Jetter automation

User Manual

JXM-IO-E02 - I/O Module on the CAN Bus

60877286

We automate your success.

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Assignment to product

This User Manual is an integral part of JXM-IO-E02:

Type: _____

Serial #: _____

Year of manufacture: _____

Order #: _____

To be entered by the customer:

Inventory #: _____

Place of operation: _____

Significance of this User Manual

This document is an integral part of the JXM-IO-E02:

- Keep this document in a way that it is always at hand until the JXM-IO-E02 will be disposed of.
- Pass this document on if the JXM-IO-E02 is sold or loaned/leased out.

In any case you encounter difficulties to clearly understand the contents of this document, please contact Jetter AG.

We would appreciate any suggestions and contributions on your part and would ask you to contact us at the following e-mail address: info@jetter.de. Your feedback will help us produce manuals that are more user-friendly, as well as address your wishes and requirements.

This document contains important information on the following topics:

- Transport
- Mounting
- Installation
- Programming
- Operation
- Maintenance
- Repair

Therefore, you must carefully read, understand and observe this document, and especially the safety instructions.

In the case of missing or inadequate knowledge of this document Jetter AG shall be exempted from any liability. Therefore, the operating company is recommended to obtain the persons' confirmation that they have read and understood this manual in writing.

Hazard levels

Introduction

This topic describes the safety labels and hazard levels used in this manual.

Safety labels

Signs using this symbol are to warn you of injuries or even death. Follow the instructions given in the corresponding topic to prevent hazards.

Hazard levels

Safety information is classified into the following hazard levels:

Hazard level	Consequences	Probability
DANGER	Death/severe injury (irreversible)	The hazard is imminent.
WARNING	Death/severe injury (irreversible)	Potential occurrence
CAUTION	Slight injury (reversible)	Potential occurrence
CAUTION	Material damage	Potential occurrence

Table of Contents

1 Safety instructions

Introduction

This chapter informs the user of basic safety instructions. It also warns the user of residual dangers, if there are any.

Contents

Basic safety instructions

Introduction

This device complies with the valid safety regulations and standards. Jetter AG attaches great importance to the safety of the users.

Of course, the user should adhere to the following regulations:

- Relevant accident prevention regulations
- Accepted safety rules
- EC guidelines and other country-specific regulations

Intended conditions of use

Intended conditions of use include operation in accordance with this User Manual.

The JXM-IO-E02 has been designed as a peripheral module for use in commercial vehicles and mobile machines and is intended for connection to an already existing controller. The peripheral module JXM-IO-E02 has been designed for various input and output signals.

The JXM-IO-E02 meets the requirement of the European Automotive EMC Directive for electric/electronic subassemblies.

The JXM-IO-E02 may only be operated within the limits set forth in the technical specifications. The operating voltage of the JXM-IO-E02 is classified as SELV (Safety Extra Low Voltage). Therefore, the JXM-IO-E02 is not subject to the EU Low Voltage Directive.

Usage other than intended

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

The JXM-IO-E02 is no safety-related part as per Machinery Directive 2006/42/EC. This device is not qualified for safety-relevant applications and must, therefore, NOT be used to protect persons.

If you intend to operate the device at ambient conditions not being in conformity with the permitted operating conditions, please contact Jetter AG beforehand.

Personnel qualification

Depending on the life cycle of the product, the persons involved must possess specific qualifications. The qualifications required to ensure safe handling of the device at different phases of the product life cycle are listed below:

Product life cycle	Minimum qualification
Transport/storage:	Trained and instructed personnel with knowledge in handling electrostatically sensitive components
Mounting/installation:	Specialized personnel with training in electrical/automotive engineering, such as automotive mechatronics fitters
Commissioning/ programming:	Trained and instructed experts with profound knowledge of, and experience with, automotive/automation technology, such as automotive engineers for mobile machinery
Operation:	Trained, instructed and assigned personnel with knowledge in operating electronic devices for mobile machinery

Product life cycle	Minimum qualification
Decommissioning/ disposal:	Specialized personnel with training in electrical/automotive engineering, such as automotive mechatronics fitters

Modifications and alterations to the module

For safety reasons, no modifications and changes to the device and its functions are permitted.

Any modifications to the device not expressly authorized by Jetter AG will result in a loss of any liability claims to Jetter AG.

The original parts are specifically designed for the device. Parts and equipment from other manufacturers have not been tested by Jetter AG and are, therefore, not released by Jetter AG.

The installation of such parts may impair the safety and the proper functioning of the device.

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

Transport

The device contains electrostatically sensitive components which can be damaged if not handled properly.

To exclude damages to the device during transport it must be shipped in its original packaging or in packaging protecting against electrostatic discharge.

- Use an appropriate outer packaging to protect the device against impact or shock.
- In case of damaged packaging inspect the device for any visible damage. Inform your freight forwarder and Jetter AG.

Storing

When storing the device observe the environmental conditions given in the technical specification.

Repair and maintenance

The operator is not allowed to repair the device. The device does not contain any parts that could be repaired by the operator.

If the device needs repairing, please send it to Jetter AG.

Disposal

When disposing of devices, the local environmental regulations must be complied with.

Residual dangers and protective measures

Residual dangers

Consider the residual dangers mentioned in this chapter when assessing the risks associated with your machine.

DANGER

Hazard in explosive gas atmosphere!

This device can become a source of ignition in potentially explosive atmospheres.

➢ **Do not use this device in potentially explosive atmospheres.**

WARNING

Hot surface hazard!

The JXM-IO-E02 can heat up during operation. During operation the surface temperature of this device will become hot enough (> 60 °C) to cause burns.

➢ **Take protective measures to prevent inadvertent contact with the device, e.g. install protective covers.**

➢ Allow the device to cool down for some time before you start working on it, e.g. to carry out maintenance jobs.

CAUTION

Possible occurrence of malfunctions!

CAN wires which have not been twisted may increase susceptibility to noise. This may disturb communications with the device which, in turn, may cause malfunctions.

➢ Make sure that twisted pair cables are used for connecting the CAN interfaces.

2 Product description and design

Introduction

This chapter covers the design of the device, as well as how the order reference is made up including all options.

Contents

JXM-IO-E02 - Product description

The JXM-IO-E02 module

The module JXM-IO-E02 is an I/O node and has especially been designed for use in the harsh environment of commercial vehicles and mobile machines.

Product features

The features of this product are listed below:

- CANopen® node with 1 interface to CAN-2.0B
- 16 digital active-high inputs
- 8 digital active-high outputs supplying up to 2.5 A
- 8 digital active-high outputs supplying up to 5.0 A
- 2 switch feed outputs, 2.5 A max.
- 5 digital inputs which can be configured as active-high or active-low inputs
- 1 analog output (resolution: 10 bits)
- 4 analog inputs (voltage, current, resolution: 10 bits)
- 2 frequency inputs (5 Hz ... 20 kHz, resolution: 62.5 ns)
- 3 PWM outputs, 2.5 A max. (resolution: 10 bits)
- 1 H-bridge, 2.5 A max.
- 2 tri-state inputs for setting the node ID

Compatibility - Overview

The following table lists the device/PCB revision numbers and the compatible OS versions:

Device revision	PCB revision	OS version
06.xx and older	02.xx and older	Unknown (no support)
All revisions 07.xx	03.xx	V 3.16.0.00 and V 3.29.0.00
All revisions 10.xx	05.xx	V 3.16.0.00 and V 3.29.0.00
All revisions 12.xx	07.xx	V 3.29.0.00 or higher

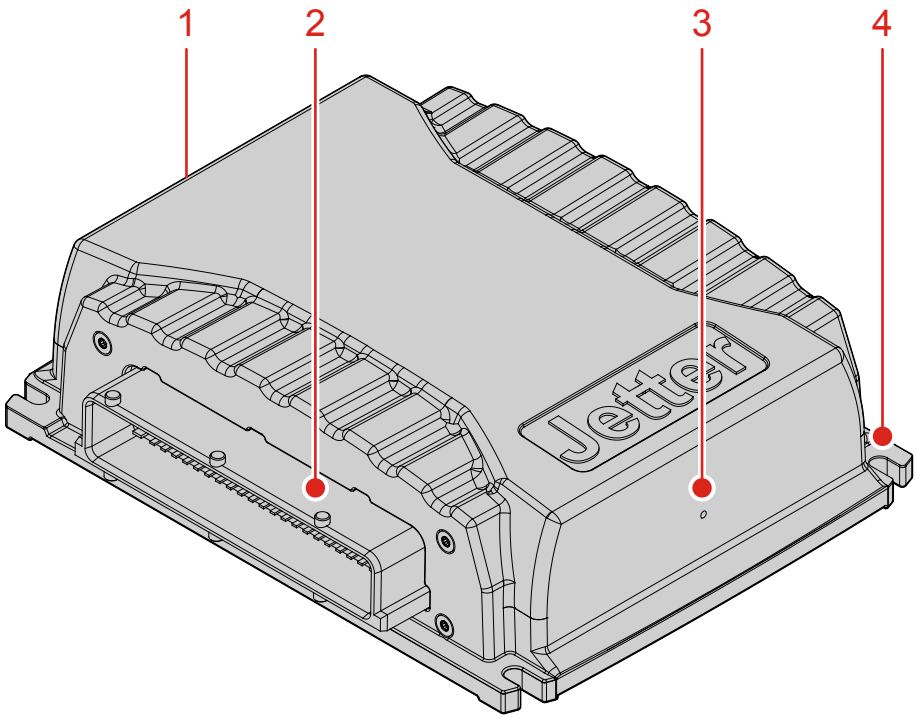
Parts and interfaces

Introduction

This chapter describes the parts and interfaces of the JXM-IO-E02.

Parts and interfaces

The JXM-IO-E02 features the following parts and interfaces:



Number	Element	Function
1	Nameplate	For identifying the JXM-IO-E02
2	Female connector	For connecting external components and the controller
3	Pressure compensation membrane	Compensation of inside and outside air pressure
4	Fastening lugs	For screwing down the JXM-IO-E02

Order reference/options

Order reference

The JXM-IO-E02 is available in different configurations. To order a specific configuration from Jetter AG, please specify the corresponding item number.

Item no.	Order reference	Name
10000818	JXM-IO-E02-G06-K00	Standard I/O node

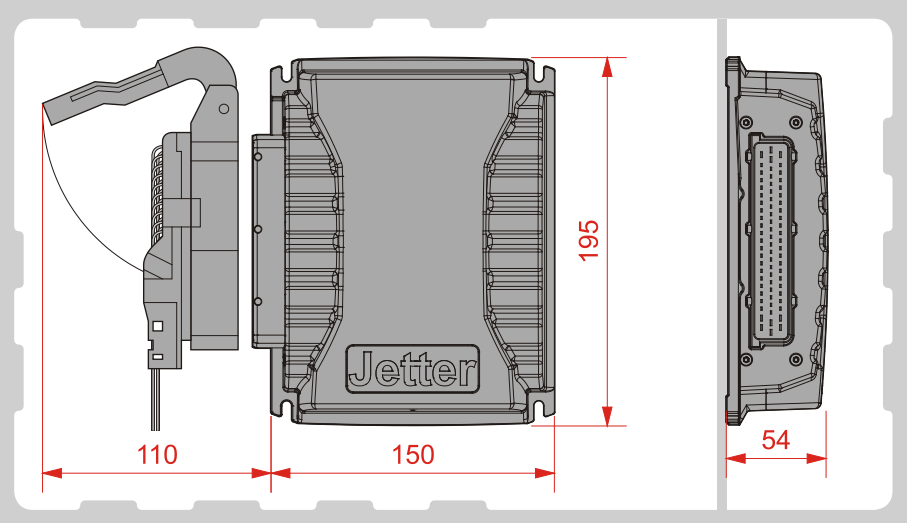
Physical dimensions

Introduction

This chapter details the physical dimensions of the JXM-IO-E02 and the conditions for its installation.

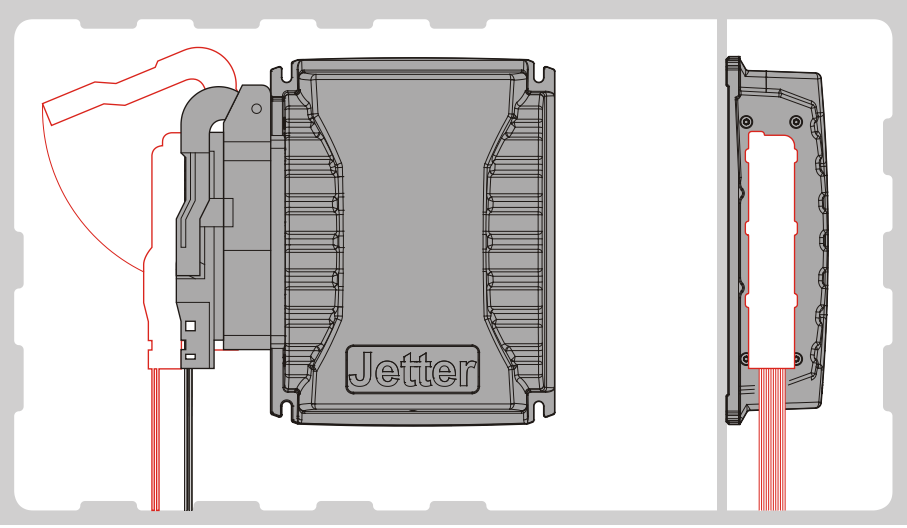
Physical dimensions

The illustration shows the physical dimensions of the JXM-IO-E02.



Space required for installation and service

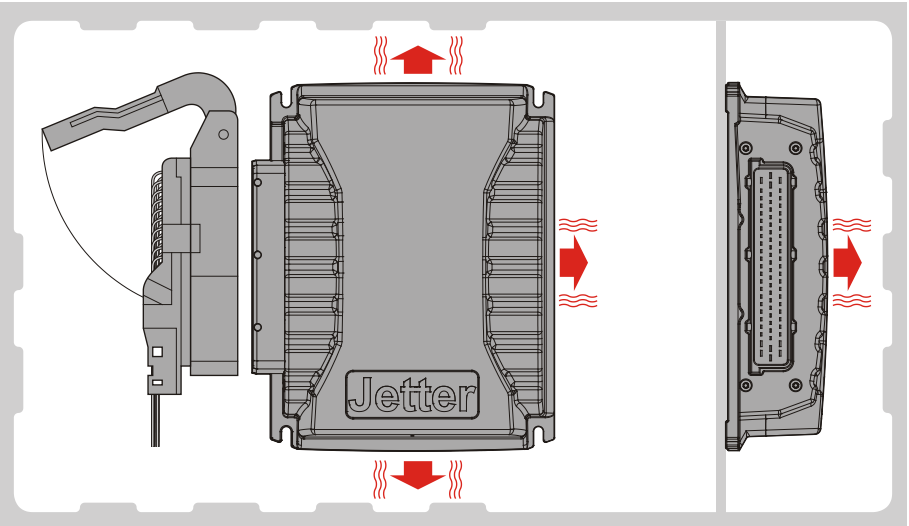
The diagram shows the space required for the JXM-IO-E02.



Ensure there is enough space around the connector for servicing requirements. It should be possible to disconnect the connector at any time.

Space required to protect against overheating

The diagram indicates the safety distances to protect against overheating.



Please note:

- The JXM-IO-E02 increases the temperature of the environment as a result of heat emission under load.
- The JXM-IO-E02 operates without interruption at an ambient temperature of up to +85 °C.

Consider the heat emission from the device, in particular when installing it in a critical environment:

- In the vicinity of the fuel tank
- In the vicinity of the fuel pipe
- In the vicinity of flammable vehicle components
- In the vicinity of thermally malleable vehicle components

3 Identifying the module

Purpose of this chapter

This chapter supports you in retrieving the following information from the JXM-IO-E02:

- Hardware revision
- Retrieving Electronic Data Sheet (EDS) information. Numerous production-relevant data are permanently stored in the EDS.
- Determining the OS version of software components

Prerequisites

To be able to identify the JXM-IO-E02 the following prerequisites must be fulfilled:

- The module is connected to a controller and a PC via CANopen® bus.
- Communication with the module takes place via CANopen®.

Information for hotline requests

If you wish to contact the hotline of Jetter AG in case of a problem, please have the following information on the JXM-IO-E02 ready:

- Serial number
- Software version
- Hardware revision

Contents

3.1 Identification by means of the nameplate

Introduction

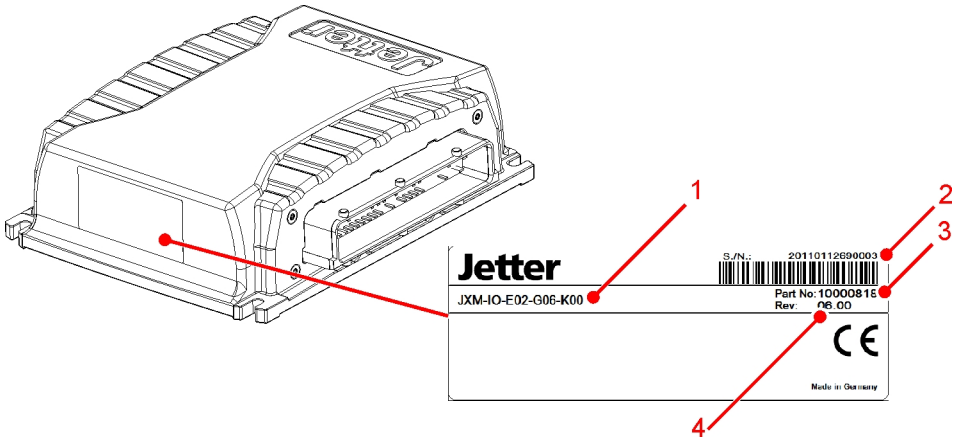
The nameplate is attached to the housing of the JXM-IO-E02 and contains details, such as hardware revision number and serial number. If you wish to contact the hotline of Jetter AG in case of a problem, please have this information ready.

Contents

Nameplate

Nameplate

The nameplate of a JXM-IO-E02 contains the following information:



Number	Description
1	Module type
2	Serial number
3	Item number
4	Hardware revision

3.2 Identification via CANopen® bus

Introduction

Each module features an Electronic Data Sheet (EDS). Numerous production-relevant data are permanently stored in the EDS. EDS data can be retrieved via CANopen® bus.

Contents

Electronic Data Sheet (EDS) and software version of the module

Communication with the JXM-IO-E02

Communication with the JXM-IO-E02 takes place via CAN bus. The CANopen® standard is used as protocol. CANopen® is an open standard for networking and communication in the automobile sector.

The CANopen® protocol has been further developed by the CiA e.V. (CAN in Automation) and works on the physical layer with CAN Highspeed in accordance with ISO 11898.

Electronic Data Sheet (EDS)

The Electronic Data Sheet (EDS) provides information clearly identifying the JXM-IO-E02. Data contained in the EDS are production-specific and are relevant for support purposes. The object **Electronic Data Sheet** (0x4555) lets you retrieve EDS information.

Software version of the JXM-IO-E02

The object "Detailed Software Version" (0x4559) lets you read out the version of the software running in the JXM-IO-E02. This read-only object returns the same software version as object **0x100A**, but in a 32-bit unsigned integer format which is compatible with the standard IP-type version numbers used at Jetter AG.

Example:

The 32-bit word 0x01070001 translates to a software version of 1.07.00.01.

Useful documents

The CANopen® specifications can be obtained from the **CiA e.V. http://www.can-cia.org** homepage. The key specification documents are:

- CiA DS 301 - This document is also known as the communication profile and describes the fundamental services and protocols used under CANopen®.
- CiA DS 302 - Framework for programmable devices (CANopen® Manager, SDO Manager)
- CiA DR 303 - Information on cables and connectors
- CiA DS 4xx - These documents describe the behavior of a number of device classes in, what are known as, device profiles.

Related topics

- **Electronic Data Sheet Object** (see page 85)
- **Detailed Software Version Object** (see page 102)

4 Mounting and installation

Purpose of this chapter

This chapter is to support you in mounting and installing the JXM-IO-E02 in the vehicle and covers the following topics:

- Planning the wiring of a JXM-IO-E02
- Connecting sensors and actuators to the JXM-IO-E02
- Installation
- CANopen® Bus - Engineering

Contents

4.1 Wiring

Purpose of this chapter

This chapter describes how to wire the JXM-IO-E02 and covers the following topics:

- Wiring principle
- Pin assignment
- Example of wiring
- Technical specifications

Contents

Wiring principle

Introduction

This chapter covers the wiring principle of the JXM-IO-E02.

Wiring principle

The JXM-IO-E02 is connected through a wiring harness with external components, such as:

- Power supply
- Controller
- Peripheral module
- Sensors
- Actuators
- Indicator lights

The wiring harness connects to the JXM-IO-E02 with a male connector. This connector is not included in the scope of delivery. This connector is available as accessory.

Connector specification

The connector specification is listed below:

Connector specification	
Manufacturer/Model	Tyco AMP
Item number	963484
Design	70-pin
Coding	A 1

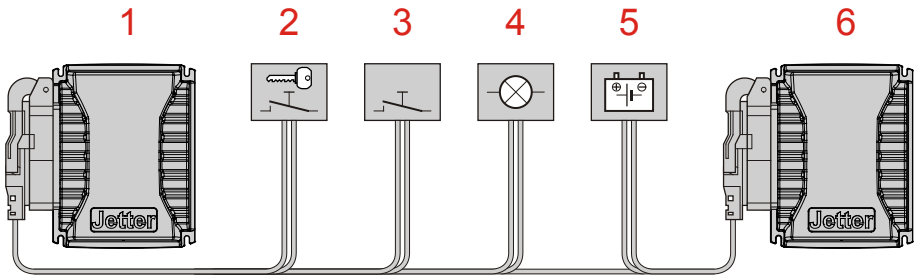
If the connector is used in a humid environment, we recommend to use single wire seals (sealing plugs).

