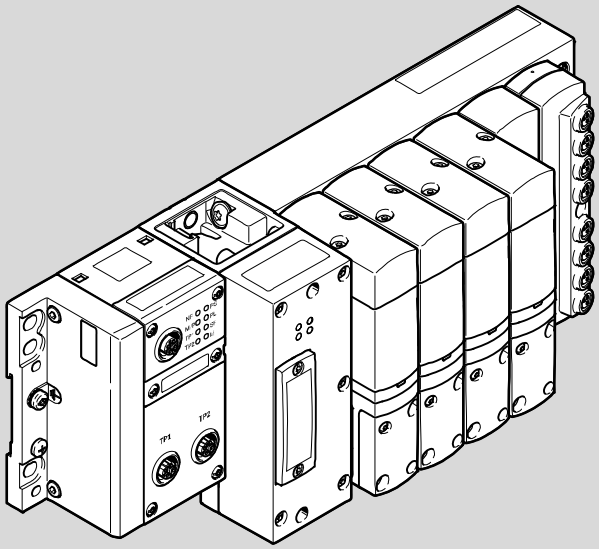
Motion Terminal

VTEM



Description

Function
Parameterisation

8092388
2018-05a
[8090102]

Translation of the original instructions
VTEM-Func+Par-EN

Table of contents

1 About this document

This document describes the function and parameterisation of the product stated in the title. Safe use of the product is described in a separate document (➔ 1.1 Further applicable documents).

1.1 Further applicable documents

Document	Contents
Assembly instructions for Motion Terminal CPX, VTEM (CPX_VTEM-...)	Instructions and important notes on the mounting of the Motion Terminal VTEM with connected CPX terminal
Instructions for use of the Motion Terminal VTEM (VTEM-...)	Instructions on safe use and important notes on handling, installation, commissioning and maintenance of the Motion Terminal VTEM
Description of the Motion Terminal VTEM, Motion app ... (VTEM-MA...-...)	Detailed description of the Motion apps for the Festo Motion Terminal VTEM
CPX system description (P.BE-CPX-SYS-...)	Information on the complete system of the CPX terminal

Tab. 1.1

For all available product documentation ➔ www.festo.com/pk

1.2 Target group

This document is intended for qualified personnel. Experience with electrical and pneumatic control systems is required in order to understand this documentation.

1.3 Product version

This document refers to the following product versions:

Product	Version
VTEM-...	Motion Terminal VTEM, revision 01 or later
CTMM-S1-C	Controller for the Motion Terminal VTEM, revision 01 or later
Firmware	Firmware for the controller CTMM, version 4.0.2 or later
VEVM-S1-27-...	Valve for Motion Terminal VTEM, revision 01 or later
CTMM-S1-D-8E-M8-3	Digital input module for Motion Terminal VTEM, revision 01 or later
CTMM-S1-A-8E-A-M8-4	Analogue input module for Motion Terminal VTEM, revision 01 or later
Browser	Firefox version 38 or later[1)]

1) Use latest version.

Tab. 1.2

The product version can be identified from the product label or with the help of appropriate software from Festo.

Appropriate software for identifying the product version can be found in the Festo Support Portal (➔ www.festo.com/sp).
Information on using the software can be found in the integrated Help function.

Note

There may be an updated version of this document for these or later product versions.

- Check whether a corresponding version of this document is available (➔ www.festo.com/sp).

1.3.1 Product labelling

Product labelling is made up of several individual labels. These are shown below.
The Product Key for the Motion Terminal and the associated Data Matrix Code are shown on the labels on the Motion Terminal (➔ 1 Fig. 1.1) and on the left end plate (➔ 4 Fig. 1.1).
Scanning the Data Matrix Code with an appropriate device opens the Festo Support Portal with information appropriate for the product. Alternatively, the Product Key (11-digit alphanumeric code on the product labelling) can be entered in the search field of the Support Portal.

1 Label on Motion Terminal with Product Key (Motion Terminal)
2 Label on input module
3 Label on valve
4 Product Key (Motion Terminal)
5 Label on controller

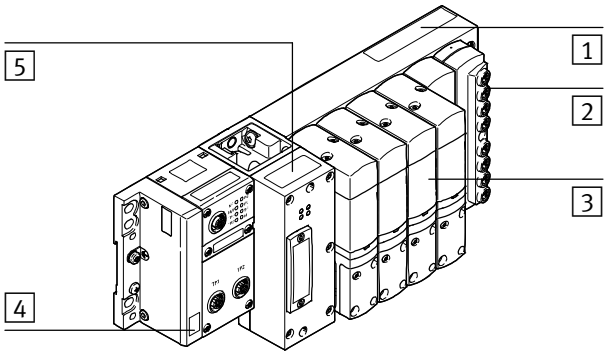


Fig. 1.1

Label on Motion Terminal

1 Revision
2 Serial number
3 Part number
4 Operating pressure range
5 Pilot pressure range
6 Registration number for KC certification
7 Data Matrix Code
8 Product Key

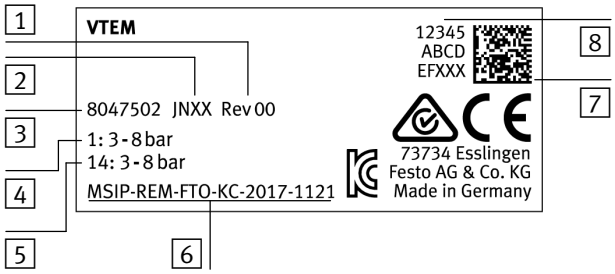


Fig. 1.2

Label on input module

1 Order code
2 Part number
3 Serial number
4 Revision
5 Product Key
6 Data Matrix Code

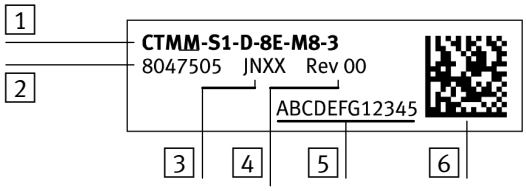


Fig. 1.3

Label on valve

1 Order code
2 Part number
3 Data Matrix Code
4 Product Key
5 Circuit symbol
6 Information on normal position of valve
C: Normally closed
7 Serial number
8 Revision

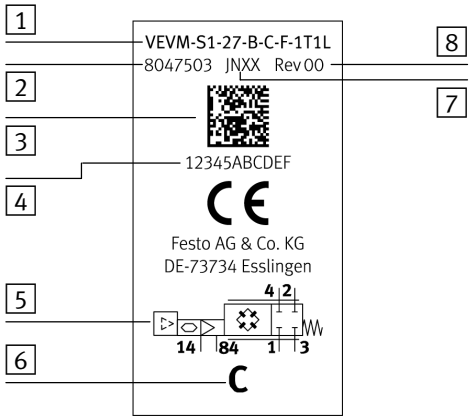


Fig. 1.4

Label on controller

1 Order code
2 Serial number
3 Product Key
4 Data Matrix Code

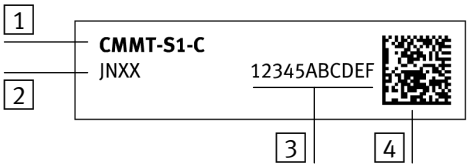


Fig. 1.5

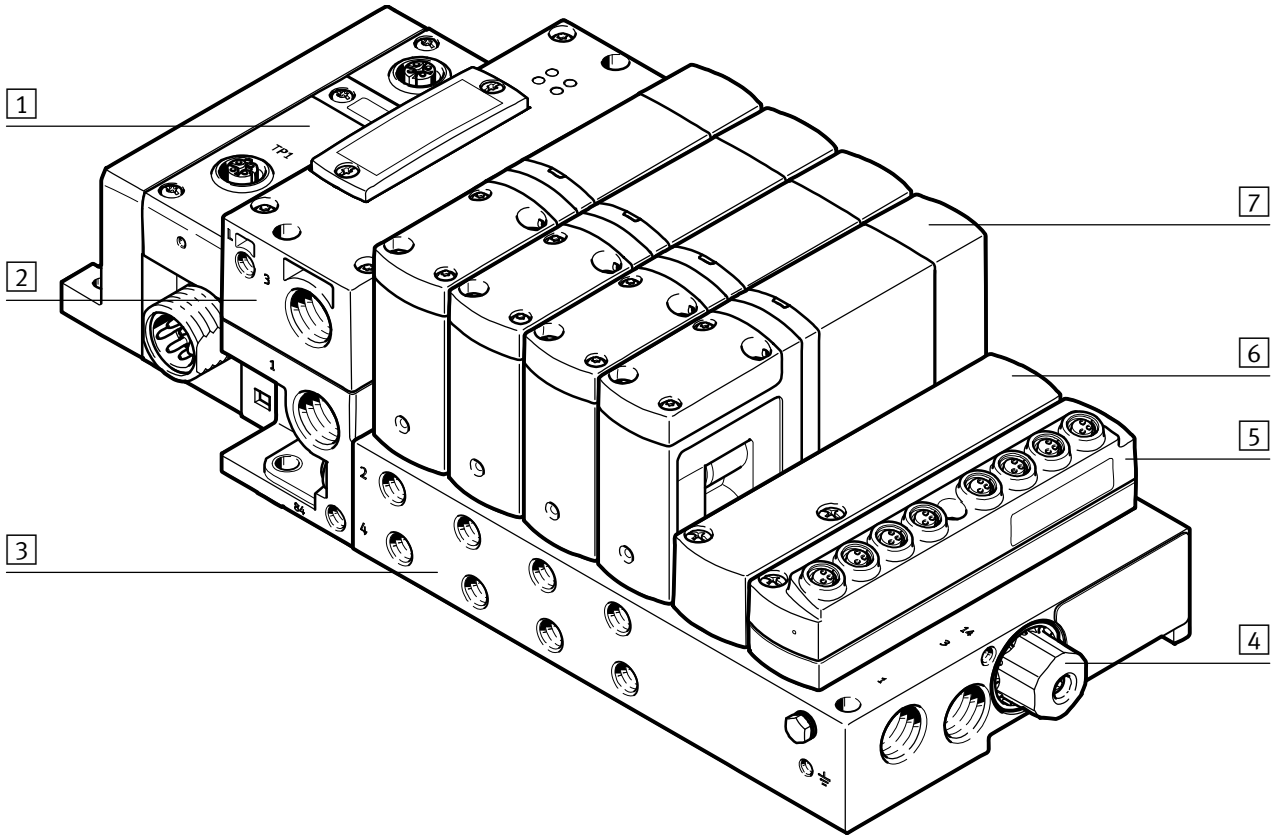
2 Function

2.1 General remarks

The Motion Terminal VTEM provides a range of pneumatic open-loop and closed-loop control functions that are executed in the form of Motion apps (MA). Parameters and setpoint values for executing a Motion app can be specified. The Motion app converts these specifications into control commands at the corresponding valve.

2.1.1 Product design

The product can consist of the following modules, dependent on the configuration ordered:



1 CPX terminal
2 Motion Terminal controller CTMM-S1-C
3 Manifold rail
4 Pilot pressure regulator
5 Input module CTMM-S1-A/D-... (optional)
6 Cover plate VABB-P11-27-T
7 Valve VEVM-S1-27-...

Fig. 2.1

2.1.1.1 CPX terminal

The CPX terminal establishes the connection to a higher-order controller by means of an internal controller (CPX-CEC-...-V3) or a bus node (➔ C.1).

2.1.1.2 Motion Terminal controller CTMM-S1-C

The Motion Terminal controller forms the interface between the CPX terminal and the components of the Motion Terminal.
The controller has an Ethernet interface for accessing the WebConfig user interface for the Motion Terminal.
Compressed air (1) and common exhaust or vacuum (3), and pilot exhaust air (84) and pressure compensation (L) can be connected to the controller housing.
From the perspective of the CPX terminal, the Motion Terminal is a single component and is modelled with a defined amount of input and output data in the process data of the CPX terminal
(➔ 2.4 Communication between PLC and Motion Terminal).

2.1.1.3 Manifold rail

The manifold rail provides the working ports (2) and (4) for each of the valves, as well as the ports for compressed air supply (1) and common exhaust (3). In addition, the manifold rail can be connected to an external pilot air supply (14). The changeover between internal and external pilot air is effected using a blanking plug or selector in the manifold rail (➔ Instructions for use of the Motion Terminal VTEM).

2.1.1.4 Pilot pressure regulator

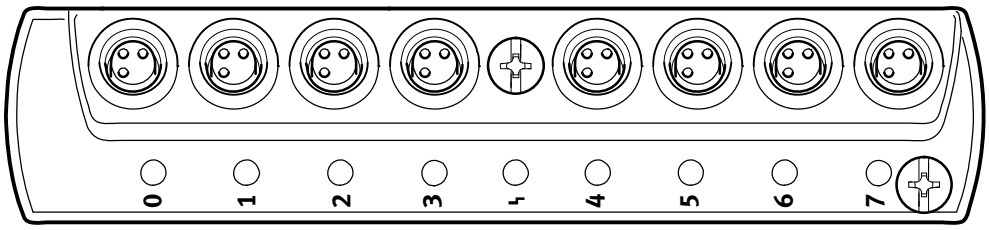
The pressure regulator ensures a constant pilot pressure for the valves.

The pressure regulator is set and sealed at the factory. The setting must not be changed; doing so will invalidate the warranty.

2.1.1.5 Input module CTMM-S1-A/D-... (optional)

Individual Motion apps include the evaluation of digital or analogue sensor signals. The sensors necessary for this are connected to the CTMM input modules. Here, the inputs of the input modules are permanently assigned to the slots for the valves. The slots are numbered sequentially from left to right, starting at the right of the controller with slot 0.

– The even-numbered inputs are used to detect the ‘retracted’ end position ((2) pressurised, (4) exhausted, switching position 12).
– The odd-numbered inputs are used to detect the ‘advanced’ end position ((4) pressurised, (2) exhausted, switching position 14).



