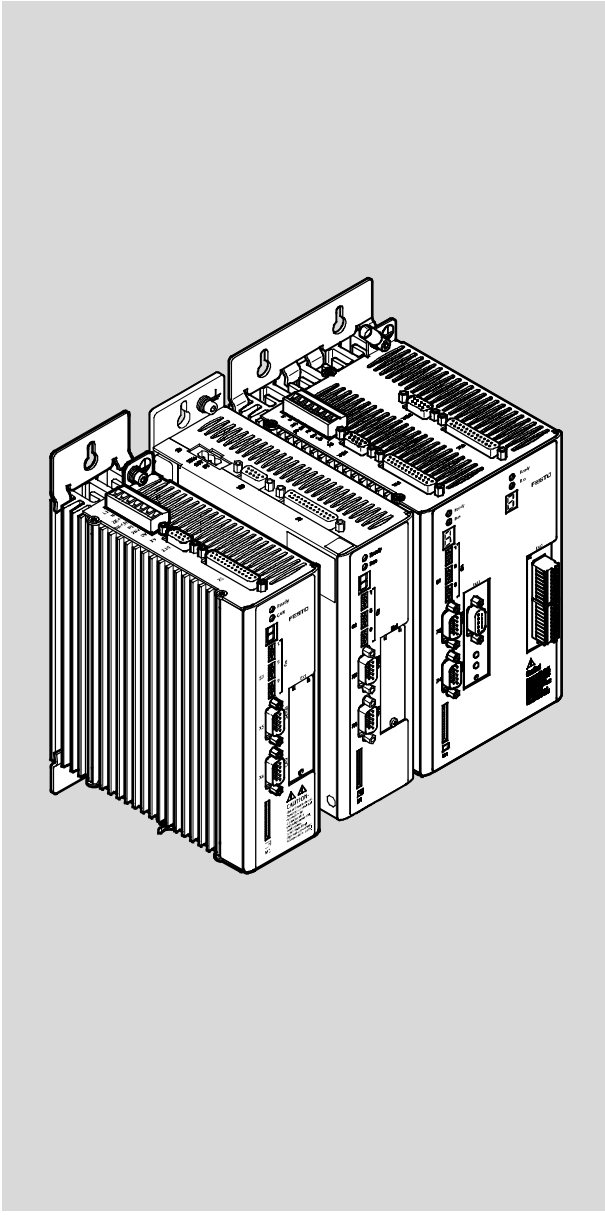
Motor controller

CMMS-AS/CMMS-ST/CMMD-AS



FESTO

Description

Fuctions and
commissioning

Firmware-Version
from 1.4.0.x.6

8040107
1404NH
[8034520]

Translation of the original instructions
GDCP-CMMS/D-FW-EN

Identification of hazards and instructions on how to prevent them:

Warning
Hazards that can cause death or serious injuries.

Caution
Hazards that can cause minor injuries or serious material damage.

Other symbols:

Note
Material damage or loss of function.

Recommendations, tips, references to other documentation.

Essential or useful accessories.

Information on environmentally sound usage.

Text designations:
- Activities that may be carried out in any order.
1. Activities that should be carried out in the order stated.
– General lists.

Table of contents – CMMS-AS/CMMS-ST/CMMD-AS

Instructions on this description
This documentation is intended to help you work safely with the motor controller CMMS-AS/CMMS-ST/CMMD-AS and describes the functions, commissioning procedure and error messages.

Target group
This documentation is intended exclusively for technicians trained in control and automation technology, who have experience in installation, commissioning, programming and diagnostics of positioning systems.

Versions
This documentation refers to the following versions:

Motor controller	Version
CMMS-AS-...	Motor controller CMMS-AS-C4-3A-G2: From Rev 03
	Firmware: From version 1.4.0.2.6
	FCT plug-in CMMS-AS: From version 2.0.0.x
CMMS-ST-...	Motor controller CMMS-ST-C8-7-G2: From Rev 05
	Firmware: From version 1.4.0.1.6
	FCT plug-in CMMS-ST: From version 2.0.0.x
CMMD-AS-...	Motor controller CMMD-AS-C8-3A: From Rev 03
	Firmware: From version 1.4.0.3.6
	FCT plug-in CMMD-AS: From version 2.0.0.x

Note
Before using a newer firmware version, check whether a newer version of the FCT plug-in or documentation is available
➔ Support portal: http://www.festo.com/sp.

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

Product identification
For additional information about the rating plate and manufacturing date ➔ “Mounting and installation” description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

Type codes CMMS-AS-C4-3A-G2

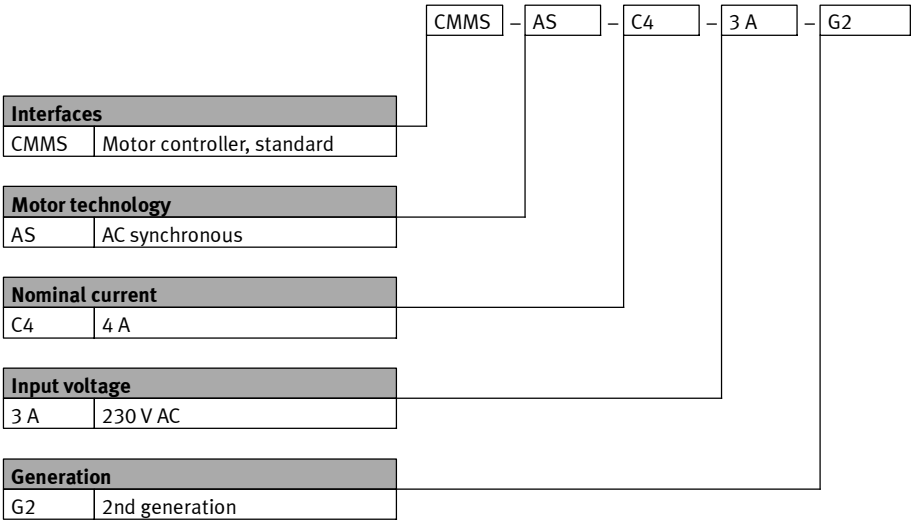


Fig. 1 Type codes CMMS-AS-C4-3A-G2

Type codes CMMS-ST-C8-7-G2

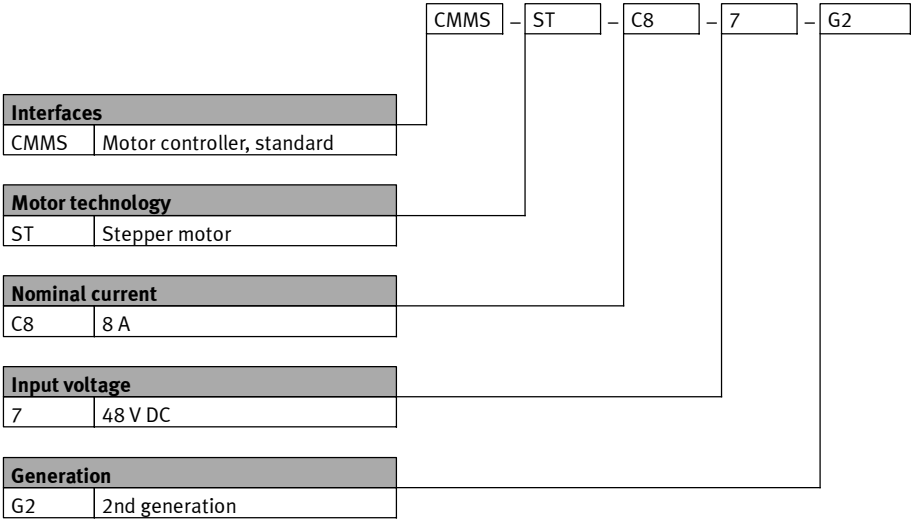


Fig. 2 Type codes CMMS-ST-C8-7-G2

Type codes CMMD-AS-C8-3A

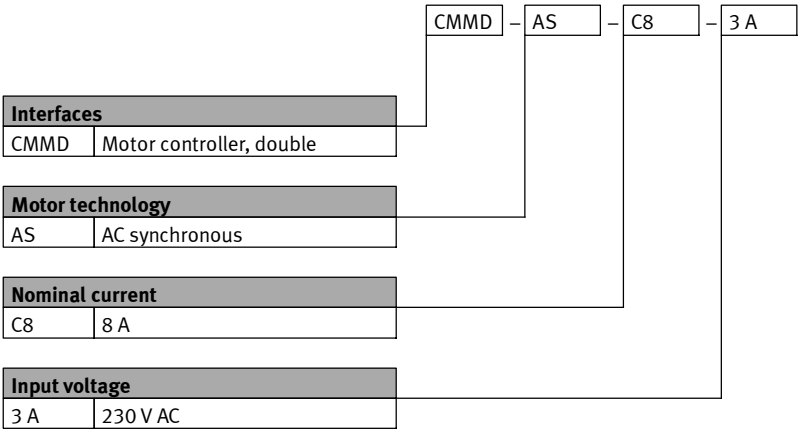


Fig. 3 Type codes CMMD-AS-C8-3A

Documentation

Additional information on the motor controllers CMMS-AS/CMMS-ST/CMMD-AS can be found in the following documentation:

Documentation		**Device type**	**Contents**
Assembly and installation	GDCP-CMMS-AS-G2-HW-...	CMMS-AS	– Mounting – Installation (pin allocations) – Error messages – Technical data
	GDCP-CMMD-AS-HW-...	CMMD-AS	
	GDCP-CMMS-ST-G2-HW-...	CMMS-ST	
Functions and commissioning	GDCP-CMMS/D-FW-...	CMMS-AS CMMD-AS CMMS-ST	– Control interfaces – Operating modes/operational functions – Commissioning with FCT – Error messages
STO safety function	GDCP-CMMS-AS-G2-S1-...	CMMS-AS	– Functional safety engineering with the STO safety function (Safe Torque Off)
	GDCP-CMMD-AS-S1-...	CMMD-AS	
	GDCP-CMMS-ST-G2-S1-...	CMMS-ST	
Device profile FHPP	GDCP-CMMS/D-C-HP-...	CMMS-AS CMMD-AS CMMS-ST	– Description of the interfaces: – CAN bus (CANopen) – Interface CAMC-PB (PROFIBUS) – Interface CAMC-DN (DeviceNet) – Control and parameterisation via the device profile FHPP (Festo Handling and Positioning Profile) with PROFIBUS, DeviceNet or CANopen.
Device profile CiA 402	GDCP-CMMS/D-C-CO-...	CMMS-AS CMMD-AS CMMS-ST	– Description of the interface: – CAN bus (CANopen, DriveBus) – Control and parameterisation via the device profile CiA 402 (DS 402).
Software Help	Help for the CMMS-AS plug-in	CMMS-AS	– User interface and functions in the Festo Configuration Tool for the plug-in
	Help for the CMMD-AS plug-in	CMMD-AS	
	Help for the CMMS-ST plug-in	CMMS-ST	

Tab. 1 Documentation on the motor controllers

The documentation is available on the following media:
- CD-ROM (scope of delivery)
- Support Portal: www.festo.com/sp

1 Safety and requirements for product use

1.1 Safety

1.1.1 Safety instructions

Warning
Danger of electric shock
Touching live parts causes severe injuries and can lead to death:
– when the module or cover plate is not mounted on the card slots [EXT] (CMMS)/[EXT1/EXT2] (CMMD)
– when cables are not mounted to the plugs [X6] (CMMS)/[X6.1/X6.2] (CMMD) and [X9]
– when connecting cables are disconnected when powered.
The product must be installed in a control cabinet and may only be used if all safeguarding has been initiated.
Before touching live parts during maintenance, repair and cleaning work and when there have been long service interruptions:
1. Switch off power to the electrical equipment via the mains switch and secure it against being switched on again.
2. After switch-off, wait at least 5 minutes discharge time and check that power is turned off before accessing the controller.

Caution
Danger of burns from hot surfaces
Dependent on the load of the motor controller, housing temperatures › 80 °C are possible in operation.
- Protect hot surfaces from contact in operation.
- Touch them only in a switched-off, cooled-off status.

Note
Danger from unexpected movement of the motor or axis
- Make sure that the movement does not endanger anyone.
- Perform a risk assessment in accordance with the EC machinery directive.
- Based on this risk assessment, design the safety system for the entire machine, taking into account all integrated components. This also includes the electric drives. Bypassing of safety equipment is impermissible.

1.1.2 Intended use

Motor controller CMMS-AS:

The motor controller is intended for use as a controller for a 3-phase servo motor of the EMMS-AS series in a closed loop (with motor encoder/closed loop).

Motor controller CMMS-ST:

The motor controller CMMS-ST is intended for use as a controller for a 2-phase stepper motor of the EMMS-ST/MTR-ST series in a closed loop (with motor encoder/closed loop) or in an open loop (without motor encoder/open loop).

Motor controller CMMD-AS:

The motor controller is intended for use as a controller for two 3-phase servo motors of the EMMS-AS series in a closed loop (with motor encoder/closed loop).

Motor controller CMMS-AS/CMMS-ST/CMMD-AS:

All motor controllers enable the regulation of current, speed and position, and they contain a positioning controller with stored positioning records. The motor controller is designed for installation in a control cabinet.

The product is intended for use in industrial environments. Outside of industrial environments, e.g. in commercial and mixed-residential areas, actions to suppress interference may have to be taken.

Use exclusively:

- In faultless technical condition
- In original status without unauthorised modifications; only the expansions described in the documentation supplied with the product are permitted.
- Within the limits of the product defined through the technical data
  ➔ “Mounting and installation” description,
  GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...
- In an industrial environment
- In a control cabinet.

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

The motor controller supports the following safety function:

- “Safe torque off” (STO)

Additional information ➔ “STO safety function” description,
GDCP-CMMS-AS-G2-S1-.../GDCP-CMMS-ST-G2-S1-.../GDCP-CMMD-AS-S1-....

1.2 Requirements for product use

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

1.2.1 Transport and storage conditions

- Protect the product during transport and storage from impermissible burdens, such as:
  – Mechanical loads
  – Impermissible temperatures
  – Moisture
  – Aggressive atmosphere
- Store and transport the product in its original packaging. The original packaging offers sufficient protection from typical stresses.

1.2.2 Technical requirements

For correct and safe use of the product:

- Comply with the connection and ambient conditions of the product specified in the technical data ➔ “Mounting and installation” description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../ GDCP-CMMS-ST-G2-HW-..., Appendix A.1, and of all connected components. Compliance with the limit values and load limits permits operation of the product in compliance with the relevant safety regulations.
- Observe the instructions and warnings in this documentation.

1.2.3 Qualification of trained personnel

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

– Installation and operation of electrical control systems,
– The applicable regulations for operating safety-engineered systems,
– The applicable regulations for accident protection and operational reliability, and
– The documentation for the product.

1.2.4 Range of application and certifications

The motor controller with integrated STO safety function is a safety-related part of the control systems.
The motor controller carries the CE marking; for standards and test values
➔ “Mounting and installation” description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../ GDCP-CMMS-ST-G2-HW-..., Appendix A.1.
The product-relevant EU directives can be found in the declaration of conformity.

Certificates and the declaration of conformity for this product ➔ www.festo.com/sp

2 Product overview

2.1 Motor controller CMMS-AS-C4-3A-G2

2.1.1 Control, sensor and safety function interfaces

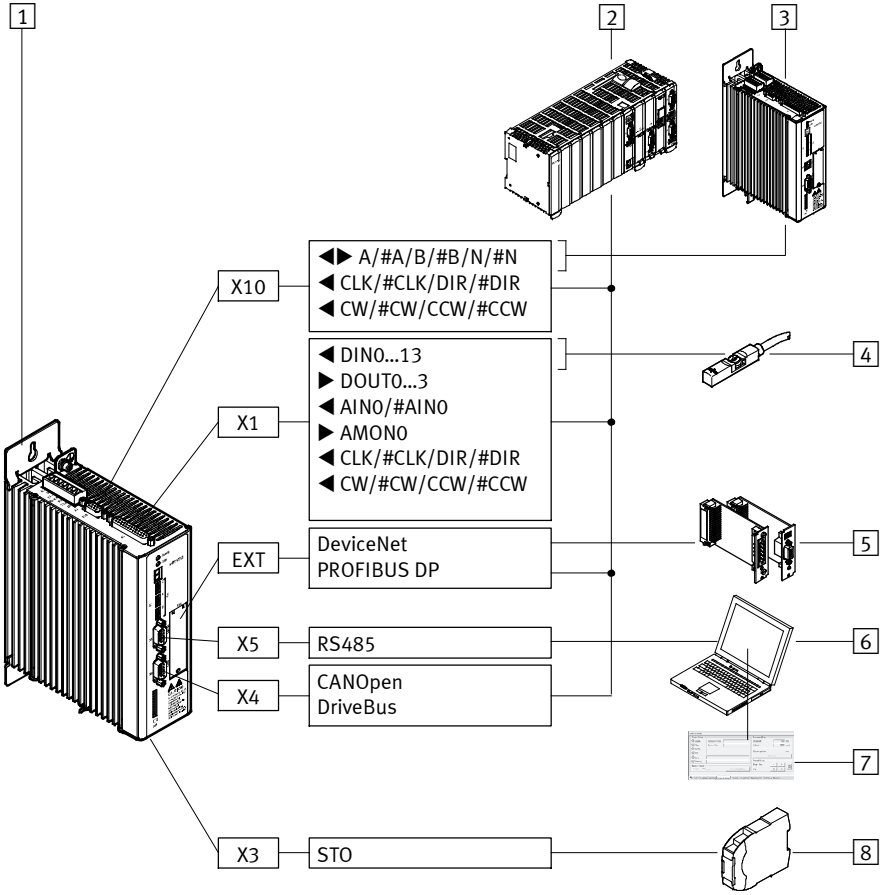


Fig. 2.1 Overview: Control, sensor and safety function interfaces

Interface		Function	Page
1	Motor controller CMMS-AS-C4-3A-G2	Digital interface [X1]	
		– Digital inputs (DIN0...13)	50
		– Digital outputs (DOUT0...3)	50
		Analogue interface [X1]	
		– Analogue inputs (AIN0/#AIN0)	65
		– Analogue output (AMON0)	66
		Synchronisation interfaces [X1][X10]	
		– Encoder inputs	67
		– Encoder outputs	68
		– Incremental signals (A/#A/B/#B/N/#N)	69
		– Pulse/direction signals [X10] (CLK/#CLK/DIR/#DIR)	70
		– Forward/reverse signals [X10] (CW/#CW/CCW/#CCW)	71
		CAN interface [X4]	
		– CANopen	72
		– DriveBus	72
		Slot [EXT]	
		– Interface module CAMC-... ➔ 5	72
		RS485 interface [X5]	240
2	Control	Master device	
3	Motor controller CMM...	Master or slave device	
4	Sensors	Limit switches	77
		Sequence control (NEXT1/2)	148/
5	Interface module CAMC-...	DeviceNet (CAMC-DN)	72
		PROFIBUS DP (CAMC-PB)	72
6	PC	Master device, RS485 interface	
7	Festo Configuration Tool (FCT)	Jog/individual step	172
8	Safety switching device	Safety function STO (Safe Torque Off)	12

Tab. 2.1 Overview: Control, sensor and safety function interfaces

2.1.2 Power supply, motor and motor encoder interfaces

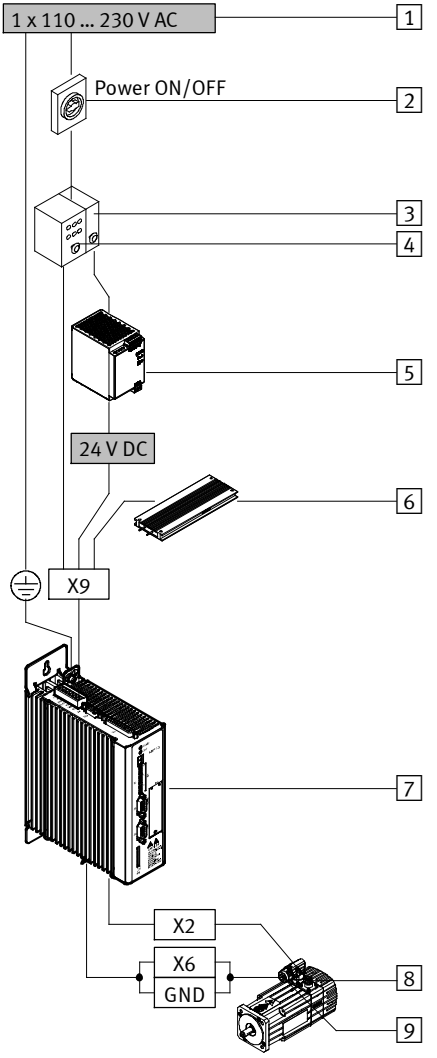


Fig. 2.2 Overview: Power supply, motor and motor encoder interfaces

Interface		Function	Page
1	Mains supply		
2	Power switch		
3	Fuse “control section”	Application-dependent	
4	Fuse “power section”	Application-dependent	
5	Power supply unit “control section”	Output voltage: 24 V DC	
6	External braking resistor (optional)	– Resistance ≥ 100 Ω – Rated output ≤ 100 W – Pulse power ≤ 1600 W – Nominal voltage 400 V AC	
7	Motor controller CMMS-AS-C4-3A-G2	Protective earthing ⏚ (housing)	12
		Power supply [X9] – Power section: 230 V AC (L1/N/PE) – Control section: 24 V DC (24 V/0 V) – External braking resistor (ZK+/BR-CH)	
		Motor interfaces [X6] – Motor (U/V/W/PE) – Holding brake (BR+/BR–) – Motor temperature sensor (MT+/MT–)	
		Motor encoder [X2] – EnDat interface	
		Terminal “motor cable screening GND” (connected with protective earthing ⏚)	
8	Motor encoder (closed loop)	EnDat interface	12
9	Servo motor EMMS-AS	– Motor (U/V/W/PE) – Holding brake (BR+/BR–) – Motor temperature sensor (MT+/MT–)	12

Tab. 2.2 Overview: Power supply, motor and motor encoder interfaces

2.1.3 Parameter/firmware interfaces

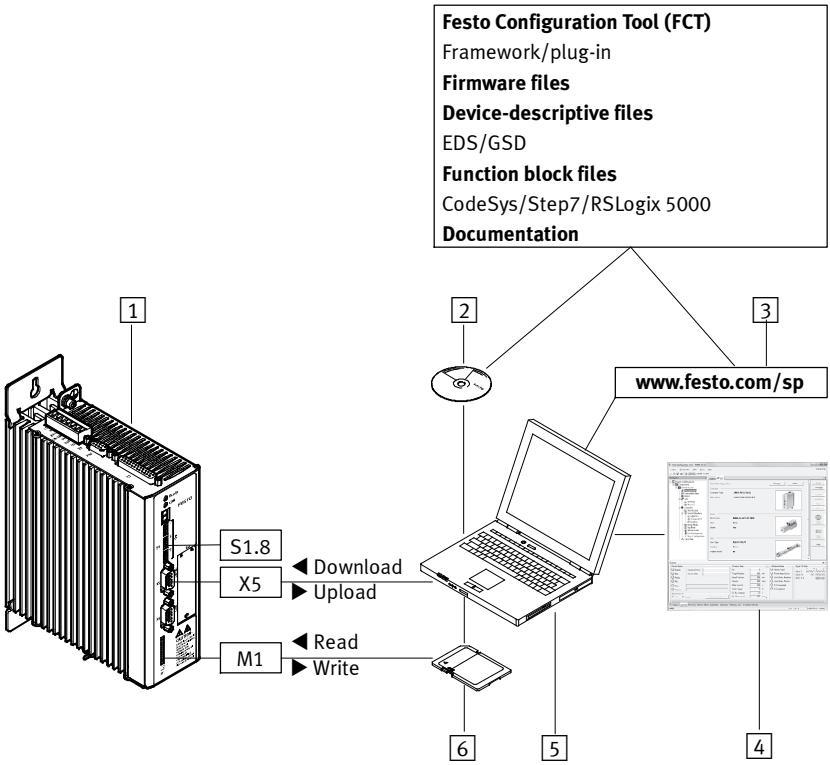


Fig. 2.3 Overview: Parameter/firmware interfaces

Interface		Function	Page
1	Motor controller CMMS-AS-C4-3A-G2	DIL switch [S1.8] – Firmware download activation from the memory card	83
		RS232 interface [X5] – Online data interface	235
		Card slot [M1] – Slot for memory card	
2	CD-ROM	Included in the scope of delivery	
3	Internet	Support Portal: www.festo.com/sp	
4	Festo Configuration Tool (FCT)	Parameterisation/configuration	79
		Data transfer control – Firmware file – Device data (FCT) – Parameter set data (motor controller)	 86 89 92
5	PC	Operating system “Windows ...”	
6	Memory card	– Supported card type: SD (version 1 and 2) – Supported file system: FAT16 (max. 2 GB)	
		Data transfer control Download firmware file (.S) Read parameter file (.DCO) Write parameter file (.DCO)	 87 93 93

Tab. 2.3 Overview: Parameter/firmware interfaces

2.1.4 LED indicators, seven-segment displays and DIL switches

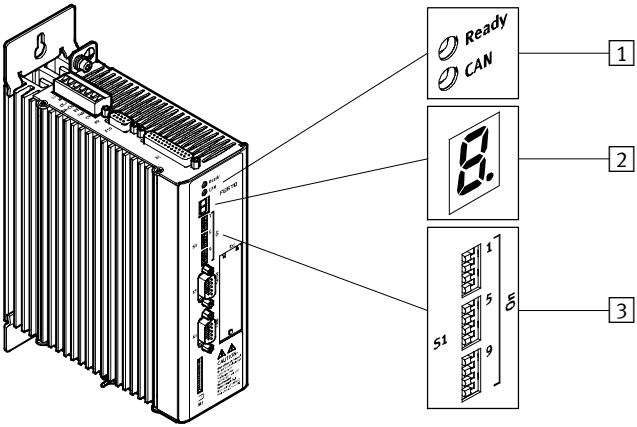


Fig. 2.4 Overview: LED indicators, seven-segment displays and DIL switches

Interface	Function	Page
1 LED indicators	Ready (green)	212
	CAN communication (yellow)	
2 Seven-segment displays	Error/warning messages	212
	Operating modes	
	Bootloader	
	Safety function	
3 DIL switch [S1]	Fieldbus address/MAC-ID configuration [S1.1…7]	82
	Firmware download activation from the memory card [S1.8]	83
	Data rate configuration [S1.9…10] (CAN bus/DeviceNet)	83
	CAN bus activation [S1.11]	83
	Terminating resistor activation [S1.12] (CAN bus)	84

Tab. 2.4 Overview: LED indicators, seven-segment displays and DIL switches

2.2 Motor controller CMMS-ST-C8-7-G2

2.2.1 Control, sensor and safety function interfaces

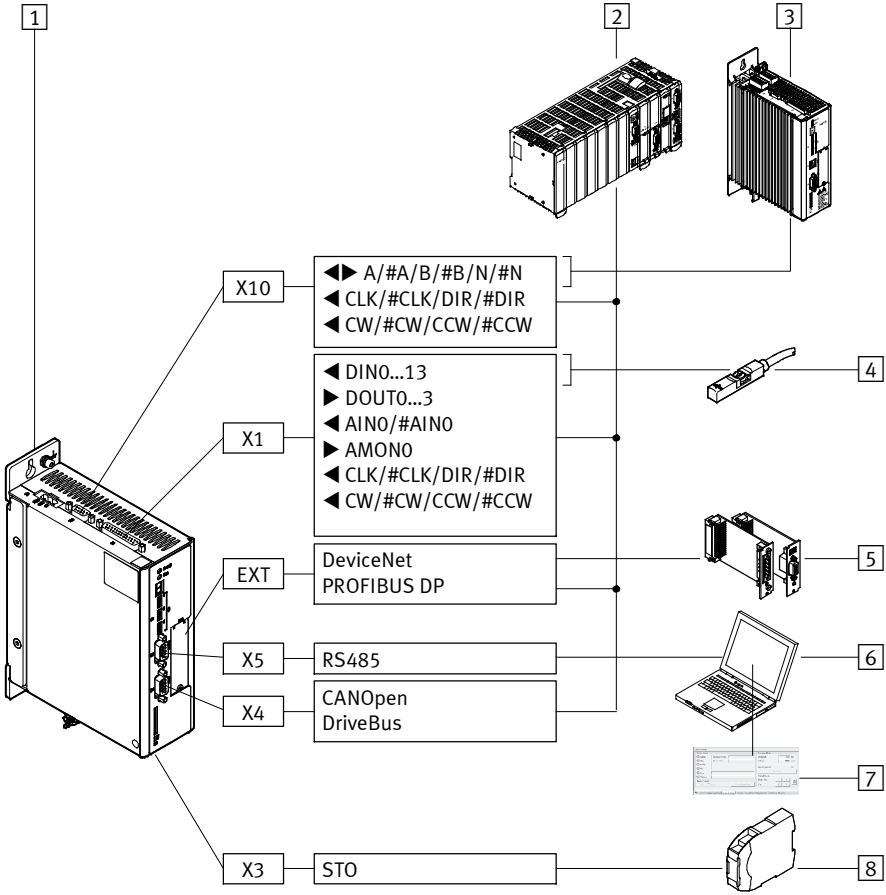
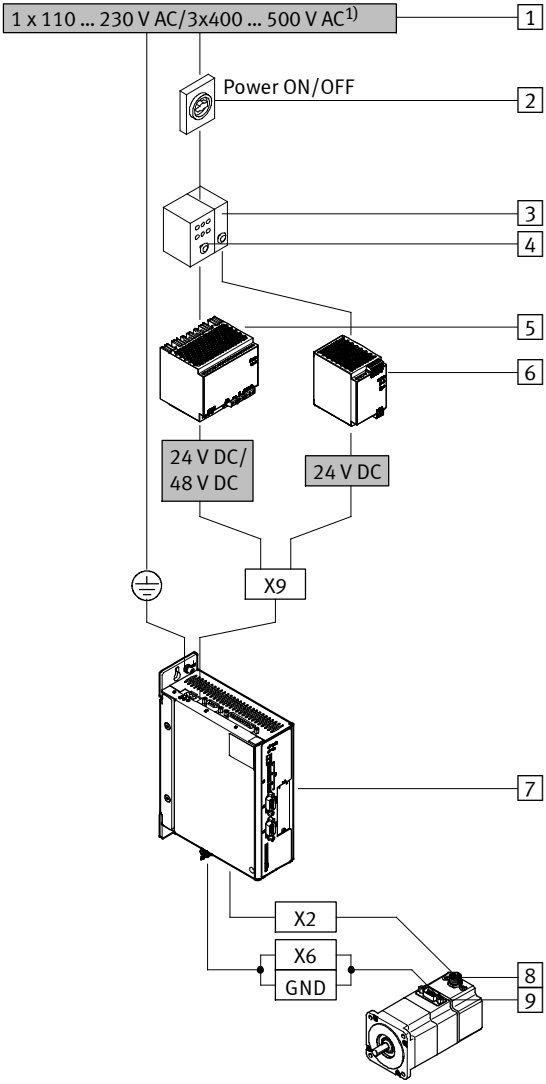


Fig. 2.5 Overview: Control, sensor and safety function interfaces

Interface	Function	Page
1 Motor controller CMMS-ST-C8-7-G2	Digital interface [X1]	
	– Digital inputs (DIN0...13)	50
	– Digital outputs (DOUT0...3)	50
	Analogue interface [X1]	
	– Analogue inputs (AIN0/#AIN0)	65
	– Analogue output (AMON0)	66
	Synchronisation interfaces [X1][X10]	
	– Encoder inputs	67
	– Encoder outputs	68
	– Incremental signals (A/#A/B/#B/N/#N)	69
	– Pulse/direction signals [X10] (CLK/#CLK/DIR/#DIR)	70
	– Forward/reverse signals [X10] (CW/#CW/CCW/#CCW)	71
	CAN interface [X4]	
	– CANopen	72
	– DriveBus	72
	Slot [EXT]	
	– Interface module CAMC-... ➔ 5	72
	RS485 interface [X5]	240
2 Control	Master device	
3 Motor controller CMM...	Master or slave device	
4 Sensors	Limit switches	77
	Sequence control (NEXT1/2)	148/ 149
5 Interface module CAMC-...	DeviceNet (CAMC-DN)	72
	PROFIBUS DP (CAMC-PB)	72
6 PC	Master device, RS485 interface	
7 Festo Configuration Tool (FCT)	Jog/individual step	172
8 Safety switching device	Safety function STO (Safe Torque Off)	12

Tab. 2.5 Overview: Control, sensor and safety function interfaces

2.2.2 Power supply, motor and motor encoder interfaces



1) Dependent on the power supply “power supply unit power section”

Fig. 2.6 Overview: Power supply, motor and motor encoder interfaces

Interface		Function	Page
1	Mains supply		
2	Power switch		
3	Fuse “control section”	Application-dependent	
4	Fuse “power section”	Application-dependent	
5	Power supply unit “power section”	Output voltage: 24/48 V DC	
6	Power supply unit “control section”	Output voltage: 24 V DC	
7	Motor controller CMMS-ST-C8-7-G2	Protective earthing ⏚ (housing)	12
		Power supply [X9] – Power section: 24/48 V DC (ZK+/0 V) – Control section: 24 V DC (24 V/0 V)	
		Motor interfaces [X6] – Motor string (A/#A/B/#B) – Holding brake (BR+/BR–) – Motor temperature sensor (MT+/MT–)	
		Motor encoder [X2] – Incremental signals (A/#A/B/#B/N/#N)	
		Terminal “motor cable screening GND” (connected with protective earthing ⏚)	
8	Motor encoder[1] (closed loop)	Incremental signals (A/#A/B/#B/N/#N)	12
9	Stepper motor EMMS-ST/MTR-ST	– Motor string (A/#A/B/#B) – Holding brake (BR+/BR–) – Motor temperature sensor (MT+/MT–)	12

1) If the stepper motor is configured without a motor encoder in the Festo Configuration Tool (FCT), the motor controller is automatically operated in an open control circuit (open loop).

Tab. 2.6 Overview: Power supply, motor and motor encoder interfaces

2.2.3 Parameter/firmware interfaces

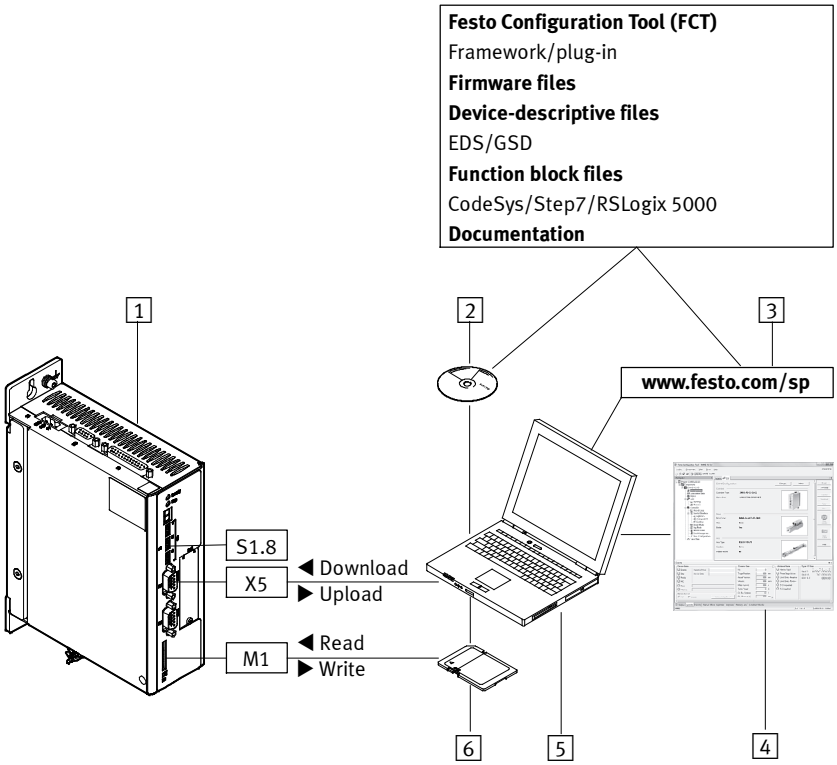


Fig. 2.7 Overview: Parameter/firmware interfaces

Interface	Function	Page
1 Motor controller CMMS-ST-C8-7-G2	DIL switch [S1.8] – Firmware download activation from the memory card	83
	RS232 interface [X5] – Online data interface	235
	Card slot [M1] – Slot for memory card	
2 CD-ROM	Included in the scope of delivery	
3 Internet	Support Portal: www.festo.com/sp	
4 Festo Configuration Tool (FCT)	Parameterisation/configuration	79
	Data transfer control – Firmware file – Device data (FCT) – Parameter set data (motor controller)	 86 89 92
5 PC	Operating system “Windows ...”	
6 Memory card	– Supported card type: SD (version 1 and 2) – Supported file system: FAT16 (max. 2 GB)	
	Data transfer control Download firmware file (.S) Read parameter file (.DCO) Write parameter file (.DCO)	 87 93 93

Tab. 2.7 Overview: Parameter/firmware interfaces

2.2.4 LED indicators, seven-segment displays and DIL switches

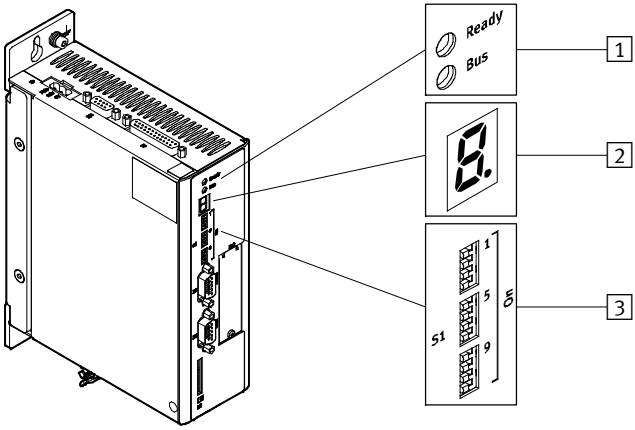


Fig. 2.8 Overview: LED indicators, seven-segment displays and DIL switches

Interface	Function	Page
1 LED indicators	Ready (green)	212
	BUS communication (yellow)	
2 Seven-segment displays	Error/warning messages	212
	Operating modes	
	Bootloader	
	Safety function	
3 DIL switch [S1]	Fieldbus address/MAC-ID configuration [S1.1…7]	82
	Firmware download activation from the memory card [S1.8]	83
	Data rate configuration [S1.9…10] (CAN bus/DeviceNet)	83
	CAN bus activation [S1.11]	83
	Terminating resistor activation [S1.12] (CAN bus)	84

Tab. 2.8 Overview: LED indicators, seven-segment displays and DIL switches

2.3 Motor controller CMMD-AS-C8-3A

2.3.1 Control, sensor and safety function interfaces

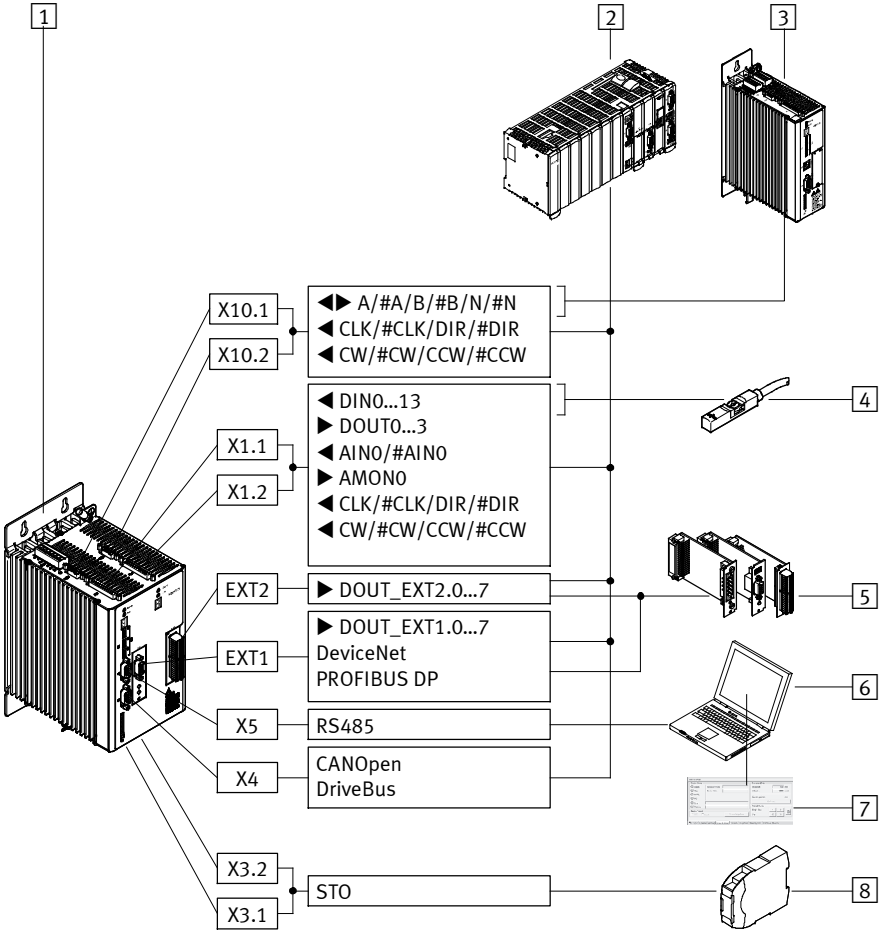


Fig. 2.9 Overview: Control, sensor and safety function interfaces

Interface		Function	Page
1	Motor controller CMMD-AS-C8-3A	Digital interface [X1.1/X1.2]	
		– Digital inputs (DIN0...13)	50
		– Digital outputs (DOUT0...3)	50
		Analogue interface [X1.1/X1.2]	
		– Analogue inputs (AIN0/#AIN0)	65
		– Analogue output (AMON0)	66
		Synchronisation interfaces [X1.1/X1.2][X10.1/X10.2]	
		– Encoder inputs	67
		– Encoder outputs	68
		– Incremental signals (A/#A/B/#B/N/#N)	69
		– Pulse/direction signals [X10.1/X10.2] (CLK/#CLK/DIR/#DIR)	70
		– Forward/reverse signals [X10.1/X10.2] (CW/#CW/CCW/#CCW)	71
		CAN interface [X4]	
		– CANopen	72
		– DriveBus	72
		Slots [EXT1/2]	
		– Interface module CAMC-... ➔ 5	72
		– Input/output module CAMC-D-... ➔ 5	
		RS485 interface [X5]	240
2	Control	Master device	
3	Motor controller CMM...	Master or slave device	
4	Sensors	Limit switches	77
		Sequence control (NEXT1/2)	148/
5	Interface module CAMC-... Input/output module CAMC-D-...	DeviceNet (CAMC-DN)	72
		PROFIBUS DP (CAMC-PB)	72
		Digital inputs/outputs (CAMC-D-8E8A)[1)]	49
6	PC	Master device	
7	Festo Configuration Tool (FCT)	Jog/individual step	172
8	Safety switching device	Safety function STO (Safe Torque Off)	12

1) Digital inputs cannot be used.

Tab. 2.9 Control, sensor and safety function interfaces

2.3.2 Power supply, motor and motor encoder interfaces

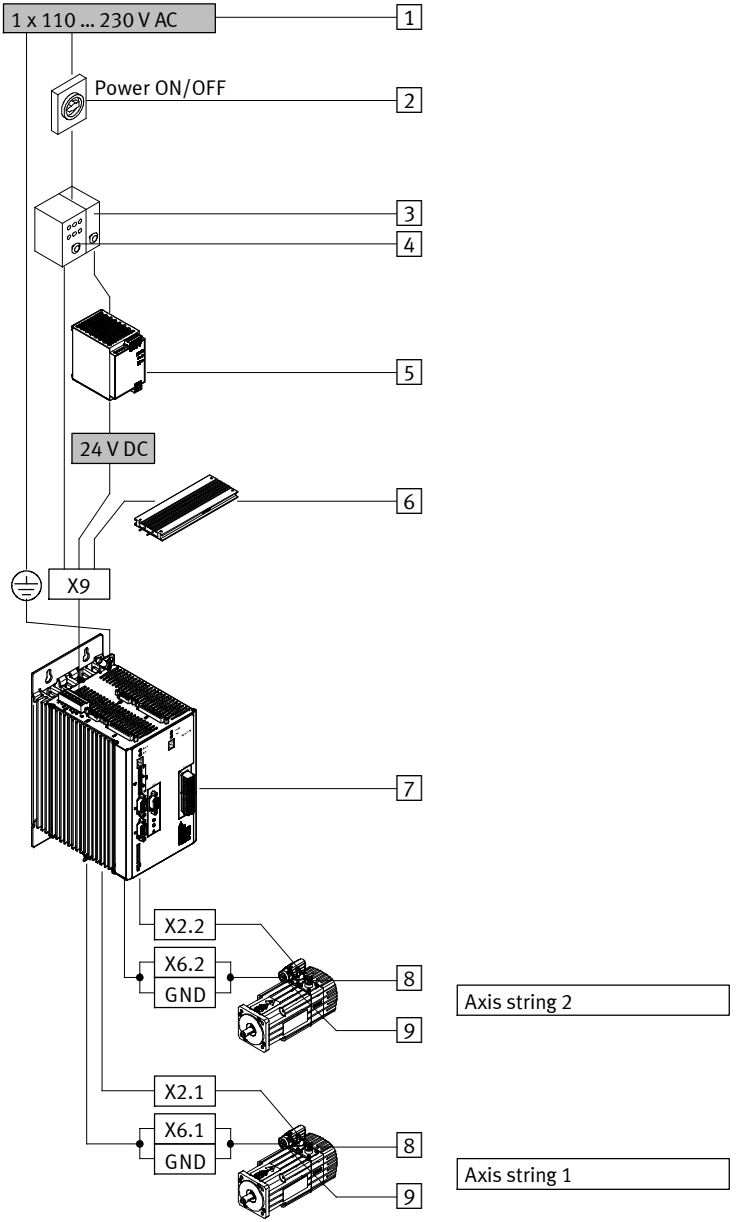


Fig. 2.10 Overview: Power supply, motor and motor encoder interfaces

Interface		Function	Page
1	Mains supply		
2	Power switch		
3	Fuse “control section”	Application-dependent	
4	Fuse “power section”	Application-dependent	
5	Power supply unit “control section”	Output voltage: 24 V DC	
6	External braking resistor (optional)	– Resistance ≥ 100 Ω – Rated output ≤ 100 W – Pulse power ≤ 1600 W – Nominal voltage 400 V AC	
7	Motor controller CMMD-AS-C8-3A	Protective earthing ⏚ (housing)	12
		Power supply [X9] – Power section: 230 V AC (L1/N/PE) – Control section: 24 V DC (24 V/0 V) – External braking resistor (ZK+/BR-CH)	
		Motor interfaces [X6.1/X6.2] – Motor (U/V/W/PE) – Holding brake (BR+/BR–) – Motor temperature sensor (MT+/MT–)	
		Motor encoder [X2.1/X2.2] – EnDat interface	
		Terminal “motor cable screening GND” (connected with protective earthing ⏚)	
8	Motor encoder (closed loop)	EnDat interface	12
9	Servo motor EMMS-AS	– Motor (U/V/W/PE) – Holding brake (BR+/BR–) – Motor temperature sensor (MT+/MT–)	12

Tab. 2.10 Overview: Power supply, motor and motor encoder interfaces

2.3.3 Parameter/firmware interfaces

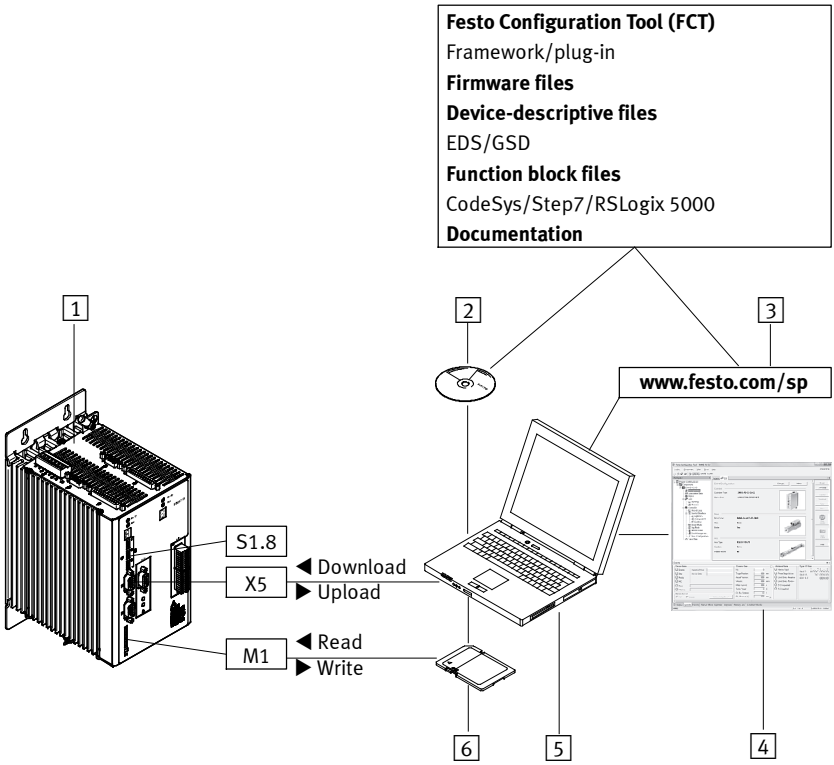


Fig. 2.11 Overview: Parameter/firmware interfaces

Interface	Function	Page
1 Motor controller CMMD-AS-C8-3A	DIL switch [S1.8] – Firmware download activation from the memory card	83
	RS232 interface [X5] – Online data interface	235
	Card slot [M1] – Slot for memory card	
2 CD-ROM	Included in the scope of delivery	
3 Internet	Support Portal: www.festo.com/sp	
4 Festo Configuration Tool (FCT)	Parameterisation/configuration	79
	Data transfer control – Firmware file – Device data (FCT) – Parameter set data (motor controller)	 86 89 92
5 PC	Operating system “Windows ...”	
6 Memory card	– Supported card type: SD (version 1 and 2) – Supported file system: FAT16 (max. 2 GB)	
	Data transfer control Download firmware file (.S) Read parameter file (.DCO) Write parameter file (.DCO)	 87 93 93

Tab. 2.11 Overview: Parameter/firmware interfaces

2.3.4 LED indicators, seven-segment displays and DIL switches

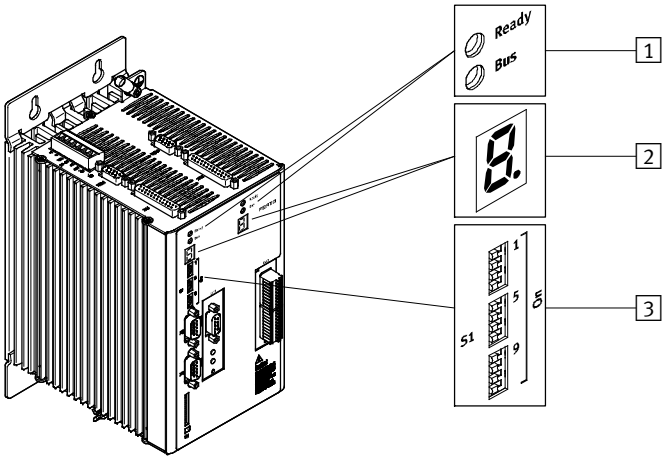


Fig. 2.12 Overview: LED indicators, seven-segment displays and DIL switches

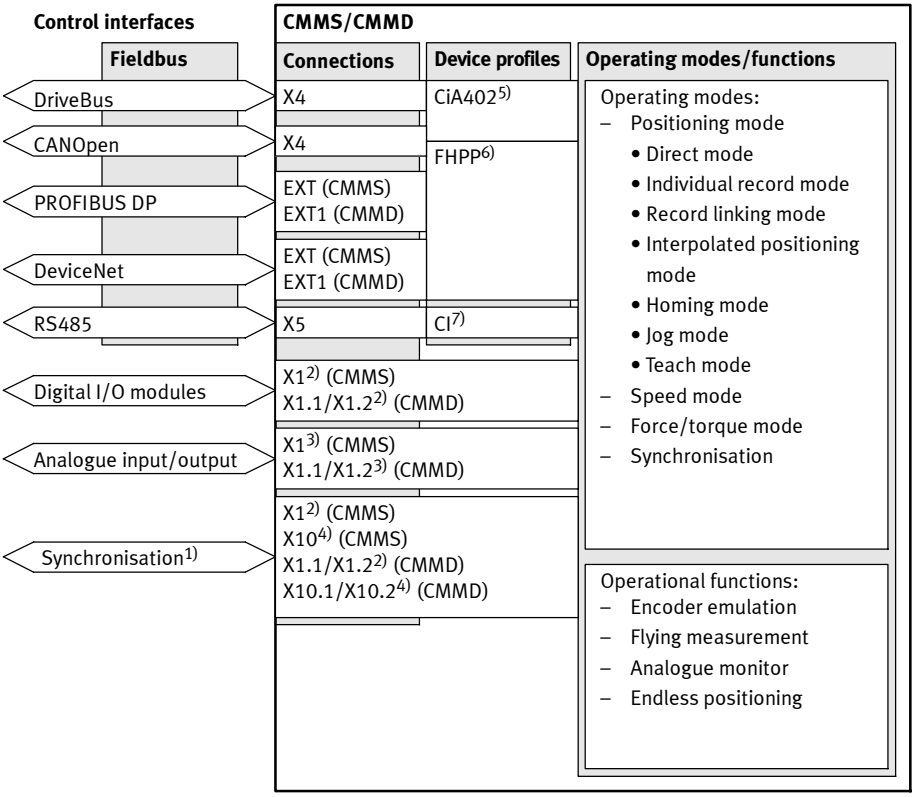
Interface	Function	Page
1 LED indicators	Ready (green)	212
	BUS communication (yellow)	
2 Seven-segment displays	Error/warning messages	212
	Operating modes	
	Bootloader	
	Safety function	
3 DIL switch [S1]	Fieldbus address/MAC-ID configuration [S1.1…7]	82
	Firmware download activation from the memory card [S1.8]	83
	Data rate configuration [S1.9…10] (CAN bus/DeviceNet)	83
	CAN bus activation [S1.11]	83
	Terminating resistor activation [S1.12] (CAN bus)	84

Tab. 2.12 Overview: LED indicators, seven-segment displays and DIL switches

2.4 Control interfaces – operating modes – operational functions

The motor controller can be operated through a number of interfaces. Various operating modes and operational functions are available, dependent on the selected control interface and the device profile (only for fieldbus). The control interfaces are permanently assigned to the connections. You can take the possible combinations from the following overviews.

