Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth Bosch Group

Rexroth IndraDrive
Rexroth IndraMotion MLD (2G)
Commissioning as of MPx-18

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Commissioning Manual

Title Rexroth IndraDrive
Rexroth IndraMotion MLD (2G)
Commissioning as of MPx-18

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Purpose of Documentation This document explains how to commission the drive and how to create a simple PLC program for IndraMotion MLD with IndraLogic 2G.

Record of Revisions See chapter "About This Documentation", marginal note "Editions of This Documentation"

Note This document has been printed on chlorine-free bleached paper.

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1 About This Documentation

Editions of This Documentation

Edition	Release date	Notes
DOK-INDRV*-MLD3-F*STEP-CO01-EN-P	2013-11-25	First edition

Tab.1-1: Record of Revisions

Means of Representation in This Documentation

To facilitate reading this documentation, the table below contains the means of representation and notations of recurring terms.

What?	How?	For example...
Paths and sequences of menus...	...are represented step by step in boldface	Click **Window** ▸ **Show view** ▸ **Properties**
Buttons and keys...	... are represented in angle brackets	Click <Add> or Press <Ctrl>+<Alt>
Important facts which are to be highlighted in the body text	Boldface	**For remote axes**, "Active"=TRUE signals that ...
Parameter names, diagnostic message names, function designations	Quotation marks	"Axis2" to "Axis10" correspond to the remote axes. The remote axes contained in the list "P-0-1801.x.10, CCD: Addresses of projected drives" ...

Tab.1-2: Conventions of Notation

All important notes are highlighted. A symbol tells you what kind of note is used in the text. The symbols have the following significances:

⚠ DANGER ...

DANGER indicates a hazardous situation which, if not avoided, **will** result in death or serious injury.

⚠ WARNING ...

WARNING indicates a hazardous situation which, if not avoided, **could** result in death or serious injury.

⚠ CAUTION ...

In case of non-compliance with this safety instruction, minor or moderate injury **could** occur.

NOTICE ...

In case of non-compliance with this safety instruction, property damage **could** occur.

This box contains important information that should be taken into consideration.

This symbol highlights useful tips and tricks.

About This Documentation

Your Feedback

Your experience is important for our improvement processes of products and documentations.

If you discover mistakes in this documentation or suggest changes, you can send your feedback to the following e-mail address:

Dokusupport@boschrexroth.de

We need the following information to handle your feedback:

- The number indicated under "Internal File Reference".
- The page number.

2 Introduction

2.1 Overview

This documentation explains how to commission the drive, install IndraWorks with MLD-2G and create a simple PLC program for IndraMotion MLD-S and MLD-M with the MPx-18VRS firmware.

The paragraphs below describe the steps required when using Rexroth IndraMotion MLD for the first time. We distinguish the following phases:

- Preparation and Setup
- Commissioning
- Programming

☞ The steps for setup and commissioning are only required for the initial commissioning.

The figure below shows an overview of the required commissioning steps.

Introduction

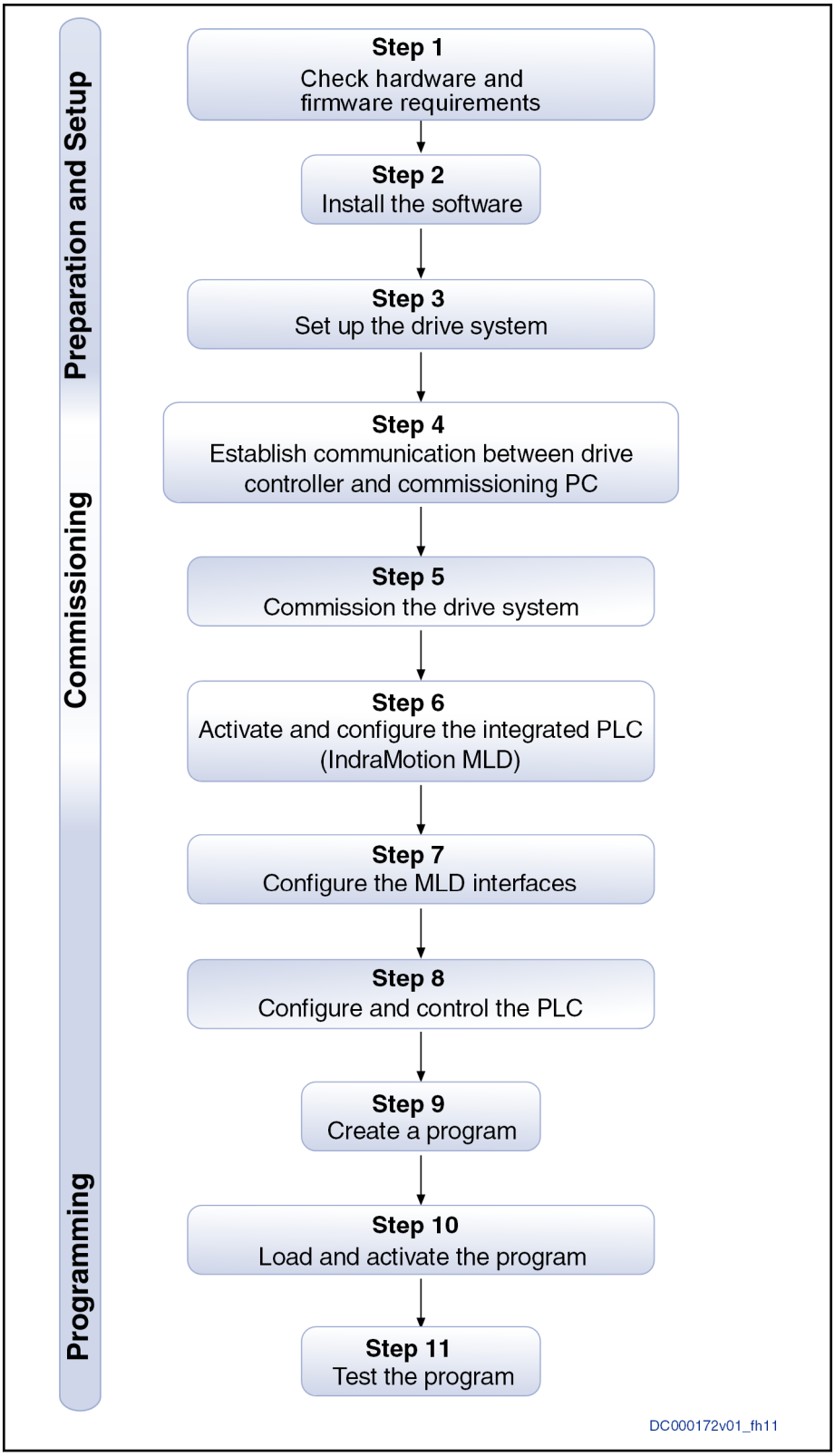


Fig.2-1: Commissioning Rexroth IndraMotion MLD

2.2 Reference Documentations

2.2.1 Drive Systems, System Components

Drive Systems with Single-Axis or Double-Axis Drive Controllers

Title Rexroth IndraDrive …	Kind of documentation	Document typecode[1)] DOK-INDRV*-…	Material number R911…
Cs Drive Systems with HCS01	Project Planning Manual	HCS01******-PRxx-EN-P	322210
Mi Drive Systems with KCU02, KSM02, KMS02	Project Planning Manual	KCU02+KSM02-PRxx-EN-P	335703
Drive Systems with HMV01/02 HMS01/02, HMD01, HCS02/03	Project Planning Manual	SYSTEM*****-PRxx-EN-P	309636
Supply Units, Power Sections HMV, HMS, HMD, HCS02, HCS03	Project Planning Manual	HMV-S-D+HCS-PRxx-EN-P	318790
Control Sections CSE02, CSB02, CDB02, CSH02	Project Planning Manual	Cxx02******-PRxx-EN-P	338962
Additional Components and Accessories	Project Planning Manual	ADDCOMP****-PRxx-EN-P	306140

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: PR01 is the first edition of a Project Planning Manual)

Tab.2-1: Documentations – Drive Systems, System Components

2.2.2 Motors

Title Rexroth IndraDyn …	Kind of documentation	Document typecode[1)] DOK-MOTOR*-…	Material number R911…
A Asynchronous Motors MAD / MAF	Project Planning Manual	MAD/MAF****-PRxx-EN-P	295781
H Synchronous Kit Spindle Motors	Project Planning Manual	MBS-H******-PRxx-EN-P	297895
L Synchronous Linear Motors	Project Planning Manual	MLF********-PRxx-EN-P	293635
L Ironless Linear Motors MCL	Project Planning Manual	MCL********-PRxx-EN-P	330592
S Synchronous Motors MKE	Project Planning Manual	MKE*GEN2***-PRxx-EN-P	297663
S Synchronous Motors MSK	Project Planning Manual	MSK********-PRxx-EN-P	296289
S Synchronous Motors MSM	Data Sheet	MSM********-DAxx-EN-P	329338
S Synchronous Motors QSK	Project Planning Manual	QSK********-PRxx-EN-P	330321
T Synchronous Torque Motors	Project Planning Manual	MBT********-PRxx-EN-P	298798

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: PR01 is the first edition of a Project Planning Manual)

Tab.2-2: Documentations – Motors

Introduction

2.2.3 Cables

Title	Kind of documentation	Document typecode[1] DOK-CONNEC-…	Material number R911…
Rexroth Connection Cables IndraDrive and IndraDyn	Selection Data	CABLE*INDRV-CAxx-EN-P	322949

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: CA02 is the second edition of the documentation "Selection Data")

Tab.2-3: Documentations – Cables

2.2.4 Firmware

Title	Kind of documentation	Document typecode[1]	Material number R911…
Rexroth IndraDrive [2]MPx-18 Functions	Application Manual	DOK-INDRV*-MP*-18VRS**-APxx-EN-P	338673
Rexroth IndraDrive MPx-18 Version Notes	Release Notes	DOK-INDRV*-MP*-18VRS**-RNxx-EN-P	338658
Rexroth IndraDrive MPx-16 to MPx-18 Parameters	Reference Book	DOK-INDRV*-GEN1-PARA**-RExx-EN-P	328651
Rexroth IndraDrive MPx-16 to MPx-18 Diagnostic Messages	Reference Book	DOK-INDRV*-GEN1-DIAG**-RExx-EN-P	326738
Rexroth IndraDrive Integrated Safety Technology as of MPx-1x (Safe Torque Off)	Application Manual	DOK-INDRV*-SI3-**VRS**-APxx-EN-P	332634
Rexroth IndraDrive Integrated Safety Technology as of MPx-1x (Safe Motion)	Application Manual	DOK-INDRV*-SI3*SMO-VRS-APxx-EN-P	338920
Rexroth IndraDrive Rexroth IndraMotion MLD (2G) Libraries as of MPx-18	Reference Book	DOK-INDRV*-MLD-SYSLIB3-RExx-EN-P	338916
Rexroth IndraDrive [2]Rexroth IndraMotion MLD (2G) as of MPx-18	Application Manual	DOK-INDRV*-MLD3-**VRS*-APxx-EN-P	338914

Title	Kind of documentation	Document typecode[1)]	Material number R911…
Rexroth IndraDrive [2)]Rexroth IndraMotion MLD (2G) as of MPx-18	Commissioning Manual	DOK-INDRV*-MLD3-F*STEP-COxx-EN-P	341708
Rexroth IndraMotion MLD 13VRS Service Tool	Reference Book	DOK-IM*MLD-IMST****V13-RExx-EN-P	341347

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: RE02 is the second edition of a Reference Book)
2) In preparation

Tab.2-4: Documentations – Firmware

3 Important Directions for Use

3.1 Appropriate Use

3.1.1 Introduction

Rexroth products reflect the state-of-the-art in their development and their manufacture. They are tested prior to delivery to ensure operating safety and reliability.

⚠ WARNING **Personal injury and property damage caused by incorrect use of the products!**

The products have been designed for use in industrial environments and may only be used in the appropriate way. If they are not used in the appropriate way, situations resulting in property damage and personal injury can occur.

☞ 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, the following pre-requisites must be met to ensure appropriate use of the products:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with their appropriate use.
- If the products take 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.
- Damaged or faulty products may not be installed or put into operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

3.1.2 Areas of Use and Application

Drive controllers made by Rexroth are designed to control electrical motors and monitor their operation.

Control and monitoring of the Drive controllers may require additional sensors and actors.

☞ The drive controllers may only be used with the accessories and parts specified in this documentation. If a component has not been specifically named, then it may neither be mounted nor 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 Functional Descriptions.

Drive controllers have to be programmed before commissioning to ensure that the motor executes the specific functions of an application.

Drive controllers of the Rexroth IndraDrive line have been developed for use in single- and multi-axis drive and control tasks.

Important Directions for Use

To ensure application-specific use of Drive controllers, device types of different drive power and different interfaces are available.

Typical applications include, for example:

- Handling and mounting systems,
- Packaging and food machines,
- Printing and paper processing machines and
- Machine tools.

Drive controllers may only be operated under the assembly and installation conditions described in this documentation, in the specified position of normal use and under the ambient conditions as described (temperature, degree of protection, humidity, EMC, etc.).

3.2 Inappropriate Use

Using the Drive controllers outside of the operating conditions described in this documentation and outside of the technical data and specifications given is defined as "inappropriate use".

Drive controllers may not be used, if ...

- they are subject to operating conditions that do not meet the specified ambient conditions. This includes, for example, operation under water, under extreme temperature fluctuations or extremely high maximum temperatures.
- Furthermore, Drive controllers may not be used in applications which have not been expressly authorized by Rexroth. Please carefully follow the specifications outlined in the general Safety Instructions!

☞ Components of the Rexroth IndraDrive system are **products of category C3** (with limited availability) according to IEC 61800-3. To ensure that this category (limit values) is maintained, suitable line filters must be used in the drive system.

These components are not provided for use in a public low-voltage network supplying residential areas with power. If these components are used in such a public network, high-frequency interference is to be expected. This can require additional measures of radio interference suppression.

4 Safety Instructions for Electric Drives and Controls

4.1 Definitions of Terms

Application Documentation Application documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: Operating Instructions, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Description, etc.

Component A component is a combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.

Control System A control system comprises several interconnected control components placed on the market as a single functional unit.

Device A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.

Electrical Equipment Electrical equipment encompasses all devices used to generate, convert, transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.

Electric Drive System An electric drive system comprises all components from mains supply to motor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and cables.

Installation An installation consists of several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.

Machine A machine is the entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.

Manufacturer The manufacturer is an individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the individual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, the manufacturer must always have overall control and possess the required authority to take responsibility for the product.

Product Examples of a product: Device, component, part, system, software, firmware, among other things.

Project Planning Manual A project planning manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.

Qualified Persons In terms of this application documentation, qualified persons are those persons who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work

requires. To comply with these qualifications, it is necessary, among other things,

1) to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them

2) to be trained or instructed to maintain and use adequate safety equipment

3) to attend a course of instruction in first aid

User A user is a person installing, commissioning or using a product which has been placed on the market.

4.2 General Information

4.2.1 Using the Safety Instructions and Passing Them on to Others

Do not attempt to install and operate the components of the electric drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.

If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.

Improper use of these components, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, could result in property damage, injury, electric shock or even death.

4.2.2 Requirements for Safe Use

Read the following instructions before initial commissioning of the components of the electric drive and control system in order to eliminate the risk of injury and/or property damage. You must follow these safety instructions.

- Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.
- Only use accessories and spare parts approved by Rexroth.
- Follow the safety regulations and requirements of the country in which the components of the electric drive and control system are operated.
- Only use the components of the electric drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the available application documentation must be observed.
- Applications for functional safety are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technolo-

gy". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.

- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturers must

  – make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,

  – make sure that their individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.

- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

  The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.
- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user must take into account

- European countries: In accordance with European EN standards
- United States of America (USA):
  – National Electrical Code (NEC)
  – National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  – Regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  – International Organization for Standardization (ISO)
  – International Electrotechnical Commission (IEC)

4.2.3 Hazards by Improper Use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!

- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

4.3 Instructions with Regard to Specific Dangers

4.3.1 Protection Against Contact with Electrical Parts and Housings

☞ This section concerns components of the electric drive and control system with voltages of **more than 50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating components of the electric drive and control system, it is unavoidable that some parts of these components conduct dangerous voltage.

High electrical voltage! Danger to life, risk of injury by electric shock or serious injury!

- Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.
- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:

  Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- Under specific conditions, electric drive systems can be operated at mains protected by residual-current-operated circuit-breakers sensitive to universal current (RCDs/RCMs).

- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

High housing voltage and high leakage current! Danger to life, risk of injury by electric shock!

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller than 10 mm^2 (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Cross section outer conductor	Minimum cross section equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1.5 mm^2 (16 AWG)	10 mm^2 (8 AWG)	2 × 1.5 mm^2 (16 AWG)
2.5 mm^2 (14 AWG)		2 × 2.5 mm^2 (14 AWG)
4 mm^2 (12 AWG)		2 × 4 mm^2 (12 AWG)
6 mm^2 (10 AWG)		2 × 6 mm^2 (10 AWG)
10 mm^2 (8 AWG)		-
16 mm^2 (6 AWG)	16 mm^2 (6 AWG)	-
25 mm^2 (4 AWG)		-
35 mm^2 (2 AWG)		-
50 mm^2 (1/0 AWG)	25 mm^2 (4 AWG)	-
70 mm^2 (2/0 AWG)	35 mm^2 (2 AWG)	-
...	...	...

Tab.4-1: Minimum Cross Section of the Equipment Grounding Connection

4.3.2 Protective Extra-Low Voltage as Protection Against Electric Shock

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

On components of an electric drive and control system provided by Rexroth, all connections and terminals with voltages up to 50 volts are PELV ("Protective Extra-Low Voltage") systems. It is allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections.

Safety Instructions for Electric Drives and Controls

Danger to life, risk of injury by electric shock! High electrical voltage by incorrect connection!

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV ("Protective Extra-Low Voltage").

4.3.3 Protection Against Dangerous Movements

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

- Improper or wrong wiring or cable connection
- Operator errors
- Wrong input of parameters before commissioning
- Malfunction of sensors and encoders
- Defective components
- Software or firmware errors

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

The monitoring functions in the components of the electric drive and control system will normally be sufficient to avoid malfunction in the connected drives. Regarding personal safety, especially the danger of injury and/or property 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, serious injury or property damage!

A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the electric drive and control system are installed.

As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine’s range of motion and moving machine parts. Prevent personnel from accidentally entering the machine’s range of motion by using, for example:
  - Safety fences
  - Safety guards
  - Protective coverings
  - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equip-

ment works. Do not operate the machine if the emergency stopping switch is not working.

- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches/OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to safe standstill before accessing or entering the danger zone.
- Additionally 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 or
  - ensuring sufficient counterbalancing of the vertical axes.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the components of the electric drive and control system using the master switch and secure them from reconnection ("lock out") 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 components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

4.3.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors or permanent magnets of electric motors represent a serious danger to persons with heart pacemakers, metal implants and hearing aids.

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

- Persons with heart pacemakers and metal implants are not allowed to enter the following areas:
  - Areas in which components of the electric drive and control systems are mounted, commissioned and operated.
  - Areas in which parts of motors with permanent magnets are stored, repaired or mounted.
- If it is necessary for somebody with a heart pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of implanted heart pacemakers differs so greatly that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above.

Safety Instructions for Electric Drives and Controls

4.3.5 Protection Against Contact with Hot Parts

Hot surfaces of components of the electric drive and control system. Risk of burns!

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C** (140 °F) during or after operation.
- Before touching motors after having switched them off, let them cool down for a sufficient period of time. Cooling down can require **up to 140 minutes**! The time required for cooling down is approximately five times the thermal time constant specified in the technical data.
- After switching chokes, supply units and drive controllers off, wait **15 minutes** to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, and in accordance with the respective safety regulations, the manufacturer of the machine or installation must take measures to avoid injuries caused by burns in the final application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

4.3.6 Protection During Handling and Mounting

Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!

- Observe the relevant statutory regulations of accident prevention.
- Use suitable equipment for mounting and transport.
- Avoid jamming and crushing by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- Use suitable protective equipment (hard hat, safety goggles, safety shoes, safety gloves, for example).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

4.3.7 Battery Safety

Batteries consist of active chemicals in a solid housing. Therefore, improper handling can cause injury or property damage.

Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not attempt to recharge the batteries as this may cause leakage or explosion.
- Do not throw batteries into open flames.
- Do not dismantle batteries.

- When replacing the battery/batteries, do not damage the electrical parts installed in the devices.
- Only use the battery types specified for the product.

☞ Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separately from other waste. Observe the national regulations of your country.

4.3.8 Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors and components cooled with liquids and compressed air can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricants. Improper handling of the connected supply systems, supply lines or connections can cause injuries or property damage.

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

☞ Environmental protection and disposal! The agents (e.g., fluids) used to operate the product might not be environmentally friendly. Dispose of agents harmful to the environment separately from other waste. Observe the national regulations of your country.

4.4 Explanation of Signal Words and the Safety Alert Symbol

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is meant to draw the reader's attention to the safety instruction and identifies the hazard severity.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

⚠ DANGER

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

Safety Instructions for Electric Drives and Controls

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury **could** occur.

⚠ CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury could occur.

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

5 Preparation and Setup

5.1 Step 1: Check Hardware and Firmware Requirements

5.1.1 Hardware Requirements

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

Power section / control section: IndraDrive Cs

- HCS01.1E-Wxxxx-A-0y-**B**-... (as of FWA-INDRV-MPB18VRS)
- HCS01.1E-Wxxxx-A-0y-**A**-... (as of FWA-INDRV-MPC18VRS and MLD-M)

☞ MLD cannot be used with Economy devices (HCS01.1E-Wxxxx-A-0y-**E**-...)!

MLD is not available for multi-axis devices (HCQ01.1 and HCT01.1).

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

5.1.2 Firmware Requirements

Using the drive-integrated PLC (Rexroth IndraMotion MLD) requires the base package of the firmware and a functional firmware package (optional expansion package). The functional firmware package must be enabled / licensed (see Delivery and Licensing of the PLC).

Optional Expansion Package "IndraMotion MLD"

The following designs of the optional expansion package "IndraMotion MLD" are available:

- The **"ML"** design allows:
  - Loading and using self-contained PLC programs (technology functions) by Rexroth (see "Technology Functions")
  - Freely programming Rexroth IndraMotion MLD-S / MLD-M using the function block libraries made available by Rexroth and supported by "IndraMotion MLD" (see "Library Description IndraMotion MLD (2G)")
- The **"MA"** design allows using a freely programmable "Advanced" PLC for complex tasks.

☞ The technology functions can be loaded via IndraWorks (see also MLD Application Manual: "Using Technology Functions").

Examples of technology functions: Following-on cutting devices, pick&place, process controller (register controller, winding computation, …), preventive maintenance, …

The table below contains an overview of the base packages of the firmware and the available designs of the optional expansion package "IndraMotion MLD":

Preparation and Setup

Firmware version	Characteristic	MLD-S		MLD-M	
	Option	ML	MA	ML	MA
FWA-INDRV-MP*18VRS	MPB	X	X	-	-
	MPC	X	X	X	X
	MPE	-	-	-	-
	MPM	-	-	-	-

X Optional expansion package possible for this firmware
- Optional expansion package not possible for this firmware

Tab.5-1: Overview of Base Packages of Firmware and Available Designs of Optional Expansion Package "IndraMotion MLD"

See also Functional Description of firmware "Firmware Types"

See also Functional Description of firmware "Additive Functional Packages"

Delivery and Licensing of the PLC

When you order the firmware base package plus the functional firmware package, "IndraMotion MLD" is already enabled at the factory. If you order the functional firmware package subsequently, this requires so-called additional licensing; i.e., the user must subsequently enable or license the PLC functionality.

☞ If the PLC has not been enabled, the drive refuses to communicate with the PLC programming system. A message will be generated. Furthermore, please keep in mind that the guarantee for the drive expires, if you use the PLC without licensing!

See also Functional Description of firmware "Enabling of Functional Packages"

5.2 Step 2: Install Software

The PLC programming interface IndraLogic is automatically available when the commissioning software IndraWorks MLD 13VRS is installed. The PLC programming interface has been embedded in the drive configuration and is called from the IndraWorks project tree.

