Linear gantry with control system

EXCT-...-C...

FESTO

Description

Commissioning

8059088
1601NH
[8059090]
Translation of the original instructions
EXCT-...-C...-EN

CODESYS® is a registered trademark of its respective trademark holder in certain countries.

Identification of hazards and instructions on how to prevent them:

**Danger**
Immediate dangers which can lead to death or serious injuries

**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
  ➔ Result of an action/References to more detailed information
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1 Safety and requirements for product use

1.1 Safety

1.1.1 General safety information

- Observe all warnings in this documentation.
- Observe all warnings and safety instructions for the related accessories.

**Danger**
Risk of injury from electric shock.

- Switch off all supply lines and verify they are free of voltage prior to mounting, installation and/or maintenance work and secure them from being switched back on.
- Dangerous residual voltage even after the power supply is switched off:
  Start work on plugs and interfaces only when the residual voltage has fallen below 60 V.
- Only use power sources which guarantee reliable electrical isolation of the operating voltage in accordance with EN 60204-1 (PELV).
- Connect all PE protective conductors before commissioning.
- Observe the regulations of EN 50178 and EN 60204-1 for protective earthing during installation.
- Switch the power supply back on only after completion of work.

**Danger**
Uncontrolled movements of the product or falling interface (Z-axis).
The interface (Z-axis) can fall in an uncontrolled manner in the following cases:
- Through release of the motor brakes.
- If the toothed belt breaks during operation or standstill.
Risk of injury due to electric shock, impact, crushing.

- Perform a risk assessment for operation of the product.
- Only operate the product if the dangers to people identified in the risk assessment can be excluded through appropriate measures.
- Use appropriate safeguards to ensure that no one can stand in or below the operating area of the product.
- Before releasing the motor brakes or switching off the power supply, ensure the following:
  - Motors are inactive (no rotation)
  - Interface (Z-axis) is in the lower end position
**Warning**

If installation and commissioning procedures are not performed correctly:

Risk of injury due to impact, crushing or electric shock.

- Commissioning should only be carried out by specially trained personnel.

The following qualifications are required:

- Knowledge of the Festo Configuration Tool (FCT) software
- Experience with installation and operation of electrical control systems

For support during the commissioning phase:

- Please contact your regional Festo contact person (世界观www.festo.com/sp).

**Note**

Damage to the product from incorrect handling.

- Never pull out or plug in the plug connectors and interfaces when powered.
- Observe the handling specifications for electrostatically sensitive devices.

**Note**

Unauthorised access to the device can cause damage or malfunctions.

When connecting the device to a network:

- Protect the network from unauthorised access.

Measures for protecting the network include:

- Firewall
- Intrusion Prevention System (IPS)
- Network segmentation
- Virtual LAN (VLAN)
- Virtual Private Network (VPN)
- Security at physical access level (port security)

Additional information: standards/guidelines for security in information technology.
1 Safety and requirements for product use

1.1.2 Intended use
The linear gantry EXCT, subsequently referred to as the product, and the control system CMCA-...-B... are intended for executing positioning tasks within machines or automated systems with a higher-order controller.

- Only use the product and the control system as follows:
  - In perfect technical condition
  - In its original status, without unauthorised modifications
  - Within the limits of the product defined by the technical data
  (Accompanying documentation)
  - In an industrial environment

The safety circuit of the control system CMCA-...-B... is only one part of the safety concept for a machine, whereby the safety concept must be based on a risk assessment of the entire machine to be performed by the machine manufacturer.

Note
The removal of mechanical components (e.g. toothed belts) results in homing settings being lost. A new homing procedure and adaptation of the feed constants are required during the subsequent commissioning phase.

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

1.1.3 Foreseeable misuse

- Never use the product under the following conditions:
  - The safety circuit of the control system CMCA-...-B... is changed in its function.
  - With the control system CMCA-...-B... safety functions are implemented that are not described in this documentation.
  - The safety circuit is not appropriate for the application.
  - Without verification and validation of the circuit in the machine
  - Without a risk assessment of the complete system
  - Without a safety concept for the complete system

1.1.4 Specified standards/guidelines

<table>
<thead>
<tr>
<th>Issue status</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN ISO 13849-1:2008-12</td>
</tr>
<tr>
<td>Tab. 1.1</td>
</tr>
</tbody>
</table>
1.2 Requirements for product use

- Provide this documentation to the following persons:
  - Design engineer
  - Installer
  - Commissioner
- Comply with the specifications of the documentation.
  Follow all accompanying documentation and the documentation of any associated accessories.
- Take the following into consideration for the destination:
  - Regulations and standards
  - Regulations of the testing organisations and insurers
  - National specifications
- For correct and safe use, take the following into account:
  - All warnings and instructions
  - Comply with the load limits of the product and the connected components
    (Technical data of the corresponding documentation).

1.2.1 Qualification of specialized personnel
Mounting, installation, commissioning, maintenance and care, disassembly and repair, as well as disposal should only be performed by qualified personnel who are familiar with the following:
- Installation and operation of electrical control systems
- Installation and operation of pneumatic control systems
- Mounting and operation of mechatronic handling systems
- Regulations for accident prevention and occupational safety
- Documentation and mode of operation of the product

1.2.2 Range of applications and certifications
Standards and test data of the products (Technical data of the corresponding documentation). Certificates and declaration of conformity (www.festo.com/sp).
2 Overview

2.1 System overview
The system EXCT-...-C... consists of the linear gantry EXCT and the control system CMCA-...-B...

Linear gantry EXCT
Two fixed servo motors drive a toothed belt arrayed in a T-shape.
The toothed belt moves the slide of the Y-axis and the interface located on the Z-axis in a 2-dimensional space.
A controller calculates the position of the interface.
The controlled interaction of the motors results in the corresponding movement of the interface.

Control system CMCA-...-B...
The control system CMCA-...-B..., subsequently referred to as the control system, includes the following components that are necessary for activation of the linear gantry:
- Multi-axis controller CMXR-C2; subsequently referred to as the multi-axis controller
- Motor controller CMMP; subsequently referred to as the motor controller
There is also an integrated safety circuit which, together with the operator unit CDSA, represents the basic functionality.

2.2 Accessories
The following are required for commissioning the linear gantry together with the control system:
- PC/laptop with installed Festo Configuration Tool (FCT), including the plug-ins for the multi-axis controller and the motor controllers
- USB memory card with documentation and software (3.1.3 USB memory card) (included in scope of delivery)
- Setting piece with separate spacing bolt for homing procedures and determination of feed constants (included in scope of delivery)
- Accompanying documentation
- Operator unit CDSA (not included in scope of delivery); subsequently referred to as the operator unit
3 Commissioning

This chapter describes the procedure for commissioning the system comprising the linear gantry and control system in its delivery status (3.1.2 Delivery status).

Note
Commissioning requires knowledge of how to work with the following systems:
- Control system and the components contained therein
- Operator unit
Specific instructions on the individual products and components required for commissioning can be found in the corresponding documentation.
- Prior to commissioning of the system, make sure you have read and understood the documentation.

The control system is available in various designs.
as a completely configured control cabinet or as a mounting plate for installation in a control cabinet by the system manufacturer or operator.
In this description, the control elements are designated corresponding to the control cabinet version.
- In case of a user-specific or user-produced control cabinet:
  Note the possibly deviating designations of the control elements.

