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

Rexroth
Bosch Group

Rexroth IndraMotion MTX micro Easy setup for Standard Turning and Milling Machines

R911332281
Edition 04

Commissioning Manual

Title Rexroth IndraMotion MTX micro
Easy setup for Standard
Turning and Milling Machines

Type of Documentation Commissioning Manual

Document Typecode DOK-MTXMIC-EASY*******-CO04-EN-P

Internal File Reference RS-2108e8095cde7adf0a6846a0017a754a-1-en-US-2

Purpose of Documentation This documentation gives an overview of the components of the IndraMotion MTX micro control system and supports the initial commissioning with handling instructions and examples.

Record of Revision

Edition	Release Date	Notes
120-1450-B302/EN -01	07.2009	First edition not pusblished
120-1450-B302/EN -02	12.2009	Revision of all chapters
120-1450-B302/EN -03	07.2010	Revision of all chapters
120-1450-B310/EN -04	09.2010	Replacement for DOK-MTXMIC-EASY****V10-COxx-EN-P, R911330706

Published by Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2 ■ 97816 Lohr a. Main, Germany
Phone +49 (0)93 52/ 40-0 ■ Fax +49 (0)93 52/ 40-48 85
http://www.boschrexroth.com/
Systementwicklung Werkzeugmaschinen, PeSc (SyMu/PiGe)

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

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1 System Overview

1.1 Introduction

IndraMotion MTX micro is the most cost-effective complete solution of the MTX series, combining the CNC, MotionControl and PLC functionalities in a single system. HCT02 for 3-axis applications and HCQ02 for 4-axis applications are compact hardware units which incorporate control and drive controller assemblies. All HMI functions are executed and displayed via the VDP80 control panels.

Fig.1-1: MTX micro - summary

The MTX micro can be specified as turning machine (with VDP80.1FAN-.. control panel) or as milling machine (with VDP80.1FBN-.. control panel). The panels feature special machine-type-related functions, e.g., a built-in handwheel (turning machine) or override switches for spindle and feed (milling machine). The display size and axis configurations are adjusted to these applications so that the following solutions can be offered at optimal costs:

System Overview

1.2 Performance of the Control System

CNC key data

Hardware	HCQ02	HCT02
Processor type	32 bits / 500 MHz	32 bits / 500 MHz
RAM memory	64 Mbytes	64 Mbytes
CF card	128 MB	128 MB
IPO cycle time	4 ms	4 ms
CNC channels	2	2
Interpolating axes	4	3
Spindle / c-axes	2	1
USB port (on VDP)	Available	Available
Ethernet (TCP/IP)	Available	Available

Fig.1-2: CNC features of MTX micro-c

PLC key data

Hardware	HCQ02	HCT02
PLC tasks	1	1
PLC cycle time	20 ms	20 ms
PLC processing time per instruction	0.03 µs	0.03 µs
Digital I/Os (on board)	32 I /16 O	32 I /16 O
Digital I/Os (optional)	64 I /32 O	64 I /32 O
Digital I/Os (HMI)	256 I /96 O	256 I /96 O
Output current (per output)	24 V DC/500 mA	24 V DC/500 mA
Programming (IEC61131)	IL, LD, ST, FBD, SFC	IL, LD, ST, FBD, SFC
Programming via HMI (LD only)	in preparation	in preparation

Fig.1-3: PLC features of MTX micro-c

Drive key data

Hardware	HCQ02	HCT02
SERCOS axes (incl. spindles)	4	3
SERCOS spindles	2	1
Multi-encoder interfaces (ES)	5	4
Max. main spindle power	11 kW	11 kW
Max. torque of servo axes	17 Nm/12 Nm/12 Nm	12 Nm/12 Nm
Voltage supply (with direct U_{LN} connection)	200...500 V	200...500 V
Max. power	25 kW	25 kW
Regenerative	No	No
Ext. braking resistor	Available	Available

