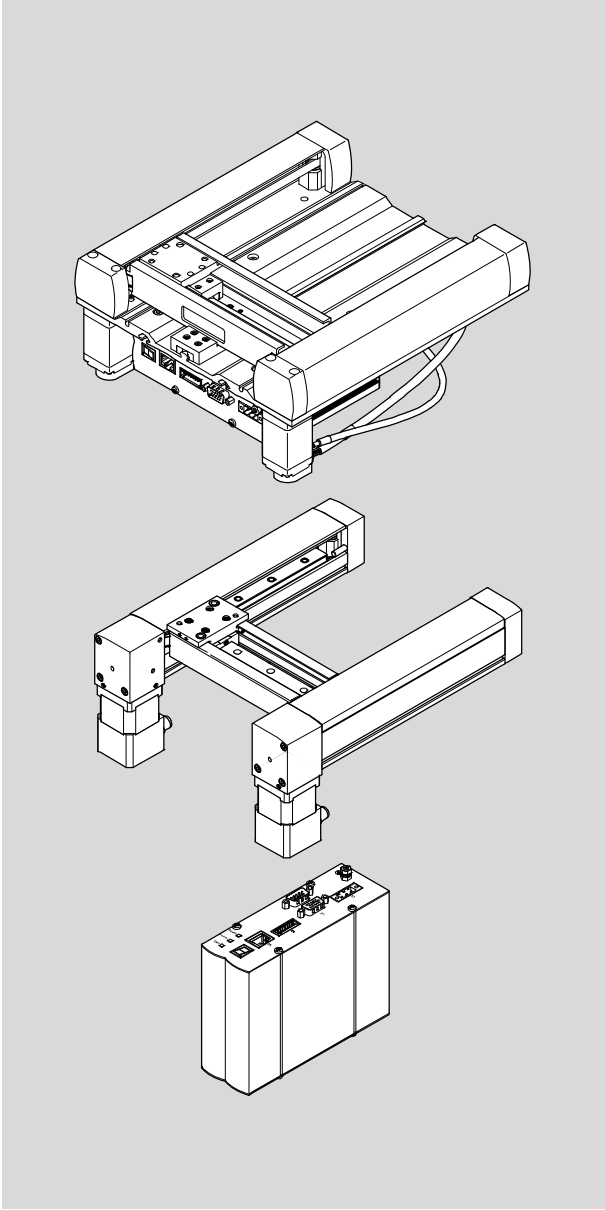
Planar surface gantry with controller

EXCM-10/-30-...-E



FESTO

Description

Commissioning

8068047
1612b
[8068049]

Translation of the original instructions
EXCM-10/-30-...-E-EN

Identification of hazards and instructions on how to prevent them:

Danger
Immediate dangers which can lead to death or serious injuries

Warning
Hazards that can cause death or serious injuries

Caution
Hazards that can cause minor injuries

Other symbols:

Note
Material damage or loss of function

Recommendations, tips, references to other documentation

Essential or useful accessories

Information on environmentally sound usage

Text designations:
- Activities that may be carried out in any order
1. Activities that should be carried out in the order stated
– General lists
➔ Result of an action/References to more detailed information

Table of Contents – EXCM-10/-30-...-E

Instructions on this documentation

This documentation serves to promote safe commissioning and operation of the planar surface gantries EXCM with the controller belonging to it.

Product identification, versions

The hardware version specifies the version status of the controller's electronics. The firmware version indicates the version status of the operating system.
You can find the specifications of the version status as follows:
– Hardware version and firmware version in the Festo Configuration Tool (FCT) with active online connection to the controller on the "Controller" page.

Firmware design from	What's new?	Which FCT plug-in?
V 1.0.0.x	The controller supports the following planar surface gantries: – EXCM-10 – EXCM-30	EXCM V 1.0.0.x

Tab. 1 Firmware Design

Service

Please consult your regional Festo contact if you have any technical problems.

Documentation

You will find more extensive information in the following documentation:

User documentation for the EXCM-10/-30-...-E		
Name	**TYPE**	**Contents**
Help system for the software (included in the FCT software)	Dynamic and static Help for the FCT plug-in "EXCM".	Functional descriptions for the Festo Configuration Tool configuration software.
Operating instructions	Such as for the planar surface gantry EXCM-10 or EXCM-30	Description and mounting of the planar surface gantry.

Tab. 2 Documentation for EXCM-10/-30-...-E

1 Safety and requirements for product use

1.1 Safety

1.1.1 General safety instructions

In the commissioning and programming of positioning systems, the safety regulations in this description and in the documentation for the other components must always be observed.

The user must ensure that nobody is within the sphere of influence of the connected planar surface gantry. Access to the possible danger zone must be prevented by suitable measures such as shut-offs and warning signs.

Warning

Planar surface gantries travel with great force and speed. Collisions can lead to serious injury to people and damage to components.

- Make sure that nobody can grasp into the sphere of influence of the planar surface gantry as well as other connected actuators – e.g. through protective guards – and no items are located in the travel range as long as the system is connected to energy sources.

Caution

Parameterisation errors can cause injury to people and damage to property.

- Enable the controller only if the planar surface gantry has been professionally installed and parameterised.

Note

Damage to the product from incorrect handling.

- Switch off the supply voltage before mounting and installation work. Switch on supply voltage only when mounting and installation work are completely finished.
- Never unplug or plug in a product when powered!
- Observe the handling specifications for electrostatically sensitive devices.

1.1.2 Intended use

The controller is used for controlling planar surface gantries with a single rotating toothed belt in accordance with the Festo catalogue and is used exclusively for controlling planar surface gantries of type EXCM.
The functions of the controller are documented in this description.
The planar surface gantries of type EXCM as well as the additional components are documented in separate documentation.

The controller and the connectable modules and cables may only be used as follows:
– in perfect technical condition
– in original status without unauthorised modifications, except for the adaptations described in this documentation.
– within the limits of the product defined through the technical data
(➔ A Technical data).

- Observe the safety instructions and intended use in the documentation for all the components and modules.
- Observe the standards specified in the relevant chapters as well as the regulations of the trade associations, the German Technical Control Board (TÜV), the VDE conditions or relevant national regulations.
- Observe the limit values for all additional components (e.g. sensors, actuators).

Note
In the event of damage caused by unauthorised manipulation or other than intended use, the guarantee is invalidated and the manufacturer is not liable for damages.

1.2 Requirements for product use

- Make this documentation available to the design engineer, installer and personnel responsible for commissioning the machine or system in which this product is used.
- Make sure that the specifications of the documentation are always complied with. Also consider the documentation for the other components and modules.
- Take into consideration the legal regulations applicable for the destination as well as:
  – regulations and standards
  – regulations of the testing organizations and insurers
  – national specifications

1.2.1 Technical requirements

General conditions for the correct and safe use of the product, which must be observed at all times:

- Comply with the connection and environmental conditions specified in the technical data of the product (➔ A Technical data) and of all connected components.
  Only compliance with the limit values or load limits permits operation of the product in accordance with the relevant safety regulations.
- Observe the instructions and warnings in this documentation.

1.2.2 Qualification of the specialists (requirements for the personnel)

The product may be placed in operation only by a qualified electrotechnician, who is familiar with:

– installation and operation of electrical control systems
– the applicable regulations for operating safety-engineering systems
– the applicable regulations for accident protection and industrial safety
– the documentation for the product

1.2.3 Range of application and certifications

Standards and test values that the product complies with and fulfils can be found in appendix (➔ A Technical data). The product-relevant EU directives can be found in the declaration of conformity.

Certificates and the declaration of conformity for this product (➔ www.festo.com).

2 Overview

2.1 General properties

- FCT-compatible: configuration, parameterisation and backup via Festo Configuration Tool (FCT)
- Energy-optimised operation and low heat development
- Separated load and logic supply (renewed homing not required after emergency stop)
- LED-display components for representation of device and communication status
- 7-segments display for representation of equipment statuses, malfunctions and warnings

2.2 Function and application

The controller controls two servo motors, which drive an H-shaped rotating toothed belt. The toothed belt moves a slide, whose position is calculated by the controller from the encoder signals of the motors.
The motors are not directly assigned to an axis (X- or Y-axis) of the planar surface gantry. Instead, the movement of the slide towards an axis is achieved through the interaction of the two motors, which is controlled by the controller (➔ Fig. 2.1 Functional principle).

Functional principle

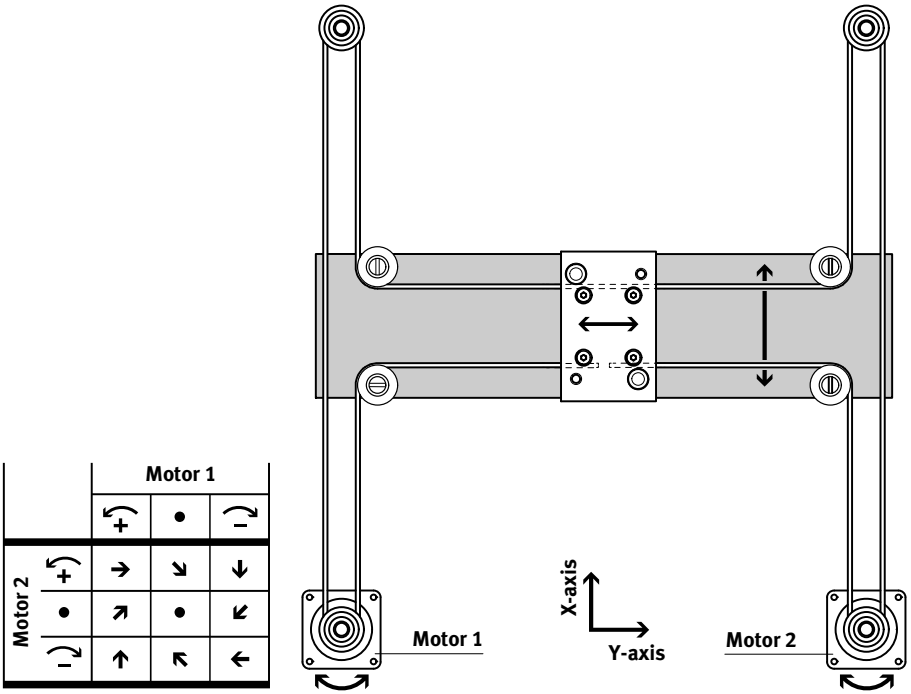


Fig. 2.1 Functional principle

2.3 Monitoring functions

The controller has numerous monitoring functions:
- Monitoring of the logic and load voltage supply
- Current monitoring/I²t monitoring
- Software end-position detection
- Standstill and following error monitoring

2.4 Switch-off functions

The drive can be switched off through the switch-off functions Torque Off - TO and External Stop - ES.

2.4.1 Torque Off - TO

In the case of a requirement of the switch-off function Torque OFF - TO, the energy supply to the motors is interrupted through switching off of the output stage. The motor brake is not activated thereby. The status of the driver supply is acknowledged through the two contacts DIAG1 and DIAG2.

2.4.2 External stop - ES

If the External stop - ES switch-off function is requested, the motors are run down in a controlled way until they are at rest. After the rest state is reached, the motor brakes are activated and the output stage is switched off.

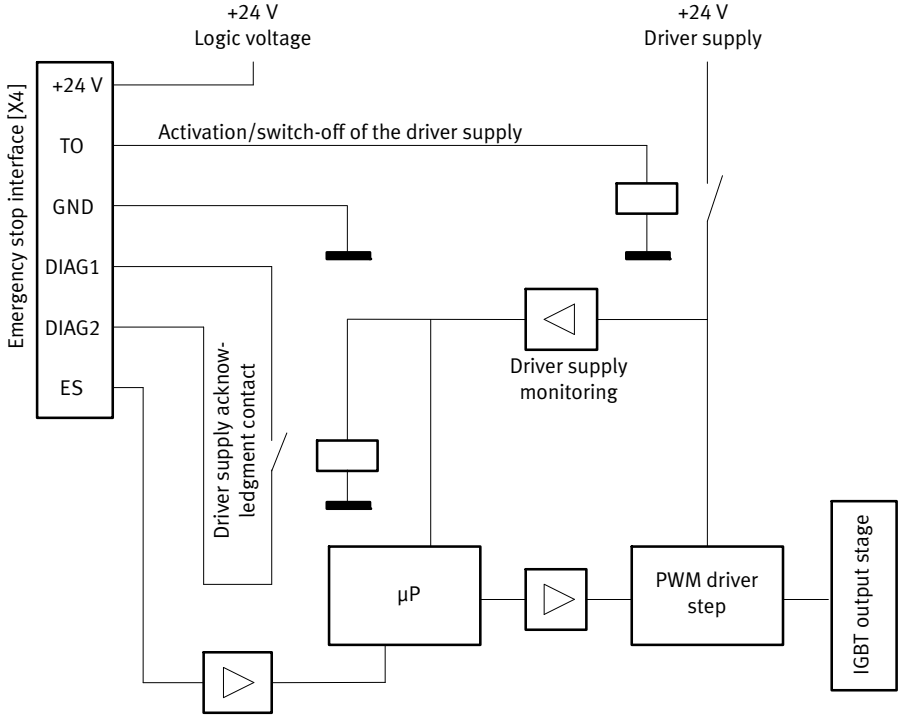


Fig. 2.2 Switch-off functions - block diagram

2.5 Drive functions

2.5.1 Jogging

During jogging, the slide of the planar surface gantry moves as long as a corresponding signal is present. Jogging can always take place only in one direction, either in the direction of the X-axis or in the direction of the Y-axis, whereby differentiation is made between creeping run and normal run. The CANopen or Ethernet interface can be used as control interfaces, but the I/O interface cannot.
This function is normally used to run the slide off the path.

As long as a valid reference point has not been reached, the software end positions are deactivated and the slide can also be positioned behind the software end positions through jogging.

2.5.2 Homing

After each restart of the controller, a homing run must be performed to anchor the reference point, and thus the dimension reference system, in the travel range of the planar surface gantry. Without successful homing, positioning cannot be started (exception: jogging). Homing can be started via the control byte CPOS (➔ 6.2.2 Description of the control bytes CCON/CPOS) or through selection of record 0 and always takes place to the stop in the origin of the selected coordinate system
(➔ 2.7.2 Selection of the coordinate system). The stop is detected by a motor shutdown in combination with a sharp rise in the motor current. After the fixed stop is reached, a movement to zero is automatically performed in order to reach a permanently defined and unchangeable minimum distance from the mechanical stop.

2.5.3 Brake

If the motors are equipped with a brake, they are controlled as follows:

Switch-on delay

When enable is being set (ENABLE), the switch-on delay time (10 ms) starts to run and the position controller of the controller takes over control of the connected planar surface gantry. The brake opens simultaneously. The controller accepts positioning jobs only after the switch-on delay has expired.

Switch-off delay

When the enable signal is removed, the time set for the switch-off delay starts to run. The brake closes during this time. But the position controller still holds the drive in position. The position controller is only switched off after expiration of the switch-off delay.
If enable is withdrawn while the drive of the planar surface gantry is carrying out a record, the drive is brought to a rest with the quick stop edge (Quick Stop). As soon as the drive has come to a rest, the brake output is reset: the brake/clamping unit closes. Simultaneously, the switch-off delay time begins to run. The controller continues to control the position. Then the controller end stage is switched off after the switch-off delay.

2.6 Operating modes

If positioning is begun, it is always continued to the end in all operating modes.
A new positioning job is ignored before the end of a started positioning.

2.6.1 Direct mode

A target position (X- and Y-coordinates) as well as values for travel speed and acceleration are transferred to the controller. The target position is linearly approached by the current actual position. Additional possible functions in direct mode are jogging as well as homing. The CANopen or Ethernet interface can be used as control interfaces.

2.6.2 Record selection

Positioning jobs are saved in the controller in a record table in the form of parameter records (➔ 5.3.6 Record table). In operation, the higher-order controller (PLC/IPC) then selects individual records by transferring a record number (record selection).
Additional possible functions in record selection are jogging as well as homing.
The I/O, CANopen or Ethernet interface can be used as a control interface.

Parameter records can only be parameterised via the Festo Configuration Tool (FCT) (➔ 5.3.6 Record table).

