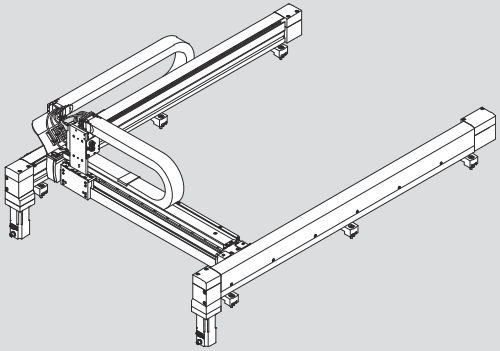
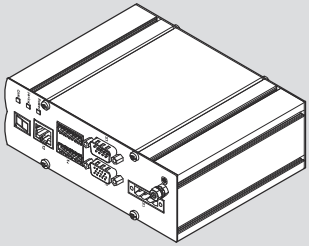
EXCM-30/-40-...-PF

Planar surface gantry with controller





FESTO

Operating instructions

8158233

8158233
2022-02c
[8158235]

Translation of the original instructions

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1 About this document

1.1 Applicable documents

All available documents for the product ➔ www.festo.com/sp.

The complete description of the system, comprising controller and gantry, includes the following documents:

Designation	Contents
Assembly instructions CMXH	Notes on the mechanical installation of the CMXH
Description EXCM-30/-40	Description of the mechanical installation of the planar surface gantry EXCM-30/-40
Description of EXCM-30/-40-...-PF-...	Commissioning of the planar surface gantry EXCM-30/-40 with the CMXH controller
Help system for the FCT plug-in CMXH	Help system in the FCT for support of commissioning and parameterisation of the CMXH controller
Description CMXH	Use of the STO safety function (Safe torque off)

Tab. 1: Documentation for the system EXCM-30/-40 with CMXH

1.2 Notes regarding this documentation

This document solely describes the commissioning of the planar surface gantry EXCM-30/-40 with the related controller CMXH and refers to the following versions of the software:

CMXH firmware version	Required CMXH plug-in
V1.3 or later	V2.1 or later

Tab. 2: Software versions

Differences in the firmware versions		
CMXH firmware version	V1.2 and earlier	V1.3 or later
Control via Ethernet (CvE)	supported	not supported
Control via Modbus	not supported	supported
FHPP data (I/O)	8 bytes/8 bytes	16 bytes/16 bytes

Tab. 3: Differences in the firmware versions

New control modules will be required from V1.3 due to the change of the FHPP data.

1.3 Range of application and approvals

Product conformity

The directives and standards applicable for the product are listed in the declaration of conformity ➔ www.festo.com/sp.

Product conformity	
CE	in accordance with EU EMC Directive in accordance with EU Machinery Directive in accordance with EU RoHS Directive
UKCA	to UK EMC Regulations to UK Supply of Machinery Regulations to UK RoHS Regulations

Tab. 4: Product conformity

1.3.1 Specified standards

Standards and test values with which the product complies and fulfills (➔ 10 Technical appendix).

Version
EN ISO 13849-1:2015
EN 50178:1997
EN 60068-2-6:2008
EN 60068-2-27:2009
EN 60204-1:2018
EN 61800-5-2:2007, EN 61800-5-2:2017
EN 62061:2005 + AC:2010 + A1:2013 + A2:2015

Tab. 5: Standards specified in the document

2 Safety

2.1 Intended use

This product is a handling system. The handling system executes positioning tasks within machines or automated systems with a higher-order controller. The controller CMXH is used exclusively for the control of planar surface gantries with a circulating toothed belt of type EXCM-30/-40-...-SB/-ST.
Use the product only as follows:
- in perfect technical condition
- in its original condition, without unauthorised modifications
- within the limits of the product defined by the technical data
- in an industrial environment
- permanently mounted

2.2 Foreseeable misuse

Never use the product as follows:
- with unauthorised modifications or alterations to the product
- with load limits exceeded
- in an invalid mounting position

2.3 Training of qualified personnel

Only qualified personnel may carry out the installation, commissioning, maintenance and disassembly of the product.
The personnel must be familiar with the installation of mechatronic systems.

3 Additional information

- Accessories ➔ www.festo.com/catalogue.
- Spare parts ➔ www.festo.com/spareparts.

4 Service

If you have technical questions contact your regional Festo contact person ➔ www.festo.com.

5 Overview

5.1 General characteristics

- FCT-compatible: configuration, parameterisation and backup via Festo Configuration Tool (FCT)
- Energy-optimised operation and low heat development
- Separation between load and logic voltage
- LED display components for representation of device and communication status
- 7-segment display for display of equipment status, errors and warnings

5.2 System overview

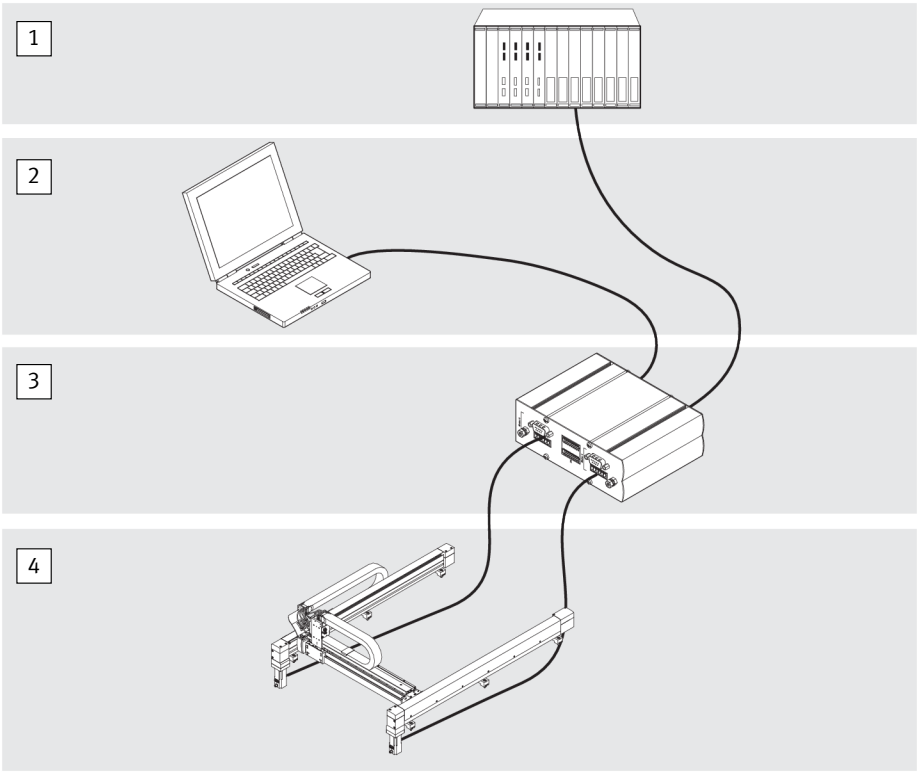

Fig. 1: System overview

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

5.3 Function and application

The controller controls two stepper motors that drive an endless toothed belt. The toothed belt moves a slide, the position of which is calculated by the controller from the encoder signals of the motors.

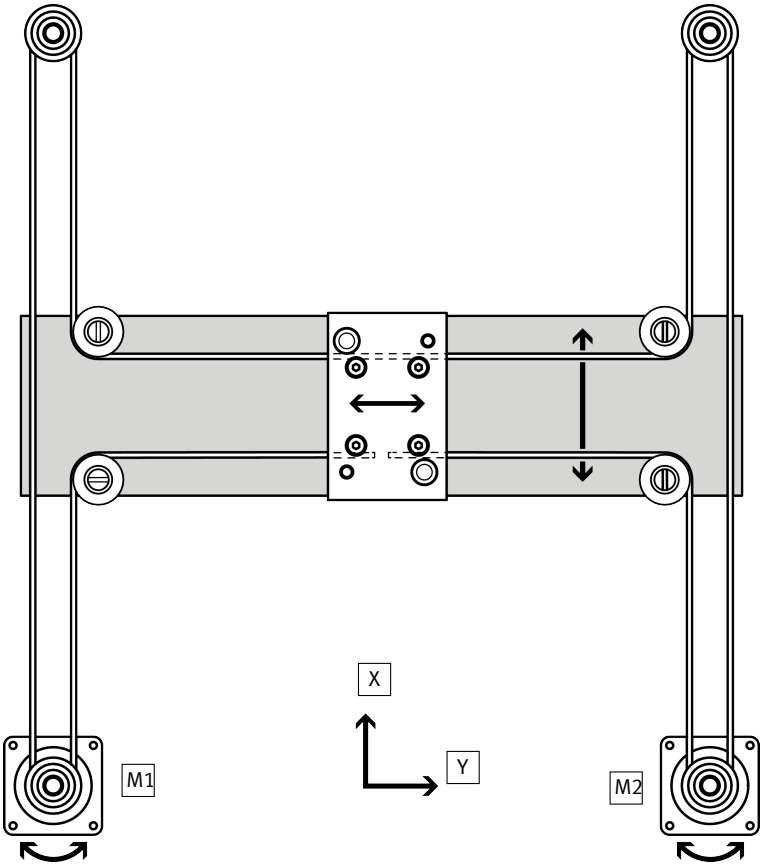

Fig. 2: Functional principle

M1	Motor 1	X	X-axis
M2	Motor 2	Y	Y-axis

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 actuated by the interaction between the two motors, which is controlled by the controller.

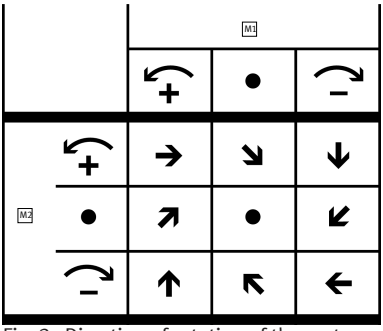

Fig. 3: Direction of rotation of the motors

5.4 Monitoring functions of the controller

The controller has numerous monitoring functions, such as:
- monitoring of logic and load voltage
- current monitoring//I^2t monitoring
- Software end-position detection
- standstill and following error monitoring
- short circuit detection

5.5 Switch-off functions of the controller

The drive can be switched off by the Safe Torque Off (STO) and External Stop (ESTOP) switch-off functions.

5.5.1 External stop ESTOP

If the External Stop - ESTOP switch-off function is requested, the motors are decelerated with the quick stop braking ramp (Quick Stop) until they are at rest. After the standstill has been reached, the brake control is activated and the power stage switched off.

5.5.2 Safety function Safe Torque Off - STO

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The safety function STO (“Safe Torque Off”) is described in detail in the document “CMXH description STO” and may only be used in the manner described there. (➔ Tab. 1 Documentation for the system EXCM-30/-40 with CMXH)

The safety function enables two-channel shut-down of the power supply to the motors connected to the CMXH and therefore safely switched-off torque (Safe Torque Off, STO) via the connection [X4]. Two channels are achieved by two inputs STO1 and STO2. Switching off the power stage safely disconnects the power supply to the motor. The brake control is activated at the same time.

5.6 Drive functions

5.6.1 Jogging

During jogging the slide of the planar surface gantry moves as long as a corresponding signal is present. Jogging can only ever take place in one direction; either in the direction of the X-axis or in the direction of the Y-axis, with a differentiation between a creep movement and normal movement. The CANopen or Ethernet interface (control by Modbus TCP) can be used as a control interface but not the I/O interface. This function is normally used to run the slide manually into a defined initial position.

i

Provided 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 by jogging.

5.6.2 Homing

Homing determines the homing point of the dimension system. The homing point is the absolute reference point for the axis zero point. Tasks can only be started if a homing has been successfully completely (exception: jogging).

NOTICE

The homing point is saved temporarily in the controller. If the logic power supply is interrupted, the homing point is lost.

Homing can be started by selection of record 0 or by the control byte CPOS (➔ 8.2.4 Description of the CCON/CPOS control bytes) and is always to the stop in the origin of the selected coordinate system (➔ 5.8.2 Selection of the coordinate system).
Depending on the configuration, travel is first in the X-direction and then in the Y-direction or first travel in the Y-direction and then in the X-direction, in each case to the stop.
After reaching the stop at the origin of the selected coordinate system, travel to zero is automatically run in order to reach a permanently defined and unchangeable minimum distance from the mechanical stop. The stop is detected by motor standstill in combination with a sharp rise in the motor current.
The maximum force with which the slide is pressed against the stop can be parameterised.

5.6.3 Brake

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

Automatic actuation of the brake

The controller automatically controls the brake by enabling the drive:
- The brake is opened when the drive is enabled.
- The brake is closed when the drive is blocked (either by a control command or by an error with error response "Power stage off").

Due to the mechanical inertia of the brake, opening and closing take a certain length of time. The behaviour of the controller when the drive is enabled is adjusted to the mechanical inertia of the brake by the switch-on and switch-off delay.

Switch-on delay

When enable is being set (ENABLE), the switch-on delay time (150 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 tasks only after the switch-on delay has expired.

Switch-off delay

The time set for the switch-off delay starts to run (150 ms) when the enable signal is removed. The brake closes during this time. However, the position controller still holds the drive in position. The position controller and the power stage are only switched off after the switch-off delay has elapsed.

NOTICE

When switching off the power stage, e.g. by blocking the drive, or if the power supply is interrupted during the movement, the drive is not slowed down via a braking ramp. The holding brake is closed immediately. This results in increased wear and may damage the motors if it occurs repeatedly.

- Avoid immediate blocking of the drive during movement
- Before blocking the drive, make sure that the drive is stopped, such as by resetting STOP (control byte CCON bit 1) or by triggering an external stop (input ESTOP at [X4])

Manual release of the brake

⚠ WARNING

Risk of injury due to unexpected movement of components.

- Before manual release of the brake, move the axes to a stable end position or secure axes against unexpected movements.

If the drive is blocked (by a control command or by an error with error response "Power stage off"), there is the option of releasing the brake manually.

This is possible in the following ways:

– by a hardware input (➔ 6.2.5 Switch-off functions interface [X4])
– by a control bit in the CCON control word (➔ 8.2.4 Description of the CCON/CPOS control bytes)
– by the FCT

In the case of a blocked drive, if the command to release is issued via at least one of these signals, the brake is released.

NOTICE

The signal to release the brake always has priority. If a voltage of +24 V is applied to the RB input (release brake), the brake is released permanently. In the event of an error (in the event of an error with the error response "Power stage off"), the brake remains released because the signal to release the brake is present:

- Leave the signal at “brake active” (0 V at the input RB).
- Only release the brake manually in a genuine case of need.

5.7 Operating modes of the controller

5.7.1 Direct mode

The CANopen or Ethernet interface (control by Modbus TCP) can be used as a control interface. The X and Y target position and velocity are transmitted by the higher-order controller/PC. The target position is approached in linear manner from the current actual position.

Other possible functions are:

– Jogging
– Homing

5.7.2 Record selection

The I/O, CANopen or Ethernet interface (control by Modbus TCP) can be used as a control interface. Records consist of record type, target position X and Y, velocity, acceleration and jerk. They are saved in the controller in a record table with a record number (➔ 7.5.1 Record table). A maximum of 31 records can be configured by the user. Record 0 is reserved for homing. During operation, the higher-order controller/PC selects individual records by transferring a record number (record selection). The target position is approached in linear manner from the current actual position.
Other possible functions are:
– Jogging
– Homing

i

- If positioning is started, it is always continued to the end in all operating modes.
- A new positioning job is ignored before the end of a started positioning.
- Records can only be parameterised with the Festo Configuration Tool (FCT) (➔ 7.5.1 Record table).
- Coordinate transformation is performed in the CMXH controller.

5.8 Dimension system

5.8.1 Basic concepts

Homing
The position of the axis zero point AZ is determined during homing.

Stop point BZ (block zero point)
A fixed point in the origin of the selected coordinate system that is the target for homing.

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

Axis zero point AZ
It is shifted by a defined distance from the stop point BZ in the origin of the selected coordinate system. This distance is determined depending on the size of the planar surface gantry in the direction of the X- and Y-axis (➔ Tab. 7 Explanation of dimension reference points).

Project zero point (PZ)
A point to which the actual position and the absolute target positions 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 usable 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. The software end positions are shifted by a defined distance from the axis zero point AZ.

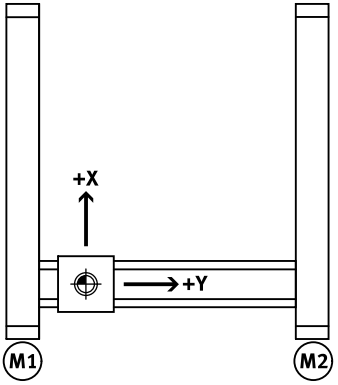
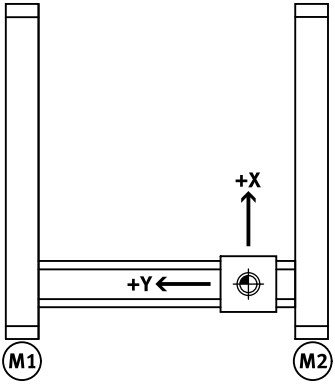
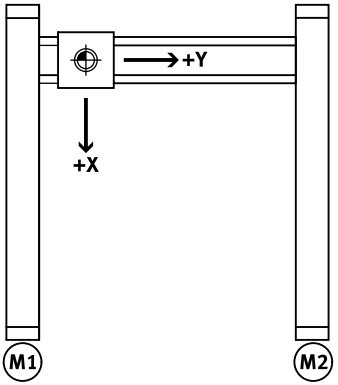
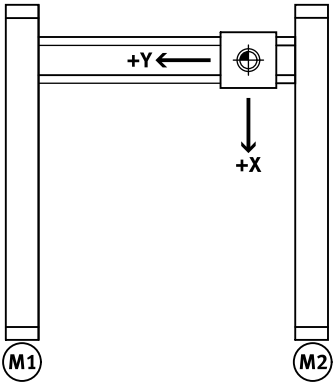
Usable stroke
The distance of the software end positions in the direction of the X- or Y-axis. Maximum stroke by which the planar surface gantry can travel in the corresponding direction.

Increments

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

1 mm = 1000 SINC

5.8.2 Selection of the coordinate system

Selection 1	Selection 2
 Axis zero point at corner point 1 (default)	 Axis zero point at corner point 2
Selection 3	**Selection 4**
 Axis zero point at corner point 3	 Axis zero point at corner point 4

Tab. 6: Specification of the axis zero point

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

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The axis zero point is determined exclusively by the Festo Configuration Tool (FCT) (➔ 7.4 Configuration).

