

Festo Handling and Positioning Profile for Multi-axis Motion

FESTO

Manual

Multi-axis interface
CPX-CMXX

Festo Handling and
Positioning Profile
for Multi-axis Motion
(FHPP-MAX)



Manual

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Designated use

This manual contains the Festo Handling and Positioning Profile for Multi-axis Motion (FHPP-MAX).

The FHPP-MAX is used to control the CPX-CMXX Multi-axis interface.

This provides you with supplementary information about controlling, diagnosing and parameterizing the Multi-axis interface via the fieldbus.



Please note

Always follow the safety-related instructions listed in the product manual for the multi-axis interface and the drive controller used.



You will find additional information in the documentation on the CPX-CMXX and the software package FST:

- Manual P.BE-CPX-CMXX-...:
Mechanical – electrical – overview of the function range.
- Online help on the FCT PlugIn CPX-CMXX
- Software package FST Version 4, P.BE-FST4-B1-...
Programming in statement list and ladder diagram for the FEC

Safety instructions

When commissioning and programming positioning systems, you must always observe the safety regulations in this manual as well as those in the operating instructions for the other components used.

The user must make sure that nobody is in the operating range of the connected actuators or axis system. Access to the possible danger area must be prevented by suitable measures such as protective screens and warning signs.



Warning

Axes can move with high force and at high speed. Collisions can lead to serious injury to human beings and damage to components.

- Make sure that nobody can reach into the operating range of the axes or other connected actuators and that no objects lie in the positioning range while the system is still connected to a power supply.



Warning

Faults in parametrization can cause injury to human beings and damage to property.

- Enable the axis groups of the Multi-axis system only if the Multi-axis system has been properly installed and parameterized.

Target group

This manual is intended exclusively for technicians trained in control and automation technology, who have experience in installing, commissioning, programming and diagnosing positioning systems.

Service

Please consult your local Festo Service or write to the following e-mail address if you have any technical problems:

service_international@festo.com

Important user instructions

Danger categories

This manual contains instructions on the possible dangers which may occur if the product is not used correctly. These instructions are marked (Warning, Caution, etc.), printed on a shaded background and marked additionally with a pictogram. A distinction is made between the following danger warnings:



Warning

This means that failure to observe this instruction may result in serious personal injury or damage to property.



Caution

This means that failure to observe this instruction may result in personal injury or damage to property.



Please note

This means that failure to observe this instruction may result in damage to property.

The following pictogram marks passages in the text which describe activities with electrostatically sensitive components.



Electrostatically sensitive components may be damaged if they are not handled correctly.

Marking special information

The following pictograms mark passages in the text containing special information.

Pictograms



Information:
Recommendations, tips and references to other sources of information.



Accessories:
Information on necessary or sensible accessories for the Festo product.



Environment:
Information on environment-friendly use of Festo products.

Text markings

- The bullet indicates activities which may be carried out in any order.
- 1. Figures denote activities which must be carried out in the numerical order specified.
- Hyphens indicate general activities.

Information on the version

This document describes FHPP-MAX Revision 1.13.

The basis for FHPP-MAX Revision 1.13 is FHPP Version 1.00
Revision 13 from 29 August 2007.

Terms and abbreviations

The following terms and abbreviations are used in this manual:

Term/abbreviation	Meaning
0-signal	Input or output provides 0 V (also LOW, FALSE or logical 0)
1-signal	Input or output provides 24 V (also HIGH, TRUE or logical 1)
0xA0 A0 _h	Hexadecimal numbers are marked by a prefixed “0x” or by a lowered “h” Example: 0xA0 = A0 _h = 160 decimal
Axis	Complete actuator, consisting of motor, encoder and drive, optionally with gear, if applicable with drive controller
CPX-CMXX	Multi-axis interface CPX-CMXX
CPX-FEC	Front-end controller as CPX module PLC integrated into the CPX terminal
CPX module	Collective term for the various modules which can be integrated in a CPX terminal
Drive	Mechanical component of an axis, which transfers the driving power for the movement, defines the guide for the positioning run and also enables the work load and the homing switch to be configured
Drive controller	Control electronics, which evaluate the control signals and provide the voltage supply for the motor via the power electronics (power electronics + closed loop controller + positioning controller)
FCT	Festo Configuration Tool Software with standardised project and data management for supported device types. The special requirements of a device type are supported with the necessary descriptions and dialogues by means of plug-ins.
FHPP	Festo Handling and Positioning Profile The FHPP is a fieldbus data profile for positioning controllers from Festo
FHPP-MAX	Festo Handling and Positioning Profile for Multi-axis Motion The FHPP-MAX is a fieldbus data profile for Multi-axis systems from Festo The basis for the FHPP-MAX is the FHPP

Term/abbreviation	Meaning
FHPP-MAX operating mode	How the CPX-CMXX Multi-axis interface is triggered via FHPP-MAX: <ul style="list-style-type: none"> – Record select – Direct mode – Commissioning – Parameterisation
FPC	Festo Parameter Channel FHPP- or FHPP-MAX-specific parameter access
FST	Festo Software Tools for programming in statement list and ladder diagram for the CPX-FEC and other PLCs from Festo
Functions	Special functions in the different operating modes <ul style="list-style-type: none"> – Jog mode – Reference travel (Homing run)
I O I/O	Input Output Input and/or output
Jog mode	Manual positioning of an axis in positive or negative direction
Linking	With linking, position records can be automatically performed one after another
PLC	Control of the CPX terminal and the CPX-CMMX is alternatively carried out through: <ul style="list-style-type: none"> – a higher-level PLC: a PLC connected via fieldbus to the CPX terminal – a CPX-FEC: a PLC integrated into the CPX terminal
Position record	Positioning task defined in the position record table, consisting of target position, velocity, acceleration, ...

Tab. 0/1: Index of terms and abbreviations

Overwiev

Chapter 1

1. Overwiev

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1. Overview

1.1 Method of operation

Festo has developed an optimised data profile especially tailored to the target applications for handling and positioning tasks of multi-axis systems, the “Festo Handling and Positioning Profile for Multi-axis Motion (FHPP-MAX)”. The FHPP-MAX builds on the FHPP profile developed for single-axis controls. The FHPP-MAX permits uniform control and programming for various multi-axis systems from Festo with up to 2 groups of 4 axes each.

It defines for the user

- the operating modes,
- I/O data structure,
- parameter objects,
- sequence control.

Control and status data

Communication over the fieldbus is effected per axis group by way of 8-byte control and status data. Functions and status messages required in operation can be written and read directly.

Record select mode

Saved position sets can be processed in the Record select mode.

Direct mode

In the Direct mode, dynamically calculated position record parameters are loaded into the selected position record of the CPX-CMXX via the record register, and then the position record is executed as in the Record select mode.

In addition, stored position records can also be executed as in the Record select mode.

Commissioning

This operating mode is used to place the axis group in operation. The following functions are available:

- Jog
- Homing

Parameterisation

In this operating mode, the PLC can access all parameter values of the CPX-CMXX.

Sequence control

Chapter 2

2. Sequence control

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2. Sequence control

2.1 FHPP-MAX operating modes

The FHPP-MAX operating modes differ in the content and meaning of the cyclic I/O data and in the functions that can be accessed in the multi-axis interface.

Operating mode	Description
Record select mode	From a position record table stored in the CPX-CMXX, the PLC selects a record that contains all parameters required for a positioning task. A record contains parameters for one or more axes of an axis group. The record number is transferred to the cyclic output data as a setpoint.
Direct mode	Through the record register, dynamic positioning tasks are stored incrementally in the position record table of the CPX-CMXX. In addition, records from the position record table stored in the CPX-CMXX are executed.
Commissioning	In this operating mode, the following functions can be performed: <ul style="list-style-type: none">– Jogging– Homing The functions are carried out only with the selected axis.
Parameterisation	Parameters are passed on in this operating mode.

Tab. 2/1: Overview of operating modes

2.1.1 Switching the operating mode

The operating mode is switched by the control byte CCON and acknowledged in the status word SCON.

The switch into commissioning or parameter setting is not possible in the status S4 “Operation Enabled”.

The switch between Record select mode and Direct mode is possible in every status.

The statuses are described in section 2.6, Status Machine, page 2-20.

2. Sequence control

2.1.2 Record select mode

Per axis group, the CPX-CMXX has over 1024 records that contain all information necessary for a positioning task.

The record number that the CPX-CMXX is to process at the next start is transferred in the PLC's output data.

The CPX-CMXX does not support any automatic mode, i.e. no user program. Records cannot be processed automatically with a programmable logic. The CPX-CMXX cannot accomplish any tasks sensibly as a stand-alone – close coupling with the PLC is always necessary.

However, it is also possible to link various records and execute them one after the other with the help of a start command.

In this way, positioning profiles can be created without any effect by the inactive times which arise from the transfer in the fieldbus and the PLC's cycle time.

2.1.3 Direct mode

In the Direct mode, it is possible to dynamically calculate the parameters for each positioning task. This makes it possible to adjust the system to different tool sizes, for example, without having to re-parameterise the position record table. The positioning data are managed completely in the PLC and sent directly to the CPX-CMXX.

The parameters for a dynamic positioning task are loaded via the record register in the position record table of the CPX-CMXX. The positioning task is worked off like a record in the Record select operating mode.

2. Sequence control

2.1.4 Commissioning

In this operating mode, the following functions are available:

- Jogging
- Homing

These functions apply only to the chosen axis.

Switching to the Commissioning operating mode is not possible in the status S4 “Operation Enabled”.

The statuses are described in section 2.6, Status Machine, page 2-20.



The control and status signals have different effects in the Commissioning and Record select operating modes.

2.1.5 Parameterisation

In this operating mode, parameters are transferred via the cyclical data of the FHPP-MAX.

The first CCON control byte is transferred to control the enabling and operating mode of the axis/axis group. The seven additional bytes are occupied by the Festo Parameter Channel (FPC).

Switching to the Parameterisation operating mode is not possible in the status S4 “Operation Enabled”.

The statuses are described in section 2.6, Status Machine, page 2-20.

During parameterisation, a drive cannot be moved, but a vertical drive can be held stationary.

2. Sequence control

2.2 Configuration of the I/O data

2.2.1 Concept

The PLC exchanges the following data with the CPX-CMXX via FHPP-MAX:

- Control and status bytes
- Record number or record register content in the output data
- Acknowledgement of actual position in the input data
- Parameters as per FPC

Fundamentally, 8 byte input and 8 byte output data are planned per axis group. Of these, the first byte is permanently occupied. It remains intact in each operating mode and controls the enabling of the drive controller and the operating modes. The other bytes are dependent on the chosen operating mode. Additional control or status bytes and target and actual values can be transferred here.

Overview of the control and status bytes			
No.	PLC	Acknowledgement	Description
1	CCON	SCON	Enabling and operating mode
2	CPOS	SPOS	Positioning, homing and jogging
3	CASEL	SASEL	In the Commissioning operating mode: Selection of the axis In the Direct operating mode: Load register
4	Reserved	Error No.	Fault number

Tab. 2/2: Control and status bytes

2. Sequence control

2.2.2 I/O data in the various operating modes (control view)

Record select mode								
	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	CPOS	CASEL	Reserved	Record number			
Input data	SCON	SPOS	SASEL	Error No.	Actual position			

Tab. 2/3: Control and status bytes in the Record select mode

Direct mode								
	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	CPOS	CASEL	Reserved	Record number			
				Register No.	Register value			
Input data	SCON	SPOS	SASEL	Error No.	Actual position of the selected axis			
					Register value			

Tab. 2/4: Control and status bytes in the Direct mode

Commissioning								
	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	CPOS	CASEL	Velocity in %	Jog interval			
Input data	SCON	SPOS	SASEL	Error No.	Actual position of the selected axis			

Tab. 2/5: Control and status bytes in the Commissioning operating mode

Parameter setting (FPC)								
	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	Subindex	Request identifier + parameter number		Value			
Input data	SCON	Subindex	Response identifier + parameter number		Value			

Tab. 2/6: Control and status bytes in the parameter setting (FPC) operating mode

2. Sequence control

2.3 Assignment of the control bytes and status bytes (overview)

Assignment of the control bytes (overview)								
CCON	B7 OPM2	B6 OPM1	B5 LOCK	B4 –	B3 RESET	B2 –	B1 STOP	B0 ENABLE
	Operating mode selection		Block FCT access	–	Quit fault	–	Stop	Enable axis/axis group
CPOS	B7 –	B6 CLEAR	B5 –	B4 JOGN	B3 JOGP	B2 HOM	B1 START	B0 HALT
	–	Delete re-remaining path	–	Jogging negative	Jogging positive	Start Homing run	Start position. task	Halt
CASEL	B7 LOAD_R	B6 CMD2	B5 CMD1	B4 CMD0	B3 –	B2 –	B1 SELAX1	B0 SELAX0
	Load Register	Load commands			–	–	Axis selection	

Tab. 2/7: Assignment of the control bytes

Assignment of the status bytes (overview)								
SCON	B7 OPM2	B6 OPM1	B5 LOCK	B4 DREADY	B3 FAULT	B2 WARN	B1 OPEN	B0 ENABLED
	Acknowledgement Operating mode		Control hierarchy FCT	Ready	Fault	Warning	Operation enabled	Axis/axis group enabled
SPOS	B7 REF	B6 –	B5 –	B4 MOV	B3 –	B2 MC	B1 ACK	B0 HALT
	Referenced	–	–	Position. task active	–	Motion complete	Confirmation	Halt
SASEL	B7 Load_CPL	B6 CMD2	B5 CMD1	B4 CMD0	B3 –	B2 –	B1 SELAX1	B0 SELAX0
	Loading perform.	Acknowledgement of the load commands			–	–	Chosen axis	

Tab. 2/8: Assignment of the status bytes

2. Sequence control

2.4 Description of the control bytes

The following tables contain the German and English designations of the functions/status information. The designations of the bits have been derived from the English designations of the functions/status information.

The interconnection of the control bits is explained in chapter 3, Drive functions.

2.4.1 Control byte 1 (CCON)

CCON controls the statuses that must be available in all operating modes.

Control byte 1 (CCON)			
Bit	German	English	Description
B0 ENABLE	Achse/Achs- gruppe freigeben	Enable axis/ axis group	= 1: Enable axis/axis group = 0: Block axis/axis group
B1 STOP	Stopp	Stop	= 1: Enable operation of the axis/axis group. = 0: Cancel positioning task. The axis/axis group stops independently of the device type with a braking ramp. The positioning task is reset.
B2 –	–	–	Reserved
B3 RESET	Störung quittieren	Reset Fault	= 0 → 1: With the rising edge, a fault is acknowl- edged and the fault value is deleted.
B4 –	–	–	Reserved, must be at 0.
B5 LOCK	FCT-Zugriff blockieren	Lock FCT Access	Controls FCT access. = 1: FCT must not take over control hierarchy. = 0: FCT may take over control hierarchy.
B6 OPM1	Betriebsarten- wahl	Select Operating Mode	<u>Bit 7 6</u> <u>Operating mode</u>
B7 OPM2			0 0 Record selection 0 1 Direct mode 1 0 Commissioning 1 1 Parameterisation

Tab. 2/9: Control byte 1 (CCON)

2. Sequence control

Operating-mode-dependent effect of CCON

Bit	Operating mode		
	Record selection	Direct operation	Commissioning
CCON.ENABLE CCON.STOP	Effect on all axes in the group		Effect only on the chosen axis; see CASEL

Tab. 2/10: Operating-mode-dependent effect of CCON

2. Sequence control

2.4.2 Control byte 2 (CPOS)

CPOS controls the positioning sequences as soon as the chosen axis has been enabled.