Fig.1-4: Drive features of MTX micro-c

1.3 4-axis Configuration - for the Classical Milling Machine

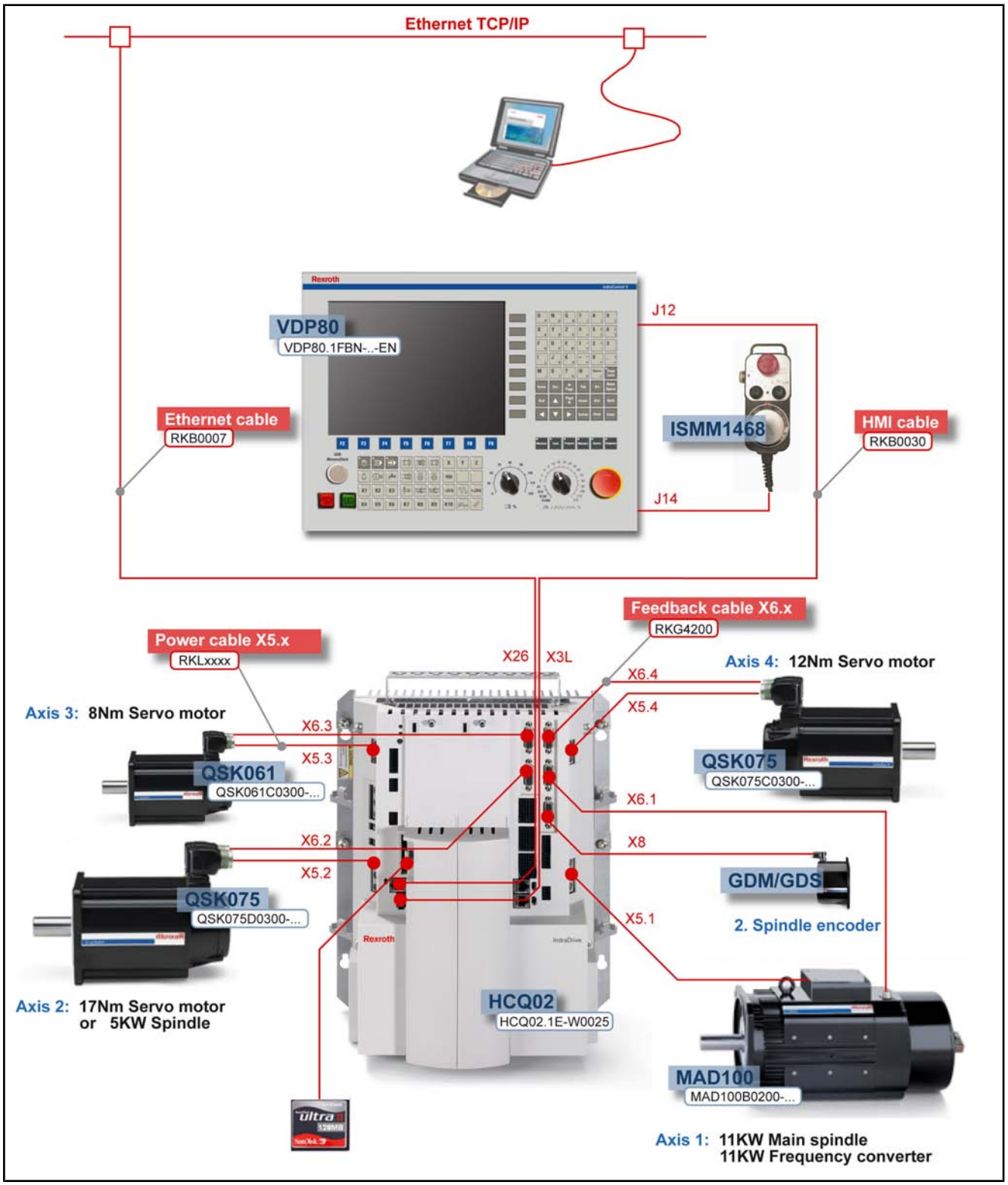


Fig. 1-5: Components of a 4-axis configuration

System Overview

1.4 3-axis Configuration - for the Classical Turning Machine

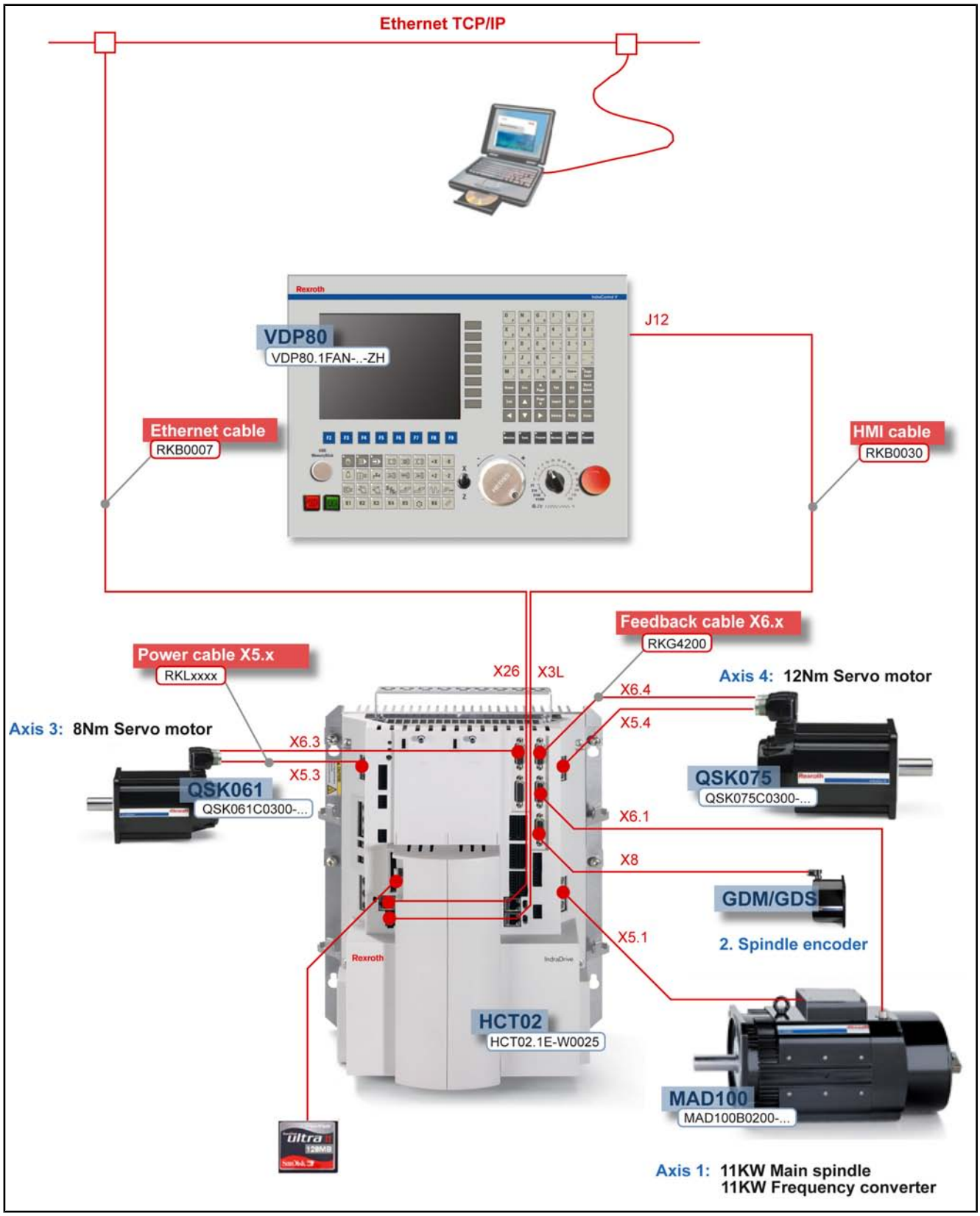


Fig.1-6: Components of a 3-axis configuration

2 Important Instructions for Use

2.1 Appropriate Use

2.1.1 Introduction

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

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

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

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

- Personnel that in a way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in the original state, in other words, no structural changes are permitted. It its not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

2.1.2 Areas of Use and Application

The Rexroth IndraMotion MTX control is used to

- Programming contour and machining technology (feedrate, spindle speed, tool change) or a workpiece.
- Guiding a machining tool along a programmed path.

Feed drives, spindles and auxiliary axes of a machine tool are activated via SERCOS interface.

☞ This additionally requires I/O components for the integrated PLC which, in combination with the actual CNC, controls the machining process as a whole and also monitors this process with regard to technical safety.

The unit may be operated only with the explicitly specified hardware component configurations and combinations and only with the software and firmware specified in the appropriate documentations and functional descriptions.

The Rexroth IndraMotion MTX has been developed for control tasks in multi-axis installations.

Typical applications are:

- lathes
- milling machines

- machining centers

2.2 Inappropriate Use

Using the Rexroth IndraMotion MTX outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as "inappropriate use".

The Rexroth IndraMotion MTX may not be used if ...

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extreme maximum temperatures or if
- Bosch Rexroth has not specifically released Rexroth IndraMotion MTX for that intended purpose. Please note the specifications outlined in the general safety instructions!

3 Safety Instructions for Electric Drives and Controls

3.1 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: User Guide, Operation Manual, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Manual, 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.

3.2 General Information

3.2.1 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 Bosch 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.

3.2.2 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.

- Bosch 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 Bosch 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 Technology". 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)

3.2.3 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!

Safety Instructions for Electric Drives and Controls

- 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!

3.3 Instructions with Regard to Specific Dangers

3.3.1 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)	-
...	...	...

Fig.3-1: Minimum Cross Section of the Equipment Grounding Connection

3.3.2 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 Bosch Rexroth, all connections and terminals with voltages between 5 and 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.

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 Bosch Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV ("Protective Extra-Low Voltage").

3.3.3 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 equipment 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.

3.3.4 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.

3.3.5 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.

3.3.6 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!

3.3.7 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.

Safety Instructions for Electric Drives and Controls

3.3.8 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.

3.4 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 Z535.6-2006).

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.

⚠ 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.