5.8.3 Dimension reference points

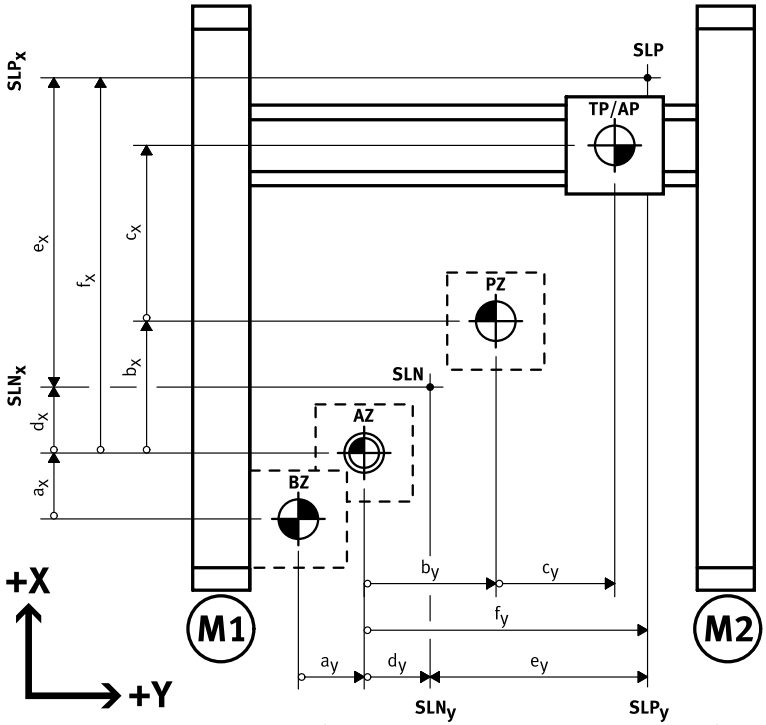


Fig. 4: Dimension reference points (example for axis zero point at corner point 1)

Explanation		Calculation
BZ	(Block Zero) stop point	
AZ	(Axis Zero Point) axis zero point	= BZ + a
PZ	(Project Zero Point) project zero point	= AZ + b
SLN	(Software Limit Negative) negative software end position	= AZ + d
SLP	(Software Limit Positive) positive software limit	= AZ + f
TP/AP	(Target Pos./Actual Pos.) target position/actual position	= PZ + c = AZ + b + c
a	Offset BZ to AZ (fixed)	EXCM-30: 1.4 mm EXCM-40: 2.0 mm
b	Offset AZ to PZ	
c	Offset PZ to TP/AP	

Explanation		Calculation
d	Offset AZ to SLN	
e	Usable stroke	
f	Offset AZ to SLP	

Tab. 7: Explanation of dimension reference points

5.9 General design of the controller

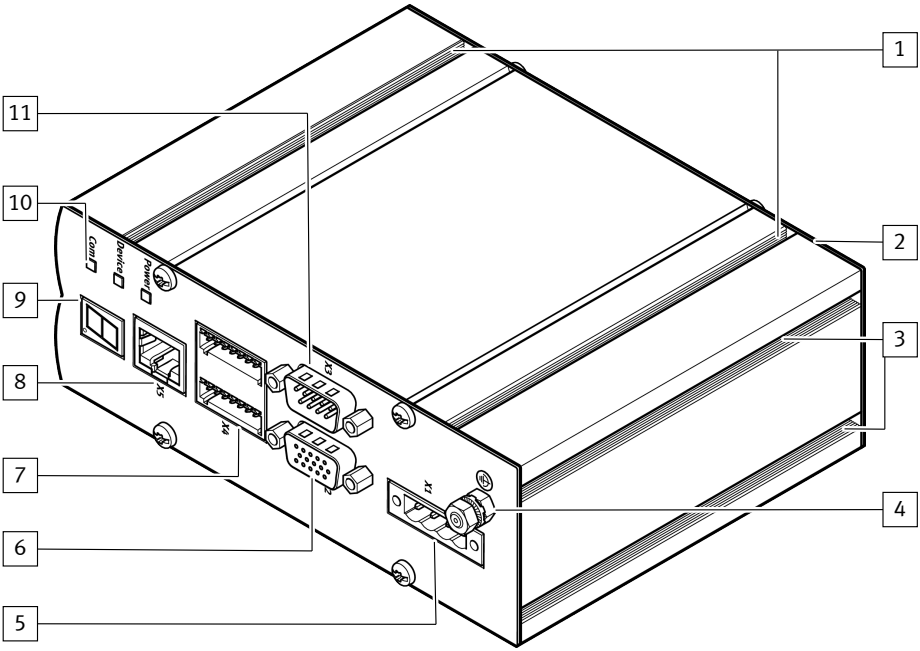


Fig. 5: General structure

1 Mounting slots
2 Connection side to the planar surface gantry
3 Mounting slots
4 Functional earth connection
5 Power supply [X1] connection
6 I/O interface [X2]
7 Switch-off functions interface [X4]
8 Ethernet interface [X5]
9 7-segment display
10 LED display components
11 CANopen interface [X3]

5.9.1 Interfaces

The controller has three interfaces for communication with a higher-order controller:
- I/O interface
- CANopen interface
- Ethernet interface

The active control interface is established via the Festo Configuration Tool (FCT) (➔ 7.4 Configuration).

5.9.2 LED display components

Equipment and function statuses of the controller are displayed via the three LED display components. The behaviour and the colour of the LEDs vary depending on the type of status display.

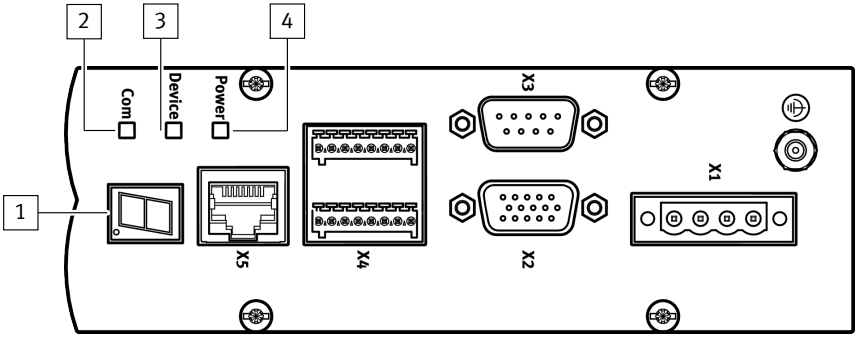


Fig. 6: Display components

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

1 Static and dynamic behaviour

2 Only static behaviour (on/off)

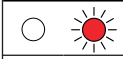
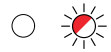
Power

The “Power” LED display is on only when the load voltage is present and simultaneously (STO1 = 1) and (STO2 = 1).

Device

The operational readiness of the controller and existing malfunctions (errors/warnings) are signalled by the “Device” LED display (➔ Tab. 8 LED display - device).

LED (green/red)	Status	Meaning
○ ☀ ○		Ready for operation (controlled status)
○ ☀ ○	ON / OFF	Not ready for operation (uncontrolled status)

LED (green/red)	Status	Meaning
		Error is pending
		Warning is pending or controller identification is active (➔ 7.5.4 Controller identification)

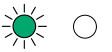
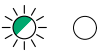
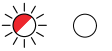
Tab. 8: LED display - device

COM

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

COM - I/O operation		
LED (green/yellow/red)	Status	Meaning
		Communication active.

Tab. 9: COM LED display - I/O operation

COM - CANopen operation		
LED (green/yellow/red)	Status	Meaning
		Normal operating status. Communication through SDOs and PDOs possible (operational).
		Normal status after switch-on. Communication only possible through SDOs (pre-operational).
		Bus line not connected or bus parameters not configured.
		No bus connection (bus OFF).
		Telegrams cannot be received or sent (warning limit).
		Time exceeded for communication monitoring (node guarding).

Tab. 10: COM LED display - CANopen operation

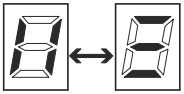
COM LED display - Modbus TCP operation		
LED (green/yellow/ red)	Status	Meaning
		Communication active.

Tab. 11: COM LED display - Modbus TCP operation

5.9.3 7-segment display

Operating mode, record number and malfunctions are displayed by the single-digit 7-segment display. Four characters are displayed in succession followed by a time delay.

Fig. 7: 7-segment display, example I/O operation, record number 3

Display		Operating mode/event	Priority
BLE		Bootloader error	1
E0xx (xx = exception status)[1)]		System errors	2
E1xx (xx = exception status)[1)]		Error motor 1	
E2xx (xx = exception status)[1)]		Error motor 2	
A0xx (xx = exception status)[1)]		Warning[2)]	3
HHHH		STO function was requested	4
P000		Homing	5
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 number) P200 (00 = direct application)		CANopen operation	
P3xx (xx = record number) P300 (00 = direct application)		Controller via FCT	
P4xx (xx = record number) P400 (00 = direct application)		Modbus TCP operation	
	Alternate between vertical and horizontal segments.	Firmware download active	--
	flashing dot	Controller identification active (➔ 7.5.4 Controller identification)	

1) hexadecimal

2) Is displayed 2x, one after the other

Tab. 12: Messages of the 7-segment display

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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 (➔ 9.1 Diagnostic memory) in order to see all the recorded messages displayed.

5.10 Emergency stop concept

NOTICE

- Check which measures are required for your machine/system in case of an emergency stop as part of your emergency stop concept.
- Observe the contents of this documentation on the switch-off functions (➔ 5.5 Switch-off functions of the controller).

6 Electrical installation

6.1 General information

NOTICE

A prerequisite for installation is completed mounting of the planar surface gantry EXCM-30/-40 and the controller CMXH. Mounting is described in separate documents (➔ Tab. 1 Documentation for the system EXCM-30/-40 with CMXH).

⚠ WARNING

Risk of injury due to unexpected movement of components.

- Before working on the product, switch off the power supply and lock it against being switched on again.

NOTICE

Damage to the product due to incorrect handling.

- Observe the handling specifications for electrostatically sensitive devices.
- Never unplug or plug in a product when it is energised!

NOTICE

To ensure compliance with the IP degree of protection (if required):

- Note that the specified IP degree of protection is only achieved if all pins are assigned.

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

6.2 Connections and interfaces

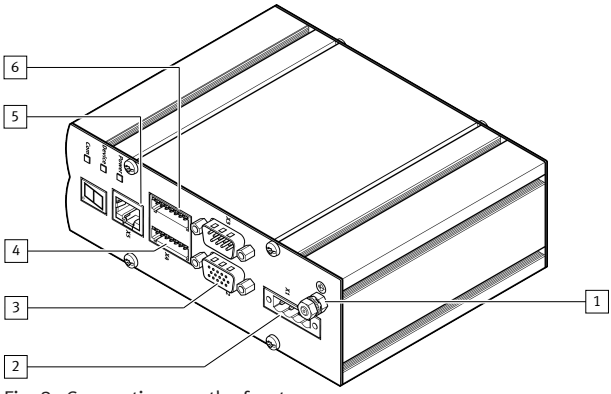


Fig. 8: Connections on the front

1 Functional earth
2 Power supply [X1]
3 I/O interface [X2]
4 Switch-off functions interface [X4]
5 Ethernet interface [X5]
6 CANopen interface [X3]

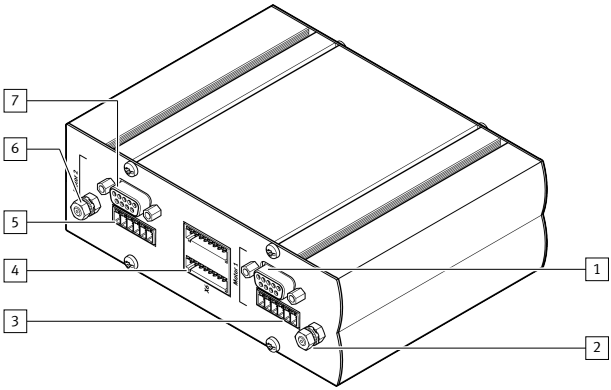
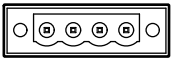


Fig. 9: Connections on the back cover

1 Encoder motor 1
2 Screening motor 1
3 Power supply motor 1
4 reserved [X6]
5 Power supply motor 2
6 Screening motor 2
7 Encoder motor 2

6.2.1 Power supply [X1]

Connection	Pin	Function		
1  4	1	GND	0 V	Reference potential for load voltage
	2	Load voltage	+24 V ±10% or +48 V ±10%	Power supply of the power output stages of the motors
	3	GND	0 V	Reference potential for logic voltage
	4	Logic voltage	24 V ±15%	Power supply for the control electronics and brakes

Tab. 13: Power supply [X1] connection

NOTICE

- Observe the technical data of the power supply (➔ 10.1.4 Electrical Characteristics).
- The maximum length of the individual cables must not exceed 30 m.

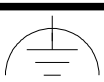
⚠ WARNING

Risk of injury due to electric shock.

- For the electrical power supply, use only PELV circuits in accordance with EN 60204-1 (protective extra-low voltage, PELV). Also take into account the general requirements for PELV circuits in accordance with EN 60204-1.
- Only use power sources which guarantee reliable electrical isolation of the operating voltage from the mains in accordance with EN 60204-1.

6.2.2 Functional earth

The threaded bolts next to the power supply [X1] of the controller serve to connect the functional earth (galvanically separated from the reference potentials) to comply with EMC safety.

Connection		Function
		Functional earth

Tab. 14: Functional earth connection

NOTICE

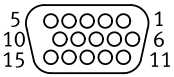
- Connect the functional earth connection with low impedance to the earth potential to avoid electromagnetic malfunctions.

6.2.3 I/O interface [X2]

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

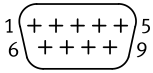
NOTICE

The switching logic of the I/O interface is executed as PNP, based on IEC 61131-2 for PLC.

Connection	Pin	Function		
	1	RDYEN	Output	Ready for enable
	2	DIN1	Input	Record selection Records 1...31 (record 0 = homing)
	3	DIN2		
	4	DIN3		
	5	DIN4		
	6	DIN5		
	7	24 V logic	Output	Logic voltage +24 V
	8	START	Input	Start record or homing
	9	ENABLE	Input	Enable drive and operation
	10	RESET	Input	Acknowledge error
	11	ENABLED	Output	Drive and operation are enabled
	12	FAULT	Output	Error present
	13	ACK	Output	Acknowledgment for start signal
	14	MC	Output	Motion Complete
	15	GND24		Logic voltage reference potential

Tab. 15: I/O interface connection [X2]

6.2.4 CANopen interface [X3]

Connection X3	Pin	Function	
	1	–	not used
	2	CAN-L	Low signal
	3	0 V (GND)	Reference potential
	4	–	not used
	5	Shielding	Shielded connection
	6	–	not used
	7	CAN-H	High signal
	8	–	not used
	9	–	not used

Tab. 16: Connection, CANopen interface [X3] to the controller

6.2.5 Switch-off functions interface [X4]

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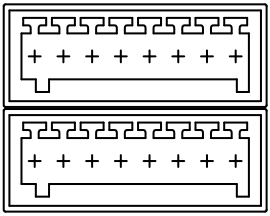
The safety function STO (“Safe Torque Off”) is described in detail in the document “CMXH description STO” and may only be used in the manner described there. (➔ Tab. 1 Documentation for the system EXCM-30/-40 with CMXH)

To establish ready status, the circuitry of the control inputs STO1/STO2 and ESTOP with +24 V at [X4] is required. If the STO safety function is not needed, a suitable circuitry of the control inputs STO1/STO2 is required for operation of the controller.

Connection X4	Pin	Function		
Pin 16 ... 9  Pin 1 ... 8	1	24 V logic	Output	Logic voltage +24 V
	2	STO1	Input	Safe Torque Off function: At 0 V: safely switch off supply voltage to the motors
	3	STO2	Input	
	4	–		reserved
	5	FAULT	Output	At +24 V: error is pending
	6	DIAG1		Potential-free diagnostic contacts (low impedance if the STO function has been activated)
	7	DIAG2		
	8	0 V GND		GND (reference potential)
	9	–	–	reserved
	10	–	–	
	11	–	–	
	12	–	–	
	13	–	–	
	14	RB	Input	With +24 V: release brake At 0V: brake control via the control word CCON[1)]
	15[2)]	ESTOP	Input	External stop With 0 V: trigger braking ramp
	16	24 V logic	Output	Logic voltage +24 V

1) If there is no controller with the master control, the brake remains in its last status on application of 0 V.
2) At standstill, the power stage is switched off and any motor brakes that may be present are closed.

Tab. 17: Switch-off functions interface [X4]

NOTICE

The signal to release the brake always has priority. If a voltage of +24 V is applied to the RB input (release brake), the brake is released permanently. In the event of an error (in the event of an error with the error response "Power stage off"), the brake remains released because the signal to release the brake is present:

- Leave the signal at “brake active” (0 V at input RB).
- Only release the brake manually in a genuine case of need

6.2.6 Ethernet interface [X5]

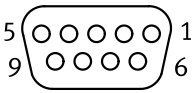
The Ethernet interface can thereby be used both for control via the FCT and also for operation via the function “Control via Modbus TCP”.

NOTICE

- Use a network cable of category 5 or better.

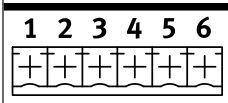
6.2.7 Encoder connection

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

Connection	Pin	Function	
	1	Vcc	+5 V ±10% supply of the encoder. Max. 100 mA, not proof against short circuit.
	2	GND	Reference potential
	3	N	Encoder signal zero pulse N+
	4	B	Encoder signal B+
	5	A	Encoder signal A+
	6	–	reserved
	7	N/	Encoder signal zero pulse N–
	8	B/	Encoder signal B–
	9	A/	Encoder signal A–

Tab. 18: Encoder connection

6.2.8 Motor connection

Connection[1)]	Pin	Function	
	1	A	Connection of the motor strings
	2	A/	
	3	B	
	4	B/	
	5	BR+	Connection of the holding brake. Short-circuit and overload-protected. BR– = GND, BR+ is switched (+24 V)
	6	BR–	

1) Next to the motor ports is an M4 threaded bolt to connect the shield of the motor cable by a cable lug

Tab. 19: Motor connection

7 Commissioning with the FCT

NOTICE

A prerequisite for commissioning is the completed installation of the planar surface gantry EXCM-30/-40 and the CMXH controller (➔ 6 Electrical installation).

7.1 Safety instructions

⚠ WARNING

Risk of injury due to unexpected movement of components.

- Make sure that an ENABLE signal is not present at the control interfaces when the controller is switched on.
- Completely parameterise the entire system before activating the power stage.
- Make sure that no one is located in the movement area during the axis movements.

NOTICE

The controller does not execute direct tasks or records if a valid reference point is not present (exception, jogging).

- Always carry out homing after every switch-on or failure of the logic voltage in order to anchor the dimension system to the reference point.

NOTICE

Damage to components if the permissible impact pulse is exceeded.

- Operate the planar surface gantry only with the maximum permissible load (➔ Tab. 1 Documentation for the system EXCM-30/-40 with CMXH).

NOTICE

Interruption of ongoing tasks due to inadequate load voltage.

- Make sure that the tolerance of the load voltage at the input of the controller is complied with under full load (➔ 10.1.4 Electrical Characteristics).

7.2 Network connection via Ethernet

7.2.1 Connection to PC/laptop

In order for the controller and the FCT to communicate you must connect the controller to your PC/laptop via the Ethernet interface. Use a commercially available network cable for this purpose (RJ-45 plug connector). The cable type (straight or crossed connection) is recognised automatically.

NOTICE

On delivery the controller has an active DHCP server. The controller cannot be connected to a network immediately at initial start-up as it can lead to network malfunctions if two active DHCP servers are present in one network.

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 from the range 192.168.178.110 ... 192.168.178.209 and subnet mask 255.255.255.0. A gateway is not assigned.

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If the DHCP client on your PC/laptop is active (usually default 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 establish a connection to the controller ➔ 9.3.3 Problems with the Ethernet connection.

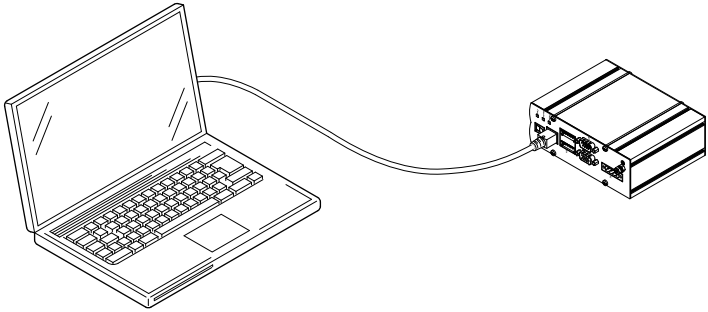

Fig. 10: Connection to PC/laptop

7.2.2 Network settings

Network settings on delivery

Parameter	Value
IP	192.168.178.1
DHCP-Server	Active
Port (FCT)	7508
Port (Modbus TCP)	502
Subnet mask	255.255.255.0
Gateway	0.0.0.0 (none)

Tab. 20: Network settings on delivery

Display or change the network settings of the controller

The network settings can be made via the FCT as needed. In the FCT plug-in via the ‘Controller’ ‘Set network settings’ page.

– or –

By a network scan via the FCT.

1. Menu ‘Component’ ‘FCT interface’ ‘Search...’ button.
2. Select one of the devices found from the ‘Network’ context menu.
3. To change the network settings, select one of the following options:
   - ‘DHCP server active’ The controller has valid network settings at delivery (➔ Tab. 20 Network settings on delivery)
   - ‘Retrieve IP Address automatically’
     The controller obtains its IP address from a DHCP server in your network.
   - ‘Use the following IP address’
     You can assign a fixed IP address to the controller manually.