2.4.1 Overview: Control interfaces/connections/device profiles/ operating modes/operational functions



1) Encoder input for the "synchronisation" operating mode
2) HTL signal (high transistor logic): High signal = 24 V
3) Analogue input signal: ± 10 V, analogue output signal: + 10 V
4) TTL signal (transistor-transistor logic): High signal = 5 V
5) CANopen device profile CiA 402
6) Festo handling and positioning profile (FHPP)
7) CAN-Interpreter

Fig. 2.13 Overview: Control interfaces/connections/device profiles/operating modes/operational functions

2.4.2 Positioning mode: Direct mode, individual record mode, record linking mode and interpolated positioning mode

Control interfaces ➔ page 46								
	Inputs/outputs							
	Digital inputs/outputs DIN/DOUT, 24 V							
		Analogue input AIN, ± 10 V						
			Synchronisation (encoder input), 5 V					
				Fieldbus				
				DriveBus (Motion Control)				
					CANOpen			
						PROFIBUS DP		
							DeviceNet	
								RS485
Device profile								
– **C** = CiA 402 (CANopen) – **CI** = CAN-Interpreter (CiA 402, SDO) – **F** = FHPP (Festo)				**C**	**F/C**	**F**	**F**	**CI**
Operating modes								
Positioning mode (position control) ➔ page 112								
Direct mode ➔ page 115								
Direct application					F/C	F	F	CI
Individual record mode ➔ page 119								
Record selection (Positioning record 1...63)	DIN				F	F	F	
Record linking mode ➔ page 136								
Record selection (Positioning record 1...7)	DIN							
Record selection (Positioning record 1...63)					F	F	F	
Interpolated positioning mode ➔ page 152								
Direct application				C	C			

Tab. 2.13 Overview: Positioning mode “direct mode, individual record mode, record linking mode and interpolated positioning mode”

2.4.3 Positioning mode: Homing mode/jog mode/teach mode

Control interfaces ➔ page 46								
	Inputs/outputs							
	Digital inputs/outputs DIN/DOUT, 24 V							
		Analogue input AIN, ± 10 V						
			Synchronisation (encoder input), 5 V					
				Fieldbus				
				DriveBus (Motion Control)				
					CANOpen			
						PROFIBUS DP		
							DeviceNet	
								RS485
Device profile								
– **C** = CiA 402 (CANopen)				**C**	**F/C**	**F**	**F**	**CI**
– **CI** = CAN-Interpreter (CiA 402, SDO)								
– **F** = FHPP (Festo)								
Operating modes								
Positioning mode (position control) ➔ page 112								
Homing mode/homing ➔ page 154								
Direct application				C	F/C	F	F	CI
Record selection (Positioning record 0)	DIN							
Jog mode ➔ page 171								
Direct application					F	F	F	
Digital inputs	DIN							
Teach mode ➔ page 177								
Direct application					F	F	F	
Record selection (Positioning record 1...63)	DIN							

Tab. 2.14 Overview: Positioning mode “homing mode/jog mode/teach mode”

2.4.4 Speed mode, force mode and torque mode

Control interfaces ➔ page 46								
	Inputs/outputs							
	Digital inputs/outputs DIN/DOUT, 24 V							
		Analogue input AIN, ± 10 V						
			Synchronisation (encoder input), 5 V					
				Fieldbus				
				DriveBus (Motion Control)				
					CANOpen			
						PROFIBUS DP		
							DeviceNet	
								RS485
Device profile								
– **C** = CiA 402 (CANopen)				**C**	**F/C**	**F**	**F**	**CI**
– **CI** = CAN-Interpreter (CiA 402, SDO)								
– **F** = FHPP (Festo)								
Operating modes								
Speed mode (speed adjustment) ➔ page 182								
Direct mode								
Direct application					F/C	F	F	CI
Analogue setpoint value								
Analogue input		AIN						
Force mode[1]/torque mode[2] (current control) ➔ page 187								
Direct mode								
Direct application					F/C	F	F	CI
Analogue setpoint value								
Analogue input		AIN						

1) Only for configuration “linear axis” active.

2) Only for configuration “rotative axis” active.

Tab. 2.15 Overview: Speed mode, force mode and torque mode

2.4.5 Synchronisation

Control interfaces ➔ page 46								
	Inputs/outputs							
	Digital inputs/outputs DIN/DOUT, 24 V							
		Analogue input AIN, ± 10 V						
			Synchronisation (encoder input), 5 V					
				Fieldbus				
				DriveBus (Motion Control)				
					CANOpen			
						PROFIBUS DP		
							DeviceNet	
								RS485
Device profile								
– **C** = CiA 402 (CANopen)				**C**	**F/C**	**F**	**F**	**CI**
– **CI** = CAN-Interpreter (CiA 402, SDO)								
– **F** = FHPP (Festo)								
Operating mode								
Synchronisation (position control) ➔ page 192								
Incremental signals (A/#A/B/#B/N/#N)								
Incremental inputs			IN					
Pulse/direction signals (CLK/#CLK/DIR/#DIR)								
Incremental inputs			IN					
Digital inputs	DIN							
Forward/reverse signals (CW/#CW/CCW/#CCW)								
Incremental inputs			IN					
Digital inputs	DIN							

Tab. 2.16 Overview: Synchronisation

2.4.6 Operational functions: Encoder emulation, flying measurement, analogue monitor and endless positioning

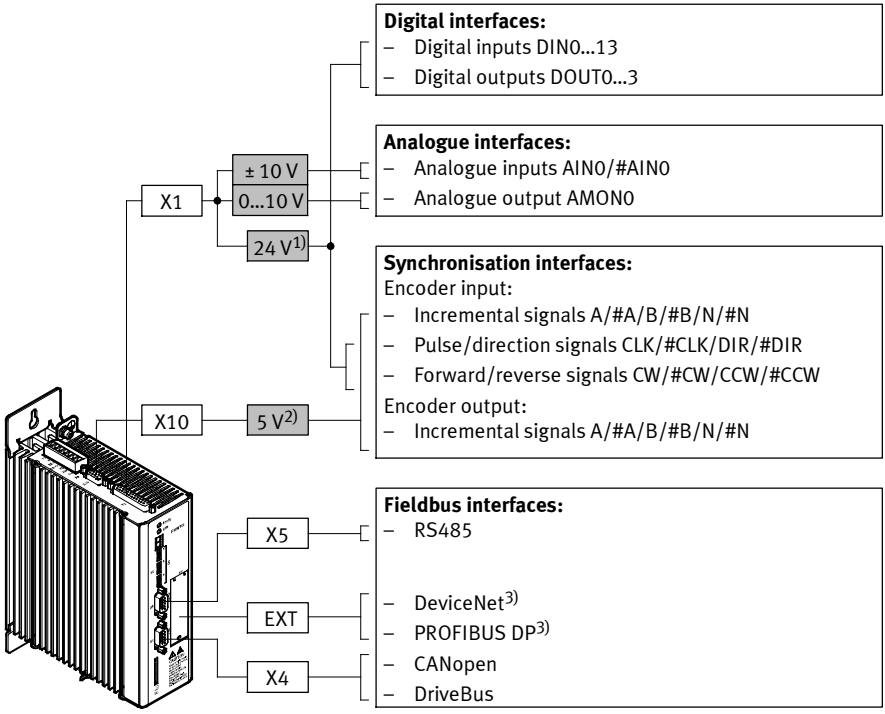
Control interfaces ➔ page 46								
	Inputs/outputs							
	Digital inputs/outputs DIN/DOUT, 24 V							
		Analogue input AIN, ± 10 V						
			Synchronisation (encoder input), 5 V					
				Fieldbus				
				DriveBus (Motion Control)				
					CANOpen			
						PROFIBUS DP		
							DeviceNet	
								RS485
Operational functions								
Encoder emulation ➔ page 198								
Incremental outputs	yes	yes	no	yes	yes	yes	yes	yes
Flying measurement ➔ page 200								
Digital input	no	no	no	yes	yes	yes	yes	yes
Analogue monitor (AMON0) [0...10 V] ➔ page 202								
Analogue output	yes	yes	yes	yes	yes	yes	yes	yes
Endless positioning ➔ page 205								
	yes	yes	yes	yes	yes	yes	yes	yes
Resonance filter (only for motor controller CMMS-ST-C8-7-G2) ➔ page 207								
	yes	yes	yes	yes	yes	yes	yes	yes

Tab. 2.17 Operational functions: Encoder emulation, flying measurement, analogue monitor and endless positioning

3 Control interfaces

3.1 Digital, analogue, synchronisation and fieldbus interfaces

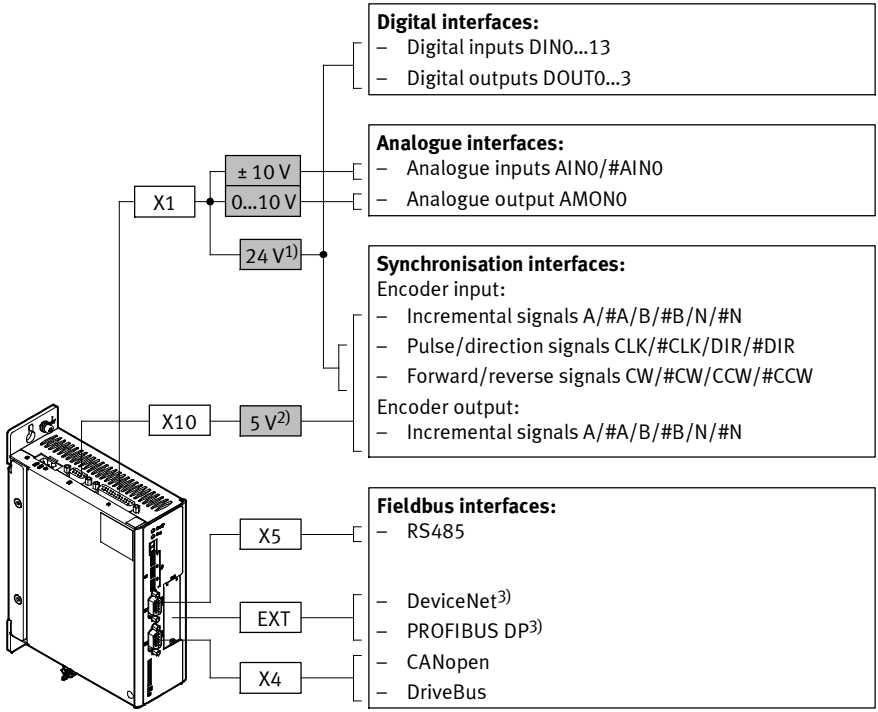
3.1.1 Motor controller CMMS-AS-C4-3A-G2



1) HTL signal (high transistor logic): High signal = 24 V
2) TTL signal (transistor-transistor logic): High signal = 5 V
3) Interface module CAMC-... (optional)

Fig. 3.1 Overview: Digital, analogue, synchronisation and fieldbus interfaces

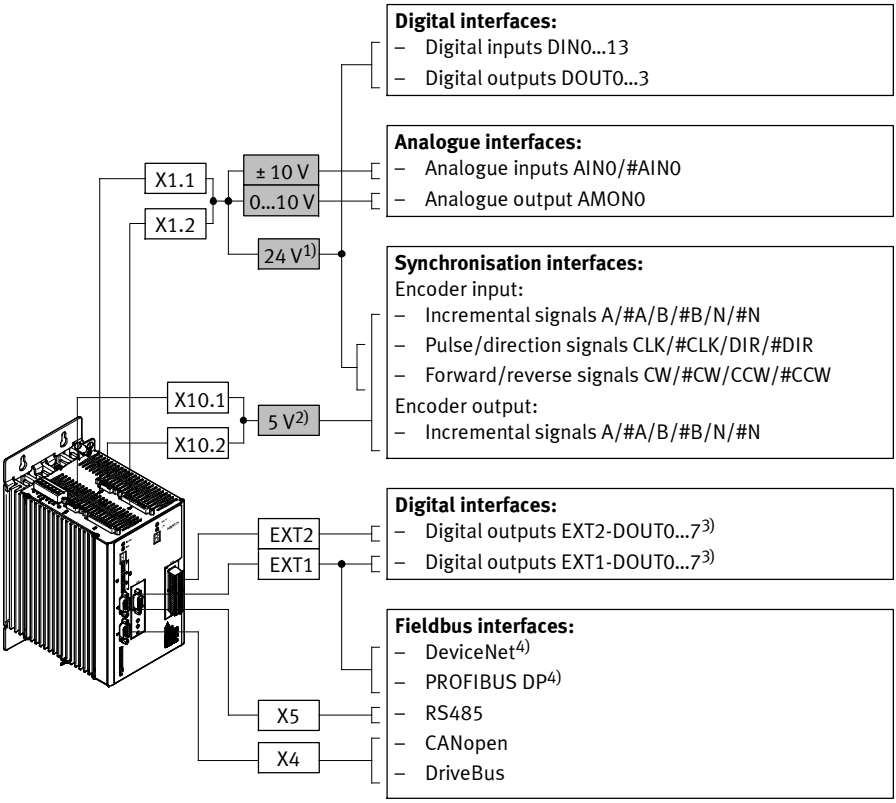
3.1.2 Motor controller CMMS-ST-C8-7-G2



1) HTL signal (high transistor logic): High signal = 24 V
2) TTL signal (transistor-transistor logic): High signal = 5 V
3) Interface module CAMC-... (optional)

Fig. 3.2 Overview: Digital, analogue, synchronisation and fieldbus interfaces

3.1.3 Motor controller CMMD-AS-C8-3A



1) HTL signal (high transistor logic): High signal = 24 V
2) TTL signal (transistor-transistor logic): High signal = 5 V
3) Input/output module CAMC-D-8E8A (optional)
4) Interface module CAMC-... (optional)

Fig. 3.3 Overview: Digital, analogue, synchronisation and fieldbus interfaces

3.2 Digital interfaces [X1] [X1.1/X1.2/EXT1/EXT2]

3.2.1 Digital I/O modules (DIN…/DOUT…)

Motor controller CMMS:

The motor controller has 14 digital inputs (DIN0…DIN13) and 4 digital outputs (DOUT0…3) at connection [X1]. The digital input/output signals are dependent on the operating mode selected ➔ page 50.

Motor controller CMMD:

The motor controller has 14 digital inputs (DIN0…DIN13) and 4 digital outputs (DOUT0…3) at each of the connections [X1.1/X1.2]. The digital input/output signals are dependent on the operating mode selected ➔ page 50.

The motor controller can be optionally expanded by an input/output module CAMC-D-8E8A at slots EXT1/EXT2. The digital outputs (EXT1-DOUT0…7) and (EXT2-DOUT0…7) can be freely configured and assigned to one of the two strings. The 8 digital inputs cannot be used by the motor controller for operation.

3.2.2 Selecting the operating mode/mode via digital input signals

The following operating modes/modes can be selected via the digital input signals “Mode bit 0” and “Mode bit 1”.

Operating mode	Mode	Mode bit 1 (DIN9)[1)]	Mode bit 0 (DIN12)[2)]
Individual record/homing mode	Mode 0	0	0
Jog/teach-in mode	Mode 1	0	1
Record linking operation	Mode 2	1	0
Synchronisation mode	Mode 3	1	1

1) The digital input (DIN9) is used as a sample input with flying measurement.

2) The digital input (DIN12) is used as an analogue input “AIN0” in speed, force or torque mode.

Tab. 3.1 Overview: Selecting the operating mode/mode via digital input signals “Mode bit 0/1”

3.2.3 Digital input/output signals as a function of the operating mode/mode

Designation	Pin [X1.x] [X1.1.x] [X1.2.x]	Mode 0 Individual record	Mode 1 Jogging	Mode 1 Teaching	Mode 2 Record linking	Mode 3 Synchronisation
24 V DC	[18]	Supply voltage 24 V DC (output)[1]				
GND 24 V	[6]	Load “DIN/DOUT”				
DIN 0	[19]	Record selection bit 0				–
DIN 1	[7]	Record selection bit 1				–
DIN 2	[20]	Record selection bit 2				CLK/CW_24
DIN 3	[8]	Record selection bit 3			Halt record sequence	DIR/CCW_24
DIN 4	[21]	Output stage enable				
DIN 5	[9]	Controller enable				
DIN 6	[22]	Limit switch 0				
DIN 7	[10]	Limit switch 1				
DIN 8	[23]	Start positioning	–	Teach	Start record sequence	Start synchronisation
DIN 9[2] (Sample)	[11]	Mode bit 1 = 0			Mode bit 1 = 1	
DIN 10	[3]	Record selection bit 4	Jog+	Record selection bit 4	NEXT1	–
DIN 11	[16]	Record selection bit 5	Jog–	Record selection bit 5	NEXT2	–
DIN 12[3] (AIN0)	[2]	Mode bit 0 = 0	Mode bit 0 = 1		Mode bit 0 = 0	Mode bit 0 = 1
DIN 13[3] (#AIN0)	[15]	Stop				
DOUT0	[24]	Controller ready for operation				
DOUT1	[12]	Motion complete (MC)[4]				Standstill reached
DOUT2	[25]	Start confirmed[4]	–	Teach confirmed	Start confirmed[4]	Position synchronous
DOUT3	[13]	Common error[4]				

1) Internally connected with power supply “24 V DC” (input) at the connection [X9.6].

2) The digital input (DIN9) is used as a sample input with flying measurement.

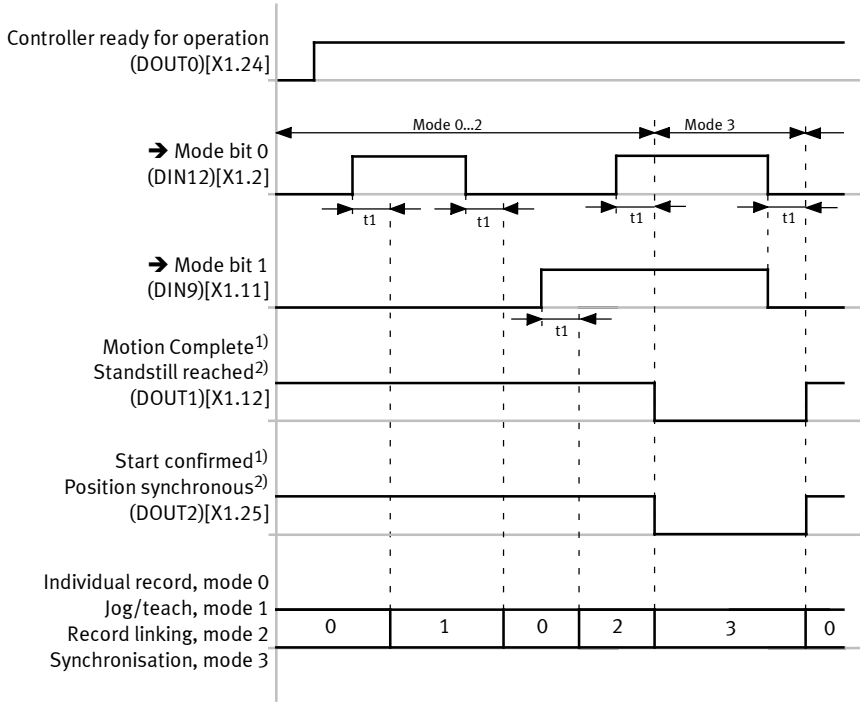
3) The digital inputs (DIN12/DIN13) are used as analogue inputs (AIN0/#AIN0) in speed, force or torque mode.

4) The digital output can be freely configured (default setting in the Festo Configuration Tool (FCT)).

Tab. 3.2 Overview: Digital I/O modules dependent on the operating mode/mode

Timing diagram: Selecting the operating mode/mode via digital input signals

The timing diagram shows the dependency of the four operating modes “Individual record (Mode 0)/ Jogging and teaching (Mode 1)/Record linking (Mode 2)/Synchronisation (Mode 3)” on the digital input signals “Mode bit 0/Mode bit 1”.



1) Only active for mode 0...2

2) Only active for mode 3

t1 ≤ 5 ms

Fig. 3.4 Timing diagram: Selecting the operating mode/mode via digital input signals “Mode bit 0/1”

3.2.4 Digital input signals

The digital input signals are permanently assigned to the digital inputs (DIN0...13). The function is dependent on the selected operating mode/mode of the control interface “digital inputs/outputs” ➔ page 50.

Signal	Description	Signal
General operating signals		
Enable Power (DIN4) [X1.21]/[X1.1.21/X1.2.21]	– High signal for release of the output stage (motor energised) ➔ page 101. – Low signal for immediate blocking of the output stage • The category 0 STOP function, EN 60204-1 can be realised in combination with an external safety switching device ➔ description “Safety function STO”, – GDCP-CMMS-AS-G2-S1-... – GDCP-CMMS-ST-G2-S1-... – GDCP-CMMD-AS-S1-.... • Functional timing diagram of the input ➔ page 107.	high active
Enable Control (DIN5) [X1.9]/[X1.1.9/X1.2.9]	– High signal for release of the controller ➔ page 101. – Low signal for blocking the controller enable function; results in controlled braking of the motor • The category 1 STOP function, EN 60204-1 can be realised in combination with an external safety switching device ➔ description “Safety function STO”, – GDCP-CMMS-AS-G2-S1-... – GDCP-CMMS-ST-G2-S1-... – GDCP-CMMD-AS-S1-.... • Functional timing diagram of the input ➔ page 108. – Low signal for acknowledgement of error messages ➔ page 214.	high active
Stop (DIN13) [X1.15]/[X1.1.15/X1.2.15]	Low signal for controlled stopping of the current movement • The category 2 STOP function, EN 60204-1 can be realised in combination with an external safety switching device for standstill monitoring. • Functional timing diagram for – Individual record operation ➔ page 123 – Record linking operation ➔ page 141 – Homing mode ➔ page 159	low active

Signal	Description	Signal
Limit switches		
Limit Switch 0 (DIN6) [X1.22]/[X1.1.22/X1.2.22]	Signal when the reference/end position is reached. – With the configured edge of the limit switch 0, reaching of the reference/end position is signaled.	configur-able
Limit Switch 1 (DIN7) [X1.10]/[X1.1.10/X1.2.10]	Signal when the reference/end position is reached. – With the configured edge of the limit switch 1, reaching of the reference/end position is signaled.	configur-able
Operating mode selection		
Mode Select Bit 0 (DIN12) [X1.2]/[X1.1.2/X1.2.2]	Signals for selection of the operating mode/mode ➔ page 49.	high active
Mode Select Bit 1 (DIN9) [X1.11]/[X1.1.11/X1.2.11]		high active
Record selection		
Record Select Bit 0...5 Bit 0...2: (DIN0/.../DIN2) Bit 3...5: (DIN3/DIN10/DIN11) [X1.x]/[X1.1.x/X1.2.x]	Signals for selecting (binary code) the positioning record. – Individual record operation: Bit 0...5 active ➔ page 121 – Record linking operation: Bit 0...2 active ➔ page 138 – Homing mode: Bit 0...5 active ➔ page 156 – Teach mode: Bit 0...5 active ➔ page 179	high active
Individual record operation (mode 0)		
Start Positioning (DIN8) [X1.23]/[X1.1.23/X1.2.23]	Signal for starting the individual record ➔ page 122. – With the rising edge, the record selection is evaluated and the parameters of the active positioning record are executed by the controller-internal positioning controller.	high active
Record linking operation (mode 2)		
Start Record Sequence (DIN8) [X1.23]/[X1.1.23/X1.2.23]	Signal for starting the record sequence ➔ page 139. – With the rising edge, the record selection is evaluated and the parameters of the active record sequence are executed by the controller-internal positioning controller/drive.	high active
Halt Record Sequence (DIN3) [X1.8]/[X1.1.8/X1.2.8]	Signal for interrupting the record sequence ➔ page 140. – With the low signal, the record sequence is stopped. – With the high signal, the record sequence is continued at the stopped position.	low active

Signal	Description	Signal
Sequence control		
NEXT1 (DIN10) [X1.3]/[X1.1.3/X1.2.3]	Signals for control of the sequence controller. Through the configured input (NEXT1/2), continuation can be controlled to the next positioning record. With the configured edge (rising/falling) the record sequence is continued. – Positioning record parameter (FCT) “Command: NRI/NFI”: Continuation is executed immediately with the edge. – Positioning record parameter (FCT) “Command: NRS/NFS”: Continuation is executed with the edge and the output signal “Motion complete = high”.	configur-able
NEXT2 (DIN11) [X1.16]/[X1.1.16/X1.2.16]		configur-able
Homing mode (mode 0, positioning record 0)		
Start Positioning (DIN8) [X1.23]/[X1.1.23/X1.2.23]	Starting for starting homing ➔ page 157. – With the rising edge, homing is performed in accordance with the parametrised homing method.	high active
Jog operation (mode 1)		
Jogging+ (DIN10) [X1.3]/[X1.1.3/X1.2.3]	Signal for control of the positive jog travel ➔ page 174. – With the rising edge, jog travel (creep/jog speed) is started. – With the falling edge, jog travel is ended.	high active
Jogging– (DIN11) [X1.16]/[X1.1.16/X1.2.16]	Signal for control of the negative jog travel ➔ page 174. – With the rising edge, jog travel (creep/jog speed) is started. – With the falling edge, jog travel is ended.	high active
Teach operation (mode 1)		
Teach (DIN8) [X1.23]/[X1.1.23/X1.2.23]	Signal for storing the teach/actual position ➔ page 180. – With the rising edge, teaching is prepared. The current actual position of the drive and the record selection (bit 0...5) are evaluated. – With the falling edge, the current actual position is temporarily stored in the selected positioning record. The taught positions are not permanently stored until there is a falling edge of the controller enable signal (DIN5)[X1.9].	high active

Signal	Description	Signal
Synchronisation (mode 3)		
Start Synchronisation (DIN8) [X1.23]/[X1.1.23/X1.2.23]	Signal for starting synchronisation ➔ page 196. – With the high signal, synchronisation is started. – With the low signal, synchronisation is stopped.	high active
CLK/CW_24 (DIN2) [X1.20]/[X1.1.20/X1.2.20]	Encoder signals for synchronising the motor controller. – CLK: Pulse signal – CW: Forward signal	configur-able
DIR/CCW_24 (DIN3) [X1.8]/[X1.1.8/X1.2.8]	Encoder signals for synchronising the motor controller. – DIR: Direction signal – CCW: Reverse signal	configur-able
Flying measurement		
Sampling (DIN9) [X1.11]/[X1.1.11/X1.2.11]	Signal for storing the actual position ➔ page 200. – With the configured edge of the sample signal, the current actual position of the drive is taken over into the sample memory. The higher-order controller can interrogate the last stored actual position via the active fieldbus.	configur-able edge trigger

Tab. 3.3 Overview: Digital input signals

3.2.5 Digital output signals

The configurable digital output signals can be freely assigned to the digital outputs (DOUT1/2/3)[X1.12/25/13]. The digital outputs (EXT1-DOUT0...7) or (EXT2-DOUT0...7) can be optionally configured by the motor controller CMMD with mounted input/output module CAMC-D-8E8A.

Signal	Description	Signal
Operating status		
Output stage active (configurable)	The signal is high as long as the following conditions are met: – The output stage enable signal (DIN4) is high – The controller enable (DIN5) is high – No error message is present – The intermediate circuit is loaded – Master control is issued	high active
Controller ready for operation (DOUT0) [X1.24]/[X1.1.24/X1.2.24]	The signal is high as long as all of the following conditions are met: – The output stage enable signal (DIN4) is high – The controller enable (DIN5) is high – The stop signal (DIN13) is high Exception (DIN13): When using the “Analogue input” control interface, the analogue input #AIN0 is active – No error message is present – The intermediate circuit is loaded – Master control is issued	high active
Quality		
Enable power granted (configurable)	The signal returns the status of the digital input signal “Output stage enable (DIN4)”. This signal does not contain the status of the output stage (see digital output signal “Output stage active”)	high active
Start		
Acknowledge start (configurable)	The signal becomes low with the start of a positioning record. – During individual record operation the signal remains low until the digital input signal “Start positioning” is withdrawn again. – During record linking operation the signal is automatically withdrawn (approx. 16 ms) after setting the digital input signal “Start record sequence”.	low active

Signal	Description	Signal
Speed		
Target velocity reached (configurable)	The signal is high as long as the actual speed is within the parametrised message window (message “Speed reached”) of the parametrised speed (positioning mode) ➔ page 61.	high active
Declared velocity achieved (configurable)	The signal is high as long as the actual speed is within the parametrised message window and the parametrised declared speed (message “Speed reached”) ➔ page 62.	high active
Standstill reached (configurable)	The signal is high as long as the actual position is within the parametrised message window (message “Speed reached”) of the standstill status (0 mm/s) ➔ page 63.	high active
Item		
Motion Complete “MC” (configurable)	The signal becomes high if the actual position is within the parametrised message window and the parametrised damping time (message “Target reached”) has expired ➔ page 59.	high active
Target position reached (configurable)	The signal is high as long as the actual position is within the parametrised message window (message “Target reached”) related to the current setpoint position of the positioning curve controller-internal positioning controller ➔ page 59.	high active
Remaining distance message (configurable)	The signal is high as long as the actual position is within the parametrised message window (message “Remaining distance”) ➔ page 64.	high active
Homing		
Homing mode complete (configurable)	CMMS-AS/CMMD-AS: – Single-turn absolute encoder (servo motor EMMS-AS-...-TS...): The signal becomes high as soon as homing has been completed without error. – Multi-turn absolute encoder (servo motor EMMS-AS-...-TM...): The signal is high. If homing is aborted due to an error, the signal becomes low. CMMS-ST – The signal becomes high as soon as homing has been completed without error.	high active

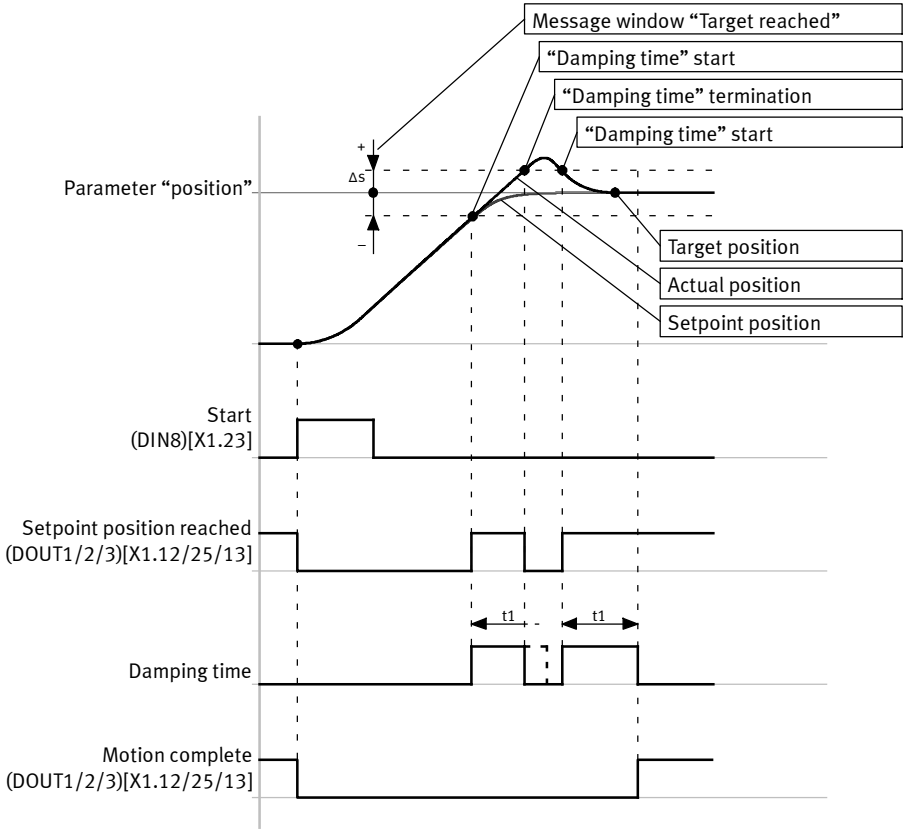
Signal	Description	Signal
Teaching		
Teach Acknowledge (DOUT2) [X1.25]/[X1.1.25/X1.2.25]	The signal is low as long as the teach signal is high. The signal becomes high after the parametrised debounce time (for jog operation parameters) expires ➔ page 180.	low active
Synchronisation		
Position synchronous (DOUT2) [X1.25]/[X1.1.25/X1.2.25]	The signal is high as long as the actual position is within the parametrised message window (message “Following error”) of the “Synchronisation” setpoint value specification ➔ page 60.	high active
Safety function		
Safety halt active (configurable)	The signal is high as long as the output stage enable signal (DIN4)[X1.21] and the “Driver supply, impulse block” (REL)[X3.2] = 0 V DC.	high active
Error/warning		
Error (configurable)	The signal becomes low if at least one error message is active.	low active
Warning (configurable)	The signal becomes high if at least one warning message is active.	high active
Following error (configurable)	The signal becomes high as soon as the actual position is outside the parametrised message window and the parametrised response delay has expired (message: Following error) ➔ page 60.	high active
I^2t Motor/output stage (configurable)	The signal becomes high as soon as the motor or output stage workload has exceeded the critical range ➔ page 210.	high active
Permanent signal		
Off (configurable)	The signal is permanently low (0 V).	low
On (configurable)	The signal is permanently high (24 V).	high

Tab. 3.4 Overview: Digital output signals

3.2.6 Message “Target reached”

The course of the digital output signals “Target position reached” and “Motion Complete (MC)” is determined via the message “Target reached”.

Timing diagram: Message “Target reached”



Δs = +/– ... mm (linear axis)
= +/– ... R (rotative axis)
(FCT: Dependent on the parameter “Message window” in the message “Target reached”)

t1 = ... ms (FCT: Dependent on the parameter “Damping time” in the message “Target reached”)

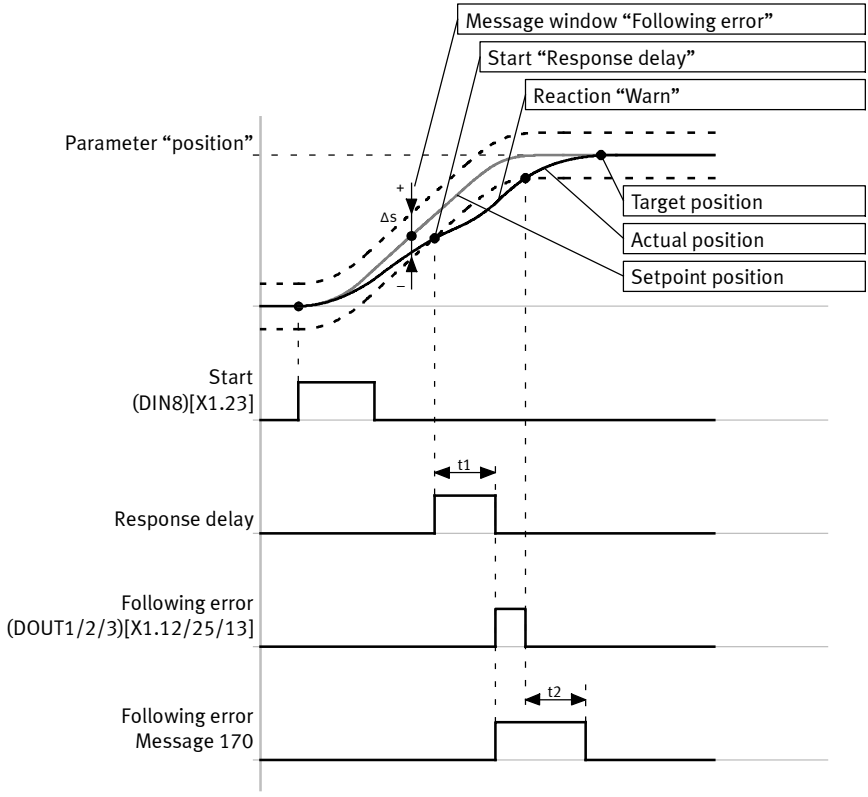
Fig. 3.5 Timing diagram: Message “Target reached”

3.2.7 Message “Following error”

The course of the digital output signals “Following error” and “Position synchronous” is determined via the message “Following error”.

Timing diagram: Message “Following error”

Example: Message “Following error” with the reaction “Warn”. For additional information regarding the reactions ➔ page 208.



Δs = +/– ... mm (linear axis)
= +/– ... R (rotative axis)
(FCT: Dependent on the parameter “Message window” in the message “Following error”)

t1 = ... ms (FCT: Dependent on the parameter “Response delay” in the message “Following error”)

t2 ≈ 5 s (time after which the warning message is automatically removed)

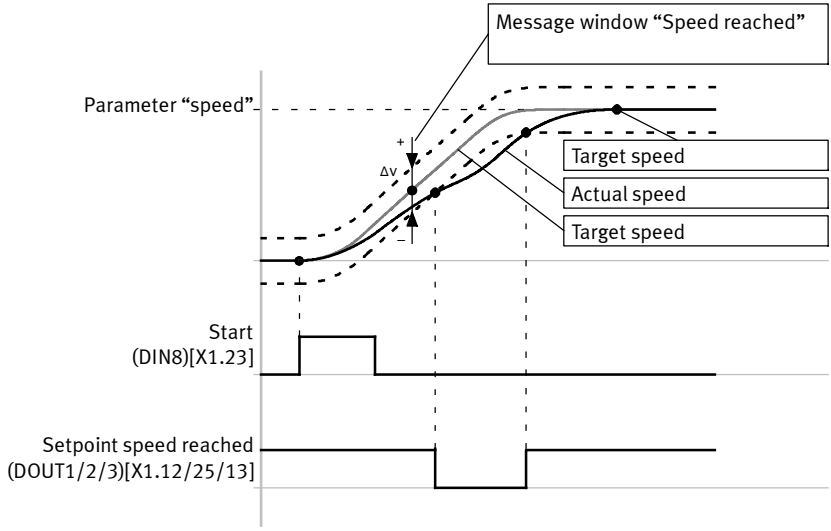
Fig. 3.6 Timing diagram: Message “Following error”

3.2.8 Message “Speed reached”

The course of the digital output signals “Setpoint speed”, “Declared speed achieved” and “Standstill reached” is determined via the message “Speed reached”.

Timing diagram: Digital output signal “Setpoint speed reached”

The timing diagram shows the dependency of the digital output signal “Setpoint speed” on the message window “Speed reached”.

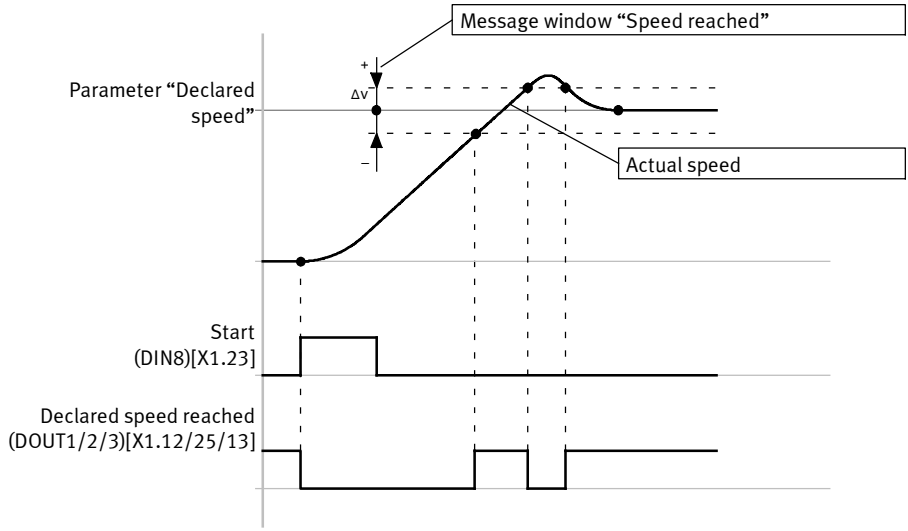


Δv = +/– ... mm/s (linear axis)
= +/– ... rpm (rotative axis)
(FCT: Dependent on the parameter “Message window” in the message “Speed reached”)

Fig. 3.7 Timing diagram: Digital output signal “Setpoint speed reached”

Timing diagram: Digital output signal “Declared speed achieved”

The timing diagram shows the dependency of the digital output signal “Declared speed achieved” on the message window “Speed reached”.

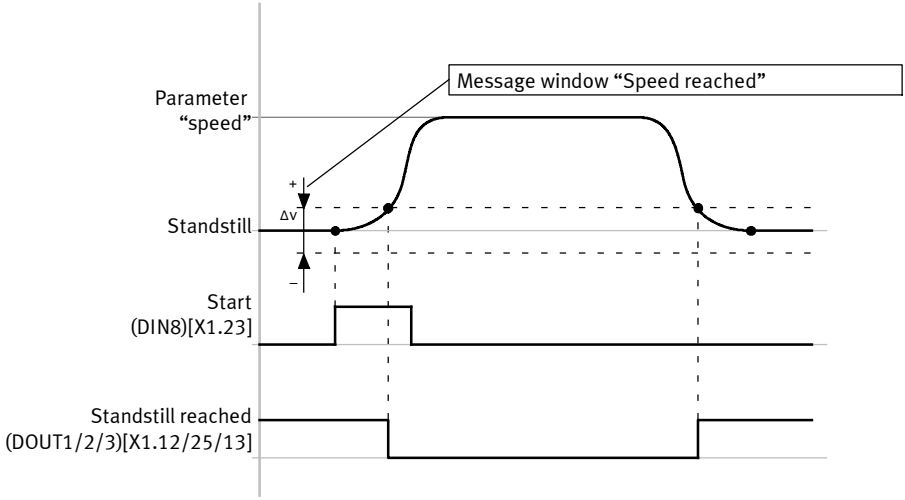


Δv = +/– ... mm/s (linear axis) or
= +/– ... rpm (rotative axis)
(FCT: Dependent on the parameter “Message window” in the message “Speed reached”)

Fig. 3.8 Timing diagram: Digital output signal “Declared speed achieved”

Timing diagram: Digital output signal “Standstill reached”

The timing diagram shows the dependency of the digital output signal “Standstill reached” on the message window “Speed reached”.



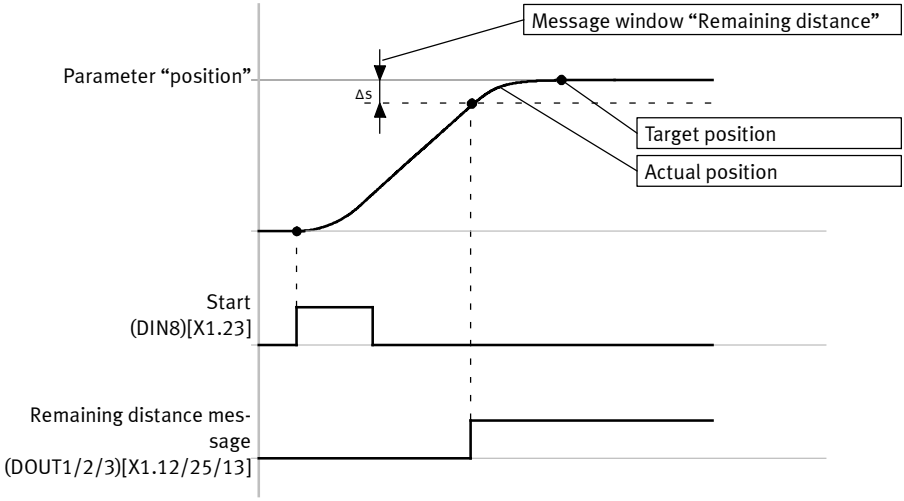
Δv = +/– ... mm/s (linear axis) or
= +/– ... rpm (rotative axis)
(FCT: Dependent on the parameter “Message window” in the message “Speed reached”)

Fig. 3.9 Timing diagram: Digital output signal “Standstill reached”

3.2.9 Message “Remaining distance”

The course of the digital output signal “Remaining distance message” is determined via the message “Remaining distance”.

Timing diagram: Message “Remaining distance”



Δs = +/– ... mm (linear axis) or
= +/– ... R (rotative axis)
(FCT: Dependent on the parameter “Message window” in the message “Remaining distance“)

Fig. 3.10 Timing diagram: Message “Remaining distance”

3.3 Analogue interface [X1] [X1.1/X1.2]

3.3.1 Analogue input/output (AIN0/AMON0)

Motor controller CMMS:

The motor controller has a differential analogue input (AIN0/#AIN0) and an analogue output (AMON0) at connection [X1].

Motor controller CMMD:

The motor controller has a differential analogue input (AIN0/#AIN0) and an analogue output (AMON0) at each of the connections [X1.1/X1.2].

Overview: Analogue input/output

Designation	Description
AIn0 (DIN12)[1)] [X1.2]/[X1.1.2/X1.2.2]	Analogue input, differential
#AIN0 (DIN13)[1)] [X1.15]/[X1.1.15/X1.2.15]	
+VREF [X1.4]/[X1.1.4/X1.2.4]	Reference voltage, 10 V DC
AGND [X1.14]/[X1.1.14/X1.2.14]	Analogue load, reference potential for – Reference voltage +VREF – Analogue monitor – Analogue input
SGND [X1.1]/[X1.1.1/X1.2.1]	“Analogue signal” screening
AMONO [X1.17]/[X1.1.17/X1.2.17]	Analogue monitor (output)

1) The analogue inputs (AIN0/#AIN0) are used in the positioning mode or during synchronisation (master operation) as digital inputs (DIN12, mode bit 1) and (DIN13, stop signal).

Tab. 3.5 Overview: Analogue input/output

3.3.2 Analogue input signal (analogue setpoint value specification)

Function	Description
Positive analogue signal (AIN0) [X1.2]/[X1.1.2/X1.1.2]	Differential analogue signals (± 10 V, 12 bit resolution) for controlling the motor controller in the operating modes: – Speed mode (speed setpoint value) – Force/torque mode (torque setpoint value)
Negative analogue signal (#AIN0) [X1.15]/[X1.1.15/X1.2.15]	

Tab. 3.6 Function overview: Analogue input signals (setpoint value signal)

3.3.3 Analogue output signal (analogue monitor)

Function	Description
Analogue monitor signal (AMON0) [X1.17]/[X1.1.17/X1.2.17]	Configurable monitor signal 0...10 V (Reference potential: Analogue load “AGND”) ➔ page 203.

Tab. 3.7 Function overview: Analogue output signal (analogue monitor)

3.4 Synchronisation interfaces [X1/X10] [X1.1/X1.2/X10.1/X10.2]

3.4.1 Encoder input for synchronisation (slave interface)

Motor controller CMMS:

The motor controller has different encoder inputs at the connections [X1/X10]. The encoder signals are used for the “synchronisation” mode of the motor controller.

Motor controller CMMD:

The motor controller has different encoder inputs at the connections [X1.1/X1.2/X10.1/X10.2]. The encoder signals are used for the “synchronisation” mode of the motor controller.

The following encoder signals are available:

Encoder input signals [5 V, TTL]		**Encoder input [X10] [X10.1/X10.2]**	
		CMMS	CMMD
Incremental signals	A/#A[1)] B/#B[1)] N/#N[1)]	[X10.1/6][2)] [X10.2/7][2)] [X10.3/8][2)]	[X10.1.1/6][2)]/[X10.2.1/6][2)] [X10.1.2/7][2)]/[X10.2.2/7][2)] [X10.1.3/8][2)]/[X10.2.3/8][2)]
Pulse/direction signals	CLK/#CLK[1)] DIR/#DIR[1)]	[X10.1/6] [X10.2/7]	[X10.1.1/6]/[X10.2.1/6] [X10.1.2/7]/[X10.2.2/7]
Forward/reverse signals	CW/#CW[1)] CCW/#CCW[1)]		

1) Differential signals in accordance with RS422

2) The encoder input is used as an encoder output during encoder emulation (master operation).