Single wire seals (large contacts)	
Manufacturer	AMP Deutschland GmbH
Item number	828922-1

Single wire seals (small contacts)	
Manufacturer	TE Connectivity
Item number	963531-1

Example

The illustration shows an example of a wiring layout.

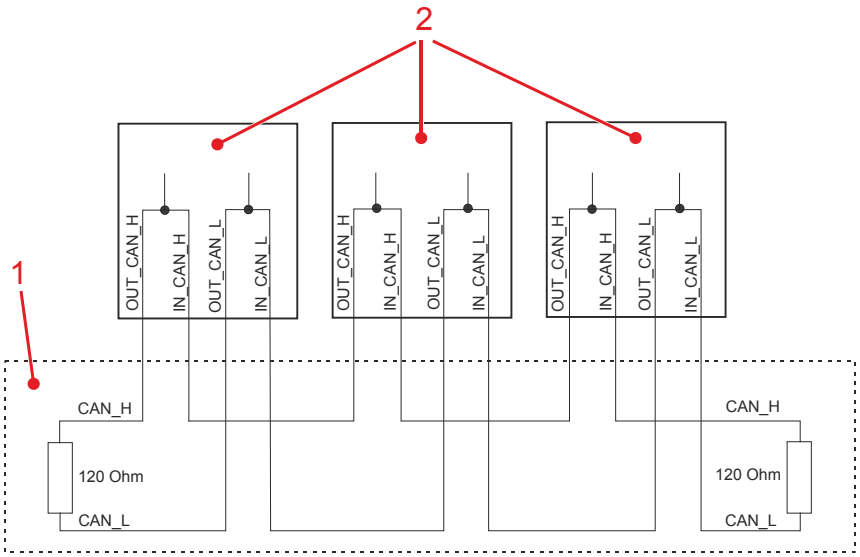


Number	Description
1	Module JXM-IO-E02
2	Ignition lock
3	Door contact switch
4	Indicator light
5	Battery
6	Controller JCM-350-E03

CAN bus cable - Specification

Diagram of the CAN bus wiring

Wire up Jetter AG CANopen® devices in accordance with the following diagram.



Number	Description
1	CAN bus
2	Jetter AG CANopen® devices

There is an option to enable a resistor in the device as a bus termination resistor of 120 Ohm.

The stub length with this type of wiring is almost zero.

The CAN_L and CAN_H cables must be twisted together and shielded.

Specification - CAN bus cable

Parameter	Description
Core cross-sectional area	1000 kBaud: 0.25 … 0.34 mm^2 500 kBaud: 0.34 … 0.50 mm^2 250 kBaud: 0.34 … 0.60 mm^2 125 kBaud: 0.50 … 0.60 mm^2
Cable capacitance	60 pF/m max.
Resistivity	1000 kBaud: 70 Ω/km max. 500 kBaud: 60 Ω/km max. 250 kBaud: 60 Ω/km max. 125 kBaud: 60 Ω/km max.
Number of cores	2
Shielding	Complete shielding, no paired shielding
Twisting	Core pairs CAN_L and CAN_H are twisted

Cable lengths

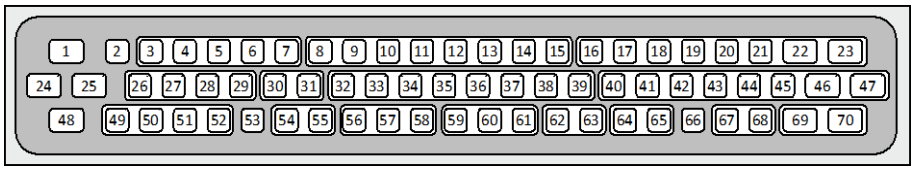
The maximum permitted cable length depends on the baud rate used and the number of CANopen® devices connected.

Baud rate	Cable length	Stub length	Total stub length
1000 kBaud	25 m max.	0.3 m max.	1.5 m
500 kBaud	100 m max.	5 m max.	30 m
250 kBaud	250 m max.	10 m max.	60 m
125 kBaud	500 m max.	20 m max.	120 m

Pin assignment - Overview

Connector pinout

The diagram below shows the pinout of the connector (as viewed from the front):



Pin	Description	Pin	Description	Pin	Description
1	PROTECTED FEED (DC 12 V or +DC 24 V)	**25**	Ground: Analog output	**49**	Analog input # 1
2	Ignition (+) (IGNITION FEED)	**26**	Ground: Analog input 1	**50**	Analog input # 2
3	Digital input 1	**27**	Ground: Analog input 2	**51**	Analog input # 3
4	Digital input 2	**28**	Ground: Analog input 3	**52**	Analog input # 4
5	Digital input 3	**29**	Ground: Analog input 4	**53**	Analog output
6	Digital input 4	**30**	Switch feed output 1	**54**	Frequency input # 1
7	Digital input 5	**31**	Switch feed output 2	**55**	Frequency input # 2
8	Universal I/O: IN 6/OUT 1	**32**	Ground return: IN 6/OUT 1	**56**	PWM output 1
9	Universal I/O: IN 7/OUT 2	**33**	Ground return: IN 7/OUT 2	**57**	PWM output 2
10	Universal I/O: IN 8/OUT 3	**34**	Ground return: IN 8/OUT 3	**58**	PWM output 3
11	Universal I/O: IN 9/OUT 4	**35**	Ground return: IN 9/OUT 4	**59**	Ground return: PWM output 1
12	Universal I/O: IN 10/OUT 5	**36**	Ground return: IN 10/OUT 5	**60**	Ground return: PWM output 2
13	Universal I/O: IN 11/OUT 6	**37**	Ground return: IN 11/OUT 6	**61**	Ground return: PWM output 3
14	Universal I/O: IN 12/OUT 7	**38**	Ground return: IN 12/OUT 7	**62**	OUT_CAN_L
15	Universal I/O: IN 13/OUT 8	**39**	Ground return: IN 13/OUT 8	**63**	OUT_CAN_H
16	Universal I/O: IN 14/PROTECTED OUT 9	**40**	Ground return: IN 14/PROTECTED OUT 9	**64**	IN_CAN_L
17	Universal I/O: IN 15/PROTECTED OUT 10	**41**	Ground return: IN 15/PROTECTED OUT 10	**65**	IN_CAN_H
18	Universal I/O: IN 16/PROTECTED OUT 11	**42**	Ground return: IN 16/PROTECTED OUT 11	**66**	Regulated output DC 5 V
19	Universal I/O: IN 17/PROTECTED OUT 12	**43**	Ground return: IN 17/PROTECTED OUT 12	**67**	Node ID (tri-state input # 1)
20	Universal I/O: IN 18/PROTECTED OUT 13	**44**	Ground return: IN 18/PROTECTED OUT 13	**68**	Node ID (tri-state input # 2)
21	Universal I/O: IN 19/PROTECTED OUT 14	**45**	Ground return: IN 19/PROTECTED OUT 14	**69**	H-bridge outputs
22	Universal I/O: IN 20/PROTECTED OUT 15	**46**	Ground return: IN 20/PROTECTED OUT 15	**70**	H-bridge outputs

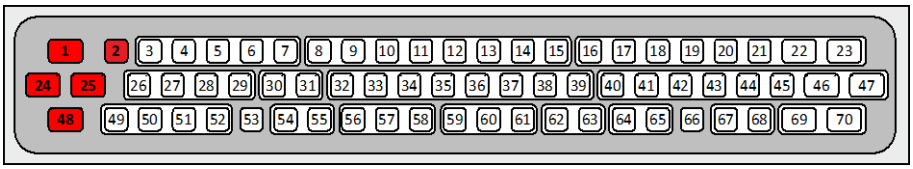
Pin	Description	Pin	Description	Pin	Description
23	Universal I/O: IN 21/PROTECTED OUT 16	**47**	Ground return: IN 21/PROTECTED OUT 16		
24	STANDARD FEED (DC 12 V or DC 24 V)	**48**	Weight		

Connecting the power supply and the 5 V output

Introduction

The following diagrams show the pinout of the connector (as viewed from the front):

Power supply



Pin	Description	Terminal number in vehicles
1	PROTECTED FEED (DC 12 V or DC 24 V)	Terminal # 30
2	Ignition (+) (IGNITION FEED)	Terminal # 15
24	STANDARD FEED (DC 12 V or DC 24 V)	Terminal # 30
25	Weight	Terminal # 31
48	Weight	Terminal # 31

Ignition (IGNITION FEED)

- IGNITION FEED sources the digital electronics that control the inputs and outputs.
- Ignition must be on for the JXM-IO-E02 to be active.
- The JXM-IO-E02 will continue to run on a minimum input voltage of 5.9 V (on IGNITION FEED) in order to survive engine cranking (ISO 7637-2 Test Pulse 5 compliant).
  In general, the following conditions apply: The JXM-IO-E02 is designed to work with an input power voltage range of 8 V up to 32 V.
- The maximum current draw on this line is 2 A.

STANDARD FEED

- STANDARD FEED provides power for some of the outputs of the JXM-IO-E02.
- The maximum current draw on this line is 20 A.
- The input current on STANDARD FEED is monitored by the JXM-IO-E02.

PROTECTED FEED

- PROTECTED FEED provides power for some of the outputs of the JXM-IO-E02.
- The maximum current draw on this line is 20 A.
- If an error occurs, the internal protection circuits switch off the outputs. PROTECTED FEED is protected by solid-state switches.
  If the current current consumption exceeds 30 A or if one of the microcontrollers is defective, the solid-state switches are disabled by the redundant microcontrollers.

Note on ignition

To launch the JXM-IO-E02, pin 2 (IGNITION FEED) must be connected with pin 24 (STANDARD FEED). The ignition control signal is issued when the key is in position "Ignition ON".

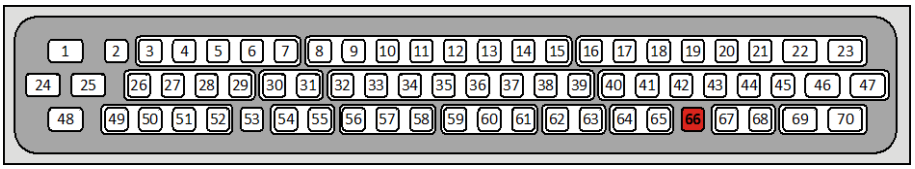
Power Supply - Technical Data

Parameter	Description
Rated voltage	DC 12 V or DC 24 V
Permissible voltage range	DC 8 ... 32 V
Current consumption at 12 V (without load)	120 mA
Current consumption at 24 V (without load)	100 mA

Note on current consumption

The base current consumption is measured shortly after switching on the JXM-IO-E02 while there are no active output signals and input signals are not connected. Active outputs and also certain connected input signals will affect the current consumption.

Regulated 5 V output



Pin	Description
66	Regulated 5 V output

Technical data - Regulated output

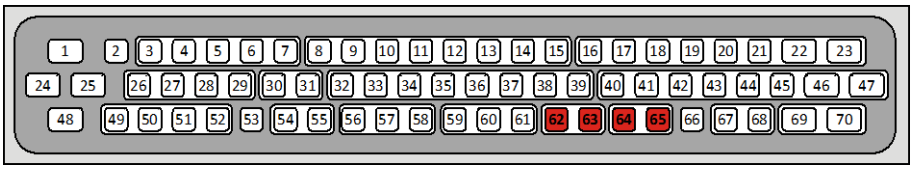
Parameter	Description
Controlled voltage	DC 5 V
Load current	250 mA max.
Over-current detection	Yes

CAN Interface and Node ID

Introduction

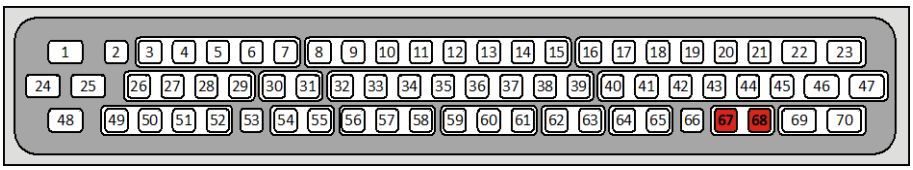
The following diagrams show the pinout of the connector (as viewed from the front):

CANopen®



Pin	Description
62	OUT_CAN_L
63	OUT_CAN_H
64	IN_CAN_L
65	IN_CAN_H

Node ID



Pin	Description
67	Node ID (tri-state input # 1)
68	Node ID (tri-state input # 2)

Technical data - Tri-state inputs

Parameter	Description
Purpose	■ For device coding ■ As digital inputs
Type of inputs	Pull-up resistor 22 kΩto IGNITION FEED and pull-down resistor 276 Ω to ground
Tri-state detection	Tri-state operation is detected by a pull-down resistor to ground.
Rated voltage	IGNITION FEED
Operating point OFF:	≤ 1.0 V
Operating point ON:	≥ 4.0 V

Note

Note that because these inputs are tri-state enabled, they will always have bias voltage on the pin capable of sourcing current.

Calculating the node ID based on tri-state input state

The following table shows the resulting node ID given that the default base ID of 0x10 is used:

State of pin 67	State of pin 68	CANopen® Node ID
Not connected	Not connected	0x10
Not connected	OFF	0x11
Not connected	ON	0x12
OFF	Not connected	0x13
OFF	OFF	0x14
OFF	ON	0x15
ON	Not connected	0x16
ON	OFF	0x17
ON	ON	0x18

Related topics

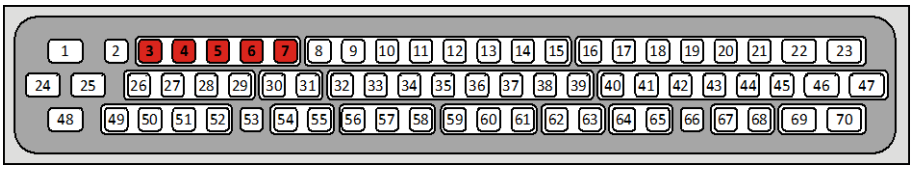
- **Specification - CAN bus cable** (see page 29)

Connecting Digital Inputs and Outputs

Introduction

The following diagrams show the pinout of the connector (as viewed from the front):

Digital inputs

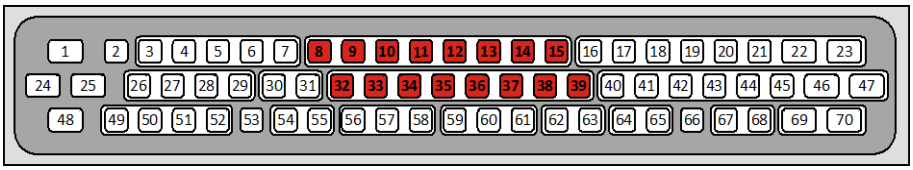


Pin	Description
3	Digital input 1
4	Digital input 2
5	Digital input 3
6	Digital input 4
7	Digital input 5

Technical data - Digital inputs IN 1 ... IN 5

Parameter	Description
Type of inputs	Software selectable with either 2 kΩ pull-up resistor to IGNITION FEED or 2 kΩ pull-down resistor to ground.
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Operating point OFF:	≤ 1.0 V
Operating point ON:	≥ 3.5 V

Digital universal I/Os (STANDARD)



Pin	Description
8	Universal I/O: IN 6/OUT 1
9	Universal I/O: IN 7/OUT 2
10	Universal I/O: IN 8/OUT 3
11	Universal I/O: IN 9/OUT 4
12	Universal I/O: IN 10/OUT 5
13	Universal I/O: IN 11/OUT 6
14	Universal I/O: IN 12/OUT 7
15	Universal I/O: IN 13/OUT 8

Pin	Description
32	Ground return: IN 6/OUT 1
33	Ground return: IN 7/OUT 2
34	Ground return: IN 8/OUT 3
35	Ground return: IN 9/OUT 4
36	Ground return: IN 10/OUT 5
37	Ground return: IN 11/OUT 6
38	Ground return: IN 12/OUT 7
39	Ground return: IN 13/OUT 8

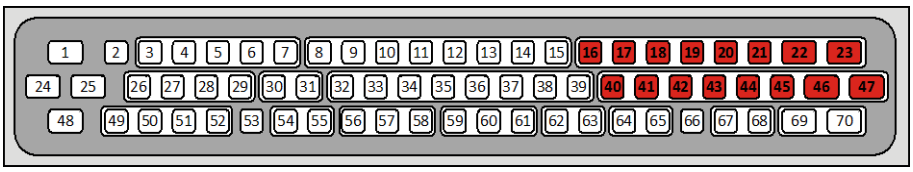
Technical data - Digital inputs IN 6 ... IN 13

Parameter	Description
Type of inputs	Can be configured as active-high inputs
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Operating point OFF:	< 51 % of IGNITION FEED
Operating point ON:	> 51 % of IGNITION FEED
Input impedance	100 kΩ

Technical data - Digital outputs (STANDARD FEED)

Parameter	Description
Type of outputs	Active-high output
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Signal voltage OFF	< 1.0 V
Signal voltage ON	$U_{STANDARD}$ - 0.5 V
Load current of OUT 1 ... OUT 8	2.5 A max.
Short-circuit capability	Yes
Over-current detection	Yes
No-load detection	Yes

Digital universal I/Os (PROTECTED)



Pin	Description
16	Universal I/O: IN 14/PROTECTED OUT 9
17	Universal I/O: IN 15/PROTECTED OUT 10
18	Universal I/O: IN 16/PROTECTED OUT 11
19	Universal I/O: IN 17/PROTECTED OUT 12
20	Universal I/O: IN 18/PROTECTED OUT 13
21	Universal I/O: IN 19/PROTECTED OUT 14
22	Universal I/O: IN 20/PROTECTED OUT 15
23	Universal I/O: IN 21/PROTECTED OUT 16
40	Ground return: IN 14/PROTECTED OUT 9
41	Ground return: IN 15/PROTECTED OUT 10
42	Ground return: IN 16/PROTECTED OUT 11
43	Ground return: IN 17/PROTECTED OUT 12
44	Ground return: IN 18/PROTECTED OUT 13
45	Ground return: IN 19/PROTECTED OUT 14
46	Ground return: IN 20/PROTECTED OUT 15
47	Ground return: IN 21/PROTECTED OUT 16

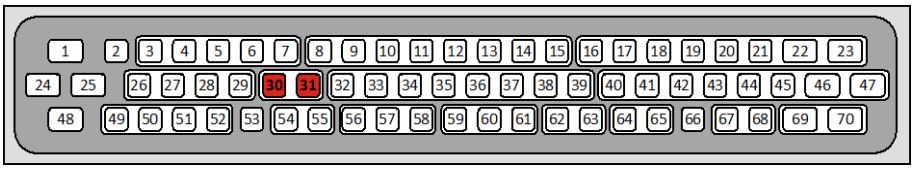
Technical data - Digital inputs IN 14 ... IN 21

Parameter	Description
Type of inputs	Can be configured as active-high inputs
Rated voltage	PROTECTED FEED
Permissible voltage range	DC 8 ... 32 V
Operating point OFF:	< 51 % of IGNITION FEED
Operating point ON:	> 51 % of IGNITION FEED
Input impedance	100 kΩ

Technical data - Digital outputs (PROTECTED)

Parameter	Description
Type of outputs	Active-high output
Rated voltage	PROTECTED FEED
Permissible voltage range	DC 8 ... 32 V
Signal voltage OFF	< 1.0 V
Signal voltage ON	$U_{PROTECTED}$ - 0.5 V
Load current of PROTECTED OUT 9 ... PROTECTED OUT 16	5.0 A max.
Can be switched off by electronic safety switch	Yes
Short-circuit capability	Yes
Over-current detection	Yes
No-load detection	Yes

Switch feed outputs

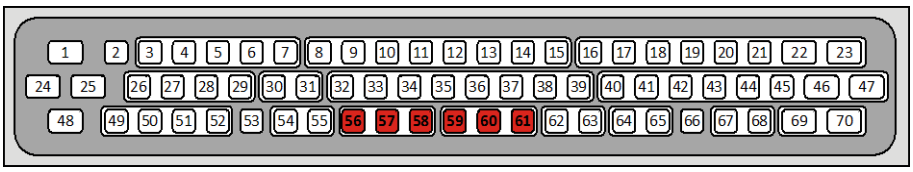


Pin	Description
30	Switch feed output 1
31	Switch feed output 2

Technical data - Switch outputs

Parameter	Description
Type of switch outputs	Active-high output
Possible use	As digital active-low inputs
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Signal voltage OFF	< 1.0 V
Signal voltage ON	$U_{STANDARD}$ - 0.5 V
Load current	Each 2.5 A max.
Short-circuit capability	Yes, thermal (undefined current)
Over-current detection	Detection whether the output has switched off.
No-load detection	Yes

PWM outputs



Pin	Description
56	PWM output 1
57	PWM output 2
58	PWM output 3
59	Ground return: PWM output 1
60	Ground return: PWM output 2
61	Ground return: PWM output 3