Inputs	0	1	2	3	4	5	6	7
Valve on slot	0		1		2		3	
End position with switching position	12	14	12	14	12	14	12	14

Tab. 2.1

For Motion Terminals with more than 4 valves, Motion apps that require input signals to function are only run on valves on the first 4 slots from the left.

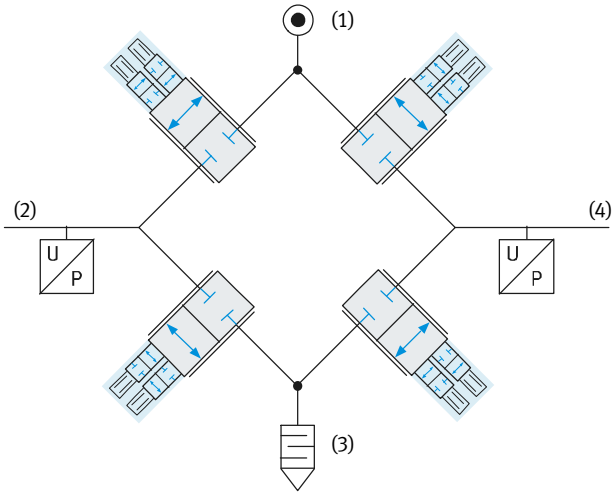
The inputs are evaluated only by the controller of the Motion Terminal. The states of the inputs cannot be queried directly by the higher-order controller. However, various Motion apps provide information about the states or values of the sensors.

2.1.1.6 Cover plate VABB-P11-27-T

Vacant valve or module positions must be sealed with a cover plate.

2.1.1.7 Valves

The valves together with the controller form the central component of the Motion Terminal. A valve VEVM-S1-27-... in each case contains 4x 2/2-way dynamic control valves with piezo pilot valves interconnected to form a full bridge. Each valve is additionally equipped with sensors so as to be able to detect the actual state of the valve and regulate it.



One of the licensed Motion apps can be run on each valve, independently of the other valves.

Numbering of the valves

The slots for the valves are numbered sequentially in ascending order from left to right, starting at the right of the controller with slot 0. The number (address) of a valve is given by the slot on which it is mounted.

2.1.2 Display components

For behaviour of display components and diagnostics options see ➔ 2.7.1 LED display components

2.1.2.1 Controller

1 CPX-specific LEDs
2 Ethernet-specific LED

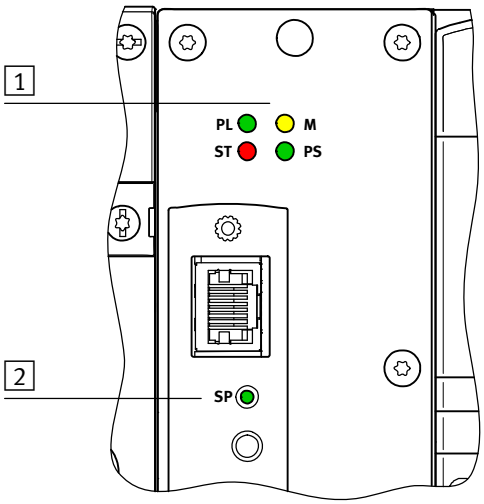


Fig. 2.2

CPX-specific LEDs

LED	Significance	
PL (green)	Power load	Monitoring the load voltage supply U_{VAL}
M (yellow)	Modify	Parameterisation mode (via CPX bus node or WebConfig interface)
SF (red)	System Failure	Communication error

LED	Significance	
PS (green)	Power system	Monitoring the operating voltage supply $U_{EL/SEN}$

Tab. 2.2

Ethernet-specific LED

LED	Significance	
TP (green)	Ethernet Link/Traffic	Ethernet connection/data traffic

Tab. 2.3

2.1.2.2 Valve

[1] LED indicator on valve (red/blue)

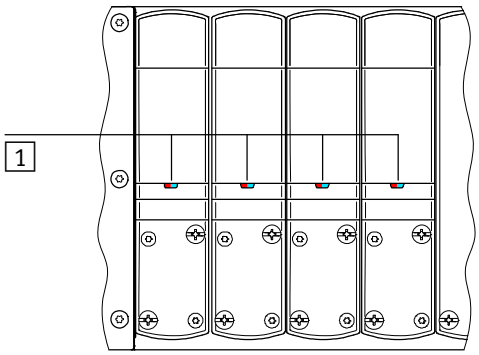


Fig. 2.3

LED	Significance
(red)	Valve error
(blue)	Operation/update

Tab. 2.4

2.1.2.3 Input modules

[1] LED indicator for input status (green, only digital input modules CTMM-S1-D-...)
[2] LED indicator for module error (red)

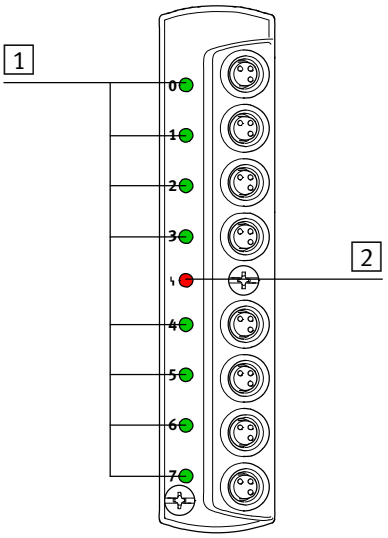


Fig. 2.4

LED	Significance
(green)	Input status (digital input modules CTMM-S1-D-... only)
↳ (red)	Short circuit/overload

2) Logic: LED illuminated when the connected PNP N/O contact is closed.

Tab. 2.5

2.1.3 Control components

The product has no mechanical control components. Parameters and setpoint values are set solely via the WebConfig user interface or using the higher-order controller (PLC).
The WebConfig interface can be opened with a web browser if there is an existing Ethernet connection to the controller of the Motion Terminal (➔ 2.2 WebConfig user interface).

2.1.4 Connection components

2.1.4.1 Electrical

[1] Functional earth connection
(must be connected in addition to the functional earth on the CPX side)

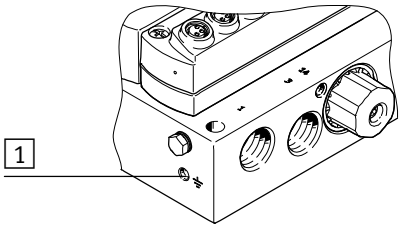


Fig. 2.5

[1] Ethernet interface

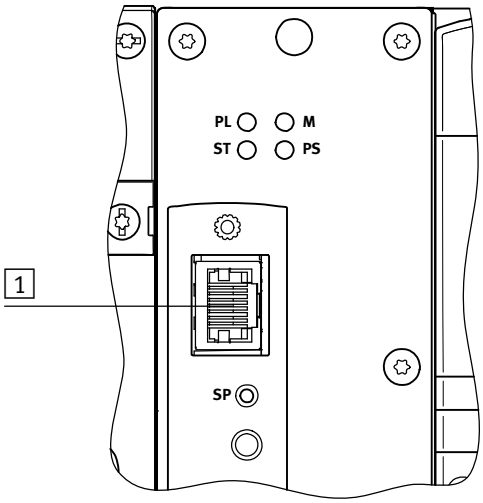


Fig. 2.6

Ethernet interface
The Ethernet interface is located on the controller behind a transparent cover.
The Ethernet interface is used exclusively for accessing the WebConfig user interface for the controller.

Note
Unauthorised access to the device can cause damage or malfunctions.
When connecting the device to a network:
- Protect the network against unauthorised access.

Measures to protect the network include:
– Firewall
– Intrusion prevention system (IPS)
– Network segmentation
– Virtual LAN (VLAN)
– Virtual private network (VPN)
– Security at physical access level (port security)

For additional information ➔ Guidelines and standards for security in information technology, e.g. IEC 62443, ISO/IEC 27001.

Input modules

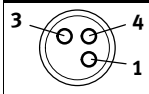
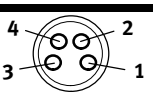
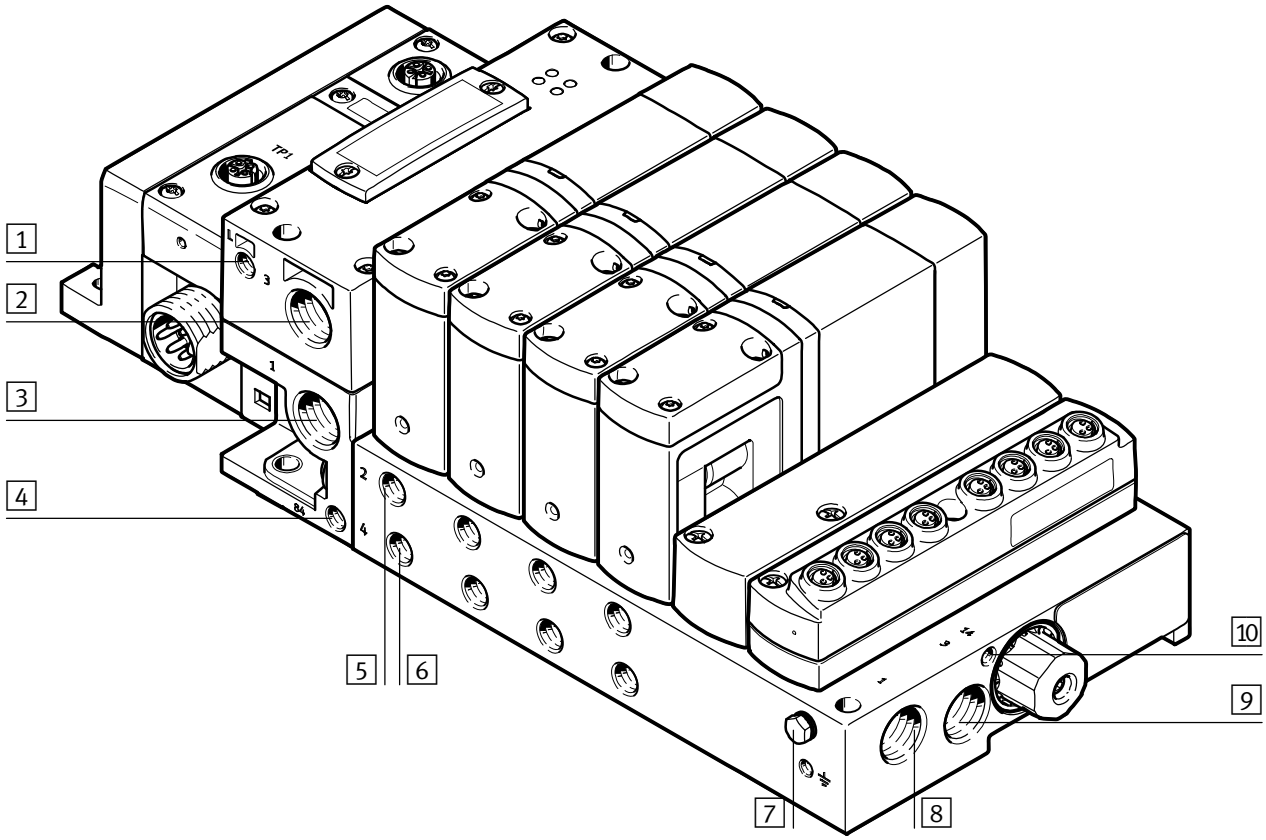
CTMM-...-D-...			CTMM-...-A-...		
	1	+24 V $U_{EL/SEN}$		1	+24 V $U_{EL/SEN}$
	3	0 V $U_{EL/SEN}$		2	Input
	4	Input		3	0 V $U_{EL/SEN}$
				4	n.c.

Fig. 2.7

2.1.4.2 Pneumatic

Ports for compressed air supply (1) and common exhaust (3) are available both on the controller and on the right-hand end of the manifold rail. The ports are internally connected in each case and can be used as alternatives or in parallel.

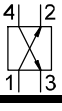


1 M7 connection for pressure compensation (L)
2 G3/8 connection for common exhaust (3)
3 G3/8 connection for compressed air supply (1)
4 M7 connection for pilot exhaust air (84)
5 G1/8 connection for working air (2)
6 G1/8 connection for working air (4)
7 M5 selector/blanking plug (changeover of internal/external pilot air)
8 G3/8 connection for compressed air supply (1)
9 G3/8 connection for common exhaust (3)
10 M5 connection for external pilot air (14)

Fig. 2.8

2.1.5 Definition of direction of movement/position of the drive

In this document and on the WebConfig interface, the direction of movement and the position of drives that are controlled by the Motion Terminal are generally described using the terms ‘advancing’ or ‘advanced’ and ‘retracting’ or ‘retracted’, respectively, which relate to piston rod cylinders with a piston rod at one end.
The significance of the terms can be transferred to other drives by means of the pneumatic function.

Term	Port (4)	Port (2)	Switching position of the valve	
Advancing/advanced	Pressurised	Exhausted	14	
Retracting/retracted	Exhausted	Pressurised	12	

Tab. 2.6

2.2 WebConfig user interface

The Motion Terminal has a WebConfig interface for commissioning and functional testing. This can be opened using a browser on a device connected to the Motion Terminal controller.

Factory settings of the controller:
IP address: 192.168.4.2, subnet address: 255.255.0.0
Password: vtem
The password can be changed via the WebConfig interface.

The device on which the WebConfig interface is to be opened must be connected directly to the Motion Terminal controller.
It is not possible to access the WebConfig interface for the controller using the Ethernet connection of a bus node in the CPX terminal.

Operation of the WebConfig interface is described in the “Motion Terminal VTEM, WebConfig interface” QuickGuide (➔ www.festo.com/sp).

2.2.1 Manual override

To enable testing of the functionality and pneumatic connection of a connected drive, the WebConfig interface has a ‘manual override’ that makes it possible to use the basic logic function of the valves without using a Motion app. The manual override is also used to test the tubing connection and direction of movement of the drive (➔ 2.1.5 Definition of direction of movement/position of the drive).