Tab. 3.8 Overview: Encoder input signals at the encoder input

The following encoder signals are optionally available at connection [X1] [X1.1/X1.2]:

Encoder input signals [24 V, HTL]		**Digital input [X1] [X1.1/X1.2]**	
		CMMS	CMMD
Pulse/direction signals	CLK DIR	[X1.20] [X1.8]	[X1.1.20]/[X1.2.20] [X1.1.8]/[X1.2.8]
Forward/reverse signals	CW CCW		

Tab. 3.9 Overview: Encoder input signals at the digital input

Max. cycle rate

The encoder signals can be operated with the following cycle rates:

Digital input [X1]: Max. 20 kHz

Encoder input [X10]: Max. 150 kHz

3.4.2 Encoder output for encoder emulation (master interface)

Motor controller CMMS:

The motor controller has an encoder output at connection [X10]. Incremental signals (A/#A/B/#B/N/#N) are generated by the encoder emulation (operational function) and made available via the encoder output.

Motor controller CMMD:

The motor controller has an encoder output at each of the connections [X10.1/X10.2]. Incremental signals (A/#A/B/#B/N/#N) are generated by the encoder emulation (operational function) and made available via the encoder outputs.

Encoder output signals [5 V, TTL]		**Encoder output [X10] [X10.1/X10.2]**	
		CMMS	CMMD
Incremental signals	(A/#A)[1)]	[X10.1/6][2)]	[X10.1.1/6][2)]/[X10.2.1/6][2)]
	(B/#B)[1)]	[X10.2/7][2)]	[X10.1.2/7][2)]/[X10.2.2/7][2)]
	(N/#N)[1)]	[X10.3/8][2)]	[X10.1.3/8][2)]/[X10.2.3/8][2)]

1) Differential signals in accordance with RS422

2) The encoder output is used as an encoder input during synchronisation (slave operation).

Tab. 3.10 Overview: Encoder output signals and control interface

3.4.3 Incremental signals (A/#A/B/#B/N/#N)

Signal	Description
A/B (positive) #A/#B (negative)	Incremental signals for controlling the rotational speed/direction. – The signals “A/#A” and “B/#B” are out of phase. In the basic setting, without reversing the direction of rotation, the A signals are 90° ahead of the B signals if the direction of rotation is positive. If the direction of rotation is negative, the B signals are 90° ahead of the A signals. Through the phase shift and edge sequence (rising/falling) of the signals “A/#A/B/#B”, the motor controller can determine the rotational speed/direction.
N (positive) #N (negative)	Zero pulse signals for identification of a revolution. – The signals “N/#N” serve as a reference mark for a revolution. In the “Synchronisation” operating mode, these signals are used for counting the revolutions. With each zero-pulse passage, counting of the signals “A/#A/B/#B” is restarted.

Tab. 3.11 Overview: Incremental signal (A/#A/B/#B/N/#N)

Timing diagram: Incremental signal for direction of rotation to the right (basic setting)

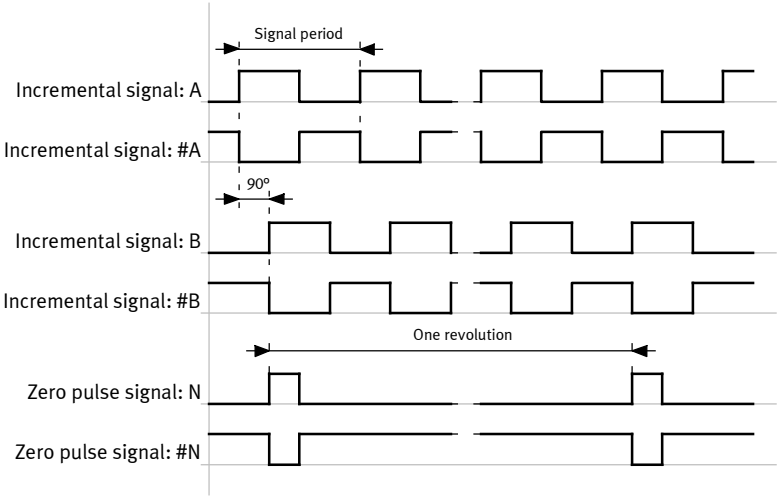


Fig. 3.11 Timing diagram: Incremental signal for direction of rotation to the right (basic setting)

3.4.4 Pulse/direction signals (CLK/#CLK/DIR/#DIR)

Through these signals, the motor controller can be controlled by a stepper motor control card.

Signal	Description
CLK/#CLK	Pulse signals for control of the rotations/speed.
DIR/#DIR	Direction signals for control of the direction of rotation. – DIR = high: Positive direction of rotation – DIR = low: Negative direction of rotation

Tab. 3.12 Pulse/direction signals (CLK/#CLK/DIR/#DIR)

Timing diagram: Pulse/direction signals

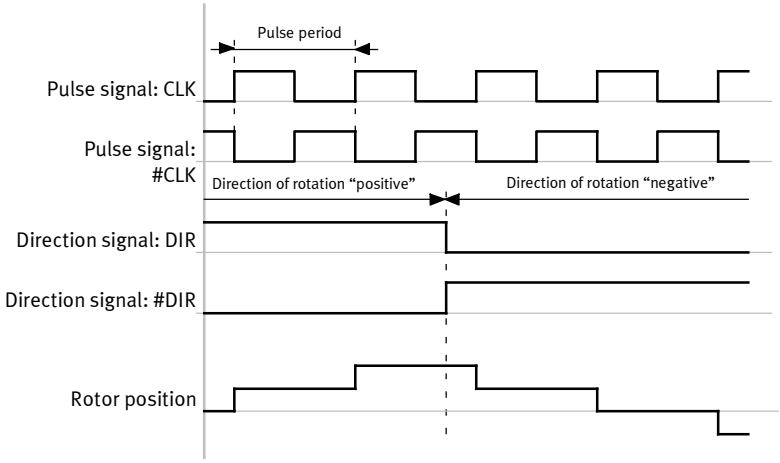


Fig. 3.12 Timing diagram: Pulse/direction signals

3.4.5 Forward/reverse signals (CW/#CW/CCW/#CCW)

Signal	Description
CW/#CW	Forward signals for control in a positive direction of rotation.
CCW/#CCW	Reverse signals for control in a negative direction of rotation.

Tab. 3.13 Overview: Forward/reverse signals (CW/#CW/CCW/#CCW)

Timing diagram: Forward/reverse signals

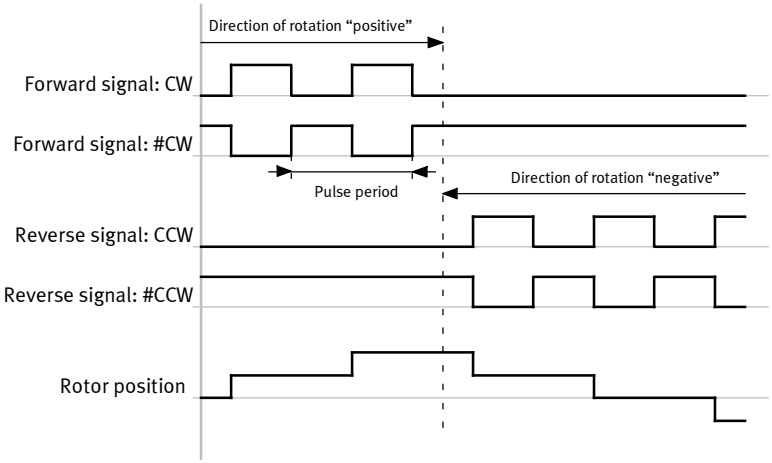


Fig. 3.13 Timing diagram: Forward/reverse signals

Only one signal pair may be active for activation of the motor controller.
- Forward signals CW/#CW
- Reverse signals CCW/#CCW

3.5 Fieldbus interfaces [X4] [X5] [EXT/EXT1]

3.5.1 Supported fieldbuses

The motor controller CMMS-AS/CMMS-ST/CMMD-AS can be controlled through various fieldbuses. As standard, the fieldbuses “CANopen” or “DriveBus” can be controlled via the integrated CAN bus connection [X4] or the fieldbus “RS485” via the integrated RS232/RS485 connection [X5]. Optionally, the fieldbuses “PROFIBUS DP” or “DeviceNet” can be controlled via the corresponding interface module at the connection [EXT] (CMMS)/[EXT1] (CMMD).
Only one fieldbus may be used for activation of the motor controller.
The Festo Profile for Handling and Positioning (FHPP) and the CANopen device profile CiA 402 have been implemented as the device profile (communication protocol) in the motor controller.
For every fieldbus, a factor group can be used so that application data can be transferred in user-specific units.

Overview: Fieldbus and device profile

The fieldbus documentation is included in the following media:
– CD-ROM of the motor controller CMMS-AS/CMMS-ST/CMMD-AS (scope of delivery)
– Support Portal ➔ www.festo.com/sp.

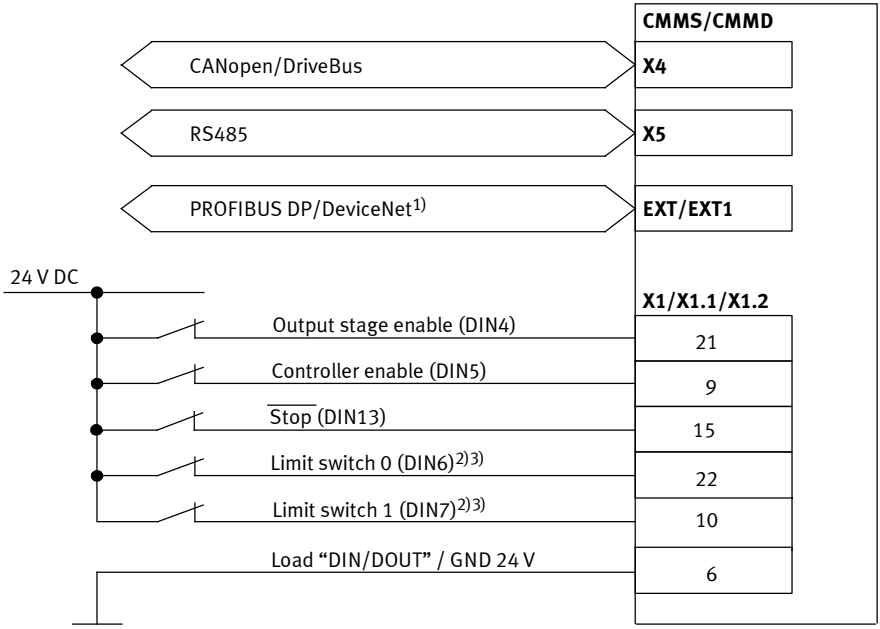
Fieldbus	Connection	Interface module	Device profile	Documentation
CANopen	[X4]	—	FHPP[1)] CiA 402[2)]	GDCP-CMMS/D-C-HP-... GDCP-CMMS/D-C-CO-...
DriveBus	[X4]	—	CiA 402[2)]	GDCP-CMMS/D-C-CO-...
PROFIBUS DP	[Ext] (CMMS) [Ext1] (CMMD)	CAMC-PB	FHPP[1)]	GDCP-CMMS/D-C-HP-...
DeviceNet	[Ext] (CMMS) [Ext1] (CMMD)	CAMC-DN	FHPP[1)]	GDCP-CMMS/D-C-HP-...
RS485	[X5]	—	CI[3)]	➔ page 240

1) FHPP: Festo Handling and Positioning Profile ➔ page 74
2) CiA 402: Device profile CiA 402 ➔ page 74
3) CI: CAN Interpreter, device profile CiA 402

Tab. 3.14 Overview: Fieldbus and device profile

3.5.2 Required digital inputs/outputs with a fieldbus activation

The connection diagram shows the required digital inputs for drive enable and movement via the fieldbus.



1) Interface module CAMC-... (optional)
2) The limit switches are set by default to N/C contact (configuration over FCT)
3) Only required for applications with limited positioning range or homing methods with limit switch.

Fig. 3.14 Connection: Required digital inputs/outputs with fieldbus control

3.6 Device profiles for fieldbuses

3.6.1 Device profile: Festo handling and positioning profile (FHPP)

Independent of the fieldbus used, a uniform control concept can be implemented through the device profile “FHPP”. The user does not have to know the specific functions of the respective fieldbuses or controllers, but can commission and control the drive in the shortest possible time through a uniform profile.
FHPP distinguishes between the triggering methods “record selection” and “direct operation”.
With record selection, the positioning records parametrised in the motor controller are used.
In the direct mode, the following operating modes can be used:
– Positioning mode (position control)
– Speed mode (speed adjustment)
– Force/torque mode (current control)

The operating modes can be switched over in direct operation as needed.
For additional information ➔ “Device profile FHPP” description, GDCP-CMMS/D-C-HP-...

3.6.2 Device profile: CANopen, CiA 402 (for electric drives)

Through the device profile “CiA 402”, the following operating modes can be used:
– Positioning mode (CiA 402: Profile position mode)
– Homing mode (CiA 402: Homing mode)
– Interpolating position mode (CiA 402: Interpolated position mode)
– Speed mode (CiA 402: Profile velocity mode)
– Force/torque mode (CiA 402: Profile torque mode)

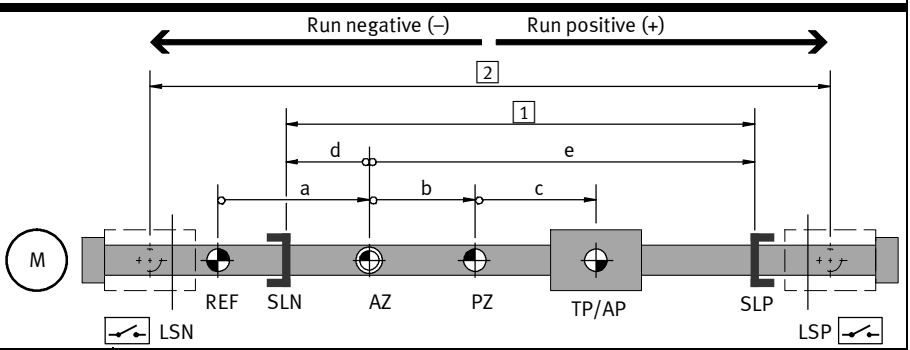
Communication can take place either over SDOs (service data objects) and/or PDOs (process data objects). Up to 2 PDOs are available for each sending direction (transmit/receive).
For additional information ➔ “Device profile CiA 402” description, GDCP-CMMS/D-C-CO-...

4 Measuring system

4.1 Measuring system for electrical drives

4.1.1 Measuring system for linear drives

Example: Homing method “limit switch”, negative direction



REF	Homing point (reference point)[1)]
AZ	Axis zero point[1)]
PZ	Project zero point
SLN	Negative software end position (SW limit negative)
SLP	Positive software end position (SW limit positive)
LSN	Limit switch (hardware) negative (Limit switch negative)[1)]
LSP	Limit switch (hardware) positive (Limit switch positive)[1)]
SP	Target position
AP	Actual position1)
a	Offset “axis zero point (AZ)”
b	Offset “project zero point (PZ)”
c	Offset “target/actual position (TP/AP)”
d	Offset “Software end position negative (SLN)”
e	Offset “Software end position positive (SLP)”
1	Effective stroke
2	Working stroke (no hardware limit switches)

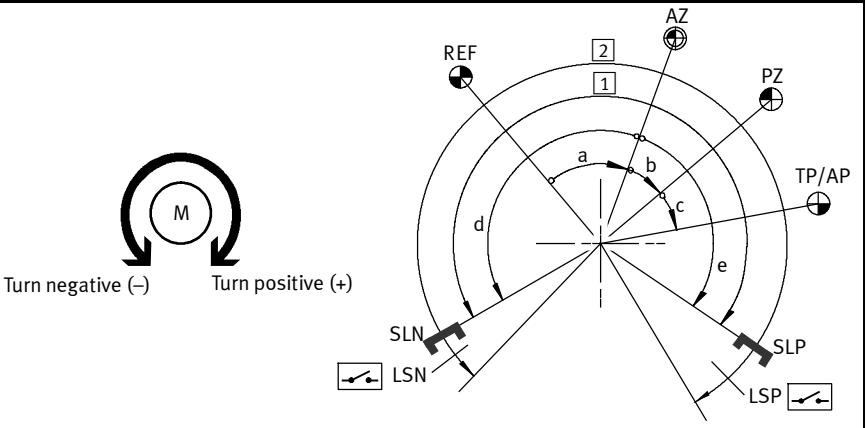
1) Additional information ➔ page 161.

Tab. 4.1 Measuring system for linear drives

Additional information ➔ CD-ROM: Documentation “CMMS-AS_de.pdf/CMMS-ST_de.pdf/CMMD-AS_de.pdf” or the Festo Configuration Tool (FCT): Dynamic/static plug-in help.

4.1.2 Measuring system for rotative drives

Example: Homing method “current position”



REF	Homing point (reference point)[1]
AZ	Axis zero point[1]
PZ	Project zero point
SLN	Negative software end position (SW limit negative)
SLP	Positive software end position (SW limit positive)
LSN	Limit switch (hardware) negative (Limit switch negative)[1]
LSP	Limit switch (hardware) positive (Limit switch positive)[1]
SP	Target position
AP	Actual position[1]
a	Offset “axis zero point (AZ)”
b	Offset “project zero point (PZ)”
c	Offset “target/actual position (TP/AP)”
d	Optional: Offset “Software end position negative (SLN)”[2]
e	Optional: Offset “Software end position positive (SLP)”[2]
1	Effective positioning range
2	Working positioning range (no hardware limit switches)

1) Additional information ➔ page 161.

2) In the “Endless positioning” operational function, no limit switch can be parameterised.

Tab. 4.2 Measuring system for rotative drives

Additional information ➔ CD-ROM: Documentation “CMMS-AS_de.pdf/CMMS-ST_de.pdf/CMMD-AS_de.pdf” or the Festo Configuration Tool (FCT): Dynamic/static plug-in help.

4.2 Calculation rules for the measuring system

Point of reference	Calculation rule			
Axis zero point	AZ	= REF + a		
Project zero point	PZ	= AZ + b	= REF + a + b	
Negative software end position	SLN	= AZ + d	= REF + a + d	
Positive software end position	SLP	= AZ + e	= REF + a + e	
Target position/actual position	TP/AP	= PZ + c	= AZ + b + c	= REF + a + b + c

Tab. 4.3 Calculation rules for the measuring system

4.3 Limit switch (hardware) and software end position

4.3.1 Limit switch LSN/LSP (hardware)

If the axis (linear/rotative) is restricted, the negative limit switch (LSN) and the positive limit switch (LSP) is supported. These limit the absolute effective stroke/effective positioning range of the drive. The switching function “NC contact” or “N/O contact” can be parameterised dependent on the limit switch type.

One limit switch active:

If one of the limit switch positions is reached, the drive is braked with the reaction parametrised in the FCT error management “PS off/Qstop/Warn” of message “430/431” ➔ page 208.

After that, the positioning direction of the respective active limit switch is blocked. That is, the drive can only be run in the positioning direction of the inactive limit switch.

Both limit switches active:

If both limit switches are active simultaneously, the drive is braked with the reaction parametrised in the FCT error management “PS off/Qstop/Warn” of message “439” (the message “439” is configured via message “430”) ➔ page 208.

4.3.2 Software end position SLN/SLP

If the axis is restricted, the negative software end position (SLN) and the positive software end position (SLP) for limitation of the working stroke/working positioning range can also be parameterised relative to the axis zero point between the limit switches (hardware). As with the LSN/LSP limit switches (hardware), here, too, the positioning range is blocked when the software end position is blocked. In addition, before the software end position is reached, braking with the stop deceleration “limit switch” is started so that the position of the software end position is not overtravelled.

Before starting, a check is made whether the target positions of the positioning records lie between the software end positions SLN/SLP. If a target position lies outside this range, the positioning record is not executed and the reaction parameterised in the FCT error management of messages “400...403” is carried out.

5 Commissioning

5.1 Configuration/parameterisation of the drive system and motor controller

5.1.1 Festo Configuration Tool (FCT)

The Festo Configuration Tool (FCT) is the Windows-based software platform for configuration, parameterisation and commissioning of different components and devices from Festo.

– Management of data/files via the RS232 data interface (online) or memory card
  - Device data: FCT parameterisation
  - Firmware file: Firmware data
  - Parameter file: DCO file on memory card
– Manual operation (e.g. jog, etc.)
– Diagnostics
– Recording of measurement data
– Automatic calculation of the controller data for the selected motor-gear unit-axis combination
– Manual precision adjustment of the controller data

The FCT consists of the following components:

– a framework with uniform project and data management for all supported types of equipment
– one plug-in for every type of equipment (e. g. CMMS-AS/CMMS-ST/CMMD-AS)

The plug-ins are managed and started from the framework. They support the execution of all necessary steps for configuration/parameterisation of the drive system and commissioning of the motor controller. Parameterisation of the motor controller is executed offline (without RS232 connection) on a PC. This enables preparation for the actual commissioning, for example in the planning office when a system is being planned.

5.1.2 Installing the FCT framework/plug-in

The FCT is installed on your PC with an installation programme:

1. Close all other programmes before starting installation.
2. Insert the “Festo Configuration Tool” CD in your CD-ROM drive.
   - If Auto-Run is enabled: The installation process starts automatically.
   - If Auto-Run is disabled: Manually launch the Setup.exe file on the CD-ROM.

Note
The operating system “Windows 2000/2003/XP/7/8” and Windows administrator rights are required for installing the FCT framework.

3. Follow the instructions of the FCT wizard.

Note
The current FCT plug-in “CMMS-AS/CMMS-ST/CMMD-AS”, version 2.0.x, supports all previous firmware versions (up to 1.4.0.x.8).
For newer versions of the motor controller, check whether there is an updated FCT plug-in “CMMS-AS/CMMS-ST/CMMD-AS” available. If necessary, consult Festo.

5.1.3 Configuring/parameterising the Festo Configuration Tool (FCT)

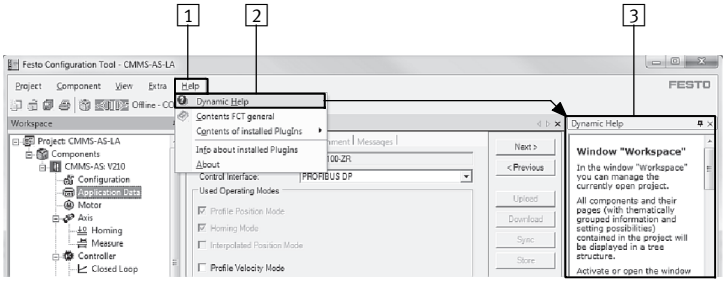
1. Start the FCT:
   – Double click on the FCT icon on the desktop
   – Select the following Windows path:
   [Start] [Open Program Path] [Festo Software] [Festo Configuration Tool].
2. Create a new project or open an existing project.
   – [Menu bar] [Project] [New].
   – Double click the existing project in the workspace.
   ➔ Help for the FCT framework: [Menu bar] [Help] [Contents FCT general].
3. Add a new component to the project as follows:
   Menu bar [Component] [Add] [CMMS-AS/CMMS-ST/CMMD-AS].
   ➔ Help for the FCT framework: [Menu bar] [Help] [Contents FCT general].
4. Configure and parameterise the components of the drive system (motor controller, motor, gear unit, axis, etc.) and the operating parameters (control interface, operating mode, error management, etc.). Complete all further steps in accordance with the plug-in help instructions, chapter “Working with the plug-in”:
   – Menu bar [Help] [Contents of installed plug-ins] [Festo (manufacturer name)] [CMMS-AS/CMMS-ST/CMMD-AS (plug-in name or component name)].
   – CD-ROM: Documentation “CMMS-AS_de.pdf/CMMS-ST_de.pdf/CMMD-AS_de.pdf”.
   – Dynamic/static help for the FCT plug-in ➔ page 80.

5.1.4 FCT Help

The following Help functions are available in the FCT:

Dynamic Help:

- Activate dynamic Help in the FCT user interface: [Menu bar] [Help] [Dynamic help]. When you click on a field, Help is always displayed dynamically.



1 Menu bar: Help
2 Button. Dynamic Help
3 Window: Dynamic Help

Fig. 5.1 Overview: Dynamic Help in the Festo Configuration Tool (FCT)

Static Help:

– Click in the FCT user interface in a parameter/configuration field. When the F1 key is pressed, the Static Help is displayed for the parameter/configuration field.
– Activate static Help in the FCT user interface:
[Menu bar] [Help] [Contents of installed plug-ins] [Festo] [CMMS-AS/CMMS-ST/CMMD-AS].
Clicking the button “CMMS-AS/CMMS-ST/CMMD-AS” displays the static Help.

Offline Help (PDF document):

– Print individual pages or all of the pages in a book directly from the Help contents by using the “Print” button in the Help window.
– Print a prepared version of the help in Adobe PDF format:

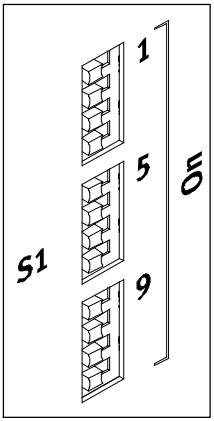
Printed version	Directory	File
FCT help (framework)	...(FCT installation directory)\Help\	– FCT_de.pdf
Plug-in Help CMMS-AS	...(FCT installation directory)\HardwareFamilies\ Festo\CMMS-AS\V...\Help\	– CMMS-AS_de.pdf
Plug-in Help CMMS-ST	...(FCT installation directory)\HardwareFamilies\ Festo\CMMS-ST\V...\Help\	– CMMS-ST_de.pdf
Plug-in Help CMMD-AS	...(FCT installation directory)\HardwareFamilies\ Festo\CMMD-AS\V...\Help\	– CMMD-AS_de.pdf

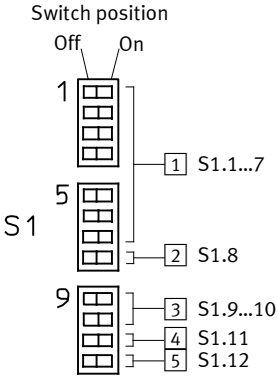
Tab. 5.1 Overview: Offline Help

5.1.5 Configuring fieldbus/firmware functions via DIL switch

The following fieldbus/firmware functions can be configured via the DIL switches.

Overview: DIL switches [S1.1…12]





1 Fieldbus address/MAC-ID configuration
2 Firmware download activation from the memory card
3 Data rate configuration (CAN bus/DeviceNet)
4 CAN bus activation
5 Terminating resistor activation (CAN bus)

Fig. 5.2 Overview: DIL switches [S1.1…12]

5.1.6 Fieldbus address/MAC-ID configuration

The address/ID configuration is evaluated for each power ON procedure or controller reboot (FCT). The address/MAC-ID can be configured via the DIL switches [S1.1...7].

Fieldbus	**DIL switch**						
	[S1.7] Bit 6 $2^6 = 64$	[S1.6] Bit 5 $2^5 = 32$	[S1.5] Bit 4 $2^4 = 16$	[S1.4] Bit 3 $2^3 = 8$	[S1.3] Bit 2 $2^2 = 4$	[S1.2] Bit 1 $2^1 = 2$	[S1.1] Bit 0 $2^0 = 1$
CANOpen							
CAN address: 1...127	X	X	X	X	X	X	X
DriveBus							
CAN address: 2...13	–	–	–	X	X	X	X
PROFIBUS DP							
Bus address: 3...126[1)]	X	X	X	X	X	X	X
DeviceNet							
MAC-ID: 0...63	–	X	X	X	X	X	X
RS485							
Address: 0...127	X	X	X	X	X	X	X
Example: 57 = (Switch position)	+ 0 (OFF)	+ 32 (ON)	+ 16 (ON)	+ 8 (ON)	+ 0 (OFF)	+ 0 (OFF)	+ 1 (ON)

1) The addresses "0...2" in Profibus DP are assigned to defined interfaces (e.g.: Higher-order controller, etc.).

Tab. 5.2 Fieldbus address/MAC-ID configuration

Note the instructions for address/MAC-ID parameterisation of fieldbuses
➔ Description "device profile FHPP", GDCP-CMMS/D-C-HP-...
➔ Description "device profile CiA 402", GDCP-CMMS/D-C-CO-...

5.1.7 Firmware download activation from the memory card

The process for downloading firmware from the memory card can be configured via DIL switch [S1.8] ➔ page 87.

Bootloader	DIL switch [S1.8]	
	ON	OFF
Download firmware file (.S) from the memory card after Power ON/FCT: Reboot controller	active	inactive

Tab. 5.3 Firmware download activation from the memory card

5.1.8 Data rate configuration (CAN bus/DeviceNet)

The data rate configuration is evaluated for each power ON procedure or controller reboot (FCT). The bit/transmission rate can be configured via the DIL switches [S1.9/S1.10].

Fieldbus	Bit/transmission rate	DIL switch	
		[S1.10]	[S1.9]
CANopen (CAN bus)/DeviceNet	125 KBit/s (125 kBaud)	OFF	OFF
	250 KBit/s (250 kBaud)	OFF	ON
	500 KBit/s (500 kBaud)	ON	OFF
CANopen (CAN bus)	1 MBit/s (1000 kBaud)	ON	ON

Tab. 5.4 Data rate configuration (CAN bus/DeviceNet)

5.1.9 CAN bus activation

Activation of the CAN bus can be configured via DIL switch [S1.11].

Fieldbus	Port	DIL switch [S1.11]	
		ON	OFF
CANOpen	CAN bus	active[1)]	inactive
DriveBus			

1) The CAN bus interface is disabled with installation of the interface module “CAMC-PB/PROFIBUS DP” or “CAMC-DN/DeviceNet”.

Tab. 5.5 CAN bus activation

5.1.10 Terminating resistor activation (CAN bus)

The CAN bus is terminated at the ends via the terminating resistor. Final termination is to be activated at the end participants of the CAN bus.

DIL switch [S1.12] can be used exclusively for activation of the “CAN BUS” terminating resistor.

Fieldbus	**Note**	**DIL switch** S1.12	
		ON	OFF
CANopen (CAN bus)	Integrated terminating resistor (120 Ω)	active	inactive
DriveBus (CAN bus)			

Tab. 5.6 Terminating resistor activation (CAN bus)

In the PROFIBUS DP, the terminating resistor is integrated into the “CAMC-PB” interface module.

The terminating resistor (120 Ω) can be connected externally to the end participant, if required, for DeviceNet and RS485.

5.2 Data interfaces (parameter/firmware)

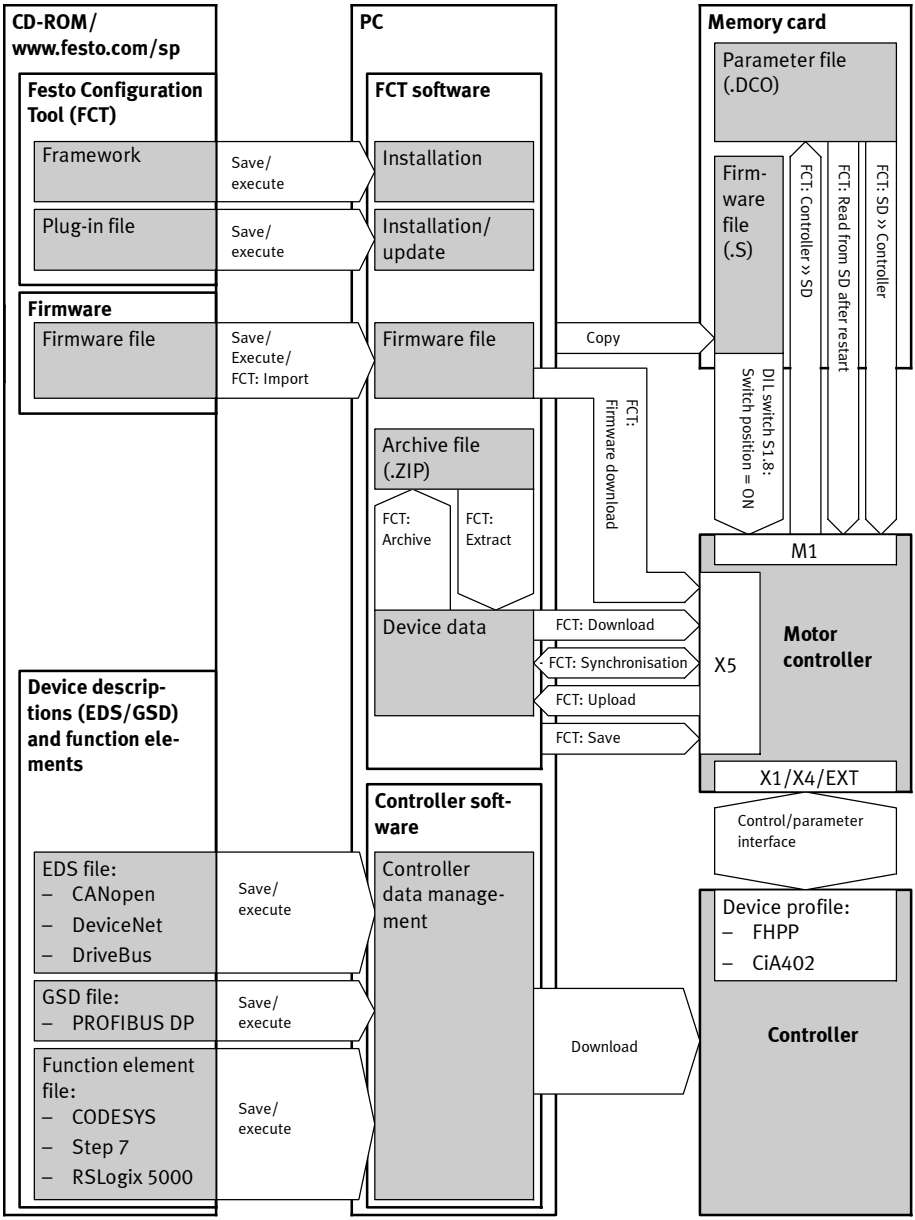


Fig. 5.3 Overview: Data interfaces (parameter/firmware)

5.2.1 Firmware file

The firmware for the motor controller is included in the firmware file. The firmware file can be updated online from a PC or via the memory card.

Note

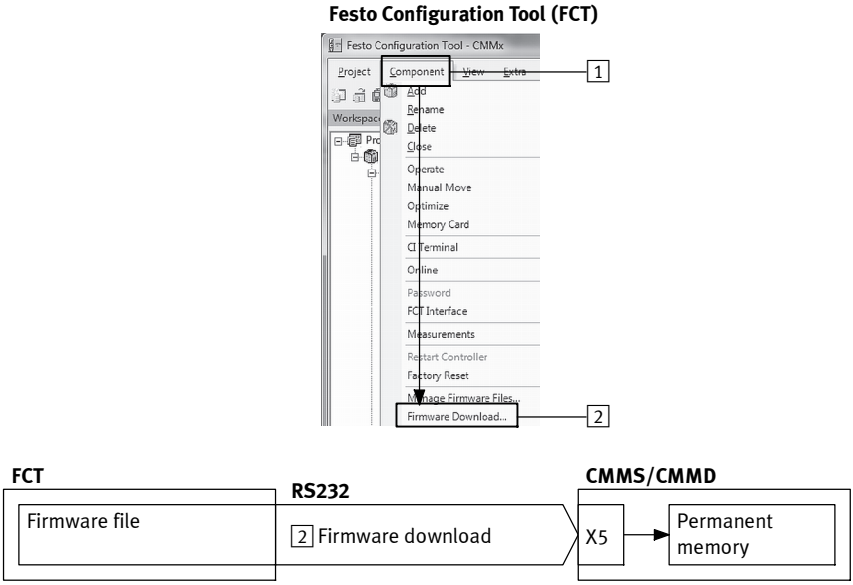
Loss of the parameter set in the motor controller

In the event of a firmware download, the parameter set of the motor controller is deleted (“factory setting” status).

– Before downloading the firmware, back up the device data to the Festo Configuration Tool (FCT) (Upload/Synchronisation) or save the current parameter set of the motor controller to the memory card (FCT: Controller ›› SD) as a parameter file (.DCO).
– After downloading the firmware load the device data from the Festo Configuration Tool (FCT) to the motor controller (Download) or load the parameter file (.DCO) from the memory card to the motor controller (FCT: SD ›› Controller).

5.2.2 Downloading the firmware file (FCT ›› motor controller)

The process for downloading the firmware file can be started via the following buttons.



1 “Component” menu bar 2 Firmware Download

Fig. 5.4 Overview: Downloading the firmware file (FCT ›› motor controller)

5.2.3 Downloading the firmware file (.S) (memory card ›› motor controller)

The process for downloading the firmware file (.S) from the memory card can be configured via DIL switch [S1.8]. If the DIL switch position = ON, the process for downloading the firmware is restarted with every Power ON procedure/controller reboot (FCT).

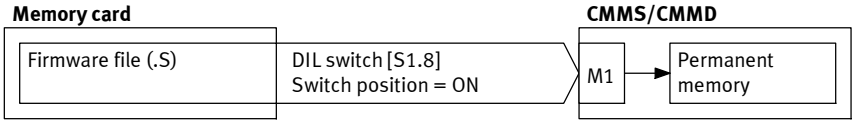


Fig. 5.5 Downloading the firmware file (.S) (memory card ›› motor controller)

To download the firmware from the memory card, proceed as follows:

1. Copy the firmware file (.S) from the PC to the memory card.

Note:
- Only one firmware file should be stored on the memory card.
- No subdirectories should be created on the memory card.

File names			Example
Letters	Format	Extension	
large/small	32.1	.S	CMMS-AS: FW_CMMS-AS_V1p4p0p2p6.S CMMS-ST: FW_CMMS-ST_V1p4p0p1p6.S CMMD-AS: FW_CMMD-AS_V1p4p0p3p6.S

Tab. 5.7 Requirement for firmware file names

2. Insert the memory card into the card slot [M1].
3. Set the DIL switch [S1.8] to the “ON” position.
4. Switch the “control section” power supply off and on.
5. During the boot procedure the motor controller performs a check (illuminated decimal point “.” on the seven-segment display) to verify whether a memory card is inserted in the card slot [M1] and whether the card contains a valid firmware version.

Possible causes of an error:
- Memory card is damaged
- Memory card is not inserted.
- Firmware file is damaged.
- The firmware version in the motor controller and on the memory card are identical.

If the errors listed above occur, the firmware is not downloaded and the firmware last saved in the permanent memory is loaded.

6. The process for downloading the firmware file is executed (flashing decimal point “.” on the seven-segment display) if a valid firmware file is present on the memory card and if this file is of a different version to the firmware currently in use.

If multiple firmware files are present on the memory card, the firmware file with the latest date is loaded into the motor controller!

When the process for downloading the firmware starts, the firmware in the permanent memory is initially deleted. If the download fails or if the power supply was interrupted during the download process, no firmware will have been transferred to the permanent memory. The firmware download process must be restarted again.

7. The newly loaded firmware starts automatically.
8. Set the DIL switch [S1.8] to the “OFF” position.

5.2.4 Device data (FCT)

The device data contains all of the data that has been parameterised, configured and saved via the Festo Configuration Tool (FCT).

5.2.5 Downloading/synchronising/uploading/saving device data (FCT ‹‹/‹=›/›› motor controller)

The device data can be transferred between the FCT and the motor controller as follows:

– Download (››): From FCT to the motor controller
– Upload (‹‹): From the motor controller to the FCT
– Synchronisation (‹=›): Between FCT and motor controller

Note

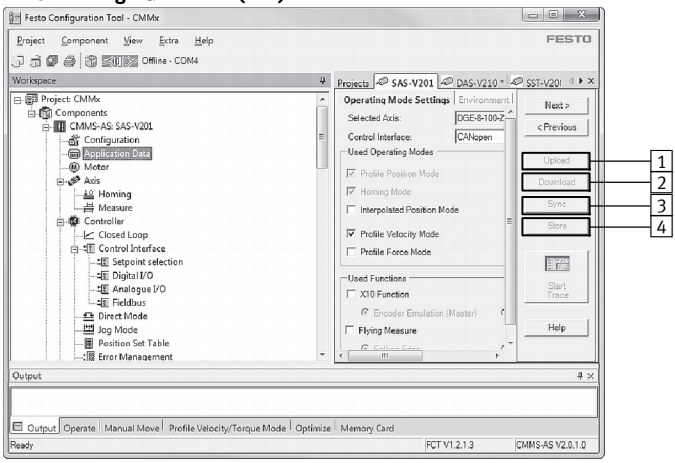
Loss of device data

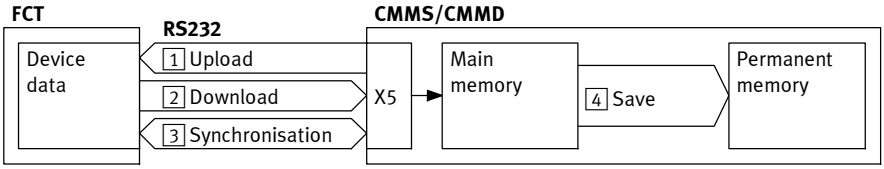
If the “control section” power supply is interrupted, any modifications made to the device data that have not been saved to the permanent memory will be lost.

– Save all modifications made to the device data in the permanent memory of the motor controller (FCT: Save).

The process for transferring device data can be started via the following buttons.

Festo Configuration Tool (FCT)





1 Upload
The current device data on the motor controller is loaded into the Festo Configuration Tool (FCT).

2 Download
The current device data on the Festo Configuration Tool (FCT) is loaded into the motor controller.

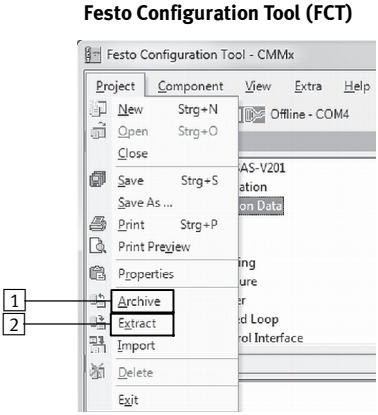
3 Syncronisation
The device data on the Festo Configuration Tool (FCT) and the motor controller is synchronised.

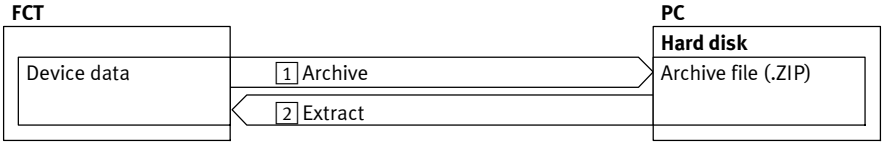
4 Store
The device data is saved from the main memory to the permanent memory of the motor controller.

Fig. 5.6 Overview: Downloading/synchronising/uploading/saving device data (FCT «/=/» motor controller)

5.2.6 Archiving/extracting device data (FCT ›»/«‹ PC)

The process for transferring device data can be controlled via the following buttons.





1 Archive:
The device data from the Festo Configuration Tool (FCT) is saved to the PC's hard disk as an archive file (.ZIP).

2 Extract:
The archive file (.ZIP) containing the device data is loaded from the PC's hard disk into the Festo Configuration Tool (FCT).

Fig. 5.7 Overview: Archiving/extracting device data (FCT ›»/«‹ PC)

5.2.7 Parameter file (.DCO)

The parameter file (.DCO) contains the complete parameter set for the motor controller.

The parameter file (.DCO) can be transferred between the memory card and motor controller as follows:

– SD»Controller/after restart ... (read): From the memory card to the motor controller
– Controller»SD (write): From the motor controller to the memory card

Requirement for parameter file names

File names				**Example**
Letters	Format	File name	Extension	
large	8.3	8-digit[1)]	.DCO	CMMS-AS: CMMSAS01.DCO
				CMMS-ST: CMMSST01.DCO
				CMMD-AS: CMMDAS01.DCO

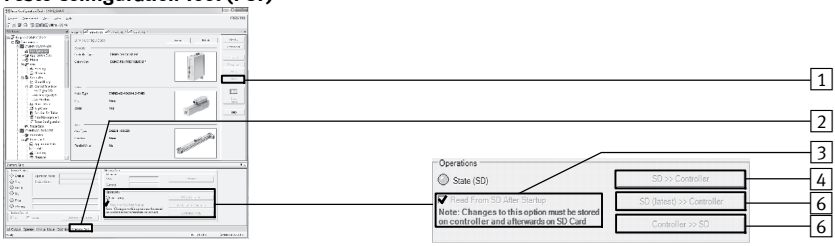
1) xxxxxxnn.DCO:
x = digits 1–6 are used for the file name. Any ASCII characters can be used here.
n = digits 7+8 are used for the consecutive number of the file. This increases automatically from “00”.

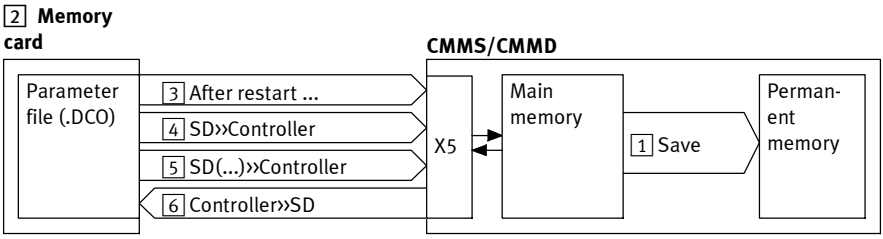
Tab. 5.8 Requirement for parameter file names

5.2.8 Reading/writing/saving the parameter file (.DCO) (memory card ››/‹‹ motor controller)

The process for transferring a parameter file (.DCO) can be started via the following buttons or check boxes.

Festo Configuration Tool (FCT)





1 Store
In the motor controller, the current parameter set is written from the main memory and saved to the permanent memory.

2 Memory Card

3 Read from SD after Startup:
If the check box is active (check mark set), a search is conducted on the memory card for the parameter file (.DCO) designated "Latest" after every restart (Power ON/FCT: Restart controller); when located, it is loaded automatically into the main memory of the motor controller.

4 SD››Controller (SD››Controller):
A search is conducted on the memory card for the parameter file (.DCO) designated "Latest"; when located, it is loaded automatically into the main memory of the motor controller.

5 SD(latest)››Controller:
A search is conducted on the memory card for the parameter file (.DCO) with the latest date; when located, it is loaded automatically into the main memory of the motor controller.

6 Controller››SD:
The latest parameter set of the motor controller is written to the memory card as a parameter file (.DCO).

Fig. 5.8 Overview: Downloading/uploading the parameter file (.DCO) (memory card ››/‹‹ motor controller)

5.3 Commissioning the motor controller

5.3.1 Preparing for initial start-up

CAMC module and cover plate:

- Check the installation of the module or cover plate on slot [EXT] [EXT1/EXT2].
- Motor controller CMMD:
  The interface module CAMC (PROFIBUS DP/DeciveNet) should only be installed in slot [EXT1].

Electrical interfaces:

- Check the wiring of the system (controller/motor/motor encoder/limit switch/mains supply/safety switching device/etc.).
- Check the pin allocation of the connector [X...] and the connection of the screening.
- Check the connection of the protective conductor (PE).
- Check all electrical connections for short circuit and disconnection.

For additional information ➔ “Mounting and installation” description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

Fieldbus interfaces:

- Check the fieldbus address/MAC-ID ➔ page 82.
- Check the data rate (CAN bus/DeviceNet) ➔ page 83.
- Check CAN bus activation (CANopen/DriveBus) ➔ page 83.
- Check the terminating resistor:
  - The activation of the CAN bus terminating resistor (CANopen/DriveBus) ➔ page 84.
  - The activation of the PROFIBUS terminating resistor
    ➔ “Device profile FHPP” description, GDCP-CMMS/D-C-HP-....
  - The connection of the external terminating resistor (DeviceNet/RS485)
    ➔ “Mounting and installation” description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

Firmware update:

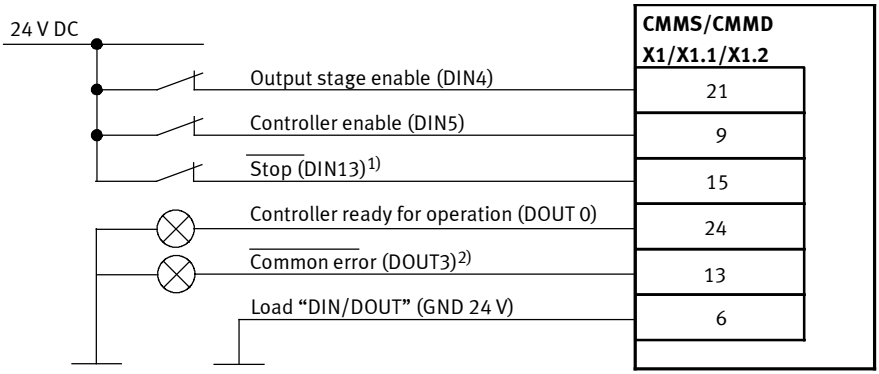
- Check the status of the firmware version ➔ Support portal: www.festo.com/sp.

Note
Before using a newer firmware version, check whether a newer version of the FCT plug-in or documentation is available ➔ Support portal: http://www.festo.com/sp.

5.3.2 Required digital inputs/outputs for operation

In order to operate the motor controller safely in all operating modes, the following digital inputs/outputs are required.

Connection: Digital inputs/outputs for operation



The connection diagram shows the switch positions in operation.

1) The digital input (DIN13) is used as an analogue input (#AIN0) in speed, force or torque mode.

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 5.9 Connection: Digital inputs/outputs for operation

5.3.3 Status diagram of the motor controller

The status diagram shows the basic functions of the motor controller. Detailed information regarding the controller functions can be found in the respective operating modes.

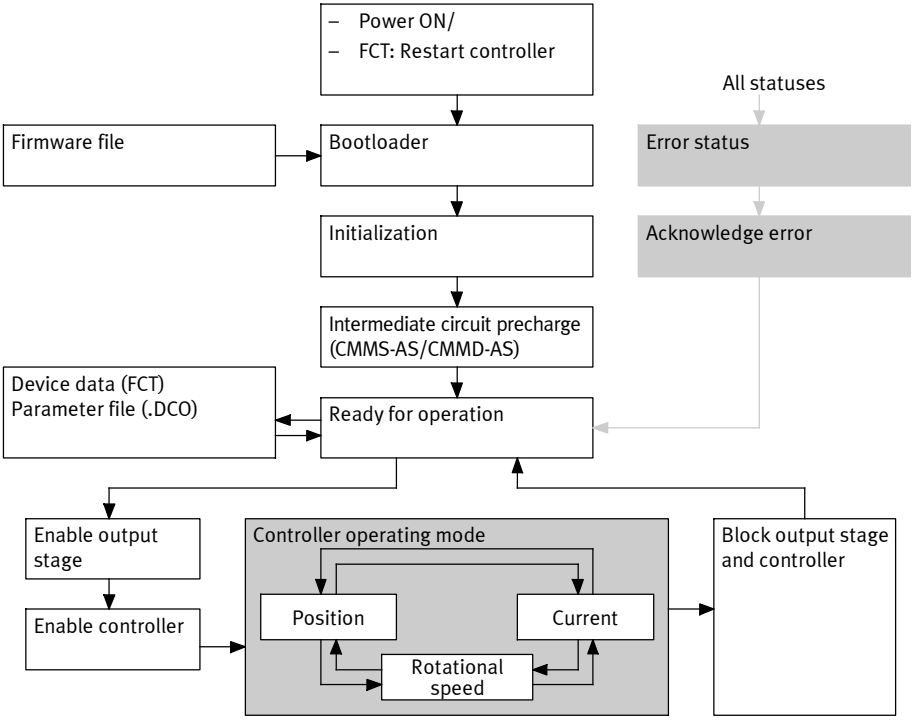


Fig. 5.10 Status diagram of the motor controller

5.3.4 Switching on the power supply (Power ON)

The motor controller is supplied with the following voltage when the power switch is activated (Power ON). The boot process of the motor controller is started automatically with the Power ON procedure.