Control byte 2 (CPOS)			
Bit	DE	EN	Description
B0 HALT	Halt	Halt	= 1: Halt is not active = 0: Halt activated (Do not cancel positioning task). The axis/axis group stops independently of the device with a braking ramp; the positioning task remains active. With CPOS.B6, the remaining path can be deleted. The Halt command can be activated and deactivated with parameter 522, bit 0.
B1 START	Start Positionier-auftrag	Start positioning task	= 0 → 1: With the positive edge, the current position record is taken over and positioning of all participating axes started
B2 HOM	Start Referenzfahrt	Start Homing	= 0 → 1: With the positive edge, the homing run of the chosen axis is started with the set parameters
B3 JOGP	Tippen positiv	Jog positive	The drive of the chosen axis moves at the specified speed in the direction of larger actual values, as long as the bit is set. The movement begins with the positive edge and ends with the negative edge.
B4 JOGN	Tippen negativ	Jog negative	The drive of the chosen axis moves at the specified speed in the direction of smaller actual values, as long as the bit is set. The movement begins with the positive edge and ends with the negative edge.
B5 –	–	–	Reserved
B6 CLEAR	Restweg löschen	Clear Remaining Position	= 0 → 1: In the “Halt” status, the positive edge causes deletion of the positioning task and transfer to the “Ready” status. MC is set again.
B7 –	–	–	Reserved, must be at 0.

Tab. 2/11: Control byte 2 (CPOS)

2. Sequence control

Operating-mode-dependent effect of CPOS

Bit	Operating mode		
	Record selection	Direct mode	Commissioning
CPOS.CLEAR	Effect on all axes in the group		No effect
CPOS.START	Has effect only in these operating modes		No effect
CPOS.HOM CPOS.HALT	Effect on all axes in the group		Effect only on the chosen axis; see CASEL
CPOS.JOGP CPOS.JOBN	No effect		Effect only on the chosen axis; see CASEL

Tab. 2/12: Operating-mode-dependent effect of CPOS

2. Sequence control

2.4.3 Control byte 3 (CASEL)

CASEL chooses the axis in the Commissioning operating mode.

Control byte 3 (CASEL)			
Bit	DE	EN	Description
B0 SELAX0	Achswahl für Inbetriebnahme oder Istposition	Select Axis	<u>Bit</u> 1 0 <u>Axis</u>
B1 SELAX1			0 0 1st axis (X)
			0 1 2nd axis (Y)
			1 0 3rd axis (Z)
B2 –	–	–	Reserved
B3 –	–	–	Reserved
B4 CMD0	Lade Befehl	Load Command	<u>Bit</u> 6 5 4 <u>Command</u>
B5 CMD1			0 0 0 No action
B6 CMD2			0 0 1 Write Register
			0 1 0 Add Register
			0 1 1 Sub Register
			1 0 0 Read Register
			Reg. no. in byte 4, register value in byte 5, 6, 7, 8
B7 LOAD_R	Lade Register	Load Register	= 0 → 1: With the positive edge, the action in CMD0, CMD1 and CMD2 is performed

Tab. 2/13: Control byte 3 (CASEL)

2. Sequence control

Operating-mode-dependent effect of CASEL

Bit	Operating mode		
	Record selection	Direct operation	Commissioning
CASEL.SELAX0 CASEL.SELAX1	Axis choice for display of actual position	Axis choice for display of actual position	Axis choice for commissioning
CASEL.CMD0 CASEL.CMD1 CASEL.CMD2	Not relevant	Load commands	Not relevant
CASEL.LOAD_R	Reserved, must be at 0!	= 0 → 1: With the positive edge, the action in Load Command is carried out	Reserved, must be at 0!

Tab. 2/14: Operating-mode-dependent effect of CASEL

2. Sequence control

2.5 Description of the status byte

The following tables contain the German and English designations of the functions/status information. The designations of the bits have been derived from the English designations of the functions/status information.

2.5.1 Status byte 1 (SCON)

Status byte 1 (SCON)			
Bit	DE	EN	Description
B0 ENABLED	Achse/Achs- gruppe freigegeben	Axis/Axis Group Enabled	= 0: Axis/axis group not enabled = 1: Axis/axis group enabled
B1 OPEN	Betrieb freigegeben	Operation Enabled	= 0: Stop active = 1: Operation enabled, positioning possible
B2 WARN	Warnung	Warning	= 0: Warning not applied = 1: Warning applied
B3 FAULT	Störung	Fault	= 0: No fault = 1: There is a fault or fault reaction is active Fault code in the diagnostic memory and also in the error byte of FHPP-MAX
B4 DREADY	Achsgruppe bereit	All Drives are Ready	= 0: One or more axes are initialised = 1: All axes in the group are ready Target -actual configuration is OK
B5 LOCK	Steuerhoheit FCT	Drive Control by FCT	= 0: The PLC controls the CPX-CMXX = 1: The FCT controls the CPX-CMXX (Drive control by FCT) (PLC control is Locked)
B6 OPM1	Rückmeldung Betriebsart	Display Operating Mode	<u>Bit 7 6</u> <u>Operating mode displayed</u>
B7 OPM2			0 0 Record selection 0 1 Direct mode 1 0 Commissioning 1 1 Parameterisation

Tab. 2/15: Status byte 1 (SCON)

2. Sequence control

Operating-mode-dependent effect of SCON

Bit	Operating mode		
	Record selection	Direct mode	Commissioning
SCON.ENABLED SCON.OPEN	Status of all axes in the group (AND link of the statuses of all individual axes in the group)		Status of the chosen axis, see CASEL.

Tab. 2/16: Operating-mode-dependent effect of SCON

2.5.2 Status byte 2 (SPOS)

Status byte 2 (SPOS)			
Bit	DE	EN	Description
B0 HALT	Halt	Halt	= 0: Halt is active = 1: Halt is not active, drive can be moved
B1 ACK	Bestätigung	Acknowledge	= 0: Ready for start (positioning task, homing, jogging) = 1: Start executed (positioning task, homing, jogging)
B2 MC	Motion Complete	Motion Complete	= 0: Positioning task active = 1: Positioning task completed Note: – If a positioning task was completed with an error, MC is set only after acknowledgement of the error. – MC is set after device is switched on (status “Drive blocked”)
B3 –	–	–	Reserved
B4 MOV	Achse bewegt sich	Axis is moving	= 0: Selected axis at standstill. = 1: Selected axis is moving.
B5 –	–	–	Reserved
B6 –	–	–	Reserved
B7 REF	Achse referenziert	Axis is referenced	= 0: Referencing must be carried out = 1: Reference information present, reference travel need not be performed

Tab. 2/17: Status byte 2 (SPOS)

2. Sequence control

Operating-mode-dependent effect of SPOS

Bit	Operating mode		
	Record selection	Direct mode	Commissioning
SPOS.HALT SPOS.MC SPOS.MOV SPOS.REF	Status of all axes in the group (AND link of the statuses of all individual axes in the group)		Status of the chosen axis, see CASEL.

Tab. 2/18: Operating-mode-dependent effect of SPOS

2. Sequence control

2.5.3 Status byte 3 (SASEL)

The status byte 3 (SASEL) reports back the chosen axis in the commissioning operating mode.

Status byte 3 (SASEL)			
Bit	DE	EN	Description
B0 SELAX0	Gewählte Achse	Selected Axis	<u>Bit 1 0</u> <u>Selected axis</u> 0 0 1st axis (X) 0 1 2nd axis (Y) 1 0 3rd axis (Z) 1 1 4th axis (U)
B1 SELAX1			
B2 –	–	–	Reserved
B3 –	–	–	Reserved
B4 CMD0	Rückmeldung Lade Befehle	Load Command	<u>Bit 6 5 4</u> <u>Acknowledgement</u> 0 0 0 No action 0 0 1 Write Register *) 0 1 0 Add Register *) 0 1 1 Sub Register *) 1 0 0 Read Register *)
B5 CMD1			
B6 CMD2			*) Reg. no. in byte 4, value in bytes 5, 6, 7, 8. Value remains stationary as long as Load_CPL is active
B7 Load_CPL	Laden ausgeführt	Load completed	= 0 → 1: With the positive edge, the action in CMD0, CMD1 and CMD2 was performed. Load_CPL remains stationary as long as Load_R (CASEL.B7) is active.

Tab. 2/19: Status byte 3 (SASEL)

2. Sequence control

Operating-mode-dependent effect of SASEL

Bit	Operating mode		
	Record selection	Direct mode	Commissioning
SASEL.SELAX0 SASEL.SELAX1	Chosen axis for display of actual position	Chosen axis for display of actual position	Chosen axis for commissioning
SASEL.CMD0 SASEL.CMD1 SASEL.CMD2	No effect	Load commands	No effect
SASEL.LOAD_CPL	Reserved, must be at 0!	= 0 → 1: With the positive edge, the action in Load Command was carried out.	Reserved, must be at 0!

Tab. 2/20: Operating-mode-dependent effect of SASEL

2. Sequence control

2.6 FHPP-MAX status machine

2.6.1 General depiction

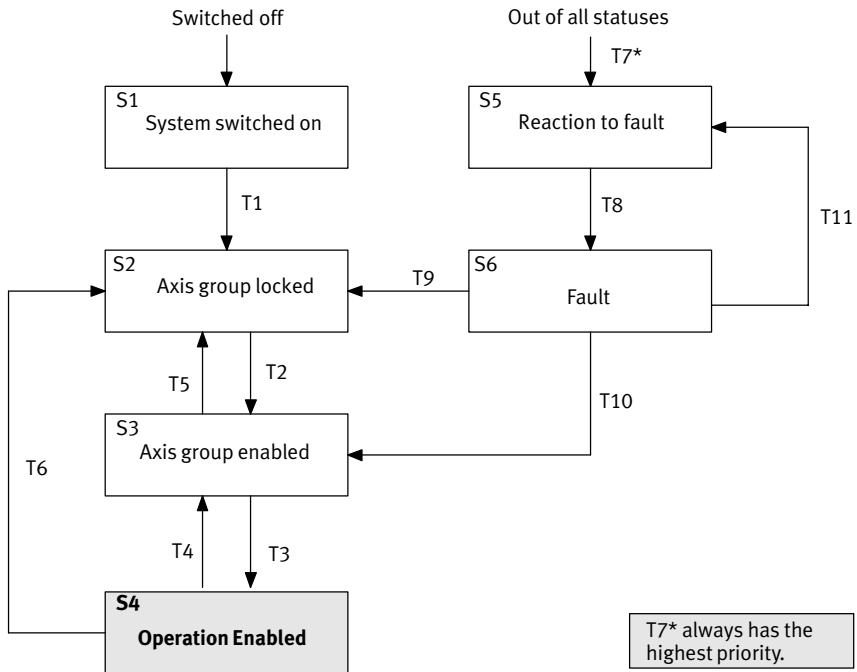


Fig. 2/1: FHPP-MAX status machine

S1 ... S6: Statuses
T1 ... T11: Transitions (Status transitions)

2. Sequence control

Description of the transitions Tx

T	Internal conditions	Actions of the user	Remarks
T1	System is switched on There is no fault		
T2	Load voltage applied PLC controls CPX-CMXX	“Axis group enabled” = 1 CCON = xxx0.xxx1	
T3		“Stop” = 1 CCON = xxx0.xx11	Not permitted in the Parameterisation mode, since the status S4 “Operation enabled” does not exist in this operating mode.
T4		“Stop” = 0 CCON = xxx0.xx01	Not present in the Parameterisation mode.
T5		“Axis group enabled” = 0 CCON = xxx0.xxx0	
T6		“Axis group enabled” = 0 CCON = xxx0.xxx0	Not present in the Parameterisation mode.
T7*	Fault recognised		T7* has the highest priority. T7 is executed from the statuses S5 and S6 when a fault with higher priority occurs. This means that a serious fault can suppress a simple fault.
T8	Reaction to fault complete; drive stopped		
T9	Fault type 2 is no longer present	“Quit fault” = 0 →□1 CCON = xxx0.Pxxx	
T10	Fault type 1 is no longer present	“Quit fault” = 0 →□1 CCON = xxx0.Pxx1	
T11	Fault still exists	“Quit fault” = 0 →□1 CCON = xxx0.Pxx1	
Key: 0 →□1 = P = positive edge 1 →□0 = N = negative edge x = any * highest priority			

Tab. 2/21: Description of the transitions Tx

2. Sequence control

2.6.2 Status S4 “Operation Enabled”

The transition T3 changes to status S4, which itself contains its own sub-status machine, the statuses of which are marked with “SAx” and the transitions of which are marked with “TAX”, see Fig. 2/2.

Transitions T4, T6 and T7* are executed from every sub-state SAx and automatically have a higher priority than any transition TAX.

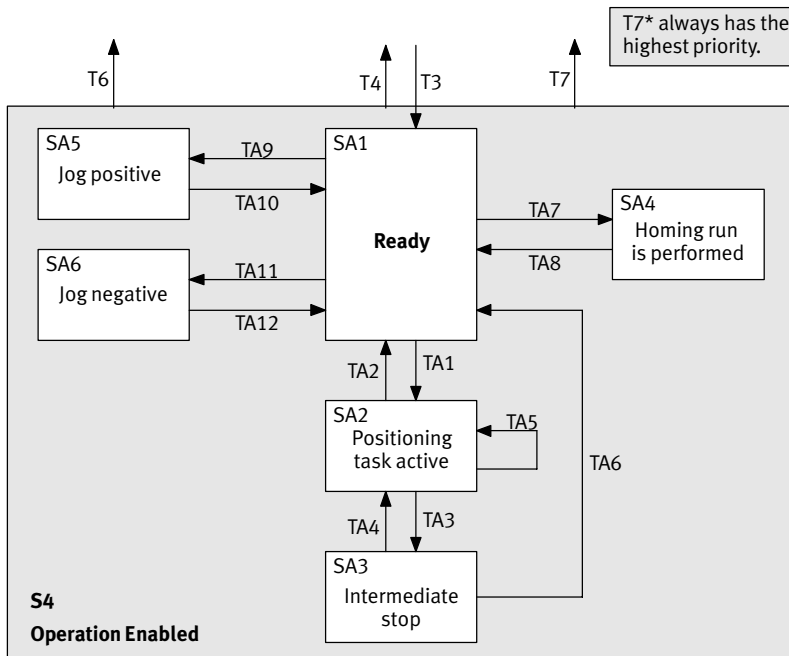


Fig. 2/2: Status S4 “Operation Enabled”

SA1 ... SA6: Sub-statuses of the status S4

TA1 ... TA12: Transitions (status transitions) within status S4

2. Sequence control

Description of the transitions TAx

Fundamentally, the following applies:

Transitions T4, T6 and T7* always have priority!

Halt is only effective if parameter 522, bit 1 = 0.