2.7 Measuring reference system

2.7.1 Basic concepts

Homing
During homing, the position of the axis zero point AZ is determined.

Stop point BZ (block zero)
A fixed point in the origin of the selected coordinate system, which is travelled to in homing.

Movement to zero
After the stop point BZ is reached, the drive is travelled to at a defined distance in order to reach the axis zero point AZ.

Axis zero point AZ (Axis Zero)
It is shifted by a defined distance from the stop point BZ in the origin of the selected coordinate system. This distance is established with 1.2 mm each in the direction of the X- and Y-axis.
The software end positions and the project zero point PZ refer to the axis zero point AZ.

Project zero point PZ (Project Zero)
is a point to which the actual position and the absolute target positions from the position record table refer. The project zero point is shifted by a defined distance from the axis zero point AZ.

Software end positions SLN (Software Limit Negative)/SLP (Software Limit Positive)
Limit the effective stroke in the direction of the X- or Y-axis. If the target position of a positioning job is outside the software end positions, the positioning job is not executed and a malfunction is reported.

Usable stroke
The distance of the software end positions in the direction of the X- or Y-axis. Maximum stroke by which the planar surface gantry can travel in the corresponding direction.

Increments
The controller works in the range of the drive controller with encoder increments (EINC). In contrast, so-called interface increments (SINC) are used at all user interfaces and in the field of internal data management.

1 mm = 1000 SINC
1 EINC ~ 19.5 µm

2.7.2 Selection of the coordinate system

The following 4 selection options are available for establishing the axis zero point:

Selection 1

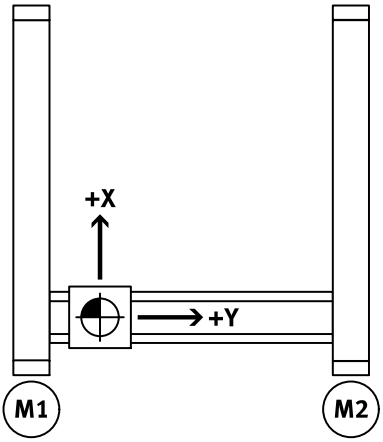


Fig. 2.3 Axis zero point at corner point 1 (default)

Selection 2

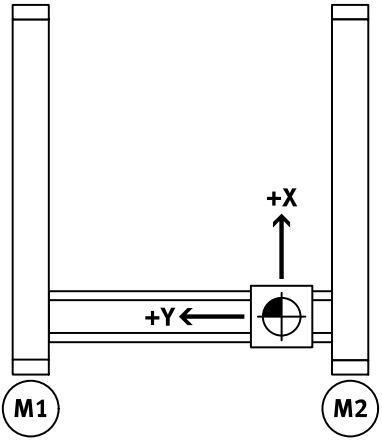


Fig. 2.4 Axis zero point at corner point 2

Selection 3

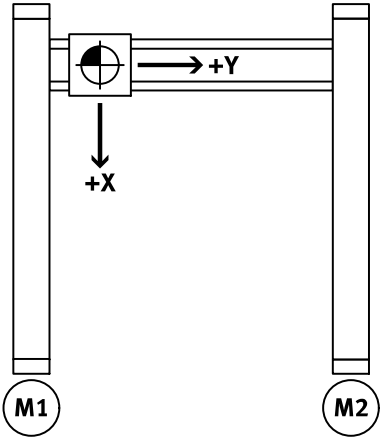


Fig. 2.5 Axis zero point at corner point 3

Selection 4

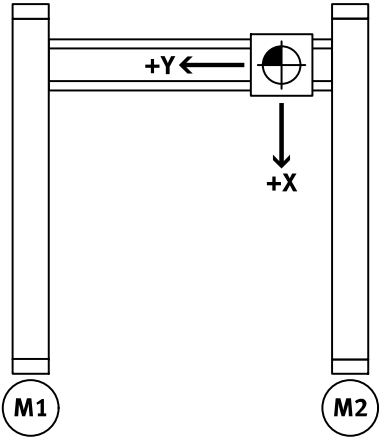


Fig. 2.6 Axis zero point at corner point 4

Establishment of the axis zero point is performed exclusively through the Festo Configuration Tool (FCT) (➔ 5.3.5 Component settings) .

2.7.3 Dimension reference points

Dimension reference points (example for axis zero point at corner point 1)

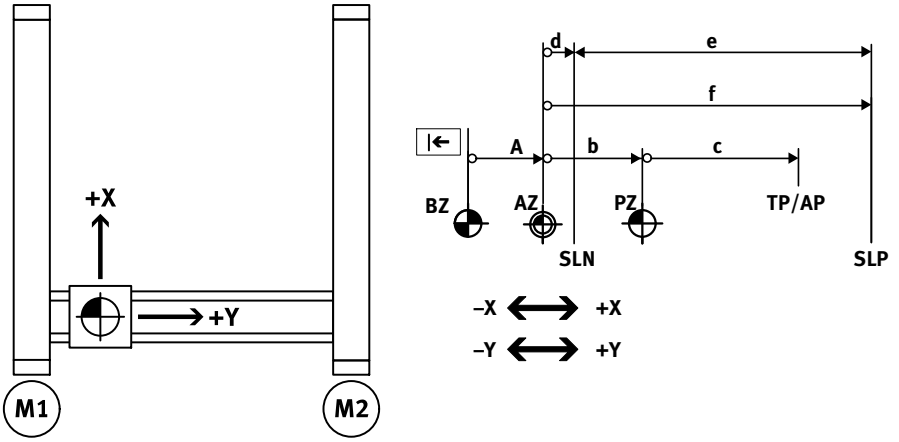


Fig. 2.7 Dimension reference points

Explanation	
BZ	Stop point BZ (block zero)
AZ	Axis zero point AZ (Axis Zero)
PZ	Project zero point PZ (Project Zero)
SLN	Negative software end position SLN (Software Limit Negative)
SLP	Positive software end position SLP (Software Limit Positive)
TP/AP	Target position/actual position TP/AP (Target Pos./Actual Pos.)
a	Offset BZ to AZ (fixed)
b	Offset AZ to PZ
c	Offset PZ to TP/AP
d	Offset AZ to SLN
e	Usable stroke
f	Offset AZ to SLP

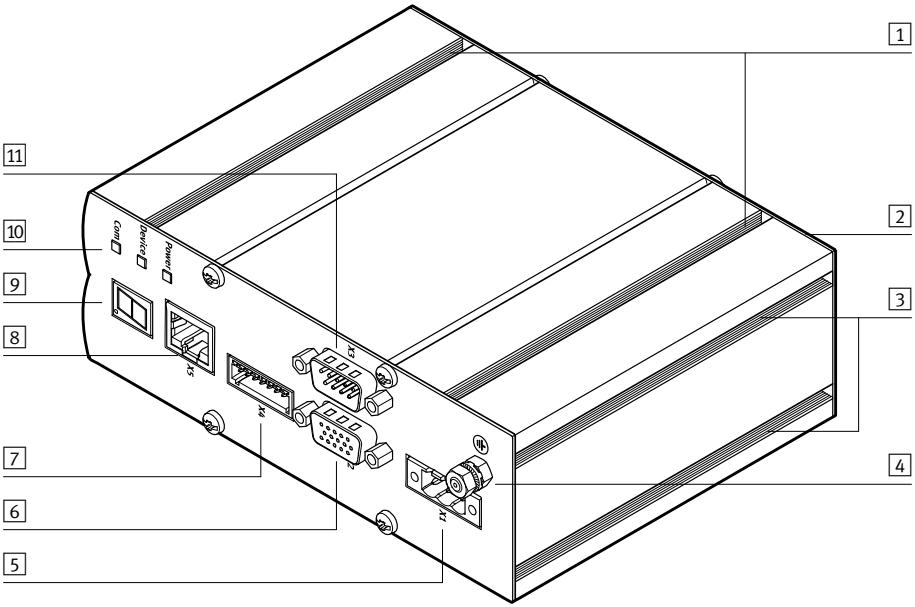
Tab. 2.1 Explanation of dimension reference points

2.7.4 Calculation rules

Point		Calculation rule
AZ	Axis zero point	= BZ + a (a = 1.2 mm)
PZ	Project zero point	= AZ + b
SLN	Negative software limit	= AZ + d
SLP	Positive software limit	= AZ + f
TP/AP	Target position/actual position	= PZ + c = AZ + b + c

Tab. 2.2 Calculation rules

2.8 General structure



1 Mounting slots
2 Connection side to the planar surface gantry
3 Mounting slots
4 Functional earth connection
5 Voltage supply [X1] connection
6 I/O interface [X2]
7 Emergency stop interface [X4]
8 Ethernet interface [X5]
9 7-segments display
10 LED indicators
11 CANopen interface [X3]

Fig. 2.8 General structure

2.8.1 Control interfaces

The controller has three control interfaces in order to communicate with a higher-order controller. The active control interface is established via the Festo Configuration Tool (FCT)
(➔ 5.3.5 Component settings).

– I/O interface
– CANopen interface
– EtherCat interface

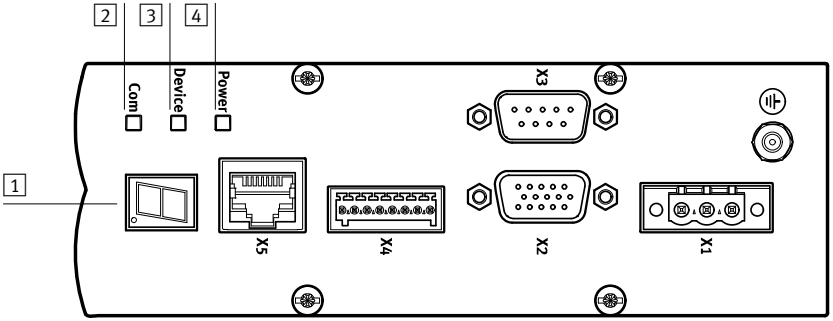
The Ethernet interface can thereby be used both for control via the FCT and also for control via Ethernet (CVE).

Of the control interfaces named, at all times only one can have the master control.

2.8.2 LED display components

Equipment and function statuses of the controller are displayed over the three LED display components.

The behaviour and the colour of the LEDs differ dependent on the type of status display.



1 7-segments display
2 COM (green/yellow/red)[1)]
3 Device (green/red)[1)]
4 Power (green)[2)]

1) Static and dynamic behaviour
2) Only static behaviour (LED on/off)

Fig. 2.9 LED display components

Power

An existing load voltage is displayed over the “Power” LED indicator.

If there is no load voltage present or it is too low, the LED indicator remains dark.

Device

The operational readiness of the controller and existing malfunctions (errors/warnings) are signalled through the “Device” LED display (➔ Tab. 2.3 Possible statuses of the LED display - device).

LED (green/red)	Status	Significance
	Illuminated green	Ready for operation (controlled status)
	Flashes green (– – – ...) ON OFF 	Not ready for operation (uncontrolled status)
	Illuminated red	Error is present
	Flashes red (— — — ...) ON OFF 	Warning is present or controller identification is active (➔ 5.3.9 Controller identification)

Tab. 2.3 Possible statuses of the LED display - device

COM

The LED display “COM” displays an active communication through a green-flashing display component. The interface assignment is shown through the flashing behaviour of the LED indicator.
A CANopen-specific message is signaled through a yellow or red LED display component.

COM - I/O operation		
LED (green/yellow/red)	**Status**	**Significance**
	Flashes green (– – – ...) 	Communication active.

Tab. 2.4 LED indicator COM - I/O operation

COM - CANopen operation		
LED (green/yellow/red)	**Status**	**Significance**
	Illuminated green	Normal operating status. Communication through SDOs and PDOs possible (operational).
	Flashes green (· · · · ...) 	Normal status after switch-on. Communication only possible through SDOs (pre-operational).
	Illuminates yellow	No bus cable connected or no bus parameters configured.
	Illuminated red	No bus connection (bus OFF).
	Flashes red (· · · ...) 	Telegrams cannot be received or sent (Warning Limit).
	Flashes red (·· ·· ·· ...) 	Time exceeded for communication monitoring (Node Guarding).

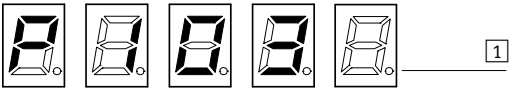
Tab. 2.5 LED indicator COM - CANopen operation

COM - CVE operation		
LED (green/yellow/red)	**Status**	**Significance**
	Flashes green (– · – · ...) 	Communication active.

Tab. 2.6 LED indicator COM - CVE operation

2.8.3 7-segments display

Operating mode, record number and malfunctions are displayed over the 7-segments display. For messages, 4 characters are displayed in succession; after that a time delay follows.



1 Point for controller identification (➔ 5.3.9 Controller identification)

Fig. 2.10 7-segments display

Possible messages

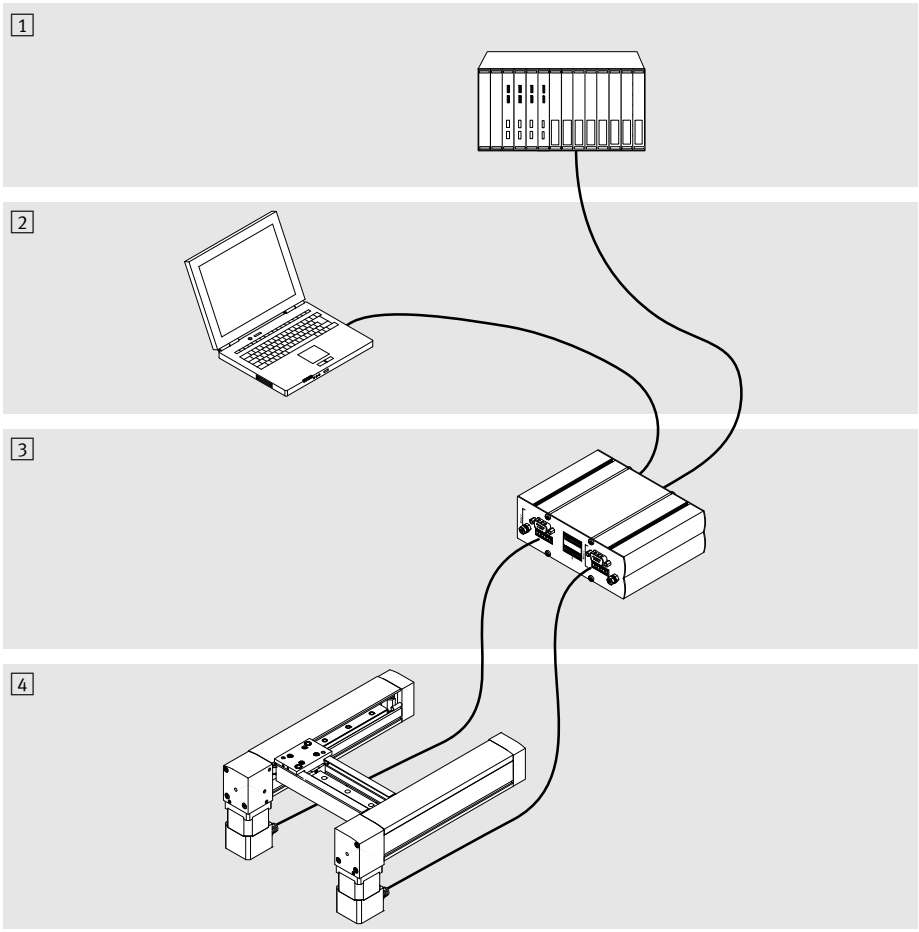
Display	Operating mode/event	Priority
BLE	Bootloader error	1
E0xx (xx = error no.)	System error	2
E1xx (xx = error no.)	Error motor 1	
E2xx (xx = error no.)	Error motor 2	
Exxx	TO – Torque Off	
Axxx (xxx = error no.)	Warning	3
P000	Homing	4
P070	Jog positive (X-axis)	
P071	Jog negative (X-axis)	
P072	Jog positive (Y-axis)	
P073	Jog negative (Y-axis)	
P1xx (xx = record number)	I/O operation	
P2xx (xx = record no.) **P2**00 (00 = direct mode)	CANopen operation	
P3xx (xx = record number) **P3**00 (00 = direct mode)	CVE operation or control via FCT	

Tab. 2.7 Messages of the 7-segments display

Messages with a higher priority interrupt messages with a lower priority. As malfunctions can occur faster than they can be displayed on the 7-segments display, it may be the case that not all malfunctions are displayed.