2.3 Motion apps

The functions of the Motion Terminal are defined by what are known as Motion apps. A Motion app generally executes a pneumatic task such as pressure regulation, flow control or the controlled acceleration and braking of a movement.
Motion App #01 “Directional control valve functions”, which is part of the basic equipment of the Motion Terminal, is described in this document (➔ 2.5 Motion App #01: Directional control valve functions).

Additional Motion apps are each described in separate documentation (➔ www.festo.com/sp).

2.3.1 Motion app ID

Each Motion app has a unique ID. This ID is required both to select and to parameterise the Motion app.
The respective ID is given in the Motion app documentation.

2.3.2 Licences

To be able to use a Motion app, a corresponding licence must be stored on the Motion Terminal controller. For many Motion apps, the number of licences required for each app is based on the desired number of valves on which the Motion app should run simultaneously.
Motion App #01 “Directional control valve functions” is licensed as standard for all valves on the Motion Terminal. It is therefore possible, for example, to run a different directional control valve function on each of the maximum 8 valves of a Motion Terminal.
Additional Motion apps can either be run simultaneously on all valves of the Motion Terminal with just one licence, or can be run on the same number of valves as there are licences for the Motion app stored on the Motion Terminal controller.
If, for example, Motion App #03 “Proportional pressure regulation” is to be run on 3 valves at the same time, there must be 3 licences stored for this app.

The number of licences stored on the Motion Terminal and the number that are free (not in use by an active Motion app) can be viewed on the WebConfig interface.

The licences are not assigned to a particular valve position. Each licensed Motion app can be run on any valve. The restrictions relating to the number of licences only apply in respect of running a Motion app simultaneously on multiple valves.

Information on adding to your available licences can be found in the Festo catalogue (➔ www.festo.com/catalogue).

2.3.3 System and application parameters

The basic conditions for operating a Motion app are set using system and app-specific parameters. There is a distinction here between 2 types of parameters:

– System parameters describe the components that are connected to the Motion Terminal (tubes, drive, mounting position, etc.). System parameters apply to a valve position and hence jointly to all Motion apps running on this valve position.
– Application parameters describe the application of the Motion app (moving mass, travel time, minimum force, etc.). Application parameters can be stored separately on each valve for each Motion app.

The following sections relate to transferring the system and application parameters using the higher-order controller (PLC). Since communication only allows for integer values, the unit-based values are increased by a factor to give integer values.

Example:

The tube internal diameter can be defined in 0.01 mm steps in the range from 0 ... 100 mm. To do this, a value in the range 0 ... 10000 is transferred. One increment (digit) therefore corresponds to 0.01 mm.

2.3.3.1 System parameters

System parameters describe the peripherals attached to a valve, using attributes such as tube length, cylinder type and mounting position. The system parameters of a parameter set apply jointly to all Motion apps running on a valve, but are not used by all Motion apps.

The parameters required to run a Motion app must be transferred before starting the Motion app.

Overview of system parameters

All the system parameters listed here will be explained below.

ID	System parameters	Range of values
12	Tube length at (2)	0 ... 20000 mm
13	Tube length at (4)	0 ... 20000 mm
14	Tube I.D. at (2)	0 ...100 mm
15	Tube I.D. at (4)	0 ...100 mm
20	Drive type	–32768 ... +32767
21	Drive stroke	0 ... 5000 mm
40	Volume at (2)	0 ... 32 l
41	Volume at (4)	0 ... 32 l
60	Mounting position of drive	–180 ... +180°

Tab. 2.7

Tube length at (2)

ID	Range of values	Digit value	Digit range
12	0 ... 20000 mm	1 mm	0 ... 20000 × 1 mm

Tab. 2.8

Tube length at (4)

ID	Range of values	Digit value	Digit range
13	0 ... 20000 mm	1 mm	0 ... 20000 × 1 mm

Tab. 2.9

Tube I.D. at (2)

ID	Range of values	Digit value	Digit range
14	0 ... 100 mm	0.01 mm	0 ... 10000 × 0.01 mm

Tab. 2.10

Tube I.D. at (4)

ID	Range of values	Digit value	Digit range
15	0 ... 100 mm	0.01 mm	0 ... 10000 × 0.01 mm

Tab. 2.11

Internal diameter [mm] for Festo tubing				
Outside Ø [mm]	**4**	**6**	**8**	**10**
PUN	2.6	4.0	5.7	7.0
PUN-CM	2.5	4.0	5.5	7.0
PUN-H	2.6	4.0	5.7	7.0
PUN-V0	–	4.0	5.7	7.0
PUN-V0-C	2.0	2.0	4.0	6.0
PLN	2.9	4.0	5.9	7.0

Internal diameter [mm] for Festo tubing				
Outside Ø [mm]	**4**	**6**	**8**	**10**
PEN	2.7	4.0	5.7	7.0
PAN	2.9	4.0	5.9	7.0
PAN-MF	2.5	4.0	6.0	7.5
PAN-R	2.5	3.8	5.0	6.2
PFAN	2.9	4.0	5.9	7.0

Tab. 2.12

Drive type

The Festo drives supported by the Motion Terminal are shown in a list. The list contains a value for the “drive type” parameter for each drive. The default value must be replaced with the value for one of the listed drive types before using a corresponding Motion app.

ID	Range of values
20	➔ C Supported peripherals

Tab. 2.13

Drive stroke

The drive stroke describes the maximum stroke of the drive without taking into consideration mechanical stops within the total stroke.

ID	Range of values	Digit value	Digit range
21[1)]	0 … 5000 mm	1 mm	0 … 5000 × 1 mm
	0 … 270°	1°	0 … 270°

1) When selecting a semi-rotary drive as drive type, the “drive stroke” parameter does not need to be defined. The value for the swivel angle is determined from the order code for the semi-rotary drive and is automatically transferred to the “degrees” unit in the “drive stroke” parameter.

Tab. 2.14

Volume at (2)

ID	Range of values	Digit value	Digit range
40	0 … 32 l	0.001 l	0 … 32000 × 0.001 l

Tab. 2.15

Volume at (4)

ID	Range of values	Digit value	Digit range
41	0 … 32 l	0.001 l	0 … 32000 × 0.001 l

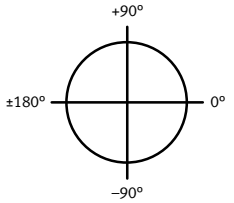
Tab. 2.16

Mounting position of drive

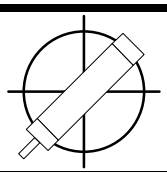
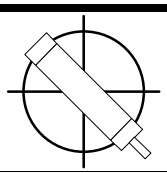
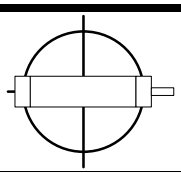
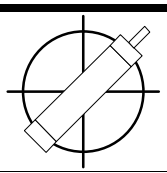
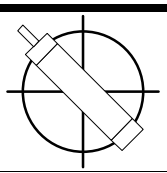
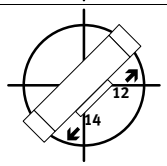
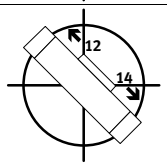
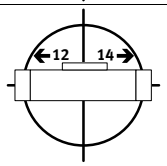
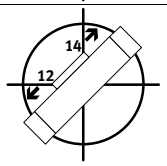
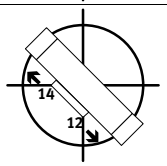
ID	Range of values	Digit value	Digit range
60	–180 … +180°	0.01°	–18000 … 18000 × 0.01°

Tab. 2.17

A positive value means that the mass is moved when advancing upward (away from the ground) (port (4) pressurised, port (2) exhausted, switching position 14).



The value given for the mounting position relates to the position of the plane on which the mass is moved, and therefore changes as a function of the drive selected (➔ System parameter 20 “drive type”).

Drive system	-135°	-45°	0°	45°	135°
Cylinder with piston rod					
Linear drive (12 = ‘retracting’) (14 = ‘advancing’)					
Semi-rotary drive	Semi-rotary drives may only be used in the following mounting situations where the gravitational force resulting from the mounting position does not affect the movement behaviour of the semi-rotary drive. – Centre of gravity in the axis of rotation: Any installation position is permitted. – Centre of gravity outside the axis of rotation (not recommended): Only vertical mounting position permitted; axis points vertically upward or downward. In these cases, there is no need to parameterise the “mounting position of drive” parameter. Use outside of the above-described mounting situations can lead to unpredictable movement behaviour of the semi-rotary drive and is therefore not permitted.				

Tab. 2.18

2.3.3.2 Application parameters

Application parameters describe the basic conditions under which a Motion app is to be executed, using attributes such as mass during retracting and advancing, travel time, and acceleration. Here, the application parameters of a parameter set (➔ 2.3.3.4 Parameter sets) can be individually adapted for each Motion app. This means that the “mass during retracting” can be defined differently for different Motion apps on the same valve.
Not all Motion apps use application parameters.

The parameters required to run a Motion app must be transferred before starting the Motion app.

Overview of application parameters

ID	Application parameters
100	Retracting load[1)]
101	Advancing load[2)]
120	Travel time, retracting[1)]
121	Travel time, advancing[2)]
182	Max. pressure rise at (2)
183	Max. pressure rise at (4)
200	Max. leakage for status “good”
201	Max. leakage for status “warning”
202	Max. leakage for status “critical”
220	Characteristic (2)
221	Characteristic (4)
222	Pressure build-up function

1) (2) pressurised, (4) exhausted; switching position 12
2) (4) pressurised, (2) exhausted; switching position 14

ID	Application parameters
255	Motion app to be taught in

1) (2) pressurised, (4) exhausted; switching position 12
2) (4) pressurised, (2) exhausted; switching position 14

Tab. 2.19

Retracting load ((2) pressurised)

ID	Range of values	Digit value	Digit range
100	0 ... 100 kg	0.01 kg	0 ... 10000 × 0.01 kg

Tab. 2.20

Advancing load ((4) pressurised)

ID	Range of values	Digit value	Digit range
101	0 ... 100 kg	0.01 kg	0 ... 10000 × 0.01 kg

Tab. 2.21

Travel time, retracting ((2) pressurised)

ID	Range of values	Digit value	Digit range
120	0 ... 300 s	0.01 s	0 ... 30000 × 0.01 s

Tab. 2.22

Travel time, advancing ((4) pressurised)

ID	Range of values	Digit value	Digit range
121	0 ... 300 s	0.01 s	0 ... 30000 × 0.01 s

Tab. 2.23

Max. pressure rise at (2)

ID	Range of values	Digit value	Digit range
182	0.1 ... 200 bar/s	0.01 bar/s	10 ... 20000 × 0.01 bar/s

Tab. 2.24

Max. pressure rise at (4)

ID	Range of values	Digit value	Digit range
183	0.1 ... 200 bar/s	0.01 bar/s	10 ... 20000 × 0.01 bar/s

Tab. 2.25

Max. leakage for status “good”

ID	Range of values	Digit value	Digit range
200	2 ... 600 l/h	0.1 l/h	20 ... 6000 × 0.1 l/h

Tab. 2.26

Max. leakage for status “warning”

The actual range of values for this parameter depends on the “adjacent” parameters (200 and 202) and must be between the values for these parameters.

ID	Range of values	Digit value	Digit range
201	2 … 600 l/h	0.1 l/h	20 … 6000 × 0.1 l/h

Tab. 2.27

Max. leakage for status “critical”

ID	Range of values	Digit value	Digit range
202	2 … 600 l/h	0.1 l/h	20 … 6000 × 0.1 l/h

Tab. 2.28

Characteristic (2)

ID	Range of values	Digit value	Digit range
220	0 … 3[1)]	1	0 … 3[1)]

1) Significance is specific to the Motion app

Tab. 2.29

Characteristic (4)

ID	Range of values	Digit value	Digit range
221	0 … 3[1)]	1	0 … 3[1)]

1) Significance is specific to the Motion app

Tab. 2.30

Pressure build-up function

When moving a pneumatic drive towards a chamber which is only supplied with low pressure (e.g. ambient pressure), the movement of the drive may be unexpectedly fast.

The pressure build-up function prevents this behaviour by checking the pressure in the corresponding chamber. If the pressure is too low, the chamber is actively pressurised before executing a travel command. The execution of the travel command can therefore be delayed as a function of the connected peripherals and the prevailing pressure conditions.

Owing to the pressure build-up in the chamber that is to be exhausted according to the travel command, there may be a brief movement of the drive in the direction opposite to the travel command.
For applications in which this behaviour is undesirable, the pressure build-up function can be deactivated.

ID	Status of function	Value of parameter
221	Active	1
	Inactive	0

Tab. 2.31

Motion app to be taught in

The ID of the Motion app for which the teach-in data and reference value are to be determined during execution of the teach-in run must be entered as a value in this parameter.

ID	Range of values	Digit value	Digit range
255	1 … 59	1	1 … 59

Tab. 2.32

2.3.3.3 Teach-in data

Some Motion apps require a teach-in process to determine the characteristics of the connected peripherals and to achieve the desired result during movement (➔ 2.6 Teach-in run). The data from this teach-in process are stored in the parameter set in a manner specific to the Motion app (➔ 2.3.3.4 Parameter sets).
These data are continuously updated when the corresponding Motion app is in operation.

The teach-in data are stored in the parameter set that is currently active.

2.3.3.4 Parameter sets

The Motion Terminal can manage 5 different parameter sets for each valve, each set comprising system parameters, application parameters and teach-in data (➔ 2.6 Teach-in run). When changing over the connected peripherals, it is easy to modify the parameterisation of the valve by activating a different parameter set.

Parameter set 1 is automatically selected when the Motion Terminal is started. Changing the parameter set is described in section ➔ 3.4 Changing parameter set.

Structure of a parameter set

The following example is intended to illustrate the structure of a parameter set.

Valve on slot 1					Valve on slot 2	
Parameter set 1	Parameter set 2	Parameter set 3	Parameter set 4	Parameter set 5	Parameter set 1	...