TA	Internal conditions	Actions of the user	Remarks
TA1	Referencing is running	Start positioning task = 0 → <input type="checkbox"/> 1 Halt = 1 CCON = xxx0.xx11 CPOS = 0xx0.00 P1	
TA2	Motion Complete = 1 The current record is completed. The next record is not processed automatically	“Halt” status is any CCON = xxx0.xx11 CPOS = 0xxx.xxxx	
TA3	Motion Complete = 0	Halt = 1 → 0 CCON = xxx0.xx11 CPOS = 0xxx.xxxx 0	In the Commissioning operating mode, with Halt = 1 → 0, the switch is made into the status SA1. In the Commissioning mode, there is no status SA3 “Intermediate Stop”.
TA4		Halt = 1 Start positioning task = 0 → <input type="checkbox"/> 1 Clear remaining travel = 0 CCON = xxx0.xx11 CPOS = 00 xx.xx P1	Not present in the Commissioning mode.
TA5			Not present in the Commissioning mode.
	Record select and Direct mode: – A single record is finished – The next record is processed automatically	CCON = xxx0.xx11 CPOS = 0xxx.xxxx1	
TA6		Clear remaining travel = 0 → 1 CCON = xxx0.xx11 CPOS = 01 xx.xxxx	
Key: 0 → 1 = P = positive edge, 1 → 0 = N = negative edge, x = any			

2. Sequence control

TA	Internal conditions	Actions of the user	Remarks
TA7		Start reference travel = 0 → \square 1 Halt = 1 CCON = xxx0.xx11 CPOS = 0xx0.0Px1	
TA8	Referencing finished or stopped	Only for halt: Halt = 1 → 0 CCON = xxx0.xx11 CPOS = 0xx.xxxN	
TA9		Jog positive = 0 → \square 1 Halt = 1 CCON = xxx0.xx11 CPOS = 0xx0.Pxx1	
TA10		Either – Jog positive = 1 → \square 0 – CCON = xxx0.xx11 – CPOS = 0xxx.0xx1 or – Halt = 1 → 0 – CCON = xxx0.xx11 – CPOS = 0xxx.xxxN	
TA11		Jog negative = 0 → 1 Halt = 1 CCON = xxx0.xx11 CPOS = 0xxP.xxx1	
TA12		Either – Jog negative = 1 → 0 – CCON = xxx0.xx11 – CPOS = 0xxN.xxx1 or – Halt = 1 → 0 – CCON = xxx0.xx11 – CPOS = 0xxx.xxxN	
Key: 0 → 1 = P = positive edge, 1 → 0 = N = negative edge, x = any			

Tab. 2/22: Description of the transitions TAX

2. Sequence control

2.6.3 Special features in the Commissioning mode

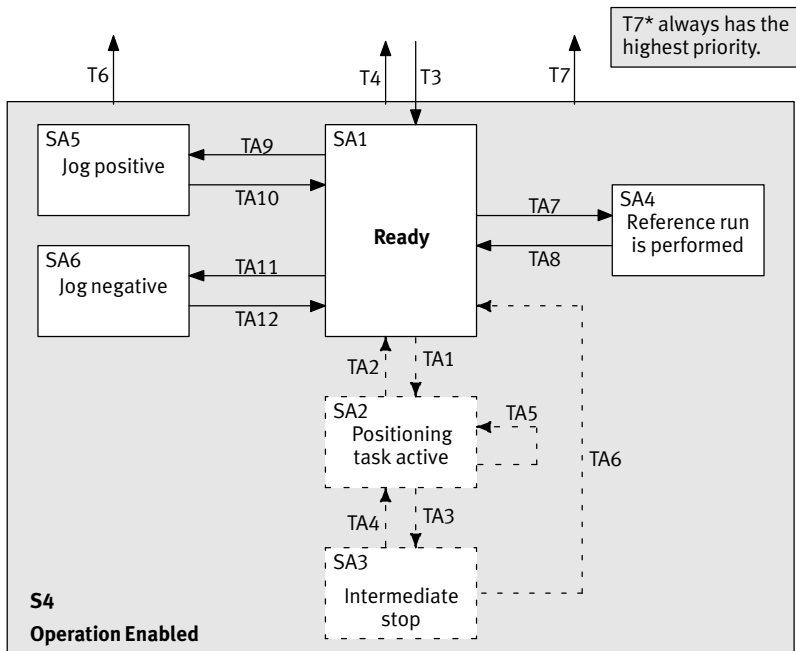


Fig. 2/3: Status S4 "Operation Enabled" in the Commissioning operating mode

SA2 and SA3: Does not exist here. If Halt=0, the axis group changes after SA1.

TA1, TA2, TA3,

TA4, TA5 and TA6: The transitions are not present.

2. Sequence control

2.6.4 Special features in the Parameterisation mode

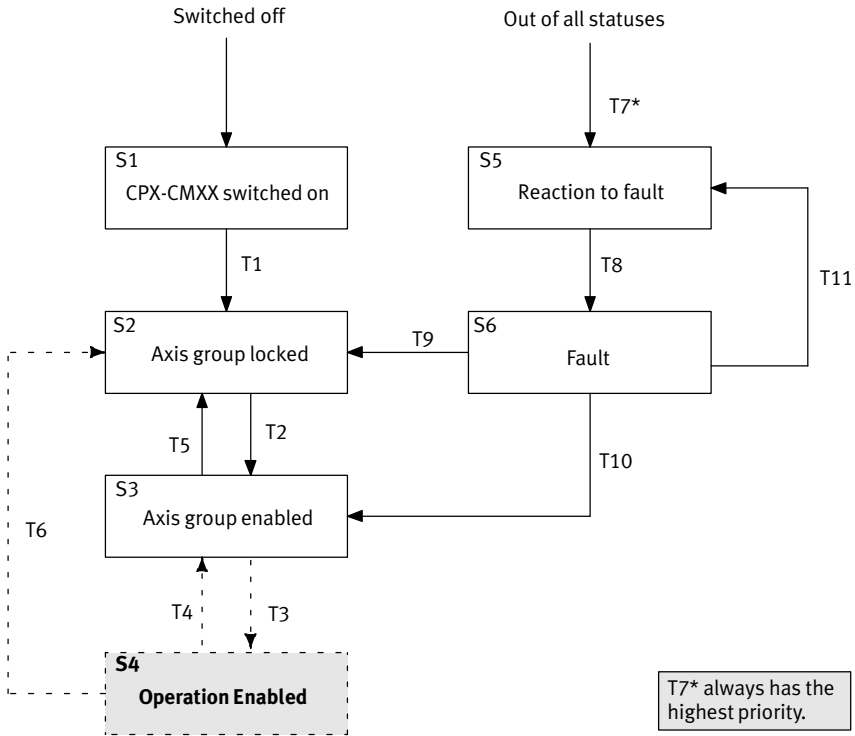


Fig. 2/4: FHPP-MAX status machine in the parameter setting operating mode

S4: Does not exist here.

T3: The transition is not permitted.

2.7 Examples of control and status bytes

On the following pages you will find typical examples of control and status bytes:

- Safeguard device control
- Create readiness to operate – Record select
- Create readiness to operate – Direct mode
- Fault handling
- Reference travel (Homing run)
- Positioning Record select
- Positioning Direct mode

The following examples are presented in tables. The column control bytes contains the setpoints and the column status bytes the acknowledgements.

2. Sequence control

1. Safeguard device control

Step/ Description	Control bytes									Status bytes								
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
1.1 Device control FCT on, SCON.B5 =1	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	0	0	0	0	0	0	0	SCON	0	0	1	1	0	0	0	0
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	0	0	SPOS	0	0	0	0	0	1	0	0
0: 0-signal		1: 1-signal			x: Not relevant (any)													
P: positive edge		N: negative edge																

Tab. 2/23: Control and status bytes “Device control active”

Description of 1. Safeguard device control

- 1.1 The device control through the FCT (Festo Configuration Tool) is activated.
For control over FHPP-MAX, the device control must first be deactivated through the FCT; see online help FCT Plugin CMXX.

2. Sequence control

2. Create readiness to operate – Record select

Step/ Description	Control bytes								Status bytes									
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
2.1 Basic status (Device control FCT off, SCON.B5 =0)	Byte 1	OPM2	OPM1	LOCK	–	RESET	–	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	0	0	0	0	0	0	0	SCON	0	0	0	1	0	0	0	0
2.2 Disable device control FCT	Byte 2	–	CLEAR	–	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	–	–	MOV	–	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	0	0	SPOS	0	0	0	0	0	1	0	0
2.3 Enable drive, enable operation (Record select)	Byte 1	OPM2	OPM1	LOCK	–	RESET	–	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	0	x	0	0	0	1	1	SCON	0	0	0	1	0	0	1	1
	Byte 2	–	CLEAR	–	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	–	–	MOV	–	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	0	1	SPOS	0	0	0	0	0	1	0	1
0: 0-signal		1: 1-signal		x: Not relevant (any)														
P: positive edge		N: negative edge																

Tab. 2/24: Control and status bytes “Create readiness to operate a Record select”

Description of 2. Create readiness to operate

- 2.1 Basic status of the axis group when the supply voltage has been switched on.
→ Continue with step 2.2 or 2.3
- 2.2 Disable device control by FCT.
Optionally, the takeover of device control by the FCT can be disabled with CCON.B5 = 1 (LOCK).
→ Continue with step 2.3
- 2.3 Enable axis group in Record select mode.
→ See example 5. Reference travel, Tab. 2/27.



If there are faults after switching on or after setting CCON.B0 (ENABLE):
→ See example 4. Fault handling, Tab. 2/26.

2. Sequence control

3. Create readiness to operate – Direct mode

Step/ Description	Control bytes									Status bytes								
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
3.1 Basic status (Device control FCT off, SCON.B5 = 0)	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	0	0	0	0	0	0	0	SCON	0	0	0	1	0	0	0	0
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	0	0	SPOS	0	0	0	0	0	1	0	0
3.2 Disable device control FCT	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	x	x	1	0	x	0	x	x	SCON	x	x	0	1	x	x	x	x
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	x	0	x	x	x	x	x	SPOS	x	0	0	x	0	x	x	x
3.3 Enable drive, enable operation (Direct mode)	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	1	x	0	0	0	1	1	SCON	0	1	0	1	0	0	1	1
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	0	1	SPOS	0	0	0	0	0	1	0	1
0: 0-signal		1: 1-signal			x: Not relevant (any)													
P: positive edge		N: negative edge																

Tab. 2/25: Control and status bytes “Create readiness to operate – Direct mode”

Description of 3. Create readiness to operate

- 3.1 Basic status of the axis group when the supply voltage has been switched on.
→ Step 3.2 or 3.3
- 3.2 Disable device control FCT.
Optionally, the takeover of device control by the FCT can be disabled with CCON.B5 = 1 (LOCK).
→ Step 3.3
- 3.3 Enable axis group in the direct mode.
→ See example 5. Reference travel, Tab. 2/27.

If there are faults after switching on or after setting CCON.B0 (ENABLE):
→ See example 4. Fault handling, Tab. 2/26.



2. Sequence control

4. Fault handling

Step/ Description	Control bytes								Status bytes									
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
4.1 Fault	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	X	X	X	0	X	0	X	X	SCON	X	X	X	1	1	X	X	X
4.2 Warning	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	X	0	X	X	X	X	X	SPOS	X	0	0	X	X	X	X	X
4.3 Quit fault with CCON.B3 (RESET)	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	X	X	0	P	0	X	1	SCON	0	X	0	1	0	0	0	0
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	X	X	SPOS	X	0	0	0	0	1	0	1
0: 0-signal		1: 1-signal		x: Not relevant (any)														
P: positive edge		N: negative edge																

Tab. 2/26: Control and status bytes “Error treatment”

Description to 4. Fault handling

- 4.1 A fault is shown with SCON.B3 (FAULT).
→ Positioning can no longer be undertaken.
- 4.2 A warning is shown with SCON.B2 (WARN).
→ Positioning can still be undertaken.
- 4.3 Quit fault with positive edge at CCON.B3 (RESET).
→ Fault bit SCON.B2 (FAULT) or
SCON.B3 (WARN) will be reset
→ SPOS.B2 (MC) will be set
→ Axis group is ready for operation

2. Sequence control

5. Reference travel

Step/ Description	Control bytes									Status bytes								
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
5.1 Start reference travel	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	x	x	0	0	0	1	1	SCON	0	x	0	1	0	0	1	1
5.2 Reference travel runs	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	0	0	0	0	P	0	1	SPOS	0	0	0	0	0	0	1	1
5.3 Reference travel concluded	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL
	CCON	0	x	x	0	0	0	1	1	SCON	0	x	0	1	0	0	1	1
5.3 Reference travel concluded	Byte 2	-	CLEAR	TEACH	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT
	CPOS	0	0	0	0	0	0	0	1	SPOS	1	0	0	0	0	1	0	1
0: 0-signal 1: 1-signal x: Not relevant (any) P: positive edge N: negative edge																		

Tab. 2/27: Control and status bytes “Reference travel”

Description to 5. Reference travel

5.1 A positive edge at CPOS.B2 (HOM, Start reference travel) starts the reference travel. The start is confirmed with SPOS.B1 (Quit Start) as long as CPOS.B2 (HOM) is set.

5.2 After successful reference travel SPOS.B2 (MC, Motion Complete) and SPOS.B7 (REF) will be set.

If there are faults during reference travel:

→ See example 4. Fault handling, Tab. 2/26.



2. Sequence control

6. Positioning Record select / Direct mode

Step/ Description	Control bytes								Status bytes										
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0	
6.1 Preselect record number (control bytes 5 and 6)	Byte5	Record Number Byte 5																	
	Byte6	Record Number Byte 6																	
	Record No.	Record no. (1 ...)																	
6.2 Start task	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL	
	CCON	0	0	x	0	0	0	1	1	SCON	0	0	0	1	0	0	1	1	
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT	
	CPOS	0	0	0	0	0	0	P	1	SPOS	1	0	0	0	0	0	1	1	
6.3 Order runs	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL	
	CCON	0	0	x	0	0	0	1	1	SCON	0	0	0	1	0	0	1	1	
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT	
	CPOS	0	0	0	0	0	0	1	1	SPOS	1	0	0	1	0	0	1	1	
6.4 Order concluded	Byte 1	OPM2	OPM1	LOCK	-	RESET	-	STOP	ENABL	Byte 1	OPM2	OPM1	LOCK	DRDY	FAULT	WARN	OPEN	ENABL	
	CCON	0	0	x	0	0	0	1	1	SCON	0	0	0	1	0	0	1	1	
	Byte 2	-	CLEAR	-	JOGN	JOGP	HOM	START	HALT	Byte 2	REF	-	-	MOV	-	MC	ACK	HALT	
	CPOS	0	0	0	0	0	0	0	1	SPOS	1	0	0	0	0	1	0	1	
									Byte 5...8	new									
									Actual position	Actual position (1/1000 mm or 1/1000 °)									
0: 0-signal		1: 1-signal		x: Not relevant (any)															
P: positive edge		N: negative edge																	

Tab. 2/28: Control and status bytes “Positioning Record select / Direct mode”

Description of 6. Positioning Record select

(steps 6.1 ... 6.3 conditional sequence)

When the readiness to operate is created and the reference travel has been carried out, a positioning task can be started.

- 6.1 Preselect record number:
Byte 5 and 6 of the output data
- 6.2 With CPOS.B1 (START, Start task) the preselected positioning task will be started. The start is confirmed with SPOS.B1 (Quit Start) as long as CPOS.B1 (START) is set.
- 6.3 At the end of the positioning task, SPOS.B2 (MC, Motion Complete) will be set.

If there are faults during positioning:

→ See example 4. Fault handling, Tab. 2/26.



2. Sequence control

7. Write record register – Direct mode

Step/ Description	Control bytes								Status bytes									
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
7.1 Set data	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0									
	CASEL	0	0	0	1	0	0	x	x									
	Byte 4	Register Number Byte 4																
	Tab	Register number																
	Byte 5...8	Register Number Byte 5...8																
	Value	New register value																
7.2 Load	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0	Byte 3	L_CPL	CMD2	CMD1	CMD0	-	-	SAX1	SAX0
	CASEL	1	0	0	1	0	0	x	x	SASEL	1	0	0	1	0	0	x	x
7.3 Loading ended	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0	Byte 3	L_CPL	CMD2	CMD1	CMD0	-	-	SAX1	SAX0
	CASEL	0	0	0	1	0	0	x	x	SASEL	0	0	0	1	0	0	x	x
0: 0-signal		1: 1-signal		x: Not relevant (any)														
P: positive edge		N: negative edge																

Tab. 2/29: Write record register – Direct mode

Description to 7. Write record register – Direct mode

- 7.1 Register preselection:
 Register number: Byte 4 of the output data
 Register value: Byte 5 -8 of the output data
- 7.2 The register is loaded with CASEL.B7 (LOAD_R).
 The task is confirmed with SASEL.B7 (Load_CPL).
- 7.3 At the end of the load process, CASEL.B7 (LOAD_R) is reset. The end of the load process is confirmed by resetting SASEL.B7 (LOAD_CPL).



If there are faults while writing record register:
 → See example 4. Fault handling, Tab. 2/26.

