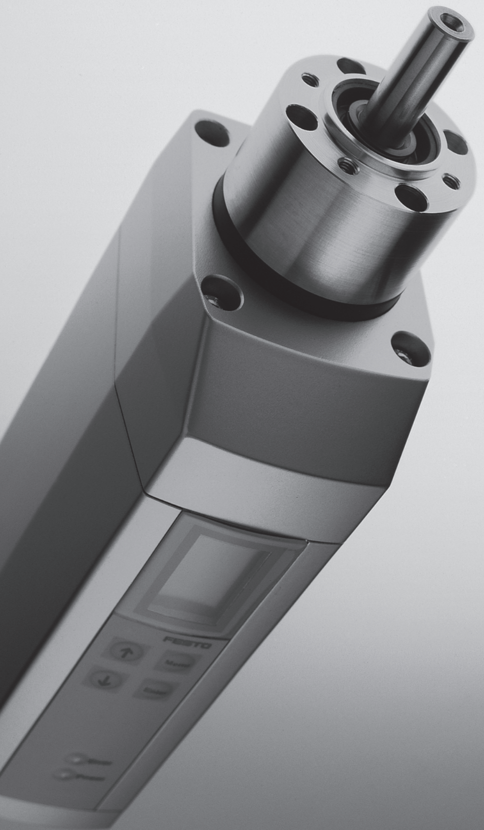
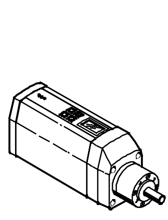
Motor unit
MTR-DCI



Description

MTR-DCI-...-CO



Description
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Designated use

The MTR-DCI motor unit is an intelligent servo motor consisting of DC motor, planetary gear, encoder and integrated control electronics (positioning control and position regulator).

The MTR-DCI is optimized for use with Festo axes (e. g. DMES-... or DNCE-...).

This manual deals with the basic functions of the MTR-DCI and control via the CANopen field bus.

The fieldbus interface supports the Festo Fieldbus Handling and Positioning Profile (FHPP), and permits as an alternative the use of CIA-defined profile CiA 402.

The MTR-DCI and the connectable modules and cables may only be used as follows:

- as designated
- in industrial applications
- in faultless technical condition
- in orignial condition without modification (only the conversions or modifications described in the documentation supplied with the product are permitted).

- Follow the safety instructions and use all the components and modules as described in the documentation.
- Please comply with national and local safety laws and regulations.
- Note the maximum limits of all additional components (e. g. sensors, actuators).

Safety instructions

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

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

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

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

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

Only enable the controller if the axis system has been installed and parametrized by technically qualified staff.

Target group

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

Service

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

service_international@festo.com

Scope of delivery

The following items are supplied with motor unit type MTR-DCI:

- Motor unit with integrated controller, optionally with control panel
- Operating package on CD ROM:
  - User documentation (descriptions)
  - Festo Configuration Tool with MTR-DCI plug-in
- User documentation (descriptions)

Available as accessories (see Appendix A.2):

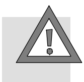
- Connecting cable and fieldbus plug
- Programming cable
- User documentation in paper form

Important user instructions

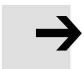
Danger categories

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

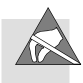
Warning
... means that failure to observe this instruction may result in serious personal injury or damage to property.



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



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



Electrostatically sensitive devices: Incorrect handling can result in damage to components.

Identifying special information

The following pictograms mark passages in the text which contain special information.

Pictograms

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

Accessories:
Information on necessary or useful accessories

Environment:
Information on the environment-friendly use of the products

Text designations

- The bullet indicates activities which may be carried out in any order.

1. Figures denote activities which must be carried out in the numerical order specified.

– Hyphens indicate general activities.

Manuals on motor unit type MTR-DCI

This description contains information on the method of operation, as well as on mounting, installation and commissioning of electric valve actuators with motor unit type MTR-DCI-...-CO (CANopen interface).

Information on components, e. g. reference switches, can be found in the operating instructions for the relevant product.

Type	Designation	Content
Operating package with brief description + descriptions (+ commissioning software) on CD ROM	P.BP-MTR-DCI	Brief description: Important instructions on commissioning and preliminary information. Descriptions on CD ROM: Contents as described below
Description	**Motor unit MTR-DCI with CANopen interface** P.BE-MTR-DCI-CO-...	Installation, commissioning and diagnosis of electric axes with motor unit MTR-DCI; communication via CANopen interface.
Help system for software	Festo Configuration Tool help (contained in FCT software)	Function description of the Festo Configuration Tool (FCT) configuration software.
Operating instructions	**Axes** e. g. DMES-... / DNCE-...	Installing and commissioning the axes
Further descriptions	**Motor unit MTR-DCI with other communication interfaces e.g.** P.BE-MTR-DCI-IO-... P.BE-MTR-DCI-PB-...	Installing, commissioning and diagnosing electric axes with motor unit MTR-DCI; communication via I/O interface or via the relevant field bus.

Tab. 0/1: Documentation on the MTR-DCI

Information on the version

The hardware version specifies the version status of the mechanical parts and electronics of the MTR-DCI. The firmware version specifies the version status of the operating system of the MTR-DCI.

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

– Hardware version and firmware version in the Festo Configuration Tool with active device connection to the MTR-DCI under "Device data."

– Firmware version on the control panel under [Diagnostic] [Software information]

Firmware version	What is new ?	Which FCT-PlugIn ?
V1.00	Supports the listed sizes of the MTR-DCI-CO in combination with the following axes from Festo: **Motor unitAxes** MTR-DCI-32... DMES-18; DNCE-32 MTR-DCI-42... DMES-25; DNCE-32/40 MTR-DCI-52... DMES-40; DNCE-40/63 MTR-DCI-62... DMES-63; DNCE-63	MTR-DCI-CO V2.0.0

Tab. 0/2: Firmware versions

Product-specific terms and abbreviations

The following product-specific terms and abbreviations are used in this manual:

Term/Abbreviation	Meaning
0-signal	There is a 0 V signal present at the input or output (positive logic, corresponds to LOW)
1-signal	There is a 24 V signal present at the input or output (positive logic, corresponds to HIGH)
Axis	Mechanical component of a drive which converts the motor revolutions into positioning movements of a work load. An axis (e. g. positioning axis DMES-...) enables the attachment and guiding of the work load and the attachment of a reference switch.
Axis zero point (AZ)	Reference point for the software end positions and the project zero point PZ. The axis zero point AZ is defined by a preset distance (offset) from the reference point REF.
Controller	Contains power electronics + regulator + position control, evaluates sensor signals, calculates movements and forces and provides the power supply for the motor via the power electronics.
Drive	Complete actuator, consisting of controller, motor, measuring system and, if applicable, gear and (linear) axis.
EMC	Electromagnetic compatibility
Encoder	Optical pulse generator (rotor position transducer on the motor shaft of the MTR-DCI). The electric signals generated are sent to the controller, which then calculates the position and speed on the basis of the signals received.
Festo Configuration Tool (FCT)	Commissioning software with uniform project and data management for all supported device types. The special requirements of a device type are supported with the necessary descriptions and dialogues by means of PlugIns.
Festo Handling und Positioning Profile (FHPP)	Uniform field bus data profile for positioning controllers from Festo. Parameter values, control and status bytes required during operation can be written and read via the FHPP Object Directory.
Festo Parameter Channel (FPC)	FHPP-specific parameter access via PDO 2.

Term/Abbreviation	Meaning
FHPP standard	FHPP sequence control via PDO 1.
HMI	Human Machine Interface, with the MTR-DCI the control panel with LC display and 4 operating buttons.
Homing	Positioning procedure in which the reference point and therefore the source of the measuring reference system are defined.
Homing mode	Operating mode in which reference travel is carried out.
Homing (reference travel) method	Method for finding the reference point REF: via the reference switch within the possible positioning path or by overcurrent evaluation during movement to a stop.
I O I/O	Input Output Input and/or output
Jog mode	Manual positioning in positive or negative direction.
Load voltage, logic voltage	The load voltage supplies the power electronics of the controller and thereby the motor. The logic voltage supplies the evaluation and control logic of the controller.
Motor unit	Integrated unit consisting of the controller, motor, measuring system and, if applicable, gears (e. g. motor unit type MTR-DCI).
Operating mode	is used in the following correlations: – Type of access: Record Select, Direct mode – Internal logic status of the controller: Position Profile mode, Profile Torque mode, Homing mode, ...
PLC	Programmable logic controller; in brief: controller: PLC: progammable logic controller).
Positioning mode (profile position mode)	Operating mode for executing a position set or a direct positioning task with position control (closed loop position control)
Position set	Positioning command defined in the position set table, consisting of: – The number of the position set – The absolute or relative basis of the target position – Target position – Positioning speed
Power operation (profile torque mode)	Operating mode for executing a direct positioning task with power operation (open loop transmission control) with motor current regulation.

Term/Abbreviation	Meaning
Project zero point (PZ) (project zero point)	Reference point for all positions in positioning tasks. The project zero point PZ forms the basis for all absolute position specifications (e. g. in the position set table or with direct control via the controller or diagnostic interface). The project zero point PZ is defined by a preset distance (offset) from the axis zero point.
Reference point (REF)	The reference point defines a known position/orientation within the positioning path of the drive. It is the basic reference point for the measuring reference system.
Reference switch	External sensor which serves for ascertaining the reference position and is connected directly to the controller.
Referencing	Defining the measuring reference system of the axis
Software end position	Programmable stroke limitation (basis point = axis zero point) – Software end position, positive: max. limit position of the stroke in the positive direction; must not be exceeded during positioning. – Software end position, negative: min. limit position in the negative direction; must not be exceeded during positioning.
Teach mode (Teach mode)	Operating mode for setting positions by moving to the target position, e. g. when creating positioning sets.

Tab. 0/3: Index of terms and abbreviations

CANopen specific terms and abbreviations

Term/abbreviation	Meaning
0x1234 or 1234h	Hexadecimal numbers are marked by a prefixed “0x” or by a suffixed “h.”
BCD	Binary coded decimal
EDS	Electronic Data Sheet; contains the specific properties of the slave (e. g. number of I/Os, parameters, etc.).
LSB	Least significant bit (lower-value bit)
MSB	Most significant bit (higher-value bit)

Term/abbreviation	Meaning
Object Directory	The Object Directory contains all device parameters and current processing data which are directly accessible via SDO. The Object Directory is divided into a range which contains general specifications on the device (device identification, manufacturer name etc.) and communication parameters, as well as a range which describes the specific device functions. The identification of an entry ("Object") in the Object Directory is made via a 16-bit index and an 8-bit subindex.
PDO	Process data object PDOs are generally transmitted event-orientated, cyclically or on demand. A message can be received and evaluated simultaneously by all slaves. The assignment of a PDO takes place via a structure description ("PDO mapping") and can therefore be adapted to the relevant application requirements of a device. In a PDO the values of several objects can also be transmitted and the recipients of the PDOs can use only parts of the data depending on their PDO mapping entries.
SDO	Service data object SDOs are used mainly for transmitting acyclic data, e. g. for initializing during the boot procedure. With SDOs you can access all entries in the Object Directory. The relevant Object Directory entries can be addressed with the index and subindex of the entry. Within an SDO only one object can be accessed. A reply is always sent to an SDO: A pair of CAN telegrams per object are transmitted.
Terminating resistor	Resistor for minimizing signal reflections. Terminating resistors must be installed or switched in at the end of bus segment cables.

Tab. 0/4: Index of CANopen terms and abbreviations

System overview

Chapter 1

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1.1 Positioning with electric drives

1 Sequence control and parameter access by the higher-order controller/field bus master

2 Software level: Commissioning with the Festo Configuration Tool software

3 Drive level with

- Motor unit
- Coupling
- Coupling housing
- Axis

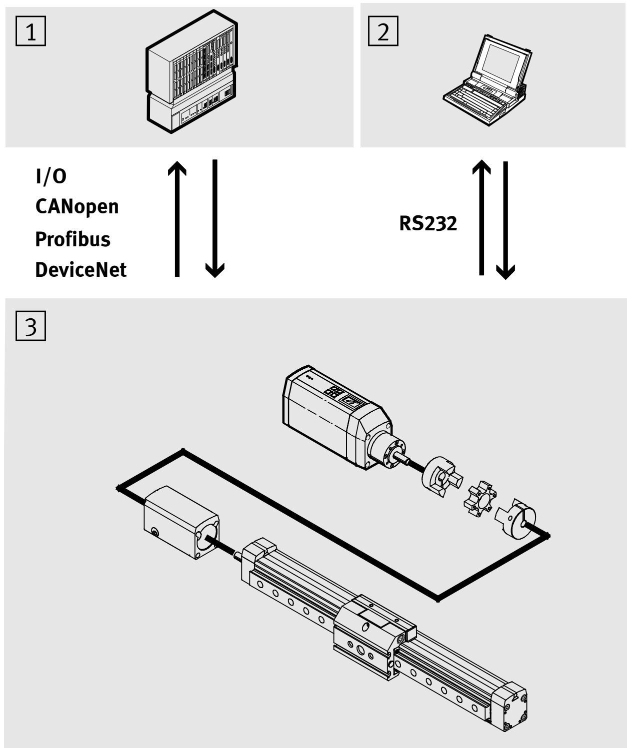


Fig. 1/1: Principle of a positioning system with the MTR-DCI

The motor unit type MTR-DCI-...-CO with CANopen fieldbus interface permits positioning of the connected linear or rotation axis:

- corresponding to the device profile “CiA 402” from the user organisation CIA.
- as per the “Festo Handling and Positioning Profile:”

You can parametrize and commission the MTR-DCI as follows:

- with the FCT software package via the RS232 interface of your PC
- with the optional control panel with display and 4 operating buttons (only MTR-DCI-...-H2)
- via the field bus.

Functions		**HMI**	**FCT**	**Field bus**
Parametrizing	– Selecting the axis type and the axis parameters – Specifying a gear factor (with external gears) – Uploading/downloading configuration data – Saving different configurations in projects	x – – –	x x x x	x x x –
Position records	– Compiling a position set table with set number, target position, positioning mode, positioning speed, acceleration	x	x	x
Commissioning	– Reference run (homing) – Jog mode – Teaching positions – Moving in individual steps – Starting and stopping positioning procedures while commissioning – Extended test functions e.g. status displays – Testing or demonstrating the position records	x x x – x (x) x	x x x x x x x	x x x x x x x
Diagnostics/ Service	– Reading and displaying diagnostic data	x	x	x

All parameters are entered or displayed in the relevant set measuring units.

Measuring units			**Control panel**	**FCT**	**Field bus**
Linear axis	Metric	Metric measuring units, e. g. mm, mm/s, mm/s^2	x	x	–
	Inches [1)]	Imperial measuring units, e. g. inch, inch/s, inch/s^2	–	x	–
	Increments	Increment-based measuring units, e. g. inc, inc/s, inc/s^2	–	–	x
Rotation axis	Degree	Angle dimension 360° = 1 revolution e. g. deg, deg/s, deg/s^2	x	x	–
	Revolutions [2)]	Number of revolutions e. g. rev, rev/min, rev/min^2	x	–	–
	Increments	Increment-based measuring units, e. g. inc, inc/s, inc/s^2	–	–	x

[1)] Only with FCT when setting up a project
[2)] Setting only with control panel [Settings] [Axis type] [Rotation axis]

Setting the units of measurement influences only the display. All parameters are saved internally in the controller in increments (inc, inc/s, inc/s^2 ...) and are not converted until they are written or read.
Dimensions transmitted by the RS232 or by the field bus refer to an increment basis (conversion see appendix A.4)

1.2 Field bus communication

1.2.1 Data exchange in CANopen

CANopen devices have an object directory which makes all important slave parameters accessible in a standardized manner. A CANopen system is essentially configured by accessing the objects in the object directory of the individual stations. The data exchange in CANopen is in the form of telegrams with which the work data is transmitted. A distinction is made between Service Data Objects (SDO), which are used for transmitting service data from and to the object directory, and between Process Data Objects (PDO), which serve for the fast transfer of current process states. In addition, telegrams are defined for the network management and the fault messages.

SDO

With SDOs you can access all entries in the Object Directory. The relevant Object Directory entries can be addressed with the index and subindex of the entry. SDOs are used mainly for transmitting acyclic data, e. g. for initializing during the boot procedure. Within an SDO only one object can be accessed. A reply is always sent to an SDO: A pair of CAN telegrams per object are transmitted.

PDO

PDOs are in principle a grouping of objects (variables or parameters) from the Object Directory. Maximum 8 bytes from different objects can be sent together in a PDO, i. e. the objects are mapped in the PDO. Process Data Objects can be transmitted event-controlled, synchronous to a system pulse sequence or on demand. PDOs are transmitted by simple CAN messages and are suitable for transmitting cyclic data.

1.2.2 Data profiles FHPP and CiA 402

Festo has developed an optimised data profile, the “Festo Handling and Positioning Profile (FHPP)” tailored to handling and positioning tasks.
For drives with a CANopen interface, the CANopen profile CiA 402 for control by the master can also be used as an alternative to the Festo profile. The CiA 402 profile is then also the internally implemented profile; the FHPP interface is mapped by an implementation of CiA 402. The communications profile is in both cases DS 301.

Data profile	Description
FHPP	**Controller** Control is efected via the cyclic 8-byte control and status data, see sections 5.5.2 and 5.5.3 **Parametrizing** Parametrizing is carried out: – via a further 8 I/O bytes (Festo Parameter Channel FPC) – optionally via releant SDO accesses. For detailed information on the implemented objects see appendix B.1.1.
CiA 402	**Controller** Control is effected as per device profile CiA 402 with the following deviations: – “Positioning profile” subprofile – Status transfer 19 and 20, see section C.2. – Quick Stop active, status transition 12, see section C.2. **Parameterisation** Parameterisation is effected via SDO accesses (CiA 402). For detailed information on the implemented objects see appendix C.1.

Tab. 1/1: Control and parametrizing methods depending on data profile

The FHPP enables uniform control and programming for the various field bus systems and controllers from Festo. Parameter values, control and status bytes required during operation can be written and read via the Object Directory and a structure description. Communication via the CANopen field bus is made via 8 bytes of I/O data.

The FHPP defines uniform operating modes and I/O data structures for the user.

- Parameter access as per FHPP FPC (PDO 2; optional: SDO)
- Sequence control as per FHPP Standard (PDO 1) with the operating modes Direct mode or Record Select.

Direct mode

Positioning tasks in positioning or power operation can be executed as direct mode. The positioning task is transferred directly in the I/O telegram (FHPP standard). The most important nominal values (position, velocity, force/torque...) are thereby transferred. Supplementary parameters are determined via the parametrizing (FHPP FPC).

Record Select

Positioning tasks in positioning mode can be executed with Record Select. The positioning data are set indirectly via positioning sets which are taught via FCT, the control panel or field bus and saved in the controller. 31 position sets can be saved in the MTR-DCI. A record contains all the parameters which are specified for a positioning task. The record number is transferred to the cyclic I/O data as the nominal or actual value (FHPP standard).

Detailed information on the FHPP can be found in chapter 5.5.

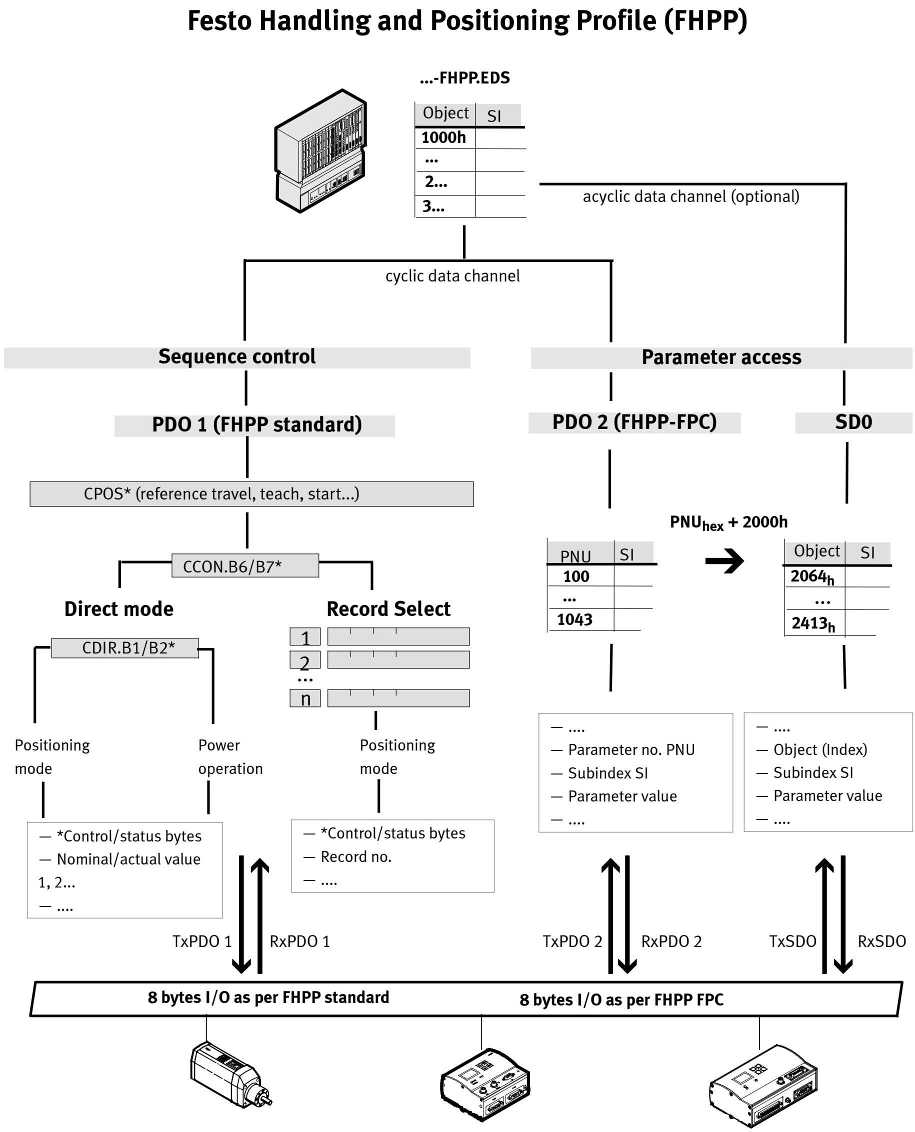


Fig. 1/2: Festo Handling und Positioning Profile (FHPP)

1.3 Components

For setting up an electric drive with the MTR-DCI you will require the following components:

Servo-motor unit MTR-DCI	Motor with controller, available in four sizes, optionally with control panel (type ...-H2). By means of different gear reductions, different requirements can be fulffilled in respect of (gear) drive torque) and (gear) drive speed (see appendix A.1). High drive output torques with low drive output speeds are characteristic for positioning functions. With the smaller gear reduction, the positioning speed of the axis can be increased with correspondingly reduced positioning force.
Axis	Linear or rotation axes as per catalogue
Coupling with coupling housing	In order to fit Festo axes, e.g. type DMES-... or type DNCE-..., couplings and coupling housings are available as accessories. The motor unit is connected to the axis by means of a clamping connector in the coupling housing. Additional motor flanges are not therefore necessary. Further information can be found in the operating instructions for the axis.
Power supply cable	Power supply to the MTR-DCI via a power supply unit. The electronics (logic voltage) can also be supplied with power separately from the load voltage (see section 3.3).
Programming cable	Parameterisation of the MTR-DCI during commissioning with the FCT
Field bus cable	Operating the MTR-DCI on a higher-order controller (PLC/IPC).
Reference switch	Sensor as per appendix A.2.
Accessories	For positioning systems Festo offers special matching accessories (see Festo delivery program or catalogue).

1.4 Control and regulating functions

The controller takes over the following tasks:

– Activation via FHPP or CiA 402,

– Specification of the nominal values

– Control of the following variables: position, speed, acceleration, current.

1 Motor controller

2 Regulator

3 Nominal value generator

4 Position controller

5 Speed regulator

6 Current regulator

7 Output stage

8 Signal converter

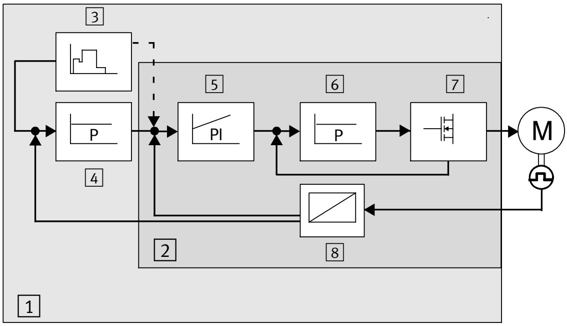


Fig. 1/3: Simplified diagram of the cascade regulator

Profile Position Mode

Positioning mode
Operating mode for processing a positioning record or a direct positioning task with position control (closed loop position control)
The target position defines the position to which the drive controller is to run. The target position is interpreted either as an absolute or relative specification. The set target position is transferred to the nominal value generator. This generates a nominal position value for the position controller. For position control, the current settings for speed, acceleration, braking deceleration, etc. are taken into account.

Changes in position are recognized by the internal incremental sensor (optical encoder). With a known starting point the actual position is calculated from the gear reduction and/or the spindle slope.

Profile Torque Mode

Power operation
Operating mode for executing a direct positioning task with power operation (open loop transmission control) with motor current regulation. This operating mode enables an external nominal torque value (relative to the rated motor current) to be specified to the controller. Power control takes place indirectly via the regulation of the motor current. All specifications on forces/torques refer to the rated motor torque or current.

Homing mode

Reference travel
Execution of a positioning procedure in which the reference point and therefore the source of the measuring reference system of the axis are defined, e.g. via a reference switch within the possible positioning path or with overcurrent evaluation n the case of movement to a stop.

For commissioning, for testing or for demonstration the following functions are also available via the control panel of the MTR-DCI-...H2:

– Positioning travel for defining the target position of a positioning record (Teach Mode), [Settings] [Position set]

– Positioning travel for testing all positioning records in the positioning record table, [Demo posit tab]

– Positioning travel for testing a certain positioning record in the positioning record table [Move posit set].

1.5 Operational safety

An extensive system of sensors and monitoring functions ensures operational safety:

– i^2t-monitoring

– Temperature monitoring (measuring the motor temperature and the power end stage temperature)

– Current monitoring

– Voltage monitoring

  – Recognizing faults in the internal voltage supply.

  – MTR-DCI-62...: Recognition of overvoltages in the intermediate circuit; brake chopper integrated.

– Drag error monitoring

– Software end position recognition

note the following:

- By the arrangement of the limit switches and, if necessary, additionally by means of mechanical stops, make sure that the axis always lies within the permitted positioning range.

- To detect a bus failure (wire break, master shutdown, ...) activate Node Guarding as necessary on the CANopen master; see section 6.5.1.

Warning
Check the measures which are necessary within the framework of your EMERGENCY STOP circuit 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).
  - Cancelling the ENABLE signal at the controller interface
  - Switch off the load voltage.

1.6 Measuring reference system

For commissioning, a measuring reference system for referencing the reference coordinates must be defined. By means of the measuring system all (absolute) positions are defined and movement can be made to them.

1.6.1 Reference points and positioning range

The measuring reference system is defined as follows:

1. Homing for defining the reference point
2. Setting the zero point (offset axis zero point and project zero point)
3. Limiting the positioning range (software end positions).

Reference point REF — binds the measuring reference system to a reference switch or a fixed stop, depending on the homing method. (see also section "Homing reference travel").

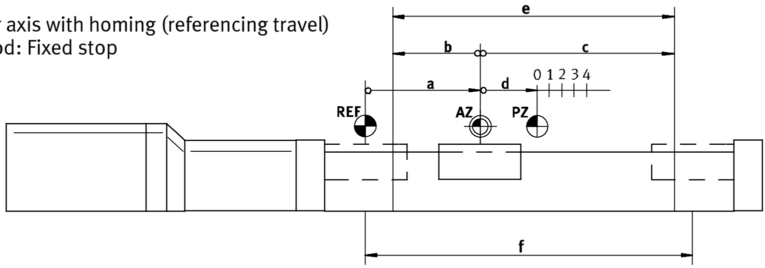
Axis zero point AZ — is shifted by a defined distance to the reference point REF (offset of the axis zero point).

Project zero point PZ — is a reference point within the effective stroke which the user can select, and to which both the actual position and the target positions in the position record table refer.
The project zero point is shifted by a defined distance to the axis zero point AZ (offset of the project zero point). The project zero point PZ can only be set via FCT or CAN/CI object $21F4_h$ / FHHP 500 (not on the control panel).

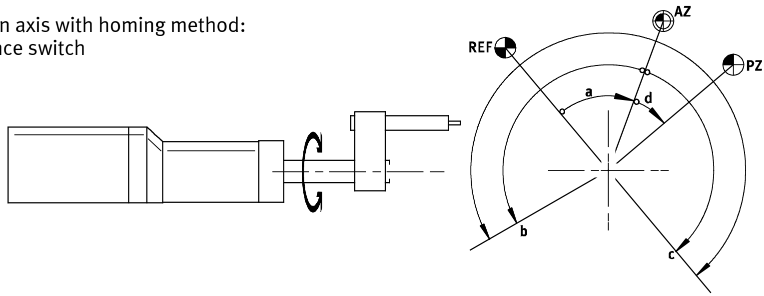
Software end positions — The permitted positioning range (work stroke) is limited by the settings of the software end positions. The software end positions refer to the axis zero point. If the target position of a positioning command lies outside the software end positions, the positioning command will not be processed and an error status will be set.

Measuring reference system

Linear axis with homing (referencing travel)
method: Fixed stop



Rotation axis with homing method:
Reference switch



REF AZ PZ	Reference point: Point ascertained during the reference run: reference switch or stop Axis zero point: reference point for the project zero point and the software end positions. Project zero point: Reference point for the actual position and absolute positions of the positioning table.
a b, c d	Offset axis zero point: Distance of axis zero point AZ from reference point REF Offset software end positions: limit the permitted positioning range (usable stroke). Offset project zero point: distance from AZ
e f	Effective stroke: Permitted positioning range Rated stroke of the axis used

Tab. 1/2: Measuring reference system

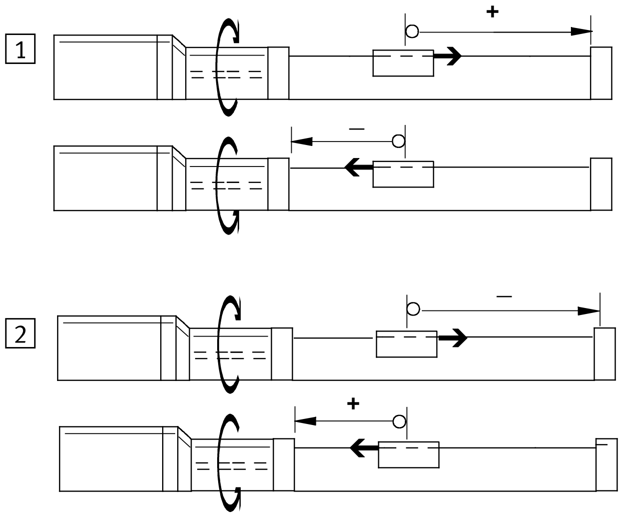
Reference point	Calculating specification		
Axis zero point	AZ	= REF + a	
Project zero point	PZ	= AZ + d	= (REF + a) + d
Lower software end position	LSE	= AZ + b	= (REF + a) + b
Upper software end position	USE	= AZ + c	= (REF + a) + c

Tab. 1/3: Calculating specifications for the measuring reference system with incremental measuring systems

1.6.2 Signs and directions

All offsets and position values are vectors (with sign). The +/- direction of the vectors can be assigned to the direction of rotation of the motor shaft (view towards the motor shaft). The factory setting is “+” for rotation in a clockwise direction; “-” for rotation in an anti-clockwise direction. The assignment can be reversed on the control panel (see chapter 4.5.2) or via the FCT. This can be advantageous if you are using angled or toothed belt drives. Afte reversal new homing (reference travel) is then required.

The direction in which the work load moves depends on the gear, the spindle type (left/right-hand turning), the sign for the position specifications (+/-) and the work direction set.



1 Factory setting of the work direction

2 Direction reversal by modifying the work direction

Fig. 1/4: Setting the work direction (example MTR-DCI + DMES, axial gear, right-hand turning spindle)

1.6.3 Reference run (homing)

In the case of drives with incremental measuring system, homing must always be carried out when the device is switched on. This is defined drive-specifically with the parameter "Homing (reference travel) required" (PNU 1014, CANopen/CI 23F6h).

The following homing modes are permitted:

- Search for stop in a negative direction
- Search for stop in a positive direction
- Search for reference switch in a positive direction
- Search for reference switch in a negative direction (default).

In order to search for the reference point and for positioning the drive in the axis zero point, you can set two different speeds.

Homing sequence:

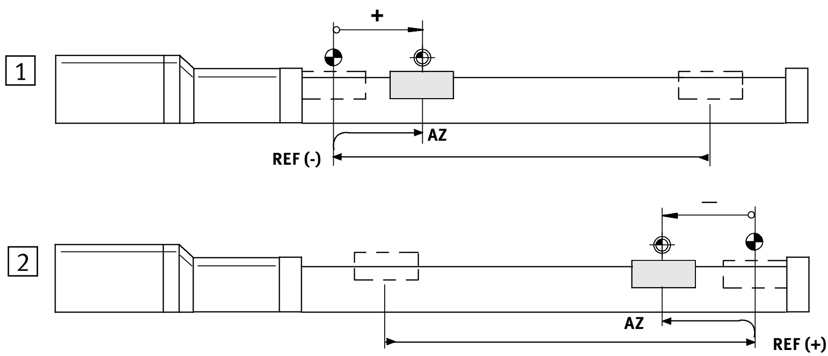
1. Search for the reference point in accordance with the configured method.
2. Move from reference point to axis zero point AZ (offset axis zero point)
3. Set at axis zero point:
   Current position = 0 – offset project zero point PZ.

After successful reference travel the drive stands at the axis zero point AZ. On initial commissioning or following a change of homing method the axis zero offset is = 0; after homing the drive is then positioned at the reference point (REF).

Search for fixed stop

With this reference travel method, the drive moves at first at search speed in a negative or positive direction until it reaches the fixed stop. A rise in the motor current signals that the stop has been reached. When the maximum motor current is reached at the same time as the motor is at a standstill, the MTR-DCI recognizes that the stop, and therefore the reference position, has been reached.

As the axis must not stand still at the stop, the offset axis zero point must ≠ 0 (min. 0.25 mm).



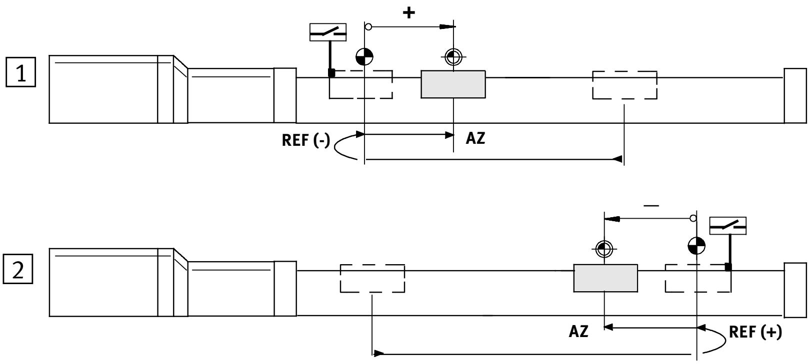
1 Stop in a negative direction

2 Stop in a positive direction

Fig. 1/5: Homing methods “Search for stop...”

Search for reference switch

In this reference travel method, the drive moves at first at search speed in a negative or positive direction until it reaches the limit switch. Then it moves back at creeping speed: The reference position lies at the point at which the reference switch becomes inactive again when the drive moves back.



1 Reference switch in negative direction

2 Reference switch in positive direction

Fig. 1/6: Homing methods "Search for switch..."

If the drive stands on the reference switch at the start of reference travel, it will move in the opposite direction to the reference switch. The drive then moves as usual to the axis zero point.

Mounting

Chapter 2

Contents

2. Mounting 2-1

2.1 General instructions 2-3
2.2 Dimensions of the motor unit 2-4
2.3 Fitting electric axes 2-5

2.1 General instructions

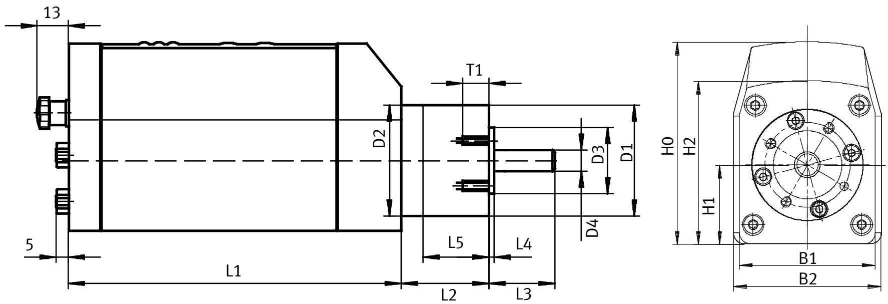
Warning
Danger of electric shock, short circuits or unexpected movements of the drive.

- Always switch off the power supply before carrying out fitting, installation and maintenance work.

Note
Handle all modules and components with great care. Note especially the following:

- Screw connections must be fitted free of offset and mechanical tension. Screws must be fitted accurately (otherwise threads will be damaged).
- The specified torques must be observed.
- The modules must not be offset.
- Contact surfaces must be clean (avoid contact faults).

2.2 Dimensions of the motor unit



Sizes [mm] Gear ratio			**32** G7/G14	**42** G7	 G14	**52** G7	 G14	**62** G7/G14/G22
Diameter of flange/shaft	D	D1 D2 D3 D4	— — 21.5 h8 6 h7	42 g10 42 ±0.1 25 h8 8 h7		52 g10 52 ±0.1 32 h8 12 h7		62 g10 62 ±0.1 40 j7 14 h7
Height	H	H0 H1 H2	65.3 ±0.4 21.6 ±0.15 41.5 ±0.3	70.8 ±0.4 26.5 ±0.6 54.5 ±0.4		94.8 ±0.4 37 ±0.9 76.5 ±0.4		128 ±0.5 60.8 ±0.35 128 ±0.5
Length	L	L1 L2 L3 L4	175.5±1 — 18.7 ±0.6 2.5 ±0.3	176 ±1 33.3 ±1 25 ±1 2 ±0.2	176 ±1 46.3 ±1 25 ±1 2 ±0.2	194 ±1 39 ±1 33 ±1 3 ±0.3	194 ±1 53 ±1 33 ±1 3 ±0.3	270 ±1 47 ±1 39 ±1 5 ±0.3
Width	B	B1 B2	33.8 ±0.3 46.3 ±0.4	44.8 ±0.4 53.3 ±0.4		63.8 ±0.4 69.5 ±0.4		105.1 ±0.4 105.1 ±0.4
Depth	T	T1	6	M3: 7 / M4: 10		10		10

Tab. 2/1: Dimensions of the motor unit

2.3 Fitting electric axes

When fitting electric axes refer to the documentation for the axes and accessory components used.

Warning
If an axis is fitted in a sloping or vertical position, the work load may fall down and injure somebody.

- Use the motor unit preferably with self-locking or self-braking spindle drives. You can then prevent the working load sliding down suddenly if there is a power failure.
- With DMES-...: Check whether additional external safety measures against spindle nut fracture are necessary (e. g. toothed latches or moving bolts).

Make sure that:

- the drive is fitted securely and is correctly aligned
- the work space, in which the axis and work load move, is of sufficient size for operation with a work load,
- the work load does not collide with any component of the drive when the slide moves into the end position.
- Make sure that you observe the maximum permitted values of the following variables: the basis point for forces and torques is the centre of the shaft (L3 see Tab. 2/1).

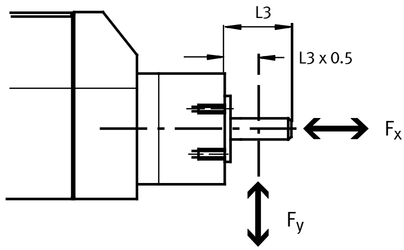


Fig. 2/1: Forces and torques

Forces and torques		**32**	**42**	**52**	**62**
MTR-DCI-...-G7 1-stage					
– Radial shaft load – Axial shaft load – Maximum permitted shaft output torque of the gear [1]	F_y [N] F_x [N] Mx [Nm]	40 10 0,4	160 50 0,8	200 60 2,0	240 50 4
MTR-DCI-...-G14/G22 2-stage					
– Radial shaft load – Axial shaft load – Maximum permitted shaft output torque of the gear [1]	F_y [N] F_x [N] M_x [Nm]	70 20 1,0	230 80 7,5	320 100 12,0	360 70 25 [2]
1) With operating factor cb=1.0 (3 hours operation daily, no shocks, direction of rotation constant). The gear output torque of the motor unit is usually much lower, see Technical specifications, Appendix A, Mechanical specifications. 2) MTR-DCI-62...-G22: in the start-up phase speed torque peaks up to 37 Nm are possible at 20 A peak current.					

Tab. 2/2: Permitted loading of the gear shaft

Note
Motor unit MTR-DCI-62-...-G22 can generate up to 37 Nm at a peak current of 20 A in the start-up phase.

- Make sure by calculating the dynamic loading that the maximum permitted shaft output torque of the gear is not exceeded in the start-up phase (e.g. by reducing the load).

Use the thread on the front of the gear (see Fig. 2/2) for fitting the MTR-DCI to a mechanical drive device (machine frame).

- In order to minimize the shaft offset: Position the axis with the aid of the centring diameter (D1 or D3 see Tab. 2/1) relative to the rotary axis of the mechanism to be driven.

- Fasten the motor unit with 4 screws and tighten the 4 screws with the specified tightening torque.

The motor unit MTR-DCI-32 has a total of 6 threads for different motor mounting variants (axial, parallel). In each case only 4 screws must be used.

Size	Thread depth		Tightening torque
MTR-DCI-32-...	M3	6 mm	1.2 Nm
MTR-DCI-42-...	M3	7 mm	1.2 Nm
	M4	10 mm	2.9 Nm
MTR-DCI-52-...	M5	10 mm	5.9 Nm
MTR-DCI-62-...	M5	10 mm	5.9 Nm

Tab. 2/3: Tightening torques

In order to fit Festo axes, e. g. type DMES-... or DNCE-..., couplings and coupling housings are available as accessories. The motor unit is connected to the axis by means of a clamp in the coupling housing. Additional motor flanges are not therefore necessary. Further information can be found in appendix A.2 and in the operating instructions for the axis.

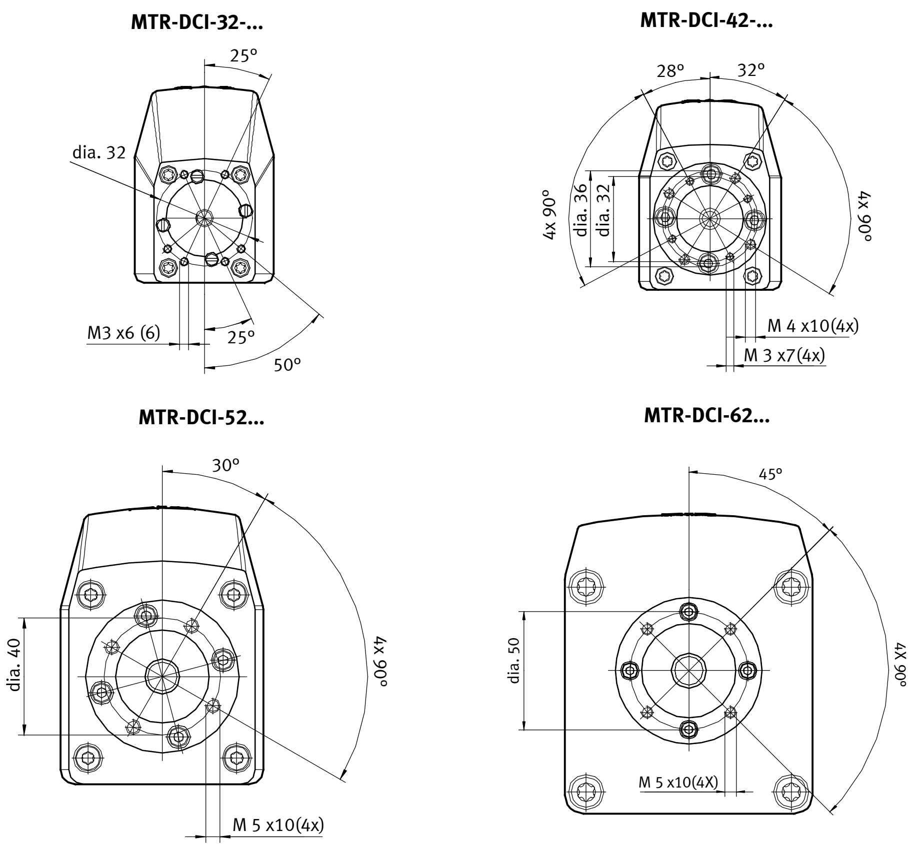


Fig. 2/2: Fastening the drive by means of the front threads (direct fastening)

Installation

Chapter 3

Contents

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3.7.1	Field bus cable	3-18
3.7.2	Fieldbus bit rate and fieldbus length	3-19
3.7.3	Bus termination with terminating resistors	3-20

3.1 Overview of installation

Warning
Danger of electric shock, short circuits or unexpected movements of the drive.

- Always switch off the power supply before carrying out fitting, installation and maintenance work.

Caution
Incorrectly pre-assembled cables may damage the electronic components and trigger unexpected movements of the motor.

- For connecting the electric components of the system, use only the cables listed as accessories (see Tab. 3/2). Only in this way can you be sure that the system will work properly.

Note
- Lay all moveable motor and sensor cables free of bends and free of mechanical stress, if necessary, in a drag chain.