Parameter set 3	Motion App #01	Motion App #02	Motion App #03	Motion App #04	Motion App #...
System parameters	Sys. par. a				
	Sys. par. b				
	Sys. par. c				
	Sys. par. ...				
Application parameters	App. par. x	App. par. x	App. par. x	App. par. x	App. par. x
	App. par. y	App. par. y	App. par. y	App. par. y	App. par. y
	App. par. z	App. par. z	App. par. z	App. par. z	App. par. z
	App. par. ...	App. par. ...	App. par. ...	App. par. ...	App. par. ...
Teach-in data	Data record 1	Data record 2	Data record 3	Data record 4	Data record 5

Tab. 2.33

2.3.4 Setpoint and actual values

Setpoint and actual values can be written and read cyclically by the process data.

Writing setpoint values:	Output data (PDO, process data output)
Reading actual values:	Input data (PDI, process data input)

The setpoint and actual values are specific to the individual Motion apps. The structure of the process data is described in section ➔ 2.4 Communication between PLC and Motion Terminal.

2.3.5 Waiting time between Motion apps

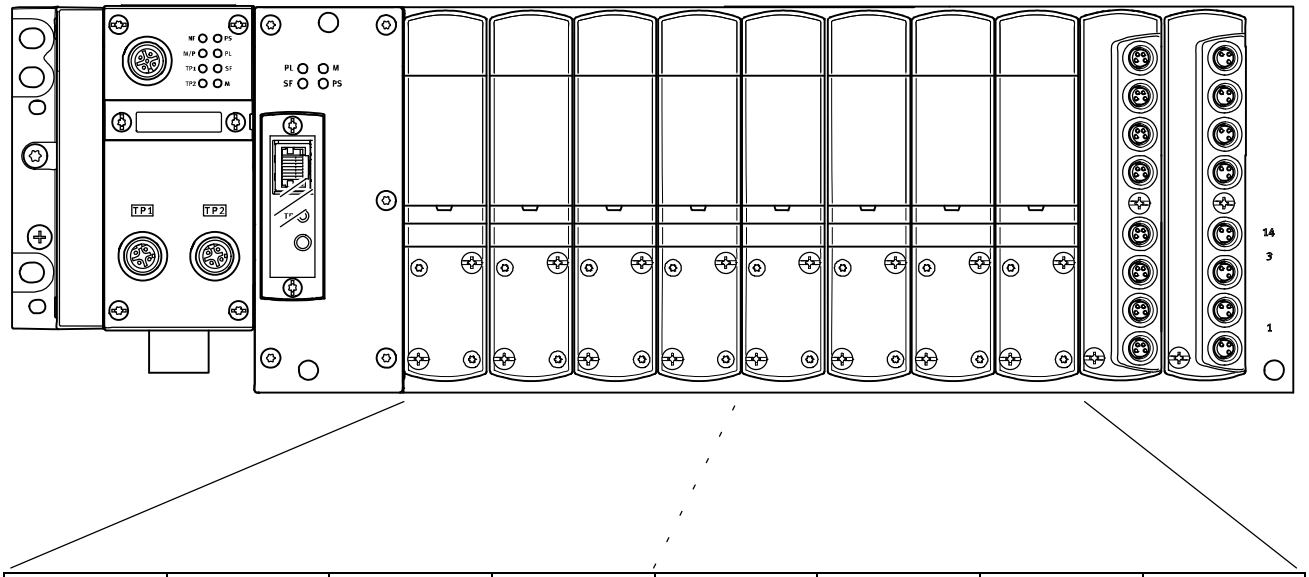
In the following cases, calibration of the associated valve takes place before the Motion app that has been started is executed:

– Following a restart of the Motion Terminal, a Motion app is started for the first time.
– After execution of Motion App #01, a different Motion app is started for the first time.

This calibration can take up to 20 seconds and will be performed automatically prior to execution of the Motion app.

2.4 Communication between PLC and Motion Terminal

The communication between the higher-order controller (PLC) and the Motion Terminal controller is based on input and output data of in each case 8 × 6 bytes from the CPX terminal. Each of the maximum 8 valves on a Motion Terminal is assigned 6 bytes of input data (PDI) and 6 bytes of output data (PDO), regardless of the actual number of valves present.



Valve on slot 0	Valve on slot 1	Valve on slot 2	Valve on slot 3	Valve on slot 4	Valve on slot 5	Valve on slot 6	Valve on slot 7
6 bytes PDI	6 bytes PDI	6 bytes PDI	6 bytes PDI	6 bytes PDI	6 bytes PDI	6 bytes PDI	6 bytes PDI
6 bytes PDO	6 bytes PDO	6 bytes PDO	6 bytes PDO	6 bytes PDO	6 bytes PDO	6 bytes PDO	6 bytes PDO

Depending on the current operating mode of a valve (➔ 2.4.2.1 Structure of the output data (PDO)), the following functions and content can be transferred using the process data:
- Starting/running/ending a Motion app (➔ 2.4.2 Structure of the process data when running a Motion app)
- Parameterisation of the Motion app using the PLC (parameter download ➔ 3.1 Setting system and application parameters)
- Reading the configured Motion app (parameter upload) (➔3.2 Reading out system and application parameters)
- Diagnostic information and acknowledging errors (➔ 2.7.3.6 Acknowledging errors)

2.4.1 Numerical representation

Setpoint values and actual values, as well as system and application parameters, are represented within the process data as a two's complement value in the format “16 bit signed integer”.

2.4.2 Structure of the process data when running a Motion app

The use of process data when running a Motion app is described in section ➔ 2.4.3.

2.4.2.1 Structure of the output data (PDO)

When a Motion app is running, the 6 bytes of output data (PDO) for each valve slot are divided into 3 sections:

– Command
– Setpoint value 1
– Setpoint value 2

Valve on slot 0						Valve on slot 1			Valve on slot 7		
Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Setpoint value 2		Setpoint value 1		Command		Setpoint value 2		Set-point	Value 1	Command	

“Command” section

PDO byte 1								PDO byte 0							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
app option								app control		valve mode					

Valve mode

The valve mode is specified by bits 5 ... 0 in byte 0 (PDO).

PDO byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

This section is allocated the same function in every operating mode and is of central importance for the control of the Motion Terminal. Allocation of the other sections depends on the current operating mode of the valve.

Value dec.	Valve mode	Description
0	Reserved	Invalid value
1 ... 59	Run Motion app (value corresponds to Motion app ID)	Selection of the Motion app to be run, by means of its ID. The setpoint values required to run the Motion app are transferred using bytes 5 ... 2 (PDO).
60	Teach-in run	Teaching in of the relevant characteristics of the connected system for execution of particular Motion apps.
61	End Motion app	Ending the Motion app currently running on the valve.
62	Acknowledge error	Error must be acknowledged to change the valve status from “not ready” to “configurable”.
63	Transfer mode	Transfer of parameters, diagnostic information and settings for the valves (➔ 2.4.4 Transfer mode).

Tab. 2.34

Control of the Motion app (app control)

The information for controlling the Motion app is specified using bits 7 ... 6 in byte 0 (PDO).

PDO byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

The exact function is specific to the Motion app and can be found in the description of the Motion app.

Setting the Motion app (app option)
The setting for a Motion app is specified using byte 1 (PDO).

PDO byte 1

The exact function is specific to the Motion app and can be found in the description of the Motion app.

“Setpoint value 1” and “setpoint value 2” sections
Setpoint values for executing a Motion app are specified using bytes 5 ... 4 (PDO) (setpoint 2) and 3 ... 2 (PDO) (setpoint 1).

PDO byte 5	PDO byte 4	PDO byte 3	PDO byte 2
Setpoint value 2		Setpoint value 1	

The exact function is specific to the Motion app and can be found in the description of the Motion app.

2.4.2.2 Structure of the input data (PDI)

Valve on slot 0						Valve on slot 1			Valve on slot 7		
Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Actual value 2		Actual value 1		Status		Actual value 2		Actual	Value 1	Status	

“State” section

PDI byte 1								PDI byte 0							
Status															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
app state								valve state		valve mode					

Valve mode
The valve mode that is currently active is fed back using bits 5 ... 0 in byte 0 (PDI).

PDI byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Value dec.	Valve mode	Description
1 ... 59	Motion app being run	Display of currently running Motion app using the ID.
60	Teach-in run	
61	Valve inactive (in normal position)	No Motion app is currently being executed, or the most recently executed Motion app has been stopped.
62	Reserved	Not used. Feedback for command “62” (end Motion app) is “61” (valve inactive).
63	Transfer mode active	Parameters can be transferred (➔ 2.4.4 Transfer mode)

Tab. 2.35

Example
To start Motion App #05, the value “5” is transferred in the PDO section “valve mode”.
The Motion app is only actually started when the value “5” is present in the PDI section “valve mode” (and “2” is present in the “valve state” section).

Valve state
The current state of the valve is given by bits 7 ... 6 in byte 0 (PDI).

PDI byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Valve state	Significance	Bit 7	Bit 6	Dec.
Not ready	Start process for Motion Terminal is not completed or an error that has been detected and eliminated is yet to be acknowledged.	0	0	0
Configurable	A Motion app can be run or a switch to transfer mode can be made.	0	1	1
Running	A Motion app is currently being executed.	1	0	2
Failure	An error has been detected but not yet eliminated. The Motion app has been stopped.	1	1	3

Tab. 2.36

App state
The current state of the app is given by a range of information using bits 7 ... 0 in byte 1 (PDI).

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

The information described here is valid when running all Motion apps.
Additional information specific to the Motion app, which is transferred in the app state, is given in the description for the Motion app in question.

Indicating warnings
The presence of warnings in the diagnostic memory of the Motion Terminal is indicated using bit 7 in byte 1 (PDI).

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Value	Description
0	No warning present.
1	The active Motion app is reporting a warning that is present in the diagnostic memory of the Motion Terminal.

Tab. 2.37

For how to deal with warnings and errors ➔ 2.7 Diagnostics options.

2.4.3 Running a Motion app

Depending on the Motion app to be run, the system and application parameters must be defined before operation (➔ 2.3.3 System and application parameters). The system and/or application parameters used by a Motion app are documented in the description for the Motion app in question.

2.4.3.1 Prerequisites

- The Motion Terminal boot procedure is completed.
- System and application parameters required by the Motion app have been transferred (➔ 3.1 Setting system and application parameters).
- If necessary, a teach-in run for the Motion app has been carried out (➔ 2.6 Teach-in run).

– The state of the valve on which the Motion app is to be run is “configurable” (➔ 2.4.2.2 Structure of the input data (PDI)).
– There is no active error on the valve on which the Motion app is to be run (➔ 2.7.3.5 Readout of the diagnostic memory, ➔ 2.7.3.6 Acknowledging errors).

2.4.3.2 Starting a Motion app

To start a Motion app, setpoint values 1 and 2 and the command (comprising “valve mode”, “app control” and “app option”) must be transferred in the 6 byte PDO for the corresponding valve.

Example

Motion App #02 “Proportional directional control valve” (PDO byte 0 bits 5 ... 0 => 2_{10}) is to be started with the following specifications:

– Switching status of the working ports (app control):
  (2) active, (4) active (PDO byte 0 bit 7 => 1, PDO byte 0 bit 6 => 1)
– Valve type (app option): 2 x 3/3 (PDO byte 1 => 15_{10})
– Valve position (setpoint value 1): +50 % (PDO byte 2+3 => 5000_{10})

PDO byte	5	4	3	2	1								0							
Area	setpoint value 2		setpoint value 1		command															
Bits	15 ... 0		15 ... 0		7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Function	setpoint value 2		setpoint value 1		app option								app control		valve mode					
Value	4000		5000		0	0	0	0	1	1	1	0	1	1	0	0	0	0	1	0

The input data are used to feed back the current state of the valve and of the Motion app:

– Valve mode: Motion App #02 (PDI byte 0 bits 5 ... 0 => 000010_2)
– Valve state: running (PDI byte 0 bits 7 ... 6 => 10_2)
– App state:
  – Status information of Motion app: not used (PDI byte 1 bits 6 ... 0 => 000000)
  – End-position sensing:
    Sensor for end position ‘advanced’ gives “1” (PDI byte 1 bit 2 => 1)
    Sensor for end position ‘retracted’ gives “0” (PDI byte 1 bit 0 => 0)
  – Warning: no warning present (PDI byte 1 bit 7 => 0)
– Actual value 1: valve position: e.g. +50.02 % (PDI byte 3 ... 2 => 5002_{10})
– Actual value 2: valve position: e.g. +39.99% (PDI byte 5 ... 4 => 3999_{10})

PDI byte	5	4	3	2	1								0							
Area	actual value 2		actual value 1		status															
Bits	15 ... 0		15 ... 0		7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Function	actual value 2		actual value 1		app state								valve state		valve mode					
Value	3999		5002		0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0

2.4.3.3 Controlling a Motion app

During operation, the behaviour of a Motion app can be controlled by adjusting the values for “app control”, “app option”, “setpoint value 1” and “setpoint value 2”.

2.4.3.4 Ending a Motion app

To end a Motion app, the valve mode must be set to “61”. The Motion app is then ended. The value in the “valve state” section of the input data (PDI) changes to “1” (configurable).
Another Motion app can now be started, or a switch to transfer mode can be made (➔ 2.4.4 Transfer mode).