3.1 General information

3.1.1 Prior to commissioning
Carry out the following steps to prepare for commissioning:
1. Mount the kinematics (Description of linear gantry EXCH “Mechanical Installation”).
2. Connect control system (Description of control system CMCA-...-B... “Electrical Installation”).

3.1.2 Delivery status
FCT base projects for all available kinematics variants can be found on the USB memory card.

Note
When delivered, the control system is not yet configured for the linear gantry.
The following steps must also be performed during commissioning:
- Create a kinematic-specific FCT project from the FCT base project that fits the kinematics (3.4).
- Transfer control data of the kinematics-specific FCT project into the components of the control system (3.5).
### 3.1.3 USB memory card

The accompanying USB memory card includes documentation and software for commissioning (Tab. 3.1):

- Documentation regarding the linear gantry and control system
- FCT software and plug-ins
- FCT base projects for various kinematics variants (Tab. 3.2)

#### Fold out interface

![Fig. 3.1](image1)

![Fig. 3.2](image2)

#### Content structure

<table>
<thead>
<tr>
<th>Directories</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>← ⬇️ Documentation</td>
<td>Declaration of incorporation in accordance with EC Machinery Directive 2006/42/EC</td>
</tr>
<tr>
<td>← ⬇️ Declaration of Incorporation</td>
<td>Description of EXCT “Mechanical installation”</td>
</tr>
<tr>
<td>← ⬇️ Description Mechanical Installation</td>
<td>Description CMCA-...-B... “Electrical Installation”</td>
</tr>
<tr>
<td>← ⬇️ Description Electrical Installation</td>
<td>Description of EXCT-...-C...“Commissioning”</td>
</tr>
<tr>
<td>← ⬇️ Description Comissioning</td>
<td>Assembly instructions for the accessories</td>
</tr>
<tr>
<td>← ⬇️ Description Accessories</td>
<td></td>
</tr>
<tr>
<td>← ⬇️ Software</td>
<td>Installation file for FCT framework and CMMP plug-in</td>
</tr>
<tr>
<td>← ⬇️ CMMP</td>
<td>Firmware file for motor controller (to install on it when a motor controller is replaced)</td>
</tr>
<tr>
<td>← ⬇️ CMXR-C2</td>
<td>Installation file for FCT framework and CMXR-C2 plug-in</td>
</tr>
<tr>
<td>← ⬇️ Base_projects</td>
<td>FCT base projects for various kinematics variants with multi-axis controller CMXR-C2</td>
</tr>
<tr>
<td>← ⬇️ Target</td>
<td>Target Support Package Codesys</td>
</tr>
<tr>
<td>← ⬇️ CoDeSys</td>
<td>Installation file for Codesys</td>
</tr>
<tr>
<td>← ⬇️ FCT plug-in</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 3.1
FCT base projects

The base projects have been prepared for various kinematics variants and differ in content regarding the following product characteristics and variants.

In the file name of the base projects, the included characteristics and their variants are designated with the following codes.

<table>
<thead>
<tr>
<th>Product characteristic and variant</th>
<th>Code in the base project name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>EXCT -15 -...</td>
</tr>
<tr>
<td></td>
<td>-30 -...</td>
</tr>
<tr>
<td></td>
<td>-100 -...</td>
</tr>
<tr>
<td>Motor attachment position</td>
<td>-... -VV</td>
</tr>
<tr>
<td>Both at the front</td>
<td>-... -VH</td>
</tr>
<tr>
<td>Motor 1 (left): Front; motor 2 (right): Rear</td>
<td>-... -HV</td>
</tr>
<tr>
<td>Motor 1 (left): Rear; motor 2 (right): Front</td>
<td>-... -HH</td>
</tr>
<tr>
<td>Both at the rear</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 3.2 Code for file names of the base projects

Note

The FCT base projects do not yet include all kinematics-specific specifications.

For commissioning, the base project that fits the kinematics must be selected and expanded to a kinematics-specific FCT project (⇒ 3.4 Creating kinematics-specific FCT project).
### 3.1.4 Axes and motors

![Diagram of linear gantry EXCT-15-...-AB-VV]

- **Drive housing**
- **Coupling housing**
- **Motor 2 (right)**
- **Y-axis**
- **Z-axis**
- **Interface for attachment components**
- **Multi-pin plug distributor**
- **Motor 1 (left)**
- **Slide units of the Y-axis**
- **Mounting kit**
- **Energy chain of the Y-axis**
- **Energy chain of the Z-axis**

1) Optional

---

**Fig. 3.3** Example illustration of linear gantry EXCT-15-...-AB-VV

The motor attachment position depends on the order. The motors are not assigned directly to an axis. A controller calculates the position of the interface. The controlled interaction of the motors results in the corresponding movement of the interface.
3.1.5 Control elements

1 Interlock for control cabinet doors
2 Mains switch
3 Connection for operator unit

Fig. 3.4 Control cabinet

4 Control and signal elements (Fig. 3.5)
5 Emergency stop switches
Illuminated pushbutton “acknowledge emergency stop”: Confirms that the emergency stop circuit is unlocked

Indicator light “external emergency stop”: External emergency stop triggered

Indicator light “automatic control”: Automatic operation active

Key switch “automatic/manual”: Switches between
- Automatic operation “automatic” (switch in position “0”) and

The switch is only active when the “local” operating mode has been selected by means of link plugs (Description of control system CMCA-...-B... “Electrical installation”). With “external” operating mode, the switch is without effect.

Indicator light “manual control”: Manual override active

Key switch “brake release”: Release motor brakes.

Only possible in the manual override mode and by using the operator unit (3.1.9 Releasing the brakes).

Fig. 3.5 Operating and signal elements

The labels for marking the control elements in German are also included with the control cabinet.
### 3.1.6 Operator unit

**Warning**
Ineffective emergency stop actuation if the operator unit is not connected.
Risk of injury due to electric shock, impact, crushing.
- If an operator unit is not connected, keep it out of the reach of the user.

Unplugging the connection cover or the operator unit triggers an emergency stop.
- Ensure the system is at a standstill before the connection cover or the operator unit is plugged in or unplugged.
Either the operator unit must be connected to the control system or the connection cover must be mounted. Otherwise, the emergency stop circuit is opened (emergency stop active).

**Connecting the operator unit**

1. Switch off the control system at the mains switch.

   - If the operator unit is connected when the control system is switched on, an emergency stop is triggered (Description of control system CMCA-...-B... “Electrical Installation”).
   - Before starting the commissioning phase: Acknowledge the emergency stop.

**Warning**
Unexpected movements of the interface (Z-axis): the enabling buttons of the operator unit become operational immediately after the connection is established.
Risk of injury due to electric shock, impact, crushing.
- Please note that movements of the interface are triggered when actuating the enabling buttons under the following condition:
  - The control system is switched on and
  - The control system is set to manual override and
  - Key switch “brake release” is set to the “2 o’clock position”.

2. Connect the operator unit to the connection on the left control cabinet door (3.1.5 Control elements) or for orders without control cabinet, on the mounting plate.
3. Switch on the control system at the mains switch.
**Function of the enabling button**
The operator unit has two enabling buttons, which can be actuated alternatively.
The enabling buttons have the following three possible switch positions.