Motor controller	Control section	Power section
CMMS-AS	24 V DC	230 V AC
CMMS-ST	24 V DC	24...48 V DC
CMMD-AS	24 V DC	230 V AC

Tab. 5.9 Overview: Power supply

Warning
Dangerous electrical voltage
Touching live parts will cause an electric shock, which can result in death or severe injuries:
- at an open slot:
  - CMMS: [EXT]
  - CMMD: [EXT1/EXT2]
- at the connection or connector:
  - Motor [X6] (CMMS) /[X6.1/X6.2] (CMMD)
  - Power supply [X9]

1. Equip the open slot [EXT] (CMMS) /[EXT1/EXT2] (CMMD) with the missing module or cover plate.
2. Install the product in a control cabinet.

Caution
Unexpected movement of the drive
If the following conditions are fulfilled during the Power ON process:
- Output stage enable is enabled (DIN4 = 24 V)[X1.21][X1.1.21/X1.2.21]
- Controller enable is enabled (DIN5 = 24 V)[X1.9][X1.1.9/X1.2.9]
- Setpoint value specified via control interface “Fieldbus/analogue input”

the drive (motor/axis) will start moving; it is then capable of causing crushing injuries in the operating area of the drive.
- Make sure the controller enable (DIN5)[X1.9][X1.1.9/X1.2.9] is disabled during the Power ON process (= 0 V).

Caution
Hot housing surfaces
The housing can reach a temperature of › 80° C during operation, which can cause burns.
1. Install the product in a control cabinet.
2. Check the temperature of the housing before touching it (e.g. by slowing moving the back of your hand towards the housing).

Note

Impermissible voltage or overvoltage

The motor controller will be damaged if

1. the voltage exceeds the permissible range.
   – Observe the maximum voltage level.
2. the mains phase (L1) is connected to connection [X9] on the motor controller “CMMS-AS/CMMD-AS” prior to the neutral conductor (N).
   – Use a mains switch with leading neutral conductor (N).
3. the pins of the power supply have incorrect polarity at the connection “Power supply [X9]”.
   – Before switching on, check to ensure the power supply is connected to the correct pins at connection [X9].
4. the connections “Power supply [X9]” and “Motor [X6] [X6.1/X6.2]” are interchanged.
   – Before switching on, check to ensure the power supply is connected to connection [X9] and the motor is connected to connection [X6] [X6.1/X6.2].
5. at the connection “Motor [X6] [X6.1/X6.2]” a motor phase has been short-circuited with the PE conductor.
   – Before switching on, check the motor phases at the connection “Motor [X6] [X6.1/X6.2]” for PE short circuit.
6. the grounding or screening element is insufficient or has not been connected.
   – Before switching on, check to ensure the grounding and screening elements are connected.
7. The plug connector is disconnected during operation.
   – Do not disconnect any plug connectors during operation.

1. Block the controller enable function (DIN5)[X1.9][X1.1.9/X1.2.9] = 0 V.
2. Switch on the power supplies (Power ON).
   - CMMS-AS/CMMD-AS: Control section 24 V DC/power section: 230 V AC
   - CMMS-ST: Control section 24 V DC/power section: 24...48 V DC

If required, the process for downloading the firmware from the memory card can be activated via DIL switch [S1.8], switch position = ON.

The Ready LED on the front of the motor controller should now light up.

The following malfunctions can occur:
– The seven-segment display shows an error message (4-digit character sequence "E x x x") or a warning message (5-digit character sequence "– x x x –") ➔ appendix A, page 216.
– The LED (Ready/Bus (CMMS-ST/CMMD-AS) or CAN (CMMS-AS)) or seven segment display do not light up.

Perform the following steps:
1. Measure the voltage levels at the input/output of the power supply unit and the power switch.
2. Switch off the power supplies (Power OFF).
3. Wait five minutes until the intermediate circuit voltage has discharged.
4. Check the cabling and the connection of the wires at the connection "Power supply".
5. Switch on the power supplies (Power ON).

5.3.5 Downloading device data (FCT) to the motor controller

1. Connect the PC to the motor controller.

Observe the pin allocation of the RS232 interfaces ➔ page 235.

2. Start the Festo Configuration Tool (FCT).
3. Establish an online connection to the motor controller in the FCT.

The online firmware download process can be executed if required.

4. Start downloading the device data (FCT) ➔ page 89

5.3.6 Enabling the motor controller via digital inputs

When the output stage enable (DIN4) and controller enable (DIN 5) are activated, the specifications issued by the controller are carried out by the drive.

Caution

Unexpected movement of the drive

If the following conditions are fulfilled:

– Activate output stage enable (DIN4 = 24 V)[X1.21][X1.1.21/X1.2.21]
– Activate controller enable (DIN5 = 24 V)[X1.9][X1.1.9/X1.2.9]
– Setpoint value specified via control interface “Fieldbus/analogue input”

the drive (motor/axis) will start moving; it is then capable of causing crushing injuries in the operating area of the drive.

- Make sure that no personnel are in the operating area of the drive.
- Make sure that the motor controller is only controlled by one control interface (master control).

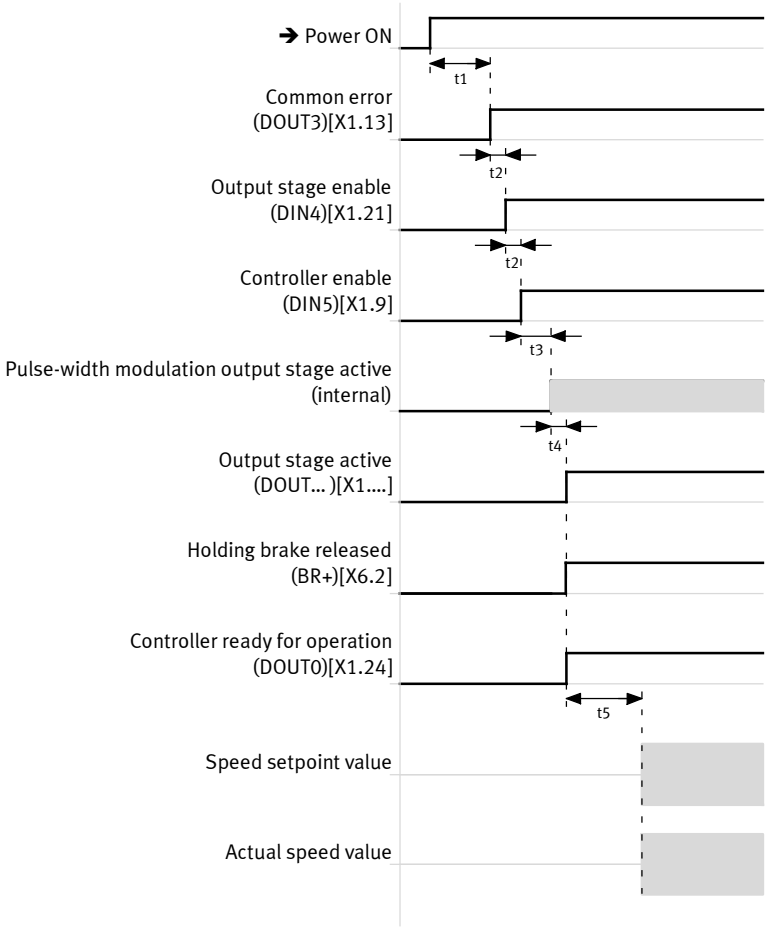
Caution

Defective safety function STO (Safe Torque Off)

If the safety function at connection [X3][X3.1/X3.2] is bypassed, it means the motor controller cannot be deactivated in the event of an emergency via safety components (e.g. emergency off switch with safety switching device), which can result in crushing injuries within the operating area of the drive.

- Parameterise the motor controller with the Festo Configuration Tool (FCT) before the controller enable is enabled (DIN5)[X1.9][X1.1.9/X1.2.9] (= 24 V).
- Bypassing of safety equipment is impermissible.
  Recommendation for initial start-up without safety equipment:
  – Minimum circuitry with emergency stop switching device at connection [X3][X3.1/X3.2]
  – Two-channel switch-off via control ports REL [X3.2][X3.1.2/X3.2.2] and the output stage enable (DIN4)[X1.21][X1.1.21/X1.2.21].

Timing diagram: Enabling the output stage (DIN4) and controller (DIN5)
Example: Speed mode via analogue input



t1 ≈ 500 ms
(dependent on the boot phase and start of the application)
t2 ≥ 2.5 ms
t3 ≤ 10 ms (dependent on the operating mode and the status of the drive)
t4 ≤ 2.5 ms
t5 = 0...6553 ms (FCT: Dependent on the parameterised switch-on delay (brake control, brake timing))

Fig. 5.11 Timing diagram: Enabling the output stage (DIN4) and controller (DIN5)

5.3.7 Commutation finding by motor controller CMMS-ST-C8-7-G2

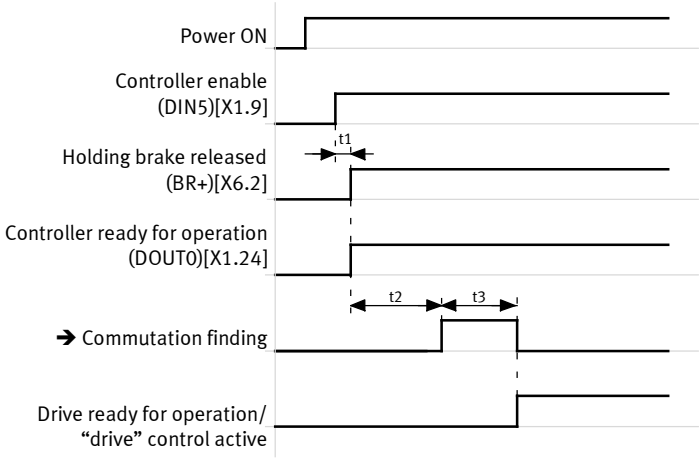
The commutation finding process is only performed by motor controller CMMS-ST-C8-7-G2 if the stepper motor with motor encoder EMMS-ST-...-...E... (closed loop) has been configured in the Festo Configuration Tool (FCT). In the commutation finding process the stepper motor executes a brief rotation (‹3.6 °) the first time it is supplied with power after the controller enable (DIN5 = 24 V). The angle offset between the motor and motor encoder is determined here and temporarily stored in the main memory of the motor controller.

Note

Operation of vertical axes

A maximum of 50 % of the permissible total load may be used for operation of vertically mounted axes.

Timing diagram: Commutation finding with the first controller enable (DIN5) after Power ON



t1 ≤ 10 ms (dependent on the operating mode and the status of the drive)
t2 = 0...6553 ms (FCT: Dependent on the parameterised switch-on delay (brake control, brake timing))
t3 ‹ 1 s

Fig. 5.12 Timing diagram: Commutation finding with the first controller enable (DIN5) after Power ON

5.3.8 Checking motor and limit switch functionality

Checking activation of the motor

Activate the motor controller by using the jog function in the Festo Configuration Tool (FCT) ➔ page 172 to check the function and direction of rotation of the motor.

Possible causes of an error:

– Motor does not rotate.
  - Check the wiring to the motor.
  - Check the pin allocation on the motor and the connector [X6] of the motor controller, as well as the screening connection.
  - Check all electrical connections for short circuit and disconnection.
  - Warning, dangerous electrical voltage.
    Check the motor voltage levels at connection [X6] of the motor controller.

  For additional information ➔ "Mounting and installation" description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-....
  If the error cannot be remedied by the measures described above, replace the motor.
– Direction of rotation/travel incorrect.
  - Enable/disable (check box) the process for reversing the direction of rotation (field/installation) in the Festo Configuration Tool (FCT).

Checking the position and switching function of the limit switches (limited axis only)

Activate the drive by using the jog function in the Festo Configuration Tool (FCT) ➔ page 172 to check the switching function and position of the limit switches.

Possible causes of an error:

– Limit switch does not switch.
  - Check the wiring to the limit switch.
  - Check the pin allocation on the connector [X1] of the motor controller and, if applicable, on the distributor block.
  - Check all electrical connections for short circuit and disconnection.
  - Check the power supply for the limit switch.

  For additional information ➔ "Mounting and installation" description, GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...
– Limit switch is outside the working stroke of the drive.
  - Move the drive to the desired limit switch position
  - Adjust the limit switch until the switch switches.

5.3.9 Carrying out homing

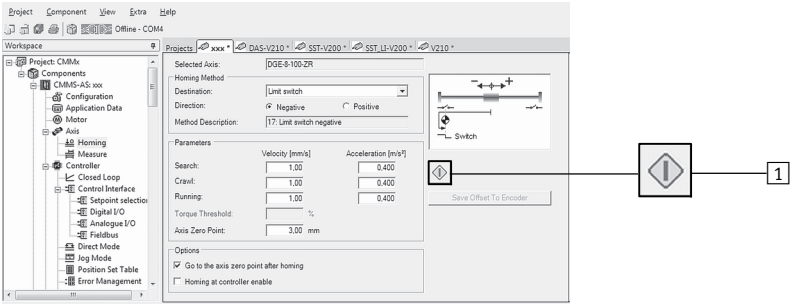
The procedure for carrying out homing is dependent on the following conditions.

1. If one of the following modes is used for positioning:
   - Direct operation
   - Individual record operation
   - Record linking operation
   - Interpolated positioning mode
2. If one of the following motor encoders is used:
   - Single-turn absolute encoder (CMMS-AS/CMMD-AS):
     After each Power ON/Controller restart (FCT)
   - Multi-turn absolute encoder (CMMS-AS/CMMD-AS):
     On initial start-up or after replacing the motor
   - Incremental encoder (CMMS-ST):
     After each Power ON/Controller restart (FCT)
3. If the axis has been parameterised in the Festo Configuration Tool (FCT) with a limited working stroke (linear)/positioning range (rotative).

For additional information on homing ➔ page 154.

Start homing in the Festo Configuration Tool (FCT).

Festo Configuration Tool (FCT)



1 Button: “Start homing”

5.4 Behaviour of the motor controller in the event of an interruption or disconnection

5.4.1 Holding brake

The holding brake is used during operation to hold the motor/drive position when at a state of rest.
The function of the holding brake can be controlled via the following:

– Release holding brake:
  • Enable output stage (DIN4) and controller (DIN5) ➔ page 101.
– Lock holding brake:
  • Switch off output stage enable (DIN4) ➔ page 107.
  • Switch off controller enable (DIN5) ➔ page 108.
  • Interrupt mains supply ➔ page 106.

The holding brake is configured in the Festo Configuration Tool (FCT) via the selection of the motor type. When the holding brake has been configured, the time delays in the brake control are activated and can be parameterised.

Note

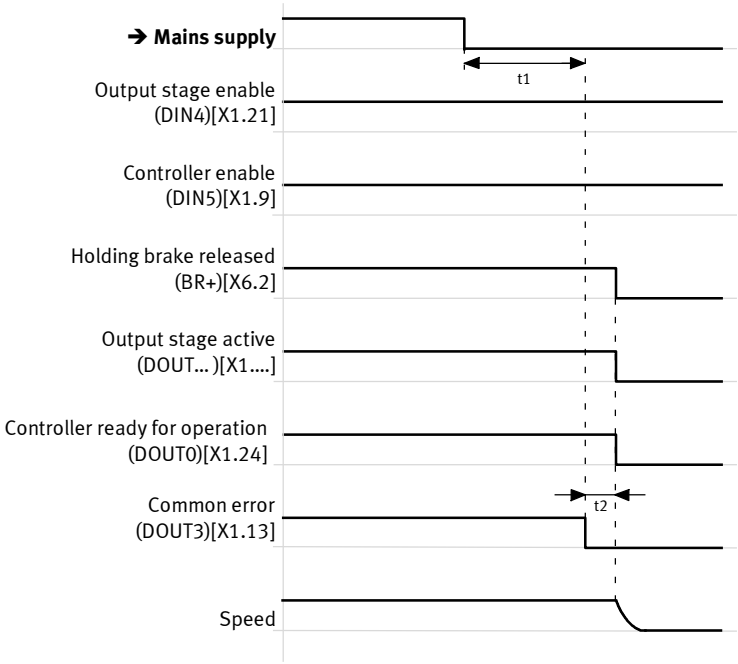
Using the holding brake

The holding brake is not suitable for braking the motor or payloads in the event of a power interruption or if the motor controller has been switched off. Non-intended use of the holding brake will result in increased wear of the holding jaws and a reduction of the overall holding effect. A secure holding function is therefore no longer guaranteed.

5.4.2 Interruption of the mains supply

The timing diagram shows the behaviour of the motor controller when the mains supply is interrupted.

Timing diagram: Interruption of the mains supply



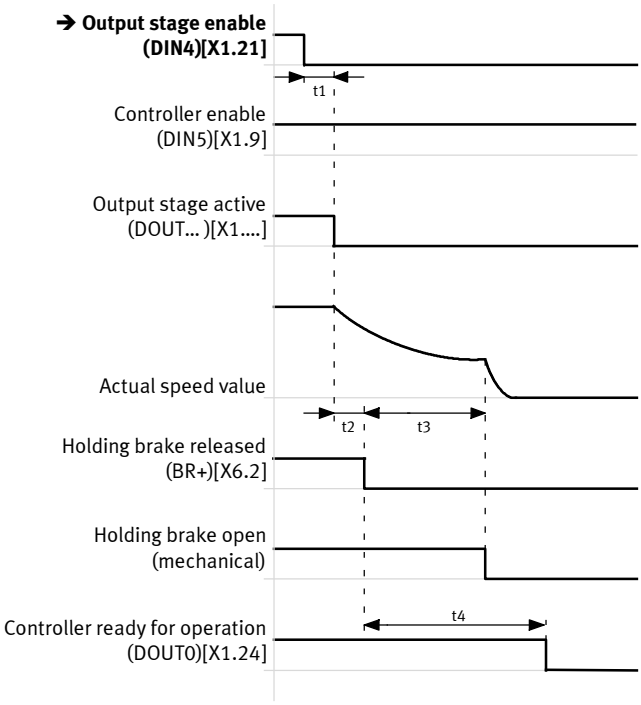
t1 = 60 ms t2 ≤ 2.5 ms

Fig. 5.13 Timing diagram: Interruption of the mains supply

5.4.3 Switching off the motor controller via output stage enable (DIN4)

The timing diagram shows the behaviour of the motor controller after the output stage enable (DIN4) has been switched off. The output stage is disabled immediately in all operating modes (motor not energised). The residual energy in the mechanical system results in uncontrolled movements (coasting) until a state of rest is reached.

Timing diagram: Switching off the motor controller via output stage enable (DIN4)



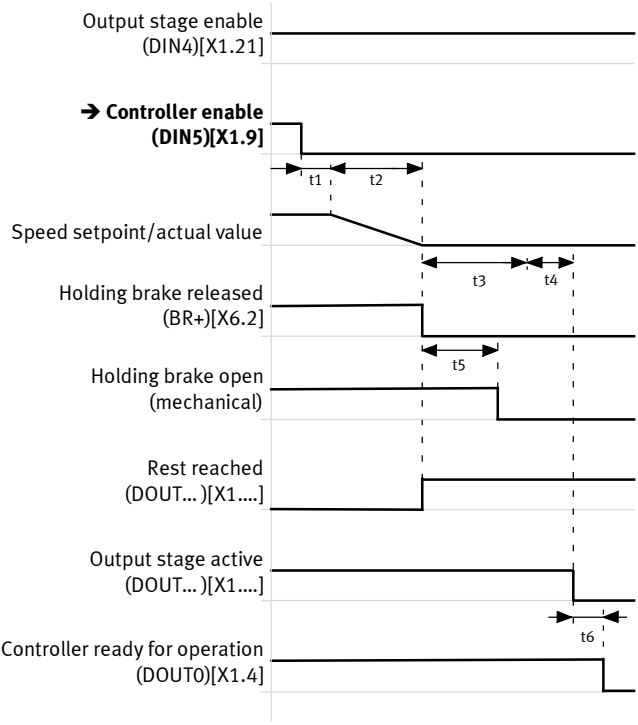
t1 ≤ 5 ms
t2 ≤ 2.5 ms
t3 ≈ 50...500 ms
t4 = 0...6553 ms (FCT: Dependent on the parameterised switch-off delay (brake control, brake timing))

Fig. 5.14 Timing diagram: Switching off the motor controller via output stage enable (DIN4)

5.4.4 Switching off the motor controller via controller enable (DIN5)

The timing diagram shows the behaviour of the motor controller after the controller enable (DIN5) has been switched off. The drive is decelerated in a controlled manner for all operating modes with the “Quick stop” parametrised delay. After reaching the rest state or the parametrised monitoring time Quick Stop the output stage is blocked (motor not energised).

Timing diagram: Switching off the motor controller via controller enable (DIN5)



t1 ≤ 5 ms
t2 = 0 ms...10 s (FCT: Dependent on the parametrised Quick stop delay and Quick stop monitoring time of the speed actual value)
t3 = 0...6553 ms (FCT: Dependent on the parameterised switch-off delay (brake control, brake timing))
t4 ≤ 5 ms
t5 ≈ 50...500 ms
t6 ≤ 5 ms

Fig. 5.15 Timing diagram: Switching off the motor controller via controller enable (DIN5)

5.5 Master control

5.5.1 Master control over the motor controller

Master control determines who can access the control interface of the motor controller. Before controlling the motor controller, master control must be assumed. Master control cannot be assumed simultaneously from multiple interfaces.

The motor controller can be controlled via the following control interfaces:

– Digital inputs (DIN)
– Fieldbus (CANopen/DriveBus/PROFIBUS DP/DeviceNet/RS485)
– Festo Configuration Tool (FCT)

The following digital inputs are always active for all control interfaces:

– Output stage enable (DIN4)[X1.21]
– Controller enable (DIN5)[X1.9]
– Stop (DIN13)[X1.15] (not for the “Analogue input” control interface)

Caution

Unexpected movement of the drive

If the following conditions are fulfilled:

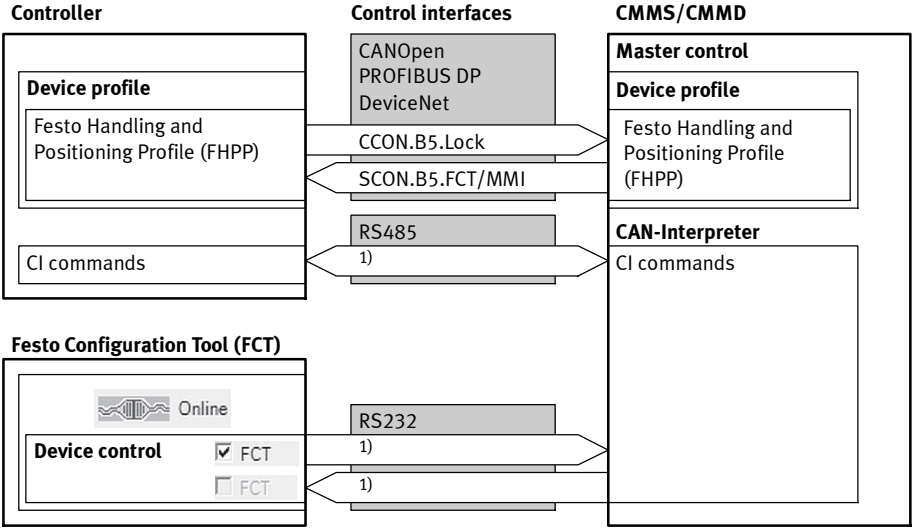
– Output stage enable is enabled (DIN4 = 24 V)[X1.21][X1.1.21/X1.2.21]
– Controller enable is enabled (DIN5 = 24 V)[X1.9][X1.1.9/X1.2.9]
– Setpoint value specified via control interface “Fieldbus/analogue input”

the drive (motor/axis) will start moving; it is then capable of causing crushing injuries in the operating area of the drive.

- Make sure that the motor controller is only controlled by one control interface (master control).

When the motor controller is switched on, the control interface that was last configured via the Festo Configuration Tool (FCT) is activated by default (default setting: Digital inputs/outputs).

Overview: Master control over the motor controller



1) Note the information regarding interface: RS232 ➔ page 236 and RS485 ➔ page 240.

Fig. 5.16 Overview: Master control over the motor controller

5.5.2 FCT master control over the motor controller

The timing diagram shows the transfer of master control from the “digital inputs” control interface to the Festo Configuration Tool (FCT).

Timing diagram: FCT master control over the motor controller

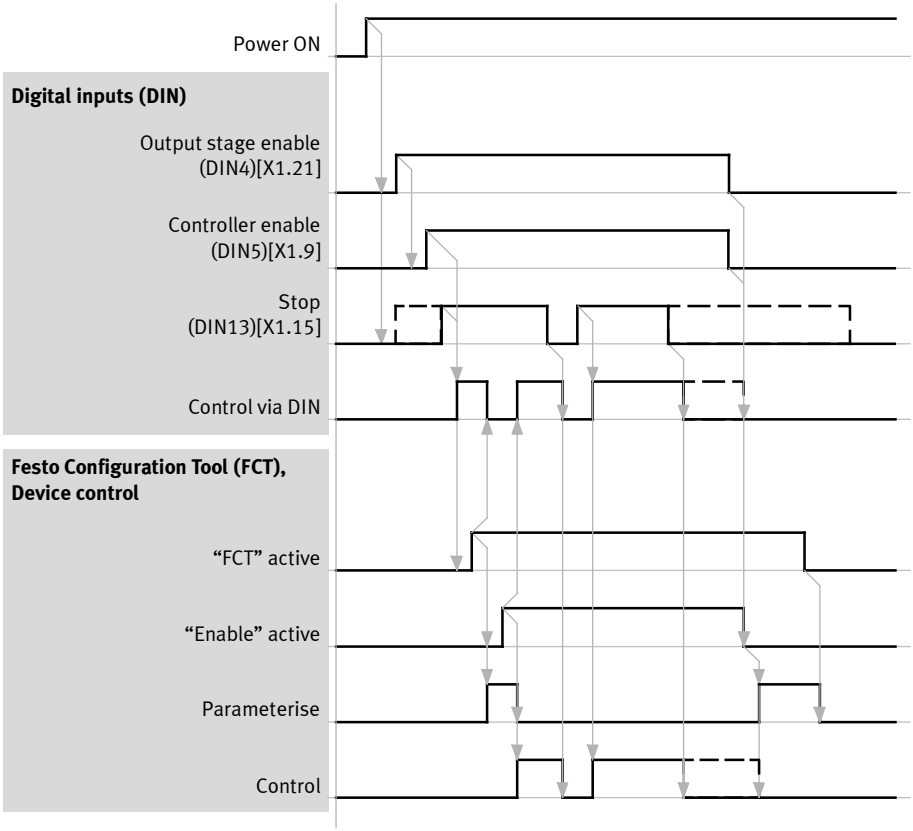


Fig. 5.17 Timing diagram: FCT master control over the motor controller

6 Positioning mode

6.1 Function: Position control

In the positioning mode, the motor controller receives the positioning setpoint value(position/position record number) via the control interface (fieldbus/digital inputs).

– In the direct, individual record, record linking, homing and jog modes, the point-to-point positioning (trapezoidal speed curve) is calculated in the controller-internal positioning controller from the positioning parameters and passed on as position/speed setpoint values.
– In the case of interpolating positioning mode, the interpolated positioning curve is calculated in the interpolator and passed on as position/speed setpoint values.

The regulator cascade (position, speed and current regulator) processes the deviation between set-point value and actual value and thus controls the output stage and the connected motor.

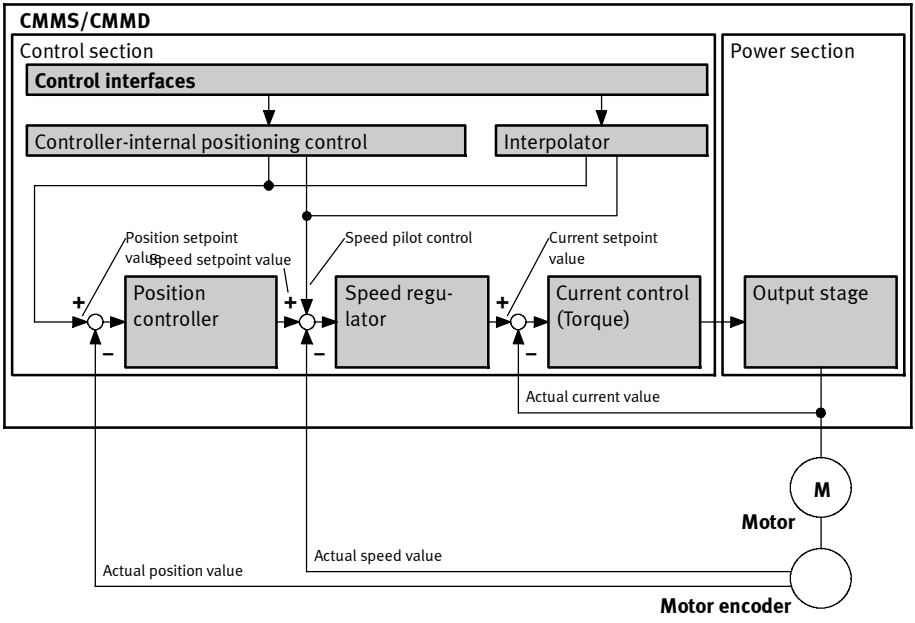


Fig. 6.1 Overview: Position control

6.2 Record selection and positioning records

6.2.1 Function: Record selection and positioning records

In the motor controller, positioning records can be configured to control point-to-point positioning with trapezoidal velocity curve. The positioning records are selected via record selection “0...63” and they can be controlled in the individual record/record linking/homing/jog mode via the control data of the active fieldbus (CANopen/PROFIBUS DP/DeviceNet) or the record selection bit 0...5 of the digital inputs. The positioning records “0...63” are permanently assigned to the record selection “0...63”. The positioning record “0” is reserved for homing. The positioning records “1...63” can be used for the individual record/record linking/teach mode ➔ page 114. A profile (0...8) in the positioning record profile is to be assigned to each parameterised positioning record (1...63) ➔ page 120. Several individual records in the positioning record list can be linked to a record sequence via the record linking function. The selected positioning record can be activated with the start command (control data or DIN8). From the parameters, the controller-internal positioning controller calculates the corresponding positioning curve for the individual record/record linking/homing mode.
In the Festo Configuration Tool (FCT), the individual record/record linking mode can be parameterised via the parameters “positioning record list/positioning record profiles” and the homing mode can be parameterised via the “homing” parameters.

Activating record selection (positioning record) via fieldbus or digital inputs

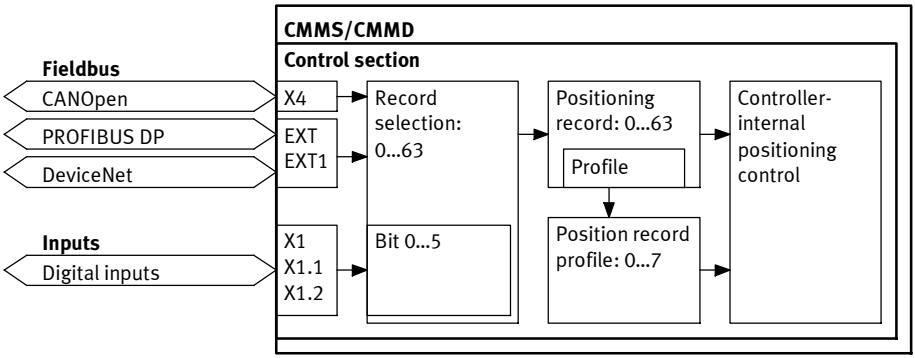


Fig. 6.2 Overview: Activating record selection (positioning record) via fieldbus or digital inputs

6.2.2 Record selection (positioning record) – control interface – operating mode

The selection of the record selection/positioning record is dependent on the control interface and operating mode:

Control interface	Operating mode			
	Individual record mode	Record linking mode	Homing mode	Teach mode
CANOpen PROFIBUS DP DeviceNet	Record selection/ positioning record 1...63	Record selection/ positioning record 1...63	Record selection/ positioning record 0	Record selection/ positioning record 1...63
Digital inputs ➔ page 49	Mode 0 – Record selection bit 1...5 – Positioning record 1...63 ➔ page 121	Mode 2 – Record selection bit 1...2 – Positioning record 1...7 ➔ page 138	Mode 0 – Record selection bit 1...5 – Positioning record 0 ➔ page 156	Mode 1 – Record selection bit 1...5 – Positioning record 1...63 ➔ page 179

Tab. 6.1 Overview: Record selection (positioning record) – control interface – operating mode

6.3 Relative positioning

The motor controller calculates internally with 65536 increments (16 bit) per revolution (360°). For positioning tasks that do not have a whole number (integer) as the result, the motor controller rounds up to the next whole number. This can result in deviations when positioning.
Example: Rotary indexing table
4 positions. (90°) 65536:4= 16384 ----› Integer
6 positions. (60°) 65536:6= 10922.666 ----› The controller positions at 10923 (60.0018°).

6.4 Direct mode

6.4.1 Function: Direct mode

In the direct mode, the motor controller controls the point-to-point positioning with trapezoidal velocity curve of the drive. The motor controller receives the position setpoint value cyclically from the control system. The motor controller is controlled via the active fieldbus (CANopen/PROFIBUS DP/DeviceNet/ RS485). The controller-internal positioning controller calculates the positioning curve from the position setpoint value and the direct mode parameters and transfers the position setpoint values cyclically to the position control. The controller-internal positioning controller retains the positioning parameters for each additional direct application if a new parameterisation process has not been executed via the active fieldbus. The positioning parameters can be parameterised via fieldbus or the Festo Configuration Tool (FCT).

Activating direct mode via fieldbus

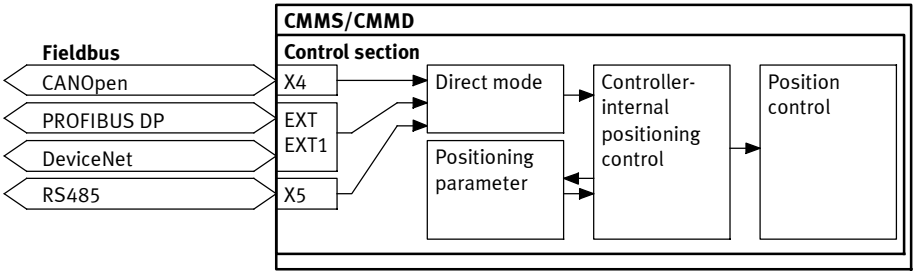
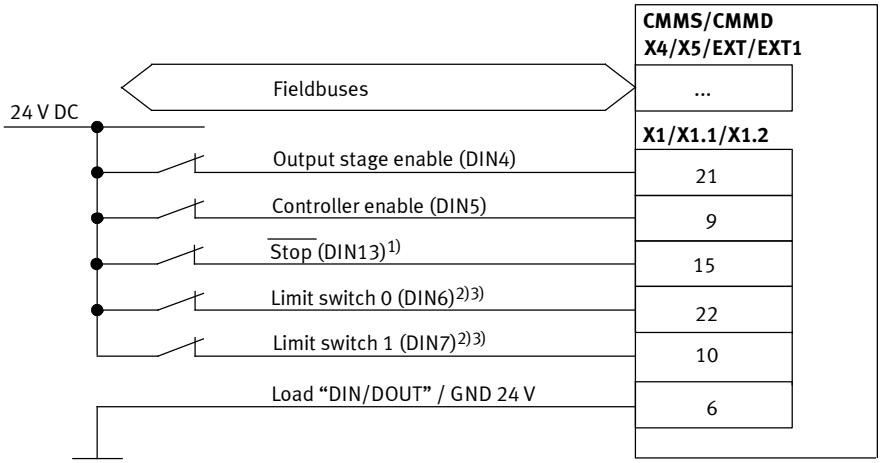


Fig. 6.3 Overview: Activating direct mode via fieldbus

6.4.2 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the direct mode.



1) The digital input (DIN13) is used as an analogue input (#AIN0) in speed, force or torque mode.
2) The limit switches are set by default to N/C contact (configuration over FCT)
3) Only required for applications with limited positioning range or homing methods with limit switch.

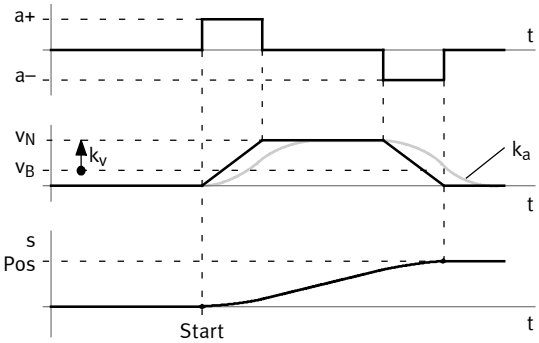
Fig. 6.4 Connection: Required digital inputs/outputs with fieldbus control

6.4.3 Parameterising the direct mode

The following parameters (FCT) can be parameterised for the direct mode:

Parameters: Position, acceleration, deceleration, base value of speed and smoothing

The diagram shows the parameters for point-to-point positioning and the “smoothing” option.



Parameter		Description
a+	Acceleration	Setpoint value for acceleration.
a–	Deceleration	Setpoint value for deceleration.
v_N	Velocity	– Device profile FHPP: The setpoint value is calculated by multiplying the base value of velocity v_B and the percentage value of velocity k_v. – Device profile CiA 402: Setpoint value[1] for speed.
v_B	Base value of velocity	– Device profile FHPP: Base value for calculating velocity v_n.
k_v	Percentage value of velocity	– Device profile FHPP: Percentage value[1] for calculating velocity v_n.
k_a	Smooth	Value for duration of filtering from acceleration and deceleration ramp ➔ page 130.
Pos	Position	Setpoint value[1] for the relative or absolute position.

1) The value and the unit is set in the cyclic data of the control system.

Tab. 6.2 Parameters: Position, acceleration, deceleration, velocity, base value of velocity and smoothing

Note

The motor controller calculates internally with 65536 increments (16 bit) per revolution (360°). For positioning records that do not have a whole number (integer) as the result, the motor controller rounds up to the next whole number.

– Take into consideration the deviation of the rounded position values when parameterising the position ➔ page 114.

6.5 Individual record mode

6.5.1 Function: Individual record mode

In the individual record mode, the motor controller controls the point-to-point positioning with trapezoidal velocity curve of the drive. The motor controller can be controlled via the active fieldbus (CANopen/PROFIBUS DP/DeviceNet) or the digital inputs (mode 0 ➔ page 49). Through record selection, the controller-internal positioning controller receives the parameters “Positioning record (1...63)” and “Positioning record profiles (0...7)” of the selected individual record. The controller-internal positioning controller calculates the positioning curve from the parameters and transfers the position setpoint values cyclically to the position control. Each individual record is started with its own start command/signal. The positioning records and positioning record profiles can be parameterised via fieldbus or the Festo Configuration Tool (FCT).

The positioning record “0” is reserved exclusively for homing in the homing mode.

Activating the individual record mode via fieldbus/digital inputs

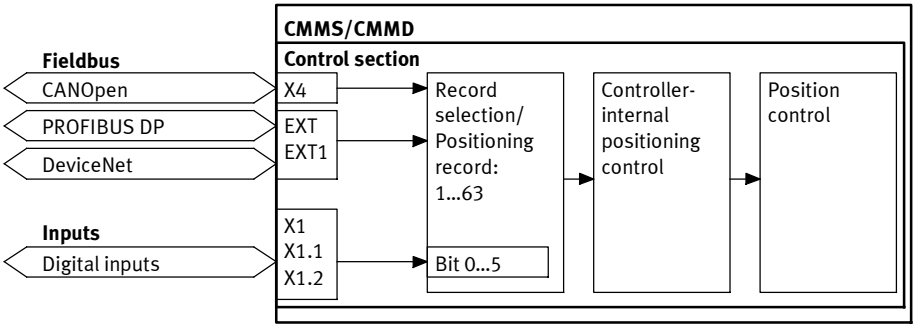
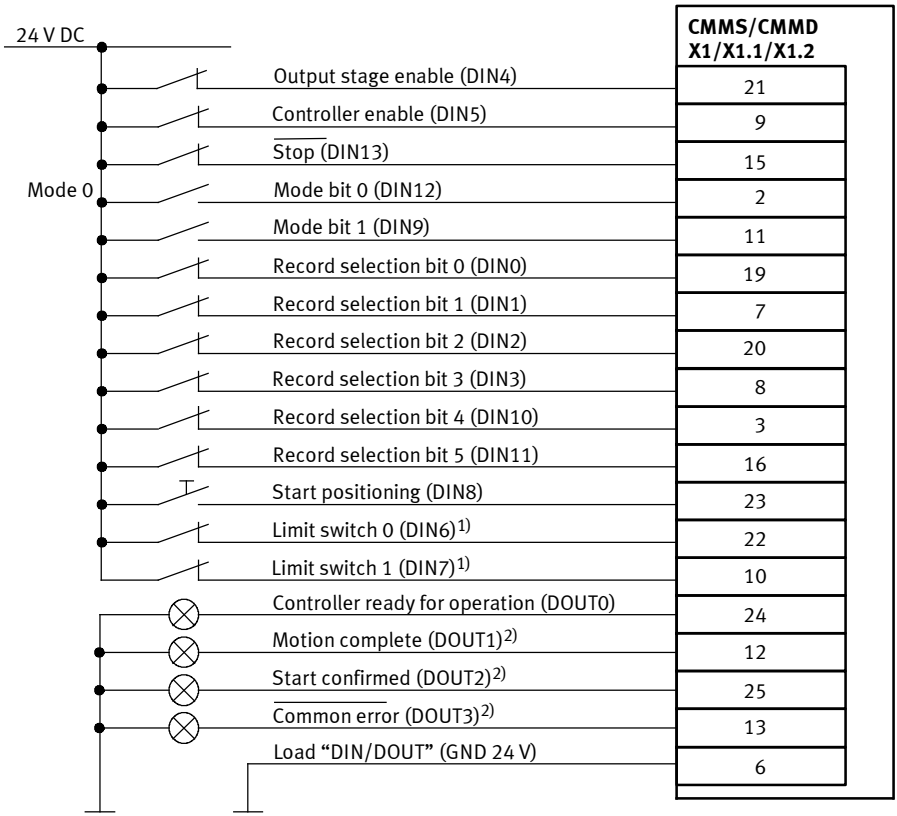


Fig. 6.5 Overview: Activating the individual record mode via fieldbus and digital inputs

6.5.2 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the individual record mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 6.6 Connection: Digital inputs/outputs

Activating the positioning record via digital inputs (record selection bit 0...5)

The positioning record (1...63) for the individual record is selected via the record selection bit 0...5.

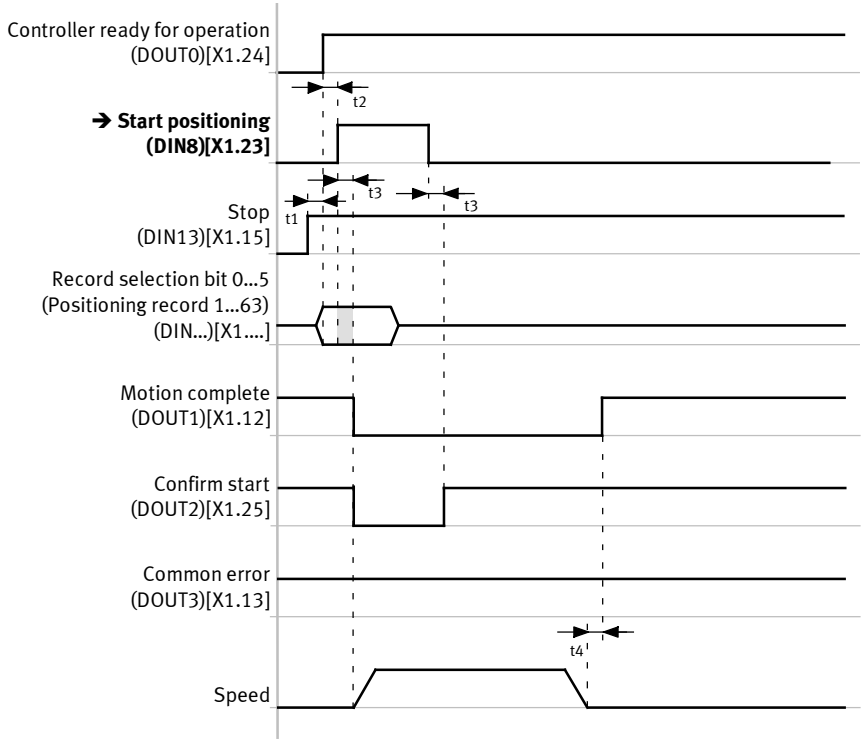
Positioning record	**Record selection**					
	Bit 5 (2^5) (DIN11) [X1.16] [X1.1.16] [X1.2.16]	Bit 4 (2^4) (DIN10) [X1.3] [X1.1.3] [X1.2.3]	Bit 3 (2^3) (DIN3) [X1.8] [X1.1.8] [X1.2.8]	Bit 2 (2^2) (DIN2) [X1.20] [X1.1.20] [X1.2.20]	Bit 1 (2^1) (DIN1) [X1.7] [X1.1.7] [X1.2.7]	Bit 0 (2^0) (DIN0) [X1.19] [X1.1.19] [X1.2.19]
1	0	0	0	0	0	1
2	0	0	0	0	1	0
3	0	0	0	0	1	1
4	0	0	0	1	0	0
...						
7	0	0	0	1	1	1
8	0	0	1	0	0	0
...						
15	0	0	1	1	1	1
16	0	1	0	0	0	0
...						
32	1	0	0	0	0	0
...						
63	1	1	1	1	1	1

Tab. 6.3 Overview: Activating the positioning record via digital inputs (record selection bit 0...5)

6.5.3 Timing diagram: Start/cancel individual record

Timing diagram: Start individual record via Start positioning signal

The timing diagram shows the starting of the individual record via the Start positioning signal (DIN8).

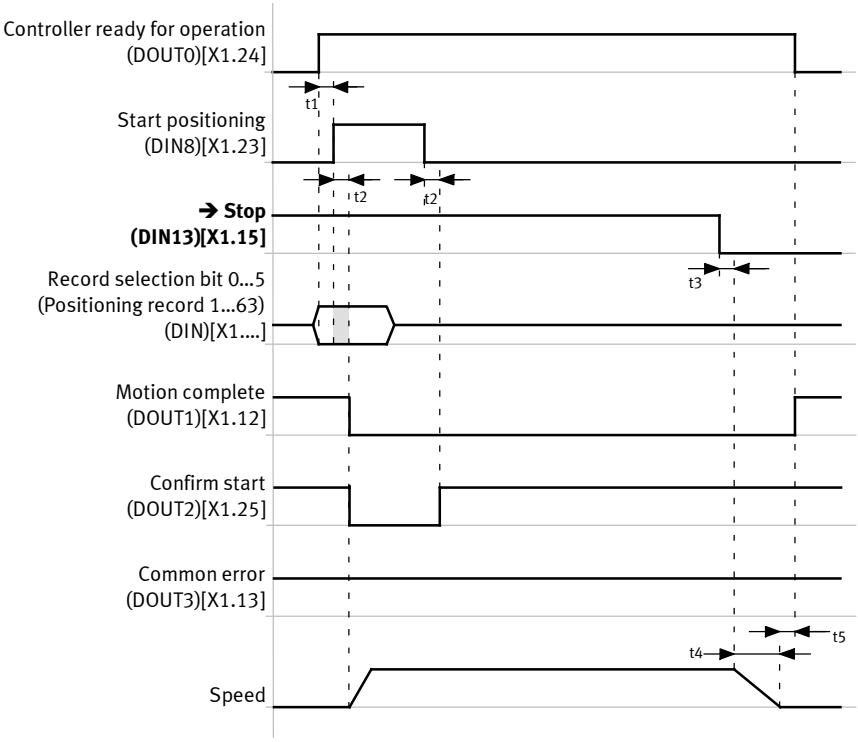


t1 ≤ 2.5 ms
t2 ≥ 2.5 ms
t3 ≤ 5 ms
t4 = ... ms (FCT: Dependent on the parameters "Message window" and "Damping time" in the message "Destination reached")

Fig. 6.7 Timing diagram: Start individual record via start positioning signal

Timing diagram: Cancel individual record via Stop signal

The timing diagram shows the stopping of the individual record via the stop signal (DIN13).

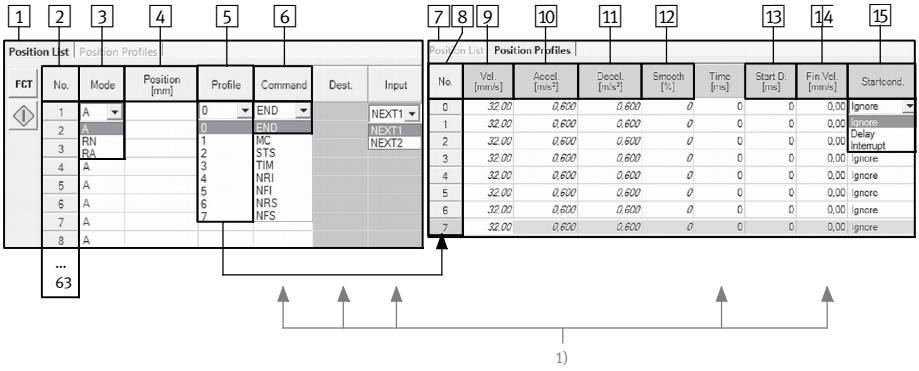


t1 ≥ 2.5 ms
t2 ≤ 5 ms
t3 ≤ 2.5 ms
t4 = ... ms (FCT: Dependent on the parameter "Stop input" in the stop decelerations)
t5 = ... ms (FCT: Dependent on the parameters "Message window" and "Damping time" in the message "Destination reached")

Fig. 6.8 Timing diagram: Cancelling the individual record via the stop signal

6.5.4 Parameterising the individual record mode

The following parameters (FCT) can be parameterised for the individual record mode:



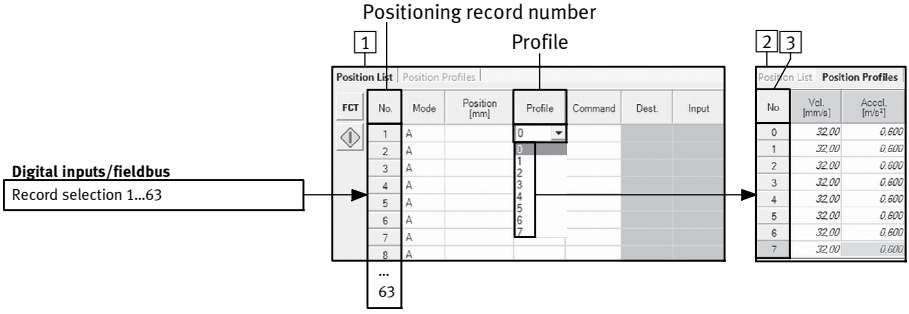
1) Record linking parameters: Command/destination/input/time/end speed ➔ page 143

Parameter		Variant	Page
1	Position List		
2	Position List Number	1...63	125
3	Mode	A/RA/RN	126/128
4	Position		126
5	Profile	1...7 (8)	125
6	Command	END	126
7	Position Profiles		
8	Position Profiles Number	1...7	125
9	Velocity		126
10	Acceleration		126
11	Deceleration		126
12	Smooth		126/129
13	Start Delay		131
14	Final Velocity		132
15	Start Condition	Ignore	133
		Delay	134
		Interrupt	135

Tab. 6.4 Overview: Positioning record table, positioning record list and positioning record profiles

Parameters: Positioning record number and profile

The diagram shows the relationship between record selection/positioning record number/profile. A positioning profile can be assigned to each positioning record via the “Profile” parameter.