2.4.3.5 Feedback in the case of incorrect output data

If incorrect output data is transferred from the higher-order controller to the Motion Terminal controller during operation of a Motion app, the Motion app currently running is stopped and corresponding feedback is sent using the input data:

- Valve mode: 61 (Motion app stopped) (PDI byte 0 bits 5 ... 0 => 111101_2)
- Valve state: configurable (PDI byte 0 bits 7 ... 6 => 01_2)
- App state: ➔ Tab. 2.38
- Actual value 1: (PDI byte 3 ... 2 => current pressure [mbar] at port (2))
- Actual value 2: (PDI byte 5 ... 4 => current pressure [mbar] at port (4))

PDI byte	5	4	3	2	1								0							
Area	actual value 2		actual value 1		status															
Bits	15 ... 0		15 ... 0		7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Function	actual value 2		actual value 1		app state								valve state		valve mode					
Value	current pressure		current pressure		➔ Tab. 2.38								0	1	1	1	1	1	0	1

PDI byte 1

Value dec.	app state	Significance
1	valve mode invalid	Invalid value in “valve mode” section
2	app control invalid	Invalid value in “app control” section
3	app option invalid	Invalid value in “app option” section
4	setpoint1 invalid	Invalid value in “setpoint value 1” section
5	setpoint2 invalid	Invalid value in “setpoint value 2” section
6	parameters invalid	Incorrect parameterisation[1)]
10	access denied (WebConfig access)	Access by PLC denied owing to active access by WebConfig interface.
11	blocked due to saving	Access blocked due to active save process.
12	no licence for this app	No licence available for the requested Motion app.
13	all licences in use	No free licence available for the requested Motion app.
14	licence file invalid	Licence file is invalid.
15	no valve detected	No valve detected on the valve position addressed.
16	valve self calibration running	Valve self-calibration process in operation.

1) More precise information can be determined using the diagnostics channel in the transfer mode (➔ 2.7.3 Diagnostics channel in transfer mode, ➔ Appendix D Diagnostics using transfer mode, error codes 71 ... 74)

Tab. 2.38

2.4.4 Transfer mode

The transfer mode (valve mode = “63”) gives the option of exchanging information such as parameters or diagnostic information between the Motion Terminal and the higher-order controller using a range of channels. The transfer mode makes use of process data (6 bytes output data (PDO) and 6 bytes input data (PDI) for each valve).

2.4.4.1 Structure of the process data in transfer mode

Structure of the output data (PDO)

When using transfer mode, the 6 bytes of output data (PDO) for each valve slot are divided into 3 sections:

– Command
– Parameter
– Value

Valve on slot 0						Valve on slot 1			Valve on slot 7		
Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Value		Parameter		Command		Value		Para	meter	Command	

“Command” section

PDO byte 1								PDO byte 0							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
transfer control			channel					–		valve mode = 63					

Byte 0

The valve is set to transfer mode using the valve mode (PDO byte 0 bits 5 ... 0) with value “63”.

PDO byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Bits 7 ... 6 on byte 0 (PDO) are ignored in transfer mode.

Channel

Bits 4 ... 0 in byte 1 (PDO) are used to select the channel on which information is to be transferred.

PDO byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Value dec.[1)]	Channel	Significance
1	parameter set 1[2)]	Parameterisation in parameter set 1
2	parameter set 2[2)]	Parameterisation in parameter set 2
3	parameter set 3[2)]	Parameterisation in parameter set 3
4	parameter set 4[2)]	Parameterisation in parameter set 4
5	parameter set 5[2)]	Parameterisation in parameter set 5
15	valve setting	Valve settings
25	Information[3)]	Information on the status of the terminal
31	malfunctions[3)]	Access to the diagnostic memory

1) Values that are not listed are reserved and cannot be used.
2) ➔ 2.3.3.4 Parameter sets
3) ➔ Tab. 2.41

Tab. 2.39

Transfer control

Transfer in transfer mode is controlled using bits 7 ... 5 in byte 1 (PDO).

PDO byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Value dec.[1)]	Transmitting	Significance
1	Download	Transfer from the PLC to the Motion Terminal
2	Upload	Transfer from the Motion Terminal to the PLC
3	End transfer mode	Transfer mode is exited; the valve mode switches to 61 (valve in normal position), the valve state to 1 (configurable).
4	Save parameterisation as persistent data	The data for the valve currently being parameterised are saved to the Motion Terminal as persistent data.

1) Values that are not listed are reserved and cannot be used.

Tab. 2.40

Valve on slot 0						Valve on slot 1			Valve on slot 7		
Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Value		Parameter		Command		Value		Para	meter	Command	

“Parameter” section

PDO byte 3								PDO byte 2							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
index								addressed Motion app							

Addressed Motion app

When writing or reading application parameters, the ID of the addressed Motion app is entered in byte 2 (PDO).

PDO byte 2

For settings that are not specific to the Motion app (e.g. system parameters, or the selection of the active parameter set), a “0” is entered here.

Index

Depending on the channel selected, the information to be transferred is more precisely identified by means of byte 3 (PDO).

PDO byte 3

Channel	Index	Significance	Digit value
1 … 5	0 … 255	ID of the system or application parameter that is to be transferred	1
15	1	The entry in the “value” section corresponds to the number of the active parameter set	1

1) The valve on which the transfer mode will be executed

2) For commissioning with the reference value determined in the teach-in run for Motion App #12 “Leakage diagnostics”

Channel	Index	Significance	Digit value
25	1	Ambient pressure	0.001 bar abs.
	2	Supply pressure (absolute)	0.001 bar abs.
	3	Supply pressure (relative)	0.001 bar rel.
	4	Exhaust air pressure (absolute)	0.001 bar abs.
	5	Exhaust air pressure (relative)	0.001 bar rel.
	10	Temperature at atmospheric pressure sensor	0.1 °C
	11	Temperature at supply pressure sensor	0.1 °C
	12	Temperature at exhaust air pressure sensor	0.1 °C
	13	Temperature at valve[1)], working port (2)	0.1 °C
	14	Temperature at valve[1)], working port (4)	0.1 °C
	100	Leakage reference value[2)] for working port (2), parameter set 1	0.1 l/h
	101	Leakage reference value[2)] for working port (4), parameter set 1	0.1 l/h
	102	Leakage reference value[2)] for working port (2), parameter set 2	0.1 l/h
	103	Leakage reference value[2)] for working port (4), parameter set 2	0.1 l/h
	104	Leakage reference value[2)] for working port (2), parameter set 3	0.1 l/h
	105	Leakage reference value[2)] for working port (4), parameter set 3	0.1 l/h
	106	Leakage reference value[2)] for working port (2), parameter set 4	0.1 l/h
	107	Leakage reference value[2)] for working port (4), parameter set 4	0.1 l/h
	108	Leakage reference value[2)] for working port (2), parameter set 5	0.1 l/h
	109	Leakage reference value[2)] for working port (4), parameter set 5	0.1 l/h
31	1 … 40	Number of position in diagnostic memory of content to be read	1
	253	Position of the most recent diagnostic message of type “error”	1
	254	Position of the earliest diagnostic message of type “error”	1
	255	Number of diagnostic messages in the diagnostic memory	1

1) The valve on which the transfer mode will be executed

2) For commissioning with the reference value determined in the teach-in run for Motion App #12 “Leakage diagnostics”

Tab. 2.41

“Value” section

PDO byte 5	PDO byte 4
Value	

This section is used to transfer numerical values. The significance and function of the numerical values are defined by the sections described above.

Structure of the input data (PDI)

In transfer mode, the input data (PDI) serve to confirm the transfer that has taken place. To do this, the information as to “valve mode”, “channel”, “transfer control”, “addressed app” and “index” that has been transferred to the output data is fed back at the corresponding positions in the input data.

The “valve state” section gives the information described in section ➔ 2.4.2.2.

Valve on slot 0						Valve on slot 1			Valve on slot 7		
Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Value		Parameter		Status		Value		Para	meter	Status	

“Command” section

PDI byte 1								PDI byte 0							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
transfer control			channel					valve state		valve mode = 63					

Valve on slot 0						Valve on slot 1			Valve on slot 7		
Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Value		Parameter		Status		Value		Para	meter	Status	

“Parameter” section

PDI byte 3								PDI byte 2							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
index								addressed Motion app							

2.4.4.2 Feedback in the case of incorrect output data

If invalid information is transmitted as part of the output data, corresponding feedback is provided in the input data in transfer mode:

- Valve mode: 63 (transfer mode active) (PDI byte 0 bits 5 ... 0 => 111111_2)
- Valve state: gives the information described in section ➔ 2.4.2.2.
- Channel: (PDI byte 1 bits 4 ... 0 => 0)
- Transfer control: (PDI byte 1 bits 7 ... 5 => 0)
- Addressed Motion app: (PDI byte 2 => 0)
- Index: (PDI byte 3 => 0)
- Value: (PDI byte 5 ... 4 ➔ Tab. 2.42)

Allocating invalid information

The “value” section indicates which part of the output data contains invalid information.

PDI byte 5	PDI byte 4
Value	

Value	invalid command	Significance
1	invalid channel	Invalid value in “channel” section
2	invalid transfer control	Invalid value in “transfer control” section

Value	invalid command	Significance
3	invalid addressed app	Invalid value in “addressed app” section
4	invalid index	Invalid value in “index” section
5	Invalid value	Invalid value in “value” section
6	invalid combination	Invalid combination of values in various sections

Tab. 2.42

Example of input data with incorrect value in “index” section

PDI byte 1								PDI byte 0							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	...	...	1	1	1	1	1	1
transfer control = 0			channel = 0					valve state		valve mode = 63 (transfer mode)					

PDI byte 3								PDI byte 2							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
index = 0								addressed Motion app = 0							

PDI byte 5								PDI byte 4							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
value = 4															

2.4.4.3 Saving settings as persistent data

To save the current settings of a valve on the Motion Terminal as persistent data, the transfer control method “save persistent” (transfer control = 4) is used. No special channel is required for this; the value “channel” is not evaluated.

After performing a teach-in run, the “save persistent” function should be executed to store the data obtained during the teach-in run permanently on the Motion Terminal controller.
Otherwise, the teach-in run must be executed again after restarting the Motion Terminal
(➔ 2.6.7 Saving the teach-in data).

Status of save process

The status of the save process is shown in the “value” section of the input data (PDI).

PDI byte 5	PDI byte 4
Value	

Value	Saving progress	Significance/remedy
1	saving in progress	Save process active.
2	saving successful	Save process is completed.
3	saving not possible	Save process cannot be executed. • Repeat the process. • If the problem persists, contact Festo Support.
4	saving failed	Save process failed. • Repeat the process. • If the problem persists, contact Festo Support.

Tab. 2.43

Content of output data for saving as persistent data

PDO byte 1								PDO byte 0							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	0	...	...	...	...	...	0	0	1	1	1	1	1	1
transfer control = 4 (save persistent)			channel = ... (ignored)					–		valve mode = 63 (transfer mode)					

PDO byte 3								PDO byte 2							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
index = 0								addressed Motion app = 0							

PDO byte 5								PDO byte 4							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value = 0															

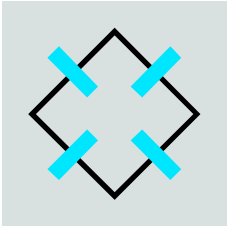
Content of input data if save process is successful:

PDI byte 1								PDI byte 0							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	0	...	...	...	...	...	...	...	1	1	1	1	1	1
transfer control = 4 (save persistent)			channel = ...					valve state		valve mode = 63 (transfer mode)					

PDI byte 3								PDI byte 2							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	1	1	1	1	0	0	1	1	1	1	1	1
index = 0								addressed Motion app = 0							

PDI byte 5								PDI byte 4							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
value = 2 (saving successful)															

2.5 Motion App #01: Directional control valve functions

Motion app ID	Pictogram for Motion app
01	

Tab. 2.44

The Motion app ID must be transferred using the “valve mode” section of the process data (bits 5 ... 0 in byte 0 (PDO)) to run the Motion app on a valve (➔ 2.4.2.1 Structure of the output data (PDO)).

2.5.1 Functional description

The Motion app makes 9 directional control valve functions available for execution by the corresponding valve. The directional control valve function makes it possible to assign the characteristics of a conventional switching valve to a valve on the Motion Terminal. The integrated sensors enable monitoring of the switching position and of the pressure at the working ports. If the pilot pressure or power supply are interrupted, the valve reverts to its mechanical normal position (all channels are blocked).
The valve types listed in section ➔ 2.5.5.1 can be allocated cyclically to the CPX terminal by means of the process data. In addition, the switching status of the particular valve type can be specified cyclically using the process data of the CPX terminal.

2.5.2 Sensors required

None

2.5.3 System parameters used

None

2.5.4 Application parameters used

None

2.5.5 Set values

The structure of the process data when running a Motion app is described in section ➔ 2.4.2.

2.5.5.1 Setting the Motion app (app option)

Valve type
The valve type is defined using byte 1 (PDO).

PDO byte 1

Valve type	Value dec.
4/2 mono	0
4/3 G (normally closed) (default setting)	1
4/3 B (normally open)	2
4/3 E (normally exhausted)	3
2 × 3/2 O (normally open)	4
2 × 3/2 G (normally closed)	5
3/2 O + 3/2 G	6
4/2 bistable	7
2 × 2/2 G (normally closed)	8

Tab. 2.45

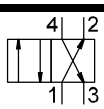
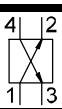
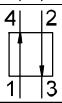
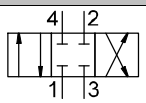
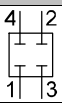
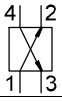
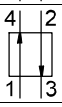
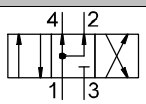
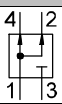
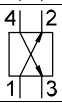
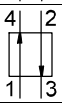
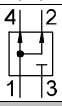
2.5.5.2 Control of the Motion app (app control)

Switching status of the valve

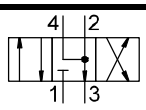
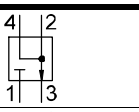
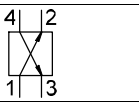
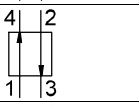
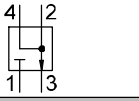
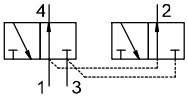
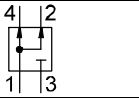
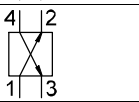
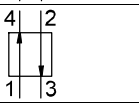
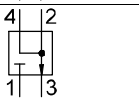
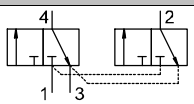
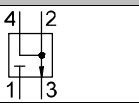
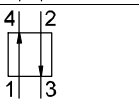
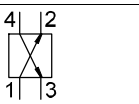
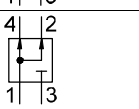
The switching status at the working ports (2) and (4) of the valve is controlled using bits 7 ... 6 in byte 0 (PDO) and is dependent on the valve type defined.