Technical data - PWM outputs

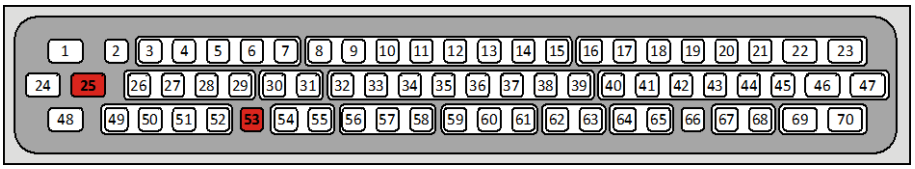
Parameter	Description
Operating modes	■ Current-controlled output ■ PWM output with static duty cycle
PWM frequency	Configurable values: 0 = 1.954 kHz 1 = 977 Hz 2 = 488 Hz 3 = 244 Hz 4 = 122 Hz 5 = 61 Hz 6 = 30 Hz
Resolution	10 bits
Load current	0 ... 2.5 A
Short-circuit capability	Yes
Over-current detection	Yes
No-load detection	Yes

Connecting Analog Inputs and Outputs

Introduction

The following diagrams show the pinout of the connector (as viewed from the front):

Analog output

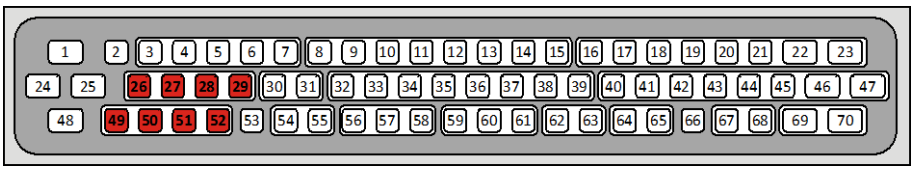


Pin	Description
25	Weight
53	Analog output

Technical data - Analog output

Parameter	Description
Voltage range at 50 mA	0 ... STANDARD FEED
Current range	0 ... 100 mA
Resolution	10 bits
Electrical isolation	None
Short circuit detection	Yes

Analog inputs

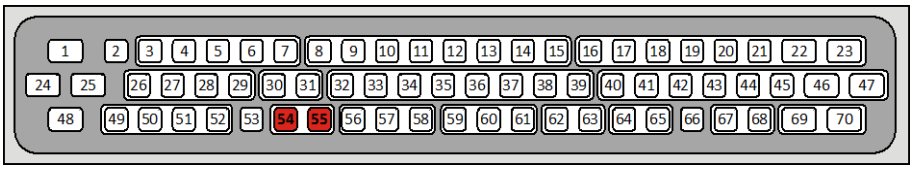


Pin	Description
26	Ground: Analog input 1
27	Ground: Analog input 2
28	Ground: Analog input 3
29	Ground: Analog input 4
49	Analog input # 1
50	Analog input # 2
51	Analog input # 3
52	Analog input # 4

Technical data - Analog inputs

Parameter	Description
Voltage range	■ 0 ... 5 V ■ 0 ... 40 V
Current range	■ 0 ... 20 mA
Input impedance at 0 ... 5 V	100 kΩ
Input impedance at 0 ... IGNITION FEED	50 kΩ
Input impedance at 0 ... 20 mA	240 Ω
Resolution	10 bits
Electrical isolation	None

Frequency inputs

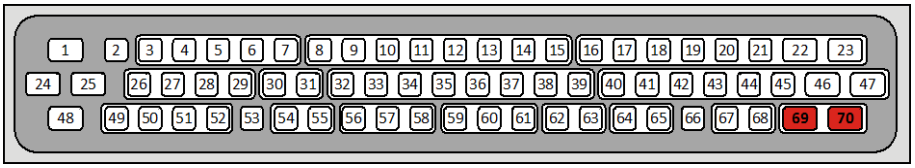


Pin	Description
54	Frequency input # 1
55	Frequency input # 2

Technical data - Frequency inputs

Parameter	Description
Purpose	■ As frequency counter ■ As digital input
Type of inputs	Software selectable with either 2 kΩ pull-up resistor to STANDARD FEED or 2 kΩ pull-down resistor to ground.
Frequency measurement range	5 Hz ... 20 kHz
Measurement method	Time-based
Result of measurement	Period of the signal in nanoseconds
Resolution	62.5 ns
As of hardware revision ≥ 12.04 the following operating point parameters apply:	
Operating point OFF:	< 1.7 V for mode 1 ... 4 and IGNITION FEED = 12 V
Operating point ON:	> 3.6 V for mode 1 ... 4 and IGNITION FEED = 12 V
Operating point OFF:	< 3.4 V for mode 1 ... 4 and IGNITION FEED = 24 V
Operating point ON:	> 7.2 V for mode 1 ... 4 and IGNITION FEED = 24 V
Operating point OFF:	AC signal < 350 mV for mode 5
Operating point ON:	AC signal > 350 mV for mode 5

H-bridge outputs



Pin	Description
69	H-bridge outputs
70	

Technical data - H-bridge

Parameter	Description
Purpose	■ As H-bridge ■ As two independent digital inputs ■ As two independent PWM outputs (active-high and active-low)
Rated output current	2.5 A max.
Accuracy of current measurement for H-bridge	< 100 mA
Short-circuit capability	Yes
Overcurrent detection	Yes
No-load detection	Yes

4.2 Installing the JXM-IO-E02

Introduction

This chapter describes how to install the JXM-IO-E02.

Contents

Installing the JXM-IO-E02

Selecting a place for installation

Select a suitable place for the device to be installed.
A place is suitable if it fulfills the following requirements:

- The installation surface must be made from one of the following materials:
  - Aluminum plate
  - Galvanized steel plate
  - Painted steel plate
- The installation surface must be vertical.
- The installation surface must be level.
- The installation location must allow adequate air circulation.
- The installation location must be accessible for servicing.
- The installation location must be of sufficient size.

For further information refer to **Physical Dimensions** (see page 17)

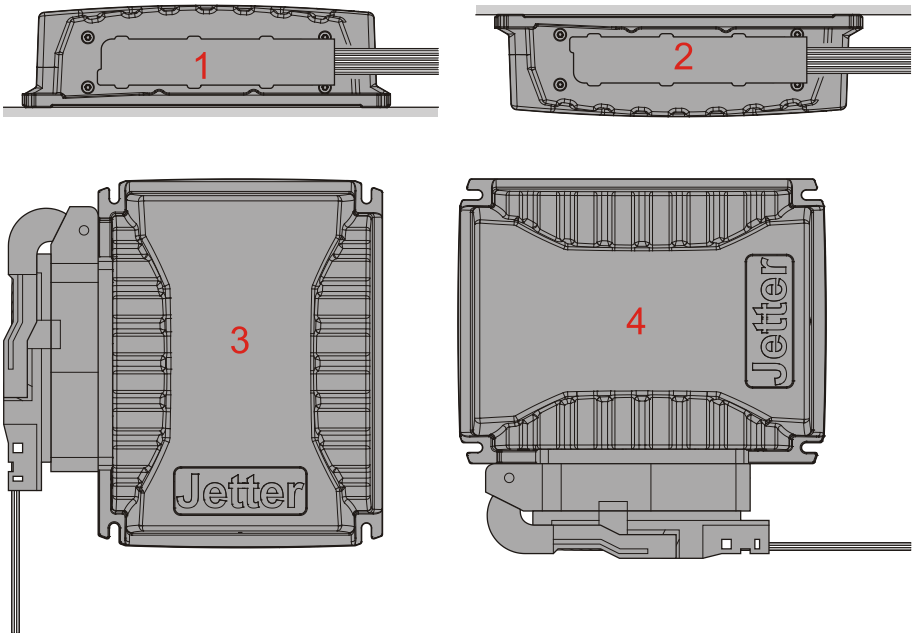
Avoiding unsuitable installation locations

Do not install the device in locations that do not meet the a.m. requirements.
The following locations are not appropriate for installing the JXM-IO-E02:

Inappropriate location	Reason
Unventilated installation location	The device could overheat as heat builds up.
Stainless steel surfaces	Galvanic corrosion may occur between device and mounting surface
Installation location close to heat-sensitive materials	The materials could become warped or misshapen as a result of heat produced by the device.
Uneven installation surfaces	The installation surface could become misshapen when fitting the device. Fastening is unstable and precarious.

Permitted installation positions

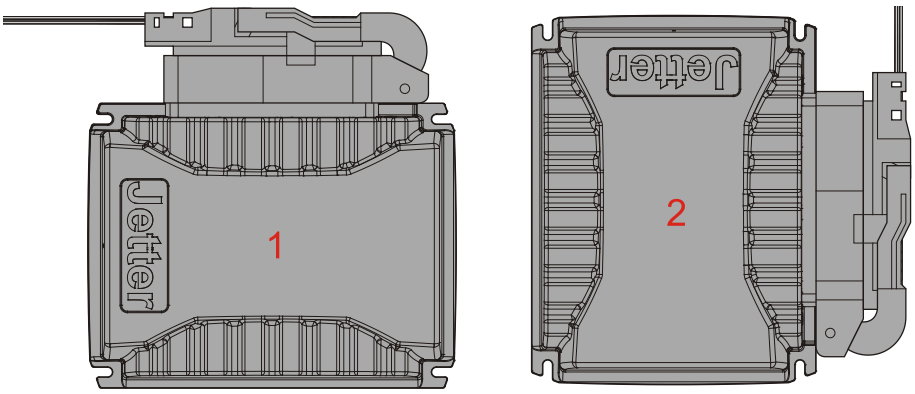
The illustration shows the positions permitted for installation.



Number	Permitted installation position
1	Horizontally, lying
2	Horizontally, hanging
3	Vertically, connector left
4	Vertically, connector downwards

Prohibited installation positions

The diagram shows the positions prohibited for installation.



Number	Prohibited installation positions
1	Vertically, connector upwards
2	Vertically, pressure equalizing membrane upwards

Why are these installation positions prohibited?

- Vertically, connector upwards: The accumulation of moisture and water droplets in the connector can lead to current leakages and corrosion.
- Vertically, pressure equalizing membrane upwards: The accumulation of moisture and water droplets can block the hole which may impede pressure compensation.

Selecting installation hardware

For installation use the following hardware:

Part	Description
Screws/bolts	Size: M 5 x 15 Surface: Galvanized Strength class: 8.8
Washers	Size: 5.3 x 10 Surface: Galvanized
Screw nuts	Size: M 5 Surface: Galvanized Strength class: 8.8

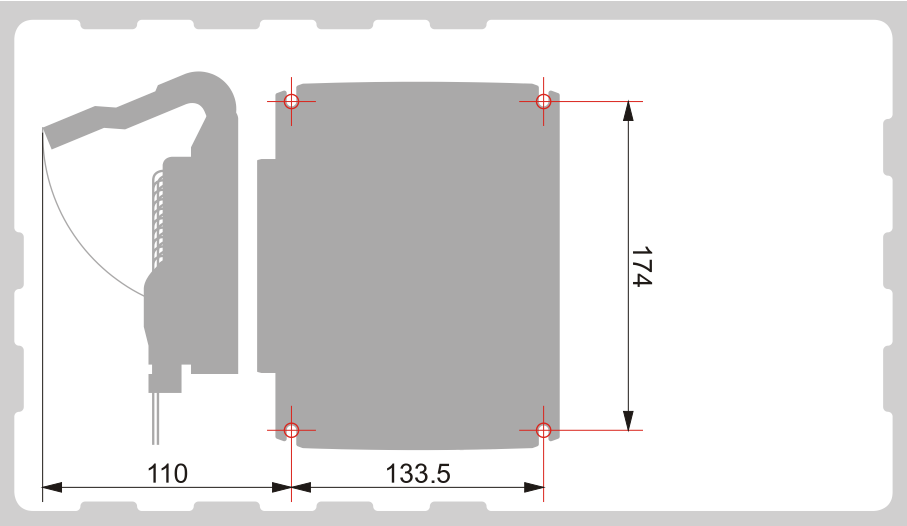
Avoid improper installation material

You must avoid installation material made from stainless steel. In connection with the housing material of the JXM-IO-E02 galvanic corrosion may occur.

Preparing for installation

Mark off the positions of the four mounting holes.

Center-punch the four holes.



If ...	... then ...
... the thickness of the mounting surface is ≥ 6 mm (steel) and ≥ 8 mm (aluminum), ...	... drill tapped holes: ■ Pre-drill Ø 4.2 mm. ■ Tap a thread M 5.

If ...	... then ...
... the thickness of the mounting surface is < 6 mm (steel) and < 8 mm (aluminum), ...	... drill simple holes: ■ Drill the holes Ø 6 mm. ■ Deburr the holes.

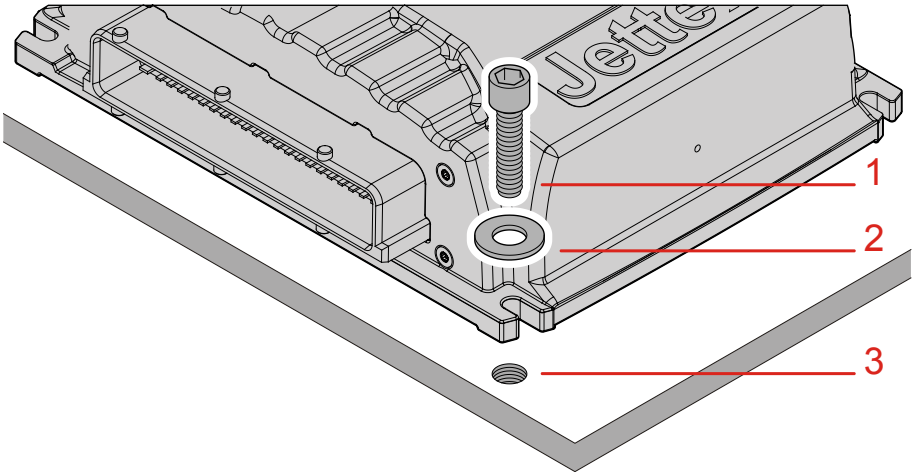
Notes on installation

Direct contact between housing and installation surface improves heat dissipation. Therefore:

- Generally install the device directly on the installation surface.
- Do not use insulating material.
- Do not use spacers.

Installing the JXM-IO-E02 (tapped holes)

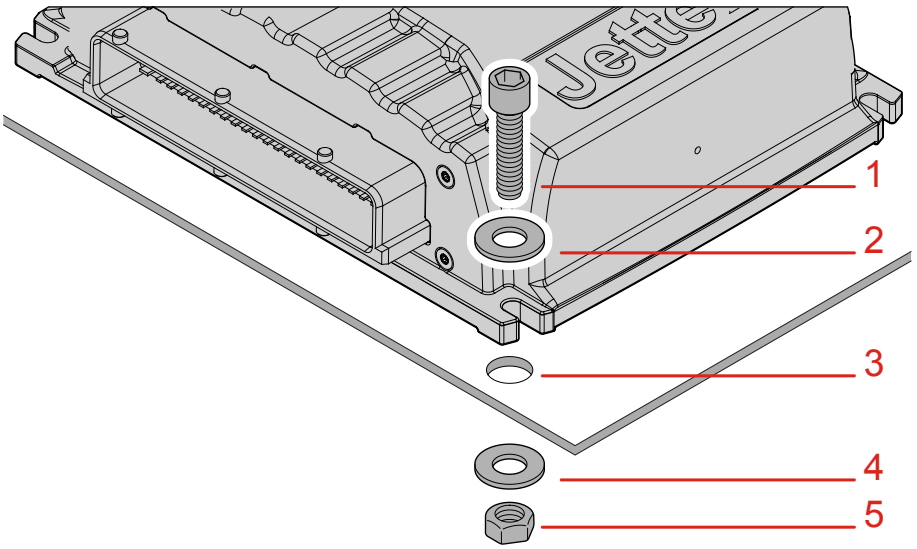
Screw the device down to the installation surface.



Number	Description
1	Screw
2	Washer
3	Tapped hole

Installing the JXM-IO-E02 (through holes)

Screw the device down to the installation surface.



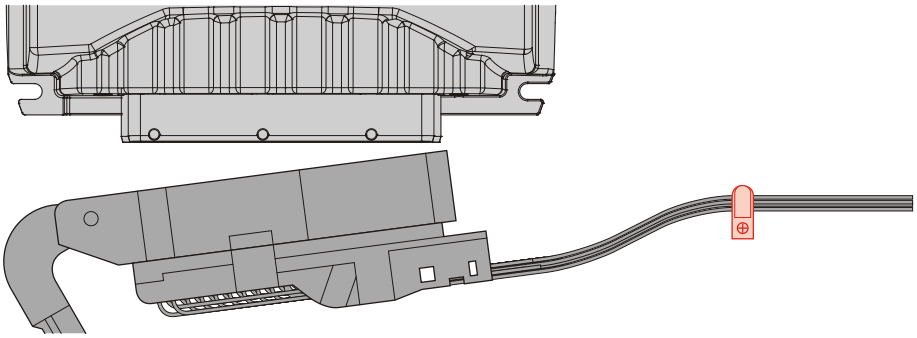
Number	Description
1	Screw
2	Washer
3	Through hole
4	Washer
5	Screw nut

Installing the strain relief

Install a strain relief for the connection cable.

Take care to leave enough space for the connector.

The connector should not be obstructed, so that it can be removed in the event of a service requirement.



5 Initial commissioning

Introduction

This chapter describes how to commission the JXM-IO-E02 and covers the following steps:

- Connecting the power supply and interfaces
- Initial commissioning via CANopen® interface

Contents

Preparatory work for initial commissioning

Introduction

To be able to commission and program the JXM-IO-E02, complete the following activities first:

- Connecting a controller with power supply, ignition and CAN interface.
- Changing the node ID in the case of several CANopen® nodes of the same module type.

Default values

Some of the default values of the JXM-IO-E02 module are listed below:

- Baud rate: 250 kBaud
- CAN terminating resistor: 0x01
  This value means that the CAN terminating resistor of 120 Ω at the end of the CAN bus is enabled.
- Node ID: 0x10

Wiring

To wire the module JXM-IO-E02, proceed as follows:

Step	Action
1	Connect the following terminals with the power supply DC 8 - 32 V: ■ PROTECTED FEED **Pin 1** (terminal 30 in the vehicle) ■ IGNITION **Pin 2** (terminal 15 in the vehicle) ■ STANDARD FEED **Pin 24** (terminal 30 in the vehicle) ■ GROUND **Pin 25** (terminal 31 in the vehicle)
2	Connect the module to the CANopen® bus (**pin 62** and **pin 63, pin 64** and **pin 65**).
3	Make sure that there is a terminating resistor of 120 Ω at both ends of the CAN bus.
4	Switch on the ignition to energize the module. Communication with the module is now possible.

Result: The module is now operational and can be initialized by the controller.

Data collision in the case of several modules with the same node ID.

If you connect several nodes of the same type to the CANopen® bus, this leads to data collisions on the CANopen® bus. The reason for this is that modules of the same type in as delivered condition have got the same node ID. To allow communication with all nodes on the bus, the node ID of modules with the same default ID must be changed. There are two ways to change the node ID:

Option 1:

Connect modules with different states of the tri-state inputs. The resulting node IDs are as follows:

Module	State of pin 67	State of pin 68	CANopen® Node ID
Module 1	Not connected	Not connected	0x10
Module 2	Not connected	OFF (terminal 31 in the vehicle)	0x11
...	...	...	...
Module 9	ON (terminal 15 in the vehicle)	Not connected	0x16

Option 2:

Connect the modules one after the other to the CANopen® bus. Then, change the node ID through the system parameters as described below:

Step	Action	Result
1	Connect module 1 to the CANopen® bus.	
2	Enter a new node ID into the system parameter with index 0x4556 (sub-index 4).	As a result, module 1 has got a new node ID.
3	Then, connect module 2 to the CANopen® bus.	
4	Enter a new node ID into the system parameter with index 0x4556 (sub-index 4).	As a result, module 2 has got a new node ID.
5	Repeat this procedure for all modules of the same type until all modules are connected to the CANopen® bus.	Now, collision of data is avoided in communication between nodes of the same type connected to the CANopen® bus since each node has got an individual node ID.

Related topics

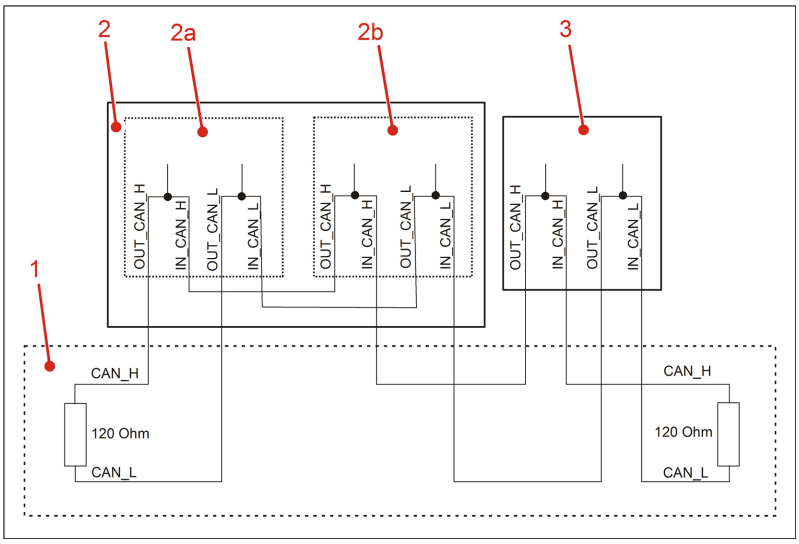
- **Wiring** (see page 26)
- **Information on communication with the module** (see page 54)
- **CANopen® interface and node ID** (see page 35)

Information on communication with a JXM-IO-E02

Wiring diagram - Example

The illustration below shows a wiring example of the following CANopen® devices by Jetter AG:

- Controller JCM-350-E03
- Peripheral module JXM-IO-E02



Number	Description	Node ID
1	CAN bus	
2	Jetter controller JCM-350-E03	
2a	Controller JCM-350	0x7F (127 decimal)
2b	I/O module JXM-IO-E02	0x10 (16 decimal)
3	Separate I/O module JXM-IO-E02	0x11 (17 decimal) for tri-state inputs that have been configured by the user

CANopen® interface - Restrictions

During initial commissioning take into account the following restrictions/limitations of the CANopen® interface on the JXM-IO-E02:

- PDOs are not user configurable.
- PDOs are transmitted only asynchronously on request.