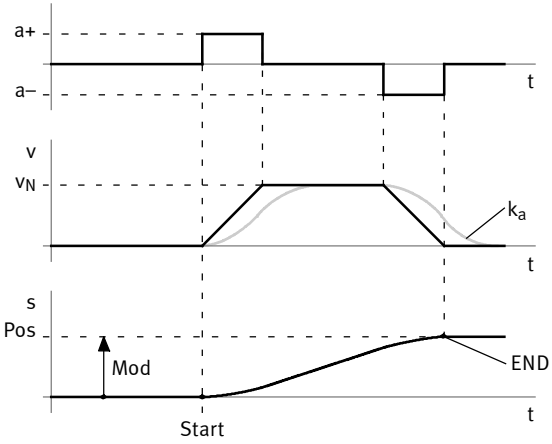


1 Positioning record list
2 Positioning record profiles
3 Positioning record profile number (0...7)

Parameter	Description
Position List Number	Selection of the positioning record. – The positioning record in the individual record is selected via the record selection of the control interface.
Profile	Selection of a positioning record profile “0...7” (table “Positioning record profiles”).

Tab. 6.5 Parameters: Positioning record number and profile

Parameters: Position, acceleration, deceleration, velocity, mode, command (END) and smoothing
The diagram shows the parameters for point-to-point positioning and the “smoothing” option.

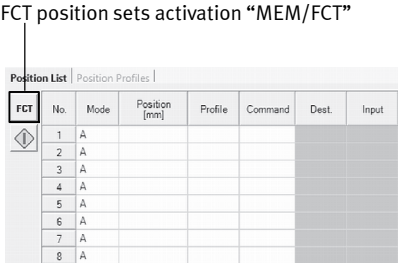


Parameter	Description
a+ Acceleration	Setpoint value for acceleration.
a– Deceleration	Setpoint value for deceleration.
v_N Velocity	Setpoint value for speed.
k_a Smooth	Value for duration of filtering from acceleration and deceleration ramp ➔ page 130.
Pos Position	Setpoint value for the relative or absolute position.
Mod Mode	Selection of a relative or absolute positioning mode ➔ page 128: A = Absolute positioning related to a fixed zero point (axes/project zero point) (default) RA = Relative positioning related to the current actual position RN = Relative positioning related to the current setpoint position
END Command	The individual record is ended upon reaching the position.

Tab. 6.6 Parameters: Position, acceleration, deceleration, velocity, mode, command (END) and smoothing

Note
The motor controller calculates internally with 65536 increments (16 bit) per revolution (360°). For positioning records that do not have a whole number (integer) as the result, the motor controller rounds up to the next whole number.
– Take into consideration the deviation of the rounded position values when parameterising the position ➔ page 114.

FCT position sets activation “MEM/FCT”
If the FCT position sets activation is “FCT” and with relative positioning “RA/RN”, only the relative positioning “RA” (related to the current actual position) is carried out ➔ page 128.



Type of positioning	FCT position sets activation	
	MEM	FCT
Absolute positioning “A”	yes	yes
Relative positioning “RA”	yes	yes
Relative positioning “RN”	yes	no

Tab. 6.7 FCT-Verfahrsatz-Ansteuerung „MEM/FCT“

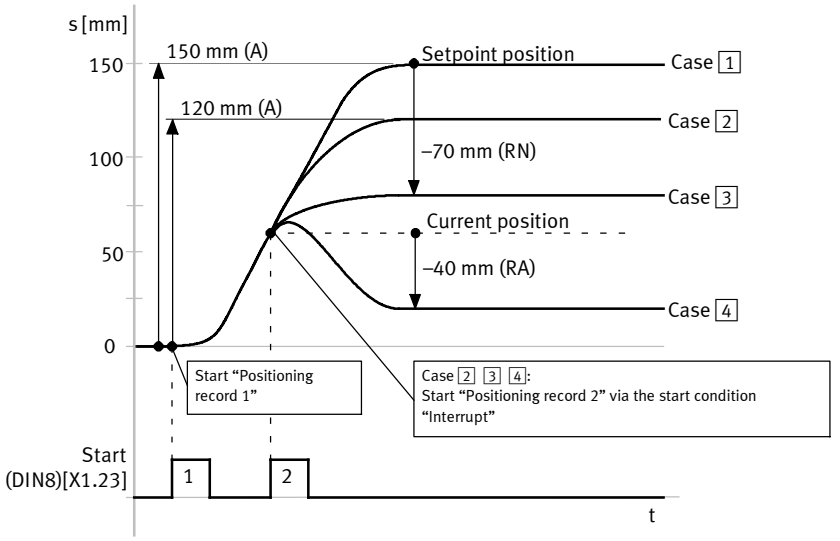
Example for parameters: Mode “A/RA/RN”

This example describes the activation of a linear axis in four individual cases. The course of the positioning curve is dependent on the parameterised parameters “Mode: A/RA/RN” and “Start condition: Ignore/interrupt”.

Case	Positioning record	Positioning record list			Positioning profile	
		Mode	Position	...	Start condition	...
1	1	A	150 mm	...	Ignore	...
2	1	A	150 mm	...	Interrupt	...
	2	A	120 mm	...	Ignore	...
3	1	A	150 mm	...	Interrupt	...
	2	RN	–70 mm	...	Ignore	...
4	1	A	150 mm	...	Interrupt	...
	2	RA	–40 mm	...	Ignore	...

Tab. 6.8 Parameters: Mode “A/RA/RN”

Timing diagram: Parameters: Mode “A/RA/RN”



A = Absolute positioning related to a fixed zero point (e.g. project zero point)

RA = Relative positioning related to the current actual position

RN = Relative positioning related to the current setpoint position

Fig. 6.9 Timing diagram: Parameters: Mode “A/RA/RN”

Parameter example: Smoothing (jerk filter)

The progression of the parameterised acceleration (a+)/deceleration (a–) can be altered with smoothing (jerk filter).

If smoothing is “100 %”, the acceleration/deceleration ramps are filtered with the maximum filter time t_{fi} “50 ms”. The drive is moved with the filtered acceleration/deceleration, and the least stresses occur for the drive mechanics. The parameterised velocity (v_N) and the position are reached with a time delay.

If smoothing is “0 %”, the smoothing function is deactivated and the acceleration/deceleration ramps are not filtered. The drive is moved with the parameterised acceleration/deceleration, and the highest stresses occur for the drive mechanics. The parameterised velocity (v_N) and the position are reached in the shortest amount of time.

Diagram: Filter time t_{fi} as a function of smoothing

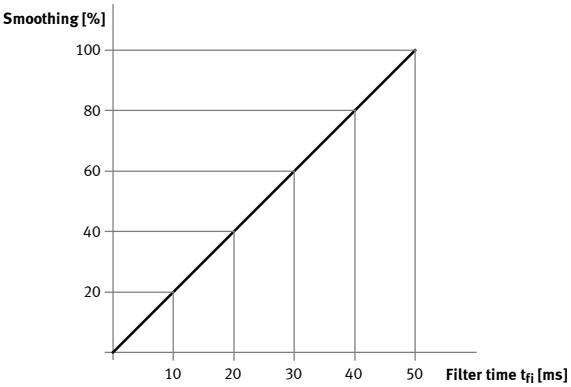
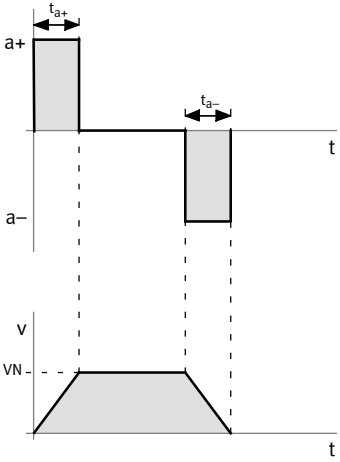


Fig. 6.10 Diagram: Filter time t_{fi} as a function of smoothing

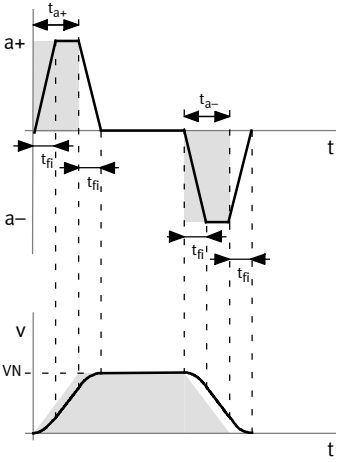
Timing diagram: Smoothing

Example: Smoothing with an acceleration time t_{a+}/time delay t_{a-} = 25 ms

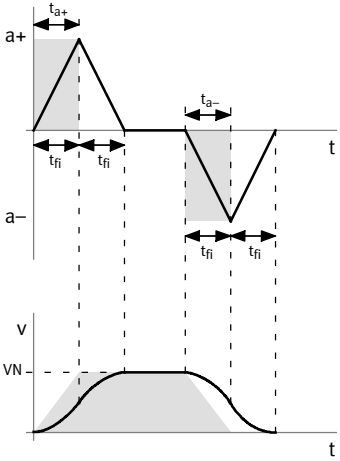
A) Smoothing 0 %:
Filter time t_{fi} = 0 ms (time-optimised)



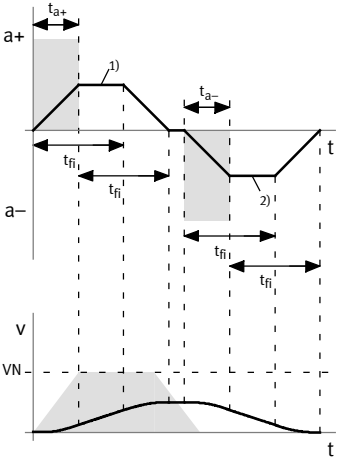
B) Smoothing 25 %:
Filter time t_{fi} = 12.5 ms



C) Smoothing 50 %:
Filter time t_{fi} = 25 ms



D) Smoothing 100 %:
Filter time t_{fi} = 50 ms



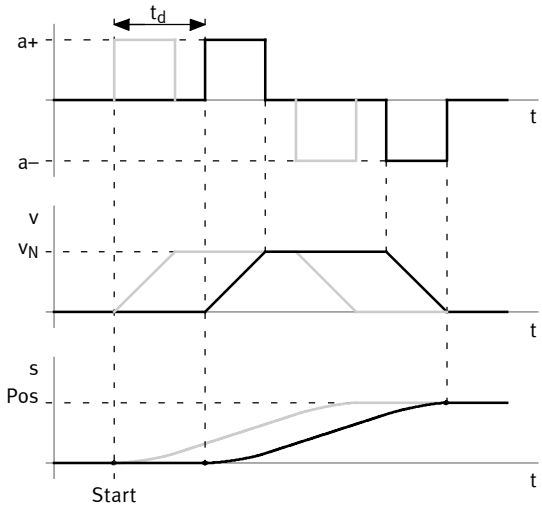
a+ = Acceleration
a– = Deceleration
v_N = Velocity

1) Movement with reduced acceleration
2) Movement with reduced deceleration

Fig. 6.11 Timing diagram: Smoothing

Parameter: Start delay

The diagram shows the deceleration for point-to-point positioning as a function of the “Start delay” parameter.



a+ Acceleration
a– Deceleration
v_N Velocity
Pos Position

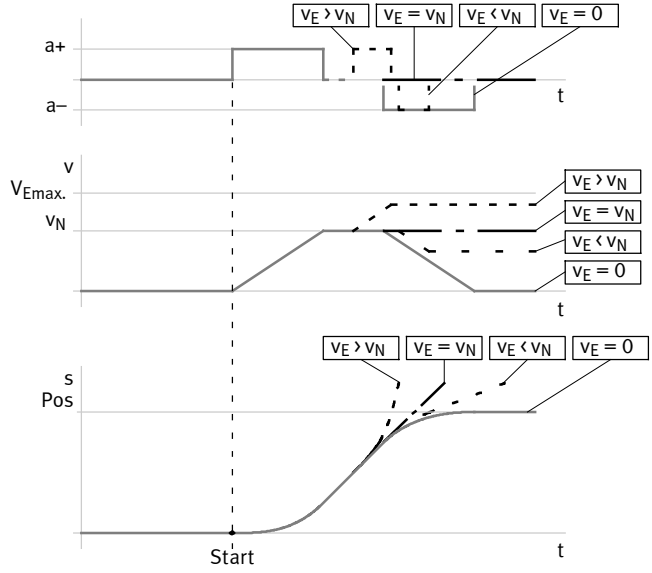
Parameter	Description
t_d Start Delay	Setpoint value for the time delay until the current positioning record is started.

Tab. 6.9 Parameter: Start delay

Parameter: Final velocity

The diagram shows the course for “acceleration/velocity/position” as a function of the “Final velocity” parameter. The following variants are represented:

– Final velocity $v_E = 0$ (default setting, linear axis = 0 mm/s, rotative axis = 0 rpm)
– Final velocity v_E ‹ velocity v_N
– Final velocity v_E = velocity v_N
– Final velocity v_E › velocity v_N



a+ Acceleration
a– Deceleration
v_N Velocity
Pos Position

Parameter	Description
v_E Final Velocity[1)]	Setpoint value for the end speed at which the position is travelled through and subsequently continued. In order to achieve short acceleration times/time delays to the subsequent positioning record, the end speed v_E can be parameterised to the same value as the speed v_N of the subsequent positioning record.

1) The max. value is limited by the setpoint value specification of the “axis” parameter.

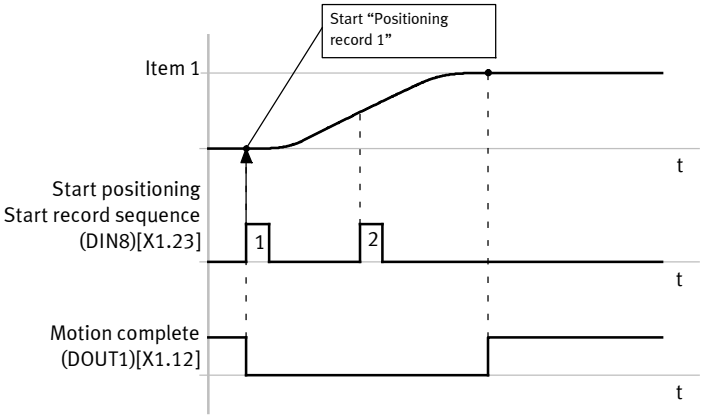
Tab. 6.10 Parameter: Final velocity

Parameter: Start condition

One of the conditions “Ignore/delay/interrupt” can be configured for the start of the new positioning record via the “Start condition” parameter.

Parameter: Start condition “Ignore”

The diagram shows the course for the parameter “Start condition: Ignore”.

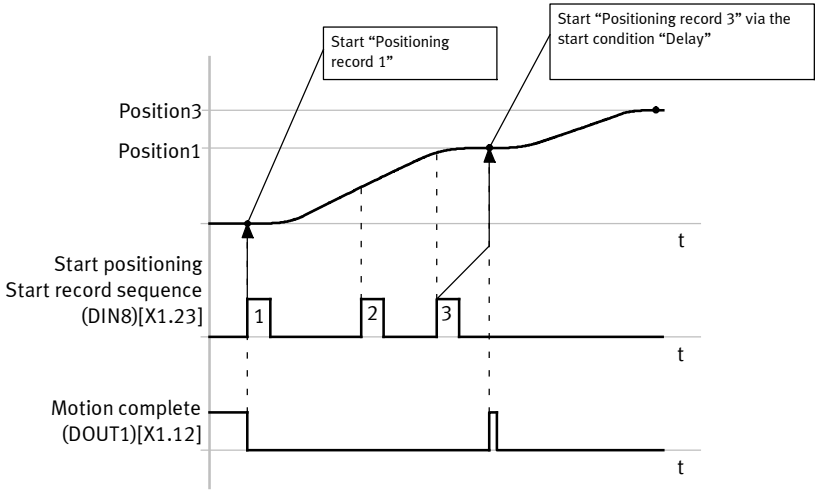


Parameter	Description
Start condition	– Ignore: Other start signals do not have any effect when executing the current positioning record. The current positioning record moves to parameterised position 1. After reaching the position the next positioning record can be started.

Tab. 6.11 Parameter: Start condition “Ignore”

Parameter: Start condition “Delay”

The diagram shows the course for the parameter “Start condition: Delay”.

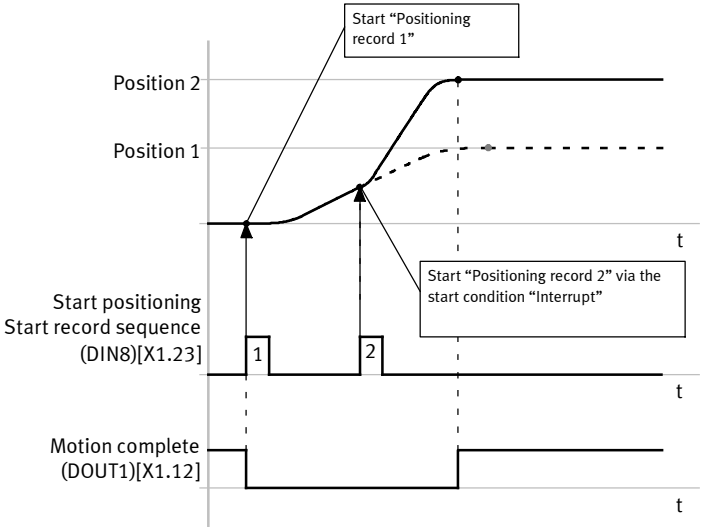


Parameter	Description
Start condition	– Delay: The current positioning record moves to parameterised position 1. The next positioning record then starts. The positioning record that was last activated with the start signal is moved.

Tab. 6.12 Parameter: Start condition “Delay”

Parameter: Start condition “Interrupt”

The diagram shows the course for the parameter “Start condition: Interrupt”.



Parameter	Description
Start condition	– Interrupt: The current positioning record is interrupted and the next record is started immediately. Note: The error message “E421” is generated if the new setpoint position cannot be approached from the current drive status (actual position value, actual speed value) (e.g. if the new position cannot be approached with the parameterised delay due to the current travel speed).

Tab. 6.13 Parameter: Start condition “Interrupt”

6.6 Record linking mode

6.6.1 Function: Record linking mode

In the record linking mode the motor controller controls the linking of multiple individual records into a record sequence. The motor controller can be controlled via the active fieldbus (CANopen/ PROFIBUS DP/DeviceNet) or the digital inputs (mode 2 ➔ page 49). Through record selection, the controller-internal positioning controller receives the parameters “Positioning records (1...63)” and “Positioning record profiles (0...7)” of the selected record sequence. The controller-internal positioning controller calculates the positioning curve from these parameters and transfers the position setpoint values cyclically to the position control. In addition to the individual record mode, the conditions for continuation and sequence control can be parameterised in the record linking mode.

The positioning record “0” is reserved exclusively for homing in the homing mode and cannot be integrated into a record sequence.

Activating the record linking mode via fieldbus/digital inputs

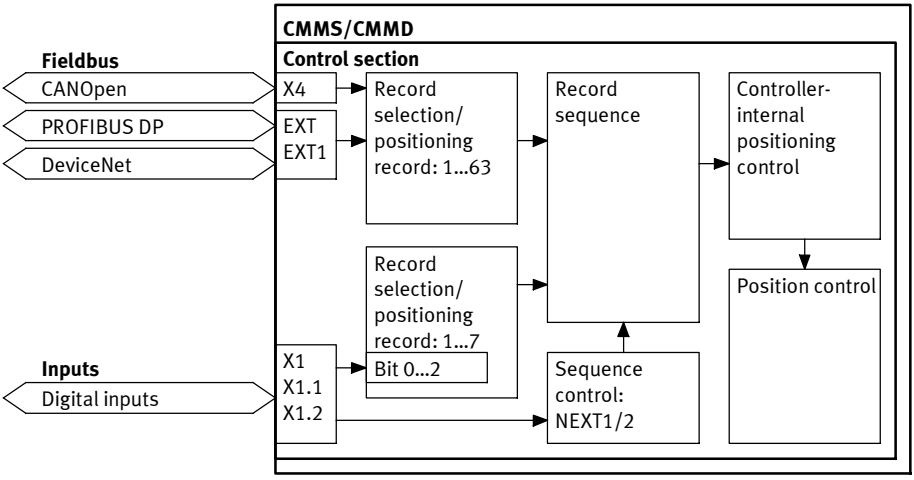
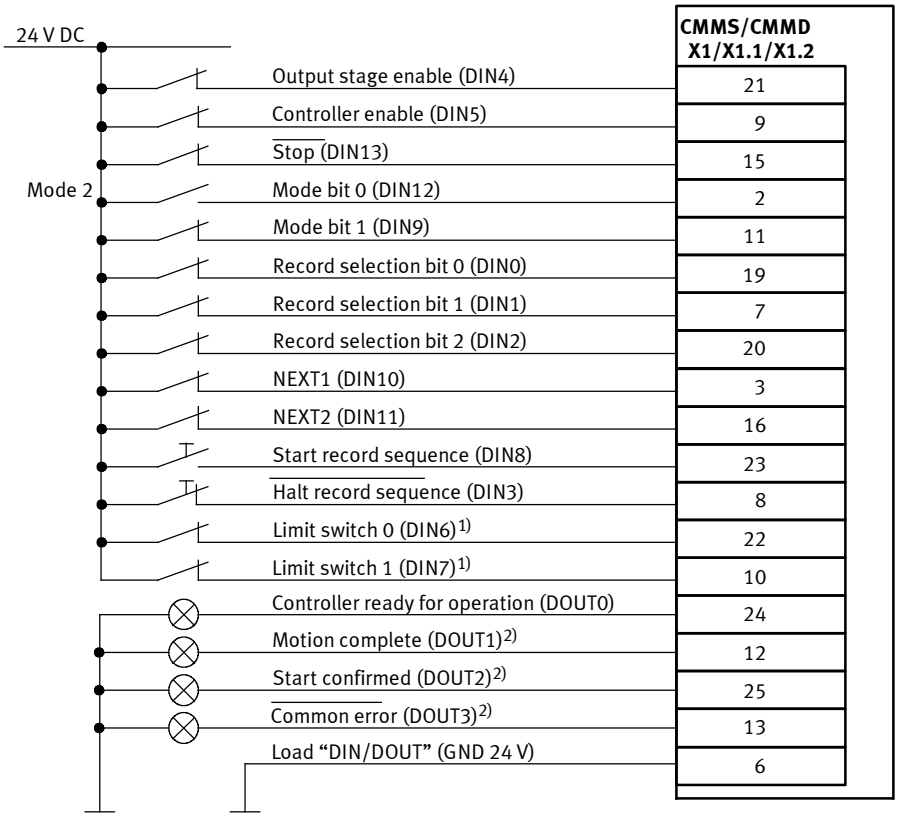


Fig. 6.12 Overview: Activating the record linking mode via fieldbus and digital inputs

6.6.2 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the record linking mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 6.13 Connection: Digital inputs/outputs

Activating the positioning record via digital inputs (record selection bit 0...2)

The first positioning records (1...7) for record linking are selected via the record selection bit 0...2.

Note

In the record linking mode, the record selection bits 3...5 are used for the digital input signals “Halt record sequence/NEXT1/NEXT2”. The positioning records 8...63 cannot be directly controlled via the “digital inputs/outputs” control interface. These positioning records can only be used in the record sequence via the “destination” parameter.

Positioning record	**Record selection**[1)]		
	Bit 2 (2^2) (DIN2) [X1.20] [X1.1.20] [X1.2.20]	Bit 1 (2^1) (DIN1) [X1.7] [X1.1.7] [X1.2.7]	Bit 0 (2^0) (DIN0) [X1.19] [X1.1.19] [X1.2.19]
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
...			
7	1	1	1

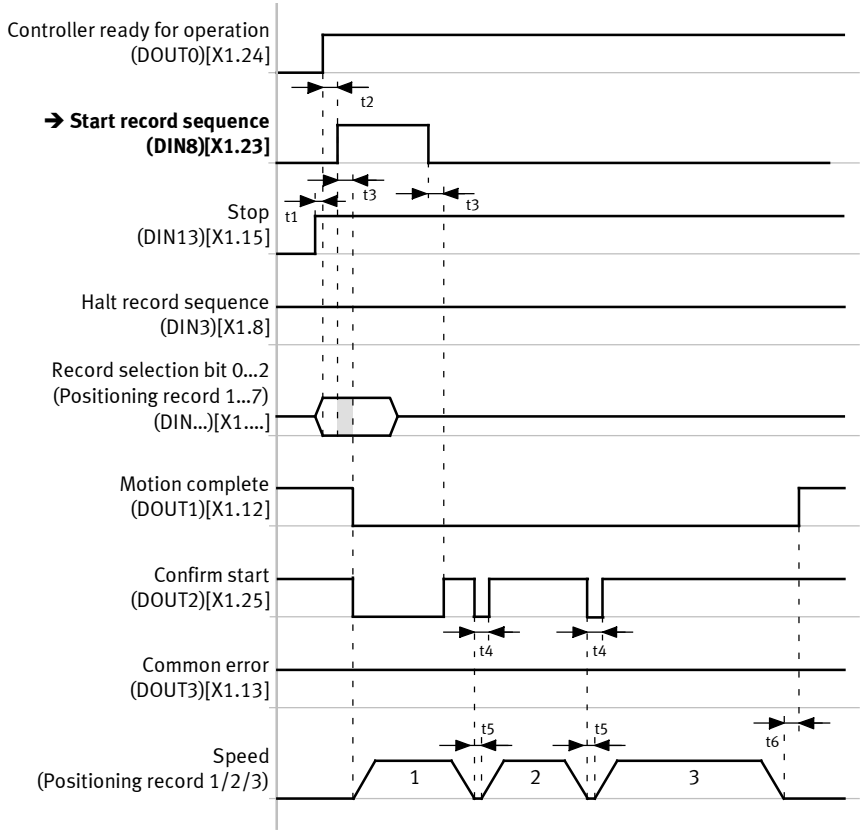
1) In the record linking mode, the digital inputs (DIN3/DIN10/DIN11) are used for the digital input signals “Halt record sequence/NEXT1/NEXT2”.

Tab. 6.14 Overview: Activating the positioning record via digital inputs (record selection bit 0...2)

6.6.3 Timing diagram: Start/interrupt/cancel record sequence

Timing diagram: Starting the record sequence via the start record sequence signal

The timing diagram shows the starting of the record sequence via the start record sequence signal (DIN8).

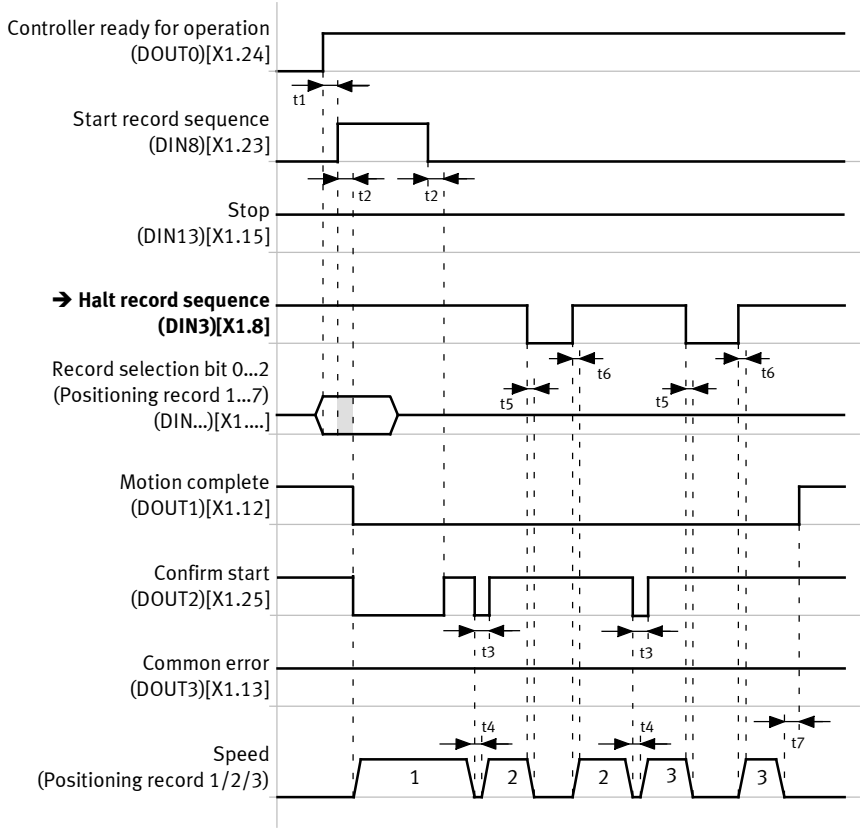


t1 ≤ 2.5 ms
t2 ≥ 2.5 ms
t3 ≤ 5 ms
t4 ≈ 16 ms
t5 ≤ 2.5 ms
t6 = ... ms (FCT: Dependent on the parameters “Message window” and “Damping time” in the message “Destination reached”)

Fig. 6.14 Timing diagram: Starting the record sequence via the start record sequence signal

Timing diagram: Interrupting the record sequence via the halt record sequence signal

The timing diagram shows the interruption and continuation of the record sequence via the halt record sequence signal (DIN3).

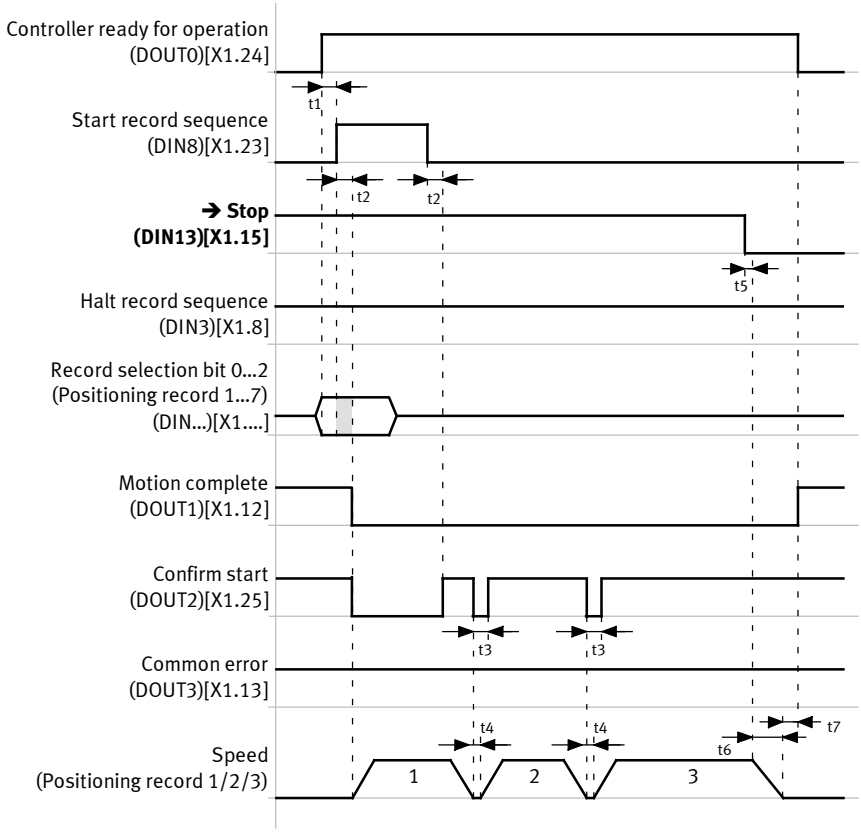


t1 ≥ 2.5 ms
t2 ≤ 5 ms
t3 ≈ 16 ms
t4 ≤ 2.5 ms
t5 = ... ms (FCT: Dependent on the deceleration ramp)
t6 = ... ms (FCT: Dependent on the acceleration ramp)
t7 = ... ms (FCT: Dependent on the parameters “Message window” and “Damping time” in the message “Destination reached”)

Fig. 6.15 Timing diagram: Interrupting the record sequence via the halt record sequence signal

Timing diagram: Cancelling the record sequence via the stop signal

The timing diagram shows the stopping of the record sequence via the stop signal (DIN13).

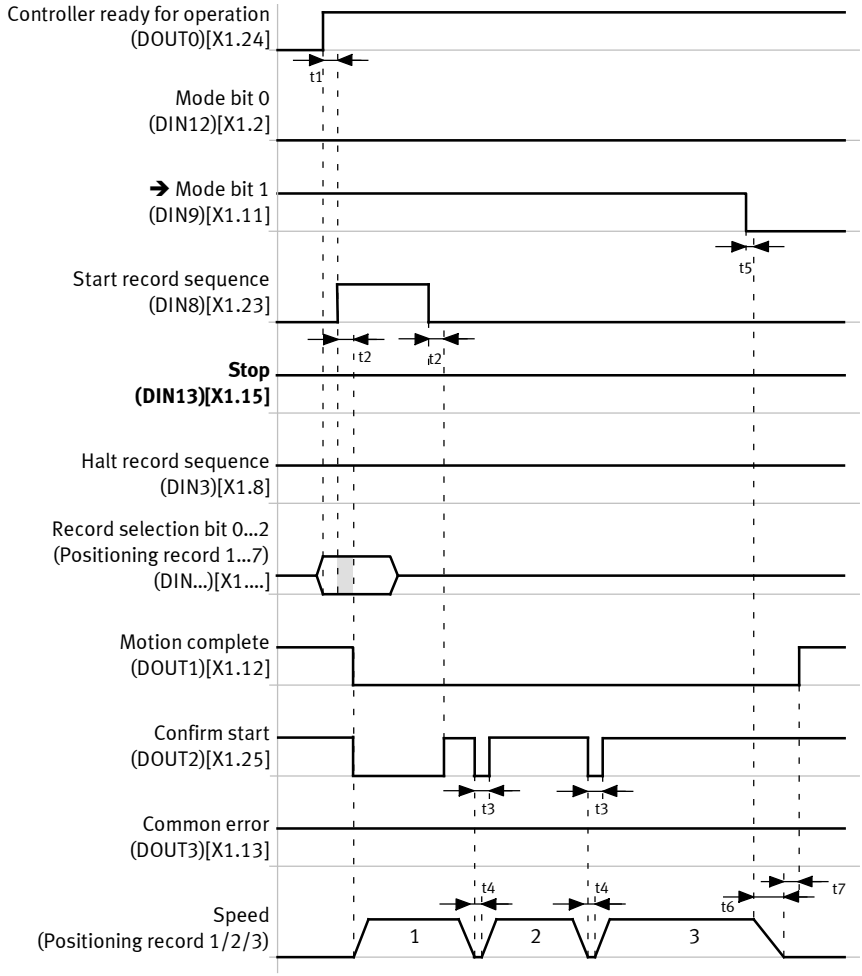


t1 ≥ 2.5 ms
t2 ≤ 5 ms
t3 ≈ 16 ms
t4 ≤ 2.5 ms
t5 ≤ 2.5 ms
t6 = ... ms (FCT: Dependent on the parameter "Stop input" in the stop decelerations)
t7 = ... ms (FCT: Dependent on the parameters "Message window" and "Damping time" in the message "Destination reached")

Fig. 6.16 Timing diagram: Cancelling the record sequence via the stop signal

Timing diagram: Cancelling the record sequence via mode bit 1

The timing diagram shows the cancellation of the record sequence via mode bit 1 (DIN9).

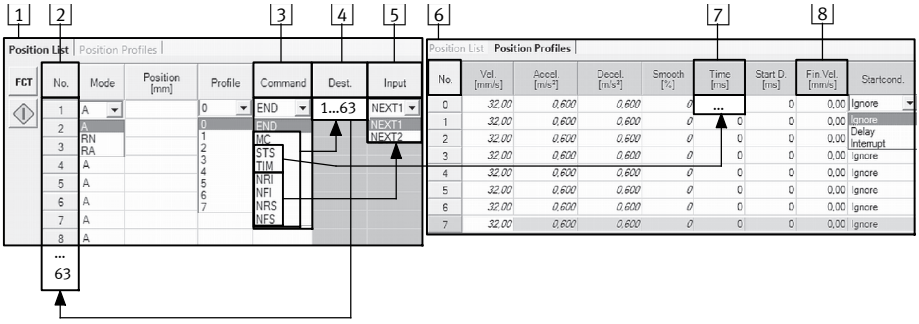


t1 ≥ 2.5 ms
t2 ≤ 5 ms
t3 ≈ 16 ms
t4 ≤ 2.5 ms
t5 ≤ 2.5 ms
t6 = ... ms (dependent on reaching the position of the current positioning record)
t7 = ... ms (FCT: Dependent on the parameters “Message window” and “Damping time” in the message “Destination reached”)

Fig. 6.17 Timing diagram: Cancelling the record sequence via mode bit 1

6.6.4 Parameterising the record linking mode

The following parameters (FCT) can be parameterised for the record linking mode:



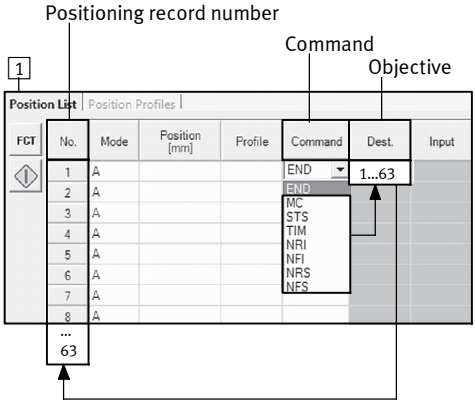
Parameter		Variant	Page
1	Position List		
2	Position List Number	1...63	144
3	Command for record continuation	END	144/145
		MC[1)]	145
		STS[2)]	146
		TIM[3)]	147
		NRI/NFI[4)]	148
		NRS/NFS[5)]	149
4	Destination	1...63 (2)	144
5	Input	NEXT1/NEXT2	148/149
6	Position Profiles		
7	Time		146/147
8	Final Velocity		151

1) Record continuation is effected via the Motion Complete signal
2) Record continuation is effected after expiration of the rest time
3) Record continuation is effected after expiration of the time
4) Record continuation is effected via the NEXT... signal
5) Record continuation is effected via the NEXT... signal and Motion Complete signal

Tab. 6.15 Overview: Positioning record table, positioning record list and positioning record profiles

Parameters: Positioning record number, command and destination

The diagram shows the relationship between the record selection/positioning record number and record continuation via the parameters “command/destination”.



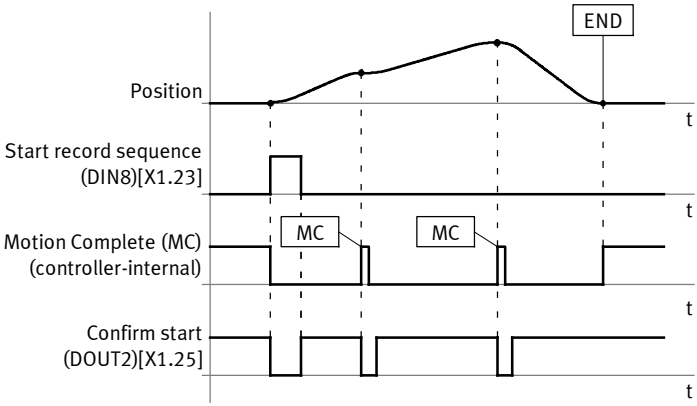
1 Positioning record list

Parameter	Description
Position List Number	Selection of the positioning record. – The first positioning record in the record sequence is selected via the record selection of the control interface.
Command	Selection of the record continuation type in the record sequence. The following commands can be used for record continuation: – MC (Motion Complete) ➔ page 145 – STS (rest) ➔ page 146 – TIM (time) ➔ page 147 – NRI/NFI (NEXT...) ➔ page 148 – NRS/NFS (NEXT... and Motion Complete) ➔ page 149 The record sequence is terminated with the “END” command.
Destination	Selection of the subsequent positioning record in the record sequence. – All positioning record numbers can be used as the destination.

Tab. 6.16 Parameters: Positioning record number, command and destination

Parameter: Command “MC (Motion Complete)/END”

The diagram shows record continuation via the parameter “Command: MC (controller-internal Motion Complete signal)” and the end of the record sequence via the parameter “Command: END”.

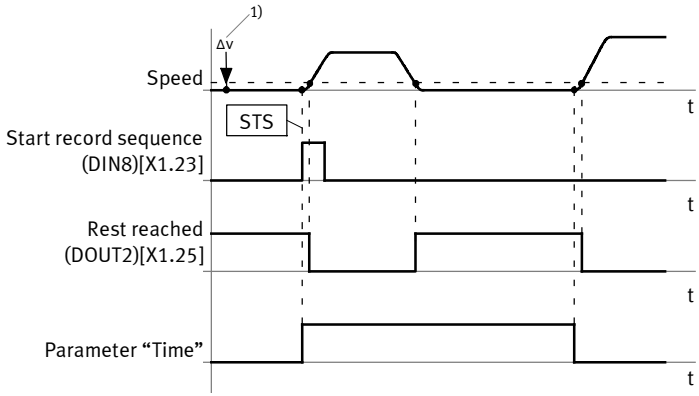


Parameter	Description
Command	MC = Motion Complete: Continuation takes place when the controller-internal Motion Complete signal = high (position reached). END = End of record linking (record sequence): The record sequence is ended upon reaching the position.

Tab. 6.17 Parameter: Command “MC (Motion Complete)/END”

Parameter: Command “STS” (rest) and time

The diagram shows record continuation via the command “STS (rest)” as a function of the parameter “Time”.



1) Message window “Velocity reached” ➔ page 63.

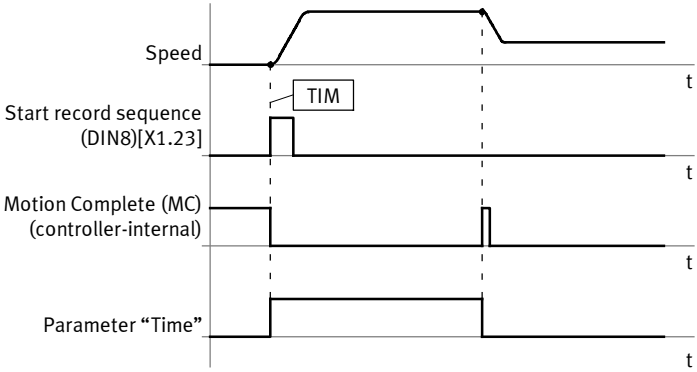
Parameter	Description
Command	STS = Continuation after expiration of the time at rest. Continuation takes place if the drive has reached rest and the parameterised time (positioning record profile parameter) has expired. Measurement of the time starts when the position set starts. Note: Rest not only means the end of the positioning record/record sequence, but also running to a stop (e.g. mechanical stop) at any position.
Time	Setpoint value for the time until the continuation is executed. The parameter is activated via the positioning record profile parameter “Command: STS”.

Tab. 6.18 Parameter: Command “STS” (rest) and time

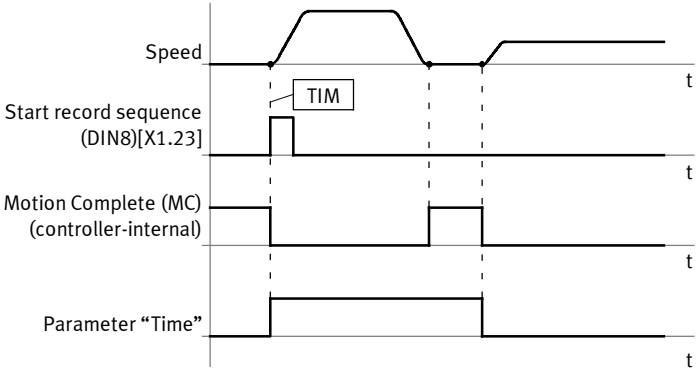
Parameter: Command “TIM” and time

The diagrams show record continuation via the parameter “Command: TIM (time)” as a function of the parameter “Time”. Continuation during a current positioning process and continuation after a closed positioning process are shown here by way of example.

1. Behaviour in the event of positioning time › time “TIM”.



1. Behaviour in the event of positioning time ‹ time “TIM”.

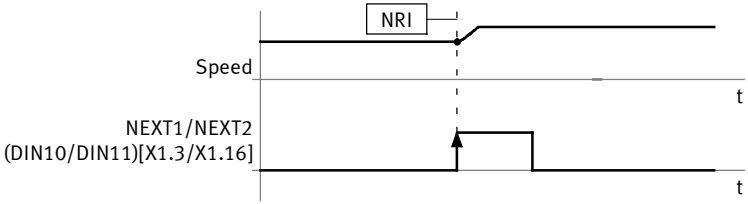


Parameter	Description
Command	TIM = Continuation after expiration of the time. Continuation takes place if the parametrised time (positioning record profile parameter) has expired. Measurement of the time starts when the position set starts.
Time	Setpoint value for the time until the continuation is executed. The parameter is activated via the positioning record profile parameter “Command: TIM”.

Tab. 6.19 Parameter: Command “TIM” and time

Parameter: Command “NRI” (rising edge “NEXT1/NEXT2”)

The diagram shows record continuation via the parameter “Command: NRI”.

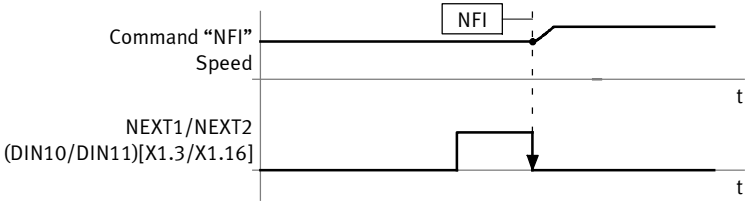


Parameter	Description
Command	NRI = Continuation with rising edge (NEXT...): The current positioning record is interrupted with the rising edge (NEXT1/2), and the next positioning record in the record sequence is started immediately.

Tab. 6.20 Parameter: Command “NRI”

Parameter: Command “NFI” (falling edge “NEXT1/NEXT2”)

The diagram shows record continuation via the parameter “Command: NFI”.



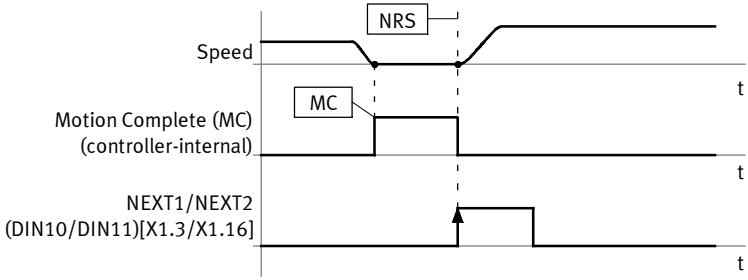
Parameter	Description
Command	NFI = Continuation with falling edge (NEXT...): The current positioning record is interrupted with the falling edge (NEXT1/2), and the next positioning record in the record sequence is started immediately.

Tab. 6.21 Parameter: Command “NFI”

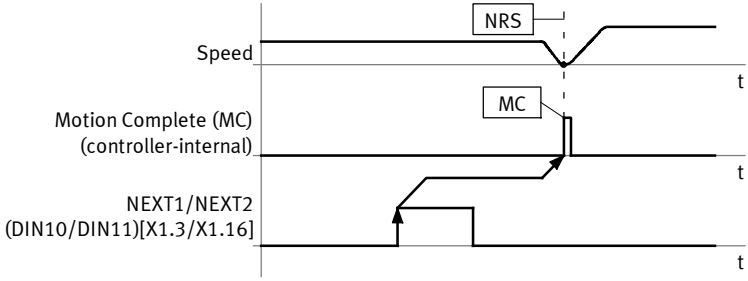
Parameter: Command “NRS” (Motion Complete (MC) and rising edge “NEXT1/NEXT2”)

The diagrams show record continuation via the parameter “Command: NRS”.

1. Behaviour in the event of signal sequence: Motion Complete (MC) before NEXT....



2. Behaviour in the event of signal sequence: Motion Complete (MC) after NEXT....



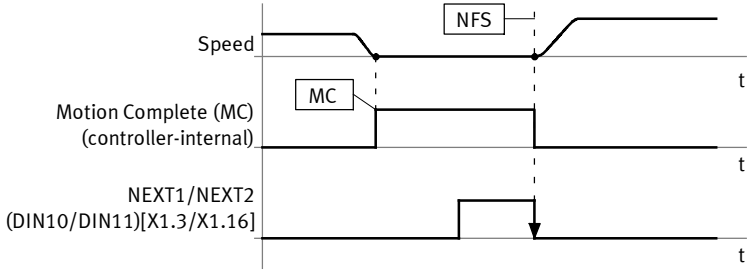
Parameter	Description
Command	NRS = Continuation with Motion Complete and rising edge (NEXT...): Continuation takes place when the controller-internal signal “Motion Complete = high” and a rising edge is detected at the digital input (NEXT1/2). The signals can occur in any sequence.

Tab. 6.22 Parameter: Command “NRS”

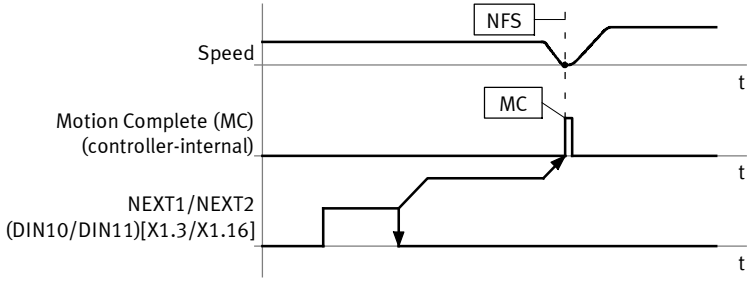
Parameter: Command “NFS” (Motion Complete (MC) and falling edge “NEXT1/NEXT2”)

The diagrams show record continuation via the parameter “Command: NFS”.

1. Behaviour in the event of signal sequence: Motion Complete (MC) before NEXT....



2. Behaviour in the event of signal sequence: Motion Complete (MC) after NEXT....

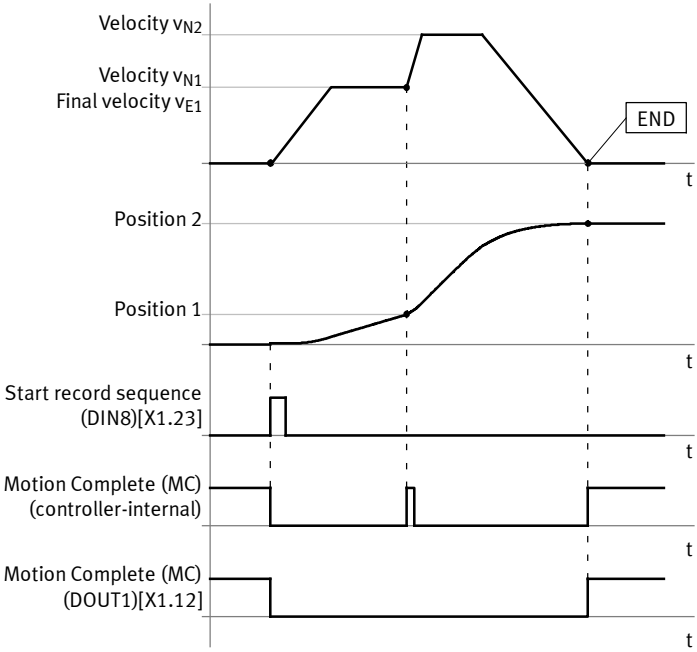


Parameter	Description
Command	NFS = Continuation with Motion Complete and falling edge (NEXT...): Continuation takes place when the controller-internal signal “Motion Complete = high” and a falling edge is detected at the digital input (NEXT1/2). The signals can occur in any sequence.