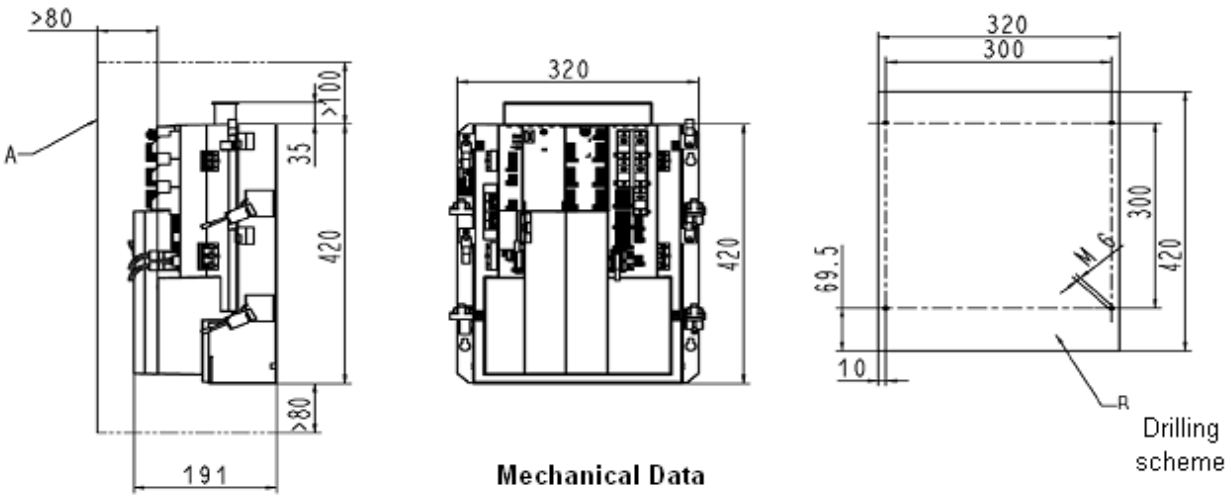
Safety Instructions for Electric Drives and Controls

NOTICE

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

4 Selecting and Connecting the Hardware

4.1 HCT02/HCQ02

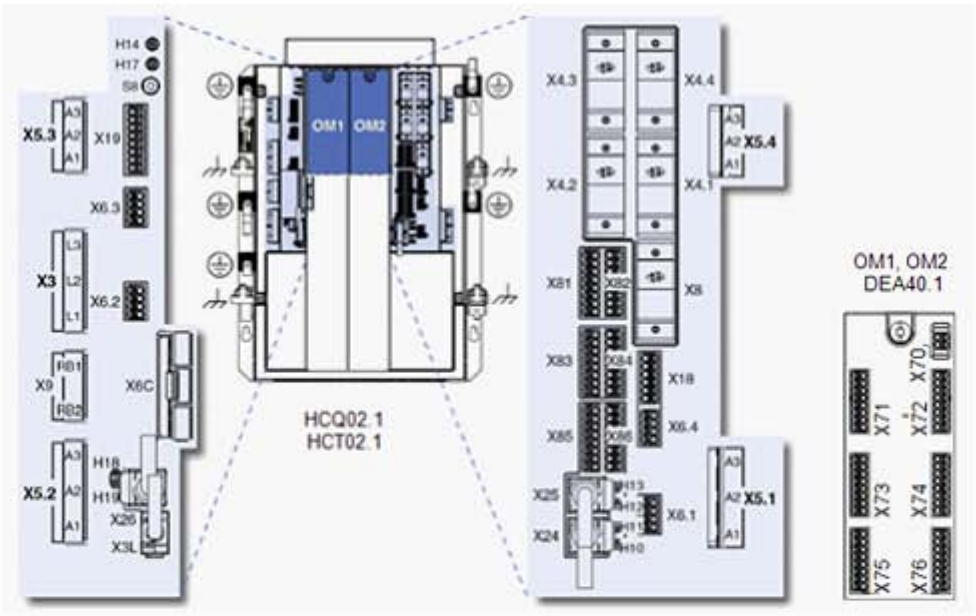


Mechanical Data

Electrical Data	Symbol	HCQ02.1E-W0025-_-03 HCT02.1E-W0025-_-03			
		Axis 1	Axis 2 [1)]	Axis 3	Axis 4
3-Phase Rated Input Voltage U_{LN} (TT,TN-C,TN-S,IT Networks)	V	200..500±10%			
Rated Frequency f	Hz	50..60±2Hz			
Mains Connection Power S_{LN} with Mains Choke	kVA	30			
Rated Input Current IL_{cont}	A	44			
Rated Output Power P_{cont} with Mains Choke	kW	25			
Mains Choke Type	-	HNL01.1E-400-N0051-A-480-NNNN			
Mains Fuse according to IEC 60364-5-52; with Mains Choke	A	63; gL			
Nominal Current AC1 for Mains Contactor with Mains Choke	A	44			
Required Wire Sizes according to IEC 60364-5-52 / UL 508	mm² AWG	10 AWG 8			
Switching Frequencies f_s	kHz	4, (8)			
Maximum Output Voltage U_{out_eff}	V	~0,71*U_{DC}			
Output Frequency Range at fs = 4 kHz	Hz	0..400			
Maximum Output Current at fs = 4 kHz, 400ms	A	55,0	50,0	27,0	27,0
Continuous Output Current at fs = 4 kHz	A	32,0	20,0	14,0	14,0

Fig.4-1: Technical data of HCx02 hardware units

Selecting and Connecting the Hardware



Connector	Pins	Function	
X3	3	Power supply (3 phas. AC. 400V, 50Hz)	
X4.1-X4.4	15	Encoder evaluation (X4.1 ► Axis 1, X4.2 ► Axis 2...)	X4.2 without HCT
X5.1-X5.4	3	Motor connection (X5.1 ► Axis 1, X5.2 ► Axis 2...)	X5.2 without HCT
X6.1-X6.4	4	Motor temperature monitoring & motor holding brake (X6.1 ► Axis 1, X6.2 ► Axis 2...)	X6.2 without HCT
X8	15	Optional encoder evaluation	
X9	2	Ext. brake and charging resistor	
X18	6	24V power supply for control, "on Board" IO's and motor brake	
X19	8	Actuation of DC link short circuit, Bb-contact	
X24	8	SERCOS III Master activation 1	
X25	8	SERCOS III Master activation 2	
X26	8	RJ-45 Ethernet Interface	
X81-X86	8	Digital "on board" inputs and outputs (32 inputs/ 16 outputs)	
X3L	8	HMI interface (LVDS + USB)	
X6C	-	Slot for CF memory card	
H14	-	Drive diagnostics LED	
H17	-	System diagnostics LED	
H18,H19	-	Ethernet diagnostics LEDs	
S8	-	System reset probe	

OM1, OM2 DEA40.1	Description	Data
X70	Power supply	24V±20%, 4A max.
X71	16 digital outputs	8 x 24V/0,5A, 2A max. in total
X72		8 x 24V/0,5A, 2A max. in total
X73	32 digital inputs	8 x 24V
X74		8 x 24V
X75		8 x 24V
X76		8 x 24V

Fig.4-2: HCx02 pin assignments and DEA40.1 optional module

⚠ WARNING **Temperatures above 105 °C will cause material damage!**

Please keep the minimum distances specified!