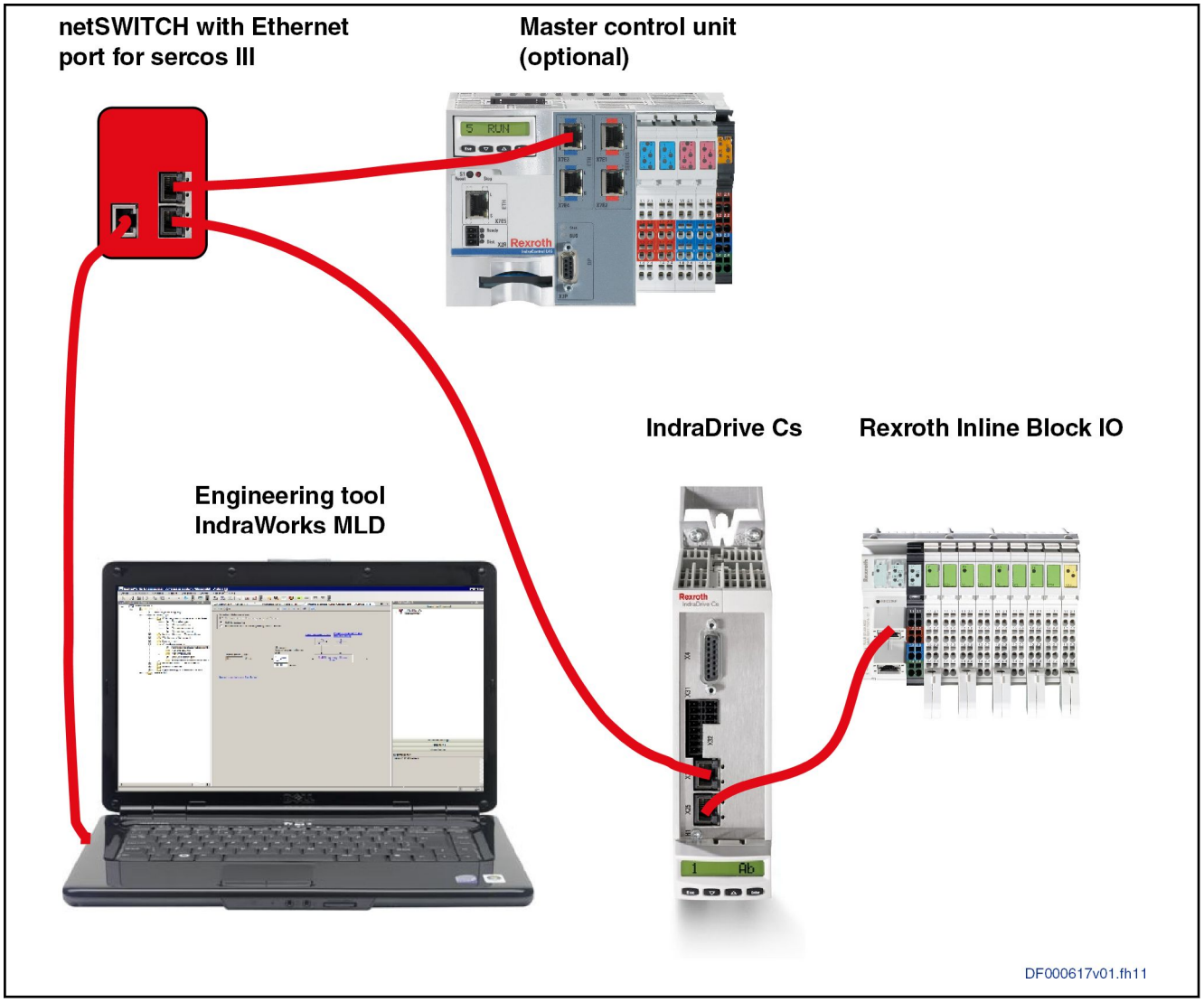
The parts of the PLC program, variable lists, data types, etc. are displayed as individual pages in IndraWorks MLD.

IndraWorks with IndraLogic is installed automatically so that the user does not need to select specific software components.

5.3 Step 3: Set up the Drive System

5.3.1 IndraMotion MLD-S

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



Connection Please see the respective Project Planning Manual for the interfaces via which the components are interconnected

Fig.5-1: 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 also "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)

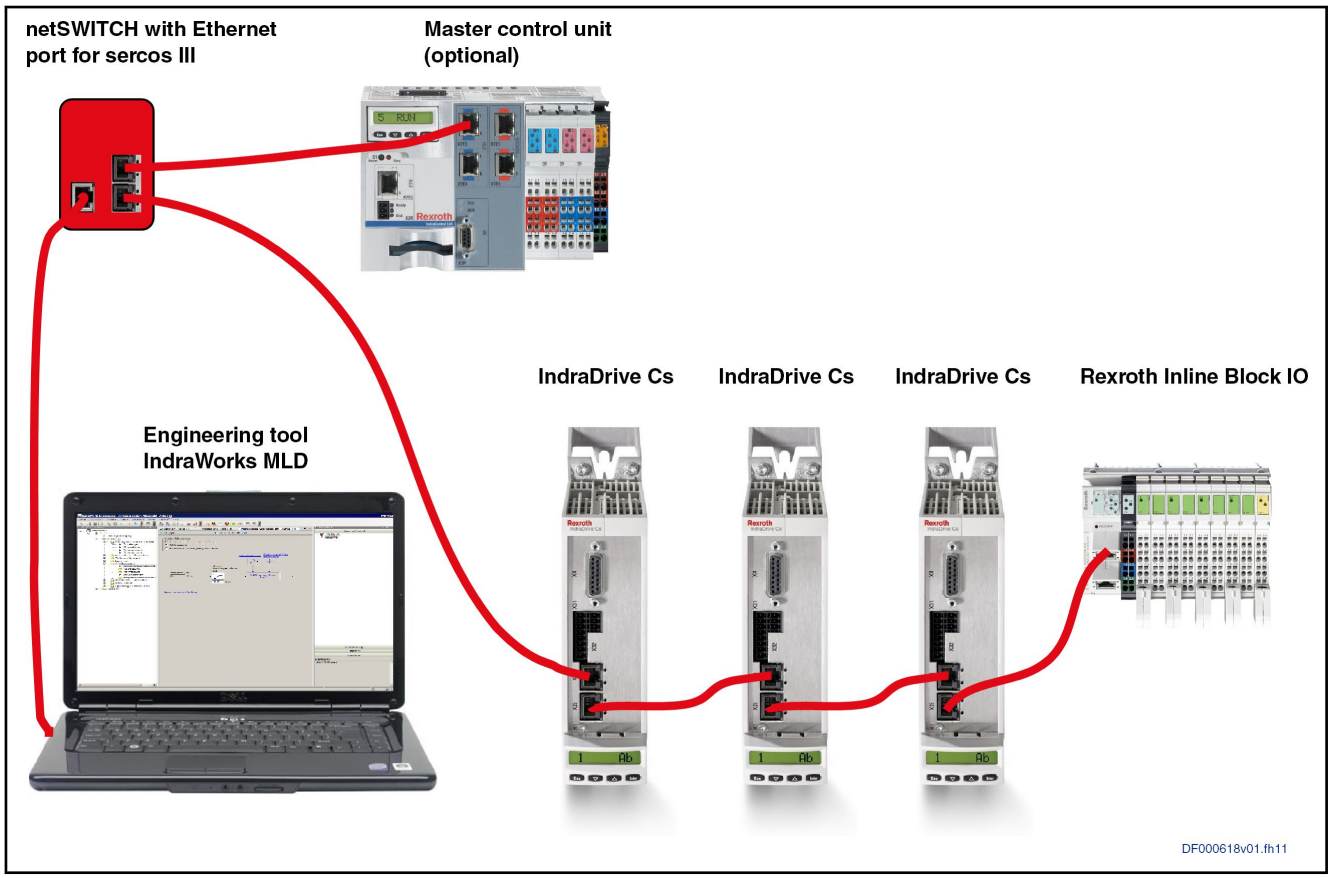
Additionally for the characteristic "stand-alone single-axis Motion Logic Control":

- Motion Control functionality for one axis by command triggering of the local axis by corresponding Motion Control library according to PLCopen

Preparation and Setup

5.3.2 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":



Connection Please see the respective Project Planning Manual for the interfaces via which the components are interconnected

Fig.5-2: System Structure of "IndraMotion MLD-M"

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 10 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
- Motion command triggering of the local and remote axes [see "Command triggering of local and remote axes (MLD-M)"]
- Connection of other inputs/outputs
  - I/O modules or optional modules in the remote axes
  - Rexroth Inline Block IOs
  - Rexroth Inline Modular IOs
- 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: max. 9 slaves (T=500 µs with 1 slave, T = 1000 … 4000 µs with 2…9 slaves)
- Cyclic data channel (MDT, AT) with a max. of 48 bytes and 16 parameters each
- Parameter or service channel (4-byte info container)

5.4 Step 4: Establish Communication between Drive Controller and Commissioning PC

5.4.1 Establishing an Ethernet Connection to the Drive Controller

Requirements

The following components and requirements are needed for Ethernet communication with the drive controller:

- IndraDrive Cs (Basic or Advanced design)
- MPx18V04 firmware or higher
- Standard Ethernet cable
- Unassigned Ethernet connection at PC or notebook

Setting the IP Address and Network Mask at the Drive Controller

To establish the Ethernet communication with the drive controller, the IP address and the network mask must be parameterized.

These settings can be made via IndraWorks or via the control panel of the drive controller.

IP Address Range

For local networks, IP addresses can be assigned in the following address ranges:

- 10.0.0.0 to 10.255.255.255,
- 172.16.0.0 to 172.31.255.255 and
- 192.168.0.0 to 192.168.255.255

Suggestion:

IP address: 192.168.0.**6**

Network mask: 255.255.255.0

Default gateway: 0.0.0.0

The desired IP address, network mask and default gateway can only be parameterized 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

To set the IP address via the control panel, proceed as follows:

1. Switch on the control voltage of the drive controller.
2. Press the Enter key at the control panel.
3. With the ▽/△ keys, select "Ethernet" and confirm the selection with the Enter key.
4. With the ▽/△ keys, now select the interface you would like to configure
   - IndraDrive Cs - Advanced performance
     X26 - engineering interface

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- IndraDrive Cs - Basic performance
  X22 / X23 - sercos interface

5. Now select the address you would like to configure or control
   - IP address
   - MAC address
   - Gateway address
   - Network mask (subnet mask)

The individual octets are applied by pressing the Enter key. To return press the Esc key.

6. In order that the parameter setting of desired IP address, network mask and default gateway takes effect, switch the control voltage of the drive controller off and on again.

Setting the IP Address and Network Mask in the PC

To establish the Ethernet communication with the drive controller, an IP address and a subnet mask must be assigned for the unassigned Ethernet connection at your PC or notebook.

Establishing the RDT Connection

1. Open the Properties of the network adapter (3) via which the communication to the drives is to be established.

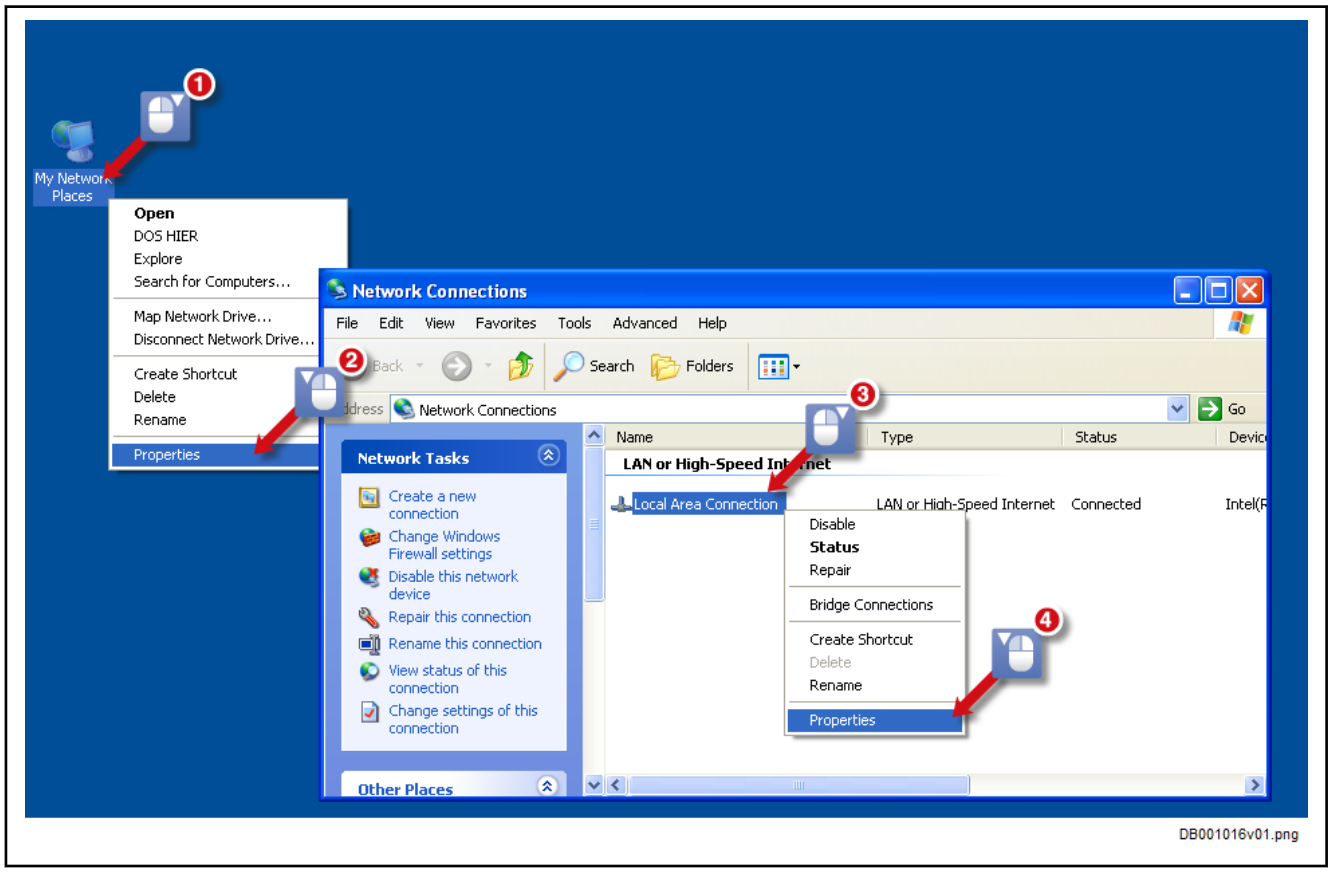


Fig.5-3: Calling the Properties of the Active Network Adapter

2. Double-click the "Internet Protocol (TCP/IP)" entry.

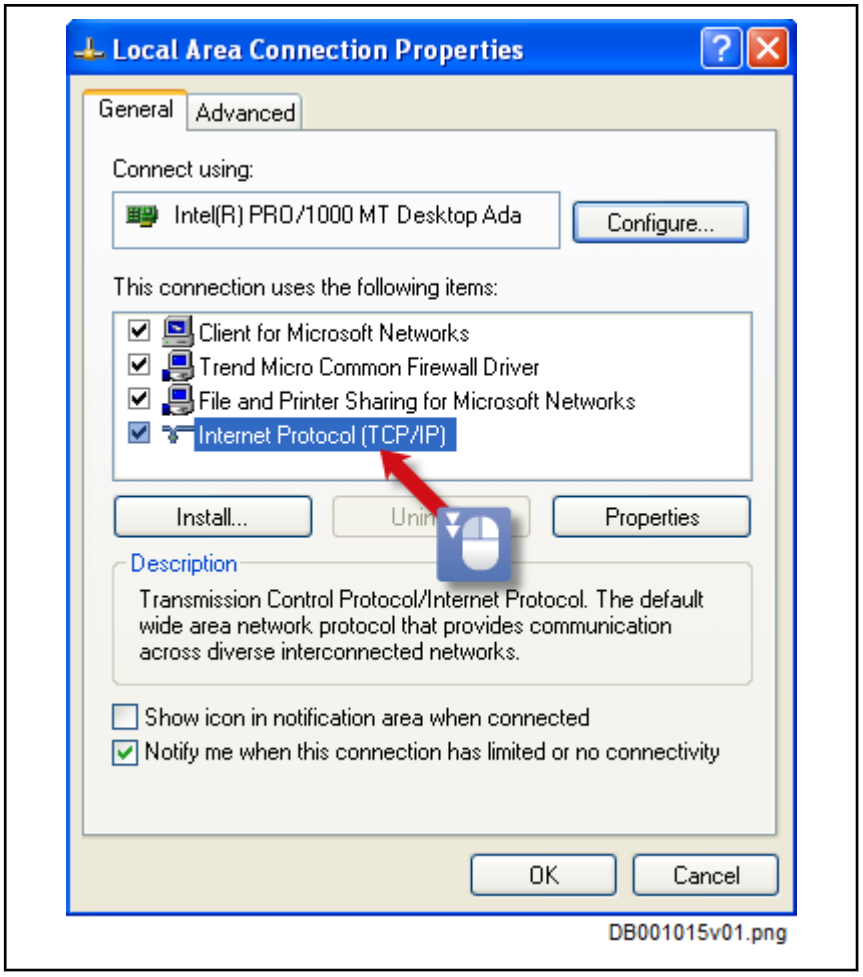


Fig.5-4: Calling the Properties of "Internet Protocol (TCP/IP)"

If the control unit is connected to the company network, observe the specifications of your network administrator.

3. Click "Use the following IP address".
   Now enter the desired "IP address" and the "Subnet mask".

It is not necessary to enter any data in the "Default gateway" field.

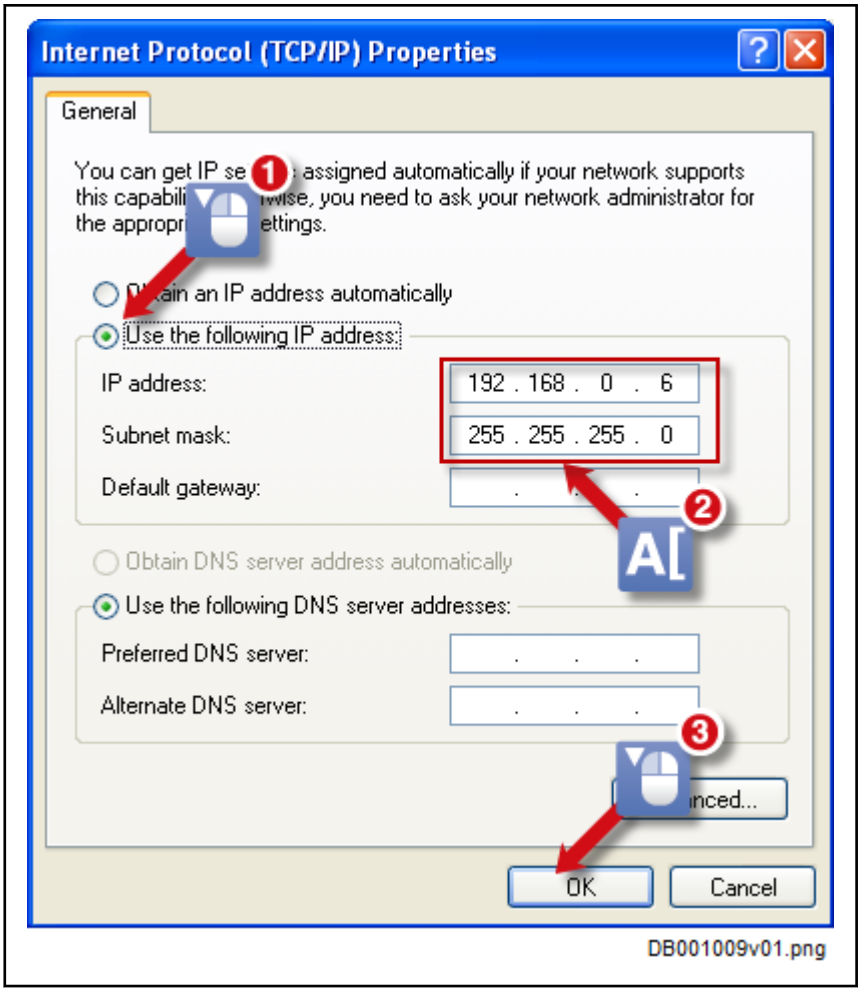


Fig.5-5: Setting IP Address and Subnet Mask

4. Now close all the windows you opened to parameterize the network adapter.

☞ The refreshed IP address should now be active; if necessary, re-start the computer.

TCP/IP Communication between PC and IndraDrive

Connect the X26 or X22/X23 interface of the drive controller and the Ethernet connection at your PC or notebook to a standard Ethernet cable.

Testing the TCP/IP Communication

Testing the TCP/IP communication requires the following steps:

1. In Windows, start the "MS-DOS command prompt" by calling **Start ▸ Run** and entering "cmd".

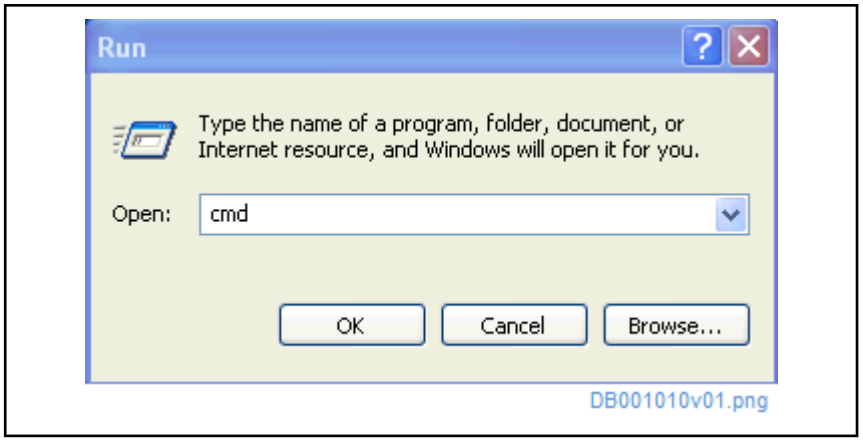


Fig.5-6: MS-DOS Command Prompt

2. With the `ping <IP address>` command, you can now test the network connection(s). For example, enter `ping 192.168.0.6` to test the connection to the node with the IP address 192.168.0.6.

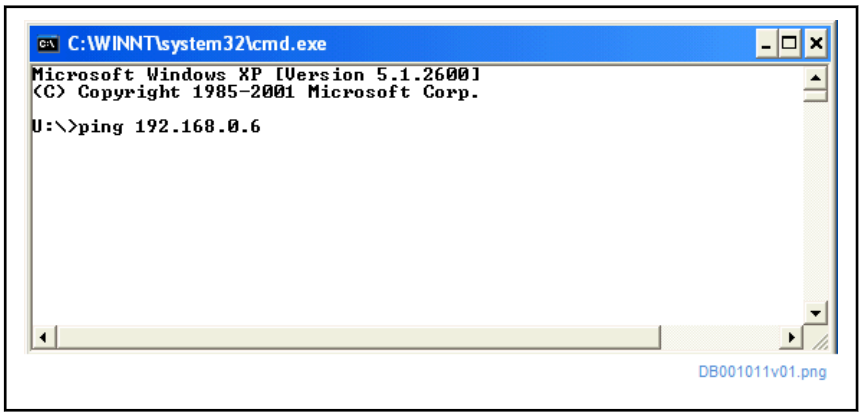


Fig.5-7: Testing the Network Connection

3. Now test the TCP/IP communication to your nodes, but also to the IP adess of your PC or notebook.
4. With the `exit` command, close the MS-DOS command prompt.

Start IndraWorks: **Start** ▸ **Programs** ▸ **Rexroth** ▸ **IndraWorks** ▸ **Engineering**.

Establishing the Connection

1. In the Project Explorer, select the drive to which the connection is to be established.
2. In the main menu, select **Project** ▸ **Switch Devices Online…** to establish the connection to the drive.

If IndraWorks is unable to automatically find the IndraDrive controller via Ethernet, the following message is output:

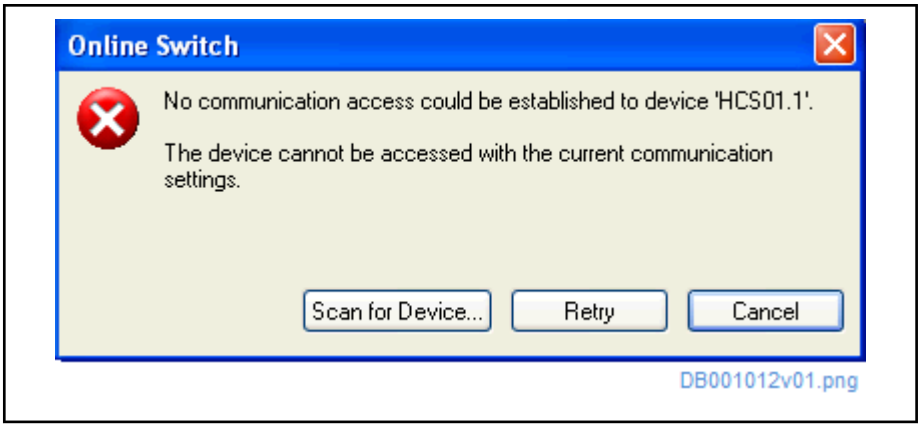


Fig.5-8: Establishing the Connection Failed

Via the **Scan for Device…** button, you can now parameterize the Ethernet communication settings to manually search for an IndraDrive controller.