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

7.2.3 Security in the network

NOTICE

When connecting the controller 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. by use of safety network components (special gateways/firewalls).
- Use a password to make unauthorised or inadvertent access to the controller more difficult (in the FCT: Menu ‘Component’ ‘Online’ ‘Password’).

7.2.4 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 as the timeout is adjusted dynamically to the transmission rate.

7.3 The Festo Configuration Tool (FCT)

7.3.1 General information

The Festo Configuration Tool (FCT) is the software platform for configuring and commissioning different components and devices from Festo. Each type of equipment is managed through its own plug-in. Detailed information about working with projects and adding a component to a project can be found in the Help on the FCT.

– Select in the menu ‘Help’ ‘General contents of FCT’.

FCT plug-in

A FCT plug-in supports the device-specific performance of all necessary steps for commissioning a device. The plug-ins are managed and started from the FCT. The required parameters can be determined offline, i.e. without connecting the device to the PC or laptop. For example, this makes it possible to prepare commissioning in the office.

Further information on the FCT plug-in CMXH can be found in the plug-in Help:

– Select in the menu ‘Help’ ‘Contents of installed plug-ins’ ‘Festo’ ‘CMXH’.

Printing out Help

You can also print all or part of the Help for use independently of a PC.

1. Click on the ‘Print’ button in the Help window.
2. Select the desired topics in the ‘Print topics’ dialogue.

7.3.2 Installing the FCT

Both the FCT framework and the FCT plug-in of the controller must be installed for commissioning. Download the current CMXH plug-in from the Support portal (➔ www.festo.com/sp). Search term “CMXH”. Set-up of the FCT is always included in set-up of the plug-in. If necessary, the FCT is automatically installed with it.

NOTICE

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

7.3.3 Starting the FCT

After installation of the FCT software on your PC, you can start it in two ways.
- Double-click the FCT icon on the desktop.
- Select the entry ‘Festo Software’ ‘Festo Configuration Tool’ in the start menu from the list of programs.

7.3.4 Create a new project

After you have installed and started the FCT you can create a new project as follows.
1. In the ‘Project’ menu select ‘New’.
2. In the dialogue ‘New Project - Project Characteristics’, assign a name and title to your project. You can optionally also write a project description.
3. Confirm your input with the ‘OK’ button.
4. In the ‘Component selection’ dialogue select the ‘CMXH’ component in the project tree.
5. Assign a component name
6. In the dropdown menu, choose the desired version of the plug-in next to the ‘OK’ button.
7. Confirm your input with the ‘OK’ button.

7.4 Configuration

Specifications and settings are required for the components involved for commissioning the controller with the planar surface gantry. The corresponding register and parameter pages are selected in the work space of the FCT.

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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 the menu ‘Help’ ‘Contents of installed plug-ins’ ‘Festo’ ‘CMXH’.

7.4.1 Create new drive configuration/change drive configuration

The ‘Create new drive configuration’ button only appears if a drive has not yet been configured. Otherwise, the existing drive configuration can be changed in this menu.
1. Select ‘Configuration’ ‘Create new drive configuration’ ‘Configuration’ ‘Change’ on the parameter page.

Configure/change controllers
2. Select the load voltage (DC link voltage) of the controller.
3. Select the control interface. If the control interface has been changed, a restart of the CMXH is required.
4. Selecting ‘Continue’ opens the configuration of the planar surface gantry.

Configure/change planar surface gantry
5. Select the size of the planar surface gantry.
6. Specify the stroke of the working space in the direction of the X- and Y-axis.
7. Set specifications for the motor brake and motor position.
8. Select ‘Continue’ to open the configuration result.
   Check the specifications and confirm the result with ‘End’.

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Then navigate through the individual parameter pages using the ‘Continue’ and ‘Back’ buttons and make the settings for the individual topics. In the ‘Workplace’ view you can directly select a page in the displayed tree.

7.4.2 Gantry

1. Enter all required values.

Dimension system

2. Choose a coordinate system by determining the position of the axis zero point (➔ 5.8 Dimension system).
3. Specify the project zero point and the software end positions (positive/negative) of both axes (➔ 5.8 Dimension system).

Homing

4. Select the sequence of movement directions during homing.
5. Enter all required velocity and acceleration values.

7.4.3 Controller

- Select in the ‘Project’ ‘Component’ menu the ‘Controller’ entry. The firmware version and network settings of the connected CMXH are visible here in online mode. The network settings can be adjusted as needed (➔ 7.2.2 Network settings).

Fieldbus

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This page is only visible if CANopen or Modbus TCP have been selected as the control interface.

CANopen control interface:
– Select the device profile: - FHPP (default) - FHPP with parameter channel (EFPC).
– Select the bit rate.
– Specify the node number (range of values 1 ... 127, default: 1).
Modbus TCP control interface:
– Select the device profile: - FHPP (default) - FHPP with parameter channel (EFPC).
– Determine the port, if necessary (range of values 1 ... 65535, default: 502, reserved: 7508).
– Activate or deactivate the connection monitor
(➔ 8.5.7 TCP/IP connection monitoring (node guard, timeout) and if necessary set the monitoring time for the timeout (range of values 100 ... 5000 ms, default: 2000 ms).

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Modified fieldbus parameters only become effective after a restart of the controller.

7.5 Settings of the operating parameters

7.5.1 Record table

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

Every 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
- Velocity, acceleration and jerk
- Comments (optional)

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

7.5.2 Teach-in

In the referenced status the current position can be added as a parameter via the FCT:
1. Display ‘Dimension system’ or ‘Record table’ parameter page
2. The slide is brought to the desired position (e.g. by jogging or by hand).
3. By pressing the ‘Accept as...’ button in the online tab ‘Manually travel’, the current position is imported into the record table as a software end position or project zero point.

7.5.3 Enable device control via FCT

In order to control the controller through the FCT you must activate device control via FCT.
- Activate the ‘FCT’ check box in the project output in the ‘Device Control’ check box.

NOTICE

Setting the ‘FCT’ check box interrupts control via the control interfaces, which may result in malfunctions in the process or damage to the system. The interfaces only have read access to the controller.

- Also set the ‘Enable’ check box to enable the drive.

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.

7.5.4 Controller identification

For identification of a specific controller from a group of several controllers:
1. Select ‘Component’ ‘FCT interface’ in the menu.
2. In the ‘FCT interface’ dialogue press the ‘Search...’ button.
3. In the dialogue that appears, select a controller with the right mouse button.
4. Select the ‘Identification’ ‘On’ entry.
   - The red LED ‘Device’ light (➔ 5.9.2 LED display components) and the dot on the 7-segment display (➔ Fig. 11) of the identified controller start flashing.
5. Then switch the controller identification off ‘Identification’ ‘Off’.

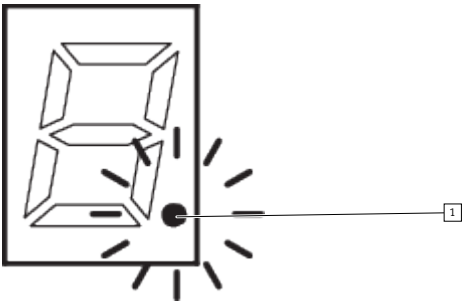

Fig. 11: Controller identification

1 Point for controller identification

7.5.5 Firmware update

NOTICE

Before using a newer firmware version:

- Check whether a newer corresponding version of the FCT plug-in or user documentation is available ➔ www.festo.com/sp.

Proceed as follows for a firmware update:

1. Install the latest plug-in recommended for the firmware.
2. Create new component with this plug-in version.
3. Create connection to the controller with the old firmware.
4. Read and back up the project.
5. Download firmware
6. Create a connection and download project.

8 Operation

8.1 Instructions for operation

Safety

NOTICE

The safety instructions for commissioning also apply to ongoing operation.

- Observe the safety instructions in the chapter on commissioning with the FCT (➔ 7.1 Safety instructions).

⚠ WARNING

Risk of injury due to unexpected movement of components.

- Make sure that no one is located in the movement area during the axis movements.

Password protection

NOTICE

Protection against unauthorised or unintended overwriting of parameters.

- Set up a password in the FCT (➔ Plug-in help).

Password protection is not set on delivery.

Maintenance and care

NOTICE

The controller is maintenance-free.

- However, observe the maintenance notes of the planar surface gantry as well as any additional components.

Disposal and environment

NOTICE

Environmentally-friendly disposal

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

8.2 Communication principle, general

Communication between a higher-order controller and the controller takes place in all operating modes with the FHPP protocol (Festo Handling and Positioning Profile) with the cyclical data exchange of 16 bytes of input and output data each with control via CANopen or Modbus TCP. If required, an additional 8 bytes of output and input data can be used for FPC parameterisation (➔ 12.3 Festo Parameter Channel (FPC)).

8.2.1 Overview of control and status bytes

NOTICE

The functional allocation of the control and status bytes (byte 3 ... 16) depends on the operating mode.

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Data identified as reserved are ignored.

Recommendation: set reserved bytes to 0.

Record selection with control via CANopen interface and Modbus TCP

Output data (control bytes) - record selection								
X-axis					Y-axis			
1	2	3	4	5 … 8	9	10	11, 12	13 … 16
CCONx	CPOSx	Record no.	Reserved		CCONy	CPOSy	Reserved	

Tab. 21: Output data (control bytes) - record selection

Input data (status bytes) - record selection								
X-axis					Y-axis			
1	2	3	4	5 … 8	9	10	11, 12	13 … 16
SCONx	SPOSx	Record no.	Reserved	Actual position X	SCONy	SPOSy	Reserved	Actual position Y

Tab. 22: Input data (status bytes) - record selection

Direct mode with control via CANopen interface and Modbus TCP

Output data (control bytes) - direct mode								
X-axis					Y-axis			
1	2	3	4	5 … 8	9	10	11, 12	13 … 16
CCONx	CPOSx	CDIRx	Target velocity [%]	Setpoint position X	CCONy	CPOSy	CDIRy	Setpoint position Y

Tab. 23: Output data (control bytes) - direct mode

Input data (status bytes) - direct mode								
X-axis					Y-axis			
1	2	3	4	5 … 8	9	10	11, 12	13 … 16
SCONx	SPOSx	SDIRx	Actual velocity [%]	Actual position X	SCONy	SPOSy	SDIRy	Actual position Y

Tab. 24: Input data (status bytes) - direct mode

Optional extended I/O data with control via CANopen interface and Modbus TCP

Extended output data (control bytes)								
FHPP	EFPC							
1 ... 16	17	18	19	20	21	22	23	24
FHPP Standard	FPCC	Subindex	Parameter number		Parameter value			

Tab. 25: Extended output data (control bytes)

Extended input data (status bytes)								
FHPP	EFPC							
1 ... 16	17	18	19	20	21	22	23	24
FHPP Standard	FPCS	Subindex	Parameter number		Parameter value (EFPC error code)			

Tab. 26: Extended input data (status bytes)

8.2.2 Assignment of the control bytes CCON/CPOS

Control bytes X-axis								
Bit	7	6	5	4	3	2	1	0
CCONx	–	OPM	Lock	–	RESET	BRAKE	STOP	ENABLE
	–	Mode selector	Block FCT access	–	Acknowl-edge malfunc-tion	Release brake	Stop	Enable drive
CPOSx	–	–	–	JOGN	JOGP	HOME	START[1)]	–
	–	–	–	Negative jogging	Positive jogging	Start homing	Start motion task	–
CDIRx	–	–	–	–	–	–	–	ABS
	–	–	–	–	–	–	–	Abso-lute/ Relative

1) For a controller using CAN, the start bits of the X-axis and Y-axis must be set in order to start a positioning (because the setpoint position of the individual axes is transmitted via 2 separate PDOs). With control via Modbus only the start bit of the X-axis needs to be set to start a positioning. Reserved control bits are ignored. Recommendation for the user: set to 0.

Tab. 27: Assignment of the control bytes X-axis

Y-axis control bytes								
Bit	7	6	5	4	3	2	1	0
CCONy	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
CPOSy	–	–	–	JOGN	JOGP	–	START (CAN only)[1)]	–
	–	–	–	Negative jogging	Positive jogging	–	–	–
CDIRy	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–

1) For a controller using CAN, the start bits of the X-axis and Y-axis must be set in order to start a positioning (because the setpoint position of the individual axes is transmitted via 2 separate PDOs). With control via Modbus only the start bit of the X-axis needs to be set to start a positioning. Reserved control bits are ignored. Recommendation for the user: set to 0.

Tab. 28: Assignment of the Y-axis control bytes

8.2.3 Assignment of status bytes SCON/SPOS

Status bytes X-axis								
Bit	7	6	5	4	3	2	1	0
SCONx	–	OPM	FCT/MMI	VLOAD	FAULT	WARN	OPEN	ENABLED
	–	Operating mode feedback	Devices controlled via FCT	Voltage applied at STO inputs	Malfunction	Warning	Operation enabled	Enable drive
SPOSx	REF	STILL	FOLERR	MOV	–	MC	ACK	–
	Drive homed	Standstill monitoring	Following error	Drive moves	0	Motion Complete	Start acknowledgment	0
SDIRx	–	–	–	–	–	–	–	ABS
	0	0	0	0	0	0	0	Absolute/ Relative

Tab. 29: Assignment of status bytes X-axis

Y-axis status bytes								
Bit	7	6	5	4	3	2	1	0
SCONy	–	–	–	–	–	–	–	–
	0	0	0	0	0	0	0	0
SPOSy	–	–	–	–	–	–	–	–
	0	0	0	0	0	0	0	0
SDIRy	–	–	–	–	–	–	–	–
	0	0	0	0	0	0	0	0

Tab. 30: Assignment of the Y-axis status bytes

8.2.4 Description of the CCON/CPOS control bytes

All the necessary statuses are controlled with the CCON control byte.

Control byte 1 (CCON)				
Bit	Function		Description	
0	Enable drive	ENABLE[1)]	0	Drive (closed-loop controller) blocked
			1	Enable drive (closed-loop controller)
1	Stop	STOP[1)]	0	Stop active (stop with the permissible ramp and cancel positioning task).
			1	Enable operation
2	Release brake	BRAKE[1)]	0	Brake active
			1	Release brake, only effective if the drive is blocked (ENABLED = 0) and brake active (RB = 0 at interface X4)
3	Acknowledge malfunction	RESET[1)]	With a rising edge any error message present is deleted and, if successful, the malfunction status is exited.	
4	Reserved	–	0	Reserved
5	Reserved		0	Reserved
6	Mode selector	OPM[1)]	0	Record selection mode
			1	Direct mode
7	Reserved		0	Reserved

1) Not evaluated with Y-axis.

Tab. 31: CCON control byte 1

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

Control byte 2 (CPOS)				
Bit	Function		Description	
0	Reserved		0	Reserved
1	Start positioning job	START	The current nominal values are transferred in response to a rising edge and positioning started.	
2	Start Referenzfahrt	HOM[1)]	A rising edge starts homing with the preset parameters.	
3	Positive jogging	JOGP	The drive moves at the configured velocity in the direction of greater actual values, so long as the bit is set.	
4	Negative jogging	JOGN	The drive moves at the configured velocity in the direction of lesser actual values, so long as the bit is set.	
5	Reserved		0	Reserved
6	Reserved		0	Reserved
7	Reserved		0	Reserved

1) Not evaluated with Y-axis.

Tab. 32: Control byte 2 CPOS

Direct task

Control byte 3 (CDIR) – direct application				
Bit	Function		Description	
0	Absolute/Relative[1)]	ABS	0	Setpoint value is absolute.
			1	Setpoint value is relative to last setpoint value.
1	Reserved		0	Reserved
2	Reserved		0	Reserved
3	Reserved		0	Reserved
4	Reserved		0	Reserved
5	Reserved		0	Reserved
6	Reserved		0	Reserved
7	Reserved		0	Reserved

1) Whether travel is relative to the last setpoint or actual value can be set in PNU 524.

Tab. 33: Control byte 3 (CDIR) – direct application

Control byte 4 (setpoint value 1) – direct task			
Bit	Function		Description
0 … 7	Velocity	Velocity	Velocity [% of the base value] ➔ PNU 540.

Tab. 34: Control byte 4 (setpoint value 1) – direct task

Control byte 5 … 8 (setpoint value 2) - direct task			
Bit	Function		Description
0 … 31	Position	Position	Position [SINC]

Tab. 35: Control byte 5 … 8 (setpoint value 2) - direct task

Record selection

Control byte 3 (setpoint value 1) – record selection			
Bit	Function		Description
0 … 7	Record number	Record number	Record number preselection

Tab. 36: Control byte 3 (setpoint value 1) – record selection

Control byte 4 … 8 (setpoint value 2) - record selection				
Bit	Function		Description	
0 … 7	–	–	0	reserved

Tab. 37: Control byte 4 … 8 (setpoint value 2) - record selection

8.2.5 Description of status bytes SCON/SPOS

The status byte SCON provides feedback about the drive statuses.

Status byte 1 (SCON)				
Bit	Function		Description	
0	Drive enabled	ENABLED[1)]	0	Drive/closed-loop controller blocked, controller not active
			1	Drive/closed-loop controller enabled
1	Operation enabled	OPEN[1)]	0	Stop active
			1	Operation enabled, positioning possible
2	Warning	WARN[1)]	0	No warning
			1	Warning is pending
3	Malfunction	FAULT[1)]	0	No malfunction
			1	Malfunction is pending, malfunction reaction active, malfunction code in malfunction buffer
4	STO voltage present	VLOAD[1)]	0	at STO1 or STO2 24 V not present
			1	at STO1 and STO2 24 V present
5	Device control by FCT	FCT[1)]	0	FCT not active, device control through control interface possible
			1	FCT active, device control through control interface not possible
6	Operating mode feedback	OPM[1)]	0	Record selection mode (standard)
			1	Direct mode
7	Reserved		0	Reserved

1) Only returned with X-axis. Also applicable for Y-axis

Tab. 38: Status byte 1 SCON

The status byte SPOS provides feedback about the positioning sequences.

