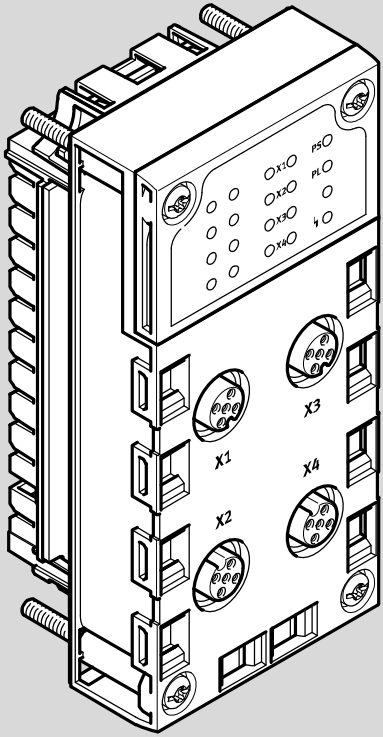
Terminal CPX

Electrical interface CPX-CTEL-4-M12-5POL

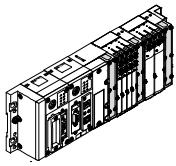


FESTO

Description

CTEL master module

I-Port



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Translation of the original instructions
P.BE-CPX-CTEL-EN

IO-Link® is a registered trademark of its respective trademark holder in certain countries.

Identification of hazards and instructions on how to prevent them:

Warning
Hazards that can cause death or serious injuries

Caution
Hazards that can cause minor injuries

Other symbols:

Note
Material damage or loss of function

Recommendations, tips, references to other documentation

Essential or useful accessories

Information on environmentally sound usage

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

Table of Contents – Electrical interface CPX-CTEL-4-M12-5POL

Information about this documentation

This description contains specific information regarding the mode of operation, mounting, installation and commissioning of the electrical interface CPX-CTEL-4-M12-5POL.

The product described here is referred to as the CTEL master module in this documentation.

A list of other documents for the components of the CPX and/or CTEL system, as well as an overview of the structure of the user documentation for the CPX terminal can be found in the CPX system description (➔ P.BE-CPX-SYS-...).

Service

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

1 Safety and requirements for product use

1.1 Safety

1.1.1 General safety information

- Observe the general safety information in the corresponding chapters.

Specific safety regulations can be found immediately before the task instructions.

Note

Damage to the product from incorrect handling.

- Switch off power supplies prior to any assembly or installation work. Only switch on the power supply when the product has been assembled and installation work is complete.
- Never unplug or plug in a product when powered!
- Observe the handling specifications for electrostatically sensitive devices.

1.1.2 Intended use

The module provides 4 external I-Port interfaces, each of which can be connected to a device with an I-Port interface (➔ 2.2 I-Port).

The individual I-Port devices are documented in specific descriptions. The safety instructions specified in these descriptions must be observed and the respective device must only be used as intended.

The module described in this document has been designed exclusively for use in combination with CPX terminals from Festo. The CPX terminal and its connected modules are intended for installation in machines and/or automated systems and may be used only as follows:

– In perfect technical condition
– in original status without unauthorised modifications, except for the adaptations described in this documentation.

1.2 Requirements for product use

- Make this documentation available to the design engineer, installer and personnel responsible for commissioning the machine or system in which this product is used.
- Make sure that the specifications of the documentation are always complied with. Also take into account the documentation for other components and modules e.g. the CPX system description (➔ P.BE-CPX-SYS-...).
- Take into account the legal regulations applicable for the location as well as:
  - Regulations and standards
  - Regulations of the testing organisations and insurers
  - National specifications.

1.2.1 Technical requirements

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

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

1.2.2 Training of skilled personnel (requirements for staff)

This description is directed exclusively to technicians trained in control and automation technology, who are experienced in:

- The installation, commissioning, programming and diagnostics of programmable logic controllers (PLCs) and fieldbus systems,
- The applicable regulations for operating safety-engineered systems,
- The applicable regulations for accident prevention and occupational safety,
- The documentation for the product.

1.2.3 Range of applications and certifications

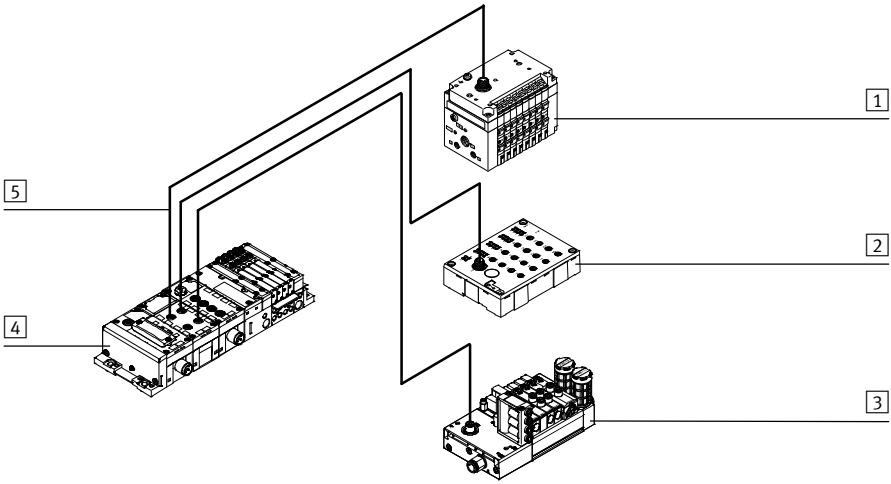
Standards and test values, which the product must comply with and fulfil, can be found in the section “Technical data” (➔ A.1 Technical data). The product-relevant EC directives can be found in the declaration of conformity.

Certificates and the declaration of conformity for this product can be found on the Festo website (➔ www.festo.com).

2 System overview, CTEL system

2.1 Overview of the CTEL system

The CTEL master module enables devices with an I-Port interface (I-Port devices) to be connected to a CPX system. Up to 4 devices per CTEL master module can be integrated into the CPX system.



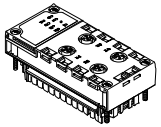
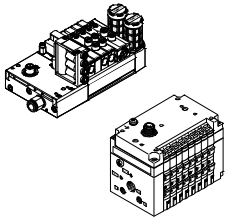
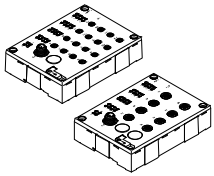
1 Valve terminal with I-Port
2 I-module with I-Port
3 Valve terminal with I-Port
4 CPX terminal with CTEL master module
5 I-Port connecting cables

Fig. 2.1

A CTEL system consists of the CTEL master module and the devices that are connected to the CTEL master module via specified I-Port connecting cables. In this way, it is possible to decentralise the arrangement of the devices. The compact valve terminals and I/O modules with I-Port can thus be mounted very close to the cylinders to be controlled. This means that the length of the air supply lines can be reduced.
Short compressed air lines minimise the friction losses and the times for pressurising and exhausting the tubes.
This enables smaller valves with sufficient flow to be used, thereby helping to reduce costs.

2.1.1 Mode of operation of the CTEL system

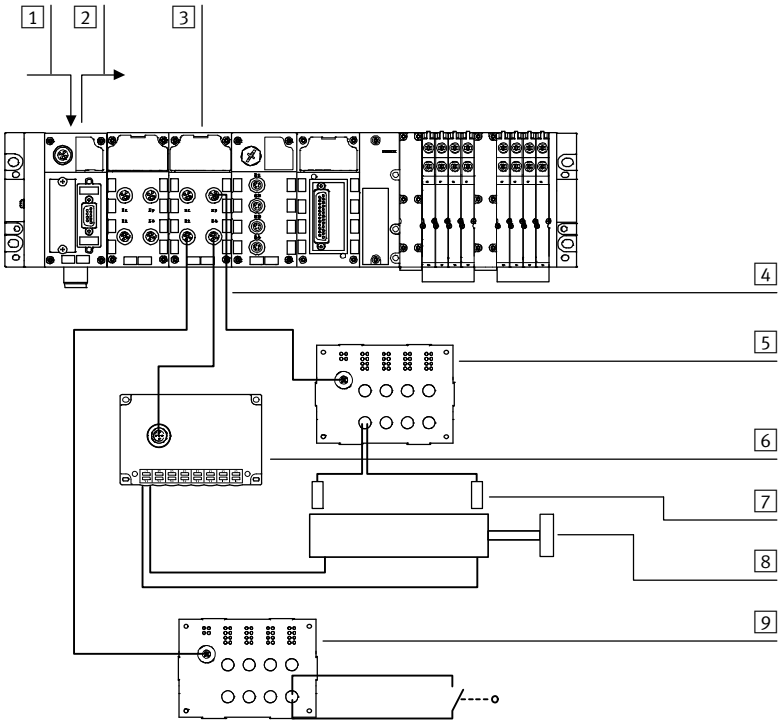
CTEL systems are composed of the following modules:

Modules	Functions
CTEL master module 	– Are components of a CPX system and serve as a gateway between CPX and I-Port modules. – Provide connections for up to 4 valve terminals or I/O modules per CTEL master module. – Transmit control signals to the connected modules and monitor their ability to function.
I-Port valve terminals 	– Make available various valve functions for controlling pneumatic actuators. – Relay plates, pressure zone separation plates and blanking plates can also be integrated.
I-Port input modules 	– Make available inputs for connecting sensors and enable interrogation of cylinder positions, for example.
Other I-Port modules	

Tab. 2.1

Each CTEL master module controls the data transfer to the decentralised I-Port I/O-modules in a CPX terminal.
In principle, several CTEL master modules can be placed in a CPX terminal.