Now parameterize the IP address window in which to search for devices.

☞ The **Default Settings** button automatically sets the IP address range to 192.168.1.1 to 192.168.1.5 and the IP port to 5002 to 5003.

The search is started with the **Next >>** button.

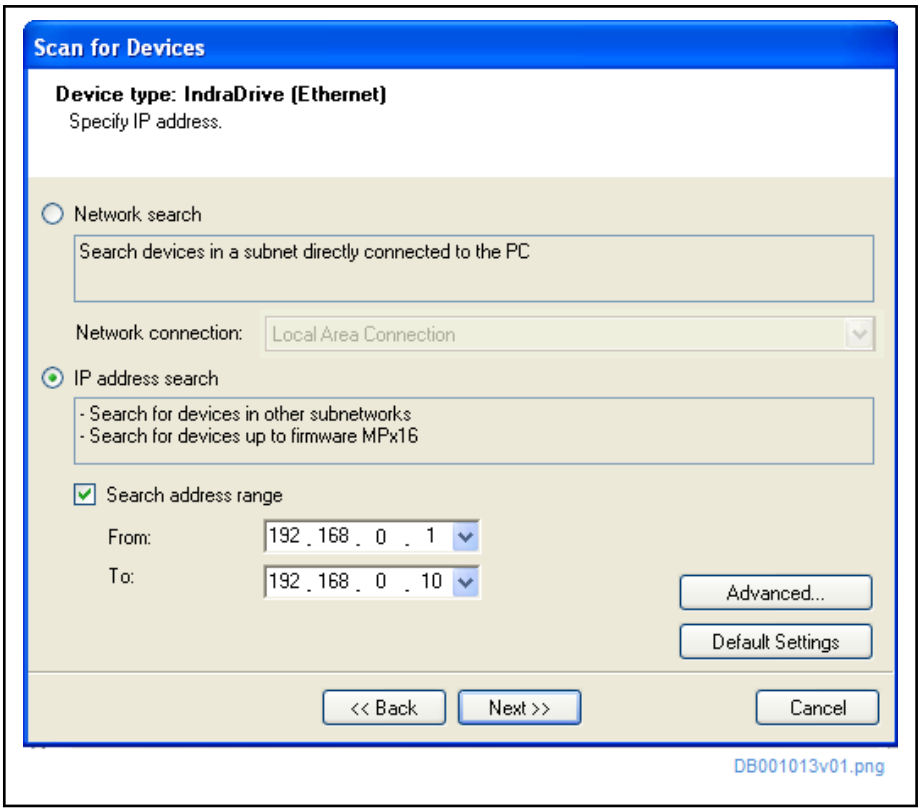


Fig.5-9: Setting the Ethernet Communication

IndraWorks now scans the IP range you set for devices.

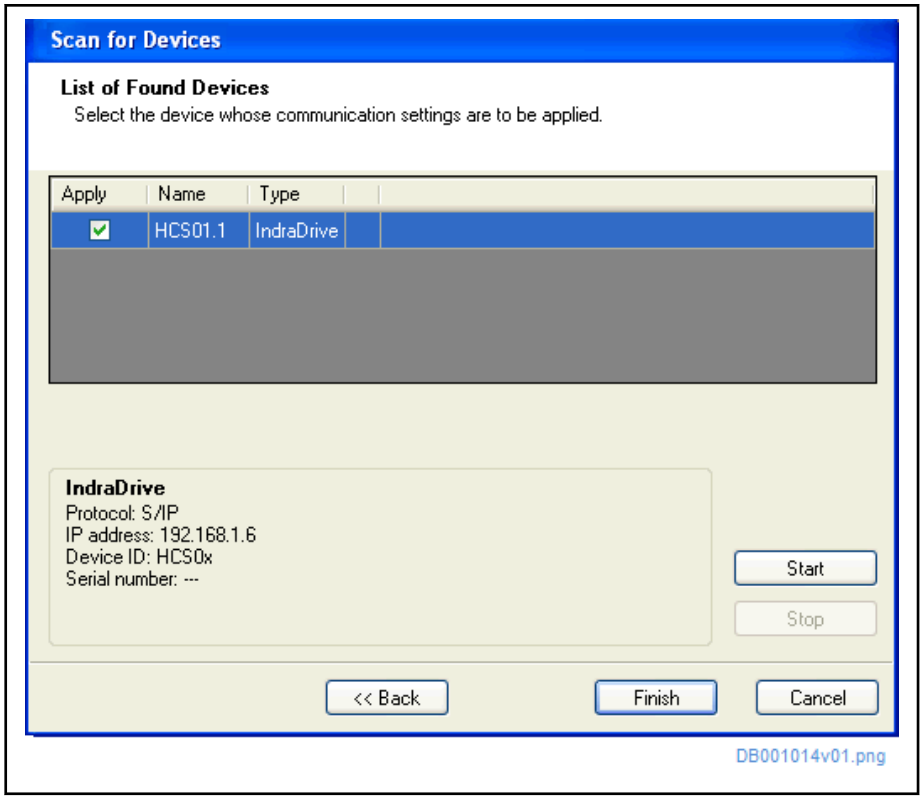


Fig.5-10: Displaying the Devices Found

The establishment of the connection can now be completed with the **Finish** button.

6 Commissioning and Parameterization

6.1 Step 5: General Commissioning an Parameterization of the Drive

☞ By starting the command "PL - Load basic parameters", the drive should be brought to a defined initial state (see also Functional Description "Load basic parameters").

1. To load basic parameters, the drive controller must be switched to the parameter mode. This can either be initiated directly via the **PM** button in the toolbar or via the context menu of the axis.

   The display at the control panel of the drive controller changes to "PM".

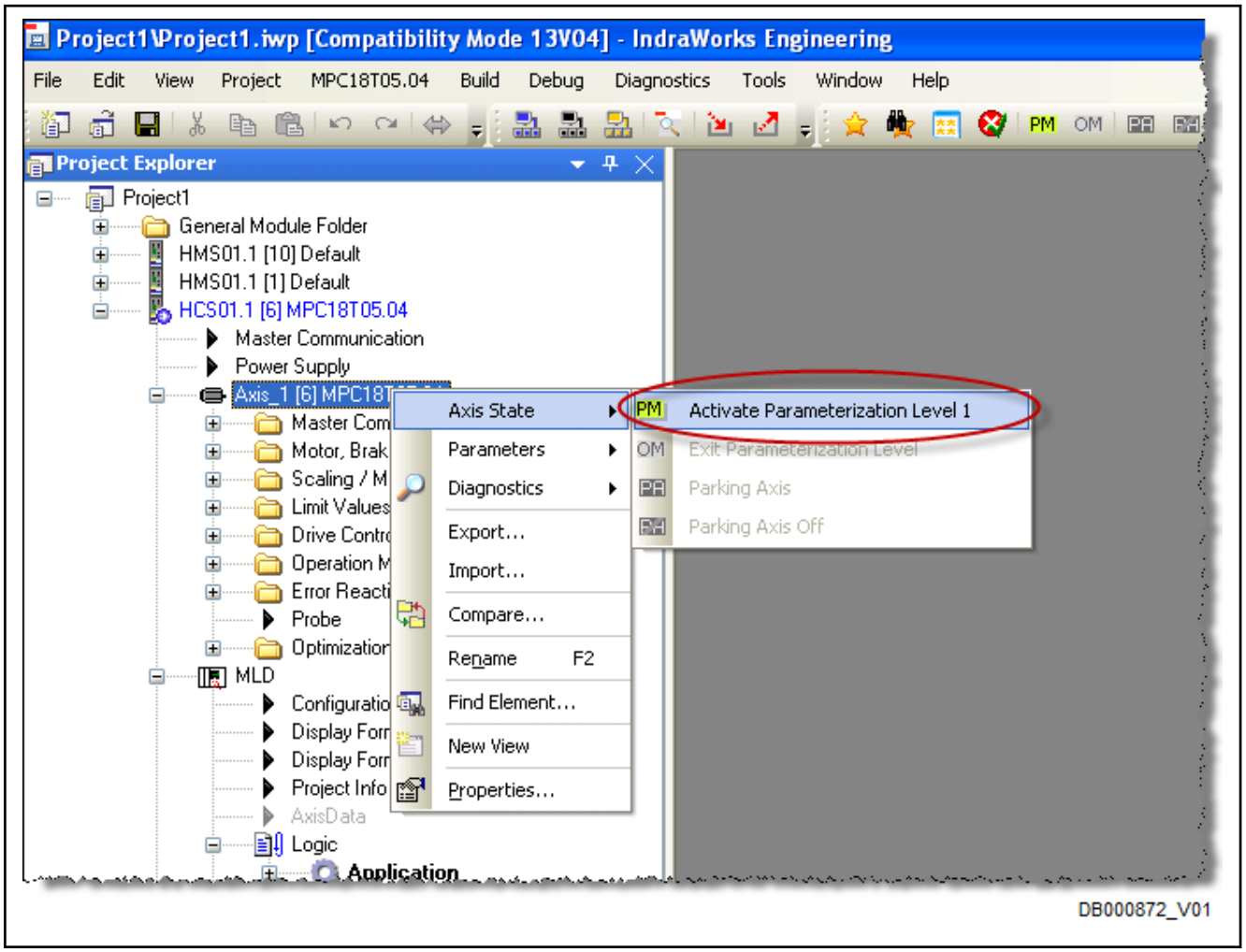


Fig.6-1: Switching to the Parameter Mode

2. Call the dialog for loading the basic parameters:

Commissioning and Parameterization

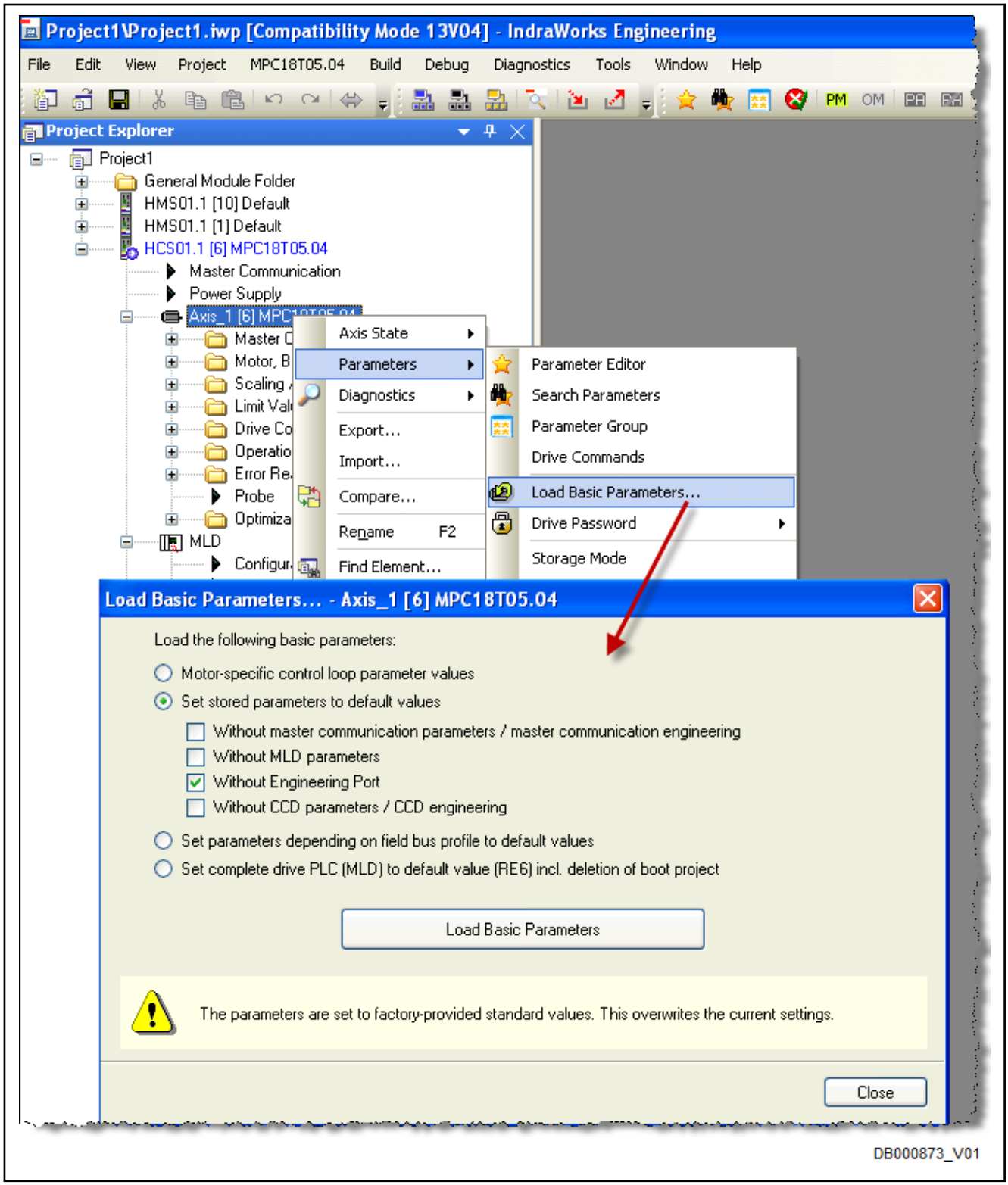


Fig.6-2: Loading the Basic Parameters

☞ For all further notes on the commissioning, see the IndraWorks MLD dialogs online.

For further information on the commissioning, see chapter "Notes on Commissioning and Application" in the Application Manual of "Rexroth IndraMotion MLD (2G)".

6.2 Step 6: Activate and Configure the Integrated PLC (IndraMotion MLD)

6.2.1 Activating IndraMotion MLD

- Call the "Functional Packages" dialog via the context menu.
- Select the functional package "IndraMotion MLD".

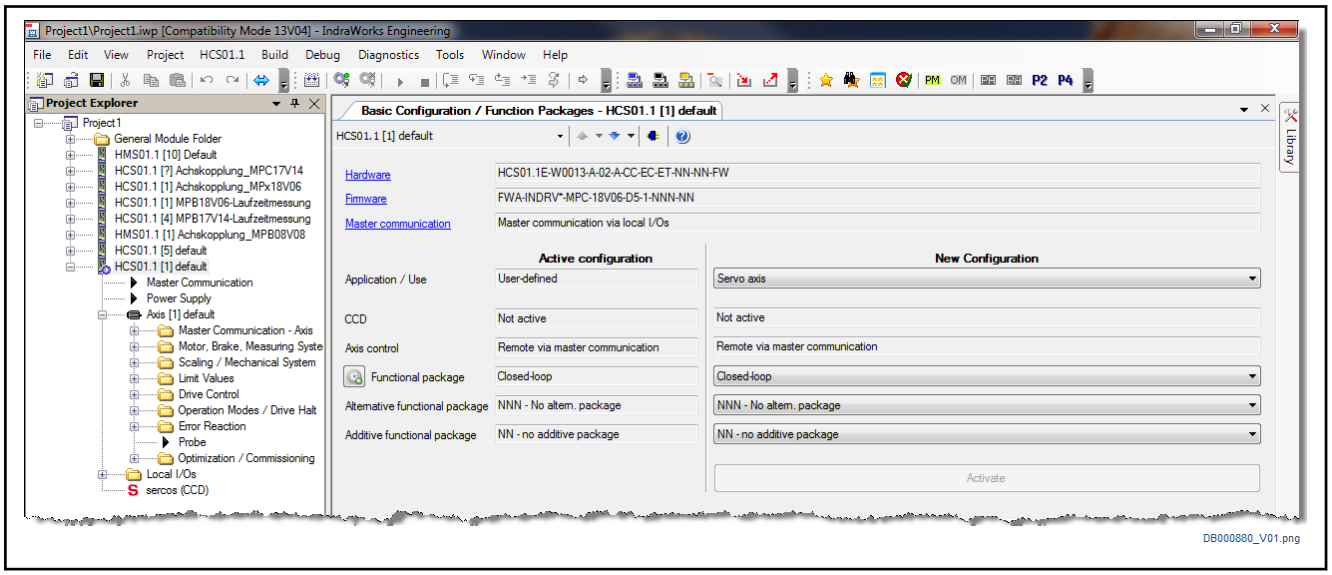


Fig.6-3: Activating the Functional Package "IndraMotion MLD"

Enabling "IndraMotion MLD" requires licensing. After you have selected the functional package "IndraMotion MLD" and confirmed your selection, a message box for the license agreement will open. If you are interested in the function, please contact our Rexroth sales representative!

- Apply the setting with "**Activate**". Afterwards, switch the control voltage of the drive off and on again or start the "Reboot" of the drive.

The "drive PLC" will only be enabled after a restart or reboot!

See also Functional Description of firmware "Enabling of Functional Packages".

6.2.2 MLD Settings

The MLD settings can be preset via the corresponding functions:

Commissioning and Parameterization

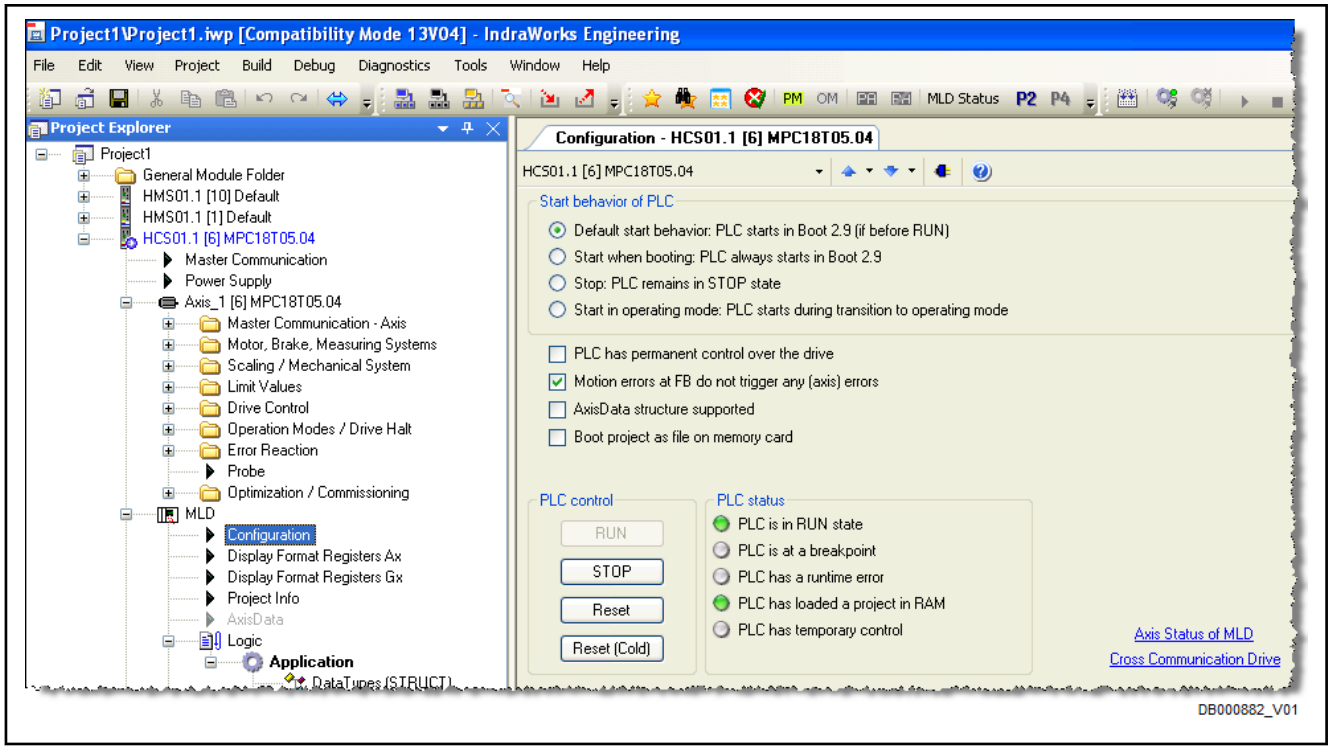


Fig.6-4: MLD Configuration Dialog

Configuration

Make the following settings in the PLC or MLD configuration dialog:

- **Start behavior of PLC**

  Here you can set the start behavior of the PLC after the booting process.

- **Permanent control**

  By selecting "PLC has permanent control over the drive", MLD is used as "stand-alone motion control" for control tasks; otherwise, MLD has temporary control over the drive and can be used as an "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 detected by the corresponding PLC function blocks during command triggering of the axes.

  Selecting "Motion errors at FB do not trigger any (axis) errors" deactivates the automatic reaction of the drive. If the option has not been selected, the drive generates the error F2150 when an error occurred during the command triggering with a motion function block.

- **AxisData structure supported**

  "AxisData structure supported" is activated in this case. The function is explained in detail under Data Channels.

- **Boot project as file on memory card**

  With MPC, the boot project can be stored on the external memory card (µSD); with MPB, the external memory card is not available.

- **PLC control / PLC status**

  In the status display, you can recognize whether a PLC project has been loaded and which state it is in. If required, you can furthermore start and stop the programs in this dialog, or carry out a reset.

☞ Starting and stopping the PLC in this dialog only makes sense in exceptional cases. Normally, this will be done in the programming system / IndraWorks MLD.

Display Format Registers Ax / Display Format Registers Gx

In the dialogs for Display Format Registers Ax / Display Format Registers Gx, the selection of the data type, number of decimal places etc. can be set, for example.

Project Info

The "Project Info" dialog provides the following options:

- Get information on the current MLD project.
- Start or stop the PLC program and see its current status.
- Load or delete the MPD project.

AxisData

In the "AxisData" dialog, you can configure additional user-specific command values and actual values which are to be transmitted via the "AxisData" structure (see also MLD Data Channels).

6.2.3 Activating MLD-M for Multi-Axis Applications

To use the MLD-M system mode, it must be activated. This is done in IndraWorks as follows:

Activating the MLD-M System Mode

1. Open the dialog for the basic CCD settings by selecting, in the context menu of the "sercos" branch, "CCD: Basic Settings".
2. Select "Cross Communication Drive active".
3. Select "MLD-M in CCD master (MLD-M system mode)".
4. Set the CCD cycle time.
5. Clicking the **Apply** button starts the search for the available slaves. The devices found are displayed with the sercos addresses.
6. The slaves found (sercos addresses) are configured in the lists "Axis projecting" or "I/O projecting".
7. Confirm the configuration by clicking the **Apply** button.

Commissioning and Parameterization

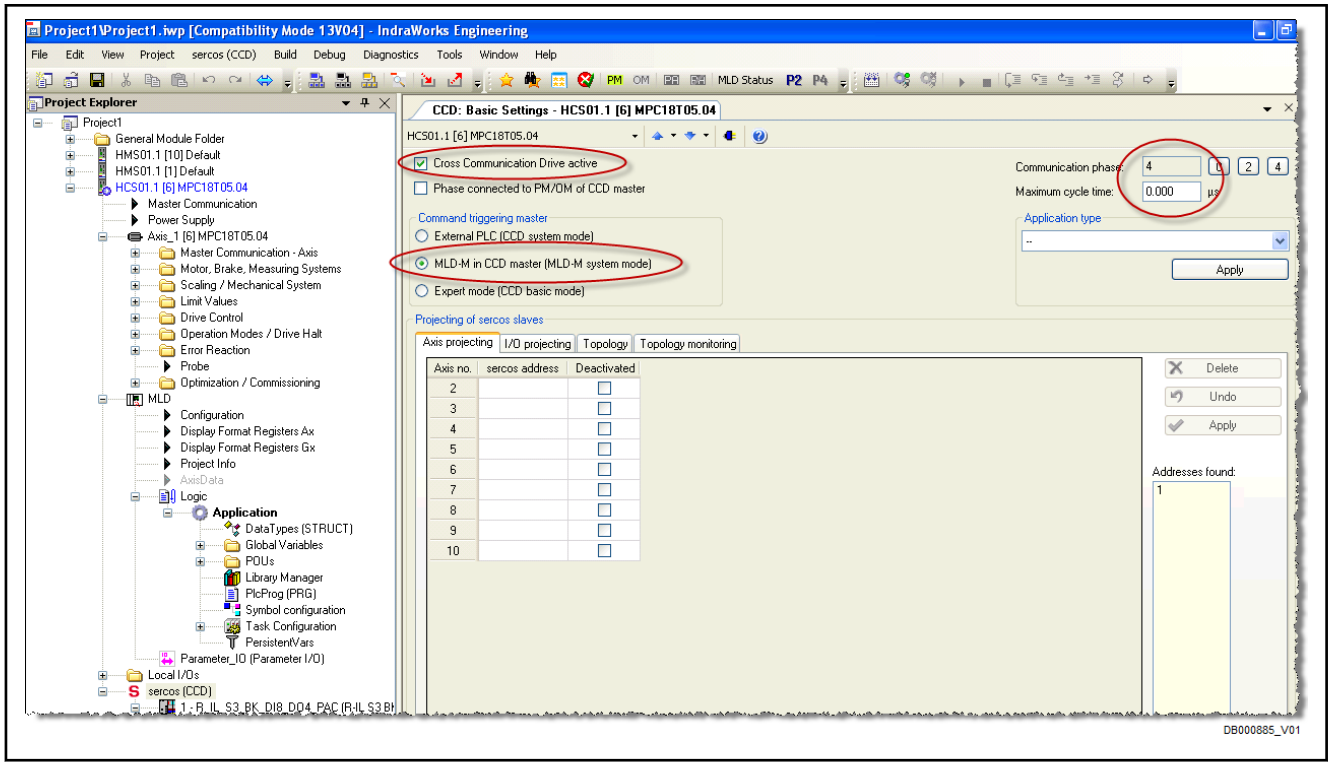


Fig.6-5: Activating MLD-M, Address Setting of the Connected Slaves / IOs

Axis Addressing

All axes listed in this dialog 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 created as global variables.