2. Sequence control

8. Add record register – Direct mode

Step/ Description	Control bytes								Status bytes									
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
8.1 Set data	Byte 3 CASEL	LD_R 0	CMD2 0	CMD1 1	CMD0 0	- 0	- 0	SAX1 X	SAX0 X									
	Byte 4 Tab	Register Number Byte 4 Register number																
	Byte 5...8 Value	Register Number Byte 5...8 Addition value																
8.2 Load	Byte 3 CASEL	LD_R 1	CMD2 0	CMD1 1	CMD0 0	- 0	- 0	SAX1 X	SAX0 X	Byte 3 SASEL	L_CPL 1	CMD2 0	CMD1 1	CMD0 0	- 0	- 0	SAX1 X	SAX0 X
	8.3 Loading ended	Byte 3 CASEL	LD_R 0	CMD2 0	CMD1 1	CMD0 0	- 0	- 0	SAX1 X	SAX0 X	Byte 3 SASEL	L_CPL 0	CMD2 0	CMD1 1	CMD0 0	- 0	- 0	SAX1 X
0: 0-signal		1: 1-signal		x: Not relevant (any)														
P: positive edge		N: negative edge																

Tab. 2/30: Add record register – Direct mode

Description for 8. Add record register – Direct mode

- 8.1 Register preselection:
Register number: Byte 4 of the output data
Addition value: Byte 5 -8 of the output data
- 8.2 With CASEL.B7 (LOAD_R), the addition value is added to the register content. The task is confirmed with SASEL.B7 (Load_CPL).
- 8.3 At the end of the load process, CASEL.B7 (LOAD_R) is reset. The end of the load process is confirmed by resetting SASEL.B7 (LOAD_CPL).

If there are faults while adding record register :
→ See example 4. Fault handling, Tab. 2/26.



2. Sequence control

9. Subtract record register – Direct mode

Step/ Description	Control bytes								Status bytes									
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
9.1 Set data	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0									
	CASEL	0	0	1	1	0	0	x	x									
	Byte 4	Register Number Byte 4																
	Tab	Register number																
	Byte 5...8	Register Number Byte 5...8																
	Value	Subtraction value																
9.2 Load	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0	Byte 3	L_CPL	CMD2	CMD1	CMD0	-	-	SAX1	SAX0
	CASEL	1	0	1	1	0	0	x	x	SASEL	1	0	1	1	0	0	x	x
9.3 Loading ended	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0	Byte 3	L_CPL	CMD2	CMD1	CMD0	-	-	SAX1	SAX0
	CASEL	0	0	1	1	0	0	x	x	SASEL	0	0	1	1	0	0	x	x
0: 0-signal		1: 1-signal		x: Not relevant (any)														
P: positive edge		N: negative edge																

Tab. 2/31: Subtract record register – Direct mode

Description for 9. Subtract record register – Direct mode

9.1 Register preselection:

Register number: Byte 4 of the output data

Subtraction value: Byte 5-8 of the output data

9.2 With CASEL.B7 (LOAD_R), the subtraction value is subtracted from the register content. The task is confirmed with SASEL.B7 (Load_CPL).

9.3 At the end of the load process, CASEL.B7 (LOAD_R) is reset. The end of the load process is confirmed by resetting SASEL.B7 (LOAD_CPL).



If there are faults while subtracting record register:

→ See example 4. Fault handling, Tab. 2/26.

2. Sequence control

10. Write record register – Direct mode

Step/ Description	Control bytes								Status bytes									
	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Byte	B7	B6	B5	B4	B3	B2	B1	B0
10.1 Set data	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0									
	CASEL	0	1	0	0	0	0	X	X									
	Byte 4	Register Number Byte 4																
	Tab	Register number																
10.2 Load	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0	Byte 3	L_CPL	CMD2	CMD1	CMD0	-	-	SAX1	SAX0
	CASEL	1	1	0	0	0	0	X	X	SASEL	1	1	0	0	0	0	X	X
10.3 Loading ended	Byte 3	LD_R	CMD2	CMD1	CMD0	-	-	SAX1	SAX0	Byte 3	L_CPL	CMD2	CMD1	CMD0	-	-	SAX1	SAX0
	CASEL	0	1	0	0	0	0	X	X	SASEL	0	1	0	0	0	0	X	X
0: 0-signal		1: 1-signal		x: Not relevant (any)														
P: positive edge		N: negative edge																

Tab. 2/32: Write record register – Direct mode

Description of 10. Write record register – Direct mode

10.1 Register preselection:

Register number: Byte 4 of the output data

10.2 The register content is read with CASEL.B7 (LOAD_R). The task is confirmed with SASEL.B7 (Load_CPL).

10.3 At the end of the load process, CASEL.B7 (LOAD_R) is reset. The end of the load process is confirmed by resetting SASEL.B7 (LOAD_CPL).

If there are faults while loading record register:

→ See example 4. Fault handling, Tab. 2/26.



Drive functions

Chapter 3

3. Drive functions

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3. Drive functions

3.1 Jog mode

When the Commissioning operating mode is selected, the axes of the axis group in the status S4 “Operation Enabled” can be driven positively/negatively by jogging.

This function is usually used for:

- moving axes out of the way (e.g. after a system fault)
- manual positioning as a normal operating mode (manually operated feed).

Process

1. Choose axis with CASEL.SELAX0 (B0) and CASEL.SELAX1 (B1).
2. Set positioning speed in output byte 4:
1 ... 100 % of Vmax
3. Reference axis.
4. When one of the signals “Jog positive (JOGP) / Jog negative (JOGN)” is set, the axis starts to move.
 - If PNU522 bit 6 = 0
The axis runs, dependent on the jog interval, in the output bytes 5 ... 8 as follows:
Jog interval = 0: axis runs up to the SW limit switch.
Jog interval > 0: axis runs the path in jog interval.
 - If PNU522 bit 6 = 1
The axis is moved continuously in the speed control mode if supported by the drive controller. As a result, simultaneous moving of several axes (through switching of the axis choice with SASEL.SELAX0 and SASEL.SELAX1) is possible.
5. If the signal changes to 0, the axis is braked with the pre-set maximum deceleration.

3. Drive functions

Overview of the parameters involved	
Parameters involved	Description
PNU 522 bit 6 Jog mode via velocity mode	= 0: Jogging with evaluation of the jog interval = 1: Axis is continuously moved in the velocity mode
Start	CPOS.B3 = 0 → <input type="checkbox"/> 1: Jogging positive (direction of larger actual values) CPOS.B3 = 0 → <input type="checkbox"/> 1: Jogging negative (direct. of smaller actual values)
Velocity	Output byte 4 (in % of Vmax)
Jog interval	Output byte 5, 6, 7 and 8; value range 0 ... $2^{32} - 1$

Tab. 3/1: Parameters involved in jogging mode

3.2 Record select mode

A position record can be started in the status S4 “Operation Enabled”. This function is usually used for:

- freely selected travel through the PLC of position records of the CPX-CMXX position record table
- processing a positioning profile by linking position records
- known target positions, which seldom change (e.g. with formulation change).

A total of 1024 position records is available.

The position records are configured in the CPX-CMXX FCT PlugIn.



3. Drive functions

3.2.1 Record select mode process

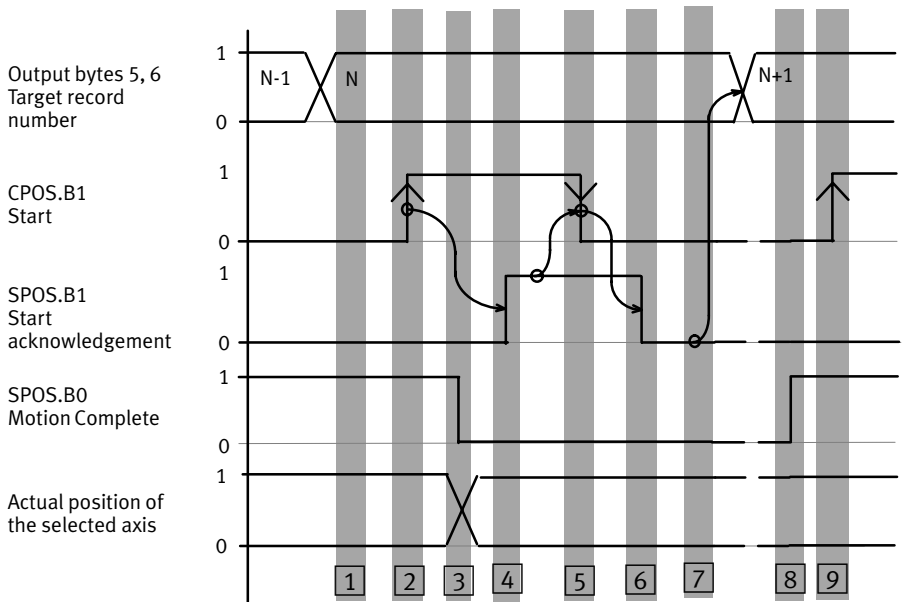


Fig. 3/1: Record start process

- 1 Set the desired record number in the PLC's output data.
- 2 If ACK (SPOS.B1, acknowledgement) = 0, the PLC can initiate execution of the record with a rising edge at START (CPOS.B1).
- 3 The CPX-CMXX takes over the record number and starts positioning.
In the input data of the PLC, the actual position of the selected axis is set and MC (SPOS.B2) reset.
- 4 The CPX-CMXX now signals with the rising edge at ACK (SPOS.B1) that the output data of the PLC have been taken over and the positioning task is active.

3. Drive functions

- 5 The PLC recognises the acknowledgement ACK (SPOS.B1) = 1 in its input data and resets START (CPOS.B1) in its output data.
Resetting of CPOS.START (B1) to 0 does not influence the positioning task.
- 6 With the resetting of ACK (SPOS.B1), the CPX-CMXX acknowledges the resetting of START (CPOS.B1).
- 7 After the PLC detects ACK (SPOS.B1) = 0, it can write a new record number into its output data. The CPX-CMXX ignores this until the next start.
- 8 The CPX-CMXX sets SPOS.MC as soon as all axes involved have reached their target position.
- 9 The next positioning task can be started.

Note:

- As soon as the PLC detects the rising edge at ACK (SPOS.B1), it can assume that SPOS.MC is valid.
- If the actual position is within the tolerance of the target position, the handshake is carried out but the positioning task is not started. Motion Complete then stays set. The positioning task is ended immediately.

3. Drive functions

Typical causes of errors in applications

- Referencing has not been carried out.
- Selection of an invalid record number or a record that has not been initialised.
- The target value lies outside the software end positions.
- Error in the record parameters, e.g. invalid record linking.
- Subsequent record with further record switching not initialised.

Problems in applications

- Why does the CPX-CMXX not react to the rising edge at START (CPOS.B1)?
If the CPX-CMXX does not react to the rising edge at START, please check whether ACK (SPOS.B1) has really been reset. After the PLC sets start = 0 (Fig. 3/1 [6]), it must wait for ACK (SPOS.B1) = 0 (Fig. 3/1 [7]). Otherwise, it may be that the time for START = 0 is too short to be recognised by the CPX-CMXX.

Overview of the parameters involved	
Parameters involved	Description
Start	CPOS.B1 = 0 → [1]: Start Jogging and homing have priority
Target record number	Output byte 5 and 6
Acknowledgement	SPOS.ACK = 0 → [1]: Acknowledgement of start SPOS.MC = 0: Motion Complete

Tab. 3/2: Record select parameters involved

3. Drive functions

3.2.2 Record linking

The Record select mode and Direct mode make it possible to link several positioning tasks. This means that, starting at CPOS.START, various position records are automatically executed one after the other. With this, a motion profile can be defined.

With the “record linking” position record parameter, the record number of the position record to be executed as the next record is specified. This permits any jumping desired in the position record table.

If the value of the position record parameter “record linking” = 0, no further switching takes place.

If the value of the “record linking” position record parameter > 0, further switching occurs after the target value is reached, i.e. when the motion-complete condition is fulfilled (MC = 1).

3.2.3 Changeover from Direct mode to Record select mode



Warning

Danger of injury through uncontrolled movements of drive axes.

Through the Direct mode operating mode, the random access memory of the CPX-CMXX can contain a position record table, which differentiates itself from the position record table in the permanent memory of the CPX-CMXX. Switching from Direct mode to Record select mode does not overwrite the position record table in the random access memory of the CPX-CMXX.

- Note that execution of position records can lead to undesired movements of the axis group.

3.3 Direct mode

The Direct mode is an extension of the Record select operating mode.

All parameters of the position record table can be overwritten by the PLC.

This function is normally used:

- for freely selected movement to positions
- if the target positions are unknown during planning or if they change frequently (several different work item positions).



Please note

Changed position record parameters can be lost:

- after the power supply is switched off and back on; overwritten position record parameters are stored only in the random access memory of the CPX-CMXX.
- through the FCT PlugIn functions download and adjustment of the FCT-PlugIn to the CPX-CMXX; the position records in the random access and permanent memory are overwritten.



Please note

The FCT PlugIn functions Upload and Adaptation from CPX-CMXX to the FCT PlugIn only access the position records in the permanent memory of the CPX-CMXX. The position records in the random access memory of the CPX-CMXX are not transferred to the FCT PlugIn.

3. Drive functions

The position record parameters are written to the position record selected via the record register. Each record register corresponds to a parameter of the selected position record. The composition of the record register can be found in the following section.

The position records are started as in the Record select operating mode.

3.3.1 Structure of the record register

RegNo	Designation	Description	Value range	Unit
0	Record No.	Selects the record for all coming register commands	1 ... 1024	
1	Record control word	Bit 0 = 0: absolute positioning Bit 0 = 1: relative positioning Bit 1 ... 4: Axes 1 ... 4 are synchronised (PTP- synchronously) controlled Bit 5 = 0: Record not configured Bit 5 = 1: Record configured		
2	Target position axis 1		$-2^{31} \dots 2^{31} - 1$	1/1000 mm or 1/1000 °
3	Target position axis 2		$-2^{31} \dots 2^{31} - 1$	1/1000 mm or 1/1000 °
4	Target position axis 3		$-2^{31} \dots 2^{31} - 1$	1/1000 mm or 1/1000 °
5	Target position axis 4		$-2^{31} \dots 2^{31} - 1$	1/1000 mm or 1/1000 °
6	Velocity axis 1		$0 \dots 2^{31} - 1$	1/1000 mm/s or 1/1000 °/s
7	Velocity axis 2		$0 \dots 2^{31} - 1$	1/1000 mm/s or 1/1000 °/s
8	Velocity axis 3		$0 \dots 2^{31} - 1$	1/1000 mm/s or 1/1000 °/s

3. Drive functions

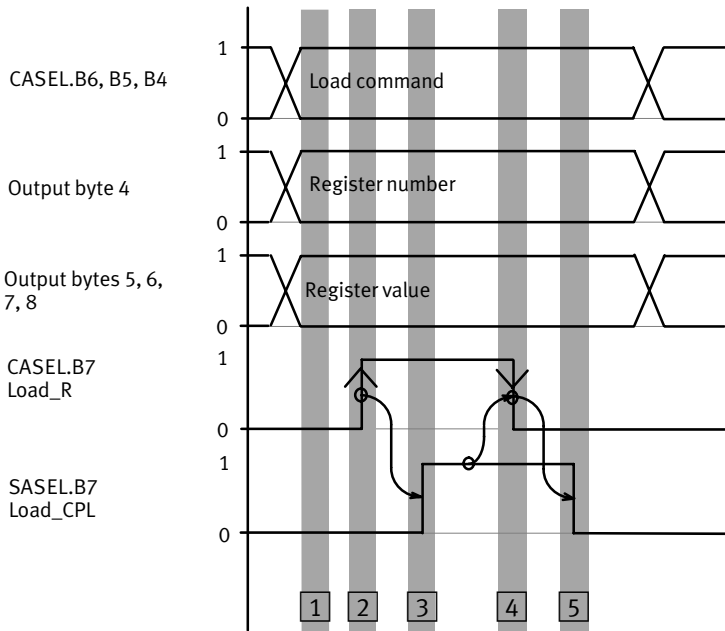
RegNo	Designation	Description	Value range	Unit
9	Velocity axis 4		0 ... $2^{31} - 1$	1/1000 mm/s or 1/1000 °/s
10	Acceleration axis 1		0 ... $2^{31} - 1$	1/1000 mm/s ² or 1/1000 °/s ²
11	Acceleration axis 2		0 ... $2^{31} - 1$	1/1000 mm/s ² or 1/1000 °/s ²
12	Acceleration axis 3		0 ... $2^{31} - 1$	1/1000 mm/s ² or 1/1000 °/s ²
13	Acceleration axis 4		0 ... $2^{31} - 1$	1/1000 mm/s ² or 1/1000 °/s ²
14	Velocity track		0 ... $2^{31} - 1$	1/1000 mm/s or 1/1000 °/s
15	Acceleration track		0 ... $2^{31} - 1$	1/1000 mm/s ² or 1/1000 °/s ²
16	Reserved			
17	Record linking	0: No linking 1 ... 1024: The selected record is executed as next record	0 ... 1024	
18	Response time	Time from reaching the target position to the start of the linked record.	0 ... 2^{32}	ms

Tab. 3/3: Record register for Direct mode

3. Drive functions

3.3.2 Direct mode process

1. Load new parameter in position record



3. Drive functions

- 1 Put new register value into the output bytes 5, 6, 7, 8, the register number in byte 4 and the load action (e.g. here: 1 for writing) in CASEL.B4, B5, B6.
- 2 With the rising edge at LOAD_R (CASEL.B7), the CPX-CMXX takes over the register value and writes it into the selected position record parameter.
- 3 The CPX-CMXX with rising edge at LOAD_CPL (SASEL.B7) reports that the write procedure is completed.
- 4 The PLC takes back the LOAD_R signal as soon as it has detected the LOAD_CPL (SASEL.B7).
- 5 The CPX-CMXX takes back LOAD_CPL as soon as the PLC takes away the LOAD_R signal.
The steps 1 to 5 are repeated until all desired position record parameters have been changed. The first command must always access register 0 to select the desired position record number.