Communication with peripheral modules

The following information supports you in commissioning peripheral modules, such as JXM-IO-E02:

- Initialize the controller as described in the documentation on JCM-350-E03.
- Send an RTR frame to the peripheral module. This parameter is needed once in order to prompt the peripheral module to send the required data to the controller.

JetSym STX sample program

The following sample program shows how the states of the digital inputs on the JXM-IO-E02 can be read by a Jetter controller, such as JCM-350.

```
Const
    CAN_CONTROLLER_0 = 0;

    //Node ID of the controller
    NodeID_Node_0 = 0x7F;

    //Node ID of the I/O module
    NodeID_Node_1 = 0x10;

    Event_Time = 100;
    Inhibit_Time = 20;
End_Const;

Var
//State of the digital inputs
    Data_Inputs: Word;
    SW_Version: String;
End_Var;


Task Main Autorun

// Software version of the controller
SW_Version := 'v4.3.0';

// Initializing CAN 0

CanOpenInit(CAN_CONTROLLER_0, NodeID_Node_0, SW_Version);

// Entering process data to be received
CanOpenAddPDORx(CAN_CONTROLLER_0,
CANOPEN_PDO1_RX(NodeID_Node_1), 2, CANOPEN_WORD,
sizeof(Data_Inputs), Data_Inputs, Event_Time, Inhibit_Time,
CANOPEN_ASYNCPDORTRONLY);

// All nodes on the CAN bus are in PREOPERATIONAL state
// Setting all devices on the CAN bus to OPERATIONAL status
CanOpenSetCommand(CAN_CONTROLLER_0,
CAN_CMD_NMT_Value(CAN_CMD_NMT_ALLNODES, CAN_CMD_NMT),
CAN_NMT_START);

End_Task;
```

Related topics

- **CANopen® objects** (see page 57)

6 CANopen® objects

Introduction

This chapter covers the CANopen® objects implemented on the JXM-IO-E02 and their functions, as well as the permanently mapped process data objects (PDO).

Restrictions

Due to design constraints the following restrictions/limitations apply to the CANopen® interface of the JXM-IO-E02:

- SDO expedited transfer only supports 4-byte transfers. Any smaller data element must be extended to 32 bit before the SDO transfer.
- SDO segmented transfer is only supported on certain objects. Most notably the OS update feature makes use of segmented transfer, but also some other objects that need to transfer strings implement SDO segmented transfer for this purpose. Unless an object is documented to support segmented transfers, assume that it does not.
- SDO block transfer is NOT implemented.
- PDOs are not user configurable.
- PDOs are transmitted only asynchronous on request unless otherwise specified.
- Although emergency messages are transmitted to notify of detected faults, the CANopen® emergency handling system is not fully implemented.
- The Error Register does not save its state in non volatile memory. After each reset or power cycle, the error list is cleared.

Contents

6.1 CANopen® object dictionary for JXM-IO-E02

Purpose of this chapter

This chapter describes the CANopen® objects implemented on the JXM-IO-E02 and their function.

Supported objects

There are objects which are mandatory according to the CANopen® specification. These objects are not covered in this document. The table below lists the objects which are covered in this document.

Index (hex)	Object name	Object (code)	Type	see
1000	Device type	VAR	Unsigned32	**Page** 60
1001	Error Register	VAR	Unsigned8	**Page** 60
1003	Pre-defined error field	ARRAY	Unsigned32	**Page** 60
100A	Manufacturer software version	VAR	String	**Page** 60
1017	Producer heartbeat time	VAR	Unsigned16	**Page** 60
1018	Identity	RECORD	Identity (23h)	-
2000	Features	ARRAY	Unsigned32	**Page** 60
2100	Digital Inputs	ARRAY	Unsigned32	**Page** 62
2101	Universal I/O	ARRAY	Unsigned32	**Page** 64
2102	Tri-state Inputs	ARRAY	Unsigned32	**Page** 66
2103	Switch Feed Outputs	ARRAY	Unsigned32	**Page** 68
2200 - 2203	Analog Input	ARRAY	Unsigned32	**Page** 69
2210	Voltage Sense Analog Input	ARRAY	Unsigned32	**Page** 71
2211	Feed Currents	ARRAY	Unsigned32	**Page** 72
2300	Analog Output	ARRAY	Unsigned32	**Page** 73
2400 - 2402	PWM Output	ARRAY	Unsigned32	**Page** 75
2500	H-Bridge	ARRAY	Unsigned32	**Page** 80
2600, 2601	Frequency Input	ARRAY	Unsigned32	**Page** 82
2800	5 V Output	ARRAY	Unsigned32	**Page** 84
4554	OS Update	ARRAY	Unsigned32	**Page** 85
4555	Electronic Datasheet	ARRAY	Unsigned32	**Page** 85
4556	System Parameters	ARRAY	Unsigned32	**Page** 86
4557	OS Status	ARRAY	Unsigned32	**Page** 101
4559	Detailed Software Version	ARRAY	Unsigned32	**Page** 102
4560	Slave CAN termination	ARRAY	Unsigned32	**Page** 103
4561	Master CAN termination	ARRAY	Unsigned32	**Page** 104
4565	ENP SDO	ARRAY	Unsigned32	**Page** 105

Index (hex)	Object name	Object (code)	Type	see
5000	User EEPROM Access	ARRAY	Unsigned32	**Page** 106

Contents

Objects ranging from index 0x1000 through 0x2000

Device Type (Index 0x1000)

The structure of the object "Device Type" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x1000	0	0x008F0191	Type of device	ro (read only)

This object is read-only and conforms with the CANopen® specification.

Error Register (Index 0x1001)

The structure of the object "Error Register" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x1001	0	0	Error register	ro (read only)

This object implements the CANopen® error register functionality.

Bit 0 = Generic error
Bit 1 = Current error
Bit 2 = Voltage error
Bit 3 = Temperature error
Bit 4 = Communication error
Bit 5 = Parameter mismatch
Bit 6 = Not applicable
Bit 7 = Manufacturer-specific error, for example, hardware error

Pre-defined Error Field (Index 0x1003)

The structure of the object "Pre-defined Error Field" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x1003	0	0	Number of errors entered in the array's standard error field	rw (read & write)
	1	0	Most recent error; **0** indicates no error	ro (read only)
	2 ... 64	-	Earlier errors	ro

This object shows a history list of errors that have been detected by the JXM-IO-E02. The maximum length of the list is 64 errors. The list content is deleted on restart.

As per CANopen® specification this list can be cleared by entering the value **0** into sub-index 0.

Composition of Pre-defined Error Field

2-byte LSB: Error code

2-byte MSB: Additional information

Manufacturer Software Version (Index 0x100A)

The structure of the object "Manufacturer Software Version" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x100A	0		Software version	const

Use only the STX function `CanOpenUploadSDO()` to determine the version of the software running in the JXM-IO-E02.

The version string has a length of 9 characters and is of the format **2.00.0.00**. The first digit is the major revision followed by the minor revision and the branch and beta indicators (which will usually be zero). This value is read-only (ro).

Producer Heartbeat Time (Index 0x1017)

The structure of the object "Producer Heartbeat Time" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x1017	0	1,000 [ms]	Heartbeat time	rw (read & write)

The legal range for values is 250 ... 65,535.

Features (Index 0x2000)

The structure of the object "Features" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x2000	0		Features Object	ro (read only)

This object is only provided for compatibility reasons.

Object "Digital Outputs" (Index 0x2100)

Digital Input (Index 0x2100)

The structure of this object is shown in the table below. This object is for configuring the digital inputs IN 1 ... IN 5 and for retrieving their states.

Index	Sub-index	Default	Description	Attributes
0x2100	0	6	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Active-high/active-low selection	rw (read & write)
	3	1	Not used	
	4	0	Process value 0: Input states (2 bits/channel)	ro
	5	0	Process value 1: Input states (1 bit/channel)	ro
	6	5	Parameter 0: Amount of inputs	ro

Sub-index 2

The function of sub-index 2 is described below:

- Sub-Index 2 lets you set inputs IN 1 through IN 5 to either active-high (internal pull down resistor) or active-low (internal pull up resistor) mode.
- A bit value of **0** sets the input to active-low (input state "OFF") and a bit value of **1** sets the input to active-high (input state "ON"). The value can also be read back to confirm.
- Sub-index 2 uses the one bit per channel data structure described below:
  - Bit 0: Digital input IN 1
  - Bit 1: Digital input IN 2
  - Bit 2: Digital input IN 3
  - Bit 3: Digital input IN 4
  - Bit 4: Digital input IN 5

Sub-index 4

The function of sub-index 4 is described below:

- Sub-index 4 lets you retrieve the current state of IN 1 through IN 5.
- Sub-index 4 returns the data in a two bit per channel format (provided for backwards compatibility).
- Sub-index 4 uses the two bit per channel data structure described below:
  - Bit 1, 0: Digital input IN 1
  - Bit 3, 2: Digital input IN 2
  - Bit 5, 4: Digital input IN 3
  - Bit 7, 6: Digital input IN 4
  - Bit 9, 8: Digital input IN 5
- In the two bit per channel configuration, the following data values are possible:
  - 0b00: Not used
  - 0b01: Input state OFF

	• 0b10: Input state ON • 0b11: Not used
Sub-index 5	The function of sub-index 5 is described below: ▪ Sub-index 5 lets you retrieve the current state of IN 1 through IN 5. ▪ Sub-index 5 returns the data in the one bit per channel data structure described below: ▪ Sub-index 5 uses the one bit per channel data structure described below: • Bit 0: Digital input IN 1 • Bit 1: Digital input IN 2 • Bit 2: Digital input IN 3 • Bit 3: Digital input IN 4 • Bit 4: Digital input IN 5 ▪ In the one bit per channel configuration, the following data values are possible: • 0: Input state OFF • 1: Input state ON
Sub-index 6	Sub-index 6 lets you retrieve the number of available inputs. In the given case, five inputs are available.

Object " Digital Universal-I/O" (Index 0x2101)

Universal I/O

A universal I/O, that is, a multi-purpose I/O, can be used as digital input or digital output. Therefore, universal I/Os must be configured correspondingly.

- You can configure as many universal I/Os as required as digital input or output.
- If a universal I/O is used as digital input, the related digital output must be disabled (OFF).

Universal I/O (Index 0x2101)

This object lets you configure universal I/Os. It allows either to read out the state of the digital inputs **IN 6 ... IN 21**, or to set the digital outputs **OUT 1 ... 16**.

The structure of this object is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2101	0	6	Number of entries	ro (read only)
	1	0	Enabling channel	rw (read & write)
	2	0	Disabling channel	rw
	3	4	Not used	
	4	0	Process value 0: Reading back output states / reading out input states	rw
	5	0	Process value 1: Output states	rw
	6	16	Parameter 0: Number of inputs/outputs	ro

Sub-index 1

The function of sub-index 1 is described below:

- Sub-index 1 lets you enable individual channels.
- To enable a channel, enter its number (**1 ... 16**) into sub-index 1.
- Reading out sub-index 1 will always return the value **0**.

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 lets you disable individual channels.
- To disable a channel, enter its number (**1 ... 16**) into sub-index 2.
- Reading out sub-index 2 will always return the value **0**.

Sub-index 4

The function of sub-index 4 is described below:

- Sub-index 4 lets you retrieve the current state of **IN 6 ... IN 21**.
- In addition, it lets you read back the states of **OUT 1 ... OUT 15**.
- In sub-index 4, each bit is assigned to a channel:
  - Bit 0: Channel 1 (IN 6 or OUT 1)
  - Bit 1: Channel 2 (IN 7 or OUT 2)
  - ...
  - Bit 14: Channel 15 (IN 20 or OUT 15)
  - Bit 15: Channel 16 (IN 21 or OUT 16)
- If a universal I/O is used as digital input, the related digital output must be disabled (OFF).

Sub-index 5

The function of sub-index 5 is described below:

- Sub-index 5 lets you set or reset the digital outputs **OUT 1 ... OUT 16**.
- In sub-index 5, each bit is assigned to a channel:
  - Bit 0: Channel 1 (OUT 1)
  - Bit 1: Channel 2 (OUT 2)
  - ...
  - Bit 14: Channel 15 (OUT 15)
  - Bit 15: Channel 16 (OUT 16)
- Depending on the bit value, the output state is as follows:
  - 0: Output state OFF
  - 1: Output state ON

Sub-index 6

Sub-index 6 lets you read out the number of available inputs/outputs. In the given case, 16 inputs/outputs are available.

Object "Tri-state Input" (Index 0x2102)

Purpose of tri-state inputs

Tri-state inputs are generally used for obtaining the node ID or changing the default node ID (device coding). However, in applications where device coding is not required, these inputs can be freely used as general-purpose digital inputs. This may be the case if only one JCM-350-E03 or JXM-IO-E02 is connected to the CAN bus.

Object **System Parameters** (Index 0x4556, sub-index 38) lets you disable the flag "Tri-state Coding Enable". To do so, enter the value **0**.

Tri-state Input (Index 0x2102)

The object **Tri-State Inputs** is read-only. Read this object to obtain the states of the tri-state inputs. The structure of this object is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2102	0	6	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Not used	
	3	3	Not used	
	4	0	Process value 0: Input states	ro
	5	0	Process value 1: Not used	
	6	2	Parameter 0: Amount of inputs	ro

Sub-index 4

Sub-index 4 lets you read out the latest measured states of the two tri-state inputs.

Because each input can be in one of three different input states, sub-index 4 uses the two bit per channel data structure described below:

- Bit 1, 0: Tri-state input 1 (pin 67)
- Bit 3, 2: Tri-state input 2 (pin 68)

The following values are allowed:

- 0b00: Tri-state (not connected)
- 0b01: Input state OFF
- 0b10: Input state ON
- 0b11: Not used

Sub-index 6

Sub-index 6 lets you read out the number of available inputs. In the given case, two inputs are available.

Calculating the node ID based on tri-state input state

The following table shows the resulting node ID given that the default base ID of 0x10 is used:

State of pin 67	State of pin 68	CANopen® Node ID
Not connected	Not connected	0x10

State of pin 67	State of pin 68	CANopen® Node ID
Not connected	OFF	0x11
Not connected	ON	0x12
OFF	Not connected	0x13
OFF	OFF	0x14
OFF	ON	0x15
ON	Not connected	0x16
ON	OFF	0x17
ON	ON	0x18

Changing the default node ID 0x10

The node ID is stored in the internal EEPROM and is read out during the boot process. For special applications, the object **System Parameters** (index 0x4556, sub-index 4) lets you change the value stored in the EEPROM.

Object "Switch Feed Output" (Index 0x2103)

Switch Feed Output (Index 0x2103)

This object lets you enable or disable the two switch feed outputs. The structure of this object is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2103	0	6	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Not used	
	3	4	Not used	
	4	0	Process value 0: Information on the state	
	5	0	Process value 1: Output state	rw (read & write)
	6	2	Parameter 0: Number of outputs	ro

Sub-index 4

Sub-index 4 returns the following status information on the switch feed outputs:

- Bit 0 represents switch feed output 1
- Bit 1 represents switch feed output 2
- The following bit values are possible:
  - 0: An error has occurred
  - 1: Normal operation, no error

Sub-index 5

The function of sub-index 5 is described below:

- Sub-Index 5 lets you enable/disable the output state of both switch feed channels.
- Sub-index 5 uses the one bit per channel data structure described below:
  - Bit 0 = Switch feed output 1
  - Bit 1 = Switch feed output 2
- The following values are allowed:
  - 0: Disable the switch feed output
  - 1: Enable the active-high switch feed output

Sub-index 6

Sub-index 6 lets you read out the number of available switch feed outputs.

Digital active-low-side outputs

Switch feed outputs can also be used as digital active-low-side outputs. If an output is disabled and no load is connected to it, then status bit in sub-index 4 is "0". If there is a low-resistance connection to ground, then status bit 4 is "1".

Objects "Analog Input" (Index 0x2200 ... 0x2203)

Analog Input (Index 0x2200 ... 0x2203)

These objects let you configure analog inputs 1 ... 4. The analog input signal can be read out as process value. The structure of these objects is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2200 ... 0x2203	0	7	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Operating mode	rw (read & write)
	3	0x30	Not used	
	4	0	Process value 0: Analog input signal	ro
	5	0	Process value 1: Analog input signal [mV]	ro
	6	8,191	Parameter 0: Maximum output value	ro
	7	40,000	Parameter 1: Maximum output value	ro

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 lets you select between two modes of operation. One of these modes supports Automatic Gain Control (AGC). The other mode of operation supports either voltage measurement or current measurement.
- To select the operating mode, set or reset bit 0 and bit 4:
  - Bit 0 = 0: Disable AGC
  - Bit 0 = 1: Enable AGC
  - Bit 4 = 0: Select voltage measurement
  - Bit 4 = 1: Select current measurement
- If AGC is enabled, the analog input lets you measure input signals in the range of 0 ... 40 V.

  If AGC is disabled, the analog input lets you measure input signals in the range of 0 ... 5 V.
- If current measurement is enabled, the analog input lets you measure current signals of 0 or 4 ... 20 mA.

  Effectively, this mode changes the input impedance of the analog input to 240 Ω. 20 mA generate a 4.8 V signal, 4 mA generate a 960 mV signal, and 0 mA result in a 0 V signal.
- To allow for backwards compatibility, writing a value of **0x81** to sub-index 2 will disable the AGC mode. The value of **0x90** will disable the current measurement mode to enable voltage measurement.

Sub-index 4

The function of sub-index 4 is described below:

	▪ Sub-index 4 lets you read the value of the latest measured analog input signal. ▪ With AGC enabled, the measured value will range between 0 ... 8,191. ▪ With AGC disabled, the measured value will range between 0 ... 1,023.
Sub-index 5	The function of sub-index 5 is described below: ▪ Sub-index 5 lets you read the value of the latest measured analog input signal, too. ▪ The value is indicated in millivolts (mV). ▪ With AGC enabled, the measured value will range between 0 ... 40,000. ▪ With AGC disabled, the measured value will range between 0 ... 5,000.
Sub-index 6	The function of sub-index 6 is described below: ▪ Sub-index 6 lets you read the maximum value that can be output via sub-index 4.
Sub-index 7	The function of sub-index 7 is described below: ▪ Sub-index 7 lets you read the maximum value that can be output via sub-index 5.
Current mode	If this input is used as current input (0 ... 20 mA), it measures the voltage through an internal resistor of 240 Ω. That is why a current of 20 mA results in a voltage of 4.8 V. This value corresponds to a measured value of 982. The full-scale value of 1023 is reached if the input current is 20.8 mA.

Object "Voltage Sense Analog Input" (Index 0x2210)

Voltage Sense Analog Input (Index 0x2210)

This read-only object returns as process value the measured value of the three power feeds.

The structure of this object is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2210	0	6	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Not used	
	3	0	Not used	
	4	0	Process value 0: STANDARD FEED voltage [mV]	ro
	5	0	Process value 1: IGNITION FEED voltage [mV]	ro
	6	0	Process value 2: PROTECTED FEED ON/OFF	ro

Sub-index 4

The function of sub-index 4 is described below:

- Sub-index 4 lets you read the measured voltage of STANDARD FEED in millivolts.

Sub-index 5

The function of sub-index 5 is described below:

- Sub-index 5 lets you read the measured voltage of IGNITION FEED in millivolts.

Sub-index 6

The function of sub-index 6 is described below:

- Sub-Index 6 lets you read out whether PROTECTED FEED (after the safety switch/relay) is enabled or disabled:
  - 0: PROTECTED FEED disabled
  - 1: PROTECTED FEED enabled
- This object does not have an analog measurement.

Object "Feed Currents" (Index 0x2211)

Feed Currents (Index 0x2211)

The object **Feed Currents** is read-only. This object lets you read out the latest measurements of the STANDARD FEED and PROTECTED FEED currents. The structure of this object is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2211	0	2	Number of entries	ro (read only)
	1	0	Current measurement STANDARD FEED	ro
	2	0	Current measurement PROTECTED FEED	ro

Sub-index 1

The function of sub-index 1 is described below:

- Sub-index 1 lets you read the measured current of STANDARD FEED in mA.

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 lets you read the measured current of PROTECTED FEED in mA.

Object "Analog Output" (Index 0x2300)

Analog Output (Index 0x2300)

This object lets you configure the analog output. Also, the analog output voltage/current can be set as process value.