- Read the diagnostic memory (➔ 7.1 Diagnostic memory) in order to have all messages displayed.

2.9 System overview



1 Higher-order control level: PLC/IPC
2 Parameterisation and commissioning level: Festo Configuration Tool (FCT)
3 Controller level
4 Drive level: planar surface gantry

Fig. 2.11 System overview

2.10 Emergency stop concept

Note

- As part of your emergency stop concept, check which measures are required for your machine/system in case of an emergency stop.
- Observe the contents of this documentation on the switch-off functions (➔ 2.4 Switch-off functions).

- If an emergency stop circuit is necessary, use additional, separated safety limit switches (e.g. as normally closed contacts in a series circuit).
- Note the following aspects:

Action	Behaviour
Removal of the ENABLE signal	– Without brake/clamping unit: The drive brakes with the quick stop edge (Quick Stop). Then the controller end stage is switched off. – If a brake/clamping unit is used: If the drive moves when ENABLE is removed, it is first brought to rest with the stop delay. As soon as the drive has come to a rest, the brake output is reset: the brake/clamping unit closes. Simultaneously, the switch-off delay time begins to run. The controller continues to control the position. Then the controller end stage is switched off after the switch-off delay.
Switching off the load voltage	The load voltage is switched off. The effective load on the drive may continue to move due to inertia, or it will fall if mounted in a vertical or sloping position.

3 Assembly

3.1 General instructions

Caution
Uncontrolled movements of the planar surface gantry can cause injury to people and material damage.
- Switch off the power supplies prior to any mounting, installation or maintenance work and prevent them from being restarted accidentally.

Note
When mounting the controller:
- Also observe the documentation of the planar surface gantry and the additional components (e.g. assembly instructions of the cables).
- Observe the IP protection class of the controller and of the plugs and cables (➔ A.1 General data or documentation of the cables).

3.2 Dimensions of the controller

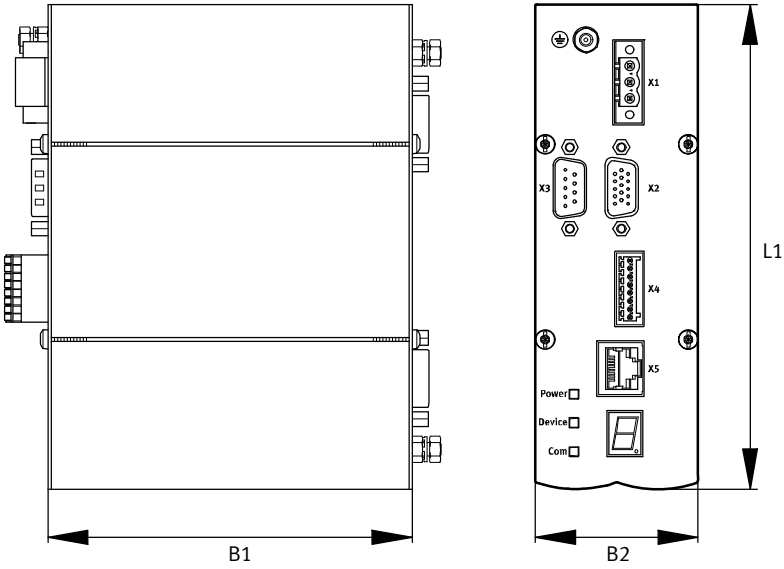


Fig. 3.1 Dimensions

Dimensions [mm]		
B1	**B2**	**L1**
112	50	149

Tab. 3.1

3.3 Mounting the controller

The controller is mounted in the mounting slots with M4 screws
(➔ Fig. 3.2 Distances of the mounting slots).

Note

EXCM-10

– On the planar surface gantry EXCM-10, the controller is already mounted.

EXCM-30

- Observe the maximum screw-in depth in the mounting slots of 6 mm.
- When tightening the screws, observe the recommended tightening torque of 1±0.1 Nm.

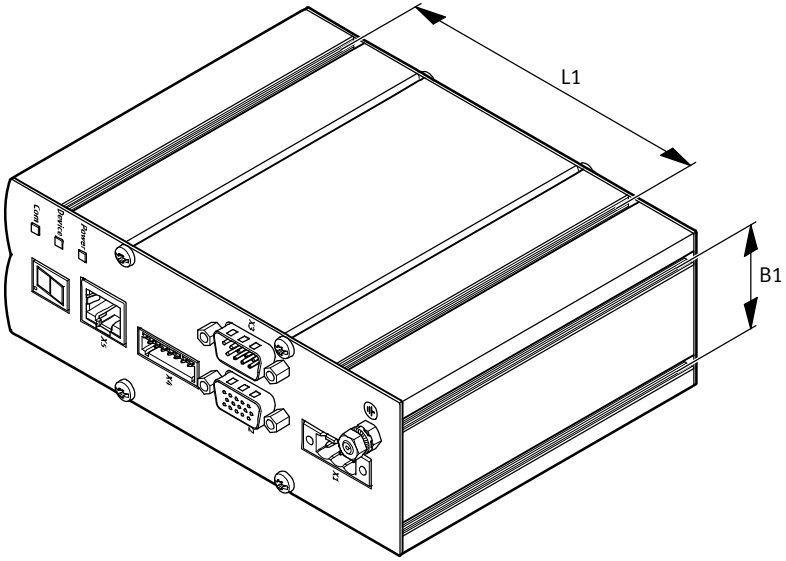


Fig. 3.2 Distances of the mounting slots

Dimensions [mm]	
B1	**L1**
34	104

Tab. 3.2

4 Electrical installation

4.1 General instructions

Caution
Uncontrolled movements of the planar surface gantry can cause injury to people and material damage
- Switch off the power supplies prior to any mounting, installation or maintenance work and prevent them from being restarted accidentally.

Caution
Defectively made cables can destroy electronics and trigger unforeseeable movements.
- Use only the plug connectors provided and preferably the cables listed as accessories to install the system
  (➔ Tab. 4.1)Cables for connections on the front (accessories).
- Lay all flexible lines so that they are free of kinks and free of mechanical stress; if necessary use chain link trunking.

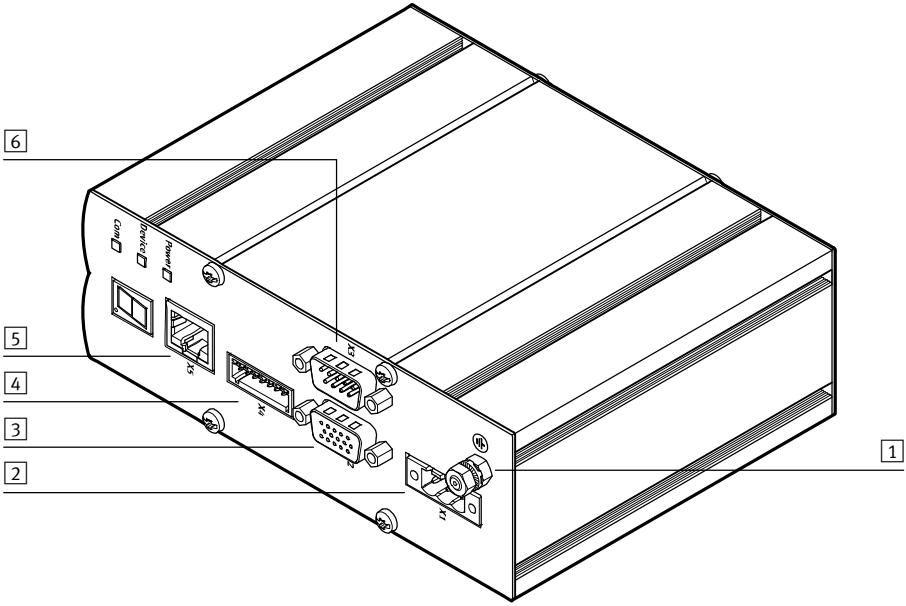
For unused plug connectors, there is the danger that damage may occur to the controller or other system parts if touched due to electrostatic discharges (ESD = electrostatic discharge). Place protective caps on unused terminals to prevent such discharges.

Note
To ensure compliance with the IP protection class (if required):
- Please note that the specified IP protection class is only achieved if all plugs are assigned.

Observe the tightening torques in the documentation of the cables and plugs used.

4.2 Connections and interfaces

Connections on the front



1 Functional earth
2 Power supply [X1]
3 I/O interface [X2]
4 Emergency stop interface [X4]
5 Ethernet interface [X5]
6 CANopen interface [X3]

Fig. 4.1 Connections on the front

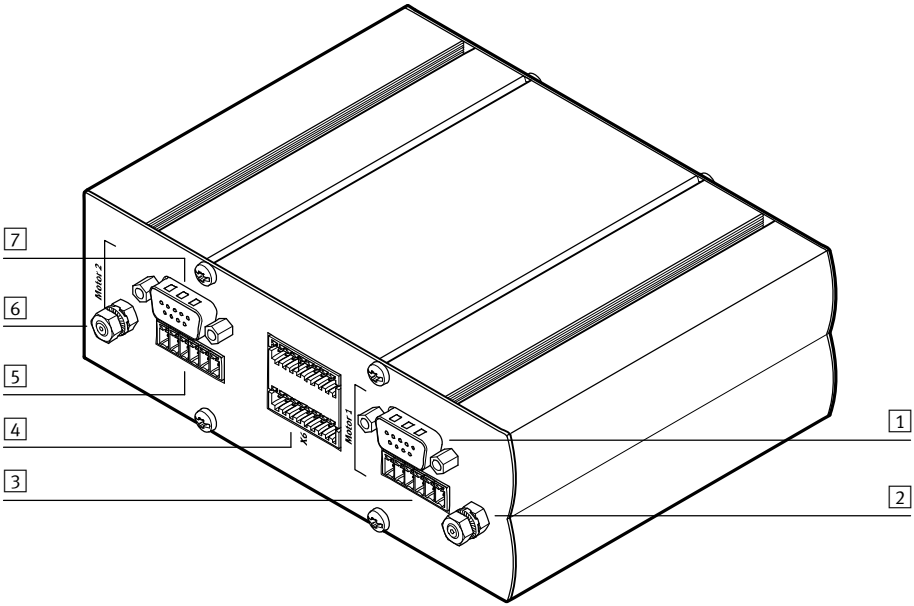
Cables

Connection		Cable
1	Functional earth	Prepared by the customer
2	Power supply [X1]	Prepared by the customer
3	I/O interface [X2]	NEBC-S1H15-E-...-N-LE15[1)]
4	Emergency stop interface [X4]	Prepared by the customer
5	Ethernet interface [X5]	Network cable, RJ45 plug; Cat. 5 (or better)
6	CANopen interface [X3]	Prepared by the customer

1) Subject to change. Only the current specifications in the Festo catalogue are relevant: www.festo.com

Tab. 4.1 Cables for connections on the front (accessories)

Connections on the back cover



1 Encoder motor 1
2 Screening motor 1
3 Voltage supply motor 1
4 Reserved [X6]
5 Voltage supply motor 2
6 Screening motor 2
7 Encoder motor 2

Fig. 4.2 Connections on the back cover

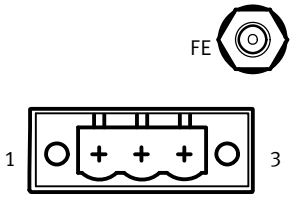
Cables

Connection		Cable[1)]	
		EXCM-10	**EXCM-30**
1	Encoder motor 1	NEBM-S1G9-K-0.25-N-L2G10	NEBM-M12G8-E-...-N-S1G9
2 3	Voltage supply and screening motor 1	Cable permanently connected to the motor.	NEBM-S1G9-E-...-N-C1G6 (with brake) NEBM-M12G5-E-...-N-C1G6 (without brake)
4	Reserved	–	–
5 6	Voltage supply and screening motor 2	Cable permanently connected to the motor.	NEBM-S1G9-E-...-N-C1G6 (with brake) NEBM-M12G5-E-...-N-C1G6 (without brake)
7	Encoder motor 2	NEBM-S1G9-K-0.25-N-L2G10	NEBM-M12G8-E-...-N-S1G9

1) Subject to change. Only the current specifications in the Festo catalogue are relevant: www.festo.com

Tab. 4.2 Cables for connections on the back cover (accessories)

4.2.1 Power supply [X1]

Connection	Pin	Function		
	FE	Functional earth		
	1	Logic voltage	+24 V (±15 %)	Power supply for the control electronics
	2	Load voltage	+24 V (±15 %)	Power supply for the output stage and the motor
	3	Reference potential	0 V	Reference potential for load voltage, logic voltage and control interface

Tab. 4.3 Voltage supply [X1] connection

Note

To ensure compliance with EMC safety:

– The maximum length of the individual cables should not exceed 30 m.
– With a line length of 3 m or greater, a folding ferrite with the following characteristics must be attached to the power supply cable in front of the controller:
  – Impedance at 100 MHz: 241 Ω; impedance at 25 MHz: 141 Ω

Requirements to be met by the power supply

Warning

- Use only PELV circuits in accordance with IEC/DIN EN 60204-1 (protective extra-low voltage, PELV) for the electrical power supply.
  Also comply with the general requirements for PELV circuits laid down in IEC/DIN EN 60204-1.
- Use only power units which guarantee reliable electrical isolation of the operating voltage as per IEC/DIN EN 60204-1.

Protection against electric shock (protection against direct and indirect contact) is guaranteed in accordance with IEC/DIN EN 60204-1 by using PELV circuits (Electrical equipment of machines, general requirements).

Caution

Damage to the device

The power supply inputs have no special protection against overvoltage.

- Make sure the permissible voltage tolerance is never exceeded.

Technical data of the voltage supply (➔ A.2 Electrical data).

4.2.2 Functional earth

The threaded pin next to the power supply input of the controller serves to connect the functional earth (galvanically separated) to comply with the EMC security.

Note

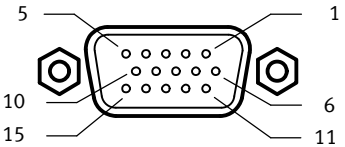
- Connect the functional earth connection with low impedance to the earth potential to avoid electromagnetic disturbances.
- Ensure electromagnetic compatibility in accordance with the EMC Directives.

4.2.3 I/O interface [X2]

Communication with a higher-order controller (PLC/IPC) takes place through the I/O interface.

Note

All inputs and outputs are executed as NPN with inverse logic, i.e. they are active with a low signal (17 V ... 29 V) and inactive with a high signal (0 V ... 15 V).
If an input is not connected (broken cable), this is detected and evaluated as a low signal.

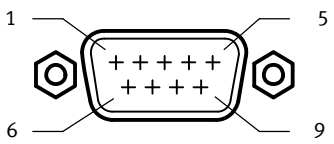
Connection	Pin	Function	
	1	24VL	Output: ready for communication
	2	DI 1	Inputs: record selection
	3	DI 2	
	4	DI 3	
	5	DI 4	
	6	DI 5	
	7	DI 6	Not used
	8	START	Input: start record
	9	ENABLE	Input: enable controller
	10	RESET	Input: acknowledge malfunction
	11	ENABLED	Output: controller enabled
	12	FAULT	Output: malfunction
	13	ACK	Output: acknowledgment
	14	MC	Output: motion complete
	15	O V	Reference potential

Tab. 4.4 Connection, I/O interface [X2]

Specification of the I/O interface		
High signal (inverse logic)	[V]	0 ... 15
Low signal (inverse logic)	[V]	17 ... 29
Inputs (not galvanically separated)		
Scanning rate	[ms]	2
Input current at nominal input voltage per input	[mA]	2
Max. permissible input voltage	[V]	29
Outputs (secure against short circuit)		
Maximum current per output	[mA]	100

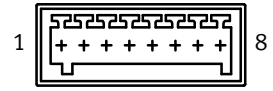
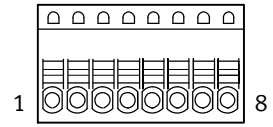
Tab. 4.5 Specification of the I/O interface [X2]

4.2.4 CANopen interface [X3]

Connection	Pin	Function	
	1	–	Not used
	2	CAN-L	Low signal
	3	0 V (GND)	Reference potential
	4	–	Not used
	5	Screening	Screened connection
	6	–	Not used
	7	CAN-H	High signal
	8	–	Not used
	9	–	Not used

Tab. 4.6 Connection, CANopen interface [X3]

4.2.5 Emergency stop interface [X4]

Connection	Pin	Function	
Interface at the controller  Plug on connection side 	1	+24 V logic	Output: logic voltage +24 V
	2	TO	Input: disconnect supply voltage of the motors (at 0 V)
	3	ES[1)]	Input: trigger brake edge (at 0 V)
	4	RB	Input: release brake (at +24 V)
	5	FAULT[2)]	Output: malfunction present (at +24 V)
	6	DIAG1 (Contact 1)	Potential-free diagnostic contacts. High impedance with switched-off driver supply. (Diagnostic contacts 1 and 2 opened).
	7	DIAG2 (Contact 2)	
	8	0 V (GND)	Reference potential

1) At rest, the output stage is switched off and any motor brakes present are closed.