PDO byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Possible switching statuses:
- Closed (G)
- Pressurised (B)
- Exhausted (E)

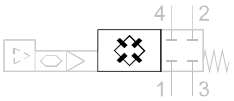
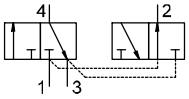
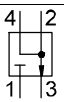
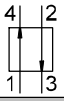
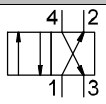
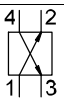
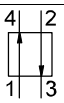
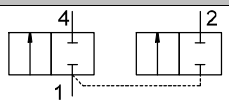
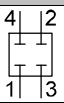
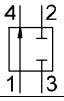
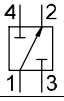
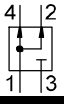
Conventional valve type	Switching status (4)	Switching status (2)	Replacement symbol[1]	Byte 0 Bit 7	Byte 0 Bit 6	Dec.
4/2 mono 	E	B		– [2]	0	0
	B	E		– [2]	1	1
4/3 G (normal position: closed) 	G	G		0	0	0
	E	B		0	1	1
	B	E		1	0	2
	G	G		1	1	3
4/3 B (normal position: pressurised) 	B	B		0	0	0
	E	B		0	1	1
	B	E		1	0	2
	B	B		1	1	3

1) The symbol in this column replaces the full bridge in the circuit diagram for the valve VEVM and therefore represents the function in the switched state of the valve with corresponding setpoint value (right columns).
2) This bit is ignored

Conventional valve type	Switching status		Replacement symbol[1]	Byte 0		Dec.
	(4)	(2)		Bit 7	Bit 6	
4/3 E (normal position: exhausted) 	E	E		0	0	0
	E	B		0	1	1
	B	E		1	0	2
	E	E		1	1	3
2 × 3/2 O (normal position: open) 	B	B		0	0	0
	E	B		0	1	1
	B	E		1	0	2
	E	E		1	1	3
2 × 3/2 G (normal position: closed) 	E	E		0	0	0
	B	E		0	1	1
	E	B		1	0	2
	B	B		1	1	3

1) The symbol in this column replaces the full bridge in the circuit diagram for the valve VEVM and therefore represents the function in the switched state of the valve with corresponding setpoint value (right columns).

2) This bit is ignored

Conventional valve type	Switching status		Replacement symbol[1]	Byte 0		Dec.
	(4)	(2)		Bit 7	Bit 6	
3/2 O + 3/2 G  Normal position: retracting ((2) pressurised, (4) exhausted)	E	B		0	0	0
	B	B		0	1	1
	E	E		1	0	2
	B	E		1	1	3
4/2 bistable  Initial position: When the valve type is selected for the first time, (2) and (4) are blocked. If a switch is made from a different valve type to 4/2 bistable, the most recent switching position remains active.	Hold status			0	0	0
	E	B		0	1	1
	B	E		1	0	2
	Hold status			1	1	3
2 × 2/2 G  Normal position: closed	G	G		0	0	0
	B	G		0	1	1
	G	B		1	0	2
	B	B		1	1	3

1) The symbol in this column replaces the full bridge in the circuit diagram for the valve VEVM and therefore represents the function in the switched state of the valve with corresponding setpoint value (right columns).

2) This bit is ignored

Tab. 2.46

2.5.5.3 Setpoint value 1 and setpoint value 2

The Motion app does not use any setpoint functions.

2.5.6 Feedback values

2.5.6.1 App state

Status of the digital inputs (end-position sensing)

The status of the inputs of the digital input module CTMM-...-D-... that are assigned to the valve currently in use (➔ 2.1.1.5 Input module CTMM-S1-A/D-... (optional)) is shown using bits 2 and 0 in byte 1 (PDI).

Assigning the inputs to the valve slots is described in section ➔ 2.1.1.5.

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Position	Bit 2	Bit 1	Bit 0
Status at input with odd number (corresponds to position "'advanced' end position reached"[1])	⅟₁		
Status at input with even number (corresponds to position "'retracted' end position reached"[2])			⅟₁

1) (4) pressurised, (2) exhausted; switching position 14
2) (2) pressurised, (4) exhausted; switching position 12

Tab. 2.47

Switching position at the working ports (2) and (4)

The switching position at the working ports (2) and (4) of the valve is given by bits 6 ... 5 (4) and 4 ... 3 (2) in byte 1 (PDI).

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Switching position		Bit 6	Bit 5	Bit 4	Bit 3
(4)	(2)				
Closed		0	0		
Pressurised		0	1		
Exhausted		1	0		
Error1)		1	1		
	Closed			0	0
	Pressurised			0	1
	Exhausted			1	0
	Error[1]			1	1

1) If the problem persists, contact Festo Support.

Tab. 2.48

Warning

The presence of warnings in the diagnostic memory of the Motion Terminal is indicated using bit 7 in byte 1 (PDI).

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Value	Description
0	No warning present.
1	Warning is present in the diagnostic memory of the Motion Terminal.

Tab. 2.49

For how to deal with warnings and errors ➔ 2.7 Diagnostics options.

2.5.6.2 Actual value 1 and actual value 2

Measured pressure at working ports (2) and (4)

The measured pressure at the working ports (2) and (4) of the valve is given as a signed integer value by bytes 5 ... 4 (PDI) (4) and 3 ... 2 (PDI) (2).

PDI byte 5	PDI byte 4	PDI byte 3	PDI byte 2
(4)		(2)	

Connection	Range of values	Digit value	Digit range	Data type	Byte (PDI)
(4)	–1000 ... +32767 mbar	1 mbar	–1000 ... +32767 × 1 mbar	16 bit signed integer	5 ... 4
(2)	–1000 ... +32767 mbar	1 mbar	–1000 ... +32767 × 1 mbar	16 bit signed integer	3 ... 2

Tab. 2.50

2.6 Teach-in run

Various motion apps require information about the physical behaviour of the connected peripherals in order to run. This information is determined by the Motion Terminal during the process referred to as the “teach-in run”.
The information is saved as “teach-in data” within a parameter set on the Motion Terminal controller (➔ 2.3.3 System and application parameters).
A teach-in run can be executed in 2 different modes:

– Automatic
  An automatic program is executed which determines and saves the corresponding teach-in data.
– Manual
  The valve is in teach-in mode. The movements of the drive are controlled manually (via the WebConfig interface or using the higher-order controller).
  This allows individual movements to be executed which can each then be analysed by the teach-in routine.

The type of teach-in run that can be used depends on the Motion app for which the teach-in data are to be determined. Not all Motion apps have the option of both types of teach-in run.

2.6.1 Prerequisites for starting the teach-in run

Before starting a teach-in run for a particular Motion app, the system and application parameters used by this Motion app must have been parameterised.
In addition, the application parameter “Motion app to be taught in” (255) must be parameterised to the ID of the Motion app for which the teach-in run is to be executed (➔ 3.1 Setting system and application parameters).

Application parameters can be defined individually for each Motion app on a valve (➔ 2.3.3 System and application parameters).
To carry out the teach-in run, the application parameter “Motion app to be taught in” (255) must be defined for the “teach-in run” mode (60). In this case, the teach-in run is treated like a Motion app.
The ID of the Motion app for which a teach-in run is to be executed must be assigned as a value to the application parameter.
Example
A teach-in run for Motion App #07 “Travel time specification” is to be executed.
To do this, the value “7” must be assigned to the application parameter “Motion app to be taught in” (255) for the “teach-in run” mode (60).

After defining the application parameter 255, you must exit transfer mode. The valve can now be switched to the “teach-in run” mode (60).

2.6.2 Selection of the teach-in run mode

The teach-in run mode (automatic/manual) is specified using bits 7 ... 6 in byte 0 (PDO).

PDO byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

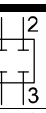
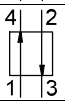
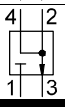
Teach-in run mode	Bit 7	Bit 6	Dec.
Stop teach-in run	0	0	0
Execute automatic teach-in run	0	1	1
Execute manual teach-in run	1	0	2
Reserved	1	1	3

Tab. 2.51

2.6.3 Controlling the manual teach-in run

The movement of the drive for manual determination of the teach-in data is controlled using bytes 3 ... 2 (PDO).

PDO byte 3	PDO byte 2

Function	Switching status (4)	(2)	Replacement symbol[1]	Value dec.
Blocked	G	G		0
Advancing	B	E		1
Retracting	E	B		2
Exhausting	E	E		3

1) The symbol in this column replaces the full bridge in the circuit diagram for the valve VEVM and therefore represents the function in the switched state of the valve with corresponding setpoint value (right column).

Tab. 2.52

2.6.4 End-position sensing

If the Motion app to be taught in requires sensors, the information as to whether the end positions have been reached is provided by bits 2 and 0 in byte 1 (PDI).

Assigning the inputs to the valve slots is described in section ➔ 2.1.1.5.

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Position	Bit 2	Bit 1	Bit 0
Status at input with odd number (corresponds to position "'advanced' end position reached"[1])	1		
Status at input with even number (corresponds to position "'retracted' end position reached"[2])			1

1) (4) pressurised, (2) exhausted; switching position 14

2) (2) pressurised, (4) exhausted; switching position 12

Tab. 2.53

2.6.5 State of teach-in run

The current state of the teach-in run is given by bits 6 ... 3 in byte 1 (PDI).

PDI byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Status	Bit 6	Bit 5	Bit 4	Bit 3	Dec.
Reserved	0	0	0	0	0
No teach-in data present (unlearned)	0	0	0	1	1
Tubing connection being checked (check tubes)	0	0	1	0	2
Control algorithm being determined (choose control)	0	0	1	1	3
Movement parameters being adjusted (tune trajectory)	0	1	0	0	4
Reference value being determined (determine reference value)	0	1	0	1	5
Partially completed (only for (2))	1	1	0	0	12
Partially completed (only for (4))	1	1	0	1	13
Teach-in run completed (finished)	1	1	1	0	14
An error has occurred (error)	1	1	1	1	15

Tab. 2.54

2.6.6 Sequence of teach-in run

2.6.6.1 Automatic teach-in run

After the teach-in run mode (➔ 2.6.2) has been set to “Execute automatic teach-in run”, the teach-in run starts. In this mode, the drive is moved from one end position to the other until the data required to execute the motion app have been determined.
The teach-in run state then changes to “14” (finished) (➔ 2.6.5).

2.6.6.2 Manual teach-in run

After the teach-in run mode (➔ 2.6.2) has been set to “Execute manual teach-in run”, the drive can be moved between the end positions using the control for the manual teach-in run (➔ 2.6.3). The process can be observed using the “state of the teach-in run” (➔ 2.6.5).
The teach-in run is completed when the “state of the teach-in run” changes to “14” (finished) (➔ 2.6.5).

2.6.7 Saving the teach-in data

The teach-in data and reference values determined during the teach-in run are automatically saved in the active parameter set on the Motion Terminal controller as persistent data.
While the Motion app is running, the teach-in data are continuously reviewed and adjusted if appropriate. These adjustments are also saved directly as persistent data.

In the event of a change to the system and/or application parameters, the teach-in data and reference values are discarded, as in this case it must be assumed that they no longer match the modified configuration.
Therefore, following the change to the system and/or application parameters in a parameter set, a new teach-in run must be executed for the Motion app affected by the changes.

The teach-in data and reference values are also reset if the system and application parameters, which are always the same, are transferred from the higher-order controller at system start but have never been saved as persistent data on the Motion Terminal controller.
In this case, the Motion Terminal starts with the default values for the parameters. As soon as these are overwritten by the higher-order controller, this change to the parameters causes the teach-in data and reference values to be discarded.
To prevent this behaviour, the system and application parameters must be saved once as persistent data on the Motion Terminal controller. This ensures that, when the higher-order controller transfers the parameters, which are always the same, no change can be detected between the saved and transferred values.

2.7 Diagnostics options

Various options are available for diagnosing malfunctions.

Diagnostics option	Description	Detailed information
LED display components	The general system status of the Motion Terminal is indicated by the LED display components on the controller, on the valves and on the input modules.	➔ 2.7.1
CPX system diagnostics	The CPX system diagnostics provides information on the nature of malfunctions within the CPS terminal (including the Motion Terminal) by way of CPX error numbers.	➔ 2.7.2 ➔ CPX system description
Diagnostics channel in transfer mode (Motion Terminal)	In addition to the information from the CPX diagnostics, the Motion Terminal provides information on errors and warnings. This information can be accessed via the diagnostics channel in transfer mode.	➔ 2.7.3

Tab. 2.55

2.7.1 LED display components

2.7.1.1 Controller

LED indicator PL (power load, load voltage supply U_{VAL})			
LED (green)		**Significance**	**Action**
Illuminated	ON OFF	Voltage is present. No error.	–
Off	ON OFF	Voltage is not present.	• Check connection of the power supply.

Tab. 2.56

LED indicator M (modify)			
LED (yellow)		**Significance**	**Action**
Off	ON OFF	Configuration inactive: no access via the WebConfig interface.	–
Illuminated	ON OFF	Configuration active: The WebConfig interface has write access, or the PLC is executing write access on the parameterisation of the controller.	–

Tab. 2.57

LED indicator PS (power system, operating voltage supply $U_{EL/SEN}$)			
LED (green)		**Significance**	**Action**
Illuminated	ON OFF	Voltage is present. No error.	–
Flashing	ON OFF	Voltage is present but outside the tolerance range.	• Eliminate short circuit/overload.
Off	ON OFF	Voltage is not present.	• Check connection of the power supply.