The number of CTEL master modules that can be placed in a CPX terminal is limited by the available address space of the CPX terminal of up to 64 bytes of inputs and 64 bytes of outputs.



1 Fieldbus (incoming)
2 Fieldbus (continuing)
3 CTEL master module
4 I-Port connecting cables
5 I-Port input module
6 I-Port valve terminal
7 Sensor
8 Cylinder
9 I-Port input module

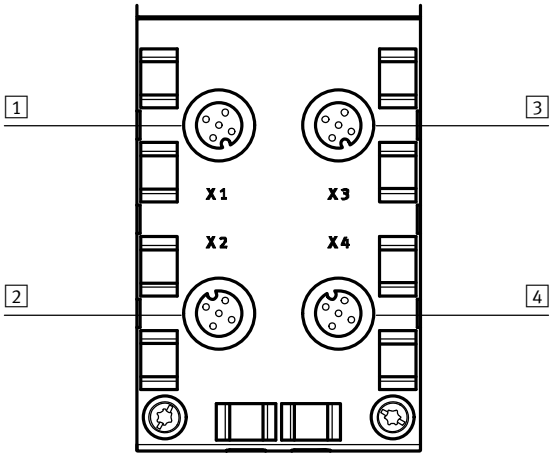
Fig. 2.2

A constant I/O data exchange takes place through the CTEL master module between the CPX terminal and the devices connected to the CTEL master module.

2.2 I-Port

The CTEL master module has 4 I-Port interfaces. I-Port is an interface for the exchange of serial data for the connection of decentralised function modules (devices) from Festo at field level. It is based on the IO-Link technology and is compatible with it in certain areas.
The limitations compared to the IO-Link standard are, among others:
– Permanently set baud rate of 230.4 kbps.
– SIO mode is not supported.
– The maximum length of the process data is limited to 32 bytes of input data and 32 bytes of output data.
– Only one extract of the master commands is used.
– "Plug & work" principle, configuration via IODD is not supported.
The connection type corresponds to a star topology. That means, only 1 device can be connected to each I-Port.

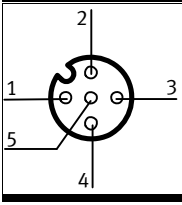
2.2.1 I-Port interfaces



1 I-Port 1 (X1)
2 I-Port 2 (X2)
3 I-Port 3 (X3)
4 I-Port 4 (X4)

Fig. 2.3

2.2.2 Pin allocation

Top view (socket)	Pin	Allocation	Function
	1	24 V $U_{EL/SEN}$ (PS)	Operating voltage supply (+)
	2	24 V $U_{VAL/OUT}$ (PL)	Load voltage supply(+)
	3	0 V $U_{EL/SEN}$ (PS)	Operating voltage supply (–)
	4	C/Q $_{I\text{-}Port}$	Communication C/Q
	5	0 V $U_{VAL/OUT}$ (PL)	Load voltage supply (–)

Tab. 2.2

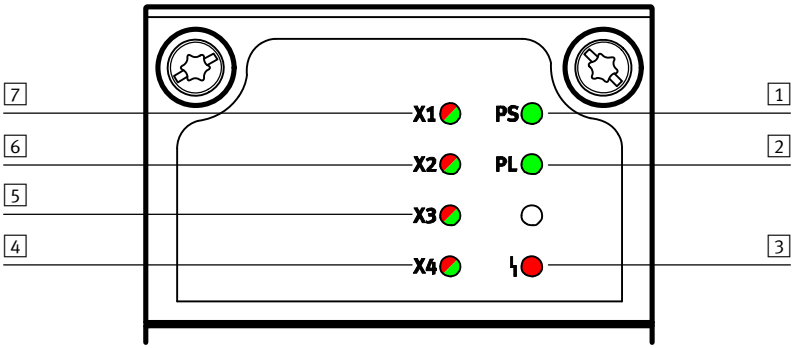
2.2.3 I-Port connecting cables

Operation in accordance with the specifications is only guaranteed if original connecting cables from Festo are used.
For operation in accordance with specifications, the maximum length of the I-Port connecting cables must always be observed (➔ 3.3 I-Port connecting cables).

2.3 Display components

The CTEL master module is equipped with seven LED indicators, with whose help the current status (operating status) of the CTEL system and the devices connected to it can be determined.

2.3.1 Overview of the LED indicators



1 PS (Power System)
2 PL (Power Load)
3 Module error
4 X4 (status I-Port 4)
5 X3 (status I-Port 3)
6 X2 (status I-Port 2)
7 X1 (status I-Port 1)

Fig. 2.4

2.3.2 Meaning of the LED displays

LED	Behaviour	Significance
PS	Off	Operating voltage $U_{EL/SEN}$ (PS) is not connected or has fallen below the minimum supply voltage (CTEL master module is not active)
	Lights up green	Operating voltage $U_{EL/SEN}$ (PS) is connected; supply for all I-Ports OK
	Flashes green (approx. 1 Hz)	Undervoltage of the operating voltage $U_{EL/SEN}$ (PS)
PL	Off	Several causes are possible: – Load voltage U_{VAL} (PL) not connected – No devices connected – Devices are connected that do not use the load voltage U_{VAL} (PL) – All 4 I-Ports are configured to “Port inactive”
	Lights up green	Load voltage U_{VAL} (PL) present at all connected devices and is OK
	Flashes green (approx. 1 Hz)	At least one device reports undervoltage U_{VAL} (PL)

LED	Behaviour	Significance
ϟ	Off	CPX system-internal communication OK
	Lights up red	Several causes are possible: – CPX system starts momentarily, display then turns off – General fault
X1 ... X4	Off	No connection to a device
	Lights up green	Device connected, communication OK
	Flashes green	Several causes are possible: – Connection established to the device, diagnostics running – I/O length of the recognised device is too large
	Lights up red	Device error. Several causes are possible: – Connection to the device interrupted – Error in the I-Port communication
	Flashes red	Compatibility error. Several causes are possible: – An incompatible device is connected to the corresponding I-Port. – The corresponding port is deactivated, but a connected device is recognised.
	All four LEDs flashing red	Configuration error. Several causes are possible: – Invalid configuration (e.g. through exceeding of the available address space) – Device has been replaced by another device type

Tab. 2.3

Monitoring of the load voltage U_{VAL} (PL) takes place in the devices and is passed on to the CTEL master module.
Since all connected devices use this LED, the display of an error has priority over the display “OK” (LED illuminated green).
The I-Port at which the error has occurred can be determined through the FMT/MMI using the diagnostic messages.
Information on eliminating the displayed errors:
➔ 5.2.2 Diagnostic/error messages by CPX error numbers.

2.4 Address space

The CTEL master module can make available a total of up to 32 bytes for inputs and 32 bytes for outputs. The precise number of the I/O bytes made available depends on the requirements of the connected devices.

I/O configuration presettings

The address space that the CTEL master module makes available and assigns accordingly in the CPX system can be configured according to different presettings (➔ Tab. 2.4). These presettings correspond to the selection options that are supported within the configuration files for the respective host system (➔ 3.6 Connection with the host system).

For the CTEL master module there are 3 presettings available for operation as a “pure input module”, a “pure output module” and for “mixed operation”. In addition, there is also a setting for operation without connected devices.

Operation as	Inputs[1)]	Outputs[1)]
Unused module (no devices connected)	0 bytes	0 bytes
Pure output module	0 bytes	8 bytes
	0 bytes	16 bytes
	0 bytes	24 bytes
	0 bytes	32 bytes
Pure input module	8 bytes	0 bytes
	16 bytes	0 bytes
	24 bytes	0 bytes
	32 bytes	0 bytes
Mixed operation	8 bytes	8 bytes
	16 bytes	16 bytes
	24 bytes	24 bytes
	32 bytes	32 bytes

1) Related to the complete CTEL master module

Tab. 2.4

The I/O lengths listed here are the sum of the bytes available for all I-Ports together.

2.5 I/O configuration presetting

The I/O configuration presetting is implemented via the DIL switches on the left side of the CTEL master module, directly below the housing cover. These are only accessible if the module is removed from the CPX system.

