Rexroth IndraMotion MLD
Getting Started

Summary
This document explains how to commission the drive and create a simple PLC program for MLD-S and MLD-M.
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1 Introduction

1.1 Overview

This document explains how to commission the drive and create a simple PLC program for MLD-S and MLD-M.

The steps required for using Rexroth IndraMotion MLD for the first time are described below. We distinguish the following phases:

- Preparation and Assembly
- Commissioning
- Programming

Note: Assembly and commissioning are only required when Rexroth IndraMotion MLD is used for the first time.
The figure below contains an overview of the required commissioning steps.

Fig. 1-1: Commissioning Rexroth IndraMotion MLD
2 Important directions for use

2.1 Appropriate use

Introduction

Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.

- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.

- Do not mount damaged or faulty products or use them in operation.

- Make sure that the products have been installed in the manner described in the relevant documentation.
Areas of use and application

Drive controllers made by Bosch Rexroth are designed to control electrical motors and monitor their operation. Control and monitoring of the motors may require additional sensors and actors.

Note: The drive controllers may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines. Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Every drive controller has to be programmed before starting it up, making it possible for the motor to execute the specific functions of an application. The drive controllers of the ECODRIVE03 family are designed for use in single or multiple-axis drive and control applications.

To ensure an application-specific use, the drive controllers are available with differing drive power and different interfaces.

Typical applications of drive controllers belonging to the ECODRIVE03 family are:
- handling and mounting systems,
- packaging and foodstuff machines,
- printing and paper processing machines and
- machine tools.

The drive controllers may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

2.2 Inappropriate use

Using the drive controllers outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as “inappropriate use”.

Drive controllers may not be used if
- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general safety instructions!
3 Safety Instructions for Electric Drives and Controls

3.1 Introduction

Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

Do not attempt to install or start up this equipment without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation of the equipment prior to working with the equipment at any time. If you do not have the user documentation for your equipment, contact your local Bosch Rexroth representative to send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the equipment is resold, rented or transferred or passed on to others, then these safety instructions must be delivered with the equipment.

**WARNING**

Improper use of this equipment, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

3.2 Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions.

<table>
<thead>
<tr>
<th>Warning symbol with signal word</th>
<th>Degree of hazard seriousness according to ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="DANGER" /></td>
<td>Death or severe bodily harm will occur.</td>
</tr>
<tr>
<td><img src="image" alt="WARNING" /></td>
<td>Death or severe bodily harm may occur.</td>
</tr>
<tr>
<td><img src="image" alt="CAUTION" /></td>
<td>Bodily harm or material damage may occur.</td>
</tr>
</tbody>
</table>

Fig. 3-1: Hazard classification (according to ANSI Z535)
3.3 Hazards by Improper Use

- **DANGER**
  - High voltage and high discharge current! Danger to life or severe bodily harm by electric shock!

- **DANGER**
  - Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

- **WARNING**
  - High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock!

- **WARNING**
  - Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

- **CAUTION**
  - Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

- **CAUTION**
  - Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock or incorrect handling of pressurized systems!

- **CAUTION**
  - Risk of injury due to incorrect handling of batteries!
3.4 General Information

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Only persons who are trained and qualified for the use and operation of the equipment may work on this equipment or within its proximity.
  - The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and equipment on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The equipment is designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Use only safety features and applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded.
  The following areas of use and application, for example, include safety features and applications: construction cranes, elevators used for people or freight, devices and vehicles to transport people, medical applications, refinery plants, transport of hazardous goods, nuclear applications, applications in which electrical devices with vital functions can be electromagnetically disturbed, mining, food processing, control of protection equipment (also in a machine).
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
  The machine and installation manufacturer must
    make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
    make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
• Operation is only permitted if the national EMC regulations for the application are met.
The instructions for installation in accordance with EMC requirements can be found in the documentation "EMC in Drive and Control Systems".
The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.

• Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.
### 3.5 Protection Against Contact with Electrical Parts

**Note:** This section refers to equipment and drive components with voltages above 50 Volts.

Touching live parts with voltages of 50 Volts and more with bare hands or conductive tools or touching ungrounded housings can be dangerous and cause electric shock. In order to operate electrical equipment, certain parts must unavoidably have dangerous voltages applied to them.

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**DANGER**

**High electrical voltage! Danger to life, severe bodily harm by electric shock!**

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.

- Follow general construction and safety regulations when working on high voltage installations.

- Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.

- Do not operate electrical equipment at any time, even for brief measurements or tests, if the ground wire is not permanently connected to the points of the components provided for this purpose.

- Before working with electrical parts with voltage higher than 50 V, the equipment must be disconnected from the mains voltage or power supply. Make sure the equipment cannot be switched on again unintended.

The following should be observed with electrical drive and filter components:

- Wait thirty (30) minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.

- Never touch the electrical connection points of a component while power is turned on.

- Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.

- A residual-current-operated protective device (RCD) must not be used on electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

- Electrical components with exposed live parts and uncovered high voltage terminals must be installed in a protective housing, for example, in a control cabinet.
To be observed with electrical drive and filter components:

**DANGER**

**High electrical voltage on the housing!**
**High leakage current! Danger to life, danger of injury by electric shock!**

Connect the electrical equipment, the housings of all electrical units and motors permanently with the safety conductor at the ground points before power is switched on. Look at the connection diagram. This is even necessary for brief tests.

Connect the safety conductor of the electrical equipment always permanently and firmly to the supply mains.

Leakage current exceeds 3.5 mA in normal operation.

Use a copper conductor with at least 10 mm² cross section over its entire course for this safety conductor connection!

Prior to startups, even for brief tests, always connect the protective conductor or connect with ground wire. Otherwise, high voltages can occur on the housing that lead to electric shock.

### 3.6 Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 0 and 50 Volts on Rexroth products are protective low voltages designed in accordance with international standards on electrical safety.

**WARNING**

**High electrical voltage due to wrong connections! Danger to life, bodily harm by electric shock!**

Only connect equipment, electrical components and cables of the protective low voltage type (PELV = Protective Extra Low Voltage) to all terminals and clamps with voltages of 0 to 50 Volts.

Only electrical circuits may be connected which are safely isolated against high voltage circuits. Safe isolation is achieved, for example, with an isolating transformer, an opto-electronic coupler or when battery-operated.
3.7 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors. Some common examples are:

- Improper or wrong wiring of cable connections
- Incorrect operation of the equipment components
- Wrong input of parameters before operation
- Malfunction of sensors, encoders and monitoring devices
- Defective components
- Software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.
Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.

Pay attention to unintended machine motion or other malfunction in any mode of operation.

Keep free and clear of the machine’s range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine’s range of motion:
- use safety fences
- use safety guards
- use protective coverings
- install light curtains or light barriers

Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.

Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don’t operate the machine if the emergency stop is not working.

Isolate the drive power connection by means of an emergency stop circuit or use a starting lockout to prevent unintentional start.

Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.

Secure vertical axes against falling or dropping after switching off the motor power by, for example:
- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!

Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such equipment cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.
3.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated near current-carrying conductors and permanent magnets in motors represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

**WARNING**

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

Persons with heart pacemakers, hearing aids and metal implants are not permitted to enter the following areas:

- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, operated, repaired or mounted.

If it is necessary for a person with a heart pacemaker to enter such an area, then a doctor must be consulted prior to doing so. Heart pacemakers that are already implanted or will be implanted in the future, have a considerable variation in their electrical noise immunity. Therefore there are no rules with general validity.

Persons with hearing aids, metal implants or metal pieces must consult a doctor before they enter the areas described above. Otherwise, health hazards will occur.
3.9 Protection Against Contact with Hot Parts

**CAUTION**

Housing surfaces could be extremely hot!
Danger of injury! Danger of burns!

Do not touch housing surfaces near sources of heat!
Danger of burns!

After switching the equipment off, wait at least ten (10) minutes to allow it to cool down before touching it.

Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors.
Danger of burns!

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3.10 Protection During Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

**CAUTION**

Risk of injury by incorrect handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock!

Observe general installation and safety instructions with regard to handling and mounting.

Use appropriate mounting and transport equipment.

Take precautions to avoid pinching and crushing.

Use only appropriate tools. If specified by the product documentation, special tools must be used.

Use lifting devices and tools correctly and safely.

For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.

Never stand under suspended loads.

Clean up liquids from the floor immediately to prevent slipping.
3.11 Battery Safety

Batteries contain reactive chemicals in a solid housing. Inappropriate handling may result in injuries or material damage.

**CAUTION**

Risk of injury by incorrect handling!

- Do not attempt to reactivate discharged batteries by heating or other methods (danger of explosion and cauterization).
- Never charge non-chargeable batteries (danger of leakage and explosion).
- Never throw batteries into a fire.
- Do not dismantle batteries.
- Do not damage electrical components installed in the equipment.

**Note:** Be aware of environmental protection and disposal! The batteries contained in the product should be considered as hazardous material for land, air and sea transport in the sense of the legal requirements (danger of explosion). Dispose batteries separately from other waste. Observe the legal requirements in the country of installation.