Tab. 6.23 Parameter: Command “NFS”

Parameter: Final velocity

The diagram shows the effect of the parameter “Final velocity” on record continuation. In the first positioning record the parameters “Final velocity v_{E1}/velocity v_{N1}” have the same value.



1) Final velocity v_E = velocity v_N

Parameter	Description
v_E Final Velocity1)	Setpoint value for the final velocity at which the position is travelled through and subsequently continued.

1) The max. value is limited by the setpoint value specification of the “axis” parameter.

Tab. 6.24 Parameter: Command “Final velocity”

6.7 Interpolated positioning mode

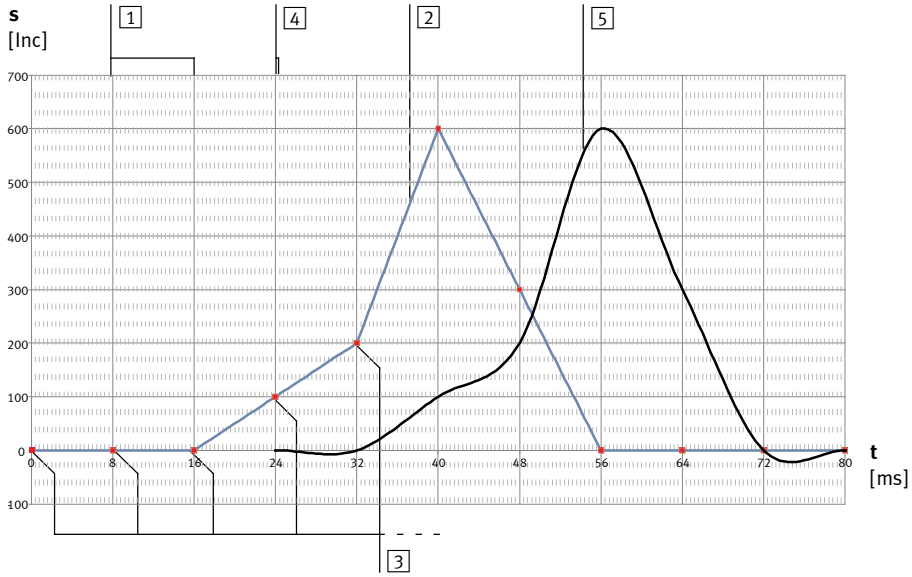
6.7.1 Function: Interpolated positioning mode

The interpolated positioning mode (IP) permits specification of setpoint position values in a multi-axis application of the motor controller. For this, synchronisation telegrams (SYNC) and position setpoint values are specified by a higher-order controller in a fixed time slot pattern (synchronisation interval). Since the interval is normally greater than one position controller cycle, the motor controller (interpolator) independently interpolates the setpoint values between two specified position values
➔ Fig. 6.18.

The shortest synchronisation interval is 6.4 ms. This is also the default value in the interpolation_time_period object ($60C2_h$). The external position setpoint values are interpolated internally in the 400 µs position controller cycle.
Recommendation for an optimal path interpolation:

- Set the sync interval in integer multiples of 400 µs, e.g. 8 ms, 10 ms, 12 ms, ...

For additional information ➔ “Device profile CiA 402” description, GDCP-CMMS/D-C-CO-...



1 Interpolation cycle 8 ms (preset by the controller)
2 Specification of the position setpoint values
3 Support points (in the interpolation cycle)
4 Position controller cycle 400 µs
5 Internal setpoint value of the position controller in a 400 µs position controller cycle

Fig. 6.18 Interpolated positioning mode

Activating the interpolated positioning mode via fieldbus

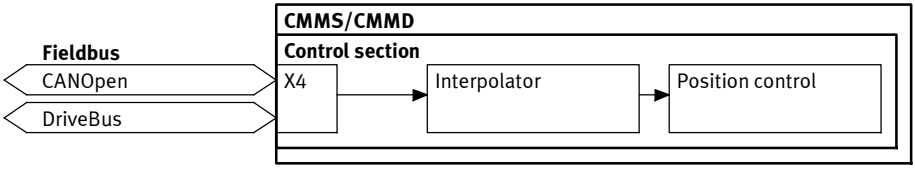
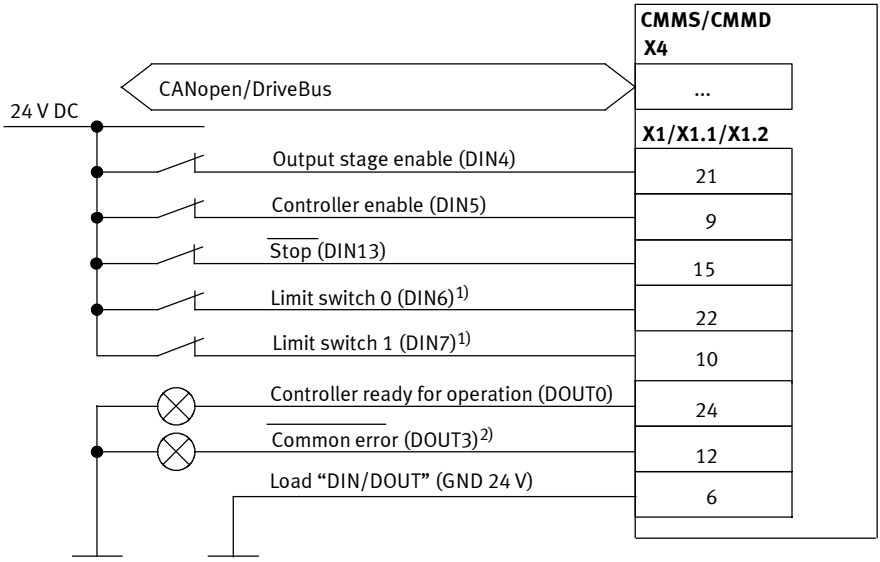


Fig. 6.19 Overview: Activating the interpolated positioning mode via fieldbus

6.7.2 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the interpolated positioning mode



1) The limit switches are set by default to N/C contact (configuration over FCT)
2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 6.20 Connection: Digital inputs/outputs

6.8 Homing mode/homing

6.8.1 Function: Homing mode

In the homing mode, the homing point of the dimension reference system is ascertained via homing. The homing point is the absolute point of reference for the axis zero point and the project zero point of the dimension reference system. Homing can be executed via the active fieldbus (CANopen/DriveBus/ PROFIBUS DP/DeviceNet/RS485), the digital inputs (mode 0 ➔ page 49) or the Festo Configuration Tool (FCT). Through direct application or record selection (positioning record 0) the controller-internal positioning controller receives the homing parameters. The controller-internal positioning controller calculates the homing curve from these parameters and transfers the position setpoint values cyclically to the position control. The homing parameters can be parameterised via fieldbus or the Festo Configuration Tool (FCT).

For homing, the following settings must be parameterised in the Festo Configuration Tool (FCT):

– Homing ➔ page 161
– Measuring system ➔ page 75

Note

When using drives with a single-turn absolute encoder (CMMS/D-AS) or incremental encoder (CMMS-ST), the offset data “Homing point of the measuring system” will be erased from the main memory if the power supply for the “control section” is interrupted (e.g. power failure).

– After each interruption to the power supply for the “control section” conduct a homing process to align the homing point of the dimension reference system and the zero point of the motor encoder.

Activating the homing mode via fieldbus/digital inputs

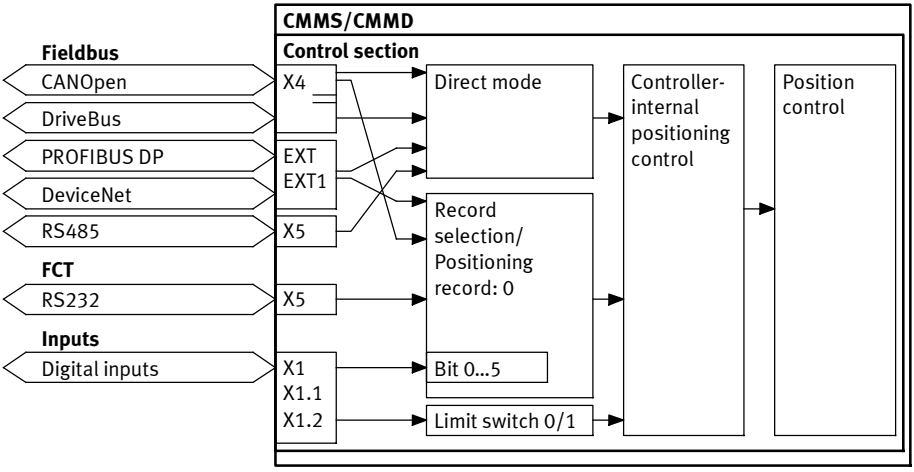
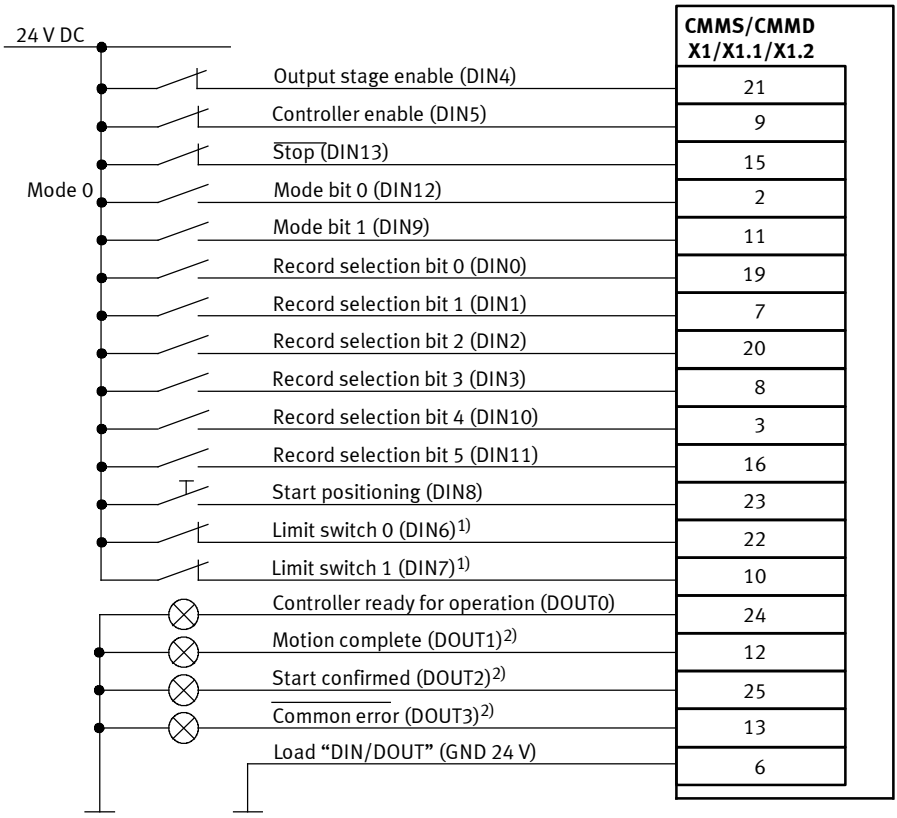


Fig. 6.21 Overview: Activating the homing mode via fieldbus and digital inputs

6.8.2 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the homing mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 6.22 Connection: Digital inputs/outputs

Activating the positioning record via digital inputs (record selection bit 0...5)

The positioning record (0) for homing is selected via the record selection bit 0...5.

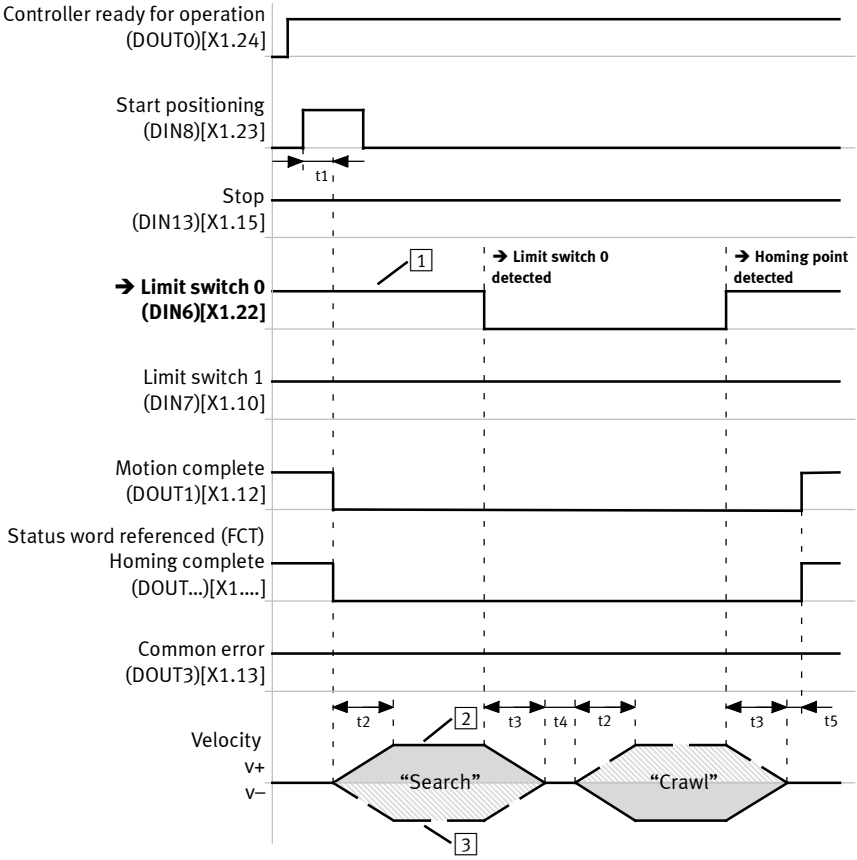
Positioning record	**Record selection**					
	Bit 5 (2^5) (DIN11) [X1.16] [X1.1.16] [X1.2.16]	Bit 4 (2^4) (DIN10) [X1.3] [X1.1.3] [X1.2.3]	Bit 3 (2^3) (DIN3) [X1.8] [X1.1.8] [X1.2.8]	Bit 2 (2^2) (DIN2) [X1.20] [X1.1.20] [X1.2.20]	Bit 1 (2^1) (DIN1) [X1.7] [X1.1.7] [X1.2.7]	Bit 0 (2^0) (DIN0) [X1.19] [X1.1.19] [X1.2.19]
0	0	0	0	0	0	0

Tab. 6.25 Overview: Activating the positioning record via digital inputs (record selection bit 0...5)

6.8.3 Timing diagram: Cancelling homing to limit switch/stop

Timing diagram: Homing to limit switch

The timing diagram shows the search for limit switch “0” and the determination of the homing point.
For additional information on the “limit switch” homing method ➔ page 161.



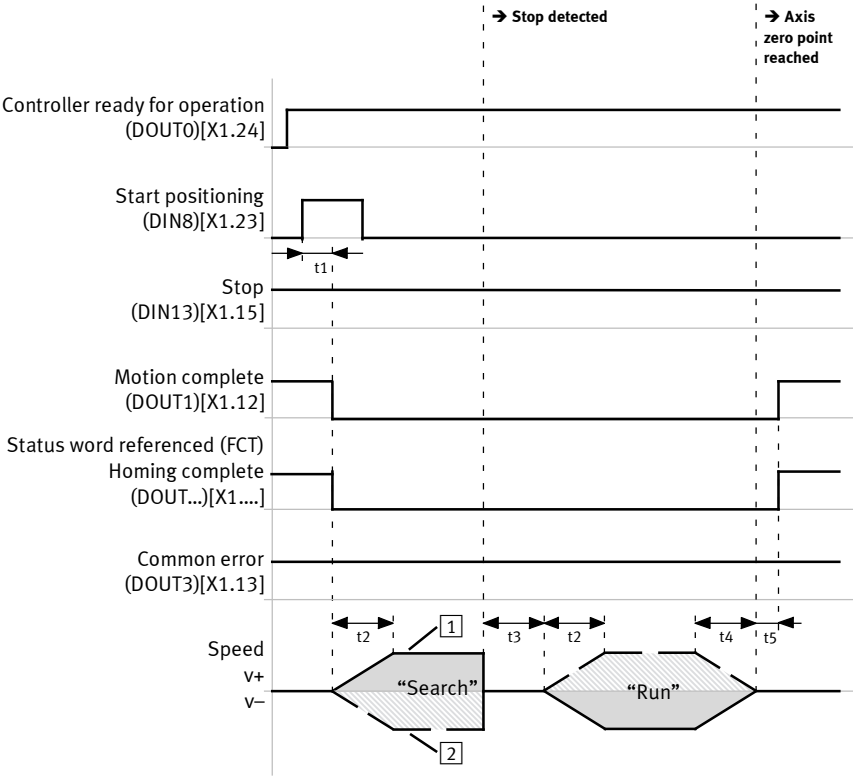
t1 ≤ 5 ms
t2 = ... ms (dependent on the acceleration ramp)
t3 = ... ms (dependent on the deceleration ramp)
t4 ≤ 2.5 ms
t5 = ... ms (FCT: Dependent on the parameters “Message window” and “Damping time” in the message “Destination reached”)

1 Example: Limit switch with “Normally closed” switching function
2 Travel curve with “Positive limit switch” homing methods
3 Travel curve with “Negative limit switch” homing methods

Fig. 6.23 Timing diagram: Starting homing to the limit switch via the start positioning signal

Timing diagram: Homing to stop

The timing diagram shows the search for the stop and the subsequent approach of the axis zero point.
For additional information on the “stop” homing method ➔ page 161.



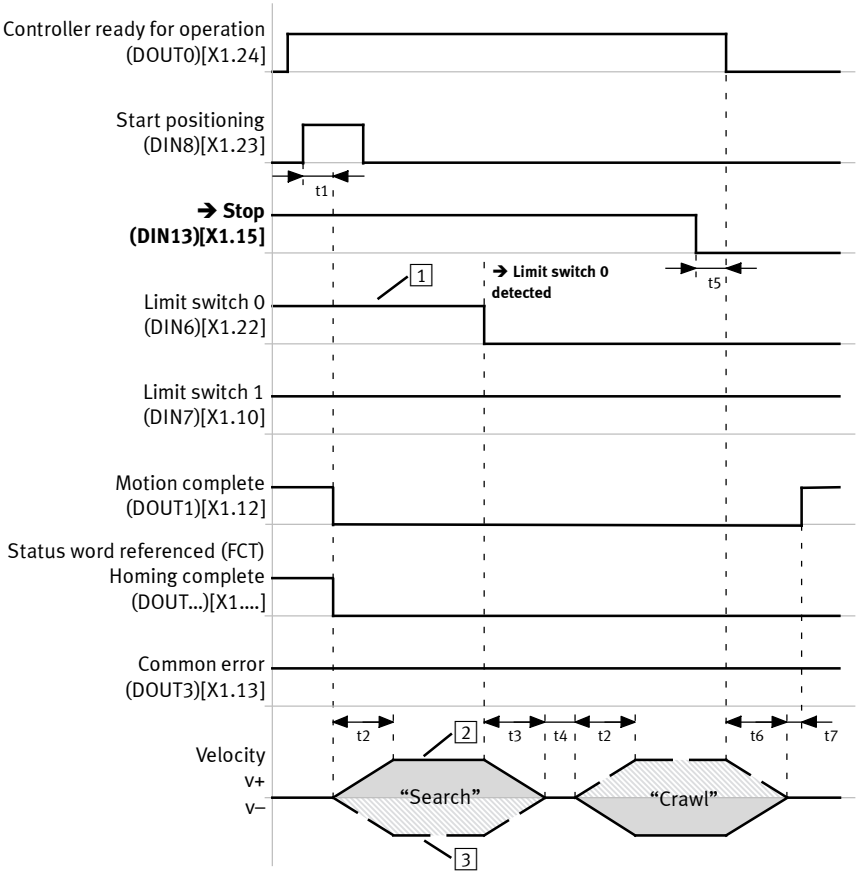
t1 ≤ 5 ms
t2 = ... ms (FCT: Dependent on the acceleration ramp)
t3 = ... ms (dependent on the torque threshold (FCT) and damping characteristic of the stop)
t4 = ... ms (FCT: Dependent on the deceleration ramp)
t5 = ... ms (FCT: Dependent on the parameters “Message window” and “Damping time” in the message “Destination reached”)

1 Travel curve with “Positive stop” homing methods
2 Travel curve with “Negative stop” homing methods

Fig. 6.24 Timing diagram: Homing to stop

Timing diagram: Cancel homing via Stop signal

The timing diagram shows the stopping of the homing process via the stop signal (DIN13).

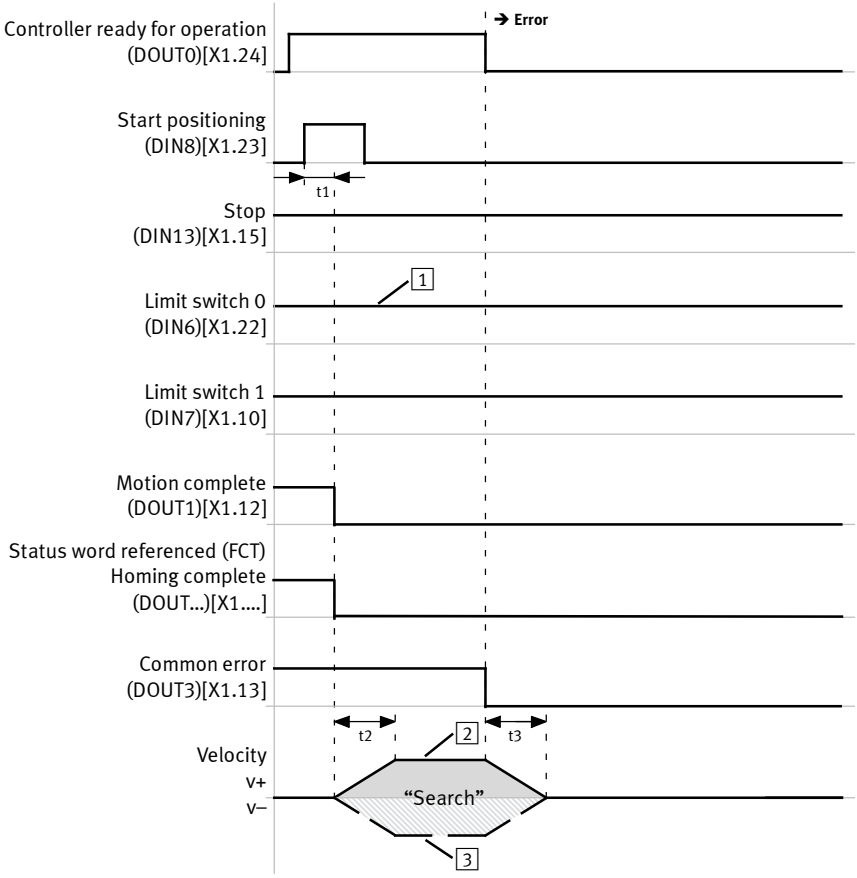


t1 ≤ 5 ms
t2 = ... ms (dependent on the acceleration ramp)
t3 = ... ms (dependent on the deceleration ramp)
t4 ≤ 2.5 ms
t5 ≤ 2.5 ms
t6 = ... ms (FCT: Dependent on the parameter "Stop input" in the stop decelerations)
t7 = ... ms (FCT: Dependent on the parameters "Message window" and "Damping time" in the message "Destination reached")
1 Example: "Normally closed" limit switch type
2 Travel curve with "Positive limit switch" homing methods
3 Travel curve with "Negative limit switch" homing methods

Fig. 6.25 Timing diagram: Cancelling homing via stop signal

Timing diagram: Cancelling homing through an error

The timing diagram shows as an example the cancellation of the homing process due to an error (e.g. as a result of a following error).



t1 ≤ 5 ms
t2 = ... ms (dependent on the acceleration ramp)
t3 = ... ms (dependent on the configuration “error function” in the error management and the corresponding parameter in the stop deceleration)

1 Example: “Normally closed” limit switch type
2 Travel curve with “Positive limit switch” homing methods
3 Travel curve with “Negative limit switch” homing methods

Fig. 6.26 Timing diagram: Cancelling homing through an error

6.8.4 Configuring and parameterising the homing mode/homing

The following parameters (FCT) can be configured/parameterised for the homing mode (homing):

Settings	Description
Homing method	
Destination	The following destinations (homing methods) can be configured for homing: – Actual position ➔ page 164. – Limit switch ➔ page 165. – Limit switch with zero pulse ➔ page 166. – Block ➔ page 167. – Block with zero pulse ➔ page 168. – Zero pulse ➔ page 169.
Direction	For homing, the following search directions can be configured: – Positive direction – Negative direction

Settings	Description
Parameters	
(Search): Travel to the limit switch or stop	
Velocity	Setpoint value for travel with “Search” speed.
Acceleration	Setpoint value for acceleration to “Search” speed or for deceleration to rest. Note: Parameterise the deceleration sufficiently high so that the drive does not overrun the limit switch too far.
Crawl: Travel to the homing point	
Velocity	Setpoint value for travel with “Crawl” speed. Note: Parameterise the speed very low so that the homing point can be detected precisely by the motor controller.
Acceleration	Setpoint value for acceleration to “Crawl” speed or for deceleration to rest.
Running: Travel to the axis zero point	
Velocity	Setpoint value for travel with “Run” speed.
Acceleration	Setpoint value for acceleration to “Run” speed or for deceleration to rest.
Additional parameters	
Torque Threshold	Requirement: Homing method “Stop” has been activated. Threshold value for the torque related to the nominal torque at which the stop is detected.
Axis Zero Point	Setpoint value for the distance to the homing point.
Options	
Go to the axis zero point after homing	If this option is activated, the drive is automatically driven to the axis zero point after every successful homing.
Homing at controller enable	“Digital inputs/outputs” control interface: – Homing is started automatically with each positive edge of the controller enable signal (DIN5) when the output stage enable (DIN4)[X1.21] = 24 V DC. “Fieldbus” control interface: – Homing is started automatically with each enable (control data) when the output stage enable (DIN4)[X1.21] and the controller enable (DIN5)[X1.9] = 24 V DC.

Settings	Description
Options	
Save Offset To Encoder	By selecting this option the offset data is transferred from the zero point synchronisation (dimension reference system and motor encoder) and stored permanently in the multi-turn absolute encoder ➔ page 170.

Tab. 6.26 Configure and parameterise homing

Homing methods

The options for the homing method are dependent on the selected axis, the application and the condition of the system.

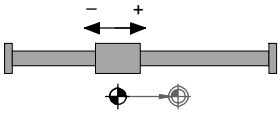
Accuracy of the homing point

To increase the absolute positioning accuracy, the zero pulse of the motor encoder can be used for the evaluation.

Software end positions

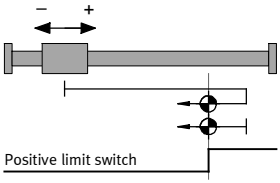
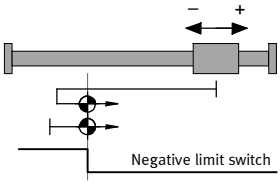
The software end positions are deactivated with the start of homing and reactivated after completion of homing.

Current position (No homing is carried out)

Code		Description	
hex	dec		
23 h	35	**Current position** 1. The current position is taken as the homing point. 2. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	

Tab. 6.27 Overview: Current position

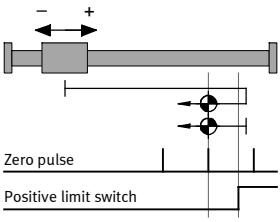
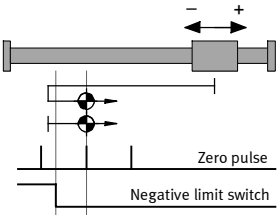
Homing to limit switch

Code hex	Code dec	Description	
12 h	18	**Positive limit switch** 1. Search for limit switch in the positive direction[1]: Travel with “Search” speed in a positive direction until the limit switch has been detected. 2. Search for homing point in the negative direction: Travel with “Crawl” speed in a negative direction until the limit switch switches back into the neutral position. This position is taken as the homing point. 3. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	
11 h	17	**Negative limit switch** 1. Search for limit switch in the negative direction[1]: Travel with “Search” speed in a negative direction until the limit switch has been detected. 2. Search for homing point in the positive direction: Travel with “Crawl” speed in a positive direction until the limit switch switches back into the neutral position. This position is taken as the homing point. 3. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	

1) If the limit switch is active, continue at 2nd point.

Tab. 6.28 Overview: Homing to limit switch

Homing to limit switch and zero pulse signal (N/#N)

Code hex	Code dec	Description	
02 h	02	**Positive limit switch and zero pulse[1)]** 1. Search for limit switch in the positive direction[2)]: Travel with “Search” speed in a positive direction until the limit switch has been detected. 2. Search for homing point in a negative direction: Travel with “Crawl” speed in a negative direction until the limit switch switch is back at the neutral position and the first zero pulse has been detected. This position is taken as the homing point. 3. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	
01 h	01	**Negative limit switch and zero pulse[1)]** 1. Search for limit switch in the negative direction[2)]: Travel with “Search” speed in a negative direction until the limit switch has been detected. 2. Search for homing point in a positive direction: Travel with “Crawl” speed in a negative direction until the limit switch switch is back at the neutral position and the first zero pulse has been detected. This position is taken as the homing point. 3. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	

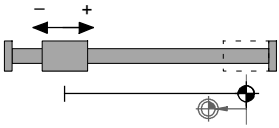
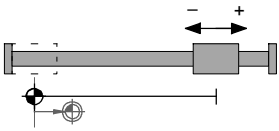
1) Motors have shaft encoder with zero pulse as standard.

2) If the limit switch is active, continue at 2nd point.

Tab. 6.29 Overview: Homing to limit switch and zero pulse signal (N/#N)

Homing to stop

The motor controller must not permanently control to the stop.
Recommendation: Parameterise an axis zero point outside the effective range of the stop and end-position cushioning (e.g. ≥ 3 mm) and activate the FCT option “Travel to axis zero point after homing”.

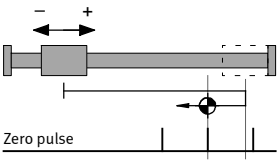
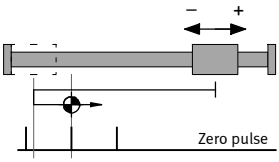
Code hex	Code dec	Description	
EEh	-18	**Positive stop**[1)] 1. Search for stop/homing point in the positive direction: Travel with “Search” speed in a positive direction until the stop[2)] has been detected. This position is taken as the homing point. 2. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	
EFh	-17	**Negative stop**[1)] 1. Search for stop/homing point in the negative direction: Travel with “Search” speed in a negative direction until the stop[2)] has been detected. This position is taken as the homing point. 2. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	

1) Limit switches are ignored during travel to the stop.

2) The stop is detected after the current has risen.

Tab. 6.30 Overview: Homing to stop

Homing to stop and zero pulse signal (N/#N)

Code hex	Code dec	Description	
FEh	-2	**Positive stop and zero pulse[1)2)]** 1. Search for stop in the positive direction: Travel with “Search” speed in a positive direction until the stop[3)] has been detected. 2. Search for homing point in the negative direction: Travel with “Crawl” speed in a negative direction until the first zero pulse has been detected. This position is taken as the homing point. 3. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	
FFh	-1	**Negative stop and zero pulse[1)2)]** 1. Search for stop point in the negative direction: Travel with “Search” speed in a negative direction until the stop[3)] has been detected. 2. Search for homing point in the positive direction: Travel with “Crawl” speed in a positive direction until the first zero pulse has been detected. This position is taken as the homing point. 3. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	

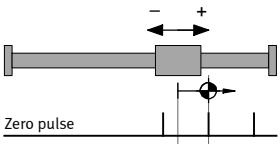
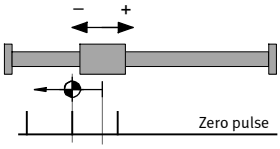
1) Motors have shaft encoder with zero pulse as standard.

2) Limit switches are ignored during travel to the stop.

3) The stop is detected after the current has risen.

Tab. 6.31 Overview: Homing to stop and zero pulse signal (N/#N)

Homing to zero pulse signal (N/#N)

Code hex	Code dec	Description	
22 h	34	**Zero pulse in positive direction**[1)] 1. Search for zero pulse in the positive direction: Travel with “Crawl” speed in a positive direction until the first zero pulse has been detected. This position is taken as the homing point. 2. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	
21 h	33	**Zero pulse in negative direction**[1)] 1. Search for zero pulse in the negative direction: Travel with “Crawl” speed in a negative direction until the first zero pulse has been detected. This position is taken as the homing point. 2. If an axis zero point is parameterised and the FCT option “Travel to axis zero point after homing” is activated: Travel with “Run” speed to the axis zero point.	

1) Motors have shaft encoder with zero pulse as standard.

Tab. 6.32 Overview: Homing to zero pulse signal (N/#N)

Option: Save zero point shift

Multi-turn absolute encoder

For drives with multi-turn absolute encoder, only one homing is required for commissioning to align the homing point of the dimension reference system and the zero point of the motor encoder. This offset data can be stored permanently in the multi-turn absolute encoder via the command “Save zero point shift”. If the power supply is interrupted, the offset data is not lost. When the power supply is switched on, drives with a multi-turn absolute encoder are always homed to the absolute encoder zero point stored in the motor encoder.

6.9 Jog mode

6.9.1 Function: Jog mode

The drive can be manually moved in the jog mode to any position within the parameterised limits (e.g. limit switches). The motor controller can be controlled in the jog mode directly via the active fieldbus (CANopen/PROFIBUS DP/DeviceNet), the digital inputs (mode 1 ➔ page 49) or the parameter interface (RS232, Festo Configuration Tool (FCT)). Through the direct application of the fieldbus, the digital inputs “Jog+ (DIN10)/Jog– (DIN11)” or the Festo Configuration Tool (FCT) “Jog‹‹/Jog››”, the controller-internal positioning control receives the travel direction for the jog mode. The controller-internal positioning controller calculates the jog curve from the jog parameters and transfers the position setpoint values cyclically to the position control. The drive first runs at creep speed in the jog mode. If, after expiration of the creep duration, control is still active, the drive accelerates to jog speed in order to travel through large paths quickly. Jog mode is quit with the falling edge of the jog signal.
This operating mode can be used in the following applications:

– Approaching the teach position
– Drive free running (e.g. after a malfunction)
– Manual running (manually operated feed)

The jog parameters can be parameterised via fieldbus or Festo Configuration Tool (FCT).

Activating the jog mode via fieldbus/FCT/digital inputs

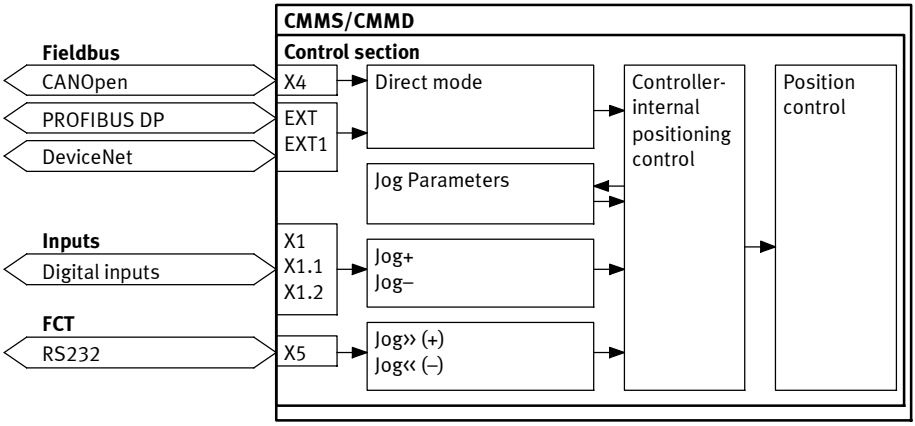
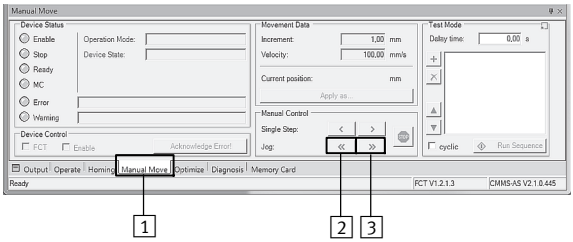


Fig. 6.27 Overview: Activating the jog mode via fieldbus/FCT/digital inputs

6.9.2 Jog mode via Festo Configuration Tool (FCT)

The jog mode can be manually controlled via the interfaces “Jog‹‹ (–)/Jog›› (+)” in the FCT window “Project output” in the online tab “Manual move”.

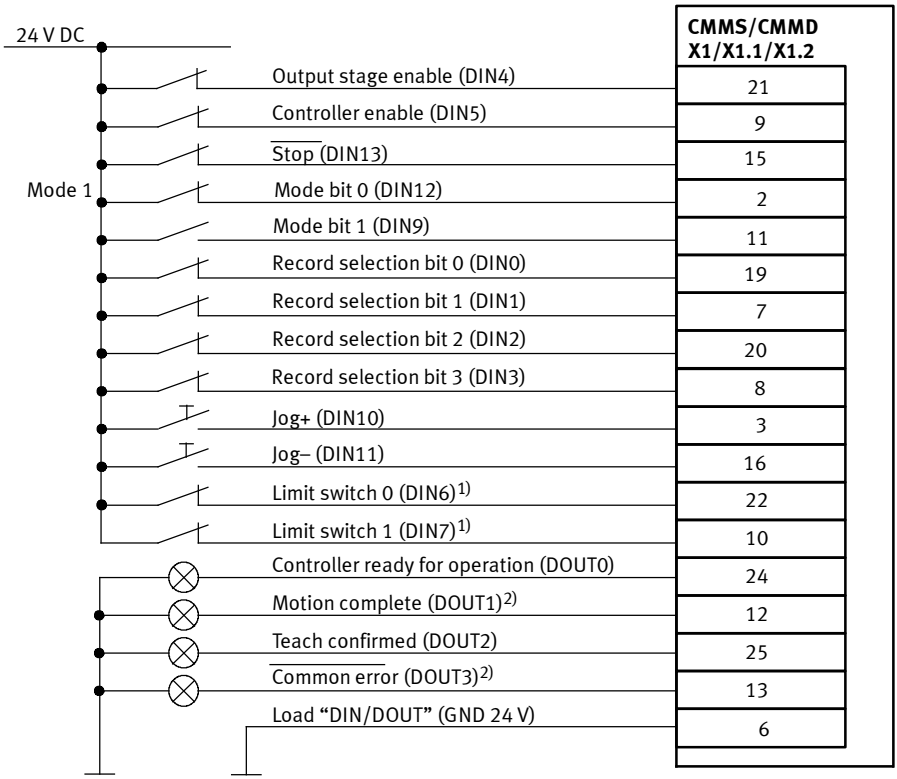


1 Manual Move
2 ‹‹: Jog in negative direction
3 ››: Jog in positive direction

Fig. 6.28 Manual jog via Festo Configuration Tool (FCT)

6.9.3 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the jog mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

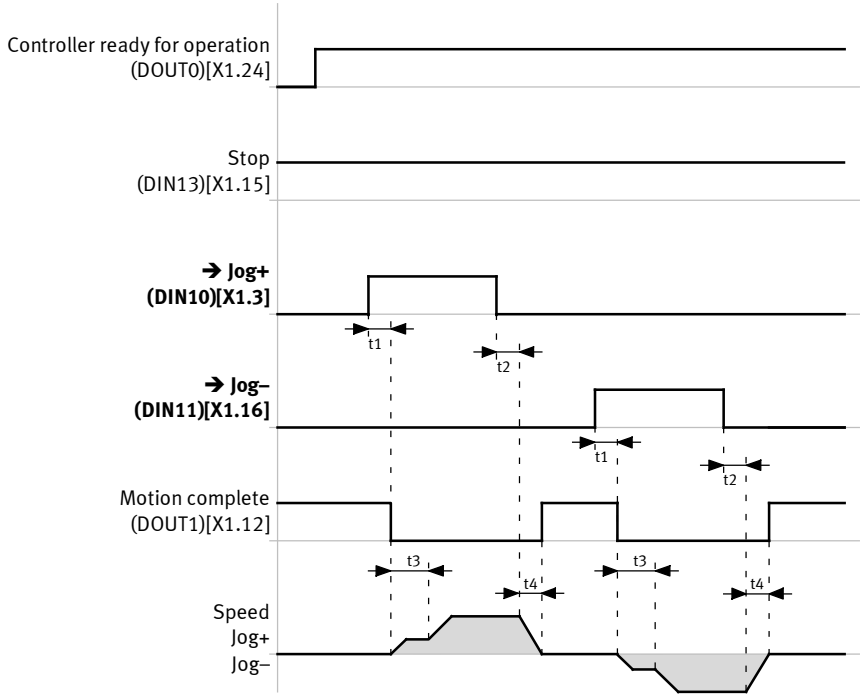
2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 6.29 Connection: Digital inputs/outputs

6.9.4 Timing diagram: Jog travel via jog+/jog–

Timing diagram: Individually actuating jog+/jog–

The timing diagram shows the course of jog travel with separate actuation of jog+/jog–.



t1 ≤ 5 ms
t2 ≤ 5 ms
t3 = ... ms (FCT: Dependent on the crawl duration ➔ page 176)
t4 = ... ms (FCT: Dependent on the jog deceleration ramp)

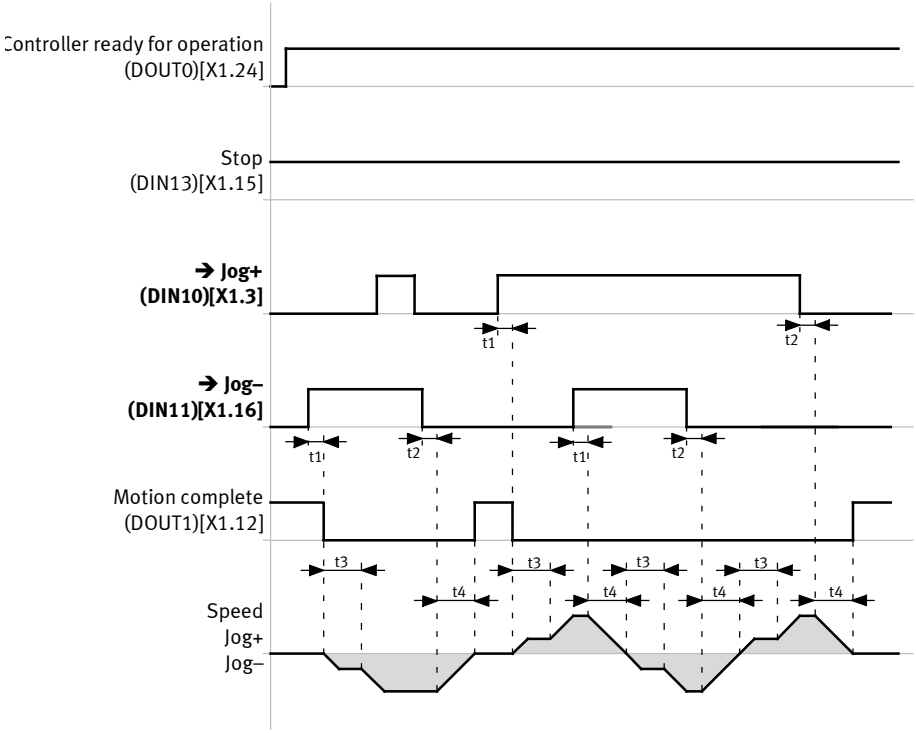
Fig. 6.30 Timing diagram: Jog travel via jog+/jog–

Timing diagram: Simultaneously actuating jog+/jog–

The timing diagram shows the course of jog travel with simultaneous actuation of jog+/jog–.

Priority of the jog signals

The signal “jog–” has a higher priority than the signal “jog+”. If both signals are active simultaneously, the signal “jog–” is executed.

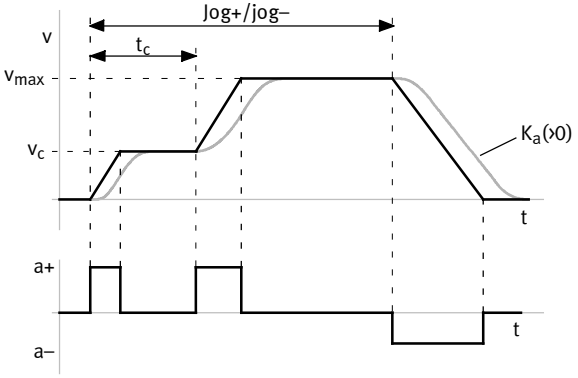


t1 ≤ 5 ms
t2 ≤ 5 ms
t3 = ... ms (FCT: Dependent on the crawl duration ➔ page 176)
t4 = ... ms (FCT: Dependent on the jog deceleration ramp)

Fig. 6.31 Timing diagram: Jog travel with simultaneous activation of jog+/jog–

6.9.5 Parameterise jog mode

The timing diagram shows the course of jog travel as a function of the jog parameters:



Parameter	Description
Crawling:	
v_c Crawling Velocity	Setpoint value for travel at crawl speed.
t_c Slow Moving Time	Setpoint value for duration of crawling.
Jog parameters/jog travel:	
v_{max} Max. Max. Velocity	Setpoint value for travel at max. speed.
a+ Acceleration	Setpoint value for the following accelerations: – Crawling: Acceleration to crawl speed. – Jog travel: Acceleration to max. speed.
a– Deceleration	Setpoint value for deceleration (for crawling and jog travel) to rest.
Crawling/jog travel:	
k_a Smooth	Value for duration of filtering of acceleration and deceleration ramp ➔ page 130.

Tab. 6.33 Parameterise jog mode

Software end position:

If the drive is referenced, the drive automatically stops when it reaches a software end position. The software end position is not passed (deceleration path is taken into account).

6.10 Teach mode

6.10.1 Function: Teach mode

In the teach mode, the current actual position of the drive can be stored in a positioning record. Prior to teaching, the drive must be moved to the desired teach position (jog mode or manually). The teach procedure can be triggered directly via the active fieldbus (CANopen/PROFIBUS DP/DeviceNet) or the digital inputs (mode 1 ➔ page 49). The positioning record (1...63) in which the teach position is to be stored is selected through direct application (fieldbus) or record selection (fieldbus or digital inputs). During direct application the motor controller receives the positioning record number directly from the controller ➔ “Device profile FHPP” description, GDCP-CMMS/D-C-HP-.... When using record selection, the teach position is evaluated with the rising edge (control data or DIN8) and with the falling edge (control data or DIN8) the teach position is temporarily stored in the selected positioning record (positioning record parameter “Position”). Simultaneously, the parameterised debounce time starts to run, which blocks a new evaluation of the record selection during storage.

➔ **Note**

If the “control section” power supply is interrupted (e. g. power failure), the teach positions in the main memory will be lost if the positions have not been backed up in the permanent memory.

– Store the teach position, e. g. with the falling edge of the controller enable signal (DIN5)[X1.9], in the permanent memory.

Activating the teach mode via fieldbus/digital inputs

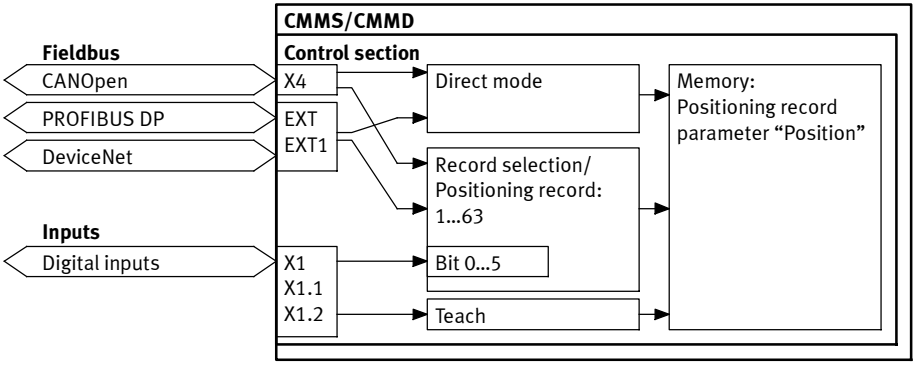
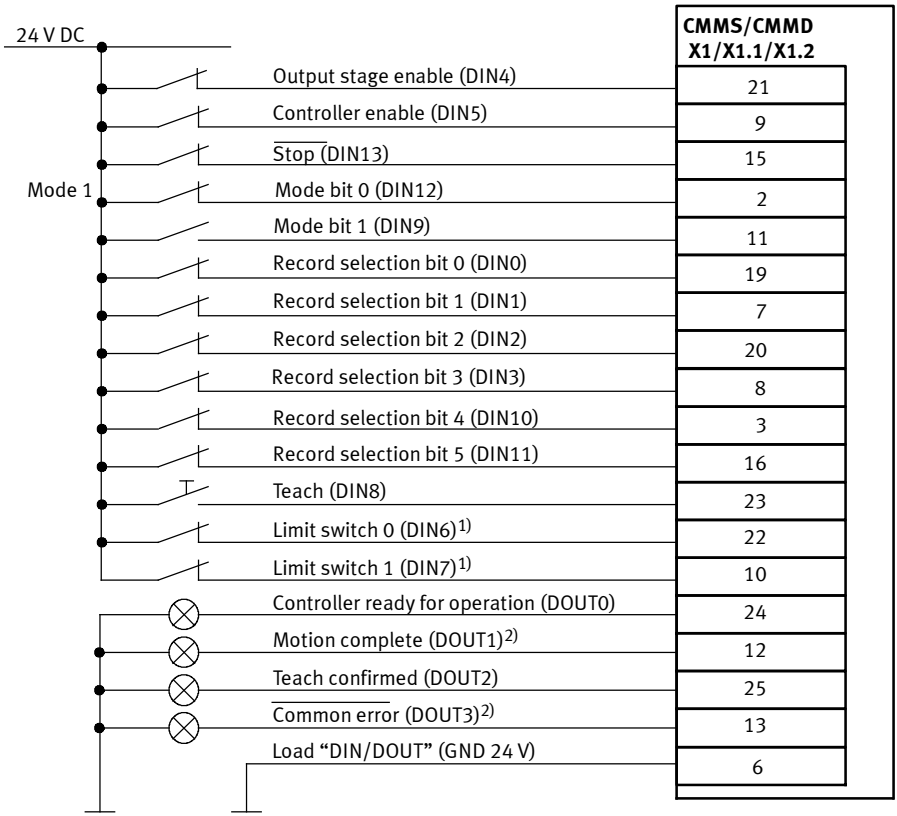


Fig. 6.32 Overview: Activating the teach mode via fieldbus and digital inputs

6.10.2 Connection: Digital inputs/outputs

The connection diagram shows the required digital inputs for the teach mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 6.33 Connection: Digital inputs/outputs

Activating the positioning record via digital inputs (record selection bit 0...5)

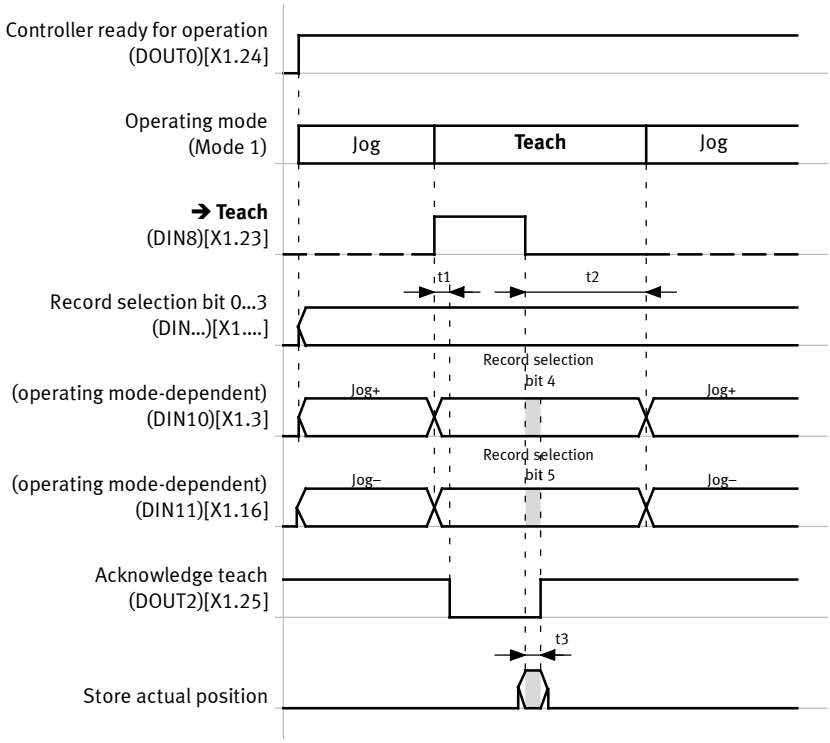
The positioning record (1...63) for the teach position is selected via the record selection bit 0...5.