1 Serial interface

2 Connection for the reference switch

3 CANopen field bus (I/F)

4 Power supply (Power)

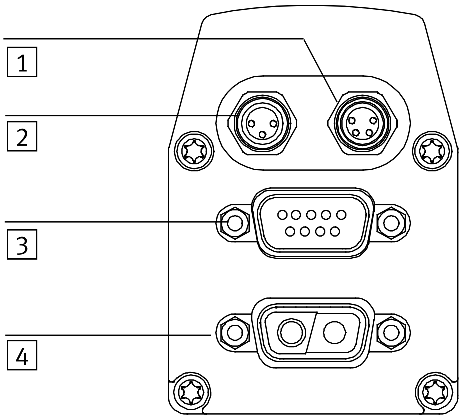
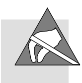


Fig. 3/1: Connections on the MTR-DCI

Connection on the MTR-DCI			Description
1	Serial interface	– M8x1, 4-pin – Socket	RS232 interface for parameterizing, commissioning and diagnosing with FCT
2	Reference switch	– M8x1, 3-pin – Socket	Sensor input for switch type normally open contact in the design PNP
3	CANopen field bus	– Sub-D, 9-pin – Plug	Interface for connection to CANopen field bus
4	Power supply	– Sub-D, 2-pin – Plug	Connection with 2 high-current contacts

Tab. 3/1: Description of the connections



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

The plug connectors on the Festo cables listed in the following are designed to conform to protection class IP54 when connectors are plugged in and secured, or when the connections on the MTR-DCI are equipped with protective caps.

Caution
Long lines reduce immunity to interference (EMC).

- Observe the specified maximum cable lengths.

Connection	Cable	Designation	Length [m]
Serial interface	Programming cable	KDI-MC-M8-SUB-9-2,5	2.5 (max. 2.5)
Reference switch	Connecting cable	KM8-M8-GSGD-...	0.5 / 1 / 2 / 5
Voltage supply	Power supply cable	KPWR-MC-1-SUB-9HC-...	2.5 / 5 / 10 (max. 10)
Power supply	Supply cable	KPWR-MC-1-SUB-9HC-...	2.5 / 5 / 10 (max. 10)

Tab. 3/2: Overview of cables (accessories)

Complying with the IP protection class

- Seal unused M8 connections with ISK-M8 protective caps (accessories),
- Tighten the union nuts/locking screws on the plugs by hand.

Observe the permissible torques specified in the documentation for the cables and connectors used.

3.2 Earthing

Note

- Connect the earth connection of the MTR-DCI with low impedance (short cable with large cross-sectional area) to the earth potential.

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

In order to connect the MTR-DCI to the earth potential, use **only** the following earth connection:

– Earthing strap on the free end of the power supply cable, see assembly instructions for cable KPWR-MC-1-SUB-9HC-... (See chapter 3.3.2)

Caution

Earth or ground loops can make EMC safety measures ineffective and allow high compensating currents to destroy the motor unit.

- Connect **only** the cable screen of the power supply cable to the functional earth FE.
- The GND connection must **not** be made to the housing, screening or functional earth FE!
- Never connect one of the voltage connections (see chapter 3.2, A1, A2) to FE or the housing.

This will avoid damaging the device and impairing protection against electromagnetic interference (EMC).

3.3 Power supply

3.3.1 Requirements of the power supply

Warning

- In order to provide the electric power supply, use only PELV **circuits** as per IEC/DIN EN 60204-1 (Protective Extra-Low Voltage, PELV).
  Take into account also the general requirements for PELV circuits as per IEC/DIN EN 60204-1.
- Use only power **sourcers** which guarantee reliable electrical isolation of the operating voltage as per IEC/DIN EN 60204-1.

By the use of PELV power units, protection against electric shock (protection against direct and indirect contact) is guaranteed in accordance with IEC/DIN EN 60204-1 (electrical equipment of machines, general requirements).

Caution

Damage to the device caused by overvoltage

The voltage inputs of the motor unit have no internal protection against overvoltage.

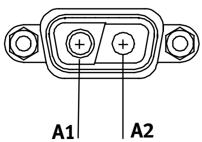
- Make sure that the permitted voltage tolerance is not exceeded. The tolerance must also be observed directly at the voltage connections of the MTR-DCI (see appendix A.1).
- Install external fuses (see Tab. 3/4).

3.3.2 Load and logic voltages

Load voltage

The power electronics and the motor are supplied with direct current via the voltage connection.

- Use the power supply cable KPWR-MC-1-SUB-9HC-... (max length of 10 m).
- Use a closed-loop controlled power unit with high output reserve and external fuse for the load voltage supply.

Plug	Pin	Colour [1]	Description	
	A1	black (1)	MTR-DCI-32/42/52: MTR-DCI-62:	POWER +24 VDC POWER +48 VDC
	A2	black (2)	MTR-DCI-32/42/52/62:	POWER GND [2]

[1] Cable colours with power supply cable KPWR-MC-1-SUB-9HC-...
[2] Do not connect GND with the housing, screening or functional earth (FE)!

Tab. 3/3: Connecting the power supply to the motor unit

Closed-loop controlled DC motors have a much higher current consumption during the switch-on or starting torque than in rated operation. These consumers cause a brief overloading of the power supply or a short circuit.
Power supply units with U/I output curve continue to provide the full output current (at reduced output voltage) even in the event of a higher load or short circuit.
With power units with additional output reserve (power boost), the output voltage remains constant even during overload. Power units with U/I characteristic curve and power reserve are therefore optimally suited for universal industrial use.

Note the following selection criteria with the power supply of the MTR-DCI:

– The power unit rated current should correspond at least to the motor starting current (peak current).

– Motor tolerances with 20 % - 50 % output reserve should be considered.

Voltage supply		MTR-...-32	MTR-...-42	MTR-...-52	MTR-...-62
Rated motor current	A	0.73	2	5	6.19
Peak motor current	A	2.1	3.8	7.7	20
Nominal current of power supply unit	A	≥ 3	≥ 6	≥ 10	≥ 15 [1)]
External fuse (secondary side)	A	5 A slow-blowing	7 A slow-blowing	10 A slow-blowing	25 A slow-blowing
[1)] Exception					

Tab. 3/4: Requirement for power units and fuses

1 External fuse

2 Earth connection (see chapter 3.2)

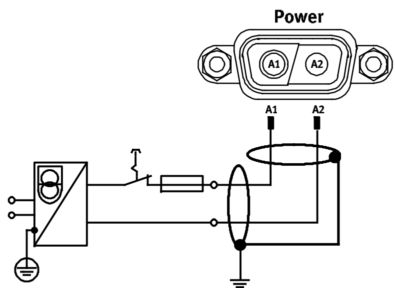


Fig. 3/2: Example of connection – Power supply

Logic voltage

The logic voltage is supplied either **together** with the load voltage via the power supply connection (internal) or **separately** from the load voltage (external) via the field bus adapter FBA-... . The MTR-DCI-32 can only be supplied with logic voltage via the field bus adapter.

Logic voltage supply	**32**	**42**	**52**	**62**
– via power supply	—	x	x	x
– via field bus adapter FBA-...	x	x	x	x

Tab. 3/5: Logic voltage supply

Logic voltage supply via field bus adapter FBA-...

The load voltage is supplied via the power supply connection. The logic voltage is supplied via the field bus adapter FBA-... .

Due to the separate power supply, the load voltage can be switched off e.g. in the event of EMERGENCY STOP. Despite this, the controller still functions and maintains its reference position.

Information on the connection specifications of the field bus adapter can be found in chapter 3.6. and in the assembly instructions for the field busa adapter.

Switch-on sequence

Do **not** switch on the logic voltage **after** the load voltage, as the MTR-DCI may thereby be switched off and on again (Reset).

Failure of logic voltage

If there is a failure of the logic voltage, the controller will switch itself off.
With MTR-DCI 42, 52, 62: If the load voltage is still applied, the controller will switch itself on again, but is no longer referenced.

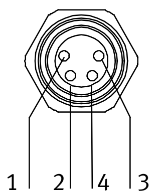
3.4 Serial interface

Serial interface for parametrizing, commissioning and diagnosing

■ ■ ■

In order to connect a PC to the MTR-DCI, use exclusively the following cable:
– Programming cable KDI-MC-M8-SUB-9-2,5

- If necessary, remove the protective cap from the serial interface of the MTR-DCI.
- Connect the following terminals with the programming cable:
  - the connection socket on the MTR-DCI
  - a serial interface COMx of the diagnostic PC.

M8x1 socket		Description	
	1	GND	Ground
	2	TXD	RS232 transmitting cable [1]
	3	RXD	RS232 receiving cable [1]
	4	---	reserved for servicing personnel – do not connect.

[1] The levels correspond to the RS232 standard
Data transfer rate: 9600 bit/s

Tab. 3/6: Pin assignment of the serial interface on the MTR-DCI

Information on commissioning and parametrizing the MTR-DCI via the serial interface can be found in chapter 5.3 and in the help system for the FCT software package. Information on transmitting CI commands via the serial interface can be found in the appendix C.3.2.

Note
The RS232 interface is not electrically isolated. It is not suitable for permanent connection to PC systems, nor for use as a control interface.

- Use this terminal only for commissioning.
- Remove the programming cable in continuous operation.
- Seal the terminal with the protective cap supplied (ISK-M8).

3.5 Input for external reference switch

If you are not using a reference switch:

- Seal the terminal with the protective cap supplied (ISK-M8).

Selecting the reference switch:

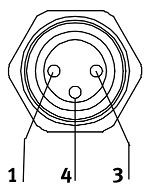
- Use the correct switch type “normally-open contact” in the PNP variant for the reference switch.
- Usea reference switch with screw locking (outer thread M8x1) at the end of the cable or, as adapter, the connecting cable KM8-M8-... with screw locking.

Use e. g. the following proximity switches from Festo:

– Magnetic proximity switches SMT-8M-...

– Inductive proximity sensor SIEN-...-M8B-...

- When selecting the sensor, note that the accuracy of the switchover point of the sensor determines the accuracy of the reference point.

M8x1 socket	Description		
	1	DC +24 V	DC +24 V voltage output (only for reference switch)
	4	REF	Contact reference switch
	3	GND	Ground

Tab. 3/7: Connection REF (reference switch) on the MTR-DCI

The power supply for the reference switch (DC 24 V/Ground) is provided via pin 1/3.

Caution

Damage to the device.

The DC 24 V voltage at pin 1 does not have any special protection against overload; the voltage is taken from the main supply with protection against ESD and incorrect polarity.

- Use this connection only for the reference switch (sensor supply).

Use of this connection as a power supply for other devices is not permitted.

The input for sensor signal REF complies in its electrical features with the input specification in the appendix "Technical specifications".

3.6 Controller

Communication with the higher-order controller is made via the control connection on the MTR-DCI-...

There is a 9-pin Sub-D plug on the MTR-DCI-...-CO for connecting the field bus. This connection serves for the incoming and continuing field bus cables.

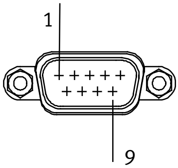
Note
Only the field bus plug FBA-CO-SUB-9-M12 from Festo complies with IP 54.

Note
The screening connection at pin 5 of the fieldbus interface is capacitively connected internally with high impedance to the housing. This prevents compensating currents from flowing via the screening of the fieldbus cable (see Fig. 3/3).

1 Capacitive connection

2 Housing

Fig. 3/3: Screening connection inside the MTR-DCI

Connection	Pin	Designation	Function
	1	n.c.	not connected
	2	CAN_L	CAN Bus Low
	3	CAN GND	CAN bus reference potential
	4	n.c.	not connected
	5	CAN_SHLD	screening, capacitive connection to housing
	6 1)	**n.c.**	optional for MTR-DCI-42,52,62: not connected (= internal GND supply)
		CAN_V-	external supply GND
	7	CAN_H	CAN Bus High
	8	n.c.	not connected
	9 1)	**n.c.**	optional for MTR-DCI-42,52,62: not connected (= internal 24 V supply)
		CAN_V+	external supply 24 V
	–	Screening/ housing	connection to functional earth
1) internal or external supply of the bus interface see Tab. 3/9			

Tab. 3/8: Connection “I/F” (controller connection) on the MTR-DCI-...-CO

Power supply to the bus interface	32	42 [1]	52 [1]	62 [1]
Internal supply: – Do not connect pins 6 and 9 – CAN bus (pins 2, 3, 7) potential refers to (load) voltage supply of the MTR-DCI.	–	x [2]	x [2]	x [2]
External power supply: – Pins 6 and 9 must be supplied with 24 V (logic voltage) – CAN bus (pins 2, 3, 7) potential refers to the bus voltage supply (enables electrically isolated bus connection).	x [2]	x	x	x
[1] Depends on parametrizing – "CAN voltage supply (CAN power supply)" (see section 5.2.7) or – [CAN volt.supply] on the control panel (see section 4.5, [CAN parameter]) [2] default				

Tab. 3/9: Power supply for bus interface

Caution
Damage to other field bus devices

If you are using the external logic power supply via the field bus adapter FBA-... (see chapter Accessories) there will be a voltage of DC 24 V at pin 9.

- Check whether there is any danger for other field bus slaves.
- Note the pin assignment in accordance with the assembly instructions for the field bus adapter.

3.7 Connecting the field bus

3.7.1 Field bus cable

Note
Faulty installation and high transmission rates may cause data transmission errors as a result of signal reflections and attenuations.
Transmission errors can be caused by:

- missing or incorrect terminating resistor
- incorrect screened connection
- branches
- transmission over large distances
- inappropriate cables

Observe the cable specification! For information on the cable type refer to the manual for your controller or to CIA specification DS 102.

Note
If the MTR-DCI is fitted onto the moving part of a machine, the field bus cable on the moving part must be provided with strain relief. Please observe also the relevant regulations in EN 60204 part 1.

Use a twisted-pair, screened 4-wire cable as fieldbus cable.

If you are using the Festo field bus plug, a cable diameter of 5 ... 8 or 7 ... 10 mm is permitted.

Bus length

Exact specifications on the bus length can be found in the next section and in the manuals for your control system.

3.7.2 Fieldbus bit rate and fieldbus length

Note
The maximum permissible fieldbus segment lengths depend on the bit rate used. You will find detailed information in the manuals for your control system or bus interface, or in CiA specification DS 102.

- Observe the maximum permissible segment length (cable length without repeater) if you connect the MTR-DCI to a fieldbus segment.
- Avoid branch lines.

Note
- Refer to the manuals for your control system or bus interface in order to ascertain which T-adapter and maximum branch line length are permitted for your controller.

  Also take into account the sum of the branch line lengths when calculating the maximum permitted length of the fieldbus cable.

Bit rate	Maximum segment length
1000 kbit (1 Mbit)	40 m
20 kbit	1000 m

Tab. 3/10: Maximum fieldbus segment lengths depending on the bit rate

Notes on setting the bit rate and further bus parameters on the control panel can be found in section 5.2.7.

3.7.3 Bus termination with terminating resistors

Note
If the MTR-DCI is at the beginning or end of the field bus segment, a bus termination will be required.

- **Always** use a bus termination at both ends of the field bus.

If the MTR-DCI is to be connected at the end of the fieldbus, a terminating resistor (120 Ω, 0.25 W) must be installed in the fieldbus socket:

- Connect the terminating resistor between the cores for CAN_H and CAN_L.

Control panel (only type MTR-DCI-...-H2)

Chapter 4

Contents

4. Control panel (only type MTR-DCI-...-H2) 4-1

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The control panel of the motor unit MTR-DCI-...-**H2** enables commissioning directly on the MTR-DCI. An overview of the key and menu functions can be found in this chapter. Commissioning with the control panel is described starting in chapter 5.2.

With the MTR-DCI-...-**R2** (without control panel) you can commission the MTR-DCI via the RS232 interface (with FCT software). Instructions on this can be found in section 5.3.

Caution
Simultaneous access of control functions and operating functions by the FCT and the control panel can cause faults.

- Make sure that FCT and the control panel are not used at the same time.
- If necessary, use the possibility of blocking parametrizing and positioning functions via the control panel (HMI access, see section 5.5.2)

Note
If applicable, remove any protective foil on the display before commissioning.

4.1 Composition and function of the control panel

[1] LC display

[2] Operating buttons

[3] LEDs
- Power (green)
- I/F (green/red)
- Error (red)

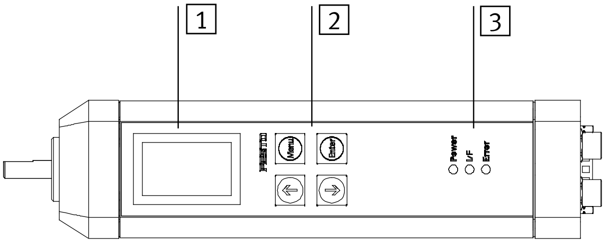


Fig. 4/1: Control panel of the MTR-DCI-...-H2-...

LC display

The graphic LCD (128 x 64 points) shows all texts in English. The display can be turned in 180° steps, see menu command [LCD adjustment].

Operating buttons

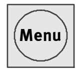
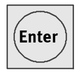
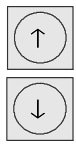
The following settings and functions for commissioning are enabled via menus using 4 keys of the touch-sensitive keyboard:

- Parametrizing and referencing the drive
- Teaching standard applications and editing positioning sets
- Processing/testing individual positioning sets.

LEDs

The operating states are shown with 3 LEDs (see also chapter 6.2).

- Power: Power supply
- I/F: Bus communication
Bus operating status: green
Bus connection: red
- Error: Error

Function		Button
MENU	Activates the main menu from the status display.	
ESC	Rejects the current entry and switches back in stages to the higher-order menu level or status display.	
EMERG.STOP	interrupts the current positioning procedure (⇢ Error mode; confirm with ‹Enter›, then automatic return to the status display) Only when HMI = on	
OK	Confirms the current selection or entry.	
SAVE	Saves parameter settings permanently in the EEPROM.	
START/STOP	Starts or stops a positioning procedure (only in Demo mode). After stop: Display of current position; use ‹Menu› to return to the higher-order menu level.	
‹- -›	Scrolls within a menu level in order to select a menu command.	
EDIT	Sets parameters.	

Tab. 4/1: Button function (overview)

4.2 The menu system

4.2.1 Accessing the main menu

```
MTR-DCI...
Xa = 0.00 mm

HMI:off
<Menu>
```

When the power supply is switched on, the MTR-DCI automatically carries out an internal check. At first the display briefly shows the Festo Logo then changes to the status display. The status display shows the following information:

- the type designation of your MTR-DCI,
- the current position of the drive x_a = ...,
- the current setting of the device control (HMI = Human Machine Interface).

The current button function will be displayed in the lower lines of the display:

‹Menu›	The main menu is accessed from the status display with the ‹Menu› button.

4.2.2 Selecting a menu command

```
→ Diagnostic
  Positioning
  Settings
  ↓         ESC <Menu>
  <-->      OK <Enter>
```

```
→ HMI control
  LCD adjustment

  ↑         ESC <Menu>
  <-->      OK <Enter>
```

‹- -›	With the arrow buttons on the control panel you can select a menu command from the list. The current selection is marked with an arrow (→ Diagnostic). Select ↓ in order to display further menu commands.
ESC	With the ‹menu› button you can interrupt the current entry and return to the status display or from a sub-menu to the higher-order menu.
OK	With the ‹Enter› button you can confirm the current selection or entry.

Menu command		Description
→ **Diagnostic**		Displays the system data and the currently effective settings (see chapter 4.3)
→ Pos. set table		Displays the position record table
→ Axis parameters		Displays axis parameters and data
→ System paramet.		Displays system parameters and system data
→ CAN Bus Diag		Displays data for CANopen diagnosis
→ Software information		Displays the operating system version (firmware)
→ **Positioning** 1) 2)		Reference run and positioning runs for testing the position records (see chapter 4.4)
→ Move posit. set		Start positioning run "Position set"
→ Demo posit. tab		Start positioning run "Position set table"
→ Homing		Start the reference run
→ **Settings** 1) 2)		Selection of the drive, parametrizing, programming the position sets ... (see chapter 4.5)
→ Axis type	→ Type DMES-...	Valve actuator DMES-...
	→ Type DNCE-...	Electric cylinder DNCE-...
	→ Rotation drive	Rotation axis with stop
	→ User config	Any linear drive
→ Axis parameters	→ Zero point 3)	Offset axis zero point
	→ Abs.min.pos 3)	Stroke limitation: Software end position, negative
	→ Abs.max.pos 3)	Stroke limitation: Software end position, positive
	→ SAVE...	Save parameters in EEPROM
→ Homing parameter	→ Homing method	Select referencing (homing) method (stop, software limit switch...)
	→ Velocity v_sw	Positioning speed for searching for the reference point
	→ Velocity v_s0	Positioning speed for moving to the axis zero point
	→ SAVE...	Save parameters in EEPROM
→ Position set	→ Position nr.	Number of the position record (0...14)
	→ Pos set mode	Absolute or relative positioning
	→ Position 3)	Target position of the position set
	→ Velocity	Positioning speed of the position set
	→ SAVE...	Save parameters in EEPROM
→ Password edit		Set up a local password with 3 figures for the control panel (see chapter 4.5)
→ CAN parameter		Setting the field bus parameter
→ **HMI control** 1)		Presetting the device control via the control panel (see chapter 4.6)
→ **LCD adjustment**		Rotate the display in steps of 90°

1) If necessary password protection 3) Teach mode
2) Controller interface must be deactivated, see [HMI] control] :HMI = on

Tab. 4/2: Menu commands (overview)

4.3 [Diagnostic] menu

In order to display the currently effective settings in the positioning set table, axis and system parameters as well as status and diagnostic information for bus communication and for firmware version:

```
→ Diagnostic
   ├── Pos.set table
   ├── Axis parameter
   ├── System paramet.
   ├── CAN-BUS Diag
   └── Sodtware
       information
```

1. Select the [Diagnostic] menu in the main menu.
2. Select a menu command (see Tab. 4/3 and Tab. 4/4).

‹- -›	You can scroll through the data with the arrow buttons.
ESC	With the ‹Menu› button you can return to the higher-order menu.

Menu command	Description	
[Pos. set table]	No.	Number of the position set
	a/r	– a = absolute positioning – r = relative positioning
	Pos	Target position
	Vel	Positioning speed
[Axis parameter] [1]	v_{max}	Maximum positioning speed
	x_{min}	Stroke limitation: Software end position, negative
	x_{max}	Stroke limitation: Software end position, positive
	x_0	Offset axis zero point
	feed [2]	Feed constant
[System param]	V power	Supply voltage [V]
	I max	Maximum current [A]
	I act	Actual current [A]
	Temp	Operating temperature [°C]
	Cycle	Number of positioning movements
	Ref.switch	Reference switch (ON/OFF)
	Mode	Measuring system e.g. mm
	Hom.meth.	– bl.pos Fixed stop in positive direction – bl.neg Fixed stop in negative direction – sw.pos Reference switch in positive direction – sw.neg Reference switch in negative direction
	Gear	Gear reduction of the motor unit (e.g. 6.75)

[1] Measuring unit depends on set measuring system
[2] not for axis type “Rotation drive”

Tab. 4/3: [Diagnostic] menu (1)

<table>
<tr><th>Menu command</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">[CAN-BUS-Diag]</td><td colspan="2">Bus diagnosis
<table><tr><td>– Guarding error [1]</td><td>“Node guarding” activated (if enabled in master), e.g. master shut down or cable break.</td></tr><tr><td>– CAN WarningLimit [1]</td><td>Telegrams not being received or cannot be sent (no acknowledgement at lowest CAN level), e.g. no bus connection.</td></tr><tr><td>– CO status stopped</td><td>“Stop” network management command received.</td></tr><tr><td>– CO status pre-op</td><td>Pre operational, normal state after power-on before the master transmits “Start node operational”.</td></tr><tr><td>– State operational</td><td>“Start node operational” transmitted by master, normal operating state.</td></tr></table></td></tr>
<tr><td>Bit rate</td><td>Set bit rate of the MTR-DCI:
Values:
1000k (1 Mbit/s), 800k, 500k, 800k, 125k, 100k, 50k, 20k (20 kBit/s)</td></tr>
<tr><td>Profiles</td><td>Pre-set data profile.
Controller or device profile used for communication between the CAN master and the MTR-DCI.
– FHPP: The MTR-DCI is controlled as per the Festo Handling and Positioning Profile.
– CiA 402: The MTR-DCI is controlled as per CiA 402.</td></tr>
<tr><td>CAN Node ID</td><td>CAN address of the MTR-DCI (hexadecimal/decimal).</td></tr>
<tr><td>Volt.supply int./ext.</td><td>CAN interface voltage supply internal/external</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>[Software information]</td><td colspan="2">Version of the firmware of the MTR-DCI, e. g. V1.20</td></tr>
<tr><td colspan="3">[1] The “Guarding Error” and “CAN WarningLimit” state displays are prioritized (regardless of the other states).</td></tr>
</table>

Tab. 4/4: [Diagnostic] menu (2)

4.4 [Positioning] menu

Warning
Damage to or impairment of the mechanical components

With all positioning procedures the motor turns or the connected axis starts to move.

- Make sure that:
  - nobody can place his/her hand in the positioning range
  - there are no objects within the positioning path.

Note

- Before starting the reference run, make sure that:
  - the positioning system is set up and wired completely, and is supplied with power.
  - the parameterizing is completed.
- Do not start a positioning run until the reference system has been defined by means of a reference run (see chapter 4.4.3).

Note
Please note that position records with speed v = 0 or invalid target positions (-> error TARGET POSITION OUT OF LIMIT) cannot be executed.

Selecting positioning travel or reference travel:

```
→ Positioning
  ├── Move position set
  ├── Demo posit tab
  └── Homing
```

1. Select the menu [Positioning] in the main menu.
2. Select the menu command:
   - [Move position set] for testing a certain position set in the position record table (see chapter 4.4.1).
   - [Demo posit tab] in order to execute all position sets in the position record table one after the other.
   - [Homing] reference travel for determining the measuring system (see chapter 4.4.3).

4.4.1 [Positioning] [Move position set]

→

> **Note**
> Do not start a positioning run until the reference system has been defined by means of a reference run.

For testing a particular position record in the position record table.

1. Select the number of the position set.

```
Move position set
Position no.
[1...31] = _?

                ESC <Menu>
EDIT <-->       OK <Enter>
```

‹- -›	You can set the desired number with the arrow buttons.
OK	You can accept the selection with the ‹Enter› button.
ESC	With the ‹Menu› button you can interrupt the activity and return to the higher-order menu.

```
Move position set
Attention! Motor moves


             ESC <Menu>
             START <Enter>
```

2. Start the positioning procedure with START ‹Enter›.

During positioning travel the following information is displayed:

– the active positioning set e.g. Pos 2

```
Move position set
Pos 2
xt = 220 mm
v  = 22 mm/s
xa = 200 mm
        EMERG.STOP<Menu>
```

– the target position xt

– the positioning speed v

– the current position xa.

EMERG. STOP	With the ‹Menu› button you can interrupt the current positioning procedure (⇢ MOTOR STOP fault).

```
Move posit set
Pos 2
xt = 220 mm/s
v  = 22 mm/s
xa = 220 mm/s
              ESC<Menu>
```

When positioning travel is completed:

ESC	With the ‹Menu› button you can return to the selection of the positioning set.

4.4.2 [Positioning] [Demo position table]

There must be at least two position records in the memory. If the position record table contains a position record with speed v = 0, this position record and all the following sets will not be executed; the positioning run will be continued with position record 1.

In order to execute all position sets in the position record table one after the other:

```
Demo position table
Attention! Motor moves


           ESC <Menu>
           START <Enter>
```

• Start the positioning procedure with START ‹Enter›.

During positioning travel the following information is displayed:

– the active position set e.g. Pos 2

```
Demo position table
Pos 2
xt = 220 mm
v  = 22 mm/s
xa = 220 mm
      DEMO STOP<Enter>
      EMERG.STOP<Menu>
```

– the target position xt

– the positioning speed v

– the current position xa.

DEMO STOP	You can interrupt the positioning procedure with ‹Enter›. The current position set will be executed before the axis stops. With a new start processing begins again with the first position set.
EMERG. STOP	With the ‹Menu› button you can interrupt the positioning procedure (⇢ MOTOR STOP fault).

4.4.3 [Positioning] [Homing]

Note
- Note also the instructions on carrying out reference travel in chapter 5.2.

First set the parameter in the menu [Settings] [Homing parameter]. (see chapter 4.5.3). Factory setting: Referencing to reference switch in negative direction.

```
Homing
Warning Motor moves.

            ESC<Menu>
            START <Enter>
```

Defining the reference point by means of reference travel

- Start reference travel with START ‹Enter›.

The following information is displayed:

– the search speed v_sw for moving to the reference point [Velocity v_sw]

– the positioning speed v_s0 for moving to the axis zero point v_0.

```
Homing
V_sw = 20 mm/s
v_s0 = 10 mm/s

         EMERG.STOP<Menu>
```

During reference travel the drive moves slowly at reduced search speed to the stop or reference switch and accepts the position as the reference point.

EMERG. STOP	With the ‹Menu› button you can interrupt the reference travel (⇢ HOMING ERROR fault).

- Acknowledge the error message with ‹Enter›.
- Repeat the reference run.

After successful reference travel the menu [Positioning] will be shown.

4.5 Menu [Settings]

The menu [Settings] contains all functions necessary for parametrizing the axis system and the position sets. Further iinformation on the individual menu commands can be found in the chapters specified (see Tab. 4/5).

```
→ Settings
   ├─ Axis type
   ├─ Axis parameter
   ├─ Homing paramet.
   ├─ Position set
   ├─ Password edit
   └─ CAN parameter
```

1. Select the menu [Settings] in the main menu.
2. Select a menu command.

[Settings]	Description	Chapter
[Axis type]	Select the axis driven by the MTR-DCI	4.5.1
[Axis parameter]	Teach mode for setting the axis parameters	4.5.2
[Homing paramet.]	Setting the reference travel method and the speed during reference travel	4.5.3
[Position set]	Teach mode for programming the position record table	4.5.4
[Password edit]	Setting up a local password with 3 figures for the control panel	4.5.5
[CAN parameter]	Setting the field bus parameters	4.5.6

Tab. 4/5: Menu [Settings]

Note
The set parameters take effect immediately after confirmation with OK ‹ENTER›. The settings are saved permanently in EEPROM with the [SAVE...] menu command:

- Choose [SAVE...] to save the parameter settings. Only then will the settings be retained even when the power supply is switched off or if there is a power failure.

4.5.1 [Settings] [Axis type]

Select the axis driven by the MTR-DCI

[Axis type]	Description
[Type DMES-...]	Festo servo axis
[Type DNCE-...]	Festo electrocylinder
[Rotation drive]	Specific rotation axis
[User config]	Specific linear axis

Tab. 4/6: Menü [Settings] [Axis type]

‹- -› With the arrow keys you can set the axis-specific features e.g. feed constant, measuring system or counting direction according to the entry request. (details see chapter 5.2.1).

SAVE You can save the settings permanently in EEPROM with the ‹Enter› button

ESC With the ‹Menu› button you can interrupt the activity and return to the higher-order menu.

- Save the settings with SAVE ‹Enter›.

4.5.2 [Settings] [Axis parameter]

Teach mode for setting the axis parameters

- In order to set the measuring system select the following parameters. Observe the instructions in chapter 5.2.4.

[Axis parameter]	**Description**
[Zero point]	Offset axis zero point
[Abs.min.pos]	Stroke limitation: Software end position, negative
[Abs.max.pos]	Stroke limitation: Software end position, positive
[SAVE...]	Save parameters in EEPROM

Tab. 4/7: Menu [Settings] [Axis parameter]

‹- -› You can move the axis into the desired position with the arrow buttons.

OK You can accept the selection with the ‹Enter› button.

ESC With the ‹Menu› button you can interrupt the activity and return to the higher-order menu.

- Choose [SAVE...] to save the parameter settings. Only then will the settings be retained even when the power supply is switched off or if there is a power failure.

4.5.3 [Settings] [Homing paramet.]

Setting the reference travel method and the speed during reference travel. Observe the instructions in chapter 5.2.2.

The maximum speed during reference travel is limited to half the maximum positioning speed v_max (v_max see [Diagnostics] [Axis parameter]).

[Hom. paramet.]	Param.	Description
[Homing method]	sw.neg (switch negative)	Homing to reference switch, negative = factory setting
	sw.pos (switch positive)	Homing to reference switch, positive
	bl.neg (block negative)	Homing to fixed stop, negative
	bl.pos (block positive)	Referencing to fixed stop, positive
[Velocity v_sw]	v_sw	Speed for searching for the reference point
[Velocity v_s0]	v_s0	Speed for moving to the axis zero point
[SAVE...]	Save parameters in EEPROM	

Tab. 4/8: Menu [Settings] [Homing paramet.]

- Choose [SAVE...] to save the parameter settings.

4.5.4 [Settings] [Position set]

Programming the position record table

- Select the number of the desired position set. The following settings refer to the currently selected position set. Note also the instructions on programming the position sets in chapter 5.2.5.

[Position set]	**Param.**	**Description**
[Position no.]	No.	Number of the position set
[Pos set mode]	[absolute/ relative]	Positioning mode absolute = absolute position specification, related to the project zero point relative = relative position specification, related to the current position
[Position]	xt	Teach mode for setting the target position in the selected measuring system e.g. [mm]. Do not teach the positions until the reference system has been defined by means of a reference run. (see chapter 4.4.3)
[Velocity]	v	Positioning speed in the selected measuring system e.g. [mm/s]
[SAVE...]	Save parameters in EEPROM	

Tab. 4/9: Menü [Settings] [Position set]

‹- -› You can move the axis into the desired position or select the parameter setting with the arrow buttons.

OK You can accept the selection with the ‹Enter› button.

ESC With the ‹Menu› button you can interrupt the activity and return to the higher-order menu.

- Choose [SAVE...] to save the parameter settings. Only then will the settings be retained even when the power supply is switched off or if there is a power failure.

4.5.5 [Settings] [Password edit]

In order to prevent unauthorized or unintentional overwriting or modification of parameters in the device, access via the control panel can be protected by a (local) password. No password has been preset at the factory (presetting = 000).

- Keep the password for the MTR-DCI in a safe place, e.g. with the internal documentation for your system.

If the active password in the MTR-DCI should be lost in spite of care being taken:
the password can be deleted by entering a master password. In this case please contact your Festo Service partner.

Activate password

Select the menu [Settings] [Password edit].

```
New Password:
[?xx] =

      ESC<Menu>
EDIT <-->   OK <Enter>
```

Enter a password with 3 figures (0...9). The current entry position is marked with a question mark.

1. Use the arrow buttons to select a figure.
2. Confirm your entry with ‹Enter›.
3. Set a figure for the next entry position “?”.
4. After entering the third figure, save the password with SAVE ‹Enter›.

After saving, access to all parameter functions and control functions of the control panel is only possible with a password access blocked.

Enter password

```
Enter Password:
[?xx] =

          ESC<Menu>
EDIT <-->   OK <Enter>
```

As soon as a password is active, it will be scanned automatically when the menu commands [Positioning], [Settings] or [HMI control] are accessed.

The current entry position is marked with a question mark.

1. Use the arrow buttons to select a figure 0...9.
2. Confirm your entry with ‹Enter›. The next entry position will be displayed.
3. Repeat the entry for the remaining entry positions.

When the correct password is entered, all parameterising and control functions of the control panel are enabled until the power supply is switched off.

Modify/deactivate password

Select the menu [Settings] [Password edit].

```
Enter Password:
[?xx] =

            ESC<Menu>
EDIT <-->     OK <Enter>
```

Enter the previous password with 3 figures 0...9. The current entry position is marked with a question mark.

1. Set the first figure of the previous password with the arrow buttons.
2. Confirm the figure with OK ‹Enter›.
3. Set the figure for the next entry position "?".

   After selecting the 3rd. figure of the previous password, you can modify or deactivate the password.

```
New Password:
[?xx] =

            ESC<Menu>
EDIT <-->     OK <Enter>
```

   Enter the new password with 3 figures or "000" in order to deactivate the old password:

4. Use the arrow buttons to select the first figure.

4. Control panel (only type MTR-DCI-...-H2)

5. Confirm the figure with ‹Enter›.

6. Set the figure for the next entry position “?”.

7. After selecting the 3rd. figure, save your setting with SAVE ‹Enter›.

4.5.6 [Settings] [CAN parameters]

Setting the field bus parameters

[CAN parameters]	Param.	Description
[CAN Node ID]	1 ... 127 (1 ... 7fh)	Field bus address of the MTR-DCI. Representation: “1 dec, 1 hex”...“127 dec, 7f hex”
[CAN bit rate]	1000 kBd, 800 kBd, 500 kBd, 250 kBd, 125 kBd, 100 kBd, 50 kBd, 20 kBd	Fieldbus bit rate corresponding to the settings of the master.
[CAN profiles]	CiA 402, FHPP	Pre-set data profile. Controller or device profile used for communication between the CAN master and the MTR-DCI. – CiA 402: The MTR-DCI is controlled as per CiA 402. – FHPP: The MTR-DCI is controlled as per the Festo Handling and Positioning Profile.
[CAN Volt.Supply]	internal, external	only MTR-DCI 42,52,62: Supply for the CAN interface, see chapter 3.6. and 5.2.7

Tab. 4/10: Menu [Settings] [CAN parameter]

‹- -› You can select the parameter setting with the arrow buttons.

OK You can accept the selection with the ‹Enter› button.

ESC With the ‹Menu› button you can interrupt the activity and return to the higher-order menu.

The settings in the menu [CAN parameter] are saved directly and permanently (including in the event of a power failure) in the EEPROM after confirmation with OK ‹Enter›.

4.6 Menu command [HMI control]

```
HMI control
[on/off] = on?

HMI Access free
              ESC<Menu>
<-->          OK <Enter>
```

In order to select the menu commands [Positioning] and [Settings], you must enter the setting “HMI on”. Only then is the MTR-DCI ready to process user entries on the control panel.
When selecting the menu commands you will be requested to modify the HMI setting.

You can also modify the setting directly with the menu command [HMI control].

HMI [1]	Description
on	The device is controlled manually via the control panel. The control interface of the MTR-DCI is deactivated and the control enable is set. The actual status of the FHPP control bytes or the transmitted CiA 402 control word is then ineffective. **With activated control via the control panel, the drive cannot be stopped with the STOP bit.**
off	The device control is carried out via the control interface of the MTR-DCI.
[1] **H**uman **M**achine **I**nterface	

Tab. 4/11: States [HMI control]

‹- -›	You can select the parameter setting with the arrow buttons.
OK	You can accept the selection with the ‹Enter› button.
ESC	With the ‹Menu› button you can interrupt the activity and return to the higher-order menu.

Access to the MTR-DCI via HMI and FCT can be blocked via the field bus as follows:

– FHPP: Bit CCON.B5, “HMI Access locked”.

Commissioning

Chapter 5

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5.1 Procedure for commissioning

Before commissioning

Warning
Danger of injury.
Electric axes can move suddenly with high force and at high speed. Collisions can lead to serious injury to human beings and damage to components.

- Make sure that nobody can gain access to the operating range of the axes or of other connected actuators and that no objects lie in the path of the axes while the system is still connected to a power supply (voltage).

Note
In the following cases it is not permitted to access the MTR-DCI with the FCT writing (e. g. downloading parameters) or controlling (e. g. with "Move manually" or when starting reference travel).

– When the MTR-DCI is currently performing a positioning movement or when a movement is started during access (e. g. via the control interface or via the control panel),

– When parametrizing or operation is carried out with the control panel of the MTR-DCI.

Note the following:

- The device connection in the FCT must not be activated when the control panel is being used for control ("HMI control = on").
- Control with the control panel ("HMI control = on") must not be activated when the device connection in the FCT is activated.
- Control by the FCT must not be activated while the drive is in motion or when control is being carried out via the field bus.

- Before commissioning the servo drive make sure that:
  - the work space is of sufficient size for operation with a work load,
  - the work load does not collide with the motor or the gear of the axis when the slide moves into the end position.
- Please observe the notes in the operating instructions for the axis.

Switching on

Note
Note that the tolerance for the supply voltage must be observed. The tolerance must also be observed directly at the operating voltage connection of the MTR-DCI (see chapter 3.3).

Note
- When the power supply is switched off, wait for approx. 5 seconds before switching the device on again.

With (external) supply of the logic voltage via the field bus adapter

Switch-on sequence

Do **not** switch on the logic voltage **after** the load voltage, as the MTR-DCI may thereby be switched off and on again (Reset).

Failure of logic voltage

If there is a failure of the logic voltage, the controller will switch itself off.
With MTR-DCI 42, 52, 62: If the load voltage is still applied, the controller will switch itself on again, but is no longer referenced.

1. Switch on the power supply for the MTR-DCI. When the power supply is switched on, the MTR-DCI automatically carries out an internal check. Preset operating mode after switching on Record Select

2. Carry out parametrizing and commissioning with the control panel or the FCT software, as described in the following chapters or in the FCT/PlugIn help.

3. In order to complete commissioning note the instructions for operation in the FCT/PlugIn help and in chapter 5.7.

Note
To restore the default settings, the EEPROM can be deleted if necessary with CI object 20F1 (Data memory control) directly via the serial interface (see section C.3). User-specific settings will then be lost.

- Use CI commands only if you already have experience of Service Data Objects.
- If necessary consult Festo.

Warning
Danger of injury.

Faults in parametrizing can cause injury to human beings and damage to property. In the following cases reference travel is absolutely essential in order that the reference coordinates and the working range can be set correctly:

– with the first commissioning
– when the homing method is changed
– **each** time the logic voltage supply is switched on

5.2 Commissioning with the control panel (only MTR-DCI-...H2)

The control panel offers all functions necessary for commissioning, parametrizing, diagnosing and operating directly on the MTR-DCI. Position sets and parameters can be processed menu-guided. You can use the Teach functions to move easily to positions and transfer them to the position record table.

Information on the button functions and on the menu composition of the control panel can be found in Chapter 4.

Device control

```
   Diagnostic
   Positioning
   Settings
→  HMI control
   LCD adjustment
```

In order that the control panel can control the connected MTR-DCI, the control interface of the MTR-DCI must be deactivated and the enable for the control panel must be set [HMI=on]. The actual status of the FHPP control bytes or the transmitted CiA 402 control word is then ineffective.

Further instructions on enabling the controller can be found in section 4.6.

Overview of parametrizing and commissioning

Information on the current parametrizing of the motor unit can be found in the menu [Diagnostic] on the control panel.

Carry out the following steps in order to commission the MTR-DCI the first time with the control panel: Note the detailed description in the sections specified.

Commissioning (overview)	Chapter
1. Select the drive type and, if necessary, adapt the parametrizing to suit your axis.	5.2.1
2. Set the following parameters for homing: – Reference travel method, – Search speed to reference point, – Positioning speed to axis zero point, – With “Fixed stop ...” homing method: Teach an axis zero point ≠ 0.	5.2.2
3. Carry out a reference run.	5.2.3
4. Teach the following axis parameters for defining the axis zero point and the working area: – Offset of the axis zero point to the reference point, – Positive and negative software end positions.	5.2.4
5. Enter several position sets (target position, positioning mode, positioning speed and accelerations).	5.2.5
6. Carry out a test run to check the positioning reaction of the axis, as well as the basis coordinates and the working area.	5.2.6
7. If necessary, optimize the settings for position sets as well as for the basis coordinates and the working area.	5.2.5
8. Commission the CAN interface of the MTR-DCI. This step can be the first one.	5.2.7 and 5.4.1
9. Before completing commissioning, note the instructions on operation.	5.7

Tab. 5/1: Commissioning steps

→

Note
The project zero point PZ can only be set via FCT or CANopen/CI object $21F4_h$ (FHHP PNU 500).

5.2.1 Setting the axis type

```
→ Settings
  Axis type
  |__ Type DMES...
  |__ Type DNCE...
  |__ Rotation drive
  |__ User config
```

1. Select your type of axis in the menu [Settings] [Axis type].
2. Depending on the entry requested, set axis-specific parameters e. g. feed constant, measuring system or direction of count by means of the arrow buttons.

Axis type	Description	Parameters
Type DMES	Festo servo axis	Depending on the size of the MTR-DCI, a DMES of the corresponding size can be selected. The feed constant has already been configured.
Type DNCE	Festo electrocylinder	– FeedCon: Feed constant in [mm/revolution] (see operating instructions for the DNCE-...). – Count direction: Rotating direction of motor left or right (see chapter 1.6).
Rotation drive 1)	Rotaton axis of choice	Rotary/swivel drive of choice: – [degrees] (360°/revolution] or – [revolutions]
User config	Linear axis of choice	Linear axis of choice: Feed constant in [mm/revolution] as per documentation for your linear axis.
1) If an external gear is used, the gear factor can be set with FCT.		

Tab. 5/2: Parametrizing the axis

3. Save the setting of the axis type with SAVE ‹Enter›.

→

Note
If the axis type is changed, a reset is absolutely necessary for adaption of the internal regulator settings.

- After changing the axis type/size, switch the power supply off and then on again (Power off/on).

5.2.2 Setting the reference travel parameters

Notes on referencing to the stop

Note
Damage to components.

The slide may only move directly against a fixed stop if the maximum permitted impact energy is not exceeded (impact energy = 0.5 x mass x speed^2).

- The permitted value can be found in the manual for your positioning axis.
- If necessary, reduce the speed at which movement to the stop is made. The speed can amount to 0 % to 50 % of the rated speed.
- During referencing to the stop, set the offset of the axis zero point ≠ 0 (see chapter 5.2.4).
- Protect sensitive stops by limiting the motor current.

Positioning axis DMES-... can carry out reference travel with the factory-set current limitation (150 %). The current limitation need not be revised here.

Current limitation

The MTR-DCI recognizes a stop when the maximum motor current is reached at the same time as the motor is at a standstill. The maximum motor current during reference travel can be specified with 10 ... 200 % of the rated motor current (see help for the FCT or CI object 6073_h).

> **Note**
> – If the drive is arranged vertically, an increase in the motor current may be necessary. If the motor current is too low, reference travel cannot be carried out and a stop may be recognizrd by mistake.
> – If the motor current is too high, it may not be possible to achieve the set nominal speed.

Current limitation [1]			**32**	**42**	**52**	**62**
100 % ≙ 1 x rated motor current	Motor current Motor torque	A mNm	0.73 30	2.0 110	5.0 300	6.19 700
150 % (default) ≙ 1.5 x rated motor current	Motor current Motor torque	A mNm	1.1 46	3.0 171	7.5 460	9.29 1076
200 % ≙ 2 x rated motor current	Motor current Motor torque	A mNm	1.46 62	3.8 [2] 220	7.7 [2] 470	12.38 1450

1) Parameter specification in FCT: relative motor current in % of rated current. Setting range 10 ... 200 %.
2) Due to maximum current limitation the value does not rise further.

Tab. 5/3: Current limitation

Setting parameters

```
→ Settings
  Homing parameter
  ├── Homing method
  ├── Velocity v_sw
  ├── Velocity v_s0
  └── SAVE
```

1. Select the reference travel parameters in the menu [Settings] [Homing parameter] (see Tab. 5/5)
2. Accept each setting with OK ‹Enter›. The setting will then take effect in the drive.
3. Save the parameter settings with the menu command **[SAVE]**.