<table>
<thead>
<tr>
<th>Switch position</th>
<th>Enabling button</th>
<th>Function</th>
<th>Switch contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not actuated</td>
<td>Off (neutral position)</td>
<td>Off (opened)</td>
</tr>
<tr>
<td>2</td>
<td>Actuated (up to pressure point)</td>
<td>Permission</td>
<td>On (closed)</td>
</tr>
<tr>
<td>3</td>
<td>Pressed (end stop)</td>
<td>Off (panic setting)</td>
<td>Off (opened)</td>
</tr>
</tbody>
</table>

Tab. 3.3

In Tab. 3.3, the enabling function (switch position 2) of the enabling button is cancelled by

- releasing the enabling button (switch position 1) or
- pressing beyond the pressure point (switch position 3).

When the switch position is returned from 3 to 1, the enabling function is not effective.

**Logging on as administrator**

To execute various steps you will need to log onto the operator unit as an administrator.

1. After completion of the boot procedure on the operator unit:
   Use the button and “Setup” to change to the Setup mask.
2. Select “User” button on the lower edge of the screen.
3. In the “User” list field, select the user “Administrator”.
4. Enter password: Factory setting “admin”.
5. Activate write permissions: Set at “Write Access”.
6. Confirm with “OK”.

**3.1.7 Emergency stop circuits**
The control system differentiates between two emergency stop circuits:
- Internal emergency stop: Triggered at the control system.
- External emergency stop: Triggered, for example, by a higher-order controller.
  The connection contacts for external emergency stop and safety door switch are open and not bridged in the delivery status.

- Acknowledge the external emergency stop at the higher-order controller, in order to close the contacts (Description of control system CMCA-...-B... “Electrical installation”; Circuit diagram).
3.1.8 Manual override/automatic operation

The operating modes manual override and automatic operation differ primarily in the handling of safety doors and the reduced speed of the kinematics in manual override.

**Warning**

High travel speeds in automatic operation.
Risk of injury due to electric shock, impact, crushing.
- Only perform set up and checking work in manual override mode and at low speeds.

**Switching from manual override/automatic operation**

Switching of the operating modes depends on the setting for the operating mode selection.
- For local operating mode selection: With the key switch “automatic/manual” (Fig. 3.5).
- For external operating mode selection: With the higher-order controller.
  
  In this case, the “automatic/manual” key switch has no function.

**Information on setting the mode selection:**
- Description of control system CMCA-...-B... “Electrical installation”

**Manual override**

In manual override mode, the kinematics can be moved manually via the operator unit, even with open safety doors.

The manual override mode is used to check the installed system, made up of the linear gantry and the control system, as well as for setting up and commissioning the programs. The speed is limited during this mode.

**Note**

The speed limitation of the manual override is not reliable as defined by EN ISO 13849-1. Additionally, external safeguarding must be adopted for safety-relevant control tasks or for the safety of persons.

The following conditions must be met to enable motor current with the enabling buttons on the operator unit:
- All emergency stop switches unlocked.
- All emergency stop circuits acknowledged.
- For local mode selection: Key switch “automatic/manual” set to “manual”.
- For external mode selection: Corresponding specification through the higher-order controller.
- Key switch “brake release” in position “0”.

---

**Note**

Only perform set up and checking work in manual override mode and at low speeds.
**Automatic mode**

Automatic operation corresponds to the configuration in production operation. The following conditions must be met for the function (motor current enable):
- Contacts of the safety door switch closed.
- All emergency stop switches unlocked.
- All emergency stop circuits acknowledged.
- For local mode selection: Key switch “automatic/manual” set to “automatic”.
- For external mode selection: Corresponding specification through the higher-order controller.
- Key switch “brake release” in position “0”.

**3.1.9 Releasing the brakes**

Releasing the motor brakes permits manual movement of the interface (Z-axis) in direction Y and Z. Releasing the brakes is only possible in the manual override mode and with the help of the operator unit.

**Requirements**
- Active programs completed.
- Operator unit connected to the control system (3.1.6 Operator unit).

**Warning**

Unexpected movements of the interface (Z-axis): the enabling buttons of the operator unit become operational immediately after the connection is established. Risk of injury due to electric shock, impact, crushing.

- Please note that movements of the interface are triggered when actuating the enabling buttons under the following condition:
  - The control system is switched on and
  - The control system is set to manual override and
  - Key switch “brake release” is set to the “2 o’clock position”.

**Procedure**

1. Switch control system to manual override (3.1.8 Manual override/automatic operation).

**Danger**

The interface (Z-axis) falls in an uncontrolled manner due to release of the motor brakes. Risk of injury due to electric shock, impact, crushing.

- Before releasing the brakes, make sure that the interface (Z-axis) is located in the lower end position.

2. Rotate key switch “brake release” clockwise to the “2 o’clock position”.
3. Actuate the enabling button on the operator unit.
   - The brakes of the drives must unlock audibly.
   - The interface (Z-axis) can now be moved manually.

**Note**

The brakes of the drive motors are only released if these requirements are fulfilled and if the enabling button is actuated on the operator unit.
3.1.10 System inputs

The system inputs of the multi-axis control system are configured for control of the following operating statuses and user interventions.

<table>
<thead>
<tr>
<th>Input</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DI0</td>
<td>Emergency stop (active at status “0”)</td>
</tr>
<tr>
<td>DI1</td>
<td>Enabling buttons on the operator unit</td>
</tr>
<tr>
<td>DI2</td>
<td>Automatic operation selected</td>
</tr>
<tr>
<td>DI3</td>
<td>Manual override selected</td>
</tr>
<tr>
<td>DI4</td>
<td>–</td>
</tr>
<tr>
<td>DI5</td>
<td>Safety doors closed</td>
</tr>
<tr>
<td>DI6</td>
<td>Release brake active</td>
</tr>
<tr>
<td>DI7</td>
<td>External emergency stop active</td>
</tr>
</tbody>
</table>

Tab. 3.4

The status of the inputs can be observed via the I/O monitor of the operator unit.

- To call up the I/O monitor: Press $\text{Alt}$ and then select “IO-Monitor”.

3.2 Festo Configuration Tool (FCT)

The Festo Configuration Tool (FCT) is the software platform for configuring and commissioning different components from Festo.

Information on installation and operation of the FCT can be found in the FCT description. The description is on the USB memory card or, after installation of the program, in the folder `<FCT installation directory>\Help\FCT_<language>.pdf`.

The following descriptions for the Festo Configuration Tool (FCT) refer to “English” as the language setting.

the FCT language setting can be changed in the menu [Extra] [Language].

3.2.1 Required software

The files needed for installation of the FCT are on the accompanying USB memory card.

Required for commissioning are:
- FCT plug-in CMXR-C2, including FCT base program (Framework)
- FCT plug-in CMMP-AS
- Codesys
- Target support package Codesys
The component-specific FCT plug-ins each have their own help files. Three options for opening the Help menu:

- Command [Help][Content of installed PlugIns][Festo][Plug-in name]
- “Help” button in the window area or dialogue of the plug-in
- Function key F1 when a window or dialogue of the plug-in is activated

### 3.2.2 Installing FCT

Admin rights are required for installation on the PC (laptop).
- Install software in the following sequence:
  1. FCT plug-in CMXR-C2, including FCT base program
  2. Codesys
  3. FCT plug-in CMMP with all subordinate elements
  4. Target support package Codesys

For installation of target:

1. Unpack the ZIP file included on the USB memory card in any temporary directory.
2. Install via the Windows start menu:
   - [Programme][Festo Software][Codesys V... by Festo][Install Target].
3. In the “Install Target” dialogue window: With the “Open” button in the temporary directory, search for, select and “open” the file “CMXR-C2.tnf”. 
4. For the possible target systems, select and “install” “CMXR-C2”.
   - The Target program is installed.