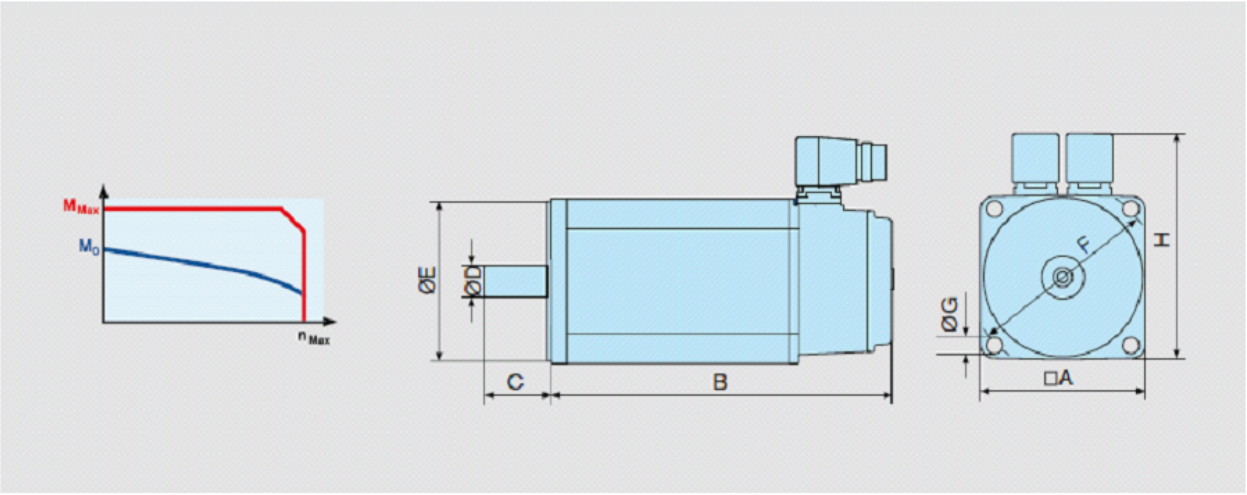
Materials present above the devices may only be materials which

- are incombustible and
- are insensitive to the high temperature that occur.

Selecting and Connecting the Hardware

4.2 Motors

4.2.1 QSK



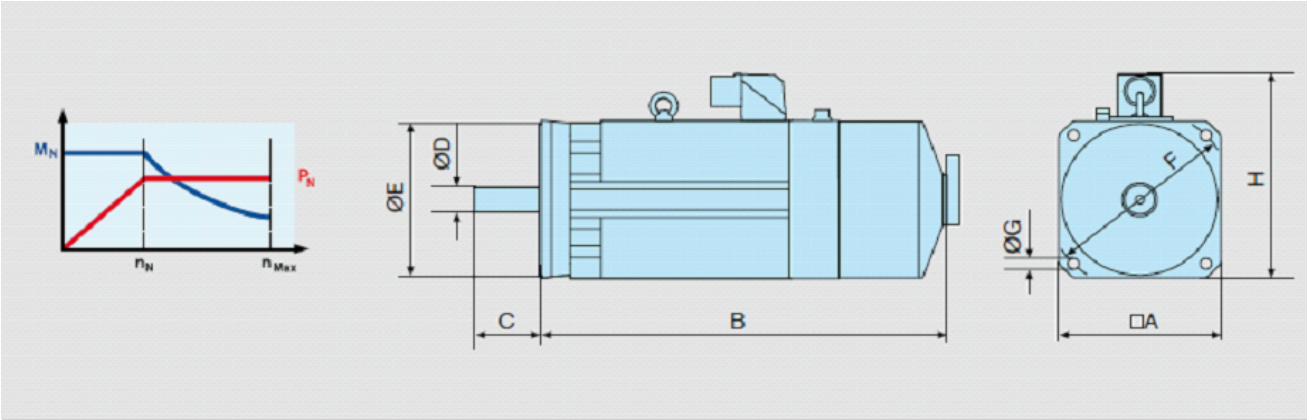
QSK Servomotor		Mechanical Data								
		Moment of Inertia	Flange	Motor Length	Shaft Length	Shaft Diameter	Pitch Circle Diameter	Pitch Circle	Boring	Total Height
		J_R	□A	B	C	Ø D	Ø E	Ø F	Ø G	H
		[kgm²]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
QSK061	B-0300	0,000440	116	235	40	19	95	130	9	156
	C-0300	0,000752		264						
QSK075	C-0300	0,003520	140	307	58	32	130	165	11	202
	D-0300	0,004900		347						

QSK Servomotor		Options		Electric Data					
		Encoder	Brake	Maximum Speed	Standstill Torque	Maximum Torque	Standstill Steady Current 60°C	Nominal Current	Maximum Current
		Single turn (S5)	without (UG0)	n_{Max}	M_0	M_{Max}	$I_{0\text{-}60(eff)}$	I_N	$I_{max(eff)}$
		Multi turn (M5)	with (UG1)	[min^{-1}]	[Nm]	[Nm]	[A]	[A]	[A]
QSK061	B-0300	S5	UG0	3000	3,5	14,0	2,1	5,2	9,4
		M5							
		S5	UG1						
		M5							
	C-0300	S5	UG0		8,0	32,0	4,3	4,3	19,4
		M5							
		S5	UG1						
		M5							
QSK075	C-0300	S5	UG0	3000	12,0	44,0	8,4	8,2	37,8
		M5							
		S5	UG1						
		M5							
	D-0300	S5	UG0		17,0	66,0	11,4	11,4	51,3
		M5							
		S5	UG1						
		M5							

Order Information			
QSK061B-0300-NN-XX-YYY-NNNN	XX	S5	Single turn encoder
		M5	Multi turn encoder (absolute via ± 2048 revolutions)
	YYY	UG0	Without engine brake
		UG1	With engine brake (electrical, 24V DC)

Fig.4-3: Technical data of QSK servo motors

4.2.2 MAD



MAD Spindle Motor		Mechanical Data								
		Inertia Torque	Flange	Motor Length	Shaft Length	Shaft Diameter	PCD	Pitch Circle	Boring	Total Height
		J_R	□A	B	C	Ø D	Ø E	Ø F	Ø G	H 1)
		[kgm²]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
MAD100	B-0150	0,0190	192	533	60	32	130	215	14	277
	B-0200									
	C-0150	0,0284		608						
	C-0200									
	D-0150	0,0392		683						
	D-0200									
MAD130	B-0100	0,0840	260	610	110	42	250	300	18	345
	B-0150									

MAD Spindle Motor		Electric Data								
		Rated Power	Rated Speed	Maximum Speed	Rated Torque	Torque at n1	Maximum Torque	Rated Current	Current for Reaching Mn1	Maximum Current
		P_N	n_N	n_{Max}	M_N	M_{n1}	M_{max}	I_N	I_{n1}	$I_{max(eff)}$
		[kW]	[min⁻¹]	[min⁻¹]	[Nm]	[Nm]	[Nm]	[A]	[A]	[A]
MAD100	B-0150	40363,0	1500	9000	30	31	68	40433,0	40310,0	40321,0
	B-0200	40426,0	2000	11000	28	30	66	40343,0	40252,0	40449,0
	C-0150	40305,0	1500	9000	48	50	110	40378,0	40257,0	39,0
	C-0200	40277,0	2000	11000	45	48	106	40384,0	40385,0	47,3
	D-0150	40246,0	1500	9000	59	64	141	40354,0	40416,0	47,6
	D-0200	40248,0	2000	11000	54	59	130	27,2	40387,0	52,7
MAD130	B-0100	40308,0	1000	6000	100	110	230	40447,0	40387,0	53,7
	B-0150	40281,0	1500	9000	85	95	200	34,9	37,4	71,0

Order Information			
MAD100C-0150-SA-S2-**X**H0-**YY**-N1		SA	Axial fan
		S2	Singleturn encoder (EnDat) 2048 incr.
	X	F	Terminal box, A-side
		K	Terminal box, B-side
		T	Terminal box, left
		S	Terminal box, right
		H	Smooth shaft without sealing ring
		0	Without holding brake
	YY	05	Flange mounting
		35	Flange or base mounting

