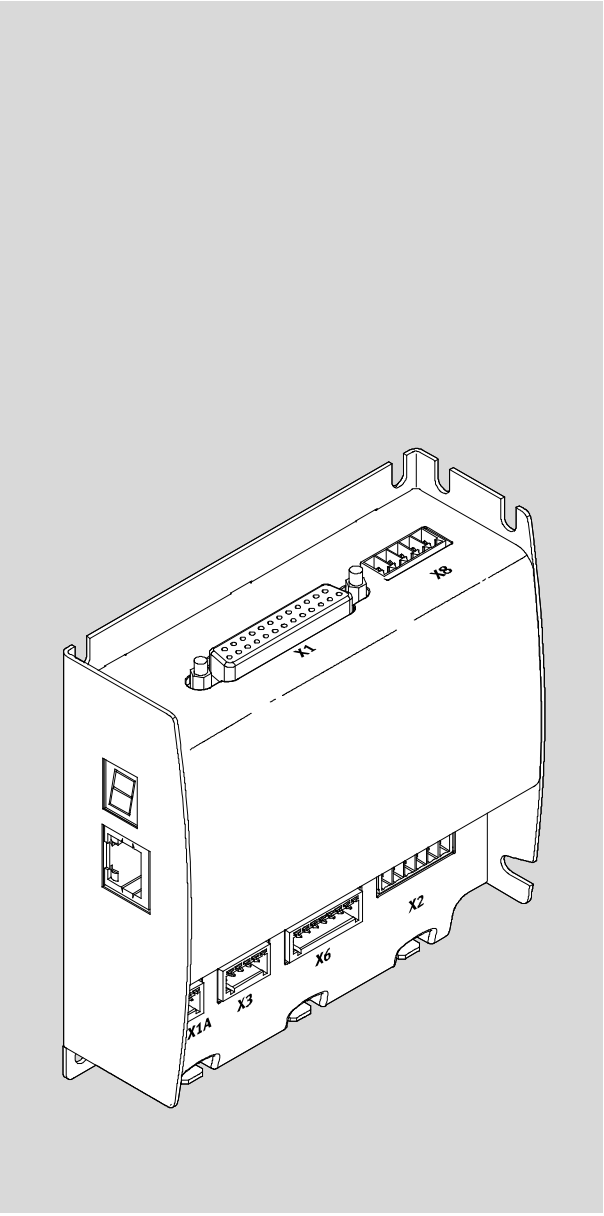
# Motor controller

# CMMO-ST




FESTO

**Description**

Motor controller
CMMO-ST-C5-1-DIO

8022056
1301a

Translation of the original instructions
GDCP-CMMO-ST-EA-SY-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 – CMMO-ST

**Instructions on this documentation**

This documentation is intended to help you safely work with the motor controller CMMO-ST.

Please note the error correction at page 18 of tis documentation.

**Product identification, versions**

The hardware version indicates the version status of the CMMO-ST's electronics. The firmware version indicates the version status of the operating system.

You can find the specifications of the version status as follows:

– Hardware version and firmware version in the Festo Configuration Tool (FCT) with an active online connection to the CMMO-ST on the "Controller" panel.

| Firmware version from | What's new? | Which FCT plug-in? |
|---|---|---|
| V 1.0.x | Motor controller CMMO-ST with I/O interface supports the following drives:<br>– EPCO<br>– For additional drives: see Festo catalogue<br>➔ www.festo.com | CMMO-ST V 1.00 |
| V 1.1.2 | Advanced parameter settings via web browser | From CMMO-ST V 1.1.0 |

Tab. 1 Firmware Version

**Service**

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

**Documentation**

You will find more extensive information in the following documentation:

| **User documentation on the CMMO-ST** | | |
|---|---|---|
| **Name** | **Type** | **Contents** |
| STO documentation with a brief overview of the CMMO-ST.<br>Enclosed in printed format. | GDCP-CMMO-ST-STO-... | Use of the STO safety function (“Safe Torque Off”).<br>Also includes intended use of the CMMO-ST and a documentation overview. |
| Description<br>(on CD-ROM) | GDCP-CMMO-ST-EA-SY-... | Installation, commissioning and diagnostics of positioning systems with the CMMO-ST with communication via I/O interface. |
| Help system for software (included in the FCT software) | Dynamic and static help for the Festo Configuration Tool | Functional descriptions for the Festo Configuration Tool configuration software. |
| UL documentation | CMMO-ST_SPUL | Requirements for observing the certified UL conditions if the product is operated in the USA or Canada. |
| Operating instructions | e.g. for electric cylinder type EPCO | Installing and commissioning the drive |

Tab. 2 Documentation on the CMMO-ST

# 1 Safety and requirements for product use

## 1.1 Safety

### 1.1.1 General safety instructions

When commissioning and programming positioning systems, the safety regulations in this description as well as those in the operating instructions for the other components used must be observed.
The user must make sure that nobody is within the sphere of influence of the connected actuators or axis system. Access to the possible danger area must be prevented by suitable measures such as shutting them off and warning signs.

**Warning**
Electric axes move with high force and at high speed. Collisions can lead to serious injury to people and damage to components.
- Make sure that nobody can place body parts in the positioning range of the axes or other connected actuators and that there are no objects in the positioning path while the system is still connected to a power supply.

**Warning**
Parameterisation errors can cause injury to people and damage to property.
- Only enable the controller if the axis system has been installed and parameterised by technically qualified staff.

**Note**
**Damage to the product from incorrect handling.**
- Switch off the supply voltage before mounting and installation work. Switch on supply voltage only when mounting and installation work are completely finished.
- Never unplug or plug in a product when powered!

- Observe the handling specifications for electrostatically sensitive devices.

### 1.1.2 Intended use

The CMMO-ST motor controller is used for controlling stepper motors in accordance with the Festo catalogue, and is especially intended for use with EPCO electric drives.
This description documents the basic functions of the CMMO-ST and the I/O interface.
EPCO drives and additional components are documented in separate operating instructions.

The CMMO-ST and the connectable modules and cables may only be used as follows:
– as intended
– only in an industrial environment
– in perfect technical condition
– in original status without unauthorised modifications (only the conversions or modifications described in the documentation supplied with the product are permitted)

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

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

## 1.2 Requirements for product use

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

### 1.2.1 Technical requirements

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

- Comply with the connection and environmental conditions specified in the technical data of the product (➔ appendix A.1) and of all connected components.
  Only compliance with the limit values or load limits permits operation of the product in accordance with the relevant safety regulations.
- Observe the instructions and warnings in this documentation.

### 1.2.2 Qualification of the specialists (requirements for the personnel)

The product may 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 industrial safety
– the documentation for the product

### 1.2.3 Range of application and certifications

Standards and test values, which the product complies with and fulfils, can be found in the “Technical data” section (➔ 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 can be found at www.festo.com.

Certain configurations of the product have been certified by Underwriters Laboratories Inc. (UL) for the USA and Canada. These configurations bear the following mark:


UL Listing Mark for Canada and the United States

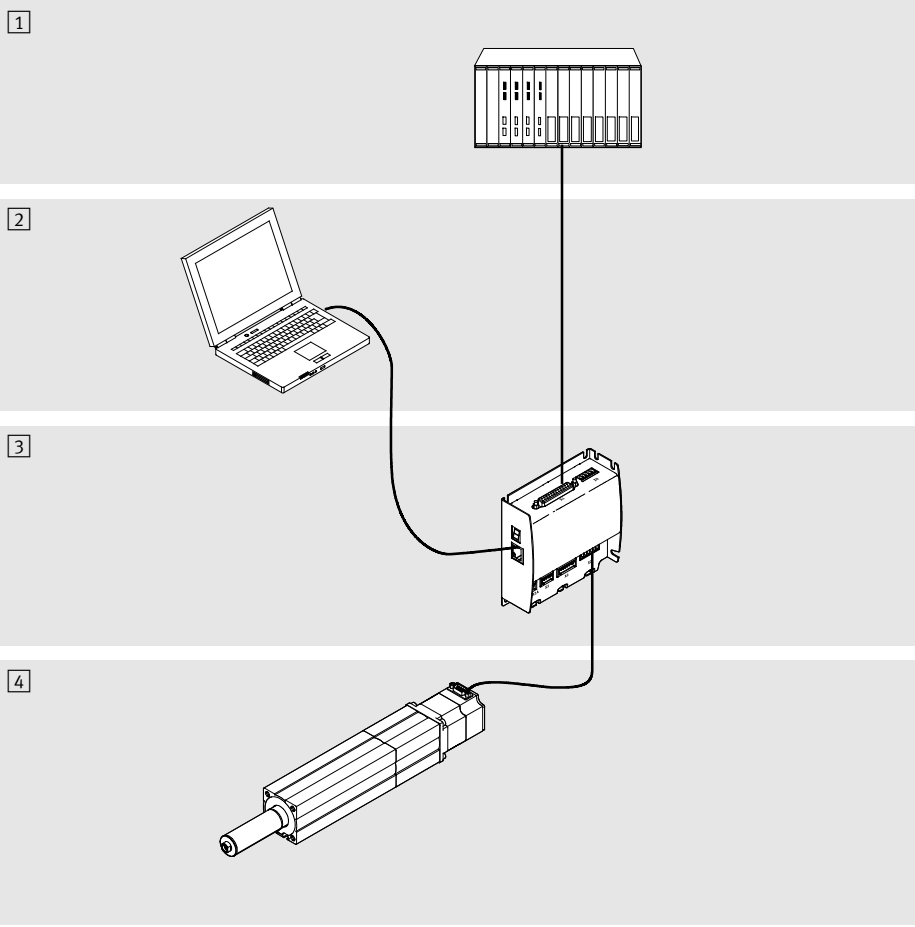
**Note**

Observe the following if the UL requirements are to be complied with in your application:

- Rules for observing the UL certification can be found in the separate UL special documentation. The technical data stated therein take priority.
- The technical data in this documentation may show values deviating from this.

# 2 Overview

## 2.1 System overview




1 Higher order controller level: PLC
2 Parameterisation and commissioning level:
Festo Configuration Tool (FCT)
- or -
web browser
3 Controller level: CMMO-ST
4 Drive level:
for example Electric cylinder with stepper motor

Fig. 2.1 System overview

## 2.2 Overview of CMMO-ST

### 2.2.1 General properties

- Rotor-oriented control: stepper motor behaves like a servo motor; force control possible, energy-optimised operation, low heat generation
- Separate load and logic supply (no new homing run required after emergency stop)
- Control cabinet unit, field use in IP40 environments is also possible (with full pin assignment)
- Ethernet interface with integrated web server
- Backup file: includes all parameterisation settings. It can be stored on separate data storage media. Enables seamless device replacement.
- 7 segment display to indicate device states, errors and warnings
- Internal braking resistor present
- The CMMO is available as an NPN variant (type code CMMO-...-DION) and a PNP variant (type code CMMO-...-DIOP). This document describes both variants.
- Function “Safe torque off” (STO):
  ➔ description GDCP-CMMO-ST-STO-...

### 2.2.2 Commissioning options

The CMMO-ST can be parameterised and commissioned as follows:

- With the integrated web server, using a mechanical drive of the OMS series (optimised motion series): diagnostics and parameterisation via standard web browser, simple positioning (➔ section 5.3)
- with **FCT**, the Festo Configuration Tool: convenient, full function range (➔ section 5.4)

Control via Ethernet (CVE):
It is possible to start records from a PC programme via the Ethernet interface. However, in-depth knowledge of programming TCP/IP applications is required for this purpose (➔ appendix B.1).

### 2.2.3 Control profiles of the I/O interface

**Valve profile (7)**

Simple I/O control: Based on the pneumatic valve pilot, **7 position records** can be selected directly through one input each (7 separate inputs). Upon reaching the target position the output corresponding to the input is set (7 separate outputs). The valve profile exclusively supports simple positioning operation, optionally with reduced torque.

**Binary profile (31)**

Flexible I/O control: **31 records** (plus record 0 = homing) can be addressed via 5 inputs. The binary profile also enables jogging and teaching, force mode, speed mode and record linking.

A detailed description of these profiles ➔ section 5.5.

### 2.2.4 Closed loop versus open-loop operation

**Regulated (with positional feedback), motor with encoder (closed-loop operation)**
In closed-loop operation the rotor position of the motor is detected by an incremental encoder/encoder and reported back to the controller (closed loop).
The **force mode** is only possible in closed-loop operation. Running or referencing to **stop** is also only possible in closed-loop operation.
In closed-loop operation only the energy required to move the load is supplied to the motor, i.e. the motor operates in an **energy-optimised manner with low heat generation**.

**Controlled (without positional feedback), motor with/without encoder (open-loop operation)**
In open-loop operation (without feedback of the rotor position) only the positioning mode and speed mode, as well as homing to proximity sensor or to "current position" are possible.
When travelling to a stop it can result in step losses and thus to defective position values.
In open-loop operation the motor is always operated with the set driving current when travelling and with the set holding current when at a standstill.
Operation of motors with an encoder can also be parameterised so that no feedback from the encoder is required.

## 2.3 Overview of CMMO-ST operating modes

**Records**
Orders are stored in a record table in CMMO-ST in the form of parameter records. Each record contains all of the information required for a specific function depending on the selected mode.
During operation, the higher-order controller (PLC) then makes a successive selection from the records that are saved in the CMMO-ST ("record selection").

### 2.3.1 Positioning mode

During positioning mode the positioning tasks are saved as a "position record" in the record table. Each position record includes information about the target position, speed, acceleration, etc.
In the binary profile record linking can also be configured.

### 2.3.2 Speed mode

The drive moves at a specified speed. The corresponding records in the record table are designated speed records. There are speed records with and without stroke limit.
The speed mode is only available in the binary profile.

### 2.3.3 Force mode

The motor generates a predetermined torque. Depending on the mechanics this results in a torque or linear force. The corresponding records in the record table are designated force records. There are force records with and without stroke limit.
The force mode is only possible with closed-loop operation (motor with encoder) and is only available in the binary profile.

## 2.4 Overview of drive functions

### 2.4.1 Jogging

During the jogging mode the drive moves as long as a corresponding signal is present. This function is commonly used to approach teaching positions or to move the drive out of the way. If the drive is not referenced, the software end positions are disabled and the drive can be positioned behind the software end positions by jogging.
This function is only available in the binary profile.

### 2.4.2 Teach

The teach function enables the current position to be adopted as a parameter:
1st step: The drive is moved to the desired position (e.g through jogging).
2nd step: The user starts the teach command; the current position is transferred to a position record as the target position.
For additional information ➔ sections 2.4.11 and 5.5.3.

### 2.4.3 Standstill monitoring

Standstill monitoring is only available during closed-loop operation in the binary profile. If the standstill position window is exited during position control, it is indicated by the standstill monitoring function: if this position window is exited for a period longer than that defined in the “standstill monitoring time”, the controller signals this to the higher-order controller. One of the freely assignable outputs (no. 6 or no. 7) can be used for this purpose.
The position controller also tries to move the drive back into the position window.

### 2.4.4 Brake

If the drive is equipped with a brake, it is controlled as follows:

**Switch-on delay**
When setting the release (ENABLE), the time set for the switch-on delay starts to run (e.g. 150 ms) and the position controller of the CMMO-ST assumes control of the connected drive. The brake opens simultaneously. The CMMO-ST only accepts positioning jobs after expiration of the switch-on delay.

**Switch-off delay**
When the enable signal is removed, the time set for the switch-off delay starts to run. The brake closes during this time. The position controller holds the drive in position. The position controller is only switched off after expiration of the switch-off delay.
If the enable signal is removed while the drive is executing a record, the drive is brought to a standstill with the quick stop ramp (Quick stop). As soon as the drive has come to a standstill, the brake output is reset: the brake/clamping unit closes. Simultaneously, the switch-off delay time begins to run. The CMMO-ST still controls the position. The controller end stage is switched off after the switch-off delay.

A closed brake can be opened via digital input no. 9.

### 2.4.5 Comparators & messages

The following drive conditions can be ascertained via so-called record messages:

- **Position comparator active**
  The drive is located between two defined positions (in the “Position zone”).
  Detailed description ➔ section 5.9.1.
- **Speed comparator active**
  The speed is within a defined range.
  Detailed description ➔ section 5.9.2.
- **Force comparator active**
  The actual force (or torque) calculated via the current is within a defined range.
  Detailed description ➔ section 5.9.3.
- **Time comparator active**
  The time since the start of the position record is within a defined range.
  Detailed description ➔ section 5.9.4.

In FCT it can be parameterised so that the presence of these states is signaled via digital outputs.

### 2.4.6 Record Linking

The record linking function allows records to be linked together: the presence of a defined step enabling condition after a record has been executed causes another record to be executed automatically. Only available in the binary profile. Detailed description section 5.8.

### 2.4.7 Record switching by PLC

The record switching function enables the PLC to start a new record before an active record has been completed. Detailed description section 5.7.

### 2.4.8 Trace

The “trace” oscilloscope function in FCT makes it possible to record drive data over a defined period in real time, e.g. speeds and contouring errors during a movement.

### 2.4.9 Firmware update

The Festo Configuration Tool (FCT) enables firmware to be updated. This should only be performed in accordance with the instructions provided by Festo Service.

### 2.4.10 Parameter file

After completing parametrisation, you can upload a parameter file from the controller to your computer; doing this creates a backup copy of the parameters in case the controller becomes damaged or before firmware updates. This includes information about the connected motor, the drive and the parameter settings executed. If the CMMO-ST needs to be replaced, you can simply import the parameter file from the old CMMO-ST into the new CMMO-ST. The new CMMO-ST is then ready for immediate use. An example of creating a parameter backup file with the web server ➔ section 5.3.4.

### 2.4.11 Flash memory

The integrated FLASH memory of the CMMO-ST includes the parameter files and the firmware.
In principle, the number of possible write cycles is limited.
Entries are written into the FLASH memory by the following procedures:
– teaching with automatic storage (➔ section 5.5.3)
– downloading a new parameter file
– a firmware update
– “saving” in FCT
– reconfiguration of malfunction properties/error responses
– recording of movements with the trace function in FCT

**Note**
Damage to the FLASH memory
The FLASH memory used by the CMMO-ST is designed for 100,000 write cycles.
- Do **not** use the TEACH function in combination with “automatic storage” in continuous operation, as this will quickly exceed the maximum number of write cycles.

Minimum time between downloading two parameter files: 3 seconds.

### 2.4.12 Higher-order control

“Higher-order control” is an **exclusive access right**.
Many motor controllers have multiple interfaces through which they can be controlled (e.g. an I/O interface and a CAN interface). Simultaneous control by multiple interfaces, however, could result in uncontrollable behaviour of the drive.
Master control ensures that only **one** interface controls the drive (i.e. it has sovereignty).
The interface that has higher-order control is specified in CVE object #3. The other interfaces then only have read access to the motor controller.

## 2.5 Interfaces and simultaneous connections

**Physical interfaces**
The CMMO-ST has two physical interfaces:
– I/O interface
– ~~EtherCat interface~~ Ethernet interface

**Logical interfaces**
Three logical interfaces can be distinguished within the Ethernet interface:
– FCT Interface
– web browser interface
– CVE interface (control via Ethernet)

| **Interfaces** | | | | |
|---|---|---|---|---|
| **Physical** | I/O interface | ~~EtherCat interface~~ Ethernet interface | | |
| **Logical** | I/O interface | FCT | Web browser | CVE |

Tab. 2.1 Physical and logical interfaces

Together with the I/O interface there are **four logical interfaces**, of which **only one can have higher-order control**.
**When the CMMO is switched on** the **I/O interface** has master control. Any other logical interface can take higher-order control from the I/O interface.
FCT can take master control from a web browser. This is not possible the other way around. The change in higher-order control can be blocked by CVE with object #4.

### 2.5.1 Number of connections

Simultaneously permissible are a maximum of:
– 1 CVE connection
– 1 web browser connection
– 2 FCT connections, of which only one can have master control.
**In total** a **maximum of two** Ethernet connections are permissible simultaneously.

## 2.6 Measuring reference system

### 2.6.1 Basic concepts

**Homing**
The position of the reference point REF is ascertained during homing.

**Movement to zero**
Following the homing run: travel from the homing point to the axis zero point (➔ section 2.7.6).

**Homing method**
defines the way in which the reference point REF is ascertained.

**Homing point REF**
binds the measuring reference system, for example, to a proximity sensor or a fixed stop (depending on the homing method).

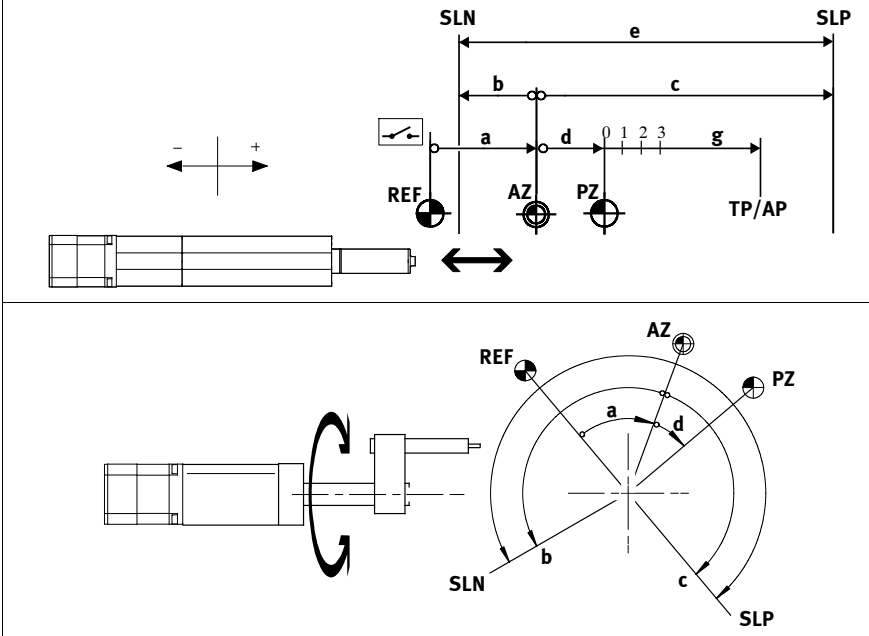
**Axis zero point AZ**
is shifted by a defined distance from the reference point REF. But this offset can also be = 0.
The software limits and the project zero point refer to the axis zero point.

**Project zero point PZ**
is a point to which the actual position and the absolute target positions from the position record table refer.
The project zero point is shifted by a defined distance from the axis zero point AZ. But this offset can also be = 0.

**Software end positions**
limit the permitted positioning range (work stroke). If the target position of a positioning command lies outside the software end positions, the positioning command will not be processed and an error will be registered.

**Usable Stroke**
The distance between the two software limits. Maximum stroke by which the axis can move with the set parameterisation.

**Measuring reference system**




| | | | |
|---|---|---|---|
| REF | Homing point (reference point) | a | Offset axis zero point |
| AZ | Axis zero point | b, c | Offset software end positions |
| PZ | Project zero point | d | Offset project zero point |
| SLN | Negative software end position (software limit negative) | e | Usable stroke |
| SLP | Positive software end position (software limit positive) | | |
| TP/AP | Target position/actual position | g | Offset TP/AP to PZ |

Tab. 2.2 Measuring reference system

### 2.6.2 Calculation rules

| Dot | | Calculation rule | |
|---|---|---|---|
| Axis zero point | AZ | = REF + a | |
| Project zero point | PZ | = AZ + d | = REF + a + d |
| Negative software end position | SLN | = AZ + b | = REF + a + b |
| Positive software end position | SLP | = AZ + c | = REF + a + c |
| Target position/actual position | TP, AP | = PZ + g | = AZ + d + g<br>= REF + a + d + g |

### 2.6.3 Prefix and direction of rotation

All points and offsets have a sign prefix. The following applies for EPCO type drives (unless reversal of direction has been activated):

| Value | Direction |
|---|---|
| + | Positive values face from the basis point in the direction of the extended end position. |
| – | Negative values face from the basis point in the direction of the retracted end position. |

### 2.6.4 Units of measurement

During parameterisation via a web browser or FCT you can use commonly used units for length specifications, such as millimetres or inches.
If you are using CVE objects, you will need the so-called interface increments SINC (➔ appendix B.2).