Tab. 2.58

LED indicator SF (system failure)			
LED (red)		**Significance**	**Action**
○ Off	ON OFF ┐└	No error	–
☀ Illuminated	ON OFF ┌─	Voltage of the load voltage supply U_{VAL} is outside the tolerance range.	• Eliminate short circuit/overload.
		Access to WebConfig interface is not possible or only conditionally.	• Switch operating voltage supply $U_{EL/SEN}$ off and back on.

Tab. 2.59

LED indicator TP (Ethernet link/traffic)			
LED (green)		**Significance**	**Action**
☀ Illuminated	ON OFF ┌─	Network connection is OK (link).	–
☀ Flashing	ON OFF ┌┐┌┐	Data traffic (traffic) Flashing frequency is dependent on the traffic.	–
○ Off	ON OFF ┐└	No network connection / network cable is not connected.	If access to the WebConfig interface is required: • Check network connection.

Tab. 2.60

2.7.1.2 Valve

LED indicator valve state			
LED (blue/red)		**Significance**	**Action**
☀ Illuminated red	ON OFF ┌─	Valve error	• Check error log (➔ 2.7.3)
		Load voltage supply U_{VAL} is not applied.	• Check connection of the power supply U_{VAL}.
☀ Illuminated blue	ON OFF ┌─	Error-free operation	–
☀ Flashing blue	ON OFF ┌┐┌┐	Update	–
		Valve booting.	–
		Valve being calibrated (➔ 2.3.5).	–
○ Off	ON OFF ┐└	Valve has no power supply.	• If the power supply of the terminal is switched on, check valve to ensure it is seated properly.

Tab. 2.61

2.7.1.3 Analogue input module

LED indicator ↳			
LED (red)		**Significance**	**Action**
○ Off	ON OFF ┐└	No error	–
☀ Illuminated	ON OFF ┌─	Short circuit/overload in sensor supply.	• Eliminate short circuit/overload.
		Module error	• Switch operating voltage supply $U_{EL/SEN}$ off and back on.

Tab. 2.62

2.7.1.4 Digital input module

LED indicator ↳			
LED (red)		**Significance**	**Action**
○ Off	ON / OFF	No error	–
☀ Illuminated	ON / OFF	Short circuit/overload in sensor supply.	• Eliminate short circuit/overload.

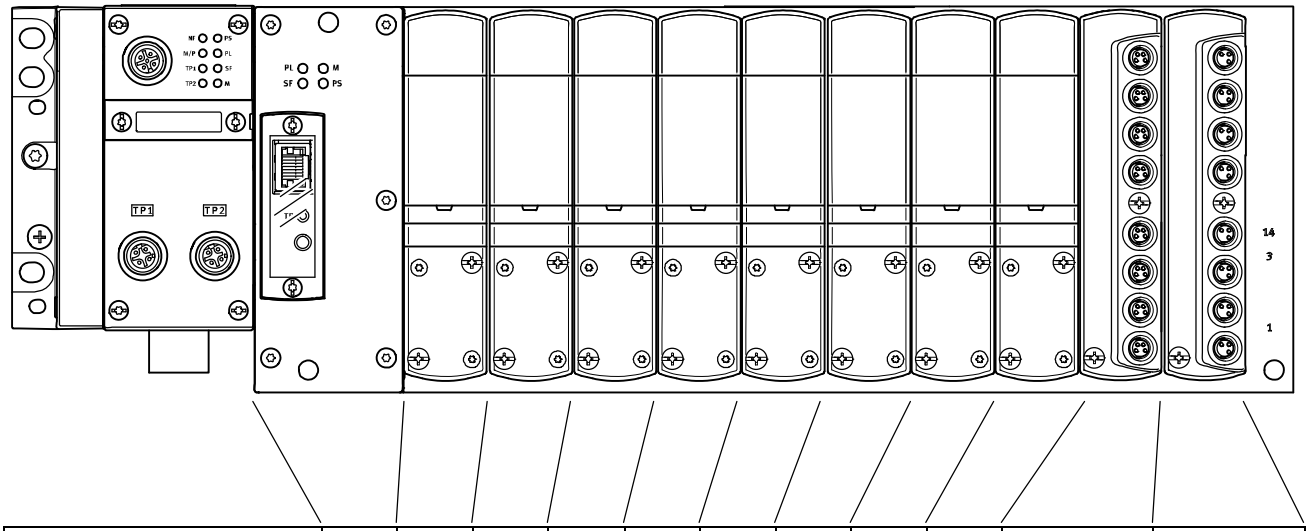
Tab. 2.63

LED indicator input status			
LED (green)		**Significance**	**Action**
☀ Illuminated	ON / OFF	Logic 1 (Signal is present).	–
○ Off	ON / OFF	Logic 0 (Signal is not present).	–

Tab. 2.64

2.7.2 Diagnostic interface

The diagnostic interface for the CPX terminal makes it possible to locate a malfunction to a specific component of the CPX terminal or of the Motion Terminal.
The source of the malfunction within the Motion Terminal can be identified using the channel information.



Input channel	I0	–	–	–	–	–	–	–	–	I1 I2 ... I9	I10 I11 ... I18
Output channel	O0	O1	O2	O3	O4	O5	O6	O7	O8	–	–

Channels I2 ... I9 and I11 ... I18 correspond to the individual inputs (0 ... 7) of the respective input module.

Depending on the structure of the CPX terminal, the channel numbers shown above must be added to the number of the I/O channels that can be assigned to additional modules in the CPX terminal.

Example

If another digital input module having 8 input channels (0 ... 7) is installed between the bus node and the Motion Terminal controller, the Motion Terminal controller uses channels I8 and O0.

2.7.3 Diagnostics channel in transfer mode

By means of the transfer mode, the Motion Terminal provides diagnostic information which, together with the CPX error number, enables more precise analysis of the cause of the malfunction
(➔ D Diagnostics using transfer mode).

2.7.3.1 Errors and warnings

The Motion Terminal distinguishes between 2 classes of malfunction:
– Error
– Warning

Error

A malfunction classified as an error is so serious that the Motion app currently running is automatically stopped or a Motion app is prevented from starting. After eliminating the cause of the error, the error must be acknowledged before it is possible to start a Motion app (➔ 2.7.3.6 Acknowledging errors).
Errors are logged in the diagnostic memory of the Motion Terminal.
The valve state changes to a value of 3 (failure) when an error is present
(➔ 2.4.2.2 Structure of the input data (PDI)). When the error has been eliminated, the value changes to “0” (not ready). Once the error has been acknowledged, the valve state changes back to a value of “1” (configurable).

Warning

A malfunction classified as a warning represents an undesirable state which, although it does not prevent the function of the Motion app that is running, may restrict the performance of the Motion app.
Warnings are therefore displayed (“app state” section, ➔ 2.4.2.1 Structure of the output data (PDO)) and logged in the diagnostic memory of the Motion Terminal. However, warnings do not have a direct impact on the operation of the Motion app.

2.7.3.2 Structure of the malfunction message

The information in the diagnostic memory of the Motion Terminal is made up of three parts:
– Malfunction code
– Malfunction subcode
– Classification of malfunction
The value transferred when the diagnostic memory is read is presented in bytes 5 ... 4 (PDI) in transfer mode and is made up of the following:

PDI byte 5								**PDI byte 4**							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Classification		Malfunction subcode						Malfunction code							

Malfunction code and subcode

The malfunction code is used by the customer to locate the cause of the malfunction.
The malfunction subcode is primarily used by Festo to evaluate a malfunction, and should be passed on to Festo Support in the event of a malfunction.
A list of malfunction codes and subcodes with a description of the possible cause and appropriate remedial measures can be found in the appendix to this document (➔ D Diagnostics using transfer mode).

Malfunction subcode

Classification of malfunction

Malfunctions in the diagnostic memory of the Motion Terminal are assigned one of the following classifications.
The classification of the malfunction is given by bits 7 ... 6 in byte 5 (PDI)

PDI byte 5							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Classification	Significance	Bit 7	Bit 6	Dec.
Reserved	–	0	0	0
Active error	The malfunction is classified as an error. The cause of the error is still present.	0	1	1
Inactive error	The malfunction is classified as an error. The cause of the error is no longer present, but the error has not been acknowledged (➔ 2.7.3.6 Acknowledging errors)	1	0	2
Warning	The malfunction is classified as a warning.	1	1	3

Tab. 2.65

2.7.3.3 Structure of the VTEM diagnostic memory

The diagnostic memory for the Motion Terminal can accommodate up to 40 malfunction messages and is filled chronologically. Here, a new malfunction message always appears in position 1, and existing messages are moved ‘back’ by one position (previous position number + 1).
If there are already 40 malfunction messages stored in the diagnostic memory, and a new message is added, the earliest message at position 40 is overwritten.
Information about the content of the diagnostic memory is available at positions 253 ... 255:

Position	Contents
253	Position of the most recent diagnostic message of type “error”
254	Position of the earliest diagnostic message of type “error”
255	Number of diagnostic messages in the diagnostic memory

Tab. 2.66

Example

The table below shows possible content of the diagnostic memory. This contains 3 malfunction messages. The most recent malfunction message at position 1 is classified as an error.

Position	Contents	Value dec.	Significance
1	01|000000|00001010	1 | 0 | 10	Active error | malfunction subcode 0 | short circuit in one of the connected sensors on input module 1
2	11|000100|01001110	3 | 4 | 78	Warning | malfunction subcode 4 | PLC command invalid
3	11|000101|01001110	3 | 5 | 78	Warning | malfunction subcode 5 | PLC command invalid
...	00|000000|00000000	0 | 0 | 0	No malfunction message
40	00|000000|00000000	0 | 0 | 0	No malfunction message
41 ... 252	00|000000|00000000	0 | 0 | 0	Not used
253	00 000000 00000001	1	The most recent error message is at position 1
254	00 000000 00000000	1	The earliest error message is at position 1[1)]
255	00 000000 00000011	3	There are 3 malfunction messages in the diagnostic memory

1) The most recent and the earliest error message are therefore identical; there is only 1 error message in the diagnostic memory.

Tab. 2.67

2.7.3.4 Behaviour when an error occurs

When an error occurs, the valve is brought to a stop (valve state = 3 (failure)). No further errors are recorded in the diagnostic memory.
If the error is no longer present, the valve state changes to “not ready” (valve state = 0).
After acknowledging the error, the valve state changes to “configurable” (valve state = 1) (➔ 2.7.3.6).

2.7.3.5 Readout of the diagnostic memory

The diagnostic memory is read out using the transfer mode (valve mode = 63). The sections of process data are used as follows:

– Valve mode: 63 (transfer mode active) (PDO byte 0 bits 5 ... 0 => 111111_2)
– Channel: 31 (malfunctions) (PDO byte 1 bits 4 ... 0 => 11111_2)
– Transfer control: 2 (upload) (PDO byte 1 bits 7 ... 5 => 010_2)
– Addressed Motion app: 0 (PDO byte 2 => 0)
– Index: position in diagnostic memory having the value that is to be read out (➔ 2.7.3.3)
  (PDO byte 3 => 1 ... 40, 253 ... 255)
– Value: 0 (PDO byte 5 ... 4 => 0)

Example of output data for reading out the most recent entry in the diagnostic memory

The starting point is the example content of a diagnostic memory in section ➔ 2.7.3.3.

PDO byte 1								**PDO byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	1	1	1	1	1	...	...	1	1	1	1	1	1
transfer control = 2			channel = 31					–		valve mode = 63 (transfer mode)					

PDO byte 3								**PDO byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
index = 1								addressed Motion app = 0							

PDO byte 5								**PDO byte 4**							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value = 0															

Example of input data having the content of the most recent entry in the diagnostic memory
The starting point is the example content of a diagnostic memory in section ➔ 2.7.3.3.

PDI byte 1								**PDI byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	1	1	1	1	1	...	...	1	1	1	1	1	1
transfer control = 2			channel = 31					valve state		valve mode = 63 (transfer mode)					

PDI byte 3								**PDI byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
index = 1								addressed Motion app = 0							

PDI byte 5								**PDI byte 4**							
Classification		Malfunction subcode						Malfunction code							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0
1 (active error)		0 (no malfunction subcode)						10 (short circuit in one of the connected sensors at input module 2)							

2.7.3.6 Acknowledging errors

To change the valve state from “0” (not ready) to “1” (configurable), the error must be acknowledged once the cause has been eliminated.

1. End transfer mode by setting the transfer control (PDO byte 1 bits 7 ... 5) to a value of 3.
   The valve switches to mode (valve mode) 61, valve state is “failure” (value 3).
2. Eliminate fault.
   Valve state changes to “not ready” (value 0).
3. Set valve mode (PDO byte 0 bits 5 ... 0) to value “62” (“acknowledge error”).
   Valve state changes to “configurable” (value 1).

Acknowledgement deletes all entries in the malfunction list.

Acknowledging errors without using the diagnostic memory

If the error can be eliminated without using the diagnostic memory (and hence the transfer mode), the following simplified procedure results:

– An error is present. Content of process input data:

PDI byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
valve state		valve mode					
1	1	0	0	0	0	0	1
(failure)		(ID of Motion App #01)					

– The cause of the error has been eliminated. Content of process input data:

PDI byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
valve state		valve mode					
0	0	0	0	0	0	0	1
(not ready)		(ID of Motion App #01)					

– The error is acknowledged. Set the process output data “valve mode” to 62:

PDO byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
app control		valve mode					
0	0	1	1	1	1	1	0
...		62 (acknowledge error)					

– The valve is once more ready. Content of process input data:

PDI byte 0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
valve state		valve mode					
0	1	0	0	0	0	0	1
(configurable)		(ID of Motion App #01)					

After acknowledging the error, a Motion app or transfer mode can be started.

3 Parameterisation

In this chapter, parameterisation refers to the transfer of system and application parameters from the higher-order controller (PLC) to the Motion Terminal VTEM.
The transfer mode of the Motion Terminal is used to transfer the parameter values (➔ 2.4.4 Transfer mode).