3.12 Protection Against Pressurized Systems

Certain motors and drive controllers, corresponding to the information in the respective Project Planning Manual, must be provided with pressurized media, such as compressed air, hydraulic oil, cooling fluid and cooling lubricant supplied by external systems. Incorrect handling of the supply and connections of pressurized systems can lead to injuries or accidents. In these cases, improper handling of external supply systems, supply lines or connections can cause injuries or material damage.

**CAUTION**

Danger of injury by incorrect handling of pressurized systems!

- Do not attempt to disassemble, to open or to cut a pressurized system (danger of explosion).
- Observe the operation instructions of the respective manufacturer.
- Before disassembling pressurized systems, release pressure and drain off the fluid or gas.
- Use suitable protective clothing (for example safety glasses, safety shoes and safety gloves)
- Remove any fluid that has leaked out onto the floor immediately.

**Note:** Environmental protection and disposal! The media used in the operation of the pressurized system equipment may not be environmentally compatible. Media that are damaging the environment must be disposed separately from normal waste. Observe the legal requirements in the country of installation.
4 Preparation and Assembly

4.1 Step 1: Hardware and Firmware Requirements

Hardware Requirements

Using the drive-integrated PLC (Rexroth IndraMotion MLD-S/M) requires the following hardware:

Control section:
- CSH01.1C (as of FWA-INDRV-MPH02VRS)
- CSH01.2C (as of FWA-INDRV-MPH04VRS and MLD-M)
- CSB01.1** (as of FWA-INDRV-MPB03VRS)

Note: With BASIC control sections (CSB01.1), using MLD has only been enabled for "BRC technology functions"! MLD is not available for double-axis devices (HMD01.1 with CDB01.1C)

Note: As of firmware MPH04V06, IndraMotion MLD is available as multi-axis PLC (MLD-M). Access to remote axes (CCD slaves) requires the optional CCD module and the enabling of the functional firmware package "ML".

Power section:
- inverters: HMS0*.1-W0xxx
- converters: HCS0*.1-W0xxx

Note: Using the PLC functionality does not require any special optional card or control section configuration, because it is a PLC that is running in parallel in the drive processor in the real-time kernel.

Firmware Requirements

Using the drive-integrated PLC (Rexroth IndraMotion MLD) requires one of the following firmware versions and the corresponding firmware licensing:

- Advanced firmware (at least MPH02VRS) firmware package "ML"

Enabling the expansion package allows:
- loading and using ready-made Bosch Rexroth technology functions that can only be loaded via DriveTop/IndraWorks (see "Technology Functions")
- free programming of Rexroth IndraMotion MLD-S using the function block libraries made available by Bosch Rexroth (see "Libraries")
**Note:** IndraMotion MLD-M requires firmware $\geq$ MPH04VRS!

- **Basic firmware** (as of MPB03VRS) firmware package "TF"
  Enabling the expansion package allows:
  - loading and using ready-made Bosch Rexroth technology functions that can only be loaded via IndraWorks (see MLD Application Manual "Technology Functions")

See also Functional Description "Firmware Type Codes"

Using the PLC functionality requires the optional expansion package ("ML" or "TF") which has to be ordered right away when you order the firmware so that Rexroth IndraMotion MLD-S is already enabled at the factory. If the optional expansion package "ML" or "TF" is ordered subsequently, the so-called additional licensing is required; i.e. the PLC functionality is subsequently enabled or licensed by the user.

See also Functional Description "Functional Packages"

See also Functional Description "Enabling of Functional Packages"

### 4.2 Step 2: Install the Software

The installation of the commissioning software IndraWorks automatically makes available the PLC programming interface IndraLogic. This interface has been embedded in the drive project planning of IndraWorks and is started from the IndraWorks project explorer.

Installation takes place automatically so that the user does not have to select any specific software component.
4.3 Step 3: Structure of the Drive System

IndraMotion MLD-S

The figure below shows the basic system structure of "IndraMotion MLD-S":

Connections: Please see the respective Project Planning Manual for the interfaces via which the components are interconnected.

Fig. 4-1: System structure of "IndraMotion MLD-S"

Features of "IndraMotion MLD-S"

"IndraMotion MLD-S" is characterized by the following main features:

- characteristic "intelligent servo axis" (extension of drive functionality) or "stand-alone single-axis Motion Logic Control"
- command triggering of the local axis with direct access to the device control of the drive see "Command Triggering of the Local Axis (MLD-S)"
- direct access to all parameters of the drive via system-wide PLC variables, functions, function blocks or a configurable synchronous channel
- direct access to the digital and analog inputs/outputs of the drive (local axis)
- Additionally for the characteristic "stand-alone single-axis Motion Logic Control":
  - Motion Control functionality for 1 axis by command triggering of the local axis by corresponding Motion Control library according to PLCopen
IndraMotion MLD-M

"IndraMotion MLD-M" does not only control the local axis but also remote axes (so-called "CCD slaves"). The figure below shows the basic system structure of "IndraMotion MLD-M":

Connections: Please see the respective Project Planning Manual for the interfaces via which the components are interconnected.

Features of "IndraMotion MLD-M"

"IndraMotion MLD-M" is additionally characterized by the following main features:

- stand-alone multi-axis Motion Logic Control for up to 8 axes by means of corresponding Motion Control library according to PLCopen
- CCD cross communication interface to the "remote axes" on the basis of SERCOS III
- for motion command triggering of local and remote axes (see "Command Triggering of Local and Remote Axes (MLD-M)"
- connection of more inputs/outputs (I/O modules or optional modules in the remote axes)
- direct access to the digital and analog inputs/outputs of the drives (local and remote axes)
- possibility of access to all parameters of the drives (local and remote axes)
- SERCOS III interface to the slave axes:
  - number of axes and cycle time: a maximum of 7 slaves (T=500 µs with 1 slave, T = 1000 ... 4000 µs with 2...7 slaves)
  - cyclic data channel (MDT, AT) with a max. of 48 bytes and 16 parameters each
  - parameter or service channel (4-byte info container)
4.4 Step 4: Establish Communication Between Drive and Commissioning PC

Establishing the Serial Connection to IndraDrive

- Establishing connection between PC and drive. The commissioning PC is connected to the drive via the serial interface by means of the IKS0199 / 00x.0 interface cable at X2.
- Start IndraWorks
- Select "Connect online with IndraDrive (serial)"
- Select serial interface
- Select device from "List of all found devices" and complete procedure with "Finish"

![Establishing connection via serial interface of PC to drive](image)

Establishing the Ethernet Connection to IndraDrive

Requirements

- The following components and requirements are necessary to establish Ethernet communication with the IndraDrive controller:
  - CSH01.2 control section with Ethernet engineering interface
  - firmware MPx04V12 or higher
  - standard Ethernet cable
  - unassigned Ethernet connection at PC
Setting IP Address and Network Mask in IndraDrive

To establish Ethernet communication with IndraDrive you have to parameterize an IP address and the network mask on the control section. You can make these settings on the control section via IndraWorks or the control panel.

For local networks, IP addresses can be assigned in the following ranges:
- 10.0.0.0 to 10.255.255.255
- 172.16.0.0 to 172.31.255.255
- 192.168.0.0 to 192.168.255.255

**Suggestion:**
- IP address: 192.168.1.2
- Network mask: 255.255.255.0
- Default gateway: 0.0.0.0

**Note:** Setting the desired IP address, network mask and default gateway is only possible in the parameter mode. It might possibly be necessary to switch to the parameter mode via the control panel; the paragraph below describes how to do this.

### Setting the IP Address via the Control Panel

When setting the IP address via the control panel, observe the following points:

- Switch on control voltage for IndraDrive controller
- For approx. 8 s press both "ESC" and "Enter" keys at control panel
- With "Up/Down" keys select "2. Command" and confirm selection with "Enter" key
- If you have to switch to parameter mode, select "2.11 > PM" with "Up/Down" keys and start command with "Enter" key
- Select "2.3 Kom. Ethernet" and confirm selection with "Enter" key
- Under "2.3.1 P-0-1531" you can now set IP address

**Note:** The individual octets are applied by pressing the "Enter" key. To return press the "Esc" key.

- Under "2.3.2 P-0-1532" you can set the network mask
- Under "2.3.3 P-0-1533" you can set the default gateway

**Note:** In order that the parameter setting of desired IP address, network mask and default gateway takes effect, switch the control voltage for the IndraDrive controller off and on again.
When setting the IP address via IndraWorks, observe the following points:

- Switch on control voltage for IndraDrive controller
- Start IndraWorks and establish serial communication with IndraDrive

Fig. 4-4: Establishing the connection with IndraWorks

- In IndraWorks open tree in project explorer window
- Right-click “IndraDrive” (hardware level) in project explorer window and open “Sercos III” in pull-down menu

Fig. 4-5: IP address setting

- In “TCP/IP Engineering Port” area parameterize desired IP address, network mask and default gateway
Note: In order that the parameter setting of desired IP address, network mask and default gateway takes effect, switch the control voltage for the IndraDrive controller off and on again.