Fig. 3/1: Process of Load new value in record

2. Record start

The process of Record start is identical to the process of Record start in the Record select operating mode, see section 3.2.1, Fig. 3/1.

All position records can be started, even the unchanged position records

3. Drive functions

Fault reaction and diagnosis

Chapter 4

4. Fault reaction and diagnosis

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4. Fault reaction and diagnosis

4.1 Classifying the faults

We differentiate between the following types of fault:

- Warnings
- Type 1 fault (axis group remains enabled)
- Type 2 fault (axis group is blocked)

The CPX-CMMX indicates errors or faults through appropriate fault messages or warnings. These can be evaluated via the following:

- status bytes, see section 2.5,
- diagnostic memory, see section 4.3,
- FCT, see online help for FCT.

4. Fault reaction and diagnosis

4.1.1 Warnings

A warning provides the user with information that does not have any effect on the drive's behaviour.

Behaviour in the event of warnings

- Drive controller and end stage remain active
- Positioning run is not interrupted
- Start of a new positioning run is possible
- The SCON.B2 (WARN) bit is set
- If the cause of the warning disappears, the SCON.B2 bit is automatically deleted again.

Examples for causes of warnings

- Parameters cannot be written or read
(examples: not permitted in the current operating status; invalid PNU, ...)
- Contour error
- Drive has left the tolerance range after Motion Complete
- Slight control errors.

4. Fault reaction and diagnosis

4.1.2 Type 1 fault

If there is a fault, the required performance is not provided by a drive axis of the axis group. The condition of the CPX-CMXX changes to the “Fault” status.

The “Fault” status can only be exited by switching off or through a positive edge at input CCON.B3 (RESET).

Behaviour in the event of type 1 faults

- The end stages of the drive controllers are **not** switched off.
- The current positioning run is interrupted.
- A new positioning run is not possible.
- The SCON.B3 (FAULT) bit is set.

Examples of causes of type 1 faults

- Software end positions are damaged
- Time overrun with Motion Complete (Timeout).

4. Fault reaction and diagnosis

4.1.3 Type 2 fault

If there is a fault, the required performance is not provided by a drive axis of the multi-axis system. The status of the CPX-CMXX changes to the “Fault” status.

The “Fault” status can only be exited by switching off or through a positive edge at input CCON.B3 (RESET).

Behaviour in the event of type 2 faults

- The end stages of the drive controllers are switched off.
- The current positioning run is interrupted.
- A new positioning run is not possible.
- The SCON.B3 (FAULT) bit is set.

Examples of causes of type 2 faults

- Load voltage is missing (e.g. if emergency off has been implemented)
- Hardware fault (e.g. measurement system fault, bus fault)
- Impermissible operation mode switch.

4. Fault reaction and diagnosis

4.2 Diagnostic status

The diagnostic status, parameter 220, contains the codes of the last diagnostic messages. In addition, the extended device faults, parameters 205, 207, 208 and 209, can be read out.

These parameters are described in section 5.4.3.

4.3 Diagnostic memory

The diagnostic memory contains the codes of the last diagnostic messages that occurred.

The diagnostic memory is protected against power failure. If the diagnostic memory is full, the oldest element will be overwritten (ring-memory principle).

The diagnostic memory includes the parameters 200 till 203. The diagnostic memory is configured with parameter 204.

These parameters are described in section 5.4.3.

4. Fault reaction and diagnosis

4.4 Fault numbers

Fault no.	Fault type	Designation (cause)	Fault treatment	CPX error categ.
1	1	Axis not referenced	<ul style="list-style-type: none"> • Reference the axis Non-referenced axes can be <ul style="list-style-type: none"> – moved in the jog mode if PNU522 bit 6 = 1 and the drive controller supports the velocity control operating mode; see also section 3.1. – moved by hand, after the drive controller enable has been switched off. 	101
2	1	Target position invalid (Selected target position lies outside the SW end positions of the axis or selected record was not configured)	<ul style="list-style-type: none"> • Check the target position and SW end positions. SW end positions of the FCT PlugIn CPX-CMXX differentiate themselves from the SW end positions or HW end positions of the axes. • Configure the position record. 	101
3	1	Position set invalid (Number of the selected position record outside the range 1 ... 1024)	<ul style="list-style-type: none"> • Start a valid position record. 	102
4	2	Position list cache not initialized (Position records could not be written from file {permanent memory} into internal cache {random access memory})	<ul style="list-style-type: none"> • Please consult your local Festo service or service_international@festo.com 	104
5	2	Invalid FHPP-MAX command-combination (Two FHPP-MAX commands were set simultaneously, e.g. START and LOAD_R; this is not permitted)	<ul style="list-style-type: none"> • Rework the control program 	105

4. Fault reaction and diagnosis

Fault no.	Fault type	Designation (cause)	Fault treatment	CPX error categ.
8	2	Axis not initialized (Either the device is factory-new or an axis could not be initialised)	<ol style="list-style-type: none"> 1. Determine the specific error in the disturbance buffer of the FCT PlugIn. 2. Check and correct the configuration in the FCT PlugIn accordingly. 	100
9	2	Axis not enabled	<ul style="list-style-type: none"> • Enable the axis. 	107
10	2	Error active (Positioning task is sent although another error is active)	<ul style="list-style-type: none"> • Acknowledge the error. 	101
11	Warning	Homing aborted (Positioning task is sent to axis while homing run is active)	<ul style="list-style-type: none"> • Send a positioning task only when the homing run has been ended. 	0
12	Warning	Moving aborted (Positioning task is sent to axis while position record is active)	<ul style="list-style-type: none"> • Send a positioning task only when the current position record has been carried out. 	0
13	Warning	Reset aborted (Positioning task is sent to axis while reset is active)	<ul style="list-style-type: none"> • Send a positioning task only when reset has been ended. 	0
14	Warning	Axis stopped (Positioning task is sent to axis while axis stops)	<ul style="list-style-type: none"> • Send a positioning task only when the stop process has been ended. 	0
26	Warning	Velocity cannot be reached (Limit values of the axes are incorrect or acceleration path is too short)	<ul style="list-style-type: none"> • Check the position record data and the axis parameterisation. 	0
27	1	Velocity < minimum velocity	<ul style="list-style-type: none"> • Check the position record data and the axis parameterisation. 	103
30	1	Execution timeout (Axis command could not be ended in the specified time)	<ul style="list-style-type: none"> • Check the drive controller and the axis. 	101
31	Warning	Tracking error (Controller reports contour error: contour error window or time out)	<ul style="list-style-type: none"> • Check the position data, drive controller settings and the axes 	0

4. Fault reaction and diagnosis

Fault no.	Fault type	Designation (cause)	Fault treatment	CPX error categ.
32	2	Homing error (Interruption of the homing run (Halt bit), both limit switches actuated simultaneously, search section traveled larger than positioning space)	<ul style="list-style-type: none"> • Check the drive controller and the axis. 	107
36	2	Timeout on stop command	<ul style="list-style-type: none"> • Check the drive controller and the axis. 	107
37	2	Timeout on changing the operating mode	<ul style="list-style-type: none"> • Check the drive controller. 	107
42	2	Enable timeout	<ul style="list-style-type: none"> • Check the drive controller. 	107
43	2	Axis state undefined (DS402)	<ul style="list-style-type: none"> • Check the drive controller. 	107
44	1	Axis in state FAULT(_REACTION_ACTIVE)	<ol style="list-style-type: none"> 1. Check the drive controller condition – additional messages can be found directly at the drive controller: <ul style="list-style-type: none"> – Diagnostic memory – LED – Display 2. Read out the status with FCT PlugIn of the drive controller or via display. 	107
45	Warning	Warning (Warning bit of the drive controller is set. A direction of rotation is blocked, since the limit switch has been actuated)	<ul style="list-style-type: none"> • Check the position record data and the axis. 	0
46	2	Disable timeout	<ul style="list-style-type: none"> • Check the drive controller. 	107
47	2	Command for inactive axis	<ul style="list-style-type: none"> • Check the triggering or configuration. 	101
48	2	Command for inactive group	<ul style="list-style-type: none"> • Check the triggering or configuration. 	101
56	2	CAN-Device startup timeout	<ul style="list-style-type: none"> • Check the CAN bus line and terminating resistor. 	100

4. Fault reaction and diagnosis

Fault no.	Fault type	Designation (cause)	Fault treatment	CPX error categ.
57	2	Invalid CAN-ID (No CANopen device with CAN ID of the axis in PLC configuration)	<ul style="list-style-type: none"> • Check the CAN ID. 	100
58	2	No live signal from FCT (Connection between FCT PlugIn and CPX-CMXX interrupted (network connection, FCT ended))	<ul style="list-style-type: none"> • Check the connection. 	105
59	1	SDO send/receive error	<ul style="list-style-type: none"> • Check the CAN bus and drive controller. 	105
60	1	SDO status error	<ul style="list-style-type: none"> • Check the portal parameterisation, CAN bus and drive controller. 	105
61	1	SDO timeout	<ul style="list-style-type: none"> • Check the CAN bus and drive controller. 	105
62	2	Detected invalid device type	<ul style="list-style-type: none"> • Check or change the configuration. • Close the device configured in the FCT PlugIn. 	100
63	2	Detected invalid product code	<ul style="list-style-type: none"> • Check or change the configuration. • Close the device configured in the FCT PlugIn. 	100
64	2	Detected invalid firmware	<ul style="list-style-type: none"> • Check or change the configuration. • Close the device configured in the FCT PlugIn. 	100
65	Warning	Warning: detected device is not fully supported	The warning serves as information that possibly not all functions of the device are supported; operation is still possible.	0
66	2	Error on node reset.	<ul style="list-style-type: none"> • Check the CAN bus and the configuration of the node involved. 	105

4. Fault reaction and diagnosis

Fault no.	Fault type	Designation (cause)	Fault treatment	CPX error categ.
74	2	Position table open-error (Error when opening file in CPX-CMXX)	<ul style="list-style-type: none">• Please consult your local Festo service or service_international@festo.com	104
75	2	Position table read-error (Error when reading file in CPX-CMXX)	<ul style="list-style-type: none">• Please consult your local Festo service or service_international@festo.com	104
76	2	Position table close-error (Error when closing file in CPX-CMXX)	<ul style="list-style-type: none">• Please consult your local Festo service or service_international@festo.com	104
77	2	Data write-error (Error when writing to file in CPX-CMXX)	<ul style="list-style-type: none">• Please consult your local Festo service or service_international@festo.com	104
121	2	CAN-Bus offline (No slave was recognised at the CAN-Bus)	<ul style="list-style-type: none">• Check the CAN bus line and terminating resistor.	71
125	2	CAN-Bus error passive (Communication errors were determined at the CAN-Bus)	<ul style="list-style-type: none">• Check the CAN bus line and terminating resistor.	71
126	2	CAN-Bus node guarding (A CAN-Bus slave has failed)	<ul style="list-style-type: none">• Check the slave.	71

Tab. 4/4: Error messages of the CPX-CMXX

4.5 Diagnosis using FHPP-MAX status bytes

The CPX-CMXX supports the following diagnosis options using FHPP-MAX status bytes; see section 2.5:

- SCON.B2 (WARN) – Warning
- SCON.B3 (FAULT) – Fault
- Byte 4 – Fault number

Parameters

Chapter 5

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5. Parameters

5.1 FHPP-MAX general parameter structure

The CPX-CMXX contains a parameter set with the following structure.

Complete parameter setting of an axis group as well as changing the motor types, number of axes or portal configuration is only possible over FCT.

Group	Indices	Description
Device data	100 ... 199	Device identification and device-specific settings, version numbers, identifier words, etc.
Diagnostic memory	200 ... 299	Memory for diagnostic events: Fault numbers, fault time, incoming/outgoing event.
Processing data	300 ... 399	Current nominal and actual values, local I/Os, status data etc.
Project data	500 ... 599	Fundamental project settings. Maximum speeds and accelerations etc. -> Parameters are the basis for the position record table
Factor group	600 ... 699	Parameter for scaling of the target and actual values
Axis data axis 1 Electric drives	1000 ... 1099	Axis-specific parameters for electric drives
Axis data axis 2 Electric drives	1100 ... 1199	Axis-specific parameters for electric drives
Axis data axis 3 Electric drives	1200 ... 1299	Axis-specific parameters for electric drives
Axis data axis 4 Electric drives	1300 ... 1399	Axis-specific parameters for electric drives

Tab. 5/1: Parameter structure

5. Parameters

Parameter classes	Attribute / use
Simple variable (Var)	Contains only one value. Its significance, limits, unit etc. differentiate it from other simple variables. The subindex does not have a function.
Array	Contains multiple values that all have the same significance, the same limits, the same unit, etc. Example: Max. Speed (PNU502). The elements in the array are addressed using the subindex.
Struct/Record	Compilation of several single variables with different limit values etc.

Tab. 5/2: Parameter classes

5.2 Access protection

5.2.1 Access via PLC and FCT

Simultaneous operation through PLC and FCT is not possible.

You can block the takeover of the control hierarchy over the CPX-CMXX through the FCT with bit CCON.B5. The status bit SCON.B5 (control hierarchy FCT) shows whether the control hierarchy over the CPX-CMXX is exercised through the FCT.

Preventing FCT operation: CCON.B5 (LOCK)

By setting the CCON.B5 control bit, the PLC prevents the FCT from taking over control sovereignty. So if the LOCK is set, FCT cannot write parameters or control the CPX-CMXX, execute homing etc.

Program the PLC so that it enables this only through an appropriate user action. This generally exits automatic operation. As a result, you as PLC programmer can ensure that the PLC always knows when it has control over the CPX-CMXX.

Important: The block is active if the CCON.B5 has a 1 signal. It therefore does not need to be set compulsorily. If you do not need this type of locking, you can always leave it at 0.

