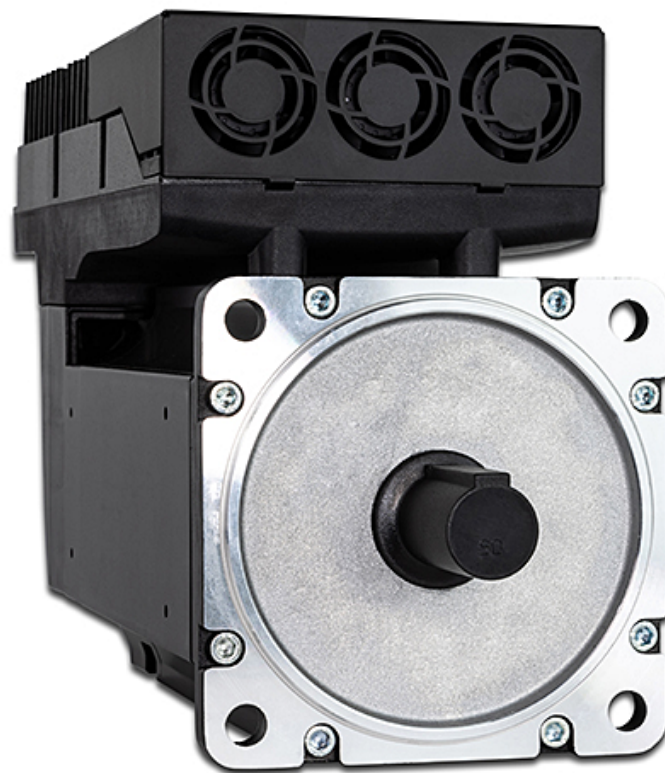


# User Manual

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**JMX50-15117**  
Distributed Drive

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Translation of the german original User Manual

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# 1 Introduction

## 1.1 Information on this document

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

### Target groups

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

### Availability of information

Make sure this document is kept at the ready in the vicinity of the product throughout its service life.

For information on new revisions of this document, visit the download area on our website. This document is not subject to any updating service.

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For further information refer to the following information products:

- JetSym software Online Help  
Detailed description of software functions with application examples
- Application-oriented manuals  
Cross-product documentation
- Version updates  
Information about new versions of software products or of the operating system of your device

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<b>i INFO</b>	<b>EtherCAT®</b> EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
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## 1.2 Typographical conventions

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

- ✓ This symbol indicates requirements which have to be met before executing the following action.
- ▶ This sign or a numbering at the beginning of a paragraph marks an action instruction that must be executed by the user. Execute the instructions one after the other.
- ⇒ The target after a list of instructions indicates reactions to, or results of these actions.

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<b>i INFO</b>	<b>Further information and practical tips</b> In the info box you will find helpful information and practical tips about your product.
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## 2 Safety

### 2.1 General Information

When placed on the market, this product corresponds to the current state of science and technology.

In addition to the operating instructions, the laws, regulations and guidelines of the country of operation or the EU apply to the operation of the product. The operator is responsible for compliance with the relevant accident prevention regulations and generally accepted safety rules.

### 2.2 Purpose

#### 2.2.1 Intended use

The distributed drives of the JMXyy-15xx model range are intended for industrial or commercial applications.

They are in conformity with the relevant parts of the harmonized standard series IEC 61800. If in special cases, that is when motors are used in non-industrial or non-commercial plants increased requirements apply, these requirements must be complied with on the part of the plant.

Typical areas of application include robotics and handling, machine tools, packaging and food machines and similar machines.

The distributed drives may only be operated within the operating ranges and ambient conditions (installation altitude, degree of protection, temperature range, electrical and mechanical data, etc.) specified in the documentation.

Before commissioning of the systems and machines where the distributed drives will be installed, the conformity of the system or machine with the Machinery Directive must be established.

Systems and machines with inverter-fed three-phase motors must meet the protection requirements of the EMC directive. The system installer is responsible for carrying out the installation properly. Signal and power lines must be shielded.

The distributed drives must not be placed in operation until after the entire system has been installed in accordance with EMC requirements.

#### 2.2.2 Usage other than intended

The use of distributed drives of the JMXyy-15xx series outside of the application ranges given here or under operating ranges and ambient conditions other than those described in the documentation is considered non-designated use.

When used in safety functions, a higher-level safety system is required and an additional monitoring and protective device must be provided in accordance with the applicable safety provisions.

Therefore, do not use the drives in technical systems for which a high level of failure safety is specified. The following application areas are considered as non-designated use:

- Aviation and aerospace
- Machines specially constructed or used for a nuclear application whose failure may lead to the emission of radioactivity
- Medical devices that come into direct contact with the human body.

- Machines for transporting and lifting persons
- Special facilities for use at fairs and amusement parks
- Devices for domestic use

## 2.3 Warnings used in this document

### DANGER



#### High risk

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

### WARNING



#### Medium risk

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

### CAUTION



#### Low risk

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

### NOTICE



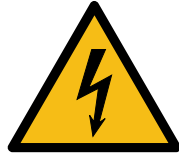
#### Material damage

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



## 2.4 General Safety Instructions

### DANGER

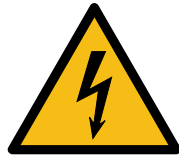


#### **Danger due to high electrical voltage**

Touching live parts may result in death or severe injuries.

- ▶ Carry out the following steps before starting work to ensure safety.
- ☑ Prepare for shutting off the system. Inform everyone involved who will be affected by the process.
- ☑ Isolate the drive system from the power supply and secure it against being turned on again.
- ☑ Wait for the discharge time (approx. 10 minutes) and check all power connections to ensure they are at zero potential.
- ☑ Ground according to requirements.
- ☑ Cover over neighboring live parts.
- ☑ Ensure the drives cannot move. Depressurize the compressed air lines and ensure that the pressure is released.

### DANGER



#### **Danger due to high operating voltage!**

The high operating voltage of the device leads to severe injuries or death.

Comply with the following rules throughout the entire work process.

- ▶ Do not remove any cover plates and keep all control cabinet doors closed during operation.
- ▶ Check whether all live connections are safely protected against contact.
- ▶ Do not open the device.
- ▶ Never touch the wiring terminals of the device for voltage supply and DC link voltage during operation.

### DANGER



#### **Risk of electric arc due to improper handling**

Improper handling can result in an electric arc, which may lead to severe injury or death.

- ▶ Open the plug connections only in de-energized state.
- ▶ Install the drive only in an environment where there is no danger of fire, corrosion or explosion, without any flammable gases or vapors.
- ▶ Observe the specified limit values for voltage.
- ▶ Wire according to regulations.

**⚠ WARNING****Risk of fire due to improper operation of the drive**

In case of improper operation or due to an error, the drive may overheat and cause a fire that may result in serious personal injuries or death.

- ▶ Operate the drive according to the specification. The maximum speed must never be exceeded.
- ▶ Do not use any damaged drives or devices.
- ▶ Turn off the drive immediately if the temperature is too high.

**⚠ WARNING****Risk of burns due to hot surfaces**

The drive may become hot during operation and can cause burns if touched.

- ▶ Take protective measures against accidentally touching the drive, for example protective covers.
- ▶ Ensure there are no parts sensitive to temperature, such as connection cables, close to or fastened onto the drive.
- ▶ Ensure there is adequate heat dissipation and maintain the required distances during installation so as not to prevent or restrict ventilation.
- ▶ Allow the drive to cool off for a while before carrying out cleaning or maintenance work on the drive.
- ▶ Wear personal protective equipment.

**⚠ WARNING****Danger due to rotating parts**

When the drive is running, there is risk of injury due to entanglement or being drawn in by open moving machine parts.

- ▶ Never touch a rotating drive shaft.
- ▶ Always wear close-fitting clothes, no jewelry and no open, long hair.
- ▶ Do not wear gloves.
- ▶ Provide monitoring and protective devices in accordance with the applicable safety requirements.
- ▶ Before all work on the drive, de-energize it and ensure that the drive is no longer able to move.
- ▶ Ensure that even an unintended movement of the drive will not endanger persons or property.

**⚠ WARNING****Risk of injury due to movable and forcibly ejected parts**

Touching movable drive elements and the forcible ejection of drive parts that come loose, such as feather keys, can cause severe injuries or death.

- ▶ Operate the drive only with the drive element mounted or with the feather key protective cap included with delivery.
- ▶ Do not touch any movable parts.
- ▶ Wear goggles.

**⚠ WARNING****Danger for persons with pacemakers and implants!**

The drive generates electromagnetic fields during operation. Electrical, magnetic and electromagnetic errors endanger especially persons with heart pacemakers or implants.

- ▶ Do not remain in the immediate vicinity of the drive if you belong to the group of persons above.
- ▶ As an affected person, maintain a minimum distance of 300 mm from the drives.

**⚠ WARNING****Risk of death due to falling loads during lifting and transport processes**

Improperly performed lifting and transport processes as well as unsuitable or defective devices and tools can lead to severe or fatal injuries and material damage.

- ▶ Lifting devices, industrial trucks and load handling attachments must meet requirements.
- ▶ The load capacity of the lifting equipment and load handling attachments must be in line with the weight of the drive.
- ▶ Fasten and secure the load to be transported carefully to the lifting equipment.
- ▶ Do not stand in the swivel range of lifting equipment or under suspended loads.

**NOTICE****Material damage due to loose power connection**

Vibrations or insufficient tightening torques can lead to loose power connections. This can lead to fire damage, defects in the device or malfunctions.

- ▶ Tighten all power connections to the specified tightening torques.
- ▶ Check all power connections at regular intervals, especially after transport.

**NOTICE****Damage to the drive due to excessive application of force**

- ▶ To avoid damage to the drive and especially the bearings, do not exert excessive (impact) force on the drive shaft.

**NOTICE****Damage to the drive due to electrostatic discharge**

Some components installed in the drive respond sensitively to electrostatic discharge.

- ▶ Discharge the static electricity preventively, place the drive on a conductive surface and avoid contact with highly insulating materials.
- ▶ Fasten the transparent cover before you supply electrical power to the system.

## 3 Product Description

The distributed drives of the JMX product family are digital drives with three-phase, brushless motors.

The drives of the JMX product family are shipped two types of software:

- **Boot firmware:** This boots the drive by activating a set of basic services, and after an initial phase of identification and diagnostics of the system runs the firmware
- **Firmware:** This manages the operating functions of the drive