Status byte 2 (SPOS)				
Bit	Function		Description	
0	Reserved		0	Reserved
1	Start acknowledgment	ACK[1)]	0	Ready for start (positioning task or homing)
			1	Start executed (positioning task or homing)
2	Motion Complete	MC[1)]	0	Positioning task active
			1	Positioning task completed (possibly with error)
3	Reserved		0	Reserved
4	Drive moves	MOV[1)]	0	Velocity of the axis < limit value
			1	Velocity of the axis ≥ limit value
5	Following error	FOLERR[1)]	0	no following error
			1	Following error active
6	Standstill monitoring	STILL[1)]	0	Axis remains in the tolerance window after MC
			1	Axis has left tolerance window after MC
7	Drive homed	REF[1)]	0	Homing must be run
			1	Homing not required, homing information available

1) Only returned with X-axis. Also applicable for Y-axis

Tab. 39: SPOS status byte 2

Direct task

Status byte 3 (SDIR) – direct task				
Bit	Function		Description	
0	Absolute/Relative	ABS	0	Setpoint value is absolute.
			1	Setpoint value is relative. Whether travel is relative to the last setpoint or actual value can be set in PNU 524.
1	Reserved		0	Reserved
2	Reserved		0	Reserved
3	Reserved		0	Reserved
4	Reserved		0	Reserved
5	Reserved		0	Reserved
6	Reserved		0	Reserved
7	Reserved		0	Reserved

Tab. 40: SDIR status byte 3 – direct task

Status byte 4 (actual value 1) – direct task		
Bit	Function	Description
0 ... 7[1)]	Velocity	Feedback velocity [% of the base value] ➔ see PNU 540

1) Only returned with X-axis. Also applicable for Y-axis

Tab. 41: Status byte 4 (actual value 1) – direct task

Status byte 5 ... 8 (actual value 2) - direct task		
Bit	Function	Description
0 ... 31	Position	Position feedback [SINC]

Tab. 42: Status byte 5 ... 8 (actual value 2) - direct task

Record selection

Status byte 3 (record number) – record selection		
Bit	Function	Description
0 ... 7	Record number	Feedback of record number

Tab. 43: Status byte 3 (record number) – record selection

Status byte 4 – record selection		
Bit	Function	Description
4	reserved	–

Tab. 44: Status byte 4 – record selection

Status byte 5 ... 8 (actual value 2) - record selection		
Bit	Function	Description
0 ... 31	Position	Position feedback [SINC]

Tab. 45: Status byte 5 ... 8 (actual value 2) - record selection

8.2.6 Start of positioning

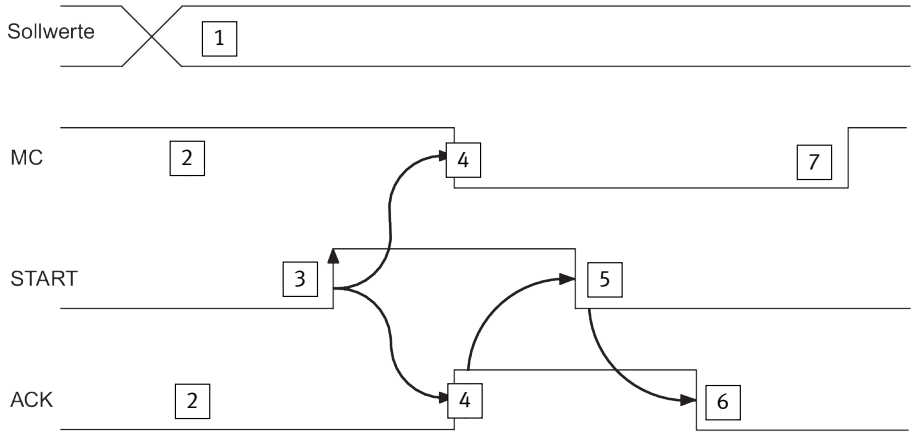

Fig. 12: Timing diagram

1 Setpoint values pre-selected
– With controller via I/O interface by creation of signals DIN1 ... DIN5 (record number)

5 Reaction of controller to [4]: START=0

6 Reaction of CMXH to [5]: ACK=0

7 Positioning task completed: MC=1

– With controller via CANopen interface, and control via Modbus TCP by creation of setpoint values byte 3 ...8 and byte 13 ... 16 (depending on operating mode, record number or target position and velocity as well as positioning absolute or relative target position)

2 Requirements for START: MC=1; ACK=0

3 Start signal by controller: START=1

4 Response of the CMXH to rising edge of START [3]: ACK=1; MC=0

8.3 Controller via I/O interface

8.3.1 General

If the controller is activated via the I/O interface [X2], only the record selection operating mode is available. The operating modes of direct mode and jogging are not available.
Record 0 is reserved for homing. Records 1 ... 31 configured with the FCT are selected randomly by the higher-order controller via the binary coded DIN1 ... DIN5 inputs.
For example, the other inputs and outputs serve to start the selected record or to output status messages.

8.3.2 Communication

Communication is via the I/O interface [X2].

NOTICE

PNP I/Os must be used.

Pin	Function		Description	
1	Output: ready for enable	RDYEN	0	Not ready for enable
			1	Ready for enable
2	Input 1 (value 1)	DIN1	Record selection, records 0 ... 31 (record 0 = homing) The inputs are evaluated together.	
3	Input 2 (value 2)	DIN2		
4	Input 3 (value 4)	DIN3		
5	Input 4 (value 8)	DIN4		
6	Input 5 (value 16)	DIN5		
7	Output +24 V	24 V logic	Logic voltage +24 V	
8	Input: start record	START	Start record or homing run by rising edge	
9	Input: enable drive	ENABLE	0	Block drive and operation
			1	Enable drive and operation
10	Input: acknowledge error	RESET	Acknowledge error by rising edge	
11	Output: drive enabled	ENABLE	0	Drive and operation blocked
			1	Drive and operation enabled
12	Output: error	FAULT	0	No error
			1	Error is pending
13	Output: acknowledge start	ACK	0	Ready for start
			1	Start executed
14	Output: motion complete	MC	0	Positioning task active
			1	Positioning task completed
15	0 V	GND24	Logic voltage reference potential	

Tab. 46: Description of the input and output interface [X2]

8.3.3 Examples

NOTICE

If a malfunction occurs during the process (➔ 9 Diagnostics).

Enable operation

Requirements:

- The position of the axis zero point AZ was correctly parameterised via the FCT.
- The drive is enabled with ENABLED=1, and no error is present, FAULT=0.
- START=0 must be pending.
- ACK=0 and MC=1 must be pending.

1. Select the homing (record number 0) by applying o all five binary coded inputs (pin 2 ... pin 6) the DIN1 ... DIN5=0 signal.
2. Apply the START=1 signal to start homing.
   - The selected record number (record number 0 = homing) is accepted and started through a rising edge at START.
   - The signal ACK = 1 is applied as soon as homing has been started.
   - As soon as the reference position is reached, the signal MC=1 is applied.

Start of a record (record selection mode)

Requirements:

- The drive is enabled with ENABLED=1, and no error is present, FAULT=0.
- Homing has been executed successfully.
- START=0 must be pending.
- ACK=0 and MC=1 must be pending.

1. Select a record by applying signals corresponding to the required record number to the binary coded inputs (pin 2 ... 6).
   - Example for the selection of record number 6:
     - DIN1=0, DIN2=1, DIN3=1, DIN4=0, DIN5=0
2. Apply the START=1 signal to start the selected record.
   - The selected record number is accepted by a rising edge at START and the record is started.
   - The signal ACK=1 is applied as soon as the record has been started.
   - As soon as the target position is reached, the MC=1 signal is applied.

8.4 Controller via CANopen interface

8.4.1 General

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

8.4.2 Communication

In a CANopen network, the CMXH controller behaves as a slave with cyclical data exchange. In each case, 8 bytes of control data and 8 bytes of status data (2 PDOs with 8 bytes each in send and receive direction) are exchanged between the higher-order controller (PLC/IPC) and the controller optionally with additional FPC with 8 bytes each (1 PDO) in send and receive direction. The data exchange takes place in the form of telegrams with a distinction between process data objects (PDO) and service data objects (SDO). Control data are transferred via transmit PDOs and status data via receive PDOs. The SDOs can be used to access objects defined in the appendix.

NOTICE

In the direct operating mode the desired acceleration and jerk value is parameterised directly in the object directory via a service data object or the FCT (direct operating parameter preset on the "Gantry" screen). You can find an overview of all CANopen objects in the appendix (➔ 11 CANopen object overview).

Transmit PDOs					
Index	Sub-index	Designation	Type	Control byte	Explanation
3000h	0	CCONx	uint8	1	➔ 8.2.4 Description of the CCON/CPOS control bytes
3001h	0	CPOSx	uint8	2	
3002h	0	Record selection mode: setpoint record number Direct mode: CDIRx	uint8	3	
3003h	0	Direct mode: setpoint velocity [% of the basic value]	uint8	4	➔ PNU 540
3004h	0	Target position X (only in direct mode)	int32	5 ... 8	32 bits Unit [0.1 mm]
3010h	0	CCONy	uint8	9	
3011h	0	CPOSy	uint8	10	
3012h	0	CDIRy	uint8	11	
3013h	0	Reserved	uint8	12	
3014h	0	Target position Y (only in direct mode)	int32	13 ... 16	32 bits Unit [0.1 mm]

Tab. 47: Transmit PDOs

Receive-PDOs					
Index	Sub-index	Designation	Type	Status byte	Explanation
3020h	0	SCONx	uint8	1	➔ 8.2.5 Description of status bytes SCON/SPOS
3021h	0	SPOSx	uint8	2	
3022h	0	Record selection: actual record number Direct mode: SDIRx	uint8	3	
3023h	0	Direct mode: actual velocity [% of the basic value]	uint8	4	➔ PNU 540

Receive-PDOs					
Index	Sub-index	Designation	Type	Status byte	Explanation
3024	0	Actual position X	int32	5 ... 8	32 bits Unit [0.1 mm]
3030h	0	SCONy	uint8	9	
3031h	0	SPOSy	uint8	10	
3032	0	Direct mode: SDIRy	uint8	11	
3033h	0	Reserved	uint8	12	
3034h	0	Actual position Y	int32	13 ... 16	32 bits Unit [0.1 mm]

Tab. 48: Receive-PDOs

NOTICE

- Use the EDS file for configuration in a CANopen network. You can find a current EDS file on the Festo Internet page (➔ www.festo.com).

8.4.3 Examples

NOTICE

- If a malfunction occurs during the process (➔ *9* Diagnostics).

Enable operation

Requirements:

– The CANopen interface is selected as control interface (➔ 7.4.1 Create new drive configuration/change drive configuration).
– There is no error.
– The signals STO1=1, STO2=1 and ESTOP=1 must be present at the inputs of the interface for switch-off functions [X4] (➔ 6.2.5 Switch-off functions interface [X4]).

1. As soon as the controller is ready, SCONx.RDYEN=1 and SPOSx.MC=1 are set.
   – CPOSx.START=0, CPOSy.START=0 and CPOSx.HOM=0 must be set.
2. Enable the drive by setting CCONx.ENABLE=1.
   – As soon as this status has been reached, SCONx.ENABLED=1 is set.
3. Enable operation by setting CCONx.STOP=1.
   – As soon as this status has been reached, SCONx.OPEN=1 is set.

The operation is enabled (controlled status).

Execute homing

Requirements:

– The position of the axis zero point AZ was correctly parameterised via the FCT.
– Operation is enabled, SCONx.OPEN=1.
– CPOSx.START=0, CPOSy.START=0, CPOS.HOM=0, CPOSx.JOGP=0, CPOSx.JOGN=0, CPOSy.JOGP=0 and CPOSy.JOGN=0 must be set.
– SPOSx.ACK=0 and SPOSx.MC=1 must be set.

1. Set CPOSx.HOM=1.
   – Homing is started with detection of the rising edge at CPOSx.HOM
2. Set CPOSx.HOM=0 as soon as SPOSx.ACK=1 has the value 1.
   – SPOSx.MC=1 and SPOSx.REF=1 are set as soon as the reference position is reached.

Homing is completed.

Start of a record (record selection mode)

Requirements:
– Operation is enabled, SCONx.OPEN=1.
– Homing has been executed successfully, SPOSx.REF=1.
– It must be CPOSx.START=0, CPOSy.START=0, CPOSx.HOM=0, CPOSx.JOGP=0, CPOSx.JOGN=0, CPOSy.JOGP=0 and CPOSy.JOGN=0.
– SPOSx.ACK=0 and SPOSx.MC=1 must be set.

1. Set CCONx.OPM=0.
   – The record selection operating mode is selected.
2. Write the desired record number to control byte 3 of the output data.
3. Set CPOSx.START=1 and CPOSy.START=1.
   – With detection of the rising edge at CPOSx.START and CPOSy.START, the pending record number is accepted and the selected record is started.
   – While the record is being executed, SPOSx.MC=0.
   – As soon as the record has been concluded, SPOSx.MC=1.
4. Set CPOSx.START=0 and CPOSy.START=0 as soon as SPOSx.ACK = 1.

Start of a direct application (direct mode)

Requirements:
– Operation is enabled, SCONx.OPEN=1.
– Homing has been executed successfully, SPOSx.REF=1.
– It must be CPOSx.START=0 and CPOSy.START=0, CPOSx.HOM=0, CPOSx.JOGP=0, CPOSx.JOGN=0, CPOSy.JOGP=0 and CPOSy.JOGN=0.
– SPOSx.ACK=0 and SPOSx.MC=1 must be set.

1. Set CCONx.OPM=1.
   – The “direct mode” operating mode is selected.
2. Define the parameters of the direct application.
   – Write the desired velocity [% of the base value] in control byte 4 of the output data. (➔ PNU 540)
   – Write the target position in X-direction into control bytes 5 ... 8 of the output data.
   – Write the target position in Y-direction into control bytes 13 ... 16 of the output data.
3. Set whether positioning should be absolute or relative.
   Positioning absolute:
   – Set CDIRx.ABS=0.
   Positioning relative:
   – Set CDIRx.ABS=1.

4. Set CPOSx.START=1 and CPOSy.START=1.
   - The direct application is accepted and started with detection of the rising edge at CPOSx.START and CPOSy.START.
   - While the direct application is being executed SPOSx.MC=0.
   - As soon as the direct application has been completed, SPOSx.MC=1.
5. Set CPOSx.START=0, CPOSy.START=0 as soon as SPOSx.ACK = 1.

8.5 Control via Modbus TCP

8.5.1 General

Modbus TCP is an open communication protocol based on the master-slave architecture. It is an established standard for communication via Ethernet-TCP/IP in automation technology. The controller can be controlled via the Ethernet port with the "control via Modbus TCP" function. The controller is pre-parameterised for this purpose with the FCT (Festo Configuration Tool). It is possible to start and jog both homing and positioning jobs with Modbus TCP. The controller can be actuated via Modbus TCP in the record selection and direct mode operating modes.

8.5.2 Communication

The Modbus TCP connection is established via the Ethernet interface [X5]. It can be used in parallel for a TCP connection with FCT. A maximum of one Modbus TCP/IP connection at a time is possible.
After the TCP connection has been established, it is normally kept open and only disconnected by the controller in case of error, timeout of the connection monitor or by the counterpart station.
Communication with the FCT remains open. The TCP port can be set with the FCT. The default port for Modbus TCP is 502.

Data encoding

Modbus TCP uses a “big-endian” transmission sequence. The “most significant byte” is sent first. The actual data (Modbus: „Register“) are processed word-by-word (2 bytes). It may therefore be necessary to “turn” these 2 bytes at the controller. This applies to the operations (Function-Codes): 0x03, 0x10, 0x17 ➔ 8.5.4 Modbus TCP master configuration.
This generally has already been done by the module if the modules supplied by Festo are used.

Allocation of the FHPP output and input data in the Modbus registers

FHPP output and input data	FHPP byte 1	FHPP byte 2	FHPP byte 3	FHPP byte 4	FHPP byte 5	FHPP byte 6	...	FHPP byte 15	FHPP byte 16
Modbus registers	Register 0x00		Register 0x01		Register 0x02			Register 0x07	

Tab. 49: FHPP data in the Modbus registers

Allocation of the EPFC output and input data in the Modbus registers								
FHPP output and input data	FHPP byte 17	FHPP byte 18	FHPP byte 19	FHPP byte 20	FHPP byte 21	FHPP byte 22	FHPP byte 23	FHPP byte 24
Modbus registers	Register 0x08		Register 0x09		Register 0x0A		Register 0x0B	

Tab. 50: optional EPFC extension of the FHPP data

Modbus TCP telegram

In general, a Modbus TCP telegram is constructed correspondingly ➔ Tab. 51 Structure of Modbus telegram (the most-significant byte is always sent first). On access to the controller the transaction number, the protocol identifier, the number of bytes to follow and the address must be sent before the function code is sent.

Byte no.	**Number of bytes**	**Function**	**Comments**	
1	2	Transaction number	Freely selectable. Returned in the answer.	Most-significant byte
2				Least-significant byte
3	2	Protocol identifier	always 0	Most-significant byte
4				Least-significant byte
5	2	Number of bytes to follow	= n + 2 (n = number of data points from byte 9)	Most-significant byte
6				Least-significant byte
7	1	Address (Unit identifier, Slave-ID)	Can be ignored (e.g. set to 0).	–
8	1	Function code	➔ 8.5.5 Modbus commands	–
9 ...	n	Data	➔ 8.5.5 Modbus commands	–

Tab. 51: Structure of Modbus telegram

8.5.3 Parameterisation of the Modbus TCP station

Before connecting the controller to the Modbus master, control interface, device profile, TCP port and monitoring time for timeout must be parameterised with the FCT plug-in (➔ 7.4.3 Controller).

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Connecting the controller to the PC ➔ 7.2 Network connection via Ethernet.

8.5.4 Modbus TCP master configuration

After parameterisation of the controller, the Modbus TCP master can be configured.

IP address
The IP address of the controller as a Modbus TCP station is identical to the IP address set in the FCT.

Address assignment and Modbus operations
The following operations (Function Codes) are supported:
- Read Holding Registers (0x03)
- Read Exception Status (0x07)
- Write Multiple Registers (0x10)
- Read/Write Multiple Registers (0x17)
- Read Device Identification (0x2B)

The start address is always “0x0000”; the byte sequence is always “Big endian”.
Supported Modbus commands ➔ 8.5.5 Modbus commands.

8.5.5 Modbus commands

Read the process data (Read holding registers)			
Field	Bytes	Values	Byte no.
Read holding registers request (0x03)			
Function code	1	0x03	8
Start address	2	0x0000	9, 10
Quantity of registers	2	0x0008: FHPP 0x000C: FHPP + EFPC	11, 12
Read holding registers response (0x03)			
Function code	1	0x03	8
Byte count	1	0x10: FHPP 0x18: FHPP + EFPC	9
Register value	16, 24	FHPP: Process input data FHPP + EFPC: Process input data ➔ 8.2.1 Overview of control and status bytes	10 ...
Read holding registers exception (0x83)			
Error code	1	0x83	8
Exception code	1	0x01: illegal function 0x02: illegal data address 0x03: illegal data value 0x04: server device failure	9

Tab. 52: Read the process data

Read exception status (Read exception status)			
Field	Bytes	Values	Byte no.
Read exception status request (0x07)			
Function code	1	0x07	8
Read exception status response (0x07)			
Function code	1	0x07	8
Output data	1	0x01 ... 0xFF: Exception status 0x00: no malfunction	9
Read exception status exception (0x87)			
Error code	1	0x87	8
Exception code	1	0x01: illegal function 0x02: illegal data address 0x03: illegal data value 0x04: server device failure	9

Tab. 53: Read exception status

Write process data (Write multiple registers)			
Field	Bytes	Values	Byte no.
Write multiple registers request (0x10)			
Function code	1	0x10	8
Start address	2	0x0000	9, 10
Quantity of registers	2	0x0008: FHPP 0x000C: FHPP + EFPC	11, 12
Byte count	1	0x10: FHPP 0x18: FHPP + EFPC	13
Register value	16, 24	FHPP: Process output data FHPP + EFPC: Process output data ➔ 8.2.1 Overview of control and status bytes	14 ...
Write multiple registers response (0x10)			
Function code	1	0x10	8
Start address	2	0x0000	9, 10
Quantity of registers	2	0x008: FHPP 0x00C: FHPP + EFPC	11, 12
Write multiple registers exception (0x90)			
Error code	1	0x90	8
Exception code	1	0x01: illegal function 0x02: illegal data address 0x03: illegal data value 0x04: server device failure	9

Tab. 54: Write process data

Read and write process data (Read/write multiple registers)			
Field	Bytes	Values	Byte no.
Read/write multiple registers request (0x17)			
Function code	1	0x17	8
Start address read	2	0x0000	9, 10
Quantity of registers read	2	0x0008: FHPP 0x000C: FHPP + EFPC	11, 12
Start address write	2	0x0000	13, 14
Quantity of registers write	2	0x0008: FHPP 0x000C: FHPP + EFPC	15, 16
Byte count write	1	0x10: FHPP 0x18: FHPP + EFPC	17
Registers values write	16, 24	FHPP: Process output data FHPP + EFPC: Process output data ➔ 8.2.1 Overview of control and status bytes	18 ...
Read/write multiple registers response (0x17)			
Function code	1	0x17	8
Byte count	1	0x10: FHPP 0x18: FHPP + EFPC	9
Register value	16, 24	FHPP: Process input data FHPP + EFPC: Process input data ➔ 8.2.1 Overview of control and status bytes	10 ...
Read/write multiple registers exception (0x97)			
Error code	1	0x97	8
Exception code	1	0x01: illegal function 0x02: illegal data address 0x03: illegal data value 0x04: server device failure	9

Tab. 55: Read and write process data

Read device data (Read device identification)			
Field	Bytes	Values	Byte no.
Read device identification request (0x2B)			
Function code	1	0x2B	8
MEI type	1	0x0E	9
Read device ID code	1	0x01: basic device identification 0x02: regular device identification	10
Object ID	1	0x00: (first object to be transferred)	11
Read device identification response (0x2B)			
Function code	1	0x2B	8
MEI Type	1	0x0E	9
Read device ID code	1	Same as request field	10
Conformity level	1	0x01: basic device identification 0x02: regular device identification	11
More follows	1	0x00: no more objects	12
Next object ID	1	0x00: no more objects	13
No of objects	1	Number of objects in this message	14
Object 1	1	➔ 8.5.6 Data objects for Modbus command “Read Device Identification”	15 ...
...	...		
Object n	1		
Read device identification exception (0xAB)			
Error code	1	0xAB	8
Exception code	1	0x01: illegal function 0x02: illegal data address 0x03: illegal data value 0x04: server device failure	9

Tab. 56: Read device data

8.5.6 Data objects for Modbus command “Read Device Identification”

Object ID		Object Name	Access	Contents
Basic	0x00	VendorName	R	Vendor name
	0x01	ProductCode	R	Product code
	0x02	MajorMinorRevision	R	Firmware version
Regular	0x00	VendorName	R	Vendor name
	0x01	ProductCode	R	Product code
	0x02	MajorMinorRevision	R	Firmware version
	0x03	VendorURL	R	Web address of manufacturer
	0x04	ProductName	R	Web address of manufacturer
	0x06	UserApplicationName	R	Project name

Tab. 57: Data objects for Modbus command “Read Device Identification”

8.5.7 TCP/IP connection monitoring (node guard, timeout)

The controller supports monitoring of the TCP/IP connection.
Node guarding is connection monitoring at the application level. If there is a timeout between two messages of the client application, the controller triggers a malfunction with exception status 0x47 or 0x48 and then behaves are parameterised in the FCT in ‘Error management’.
The monitoring time for timeout can be configured with FCT between 100 ms and 5000 ms (➔ 7.4.3 Controller). A value of 0 disables timeout monitoring.