Control sovereignty acknowledgment for FCT: SCON.B5 (LOCK)

This bit informs the PLC that the CPX-CMXX is controlled through the FCT and the PLC has no more control over the CPX-CMXX. This bit does not need to be evaluated. The PLC can react by transferring to stop or manual operation.

5. Parameters

5.3 Overview of parameters

The following overview (Tab. 5/3) shows the FHPP-MAX parameters.

The parameters are described in sections 5.4.2 to 5.4.10.

Name	FHPP-MAX			
	PNU	Subind.	Class	Type
Device data (see section 5.4.2)				
Manufacturer Hardware Version	100	–	Var	uint16
Manufacturer Firmware Version	101	–	Var	uint16
Version FHPP-MAX	102	–	Var	uint16
Supported Drive Modes	112	–	Var	uint32
Controller Serial Number	114	1 ... 12	Array	char
Manufacturer Device Name	120	1 ... 255	Array	char
User Device Name	121	1 ... 255	Array	char
Drive Manufacturer	122	1 ... 18	Array	char
Password PC / Diag	130	1 ... 8	Array	char
Axis 1 Name	180	1 ... 128	Array	char
Axis 2 Name	181	1 ... 128	Array	char
Axis 3 Name	182	1 ... 128	Array	char
Axis 4 Name	183	1 ... 128	Array	char
Diagnosis (see section 5.4.3)				
Diagnostic event	200	1 ... 16	Array	uint8
Fault Number	201	1 ... 16	Array	uint8
Time Stamp	202	1 ... 16	Array	uint32
Additional Data	203	1 ... 16	Array	uint32
Diagnostic Memory Parameter	204	1 ... 4	Array	uint8
Extended Device Error Axis 1	205	–	Var	uint16
Extended Device Error Axis 2	207	–	Var	uint16
Extended Device Error Axis 3	208	–	Var	uint16
Extended Device Error Axis 4	209	–	Var	uint16
Diagnosis Status	220	1 ... 5	Array	int32

5. Parameters

Name	FHPP-MAX			
	PNU	Subind.	Class	Type
Processing data (see section 5.4.4)				
Position Values	300	1 ... 12	Array	int32
Maintenance Parameter	305	1 ... 3	Array	uint32
Project data (see section 5.4.5)				
Software End Position	501	1 ... 8	Array	int32
Max Speed	502	1 ... 4	Array	uint32
Max Acceleration	503	1 ... 4	Array	uint32
FHPP-MAX Features Supported	522	–	Var	uint32
Factor group (see section 5.4.6)				
Position Notation Index (tens' exponent position)	600	1 ... 4	Array	int8
Position Dimension Index (unit of measurement position)	601	1 ... 4	Array	uint8
Velocity Notation Index (tens' exponent velocity)	602	1..4	Array	int8
Velocity Dimension Index (velocity unit of measurement)	603	1 ... 4	Array	uint8
Acceleration Notation Index (tens' exponent acceleration)	604	1 ... 4	Array	int8
Acceleration Dimension Index (acceleration unit of measurement)	605	1 ... 4	Array	uint8

5. Parameters

Axis data electric drives				
Axis data electric drives – axis 1 (see section 5.4.7)				
Polarity (reversal of polarity)	1000	–	Var	uint8
Position Factor	1004	1 ... 2	Array	uint32
Controller Type (drive controller type)	1030	1 ... 128	Array	char
Kinematic Type (mechanical type)	1031	–	Var	uint8
Usage (axis use)	1072	–	Var	uint8
Axis data electric drives – axis 2 (see section 5.4.8)				
Polarity (reversal of polarity)	1100	–	Var	uint8
Position Factor	1104	1 ... 2	Array	uint32
Controller Type (drive controller type)	1130	1 ... 128	Array	char
Kinematic Type (mechanical type)	1131	–	Var	uint8
Usage (axis use)	1172	–	Var	uint8
Axis data electric drives – axis 3 (see section 5.4.9)				
Polarity (reversal of polarity)	1200	–	Var	uint8
Position Factor	1204	1 ... 2	Array	uint32
Controller Type (drive controller type)	1230	1 ... 128	Array	char
Kinematic Type (mechanical type)	1231	–	Var	uint8
Usage (axis use)	1272	–	Var	uint8
Axis data electric drives – axis 4 (see section 5.4.10)				
Polarity (reversal of polarity)	1300	–	Var	uint8
Position Factor	1304	1 ... 2	Array	uint32
Controller Type (drive controller type)	1330	1 ... 128	Array	char
Kinematic Type (mechanical type)	1331	–	Var	uint8
Usage (axis use)	1372	–	Var	uint8

Tab. 5/3: Overview of FHPP-MAX parameters

5. Parameters

5.4 Descriptions of parameters according to FHPP-MAX

5.4.1 Representation of the parameter entries

Position factor					
FHPP-MAX	1004	1 ... 2		uint32	rw
7	Description	Conversion ratio for all position units (converting the user units into internal controller units)			
	Numerator	1004	1	uint32	rw
8	Denominator	Position factor numerator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... 2 ³² - 1) Default: 0x00010000 (65536)			
		1004	2	uint32	rw
		Position factor denominator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... 2 ³² - 1) Default: 0x00000001 (1)			

- 1 Name of the parameter
- 2 PNU (parameter number)
- 3 Subindices of the parameter with arrays
If the parameter is a simple variable, this field remains empty
- 4 Parameter class
- 5 Variable type of the parameter / subindices
- 6 Read/write permission:
 - ro = read only
 - rw = read and write
 - wo = write only;
 - read access returns the status, not the content
- 7 Description of the parameter
Global parameters apply for both axis groups!
- 8 Name and description of the subindices for arrays

Fig. 5/1: Representation of the parameter entries

5. Parameters

5.4.2 Device data

Manufacturer Hardware Version					
FHPP-MAX	100	–	Var	uint16	ro
Description	Global parameter Coding of the hardware version, specification in BCD: xxyy (xx = main version, yy = secondary version)				

Manufacturer Firmware Version					
FHPP-MAX	101	–	Var	uint16	ro
Description	Global parameter Coding of the firmware version, specification in BCD: xxyy (xx = main version, yy = secondary version)				

Version FHPP-MAX					
FHPP-MAX	102	–	Var	uint16	ro
Description	Global parameter Version number of the FHPP -MAX, specification in BCD: xxyy (xx = main version, yy = secondary version)				

5. Parameters

Supported Drive Modes (supported drive / control modes)																									
FHPP-MAX	112	–	Var	uint32	ro																				
Description	Global parameter The parameter describes the supported modes of the drive controllers. <table border="1"> <thead> <tr> <th>Bit</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Position control (Profile position mode – pp)</td> </tr> <tr> <td>1</td> <td>Velocity control (Velocity mode – vl)</td> </tr> <tr> <td>2</td> <td>Velocity control (profile velocity mode – pv)</td> </tr> <tr> <td>3</td> <td>Pressure / power control (profile torque mode – tq)</td> </tr> <tr> <td>4</td> <td>Reserved (reserved)</td> </tr> <tr> <td>4</td> <td>Homing run (homing mode – hm)</td> </tr> <tr> <td>6</td> <td>Interpolated position control (Interpolated positioning mode – ip)</td> </tr> <tr> <td>7 ... 15</td> <td>Reserved (reserved)</td> </tr> <tr> <td>16 ... 31</td> <td>Manufacturer-specific (customer-specific)</td> </tr> </tbody> </table> CPX-CMXX supports the following control modes Position control (pp) bit 0 = 1 Velocity control (vl) bit 1 = 1 Homing run (hm) bit 5 = 1 The value of the parameter is 35					Bit	Control mode	0	Position control (Profile position mode – pp)	1	Velocity control (Velocity mode – vl)	2	Velocity control (profile velocity mode – pv)	3	Pressure / power control (profile torque mode – tq)	4	Reserved (reserved)	4	Homing run (homing mode – hm)	6	Interpolated position control (Interpolated positioning mode – ip)	7 ... 15	Reserved (reserved)	16 ... 31	Manufacturer-specific (customer-specific)
Bit	Control mode																								
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6	Interpolated position control (Interpolated positioning mode – ip)																								
7 ... 15	Reserved (reserved)																								
16 ... 31	Manufacturer-specific (customer-specific)																								

Serial Number					
FHPP-MAX	114	Length is dependent on content	Array	char	ro
Description	Global parameter Serial number for unique identification of the CPX-CMXX. Characters not used are filled with zero (0x00=“\0”)				

Manufacturer Device Name					
FHPP-MAX	120	Length is dependent on content	Array	char	ro
Description	Global parameter Description of the device “CPX-CMXX” Characters not used are filled with zero (0x00=“\0”)				

5. Parameters

User Device Dame					
FHPP-MAX	121	1 ... 255	Array	char	rw
Description	Global parameter User's designation of the CPX-CMXX(ASCII, 7 bit). Characters not used are filled with zero (0x00='\0')				

Drive Manufacturer					
FHPP-MAX	122	Length is dependent on content	Array	char	ro
Description	Global parameter Name of the manufacturer (ASCII, 7 bit). "Festo AG & Co. KG" Characters not used are filled with zero (0x00='\0')				

Password PC/Diag													
FHPP-MAX	130	1 ... 8	Array	char	wo								
FHPP-MAX	130	-	Var	uint8	ro								
Description	<p>Global parameter</p> <p>The user can use a password to protect parameter changing through the PC via the diagnosis interface.</p> <p>Blocked is:</p> <ul style="list-style-type: none"> - changing of parameters <p>Permitted:</p> <ul style="list-style-type: none"> - display of parameters - project upload - display of actual values, target values, diagnostic data <p>If a password is defined, the connection with the FCT is only built up after the password has been correctly entered.</p> <p>If read access takes place on parameter 130, the status of the current password protection is displayed.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Value</th> <th style="text-align: left;">Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No access protection active</td> </tr> <tr> <td>1</td> <td>Access protection active, access blocked</td> </tr> <tr> <td>2</td> <td>Access protection active, access enabled</td> </tr> </tbody> </table>					Value	Meaning	0	No access protection active	1	Access protection active, access blocked	2	Access protection active, access enabled
Value	Meaning												
0	No access protection active												
1	Access protection active, access blocked												
2	Access protection active, access enabled												

5. Parameters

Axis 1 Name					
FHPP-MAX	180	1 ... 128	Array	char	rw
Description	Individual name for axis 1. Note: In a multi-axis system, the axis name permits a textual description of each axis. The device name is present only once.				

Axis 2 Name					
FHPP-MAX	181	1 ... 128	Array	char	rw
Description	Individual name for axis 2. Note: In a multi-axis system, the axis name permits a textual description of each axis. The device name is present only once.				

Axis 3 Name					
FHPP-MAX	182	1 ... 128	Array	char	rw
Description	Individual name for axis 3. Note: In a multi-axis system, the axis name permits a textual description of each axis. The device name is present only once.				

Axis 4 Name					
FHPP-MAX	183	1 ... 128	Array	char	rw
Description	Individual name for axis 4. Note: In a multi-axis system, the axis name permits a textual description of each axis. The device name is present only once.				

5. Parameters

5.4.3 Diagnosis



For a description of how the diagnostic memory functions, see section 4.3.

Diagnostic Event																																								
FHPP-MAX	200	1 ... 16	Array	uint8	ro																																			
Description	Global parameter Type of fault or diagnostic information saved in the diagnostic memory: Display whether an incoming or outgoing fault is saved.																																							
	<table border="0"> <tr> <td><u>Value</u></td> <td><u>Type of diagnostic event</u></td> <td colspan="4"></td> </tr> <tr> <td>0x00 (0)</td> <td>No fault (or fault message deleted)</td> <td colspan="4"></td> </tr> <tr> <td>0x01 (1)</td> <td>Incoming fault = occurrence of the fault</td> <td colspan="4"></td> </tr> <tr> <td>0x02 (2)</td> <td>Outgoing fault = acknowledgement of the fault</td> <td colspan="4"></td> </tr> <tr> <td>0x03 (3)</td> <td>Switch-off</td> <td colspan="4"></td> </tr> <tr> <td>0x04 (4)</td> <td>Overflow of the internal time stamp</td> <td colspan="4"></td> </tr> </table>					<u>Value</u>	<u>Type of diagnostic event</u>					0x00 (0)	No fault (or fault message deleted)					0x01 (1)	Incoming fault = occurrence of the fault					0x02 (2)	Outgoing fault = acknowledgement of the fault					0x03 (3)	Switch-off					0x04 (4)	Overflow of the internal time stamp			
<u>Value</u>	<u>Type of diagnostic event</u>																																							
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0x02 (2)	Outgoing fault = acknowledgement of the fault																																							
0x03 (3)	Switch-off																																							
0x04 (4)	Overflow of the internal time stamp																																							
Event 1	200	1		uint8	ro																																			
	Type of latest / current diagnostic message																																							
Event 2	200	2		uint8	ro																																			
	Type of second saved diagnostic message																																							
Event ...	200	...		uint8	ro																																			
	...																																							

Fault Number					
FHPP-MAX	201	1 ... 16	Array	uint8	ro
Description	Global parameter Fault number stored in the diagnostic memory, serves to identify the fault. Fault numbers see section 4.4.				
	Event 1	201	1		uint8
	Latest / current diagnostic message				
Event 2	201	2		uint8	ro
	2. Saved diagnostic message				
Event ...	201	...		uint8	ro
	...				

5. Parameters

Time Stamp					
FHPP-MAX	202	1 ... 16	Array	uint32	ro
Description	Global parameter Time of the diagnosis event in milliseconds after switch-on. In case of overflow, the time stamp jumps from 0xFFFFFFFF to 0.				
	Event 1	202	1	uint32	ro
	Time of the latest / current diagnostic message				
	Event 2	202	2	uint32	ro
	Time of the second saved diagnostic message				
	Event ...	202	...	uint32	ro
	...				