### 3.1 System overview

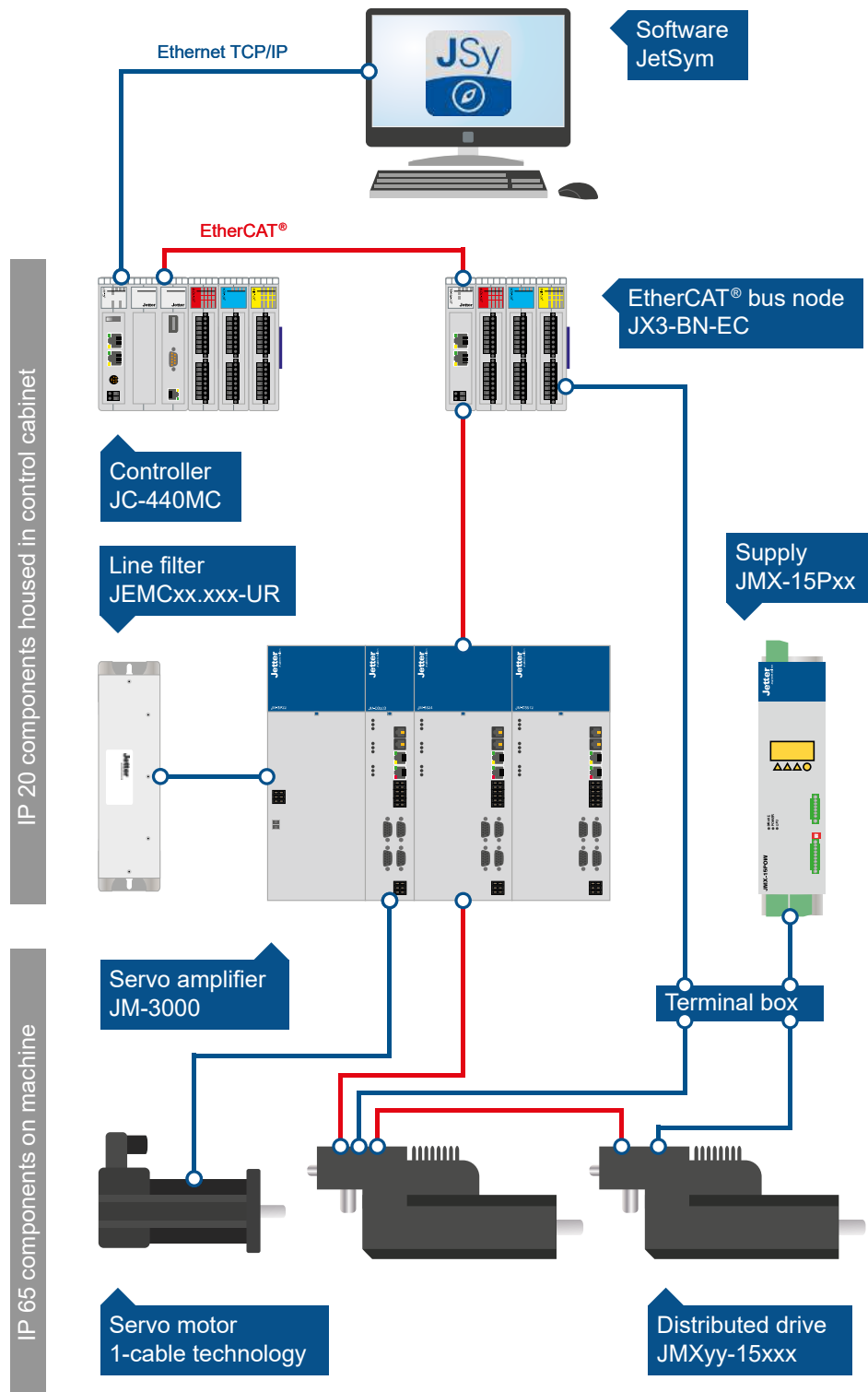


Fig. 1: System overview

### 3.2 Design

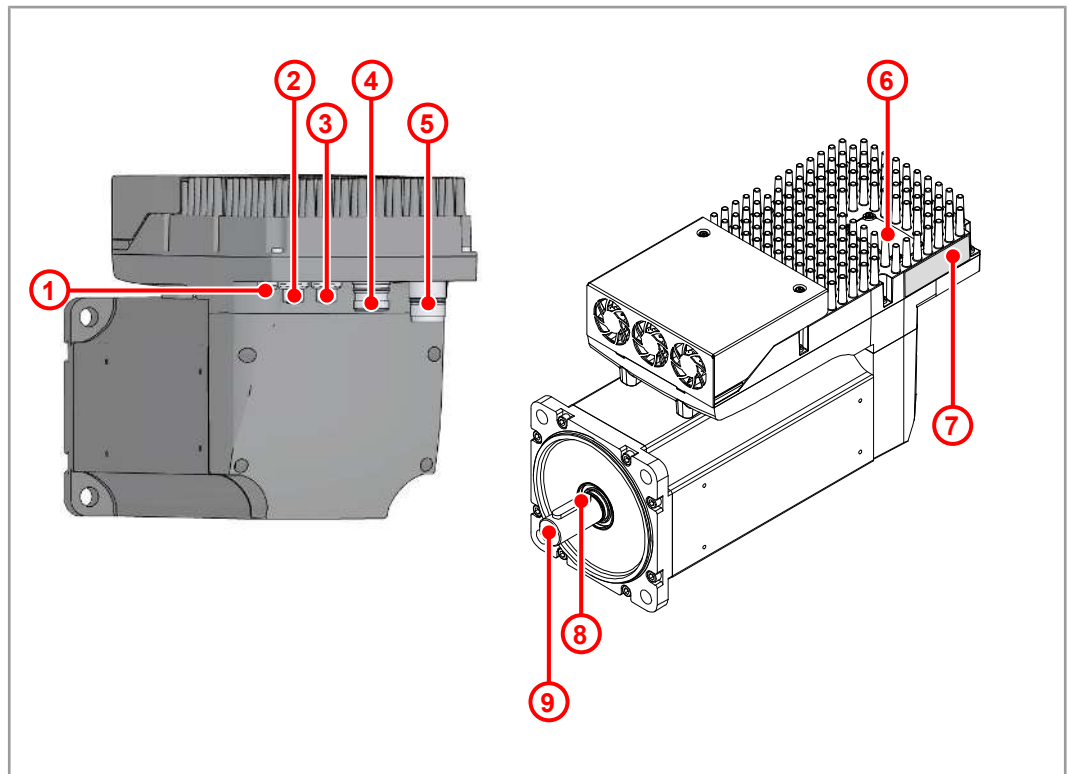


Fig. 2: Design

1	Socket CN1: RS232 n. c.*
2	Socket CN2: EtherCAT® interface input
3	Socket CN3: EtherCAT® interface output
4	Male connector CN4: Digital inputs/outputs, analog input
5	Male connector CN5: Voltage supply, STO connection and IN9
6	Status display LEDs
7	Nameplate
8	Feather key
9	Drive shaft
*n. c. = not connected (= no function)	

### 3.3 Product features

- SinCos motor feedback system with HIPERFACE®
- Holding brake (optional)
- Thermal sensor
- Interface to the fieldbus
- 4 digital inputs
- LEDs

### 3.4 Brake

A holding brake can optionally be installed in the JMX50-15117.

If it is configured, the brake is automatically managed by the drive, specifically by the enable/disable process.

It can also be switched by the controller program or the commissioning software.

The brake parameters can be found in the drive setup.

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<b>i INFO</b>	The brake is already configured for JMX drives and therefore no parameterization is required.
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### 3.5 Status indication

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

- The LEDs are controlled by the microcontroller. Therefore, the indicated operating states depend on its firmware.
- The LEDs are located on the top of the JMX50-15117 drive. They are protected by a transparent plastic cover that is screwed on.

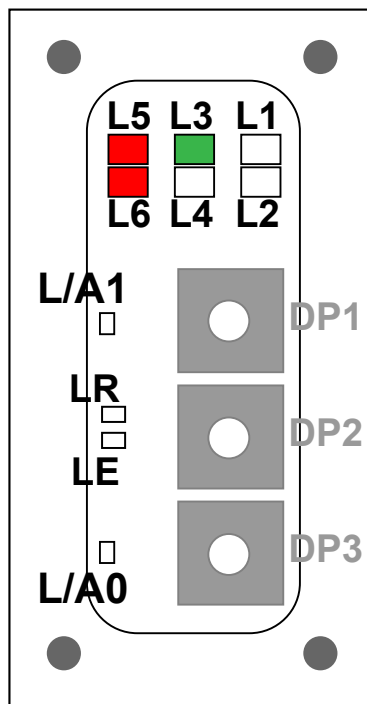


Fig. 3: Status indication



### 3.5.1 Flashing patterns of the LEDs

Parameter	Flashing pattern	Description
OFF	-	LED turned off
ON	Continuously lit	LED turned on
BLK	200 ms on, 200 ms off	Slow continuous flashing
1 FL	200 ms on, 1 s off	Flashes 1 time, after pause of 1 s flashes again
2 FL	200 ms on, 200 ms off, 200 ms on, 1 s off	Flashes 2 times, after pause of 1 s flashes again 2 times
3 FL	200 ms on, 200 ms off, 200 ms on, 200 ms off, 200 ms on, 1 s off	Flashes 3 times, after pause of 1 s flashes again 3 times
FLK	50 ms on, 50 ms off	Fast, continuous flashing (flickering)

### 3.5.2 Status display LEDs

LED	Function	Color/action	Description
L1	Enable status	Green	No error
L2			
L1	Disable status	Green	No error
L2		Green flashing	
L3		n. c.	
L4	I2T	Green-orange-red	
L5		n. c.	
L6	Hardware enable status (according to the input /STO and error status)	off ---	No voltage on the input and/or error active
		Green	Voltage on the input and no error active
LE	EtherCAT®-ERR	OFF ---	No error
		BLK	Configuration error
		1 FL	Unrequested status change
		2 FL	Watchdog of the Sync Manager (SM) active
		ON	Hardware errors <b>NOTICE! Please contact Bucher Automation AG</b>

LED	Function	Color/action	Description
RP	EtherCAT®-RUN	OFF	INIT
		BLK	PRE-OPERATIONAL
		1 FL	SAFE-OPERATIONAL
		ON	OPERATIONAL
		FLK	BOOTSTRAP
L/A0	Activity on EtherCAT® input	OFF	No connection
L/A1	Activity on EtherCAT® output		
L/A0	Activity on EtherCAT® input	ON	Connected; no transfer
L/A1	Activity on EtherCAT® output		
L/A0	Activity on EtherCAT® input	FLK	Connected; transfer active
L/A1	Activity on EtherCAT® output		

Tab. 1: Interpretation of the status of the LEDs

### 3.5.3 Warning and error status of LEDs L1 and L2

Depending on the status, LEDs L1 and L2 are lit orange (warning) or red (error). The actions are the same for both states.

If there are multiple warnings/errors, the LEDs indicate only the warning or error that has the lowest visualization order in the table below (this is equivalent to a higher priority).

#### Warning

LED	Action	Color	Priority	Description
L1	1 FL	Orange	11	EtherCAT® communication error
L2	ON			
L1	1 FL	Orange	12	Real-time error
L2	BLK			
L1	1 FL	Orange	13	Position tracking error
L2	1 FL			
L1	1 FL	Orange	14	Limit value was reached
L2	2 FL			
L1	1 FL	Orange	16	I2T limit value was reached
L2	3 FL			
L1	3 FL	Orange	23	Overspeed
L2	1 FL			
L1	3 FL	Orange	24	Internal error
L2	ON			
L1	BLK	Orange	6	Error in /STO management
L2	ON			

LED	Action	Color	Priority	Description
L1	BLK	Orange	7	Feedback sensor error
L2	BLK			
L1	BLK	Orange	8	Execution of the last command failed
L2	1 FL			
L1	ON	Orange	0	Overvoltage on the DC bus
L2	BLK			
L1	ON	Orange	1	Short circuit of the motor or power section
L2	ON			
L1	ON	Orange	2	Overcurrent of the motor or power section
L2	ON			
L1	ON	Orange	3	Temperature management
L2	1 FL			
L1	ON	Orange	4	Undervoltage on the DC bus
L2	2 FL			
L1	ON	Orange	5	Control voltage error
L2	3 FL			

**Tab. 2:** Warning status of LEDs L1 and L2

**Error**

LED	Action	Color	Priority	Description
L1	1 FL	Red	11	EtherCAT® communication error
L2	ON			
L1	1 FL	Red	12	Real-time error
L2	BLK			
L1	1 FL	Red	13	Position tracking error
L2	1 FL			
L1	1 FL	Red	14	Limit value was reached
L2	2 FL			
L1	1 FL	Red	15	I2T limit value was reached
L2	3 FL			
L1	3 FL	Red	23	Overspeed
L2	1 FL			
L1	3 FL	Red	24	Internal error
L2	ON			
L1	BLK	Red	6	Error in /STO management
L2	ON			
L1	BLK	Red	7	Feedback sensor error
L2	BLK			
L1	BLK	Red	8	Execution of the last command failed
L2	1 FL			
L1	ON	Red	0	Overvoltage on the DC bus
L2	BLK			
L1	ON	Red	1	Short circuit of the motor or power section
L2	ON			
L1	ON	Red	2	Overcurrent of the motor or power section
L2	ON			
L1	ON	Red	3	Temperature management
L2	1 FL			
L1	ON	Red	4	Undervoltage on the DC bus
L2	2 FL			
L1	ON	Red	5	Control voltage error
L2	3 FL			

**Tab. 3:** Error status of LEDs L1 and L2

### 3.5.4 Warning and error status of LED L4

For a limited amount of time, the current supplied to the drive can be higher than the rated current (**overload**).

To protect the drive and supply section during the overload periods, the converter controls the energy transferred to the drive and if necessary restricts the current supply.

Parameter I2TValue indicates the magnitude of the energy transfer according to the table below:

LED	I2TValue	Color/action	Description
L4	0	Green, 1 FL	No current supply, the drive is stopped
		Green ON	The current supply varies between the value 0 and the rated current
	> 0 and < 80	Orange, ON	The current supply exceeds the critical value for overload
	≥ 80 and < 100	Orange, flashing	Warning, the current supply is approaching the maximum level of overload
	≥ 100	Red, ON	Error, the current supply has reached the maximum level of overload and the drive will be turned off

Tab. 4: Interpretation of the status of LED L4

### 3.5.5 Warning and error status of LED L6

LED L6 indicates the status of the STO system.

The signal via LED L6 is only a message and is not certified as part of the safety system.

LED	STO status	Action
L6	Voltage present on the input and no error	ON
	No voltage on the input and/or error	OFF

Tab. 5: Interpretation of the status of LED L6

#### INFO

The above description of the LEDs does not apply during the boot phase and when starting the JMX50-15117 firmware.

**3.5.6 LED states during the boot process**

LED	L1	L2	L3	L4	L5	L6	State	
<b>Color</b>	-	-	orange	orange	-	-	<b>Boot Startup</b>	
<b>Flashing pattern</b>	OFF	OFF	ON	ON	OFF	OFF		
<b>Color</b>	-	-	Green	Green	-	-	<b>Firmware Startup</b>	
<b>Flashing pattern</b>	OFF	OFF	ON	ON	OFF	OFF		
<b>Color</b>	orange	orange	orange	orange	orange	orange	<b>Firmware download phase</b>	
<b>Flashing pattern</b>	1 FL	1 FL	ON	ON	1 FL	1 FL		
<b>Color</b>	orange	orange	orange	orange	orange	orange		
<b>Flashing pattern</b>	BLK	BLK	ON	ON	BLK	BLK		
<b>Color</b>	orange	orange	orange	orange	orange	orange		
<b>Flashing pattern</b>	ON	ON	ON	ON	ON	ON		
<b>Color</b>	orange	orange	orange	orange	orange	orange		
<b>Flashing pattern</b>	FLK	FLK	ON	ON	FLK	FLK		
<b>Color</b>	Green	Green	orange	orange	Green	Green		
<b>Flashing pattern</b>	BLK	BLK	ON	ON	BLK	BLK		
<b>Color</b>	Red	Red	Red	Red	Red	Red		
<b>Flashing pattern</b>	ON	ON	ON	ON	ON	ON		
<b>Color</b>	Red	-	Red	Red	Red	Red		<b>Firmware exception error</b> <b>Error during firmware download or damaged firmware flash memory</b>
<b>Flashing pattern</b>	ON	OFF	ON	ON	BLK	BLK		
<b>Color</b>	Red	-	Red	Red	Red	Red	<b>CPLD programming aborted due to an error</b>	
<b>Flashing pattern</b>	ON	OFF	ON	ON	BLK	BLK		
<b>Color</b>	Green	-	Red	Red	Red	Red	<b>One or more incompatibilities between boot, hardware and firmware</b>	
<b>Flashing pattern</b>	BLK	OFF	ON	ON	BLK	BLK		

### 3.6 DIP switch sliders

The DIP switches are located on the top of the JMX50-15117 drive under the plastic cover.

They have no function and must be set to 0 or OFF.