Factory setting		32	42	52	62
Speeds v_sw, v_s0	% [1] inc/s	~41 % 27000	~22 % 22400	~17 % 16800	~15 % 16800
Rated speed of the motor	rot/s inc/s	55 66000	50 100000	50 100000	56.7 113400
Reference travel (homing) method		Reference switch, negative (near motor)			
[1] % of the rated motor speed; max. = 50 %					

Tab. 5/4: Factory setting of the reference travel parameters

[Hom. paramet.]	Param.	Description
[Homing method] [1]	sw.neg (switch negative)	Homing to reference switch, negative
	sw.pos (switch positive)	Homing to reference switch, positive
	bl.neg (block negative)	Homing to fixed stop, negative
	bl.pos (block positive)	Homing to fixed stop, negative
[Velocity v_sw]	v_sw	Speed for searching for the reference point
[Velocity v_s0]	v_s0	Speed for moving to the axis zero point
[SAVE...]	Save parameters in EEPROM	
[1] Further information on the reference travel (homing) method in chapter 1.6.3.		

Tab. 5/5: Reference travel parameters

Caution
If the referencing method is changed, the offset of the axis zero point will be reset to zero. Existing offset settings of the software end positions and of the target positions of the position record table will be retained. Note that these points are shifted together with the axis zero point AZ.

- Always carry out a reference run after changing the referencing method.
- Then teach the offset of the axis zero point.

If the axis zero point is modified:

- teach the software end positions and the target positions again.

5.2.3 Starting a reference run

Note
Note that at the start in the search direction the drive must stand **in front of** the stop or reference switch (see chapter 1.6.3).

1. If necessary, position the drive in Teach mode so that at the start it stands in the search direction **in front of** the stop or reference switch.
   - Select e. g. [Settings] [Position set] [Position] (see also chapter 5.2.5).
   - Move the drive to the desired position manually with the arrow buttons.
   - Interrupt the procedure with ESC ‹Menu›, in order that the position is not included in the position set table.

```
→ Positioning
   ├── Demo posit tab
   ├── Move posit set
   └── Homing
```

2. Select [Positioning] [Homing].
3. Start reference travel with START ‹Enter›.

After successful reference travel the drive stands at the axis zero point AZ. On initial commissioning or following a change of homing method the axis zero offset is = 0; after homing the drive is then positioned at the reference point (REF).

Discontinue reference travel

If necessary, reference travel can be discontinued with the ‹Menu› button (EMERG STOP). If correct referencing has already been carried out, the previous reference point will retain its validity.

Error in the reference run

If the axis cannot find a reference switch during reference travel, it will move until it strikes a stop. It will then remain at the stop and the fault HOMING ERROR is displayed. The reference run must be repeated after the error message has been acknowledged:

The reasons for this can be:

- At the start of reference travel, the axis already stands behind the reference switch.
- The reference switch is defective.
- The axis is defective or fitted incorrectly, e. g. the coupling “does not grip.”

If a fault occurs during reference travel:

- Acknowledge the error message with ‹Enter›.
- If necessary, check the function of the reference switch.
- Check the settings of the parameters.
- If necessary, position the drive in Teach mode so that at the start it stands in the search direction **in front of** the stop or reference switch.
- Repeat the reference run.

5.2.4 Teach the axis zero point AZ and the software end positions

Caution
Damage to components.

Movement to the mechanical end positions is not permitted during operation. During movement to the end positions with a high load, the mechanical axis components (e. g. the lead screw) can block in the end positions.

- Set the axis zero point offset ≠ 0, e. g. +1.00 for homing to a negative fixed stop or -1.00 for homing to a positive fixed stop.
- Limit the positioning range by defining valid software end positions during commissioning (see chapter 1.6).
- Enter only target positions within the permitted positioning range.

Teach the axis zero point AZ:

```
→ Settings
  Axis parameter
   ├──Zero point
   ├──Abs.min.pos
   ├──Abs.max.pos
   └──SAVE
```

1. Select [Settings] [Axis parameter] [Zero point].
2. Move the drive to the desired axis zero point manually with the arrow buttons.
3. Accept the position reached with OK ‹Enter›. The setting will then take effect in the drive. The current position x_a will then become the access zero point ($x_a = 0$).

Note
If the axis zero point is modified:

check existing settings of the software end positions, and if necessary of the project zero point and of the target positions in the position table.
Note that these values are shifted together with the axis zero point AZ.

- Teach the software end positions, the project zero point and the target positions again if needed.

Teach the software end positions:

1. Select [Settings] [Axis parameter] [Abs.min.pos] or [Abs.max.pos].

2. Move the drive with the arrow keys.

3. Accept the position reached with OK ‹Enter›. The setting will then take effect in the drive.

4. Save the parameter settings with [SAVE]. Only then will the settings be retained even when the power supply is switched off or if there is a power failure.

5.2.5 Teach position records

```
→ Settings
  Position set
   ├── Position no.
   ├── Pos set mode
   ├── Position
   ├── Velocity
   └── SAVE
```

Enter the position records as follows:

1. Activate the desired position record (1...31) with [Settings] [Position set] [Position nr].

2. Select the positioning mode of the position set.

   - Select [Pos set mode].

   - Set the positioning mode with the arrow keys:
     absolute = absolute position specification, related to the project zero point
     relative = relative position specification, related to the current position.

   - Accept the value with OK ‹Enter›.

3. Teach the target position of the position record:

   - Select [Position].

   - Move the drive manually to the desired target position with the arrow keys.

   - Accept the position reached with OK ‹Enter›. The setting of the target position and the positioning mode will then take effect in the drive.

4. Set the speed:

   - Select [Velocity].

   - Set the nominal speed with the arrow keys.

   - Accept the setting with OK ‹Enter›. The setting will then take effect in the drive.

i Position records with speed v = 0 or invalid target positions (-› error TARGET POSITION OUT OF LIMIT) cannot be executed.

5. Save the position set with [Save]. Only then will the settings be retained even when the power supply is switched off or if there is a power failure.

6. Enter the next position record.

Digitalization faults of the analogue-digital convertor can accumulate in the case of relative position movements which occur frequently one after the other and lead to deviations of the position values. If necessary, insert an absolute position set or reference travel into the positioning cycle, in order to correct deviations.

5.2.6 Test run

Warning
Injury to people and damage to property

With all positioning procedures the motor turns and the connected axis starts to move.

- Make sure that:
  - nobody can place his/her hand in the positioning range
  - there are no objects within the positioning path.

Caution
Damage to components.

Movement to the mechanical end positions (blocks) during operation is not permitted. When movement is made to the end positions with a heavy load, blockage may occur in the end positions.

- Limit the positioning range by defining valid software end positions during commissioning (see chapter 5.2.4).

1. Enter several position sets:
   - Set the target positions at the limits of the positioning range in order to check the software end positions.
   - Set different speeds.

```
→ Positioning
   ├── Demo posit tab
   ├── Move posit set
   └── Homing
```

2. Select [Positioning] [Move posit set] in order to process a certain position set or
3. Select [Positioning] [Demo posit tab] in order to process all position sets. At least two position records must be entered in the position record table in order that this function can be used.

In the positioning cycle [Demo posit tab] all position sets in the position record table are executed one after the other. If the position record table contains a position record with speed v = 0, this position record and all the following sets will not be executed; the positioning run will be continued with position record 1.

4. Start the test run.

Note
With EMERG.STOP ‹Menu› you can interrupt the current positioning procedure.

With DEMO STOP ‹Enter› you can interrupt the positioning cycle [Demo posit tab]. The current position record will be executed before the drive stops.

- Check the positioning behaviour.
- Check the positions displayed.

5. If necessary, optimize the settings for position records, and for the basis points and the working range.

5.2.7 Setting CAN parameters

Before commissioning on CANopen, valid CAN parameters must be set.

Station number (CAN Node ID)

- Permitted station numbers: 1 ... 127.
- The **invalid station number 0** is preset (displayed as “???”).
  This is to make sure that a correct address is set during commissioning or exchange.

Recommendation:
Assign the station numbers in ascending order. Assign the station numbers to suit the machine structure of your system.

Note
Station numbers may only be assigned once per field bus line.

The set number does not become effective until **after** Power off/on.

Set the station number as follows:

```
→ Settings
  CAN parameter
  └─ CAN Node ID
```

1. Select [Settings] [CAN parameter] [CAN Node ID] (see also section 4.5).
2. The current address is displayed with ‹Enter›.

```
  CAN Node ID

 110 dec, 6e hex

            ESC<Menu>
EDIT <-->   OK <Enter>
```

3. Set the desired address with the arrow buttons.
4. Accept the address with OK ‹Enter›. The set address becomes effective immediately and is saved against network failure.

Bit rate (CAN bit rate)

- Possible bit rates:
  1000 kBit/s (1 Mbit/s), 800 kBit/s, 500 kBit/s, 250 kBit/s, 125 kBit/s, 100 kBit/s, 50 kBit/s, 20 kBit/s.
- Preset is an **invalid bit rate**
  (on the control panel, displayed as “???”)
  This makes sure that a correct address is set during commissioning or exchange.

Note
All the stations on a fieldbus line must use the same bit rate. Otherwise, no communication will be possible.

The set bit rate is effective only **after** Power off/on!

Set the bit rate as follows:

```
→ Settings
  CAN parameter
  └─ CAN baud rate
```

1. Select [Settings] [CAN parameter] [CAN Baud rate] (see also section 4.5).
2. With “Enter” the current bit rate is displayed.

```
CAN baud rate

1000 kBd

               ESC "Menu"
EDIT "--"      OK "Enter"
```

3. Use the arrow keys to set the desired bit rate.
4. Accept the bit rate with OK “Enter”.
   The set bit rate is saved against network failure.

Data profile (CAN profile)

- Possible data profiles:
  - FHPP:
    Control of the MTR-DCI is made as per Festo Handling and Positioning Profile.
  - CiA 402:
    The MTR-DCI is activated and parameterised in accordance with CiA 402.
- An **invalid data profile** is preset (displayed as “???”). This ensures that the correct data profile has to be entered during commissioning or when replacing the unit.

For information on the data profile see section 1.2.2.

Set the data profile as follows:

```
→ Settings
  CAN parameter
  └─ CAN profile
```

1. Select [Settings] [CAN parameter] [CAN profile] (see also section 4.5).
2. Press ‹Enter› to display the current data profile.

```
  CAN profile

    FHPP

            ESC<Menu>
EDIT <-->   OK <Enter>
```

3. Use the arrow keys to set the desired data profile.
4. Accept the data profile with OK ‹Enter›.
   The pre-set profile takes effect immediately, and is saved against network failure.

CAN power supply (CAN Voltage Supply) (not with MTR-DCI-32)

– The following settings are possible: internal/external.

– The default setting is the internal voltage supply.

For information on the CAN voltage supply, see chapter 3.6, Tab. 3/8 and Tab. 3/9.

Set the CAN voltage supply as follows:

```
→ Settings
  CAN parameter
  └─ CAN volt.supply
```

1. Select [Settings] [CAN parameter] [CAN volt. supply] (see also section 4.5).

2. Press ‹Enter› to display the current setting.

```
  CAN volt.supply

    internal

              ESC<Menu>
EDIT <-->     OK  <Enter>
```

3. Use the arrow keys to set the desired power supply.

4. Accept the setting with OK ‹Enter›.
   The setting takes effect immediately, and is saved against network failure.

5.3 Commissioning with FCT

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 types of devices.

– a PlugIn for the special demands of each device type (e. g. MTR-DCI) with the necessary descriptions and dialogues. The PlugIns are managed and started from the framework.

Printed information

In order to use the complete Help or parts of it independently of a PC, you can use one of the following options:

- With the button "Print" in the Help window, print individual pages of the Help or all the pages of a book directly from the index of the Help.
- Print a prepared printed version of the Help in Adobe PDF format or Rich Text Format (RTF).

Printed version	Directory	File
FCT help	...(FCT installation directory)\Help\	– FCT_de.pdf – FCT_de.rtf
Plug-in help (MTR-DCI)	...(FCT installation directory)\HardwareFamilies\Festo\MTR-DCI\V...\Help\	– MTR-DCI_de.pdf – MTR-DCI_de.rtf

To print in Adobe PDF format, you will require Adobe Reader.

5.3.1 Installing the FCT

Note
The PlugIn MTR-DCI supports as from version V2.0.0 the following motor units:

– MTR-DCI-...-CO: Firmware version as from V1.00

- Check with later versions of the MTR-DCI to ascertain whether an updated PlugIn is provided. If necessary consult Festo.

Note
Administrator rights are required for installing the FCT.

The FCT is installed on your PC with an installation program. The PlugIn MTR-DCI is installed on your PC together with the installation program of the FCT.

1. Close all programs.
2. Place the Festo Configuration Tool CD in your CD ROM drive. If Auto Run is activated on your system, the installation will start automatically and you can omit steps 3 and 4.
3. Select [Run] in the Start menu.
4. Enter D:\setup (if necessary replace D by the letter of your CD ROM drive).
5. Follow the instructions on the screen.

5.3.2 Procedure

Start the FCT

1. Connect the MTR-DCI to your PC via the RS232 interface. Follow the instructions in chapter 3.4.

2. Start the FCT:
   Double click on the FCT icon on the desktop
   – or –
   switch to the Windows menu [Start] and select the entry [Festo Software] [Festo Configuration Tool].

3. Create a project in the FCT or open an existing project. Add a device to the project with the PlugIn MTR-DCI.

4. Create the device connection (online connection) between the PC and the MTR-DCI via the FCT tool bar. If necessary, the device names must be the same.

Device control

In order that the FCT can control the connected MTR-DCI, the control interface of the MTR-DCI must be deactivated and "Controller enable" for the FCT must be set (FCT/HMI=On). The actual status of the control bit ENABLE then has no effect.

- Switch to the window "Project output" and the register "Operate." Then under "Device control" activate first the box "FCT/HMI" and then the box "Enable."
  The control interface of the MTR-DCI will then be deactivated and Control Enable will be set by the FCT.

Instructions on parametrizing and commissioning

FCT framework

Information on workiing with projects and on adding components to a project can be found in the help for the FCT framework with the command [Help] [Contents FCT general].

PlugIn MTR-DCI

The MTR-DCI PlugIn for the FCT supports all the steps necessary for commissioning an MTR-DCI. The necessary parametrizings can be executed offline, i. e. without the MTR-DCI being connected to the PC. This enables preparation for the actual commissioning, e. g. in the design office when a new system is planned.

Further information can be found in the PlugIn help: The command [Help] [Contents of installed PlugIns] [Festo (manufacturer name)] [MTR-DCI (PlugIn name)], e. g.:

- for describing the dialogues of the “MTR-DCI device”
- for describing the work steps for commissioning
- for the basic functions: device connection, device names, device control and for password protection.

i

By means of the CANopen interface, access to the MTR-DCI through the Festo Configuration Tool can be blocked (see section 5.5.2, FHPP control bit CCON.B5, CiA 402 control word Bit14). In this case the boxes “FCT control” and “Enable” are blocked (inactive).

5.4 Commissioning on a CANopen master

The following sections describe the configuration and addressing of the MTR-DCI on a CANopen interface or CANopen master.

The following standard specifications have been taken into account:

Standard specifications	
DS 201 to DS 207	CAN Application Layer CAL
DS 301, Version 4.02	The Draft Standard 301 relies on the CAL-based communication profile.
DS 402, Version 2.0	The Draft Standard 402 defines the activation of drives via CANopen.

In order to understand this section, you should be familiar with CANopen and the specifications DS 301 and DS 402.

5.4.1 Overview of commissioning on the field bus

The following steps are required for commissioning the MTR-DCI as a field bus slave:

1. Set the following on the MTR-DCI:

Settings	Description
CAN address	Permitted address range: 1 ... 127 [1]
CAN bit rate	Permissible bit rates: 1000, 800, 500, 250, 125, 100, 50, 20 kBit/s
CAN data profile	Data or device profile, see section 1.2.2: – FHPP – CiA 402 The communications profile is in both cases DS 301.
CAN voltage supply	Supply to CAN interface; see section 3.6. – Internal voltage supply – External voltage supply
[1] May be restricted by the master used	

- on the control panel (only with MTR-DCI-...-H2, see section 5.2.7, or
- with the Festo Configuration Tool (see help for the Festo Configuration Tool).

2. Configure the CANopen master (5.4.2):
   - Install EDS file,
   - or make settings manually.
3. Test the field bus connection in online mode.

Details can be found in the following sections.

5.4.2 Configuration of the CANopen master ("I/O configuration")

Configuration with EDS file

"EDS files" are available for configuring the CANopen master. These files are installed with the aid of the configuration software of the CANopen master. The detailed procedure can be found in the manuals for this software.

Obtainable from:

The accompanying CD contains EDS files for the MTR-DCI in the "CANopen" folder. You will find the latest EDS files on the Festo website (www.festo.com).

EDS file:

For the MTR-DCI you will need one of the following EDS files (in English):

- MTR-DCI-32/42/52/62-FHPP.eds
  for data profile FHPP, depending on size.
- MTR-DCI-32/42/52/62-DS402.eds
  for data profile CiA 402, depending on size.

Manual configuration

Manufacturer's ID:

- 1Dh

Profile ID dependent on data or device profile:

- FHPP: 12Dh
- CiA 402: 420192h

5.4.3 Communication

When the power unit is switched on, all the slaves on the bus initialize themselves and then remain in the network status “Pre-Operational.”

Pre-Operational

Only communication via SDO is possible in this status. This service serves exclusively for parametrizing via SDOs (DS 301 Profile, Indices 1000h ...1999h). PDO telegrams will be ignored by the individual bus slaves.

The communication parameters of the PDOs of the MTR-DCI are preassigned as follows when the device is switched on:

Object		Communication parameter
1400h	RPDO 1	– transmission type = 255 [1]
1401h	RPDO 2	
1800h	TPDO 1	– transmission type = 255 [1] – inhibit time = 0 – event timer = 0
1801h	TPDO 2	

[1] asynchronous transmission (event triggered)

This parameter setting corresponds to the default asynchronous transmission of most masters. It is possible to change to synchronous transmission, for example, by applying the corresponding values from the DS 301 communications profile to the communication parameters, though changing the mapping is not.

Operational

After successful parametrizing, the CANopen master can switch slaves into the Operational status with a special network management telegram (NMT).

In this status communication via SDO and PDO is possible. With the aid of the NMT telegrams you can switch between the different states, if required.

5.4.4 PDO mapping

The mapping is pre-set ("static mapping") and cannot be altered by the configuration software of the master.

Note
If the data on the master side are not in the same form, but saved, i. e. as byte array:

- note that the representation of words and double words appears in the "little endian" representation when transmitted via CAN (lower-value byte first).

PDO mapping in FHPP

In FHPP mode the first PDO (8 bytes I/O data) for Transmit and Receive is intended for the Record Select and Direct modes; the second PDO (8 bytes I/O data) is used for FPC (Festo Parameter Channel) parameterization.

Receive PDO 1 (FHPP standard)

Operating mode	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Record Select	CCON	CPOS	Record no.	reserved	reserved			
Direct mode			CDIR	Nominal value 1	Nominal value 2			

Receive PDO 2 (FHPP-FPC)

Function	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Control	reserved							
Parametrize	reserved	Subindex	Task identifier + parameter number		Parameter value			

Receive PDO 1 (FHPP standard)								
Operating mode	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Record Select	SCON	SPOS	Record no.	RSB	Actual position			
Direct mode			SDIR	Actual value 1				

Receive PDO 2 (FHPP-FPC)								
Function	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Control	reserved							
Parametrize	reserved	Subindex	Task identifier + parameter number		Parameter value			

PDO mapping with CiA 402

Receive PDO 1 (CiA 402) [1]							
Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Control word 6040h		Set number 2032h	Operating mode 6060h	Nominal value – Positioning mode Setpoint (nominal) position 607Ah – Power operation Nominal torque 6071h			

[1] Evaluation sequence:
- Read the operating mode 6061h
- Accept the set number 2032h
- Accept nominal value (only if set number 0 is for “Direct set”. Otherwise the value from the set list applies to the specified set).
- Execute control word 6040h.

Receive PDO 2 (CiA 402)[1)]

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Velocity 6081h				Acceleration 6083h			

1) The velocity and acceleration are only accepted if the set number received via PDO 1 is 0 for "Direct set". It is not possible to overwrite the set list by PDO.

Transmit PDO 1 (CiA 402)

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Status word 6041h		Set number 2032h	Operating mode 6061h	Actual value – Actual position 6064h [1)] – Actual torque 6077h			

1) With the Transmit PDO a new transmission is only sent if the value has changed by more than 1. (To avoid high bus loading caused by jitter on the position decoder).

Transmit PDO 2 (CiA 402)

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Reserved (this PDO is not supported).							

5.5 Festo profile for handling and positioning (FHPP standard)

5.5.1 Supported operating modes

The operating modes differ as regards their contents and the meaning of the cyclic I/O data and in the functions which can be accessed in the MTR-DCI.

Operating mode	Description
Record Select (Default)	31 position sets can be saved in the MTR-DCI. A record contains all the parameters which are specified for a positioning task. The record number is transferred to the cyclic I/O data as the nominal or actual value/FHPP standard).
Direct mode	The positioning task is transferred directly in the I/O telegram (FHPP standard). The most important nominal values (position, velocity, force/torque...) are thereby transferred. Supplementary parameters are determined via the parametrizing (FHPP FPC).

Tab. 5/6: Overview of operating modes

The operating mode is switched by the control byte CCON (see below) and indicated in the status byte SCON. Definition by means of parametrization is not possible. Switching between modes is only permitted in the “Drive disabled” or “Drive enabled” status.

Record select

Positioning mode

The MTR-DCI possesses 31 records (1 ... 31) which contain all the information necessary for a positioning task (+ record 0 = reference travel).

The record number, which the MTR-DCI is to process at the next start, is transferred to the output data of the master. The input data contains the last processed record number. The positioning task itself does not need to be active.

The MTR-DCI cannot function independently, i. e. it does not have its own user program. Records cannot be processed automatically with a programmed logic. The drive cannot accomplish any tasks sensibly with Stand Alone; close coupling to the PLC is necessary.

There are also three records with special functions (which cannot be executed in Record Select mode):

– Set 32 contains the parameters for the Jog mode.

– Set 33 contains the parameters for Direct mode.

– Set 34 is the direct set for the FCT software.

Direct mode

In the direct mode positioning tasks are formulated directly in the output data of the master.

Positioning mode

The typical application calculates dynamically the nominal target values for each task or just for some tasks. Adaption to different work item sizes is therefore possible. It is not sensible here to parametrize the record list again each time. The positioning data are managed completely in the PLC and sent directly to the MTR-DCI. Here also, close coupling between the PLC and the MTR-DCI is necessary.

Power operation

Alternatively, nominal values relative to the rated motor currennt can be specified as direct mode. This results in a rotary torque and with linear drives in a force (power control).

5.5.2 Composition of the cyclic I/O data (FHPP standard)

The FHPP standard protocol always contains 8 bytes input and 8 bytes output data.

Further 8 bytes I/O as per FHPP-FPC
In the cyclic data a further 8 bytes input data and 8 bytes output data are permitted for transmitting parameters in accordance with the FPC protocol (Festo Parameter Channel). The I/O data and the parameters are described in section B.1.

<table>
<tr><th>Data</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6</th><th>Byte 7</th><th>Byte 8</th></tr>
<tr><td>Output data</td><td colspan="2" rowspan="2">Bytes 1 and 2 (fixed) are retained in each operating mode and transmit control and status bytes (e. g. CCon, SCON....) for enabling the MTR-DCI and for setting the operating modes.</td><td colspan="6" rowspan="2">Bytes 3 to 8 depend on the operating mode selected (Direct mode, Record select) and transmit further control and status bytes (e. g. CDir, SDir...), as well as nominal and actual values.
– Record number or nominal position in the output data,
– Return message of actual position and record number in the input data,
– Further nominal and actual values depending on the operating mode.</td></tr>
<tr><td>Input data</td></tr>
</table>

I/O data Record select

Data	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	CPOS	Record number	reserved	reserved			
Input data	SCON	SPOS	Record number	RSB	Actual position			

I/O data Direct mode

Data	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Output data	CCON	CPOS	CDIR	**Nominal value 1** (velocity)	**Nominal value 2** (position, force/torque,...)			
Input data	SCON	SPOS	SDIR	**Actual value 1** (velocity, force/torque,...)	**Actual value 2** (actual position)			

Assignment of the control bytes (overview) [1]

CCON	**B7 OPM2**	**B6 OPM1**	**B5 LOCK**	**B4 –**	**B3 RESET**	**B2 BRAKE**	**B1 STOP**	**B0 ENABLE**
	Operating mode selection		MMI access blocked	–	Quit fault	–	Stop	Enable drive
CPOS	**B7 –**	**B6 CLEAR**	**B5 TEACH**	**B4 JOGN**	**B3 JOGP**	**B2 HOM**	**B1 START**	**B0 HOLD**
	–	Delete remaining path	Teach value	Jogging negative	Jogging positive	Start homing	Start positioning task	Hold
CDIR (only Direct mode)	**B7 FUNC**	**B6 FAST**	**B5 XLIM**	**B4 VLIM**	**B3 CONT**	**B2 COM2**	**B1 COM1**	**B0 ABS**
	–	–	Deactivate stroke limit	–	–	Control mode (position, force/torque, ...)		absolute/relative

[1] – : reserved

Assignment of the status bytes (overview) [1]

SCON	**B7 OPM2**	**B6 OPM1**	**B5 LOCK**	**B4 24VL**	**B3 FAULT**	**B2 WARN**	**B1 OPEN**	**B0 ENABLED**
	Reply message operating mode		Device controller FCT/MMI	Load voltage applied	Fault	Warning	Mode enabled	Drive enabled
SPOS	**B7 REF**	**B6 STILL**	**B5 DEV**	**B4 MOV**	**B3 TEACH**	**B2 MC**	**B1 ACK**	**B0 HOLD**
	Drive referenced	Downtime monitoring	Drag error	The axis moves	Quit Teach	Motion Complete	Quit Start	Hold
SDIR (only Direct mode)	**B7 FUNC**	**B6 FAST**	**B5 XLIM**	**B4 VLIM**	**B3 CONT**	**B2 COM2**	**B1 COM1**	**B0 ABS**
	–	–	Stroke limit reached	Velocity limit reached	–	Reply message control mode (position, force/torque, ...)		absolute/relative

[1] – : reserved

5.5.3 Description of the I/O data (Record select)

Description of the output data Record select

Byte	Bit	EN	Description
1	**B0 ... B7**	CCON	Control bytes, see chapter 5.5.5
2	**B0 ... B7**	CPOS	
3	**B0 ... B7**	Record number	Preselect of record number for Record select (0...31)
4	**B0 ... B7**	–	reserved (= 0)
5 ... 8	**B0...B31**	–	reserved (= 0)

Description of the input data Record select

Byte	Bit	EN	Description
1	**B0 ... B7**	SCON	Status bytes, see chapter 5.5.6
2	**B0 ... B7**	SPOS	
3	**B0 ... B7**	Record number	Reply message of record number for Record select (0...31)
4	**B0 ... B7**	Record status byte (RSB)	see SDIR with Direct mode, chapter 5.5.6
5 ... 8	**B0 ... B31**	Position, ...	Reply message of position for Record select: – position in increments (32-bit number, low byte first)

5.5.4 Description of the I/O data (Direct mode)

Output data – direct mode

Byte	Bit	EN	Description
1	**B0 … B7**	CCON	Control bytes, see chapter 5.5.5
2	**B0 … B7**	CPOS	
3	**B0 … B7**	CDIR	
4	**B0 … B7**	Velocity	Nominal value 1 Velocity in % of the maximum speed
5 … 8	**B0…B31**	Position Force, …	Nominal value 2 Specification depends on the controller operating mode (see control byte 3 CDIR) – Positioning mode Position in increments – Power operation Force/torque in % of the rated current

Input data – direct mode

Byte	Bit	EN	Description
1	**B0 … B7**	SCON	Status bytes, see chapter 5.5.6
2	**B0 … B7**	SPOS	
3	**B0 … B7**	SDIR	
4	**B0 … B7**	Velocity Force/torque	Actual value 1 Reply message depends on the controller operating mode (see control byte 3 CDIR) – Positioning mode Velocity in % of the maximum speed – Power operation Force/torque in % of the rated current
5 … 8	**B0…B31**	Position	Actual value 2 Reply message position in increments

5.5.5 Description of the control bytes CCON, CPOS, CDIR

CCON

With control byte 1 (CCON) all the states are controlled which must be available in all operating modes. The cooperation of the control bits can be found under the description of the drive functions in section 5.6.

Control byte 1 (CCON)

Bit	EN	Description
B0 **ENABLE**	Drive **Enable**	= 1: Drive (controller) enabled = 0: Drive (controller) blocked
B1 **STOP**	**Stop** 1	= 1: Operation enabled. Faults will be deleted. = 0: Stop 1 active (cancel emergency ramp + positioning task). The axis stops with maximum braking ramp, the positioning task is reset.
B2 **BRAKE**	–	reserved := 0
B3 **RESET**	**Reset** Error	With a rising edge a fault is quitted and the fault value is deleted.
B4 **–**	–	reserved := 0
B5 **LOCK**	HMI Access **Lock**ed	Controls access to the diagnostic interface of the drive. = 1: MMI and FCT may only observe the drive, the device control (HMI control) cannot be taken over by MMI and FCT. = 0: MMI or FCT may take over the device control (in order to modify parameters or to control inputs)
B6 **OPM1**	Select **Op**era-ting **M**ode	= 00: Record select = 01: Direct mode = 10: reserved = 11: reserved
B7 **OPM2**		

[1] Switching between Record select and Direct mode is also permitted in the status “Ready.”

CPOS

Control byte 2 (CPOS) controls the positioning sequences as soon as the drive is enabled.

Control byte 2 (CPOS)- Record select and Direct mode		
Bit	**EN**	**Description**
B0 **HOLD**	**Hold**	= 1: Hold is not active = 0: Hold activated (do not cancel braking ramp + positioning task). The axis stops with a defined braking ramp, the positioning task remains active (with B6 the remaining path can be deleted).
B1 **START**	**Start** positio-ning task	With a **rising edge** the current nominal values will be transferred and positioning started (record 0 = reference travel).
B2 **HOM**	Start **hom**ing	With a **rising edge** homing is started with the set parameters.
B3 **JOGP**	**Jog p**ositive	The drive moves at the specified velocity or rotational speed in the direction of larger actual values, providing the bit is set. The movement begins with the rising edge and ends with the falling edge.
B4 **JOGN**	**Jog n**egative	The drive moves at the specified velocity or rotational speed in the direction of smaller actual values, see bit 3.
B5 **TEACH**	**Teach** actual value	At a **falling edge** the current actual position is imported into the setpoint register of the currently addressed positioning set; see section 5.6.3. The Teach target is defined with PNU 520.
B6 **CLEAR**	**Clear** remai-ning position	In the “Hold” status a **rising edge** causes the positioning task to be deleted and transfer to the status “Ready.”
B7 **–**	–	reserved :=0

CDIR

Control byte CDIR is a special control byte for the operating mode “Direct mode.”

Control byte 3 (CDIR) – only Direct mode		
Bit	**EN**	**Description**
B0 **ABS**	**Abs**olute/ Relative	= 0: Nominal value is absolute = 1: Nominal value is relative to last nominal value
B1 **COM1**	**Co**ntrol **m**ode	= 00: Positioning mode (see also 5.5.7 point 6) = 01: Power operation (see also 5.5.7 point 7) = 10: reserved = 11: reserved
B2 **COM2**		
B3 **CONT**	–	reserved := 0
B4 **VLIM**	–	reserved := 0
B5 **XLIM**	Stroke (**X**-) **lim**it not active	Power control = 0: Stroke monitoring active = 1: Stroke monitoring not active
B6 **FAST**	–	reserved := 0
B7 **FUNC**	–	reserved := 0

5.5.6 Description of the status bytes SCON, SPOS, SDIR (RSB)

Status byte 1 (SCON)		
Bit	**EN**	**Description**
B0 **ENABLED**	Drive **Enable**d	= 0: Drive blocked, controller not active = 1: Drive (controller) enabled
B1 **OPEN**	**Op**eration **En**abled	= 0: Stop active = 1: Mode enabled, positioning possible
B2 **WARN**	**Warn**ing	= 0: Warning not applied = 1: Warning applied
B3 **FAULT**	**Fault**	= 0: No fault = 1: There is a fault or fault reaction is active Fault code in the fault buffer
B4 **24VL**	**S**upply **V**oltage is **A**pplied	= 0: No load voltage = 1: Load voltage applied
B5 **FCT/** **MMI**	Drive Control by FCT/MMI	= 0: Device control through PLC/fieldbus = 1: Device control through FCT/MMI (PLC control is **Lock**ed)
B6 **OPM1**	Display **Op**erating **M**ode	= 00: Record select (standard) = 01: Direct mode = 10: reserved = 11: reserved
B7 **OPM2**		

Status byte 2 (SPOS)

Bit	EN	Description
B0 **HOLD**	**Hold**	= 0: Hold is active = 1: Hold is not active, axis can be moved
B1 **ACK**	**Ack**nowledge Start	= 0: Ready for start (reference, jog) = 1: Start carried out (reference, jog)
B2 **MC**	**M**otion **C**omplete	= 0: Positioning task active = 1: Positioning task completed, where applicable with fault Note: MC is set after device is switched on (status “Drive blocked”)
B3 **TEACH**	Acknowledge **Teach**	= 0: Ready for teaching = 1: Teaching carried out, actual value is transferred
B4 **MOV**	Axis is **mov**ing	= 0: Speed of the axis < Limit value = 1: Speed of the axis >= Limit value
B5 **DEV**	Drag Error	= 0: No drag error = 1: Drag error active
B6 **STILL**	Standstill control	= 0: After MC axis remains in tolerance window = 1: After MC axis remains outside tolerance window
B7 **REF**	Axis is referenced	= 0: Referencing must be carried out = 1: Reference information exists, reference travel must not be carried out

Status byte 3 (SDIR) – Direct mode

Bit	EN	Description
B0 **ABS**	**Abs**olute/ Relative	= 0: Nominal value is absolute = 1: Nominal value is relative to last nominal value
B1 **COM1**	**Co**ntrol **M**ode feedback	= 00: Positioning mode = 01: Power operation = 10: reserved = 11: reserved
B2 **COM2**		
B3 **CONT**	–	reserved
B4 **VLIM**	Speed (**V**-) **LIM**it reached	Power operation = 1: Speed limit reached = 0: Speed limit not reached
B5 **XLIM**	Stroke (**X**-) **LIM**it reached	Power operation = 1: Stroke limit value reached = 0: Stroke limit value not reached
B6 **FAST**	–	reserved
B7 **FUNC**	–	reserved

5.5.7 Examples of the I/O data

On the following pages you will find typical examples of the I/O data as per FHPP Standard.

1. Record select: Create readiness to operate
2. Direct mode Create readiness to operate
3. Error treatment
4. Homing
5. Record select: Positioning mode
6. Direct mode Positioning mode
7. Direct mode Power operation

A description of the status machine of the MTR-DCI can be found in section B.3.

Safeguard device control

Step/ Description	**Output data**									**Input data**								
	Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	**Byte**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
0.1 device control HMI = on	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	0	0	0	0	x	0	0	SCON	0	0	**1**	**1**	0	0	0	0
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	0	0	SPOS	0	0	0	0	0	**1**	0	0
0: 0-signal 1: 1-signal; x: not relevant (optional); F: Edge positive																		

Tab. 5/7: I/O data “Device control active”

Device control via the control panel or the Festo Configuration Tool is activated. To control the MTR-DCI via the CANopen interface, device control must first be deactivated by FCT/MMI.

1. Record select Create readiness to operate

1.1 Basic status of the drive when the supply voltage has been switched on.
⟶ Step 1.2 or 1.3

1.2 Disable device control by FCT/MMI.
Optionally, assuming of device control by the FCT/MMI can be disabled with CCON.B5 = 1 (LOCK).
⟶ Step 1.3

1.3 Enable drive (Record select)
⟶ Reference travel: Example 4, Tab. 5/11.

Step/ Description	Output data Byte	B7	B6	B5	B4	B3	B2	B1	B0	Input data Byte	B7	B6	B5	B4	B3	B2	B1	B0
1.1 Basic status	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
(device control HMI = off)	CCON	0	0	0	0	0	x	0	0	SCON	0	0	**0**	**1**	0	0	0	0
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	0	0	SPOS	0	0	0	0	0	**1**	0	0
1.2 Disable device control by FCT/MMI	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	x	x	**1**	0	x	x	x	x	SCON	x	x	**0**	x	x	x	x	x
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	x	x	x	x	x	x	x	SPOS	x	x	x	x	x	x	x	x
1.3 Enable drive, enable operation	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
(Record select)	CCON	**0**	**0**	x	0	0	x	**1**	**1**	SCON	**0**	**0**	0	1	0	0	**1**	**1**
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	0	**1**	SPOS	0	0	0	0	0	1	0	**1**

0: 0-signal   1: 1-signal;   x: not relevant (optional);   F: Edge positive

Tab. 5/8: I/O data “Record select: Create readiness to operate”

If there are faults after switching on or after setting CCON.B0 (ENABLE):
⟶ Error treatment: see example 3, Tab. 5/10.

2. Direct mode Create readiness to operate

2.1 Basic status of the drive when the supply voltage has been switched on.
⟶ Step 2.2 or 2.3

2.2 Disable device control by FCT/MMI.
Optionally, assuming of device control by the FCT/MMI can be disabled with CCON.B5 = 1 (LOCK).
⟶ Step 2.3

2.3 Enable drive. (Direct mode)
⟶ Reference travel: Example 4, Tab. 5/11.

Step/ Description	**Output data**									**Input data**								
	Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	**Byte**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
2.1 Basic status	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
(device control HMI = off)	CCON	0	0	0	0	0	x	0	0	SCON	0	0	**0**	**1**	0	0	0	0
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	0	0	SPOS	0	0	0	0	0	**1**	0	0
2.2 Disable device control by FCT/MMI	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	x	x	**1**	0	x	x	x	x	SCON	x	x	**0**	x	x	x	x	x
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	x	x	x	x	x	x	x	SPOS	x	x	x	x	x	x	x	x
2.3 Enable drive, enable operation	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
(Direct mode)	CCON	**0**	**1**	x	0	0	x	**1**	**1**	SCON	**0**	**1**	0	1	0	0	**1**	**1**
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	0	**1**	SPOS	0	0	0	0	0	1	0	**1**
0: 0-signal 1: 1-signal; x: not relevant (optional); F: Edge positive																		

Tab. 5/9: Control and status bytes “Create readiness to operate – Direct mode”

If there are faults after switching on or after setting CCON.B0 (ENABLE):
⟶ Error treatment: see example 3, Tab. 5/10.

3. Error treatment

Description of faults and warnings see section 6.5.

3.1 A fault is shown with SCON.B3 (FAULT).
→ Positioning can no longer be undertaken.

3.2 A warning is shown with SCON.B2 (WARN).
→ Positioning can still be undertaken.

3.3 Acknowledge malfunction with positive edge at CCON.B3 (RESET).
→ Fault bit SCON.B3 (FAULT) or SCON.B2 (WARN) is reset
→ SPOS.B2 (MC) is set
→ Drive is ready to operate

3.4 Acknowledge malfunction with negative edge at CCON.B0 (ENABLE).
→ Fault bit SCON.B3 (FAULT) or SCON.B2 (WARN) is reset
→ SPOS.B2 (MC) is set
→ Establish readiness to operate again (see example 1, Tab. 5/8 and 2, Tab. 5/9)

Independent of the data or device profile used, emergency telegrams are sent in the event of errors (not with warnings). Form and error code as per DS 301 and CiA 402; see section 6.5.2.

Step/ Description	**Output data**									**Input data**								
	Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	**Byte**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
3.1 Fault	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	x	x	x	0	x	x	x	x	SCON	x	x	x	x	**1**	x	x	x
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	x	x	x	x	x	x	x	SPOS	x	x	x	x	x	**0**	x	x
3.2 Warning	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	x	x	x	0	x	x	x	x	SCON	x	x	x	x	x	**1**	x	x
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	x	x	x	x	x	x	x	SPOS	x	x	x	x	x	**0**	x	x
3.3 Quit fault with CCON.B3 (RESET)	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	x	x	0	**F**	x	x	1	SCON	0	x	0	1	**0**	**0**	0	0
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	x	x	SPOS	x	0	0	0	0	**1**	**0**	1
3.4 Quit fault with CCON.B0 (ENABLE)	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	x	x	0	0	x	x	**N**	SCON	0	x	0	1	**0**	**0**	x	**0**
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	x	x	SPOS	x	0	0	0	0	**1**	x	x

0: 0-signal   1: 1-signal;   x: not relevant (optional);   F: Edge positive

Tab. 5/10: I/O data “Fault treatment”

4. Reference travel (requires status 1.4 or 1.5)

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

4.2 Movement of the axis is shown with SPOS.B4 (MOV, Axis moves).

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

Step/ Description	**Output data**									**Input data**								
	Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	**Byte**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
4.1 Start reference travel	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	x	x	0	0	x	1	1	SCON	0	x	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	**F**	0	1	SPOS	0	0	0	0	0	**0**	**1**	1
4.2 Reference travel runs	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	x	x	0	0	x	1	1	SCON	0	x	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	**1**	0	1	SPOS	0	0	0	**1**	0	0	1	1
4.3 Reference travel concluded	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	x	x	0	0	x	1	1	SCON	0	x	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	**0**	0	1	SPOS	**1**	0	0	0	0	**1**	0	1
0: 0-signal 1: 1-signal; x: not relevant (optional); F: Edge positive																		

Tab. 5/11: I/O data "Reference travel"

If there are faults during reference travel:
⟶ Error treatment: see example 3, Tab. 5/10.

5. Record select Positioning mode (requires status 1.3/2.3 and 4.)

When the readiness to operate is created and the reference travel has been carried out, a positioning task can be started (steps 5.1 ... 5.4 conditional sequence)

5.1 Preselect record number: Byte 3 of the output data
0 = Reference run
1...31 = Programmable positioning records

5.2 With CPOS.B1 (START, Start job) the preselected positioning job will be started. The start is confirmed with SPOS.B1 (Acknowledge Start) as long as CPOS.B1 (START) is set.

5.3 Movement of the axis is shown with SPOS.B4 (MOV, Axis moves).

5.4 At the end of the positioning task, SPOS.B2 (MC, Motion Complete) will be set.

If there are faults during positioning:
⟶ Error treatment: see example 3, Tab. 5/10.

Step/ Description	Output data Byte	B7	B6	B5	B4	B3	B2	B1	B0	Input data Byte	B7	B6	B5	B4	B3	B2	B1	B0
5.1 Preselect record number (byte 3)	Byte3	Record number								Byte 3	Record number							
	Re-cord no.	Record no. (0...31)								Re-cord no.	Previous record no. (0...31)							
5.2 Start order	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	0	x	0	0	x	1	1	SCON	0	0	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	**F**	1	SPOS	1	0	0	0	0	**0**	1	1
5.3 Order runs	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	0	x	0	0	x	1	1	SCON	0	0	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	**1**	1	SPOS	1	0	0	**1**	0	0	**1**	1
	Byte3	Record number								Byte 3	Record number							
	Re-cord no.	Record no. (0...31)								Re-cord no.	Current record no. (0..0.31)							
5.4 Order concluded	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	0	x	0	0	x	1	1	SCON	0	0	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	**0**	1	SPOS	1	0	0	**0**	0	**1**	**0**	1
	Byte 5...8	reserved								Byte 5...8	Position							
	–	reserved								Actual posi-tion	Actual position (increments)							
0: 0-signal 1: 1-signal; x: not relevant (optional); F: Edge positive																		

Tab. 5/12: I/O data “Record Select: positioning mode”

6. Direct mode Positioning mode (requires status 1.3/2.3 and 4.)

When the readiness to operate is created and the reference travel has been carried out, a nominal position must be preselected (step 6.1 ... 6.4 conditional sequence)

6.1 The nominal position is transferred in increments in bytes 5...8 of the output word.
The nominal speed is transferred in % in byte 3 (0 = no speed; 100 = max. speed).

6.2 With CPOS.B1 START (Start positioning job) the preselected positioning job will be started. The start is confirmed with SPOS.B1 (Acknowledge Start) as long as CPOS.B1 (START) is set.

6.3 Movement of the axis is shown with SPOS.B4 (MOV, Axis moves).

6.4 At the end of the positioning task, SPOS.B2 (MC, Motion Complete) will be set.

If there are faults during positioning:
⟶ Error treatment: see example 3, Tab. 5/10.

Step/ Description	Output data Byte	B7	B6	B5	B4	B3	B2	B1	B0	Input data Byte	B7	B6	B5	B4	B3	B2	B1	B0
6.1 Preselect position and speed (bytes 4 and 5…8)	Byte 4 Velo-city	Velocity: Velocity preselect (0…100 %)								Byte 4 Veloc-ity	Velocity: Velocity reply message (0…100 %)							
	Byte 5…8 No-minal (tar-get) posi-tion	Position: Target position (increments), See section 5.5.2								Byte 5…8 Actual posi-tion	Position: Actual position (increments), See section 5.5.2							
6.2 Start order	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	1	x	0	0	x	1	1	SCON	0	1	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	**F**	1	SPOS	1	0	0	0	0	**0**	**1**	1
	Byte 3	FUNC	FAST	XLIM	VLIM	CONT	COM2	COM1	ABS	Byte 3	FUNC	FAST	XLIM	VLIM	CONT	COM2	COM1	ABS
	CDIR	0	0	0	0	0	0	0	**S**	SDIR	0	0	0	0	0	0	0	**S**
6.3. Order runs	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	1	x	0	0	x	1	1	SCON	0	1	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	**1**	1	SPOS	1	0	0	**1**	0	0	1	1
6.4 Order concluded	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	1	x	0	0	x	1	1	SCON	0	1	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	0	0	0	0	0	0	**0**	1	SPOS	1	0	0	**0**	0	**1**	0	1

0: 0-signal 1: 1-signal; x: not relevant (optional); F: Edge positive
S: Positioning condition: 0= absolute; 1 = relative

Tab. 5/13: I/O data "Direct mode: positioning mode"

7. Direct mode Power operation (requires status 1.3/2.3 and 4.)

When the readiness to operate is created and the reference travel has been carried out, a nominal position must be preselected and the power operation must be prepared.