### 3.2.3 Starting the FCT

1. Start the FCT via the symbol on the Desktop or via the Windows start menu:
   - [Programme][Festo Software][Festo Configuration Tool].
2. Close the dialogue window “New project - Project properties”.

### 3.2.4 De-archiving an FCT project

1. Open the De-archive dialogue: [Project][Extract].
2. Select button “Search”.
3. In the dialogue window: Select in the directory of the USB memory card the FCT base project (ZIP file) that fits the kinematics (3.1.3 USB memory card).
   - The project is de-archived and opened in the FCT.
3.3 Network configuration

3.3.1 IP addresses

The control system has an integrated Ethernet network, to which the following components are connected:
- Multi-axis controller
- Operator unit (via integrated CAMI-C interface housing)
- Motor controller

Communication is via the TCP/IPv4 protocol.

At the time of commissioning with the control system, the components have the following settings:

<table>
<thead>
<tr>
<th>Component</th>
<th>TCP/IP parameters</th>
<th>Settings</th>
<th>Adapt IP address¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-axis controller CMXR-C2</td>
<td>IP address</td>
<td>192.168.100.100</td>
<td>3.3.3</td>
</tr>
<tr>
<td></td>
<td>Subnet mask</td>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gateway address</td>
<td>192.168.100.1</td>
<td></td>
</tr>
<tr>
<td>Operator unit²</td>
<td>IP address</td>
<td>192.168.100.101</td>
<td>3.3.5</td>
</tr>
<tr>
<td></td>
<td>Subnet mask</td>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gateway address</td>
<td>192.168.100.1</td>
<td></td>
</tr>
<tr>
<td>Motor controller CMMP-AS-…</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...C5-…-M0 for A1 Motor 1³</td>
<td>IP address</td>
<td>192.168.100.102</td>
<td>3.3.4</td>
</tr>
<tr>
<td></td>
<td>Subnet mask</td>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gateway address</td>
<td>192.168.100.1</td>
<td></td>
</tr>
<tr>
<td>...C5-…-M0 for A2 Motor 2³</td>
<td>IP address</td>
<td>192.168.100.103</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subnet mask</td>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gateway address</td>
<td>192.168.100.1</td>
<td></td>
</tr>
<tr>
<td>...C2-…-M0 for A3 Rotary drive on the front unit²</td>
<td>IP address</td>
<td>192.168.100.104</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subnet mask</td>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gateway address</td>
<td>192.168.100.1</td>
<td></td>
</tr>
</tbody>
</table>

¹ For orders without a control system, the IP addresses deviate from these and must be adapted.
² Optional
³ Explanation of the motors (3.1.4 Axes and motors)

Tab. 3.5

To create the connection between the control system and FCT-PC:
- Adapt network settings of the FCT-PC to the network settings of the control system (3.3.2 Adapt IP address of the FCT-PC).

The multi-axis controller, the motor controller and the operator unit do not support automatic assignment of IP addresses (DHCP).

To integrate the control system into an existing network:
- Adapt IP addresses (3.3.3, 3.3.4, 3.3.5).
3.3.2 Adapt IP address of the FCT-PC

Administrator rights are required to adapt the network settings.

To create a connection to the network of the control system, the TCP/IPv4 settings of the used Ethernet interface of the FCT-PC must be adapted.
- Assign an unassigned IP address from the address range 192.168.100.1 ... 254.

<table>
<thead>
<tr>
<th>Component</th>
<th>TCP/IP parameters</th>
<th>Setting (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC with installed FCT</td>
<td>IP address</td>
<td>192.168.100.110</td>
</tr>
<tr>
<td></td>
<td>Subnet mask</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td></td>
<td>Gateway address</td>
<td>192.168.100.1</td>
</tr>
</tbody>
</table>

Tab. 3.6

After installation of the FCT (3.2 Festo Configuration Tool (FCT)), the connection can be made to the multi-axis controller via the address 192.168.100.100.

If the network settings of the FCT-PC cannot be used:
- Adapt network settings of the control system
  (3.3.3 Adapting the IP address of the multi-axis controller).

3.3.3 Adapting the IP address of the multi-axis controller

Only for orders without a control system:
- Change IP addresses according to the following procedure.

1. Connect FCT-PC to the control system.
2. Start the FCT (3.2.3 Starting the FCT).
3. Open the FCT base project that fits the kinematics.
4. In the FCT window “Workspace”, open the CPU parameters of the multi-axis control system: 
   [CMXR-C2...][Configuration][CPU Parameter].
5. Adapt the settings in the range “Network Configuration (X7)”.
6. Establish a connection with the multi-axis controller and transfer the changed configuration with the button “Download”.
7. To accept the changed configuration:
   Switch the control system off and on at the mains switch.
3.3.4 Changing IP addresses of the motor controllers

Only for orders without a control system:
The IP addresses of the motor controllers are from the range 169.254.1.0 ... 169.254.254.255 and can be adapted as needed.

- Change IP addresses according to the following procedure.

1. Connect FCT-PC to the control system.
2. Start the FCT (3.2.3 Starting the FCT).
3. Open the FCT base project that fits the kinematics.
4. In the FCT window “Workspace”, select a motor controller: [CMMP-AS...].
5. Select menu [Component][FCT Interface].
   The dialogue window “FCT Interface” is opened.
7. Select “Scan...” button: the window “Festo Field Device Tool” opens.
8. In the device list, select the motor controller of the selected axis.
9. Identification with the right mouse button and start [Identification on].
   On the motor controller, the letter sequence “H E L L O” appears in the 7-segment display.
10. Open dialogue window to the motor controller: Right mouse button and [Network].
11. Change network settings of the motor controller in accordance with the table specifications (3.5) and confirm with “OK”.
12. If the message “The command ReBoot is not supported” appears:
    Press the “Reset” button on the motor controller.
    ➔ The changed network setting is accepted.
13. Repeat steps 4. to 12. for the other motor controllers.

The supplied FCT base projects include the configured FCT components for the motor controllers of the drive motors (motor 1 and 2) on the Y-axis.
If additional motor controllers are included in the system for attachment components:
- First create the FCT components for the additional motor controllers CMMP-AS (3.4.4 Adding FCT component).
3.3.5 Adapting IP address of the operator unit
The IP address can be adapted in the Setup menu of the operator unit.
1. Make sure that the operator unit is connected correctly to the control system
   (3.1.6 Operator unit).
2. Switch on control system.
3. If the message “Enter SetUp-Mask?” appears: Press $ on the operator unit.
4. Process TCP/IP settings:
   • Set the desired IP address of the operator unit.
   • Specify the IP address and host ID of the control system to which the operator unit is connected.
5. Save the changed settings with the “Save/Exit” button.

3.4 Creating kinematics-specific FCT project

3.4.1 Definition
Different FCT base projects for the various kinematics variants can be found on the USB memory card (3.1.3 USB memory card).

Note
The FCT base projects do not yet include all kinematics-specific specifications.
For commissioning, the base project that fits the kinematics must be selected and expanded to a kinematics-specific FCT project with the following supplement:
• Adapt stroke lengths of the Y- and Z-axis.
Creation of the kinematics-specific FCT projects and further procedures for commissioning are described subsequently.