In addition to the approach described here, it is also possible to set up the parameters of the Motion Terminal using the WebConfig user interface.
Parameterisation that has been created using the WebConfig interface and saved on the Motion Terminal controller can be transferred to the higher-order controller using the upload function.

3.1 Setting system and application parameters

System and application parameters are set using the transfer mode (➔ 2.4.4 Transfer mode).

3.1.1 Prerequisites

– The Motion Terminal boot procedure is completed.
– There are no Motion apps currently running on the valve in question (valve state is not equal to “2” (running)).

3.1.2 Procedure

To transfer system and application parameters, the following settings must be selected in the transfer mode:
– Valve mode: 63 (transfer mode active) (PDO byte 0 bits 5 ... 0 => 111111_2)
– Channel: 1 ... 5 (ID of the parameter set for which the parameter is to be defined)
(PDO byte 1 bits 4 ... 0 => 00001_2 ... 00101_2)
– Transfer control: 1 (download) (PDO byte 1 bits 7 ... 5 => 001_2)
– Addressed Motion app: 0 ... 60 (PDO byte 2 => 0_{10} ... 60_{10})
0 for setting system parameters (independent of Motion app)
60 for the application parameter 255 (Motion app to be taught-in) used by the teach-in run
– Index: ID of the parameter that is to be set (PDO byte 3 => 12_{10} ... 255_{10})
– Value: value to be written to the parameter (PDO bytes 5 ... 4).

Compared to the representation in section ➔ 2.3.3, the ranges of values for the parameters may be restricted by the respective Motion app used. The specific ranges of values for each Motion app is described in the description for the Motion app in question.

Example
The system parameter “Tube I.D. at (2)” (ID 14) needs to be parameterised in parameter set 2 for a tube internal diameter of 5.7 mm.

PDO byte 1								**PDO byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	0	0	1	0	0	0	1	1	1	1	1	1
transfer control = 1 (download)			channel = 2 (parameter set 2)					–		valve mode = 63 (transfer mode)					

PDO byte 3								**PDO byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
index = 14 (parameter ID 14)								addressed Motion app = 0 (system parameter)							

PDO byte 5								**PDO byte 4**							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	0
value = 570 (570 × 0.01 mm = 5.7 mm)															

The values are displayed in the corresponding sections of the input data (PDI) for confirmation (➔ 2.4.4.1 Structure of the process data in transfer mode).

3.2 Reading out system and application parameters

System and application parameters are read out using the transfer mode (➔ 2.4.4 Transfer mode).

3.2.1 Prerequisites

- The Motion Terminal boot procedure is completed.
- There are no Motion apps currently running on the valve in question (valve state <> “2” (running)).

3.2.2 Procedure

To read out values for system and application parameters, the following settings must be selected in the transfer mode:

- Valve mode: 63 (transfer mode active) (PDO byte 0 bits 5 ... 0 => 111111_2)
- Channel: 1 ... 5 (ID of the parameter set from which a parameter value is to be read out) (PDO byte 1 bits 4 ... 0 => 00001_2 ... 00101_2)
- Transfer control: 2 (upload) (PDO byte 1 bits 7 ... 5 => 010_2)
- Addressed Motion app: 0 ... 60 (PDO byte 2 => 0_{10} ... 60_{10})
  0 for reading out system parameters (independent of Motion app)
  60 for the application parameter 255 (Motion app to be taught-in) used by the teach-in run
- Index: ID of the parameter, the value of which is to be read out (PDO byte 3 => 12_{10} ... 255_{10})
- Value: 0 (PDO byte 5 ... 4 => 0)

Example

The value of the application parameter “Travel time, advancing” (ID 121) for Motion App #07 in parameter set 4 is to be read out.

PDO byte 1								**PDO byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	0	0	1	0	0	0	0	1	1	1	1	1	1
transfer control = 2 (upload)			channel = 4 (parameter set 4)					–		valve mode = 63 (transfer mode)					

PDO byte 3								**PDO byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	1	1	1	0	0	1	0	0	0	0	0	1	1	1
index = 121 (parameter ID 121)								addressed Motion app = 7 (Motion App #07)							

PDO byte 5								**PDO byte 4**							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value = 0 (upload)															

The value of the application parameter is given by the input data in byte 5 ... 4 (PDI).

PDI byte 1								**PDI byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	0	0	1	0	0	...	...	1	1	1	1	1	1
transfer control = 2 (upload)			channel = 4 (parameter set 4)					valve state		valve mode = 63 (transfer mode)					

PDI byte 3								**PDI byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	1	1	1	0	0	1	0	0	0	0	0	1	1	1
index = 121 (parameter ID 121)								addressed Motion app = 7 (Motion App #07)							

PDI byte 5								**PDI byte 4**							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0
value = 100 (100× 0.01 s = 1 s)															

3.3 Saving parameterisation as persistent data

Saving parameterisation on the Motion Terminal controller as persistent data is described in section ➔ 2.4.4.3.

Even in the case where the parameterisation is transferred to the Motion Terminal controller by the higher-order controller at every system start, this parameterisation should additionally be saved once, as persistent data, on the Motion Terminal controller. Otherwise, the teach-in data determined during a teach-in run or the reference value for a Motion app may be lost (➔ 2.6.7 Saving the teach-in data).

3.4 Changing parameter set

Changing the active parameter set is controlled using the “valve setting” channel (channel = 15).
The “Value” section contains the number of the parameter set to be activated.

Example

Parameter set 4 is to be selected as the active parameter set.
Output data:

PDO byte 1								**PDO byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	1	1	1	1	0	0	1	1	1	1	1	1
transfer control = 1 (download)			channel = 15 (valve setting)					–		valve mode = 63 (transfer mode)					

PDO byte 3								**PDO byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	1	1	1	1	0	0	1	1	1	1	1	1
index = 1 (chosen parameter set)								addressed Motion app = 0							

PDO byte 5								**PDO byte 4**							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
value = 4															

Transfer is confirmed in the input data:

PDI byte 1								**PDI byte 0**							
Command															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	1	1	1	1	...	...	1	1	1	1	1	1
transfer control = 1 (download)			channel = 15 (valve setting)					valve state		valve mode = 63 (transfer mode)					

PDI byte 3								**PDI byte 2**							
Parameter															
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	1	1	1	1	0	0	1	1	1	1	1	1
index = 1 (chosen parameter set)								addressed Motion app = 0							

PDI byte 5								**PDI byte 4**							
Value															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
value = 4															

A Technical appendix

A.1 Technical data

A.1.1 General information

Feature		Specification/value
Operating medium		Compressed air to ISO 8573-1:2010 [7:4:4], inert gases
Pilot medium		
Note about the operating/pilot medium		Lubricated operation not possible
Nominal operating pressure/pilot pressure	[bar]	6
Operating pressure	[bar]	3 ... 8
Pilot pressure	[bar]	3 ... 8
Notes on operating pressure	[bar]	0 ... 8 with external pilot air Vacuum operation only at (3)
Flow rate per valve	[l/min]	480 ±15 %
Flow direction		Non-reversible
Pneumatic interfaces		
Air ports (2) and (4)		G1/8
Pilot air (14)		M5
Valve connection (1) and (3)		G3/8
Pilot exhaust air (84)		M7
Pressure compensation (L)		M7
Vibration and shock resistance		➔ Assembly instruction CPX_VTEM

Tab. A.1

A.1.2 Power supply

Feature		Specification/value	
		$U_{EL/SEN}$	V_{VAL}
Operating voltage (via CPX terminal)			
Nominal voltage	[V DC]	24	
Voltage range	[V DC]	18 ... 30	
Intrinsic current consumption VTEM at 24 V DC typ.			
Controller + linking	[mA]	115	85
Per valve	[mA]	28	24
Analogue input module[1)]	[mA]	12	0
Digital input module[1)]	[mA]	12	0
Per switched input	[mA]	15	0
Electrical isolation $U_{EL/SEN}$ and U_{VAL}		Yes, with separate supply at the CPX terminal	
Functional earth (FE)		To be connected on the CPX and VTEM sides	

1) Plus own consumption of the sensors

Tab. A.2

A.1.3 Operating and environmental conditions

Ambient conditions		
Permitted temperature range		
Long-term storage	[°C]	–20 ... +40
Operation	[°C]	–5 ... +50
Medium	[°C]	–5 ... +50
Relative air humidity	[%]	0 ... 90
Degree of protection		IP65[1)]

Ambient conditions	
Corrosion resistance CRC ➔ www.festo.com/sp ➔ Search for “CRC” ➔ Expert knowledge	Moderate protection (CRC 2)[1)]
CE marking (declaration of conformity ➔ www.festo.com/sp)	To EU EMC Directive (The product is intended for use in industrial environments. When used outside an industrial environment, e.g. in commercial and mixed residential areas, measures for radio interference suppression may be necessary.)

1) To ensure the degree of protection IP65, use cover caps, blanking plugs, and inspection covers to seal off unused ports. Degree of protection IP65 is not ensured when using the Ethernet port.
2) Moderate corrosion stress. Internal application in which condensation can occur. External visible parts with primarily decorative surface requirements which are in direct contact with a normal industrial environment.

Tab. A.3 Technical data: Ambient conditions

A.1.4 Input modules

General			
Feature			**Specification/value**
Maximum length of the connected cables		[m]	30
Fuse protection			Internal electronic fuse per module
Galvanic isolation between the inputs			None

Tab. A.4

Digital input module CTMM-...-D-...			
Feature			**Specification/value**
Interface			M8, 3-pin
Characteristics			Voltage input 24 V DC
Switching level	Signal 0	[V DC]	≤ 5
	Signal 1	[V DC]	≥ 11
Input characteristic			To IEC 1131-2
Switching logic			PNP, NO (normally open)

Tab. A.5

Analogue input module CTMM-...-A-...	
Feature	**Specification/value**
Interface	M8, 4-pin
Characteristics	Current input 4 ... 20 mA
Compatible sensors	Festo SDAP-...-M50-...-M8

Tab. A.6

B Glossary

Term/abbreviation	Description
Application parameters	describe the application of the Motion app (moving mass, travel time, minimum force, etc.). Application parameters can be stored separately on each valve for each Motion app.
Controller	The Motion Terminal controller forms the interface between the CPX terminal and the components of the Motion Terminal.
GSDML	Device description file in XML format ➔ www.festo.com/sp
Motion app (MA)	A Motion app converts parameter and setpoint specifications into control commands at the corresponding valve.
Motion Terminal	The Motion Terminal VTEM provides a range of pneumatic open-loop and closed-loop control functions that are executed in the form of Motion apps.
Parameter set	The system parameters of a parameter set apply jointly to all Motion apps running on a valve, but are not used by all Motion apps.
PDI	Process data input to the higher-order controller: status and states
PDO	Process data output from the higher-order controller: configurations and specifications
Process data	Cyclic data that are gained from a technical process by means of sensors. Process data represent the actual values of the Motion Terminal and of the connected peripherals.
System parameters	describe the components that are connected to the Motion Terminal (tubes, drive, mounting position, etc.). System parameters apply to a valve and hence jointly to all Motion apps running on this valve.
Teach-in run	Teach-in process to determine the characteristics of the connected peripherals and to achieve the desired result during movement.
Transfer mode	Transfer of parameters, diagnostic information and settings for the valves
WebConfig	The product has no mechanical control components for commissioning and functional testing (manual override). Parameters and setpoint values are set solely via the WebConfig user interface or using the higher-order controller (PLC). The WebConfig interface can be opened with a web browser if there is an existing Ethernet connection to the controller of the Motion Terminal.

Tab. B.1 Terms and abbreviations

C Supported peripherals

C.1 Supported CPX bus nodes

The CPX terminal can establish the connection to a higher-order controller by means of one of the following bus nodes:

Type code	Designation	Protocol
CPX-FB13	Bus node	Profibus DP
CPX-FB33/FB34	Bus node	PROFINET
CPX-FB36	Bus node	Ethernet/IP, Modbus/TCP
CPX-FB37	Bus node	EtherCAT

Tab. C.1

C.2 List of supported drives

➔ www.festo.com/sp

This list contains all Festo drives approved for the Motion Terminal and the corresponding value that must be entered in the “drive type” system parameter (ID 20) in order to be able to operate the respective drive with a Motion app.

D Diagnostics using transfer mode

Malfunktion codes and sub-codes that can be stored in the diagnostic memory of the Motion Terminal
➔ www.festo.com/sp

Description of the diagnostic function via transfer mode ➔ 2.7.3 Diagnostics channel in transfer mode

E Licences

This product uses open-source software. The following table lists the corresponding software packages as well as the licences that govern the software.

Software package	Licence	Version number	Terms of the licence
Unity	MIT	-	https://opensource.org/licenses/MIT
bbenv	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
bootgen	Xilinx	-	-
bootloader	GPL	2.0+	http://www.gnu.org/licenses
busybox	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
e2fsprogs	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
gcovr	BSD	3	https://opensource.org/licenses/BSD-3-Clause
haserl	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
libb64	Public Domain Certification	-	-
libev	BSD	2	https://opensource.org/licenses/BSD-2-Clause
libiniparser	MIT	-	https://opensource.org/licenses/MIT
libnl	LGPL	2.1	http://www.gnu.org/licenses/old-licenses/lgpl-2.1
libtool	BSD	3	https://opensource.org/licenses/BSD-3-Clause
linux	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
lua	MIT	-	https://opensource.org/licenses/MIT
luafilesystem	MIT	-	https://opensource.org/licenses/MIT
lzo	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
mkimage	GPL	2.0+	http://www.gnu.org/licenses
mtd-utils	GPL	2.0	http://www.gnu.org/licenses/oldlicenses/gpl2.0
sysroot	LGPL	2.1	http://www.gnu.org/licenses/old-licenses/lgpl-2.1
zlib	Zlib	-	http://www.gzip.org/zlib/zlib_license.html

Tab. E.1

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