7.1 Specify the nominal value in % of the rated motor current. (Note frictional influences of the connected axis).

7.2 Prepare power operation Set bit CDIR.B1 COM1 and if desired set bit CDIR.B5 XLIM for the stroke limitation.

7.3 Start the job with CPOS.B1 START. The start is confirmed with SPOS.B1 (Acknowledge Start) as long as CPOS.B1 (START) is set.

7.4 or 7.5
Depending on whether the nominal value is reached or not, the relevant bits in the status will be set.

7.6 The task will be finished automatically when the stroke limit or software end position is reached. Switching is made again to position control.

7.7 The task can be discontinued by the controller e. g. with STOP.

Note
Modification of the nominal value with power operation is only possible with a new starting edge when the last specified position (MC) has been reached.

Step/ Description	**Output data**									**Input data**								
	Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	**Byte**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
7.1 Specify nominal value	4	not relevant								4	Actual value in % of the rated current							
	5...8	Actual value in % of the rated current								5...8	Actual position in increments							
7.2 Prepare power operation	Byte 1 CCON	OPM2 0	OPM1 1	LOCK x	– x	RESET 0	BRAKE x	STOP 1	ENABLE 1	Byte 1 SCON	OPM2 0	OPM1 1	LOCK 0	24VL 1	FAULT 0	WARN 0	OPEN 1	ENABLE 1
	Byte 2 CPOS	– x	CLEAR 0	TEACH 0	JOGN 0	JOGP 0	HOM 0	START 0	HOLD 1	Byte 2 SPOS	REF 1	STILL 0	DEV 0	MOV 0	TEACH 0	MC 1	ACK 0	HOLD 1
	Byte 3 CDIR	FUNC 0	FAST 0	XUM **S**	– x	CONT 0	COM2 0	COM1 **1**	ABS 0	Byte 3 SDIR	FUNC 0	FAST 0	XUM **0**	VUM x	CONT 0	COM2 0	COM1 **0**	ABS 0
7.3 Start order	Byte 1 CCON	OPM2 0	OPM1 1	LOCK x	– x	RESET 0	BRAKE x	STOP 1	ENABLE 1	Byte 1 SCON	OPM2 0	OPM1 1	LOCK 0	24VL 1	FAULT 0	WARN 0	OPEN 1	ENABLE 1
	Byte 2 CPOS	– x	CLEAR 0	TEACH 0	JOGN 0	JOGP 0	HOM 0	START **F**	HOLD 1	Byte 2 SPOS	REF 1	STILL 0	DEV 0	MOV 0	TEACH 0	MC **0**	ACK **1**	HOLD 1
	Byte 3 CDIR	FUNC 0	FAST 0	XUM S	– x	CONT 0	COM2 0	COM1 1	ABS 0	Byte 3 SDIR	FUNC 0	FAST 0	XUM 0	VUM 0	CONT 0	COM2 0	COM1 1	ABS 0
7.4 Order runs (nominal value not reached)	Byte 1 CCON	OPM2 0	OPM1 1	LOCK x	– x	RESET 0	BRAKE x	STOP 1	ENABLE 1	Byte 1 SCON	OPM2 0	OPM1 1	LOCK 0	24VL 1	FAULT 0	WARN 0	OPEN 1	ENABLE 1
	Byte 2 CPOS	– x	CLEAR 0	TEACH 0	JOGN 0	JOGP 0	HOM 0	START **x**	HOLD 1	Byte 2 SPOS	REF 1	STILL 0	DEV 0	MOV **1**	TEACH 0	MC 0	ACK x	HOLD 1
	Byte 3 CDIR	FUNC 0	FAST 0	XUM S	– x	CONT 0	COM2 0	COM1 1	ABS 0	Byte 3 SDIR	FUNC 0	FAST 0	XUM 0	VUM **1**	CONT 0	COM2 0	COM1 1	ABS 0
7.5 Order runs (nominal value reached)	Byte 1 CCON	OPM2 0	OPM1 1	LOCK x	– x	RESET 0	BRAKE x	STOP 1	ENABLE 1	Byte 1 SCON	OPM2 0	OPM1 1	LOCK 0	24VL 1	FAULT 0	WARN 0	OPEN 1	ENABLE 1
	Byte 2 CPOS	– x	CLEAR 0	TEACH 0	JOGN 0	JOGP 0	HOM 0	START **x**	HOLD 1	Byte 2 SPOS	REF 1	STILL 0	DEV 0	MOV **0**	TEACH 0	MC **1**	ACK x	HOLD 1
	Byte 3 CDIR	FUNC 0	FAST 0	XUM S	– x	CONT 0	COM2 0	COM1 1	ABS 0	Byte 3 SDIR	FUNC 0	FAST 0	XUM 0	VUM **0**	CONT 0	COM2 0	COM1 1	ABS 0

Step/ Description	**Output data**									**Input data**								
	Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	**Byte**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
7.6 Task discontinued (stroke limit or software end position reached)	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	1	x	x	0	x	1	1	SCON	0	1	0	1	0	0	1	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	x	0	0	0	0	0	**x**	1	SPOS	1	0	0	0	0	**1**	x	1
	Byte 3	FUNC	FAST	XUM	–	CONT	COM2	COM1	ABS	Byte 3	FUNC	FAST	XUM	VUM	CONT	COM2	COM1	ABS
	CDIR	0	0	S	x	0	0	1	0	SDIR	0	0	**1**	0	0	0	**0**	0
7.7 Conclude task (e. g. with STOP)	Byte 1	OPM2	OPM1	LOCK	–	RESET	BRAKE	STOP	ENABLE	Byte 1	OPM2	OPM1	LOCK	24VL	FAULT	WARN	OPEN	ENABLE
	CCON	0	1	x	x	0	x	**0**	1	SCON	0	1	0	1	0	0	**0**	1
	Byte 2	–	CLEAR	TEACH	JOGN	JOGP	HOM	START	HOLD	Byte 2	REF	STILL	DEV	MOV	TEACH	MC	ACK	HOLD
	CPOS	x	0	0	0	0	0	**x**	1	SPOS	1	0	0	0	0	1	x	1
	Byte 3	FUNC	FAST	XUM	–	CONT	COM2	COM1	ABS	Byte 3	FUNC	FAST	XUM	VUM	CONT	COM2	COM1	ABS
	CDIR	0	0	S	x	0	0	1	0	SDIR	0	0	0	0	0	0	**0**	0

0: 0-signal 1: 1-signal; x: not relevant (optional); F: Edge positive
S: Path limitation (stroke limit) 0 = Stroke limit active, 1 = Stroke limit not active

Tab. 5/14: I/O data Direct mode Power operation

If there are malfunctions during force mode:
See example 3, Tab. 5/13 Malfunction handling.

5.6 Sequence control as per FHPP standard

5.6.1 Homing

Information on homing (reference travel), reference coordinates and work range and calculation rules in the measuring reference system can be found in chapter 1.6.

When the device is switched on, reference travel (homing) must be carried out before a positioning task can be executed (compare parameter “Reference travel required.” FHPP 1014/CANOPEN/CI 23F6h)

The drive references against a stop or a reference switch.
A stop is reached when there is an increase in the motor current at the same time as the drive shaft comes to a stand.
As the drive must not position continuously against the stop, it must move at least 0.25 mm into the stroke range again (offset axis zero point).

Sequence:

1. Search for the reference point in accordance with the configured method.

2. Move from reference point to axis zero point (corresponds to offset axis zero point AZ)

3. Set at axis zero point:
   Current position = 0 – offset project zero point PZ

Overview of parameters involved (see also section B.2.15)				
Parameters involved	**Description**	**FCT**	**PNU**	**CO/CI**
	Offset axis zero point	x	1010	607Ch
	Reference travel method	x	1011	6098h
	Reference travel speeds	x	1012	6099h
	Reference travel required	–	1014	23F6h
	Reference travel maximum torque	x	1015	23F7h
Start (FHPP)	CPOS.B2 = positive edge: Start reference travel			
Reply message (FHPP)	SPOS.B1 = positive edge: Quit Start SPOS.B7 = drive referenced			
Requirement	Device control by PLC/field bus Controller must be in status “Operation enabled” There must not be any command for jogging			

Tab. 5/15: Parameters involved in reference travel

Reference travel methods 1)		
hex	**dec.**	**Description**
17h	23	Search for reference switch in positive direction.
1Bh	27	Search for reference switch in negative direction.
EFh	-17	Search for negative stop. The point found is the reference position. As the axis must not stand still at the stop, the offset axis zero point must be ≠ 0.
EEh	-18	Search for positive stop. The point found is the reference position. As the axis must not stand still at the stop, the offset axis zero point must be ≠ 0.
1) Detailed description of the reference travel methods see section 1.6.3.		

Tab. 5/16: Overview of reference travel methods

5.6.2 Jog mode

In the status “Operation enabled” the drive can be moved to the left/right by jogging. This function is usually used for:

– moving to teach positions

– moving the drive out of the way (e. g. after a system fault)

– manual positioning as normal operating mode (hand-operated feed).

Sequence

1. When one of the signals “Jog left / Jog right” is set, the drive starts to move slowly. Due to the slow speed, a position can be defined very accurately.

2. If the signal remains set for longer than the configured “phase 1 duration”, the speed is increased until the configured maximum speed is reached. In this way large strokes can be traversed quickly.

3. If the signal changes to 0, the drive is braked with the pre-set maximum deceleration.

4. If the drive reaches a software end position, it will stop automatically. The software end position is not exceeded, the path for stopping depends on the ramp set. Jogging operation is also exited here when Jogging = 0.

1 Low speed phase 1 (slow travel)

2 Maximum speed for phase 2

3 Acceleration/ deceleration

4 Duration phase 1

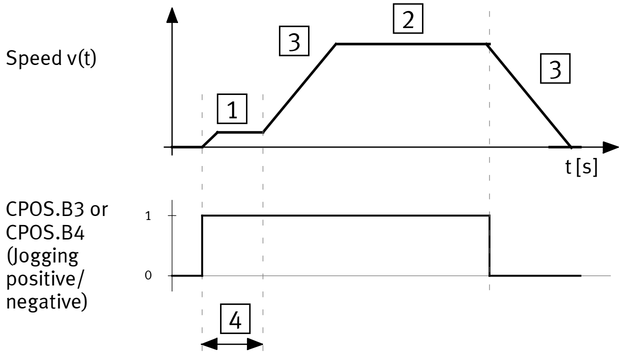


Fig. 5/2: Sequence diagram for jogging mode

Overview of parameters involved (see section B.2.9)				
Parameters involved	**Description**	**FCT**	**PNU**	**CO/CI**
	Speed phase 2 in (inc/s)	x	531	20ED/21
	Acceleration or deceleration (inc/s^2)	x	532	20EE/21
	Duration phase 1 in ms	x	534	20E9/21
Start (FHPP)	CPOS.B3 = positive edge: Jog positive (forwards) CPOS.B4 = positive edge: Jog negative (backwards)			
Reply message (FHPP)	SPOS.B4 = 1: Drive moves SPOS.B2 = 0: (Motion Complete)			
Requirement	Device control by PLC/field bus Controller must be in status “Operation enabled”			

Tab. 5/17: Parameters involved in jogging mode

5.6.3 Teaching via field bus

Position values can be taught via the field bus. Previously taught position values will then be overwritten.

Sequence

1. The drive will be moved to the desired position by the jogging mode or manually.

2. The user must make sure that the desired parameter is selected. For this the parameter "Teach target" and, if applicable, the correct record address must be entered.

Teach target (PNU 520)	**is taught**
= 1 (specification)	Nominal position in the position set – Record select: Position set after control byte 3 – Direct mode Position set after PNU=400
= 2	Axis zero point
= 3	Project zero point
= 4	Lower software end position
= 5	Upper software end position

Tab. 5/18: Overview of teach targets

3. Teaching takes place via the handshake of the bits in the control and status bytes CPOS/SPOS:

1 Ready for teaching

2 Value transferred

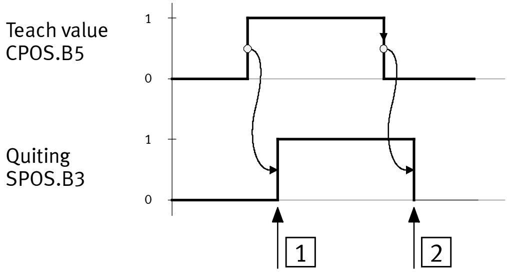


Fig. 5/3: Handshake when teaching

Note:
The drive must not stand still for teaching. However, a speed of 1 m/s means that the actual position changes by 1 mm every millisecond. With the usual cycle times of the PLC + field bus + motor controller there will be inaccuracies of several millimetres even at a speed of only 100 mm/s.

Overview of parameters involved (see sections B.2.8 and B.2.9)				
Parameters involved	**Description**	**FCT**	**PNU**	**CO/CI**
	Teach target	– 1)	520	21FEh
	Record number	– 1)	400	2190h
Start (FHPP)	CPOS.B5 = Falling edge: Teach value			
Acknowledgement (FHPP)	SPOS.B3 = 1: Value transferred			
Requirement	Device control by PLC/field bus Controller must be in status “Operation enabled”			
1) Teaching is made possible in the Festo Configuration Tool by means of special functions.				

Tab. 5/19: Teach parameters involved

5.6.4 Record select (positioning mode)

A positioning task in Record select mode is written with one record of nominal values.

A record can be started in the status “Operation enabled” with the record number. This function is usually used for:

– moving to any position in the record list by the PLC

– processing a positioning profile by linking records

– known target positions which seldom change (formulation change).

Sequence

1. Set the desired record number in the output data of the master. Up till the start the controller replies with the number of the record last processed.

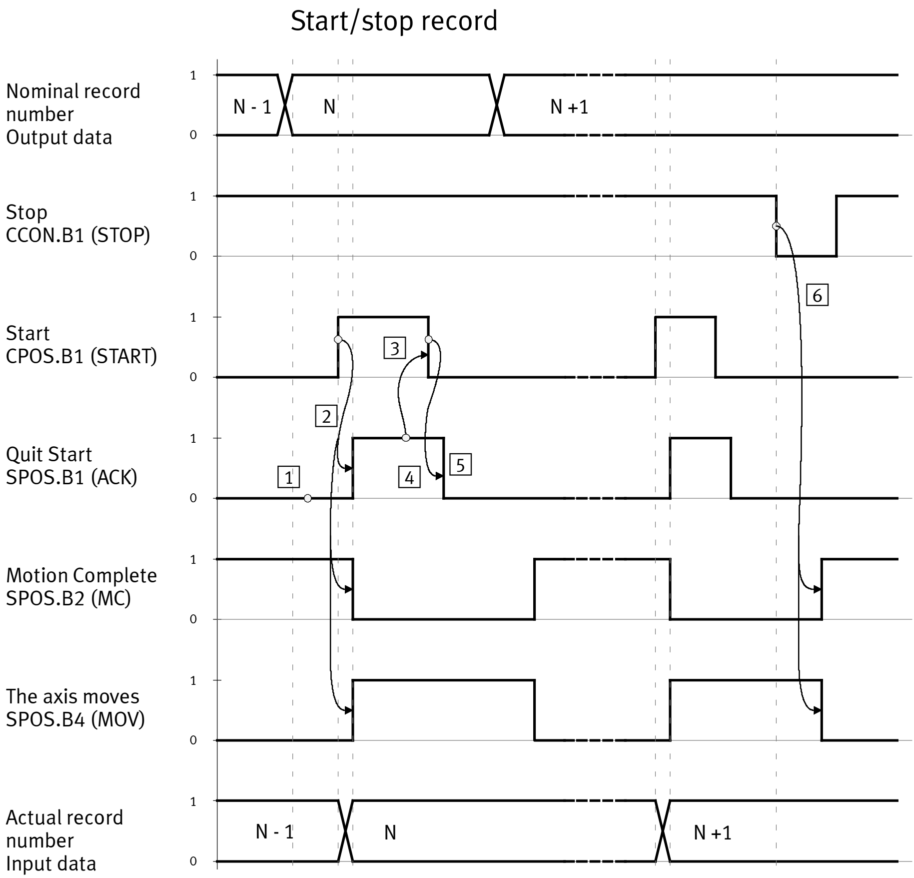
2. With a rising edge at START (CPOS.B1) the controller accepts the record number and starts the positioning task.

3. The controller signalizes with the rising edge at Quit Start that the PLC output data have been accepted and that the positioning task is now active. The positioning command will be processed irrespective of whether Start (CPOS.B1) has been reset to zero or not.

4. When the record is concluded, MC (SPOS.B2) is set.

Causes of faults:

- Referencing has not been carried out.
- The target position and/or the preselect position cannot be reached.
- Invalid record number.
- Record not initialized.



1 Prerequisite: "Quit Start" = 0

2 Rising edge at "Start" causes the new record number N to be accepted and "Quit Start" to be set

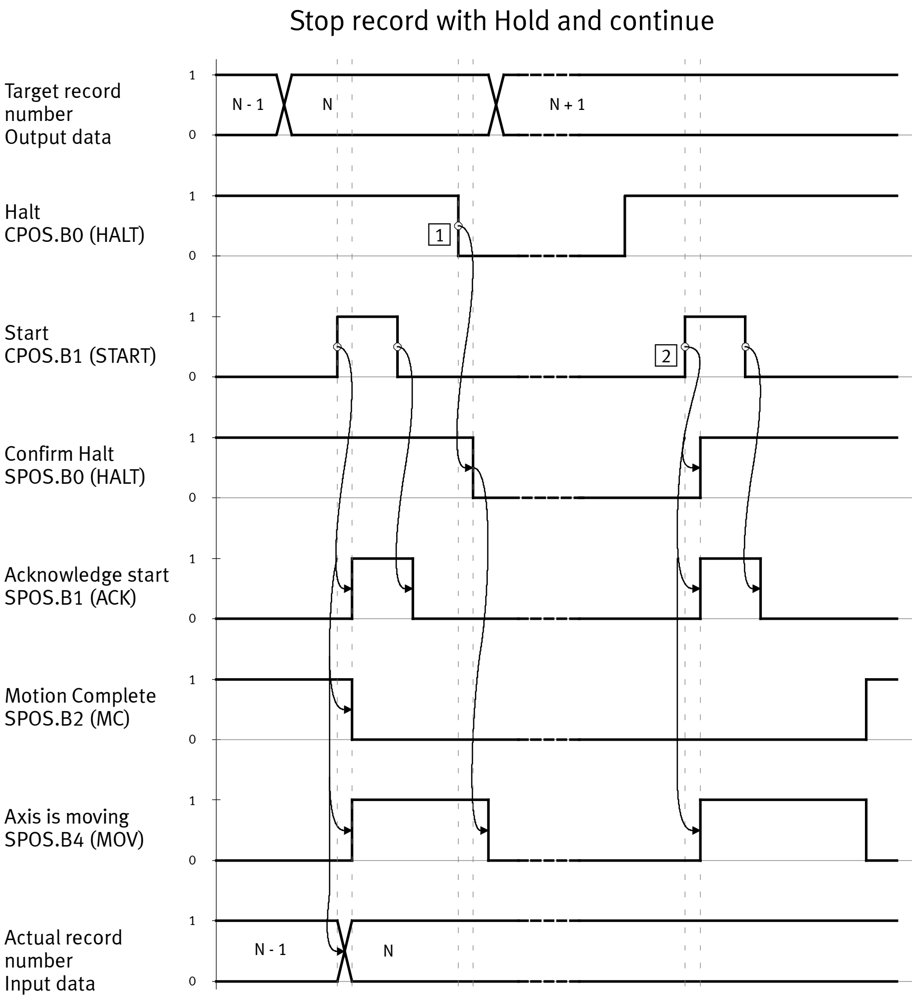
3 As soon as "Quit Start" is recognized by the PLC, "Start" may be set to 0 again

4 The controller reacts with a falling edge at "Quit Start"

5 As soon as "Quit Start" is recognized by the PLC, the next record number may be started

6 A currently running positioning task can be stopped with "Stop"

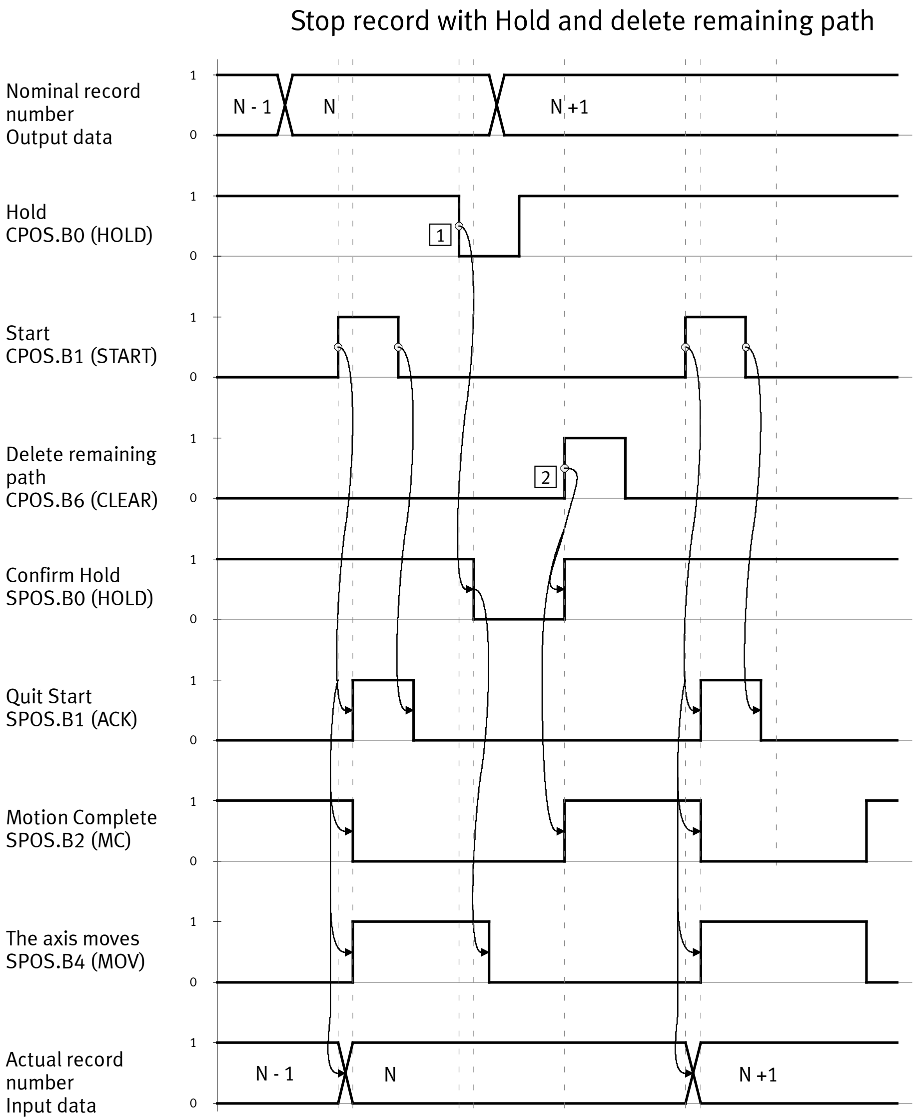
Fig. 5/4: Sequence diagram Start/stop record



1 Record is stopped with "Hold," actual record number N is retained, "Motion Complete" remains reset

2 Rising edge at "Start" starts record N again, "Confirm Hold" is set

Fig. 5/5: Sequence diagram for Stop record with Hold and Continue



1 Stop record

2 Delete remaining path

Fig. 5/6: Sequence diagram for Stop record with Hold and delete remaining path

Parameters involved

The entries in the positioning table can be written via the field bus (see Tab. 5/20). Each nominal value is addressed by its own PNU. A record consists of the nominal values with the same subindex.

The composition of the positioning table as per FHPP is described in appendix B.2.8.

Overview of parameters involved (see section B.2.8)

Record composition	**Description**	**FCT**	**PNU**	**CO/CI**
	Position absolute/relative	x	401	20E0/01h
	Target position	x	404	20E0/02h
	Velocity	x	406	20E0/03h
	Acceleration	x	407	20E0/04h
Start	CPOS.B1 = positive edge: Start Jogging and referencing have priority.			
Reply message	SPOS.B2 = 0: Motion Complete SPOS.B1 = positive edge: Quit Start SPOS.B4 = 1: Drive moves			
Requirements	Device control by PLC/field bus Controller must be in status “Operation enabled” Record number must be valid			

Tab. 5/20: Parameters involved in Record Select mode

5.6.5 Direct mode (positioning mode, power operation)

In the status “Operation enabled” (Direct mode) a positioning task is formulated directly in the I/O data which are transmitted via the field bus. The nominal (setpoint) values for positioning mode or power operation are reserved in the PLC.

A positioning profile based on consecutive positioning tasks can be implemented by means of external control by the master.

Positioning mode

The positioning mode is used in the following situations:

- moving to any position within the work stroke.
- The target positions are unknown during planning or change frequently (several different work item positions).

Sequence

1. The user sets the desired (discrete) nominal value for positioning and the positioning condition (absolute/relative) in his output data.
2. With a rising edge at START (CPOS.B1) the controller accepts the nominal position and starts the positioning task.
3. After the start you must wait for MC before a new start can be made.
4. When the nominal position is reached, MC (SPOS.B2) is set.

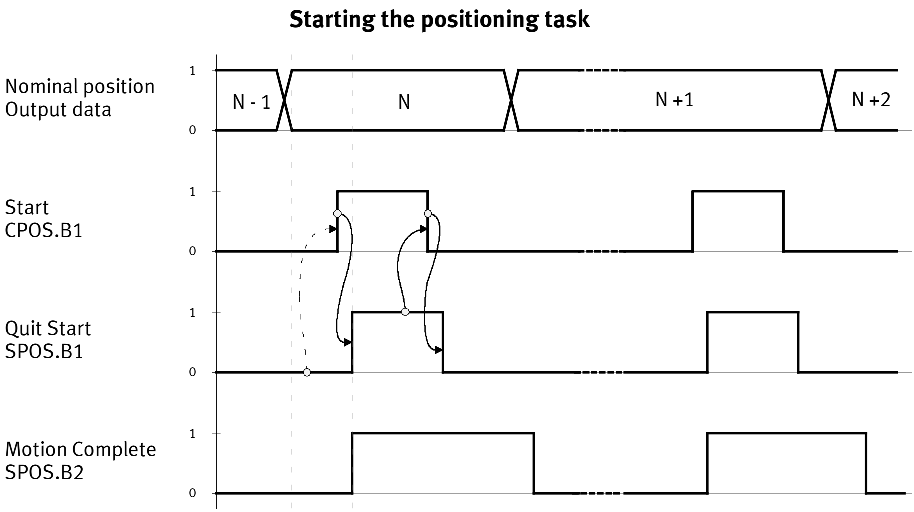


Fig. 5/7: Start the positioning task

The sequence of the remaining control and status bits as well as the functions Hold and Stop react as with the function Record select, see Fig. 5/4, Fig. 5/5 and Fig. 5/6.

Causes of faults:

– No referencing carried out.

– Target position cannot be reached or lies outside the software end positions.

Overview of parameters involved (see section B.2.9)				
Parameters involved	**Description**	**FCT**	**PNU**	**CO/CI**
Nominal values for positioning mode	Max. permitted speed[1)]	x	502	21F6/00h
	Direct mode acceleration in acceleration unit (inc/s^2)	x	541	20EE/22h
Start (FHPP control byte)	CPOS.B1 = positive edge: Start (CDIR.B0 = nominal position absolute/relative)			
Reply message (FHPP status byte)	SPOS.B2 = 0: Motion Complete SPOS.B1 = positive edge: Quit Start SPOS.B4 = 1: Drive moves			
Requirement	Device control by PLC/field bus Controller must be in status "Operation enabled"			
1) In the output data the master transfers a percent value which is multiplied by the maximum permitted speed, in order to achieve the final nominal speed.				

Tab. 5/21: Parameters involved in Direct mode (positioning mode)

Power operation

Power operation is used in the following situations:

– For clamping and holding work items as well as for procedures in which work items must be orientated (e. g. on a fixed stop).

– Pressing and inserting procedures.

– Special functions in which e. g. work items must be touched in order to receive position values.

Notes on power operation
Control of the motor torque takes place indirectly by means of the current regulation. All specifications on forces/torques refer to the rated motor torque (relative to the rated motor current). The actual force at the axis should be calculated/checked and then set with external measuring devices during commissioning.

Note
The following settings are required for parametrizing the power operation (see Tab. 5/22)

- power window (permitted deviation from the nominal value ascertained by the field bus)
- speed limitation (maximum speed which the drive should reach). Without this specification the drive would accelerate unbraked if there is no counter force (e. g. work item missing).
- rest time (time during which the nominal force must be applied, before “Motion complete” is triggered)

• Extend the rest time if the nominal force is already achieved briefly due to the increased torque when starting (before reaching the work item).

Power operation is prepared when the control mode is switched over. The drive stands with the position controlled.

Sequence

1. The user sets the desired nominal value (in % of the rated motor torque) and the speed limitation in his output data.

2. With the rising edge at Start (CPOS.B1) the controller accepts the nominal torque and builds up the force/torque in the direction of the sign of the nominal value.

   – When this speed has been reached, the bit “Speed limit reached” is set (status byte SDIR).

   – When the nominal value has been reached, taking into account the target window and the time window, the “MC” signal is set. The motor current will still be controlled.

   – If there is a resistance e. g. by a work item in the positioning range, the drive will press against the obstruction with a defined force (see Fig. 5/8).

   – If the path set in the path/stroke monitoring (relative to the starting position) is exceeded, the bit “Stroke limit reached” is set in the status byte SDIR. The drive is braked with the emergency stop ramp, held with the position controlled at the current position, and the “MC signal” is set.

Causes of faults:

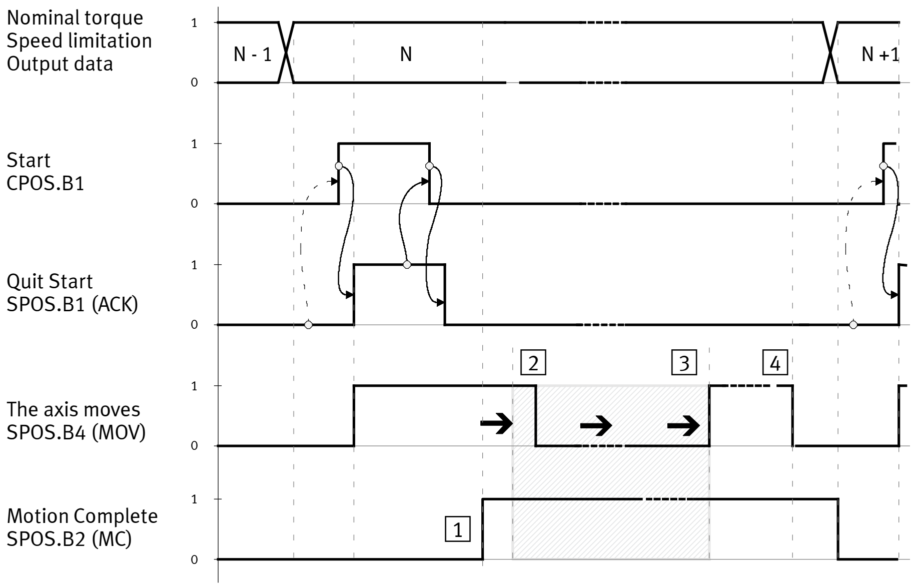
– No referencing carried out.

– Axis stands at the start of the positioning task in the software end position.

<table>
<tr><th colspan="5">Overview of parameters involved (see section B.2.9)</th></tr>
<tr><th>Parameters</th><th>Description</th><th>FCT</th><th>PNU</th><th>CI</th></tr>
<tr><td rowspan="6">Power operation [1)]</td><td>Stroke limitation</td><td>x</td><td>510</td><td>60F6/01h</td></tr>
<tr><td>Minimum torque</td><td>x</td><td>511</td><td>60F6/05h</td></tr>
<tr><td>Maximum torque</td><td>x</td><td>512</td><td>6072h</td></tr>
<tr><td>Force target window (tolerance)</td><td>x</td><td>552</td><td>60F6/03h</td></tr>
<tr><td>Damping (rest) time in [ms]</td><td>x</td><td>553</td><td>60F6/04h</td></tr>
<tr><td>Max. permitted speed</td><td>x</td><td>554</td><td>60F6/02h</td></tr>
<tr><td>Start</td><td colspan="4">CPOS.B1 = positive edge
(CDIR.B0 = nominal position absolute/relative)</td></tr>
<tr><td>Reply message</td><td colspan="4">SPOS.B2 = 0: Motion Complete
SPOS.B1 = positive edge: Quit Start
SPOS.B4 = 1: Drive moves</td></tr>
<tr><td>Requirement</td><td colspan="4">Device control by PLC/field bus
Controller must be in status “Operation enabled”</td></tr>
<tr><td colspan="5">1) Further parameters:
6071h Target torque   6076h Rated torque
6077h Actual torque   6087h Torque slope
6088h Torque profile type   CDIR.B5 Stroke limitation active/inactive</td></tr>
</table>

Tab. 5/22: Parameters involved in Direct mode (power operation)

Start the positioning task / power operation



1 Nominal torque / power reached

2 Axis presses against resistance

3 Resistance removed / overcome

4 Software end position/stroke limitation reached

Fig. 5/8: Start the positioning task / power operation

The signal “MC” (Motion Complete) is used in this control mode to mean “Nominal value/stroke limitation reached.” The sequence of the remaining control and status bits as well as the functions Hold and Stop react as with the function Record select, see Fig. 5/4, Fig. 5/5 and Fig. 5/6.

5.6.6 Standstill monitoring

With the standstill monitoring it is clear that the target position window is exited at a standstill.

When the target position has been reached and MC signalled in the status word, the drive switches to the “standstill” state, bit SPOS.B6 (standstill monitor) is reset. If, in this status, the drive is removed from the standstill position window for a minimum defined time due to external forces or other influences, the bit SPOS.B6 will be set.

As soon as the drive is in the standstill position window again for the standstill monitoring time, the bit SPOS.B6 will be reset.

1 Target position
2 Actual position
3 Standstill monitoring (SPOS.B6)
4 Motion Complete (SPOS.B2)
5 Standstill position window
6 Target position window
7 Adjustment time (Position window time)
8 Standstill monitoring time

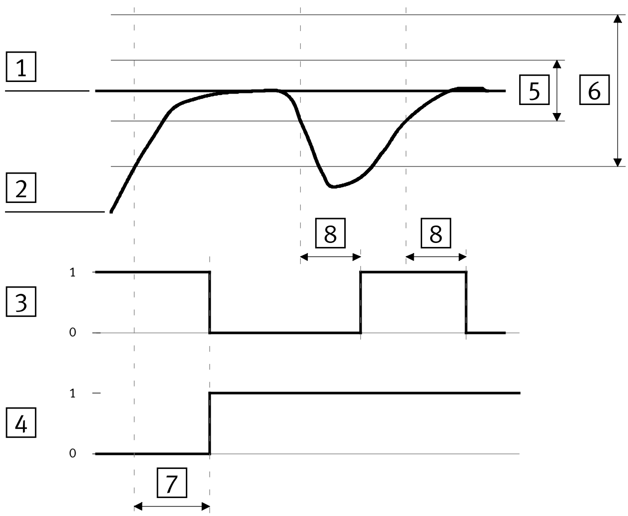


Fig. 5/9: Standstill monitoring

The standstill monitoring cannot be switched on or off explicitly. It becomes inactive when the standstill position window is set to the value “0”.

Overview of parameters involved (see section B.2.15)				
Parameters involved	**Description**	**FCT**	**PNU**	**CO/CI**
	Adjustment time for position	–	1023	6068h
	Nominal position	–	1040	6062h
	Current position	–	1041	6064h
	Standstill position window	–	1042	2040h
	Standstill monitoring time	–	1043	2041h
Start (FHPP)	SPOS.B2 = positive edge: Motion Complete			
Reply message (FHPP)	SPOS.B6 = 1: Drive has moved out of standstill position window			
Requirement	Device control by PLC/field bus Controller must be in status “Drive enabled”			

Tab. 5/23: Parameters involved in standstill monitoring

5.7 Notes on operation

Take the following instructions and recommendations into account when programming positioning systems with electric axes:

Start-up behaviour and referencing

Warning
Incorrect parameterization can cause injury to people and damage to property.

- In the following cases reference travel is absolutely essential in order that the basis coordinates and the working range can be set correctly:
  - **Every** time the logic voltage supply is switched on,
  - when the measuring reference system (reference travel method, axis zero point, direction of rotation) has been modified (compare object $607E_h$),
  - after failed/aborted reference travel.
- Make sure that before starting reference travel the axis stands in the direction of movement **in front of** the reference switch or stop.

Note
When the coupling or clamping element in the coupling housing is loosened, the motor can be turned on its longitudinal axis. The reference position will then be lost.

- Carry out a new reference run.

Note
- When the power supply is switched off, wait for approx. 5 seconds before switching the device on again.

Device connection

Caution
The RS232 interface is not electrically isolated. It is not intended for permanent connection to PC systems or as a controller interface.

- Use the connection only for parametrizing and diagnosis.

Control during operation

Warning
There is a danger of injury.

Faults in parametrizing can cause injury to people and damage to property when the controller is enabled.

- Only enable the controller if the axis system has been installed and parametrized by technically qualified staff.

Caution
Note the manufacturer's specifications for the permitted operating conditions of the motors and drives used, e. g. the permitted positioning speeds.

Caution
Damage to components of the DMES-...

Movement to the mechanical end positions is not permitted during operation. When movement is made to the end positions with a heavy load, blockage may occur in the end positions.

Note
Any functions implemented within the framework of the EMERGENCY-STOP concept must also be taken into account in the control programs

Password protection

The factory setting does not offer active protection with a password. In order to prevent unauthorized or unintentional overwriting or modification of parameters in the device, all download and control functions can be blocked.

- Recommendation:
  Protect the settings of your axis against undesired modifications with a password:
  - FCT password protection (8 characters, see PlugIn help MTR-DCI)
  - HMI password protection for MTR-DCI-...-H2-... (3 characters, see chapter 4.5)

Care and maintenance

The motor units do not require maintenance during their specified service life. Follow the maintenance instructions for the components used.

Diagnostics and error display

Chapter 6

Contents

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6.1 Overview of diagnostic possibilities

Type of diagnostic information	Connection via ...	see ...
General status display	LED status displays on the MTR-DCI	Section 6.2
	FCT: virtual LEDs in the “Device status” window	Help for PlugIn
	CANopen status bytes SCON and SPOS	Section 5.5.2
Current fault message (text display)	Control panel of the MTR-DCI (only type ...-H2)	Display
	FCT: Text field in the “Device status” window	Help for PlugIn
Diagnosis memory: the last 16 fault messages	FCT: in the “Diagnosis” window (with existing device connection)	Help for PlugIn
	FPC: The second 8 bytes of the cyclic field bus communication can also transfer the contents of the diagnostic memory.	Sections B.1.1 and 6.4
Diagnostics via CANopen	Diagnostics via the fieldbus – Emergency Messages. – Nodeguarding. – Diagnostics via FHPP status bytes SCON and SPOS.	Section 6.5
Parametrizings and general status information	Control panel: in the [Diagnosis] menu	Section 4.3
	FCT	Help for PlugIn

Tab. 6/1: Diagnostic information according to type

Access	**Brief description**	**Advantages/ features**	**Detailed description**
LEDs	The LEDs indicate the readiness to operate, positioning status, faults and bus status.	Fast “on-the-spot” recognition of faults	Section 6.2
Control panel of the MTR-DCI-...-H2	On the LCD display: Messages, warnings and faults	Fast “on-the-spot” diagnosis	Section 6.3
	In the [Diagnostic] menu: Diagnostic data, operating mode, current position set, target and actual positions, speed as well as information on communication via the field bus	Detailed “on-the-spot” diagnosis	Section 4.3
Festo Configuration Tool	With active device connection: – Display of the current position set, target and actual positions as well as speed. – Display of the operating mode, special outputs and operating states as swell as fault messages of the connected MTR-DCI. – virtual LEDs in the “Device status” window – Display the bus status – Dislpay the diagnostic memory	Detailed diagnosis during commissioning	Help for PlugIn MTR-DCI
CANopen diagnosis	– Emergency messages – Node guarding – Scanning the devices and communication status via SDO – Diagnosis via FHPP status bytes SCON and SPOS.	Simple diagnosis via the field bus	Section 6.5
	– Extended access to diagnostic data, e. g. diagnostic memory via FPC	Detailed diagnosis via the field bus	Sections 6.4 and 6.6

Tab. 6/2: Diagnostic information after reception

6.2 LED status displays

1 LED POWER

2 LED I/F

3 LED ERROR

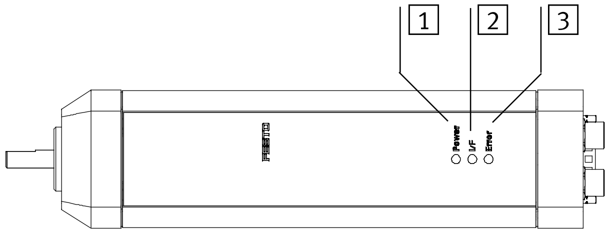

Fig. 6/1: LEDs on the control panel of the MTR-DCI-...

POWER	GREEN	Power supply
	ON	Logic and load voltages applied.
	FLASHES	Logic voltage is applied. Load voltage is **not** applied.
	OUT	There is no voltage.

Tab. 6/3: LED “Power”

ERROR	RED	Fault display
	ON	Fault. Device is not ready to operate. Check cause and rectify if necessary, see also section 6.3.
	FLASHES	Warning. Check cause and rectify if necessary, see also section 6.3.
	OUT	No internal fault reported.

Tab. 6/4: LED “Error”

I/F 1)		**GREEN**	**Bus - operating status (status machine)**
	ON OFF	ON	**"Operational"** – System in "operational" status
	ON OFF	FLASHES ONCE	**"Stopped"** – Master has sent Stop signal (transition status, system again in pre-operational status).
	ON OFF	FLASHES	**"Pre-operational"** – MTR-DCI not yet set by CAN master to Operational mode (but SDOs are available).
I/F 1)		**RED**	**Bus - connection**
	ON OFF	OUT	**Connection error-free**
	ON OFF	FLASHES ONCE	**"Warning Limit reached"** – Several communication errors have occurred or the MTR-DCI does not receive a reply (master switched off or cable break).
	ON OFF	FLASHES TWICE	**"Node guarding error"** – Node Guarding error occurred (only if activated). If occurring simultaneously, has priority over "Warning Limit reached"
	ON OFF	ON	**Bus parameter not parameterised** – For example, at switch on, if not all bus parameters (node ID, CiA 402/FHPP, bit rate) are available.

1) Two-colour LED as per DS 303-3. If occurring simultaneously, the red LED has priority – no "mixed" display of red and green.

Tab. 6/5: "I/F" LED

6.3 Fault messages

6.3.1 Overview

Cate-gory	Name, display	Description	Device error [1]	Fault number	Fault LED	Status bytes [2]
Fault	POSITION ERROR	Drag error	0x0001	31	ON	FAULT, DEV
Fault	MOTOR STOP	Motor stop	0x0002	106	ON	FAULT
Fault	HOMING-ERROR	Reference travel fault	0x0004	32	ON	FAULT
Fault	OVERHEATING	Overtemperature (ActTemp › 80°C)	0x0008	101	ON	FAULT
Fault	LOAD-POWER-DOWN	Load voltage moni-toring	0x0010	70	ON	FAULT
Fault	I2t-ERROR	Current monitoring (i^2t)	0x0020	100	ON	FAULT
Fault	HARDWARE-ERROR	Device fault	0x0040	52	ON	FAULT
Fault	TARGET POSITION OUT OF LIMIT	Target position cannot be reached	0x0080	2	ON	FAULT
War-ning	ILLEGAL RECORD	Invalid record number	0x0100	3	FLASHES	WARN
Fault	PLEASE ENFORCE HOMING RUN	Reference travel required	0x0200	1	ON	FAULT
War-ning	STANDSTILL WARNING	Standstill monitoring	0x4000	36	FLASHES	WARN, STILL
Fault	CAN-BUS INIT NO PARAMETER ERROR	CAN bus fault: Bus parameter not set.	0x8000	51	ON	FAULT
Fault	CAN-BUS NO EXT. SUPPLY VOLTAGE	CAN bus fault: External CAN supply fault.	0x8000	51	ON	FAULT

1) see PNU 205/CO 2FF1/00
2) FHPP status bytes, see section 5.5.2

Category	Name, display	Description	Device error [1]	Fault number	Fault LED	Status bytes [2]
Warning	HOT TEMPERATURE	Overheating	–	–	FLASHES	WARN
Warning	COLD TEMPERATURE	Under temperature	–	–	FLASHES	WARN

[1] see PNU 205/CO 2FF1/00
[2] FHPP status bytes, see section 5.5.2

Tab. 6/6: Faults and warnings with fault numbers and fault bits

6.3.2 Description of the messages, warnings and faults

Messages

Messages inform about operating states.

Message	Cause
Attention Motor moves...	Message before the start of a positioning movement. After confirmation with the ‹ENTER› button the drive moves.
Profile velocity = 0. Please set v.	The menu command [Move position set] is not processed because the positioning speed of the positioning set v = 0. Modify the parametrizing or select a different postioning set.

Warning

Warnings have no influence on the reaction of the drive. The cause of the warning should be eleiminated in order that it does not lead to a fault.
If a warning occurs, the fault LED will flash and the WARNING output will be set (FHPP status bits, SCON.B2).

Warning	**Cause**
HOT TEMPERATURE	Operating temperature 70 °C < T < 80 °C, Check whether drive is overloaded, check the mechanical parts, e. g. for stiffness, reduce ambient temperature.
COLD TEMPERATURE	Operating temperature < –10 °C, Increase the ambient temperature as appropriate.
STANDSTILL WARNING	The axis has moved outside the standstill tolerance window.
ILLEGAL RECORD WARNING	Non-permitted record number

Fault

If there is a fault, the drive will be stopped. The fault LED will flash.

1. Eliminate the cause of the fault.

2. Quit the fault message:
   – With <Enter> on the control panel,
   – via the field bus with a falling edge at the ENABLE signal,
   – via the field bus with a rising edge at the RESET signal CCON.B3,
   – with the button “Quit error” in the Festo Configuration Tool.