8.5.8 Examples

NOTICE

If a malfunction occurs during the process (➔ 9 Diagnostics).

Enable operation

Requirements:
- There is no error.
- The signals STO1=1, STO2=1 and ESTOP=1 must be present at the inputs of the interface for switch-off functions [X4] (➔ 6.2.5 Switch-off functions interface [X4]).

1. As soon as the controller is ready, SCONx.RDYEN=1 and SPOSx.MC=1 are set.
2. CPOSx.START=0 and CPOSx.HOM=0 must be set.
3. Enable the drive by setting CCONx.ENABLE=1.
   - As soon as this status has been reached, SCONx.ENABLED=1 is set.
4. Enable operation by setting CCONx.STOP=1.
   - As soon as this status has been reached, SCONx.OPEN=1 is set.

The operation is enabled (controlled status).

Execute homing

Requirements:
- The position of the axis zero point AZ was correctly parameterised via the FCT.
- Operation is enabled, SCONx.OPEN=1.

- It must be CPOSx.START=0, CPOSx.HOM=0, CPOSx.JOGP=0, CPOSx.JOGN=0, CPOSy.JOGP=0 and CPOSy.JOGN=0.
- SPOSx.ACK=0 and SPOSx.MC=1 must be set.

1. Set CPOSx.HOM=1.
   - Homing is started with detection of the rising edge at CPOSx.HOM.
2. Set CPOSx.HOM=0 as soon as SPOSx.ACK=1.
   - SPOSx.MC=1 and SPOSx.REF=1 are set as soon as the reference position is reached.

Start of a record (record selection mode)

Requirements:

- Operation is enabled, SCONx.OPEN=1.
- Homing has been executed successfully, SPOSx.REF=1.
- It must be CPOSx.START=0, CPOSx.HOM=0, CPOSx.JOGP=0, CPOSx.JOGN=0, CPOSy.JOGP=0 and CPOSy.JOGN=0.
- SPOSx.ACK=0 and SPOSx.MC=1 must be set.

1. Set CCONx.OPM=0.
   - The record selection operating mode is selected.
2. Write the desired record number to control byte 3 of the output data.
3. Set CPOSx.START=1.
   - With detection of the rising edge at CPOSx.START and CPOSy.START, the pending record number is accepted and the selected record is started.
   - While the record is being executed, SPOSx.MC=0.
   - As soon as the record has been concluded, SPOSx.MC=1.
4. Set CPOSx.START=0, as soon as SPOSx.ACK=1.

Start of a direct application (direct mode)

Requirements:

- Operation is enabled, SCONx.OPEN=1
- Homing has been executed successfully, SPOSx.REF=1.
- It must be CPOSx.START=0, CPOSx.HOM=0, CPOSx.JOGP=0, CPOSx.JOGN=0, CPOSy.JOGP=0 and CPOSy.JOGN=0
- SPOSx.ACK=0 and SPOSx.MC=1 must be set.

1. Set CCONx.OPM=1.
   - The “direct mode” operating mode is selected.
2. Set the desired parameters (target position in X and Y-direction as well as velocity) of the direct application.
   - Write the target position in the X-direction to control bytes 5 to 8 of the output data.
   - Write the target position in the Y-direction to control bytes 13 to 16 of the output data.
   - Write the velocity [% of the base value] to control byte 4 of the output data (➔ PNU 540).
3. Set whether positioning should be absolute or relative.
   Positioning absolute:
   - Set CDIRx.ABS=0.

   Positioning relative:
   - Set CDIRx.ABS=1.

4. Set CPOSx.START=1.
   – The direct application is accepted and started with detection of the rising edge at CPOSx.START.
   – While the direct application is being executed SPOSx.MC=0.
   – As soon as the direct application has been completed, SPOSx.MC=1.
5. Set CPOSx.START=0, as soon as SPOSx.ACK=1.

9 Diagnostics

9.1 Diagnostic memory

A maximum of 200 error messages are stored securely against power failure in the ring buffer of the diagnostic memory.
The diagnostic memory can be read and erased via the Festo Configuration Tool (FCT). Erasing generates a “switch-on event” (malfunction 0x3D). The malfunction counter is not reset as part of this event.

9.2 Malfunction messages

Malfunctions are subdivided into errors, warnings and information. Error messages of the controller that can be parameterised can be defined in the FCT (parameter-side error management) as an error, a warning or information.

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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 (➔ 9.1 Diagnostic memory) in order to see all the recorded messages displayed.

Error (high priority)
An error always has an error response as a result (➔ 9.3.1 Error responses). The error response to some errors can be parameterised via the FCT (parameter-side error management). 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 to prevent it resulting in an error. Warnings have a lower priority than errors and are not displayed on the 7-segment display if they occur when an error is already displayed. Otherwise, they are displayed twice in succession. Warnings do not need to be acknowledged. Warnings are also displayed on the FCT or the controller even if there is an active error.

Information (low priority)
If a malfunction message has been parameterised as “information”, it is not displayed on the 7-segment display. It is stored in the diagnostic memory according to the parameterisation (➔ 9.1 Diagnostic memory).
Malfunction messages can be shown simultaneously via different display components in the form of LED indicators and the 7-segment display.

NOTICE

- Note the following in the display with the 7-segment display:
  - Four characters are displayed in succession followed by a space.
  - Malfunction numbers are represented in hexadecimal form (➔ 9.3.2 Table of malfunction messages).

General malfunction messages

LED display	7-segment display	Malfunction	Priority
○ ☀ ○	A. E. E.	Error in firmware update: switch the device off and on again.	1
○ ☀ ○	E. 0.	System error + malfunction number	2
○ ☀ ○	E. 1.	Error motor 1 + malfunction number	
○ ☀ ○	E. 2.	Error motor 2 + malfunction number	
○ ☀ ○	A. 0.	Warning + malfunction number[1)]	3

1) Only displayed 2x one after the other

Tab. 58: General malfunction messages

CANopen-specific malfunction messages

LED display	Malfunction
☀ ○ ○	Bus line not connected or parameters not configured.
☀ ○ ○	Bus OFF
☀ ○ ○	Warning Limit or Node Guarding

Tab. 59: CANopen-specific malfunction messages

9.3 Malfunctions: causes and remedies

9.3.1 Error responses

The following responses to errors are anticipated. The malfunction message table contains the response for every error set at the factory [in brackets] and what additional responses can be parameterised.

Code letters and description of the error responses		
A	Free run-out	Switch off power stage, no braking ramp.
B	QS delay + power stage off	Quick stop braking ramp (Quick Stop), then switch off the power stage.
C	Motion task delay + power stage off	Braking ramp (of the current motion task), then switch off the power stage.
D	End motion task + power stage off	Execute motion task to end (to MC = 1), then switch off the power stage.
E	QS delay + power stage on	Quick stop braking ramp (Quick Stop), power stage remains switched on afterwards.
F	Motion task delay + power stage on	Braking ramp (of the current motion task), power stage remains switched on afterwards.
G	End motion task + power stage on	Execute motion task to end (to MC = 1), after that the power stage remains switched on.

Tab. 60: Error responses

9.3.2 Table of malfunction messages

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You can parameterise the malfunction messages with the Festo Configuration Tool (FCT) on the Parameterise ‘Error management’ screen.

Explanations for table of malfunction messages:

Can be parameterised as:
F/W/I = Error/Warning/Information (➔ 9.2 Malfunction messages).
Specifies the parameterisation options for a malfunction message. The factory setting is in brackets [here, error].
If a parameterisation option is not available, this is indicated by dashes, e.g. "[F]/-/-", if the malfunction message is treated exclusively as an error.

Can be parameterised as:
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 (➔ 9.3.1 Error responses). The factory setting for the error responses is in brackets.

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 corrupt. – Reload the default parameter file into the device via a firmware update. If the error is still present it means the memory may be defective and the device needs to be replaced. Acknowledgement option: cannot be acknowledged, software reset required. Parameterisable error response(s): [A]			
04	4	Non-permitted 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]			

Hex	Dec	Error name	Type of error/diagnostic memory
05	5	Zero angle determination (Zero angle determination)	Can be parameterised as: [F]/-/- Diagnostic memory: always
The rotor position could not be clearly 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 into a middle position manually. – No load voltage present: connect the load power supply. – The "Safe Torque Off" function is active: check for correct wiring of the safety devices (➔ Tab. 1 Documentation for the system EXCM-30/-40 with CMXH) If wiring is correct: eliminate the cause if possible. – Encoder cables reversed: correct connections. – Encoder or encoder cable is defective: replace the encoder or the encoder cable. – Impermissibly high load: reduce load. – The closed-loop controller parameters are incorrectly set: set closed-loop controller parameters correctly. Acknowledgement option: can be acknowledged if drive enable is not applied. If the malfunction is not remedied it will occur again when the drive is enabled. Parameterisable error response(s): [A]			
06	6	Measuring system (Encoder)	Can be parameterised as: [F]/-/- diagnostic memory: always
An error has occurred during evaluation of the encoder; the position values might 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]			
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. Write a valid parameter set to the device. If the error is still present, the hardware may be defective. Acknowledgement option: error can only be acknowledged after eliminating the cause. 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 the firmware update has been successfully completed. If this error is still present, the hardware may be defective. Acknowledgement option: cannot be acknowledged, software reset required. Parameterisable error response(s): [A]			

Hex	Dec	Error name	Type of error/diagnostic memory
0D	13	Overcurrent (Overcurrent)	Can be parameterised as: [F]/-/- Diagnostic memory: always
Short circuit in the motor, cables or brake chopper. Power stage defective. Incorrect parameterisation of the current regulator. – Check parameterisation of the current regulator. An incorrectly parameterised current regulator can generate currents up to the short-circuit limit; as a rule this is obvious due to the high-frequency whistling. – If the error message appears immediately when the load voltage is applied: short circuit in the power stage. The device must be replaced. – If the error message does not occur until the drive is enabled: – disconnect the motor plug directly at the controller; if the error still occurs: replace the controller. – If the error only occurs when the motor cable is connected: Check motor and cable for short circuits. Acknowledgement option: cannot be acknowledged, software reset required. Parameterisable error response(s): [A]			
0E	14	I^2t motor error (I^2t malfunction motor)	Can be parameterised as: [F]/-/- Diagnostic memory: always
The I^2t limit for the motor has been reached. The motor or the drive system may be undersized 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 (Softwarelimit positive)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The position setpoint has reached or exceeded the software end position while jogging. The error is 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. – Jog the axis of the planar surface gantry in negative direction. Acknowledgement option: error can be acknowledged. Parameterisable error response(s): A, [B], C, E, F			

Hex	Dec	Error name	Type of error/diagnostic memory
12	18	Software limit negative (Softwarelimit negative)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The position setpoint has reached or exceeded the software end position while jogging. The error is 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. – Jog the axis of the planar surface gantry in positive direction. Acknowledgement option: error can be acknowledged. Parameterisable error response(s): A, [B], C, E, F			
13	19	Direction blocked Direction locked	Can be parameterised as: [F]/-/- Diagnostic memory: optional
A limit switch error or a software limit position error has occurred and subsequent positioning in the blocked direction has been initiated. – Check target data. – Check positioning range. – This error can be acknowledged immediately. Afterwards start a corresponding positioning record or move the drive by using the jogging function. Movements in a positive direction are blocked. Acknowledgement option: error can be acknowledged. Parameterisable error response(s): A, [B], C, E, F			
17	23	Logic voltage exceeded (Logic voltage exceeded)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The logic voltage monitor has detected an overvoltage. – Check logic voltage directly at the device. – If the error is still present after a reset, it means that there is an internal defect and the device must 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 voltage monitor has detected an undervoltage. This is either due to an internal defect or an overload/short circuit caused by connected peripherals. – Disconnect device from all peripherals and check whether the error is still present after reset. If it is then there is an internal defect and the device must be replaced. Acknowledgement option: cannot be acknowledged, software reset required. Parameterisable error response(s): [A]			

Hex	Dec	Error name	Type of error/diagnostic memory
1A	26	DC link voltage exceeded (Intermediate circuit voltage exceeded)	Can be parameterised as: [F]/-/- Diagnostic memory: always
Load voltage outside permissible range. Internal braking resistor is overloaded; too much braking energy which cannot dissipate quickly enough. Internal braking resistor defective or internal defect. – Check parameterisation of the load voltage. – Check load voltage; measure load 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]			
1B	27	DC link voltage too low (Intermediate circuit voltage too low)	Can be parameterised as: [F]/W/- Diagnostic memory: optional
Load voltage too low or incorrectly parameterised. – Check parameterisation of the load voltage. – 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. If parameterisation as a warning: the warning disappears when the load voltage is back in the permissible range. For parameterisation as an error: the error can be acknowledged. Parameterisable error response(s): [A]			
1C	28	CAN Node Guarding, FB has master control (CAN Node Guarding, FB has master 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			

Hex	Dec	Error name	Type of error/diagnostic memory
1D	29	CAN bus communication stopped by master, FB has master control (CAN bus communication stopped by master, FB has master 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 by the positioning or edge condition options. – Check parameterisation of the applicable 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 eliminating the cause. Parameterisable error response(s): [A]			
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 to internal flash memory. – Repeat last operation. If the error is still present, then the hardware may be defective. Acknowledgement option: error can only be acknowledged after eliminating the cause. Parameterisable error response(s): [G]			
28	40	Homing required (Homing required)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
A valid homing has not yet been conducted. The reference point is no longer valid (e.g. due to logic voltage failure or because the axis zero point has been changed). – Perform a homing run or repeat the last homing process if it was not completed successfully. Acknowledgement option: error can only be acknowledged after eliminating the cause. Parameterisable error response(s): [B], C, D, E, F, G			

Hex	Dec	Error name	Type of error/diagnostic memory
29	41	Target position behind negative software limit (Target position behind negative software limit)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The start of a positioning process was suppressed because the target is past the relevant software limit switch. – Check target data. – Check positioning range. – Check record type (absolute/relative) Acknowledgement option: error can only be acknowledged after eliminating the cause. Parameterisable error response(s): [B], C, E, F			
2A	42	Target position behind positive software limit (Target position behind positive software limit)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The start of a positioning process was suppressed because the target is past the relevant software limit switch. – Check target data. – Check positioning range. – Check record type (absolute/relative) Acknowledgement option: error can only be acknowledged after eliminating the cause. 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 could not be performed. The firmware version is incompatible with the hardware. – Find the version of your hardware. You can find the compatible firmware versions and download the appropriate firmware from the Festo internet page. For parameterisation as an error: the error can only be acknowledged after the cause is eliminated. Parameterisable error response(s): [A] For parameterisation as a warning: the warning disappears when a new firmware download is started.			
2C	44	Impermissible 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] For parameterisation as a warning: the warning disappears when a record with a valid record number is started.			

Hex	Dec	Error name	Type of error/diagnostic memory
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. For parameterisation as a warning: the warning disappears when the I^2t integral falls below 80%.			
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, velocity, jerk or load too great? Mechanics stiff? – Motor overloaded (current limitation from I^2t monitoring active?) For parameterisation as an error: the error can be acknowledged. Parameterisable error response(s): B, C, [E], F For parameterisation as a warning: the warning disappears when the following error is back in the permissible range.			
30	48	External stop active (Extern stop)	Can be parameterised as: [F]/-/- Diagnostic memory: always
The “External stop” switch-off function at the interface for switch-off functions [X4] is active and the current positioning task has been interrupted. – Deactivate the “External stop” function: apply a voltage +24 V at pin 15 of the interface for switch-off functions [X4]. Acknowledgement option: error can only be acknowledged after eliminating the cause. Parameterisable error response(s): [B]			
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. For 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			

Hex	Dec	Error name	Type of error/diagnostic memory
34	52	Safe Torque Off (STO) (Safe Torque Off (STO))	Can be parameterised as: [F]/-/- Diagnostic memory: optional
Observe the separate documentation for the STO function (➔ Tab. 1 Documentation for the system EXCM-30/-40 with CMXH). The “Safe Torque Off” function has been requested. – Deactivate the “Safe Torque Off” function: apply a voltage of +24 V at pin 2 and pin 3 of the interface for switch-off functions [X4]. Acknowledgement option: error can only be acknowledged after eliminating the cause. Parameterisable error response(s): [A]			
35	53	CAN Node Guarding, warning, FB does not have master control (CAN Node Guarding, warning, FB does not have master control)	Can be parameterised as: -/[W]/- Diagnostic memory: optional
A wire break has occurred or the CAN master has failed. – Check the CAN cable for a wire break: 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 master 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 downtime window. Parameterisation of the window may be too narrow. – Check parameterisation of the standstill window. For 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 read and write routines for the parameter file are blocked. – Wait until the process is complete. The time between downloading two parameter files should be less than 3 seconds. Acknowledgement option: error can be acknowledged. Parameterisable error response(s): [G]			

Hex	Dec	Error name	Type of error/diagnostic memory
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 eliminating the cause. 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 was already a start-up event. – This event is only used for improved documentation of the malfunctions.			
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 occurs again, a command memory module may be defective or an incorrect entry was stored. – Erase the diagnostic memory. If the error still occurs, the controller must be replaced. Acknowledgement option: error can only be acknowledged after eliminating the cause. 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 eliminating the cause. 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 eliminating the cause. Parameterisable error response(s): [A]			

Hex	Dec	Error name	Type of error/diagnostic memory
43	67	FCT connection without master control (FCT connection without master control)	Can be parameterised as: -/[W]/I Diagnostic memory: optional
There is no longer a connection to the FCT, e.g. the cable was disconnected. – Check connection and perform a reset, if necessary. For parameterisation as a warning: the warning disappears when the connection to the FCT is restored.			
44	68	Parameter file not suitable for the firmware (Parameter file not compatible with firmware)	Can be parameterised as: -/[W]/I Diagnostic memory: always
The parameter file that was just written to the device is not suitable for the firmware of that device. As much data as possible are automatically imported from the parameter file. Parameters that cannot be initialised by the parameter file are imported from the default parameter file. If new firmware is required, all parameters might not be written. – Load a valid parameter file into the device. For parameterisation as a warning: the warning disappears when a new parameter file is successfully written.			
47	71	Modbus connection with master control (Modbus connection with master control)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The Modbus connection to the controller was interrupted. – Check the connection and perform a reset. Acknowledgement option: error can be acknowledged. Parameterisable error response(s): [B], C, D, E, F, G			
48	72	Modbus connection without master control (Modbus connection without master control)	Can be parameterised as: -/[W]/I Diagnostic memory: optional
There is no longer a connection to the controller, e.g. the cable was disconnected. – Check the connection and perform a reset. For parameterisation as a warning: the warning disappears if the connection to the controller is re-established			
4C	76	Value range violated (Value is out of range)	Can be parameterised as: [F]/-/- Diagnostic memory: optional
The object value could not be written because the value lies outside the permitted range of values. – Write the object again taking due account of the permitted range of values. Acknowledgement option: error can be acknowledged. Parameterisable error response(s): [B], C, D, [E], F, G			

Hex	Dec	Error name	Type of error/diagnostic memory
4D	77	Bootloader memory error (Bootloader memory error)	Can be parameterised as: [F]/-/- Diagnostic memory: always
A defective memory cell was detected during the boot process. – Check the connection and perform a reset. Acknowledgement option: cannot be acknowledged, software reset required. Parameterisable error response(s): A			

Tab. 61: Table of malfunction messages

9.3.3 Problems with the Ethernet connection

Connection to the controller not possible

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The network settings of the controller at delivery can be found at ➔ 7.2.2 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 accessible in your network.
  – Check the network settings of your computer. Contact your network administrator, if necessary.
  – Carry out a network scan via the FCT (➔ 7.2.2 Network settings).