The structure of this object is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2300	0	5	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Instruction	rw (read & write)
	3	0x05	Not used	
	4	0	Process value 0: Output voltage	rw
	5	0	Process value 1: Output current	rw

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 lets you select between the following modes of operation.
  - 0x00: Disabled, no output function
  - 0x01: Constant output current
  - 0x02: Constant output current (ratiometric value specified)
  - 0x03: Constant output current (absolute value specified)
- To select one of the above modes, enter the corresponding value into sub-index 2.
- When you read out sub-index 2, the currently set mode is returned.
  The following information can be obtained:
  - 0x00: Disabled, no output function
  - 0x01: Constant output current
  - 0x02: Constant output current (ratiometric value specified)
  - 0x03: Constant output current (absolute value specified)
  - 0x08: Short-circuit to ground fault has been detected

Sub-index 4

The function of sub-index 4 is described below:

- Sub-index 4 lets you output a specific analog output voltage.
- With mode "Constant output voltage (ratiometric value specified)" enabled, the value will range between 0 ... 1,023.
  This value range relates to 0 ... 100 % of the input voltage.
- With mode "Constant output voltage (absolute value specified)" enabled, the value specifies the output voltage in mV units.
  If you enter a value that is larger than the maximum value, the output voltage will be clipped.
- The maximum output voltage of the analog output will always be slightly less than STANDARD FEED voltage.
- Sub-index 4 lets you read out the recently measured output voltage in mV units.

Sub-index 5

The function of sub-index 5 is described below:

- Sub-index 5 lets you set the analog output current.
- With mode "Constant output current" enabled, the value specifies the output current in 1 mA units.
- With mode "Constant output voltage (absolute value specified)" enabled, the value specifies the desired maximum output current.

  If the specified output voltage causes the output current to exceed this value, the output is clipped to control the output current.
- The maximum output voltage of the analog output will always be slightly less than STANDARD FEED voltage.
- Sub-index 5 lets you read out the recently measured output current in 1 mA units.

Objects "PWM Output" (Index 0x2400 ... 0x2402)

PWM Output 1 ... 3 (Index 0x2400 ... 0x2402)

These objects let you configure the three PWM outputs. Also, the controlled output current or a PWM duty cycle can be set as process value. By means of the system parameters, a Dither function can be set. The structure of these objects is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x2400 ... 0x2402	0	14	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Operating mode	rw (read & write)
	3	0	Not used	
	4	0	Process value 0: Output current	rw
	5	0	Process value 1: Pulse control factor	rw
	6	2,500	Parameter 0: Maximum value	ro
	7	1,023	Parameter 1: Maximum value	ro
	8	0	Predictor parameter	rw
	9	0	Proportional parameter	rw
	10	0	Integrator parameter	rw
	11	0	PWM predictor auto-tune function	rw
	12	0	Saving the system parameter settings	rw
	13	0	Locking the controller	rw
	14	0	PWM, averaging window (x times 8 ms) of analog-to-digital converter (ADC)	rw

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 lets you select one of the following modes of operation.
  - 0x01: Current-controlled PWM output
  - 0x02: PWM output with static duty cycle
- To select one of the above modes, enter the corresponding value into sub-index 2.
- In static PWM duty-cycle output mode the output current will not be controlled.

  However, it will be monitored. If the measured current exceeds a user set threshold, the PWM output is disabled and the JXM-IO-E02 reports an error. The maximum value is to be entered into sub-index 6.

Sub-index 4

The function of sub-index 4 is described below:

- In current-controlled PWM output mode, write to sub-index 4 to set the output current.
- The value is in the range of 0 ... 2499 mA.
- Sub-index 4 lets you read out the recently measured output current in 1 mA units.

Sub-index 5

The function of sub-index 5 is described below:

- Sub-index 5 is used to set the PWM duty cycle.
- The value must be in the range of 0 ... 1,023, where 0 is a 0 % duty cycle and 1,023 is a 100 % duty cycle.
- Use the mode "PWM Output with Static Duty Cycle" in order to use the PWM output as a digital output.
- Reading sub-index 5 returns the most recent PWM duty cycle as a value in the range 0..1,023.

Sub-index 6

The function of sub-index 6 is described below:

- Sub-index 6 lets you read out the maximum value that can be input via sub-index 4.

Sub-index 7

The function of sub-index 7 is described below:

- Sub-index 7 lets you read out the maximum value that can be input via sub-index 5.

Sub-index 8

The function of sub-index 8 is described below:

- In "Current-Controlled PWM Output" mode sub-index 8 lets you set the Predictor parameter for the current control algorithm.
- This parameter is an unsigned 16-bit word where the least significant byte is the divisor and the most significant byte is the multiplier.
- The least significant byte of this parameter is not allowed to be zero because it is a divisor.

Sub-index 9

The function of sub-index 9 is described below:

- In "Current-Controlled PWM Output" mode sub-index 9 lets you set the Proportional parameter for the current control algorithm.
- This parameter is an unsigned 16-bit word where the least significant byte is the divisor and the most significant byte is the multiplier.
- The least significant byte of this parameter is not allowed to be zero because it is a divisor.

Sub-index 10

The function of sub-index 10 is described below:

- In "Current-Controlled PWM Output" mode sub-index 10 lets you set the Integrator parameter for the current control algorithm.
- This parameter is an unsigned 16-bit word where the least significant byte is the divisor and the most significant byte is the multiplier.
- The least significant byte of this parameter is not allowed to be zero because it is a divisor.

Current control

In "Current-Controlled PWM Output" mode the PWM duty cycle is controlled using the above three parameters in the following formula:

$$PWM_{DutyCycle} = \frac{Pre_{mul} \cdot Current_{Demand}}{Pre_{div}} + \frac{Pro_{mul} \cdot Error}{Pro_{div}} + \frac{Int_{mul}}{Int_{div} \cdot IntegratedError}$$

Where:

- Pre_{mul} and Pre_{div} are the Predictor multiplication and division factors (sub-index 8),
- Pro_{mul} and Pro_{div} are the Proportional multiplication and division factors (sub-index 9),
- Int_{mul} and Int_{div} are the Integrator multiplication and division factors (sub-index 10),
- $Current_{Demand}$ is the user input in milliamp,
- Error is the difference between the measured and commanded output current (also in milliamp).
- Integrated Error is the integral of the error signal.

Calculating the PWM duty cycle

When a new output current is requested, the "Error" and "Integrated Error" terms are zero. The output duty cycle is therefore calculated based on the user input and the Predictor parameters. To ensure that this first output level is accurate, the predictor parameter must be set for the load that it will be driving.

After the initial duty cycle calculation, the PWM algorithm uses the difference between the measured output current and the current demand to adjust the PWM duty cycle. The proportional and integrator parameters influence how fast the algorithm responds to a difference between the measured and demanded current. These two parameters also determine how much overshoot there will be.

All three parameters are highly dependent on the load that is being driven. Therefore it is the users' responsibility to tune these parameters for their own application.

If the PWM is already driving an output at a certain current level and a new output current is requested, the algorithm uses the actual output current to calculate the new duty cycle. This method reduces the sensitivity to incorrect predictor parameters, but does not remove it – these parameters will still affect the normal operation.

The PWM duty cycle is calculated as follows:

$$DC_0 = 1024 \times demand \times \frac{CR}{U_{batt}} \times 0.75$$

$$DC_n = DC_{n-1} + Err \times \frac{EP}{1024} + Int \times \frac{IP}{1024}$$

Where:

- DC_0 is the initial duty cycle (the first duty cycle after the current value has been entered (*Current Demand*)).
- *Current Demand* is the current demand in mA,
- *CR* is the coil resistance that has been specified in the system parameters or calculated by the software.
- U_{batt} is the measured battery voltage (STANDARD FEED).
- DC_n is the next duty cycle.
- DC_{n-1} is the current duty cycle.
- *Err* is the error in the load current (difference between demand and actual value) in mA.
- *EP* is the error parameter – specified in the system parameters.
- *Int* is the integral of the error signal (basically the sum of the error currents, but the integral is multiplied by 0.25 after every cycle).
- *IP* is the integrator parameter – specified in the system parameters.

When you update the software of a device that has been configured for using the old PWM algorithm, the following settings are used:

The coil resistance is calculated by the predictor parameter. The formula that is now used to calculate DC0 has been integrated into the predictor parameter.

The proportional parameter (error parameter) is set to 160. The integrator parameter is set to 420. These values have been experimentally selected and have proven to be safe for a wide range of solenoid valves.

Sub-index 11

The function of sub-index 11 is described below:

- Sub-index 11 offers an automatic tuning of the Predictor parameter.
- To activate this function, write a 16-bit current value to sub-index 11.
- The system will then attempt to drive this current on the PWM and calculate what the predictor parameters must be in order to accurately guess the PWM duty cycle when a new current is requested.
- While this function is still running, the predictor parameter in sub-index 8 will read as **0**.
- As soon as the function completes (this may take up to 10 seconds, but is usually faster), the calculated Predictor parameters are available for reading from sub-index 8. The PWM algorithm will also use these parameters immediately.
- However, the newly calculated parameters will not be written to non-volatile memory. When the JXM-IO-E02 is reset or power cycled, these parameters will fall back to the previous parameters stored in the non-volatile memory.

  It is up to the user to first test the new parameters, read them from sub-index 8, and then write it to the System Parameters for permanent storage.

No-load detection	The function "No-load detection" is described below: ■ No-load detection can be activated for each PWM channel individually. ■ When "Current Control" mode is selected, no-load will be detected if the duty cycle reaches maximum and the load current remains below the specified threshold. ■ In the "Static PWM Duty Cycle Output" mode, no-load is detected whenever the duty cycle is non-zero and the load current is below the threshold. ■ The no-load threshold is set in object **System Parameter** (index 0x4556, sub-index 40).
Sub-index 12	The function of sub-index 12 is described below: ■ To store the values from sub-index 11 to the system parameters, enter these values into sub-index 12. Then, enter "1" into 0x4556, sub-index 0 (enable write access to system parameters).
Sub-index 13	The function of sub-index 13 is described below: ■ When writing values to sub-index 12 is completed, sub-index 13 introduces a new parameter: **Control Inhibit**. ■ This parameter is used to slow down the PWM algorithm. ■ **Control Inhibit** is necessary because the PWM algorithm can run faster than the current rise/fall time in the load.
Sub-index 14	The function of sub-index 14 is described below: ■ For the purpose of current control the analog-to-digital converter measures via a shunt resistor the current that is produced by the PWM signal. ■ Sub-index 14 lets you set the number of measured values to be used by the ADC for averaging (x times 8 ms).

Object "H-Bridge" (index 0x2500)

H-Bridge (Index 0x2500)

This object lets you configure the H-bridge. Also, this object can be used to read the output states. It returns the PWM duty cycle when the H-bridge is in a PWM-controlled mode. The structure of the object "H-Bridge" is shown in the following table.

Index	Sub-index	Default	Description	Attributes
0x2500	0	7	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Operating mode	rw (read & write)
	3	0	Not used	
	4	0	Process value 0: Measured current	ro
	5	0	Process value 1: Output states/duty cycle	rw
	6	1,023	Parameter 0: Maximum output value	ro
	7	7	Parameter 1: Bridge configuration	ro

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 lets you select between the following modes of operation.
  - 0x01: The two output channels (pins 69 and 70) are used as independent digital outputs.
  - 0x02: The output connected to pin 69 is a PWM-controlled high-side output, whereas the output connected to pin 70 is always low.
  - 0x04: The output connected to pin 70 is a PWM-controlled high-side output, whereas the output connected to pin 69 is always low.
- To select one of the above modes, enter the corresponding value into sub-index 2.

Sub-index 4

The function of sub-index 4 is described below:

- Sub-index 4 lets you read out the recently measured current in mA units.
- Note that current measurement is not available when the H-Bridge outputs are used as independent digital outputs.

Sub-index 5

The function of sub-index 5 is described below:

- When the H-Bridge outputs are used as two independent digital outputs, the least significant byte sets the output state:
  - Bit 1, 0: Pin 69 is set as output
  - Bit 5, 4: Pin 70 is set as output
- In the configuration as two independent digital outputs, the following data values are possible:
  - 0b00: Tri-state output

	• 0b01: Output state OFF • 0b10: Output state ON ▪ In PWM-controlled mode, a value in the range of 0 ... 1023 sets the PWM duty cycle. ▪ In PWM-controlled mode, sub-index 5 lets you set the PWM duty cycle.
Sub-index 6	The function of sub-index 6 is described below: ▪ Sub-index 6 lets you read out the maximum value for the duty cycle that can be input via sub-index 5.

Objects "Frequency Input" (Index 0x2600 ... 0x2601)

Frequency Input (Index 0x2600 ... 0x2601)

These objects let you configure input pins 54 and 55 either as frequency inputs or as simple digital inputs. In frequency input mode, the period length of the incoming signal is measured. The structure of these objects is shown in the table below.

Index	Sub-index	Default	Description	Attributes
0x2600 ... 0x2601	0	7	Number of entries	ro (read only)
	1	0	Not used	
	2	0	Operating mode	rw (read & write)
	3	1	Not used	
	4	0	Process value 0: Period length [ns]	ro
	5	0	Process value 1: Digital input state	ro
	6	0xFFFFFFFF	Parameter 0: Maximum frequency value	ro
	7	0	Pulse count	ro

Sub-index 2

The function of sub-index 2 is described below:

- To select the operating mode, enter the following values into sub-index 2:
  - 0: Frequency input mode (no pull-up/pull-down resistor)
  - 1: Digital input (active-low)
  - 2: Digital input (active-high)
  - 3: Frequency input (with pull-up resistor)
  - 4: Frequency input (with pull-down resistor)
  - **As of device revision 12.xx** a new parameter is available:

    5: Frequency input (with low operating point and hysteresis for **Variable Reluctance Sensor**)
- Sub-index 2 lets you read out the current operating mode.

Sub-index 4

The function of sub-index 4 is described below:

- In frequency input mode, sub-index 4 lets you read out the value of the latest measured period length.
- The returned value is a 32-bit unsigned integer specifying the period length of the signal in nanoseconds.
- This result is updated every 17 or 18 cycles of the external signal.

Sub-index 5

The function of sub-index 5 is described below:

- In digital input mode, sub-index 5 lets you read out the current state of input pin 54 or 55.
- The following values are allowed:
  - 0: Input state OFF
  - 1: Input state ON

Sub-index 7

The function of sub-index 7 is described below:

- The two frequency input circuits will always count pulses on these inputs regardless of their input mode. The pulse period must not be less than 1 millisecond. The pulse must be active for at least 1 millisecond each period in order to be counted.
- The pulse count always starts at zero at power on/reset. The value is also reset to zero every time that it is read via this SDO.
- The returned value is a 32-bit unsigned integer.
- The frequency of the input signal must be less than 500 Hz.

Object "5 V Output" (Index 0x2800)

5 V Output (Index 0x2800)

The structure of this object is shown in the table below.

Index	Sub-index	Default	Description
0x2800	0	2	Number of entries
	1	0	5 V output error state
	2	0	5 V output is activated

Sub-index 1

The function of sub-index 1 is described below:

- Sub-index 1 returns the error state of the 5 V output.
  - Value **0** means no error.
  - Value **1** indicates that the protection has been activated due to an external fault.

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 returns the current drive status of the 5 V output.
  - 0: 5 V output is disabled
  - 1: 5 V output is enabled
- Sub-index 2 also supports write access (OS version 3.03.0.00 or higher). This lets you enable/disable the 5 V output for production testing.
  - Value **0** disables the 5 V output.
  - Value **1** enables the 5 V output.
- Only sub-index 2 is writable.

Objects "OS Update" (Index 0x4554) and EDS (Index 0x4555)

OS Update (Index 0x4554)

This object is used for OS updates.
It should not be accessed directly in most applications.

Electronic Data Sheet (Index 0x4555)

This object is read-only. This object lets you retrieve, for instance, the PCB revision. If you wish to contact the hotline of Jetter AG in case of a problem, please have this information ready.

Index	Sub-index	Default	Description	Attributes
0x4555	0	15	Number of entries	ro (read only)
	1	0	Status	ro
	2	0	Instruction	ro
	3		Page 0: Version	ro
	4		Page 0: Module code	ro
	5		Page 0: Module name (string)	ro
	6		Page 0: PCB revision	ro
	7		Page 0: PCB options	ro
	8		Page 1: Revision	ro
	9		Page 1: Module serial number (string)	ro
	10		Page 1: Production date: Day	ro
	11		Page 1: Production date: Month	ro
	12		Page 1: Production date: Year	ro
	13		Page 1: Test device number	ro
	14		Page 1: Test device version	ro
	15		Page 0: Minimum OS version	ro

Object "System Parameters" (Index 0x4556)

System Parameters (Index 0x4556)

Use the object "System Parameters" to permanently change the parameters mentioned below. Any changes made to these parameters are stored in non-volatile memory and are therefore recovered when the JXM-IO-E02 is next powered up. The device must be rebooted for the changes to take effect.

Note that some of these settings can also be set using other SDO objects. However, the **System Parameters** object is the only way to make these changes permanently.

Index	Sub-index	Default	Description	Attributes
0x4556	0	83	Number of entries	ro (read only)
	1	0	Version	ro
	2	0	CAN bus termination	rw (read & write)
	3	1	CAN baud rate	rw
	4	0x10	CANopen® node ID	rw
	5	1,000	CANopen® heartbeat time period	rw
	6	0x0A16	PWM 1: Predictor parameter	rw
	7	0x0302	PWM 1: Proportional parameter	rw
	8	0x0101	PWM 1: Integrator parameter	rw
	9	0x0A16	PWM 2: Predictor parameter	rw
	10	0x0302	PWM 2: Proportional parameter	rw
	11	0x0101	PWM 2: Integrator parameter	rw
	12	0x0A16	PWM 3: Predictor parameter	rw
	13	0x0302	PWM 3: Proportional parameter	rw
	14	0x0101	PWM 3: Integrator parameter	rw
	15	0	Analog input 1: Mode select	rw
	16	0	Analog input 2: Mode select	rw
	17	0	Analog input 3: Mode select	rw
	18	0	Analog input 4: Mode select	rw
	19	25	Digital output 1 (STANDARD): Current limit	rw
	20	25	Digital output 2 (STANDARD): Current limit	rw
	21	25	Digital output 3 (STANDARD): Current limit	rw
	22	25	Digital output 4 (STANDARD): Current limit	rw

Index	Sub-index	Default	Description	Attributes
	23	25	Digital output 5 (STANDARD): Current limit	rw
	24	25	Digital output 6 (STANDARD): Current limit	rw
	25	25	Digital output 7 (STANDARD): Current limit	rw
	26	25	Digital output 8 (STANDARD): Current limit	rw
	27	50	Digital output 9 (PROTECTED): Current limit	rw
	28	50	Digital output 10 (PROTECTED): Current limit	rw
	29	50	Digital output 11 (PROTECTED): Current limit	rw
	30	50	Digital output 12 (PROTECTED): Current limit	rw
	31	50	Digital output 13 (PROTECTED): Current limit	rw
	32	50	Digital output 14 (PROTECTED): Current limit	rw
	33	50	Digital output 15 (PROTECTED): Current limit	rw
	34	50	Digital output 16 (PROTECTED): Current limit	rw
	35	1	PWM output 1: Mode	rw
	36	1	PWM output 2: Mode	rw
	37	1	PWM output 3: Mode	rw
	38	1	Tri-state coding enable	rw
	39	100	Digital output: No-load threshold	rw
	40	100	PWM output: No-load threshold	rw
	41	0	Frequency input 1: Mode	rw
	42	0	Frequency input 2: Mode	rw
	43	2,500	H-bridge: Current limit	rw
	44	100	H-bridge: No-load threshold value	rw
	45	2,500	PWM output: Current limit	rw
	46	0	Digital inputs IN 1 ... IN 5: Active-low/active-high selection	rw
	47	0	Switch feed output: Initial output state	rw

Index	Sub-index	Default	Description	Attributes
	48	0	Digital outputs: No-load detection enable	rw
	49	0	PWM: No-load detection enable	rw
	50	0	H-bridge: No-load detection enable	rw
	51	0x00000C00	Event-based PDO TX enable	rw
	52	0xC000	Digital output: Start-up current pulse select	rw
	53	0	PWM software mode	rw
	54	10	PWM 1: Control inhibit	rw
	55	10	PWM 2: Control inhibit	rw
	56	10	PWM 3: Control inhibit	rw
	57	0	H-bridge: Initial output mode	rw
	58	100	Analog output: Maximum output current	rw
	59	2000	Frequency input 1: High frequency reject	rw
	60	2000	Frequency input 2: High frequency reject	rw
	61	2	Frequency input 1: Number of periods	rw
	62	2	Frequency input 2: Number of periods	rw
	63	0	RX PDO timeout period	rw
	64	0	RX PDO timeout enable	rw
	65	0	Analog output: Initial mode	rw
	66	128	Frequency input 1: Timeout period	rw
	67	128	Frequency input 2: Timeout period	rw
	68	15	Analog input 1: Change threshold	rw
	69	15	Analog input 2: Change threshold	rw
	70	15	Analog input 3: Change threshold	rw
	71	15	Analog input 4: Change threshold	rw
	72	2	TX-PDO-1 - Minimum time	rw
	73	2	TX-PDO-2 - Minimum time	rw
	74	2	TX-PDO-3 - Minimum time	rw

Index	Sub-index	Default	Description	Attributes
	75	2	TX-PDO-4 - Minimum time	rw
	76	60	TX-PDO-1 - Maximum time	rw
	77	60	TX-PDO-2 - Maximum time	rw
	78	60	TX-PDO-3 - Maximum time	rw
	79	60	TX-PDO-4 - Maximum time	rw
	80	1	PWM 1: Averaging window (x times 8 ms) of ADC	rw
	81	1	PWM 2: Averaging window (x times 8 ms) of ADC	rw
	82	1	PWM 3: Averaging window (x times 8 ms) of ADC	rw
	83	0	PWM frequency	rw
	84	0	PWM 1: Dither amplitude	rw
	85	0	PWM 2: Dither amplitude	rw
	86	0	PWM 2: Dither amplitude	rw
	87	0	Period of Dither signal	rw

Version (sub-index 1)

This parameter is read-only. The return value of this parameter should be **0**.