## 2.7 Homing run

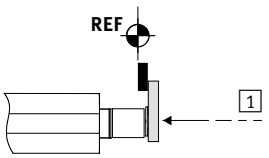
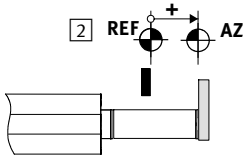
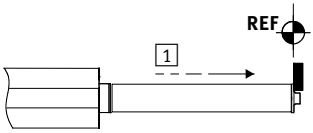
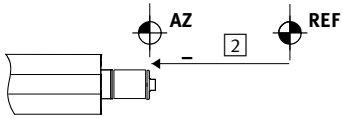
A homing run must be performed every time the logic voltage supply is switched on in order to anchor the reference point and the measuring reference system in the positioning range of the axis. A drive function cannot be started without a successful homing run (exception: jogging).

### 2.7.1 Homing overview

– Homing methods to a fixed stop
  (➔ section 2.7.2)
– Homing methods to reference switch with/without index
  (➔ section 2.7.3)
– Homing method “current position”
  (➔ section 2.7.4)
– Automatic homing (valve profile)
  (➔ section 2.7.5)
– Movement to zero
  (➔ section 2.7.6)

### 2.7.2 Homing methods to a fixed stop

Homing to a fixed stop is **only possible in closed-loop operation** (➔ section 2.2.4).
The stop is detected by a motor shutdown in combination with a sharp rise in the motor current. The parameters for stop detection can be set in FCT.

| **Homing methods to the stop** |
|---|
| – Negative fixed stop (retracted end position) |
|   |
| – Positive fixed stop (extended end position) |
|   |
| 1 Homing: The drive moves to the fixed stop at the search speed (= reference point REF).<br>2 Movement to zero: the drive moves from the reference point REF to the axis zero point AZ. |

Tab. 2.3 Homing to the stop

➔

**Note**
Material damage due to moved measuring reference system
In the event of greatly reduced dynamic values (low maximum motor current) combined with high travelling resistance (e.g. due to frictional grip), there is a danger that the drive will come to a standstill and the controller will recognise a stop incorrectly.

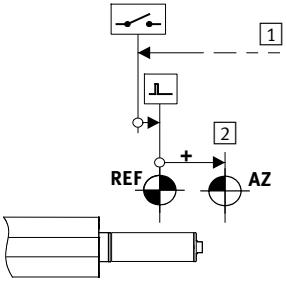
A movement to zero should be executed when homing **to a fixed stop** (➔ section 2.7.6) in order to exit the stop position. Otherwise the drive could be driven continuously against an elastic stop, which would result in a strong temperature increase and eventually lead to the controller shutting down.

If the system does not have a stop (axis of rotation), the homing run will never be completed, i.e. the drive will run continuously at the parameterised search speed.

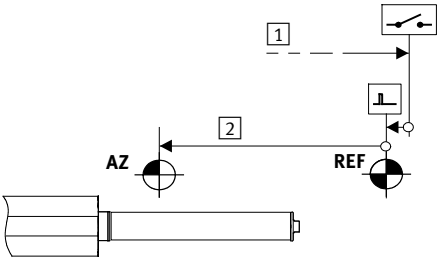
### 2.7.3 Homing methods to switch with/without index search

**Homing methods to switch**

– Direction: negative




– Direction: positive




1 The drive runs to the switch at the search speed, turns around and moves slowly at creep speed in the reverse direction. The reference point REF is at the switch-off point of the switch or on the following index pulse (depending on parameterisation).

2 Optional movement to zero: The drive runs from the reference point REF at positioning speed to the axis zero point AZ.

Tab. 2.4 Homing to switch

**For closed-loop operation** (➔ section 2.2.4):

A distinction is made between the following options:

1. **At the start of the homing run the switch is already actuated.**
   In this case, the drive runs counter to the parameterised homing direction.
2. **The switch is only found after the start of the movement.**
   In this case, the drive initially runs in the parameterised homing direction, turns after locating the switch edge and moves in the reverse direction.
3. **The drive moves against a stop before a switch is found.**
   In this case, the drive reverses and searches for the switch in the reverse direction. If a switch is found, the drive moves through the complete switching range.

**In all cases** the reference point is either at the switch-off point or on the following index pulse (dependent on the homing method selected).

**For the last case:** If a switch is not found in the reverse direction before a stop is reached, the homing run is aborted with an error message.

**If no switch is found at all** and no stop is available, the homing run will never be completed, i.e. the drive will run continuously at the parameterised search speed.

For a homing run with **index search**: If no index pulse is found during the index search over more than one motor rotation, the homing run is aborted with an error message.

**For open-loop operation** (➔ section 2.2.4):
The homing run in open-loop operation is generally executed in the same way as in closed-loop operation. However, the following special features apply:
– Stops are not detected
– An index search is not possible
– If a switch has not been found after a certain period of time, the homing run is aborted with an error message. This timeout time can be set in FCT (“Homing” panel, “Settings” tab). The drive therefore must always be positioned before the start of a homing run so that it can find the switch.

### 2.7.4 Homing method “current position”

The current position becomes the reference position. Apart from an optional movement to zero (➔ section 2.7.6), no positioning motion is executed.
In open-loop operation (➔ section 2.2.4) without a reference switch, this is the only possible homing method.

### 2.7.5 Automatic homing (valve profile)

An “automatic homing run“ can be parameterised in the valve profile (FCT: “Homing” panel, “Settings” tab).
This is executed automatically if the drive is not referenced at the start of a position record. The started position record is then executed.
The automatic homing run is aborted if the position record input is reset again before the automatic homing run has been executed completely.

### 2.7.6 Movement to zero

A movement to zero is possible after a homing run. This is where the drive moves to the parameterised axis zero point after finding the reference point.
Whether or not a movement to zero is executed can be defined as a homing run parameter in FCT. The movement to zero is required when homing to the stop; the minimum offset to the axis zero point is 1 mm.
If a movement to zero is not executed, the drive remains at position (-1) * offset axis zero point. Make sure that this position is not outside the software end positions.

If a movement to zero is to follow a homing run, “Motion complete” will only appear after completion of the movement to zero. Motion Complete remains inactive between the homing run and movement to zero.

A movement to zero should be executed when homing **to the stop** in order to exit the stop position. Otherwise the drive could be driven continuously against an elastic stop, which would result in a strong temperature increase and eventually lead to the controller shutting down.

## 2.8 Monitoring functions

A complex system of sensors and monitoring functions ensures operational reliability:
- Voltage monitoring: detection of undervoltages and overvoltages in the logic and load voltage supply.
- Temperature monitoring: output stage and CPU temperature in the CMMO-ST.
- $I^2t$ monitoring/overload protection
- Software end position recognition
- In the binary profile: contouring error monitoring (e.g.in the event of sluggishness or overloading of the drive).

## 2.9 Safety aspects

**Note**
Check within the framework of your EMERGENCY STOP procedures to ascertain the measures that are necessary for switching your machine/system into a safe state in the event of an EMERGENCY STOP.

- If an EMERGENCY STOP circuit is necessary for your application, use additional, separate safety limit switches (e.g. as normally closed limit switches wired in series).
- Use hardware limit switches or, if required, mechanical safety limit switches and fixed stops or shock absorbers as appropriate in order to make sure that the axis always lies within the permitted positioning range.
- Note the following points:

| Action | Behaviour |
|---|---|
| Cancellation of the ENABLE signal on the I/O interface | – Without brake/clamping unit:<br>The drive brakes with the quick stop ramp (Quick stop). The controller output stage is then switched off. The effective load could possibly slide down if mounted in a vertical/inclined position.<br>– When using a brake/clamping unit:<br>If the drive moves when ENABLE is cancelled, then it will initially be brought to rest using Quick Stop deceleration. As soon as the drive has come to a standstill, the brake output is reset: the brake/clamping unit closes. Simultaneously, the switch-off delay time begins to run. The CMMO-ST still controls the position. The controller end stage is switched off after the switch-off delay. |
| Switching off the load voltage | The load voltage is switched off. The effective load on the drive may continue to move due to inertia, or it will fall if mounted in a vertical or sloping position. |

For STO function: ➔ separate document GDCP-CMMO-ST-STO-...

# 3 Mounting

## 3.1 General instructions

**Caution**
Uncontrolled drive motion may cause personal injury and material damage.
- Switch off the **power supplies** prior to any assembly, installation or maintenance work and prevent them from being restarted accidentally.

**Caution**
If a drive is mounted in a sloping or vertical position, loads may fall and cause personal injury.
- Check whether external safety measures are necessary (e.g. toothed latches or moveable bolts).

This will prevent the work load from sliding suddenly if there is a voltage failure.

**Note**
When mounting the controller on the machine:
- Observe the IP protection class of the controller and the connectors/cables.

Also observe the operating instruction(s) for the drive and the instructions provided with any additional components (e.g. assembly instructions for the cables concerning bending radii or suitability for use with energy chains).

## 3.2 Dimensions of the controller

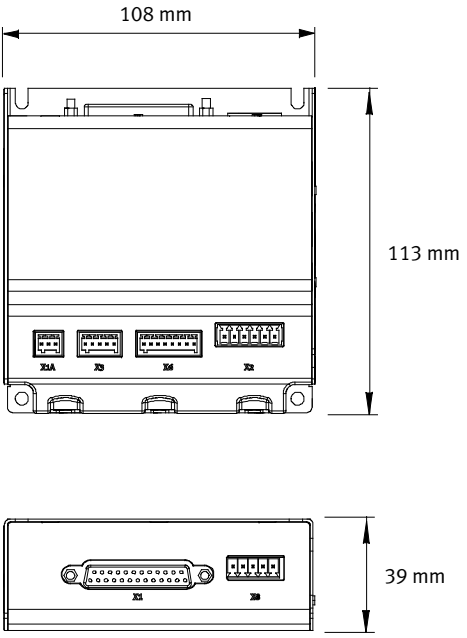


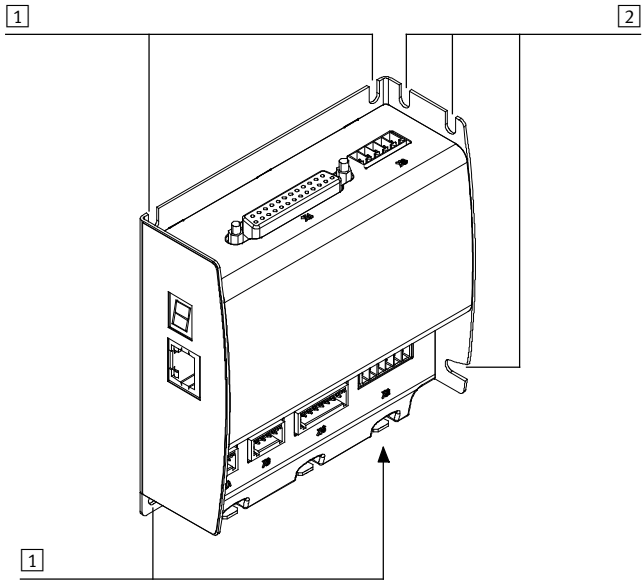

Fig. 3.1 Dimensions of the controller

## 3.3 Mounting the controller

You can mount the controller in one of two ways:
1. Threaded connection on a flat surface
2. H-rail mounting

### 3.3.1 Fitting

You will need 3 or 4 M4 screws, with washers/spring washers if necessary. If a H-rail clip is mounted, you can remove it.
The following figure shows the location of the holes and recesses that can be used for mounting the controller:




1 Mounting with 4 screws to the base (lying flat)
2 Mounting on the side with 3 screws (vertical)

Fig. 3.2 Mounting with screws

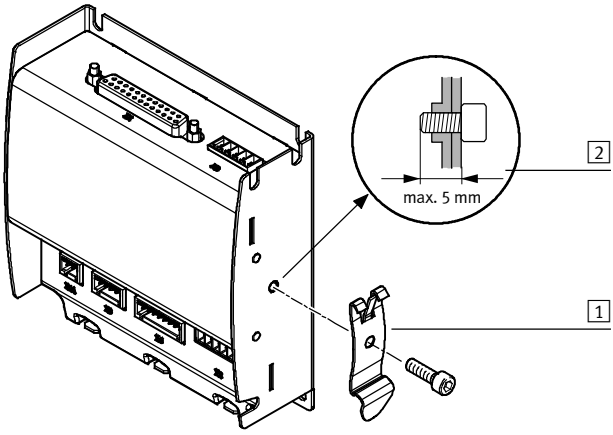
When mounting on the side ( 2 ): To exchange the controller, you only need to loosen the 3 screws by a few rotations, after which the controller can be tilted out.

### 3.3.2 H-rail mounting

1. Mount an H-rail (mounting rail in accordance with IEC/EN 60715: TH 35–7.5 or TH 35–15).
2. If not already mounted: Screw the H-rail clip [1] to the side of the controller (➔ Fig. 3.3).

**Note**
When using another screw: Please observe the maximum permitted screw-in depth of 5 mm.

3. Hang the CMMO on the H-rail as follows:
   - by inserting the top into the hooks in the clip first, then
   - press the H-rail downwards until the CMMO clicks into place.




[1] H-rail clip
[2] Maximum screw-in depth

Fig. 3.3 H-rail mounting

# 4 Electrical installation

## 4.1 Overview

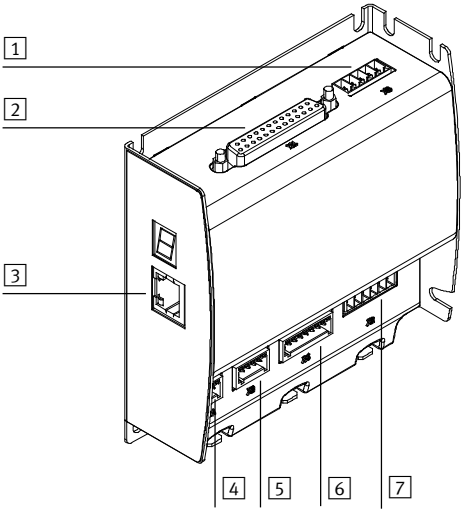
**Caution**
Uncontrolled drive motion may cause personal injury and material damage
- Switch off the **power supplies** prior to any assembly, installation or maintenance work and prevent them from being restarted accidentally.

**Caution**
Faulty pre-assembled lines may destroy the electronics and trigger unexpected movements of the motor.
- When wiring the system only use the supplied connectors and preferably the cables that are listed as accessories (➔ Tab. 4.1).
- Lay all flexible lines so that they are free of kinks and free of mechanical stress; if necessary use chain link trunking.

If unused plug connectors are touched, there is a danger that damage may occur to the CMMO or to other parts of the system as a result of electrostatic discharge (ESD). Place protective caps on unused terminals to prevent such discharges.

**Note**
To ensure compliance with EMC safety:
The maximum length of the individual cables should not exceed 30 m.
The project engineering performance data relates to a maximum cable length of 10 m.

To ensure compliance with the IP protection class (if required):
- Please note that the specified IP protection class is only achieved with a full plug and cable assignment.




1 Power supply (X9)
2 Higher-order controller (PLC/IPC) (X1)
3 Ethernet (X18)
4 Reference switch (X1A)
5 STO (X3)
6 Encoder (X2)
7 Motor (X6)

Fig. 4.1 Connections on the CMMO-ST

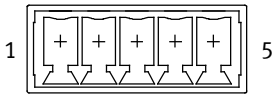
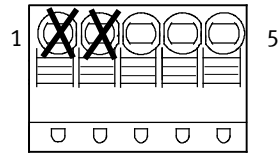
| Port | | Cable and Festo type code [1] | |
|---|---|---|---|
| 1 | Power (X9) | To be prepared by the customer | |
| 2 | PLC/IPC (X1) | Connecting cable: | NEBC-S1G25-K-...-N-S1G25 |
| | | Control cable: | NEBC-S1G25-K-3.2-N-LE25 |
| | | Connection block: | NEBC-S1G25-C2W25-S7 |
| | | Plug: | NEBC-S1G25-C2W25-S6 |
| 3 | Ethernet (X18) | Standard network cable, RJ45 plug connector; category 5 or higher | |
| 4 | Reference switch (X1A) | See Festo catalogue | |
| 5 | STO (X3) | To be prepared by the customer | |
| 6 | Encoder (X2) | Encoder cable<br>– NEBM-M12G8/W8-E-...-LE (G = straight; W = angled) | |
| 7 | Motor (X6) | Motor cable<br>– NEBM-S1W15-E-...-Q7: for motors with 15-pin plug<br>– NEBM-S1W9-E-...-Q5: for motors with 9-pin plug<br>– NEBM-M12G8-E-...-Q5: for size 28 motors | |

1) Specifications status August 2012. Only the current specifications in the Festo catalogue are relevant: www.festo.com

Tab. 4.1 Overview of cables (accessories)

Observe the tightening torques specified in the documentation for the cables and plugs used. The assortment of plugs supplied with the CMMO-ST is also available under the type code NEKM-C-10.

## 4.2 Power supply [X9]

| Port | Pin | Function | |
|---|---|---|---|
|  **X9**  | 1 | – | Do not connect! |
| | 2 | – | Do not connect! |
| | 3 | Logic voltage | +24 V supply of the control electronics |
| | 4 | Reference potential | 0 V reference potential for load voltage, logic voltage, STO and controller interface |
| | 5 | Load voltage | +24 V supply of the power output stage and the motor |

Tab. 4.2 Port X9 “Power” (power supply)

**Caution**
Damage to the device
With port X9, always pay attention to the correct pin number corresponding to the plug location on the device.
- Make sure that Pin 1 and Pin 2 are **not** connected.

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

**Warning**

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

**Caution**

Damage to the device

The power supply inputs have no special protection against overvoltage.

- Make sure the permissible voltage tolerance is never exceeded.

Technical data of the voltage supply: (➔ appendix A.1).

## 4.3 Functional earth

The metal sub-base of the CMMO-ST is used as a functional earth. It is galvanically isolated from the power supply and, among other things, ensures EMC safety.

**Note**

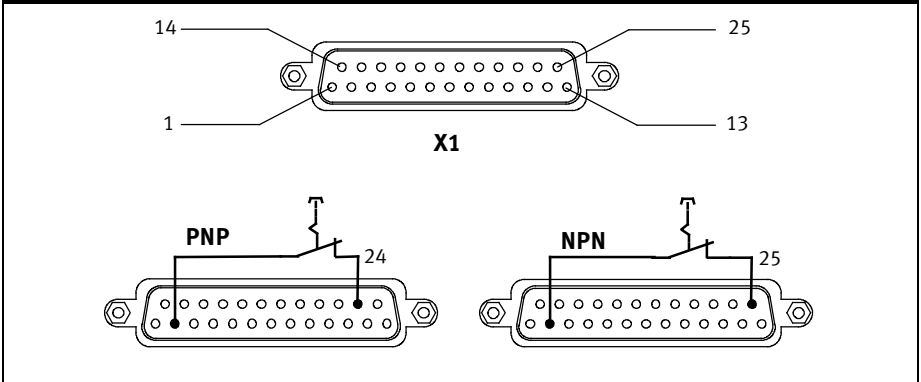
- Connect the metal sub-base of the CMMO-ST to the earth potential with low impedance (short cable with large cross section).

This prevents interference from electromagnetic sources and ensures electromagnetic compatibility in accordance with EMC directives.

## 4.4 I/O interface [X1]

Communication with the higher-order controller (PLC/IPC) occurs via the I/O interface.

**Connection to the CMMO**




| Pin | 1 | 2 | ... | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I/O | 1 | 2 | ... | 11 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | – | +24 V | 0 V |
| | Inputs | | | | Outputs | | | | | | | | | | | – | Out | GND |

Tab. 4.3 Port X1

Pin 24 and pin 25 can be used to switch an input (➔ illustration in Tab. 4.3):

– PNP version: Pin 24 at input
– NPN version: Pin 25 at input

**Caution**
Damage to the device
Pin 24 and pin 25 are not short circuit proof.

The functional description of the I/O interface, dependent on the selected profile, can be found in the Commissioning chapter.

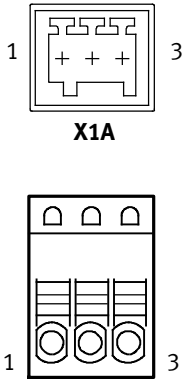
### 4.4.1 Electrical specifications of [X1]

The following specifications apply to both the PNP and NPN variants of the CMMO-ST.

| Specifications for the I/O controller interface | |
|---|---|
| Signal level | Based on EN 61131-2, type 1 |
| **Inputs** | |
| Scanning rate | 1 ms |
| Input current at nominal input voltage | Typically 2 mA per input |
| Max. permissible input voltage | 29 V |
| Galvanic isolation | No |
| **Outputs** | |
| Maximum Current | 0.1 A per output |
| Overload protection | Protected against short circuits |
| **Pin 24 (24 V carried out)** | |
| Overload protection | No (not protected against short circuits). Only use for switching inputs. Max. 0.1 A. |

Tab. 4.4 Specifications for the I/O controller interface

## 4.5 Reference switch [X1A]

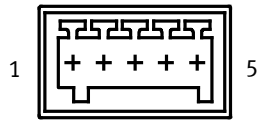
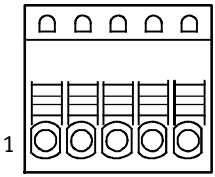
| Port | Pin | Function | |
|---|---|---|---|
|  | 1 | +24 V logic | Voltage output for supplying the reference switch (from X9). Not protected against short circuits. |
| | 2 | Signal | Voltage input: +24 V with closed or open reference switch contact (depending on switch type). |
| | 3 | 0 V | Reference potential |

Tab. 4.5 Connection X1A reference switch

The types listed in the Festo catalogue for the respective drive are suitable for use as reference switches (➔ www.festo.com).