### 3.7 Nameplate

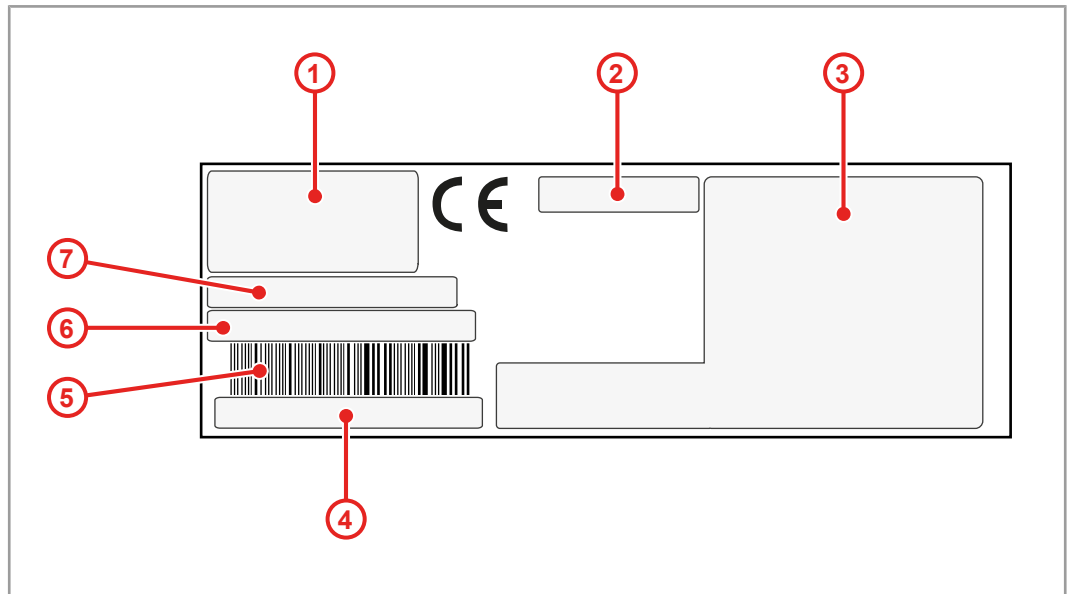


Fig. 4: Nameplate

1	Company logo		
2	Warning signs and mandatory signs		
3	Power data		
		$U_{PWR}$	Supply voltage
		$P_{PWR}$	Power consumption including power dissipation
		$P_n$	Rated power
		$M_0$	Continuous stall torque
		$M_n$	Rated torque
		$N_n$	Rated speed
		$U_{Ctr}$	Control voltage
		$I_{Ctr}$	Power consumption on control voltage side
		$T_A$	Ambient temperature
		HW	Hardware revision
		IP	Degree of protection
4	Serial number		
5	Barcode of the serial number		
6	Item number		
7	Article designation (see <a href="#">Order number code [► 24]</a> )		

### 3.7.1 Order number code

JetMove External	PK	Module			Servoamplifier				Motor						
Order number code	JMxx	-	1	0	xxx	-	S1	I4	R1	-	V	B	Px	Fxx	X

**Product class**

**JMX = JetMove External**

- 1. x = Basic flange size
- 2. x = Additional information:  
0 = No difference; 1 = Shaft;  
2 = Centering;  
3 = Flange size larger than 1<sup>st</sup> x;  
4 = Others

**Module (product group)**

Series  
1xxx = Series 1000

**Power supply voltage**

- 0 = DC 0 ... 48 V
- 2 = AC 230 V
- 4 = AC 400 ... 480 V
- 5 = DC 560 V (supply)

**Power class in Mrated in Ndm**

008: 0,8 Nm  
016: 1,6 Nm  
....

**Servoamplifier options**

**S = Safety options (optional)**

- = No option
- S1 = STO (Save Torque Off) = On JMX board**

**I = Communication interface (optional)**

- = No option = EtherCAT = Standard/none = EtherCAT as standard interface
- I4 = CANopen interface
- ...

**R = Brake resistor (optional)**

- R1 = Brake resistor integrated into JMX
- = No option = without integrated resistor ⇒ external resistor required

**Motor options**

**\_ = IP Protection**

Standard = IP65 for motor and controller  
JMX50: Standard = motor and controller IP65, heat sink IP56

**\_ = Brake (\_ = without brake)**

**B** = With motor holding brake DC 24 V

**\_ = Feather Key**

**P** = With key = Shaft with keyway (standard)  
Without P = without key = plain shaft = option

**F = Encoder type**

- \_ = 4096 Inc - singleturn, 12 bit, absolute JMX-10xxx**  
F51 = Multiturn-Absolut 4096 Inc multiturn, absolutely battery buffered
- F11 = SEK 37 (singleturn) - JMX-15xxx**
- F14 = SKM 36 (multiturn absolut encoder) - JMX-15xxx

**X = Special style**



### 3.8 Scope of delivery

Scope of delivery	Item number	Quantity
JMX50-15117		1
Plastic cap for M8 connection		1
Protective dust cap for M23 I/O connection		1
Feather key protective cap		1
Supplementary sheet with installation instructions		1
USB stick with complete documentation		1

## 4 Technical data

This chapter contains electrical, mechanical data and operating data of the JMX50-15117.

### 4.1 Dimensions

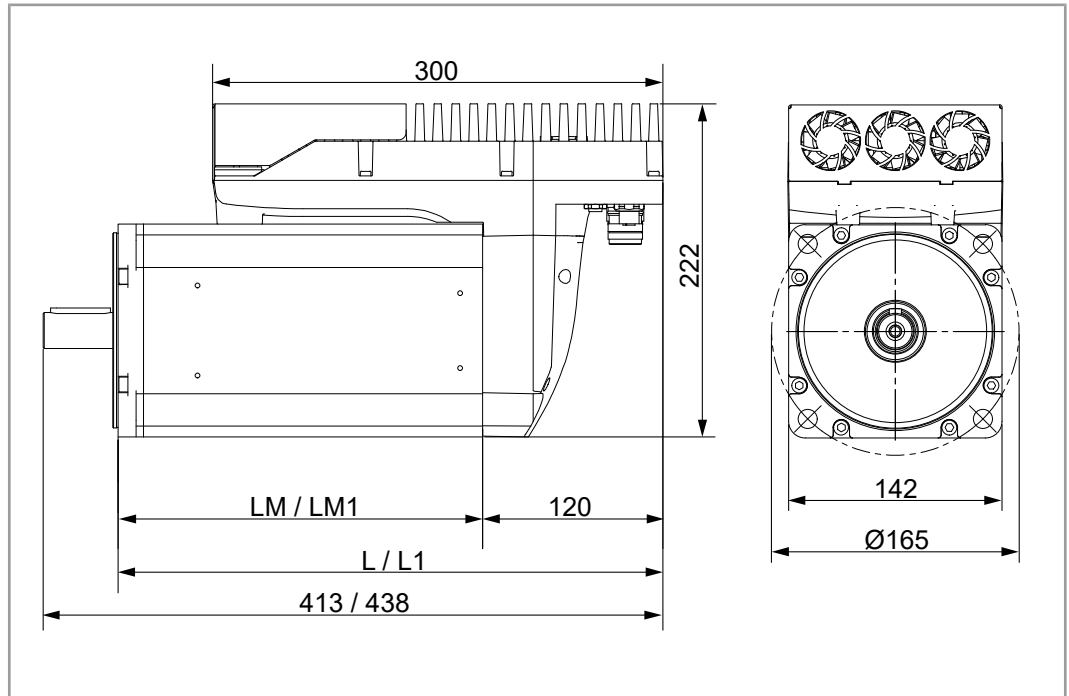


Fig. 5: Dimensions in mm

LM without brake	LM1 with brake	L without brake	L1 with brake
243 mm	268 mm	363 mm	388 mm

#### **i** INFO

#### CAD data

CAD data of the device can be found in the download area of our [homepage](#).

## 4.2 Mechanical specifications

Parameter	Description	Standards
Mounting orientation	No limitation	
Weight without brake	17.0 kg	
Weight with brake	18.5 kg	
Flange size	142 mm	
Moment of inertia without brake / with brake	11.5 / 13.2 kg*cm <sup>2</sup>	
Axial load	70 N	
Radial load	700 N	
<b>Enclosure specifications</b>		
Material	Metal, plastic	
Cooling	With additional fans	
<b>Insulation class</b>		
Insulation class	F	
<b>Brake holding torque</b>		
Brake holding torque	15 Nm	
<b>Vibration resistance</b>		
Frequency sweeps	1 octave/minute, sinusoidal	DIN EN 60068-2-6
Constant acceleration	2 g	5 Hz ≤ f ≤ 500 Hz
Number and direction	10 sweeps for all 3 spatial axes	
<b>Shock resistance</b>		
Type of shock	Half-sine wave	DIN EN 60068-2-27
Intensity and duration	14 g for 11 ms	
Number and direction	3 shocks in the directions of all 3 spatial axes	
<b>Degree of protection</b>		
Degree of protection	IP65	DIN EN 60529
<b>NOTICE! The fans have the IP code IP56</b>		
<b>Bearing service life</b>		
At rated speed of 3,000 rpm	20,000 h	

Tab. 6: Mechanical specifications

## 4.3 Electrical properties

### Power data

Parameter	Description	Value
$U_{PWR}$	Supply voltage	DC 560 V (DC 275 ... 730 V)
	<b>NOTICE! The DC bus must originate from a TT or TN power grid.</b>	
	Line voltage (rated voltage between phase and ground)	Max. 300 V (overvoltage category III)
	DC link capacitance	5.45 $\mu$ F
$P_{PWR}$	Power consumption including power dissipation	4300 W
$P_n$	Rated power	3680 W
$M_0$	Continuous stall torque	15.4 Nm
$M_n$	Rated torque	11.7 Nm
$N_n$	Rated speed	3,000 rpm @DC 560 V
$U_{Ctr}$	Control voltage	DC 24 V (DC 20.4 ... 25.4 V) <b>NOTICE! A power supply unit (PELV) with DC 24 V is required for the control voltage.</b>
	Internal fuse	4A-T, not-replaceable
	Minimum voltage for brake operation	21.6 V
	Additional protective measures	Electronic protection against short circuit
$I_{Ctr}$	Power consumption on control voltage side	Max. 0.5 A (Dig Out Off) plus 1.0 A with use of the motor brake
$I_n$	Motor rated current	7.2 A
$I_o$	Motor continuous stall current	9.45 A
$M_{max}$	Max. motor torque	45 Nm
$I_{max}$	Max. motor current	28 A
$N_{max}$	Max. speed	4,000 rpm
KE	Back EMF constant	98.4 V/1000 rpm
KT	Torque constant	1.63 Nm/A
R2ph	Winding resistance	0.93 $\Omega$
L2ph	Winding inductance	11.68 mH
$P_{mot}$	Motor pole count	8

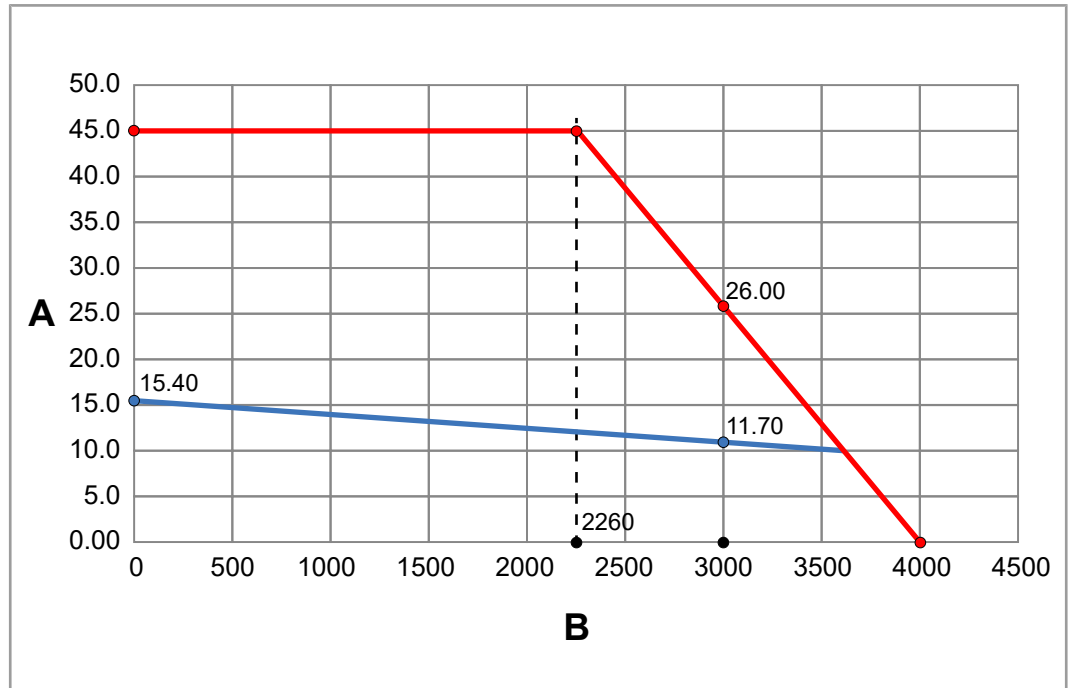
Tab. 7: Power data

**Electrical safety**

Parameter	Description	Standard
Class of protection	III	DIN EN 61131-2
Dielectric test voltage	Functional ground is internally connected to chassis ground.	
Overtoltage category	II	