Fig.4-4: Technical data of MAD spindle motors

Selecting and Connecting the Hardware

4.3 Connecting Cables

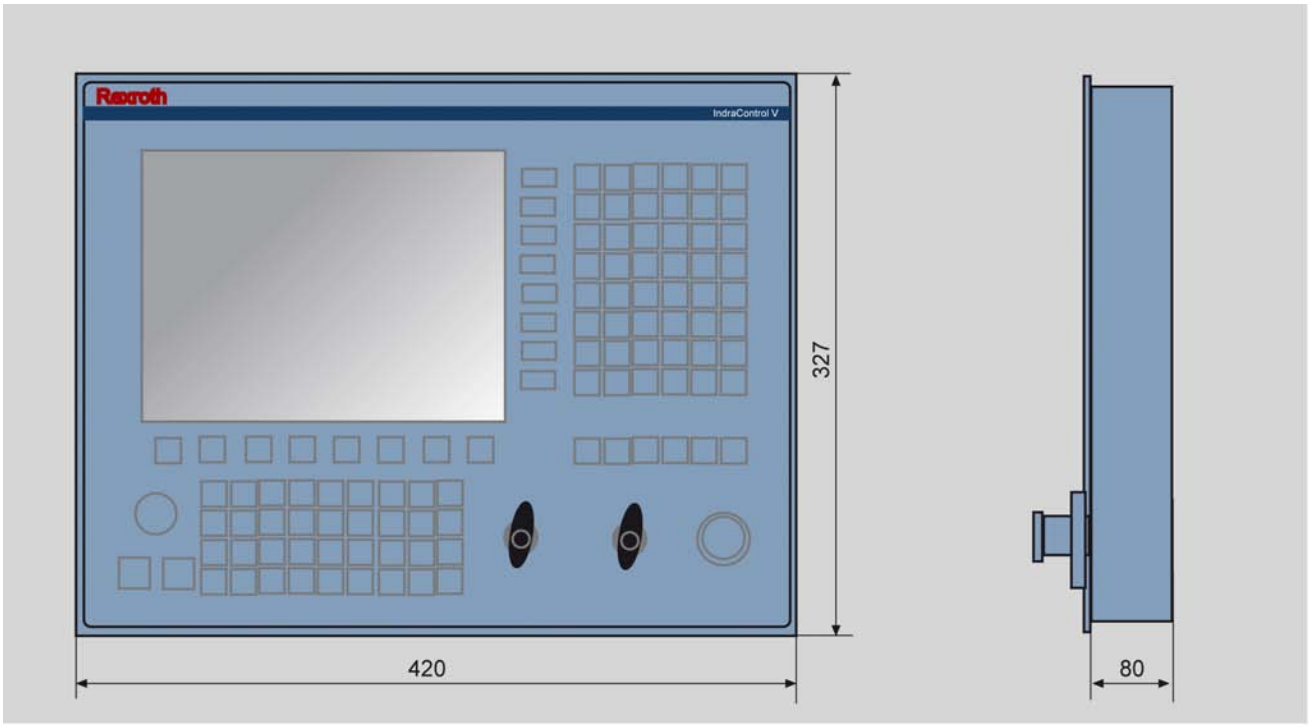
Motor		Power Cable	Cable Type	Cross Section	Encoder Cable
QSK061	B-0300	RKL0020		1.0mm²	
	C-0300			1.0mm²	
QSK075	C-0300	RKL0022		1.5mm²	
	D-0300			1.5mm²	
	E-0300			1.5mm²	
MAD100	B-0150	RKL0024		1.5mm²	RKG4200
	B-0200			1.5mm²	
	C-0150	RKL0025		2.5mm²	
	C-0200	RKL0026		4.0mm²	
	D-0150			4.0mm²	
	D-0200			4.0mm²	
MAD130	B-0100	RKL0031		4.0mm²	
	B-0150	RKL0032		6.0mm²	

Encoder Cable	Encoder Types
RKG4200	Rexroth encoder types - M1,S1,M2,S2,M5,S5
RKG0035	Sine encoder, 1Vpp, 5V
RKG0036	Digital encoder EnDat2.1, 5V, Heidenhain

Fig.4-5: Motor cable assignment for power connection

4.4 HMI Control Panels

4.4.1 VDP80.1FBN-C1-NN-EN for Milling Machines



Electrical Data	
Screen Size	10,4”
Display Resolution	640x480px
Handwheel	ext. connectable (ISMM1468)
OP Menu Keys	6
MOP Keys	38
Override Switch	Spindle and Feed
USB 2.0	Front Panel
Protection Type	IP54
Power Supply	24V DC / 36W

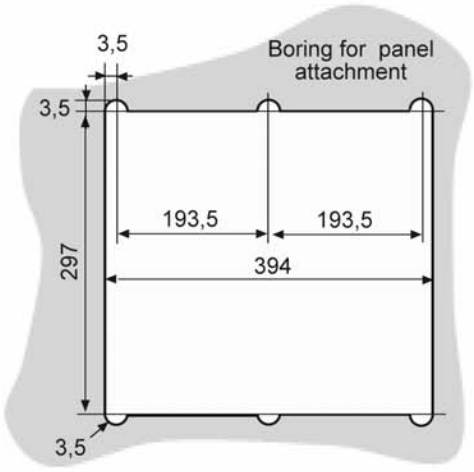
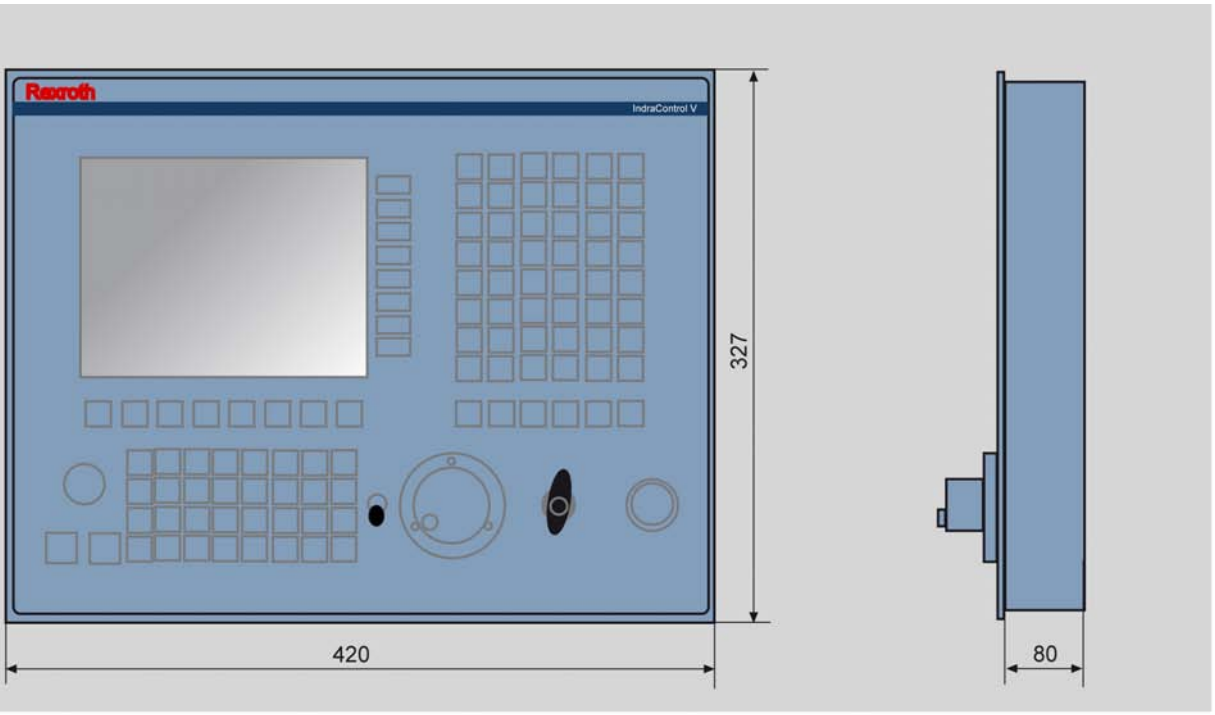