2) The output is high impedance. To signal malfunctions, a low impedance consumer is used.

Tab. 4.7 Connection, emergency stop interface [X4]

The inputs and outputs are designed as PNP. For commissioning of the controller, apply a voltage of +24 V to the inputs 2 and 3.

Note

If a voltage of +24 V is applied to the RB input (Release brake), the brake is always released and this status can no longer be changed through software. This input serves mainly to release the brake in order to move planar surface gantries with brake by hand.

4.2.6 Ethernet interface [X5]

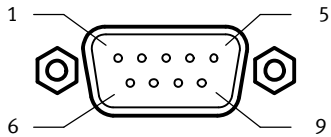
The Ethernet interface can thereby be used both for control via the FCT and also for operation via the function CVE.

Note

- Use a network cable of category 5 or better.

4.2.7 Encoder connection

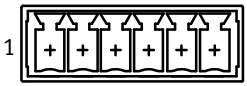
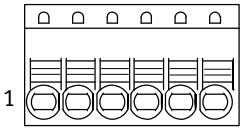
An incremental encoder with signals in accordance with RS422 can be connected to the encoder port.

Connection	Pin	Function	
	1	A[1)]	Incremental encoder signal A+, Positive polarity
	2	B[1)]	Incremental encoder signal B+, Positive polarity
	3	N[1)]	Incremental encoder signal zero pulse, Positive polarity
	4	0 V	Reference potential
	5	+5 V ±10 %	Supply of the encoder. Max. 100 mA, not secure against short circuit.
	6	A/[1)]	Incremental encoder signal A–, Negative polarity
	7	B/[1)]	Incremental encoder signal B–, Negative polarity
	8	N/[1)]	Incremental encoder signal zero pulse, Negative polarity
	9	–	–

1) Each 5 V; Ri = approx. 120 Ω

Tab. 4.8 Encoder connection

4.2.8 Motor connection

Port[1)]	Pin	Function	
Interface at the controller  Plug on connection side 	1	String A	Connection of the two motor strings
	2	String A/	
	3	String B	
	4	String B/	
	5	BR+	Connection of the holding brake. Short-circuit- and overload-protected. BR– = GND, BR+ is switched (24 V load)
	6	BR–	

1) Next to the motor connections is an M4 threaded pin to connect the screening of the motor cable through a cable lug

Tab. 4.9 Motor connection

5 Commissioning with the FCT

5.1 Safety instructions

Warning
Planar surface gantries travel with great force and speed. Collisions can lead to serious injury to people and damage to components.
- Make sure that nobody can grasp into the sphere of influence of the planar surface gantry as well as other connected actuators – e.g. through protective guards – and no items are located in the travel range as long as the system is connected to energy sources.

Caution
Unexpected movements of the planar surface gantry due to incorrect parameterisation.
- Make sure that an ENABLE signal is not present at the control interfaces when the controller is switched on.
- Parameterise the entire system completely before you activate the output stage.

Caution
Housing surfaces can reach high temperatures. A person touching the surface can be startled and have uncontrolled reactions, which can result in further injury.
- Make sure that the surface cannot be touched accidentally and inform your operating and maintenance staff of the possible hazards.

Note
The controller does not execute direct tasks or records if a valid reference point is not present (exception, jogging).
- Always carry out a homing run every time the logic voltage supply is switched on, in order to anchor the dimension reference system to the reference point.

Note
Damage to components when the permissible impact pulse is exceeded.
- Operate the planar surface gantry only with the maximum permissible load (➔ documentation of the planar surface gantry).

Note
Interruption of ongoing tasks due to inadequate load voltage supply.
- Make sure that the tolerance of the load voltage supply at the input of the controller is complied with under full load (➔ A.2 Electrical data).

5.2 Network connection via Ethernet

5.2.1 Connection to PC/laptop

For communication between the controller and the FCT to take place, you must connect the controller to your PC/laptop via the Ethernet interface. Use a commercially available network cable for this purpose (plug connector RJ-45). The cable type (straight or crossed connection) is recognised automatically.
The DHCP server of the controller is intended for creating a direct connection between the controller and an individual PC/laptop. It is not intended to supply larger networks with IP addresses.
It assigns IP addresses in a range of 192.168.178.110 ... 192.168.178.209 and the subnet mask 255.255.255.0. A gateway is not assigned.

Note
At delivery, the controller has an active DHCP server.
The controller cannot be connected to a network immediately at initial start-up, since its active DHCP server could lead to network malfunctions if two active DHCP servers are present in one network.

If the DHCP client on your PC/laptop is active (usually standard setting), then the DHCP server of the controller assigns your PC/laptop an IP address at initial start-up, and you can access the controller.

If you cannot build up a connection to the controller
➔ 7.4.3 Problems with the Ethernet connection.

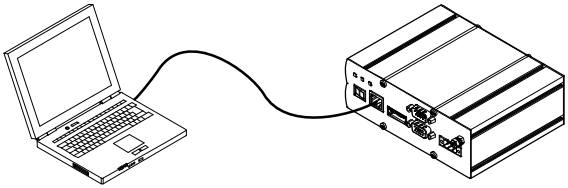


Fig. 5.1 Connection to PC/laptop

5.2.2 Network settings

Network settings upon delivery

Parameters	Value
IP	192.168.178.1
DHCP server	Active
Port (FCT)	7508
Port (CVE)	49700
Subnet mask	255.255.255.0
Gateway	0.0.0.0 (none)

Tab. 5.1 Network settings upon delivery

IP address (obtain automatically/fixed)

The controller can automatically obtain its IP address from a DHCP server in your network. Alternatively, you can also assign the controller a fixed IP address.

You can make these settings as needed through the FCT (➔ following point).

Display or change the network settings of the controller

In the FCT plug-in via the “Controller” page [Set network settings].

– or –

Through a network scan via the FCT.

1. Menu [Component] [FCT interface] [“Search...” button].
2. Select one of the found devices from the context menu [network settings].
3. Assign a fixed IP address to the selected device.

After a change to the network settings in the controller, it has to be restarted in order for the changes to become active.

5.2.3 Safety in the network

Caution

When the controller is connected to existing networks (e.g. to the Internet):
Unauthorised or inadvertent access to the controller could cause it to behave in an unforeseen way.

- Use the controller only in subnetworks that are protected against unauthorised access from outside, e.g. through use of safety network components (special gateways/firewalls).

Use a password if you want to make inadvertent access to the controller more difficult (in the FCT: Menu [Component] [Online] [Password]).

5.2.4 Timeout

The controller recognises if the connection to the FCT software has been interrupted and then behaves as parameterised in the FCT on the “Error management” page (malfunction number 0x32).
The typical timeout is 1 s, but can be longer in slow networks, since the timeout is adjusted dynamically to the transmission rate.

5.3 The Festo Configuration Tool (FCT)

5.3.1 General information

The Festo Configuration Tool (FCT) is the software platform for configuring and commissioning different components and devices from Festo.
The FCT consists of a framework and a device-specific plug-in.

FCT framework

The FCT framework serves as a program start and entry point with uniform project and data management for all supported types of equipment.
Detailed information on working with projects and adding a device to a project can be found in the Help on the FCT framework.

- Select it in the Menu [Help] [General contents of FCT].

FCT plug-in

An FCT plug-in supports the device-specific performance of all necessary steps for commissioning of a device. The plug-ins are managed and started from the framework. The necessary parameterisations can be executed offline, i.e. without connecting the device to a PC/laptop. This makes it possible to prepare commissioning in the office, for example.
Further information can be found in the relevant plug-in help:

- Select it in the Menu [Help] [Contents of installed plug-ins] [Festo] [EXCM].

In order to use the entire Help or parts of it independently of a PC, you can also print these out.

1. Click in the Help window on the “Print” button.
2. Select the desired topics in the “Print topics” dialogue.

5.3.2 Installation of the FCT

For commissioning, both the FCT framework and the FCT plug-in of the controller must be installed.
The FCT is installed on your PC/laptop with an installation program.
You will find the files needed for installation on the accompanying data storage medium.

- First install the FCT framework and then the FCT plug-in EXCM.

Note

The FCT plug-in EXCM V 1.0.0 supports controllers with firmware version V 1.0.0.x

- Check whether an updated FCT plug-in is present (➔ www.festo.com).

Attention: A newer FCT plug-in might no longer support the firmware version of the controller.

5.3.3 Starting the FCT

After installation of the FCT software on your PC/laptop, you can start it in two ways.

- Double click on the FCT icon on your desktop.
- Select the entry [Festo Software] [Festo Configuration Tool] in the start menu from the list of programs.

5.3.4 Creating a new project

After you have installed and started the FCT, you can create a new project as follows.

1. Select in the [Project] menu the entry [New].
2. In the dialogue “New Project - Project Characteristics”, assign a name and a title to your project. You can optionally also write a project description.
3. Confirm your inputs with the “OK” button.
4. In the [Component Selection] dialogue, select the component “EXCM” via the project tree.
5. Assign a component name and select the desired version.
6. Confirm your inputs with the “OK” button.

5.3.5 Component settings

For commissioning the controller, specifications and settings are required for the components involved. The corresponding tab and pages are selected in the work space of the FCT.

The following points merely describe the minimum required settings to operate a planar surface gantry with the controller.

- For information on further settings, use the plug-in Help via menu [Help] [Contents of installed plug-ins] [Festo] [EXCM].

Configuration

1. Select the size of the planar surface gantry.
2. Specify the path of the working space, dependent on the size.
   – EXCM-10: Working space in the direction of the X-axis
   – EXCM-30: Working space in the direction of the X- and Y-axis
3. Make specifications on the motor brake and motor position.

Control interface

- Select the control interface and enter additional interface parameters, if necessary.
  – Digital I/O (no additional settings required)
  – CANOpen
    - Select the bit rate
    - Specify the node number (range of values 1 ... 127, default: 1)
  – Control via Ethernet (CVE)
    - Determine the port, if necessary (range of values 1 ... 65535, default: 49700)

System of measurement units

- Choose a coordinate system by determining the position of the axis zero point (➔ 2.7 Measuring reference system).
- Specify the project zero point and the SW end positions (positive/negative) of both axes (➔ 2.7 Measuring reference system).

5.3.6 Record table

The parameters of positioning jobs are created via the FCT and saved in a record table in the form of parameter records. A record table consists of a maximum of 31 records.
The parameter records are selected individually in the “Record selection” operating mode using the record number.
Each parameter record consists of the following parameters:

– Record type: Positioning absolute (PA), relative to the setpoint position (PRN) or relative to the actual position (PRA)
– Target position X and target position Y
– Speed and acceleration
– Comments (optional)

Records are parameterised exclusively via the Festo Configuration Tool (FCT).

5.3.7 Teaching

The current position can be taken over as parameters through the FCT:

1. The slide is brought to the desired position (e.g. by jogging or by hand).
2. Through actuation of the “Accept as...” button in the online tab “Manually travel”, the current position is taken over into the record table as a software end position or project zero point.

5.3.8 Enable device control via FCT

To control the controller through the FCT, you must activate the device control via FCT.

- Set the “FCT” check box in the online tab “Operate”.

Caution
Setting the “FCT” check box interrupts control through the control interfaces, which can result in malfunctions in the process or damage to the system. The interfaces can only read access the controller.

- Also set the “Enable” check box to enable the controller.

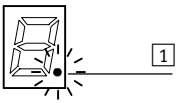
To deactivate the device control through the FCT, the check in the check box must be removed. Then the interface set in the FCT Project takes over control again.

5.3.9 Controller identification

For identification of a specific controller from a group of several controllers:

1. Select in the menu [Component] [FCT Interface].
2. In the dialogue “FCT Interface”, actuate the “Search...” button.
3. In the dialogue that appears, select a controller with the right mouse button.
4. Select the entry [Identification] [On].
   – The red LED display component “Device” (➔ 2.8.2 LED display components) and the point of the 7-segments display (➔ Fig. 5.2 Controller identification) of the identified controller flash.

5. The switch the controller identification back off [Identification] [Off].



1 Point for controller identification

Fig. 5.2 Controller identification

5.3.10 Firmware update

Note

With firmware changes, the network settings are reset to the delivery status (➔ 5.2.2 Network settings).

- Carry out a firmware update only upon instruction by Festo Service in order to avoid unforeseeable behaviour by the planar surface gantry due to a possibly defective configuration.

6 Operation

6.1 Instructions on operation

Safety

Caution
The safety instructions for commissioning also apply during ongoing operation.
- Observe the safety instructions in the chapter Commissioning with the FCT (➔ 5.1 Safety instructions).

Caution
Unexpected movements of the planar surface gantry after the controller is enabled.
- Make sure that no persons or items are in the travel range of the planar surface gantry when the controller is enabled.

Password protection

Note
Protection against unauthorised or unintended overwriting of parameters.
- Set up a password through the FCT (➔ Plug-in Help).

At delivery, protection through a password is not active.

Maintenance and care

Note
The controller is maintenance-free.
- But observe the maintenance information of the planar surface gantry as well as possible additional components.

Disposal and environment

Note
Environmentally friendly disposal
- Observe the local regulations for environmentally friendly disposal of electronic components.

6.2 Communication principle, general

Communication between a higher-order controller and the controller takes place in all operating modes through the FHPP protocol (Festo Handling and Positioning Profile) with cyclical data exchange of 8 bytes of output and 8 bytes of input data each. Output data are transferred via the control bytes CCON and CPOS and the input data via the status bytes SCON and SPOS.
The following data are replaced thereby:

- Control word CCON/CPOS (control byte 1 and 2): control of statuses and positioning sequences (➔ 6.2.2 Description of the control bytes CCON/CPOS).
- Status word SCON/SPOS (status byte 1 and 2): feedback via statuses and positioning sequences (➔ 6.2.3 Description of the status bytes SCON/SPOS).
- Other output data (control bytes 3 ... 8): control of record numbers, speed and setpoint positions (➔ Tab. 6.1 Control byte overview).
- Other input data (status bytes 3 ... 8): feedback via record numbers, fault numbers and actual positions (➔ Tab. 6.2 Status byte overview).

6.2.1 Overview of the control and status bytes

	Control word		**Output word 1**		**Output word 2**		**Output word 3**	
Data	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Output data (control bytes)	CCON	CPOS	Dependent on the operating mode: – Record number, speed, setpoint position					

Tab. 6.1 Control byte overview

	Status word		**Input word 1**		**Input word 2**		**Input word 3**	
Data	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Input data (status bytes)	SCON	SPOS	Dependent on the operating mode: – Record number, fault number, actual position					

Tab. 6.2 Status byte overview

The function assignment of the control and status bytes (byte 3 ... 8) is dependent on the operating mode.

Record selection operating mode								
Data	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Output data	CCON	CPOS	Record no.	Reserved				
Input data	SCON	SPOS	Record no.	Fault no.	Actual position X		Actual position Y	

Tab. 6.3

Direct operating mode								
Data	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Output data	CCON	CPOS	Speed		Setpoint position X		Setpoint position Y	
Input data	SCON	SPOS	Reserved	Fault no.	Actual position X		Actual position Y	

Tab. 6.4

6.2.2 Description of the control bytes CCON/CPOS

All necessary statuses were controlled with the control byte CCON.