**Tab. 8:** Electrical safety

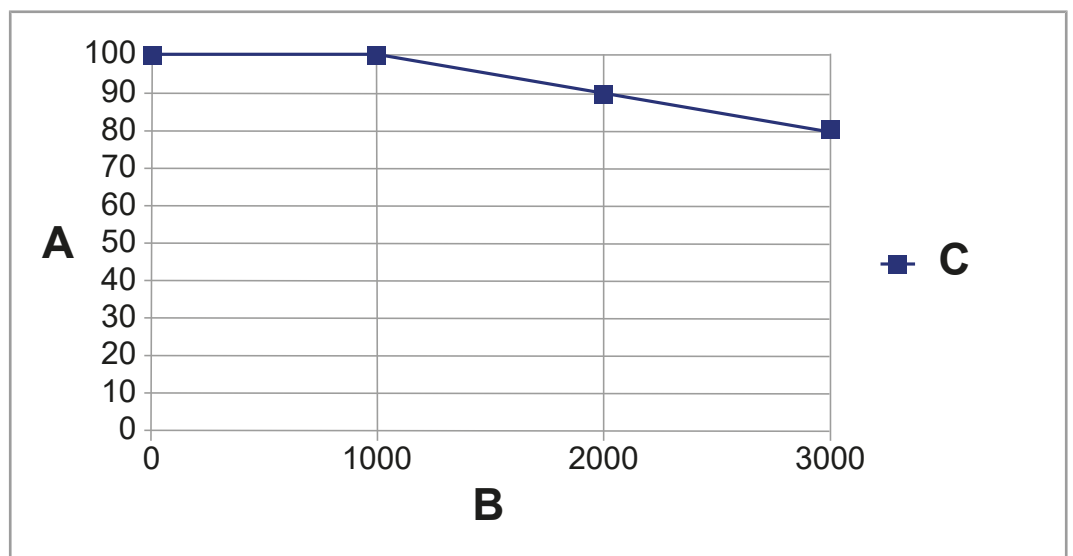
**4.4 Torque curves**



**Fig. 6:** Torque curves

A	Torque in Nm
B	Speed in rpm

**4.4.1 Torque reduction**



**Fig. 7:** Torque reduction depending on the altitude

## 4.5 Environmental conditions

Parameter	Description	Standards
Operating temperature	0 ... +40 °C	DIN EN 61131-2
Storage temperature	-20 °C ... +70 °C	DIN EN 60068-2-1
Air humidity	5 % ... 95 % at 40 °C, non-condensing	IEC 60068-2-78
Max. operating altitude	2,000 m above sea level	DIN EN 61131-2
<p><b>NOTICE! For an installation altitude between 2,000 m and 4,000 m above sea level, in order to counteract the transient overvoltages, overvoltage protection must be installed on the machine to restrict the overvoltages of the circuit to overvoltage category II. This can be achieved with a galvanic isolation transformer.</b></p>		
Installation location	<p>The drives must not be used in an environment where there is risk of fire, corrosion or explosion.</p> <p>The drives can be used / installed outdoors, but must not be exposed to direct sunlight (UV rays).</p>	
Corrosion immunity and chemical resistance	<p>No special protection against corrosion. The ambient air must be free of high concentrations of acids, alkalis, corrosive agents, salt, metal vapors or other corrosive or electrically conductive impurities.</p>	
Degree of pollution – electronic environment	Level 3	DIN EN 61131-2
	<p>Occurrence of conductive impurities or dry non-conductive impurities that become conductive, since condensation may be expected.</p>	

**Tab. 9:** Environmental conditions

## 5 Mechanical installation

This section describes the quick assembly of the JMX50-15117 drive.

### CAUTION



**Possible risk of personal injuries and material damage due to failure to comply with the safety instructions**

- ▶ Before assembling the drive, read and comply with the safety precautions and restrictions on usage provided in the safety chapter.
- ▶ All work on the device must be carried out only by authorized and qualified personnel.

### NOTICE



**Damaged drives**

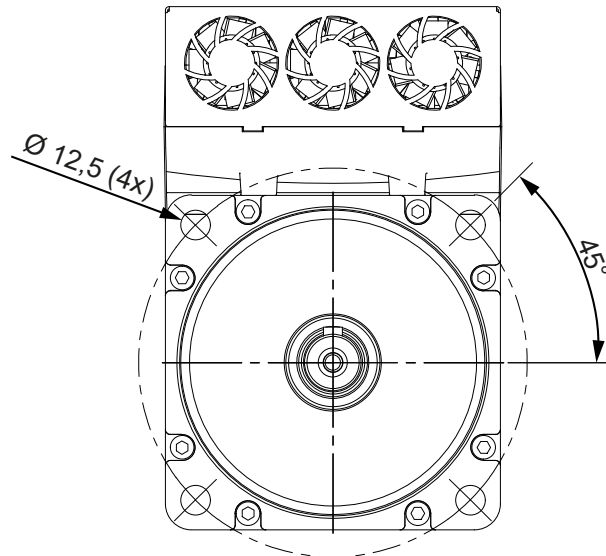
Damaged drives can result in considerable material damage.

- ▶ Check the drive for external damage and incorrect connections.
- ▶ Install only completely intact drives.

### 5.1 Required equipment

- ▶ Have the following devices, tools and materials on hand:
  - JetControl controller and supply unit
  - Power cable for connecting to socket CN5
  - Screwdriver for tightening the cables according to the designated wiring
  - 4 M8 screws for fastening the flange
  - Various connection cables

## 5.2 Mounting the drive



1. Screw the motor onto the flange in the designated position with the 4 matching screws.
2. Ensure to allow for unimpeded ventilation of the motor. Observe the permitted ambient temperature.

## 5.3 Mounting the protective conductor

### ⚠ CAUTION



#### Risk of injury due to electric shock

Loose connections and contacts will result in a loss of the safety function of the protective conductor.

- ▶ Check all connections to have good contact and be tightly seated so that they cannot come loose by themselves.
- 
- ▶ Connect the PE protective conductor with the PE pin of the voltage supply input connection and connect the motor flange with the potential equalization of the machine.



## 6 Electrical connection

### NOTICE



#### Damages to material or functional impairment

Improper implementation of the wiring harness may cause mechanical stress.

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

### 6.1 Connection CN5 - voltage supply

#### Interface

Connect the following to male connector CN5:

- DC 560 V DC link voltage from supply unit JMX-15P
- DC 24 V logic voltage
- Safe outputs to control the STO function

#### Pin assignment

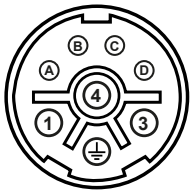


Fig. 8: M23, male, 8-pin

Pin	Signal	Description
1	HV-	Supply voltage (negative pole)
2	⊕	PE conductor
3	-	n. c.*
4	HV+	Supply voltage (positive pole)
A	/STO	Safe torque off input
B	GND	Reference potential (control voltage and dig. inputs)
C	IN9	Digital input 9
D	CV	Control voltage (24 VDC)

\*n. c. = not connected (= no function)

Tab. 10: Pinout for male connector CN5

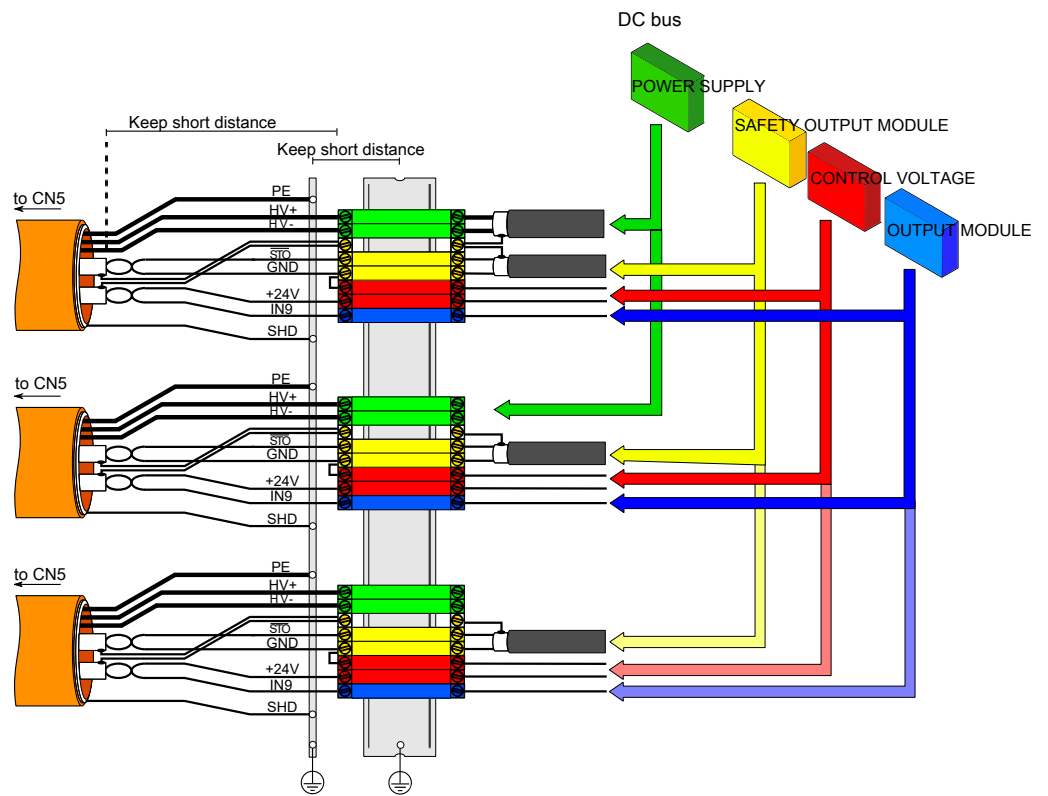


Fig. 9: Connection diagram

**INFO**

**Cable gland in a terminal distributor box**

1. When using cable glands in a terminal distributor box, use a variant that makes it possible to ground the outer shielding (SHD) via a conductive connection with the grounded distributor box (for example the AGRO easy connect metal cable gland with metal spring).
2. Route the shields of the signal lines to PE.

The illustration below shows a connection example of the inputs and outputs. The 24 V voltage for the inputs and outputs and the ground reference of the outputs are set up via internal connections of the JMX50-15117.

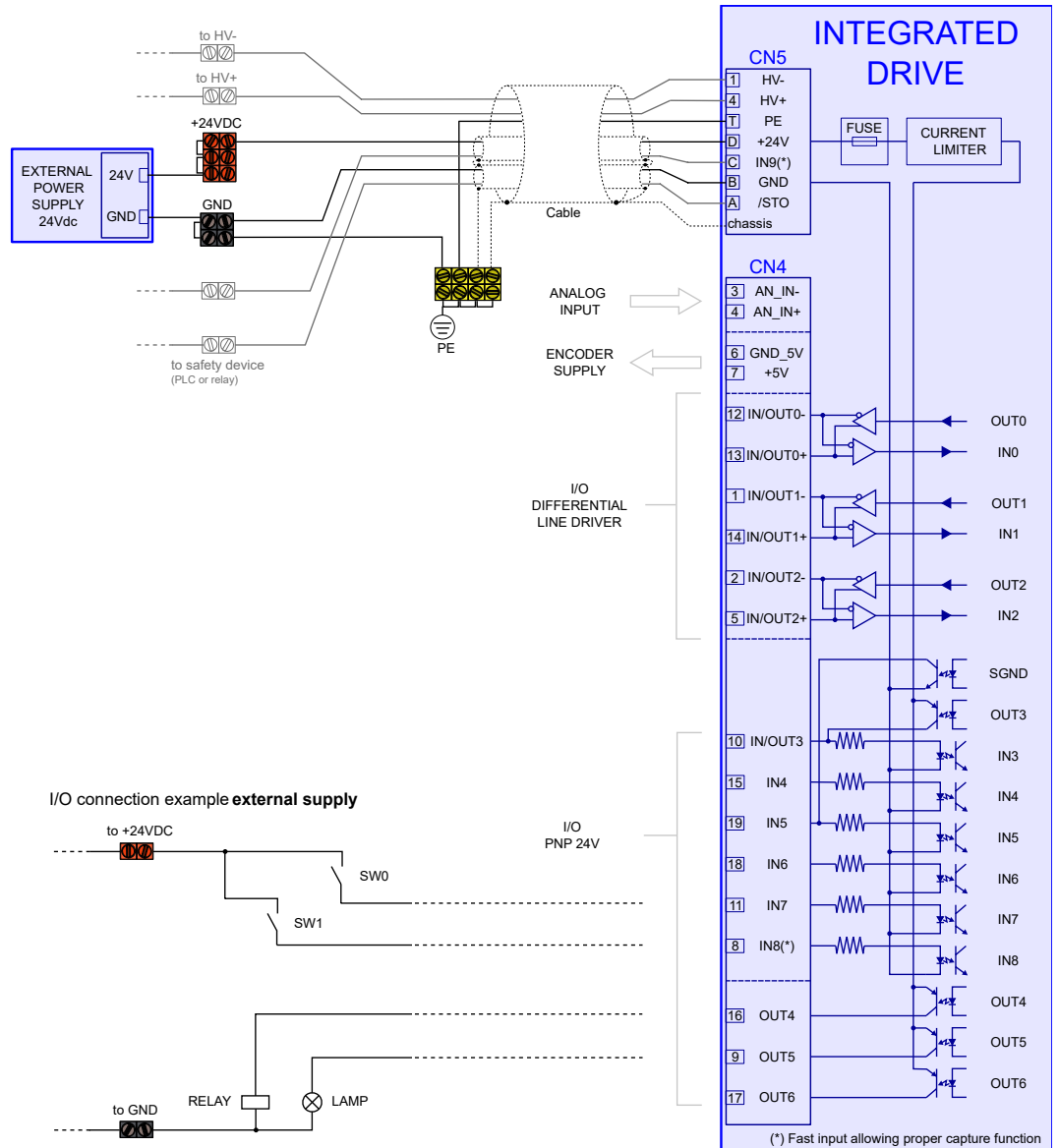


Fig. 10: Wiring example and internal connections

**INFO**

Avoid placing the I/O signal cable parallel to the power cables. Choose a suitable form of laying them separately.

We recommend using a shielded cable and connecting the shielding with the metallic part of the round connector. Follow the manufacturer's specifications for connecting the shield on the controller/ PLC side.

## 6.2 Connection CN2, CN3 - EtherCAT®

### Ports and interfaces

Connect to sockets CN2 and CN3:

- EtherCAT® fieldbus
- 1. Connect the connection coming from the EtherCAT® master to socket CN2.
- 2. Connect to socket CN3 EtherCAT® Slave Stations if the EtherCAT® fieldbus is to be connected with additional slave stations.

### Assignment

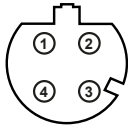


Fig. 11: M12, d coded, 4-pin, female

Pin	Signal	Description
1	TX Data+	Data output +
2	RX Data+	Data input +
3	TX Data-	Data output -
4	RX Data-	Data input -
Housing	PE	Grounding

Tab. 11: Pin assignment of sockets CN2 and CN3

### 6.2.1 Communication with the EtherCAT® master

#### NOTICE



#### Damage to the drive

- ▶ Connect and disconnect the communication connector only when the drive is turned off.
- ▶ Check also whether the drive, master, PC, all devices and the grounding control supply pin of the power supply input connector are correctly connected with the protective conductor.