CAN bus termination

This parameter selects whether the CAN termination resistors (120 Ω) inside the JXM-IO-E02 must be activated (one each at both ends of the CAN bus).

The following values are allowed:

- 0x00: Both resistors are disabled
- 0x01: Resistor at the end of the CAN bus is enabled (default value)
- 0x02: Resistor at the beginning of the CAN bus is enabled
- 0x03: Both resistors are enabled

When using the built-in CAN termination resistors, keep the following fact in mind:

If a device with enabled CAN termination resistors fails, the whole CAN communication breaks down.

CAN baud rate

This parameter lets you select the CAN Baud rate.

The following values are allowed:

- 0: 125 kBaud
- 1: 250 kBaud (default)
- 2: 500 kBaud
- 3: 1 MBaud

CANopen® node ID

Even with coding via tri-state inputs 1 (pin 67) and 2 (pin 68) enabled, this parameter lets you set the node ID of the JXM-IO-E02.

If the device is configured NOT to use the tri-state inputs 1 and 2 for selecting the node ID, then the value stored in this parameter will be the final node ID.

	The following values are allowed: ■ The value is in the range of 0x01 and 0x76. ■ The default value is 0x10.
CANopen® heartbeat time period	This is the time period, specified in milliseconds (ms), at which the JXM-IO-E02 will transmit a CANopen® heartbeat message. The own heartbeat status is sent as content of this message. Time periods less than 250 ms are allowed by CANopen® but do not make practical sense for the JXM-IO-E02 and are therefore not allowed. The following values are allowed: ■ The legal range for values is between 250 and 65,535 ms. ■ The default value is 1000.
PWM - Predictor, proportional and integrator parameters	Please refer to the description on object 0x2400, sub-index 8 ... 10.
Analog input mode selection	The parameters of **sub-index 15 ... 18** let you select the initial mode for the analog inputs at power on. These parameters correspond to objects **0x2200 ... 0x2203** (sub-index 2). For mode "current measurement" the following values with their predefined value ranges are allowed: ■ 0: 0 ... 5 V (default) ■ 1: 0 ... 40 V ■ 4: 0 ... 5 V with the pull-up resistor 240 Ω enabled. ■ 5: 0 ... 40 V with the pull-up resistor 240 Ω enabled. ■ 16: 0 ... 20 mA with the pull-up resistor 240 Ω enabled. ■ 20: 0 ... 5 V with the pull-up resistor 240 Ω enabled. ■ All other values are illegal.
Digital outputs 1 ... 8 (STANDARD) - Current limit	The parameters of **sub-index 19 ... 26** let you set the current limits for the digital outputs (STANDARD FEED). The data is in units of 100 mA, i.e. 1 = 100 mA; 25 = 2.5 A. The following values are allowed: ■ The current limit must be in the range 1 ... 30 (100 mA ... 3 A). ■ The default value is 25 (2.5 A).
Digital outputs 9 ... 16 (PROTECTED) - Current limit	The parameters of **sub-index 27 ... 34** let you set the current limits for the digital outputs (PROTECTED FEED). The data is in units of 100 mA, i.e. 1 = 100 mA; 25 = 2.5 A. The following values are allowed: ■ The current limit must be in the range 1 ... 55 (100 mA ... 5.5 A). ■ The default value is 50 (5 A).
Digital outputs 1 ... 16 - Current measurement	The current measurement of the JXM-IO-E02 is temperature dependent. At low temperatures the output current will be slightly larger than the limit above

before being limited and at high temperatures the output current will be slightly smaller.

The following formula gives the relation between the specified current and the actual measured current:

$$I_{Ist} = I_{Soll} * \frac{K}{9.500}$$

Where K is taken from the following table:

Load current	K at T = -40 °C	K at T = 25 °C	K at T = 125 °C
0.5 A	12,000	12,000	12,000
2.5 A	10,000	9,700	9,300
5.0 A	10,000	9,700	9,300

The temperature specified in the above table is not the ambient temperature, but rather an internal device temperature.

This temperature will be at least 20°C higher than the ambient when the JXM-IO-E02 has been working for a few minutes.

Especially for lower output currents, the measurement value will be far less accurate. It is recommend for setting the no-load and overcurrent thresholds that the thresholds are set with healthy safety margins.

PWM Outputs - Mode selection

The parameters of **sub-index 35 ... 37** let you select the initial mode for the PWM outputs 1 ... 3 at power on. Please refer to the description on object **0x2400**, sub-index 2.

The following values are allowed:

- 0: Output is disabled.
- 1: Current-controlled operation (default).
- 2: Static duty cycle operation (default).

Tri-state coding enable

When this parameter is set to 1, the JXM-IO-E02 will use the tri-state inputs to calculate its node ID.

Set this parameter to "0" in order to disable this function.

The default value is "1".

Digital outputs: Threshold for no-load detection

Sub-index 39 lets you set the no-load detection threshold for the 16 digital outputs.

The threshold is specified in milliamps. The following values are allowed:

- The allowed range is 50 ... 250 (50 mA ... 250 mA).
- The default value is 100 (100 mA).

When a digital output's load current is low (less than 1 A), the current measurement becomes inaccurate (refer to section "Digital outputs 1 ... 16 - Current measurement"). If a threshold current of 100 mA is specified, it is likely that the actual measured current is 126 mA.

PWM outputs: Threshold for no-load detection

Sub-index 40 lets you set the no-load detection threshold for the 3 PWM outputs. No-load detection is available only in "static PWM duty-cycle output mode" (no current control).

The threshold is specified in milliamps. The following values are allowed:

- The allowed range is 10 ... 1,000 (10 mA ... 1,000 mA).
- The default value is 100 (100 mA).

Frequency input mode selection

Sub-index 41 ... 42 let you select the initial mode for the frequency inputs 1 ... 2 at power on. Please refer to the description on objects **0x2600 ... 0x2601**, sub-index 2.

The following values are allowed:

- 0: Mode "Frequency measurement without bias" (default)
- 1: Mode "Digital input with pull-up resistor"
- 2: Mode "Digital input with pull-down resistor"
- 3: Mode "Frequency measurement with pull-up resistor"
- 4: Mode "Frequency measurement with pull-down resistor"

H-bridge: Current limit

Sub-index 43 lets you set the output current limit of the H-bridge.

The data is in units of 1 mA (i.e. 1 = 1 mA; 2,500 = 2.5 A).

The following values are allowed:

- The current limit must be in the range 250 ... 3,000 (250 mA ... 3.0 A).
- The default value is 2,500 (2.5 A).

H-bridge: Threshold for no-load detection

Sub-index 44 lets you set the no-load detection threshold for the H-bridge.

The threshold is specified in milliamps. The following values are allowed:

- The allowed range is 100 ... 250 (100 mA ... 250 mA).
- The default value is 100 (100 mA).

PWM output: Current limit

Sub-index 45 lets you set the output current limit of the PWM outputs 1 ... 3.. This parameter applies only when the outputs are used in "static PWM duty-cycle output mode" without current control. The data is in units of 1 mA (i.e. 1 = 1 mA; 2,500 = 2.5 A).

The following values are allowed:

- The current limit must be in the range 500 ... 2,500 (500 mA ... 2.5 A).
- The default value is 2,500 (2.5 A).

Digital inputs 1 ... 5: Bias value

Sub-index 46 lets you set the bias value of digital inputs 1 ... 5 at power on. Please refer to the description on object **0x2100**, sub-index 2.

Each digital input is represented by a single bit in the 5-bit word.

- Bit 0 = Digital input 1
- Bit 1 = Digital input 2
- ...
- Bit 4 = Digital input 5

Legal bit values are:

- 0: Pull-up resistor (active-low) enabled (default).
- 1: Pull-down resistor (active-high) enabled

Switch feed output states

Sub-index 47 lets you set the inital state of the two switch feed outputs at power on. Please refer to the description on object **0x2103**, sub-index 5.

The following values are allowed:

- The value must be in the range of 0 ... 3.

	▪ The default value is "0" selecting both outputs to be disabled.
Digital outputs: No-load detection enable	**Sub-index 48** lets you enable/disable the no-load detection for the 16 digital outputs. Each channel is represented by a single bit in the 16-bit word. ▪ Bit 0: Channel 1 (OUT 1) ▪ Bit 1: Channel 2 (OUT 2) ▪ ... ▪ Bit 14: Channel 15 (OUT 15) ▪ Bit 15: Channel 16 (OUT 16) To enable/disable no-load detection set the corresponding bit value: The following values are allowed: ▪ 0: No-load detection is disabled (default for all channels) ▪ 1: No-load detection is enabled No validation is performed on this parameter because all possible values (0 ... 65535) are legal.
PWM outputs: No-load detection enable	**Sub-index 49** lets you enable/disable the no-load detection for the 3 PWM outputs. Each PWM output is represented by a single bit: ▪ Bit 0: PWM output 1 ▪ Bit 1: PWM output 2 ▪ Bit 2: PWM output 3 To enable/disable no-load detection set the corresponding bit value. The following values are allowed: ▪ 0: No-load detection is disabled (default). ▪ 1: No-load detection is enabled The legal range for values is 0 ... 7 (inclusive).
H-bridge: No-load detection enable	**Sub-index 50** lets you enable/disable the no-load detection for the H-bridge. This parameter applies only when the H-bridge is used in PWM mode. The following values are allowed: • 0: No-load detection is disabled (default). • 1: No-load detection is enabled
Event-based PDO TX enable	**Sub-index 51** lets you select which inputs are allowed to trigger event-based PDO transmission. For more information, refer to section **CANopen® PDO Specification** (see page 108). Each of the 21 inputs is represented by a single bit in the 32-bit word. ▪ Bit 0: Digital input IN 1 ▪ Bit 1: Digital input IN 2 ▪ Bit 2: Digital input IN 3 ▪ Bit 3: Digital input IN 4 ▪ Bit 4: Digital input IN 5 ▪ Bit 16: Digital input IN 6 ▪ Bit 17: Digital input IN 7

- ...
- Bit 30: Digital input IN 20
- Bit 31: Digital input IN 21

To enable/disable event-triggered transmission of a PDO message set the corresponding bit value:

- 0: Event-triggered transmission is disabled
- 1: Event-triggered transmission is enabled
- The default value is "x00000C000" disabling event-triggered transmission of a PDO message for all inputs. This setting enables transmission of frequency measurement PDOs.
- Legal value range: The three reserved bits (bits 7, 6 and 5) must be zero. This means that the value of the least significant byte must never be higher than 31.

Digital output - Startup current pulse load

Sub-index 51 lets identify digital output channels that may draw a large current pulse at startup (inrush current).

This parameter accepts a 16-bit integer value. Each bit corresponds to one output channel:

- Bit 0: Digital output 1
- ...
- Bit 15: Digital output 16

For outputs that drive higher loads, set the corresponding bit in this parameter to 1. This informs the software to switch on this channel separately from all other channels to minimize the effect of the in rush currents in the device

The default value is 0xC000.

- This setting enables this feature for output channels 15 and 16.
- Because all possible values (0 to 65535) are valid, no validation checking is done on this parameter.

PWM software mode

- Refer to the PWM parameters below.

PWM - Control inhibit

Sub-index 54 ... 56 lets you set the rate at which the PWM current control algorithm runs.

- The cycle time of this algorithm is 8 ms.
- This parameter sets the delay between every new control algorithm.
- The legal range for values is 1 ... 100 (inclusive).
- The default value is "10".

H-bridge: Default mode of H-bridge output

Sub-index 57 lets you set the default mode of the H-bridge output.

- The value range is the same as for SDO object **0x2500**, sub-index 2.
- The following values are allowed:
  - 0: H-bridge disabled (default)
  - 1: Independent push/pull digital outputs
  - 2: Static duty cycle PWM: left-side output high, right-side output low
  - 4: Static duty cycle PWM: right-side output high, left-side output low

Analog output – Maximum current

Sub-index 58 lets you set the maximum output current [mA] for the analog output.

- The legal range for values is 1 ... 100.
- The default value is "100".

This parameter only has an effect when the analog output is used in one of the voltage output modes.

Frequency inputs - High frequency reject

Sub-index 59 ... 60 lets you set the maximum frequency that should be measured by frequency inputs 1 .. 2.

This parameter allows high frequency noise signals to be ignored.

The following values are allowed:

- 0: To disable this function
- Value range 100 Hz ... 20.000 Hz
- The default value is "2000".

Frequency input - Number of wave periods

Sub-index 61 ... 62 lets you set the number of signal periods counted and averaged for calculating the frequency for frequency inputs 1 .. 2.

The higher this number is, the more immune the measurement is to noise disturbances, but at the cost of taking longer to respond to changes in the signal frequency.

The following values are allowed:

- Value Range 1 ... 15.
- The default value is "2".

Timeout for receiving PDO messages

Sub-index 63 lets you set the maximum time within which the JXM-IO-E02 must receive PDO commands before disabling outputs. This value is specified in milliseconds [ms].

The following values are allowed:

- 0: To disable this function (default)
- Value Range 500 ... 60,000 ms.

For more information, refer to the description of the parameter "PDO timeout enable".

PDO timeout enable

Sub-index 64 lets you enable/disable PDO timeout (see sub-index 63) for each of the four RX-PDOs.

Each bit corresponds to a RX-PDO:

- Bit 0: RX-PDO-1
- Bit 1: RX-PDO-2
- Bit 2: RX-PDO-3
- Bit 3: RX-PDO-4

To enable/disable this feature set the corresponding bit value.

- 0: The feature is disabled (default).
- 1: The feature is enabled

The legal range for values is 0 ... 15 (inclusive).

Analog output - Default output mode

Sub-index 65 lets you set the default mode of the analog output.

The value range is the same as for SDO object **0x2300**, sub-index 2. The

following values are allowed:

- 0: Output disabled (default)
- 1: Current-controlled
- 2: Voltage-controlled (ratiometric)
- 3: Voltage-controlled (absolute)

Frequency inputs 1 ... 2 - Timeout

The parameters of **sub-index 66 ... 67** (frequency input 1 ... 2) let you set the maximum timeout period for the system to wait for a signal edge.

If no signal is received during this period, the frequency measurement aborts and returns the value **0**.

This parameter is specified in units of 16 ms. The following values are allowed:

- Value range 0 ... 128.
- The default value is "128".

Analog Inputs 1 ... 4: Change threshold

The parameters of **sub-index 66 ... 67** let you set the change threshold for the analog outputs 1 ... 4. The change threshold specifies the change in measurement that will register as an input change for triggering event-based PDO transmission.

The change in measurement must be at least 10 steps in order to trigger a PDO transmit.

The following values are allowed:

- Value range 1 ... 200.
  A value of 1 corresponds to 0.5 per cent. For example, 2 means 1 % of the full 1024-step measurement range.
- The default value is 15 which is 7.5 % of 1024 or 77 measurement steps.

TX-PDO 1 ... 4: Minimum time between transmissions

The parameters of **sub-index 72 ... 75** let you set the minimum amount of time between automatic (event-based) transmissions of TX-PDO-1.

If an input change triggers transmitting this PDO, the specified minimum amount of time must pass before the PDO will retransmit for a new input change event.

Requesting this PDO with CAN RTR messages will also reset this delay time.

This parameter is specified in units of 50 ms. The following values are allowed:

- Value range 0 ... 2540.
- Value **0** disables this feature.
- The default value is **2** which corresponds to a time period of 100 ms.

TX-PDO 1 ... 4: Maximum time between transmissions

The parameters of **sub-index 76 ... 79** let you set the maximum amount of time between automatic (event-based) transmissions of TX-PDO-1.

If no input change event occurs that triggers transmitting the PDO for the duration specified by this parameter, the device will transmit the PDO regardless. So, the external controller can have confidence that input signals are still being monitoring.

This parameter is specified in units of 50 ms. The following values are allowed:

- Value range 0 ... 254.
- Value **0** disables this feature.

	▪ The default value is 60 which corresponds to a time period of 3 ms.
PWM 1 ... 3: Averaging window (x times 8 ms) of ADC	The parameters of **sub-index 80 ... 82** let you select the ADC averaging window. Every 8 seconds a current measurement takes place. This parameter returns the average value for the last x current measurement. Where x is the value that is specified in this parameter. The following values are possible: • 1 (default): Displays the last current measurement value. • 2 (default): Displays the average value of the last two current measurements. • 3 (default): Displays the average value of the last three current measurements. • ... • 63 (default): Displays the average value of the last 63 current measurements. • 64 (default): Displays the average value of the last 64 current measurements.
PWM frequency - Values	**Sub-index 83** lets you set the frequency for the 3 PWM outputs. The following values are allowed: • 0: 1.954 kHz (default) • 1: 977 Hz • 2: 488 Hz • 3: 244 Hz • 4: 122 Hz • 5: 61 Hz • 6: 30 Hz
PWM 1 ... 3: Dither amplitude	The parameters of **sub-index 84 ... 86** let you set the Dither amplitude. ▪ Permitted value range: 0 ... 25 [%] ▪ The default value is 0
Period of the Dither signal	The parameter **sub-index 87** lets you set the period of the Dither signal. The set value applies to all three PWM outputs simultaneously. This means that the period can NOT be set for each channel individually. ▪ Permitted value range: 4 ... 200 [ms] ▪ The default value is 0

Validating and setting system parameters

Validating system parameters

The first check is the system parameter version number. This value must not be 0xFF. If it is, this is considered to indicate an unprogrammed EEPROM. Therefore, all system parameters are set to their default values.

The next check counts the number of bytes in the system parameters that have a value of 0xFF. If the count finds more than 50 % at this value, all system parameters are invalidated and reset to their default values.

Individual parameters are range-checked at start-up. Each parameter has a specific minimum and maximum value or data pattern that must be adhered to. These ranges and/or patterns are described in the section above. If the value of any parameter does not match the requirements at start-up, the value of this parameter is reset to the default value.

If any of the three tests above finds a problem in the system parameters, EMCY 0x8002 is triggered.

Finally, the slave controller requests a copy of the system parameters as it is stored in the master controller. If the copy from the master controller does not match the slave, the master controller is reprogrammed to match the values stored in the slave. If this happens, the EMCY 0x8001 is triggered to indicate that a device reset occurred in order to reprogram and test system parameters.

Writing/setting system parameters

To write several system parameters in one go, proceed as follows:

Step	Action
1	In object **0x4556**, sub-index 0, enter the value **0**.
2	Now, enter the required values into the individual sub-indeces 2 ... 83.
3	In object **0x4556**, sub-index 0, enter the value **1**.
4	Wait at least several 100 ms.
5	In object **0x4557** read out sub-index 1. Upon completion of the write process, the value **0** should be returned. Note that during a write access it is possible that reading this sub-index could result in a timeout error.

To make changes to only one system parameter, proceed as follows:

Step	Action
1	Enter the new system parameter value.
2	In object **0x4557** read out sub-index 1. Upon completion of the write process, the value **0** should be returned. Note that during a write access it is possible that reading this sub-index could result in a timeout error.

Setting the delay

When writing to the system parameters, **make sure** that a `delay` is implemented after the SDO command.

The JXM-IO-E02 will reply to the SDO request to write to system parameters and will then write the data to non-volatile memory. This process can take as much as 50 ms. Therefore, it is recommended that a delay of 100 ms be implemented before the next SDO or PDO access to the same JXM-IO-E02.

Setting PWM parameters

Version 3 or higher of the JXM-IO-E02 software uses a different PWM current control algorithm. Please refer to the section *PWM output objects (Index 0x2400 ... 0x2402)* for information about the new PWM control algorithm.

As a result of this change, the control parameters had to change accordingly. But, for compatibility, the system parameters (index 0x4556) will allow control parameters based on both, the old and new algorithm. Therefore, if an older JXM-IO-E02 is upgraded from software version 2 to software version 3, the old PWM parameters will still work.

The system parameters at sub-indexes 6 ... 14 can stay exactly as before, or it can change to new values. The new parameter **PWM software mode** (sub-index 53) lets you select between old and new parameters. The default value for this parameter is to use "old" parameters. The three least significant bits of this parameter let you set the mode for each PWM output individually. Each bit corresponds to a PWM output:

- Bit 0: PWM 1
- Bit 1: PWM 2
- Bit 2: PWM 3

Legal bit values are:

- 0 = Old parameters
- 1 = New parameters

If the value **1** has been entered, the PWM system parameters change as listed below:

Sub-index	**Description**	**Valid range and default**
6, 9, 12	Coil resistance for PWM 1, 2, and 3	250 ... 65278 (inclusive) The default value is calculated during auto-tuning.
7, 10, 13	Error parameter for PWM 1, 2, and 3	0 ... 4095 (inclusive) The default value is "160".
8, 11, 14	Integrator parameter for PWM 1, 2, and 3	0 ... 4095 (inclusive) The default value is "420".