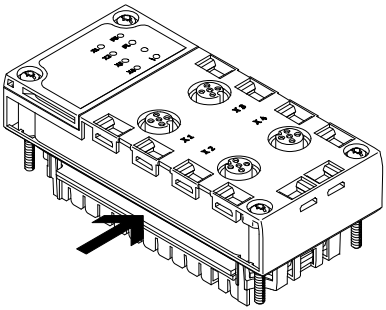
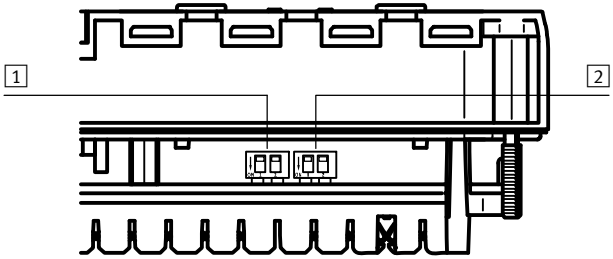


Fig. 2.5

2.5.1 DIL switches



1 DIL switch group 1 (I/O mode)
2 DIL switch group 2 (I/O length)

Fig. 2.6

The I/O mode of the CTEL master module is set via DIL switch group 1 (➔ Tab. 2.5). The setting of the I/O length, i.e. the determination of available I/O bytes per I-Port, is implemented via DIL switch group 2 (➔ Tab. 2.6).

Setting the I/O mode

DIL switch group 1	S1.1	S1.2	Function
	OFF	OFF	Module unused[1)2)]
	OFF	ON	Operation as pure output module
	ON	OFF	Operation as pure input module
	ON	ON	Mixed operation (inputs and outputs)

1) Factory setting

2) No devices connected; DIL switch group 2 without function

Tab. 2.5

If the CTEL master module is not used, i.e. there are no devices connected, DIL switch group 2 has no function and the I/O length is automatically set to 0 bytes in each case.

Setting the I/O length

DIL switch group 2	S2.1	S2.2	Function
	OFF	OFF	8 bytes I/Os (2 bytes per I-Port)[1)]
	OFF	ON	16 bytes I/Os (4 bytes per I-Port)
	ON	OFF	24 bytes I/Os (6 bytes per I-Port)
	ON	ON	32 bytes I/Os (8 bytes per I-Port)

1) Factory setting

Tab. 2.6

The I/O length specified always applies for all 4 I-Ports (max. 8 bytes per I-Port).

3 Installation

3.1 General instructions for installation

Warning
Personal injury or material damage may result due to accidental movement of the connected actuators and uncontrollable movements of loose tubing.
Before carrying out mounting, installation and maintenance work, switch off the following:
– Compressed air supply
– Operating voltage supply for electronics/sensors ($U_{EL/SEN}$)
– Load voltage supplies for outputs/valves (U_{OUT}/U_{VAL})

Note
Electrostatically sensitive devices
- Do not touch any components.
- Observe the handling specifications for electrostatically sensitive devices.

Note
- Handle all modules and components carefully.
- Comply with the specified torques.

Information on mounting the CPX terminal can be found in the CPX system description (➔ P.BE-CPX-SYS-...).

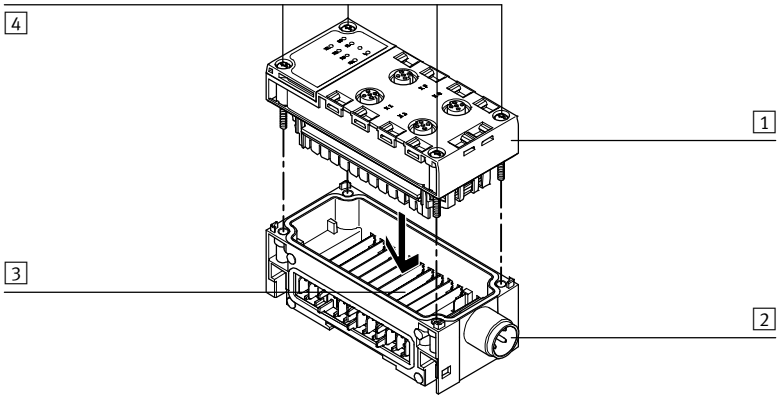
3.2 Mounting and dismantling

The CTEL master module is designed for mounting in a CPX interlinking block (➔ Fig. 3.1).

Warning
The CTEL master module must always be mounted /dismantled in a de-energised state.
- Disconnect the corresponding CPX terminal completely from the related power supply or switch it off.

Note
The CTEL master module does not have a separate connection block, but is designed as a complete unit.

The desired I/O configuration presetting should be implemented and checked via the DIL switches (➔ 2.5) before the CTEL master module is mounted, as these switches can no longer be reached after mounting.



1 Electrical interface CPX-CTEL-4-M12-5POL (CTEL master module)
2 Interlinking block (here with additional power supply, as an example)
3 Contact rails
4 Screws

Fig. 3.1

Mounting

Mount the module as follows:

1. Check seal and sealing surface.
2. Insert module into the interlinking block. Make sure that the corresponding slots with the contacts on the bottom of the module lie above the contact rails.
3. Push the module carefully and without tilting into the interlinking block up to the stop.
4. Screws should only be tightened by hand. Screws must be set so that the self-cutting threads can be used.
5. Tighten screws (tightening torque 0.9 ... 1.1 Nm).

Dismantling

Dismantle the module as follows:

1. Loosen the screws.
2. Pull the module carefully and without tilting away from the contact rails of the interlinking block.

3.3 I-Port connecting cables

Note

Operative malfunction due to impermissible cabling.

- To connect the I-Port devices to the CTEL master module, only use the special I-Port connecting cables from the Festo catalogue (➔ www.festo.com/catalogue)
- Observe the maximum length of 20 m for the I-Port connecting cables.

You will then avoid errors in data exchange between the CTEL master module and the connected devices.

For an operation with tool change, there are special specifications that must be observed in designing the connection lines. The interface in the connecting cable must be constructed in such a way that, when establishing the connection, the contacts of the power supply for the device (24 V and 0 V U_{VAL}) are connected first. Otherwise, a short circuit may be reported temporarily through the voltage present on the C/Q cable when the connection is established.

3.4 Connecting the devices

A total of up to 4 I-Port devices can be connected to one CTEL master module.
The devices are connected to the CTEL master module via I-Port connecting cables from Festo (➔ 2.1 Overview of the CTEL system and 3.3 I-Port connecting cables).

If errors occur on several devices simultaneously, only the diagnostic/error message of the device with the highest priority is displayed (➔ 5.2.1 Priorities of the diagnostic/error messages).
After this error is eliminated, the error with the next lowest priority is displayed. The priority of the connected devices results from the number of the I-Port used. The device connected at I-Port 1 has the highest priority, while the device at I-Port 4 has the lowest priority when displaying a diagnostic/error message. If the CTEL master module is configured to "I/O mixed operation", diagnostic/error messages from inputs have priority over diagnostic/error messages from outputs.

With use of more than one CTEL master module in a CPX terminal, the module that is mounted closer to the CPX bus node has the higher priority.

The result of this is that devices with process-critical functions must be connected to the I-Ports as high a priority as possible.

Connect devices:
1. Connect devices with the I-Port connecting cables to the CTEL master module corresponding to their priority (see above).
2. Tightly screw the plug connector of the I-Port connecting cables to the connection of the CTEL master module by using the union nut. In this way the electrical contact is guaranteed.
3. With the inscription labels (type IBS 6x10 or IBS 9x20), mark the I-Port to which the device is connected. In this way you can avoid confusion during later repair and maintenance work.

3.5 Connecting the power supply

- Take the following aspects into consideration when installing a CPX system with CTEL master module:
  - Power supply (➔ 3.5.1 Power supply)
  - Current consumption (➔ 3.5.2 Determining the current consumption)
  - Formation of voltage zones (➔ CPX system description P.BE-CPX-SYS-...)

Note
- Observe the instructions on earthing the I-Port devices in the description for the relevant module.

Recommendation:
- When implementing an emergency stop function, route the load voltage for the corresponding actuators separately.

Note
- Check whether a pressure switch-off function is also required for the machine/system in the event of an emergency stop.

3.5.1 Power supply

The CPX terminal has 3 different conductors:
- Operating voltage supply $U_{EL/SEN}$ (PS) for internal electronics of the CTEL master module and the connected devices
- Load voltage supply U_{OUT} for digital output modules
- Load voltage supply U_{VAL} (PL) for valve terminals, output modules or other consumers.

The load voltage supply U_{OUT} is not used by the module described here. Additional information about the power supply and the formation of voltage zones can be found in the CPX system description (➔ P.BE-CPX-SYS-...).

Note

Operative malfunctions due to insufficient power supply.
- The load voltage supply U_{VAL} must be sufficiently dimensioned to be able to supply the connected actuators.
- Observe that, dependent on the respective length of the I-Port connecting cable and current consumption of the connected I-Port device, a voltage drop results between the CTEL master module and the device.
  Therefore, when using connecting cables > 5 m, the operating voltage supply $U_{EL/SEN}$ should not be fallen below by more than 10 %.
- The total current requirement of the CPX terminal and the CTEL system, as well as the limit values for the maximum current intensities, must be taken into account in the design of the voltage supply (➔ 3.5.2 Determining the current consumption).

3.5.2 Determining the current consumption

The current consumption of a CTEL system depends on the number and type of connected I-Port devices.

Recommendation:
- Use a regulated power supply.
- When selecting the power supply unit, check whether it has sufficient output. Calculate the total current consumption, if necessary.