- ▶ Connect the cables of the EtherCAT® network to the EtherCAT® fieldbus connection.

### Baud rate

- The baud rate (communication speed) is set to 100 Mbit/s according to its technical properties.
- The node number is defined by the position (position address).
  - This method is generally used by masters for automatic detection of drives in the EtherCAT® network.
  - The master gives each node an address that matches the physical position of the drive in the network.

See also [Status display LEDs \[▶ 17\]](#)

### 6.2.2 File access via the EtherCAT® protocol (FoE)

- The FoE protocol is implemented in the drive, but is only used to update the firmware.
- It is used automatically by JetSym during a firmware download.

#### **i** INFO

Please note the instructions in JetSym for the firmware download.

### 6.2.3 Error due to an interruption in communication

If a main bus communication cable is disconnected or cut off, communication is interrupted immediately.

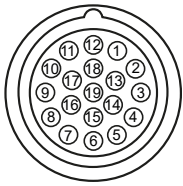
The error message in this case is as described under EtherCAT® communication error. See [Error list \[▶ 43\]](#)

## 6.3 Connection CN4 - digital input and output, analog input

### Interface

Connect the following to male connector CN4:

### Assignment



**Fig. 12:** M23, male, 19-pin

Pin	Signal	Description
1	IN/OUT1 -	Differential digital input/output 1 (-) Additional encoder channel B-
2	IN/OUT2 -	Differential digital input/output 2 (-) Additional encoder channel I-
3	AN_IN -	Analog input (-)
4	AN_IN +	Analog input (+)
5	IN/OUT2 +	Differential digital input/output 2 (+) Additional encoder channel I+
6	GND_5V	Ground of +5 V
7	+5 V	+5 V supply (max 150 mA) for additional encoder
8	IN8	Touch probe input
9	OUT5	Output 5; n. c.*
10	IN/OUT3	Digital input/output 3; n. c.*
11	IN7	Reference switch Input
12	IN/OUT0 -	Differential digital input/output 0 (-) Additional encoder channel A-
13	IN/OUT0 +	Differential digital input/output 0 (+) Additional encoder channel A+
14	IN/OUT1 +	Differential digital input/output 1 (+) Additional encoder channel B+
15	IN4	Input 4; n. c.*
16	OUT4	Output 4; n. c.*
17	OUT6	Output 6; n. c.*
18	IN6	Limit switch (-) input
19	IN5	Limit switch (+) input
Housing	PE	Grounding

\*n. c. = not connected (= no function)

**Tab. 12:** Pinout for male connector CN4

## 7 Configuration of the power supply

### DANGER



#### Electric shock

An incorrect connection can lead to high electrical voltage.

- ▶ Connect the power grid and grounding according to applicable safety requirements.

### NOTICE



#### Material damage due to incorrect dimensioning

Inadequately dimensioned lines can lead to overheating and thus to a risk of fire.

- ▶ The supply unit is intended for a fixed connection to a three-phase power grid type TT or TN. The rated current for the short circuit of the electrical line must be <math>< 5\text{ kA}</math>.
- ▶ Read the operating instructions of the devices you are using before starting with the installation.
- ▶ Do not make the connection for the power supply until after the wiring and the protective devices connected by it are correctly dimensioned.
- ▶ Ensure that the protective devices at the input of the supply unit have adequate interrupt rating.

### 7.1 Electrical requirements for the supply unit

The following preconditions must be observed to comply with the electrical requirements:

- The supply unit must be installed in a TT or TN power grid.
- The line voltage between phase and ground must be equal to or less than AC 300 V.
- The output voltage of the DC bus must be in line with the electrical properties of the connected drives to ensure the required output in terms of speed and torque.
  - Reducing the DC link voltage generally leads to a proportional reduction of the motor speed.
- The maximum voltage must be appropriate for the electrical properties of the connected drives,
  - In particular, a margin must be ensured to prevent overvoltage errors on the DC bus.
- The maximum current requirement of the individual drives is linked with parameter I2T. For details see [Warning and error status of LED L4](#) [▶ 21].

Function	Parameter	Requirement
Output voltage	VDC	Min. DC 275 V; max. DC 730 V
Ripple of the output voltage	DVdc	The supply unit must ensure leveling of the output voltage in line with the output requirements.
Maximum output voltage during the braking process	Vdc <sub>max</sub>	DC 785 V
Soft-Start	-	A soft-start system is required by which the supply unit limits the charge current of the capacitors during power-on to prevent overcurrent and overvoltage surges on the DC bus.
Output current	Idc	The supply unit must provide a rated and surge current that is appropriate for the type and current requirement of each individual drive and also for the simultaneity factor.
Protection against overcurrent and short circuit of the output	-	The supply unit must be equipped with internal protective devices against short circuit and overvoltage on the DC bus that are appropriate for the installation. Otherwise the cables of the DC bus must be protected with external devices (for example fuses) in line with the load, the electrical properties of the installation and the requirements of the applicable standards.

Tab. 13: Electrical requirements

## 7.2 Selecting the DC bus supply

The power section of the drives of the JMX product family is designed for supply with a continuous voltage that can be obtained without any problems from the line voltage via the AC/DC supply unit JMX-15P.

However, it is possible to implement an installation with another voltage supply that meets the conditions listed in the section [Electrical requirements for the supply unit](#) [▶ 38].

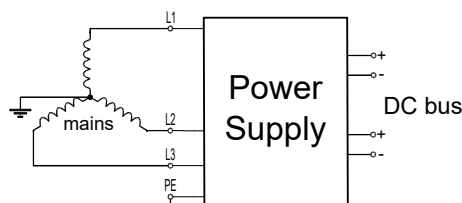


Fig. 13: Power supply connection diagram

## 7.3 DC bus supply with JMX-15P

A supply unit of JMX-15P series is preferable to supply power to the drives of the JMX series.

For more detailed information refer to the corresponding operating instructions.

### Benefits of the JMX-15P

- The JMX was designed for power supply to the drives of the JMX-15P model range
- Built-in overcurrent protection devices
- The direct current properties of the DC link voltage are suitable for drives of the JMX series
- Integrated protective functions
  - Overload on the outputs of the DC bus
  - Short circuit in the brake circuit
  - Brake energy overload
  - Charging energy overload
  - Undervoltage/overvoltage/excessive ripple of the DC bus
  - Overtemperature in the power and control section

### Configuration of DC bus outputs

- The supply units of JMX-15P series have 2 DC bus outputs.
- It is possible to separate these outputs with 2 branches or to interconnect them in parallel. For the latter configuration, the flow of current through the cable must be adjusted after the cables come together to the maximum permitted current of the supply unit.
- One or more drives of the JMX series can be connected to the same output line of the supply unit.

## 7.4 DC bus supply with generic power supply unit

The drives can be supplied via a DC bus that is generated by a generic power supply unit.

### Prerequisites

- The requirements described in sections [Electrical requirements for the supply unit \[▶ 38\]](#) and [DC bus supply with JMX-15P \[▶ 40\]](#) must be observed.
- In addition, compliance with the applicable standards for electrical drive systems with variable speed must be ensured.



## 7.5 Topology of the energy supply

The drives of the JMX series can be operated in a **star configuration**.

This means that the current supply and control supply as well as any other signals on the power supply input connection must be connected from each source to the drive with a point-to-point connection.

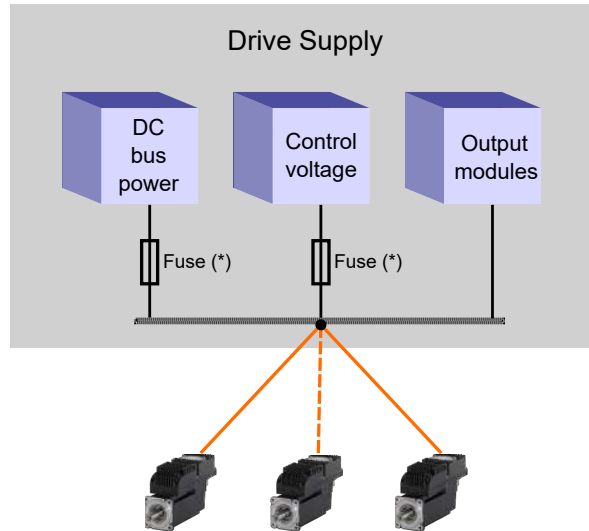


Fig. 14: Block diagram – power supply unit connection

**NOTICE!** The fuses identified with (\*) are only required in the case of an unprotected power supply. Protective measures like these are not necessary if the JMX-15P is used for the DC bus.

The protective measures described in the illustration above require wiring with the same conductor cross-section, including to any branches.

**NOTICE!** The dimensioning of the fuses for the DC link and control section as well as the selection of the cables must be coordinated with the overall load and the properties of the installation (in accordance with applicable requirements). If these aspects are not taken into consideration, the sections must be protected individually.

## 7.6 Supply voltages

The drives of the JMX model range have two areas, control and power, that must be supplied separately with DC voltage (electrical isolation between these two areas).

1. Check whether the voltage values specified in section [Electrical properties \[▶ 28\]](#) are being observed.
2. Pay special attention to possible voltage fluctuations to prevent undesirable error or warning notifications.
3. Take into consideration that the drive cannot expend the energy of the power feedback.
4. Pay attention to a drop in the motor output due to a reduction in the supply voltage.

### **i** INFO

Supply the rated voltage to the power section.

- If the supply voltage of the control section falls below the lowest limit value, the drive is deactivated. See [Electrical properties \[▶ 28\]](#).
- For motors with brake, there is a limit value that puts the drive in an error state if the supply voltage of the control section is not sufficient to ensure safely releasing the brake. See [Error list \[▶ 43\]](#): Control voltage error.

## 7.7 Power feedback

Power feedback is a work phase of the drive in which it feeds energy back into the DC link while the motor is decelerating.

If this energy is not absorbed or diverted, the DC link voltage can rise and cause a drive error.

The drives of the JMX series are not capable of diverting this energy internally. Therefore, the DC bus must be supplied either

- with a bidirectional supply unit, or
- with a supply unit with a brake chopper with connected braking resistor.

Both variants limit the DC bus voltage and allow the drive to work normally even when the motor is braking.

### **i** INFO

To evaluate the level of power feedback of the drive, the peak value of the kinematic energy generated by the motor during its deceleration and the continuously generated total energy must be taken into consideration. This data is the decisive factor for selecting the DC power supply.

- ▶ Please read the manual and the documents of the supply unit.

## 8 Error list

- Errors always lead to an error response from the drive:
  - The drive shaft will be stopped
  - An error number will be reported to JetControl
- The state of the MCX axis changes to **ERROR DISABLE** state
- An error acknowledgment command (**ClearErrors()**) is required to quit this state

The tables below give a summary of error numbers and causes and error responses of the drives.

### Overvoltage on the DC bus

Error number	Error designation	Description	Error response
0.1	Overvoltage on the DC bus.	<p>Overvoltage in the voltage supply of the power section (DC bus <math>\geq 840</math> V).</p> <ol style="list-style-type: none"> <li>1. Check the line cross-section of the voltage supply and the electrical connections.</li> <li>2. Check the power feedback unit circuit as well.</li> </ol>	The drive switches off.

**Tab. 14:** Error category Overvoltage on the DC bus

## Temperature management

Error number	Error designation	Description	Error response
1.0	Overtemperature of the power section.	Overtemperature of the power section ( $T \geq 110 \text{ }^\circ\text{C}$ ). <ul style="list-style-type: none"> <li>▶ Check the ambient temperature and ventilation of the power section.</li> </ul>	The drive is stopped with the quick stop ramp and deactivated.
1.1	Overtemperature of the control section.	Overtemperature of the control section ( $T \geq 95 \text{ }^\circ\text{C}$ ). <ul style="list-style-type: none"> <li>▶ Check the ambient temperature, ventilation and power consumption of the control section.</li> </ul>	
1.2	Overtemperature of the motor.	Overtemperature of the motor. <ul style="list-style-type: none"> <li>▶ Check the ambient temperature, ventilation and heat dissipation and analyze the work cycle in relation to motor output and the torque characteristics.</li> </ul>	
1.6	Hardware error of the temperature sensor on the power section.	Sensor failure. <ul style="list-style-type: none"> <li>▶ Contact Bucher Automation AG.</li> </ul>	
1.7	Hardware error of the temperature sensor on the control section.	Sensor failure. <ul style="list-style-type: none"> <li>▶ Contact Bucher Automation AG.</li> </ul>	
1.8	Hardware error of the motor temperature sensor.	Sensor failure. <ul style="list-style-type: none"> <li>▶ Contact Bucher Automation AG.</li> </ul>	
1.9	Overtemperature of the feedback sensor.	Overtemperature of the feedback sensor: $T \geq 115 \text{ }^\circ\text{C}$ for single-turn rotary encoder; $T \geq 110 \text{ }^\circ\text{C}$ for multi-turn rotary encoder. <ul style="list-style-type: none"> <li>▶ Check the ambient temperature, ventilation and heat dissipation and analyze the work cycle in relation to motor output and the torque characteristics.</li> </ul>	

**Tab. 15:** Error category Temperature management

**Undervoltage on the DC bus**

Error number	Error designation	Description	Error response
3.0	Undervoltage on the DC bus.	<p>Undervoltage in the voltage supply of the power section (DC bus <math>\leq 150</math> V).</p> <ol style="list-style-type: none"> <li>1. Check the supply voltage of the drive and wiring. If a voltage drop occurs during a certain movement, use an oscilloscope to monitor the course of the characteristic curve of the DC link voltage on the power section.</li> <li>2. Reduce the speed and acceleration in the work cycle or use a more powerful voltage supply.</li> </ol>	The drive switches off.