Bit	Function		Description
0	Enable the drive (controller)	ENABLE	= 0 Drive (controller) blocked = 1 Enable the drive (controller)
1	Stop	STOP	= 0 Stop active (Stop with permissible edge, cancel positioning job). = 1 Enable operation
2	Release brake	BRAKE	= 0 Brake active = 1 Release brake (only effective with ENABLE = 0)
3	Acknowledge malfunction	RESET	With a rising edge, a malfunction message is deleted and, if successful, the malfunction status is abandoned.
4	Reserved		Reserved, must be 0.
5	Axis selection	AXSEL	= 0 X-axis selected = 1 Y-axis selected (only effective for jog operation)
6	Operating mode selection	OPM	= 0 Record selection = 1 Direct mode
7	Reserved		Reserved, must be 0.

Tab. 6.5 Control byte CCON

The CPOS control byte controls the positioning sequences after the drive is enabled.

Bit	Function		Description
0	Positioning Absolute/relative	ABS/REL	= 0 Positioning absolute = 1 Positioning relative to the next setpoint value (only effective in direct mode)
1	Start positioning job	START	With a rising edge, the current setpoint values are accepted and positioning started.
2	Start homing	HOM	A rising edge starts homing with the preset parameters.
3	Jog positive	JOGP	As long as the bit is set, the drive travels with specified speed in the direction of larger actual values of the axis selected in AXSEL.
4	Jog negative	JOGN	As long as the bit is set, the drive travels with specified speed in the direction of smaller actual values of the axis selected in AXSEL.
5	Reserved		Reserved, must be 0.
6	Reserved		Reserved, must be 0.
7	Reserved		Reserved, must be 0.

Tab. 6.6 Control byte CPOS

6.2.3 Description of the status bytes SCON/SPOS

The status byte SCON provides feedback about the drive statuses.

Bit	Function		Description	
0	Drive (controller) enabled	ENABLED	= 0 = 1	Drive (controller) blocked, not active Drive (controller) enabled
1	Operation enabled	OPEN	= 0 = 1	Stop active Operation enabled, positioning possible
2	Warning	WARN	= 0 = 1	No warning present Warning present
3	Malfunction	FAULT	= 0 = 1	Malfunction is not present Malfunction is present, malfunction reaction active (malfunction code in the malfunction buffer)
4	Load voltage is applied	24VL	= 0 = 1	No load voltage (e.g. emergency stop) Load voltage is applied
5	Reserved		= 0	
6	Feedback Operating mode	OPM	= 0 = 1	Record selection Direct mode
7	Reserved		= 0	

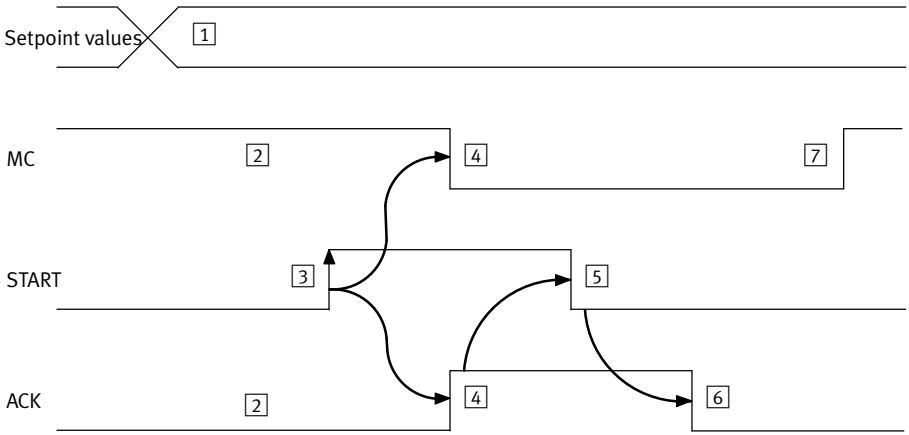
Tab. 6.7 Status byte SCON

The status byte SPOS provides feedback about the positioning sequences.

Bit	Function		Description	
0	Reserved		= 0	Reserved
1	Feedback Start	ACK	= 0 = 1	Ready to start Start carried out
2	Motion Complete	MC	= 0 = 1	Positioning job active Positioning job completed (possibly with malfunction)
3	Reserved		= 0	Reserved
4	Drive is moving	MOV	= 0 = 1	Speed of the axis ‹ limit value Speed of the axis ›= limit value
5	Reserved		= 0	Reserved
6	Reserved		= 0	Reserved
7	Homing	REF	= 0 = 1	Homing required Reference information present

Tab. 6.8 Status byte SPOS

6.2.4 Timing diagram



1 Setpoint values preselected (dependent on the operating mode, record number or speed, as well as positioning absolute or relative to the setpoint position)
2 Requirements for START:
MC = 1 (status byte SPOS bit 2)
ACK = 0 (status byte SPOS bit 1)
3 Start positioning job: START = 1 (control byte CPOS bit 1)
4 Reaction to positive edge of 3:
ACK = 1 (status byte SPOS bit 1)
MC = 0 (status byte SPOS bit 2)
5 Reaction to 4: START = 0 (control byte CPOS bit 1)
6 Reaction to 5: ACK = 0 (status byte SPOS bit 1)
7 Positioning job completed: MC = 1 (status byte SPOS bit 2)

Fig. 6.1 Timing diagram

6.3 Control via I/O interface

6.3.1 General remarks

If the controller is activated via the I/O interface [X2], only the record selection operating mode is available. The direct operating mode and jog operation are not possible.
The records configured with the FCT are selected by the higher-order controller via 5 binary coded inputs. The other inputs and outputs serve to start the selected record or to output status messages, for example.

6.3.2 Communication

Communication over the I/O interface [X2] takes place through signals with negative logic at inputs and outputs, i.e. through a low signal at one input, the assigned bit is set or, in the case of a high signal, reset. The bit statuses are output through signals at the outputs (low signal = bit set/high signal = bit not set).

Note
All inputs and outputs are executed as NPN with inverse logic, i.e. they are active with a low signal (17 V ... 29 V) and inactive with a high signal (0 V ... 15 V).
If an input is not connected (broken cable), this is detected and evaluated as a low signal.

Pin	Function		Description
1	Output: 24 V load voltage	24VL	= 0 No load voltage = 1 Load voltage is applied
2	Input 1 (value 1)	DI1	Record selection records 0 ... 31 (Record 0 = homing) The inputs are evaluated together.
3	Input 2 (value 2)	DI2	
4	Input 3 (value 4)	DI3	
5	Input 4 (value 8)	DI4	
6	Input 5 (value 16)	DI5	
7	Reserved		Reserved
8	Input: start record	START	Start record though rising edge
9	Input: enable drive (controller)	ENABLE	= 0 Disable drive (controller and operation) = 1 Enable drive (controller and operation)
10	Input: acknowledge malfunction	RESET	Acknowledge malfunction through rising edge
11	Output: drive (controller) enabled	ENABLED	= 0 Drive (controller) blocked = 1 Drive (controller) enabled
12	Output: malfunction	FAULT	= 0 No malfunction = 1 Malfunction is present
13	Output: acknowledgment	ACK	= 0 Ready to start = 1 Positioning started
14	Output: motion complete	MC	= 0 Positioning job active = 1 Positioning job completed
15	0 V		Reference potential

Tab. 6.9 Description of the input and output interface [X2]

6.3.3 Examples

Note
If a malfunction occurs during the process (➔ 7 Diagnostics).

Enable operation
Requirements:
– The drive was switched on and a malfunction is not present.
– The inputs of the emergency stop interface [X4] are active, that is, +24 V must be applied to TO and ES and 0 V to RB (➔ 4.2.5 Emergency stop interface [X4]).

1. Establish the I/O interface as a control interface via the FCT by selecting “Digital I/O” on the control interface page, then “saving”, and switching the controller off and back on again.
   – As soon as the controller is ready, a low signal is present at Pin 1 and 14 (24VL = 1 and MC = 1).
2. Enable the drive and operation by applying a low signal at Pin 9 (ENABLE).
   – After the drive (controller) is enabled, a low signal is applied to Pin 1 (ENABLED = 1).

The operation is enabled.

Execute homing
Requirements:
– The drive (controller) is enabled and a malfunction is not present.
– The position of the axis zero point AZ was correctly parameterised via the FCT.

Homing is executed by selecting and starting record number 0.

1. Select homing (record number 0) by applying a high signal (DI1 ... 5 = 0) to all five binary-coded inputs (Pin 2 ... 6).
2. Apply a low signal to Pin 8 (START) to start homing.
   – Homing (record 0) is taken over and started through a rising edge at Pin 8.
   – A low signal is applied to Pin 13 as soon as homing has been started (ACK = 1).
   – As soon as the reference position is reached, a low signal is applied to Pin 14 (MC = 1).

Start of a record (record selection)
Requirements:
– The drive (controller) is enabled and a malfunction is not present.
– Homing has been executed successfully.

1. Select a record by applying signals to the binary coded inputs (Pin 2 ... 6) corresponding to the desired record number.
   – Example for the selection of record number 6:
     • Apply a low signal (DI2 and DI3 = 1) to Pin 3 (value 2) and Pin 4 (value 4).
2. Apply a low signal to Pin 8 (START) to start the positioning job of the selected record.
   – The selected record number is taken over through a rising edge at Pin 8 and the positioning job is started.
   – A low signal is applied to Pin 13 as soon as the positioning job has been started (ACK = 1).
   – As soon as the target position is reached, a low signal is applied to Pin 14 (MC = 1).

6.4 Controller via CANopen interface

6.4.1 General remarks

The controller can be actuated via the CANopen interface from a higher-order controller in the two operating modes “record selection” and “direct mode”. It is possible to start both homing and positioning jobs.

6.4.2 Communication

In a CANopen network, the controller functions as a slave with cyclical data exchange. In each case, 8 bytes of control data and 8 byte of status data are thereby exchanged between the higher-order controller (PLC/IPC) and the controller. The data exchange takes place in the form of telegrams, whereby process data objects (PDO) and service data objects (SDO) are differentiated. Control data are transferred via transmit PDOs and status data via receive PDOs.
The entire object directory can be accessed through the service data objects.

In the direct operating mode, the desired acceleration value is parameterised directly in the object directory through a service data object. You can find an overview of all CANopen objects in the appendix (➔ B.1 CANopen object overview).

Transmit-PDOs					
Index	**Sub-bindex**	**Designation**	**Type**	**Control byte**	**Explanation**
3000h	0	Control word CCON/CPOS	uint16	1 … 2	➔ 6.2.2
3001h	0	Record selection: record number Direct mode: speed	uint16	3 3 … 4	Record 0 … 31 Unit [mm/s]
3002h	0	Target position X (only direct mode)	int16	5 … 6	Unit [0.1 mm]
3003h	0	Target position Y (only direct mode)	int16	7 … 8	Unit [0.1 mm]

Tab. 6.10 Transmit-PDOs

Receive-PDOs					
Index	**Sub-bindex**	**Designation**	**Type**	**Status byte**	**Explanation**
3020h	0	Status word SCON/SPOS	uint16	1 … 2	➔ 6.2.3
3021h	0	Record selection: record and malfunction number Direct mode: malfunction number	uint16	3 … 4 4	 255: no malfunction
3022h	0	Actual position X	int16	5 … 6	Unit [0.1 mm]
3023h	0	Actual position Y	int16	7 … 8	Unit [0.1 mm]

Tab. 6.11 Receive-PDOs

Note

- Use the EDS file on the accompanying data storage medium for configuration of the controller in a CANopen network.

You can find a current EDS file on the Festo Internet page (➔ www.festo.com).

6.4.3 Examples

Note
If a malfunction occurs during the process (➔ 7 Diagnostics).

Enable operation
Requirements:
– The drive was switched on and a malfunction is not present.
– The inputs of the emergency stop interface [X4] are active, that is, 24 V must be applied to TO and ES and 0 V to RB (➔ 4.2.5 Emergency stop interface [X4]).

1. Establish the CANopen interface as a control interface (incl. parameters) via the FCT by selecting “CANopen” on the control interface page, specifying the bit rate and node number, and then “saving” and switching the controller off and back on again.
   – As soon as the controller is ready, bit 2 is set to value 1 in the SPOS status byte (MC = 1).
   – In the control byte CPOS, bit 1 and 2 must be set to the value 0 (START = 0 and HOM = 0).
2. Enable the drive (controller) by setting bit 0 in the control byte CCON to the value 1 (ENABLE = 1).
   – As soon as this status has been reached, bit 0 in the SCON status byte is set to value 1 (ENABLED = 1).
3. Enable the operation by setting bit 1 in the control byte CCON to the value 1 (STOP = 1).
   – As soon as this status has been reached, bit 1 in the SCON status byte is set to value 1 (OPEN = 1).

The operation is enabled (controlled status).

Execute homing
Requirements:
– The operation is enabled.
– The position of the axis zero point AZ was correctly parameterised via the FCT.
– In the control byte SPOS, bit 1 must be set to the value 0 and bit 2 must be set to the value 1 (ACK = 0 and MC = 1).
– In the control byte CPOS, bit 1 and bit 2 must be set to the value 0 (START = 0, HOM = 0), so that a rising edge can be detected.
– In the control byte CPOS, bit 3 and bit 4 must be set to the value 0 (JOGP = 0 and JOGN = 0).

1. Set the bit 2 in the control byte CPOS to the value 1 (HOM = 1).
   – Homing is started.
2. Reset the bit 2 in the control byte CPOS to the value 0 (HOM = 0) as soon as bit 1 in the status byte SPOS has the value 1 (ACK = 1).
   – As soon as the reference position is reached, bit 2 and bit 7 in the control byte SPOS must be set to the value 1 (MC = 1 and REF = 1).

Homing is completed.

Start of a record (record selection)

Requirements:

– The operation is enabled.
– Homing has been executed successfully.
– In the control byte SPOS, bit 1 must be set to the value 0 and bit 2 must be set to the value 1 (ACK = 0 and MC = 1).
– Bit 1, bit 2, bit 3 and bit 4 in the control byte CPOS must be set to the value 0 (START = 0, HOM = 0, JOGP = 0 and JOGN = 0).

1. Set the bit 6 in the control byte CCON to the value 0 (OPM = 0).
   – The “record selection” operating mode is selected.

2. Write the desired record number in the control byte 3 of the output data.
   – The desired record is selected.

3. Set the bit 1 in the control byte CPOS to the value 1 (START = 1).
   – The selected record is started.
   – While the positioning job is being executed, bit 2 of the status byte SPOS has the value 0 (MC = 0).
   – As soon as the positioning job has ended, bit 2 of the status byte SPOS has the value 1 (MC = 1).

4. Reset the bit 1 in the control byte CPOS to the value 0 (START = 0) as soon as bit 1 in the status byte SPOS has the value 1 (ACK = 1).

Start of a positioning job (direct mode)

Requirements:

– The operation is enabled.
– Homing has been executed successfully.
– In the control byte SPOS, bit 1 must be set to the value 0 and bit 2 must be set to the value 1 (ACK = 0 and MC = 1).
– Bit 1, bit 2, bit 3 and bit 4 in the control byte CPOS must be set to the value 0 (START = 0, HOM = 0, JOGP = 0 and JOGN = 0).

1. Set the bit 6 in the control byte CCON to the value 1 (OPM = 1).
   – The “direct” operating mode is selected.

2. Set the desired parameters (target position in X- and Y-direction, speed) of the positioning job.
   • Write the desired speed to the control bytes 3 and 4 of the output data.
   • Write the target position in the X-direction to the control bytes 5 and 6 of the output data.
   • Write the target position in the Y-direction to the control bytes 7 and 8 of the output data.

3. Set whether positioning should take place absolutely or relative to the setpoint position.
   Positioning absolute:
   • Set the bit 0 in the control byte CPOS to the value 0 (ABS/REL = 0).
   Positioning relative:
   • Set the bit 0 in the control byte CPOS to the value 1 (ABS/REL = 1).