- Exit IndraWorks

Setting IP Address and Network Mask in PC
To establish Ethernet communication to IndraDrive you have to assign an IP address and subnet mask for the unassigned Ethernet connection at your PC or laptop.

Establishing Dial-Up Connection
Call Windows "Control Panel" and open network properties by double-clicking symbol "Network and Dial-up Connections"
Start\Settings\Control Panel\Network and Dial-up Connections

![Establishing the dial-up connection](image_url)

By double-clicking network connection or network card to be set, open status window for this connection.

Click "Properties" to call property sheet.
If Microsoft Client has not yet been installed, install Client via "Install..." button.

![Eigenschaften von LAN-D-Link](image)

Fig. 4-7: Installing the client

Select "Internet Protocol (TCP/IP)" and click "Properties" button.
Click "Use the following IP address".

Enter desired "IP address" and "Subnet mask".

**Note:** It is not necessary to make an input for "Default gateway".

Close all windows you have opened to parameterize the network card.

**TCP/IP Communication Between PC and IndraDrive**

With a standard Ethernet cable, connect the engineering interface X26 at the IndraDrive control section to the Ethernet connection at your PC or laptop.
Establishing Connection Manually

Select "Connect online with: IndraDrive (Ethernet)" and confirm selection with "OK" button.

Fig. 4-9: Selecting the connection

If IndraWorks cannot automatically find an IndraDrive controller via Ethernet, the following message is output.

Fig. 4-10: Scan for Device

You can parameterize the Ethernet communication connection via the button "Scan for Device..." in order to search for an IndraDrive controller manually.

Parameterize the IP address window in which you want to scan for devices.
For IP port enter from 5002 to 5003.

Note: Pressing the button "Default" automatically sets the IP address range to 192.168.1.1 to 192.168.1.5 and the IP port to 5002 to 5003.

With the "Next" button you can start scanning.
Fig. 4-11: Settings for Ethernet communication

IndraWorks now scans the IP range you parameterized for devices.

Fig. 4-12: Display of devices found

The preparations for establishing the connection can now be completed with the "Finish" button.
Establishing Connection Automatically

Select "Connect online with: IndraDrive (Ethernet)" and confirm selection with "OK" button.

Fig. 4-13: Selecting the connection

With the last communication settings, IndraWorks tries to establish the connection to an IndraDrive controller via Ethernet.
5 Commissioning and Parameterization

5.1 Step 5: General Commissioning and Parameterization of the Drive

Note: By starting the command "PL", the drive should be brought to a defined initial status. See also Functional Description "Load basic parameters"

1. In order that basic parameters can be loaded you have to switch drive controller to parameter mode. This can be done either directly via icon (PM) in toolbar or by right-clicking "Start parameterization level 1". Control panel display changes to "PM".

Fig. 5-1: Switching to parameterization level 1
2. Call dialog for initial commissioning

![Initial Commissioning - AddX (2.1) CCM-Master](DB000217v01_en.tif)

Fig. 5-2: Load basic parameters

**Note:**
For all other instructions on commissioning see online dialogs of DriveTop (up to MP*02VRS) or IndraWorks D (as of MP*03VRS)!

See also Functional Description "Steps of Commissioning"
5.2 Step 6: Activation and Configuration of IndraMotion MLD

Activating MLD

- Call dialog "Functional Packages" by right-clicking.
- Select functional package "Drive PLC".

**Fig. 5-3:** Activating functional package "Drive PLC"

**Note:**
Enabling the PLC requires licensing. After you have selected the functional package "Drive PLC" and confirmed your selection, a window containing information on the license agreement will open. If you are interested in the function, talk to your contact person in the Rexroth sales department!

- Apply setting with "Close". Switch control voltage of drive off and on again.

**Note:**
The enabling of the PLC only takes effect after a restart!

See also Functional Description "Enabling of Functional Packages"
Configuring MLD

Make the following settings in the MLD configuration dialog:

- **Start behavior of PLC**
  Set when PLC is to start.

- **Temporary or permanent control**
  MLD as "stand-alone Motion Control" for control tasks (ON) or as "intelligent servo axis" to extend the drive functionality.

- **Error generation in the case of programming errors**
  It is possible to control the behavior for errors which are generated by the corresponding PLC function blocks during command triggering of the axes. With active reaction, the drive error F2150 is generated. The automatic reaction of the drive can be deactivated in this dialog.

- **Activation of the AxisData structure**
  (will be explained in detail under "Data Channels")

- **Format adjustment for global registers Gxx**
  It is possible to set, for example, data type, number of decimal places etc.

- **A direct link is available to dialog "Cross Communication Drive"**.

![Fig. 5-4: Dialog MLD Configuration](DB000219v01_en.tif)
Diagnosis

In the MLD diagnosis you can see whether a PLC project has been loaded and in which status it is. In addition, the program can be started and stopped.

![Dialog MLD Diagnosis](DB000220v01_en.tif)

**Fig. 5-5:** Dialog MLD Diagnosis

**Note:** Starting and stopping the PLC in this dialog only makes sense in exceptional cases. Normally, this will be done in the programming system IndraLogic.

PLC IO Diagnosis

In the PLC IO Diagnosis dialog you can control the status of the process image of inputs and outputs. Inputs assigned to the PLC are displayed in this dialog.

![Dialog PLC IO Diagnosis](DB000221v01_en.tif)

**Fig. 5-6:** Dialog PLC IO Diagnosis

**Note:** The inputs which are not used in the PLC program are not displayed in IndraLogic. This dialog displays the entire process image of MLD, independent of its use in the program.
5-6 Commissioning and Parameterization

**PLC Register Diagnosis**

This dialog allows watching the status of the PLC register parameters.

![Diagram of PLC Register Diagnosis]

Fig. 5-7: Dialog PLC Register Diagnosis

**Technology Functions**

This dialog is relevant only to the use of self-contained technology functions without individual PLC programming.

**AxisData**

This dialog allows configuring additional, user-defined command values and actual values which are to be transmitted via the “AxisData structure” (see also “MLD Data Channels”).
Activating MLD-M for Multi-Axis Applications

To use the MLD-M system mode, you have to activate it. This is done in IndraWorks as described below:

- Open CCD dialog
- Activate CCD by "ticking" it
- Select CCD mode "MLD-M in CCD system mode"
- Set CCD cycle time
- Search for available slaves by clicking "Scan" button
- Select from slaves found and add to list "Projected slaves"
- Confirm configuration with "Apply" button
### Axis Addressing

All listed axes can be addressed via MLD-M. The axis addressing to be set in the PLC is based on the order of projected slaves. In the programming interface the axis addresses have already been generated as global variables:

![Axis Addressing in IndraLogic](image)

**Fig. 5-9:** Axis addressing in IndraLogic

Addressing takes place as follows:

- **"Axis 1"** always addresses the local axis. This axis is not displayed in dialog Fig. 5-8 "Cross Communication Drive Settings".

- **"Axis 2"** addresses the first projected slave (axis address 4 in this exemplary dialog)

- **"Axis 3"** addresses the second projected slave (axis address 7 in this exemplary dialog)

- **...**

- **"Axis 8"** addresses the seventh projected slave

### Controlling the Drive

Before MLD can take over motion command triggering for the master, it must have control over the drive. This can be done in the following ways:

- permanently via setting "PLC has permanent control over the drive" (see Fig. 5-4) (standard setting when using MLD-M) or

- temporarily via function block "MX_SetControl"
5.3 Step 7: Configuration of Interfaces and Data Channels of
MLD

General Information

IndraMotion MLD provides many data channels:

- for **cyclic data exchange** between MLD and axes
- for **acyclic parameter communication** between MLD and axes
- to connect MLD to **external control units** or **external control panels**
  (HMIs); see also "Getting Started VI Composer 02VRS"

**Note:** As regards access to the local axis, IndraMotion MLD-S and
IndraMotion MLD-M do not differ. As regards access to remote
axes, some specific features must be observed for
IndraMotion MLD-M.
Fig. 5-10: Data channels of IndraMotion MLD for access to local and “remote” axes

Based on a simplified device model, the schematic diagram above shows the data channels starting at MLD. Access to remote axes takes place via CCD.
Cyclic Data Channels

There are many data channels for accessing, from the PLC program, drive-internal variables and parameters or inputs/outputs and sensors evaluated by the drive, or other interfaces of the drive. Rexroth IndraMotion MLD supports the following data channels:

- **I/O channel (PII, POI)**
  Access to analog and digital inputs/outputs of the drive by means of a process image.

- **Local real-time channel**
  Cyclic, synchronized actual value and command value processing with the drive [comparable with drive telegram (AT) / master data telegram (MDT)].
  (It is only possible to access the local axis.)

- **Cyclic axis data "AxisData"**
  Cyclic actual values and command values are made available by means of a data structure. This structure is particularly suited when used as single-axis and multi-axis control.

Acyclic Data Channels / Interfaces

For acyclic access to axis parameters, there are the following alternatives when using IndraMotion MLD-S/IndraMotion MLD-M:

- **Direct variable channel**
  Single and quick functional access from the PLC program to cyclically configurable S- and P-parameters in the drive. (It is only possible to access the local axis.)