**Tab. 16:** Error category Undervoltage on the DC bus**Short circuit of the motor or power section**

Error number	Error designation	Description	Error response
4.0	Short circuit of the motor or power section.	<p>Short-circuit error of the motor or power section.</p> <ol style="list-style-type: none"> <li>1. Wait 20 seconds before resetting the error to allow the accumulated energy to be given off.</li> <li>2. If the problem recurs, contact Bucher Automation AG.</li> </ol>	The drive switches off.

**Tab. 17:** Error category Short circuit of the motor or power section

**Fatal parameter error**

<b>Error number</b>	<b>Error designation</b>	<b>Description</b>	<b>Error re- sponse</b>
6.0	Blocking current is not set.	The parameter is not consistent. <b>1.</b> Turn the device off and back on again. <b>2.</b> If the problem recurs, contact Bucher Automation AG.	The drive is stopped with the quick stop ramp and deactivated.
6.1	Surge current of the motor is not set.		
6.2	Torque constant of the motor is not set.		
6.3	Inductance of the motor is not set.		
6.4	Resistance of the motor is not set.		
6.5	Inertia of the motor is not set.		
6.6	Pole count of the motor is not set.		
6.7	Rated speed of the motor is not set.		
6.8.	Feedback sensor is not set.		
6.9	Maximum rated current is not set.		
6.10	Maximum surge current of the motor is not set.		
6.11	Amperage is not calibrated.		
6.12	Voltage level is not calibrated.		
6.13	Feedback sensor is not supported.		
6.14	Position encoder is not aligned: Commutation not possible.		
6.15	Pole pitch is not set.		

**Tab. 18:** Error category Fatal parameter error

**Real-time error**

<b>Error number</b>	<b>Error designation</b>	<b>Description</b>	<b>Error response</b>
7.0	EtherCAT is not in <b>Operational</b> state.	The interpolation parameters of the master are not consistent.  <ol style="list-style-type: none"> <li>1. Restart JetControl together with the drives.</li> <li>2. If the problem recurs, contact Bucher Automation AG.</li> </ol>	The drive is stopped with the quick stop ramp and deactivated.
7.1	PDO missing.		
7.2	Parameters of cubic interpolation are not compatible.		
7.3	Incorrect cycle time for cubic interpolation.		
7.4	Incorrect period for interpolation.		
7.5	Interpolation parameters are outside of the permitted range.		
7.6	Interpolation type is not compatible.		

**Tab. 19:** Error category Real-time error

**EtherCAT®  
communication error**

Error number	Error designation	Description	Error response
8.0	Watchdog of the Sync Manager has expired.	The watchdog of the <i>Sync Managers (SM)</i> for RxPDO has expired; RxPDO was not received.  <ol style="list-style-type: none"> <li>1. Restart JetControl together with the drives.</li> <li>2. If the problem recurs, contact Bucher Automation AG.</li> </ol>	The drive is stopped with the quick stop ramp and deactivated.
8.1	Watchdog of the Sync 0 has expired.	The watchdog for <i>Sync signal 0</i> has expired.  <ol style="list-style-type: none"> <li>1. Restart JetControl together with the drives.</li> <li>2. If the problem recurs, contact Bucher Automation AG.</li> </ol>	
8.2	PLL error	PDO and <i>Sync Signal 0</i> are not synchronized.  <ol style="list-style-type: none"> <li>1. Restart JetControl together with the drives.</li> <li>2. If the problem recurs, contact Bucher Automation AG.</li> </ol>	
8.3	Synchronization error	RxPDO has not been received, or has not been received synchronously with the set synchronization reference.  <ol style="list-style-type: none"> <li>1. Restart JetControl together with the drives.</li> <li>2. If the problem recurs, contact Bucher Automation AG.</li> </ol>	

**Tab. 20:** Error category EtherCAT® communication error



**Overcurrent of the motor or power section**

Error number	Error designation	Description	Error response
10.0	Short circuit of the motor or power section.	<p>Amperage in the power section or in the motor phases is unusually high or too high. This typically occurs when the drive is not capable of controlling the amperage correctly due to a deviation or suboptimal parameterization (tuning).</p> <p>The magnitude and duration of the overcurrent can damage the drive.</p> <ul style="list-style-type: none"> <li>▶ Check the tuning of the current control loop and reduce the dynamic response behavior.</li> </ul> <p>This deviation can occur if the ActualFieldCurrent (Id) &lt; -50 % IS with a brake ramp that is simultaneously very stable. Under these conditions, the supply voltage of the DC bus is too weak to control the amperage. The electric motor counterforce allows the amperage to rise to values above the tolerance limit, which can trigger an overcurrent error.</p> <ol style="list-style-type: none"> <li>1. Reduce the brake ramp or the speed of the start ramp. Increase the supply voltage of the DC bus.</li> <li>2. Wait 20 seconds before resetting the error to allow the accumulated energy to be given off.</li> <li>3. If the problem recurs, contact Bucher Automation AG.</li> </ol>	The drive switches off.

**Tab. 21:** Error category Overcurrent of the motor or power section**Position tracking error**

Error number	Error designation	Description	Error response
12.0	Position tracking error	<p>The tracking error is outside of the defined error limit.</p> <ul style="list-style-type: none"> <li>▶ Check whether the motor movement is compatible with the settings.</li> </ul>	The drive is stopped with the quick stop ramp and deactivated.

**Tab. 22:** Error category Position tracking error

**Execution of the last command failed**

Error number	Error designation	Description	Error response
13.0	Execution of the last command failed.	The last command from SysMng-Command was terminated with an error.	The drive is stopped with the quick stop ramp and deactivated.

**Tab. 23:** Error category Execution of the last command failed**Error in /STO management**

Error number	Error designation	Description	Error response
14.0	/STO = 0 V with drive activated.	Occurs in the following cases: <ul style="list-style-type: none"> <li>• The drive is active and no voltage is applied to the digital /STO input.</li> <li>• An attempt was made to activate the drive with the /STO signal missing.</li> </ul>	The drive switches off.
14.1	/STO input level is outside of the permitted range.	<ol style="list-style-type: none"> <li>1. The voltage applied to the /STO input was in the middle range of the defined limit values for longer than 500 ms.</li> <li>2. Ensure that the transition between the voltage levels takes place in less than 500 ms and that the voltage values are within the permitted limits (see <a href="#">Electrical properties of the STO input</a> ▶ 59).</li> </ol>	
14.2	Error in the /STO hardware circuit.	A deviation was detected in the internal signals of the safety system. <ul style="list-style-type: none"> <li>▶ Contact Bucher Automation AG.</li> </ul>	
14.3	Configuration of the /STO DIP switch is invalid.	An invalid setting of the DP5-DIP switch was detected (see <a href="#">DIP switch sliders</a> ▶ 23).	
14.4	Hardware error of the /STO-internal supply.	A deviation was detected in the safety system. <ul style="list-style-type: none"> <li>▶ Contact Bucher Automation AG.</li> </ul>	

**Tab. 24:** Error category Error in /STO management

**I2T limit value was reached**

Error number	Error designation	Description	Error response
16.0	I2T limit value was reached.	The I2T value has reached 100 %. This means that the maximum overload of the drive has been reached.	The drive is stopped with the quick stop ramp and deactivated.

**Tab. 25:** Error category I2T limit value was reached**Feedback sensor error**

Error number	Error designation	Description	Error response
23.1281 ... 23.1310	Internal sensor error.	Internal sensor error.  ▶ If the problem recurs, contact Bucher Automation AG.	The drive switches off.
23.1328 23.1329	Communication: Time-out while receiving data.	Communication with the sensor failed. Reset the error.  ▶ If the problem recurs, contact Bucher Automation AG.	
23.1333	Communication: No free storage space available.	Communication with the sensor failed. Stop the oscilloscope and reset the error.  ▶ If the problem recurs, contact Bucher Automation AG.	
23.1344	Communication: Checksum error	Communication with the sensor failed.  <b>1.</b> Reset the error.  <b>2.</b> If the problem recurs, contact Bucher Automation AG.	
23.1345	Communication: Parity error	Communication with the sensor failed.  <b>1.</b> Reset the error.  <b>2.</b> If the problem recurs, contact Bucher Automation AG.	
23.1346	Communication: Framing error	Communication with the sensor failed.  <b>1.</b> Reset the error.  <b>2.</b> If the problem recurs, contact Bucher Automation AG.	
23.1347	Communication: Overflow error	Communication with the sensor failed.  <b>1.</b> Reset the error.  <b>2.</b> If the problem recurs, contact Bucher Automation AG.	

Error number	Error designation	Description	Error response
23.1367	Commutation search: Error during the initialization of the incremental counter.	The alignment between rotary encoder and motor position failed.  ▶ If the problem recurs, contact Bucher Automation AG.	The drive switches off.
23.1370	Commutation search: Sine or cosine polarity is incorrect.	The polarity of the sine or cosine signals is incorrect.  ▶ If the problem recurs, contact Bucher Automation AG.	
23.1392	Position tracking error: Offset of analog and digital position.	Electrical problems occurred when the position was restored from analog and digital signals.  1. Reset the error.  2. If the problem recurs, contact Bucher Automation AG.	
23.1393	Incorrect sine or cosine values.	Electrical problems occurred when the position was restored from sine or cosine signals.  1. Reset the error.  2. If the problem recurs, contact Bucher Automation AG.	
23.1396	Hardware error of the sine and cosine signal.	Drive-internal electrical problems.  1. Reset the error and the logic supply.  2. If the problem recurs, contact Bucher Automation AG.	

**Tab. 26:** Error category Feedback sensor error

### Control voltage error

Error number	Error designation	Description	Error response
25.0	The control voltage is too low for the brake.	The supply voltage of the control section is not adequate to ensure the braking power.  ▶ Increase or stabilize the supply voltage.	The drive is stopped with the quick stop ramp and deactivated.

**Tab. 27:** Error category Control voltage error

**Overspeed**

Error number	Error designation	Description	Error response
28.0	Overspeed	The defined maximum speed was exceeded for more than 10 ms. The limit value can be calculated from <i>MaxMator-Speed*1.2</i> and is thus 20 % above the maximum speed reached by the motor.	The drive switches off.

**Tab. 28:** Error category Excessive rpms**Internal error**

Error number	Error designation	Description	Error response
31.0	Internal software reset.	<p>An internal firmware error occurred.</p> <ul style="list-style-type: none"> <li>▶ Execute the following STX commands:</li> </ul> <pre>&lt;MCaxis&gt;.Drive.GenericAccess.CANopen.ReadUint16(0x55A4,03)</pre> <p>and</p> <pre>&lt;MCaxis&gt;.Drive.GenericAccess.CANopen.ReadUint32(0x55A4,03)</pre> <ul style="list-style-type: none"> <li>▶ Report this error to Bucher Automation AG.</li> </ul>	

**Tab. 29:** Error category Internal error

## 9 Warning messages

- Warning messages are only displayed in the **JetControl** controller. There is no stop and the drive does not switch off.
- If the reason for the warning message no longer exists, the display is deleted automatically and no acknowledgment is needed.

Warning message in JetSym	Description
Undervoltage DC link	<p>Undervoltage for the power supply of the power section (DC bus <math>\leq 200</math> V).</p> <ol style="list-style-type: none"> <li>1. Check the supply voltage of the drive and wiring. If a voltage drop occurs during a certain movement, use an oscilloscope to monitor the course of the characteristic curve of the DC link voltage on the power section.</li> <li>2. Reduce the speed and acceleration in the work cycle or use a more powerful voltage supply.</li> </ol>
Overtemperature drive	<p>Overtemperature of the power section (<math>T \geq 105</math> °C) or overtemperature of the control section (<math>T \geq 85</math> °C).</p> <ul style="list-style-type: none"> <li>▶ Check the ambient temperature and ventilation of the power section. and control section and the power consumption of the control section.</li> </ul>
Overtemperature motor	<p>Overtemperature of the motor. The motor temperature is 10 °C lower than the error limit value.</p> <ul style="list-style-type: none"> <li>▶ Check the ambient temperature, ventilation and heat dissipation and analyze the work cycle in relation to motor output and the torque characteristics.</li> </ul>
I2TMotor	The I2T value has reached 80 %.
DriveSpecific	This warning refers to special states that are measured in the JMX50-15117 and are not listed in the general warnings of the Bucher Automation drives above.

**Tab. 30:** Warning messages

# 10 Safety function STO

## 10.1 General information

<b>Safe Torque Off</b>	STO stands for "Safe Torque Off". The STO function is the most standard and fundamental safety function integrated into the drive.
<b>Function</b>	The STO function corresponds to stop category 0 according to EN 60204-1 and prevents unintentional movement.
<b>Procedure</b>	The energy supply to the drive is interrupted immediately and the drive is shut down uncontrolled. The drive can no longer generate a torque after shutdown. This status is monitored internally in the drive.

### ⚠ CAUTION



#### Risk due to unwanted coastdown!

Triggering the STO function by deactivating the digital input only interrupts the energy supply for the drive and the motor movement can no longer be controlled. The voltage of the DC bus is not disconnected!

- ▶ Always stop the drive before you trigger the STO function.
- ▶ In case of suspended loads, install a mechanical brake to prevent the load from falling down.

### ⚠ CAUTION



#### Risk of personal injury

Safe shutdown of the torque must be ensured.

- ▶ Use the STO function only on the preset input designated for this purpose with STO.

## 10.2 Stop categories in accordance with DIN EN 60204-1

<b>Stop function</b>	<ul style="list-style-type: none"> <li>– The stop function stops the drive in normal operation.</li> <li>– The stop function is defined in standard DIN EN 60204-1.</li> <li>– Stop functions must have priority over assigned start-up functions.</li> <li>– Stops of category 0 and category 1 must be triggered independently of the operating mode and a category 0 stop must have priority.</li> <li>– If necessary, take precautions for connecting protective devices and interlocks.</li> <li>– If necessary, the stop function must report its status to the control logic.</li> <li>– Resetting the stop function must not result in a hazardous situation.</li> </ul>
<b>Stop categories</b>	<ul style="list-style-type: none"> <li>– The stop categories differ in the way electrical machines are shut down.</li> <li>– The stop category must be determined by a risk assessment of the machine carried out by the machine and system manufacturer.</li> </ul>

### Stop Category 0

The STO function brings about an uncontrolled shutdown by switching off the energy. The motor is switched off and then coasts to a stop or is mechanically braked.