4. Set the bit 1 in the control byte CPOS to the value 1 (START = 1).
   - The positioning job is started.
   - While the positioning job is being executed, bit 2 of the status byte SPOS has the value 0 (MC = 0).
   - As soon as the positioning job has ended, bit 2 of the status byte SPOS has the value 1 (MC = 1).
5. Reset the bit 1 in the control byte CPOS to the value 0 (START = 0) as soon as bit 1 in the status byte SPOS has the value 1 (ACK = 1).

6.5 Control via Ethernet (CVE)

6.5.1 General remarks

With the function “Control via Ethernet” (CVE), the controller can be controlled via the Ethernet interface. The controller is pre-parameterised for this purpose with the Festo Configuration Tool (FCT). It is possible to start both homing and positioning jobs via CVE.
The controller can be actuated via the CVE interface in the record selection and direct mode operating modes (➔ 2.6 Operating modes).

6.5.2 Communication

The base for CVE communication is TCP data transfer (Transmission Control Protocol). The controller acts as the server in this setup, while the PC application acts as the client, i.e. the PC application always sends a request to the controller, which sends back a response (client-server principle).
The TCP connection is typically built up once and then remains in place as long as communication with the controller is required. If the drive is in motion when the connection is ended, a Quick Stop function is triggered.
The TCP port used can be set via the FCT. The port number 49700 is set at the factory.

Communication with the controller takes place via the CVE protocol. This must be implemented in the PC application. Knowledge of programming TCP/IP applications is required for this purpose.

CVE communication takes place via the CVE protocol (➔ 6.5.3 CVE protocol), whereby control data are written to CVE objects and status data are read out of SCE objects.
In the record selection operating mode, a record parameterised via the FCT is selected via CVE objects and the positioning job is started.
In the direct mode, the target position in the direction of the X- and Y-axis as well as the speed and acceleration values are written directly to CVE objects. The information on whether positioning should take place absolutely or relative to the last setpoint position as well as the start of the positioning job is also realised by writing to CVE objects.

Caution
Personal injury and material damage may result from other than intended use of the CVE interface.
– The CVE interface is not real-time capable.
Control of the controller via Ethernet requires a risk evaluation by the user, interference-free ambient conditions and securing of the data transfer, e.g. via the higher-order controller.
- Only use the CVE function in applications in which the lack of real-time capability cannot pose risks.

6.5.3 CVE protocol

Access to the data of the controller is through CVE objects. A CVE object always has a unique index that enables identification of the object.

Note
A series of CVE objects is listed in the appendix (➔ C.1 CVE object overview).

Caution
Personal injury and material damage
Inadvertent writing to non-documented objects can result in unforeseeable behaviour of the planar surface gantry.
- Use only objects listed in the appendix (➔ C.1 CVE object overview).

Each CVE object has one of the following listed data types (➔ Tab. 6.12 Data types).
The byte sequence is Little Endian, that is, the lowest-value byte first.

Data types

Value	Type	Bytes	Description	Range of values
0x00	–	–	Unknown data type	–
0x01	–	–	–	–
0x02	UINT32	4	32 bit unsigned integer	0 ... 4294967295
0x03	UINT16	2	16 bit unsigned integer	0 ... 65535
0x04	UINT08	1	8 bit unsigned integer	0 ... 255
0x05	–	–	–	–
0x06	SINT32	4	32 bit signed integer	– 2147483647 ... 2147483647
0x07	SINT16	2	16 bit signed integer	– 32767 ... +32767
0x08	SINT08	1	8 bit signed integer	– 127 ... +127

Tab. 6.12 Data types

Read object
To read a CVE object, a request corresponding to Tab. 6.13 must be sent to the controller. This sends back a response corresponding to Tab. 6.14.

Write object:
To write a CVE object, a request corresponding to Tab. 6.15 must be sent to the controller. This sends back a response corresponding to Tab. 6.16.

As both directions concern an endless TCP data stream, the individual messages must be filtered out from this. Specification and strict compliance with the message length are required for this.

Request “Read CVE object”

Byte	Function	Data type	Description
0x00	Service ID	UINT08	0x10 = Read CVE object from controller
0x01 0x02 0x03 0x04	Message ID	UINT32	Message ID freely assignable by the application. It is always sent back unchanged in the response. This enables a unique assignment of the request and response. The message ID can be used but is not mandatory.
0x05 0x06 0x07 0x08	Data length	UINT32	Always 4 for this request
0x09	Acknowledge	UINT08	In the request, this field always remains empty (initialise with 0).
0x0A 0x0B 0x0C 0x0D	Reserved	UINT32	Placeholder (initialise with 0).
0x0E 0x0F	Object index	UINT16	Index of the CVE object to be read.
0x10	Object subindex	UINT08	Subindex of the CVE object to be read.
0x11	Reserved	UINT08	Placeholder (initialise with 0).

Tab. 6.13 Request “Read CVE object”

Response “Read CVE object”

Byte	Function	Data type	Description
0x00	Service ID	UINT08	0x10 = Read CVE object from controller
0x01 0x02 0x03 0x04	Message ID	UINT32	Message ID included in the request.
0x05 0x06 0x07 0x08	Data length	UINT32	The data length is dependent on the data type of the read CVE object. The following applies: Data length = 4 bytes + data type length Example for UINT32: Data length = 4 bytes + 4 bytes = 8 bytes
0x09	Acknowledge	UINT08	0 if everything is ok. All other values mean that the object could not be read. A listing of possible causes of error ➔ Tab. 6.17.
0x0A 0x0B 0x0C 0x0D	Reserved	UINT32	Placeholder
0x0E 0x0F	Object index	UINT16	Index of the read CVE object.
0x10	Object subindex	UINT08	Subindex of the read CVE object.
0x11	Data type	UINT08	Data type of the read CVE object.
0x12	Data byte 1	corresponding to data type of the CVE object	Value of the read CVE object.
...	Data byte K		

Tab. 6.14 Response “Read CVE object”

Request “Write CVE object”

Byte	Function	Data type	Description
0x00	Service ID	UINT08	0x11 = Write CVE object to the controller.
0x01 0x02 0x03 0x04	Message ID	UINT32	Message ID freely assignable by the application. It is always sent back unchanged in the response. This enables a unique assignment of the request and response. The message ID can be used but is not mandatory.
0x05 0x06 0x07 0x08	Data length	UINT32	The data length depends on the data type of the CVE object to be written. The following applies: Data length = 4 bytes + data type length Example for SINT08: Data length = 4 bytes + 1 byte = 5 bytes
0x09	Acknowledge	UINT08	In the request, this field always remains empty (initialise with 0).
0x0A 0x0B 0x0C 0x0D	Reserved	UINT32	Placeholder (initialise with 0).
0x0E 0x0F	Object index	UINT16	Index of the CVE object to be written.
0x10	Object subindex	UINT08	Subindex of the CVE object to be written.
0x11	Data type	UINT08	Data type of the CVE object to be written.
0x12	Data byte 1	corresponding to data type of the CVE object	Value
...	Data byte K		

Tab. 6.15 Request “Write CVE object”

Response “Write CVE object”

Byte	Function	Data type	Description
0x00	Service ID	UINT08	0x11 = Write CVE object to the controller.
0x01 0x02 0x03 0x04	Message ID	UINT32	Message ID included in the request.
0x05 0x06 0x07 0x08	Data length	UINT32	Always 4 for this response.
0x09	Acknowledge	UINT08	0 if everything is ok. All other values mean that the object could not be written. A listing of possible causes of error ➔ Tab. 6.17.
0x0A 0x0B 0x0C 0x0D	Reserved	UINT32	Placeholder
0x0E 0x0F	Object index	UINT16	Index of the written CVE object.
0x10	Object subindex	UINT08	Subindex of the written CVE object.
0x11	Data type	UINT08	Data type of the written CVE object. If an attempt has been made to write an object with an invalid data type, the correct data type is returned.

Tab. 6.16 Response “Write CVE object”

Confirmation (acknowledge)

Byte	Description	Remedy
0x00	Everything OK.	–
0x01	Service is not supported.	Check the service ID of the request.
0x03	User data length of the request is invalid.	Check the structure of the request.
0xA0	Range of values of another CVE object violated.	Correct range of values.
0xA2	Invalid object index.	Correct the object index.
0xA4	The CVE object cannot be read.	–
0xA5	The CVE object cannot be written.	–
0xA6	The CVE object cannot be written while the drive is in an “Operation enabled” status.	Quit the “Operation enabled” status.
0xA7	The CVE object must not be written without master control.	Setting and releasing the control interface in the FCT.
0xA9	The CVE object cannot be written, as the value is lower than the minimum value.	Correct the value.
0xAA	The CVE object cannot be written, as the value is greater than the maximum value.	Correct the value.
0xAB	The CVE object cannot be written, as the value is not within the valid value set.	Correct the value.
0xAC	The CVE object cannot be written, as the specified data type is incorrect.	Correct the data type.
0xAD	The CVE object cannot be written, as it is password protected.	Remove password protection via FCT.
0xE0	Control interface is blocked by FCT.	Enabling the control interface in the FCT.

Tab. 6.17 Confirmation (acknowledge)

6.5.4 Examples

Note
If a malfunction occurs during the process (➔ 7 Diagnostics).

Establish CVE control interface

- Establish the CVE interface as a control interface via the FCT by selecting “Control via Ethernet CVE” on the control interface page, then “saving”, and switching the controller off and back on again.
  – As soon as the controller is ready, bit 2 is set to the value 1 (MC = 1) in the SPOS status byte (CVE object 239/0).

Takeover of master control through CVE

After the FCT device control is deactivated, the CVE control interface does not automatically receive back master control but must actively take it back itself.

1. Establish an Ethernet connection with the controller.
2. Write the value 2 to the CVE object 3/0.
   – The CVE interface has the master control.

Enable operation

Requirements:

– The drive is switched on, the CVE interface has been set and there is no malfunction.
– The inputs of the emergency stop interface [X4] are active, that is, 24 V must be applied to TO and ES and 0 V to RB (➔ 4.2.5 Emergency stop interface [X4]).
– In the control byte CPOS (CVE object 240/0), bit 1 and 2 must be set to the value 0 (START = 0 and HOM = 0).

1. Enable the drive (controller) by setting bit 0 in the control byte CCON (CVE object 240/0) to the value 1 (ENABLE = 1).
   – As soon as this status has been reached, bit 0 in the SCON status byte (CVE object 239/0) is set to value 1 (ENABLED = 1).
2. Enable the operation by setting bit 1 in the control byte CCON (CVE object 240/0) to the value 1 (STOP = 1).
   – As soon as this status has been reached, bit 1 in the SCON status byte (CVE object 239/0) is set to value 1 (OPEN = 1).

The operation is enabled (controlled status).

Execute homing

Requirements:

– The operation is enabled.
– The position of the axis zero point AZ was correctly parameterised via the FCT.
– In the status byte SPOS (CVE object 239/0), bit 1 must be set to the value 0 and bit 2 must be set to the value 1 (ACK = 0 and MC = 1).
– In the control byte CPOS (CVE object 240/0), bit 1 and bit 2 must be set to the value 0 (START = 0, HOM = 0), so that a rising edge can be detected.
– In the control byte CPOS (CVE object 240/0), bit 3 and bit 4 must be set to the value 0 (JOGP = 0 and JOGN = 0).

1. Set the bit 2 in the control byte CPOS (CVE object 240/0) to the value 1 (HOM = 1).
   – Homing is started.
2. Reset the bit 2 in the control byte CPOS (CVE object 240/0) to the value 0 (HOM = 0) as soon as bit 1 in the status byte SPOS (CVE object 239/0) has the value 1 (ACK = 1).
   – As soon as the reference position is reached, bit 2 and bit 7 in the status byte SPOS (CVE object 239/0) must be set to the value 1 (MC = 1 and REF = 1).

Start of a record (record selection)

Requirements:

– The operation is enabled.
– Homing has been executed successfully.
– In the status byte SPOS (CVE object 239/0), bit 1 must be set to the value 0 and bit 2 must be set to the value 1 (ACK = 0 and MC = 1).
– Bit 1, bit 2, bit 3 and bit 4 in the control byte CPOS (CVE object 240/0) must be set to the value 0 (START = 0, HOM = 0, JOGP = 0 and JOGN = 0).

1. Set the bit 6 in the control byte CCON (CVE object 240/0) to the value 0 (OPM = 0).
   – The “record selection” operating mode is selected.
2. Write the desired record number in the CVE object 240/1.
   – The desired record is selected.
3. Set the bit 1 in the control byte CPOS (CVE object 240/0) to the value 1 (START = 1).
   – The selected record is started.
   – As long as the positioning job is being executed, bit 2 of the status byte SPOS (CVE object 239/0) has the value 0 (MC = 0).
   – As soon as the positioning job has ended, bit 2 of the status byte SPOS (CVE object 239/0) has the value 1 (MC = 1).
4. Reset the bit 1 in the control byte CPOS (CVE object 240/0) to the value 0 (START = 0) as soon as bit 1 in the status byte SPOS (CVE object 239/0) has the value 1 (ACK = 1).

Start of a positioning job (direct mode)

Requirements:

– The operation is enabled and homing has been executed successfully.
– In the status byte SPOS (CVE object 239/0), bit 1 must be set to the value 0 and bit 2 must be set to the value 1 (ACK = 0 and MC = 1).
– Bit 1, bit 2, bit 3 and bit 4 in the control byte CPOS (CVE object 240/0) must be set to the value 0 (START = 0, HOM = 0, JOGP = 0 and JOGN = 0).

1. Set the bit 6 in the control byte CCON (CVE object 240/0) to the value 1 (OPM = 1).
   – The “direct” operating mode is selected.

2. Set the desired parameters (target position in X- and Y-direction as well as speed) of the positioning job.
   • Write the target position in the X-direction to the CVE object 305/0.
   • Write the target position in the Y-direction to the CVE object 305/1.
   • Write the speed to the CVE object 240/1.

3. Set whether positioning should take place absolutely or relative to the setpoint position.
   Positioning absolute:
   • Set the bit 0 in the control byte CPOS (CVE object 240/0) to the value 0 (ABS/REL = 0).
   Positioning relative:
   • Set the bit 0 in the control byte CPOS (CVE object 240/0) to the value 1 (ABS/REL = 1).

4. Set the bit 1 in the control byte CPOS (CVE object 240/0) to the value 1 (START = 1).
   – The positioning job is started.
   – As long as the positioning job is being executed, bit 2 of the status byte SPOS (CVE object 239/0) has the value 0 (MC = 0).
   – As soon as the positioning job has ended, bit 2 of the status byte SPOS (CVE object 239/0) has the value 1 (MC = 1).

5. Reset the bit 1 in the control byte CPOS (CVE object 240/0) to the value 0 (START = 0) as soon as bit 1 in the status byte SPOS (CVE object 239/0) has the value 1 (ACK = 1).

7 Diagnostics

7.1 Diagnostic memory

The diagnostic memory includes up to 200 error messages that are saved in case of a power failure. If the memory is full, the oldest element will be overwritten (ring buffer).

You can read the diagnostic memory via the Festo Configuration Tool (FCT).

- Tab [Diagnostics] [“Read” button]

Deleting the diagnostic memory

The diagnostic memory can be deleted via the Festo Configuration Tool (FCT), whereby a “switch-on event” (malfunction 3Dh) is generated. The malfunction counter is not reset thereby.

7.2 Types of malfunctions

Malfunctions are distinguished between errors, warnings and information, which have different priorities. The type of malfunction can be parameterised via the Festo Configuration Tool (FCT).

Messages with a higher priority interrupt messages with a lower priority. As malfunctions can occur and be acknowledged faster than they can be displayed on the 7-segment display, it may be the case that not all malfunctions are displayed. Read the diagnostic memory (➔ 7.1 Diagnostic memory) in order to view all messages.

Error (high priority)

An error always has an error response as a result (➔ 7.4.1 Error responses). The error response can be parameterised via the FCT. Error messages interrupt messages with a lower priority and must be acknowledged. Errors cannot be acknowledged until their cause has been remedied.