- **Parameter channel**
  For acyclic access (read and write) to axis parameters of the local and remote axes by means of custom-made functions or function blocks. Allows access to all S- and P-parameters in the drive, including the "PLC register" parameters, via function blocks and functions.

- **PLC parameters for general purpose (PLC registers)**
  Drive parameters to be freely used in the PLC program for data management and/or communication of Rexroth IndraMotion MLD with external devices, inputs/outputs, sensors. (This actually is not a data channel, but drive parameters which can be used for communication or data management.)

- **Motion command channel**
  Internal data channel for transmitting consistent input from motion function blocks. This channel is not visible to the user and cannot be directly accessed, but is used by the motion control of MLD.
Explanation of the MLD Data Channels

See also "MLD Application Manual"

I/O Channel (PII, POI)

Brief Description
The I/O channel is MLD’s contact to external devices as it allows evaluating and addressing digital and analog inputs/outputs.

![Fig. 5-11: I/O channel (PII, POI)](image)

Features
The I/O channel has the following features:

- Inputs and outputs are in the respective process image.
- There is one common process image for all tasks.
- The PLC works in word-oriented form according to IEC1131.
- **Update of process image inputs** (PII) max. $T_{PLC}/2$ (500 µs for ADVANCED) before the PLC task. For inputs which are read via the master communication or via CCD, the update of the process image inputs is additionally delayed by the corresponding bus cycle time.
- **Update of process image outputs** (POI) max. $T_{PLC}/2$ (500 µs for ADVANCED) after the PLC task. For outputs which are written via the master communication or via CCD, the update of the process image outputs is additionally delayed by the corresponding bus cycle time.
- Distribution of physical inputs/outputs between drive and PLC is possible via IDNs (parameters).
- Changes in the I/O configuration take effect after switching from parameter mode to operating mode.
- I/O channel is configured by means of IndraWorks dialogs.
- **To be observed:** Only those inputs and outputs used in the program are updated.
Configuring Local Inputs/Outputs

The paragraphs below are describing the following examples of configuration by means of IndraWorks dialogs:

- assignment of PLC variables (or parameters) to digital inputs/outputs
- assignment of PLC variables (or parameters) to analog inputs/outputs

Configuring Digital Inputs/Outputs of Control Section

Each input and output of the control section can be individually used in the drive or assigned to the PLC. Digital inputs/outputs of the control section are assigned to PLC parameters by assigning the desired bits of a PLC parameter to a digital input or output. In IndraWorks a dialog is available for this purpose.

See also Functional Description "Digital Inputs/Outputs"

Configuring Analog Outputs of Control Section

Outputting PLC variables via an analog output requires configuring the respective PLC parameters (P-0-1410,...). The example below illustrates the assignment of a PLC parameter to an analog output.

See also Functional Description "Analog Inputs"
Assigning a parameter to an analog output

Configuring Analog Inputs of Control Section

Reading in analog voltage values requires configuring the respective PLC parameters (P-0-1390, ...) for the analog inputs. The example below illustrates the assignment of the PLC parameter "P-0-1391, PLC input WORD1 AT %IB2" to analog input 1.

See also Functional Description "Analog Inputs"
The configurations of the modules "parallel interface", optional modules MD1 and MA1 are described in detail in the MLD Application Manual in chapter "Data Channels".

**Configuring Remote I/Os at Slave Axes (MLD-M via CCD)**

When using IndraMotion MLD-M it is possible to use the peripherals of the connected axes in the PLC. In this case, the data are exchanged via the CCD mechanism.

Parameter setting takes place in the dialog "I/O Configuration" under MLD. On the left side, the dialog shows a selection of the process image parameters. You have to enter the desired parameter of the process image. The right side displays a selection of all inputs or outputs available on the slave. The corresponding register of the I/O module has to be entered.

**Note:** The parameters set in this dialog are automatically added to the cyclic command values or actual values of the respective axis. A list of all cyclic parameters can be seen in the CCD dialog "Diagnosis, process data, command values or actual values", see also "CCD Configuration in MLD-M System Mode".

The following examples show how to configure remote inputs/outputs for MLD-M.
In the first example the input double word 25 (P-0-1440) was assigned via P-0-0303 to the digital inputs of slave #1. You have to observe in which bits the corresponding terminals take effect. (See parameter setting of digital inputs/outputs X31/X32). Furthermore, the input word 0 (P-0-1390) is assigned via P-0-0082 to the digital inputs of the MD1 module in slave #1.

P-0-0303 contains 32 bits and therefore has to be assigned to a 32-bit process image register, such as P-0-1440.
Example 2 In the second example the output word 0 (P-0-1410) was assigned via P-0-0304 to the digital outputs of slave #1. The individual bits %QX0.0 and following control the outputs of the slave. You have to observe which bits take effect at the corresponding terminals (see parameterization of digital inputs/outputs X31/X32). In this case, it is possible that digital outputs of the slave control section are controlled by the PLC in the master and others by the slave drive itself. Furthermore, the output word 1 (P-0-1411) is assigned via P-0-0081 to the digital outputs of the MD1 module in slave #1. In addition, P-0-1412 is written to the analog output 1 of the slave.

![Fig. 5-16: Digital and analog outputs of control section and MD1 of a slave axis](image)

Courtesy of CMA/Flodyne/Hydradyne ▪ Motion Control ▪ Hydraulic ▪ Pneumatic ▪ Electrical ▪ Mechanical ▪ (800) 426-5480 ▪ www.cmafh.com
Example 3  When using IndraMotion MLD-M, it is possible to access the local peripherals via the CCD mechanism. This allows updating both local and remote peripherals at the same time.

In the third example the digital inputs of the local axis are read via CCD by means of P-0-1441 to the input double word #26. In this way, these digital inputs are read via the CCD mechanism at the same time as the inputs of remote axes. As a result, the (local) input takes effect at the same time as inputs which are read from remote axes via SERCOS III.

The same applies analogously to outputs on the local axis which have been configured via the CCD mechanism ("virtual slave").

Fig. 5-17: Accessing local inputs/outputs via CCD (virtual slave)
Local Real-Time Channel

This exclusively local data channel is predominantly used for specific control tasks and is not required for motion control.

The local real-time channel allows consistent cyclic data exchange of several process values.

The real-time channel is used when actual values or command values have to be exchanged consistently between PLC and local drive.

For the local axis (MLD-S), it provides simple, high-performance cyclic data exchange.

Fields of application:
- process controllers (register controller, winding computation...)
- realization of technology functions that require processing synchronous to the clock
- command value generators

Note: The real-time channel is not suited for Motion Control. For this purpose, there is the motion channel with its library functions according to PLCopen.
Features:
- periodic ("cyclic") task (as of 1 ms interval)
- data exchange synchronized with the drive
- a maximum of 4 consistent actual values and command values
- time-constant command value input in spite of calculating time variations
- synchronous actual values and points at which they take effect at all cyclically configurable parameters
- easy to use (without configuration)
- control of "remaining" calculating time
- It is possible to use all the cyclically configurable parameters contained in "S-0-0187, List of configurable data in the AT" and "S-0-0188, List of configurable data in the MDT".

Note: The "remaining" calculating time is automatically controlled. If the time is exceeded, an error is signaled at the function block output (see also function block "MX_SynchronControl").

Pertinent Function Blocks
For extended control and diagnosis of the real-time channel, there is the function block "MX_SynchronControl" available.

AxisData
As of MP*04VRS, there are predefined axis data structures ("AxisData") with some command values and actual values available for cyclic access to local and remote axes.

Fig. 5-18: Accessing local and remote axes by means of data structure "AxisData"
"AxisData" is an IEC1131 data structure definition which contains some important actual values of the axis. In addition, it contains configurable actual values and command values with which the user can read and, if applicable, write his own cyclic data. This allows easily accessing the most important axis data.

Processing "AxisData" is optional and therefore has to be activated. "AxisData" is activated by the PLC configuration P-0-1367, bit 6 = 1; by default, "AxisData" is not active.

Features

- "AxisData" is an IEC1131 data structure definition which contains some important actual values of the axis. In addition, it contains configurable actual values and command values with which the user can read and, if applicable, write his own cyclic data. This allows easily accessing the most important axis data.
- Processing "AxisData" is optional and therefore has to be activated. "AxisData" is activated by the PLC configuration P-0-1367, bit 6 = 1; by default, "AxisData" is not active.

Fig. 5-19: Activating AxisData

Note:
1. When "AxisData" is used, permanent control must have been activated for the local axis and, for MLD-M, the MLD-M system mode must have been additionally activated.
2. After AxisData has been activated for the first time, the drive has to be switched off and on again.
3. "AxisData" is not yet available for MPB04.

- The declaration of the structure has already been made in the library "MX_Base.lib" as an array "Array of Struct" over all real axes.
  "AxisData : ARRAY[1..8] OF MX_AXISDATA"
In order to achieve synchronized (dead-time-optimized) command values processing for all axes in the MLD-M system mode, the local axis, apart from the remote axes (CCD slaves) is commanded, too, in the CCD master via CCD (SERCOS III).