Additional information about the parameters as well as their transfer to the components (Description of FCT or Help files of the corresponding plug-ins).

3.4.2 Requirements
– FCT started (3.2.3 Starting the FCT).
– The FCT base project that fits the kinematics is selected (3.4.1 Definition).
   The specifications on the rating plate have been observed.
– The FCT base project that fits the kinematics is opened (3.2.4 De-archiving an FCT project).
3.4.3 Adapting stroke lengths

**Note**
In the FCT base project, only provisional values are entered as stroke lengths for the Y- and Z-axis; these do not normally comply with the actual stroke lengths.
- The entered values must be replaced by the existing stroke lengths of the linear gantry.

![Diagram](image)

1 Setting piece for homing (3.6 Homing and checking)

\[\begin{align*}
 y_1/z_1 & \quad \text{Distance between the homing point and mechanical stop (accessory: Setting piece).} \\
 & \quad 30 \text{ mm is entered in the FCT base project.} \\
 y_2/z_2 & \quad \text{Mechanical stroke} \\
 a/b & \quad \text{“Limits of the workspace” of the multi-axis controller (software end position).} \\
 & \quad \text{In the FCT base project, 3 mm is preset as additional travel distance.} \\
 & \quad \text{The available travel distance on the Y- and Z-axis can be extended by increasing this value: FCT window “Workspace” [CMXR-C2...][Kinematics Type].} \\
 & \quad \text{Maximum value of “Limits of the workspace” a/b: 30 mm}
\end{align*}\]

Fig. 3.6
1. Determine the actual stroke lengths of the Y- and Z-axis from the type code on the product labelling of the linear gantry.

   Example for type code: “EXCT-15-500-200-...”

<table>
<thead>
<tr>
<th>Type code</th>
<th>Type</th>
<th>Size</th>
<th>Stroke of the Y-axis [mm]</th>
<th>Stroke of the Z-axis [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>EXCT</td>
<td>15</td>
<td>500</td>
<td>200</td>
</tr>
<tr>
<td>On the existing linear gantry</td>
<td>EXCT</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

   Tab. 3.7

2. In the FCT window “Workspace”: Open [CMXR-C2...] [Kinematics Type].

3. In the FCT window:
   - Enter the stroke of the Y-axis for “Ymax: maximum mechanical stroke Y”.
   - Select the stroke of the Z-axis for “Zmax: maximum mechanical stroke Z”.

   The travel distances that are actually available on the axes can be calculated by using the determined stroke lengths and the following formula:
   - Travel distance on the Y-axis = Y_{max} - 2y_{1} + 2a
   - Travel distance on the Z-axis = Z_{max} - 2z_{1} + 2b

   Example calculation:
   \( Y_{max} = 500 \text{ mm}; Z_{max} = 200 \text{ mm}; y_{1}/z_{1} = 30 \text{ mm}; a/b = 3 \text{ mm} \)

   ➔ Available travel distances:
   - Y-axis: 446 mm
   - Z-axis: 146 mm

3.4.4 Adding FCT component

   The supplied FCT base projects include the configured FCT components for the motor controllers of the drive motors (motor 1 and 2) (3.1.4 Axes and motors).

   If additional motor controllers and attachment components are included in the system:
   - Add the FCT components for the additional included motor controllers CMMP-AS and configure for the attachment component used.

   Information on adding and configuring the FCT components can be found in the FCT description and the Help files of the FCT plug-ins.

   The FCT description is on the USB memory card or, after installation of the program, in the folder `<FCT installation directory>\Help\FCT_<language>.pdf.`
3.5 Configuring the control system

For commissioning, the control parameters of the kinematics-specific FCT project are transferred into the components of the control system and a boot project is set up on the multi-axis controller.

Additional information about the parameters as well as their transfer to the components (⇒ Description of FCT or Help files of the corresponding plug-ins).

3.5.1 Requirements

The following conditions must be met to transfer (download) the parameters onto the multi-axis control system and the motor controllers:

- Kinematics-specific FCT project created (⇒ 3.4 Creating kinematics-specific FCT project).
- Function-ready connection of the control system components to the FCT-PC:
  - Ethernet connection to the multi-axis controller
  - Ethernet or USB connection to the motor controllers
  Additional information (⇒ 3.3 Network configuration).
- Agreement of the plug-in versions of the components of the control system with the plug-in versions of the FCT project.

3.5.2 Preparation

1. Start the FCT (⇒ 3.2.3 Starting the FCT).
2. Open the kinematics-specific FCT project.

3.5.3 Multi-axis controller with Codesys

3. In the FCT window “Workspace” select the multi-axis controller: [CMXR-C2...].
4. Check the set interface: [Component] [FCT Interface]

For configuration of the multi-axis controller, download of the Codesys project is required.

5. In the FCT window “Workspace”, select: [CMXR-C2...][CODESYS].
6. In the “CoDeSys Project Status” window, select the “Start CoDeSys” button.
7. In the Codesys dialogue window, select: [Online][Login].
8. [Online][Create boot project].
9. [File][Exit].
10. In the Save dialogue window, select “Yes”.
11. In the “CoDeSys Project Status” window, select “Update PLC configuration”.
12. Create the connection between FCT and the multi-axis controller: [Component][Online][OK].
3. With “Download”, on the right side of the function bar, call up the dialogue window for transferring the settings.
   - Option field “Transmit configuration” is already preset as activated: ✓.
   - Activate option field “Transmit FTL projects”: ✓.
   - Activate option field “Transmit CoDeSys sources”: ✓.

14. Start data transmission with “Confirm”.
    The parameters of the FCT project are transferred to the multi-axis controller.

15. Select “Restart CMXR” on the right side of the function bar.

16. In the dialogue window, confirm the restart with “OK”.
    The multi-axis controller starts with the updated parameters.

3.5.4 Motor controller
17. In the FCT window “Workspace”, select a motor controller: [CMMP-AS...].
18. Establish a connection between FCT and the motor controller: [Component][Online][Login].
19. Select “Download” on the right side of the function bar.
20. In the dialogue window “Synchronize project and device data”, select “Download”.
21. In the dialogue window “FCT Device Control...”, select “OK”.
    The parameters of the FCT project are transferred to the motor controller.
22. Repeat steps 17. to 21. for the other motor controllers.

Transfer of the control parameters to the components of the control system is completed.
Next step: 3.6 Homing and checking
3.6 Homing and checking

3.6.1 Drives: Direction of movement, allocation and homing

Note
Homing of the drives is required in the following cases:
- during the initial start-up procedure
- when changing the position of the motor connections after the initial start-up procedure
- after changing the toothed belt
  - Use the setting piece for the homing procedure.

Requirement
- Operator unit connected to the control system (⇒ 3.1.6 Operator unit).

Preparation
1. Start the FCT (⇒ 3.2.3 Starting the FCT).
2. Open the kinematics-specific FCT project.

Danger
The interface (Z-axis) falls in an uncontrolled manner due to release of the motor brakes.
Risk of injury due to electric shock, impact, crushing.
- Before releasing the brakes, make sure that the interface (Z-axis) is located in the lower end position.

4. Rotate key switch “brake release” clockwise to the “2 o’clock position”.
5. To release the motor brakes actuate the enabling button on the operator unit.
   - The motor brakes must unlock audibly.
   - The interface (Z-axis) can now be moved manually.