Warning (medium priority)

Warnings have no influence on the drive behaviour and do not have to be acknowledged. But the cause of the warning should be eliminated so it will not result in an error.
Warnings have a lower priority than errors and are not displayed if they occur when an error is already displayed. Otherwise, they are displayed twice in succession. Warnings do not have to be acknowledged.

Information (low priority)

If an error message has been parameterised as “information”, it is not displayed on the 7-segments display. But dependent on the parameterisation, it is stored in the diagnostic memory (➔ 7.1 Diagnostic memory).

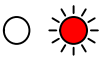
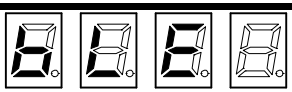
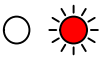
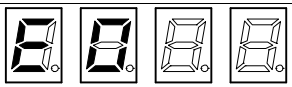
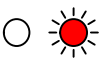
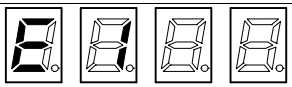
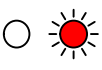
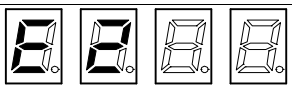
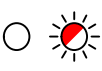
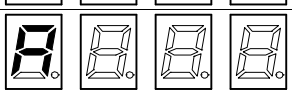
7.3 Error messages

Error messages can be represented simultaneously via different display components in the form of LED indicators and the 7-segments display.

Note

- In the representation of the 7-segments display, note the following:
  - Four characters are displayed in succession; after that, a space follows.
  - Malfunction numbers are represented decimally or hexadecimally, dependent on the control interface (➔ 7.4.2 Table of error messages).

General error messages

LED indicator	7-segments display	Malfunction	Priority
		Error in the firmware update: Switch the device off and on again.	1
		System error + malfunction number[1)]	2
		Error motor 1 + malfunction number[1)]	
		Error motor 2 + malfunction number[1)]	
		Warning + malfunction number[1)]	3

1) ➔ 7.4.2 Table of error messages

Tab. 7.1 General error messages

CANopen-specific error messages

LED indicator	Malfunction	Priority
	No bus cable connected or no parameters configured.	4
	Bus OFF	
	Warning Limit or Node Guarding	

Tab. 7.2 CANopen-specific error messages

7.4 Malfunctions: Causes and remedy

7.4.1 Error responses

The following responses to errors are intended. For each error, the error messages table specifies which response is set at the factory (printed in bold face) and which additional responses can be parameterised.

Code letters and description of the error responses		
A	Free run-out	Switch off output stage, no braking ramp.
B	QS deceleration + output stage off	Fast stop braking ramp (quick stop), then switch off output stage.
C	Positioning job deceleration + output stage off	Braking ramp (of the current positioning job), then switch off output stage.
D	Terminate positioning job + output stage off	Execute positioning job to the end (until MC = 1), then switch off output stage.
E	QS deceleration + output stage on	Fast stop braking ramp (quick stop), then output stage remains switched on.
F	Positioning job deceleration + output stage on	Braking ramp (of the current positioning job), then output stage remains switched on.
G	Terminate positioning job + output stage on	Execute positioning job to the end (until MC = 1), then output stage remains switched on.

Tab. 7.3 Error responses

7.4.2 Table of error messages

You can parameterise the error messages via the Festo Configuration Tool (FCT) on the page “Parameterise error management”.

Explanations for table of error messages:

Can be parameterised as:

F/W/I = fault/warning/information (➔ 7.2 Types of malfunctions).

Specifies the parameterisation options for an error message. The factory setting is printed in bold (here, error).

If a parameterisation option is not available, this is indicated by dashes, e.g. “F/-/-” if the error message is treated exclusively as a fault.

Diagnostic memory

Always/optional: Specifies whether an entry is generally made in the diagnostic memory or whether an entry can be parameterised via the FCT.

Software reset

Restart of the controller, either by switching off and back on or via the FCT in the menu [Components / Online / Restart controller].

Error response(s)

A list of the error responses (➔ 7.4.1 Error responses). The factory setting of the error responses is always printed in bold.

Hex	Dec	Error name	Type of error/diagnostic memory
01	**1**	**Software error** (Software error)	Can be parameterised as: **F**/-/- Diagnostic memory: always
An internal firmware error has been detected. • Contact Festo Service. – Acknowledgement option: Cannot be acknowledged, software reset required. Parameterisable error response(s): **A**			
02	**2**	**Default parameter file invalid** (Default parameter file invalid)	Can be parameterised as: **F**/-/- Diagnostic memory: always
An error has been detected when examining the default parameter file. The file is damaged. • Reload the default parameter file into the device via a firmware update. If the error is still present, it means the memory may be faulty and the device needs to be replaced. – Acknowledgement option: Cannot be acknowledged, software reset required. Parameterisable error response(s): **A**			
04	**4**	**Invalid hardware** (Non-permitted hardware)	Can be parameterised as: **F**/-/- Diagnostic memory: always
The internal hardware identification is faulty. • The controller must be replaced: Replace the controller. – Acknowledgement option: Cannot be acknowledged, software reset required. Parameterisable error response(s): **A**			
05	**5**	**Zero angle definition** (Zero angle determination)	Can be parameterised as: **F**/-/- Diagnostic memory: always
The rotor position could not be uniquely identified. The commutation point is invalid. • The drive is blocked or the movement space is too small: Ensure free mobility by moving the planar surface gantry by hand into a medium position. • No load voltage present: Provide the load voltage supply. • The “Torque Off” function is active: Apply voltage of +24 V at Pin 2 of the emergency stop interface [X4]. • Encoder or encoder cable is defective: Replace the encoder or the encoder cable. • Impermissibly high load: Reduce load. • The controller parameters are incorrectly set: Set controller parameters correctly. – Acknowledgement option: Can be acknowledged if controller enable is not present. If the malfunction is not remedied, it occurs again in controller enable. Parameterisable error response(s): **A**			
06	**6**	**Displacement encoder** (encoder)	Can be parameterised as: **F**/-/- Diagnostic memory: always
An error has occurred during evaluation of the encoder. The current position values may be incorrect. • Execute a software reset with commutation angle search and homing. – Acknowledgement option: Cannot be acknowledged, software reset required. Parameterisable error response(s): **A**			

Hex	Dec	Error name	Type of error/diagnostic memory
0B	**11**	**Parameter file invalid** (Parameter file invalid)	Can be parameterised as: **F**/-/- Diagnostic memory: always
No valid parameter set stored. • The default parameter set is loaded automatically. Enter a valid parameter set in the device. If the error is still present, the hardware may be defective. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **A**			
0C	**12**	**Firmware update execution error** (Firmware update execution error)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The firmware update has not been properly executed/completed. • Check the Ethernet connection between the controller and PC and run the firmware update again. The previous firmware version remains active until successful completion of the firmware update. If this error is still present, the hardware may be defective. – Acknowledgement option: Cannot be acknowledged, software reset required. Parameterisable error response(s): **A**			
0E	**14**	**I^2t error motor** (I^2t malfunction motor)	Can be parameterised as: **F**/-/- Diagnostic memory: always
The I^2t limit for the motor is reached. The motor or the drive system may be insufficient for the required task. • Check design of the drive system and mechanical system for sluggishness. • Reduce load/dynamics, longer breaks. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): B, **C**			
11	**17**	**Software limit positive** (Software limit positive)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The setpoint position value has reached or exceeded the relevant software limit switch. Only in jog operation is this error triggered only once and cannot be triggered again until after the drive has returned to the permissible area. After the error occurs, jogging can no longer take place in a positive direction. • Travel the respective axis of the planar surface gantry in a negative direction through jog operation. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): A, **B**, C, E, F			
12	**18**	**Software limit negative** (Software limit negative)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The setpoint position value has reached or exceeded the relevant software limit switch. Only in jog operation is this error triggered only once and cannot be triggered again until after the drive has returned to the permissible area. After the error occurs, jogging can no longer take place in a negative direction. • Travel the respective axis of the planar surface gantry in a positive direction through jog operation. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): A, **B**, C, E, F			

Hex	Dec	Error name	Type of error/diagnostic memory
17	**23**	**Logic voltage exceeded** (Logic voltage exceeded)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The logic power supply monitor has detected an overvoltage. This is either due to an internal defect or an excessive supply voltage. • Check external supply voltage directly on the device. • If the error is still present after a reset has been conducted, it means there is an internal defect and the device has to be replaced. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): A, **B**			
18	**24**	**Logic voltage too low** (Logic voltage too low)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The logic power supply monitor has detected an undervoltage. This is either due to an internal defect or an overload/short circuit caused by connected peripherals. • Separate device from the entire peripheral equipment and check whether the error is still present after reset. If it is, it means there is an internal defect and the device has to be replaced. – Acknowledgement option: Cannot be acknowledged, software reset required. Parameterisable error response(s): **A**			
19	**25**	**Temperature LM-CPU** (Temperature LM-CPU)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The monitor has detected a CPU temperature outside the permissible range. • Check whether the ambient temperature is within the permissible range for the controller. If the error is still present, it means there is an internal defect and the device must be replaced. • The error can only be acknowledged if the temperature is within the permissible range. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): A, **B**			
10	**26**	**Intermediate circuit voltage exceeded** (Intermediate circuit voltage exceeded)	Can be parameterised as: **F**/-/- Diagnostic memory: always
Load voltage not within the permissible range. Braking resistor is overloaded; too much braking energy, which cannot be dissipated quickly enough. Braking resistor defective or not connected. • Check the load voltage; measure voltage directly at the controller input. • In the event of a defective internal braking resistor: Replace the controller. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): A, **B**			

Hex	Dec	Error name	Type of error/diagnostic memory
1B	**27**	**Intermediate circuit voltage too low** (Intermediate circuit voltage too low)	Can be parameterised as: **F**/W/- Diagnostic memory: optional
Load voltage too low. • Voltage drop under load: power supply unit too weak, supply line too long, cross section too small? • Measure load voltage (directly at the controller input). • If you intentionally want to operate the device with a lower voltage, parameterise this malfunction as a warning or information. – If parameterisation as a warning: The warning disappears when the load voltage is back in the permissible range. – If parameterisation as an error: The error can be acknowledged. Parameterisable error response(s): **A**			
1C	**28**	**CAN Node Guarding, FB has overall control** (CAN Node Guarding, FB has overall control)	Can be parameterised as: **F**/-/- Diagnostic memory: always
A wire break has occurred, or the CAN-Master has failed. • Check the CAN cable for a wire break: Repair or replace the CAN cable. • Check the function of the CAN-Master. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): **B**, C, E, F			
1D	**29**	**CAN bus communication stopped by master, FB has master control** (CAN bus communication stopped by master, FB has overall control)	Can be parameterised as: **F**/-/- Diagnostic memory: always
The CAN-Master sent “Node Stop” to the controller. • Check the system and the function of the CAN-Master. • Send “Node Start” to the controller. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): **B**, C, E, F			
25	**37**	**Path calculation** (Path calculation)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The positioning target cannot be reached through the positioning or edge condition options. • Check the parameterisation of the affected records. • Check parameterisation of the MC window. • Make sure that the drive is at rest before the start of positioning. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **A**			

Hex	Dec	Error name	Type of error/diagnostic memory
26	**38**	**CAN fieldbus parameters missing** (CAN fieldbus parameters missing)	Can be parameterised as: **F**/-/- Diagnostic memory: always
One or more CAN bus parameters are not correct. • Check the CAN bus parameters. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): **B**			
27	**39**	**Save parameters** (Save parameters)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
Error when writing the internal flash memory. • Execute the last operation again. If the error continues to occur, the hardware may be defective. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **G**			
28	**40**	**Homing required** (Homing required)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
A valid homing run has not yet been executed. The reference point is no longer valid (e.g. through logic voltage failure or because the axis zero point has been changed). • Perform a homing run or repeat the last homing run if it was not completed successfully. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**, C, D, E, F, G			
29	**41**	**Target position behind negative software end position** (Target position behind negative software end position)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The start of a positioning process was suppressed as the target is past the relevant software limit switch. • Check the target data. • Check positioning area. • Check type of travel record (absolute/relative) – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**, C, E, F			

Hex	Dec	Error name	Type of error/diagnostic memory
2A	**42**	**Target position behind positive software end position** (Target position behind positive software end position)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The start of a positioning process was suppressed as the target is past the relevant software limit switch. • Check the target data. • Check positioning area. • Check type of travel record (absolute/relative) – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**, C, E, F			
2B	**43**	**Firmware update, invalid firmware** (Firmware update, invalid firmware)	Can be parameterised as: **F**/W/- Diagnostic memory: optional
The firmware update process could not be performed. The firmware version is incompatible with the hardware used. • Ascertain the version of your hardware. You can ascertain the compatible firmware designs and download the appropriate firmware from the Festo website. – For parameterisation as an error: The error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **A** – If parameterisation as a warning: The warning disappears when a new firmware download is started.			
2C	**44**	**Invalid record number** (Incorrect record number)	Can be parameterised as: **F**/W/I Diagnostic memory: optional
An attempt was made to start a record with a record number greater than 31. • Select a new record with a valid record number – For parameterisation as an error: The error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **G** – If parameterisation as a warning: The warning disappears when a record with a valid record number is started.			
2D	**45**	**I^2t warning motor** (I^2t warning motor)	Can be parameterised as: -/**W**/I Diagnostic memory: optional
The I^2t integral is up to 80% full. • You can parameterise this message as a warning or suppress it completely as information. – If parameterisation as a warning: The warning disappears when the I^2t integral falls below 80%.			

Hex	Dec	Error name	Type of error/diagnostic memory
2F	**47**	**Following error** (Following error)	Can be parameterised as: **F**/W/I Diagnostic memory: optional
The following error has become too large. • Increase error window. • Acceleration, speed, jerk or load too great? Mechanics sluggish? • Motor overloaded (current limiter from I²t monitoring active?) – If parameterisation as an error: The error can be acknowledged. Parameterisable error response(s): B, C, **E**, F – If parameterisation as a warning: The warning disappears when the following error is back in the permissible range.			
30	**48**	**External stop active** (External stop)	Can be parameterised as: **F**/-/- Diagnostic memory: always
The switch-off function “External stop” at the emergency stop interface [X4] is active and the current positioning record has been interrupted. • Deactivate the “External stop” function: Apply a voltage +24 V at Pin 3 of the emergency stop interface [X4]. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**			
31	**49**	**CVE connection** (CVE connection)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
A connection error has occurred during “Control via Ethernet” (CVE). • Check the connection: plug disconnected, cable lengths observed, shielded cable used, screening connected? – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**, C, D, E, F, G			
32	**50**	**FCT connection** (FCT connection)	Can be parameterised as: **F**/W/I Diagnostic memory: optional
Connection to the FCT has been interrupted. • Check the connection and perform a reset if necessary. – If parameterisation as a warning: The warning disappears when the connection to the FCT has been established again. – For parameterisation as an error: The error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**, C, D, E, F, G			
34	**52**	**Torque Off (TO)** (Torque Off (TO))	Can be parameterised as: **F**/-/- Diagnostic memory: always
The “Torque Off” function has been requested. • Deactivate the “Torque off” function: Apply a voltage +24 V at Pin 2 of the emergency stop interface [X4]. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **A**			

Hex	Dec	Error name	Type of error/diagnostic memory
35	**53**	**CAN Node Guarding, warning, FB does not have overall control** (CAN Node Guarding, warning, FB does not have overall control)	Can be parameterised as: **-/W**/I Diagnostic memory: optional
A wire break has occurred, or the CAN-Master has failed. • Check the CAN cable for a wire break: Repair or replace the CAN cable. • Check the function of the CAN-Master.			
36	**54**	**CAN bus communication stopped by master; warning, FB does not have master control** (CAN bus communication stopped by master, warning, FB does not have overall control)	Can be parameterised as: -/**W**/- Diagnostic memory: optional
The CAN-Master sent “Node Stop” to the controller. • Check the system and the function of the CAN-Master. • Send “Node Start” to the controller.			
37	**55**	**Standstill monitoring** (Standstill monitoring)	Can be parameterised as: -/**W**/I Diagnostic memory: optional
The actual position is outside the standstill window. Parameterisation of the window may be too narrow. • Check parameterisation of the standstill window. – If parameterisation as a warning: The warning disappears when the actual position is back within the standstill window.			
38	**56**	**Parameter file access** (Parameter file access)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
During a parameter file procedure, all other reading and writing routines for the parameter file are blocked. • Wait until the process is complete. The time between two parameter file downloads should not fall below 3 seconds. – Acknowledgement option: Error can be acknowledged. Parameterisable error response(s): **G**			
3A	**58**	**Homing timeout** (Homing Timeout)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
Error during homing. The stop was not found within a specified time. • Check the drive for a mechanical defect (e.g. torn toothed belt). • Increase the search speed. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **B**, C, E, F			
3D	**61**	**Start-up event** (Start-up event)	Can be parameterised as: -/-/**I** Diagnostic memory: always
The controller has been switched on or was switched on for longer than 48 days. This event also occurs when deleting the diagnostic memory. The start-up event does not occur if the preceding entry in the diagnostic memory has already been a start-up event. • This event is only used for improved documentation of the malfunctions.			