Calculation
- Use the following table to calculate the total current consumption (➔ Tab. 3.1).
- Please refer to the relevant technical data for current consumption of the I-Port devices.

Note
- Select a power supply unit that provides sufficient power for subsequent expansions to the CTEL system.
- Observe the instructions regarding selection of the power supply unit in the CPX system description (➔ P.BE-CPX-SYS-...).

- When using I-Port output modules with a separate load voltage connection, take into account the corresponding current consumption when selecting a power supply unit.

Current consumption from $U_{EL/SEN}$ of the CPX terminal		
Internal electronics current consumption, CTEL master module		approx. 0.06 A
Internal electronics current consumption, device I-Port 1[1)]	_____ A	
Sensor current consumption at I-Port 1[1)]	+_____ A	
Sum of the current consumption at I-Port 1 (max. 1.6 A)	=_____ A	+_____ A
Internal electronics current consumption, device I-Port 2[1)]	_____ A	
Sensor current consumption at I-Port 2[1)]	+_____ A	
Sum of the current consumption at I-Port 2 (max. 1.6 A)	=_____ A	+_____ A
Internal electronics current consumption, device I-Port 3[1)]	_____ A	
Sensor current consumption at I-Port 3[1)]	+_____ A	
Sum of the current consumption at I-Port 3 (max. 1.6 A)	=_____ A	+_____ A
Internal electronics current consumption, device I-Port 4[1)]	_____ A	
Sensor current consumption at I-Port 4[1)]	+_____ A	
Sum of the current consumption at I-Port 4 (max. 1.6 A)	=_____ A	+_____ A
Sum of the current consumption of the CTEL system (max. 9 A[2)])		=_____ A

1) ➔ Manufacturer's specifications

2) Limit value within a voltage zone, minus the other consumers within the voltage zone

Tab. 3.1

An additional power supply of 1.6 A per I-Port can be made available through the load voltage supply U_{VAL}.

Caution

Malfunctions due to exceeding of the maximum permissible current consumption.

– Make sure that the current consumption from $U_{EL/SEN}$ does not exceed the maximum permissible value of 1.6 A per I-Port.
– Make sure that the current consumption from U_{VAL} does not exceed the maximum permissible value of 1.6 A per I-Port.
– Make sure that the total current consumption of the CTEL system does not exceed the maximum permissible 9 A (with deduction of the other consumers within the voltage zone).

Note

The supply of the actuators via the load voltage supply U_{VAL} can occur in an isolated manner compared to $U_{EL/SEN}$.

3.6 Connection with the host system

For the required connection between the CTEL master module in the CPX terminal and the higher-order host system, it is required that the configuration file entry that corresponds to the current I/O configuration presetting of the CTEL master module is selected in the host system.
Only in this case is the CTEL master module correctly recognised when the system is run up.
Otherwise, communication cannot be established and no diagnostic/error message is issued.

3.7 Ensuring degree of protection IP65/67

Note

To comply with degree of protection IP65/IP67:

- Seal unused I-Port interfaces with protective caps from the Festo catalogue (➔ www.festo.com/catalogue).

4 Commissioning

4.1 Configuration

Configuration of the I/O mode

When configuring the I/O mode, DIL switch group 1 is used to determined whether the CTEL master module only makes inputs available at all 4 I-Ports (pure input module), only outputs (pure output module), or inputs and outputs (mixed operation) (➔ Tab. 2.5).

Configuration of I/O lengths

Configuration of the I/O lengths is conducted via DIL switch group 2 and is determined together for all 4 I-Ports (➔ Tab. 2.6). An I/O length of 4 bytes per I-Port, for example, corresponds to a setting of 16 bytes for the entire module.

Each I-Port device that corresponds to the set configuration can be connected during operation.
The connected devices must not exceed the set I/O lengths. Otherwise, an I-Port configuration error is issued.

Example

The following devices should be connected to the CTEL master module at system start:

– Output module with 16 outputs (2 bytes O)
– Input module with 8 inputs (1 byte I)
– Valve terminal with 32 outputs (4 bytes O)
– Input module with 16 inputs (2 bytes I)

Since devices with inputs and outputs are to be connected, the I/O mode of the CTEL master module must be set to “mixed operation” (switch S1.1 and S1.2 to “ON”).

The I/O length results from the device with the highest I/O requirements (4 bytes for the valve terminal in this example).

Since individual I/O lengths are not possible during configuration, an I/O length of 4 bytes per I-Port, that is 16 bytes (for all I-Ports together), must be selected (switch S2.1 to “OFF”, S2.2 to “ON”).
The I/O configuration presetting selected here is thus 16 bytes inputs/16 bytes outputs.
In cases in which the reserved address space is not completely used by the connected devices, this results in input and output addresses (channels) to which no device input or output is assigned.

Unused channels
Input channels to which no device input is assigned are automatically set to the value “0” in the CPX system.
Output channels to which no device output is assigned are ignored in data transmission.
Sequence at system start
At the start of the system, the CTEL master module checks all I-Ports for connected devices and their agreement with the selected configuration presetting.

Communication with the host system
To enable a connection set-up between the CPX terminal and higher-order controller, the I/O configuration presetting of the CTEL master module must comply with the entry of the configuration file in the host system (➔ 3.6 Connection with the host system).

4.1.1 Address assignment in the CPX system

I/O bytes are assigned in the CPX system corresponding to the selected configuration presetting.
The assigned address spaces are thereby filled “from below”, that is, the starting point is the least significant address (LSB). The unused data in the upper address range expires.
The distribution of the device addresses to the address space of the CTEL master module would be as follows when using the example in 4.1:

Address assignment of the inputs (16 bytes):

Device	Device address	Input address CTEL
I-Port 1 (unused)	–	Byte 0
	–	Byte 1
	–	Byte 2
	–	Byte 3
I-Port 2 (1 byte)	Byte 0	Byte 4
	–	Byte 5
	–	Byte 6
	–	Byte 7
I-Port 3 (unused)	–	Byte 8
	–	Byte 9
	–	Byte 10
	–	Byte 11
I-Port 4 (2 bytes)	Byte 0	Byte 12
	Byte 1	Byte 13
	–	Byte 14
	–	Byte 15

Legend: White = assigned; grey = unused

Address assignment of the outputs (16 bytes):

Device	Device address	Output address CTEL
I-Port 1 (2 bytes)	Byte 0	Byte 0
	Byte 1	Byte 1
	–	Byte 2
	–	Byte 3
I-Port 2 (unused)	–	Byte 4
	–	Byte 5
	–	Byte 6
	–	Byte 7
I-Port 3 (4 bytes)	Byte 0	Byte 8
	Byte 1	Byte 9
	Byte 2	Byte 10
	Byte 3	Byte 11
I-Port 4 (unused)	–	Byte 12
	–	Byte 13
	–	Byte 14
	–	Byte 15

Legend: White = assigned; grey = unused

4.2 Procedure for commissioning

In order to avoid connecting and configuration errors, commissioning in steps is required.
Proceed as follows:

1. Check the CTEL master module and the connected I-Port devices (➔ 4.3 Preparing the CTEL system for commissioning).
2. Determine the required I/O configuration presetting (➔ 2.4 Address space).
3. If required: Parameterisation of the CTEL master module and the I-Port devices (➔ 4.6 Parameters).
4. Check power supplies (➔ 3.5 Connecting the power supply).
5. Commissioning of the entire system (➔ Description of the specific CPX bus node).

4.3 Preparing the CTEL system for commissioning

Note

Addressing errors caused by changing address ranges during operation

- Do not connect the CPX terminal to a higher-order controller yet to prepare for commissioning.

The integration of the CTEL master module into the host system might have to take place via a device description file, dependent on the CPX bus node used. Corresponding device description files can be found in the Festo Support Portal (➔ www.festo.com/sp).

Check the CTEL master module and the connected I-Port devices

- Check the position of the DIL switches to guarantee the desired configuration presetting (➔ Tab. 2.5 and Tab. 2.6).
- Check the CTEL master module to ensure it is securely seated in the interlinking block.
- Check whether the connected I-Port devices correspond to the entry of the configuration file in the host system (➔ 3.6 Connection with the host system).
- Check whether the connected I-Port devices are distributed to the I-Ports corresponding to their priority for diagnostic/error messages (➔ 5.2.1 Priorities of the diagnostic/error messages).
- Check whether the current consumption of the connected I-Port devices and the other CPX modules corresponds to the specifications and limit values (➔ 3.5 Connecting the power supply).
- Check the power supply connections at the interlinking blocks.

4.4 Behaviour in case of malfunctions in operation

If a malfunction occurs at an I-Port during operation, e.g. wire break, this will be indicated by flashing or illumination of the LED display (X1 ... X4) of the corresponding I-Port on the CTEL master module (➔ 2.3 Display components). The behaviour of the affected device is dependent on the device type. Moreover, additional diagnostic information relating to the CTEL master module is available, which can be called up via the fieldbus used as well as via the Festo Maintenance Tool (FMT) or the operator unit (MMI) (➔ 5.1 Summary of diagnostics options).