9.3.4 Other problems and remedies

Problem	Cause and remedy
The 7-segment display is not on	No or too little logic voltage is present. – Check the logic voltage. – Observe the data in the attachment (➔ 10.1.4 Electrical Characteristics).
The controller does not work at all	Short circuit, line interrupt or incorrect pin allocation. – Check all cables and connections as well as the pin allocation. – Observe the notes in the assembly instructions for the cables and plugs used. Burned-out internal fuse: internal short circuit. – Replace the controller.
The controller does not achieve the specified performance data	Incorrect control signals of the higher-order controller (signals/level). – Check the control program; see the timing diagram (➔ 8.2.6 Start of positioning). Incorrect closed-loop controller setting. – Observe the notes in the online help section of the FCT plug-in for the correct settings of the closed-loop controller parameters. Error in the power supply. – Observe the tolerances of the data in the appendix (➔ 10.1.4 Electrical Characteristics).

Tab. 62: Other problems and remedies

10 Technical appendix

10.1 CMXH

10.1.1 General features

Property		Specification/value
Type of mounting		With H-rail clip on H-rail
		With screws in the mounting slots
Weight	[kg]	0.7
Supported kinematic systems		Planar surface gantry EXCM-30
		Planar surface gantry EXCM-40
Dimensions		(➔ www.festo.com/catalogue)

Tab. 63

10.1.2 Operating and environmental conditions

Property		Specification/value
Ambient temperature	[°C]	0 ... +50
Storage temperature	[°C]	–25 ... +75
Relative humidity (at 25 °C)	[%]	0 ... 90 (non-condensing)
Degree of protection		IP20 (with full pin allocation)
Corrosion resistance class (CRC)		1
Degree of contamination in accordance with EN 50178		2[1)]
Permissible installation altitude (above sea level)	[m]	< 2000
Vibration resistance in accordance with EN 60068-2-6		with wall mounting: severity level 2
		with H-rail mounting: severity level 1
Shock resistance in accordance with EN 60068-2-27		with wall mounting: severity level 2
		with H-rail mounting: severity level 1

1) The pollution degree must be set by the type of installation (e.g. installation in a control cabinet with IP54 degree of protection).

Tab. 64

10.1.3 Product conformity and approvals

Technical data, safety engineering

Approval information, safety engineering	
CE	
Type-examination	The functional safety engineering of the product has been certified by an independent testing body, see EC-type examination certificate ➔ www.festo.com/sp
Certificate issuing authority	TÜV Rheinland, Certification Body of Machinery, NB 0035
Certificate no.	01/205/5519.01/21
UKCA	
Type-examination	The functional safety engineering of the product has been certified by an independent body, see UK-type examination certificate ➔ www.festo.com/sp
Certificate issuing authority	TUV Rheinland UK Ltd, UK Approved Body No. 2571
Certificate no.	01/205U/5519.00/22

Tab. 65: Approval information, safety engineering

Product conformity and approvals	
CE marking (see declaration of conformity ➔ www.festo.com)	in accordance with EU EMC Directive[1)]
	in accordance with EU Machinery Directive
Approvals	RCM (Regulatory Compliance Mark)

1) The component is intended for operation in the industrial sector. Outside industrial environments, e.g. in commercial and mixed-residential areas, measures to suppress interference may be required.

Tab. 66

10.1.4 Electrical Characteristics

Feature			CMXH
Load supply[1)]	Nominal voltage	[V]	24 ±10% or 48 ±10%
	Nominal current	[A]	10
	Maximum current	[A]	12
Logic supply[1)]	Nominal voltage	[V]	24 ±15 %
	Maximum current without brake (without power supply to the digital outputs)	[A]	0.2
	Maximum current with brake (without power supply to the digital outputs)	[A]	0.9
	Mains buffering time	[ms]	10[2)]
Digital outputs	Maximum current per output	[A]	0.1
Coding of the digital inputs and outputs			PNP
Protection against electric shock (protection from direct or indirect contact in accordance with EN 60204-1)			By PELV circuit (Protected Extra-Low Voltage)
Protection class			III
Encoder resolution			500 pulses/revolution, the internal 4x electronic increase results in 2000 pulses/revolution

1) The connections are not protected from overvoltage

2) The use of a brake reduces the up time during a power failure. Ensure the required mains buffering time through suitable measures (e.g. clocked fixed power supply or buffer module).

Tab. 67

10.2 System characteristics

System characteristics of the product combination consisting of planar surface gantry and controller (➔ www.festo.com/catalogue).

11 CANopen object overview

All parameter numbers (PNU) of the FHPP parameters can be accessed via the service data objects (SDO).

CANopen objects 1000h ...

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: motor overcurrent (I^2t) Bit 2: voltage monitoring error Bit 3: motor overtemperature 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	Last saved error. Error numbers from 16-bit code. Lower 2 bytes (LSB) = error code Upper 2 bytes (MSB) = 0
	1	Standard error field	UINT32	ro	
	2		UINT32	ro	
	3		UINT32	ro	
	4		UINT32	ro	
	5		UINT32	ro	
	6		UINT32	ro	
	7		UINT32	ro	
	8		UINT32	ro	
1005h	0	COB-ID SYNC message	UINT32	rw	COB_ID of SYNC message Specification: 128
1008h	0	Manufacturer device name	String	ro	Type designation of the controller "CMXH-ST2-C5-7-DIOP"
1009h	0	Manufacturer hardware version	String	ro	Hardware version (format "Vxx.yy")
100Ah	0	Manufacturer software version	String	ro	Firmware Version (format "Vxx.yy.bb.pp")

Index	Sub-index	Designation	Type	Attr.	Explanation
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 Specification: 128 + Node-ID
1015h	0	Inhibit time EMCY	UINT16	rw	Inhibit time for emergency message Specification: 0
1018h	0	Identity object	Record	ro	
	1	Vendor-ID	UINT32	ro	Supplier identifier
	2	Part number	UINT32	ro	Part number: 3605478d/ 0x003703E6
	3	Revision number	UINT32	ro	0x10000
	4	Serial Number	UINT32	ro	MAC-ID
1200h	0	SDO server parameter	Record	ro	
	1	COB-ID client ➔ server (rx)	UINT32	ro	Specification 0x600 + node ID
	2	COB-ID server➔ client (tx)	UINT32	ro	Specification 0x580 + node ID
1400h	0	Receive PDO1 communication parameter	Record	ro	X-axis
	1	COB ID of PDO1	UINT32	rw	Specification: 0x200 + node ID
	2	Transmission type	UINT8	rw	Specification: 0xFF
1401h	0	Receive PDO2 communication parameter	Record	ro	Y-axis
	1	COB ID of PDO2	UINT32	rw	Specification: 0x300 + node ID
	2	Transmission type	UINT8	rw	Specification: 0xFF
1402h	0	Receive PDO3 communication parameter	Record	ro	FPC
	1	COB ID of PDO3	UINT32	rw	Specification: 0x400 + node ID
	2	Transmission type	UINT8	rw	Specification: 0xFF
1600h	0	Receive PDO1 Axis X mapping parameter	Record	const	X-axis
	1	CCONx	UINT32	const	0x30000008
	2	CPOSx	UINT32	const	0x30010008

Index	Sub-index	Designation	Type	Attr.	Explanation
1600h	3	CDIRx	UINT32	const	0x30020008
	4	Control byte 4	UINT32	const	0x30030008
	5	Target position X	UINT32	const	0x30040020
1601h	0	Receive PDO2 axis Y mapping parameter	Record	const	Y-axis
	1	CCONy	UINT32	const	0x30100008
	2	CPOSy	UINT32	const	0x30110008
	3	CDIRy	UINT32	const	0x30120008
	4	Control byte 12	UINT32	const	0x30130008
	5	Target position Y	UINT32	const	0x30140020
1602h	0	Receive PDO3 FPC mapping parameter	Record	const	FPC
	1	FPCC	UINT32	const	0x31000008
	2	Subindex	UINT32	const	0x31010008
	3	PNU	UINT32	const	0x31020008
	4	Parameter value	UINT32	const	0x31020020
1800h	0	Transmit PDO 1 Axis X communication parameter	Record	ro	
	1	COB ID of PDO	UINT32	rw	Specification: 0x180 + node ID
	2	Transmission type	UINT8	rw	Specification: 0xFF
	3	Inhibit time	UINT16	ro	0x000
	4	Compatibility entry	UINT32	ro	0x00000000
	5	Event timer	UINT16	ro	Specification: 0x0000
1801h	0	Transmit PDO2 axis Y communication parameter	Record	ro	
	1	COB ID of PDO	UINT32	rw	Specification: 0x280 + node ID
	2	Transmission type	UINT8	rw	Specification: 0xFF
	3	Inhibit time	UINT16	ro	0x000
	4	Compatibility entry	UINT32	ro	0x00000000
	5	Event timer	UINT16	ro	Specification: 0x0000

Index	Sub-index	Designation	Type	Attr.	Explanation
1802h	0	Transmit PDO3 FPC communication parameter	Record	ro	
	1	COB ID of PDO	UINT32	rw	Specification: 0x380 + node ID
	2	Transmission type	UINT8	rw	Specification: 0xFF
	3	Inhibit time	UINT16	ro	0x000
	4	Compatibility entry	UINT32	ro	0x00000000
	5	Event timer	UINT16	ro	Specification: 0x0000
1A00h	0	Transmit PDO1 Axis X mapping parameter	Record	const	X-axis
	1	SCONx	UINT32	const	0x30200008
	2	SPOSx	UINT32	const	0x30210008
	3	SDIRx	UINT32	const	0x3022008
	4	Status byte 4	UINT32	const	0x30230008
	5	Actual position X	UINT32	const	0x30240020
1A01h	0	Transmit PDO2 axis Y mapping parameter	Record	const	Y-axis
	1	SCONy	UINT32	const	0x30300008
	2	SPOSy	UINT32	const	0x30310008
	3	SDIRy	UINT32	const	0x30320008
	4	Status byte 12	UINT32	const	0x30330008
	5	Actual position Y	UINT32	const	0x30340020
1A02h	0	Transmit PDO3 FPC mapping parameter	Record	const	FPC
	1	FPCS	UINT32	const	0x31200008
	2	Subindex	UINT32	const	0x31210008
	3	PNU	UINT32	const	0x31220010
	4	Parameter value	UINT32	const	0x31230020

Tab. 68: CANopen object overview

CANopen object overview 2000 ...

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SDO communication is implemented by the 2000 series CANopen objects. The SDO object number consists of the constant 2000h and the parameter number (PNU). The parameter number (PNU) must be converted into a hexadecimal number.
SDO index = 2000h + PNU
Example "PNU 100 (= 64h)": 2000h + 64h = 2064h

CANopen object overview 3000 ...

Index	Sub-index	Designation	Type	Attr.	Explanation
3000h	0	X_CCON	UINT8	wo	Control byte CCONx (➔ 8.2.4 Description of the CCON/CPOS control bytes)
3001h	0	X_CPOS	UINT8	wo	CPOSx control byte (➔ 8.2.4 Description of the CCON/CPOS control bytes)
3002h	0	X_REC_NR/CDIR	UINT8	wo	Record selection: target record number Direct mode: CDIRx
3003h	0	X_RES/DEM_VAL1/ PARA1	UINT8	wo	Direct mode: setpoint velocity [% of the base value] ➔ PNU 540
3004h	0	X_TARGET_POS	INT32	wo	Direct mode: target position X-axis Unit: [SINC] (1mm = 1000 SINC)
3010h	0	Y_CCON	UINT8	wo	Byte 1: Control byte CCONy (➔ 8.2.4 Description of the CCON/CPOS control bytes)
3011h	0	Y_CPOS	UINT8	wo	Byte 1: CPOSy control byte (➔ 8.2.4 Description of the CCON/CPOS control bytes)
3012h	0	Y_REC_NR/CDIR	UINT8	wo	Reserved
3013h	0	Y_RES/DEM_VAL1/ PARA1	UINT8	wo	Reserved
3014h	0	Y_TARGET_POS	INT32	wo	Direct mode: target position Y-axis Unit: [SINC] (1mm = 1000 SINC)

Index	Sub-index	Designation	Type	Attr.	Explanation
3020h	0	X_SCON	UINT8	ro	Byte 1: SCONx status byte (➔ 8.2.5 Description of status bytes SCON/ SPOS)
3021h	0	X_SPOS	UINT8	ro	Byte 2: SPOSx status byte (➔ 8.2.5 Description of status bytes SCON/ SPOS)
3022h	0	X_REC_NR/SDIR	UINT8	ro	Record selection: actual record number Direct mode: SDIRx
3023h	0	X_RSB/ACT_VAL1	UINT8	ro	Direct mode: actual velocity [% of the base value] ➔ PNU 540
3024h	0	X_ACT_POS	INT32	ro	Actual position X-axis Unit: [SINC] (1mm = 1000 SINC)
3030h	0	Y_SCON	UINT8	ro	Byte 9: SCONy status byte (➔ 8.2.5 Description of status bytes SCON/ SPOS)
3031h	0	Y_SPOS	UINT8	ro	Byte 10: SPOSy status byte (➔ 8.2.5 Description of status bytes SCON/ SPOS)
3032h	0	Y_REC_NR/SDIR	UINT8	ro	Reserved
3033h	0	Y_RSB/ACT_VAL1	UINT8	ro	Reserved
3034h	0	Y_ACT_POS	INT32	ro	Actual position Y-axis Unit: [SINC] (1mm = 1000 SINC)
3100h	0	FPCC	UINT8	wo	–
3101h	0	Subindex/Packet ID	UINT8	wo	–
3102h	0	PNU	UINT16	wo	–
3103h	0	PWE	INT32	wo	–
3120h	0	FPCS	UINT8	ro	–
3121h	0	Subindex/Packet ID	UINT8	ro	–

Index	Sub-index	Designation	Type	Attr.	Explanation
3122h	0	PNU	UINT16	ro	–
3123h	0	PWE	INT32	ro	–

Tab. 69: CANopen object overview 3000 ...

12 FHPP parameters

12.1 FHPP parameter overview

The controller contains a parameter set with the following structure.

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General instructions for the parameter names: the names are mostly based on the CANopen device profile CiA 402. Some names may vary from product to product while the function remains the same.

12.1.1 Overview of device data

Version numbers	PNU (SDO)	Subindex	Type
Manufacturer's hardware version (Manufacturer Hardware Version)	100 (2064h)	1	uint16
Manufacturer's firmware version (Manufacturer Firmware Version)	101 (2065h)	1 ... 4	uint16
FHPP version (Version FHPP)	102 (2066h)	1	uint16
Required software version (Required Software Version)	104 (2068h)	1	uint16

Tab. 70: Version numbers

Identification	PNU (SDO)	Subindex	Type
Type of controller (Controller Type)	115 (2073h)	1 ... 5	uint8
Manufacturer's device name (Manufacturer Device Name)	120 (2078h)	1 ... 30	char
User's device name (User Device Name)	121 (2079h)	1 ... 30	char
Name of the drive manufacturer (Drive Manufacturer Name)	122 (207Ah)	1 ... 30	char
HTTP address of manufacturer (HTTP Drive Catalog Address)	123 (207Bh)	1 ... 30	char
Festo order number (Festo Order Number)	124 (207Ch)	1 ... 30	char

Tab. 71: Identification

HMI parameters	PNU (SDO)	Subindex	Type
Master control (Controllogic)	125 (207Dh)	1	uint8
Data memory control (Data Memory Control)	127 (207Fh)	1 ... 4	uint8

Tab. 72: HMI parameters

12.1.2 Diagnostics

Diagnostic parameters	PNU (SDO)	Subindex	Type
Diagnostic event (Diagnostics Event)	200 (20C8h)	1 ... 200	uint8
Diagnostic number (Diagnostics Number)	201 (20C9h)	1 ... 200	uint16
Time stamp (Time Stamp)	202 (20CAh)	1 ... 200	uint32
Additional information (Additional Information)	203 (20CBh)	1 ... 200	uint32
Diagnostic memory parameters (Diagnostics Memory Parameter)	204 (20CCh)	3, 4	uint8
Device malfunction (Device Fault)	205 (20CDh)	1	uint16
Current malfunction messages (Actual Malfunction Messages)	220 (20DCh)	1 ... 32	uint32
Current warning messages (Actual Warning Messages)	221 (20DD)	1 ... 32	uint32
Current malfunction can be acknowledged (Actual Acknowledged Malfunction)	230 (20E6h)	1	uint8
Permitted error response 1 (Permissible Error Reaction 1)	234 (20EAh)	1 ... 255	uint16
Error response 1 (Error Reaction 1)	242 (20F2h)	1 ... 255	uint16
Malfunction handling 1 (Malfunction Handling 1)	246 (20F6h)	1 ... 255	uint16
Safety status (Safety State)	280 (2118h)	1	uint8

Tab. 73: Diagnostic parameters

12.1.3 Process data

General process data	PNU (SDO)	Subindex	Type
Position values (Position Values)	300 (212Ch)	1, 2 and 5, 6	int32
Local digital inputs (Local Digital Inputs)	303 (212Fh)	1	uint32
Local digital outputs (Local Digital Outputs)	304 (2130h)	1	uint32
Mileage (Mileage)	305 (2131h)	1, 2	int32
FHPP status information (FHPP State Information)	320 (2140h)	1 ... 4	int32
FHPP control information (FHPP Control Information)	321 (2141h)	1 ... 4	int32/ uint32

Tab. 74: General process data

12.1.4 Record list

Record data	PNU (SDO)	Subindex	Type
Record control byte 1 (Record Control Byte 1)	401 (2191h)	1 ... 31	uint8
Target position X (Target Position X)	404 (2194h)	1 ... 31	int32
Target position Y (Target Position Y)	405 (2195h)	1 ... 31	int32
Velocity (Velocity)	406 (2196h)	1 ... 31	int32
Acceleration (Acceleration)	407 (2197h)	1 ... 31	int32
Jerk (Jerk)	409 (2199h)	1 ... 31	uint32
Max. following error (Max. Following Error)	424 (21A8h)	1 ... 31	uint8

Tab. 75: Record data

12.1.5 Project data

General project data	PNU (SDO)	Subindex	Type
Project zero point (Project Zero Point)	500 (21F4h)	1, 2	int32
Software end position (Software Limit)	501 (21F5h)	1 ... 4	int32
Maximum permitted velocity (Max. Velocity)	502 (21F6h)	1	int32
Maximum permitted acceleration (Max. Acceleration)	503 (21F7h)	1	int32