Hex	Dec	Error name	Type of error/diagnostic memory
3E	**62**	**Diagnostic memory** (Diagnostic memory)	Can be parameterised as: **F**/-/- Diagnostic memory: always
An error has occurred when writing or reading from the diagnostic memory. • Acknowledge the error. If the error is still present, it means a memory module is probably defective or an incorrect entry has been stored. • Erase the diagnostic memory. If the error still occurs, the controller must be replaced. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **G**			
3F	**63**	**Record invalid** (Record invalid)	Can be parameterised as: **F**/-/- Diagnostic memory: optional
The started record is invalid. The record data are not plausible or the record type is invalid. • Check the parameters of the record. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): B, C, D, **E**, F, G			
41	**65**	**System reset** (System reset)	Can be parameterised as: **F**/-/- Diagnostic memory: always
An internal firmware error has been detected. • Contact Festo Service. – Acknowledgement option: Error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): **A**			

Tab. 7.4 Table of error messages

7.4.3 Problems with the Ethernet connection

No connection possible to the controller

The network settings of the controller at delivery can be found at ➔ 5.2.2 Network settings.

– It may mean the DHCP client on your computer has been deactivated.
  - Check your TCP/IP settings.
  - Make sure that the IP address is automatically obtained.

– The controller might not be reachable in your network.
  - Check the network settings of your computer. Contact your network administrator, if necessary.
  - Carry out a network scan via the FCT (➔ 5.2.2 Network settings).

7.4.4 Other problems and remedies

Problem	Cause and remedy
The 7-segments display does not light up	No logic voltage, or too little, is present. • Check the logic voltage. • Observe the electrical data in the appendix (➔ A.2 Electrical data).
The controller does not work at all	Short circuit, line interrupt or incorrect pin allocation. • Check all lines and connections as well as the pin allocation. • Observe the instructions in the assembly instructions for the cables and plugs used. Burned-through internal fuse: internal short circuit. • Replace the controller completely.
The controller does not achieve the specified performance data	Incorrect control signals of the higher-order controller (signals/levels). • Observe the timing diagram (➔ 6.2.4 Timing diagram). Incorrect controller setting. • Observe the information in the online help section of the FCT plug-in for the correct settings of the controller parameters. Error in the power supply. • Observe the tolerances of the electrical data in the appendix (➔ A.2 Electrical data).

Tab. 7.5 Other problems and remedies

A Technical data

A.1 General data

Characteristic		Specification/value
Protection class of entire system to EN 60529		IP20 (with full pin allocation)
Degree of contamination in accordance with EN 50178		2
Note on materials		RoHS-compliant
Corrosion resistance class (CRC)		1
Ambient temperature in operation	[°C]	+10 ... +45
Ambient temperature in storage/conveying	[°C]	–10 ... +60
Relative air humidity (at 25 °C)	[%]	0 ... 90 (non-condensing)
Weight	[g]	660
Electromagnetic compatibility (EMC)[1)]		CE marking (see declaration of conformity) (➔ www.festo.com)
Vibration Checked in accordance with DIN EN 60068 part 2-6		With wall mounting: severity level 2 With H-rail mounting: severity level 1
Shock Checked in accordance with DIN EN 60068 part 2-27		With wall mounting: severity level 2 With H-rail mounting: severity level 1
Continuous shock test Checked in accordance with DIN EN 60068 part 2-29		With wall and H-rail mounting: Severity level 1

1) The device is intended for use in an industrial environment. Measures for interference suppression may need to be taken in the residential or laboratory areas.

A.2 Electrical data

Characteristic		Specification/value
Power supply	[V]	24 ±15 %
Nominal current load voltage (EXCM-10)	[A]	2.8
Nominal current load voltage (EXCM-30)	[A]	6.0
Peak current (load voltage)	[A]	8.0
Nominal current, logic supply (without power supply to the outputs)	[A]	0.3
Nominal current of the logic supply (per output of the I/O interface)	[A]	0.1
Total current consumption		Dependent on system configuration
Protection against electric shock (Protection against direct and indirect contact in accordance with IEC/DIN EN 60204-1)		By means of PELV power circuit (Protected Extra Low Voltage)
Encoder resolution		Starting at 500 pulses/revolution, through the internal electronic multiplication result in 2000 pulses/revolution (maximum encoder resolution 19µm)
Max. speed and torque of the motors		➔ Operating instructions of the drives

B CANopen

B.1 CANopen object overview

Index	Sub-index	Designation	Type	Attr.	Explanation
1000h	0	Device type	uint32	ro	Value = 301
1001h	0	Error register	uint8	ro	Error register Bit 0: General error Bit 1: Excess current motor (I^2t) Bit 2: Voltage monitoring error Bit 3: Overtemperature motor Bit 4: Communication error Bit 5: Device-specific Bit 6: Reserved (fixed at 0) Bit 7: Manufacturer-specific
1003h	0	Predefined error field	uint32	rw/ro	
	1	Standard error field	uint32	ro	Last saved error. Error numbers from 16-bit code. Lower 2 bytes (LSB) = error code Upper 2 bytes (MSB) = 0
	2		uint32	ro	
	3		uint32	ro	
	4		uint32	ro	
	5		uint32	ro	
	6		uint32	ro	
	7		uint32	ro	
	8		uint32	ro	
1008h	0	Manufacturer device name	String	ro	Type designation of the controller “EXCM-2ST-C3-1”
1009h	0	Manufacturer hardware version	String	ro	Hardware version (Format “Vxx.yy”)
100Ah	0	Manufacturer software version	String	ro	Firmware design (Format “Vxx.yy.bb.pp”)
100Ch	0	Guard time	uint16	rw	Monitoring time
100Dh	0	Life time factor	uint8	rw	Factor for monitoring time
1014h	0	COB-ID emergency object	uint32	rw	COB-ID of the emergency object Default: 128 + Node-ID
1015h	0	Inhibit time EMCY	uint16	rw	Inhibit time for emergency message Default: 0

Index	Sub-index	Designation	Type	Attr.	Explanation
1018h	0	Identity object	Record	ro	
	1	Vendor ID	uint32	ro	Supplier identifier
	2	Part number	uint32	ro	Part number: 1600815d/0x00186D2F
	3	Reserved	uint32	ro	0x00000000
	4	Reserved	uint32	ro	0x00000000
1400h	0	Receive PDO communication parameter	Record	ro	
	1	COB-ID of PDO1	uint32	rw	Default: 0x200 + node ID
	2	Transmission type	uint8	rw	Default: 0xFF
	3	Inhibit time	uint16	ro	Inhibit time (not for RPD0)
	4	Compatibility entry	uint32	ro	0x00000000
	5	Event timer	uint16	ro	Default: 0x0000
1600h	0	Receive PDO mapping parameter	Record	ro	
	1	FHPP control word CCON/CPOS	uint32	ro	0x30000008
	2	Record number or speed	uint32	ro	0x30010008
	3	Target position X	uint32	ro	0x30020008
	4	Target position Y	uint32	ro	0x30030008
1800h	0	Transmit PDO communication parameter	Record	ro	
	1	COB-ID of PDO1	uint32	rw	Default: 0x180 + node ID
	2	Transmission type	uint8	rw	Default: 0xFF
	3	Inhibit time	uint16	ro	0x00
	4	Compatibility entry	uint32	ro	0x00000000
	5	Event timer	uint16	ro	Default: 0x0000
1A00h	0	Transmit PDO mapping parameter	Record	ro	
	1	FHPP control word CCON/CPOS	uint32	ro	0x30200008
	2	Error number	uint32	ro	0x30210008
	3	Actual position X	uint32	ro	0x30022008
	4	Actual position Y	uint32	ro	0x30230008
2066h	0	Version	uint16	ro	
2072h	0	Serial number of the controller	String	ro	
20FDh	0	User's device name	String	rw	

Index	Sub-index	Designation	Type	Attr.	Explanation
21F4h	0	Project zero point X	int32	rw	Distance from axis zero point to the project zero point; default: 0 Unit: [SINC] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
21F5h	0	Project zero point Y	int32	rw	
21F6h	0	Max. permissible speed	uint32	rw	General system limitation Default: 0 Unit: [SINC/s] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
21F7h	0	Max. permissible acceleration	uint32	rw	General system limitation; default: 0 Unit: [SINC/s²] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
21F8h	0	Current acceleration for direct mode	uint32	rw	Condition: not › max. permissible acceleration; default: 0 Unit: [SINC/s²] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
21F9h	0	Max. following error for direct mode	uint32	rw	
2200h	0	Positive SW end position X	int32	rw	Positive SW end position X; default: 0 Unit: [SINC] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
2201h	0	Negative SW end position X	int32	rw	Negative SW end position X; default: 0 Unit: [SINC] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
2202h	0	Positive SW end position Y	int32	rw	Positive SW end position Y; default: 0 Unit: [SINC] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
2203h	0	Negative SW end position Y	int32	rw	Negative SW end position X; default: 0 Unit: [SINC] (1 mm = 1000 SINC) Values: –2147483648 ... +2147483648
3000h	0	FHPP control word	uint16	rw	Byte 1: control byte CCON Byte 2: control byte CPOS (➔ 6.2.2)
3001h	0	Target record number or path speed	uint16	rw	Dependent on the operating mode: Record selection: target record no. 0 ... 31 Direct mode: speed [mm/s]
3002h	0	Target position X-axis	int16	rw	Unit [0.1 mm]
3003h	0	Target position Y-axis	int16	rw	Unit [0.1 mm]

Index	Sub-index	Designation	Type	Attr.	Explanation
3020h	0	FHPP status word	uint16	ro	Byte 1: status word SCON Byte 2: status word SPOS (➔ 6.2.3)
3021h	0	Actual record number or error number	uint16	ro	Dependent on the operating mode: Record selection: record and error number Direct mode: error number (Error number 0xFF = no error)
3022h	0	Actual position X-axis	int16	ro	Unit [0.1 mm]
3023h	0	Actual position Y-axis	int16	ro	Unit [0.1 mm]

Tab. B.1 CANopen object overview

C Control via Ethernet (CVE)

C.1 CVE object overview

Explanation of read and write access

Code	Significance
R	The object is readable.
W1	The object can be written if the drive (controller) is blocked (ENABLED = 0) (➔ 6.2.3 Description of the status bytes SCON/SPOS).
W2	The object can be written if the drive (controller) is enabled (ENABLED = 1) (➔ 6.2.3 Description of the status bytes SCON/SPOS).
W3	The object can also be written by an interface that does not currently have master control.
Admin	The object is protected by the administrator password.

Tab. C.1 Access rights

Detail descriptions of the CVE objects

Index 3	Subindex 0	Master control	
System		UINT08	R/W1/W2/W3/-
The master control determines which interface the planar surface gantry may control: To activate the CVE interface, the value 2 must be written to the CVE object. 0x00: I/O 0x01: FCT (Festo Configuration Tool) 0x02: CVE (Control via Ethernet) 0x04: CANopen Values: 0 ... 255 Default: 0			

Index 239	Subindex 0	Status word	
FHPP		UINT16	R/-/-/-/-
Status bytes SCON/SPOS (➔ 6.2.3 Description of the status bytes SCON/SPOS) Values: 0 ... 65535 Default: 0			

Index 239	Subindex 1	Error number	
FHPP		UINT16	R/-/-/-/-
Error number In the record selection operating mode, the current record number is in the high byte. With direct mode, the high byte = 0. Values: 0 ... 255 Default: 255 (255 is not an error, values are in the low byte)			

Index 240	Subindex 0	Control word	
FHPP		UINT16	R/W1/W2/-/-
Control bytes CCON/CPOS (➔ 6.2.2 Description of the control bytes CCON/CPOS) Values: 0 ... 65535 Default: 0			

Index 240	Subindex 1	Dependent on the operating mode	
FHPP		UINT16	R/W1/W2/-/-
Record number preselection (for record selection) Number of the preselected positioning record. At the control interface, a new positioning record can be preselected while an old one is still active. Record 0 (homing) Record 1 ... 31 (normal records) Values: 0 ... 31 Default: 0			
Speed (with direct mode) Speed for a direct positioning job. Unit: mm/s Values: 0 ... 65535 Default: 0			

Index 303	Subindex 0	Actual position X	
FHPP		SINT32	R/-/-/-/-
The current actual position in the direction of the X-axis. Unit: SINC (1 mm = 1000 SINC) Values: –2147483648 ... 2147483647 Default: 0			

Index 303	Subindex 1	Actual position Y	
FHPP		SINT32	R/-/-/-/-
The current actual position in the direction of the Y-axis. Unit: SINC (1 mm = 1000 SINC) Values: –2147483648 ... 2147483647 Default: 0			

Index 304	Subindex 0	Setpoint position X	
FHPP		SINT32	R/-/-/-/-
The current setpoint position X is calculated by the controller. Unit: SINC (1 mm = 1000 SINC) Values: –2147483648 ... 2147483647 Default: 0			

Index 304	Subindex 1	Setpoint position Y	
FHPP		SINT32	R/-/-/-/-
The current setpoint position Y is calculated by the controller. Unit: SINC (1 mm = 1000 SINC) Values: –2147483648 ... 2147483647 Default: 0			

Index 305	Subindex 0	Target position X (only for direct mode)	
FHPP		SINT32	R/W1/W2/-/-
Specification of the target position X is dependent on the value of bit 0 (ABS/REL) in the control byte CPOS (absolute or relative to the last setpoint position). Unit: SINC (1 mm = 1000 SINC) Values: –2147483648 ... 2147483647 Default: 0			

Index 305	Subindex 1	Target position Y (only for direct mode)	
FHPP		SINT32	R/W1/W2/-/-
Specification of the target position Y is dependent on the value of bit 0 (ABS/REL) in the control byte CPOS (absolute or relative to the last setpoint position). Unit: SINC (1 mm = 1000 SINC) Values: –2147483648 ... 2147483647 Default: 0			

Index 311	Subindex 0	Acceleration (only for direct mode)	
FHPP		SINT32	R/W1/W2/-/-
Acceleration for a direct positioning job. If a new acceleration value is not written, the value last used is taken. Unit: SINC/s² (1 mm = 1000 SINC) Values: –2147483647 ... 2147483647 Default: 0			

D Glossary

Term/abbreviation	Description
Acknowledge	“Acknowledge an error”: the user confirms that he has noted the error. The device then leaves the error status.
Effective stroke	Maximum stroke, distance of the software end positions.
EMC	Electromagnetic compatibility
FCT	Parameterisation and commissioning software (FCT = Festo Configuration Tool)
FHPP	Communication protocol for data exchange (FHPP = Festo Handling and Positioning Profile)
Following error	Calculated deviation during execution of a positioning record between the target position (in accordance with previously calculated course of the path) and the actual position.
Homing	Positioning job to determine the reference point.
I/O	Input/output
Jog mode	The drive moves as long as a corresponding signal is present.
Load voltage	Power supply of the controller power electronics and thus of the motors.
Logic voltage	Power supply of the evaluation and control logic of the controller.
MC (Motion Complete)	Target position reached.
PLC/IPC	Programmable logic controller/industrial PC.
Record	Record of parameters defined in the record table, comprising record type, target position X and Y, speed and acceleration.
Software end position	Limitation of the network stroke.

Tab. D.1 Product-specific terms and abbreviations

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