Fig.4-6: Technical data of the VDP80.1FBN-C1-NN-EN control panel

Selecting and Connecting the Hardware

4.4.2 VDP80.1FAN-C1-NN-EN for Turning Machines



Electrical Data	
Screen Size	8,4”
Display Resolution	640x480px
Handwheel	1x on board, + ext. connectable (ISMM1468)
OP Menu Keys	6
MOP Keys	34
Override Switch	Feed
USB 2.0	Front Panel
Protection Type	IP54
Power Supply	24V DC / 36W

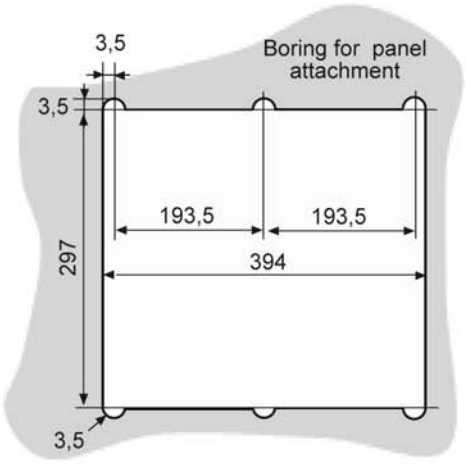


Fig.4-7: Technical data of the VDP80.1FAN-C1-NN-EN control panel

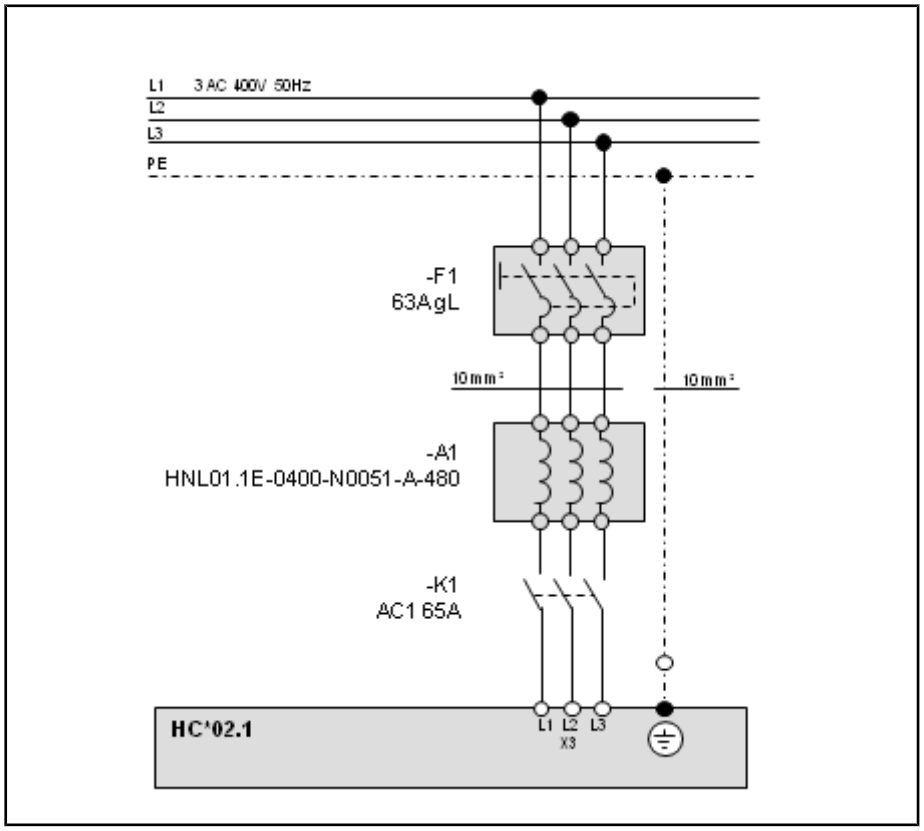
The control panels can be delivered with English labeling (e.g. VDP80.1FAN-C1-NN-EN) or with Chinese labeling (e.g. VDP80.1FAN-C1-NN-ZH).

4.5 Selecting and Connecting the Hardware

4.5.1 Configuration Instructions

Power Connection

The HCQ02 or HCT02 is directly connected to the external power supply via terminal X3. The allowed line voltage range is 200..500 V ULN. The allowed line frequency range is 50..60 Hz. Any other values specified below refer to the typical case of connection to a power supply network of 3 AC 400 V, 50 Hz.



-F1: Line fuse
-A1: HNL line reactor
-K1: Line contactor
Fig.4-8: Power supply connection for HCQ/HCT

- The cross-section required for connection to the power supply network is 10 mm².
- The cross-section required for connection of the protective conductor is also 10 mm² (also see "Grounding").
- Strain relief must be provided for the connection terminals (X3). The necessary HAS02 connecting accessories are available.
- The line fuse must be designed with 3 phases, with 63 A gL for each phase. We recommend that you use a motor protecting switch with a tripping current of 65 A.
- The HNL01.1E-0400-N0051-A-480 line reactor must be used to protect the power supply.
- The line contactor must be designed for a rated current of AC1 65 A.

Selecting and Connecting the Hardware

Network Types

Direct three-phase connection of the HCQ02 and HCT02 devices is allowed to the following network types:

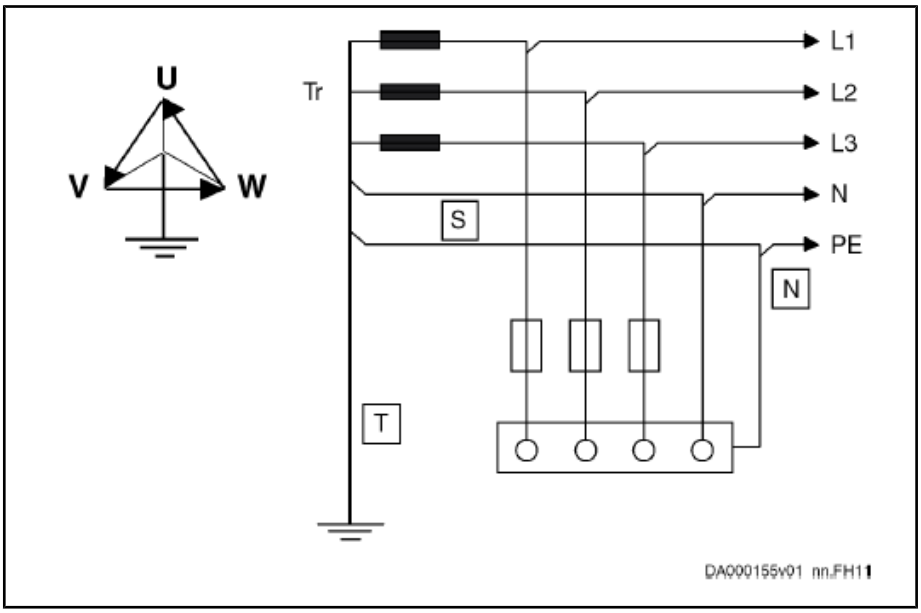
- TN-S, TN-C

Under certain circumstances, the devices can also be connected to the following network types:

- TT
- IT
- Networks with grounded outer conductor (corner-ground delta networks)

TN-S network

The TN-S network type is the usual network type in Europe. The HCQ and HCT devices can be directly connected to the TN-S network.