The data contents of all axes are updated in the course of the MDT/AT telegrams of cross communication (CCD). Thereby, access to the axes (CCD master and slaves) takes place synchronously.
Note: In contrast to PII and POI, the axis data are not processed synchronously to task processing; this must be ensured by the corresponding access in the program. When synchronous actual values or command values are required, the corresponding structure elements are copied at the beginning of the task. The update of AxisData synchronously to the PLC task is in preparation.

- If user-specific command values and actual values are to be transmitted in addition to the preset actual values, "AxisData" must be configured in the following dialog:

![Fig. 5-21: Dialog for setting the configurable elements of AxisData](image)

- The parameters input in dialog "MX_AXIIDATA" are automatically entered in the CCD configuration. You can have the entire resulting list of cyclic values via CCD displayed in the dialogs of CCD configuration (see "CCD: diagnosis, process data, command values or actual values").

- Access to the data structure "AxisData" does not take place via function blocks, but via direct access to the data structures.
Accessing Elements in "AxisData"

These are some examples of code for access to the elements of "AxisData".

Declaration in MX_Base.lib:

```pascal
AxisData : ARRAY[1..8] OF MX_AXISDATA;
```

Examples for use in the PLC program:

```pascal
bMyStandstill := AxisData[MyAxis.AxisNo].Axis_Standstill;
AxisData[MyAxis.AxisNo].dwUserCmdDataA_q.REAL := rMyValue;
rTorque := AxisData[Axis3.AxisNo].rActualTorqueForce_i;
```

Free Process Data in MLD-M

In MLD-M it is possible to define additional cyclic process data for specific requirements. This is not necessary for normal motion tasks but can make sense for specific constellations.

Other cyclic actual values and command values can be configured in the IndraWorks dialog "CCD: Free process data".

Note:

The parameters set in this dialog are automatically added to the cyclic command values or actual values of the respective axis. A list of all cyclic parameters can be seen in the CCD dialog (see "CCD: diagnosis, process data, command values or actual values").

In the example below, an additional command value has been configured; the PLC register P-0-1370 of MLD-M is cyclically transmitted to slave #1 to parameter S-0-0048.

![Free process data configuration](DB000234v01_en.tif)

Fig. 5-22: Free process data configuration
Accessing Local Parameters via Direct Variables

Another possibility of processing parameters in a simple and quick way is accessing them via direct variables. This allows accessing parameters in a reading and writing way in the PLC program with simple syntax, without function call or function blocks and without taking the detour via the process image. The PLC source code therefore is very simple and clearly structured.

Note: As in the case of processing of cyclic master communication data, storage and limit value check or error handling is not carried out in this case.

Features

Access via direct variables allows directly accessing all cyclically configurable parameters in the drive (cf. “S-0-0187, List of configurable data in the AT” and “S-0-0188, List of configurable data in the MDT”).

Note: All direct variables have already been declared in MX_Base.lib.
Accessing parameters via direct variables provides the following advantages:
- rapid parameter access
- no instances required
- simple and clearly structured programming in PLC

Accessing parameters via direct variables implies the following restrictions:
- access to cyclically configurable parameters only
- no access to parameters of remote axes
- direct variables cannot be triggers for a PLC event task
- direct variables are invisible for debuggers (as no memory reserved)
- bit access impossible (e.g. "DV_P_0_0115.3")

**Parameter Channel**
The parameter channel allows acyclically accessing (reading and writing) all S- and P-parameters of the drive.

**Note:** The parameters are directly accessed, i.e. the duration of a reading or writing process is very short for the local axis.
Access to parameters of remote axes is possible and uses the service channel of CCD in SERCOS III. The result is that the function blocks have to be called several times and signal "Done" when transmission is over.

**Access via Function or Function Block**
Several possibilities are provided for access to parameters.

Features of access to parameters via function:
- faster than function block
- no instances
- no error control
- no access to remote axes

Features of access to parameters via function block:
- transmission with error control
- instance required
- action takes place at rising "Execute" edge
- access also to remote axes

**Features of Parameter Channel**
The parameter channel has the following features:
- The blocks and functions for processing the parameters are contained in the following libraries:
  - target "IndraDrive MPH02": "Base_MPH02.lib"
  - target "IndraDrive MP03": "Base_MP03.lib"
  - as of target "IndraDrive MP04": "MX_Base.lib"

**Note:** Independent of the target, the term "Base library" will be used in the following paragraphs.
For a single-axis system, you always have to indicate the axis number "Axis1".

Not all of the function blocks allow accessing remote axes via CCD; see Library Description (online help via <F1>) or function block header in IndraLogic.

Addressing

The parameters are addressed via constants from the base library (FP,...). The constants used in this library contain the SERCOS-compatible address for S-/P-parameters. In the case of the function blocks of the base library, the "Ident" or "ParameterNumber" input is supplied with these constants.

Fig. 5-24: Addressing parameters via constants

Parameter Channel Libraries

Fig. 5-25: Functions and function blocks in the "Base library"
Example

In this example, element 10 of parameter P-0-4006 would be read on the 1st CCD slave (Axis2).

![Diagram](image)

Fig. 5-26: Example of a read function

For further information on access by means of functions and function blocks see Library Description of the base library.

PLC Parameters for General Purpose (Global Registers)

Access via "parameters for general purpose" (global registers) can be used for data exchange of MLD with a neighboring drive (as of MP04VRS via CCD) or a higher-level control unit or an external operator terminal (e.g. BTV).

Note: The global registers (G0...G15) do not have any direct influence on the drive, but only take effect in conjunction with MLD.

Features

Parameter access via global registers is characterized by the following features:

- 16 global registers (P-0-1370 ... P-0-1385) with freely definable data format for parameterizing PLC functions or function blocks
- 2 global text registers (P-0-1386, P-0-1387) as freely usable text parameters for displaying diagnostic message texts

Format Adjustment for Global Registers Gxx

The display formats of the global registers can be individually adjusted with "P-0-1386, PLC display format Global Register". Apart from the display format (e.g. BIN, Dec, Hex,...), it is possible to define the number of decimal places.
The content of the global registers "Gxx" and "GLx" is backed up in case control voltage fails, i.e. the register contents are stored in non-volatile form so that the parameter contents do not get lost in case voltage fails.

### Applications for Global Registers Gxx

The global registers G0 ... G15 or GL0 can therefore be used for the following applications:

- parameterization of PLC functions or function blocks
- communication with the external control unit via the master communication
- use as non-volatile (permanent) memory for the MLD-S because the contents are retained in case voltage fails

### Applications for Global Registers Axx

In addition there are the two global registers "P-0-1387, PLC Global Register AT0" and "P-0-1387, PLC Global Register AT1" which are available as freely usable text parameters with a maximum of 255 characters plus closing "0" character.

### Note:

The two global text parameters of the PLC are not stored.

### Applications for Global Registers Axx

The global registers (AT0 and AT1) can therefore be used for the following applications:

- communication with higher-level control unit or HMI
- definition of freely definable diagnostic message texts
Motion Command Channel

The motion command channel is an internal data channel for transmitting consistent inputs of ready-made motion function blocks. These ready-made motion function blocks can be called directly from the PLC program. The motion command channel internally is mainly used for realizing Motion Control tasks or for technology functions. The available motion function blocks conform to PLCopen; i.e. programs created with the motion function blocks can be transferred to other targets.

- The motion function blocks have a logic axis address for selecting the axis. In the single-axis system MLD-S, this allows controlling the local axis and the master axis generator.
- In the multi-axis system MLD-M, the axes connected via CCD can be additionally controlled.
- The most important inputs during motion control take place via the corresponding inputs at the motion function blocks. Other specific settings, such as scaling, jerk etc., are parameterized. This is normally done during the commissioning of the axes with the parameterization interface IndraWorks. By means of parameter access it is also possible to change other settings (e.g. the jerk).
- Axis motion via a motion function block can only be carried out when MLD has control over the drive. This can be done either "permanently" by activating the "permanent control" (see Fig. 5-4) or "temporarily" by the function block MX_SetControl.

PLCopen

Motion control via the PLC program is carried out by means of function blocks according to PLCopen. For this purpose, PLCopen has defined several IEC1131 function blocks by means of which the axes can be controlled. Apart from the function blocks defined by PLCopen, there are additional function blocks which are based on the standard.

Programming

Programming takes place with the function blocks of the "MX_Base.lib" and "MX_PLCopen.lib" libraries. The function blocks have been designed in such a way that they are cyclically called. They are predominantly activated by an input edge and provide information on status outputs. The exact functional principles are described in the respective library documentation.

Libraries

The library "MX_Base.lib" contains function blocks for axis control, such as "MC_Power" and "MC_Reset", which are used to bring the axis in control or clear an error.

The library "MX_PLCopen.lib" contains function blocks for motion control, such as "MC_MoveAbsolute" or "MC_Stop".

Settings

After the permanent control has been activated for the local axis, or the MLD-M system mode for control of remote axes, the required operating modes of the axes are automatically parameterized. The operating mode is thereby automatically selected. Normally it is not necessary to make further settings.
During commissioning, the scaling of the axes is carried out in the corresponding dialogs of the parameterization interface IndraWorks. At the motion function blocks the preset values are set via the function block inputs as physical values according to standard.