## 4.6 STO [X3]

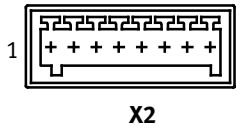
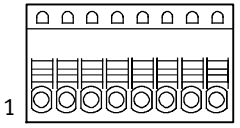
The STO safety function (“Safe Torque Off”) is described in detail in the document GDCP-CMMO-ST-STO-...
The STO function should only be used in the manner described in this document.

| Port | Pin | Function | |
|---|---|---|---|
|  **X3**  | 1 | +24 V logic | Logic voltage output (from X9) |
| | 2 | STO 1 | Channel 1: switch off the supply voltage |
| | 3 | STO 2 | Channel 2: switch off the supply voltage |
| | 4 | Diagnostics 1 | The diagnostic contacts are potential-free.<br>The diagnostic contact is low impedance if the STO function has been requested and activated via two channels. |
| | 5 | Diagnostics 2 | |

Tab. 4.6 Connection X3 STO

## 4.7 Encoder [X2]

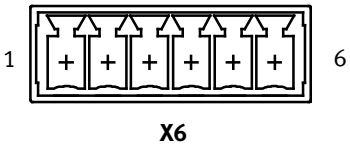
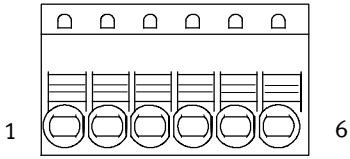
An incremental encoder with signals in accordance with **RS422** can be connected at connection X2.

| Port | Pin | Function | |
|---|---|---|---|
|   | 1 | A/ [1] | Incremental encoder signal A+, Positive polarity |
| | 2 | A/ [1] | Incremental encoder signal A–, Negative polarity |
| | 3 | B/ [1] | Incremental encoder signal B+, Positive polarity |
| | 4 | B/ [1] | Incremental encoder signal B–, Negative polarity |
| | 5 | N/ [1] | Increment encoder signal zero pulse, positive polarity |
| | 6 | N/ [1] | Increment encoder signal zero pulse, negative polarity |
| | 7 | 5 V (± 10 %) | Supply of the encoder. Max. 100 mA permissible. Not protected against short circuits. |
| | 8 | 0 V | Reference potential |

1) Each 5 V and Ri = approx. 120 Ω

Tab. 4.7 Connection X2 encoder

## 4.8 Motor [X6]

| Port | Pin | Function | |
|---|---|---|---|
|  | 1 | String A | Connection of the two motor strings |
| | 2 | String A/ | |
| | 3 | String B | |
| | 4 | String B/ | |
|  | 5 | BR+ | Connection of the holding brake Short circuit and overload-proof. 24 V, max. 1.4 A ➔ 33 W. BR– = GND, BR+ is switched (24 V load) |
| | 6 | BR– | |

Tab. 4.8 Connection X6 motor

# 5 Commissioning

## 5.1 Safety regulations

**Warning**
Risk of injury.
Electric axes move with high force and at high speed. Collisions can lead to serious injury to people and damage to components.
- Make sure that nobody can reach into the operating range of the axes or other connected actuators – e.g. with a **protective grille** – and that no objects lie in the positioning range while the system is still connected to a power supply.

**Caution**
Unexpected movement of the drive due to incorrect or incomplete parametrisation!
When the CMMO-ST is switched on, the I/O control interface is activated as standard.
- Make sure that there is no active ENABLE signal when switching on the CMMO-ST on the I/O control interface.
- Parameterise the entire system completely before activating the output stage with ENABLE.

**Caution**
When control via the web browser or FCT is activated, the drive **cannot** be stopped with the PAUSE/STOP input or the ENABLE input of the I/O control interface.

**Caution**
The CMMO-ST cannot detect if the connection to the web browser has been interrupted. Movements that have been started via the web browser can **no longer** be stopped by using the web browser if the Ethernet connection is interrupted during the movement.
- Only use the web browser if you are sure that accidental movements will not result in any damage.

**Caution**
Housing surfaces can reach high temperatures. Contact with the surface may result in shock and uncontrolled reactions with subsequent damages.
- Make sure that the surface cannot be touched accidentally and inform your operating and maintenance staff of the possible hazards.

**Note**

The CMMO-ST does not carry out any positioning jobs/records if it is not referenced.

- Carry out a homing run in the following cases to anchor the measuring reference system to the reference point:
  - every time the logic voltage supply is switched on or after every failure
  - after changing the homing method, the axis zero point, the direction of rotation or the encoder resolution

**Note**

If the axis zero point is modified:

Existing software end positions and the target positions in the record table will be shifted together with the axis zero point.

- Adjust the software end positions and the target positions if necessary.

**Note**

Damage to components when the permissible impact pulse is exceeded.

- Operate the drive only with the permissible load (➔ operating instructions for the drive).
- If necessary, limit the maximum current (motor force) when travelling to the stop.

**Note**

Interruption of ongoing tasks due to inadequate load voltage supply.

- Make sure that the tolerance of the load voltage supply can be maintained at full load directly on the voltage terminal of the CMMO-ST (➔ section 4.2).

## 5.2 Ethernet interface (RJ-45)

### 5.2.1 Delivery status of the CMMO-ST

**Note**
The CMMO-ST is equipped during production with a **active DHCP server** (Dynamic Host Configuration Protocol).
- Before adding the CMMO-ST to an existing network, please observe the instructions in section 5.2.5 “Initial start-up”, as these will enable you to prevent network malfunctions.

Computers with an active DHCP client accept all DHCP servers. If two DHCP servers are activated in a network by mistake, the functionality of the network may be impaired.

| **CMMO-ST network settings** | |
|---|---|
| **Parameters** | **Value** |
| IP | 192.168.178.1 |
| DHCP server | Active |
| Port | Web browser: 80<br>FCT: 7508<br>CVE (= Control via Ethernet): 49700 |
| Subnet mask | 255.255.255.0 |
| Gateway | 0.0.0.0 (none) |

Tab. 5.1 Network settings: delivery status

### 5.2.2 DHCP or fixed IP address

**Behaviour of the DHCP server**
The DHCP server of the CMMO-ST is intended to establish a **direct connection** between the CMMO-ST and an individual computer. It is not intended to supply larger networks with IP addresses.
It assigns IP addresses in a range of 192.168.178.110 ... 192.168.178.209 and the subnet mask 255.255.255.0. A gateway is not assigned.

**Additional configuration options**
**DHCP client**
The CMMO-ST can also be configured as a DHCP client. It then obtains its IP address from a DHCP server in your network.
**Specifying a fixed IP address**
Alternatively you can also assign a fixed IP address to the CMMO-ST.

These settings can be adjusted, if required, in FCT (➔ section 6.4.3).

After making changes to the network configuration of the CMMO-ST, it will need to be restarted in order for the changes to take effect.

### 5.2.3 Safety in the network

**Caution**

When connecting the CMMO-ST to existing networks (e.g. the Internet): any unauthorised or accidental access to the CMMO-ST could result in unforeseeable behaviour.

- Only use the CMMO-ST in subnets that are protected from external unauthorised access, e.g. by using network security components (special **gateways/firewalls**).

Use a password if you want to prevent accidental access to the CMMO-ST (in FCT: menu option “Component” / Online / Password).

### 5.2.4 Timeout

The CMMO-ST detects if the connection to the FCT software has been interrupted and it behaves in accordance with the settings parameterised in FCT under “Error management” (error number 0x32). The timeout period is typically 1 s, but it can be longer in slow networks, as the timeout period is dynamically adapted to the transmission rate.

**Caution**

The CMMO-ST cannot detect if the connection to the web browser has been interrupted. Movements that have been started via the web browser can **no longer** be stopped by using the web browser if the Ethernet connection is interrupted during the movement.

- Only use the web browser if you are sure that accidental movements will not result in any damage.

### 5.2.5 Initial start-up via Ethernet

The CMMO-ST will need to be connected directly to a computer/laptop for the initial start-up phase. The CMMO-ST **cannot** be connected immediately to a network during the initial start-up phase, as its active DHCP server could result in network malfunctions.

1. Switch on the CMMO-ST and connect it to your computer/notebook by using a standard Ethernet cable (connector: RJ-45). The cable type, i.e. whether it has a straight or crossed connection, is detected automatically. The DHCP server in the CMMO-ST will now assign an IP address to your computer, enabling you to access the CMMO-ST (requirement: a DHCP client is active on your computer = default setting for most computers).

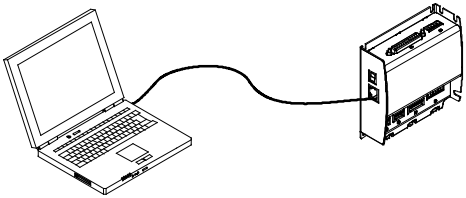


Fig. 5.1 Initial start-up via direct connection

2. Launch your **web browser** (activate Internet Explorer ›6; Firefox ›3; JavaScript) and type the IP address of the CMMO-ST into the address bar (default setting: 192.168.178.1). The CMMO-ST website will now appear (➔ section 5.3).
3. **Alternatively** to the web browser, you can also install the **FCT software** from the CD. The FCT software makes more complex configurations possible than the web browser does (➔ section 5.4).

If you cannot establish a connection to the CMMO-ST: ➔ section 6.4.3.

## 5.3 Commissioning via web server

The web server integrated in the CMMO-ST provides access to an English-language parameterisation and commissioning website, which you can call up with a web browser. Commissioning via the web server is possible for selected products, i.e. axis mechanisms optimised by Festo.

### 5.3.1 What does the web server enable?

**Parameter files**
Uploading and downloading parameter files for initial start-up or for use as backup files.

**Homing**
Starting a homing run in accordance with the homing method parameterised in the CMMO-ST (default settings: ➔ Tab. 5.2).
The homing run can only be started; a change of the homing method must take place in FCT.

**Jogging**
Jog mode in both directions.

**Teaching**
Teaching of up to 7 absolute target positions; parametrisation of speed and acceleration of the resulting position records.
Relative target positions cannot be taught. Corresponding position records, however, can be entered by hand.

**Positioning**
Starting and stopping the 7 position records.

**I/O**
Display of the electro-physical status of the inputs and outputs of the I/O interface.

**Diagnostics**
Read-out of the diagnostic memory and display of the most important controller statuses.

**Identification**
Wave function: Activating a radio button (“Identify this CMMO”, ➔ Fig. 5.2) causes the decimal point in the 7-segment display of the currently connected CMMO-ST to start flashing.

### 5.3.2 Parameter files

The parameter files support the initial start-up of your drive. The parameter files corresponding to the respective drive type can be found:
– on the supplied CD
– on the Festo Support Portal for download
– as “Cloud” parameter on the Festo Internet Server

The parameter files for EPCO drives include the following settings, for example:

| Parameters | Default setting |
|---|---|
| Control Profile | Valve profile (7), i.e. 7 position records can be parameterised via web servers, for example:<br>– target position (absolute/relative)<br>– travel speed<br>– acceleration (start up/braking)<br>– reduction of the feed force (force limit) |
| Reference travel method (controlled operation) | – negative stop (motor-side) with movement to zero<br>– force limit for stop detection<br>– movement to zero 3 mm |
| Reference travel speeds:<br>– Search speed (travel to the switch/stop)<br>– Creep speed (travel to the switch edge/index pulse)<br>– Positioning speed (travel to the axis zero point) | <br>– 2.5 % of the maximum speed [1)]<br><br>– 1.25 % of the maximum speed [1)]<br><br>– 5 % of the maximum speed [1)] |
| Dimensional reference system:<br>– Position of the axis zero point<br>– Software limit switch (negative)<br>– Software limit switch (positive) | <br>– + 3 mm from the mechanical stop<br>– – 3 mm<br>– (stroke length – 3 mm) |
| Jogging<br>– Speed phase 1 (slow travel)<br>– Duration of phase 1<br>– Speed phase 2 (fast travel) | <br>– 1.25 % of the maximum speed [1)]<br>– 2 s<br>– 5 % of the maximum speed [1)] |
| Condition for the “Position reached” message (Motion complete)<br>– Target window<br>– Message Delay | <br>– +/- 0.2 mm<br>– 100 ms |
| STOP button in the web browser | Deceleration ramp of the current function (e.g. of the current record) |
| Quick Stop (triggered by the controller, e.g. in the event of a serious error) | 70 % of the maximum deceleration [1)] |

1) The maximum values for speed, acceleration, force, etc. depend on the mechanical system used and can be read via FCT if required.

Tab. 5.2 Valve profile: default values (EPCO)

All other settings of the parameter files can be read in FCT as needed.

### 5.3.3 Initial start-up with the web server

If you have accessed the CMMO-ST website in accordance with section 5.2.5, you will initially be presented with the diagnostics page:

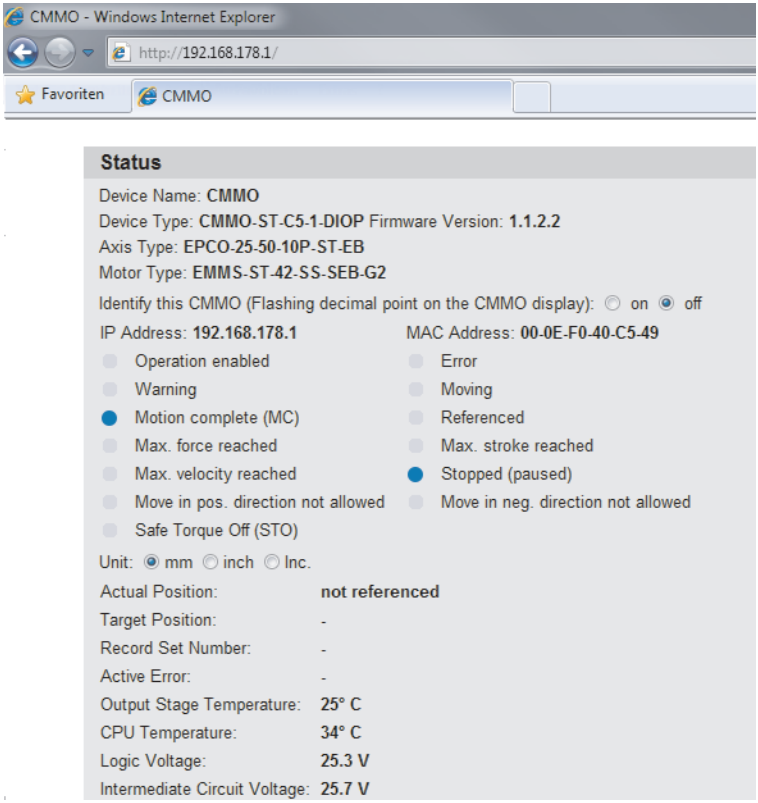



Fig. 5.2 Website: diagnostics

1. Switch to the parameterisation page by clicking ‹Parameters› at the far right.
2. Enter the type code of your EPCO drive in the uppermost text box in accordance with the rating plate, and click ‹Search› to download a suitable parameter file from the Festo website (Internet access required). **Caution**: Incomplete entry of the code may result in malfunctions, uncontrolled behaviour and damage.
   If you do not have a second network connection (e.g. WLAN/WiFi), you can continue to step 4 and use the parameter file on the CD.

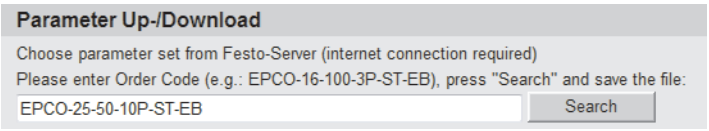



Fig. 5.3 Website: parameters

3. Click ‹Save› in the Windows dialogue window “Download file” to save the file to your computer.
4. Click ‹Browse› and select the downloaded parameter file in the dialogue window.

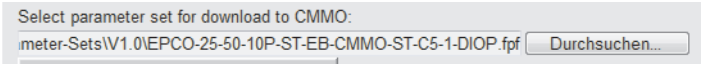



Fig. 5.4 Selecting a parameter file

5. Click the box next to “Device Control” to assume higher-order control.


Fig. 5.5 Assuming higher-order control

6. Click on ‹Download parameter set to CMMO›.


Fig. 5.6 Transferring a parameter file to the CMMO-ST

7. The following screen confirms the successful transmission. The parameter file is automatically saved in the CMMO-ST.


Fig. 5.7 Download completed successfully

8. **To teach position records:** Switch to the parameter side again by clicking ‹Parameters› at the far right. Then set the enable signal for the output stage by clicking the box next to “Control Enable”.


Fig. 5.8 Setting enable

9. First, start a **homing run** by clicking the ‹Start Homing› button (default setting: negative stop (motor-side) with movement to zero ➔ Tab. 5.2).
Then click the ‹Jog neg.› or ‹Jog pos.› buttons to move the drive in a negative or positive direction (in this example: to position 10.00 mm).


Fig. 5.9 Jogging

10. Select “Positioning to absolute position” from the first drop-down menu in the position record table and then click ‹Teach Pos›.


Fig. 5.10 Teach

11. Move to a different position and teach this position to position record no. 2.
12. Enter the additional positions. Relative target positions can be entered by hand, but they cannot be taught.

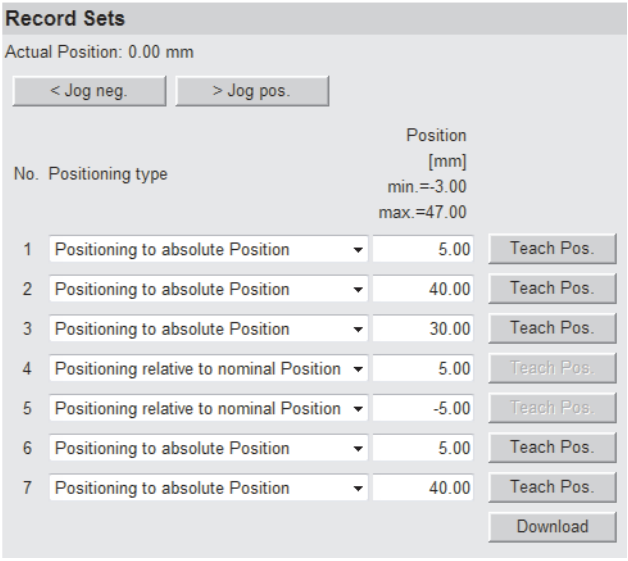



Fig. 5.11 Website: Parameters – Record Sets (1)

13. Adjust the values for travel speed, acceleration and force limit.

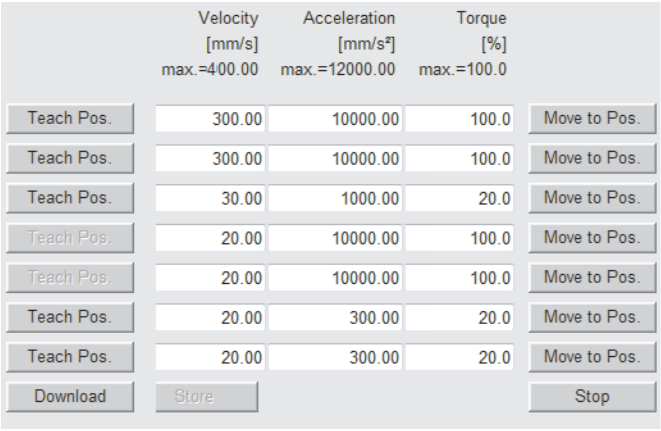



Fig. 5.12 Website: Parameters – Record Sets (2)

Through the digital output “Force limit reached” (DOUT 11), reaching the parameterised maximum force (“Torque”) can be displayed. In this way, with corresponding parameterisation, a load limit can be displayed at which the motor can no longer follow the position sequence (following error). An additional following error message is not activated with these parameter records.

14. Click the ‹Download› button underneath the position record table in order to transfer the new position records to the CMMO-ST.
15. **To test** the taught position records: click the ‹Move to Pos.› button next to the desired position record. The drive moves to the respective position.


Fig. 5.13 Executing position records

16. To permanently **store** the new position records in the CMMO-ST: remove the check mark next to “Control Enable” and then click the ‹Store› button underneath the position record table.


Fig. 5.14 Saving position records in the CMMO-ST

### 5.3.4 Creating a parameter backup file

When parameterisation is complete you can create a backup copy of your parameters by using the web browser. If you ever need to replace the CMMO-ST, you can import this parameter file into the new CMMO-ST. Re-parameterisation is therefore no longer required.

1. Establish a connection to the CMMO-ST and launch your web browser as described in section 5.2.5.
2. Click ‹Upload parameter set to PC›.

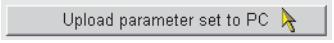



Fig. 5.15 Creating a backup copy

3. Click ‹Save› in the Windows dialogue window “Download file” to save the file to your computer. Give the file a unique name (*.fpf = Festo Parameter File).
4. To import the parameter backup file into a new CMMO-ST: proceed as described in section 5.3.3 under points 4 ... 7.

The backup copy can also be created by using FCT (“Component / Online / Administer recovery file...”).

## 5.4 Commissioning with FCT (Festo Configuration Tool)

The Festo Configuration Tool (FCT) is the software platform for configuring and commissioning different components and devices from Festo.
The FCT consists of the following components:
– A framework as program start and entry point with uniform project and data management for all supported device types.
– A plug-in for the special requirements of each device type (e.g. CMMO-ST) with the necessary descriptions and dialogues. The plug-ins are managed and started from the framework.

The FCT software provides more extensive configuration options than the web browser. The binary profile can be used in particular, which also enables jogging and teaching via the I/O interface, force mode, speed mode and record linking.

The following pages only describe the first few steps in FCT. Implement all other steps in accordance with the instructions in the integrated FCT help system.

### 5.4.1 Installing the FCT

**Note**
FCT plug-in CMMO-ST V 1.0.0 supports the motor controller CMMO-ST-...-IO with firmware version V 1.0.x
For later versions of the CMMO-ST check whether an updated plug-in is available. If necessary, consult Festo.

**Note**
Windows administrator rights are required for installing the FCT.

The FCT is installed on your PC with an installation program.
1. Close all programs.
2. Insert the “Festo Configuration Tool” CD into your CD-ROM drive. If Auto-Run is activated on your system, the installation starts automatically and you can skip steps 3 and 4.
3. Select [Execute] in the Start menu (for Windows 7: see “Accessories” menu).
4. Enter D:\Start (if necessary replace D by the letter of your CD ROM drive).
5. Follow the instructions on the screen.

### 5.4.2 Starting the FCT

1. Connect the CMMO-ST to your PC via the Ethernet interface (➔ section 5.2.5).
2. Start the FCT:
   double click the FCT icon on the Desktop
   – or –
   In the Windows menu [Start], select the entry [Festo Software] [Festo Configuration Tool].
3. Create a project in the FCT or open an existing project. Add a CMMO-ST to the project:
   menu [Components] [Insert].

**Instructions on parameterising and commissioning**

**FCT framework**

Information on working with projects and on inserting a device in a project can be found in the help for the FCT framework with the command [Help] [Contents FCT general].

**Plug-in CMMO-ST**

The plug-in CMMO-ST for the FCT supports processing of all the steps necessary for commissioning a CMMO-ST. The necessary parameterisation settings can be performed offline, i.e. without the CMMO-ST being connected to the PC. This enables preparation for the actual commissioning process, e.g. in the design office when a new system is being planned.

Additional information can be found in the plug-in help: command [Help] [Contents of installed plug-ins] [Festo (manufacturer name)] [CMMO-ST (plug-in name)].

**Device control / master control**

When the CMMO-ST is switched on, the I/O interface is activated as standard.

**Caution**

Unexpected movements of the drive due to incorrect parameterising

- Make sure there is no active ENABLE signal when switching on the CMMO-ST on the I/O interface.
- Parameterise the entire system completely before activating the output stage with ENABLE.

In order for the FCT to control the connected CMMO-ST, the I/O interface of the CMMO-ST must be deactivated and control must be enabled for the FCT. The status of the ENABLE I/O input then has no effect.

- To do this, go to the “Project output” window, select the “Operate” tab and, under “Device Control”, activate the “FCT” check box.
  This deactivates the I/O control interface of the CMMO-ST and sets the controller enable for the FCT.

**More information**

**Printed information**

You can use one of the following options to be able to use the complete Help or parts thereof independently of a PC:

- 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 |
| PlugIn help (CMMO-ST) | ...(FCT installation directory)\HardwareFamilies\ Festo\CMMO-ST\V...\Help\ | – CMMO-ST_de.pdf |

In order to use the printed version in Adobe PDF format, you will require Adobe Reader.