If the value **0** has been entered, the following range checking applies:

Sub-index	**Description**	**Valid range**
6, 9, 12	Predictor parameter (PWM-1, -2, and -3)	The value must be > 0, and the least significant byte must be >0.
7, 10, 13	Error parameter for PWM 1, 2, and 3	The least significant byte must be > 0.
8, 11, 14	Integrator parameter for PWM 1, 2, and 3	The least significant byte must be > 0.

The value of parameter **PWM software mode** (sub-index 53) is also considered during the validation of the PWM parameters. If one or more parameters have an invalid value, all PWM parameters (including PWM software mode) are reset to default.

If "old parameters" are selected, the JXM-IO-E02 software will use the old-style predictor parameter (from sub-indexes 6, 9, and 12) to calculate an appropriate value for the coil resistance. The error parameter and integrator parameter are set to the default values of 160 and 420 respectively.

Converting from old to new parameters

The procedure for converting old parameters to new parameters is set out in section *PWM output objects (index 0x2400 ... 0x2402*. This procedure will make all the necessary changes to system parameters.

Resetting system parameters to their default values

The object **System Parameters** (Index 0x4556) lets you reset system parameters to their default values. To prevent accidental triggering of this function, it is locked. To release this function, proceed as follows.

Step	Action
1	First, write to **0x4556, sub-index 1** (version), the unsigned 32-bit value **0x01042006**.
2	Then, write the unsigned 32-bit value **0xC1EA5AFE** to the same sub-index.
3	Wait a few seconds.
⇨	When the JXM-IO-E02 receives the second code correctly, it will immediately reset the parameters in EEPROM.

If a wrong code is entered at any stage, the JXM-IO-E02 will respond with a general CANopen® error message. Then you must repeat the whole procedure.

Object "OS Status" (Index 0x4557)

Object "OS Status" (Index 0x4557)

The structure of this object is shown in the table below. This read-only object provides access to some useful information.

Index	Sub-index	Default	Description
0x4557	0	5	Number of entries
	1	0	System parameters: Write status
	2	0	BSP state
	3	2	PCB revision number
	4	0	System parameters fault
	5	0	Not used

Sub-index 1

The function of sub-index 1 is described below:

- Sub-index 1 returns the status of writing system parameter data to the EEPROM.
- As long as the writing process is still ongoing, this sub-index will return a non-zero value. 0 indicates that the process has finished.
- Note that during the writing to EEPROM it is possible that reading this sub-index could result in a CANopen® timeout error.

Sub-index 2

The function of sub-index 2 is described below:

- Sub-index 2 returns the BSP state machine state number.
- The BSP uses specific modes for certain tasks that must be performed at start-up. Once all these tasks have been completed successfully, the BSP returns state 255 which indicates normal operation.

Sub-index 3

The function of sub-index 3 is described below:

- Sub-index 3 returns the PCB revision number.
  - A value of **1** indicates the former hardware type.
  - A value of **2** indicates the latest hardware type.

Sub-index 4

The function of sub-index 4 is described below:

- Sub-index 4 returns either **0** or **1**. If during start-up one or more system parameters were set to a default value, this value is set to **1**.

Object "Detailed Software Version" (Index 0x4559)

Object "Detailed Software Version" (Index 0x4559)

The structure of this object is shown in the table below. This read-only object returns the same software version as object **0x100A**, but in a 32-bit unsigned integer format which is compatible with the standard IP-type version numbers used at Jetter AG.

In addition, this object will also return the software version number for the two processors including their bootloader version numbers.

Index	Sub-index	Default	Description	Attributes
0x4559	0	5	Number of entries	ro (read only)
	1	-	Software version	ro
	2	0	Master OS version	ro
	3	0	Master bootloader version	ro
	4	0	Slave OS version	ro
	5	0	Slave bootloader version	ro

Object "Slave CAN Termination" (Index 0x4560)

Object "Slave CAN Termination" (Index 0x4560)

This object lets you read out or set the slave CAN bus (CANopen®) termination setting. The structure of this object is shown in the table below.

Index	Sub-index	Default	Description
0x4560	0		Current termination resistor setting

Sub-index 0

Sub-index 0 lets you read out the current setting, or make changes to it.

The following values are allowed:

- 0: Termination is disabled
- 1: Termination is enabled

Note that changing the CAN termination in this way is not permanent. This setting only has effect until the next time that the device restarts (power cycle, CANopen® reset command, writing to system parameters).

After a restart the JXM-IO-E02 again assumes the setting that is set in system parameters.

Object "Master CAN Termination" (Index 0x4561)

Object "Master CAN Termination" (Index 0x4561)

This object lets you read out or set the master CAN bus termination setting. The structure of this object is shown in the table below.

Index	Sub-index	Default	Description
0x4561	0		Current termination resistor setting

Sub-index 0

Sub-index 0 lets you read out the current setting, or make changes to it.

The following values are allowed:

- 0: Termination is disabled
- 1: Termination is enabled

Note that changing the CAN termination in this way is not permanent. This setting only has effect until the next time that the device restarts (power cycle, CANopen® reset command, writing to system parameters).

After a restart the JXM-IO-E02 again assumes the setting that is set in system parameters.

Object "Electronic Name Plate" (Index 0x4565)

Object "Electronic Name Plate" (Index 0x4565)

The structure of this object is shown in the table below.

Index	Sub-index	Default	Description
0x4565	0	5	Number of entries
	1	0	Version number of the electronic name plate
	2	0	Instruction
	3	""	Product serial number
	4	""	Item number
	5	""	Product revision

Sub-indexes 3, 4, 5

The function of sub-indexes 3 ... 5 is described below.

Sub-indexes 3, 4, and 5 return strings containing the following information:

- Serial number of JXM-IO-E02 (32 characters)
- Item number (16 characters)
- Revision number of JXM-IO-E02 (16 characters)

Object "User EEPROM Access" (Index 0x5000)

Object "User EEPROM Access" (Index 0x5000)

The structure of the object "User EEPROM Access" is shown in the following table. This object grants the user read/write access to the EEPROM.

Index	Sub-index	Default	Description	Attributes
0x5000	0	6	Number of entries	ro (read only)
	1	0	Byte offset inside memory space	rw (read & write)
	2	1,024	Size of memory (in bytes)	ro
	3	1	Auto increment	ro
	4	-	Byte R/W access	rw
	5	-	16-bit word R/W access	rw
	6	-	32-bit word R/W access	rw

Sub-index 1

The function of sub-index 1 is described below:

- To use this object, enter the byte offset inside the memory space in sub-index 1.
- If the byte offset is less than zero, the CANopen® error “Value of parameter written too low” is returned.
- If the byte offset is larger than the value in sub-index 2 (default value: 1,024), the CANopen® error “Value of parameter written too high” is returned.
- Also, if the byte offset is set to one of the last byte values and an attempt is made to read or write a 16-bit or 32-bit word which would cause reading/writing outside the memory space, the “General error” message is returned.
  Unfortunately CANopen® doesn’t have an error code that accurately describes this condition.
  Example:
  If the byte offset is 1,022 and an attempt is made to read a 32-bit word, this would normally try to read beyond the last memory address of 1023. This is not allowed and the message "General error" is returned.

Sub-index 2

The function of sub-index 2 is described below:

- The JXM-IO-E02 offers 1 kByte of EEPROM memory space. But for some special devices the amount may differ.
- Reading sub-index 2 returns the available memory size in bytes.
- This sub-index is read-only.

Sub-index 3

The function of sub-index 3 is described below:

- Use sub-index 3 to enable/disable the function "Auto Increment":
  - 0: Auto increment is disabled
  - 1: Auto increment is enabled
- Auto increment works as follows:
  - After either a read or write operation, the object will increment the offset in the memory space by the number of bytes that were transferred.
  - **Example:**

  After a byte read the byte offset is incremented by 1.
  After a 32-bit write the byte offset is incremented by 4.

Sub-index 4

The function of sub-index 4 is described below:

- Read sub-index 4 to read a byte from the memory.
- Enter a value into sub-index 4 to write a byte in the memory.

Sub-index 5

The function of sub-index 5 is described below:

- Read sub-index 5 to read a 16-bit word from the memory.
- Enter a value into sub-index 5 to write a 16-bit word in the memory.

Sub-index 6

The function of sub-index 6 is described below:

- Read sub-index 6 to read a 32-bit word from the memory.
- Enter a value into sub-index 6 to write a 32-bit word in the memory.

Delay

When writing to the EEPROM, a delay **must** be implemented after the SDO command. The JXM-IO-E02 first writes to the EEPROM memory. This may take a while before the JXM-IO-E02 transmits the SDO reply. This process can take at least 50 ms. Therefore, it is recommended that a delay of 100 ms be implemented before the next SDO or PDO access to the same JXM-IO-E02.

6.2 CANopen® PDO Specification

Introduction

This chapter describes the CANopen® PDO specification implemented on the JXM-IO-E02. PDO is short for Process Data Object. The PDO data allocation is fixed and cannot be changed by the application.

The JXM-IO-E02 allows PDO access when it has been set to operational state.

Contents

RX PDO allocation on the JXM-IO-E02

PDO assignment and parameters

The tables below show the allocation of RX PDOs implemented on the JXM-IO-E02. CANopen® objects are linked with their corresponding PDOs. Therefore, writing to that PDO will be the same as writing to that SDO index and sub-index.

The controller is able to read back the following data from the JXM-IO-E02 via PDO1_TX (0x200 + node ID):

Byte offset	Index/sub-index	Size [byte]	Description
0	0x2101/05	2	Digital outputs
2	0x2103/05	1	Switch feed outputs

The controller is able to read back the following data from the JXM-IO-E02 via PDO2_TX (0x300 + node ID):

Byte offset	Index/sub-index	Size [byte]	Description
0	0x2500/05	2	H-bridge output state
2	0x2400/04	2	PWM-1 current
4	0x2401/04	2	PWM-2 current
6	0x2402/04	2	PWM-3 current

Please note that specification of current values is allowed only in mode "Current-Controlled PWM Output".

If the PWM output is set to static duty-cycle mode, this parameter will actually change to sub-index 5 to allow writing to the duty-cycle register. The PDO interface can therefore be used to also select the duty cycle.

The controller is able to read back the following data from the JXM-IO-E02 via PDO3_TX (0x400 + node ID):

Byte offset	Index/sub-index	Size [byte]	Description
0	0x2300/04	2	Analog output - voltage
2	0x2300/05	2	Analog output - current

New software

The new JXM-IO-E02 software release (OS 3.00.0.00 or higher) contains a new system parameter feature. This feature lets the user detect a timeout for the a.m. RX-PDOs. When activated in the system parameters, the JXM-IO-E02 will expect to receive the RX PDOs in the specified time. If the RX PDO message does not arrive, the fault is triggered and all outputs controlled by this PDO are disabled.

TX PDO allocation on the JXM-IO-E02

PDO assignment and parameters

The tables below show the allocation of TX PDOs implemented on the JXM-IO-E02. CANopen® objects are linked with their corresponding PDOs.

The controller is able to read back the following data from the JXM-IO-E02 via PDO1_RX (0x180 + node ID):

Byte offset	Index/sub-index	Size [byte]	Description
0	0x2101/04	2	Digital outputs read back
2	0x2100/04	2	Digital inputs
4	0x2100/04	1	Tri-state input
5	-	1	Frequency input - Digital inputs
6	-	1	Switch feed output states

The controller is able to read back the following data from the JXM-IO-E02 via PDO2_RX (0x280 + node ID):

Byte offset	Index/sub-index	Size [byte]	Description
0	0x2200/04	2	Analog input # 1
2	0x2201/04	2	Analog input # 2
4	0x2202/04	2	Analog input # 3
6	0x2203/04	2	Analog input # 4

The controller is able to read back the following data from the JXM-IO-E02 via PDO3_RX (0x380 + node ID):

Byte offset	Index/sub-index	Size [byte]	Description
0	0x2600/04	4	Frequency input # 1
4	0x2601/04	4	Frequency input # 2

For PDO-3_RX, the frequency input fields change to sub-index 5 of the respective objects when the frequency input is used as a digital input. This allows monitoring of the digital input level by means of PDO.

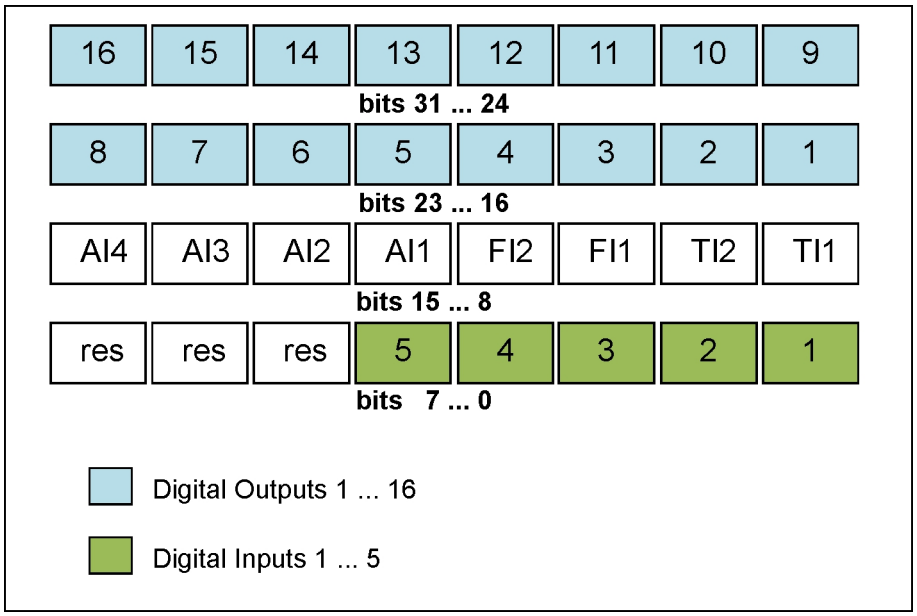
Normally, the PDOs are transmitted asynchronously on request. However, PDO1_RX can also be enabled to be transmitted asynchronously on events. This is done using the “Event-based PDO TX enable” option in the System Parameters interface.

Additionally, from OS version 2.10.0.01 PDO3_RX is also transmitted asynchronously on events. The event that triggers this is the completion of a frequency measurement. This function cannot be disabled and is only available for frequency measurement at this time.

TX PDOs are transmitted upon receiving a remote request (RTR) message. But, event-based triggering of the TX PDOs can also be enabled in the system parameters.

Digital input - Event-based PDO transmission enable

This parameter enables/disables triggering for individual inputs. The following diagram shows the bit mapping for this parameter:



In the diagram, the green bits represent the five digital input channels. The blue bits represent the sixteen digital output read back functions. The other bits are labelled:

- TI1 and TI2: Tristate inputs 1 and 2
- FI1 and FI2: Frequency inputs 1 and 2
- AI1, AI2, AI3, AI4: Analog inputs 1 through 4
- res: Reserved bits (must be set to zero)

For all digital inputs, the PDO is triggered when a state change is detected. In the case of the frequency inputs in "frequency measurement" mode, the PDO is triggered when a measurement is completed, but only if a minimum delay of 50 ms has expired. This is to prevent the PDO being transmitted every 1 ms, while the input signal has a frequency of 1 kHz or higher. Presently, configuring this delay is not possible yet.

A state change for the analog inputs is defined as a change in the measurement of at least 7.5 % (this percentage is now configurable in system parameters) of the full-scale measurement. This prevents triggering PDOs due to small noise signals. But it does mean that smaller changes in the analog value measured are not responded to. Therefore, it is recommended that especially the analog input PDO be requested by remote request (RTR) at regular intervals in addition to event-triggering.

Time restrictions for automatic transmission of PDOs

"Automatic transmission" means transmission of a PDO message which has not been requested by a CAN RTR message. Usually this implies that the PDO transmission has been triggered by an input change event.

Since software version 3.09.0.00, new system parameters have been added to configure time restrictions on these automatic transmissions:

1. Minimum cycle time

- A minimum period of time must pass between consecutive PDO messages transmitted. This is to prevent CAN bus overload when an input is changing very rapidly. Whenever a PDO message is transmitted, this delay

timer is reset. This also applies the PDO message being transmitted due to a received CAN RTR message. The default delay time is set to 100 ms. This feature can be disabled for individual PDO channels.

2. Maximum cycle time

- A maximum period of time between PDO transmissions is also specified.
- Once this period has elapsed, a PDO with the current data is automatically transmitted if
  - no CAN RTR messages have been received
  - no input change event has triggered transmission of the PDO.
- This ensures that
  - the PDO data is always received by the external controller,
  - there is never a doubt whether the JXM-IO-E02 is still monitoring its inputs.

Restrictions

Due to design constraints some restrictions/limitations had to be applied to the CANopen® interface.

- SDO expedited transfer only supports 4-byte transfers. Any smaller data element must be extended to 32 bit before the SDO transfer.
- SDO segmented transfer is only supported on certain objects. Unless an object is documented to support segmented transfers, assume that it does not.
- SDO block transfer is NOT implemented.
- PDOs are not user configurable.
- PDOs are transmitted only asynchronous on request unless otherwise specified.
- Although emergency messages are transmitted to notify of detected faults, the CANopen® emergency handling system is not fully implemented.
- The error register does not save its state in non volatile memory. After each reset or power cycle, the error list is cleared.

7 Protection and diagnostic features - JXM-IO-E02

Purpose of this chapter

This chapter describes the available protection and diagnostics features implemented on the JXM-IO-E02. The following features are currently supported:

- Detecting an error by means of the application or visualization program
- Identifying the root cause of an error
- Troubleshooting an error that caused a fault message.

Prerequisites

To be able to troubleshoot a fault on the JXM-IO-E02, the following prerequisites must be fulfilled:

- The JXM-IO-E02 is either connected to a controller, or is integrated into the controller JCM-350-E03.
- The controller is connected to a PC.
- The JetSym programming software has been installed on the PC.
- The minimum requirements regarding modules, controllers and software are fulfilled.

Background

When a fault is detected, the JXM-IO-E02 will disable the function that caused the fault. It will transmit a CANopen® Emergency Object to inform the controller of the problem. The fault is also recorded in a history list of error events. These error events are compliant to the CANopen® "Pre-defined Error Field".

The external controller can immediately reactivate the function, but as long as the fault remains, the JXM-IO-E02 will again disable the function and retransmit the error notification.

Locking-out outputs

If an output has experienced a defined number of faults (short to ground, overcurrent, or overtemperature), the software will lock this output to prevent it being switched on again. If the controller demands switching on this output, the lock-out fault is triggered. Once an output is locked, the JXM-IO-E02 must be power cycled before the output can be activated again. Check the JXM-IO-E02 before you put it into normal operation.

Contents

Standard feed power input (STANDARD FEED)

Detecting the error

The input current on STANDARD FEED is monitored by software. The software will issue an over-current error notification if the current exceeds 30 A.

The software implements a function allowing temporary over-current. This is useful in situations where high peak currents are required.

The battery voltage at the STANDARD FEED terminal is monitored by software. If the voltage is below 5 V for more than 30 seconds, the error message "Battery voltage too low" is triggered. If the voltage exceeds 32 V for more than 64 seconds, the error message "Battery voltage too high" is triggered.

Root cause of the error

This error may be caused by the following root causes:

- The maximum current of 30 A has been exceeded.
- The time limit for over-current has been exceeded.
- The battery voltage has dropped below 5 V for more than 30 seconds.
- The battery voltage has exceeded 32 V for more than 64 seconds.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Overcurrent	0x2323	2
Battery voltage is too low	0x3023	2
Battery voltage is too high	0x3024	2

Fixing the root cause

The controller must respond to the error message and disable the outputs on the module JXM-IO-E02.

Protected feed power input (PROTECTED FEED)

Detecting the error

The input current on PROTECTED FEED is monitored by software. The software will issue an over-current error notification if the current exceeds 30 A.

The solid state switch used to disable the safety outputs (safety switch) also implements a hardware limit. The safety switch will switch off automatically if the switch temperature rises too high and the set actual current is exceeded. The actual current that will cause the safety switch to disconnect is dependent on the ambient temperature.

The software implements a function allowing temporary over-current. This is useful in situations where high peak currents are required.

Root cause of the error

This error may be caused by the following root causes:

- The maximum current of 30 A has been exceeded.
- The time limit for over-current has been exceeded.
- The safety switch temperature is too high and the actual current is at least 30 A.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Overcurrent	0x2322	2
Safety Switch Failure	0x5001	8

If the switch fails in the ON state, the JXM-IO-E02 will additionally issue the "Safety Switch Failure" notification.

Digital Outputs 1 ... 8 (Standard Outputs)

Detecting the error

A threshold can be programmed for both over-current and cable breakage (no-load) via the System Parameters interface. Over-current limit can be set to between 100 mA and 2.5 A per channel. The no-load threshold can be set between 50mA and 250mA.

Note that this no-load threshold is shared for all digital outputs. No-load detection can be enabled or disabled for individual output channels. A no-load fault can only be detected when a channel is switched on (enabled).

The software implements a function allowing temporary over-current. This is useful in situations where high peak currents are required.

A short to ground is reported in the event of a massive overcurrent.

If an output has experienced at least 4 shorts to ground and/or overcurrent faults, the software will lock this output to prevent it being switched on again.