The motor brakes are only released when the enabling button on the operator unit is pressed.
Checking direction of movement and assignment of the drives

6. On the operator unit:
   - Use the button to change to the position mask (coordinate view).
   - In the menu bar, select [Joints].

7. When the enabling button on the operator unit is depressed: Move the interface in direction Y and Z on the linear gantry.
   During the movement procedure check the operator unit to verify
   - whether the value of the corresponding axis changes and
   - whether the change in value agrees with the direction of movement.
     The value must become smaller in each case,
     - Y-value: When the interface is moved to the left in the direction of motor 1.
     - Z-value: When the interface is moved upwards.

   If the change in value differs, an incorrect base project has been selected.
   - Start the commissioning process again with the corresponding base project for the linear gantry (3.1.3 USB memory card).

8. Set the interface (Z-axis) to the lower end position.
9. Release the enabling button on the operator unit.
   ➔ The motor brakes must lock audibly.
**Aligning the interface with the reference position**

The reference position is the axis zero point of the Y- and Z-axis.

1. M4 screw
2. Setting piece
3. Side cover of the Y-axis, left
4. Motor 1 (left)
5. Cover of the Y-axis
6. Interface (Z-axis)

Fig. 3.7  Reference position

10. Secure the setting piece to the interface (Z-axis) until it is flush by using the supplied screw M4 (Fig. 3.7).

**Note**
For a unique reference position:
- Make sure that the setting piece is straight and flat on the interface.

11. Tighten screw M4 (tightening torque 2.5 Nm).

**Danger**
The interface (Z-axis) falls in an uncontrolled manner due to release of the motor brakes.
Risk of injury due to electric shock, impact, crushing.
- Before releasing the brakes, make sure that the interface (Z-axis) is located in the lower end position.

12. To release the motor brakes actuate the enabling button on the operator unit.
   ➔ The motor brakes must unlock audibly.
13. Slide the interface with the setting piece upwards as far as the stop on the cover of the Y-axis.
14. Slide the interface with the setting piece to the left as far as the stop on the side cover of the Y-axis.
15. Hold the interface at the upward and left stop until the motor brakes are activated.
16. Release the enabling button on the operator unit.
   ➔ The motor brakes must lock audibly.
   ➔ The interface (Z-axis) is held at the reference position by the motor brakes.
17. Set key switch “brake release” to position “0”.

**Homing**

18. Switch control system to automatic operation (3.1.8 Manual override/automatic operation).
20. Establish a connection between FCT and the motor controller: [Component] [Online] [Login].
21. Call up Homing settings:
   [CMMP-AS: A1] [Axis] [Homing].
22. Make sure that “Current Position” is selected in the destination of the homing method.
23. In the FCT area “Project Output”, open the tab “Homing”.
24. In the “Device Control” area:
   • Activate options fields for “FCT” and “Enable” with ✓.
     Device control is activated and released via FCT.
25. Start homing: In the FCT window “Homing”, select the “Start Homing” button.
   Homing is carried out.
26. When homing is complete, the “Homing successful” dialogue window is displayed:
   Confirm with “OK”.
27. Lock device control: In the FCT window “Homing”, deactivate the option field “Enable”.
28. Transfer reference values to the motor controller:
   Select the button “Save Offset To Encoder”.
29. The dialogue window “Warning!” appears with reference to the reference position: Confirm with “OK”.
   The reference position is transferred to the motor controller of X-axis 1.
30. Deactivate device control via FCT: Deactivate the option field “FCT” in the FCT window “Homing”.
31. End connection to the motor controller: [Component][Online][Logout].
32. Home the motor controller for motor 2:
   Repeat steps 19. to 31. for [CMMP-AS: A2].
Ending the homing procedure
33. Switch control system to manual override (3.1.8 Manual override/automatic operation).
34. Rotate key switch “brake release” clockwise to the “2 o’clock position”.

<table>
<thead>
<tr>
<th>Danger</th>
</tr>
</thead>
<tbody>
<tr>
<td>The interface (Z-axis) falls down due to release of the motor brakes.</td>
</tr>
<tr>
<td>Risk of injury due to electric shock, impact, crushing.</td>
</tr>
<tr>
<td>• Before releasing the brakes, hold the interface (Z-axis) or secure it from falling.</td>
</tr>
</tbody>
</table>

35. To release the motor brakes actuate the enabling button on the operator unit.
   ➔ The motor brakes must unlock audibly.
36. Slowly lower the interface (Z-axis) by hand to the lower end position.
37. Check whether the feed constants are to be adjusted (e.g. during the initial start-up phase).
   When doing this, please observe the first note in chapter
   “3.6.2 Determining and adapting feed constants”.
   Adjustment of the feed constants
   – Required: Next step ➔ 3.6.2 Determining and adapting feed constants.
   – Not required: ➔ Remove setting piece (steps 38. and 39.).

Removing the setting piece

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of damage to the product if operated with a mounted setting piece.</td>
</tr>
<tr>
<td>• Remove the setting piece when the homing procedure is complete.</td>
</tr>
</tbody>
</table>

38. Unscrew screw M4 from the setting piece.
39. Remove the setting piece from the interface.
3.6.2 Determining and adapting feed constants

The feed constants describe the ratio between motor speed and distance travelled by the toothed belt.

**Note**

Because changes in temperature alter the pretensioning of the toothed belt and thus the ratio between motor speed and distance travelled:

- Determine and adapt the feed constants in the following cases:
  - for initial start-up (recommendation)
  - if system precision is no longer sufficient (e.g. due to altered ambient temperature)
  - after changing the toothed belt and setting the toothed belt pretensioning
  - after replacement of the reversing sprockets

**Requirements**

- Homing successfully completed (3.6.1 Drives: Direction of movement, allocation and homing).
- Operator unit connected to the control system (3.1.6 Operator unit).

**For high system precision:**

- Determine the feed constants at the intended ambient and operating temperatures.

**Preparation**

1. Start the FCT (3.2.3 Starting the FCT).
2. Open the kinematics-specific FCT project.

**Danger**

The interface (Z-axis) falls in an uncontrolled manner due to release of the motor brakes.

Risk of injury due to electric shock, impact, crushing.

- Before releasing the brakes, make sure that the interface (Z-axis) is located in the lower end position.

4. Rotate key switch “brake release” clockwise to the “2 o'clock position”.
5. To release the motor brakes actuate the enabling button on the operator unit.
   - The motor brakes must unlock audibly.
   - The interface (Z-axis) can now be moved manually.

**Note**

The motor brakes are only released when the enabling button on the operator unit is pressed.
Positioning the setting piece with spacing bolts

1. Fully insert the spacing bolt included in the scope of delivery into the setting piece.
2. Determine the exact dimension “A” of the inserted spacing bolt by measuring it (e.g. 80.05 mm).
3. Secure the setting piece with spacing bolt to the interface until flush by using the supplied screw M4 (Fig. 3.8).

**Note**
For correct determination of the feed constants:
- Make sure that the setting piece is straight and flat on the interface.

4. Tighten screw M4 (tightening torque 2.5 Nm).
Danger
The interface (Z-axis) falls in an uncontrolled manner due to release of the motor brakes.
Risk of injury due to electric shock, impact, crushing.
- Before releasing the brakes, make sure that the interface (Z-axis) is located in the lower end position.