Positioning record	**Record selection**					
	Bit 5 (2^5) (DIN11) [X1.16] [X1.1.16] [X1.2.16]	Bit 4 (2^4) (DIN10) [X1.3] [X1.1.3] [X1.2.3]	Bit 3 (2^3) (DIN3) [X1.8] [X1.1.8] [X1.2.8]	Bit 2 (2^2) (DIN2) [X1.20] [X1.1.20] [X1.2.20]	Bit 1 (2^1) (DIN1) [X1.7] [X1.1.7] [X1.2.7]	Bit 0 (2^0) (DIN0) [X1.19] [X1.1.19] [X1.2.19]
1	0	0	0	0	0	1
2	0	0	0	0	1	0
3	0	0	0	0	1	1
4	0	0	0	1	0	0
...						
7	0	0	0	1	1	1
8	0	0	1	0	0	0
...						
15	0	0	1	1	1	1
16	0	1	0	0	0	0
...						
32	1	0	0	0	0	0
...						
63	1	1	1	1	1	1

Tab. 6.34 Overview: Activating the positioning record via digital inputs (record selection bit 0...5)

6.10.3 Timing diagram: Teaching the current actual position of the drive

The timing diagram shows the selection of the positioning record (record selection) and the storage of the current actual position of the drive.



t1 ≤ 2.5 ms
t2 = ... ms (FCT: Dependent on the debounce time)
t3 ≤ 2.5 ms

Fig. 6.34 Timing diagram: Teaching

6.10.4 Parameterising the teach mode

The following parameters (FCT) can be parameterised for the teach mode:

Settings	Description
Debounce time of the DINs after teaching (Time To Ignore DINs After Teach)	
Ignore time	Setpoint value for the duration after the falling flank “Teach (DIN8)” until the digital inputs “Jog+ (DIN10)” and “Jog– (DIN11)” are evaluated again.

Tab. 6.35 Parameterise teach mode

7 Speed mode and force/torque mode

7.1 Speed mode

7.1.1 Function: Speed adjustment

In the speed mode, the motor controller receives the speed setpoint value via the control interface (fieldbus/analogue input/Festo Configuration Tool (FCT)). The regulator cascade (speed and current regulator) processes the deviation between the “speed setpoint value” and the “actual speed value” and thus controls the output stage and the connected motor. The speed setpoint value ramp can optionally be activated.

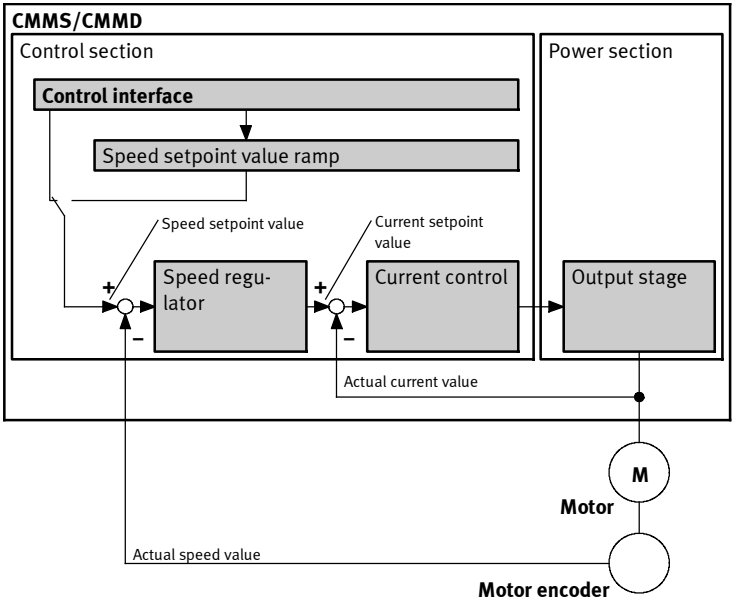


Fig. 7.1 Overview: Speed adjustment

7.1.2 Function: Speed mode

In the speed mode, the higher-order controller or the Festo Configuration Tool (FCT) controls the speed of movement of the drive. The motor controller can be controlled via the active fieldbus (CANopen/ PROFIBUS DP/DeviceNet/RS485), the analogue input or the Festo Configuration Tool (FCT). Through the direct application (fieldbus/FCT) or the analogue setpoint value (analogue input), the speed adjustment receives the speed setpoint value. Optionally, the speed setpoint value ramp can be activated in the Festo Configuration Tool (FCT) to parameterise the acceleration and deceleration ramps for the positive/negative direction.

For speed mode, no homing is required.

Activate speed mode via fieldbus/analogue input

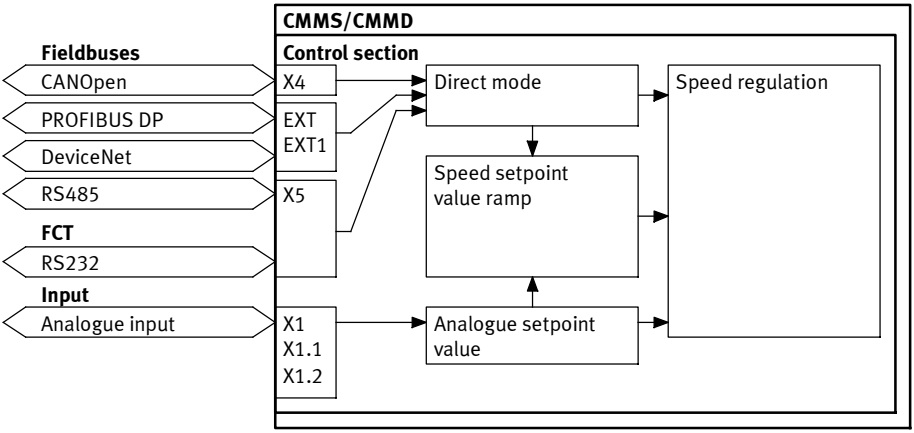
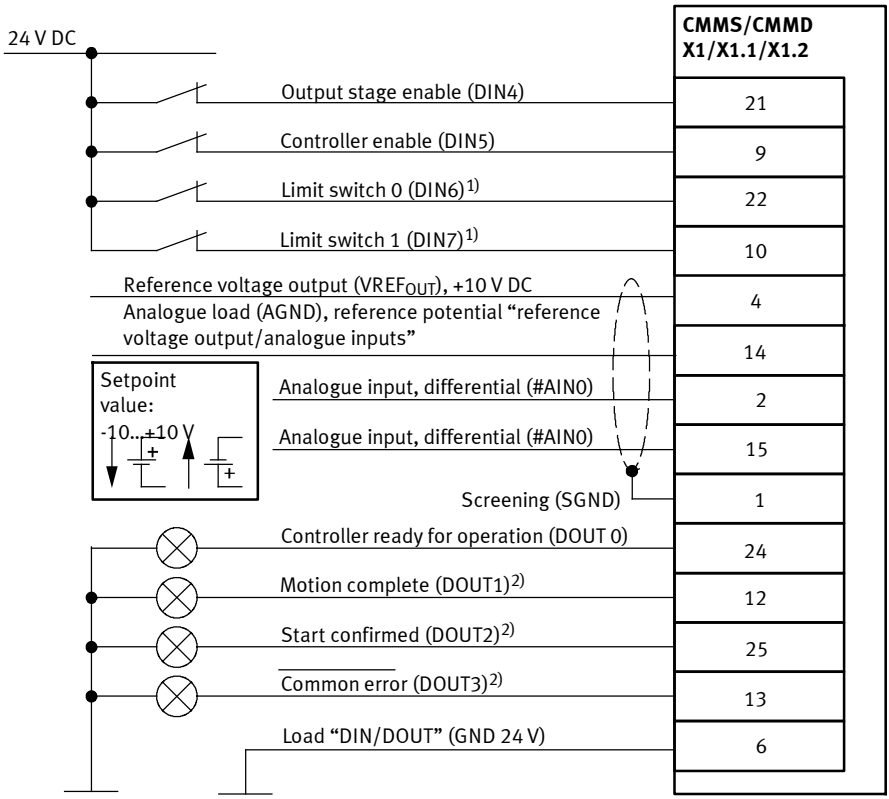


Fig. 7.2 Overview: Activating the speed mode via fieldbus or analogue input

7.1.3 Connection: Analogue and digital inputs/outputs

The connection diagram shows the required digital inputs for the speed mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 7.3 Connection: Analogue and digital inputs/outputs

7.1.4 Parameterise speed mode

The following parameters (FCT) can be parameterised for the speed mode:

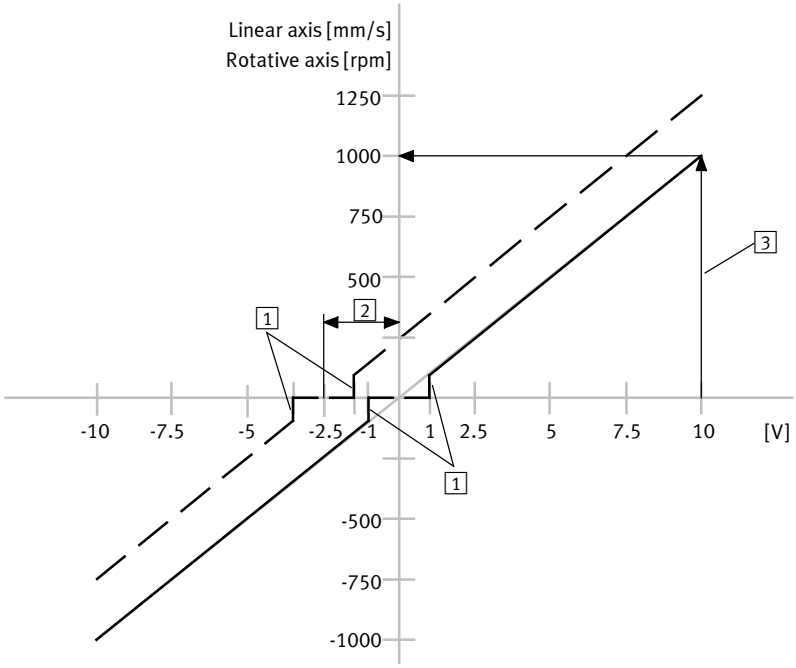
Settings	Description
Analogue Input	
Scaling[1)]	Value for scaling (linear axis: mm/s or rotative axis: rpm) of the analogue setpoint value (± 10 V) in a speed setpoint value ➔ page 186.
Offset[1)]	Value for the height of the voltage shift “rotational speed/speed characteristic curve” to the zero point ➔ page 186.
Safe Zero[1)]	Threshold value for the analogue setpoint value range in which the rotational speed/speed characteristic curve is valued as rest (linear axis = 0 mm/s or rotative axis = 0 rpm) ➔ page 186. Input malfunctions (e.g. offset fluctuations, noise, etc.) can be suppressed or a defined rest of the drive can be parameterised. If the motor controller is operated via an external control circuit, the value “0 V” should be parameterised as a Safe Zero to ensure the stability of the external control circuit.
Setpoint value selection/speed setpoint value ramp	
Ramp Type	Selection of the ramp type Dependent on the ramp type, the parameters “acceleration, deceleration and positive/negative direction” can be parametrised individually or grouped.
Acceleration: Positive/negative direction	Setpoint value for acceleration to the speed setpoint value.
Deceleration: Positive/negative direction	Setpoint value for deceleration to the speed setpoint value.

1) The parameter can only be parameterised in the Festo Configuration Tool (FCT) with activation of the control interface “Analogue input”.

Tab. 7.1 Parameterise speed mode

Parameters: Scaling, offset and safe zero

The diagram shows the course of the rotational speed/speed characteristic curve as a function of the analogue input, taking into account the parameters “scaling/offset/safe zero”.



1 Safe Zero = 1 V
2 Offset = -2.5 V
3 Scaling: 10 V = 1000 [mm/s][rpm]

Fig. 7.4 Rotational speed/speed characteristic curve

Offset:
If the parameter “Offset” is used, the reference zero point is shifted by the value of the offset to the offset zero point. The rotational speed/speed characteristic curve is thus asymmetric.
Example: Asymmetry at offset = -2.5 V ➔ Fig. 7.4:
– Linear axis: -10 V = -750 mm/s, + 10 V = 1250 mm/s.
– Rotative axis: -10 V = -750 rpm, + 10 V = 1250 rpm.

Safe Zero:
If the parameter “Safe Zero” is used, the control range of the rotational speed/speed characteristic curve is reduced by the range “Safe Zero”.

7.2 Force/torque mode

7.2.1 Function: Current regulation

In the force/torque mode, the motor controller receives the force/torque setpoint value (current setpoint value) via the control interface (fieldbus/analogue input/Festo Configuration Tool (FCT)). The current regulator processes the deviation between the “current setpoint value” and the “actual current value” and thus controls the output stage and the connected motor.

All specifications on forces/torques refer to the motor nominal torque or the motor nominal current. Since force/torque are proportional to the motor current, only the current regulator is activated in this operating case.

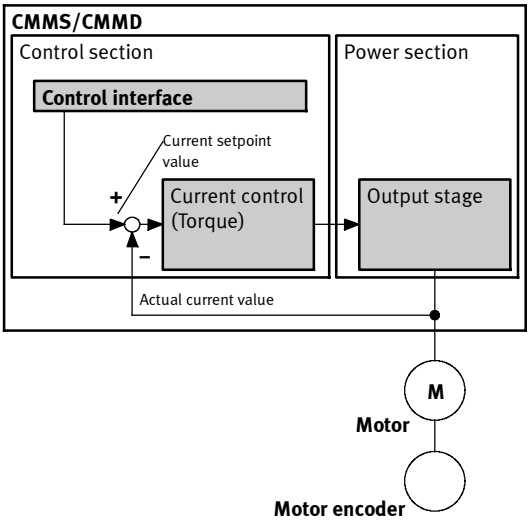


Fig. 7.5 Overview: Current regulation

7.2.2 Function: Force/torque mode

In the force/torque mode, the higher-order controller or the Festo Configuration Tool (FCT) controls the force/torque movement of the drive. The motor controller can be controlled via the active fieldbus (CANopen/PROFIBUS DP/DeviceNet/RS485), the analogue input or the Festo Configuration Tool (FCT). Through the direct application (fieldbus) or the analogue setpoint value (analogue input), the current control (torque) receives the current setpoint value.

No homing is required with force/torque mode.

Activate force/torque mode via fieldbus/analogue input

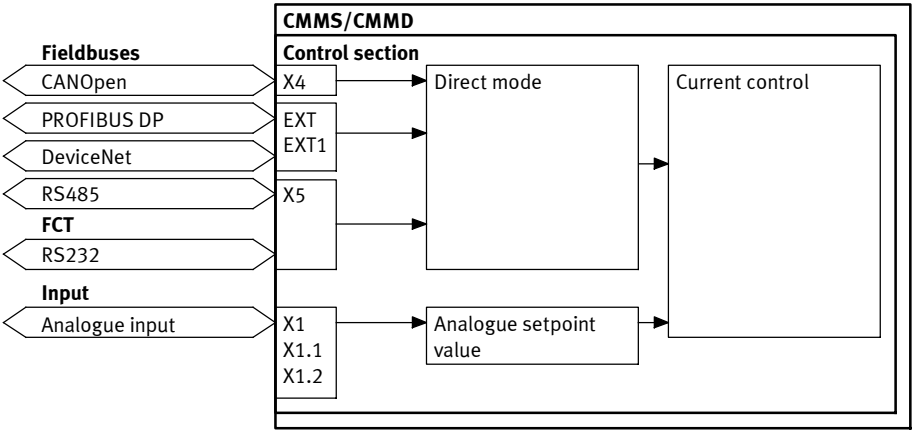
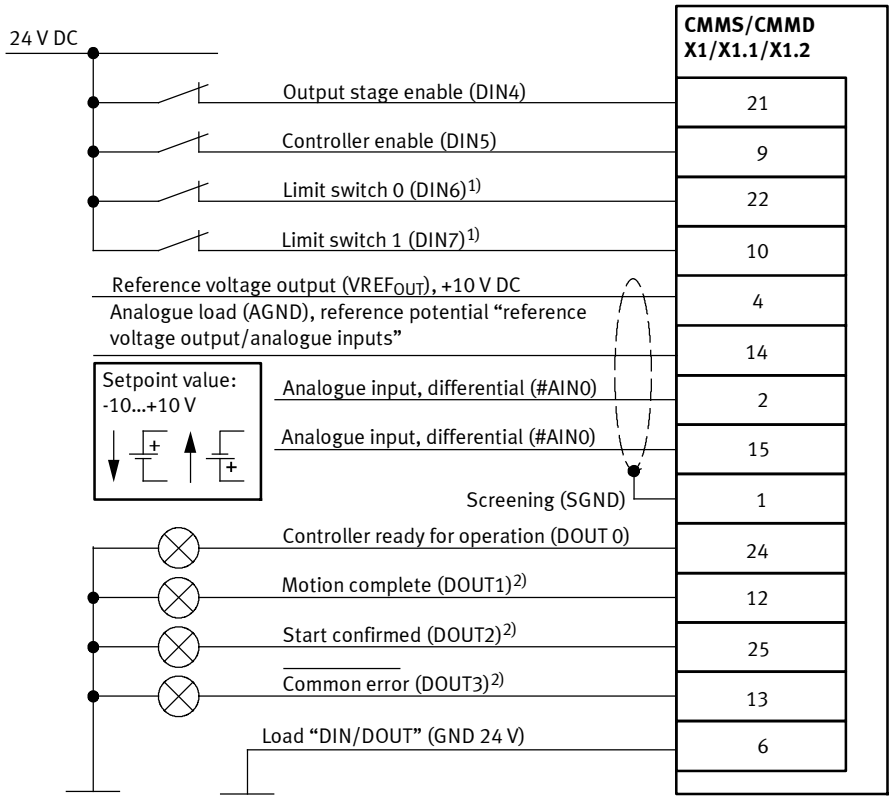


Fig. 7.6 Overview: Activating force/torque mode via fieldbus or analogue input

7.2.3 Connection: Analogue and digital I/O modules

The connection diagram shows the required digital inputs for the force/torque mode.



1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 7.7 Connection: Analogue and digital inputs/outputs

7.2.4 Parameterise force/torque mode

The following parameters (FCT) can be parameterised for the force/torque mode:

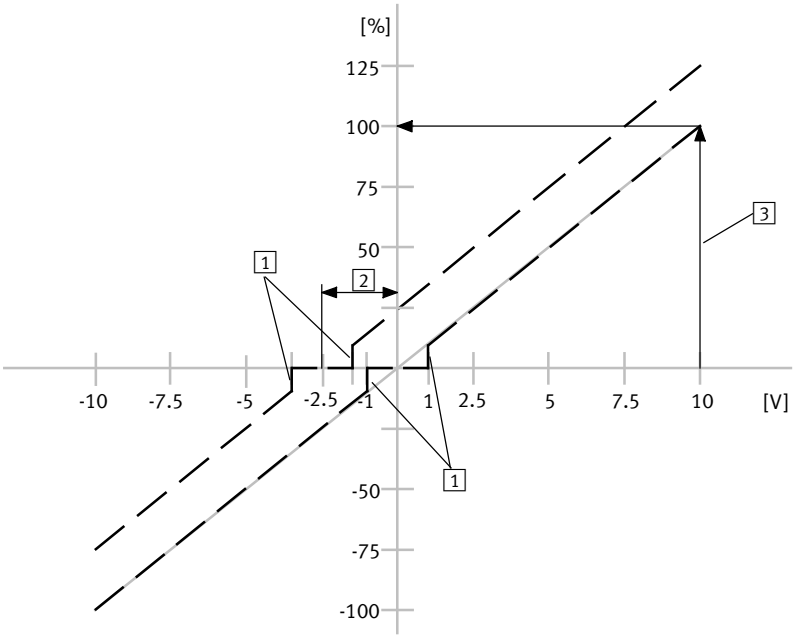
Settings	Description
Analogue Input	
Scaling[1)]	Value for scaling (%) of the analogue setpoint value (± 10 V) in a current setpoint value (motor nominal torque) ➔ page 191.
Offset[1)]	Value for the height of the voltage shift “torque/force characteristic curve” to the zero point ➔ page 191.
Safe Zero[1)]	Threshold value for the analogue setpoint value range in which the torque/force characteristic curve is valued as free of torque/force (0 mA) ➔ page 191. Input malfunctions (e.g. offset fluctuations, noise, etc.) can be suppressed or a defined rest of the drive can be parameterised. If the motor controller is operated via an external control circuit, the value “0 V” should be parameterised as a Safe Zero to ensure the stability of the external control circuit.

1) The parameter can only be parameterised in the Festo Configuration Tool (FCT) with activation of the control interface “Analogue input”.

Tab. 7.2 Parameterise force/torque mode

Parameters: Scaling, offset and safe zero

The diagram shows the course of the torque/force characteristic curve as a function of the analogue input, taking into account the parameters “scaling, offset and safe zero”.



1 Safe Zero = 1 V
2 Offset = -2.5 V
3 Scaling: 10 V = 100 % (related to the motor nominal current)

Fig. 7.8 Torque/force characteristic curve

Offset:
If the parameter “Offset” is used, the reference zero point is shifted by the value of the offset to the offset zero point. The torque/force characteristic curve is thus asymmetric.
Example: Asymmetry at offset = -2.5 V ➔ Fig. 9.7:
– Linear/rotative axis: -10 V = -75 %, + 10 V = 125 % of the motor nominal current.

Safe Zero:
If the parameter “Safe Zero” is used, the control range of the torque/force characteristic curve is reduced by the range “Safe Zero”.

8 Synchronisation

8.1 Synchronisation (slave mode)

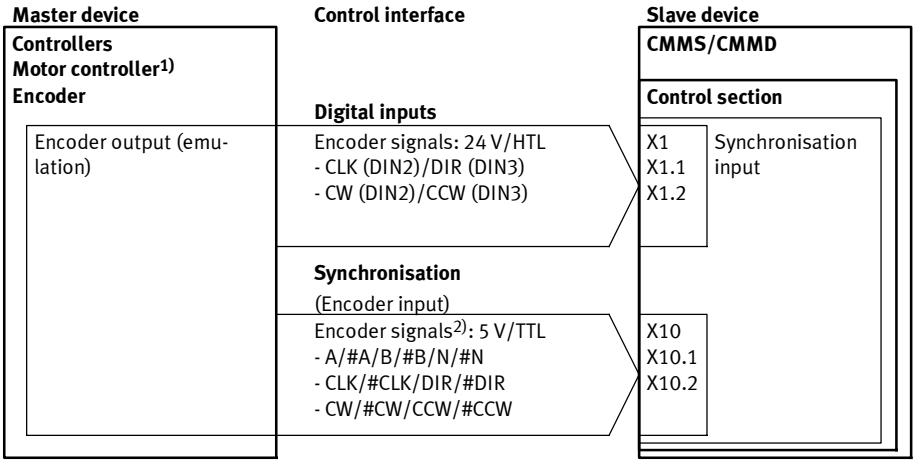
8.1.1 Function: Synchronisation

During synchronisation (slave mode), the motor controller is synchronised to the synchronisation setpoint value. The encoder signals “incremental signal (A/B/N), pulse/direction signal (CLK/DIR) or forward/reverse signal (CW/CW)” can be used for this purpose. The motor controller receives the synchronisation setpoint value from an incremental encoder, a controller or a master motor controller. The motor controller can be controlled via the synchronisation interface “encoder input [X10][X10.1/X10.2]” or the control interface “digital inputs [X10][X10.1/X10.2]”. From the setpoint value of the encoder signal, the parameterised line count and the parameterised “virtual gear unit”, the motor controller calculates the position setpoint values and transfers these cyclically to the position control.

The incremental signals “A/#A/B/#B/N/#N” from the synchronisation interface [X10/X10.1/X10.2] can either be used as an encoder input for synchronisation or as an encoder output for encoder emulation (default setting).

During synchronisation, all other operating modes are on hold.

Activate synchronisation via encoder signal



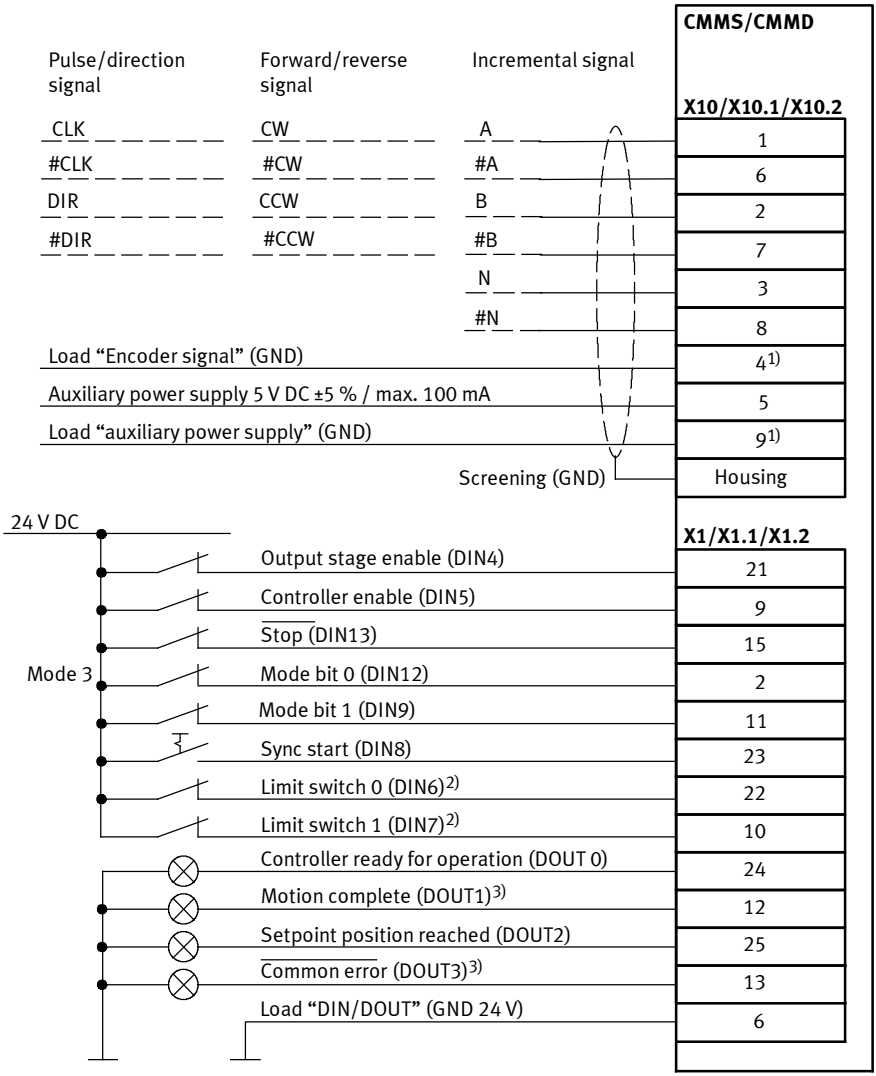
1) Motor controller with implemented encoder output and incremental signal “A/#A/B/#B/N/#N”.

2) Differential signals in accordance with RS422

Fig. 8.1 Overview: Activating synchronisation via encoder signals

8.1.2 Connection: Digital inputs/outputs (24 V) and encoder input (5 V)

The connection diagram shows the required digital inputs for synchronisation via the connection [X10][X10.1/X10.2].

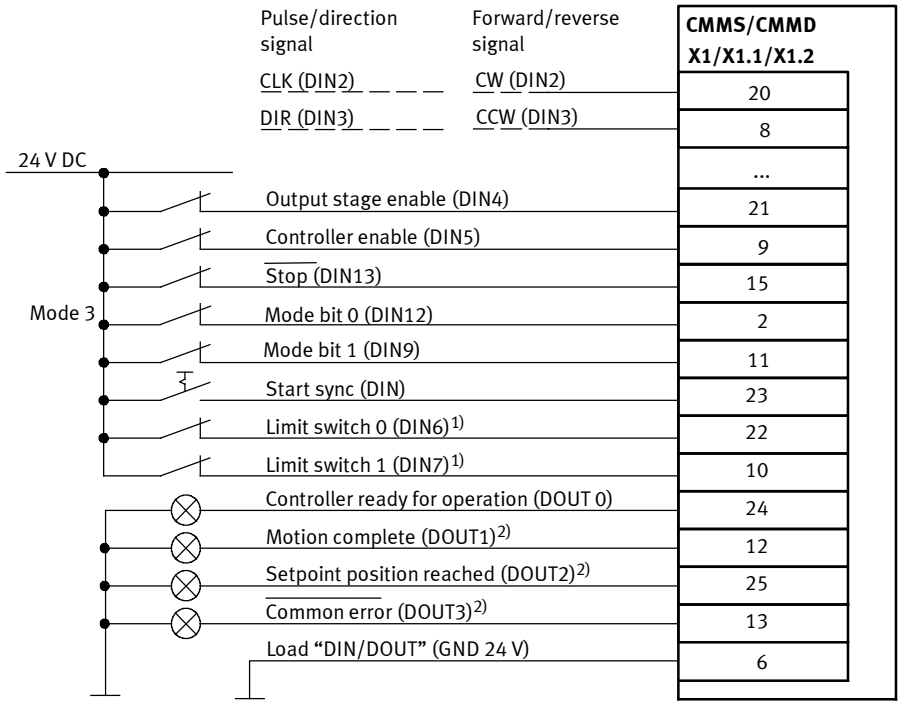


1) Pin “4” and “9” are connected internally.
2) The limit switches are set by default to N/C contact (configuration over FCT)
3) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 8.2 Connection: Digital inputs/outputs and synchronisation input (5 V)

8.1.3 Connection: Digital inputs/outputs (24 V)

The connection diagram shows the required digital inputs for synchronisation via the connection [X1][X1.1/X1.2].



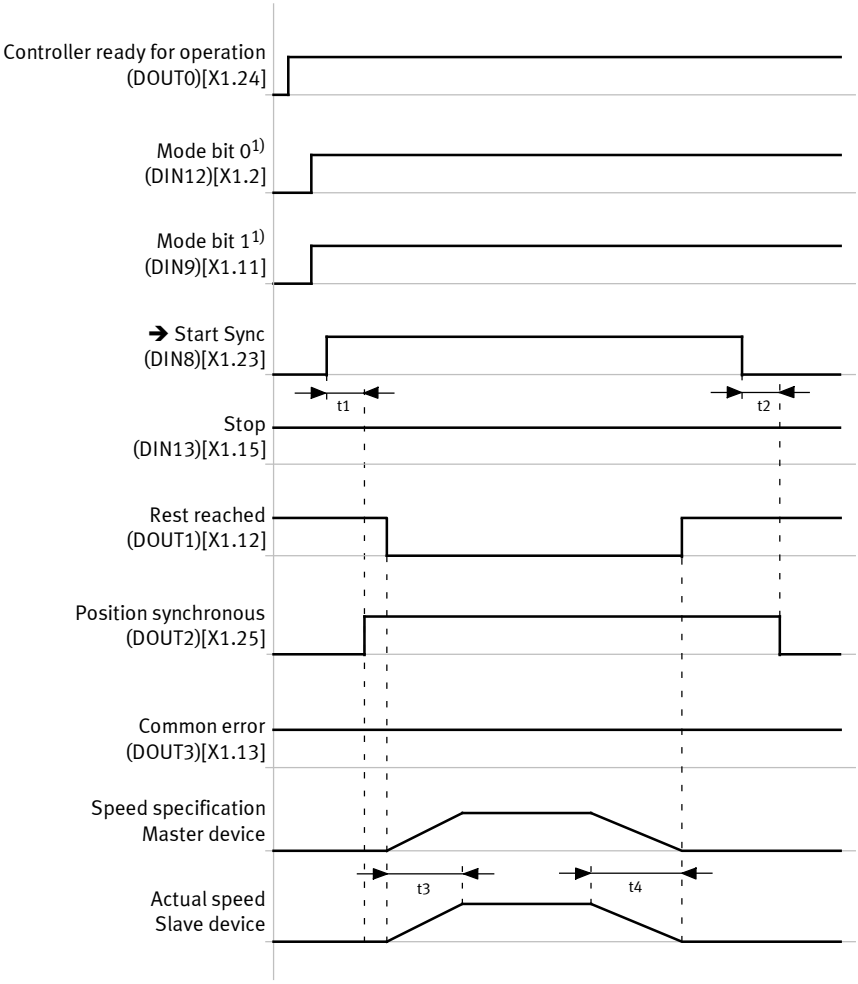
1) The limit switches are set by default to N/C contact (configuration over FCT)

2) Default setting, freely configurable in the Festo Configuration Tool (FCT).

Fig. 8.3 Connection: Digital inputs/outputs (24 V)

8.1.4 Timing diagram: Starting synchronisation via Start Sync signal

The timing diagram shows the start of synchronisation via the Start Sync signal (DIN8).



t1 ≤ 5 ms
t2 ≤ 5 ms
t3 = ... ms (dependent on the master acceleration ramp)
t4 = ... ms (dependent on the master deceleration ramp)

1) Activation of the “synchronisation” operating mode (mode 3)

Fig. 8.4 Timing diagram: Starting synchronisation

8.1.5 Configure/parameterise synchronisation

The following parameters (FCT) can be configured/parameterised for synchronisation:

Settings	Description
Signal Form	
(Signal Form)	Select encoder signal: – A/#A/B/#B/N/#N: Incremental signals with zero pulse – CLK/DIR: Pulse/direction signal – CW/CCW: Forward/reverse signal
Encoder Data	
Synchronisation Input	Select synchronisation input: (Only for encoder signal “CLK/DIR” and “CW/CCW” active) – Connection [X10]: 5 V signal – Connection [X1]: 24 V signal (DIN2/DIN3)
Number of Increments	Value for the number of increments on the rotation angle “90°/360°”. The encoder signals are evaluated differently through the squared evaluation of the motor controller. The line count “1” refers to the following angle ranges: – Incremental signal (A/#A/B/#B): 360° (one revolution). – Pulse/direction signal (CLK/DIR): 90° (quarter revolution) – Forward/reverse signal (CW/CCW): 90° (quarter revolution)
Gear	Transmission ratio (gear ratio) of a virtual gear unit
Options	
Ignore Zero Pulse	The zero pulse signals “N/#N” are not used for counting the revolutions. With this option, malfunctions due to faulty evaluation of the A/#A/B/#B signals can be suppressed.
Reversal of Rotation Direction	The evaluation of the phase displacement of the signals “A/#A” and “B/#B” is rotated 180°.

Tab. 8.1 Configure/parameterise synchronisation

9 Operational functions

9.1 Encoder emulation (master operation)

9.1.1 Function: Encoder emulation

During encoder emulation (master operation), the motor controller can output the current actual position (rotor position) as incremental signals (A/#A/B/#B/N/#N) at the encoder output [X10]. The incremental signals can be used by a connected slave device as synchronisation signals. Depending on the cable length, up to 32 slave motor controllers can be controlled via the encoder output (synchronisation interface [X10]) of the master motor controller.

The incremental signals “A/#A/B/#B/N/#N” from the synchronisation interface [X10/X10.1/X10.2] can either be used as an encoder input for synchronisation or as an encoder output for encoder emulation (default setting).

Output encoder emulation through encoder output

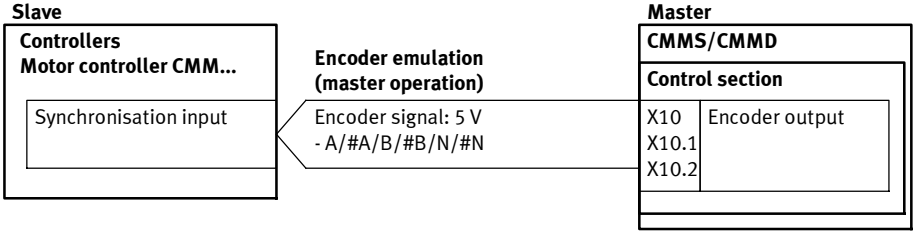
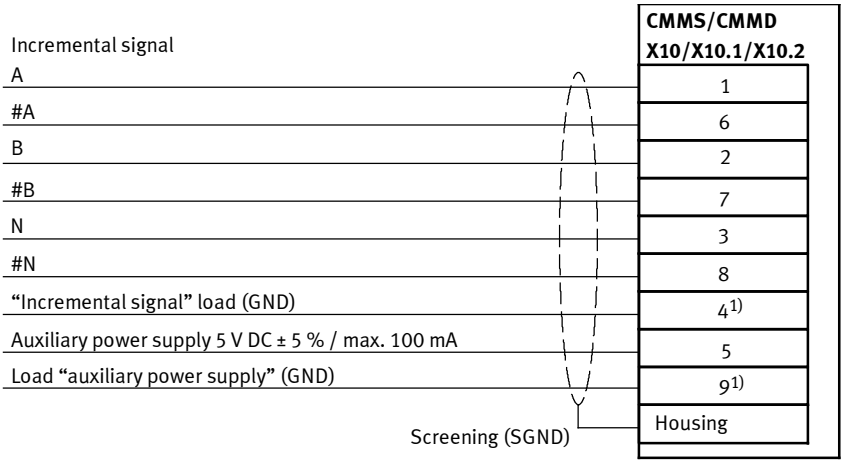


Fig. 9.1 Overview: Output encoder emulation via encoder signals

9.1.2 Connection: Encoder output (5 V)

The connection diagram shows the digital outputs for encoder emulation.



1) Pin “4” and “9” are connected internally.

Fig. 9.2 Connection: Encoder output, 5 V

9.1.3 Configure/parameterise encoder emulation

The following settings can be configured and parameterised in the Festo Configuration Tool (FCT):

Settings	Description
Encoder Data	
Number of Increments	Value, number of increments per revolution (360°). The number of increments specifies the number of emulated incremental signals “A/#A/B/#B” per revolution.
Options	
Ignore Zero Pulse	The zero pulse signals “N/#N” are not passed on to the slave device.
Reversal of Rotation Direction	The phase displacement of the signals “A/#A” and “B/#B” is rotated by 180°.

Tab. 9.1 Configure/parameterise encoder emulation

To avoid rounding errors, the number of lines per revolution should contain the factor 2^n. (1, 2, 4, 8, ... 2048).

9.2 Flying measurement (sampling)

9.2.1 Function: Flying measurement

In flying measurement, the “actual position” measured value can be stored in the motor controller through the fast sample input (DIN9)[X1.11][X1.1.11/X1.2.11]. With the configured edge of the sample input, the current actual position of the drive is written to the sample memory. A higher-order controller can read the last stored actual position via the active fieldbus (CANopen/PROFIBUS DP/DeviceNet/ RS485). The last stored actual position is displayed in the “Project output” FCT window in the online tab “Operation” in the dynamic data.

Activate flying measurement via digital input

The sample input (DIN9) is only active and configurable for the control interface “CANopen/PROFIBUS DP/DeviceNet/RS485”.

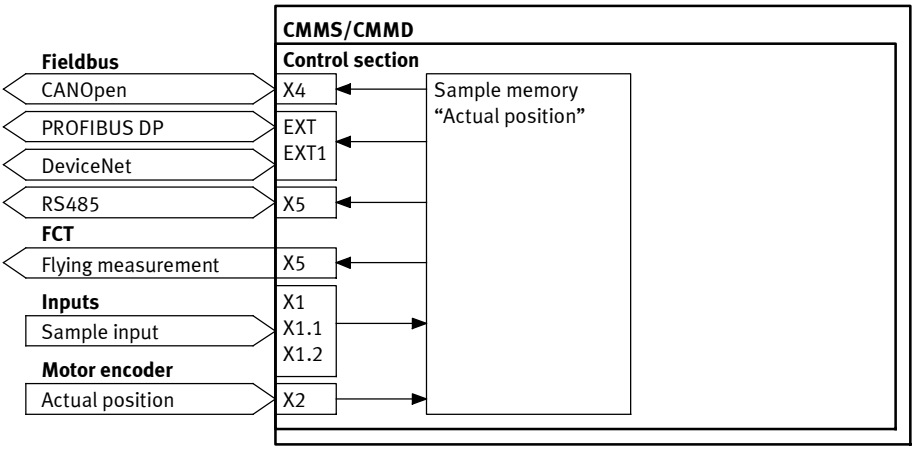
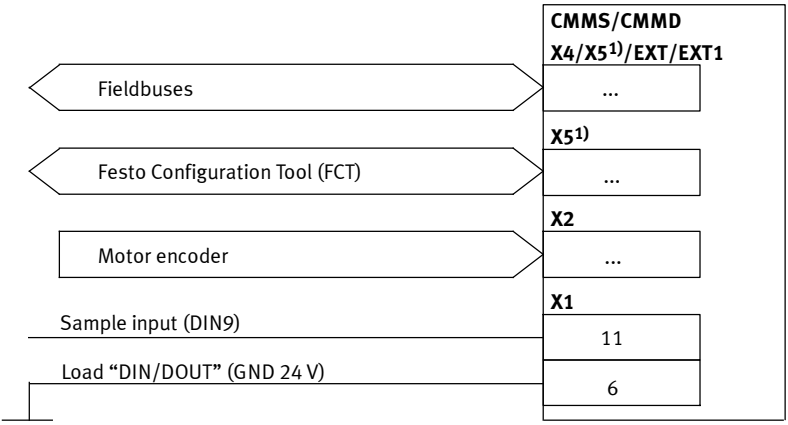


Fig. 9.3 Control flying measurement via digital input

9.2.2 Connection: Digital input

The connection diagram shows the required digital input for the flying measurement.



1) The connection [X5] can either be used for the Festo Configuration Tool (FCT) or for the fieldbus “RS485”.

Fig. 9.4 Connection: Digital input

9.3 Analogue monitor

9.3.1 Function: Analogue monitor

Through the analogue monitor (AMON0)[X1.17], the motor controller can provide various setpoint/actual values, for example, to a controller or oscilloscope as an analogue output signal.

Output analogue monitor through digital output

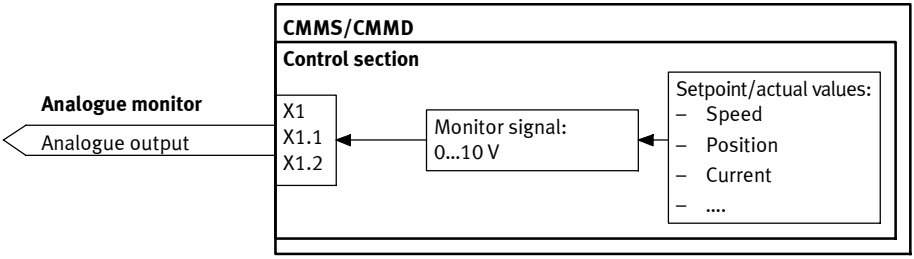


Fig. 9.5 Overview: Output analogue monitor through digital output

9.3.2 Connection: Analogue output

The connection diagram shows the analogue output for the analogue monitor.

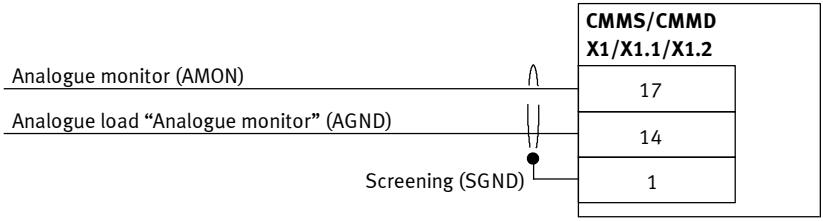


Fig. 9.6 Connection: Analogue output

9.3.3 Configure/parameterise analogue monitor

The following parameters (FCT) can be configured/parameterised for the analogue monitor:

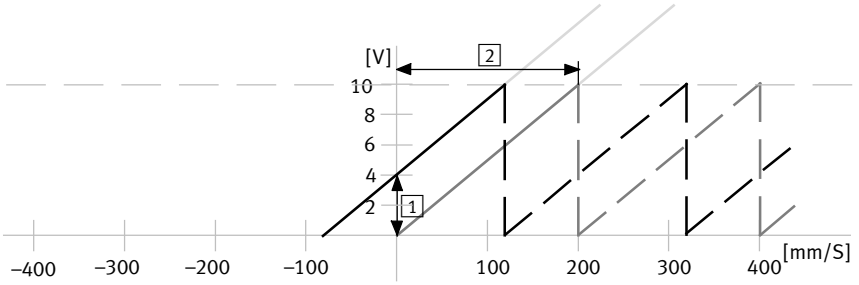
Settings	Description
Analogue Output	
Analogue Monitor	The following signals can be output as analogue monitor signal: – Speed setpoint value – Speed actual value (raw) – Speed actual value (filtered) – Position setpoint value – Position actual value – Effective current setpoint value – Effective current actual value – Reactive current setpoint value – Reactive current actual value – Phase current U – Phase current V – Rotor position – Following error – Output stage voltage – Fixed voltage level
Scaling	Value for scaling of the “analogue monitor” parameter to the analogue output signal (0...10 V) ➔ Fig. 9.7.
Offset	Value for the height of the “Offset” voltage shift to the load (AGND)[X1.14] ➔ Fig. 9.7/Fig. 9.8.
Numeric Overflow Limitation	Function for overflow limitation of the analogue output signal ➔ Fig. 9.8.

Tab. 9.2 Configure/parameterise analogue monitor

Analogue monitor with offset adjustment

The diagram shows the course of the analogue monitor signal as a function of the parameters “scaling/ offset”.

The analogue monitor signal “speed setpoint value” is illustrated here as an example.

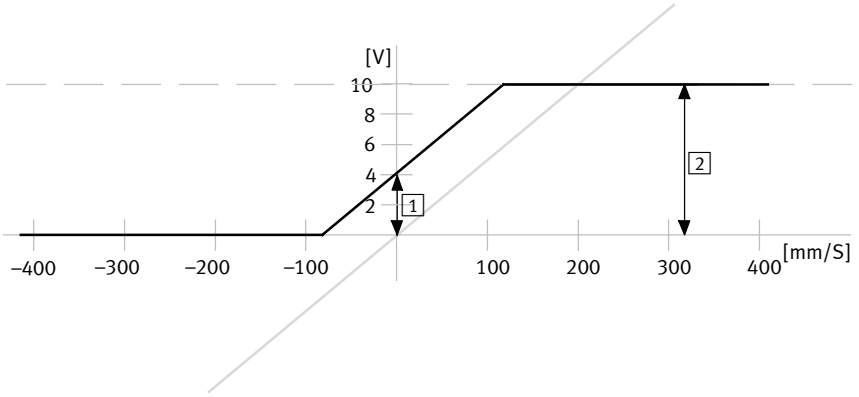


1 Offset = 4 V DC
2 Scaling: Speed setpoint value = 200 mm/s

Fig. 9.7 Analogue monitor with offset adjustment

Analogue monitor with offset adjustment and numeric overflow limitation

The diagram shows the course of the analogue monitor signal with offset adjustment and active numeric overflow limitation.



1 Offset = 4 V DC
2 Numeric overflow limitation active

Fig. 9.8 Analogue monitor with offset adjustment and numeric overflow limitation

9.4 Endless positioning

9.4.1 Function: Endless positioning

For applications such as “synchronised conveyor belt” or “rotary indexing table”, endless positioning is possible in one direction through relative positioning records. For relative positioning records, an overrun of the position counter is possible. That is, the position counter jumps from +32767 revolutions to -32768 revolutions, for example.

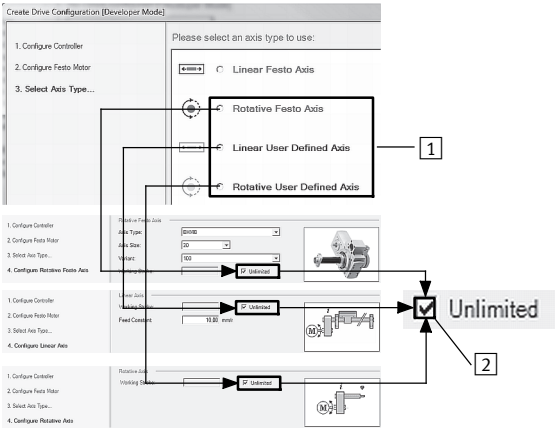
Note

The motor controller calculates internally with 65536 increments (16 bit) per revolution (360°). For positioning records that do not have a whole number (integer) as the result, the motor controller rounds up to the next whole number.

– Take into consideration the deviation of the rounded position values when parameterising the position ➔ page 114.

Configure endless positioning in the Festo Configuration Tool (FCT)

To be able to use the “Endless positioning” function, the following settings must be taken into account in configuration of the linear axis/axis of rotation in the Festo Configuration Tool (FCT).



1. Mark either the option field “Rotative Festo axis”, “Linear user-defined axis” or “Rotative user-defined axis” in the drive configuration.
2. Activate the “Unlimited” control field for endless positioning.

Fig. 9.9 Configure endless positioning in the Festo Configuration Tool (FCT)

For endless positioning, only the relative positioning types “RA/RN” can be used (position record list parameter “Mode” ➔ page 128).

The minimum or maximum absolute position is always used as a target in the jog mode. For this reason, endless positioning is not possible.

The connected limit switches are only active during homing.

9.5 Resonance filter (motor controller CMMS-ST-C8-7-G2)

9.5.1 Function: Resonance filter

The resonance filter is only effective for motor controller CMMS-ST-C8-7-G2 with open loop (without motor encoder/open loop). Resonance oscillations of the drive can be avoided with the resonance filter. In the motor controller, three resonance speed ranges can be parameterised via the parameters “speed”. and “band width”. If the drive reaches the parameterised resonance speed range during operation, this range will be skipped.

Speeds that have been parameterised as a resonance speed cannot be run constantly.