## 5.5 I/O interface

### 5.5.1 Profiles for selection

Two profiles are available for control of the CMMO-ST via the I/O interface:

**Valve profile (7)**

The valve profile is based on the control of pneumatic valves and is very easy to configure. Use this profile if **7 position records** are sufficient (simple positioning operation only).

**Binary profile (31)**

The binary profile uses 5 binary coded inputs and can therefore select **31 records** (plus record 0 = homing).

The following are also available:

– jogging and teaching
– Force mode
– Speed mode
– Record Linking

**Initial start-up**

During the initial start-up phase the valve profile is active. An initial start-up is thereby possible with both a web browser and with FCT.

**Change profile**

A change between profiles must be effected using FCT. FCT ensures that no inconsistent states arise when switching.

The web server only supports the valve profile. A change to the binary profile is not possible.

### 5.5.2 Properties of the valve profile (7)

**Signal pairs**
There are signal pairs comprising an input n and an output n, each of which relate to a particular position record. The corresponding position record is started by setting the input. The input must remain active until the specified target is reached. When the target position (MC) is reached, the output is set. As long as no other input is set, the output remains set even if the input is reset.

**Change of position record**
If the active input is changed while executing a position record, a change is made to the new position record continuously without stopping. Sequence when changing a record: First, enable the input of the new record, then disable the input of the first record(also refer to the timing diagrams).

**Following error**
If the drive comes up against a physical stop, it uses the parameterised torque to press against the stop until the input becomes inactive. There is **no** following error monitoring in the valve profile.

**Standstill monitoring**
There is **no** standstill monitoring in the valve profile, i.e. after completion of a position record the drive can be shifted by external forces without it being reported to the PLC.
- In **closed-loop** operation the position controller tries to hold the drive in position, but it only does this up to the maximum peak current that has been parameterised. In critical circumstances use the PRN variant for relative positioning tasks (positioning relative to the last target position).
- In **open-loop** operation the drive is held in position with the parameterised holding force. Make sure that the holding force is sufficient to hold the position.

**Automatic homing**
A homing run can be executed automatically in the valve profile if the drive is not referenced at the start of a position record, ➔ section 2.7.5.

**Assigning the inputs and outputs**

| **Valve profile: Inputs** | | |
|---|---|---|
| **Input** | **Designation** | **Description** |
| 1 | Position record 1 [1)] | Start and execute position record 1 as long as input 1 remains active. |
| 2 | Position record 2 [1)] | Start and execute position record 2 as long as input 2 remains active. |
| 3 ... 6 | ... [1)] | ... |
| 7 | Position record 7 [1)] | Start and execute position record 7 as long as input 7 remains active. |
| 8 | REF | Starts a homing run in accordance with the parameterised method. |
| 9 | BRAKE | An active input overrides automatic brake control and opens the closed brake. This input can be used to open a closed brake, however, it cannot be used to close an open brake (prevention of brake wear as a result of faulty application). |
| 10 | ENABLE | After setting this enable signal the CMMO-ST assumes control of the connected drive. |
| 11 | RESET | A reported error is reset (if possible). |

1) If the drive is not referenced at the start of a position record, a homing run can be started automatically ➔ section 2.7.5.

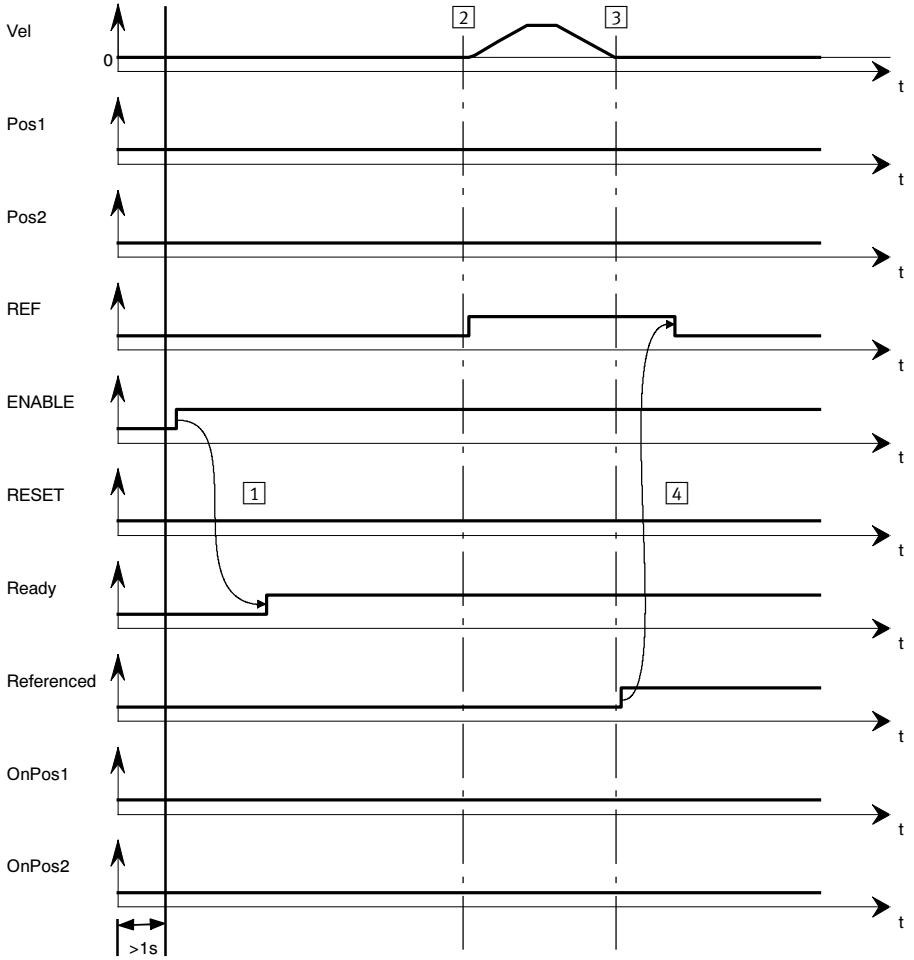
Tab. 5.3 Valve profile: Assignment of inputs

| **Valve profile: Outputs** | | |
|---|---|---|
| **Output** | **Designation** | **Description** |
| 1 | Position 1 reached | The target position of the respective position record has been reached. |
| 2 | Position 2 reached | |
| 3 ... 6 | ... | |
| 7 | Position 7 reached | |
| 8 | In Zone<br>(➔ section 5.9.1) | The drive is located within the position zone of the active position record parameterised in FCT. The position zone is formed by the position comparators.<br>If the input is inactive, output 8 remains set. If, however, the drive is pushed out of position and then returns, the output remains inactive.<br>If another input is active, then the current position is compared to its position zone and output 8 is set again depending on the result. |
| 9 | Referenced | After a successful homing run this output is set and remains set for as long as the drive is referenced. |
| 10 | Ready | Drive is ready for operation. All requirements for starting a position record are fulfilled (e.g. load voltage is present, ENABLE is set, no serious error). |
| 11 | Torque Limit reached | The parameterised torque/force limit has been reached. |

Tab. 5.4 Valve profile: Assignment of outputs

Electrical specification of the inputs and outputs: ➔ section 4.4.1.

**1) Valve profile: Switching on, homing**




1 ENABLE
2 Start homing
3 Homing run ended
4 Reset REF

Fig. 5.16 Timing diagram: Valve profile – switching on, homing

**Switching on**
After switching on: Wait a second and then set the inputs.

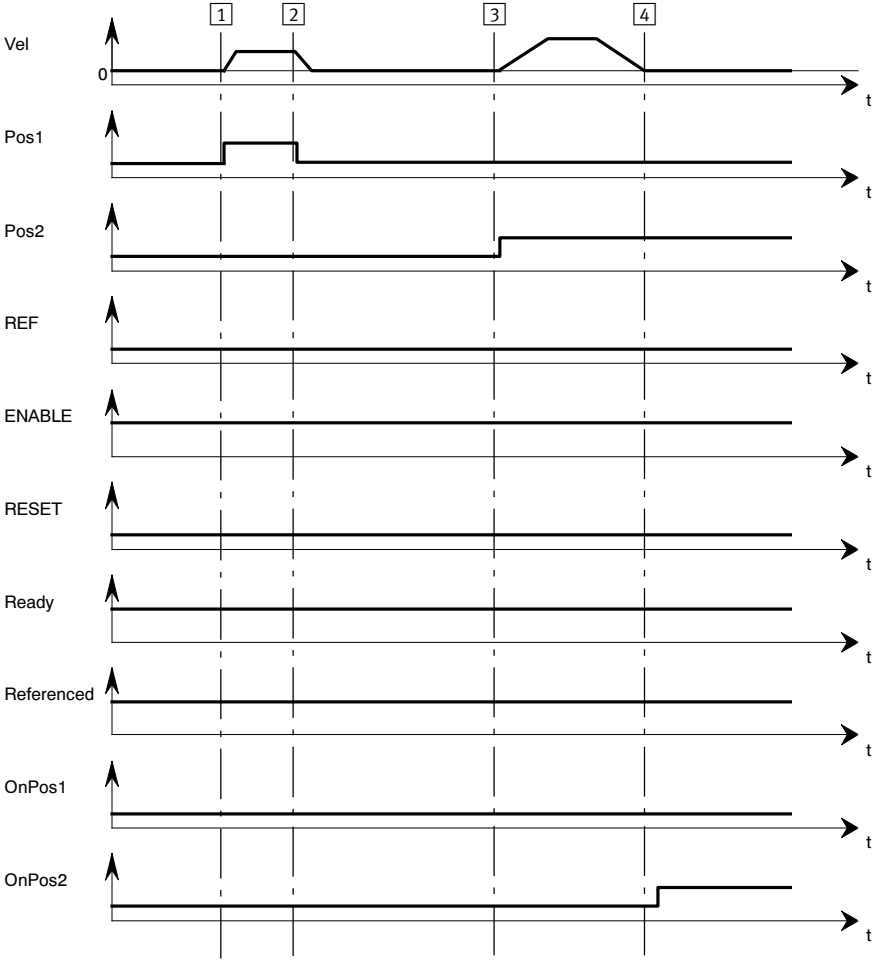
**ENABLE**
Set ENABLE input. The first time ENABLE is set after the switch-on procedure, the drive conducts a commutation angle search (duration: up to 2 seconds). Wait for Ready output.

**Start homing**
Start homing via REF input.

**Homing run ended**
Following successful completion of the homing run the Referenced output is set.

**Reset REF**
The REF input may only be reset after successful completion of the homing run.

**2) Valve profile: Terminate record 1, start record 2**




1 Start record 1
2 Cancel record 1
3 Start record 2
4 Destination 2 reached

Fig. 5.17 Timing diagram: Valve profile – terminate record 1, start record 2

**Requirements**
Drive is referenced and ready.

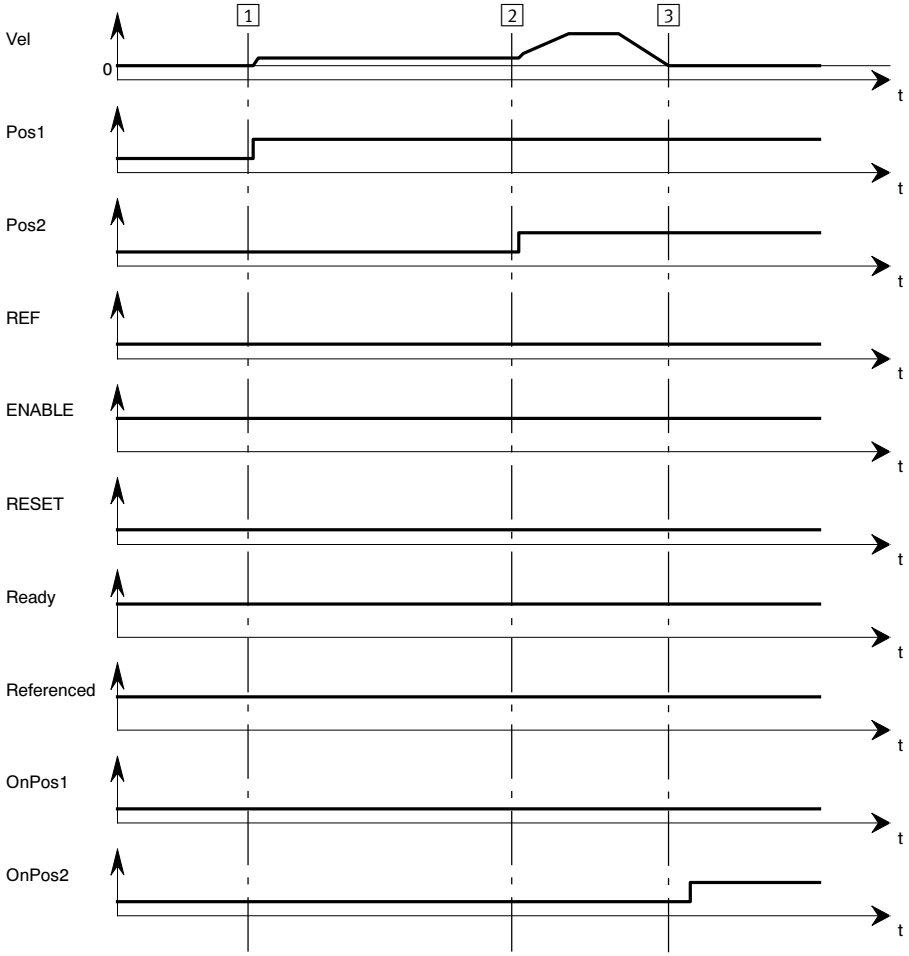
**Start record 1**
Record 1 is started by setting input Pos1.

**Terminate record 1**
Record 1 is terminated if input Pos1 is removed. The output OnPos1 is not set in this example, as the target position has not yet been reached.

**Start record 2**
Record 2 is started by setting input Pos2.

**Destination 2 reached**
After reaching the parameterised target position window and after expiration of the parameterised damping time, the output OnPos2 is set.

**3) Valve profile: Record switching**




1 Start record 1
2 Switching
3 Destination 2 reached

Fig. 5.18 Timing diagram: Valve profile – record switching

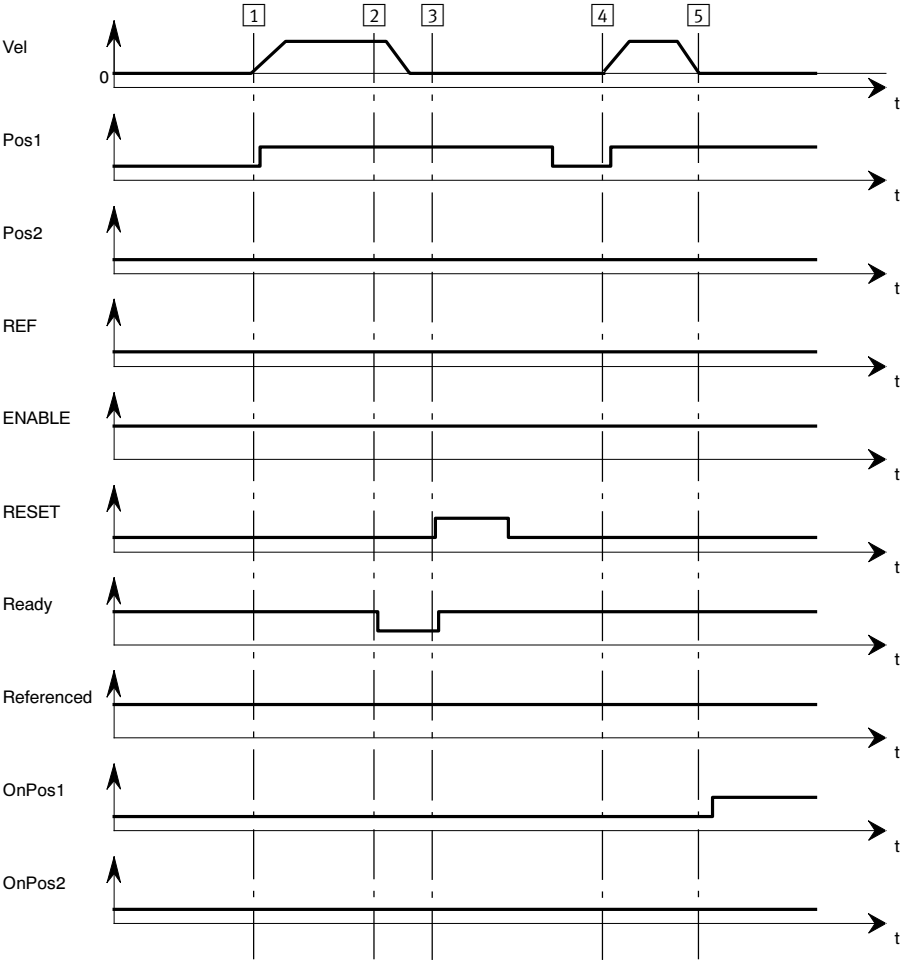
**Requirements**
Drive is referenced and ready.

**Start record 1**
Record 1 is started by setting input Pos1.

**Switch over**
While record 1 is being executed, input Pos2 is set. The drive switches immediately to record 2.

**Destination 2 reached**
After reaching the parameterised target position window and after expiration of the parameterised damping time, the output OnPos2 is set.

**4) Valve profile: Acknowledging errors**




1 Start record 1
2 Error
3 Acknowledge error
4 Restart record 1
5 Destination 1 reached

Fig. 5.19 Timing diagram: Valve profile – acknowledging errors

**Requirements**
Drive is referenced and ready.

**Start record 1**
Record 1 is started by setting input Pos1.

**Error**
An error occurs, e.g. a following error. In this example, this malfunction has been parameterised as an error and, as a response, a deceleration is effected with the quick stop ramp (Quick stop).
The Ready output is reset.
The drive brakes with the quick stop ramp and remains stationary.

**Acknowledge error**
The error is acknowledged by setting the RESET input. After setting this input the parameterised time for the switch-on delay of the holding brake starts to run. When this time has expired the Ready output is set again.

**Restart record 1**
When the input Pos1 has been reset, record 1 can be restarted by setting this input again.

**Destination 1 reached**
After the parameterised target position window is reached and the parameterised damping time has expired, the output OnPos1 is set.

### 5.5.3 Properties of the binary profile (31)

**31 command records**
31 command records can be selected via 5 inputs (plus record 0 = homing).
These 31 command records can be positioning records, force records or speed records.

**Jogging**
By using manual "jogging" (i.e. setting a particular input signal at the I/O interface) a position can be approached, which is then transferred to an absolute position record by "teaching".

**Teaching**
When teaching via the I/O interface you can set whether the value is stored permanently or only temporarily until the next restart procedure (FCT: "Digital I/O", "Automatic storage" page).
Teaching via the I/O interface is only intended for commissioning; the flash memory is **not** suitable for permanent teaching during operation (➔ section 2.4.11).

**Record linking**
When a step enabling condition occurs, another record is automatically started after the end of the current record (➔ section 5.8).

**Record switching**
While a command record is being executed, another command record can be switched to at any time; in this process the higher-order controller (PLC) pre-selects a new command record and sends a new START signal (➔ section 5.7).

**Pause (intermediate stop)**
An "intermediate stop" is triggered on the CMMO-ST via the **I/O interface**. This works as follows:
1. If the signal at digital input no. 7 "PAUSE" is removed during a record (= physical 0 signal), the drive brakes at the braking ramp that has been parameterised for this record and remains stationary. The record remains active, "Motion complete" is not set.
2. A renewed setting of input no. 7 initially has no effect on the behaviour of the drive. The drive continues to remain stationary.
3. A new START signal results in the record running to the end.
4. If another record has been selected at the inputs after step 2, this is ignored.
5. If the RESET input is set after step 2, "Motion complete" appears, as the record is considered completed. If a new record is then selected and START is set, the new record is executed.

**Assigning the inputs and outputs**

The binary profile has two modes:

– You can execute records in **Mode 0** (positioning mode, force mode or speed mode).
– You can jog and teach in **Mode 1**.

You can switch between the two modes by using input no. 8.

| **Binary profile: Inputs** | | | | |
|---|---|---|---|---|
| **DIN** | **Mode 0: Normal operation** | | **Mode 1: Jogging and teaching** | |
| 1 | **Record 0 ... 31** (Record 0 = homing) | These inputs are evaluated together. Coding: ➔ Tab. 5.6. | **Record 1 ... 7** (Record 0 cannot be taught) | These inputs are evaluated together. Coding: ➔ Tab. 5.6. |
| 2 | | | | |
| 3 | | | | |
| 4 | | | JOG+ | Jog positive |
| 5 | | | JOG– | Jog negative |
| 6 | **Start** | Starts a record. | TEACH | Transfer current position in position record. |
| 7 | **PAUSE** | Removal of the physical signal stops the drive (this input is inverted, i.e. negative logic) | | |
| 8 | **Mode 0 ➔ Normal operation** | | **Mode 1 ➔ Jog/teach** | |
| 9 | **BRAKE** | Setting the input opens the brake. Only relevant if the controller is not enabled, i.e. not in a “Ready” state. | | |
| 10 | **ENABLE** | Activate/enable the controller, release brake. | | |
| 11 | **RESET** | Acknowledge error - or - delete remaining path (if a position record has been interrupted with input 7). | | |

Tab. 5.5 Binary profile: Inputs

| **DIN** | **REF** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **...** | **31** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | ... | 1 |
| 2 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | ... | 1 |
| 3 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | ... | 1 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | ... | 1 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 1 |

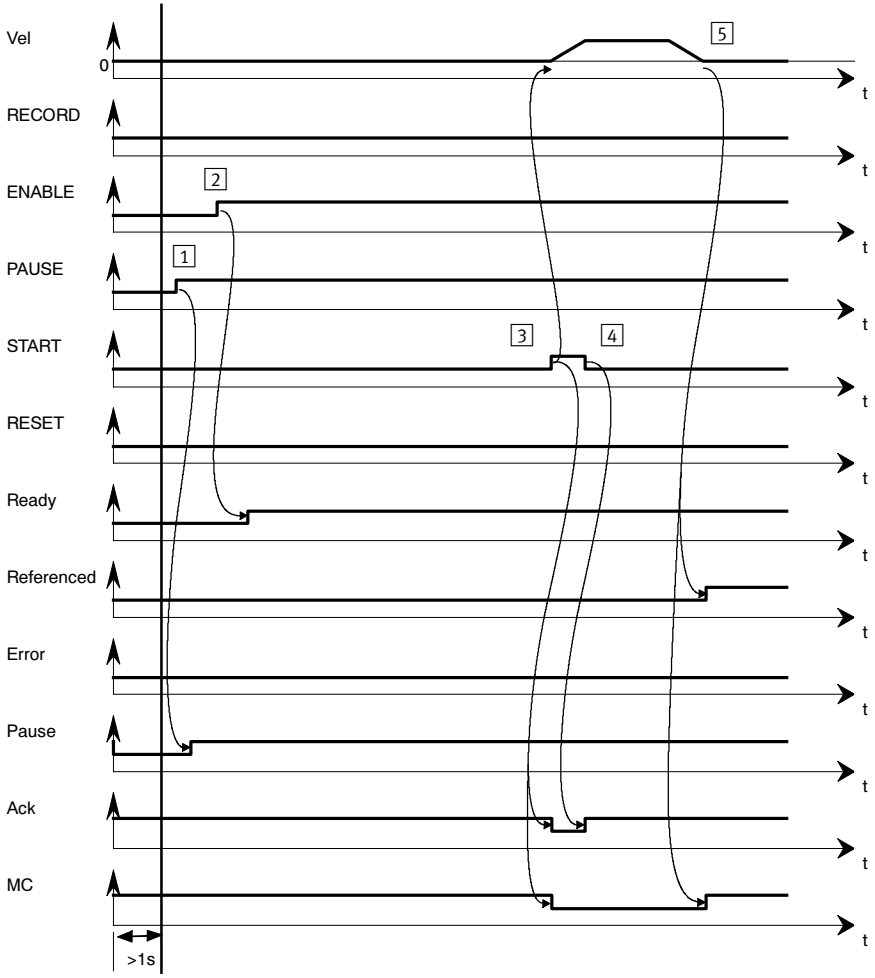
Tab. 5.6 Binary coding of the records

| Binary profile: Outputs | | |
|---|---|---|
| **DOUT** | **Designation** | **Description** |
| 1 | Motion complete | Target position, target force or target speed reached. |
| 2 [1)] | ACK/TEACH | Confirmation of the start of a record<br>- or -<br>confirmation of successful teaching |
| 3 [1)] | PAUSE (Stopped) | The drive has been stopped. |
| 4 | Moving | The drive moves. |
| 5 [1)] | Alarm (Error) | An error has occurred. |
| 6 | Configurable | Different signals can be allocated to these outputs by using FCT. |
| 7 | | |
| 8 | In Zone | The drive is located within the configured position zone of the current position record, i.e. within the position comparators. |
| 9 | Referenced | The drive is referenced. |
| 10 | Ready | The drive is ready for operation. |
| 11 | Torque limit reached | Target force reached. Only for positioning and speed mode. |

1) The output is inverted, i.e. the message is issued through logic 0.