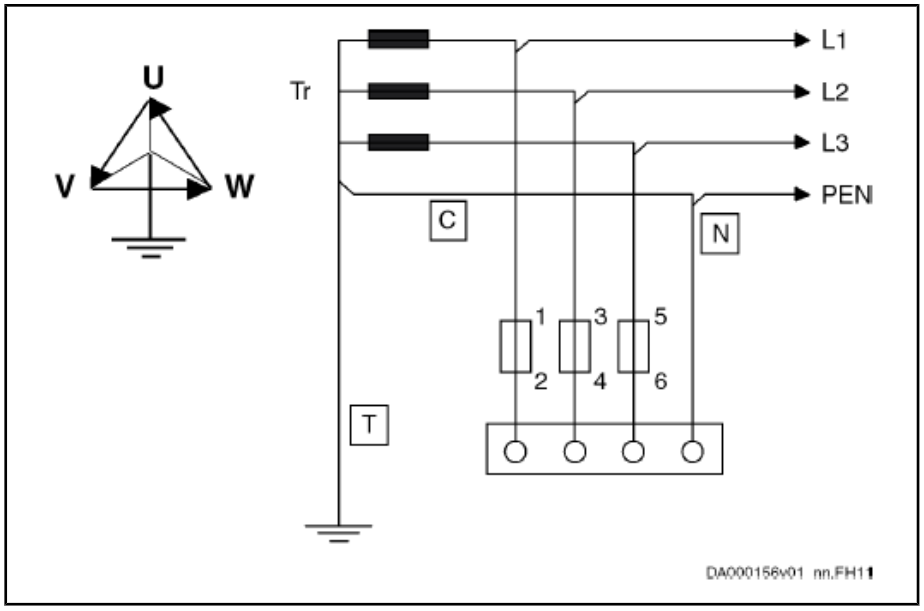


T: Direct grounding of a point (signal ground)
N: Body directly connected to the signal ground
S: Separate neutral conductor and protective conductor in the entire network

Fig.4-9: TN-S network type

TN-C network

This network type is characterized by a common neutral and protective conductor (C). The HCQ and HCT devices can be directly connected to the TN-C network.



T: Direct grounding of a point (signal ground)
N: Body directly connected to the signal ground
C: Functions of neutral and protective conductors in the entire network combined in a single conductor, i.e., the PEN conductor

Fig.4-10: TN-C network type

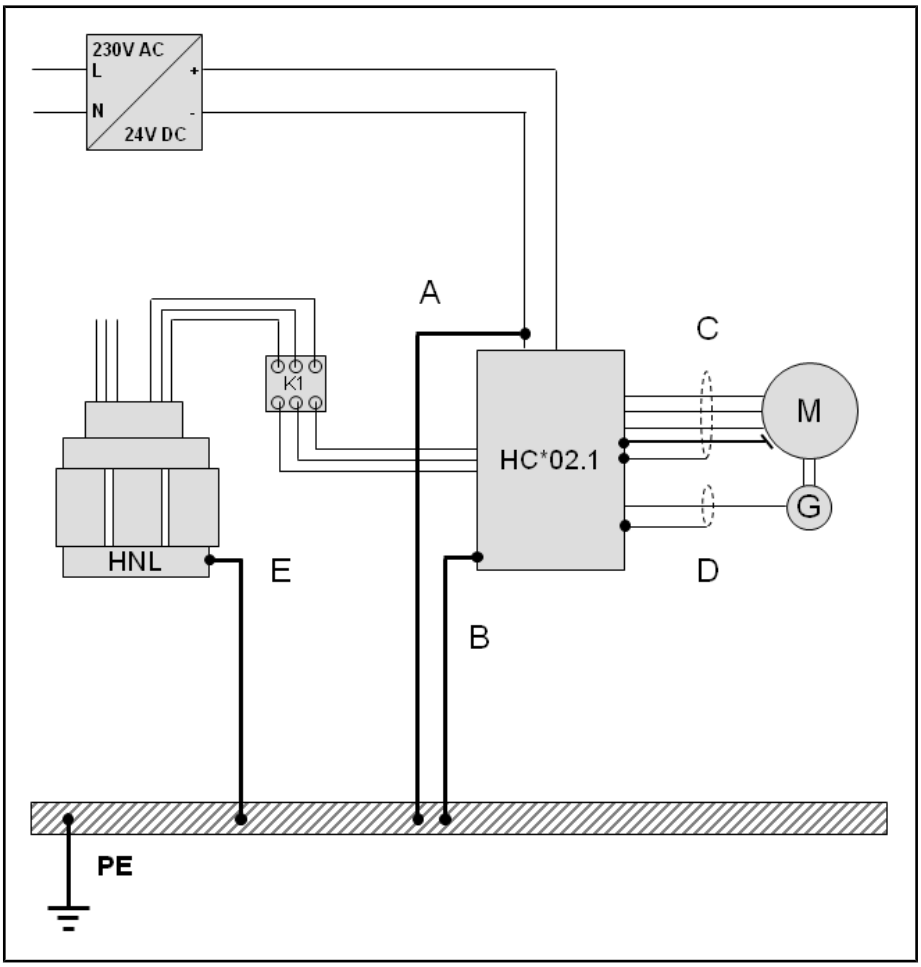
We strongly recommend that you connect the devices to TN networks. Please contact us if you prefer connection of the devices to a TT network, an IT network or a network with grounded outer conductor.

For more information about this subject, please refer to the project planning instructions on IndraDrive (DOK-INDRV*-SYSTEM*****-PR04-EN-P).

Selecting and Connecting the Hardware

Grounding Concept

In order to prevent faults in the electronic circuits and to ensure protection against contact, the MTX micro system may only be operated if it is grounded as described here.



A	The 24-V control voltage should be grounded (at 0 V) as closely to the drive controller as possible in order to ensure that the impedance to the ground of the drive controller is as low as possible.
A	The connection of the 0-V terminals of the control voltage to the housing potential is conductive. That is why it is not possible to use an insulation monitoring feature at +24 V and 0 V against the housing.
B	Establish a conductive connection of the bare metallic mounting rails of the HCQ controller to the mounting surface in the control cabinet.
B	Establish a conductive connection of the mounting surface to the protective conductor system.
C, D	Only use shielded motor and encoder cables for the MTX micro. We strongly recommend that you use Rexroth RKL and RKG cables.
A-E, PE	Connect all grounds and protective conductors to a common star point in the control cabinet along routes that are as short as possible.

Fig.4-11: MTX micro grounding concept

External Resistor

The external resistor (connected to terminal X9) is used to limit the charging current when the line voltage is turned on. After the turn-on, the resistor is used as braking resistor. The following resistors are available for use with the MTX micro-c:

- HLR01.1N-0470-N11R7-A-007-NNNN (R911305932)

Technical data are specified in the Annex.

- It is not allowed to operate the HCQ02 without any external resistor.
- The line cross-section required for connecting the external resistor is 6 mm².
- Only use shielded or twisted lines for connecting the external resistor.
- The lines must be designed for a load of 630 V, 32 A DC peak, 15 A DC effective.
- The maximum line length is 5 m.
- It must be ensured that the line voltage is turned off after the drives have stopped if there is a DC bus short-circuit (24-V drop at input X19.1 (DC bus voltage)). Otherwise, the external resistor may be destroyed. This is ensured by the circuit examples shown herein.