Fault	**Possible cause**	**Remedy**
CAN-BUS INIT NO PARAMETER ERROR	Essential bus parameters not set. – MTR-DCI not on the bus.	• Set bus parameters (see section 5.2.7): – CAN Node-ID – CAN bit rate – CAN profile
CAN-BUS NO EXT. SUPPLY VOLTAGE	External CAN supply missing (only if parameterised, see section 4.5.6, Tab. 4/10 or object 2FF6h, section C.3.4).	• Check external CAN supply (see section 3.6 or • Set internal CAN supply (see section 5.2.7)
HARDWARE ERROR	Device fault (EEPROM defective, or user data destroyed)	• Contact Festo Service.
I2t-ERROR	Current monitoring i^2t. – The drive is blocked	• Check the mechanical system of the drive.
HOMING ERROR	Error during homing – Homing run interrupted – Reference switch defective	• If necessary, check the function of the reference switch. • It is essential that you repeat homing.
LOAD-POWER-DOWN	Voltage monitoring – Load voltage too low MTR-DCI 32/42/52: U < 18 V MTR-DCI 62: U < 34 V – Voltage drops under load	• Check the power supply: – Power supply unit too weak? – Supply line too long?
MOTOR STOP	Error during the positioning procedure – A positioning procedure is discontinued on the control panel with EMERG.STOP (Taste ”Menu”).	• Acknowledge the error on the control panel with ”Enter”
OVERHEATING	Overheating (Operating temperature > 80 °C). – Temperature of power output stage too high. – Ambient temperature too high	• Check: – That the limits are complied with (motor characteristic curves), – the mechanical system e.g. for sluggishness. • If necessary, reduce the ambient temperature.

Fault	Possible cause	Remedy
PLEASE ENFORCE HOMING RUN!	When starting a positioning record: – A valid reference travel has not yet been conducted. – Due to a logic voltage failure the reference position has been lost.	• Carry out homing.
POSITION ERROR	Position error (following error). – The drive is blocked. – The parameterised speed cannot be reached. – The effective load is too heavy.	• Check: – the mechanics of the drive, – the speed of the positioning record.
TARGET POSITION OUT OF LIMIT	Target position fault – The specified target position is outside the permitted positioning range.	– the software end positions, – the target position, – the reference of the nominal position (absolute or relative).

Tab. 6/7: Fault messages

6.4 Diagnostic memory

The diagnostic memory contains the last 16 diagnostic messages. It is backed up if possible in the event of power failure. If the memory is full, the oldest element will be overwritten (ring buffer).

Structure of the diagnostic memory			
Parameters [1]	CO/CI 20C8$_h$ PNU 200	CO/CI 20C9$_h$ PNU 201	CO/CI 20CA$_h$ PNU 202
Format	uint8	uint16	uint32
Meaning	Diagnostic event	Fault number	Time
Subindex 1	Current diagnostic message		
Subindex 2	Previous diagnostic message		
...	...		
Subindex 16	Oldest diagnostic message		
[1] see section B.2.6			

Tab. 6/8: Diagnostic memory: Structure

Configuration of the diagnostic memory with parameter CO/CI 20CCh (PNU 204)				
SI	**Description**	**Specification:**	**Min.**	**Max.**
1	= 1: Record incoming and outgoing*) faults = 2: Record only incoming faults	1	1	2
2	= 1: Resolution time stamp 10 ms = 2: Resolution time stamp 1 ms	1	1	2
3	Deleting the diagnostic memory. – Writing with value = 1 deletes the diagnostic memory – Read will always be answered with value = 0.	0	0	1
4	Number of valid entries in the diagnostic memory.	0	0	16
*) outgoing fault = time point when the fault was quitted.				

Tab. 6/9: Diagnostic memory: Configuration

The faults are divided into logical groups according to the fault numbers.

Group	Name	Comment
0	–	No fault active
1 ... 19	Processing fault	Examples: No reference travel, nominal position outside software end positions, nominal value calculation not possible. Although the system is OK, a user comand cannot be processed. In most cases there is a fault in operation. Source: Sequence control, controller
20..29	Parameter fault	Example: Software end positions outside the working stroke. A parameter lies within the limit values so that it can be written by the user. During the new calculation of the controller, it was ascertained that it is not permitted in the context of the other parameters. Note: Non-permitted parameters are rejected by the parameter protocol and do not generate a fault in the controller.
30..49	Controller	Examples: Positioning timeout, reference travel not succesful, drag error too large, The task could not be processed correctly. No hardware fault is recognized here. Source: Controller
50..69	Initialization	Fault in initializing the controller
70..79	Run time of controller	Fault in controller run time: Undervoltage, checksum
80 ... 89	–	reserved
90 ... 99	–	reserved
100 ... 109	Run time of motor	Run time of motor: Undervoltage, overtemperature,
110 ... 119	–	reserved

Tab. 6/10: Overview of fault numbers

A detailed description of the warnings and faults can be found in section 6.3.2.

6.5 Diagnosis via CANopen

The MTR-DCI supports the following diagnostic possibilities via CANopen:

- FHPP status bytes (see section 5.5.2):
  - SCON.B2: WARN – Warning
  - SCON.B3: FAULT – Fault
  - SPOS.B5: DEV – Drag fault
  - SPOS.B6: STILL – Standstill monitoring
- Node guarding, if activated (see section 6.5.1).
- Emergency Messages (see section 6.5.2).

6.5.1 Node guarding (reaction to bus failure)

In order that a CAN bus failure can be detected, node guarding must be activated (default: switched off).

In the case of actuators it is advisable to monitor the master for failure in order to provide an appropriate emergency shutdown strategy.

Then the CANBUS master is monitored based on monitoring of activation with the configured monitoring time (see DS 301). When monitoring is activated, the configured emergency stop response (Fault Reaction Option Code object 605Eh, PNU 1021) is executed and the drive is stopped.

Select the Guard Time with reference to the system's dynamic response and make sure that the selected refreshment/synchronisation time of your master with the selected bit rate and number of participants is sufficiently long for the number of CAN telegrams to be exchanged.

i

Refer to your master documentation for details on how to activate node guarding.

6.5.2 Emergency messages

Errors, but not warnings, are signaled by emergency messages as per DS 301 and CiA 402, independent of the set device profile.

Fault code	**Type of fault**	**Fault register**
2310	I^2t-fault	Bit 1
4210	Temperature monitoring	Bit 3
5112	Load voltage monitoring	Bit 2
5441	Homing error	Bit 5
6310	No Homing: No homing performed prior to positioning task	Bit 5
6320	Out of Limit, target position too large/small	Bit 5
7122	Motor emergency stop	Bit 5
7600	Hardware fault (EEPROM)	Bit 5
8500	Motor fault (current monitoring, cable break)	Bit 5
8600	Drag error	Bit 5
Communication emergency messages as per DS 301 may also be signalled.		

Tab. 6/11: Emergency messages

6.6 Diagnosis via parameter channel (FPC)

The Festo parameter channel offers the following possibilities of access to diagnostic information:

Diagnosis	PNU	Section
Diagnostic memory	– PNU 200 (CO /CI 20C8h) – PNU 201 (CO /CI 20C9h) – PNU 202 (CO /CI 20CAh), – PNU 204 (CO /CI 20CCh)	compare sections B.2.6 and 6.5
Current device fault (faults, warnings)	– PNU 205 (CO /CI 2FF1h)	compare sections B.2.6 and 6.3
CANopen diagnosis	– PNU 206 (CO /CI 2FF2h).	compare section B.2.6

Technical appendix

Apendix A

Contents

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A.1 Technical specifications A-3
A.2 Accessories A-6
A.3 Motor characteristic curves A-8
A.4 Conversion of the measuring units A-14

A.1 Technical specifications

General information	
Protection class as per EN 60529	IP54 (plug connector inserted or fitted with protective cap)
Relative humidity	0 to 95 %, non-condensing
Temperature range	operation: 0 ... +50 °C storage/transport: -25 ... +60 °C
Vibration	As per DIN/IEC 68/EN 60068 part 2-6, Severity level 1
Shock	As per DIN/IEC 68/EN 60068 part 2-27, Severity level 1
Protection against electric shock [1]	Protection against direct and indirect contact as per IEC/DIN EN 60204-1 by PELV circuits (Protected Extra-Low Voltage)
Electromagnetic compatibility (EMC) [2]	see conformity declaration (www.festo.com)
Gear type	Planetary gear
Encoder (with 4-fold evaluation)	MTR-DCI-32: 300 x 4 —› 1200 Inc/revolution MTR-DCI-42,52,62: 500 x 4 —› 2000 Inc/revolution
Temperature monitoring	Warning message at 70 °C ‹ T ‹ 80 °C Shut-down at temperature ≥ 80 °C
Display resolution	128 x 64 pixels

[1] The device is intended for industrial use.
[2] The maximum permitted I/O signal cable length is 30 m.

Motor data		32	42	52	62
Nominal torque (motor without gears)	[mNm]	32	110	300	800
MTR-DCI-...-G7: gear reduction 6.75:1; 1-stage					
Gear unit 1) – Drive output speed – Torsional backlash – Drive output torque – Efficiency	 [rpm] [°] [Nm] –	 481 ≤ 1.9 0.15 0.75	 444 ≤ 1.3 0.59 0.8	 444 ≤ 1.1 1.62 0.8	 504 ≤ 1.0 3.78 0.8
Mass moment of inertia – Rotor – Gear	 [kg cm²] [kg cm²]	 0.024 0.00089	 0.0323 0.00235	 1.209 0.01132	 3.3 0.017
MTR-DCI-...-G14: gear reduction 13.73:1; 2-stage					
Gear unit 1) – Drive output speed – Torsional backlash – Drive output torque – Efficiency	 [rpm] [°] [Nm] –	 237 ≤ 1.55 0.29 0.7	 218 ≤ 0.95 1.13 0.75	 218 ≤ 0.75 3.08 0.75	 248 ≤ 1.5 7.20 0.75
Mass moment of inertia – Rotor – Gear	 [kg cm²]	 0.024 0.00149	 0.323 0.00441	 1.209 0.01711	 3.3 0.035
MTR-DCI-...-G22: Gear reduction ratio 22.21:1					
Gear unit 1) – Drive output speed – Torsional backlash – Drive output torque – Efficiency	 [rpm] [°] [Nm] –	 –	 –	 –	 153 ≤ 1.5 11.66 0.75
Mass moment of inertia – Rotor – Gear	 [kg cm²] [kg cm²]	 –	 –	 –	 3.3 0.022
1) Permitted loading of gear shaft see chapter 2, Tab. 2/2					

Electrical data	32	42	52	62
Specifications for serial interface	see section 3.4			
Specifications for reference switch input	see section 3.5			
Load voltage supply				
Connection	Power (Pin A1, A2) see section 3.3			
Rated voltage	DC 24 V ±10 %			DC 48 V + 5 ... -10 %
Rated current	0.73 A ± 20 %	2 A ± 20 %	5 A ± 20 %	6.19 A ± 20 %
Peak current	2.1 A ± 20 %	3.8 A ± 20 %	7.7 A ± 20 %	20 A ± 20 %
Field bus/logic power supply *)				
Connection	Connection, see 3.3.2			
Rated voltage	DC 24 V ±10 %			
Rated current	0.15 A			
Peak current	0.8 A			
*) Only relevant for separate power supply				

Product weight		32	42	52	62
MTR-DCI-...-G7	[kg]	0.7	1.7	3.1	7.6
MTR-DCI-...-G14	[kg]	0.7	1.8	3.3	8.0
MTR-DCI-...-G22	[kg]	–	–	–	8.0

CANopen data	
Design – Physical Layer – Data Link Layer	 as per ISO 11898 (corresponding to DS 102) as per CAN specification 2.0
CAN protocol	as per DS 301 and CiA 402
Manufacturer ID	29 (0x1D)
Profile ID (device type)	Dependent on data profile: – CiA 402: 131474 (0x00420192) – FHPP: 301 (0x0000012d)
Address range (node ID).	1 ... 127
Transmission rate	20, 50, 100, 125, 250, 500, 800 and 1000 kBit/s
Interface – Plug – Electrical isolation depending on parameterization (see sections 3.3.2, 4.5 and 5.2.7) – Integrated bus termination	 D-Sub, 9-pin Parameter “CAN Voltage Supply”: – internal: No electrical isolation (default) – external: Electrical isolation No
Cable type	Dependent on cable length and fieldbus bit rate, see controller manual or DS 102.

A.2 Accessories

Connection	Accessories	Designation	Length [m]
Voltage supply	Power supply cable	KPWR-MC-1-SUB-9HC-...	2.5 / 5 / 10
Serial interface	Programming cable	KDI-MC-M8-SUB-9-...	2.5
Reference switch	Switch, magnetic Switch, inductive	SMT-8M-...-M8D SIEN-...-M8B-...	–
	Connecting cable with screw-type lock	KM8-M8-GSGD....	0.5 / 1 / 2 / 5
Field bus connection incl. logic power supply	Field bus adapter (IP54)	FBA-CO-SUB-9-M12	–

User documentation in paper form	
German	P.BE-MTR-DCI-CO-DE
English	P.BE-MTR-DCI-CO-EN
French	P.BE-MTR-DCI-CO-FR
Italian	P.BE-MTR-DCI-CO-IT
Spanish	P.BE-MTR-DCI-CO-ES
Swedish	P.BE-MTR-DCI-CO-SV

A.3 Motor characteristic curves

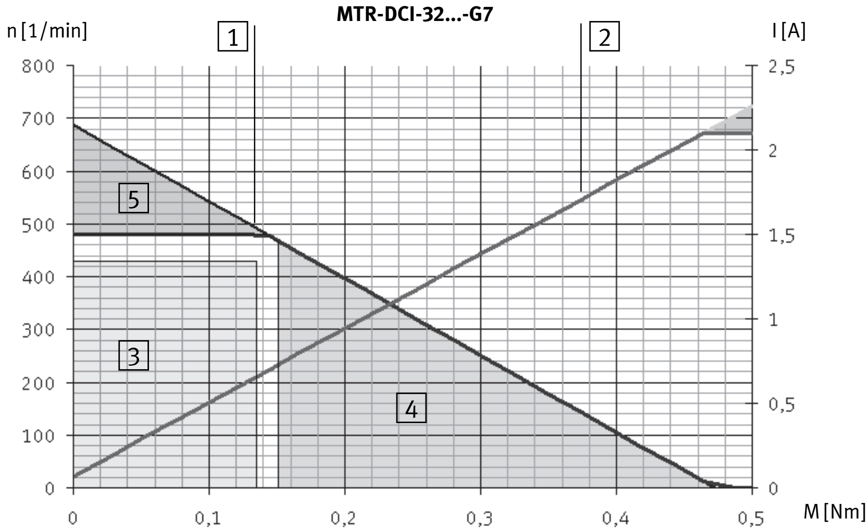
1 Drive output torque of gear shaft M [Nm]

2 Current I [A]

3 Recommended mode

4 Non-permitted range

5 Overload capacity



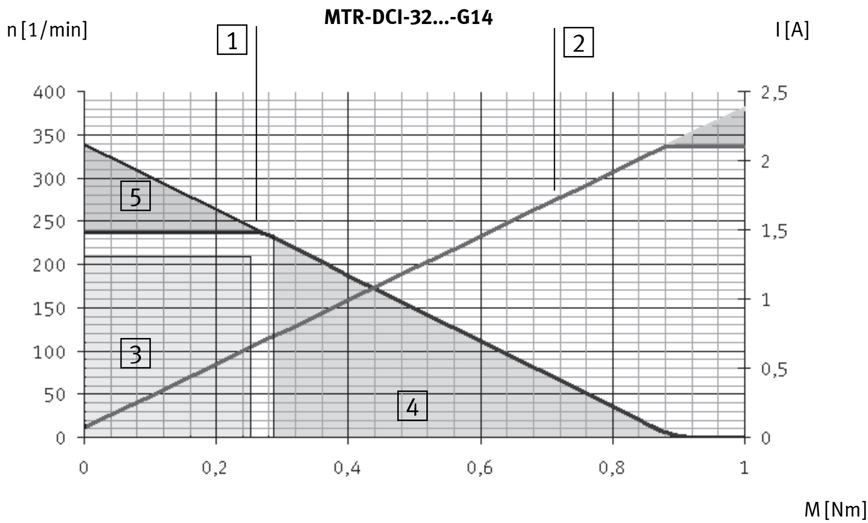
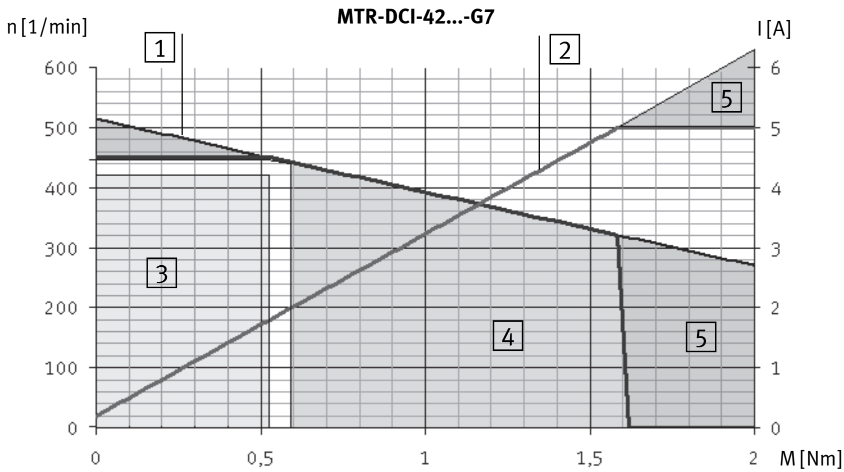


Fig. A/1: Motor characteristic curves MTR-DCI-32...



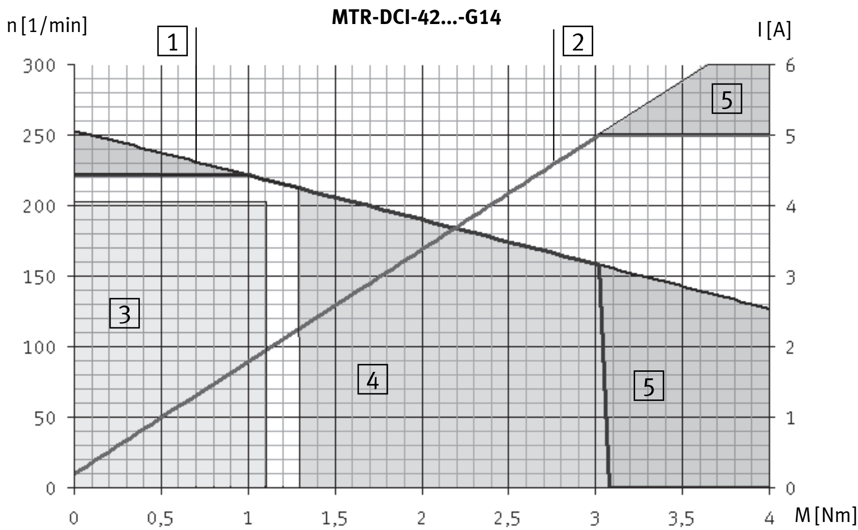


Fig. A/2: Motor characteristic curves MTR-DCI-42...

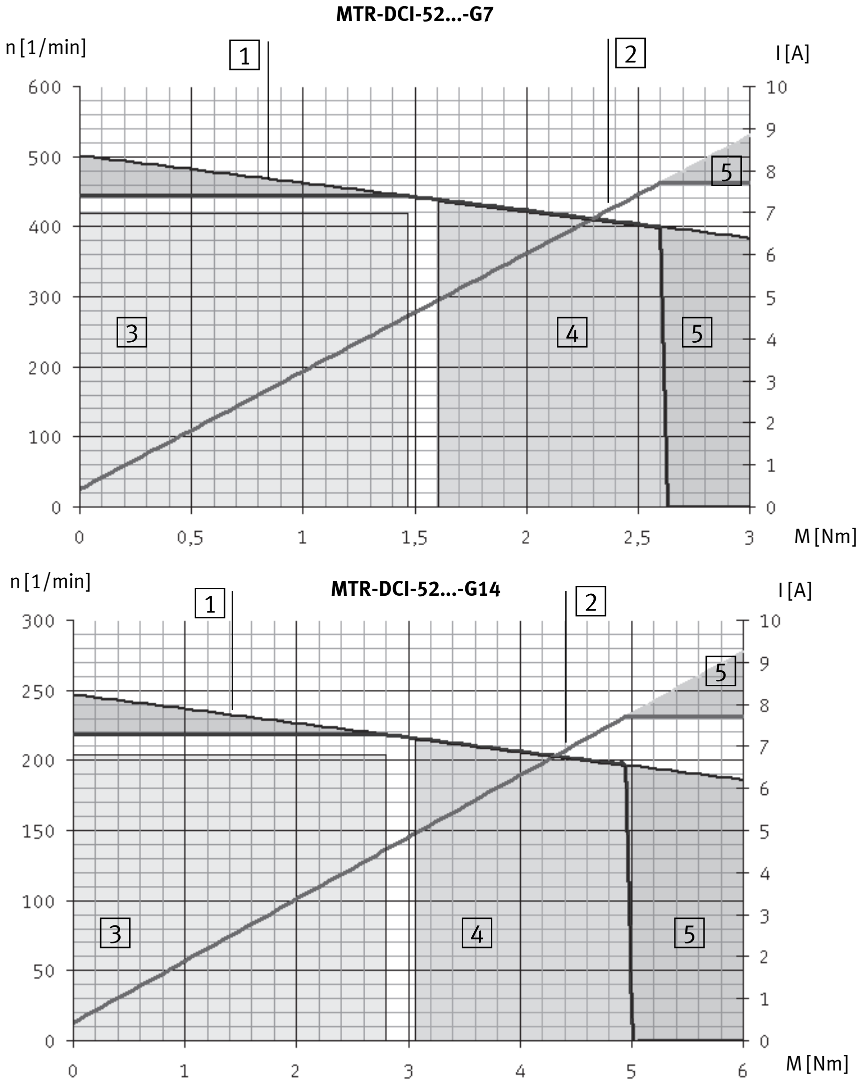
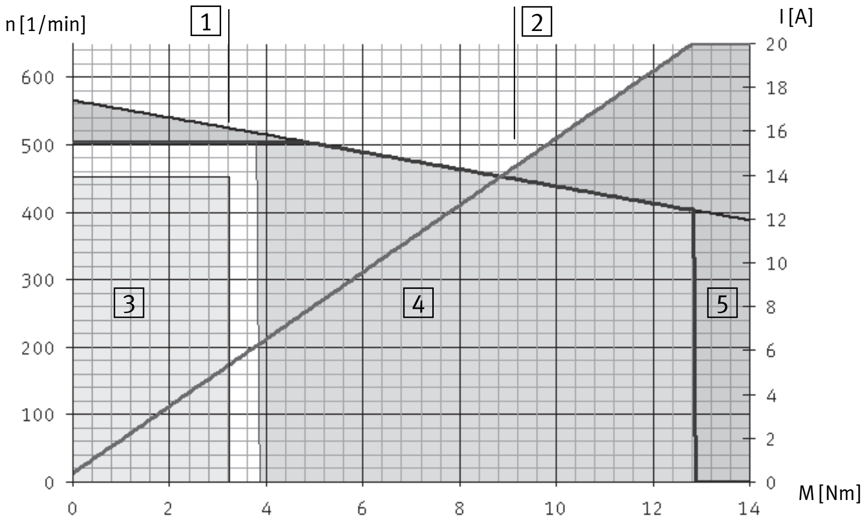


Fig. A/3: Motor characteristic curves MTR-DCI-52...

MTR-DCI-62...-G7



MTR-DCI-62...-G14

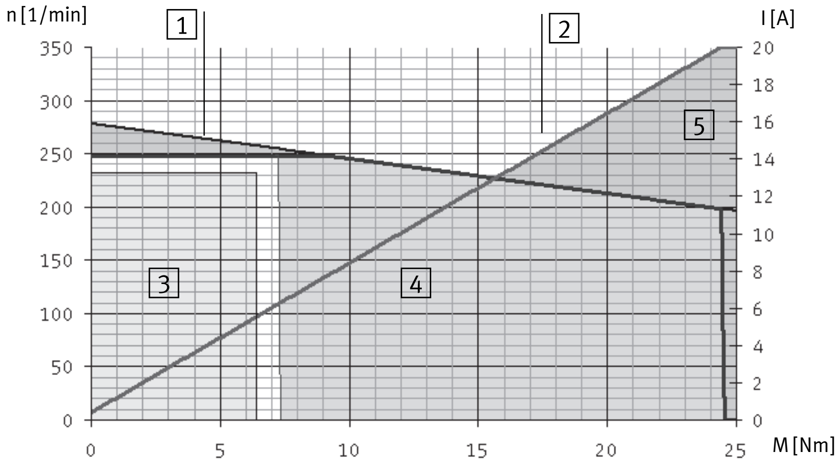


Fig. A/4: Motor characteristic curves MTR-DCI-62...

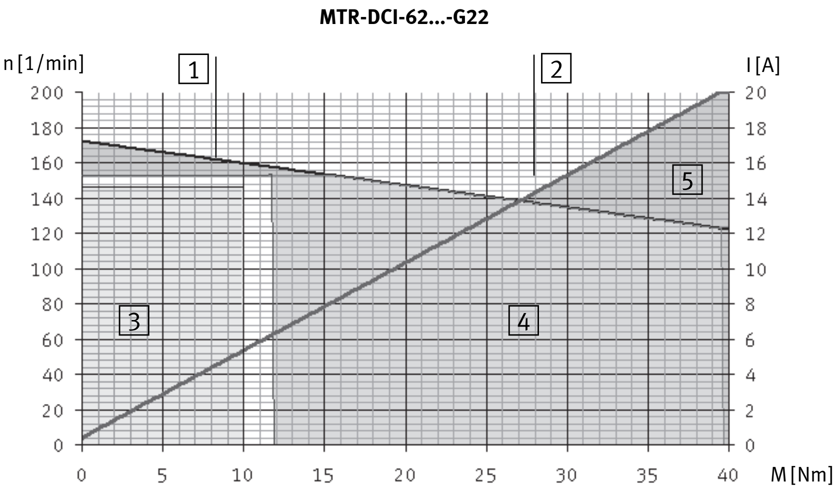


Fig. A/5: Motor characteristic curves MTR-DCI-62...

A.4 Conversion of the measuring units

A measuring system must be defined for specifying the parameters of the electric axis. In order to enable simple parametrizing for different application cases, the controller can be set via the control panel or FCT so that the user can specify or read all variables directly in the desired units on the power take-off, e. g.:

- The metric measuring system for linear movements (mm, mm/s, mm/s^2)
- The angle measuring system for purely rotational movements (degree, degree/s, degree/s^2) or (rev, rev/s, rev/s^2)
- The imperial measuring system (inch, inch/s, inch/s^2)

Each physical variable (position, speed and acceleration) is adapted to the relevant measuring system by means of a conversion factor.

In the controller all parameters are always saved in increment specifications (inc, inc/s, inc/s^2) and not converted until they are written or read. For the display, conversion from the internal basis system into the (pre)set measuring system takes place within the firmware; for representation on the PC monitor within the FCT software. In this way, the user does not need to carry out conversion when entering values or when reading on the control panel or in the FCT.
The direct transfer of values via the serial interface with CI commands always takes place in the basis system and it is assumed that conversion into increments has already taken place.

Conversion is carried out via the parameters:

- Feed constant (depending on the drive type)
- Gear reduction
- Encoder resolution = physical measuring steps per motor revolution. With MTR-DCI: pulse quadruplication by digital interpolation

Parameters	MTR-DCI-32	MTR-DCI-42	MTR-DCI-52	MTR-DCI-62
feed [1)]	DMES-18-...: 1500 [µm/red]	DMES-25-...: 2500 [µm/red]	DMES-40-...: 4000 [µm/red]	DMES-63-...: 6000 [µm/red]
enc [2)]	300 x 4 = 1200 [incr/rev]	500 x 4 = 2000 [incr/rev]		
gear [3)]	MTR-DCI-...-G7 (6.75:1) ⇢ 27:4 MTR-DCI-...-G14 (13.73:1) ⇢ 3969:289 MTR-DCI-...-G22 (22.2:1) ⇢ 1710:77			

1) Feed constant: dependent on the axis type, here DMES-...
2) Encoder resolution for MTR-DCI: impulse four-fold multiplication through digital interpolation
3) Gear reduction: specification in 2 real numbers for numerator or denominator of the fraction

Tab. A/1: Basis parameter for the measuring system

Drive		Conversion factors UF	
		Increments ⇠ ⇢ millimetres Increments = millimetres*UF Millimetres = increments/UF	Increments ⇠ ⇢ inch Increments = inches*UF Inches = increments/UF
MTR-DCI-32... (+DMES-18)	-G7 -G14	5400 10986.851211	13716 27906.602076
MTR-DCI-42... (+DMES-25)	-G7 -G14	5400 10986.851211	137160 27906.602076
MTR-DCI-52... (+DMES-40)	-G7 -G14	3375 6866.782007	85725 17441.626298
MTR-DCI-62... (+DMES-63)	-G7 -G14 -G22	2250 4577.854671 7402.597403	57150 11627.750865 18802.597403

Tab. A/2: Special conversion factors for the MTR-DCI with DMES-...

General conversion factors UF

$$1\,[\text{inch}] = 25.4\,[\text{mm}]$$

$$1\,[\mu\text{inch}] = 0.0254\,[\mu\text{m}]$$

$$1\,[^\circ] = \frac{1}{360}\,[\text{rot}]$$

[µm] ⇢ [inc]

$$UF_{\mu m}\left[\frac{\text{inc}}{\mu\text{m}}\right] = \frac{\text{enc} \times \text{gear}}{\text{feed}_{\mu m}} \quad \left[\frac{\frac{\text{inc}}{\text{rot}} \times \frac{\text{rot}}{\text{rot}}}{\frac{\mu\text{m}}{\text{rot}}}\right]$$

[µinch] ⇢ [inc]

$$UF_{\mu inch}\left[\frac{\text{inc}}{\mu\text{inch}}\right] = \frac{\text{enc} \times \text{gear}}{\text{feed}_{\mu inch}} \quad \left[\frac{\frac{\text{inc}}{\text{rot}} \times \frac{\text{rot}}{\text{rot}}}{\frac{\mu\text{inch}}{\text{rot}}}\right]$$

$$= \frac{\text{enc} \times \text{gear}}{\text{feed}_{\mu m} \times \frac{1}{0.0254}} \quad \left[\frac{\frac{\text{inc}}{\text{rot}} \times \frac{\text{rot}}{\text{rot}}}{\frac{\mu\text{m}}{\text{rot}} \times \frac{\mu\text{inch}}{\mu\text{m}}}\right]$$

$$= UF_{\mu m} \times 0.0254 \quad \left[\frac{\text{inc}}{\mu\text{m}} \times \frac{\mu\text{m}}{\mu\text{inch}}\right]$$

[rev] ⇢ [inc]

$$UF_{rot}\left[\frac{\text{inc}}{\text{rot}}\right] = \text{enc} \times \text{gear} \quad \left[\frac{\text{inc}}{\text{rot}} \times \frac{\text{rot}}{\text{rot}}\right]$$

Physical variable	Conversion into increments		
Position	**POS [inc]**		
– Target position – Reference point – Project zero point – Software end position, positive – Software end position, negative	[µm] ⇢ [inc]	= $POS_{\mu m}$ x $UF_{\mu m}$	[µm] x [inc/µm]
	[µinch] ⇢ [inc]	= $POS_{\mu inch}$ x (0.0254 x $UF_{\mu m}$) * = $POS_{\mu inch}$ x $UF_{\mu inch}$	[µinch] x [µm/µinch] x [inc/µm] [µinch] x [inc/µinch]
	[rev] ⇢ [inc]	= POS_{rev} x UF_{rev}	[rev] x [inc/rev)
Speed	**V [inc/s] =**		
– Positioning speed to target position – Search speed during reference travel – Positioning speed to the axis zero point during reference travel	[µm] ⇢ [inc]	= $V_{\mu m}$ x $UF_{\mu m}$	[µm/s] x [inc/µm]
	[µinch] ⇢ [inc]	= $V_{\mu inch}$ x (0.0254* x $UF_{\mu m)}$ * = $V_{\mu inch}$ x $UF_{\mu inch}$	[µinch/s] x [µm/µinch] x [inc/µm] [µinch/s] x [inc/µinch]
	[rev] ⇢ [inc]	= V_{rev} x UF_{rev}	[rev/s] x [inc/rev]
Acceleration	**a [inc/s^2] =**		
– Nominal acceleration	[µm] ⇢ [inc]	= $a_{\mu m}$ x $UF_{\mu m}$	[µm/s^2] x [inc/µm]
	[µinch] ⇢ [inc]	= $a_{\mu inch}$ x (0.0254* x $UF_{\mu m)}$ * = $a_{\mu inch}$ x $UF_{\mu inch}$	[µm/s^2] x [µm/µinch] x [inc/µm] [µinch/s^2] x [inc/µinch]
	[rev] ⇢ [inc]	= a_{rev} x UF_{rev}	[rev/s^2] x [inc/rev]
* conversion [µm] ⇢ [µinch] : 1 µinch = 0.0254 µm			

Tab. A/3: General formulae for conversion

Reference – Festo Handling and Positioning Profile (FHPP)

Appendix B

Contents

B. Reference – Festo Handling and Positioning Profile (FHPP) B-1

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- B.1.2 Task identifiers, Response identifiers and fault numbers B-5
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B.1 The Festo Parameter Channel (FPC)

As an alternative to the Festo Parameter Channel for cyclic data (PDO2), parametrizing can also take place via the acyclic data channel. The corresponding SDO object number can be defined via the parameter number. (object = PNU (hex) +2000h). An overview of the object numbers can be found in Appendix B.2.2.

B.1.1 Composition of the cyclic I/O data (FHPP-FPC)

The parameter channel serves for transmitting parameters. The parameter channel comprises the following:

Components	Description
Parameter identifier (PKE)	Component of the parameter channel component which contains the Task and Response identifiers (AK) and the parameter number (PNU). The parameter number serves for identifying or addressing the individual parameter. The Task or Response identifier (AK) describes the task or the reply in the form of an identifier number.
Subindex (IND)	addresses an element of an array parameter (sub-parameter number)
Parameter value (PWE)	Value of the parameter If a task of the parameter processing cannot be carried out, a fault number will be shown instead of the value in the reply telegram. The fault number describes the cause of the fault.

Tab. B/1: Components of the parameter channel (FPC)

The parameter channel consists of 8 octets. The structure of the parameter channel as a factor of the size or type of the parameter value is shown in the following table:

FPC (PDO2)	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Output data	0	IND	ParID (PKE)		Value (PWE)			
Input data	0	IND	ParID (PKE)		Value (PWE)			
IND	Subindex - for addressing an array element							
ParID (PKE)	Parameter Identifier - consists of ReqID or ResID and PNU							
Value (PWE)	Parameter value, parameter value: – with double word: bytes 5...8 – with word: Bytes 7, 8 – with byte: Byte 8							

Tab. B/2: Structure of parameter channel

Parameter identifier (PKE)

The parameter identifier contains the Task or Response identifier (AK) and the parameter number (PNU).

PKE	**Octet 1 (byte 3)**								**Octet 2 (byte 4)**							
Bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Task	ReqID (AK)				res.	Parameter number (PNU)										
Reply	ResID (AK)				res.	Parameter number (PNU)										
ReqID (AK)	Request identifier – task identifier (read, write, ...)															
ResID (AK)	Response identifier – response identifier (transfer value, fault, ...)															
Value (PNU)	Parameter number – serves for identifying or addressing the relevant parameter (see section B.1). The Task or Response identifier indicates the type of task or reply (see section B.1.2).															

Tab. B/3: Structure of parameter identifier (PKE)

B.1.2 Task identifiers, Response identifiers and fault numbers

The Task identifiers are shown in the following table:

ReqID	Description	Response identifier	
		positive	negative
0	No task	0	–
1	Request parameter [1)]	1, 2	7
2	Modify parameter value (word) [1)]	1	7
3	Modify parameter value (double word) [1)]	2	7
(4)	– (reserved - Request describing element) [2)]	–	–
(5)	– (reserved - Modify describing element) [2)]	–	–
6	Request parameter (array)	4, 5	7
7	Modify parameter value (array, word)	4	7
8	Modify parameter value (array, double word)	5	7
(9)	– (reserved - Request array elements) [2)]	–	–
(10)	– (reserved) [2)]	–	–
11	Modify parameter value (byte) [1)]	11	7
12	Modify parameter value (array, byte)	12	7
(13)	– (reserved - Request lower limit value) [2)]	–	–
(14)	– (reserved - Request upper limit value) [2)]	–	–
(15)	reserved [2)]	–	–

1) When access is made with order numbers for simple variables to parameters which are implemented as arrays, the subindex will be ignored or set to 0. This means that it is always the first element of an array which is addressed.

2) Tasks with non-supported task numbers (ReqID) will be answered with Response identifier 7 and fault number 22.

Tab. B/4: Task identifiers

If the task cannot be carried out, Response identifier 7 as well as the appropriate fault number will be transmitted (negative reply).

The following table shows the Response identifiers:

ResID	Description
0	No reply
1	Parameter transferred (word)
2	Parameter transferred (double word)
(3)	– (reserved - Describing element transferred) 1)
4	Parameter value transferred (array, word)
5	Parameter value transferred (array, double word)
6	Number of array elements transferred
7	Task cannot be carried out (with fault number) 2)
(8)	– (reserved - No higher order for PKW interface) 1)
(9)	– (reserved - Spontaneous message – word) 1)
(10)	– (reserved - Spontaneous message – double word) 1)
11	Parameter value transferred (byte)
12	Parameter value transferred (array, byte)
(13)	– (reserved - Lower limit value transferred) 1)
(14)	– (reserved - Upper limit value transferred) 1)
(15)	– (reserved) 1)
1) Not used with MTR-DCI 2) Fault numbers see following table	

Tab. B/5: Response identifiers

If the task of the parameter processing cannot be carried out, an appropriate fault number will be transmitted in the reply telegram (octets 7 and 8 of the FPC range). The following table shows the possible fault numbers:

Fault numbers		Description
0	0x00	Non-permitted PNU The parameter does not exist.
1	0x01	Parameter value cannot be modified (read only)
(2)	0x02	– (reserved - Lower or upper limit value exceeded) 1)
3	0x03	Faulty subindex
4	0x04	No array
5	0x05	Incorrect data type
(6)	0x06	– (reserved - Setting not permitted – can only be reset) 1)
(7)	0x07	– (reserved - Describing element cannot be modified) 1)
(8)	0x08	– (reserved - PPO-Write requested in IR does not exist) 1)
9	0x09	Description data do not exist
(10)	0x10	– (reserved - Access group incorrect) 1)
11	0x0A	No higher-order
(12)	0x0B	– (reserved - Password incorrect) 1)
13	0x0C	Text not legible in cyclic exchange
(14)	0x0D	– (reserved - Name not legible in cyclic exchange) 1)
(15)	0x0E	– (reserved - Text array does not exist) 1)
(16)	0x10	– (reserved - PPO-Write missing) 1)
(17)	0x11	– (reserved - Order cannot be processed because of operating status) 1)
(18)	0x12	– (reserved - Other faults) 1)
(19)	0x13	– (reserved - Date not legible in cyclic exchange) 1)
(20)	0x14	– (reserved - Non-permitted value) 1)
(21)	0x15	– (reserved - Reply too long) 1)
22	0x16	non-permitted: Attributes, number of elements, PNU or IND
(23)	0x17	– (reserved - Write request: non-permitted format) 1)
24	0x18	Write request: Number of values not permitted
(...99)	0x64	– (reserved - PROFIBUS)
100	0x65	– (reserved - Festo: ReqID is not supported) 1)
(...255)	0xFF	– (reserved - Festo)

1) These fault numbers are not used

B.1.3 Rules for task reply processing

Rules	Description
1	If the master sends the identifier for "No task," the MTR-DCI replies with the Response identifier for "No reply."
2	A task or reply telegram always refers to a single parameter.
3	The master must continue to send a task until it receives the appropriate reply from the MTR-DCI.
4	The master recognizes the reply to the task placed: – by evaluating the Response identifier – by evaluating the parameter number (PNU) – if applicable, by evaluating the subindex (IND) – if applicable, by evaluating the parameter value.
5	The MTR-DCI provides the reply until the master sends a new task.
6	a) A write task, even with cyclic repetition of the same task, will only be carried out once by the MTR-DCI. b) Between two consecutive tasks with the same Task identifier (AK), parameter number (PNU) and subindex (IND), the Task identifier 0 (no task) must be sent and the Response identifier 0 (no reply) must be awaited. This is to ensure that an "old" reply is not interpreted as a "new" reply.

Tab. B/6: Rules for task reply processing

Sequence of parameter processing

Caution
Observe the following when modifying parameters:
An FHPP control signal, which is to refer to a modified parameter, may only follow when the Response identifier "Parameter value transferred" is received for the relevant parameter and if applicable for the index.

If, e. g. a position value in a position register is to be modified and if movement is then to be made to this position, the positioning command must not be given until the MTR-DCI has completed and confirmed the modification of the position register.

Caution
In order to be sure that an "old" reply cannot be interpreted as a "new" reply, the Task identifier 0 (no task) must be sent and the Response identifier 0 (no reply) must be awaited between two consecutive tasks with the same Task identifier (AK), parameter number (PNU) and subindex (IND).

Evaluating faults

In the case of tasks which cannot be carried out, the slave replies as follows:

– Output Reponse identifier = 7

– Output a fault number in bytes 7 and 8 of the parameter channel (FPC).

B.1.4 Example of parametrizing

The following tables show an example of parametrizing a positioning task in the position record table via FPC – (Festo Parameter Channel).

Step 1

Output status of the 8 bytes of FPC data:

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x00	0x**0**0	0x00	0x00	0x00	0x00	0x00
Input data	0x00	0x00	0x**0**0	0x00	0x00	0x00	0x00	0x00

Step 2

Write record number 1 with absolute positioning:
PNU 401, subindex 2 – Modify parameter value, array, byte:
ReqID 12 (0xC) with value 0x00.

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x**02**	0x**C1**	0x**91**	Unused	Unused	Unused	0x**00**
Input data	0x00	0x**02**	0x**C1**	0x**91**	0x00	0x00	0x00	0x**00**

Step 3

After receiving the input data with ResID 0xC send output data with ReqID = 0x0 and wait for input data with ResID = 0x0:

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x02	0x**0**1	0x91	Unused	Unused	Unused	0x00
Input data	0x00	0x02	0x**0**1	0x91	0x00	0x00	0x00	0x00

Step 4

Write record number 1 with target position 0x1234 (decimal 4660 increments): PNU 404, subindex 2 – Modify parameter value, array, double word: ReqID 8 (0x8) with value 0x00001234.

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x02	0x**81**	0x**94**	0x**00**	0x**00**	0x**12**	0x**34**
Input data	0x00	0x02	0x**81**	0x**94**	0x**00**	0x**00**	0x**12**	0x**34**

Step 5

After receiving the input data with ResID 0x8 send output data with ReqID = 0x0 and wait for input data with ResID = 0x0:

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x02	0x**0**1	0x94	0x00	0x00	0x12	0x34
Input data	0x00	0x02	0x**0**1	0x94	0x00	0x00	0x12	0x34

Step 6

Write record number 1 with speed 0x7743 (decimal 30531 increments/s): PNU 406, subindex 2 – Modify parameter value, array, double word: ReqID 8 (0x8) with value 0x00007743.

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x02	0x**81**	0x**96**	0x**00**	0x**00**	0x**77**	0x**43**
Input data	0x00	0x02	0x**81**	0x**96**	0x**00**	0x**00**	0x**77**	0x**43**

Step 7

After receiving the input data with ResID 0x8 send output data with ReqID = 0x0 and wait for input data with ResID = 0x0:

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
	reserved	Subindex	ReqID/ResID + PNU		Parameter value			
Output data	0x00	0x02	0x**0**1	0x94	0x00	0x00	0x77	0x43
Input data	0x00	0x02	0x**0**1	0x94	0x00	0x00	0x77	0x43

B.2 Parametrizing as per FHPP-FPC

B.2.1 General parameter structure

Group	Indices	Description
Device data	100..199	Device identification and device-specific settings, version numbers, identifier words, etc.
Diagnostic memory	200...299	Memory for diagnostic events: Fault numbers, fault time, incoming/outgoing event
Processing data	300...399	Current nominal and actual values, local I/Os, status data etc.
Record list	400...499	A record contains all the nominal value parameters required for a positioning procedure
Project data	500...599	Basic project settings. Maximum speed and acceleration, offset project zero point etc. -> Parameters are the basis for the record list.
Factor group	600...699	reserved
Axis data Electric drives 1	1000...1099	All axis-specific parameters for electric drives. Gear factor, feed constant, reference parameter ...

B.2.2 Object overview

The following overview (Tab. B/7) shows all defined parameters of the FHPP with

– The parameter number PNU for parametrizing as per FHPP FPC (PDO 2),

– The object number (object) for parametrizing via SDO

and the corresponding CANopen or CI object numbers.

You will find descriptions of these parameters in sections B.2.4 to B.2.19 (cf. “see” column).

You will find an overview of the available CANopen objects in section C.1. You will find an overview of the available CI objects in section C.3.3.