This stop category must only be used for switching off in case of danger.

### Stop Category 1

A controlled shutdown occurs with the energy supply not interrupted until standstill is reached.

The following steps must be carried out in order:

1. Braking of the motor by a brake ramp performed by the drive.
2. Disabling of the drive when the motor is at a standstill.
3. Safe reset of the STO function at the /STO input.

This stop category as well must only be used for switching off in case of danger.

The diagram below shows the individual steps of a controlled stop.

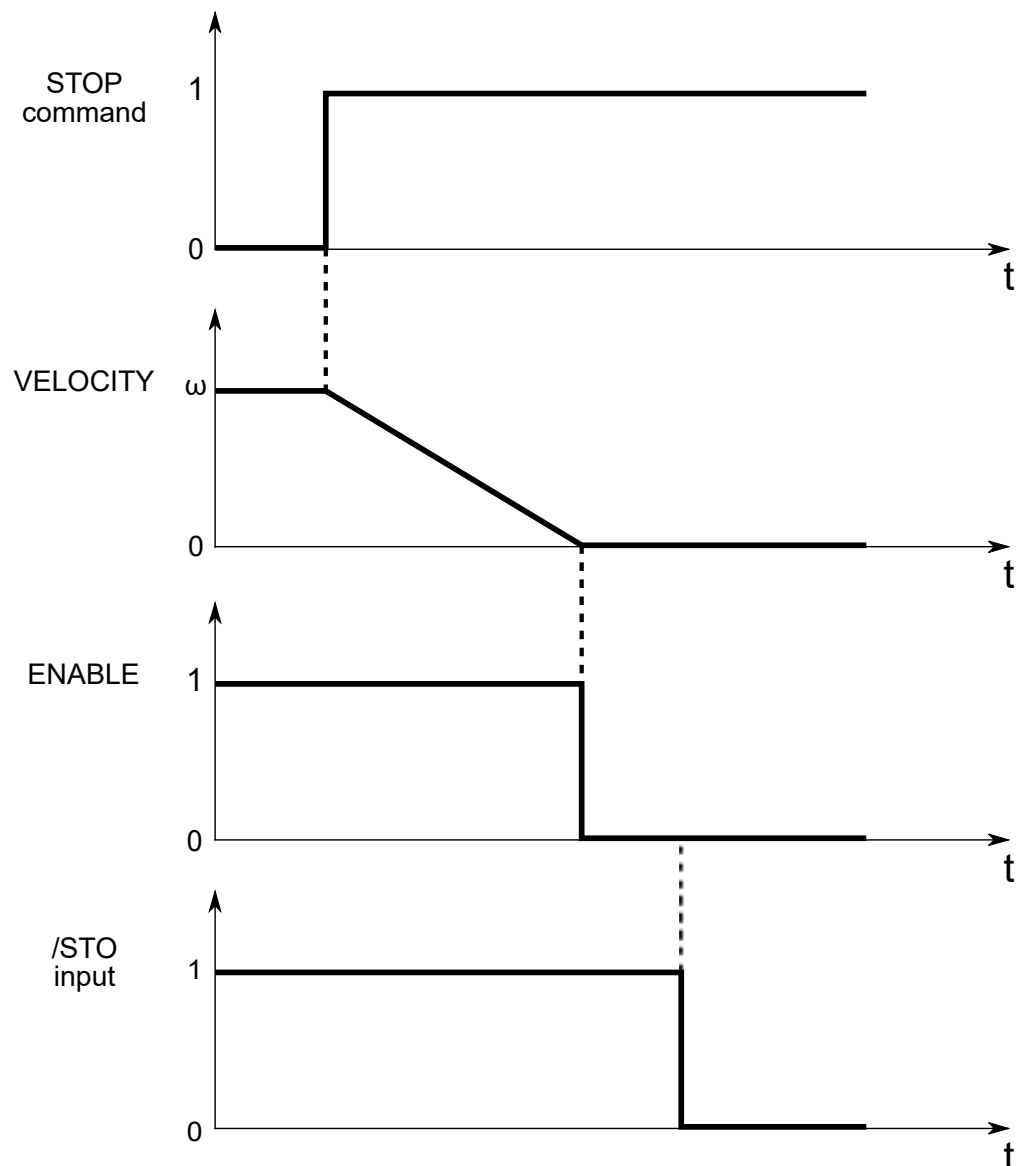
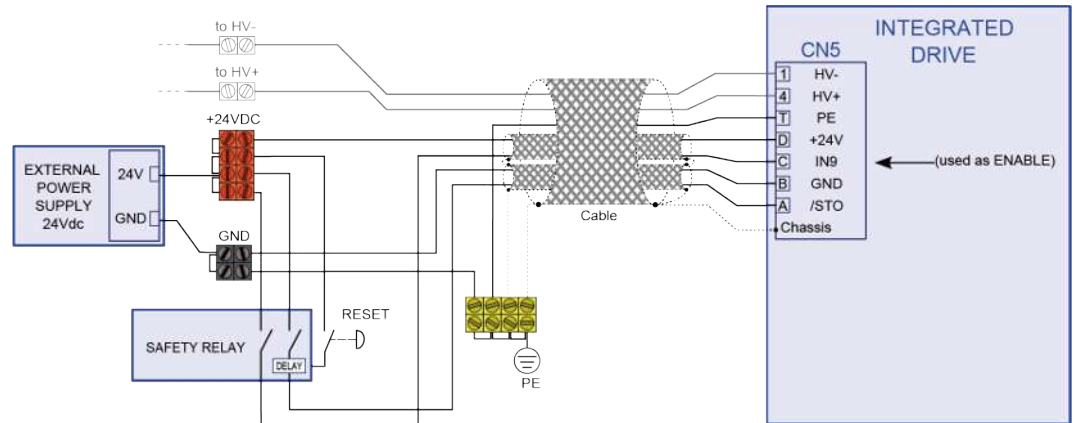


Fig. 15: Sequence of a controlled stop



### Wiring example

The diagram below shows an example of the wiring of the drive for a category 1 stop.



## NOTICE



### Residual risks

- ▶ Digital input IN9 is not part of the safety system. Therefore, the deceleration of the drive does not constitute a safety function.
- ▶ If a short-circuit error occurs on one or more semiconductors of the inverter, there is a residual risk, despite the torque being safely shut off, that the drive will continue turning by 45°.

## 10.3 Functional specifications

### 10.3.1 Safety system

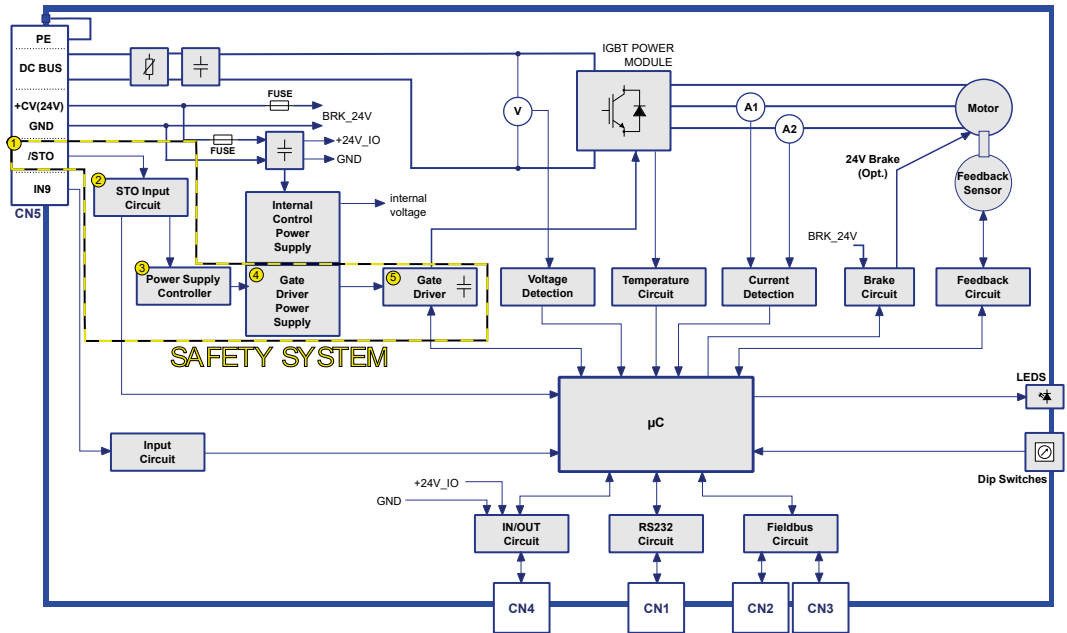


Fig. 16: Block diagram of safety system

1	/STO input at the STO connection
2	STO input circuit
3	IC controller for managing the converter that supplies the gate drivers
4	Converter for the power supply of the gate drivers
5	Gate drivers for the power semiconductors

### 10.3.2 Operating conditions

As described above, the STO safety system makes it possible to interrupt the control voltage of the power semiconductors (IGBT) and prevents them from generating sufficient voltage to supply current to the motor.

The operating states for the safety system are:

Logic level on the /STO input	Response of STO safety system	Consequences	Status
high	Enable of drive	Torque possible	Potentially unsafe state
Low	Interruption of the power supply	<ul style="list-style-type: none"> <li>– No torque</li> <li>– No automatic start possible</li> </ul>	Safe state

Tab. 31: Operating states of the STO safety system

**Re-enable of the drive**

To re-enable the drive, follow these steps.

1. Restore the high logic level on the /STO input.
2. Delete the alarms in the software.
3. Send the command to re-enable the drive.

**NOTICE! The safety function is always active and is executed continuously. It is not possible to shut down the safety function temporarily.**

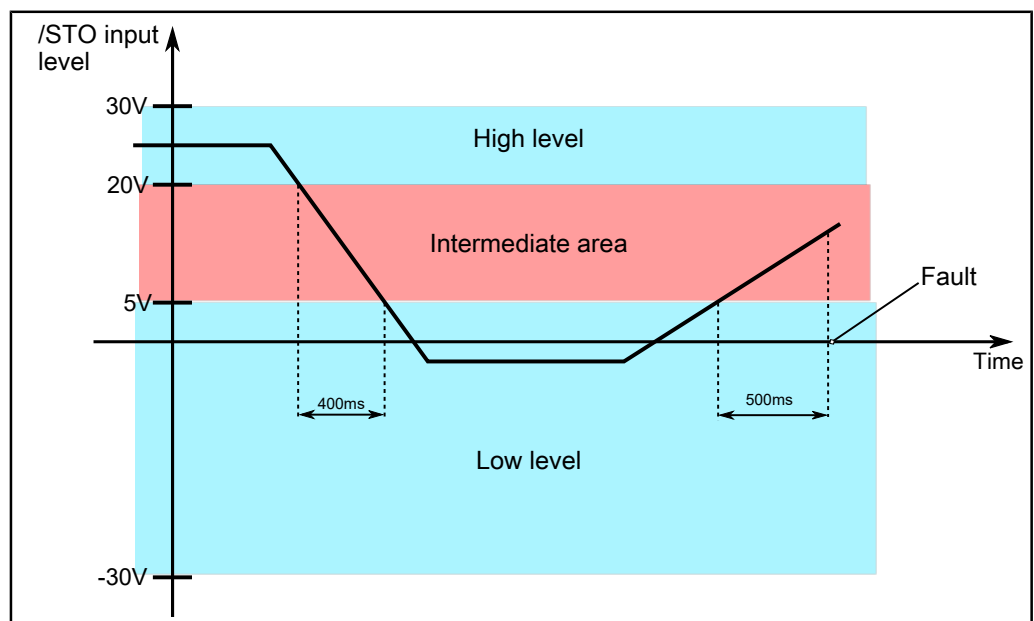
**10.3.3 Electrical properties of the STO input**

/STO input	
Type of input	PNP
Typical input current @Vin = 24 V	10.5 mA
Input voltage (high or low logic level)	
Nominal	DC +24 V
For Low signals	DC -30 V ... +5 V
For high signals	DC +20 V ... +30 V
Response time	Max. 120 ms
Compatibility to safety signals with OSSD (pulsed signals)	
Pulse duration	Max. 1 ms

**Tab. 32:** Electrical properties of the STO input

**10.3.4 Validation of the /STO input**

The validation function of the /STO input continuously monitors the voltage level applied to the input: If this level persists for longer than 500 ms at a value between the reference values +20 V for the high level and +5 V for the low level, an error is indicated.



**Fig. 17:** Voltage level on the /STO input

### 10.3.5 Safety parameters - STO

The environmental and operating conditions provided and ensured for the function of the safety system are the same as for the function of the complete system.

Safety parameter	Value	Comment
<b>Values according to EN ISO 13849-1:2015</b>		
Category	Cat. 3	
Performance level	PL d	
<b>Values according to EN 618005-2:2007</b>		
Safety integrity level	SIL 3	
PFH <sub>D</sub>	< 10	Dangerous failures
SFF [%]	99	

Tab. 33: STO safety parameters

### 10.3.6 Risk reduction

The STO function has a single-channel architecture. This means that if a single error occurs in the /STO external signal connection that supplies enough energy to keep the input at the high logic level (for example /STO signal short-circuit with a voltage of 24 V), and this error is not detected, there may be an interruption in the STO function.

To reduce the risk of a possible failure, the external connection of the /STO signal must be protected against errors that can unintentionally generate a voltage that would put the system in a non-safe state.

There are various ways to achieve this:

1. By completely isolating the /STO signal from the output of the device that controls the drive input; or
2. By shielding the /STO signal connection cable and connecting the shielding to GND (potential reference of the control voltage of the /STO signal); or
3. By monitoring the status of the /STO signal (e.g. using a control device with a test pulse output that is connected with the /STO), thus making it possible to deactivate the drive independently.