Starting the CPX terminal with system setting “Stored parameters”

If the start setting “Stored parameters” is configured in the system settings of the CPX terminal instead of “Standard parameters”, the current assignment of the I/O address space of all modules remains permanently stored in the CPX terminal.

The following must be noted in this case:
If the I/O assignment of the I-Ports is modified (e.g. by changing DIL switch 2), the error “Incorrect I/O length” is reported, since the currently existing I/O configuration of the CTEL master module differs from the configuration stored in the CPX terminal.

4.5 Notes on operation

Warning
Unintentional movement of the connected actuators as a result of accidentally interchanging the connected I-Port devices.
Caution with subsequent modification of the I-Port assignment:
- Make sure that devices are not separated from an I-Port and accidentally connected to another I-Port. Use the inscription labels (type IBS-6x10 or IBS-9x20) in order to uniquely identify the devices.
- Before starting the system, check whether the I-Port assignment corresponds to the configuration in the host system.

Warning
Accidental activation of actuators!
An incorrect status of the valves and outputs can lead to dangerous situations!
- Make sure that valves and outputs are put in a safe status when malfunctions occur.

Note
Please note the following if the outputs of a valve terminal are reset after a master stop, fieldbus interruption or malfunction:
– Monostable valves move to the initial position
– Double-solenoid valves remain in the current position
– Mid-position valves go into mid-position (pressurized, exhausted or closed, depending on valve type).
- Observe the product specific instructions in the documentation supplied with the valve terminal components.

4.6 Parameters

The CTEL master module can be adapted to the respective situation by using various parameters. In addition, read-only parameters are available for reading out system statuses.

4.6.1 Overview of module parameters

The following table includes an overview of the user-relevant module parameters.
The default settings are shown in **bold**.

Relative Address Mod. par.	R/W	Bit 7	6	5	4	3	2	1	0	Module parameter
0	RW						X			Monitoring U_{OUT}/U_{VAL} 0 = inactive **1 = active**
6	RW	X		X		X		X		Error control per I-Port: I-Port 1 configuration I-Port 2 configuration I-Port 3 configuration I-Port 4 configuration **00=Use existing device** 01 = Expect device 10 = Port inactive
7	RW	X				S2.1	S2.2	S1.1	S1.2	Behaviour after I-Port short circuit. **0 = Leave switched off** 1 = Switch on again CTEL I/O mode[1] **00 = reserved** 01 = only outputs[2] 10 = only inputs[2] 11 = Inputs and outputs[2] CTEL I/O length[1] **00 = 2 bytes per I-Port** 01 = 4 bytes per I-Port 10 = 6 bytes per I-Port 11 = 8 bytes per I-Port

1) These parameters are read out only during initialisation of the CTEL master module. Subsequent changes of the parameters have no effects. Bits 0 ... 3 cannot be written in combination with the Festo Maintenance Tool and the operator unit. They are represented in the online mode as read-only parameters.

2) with fixed length

Relative Address Mod. par.	R/W	Bit								Module parameter
		7	6	5	4	3	2	1	0	
8 ... 15	RW	8 bytes (hexadecimal, subdivided word by word)								Device parameter I-Port 1
16 ... 23	RW	8 bytes (hexadecimal, subdivided word by word)								Device parameter I-Port 2
24 ... 31	RW	8 bytes (hexadecimal, subdivided word by word)								Device parameter I-Port 3
32 ... 39	RW	8 bytes (hexadecimal, subdivided word by word)								Device parameter I-Port 4
40 ... 43	R	32-bit (hexadecimal)								Device type I-Port 1
44 ... 47	R	32-bit (hexadecimal)								Device type I-Port 2
48 ... 51	R	32-bit (hexadecimal)								Device type I-Port 3
52 ... 55	R	32-bit (hexadecimal)								Device type I-Port 4
56+57	R	16-bit (hexadecimal)								Device error code I-Port 1
58+59		16-bit (hexadecimal)								Device error code I-Port 2
60+61		16-bit (hexadecimal)								Device error code I-Port 3
62+63		16-bit (hexadecimal)								Device error code I-Port 4

1) These parameters are read out only during initialisation of the CTEL master module. Subsequent changes of the parameters have no effects. Bits 0 ... 3 cannot be written in combination with the Festo Maintenance Tool and the operator unit. They are represented in the online mode as read-only parameters.

2) with fixed length

Tab. 4.1

4.6.2 Parameter “Monitoring U_{OUT}/U_{VAL}”

Monitoring of the load voltage U_{OUT} or U_{VAL}, which is activated as standard, can be deactivated via the parameter “Monitoring U_{OUT}/U_{VAL}”.

When monitoring is deactivated, any undervoltage that then occurs is ignored. If the CTEL master module already reports an undervoltage (related to U_{OUT}/U_{VAL}), this message is deleted when this parameter is set to “inactive”.

Setting of this parameter applies for the entire module, that is, for all I-Ports equally.

4.6.3 Parameter “I-Port configuration”

Through the parameter “I-Port X configuration” (X = number of the I-Port), the type of diagnostics or error control can be established for each I-Port.

First and foremost, the setting is used for monitoring whether a device is connected and, if so, whether it fits the configuration presetting.

At system start, the parameter is set to “Use existing device”. This setting can only be changed after the system start.

Nominal configuration

Devices recognised at system start are saved as the “nominal configuration”. This nominal configuration remains intact even after modification of the parameter “I-Port configuration” and is sometimes even used by other configurations.

The following I-Port configurations are available:

– **Use existing device (default setting)**
  Communication with the device functions according to the set I/O configuration (providing that the device corresponds to this configuration). If communication is interrupted, an error is not output. If the device is replaced by another device, various sequences are possible (➔ 5.7 Behaviour after lost connection to the device).
– **Expect device**
  This I-Port configuration always requires a device connected to the corresponding I-Port. An I-Port with this I-Port configuration must always be connected to a device. Otherwise, an error is output. The following scenarios are possible:
  – A device with suitable I/O length was detected at system start. The device is connected to “Expect device” when the I-Port configuration is changed.
    ➔ Function OK.
  – A device was recognized at system start and stored as nominal configuration. The device is disconnected after the I-Port configuration is changed to “Expect device”.
    ➔ Error message “I-Port device missing/failed”. The error is reset when the device is reconnected.
  – At system start, a device is recognized with an I/O length larger than the one defined.
    ➔ Error message “I-Port configuration error”. The rrror is reset when the device is disconnected.
  – No device was recognized at system start. The I-Port configuration is still changed to “Expect device”.
    ➔ Error message “I-Port device missing/failed”. The error is reset when a device with suitable I/O length is connected.
– **Port inactive**
  The I-Port is deactivated and cannot be used. A device that is still connected results in output of an “I-Port configuration error”.

The set address space is also assigned for deactivated I-Ports in the CPX system.

4.6.4 Parameter “Behaviour after I-Port short circuit”

Through the parameter “Behaviour after I-Port short circuit”, the status of the load voltage supply can be established for an I-Port device after elimination of a short circuit in an I-Port connecting cable.
After the short circuit is eliminated, the power supply for the corresponding device can

– remain switched off (setting “Leave switched-off”) or
– be automatically switched on again (setting “switch on again”).

The parameter “Behaviour after I-Port short circuit” is embedded as bit 7 in parameter 8. The remaining 7 bits are assigned otherwise (➔ Tab. 4.1).
When the parameter for changing of the setting is overwritten, the content of the bits 6 ... 0 can be any desired. Only bit 7 is evaluated for parameterisation.

With access via FMT or MMI, the parameter can be selected and changed separately. In this way, the parameters “I/O mode” and “I/O length” can only be read.

Parameter information

The setting is conducted via bit 7 of parameter 8 (relative address 7).

Bit 7	Parameter setting
0	Leave switched off (default setting)
1	Switch on again

Tab. 4.2

4.6.5 Parameter “Device parameter I-Port”

For each connected device, 8 bytes are available for representation of the device parameters. These parameters are individually interpreted by each device and are defined in the description of the corresponding device.