Addressing takes place as follows:

- "Axis1" always addresses the local axis (which is not displayed in this case)
- "Axis2" addresses the first projected slave
- "Axis3" addresses the second projected slave
- …
- "Axis10" addresses the ninth projected slave

Controlling the Drive

Before MLD can take over the motion command triggering, it must have the control over the drive. This can be done either permanently via the setting "PLC has permanent control over drive" (standard setting when using MLD-M) or temporarily via the "MX_SetControl" function block.

6.3 Step 7: Configure the Interfaces and Data Channels of MLD

6.3.1 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)

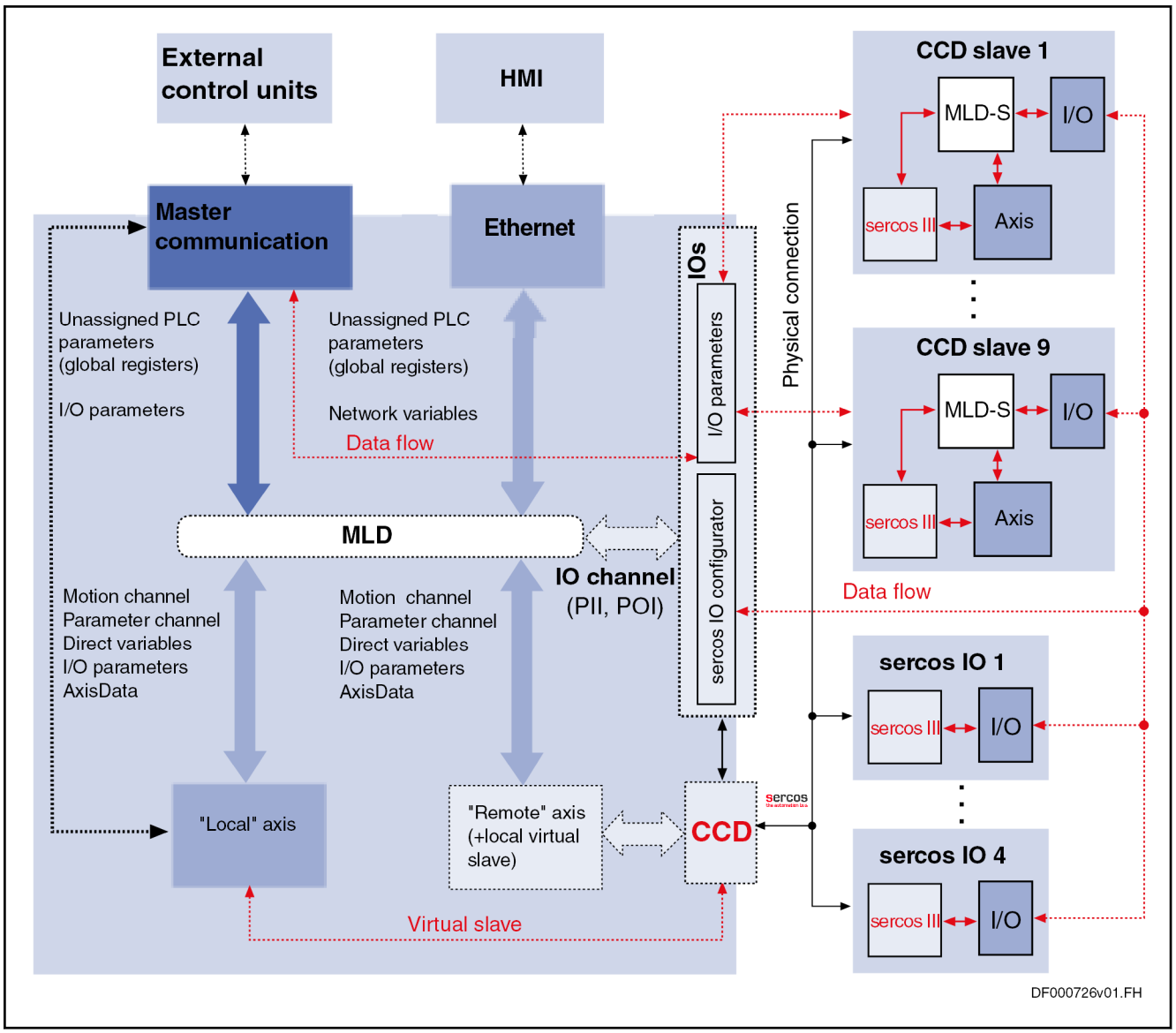


Fig.6-6: Data Channels of IndraMotion MLD for Access to Local and Remote Axes

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.

6.3.2 Cyclic Data Channels

A great number of data channels provides access from the PLC program to 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.

- **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.

☞ The local real-time channel is no longer made available in MLD-2G. Instead, the AxisData interface and synchronized tasks can be used in applications to replace applications with the real-time variables used in MLD-1G (see "chapter "Replacing the Local Real-Time Channel" on page 70").

6.3.3 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. (The only axis that can be accessed is 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. It allows accessing all S- and P-parameters in the drive, including the "PLC register" parameters, via functions and function blocks.

- **Unassigned PLC parameters (PLC registers)**

  Drive parameters to be freely used in the PLC program for data management and/or communication of Rexroth IndraMotion MLD-S 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.

6.3.4 Explanation of the MLD Data Channels

I/O Channel (PII, POI)

The I/O channel is the contact of IndraMotion MLD to external devices, as it allows evaluating and addressing digital and analog inputs/outputs.

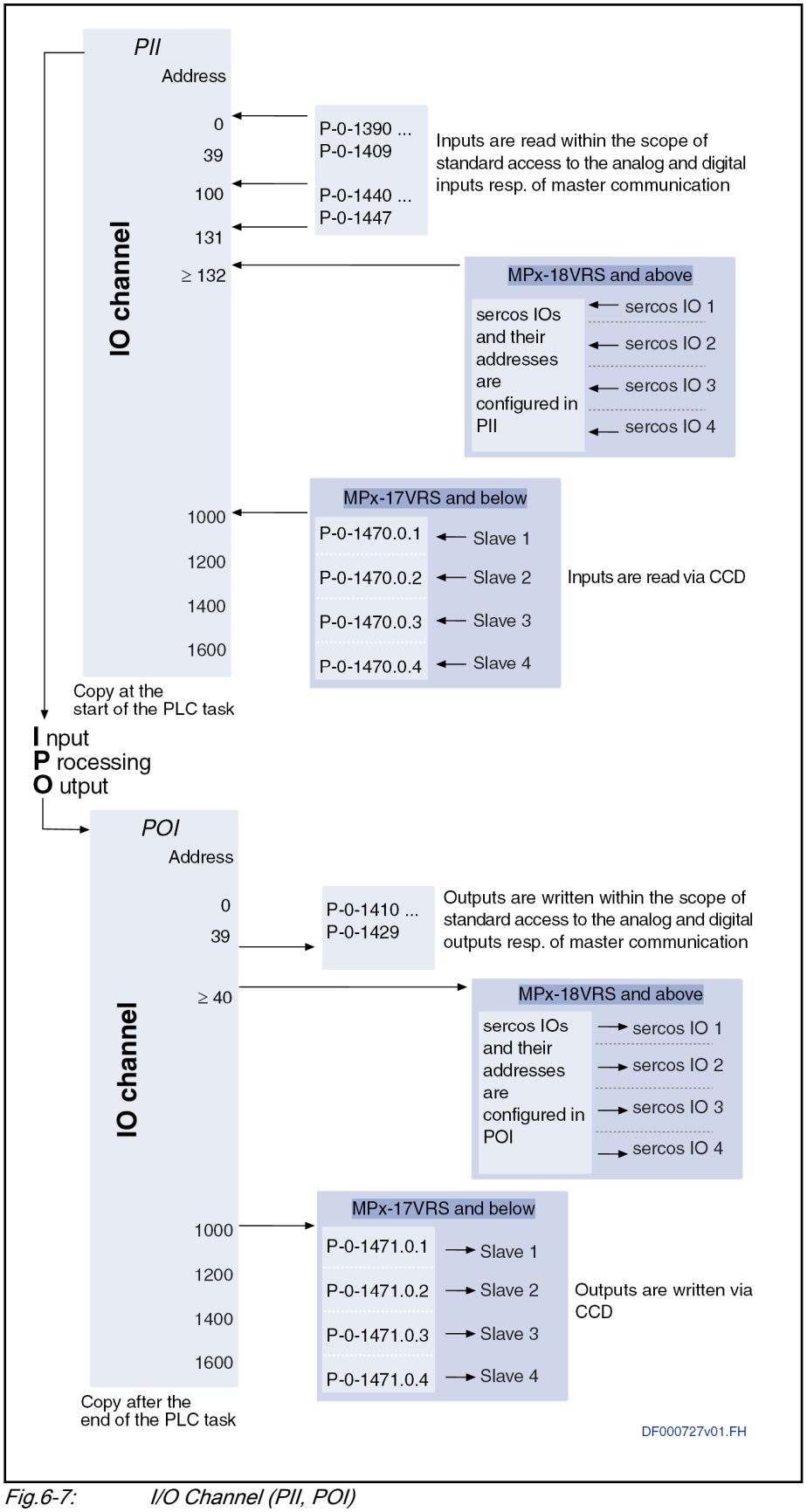


Fig.6-7: I/O Channel (PII, POI)

Commissioning and Parameterization

Features

The I/O channel has the following features:

- Inputs and outputs are in the respective process image.
  - **Update of the process input images** (PII) max. $T_{PLC}/2$ (500 µs for ADVANCED) before the PLC task. If inputs are read via the master communication or via CCD, the update of the process input images is additionally delayed by the corresponding bus cycle time.
  - **Update of the process output images** (POI) max. $T_{PLC}/2$ (500 µs for ADVANCED) after the PLC task. If outputs are written via the master communication or via CCD, the update of the process output images is additionally delayed by the corresponding bus cycle time.
- There is one common process image for all tasks.
- Since MLD-2G, the PLC has been working in a byte-oriented way.
- Distribution of physical inputs/outputs between drive and PLC is possible via IDNs (parameters) and I/O configurator.
- Changes in the I/O configuration take effect after switching from parameter mode to operating mode.
- The I/O channel is configured by means of IndraWorks dialogs.
- To be observed: Inputs and outputs are only updated when they are used in the program.
- Reset of all outputs in case of a PLC stop or error
- Reset of all inputs of the master control unit in case communication is interrupted
- Reset of all inputs of slave axes in case communication is interrupted
- Reset of all inputs of sercos III I/O devices in case communication is interrupted

Configuration of local inputs/outputs

Based on IndraWorks dialogs, the paragraphs below describe the following examples of configuration:

- 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 the 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. IndraWorks features a dialog for this purpose. The dialog is called in the device tree under **Local I/O ▸ I/O X31/X32**.

See also Functional Description "Digital Inputs/Outputs".

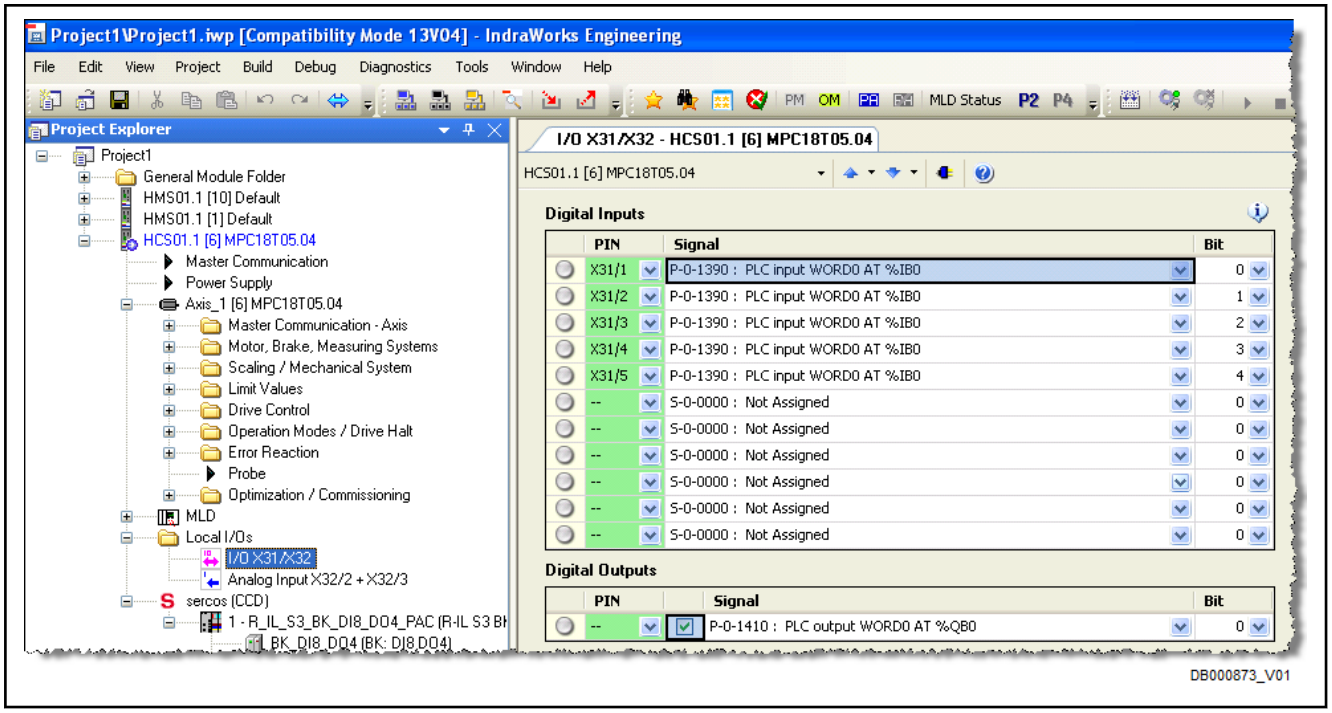


Fig.6-8: Configuring the Digital Inputs/Outputs in IndraWorks

Configuring Analog Outputs of the Control Section

Outputting PLC variables via an analog output requires configuring the respective PLC parameters (P-0-1410,…). To output analog signals, the drive must be extended by Inline IO Modules by Rexroth (or similar). Analog outputs are not available at the drive.

Configuring Analog Inputs of the Control Section

Analog voltage values can be read in via the analog input of the device. As an alternative, Inline IO Modules can be connected. The figure below illustrates the operating steps required to configure the analog input.

See also Functional Description "Analog Inputs"

Commissioning and Parameterization

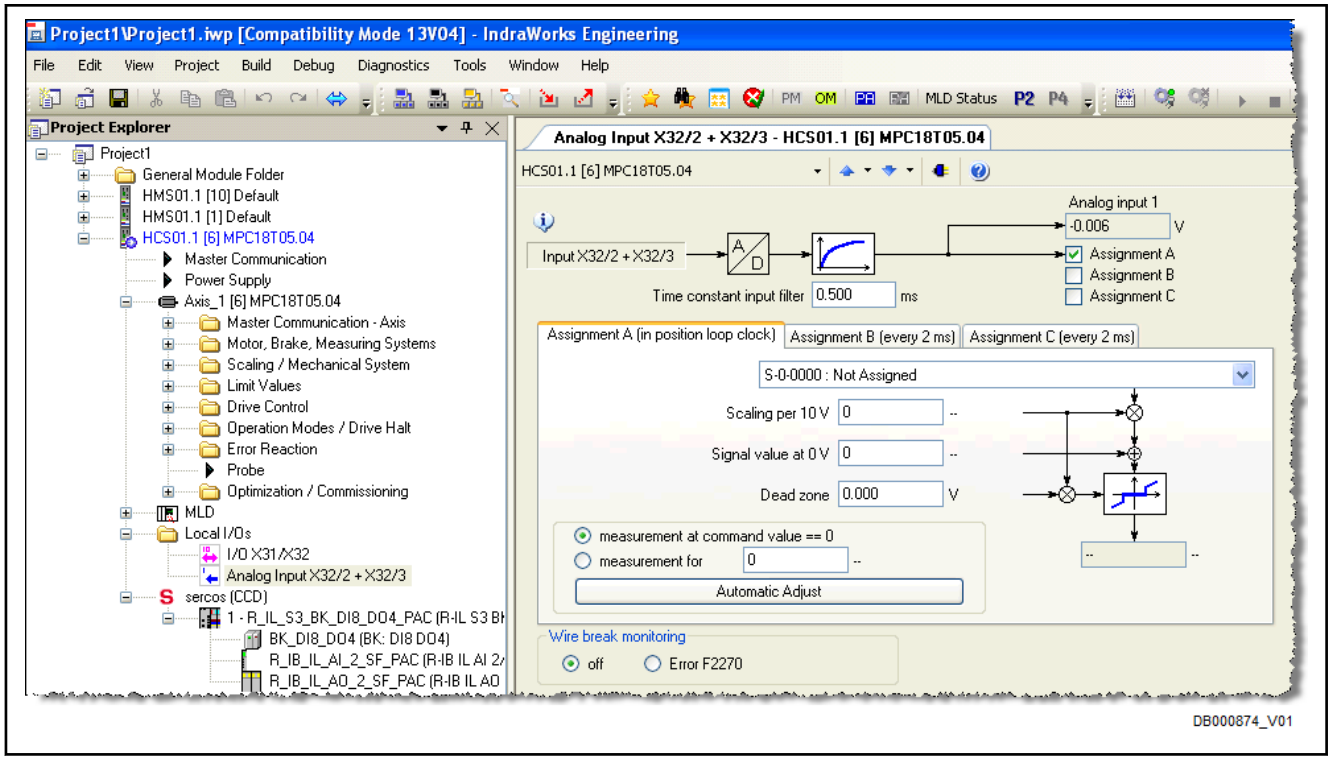


Fig.6-9: Configuring an Analog Input in IndraWorks

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

When using IndraMotion MLD-M, the peripherals of the connected axes can be used in the PLC. In this case, the data are exchanged via the "cross communication" (**C**ross **C**ommunication **D**rives) device function.

The parameterization takes place in the dialog for MLD-M I/O configuration. In its left half, the dialog provides some process image parameters to be selected; the desired parameter of the process image has to be entered. Its right half displays a selection of all inputs or outputs available on the slave; the corresponding register of the I/O module has to be entered.

☞ The parameters set in this dialog are automatically added to the cyclic command values or actual values of the respective axis. For a list of all cyclic parameters, see the CCD dialog (see also "CCD Configuration in the 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 to the digital inputs of slave #4 via P-0-0303.

☞ Please observe in which bits the corresponding terminals take effect.

☞ P-0-0303 contains 32 bits and therefore has to be assigned to a 32-bit process image register, such as P-0-1440.

In addition, input word 1 (P-0-1391) was assigned to analog input 1 of slave #4 via P-0-0210.

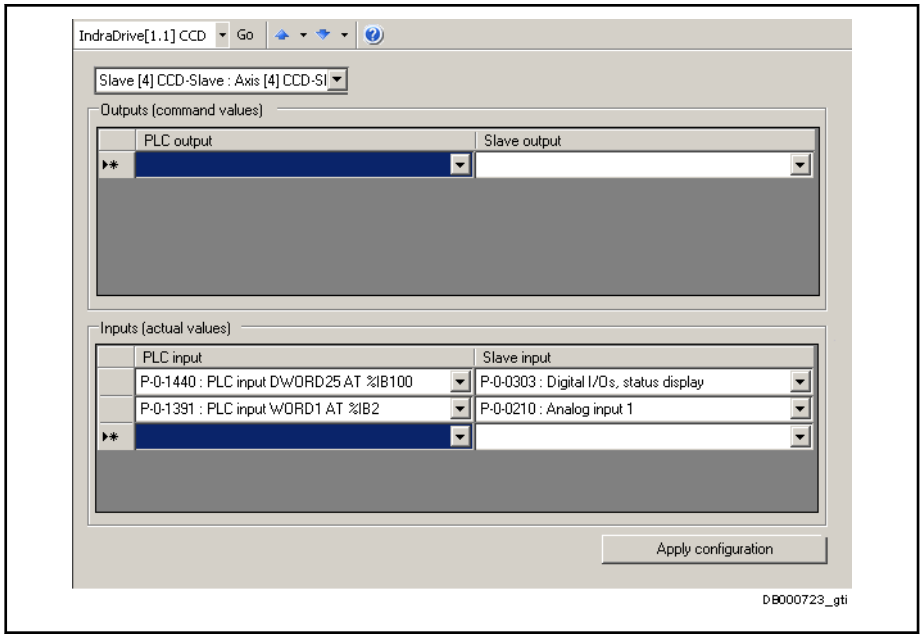


Fig.6-10: Assigning Inputs

In the second example, output word 0 (P-0-1410) was assigned to the digital outputs of slave #4 via P-0-0304. The individual bits %QX2.0 et seq. control the outputs of the slave.

Please observe in which bits the corresponding terminals take effect.

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.

In addition, output word 2 (P-0-1412) was assigned to analog output 1 of slave via P-0-0139.

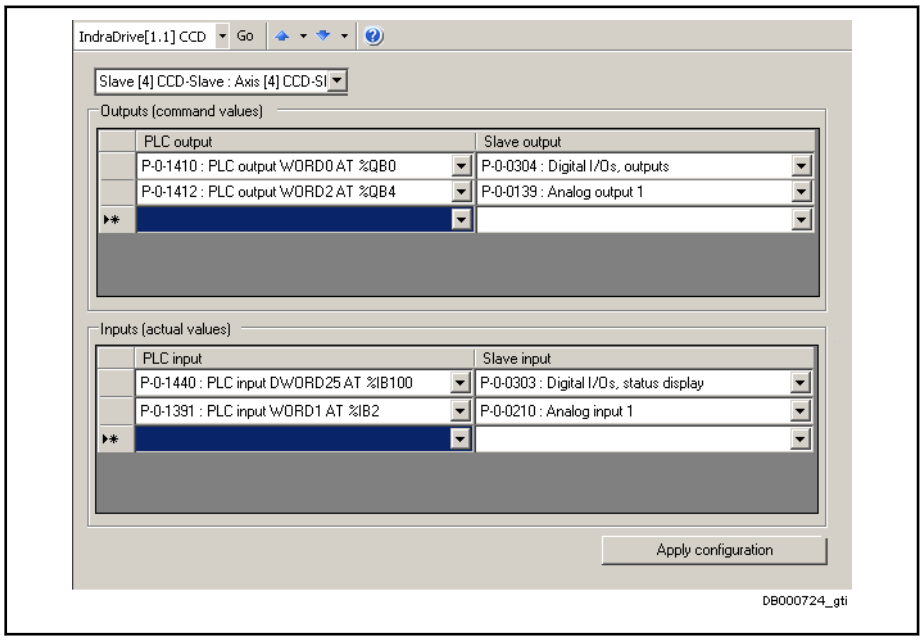


Fig.6-11: Assigning Outputs

In the third example, the digital inputs of the local axis are read in via CCD by means of P-0-1441 and the digital outputs are read out by means of P-0-1413. This example is intended to show that using IndraMotion MLD-M also allows accessing the local I/Os via the CCD mechanism ("virtual slave"). If the CCD master is configured as a virtual slave, the local I/Os and the I/Os of remote axes are simultaneously updated; i.e. the digital inputs/outputs of the local axis are read in or out via sercos III at the same time as the inputs/ outputs of remote axes.