### 10.3.7 Risk assessment

Before a machine can be enabled for regular operation, its manufacturer must carry out a risk assessment procedure according to the Machinery Directive 2006/42/EC. The manufacturer should thereby identify the relevant health and safety requirements for its machinery and take the appropriate measures to that end. To reduce the risk, the manufacturer is obliged to adopt protective measures. These include:

1. An inherently safe design (see EN ISO 12100:2010).
2. Use of guards and protective devices (see EN ISO 12100:2010).
3. Provision of user information that informs about the machine's intended use, warns the user about the residual risk, and defines the required behavior (see EN ISO 12100:2010).

The risk assessment procedure is a multi-stage process and is described in more detail in EN ISO 12100:2010.

Following a risk assessment, which has been successfully prepared by the machine manufacturer, the prerequisites have been met to define the requirements for the safety-related controllers according to EN ISO 13849-1.

A required performance level (PLr) must be defined and documented for each safety function carried out by the safety-related controller. The achieved performance level (PL) of the respective safety function must meet the requirements of PLr. It is the task of the user of the integrated safety equipment to thoroughly study the associated guidelines and standards, and the legal situation.

### 10.3.8 Testing the STO safety function

The STO safety function test is often referred to as an “acceptance test” or “configuration test” (EN 61800-5-2:2007).

Testing the STO safety function is necessary:

- upon initially commissioning the plant or machine,
- when replacing the drive module,
- when making changes to the installation,
- at the specified diagnostic test interval.

The required diagnostic test interval depends on the application and should be performed at least once a year for category 3 PL d and every 3 months for category 3 PL e.

One part of the acceptance test of the entire machine or plant is the acceptance test of the drive module. The acceptance test of the drive module is a check whether the drive-integrated safety functions are configured to match the projected safety function of the machine.

### 10.3.9 Periodic check / verification process

1. Check whether the STO circuit wiring is designed correctly in relation to the drive and control circuit, as described in the /STO input connection examples.
2. Check whether the shielding of the /STO input cable is electrically connected to GND in accord with the signal source and the drive connection. (Mandatory, where mode "b" was adopted in regard to the section on risk reduction).
3. With high logic level on the /STO input and status ENABLE on the drive, check whether the torque is applied to the motor and no safety alarms are present.
4. Turn off the drive and then interrupt the voltage from the /STO input (using a control device or devices suitable for this). Ensure that the error "/STO = 0 V with drive activated" or other safety alarms are not present (see /STO Management Error) and that the motor can be moved freely (no torque applied).
5. When the drive is deactivated and the /STO input is on low logic level, activate the drive again. Check whether the alarm message for the attempt to activate with /STO input on low logic level ("/STO = 0 V with error and drive activated") is present and whether the motor can still be moved freely (no torque applied – safe state).
6. Under these conditions, switch the /STO input to the high logic level and check whether the motor can still be moved freely (no torque applied – safe state). Check also whether the error noted above is present.
7. Reset the alarm and activate the drive with the /STO input. Under these conditions, the drive must be activated (torque applied) and neither alarm "/STO = 0 V with error and drive activated" nor any other safety alarms may be present.

**⚠ WARNING****Risk of injury due to uncontrolled drive behavior**

If an error occurs in the plausibility check by the higher-level controller, this lack of function is indicated; the STO function is no longer ensured.

- ▶ Take immediate steps to prevent further operation, e.g. by removing the Power Enable signal or by switching off the mains contactor.
- ▶ Contact Bucher Automation AG to obtain appropriate support and document the error event.
- ▶ Have repair work carried out by authorized personnel to ensure safe use of the drive.

# 11 Malfunctions

This section contains a summary of possible faults and how to eliminate them for JMX50-15117 device.

## 11.1 General problems

Problem	Solution
The LEDs are turned off.	<ul style="list-style-type: none"> <li>– Check whether the drive is being supplied correctly, especially the control section. See also <a href="#">Supply voltages [▶ 42]</a></li> <li>– Check the wiring.</li> </ul>
The LEDs are lit, but the drive is not communicating.	<ul style="list-style-type: none"> <li>– See also <a href="#">LED states during the boot process [▶ 22]</a></li> </ul>
Interpretation of the boot sequence based on the LED status	
The internal brake does not hold the motor securely in position.	<ul style="list-style-type: none"> <li>– If the load exerts a higher torque on the braking torque, more powerful brake systems must be used</li> <li>– The internal brake is damaged. It may be necessary to perform a brake inspection. <b>Please contact Bucher Automation AG.</b></li> </ul>

Tab. 34: General problems

## 11.2 Electrical and connection issues

Problem	Solution
What is the reference voltage (0 V) of the digital inputs and outputs?	The voltages of the digital inputs and outputs are relative to the reference potential of the power supply socket CN5.

Tab. 35: Electrical and connection issues

### 11.3 communication issues

Problem	Solution
<p>The drive is not communicating via EtherCAT®.</p>	<ul style="list-style-type: none"> <li>– Connect the drive and look at the connection settings as they are listed in <b>Communication with the EtherCAT® master [▶ 36]</b>.</li> <li>– Check whether the drive is turned on: LEDs L1 and L2 must not be switched off.</li> <li>– Check the connection between the communication ports connected to the EtherCAT® network: the corresponding LEDs L/A 0 and L/A 1 must not be switched off.</li> <li>– Check to ensure the status of LED ERR is ON and the EtherCAT® communication error (see <b>Error list [▶ 43]</b>) is not active. If necessary remedy the error.</li> </ul>
<p>Error during firmware download</p>	<p>Check whether communication with the drive is active and check the messages displayed in JetSym.</p>

**Tab. 36:** communication issues



## 12 Service

### 12.1 Customer service

Should you have any questions, suggestions, or problems, please don't hesitate to contact our service representatives. To contact them, please call our technical hotline or use the contact form on our homepage:

[Technical hotline | Bucher Automation - We automate your success.](#)

You are also welcome to send an e-mail to our technical hotline:

[hotline@bucherautomation.com](mailto:hotline@bucherautomation.com)

Please supply the following information when contacting our technical hotline:

- Hardware revision and serial number  
For the hardware revision and serial number of your product, please refer to the nameplate.

# 13 Spare parts and accessories

## NOTICE



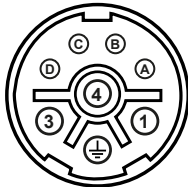
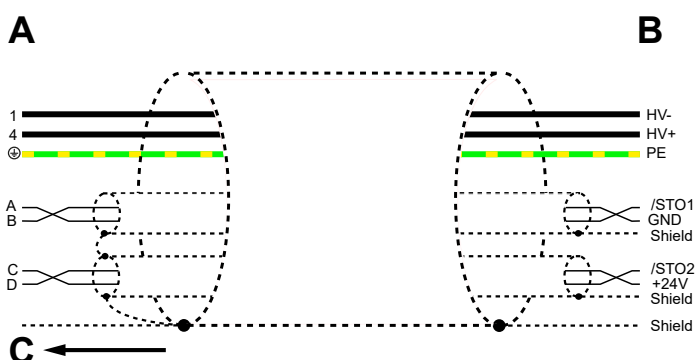
**Inadequate accessories might cause damage to the product**

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

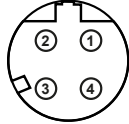
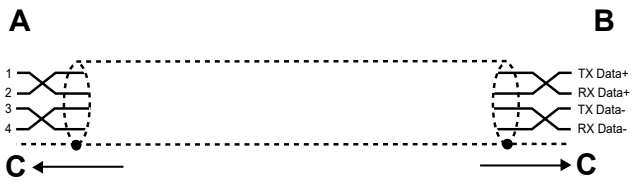
- ▶ Only use accessories recommended by Bucher Automation AG.

### 13.1 Cable and plug connections

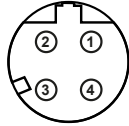
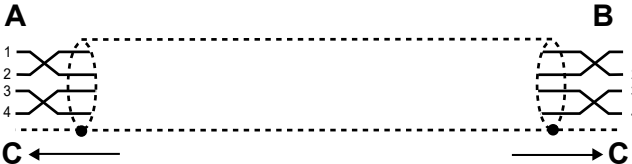
The following plug connectors and cables are required for the installation of the JMX50-15117:

Connector	Cables	
 <p>female, Hummel Front view</p>		
<ul style="list-style-type: none"> <li>– Manufacturer: Hummel</li> <li>– Connector: 7.550.600.000</li> <li>– Socket: 7.084.943.122</li> <li>– Pins:                             <ul style="list-style-type: none"> <li>– (3x, Pin 1, 4, T) 7.010.942.002</li> <li>– (4x) 7.010.941.002</li> </ul> </li> </ul>	A	JMX side
	B	Power supply unit side
	C	On the heat sink
	<ul style="list-style-type: none"> <li>– Overall shielding</li> <li>– 2 wires + PE + 2 shielded and twisted pairs</li> <li>– low capacity</li> <li>– Maximum total length: 50 m</li> <li>– Bucher Automation cable art. no. 60886888_02 KAY_1513_0200 or</li> <li>– Molino Movinflex 4G25-2RC/PUR or</li> <li>– UNIKA UNIDRALL 5005 art. no. 3J049</li> </ul>	

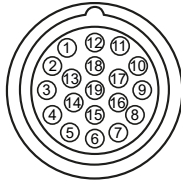
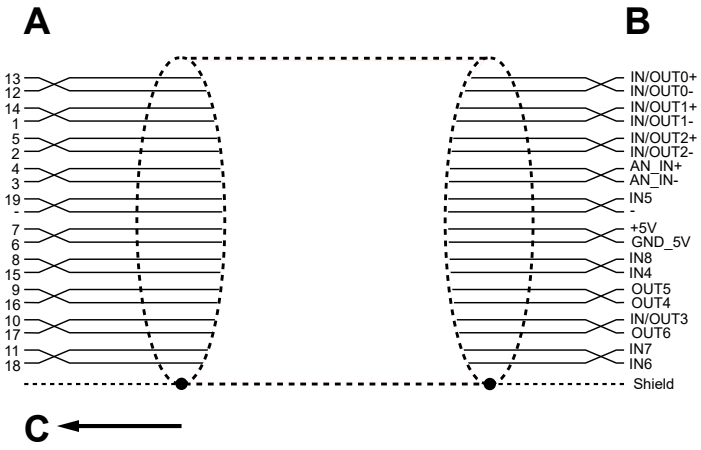
**Tab. 37:** Cable for connection to CN5

Connector	Cables		
 <p>male, D-code Front view</p>			ETC
<p>Example: Connector: M12, D-code (ETC)</p>	A	JMX side	
	B	Master side	
	C	On the heat sink	
	<ul style="list-style-type: none"> <li>– Complete shielding (foil and braiding)</li> <li>– 2 twisted-pairs</li> <li>– Maximum total length: 100 m (ETC)</li> <li>– Conductor material: Tin-plated copper</li> <li>– Bucher Automation cable from M12 to controller (RJ45) art. no. 60887212_00 KAY_ST_ST_04_M12D-PURS_RJ45_2M</li> </ul>		

Tab. 38: Main bus cable master – CN2

Connector	Cables		
 <p>Male, D-code Front view</p>			ETC
<p>Connector: M12, D-code (ETC)</p>	A	JMX-CN2 side	
	B	Next JMX to CN2	
	C	On the heat sink	
	<ul style="list-style-type: none"> <li>– Complete shielding (foil and braiding)</li> <li>– 2 twisted-pairs</li> <li>– Maximum total length: 100 m (ETC)</li> <li>– Conductor material: Tin-plated copper</li> <li>– Bucher Automation cable from M12 (X3 1. JMX) to M12 (X2 2. JMX art. no. 60885976_00 KAY_ST_ST_04_M12DPURS_1M</li> </ul>		

Tab. 39: ETC cable for connection to CN3

Connector	Cables	
 <p style="text-align: center;">female Front view</p>		
<p>Connector: M23</p>	<p>A</p>	<p>JMX side</p>
	<p>B</p>	<p>Controller and actuator side</p>
	<p>C</p>	<p>On the heat sink</p>
	<ul style="list-style-type: none"> <li>– Overall shielding</li> <li>– 10 twisted pairs or alternatively 11 wires + 4 twisted-pairs*</li> <li>– Maximum total length: 30 m</li> <li>– Bucher Automation cable art. no. 60886909_02 KAY_1520_xxxx</li> </ul>	

**Tab. 40:** I/O cable for connection to CN4

\* The wire pairs that must be twisted are those corresponding to the differential IN/OUT and the analog input.

## 14 Maintenance

This device is maintenance-free.

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

### 14.1 Repairs

Defective components could cause dangerous malfunctions and could compromise safety.

Only the manufacturer is allowed to repair the device.

It is forbidden to open the device.

#### **Modifications to the device**

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

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

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

### 14.2 Storage and shipment

#### **Storage**

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

#### **Shipment and packaging**

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

To protect the device from impact or shock, it must be shipped in its original packaging, or in an appropriate protective ESD packaging.

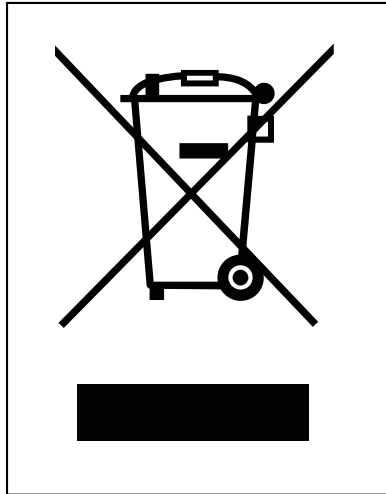
In case of damaged packaging inspect the device for any visible damage, and inform your freight forwarder and the Bucher Automation AG of the damage caused during shipment. If the device is damaged or has been dropped, it is strictly forbidden to use it.

## 14.3 Return and disposal

### Disposal options

Return your Bucher Automation AG product to us for proper disposal. Visit our [home-page](#) for detailed information and to download the required Returns form.

### Meaning of WEEE icon



**Fig. 18:** WEEE icon – crossed out trash can

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

### Batteries

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

### Personal data

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

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