Other settings, such as jerk, are not parameterized at the function blocks, but in the parameterization interface IndraWorks. If such values are to be changed, they can be set at runtime via the parameter channel (e.g. "MC_WriteParameter").

Configuration of Cyclic Data in MLD-M System Mode

In the MLD-M system mode, the cyclic parameters of the axes are automatically configured from the fixed parameters for the motion channel and other parameters. The resulting cyclic parameters are only displayed. According to their function, there are different dialogs for parameterizing the cyclic data.

Summary of all cyclic numerical data:

- Motion data
  The parameters of the motion channel are automatically added to the cyclic parameters. There are no inputs for this purpose.

- MLD-M I/O
  The parameters required for exchanging data with remote I/Os are entered. There is the dialog for MLD-M I/O configuration for this purpose.

- AxisData
  The parameters required for the user data are defined in AxisData. See dialog "AxisData Fig. 5-21"

- Free process data
  Other freely selectable cyclic parameters can be entered for specific communication. See dialog for definition of CCD free process data.

- Signal status and signal control bits
  The signal control or signal status word is permanently cyclically configured in the motion data. Thereby, 12 bits of the 16 possible bits have been defined or reserved. The remaining 4 bits (bit #12…bit #15) can be used via AxisData as actual value or command value bits. This is set in the dialog for AxisData. The CCD configuration includes the dialog in which all cyclic parameters are summarized.
Fig. 5-28: Dialog displaying all cyclic data (in preparation)

Fig. 5-29: Dialog displaying the resulting configuration of the signal control word
The example below shows how the cyclic data of "Motion", "AxisData", "I/Os" and "free process data" are summarized. In the dialog on the right hand side all cyclic data are displayed. When data are entered in the individual dialogs, the configurations of the MDT/AT data of the slave axes are automatically created.
Bitzuweisungen

Mit der Bitzuweisung werden die Bits 12 bis 15 des Signalsteuerwortes konfiguriert.

**Fig. 5-31: Summary of the cyclic data**
6 Programming

6.1 Step 8: Start IndraLogic

The Logic node shows the PLC structure and is used for configuration of global PLC properties and context-sensitive call of the PLC programming system.

Calling the IndraLogic Programming System

By double-clicking the Logic node and each of its subnodes, IndraLogic is opened globally or with the corresponding editor. When started from IndraWorks,

- the necessary communication settings for program download
- the target settings
- a main program (PLC_PRG) with task configuration (10 ms)

are automatically created in IndraLogic. It is not necessary to make settings within IndraLogic.
Configuring and Controlling the PLC

When IndraLogic has not been started, right-clicking opens the following context menu:

- **Open**
  Starts PLC programming system IndraLogic.

- **Save**
  Saves the IndraLogic project. When this is done, the project is stored as a file within the IndraWorks project.

- **Save PLC project file as...**
  The IndraLogic project (PRO file) can be saved under a different name.

**Note:** This generates a copy of the project. IndraWorks still uses the current project. The PLC project within IndraWorks can be renamed in the properties.

- **Print project**
  Prints the project components contained in IndraLogic.
  Note: Printing starts immediately on the standard printer.

- **Update**
  The PLC structure data of IndraWorks and IndraLogic are adjusted. When this is done, the updated PLC project tree is displayed, for example.

- **Start PLC!**
  The PLC is started.

- **Stop PLC!**
  The PLC is stopped.

- **Import project data...**
  A PLC project (PRO file) can be partly or completely imported.
Fig. 6-3: Importing an existing project (PRO file)

- Properties
  The dialog for the project properties of IndraLogic is only available when IndraLogic has not been opened.
6.2 Step 9: Create Program

Creating a New Program

Declaring Variables and Writing Program

The variables used in the program have to be declared and, if necessary, addressed to digital inputs or outputs.
Including a Function Block

Select a type of block and the language in which it is to be programmed:

Fig. 6-5: Including a function block

Changing Task Configuration

Blocks of the "Program" type have to be assigned to tasks ("Object Organizer": "Resources", Task Configuration"). They determine, for example, on which time base and with which priority programs are called and processed.

Fig. 6-6: Task configuration
Changing Target

If the target is to be changed, this can be done in the following dialog.

Using an Existing Program

If an existing program is to be used, it can be imported.
See also: Importing an existing project (PRO file)

6.3 Step 10: Load and Activate the Program

Loading the Program

In IndraLogic carry out the menu command “Online”-“Login” (alternative: shortcut <Alt>+<F8>). Then there is a safety prompt you have to confirm with “Yes” in order to load the PLC program to the drive.
Starting the Program

To start the PLC program carry out the menu command "Online"-"Run" (alternative: <F5>).

Creating a Boot Project

To have the program written to the drive in storing form it must be saved as a boot project. It is thereby available after the drive has been switched off and on again.
6.4 Step 11: Test the Program

Online Display

In running operation it is possible to once set variables to a specific value ("Online"-"Write Values") or write a new specific value to the variables after each cycle ("Online"-"Force Values"). You can change the variable value in online operation by double-clicking it. Boolean variables thereby go from TRUE to FALSE or vice versa; for all other variables you get the dialog "Write variable xy" in which you can edit the current variable value.

Fig. 6-11: Controlling and watching the PLC program with the online display
Watching Variables with Trace Recording

The trace recording allows watching all PLC variables in their chronological interrelation.

![Trace recording](DB000048v01_en.bmp)

**Fig. 6-12: Trace recording**

Oscilloscope Function

The oscilloscope function can be used to record drive-internal and external signals and status variables (parameter contents). This function can be effectively used both for initial commissioning and debugging. Its functionality can be compared to that of a 4-channel oscilloscope.

![Starting the oscilloscope function](DB000246v01_en.tif)

**Fig. 6-13: Starting the oscilloscope function**
Fig. 6-14: Oscilloscope function

See also Functional Description "Oscilloscope Function"
7 Examples

7.1 MLD-S, Example of Application – Sinusoidal Motion

Task Definition – Application Description

A short program is to be created with which the integrated PLC internally generates a velocity command value which is then transmitted to the drive via the motion function block MC_MoveVelocity. By using MC_MoveVelocity, the drive is automatically switched to velocity control. In the drive, the generated velocity command value is mapped to parameter "S-0-0036, Velocity command value".

To do this, a sinusoidal command value is generated in this example and its periodic time and amplitude can be changed via a PLC variable.

Parameterizing / Configuring the Drive

Starting from the basic parameters, you have to make some fundamental settings for the example of application "sinusoidal motion". The following paragraphs will explain these settings in short form.

Enabling of Functional Packages

To use MLD-S, the functional package "Drive PLC" must have been enabled in the drive. Other optional functional packages are not required.

![Fig. 7-1: Enabling of functional package "Drive PLC"](image-url)
According to the mechanical configuration, you have to set the scaling, gear and feed constant.
MLD Configuration  

For the drive PLC, you have to select permanent control for the drive.

![MLD configuration](DB000264v01_en.tif)

**Configuration of Digital I/Os**  
The digital inputs and outputs at X31/32 have to be parameterized at the drive as follows.

![Configuration of X31 at the drive](DB000265v01_en.tif)

- X31.3: P-0-1390, bit 0 (%IX0.0) bEnable

**Fig. 7-4:** Configuration of X31 at the drive
Programming

1. **Variable declaration**
   In the variable declaration, the variables which are used are created and assigned to the inputs and outputs.

```
PROGRAM PLC_PROG
VAR
  (* variable declaration *)
  rPower : MC_Power; (* function block to switch axis to control (AF, AU)*)
  rMoveVelocity : MC_MoveVelocity; (* function block for velocity control *)
  bEnable : A7 1200.0 : BOOL; (* digital input I_1 is set, the drive PLC switches the axis to drive enable (AF) via MC_Power *)
  rDurationSinePeriod : REAI := 100; (* input of periodic time in sec. of sine signal to be generated *)
  rAmplitude : REAI := 0.4; (* input of amplitude in rpm of sine signal to be generated *)
END_VAR

rPI CONSTANT
  : PI := 3.1416; (* declaration of constant Pi *)

DB000266v01_en.tif
```

Fig. 7-5: Variable declaration

2. **Set drive enable**
   When the digital input I_1 is set, the drive PLC switches the axis to drive enable (AF) via MC_Power.

```
(* calling an instance of function block MX_Power: with 1-signal to "bEnable" via digital input I_1 the drive is switched to control (AF or AU)*)

FBPower
  Enable := bEnable,
  Axis := Axial
;

DB000267v01_en.tif
```

Fig. 7-6: Setting drive enable

3. **Generate sine signal**
   In the following program section, the sine signal is generated. The signal can be influenced via the following variables:
   - rAmplitude amplitude of sine signal
   - rDurationSinePeriod periodic time of sine signal

```
0010 (* generating sine velocity command value *)
0012 rCounter := rCounter + 1;
0013 rSine := SIN(2*rPI*rCounter / 1000 / rDurationSinePeriod);
0014 rVCommandValue := rAmplitude*rSine;

DB000268v01_en.tif
```

Fig. 7-7: Generating sine signal

4. **Travel sine profile**
   The generated sine signal is switched to the drive via the motion function block "MoveVelocity". By calling the function block, the drive is automatically operated in velocity control.
Commissioning and Testing

For commissioning and testing, the following steps have to be carried out:

1. Compile program and then load it to drive
2. Start drive PLC
3. Switch axis to operating mode (OM). Clear possibly present errors via “Esc” key
4. Switch power on. Axis must show status "Ab"
5. Establish position data reference (e.g. set absolute measuring)
6. Application can be started via 1-signal at input I_1 at X31 of drive

Visualizing and Diagnosing

The signals can be watched either via

- the online display,
- the IndraLogic trace function or
- the oscilloscope function of the drive.
Fig. 7-9: IndraLogic trace recording

Fig. 7-10: Oscilloscope recording in the drive
7.2 MLD-M, Example of Application – Simple Double-Axis Positioning Control (Pick and Place)

Task Definition – Application Description

Products are to be moved from one place to another place. The axis motions are carried out one after the other. The control (digital output) and feedback (digital input) of the pneumatic picker are to be handled via MLD. The procedure is to be started via a switch-key which is read in at a digital input at the master.

