ⓘ Info

Ordering Accessories

The accessories are not part of the scope of delivery.

Suitable accessories can be obtained from Bucher Automation AG.

Accessories	Item number
Cable harness of 3 m length with open end, incl. connector	60882322_01
Connector set including crimp contacts and blanking plugs for individual pins	10001729

Tab. 62: Accessories

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