4.7 Commissioning with the operator unit (CPX-MMI)

The operator unit (CPX-MMI) offers convenient and extended functions for commissioning the CTEL master module.
This section includes an overview of the specific commissioning functions for the CTEL master module with the operator unit:

– General information on representation
  (➔ 4.7.1 Menu commands of the CTEL master module on the operator unit (CPX-MMI))
– Display of signal statuses (➔ 4.7.2 Observe signal statuses (monitoring))
– Parameterisation (➔ 4.7.3 Parameterisation with the operator unit (CPX-MMI))

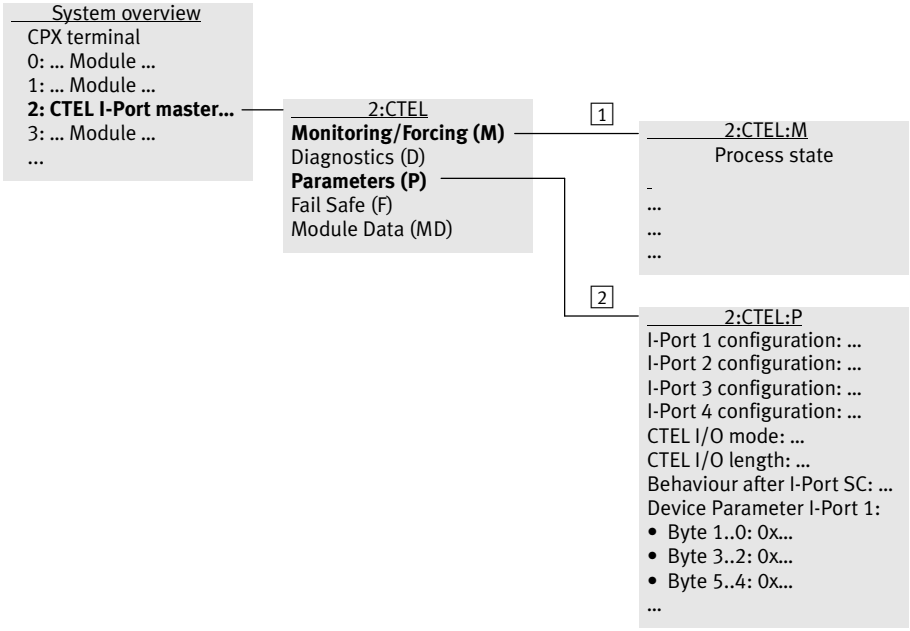
General information about the operator unit (CPX-MMI) and commissioning the CPX terminal can be found in the description (➔ P.BE.CPX-MMI-1-...).

Warning
The connected actuator technology can move unexpectedly!
Modification of the signal statuses and parameters using the operator unit can trigger dangerous movements of the connected actuator technology.

- Make sure that nobody is in the positioning range of the connected actuators and be very careful with parameterisation or manipulation of signal statuses.
- Observe the notes on “Force”, “Idle mode” and “Fail safe” in the CPX system description and in the description for the operator unit if the CPX bus node used supports these parameterisation types.

4.7.1 Menu commands of the CTEL master module on the operator unit (CPX-MMI)

Fig. 4.1 shows as an example the special menu structure for the CTEL master module. For reasons of clarity, only the parameter name is shown for the parameters.



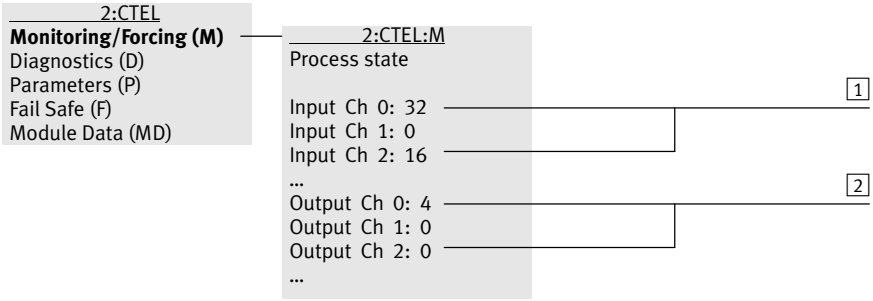
1 "Monitoring/Forcing (M)" menu, also "Fail safe" (➔ Fig. 4.2)

2 "Parameters" menu (➔ Fig. 4.3)

Fig. 4.1

4.7.2 Observe signal statuses (monitoring)

You can use the operator unit (CPX-MMI) to observe the signal statuses of the connected (and recognised) I-Port devices.



[1] Channels of the device at the first assigned I-Port (here input module)

[2] Channels of the devices at further assigned I-Ports (here output module)

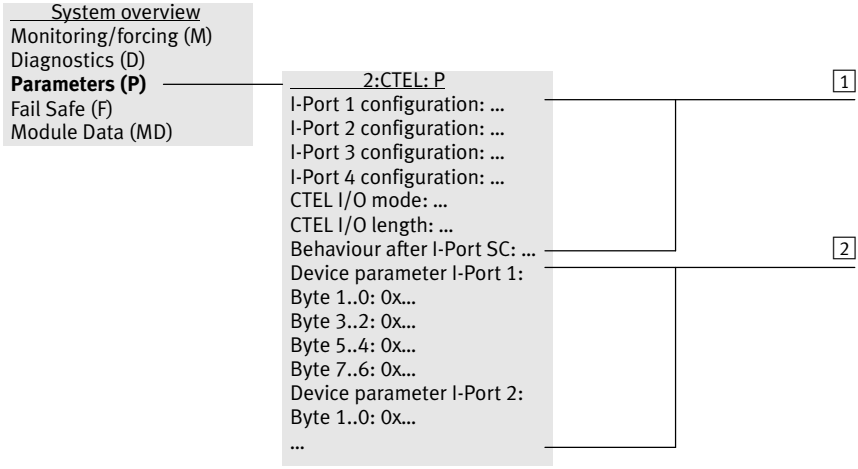
Fig. 4.2

The “Force” function can also be called up via the “Monitoring/Forcing (M)” menu. This function allows you to force signal statuses during the commissioning phase for test purposes.

The representation of the I-Port devices also applies accordingly to the “Idle mode” and “Fail safe” functions.

4.7.3 Parameterisation with the operator unit (CPX-MMI)

You can use the operator unit to parameterise for test purposes in the commissioning phase, for troubleshooting or for fieldbus protocols which do not support parameterisation via the fieldbus (➔ Fig. 4.3).



1 Parameter CTEL master module

2 Parameter I-Port devices

Fig. 4.3

4.8 Commissioning with the Festo Maintenance Tool software (CPX-FMT)

The Festo Maintenance Tool software (CPX-FMT) can also be used for commissioning, parameterisation and advanced diagnostics of the CTEL master module. The current software version can be found online (➔ www.festo.com/sp).
Fig. 4.4 shows the list of parameters of a CTEL master module as an example.

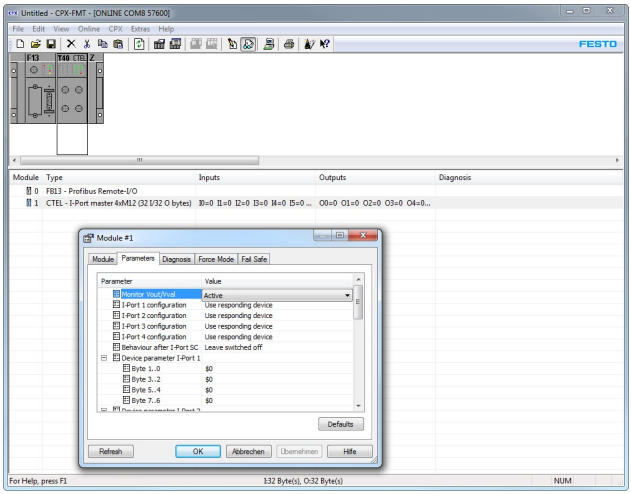


Fig. 4.4

Warning
The connected actuators can move unexpectedly!
Modification of the signal statuses and parameters with the FMT can trigger dangerous movements of the connected actuator technology.

- Make sure that nobody is in the positioning range of the connected actuators and be very careful with parameterisation or manipulation of signal statuses.
- It is imperative that you observe the notes on “Forcing”, “Idle mode” and “Fail safe” in the CPX system description (➔ P.BE-CPX-SYS-...).

5 Diagnostics and error handling

5.1 Summary of diagnostics options

The CTEL master module supports various options for diagnostics and error handling in the CPX terminal. An overview is provided by Tab. 5.1.

Diagnostics option	Explanation/advantages	Detailed description
Error messages	The CTEL master module reports specific malfunctions as error messages (error numbers) to the CPX bus node. Advantage: Error messages can be evaluated via the CPX bus node, operator unit or FMT.	➔ 5.2 ➔ CPX system description (P.BE-CPX-SYS-...)
LED display	The CTEL master module reports specific malfunctions as error messages (error numbers) to the CPX bus node. Advantage: Fast “on-site” error detection.	➔ 5.3
Status bits, I/O diagnostic interface and specific diagnostic functions	The errors recognised by the CTEL master module are reported in some cases to the CPX bus node with special additional information. Advantage: Fast access to error messages via the fieldbus, etc.	➔ 5.4 ➔ CPX system description (P.BE-CPX-SYS-...) ➔ CPX bus node description
Diagnostics via the operator unit	Menu-driven display of diagnostic information on the operator unit. Advantage: Fast “on-site” error detection.	➔ 5.5 ➔ Operator unit description (P.BE-CPX-MMI-1-...)
Diagnostics via the Festo Maintenance Tool (FMT)	The FMT offers the option to display diagnostic information on a PC. Advantage: Fast “on-site” error detection; diagnostics also possible from a higher automation level	➔ 5.6 ➔ Online help for the FMT

Tab. 5.1 Diagnostics options

The available diagnostic information may depend on the settings of the CPX bus node or on the parameterisation.

5.2 Diagnostic/error messages

Note
A requirement for transmission of diagnostic/error messages (if supported by the respective fieldbus) is an existing connection to the host system
(➔ 3.6 Connection with the host system) and a corresponding parameterisation of the CTEL master module (➔ 4.6 Parameters).