Root cause of the error

This error may be caused by the following root causes:

- The programmed limit for over-current has been exceeded.
- The load current has exceeded 10 A and the over-current situation has exceeded 180 ms.
- The programmed limit for no-load has been exceeded.
- One output has experienced at least 4 shorts to ground and overcurrent faults.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Short to GND	0x9000 - 0x9007	1
Overcurrent	0x2300 - 0x2307	1
No-load (cable breakage)	0x23A0 - 0x23A7	1
Lock-out	0x5300	0

Digital Outputs 9 ... 16 (Safety Outputs)

Detecting the error

A threshold can be programmed for both over-current and cable breakage (no-load) via the System Parameters interface. Over-current limit can be set to between 100 mA and 5 A per channel. The no-load threshold can be set between 50mA and 250mA.

Note that this no-load threshold is shared for all digital outputs. No-load detection can be enabled or disabled for individual output channels. Therefore, a no-load fault can only be detected when a channel is switched on (enabled).

The software implements a function allowing temporary over-current. This is useful in situations where high peak currents are required.

A short to ground is reported in the event of a massive overcurrent.

If an output has experienced at least 4 shorts to ground and/or overcurrent faults, the software will lock this output to prevent it being switched on again.

Root cause of the error

This error may be caused by the following root causes:

- The programmed limit for over-current has been exceeded.
- The load current has exceeded 10 A and the over-current situation has exceeded 180 ms.
- The programmed limit for no-load has been exceeded.
- One output has experienced at least 4 shorts to ground and overcurrent faults.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Short to GND	0x9010 - 0x9017	1
Overcurrent	0x2310 - 0x2317	1
No-load (cable breakage)	0x23B0 - 0x23B7	1
Lock-out	0x5310	0

Analog output

Detecting the error

The analog output will detect short circuit to ground faults.

An over-current fault is triggered in software when the measured load current exceeds the maximum output current specified in the system parameters.

A power dissipation fault is triggered when the internal power dissipation exceeds 2 W. Internal dissipation is calculated according to the following formula:

$P_D=(V_{STD\text{-}Feed}-V_{out}) \times I_{out}$

A short to ground is reported in the event of a massive overcurrent.

If an output has experienced at least 5 shorts to ground and/or overcurrent faults, the software will lock this output to prevent it being switched on again.

Root cause of the error

This error may be caused by the following root cause:

- When a short to ground is detected, the output is disabled and the fault notification is sent out.
- The programmed load current value of 250 mA has been exceeded.
- One output has experienced at least 5 shorts to ground and overcurrent faults.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error. The analog output will remain disabled until the module is instructed to set the analog output to a normal mode again or until a power cycle has occurred.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Short to GND	0x9020	1
Overcurrent	0x2370	
Power dissipation	0x4220	
Lock-out	0x5500	

PWM outputs 1 ... 3

Detecting the error

The PWM outputs can be used in one of two modes:

- Current-controlled output
- PWM output with static duty cycle.

When these outputs are used as current-controlled outputs, the JXM-IO-E02 will detect short circuit to ground and no-load faults. No-load is defined by a current threshold which is user selectable through the System Parameters interface.

When a PWM output is set as a static duty-cycle output, the JXM-IO-E02 will additionally detect over-current faults. These faults are also defined by a user selectable current threshold.

A short to ground is reported in the event of a massive overcurrent.

If an output has experienced at least 5 shorts to ground and/or overcurrent faults, the software will lock this output to prevent it being switched on again.

Root cause of the error

This error may be caused by the following root causes:

- The programmed limit for over-current has been exceeded.
- The programmed limit for no-load has been exceeded.
- A short-circuit to ground has occurred.
- One output has experienced at least 5 shorts to ground and overcurrent faults.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Short to GND	0x90D0 - 0x90D2	1
Overcurrent	0x23D0 - 0x23D2	1
No-load (cable breakage)	0x23C0 - 0x23C2	1
Lock-out	0x5100	0

H-bridge

Detecting the error

Full protection is only available when the H-Bridge is used in the H-Bridge PWM output modes.

If the H-Bridge is used as two independent digital outputs, only short-circuit to ground fault detection is possible. This feature is unable to detect which of the outputs has caused the problem and will disable all four outputs in the case of a problem.

Overcurrent and no-load faults have user selectable thresholds. These can be set through the System Parameters interface.

Short circuit fault is triggered when a massive overcurrent occurs either in a high-side switch or in a low-side switch. This can trigger regardless of the output mode of the H-bridge.

If an output has experienced at least 5 short-circuit and/or overcurrent faults, the software will lock this output to prevent it being switched on again.

Root cause of the error

This error may be caused by the following root causes:

- The programmed limit for over-current has been exceeded.
- The programmed limit for no-load has been exceeded.
- A short-circuit to ground has occurred.
- One output has experienced at least 5 short-circuit and overcurrent faults.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Short to GND	0x9021	1
Overcurrent	0x2321	1
No-load (cable breakage)	0x2331	1
Lock-out	0x5200	0

Switch feed outputs 1 ... 2

Detecting the error

Although the fault condition is "Overtemperature", this fault encompasses both, short-circuit to ground and over-current faults. If either fault occurs, the module JXM-IO-E02 will issue an over-temperature error for the output.

A short to ground is reported in the event of a massive overcurrent.

If an output has experienced at least 5 faults, the software will lock this output to prevent it being switched on again.

Root cause of the error

This error may be caused by the following root causes:

- The limit for over-current has been exceeded.
- A short-circuit to ground has occurred.
- One output has experienced at least 5 faults.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Overtemperature	0x4231 - 0x4232	4
Lock-out	0x5400	0

Safety switch (solid-state relay)

Root cause of the error

This error may be caused by the following root cause:

- The safety switch (solid-state relay) fails to disable the safety outputs.

Response of the module to this error

The module will set the corresponding bit in the CANopen® error register and will send the following error code to the controller:

Error type	Error code	Error register
Hardware error	0x5001	8

5 V reference output

Root cause of the error

This error may be caused by the following root causes:

- The limit for overcurrent has been exceeded.
- A short-circuit to ground has occurred.
- 5 V output has turned off.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Overcurrent	0x2320	2
5 V output error	0x3020	2

Generic fault detection

Fault description	The JXM-IO-E02 can also detect certain faults which are not directly linked to a specific input or output. These faults are listed in the table below: ▪ Internal communication failure ▪ Internal temperature ▪ System parameter reset ▪ RX PDO timeout ▪ CAN passive mode ▪ Bus off recorder
Internal communication failure	If the internal communication of the JXM-IO-E02 fails, this error is reported. If this event occurs, certain inputs and/or output may no longer be controllable and the external controller should consider it a serious failure.
Internal temperature failure	The internal temperature sensor will trigger this fault if the internal temperature exceeds 125 °C. If this fault is triggered, the JXM-IO-E02 must be powered down and allowed to cool down before normal use continues.
Reset of system parameter conflict	At start-up, the software compares the system parameters stored in two different memories. If there is a conflict, the software will default to the copy kept by the slave controller. This requires an internal restart to reprogram the system parameters. Triggering of this fault is for informational purposes. However, if the system parameter reset fault is triggered continuously, this informs of a more serious failure. Normal operation is not possible at this time.
RX PDO timeout	When activated in the system parameters, the JXM-IO-E02 will expect to receive the RX PDOs in the specified time. If the RX PDO message does not arrive, the fault is triggered and all outputs controlled by this PDO are disabled.

Response of the module to this error

The module responds to this error in the following levels:

Step	Description
1	The module will send a CANopen® emergency object to the controller.
2	The module will block the function that has caused the error.

The module will set the corresponding bit in the CANopen® error register and will send the following error code:

Error type	Error code	Error register
Internal communication failure	0x5002	5
Internal temperature	0x4200	4
System parameter reset	0x8001	0
RX-PDO-1 timeout	0x8101	
RX-PDO-2 timeout	0x8102	
RX-PDO-3 timeout	0x8103	
RX-PDO-4 timeout	0x8104	
CAN passive mode	0x8120	REC < 127 or TEC < 127
Bus off recorder	0x8140	TEC > 255

Appendix

Introduction

This appendix contains electrical and mechanical data, as well as operating data.

Contents

A: Technical data

Introduction

This chapter contains information on electrical and mechanical data, as well as on operating data of the JXM-IO-E02.

Contents

Technical specifications

Connector

Parameter	Description
Manufacturer/Model	Tyco AMP
Item number	963484
Design	70-pin
Coding	A 1

Electrical data - Power supply

Parameter	Description
Operating voltage	DC 8.0 ... 32.0 V
Operating voltage - IGNITION FEED	Minimum DC 5.9 V
Peak Current:	
IGNITION FEED	2.0 A max.
STANDARD FEED	20.0 A max. (fused up to 30 A)
SAFETY FEED	20.0 A max. (fused up to 30 A)
Over-current detection	Yes

Communication

Parameter	Description
Bus type	CAN bus
Protocol	CANopen®
Baud rate	250 kBaud (1 MBaud max.)
Terminating resistor	Can be activated by means of software

Technical data - Tri-state inputs

Parameter	Description
Purpose	■ For device coding ■ As digital inputs
Type of inputs	Pull-up resistor 22 kΩto IGNITION FEED and pull-down resistor 276 Ω to ground
Tri-state detection	Tri-state operation is detected by a pull-down resistor to ground.
Rated voltage	IGNITION FEED
Operating point OFF:	≤ 1.0 V
Operating point ON:	≥ 4.0 V

Technical data - Digital inputs IN 1 ... IN 5

Parameter	Description
Type of inputs	Software selectable with either 2 kΩ pull-up resistor to IGNITION FEED or 2 kΩ pull-down resistor to ground.
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Operating point OFF:	≤ 1.0 V
Operating point ON:	≥ 3.5 V

Technical data - Digital inputs IN 6 ... IN 13

Parameter	Description
Type of inputs	Can be configured as active-high inputs
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Operating point OFF:	< 51 % of IGNITION FEED
Operating point ON:	> 51 % of IGNITION FEED
Input impedance	100 kΩ

Technical data - Digital outputs (STANDARD FEED)

Parameter	Description
Type of outputs	Active-high output
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Signal voltage OFF	< 1.0 V
Signal voltage ON	$U_{STANDARD}$ - 0.5 V
Load current of OUT 1 ... OUT 8	2.5 A max.
Short-circuit capability	Yes
Over-current detection	Yes
No-load detection	Yes

Technical data - Digital inputs IN 14 ... IN 21

Parameter	Description
Type of inputs	Can be configured as active-high inputs
Rated voltage	PROTECTED FEED
Permissible voltage range	DC 8 ... 32 V
Operating point OFF:	< 51 % of IGNITION FEED
Operating point ON:	> 51 % of IGNITION FEED
Input impedance	100 kΩ

Technical data - Digital outputs (PROTECTED)

Parameter	Description
Type of outputs	Active-high output
Rated voltage	PROTECTED FEED
Permissible voltage range	DC 8 ... 32 V
Signal voltage OFF	< 1.0 V
Signal voltage ON	$U_{PROTECTED}$ - 0.5 V
Load current of PROTECTED OUT 9 ... PROTECTED OUT 16	5.0 A max.
Can be switched off by electronic safety switch	Yes
Short-circuit capability	Yes
Over-current detection	Yes
No-load detection	Yes

Technical data - Switch outputs

Parameter	Description
Type of switch outputs	Active-high output
Possible use	As digital active-low inputs
Rated voltage	STANDARD FEED
Permissible voltage range	DC 8 ... 32 V
Signal voltage OFF	< 1.0 V
Signal voltage ON	$U_{STANDARD}$ - 0.5 V
Load current	Each 2.5 A max.
Short-circuit capability	Yes, thermal (undefined current)
Over-current detection	Detection whether the output has switched off.
No-load detection	Yes

Technical data - PWM outputs

Parameter	Description
Operating modes	■ Current-controlled output ■ PWM output with static duty cycle
PWM frequency	Configurable values: 0 = 1.954 kHz 1 = 977 Hz 2 = 488 Hz 3 = 244 Hz 4 = 122 Hz 5 = 61 Hz 6 = 30 Hz
Resolution	10 bits
Load current	0 ... 2.5 A
Short-circuit capability	Yes
Over-current detection	Yes
No-load detection	Yes

Technical data - Analog output

Parameter	Description
Voltage range at 50 mA	0 ... STANDARD FEED
Current range	0 ... 100 mA
Resolution	10 bits
Electrical isolation	None
Short circuit detection	Yes

Technical data - Analog inputs

Parameter	Description
Voltage range	■ 0 ... 5 V ■ 0 ... 40 V
Current range	■ 0 ... 20 mA
Input impedance at 0 ... 5 V	100 kΩ
Input impedance at 0 ... IGNITION FEED	50 kΩ
Input impedance at 0 ... 20 mA	240 Ω
Resolution	10 bits
Electrical isolation	None

Technical data - Frequency inputs

Parameter	Description
Purpose	■ As frequency counter ■ As digital input
Type of inputs	Software selectable with either 2 kΩ pull-up resistor to STANDARD FEED or 2 kΩ pull-down resistor to ground.
Frequency measurement range	5 Hz ... 20 kHz
Measurement method	Time-based
Result of measurement	Period of the signal in nanoseconds
Resolution	62.5 ns
As of hardware revision ≥ 12.04 the following operating point parameters apply:	
Operating point OFF:	< 1.7 V for mode 1 ... 4 and IGNITION FEED = 12 V
Operating point ON:	> 3.6 V for mode 1 ... 4 and IGNITION FEED = 12 V
Operating point OFF:	< 3.4 V for mode 1 ... 4 and IGNITION FEED = 24 V
Operating point ON:	> 7.2 V for mode 1 ... 4 and IGNITION FEED = 24 V
Operating point OFF:	AC signal < 350 mV for mode 5
Operating point ON:	AC signal > 350 mV for mode 5

Technical data - H-bridge

Parameter	Description
Purpose	■ As H-bridge ■ As two independent digital inputs ■ As two independent PWM outputs (active-high and active-low)
Rated output current	2.5 A max.
Accuracy of current measurement for H-bridge	< 100 mA
Short-circuit capability	Yes
Overcurrent detection	Yes
No-load detection	Yes

Technical data - Regulated output

Parameter	Description
Controlled voltage	DC 5 V
Load current	250 mA max.
Over-current detection	Yes

Protective and diagnostic functions

Malfunction	Response
Short circuit	■ The faulty function is disabled automatically ■ A CANopen® emergency object is sent to the controller ■ The error message is stored to a history list which is compatible with the CANopen® standard
Overload	
No-load (cable breakage)	

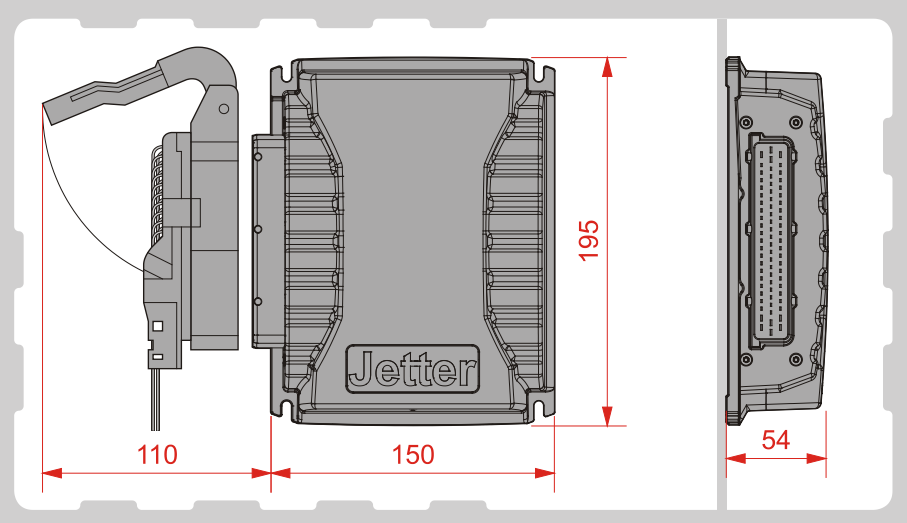
Physical dimensions

Introduction

This chapter details the physical dimensions of the JXM-IO-E02 and the conditions for its installation.

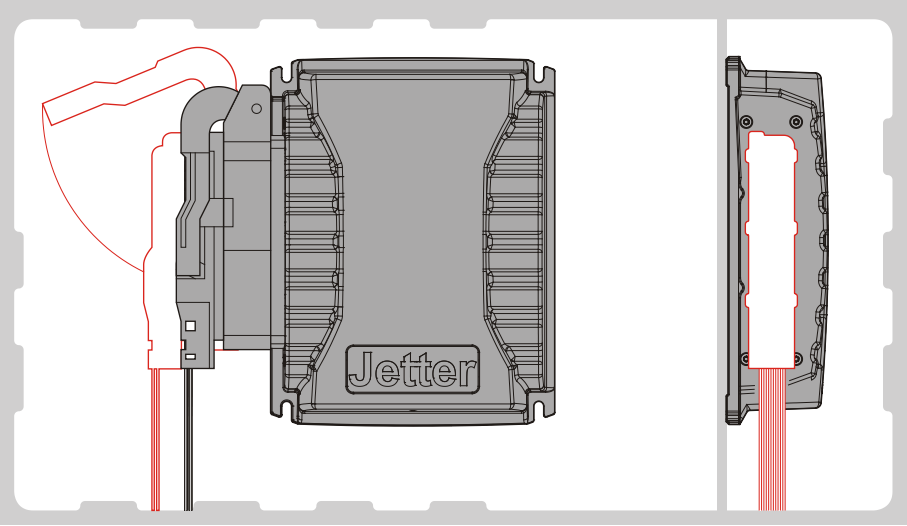
Physical dimensions

The illustration shows the physical dimensions of the JXM-IO-E02.



Space required for installation and service

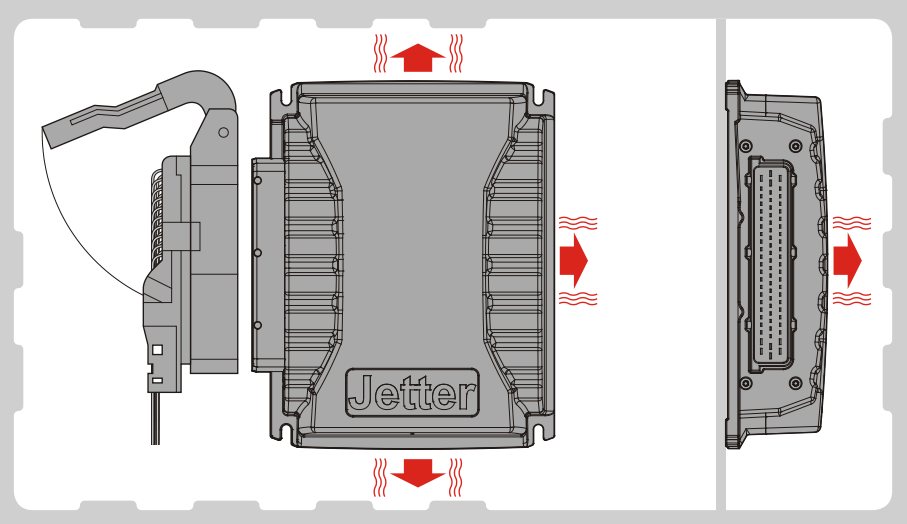
The diagram shows the space required for the JXM-IO-E02.



Ensure there is enough space around the connector for servicing requirements. It should be possible to disconnect the connector at any time.

Space required to protect against overheating

The diagram indicates the safety distances to protect against overheating.



Please note:

- The JXM-IO-E02 increases the temperature of the environment as a result of heat emission under load.
- The JXM-IO-E02 operates without interruption at an ambient temperature of up to +85 °C.

Consider the heat emission from the device, in particular when installing it in a critical environment:

- In the vicinity of the fuel tank
- In the vicinity of the fuel pipe
- In the vicinity of flammable vehicle components
- In the vicinity of thermally malleable vehicle components

Operating parameters - Environment and mechanics

Environment

Parameter	Value	Standard
Operating temperature range	-40 ... +85 °C	
Storage temperature range	-40 ... +85 °C	DIN EN 61131-2 DIN EN 60068-2-1 DIN EN 60068-2-2
Air humidity	10 ... 95 %	DIN EN 61131-2
Climate test	Humid heat	DIN EN 60068-2-30
Pollution degree	2	DIN EN 61131-2

Mechanical parameters

Parameter	Value	Standard
Vibration resistance	Vibration, broadband noise	DIN EN 60068-2-6 Severity level 2
Shock resistance	30 g occasionally, 18 ms, sinusoidal half-wave, 3 shocks in the directions of all three spatial axes	DIN EN 60068-2-27
Degree of protection	IP68 only if the individual wires of the mating connector are sealed	DIN EN 60529

Operating parameters - EMC

EMC - Emitted interference

This device has been tested as per Directive 72/245/EEC with all amendments up to 2009/19/EC and meets all test criteria.

EMC - Immunity to interference

Parameter	Value	Standard
Interference immunity to conducted faults	Compliant	Directive 72/245/EEC with all amendments including 2009/19/EC
Interference immunity to external magnetic field	20 ... 1,000 MHz: 100 V/m 1,000 ... 2,000 MHz: 30 V/m	Directive 72/245/EEC with all amendments including 2009/19/EC
Load dump	Impulse 5b 70 V	ISO 7637-2

B: Index

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