Additional Data (additional info)					
FHPP-MAX	203	1 ... 16	Array	uint32	ro
Description	Global parameter The groups and axes are encoded in the additional information. This identifies the source of the error.				
	<u>Bit</u> 9 8 2 1 0 <u>Source of the diagnostic event</u>				
	0 0 0 0 0 CPX-CMXX				
	0 1 0 0 0 Group 1				
	0 1 0 0 1 Group 1, axis 1				
	0 1 0 1 0 Group 1, axis 2				
	0 1 0 1 1 Group 1, axis 3				
	0 1 1 0 0 Group 1, axis 4				
	1 0 0 0 0 Group 2				
	1 0 0 0 1 Group 2, axis 1				
	1 0 0 1 0 Group 2, axis 2				
	1 0 0 1 1 Group 2, axis 3				
	1 0 1 0 0 Group 2, axis 4				
	Bits 3 ... 7 Reserved				

5. Parameters

Diagnostic Memory Parameter					
FHPP-MAX	204	1 ... 4	Array	uint8	rw/ro
Description	Global parameter Configuration of the diagnostic memory.				
	Fault Type	204	1		uint8
Resolution	Recording of faults. 0x01 (1): Record all faults 0x02 (2): Record only incoming faults (default)				
		204	2		uint8
Clear Memory	Resolution time stamp: 0x01 (1): Resolution time stamp 10 ms (default) 0x02 (2): Resolution time stamp 1 ms				
		204	3		uint8
Number of Entries	Delete diagnostic memory: Write with value = 1 deletes the memory Reading is always answered with value = 0				
		204	4		uint8
Read out the number of valid entries in the diagnostic memory. Writing is not permitted. Value range: 0x00 ... 0x0F (0 ... 15)					

5. Parameters

Extended Device Error Axis 1					
FHPP-MAX	205	–		uint16	ro
Description	Read-out of the fault numbers axis 1				

Extended Device Error Axis 2					
FHPP-MAX	207	–		uint16	ro
Description	Read-out of the fault numbers axis 2				

Extended Device Error Axis 3					
FHPP-MAX	208	–		uint16	ro
Description	Read-out of the fault numbers axis 3				

Extended Device Error Axis 4					
FHPP-MAX	209	–		uint16	ro
Description	Read-out of the fault numbers axis 4				

Diagnosis Status					
FHPP-MAX	220	1..5	Array	int32	ro
Description	All faults and warnings can be read out with this object. While the diagnostic buffers show the history, here can be determined which faults and warnings are present.				
	220	1		int32	ro
	Fault / Warning axis group				
	220	2		int32	ro
	Fault / Warning axis 1				
	220	3		int32	ro
	Fault / Warning axis 2				
	220	4		int32	ro
	Fault / Warning axis 3				
	220	5		int32	ro
	Fault / Warning axis 4				

5. Parameters

5.4.4 Processing data

Position Values					
FHPP-MAX	300	1 ... 12	Array	int32	ro
Description	Current position values				
Axis 1					
Actual Position	300	1			
	Current actual position axis 1				
Nominal Position	300	2			
(target position1)	Current target position axis 1				
Actual Deviation	300	3			
(control deviation)	Current control deviation axis 1				
Axis 2					
Actual Position	300	4			
	Current actual position axis 2				
Nominal Position	300	5			
	Current target position axis 2				
Actual Deviation	300	6			
(control deviation)	Current control deviation axis 2				
Axis 3					
Actual Position	300	7			
	Current actual position axis 3				
Nominal Position	300	8			
	Current target position axis 3				
Actual Deviation	300	9			
(control deviation)	Current control deviation axis 3				
Axis 4					
Actual Position	300	10			
	Current actual position axis 4				
Nominal Position	300	11			
	Current target position axis 4				
Actual Deviation	300	12			
	Current control deviation axis 4				

5. Parameters

Maintenance Parameter					
FHPP-MAX	305	1 ... 3		uint32	ro
Description	Global parameter				
	Support of the user with information about performance.				
Electrical drives					
Number of Cycles	305	1			
	Reserved, fixed at 0				
Total Path of the Axis Group	305	2			
	Reserved, fixed at 0				
Operating Time Counter	305	3			
	Reserved, fixed at 0				

5. Parameters

5.4.5 Project data

Software End Positions					
FHPP-MAX	501	1 ... 8	Array	int32	rw
Description	Lower and upper software end positions A nominal value specification (position) outside the end positions is not permitted and will lead to a fault. The offset to the axis zero point is entered. Plausibility rule: Min. limit \leq Max. limit Value range: 0x80000000 ... 0x7FFFFFFF (-2 ³¹ ... +2 ³¹ - 1)				
Axis 1					
Lower Limit (lower limit value)	501	1		int32	rw
	Lower software end position axis 1 Default: 0xFFFF8000 (-32768)				
Upper Limit (lower limit value)	501	2		int32	rw
	Upper software end position axis 1 Default: 0x00008000 (32768)				
Axis 2					
Lower Limit (lower limit value)	501	3		int32	rw
	Lower software end position axis 2 Default: 0xFFFF8000 (-32768)				
Upper Limit (lower limit value)	501	4		int32	rw
	Upper software end position axis 2 Default: 0x00008000 (32768)				
Axis 3					
Lower Limit (lower limit value)	501	5		int32	rw
	Lower software end position axis 3 Default: 0xFFFF8000 (-32768)				
Upper Limit (lower limit value)	501	6		int32	rw
	Upper software end position axis 3 Default: 0x00008000 (32768)				
Axis 4					
Lower Limit (lower limit value)	501	7		int32	rw
	Lower software end position axis 4 Default: 0xFFFF8000 (-32768)				
Upper Limit (lower limit value)	501	8		int32	rw
	Upper software end position axis 4 Default: 0x00008000 (32768)				

5. Parameters

Max Speed (max. permitted speed)					
FHPP-MAX	502	1 ... 4	Var	uint32	rw
Description	Max. permitted speed This value limits the speed in all operating modes. Value range: 0x00000001 ... 0xFFFFFFFF (1 ... $+2^{32} - 1$) Default: 0x00000001				
	Axis 1	502	1		
	Max. permitted speed axis 1				
	Axis 2	502	2		
	Max. permitted speed axis 2				
	Axis 3	502	3		
	Max. permitted speed axis 3				
	Axis 4	502	4		
	Max. permitted speed axis 4				

Max Acceleration (max. permitted acceleration)					
FHPP-Max	503	1 ... 4	Var	uint32	rw
Description	Max. permitted acceleration. Value range: 0x00000001 ... 0xFFFFFFFF (1 ... $+2^{32} - 1$) Default: 0x00000001 (1)				
	Axis 1	503	1		
	Max. permitted acceleration axis 1				
	Axis 2	503	2		
	Max. permitted acceleration axis 2				
	Axis 3	503	3		
	Max. permitted acceleration axis 3				
	Axis 4	503	4		
	Max. permitted acceleration axis 4				

5. Parameters

FHPP-MAX Features Supported					
FHPP-MAX	522	–	Var	uint32	rw
Description	Global parameter With this parameter, specific features of the FHPP-MAX can be activated or deactivated. Bit 0 = 0 “Halt” status is permitted Bit 0 = 1 “Halt” status is not supported Bit 1 ... 5 Reserved Bit 6 = 0 Jog mode via velocity mode off Bit 6 = 1 Jog mode via velocity mode on Bit 7 ... 31 Reserved Default: PNU522 = 1, i.e. Bit 0 = 1				

5.4.6 Factor group

Position Notation Index (tens' exponent position)					
FHPP-MAX	600	1 ... 4	Array	int8	ro
Description	Tens' exponent for position values = -6: for linear axes = -3: for rotative axes Default: = -6				
Axis 1	600	1		int8	
	Tens' exponent for position values of axis 1				
Axis 2	600	2		int8	
	Tens' exponent for position values of axis 2				
Axis 3	600	3		int8	
	Tens' exponent for position values of axis 3				
Axis 4	600	4		int8	
	Tens' exponent for position values of axis 4				

5. Parameters

Position Dimension Index (position unit of measurement)						
FHPP-MAX	601	1 ... 4	Array	uint8	ro	
Description	Unit of measurement for position values = 0x01 [m] for linear axes = 0x41 [°] for rotative axes Default: = 0x01					
	Axis 1	601	1		uint8	
	Unit of measurement for position values of axis 1					
	Axis 2	601	2		uint8	
	Unit of measurement for position values of axis 2					
	Axis 3	601	3		uint8	
	Unit of measurement for position values of axis 3					
	Axis 4	601	4		uint8	
	Unit of measurement for position values of axis 4					

Velocity Notation Index (tens' exponent velocity)						
FHPP-MAX	602	1 ... 4	Array	int8	ro	
Description	Tens' exponent for velocity values = -6: for linear axes = -3: for rotative axes Default: = -6					
	Axis 1	602	1		int8	
	Tens' exponent for velocity values of axis 1					
	Axis 2	602	2		int8	
	Tens' exponent for velocity values of axis 2					
	Axis 3	602	3		int8	
	Tens' exponent for velocity values of axis 3					
	Axis 4	602	4		int8	
	Tens' exponent for velocity values of axis 4					

5. Parameters

Velocity Dimension Index (unit of measurement velocity)					
FHPP-MAX	603	1 ... 4	Array	uint8	ro
Description	Unit of measurement for velocity values = 0xA6 [m/sec] for linear axes = 0xF2 [°/sec] for rotative axes Default: = 0xA6				
Axis 1	603	1		uint8	
	Unit of measurement for velocity values of axis 1				
Axis 2	603	2		uint8	
	Unit of measurement for velocity values of axis 2				
Axis 3	603	3		uint8	
	Unit of measurement for velocity values of axis 3				
Axis 4	603	4		uint8	
	Unit of measurement for velocity values of axis 4				

Acceleration Notation Index (tens' exponent acceleration)					
FHPP-MAX	604	1 ... 4	Array	int8	ro
Description	Tens' exponent for acceleration values = -6: for linear axes = -3: for rotative axes Default: = -6				
Axis 1	604	1		int8	
	Tens' exponent for acceleration values axis 1				
Axis 2	604	2		int8	
	Tens' exponent for acceleration values axis 2				
Axis 3	604	3		int8	
	Tens' exponent for acceleration values axis 3				
Axis 4	604	4		int8	
	Tens' exponent for acceleration values axis 4				

5. Parameters

Acceleration Dimension Index (unit of measurement acceleration)					
FHPP-MAX	605	1 ... 4	Array	uint8	ro
Description	Unit of measurement for acceleration values = 0xF3 [m/sec ²] for linear axes = 0xF5 [°/sec ²] for rotative axes Default: = 0xF3				
	Axis 1	605	1		uint8
	Unit of measurement for acceleration values axis 1				
	Axis 2	605	2		uint8
	Unit of measurement for acceleration values of axis 2				
	Axis 3	605	3		uint8
	Unit of measurement for acceleration values axis 3				
	Axis 4	605	4		uint8
	Unit of measurement for acceleration values axis 4				

5.4.7 Axis data electric drives axis 1

Polarity Axis 1 (direction reversal axis 1)														
FHPP-MAX	1000	-	Var	uint8	rw									
Description	Direction of the position values for axis 1.													
	<table border="0"> <tr> <td><u>Values</u></td> <td><u>Position value (vector)</u></td> </tr> <tr> <td>0x00 (0):</td> <td>normal</td> </tr> <tr> <td>0x80 (128):</td> <td>inverted (multiplied by -1)</td> </tr> <tr> <td colspan="2">Default: 0x00 (0)</td> </tr> <tr> <td colspan="2">When writing, all values not equal to zero are picked up as 0x80</td> </tr> </table>					<u>Values</u>	<u>Position value (vector)</u>	0x00 (0):	normal	0x80 (128):	inverted (multiplied by -1)	Default: 0x00 (0)		When writing, all values not equal to zero are picked up as 0x80
<u>Values</u>	<u>Position value (vector)</u>													
0x00 (0):	normal													
0x80 (128):	inverted (multiplied by -1)													
Default: 0x00 (0)														
When writing, all values not equal to zero are picked up as 0x80														

5. Parameters

Position Factor Axis 1					
FHPP-MAX	1004	1 ... 2	Array	uint32	rw
Description	Conversion ratio for all position units (converting the user units into internal controller units).				
Numerator	1004	1		uint32	rw
Denominator	Position factor – numerator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... +2 ³² - 1) Default: 0x00010000 (65536 = 2 ¹⁶)				
	1004	2		uint32	rw
Denominator	Position factor – denominator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... +2 ³² - 1) Default: 0x00000001 (1)				

Controller Type Axis 1					
FHPP-MAX	1030	1 ... 128	Array	char	ro
Description	Name of the drive controller, e.g. 'MTR -DCI'				

Kinematic Type Axis 1 (mechanism type axis 1)					
FHPP-MAX	1031	-	Var	uint8	ro
Description	= 0 Linear axis = 2 Rotative axis Default = 0				

Usage Axis 1					
FHPP-MAX	1072	-	Var	uint8	ro
Description	= 0 not used = 1 Positioning axis = 2 Gantry axis Default = 0				

5. Parameters

5.4.8 Axis data electric drives axis 2

Polarity Axis 2 (direction reversal axis 2)					
FHPP-MAX	1100	-	Var	uint8	rw
Description	Direction of the position values for axis 2 Values: Position value (vector) 0x00 (0): normal 0x80 (128): inverted (multiplied by -1) Default: 0x00 (0) When writing, all values not equal to zero are picked up as 0x80				

Position Factor Axis 2					
FHPP-MAX	1104	1 ... 2	Array	uint32	rw
Description	Conversion ratio for all position units (converting the user units into internal controller units).				
Numerator	1104	1		uint32	rw
Denominator	Position factor – numerator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... $+2^{32} - 1$) Default: 0x00010000 ($65536 = 2^{16}$)				
	1104	2		uint32	rw
	Position factor – denominator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... $+2^{32} - 1$) Default: 0x00000001 (1)				

Controller Type Axis 2					
FHPP-MAX	1130	1 ... 128	Array	char	ro
Description	Name of the drive controller, e.g. 'MTR -DCI'				

Kinematic Type Axis 2 (mechanism type axis 2)					
FHPP-MAX	1131	-	Var	uint8	ro
Description	= 0 Linear axis = 2 Rotative axis Default = 0				

5. Parameters

Usage Axis 2					
FHPP-MAX	1172	-	Var	uint8	ro
Description	= 0 Not used = 1 Positioning axis = 2 Gantry axis Default = 0				

5.4.9 Axis data electric drives axis 3

Polarity Axis 3 (direction reversal axis 3)					
FHPP-MAX	1200	-	Var	uint8	rw
Description	Direction of the position values for axis 3. Values: _____ Position value (vector) _____ 0x00 (0): normal 0x80 (128): inverted (multiplied by -1) Default: 0x00 (0) When writing, all values not equal to zero are picked up as 0x80				

Position Factor Axis 3					
FHPP-MAX	1204	1 ... 2	Array	uint32	rw
Description	Conversion ratio for all position units (converting the user units into internal controller units).				
Numerator	1204	1		uint32	rw
	Position factor – numerator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... +2 ³² - 1) Default: 0x00010000 (65536 = 2 ¹⁶)				
Denominator	1204	2		uint32	rw
	Position factor – denominator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... +2 ³² - 1) Default: 0x00000001 (1)				

5. Parameters

Controller Type Axis 3					
FHPP-MAX	1230	1 ... 128	Array	char	ro
Description	Name of the drive controller, e.g. 'MTR -DCI'				

Kinematic Type Axis 3 (mechanism type axis 3)					
FHPP-MAX	1231	-	Var	uint8	ro
Description	= 0 Linear axis = 2 Rotative axis Default = 0				

Usage Axis 3					
FHPP-MAX	1272	-	Var	uint8	ro
Description	= 0 Not used = 1 Positioning axis = 2 Gantry axis Default = 0				

5.4.10 Axis data electric drives axis 4

Polarity Axis 4 (direction reversal axis 4)					
FHPP-MAX	1300	-	Var	uint8	rw
Description	Direction of the position values for axis 4. <u>Values:</u> <u>Position value (vector)</u> 0x00 (0): normal 0x80 (128): inverted (multiplied by -1) Default: 0x00 (0) When writing, all values not equal to zero are picked up as 0x80				

5. Parameters

Position Factor Axis 4					
FHPP-MAX	1304	1 ... 2	Array	uint32	rw
Description	Conversion ratio for all position units (converting the user units into internal controller units).				
Numerator	1304	1		uint32	rw
Denominator	Position factor – numerator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... +2 ³² - 1) Default: 0x00010000 (65536 = 2 ¹⁶)				
	1304	2		uint32	rw
Denominator	Position factor – denominator Value range: 0x00000001 ... 0xFFFFFFFF (1 ... +2 ³² - 1) Default: 0x00000001 (1)				

Controller Type Axis 4 (drive controller type axis 4)					
FHPP-MAX	1330	1 ... 128	Array	char	ro
Description	Name of the drive controller, e.g. 'MTR -DCI'				

Kinematic Type Axis 4 (mechanism type axis 4)					
FHPP-MAX	1331	-	Var	uint8	ro
Description	= 0 Linear axis = 2 Rotative axis Default = 0				

Usage Axis 4					
FHPP-MAX	1372	-	Var	uint8	ro
Description	= 0 Not used = 1 Positioning axis = 2 Gantry axis Default = 0				

Parametrisation

Chapter 6

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6. Parametrisation

6.1 Parameterisation with FHPP-MAX

6.1.1 Festo parameter channel (FPC) for cyclic data (I/O data)

The parameter channel is used only for transfer of parameters in the cyclic I/O data. The parameter channel consists of 8 bytes. The following tables show the structure of the parameter channel.