Name	FHPP		CANopen / CI		see
	PNU Object	**SI**	**Object**	**SI**	
Device data					
Device data – standard parameter (see section B.2.4)					
Manufacturer hardware version	**100** 2064h	–	(1009)/ 2069	– / 00h	B.2.4
Manufacturer firmware version	**101** 2065h	–	(100A)/ 206Ah	– / 00h	B.2.4
Version FHPP	**102** 2066h	–	2066h	– / 00h	B.2.4
Controller serial number	**114** 2072h	1...12 01h...0Ch	2072h	– / 00h	B.2.4
Device data – extended parameters (see section B.2.5)					
Manufacturer device name	**120** 2078h	1...30 01h...1Eh	1008h	– / 00h	B.2.5
User device name	**121** 2079h	1...8 01h...08h	20FDh	– / 00h	B.2.5
Drive manufacturer	**122** 207Ah	1...30 01h...1Eh	6504h	– / 00h	B.2.5
HTTP drive catalog address	**123** 207Bh	1...30 01h...1Eh	6505h	– / 00h	B.2.5
Festo order number	**124** 207Ch	1...30 01h...1Eh	6503h	– / 00h	B.2.5
Device control	**125** 207Dh	–	207Dh	– / 00h	B.2.5
HMI control	**126** 207Eh	1...4 01h...04h	20FFh	01h...04h	B.2.5
Data memory control	**127** 207Fh	1, 2 01h, 02h	20F1h	01h, 02h	B.2.5
Diagnosis (see section B.2.6).					
Diagnostic event	**200** 20C8h	1...16 01h...10h	20C8h	01h...10h	B.2.6
Fault number	**201** 20C9h	1...16 01h...10h	20C9h	01h...10h	B.2.6

Name	FHPP PNU Object	FHPP SI	CANopen / CI Object	CANopen / CI SI	see
Time stamp	**202** 20CAh	1...16 01h...10h	20CAh	01h...10h	B.2.6
Diagnostic memory parameter	**204** 20CCh	1...4 01h...04h	20CCh	01h...04h	B.2.6
Device fault	**205** 20CDh	–	2FF1h	– / 00h	B.2.6
CANopen diagnosis	**206** 20CEh	1...6 01h...06h	2FF2h	01h...06h	B.2.6
Processing data (see section B.2.7)					
Local digital inputs	**303** 212Fh	–	60FDh	– / 00h	B.2.7
Local digital outputs	**304** 2130h	1, 2 01h, 02h	60FEh	01h, 02h	B.2.7
Cycle number	**305** 2131h	–	2FFFh	– / 00h	B.2.7
Keypad status	**306** 2132h	–	2FFFh	05h	B.2.7
Record list (see section B.2.8)					
Record number	**400** 2190h	–	2033h	– / 00h	B.2.8
Record control byte 1	**401** 2191h	1...32 01h...20h	20EAh	01h...20h	B.2.8
Record target position	**404** 2194h	1...32 01h...20h	20ECh	01h...20h	B.2.8
Record speed	**406** 2196h	1...32 01h...20h	20EDh	01h...20h	B.2.8
Record acceleration	**407** 2197h	1...32 01h...20h	20EEh	01h...20h	B.2.8
Project data					
Project data – General project data (see section B.2.9)					
Project zero point	**500** 21F4h	–	21F4h	– / 00h	B.2.9
Software end positions	**501** 21F5h	1, 2 01h, 02h	607Bh	01h, 02h	B.2.9

Name	**FHPP**		**CANopen / CI**		**see**
	PNU Object	**SI**	**Object**	**SI**	
Max. speed	**502** 21F6h	–	21F6h	– / 00h	B.2.9
Max. acceleration	**503** 21F7h	–	21F7h	– / 00h	B.2.9
Project data - power operation (see section B.2.10)					
Stroke limit	**510** 21FEh	–	60F6h	01h	B.2.10
Min. torque	**511** 21FFh	–	60F6h	05h	B.2.10
Max. torque	**512** 2200h	–	6072h	– / 00h	B.2.10
Project data – Teach (see section B.2.11)					
Teach target	**520** 2208h	–	21FCh	– / 00h	B.2.11

Name	FHPP		CANopen / CI		see
	PNU Object	**SI**	**Object**	**SI**	
Project data – Jog mode (see section B.2.12)					
Jog Mode Velocity Phase 2	**531** 2213h	–	20EDh	21h	B.2.12
Jog mode acceleration	**532** 2214h	–	20EEh	21h	B.2.12
Jog mode time phase 1	**534** 2216h	–	20E9h	00h / 21h	B.2.12
Project data – Direct mode (positioning mode) (see section B.2.13)					
Direct mode acceleration	**541** 221Dh	–	20EEh	22h	B.2.13
Project data – Direct mode (force mode) (see section B.2.14)					
Force target window	**552** 2228h	–	60F6h	03h	B.2.14
Damping time	**553** 2229h	–	60F6h	04h	B.2.14
Speed limit	**554** 222Ah	–	60F6h	02h	B.2.14
Axis data electric drives 1					
Axis data electric drives 1 – mechanical (see section B.2.15)					
Polarity	**1000** 23E8h	–	607Eh	– / 00h	B.2.15
Encoder resolution	**1001** 23E9h	1, 2 01h, 02h	608Fh	01h, 02h	B.2.15
Gear ratio	**1002** 23EAh	1, 2 01h, 02h	6091h	01h, 02h	B.2.15
Feed constant	**1003** 23EBh	1, 2 01h, 02h	6092h	01h, 02h	B.2.15
Position factor	**1004** 23ECh	1, 2 01h, 02h	6093h	01h, 02h	B.2.15
Axis parameter	**1005** 23EDh	1...5 01h...05h	20E2h	01h...05h	B.2.15
Axis data electric drives 1 – Homing (see section B.2.16)					
Offset axis zero point	**1010** 23F2h	–	607Ch	– / 00h	B.2.16

Name	FHPP		CANopen / CI		see
	PNU Object	**SI**	**Object**	**SI**	
Homing method	**1011** 23F3h	–	6098h	– / 00h	B.2.16
Homing speeds	**1012** 23F4h	1, 2 01h, 02h	6099h	01h, 02h	B.2.16
Homing required	**1014** 23F6h	–	23F6h	– / 00h	B.2.16
Homing max. torque	**1015** 23F7h	–	23F7h	– / 00h	B.2.16
Axis data electric drives 1 – controller parameters (see section B.2.17)					
Hold option code	**1020** 23FCh	–	605Dh	– / 00h	B.2.17
Fault reaction option code	**1021** 23FDh	–	605Eh	– / 00h	B.2.17
Target position window	**1022** 23FEh	–	6067h	– / 00h	B.2.17
Position window time	**1023** 23FEh	–	6068h	– / 00h	B.2.17
Position control parameter set	**1024** 2400h	18...23, 32 13h...17h, 20h	60FBh	12h...15h, 17h, 20h	B.2.17
Motor data	**1025** 2401h	1, 3 01h, 03h	6410h	01h, 03h	B.2.17
Drive Data	**1026** 2402h	1...8 01h...08h	6510h	31h(01h), 32h(02h), 40h(03h), 41h(04h), 42h(05h), 43h(06h), A0h(07h), 22h(08h),	B.2.17

Name	**FHPP**		**CANopen / CI**		**see**
	PNU Object	**SI**	**Object**	**SI**	
Axis data electric drives 1 – electronic rating plate (see section B.2.18)					
Motor type	**1030** 2406h	–	6402h	– / 00h	B.2.18
Max. current	**1034** 240Ah	–	6073h	– / 00h	B.2.18
Rated motor current	**1035** 240Bh	–	6075h	– / 00h	B.2.18
Rated motor torque	**1036** 240Ch	–	6076h	– / 00h	B.2.18
Axis data electric drives 1 – Standstill monitoring (see section B.2.19)					
Position target value	**1040** 2410h	–	6062h	– / 00h	B.2.19
Position actual value	**1041** 2411h	–	6064h	– / 00h	B.2.19
Standstill position window	**1042** 2412h	–	2040h	– / 00h	B.2.19
Standstill timeout	**1043** 2413h	–	2041h	– / 00h	B.2.19

Tab. B/7: Overview of FHPP parameters

B.2.3 Representing the parameter entries

Encoder resolution

FHPP	**1001**	**1…2**	**Array**	**uint32**	**rw**
Description	Encoder resolution in increments / revolutions The encoder resolution is fixed and cannot be modified by the user. The calculated value is derived from the fraction (encoder-increments/motor revolution).				
Encoder increments (encoder increments)	1001	1		uint32	rw
	Value range: 0 ... 2^{32}-1 Default: 500				
Motor revolutions (motor revolution)	1001	2		uint32	rw
	Fix = 1				
CANopen / CI	**608Fh**	**01h...02h**	**Array**	**uint32**	**rw**

1 Name of the parameter in English (German in brackets)

2 PNU (parameter number PDO)

3 Subindices of parameter, if present (–: no subindex, simple variable)

4 Element class

5 Element variable type.

6 Read/write permission: ro = read only, wo = write only, rw = read and write,
rw = read and write at any time,
rw = read and write during commissioning

7 Description of the parameter

8 Name and description of the subindices, if available (specification related to FHPP, if available)

9 Corresponding and CANopen or CI object, if present

Fig. B/6: Representing the parameter entries

B.2.4 Device data – Standard parameters

Manufacturer Hardware Version					
FHPP	**100**	**–**	**Var**	**uint16**	**ro**
Description	Hardware version, specification in BCD (binary coded decimals): xxyy (xx = main version, yy = secondary version)				
CI	**2069**	**– / 00h**	**Var**	**uint16**	**ro**
	CO: Compare Object 1009h				

Manufacturer Firmware Version					
FHPP	**101**	**–**	**Var**	**uint16**	**ro**
Description	Firmware version, specification in BCD (binary coded decimals): xxyy (xx = main version, yy = secondary version)				
CI	**206A**	**– / 00h**	**Var**	**uint16**	**ro**
	CO: Compare Object 100Ah				

Version FHPP					
FHPP	**102**	**–**	**Var**	**uint16**	**ro**
Description	Version number of FHPP, specification in BCD (binary coded decimals): xxyy (xx = main version, yy = secondary version)				
CANopen / CI	**2066h**	**– / 00h**	**Var**	**uint16**	**ro**

Controller Serial N umber					
FHPP	**114**	**1...12**	**Array**	**char**	**ro**
Description	12-position code for identifying the controller.				
CANopen / CI	**2072h**	**– / 00h**	**Var**	**V-string**	**ro**

B.2.5 Device data – extended parameters

Manufacturer Device Name					
FHPP	**120**	**1...30**	**Array**	**char**	**ro**
Description	Type designation of the drive. Example: "MTR-DCI-42S-VCSC-EG14-H2CO"				
CANopen / CI	**1008h**	**– / 00h**	**Var**	**V-string**	**ro**

User Device Name					
FHPP	**121**	**1...8**	**Array**	**char**	**rw**
Description	Device name assigned by user Max. 8 characters (ASCII, 7-bit). Default: "motor001"				
CANopen / CI	**20FDh**	**– / 00h**	**Var**	**V-string**	**rw**

Drive Manufacturer					
FHPP	**122**	**1...30**	**Array**	**char**	**ro**
Description	Name of drive manufacturer. Fixed: "Festo AG & Co. KG"				
CANopen / CI	**6504h**	**– / 00h**	**Var**	**V-string**	**ro**

HTTP Drive Catalog Address					
FHPP	**123**	**1...30**	**Array**	**char**	**ro**
Description	Internet address of the manufacturer. Fixed: "www.festo.com"				
CANopen / CI	**6505h**	**– / 00h**	**Var**	**V-string**	**ro**

Festo Order Number					
FHPP	**124**	**1...30**	**Array**	**char**	**ro**
Description	Order number of motor unit, e. g. "533742"				
CANopen / CI	**6503h**	**– / 00h**	**Var**	**V-string**	**ro**

Device Control					
FHPP	**125**	**–**	**Var**	**uint8**	**rw**
Description	Activates device control of the controller via the controller interface. Corresponds to “HMI control” on the control panel and “FCT/HMI” on the FCT. 0 (0x00): Control via controller interface OFF. via HMI (control panel) and FCT ON 1 (0x01): Control via controller interface ON (default)				
CANopen / CI	**207Dh**	**– / 00h**	**Var**	**uint8**	**rw**

HMI Control (MMI parameter)					
FHPP	**126**	**1...4**	**Var**	**uint8**	**ro**
Description	Settings on the control panel HMI (only type MTR-DCI-...H2) Influences only the display: All parameters are saved internally in increments.				
LCD current	126	1	0		ro
	Value range: 1...5 (0x01 ... 0x05). Default: 5				
LCD contrast	126	2	1		ro
	Value range: 0...63 (0x00 ... 0x3F). Default: 0				
Measuring unit	126	3	2		CI rw
	Measuring unit system for the control panel. Compare Object 20D0h. 1 (0x01): Metric measuring units (mm, mm/s, mm/s^2) 4 (0x04): Angle degree 8 (0x08): Revolutions				
Scaling factor	126	4	3		CI rw
	Number of post-decimal positions Fixed = 2. Compare Object 20D0h				
CANopen / CI	**20FFh**	**01h...04h**	**Array**	**uint8**	**rw**

Data Memory Control					
FHPP	**127**	**1, 2**	**Array**	**uint8**	**rw [1)]**
Description	Commands for the EEPROM (non-volatile data storage)				
Delete EEPROM	127	1		uint8	rw
	When the object has been written and after Power Off/On the data in the EEPROM are reset to the factory settings. Fixed: 16 (0x10): Delete data in EEPROM and restore factory settings). **Observe the note below.**				
Save data	127	2		uint8	rw
	The data in EEPROM will be overwritten with the current user-specific settings. Fixed 1 (0x01): Save data				
CANopen / CI	**20F1h**	**01h, 02h**	**Array**	**uint8**	**rw [1)]**
[1)] When reading the reply "0" always occurs					

Note
All user-specific settings will be lost when the EEPROM is deleted (except for cycle number). The status after deletion corresponds to the standard factory setting.

- Always carry out a first commissioning after deleting the EEPROM.
- When the EEPROM is deleted, the field bus parameters are also reset.

B.2.6 Diagnosis

Function method of the diagnostic memory see section 6.4.

Diagnostic Event					
FHPP	**200**	**1...16**	**Array**	**uint8**	**ro**
Description	Type of diagnostic event saved in the diagnostic memory. Display whether an incoming or outgoing fault is saved. Value — Type of diagnostic event 0 (0x00) No fault (or fault message deleted) 1 (0x01) Incoming fault 2 (0x02) Outgoing fault 3 (0x03) (reserved) 4 (0x04) Overrun time stamp				
Event 1	200	1		uint8	ro
	Active diagnostic event				
Event 2	200	2		uint8	ro
	Previous diagnostic event				
Event ...	200	...		uint8	ro
	...				
Event 16	200	16		uint8	ro
	Oldest saved diagnostic event				
CANopen / CI	**20C8h**	**01h...10h**	**Array**	**uint8**	**ro**

Fault Number					
FHPP	**201**	**1...16**	**Array**	**uint16**	**ro**
Description	Fault number saved in the diagnostic memory, serves for identifying the fault. Fault numbers: see section B.2.6.				
Event ...	201	...		uint16	ro
	see PNU 200.				
CANopen / CI	**20C9h**	**01h...10h**	**Array**	**uint16**	**ro**

Time Stamp					
FHPP	**202**	**1...16**	**Array**	**uint32**	**ro**
Description	Time point of the diagnostic event since device was switched on (unit as per PNU 204/2). In the event of an overrun the time stamp jumps from 0xFFFFFFFF to 0, an entry: "Overrun time stamp" is created in the diagnostic memory.				
Event ...	202	...		uint32	ro
	see PNU 200.				
CANopen / CI	**20CAh**	**01h...10h**	**Array**	**uint32**	**ro**

Diagnostic Memory Parameter					
FHPP	**204**	**1...4**	**Array**	**uint8**	**rw/ro**
Description	Configuration of the diagnostic memory.				
Fault type	204	1		uint8	rw
	Incoming and outgoing faults 1 (0x01): Record incoming and outgoing*) faults (default) 2 (0x02) Record only incoming faults *) outgoing fault = time point when the fault was quitted.				
Resolution	204	2		uint8	rw
	Resolution time stamp 1 (0x01): Resolution time stamp 10 ms (default) 2 (0x02): Resolution time stamp 1 ms				
Clear memory	204	3		uint8	rw
	Clear diagnostic memory by writing value = 1. Read will always reply with value = 1.				
Number of entries	204	4		uint8	ro
	Read out the number of entries in the diagnostic memory. Value range: 0 ... 15 (0x00 ... 0x0F)				
CANopen / CI	**20CCh**	**01h...04h**	**Array**	**uint8**	**rw/ro**

Device fault					
FHPP	**205**	**–**	**Var**	**uint16**	**rw**
Description	Reading or deleting the active device malfunction. Read [Bit 0...15]: see section 6.3, Tab. 6/6 Write 0 (0x0000): Delete the active device malfunction.				
CANopen / CI	**2FF1h**	**– / 00h**	**Var**	**uint16**	**rw**

CANopen Diagnosis					
FHPP	**206**	**1...6**	**Array**	**uint8**	**ro**
Description	Read out the CANopen diagnostic data				
Connection state	206	1		uint8	ro
	Current status of the CANopen connection and status machine Connection state: 16, 32, 64 (0xX0): No error 17, 33, 65 (0xX1): CAN warning limit reached 18, 34, 66 (0xX2): Guarding error Status machine status: 16, 17, 18 (0x1X): Stopped 32, 33, 34 (0x2X): preoperational 64, 65, 66 (0x4X): operational Missing bus parameters: 255 (0xFF): No bus parameters				
Bit rate	204	2		uint8	ro
	Current bit rate. 0 (0x00): 1 MBit/s 1 (0x01): 800 kBit/s 2 (0x02): 500 kBit/s 3 (0x03): 250 kBit/s 4 (0x04): 125 kBit/s 5 (0x05): 100 kBit/s 6 (0x06): 50 kBit/s 7 (0x07): 20 kBit/s 255 (0xFF): invalid bit rate (default)				
Master address	206	3		uint8	ro
	Master address. Fixed: 0 (0x00)				
Slave address	206	4		uint8	ro
	Slave address (node ID). Value range: 1 ... 127 (0x01 ... 0x7F) Default: 0 (0x00) - invalid address				
Configuration	206	5		uint8	ro
	Data Profile 0 (0x00): CiA 402 1 (0x01): FHPP Standard 255 (0xFF): Invalid value (default)				
CO diagnosis	206	6		uint8	ro
	reserved				
CANopen / CI	**2FF2h**	**01h...06h**	**Array**	**uint8**	**ro**

B.2.7 Processing data

Local Digital Inputs					
FHPP	**303**	**–**	**Var**	**uint32**	**ro**
Description	Mapping the digital inputs Bit 0, 1: reserved (= 0) Bit 2: Reference switch (1 = reference switch is actuated) Bit 3 ... 15: reserved (= 0) Bit 16 ... 20: Current record number (compare control byte 3) Bit 21: STOP (CCON.B1) Bit 22: ENABLE (CCON.B0) Bit 23: START (CPOS.B1) Bit 24 ... 31: reserved (= 0)				
CANopen / CI	**60FDh**	**– / 00h**	**Var**	**uint32**	**ro**

Local Digital Outputs					
FHPP	**304**	**1, 2**	**Array**	**uint32**	**ro**
Description	Mapping the digital outputs as per CiA402.				
Digital outputs	304	1		uint32	ro
	Bit 0...15 reserved Bit 16 MC Bit 17 READY Bit 18 EA_ACK Bit 19 ERROR Bit 20...31 reserved				
Mask	304	2		uint32	ro
	Bit 0...31 reserved				
CANopen / CI	**60FEh**	**01h, 02h**	**Array**	**uint32**	**ro**

Cycle Number					
FHPP	**305**	**–**	**Var**	**uint32**	**ro**
Description	Number of positioning records executed, reference runs etc. Value range: 0 ... (2^{32}-1)				
CANopen / CI	**2FFFh**	**– / 00h**	**Var**	**uint32**	**ro**

Keypad Status					
FHPP	**306**	**–**	**Var**	**uint8**	**ro**
Description	Scanning the control panel keypad (only type MTR-DCI-...H2). Bit Value Key 0 1 Enter 1 2 Menu 2 4 Left 3 8 Right				
CANopen / CI	**2FFEh**	**05h**	**Var**	**uint8**	**ro**

B.2.8 Record list

PNU 400 **Record number** uint8	**PNU 401** **RCB1** [1)] uint8	**PNU 404** **Target position** int32	**PNU 406** **Speed** uint32	**PNU 407** **Acceleration** uint32
0	Homing			
1	...	...	...	...
2	...	...	...	...
...	...	...	...	...
31	...	...	...	...
1) RCB = Record Control Byte. Defines whether positioning is relative or absolute.				

Tab. B/8: Position set table structure (record list)

FHPP

With FHPP record selection for reading and writing is made via the subindex of the PNUs 401 ... 407. The active record for positioning or teaching is selected with PNU 400.

CANopen

With CANopen, record selection is made with object 2032h; the record thus selected is then addressed with object 20E0h, whereby the record element is selected with the subindex, see section C.1.3, Tab. C/2.

Record Number					
FHPP	**400**	**–**	**Var**	**uint8**	**rw**
Description	The active/selected record is also valid when the drive is not in Record Select mode (e. g. during teaching). In Record Select mode this parameter is transferred to the cyclic I/O data. Value range: 0 ... 31 (0x00 ... 0x1F)				
CI	**2033h**	**– / 00h**	**Var**	**uint8**	**rw**
	Note: Object 2032h is intended for access via CANopen.				

Record Control Byte 1					
FHPP	**401**	**1...32$_d$**	**Array**	**uint8**	**rw**
Description	Record control byte 1 (RCB1) controls important settings for the positioning task in Record Select mode. Bit 0: Nominal value absolute/relative Bit 1 ... 7: reserved (= 0) Values: 0 (0x00): Nominal value is absolute (default) 1 (0x01): Nominal value is relative to the last nominal value/switch further value				
Record 0	401	1		uint8	rw
	Record control byte 0 (reference travel)				
Record ...	401	...		uint8	rw
	Record control byte positioning record 1 ... 30				
Record 31	401	32		uint8	rw
	Record control byte positioning record 31				
CI	**20EAh**	**01h...20h**	**Array**	**uint8**	**rw**
	Note: Object 20E0h/01h is intended for access via CANopen.				

Record Target Position					
FHPP	**404**	**1...32$_d$**	**Array**	**int32**	**rw**
Description	Target position of the positioning record table in increments. Value range: $-2^{31}...+(2^{31}-1)$ (0x80000000 ... 0x7FFFFFFF) Default: 0				
Record 0	404	1		int32	rw
	Nominal position value positioning record 0 (reference travel)				
Record ...	404	...		int32	rw
	Nominal position value positioning record 1 ... 30				
Record 31	404	32		int32	rw
	Nominal position value positioning record 31 ...				
CI	**20ECh**	**01h...20h**	**Array**	**int32**	**rw**
	Note: Object 20E0h/01h is intended for access via CANopen.				

Record Velocity					
FHPP	**406**	**1...32**	**Array**	**uint32**	**rw**
Description	Speed setpoint value in increments/s. CiA 402: Absolute values. FHPP: Specification relative to the maximum value in the project data. Two resolutions are possible: in percent or 1/1000 of the maximum value (see project data). Range of values MTR-DCI-... / Range of values / DMES-... ...-32...-G7 0...66000 ≙ 0...12 mm/s (DMES-18) ...-32...-G14 ≙ 0...6.0 mm/s (DMES-18) ...-42...-G7 0...100000 ≙ 0...18.5 mm/s (DMES-25) ...-42...-G14 ≙ 0...9.1 mm/s (DMES-25) ...-52...-G7 0...100000 ≙ 0...29.6 mm/s (DMES-40) ...-52...-G14 ≙ 0...14.6 mm/s (DMES-40) ...-62...-G7 0...113400 ≙ 0...50.4 mm/s (DMES-63) ...-62...-G14 ≙ 0...24.7 mm/s (DMES-63) ...-62...-G22 ≙ 0...15.3 mm/s (DMES-63) Default: 0				
Record 0	406	1		uint32	rw
	Nominal speed value positioning record 0 (reference travel)				
Record ...	406	...		uint32	rw
	Nominal speed value positioning record 1 ... 30				
Record 31	406	32		uint32	rw
	Nominal speed value positioning record 31				
CI	**20EDh**	**01h...20h**	**Array**	**uint32**	**rw**
	Additional subindex of object 20EDh see PNU 531 Note: Object 20E0h/03h is intended for access via CANopen.				

Record Acceleration					
FHPP	**407**	**1...32**	**Array**	**uint32**	**rw**
Description	Acceleration setpoint value. The value applies only to positioning; in force mode, the value is ignored. CiA 402: Absolute value in increments/s^2 FHPP: Specification relative to maximum value in the project data. Two resolutions are possible: In percent or 1/1000 of the maximum value (see project data). Range of values: MTR-DCI-32/42: 40000...480000 MTR-DCI-52/62: 40000...240000 Default: MTR-DCI-32: 480000 (0x00075300) MTR-DCI-42: 480000 (0x00075300) MTR-DCI-52: 240000 (0x0003A980) MTR-DCI-62: 160000 (0x00027100)				
Record 0	407	1		uint32	rw
	Nominal acceleration value positioning record 0 (reference travel)				
Record ...	407	...		uint32	rw
	Nominal acceleration value positioning record 1 ... 30				
Record 31	407	32		uint32	rw
	Nominal acceleration value positioning record 31				
CI	**20EEh**	**01h...20h**	**Array**	**uint32**	**rw**
	Additional subindices of object 20EEh see PNU 532 and 541 Note: Object 20E0h/04h is inteded for access via CANopen.				

B.2.9 Project data – General

Project Zero Point (offset project zero point)					
FHPP	**500**	**–**	**Var**	**int32**	**rw**
Description	Offset of axis zero point to project zero point. Reference point for target positions in the record table (compare PNU 404). Value range: -2^{31}...$+(2^{31}-1)$. Default: 0				
CANopen / CI	**21F4h**	**– / 00h**	**Var**	**int32**	**rw**

Software End Positions					
FHPP	**501**	**1, 2**	**Array**	**int32**	**rw**
Description	Software end positions in increments. The offset to the axis zero point is entered. Target positions outside the end positions are not permitted and will result in an error. An entry of 0 for both end positions deactivates the software end positions. Plausibility rule: Min-Limit ≤ Max-Limit Range of values: -2^{31}...$+(2^{31}-1)$				
Lower limit	501	1		int32	
	Lower software end position Default: 0				
Upper limit	501	2		int32	
	Upper software end position Default: 50 mm				
CANopen / CI	**607Bh**	**01h, 02h**	**Array**	**int32**	**rw**
	In CANopen “Position Range Limits”.				

Max. Velocity					
FHPP	**502**	**–**	**Var**	**uint32**	**rw**
Description	Max. permitted speed in increments/s. The specifications in Direct mode and in the record table refer to this value. Default: MTR-DCI-32: 66000 MTR-DCI-42: 100000 MTR-DCI-52: 100000 MTR-DCI-62: 113400				
CANopen / CI	**21F6h**	**– / 00h**	**Var**	**uint32**	**rw**

Max. Acceleration (max. permited acceleration)					
FHPP	**503**	**–**	**Var**	**uint32**	**rw**
Description	Max. permitted acceleration in increments/s^2. The specifications in Direct mode and in the record table refer to this value. Default: MTR-DCI-32/42: 480000_d MTR-DCI-52/62: 240000_d				
CANopen / CI	**21F7h**	**– / 00h**	**Var**	**uint32**	**rw**

B.2.10 Project data – Power operation

Stroke limit					
FHPP	**510**	**–**	**–**	**uint32**	**rw**
Description	Maximum permitted stroke with active force control. With active force control, the actual position relative to the start position must not change by more than the amount specified in this parameter. In this way you can ensure that, if force control is activated by mistake (e. g. missing work item), the axis will not perform an uncontrolled movement. This parameter is taken into account in all control modes in which the position controller is not active in the status "Operation enabled." Monitoring can be deactivated when bit RCB1.B5 is set. Value range: 0...4,294,967,295 Inc				
CANopen / CI	**60F6h**	**01h**		**uint32**	**rw**

Min. Torque (min. permitted force/torque)					
FHPP	**511**	**–**	**–**	**uint16**	**rw**
Description	This value represents the lowest permitted torque (force) of the motor. The value is specified in 1/1000 of the rated torque (6076h / PNU 509). Value range: 0...1000 (0x03E8).				
CI access	**60F6h**	**05h**		**uint16**	**rw**

Max. Torque (max. permitted force/torque)					
FHPP	**512**	**–**	**Var**	**uint16**	**rw**
Description	This value represents the highest permitted torque (force) of the motor. The value is specified in 1/1000 of the rated torque (6076h / PNU 509). Value range: 0...1000 (0x03E8).				
CANopen / CI	**6072h**	**– / 00h**	**Var**	**uint16**	**rw**

B.2.11 Project data – Teach

Teach Target					
FHPP	**520**	**–**	**Var**	**uint8**	**rw**
Description	The parameter defined is the one which is written with the actual position with the next Teach command (see section 5.6.3). Values: 1 (0x01): Target position in positioning record (default) – with Record select: positioning record corresponding to FHPP control bytes – with Direct mode Positioning record corresponding to PNU=400 2 (0x02): Axis zero point 3 (0x03): Project zero point 4 (0x04): Lower software end position 5 (0x05): Upper software end position				
CANopen / CI	**21FCh**	**– / 00h**	**Var**	**uint8**	**rw**

B.2.12 Project data – Jog mode

Jog Mode Velocity Phase 2					
FHPP	**531**	**–**	**Var**	**int32**	**rw**
Description	Speed in phase 2 (fast travel) in [inc/s] Value range: MTR-DCI-32: 66000 MTR-DCI-42: 100000 MTR-DCI-52: 100000 MTR-DCI-62: 113400 Default: MTR-DCI-32: 6600 MTR-DCI-42: 10000 MTR-DCI-52: 10000 MTR-DCI-62: 11340 Value is automatically entered when an axis type is selected (PNU 1005/4).				
CANopen / CI	**20EDh**	**21h**	**Array**	**uint32**	**rw**
	Additional subindices of object 20EDh see PNU 406				

Jog Mode Acceleration					
FHPP	**532**	**–**	**Var**	**uint32**	**rw**
Description	Acceleration and deceleration [inc/s^{2}] Value range: MTR-DCI-32/42: 40000...480000 MTR-DCI-52/62: 40000...240000 Default: 40000 Value is automatically entered when an axis type is selected (PNU 1005/4).				
CANopen / CI	**20EEh**	**21h**	**Array**	**uint32**	**rw**
	Additional subindices of object 20EEh see PNU 407 and 541				

Jog Mode Velocity Phase 1					
FHPP	**534**	**–**	**Var**	**uint32**	**rw**
Description	Duration of phase 1 (slow travel) in [ms]. Value range: 0...+(2^{32}-1). Default: 2000 (0x000007D0)				
CANopen / CI	**20E9h**	**1)**		**uint32**	**rw**
	1) Subindex dependent on data profile (PNU 206 / 2FF2/05h): – CiA 402: 20E9/00h – Var – FHPP: 20E9/21h – Array				

B.2.13 Project data – Direct mode (positioning mode)

Direct Mode Acceleration					
FHPP	**541**	**–**	**Var**	**uint32**	**rw**
Description	Acceleration and deceleration [inc/s^2] Value range: MTR-DCI-32/42: 40000...480000 MTR-DCI-52/62: 40000...240000 Default: MTR-DCI-32: 480000 MTR-DCI-42: 480000 MTR-DCI-52: 240000 MTR-DCI-62: 160000 Value is automatically entered when an axis type is selected (PNU 1005/4).				
CI [1]	**20EEh**	**21h**	**Array**	**uint32**	**rw**
	Additional subindices of object 20EEh see PNU 407 and 532 [1] CO-access: see PDO2, 6083h				

B.2.14 Project data – Direct mode (power operation)

Force Target window					
FHPP	**552**	**–**	**–**	**uint16**	**rw**
Description	This is the amount by which the actual force (actual torque) may differ from the nominal force (nominal torque), in order to be interpreted as still being in the target window. The width of the window is twice the value transferred, with the target position in the centre of the window. The value is specified in 1/1000 of the rated torque (6076h / PNU 509). Value range: 0...65535. Default: 100.				
CANopen / CI	60F6h	03h		uint16	rw

Damping Time					
FHPP	**553**	**–**	**–**	**uint16**	**rw**
Description	If the actual force (actual torque) has been in the target window this amount of time, the “Target reached” bit will be set in the status word (Motion Complete). Value range: 0...30000 ms. Default: 100 ms				
CANopen / CI	60F6h	04h		uint16	rw

Speed Limit					
FHPP	**554**	**–**	**–**	**uint32**	**rw**
Description	Maximum permitted speed with active force control. In this way you can ensure that, if force control is activated by mistake (e. g. work item missing), the axis will not undergo uncontrolled acceleration and move at high speed against a stop. This parameter is taken into account in all control modes in which the position controller is not active in the status “Operation enabled.” Value range: 1...4,294,967,295 inc/s				
CANopen / CI	60F6h	02h		uint32	rw

B.2.15 Axis parameter electric drives 1 – mechanical

Polarity (reversal of direction)					
FHPP	**1000**	**–**	**Var**	**uint8**	**rw**
Description	With this parameter the "+/-" direction of the position values (vectors) can be assigned to the direction of rotation of the motor shaft (see section 1.6.2). New reference travel is then required. Values: 0 (0x00) = factory setting ("+" corresponds to rotational movement in a clockwise direction) 128 (0x80) = reverse direction ("+" corresponds to rotational movement in an anti-clockwise direction)				
CANopen / CI	**607Eh**	**– / 00h**	**Var**	**uint8**	**rw**

Encoder Resolution					
FHPP	**1001**	**1, 2**	**Array**	**uint32**	**rw**
Description	Encoder resolution in [encoder increments / motor revolutions]				
Encoder increments (encoder increments)	1001	1		uint32	rw
	Values (fixed): MTR-DCI-32: 300 (0x012C) MTR-DCI-42/52/62: 500 (0x01F4)				
Motor revolutions (motor revolution)	1001	2		uint32	rw
	Fix = 1				
CANopen / CI	**608Fh**	**01h, 02h**	**Array**	**uint32**	**rw**
	In CANopen "Position Encoder Resolution"				

Gear Ratio					
FHPP	**1002**	**1, 2**	**Array**	**uint32**	**rw**
Description	Ratio of the internal motor revolutions to the external revolutions of the drive shaft of the MTR-DCI. The values are set fixed depending on the internal gear (see type plate of the MTR-DCI). Gear ratio = motor revolutions / spindle revolutions				
Motor revolutions	1002	1		uint32	rw
	Internal motor revolutions (gear ratio - counter) Gear G7: Fixed: 27 (0x1B) Gear G14: Fixed: 3969 (0xF81) Gear G22: Fixed: 1710 (0x6AE)				
Shaft revolutions	1002	2		uint32	rw
	External revolutions of the drive shaft of the MTR-DCI (gear ratio – denominator). Gear G7: Fixed: 4 (0x04) Gear G14: Fixed: 289 (0x121) Gear G22: Fixed: 77 (0x4D)				
CANopen / CI	**6091h**	**01h, 02h**	**Array**	**uint32**	**rw**

Feed Constant					
FHPP	**1003**	**1, 2**	**Array**	**uint32**	**rw**
Description	The feed constant specifies the path (= feed) which the slide traverses when the drive shaft of the linear axis makes one revolution (feed constant = shaft revolution).				
Feed	1003	1		uint32	rw
	Specification of feed (feed constant - counter) in [µm]. When known axis types are selected on the control panel or in FCT, the value is entered automatically.				
Shaft revolutions	1003	2		uint32	rw
	Feed constant - denominator. Fixed: 1 (0x01)				
CANopen / CI	**6092h**	**01h, 02h**	**Array**	**uint32**	**rw**

Position Factor

FHPP	**1004**	**1, 2**	**Array**	**uint32**	**rw**
Description	Read the conversion factor number of sensor increments per 1 measured unit of feed at the shaft. Additional external gears are not taken into consideration in this parameter (see PNU1005). Position Factor $= \dfrac{\text{Encoder Resolution * Gear Ratio}}{\text{Feed Constant}}$				
Numerator	1004	1		uint32	rw
	Position factor – counter				
Denominator	1004	2		uint32	rw
	Position factor – denominator				
CANopen / CI	**6093h**	**01h...02h**	**Array**	**uint32**	**rw**

Axis Parameter

FHPP	**1005**	**1...5**	**Array**	**uint32**	**rw**
Description	Specify and read out axis parameters				
Axis length	1005	1		uint32	rw
	Axis length in increments. Value range: 0...+(2^{31}-1)				
Gear numerator	1005	2		uint32	rw
	if an external gear is used: gear ratio – counter Value range: 0...+(2^{31}-1)				
Gear denominator	1005	3		uint32	rw
	if an external gear is used: gear ratio – denominator Value range: 0...+(2^{31}-1)				

Axis Parameter					
Axis type (mechanical type)	1005	4		uint32	rw
	Type of axis Values: Type of axis 01 = DMES, 02 = DNCE, 03 = rotation deg, 04 = rotation rev, 05 = USER Modification of axis type influences the following parameters: – Modifies values and permitted value range of the following parameters: 407 Positioning record acceleration 531 Jog mode speed phase 2 532 Jog mode acceleration 541 Direct mode acceleration – Modifies the values of the following parameters: 502 Max. permitted speed 503 Max. permitted acceleration 1001 Encoder resolution 1003 Feed constant 1004 Position factor 1026/3 Drive data – Rated motor current 1035 Rated motor current – Modifies permitted value range of the following parameters: 406 Positioning record speed 1012 Speed reference travel				
Axis size (mechanical size)	1005	5		uint32	rw
	Rated size of axis as per type plate When known types of axes are selected via the FCT, the value will be entered automatically (e. g. DMES-25 = 0x19).				
CANopen / CI	**20E2h**	**01h...05h**	**Record**	**uint32**	**rw**

B.2.16 Axis parameter electric drives 1 – Reference travel (Homing)

Offset Axis Zero Point					
FHPP	**1010**	**–**	**Var**	**int32**	**rw**
Description	Offset axis zero point in increments (distance from reference point) Value range: $-2^{31}...+(2^{31}-1)$.				
CANopen / CI	**607Ch**	**– / 00h**	**Var**	**int32**	**rw**
	In CANopen “Home Offset”				

Homing Method (reference travel method)					
FHPP	**1011**	**–**	**Var**	**int8**	**rw**
Description	Defines the method which the drive uses to carry out the reference run. The MTR-DCI supports the following modes: Values – Function -17 (0xEF): Search for stop in negative direction -18 (0xEE): Search for stop in positive direction 23 (17h): Search for reference switch in positive direction 27 (0x1B): Search for reference switch in negative direction Modification of the reference method resets the following parameter to the factory setting: – 1010 Offset axis zero point				
CANopen / CI	**6098h**	**– / 00h**	**Var**	**int8**	**rw**

Homing Velocities					
FHPP	**1012**	**1, 2**	**Array**	**uint32**	**rw**
Description	Speeds during homing in [inc/s].				
Search REF	1012	1		uint32	rw
	Speed when searching for the reference point REF in [inc/s] Value range: MTR-DCI-32: 200...33000 MTR-DCI-42: 200...50000 MTR-DCI-52: 200...50000 MTR-DCI-62: 200...56700 Default: MTR-DCI-32: 27000 MTR-DCI-42: 22400 MTR-DCI-52/62: 16800				
Search AZ	1012	2		uint32	rw
	Speed of travel to the axis zero point AZ in [inc/s] Value range: MTR-DCI-32: 200...33000 MTR-DCI-42: 200...50000 MTR-DCI-52: 200...50000 MTR-DCI-62: 200...56700 Default: MTR-DCI-32: 27000 MTR-DCI-42: 22400 MTR-DCI-52/62: 16800				
CANopen / CI	**6099h**	**01h, 02h**	**Array**	**uint32**	**rw**
	CiA 402: Homing Speeds				

Homing Required (reference travel necessary)					
FHPP	**1014**	**–**	**Var**	**uint8**	**rw**
Description	Defines whether or not reference travel must be carried out after switching on in order to carry out positioning tasks. **When the logic voltage supply of the MTR-DCI-CO has been switched on, a reference run must always be carried out.** Fixed = 1: Reference travel must be carried out				
CANopen / CI	**23F6h**	**– / 00h**	**Var**	**uint8**	**rw**

Homing Max. Torque (reference travel max. torque)					
FHPP	**1015**	**–**	**Var**	**uint8**	**rw**
Description	Maxmum current consumption during reference travel in percent of the rated current (see PNU 1035 / CI object 6075h). Compare PNU 1034 (specification in permil). Value range: 0 ... 200 (0xC8). Default: 150 (0x96)				
CANopen / CI	**23F7h**	**– / 00h**	**Var**	**uint8**	**rw**

B.2.17 Axis parameters electric drives 1 – Controller parameters

Hold Option Code					
FHPP	**1020**	**–**	**Var**	**uint16**	**rw**
Description	Describes the reaction to a Hold command. Fixed = 1: Brake with hold ramp				
CANopen / CI	**605Dh**	**– / 00h**	**Var**	**uint16**	**rw**

Fault Reaction Option Code					
FHPP	**1021**	**–**	**Var**	**uint16**	**rw**
Description	Describes the reaction to a fault. Fixed = 2: Brake with emergency hold ramp				
CANopen / CI	**605Eh**	**– / 00h**	**Var**	**uint16**	**rw**

Target Position Window					
FHPP	**1022**	**–**	**Var**	**uint32**	**rw**
Description	Tolerance window in increments [inc] Amount by which the current position may deviate from the target position, in order that it may still be regarded as being within the target window. The width of the window is twice the value transferred, with the target position in the centre of the window. Value range: 0 ... +(2^{32}-1). Default: 750 (0x2EE)				
CANopen / CI	**6067h**	**– / 00h**	**Var**	**uint32**	**rw**

Position Window Time (adjustment time position)					
FHPP	**1023**	**–**	**Var**	**uint16**	**rw**
Description	Adjustment time in milliseconds [ms] If the actual position has been in the target position window this amount of time, the bit “Target reached” will be set in the status word (Motion Complete). Value range: 1 ... 30000 (0x7530) Default: 100 (0x64).				
CANopen / CI	**6068h**	**– / 00h**	**Var**	**uint16**	**rw**

Position Control Parameter Set

FHPP	**1024**	**18...23, 32**	**Array**	**uint16**	**rw**
Description		Technical control parameters. Modification is only permitted for servicing purposes. If necessary consult Festo.			
Gain position	1024	18 (CI: 12h)			rw
	Gain position controller Value range: MTR-DCI-32: 1...100; MTR-DCI-42/52/62: 1...200 Default: MTR-DCI-32: 20; MTR-DCI-42: 15; MTR-DCI-52: 10; MTR-DCI-62: 8				
Gain speed	1024	19 (CI: 13h)			rw
	Gain speed controller Value range: MTR-DCI-32: 1...3000; MTR-DCI-42/52/62: 1...700 Default: MTR-DCI-32: 2800; MTR-DCI-42/52: 600; MTR-DCI-62: 500				
I-fraction speed	1024	20 (CI: 14h)			rw
	I-share speed controller Value range: 1...600 Default: MTR-DCI-32: 80; MTR-DCI-42/52/62: 340				
Gain current	1024	21 (CI: 15h)			rw
	Gain current controller Value range: MTR-DCI-32: 1...1000; MTR-DCI-42/52/62: 1...800 Default: MTR-DCI-32: 110; MTR-DCI-42/52/62: 150				
I-fraction	1024	22 (CI:16h)			rw
	I-share current controller Value range: MTR-DCI-32/42/52: 0...1000 Default: MTR-DCI-32: 90; MTR-DCI-42: 420; MTR-DCI-52: 350				
Gain velocity	1024	23 (CI: 17h)			rw
	Gain speed controller - trajectory generator Value range: 1...2. Default: 1				
Save position	1024	32 (CI: 20h)			rw
	Saves the current position in EEPROM when the device is switched off. Fixed = 240 (0x00F0): Current position will not be saved after Power-off.				
CANopen / CI	**60FBh**	**12h...17h, 20h**	**Array**	**uint16**	**rw**

Motor Data					
FHPP	**1025**	**1, 3**	**Array**	**uint32**	**rw**
Description	Motor-specific data.				
Serial number	1025	1		uint32	rw
	Serial number of the motor				
Time max. current	1025	3		uint32	rw
	I^2t time. Permitted duration of the maximum motor current (compare object 6073h). When the I^2t-time expires, the current will be limited automatically to the rated motor current in order to protect the motor (rated motor current, PNU 1035 / CI object 6075h). Time specification depends on the device (with MTR-DCI approx. 20 ms). Value range: 1 ... 32767 Default: 100 (≙ 2 s) **Note: Values which are too high can damage the motor.**				
CANopen / CI	**6410h**	**01h, 03h**	**Record**	**uint32**	**rw**

Drive Data

FHPP	**1026**	**1...8**	**Array**	**uint32**	**rw**
Description	General Drive Data				
Output stage temp.	1026	1 (CI: 01h)		uint32	rw
	Temperature of the end stage in °C. Value range: 0 ... 85				
Output stage Max. temp.	1026	2 (CI:02h)		uint32	rw
	Maximum temperature of the end stage in °C. fixed: 80 (0x0050)				
Rated motor current	1026	3 (CI: 03h)		uint32	rw
	Nominal motor current in [mA] Value is automatically entered when an axis type is selected (PNU 1005/4).				
Current limit	1026	4 (CI: 04h)		uint32	rw
	Max. motor current in permil of rated current. Identical to PNU 1034. Value range: 1...2000				
Lower current limit	1026	5 (CI: 05h)		uint32	rw
	= PNU1026.4 * (-1)				
Device control	1026	6 (CI: 06h)		uint32	rw
	Setting the device control (see PNU 125 / object 207Dh). 0: Control via HMI (control panel) or FCT, no control via fieldbus 1: Control via fieldbus – control interface (default)				
Controller serial number	1026	7 (CI: 07h)		uint32	rw
	Serial number of the controller in format 0xDDMYYSSS: DD (Day): 8 bits: 0x01...0x1F M (month): 4 bits: 0x1...0xC YY (Year): 8 bits: 0x00...0x63 SSS (serial number): 12 bits: 0x001...0xFFF				
Following error (permissible contouring error)	1026	8 (CI: 08h)		uint32	rw
	Following error monitoring				

Drive Data					
CI	**6510h**	**01h...**	**Record**		**ro/rw**
Drive Data [1]	6510h	01h...08h	–	uint32	rw
	6510h	31h, 32h, 40h, 41h 42h, 43h, A0h, 22h	–	uint16, uint16, uint32, uint16, int16, uint16, uint32, uint32	ro, ro ro, ro ro, rw ro, ro
Current actual value	6510	45h		int 16	ro
	Up-to-date actual value of the current. Note: not available via FHPP.				
Firmware Version (Firmware number)	6510	A1h	–	uint32	ro
	Firmware version, specified in BCD (binary coded decimal): xxyy (xx = main version, yy = secondary version) Note: identical to FHPP object PNU 101 (CI 206A)				
[1] Description similar to FHPP 1026/1...8					

B.2.18 Axis parameters electric drives 1 – Electronics Name plate

Motor Type					
FHPP	**1030**	**–**	**Var**	**uint16**	**rw**
Description	Classification of the motor Fixed: 0x0000				
CANopen / CI	**6402h**	**– / 00h**	**Var**	**uint16**	**rw**

Maximum Current					
FHPP	**1034**	**–**	**Var**	**uint16**	**rw**
Description	Maximum motor current in 1/1000 of the rated current (compare PNU 1035 / 8075h). In Homing (reference travel) mode: The motor force limits the current during reference runs onto stops and, in the event of an error, protects the stops during reference runs onto a reference switch. Please note Note that the current limitation also limits the maximum possible speed and that (higher) nominal speeds may not therefore be achieved. Value range: 1 ... 2000 (0x0001 ... 0x07D0) Default: 1500 (0x05DC)				
CANopen / CI	**6073h**	**– / 00h**	**Var**	**uint16**	**rw**

Rated Motor Current					
FHPP	**1035**	**–**	**Var**	**uint32**	**rw**
Description	Rated motor current in [mA], compare type plate. Identical to PNU 1026/3				
CANopen / CI	**6075h**	**– / 00h**	**Var**	**uint32**	**rw**

Rated Motor Torque					
FHPP	**1036**	**–**	**Var**	**uint32**	**rw**
Description	Rated torque of the MTR-DCI in [mNm]				
CANopen / CI	**6076h**	**– / 00h**	**Var**	**uint32**	**rw**

B.2.19 Axis parameters electric drives 1 – Standstill monitoring

Position Target Value (nominal position)					
FHPP	**1040**	**–**	**Var**	**int32**	**ro**
Description	Target position of the last positioning task in increments. Value range: -2^{31} ... $+(2^{31}-1)$				
CANopen / CI	**6062h**	**– / 00h**	**Var**	**int32**	**ro**

Position Actual Value					
FHPP	**1041**	**–**	**Var**	**int32**	**ro**
Description	Current position of the drive in increments. Value range: -2^{31} ... $+(2^{31}-1)$				
CANopen / CI	**6064h**	**– / 00h**	**Var**	**int32**	**ro**

Standstill Position Window					
FHPP	**1042**	**–**	**Var**	**uint32**	**rw**
Description	Standstill position window in increments. Amount by which the drive may move after MC, until the standstill monitoring responds. Value range: 0...$+(2^{32}-1)$. Default: 750 (0x02EE)				
CANopen / CI	**2040h**	**– / 00h**	**Var**	**uint32**	**rw**

Standstill Timeout					
FHPP	**1043**	**–**	**Var**	**uint16**	**rw**
Description	Standstill monitoring time in [ms}: Time during which the drive must be outside the standstill position window before the standstill monitoring responds. Value range: 0...65535 (0xFFFF). Default: 200 (0x00C8)				
CANopen / CI	**2041h**	**– / 00h**	**Var**	**uint16**	**rw**

B.3 Status machine FHPP

Notes on the "Operation enabled" state

The transition T3 changes to status S4, which itself contains its own sub-status machine, the states of which are marked with "SAx" and the transitions of which are marked with "TAx" Fig. B/8. This enables an equivalent circuit diagram (Fig. B/7) to be used, in which the internal states SAx are omitted.