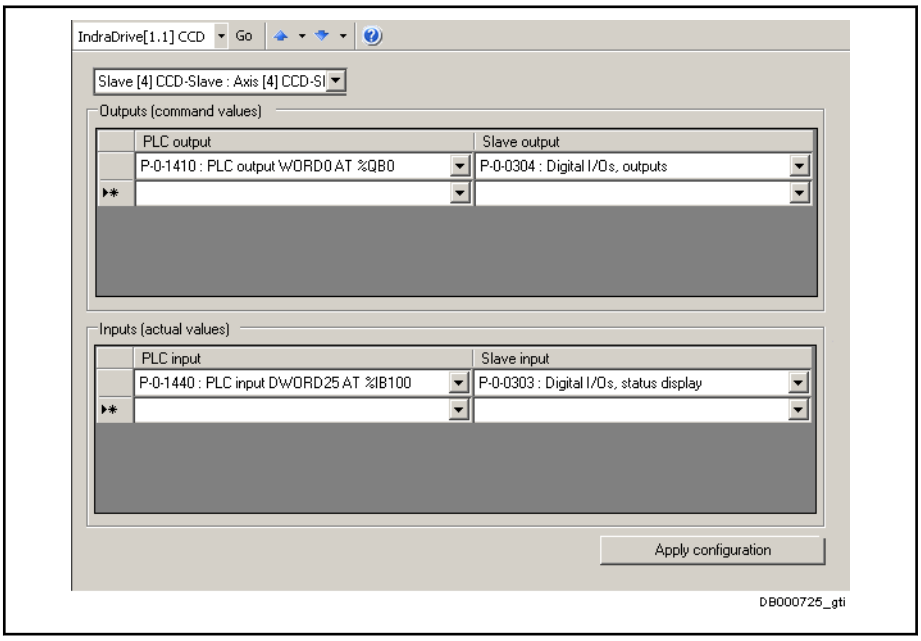


Fig.6-12: Accessing Local Inputs/Outputs via CCD (Virtual Slave)

AxisData

For cyclic access to the local axis and remote axes, there are predefined axis data structures (AxisData) with several command values and actual values available.

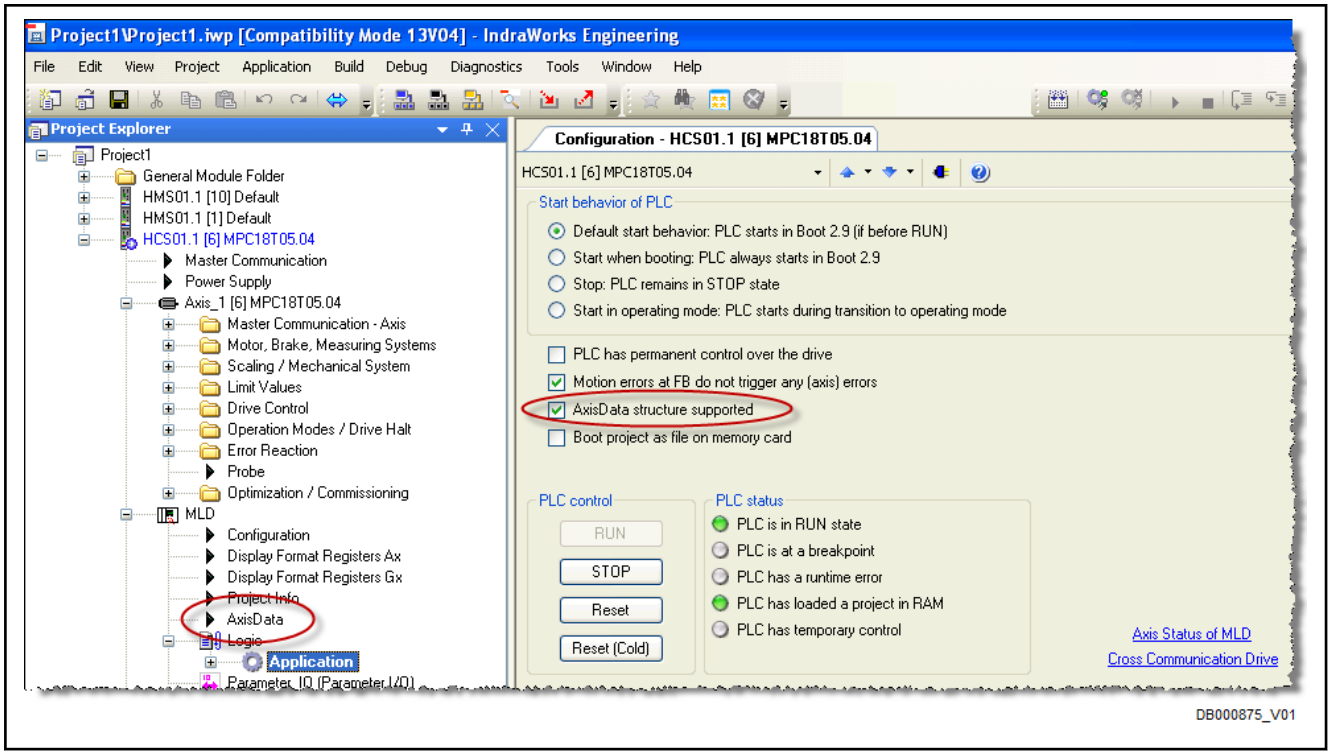


Fig.6-13: Accessing Local and Remote Axes by Means of "AxisData" Data Structure

Features

- "AxisData" is an IEC 61131 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 their own cyclic data. This allows easily accessing the most important axis data.
- The processing of the "AxisData" is optional and therefore must be activated (P-0-1367, bit 6="1"; see also fig. 6-13 "Accessing Local and Remote Axes by Means of AxisData Data Structure" on page 49).

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.

After "AxisData" has been activated for the first time, the drive has to be switched off and on again.

- The declaration of the structure of "AxisData" has already been made in the library "MX_Base.lib" as an array "Array of Struct" over all real axes. `AxisData : ARRAY[1..10] OF MX_AXISDATA`.
- In order to achieve synchronized (dead-time-optimized) command value 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, the axes (CCD master and slaves) are accessed synchronously.

Commissioning and Parameterization

In contrast to the PII and POI, the axis data are not processed synchronously to the task; therefore, this must be ensured by the appropriate access in the program If synchronous actual values or command values are required, the corresponding structure elements are copied at the beginning of the task.

- 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:

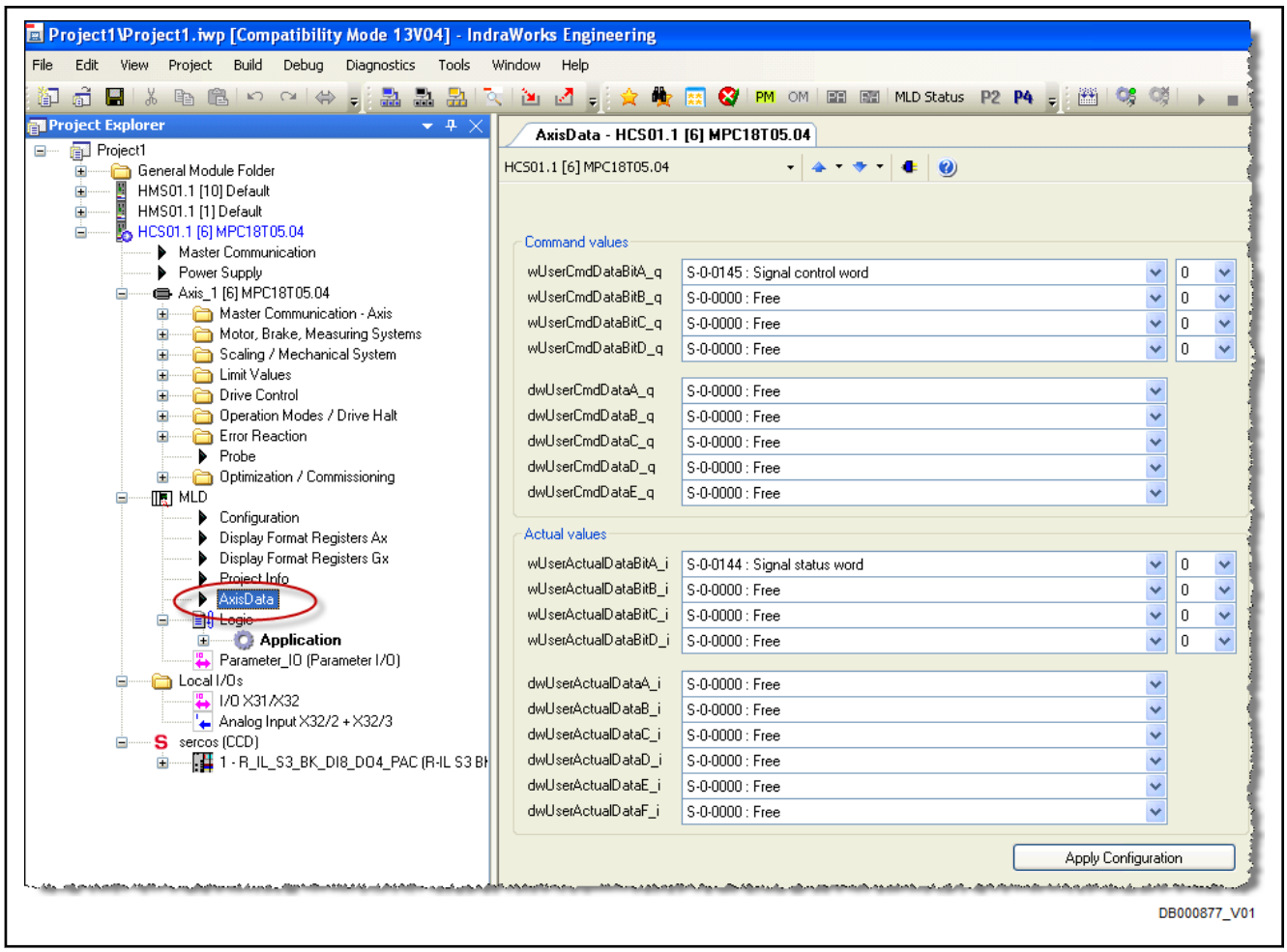


Fig.6-14: Dialog for Setting the Configurable Elements of "AxisData"

The parameters input in dialog "AxisData" are automatically entered in the CCD configuration. The entire resulting list of the cyclic values via CCD can be displayed in the dialogs of the CCD configuration (see "CCD Configuration in the MLD-M System Mode").

- Access to the "AxisData" data structure 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":

AxisData : ARRAY[1..10] OF MX_AXISDATA;

Examples of use in the PLC program:

Program:

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

Process Parameters for General Purpose in MLD-M

In MLD-M, it is possible to define additional cyclic process parameters (Drive to Drive) for specific requirements (D2D: cyclic parameters via a Drive-to-Drive connection). This is not necessary for normal motion tasks, but can make sense for specific constellations.

Parameterization

Other cyclic actual values and command values can be configured in the IndraWorks dialog "Free Process Data".

The parameters set in this dialog are automatically added to the cyclic command values or actual values of the respective axis. For a list of all cyclic parameters, see the CCD dialog (see CCD Configuration in the MLD-M System Mode).

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-0-0037.

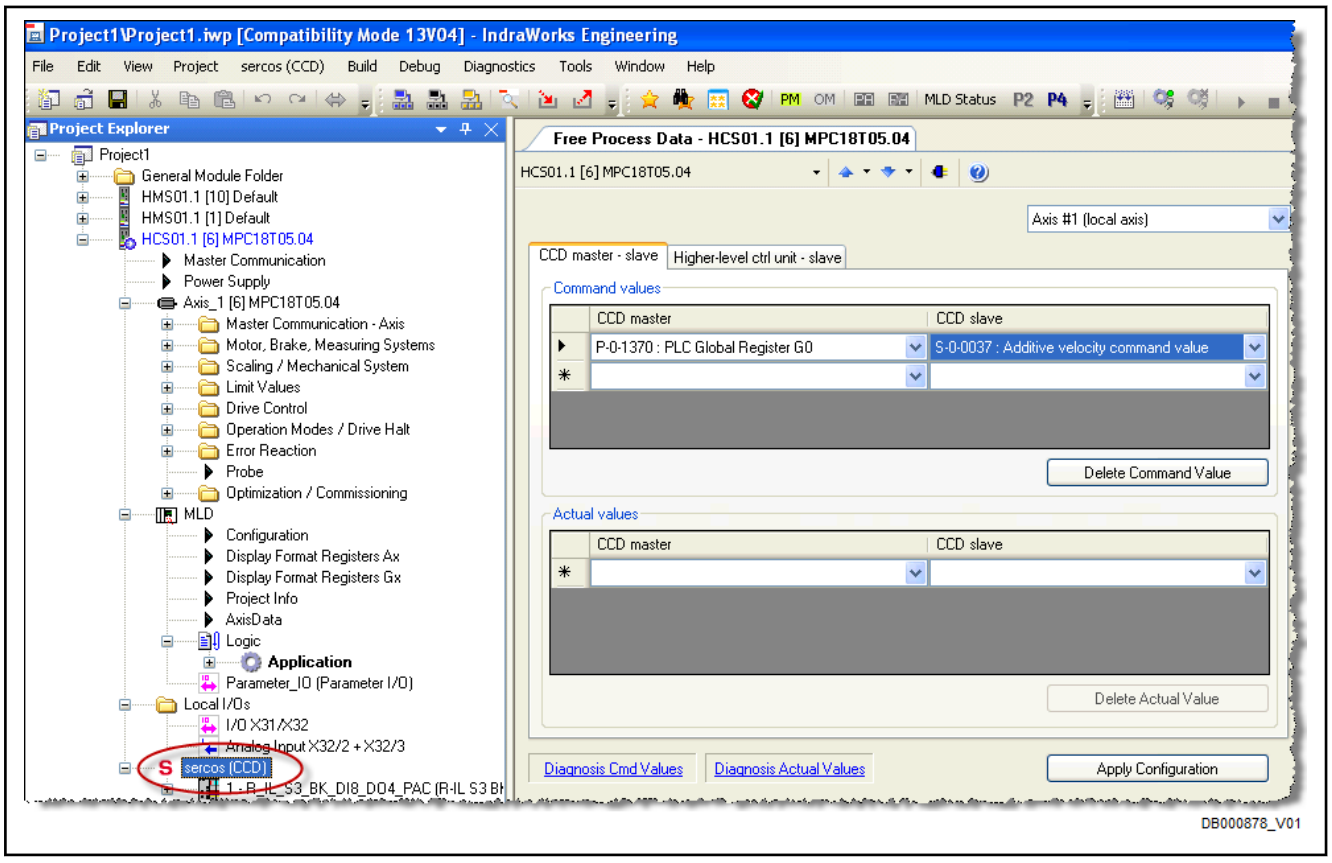


Fig.6-15: Configuring the Free Process Data

Accessing Local Parameters via Direct Variables

Another possibility of processing parameters easily and quickly is accessing them via direct variables. This allows read and write access to parameters 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.

As in the case of the processing of cyclic master communication data, the data in this case are neither stored nor is a limit value check or error handling carried out.

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").

The direct variables have been declared via the global array "DV_Array[ ]" of the "MX_DirectVarAxis" function block. The definition is part of the global variable list "GVL_Base" of the "MX_Base" library.

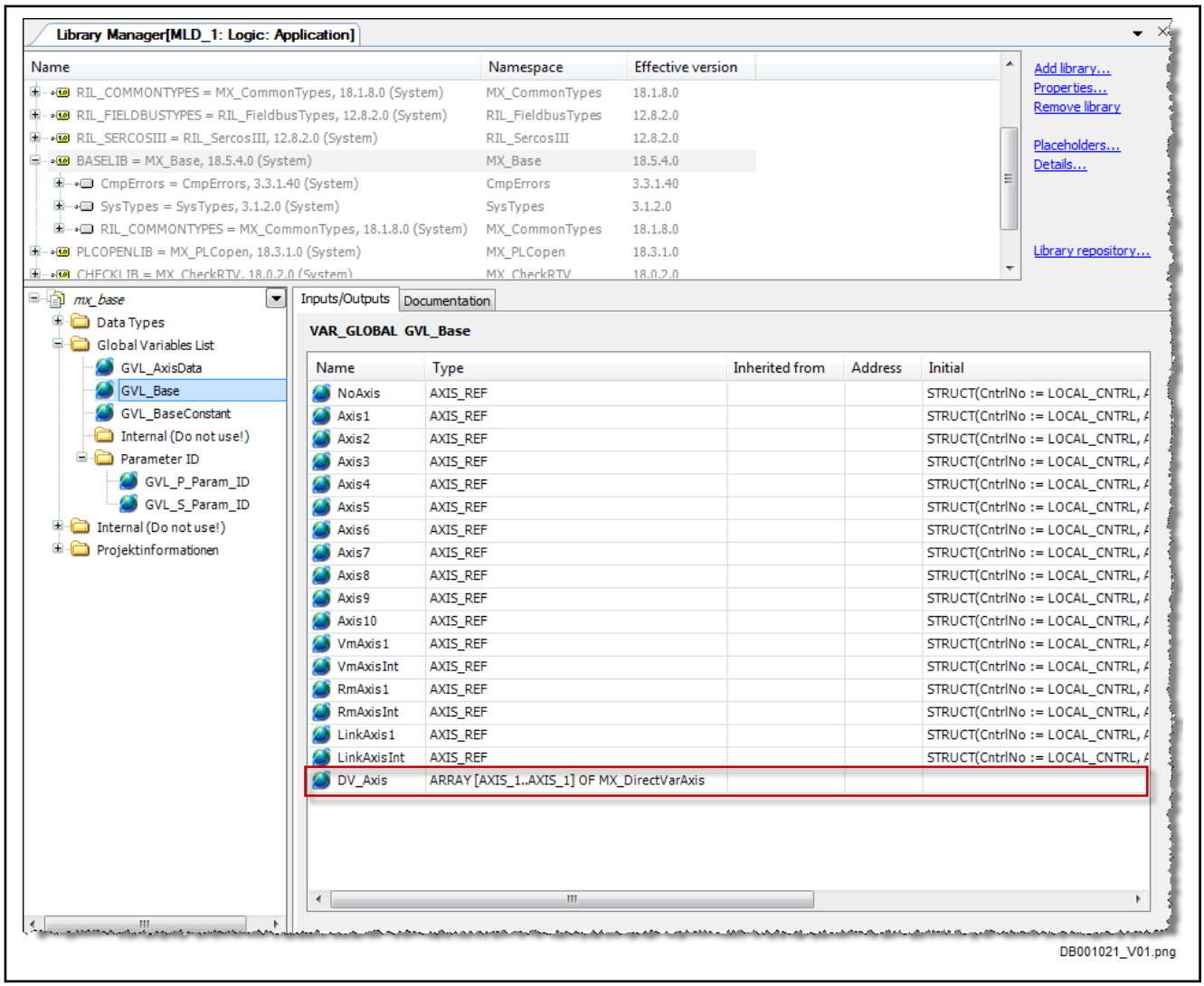


Fig.6-16: Direct Variables in MX_Base

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_Axis[AXIS_1].P_0_0115.3`)

Parameter Channel

The parameter channel allows acyclic read and write access to all S- and P-parameters of the drive.

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. As a result, the function blocks have to be called several times in the service channel and signal "Done" when transmission is over.

Access via Function or Function Block

Several options are provided for access to parameters.

Features of access to parameters via a function:

- Faster than function block
- No instances
- No error control
- No access to remote axes

Features of access to parameters via a function block:

- Transmission with error control
- Instance required
- Action takes place at rising "Execute" edge
- Access also to remote axes
- Possible access to I/O modules "Rexroth Inline" (sercos III)

Features of Parameter Channel

The parameter channel has the following features:

- The blocks and functions for processing the parameters are contained in the "MX_PLCopen.library" library.
- 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 "MX_Base.lib" (FP_....) library. The constants used in this library contain the sercos-compatible address for P-/S-parameters. In the case of the function blocks of the MX_PLCopen library, the "ParameterNumber" input is supplied with these constants.

Commissioning and Parameterization

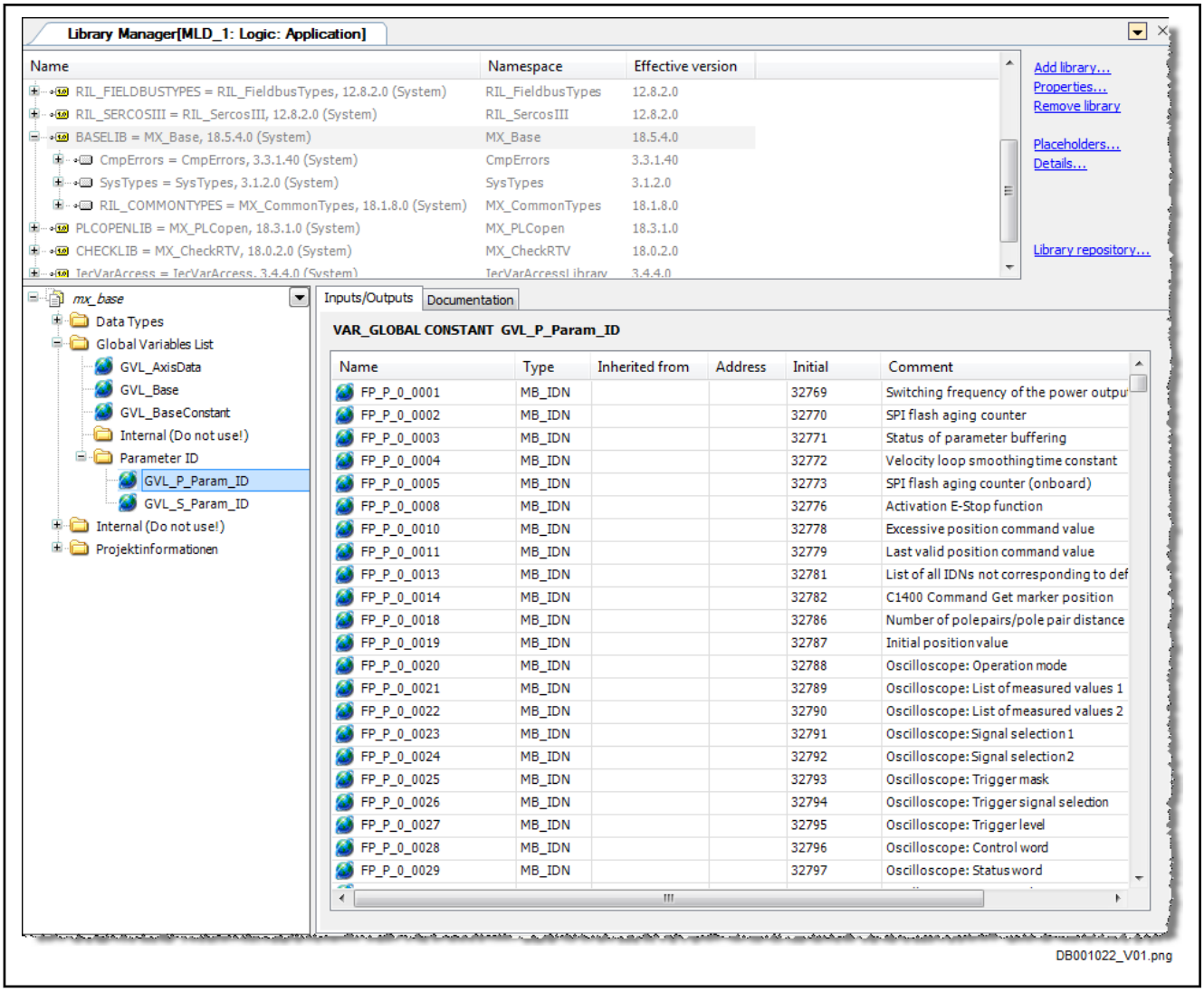


Fig.6-17: Addressing Parameters via Constants

Parameter Channel Libraries

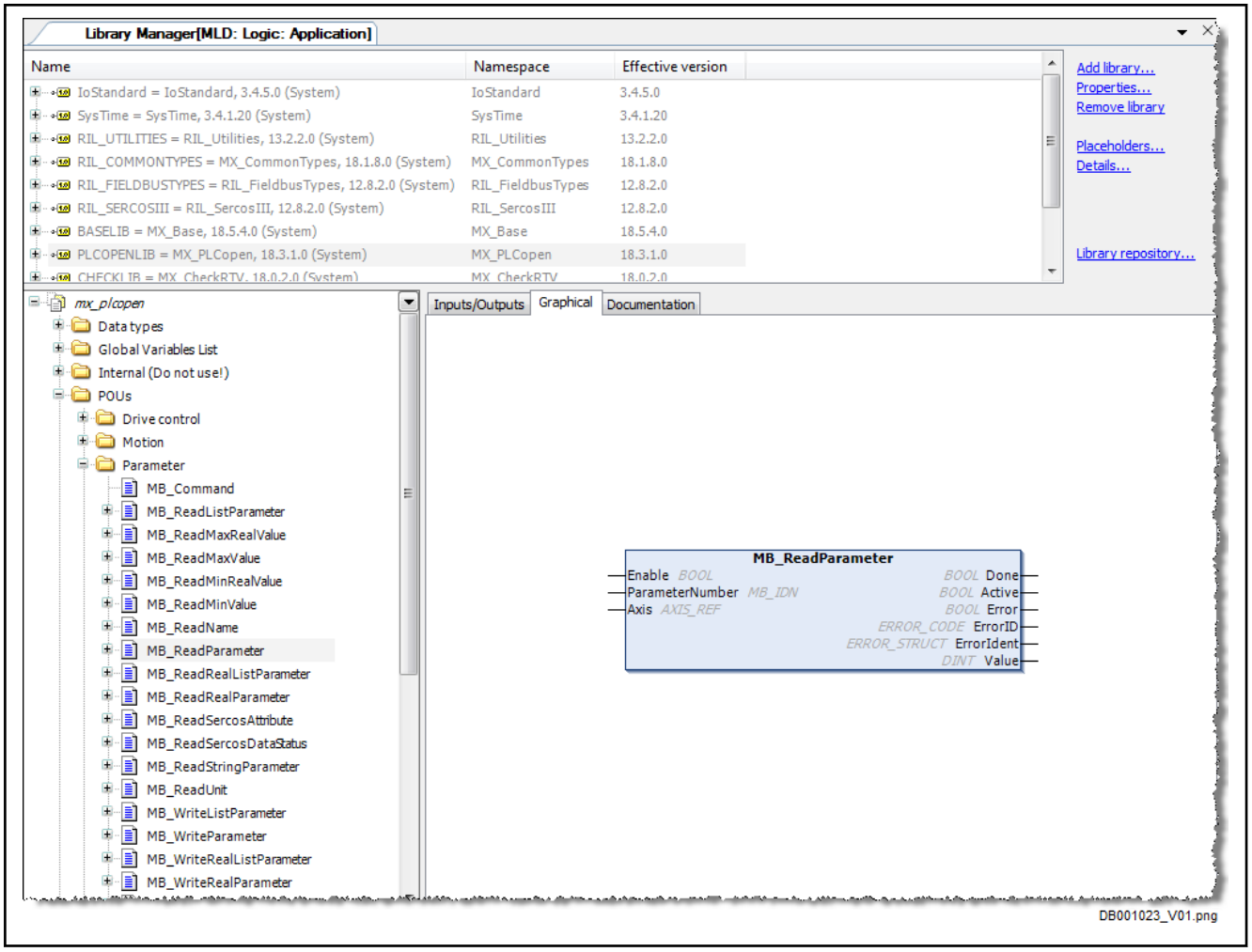


Fig.6-18: Functions and Function Blocks in "MX_PLCOpen.lib" Library

Example

In the example, element 10 of parameter P-0-4006 would be read on the local axis (Axis1).