Tab. 76: General project data

12.1.6 Direct mode

Position direct mode	PNU (SDO)	Subindex	Type
FHPP direct mode settings (FHPP Direct Mode Settings)	524 (220Ch)	1	uint8
Velocity slow – phase 1 (Velocity Slow – Phase 1)	530 (2212h)	1	int32
Velocity fast – phase 2 (Velocity Fast – Phase 2)	531 (2213h)	1	int32
Acceleration/deceleration (Acceleration/Deceleration)	532 (2214h)	1	int32
Time duration phase 1 (Time Phase 1)	534 (2216h)	1	uint16
Base value velocity (Base Value Velocity)	540 (221Ch)	1	int32
Acceleration in direct mode (Acceleration in Direct Mode)	541 (221Dh)	1	int32
Jerk in direct mode (Jerk in Direct Mode)	543 (221Fh)	1	uint32
Max. following error in direct mode (Max. Following Error in Direct Mode)	549 (2225h)	1	int32

Tab. 77: Position direct mode

12.1.7 Group of factors

Group of factors	PNU (SDO)	Subindex	Type
Position tens exponent (Position Notation Index)	600 (2258h)	1	int8
Position unit of measurement (Position Dimension Index)	601 (2259h)	1	uint8

Tab. 78: Group of factors

12.1.8 Axis parameters: electric drives

Homing parameters	PNU (SDO)	Subindex	Type
Velocities (Velocities)	1012 (23F4h)	1	int32
Acceleration/deceleration (Acceleration/Deceleration)	1013 (23F5h)	1	int32
Max. torque (Max. Torque)	1015 (23F7h)	1	int16

Tab. 79: Homing parameters

Closed-loop controller parameters	PNU (SDO)	Subindex	Type
Target message window reached (Position Target Window)	1022 (23FEh)	1	int32
Target cushioning time reached (Position Window Time)	1023 (23FFh)	1	uint16
Current I2t value (Actual I2t Value)	1027 (2403h)	1, 2	uint16
Quick stop deceleration (Quick Stop Deceleration)	1029 (2405h)	1	int32

Tab. 80: Closed-loop controller parameters

Standstill monitoring	PNU (SDO)	Subindex	Type
Standstill message window (Standstill Position Window)	1042 (2412h)	1	int32
Standstill delay time (Standstill Window Time)	1043 (2013h)	1	uint16

Tab. 81: Standstill monitoring

Following error monitoring	PNU (SDO)	Subindex	Type
Following error delay time (Following Error Timeout)	1045 (2415h)	1	uint16

Tab. 82: Following error monitoring

General drive data	PNU (SDO)	Subindex	Type
Current DC link voltage (Actual Intermediate Circuit Voltage)	1073 (2431h)	1	uint32
Current control section voltage (Actual Control Section Voltage)	1074 (2432h)	1	uint32

Tab. 83: General drive data

12.2 Description of parameters as per FHPP

12.2.1 Representation of parameter entries

1 **PNU 1001**	2 **encoder resolution (Encoder Resolution)**			
3 Subindex 1.2	4 class: array	5 Data type: uint8	6 FW ...	7 access: ro
8 The encoder resolution is the ratio ...				
9 Subindex 1	10 delete EEPROM (Delete EEPROM)			
11 depends on the installed encoder, default: 0x000007D0 (2000)				
9 Subindex 2	10 motor revolutions (Motor Revolutions)			
11 Fix: 0x00000001 (1)				

Tab. 84: Representation of parameter entries

1 parameter number (PNU
2 parameter name
3 list of subindexes of the parameter (1: no subindex, simple variable)
4 class (Class):
– Var: contains only one value
– Array: contains several values
– Struct: summary of several variables
5 data type (Data type):
Values without sign (8, 16, 32 bit)
– uint8: 0 ... 255
– uint16: 0 ... 65.535
– uint32: 0 ... 4.294.967.295
Values with sign (8, 16, 32 bit)
– int8: –128 ... 127
– int16: –32.768 ... 32.767
– int32: –2.147.483.648 ... 2.147.483.647
Character (8 bit)
– char: 0 ... 255 (ASCII)
6 valid from firmware version (... = all)
7 access (read/write authorisation):
– ro: read only
– wo: write only
– rw1: reading and writing when power stage is energised
– rw2: read and write only when power stage is switched off
8 description of the parameter
9 Subindex number
10 Name of the subindex
11 Description of the subindex

12.2.2 Device data – version numbers

PNU 100	**Manufacturer's hardware version (Manufacturer Hardware Version)**			
Subindex 1	Class: array	Data type: uint16	FW ...	Access: ro
Reading the hardware version.				
Creation date format (2nd byte/1st byte)				
Byte	Meaning			
1 (LSB)	Year			
2 (MSB)	Month			

Tab. 85

PNU 101	**Manufacturer's firmware version (Manufacturer Firmware Version)**			
Sub-index 1 ... 4	Class: array	Data type: uint16	FW ...	Access: ro
Reading firmware version.				
Subindex 1	Main version number (Major Version Number)			
1th numeral of the firmware version				
Subindex 2	Secondary version number (Minor Version Number)			
2th numeral of the firmware version				
Subindex 3	Revision number (Revision Number)			
3th numeral of the firmware version				
Subindex 4	Build number (Build Number)			
4th numeral of the firmware version				

Tab. 86

PNU 102	**FHPP version (Version FHPP)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: ro
Reading the FHPP version. The FHPP version number of the device consists of 4 numerals (e.g. “xxyy”).				
Format (16 bit, = 4 digits BCD)				
Numerals	Meaning			
xx	Main version number			
yy	Secondary version number			

Tab. 87

PNU 104	**Required software version (Required Software Version)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: ro
Reading the FCT version, which is required for operation of the firmware.				
Format (16 bit, = 4 digits BCD)				
Numerals	Meaning			
xx	Main version number			
yy	Secondary version number			

Tab. 88

12.2.3 Device data – identification

PNU 115	**Controller type (Controller Type)**			
Sub-index 1 ... 5	Class: array	Data type: uint8	FW ...	Access: ro
Reading the configuration of the controller.				
Subindex 1	Motor technology (Motor Technology)			
Technology of the motor				
Value	Meaning			
0x02 (2)	Stepper motors (-ST2)			
Subindex 2	Nominal current class (Nominal Current Class)			
Nominal current of the controller				
Value	Meaning			
0x02 (2)	5 A (C5)			
Subindex 3	Voltage class (Voltage Class)			
Voltage class of the controller				
Value	Meaning			
0x01 (1)	48 V (-7)			
Subindex 4	Fieldbus interface (Field Bus Interface)			
Bus interface of the controller				
Value	Meaning			
0x09 (9)	Digital I/O interface(-DIO)			
Subindex 5	Version of digital inputs/outputs (Digital In/Outputs)			
Version of digital inputs/outputs				
Value	Meaning			
0x01 (1)	PNP			

Tab. 89

PNU 120	**Manufacturer's device name (Manufacturer Device Name)**			
Sub-index 1 ... 30	Class: array	Data type: char	FW ...	Access: ro
Reading the manufacturer's designation of the drive (ASCII, 7-bit). Example: CMXH-ST2-C5-7-DIOP. Unused characters are populated with zero (00_h='\0').				

Tab. 90

PNU 121	**User's device name (User Device Name)**			
Sub-index 1 ... 30	Class: array	Data type: char	FW ...	Access: rw1
Reading or writing the user designation of the drive (ASCII, 7-bit). Unused characters are populated with zero (00_h='\0').				

Tab. 91

PNU 122	**Name of the drive manufacturer (Drive Manufacturer Name)**			
Sub-index 1 ... 30	Class: array	Data type: char	FW ...	Access: ro
Reading the drive manufacturer's name (ASCII, 7-bit). Fixed: "Festo AG & Co. KG" Unused characters are populated with zero (00_h='\0').				

Tab. 92

PNU 123	**HTTP address of manufacturer (HTTP Drive Catalog Address)**			
Sub-index 1 ... 30	Class: array	Data type: char	FW ...	Access: ro
Reading the manufacturer's Internet address (ASCII, 7-bit). Fixed: "http://www.festo.com" Unused characters are populated with zero (00_h='\0').				

Tab. 93

PNU 124	**Festo order number (Festo Order Number)**			
Sub-index 1 ... 30	Class: array	Data type: char	FW ...	Access: ro
Reading the Festo order number/order code (ASCII, 7-bit). Unused characters are populated with zero (00_h='\0').				

Tab. 94

12.2.4 Device data – HMI parameters

PNU 125	**Master control (Control logic)**			
Sub-index 1 ... 5	Class: Var	Data type: uint8	FW ...	Access: ro
Reading the master control. The control interface that currently has master control can enable the drive and start or stop it (control). Control interfaces: – Festo Configuration Tool (FCT): Ethernet – Fieldbus: Modbus or CAN – I/O interface In addition to the parameterised I/O interface, the following conditions must be fulfilled: – STO channels (STO1/STO2) [X4.2/3] = 24 V				
Value	Meaning			SCON.FCT
0x00 (0)	Master control with Festo Configuration Tool (FCT)			1
0x01 (1)	Master control with fieldbus (CANOpen or Modbus) Default after every Power ON (switch on “control section” power supply) or restart controller (FCT).			0
0x02 (2)	Master control with I/O			0

Tab. 95

PNU 127	**Data memory control (Data Memory Control)**			
Sub-index 1 ... 4	Class: Struct	Data type: uint8	FW ...	Access: rw2
Reading or writing the commands for permanent data storage (EEPROM). Reading returns the fixed value that has to be written to trigger the desired function.				
Subindex 1	Delete EEPROM (Delete EEPROM)			
When the object is written and after Power OFF (switch off “control section” power supply) or controller restart (FCT), the data in EEPROM are deleted.				
Value	Meaning			
0x10 (16)	Data in the EEPROM are deleted and the factory settings loaded.			
Note: All user-specific settings will be lost on deletion. The factory settings are loaded in the boot process (after Power ON or controller restart (FCT)). – After deletion, always carry out an initial commissioning.				
Subindex 2	Save data (Save Data)			
By writing the object, the data in EEPROM will be overwritten with the current user-specific settings.				
Value	Meaning			
0x01 (1)	User-specific data are stored in the EEPROM.			
Subindex 3	Reset device (Reset Device)			
By writing the object, the data are read from the EEPROM and taken over as the current settings (EEPROM is not cleared; it is in the same status as after Power OFF/ON of the “control section” power supply).				
Value	Meaning			
0x10 (16)	Reset device (restart firmware without changing the data)			
Subindex 4	Load parameter file (Load Parameter Data)			
By writing the object, parameter values are loaded from the parameter file (permanent data memory of the controller).				
Value	Meaning			
0x10 (16)	Load parameter values from parameter file			

Tab. 96

12.2.5 Diagnostic parameters

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Description of the method of operation of the diagnostic memory ➔ 9.1 Diagnostic memory.

PNU 200	**Diagnostic event (Diagnostics Event)**			
Sub-index 1 ... 200	Class: array	Data type: uint8	FW ...	Access: ro
Reading the type of diagnostic events in the diagnostic memory.				
Value	Meaning			
0x00 (0)	No malfunction (or malfunction message deleted)			
0x01 (1)	Incoming malfunction			
0x04 (4)	Overflow of the timestamp (reserved)			
0x05 (5)	Warning			
0x07 (7)	Switching on			
0x09 (9)	Information			
Subindex 1	Event 1 (Event 1)			
Type of newest/current diagnostic message				
Subindex 2	Event 2 (Event 2)			
Type of 2nd saved diagnostic message				
Sub-index 3 ... 200	Event 3 ... 200 (Event 3 ... 200)			
Type of 3rd ... 200th saved diagnostic message				

Tab. 97

PNU 201	**Diagnostic number (Diagnostics Number)**			
Sub-index 1 ... 200	Class: array	Data type: uint16	FW ...	Access: ro
Reading the detailed specifications in the diagnostic event of the diagnostic numbers. For malfunctions and warnings, this is the exact malfunction number; for configuration events it is the executed function, etc. In the case of an invalid diagnostic entry, the value 0xFFFF is returned.				
Subindex 1	Event 1 (Event 1)			
Newest/current diagnostic message				
Subindex 2	Event 2 (Event 2)			
2nd saved diagnostic message				
Sub-index 3 ... 200	Event 3 ... 200 (Event 3 ... 200)			
3rd ... 200th saved diagnostic message				

Tab. 98

PNU 202	**Time stamp (Time Stamp)**			
Sub-index 1 ... 200	Class: array	Data type: uint32	FW ...	Access: ro
Reading the time [ms] of the diagnostic events since Power ON. The time stamp has the format hh.mm.ss:nnn (hh = hours, mm = minutes, ss = seconds, nnn = milliseconds). In case of overflow, the value of the timestamp jumps from 0xFFFFFFFF to 0 and a new switch-on event (malfunction message 0x3D) is written in the diagnostic memory.				
Subindex 1	Event 1 (Event 1)			
Time of newest/current diagnostic message				
Subindex 2	Event 2 (Event 2)			
Time of 2nd saved diagnostic message				
Sub-index 3 ... 200	Event 3 ... 200 (Event 3 ... 200)			
Time of 3rd ... 200th saved diagnostic message				

Tab. 99

PNU 203	**Additional information (Additional Information)**			
Sub-index 1 ... 200	Class: array	Data type: uint32	FW ...	Access: ro
Reading the additional information for FCT or service personnel.				
Subindex 1	Event 1 (Event 1)			
Additional information for newest/current diagnostic message				
Subindex 2	Event 2 (Event 2)			
Additional information for 2nd saved diagnostic message				
Sub-index 3 ... 200	Event 3 ... 200 (Event 3 ... 200)			
Additional information for 3rd ... 200th saved diagnostic message				

Tab. 100

PNU 204	**Diagnostic memory parameters (Diagnostics Memory Parameter)**			
Subindex 3, 4	Class: Struct	Data type: uint8	FW ...	Access: ro, wo
Reading or deleting the diagnostic memory.				
Subindex 3	Delete diagnostic memory (Delete Memory)			Access: wo
Deleting the diagnostic memory.				
Value	Meaning			
1	Diagnostic memory is deleted			
Subindex 4	Number of entries (Number of Entries)			Access: ro
Read out the number of valid entries in the diagnostic memory				
Value	Meaning			
0 ... 200	Number			

Tab. 101

PNU 205	**Device malfunction (Device Fault)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: ro
Read the active malfunction with the highest priority. If a malfunction is not present, 0xFFFF (65535) is returned.				

Tab. 102

PNU 220	**Current malfunction messages (Actual Malfunction Messages)**			
Sub-index 1 ... 32	Class: array	Data type: uint32	FW ...	Access: ro
Reading all current pending malfunctions. Every diagnostic number becomes a bit number. The parameter values cannot be written. Errors cannot be acknowledged with this PNU. If the bit is set, the malfunction is active.				
Subindex 1	0 entry (0th Entry)			
Diagnostic numbers 0 ... 31				
Subindex 2	1 entry (1st Entry)			
Diagnostic numbers 32 ... 63				
...				
Subindex 32	31. Entry (31th Entry)			
Diagnostic numbers 992 ... 1023				

Tab. 103

PNU 221	**Current warning messages (Actual Warning Messages)**			
Sub-index 1 ... 32	Class: array	Data type: uint32	FW ...	Access: ro
Read all current pending warnings. Every diagnostic number becomes a bit number. The parameter values cannot be written. Warnings cannot be deleted via this PNU. If the bit is set, the warning is active.				
Subindex 1	0 entry (0th Entry)			
Diagnostic numbers 0 ... 31				
Subindex 2	1 entry (1st Entry)			
Diagnostic numbers 32 ... 63				
...				
Subindex 32	31. Entry (31th Entry)			
Diagnostic numbers 992 ... 1023				

Tab. 104

PNU 230	**Current malfunction can be acknowledged (Actual Acknowledged Malfunction)**			
Subindex 1	Class: Var	Data type: uint8	FW ...	Access: ro
Read the acknowledgment type of the currently highest priority malfunction.				
Value	Meaning			
0x00 (0)	The malfunction cannot be acknowledged.			
0x01 (1)	The malfunction is still active; the malfunction can be cleared only after fault clearance.			
0x02 (2)	The malfunction can be acknowledged immediately.			
0xFF (255)	There is no malfunction at all.			

Tab. 105

PNU 234	**Current malfunction can be acknowledged (Actual Acknowledged Malfunction)**			
Sub-index 1 ... 255	Class: array	Data type: uint16	FW ...	Access: ro
Reading the permitted error responses for the malfunctions 0 ... 254. The parameter is implemented as a bit field. A value of 0x0037 means, for example, that error responses 1, 2, 4, 16 and 32 can be parameterised. The value 65535 (0xFFFF) is returned for unassigned diagnostic numbers.				
Value	Meaning			
Output stage off:				
0x0001 (1)	A: no deceleration ramp The malfunction cannot be acknowledged.			
0x0002 (2)	B: after quick-stop deceleration ramp (EMERGENCY STOP)			
0x0004 (4)	C: after deceleration ramp (HALT)			
0x0008 (8)	D: end after positioning record			
Output stage on:				
0x0010 (16)	E: after quick-stop deceleration ramp (EMERGENCY STOP)			
0x0020 (32)	F: after deceleration ramp (HALT)			
0x0040 (64)	D: end after positioning record			
Subindex 1	Malfunction number 0 (Malfunction Number 0)			
Error response for malfunction number 0.				
Subindex 2	Malfunction number 1 (Malfunction Number 1)			
Error response for malfunction number 1.				
Sub-index 3 ... 255	Malfunction number 2 ... 254 (Malfunction Number 2 ... 254)			
Error responses for malfunction numbers 2 ... 254				

Tab. 106

PNU 242	**Error response 1 (Error Reaction 1)**			
Sub-index 1 ... 255	Class: array	Data type: uint16	FW ...	Access: rw2
Reading or parameterisation of the current error response for malfunctions 0 ....254. Definition of the error response and permissible error response. ➔ PNU 234. If the bit is set, the warning is active.				
Subindex 1	Malfunction number 0 (Malfunction Number 0)			
Error response for malfunction number 0.				
Subindex 2	Malfunction number 1 (Malfunction Number 1)			
Error response for malfunction number 1.				
Sub-index 3 ... 255	Malfunction number 2 ... 254 (Malfunction Number 2 ... 254)			
Error responses for malfunction numbers 2 ... 254.				

Tab. 107

PNU 246	**Malfunction handling 1 (Malfunction Handling 1)**			
Sub-index 1 ... 255	Class: array	Data type: uint16	FW ...	Access: rw2
Read or parameterise the current malfunction handling for malfunctions 0 ... 254. Permissible malfunction handling ➔ PNU 238.				
Bit	Value	Meaning		
0 ... 4	–	reserved		
5	0	W: malfunction is parameterised as a warning		
	1	F: malfunction is parameterised as an error		
6	0	Malfunction can be parameterised as an error or warning (bit 5)		
	1	I: malfunction is parameterised as information		
7	0	no entry in the diagnostic memory		
	1	back up in diagnostic memory		
8 ... 15	–	reserved		
Subindex 1	Malfunction number 0 (Malfunction Number 0)			
Error response for malfunction number 0.				
Subindex 2	Malfunction number 1 (Malfunction Number 1)			
Error response for malfunction number 1.				
Sub-index 3 ... 255	Malfunction number 2 ... 254 (Malfunction Number 2 ... 254)			
Error responses for malfunction numbers 2 ... 254.				

Tab. 108

PNU 280	**Safety status (Safety State)**			
Subindex 1	Class: Var	Data type: uint8	FW ...	Access: ro
Reading the enable status of the hardware. The following enable statuses are required for operation:				
Bit	Value	Meaning		
0	0	one or both STO channels = 0 V		
	1	both STO channels = 24 V		
1	Controller enable via fieldbus ➔ PNU 128 or FCT			
	1	always = 1		
	Controller enable via digital input or fieldbus ➔ PNU 128 or FCT			
	0	ENABLE (closed-loop controller enable) [X1.6] = 0 V		
	1	ENABLE (closed-loop controller enable) [X1.6] = 24 V		
2 ... 7	reserved (= 1)			
Note: Only when all bits = 1 can the status be switched to “Ready”.				