Tab. 5.7 Binary profile: Outputs

**1) Switching on, homing**




1 PAUSE
2 ENABLE
3 Start homing
4 Reset START
5 Homing run ended

Fig. 5.20 Timing diagram: Binary profile – switching on, homing

**Switching on**
After switching on: Wait a second and then set the inputs.

**PAUSE**
Set PAUSE input, wait for Pause output.

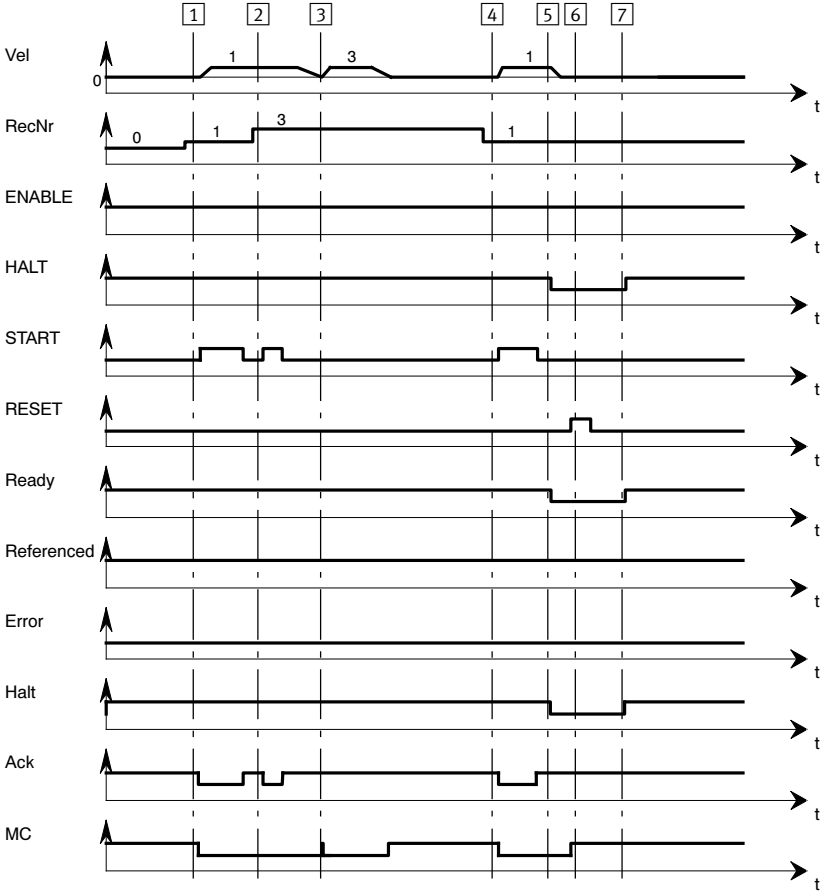
**ENABLE**
Set ENABLE input. The first time ENABLE is set after the switch-on procedure, the drive conducts a commutation angle search (duration: up to 2 seconds).
Wait for Ready output.

**Start homing**
Set record number 0 and start homing via the START input.

**Reset START**
After the outputs Ack and MC have been reset, the START input can also be reset again.

**Homing run ended**
Following successful completion of the homing run, the outputs MC and Referenced are set.

**2) Switch, pause, delete remaining path**




1 Record 1
2 Pre-select record 3
3 Start record 3
4 Record 1
5 PAUSE
6 Delete remaining path
7 Drive is ready

Fig. 5.21 Timing diagram: Binary profile – switch, pause, delete remaining path

**Requirements**
Drive is referenced and ready.

**Record 1**
Pre-select record 1 (RecNr = 1) and then start (START = 1). Ack and MC are reset. Movement starts (Vel › 0).

**Pre-select record 3**
Pre-select record 3 (RecNr = 3) and then start (START = 1). In this example, the “Start condition” for record 3 has been set to “Wait”. Record 1 is therefore still processed.

**Start record 3**
Record 3 is only started after “Motion complete” appears for record 1 (MC = 1).

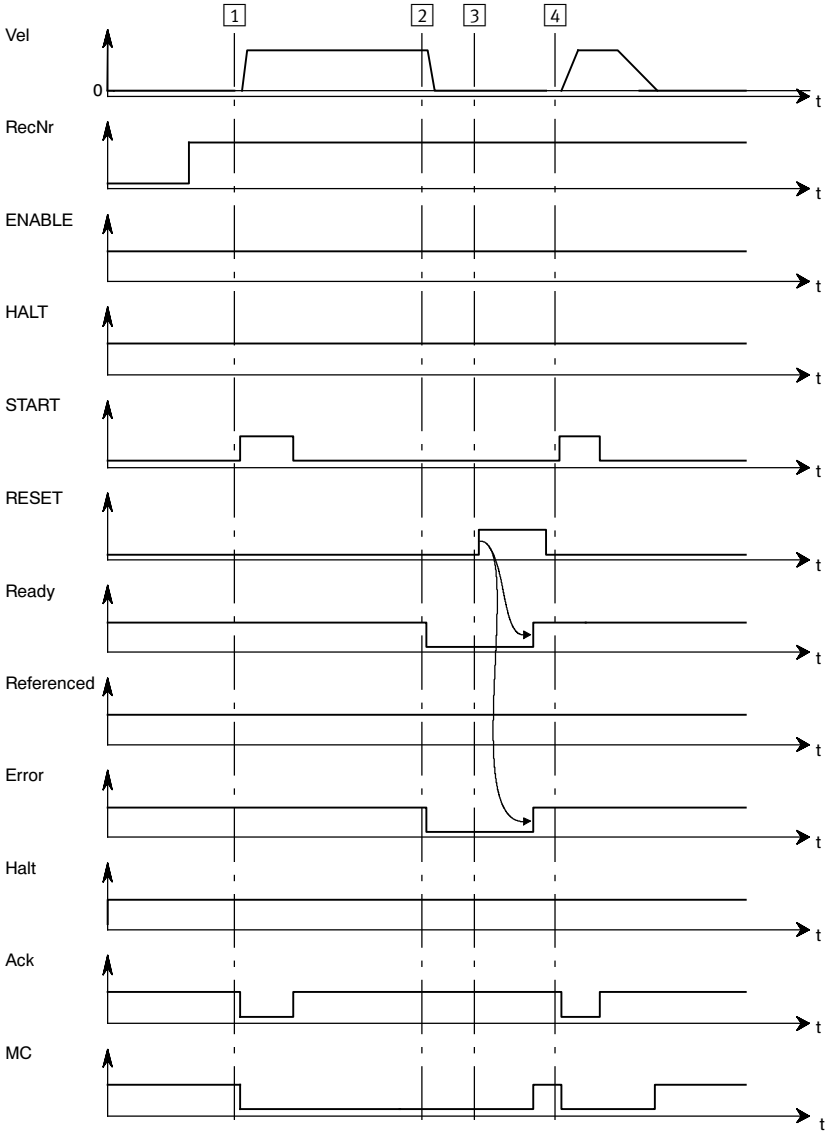
**Record 1**
Pre-select record 1 and then start.

**PAUSE**
While record 1 is being processed the input PAUSE is reset (PAUSE = 0). The outputs Ready and Pause are reset. The drive brakes and remains stationary (Vel = 0).

**Delete remaining path**
Set the RESET input. The remaining path of record 1 is thereby deleted. The record is considered complete. MC is set (MC = 1).

**Drive is ready**
Set the input PAUSE again. The outputs Pause and Ready are also set again. The drive is ready to accept new orders.

**3) Acknowledging errors**




1 Start record
2 Error
3 Acknowledge error
4 Restart

Fig. 5.22 Timing diagram: Binary profile – acknowledging errors

**Requirements**
Drive is referenced and ready.

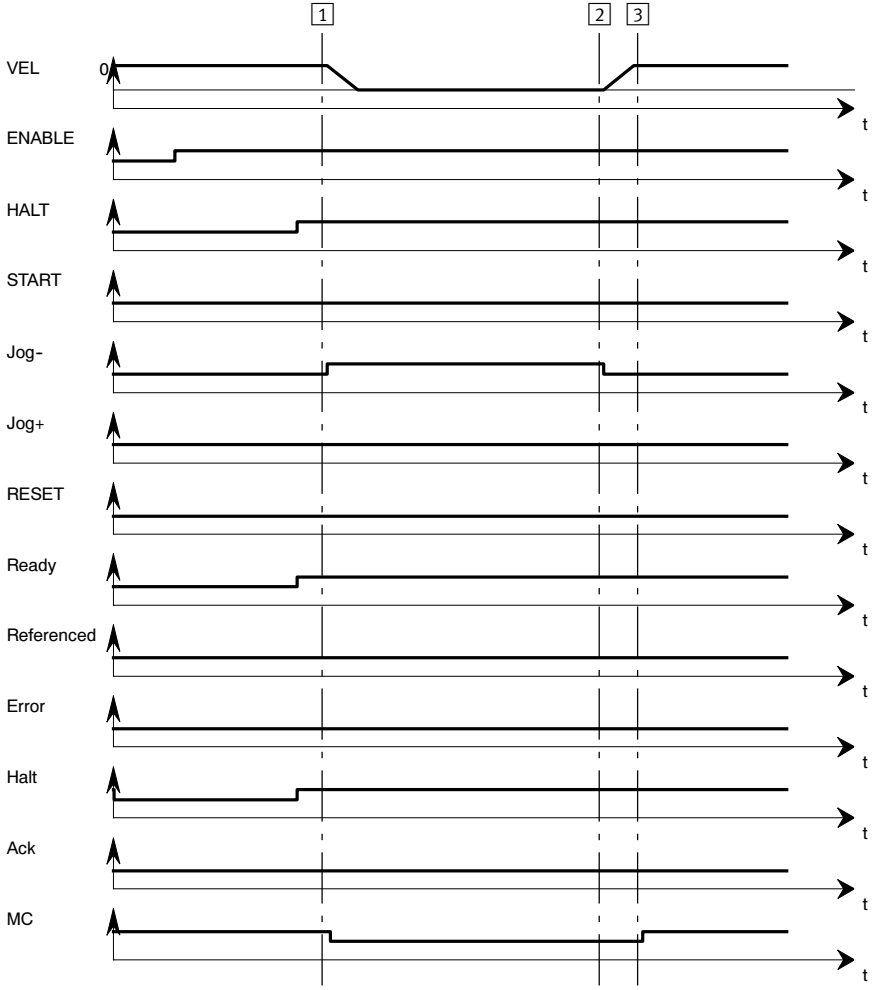
**Start record**
Pre-select a record (e.g. RecNr = 3) and start with START. Ack and MC are reset.

**Error**
An error occurs, e.g. a following error. In this example, this malfunction has been parameterised as an error and, as a response, a deceleration is effected with the quick stop ramp (Quick stop).
The outputs Ready and Error are reset.
The drive brakes with the quick stop ramp and remains stationary.

**Acknowledge error**
The error is acknowledged by setting the RESET input.
After setting this input the parameterised time for the switch-on delay of the holding brake starts to run. When this time has expired the outputs Ready and Error are set again.

**Restart**
The record is restarted with a START signal and it travels the remaining path.

**4) Jogging**




1 Start jogging
2 End jogging
3 MC

Fig. 5.23 Timing diagram: Binary profile – jogging

**Requirements**
Drive is referenced and ready, i.e. the inputs ENABLE, PAUSE and MODE are set, as are the outputs Ready and Pause.

**Start jogging**
After the input Jog– has been set, the drive starts moving in a negative direction. Motion complete (MC) is reset.

**End jogging**
When the jogging signal is removed the drive brakes and remains stationary.

**MC**
MC is set upon expiration of the MC damping time.

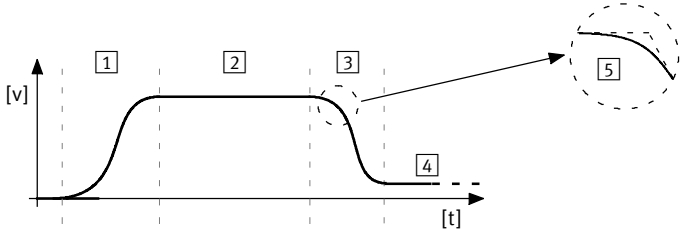
## 5.6 Structure of the records in the record table

7 positioning records are available in the valve profile (simple positioning only).
31 records are available in the binary profile (no. 1 ... 31).
Only in the binary profile: All records can be used for all operating modes, i.e. for the positioning mode, force mode or speed mode.
The records can be conveniently parameterised in FCT.
The following pages provide an overview of the parameters involved.

### 5.6.1 Positioning mode

**Record types**
A distinction is made between the following record types:
– Travel to absolute position (related to the project zero point)
– Travel relative to the last target position
– Travel relative to the actual position

**Parameter overview/objects for record table – positioning mode**




| | FCT |
|---|---|
| Record type (absolute/relative) | x |
| Target position | x |
| Speed 2 | x |
| End speed 4 (for record linking only) | x |
| Acceleration 1 | x |
| Deceleration (braking) 3 | x |
| Jerk 5 | x |
| Maximum force (force compensator) | x |
| Position deviation (= following error) | x |
| Comments (max. 32 characters per record) | x |
| Applied load (linear axis: workpiece mass; axis of rotation: inertia) | x |
| Other CVE objects: #31 record number preselection; #141 current record number | |

Tab. 5.8 Parameters for record table in positioning mode

**Target recognition (Motion complete/MC)**
The drive behaves differently during target recognition, depending on whether the end speed = 0 or ‹› 0 has been parameterised:

**End speed = 0**
A position record with a specified end speed = 0 is considered complete when the following two conditions are fulfilled:
– The actual position is located in the target position window (identical for all records, see FCT, “Messages” panel).
– The first condition has at least been fulfilled over the specified time period (“MC damping time”, identical for all positioning records, see FCT, “Messages” panel).

Behaviour after target recognition:
– In **closed-loop** operation: As long as no other drive function is executed, the drive will stop at the target position in a position-controlled manner. Standstill monitoring is activated in the binary profile.
– In **open-loop** operation: As long as no other drive function is executed, the drive will stop at the target position with the parameterised holding force.

**End speed ‹› 0 (for record linking only)**
A position record with a specified end speed ‹› 0 is considered complete when the target position has been reached or exceeded.
Behaviour after target recognition:
The drive continues to run with the end speed of the position record in a speed-controlled manner. The speed is not monitored (speed regulation, but no monitoring of the deviation). The force is limited to the maximum value defined in the position record.

### 5.6.2 Speed mode (binary profile only)

Command records of type “V” (= Velocity) or “VSL” (= Velocity Stroke limit) are used to reach and maintain a certain speed.

The actual speed is specified at the start of the speed record, e.g. by the previous command record.

| **Parameter overview/objects for record table – speed mode** | |
|---|---|
| | **FCT** |
| Record type:<br>Type “V” = speed mode without stroke limit<br>Type “VSL” = speed mode with stroke limit | x |
| Stroke limit (type “VSL” only) | x |
| Speed | x |
| Acceleration 1) | x |
| Deceleration (i.e. braking) 1) | x |
| Max. jerk 1) | x |
| Max. force 1) | x |
| Deviation (speed following error) | x |
| Comments (max. 32 characters per record) | x |
| Applied load (linear axis: workpiece mass; axis of rotation: inertia) | x |
| Other CVE objects: #31 record number preselection; #141 current record number. | |

1) These parameters always have a positive prefix.

Tab. 5.9 Parameters for record table during speed mode

**Target recognition (Motion complete/MC)**

The “target” of a speed record is deemed to have been reached if the following two conditions are fulfilled:

– The actual speed is located in the target speed window (identical for all positioning records, ➔ FCT, “Messages” page).
– The first condition has at least been fulfilled over the specified time period (“MC damping time”, identical for all records, ➔ FCT, “Messages” page).

Behaviour after target recognition:

– In **closed-loop** operation: As long as no other drive function is executed, the drive will continue to run at the setpoint speed. Monitoring of the speed deviation remains active until a new drive function is executed. The force is limited to the maximum value specified in the speed record. Stroke limitation remains active. If there are deviations from the parameterised speed, a following error is reported.
– In **open-loop** operation: As long as no other drive function is executed, the drive will continue to run with the parameterised current. Stroke limitation remains active. Deviations from the nominal speed are not detected.

**Stroke limit (for record type VSL)**
Upon reaching the stroke limit the drive is braked via the quick stop ramp (➔ FCT, “Axis”: “Quick Stop” panel). As long as no other drive function is executed, the drive will stop at the limit stroke in a position-controlled manner or with the parameterised holding force. Standstill monitoring is activated in closed-loop operation.
Stroke = sum of the difference between the actual position and the position at the start of the record.

### 5.6.3 Force mode (only in binary profile)

The drive should exert a defined force in the force mode. The force is theoretically calculated over the measured current for this purpose (the force is proportional to the motor current). The force mode is only possible in the binary profile with positional feedback, i.e. in closed-loop operation.

**Note**
Control of the motor force occurs indirectly via current regulation. All force specifications refer to the rated motor torque (relative to the rated motor current). The actual force at the axis should be ascertained/checked using external measurement devices and set during commissioning.

**Parameter overview/objects for record table – force mode**

| | FCT |
|---|---|
| Record type:<br>Type “F” = force mode without stroke limit<br>Type “FSL” = force mode with stroke limit | x |
| Stroke limit (type “FSL” only) | x |
| Max. speed [1)] | x |
| Max. acceleration [1)] | x |
| Max. deceleration (i.e. braking) [1)] | x |
| Force (prefix = direction of force) | x |
| Comments (max. 32 characters per record) | x |
| Applied load (linear axis: workpiece mass; axis of rotation: inertia) | x |
| Other CVE objects: #31 record number preselection; #141 current record number. | |

1) These parameters always have a positive prefix.

Tab. 5.10 Parameters for record table in force mode

**Target recognition (Motion complete/MC)**
A force record is considered complete when the following two conditions are fulfilled:
– The sum of the difference between the target force and the actual force calculated from the current is less than or equal to the specified maximum value (identical for all records, ➔ FCT, “Messages” page).
– The first condition has at least been fulfilled over the specified time period (“MC damping time”, identical for all records, ➔ FCT, “Messages” page).
Behaviour after target recognition:
As long as no other drive function is executed, the drive will continue to run or press in a controlled manner with the setpoint force. The speed is limited to the maximum value specified in the force record. Stroke limitation remains active.
Digital output no. 15 MOV as well as the force and position comparators are of particular interest in this regard (see section 5.9).

**Stroke limitation (type “FSL”)**
Upon reaching the stroke limit the drive is braked via the quick stop ramp (➔ FCT, “Axis”: “Quick Stop” panel). As long as no other drive function is executed, the drive will stop at the limit stroke in a position-controlled manner. Standstill monitoring is activated.
Stroke = sum of the difference between the actual position and the position at the start of the record.

## 5.7 Record switching by PLC (binary profile)

This section explains how the record switching function operates in the binary profile. Another record can be switched to at any time in the valve profile by setting a different input.

Record switching in the binary profile enables a PLC to switch flexibly between records. A specification can be made here for each record regarding how the drive should behave when this record is to be started while another record is being executed at the same time.
The following behaviour (start conditions) can be parameterised:
– **Ignore**: The START command is ignored. The current record is completed. A new record can only be started if the MC is active (new START signal required). This is the default setting.
– **Delay**: The current record is completed. The subsequent record addressed by the START signal is started after the current record has ended (immediately after the MC signal).
– **Interrupt**: The current record is interrupted immediately and the newly addressed record is executed directly.

The start conditions for the binary profile can be parameterised in FCT (see “Record table”, “Basic data” tab).

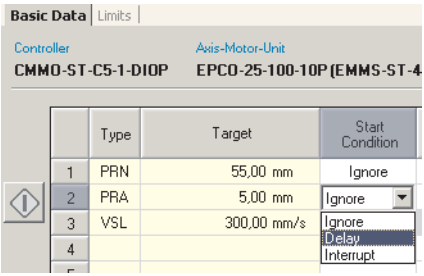



Fig. 5.24 Record switching in FCT (binary profile)

## 5.8 Record linking (binary profile only)

The record linking function allows a sequence of records to be defined. For every record in the table you can specify whether another record should be processed when a step enabling condition occurs, and if so, which record is to be processed and after which delay.
You can use the record linking function to realise complex motion sequences, such as

– Running a speed profile
– Positioning and clamping in a motion sequence
– Executing a force profile for pressing procedures

| **Overview of parameters for record linking** | |
|---|---|
| | **FCT** |
| **Step enabling condition** (e.g. a set comparator) | x |
| **Comparators** as a step enabling condition (position, speed, force, time).<br>➔ section 5.9. | x |
| **MC signal** between the individual records of a chain.<br>If the MC signal is too short to be evaluated, you can specify a start delay. The MC signal is then extended by the length of the start delay. | x |
| **Start delay (waiting time)**<br>Waiting time in [ms]: The time between the appearance of Motion Complete (MC) for a record with record linking and the start of the subsequent positioning record. | x |
| **Number** of the subsequent record | x |
| **Feedback**<br>Via the MC signal to the I/O interface. | |

Tab. 5.11 Parameters for record linking

## 5.9 Comparators

The following drive conditions can be observed in the binary profile:

- **Position comparator active:** The drive is located between two defined positions, i.e. in a position zone. This status can also be reported in the valve profile.
- **Speed comparator active**: The speed is within a defined range.
- **Force comparator active**: The force calculated via the current is within a defined range.
- **Time comparator active**: The time since the start of the command record is within a defined range.

You can allocate these comparators in FCT to a digital output: ➔ “Digital I/O” page.

### 5.9.1 Position comparators

The message “Position comparator active” is set when the following two conditions are fulfilled:

- The actual position is within the parameterised position limits ( ≥ minimum and ≤ maximum).
- The first condition has at least been fulfilled over the specified time period (damping time).

In all other cases the message is inactive.

When the drive leaves the position zone again, the message is reset immediately.