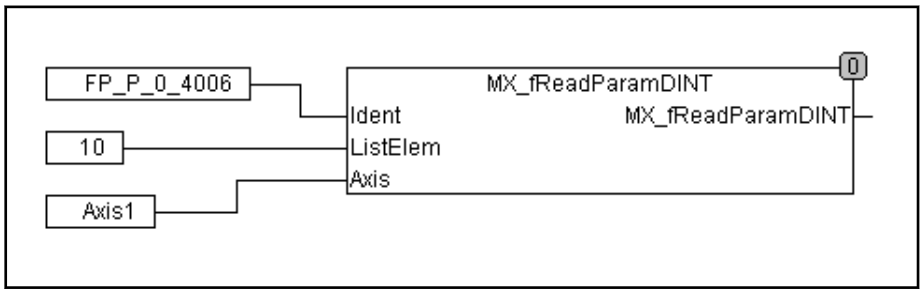


Fig.6-19: Example of a Read Function

For further information on access by means of functions and function blocks, see the library description of MX_PLCopen.lib.

Unassigned PLC Parameters (Global Registers)

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

Commissioning and Parameterization

The global registers do not have any direct influence on the drive, but only take effect in conjunction with MLD.

Features

Access to parameters via global registers has the following features:

- 32 global registers (P-0-1270…P-0-1301) with freely definable data format to parameterize PLC functions or function blocks
- 32 global registers (P-0-1370…P-0-1385, P-0-1316…P-0-1331) with freely definable data format to parameterize PLC functions or function blocks
- 2 global text registers (P-0-1387, P-0-1388) as text parameters which can be freely used to display diagnostic message texts

Format Adjustment for Global Registers

The display formats of the global registers can be individually adjusted with "P-0-1386, PLC display format Global Register". Apart from the data length (2 or 4 bytes) and the display format (e.g. BIN, Dec, Hex,..), it is possible to define the number of decimal places.

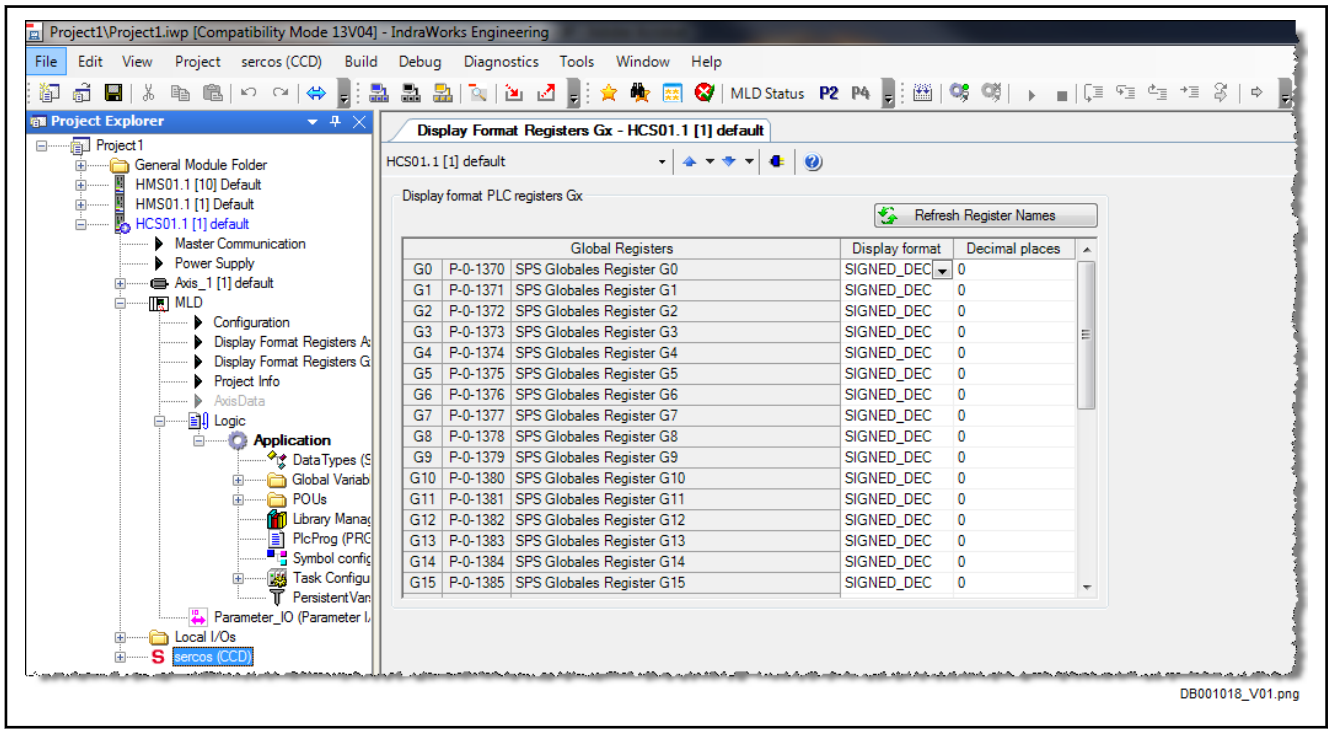


Fig.6-20: MLD Configuration Dialog

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 … G31 and GL0 ... GL2 can thus 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 MLD-S, because the contents are retained in case voltage fails

Global Registers Axx

In addition, there are the two global registers "P-0-1387, PLC Global Register AT0" and "P-0-1388, PLC Global Register AT1" which are available as freely

usable text parameters with a maximum of 255 characters plus closing "0" character.

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

Applications for Global Registers Axx

The global registers (AT0 and AT1) can thus 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. Internally, the motion command channel is mainly used for implementing 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.

Features

- 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 values during motion control are preset via the corresponding inputs at the motion function blocks. Other specific settings, such a scaling, jerk etc., are parameterized. This is normally done during the commissioning of the axes with the IndraWorks parameterization user interface. However, other settings (e.g. the jerk) can also be modified by means of parameter access.
- An axis motion via a motion function block can only be carried out when MLD has control over the drive. Control can either be permanent when "permanent control" is activated or temporary by means of the "MX_SetControl" function block.

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 IEC 61131 function blocks by means of which the axes can be controlled. Apart from the function blocks already defined by PLCopen, there are additional function blocks based on the standard.

Programming

Programming takes place with the function blocks of the "MX_PLCopen" library. The function blocks have been designed in such a way that they are cyclically called. They are normally activated by an input edge and provide information on status outputs. The exact functional principle is described in the documentation Rexroth IndraMotion MLD, Libraries as of MPx18 (DOK-INDRV*-MLD-SYSLIB3-RERS-EN-P; R911338916).

Libraries

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

Settings

After permanent control has been activated for the local axis, or the MLD-M system mode for the control of remote axes, the required operation modes of the axes are automatically parameterized. The operation modes thereby are automatically selected. Normally it is not necessary to make further settings.

Scaling

During commissioning, the axes are scaled in the corresponding dialogs of the IndraWorks parameterization user interface. At the motion function

blocks, the preset values are set via the function block inputs as physical values.

Other Settings

Other settings, such as the jerk, cannot be parameterized at the function blocks, but must be set in the IndraWorks commissioning software. If such values are to be changed, they can be set at runtime via the parameter channel (e.g. "MB_WriteParameter").

Configuring the Cyclic Data in the 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. In IndraWorks, the resulting cyclic parameters are only displayed, but not parameterized. 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 here. For this purpose, there is the dialog for MLD-M I/O configuration.
- AxisData : The required parameters for the user data in "AxisData" are defined here.
- Process parameters for general purpose: Other freely selectable cyclic parameters for specific communication can be entered here. See dialog for defining the process parameters for general purpose.
- Signal status bits and signal control bits: The signal control or signal status word is permanently and cyclically configured in the motion data. As a result, 12 bits of the 16 possible bits have been defined or reserved. The remaining 4 bits (bit #12…bit #15) can be used via the AxisData as actual value or command value bits. This is set in the dialog for AxisData. The CCD configuration includes the dialog displaying all cyclic data; all cyclic parameters are summarized in this dialog.

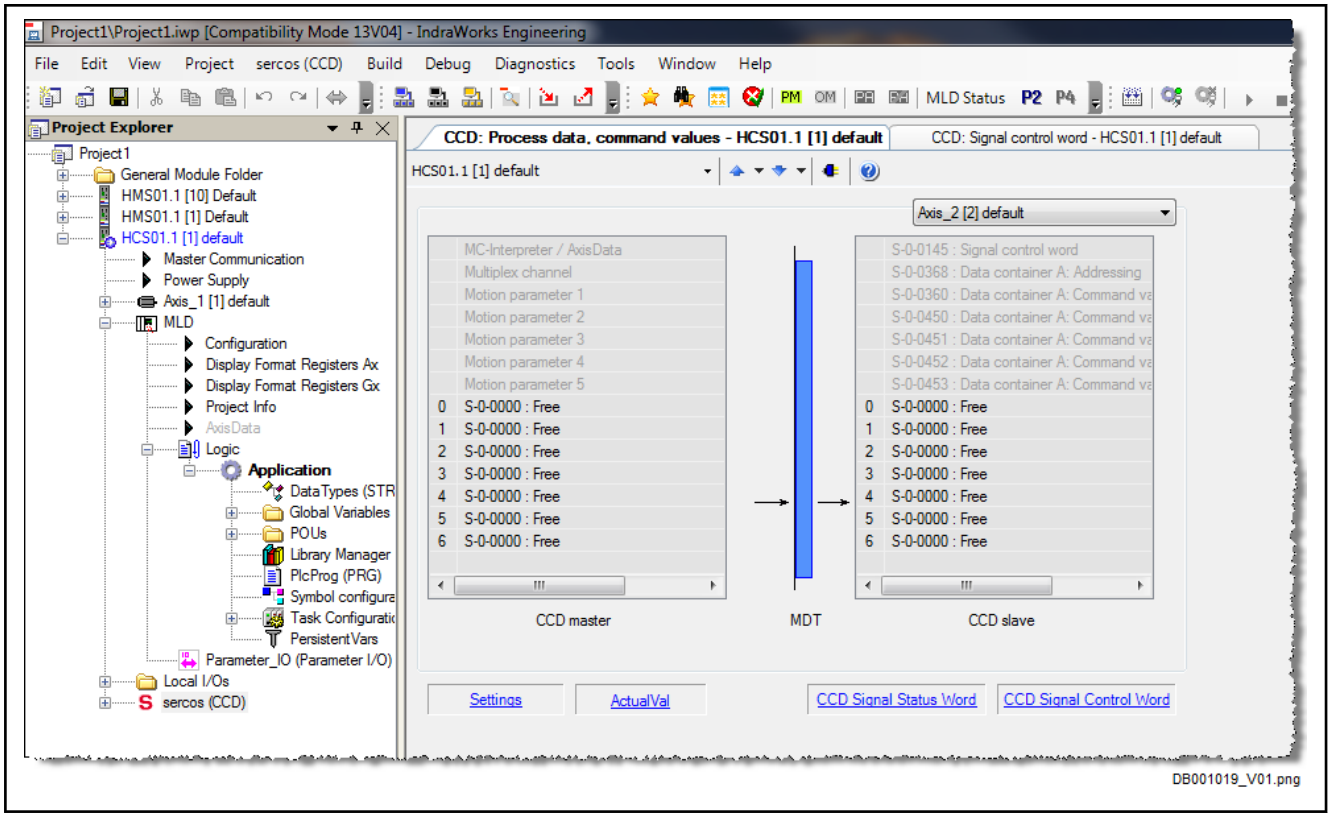


Fig.6-21: Dialog Displaying all Cyclic Data

Commissioning and Parameterization

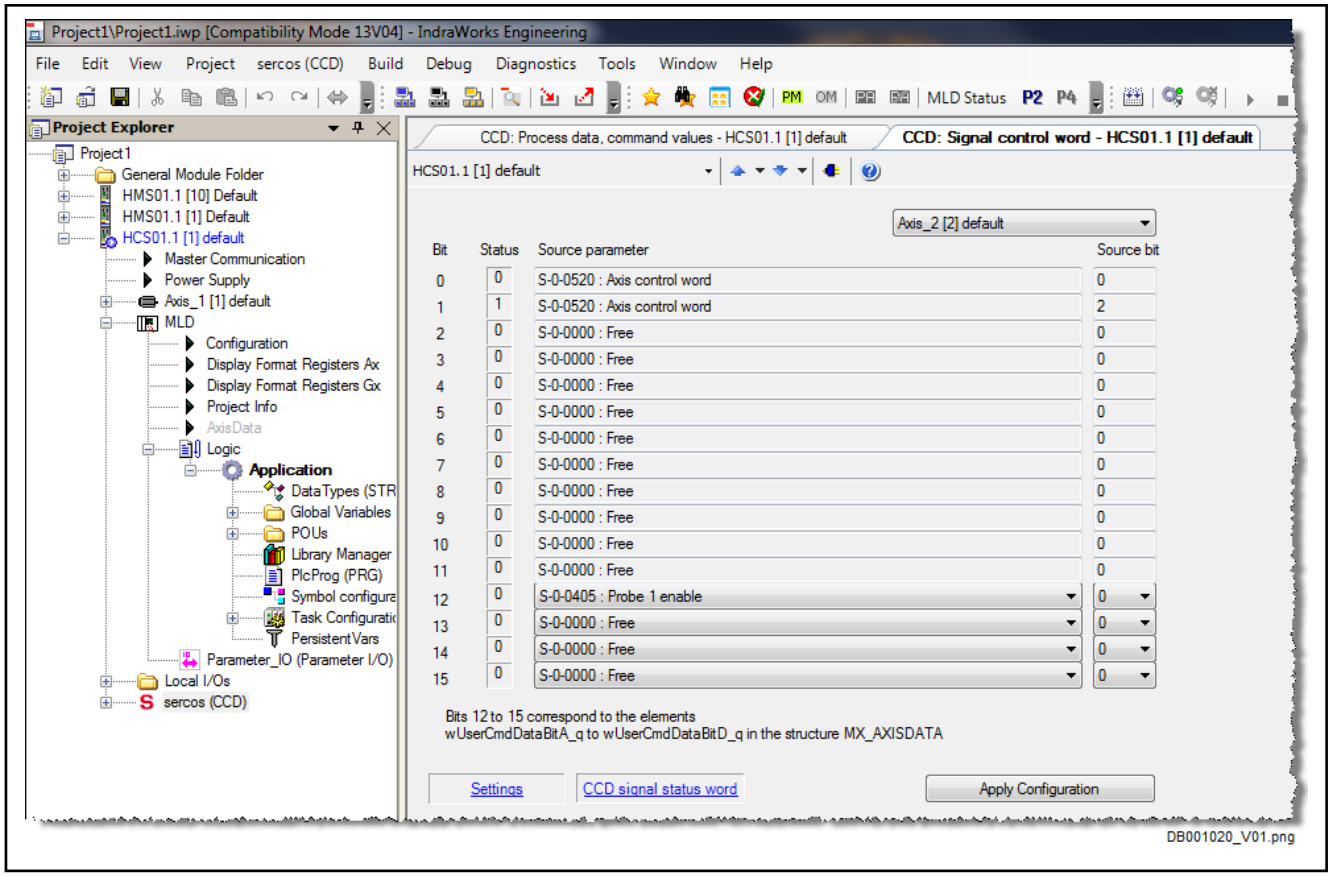


Fig.6-22: Dialog Displaying the Resulting Configuration of the Signal Control Word

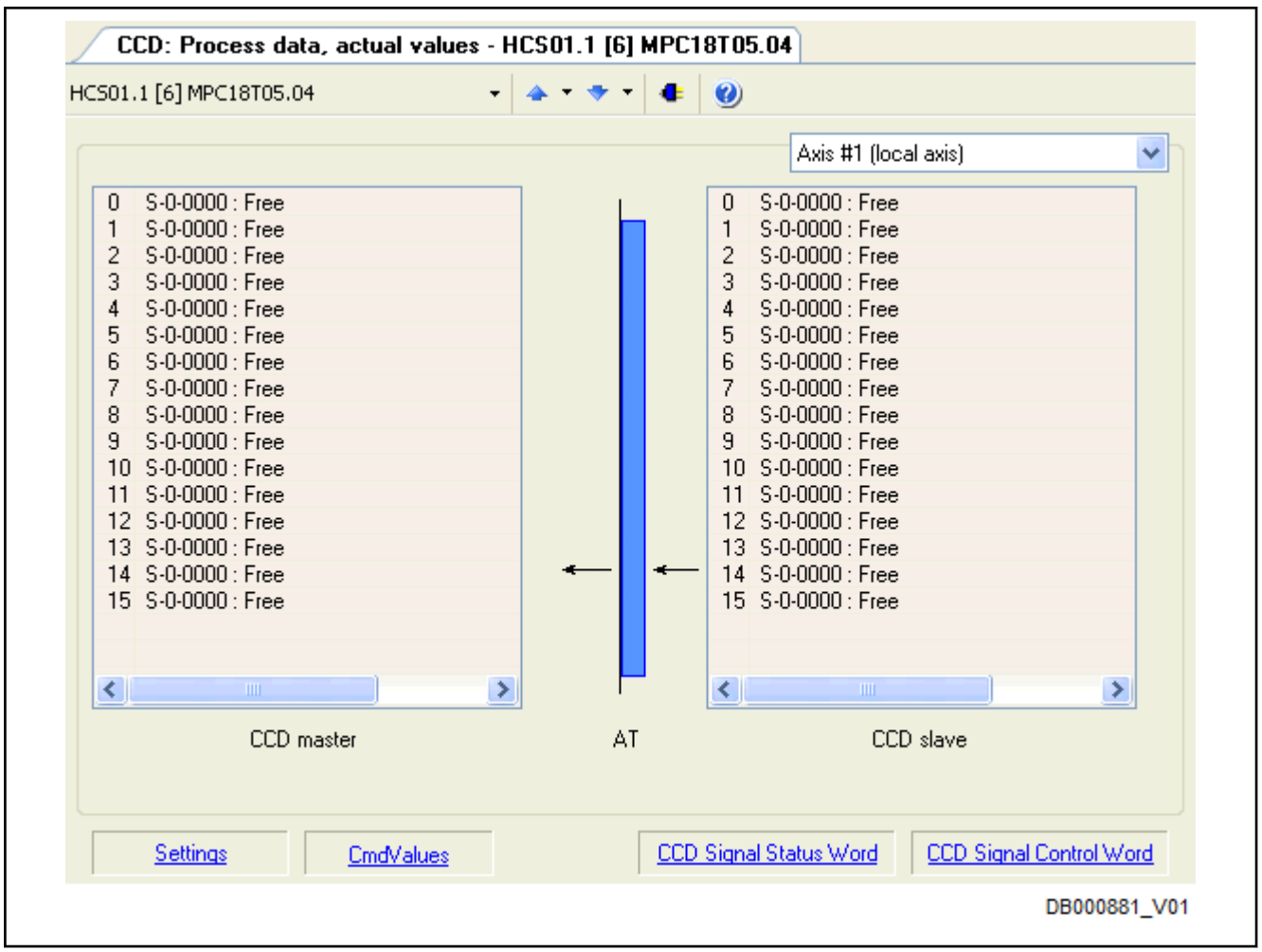
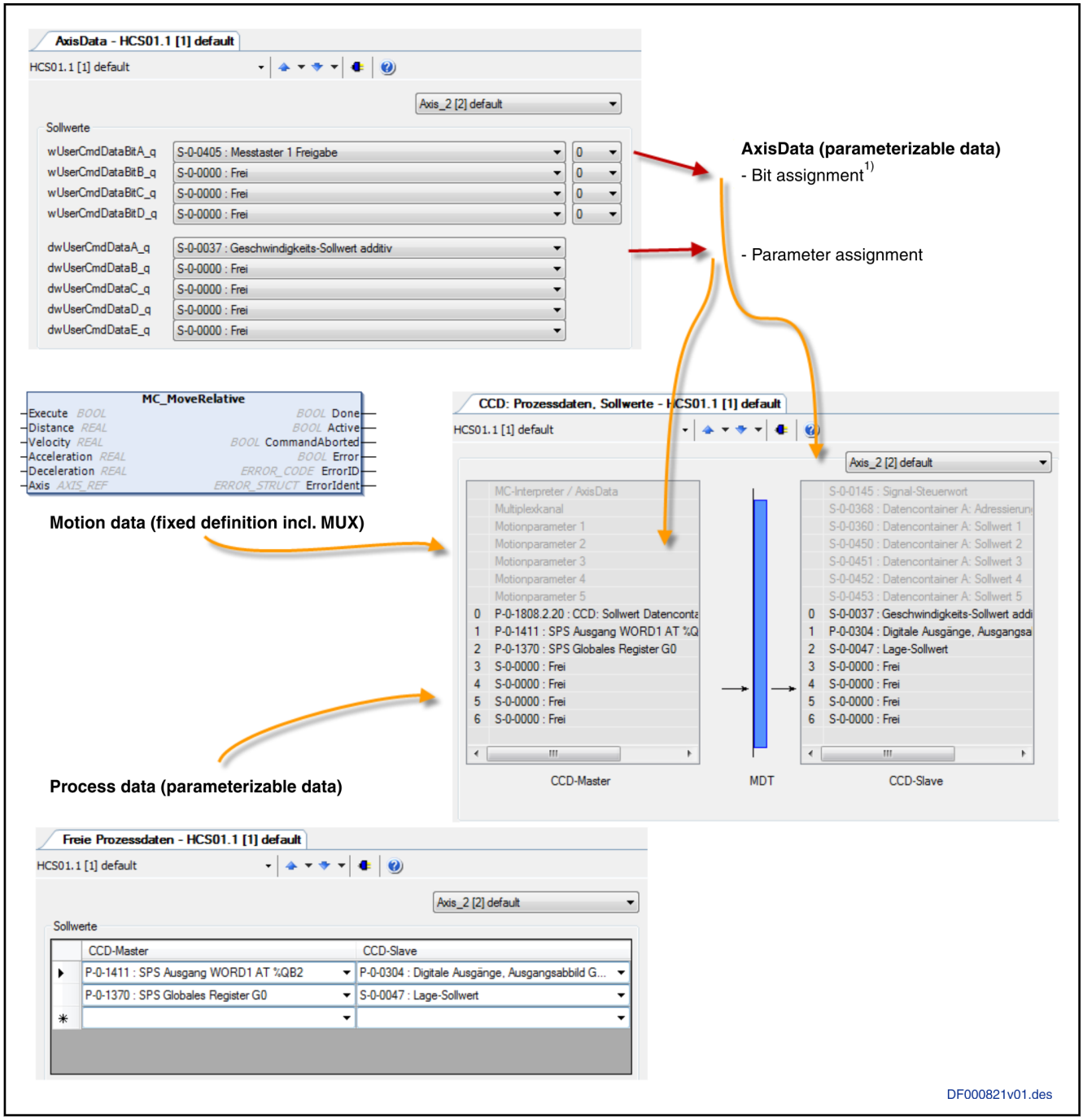


Fig.6-23: Dialog Displaying the Signal Status Word

The example below shows how the cyclic data of "Motion", "AxisData", "I/O" and "process parameters for general purpose" are summarized. The dialog on the right hand side shows all cyclic data. When data are entered in the individual dialogs, the configurations of the MDT/AT data of the slave axes are automatically created.