Tab. 109

12.2.6 Process data – general process data

PNU 300	**Position values (Position Values)**			
Subindex 1,2,5,6	Class: array	Data type: int32	FW ...	Access: ro
Reading the current position values [SINC] of the position controller.				
Subindex 1	Actual position X-axis (Actual Position X-Axis)			
The current actual position in the X-direction.				
Subindex 2	Setpoint position X axis (Setpoint Position X-Axis)			
Current setpoint position calculated by the servo drive in the X-direction.				
Subindex 5	Actual position Y-axis (Actual Position Y-Axis)			
The current actual position in the Y-direction.				
Subindex 6	Setpoint position Y-axis (Setpoint Position Y-Axis)			
Current setpoint position calculated by the servo drive in the Y-direction.				

Tab. 110

PNU 303	**Local digital inputs (Local Digital Inputs)**			
Subindex 1	Class: Var	Data type: uint32	FW ...	Access: ro
Reading the actual status of the local digital inputs.				
Bit	Meaning			
0	Input [X2.2]			
1	Input [X2.3]			
2	Input [X2.4]			
3	Input [X2.5]			
4	Input [X2.6]			
5	reserved			
6	Input [X2.8]			
7	Input [X2.9]			
8	Input [X2.10]			
0 ... 31	reserved			

Tab. 111

PNU 304	**Local digital outputs (Local Digital Outputs)**			
Subindex 1	Class: Var	Data type: uint32	FW ...	Access: ro
Reading the actual status of the local digital outputs.				
Bit	Meaning			
0	Output [X2.11]			
1	Output [X2.12]			
2	Output [X2.13]			
3	Output [X2.14]			
4	Output [X2.1]			
5 ... 31	reserved			

Tab. 112

PNU 305	**Mileage (Mileage)**			
Subindex 1, 2	Class: array	Data type: uint32	FW ...	Access: ro
Reading the mileage data of the axes. Unit: [0.1 mm].				
Subindex 1	Mileage X-axis (Mileage X-Axis)			
Total mileage in X-direction.				
Subindex 2	Mileage Y-axis (Mileage Y-Axis)			
Total mileage in Y-direction.				

Tab. 113

PNU 320	**FHPP status information (FHPP State Information)**			
Sub-index 1 ... 4	Class: Struct	Data type: uint32/ int32	FW ...	Access: ro
Reading the status data (input data).				
Subindex 1	FHPP status byte 1 ... 4 (FHPP State byte 1 ... 4)			Data type: uint32
Status information for byte 1 ... 4 (SCONx, SPOSx, ...)				
Subindex 2	FHPP status byte 5 ... 8 (FHPP State byte 5 ... 8)			Data type: int32
Status information for byte 5 ... 8 (actual position of X-axis)				
Subindex 3	FHPP status byte 9 ... 12 (FHPP State byte 9 ... 12)			Data type: uint32
Status information for byte 9 ... 12 (SCONy, SPOSy,...)				
Subindex 4	FHPP status byte 13 ... 16 (FHPP State byte 13 ... 16)			Data type: int32
Status information for byte 13 ... 16 (actual position of Y-axis)				

Tab. 114

PNU 321	**FHPP control information (FHPP Control Information)**			
Sub-index 1 ... 4	Class: Struct	Data type: uint32/ int32	FW ...	Access: ro
Reading the control data (output data).				
Subindex 1	FHPP status byte 1 ... 4 (FHPP State byte 1 ... 4)			Data type: uint32
FHPP control information for byte 1 ... 4 (CCONx, CPOSx, ...)				
Subindex 2	FHPP status byte 5 ... 8 (FHPP State byte 5 ... 8)			Data type: int32
FHPP control information for byte 5 ... 8 (setpoint position of X-axis)				
Subindex 3	FHPP status byte 9 ... 12 (FHPP State byte 9 ... 12)			Data type: uint32
FHPP control information for byte 9 ... 12 (e.g. CCONy, CPOSy,...)				
Subindex 4	FHPP status byte 13 ... 16 (FHPP State byte 13 ... 16)			Data type: int32
FHPP control information for byte 13 ... 16 (setpoint position of Y-axis)				

Tab. 115

12.2.7 Record list – record data

With FHPP, record selection for reading and writing is done via the subindex of the PNUs 401 ... 424.

PNU 401	**Record control byte 1 (Record Control Byte 1)**			
Sub-index 1 ... 31	Class: array	Data type: uint8	FW ...	Access: rw1
Reading or parameterisation of record control byte 1 (RCB1). The record control byte defines the type of a position set (positioning absolute or relative)				
Designation	Bit	Value		Meaning
ABS	0	Binary		Selection of the positioning type.
		0		Setpoint value is absolute
		1		Setpoint value is relative
COM1/2	1, 2	Bit2	Bit1	Selection of the control mode.
		0	0	Position mode
		0	1	reserved
		1	0	reserved
		1	1	reserved
–	3	–		reserved
REL	4	Binary		Selection of the reference point for the setpoint value.
		0		Setpoint value is relative to last set-point value/target
		1		Setpoint value is relative to the last actual value/actual position
–	5...7	–		reserved
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Record control byte 1 of record 1 ... 31.				

Tab. 116

PNU 404	**Setpoint value X (Target Position X)**			
Sub-index 1 ... 31	Class: array	Data type: int32	FW ...	Access: rw1
Reading or writing the target position [SINC] in X-direction.				
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Setpoint value X of record 1 ... 31.				

Tab. 117

PNU 405	**Setpoint value Y (Target Position Y)**			
Sub-index 1 ... 31	Class: array	Data type: int32	FW ...	Access: rw1
Reading or writing of the target position [SINC] in Y-direction.				
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Setpoint value Y of record 1 ... 31.				

Tab. 118

PNU 406	**Velocity (Velocity)**			
Sub-index 1 ... 31	Class: array	Data type: int32	FW ...	Access: rw1
Reading or parameterisation of max. velocity [SINC/s]. The velocity is always specified as positive. The value is automatically negated for travel in a negative direction.				
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Max. velocity of record 1 ... 31.				

Tab. 119

PNU 407	**Acceleration (Acceleration)**			
Sub-index 1 ... 31	Class: array	Data type: int32	FW ...	Access: rw1
Reading or parameterisation of acceleration [SINC/s^2]. The value is also used for the maximum deceleration.				
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Max. acceleration of record 1 ... 31.				

Tab. 120

PNU 409	**Jerk (Jerk)**			
Sub-index 1 ... 31	Class: array	Data type: uint32	FW ...	Access: rw1
Reading or parameterisation of maximum jerk [(SINC/s^3)/10] during acceleration and deceleration. Value 0 is always interpreted as maximum jerk (no return limit).				
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Max. jerk of record 1 ... 31.				

Tab. 121

PNU 424	**Max. following error (Max. Following Error)**			
Sub-index 1 ... 31	Class: array	Data type: int32	FW ...	Access: rw1
Reading or parameterisation of max. permitted following error [SINC].				
Sub-index 1 ... 31	Record 1 ... 31 (Record 1 ... 31)			
Reading the maximum permissible following error of record 1 ... 31.				

Tab. 122

12.2.8 Project data – general project data

PNU 500	**Project zero point (Project Zero Point)**			
Subindex 1, 2	Class: array	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the project zero point [SINC].				
Subindex 1	Project zero point X-axis (Project Zero Point X-Axis)			
Project zero point X-axis				
Subindex 2	Project zero point Y-axis (Project Zero Point Y-Axis)			
Project zero point Y-axis				

Tab. 123

PNU 501	**Software end positions (Software Position Limits)**			
Sub-index 1 ... 4	Class: array	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of software end positions [SINC]. A setpoint specification (position) outside the software end positions is not permissible and will result in an error. The offset to the axis zero point is entered. The software end positions are deactivated if both software end positions have value = 0.				
Subindex 1	Lower limit value X-axis (Lower Limit X-Axis)			
Lower software end position X-axis				
Subindex 2	Upper limit value X-axis (Upper Limit X-Axis)			
Upper software end position X-axis				
Subindex 3	Lower limit value Y-axis (Lower Limit Y-Axis)			
Lower software end position Y-axis				
Subindex 4	Upper limit value Y-axis (Upper Limit Y-Axis)			
Upper software end position Y-axis				

Tab. 124

PNU 502	**Maximum permitted velocity (Max. Velocity)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the maximum permitted velocity [SINC/s]. This value limits the velocity in all operating modes.				

Tab. 125

PNU 503	**Maximum permitted acceleration (Max. Acceleration)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the max. permitted acceleration [SINC/s²].				

Tab. 126

12.2.9 Project data - direct mode position

PNU 524	**FHPP direct mode settings (FHPP Direct Mode Settings)**			
Subindex 1	Class: Var	Data type: uint8	FW ...	Access: rw1
Reading or parameterisation of the characteristics for FHPP direct mode.				
Bit	Value	Meaning		
	Binary	Relative positioning type		
0	0	Setpoint value is relative to the last setpoint/target position		
	1	Setpoint value is relative to the current position (default)		
1 ... 7	–	Reserved		

Tab. 127

PNU 530	**Velocity slow – phase 1 (Velocity Slow – Phase 1)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the slow velocity [SINC/s] for phase 1 during jogging.				

Tab. 128

PNU 531	**Velocity fast – phase 2 (Velocity Fast – Phase 2)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the maximum velocity [SINC/s] for phase 2 during jogging.				

Tab. 129

PNU 532	**Acceleration/deceleration (Acceleration/Deceleration)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the acceleration/deceleration [SINC/s²] during jogging.				

Tab. 130

PNU 534	**Time duration phase 1 (Time Phase 1)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: rw2
Reading or parameterisation of the time period [ms] for phase 1 during jogging.				

Tab. 131

PNU 540	**Base value velocity (Base Value Velocity)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: rw2
Reading or parameterisation of the basic value for velocity [SINC/s]. The master transmits a percentage value, which is multiplied by the basic value to calculate the final setpoint velocity.				

Tab. 132

PNU 541	**Acceleration in direct mode (Acceleration in Direct Mode)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw1
Reading or parameterisation of maximum acceleration [SINC/s²] in direct mode. The value is also used for the maximum deceleration.				

Tab. 133

PNU 543	**Jerk in direct mode (Jerk in Direct Mode)**			
Subindex 1	Class: Var	Data type: uint32	FW ...	Access: rw1
Reading or parameterisation of maximum jerk [(SINC/s³)/10] during acceleration and deceleration in direct mode. Value 0 is always interpreted as maximum jerk (no return limit).				

Tab. 134

PNU 549	**Max. following error in direct mode (Max. Following Error in Direct Mode)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw1
Reading or parameterisation of max. permitted following error [SINC] in direct mode.				

Tab. 135

12.2.10 Group of factors

PNU 600	**Position tens exponent (Position Notation Index)**			
Subindex 1	Class: Var	Data type: int8	FW ...	Access: rw2
Reading or parameterisation of the powers of 10 exponent with the 1 SINC converted to 1 basic unit value.				
Example:	Power of 10 exponent = -7 Basic unit (0x01) = metre			
Calculation:	1 SINC: 1 * 10^{-7} 002m = 0.1 µm 10,000 SINC: 10,000 * 10^{-7} m = 1 mm			

Tab. 136

PNU 601	**Position unit of measurement (Position Dimension Index)**			
Subindex 1	Class: Var	Data type: uint8	FW ...	Access: rw2
Reading or parameterisation of the system of measurement in relation to the basic unit.				
Value	Meaning			
0x00 (0)	undefined/user-specific			
0x01 (1)	Metre (SI unit)			
0x41 (65)	Degree			
0xF0 (240)	Inch/in			
0xF6 (246)	Revolutions			

Tab. 137

12.2.11 Axis parameter: electrical drives – homing parameters

PNU 1012	**Velocities (Velocities)**			
Subindex 1	Class: array	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the velocities [SINC/s] in reference mode.				
Subindex 1	Search velocity (Search Velocity)			
Velocity when searching for the reference point (REF) at the stop.				

Tab. 138

PNU 1013	**Acceleration/deceleration (Acceleration/Deceleration)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the acceleration/deceleration [SINC/s^2] in reference mode.				

Tab. 139

PNU 1015	Max. torque (Max. Torque)			
Subindex 1	Class: Var	Data type: int16	FW ...	Access: rw2
Reading or parameterisation of the max. permitted torque via maximum current in homing. If the value is reached for a specific time, the stop is detected as reference point and the drive travels to the axis zero point.				

Tab. 140

12.2.12 Axis parameter: electrical drives – closed-loop controller parameters

PNU 1022	Target message window reached (Position Target Window)			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the target [SINC] by which the current position may deviate from the target position while still interpreted to be within the target window. The range of the message window is double that of the parameterised value. The setpoint/target position is in the centre of the window.				

Tab. 141

PNU 1023	Target cushioning time reached (Position Target Window Time)			
Subindex 1	Class: Var	Data type: int16	FW ...	Access: rw2
Reading or parameterisation of the damping time [ms]. The damping time begins when the target position window is reached. If the actual position has been in the target position window after the damping time has expired, the SPOS.MC bit is set.				

Tab. 142

PNU 1027	Current I2t value (Actual I2t Value)			
Subindex 1, 2	Class: Var	Data type: uint16	FW ...	Access: ro
Reading of the current fill level [‰] of the I²t monitoring for the motor.				
Subindex 1	Current I2t value X-axis (Actual I2t Value X-Axis)			
Current I2t value for the X-axis				
Subindex 2	Current I2t value Y-axis (Actual I2t Value Y-Axis)			
Current I2t value for the Y-axis				

Tab. 143

PNU 1029	Quick stop deceleration (Quick Stop Deceleration)			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the deceleration with Quick Stop [SINC/s2].				

Tab. 144

12.2.13 Axis parameters: electric drives – standstill monitoring

PNU 1042	**Standstill position window (Standstill Position Window)**			
Subindex 1	Class: Var	Data type: int32	FW ...	Access: rw2
Reading or parameterisation of the standstill position window [SINC]. Value of the position by which the drive may move after MC until the standstill monitoring responds.				

Tab. 145

PNU 1043	**Standstill delay time (Standstill Window Time)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: rw2
Reading or parameterisation of the standstill monitoring time [ms]. Time during which the drive must be outside the standstill position window before standstill monitoring responds.				

Tab. 146

12.2.14 Axis parameters: electric drives – following error monitoring

PNU 1045	**Standstill position window (Standstill Position Window)**			
Subindex 1	Class: Var	Data type: uint16	FW ...	Access: rw2
Reading or parameterisation of the damping time [ms] for detection of deviation (following error, velocity). Time in which the difference between the setpoint and actual variable must be larger than the max. permissible deviation before a following error is output.				

Tab. 147

12.2.15 Axis parameters: electric drives – general drive data

PNU 1073	**Current DC link voltage (Actual Intermediate Circuit Voltage)**			
Subindex 1	Class: Var	Data type: uint32	FW ...	Access: ro
Reading the current DC link voltage [mV] of the controller.				

Tab. 148

PNU 1074	**Current control section voltage (Actual Control Section Voltage)**			
Subindex 1	Class: Var	Data type: uint32	FW ...	Access: ro
Reading of the current control section voltage [mV] of the controller.				

Tab. 149

12.3 Festo Parameter Channel (FPC)

12.3.1 FPC for cyclical I/O data

The FPC is used for transmission of parameters in the cyclical I/O data. An additional 8 I/O bytes have been added to the 16 bytes of I/O data of the FHPP standard for this purpose.

Data	Byte 1 ... 16	Byte 17 ... 24
O-data	FHPP control bytes	FPC control data
I-data	FHPP status bytes	FPC status data

Tab. 150: Cyclical I/O data FHPP standard + FPC

The controller exclusively supports parameterisation via the EFPC protocol (Enhanced Festo Parameter Channel). Data transmission is not supported.

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Modules with which transmission can be easily implemented are available for some selected controllers at ➔ www.festo.com/sp.

Structure of EFPC with parameter transmission

Data	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
O-data	FPCC	Subindex	Parameter number (PNU)		Parameter value (PWE)			
I-data	FPCS	Subindex	Parameter number (PNU)		Parameter value (PWE)/error code			

Tab. 151: EFPC structure for parameter transmission

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In general, observe the specification in the bus master for representation of words and double words (Intel/Motorola). Modbus TCP/IP uses a “big-endian” transmission sequence. The “most significant byte” is sent first.

12.3.2 FPCC and FPCS – transmission mode, request and response ID

The transmission mode is switched via bits 4 to 7 of byte 1 correspondingly ➔ Tab. 152 FPCC/FPCS – coding of the transmission mode.

FPCC/FPCS[1)]	Mode	Function
0001xxxx	Parameter	Transmitting PNUs

1) values not stated = reserved

Tab. 152: FPCC/FPCS – coding of the transmission mode

Bit 0 to 3 of byte 1 contain the request or response ID ➔ Tab. 153 FPCC – coding request IDand ➔ Tab. 154 FPCS – coding response ID.

FPCC[1)]	Value	Function
xxxx0000	0	No request
xxxx0110	6	Request parameter value (array)
xxxx1000	8	Modify parameter value (array, double word)

1) values not stated = reserved

Tab. 153: FPCC – coding request ID

FPCS[1)]	Value	Function
xxxx0000	0	No response
xxxx0101	5	Transmit parameter (array, double word)
xxxx0111	7	Task cannot be carried out with error number (parameter transmission currently not possible)

1) values not stated = reserved

Tab. 154: FPCS – coding response ID

12.3.3 Parameter transmission

Process of parameter transmission

Parameters are transmitted in the following sequence:

1. Start transmission.
2. Wait until the “Transmitting parameters” acknowledgment is received.
3. Wait between 2 successive jobs, send task identifier 0 (no job, “zero request”) and response identifier 0 (no reply).
   This ensures that an “old” response is not interpreted as a “new” response.

Parallel to the transmission, the controller must evaluate possible errors.

Before and after parameter transmission, the telegram “no job” is exchanged cyclically between the control and controller.

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Written parameters must be permanently stored by writing PNU 127:2 with the value 1 so they will be secure in case of power failure.

Example of process of parameter transmission

Parameter transmission	Control ➔ controller
Write parameter PNU 440:2 with 4660_d FPCC = 0001 1000 Subindex = 0000 0010 Parameter number = 0000 0001 1011 1000 User data = 0000 0000 0000 0000 0001 0010 0011 0100	
Acknowledge	Controller ➔ open-loop control
Parameter successfully written FPCS = 0001 0101 Subindex = 0000 0010 Parameter number = 0000 0001 1011 1000 User data = 0000 0000 0000 0000 0001 0010 0011 0100	

Tab. 155: Example of process of parameter transmission

12.3.4 Error Codes

Errors are reported in the FPCS and the error code is transmitted in the user data.

Error code		Faults
0	0x00	Invalid PNU
1	0x01	Parameter value cannot be changed
2	0x02	Lower or upper value limit exceeded
3	0x03	Faulty subindex
11	0x0B	no master control
17	0x11	Task cannot be executed in the operating status
101	0x65	Request ID is not supported
102	0x66	Parameter is WriteOnly

Tab. 156: Error codes in parameter transmission

13 Glossary

Term/abbreviation	Description
I/O	Input/output
EMC	Electromagnetic compatibility
FCT	Parameterisation and commissioning software (FCT = Festo Configuration Tool)
FHPP	Communication protocol for data exchange (FHPP = Festo Handling and Positioning Profile)
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, brake and digital outputs.
MC (Motion Complete)	Target position reached.
Usable stroke	Maximum stroke, distance of the software end positions.
Acknowledge	“Acknowledge an error”: the user confirms that the error has been noted. The device then exits error status if the cause of the error has been eliminated.
Homing	Positioning job to determine the reference point.
Record	Record of parameters defined in the record table, comprising record type, target positions X and Y, velocity, acceleration and jerk.
Following error	Calculated deviation during execution of a record between the target position (in accordance with previously calculated course of the path) and the actual position.
Software end position	Limitation of the working stroke.
SPS/IPC	Programmable logic controller/industrial PC.
Jogging (Jog Mode)	The drive moves as long as a corresponding signal is present.

Tab. 157: Product-specific Terms and Abbreviations

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