5. To release the motor brakes actuate the enabling button on the operator unit.
   ➔ The motor brakes must unlock audibly.
6. Slide the interface with the setting piece upwards as far as the stop on the cover of the Y-axis.
7. Slide the interface with the setting piece to the left as far as the stop on the side cover of the Y-axis.
8. Hold the interface at the upward and left stop until the motor brakes are activated.
9. Release the enabling button on the operator unit.
   ➔ The motor brakes must lock audibly. the interface is held in position by the motor brakes.
10. Set key switch “brake release” to position “0”.

Determining and adapting feed constants
12. Actuate button “Drives”.
13. Read values for Axis_1 and Axis_2.
14. In the FCT window “Workspace”: open [CMXR-C2…][Kinematics Type].
15. Enter the values for Axis_1 and Axis_2 in the FCT according to the following table:

<table>
<thead>
<tr>
<th>Specification in the operator unit</th>
<th>Enter in the FCT for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis_1</td>
<td>Drive 1 actual position</td>
</tr>
<tr>
<td>Axis_2</td>
<td>Drive 2 actual position</td>
</tr>
</tbody>
</table>

Tab. 3.8

The value 80.00 mm is provisionally entered in the FCT for “L: length of gauge”.

16. In the FCT, for “L: length of gauge” enter the dimension “A” determined in step 2. (e.g. 80.05 mm).
   ➔ In the FCT, the new feed constants are automatically calculated and displayed:
   - fc1new: feed constant (new value)
   - fc2new: feed constant (new value)
17. Create the connection between FCT and the multi-axis controller: [Component][Online][OK].
18. With “Download”, on the right side of the function bar, call up the dialogue window for transferring the settings:
   • Option field “Transmit configuration” is already preset as activated: ✓.
   Not required:
   – “Transmit FTL projects”
   – “Transmit CoDeSys sources”
19. Start data transmission with “Confirm”.
   The updated project parameters are transferred to the multi-axis controller.
20. To accept the changed configuration:
   On the right side of the function bar, select “Restart CMXR”.
21. In the dialogue window, confirm the restart with “OK”.
   The multi-axis controller starts with the updated parameters.
   A dialogue window appears with a note of communication interruption.
22. Log in again to the operator unit.
23. Check the set feed constants.
   • On the operator unit in the position mask, change to the coordinate system “Joints”.
   • Read values for A1 and A2 and compare with the setpoint values.
     Setpoint values:
     – A1: length of gauge (e.g. 80.05 mm)
     – A2: “0”
   In case of deviation: Repeat steps 11. to 23..

**Ending the process for determining the feed constants**
25. Rotate key switch “brake release” clockwise to the “2 o’clock position”.

![Danger]

The interface (Z-axis) falls down due to release of the motor brakes.
Risk of injury due to electric shock, impact, crushing.
• Before releasing the brakes, hold the interface (Z-axis) or secure it from falling.

26. Unlock the brakes with the enabling button on the operator unit.
   ➔ The motor brakes must unlock audibly.
27. Slowly lower the interface (Z-axis) by hand to the lower end position.

![Note]

Risk of damage to the product if operated with a mounted setting piece.
• Remove the setting piece when the procedure for determining the feed constants is complete.

28. Unscrew screw M4 from the setting piece.
29. Remove the setting piece with spacing bolt from the interface.
3.6.3  Safety circuits

Checking safety circuits in manual override

1. Establish the following initial situation:
   – Control system in manual override (3.1.8 Manual override/automatic operation).
   – Motor brakes active (not released).
   – Operator unit connected to the control system (3.1.6 Operator unit).
   – Emergency stop switch unlocked and emergency stop circuits acknowledged.

2. Check safety circuits of the system with the following test steps.

<table>
<thead>
<tr>
<th>Test step</th>
<th>Expected result</th>
<th>Terminate test step</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Actuate the enabling button on the operator unit and release it again.</td>
<td>Motors of the product are enabled</td>
<td>–</td>
</tr>
<tr>
<td>• Actuate the enabling button on the operator unit and trigger <strong>internal</strong> emergency stop.</td>
<td>Illuminated pushbutton “acknowledge emergency stop” lights up / Motors are no longer active. For external emergency stop circuit: Emergency stop is reported at an external emergency stop circuit.</td>
<td>• Acknowledge internal emergency stop circuit with illuminated pushbutton.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If present, acknowledge external emergency stop circuit.</td>
</tr>
<tr>
<td>• Actuate the enabling button on the operator unit and trigger <strong>external</strong> emergency stop (if present).</td>
<td>Indicator light “external emergency stop” lights up / Motors are no longer active.</td>
<td>• Acknowledge external emergency stop circuit.</td>
</tr>
</tbody>
</table>

Tab. 3.9
Checking safety circuits in automatic operation

1. Establish the following initial situation:
   - Control system in automatic operation (3.1.8 Manual override/automatic operation).
   - Motor brakes active (not released).
   - Operator unit connected to the control system (3.1.6 Operator unit).
   - Emergency stop switch unlocked and emergency stop circuits acknowledged.
   - Contacts of the safety door switch closed.

2. Check safety circuits of the system with the following test steps.

<table>
<thead>
<tr>
<th>Test step</th>
<th>Expected result</th>
<th>Terminate test step</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Open safety doors.</td>
<td>Emergency stop symbol appears on the operator unit. Motor enable via operator unit not possible. Emergency stop is reported at an external emergency stop circuit.</td>
<td>–</td>
</tr>
<tr>
<td>• Close safety doors and acknowledge external emergency stop (if present).</td>
<td>Emergency stop symbol becomes grey.</td>
<td>–</td>
</tr>
<tr>
<td>• Actuate the “Mot” button on the operator unit.¹)</td>
<td>Motors of the kinematics system are enabled. Robot symbol on the operator unit turns grey.</td>
<td>• Actuate the “Mot” button on the operator unit again to revoke the release signal.</td>
</tr>
<tr>
<td>• Actuate the enabling button on the operator unit.</td>
<td>Motors of the kinematics system must not be enabled.</td>
<td>–</td>
</tr>
<tr>
<td>• Trigger internal emergency stop.</td>
<td>Illuminated pushbutton “acknowledge emergency stop” lights up and emergency stop is reported at an external emergency stop circuit.</td>
<td>1. Unlock emergency stop switch. 2. Acknowledge emergency stop circuit with illuminated pushbutton.</td>
</tr>
<tr>
<td>1. Actuate the “Mot” button on the operator unit.¹)</td>
<td>Indicator light “external emergency stop” lights up.</td>
<td>1. Unlock external emergency stop switch. 2. Acknowledge emergency stop circuit.</td>
</tr>
<tr>
<td>2. Trigger external emergency stop (if present).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Administrator and write access required

Tab. 3.10

3. When tests are completed:
   Switch control system to manual override (3.1.8 Manual override/automatic operation).
3.7 Conclusion of commissioning

**Warning**
Uncontrolled movements of the system as a result of faulty commissioning.
Risk of injury due to electric shock, impact, crushing.
- After completion of commissioning, check all safety equipment connected to the system and make sure that these work as intended.