Commissioning and Parameterization



1) With the bit assignment, the bits 12 to 15 of the signal control word are configured

Fig.6-24: Summary of Cyclic Data

7 Programming

7.1 Step 8: Configure and Control the PLC

7.1.1 Overview

The "Logic" branch shows the PLC structure with all subprograms, variables, the Library Manager, etc., and is used to configure global PLC properties.

The "Logic" branch is not created until you double-click "Logic".

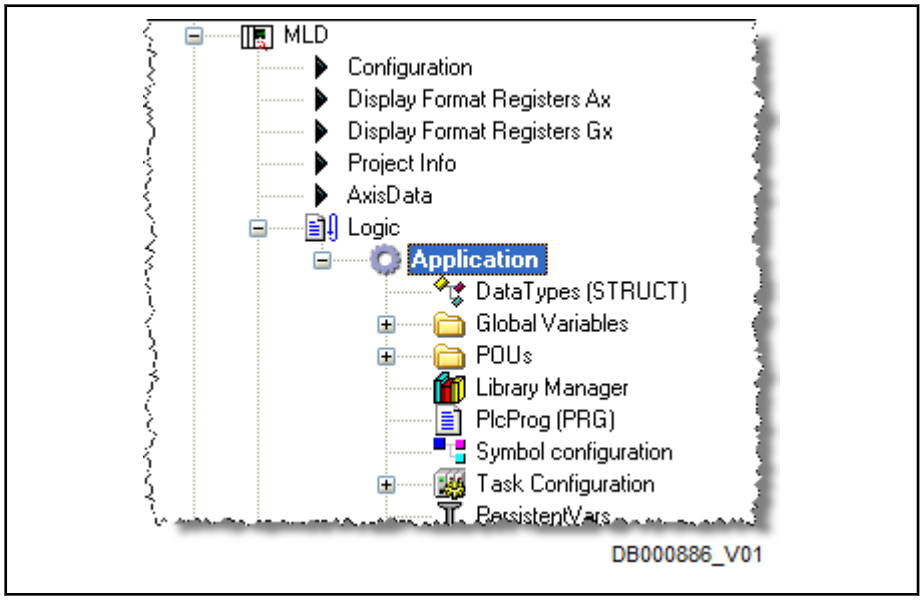


Fig.7-1: "Logic" Branch

In IndraWorks, the PLC programs, the variables and the Library Manager are displayed on separate tab pages. The IndraWorks user interface provides the following options:

- The communication settings required for program download
- The target settings
- A main program (PLC_PRG) with task configuration (10 ms)

Settings outside of IndraWorks are not required.

7.1.2 Configuring the PLC

When you right-click "Application", the following context menu is displayed:

Programming

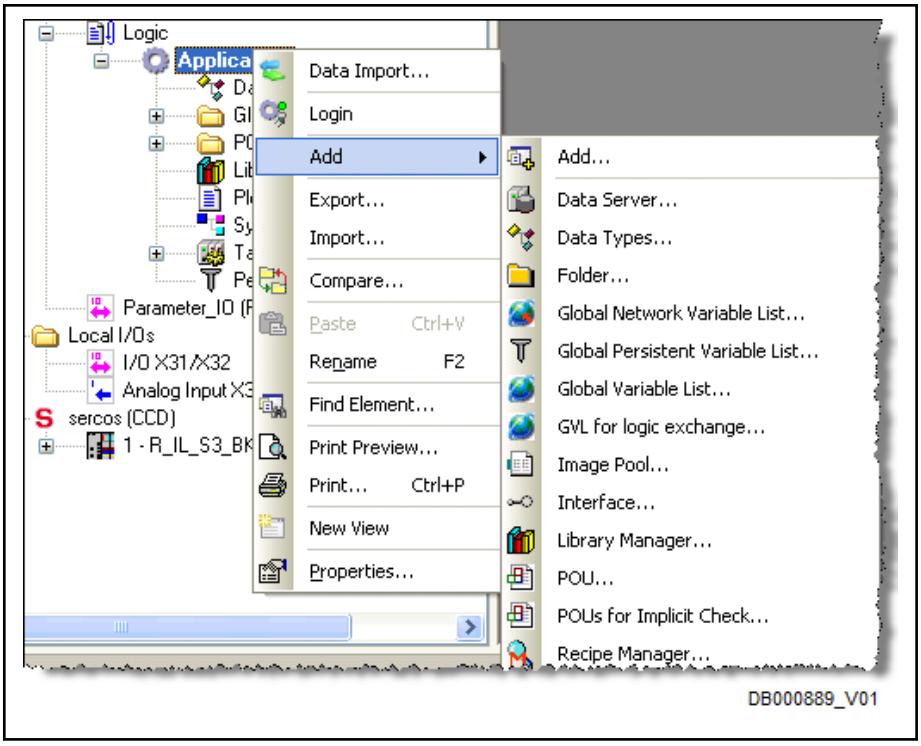


Fig.7-2: Configuring the PLC

- **Data Import...**

  Applying the data from IndraLogic MLD-1G, IndraLogic MLD-2G and CoDeSys3.0. In this dialog, it is possible to integrate PLC programs (*.prg, *.project).

- **Login**

  Logging into the control unit. When changes were made to the program, the program is compiled when logging in and loaded.

- **Add**

  Via this menu item under the "Application" branch, it is possible to include programs (POU), variable lists, data types, etc.

- **Export...**

  The data (POU, variable lists, libraries, data types, etc.) can be exported. An export file (*.exp) will be generated.

- **Import...**

  The data (POU, variable lists, libraries, data types, etc.) can be imported. An export file (*.exp) is expected for the data import.

- **Properties...**

  – "Boot application" tab page: To determine when the boot application is created.

  – "Build" tab page: To configure the compilation.

7.1.3 Controlling the PLC

The PLC can be controlled by means of the context menu of "Application". The menu items "Logout" and "Stop" or "Start" are only displayed when login into the control unit took place before and the PLC is at "RUN" or "STOP".

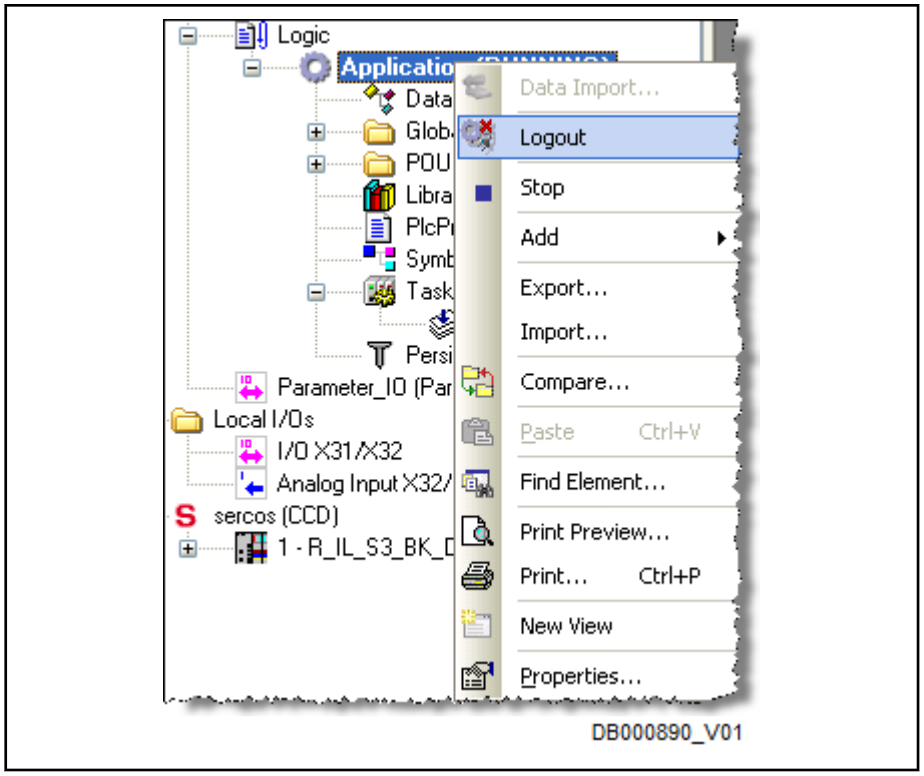


Fig.7-3: Controlling the PLC

As an alternative, the PLC can be controlled via the "IndraLogic" toolbar.

Fig.7-4: Controlling the PLC via the "IndraLogic" Toolbar

The "IndraLogic" toolbar can be activated via **View** ▸ **Toolbars** ▸ **IndraLogic**.

7.2 Step 9: Create a Program

7.2.1 Creating a New Program

Declaring Variables

The variables used in the program must be declared and, if required, addressed to digital inputs or outputs.

Programming

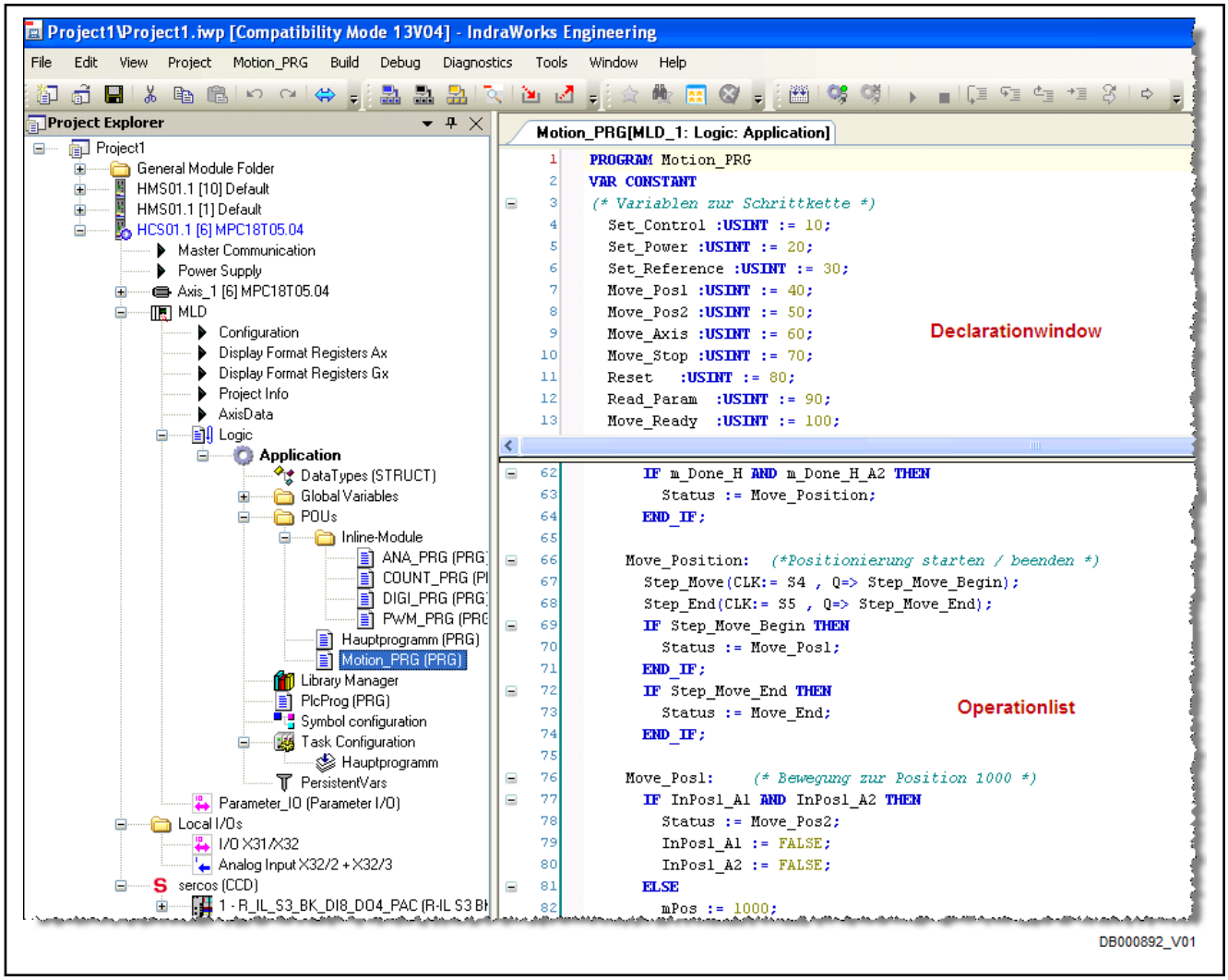


Fig.7-5: Address Range of the Main Window (Declaration Window and Operation List)

Including a Function Block Select a function block type

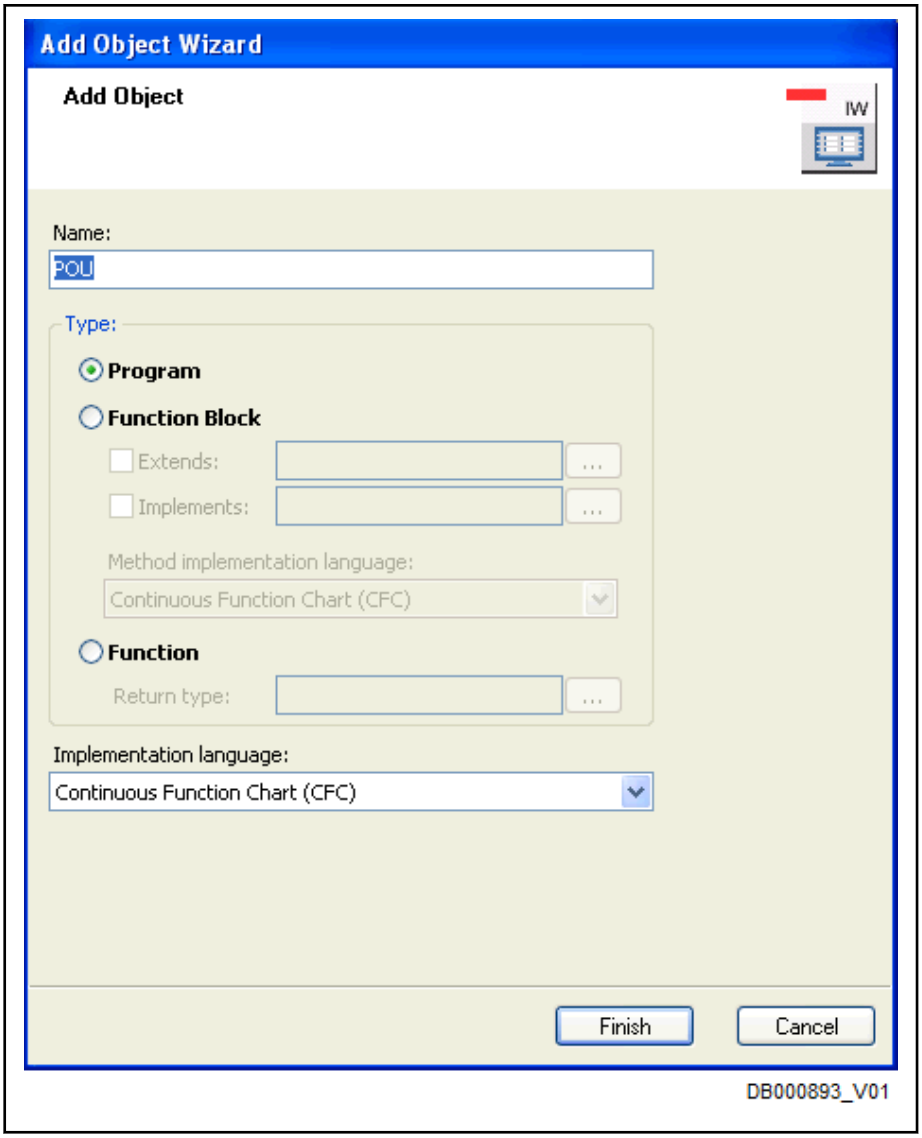


Fig.7-6: Including a Function Block

Changing the Task Configuration

Function blocks of the "programs (POU)" type must be assigned to tasks. The tasks determine, for example, on which time base and with which priority programs are called and processed.

Programming

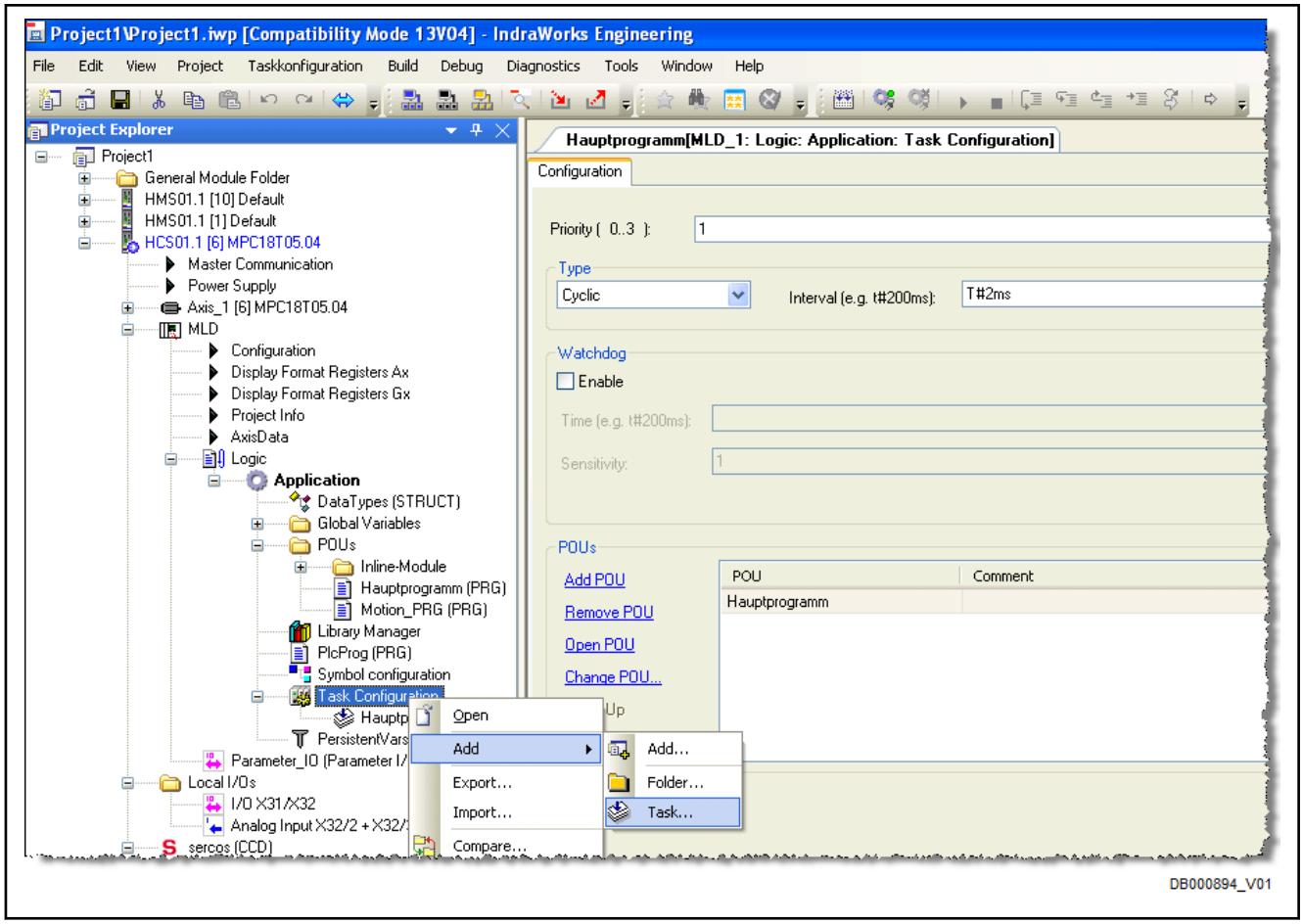


Fig.7-7: Task Configuration

7.2.2 Importing / Using an Existing Program

Project Import of Programs from MLD-1G

Monitoring Runtimes of the Project

IndraMotion MLD-2G requires more calculating time than the implementation of IndraMotion MLD-1G. With small projects, the performance of IndraMotion MLD-2G is lesser than the performance of IndraMotion MLD-1G. With big projects, the lesser performance is compensated by the more compact program code.

NOTICE	**After MLD-1G has been replaced by MLD-2G, the unused calculating time might possibly not suffice to process the MLD program.**

Before replacing MLD-1G by MLD-2G, check the runtimes of the project. With IndraMotion MLD-1G, the load should be smaller than 70%.

After MLD-1G has been replaced by MLD-2G, check again if the unused calculating time suffices to process the MLD program. With IndraMotion MLD-2G, the load should be smaller than 90%.

The easiest way to check the calculating time is by means of P-0-1364. The parameter is available in both versions and shows the unused calculating time.

The "MX_IECTaskGetLoad" function block provides a more precise analysis of the available time. In the "MX_IECTASKLOAD" structure, it contains runtime information of the task:

- "rLoad": Load of the task in the last cycle in percent in relation to the cycle time
- "rLoadMax": Maximum load of the task in percent in relation to the cycle time
- "rFreeTime": Unused calculating time of the task in µs since the last cycle until the next start of the task
- "RMinFreeTime": Minimum unused remaining calculating time of the task in µs until its next start

MLD-1G: The "MX_IECTaskGetLoad" function block can be found in the "MX_Base" library under **Tools**.

MLD-2G: The "MX_IECTaskGetLoad" function block can be found in the "MX_PLCopen" library under **POUs** ▸ **Tools**.

Target Settings

If a project is to be used that was already developed in MLD-1G, make sure to deactivate "Trace" in "Target Settings". If "Trace" remains activated, the PLC program cannot be imported.

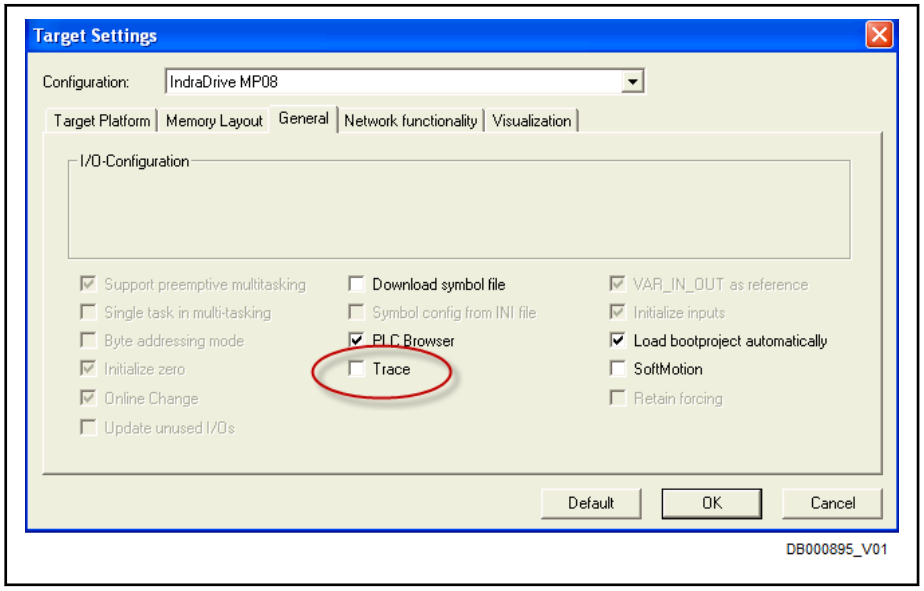


Fig. 7-8: Trace

Checking the Task System

The task system must be checked after the program was imported. IndraLogic MLD-2G supports different task systems:

- Freewheeling task

  Familiar behavior as in MLD-1G

- Event task

  With MLD-2G it is impossible to create a project with event-triggered tasks only. It is necessary to create at least one cyclic or freewheeling task.