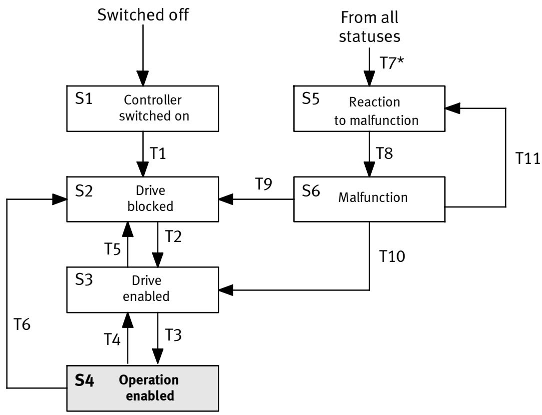

Fig. B/7: State machine equivalent circuit diagram

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

Reaction to faults

T7 ("Fault recognized") has the highest priority (and receives the asterisk "*").

T7 is then derived from S5+S6 when a fault with higher priority occurs. This means that a serious fault can suppress a simple fault.

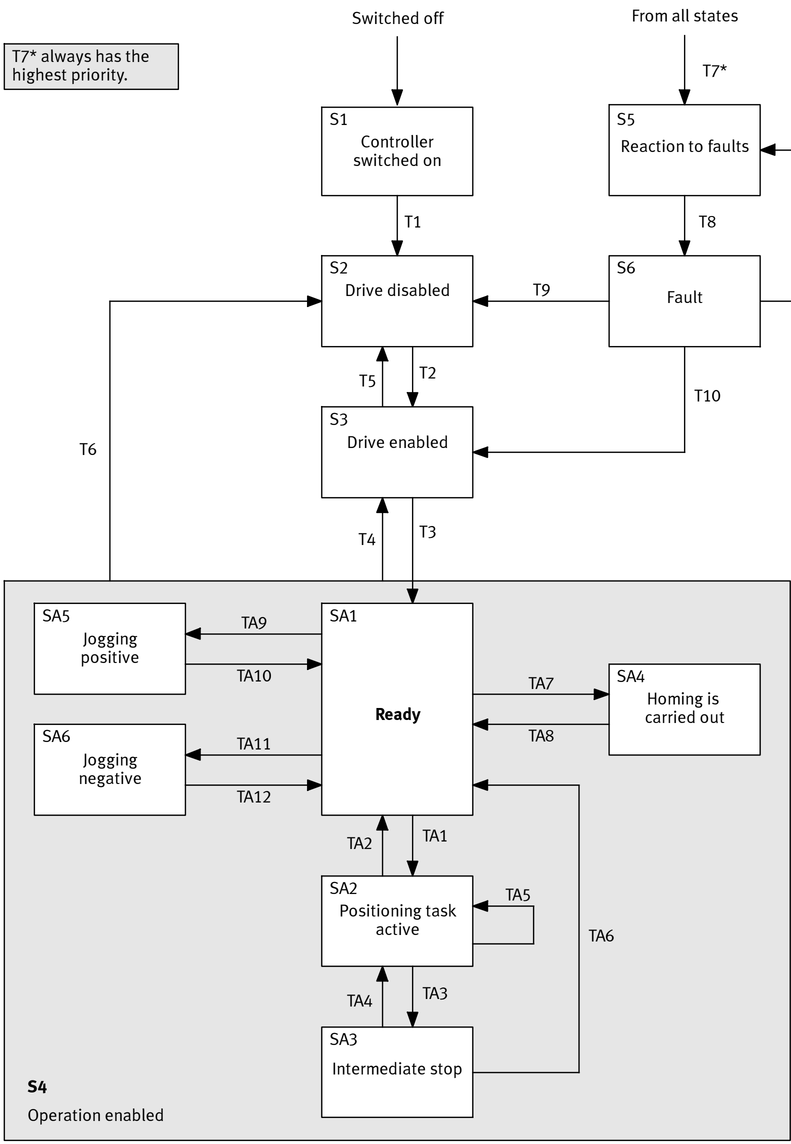

Fig. B/8: Status machine

B.3.1 Create readiness to operate

T	Internal conditions	Activities of the user
T1	Drive is switched on. A fault cannot be ascertained.	
T2	Load voltage applied. Field bus master must be higher-order controller.	"Enable drive" = 1 CCON = xxx0.xxx**1**
T3		"Stop" = 1 CCON = xxx0.xx**1**1
T4		"Stop" = 0 CCON = xxx0.xx**0**1
T5		"Enable drive" = 0 CCON = xxx0.xxx**0**
T6		"Enable drive" = 0 CCON = xxx0.xxx**0**
T7*	Fault recognized.	
T8	Reaction to fault completed, drive stopped.	
T9	There is no longer a fault. It was a serious fault.	"Quit fault" = 0 → 1 CCON = xxx0.**P**xxx
T10	There is no longer a fault. It was a simple fault.	"Quit fault" = 0 → 1 CCON = xxx0.**P**xx1
T11	Fault still exists.	"Quit fault" = 0 → 1 CCON = xxx0.**P**xx1
Key: P = positive edge, N = negative edge, x = any		

B.3.2 Positioning

The following always applies:
Transitions T4, T6 and T7* always have priority.

TA	Internal conditions	Activities of the user
TA1	Referencing is running.	Start positioning task = 0→1 Stop = 1 CCON = xxx0.xx11 CPOS = 0xx0.00P1
TA2	Motion Complete = 1 The current record is completed. The next record is not to be carried out automatically	"Stop" state is optional CCON = xxx0.xx11 CPOS = 0xxx.xxx0
TA3	Motion Complete = 0	Stop = 1→0 CCON = xxx0.xx11 CPOS = 0xxx.xxx0
TA4		Stop = 1 Start positioning task = 0→1 Clear remaining travel = 0 CCON = xxx0.xx11 CPOS = 00xx.xxP1
TA5	Record Select: – An individual record is finished. – The next record is to be processed automatically.	CCON = xxx0.xx11 CPOS = 0xxx.xxx1
	Direct mode: – A new positioning task has arrived.	CCON = xxx0.xx11 CPOS = 0xxx.xx11
TA6		Clear remaining travel = 0 → 1 CCON = xxx0.xx11 CPOS = 01xx.xxxx
TA7		Start reference travel = 0→1 Stop = 1 CCON = xxx0.xx11 CPOS = 0xx0.0Px1
Key: P = positive edge, N = negative edge, x = any		

TA	Internal conditions	Activities of the user
TA8	Referencing finished or stopped.	Only for stop: Stop = 1→0 CCON = xxx0.xx11 CPOS = 0xxx.xxxN
TA9		Jogging positive = 0→1 Stop = 1 CCON = xxx0.xx11 CPOS = 0xx0.Pxx1
TA10		Either – Jogging positive = 1 → 0 – CCON = xxx0.xx11 – CPOS = 0xxx.0xx1 or – Stop = 1→0 – CCON = xxx0.xx11 – CPOS = 0xxx.xxxN
TA11		Jogging negative = 0→1 Stop = 1 CCON = xxx0.xx11 CPOS = 0xxP.xxx1
TA12		Either – Jogging negative = 1 → 0 – CCON = xxx0.xx11 – CPOS = 0xxN.xxx1 or – Stop = 1→0 – CCON = xxx0.xx11 – CPOS = 0xxx.xxxN
Key: P = positive edge, N = negative edge, x = any		

Special features dependent on operating mode:

Operating mode	Notes on specific features
Record Select	No restrictions.
Direct mode	TA2: The condition that no new record may be processed no longer applies. TA5: A new record can be started at any time.

Reference – CANopen and CI objects

Appendix C

Contents

C. Reference – CANopen and CI objects C-1

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C.1 Overview of CANopen objects (CiA 402)

The following overview (Tab. C/1) shows all CANopen objects, where appropriate with the corresponding FHPP numbers.

You will find the descriptions of the objects in the following sections (cf. "see" column):

– Descriptions of CANopen objects in sections C.1.2, C.1.3 and C.1.4,

– Descriptions of the corresponding PNUs as per FHPP in sections B.2.4 to B.2.19.

You will find a thematically grouped listing of the FHPP objects in section B.2.2.

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
Communication Profile Area, see section C.1.2					
Device Type	1000h	– / 00h	Var	-	C.1.2
Error register	1001h	–	Var	-	C.1.2
Pre-defined error field	1003h	01...08h	Array	-	C.1.2
COB-ID SYNC message	1005h	–	Var	-	C.1.2
Manufacturer Device Name	1008h	– / 00h	Var	120	B.2.5
Manufacturer hardware version	1009h	– / 00h	Var	-	C.1.2
Manufacturer software version	100Ah	– / 00h	Var	-	C.1.2
Guard time	100Ch	–	Var	-	C.1.2
Life time factor	100Dh	–	Var	-	C.1.2

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
COB-ID Emergency object	1014h	–	Var	-	C.1.2
Inhibit time EMCY	1015h	–	Var	-	C.1.2
Identity object	1018h	01h...04h	Record	-	C.1.2
Receive PDO communication parameter	1400h, 1401h	01h...05h	Record	-	C.1.2
Receive PDO 1 mapping parameter	1600h	01h...05h	Record	-	C.1.2
Receive PDO 2 mapping parameter	1601h	01h...04h	Record	-	C.1.2
Transmit PDO communication parameter	1800h, 1801h	01h...05h	Record	-	C.1.2
Transmit PDO 1 mapping parameter	1A00h	01h...05h	Record	-	C.1.2
Transmit PDO 2 mapping parameter	1A01h	01h...04h	Record	-	C.1.2
Manufacturer specific profile area, see section C.1.3					
Record number	2032h	01h	Array 2)	-	C.1.3
Standstill position window	2040h	– / 00h	Var	1042	B.2.19
Standstill timeout	2041h	– / 00h	Var	1043	B.2.19
Version FHPP	2066h	– / 00h	Var	102	B.2.4
Controller serial number	2072h	– / 00h	Var	114	B.2.4
Device control	207Dh	– / 00h	Var	125	B.2.5
Diagnostic event	20C8h	01h...10h	Array	200	B.2.6
Fault number	20C9h	01h...10h	Array	201	B.2.6
Time stamp	20CAh	01h...10h	Array	202	B.2.6

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
Diagnostic memory parameter	20CCh	01h...04h	Array	204	B.2.6
Scaling	20D0h	01h, 02h	Array	-	C.1.3
Record table element	20E0h	01h...05h	Record	-	C.1.3
Axis parameter	20E2h	01h...05h	Array	1005	B.2.15
Controller type	20E3h	– / 00h	Var	-	C.1.3
Jog mode time phase 1	20E9h	00h / 21h	Var / Array	534	B.2.12
Jog mode velocity phase 2	20EDh	21h	Array	531	B.2.12
Jog mode acceleration	20EEh	21h	Array	532	B.2.12
Data memory control	20F1h	01h, 02h	Array	127	B.2.5
User device name	20FDh	– / 00h	V-string	121	B.2.5
HMI control	20FFh	01h...04h	Array	126	B.2.5
Project zero point	21F4h	– / 00h	Var	500	B.2.9
Max. velocity	21F6h	– / 00h	Var	502	B.2.9
Max. acceleration	21F7h	– / 00h	Var	503	B.2.9
Teach target	21FCh	– / 00h	Var	520	B.2.11
Homing required	23F6h	– / 00h	Var	1014	B.2.16
Homing max. torque	23F7h	– / 00h	Var	1015	B.2.16
Device fault	2FF1h	– / 00h	Var	205	B.2.6
CANopen Diagnosis	2FF2h	01h...06h	Array	206	B.2.6

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
Cycle number	2FFFh	– / 00h	Var	305	B.2.7
Keypad status	2FFFh	05h	Var	306	B.2.6
CiA 402: Standardised device profile area, see C.1.4					
Controlword CiA 402	6040h	– / 00h	Var	-	C.1.4
Statusword CiA 402	6041h	– / 00h	Var	-	C.1.4
Hold option code	605Dh	– / 00h	Var	1020	B.2.17
Fault reaction option code	605Eh	– / 00h	Var	1021	B.2.17
Operating modes	6060h	– / 00h	Var	-	C.1.4
Operating mode display	6061h	– / 00h	Var	-	C.1.4
Position demand value	6062h	– / 00h	Var	1040	B.2.19
Position actual value*	6063h	– / 00h	Var	-	C.1.4
Position actual value	6064h	– / 00h	Var	1041	B.2.19
Position window	6067h	– / 00h	Var	1022	B.2.17
Position window time	6068h	– / 00h	Var	1023	B.2.17
Velocity demand value	606Bh	– / 00h	Var	-	C.1.4
Velocity actual value	606Ch	– / 00h	Var	-	C.1.4
Target torque	6071h	– / 00h	Var	-	C.1.4

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
Max. torque	6072h	– / 00h	Var	512	B.2.18
Max. current	6073h	– / 00h	Var	1034	B.2.18
Rated motor current	6075h	– / 00h	Var	1035	B.2.18
Rated motor torque	6076h	– / 00h	Var	1036	B.2.18
Torque actual value	6077h	– / 00h	Var	-	C.1.4
Current actual value	6078h	– / 00h	Var	-	C.1.4
Target position	607Ah	– / 00h	Var	-	C.1.4
Position range limit	607Bh	01h, 02h	Array	501	B.2.9
Home offset	607Ch	– / 00h	Var	1010	B.2.16
Polarity	607Eh	– / 00h	Var	1000	B.2.15
Profile velocity	6081h	– / 00h	Var	-	C.1.4
Profile acceleration	6083h	– / 00h	Var	-	C.1.4
Profile deceleration	6084h	– / 00h	Var	-	C.1.4
Motion profile type	6086h	– / 00h	Var	-	C.1.4
Torque slope	6087h	– / 00h	Var	-	C.1.4
Torque profile type	6088h	– / 00h	Var	-	C.1.4
Position encoder resolution	608Fh	01h, 02h	Array	1001	B.2.15
Gear ratio	6091h	01h, 02h	Array	1002	B.2.15

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
Feed constant	6092h	01h, 02h	Array	1003	B.2.15
Position factor	6093h	01h, 02h	Array	1004	B.2.15
Homing method	6098h	– / 00h	Var	1011	B.2.16
Homing velocity	6099h	01h, 02h	Array	1012	B.2.16
Torque control parameter	60F6h	01h 02h 03h 04h 05h	Record	510 552 553 554 512	C.1.4
Position control parameter set	60FBh	12h...15h, 17h, 20h	Array	1024	B.2.17
Digital inputs	60FDh	– / 00h	Var	303	B.2.7
Digital outputs	60FEh	01h, 02h	Array	304	B.2.7
Motor type	6402h	– / 00h	Var	1030	B.2.18
Motor data	6410h	01h, 03h	Array	1025	B.2.17
Supported drive modes	6502h	– / 00h	Var	-	C.1.4
Drive catalog number	6503h	– / 00h	V-string	124	B.2.5
Drive manufacturer	6504h	– / 00h	V-string	122	B.2.5

Name	CANopen			FHPP	see
	Object	SI	Class	PNU	
HTTP drive catalog address	6505h	– / 00h	V-string	123	B.2.5
Drive Data (Drive data)	6510h	31h (01h), 32h (02h), 40h (03h), 41h (04h), 42h (05h), 43h (06h), A0h (07h), 22h (08h), 45h, A1h	Record	1026	B.2.17

Tab. C/1: Overview of CANopen objects

C.1.1 Representing the parameter entries

Encoder resolution

CANopen / CI	**608Fh**	**01h...02h**	**Array**	**uint32**	**rw2**
Description	Encoder resolution in increments / revolutions The encoder resolution is fixed and cannot be modified by the user. The calculated value is derived from the fraction (encoder-increments/motor revolution).				
Encoder increments	1001	1		uint32	rw2
	Value range: 0 ... 2^{32}-1 Default: 500				
Motor revolutions	1001	2		uint32	rw2
	Fix = 1				
FHPP	**1001**	**1...2**	**Array**	**uint32**	**rw2**

1 Name of the parameter in English

2 Object number

3 Subindices of parameter, if present (–: no subindex, simple variable)

4 Element class

5 Element variable type.

6 Read/write permission: ro = read only, wo = write only, rw = read and write,
rw1 = read and write at any time,
rw2 = read, write during commissioning

7 Description of the parameter

8 Name and description of subindices, if present

9 Corresponding FHPP parameter, if present

Fig. C/1: Representing the parameter entries

C.1.2 Communication profile area

Device type					
CANopen / CI	**1000h**	**– / 00h**	**Var**	**uint32**	**ro**
Description	Classification of the device type and the function. Bit: 31 ... 16 15 ... 0 Additional information Device Profile Number Values dependent on data profile (object 2FF2h/05h / PNU 206): Device Profile Number: CiA 402: 402 (0x0192) FHPP: 301 (0x012D) Additional information: CiA 402: 2 (0x0002) – type code for Servo Drive FHPP: 0 (0x0000) – not used				

Error register					
CANopen	**1001h**	**–**	**Var**	**uint8**	**ro**
Description	Internal errors are stored in the error register. The error register is part of the Emergency Object. Bit: Description 0 generic error: Error occurring (Or-linking of bits 1 to 7) 1 current: I2t error 2 voltage: Voltage monitoring error 3 temperature: Overtemperature of motor 4 communication error (overrun, error state) 5 Missing homing, error in homing, non-permitted target position, drag error, general hardware error 6 reserved, fixed = 0 7 reserved, fixed = 0 Values: 0 = no error; 1 = error.				

Pre-defined error field					
CANopen	**1003h**	**00h...08h**	**Array**	**uint32**	**rw/ro**
Description	Error memory for Emergency Object. The object stores the errors reported by way of the Emergency Object. Each new error is stored in subindex 01h; the previous errors move one subindex down each time a new one is added.				
Number of errors	1003h	00h		uint32	rw
	Number of recorded errors as from subindex 01h. Value range 0 ... 8 The error field can be cleared by writing “0”.				
Standard error field	1003h	01h		uint32	ro
	Last stored error. The error numbers comprise 16 bits of error code (lower 2 bytes – LSB, see section 6.5.2, error code in Tab. 6/11) and 16 bits of additional information (upper 2 bytes – MSB, for MTR-DCI = 0).				
Standard error field	1003h	02h...08h		uint32	ro
	Previously stored errors. See subindex 01h.				

COB-ID SYNC message					
CANopen	**1005h**	**–**	**Var**	**uint32**	**rw**
Description	COB ID of synchronisation object (SYNC); see DS 301 specification. Synchronous transfer can be set if the entries in the communication parameters of the PDOs are modified. For this an entry to this object by the master is essential; see DS 301 specification. Default: 128 (0x00000080)				

Manufacturer device name					
CANopen / CI	**1008h**	**– / 00h**	**Var**	**V-string**	**ro**
Description	Type designation of the drive. Example: “MTR-DCI-42S-VCSC-EG7-R2IO”				
FHPP	**120**	**1...25**	**Array**	**char**	**ro**

Manufacturer hardware version					
CANopen / CI	**1009h**	**– / 00h**	**Var**	**V-string**	**ro**
Description	Hardware version in format = "V.xx.yy" (xx = main version, yy = secondary version)				
Compare PNU 100 / object 2069h					

Manufacturer software version (manufacturer firmware version)					
CANopen / CI	**100Ah**	**– / 00h**	**Var**	**V-string**	**ro**
Description	Firmware version in format = "V.xx.yy" (xx = main version, yy = secondary version)				
Compare PNU 101 / object 206Ah					

Guard time (monitoring time)					
CANopen	**100Ch**	**–**	**Var**	**uint16**	**rw**
Description	Monitoring time in [ms]. To define the "Life time" for the "Life guarding protocol" the guard time in ms is multiplied by the "Life time factor" (object 100Dh). Default: 0 (monitoring switched off) Value range: 0 ... 32767 (0x0000 ... 0x7FFF)				

Life time factor (monitoring time factor)					
CANopen	**100Dh**	**–**	**Var**	**uint8**	**rw**
Description	Multiplication factor for the guard time (object 100Ch). Default: 0. Value range: 0 ... 255 (0x00 ... 0xFF)				

COB-ID Emergency object					
CANopen	**1014h**	**–**	**Var**	**uint32**	**rw**
Description	COB ID of Emergency object (EMCY); see DS 301 specification. The Emergency protocol is supported. Default: 128 + Node-ID (0x80 + Node-ID)				

Inhibit time EMCY					
CANopen	**1015h**	**–**	**Var**	**uint16**	**rw**
Description	Inhibit time for the emergency message. The value is multiplied by 100 μs. Default: 0				

Identity object					
CANopen	**1018h**	**01h...04h**	**Record**	**uint32**	**ro**
Description	Device identification				
Vendor ID	1018h	01h		uint32	ro
	Manufacturer identifier for Festo. Fixed: 29 (0x0000001d)				
Product code	1018h	02h		uint32	ro
	Product code for the Festo Configurator				
Revision number	1018h	03h		uint32	ro
	Firmware version, z. B. 0x0001000A for version 1.10				
Serial number	1018h	04h		uint32	ro
	See object 6510/07h or 6510/A0h.				

Receive PDO communication parameter					
CANopen	**1400h, 1401h**	**01h...05h**	**Record**	**uint32, uint8, uint16**	**rw**
Description	Communication parameters of PDOs 1 and 2 which the device can receive: – PDO 1: Object 1400h – PDO 2: Object 1401h				
COB-ID for PDO	1400h, 1401h	01h		uint32	rw
	COB ID used by the PDO. – PDO 1: Default: 0x200 + Node-ID – PDO 2: Default: 0x300 + Node-ID				
Transmission type	1400h, 1401h	02h		uint8	rw
	Transmission type Default: 255 (0xFF) – Event-triggered asynchronous transmission Value range: 0 ... 255 (0x00 ... 0xFF)				
Inhibit time	1400h, 1401h	03h		uint16	rw
	Inhibit time, not used for RPDO. Fixed: 0 (0x0000)				
Compatibility entry	1400h, 1401h	04h		–	–
	reserved				
Event timer	1400h, 1401h	05h		uint16	rw
	Event counter in [ms]. Default: 0 (0x0000)				

Receive PDO 1 Mapping Parameter (Receive PDO 1 assignment parameter)					
CANopen	**1600h**	**01h...04h**	**Record**	**uint32**	**rw**
Description	Mapping parameters of PDO 1 which the device can receive. No dynamic mapping possible. The specified mapping depends on the selected device profile.				
PDO mapping	1600h	01h...04h		uint32	rw
	PDO mapping for the n-th mapped application object, depending on the selected data/device profile: Sub-index FHPP CiA 402 01h Fixed: 0x30000008 Fixed: 0x60400010 02h Fixed: 0x30010008 Fixed: 0x20320108 03h Fixed: 0x30020008 Fixed: 0x60600008 04h Fixed: 0x30030008 Fixed: 0x607A0020 (Positioning mode)				

Receive PDO 2 Mapping Parameter (Receive PDO 2 assignment parameter)					
CANopen	**1601h**	**01h...04h**	**Record**	**uint32**	**rw**
Description	Mapping parameters of PDO 2 which the device can receive. No dynamic mapping possible. The specified mapping depends on the selected device profile.				
PDO mapping	1601h	01h...04h		uint32	rw
	PDO mapping for the n-th mapped application object, depending on the selected data/device profile: Sub-index FHPP CiA 402 01h Fixed: 0x30100008 Fixed: 0x60810020 02h Fixed: 0x30110008 Fixed: 0x60830020 03h Fixed: 0x30120010 – 04h Fixed: 0x30130020 –				

Transmit PDO communication parameter					
CANopen	**1800h, 1801h**	**01h...05h**	**Record**	**uint32, uint8, uint16**	**rw**
Description	Communication parameters of PDOs 1 and 2 which the device can transmit: – PDO 1: Object 1800h – PDO 2: Object 1801h				
COB-ID for PDO	1800h, 1801h	01h		uint32	rw
	COB ID used by the PDO. – PDO 1: Default: 0x180 + Node-ID – PDO 2: Default: 0x280 + Node-ID				
Transmission type	1800h, 1801h	02h		uint8	rw
	Transmission type Default: 255 (0xFF) – Event-triggered asynchronous transmission Value range: 0 ... 255 (0x00 ... 0xFF)				
Inhibit time	1800h, 1801h	03h		uint16	rw
	Inhibit time. Fixed: 0 (0x0000)				
Compatibility entry	1800h, 1801h	04h		–	–
	Reserved, must not be implemented (access attempts are answered with abort code).				
Event timer	1800h, 1801h	05h		uint16	rw
	Event counter in [ms]. Default: 0 (0x0000)				

Transmit PDO 1 mapping parameter					
CANopen	**1A00h**	**01h...05h**	**Record**	**uint32**	**rw**
Description	Mapping parameters of PDO 1 which the device can transmit. No dynamic mapping possible. The specified mapping depends on the selected device profile.				
PDO mapping	1A00h	01h...05h		uint32	rw
	PDO mapping for the n-th mapped application object, depending on the selected data/device profile: Sub-index FHPP CiA 402 01h Fixed: 0x30200008 Fixed: 0x60410010 02h Fixed: 0x30210008 Fixed: 0x20320108 03h Fixed: 0x30220008 Fixed: 0x60610008 04h Fixed: 0x30230008 Fixed: 0x60640020 05h Fixed: 0x30240020				

Transmit PDO 2 mapping parameter					
CANopen	**1A01h**	**01h...04h**	**Record**	**uint32**	**rw**
Description	Mapping parameters of PDO 2 which the device can transmit. No dynamic mapping possible. The specified mapping is dependent on the selected device profile.				
PDO mapping	1A01h	01h...04h		uint32	rw
	PDO mapping for the n-th mapped application object, depending on the selected data/device profile: Sub-index FHPP CiA 402 (not used) 01h Fixed: 0x30300008 Fixed: 0x60410010 02h Fixed: 0x30310008 Fixed: 0x20320108 03h Fixed: 0x30320010 Fixed: 0x60610008 04h Fixed: 0x30330020 Fixed: 0x60640020				

C.1.3 Manufacturer specific profile area

Record number					
CANopen / CI	**2032h**	**01h**	**Array [1]**	**uint8**	**rw**
	[1] Pseudo-array due to compatibility				
Description	Select a position record via the record number. The record number is saved as the target for write and read operations on the following Objects: – Object 20E0/01h...05h: position_table_element – or objects 607Ah, 6081h, 6083h, 6084h. There is a direct correlation with object 2033h (PNU 401).				
Record number	2032h	01h		uint8	rw
	Read or write record number Values: 0 (0x00): CANopen direct position record 1 (0x00): CANopen RS232 position record 2 (0x02): Homing (position record 0) 3 (0x03): Position record 1 (default) 4 (0x04): Position record 2 ... Position record ... 33 (0x21): Position record 31				

Record number MTR-DCI	**2032h** **Record number** uint8	**20E0/01h** **RCB1** uint16	**20E0/02h** **Nominal (target) position** int32	**20E0/03h** **Velocity** int32	**20E0/04h** **Acc. Movement to** int32
0	2	Homing			
1	3	...	...	...	...
2	4	...	...	...	...
...	...	...	...	...	...
31	33	...	...	...	...

Tab. C/2: Structure of CiA 402 record list

For CiA 402, the record is selected with object 2032h. The selected record is then addressed with object 20E0h, whereby the record element (column in Tab. C/2) with the sub-index is selected. From the value received via object 2032h, subtract 2 in order to get the internal record number.

Standstill position window					
CANopen / CI	**2040h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	See PNU 1042, section B.2.19.				
FHPP	**1042**	**–**	**Var**	**uint32**	**rw**

Standstill timeout					
CANopen / CI	**2041h**	**– / 00h**	**Var**	**uint16**	**rw**
Description	See PNU 1043, section B.2.19.				
FHPP	**1043**	**–**	**Var**	**uint16**	**rw**

Version FHPP					
CANopen / CI	**2066h**	**– / 00h**	**Var**	**uint16**	**ro**
Description	Version number of the FHPP, see PNU 102, section B.2.4.				
FHPP	**102**	**–**	**Var**	**uint16**	**ro**

Controller serial number					
CANopen / CI	**2072h**	**– / 00h**	**Var**	**V-string**	**ro**
Description	12-position code for clearly identifying the controller. Example: “TD15P0212345”				
FHPP	**114**	**1...12$_d$**	**Array**	**char**	**ro**

Device control					
CANopen / CI	**207Dh**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Activates device control of the controller via the controller interface. Corresponds to “HMI control” on the control panel and “FCT/HMI” on the FCT. 0 (0x00): Control via controller interface OFF. via HMI (control panel) and FCT ON 1 (0x01): Control via controller interface ON (default)				
FHPP	**125**	**–**	**Var**	**uint8**	**rw**

Diagnostic event					
CANopen / CI	**20C8h**	**01h...10h**	**Array**	**uint8**	**ro**
Description	Type of diagnostic event stored in the diagnostic memory, see PNU 200, section B.2.6.				
FHPP	**200**	**1...16$_d$**	**Array**	**uint8**	**ro**

Fault number					
CANopen / CI	**20C9h**	**01h...10h**	**Array**	**uint16**	**ro**
Description	Fault number stored in the diagnostic memory, see PNU 201 and 200, section B.2.6.				
FHPP	**201**	**1...16$_d$**	**Array**	**uint16**	**ro**

Time stamp					
CANopen / CI	**20CAh**	**01h...10h**	**Array**	**uint32**	**ro**
Description	Time point of the diagnostic event since switching on (unit as per PNU 204/2), see PNU 202 and 200, section B.2.6.				
FHPP	**202**	**1...16$_d$**	**Array**	**uint32**	**ro**

Diagnostic memory parameter					
CANopen / CI	**20CCh**	**01h...04h**	**Array**	**uint8**	**rw/ro**
Description	Configuration of the diagnostic memory, see PNU 204, section B.2.6.				
Fault type	20CCh	01h		uint8	rw
	Incoming and outgoing faults				
Resolution	20CCh	02h		uint8	rw
	Resolution time stamp				
Clear Memory	20CCh	03h		uint8	rw
	Clear diagnostic memory by writing value = 1.				
Number of entries	20CCh	04h		uint8	ro
	Read out the number of entries in the diagnostic memory.				
FHPP	**204**	**1...4**	**Array**	**uint8**	**rw/ro**

Scaling					
CANopen / CI	**20D0h**	**01h, 02h**	**Array**	**uint8**	**rw/ro**
Description	Settings on the control panel HMI (only type MTR-DCI-...H2) Influences only the display: All parameters are saved internally in increments.				
Measuring unit	20D0h	01h		uint8	rw
	Determining the measuring unit system for the control panel 1 (0x01): Metric measuring units (mm, mm/s, mm/s^2) 4 (0x04): Angle degree 8 (0x08): Revolutions Compare PNU126/20FFh.				
Scaling factor	20D0h	02h		uint8	ro
	Number of post-decimal positions Fixed = 2. Compare PNU126/20FFh.				

Record table element

CANopen / CI	**20E0h**	**01h ... 05h**	**Record**	**uint16, int32**	rw
Description	Editing the entries in the position record table: 1. Select line (= position number) with object 2032h. 2. Select column under subindex 20E0h: 01...04				

		20E0/01	20E0/02 ↓	20E0/03	20E0/04	
	Record Number	**Pos-set mode**	**Target position**	**Profile velocity**	**Profile acc.**	
	02					
2032h⟶	03	‹1›	**‹...›**	...	...	
	...					

The values are only saved in the position table with this command; no movement is made.

Positioning mode	20E0h	01h		uint16	rw
	Positioning mode (record control word). Values: 0 (0x0000): absolute positioning (default) 1 (0x0001): relative positioning				
Target position	20E0h	02h		int32	rw
	Target position in increments (≙ object 607Ah). Value range: -2^{31}...$+(2^{31}-1)$ (0x80000000 ... 0x7FFFFFFF). Default: 0				
Velocity	20E0h	03h		int32	rw
	Positioning velocity in increments (≙ object 607Ah). Value range (depending on axis type, see object 20E2/04):				

MTR-DCI-...	Value range	
...-32...-G7 (G14)	0...66000	DMES-18: ≙ 0...12 (6) mm/s
...-42...-G7 (G14)	0...100000	DMES-25: ≙ 0...18.5 (9.1) mm/s
...-52...-G7 (G14)	0...100000	DMES-40: ≙ 0...29.6 (14.6) mm/s
...-62...-G7 (G14) (G22)	0...113400	DMES-63: ≙ 0...50.4 (24.7) (15.3) mm/s

Acceleration	20E0h	04h		int32	rw
	Acceleration in increments/s^2 (≙ object 6083h). Value range (depending on axis type, see object 20E2/04): MTR-DCI-32/42: 40000...480000 MTR-DCI-52/62: 40000...240000 Default: MTR-DCI-32/42: 480000 (0x00075300) MTR-DCI-52: 240000 (0x0003A980) MTR-DCI-62: 160000 (0x00027100)				

By way of object 20E0 access is effected in part to the same parameters as with the corresponding objects 607Ah, 6081h, 6083h, 6084h or objects 20EAh to 20EFh. Different data types are converted accordingly during writing and reading.

Axis parameter					
CANopen / CI	**20E2h**	**01h...05h**	**Record**	**uint32**	**rw**
Description	Specify and read the axis parameters, see PNU 1005, section B.2.15.				
Axis length	20E2h	01h		uint32	rw
	Axis length in increments.				
Gear numerator	20E2h	02h		uint32	rw
	External gear: Gear ratio - counter				
Gear denominator	20E2h	03h		uint32	rw
	External gear: Gear ratio - denominator				
Axis type	20E2h	04h		uint32	rw
	Axis/slide type				
Axis size	20E2h	05h		uint32	rw
	Rated size of the axis (e. g. DMES-25 = 0x19)				
FHPP	**1005**	**1...5**	**Array**	**uint32**	**rw**

Controller type					
CANopen / CI	**20E3h**	**–**	**Var**	**uint8**	**rw**
Description	Type of controller Values: 0 = without display; 1 = with display.				

Jog mode time phase 1					
CANopen / CI	**20E9h**	**1)**		**uint32**	**rw**
	1) Subindex dependent on data profile (Object 2FF2h/05h / PNU 206): – CiA 402: 20E9/00h – Var – FHPP: 20E9/21h – Array				
Description	Time duration of phase 1 (T1) in [ms], see PNU 534, section B.2.12.				
FHPP	**534**	**–**	**Var**	**uint32**	**rw**

Data memory control					
CANopen / CI	**20F1h**	**01h, 02h**	**Array**	**uint8**	**rw**
Description	Commands for the EEPROM (non-volatile data storage) Pay attention to the warnings under PNU 127, section B.2.5.				
Delete EEPROM	20F1h	01h		uint8	rw
	Delete data in EEPROM.				
Save data	20F1h	02h		uint8	rw
	Overwrite data in EEPROM with the current settings.				
FHPP	**127**	**1, 2**	**Array**	**uint8**	**rw**

User device name					
CANopen / CI	**20FDh**	**– / 00h**	**Var**	**V-string**	**rw**
Description	Device name allocated by user, see PNU 121, section B.2.5.				
FHPP	**121**	**1...25**	**Array**	**char**	**rw**

HMI control (MMI parameter)					
CANopen / CI	**20FFh**	**01h...04h**	**Array**	**uint8**	**rw**
Description	Settings on the control panel (only type MTR-DCI-...-H2...) see PNU 126, section B.2.5.				
LCD current	20FFh	01h		uint8	rw
	Voltage				
LCD contrast	20FFh	02h		uint8	rw
	Contrast				
Measure	20FFh	03h		uint8	rw
	Measuring units for the LCD display				
Scaling factor	20FFh	04h		uint8	rw
	Number of post-decimal positions				
FHPP	**126**	**1...4**	**Array**	**uint8**	**rw**

Project zero point					
CANopen / CI	**21F4h**	**– / 00h**	**Var**	**int32**	**rw**
Description	Offset axis zero point – project zero point, see PNU 500, section B.2.9.				
FHPP	**500**	**–**	**Var**	**int32**	**rw**

Max. velocity					
CANopen / CI	**21F6h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Max. permitted speed in increments/s. see PNU 502, section B.2.9.				
FHPP	**502**	**–**	**Var**	**uint32**	**rw**

Max. acceleration					
CANopen / CI	**21F7h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Max. permitted acceleration in increments/s^2. see PNU 503, section B.2.9.				
FHPP	**503**	**–**	**Var**	**uint32**	**rw**

Teach target					
CANopen / CI	**21FCh**	**– / 00h**	**Var**	**uint8**	**rw**
Description	The parameter defined is the one which is written with the actual position with the next Teach command, see PNU 520, section B.2.11.				
FHPP	**520**	**–**	**Var**	**uint8**	**rw**

Homing required					
CANopen / CI	**23F6h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Defines whether or not homing must be carried out after power-on in order to execute positioning tasks, see PNU 1014, section B.2.16.				
FHPP	**1014**	**–**	**Var**	**uint8**	**rw**

Homing max. torque					
CANopen / CI	**23F7h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Max. current consumption during homing see PNU 1015, section B.2.16.				
FHPP	**1015**	**–**	**Var**	**uint8**	**rw**

Device fault					
CANopen / CI	**2FF1h**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Read/clear the active device fault, see PNU 205, section B.2.6.				
FHPP	**205**	**–**	**Var**	**uint16**	**rw**

CANopen diagnosis					
CANopen / CI	**2FF2h**	**01h...06h**	**Array**	**uint8**	**ro**
Description	Read the CANopen diagnostic data, see PNU 206, section B.2.6.				
Connection state	2FF2h	01h		uint8	ro
	Current status of the CANopen connection and status machine				
Bit rate	2FF2h	02h		uint8	ro
	Set bit rate.				
Master address	2FF2h	03h		uint8	ro
	Master address.				
Slave address	2FF2h	04h		uint8	ro
	Slave address (node ID).				
Configuration	2FF2h	05h		uint8	ro
	Data profile (CiA 402 or FHPP)				
CO diagnosis	2FF2h	06h		uint8	ro
	Reserved for compatibility reasons.				
FHPP	**206**	**1...6**	**Array**	**uint8**	**ro**

Cycle number					
CANopen / CI	**2FFFh**	**– / 00h**	**Var**	**uint32**	**ro**
Description	Number of positioning records executed, reference runs etc. see PNU 305, section B.2.7.				
FHPP	**305**	**–**	**Var**	**uint32**	**ro**

C.1.4 CiA 402: Standardised Device Profile Area

Controlword CiA 402 (control word CiA 402)					
CANopen / CI	**6040h**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Modify the current controller status or trigger an activity. Status modifications triggered by the control word must be read back via the status word. Only when the requested status can be read, may a further command be written via the control word. For a description of the state machine see section C.2. Values see Tab. C/3. Specific features when accessing via CI see section C.3.4.				

Bit	Value	Description	
0	0x0001	Switch on	Control the status transitions. These bits are evaluated together.
1	0x0002	Enable voltage	
2	0x0004	Quick stop – low-active	
3	0x0008	Enable operation	
4	0x0010	Depends on operating mode (object 6060): – Homing mode: Start homing operation – Profile position mode / torque mode: New setpoint (move to position)	
5	0x0020	Depends on operating mode (object 6060h): – Homing mode: reserved (set to 0) – Profile position mode: reserved (change_set_immediately not supported in Record Select and Direct mode) – Profile torque mode: =1: with stroke limitation; =0: without stroke limitation	
6	0x0040	Depends on operating mode (object 6060h): – Profile position mode: absolute / relative – Homing mode: reserved (set to 0) – Profile torque mode: reserved (set to 1)	
7	0x0080	Reset fault	
8	0x0100	Hold as per Hold option code – object 605Dh.	
9	0x0200	reserved (= 0)	
10	0x0400	reserved (= 0)	
11	0x0800	Jog positive: Run as long as set	
12	0x1000	Jog negative: Run as long as set	
13	0x2000	Teach: Apply current value	
14	0x4000	HMI Access locked	
15	0x8000	Symmetrical ramp transfer via PDO, i.e. acceleration value also for braking. Not when accessing via SDO or using the FCT.	

Tab. C/3: Description of control word

<table>
<tr><th colspan="6">Statusword CiA 402 (status word CiA 402)</th></tr>
<tr><td>CANopen / CI</td><td>6041h</td><td>– / 00h</td><td>Var</td><td>uint16</td><td>ro</td></tr>
<tr><td>Description</td><td colspan="5">Reading the current controller or regulator status.
For a description of the state machine see section C.2.
Values see Tab. C/4.
Specific features when accessing via CI see section C.3.4.</td></tr>
</table>

<table>
<tr><th>Bit</th><th>Value</th><th colspan="2">Description</th></tr>
<tr><td>0</td><td>0x0001</td><td>Ready to switch on</td><td rowspan="7">Bits 0 ... 3, 5 and 6 show the status of the device
(x ... irrelevant for this status)
Value (binary) — Status
xxxx xxxx x0xx 0000 — Not ready to switch on
xxxx xxxx x1xx 0000 — Switch on disabled
xxxx xxxx x01x 0001 — Ready to switch on
xxxx xxxx x01x 0011 — Switched on
xxxx xxxx x01x 0111 — Operation enabled
xxxx xxxx x00x 0111 — Quick stop active
xxxx xxxx x0xx 1111 — Fault reaction active
xxxx xxxx x0xx 1000 — Fault</td></tr>
<tr><td>1</td><td>0x0002</td><td>Switched on</td></tr>
<tr><td>2</td><td>0x0004</td><td>Operation enabled</td></tr>
<tr><td>3</td><td>0x0008</td><td>Fault</td></tr>
<tr><td>4</td><td>0x0010</td><td>Voltage enabled</td></tr>
<tr><td>5</td><td>0x0020</td><td>Quick Stop</td></tr>
<tr><td>6</td><td>0x0040</td><td>Switch on disabled</td></tr>
<tr><td>7</td><td>0x0080</td><td colspan="2">Warning (simple fault which does not require an emergency stop)</td></tr>
<tr><td>8</td><td>0x0100</td><td colspan="2">Drive moves (corresponds to bit 4 of SPOS in FHPP)</td></tr>
<tr><td>9</td><td>0x0200</td><td colspan="2">Higher-order control (corresponds to bit 5 of SCON in FHPP)</td></tr>
<tr><td>10</td><td>0x0400</td><td colspan="2">Target reached (see also objects 6067 and 6068)</td></tr>
<tr><td>11</td><td>0x0800</td><td colspan="2">Internal limit active</td></tr>
<tr><td>12</td><td>0x1000</td><td colspan="2">Depends on operating mode (object 6060):
– Profile position mode: Setpoint acknowledge
– Homing mode: Homing attained
– Profile torque mode: is running</td></tr>
<tr><td>13</td><td>0x2000</td><td colspan="2">Depends on operating mode (object 6060):
– Profile position mode: Drag error
– Homing mode: Homing error
– Profile torque mode: Stroke limit reached</td></tr>
<tr><td>14</td><td>0x4000</td><td colspan="2">Teach acknowledge (corresponding to bit 3 of SPOS in FHPP)</td></tr>
<tr><td>15</td><td>0x8000</td><td colspan="2">Homing performed (corresponds to bit 7 of SPOS in FHPP)</td></tr>
</table>

Tab. C/4: Description of status word

Hold option code					
CANopen / CI	**605Dh**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Describes the reaction to a Hold command. see PNU 1020, section B.2.17.				
FHPP	**1020**	**–**	**Var**	**uint16**	**rw2**

Fault reaction option code					
CANopen / CI	**605Eh**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Describes the reaction to a fault, see PNU 1021, section B.2.17.				
FHPP	**1021**	**–**	**Var**	**uint16**	**rw**

Operating modes					
CANopen / CI	**6060h**	**– / 00h**	**Var**	**int8**	**rw**
Description	Set the controller operating mode. Values: -2 (0xFE): Demo mode (fixed sequence) 1 (0x01): Profile position mode (default, position controller with positioning mode) 3 (0x03): reserved 4 (0x04): Profile torque mode (power operation) 6 (0x06): Homing mode				

Operating mode display					
CANopen / CI	**6061h**	**– / 00h**	**Var**	**int8**	**ro**
Description	Read current controller operating mode. Values see object 6060h.				