5.2.1 Priorities of the diagnostic/error messages

The CTEL master module differentiates between 5 error instances (system + 4 I-Ports) that can cause the diagnostic/error messages.
The error instances have different priorities in the CPX system. If several diagnostic/error messages cannot be displayed parallel to each other on the fieldbus side, the error message with the highest priority is displayed.

Priority	Error instance	Description
Highest	System	Error in the CTEL master module
•	I-Port 1	Error in the module at I-Port 1
•	I-Port 2	Error in the module at I-Port 2
•	I-Port 3	Error in the module at I-Port 3
Lowest	I-Port 4	Error in the module at I-Port 4

Tab. 5.2 Priorities of the error instances

The error instances of the I-Ports are assigned standard to the outputs. If no outputs are intended in the configuration of the CTEL master module, the error instances are assigned to the inputs.

In the CPX terminal, the individual modules also have prioritisation. This runs from the CPX bus node (always completely to the left) descending to the right. Modules that are closer to the bus node thus have a higher priority than modules that are further to the right.

Within a CPX terminal, diagnostic/error messages with reference to inputs have priority over diagnostic/error messages of outputs. This principle of error prioritisation also finds use in the CTEL master module in the I/O mixed operation.

5.2.2 Diagnostic/error messages by CPX error numbers

Tab. 5.3 shows an overview of the CPX errors as well as possible causes and information for error handling.

CPX error number	Description of possible causes	Error handling
0	Device OK	No action required
1	General error	
	– Device NOK, general diagnostics – Hardware error – device replacement – Component error – repair or replacement – General error in the power supply – Fuse triggered – Device software error	• Check device, eliminate errors
	– Mass error – Temperature overload	• Check the installation
	– Technology-specific application error	• Reset device
	Measuring range exceeded	• Check application
2	Short circuit	• Check the installation
3	Wire break	• Check the installation
5	Error in the power supply	
	– Primary voltage/main power supply too low – Undervoltage PL Device supply (only relevant if PL monitoring is active in a device)	• Check power supply
9	Below minimum value	
	– Device temperature limit fallen below	• Check the installation
	– Error in memory buffering – Low battery level	• Check batteries
10	Maximum value not reached	
	– Device temperature limit exceeded	• Check the installation
	– Primary voltage/main power supply too low	• Check power supply
17	Incorrect I/O length CPX system start with setting “Stored parameters”	• Use system setting “Standard parameter” at the start of the CPX terminal
24	Process variable range underflow	• Process data inconsistent, check
25	Process variable range overflow	• Process data inconsistent, check

CPX error number	Description of possible causes	Error handling
29	Parameter error	
	Invalid parameters received from the host system	• Check parameterisation
	Parameter error	• Check data sheet and values
	Missing parameters	• Check data sheet
	Changed parameter	• Check configuration
39	Maintenance required	• Process data inconsistent, check
56	Short circuit at I-Port (PS/PL supply or communication signal)	• Check the installation
57	I-Port device missing/failed	• Check configuration
58	I-Port configuration error	• Check configuration

Tab. 5.3 Diagnostic/error messages by CPX error numbers

When the CTEL master module is accessed via FMT/MMI, the current error for each I-Port can be determined more precisely by means of an event code if the error is due to the connected device.
A list with the relevant event codes can be found in the appendix (➔ A.2 Event codes).

5.3 Diagnostics via LEDs

LED indicators for diagnostics of the CPX terminal are available on the I-Port devices and on the CTEL master module (➔ 2.3 Display components).

The significance of the LEDs on the I-Port devices can be found in the description of the respective device.

5.4 Diagnostics via the CPX bus node

Malfunctions of the connected I-Port devices are reported to the CPX bus node as CPX error messages. The following sections describe the special features of the representation for the CPX-specific diagnostics options.

– Status bits (➔ 5.4.1 Status bits of the CPX terminal)
– I/O diagnostics interface (➔ 5.4.2 I/O diagnostic interface and diagnostic memory)
– Diagnostic memory (➔ 5.4.2 I/O diagnostic interface and diagnostic memory)

5.4.1 Status bits of the CPX terminal

Tab. 5.4 shows the effect of the CTEL master module on the status bits of the CPX terminal.

Bit	Diagnostic information with logic 1	Description	Cause of error, CTEL master module
0	Error at the valve	Module type in which the error has occurred	–
1	Error at output		–
2	Error at input		–
3	Error at analogue module/ technology module (function module)		Bit 3 is set for all errors of the CTEL master module.
4	Undervoltage	Error type	Error number 5[1)]
5	Short circuit/overload		Error number 56[1)]
6	Wire break		–
7	Other error		Error number 57, 58[1)]

1) ➔ Tab. 5.3

Tab. 5.4 Overview of status bits

Further notes on the function and content of the status bits are found in the CPX system description (➔ P.BE-CPX-SYS-...).

5.4.2 I/O diagnostic interface and diagnostic memory

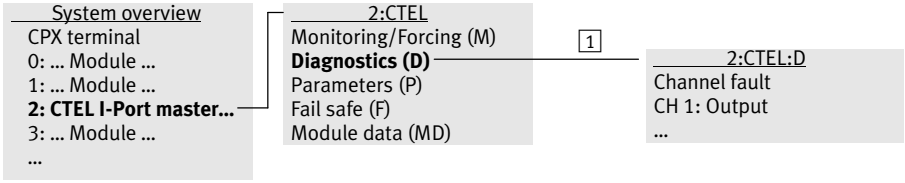
The CTEL master module reports specific diagnostic information to the CPX bus node. Via the I/O diagnostic interface and the diagnostic memory of the CPX terminal, it is possible to apply the diagnostics to individual I-Port devices. The I-Port devices connected to a CTEL master module are treated as input or output channels within the CPX terminal.

Detailed information about the I/O diagnostic interface and diagnostic memory can be found in the CPX system description (➔ P.BE-CPX-SYS-...).

5.5 Diagnostics with the operator unit (CPX-MMI)

The operator unit (CPX-MMI) offers convenient or extended functions which assist you in diagnosing and troubleshooting with the CTEL master module.

Additional diagnostic functions of the operator unit have already been described in the “Commissioning” chapter (➔ 4.7 Commissioning with the operator unit (CPX-MMI)).



1 “Diagnostics” menu

Fig. 5.1

General information regarding operation and commissioning of the CPX terminal using the operator unit can be found in the description for the operator unit (➔ P.BE-CPX-MMI-1-...).

5.6 Diagnostics with the Festo Maintenance Tool (CPX-FMT)

The Festo Maintenance Tool (CPX-FMT) offers extended functions for diagnostics and troubleshooting with the CTEL master module.

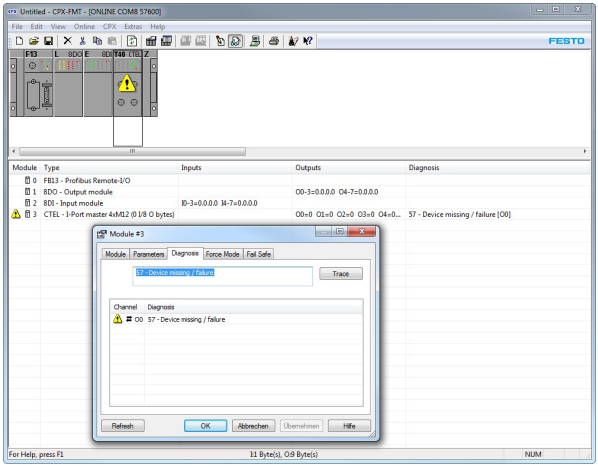


Fig. 5.2

General information regarding operation and commissioning of the CPX terminal with the FMT can be found in the CPX system description (➔ P.BE-CPX-SYS-...) and in the online help of the CPX-FMT software.

5.7 Behaviour after lost connection to the device

With an interruption of the communication between the CTEL master module and a device (e.g. through a wire break), the CTEL master module puts out various diagnostic/error messages. These are (also) dependent on the setting of the parameter “I-Port configuration”.
During operation, the I-Ports are checked for the I/Os and I/O lengths that are set and assigned in the CPX system.
If the parameter of the corresponding I-Port is set to “Use existing device”, no error is issued.
If the parameter of the corresponding I-Port is set to “Expect device”, the CTEL master module issues the error “I-Port device missing/failed” (CPX error number 57) when communication with the device is interrupted.

If input bytes are assigned for the separated device in the CPX system, these are automatically set to “0”.
For existing output bytes, their last known status is saved.

After an interruption is determined, the relevant I-Port is queried cyclically and checked for a connection-capable device.
If a device is recognised, the following procedures are possible:

The recognised device corresponds to the I/O configuration presetting.
The system can continue to be operated without limitation.

If the I/O length of the recognised device is less than the length established in the configuration, the I/O bytes used are assigned to the “lower end” of the reserved address space in the CPX system. The unassigned bytes at the “upper end” remain unused.

Example:
Configuration with an I/O length of 8 bytes. A device with an I/O length of 4 bytes is connected.
The 4 bytes of the device are assigned to the first 4 bytes in the address space of the I-Port.
The remaining 4 bytes remain unused.