10 Service

10.1 Protective and service functions

The motor controller has a complex array of sensors that monitor the control section, power section, motor and external communication to ensure that they function perfectly. Most errors cause the control section to shut down the power section (output stage). The power section cannot be switched back on until the error has been eliminated and then acknowledged.
For some of the diagnostic messages, the behaviour of the motor controller can be parameterised.
Possible reactions to the message:

a) PS off:
   The power section is switched off immediately. The residual energy results in uncontrolled movements (coasting) in the motor until a state of rest is reached.
b) Qstop:
   Quick stop with the parameterised deceleration “Quick Stop (FCT)”. The output stage is switched off after the rest state has been reached or after expiration of the parametrised monitoring time “Quick Stop (FCT)”.
c) Warn:
   Output of a warning, no further reaction.
   Exception:
   Reaction to limit switch “error number: 430/431/439”: The drive is decelerated here with the parametrised stop deceleration “limit switch”.
d) Ignore:
   No reaction

The following monitoring functions guarantee operational safety:

– Monitoring the motor temperature
– Measurement and monitoring of the power section temperature
– Detection of power interruption/failure
– Detection of earth faults (PE)
– Detection of overvoltages and undervoltages in the intermediate circuit
– I^2t-monitoring of motor and output stage
– Detection of faults in the internal voltage supply
– Monitoring of the following error
– Detection of initialisation errors
– Detection of check-sum errors during parameter transmission
– Detection of communication errors
– Monitoring of the processor (watchdog)
– Monitoring of homing

10.1.1 Overload current and short-circuit monitoring of the motor output

Overload current and short-circuit monitoring detects short circuits between two motor phases and short circuits at the motor output terminals against the positive and negative reference potential of the intermediate circuit and against earthing (PE). If the error control detects overload current, the output stage shuts down immediately, guaranteeing protection against short circuits.

10.1.2 Monitoring of interruption and failure of the mains supply

Monitoring of interruption and failure for mains supply takes effect if the mains voltage is interrupted › 60 ms.

10.1.3 Overvoltage and undervoltage monitoring for the intermediate circuit

The overvoltage monitoring for the intermediate circuit takes effect as soon as the intermediate circuit voltage exceeds the operating voltage range. The undervoltage monitoring for the intermediate circuit takes effect as soon as the intermediate circuit voltage falls below the operating voltage range. The output stage is switched off if it exceeds or falls below this range.

10.1.4 Output stage temperature monitoring

The output stage temperature is measured with a temperature sensor. In error management, the reaction to the errors “Temperature of output stage is 5 °C below maximum” and “Over-temperature of output stage” can be parametrised.

10.1.5 Monitoring the motor and motor encoder

The motor controller has the following protective functions for monitoring the motor and the connected motor encoder:

Protective function	Description
Monitoring of the encoder	A motor encoder error results in the output stage switching off. Generally true for intelligent encoders is that their various error messages are evaluated and reported by the motor controller as common error “E 08-6” and “E 08-8”.
Measurement and monitoring of the motor temperature	The motor controller can record and monitor the motor temperature through the connection [X6]. The reaction to the error “Over-temperature error (motor)” can be parametrised in error management.

Tab. 10.1 Protective functions of the motor

10.1.6 I^2t monitoring

The motor controller has I^2t monitoring to limit the average power loss in the output stage and in the motor. As the power dissipation occurring in the power electronics and motor grows with the square of the flowing current, the squared current value is assumed as the dimension of the power loss.

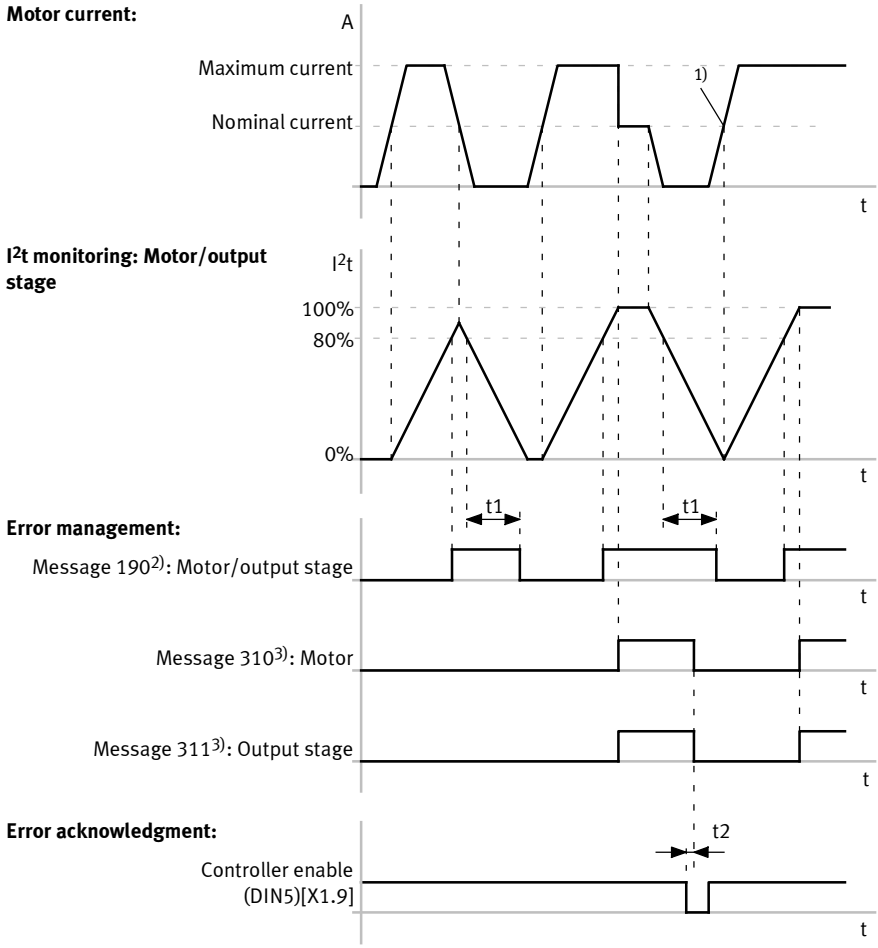
Note

I^2t monitoring is designed for a uniform temperature increase of all motor phases. At low speed (frequency) the individual phases of the motor are energised differently. This can result in the permissible temperature being exceeded in the energised phases.

– Avoid low speeds if the drive is to be operated at the load limit.

Timing diagram: I^2t monitoring

The timing diagram shows the course of I^2t monitoring as a function of the motor current and the subsequently generated messages.



1) The motor current is not limited to the nominal current, if after the message "310/311", the I^2t monitoring has reached the value 0 %.
2) The message has been configured as a warning by way of example.
3) The message has been configured as an error by way of example.

t_1 ≈ 5 s (time after which the warning message is automatically removed)
t2 ≤ 5 ms

Fig. 10.1 Timing diagram: I^2t monitoring

10.2 Operating mode and error messages

10.2.1 LED indicators (Ready/CAN/Bus)

The two LED indicators are located on the front of the motor controller.
The following functions are displayed through the LED indicators.

Component	LED colour	Function
Ready	Green	Operating status/controller enable
	Flashing green	Parameter file (xxx.DCO), memory card is being read/written
CAN[1]/Bus[2]	Yellow	The LED illuminates when communication is taking place on the CAN bus

1) Motor controller CMMS-AS
2) Motor controller CMMS-ST/CMMD-AS

Tab. 10.2 LED indicators

10.2.2 Seven-segments display

The seven-segments display is located on the front side of the motor controller.
The following operating modes and error/warning messages are displayed over the seven-segments display.

Display[1]		Function
Bootloader messages		
	Dot	Start programme (bootloader) active
	Flashing point	– Firmware file is being read from the memory card

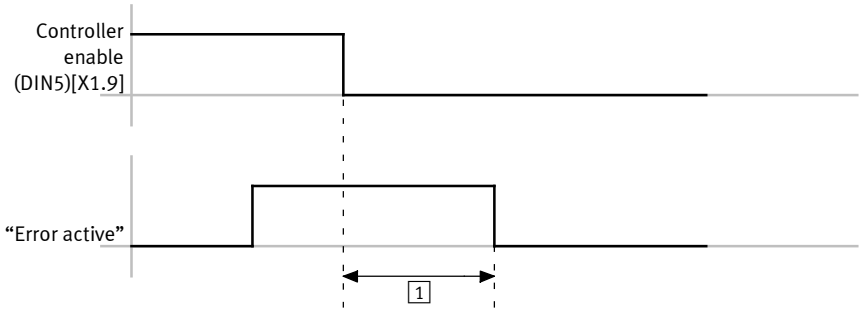
Display[1]		Function
Operating modes		
	P x x x	Positioning mode, record number x x x
	000	– No positioning record active
	001...063	– Positioning record 001 ... 063 active
	064	– Manual travel via FCT or FHPP direct record (direct operation)
	070/071	– Jog+/jog–
	P H x	Homing phase x
	0	– Searching travel to the primary destination (limit switch or stop)
	1	– Crawl to the reference point
	2	– Travel to the axis zero point
	Rotating outside segments	Speed mode (speed adjustment): Display changes corresponding to rotor position and speed.
	Middle segment	Controller enable active (motor is energised).
	I	Force/torque mode (current control)
Safety function		
	H	Two-channel safety function requested (DIN4 [X1.21] and Rel [X3.2])
Error/warning messages		
	E x x y	Error (E = error) Number: Two-position main index (x x), single-position sub-index (y) Example: E 0 1 0 ➔ appendix A.
	– x x y –	Warning Number: Two-position main index (x x), single-position subindex (y). Example: - 1 7 0 - ➔ appendix A.

1) Several characters are displayed one after the other.

Tab. 10.3 Operating mode and error display of the seven-segments display

10.3 Acknowledgement of error messages

Error messages can be acknowledged through:
- Festo Configuration Tool (FCT)
- the fieldbus (control word)
- a decreasing edge of the controller enable signal (DIN5)



1 ≤ 5 ms

Fig. 10.2 Timing diagram: Acknowledge errors

Diagnostic events that are parameterised as warnings are displayed for approx. 5 seconds and do not need to be acknowledged.

10.3.1 Diagnostic messages

The errors/warnings and their causes and remedies are described in the diagnostic messages ➔ appendix A.

10.4 Dismantling and repairs

10.4.1 Saving the parameter set for the motor controller

Save the parameter set for the motor controller prior to dismantling.

Note

Loss of the parameter set in the motor controller

In the event of a repair or replacement (new motor controller), the parameter set for the motor controller is reset to the “factory setting” status.

– Before replacing or repairing the motor controller, back up the device data to the Festo Configuration Tool (FCT) (Upload/Synchronisation) or save the current parameter set of the motor controller to the memory card (FCT: Controller » SD) as parameter file (.DCO).
– After installing the new or repaired motor controller, load the device data from the Festo Configuration Tool (FCT) to the motor controller (Download) or load the parameter file (.DCO) from the memory card to the motor controller (FCT: SD » Controller).

A Diagnostic messages

A.1 Explanations on the diagnostic messages

The following table summarises the significance of the diagnostic messages and the actions to be taken in response to them:

Terms	Meaning
No.	Main index (error group) and sub-index of the diagnostic message. Indication via the 7-segment display, in FCT or in the diagnostic memory via FHPP.
Code	The Code column includes the error code (Hex) via CiA 301.
Message	Message that is displayed in the FCT.
Cause	Possible causes for the message.
Action	Action by the user.
Reaction	The Reaction column includes the error response (default setting, partially configurable): – PS off (block output stage), – QStop (fast stop with parameterised ramp), – Warn (warning), – Ignore.

Tab. A.1 Explanations on the diagnostic messages

For a complete list of the diagnostic messages that correspond to the firmware versions used at the time of printing this document, please refer to section A.2.
Under section A.3, you will find the error codes in accordance with CiA301/402 and the error bit numbers with assignment to the error numbers of the diagnostic messages.
Under section A.4, you will find the PROFIBUS diagnostic bits with assignment to the error numbers of the diagnostic messages.

A.2 Diagnostic messages with instructions for fault clearance

Error group 01		**Internal faults**	
No.	Code	Message	Reaction
01-0	6180h	**Stack overflow (internal error)**	PS off
		Cause – Incorrect firmware? – Sporadic high processor load due to special compute-bound processes (save parameter set, etc.).	
		Action • Load approved firmware. • Contact Technical Support.	

Error group 02		**Intermediate circuit**	
No.	Code	Message	Reaction
02-0	3220h	**Undervoltage in intermediate circuit**	configurable
		Cause – Intermediate circuit voltage falls below the parameterised threshold.	
		Action • Quick discharge due to switched-off mains supply. • Check mains voltage (mains voltage level or network impedance too high?). • Check intermediate circuit voltage (measure). • Check undervoltage monitor (threshold value). • Check travel profile: If travel with lower acceleration and/or travel speeds is possible, reduced power consumption from the mains results.	

Error group 03		**Temperature monitoring, motor**	
No.	Code	Message	Reaction
03-1	4310h	**Temperature monitoring, motor**	configurable
		Cause Motor overloaded, temperature too high. – Motor too hot. – Sensor defective?	
		Action • Check parameters (current regulator, current limits). If the error persists when the sensor is bypassed: Device defective.	

Error group 04		**Temperature monitoring, electronics**		
No.	Code	Message		Reaction
04-0	4210h	**Excess/low temperature of power electronics**		configurable
		Cause	Motor controller is overheated. – Motor controller overloaded? – Temperature display plausible?	
		Action	• Check installation conditions, cooling through the housing surface, integrated heat sink and back wall. • Check the drive layout (due to possible overloading in continuous operation).	

Error group 05		**Internal power supply**		
No.	Code	Message		Reaction
05-0	5114h	**5 V electronics supply fault**		PS off
		Cause	Monitoring of the internal power supply has recognised undervoltage. This is either due to an internal defect or an overload/ short circuit caused by connected peripherals.	
		Action	• Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present ➔ Repair by the manufacturer.	
05-1	5115h	**Error in 24 V supply**		PS off
		Cause	Monitoring of the internal power supply has recognised undervoltage.	
		Action	• Check 24 V logic supply. • Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present ➔ Repair by the manufacturer.	
05-2	5116h	**12 V electronics supply fault**		PS off
		Cause	CMMS-ST only: Monitoring of the internal power supply has recognised undervoltage. This is either due to an internal defect or an overload/ short circuit caused by connected peripherals.	
		Action	• Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present ➔ Repair by the manufacturer.	
05-2	8000h	**Driver supply error/driver supply failed**		PS off
		Cause	Only CMMS-AS/CMMD-AS: Error in the plausibility check of the driver supply (safe torque off)	
		Action	• Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present ➔ Repair by the manufacturer.	

Error group 06		**Intermediate circuit**		
No.	Code	Message		Reaction
06-0	2320h	**Over-current of the intermediate circuit/output stage**		PS off
		Cause	– Motor defective. – Short circuit in the cable. – Output stage defective.	
		Action	• Check motor, cable and motor controller.	

Error group 07		**Intermediate circuit**		
No.	Code	Message		Reaction
07-0	3210h	**Overvoltage in the intermediate circuit**		PS off
		Cause	Braking resistor is overloaded; too much braking energy which cannot be dissipated quickly enough. – Resistor capacity is incorrect? – Resistor not connected correctly? – Check design (application)	
		Action	• Check the design of the braking resistor (positioning drives); resistance value may be too great. • Check the connection to the braking resistor (internal/external).	

Error group 08		**Angle encoder**		
No.	Code	Message		Reaction
08-0	7380h	**Encoder supply error**		PS off
		Cause	CMMS-ST only: Encoder supply outside the permissible range (too high/too low).	
		Action	• Test with another encoder. • Test with another encoder cable. • Test with another motor controller.	
08-6	7386h	**Angle encoder communication fault**		PS off
		Cause	Only CMMS-AS/CMMD-AS: Communication to serial angle encoders is disrupted (EnDat encoders). – Angle encoder connected? – Angle encoder cable defective? – Angle encoder defective?	
		Action	• Check whether encoder signals are faulty? • Test with another encoder. • Check angle encoder cable. For operation with long motor cables: • Observe notes on EMC-compliant installation! Additional anti-interference measures required from 15 m cable length.	

Error group 08		**Angle encoder**		
No.	Code	Message		Reaction
08-8	7388h	**Internal angle encoder error**		PS off
		Cause	Only CMMS-AS/CMMD-AS: Internal monitoring of the angle encoder has detected an error and forwarded it via serial communication to the controller. Possible causes: – Excess rotational speed. – Angle encoder defective.	
		Measure	If the error occurs repeatedly, the encoder is defective. ➔ Replace encoder including encoder cable.	

Error group 11		**Homing**		
No.	Code	Message		Reaction
11-1	8A81h	**Homing error**		PS off
		Cause	Homing was interrupted, e.g. by: – Withdrawal of controller enable. – Reference switch is beyond the limit switch. – External stop signal (termination of a homing phase).	
		Action	• Check homing sequence. • Check arrangement of the switches. • If applicable, lock the stop input during homing if it is not desired.	

Error group 12		**CAN**		
No.	Code	Message		Reaction
12-0	8181h	**CAN: General error**		configurable
		Cause	Other CAN error. Triggered by the CAN controller itself and is used as a common error for all further CAN errors.	
		Action	• Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring.	
12-1	8181h	**CAN: Error bus off**		configurable
		Cause	Errors can occur if the CAN control malfunctions or is deliberately requested by the controller of the bus-off status.	
		Action	• Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring.	

Error group 12		**CAN**	
No.	Code	Message	Reaction
12-2	8181h	**CAN: Error sending**	configurable
		Cause: Error when sending a message (e.g. no bus connected).	
		Action: • Re-start CAN controller • Check CAN configuration in the controller • Check wiring	
12-3	8181h	**CAN: Error receiving**	configurable
		Cause: Error receiving a message.	
		Action: • Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring: Cable specification adhered to, broken cable, maximum cable length exceeded, correct terminating resistors, cable screening earthed, all signals terminated?	
12-4	8130h	**CAN: Time-Out Nodeguarding**	configurable
		Cause: Node guarding telegram not received within the parametrised time. Signals corrupted?	
		Action: • Compare cycle time of the remote frames with that of the controller. • Check: Failure of the controller?	
12-5	8181h	**CAN: Error in the IPO mode**	configurable
		Cause: Over a period of 2 SYNC intervals, the SYNC telegram or the PDO of the controller has failed.	
		Action: • Re-start CAN controller. • Check CAN configuration in the controller (SYNC telegram must be parameterised). • Check wiring.	

Error group 14		**Motor identification**	
No.	Code	Message	Reaction
14-9	6197h	**Error, motor identification**	PS off
		Cause: Error in automatic determination of the motor parameters.	
		Action: • Ensure sufficient intermediate circuit voltage. • Encoder cable connected to the right motor? • Motor blocked, e.g. holding brake does not release?	

Error group 16		**Initialization**	
No.	Code	Message	Reaction
16-2	6187 h	**Initialization fault**	PS off
		Cause: Error in initialising the default parameters.	
		Action: • In case of repetition, load firmware again. If the error occurs repeatedly, the hardware is defective.	

Error group 16		Initialization	
No.	Code	Message	Reaction
16-3	6183h	**Unexpected status / programming error**	PS off
		Cause: The software has taken an unexpected status. For example, unknown status in the FHPP state machine.	
		Action: • In case of repetition, load firmware again. If the error occurs repeatedly, the hardware is defective.	

Error group 17		Following error monitoring	
No.	Code	Message	Reaction
17-0	8611h	**Following error monitoring**	configurable
		Cause: Comparison threshold for the limit value of the following error exceeded.	
		Action: • Enlarge error window. • Parameterise acceleration to be less. • Motor overloaded (current limiter from the I²t monitoring active?).	

Error group 18		Output stage temperature monitoring	
No.	Code	Message	Reaction
18-1	4280h	**Output stage temperature 5 °C below maximum**	configurable
		Cause: The output stage temperature is greater than 90 °C.	
		Action: • Check installation conditions, cooling through the housing surface, integrated heat sink and back wall.	

Error group 19		I²T monitoring	
No.	Code	Message	Reaction
19-0	2380h	**I²t at 80 %**	configurable
		Cause: Of the maximum I²t workload of the controller or motor, 80 % has been achieved.	
		Action: • Check whether motor/mechanics are blocked or sluggish.	

Error group 21		Current measurement	
No.	Code	Message	Reaction
21-0	5210h	**Error, offset current measurement**	PS off
		Cause: The controller performs offset compensation of the current measurement. Tolerances that are too large result in an error.	
		Measure: If the error occurs repeatedly, the hardware is defective. • Send motor controller to the manufacturer.	

Error group 22		**PROFIBUS**		
No.	Code	Message		Reaction
22-0	7500h	**Error in PROFIBUS initialisation**		PS off
		Cause	Fieldbus interface defective.	
		Action	• Please contact Technical Support.	
22-2	7500h	**PROFIBUS communication error**		configurable
		Cause	– Faulty initialisation of the Profibus interface. – Interface defective.	
		Action	• Check the set slave address. • Check bus termination. • Check wiring.	

Error group 25		**Firmware**		
No.	Code	Message		Reaction
25-1	6081 h	**Incorrect firmware**		PS off
		Cause	Motor controller and firmware are not compatible.	
		Action	• Update the firmware.	

Error group 26		**Data flash**		
No.	Code	Message		Reaction
26-1	5581h	**Checksum error**		PS off
		Cause	Checksum error of a parameter set.	
		Action	• Load factory setting. • If the error is still present, the hardware may be defective.	

Error group 29		**SD card**		
No.	Code	Message		Reaction
29-0	7680h	**No SD**		configurable
		Cause	An attempt was made to access a missing SD card.	
		Action	Check: • whether the SD card is inserted properly, • whether the SD card is formatted, • whether a compatible SD card is plugged in.	
29-1	7681h	**SD initialization error**		configurable
		Cause	– Error during initialization. – Communication not possible.	
		Action	• Plug card back in. • Check card (file format FAT 16). • If necessary, format card.	

Error group 29		**SD card**	
No.	Code	Message	Reaction
29-2	7682h	**SD parameter record error**	configurable
		Cause	– Checksum incorrect. – File not present. – File format incorrect. – Error backing up the parameter file on the SD card.
		Action	• Check content (data) of the SD card.

Error group 31		**I²t monitoring**	
No.	Code	Message	Reaction
31-0	2312h	**I²t error motor (I²t at 100 %)**	configurable
		Cause	I²t monitoring of the controller has been triggered. – Motor/mechanical system blocked or sluggish. – Motor under-sized?
		Action	• Check motor and mechanical system.
31-1	2311h	**I²t error controller (I²t at 100 %)**	configurable
		Cause	I²t monitoring of the controller has been triggered.
		Action	• Check power dimensioning of drive package.

Error group 32		**Intermediate circuit**	
No.	Code	Message	Reaction
32-0	3280h	**Intermediate circuit charging time exceeded**	PS off
		Cause	Only CMMS-AS/CMMD-AS: The intermediate circuit could not be charged after the mains voltage was applied. – Fuse possibly defective. – Internal braking resistor defective. – In operation with external braking resistor, the resistor is not connected
		Action	• Check mains voltage (intermediate circuit voltage < 150 V) • Check interface to the external braking resistor. • If the interface is correct, the internal braking resistor or the built-in fuse is presumably faulty ➔ Repair by the manufacturer.
32-8	3285h	**Power supply failure during controller enable**	PS off
		Cause	Interruption/power failure while the controller enable was active.
		Action	• Check mains voltage/power supply.

Error group 35		**Fast stop**		
No.	Code	Message		Reaction
35-1	6199h	**Time out for quick stop**		PS off
		Cause	The parametrised time for fast stop was exceeded.	
		Action	• Check parameterisation.	

Error group 40		**Software limit**		
No.	Code	Message		Reaction
40-0	8612h	**Negative software limit switch reached**		configurable
		Cause	The position setpoint value has reached or exceeded the negative software limit switch.	
		Action	• Check the target data. • Check positioning area.	
40-1	8612h	**Positive software limit switch reached**		configurable
		Cause	The position setpoint value has reached or exceeded the positive software limit switch.	
		Action	• Check the target data. • Check positioning area.	
40-2	8612h	**Target position lies behind the negative software limit switch**		configurable
		Cause	Start of a positioning task was suppressed because the target lies behind the negative software limit switch.	
		Action	• Check the target data. • Check positioning area.	
40-3	8612h	**Target position lies behind the positive software limit switch**		configurable
		Cause	The start of a positioning task was suppressed because the target lies behind the positive software limit switch.	
		Action	• Check the target data. • Check positioning area.	

Error group 41		**Path program**		
No.	Code	Message		Reaction
41-8	6193h	**Path program error, unknown command**		configurable
		Cause	Unknown command found during record continuation.	
		Action	• Check parameterisation.	
41-9	6192h	**Error in path program jump destination**		configurable
		Cause	Jump to a positioning record outside the permitted range.	
		Action	• Check parameterisation.	

Error group 42		**Positioning**	
No.	Code	Message	Reaction
42-1	8681h	**Positioning: Error in pre-computation**	configurable
		Cause	Positioning cannot be reached through the options of the positioning (e.g. final speed) or parameters.
		Action	• Check parametrisation of the position records in question.
42-4	8600h	**Message, homing required**	configurable
		Cause	– Positioning not possible without homing. – Homing must be carried out.
		Action	• Reset optional parameterisation “Homing required”. • Carry out a new homing run after acknowledgement of an angle encoder error.
42-9	6191h	**Error in position data record**	PS off
		Cause	– An attempt is being made to start an unknown or deactivated position record. – The set acceleration is too small for the permissible maximum speed. – (Danger of a calculation overflow in the trajectory calculation).
		Action	• Check parameterisation and sequence control and correct if necessary.

Error group 43		**Limit switch error**	
No.	Code	Message	Reaction
43-0	8612h	**Negative limit switch error**	configurable
		Cause	Negative hardware limit switch reached.
		Action	• Check parameterisation, wiring and limit switches.
43-1	8612h	**Positive limit switch error**	configurable
		Cause	Positive hardware limit switch reached.
		Action	• Check parameterisation, wiring and limit switches.
43-9	8612h	**Error in limit switch**	configurable
		Cause	Both hardware limit switches are active simultaneously.
		Action	• Check parameterisation, wiring and limit switches.

Error group 45		**STO error**		
No.	Code	Message		Reaction
45-0	8000h	**Error in driver supply**		PS off
		Cause	Driver supply is still active despite the STO requirement.	
		Action	The internal logic for the STO requirement may be disturbed due to high-frequency switching operations at the input. • Check activation; the error must not recur. • If the error occurs repeatedly when the STO is called: • Check firmware (approved version?). If all the above options have been excluded, the hardware of the motor controller is defective.	
45-1	8000h	**Error in driver supply**		PS off
		Cause	The driver supply is active again, although STO is still required.	
		Action	The internal logic for the STO requirement may be disturbed due to high-frequency switching operations at the input. • Check activation; the error must not recur. • If the error occurs repeatedly when the STO is called: • Check firmware (approved version?). If all the above options have been excluded, the hardware of the motor controller is defective.	
45-2	8000h	**Error in driver supply**		PS off
		Cause	The driver supply is not active again, although STO is no longer required.	
		Action	If the error occurs again after the STO requirement is ended, the hardware of the motor controller is defective.	
45-3	8087h	**DIN4 plausibility error**		PS off
		Cause	Output stage no longer switches off ➔ hardware defective.	
		Action	Repair by the manufacturer.	

Error group 64		**DeviceNet error**		
No.	Code	Message		Reaction
64-0	7582h	**DeviceNet communication error**		PS off
		Cause	Node number exists twice.	
		Action	• Check the configuration.	
64-1	7584h	**DeviceNet general error**		PS off
		Cause	The 24 V bus voltage is missing.	
		Action	• In addition to the motor controller, the DeviceNet interface must also be connected to 24 V DC.	

Error group 64		**DeviceNet error**	
No.	Code	Message	Reaction
64-2	7582h	**DeviceNet communication error**	PS off
		Cause – Receive buffer overflow. – Too many messages received within a short period.	
		Action • Reduce the scan rate.	
64-3	7582h	**DeviceNet communication error**	PS off
		Cause – Send buffer overflow. – Insufficient free space on the CAN bus to transmit messages.	
		Action • Increase the baud rate. • Reduce the number of nodes. • Reduce the scan rate.	
64-4	7582h	**DeviceNet communication error**	PS off
		Cause IO-message could not be sent	
		Action • Check that the network is connected correctly and does not malfunction.	
64-5	7582h	**DeviceNet communication error**	PS off
		Cause Bus off.	
		Action • Check that the network is connected correctly and does not malfunction.	
64-6	7582h	**DeviceNet communication error**	PS off
		Cause Overflow in the CAN controller.	
		Action • Increase the baud rate. • Reduce the number of nodes. • Reduce the scan rate.	

Error group 65		**DeviceNet error**	
No.	Code	Message	Reaction
65-0	7584h	**DeviceNet general error**	configurable
		Cause – Communication is activated, even though no interface is plugged in. – The DeviceNet interface is attempting to read an unknown object. – Unknown DeviceNet error.	
		Action • Check whether the DeviceNet interface is plugged in correctly. • Check that the network is connected correctly and does not malfunction.	
65-1	7582h	**DeviceNet communication error**	configurable
		Cause I/O connection timeout. No I/O message received within the expected time.	
		Action • Please contact Technical Support.	

Error group 70		**Operating mode error**		
No.	Code	Message		Reaction
70-2	6195h	**General arithmetic error**		PS off
		Cause	The fieldbus factor group cannot be calculated correctly.	
		Action	• Check the factor group.	
70-3	6380h	**Operating mode**		configurable
		Cause	This operating mode change is not supported by the motor controller.	
		Action	• Check your application. Not every change is permissible.	

Error group 76		**SSIO error**		
No.	Code	Message		Reaction
76-0	8100h	**Error SSIO communication (axis 1 - axis 2)**		configurable
		Cause	Only CMMD-AS: – Checksum error during transfer of the SSIO protocol. – Timeout during transmission.	
		Action	• Check wiring. • Check whether the screening of the motor cables is correctly applied (EMC problem). If SSIO communication is not absolutely necessary (e.g. no fieldbus interface is used, and the axes are controlled separately over I/Os), this error may be ignored.	
76-1	8100h	**Error SSIO communication (axis 2)**		configurable
		Cause	Only CMMD-AS: SSIO partner has error 76-0.	
		Action	The error is triggered when the other axis has reported an SSIO communication error. For example, if axis 2 reports the error 76-0, the error 76-1 is triggered for axis 1. Measures and description of the error response as with error 76-0.	

Error group 79		**RS232 error**		
No.	Code	Message		Reaction
79-0	7510h	**RS232 communication error**		configurable
		Cause	Overrun when receiving RS232 commands.	
		Action	• Check wiring. • Check of the transmitted data.	

A.3 Error codes via CiA 301/402

Diagnostic messages				
Code	No.	No. bit	Message	Reaction
2311h	31-1	19	I²t error controller (I²t at 100 %)	Configurable
2312h	31-0	18	I²t error motor (I²t at 100 %)	Configurable
2320h	06-0	13	Over-current of the intermediate circuit/output stage	PS off
2380h	19-0	25	I²t at 80 %	Configurable
3210h	07-0	15	Overvoltage in the intermediate circuit	PS off
3220h	02-0	14	Undervoltage in intermediate circuit	Configurable
3280h	32-0	16	Intermediate circuit charging time exceeded	PS off
3285h	32-8	17	Power supply failure during controller enable	PS off
4210h	04-0	3	Excess/low temperature of power electronics	Configurable
4280h	18-1	27	Output stage temperature 5 °C below maximum	Configurable
4310h	03-1	2	Temperature monitoring, motor	Configurable
5114h	05-0	8	5 V electronics supply fault	PS off
5115h	05-1	10	Error in 24 V supply	PS off
5116h	05-2	9	12 V electronics supply fault	PS off
5210h	21-0	12	Error, offset current measurement	PS off
5581h	26-1	62	Checksum error	PS off
6081h	25-1	11	Incorrect firmware	PS off
6180h	01-0	61	Stack overflow (internal error)	PS off
6183h	16-3	60	Unexpected status / programming error	PS off
6187h	16-2	63	Initialization fault	PS off
6191h	42-9	56	Error in position data set	PS off
6192h	41-9	42	Error in path program jump destination	Configurable
6193h	41-8	43	Path program error, unknown command	Configurable
6195h	70-2	58	General arithmetic error	PS off
6197h	14-9	39	Error, motor identification	PS off
6199h	35-1	34	Time out for quick stop	PS off
6380h	70-3	57	Operating mode	Configurable
7380h	08-0	4	Encoder supply error	PS off
7386h	08-6	5	Angle encoder communication error	PS off
7388h	08-8	6	Internal angle encoder error	PS off
7500h	22-0	47	Error in PROFIBUS initialisation	PS off
	22-2	53	PROFIBUS communication error	Configurable
7510h	79-0	55	RS232 communication error	Configurable

Diagnostic messages				
Code	No.	No. bit	Message	Reaction
7582h	64-0	52	DeviceNet communication error	PS off
	64-2	52	DeviceNet communication error	PS off
	64-3	52	DeviceNet communication error	PS off
	64-4	52	DeviceNet communication error	PS off
	64-5	52	DeviceNet communication error	PS off
	64-6	52	DeviceNet communication error	PS off
	65-1	52	DeviceNet communication error	Configurable
7584h	64-1	44	DeviceNet general error	PS off
	65-0	44	DeviceNet general error	Configurable
7680h	29-0	48	No SD	Configurable
7681h	29-1	49	SD initialization error	Configurable
7682h	29-2	50	SD parameter set error	Configurable
8000h	45-0	21	Driver supply error	PS off
	45-1	21	Driver supply error	PS off
	45-2	21	Driver supply error	PS off
	05-2	21	Driver supply error/driver supply failed	PS off
8087h	45-3	22	DIN4 plausibility error	PS off
8100h	76-0	41	Error SSIO communication (axis 1 - axis 2)	Configurable
	76-1	40	Error SSIO communication (axis 2)	Configurable
8130h	12-4	23	CAN: Time-out nodeguarding	Configurable
8181h	12-0	54	CAN: General error	Configurable
	12-1	54	CAN: Error bus off	Configurable
	12-2	54	CAN: Error when transmitting	Configurable
	12-3	54	CAN: Error receiving	Configurable
	12-5	54	CAN: Error in the IPO mode	Configurable
8600h	42-4	29	Message, homing required	Configurable
8611h	17-0	28	Following error monitoring	Configurable
8612h	40-0	31	Negative software limit switch reached	Configurable
	40-1	31	Positive software limit switch reached	Configurable
	40-2	31	Target position lies behind the negative software limit switch	Configurable
	40-3	31	Target position lies behind the positive software limit switch	Configurable
	43-0	30	Negative limit switch error	Configurable
	43-1	30	Positive limit switch error	Configurable
	43-9	30	Limit switch error	Configurable
8681h	42-1	59	Positioning: Error in pre-computation	Configurable
8A81h	11-1	35	Homing error	PS off

A.4 Profibus diagnostics

Diagnostic messages					
Unit_Diag_Bit			No.	Message	Reaction
00	E429	“Position data set”	42-9	Error in position data set	PS off
01	E703	“Operating mode”	70-3	Operating mode error	configurable
02	E702	“Arithmetic error”	70-2	General arithmetic error	PS off
03	E421	“Position precomputation”	42-1	Positioning: Error in pre-computation	configurable
04	E163	“Unexpected state”	16-3	Unexpected status / programming error	PS off
05	E010	“Stack Overflow”	01-0	Stack overflow (internal error)	PS off
06	E261	“Checksum error”	26-1	Checksum error	PS off
07	E162	“Initialisation”	16-2	Initialization fault	PS off
08	E290	“No SD available”	29-0	No SD available	configurable
09	E291	“SD initialisation”	29-1	SD initialization error	configurable
10	E292	“SD parameter set”	29-2	SD parameter set error	configurable
13	E222	“PROFIBUS communication”	22-2	PROFIBUS communication error	configurable
14	-	“unknown”	12-0	CAN: General error	configurable
			12-1	CAN: Error bus off	configurable
			12-2	CAN: Error when transmitting	configurable
			12-3	CAN: Error receiving	configurable
			12-5	CAN: Error in the IPO mode	configurable
15	E790	“RS232 communication error”	79-0	RS232 communication error	configurable
16	E761	“SSIO communication”	76-1	Error SSIO communication (axis 2)	configurable
17	E760	“SSIO communication”	76-0	Error SSIO communication (axis 1 - axis 2)	configurable
18	E418	“Record seq. Unknown cmd”	41-9	Error in path program jump destination	configurable
19	E419	Record seq. Invalid dest.”	41-8	Path program error, unknown command	configurable
20		“unknown”	64-1	DeviceNet general error	PS off
			64-2	DeviceNet communication error	PS off
			64-3	DeviceNet communication error	PS off
			64-4	DeviceNet communication error	PS off
			64-5	DeviceNet communication error	PS off
			64-6	DeviceNet communication error	PS off
			65-0	DeviceNet general error	configurable
			65-1	DeviceNet communication error	configurable
23	E220	“PROFIBUS assembly”	22-0	Error in PROFIBUS initialisation	PS off

Diagnostic messages

Unit_Diag_Bit			No.	Message	Reaction
26	E351	“Time out: Quick stop”	35-1	Time out for quick stop	PS off
27	E111	“Error during homing”	11-1	Homing error	PS off
31	E149	“Motor identification”	14-9	Motor identification error	PS off
33	E190	“I2t at 80 %”	19-0	I²t at 80 %	configurable
35	E181	“Outp. stage temp. 5 < max.”	18-1	Output stage temperature 5 °C below maximum	configurable
36	E170	“Following error”	17-0	Following error monitoring	configurable
37	E424	“Enforce homing run”	42-4	Message, homing required	configurable
38	E43x	“limit switches”	43-0	Negative limit switch error	configurable
			43-1	Positive limit switch error	configurable
			43-9	Limit switch error	configurable
39	E40x	“Software limit”	40-0	Negative software limit switch reached	configurable
			40-1	Positive software limit switch reached	configurable
			40-2	Target position lies behind the negative software limit switch	configurable
			40-3	Target position lies behind the positive software limit switch	configurable
40	E320	“Loading time link overflow”	32-0	Intermediate circuit charging time exceeded	PS off
41	E328	“Fail. power supply ctr.ena.”	32-8	Power supply failure during controller enable	PS off
42	E310	“I2t-error motor”	31-0	I²t error motor (I²t at 100 %)	configurable
43	E311	“I2t-error controller”	31-1	I²t error controller (I²t at 100 %)	configurable
45	E052	“Driver supply”	45-0	Driver supply error	PS off
			45-1	Driver supply error	PS off
			45-2	Driver supply error	PS off
			05-2	Driver supply error/driver supply failed	PS off
46	E453	“Plausibility DIN 4”	45-3	DIN4 plausibility error	PS off
47	E124	“Time out Nodeguarding”	12-4	CAN: Time-out nodeguarding	configurable
49	E052	“12 V - Internal supply”	05-2	12 V electronics supply error	PS off
48	E050	“5 V - Internal supply”	05-0	5 V electronics supply error	PS off
50	E051	“24 V - Internal supply”	05-1	Error in 24 V supply	PS off
51	E251	“Hardware error”	25-1	Incorrect firmware	PS off
52	E210	“Offset current metering”	21-0	Error, offset current measurement	PS off

Diagnostic messages					
Unit_Diag_Bit			No.	Message	Reaction
53	E060	“Overcurrent output stage”	06-0	Over-current of the intermediate circuit/output stage	PS off
54	E020	“Undervoltage power stage”	02-0	Undervoltage in intermediate circuit	configurable
55	E070	“Overvoltage output stage”	07-0	Overvoltage in the intermediate circuit	PS off
58	E03x	“Overheating error (Motor)”	03-1	Temperature monitoring, motor	configurable
59	E040	“Overtemperature power stage”	04-0	Excess/low temperature of power electronics	configurable
61	E086	“SINCOS-RS485 communication”	08-6	Angle encoder communication error	PS off
62	E088	“SINCOS track signals”	08-8	Internal angle encoder error	PS off
60	E080	“Encoder supply”	08-0	Encoder supply error	PS off

B Serial interface RS232 (diagnostics/parameterisation interface)

B.1 Activating the motor controller via the interface RS232

B.1.1 Master data of the interface RS232

Parameter	Significance
Baud rate	9.6[1)]...115 KBit/s
Data bits	8
Parity	none
Stop bit	1

1) Factory setting

Tab. B.1 Basic setting

For additional information ➔ “Mounting and installation” description,
GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

B.1.2 Connect RS232 interface with a program

To be able to operate an interface with a terminal program, such as for test purposes, the following settings are required (recommendations):

Parameter	Value
Flow control	none
Emulation	VT100
ASCII configuration	– Sent characters finish with line feed – Output entered characters locally (local echo) – During reception, attach line feed to the end of the line

Tab. B.2 Connect RS232 interface with a program

Please note that, immediately after a reset, the motor controller independently issues a bootup message via the serial interface. A reception program on the controller must either process or reject these received characters.

B.1.3 Connection [X5]: Pin allocation of the RS232 interface

Collision with interface “RS485”.

When the “RS232” interface is used, the “RS485” interface can also be activated via the FCT configuration. If a cable is used in which the pins “4” and “9” are contacted on both plugs, this can result in simultaneous access of the interfaces “RS232” and “RS485” to the motor controller.

– For communication with the interface “RS232”, only use a cable that corresponds to the pin allocation “interface RS232”.

For additional information ➔ “Mounting and installation” description,
GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

B.2 Commands/syntax of the RS232 interface

B.2.1 General commands

Command	Syntax	Answer
New initialisation of the positioning controller	RESET!	None (switch-on message)
Save the current parameter record and all position records in the non-volatile flash memory	SAVE!	DONE
Setting the transmission rate for serial communication	BAUD9600 BAUD19200 BAUD38400 BAUD57600 BAUD115200	
Unknown command	Any	ERROR!
Reading the version number of the firmware.	VERSION?	2300:VERSION:MMMM.SSSS

MMMM: Main version: 16 Bit (hexadecimal format)
SSSS: Subversion: 16 Bit (hexadecimal format)
Tab. B.3 General commands

B.2.2 Control motor controller via CAN-Interpreter (CI)

Communication of the CAN-Interpreter (CI) is based on the service data objects (SDO) of the CANopen device profile CiA 402. Through the RS232 interface, the motor controller can be parameterised and controlled.

Command syntax

Read: ?XXXXYY
8 bit write: =XXXXYY:WW
16 bit write: =XXXXYY:WWWW
32 bit write: =XXXXYY:WWWWWWWW

Brief description	Significance
XXXX	Command index
YY	Command sub-index
WWWW	Data

Tab. B.4 Command syntax RS232

For additional information on CAN objects ➔ description “device profile CiA 402, simulation of SDO access”, GDCP-CMMS/D-C-CO-...

Example: Operating the motor controller in direct mode (profile position mode)

The following describes the sequence in principle.

1. Changing of the controller enable logic
   The controller enable logic can be changed via the CAN control word (COB 6510_10). Since the simulation of the CAN interface can be completely taken over via the RS232 interface, the enable logic can also be converted to DINs + CAN.
   – **Command: =651010:0002**
   As a result, the release can be granted via the CAN control word (COB 6040_00).
   – **Command: =604000:0006 command “shutdown”**
   – **Command: =604000:0007 command “switch on/disable operation”**
   – **Command: =604000:000F Command “Enable operation”**
2. Activation of the “profile position mode”
   The positioning mode is activated via the CAN control word (COB 6060_00 mode of operation).
   – **Command: =606000:01 profile position mode**
3. Write position parameters
   The target position can be written through the CAN control word (COB 607A_00, target position)“.
   The target position is thereby written in “position units”. That means, it depends on the set CAN factor group. The default setting here is $1/2^{16}$ revolutions. (16 bit portion before the decimal point, 16 bit portion after it).
   – **Command: =607A00:00058000 target position 5.5 revolutions**
   The travel speed can be written via the CAN control word (COB 6081_00, profile velocity), the final speed via the CAN control word (COB 6082_00, end velocity).
   The speeds are thereby written in “speed units”. That means, they depend on the set CAN factor group.
   The default setting here is 1 revolution/min. (32 bit portion before the decimal point, 0 bit portion after it).
   – **Command: =608100:000003E8 travel speed 1000 rpm**
   The acceleration can be written via the CAN control word (COB 6083_00, profile acceleration), the deceleration via the CAN control word (COB 6084_00 profile deceleration) and the quick stop ramp via the CAN control word (COB 6085, quick stop deceleration).
   The acceleration is thereby written in “acceleration units”. That means, they depend on the set CAN factor group.
   The default setting here is $1/2^{8}$ revolution/min. (24 bit portion before the decimal point, 8 bit portion after it).
   – **Command: =608300:00138800 acceleration 5000 rpm**
4. Start positioning
   Positioning is started via the CAN control word (COB 6040_00):

e) Controller enable is controlled via bit 0 ... 3 (see above).
f) Positioning is started via a rising edge at bit 4. The following settings are accepted thereby.
g) Bit 5 establishes whether an ongoing positioning is ended first before the new positioning task is taken over (0), or whether the ongoing positioning should be cancelled (1).

h) Bit 6 establishes whether the positioning should be carried out absolutely (0) or relatively (1).
   - **Command: =604000:001F start absolute positioning or**
   - **Command: =604000:005F start relative positioning**
5. After positioning has been ended, the status of the controller must be reset so a new positioning can be started.
   - **Command: =604000:000F bring controller into “Ready” state.**

Example: “Homing mode” via the RS232 interface

With the CAN access simulated via the RS232 interface, the motor controller can also be operated in the CAN “Homing mode”. The following describes the sequence in principle.

1. Conversion of the controller enable logic
2. The controller enable logic can be changed via the CAN control word (COB 6010_10). Since the simulation of the CAN interface can be completely taken over via the RS232 interface, the enable logic can also be converted to DINs + CAN.
   - **Command: =651010:0002**
3. As a result, the release can be granted via the CAN control word (COB 6040_00).
   - **Command: =604000:0006 command “shutdown”**
   - **Command: =604000:0007 command “switch on/disable operation”**
   - **Command: =604000:000F command “Enable operation”**
4. Activation of the “Homing mode”
5. The reference mode is activated via the CAN control word (COB 6060_00, Mode of Operation).
   - **Command: =606000:06 Homing mode**
6. Start homing
7. Homing is started via the CAN control word (COB 6040_00).
8. Controller enable is controlled via bit 0 ... 3.
9. Homing is started via a rising edge at bit 4.
   - **Command: =604000:001F**
10. After homing has been ended, the status of the motor controller must be reset.
   - **Command: =604000:000F bring controller into “Ready” state.**

C Serial interface RS485 (control interface)

C.1 Activating the motor controller via the interface RS485

C.1.1 Master data of the interface RS485

Parameter	Significance
Baud rate	9.6[1)]...115 KBit/s
Data bits	8
Parity	none
Stop bit	1

1) Factory setting

Tab. C.1 Basic setting

For additional information ➔ “Mounting and installation” description,
GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

C.1.2 Connection [X5]: Pin allocation of the RS485 interface

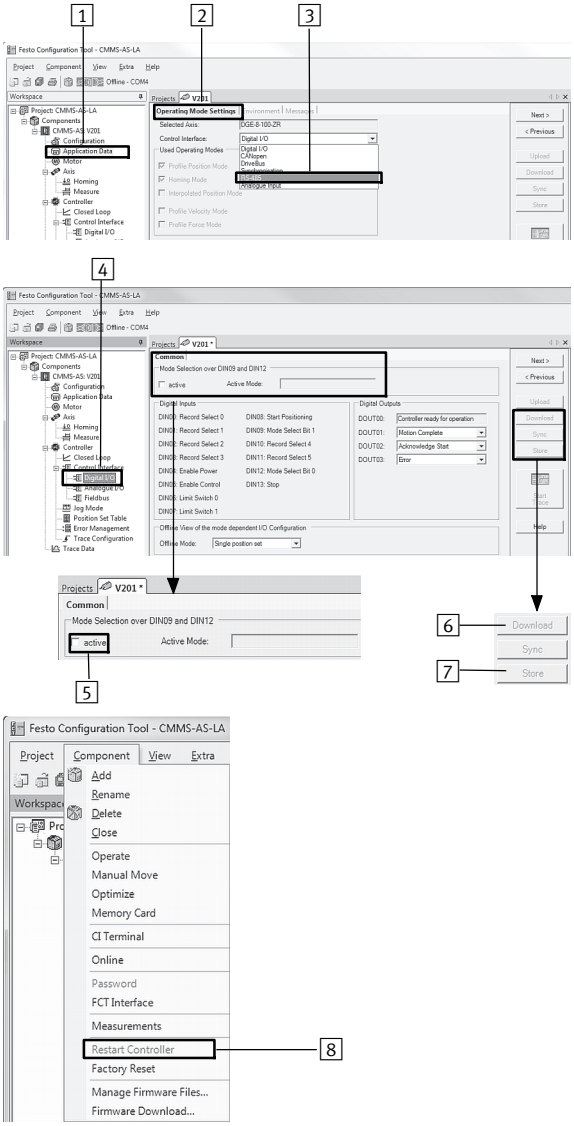
Collision with interface “RS232”.

If the control interface “RS485” is activated, interface “RS232” remains active. If the pins “2” and “3” in the cable are contacted on both plugs, this can result in the interfaces “RS232” and “RS485” simultaneously accessing the motor controller.

– For communication with the “control interface RS485”, use a cable that corresponds to the pin allocation “control interface RS485”.

For additional information ➔ “Mounting and installation” description,
GDCP-CMMS-AS-G2-HW-.../GDCP-CMMD-AS-HW-.../GDCP-CMMS-ST-G2-HW-...

C.2 Configure RS485 interface in the Festo Configuration Tool (FCT)



1. Mark the “Application data” button in the project tree.
2. Press the “Operating mode selection” button in the work space.
3. Select “RS485” as control interface. (Acknowledge the change with “OK”)
4. Mark the “Digital I/O” button in the project tree.
5. Deactivate the “active” control field in the “Mode selection via DIN9 and DIN12” field.
6. Press the “Download” button in the work space to load the new configuration in the motor controller.
7. Press the “Save” button in the work space to save the new configuration permanently.
8. Produce a reset to activate the configuration:
   – FCT: Press the “Restart controller” button ([Menu bar][Component] [Restart controller]).
   – Switch the power supply off and on.

Fig. C.1 Configure RS485 interface in the FCT

C.3 Commands/syntax of the RS485 interface

Control of the motor controller via RS485 takes place with the same objects as with RS232. Only the syntax of the commands to read/write the objects is expanded in comparison to the RS232.

Syntax:
Xtnn:HH...HH:CC

Brief description	Significance
XT	Fixed constants
nn	Node number, identical to the CANopen node number (setting via DIL switch)
HH...HH	Data (RS232 command syntax)
CC	Checksum

Tab. C.2 Command syntax RS485

- The reply sends the following characters to the first 5 positions:
  “XRnn:” with nn = node number of the device.
- All devices react to the node number 00 as “Broadcast”. In this way, each device can be addressed without knowing the node number.
- The commands of type “=” “?”, etc. support an optional checksum. This checksum is formed without the first 5 characters.
  At the byte level, all characters are added up byte-by-byte to a UINT8 number without taking the overtravel into account.
  The checksum comprises the entire command without RS485 identifier and without checksum.
  Example:
  For “XT07:=607A00:000A0000:80”
  the checksum “80” is created over
  “=607A00:000A0000:”.
- The boot-up message of the boot loader and the boot-up message of the firmware are sent only over RS232 mode.

Example “Profile position mode” via RS485
If the motor controller is operated via the RS485 interface, control, just as operation, can take place via the RS232 interface ➔ Profile position mode, page 237. If required, the node number is simply written in front of the command. The node number is set via the DIL switches.

Command: **XT07:=607A00:000A0000** Target position 10 revolutions send to node 7

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