The position comparators can be used in all operating modes (positioning mode, speed mode, force mode).

| **Overview of parameters for position comparators** | |
|---|---|
| | **FCT** |
| Lower position limit (minimum) 1) | x |
| Upper position limit (maximum) 1) | x |
| Damping time [ms]: Minimum dwell time within the position zone before the position comparator is active. | x |
| **Feedback**<br>You can allocate this signal to digital output 6 or 7 in FCT on the “Digital I/O” panel. | |

1) The specified limits are always absolute positions (related to the project zero point).
If the minimum value is greater than the maximum value, the condition for the position comparator is never fulfilled.
Example of a position zone in a negative range: “–50 … –40 mm”.
➔ “–50 mm” must be entered as the minimum value and “–40 mm” as the maximum value.

Tab. 5.12 Parameters for position comparators

The position limits are always specified in absolute values, even for relative position records.

### 5.9.2 Speed comparators

The message “Speed comparator active” is set when the following two conditions are fulfilled:

– The actual speed is within the parameterisable limits (≥ minimum and ≤ maximum).
– The first condition has at least been fulfilled over the specified time period (damping time).

In all other cases the message is inactive.

When the drive leaves the speed zone again, the message is reset immediately.

The speed comparators can be used in all operating modes (positioning mode, speed mode, force mode).

**Overview of parameters for speed comparators**

| | FCT |
|---|---|
| Lower speed limit (minimum) 1) | x |
| Upper speed limit (maximum) 1) | x |
| Damping time [ms]: Minimum dwell time within the speed zone before the speed comparator is active. | x |
| **Feedback**<br>You can allocate this signal to digital output 6 or 7 in FCT on the “Digital I/O” panel. | |

1) The limit values can be both positive and negative. If the minimum value is greater than the maximum value, the condition for the speed comparator is never fulfilled.

Tab. 5.13 Parameters for speed comparators

### 5.9.3 Force comparators

The message “Force comparator active” is set when the following two conditions are fulfilled:

– The actual force calculated with the help of the measured current is within the parameterisable limits (≥ minimum and ≤ maximum).
– The first condition has at least been fulfilled over the specified time period (damping time).

In all other cases the message is inactive.

When the drive leaves the force zone again, the message is reset immediately.

The force comparators can be used in all operating modes (positioning mode, speed mode, force mode).

**Overview of parameters for force comparators**

| | FCT |
|---|---|
| Lower force limit (minimum) 1) | x |
| Upper force limit (maximum) 1) | x |
| Damping time [ms]: Minimum dwell time within the force zone before the force comparator is active. | x |
| **Feedback**<br>You can allocate this signal to digital output 6 or 7 in FCT on the “Digital I/O” panel. | |

1) The limit values can be both positive and negative. The prefix here indicates the direction of the force. If the minimum value is greater than the maximum value, the condition for the force comparator is never fulfilled.

Tab. 5.14 Parameters for force comparators

### 5.9.4 Time comparators

The message “Time comparator active” is set when the following condition is fulfilled:

– The time since the start of the record is within the parameterisable limits (≥ minimum and ≤ maximum).

In all other cases the message is inactive.

| **Overview of parameters for time comparators** | |
|---|---|
| | **FCT** |
| Lower time limit (minimum) 1) | x |
| Upper time limit (maximum) 1) | x |
| **Feedback**<br>You can allocate this signal to digital output 6 or 7 in FCT on the “Digital I/O” panel. | |

1) The limit values can only be positive. If the minimum value is greater than the maximum value, the condition for the time comparator is never fulfilled.

Tab. 5.15 Parameters for time comparators

## 5.10 Instructions on operation

During operation, the same safety instructions must be observed as for the commissioning procedure (➔ section 5.1).

**Password protection**

Password protection is preset in the factory to inactive. In order to prevent unauthorised or unintentional overwriting or modification of parameters in the device, you can set up a password in FCT (➔ online help for the plug-in).
This password is also valid for the web browser.

**Maintenance and care**

CMMO-ST motor controllers are maintenance-free. However, follow the maintenance instructions for the drive and the additional components.

**Disposal and environment**

**Note**

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

# 6 Diagnostics

## 6.1 Types of malfunction

Malfunctions can have different levels of severity:

**Error**
An error always results in an error response. The possible error responses are listed in section 6.4.1. Errors must be acknowledged, i.e. reset. In terms of the CMMO-ST, errors can only be reset when their cause has been eliminated.

**Warning**
Warnings have no influence on the behaviour of the drive and do not need to be acknowledged. The cause of the warning should be eliminated in order that it does not lead to a malfunction.

**Information**
If an error message has been parameterised as “information”, it will not appear in the 7-segment display. It is written into the diagnostic memory, however, depending on parametrisation.

## 6.2 7-segment display

The 7-segment display on the CMMO-ST provides information about operating modes, errors and warnings. 4 characters are fundamentally displayed in succession, followed by a space.


1 Point for wave function
Fig. 6.1 7-segment display

The numbers of error messages are displayed in **hexadecimal** format. Table of error messages ➔ section 6.4.2.

**Wave function**
The point flashes if the radio button “Identify this CMMO: on” has been clicked on the CMMO website (➔ section 5.3). This enables you to identify a certain CMMO-ST amongst a group of several units (the connected CMMO-ST “waves”).
This wave function can also be activated from the FCT: Select the menu option “Component / FCT Interface” and then click the “Search” button in the “FCT Interface” dialogue window to start the “Festo Device Tool”. Then use the context menu of the CMMO-ST that has been located by the network scan to select the option “Identification On/Off”.

**Display during a firmware update**

During a firmware update the display alternates between the following two images:

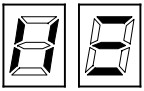


Fig. 6.2 7-segment display during a firmware update

The following messages are displayed:

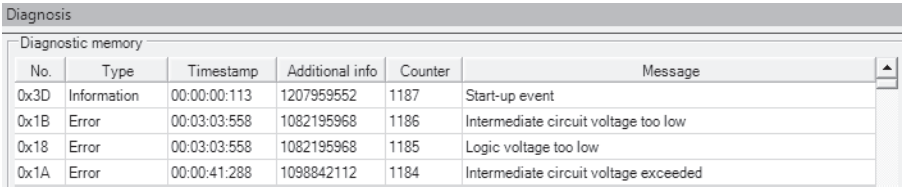
| Display | Operating mode/event | Priority | |
|---|---|---|---|
| **B L E** | Bootloader error | 1 | Error during the firmware update.<br>Switch the controller off and on again.<br>If the error persists: replace the controller. |
| **E**xxx<br>(xxx = malfunction no.) | Error | 2 | Error messages interrupt messages with a lower priority and must be acknowledged. |
| **A**xxx<br>(xxx = malfunction no.) | Warning | 3 | Warnings have a lower priority than errors and are not displayed if they occur if an error is already displayed. Otherwise they are displayed twice in succession.<br>Warnings do not have to be confirmed (acknowledged). |
| **HHHH** | STO – Safe torque off | 4 | The STO function has been requested. |
| **P**000 | Homing | 5 | Normal mode |
| **P**070 | Jog positive | | |
| **P**071 | Jog negative | | |
| **P1**xx (xx = record no.) | Positioning mode | | |
| **P2**xx (xx = record no.) | Force mode | | |
| **P3**xx (xx = record no.) | Profile Velocity Mode | | |

Tab. 6.1 Messages on the 7-segment display

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

## 6.3 Diagnostic memory

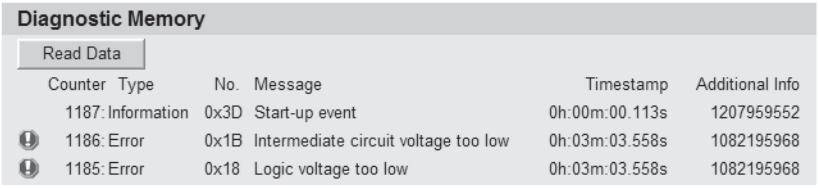
You can read the diagnostic memory via FCT. It includes up to 200 diagnostic messages and is backed up if possible in the event of power failure. If the memory is full, the oldest element will be overwritten (ring buffer).




| No. | Type | Timestamp | Additional info | Counter | Message |
|---|---|---|---|---|---|
| 0x3D | Information | 00:00:00:113 | 1207959552 | 1187 | Start-up event |
| 0x1B | Error | 00:03:03:558 | 1082195968 | 1186 | Intermediate circuit voltage too low |
| 0x18 | Error | 00:03:03:558 | 1082195968 | 1185 | Logic voltage too low |
| 0x1A | Error | 00:00:41:288 | 1098842112 | 1184 | Intermediate circuit voltage exceeded |

Fig. 6.3 Diagnostic memory in FCT

The diagnostic memory can also be read via the CMMO-ST website (➔ section 5.3):




| Counter | Type | No. | Message | Timestamp | Additional Info |
|---|---|---|---|---|---|
| 1187: | Information | 0x3D | Start-up event | 0h:00m:00.113s | 1207959552 |
| 1186: | Error | 0x1B | Intermediate circuit voltage too low | 0h:03m:03.558s | 1082195968 |
| 1185: | Error | 0x18 | Logic voltage too low | 0h:03m:03.558s | 1082195968 |

Fig. 6.4 Diagnostic memory on the website

**Deleting the diagnostic memory**

You can erase the diagnostic memory via FCT. When deleting, a “switch-on event” (malfunction 3Dh) is generated. The malfunction counter is not reset.

## 6.4 Malfunctions: Causes and remedy

### 6.4.1 Error responses

The following responses to errors are disignated. The table of error messages specifies which response is set for each error by default (in bold) and which other responses can be parameterised if necessary.

| Code letters and description of the error responses | |
|---|---|
| **A** | Switch off output stage, no braking ramp |
| **B** | Rapid stop of braking ramp (Quick stop), then switch off output stage |
| **C** | Braking ramp (of the current positioning record), then switch off output stage |
| **D** | Execute record to the end (until Motion complete MC), then switch off output stage |
| **E** | Rapid stop of braking ramp (Quick stop); output stage then remains switched on |
| **F** | Braking ramp (of the current positioning record), output stage then remains switched on |
| **G** | Execute record to the end (until Motion complete MC), output stage then remains switched on |

Tab. 6.2 Error responses

### 6.4.2 Table of error messages

Explanations for table of error messages:

**Can be parameterised as:**
**E**/W/I = Error / Warning / Information (refer to section 6.1 Types of malfunctions).
Specifies which parameterisation options are available for an error message. The factory setting is in bold (Error in this example).
If a parameterisation option is not available, this is indicated by dashes, e.g. “E/-/-” if the error message is treated exclusively as an error.

**Diagnostic memory**
Always/optional: Indicates whether an entry is made in the diagnostic memory or if it can be parameterised in FCT.

**Software reset**
Restart of the controller, either by switching it off and on again or by selecting “Component / Online / Restart controller” in the FCT menu.

**Error reaction(s)**
The list of error responses can be found in section 6.4.1. The factory setting is in bold.

You can parameterise the error messages in FCT (“Error Management” panel).

**Table of error messages**

| | | |
|---|---|---|
| **01h** | **Software error** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| An internal firmware error has been detected.<br>• Contact Festo Service.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |
| **02h** | **Default parameter file invalid** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| An error has been detected when examining the default parameter file. The file is damaged.<br>• Reload the default parameter file into the device via a firmware update. If the error is still present, it means the memory may be faulty and the device needs to be replaced.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |
| **05h** | **Zero angle determination** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| The rotor position could not be clearly identified. The commutation point is invalid.<br>• The drive is blocked: Ensure freedom of movement.<br>• Excessively high load: Reduce load.<br>• The axis is not fastened stiffly enough: Stiffen the axis mounting.<br>• The effective load is not fastened stiffly enough on the axis: Stiffen the connection.<br>• Effective load can vibrate: Form a stiffer load; modify the natural frequency of the load.<br>• If several drives are fitted in a system that can vibrate: Carry out commutation point search one after the other.<br>• Controller parameters have been set incorrectly: Determine the controller parameters and set the correct value. To do this, you may have to perform a commutation point search without a load (remove the load, correctly set the tool mass and applied load), start the axis, connect the load (correctly set the tool mass and applied load), determine the new controller parameters (see FCT help on controller parameterisation), reparameterise the drive and then restart the commutation point search with new controller parameters.<br>• This error can also occur if the set motor current is too low to move the shaft and any possible load. Correct the settings for the motor current if necessary.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A | | |
| **06h** | **Encoder** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| An error has occurred during evaluation of the encoder. The current position values may be incorrect.<br>• Conduct a software reset with a commutation angle search and homing procedure.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |

**Table of error messages**

| | | |
|---|---|---|
| **09h** | **Offset determination for current measurement** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| An error has occurred during initialisation of the current measurement.<br>• Perform a software reset.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |
| **0Bh** | **Parameter file invalid** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| No valid parameter set stored. After creation of the parameter file, a firmware update is performed, if necessary: as much data as possible is automatically taken from the parameter file. Parameters that are not initialised through the parameter file are taken over from the default parameter file.<br>• Enter a valid parameter set in the device. If the error is still present, the hardware may be defective.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A | | |
| **0Ch** | **Firmware update execution error** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The firmware update has not been properly executed/completed.<br>• Check the Ethernet connection between the controller and PC and run the firmware update again. The previous firmware version remains active until successful completion of the firmware update. If this error is still present, the hardware may be defective.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |
| **0Dh** | **Overcurrent** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| Short circuit in the motor, in the lines or in the brake chopper.<br>Output stage defective.<br>Incorrect parameterisation of the current regulator.<br>• Error message immediately after connecting to the load supply: Short circuit in the output stage. The controller must be replaced.<br>• Error message only occurs during setting of the output stage enable: - Disconnect the motor plug directly on the controller; if the error still occurs, the controller must be replaced.- If the error only occurs when the motor cable is connected, check the motor and cable for short circuits, e.g. with a multimeter.<br>• Check parameterisation of the current regulator. An incorrectly parameterised current regulator can generate currents up to the short-circuit limit; as a rule this is clearly noticeable through high frequency whistling. Inspection with the trace function in FCT (active current actual value).<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |

**Table of error messages**

| | | |
|---|---|---|
| **0Eh** | **I²t-error motor** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| The I²t limit for the motor is reached. The motor or the drive system may be insufficient for the required task.<br>• Check the layout of the drive system.<br>• Check the mechanics for sluggishness.<br>• Reduce load/dynamics, longer breaks.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): B, **C** | | |
| **11h** | **Softwarelimit positive** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The setpoint position value reached or exceeded the relevant software limit switch.<br>• Check the target data.<br>• Check positioning area.<br>• This error can only be acknowledged if the drive is within the valid movement range. If necessary, start a corresponding position set or move the drive by using the jog function. Movements in a positive direction are blocked.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A, **B**, C, E, F | | |
| **12h** | **Softwarelimit negative** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The setpoint position value reached or exceeded the relevant software limit switch.<br>• Check the target data.<br>• Check positioning area.<br>• This error can only be acknowledged if the drive is within the valid movement range. If necessary, start a corresponding position set or move the drive by using the jog function. Movements in a negative direction are blocked.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A, **B**, C, E, F | | |
| **13h** | **Positive direction locked** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| A limit switch error or a software limit position error has occurred and subsequently a movement in the blocked direction has been initiated.<br>• Check the target data.<br>• Check positioning area.<br>• This error can only be acknowledged if the drive is within the valid movement range. If necessary, start a corresponding position set or move the drive by using the jog function. Movements in a negative direction are blocked.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A, **B**, C, E, F | | |

**Table of error messages**

| | | |
|---|---|---|
| **14h** | **Negative direction locked** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| A limit switch error or a software limit position error has occurred and subsequently a movement in the blocked direction has been initiated.<br>• Check the target data.<br>• Check positioning area.<br>• This error can only be acknowledged if the drive is within the valid movement range. If necessary, start a corresponding position set or move the drive by using the jog function. Movements in a negative direction are blocked.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A, **B**, C, E, F | | |
| **15h** | **Output stage temperature exceeded** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The permissible limit value for the output stage temperature has been exceeded. The output stage is possibly overloaded.<br>• This error can only be acknowledged if the temperature is within the permissible range.<br>• Check cylinder sizing.<br>• Check motor and cabling for short circuits.<br>• Check the mechanics for sluggishness.<br>• Reduce the ambient temperature, improve heat dissipation.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): A, B, **C**, D | | |
| **16h** | **Output stage temperature too low** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The ambient temperature is below the permissible range.<br>• Increase the ambient temperature. This error can only be acknowledged if the temperature is within the permissible range.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): A, B, **C**, D | | |
| **17h** | **Logic voltage exceeded** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The logic power supply monitor has detected an overvoltage. This is either due to an internal defect or an excessive supply voltage.<br>• Check external supply voltage directly on the device.<br>• If the error is still present after a reset has been conducted, it means there is an internal defect and the device has to be replaced.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): A, **B** | | |

**Table of error messages**

| | | |
|---|---|---|
| **18h** | **Logic voltage too low** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The logic power supply monitor has detected an undervoltage. This is either due to an internal defect or an overload/short circuit caused by connected peripherals.<br>• Separate device from the entire peripheral equipment and check whether the error is still present after a reset. If so, it means there is an internal defect and the device has to be replaced.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): A | | |
| **19h** | **Temperature LM-CPU** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The monitor has detected a CPU temperature outside the permissible range.<br>• Check whether the ambient temperature is within the permissible range for the controller. If the error is still present, it means there is an internal defect and the device must be replaced.<br>• The error can only be acknowledged if the temperature is within the permissible range.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): A, **B** | | |
| **1Ah** | **Intermediate circuit voltage exceeded** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| Load voltage not within the permissible range.<br>Braking resistor is overloaded; too much braking energy which cannot be dissipated quickly enough.<br>Braking resistor defective or not connected.<br>• Check the load voltage; measure voltage directly at the controller input.<br>• Check cylinder sizing: Braking resistor overloaded?<br>• In the event of a defective internal braking resistor: Replace the controller.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): A, **B** | | |
| **1Bh** | **Intermediate circuit voltage too low** | Can be parameterised as: **E**/W/-<br>Diagnostic memory: optional |
| Load voltage too low.<br>• Voltage drops under load: power supply unit too weak, supply line too long, cross section too small?<br>• Measure load voltage (directly at the controller input).<br>• If you intentionally want to operate the device with a lower voltage, parameterise this malfunction as a warning or information.<br>– For parameterisation as an error: The error can be acknowledged.<br>Parameterisable error response(s): **A**<br>– For parameterisation as a warning: The warning disappears if the load voltage is back within the permissible range. | | |

**Table of error messages**

| | | |
|---|---|---|
| **22h** | **Homing** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Homing run to switch unsuccessful. A corresponding switch has not been found.<br>• Check to make sure the correct homing method is set.<br>• Check to see if the limit switches and/or homing switches are connected and if they have been parameterised correctly (normally closed contact/normally open contact?). Check the functionality of the switches and check the lines for wire break.<br>• If the error is still present, it means there is an internal defect and the device has to be replaced.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, E, F | | |
| **23h** | **No index pulse found** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Error during homing: no zero pulse found. Encoder defective or incorrect parameterisation of the encoder resolution.<br>• Check the output signals of the encoder, in particular the index signal.<br>• Check the parameterisation of the encoder resolution.<br>– Acknowledgement option: Cannot be acknowledged, software reset required.<br>Parameterisable error response(s): **B**, C, E, F | | |
| **24h** | **Drive function is not supported in operated mode** | Can be parameterised as: **E**/W/-<br>Diagnostic memory: optional |
| Function is not supported in this mode. The request has been ignored.<br>• Change the operating mode or select a different drive function.<br>– For parameterisation as an error: The error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **E**, F<br>– For parameterisation as a warning: The warning disappears if a switch is made to a valid drive function. | | |
| **25h** | **Path calculation** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The positioning target cannot be reached through the positioning or edge condition options.<br>For record linking: The end speed of the last record was higher than the target speed of the following record.<br>• Check the parameterisation of the affected records.<br>• Also check the actual values of the previous positioning process at the switching point, if necessary, by using the trace function. The error may be caused by the actual velocity or the actual acceleration being too high at the switching point.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A | | |

**Table of error messages**

| | | |
|---|---|---|
| **27h** | **Save parameters** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Error when writing the internal flash memory.<br>• Execute the last operation again.<br>Check the following<br>• Is it possible that another error has to be acknowledged?<br>• During download of a parameter file: Does the version of the parameter file fit the firmware version?<br>If the error continues to occur, please contact Festo Service<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): G | | |
| **28h** | **Homing required** | Can be parameterised as: **E**/W/-<br>Diagnostic memory: optional |
| A valid homing run has not yet been conducted.<br>The drive is no longer referenced (e.g. due to logic voltage failure or because the homing method or the axis zero point was changed).<br>• Perform a homing run or repeat the last homing process if it was not completed successfully.<br>– For parameterisation as an error: The error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, D, E, F, G<br>– For parameterisation as a warning: The warning disappears if the homing run has been completed successfully. | | |
| **29h** | **Target position behind negative software end position** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The start of a positioning movement was suppressed as the target is past the relevant software limit switch.<br>• Check the target data.<br>• Check positioning area.<br>• Check position set type (absolute/relative?)<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, E, F | | |
| **2Ah** | **Target position behind positive software end position** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The start of a positioning movement was suppressed as the target is past the relevant software limit switch.<br>• Check the target data.<br>• Check positioning area.<br>• Check position set type (absolute/relative?)<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, E, F | | |

**Table of error messages**

| | | |
|---|---|---|
| **2Bh** | **Firmware update, invalid firmware** | Can be parameterised as: **E**/W/-<br>Diagnostic memory: optional |
| The firmware update process could not be performed. The firmware version is incompatible with the hardware used.<br>• Ascertain the version of your hardware. You can ascertain the compatible firmware versions and download the appropriate firmware from the Festo website.<br>– For parameterisation as an error: The error can only be acknowledged after eliminating the cause. Parameterisable error response(s): **A**<br>– For parameterisation as a warning: The warning disappears if a new FW download process is started. | | |
| **2Dh** | **I²t warning motor** | Can be parameterised as: -/**W**/I<br>Diagnostic memory: optional |
| The I²t integral is up to 80% full.<br>• You can parameterise this message as a warning or suppress it completely as information.<br>– For parameterisation as a warning: The warning disappears if the I²t integral is below 80%. | | |
| **2Eh** | **Index pulse too close on proximity sensor** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The switching point of the proximity sensor is too close to the index pulse. In some cases, this can mean that no reproducible homing position can be determined.<br>• Observe the special section 6.4.5 for this error.<br>• Move the homing switch/limit switch to the axis. You can display the distance between the switch and index pulse in the FCT.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause. Parameterisable error response(s): **B**, C, E, F | | |
| **2Fh** | **Following error** | Can be parameterised as: **E**/W/I<br>Diagnostic memory: optional |
| The following error is too large. This error can occur during positioning and speed modes.<br>• Enlarge error window.<br>• Acceleration, speed, jerk or load too high? Mechanics stiff?<br>• Motor overloaded (current limitation from I²t monitoring active?)<br>– For parameterisation as an error: The error can be acknowledged. Parameterisable error response(s): B, C, **E**, F<br>– For parameterisation as a warning: The warning disappears if the following error is back within the permissible range. | | |