Control (close picker, open picker) and feedback (picker closed) for the pneumatic picker are to be controlled via digital I/Os at the SERCOS slave. This implies the additional task of accessing remote I/Os by means of MLD-M.

Mechanical configuration:

Fig. 7-11: Application – Pick and Place
Sequence of motion:

Step 1:
Upon a positive edge at input "bStartAutomatic" (P-0-1390, bit 0, %IX0.0), the X- and Y-axes are switched to enable. The X-axis first and then the Y-axis position to pick position. When the 1st positioning process of both axes has been completed, the output "bPickerCloseCmd" (P-0-1411, bit 8, %QX1.8) is set whereby the picker closes and takes up the product.

Step 2:
When the picker has closed, this is signaled by the feedback "bPickerCloseAct" (P-0-1440, bit 1, %IX50.1) and positioning to the place position is carried out. In this case, it is first the Y-axis and then the X-axis which is moved. When the place position has been reached, the output "bPickerOpenCmd" (P-0-1411, bit 9, %QX1.9) is set upon which the picker opens and places the product.

Step 3:
The 0-signal of input "bPickerCloseAct" (P-0-1440, bit 1, %IX50.1) signals that the picker has opened and this triggers positioning to start position. For this purpose, it is first the Y-axis and then the X-axis which positions. When the travel process has been completed, the enable signal is removed at the axes.
Parameterizing / Configuring the Drive

Starting from the basic parameters, you have to make some fundamental settings for the example of application "Pick and Place". The following paragraphs will explain these settings in short form.

Enabling of Functional Packages

To use MLD-M, the functional package "Drive PLC" must have been configured in the CCD master (X-axis). Other optional functional packages are not required in CCD master (X-axis) and CCD slave (Y-axis).

![Fig. 7-13: Enabling of functional package "drive PLC"](DB000272v01_en.tif)
According to the mechanical configuration, you have to set the scaling, gear and feed constant for the X- and Y-axis.

Fig. 7-14: Example of mechanical data for X-axis
CCD Configuration

First you have to activate the CCD communication and select the MLD-M mode. The axis with address 4 has been configured as CCD slave (Y-axis).

MLD Configuration

In the drive PLC, you have to select permanent control for the CCD master.

Fig. 7-15: CCD settings

The resulting axis addressing in MLD-M is:
- X-axis (axis address 2): Axis1 in MLD
- Y-axis (axis address 4): Axis2 in MLD

Fig. 7-16: MLD configuration
The digital inputs and outputs at X31/32 have to be parameterized at the X-axis (CCD master) as follows.

**X31.3**: P-0-1390, bit 0 (%IX0.0) \( b \text{StartAutomatic} \)

**X31.4**: P-0-1390, bit 1 (%IX0.1) \( b \text{ProgramReset} \)

Fig. 7-17: Configuration X31 of X-axis (CCD master)

**X32.3**: P-0-1410, bit 0 (%QX0.0) \( b \text{PickerActive} \)

Fig. 7-18: Configuration X32 of X-axis (CCD master)
The digital inputs and outputs at X31/32 have to be parameterized at the Y-axis (CCD slave) as follows.

**Configuration X31 of Y-axis (CCD slave)**

X31.3: P-0-0303, bit 1  bPickerCloseAct

You can simply configure a dummy parameter for the digital input I_1 of the CCD slave, because the status of the input is copied directly from parameter P-0-0303 (signal status of the digital inputs) to the CCD master (see also Fig. 7-21).

**Configuration X32 of Y-axis (CCD slave)**

X32.6: P-0-0304, bit 8  bPickerCloseCmd
X32.7: P-0-0304, bit 9  bPickerOpenCmd

The digital outputs only have to be configured as outputs and a dummy parameter can be assigned to them as is done for the inputs. The status of the output is influenced by the CCD master by direct writing of P-0-0304 (signal status of the digital outputs) (see also Fig. 7-21).
The following settings are required to transmit the input which has been read in from the Y-axis (CCD slave) to the X-axis (CCD master) or to set the outputs at the Y-axis (CCD slave) from MLD-M of the X-axis (CCD master):

P-0-1410 of the master is transmitted to P-0-0304 of the slave
P-0-0303 of the slave is transmitted to P-0-1440 of the master

Fig. 7-21: Configuration of the distributed I/Os

In the example of application, P-0-1410 is written by MLD-M. By the above-mentioned configuration, this parameter directly takes effect at the status of the digital outputs P-0-0304 in the Y-axis (CCD slave).

The status of the digital inputs of the CCD slave P-0-0303 is copied to parameter P-0-1440 of the CCD master and evaluated there in MLD-M. As P-0-0303 is a 32-bit value, it has to be assigned to a 32-bit process image register, such as P-0-1440.

You have to observe in which bits the corresponding terminals take effect. For example, the output I/O_8 which is used has to be addressed in the CCD slave via bit 8 of P-0-0304.

(See Parameter Description P-0-0303 and P-0-0304)
Programming

1. **Variable declaration**
   In the variable declaration, the variables which are used are created and assigned to the inputs and outputs.

```plaintext
PROGRAM PLC_PRG
VAR
  bStartAutomatic   AT %IX.0   : BOOL (*P-0-1390, bit 0*);
  bProgramReset     AT %IX.1   : BOOL (*P-0-1390, bit 1*);
  bPickerClosed     AT %IX.2   : BOOL (*P-0-1410, bit 0*);
  bPickerActive     AT %IX.0   : BOOL (*P-0-1410, bit 0*);
  bPickerClosedEnd  AT %IX.1   : BOOL (*P-0-1411, bit 0*);
  iStep             AT %Q0.0   : INT;
  bStart            AT %Q0.1   : BOOL (*P-0-1411, bit 2*);

  fStartEdge        : F_TEQG;
  sNC_PowerNaxis    : NC_Power;
  sNC_PowerYaxis    : NC_Power;
  sNC_MoveAbsoluteX : NC_MoveAbsolute;
  sNC_MoveAbsoluteZ : NC_MoveAbsolute;
  sNC_VAR
```

Fig. 7-22: Variable declaration

2. **Initialization**
   In the first initialization step, all variables or function blocks are brought to a defined status.

```plaintext
00001 (*Reset of Motion function blocks and variables; if Picker is not active or ProgramReset*)
00002 IF NOT bPickerActiv OR bProgramReset THEN
00003  sNC_MoveAbsoluteX = (ENABLE = FALSE,
00004        Axis = Axis1);
00005  sNC_MoveAbsoluteZ = (ENABLE = FALSE,
00006        Axis = Axis1);
00007  sNC_PowerX = (ENABLE = FALSE,
00008        Axis = Axis1);
00009  sNC_PowerY = (ENABLE = FALSE,
00010        Axis = Axis1);
00011  iStep = 0;
00012  bPickerActiv = FALSE;
00013  bPickerClosedEnd = FALSE;
00014  bPickerOpenEnd = FALSE;
00015  bNC_IF
```

Fig. 7-23: Initialization

3. **Generate start edge**
   After a positive edge at input "bStartAutomatic" (P-0-1390, bit 0, %IX0.0) the automatic sequence of steps is processed.

```plaintext
0019 (*"Generating a positive edge for start")
0020  bStartEdge (CLR := bStartAutomatic , C := bStart);
0021
0022  IF (bStart OR bPickerActiv) AND NOT bProgramReset THEN
0023    CASE 1Step OF
0024
```

Fig. 7-24: Starting the Pick-and-Place-application
4. **Set drive enable**

In the first step (step 0), the X- and Y-axes are switched to enable. When
the axes are in control, the program jumps to the next step.

```
0025  0: (*Enable the X-Axis and Y-Axis*)
0026    fbMC_PowerXAxis(Enable:=TRUE ,
0027        Axis:= Axis1);
0028    fbMC_PowerYAxis(Enable:=TRUE ,
0029        Axis:= Axis2);
0030 0031  (*Setting State: Picker activ*)
0032    bPickerActive := TRUE;
0033 0034  (*if Picker closed -> next step*)
0035    IF fbMC_PowerYAxis.Status THEN
0036        iStep := 10;
0037      END_IF
```