I-Port	Fixed I/O length 8 bytes	Device: 4 bytes
I-Port	Byte 0	Byte 0
	Byte 1	Byte 1
	Byte 2	Byte 2
	Byte 3	Byte 3
	Byte 4	X
	Byte 5	X
	Byte 6	X
	Byte 7	X

Tab. 5.5

The recognised device has established a larger I/O length than in the I/O configuration presetting.
The system can still be operated. But the I/O bytes that “project” beyond the reserved address space are ignored.
Example:
Configuration with an I/O length of 4 bytes. A device with an I/O length of 8 bytes is connected. The first 4 bytes of the device are assigned to the 4 bytes in the address space of the I-Port. The remaining 4 bytes of the device remain unused.

I-Port	Fixed I/O length 4 bytes	Device: 8 bytes
I-Port	Byte 0	Byte 0
	Byte 1	Byte 1
	Byte 2	Byte 2
	Byte 3	Byte 3
	X	Byte 4
	X	Byte 5
	X	Byte 6
	X	Byte 7

Tab. 5.6

An output device is recognised, but the CTEL master module is configured for operation as a pure input module.
The system can still be operated. Corresponding to the setting for the relevant I-Port, either an I-Port configuration error is reported (with setting “Expect device”) or no error message is issued (with setting “Use existing device”).
The reserved address space for input data is completely assigned; all input bits are set to the value “0”. Write access to the outputs of the connected device is not possible.

An input device is recognised, but the CTEL master module is configured for operation as a pure output module.
The system can still be operated. Corresponding to the setting for the relevant I-Port, either an I-Port configuration error is reported (with setting “Expect device”) or no error message is issued (with setting “Use existing device”).
The reserved address space for output data is completely assigned. All write access to the output bits is ignored. Changes in status of the device inputs are also ignored.

5.8 Behaviour with error at the PL/PS supply

If the CTEL master module recognises a short circuit or overload at an I-Port on one of the related power supply cables PS or PL, the I-Port involved is always switched off completely (PS and PL off). Behaviour after elimination of the error can be set via the parameter “Behaviour after I-Port short circuit” (➔ 4.6.4 Parameter “Behaviour after I-Port short circuit”).

A Commissioning

A.1 Technical data

General			
General technical data			➔ CPX-system description P.BE.-CPX-SYS-...
Degree of protection through housing[1] in accordance with IEC 60529, completely mounted, plug connector inserted or with protective caps.			IP65/IP67
Protection against electric shock Protection against direct and indirect contact in accordance with IEC 60204-1			Through the use of PELV circuits (Protected Extra-Low Voltage)
Module code (CPX-specific)			194 (0xC2)
Module identifier (in operator unit CPX-MMI)			CTEL
Part number			1577012
Dimensions W × L × H		[mm]	50 x 107 x 55 (incl. interlinking block)
Product weight		[g]	approx. 110
Information on materials - housing			PA-reinforced, PC
Note on materials			RoHS-compliant
Ambient temperature		[°C]	–5 ... +50
Storage temperature		[°C]	–20 ... +70
Moisture/heat			95 %/50 °C
Vibration and shock (mounting-dependent)[2]			
Vibration	Wall mounting		SG2
	H-rail mounting		SG1
Shock	Wall mounting		SG2
	H-rail mounting		SG1
Continuous shock resistance	Wall mounting		SG1
	H-rail mounting		SG1

1) Connected devices may only satisfy a lower degree of protection or a smaller temperature range, etc.

2) SG = severity level

Tab. A.1

Power supply		
Operation/load voltage range	[V DC]	18 ... 30
Recommended minimum voltage for load voltage supply U_{VAL} (PL) with operation of devices on I-Port connecting cables > 5 m	[V DC]	21.6 (24 – 10 %)
Nominal operating voltage	[V DC]	24
Intrinsic current consumption at 24 V from operating voltage supply $U_{EL/SEN}$ (without connected devices)	[mA]	typ. 65
Maximum current consumption per I-Port at 24 V		
from operating voltage supply $U_{EL/SEN}$ (PS)	[A]	1.6
from load voltage supply U_{VAL} (PL)	[A]	1.6
Electrical isolation		
between operating voltage supply $U_{EL/SEN}$ and load voltage supply U_{VAL}		Yes, with potential-isolated supply
Supply PS/PL between the I-Ports		No
Functional earth connection		Optional, through earthing plate
Mains buffering time	[ms]	10

Tab. A.2

CTEL system		
Design		
Protocol		I-Port
Number of I-Port interfaces		4
Maximum number of devices per I-Port		1
Maximum cable length per I-Port	[m]	20
Number of inputs/outputs for module	[byte]	32 I/32 O
Transmission rate (per I-Port)	[kbps]	230.4
Internal cycle time (dependent on the connected devices)	[ms]	1 per 1 byte of user data parallel each connected device
Electrical connection		4 × sockets M12, 5-pin, A-coded
LED indicators		Status system supply Status load voltage I-Port status/diagnostics Module status
Maximum cable length between module and device	[m]	20
Short-circuit protection		
Supply for devices (PS) and load voltage (PL)		Internal (electronic), separate for each I-Port
Behaviour after short circuit		Dependent on parameter “Behaviour after short circuit”
Reverse polarity protection		Separate for each system and load voltage, not separated per I-Port
Parameterisation		Module parameter Diagnostic behaviour Fail safe (per channel) Forcing (per channel) Idle mode (per channel)
Diagnostics		
Module-oriented diagnostics		Undervoltage PS
Undervoltage/short circuit of modules		Undervoltage PL (over device)
I-Port		Communication error Short-circuit PS/PL Device error
Undervoltage identification PS[1)]		
Trigger level	[V]	approx. 17.5
Hysteresis	[mV]	approx. 500

1) Measurement takes place in CTEL master module

Tab. A.3

A.2 Event codes

Within the I-Port communication between the CTEL master module and the devices, so-called events are used for status diagnostics, which include an error code (event code), each with a constant length of 2 bytes. The following table provides an overview of the event codes with the corresponding error description.

Information regarding error handling can be found in Tab. 5.3.

Event code	Error instance	Description	CPX error no.
---	Internal	Short circuit at I-Port supply (PS/PL) or communication signal	56
---		I-Port configuration error	58
---		I-Port device missing/failed	57
---		Invalid parameters received from the host system (parameterisation error)	29
0x...	I-Port device	All other event codes not specified in this table	1
0x0000		Device OK	0
0x1000		Device NOK, general diagnostics	1
0x4000		Temperature overload	
0x4210		Device has exceeded temperature limit	10
0x4220		Device has fallen below temperature limit	9
0x5000		Hardware error – device replacement	1
0x5010		Component error – repair or replacement	
0x5011		Error in memory buffering	9
0x5012		Low battery level	
0x5100		General error in power supply	1
0x5101		Fuse triggered	
0x5110		Primary voltage/main power supply too low	10
0x5111		Primary voltage/main power supply too low	5
0x5112		Undervoltage PL device (only relevant if PL monitoring is active in a device)	
0x6000		Device software error	1
0x6320		Parameter error	29
0x6321		Missing parameters	
0x6350		Changed parameter	

Event code	Error instance	Description	CPX error no.
0x7700	I-Port device	Wire break at device peripherals	3
0x7701 … 0x770F		Wire break at device 1 … 15	
0x7710		Short circuit	2
0x7711		Mass error	1
0x8C00		Technology-specific application error	1
0x8C10		Process variable range overflow – process data inconsistent	25
0x8C20		Measuring range exceeded	1
0x8C30		Process variable range underflow – process data inconsistent	24
0x8C40		Maintenance required – cleaning	39
0x8C41		Maintenance required – refill	
0x8C42		Maintenance required – replace wearing parts	

Tab. A.4

A.3 Accessories

➔ www.festo.com/catalogue

B Glossary

B.1 List of abbreviations

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

Term/abbreviation	Description
Bus node	Provide the connection to specific fieldbuses. Communicate with connected I/O modules and monitor their ability to function.
CPX modules	Collective term for the various modules which can be integrated into a CPX terminal.
CPX system	Totality of the software of all CPX modules of a CPX terminal.
CPX terminal	Totality of the combined CPX modules, including a bus node, without pneumatics.
Device	Any module that can be connected to the CTEL master module via the I-port interface.
FMT	Festo Maintenance Tool. PC software for commissioning, configuration and extended diagnostics of CPX terminals.
I	Digital input
I-module	Input module
I/O length	Number of bytes available for inputs and outputs.
IO-Link	Protected designation for a point-to-point communication system for connection of sensors and actuators to an automation system.
I/O mode	Operation of the CTEL master module, either as a pure input module, a pure output module or in mixed operation.
I/O modules	Collective term for the modules which provide digital inputs and outputs (e.g. CPX I/O modules, I-port input and I-port output modules).
I/Os	Digital inputs and outputs
I-Port	Interface for connecting I-Port devices to the CTEL master module.
LSB	Least significant bit/byte (bit/byte with the lowest value).
MMI	Man-Machine interface, operator unit for reading and configuring CPX systems.
MSB	Most significant bit/byte (bit/byte with the highest value).
O	Digital output
O module	Output module
SCS	Short circuit in the power supply of the system.
Slave module	➔ Device

Tab. B.1 Terms and abbreviations

Index

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