**Table of error messages**

| | | |
|---|---|---|
| **31h** | **CVE connection** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| A connection error has occurred during "Control via Ethernet" (CVE).<br>• Check the connection: plug disconnected, cable lengths observed, shielded cable used, screening connected?<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, D, E, F, G | | |
| **32h** | **FCT connection with master control** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Connection to the FCT has been interrupted.<br>• Check the connection and perform a reset if necessary.<br>– For parameterisation as an error: The error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, D, E, F, G | | |
| **33h** | **Output stage temperature warning** | Can be parameterised as: -/**W**/I<br>Diagnostic memory: optional |
| Temperature of output stage increased.<br>• Check cylinder sizing.<br>• Check motor and cabling for short circuits.<br>• Check the mechanics for sluggishness.<br>• Reduce the ambient temperature, improve heat dissipation.<br>– For parameterisation as a warning: The warning disappears if the temperature is back below the danger threshold. | | |
| **34h** | **Save Torque Off (STO)** | Can be parameterised as: **E**/**W**/I<br>Diagnostic memory: optional |
| The “Safe Torque Off” safety function has been requested.<br>• Please observe the separate documentation for the STO function.<br>– For parameterisation as an error: The error can be acknowledged.<br>Parameterisable error response(s): 0<br>– For parameterisation as a warning: The warning disappears if the STO is no longer requested. | | |
| **37h** | **Standstill monitoring** | Can be parameterised as: -/**W**/I<br>Diagnostic memory: optional |
| The actual position is outside the downtime window. Parameterisation of the window may be too narrow.<br>• Check parameterisation of the downtime window.<br>– For parameterisation as a warning: The warning disappears if the actual position is within the standstill window again or a new record has been started. | | |

**Table of error messages**

| | | |
|---|---|---|
| **38h** | **Parameter file access** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| During a parameter file procedure all other reading and writing routines for the parameter file are blocked.<br>• Wait until the process is complete. The time between two parameter file downloads should not fall below 3 seconds.<br>– Acknowledgement option: Error can be acknowledged.<br>Parameterisable error response(s): G | | |
| **39h** | **Trace warning** | Can be parameterised as: -/**W**/-<br>Diagnostic memory: optional |
| An error has occurred during trace recording.<br>• Start a new trace recording.<br>– For parameterisation as a warning: The warning disappears if a new trace has been started. | | |
| **3Ah** | **Homing Timeout** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Error during homing process in controlled operation. The switch has not been found within a certain time.<br>• Check the switch configuration and the electric connection of the switch(es).<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, E, F | | |
| **3Bh** | **Homing method invalid** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Homing error. A homing method block has been set, for example, in open-loop operation.<br>• Select a permissible homing method.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **E**, F | | |
| **3Ch** | **Two edges in one cycle** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| Two input signals have been set in the valve type in one input read cycle.<br>• Programme the PLC so that two records (or a record and homing run) are not started in a cycle. A minimum time delay of 2 ms must be maintained between two edges. In the event of manual control, only one switch should be operated after the other.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): **B**, C, E, F | | |
| **3Dh** | **Start-up event** | Can be parameterised as: -/-/**I**<br>Diagnostic memory: always |
| The controller has been switched on or was switched on for longer than 48 days. This event also occurs when deleting the diagnostic memory. The start-up event does not occur if the preceding entry in the diagnostic memory has already been a start-up event.<br>• This event is only used for improved documentation of the malfunctions. | | |

**Table of error messages**

| | | |
|---|---|---|
| **3Eh** | **Diagnostic memory** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| An error has occurred when writing or reading from the diagnostic memory.<br>• Acknowledge the error. If the error is still present, it means a memory module is probably defective or an incorrect entry has been stored.<br>• Erase the diagnostic memory. If the error still occurs, the controller must be replaced.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): G | | |
| **3Fh** | **Record invalid** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: optional |
| The started record is invalid. The record data is implausible or the record type is invalid.<br>• Check the record parameters.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): B, C, D, **E**, F, G | | |
| **40h** | **Last Teaching not successful** | Can be parameterised as: -/**W**/I<br>Diagnostic memory: optional |
| Teaching of the current positioning record is not possible.<br>• The current positioning record must be of the type “position record”.<br>– For parameterisation as a warning: The warning disappears if the following Teach test is successful or a switch takes place from the Teach mode (mode 1) to normal operation (mode 0). | | |
| **41h** | **System reset** | Can be parameterised as: **E**/-/-<br>Diagnostic memory: always |
| An internal firmware error has been detected.<br>• Contact Festo Service.<br>– Acknowledgement option: Error can only be acknowledged after eliminating the cause.<br>Parameterisable error response(s): A | | |
| **43h** | **FCT connection without master control** | Can be parameterised as: -/**W**/I<br>Diagnostic memory: optional |
| There is no longer a connection to the FCT, e.g. the cable was disconnected.<br>• Check the connection and perform a reset if necessary.<br>– For parameterisation as a warning: The warning disappears if the connection to the FCT is re-established. | | |

| Table of error messages | | |
|---|---|---|
| **44h** | **Parameter file is not suitable for the firmware** | Can be parameterised as: -/**W**/I<br>Diagnostic memory: always |
| The parameter file that was just written to the controller is not suitable for the firmware of the device. As much data as possible is automatically taken over from the parameter file. Parameters that are not initialised through the parameter file are imported from the default parameter file. If new firmware software is required, not all parameters may have to be written.<br>• Enter a valid parameter set in the device.<br>– For parameterisation as a warning: The warning disappears if a new parameter file is successfully written. | | |

Tab. 6.3 Table of error messages

### 6.4.3 Problems with the Ethernet connection

**If you cannot establish a connection to the CMMO-ST**

- It may mean the **DHCP client** on your computer has been **deactivated**. Check your DHCP settings.
  **When using Windows XP:** Start/Settings/System Control.
  Open the “Network Connections” panel and then select the Properties for the network connection to which the CMMO-ST is connected. Select “Internet Protocol (TCP/IP)” and click on “Properties”. To enable the DHCP client, select the setting in the image below.
  **When using Windows 7:** Start/System Control/Network and Internet/Network and Sharing Center/ Local Area Connection. Click on “Properties” in the “Local Area Connection Status” dialogue window and select “Internet Protocol Version 4” in the following dialogue window. To activate the DHCP client click on Properties and select the setting in the image below.

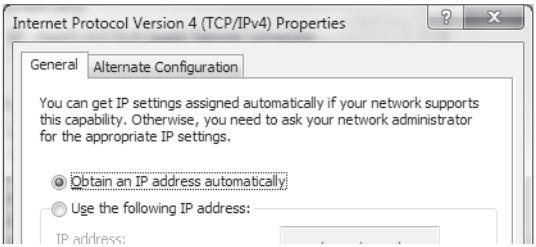



Fig. 6.5 DHCP settings

The factory settings of the CMMO-ST can be found in section 5.2.1.

- Check the **network settings** of your computer. For Windows XP/Windows 7:
  - [Start][(All)Programs][Accessories][Input Request]
  - Enter `ipconfig` or `ipconfig /all`.
  - Check whether the devices are accessible in the same subnet. Contact your **network administrator** if necessary.
- You can also use the **Ping** program to determine whether the CMMO-ST is accessible in the network. For Windows XP/Windows 7:
  - [Start][(All)Programs][Accessories][Input Request]
  - `ping 192.168.178.1` (IP address of the CMMO-ST)
- Run a network scan (➔ refer to the following point).

**If the IP address of the CMMO-ST is unknown or if you need to change the network settings of the CMMO-ST**

You can run a **network scan** by using the **FCT plug-in** for the CMMO-ST. See menu [Component] [FCT Interface] [“Search...” button].

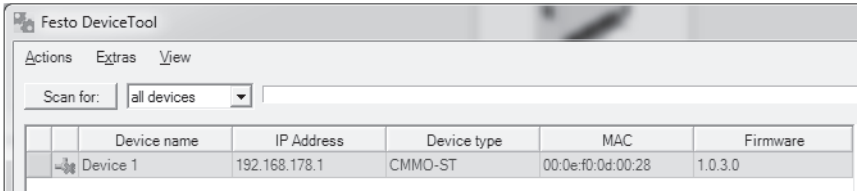



Fig. 6.6 Network scan with the “Festo Device Tool”

Select [Network Settings] from the context menu of one of the devices that has been found. You can assign a fixed IP address to this device. You can also specify whether the CMMO-ST functions as a DHCP server or client.

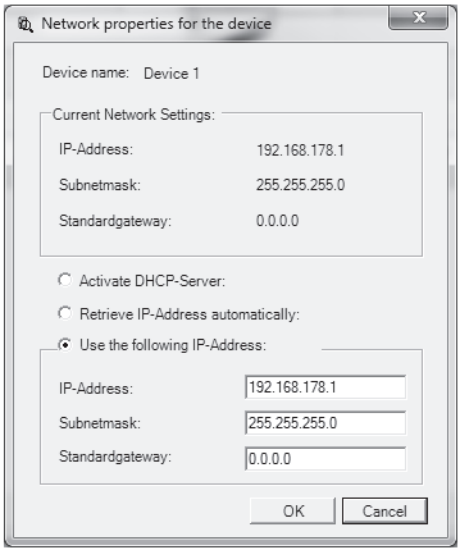



Fig. 6.7 Adapting network settings

### 6.4.4 Other problems and remedies

| Problem | Cause and remedy |
|---|---|
| Controller does not work at all | • Check all cables and connections for short circuit, disconnections or incorrect pin allocation.<br>• Observe the information in the assembly instructions for the cables and plugs used.<br>• Blown internal fuse: Internal short circuit, completely replace the controller. |
| Controller does not achieve the specified performance data | • Incorrect control signals from master controller (incorrect signals, incorrect level). Observe the timing diagrams in the Commissioning chapter.<br>• Incorrect controller setting. Observe the information in the online help section of the FCT plug-in for the correct settings of the controller parameters.<br>• Error in the power supply. Observe the tolerance values in accordance with the chapter “Technical data”. |

Tab. 6.4 Other problems and remedies

### 6.4.5 Malfunction “Index pulse too close on proximity sensor” ($2E_h$)

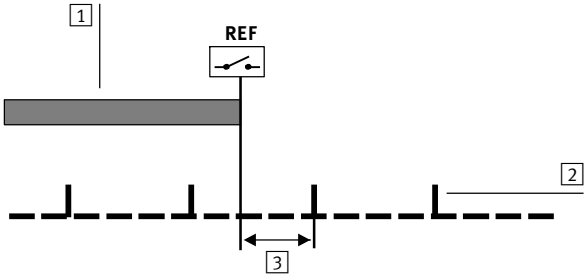
In the homing run to the proximity sensor with index search, the drive initially moves into the switching range of the sensor and then reverses. After the switching range is exited, the controller searches for the nearest index pulse. This applies as the homing point.

**Note**

Material damage due to moved measuring reference system

The following situation arises if the switching point of the proximity sensor and the index pulse lie very close to one another: If the switching point moves (e.g. due to temperature influence) so that it lies behind the index pulse, then the controller will use the index pulse after that as a reference point. The entire measuring reference system could then be shifted, for example, by a rotary drive by a full motor revolution.

1. Check the distance of the switching point to the index pulse: ➔ FCT, “Project output” window, “Homing” tab.
2. Then move the proximity sensor a few tenths of a mm up to several millimetres (depending on axis type).




1 Switching range of the proximity sensor
2 Index pulse
3 Recommended position: centrally between two index pulses

# A Technical appendix

## A.1 Technical data

| General | |
|---|---|
| Protection class of the entire system according to EN 60529 | IP40 (with full pin allocation) |
| Pollution degree | 2 (per EN 50178) |
| Ambient temperature | Operation: 0 ... +50 °C<br>Storage/transport: –25 ... +75 °C |
| Relative air humidity (at 25 °C) | 0 ... 90 %, non-condensing |
| Max. installation height | ‹ 2000 m above sea level |
| Weight | 290 g |
| Electromagnetic compatibility (EMC) [1)] | ➔ Declaration of conformity (www.festo.com) |
| Vibration<br>Checked in accordance with DIN EN 60068 part 2-6 | With wall mounting: severity level 2<br>With H-rail mounting: severity level 1 |
| Shock<br>Checked in accordance with DIN EN 60068 part 2-27 | With wall mounting: severity level 2<br>With H-rail mounting: severity level 1 |
| Continuous shock test<br>Checked in accordance with DIN EN 60068 part 2-29 | With wall and H-rail mounting:<br>Severity level 1 |

1) The component is solely intended for use in industrial environments. Maximum length of the individual connecting cables: 30 m. The project planning performance data relates to a maximum cable length of 10 m.

**Key safety data** and **certifications** can be found in the separate STO documentation for the CMMO-ST.

Requirements for observing the certified **UL** conditions if the product is operated in the USA or Canada can be found in the separate special UL documentation.

| **Electrical data** | |
|---|---|
| Voltage supply | 24 V DC ± 15 % |
| Current load voltage (pin 5) | Nominal current: 5.7 A. Peak current: 8 A. |
| Current logic supply (pin 3) | Nominal current: 0.3 A (without power supply for outputs)<br>Supply of the outputs of the I/O interface:<br>Per output max. 0.1 A: i. e. up to 1.1 A.<br>See section 4.4.1. |
| Total current consumption | Dependent on the system architecture, up to 9.4 A. |
| Protection against electric shock<br>(Protection against direct and indirect contact in accordance with<br>IEC/DIN EN 60204-1) | Through PELV circuit (Protected Extra Low Voltage) |
| Encoder for EPCO type drives<br>(unless otherwise specified) | 2000 increments/revolution, i.e. theoretical positioning accuracy 0.18°. The effective level of accuracy depends on the mechanical system used<br>(➔ mechanical data sheet).<br>In open-loop operation (i.e. without an encoder) the controller uses the same resolution. |
| Maximum speed and torque of the motors | ➔ operating instructions for the drives used,<br>e.g. type EPCO. |

# B Control via Ethernet (CVE)

## B.1 Basic principles

The CMMO-ST can be controlled via the Ethernet interface of a PC program by using the function “Control via Ethernet” (CVE). This enables status data to be written from CMMO-ST and control data to be written to CMMO-ST.
To use the CVE function the CMMO-ST is pre-parameterised with FCT. CVE cannot be used to make any changes to the parameterisation. CVE can be used to start records and a homing run. The intermediate stop (pause) as well as jogging and teaching are not supported.

Communication with the CMMO-ST is achieved via the CVE protocol. This must be implemented in the PC application. Knowledge of programming TCP/IP applications is required for this purpose.

**Caution**
Not using the CVE interface as intended can result in personal injury and material damage.
– The CVE interface is **not real-time capable**.
Controlling the CMMO-ST via Ethernet requires, among other things, a risk assessment by the user, ambient conditions that are free of interference and reliability of data transmission, e.g. via the control programme of the higher-order controller.
- Only use the CVE function in applications in which the lack of real-time capability cannot pose risks.
- In order to ensure machine safety the STO function must be used.

### B.1.1 Communication principle

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

### B.1.2 CVE protocol

Access to CMMO-ST data is effected via CVE objects. A CVE object always has a unique index that enables identification of the object.
A number of CVE objects are listed in section B.3. Only the objects listed there may be used.

**Caution**
Personal injury and damage to property
Accidentally writing over undocumented objects can result in unpredictable behaviour of the drive.
- Only use the objects listed in appendix B.3.

Each object has one of the data types listed in Tab. B.1. The byte order is little endian.

**Read object**
In order to read a CVE object, a request must be sent to the CMMO-ST in accordance with Tab. B.2. This sends back a response Tab. B.3.

**Write object:**
In order to write a CVE object, a request must be sent to the CMMO-ST corresponding to Tab. B.4. This sends back a response Tab. B.5.

As both directions concern an endless TCP data stream, the individual messages must be filtered out. Strict compliance with the message length is required for this.

**Data types**

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

Tab. B.1 Data types

**Request “Read CVE object”**

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

Tab. B.2 Request “Read CVE object”

**Response “Read CVE object”**

| Byte | Function | Data type | Description |
|---|---|---|---|
| 0x00 | Service ID | UINT08 | 0x10 = Read CVE object from controller |
| 0x01<br>0x02<br>0x03<br>0x04 | Message ID | UINT32 | Message ID included in the request. |
| 0x05<br>0x06<br>0x07<br>0x08 | Data length | UINT32 | The data length is dependent on the data type of the read CVE object. The following applies:<br>Data length = 4 bytes + data type length<br>Example for UINT32:<br>Data length = 4 bytes + 4 bytes = 8 bytes |
| 0x09 | Acknowledge | UINT08 | 0 if everything is ok. All other values mean that the object could not be read. A list of possible causes of the error: ➔ Tab. B.6 |
| 0x0A<br>0x0B<br>0x0C<br>0x0D | Reserved | UINT32 | Placeholder |
| 0x0E<br>0x0F | Object index | UINT16 | Index of the read CVE object. |
| 0x10 | Object subindex | UINT08 | Always 0 |
| 0x11 | Data type | UINT08 | Data type of the CVE object. |
| 0x12 | Data byte 1 | corresponding to data type of the CVE object | Object value |
| ... | Data byte K | | |

Tab. B.3 Response “Read CVE object”

**Request “Write CVE object”**

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

Tab. B.4 Request “Write CVE object”

**Response “Write CVE object”**

| Byte | Function | Data type | Description |
|---|---|---|---|
| 0x00 | Service ID | UINT08 | 0x11 = write CVE object to the CMMO |
| 0x01<br>0x02<br>0x03<br>0x04 | Message ID | UINT32 | Message ID included in the request. |
| 0x05<br>0x06<br>0x07<br>0x08 | Data length | UINT32 | Always 4 for this response |
| 0x09 | Acknowledge | UINT08 | 0 if everything is ok. All other values mean that the object could not be written. A list of possible causes of the error: ➔ Tab. B.6 |
| 0x0A<br>0x0B<br>0x0C<br>0x0D | Reserved | UINT32 | Placeholder |
| 0x0E<br>0x0F | Object index | UINT16 | Index of the written CVE object. |
| 0x10 | Object subindex | UINT08 | Always 0 |
| 0x11 | Data type | UINT08 | Data type of the written CVE object.<br>If an attempt has been made to write an object with an invalid data type, the correct data type is returned here. |

Tab. B.5 Response “Write CVE object”

**Confirmation (acknowledge)**

| Ack | Description | Remedy |
|---|---|---|
| 0x00 | Everything ok. | – |
| 0x01 | Service is not supported. | Check the service ID of the request. |
| 0x03 | User data length of the request is invalid. | Check the structure of the request. |
| 0xA0 | Range of values of another CVE object violated. | Writing the CVE object would cause the range of values of another CVE object to be violated. (The other object uses this CVE object as a minimum or maximum). |
| 0xA2 | Invalid object index. | Correct the object index. |
| 0xA4 | The CVE object cannot be read. | – |
| 0xA5 | The CVE object cannot be written. | – |
| 0xA6 | The CVE object cannot be written while the drive is in an “Operation enabled” status. | Quit the “Operation enabled” status. |
| 0xA7 | The CVE object must not be written without higher-order control. | Assign higher-order control to the CVE interface. Use CVE object #3 for this purpose. |
| 0xA9 | The CVE object cannot be written, as the value is lower than the minimum value. | Correct the value. |
| 0xAA | The CVE object cannot be written, as the value is greater than the maximum value. | Correct the value. |
| 0xAB | The CVE object cannot be written, as the value is not within the valid value set. | Correct the value. |
| 0xAC | The CVE object cannot be written, as the specified data type is incorrect. | Correct the data type. |
| 0xAD | The CVE object cannot be written, as it is password protected. | Remove password protection via FCT. |

Tab. B.6 Confirmation (acknowledge)

### B.1.3 Controlling the drive

The CMMO-ST has a finite state machine that executes the operating modes of the drive in accordance with the user's specifications. Fig. B.1 shows the possible states. These are described in detail in Tab. B.7. Tab. B.8 shows the possible transitions between the states.

The finite state machine is based on the CANopen standard CiA402.

**Control word**

The control word, as a bit field, is used to switch back and forth between the statuses (CVE object #2, ➔ Tab. B.9).

**Status word**

The status word, as a bit field, provides feedback about the current status (CVE object #1, ➔ Tab. B.10).

A drive function can only be started in the "Operation enabled" status.
The desired drive function must be selected via CVE object #120. Before starting a homing run the value 6 must be written into this CVE object; before starting a position record the value 1 must be written into this CVE object. The current or last executed drive function can be read via CVE object #121.