Position demand value (nominal position)					
CANopen / CI	**6062h**	**– / 00h**	**Var**	**int32**	**ro**
Description	Target position of the last positioning task in increments. see PNU 1040, section B.2.19.				
FHPP	**1040**	**–**	**Var**	**int32**	**ro**
	In FHPP: "Position target value"				

Position actual value					
CANopen / CI	**6063h**	**– / 00h**	**Var**	**int32**	**ro**
Description	Current position of the drive in increments. Value range: -2^{31} ... $+(2^{31}-1)$ Value is only updated at the end of a control cycle.				

Position actual value					
CANopen / CI	**6064h**	**– / 00h**	**Var**	**int32**	**ro**
Description	Actual position of the drive in increments (cyclic in PDO), see PNU 1041, section B.2.19.				
FHPP	**1041**	**–**	**Var**	**int32**	**ro**

Target position window					
CANopen / CI	**6067h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Tolerance window in increments, see PNU 1022, section B.2.17.				
FHPP	**1022**	**–**	**Var**	**uint32**	**rw**

Position window time (adjustment time position)					
CANopen / CI	**6068h**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Adjustment time in milliseconds, see PNU 1022, section B.2.17.				
FHPP	**1023**	**–**	**Var**	**uint16**	**rw**

Velocity demand value					
CANopen / CI	**606Bh**	**– / 00h**	**Var**	**int32**	**ro**
Description	Current nominal velocity value of speed regulator in increments. Value range: -2^{31} ... $+(2^{31}-1)$				

Velocity actual value					
CANopen / CI	**606Ch**	**– / 00h**	**Var**	**int32**	**ro**
Description	Current nominal velocity value of speed regulator in increments. Value range: -2^{31} ... $+(2^{31}-1)$				

Target torque					
CANopen / CI	**6071h**	**– / 00h**	**Var**	**int32**	**ro**
Description	Nominal value for power operation. Specified in permil of the rated current (see PNU 512 / object 6072h). Value range: 200...1500				

Maximum current					
CANopen / CI	**6073h**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Maximum motor current in 1/1000 of the specified rated current (PNU 1035 / object 6075h), see PNU 1034, section B.2.18.				
FHPP	**1034**	**–**	**Var**	**uint16**	**rw**

Rated motor current					
CANopen / CI	**6075h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Rated current of the motor, see PNU 1035, section B.2.18.				
FHPP	**1035**	**–**	**Var**	**uint32**	**rw**

Rated motor torque					
CANopen / CI	**6076h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Rated torque/force of the motor, see PNU 1036, section B.2.18.				
FHPP	**1036**	**–**	**Var**	**uint32**	**rw**

Actual torque value					
CANopen / CI	**6077h**	**– / 00h**	**Var**	**int32**	**ro**
Description	Actual value of torque during power operation. specified in permil of rated value				

Actual current value					
CANopen / CI	**6078h**	**– / 00h**	**Var**	**int32**	**ro**
Description	Actual current value specified in permil of rated value				

Target position					
CANopen / CI	**607Ah**	**– / 00h**	**Var**	**int32**	**rw**
Description	Target position in increments. Compare 20E0/02h. Writing the object does not yet trigger movement. **CiA 402:** Current target that the drive should approach in positioning mode, interpreted as relative or absolute dependent on bit 6 in control word 6040h. **FHPP:** The target position will be stored in the intended line addressed by object 2032h in the column intended in the position table for the direct mode. Value range: -2^{31} ... $+(2^{31} -1)$				

Position range limits (software end positions)					
CANopen / CI	**607Bh**	**01h, 02h**	**Array**	**int32**	**rw**
Description	Software end positions in increments, see PNU 501, section B.2.9.				
Lower limit	607Bh	01h		int32	
	Lower software end position				
Upper limit	607Bh	02h		int32	
	Upper software end position				
FHPP	**501**	**1, 2**	**Array**	**int32**	**rw**
	FHPP: "Software end positions"				

Home offset (offset axis zero point)					
CANopen / CI	**607Ch**	**– / 00h**	**Var**	**int32**	**rw**
Description	Axis zero point offset in increments, see PNU 1010, section B.2.16.				
FHPP	**1010**	**–**	**Var**	**int32**	**rw**
	FHPP: "Offset axis zero point"				

Polarity (reversal of direction)					
CANopen / CI	**607Eh**	**– / 00h**	**Var**	**uint8**	**rw**
Description	The direction of the position values is reversed. see PNU 1000, section B.2.15.				
FHPP	**1000**	**–**	**Var**	**uint8**	**rw**

Profile Velocity (speed)					
CANopen / CI	**6081h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Final speed for a positioning procedure in increment/s. Writing the object does not yet trigger movement. **CiA 402:** Speed at which travel should be done in positioning mode. **FHPP:** The velocity will be stored in the intended line addressed by object 2032h in the column intended in the position table for the direct mode. Value range and default: see 20E0/03h.				

Profile Acceleration					
CANopen / CI	**6083h**	**– / 00h**	**Var**	**uint32**	**rw**
Description	Acceleration for a positioning movement in increments/s^2. Compare 20E0/04h Writing the object does not yet trigger movement. **CiA 402:** Acceleration at which travel should be done in positioning mode. **FHPP:** The acceleration will be stored in the intended line addressed by object 2032h in the column intended in the position table for the direct mode. Value range and default: see 20E0/04h.				

Motion Profile Type (available movement profiles)					
CANopen / CI	**6086h**	**– / 00h**	**Var**	**int16**	**rw**
Description	Type of acceleration ramp (linear, $\sin^2$ etc.). Fixed = -1 (0xFFFF): Linear ramp				

Torque Slope (torque modification)					
CANopen / CI	**6087h**	**00h**	**Var**	**uint32**	**r**
Description	Modification speed of torque (or of force) Unit: Permil of rated torque (6076h) per second Fixed: 10000 (0x2710)				

Torque Profile Type					
CI access	**6088h**	**00h**	**Var**	**uint32**	**r**
Description	Type of profile with which a torque modification is undertaken. Fixed: 0x0000 - Linear ramp				

Position Encoder Resolution					
CANopen / CI	**608Fh**	**01h, 02h**	**Array**	**uint32**	**rw**
Description	Encoder resolution in [encoder increments / motor revolutions]				
Encoder increments	608Fh	01h		uint32	rw
	Values (fixed): MTR-DCI-32: 300 (0x012C) MTR-DCI-42/52/62: 500 (0x01F4) Value is automatically entered when an axis type is selected (PNU 1005/4).				
Motor revolutions	608Fh	02h		uint32	rw
	Fix = 1				
FHPP	**1001**	**1, 2**	**Array**	**uint32**	**rw**
	FHPP: “Encoder resolution”				

Gear Ratio					
CANopen / CI	**6091h**	**01h, 02h**	**Array**	**uint32**	**rw**
Description	Ratio of the internal motor revolutions to the external revolutions of the drive shaft of the MTR-DCI. The values are set fixed depending on the internal gear (see type plate of the MTR-DCI). See PNU 1002, section B.2.15.				
Motor revolutions	6091h	01h		uint32	rw
	Integrated gear: Gear ratio - counter				
Shaft revolutions	6091h	02h		uint32	rw
	Integrated gear: Gear ratio - denominator				
FHPP	**1002**	**1, 2**	**Array**	**uint32**	**rw**

Feed Constant					
CANopen / CI	**6092h**	**01h, 02h**	**Array**	**uint32**	**rw**
Description	Feed constant of the linear axis = feed / spindle revolution, see PNU 1003, section B.2.15.				
Feed	6092h	01h		uint32	rw
	Feed constant - counter Value is automatically entered when an axis type is selected (PNU 1005/4).				
Shaft revolutions	6092h	02h		uint32	rw
	Feed constant - denominator.				
FHPP	**1003**	**1, 2**	**Array**	**uint32**	**rw**

Position Factor					
CANopen / CI	**6093h**	**01h...02h**	**Array**	**uint32**	**rw**
Description	Conversion factor for number of encoder increments per 1 feed unit on the spindle, see PNU 1004, section B.2.15.				
Numerator	6093h	01h		uint32	rw
	Position factor – counter Value is automatically entered when an axis type is selected (PNU 1005/4).				
Denominator	6093h	02h		uint32	rw
	Position factor - denominator				
FHPP	**1004**	**1, 2**	**Array**	**uint32**	**rw**

Homing Method (reference travel method)					
CANopen / CI	**6098h**	**– / 00h**	**Var**	**int8**	**rw**
Description	Defines the method by which the drive performs homing, see PNU 1011, section B.2.16. Changing the homing method influences object 607Ch.				
FHPP	**1011**	**–**	**Var**	**int8**	**rw2**

Homing Speeds					
CANopen / CI	**6099h**	**01h, 02h**	**Array**	**uint32**	**rw**
Description	Speeds during homing in [inc/s]. see PNU 1012, section B.2.16.				
Search REF	6099h	01h		uint32	rw
	Speed when searching for the reference point REF				
Search AZ	6099h	02h		uint32	rw
	Speed when moving to the axis zero point AZ				
FHPP	**1012**	**1, 2**	**Array**	**uint32**	**rw**
	FHPP: “Homing velocities”				

Torque Control parameters					
CANopen / CI	**60F6h**	**01h, 05h**	**Record**	**uint16/32**	**rw**
Description	Power operation (see section B.2.10)				
Stroke limit	60F6h	01h		uint32	rw
	Maximum permitted stroke with active force control. With active force control, the actual position relative to the start position must not change by more than the amount specified in this parameter. In this way you can ensure that, if force control is activated by mistake (e. g. missing work item), the axis will not perform an uncontrolled movement. This parameter is taken into account in all control modes in which the position controller is not active in the status “Operation enabled.” Monitoring can be deactivated when bit RCB1.B5 is set. Value range: 0...4,294,967,295 Inc				
Velocity limit	60F6h	02h		uint32	rw
	Maximum permitted velocity with active force control. In this way the user can be sure that, if power operation is activated by mistake (e. g. missing work item), the axis will not accelerate uncontrolled and strike against a stop at high speed. This parameter is taken into account in all control modes in which the position controller is not active in the status “Operation enabled.” Value range: 1...4,294,967,295 inc/s				
Force target window	60F6h	03h		uint16	rw
	This is the amount by which the actual force (actual torque) may differ from the nominal force (nominal torque), in order to be interpreted as still being in the target window. The width of the window is twice the value transferred, with the target position in the centre of the window. The value is specified in 1/1000 of the rated torque (6076h). Value range: 0...65535. Default: 100.				
Damping time	60F6h	04h		uint16	rw
	If the actual force (actual torque) has been in the target window this amount of time, the “Target reached” bit will be set in the status word (Motion Complete). Value range: 0...30000 ms. Default: 100 ms				
Min. Torque (min. permitted force/ torque)	60F6h	04h		uint32	rw
	This value represents the lowest permitted torque (force) of the motor. The value is specified in 1/1000 of the rated torque (6076h / PNU 509). Value range: 0...1000 (0x03E8).				
FHPP	**510/554/ 552/553/ 511**	**–**	**Array**	**uint16/32**	**rw**

Position control parameter set					
CANopen / CI	**60FBh**	**12h...17h, 20h**	**Array**	**uint16**	**rw**
Description		Technical control parameters. Modification is only permitted for servicing purposes. If necessary consult Festo.			
Gain position	1024	12h (FHPP: 18)		uint16	rw
	Gain position controller				
Gain Velocity	1024	13h (FHPP: 19)		uint16	rw
	Gain velocity controller				
I-fraction Velocity	1024	14h (FHPP: 20)		uint16	rw
	I-share velocity controller				
Gain Current	1024	15h (FHPP: 21)		uint16	rw
	Gain current controller				
I-fraction	1024	16h (FHPP: 22)		uint16	rw
	I-share current controller				
Gain Velocity Trajectory	1024	17h (FHPP: 23)		uint16	rw
	Gain velocity controller - trajectory generator				
Save Position	1024	20h (FHPP: 32)		uint16	rw
	Save current position on power-off.				
FHPP	**1024**	**18...23, 32**	**Array**	**uint16**	**rw**

Local Digital Inputs					
CANopen / CI	**60FDh**	**– / 00h**	**Var**	**uint32**	**ro**
Description	Map of digital inputs, see PNU 303, section B.2.7.				
FHPP	**303**	**–**	**Var**	**uint32**	**ro**

Local Digital Outputs					
CANopen / CI	**60FEh**	**01h, 02h**	**Array**	**uint32**	**ro**
Description	Map of digital outputs, see PNU 304, section B.2.7.				
Digital Outputs	60FEh	01h		uint32	ro
	Mapping the digital outputs				
Mask	60FEh	02h		uint32	ro
	reserved				
FHPP	**304**	**1, 2**	**Array**	**uint32**	**ro**

Motor Type					
CANopen / CI	**6402h**	**– / 00h**	**Var**	**uint16**	**rw**
Description	Classification of the motor Fixed: 0x0000				
FHPP	**1030**	**–**	**Var**	**uint16**	**rw**

Motor Data					
CANopen / CI	**6410h**	**01h, 03h**	**Record**	**uint32**	**ro/rw**
Description	Motor-specific data, see PNU 1025, section B.2.17.				
Serial number	6410h	01h		uint32	ro
	Serial number of the motor				
Time Max. Current	6410h	03h		uint32	rw
	I^2t time. **Note: Values which are too high can damage the motor.**				
FHPP	**1025**	**1, 3**	**Array**	**uint32**	**ro/rw**

Supported Drive Modes					
CANopen / CI	**6502h**	**– / 00h**	**Var**	**uint32**	**ro**
Description	Supported control modes Fixed = 29h (41d) Bit 0: Profile position mode Bit 1: reserved (velocity mode) Bit 2: reserved (profile velocity mode) Bit 3: Profile torque mode Bit 4: reserved Bit 5: Homing mode Bit 6: reserved (interpolated positioning mode) Bit 7...31: reserved				

Drive Catalog Number					
CANopen / CI	**6503h**	**– / 00h**	**Var**	**V-string**	**ro**
Description	Order number of motor unit, e. g. "533742"				
FHPP	**124**	**1...30**	**Array**	**char**	**ro**
	FHPP: "Festo order number"				

Drive Manufacturer (manufacturer name)					
CANopen / CI	**6504h**	**– / 00h**	**Var**	**V-string**	**ro**
Description	Name of drive manufacturer. Fixed: "Festo AG & Co. KG"				
FHPP	**122**	**1...30**	**Array**	**char**	**ro**

HTTP Drive Catalog Address (HTTP address of manufacturer)					
CANopen / CI	**6505h**	**– / 00h**	**Var**	**V-string**	**ro**
Description	Internet address of the manufacturer. Fixed: "www.festo.com"				
FHPP	**123**	**1...30**	**Array**	**char**	**ro**

Drive Data					
CANopen / CI	**6510h**	**01h...08h, 22h, 31h, 32h, 40h...43h 45h, A0h, A1h**	**Record**	**int16, uint16, uint32**	**ro/rw**
Description	General motor data, see PNU 1026, section B.2.17.				
Output Stage Temp.	6510h	31h (FHPP: 1)		int16 (FHPP: uint32)	ro
	Temperature of the end stage in °C. Value range: -40 ... 85 (SI 01h: 0 ... 85)				
Output Stage Max. temp.	6510h	32h (FHPP: 2)		uint16 (FHPP: uint32)	ro
	Maximum temperature of the end stage in °C.				
Motor Rated Current	6510h	40h (FHPP: 3)		uint32 (FHPP: uint32)	ro
	Rated motor current in mA Value is automatically entered when an axis type is selected (PNU 1005/4).				
Current Limit	6510h	41h (FHPP: 4)		uint16 (FHPP: uint32)	ro
	Maximum motor current, identical to PNU 1034.				
Lower Current Limit	6510h	42h (FHPP: 5)		in16 (FHPP: uint32)	ro
	Lower current limit value in 1/1000 of the rated motor current				
I/O Control	6510h	43h (FHPP: 6)		uint16 (FHPP: uint32)	rw2
	Control of the control interface (see also object 207Dh).				
Controller Serial Number	6510h	A0h (FHPP: 7)		uint32 (FHPP: uint32)	ro
	Serial number of the controller in format 0xTTMYYSSS:				
Following Error	6510h	22h (FHPP: 8)		uint32 (FHPP: uint32)	ro
	Drag fault monitoring				
Current actual value	6510h	45h [1]		int16	ro
	Current actual value				
Firmware number	6510	A1h [2]		uint32	ro
FHPP	**1026**	**1...8**	**Array**	**uint32**	**ro/rw**

[1] Object not available via FHPP
[2] FHPP PNU 101

C.2 Finite status machine in accordance with CiA 402

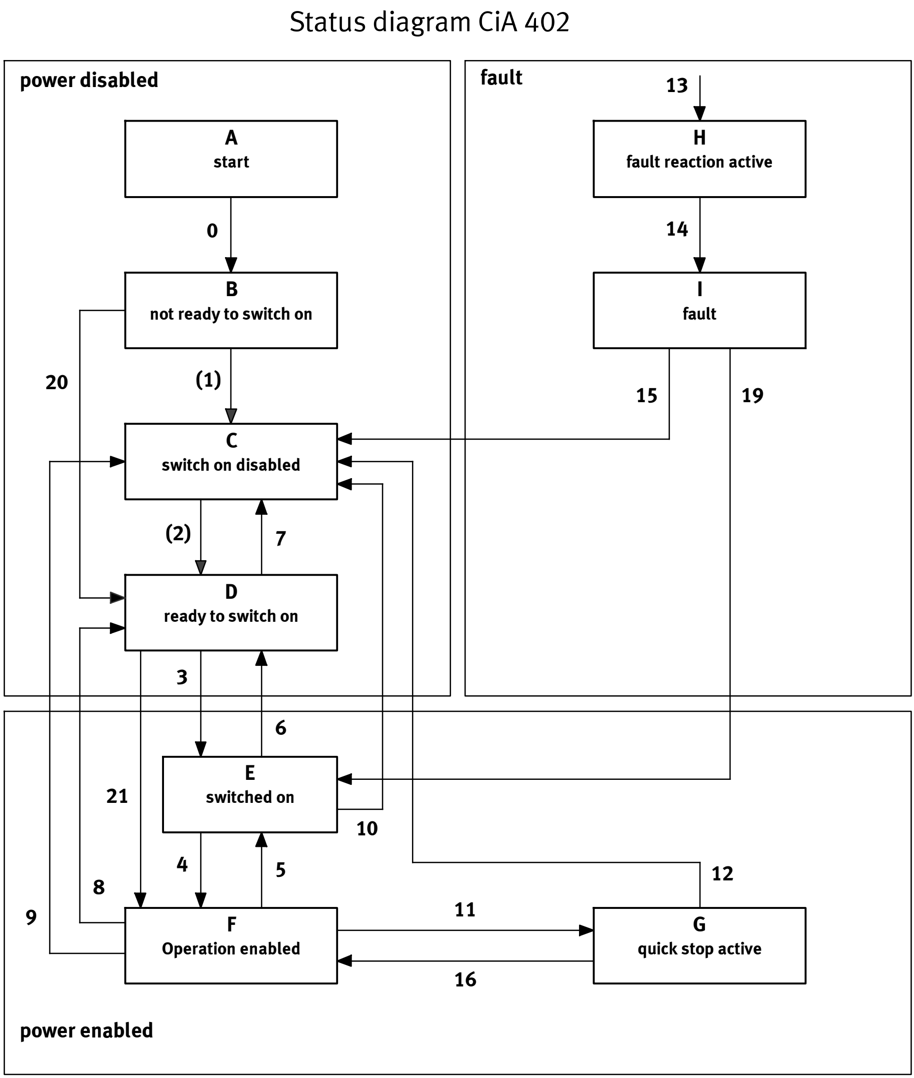

Fig. C/2: Status diagram CiA 402

Description of the states

Status	Description
A “Start”	This state is assumed at power-on, on reset or when a reset command is entered via the field bus. After execution of the startup code power to the power section is cut and the status branches to B.
B “Not ready to switch on”	In this status logic self-tests are carried out. Internal working variables are initialized. The mechanical brake is actuated, if fitted. The power supply to the power section remains cut. The field bus interface is initialized and communication enabled. The CI is initialized at the serial interface.
C “Switch on disabled”	The supply to the power section remains cut. The field bus and/or CI communication initialized in status B is started, enabling controller parameters, program records etc. to be modified. As from this status changes of state are possible only by way of field bus commands or if a serious error has occurred.
D “Ready to switch on”	Power to the power section is switched on, power section self-tests requiring no movement of the axis are carried out. By way of field bus and/or CI communication controller parameters, program records etc. can be modified (see also status E).
E “Switched on”	This status is practically identical to status D. In accordance with CiA 402, supply to the power section **must** be switched on in E, whereas it **can** be switched on in D.
F “Operation enabled”	The drive waits for positioning tasks and executes them. Normal operating status after successful initialization.
G “Quick stop active”	The Quick stop function has been activated. The drive runs as parameterized (ramp) and then stops. The power section and motor remain switched on, acceptance of positioning tasks is refused.

Status	Description
H “Fault reaction active”	This status can be assumed from any situation if a serious error is detected. The parameterized error response (emergency ramp, immediate stop etc.) is executed. Communication over the field bus is maintained, parameter modifications are permitted. The motor remains switched on.
I “Fault”	In this status the motor remains switched on, provided the error which has occurred permits. Otherwise the output stage is disabled and the mechanical brake is actuated. No more positioning movements are executed.

Tab. C/5: Description of the states

Description of the transfer conditions

Condition for status transfer	Description
0 “Start” -> “Not ready to switch on”	This status transition always takes place unconditionally after a (re)start.
1 “Not ready to switch on” -> “Switch on disabled”	**Note:** Not with MTR-DCI. Transition 20 is defined instead. The self-test of the 5V logic has been completed successfully. Communication via the fieldbus can, but does not have to be already active. No special signal levels from CiA 402 are required for the change of status.
2 “Switch on disabled” -> “Ready to switch on”	**Note:** Not with MTR-DCI. Transition 20 is defined instead. Fault Reset = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 0. No serious error.
3 “Ready to switch on” -> “Switched on”	Fault Reset = 0, Enable Operation = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 1. Note: in CiA 402 the same status transition also for Enable Operation = 1, the rest the same. This combination is also provided for transitions 4 and 16, but in 4 there is a conflict. So this combination is not applied here. No serious error present.
4 “Switched on” -> “Operation enabled”	Fault Reset = 0, Enable Operation = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 1. No serious error.

Condition for status transfer	Description
5 “Ready to switch on” -> “Switched on”	Fault Reset = 0, Enable Operation = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 1. No serious error.
6 “Switched on” -> “Ready to switch on”	Fault Reset = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 0. No serious error.
7 “Ready to switch on” -> “Switch on disabled”	Fault Reset = 0, Enable Voltage = 0 or Fault Reset = 0, Quick Stop = 0, Enable Voltage = 1. No serious error.
8 “Operation enabled” -> “Ready to switch on”	Fault Reset = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 0. No serious error.
9 “Operation enabled” -> “Switch on disabled”	Fault Reset = 0, Enable Voltage = 0. No serious error.
10 “Switched on” -> “Switch on disabled”	Fault Reset = 0, Enable Voltage = 0 or Fault Reset = 0, Quick Stop = 0, Enable Voltage = 1. No serious error.
11 “Operation enable” -> “Quick Stop active”	Fault Reset = 0, Quick Stop = 0, Enable Voltage = 1. No serious error.
12 “Quick Stop active” -> “Switch on disabled”	Fault Reset = 0, Enable Voltage = 0. No serious error.
13 From anywhere to “Fault reaction active”	Serious error, dependent on the device technology employed, which forces normal operation to be aborted. The status transition is independent of the control signals currently being sent.
14 “Fault reaction active” -> “Fault”	The cause of the fault must be eliminated (e.g. overheating, temperature reduced to permissible level). The emergency stop reaction is completed. A positive edge comes from the field bus on Fault Reset.
15 “Fault” -> “Switch on disabled”	Fault Reset = positive edge and at least one of the Enable Operation, Quick Stop, Enable Voltage and Switch on signals **not** 1. No serious error.
16 “Quick Stop active” -> “Operation enabled”	Fault Reset = 0, Enable Operation = 1, Quick Stop = 1, Enable Voltage = 1, Switch on = 1. No serious error.

Condition for status transfer	Description
19 “Fault” -> “Switched on”	Fault Reset = positive Flanke, Enable Operation = 1, Quick Stop = 1, Enable Voltage = 1, Switch on = 1. **Note:** This transition is not included in the CiA 402 profile. However, it is required for drives with non-self-locking shut-off characteristics, so as to avoid uncontrolled movement under load when the drive is switched off.
20 “Not ready to switch on” -> “Ready to switch on”	**Note:** With MTR-DCI replaces transition 1 and 2. Fault Reset = 0, Quick Stop = 1, Enable Voltage = 1, Switch on = 0. The self-test of the 5V logic has been completed successfully. Communication via the field bus can, but does not have to be already active. No serious error.
21 “Ready to switch on” -> “Operation enabled”	**Note:** Combined transition 3/4 (CiA 402 version 2.1.10 or higher) Fault Reset = 0, Enable Operation = 1, Quick Stop = 1, Enable Voltage = 1, Switch on = 1. No serious error present.

Tab. C/6: Description of the transfer conditions

C.3 The Command Interpreter (CI)

The contents of the commands implemented in the Command Interpreter of the MTR-DCI are based on the objects standardized by CANopen (CiA 402):

Device description and communication parameters:

Group 1xxx	Device description
Group 2xxx	Festo objects
Group 6xxx	Objects as per CANopen

C.3.1 Procedure for data transmission

Caution
In special application cases, access with CI commands enables parameterization and commissioning of the MTR-DCI directly via the RS232 interface. It is, however, not suitable for real-time capable communication, e.g. for control. Control of the MTR-DCI via RS232 requires also:

– an estimation of the risk by the user

– ambient conditions free of interference

– the reliability of data transmission e. g. via the control program of the host.

- You should use the control panel or the FCT for commissioning and parameterization.
- Note that control of the MTR-DCI via the RS232 does not comply with designated use.

Note
In order to restore the default settings you can, if necessary, delete the EEPROM via the serial interface with the CI command 20F1h (Data memory control) (see chapter C.3.). User-specific settings will then be lost.

- Use CI commands only if you already have experience with Service Data Objects.
- If necessary, consult Festo.

Warning
Injury to people and damage to property.

Full access to the internal variables of the servo controller is possible via CI commands. Incorrect operation can cause the controller to react unexpectedly and the motor may start uncontrolled.

- Only use the CI commands if you already have experience of Service Data Objects.
- Inform yourself about using the Objects in the CiA Draft Standard 402 before you use the CI commands of the Command Interpreter of the MTR-DCI.

For data transmission you will require a commercially-available terminal program or the CI terminal of the MTR-DCI in the Festo Configuration Tool.

Carry out the following steps:

- Connect the MTR-DCI to your PC via the RS232 interface. Follow the instructions in chapter 3.4.
- If necessary, adapt the PC interface to the following transmission protocol.

Transmission protocol	
Transmission speed (baud rate)	9600 bit/s
Data format	Asynchronous character frame: – 1 start bit – 8 data bits – no parity bit – 1 stop bit

Tab. C/7: Specifications of the transmission protocol

- Initialize the data transmission with the following command:

Command 310D $_h$	**Response** 31310D $_h$
1 <CR>	**11** <CR>

- Select the commands in accordance with the object list in section C.1, Tab. C/1.
- Use CI commands only if you already know their effects and if they are permitted for your MTR-DCI.
- For the syntax of the commands see appendix C.3.2.

→

Note
The table Tab. C/1 in section C.1 includes an overview of the CI objects. Some of the objects may be used only for certain product variants or only with limitation (e.g. writing only for service purposes).

Permitted value ranges

Transferred parameters and values are checked by the MTR-DCI before being accepted.

Note
In the case of invalid parameters or values, an error message will not appear in the response; rather, the transferred value will always be returned.

– Invalid parameters will not be accepted.

– Values outside the permitted value range will be limited to the nearest valid value.

Recommendation:
Check that values and parameters have been written correctly by downloading the current contents of the parameter or value with one of the following Read commands:

Transmission faults

If there are faults in transmission (syntax faults), the value ‹0xFF› will be transmitted instead of the usual reply.

Possible causes:

– Incorrect initial character, separating character or empty character

– Incorrect hex digit

– Incorrect value type

C.3.2 CI commands

Caution
Loss of data.

The Command Interpreter (CI) includes commands which reorganise or delete parts of the memory. Existing data are thereby destroyed:

- It is preferable to use the FCT or the control panel for commissioning and parameterisation.
- Use the CI commands only in special applications which require direct access to the controller.
- Use CI commands only if you already know their effects and if they are permissible for your MTR-DCI.

Access procedure

The higher-order controller sends the controller either a write command (WRITE) to modify a parameter in the object directory, or a read command (READ) to read out a parameter.

For each command the higher-order controller receives a response which either contains the value read or, in the case of a write command, serves as an acknowledgement. The transmitted value (1, 2 or 4 data bytes) depends on the data type of the object to be read or written.

WRITE (W)

Write commands (W) transfer a value in the specified format to the MTR-DCI. As a reply, write commands will be reflected exactly character by character from the controller of the MTR-DCI. A checksum ‹PS› will be inserted in front of the ‹CR›.

READ (R)

Read commands (R) transfer a value from the MTR-DCI. The reply from the MRE-DCI controller contains the downloaded value. A checksum ‹PS› will be inserted in front of the ‹CR›.

All commands are entered as a character sequence without any empty spaces. A hex character is a Char character in hex format.

Acc 1)	Command 2)	Reply
W	=IIIISS:‹Value›‹CR› 2)	=IIIISS:‹Value›‹PS›‹CR›
R	?IIIISS‹CR› 2)	=IIIISS:‹Value›‹PS›‹CR›

1) Access: W = write, R = read
2) Only with checksum checking enabled (object 20F3h, see section C.3.4): W: =IIIISS:‹Value›‹PS›‹CR›
R: ?IIIISS‹PS›‹CR›

Tab. C/8: Syntax of a CI command/reply

Syntax	Explanation
"=", "?"	Initial character for write or read commands
IIII	Index in 4 hexadecimal digits (4H)
SS	Subindex in 2 hexadecimal digits (2H) If the addressed object does not have an indexed parameter, subindex ‹00› will be specified.
":"	Separating character
‹Value›	Data in a format depending on data type
‹PS›	Checksum in 2 hexadecimal digits (2H)
‹CR›	End character‹Carriage Return› ($0D)

Tab. C/9: Elements of syntax of a CI command/reply

‹Value›

The transferred value (1, 2 or 4 data bytes as hex digits) depends on the data type of the object being read or written (see overview in section C.1, Tab. C/1).

The following data types are supported:

Type	Hex	Format
UINT8	2H	8 bits without sign: 0 ... 255
INT8		8 bits with sign: -128 ... 127

Type	Hex	Format
UINT16	4H	16 bits without sign: 0 ... 65535
INT16		16 bits with sign: -32768 ... 32767
UINT32	8H	32 bits without sign: 0 ...(2^{32} -1)
INT32		32 bits with sign: -2^{31} ... +(2^{31} -1)
V-string	corresponds to the preset string	

Tab. C/10: Data types

Note
The following applies when writing the objects:
- Discrete values:
  A non-permitted value will not be accepted, the previously valid value will be retained.
- Concrete values (e. g. lengths, speeds, etc.):
  A non-permitted value will be limited up to the next permitted minimum or maximum value.

Note
Direct transfer of values via the serial interface with CI commands always takes place in the basis system and requires conversion into increments.

All parameters are always saved in increments in the controller and are not converted into the relevant measuring system until they are written or downloaded. All physical variables (position, speed and acceleration) must be converted into increment values before they can be transferred.

Further information on converting can be found in chapter A.4.

All values are transferred in hexadecimal figures; 1 character represents 4 bits; it is known as a tetrad ‹Tn›. The first tetrad transferred contains the higher-value bits of the value. Generally: Tetrad ‹Tn› contains the bits $b_n ... b_{n+3}$

Example: UINT8								
Dec	26							
Hex	1				A			
Bin	0	0	0	1	1	0	1	0
	b7	b6	b5	b4	b3	b2	b1	b0
Tetrad	**T_4**				**T_0**			

Checksum ‹PS›

The checksum is formed from the sum of all transmitted asc (char) characters and shortened to 1 byte (modulo 256).

The other station must compare the sent command with the “echo” from the controller and process the checksum.

Checksum	
Syntax	IIIISS:‹Checksum›
Format	2 hexadecimal digits
Type	UINT8

Tab. C/11: Checksum

Object 2FF0

Transmission error between host (PC) and target device, e. g. due to error in host command:

– Incorrect starting, separating or empty character,

– Incorrect hex figure,

– Incorrect value type.

Name	Class	IIII	SS	Type	Acc
communication_ error	Var	2FF0	**00**	UINT16	R

Value	Comment
0xFF	In the case of a transmission error, the value ‹0xFF› will be transferred instead of the usual response.

C.3.3 Overview of CI objects

The following overview (Tab. C/12) shows all CI objects, where appropriate with the corresponding FHPP numbers.

You will find the descriptions of the CI objects in the following sections (cf. “see” column):

- Descriptions of the corresponding CANopen objects in sections C.1.2, C.1.3 and C.1.4,
- Descriptions of the corresponding PNUs as per FHPP in sections B.2.4 to B.2.19,
- Descriptions of the additional CI objects in section C.3.4.

You will find a thematically grouped overview of the FHPP objects in section B.2.2.

Name	CI			FHPP	see
	Object	SI	Class	PNU	
Device Type	1000h	– / 00h	Var	-	C.1.2
Manufacturer Device Name	1008h	– / 00h	Var	120	B.2.5
Manufacturer Hardware Version	1009h	– / 00h	Var	-	C.1.2
Manufacturer Software Version	100Ah	– / 00h	Var	-	C.1.2
Record Number	2032h	01h	Array	-	C.1.3
Record Number	2033h	– / 00h	Var	-	C.3.4

Name	CI			FHPP	see
	Object	SI	Class	PNU	
Standstill Position Window	2040h	– / 00h	Var	1042	B.2.19
Standstill Timeout	2041h	– / 00h	Var	1043	B.2.19
Version FHPP	2066h	– / 00h	Var	102	B.2.4
Version FCT PlugIn min.	2067h	– / 00h	Var	-	C.3.4
Version FCT PlugIn opt.	2068h	– / 00h	Var	-	C.3.4
Manufacturer Hardware Version	2069h	– / 00h	Var	100	B.2.4
Manufacturer Software Version	206Ah	– / 00h	Var	101	B.2.4
Controller Serial Number	2072h	– / 00h	Var	114	B.2.4
Device Control	207Dh	– / 00h	Var	125	B.2.5
Diagnostic Event	20C8h	01h...10h	Array	200	B.2.6
Fault Number	20C9h	01h...10h	Array	201	B.2.6
Time Stamp	20CAh	01h...10h	Array	202	B.2.6
Diagnostic Memory Parameter	20CCh	01h...04h	Array	204	B.2.6
Scaling	20D0h	01h, 02h	Array	-	C.1.3
Record Table Element	20E0h	01h...05h	Record	-	C.1.3
Axis Parameter	20E2h	01h...05h	Array	1005	B.2.15
Controller Type	20E3h	– / 00h	Var	-	C.1.3
Jog Mode Time Phase 1	20E9h	00h / 21h	Var / Array	534	B.2.12

Name	CI			FHPP	see
	Object	SI	Class	PNU	
Record Control Byte 1	20EAh	01h...20h	Array	401	C.3.4
Record Target Position	20ECh	01h...20h	Array	404	C.3.4
Record Velocity	20EDh	01h...20h	Array	406	B.2.8
		21h		531	B.2.12
Record Acceleration	20EEh	01h...20h	Array	407	B.2.8
		21h		532	B.2.12
		22h		541	B.2.13
Data Memory Control	20F1h	01h, 02h	Array	127	B.2.5
CI_ReceiveChecksumActive	20F3h	00h	Var	-	C.3.4
Password	20FAh	01h, 02h	Array	-	C.3.4
Local Password	20FBh	– / 00h	Var	-	C.3.4
User Device Name	20FDh	– / 00h	V-string	121	B.2.5
HMI Control	20FFh	01h...04h	Array	126	B.2.5
Project Zero Point	21F4h	– / 00h	Var	500	B.2.9
Max. Speed	21F6h	– / 00h	Var	502	B.2.9
Max. Acceleration	21F7h	– / 00h	Var	503	B.2.9
Teach Target	21FCh	– / 00h	Var	520	B.2.11
Homing Required	23F6h	– / 00h	Var	1014	B.2.16
Homing Max. Torque	23F7h	– / 00h	Var	1015	B.2.16
Communication Error	2FF0	– / 00h	Var	-	C.3.4
Device Fault	2FF1h	– / 00h	Var	205	B.2.6

Name	CI			FHPP	see
	Object	SI	Class	PNU	
CANopen Diagnosis	2FF2h	01h...06h	Array	206	B.2.6
CANopen Address	2FF3h	– / 00h	Var	-	C.3.4
CANopen Bit Rate	2FF4h	– / 00h	Var	-	C.3.4
CANopen Protocol	2FF5h	– / 00h	Var	-	C.3.4
CAN Voltage Supply	2FF6h	– / 00h	Var	-	C.3.4
Cycle Number	2FFFh	– / 00h	Var	305	B.2.7
Controlword CiA 402	6040h	– / 00h	Var	-	C.3.4
Statusword CiA 402	6041h	– / 00h	Var	-	C.3.4
Hold Option Code	605Dh	– / 00h	Var	1020	B.2.17
Fault Reaction Option Code	605Eh	– / 00h	Var	1021	B.2.17
Operating Modes	6060h	– / 00h	Var	-	C.1.4
Operating Mode Display	6061h	– / 00h	Var	-	C.1.4
Position Demand Value	6062h	– / 00h	Var	1040	B.2.19
Position Actual Value*	6063h	– / 00h	Var	-	C.1.4
Position Actual Value	6064h	– / 00h	Var	1041	B.2.19
Position Window	6067h	– / 00h	Var	1022	B.2.17
Position Window Time	6068h	– / 00h	Var	1023	B.2.17
Velocity Demand Value	606Bh	– / 00h	Var	-	C.1.4

Name	CI			FHPP	see
	Object	SI	Class	PNU	
Velocity Actual Value	606Ch	– / 00h	Var	-	C.1.4
Target Torque	6071h	– / 00h	Var	-	C.1.4
Max. Current	6073h	– / 00h	Var	1034	B.2.18
Rated Motor Current	6075h	– / 00h	Var	1035	B.2.18
Rated Motor Torque	6076h	– / 00h	Var	1036	B.2.18
Torque Actual Value	6077h	– / 00h	Var	-	C.1.4
Current Actual Value	6078h	– / 00h	Var	-	C.1.4
Target Position	607Ah	– / 00h	Var	-	C.1.4
Position Range Limit	607Bh	01h, 02h	Array	501	B.2.9
Home Offset	607Ch	– / 00h	Var	1010	B.2.16
Polarity	607Eh	– / 00h	Var	1000	B.2.15
Profile Velocity	6081h	– / 00h	Var	-	C.1.4
Profile Acceleration	6083h	– / 00h	Var	-	C.1.4
Profile Deceleration	6084h	– / 00h	Var	-	C.1.4
Motion Profile Type	6086h	– / 00h	Var	-	C.1.4
Torque Slope	6087h	– / 00h	Var	-	C.1.4
Torque Profile Type	6088h	– / 00h	Var	-	C.1.4
Position Encoder Resolution	608Fh	01h, 02h	Array	1001	B.2.15

Name	CI			FHPP	see
	Object	SI	Class	PNU	
Gear Ratio	6091h	01h, 02h	Array	1002	B.2.15
Feed Constant	6092h	01h, 02h	Array	1003	B.2.15
Position Factor	6093h	01h, 02h	Array	1004	B.2.15
Homing Method	6098h	– / 00h	Var	1011	B.2.16
Homing Speeds	6099h	01h, 02h	Array	1012	B.2.16
Position Control Parameter Set	60FBh	12h...15h, 17h, 20h	Array	1024	B.2.17
Digital Inputs	60FDh	– / 00h	Var	303	B.2.7
Digital Outputs	60FEh	01h, 02h	Array	304	B.2.7
Motor Type	6402h	– / 00h	Var	1030	B.2.18
Motor Data	6410h	01h, 03h	Array	1025	B.2.17
Supported Drive Modes	6502h	– / 00h	Var	-	C.1.4
Drive Catalog Number	6503h	– / 00h	V-string	124	B.2.5
Drive Manufacturer	6504h	– / 00h	V-string	122	B.2.5

Name	CI			FHPP	see
	Object	SI	Class	PNU	
HTTP Drive Catalog Address	6505h	– / 00h	V-string	123	B.2.5
Drive Data (drive data)	6510h	31h (01h), 32h (02h), 40h (03h), 41h (04h), 42h (05h), 43h (06h), A0h (07h), 22h (08h), 45h, A1h	Record	1026	B.2.17

Tab. C/12: Overview of CANopen objects

C.3.4 Representation of additional CI objects

The following list contains the CI objects,

– which cannot be accessed via FHPP or CANopen.

– with which access via the serial CI interface shows special features compared with access via FHPP / CANopen.

Version FCT PlugIn min. (version FCT PlugIn min.)					
CI	**2067h**	**– / 00h**	**Var**	**V-string**	**r**
Description	Minimum version of FCT PlugIn MTR-DCI required for commissioning the MTR-DCI with the firmware version being used. Format = “xx.yy” (xx = main version, yy = secondary version)				

Version FCT PlugIn opt. (version FCT PlugIn opt.)					
CI	**2068h**	**– / 00h**	**Var**	**V-string**	**r**
Description	Version of the FCT PlugIn MTR-DCI which is optimally suited for commissioning the MTR-DCI with the firmware version being used. Format = “xx.yy” (xx = main version, yy = secondary version)				

CI_ReceiveChecksumActive (activate the checksum for CI commands)					
CI	**20F3h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Enable checksum checking of received CI telegrams, see section C.3.2, Tab. C/8. Values: 0 (0x00): disabled (default) 1 (0x01): enabled Example: Delete checksum: "=20F300:0012" (12 = checksum)				

Password					
CI	**20FAh**	**01h, 02h**	**Array**	**V-string**	**rw/ro**
Description	Managing the FCT password, entering the super password				
FCT Password	20FAh	01h		V-string	rw
	Password for the FCT software Value: ‹........› (fixed 8 characters (ASCII, 7-bit) Default: ‹00000000› (status upon delivery and after reset)				
Super password	20FAh	02h		V-string	ro
	Entering the super password Resets all passwords (FCT password and HMI password, object 20FB). Contact Festo Service if you require the super password.				

Local Password					
CI	**20FBh**	**– / 00h**	**Var**	**V-string**	**rw**
Description	Managing the (local) HMI password for enabling particular functions which are carried out via the control panel. Value: ‹........› (fixed 8 characters (ASCII, 7-bit) Only the first 3 characters are evaluated. Default: ‹**000**00000› (status upon delivery and after reset)				

Communication Error (transmission error)					
CI	**2FF0h**	**– / 00h**	**Var**	**uint16**	**ro**
Description	Special object; see section C.3.2. In the case of a transmission error, the value ‹0xFF› will be transferred instead of the usual response.				

CANopen Address					
CI	**2FF3h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Slave address (node ID). Value range: 1 ... 127 (0x01 ... 0x7F) Default: 0 (0x00) - invalid address				

CANopen Bitrate					
CI	**2FF4h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Bit rate. Values: 0 (0x00): 1 MBit/s 1 (0x01): 800 kBit/s 2 (0x02): 500 kBit/s 3 (0x03): 250 kBit/s 4 (0x04): 125 kBit/s 5 (0x05): 100 kBit/s 6 (0x06): 50 kBit/s 7 (0x07): 20 kBit/s 255 (0xFF): invalid bit rate (default)				

CANopen Protocol					
CI	**2FF5h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Protocol (data or device profile). Values: 0 (0x00): CiA 402 1 (0x01): FHPP standard 255 (0xFF): Invalid address (default)				

CAN Voltage Supply					
CI	**2FF6h**	**– / 00h**	**Var**	**uint8**	**rw**
Description	Voltage supply to CAN interface. Specifies whether the interface is supplied internally or externally. External supply permits an electrically isolated bus connection, see section 3.6. Values: 0 (0x00): internal supply (default) 1 (0x01): external supply				

Controlword CiA 402					
CI	**6040h**	**– / 00h**	**Var**	**uint16**	**rw**

Description	To modify the current controller status or trigger an action.
	For description see section C.1.4.
	Specific features when accessing via CI:
	– Reset Fault (Bit 7) as per CiA 402 processing with positive edge, but level evaluated via CI.
	– Start bit (bit 4) in homing and positioning as per CiA 402 edge-triggered, but for CI level evaluated. 0-set interpreted as stop.
	– HMI access locked (bit 14) only accessible via fieldbus.
	– Switching to “Operation enable” may simultaneously include action-triggering bits (start, jog, ...).
	– Shortened status transitions:
	  – Command “Operation disable” or “Switch on” (same coding):
	    Status OPERATION ENABLE -> READY TO SWITCH ON.
	    Status READY TO SWITCH ON -> SWITCHED ON.
	  – “Disable voltage” command (bit 1 = 0, rest irrelevant) – all statuses -> READY TO SWITCH ON.
	  – “Operation enable” command (all statuses) -> OPERATION ENABLE.
	  – “Voltage disable” and “Quick stop” commands -> READY TO SWITCH ON.				

Statusword CiA 402					
CI	**6041h**	**– / 00h**	**Var**	**uint16**	**ro**
Description	To modify the current controller status or trigger an action. For description see section C.1.4. Specific features when accessing via CI: – Bit 4 in CI reversed polarity as with CiA 402. – In the Fault status, when power is applied to the axis, the status is indicated not as xxx8, but xxxA, meaning “Switched on” is set.				

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Appendix D

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