- System events

  MLD-2G supports the following system events:

  – EVENT_START - when the PLC is started
  – EVENT_STOP - when the PLC is stopped

– EVENT_BEFORE_RESET - before a reset
– EVENT_AFTER_RESET - after a reset

When using system events, make sure that as little code as possible is processed. Event tasks other than the ones described have not been approved.

- PositionLoop Event

  The PositionLoop Event is available with the corresponding IW package (e.g. MLDPosLoopDevice_V18.5.4.0.iwpackage). The IW package with the PositionLoop Event can be subsequently installed; the ordinary installation contains the MLD package without the PositionLoop Event.

Project Import of Programs from MLD-2G

Existing programs that were already developed in MLD-2G can be imported:

1. In the IndraWorks Project Explorer, right-click "Application".
2. A context menu will open in which you must select **Data Import...**.

Replacing the Local Real-Time Channel

Introduction

The local real-time channel is not made available in MLD-2G; instead, the AxisData interface and synchronized tasks can be used in applications to replace applications with the real-time variables used in MLD-1G. See paragraphs below for information on how to replace the functionality.

With the local real-time channel, it was possible to use and process up to 4 actual values and command values. Today, the "AxisData" structure provides at least 4 configurable actual values / command values.

Configuration

The access to an actual value / command value via the local real-time channel had been implemented by means of RTC variables (RTC: **R**eal-**T**ime **C**hannel).

Program:

```
VAR
  My_P_0_0034: DINT;
  My_P_0_0055: DINT;
END_VAR

PROGRAM
  My_P_0_0034 := RtcR_P_0_0034;
  ...
  ... (* more program code *)
  ...
  RtcW_P_0_0055 := My_P_0_0055;
END_PROGRAM
```

By means of the "AxisData" structure, P-0-0034 must be configured as the actual value (e.g. `dwUserActualDataA_i`) and P-0-0055 as the command value (e.g. `dwUserCmdDataA_q`).

Program:

```
VAR
  My_P_0_0034: DINT;
  My_P_0_0055: DINT;
END_VAR

PROGRAM
  My_P_0_0034 := AxisData[1].dwUserActualDataA_i.DINT_;
  ...
```

```
  ... (* more program code *)
  ...
  AxisData[1].dwUserCmdDataA_q.DINT_ := My_P_0_0055;
END_PROGRAM
```

Timing Variants for Updating the Actual Values / Command Values

When a task in synchronism with master communication had been used, the same timing behavior is achieved by using the AxisData and the task in synchronism with master communication.

If no other settings had been made, the `RtcR_…` real-time channel inputs were synchronously read in at the beginning of the task, and after the periodic time of the task the `RtcW_…` real-time channel outputs were synchronously written.

By means of the "MX_SynchronControl" function block, it had been possible to control the point of time for writing the real-time channel outputs "RtcW variables".

In the following paragraphs, the individual timing variants are considered and information is given on the required measures resulting when the real-time channel variables are replaced by the "AxisData" structure.

Task in Synchronism with Master Communication

When a task in synchronism with master communication had been used, the same timing behavior is achieved by using the "AxisData" structure and the task in synchronism with master communication.

Task in Synchronism with CCD

When a task in synchronism with CCD had been used, the same timing behavior is achieved by using the "AxisData" structure and the task in synchronism with CCD.

Cyclic 1ms-Task

When a 1ms-task had been used, the same timing behavior results by using the "AxisData" structure. The program detail below shows how to check whether the task was processed within one cycle to write command values of the AxisData. (It is also possible to set the watchdog of the task accordingly, but in this case F6010 will be triggered.)

Program:

```
VAR
  My_P_0_0034: DINT;
  My_P_0_0055: DINT;
  tStartTime: TIME;
  boInit: BOOL;
END_VAR

PROGRAM

  IF NOT boInit THEN
    tStartTime := TIME();
    boInit := TRUE;
  ELSIF ( TIME() = tStartTime + T#1MS ) THEN
    (* read actual AxisData values *)
    My_P_0_0034 := AxisData[1].dwUserActualDataA_i.DINT_;
    ...
    ...
    tStartTime := TIME();
    ...
    ...
    (* write AxisData command values *)
    AxisData[1].dwUserCmdDataA_q.DINT_ := My_P_0_0055;
  ELSE
    (* watchdog *)
  END_IF

END_PROGRAM
```

Cyclic x-ms-Task

If the behavior of the local real-time channel with a cyclic x-ms-task (x>1) is to be emulated in MLD-2G, this must be solved on the programming level.

Programming

The example below explains how real-time data are transmitted in a 4ms-task. For this purpose, a 1ms-task (priority: 0) and a 4ms-task (priority: 1) must be created, the 1ms-task getting the higher priority. Furthermore, the following global variables are required.

Program:

```
VAR
  boFlagStartRtcTask: BOOL;
  boFlagEndeRtcTask: BOOL;
  tStartTime: TIME;
  uiTaskCounter: UINT;
  CmdDelay: INT := -1;
  CycleTime: UINT := 4;
  uiDelay: UINT;
  MyGlobActualValue_1: DINT;
  MyGlobCmdValue_1: DINT;
END_PROGRAM
```

Via the programs processed in the 1ms-task and the 4ms-task, the access to the AxisData structure is coordinated and the real-time channel behavior of the 4ms-task is thereby emulated.

1 ms-Task

```
IF( NOT boFlagStartRtcTask ) THEN
  MyGlobActualValue_1 := AxisData[1]...;
  uiTaskCounter := 0;
ELSE
  uiTaskCounter := uiTaskCounter + 1;
END_IF

CASE CmdDelay OF
  -1: uiDelay := CycleTime - 1;
   0: uiDelay := 1;
ELSE
      uiDelay := CmdDelay;
END_CASE

IF( uiTaskCounter = uiDelay ) THEN
  IF boFlagEndeRtcTask THEN

    boFlagStartRtcTask := FALSE;
    boFlagEndeRtcTask  := FALSE;
    IF CmdDelay <> 0 THEN
      AxisData[1]... := MyGlobCmdValue_1;
    END_IF
  ELSE
    (*Error! 4ms-task not yet finished!*)
  END_IF
END_IF
```

4 ms-Task

```
IF( NOT boFlagStartRtcTask ) THEN
  boFlagStartRtcTask := TRUE;
END_IF

  ...
  ...

IF( NOT boFlagEndeRtcTask ) THEN
  boFlagEndeRtcTask := TRUE;
  IF CmdDelay = 0 THEN
    AxisData[1]... := MyGlobCmdValue_1;
  END_IF
END_IF
```

The program running in the 4 ms-task sets a flag at the beginning and at the end. The program running within the 1 ms-task reads in the actual values of the AxisData until the `boFlagStartRtcTask` flag is set. When the `boFlagStartRtcTask` flag is set, the task counter `uiTaskCounter` is incremented.

When the "MX_SynchronControl" function block for controlling the real-time channel (e.g., delay when writing command values) had been used in a PLC program of MLD-1G, this can be emulated in MLD-2G via the global variable "CmdDelay".

The "CmdDelay" variable determines after which time the command values of the "AxisData" are to be written; we distinguish the following cases:

- "-1" (default value):

  The command values are transmitted at the latest possible point of time (corresponds to first position controller interrupt after task cycle time – 500 µs)

- "0":

  The command values are transmitted at the earliest possible point of time (first position controller interrupt after 500 µs after start of the task)

- "0" to "cycle time of task – 1 ms":

  The command values are applied with the next position controller interrupt after the start of the task + CmdDelay[ms]

The value of the cycle time of the task, in which the local real-time channel data are used, must be assigned to the "CycleTime" variable.

7.2.3 Specific Features of MLD-2G / Changes in Comparison to MLD-1G

Accessing sercos I/Os

In MLD-2G, sercos I/Os cannot be accessed via parameters. They must be configured via the "I/O configurator" by assigning the I/O addresses of the PLC inputs (P-0-1470.0.x) and PLC outputs (P-0-1471.0.x) to the sercos I/Os.

See also Application Manual "Rexroth IndraMotion MLD (2G) as of MPx18" (material number R911338914), chapter "Configuring the Inputs and Outputs (I/O Configuration of MLD)").

Syntax of the Direct Variables

After porting the user program in MLD-2G, the direct variables can be changed by global "Find and Replace".

Example:

"Find and Replace"

MLD-1G: `DV_P_0_1370 := DV_P_0_1371;`

MLD-2G: `DV_Axis[1].P_0_1370 := DV_Axis[1].P_0_1371;`

Better:

```
DV_Axis[AXIS_1].P_0_1370 := DV_Axis[AXIS_1].P_0_1371;
```

Write Protection of Parameters P-0-1410 to P-0-1429

If the parameters P-0-1410 to P-0-1429 had been write-accessed in a project of MLD-1G, PLC outputs must instead be defined and written in MLD-2G.

Example:

```
MyOutput0 : WORD AT %QB0;
```

instead of `DV_P_0_1410`

```
MyOutput1 : WORD AT %QB2;
```

instead of `DV_P_0_1411`

The corresponding access to the process image must be changed to writing PLC outputs.

Assigning Different Data Types

When different data types are used, a warning is generated during the compilation run - the project is operable after the compilation.

Example:

Program:

```
diLagesollwert2 :DINT;
rLageistwert2 :REAL;
rLagedifferenz2 :REAL;
```

Warning is generated:

```
rLagedifferenz2 := diLagesollwert2 - rLageistwert2;
```

Correct:

```
rLagedifferenz2 :=
DINT_TO_REAL(diLagesollwert2) - rLageistwert2;
```

Remove the warning by converting data types, e.g.

- INT_TO_WORD
- DINT_TO_REAL etc.

Calling Function Blocks or Their Methods with the Function Block Type

If function blocks or their methods are called with the function block type, an error is generated during the compilation run.

As a remedy, instance the function block or call it without a prefix within the function block.

Example:

`MX_PID_ControllerPL.Init_Regler();` (→causes error)

`Init_Regler();` (→error-free)

Functions with Dummy Arguments

With MLD-1G: Functions cannot be programmed without parameter; a parameter must be set, but is not used.

With MLD-2G: Functions can be programmed **without** parameter.

7.3 Step 10: Load and Activate the Program

7.3.1 Loading the Program

In IndraWorks MLD, execute the **Debug ▸ Login** menu command to log in. Confirm the following confirmation prompt with "Yes" to load the PLC program to the drive.

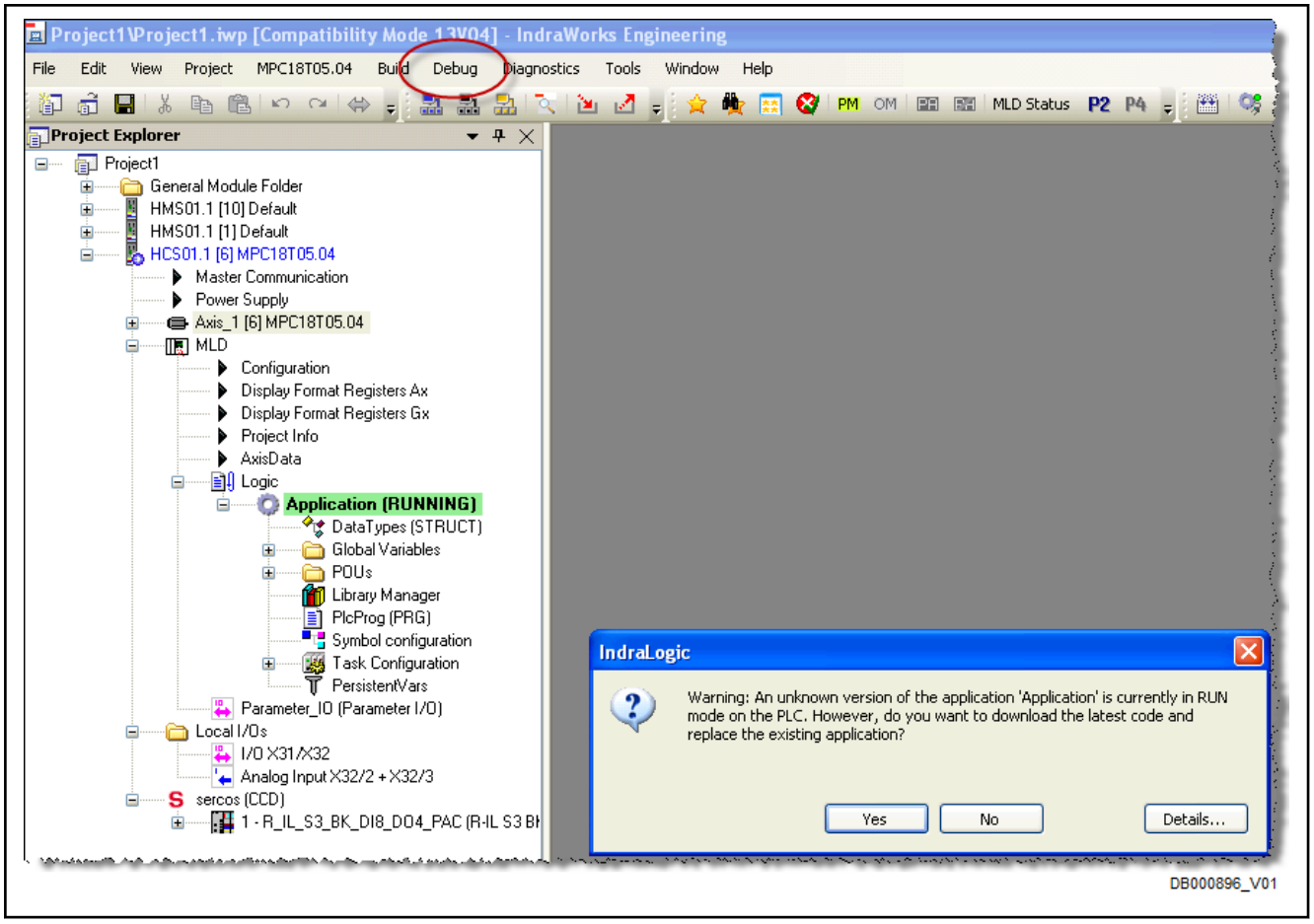


Fig.7-9: Loading the Program

7.3.2 Starting the Program

The PLC program can be started via the **Debug** ▸ **Start** menu command or the "IndraLogic" toolbar.

Programming

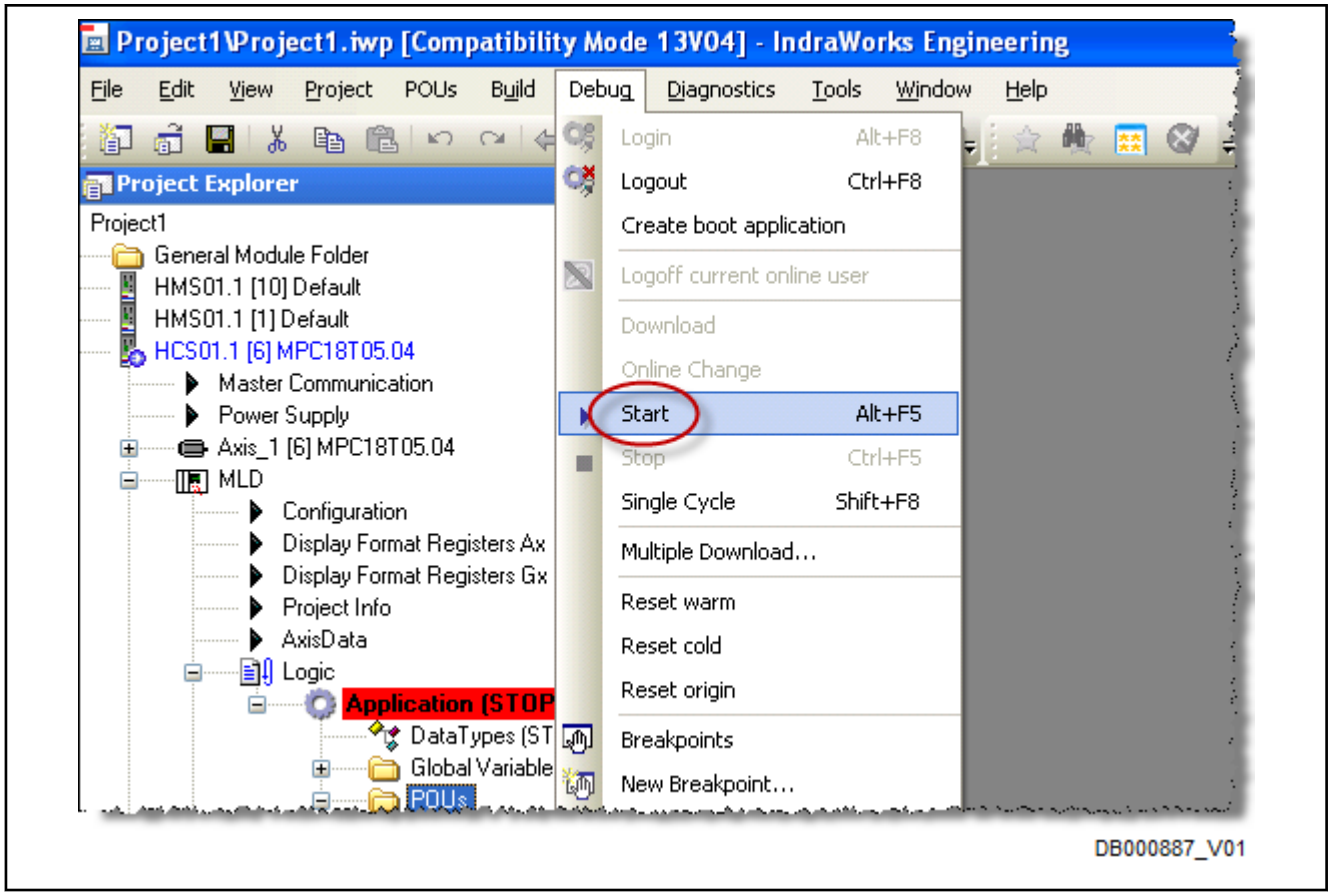


Fig.7-10: Starting the Program

When the program is running, the red background color of "Application" to be seen on the screenshot changes to green.

7.3.3 Creating a Boot Project

In order that the project is written to the drive in stored form, it must be stored as a boot project. Thus, the boot project will be available after the drive has been switched off and on again.

When a project is loaded, the loading of the boot project is automatically set. These settings can be changed in the context menu of the "Application" branch under the "Properties" menu.

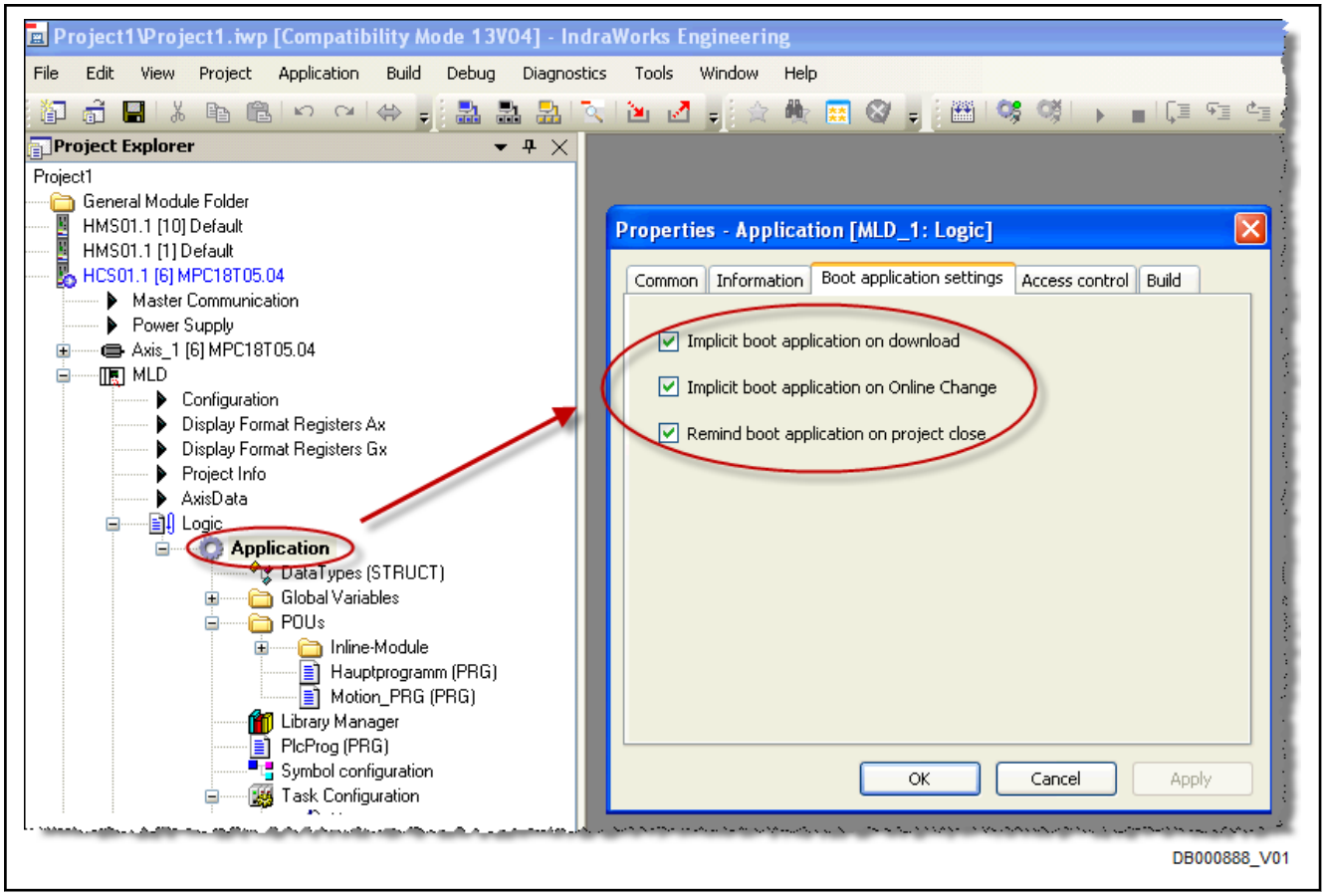


Fig.7-11: Boot Project Settings

7.4 Step 11: Test the Program

7.4.1 Online Display

In running operation, variables can be once set to a certain value (**Online ▸ Write Values**) or written again with a certain value after every cycle (**Online ▸ Force Value**).

In online operation, variable values can be changed by double-clicking the variable. Boolean variables thereby change from "TRUE" to "FALSE" or vice versa; for all other variables there is a dialog in which the value can be forced or the forcing can be canceled.

7.4.2 Monitoring Variables with Sampling Trace

With sampling trace, the PLC variables can be monitored and evaluated in their chronological contexts (available as of IndraWorks MLD 13V06).

7.4.3 Oscilloscope Function

The oscilloscope function can be used to record drive-internal and external 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.

In preparation: In the future, it will be possible to include PLC variables in an oscilloscope recording.

Programming

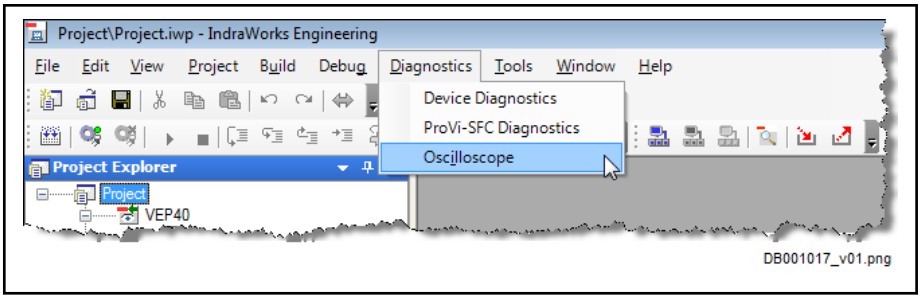


Fig.7-12: Starting the Oscilloscope Function

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Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances resulting in the malfunction
- Type plate name of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your email address)

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Notes

Rexroth
Bosch Group

Bosch Rexroth AG
Electric Drives and Controls
P.O. Box 13 57
97803 Lohr, Germany
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr, Germany
Tel. +49 9352 18 0
Fax +49 9352 18 8400
www.boschrexroth.com/electrics

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