FPC								
	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	IND	ParID		Value			
Input data	SCON	IND	ParID		Value			
CCON	Control byte 1: CCON.OPM1 = 1 and CCON.OPM2 = 1: Parameterisation operating mode							
SCON	Status byte 1: SCON.OPM1 = 1 and SCON.OPM2 = 1: Parameterisation operating mode							
IND	Subindex – for addressing an array element, see Tab. 6/2							
ParID	Parameter Identifier – consists of ReqID or ResID and PNU, see Tab. 6/2 and Tab. 6/3							
Value	Parameter value or fault number, see Tab. 6/2							

Tab. 6/1: Structure of parameter channel

Component	Description
Subindex (IND)	Addresses an element of an array parameter (sub-parameter number)
Parameter identifier (ParID)	Component of the parameter channel that contains the request or response identifier (ReqID/ResID) and the parameter number (PNU). The parameter number serves to identify or address the respective parameter. The request or response identifiers (ReqID/ResID) describe the task or the reply in the form of an identifier number, see Tab. 6/3.
Parameter value (value)	Value of the parameter. If a task of the parameter processing cannot be carried out, a fault number will be shown instead of the value in the reply telegram. The fault number describes the cause of the fault.

Tab. 6/2: Components of the parameter channel (FPC)

6. Parametrisation

Parameter identifier (ParID)

The parameter identifier contains the request or response identifier (ReqID/ResID) and the parameter number (PNU).

Parameter identifier															
Bit	Byte 3								Byte 4						
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Task	ReqID				res.	PNU									
Reply	ResID				res.	PNU									
ReqID	Request identifier – task identifier (read, write, ...)														
ResID	Response identifier – response identifier (transfer value, fault, ...)														
PNU	Parameter number – serves to identify or address the relevant parameter (see section 6.1). The task or response identifier distinguishes the type of task or response (see section 6.1.2).														

Tab. 6/3: Structure of parameter identifier (ParID)

6.1.2 Request and response identifier and fault numbers

The request and response identifiers are shown in the following table:

ReqID	Task	Response identifier	
		Positive	Negative
0x0 (0)	No task	0x0 (0)	–
0x6 (6)	Request parameters	0x5 (5)	0x7 (7)
0x8 (8)	Change parameter value	0x5 (5)	0x7 (7)
0xD (13)	Request lower limit value	0x5 (5)	0x7 (7)
0xE (14)	Request upper limit value	0x5 (5)	0x7 (7)

Tab. 6/4: Request and response identifier

6. Parametrisation

If the task cannot be carried out, response identifier 0x7 as well as the appropriate fault number will be transmitted (negative reply).

The following table shows the response identifiers:

ResID	Description
0x0 (0)	No reply
0x5 (5)	Parameter value transferred (array, double word)
0x7 (7)	Task cannot be carried out (with error number in parameter value) ¹⁾
¹⁾ Fault numbers see following table	

Tab. 6/5: Response identifier

If the task of the parameter processing cannot be carried out, an appropriate fault number will be transmitted in the reply telegram (byte 5, 6, 7 and 8 of the FPC).

The order of fault checking and the possible error numbers are shown in the following table:

Order of fault checking	Checking of	Error numbers	Description
1	PNU defined	0x00 (0)	Non-permitted PNU The parameter does not exist
2	If array: IND defined	0x03 (3)	Faulty subindex
3	ReqID permissible	0x65 (101)	ReqID is not supported
4	Access rights (read, write)	0x01 (1)	Parameter value cannot be changed (read only)
5	If change: value permissible	0x02 (2)	Lower or upper value limit exceeded

Tab. 6/6: Order of fault checking and error numbers

6. Parametrisation

6.1.3 Sequence of parameter processing

Rules for task-reply processing

Rule	Description
1	If the PLC sends the request identifier for “No task”, the CPX-CMXX reacts with the response identifier for “No response”.
2	A task or reply telegram always refers to a single parameter.
3	The PLC must continue to send a task until it receives the appropriate reply from the CPX-CMXX.
4	The PLC recognises the reply to the task placed: <ul style="list-style-type: none">– by evaluating the response identifier– by evaluating the parameter number (PNU)– if applicable, by evaluating the subindex (IND)– if applicable, by evaluating the parameter value
5	The CPX-CMXX provides the reply until the PLC sends a new task.
6	a) A write task, even with cyclic repetition of the same task, will only be carried out once by the CPX-CMMX. b) Between two consecutive tasks with the same request identifier (ReqID), parameter number (PNU) and subindex (IND), the request identifier 0 (no task) must be sent and the response identifier 0 (no reply) must be awaited. This ensures that an “old” reply is not interpreted as a “new” reply.

Tab. 6/7: Rules for task-reply processing

Evaluating faults

In the case of tasks which cannot be carried out, the CPX-CMMX replies as follows:

- Output reply identifier = 7
- Output of a fault number in bytes 5, 6, 7 and 8 of the parameter channel (FPC), see Tab. 6/6.

6. Parametrisation

Examples

Read parameters

The following tables show the process for reading parameters via FPC (Festo Parameter Channel).

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	0x00	0x0000	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 2

Read parameters

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0x6000 + PNU	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 3

Reading ended

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0x6000 + PNU	0x00000000				
Input data	0xC0	IND	0x5000 + PNU	Value				

6. Parametrisation

Read parameter – interrupted with fault

The following tables show the process for reading parameters via FPC (Festo Parameter Channel) – interrupted with fault.

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	0x00	0x0000	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 2

Read parameters

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0x6000 + PNU	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 3

Reading interrupted with fault

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0x6000 + PNU	0x00000000				
Input data	0xC0	IND	0x7000 + PNU	Error code, see Tab. 6/6				

6. Parametrisation

Write parameters

The following tables show an example for writing parameters via FPC (Festo Parameter Channel).

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	0x00	0x0000		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 2

Write parameters

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0x8000 + PNU		Value			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 3

Writing ended

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0x8000 + PNU		Value			
Input data	0xC0	IND	0x5000 + PNU		Value			

6. Parametrisation

Write parameter – interrupted with fault

The following tables show an example for writing parameters via FPC (Festo Parameter Channel) – interrupted with fault.

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	0x00	0x0000	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 2

Write parameters

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0x8000 + PNU	Value				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 3

Writing interrupted with fault

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0x8000 + PNU	Value				
Input data	0xC0	IND	0x7000 + PNU	Error code, see Tab. 6/6				

6. Parametrisation

Read lower limit value of a parameter

The following tables show an example for reading the lower limit value of a parameter via FPC – (Festo Parameter Channel).

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	0x00	0x0000		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 2

Read lower limit value of the parameter with the parameter number PNU

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0xD000 + PNU		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 3

Reading lower limit value of the parameter with the parameter number PNU ended.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0xD000 + PNU		0x00000000			
Input data	0xC0	IND	0x5000 + PNU		Value			

6. Parametrisation

Read lower limit value of a parameter – interrupted with fault

The following tables show an example for reading the lower limit value of a parameter via FPC – (Festo Parameter Channel) – interrupted with fault.

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	0x00	0x0000		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 2

Read lower limit value of the parameter with the parameter number PNU.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0xD000 + PNU		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 3

Reading lower limit value of the parameter with the parameter number PNU interrupted with fault.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0xD000 + PNU		0x00000000			
Input data	0xC0	IND	0x7000 + PNU		Error code, see Tab. 6/6			

6. Parametrisation

Read upper limit value of a parameter

The following tables show an example for reading the upper limit value of a parameter via FPC (Festo Parameter Channel).

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	0x00	0x0000		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 2

Read upper limit value of the parameter with the parameter number PNU.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0xE000 + PNU		0x00000000			
Input data	0xC0	0x00	0x0000		0x00000000			

Step 3

Reading upper limit value of the parameter with the parameter number PNU ended.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)		Parameter value (value)			
Output data	0xC0	IND	0xE000 + PNU		0x00000000			
Input data	0xC0	IND	0x5000 + PNU		Value			

6. Parametrisation

Read upper limit value of a parameter – interrupted with fault

The following tables show an example for reading the upper limit value of a parameter via FPC (Festo Parameter Channel) – interrupted with fault.

Step 1

Initialise

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	0x00	0x0000	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 2

Read upper limit value of the parameter with the parameter number PNU.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0xE000 + PNU	0x00000000				
Input data	0xC0	0x00	0x0000	0x00000000				

Step 3

Reading upper limit value of the parameter with the parameter number PNU interrupted with fault.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	CCON/ SCON	Subindex (IND)	ParID (ReqID/ResID+PNU)	Parameter value (value)				
Output data	0xC0	IND	0xE000 + PNU	0x00000000				
Input data	0xC0	IND	0x7000 + PNU	Error code, see Tab. 6/6				

Technical appendix

Appendix A

Contents

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A.1 Program examples with FST

The FST is used for programming control tasks with the CPX-FEC. The functions and characteristics of the software are described in the document P.BE-FST4-B1-...

A.1.1 Program example, start record

Description

Starting the program P11 (name chosen arbitrarily) starts record selection. The program must be started by another program, for example triggered by a command from a connected FED. After the movement ends, the program stops automatically.

The following variables must be defined in the “Allocation List” of the FST:

- CHALT: That is the HALT bit in the FHPP-MAX control word (CPOS.B0)
- CSET: Bytes 5 and 6 of the FHPP-MAX output data
- START: START bit in the FHPP-MAX control word (CPOS.B1)
- SHALT: HALT bit in the FHPP-MAX status word (SPOS.B0)
- ACK: ACK bit in the FHPP-MAX status word (SPOS.B1)
- MC: MC bit in the FHPP-MAX status word (SPOS.B2)
- sxNoHalt: Internal flag that displays whether or not the HALT feature is deactivated.
- siSetNr: Number of the record that should be started.

The FST program consists of the following steps:

- Init:
Here the flags are initialised and the record number loaded. If the HALT feature is activated (`sxNoHalt == false`), the CHALT flag is set.
- Execute0:
After acknowledgement of the SHALT flag, the START flag is set. If the HALT feature is deactivated, the START flag is set immediately.
- Execute1:
In this step, the START/ACK handshake is executed.
- Execute2:
This step waits until the MC flag is set. After that, the program is ended.

Start program listing record

```

"" =====
"" Init timer and flags
"" =====
STEP Init
IF                                NOP
THEN
    LOAD    N    sxNoHalt    'Disable HALT feature.
    TO      CHALT    'Control HALT
    LOAD    siSetNr    'Set number for readd/write/select set
    TO      CSET      'Set number

"" =====
"" Wait for Halt
"" =====
STEP Execute0
"" halt set? -> start set
IF                                SHALT    'Status Halt
    OR      N    CHALT    'Control HALT
THEN SET      START    'Start Positioning Task

"" =====
"" START/ACK
"" =====
STEP Executel
"" Acknowledge ?
IF                                START    'Start Positioning Task
    AND      ACK    'Acknowledge Start
THEN RESET    START    'Start Positioning Task

"" Acknowledge cleared ?
IF      N    START    'Start Positioning Task
    AND    N    ACK    'Acknowledge Start
THEN JMP TO Execute2

"" =====
"" Wait for MC
"" =====
STEP Execute2
"" Motion complete ?
IF                                MC    'Motion Complete
THEN RESET    P11    'Set selection

```

Fig. A/1: Program example, start record

A.1.2 Program example, homing run (reference travel)

Description

Starting the program P10 (name chosen arbitrarily) starts the homing run. The program must be started by another program, for example triggered by a command from a connected FED. Once the homing run is ended, the program stops automatically and signals the successful homing run via a flag (sxHome). The program exists in two versions – with and without time monitoring. In the more complex version with time monitoring, it is also stopped if a time monitoring fault occurs.

The following variables must be defined in the “Allocation List” of the FST:

- CHALT: That is the HALT bit in the FHPP-MAX control word (CPOS.B0)
- HOM: HOM bit in the FHPP-MAX control word (CPOS.B2)
- SHALT: HALT bit in the FHPP-MAX status word (SPOS.B0)
- ACK: ACK bit in the FHPP-MAX status word (SPOS.B1)
- REF: REF bit in the FHPP-MAX status word (SPOS.B7)
- sxNoHalt: Internal flag that displays whether or not the HALT feature is deactivated.
- sxHome: Internal flag that displays whether the axis/axes is/are referenced or not.

The FST program consists of the following steps:

- Init:
The flags are initialised here. If the HALT feature is activated (`sxNoHalt == false`), the CHALT flag is set.
- Execute0:
After acknowledgement of the SHALT flag, the HOM flag is set. If the HALT feature is deactivated, the HOM flag is set immediately.
- Execute1:
After acknowledgement of the ACK flag, the HOM flag is reset again.
- Execute2:
After acknowledgement of the REF flag, the sxHome flag is set and the program ended.

Program listing version 1 Homing run without time monitoring

```

"" =====
"" Init flags
"" =====
STEP Init
IF                                NOP
THEN
    LOAD    N    sxNoHalt    'Disable HALT feature.
    TO      CHALT    'Control HALT
    RESET   sxHome    'Homing complete

"" =====
"" Wait for Halt
"" =====
STEP Execute0
"" halt set ? → start homing
IF                                SHALT    'Status Halt
    OR      N    CHALT    'Control HALT
THEN SET                                HOM    'Start homing

"" =====
"" Wait for ACK
"" =====
STEP Execute1
"" Acknowledge received ?
IF                                ACK    'Acknowledge Start
THEN RESET                            HOM    'Start homing
    JMP TO Execute2

"" =====
"" Wait for homing complete
"" =====
STEP Execute2
"" Referenced ?
IF                                REF    'Axis is referenced.
THEN SET                            sxHome    'Homing complete
    RESET   P10    'Homing

```

Fig. A/2: Program example Homing run (reference travel) without time monitoring

Additional description version 2

For the version with time monitoring, the individual steps are still equipped with time monitoring. When a timer runs out, the corresponding fault bit is set and the homing run interrupted.

For the variant with time time monitoring, the following additional variables must be defined in the “Allocation List” of the FST:

- THome:
Timer for time monitoring of the homing run.
- TPHome:
Timer preselect for THome – is loaded with 60s.
- THomeAck:
Timer for time monitoring of the HOM/ACK or the CHALT/SHALT handshake.
- TPHomeAck:
Timer preselect for THomeAck – is loaded with 1s.
- exHome:
Internal flag that displays a fault in the homing run.

Program listing version 2 Homing run with time monitoring

```

"" =====
"" Init timer and flags
"" =====
STEP Init
IF                                NOP
THEN
    LOAD        V6000            "60sec timeout
    TO          TPHome          'Preselect homing timer
    LOAD        V100            "1sec timeout
    TO          TPHomeAck       'Preselect home ack timer
    RESET       THome           'Homing surveillance
    LOAD        N    sxNoHalt    'Disable HALT feature.
    TO          CHALT           'Control HALT
    SET         THomeAck        'Home acknowledge timer
    RESET       sxHome          'Homing complete
"" =====
"" Wait for Halt
"" =====
STEP Execute0
""timeout error
IF            N    THomeAck      'Home acknowledge timer
THEN SET     exHome          'Homing error
    RESET    CHALT           'Control HALT
    RESET    P10            'Homing
"" halt set ? —> start homing
IF                                SHALT          'Status Halt
    OR            N    CHALT     'Control HALT
THEN SET       HOM           'Start homing
"" =====
"" Wait for ACK
"" =====
STEP Executel
""timeout error
IF            N    THomeAck      'Home acknowledge timer
THEN SET     exHome          'Homing error
    RESET    HOM            'Start homing
    RESET    CHALT         'Control HALT
    RESET    P10            'Homing
"" Acknowledge received ?
IF                                ACK            'Acknowledge Start
THEN RESET   HOM            'Start homing
    SET      THome         'Homing surveillance
    JMP TO   Execute2

```

A. Technical appendix

```
"" =====  
"" Wait for homing complete  
"" =====  
STEP Execute2  
""timeout error  
IF          N          THome          'Homing surveillance  
THEN SET    exHome    'Homing error  
  RESET    CHALT      'Control HALT  
  RESET    P10        'Homing  
"" Referenced ?  
IF          REF        'Axis is referenced.  
THEN SET    sxHome    'Homing complete  
  RESET    P10        'Homing
```

Fig. A/3: Program example Homing run (reference travel) with time monitoring

A. Technical appendix

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Appendix B

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