![Fig. 7-25: Step 0: setting drive enable](DB000284v01_en.tif)

5. **Position to pick position**

In the second step (step 10), it is first the X-axis and then the Y-axis
which position to pick position. When the 1st positioning process of both
axes has been completed, the output "bPickerCloseCmd" (P-0-1411, bit
8, %QX1.8) is set whereby the picker closes and takes up the product.
When the picker has closed, this is signaled by the feedback
"bPickerCloseAct" (P-0-1440, bit 1, %IX50.1) and the program switches to
the next step.

```
0040  10: (*Positioning to pick position*)
0041      (*First movement of X-Axis*)
0042      fbMC_MoveAbsoluteXAxis;
0043          Execution:= TRUE,
0044          Position:= 00010000,
0045          Velocity:= 1000,
0046          Acceleration:=1000 ,
0047          Deceleration:= 1000,
0048          Axis:=Axis1);
0049      (*First movement of Y-Axis, if positioning of X-Axis is finished*)
0050      fbMC_MoveAbsoluteXAxis;
0051          Execution:= fbMC_MoveAbsoluteXAxis.Done,
0052          Position:= -16010000,
0053          Velocity:= 1000,
0054          Acceleration:=1000 ,
0055          Deceleration:= 1000,
0056          Axis:=Axis2);
0057      (*If Y-Axis is finished, set Command Close Picker*)
0058      IF fbMC_MoveAbsoluteXAxis.Done THEN
0059        bPickerCloseCmd := TRUE;
0060 0061      (*If Picker closed -> next step, reset motion function blocks*)
0062      IF bPickerCloseCmd THEN
0063          iStep := 25;
0064      END_IF
0065      END_IF
```

![Fig. 7-26: Step 10: positioning to pick position](DB000285v01_en.tif)
6. Position to place position

In the next step (step 20), positioning to place position is carried out. In this case, it is first the Y-axis and then the X-axis which is moved. When the place position has been reached, the output “bPickerOpenCmd” (P-0-1411, bit 9, %QX1.9) is set upon which the picker opens and places the product. The input “bPickerCloseAct” (P-0-1440, bit 1, %IX50.1) signals that the picker has opened and the program switches to the next step.

```
20: ("Positioning to place position")
    ("Faint Command view Pickers")
    bPickerOpenCmd := FALSE;

2007 ("2nd movement of Y-axis")
    if func_MoveAbsoluteYAxis:
        Execute := TRUE,
        Position := -5510000,
        Velocity := 1000,
        Acceleration := 1000,
        Deceleration := 1000,
        Axis:=Axis1;

2008 ("2nd movement of X-axis, if positioning of Y-axis is finished")
    if func.MoveAbsoluteYAxis.Done:
        Execute := func.MoveAbsoluteYAxis.Done,
        Position := 1000000000,
        Velocity := 1000,
        Acceleration := 1000,
        Deceleration := 1000,
        Axis:=Axis1;

2009 ("If X-axis is finished, set Command Open Picker")
    IF func.MoveAbsoluteYAxis.Done THEN
        bPickerOpenCmd := TRUE;

2010 ("If picker open -> next step, reset motion function blocks")
    IF bPickerOpenCmd THEN
        iStep := 0;

2011 func.MoveAbsoluteYAxis(Because:= FALSE,
        Axis:= Axis1);

2012 func.MoveAbsoluteXAxis(Because:= FALSE,
        Axis:= Axis1);
```

Fig. 7-27: Step 20: positioning to place position

7. Position to start position

In the fourth step (step 30), it is first the Y-axis and then the X-axis which positions to start position. When the travel process has been completed, the program switches to the next step.

```
30: ("Positioning to start position")
    ("Faint Command open Pickers")
    bPickerOpenCmd := FALSE;

310 ("3rd movement of Y-axis")
    if func_MoveAbsoluteYAxis:
        Execute := TRUE,
        Position := 0,
        Velocity := 1000,
        Acceleration := 1000,
        Deceleration := 1000,
        Axis:=Axis2;

311 ("3rd movement of X-axis, if positioning of Y-axis is finished")
    if func.MoveAbsoluteYAxis.Done:
        Execute := func.MoveAbsoluteYAxis.Done,
        Position := 0,
        Velocity := 1000,
        Acceleration := 1000,
        Deceleration := 1000,
        Axis:=Axis2;

312 ("If positioning of Y-axis is finished -> next step reset motion function blocks")
    IF func.MoveAbsoluteYAxis.Done THEN
        iStep := 0;

313 func.MoveAbsoluteYAxis(Because:= FALSE,
        Axis:=Axis2);

314 func.MoveAbsoluteXAxis(Because:= FALSE,
        Axis:=Axis2);
```

Fig. 7-28: Step 30: positioning to start position
8. **Reset the sequence of steps**

In the fifth step (step 100), the "bPickerActiv" signal and the sequence of steps are reset. The sequence of steps has to restart.

Step 40 has been prepared for further functionality and can be included by the corresponding changes in the program.

Step 99 has been prepared for an error reaction, but this reaction has not been programmed in the example of application.

```
0141  40: (*free step for further functionality*);
0142
0143  99: (*Errorhandling*)
0144    iStep := 100;
0145
0146  100: (*Reset state: Picker activ*)
0147    bPickerActiv := FALSE;
0148
0149    iStep := 0;
0150
0151    END_CASE
0152    END_IF
```

Fig. 7-29: Step 100: resetting the sequence of steps
Commissioning and Testing

For commissioning and testing, the following steps have to be carried out:
1. Compile program and then load it to drive
2. Start drive PLC
3. Switch both axes to operating mode (OM). Clear possibly present errors via "Esc" key
4. Switch power on. Axes must show status "Ab"
5. Establish position data reference for both axes (e.g. set absolute measuring)
6. Application can be started via input I_1 at CCD master

Visualizing and Diagnosing

The signals can be watched either via
- the online display,
- the IndraLogic trace function or
- the oscilloscope function of the drive.

Fig. 7-30: IndraLogic trace recording
Osilloskop: Achse [2.1] LCD-M_...

**Fig. 7-31:** Oscilloscope recording of X-axis

<table>
<thead>
<tr>
<th>Nr</th>
<th>Messung</th>
<th>Signal</th>
<th>Y-axis Cursor</th>
<th>Einheit</th>
<th>Einheit/Div</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Achse [2.1] CCD-MasterS-040051 Lage Positiv Unermüdbar 1</td>
<td>0.008</td>
<td>0</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Achse [2.1] CCD-MasterS-040040 Geschwindigkeit Unermüdbar 1</td>
<td>0</td>
<td>4000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Achse [2.1] CCD-MasterAP-01300 SPS Eingang W0900 ...</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Achse [2.1] CCD-MasterAP-01400 SPS Ausgang W0900 ...</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Explanation of Terms

MLD-S, MLD-M, MLD
The drive-integrated PLC "Rexroth IndraMotion MLD" is available in different variants.

The variant for single-axis applications is called "MLD-S". The control possibilities of the PLC in this case are device-internally limited to the "local axis" and the virtual master axis generator.

If drives with SERCOS III slave interface are connected via the "CCD" option (SERCOS III master interface), the PLC can control these axes. This variant is called "MLD-M".

The general short form "MLD" is used when independent functionalities are described.

CCD
"CCD" is the abbreviation of Cross Communication Drives, the interface for cross communication based on SERCOS III. Devices of the "Rexroth IndraDrive" range can be configured with the "CCD" option to allow electronic (digital) interconnection of drives and I/O devices.

CCD Master /CCD Slave
The "CCD master" is a drive with "CCD" option (SERCOS III master interface) which acts like an external control unit for the "CCD slaves" (drives with "CCD" option (SERCOS III slave interface)) of a CCD group.

Local Axis
"Local axis" for MLD-S is the axis of the drive and for MLD-M it is the axis in the drive with the "CCD" option (SERCOS III master interface).

Remote Axes
For MLD-M, "remote axes" are the axes in the CCD slaves.

Virtual Master Axis
The drive contains a master axis generator. It can be controlled similarly to a real axis and then simulates an axis motion. The position of this master axis can be used as input for the local and remote axis. MLD can control this master axis via the motion function blocks.

AT
"AT" is the abbreviation of "Antriebstelegramm" (drive telegram). The drive telegram is sent from the slave to the master via the real time data channel.

MDT
"MDT" is the abbreviation of Master Data Telegram. The master data telegram is sent from the master to the slave via the real-time data channel.

PII
"PII" is the abbreviation of "process input image". In the task cycle, the switch states are read at the inputs before the program code is called and stored in the PII. This information then is transmitted to the control program and processed.

POI
"POI" is the abbreviation of "process output image". The states in the POI are transmitted to the physical outputs at the end of the task after the program code has been processed.