**Finite state machine**

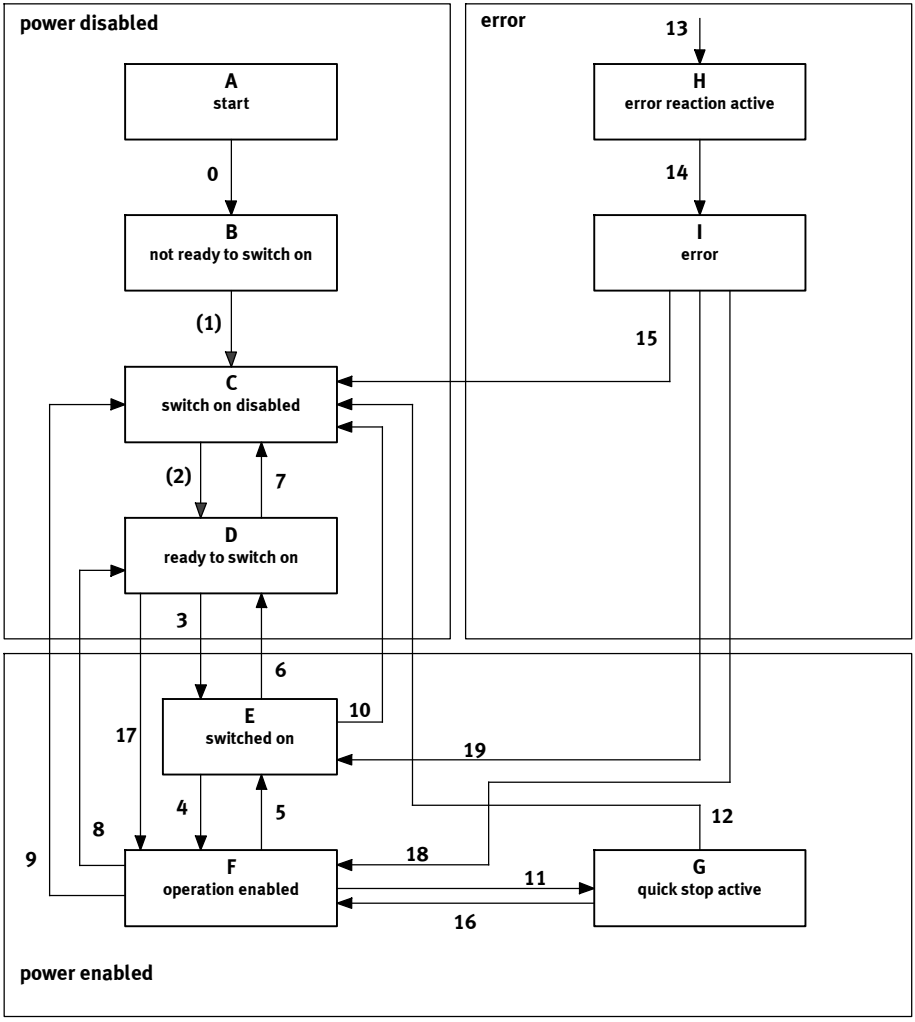



Fig. B.1 Finite state machine of the CMMO-ST

**Description of states**

| Status | | Description | Brake |
|---|---|---|---|
| A | Start | This state is assumed at power-on, on reset or when a reset command is entered (e.g. via the fieldbus). After executing the startup code the machine automatically reverts to status B. | Closed |
| B | Not ready to switch on | In this status CMMO-ST self tests are carried out. The output stage remains switched off. | Closed |
| C | Switch on disabled | The output stage remains switched off. From this status, changes of state are only possible via the control word or if a serious error has occurred. | Closed |
| D | Ready to switch on | The output stage is switched on.<br>When switching to the “Switched On” status a commutation angle search is executed (if required). | Open |
| E | Switched on | The output stage is active. | Open |
| F | Operation enabled | The drive waits for positioning tasks and executes them.<br>Normal operating status after successful initialisation. | Open |
| G | Quick Stop active | The Quick Stop function has been activated. The drive brakes with the parameterised Quick Stop deceleration and then stops. The output stage remains switched on, acceptance of positioning tasks is refused. | Open |
| H | Error reaction active | This status can be assumed from any situation if an error response has been triggered. This is executed. The output stage remains switched on. | Open |
| I | Error | Error status. No more positioning movements are executed. The output stage is either active or inactive depending on the parameterisation of the error. | Open if the output stage is active |

Tab. B.7 Description of states

**Description of transitions**

| Condition for status transition | | Description |
|---|---|---|
| 0 | Start ➔<br>Not ready to switch on | This status transition always takes place unconditionally after a (re)start. |
| 1 | Not ready to switch on ➔<br>Switch on disabled | The self test of the logic supply has been completed successfully. Automatic change of state to Switch on disabled. |
| 2 | Switch on disabled ➔<br>Ready to switch on | CW.**FR** (Error Reset) = 0<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 0 |
| 3 | Ready to switch on ➔<br>Switched on | CW.**FR** (Error Reset) = 0<br>CW.**EO** (Enable Operation) = 0<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |
| 4 | Switched on ➔<br>Operation enabled | CW.**FR** (Error Reset) = 0<br>CW.**EO** (Enable Operation) = 1<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |
| 5 | Operation enabled ➔<br>Switched on | CW.**FR** (Error Reset) = 0<br>CW.**EO** (Enable Operation) = 0<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |
| 6 | Switched on ➔<br>Ready to switch on | CW.**FR** (Error Reset) = 0<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW. **SO** (Switch on) = 0 |
| 7 | Ready to switch on ➔<br>Switch on disabled | CW.**FR** (Error Reset) = 0<br>CW.**EV** (Enable Voltage) = 0<br>or:<br>CW.**FR** (Error Reset) = 0<br>CW.**QS** (Quick Stop) = 0<br>CW.**EV** (Enable Voltage) = 1 |
| 8 | Operation enabled ➔<br>Ready to switch on | CW.**FR** (Error Reset) = 0<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 0 |
| 9 | Operation enabled ➔<br>Switch on disabled | CW.**FR** (Error Reset) = 0<br>CW.**EV** (Enable Voltage) = 0 |

| Condition for status transition | | Description |
|---|---|---|
| 10 | Switched on ➔<br>Switch on disabled | CW.**FR** (Error Reset) = 0<br>CW.**EV** (Enable Voltage) = 0<br>or:<br>CW.**FR** (Error Reset) = 0<br>CW.**QS** (Quick Stop) = 0<br>CW.**EV** (Enable Voltage) = 1 |
| 11 | Operation enabled ➔<br>Quick Stop active | CW.**FR** (Error Reset) = 0<br>CW.**QS** (Quick Stop) = 0<br>CW.**EV** (Enable Voltage) = 1 |
| 12 | Quick Stop active ➔<br>Switch on disabled | CW.**FR** (Error Reset) = 0<br>CW.**EV** (Enable Voltage) = 0 |
| 13 | From anywhere to:<br>Error reaction active | Release of an error response by the error management system. The status transition is independent of the control signals currently being sent. |
| 14 | Error reaction active ➔<br>Error | Execution of the error response is complete. Automatic change of state to Error. |
| 15 | Error ➔<br>Switch on disabled | The cause of the error must be eliminated (e.g. overheating, temperature reduced to permissible level).<br>Positive edge for **FR** (Error Reset).<br>CW.**PSOn** (output stage on after Error Reset) = 0<br>At least one of the following bits is **not** set to 1:<br>CW.**EO** (Enable Operation)<br>CW.**QS** (Quick Stop)<br>CW.**EV** (Enable Voltage)<br>CW.**SO** (Switch on) |
| 16 | Quick Stop active ➔<br>Operation enabled | CW.**FR** (Error Reset) = 0<br>CW.**EO** (Enable Operation) = 1<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |
| 17 | Ready to switch on ➔<br>Operation enabled | CW.**FR** (Error Reset) = 0<br>CW.**EO** (Enable Operation) = 1<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |

| Condition for status transition | | Description |
|---|---|---|
| 18 | Error ➔<br>Operation enabled | The cause of the fault must be eliminated<br>(e.g. over-temperature reduced to permissible value).<br>Positive edge for CW.**FR** (Error Reset)<br>CW.**PSOn** (output stage on after Error reset) = 1<br>CW.**EO** (Enable Operation) = 1<br>CW.**QS** (Quick Stop) = 1<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |
| 19 | Error ➔<br>Switched on | The cause of the fault must be eliminated<br>(e.g. over-temperature reduced to permissible value).<br>Positive edge for **FR** (Error Reset)<br>CW.**PSOn** (output stage on after Error Reset) = 1<br>CW.**EO** (Enable Operation) = 0<br>CW.**EV** (Enable Voltage) = 1<br>CW.**SO** (Switch on) = 1 |

Tab. B.8 Description of transitions

**Control word (CVE object #2)**

| Bit | Abbreviation | Description |
|---|---|---|
| 0 | CW.SO | Switch on |
| 1 | CW.EV | Enable voltage |
| 2 | CW.QS | Quick stop |
| 3 | CW.EO | Enable operation |
| 4 | CW.ST | Start |
| 5 | Must always be 0. | |
| 6 | CW.PSOn | Power stage on after reset<br>(Output stage on after error reset) |
| 7 | CW.FR | Error reset |
| 8 | CW.STP | STOP |
| 9 ... 31 | Must always be 0. | |

Tab. B.9 Control word

**Status word (CVE object #1)**

<table>
<tr><th>Bit</th><th>Abbreviation</th><th>Description</th><th colspan="2"></th></tr>
<tr><td>0</td><td>SW.RTSO</td><td>Ready to switch on<br>The output stage can be switched on via CW.SO.</td><td colspan="2">Bits 0 ... 3, 5 and 6 display the status of the device (x ... irrelevant for this status)</td></tr>
<tr><td>1</td><td>SW.SO</td><td>Switched on. The output stage is switched on.</td><td>Value (binary)</td><td>Status</td></tr>
<tr><td>2</td><td>SW.OE</td><td>Operation enabled. The drive is ready for operation.</td><td>xxxx xxxx x0xx 0000<br>xxxx xxxx x1xx 0000<br>xxxx xxxx x01x 0001<br>xxxx xxxx x01x 0011<br>xxxx xxxx x01x 0111<br>xxxx xxxx x00x 0111<br>xxxx xxxx x0xx 1111<br>xxxx xxxx x0xx 1000</td><td>Not ready to switch on<br>Switch on disabled<br>Ready to switch on<br>Switched on<br>Operation enabled<br>Quick Stop active<br>Fault reaction active<br>Fault</td></tr>
<tr><td>3</td><td>SW.F</td><td>Error. At least one error is active.</td><td colspan="2"></td></tr>
<tr><td>5</td><td>SW.QS</td><td>/Quick Stop. If this bit is inactive, a quick stop is executed.</td><td colspan="2"></td></tr>
<tr><td>6</td><td>SW.SOD</td><td>Switch on disabled. The output stage cannot be switched on.</td><td colspan="2"></td></tr>
<tr><td>7</td><td>SW.W</td><td colspan="3">Warning. At least one warning is active.</td></tr>
<tr><td>8</td><td>SW.MOV</td><td colspan="3">Move. The drive moves.</td></tr>
<tr><td>10</td><td>SW.TR</td><td colspan="3">Target reached/Motion complete. The target of a positioning motion has been reached (e.g. target position of a position record reached).</td></tr>
<tr><td>12</td><td>SW.SACK</td><td colspan="3">Setpoint Acknowledge. A start has been accepted. This bit is active when CW.ST = 1, provided that the drive function can be executed. It is inactive again when CW.ST = 0 or when SW.TR = 1.</td></tr>
<tr><td>15</td><td>SW.AR</td><td colspan="3">Referenced. The drive is referenced.</td></tr>
<tr><td>30</td><td>SW.DPB</td><td colspan="3">Direction positive blocked. The drive cannot be moved in a positive direction.</td></tr>
<tr><td>31</td><td>SW.DNB</td><td colspan="3">Direction negative blocked. The drive cannot be moved in a negative direction.</td></tr>
</table>

Tab. B.10 Status word

**Example: activation of “Operation enabled”**

Assumption: the drive has been switched on. An error is not present; the output stage is enabled via the STO input (i.e. CVE object #358 exhibits value 255). Nothing is connected to the I/O interface of the CMMO-ST. The “Switch on disabled” status is active; the status word exhibits the value 0x00800440.

1. Activate the higher-order controller for the CVE connection by writing the value 2 into CVE object #3.
2. Activate the “Ready to switch on” status by writing the control word 0x00000006. When this status has been reached, the status word exhibits the value 0x00000421.
3. Activate the “Switched on” status by writing the control word 0x00000007. As soon as this status has been reached, the status word has the value 0x00040423.
4. Activate the “Operation enabled” status by writing the control word 0x0000000F. As soon as this status has been reached, the status word has the value 0x00060427.

**Example: starting homing**

Assumption: the “Operation enabled” status is active. Homing has been parameterised correctly via FCT.

1. Select the “homing” drive function by writing the value 6 into CVE object #120.
2. Start the homing run by writing the control word 0x0000001F. At the end of the homing run the status word exhibits the value 0x00068427.
3. Reset the start signal by writing the control word 0x0000000F.

**Example: start of a record**

Assumption: the “Operation enabled” status is active. The drive is referenced (i.e. SW.AR = 1).

1. Select the “position record” drive function by writing the value 1 into CVE object #120.
2. Select the desired record by writing the record number into CVE object #31.
3. Start the record by writing the control word 0x0000001F. While the positioning record is being executed the status word exhibits the value 0x00048127. When the record has ended the status word exhibits the value 0x00068427.
4. Reset the start signal by writing the control word 0x0000000F.

## B.2 Explanation of increments

**Encoder increments**
The CMMO operates in the field of drive control (e.g. in a path generator) with encoder increments (EINC).

**Interface increments**
In contrast, so-called interface increments (SINC) are used at all user interfaces and in the field of internal data management. This enables rounding errors to be avoided when reading and writing values.

**Conversion factors**
The relationship between interface increments (SINC) and encoder increments (EINC) is established via the following conversion factors:
– Transmission ratio of the gear unit
– Feed constant

**Size of a SINC**
Interface increments are at first dimensionless, i.e, they have no defined unit or size. The unit, i.e. the size of an SINC, is specified in objects #218 “Unit of measurement” and #217 “Power of ten”:

During parameterisation in FCT you can use commonly used units for length specifications, such as millimetres or inches. You do not need any interface increments here.

Parameterise the drive completely in FCT and then read objects #218 “Unit of measurement” and #217 “Power of ten”.

EXAMPLE:
#218 = 1, i.e. Metre
#217 = –6, i.e. $10^{-6}$
➔ 1 mm = 1000 SINC

## B.3 List of CVE objects

| # | Name | Group |
|---|---|---|
| 1 | Status word | Finite state machine |
| 2 | Control word | Finite state machine |
| 3 | Higher-order control | System |
| 4 | Lock higher-order control | System |
| 31 | Record number preselection | Record |
| 57 | Actual speed | System |
| 58 | Actual current | System |
| 59 | Actual force | System |
| 60 | Setpoint position | System |
| 61 | Setpoint speed | System |
| 62 | Nominal current | System |
| 63 | Setpoint force | System |
| 70 | Actual acceleration | System |
| 72 | Nominal acceleration | System |
| 96 | Position deviation (contouring error) | System |
| 97 | Deviation velocity | System |
| 98 | Current deviation | System |
| 99 | Force deviation | System |
| 120 | Nominal operating mode | Finite state machine |
| 121 | Actual operating mode | Finite state machine |
| 141 | Current record number | Record |
| 191 | Error with top priority | Error handler |
| 194 | Error with top priority acknowledgement ability | Error handler |
| 213 | Warning with top priority | Error handler |
| 217 | Power of ten conversion factor | Drive functions |
| 218 | Unit of measurement conversion factor | Drive functions |
| 295 | Current target position | Drive functions |
| 358 | Hardware enable | System |

**Explanation of read and write access**

| Code | Meaning |
|---|---|
| R | The object is readable. |
| W1 | The object is writeable if the controller is in the “Control disabled” status (➔ description of the finite state machine). |
| W2 | The object is writeable if the controller is in the “Control enabled” status (➔ description of the finite state machine). |
| W3 | The object can also be written by an interface that does not currently have higher-order control. |
| Admin | The object is protected by the administrator password. |

Tab. B.11 Access rights

**Detailed descriptions of objects**

| #1 | Status word | | |
|---|---|---|---|
| Finite state machine | | UINT32 | R/-/-/-/- |
| ➔ separate description in section B.1.3<br>Values: 0 ... 4294967295 Default: 0 | | | |

| #2 | Control word | | |
|---|---|---|---|
| Finite state machine | | UINT32 | R/W1/W2/-/- |
| ➔ separate description in section B.1.3<br>Values: 0 ... 4294967295 Default: 0 | | | |

| #3 | Higher-order control | | |
|---|---|---|---|
| System | | UINT08 | R/W1/W2/W3/- |
| The master control specifies which interface may control the drive:<br>0x00 ➔ I/O<br>0x01 ➔ FCT (Festo Configuration Tool)<br>0x02 ➔ CVE (Control via Ethernet)<br>0x03 ➔ Web server<br>The master control may be changed by an interface that does not have this only if it is not blocked via object #4 Block master control.<br>Values: 0 ... 255 | | | |

| #4 | Lock higher-order control | | |
|---|---|---|---|
| System | | UINT08 | R/W1/W2/-/- |
| 0x00 ➔ The master control is not blocked. The higher-order controller can be changed by all interfaces.<br>0x01 ➔ The master control is blocked. Before the higher-order controller can be changed again, this block has to be removed again. Only the interface that has the higher-order controller at the time can do this.<br>Values: 0 ... 1 Default: 0 | | | |

| #31 | Record number preselection | | |
|---|---|---|---|
| Record | | UINT08 | R/W1/W2/-/- |
| Number of the preselected positioning record. At the controller interface, a new positioning record can already be preselected while an old one is still active. Note: The active positioning record is in object #141<br>Record 1 ... xx ➔ normal records<br>Values: 1 ... 31 | | | |

| #57 | Actual speed | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current actual velocity<br>Unit: SINC/s<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #58 | Actual current | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current motor current<br>Unit: mA<br>Values: –2147483648 ... 2147483647 Default: 1 | | | |

| #59 | Actual force | | |
|---|---|---|---|
| System | | SINT16 | R/-/-/-/- |
| Current actual force in one-tenth of one percent of the maximum motor current (calculated from the measured current)<br>Unit: ‰<br>Values: –32768 ... 32767 Default: 0 | | | |

| #60 | Setpoint position | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current Target Pos.<br>Unit: SINC<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #61 | Setpoint speed | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current nominal speed<br>Unit: SINC/s<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #62 | Nominal current | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current nominal current<br>Unit: mA<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #63 | Setpoint force | | |
|---|---|---|---|
| System | | SINT16 | R/-/-/-/- |
| Current nominal force in one-tenth of one percent of the maximum motor current<br>(calculated from the nominal current)<br>Unit: ‰<br>Values: –32768 ... 32767 | | | |

| #70 | Actual acceleration | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current, calculated actual acceleration<br>Unit: SINC/s²<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #72 | Nominal acceleration | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current nominal acceleration<br>Unit: SINC/s²<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #96 | Position deviation | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current following error = actual position – setpoint position<br>Unit: SINC<br>Values: –2147483648 ... 2147483647 | | | |

| #97 | Deviation velocity | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current deviation of the speed controller (comparable to following error with position) = actual speed – setpoint speed<br>Unit: SINC/s<br>Values: –2147483648 ... 2147483647 | | | |

| #98 | Current deviation | | |
|---|---|---|---|
| System | | SINT32 | R/-/-/-/- |
| Current deviation of the current controller (comparable to following error with position) = actual current – target current<br>Unit: mA<br>Values: –2147483648 ... 2147483647 | | | |

| #99 | Force deviation | | |
|---|---|---|---|
| System | | SINT16 | R/-/-/-/- |
| Current deviation of the current controller converted into force (comparable to following error with position) = actual force – target force<br>Unit: per mill of maximum motor current<br>Unit: ‰<br>Values: –32768 ... 32767 | | | |

| #120 | Nominal operating mode | | |
|---|---|---|---|
| Finite state machine | | SINT08 | R/W1/W2/-/- |
| Permissible values are:<br>0: No operating mode selected<br>1: Positioning mode<br>3: Speed mode<br>4: Force mode/torque mode<br>6: Homing mode<br>–3: Jog positive<br>–4: Jog negative<br>Values: 0, 1, 3, 4, 6, –3, –4 Default: 0 | | | |

| #121 | Actual operating mode | | |
|---|---|---|---|
| Finite state machine | | SINT08 | R/-/-/-/- |
| Operating mode that is currently being executed.<br>Values: ➔ object #120<br>Values: –128 ... 127 Default: 0 | | | |

| #141 | Current record number | | |
|---|---|---|---|
| Record | | UINT08 | R/-/-/-/- |
| Number of the record that is currently being executed or that was executed last. Refer to object #31.<br>Values: 0 ... 255 Default: 0 | | | |

| #191 | Error with top priority | | |
|---|---|---|---|
| Error handler | | UINT16 | R/-/-/-/- |
| Specifies the malfunction number of the error that currently has top priority.<br>0xFFFF means that no error is present.<br>Values: 0 ... 65535 Default: 65535 | | | |

| #194 | Error with top priority acknowledgement ability | | |
|---|---|---|---|
| Error handler | | UINT08 | R/-/-/-/- |
| Specifies whether the currently top priority error is erasable.<br>0x00 – The error cannot be acknowledged.<br>0x01 – The malfunction is still active; the error can be deleted only after the malfunction is eliminated.<br>0x02 – The error can be eliminated immediately.<br>0xFF – There is not error.<br>Values: 0 ... 255 | | | |

| #213 | Warning with top priority | | |
|---|---|---|---|
| Error handler | | UINT16 | R/-/-/-/- |
| Specifies the malfunction error of the warning that currently has the highest priority.<br>0xFFFF means that no warning is present.<br>Values: 0 ... 65535 Default: 65535 | | | |

| #217 | Power of ten conversion factor | | |
|---|---|---|---|
| Drive functions | | SINT08 | R/W1/-/-/- |
| ➔ Example in section B.2<br>Unit: $10^x$<br>Values: < 0 Default: 0 | | | |

| #218 | Unit of measurement conversion factor | | |
|---|---|---|---|
| Drive functions | | UINT08 | R/W1/-/-/- |
| ➔ Example in section B.2<br>0: Undefined<br>1: Metre<br>2: Inch<br>3: Revolutions<br>4: Degree<br>Values: 0 ... 4 Default: 0 | | | |

| #295 | Current target position | | |
|---|---|---|---|
| Drive functions | | SINT32 | R/-/-/-/- |
| Target position of the currently executed drive function.<br>The target position is calculated according to the definition as follows:<br>– Position record: absolute target position<br>– Reference travel with movement to zero: target position = 0<br>– Reference travel without movement to zero: target position = (–1) * axis zero point<br>– Jog positive: positive software end position, if this is activated, otherwise $2^{31}-1$<br>– Jog negative: negative software end position, if this is activated, otherwise $-2^{31}$<br>– Speed & force record: Absolute position specified through the stroke limit (braking begins at the stroke limit); if this is deactivated, comparable to jogging.<br>For record linking, the target position of the current positioning record is always relevant.<br>Unit: SINC<br>Values: –2147483648 ... 2147483647 Default: 0 | | | |

| #358 | Unit of measurement conversion factor | | |
|---|---|---|---|
| System | | UINT08 | R/-/-/-/- |
| Bit field for the Enable status (e.g. STO)<br>Bit 0: STO<br>Bits 1 ... 7: reserved<br>Only if all bits are 1 can the finite state machine be switched to the status “Operation enabled” through the control word.<br>Unit: Bit field<br>Values: 0 ... 255 Default: 254 | | | |

# C Glossary

| Term/abbreviation | Description |
|---|---|
| Acknowledge | “Acknowledge START”: confirm, feedback.<br>“Acknowledge an error”: the user confirms that he has noted the error. The device then exits the error status (errors can only be acknowledged for the CMMO-ST if the cause has been eliminated beforehand). |
| Auto MDI(X) | In the network cable between the CMMO-ST and your computer, the individual wires between the two RJ-45 plugs can be connected in a straight or cross-over configuration. This is detected automatically. MDI = Medium Dependent Interface. |
| AZ (= Axis Zero point) | Axis zero point ➔ section 2.6 |
| EMC | Electromagnetic compatibility |
| FCT | Parameterisation and commissioning software<br>(FCT = Festo Configuration Tool) |
| Following error | The deviation between the setpoint position (in accordance with the pre-calculated course of the path) and the actual position is calculated during the execution of a positioning record. This deviation is designated a following error. The following error can only be detected in closed-loop operation, i.e. when positional feedback is provided by an encoder (closed-loop). |
| Homing | Overview of measuring reference system ➔ section 2.6 |
| Homing Switch | Proximity sensor used for defining the reference point. |
| I/O | Input/output |
| Inputs and outputs: Statuses | Observe the difference between the electrical-physical and the logical status of an input or output.<br>Inputs:<br>– When the circuit is closed an electrical-physical 1-signal is present at the affected input. The input is “set”, the status is “HIGH”.<br>– When the input is set in an electrical-physical manner (1-signal), all inputs are also set as logical by default (1-signal).<br>An exception to this rule includes “inverted” inputs, such as the PAUSE input (STOP/HALT). This must be set in a electrical-physical manner so that the PAUSE function is inactive. The input is then logically 0, i.e. NOT logically set.<br>This is similar for the outputs. Outputs which are typically inverted include the error output or “Pause” output (Stopped). |
| Jog mode | Overview of drive functions ➔ section 2.4.1 |
| Load voltage, Logic voltage | The load voltage supplies the power electronics of the motor controller and thereby the motor. The logic voltage supplies the evaluation and control logic of the motor controller. |

| Term/abbreviation | Description |
|---|---|
| Logic 0 | ➔ “Inputs and outputs: statuses” |
| Logic 1 | ➔ “Inputs and outputs: statuses” |
| MC | Motion complete, i.e. Destination reached |
| Movement to zero | Moves from the reference point to the axis zero point ➔ section 2.7.6 |
| PLC/IPC | Programmable logic controller/industrial PC |
| PZ<br>(= Project Zero point) | Project zero point ➔ section 2.6 |
| Record | Record of parameters defined in the record table, consisting of target position, speed, acceleration, etc. (dependent on the operating mode). |
| REF<br>(= REFerence point) | Reference point ➔ section 2.6 |
| Software limit | Overview of measuring reference system ➔ section 2.6 |
| Teach mode | Overview of drive functions ➔ section 2.4.2 |

Tab. C.1 Product-specific terms and abbreviations

Copyright:
Festo AG & Co. KG
Postfach
D-73726 Esslingen

Phone:
+49 711 347-0

Fax:
+49 711 347-2144

e-mail:
service_international@festo.com

Internet:
www.festo.com

Original: de
Version: 1301a