The system is now checked and ready for application programming.
Installation and configuration of extensions to the multi-axis controller are now possible.
### 3.8 Fault clearance

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy does not correspond to the technical data</td>
<td>Feed constants not sufficiently accurate</td>
<td>• Determine and adapt feed constants (<a href="#">3.6.2</a>)</td>
</tr>
<tr>
<td></td>
<td>Zero point of an axis displaced</td>
<td>• Home drives (<a href="#">3.6.1</a>)</td>
</tr>
<tr>
<td>Motors of the kinematics system cannot be enabled</td>
<td>Emergency stop circuits not acknowledged</td>
<td>• Unlock emergency stop switch and acknowledge emergency stop circuits.</td>
</tr>
<tr>
<td></td>
<td>Supply voltage of the motors is not connected</td>
<td>• Check plug connectors of the motor controllers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check circuit breaker.</td>
</tr>
<tr>
<td></td>
<td>Plug connector or cover at the connection of the operator unit is not fully inserted (rotatable connector)</td>
<td>• Screw plug connector or cover in completely.</td>
</tr>
<tr>
<td>No connection between operator unit and the multi-axis controller</td>
<td>Plug connector at the connection for the operator unit is not fully inserted (rotatable connector)</td>
<td>• Screw plug connector in completely.</td>
</tr>
<tr>
<td></td>
<td>Incorrect TCP/IP port used on the multi-axis controller</td>
<td>• Use TCP/IP port X7 (standard configuration).</td>
</tr>
<tr>
<td></td>
<td>IP address of the operator unit not correct</td>
<td>• Adapt IP address (<a href="#">3.3.5</a>)</td>
</tr>
<tr>
<td>Coordinate system does not correspond to the “right-hand rule”</td>
<td>Incorrect and unsuitable base project selected for the product: Axes incorrectly assigned, axis labelling does not correspond to the assignment of the multi-axis controller</td>
<td>• Select the correct base project that is suitable for the product (<a href="#">3.1.3</a>)</td>
</tr>
<tr>
<td>Multi-axis control system reports error 401 at the start</td>
<td>Expansion card with an incorrect KBUS address was attached to the multi-axis controller (KBUS address does not agree with the specification of the FCT configuration)</td>
<td>• Check expansion card and addressing at the rotary switch (<a href="#">Description of the multi-axis controller CMXR-C2</a>)</td>
</tr>
<tr>
<td>Start of the multi-axis controller CMXR-C2 not successful (display not “0”)</td>
<td>Compact flash card on the multi-axis controller CMXR-C2 is not plugged in correctly</td>
<td>• Plug compact flash card in correctly.</td>
</tr>
<tr>
<td>The main axes do not move or report an “I²t error”</td>
<td>Brakes at the motor controller are connected incorrectly</td>
<td>• Check wiring of the brakes at the motor controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check low friction by manually releasing the brakes (<a href="#">3.1.9</a>).</td>
</tr>
</tbody>
</table>
### Malfunction | Possible cause | Remedy
---|---|---
Motor controller reports error E11-5 (\(I^2t\) / following error in reference travel) | Acceleration ramps parameterised inappropriately | • Check parameterisation of the acceleration ramps and adapt, if necessary.
Motor controller reports error E31-0 (\(I^2t\) motor) | Motor is blocked | • Check mobility of the motors and kinematics.
 | Application outside the permissible limits | • Check application.
Connection between multi-axis controller and PC cannot be constructed | IP address of the PC incorrect | • Check IP address of the PC.
Motor controller has an overvoltage error | Installation of the bridge for internal braking resistor faulty | • Check installation of the bridge for internal braking resistor.
Safety circuit cannot be acknowledged; red lamp at the safety switching device flashing | Emergency stop switch connected incorrectly | • Check connection and channel assignment of the emergency stop switches.
The two channels were not simultaneous | • Actuate emergency stop switch again.
 | • Check emergency stop switch and replace it, if necessary.

Tab. 3.11

Additional information on fault clearance is in the Help of the FCT and in the descriptions of the multi-axis controller and motor controller.
If the malfunction cannot be remedied:
• Contact your regional Festo contact person.
Additional information (www.festo.com/sp).
4 Operation

4.1 FCT project

4.1.1 Transferring control parameters in the FCT project

For diagnostics/servicing, or if a valid FCT project is not available:
The parameters of all components of the control system can be transferred to the FCT-PC (upload).

Requirements

The following conditions must be met to transfer the parameters of the multi-axis control system and
the motor controllers into the FCT project (upload):

– Control system configured during commissioning (3.5 Configuring the control system)
– Function-ready connections of the control system components to the FCT-PC:
  – Ethernet connection to the multi-axis controller
  – Ethernet or USB connection to the motor controllers.
  Additional information: 3.3 Network configuration
– Agreement of the plug-in versions of the components of the control system with the FCT plug-in
  versions of the FCT project.

Procedure

1. Start the FCT (3.2.3 Starting the FCT).
2. Open the kinematics-specific FCT project.
3. In the FCT window “Workspace” select the multi-axis controller: [CMXR-C2...].
4. Check the set interface: [Component] [FCT Interface].
5. Create the connection between FCT and the multi-axis controller: [Component] [Online].
6. With “Upload”, on the right side of the function bar, call up the dialogue window for uploading the
   settings.
   • Option field “Transmit configuration” is already preset as activated: ✓.
   • Activate option field “Transmit FTL projects”: ✓.
   • Activate option field “Transmit CoDeSys sources”: ✓.
7. Start upload with “Confirm”.
   The configuration of the multi-axis controller is transferred to the FCT project.
8. In the FCT window “Workspace”, select a motor controller: [CMMP-AS...].
9. Establish a connection between FCT and the motor controller: [Component][Online][Login].
10. Select “Upload” on the right side of the function bar.
11. In the dialogue window, confirm transfer of the device data with “Yes”.
    The configuration of the motor controller is transferred to the FCT project.
12. Repeat steps 8. to 11. for the other motor controllers.
13. Save and archive the FCT project: 4.1.2.
4.1.2 Saving and archiving the FCT project

Recommendation:

- After transferring the control parameters to the FCT project:
  Save the FCT project to the PC.
  The FCT project can be used for data backup and diagnostics.

1. Save the FCT project by selecting [Project] [Save As ...] and using a unique name (e.g. the serial number of the kinematics system).
2. Archive project as backup (Zip file): [Project] [Archive].
3. In the dialogue window, select the options and start the archiving process with “OK”.
5 Repair

Repair instructions are available for download from the Festo Support Portal (www.festo.com/sp).

The components of the control system cannot be repaired and have to be replaced in case of a defect.

Removal and installation of control system components

Danger

Unintended activation can trigger unexpected movements.
Risk of injury due to electric shock or severe crushing.

- Switch off all supply lines and verify they are free of voltage prior to mounting, installation and/or maintenance work and secure them from being switched back on.

Dangerous residual voltage even after the power supply is switched off:
- Start work on plugs and interfaces only when the residual voltage has fallen below 60 V.

When pneumatic attachment components are used, compressed air can be stored in the pneumatic system parts even after switch-off.
- Vent pneumatic system parts through corresponding measures.

Note

Damage to the product from incorrect handling.

- Never pull out or plug in the plug connectors and interfaces when powered.
- Observe the handling specifications for electrostatically sensitive devices.

Note

The removal of mechanical components (e.g. motor) causes referencing to be lost. At the subsequent commissioning, a new referencing (3.6.1) and adaptation of the feed constants are required (3.6.2).

Note

When the motor controller is replaced, another firmware version might have to be installed:
- Contact your regional Festo contact person.

Additional information: www.festo.com/sp
6 De-commissioning and disposal

- Observe the notes for dismantling in the descriptions for the linear gantry EXCT “Mechanical installation” and the control system CMCA-...-B... “Electrical installation”.

Disposal

- Observe regulations for environmentally friendly disposal.