Selecting and Connecting the Hardware

24-V Control Voltage Supply

When dimensioning the control voltage supply for the MTX micro-c, please observe the power consumption figures of the following components:

- Voltage supply of the HCQ/HCT device
- Digital inputs and outputs (onboard)
- Optional modules
- Activation of the motor brakes
- HMI control panel

Module		Requirement	Max. Current	Max. Power Consumption	Connector	Fuse
CNC system HCQ/HCT	Power supply control system	24V DC ± 20%	5,6A	108W	X18.1 - X18.4	LSC 8A
	Digital inputs X83-X86					
	Digital outputs X82					
	Digital outputs X81	24V DC ± 20%	2A (0.5A per output)	58W	X18.2 - X18.5	LSC 2A
	Motor brakes	24V DC ± 5%	4,5A (1.3A per brake)	113W	X6.x.3 - X6.x.4	LSC 6A
Option module DEA40.1	Digital inputs X73-X76	24V DC ± 20%	4A (0.5A per output)	116W	X70.1 - X70.2	LSC 6A
	Digital outputs X71					
	Digital outputs X72					
HMI panel VDP80.1	Power supply	24V DC ± 20%	1.5A	36W	J1.1 - J1.2	LSC 6A

Fig.4-12: MTX micro-c control voltage supply

Calculation example

Configure the 24-V voltage supply for the following example MTX micro-c system:

- CNC system HCQ02.1 with
  - spindle, 11 kW, without brake;
  - 2 servo motors, 12 Nm, without brake;
  - 1 servo motor, 17 Nm, with brake;
  - 1 optional module DEA40.1.
- HMI control panel VDP80.1

Module		Requirement	Current	Power Consumption
CNC system HCQ/HCT	Power supply	24V DC ±20%	5,6A	108W
	Digital inputs X83-X86			
	Digital outputs X82			
	Digital outputs X81		2A	58W
Option module DEA40.1	Digital inputs X73-X76		4A	116W
	Digital outputs X71			
	Digital outputs X72			
HMI panel VDP80.1	Power supply		1,5A	36W
Total 24V DC ± 20%			**13,1A**	**318W**
CNC system HCQ/HCT	Motor brake	24V DC ±5%	1,3A	33W
Total 24V DC ± 5%			**1,3A**	**33W**

Fig.4-13: Calculating the power consumption of an example system

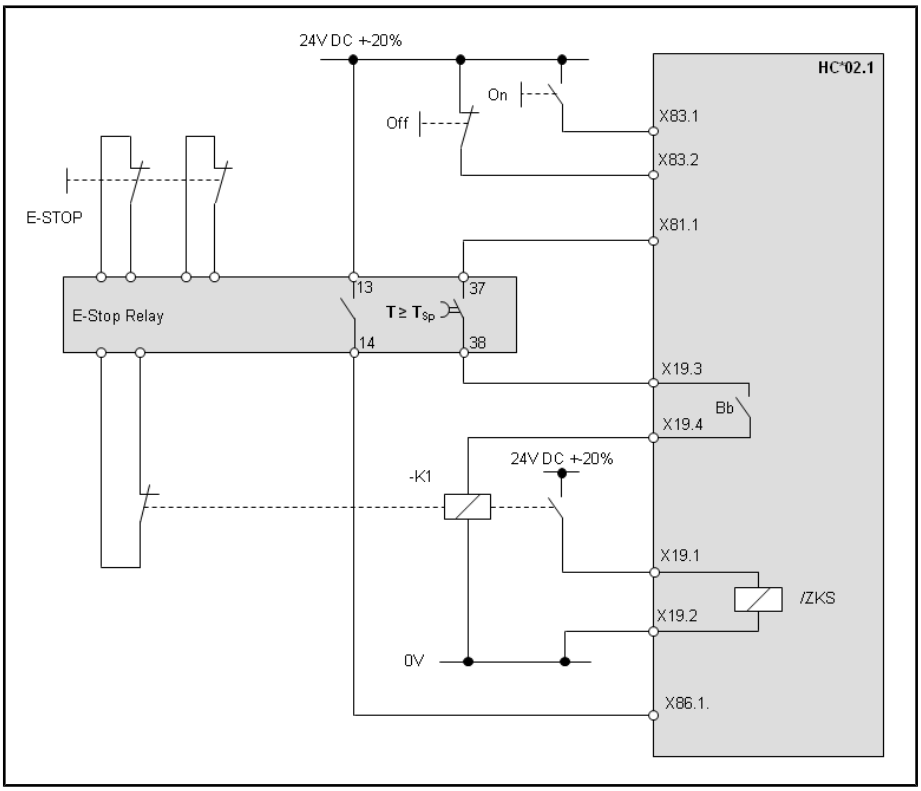
According to the calculation, approx. 320 W are required for 24 V DC ± 20%, and approx. 35 W are required for 24 V DC ± 5%. If less than the maximum possible 2 A is used for each of the outputs X81, X71 and X72, the power consumption can be reduced accordingly.

- Use an AC-adaptor or a PELV-protected control transformer according to IEC 60204-1 (Section 6.4) for the 24-V control voltage supply.
- Overvoltages exceeding 33 V must be discharged by means of measures in the electrical equipment of the machine or plant. Such measures include AC-adaptors and overvoltage limiters which are provided at the input of the control cabinet and limit incoming overvoltages. This also applies to longer 24-V lines which are placed in parallel to power and line supply cables and are able to receive overvoltages through inductive or capacitive coupling.
- Please be absolutely sure to observe the instructions on grounding of the 24-V control voltage supply described in chapter "Grounding Concept" on page 34.
- A current of 0.5 A can be delivered at each digital output. However, the sum total of all currents may not exceed 2 A per terminal (BYTE).

Selecting and Connecting the Hardware

E-stop and Power Contactor Processing

The power supply of the MTX micro-c is switched by the integrated PLC by means of an external power contactor. Irrespective of the processing by the PLC, the contactor must also be reliably turned off in the event of an E-stop. In this case, the MTX micro-c requires that the DC bus short-circuit (DC bus voltage) be activated. This ensures that the energy available in the system is used for decelerating the main spindle.



-K1 Line contactor
T Delay time of the E-stop relay
T_{Sp} Maximum braking time of the main spindle
Fig.4-14: Power contactor and E-stop processing

Description of processing

The drives are turned on by applying 24 V to X83.1, provided 24 V are simultaneously applied to X83.2 and X86.1 (E-stop). If the 24-V voltage is removed from X83.2 or X86.1, the drives are turned off. In this process, the CNC controls the drives to decelerate them to standstill; thereafter, the -K1 power contactor is turned off. The power contactor is additionally switched via a time-delayed contact of the E-stop relay. The E-stop relay also activates the DC bus short-circuit with a time delay. These measures are intended to ensure safety in case if E-stop events.

- The delay time of the E-stop relay must be selected such that it is longer than the maximum braking time of the main spindle.
- If the main spindle motor used is not an asynchronous motor (e.g. synchronous spindle motor), the DC bus short-circuit may not be activated in case of E-stop events. In such a case, please contact the Rexroth Sales Division!

Connecting the MAD Spindle Motors

Spindle motors of type MAD can be connected to connecting points X5.1 and X5.2. These motors provide maximum convenience on commissioning because the parameters are already saved in the motor encoder and are read in automatically.

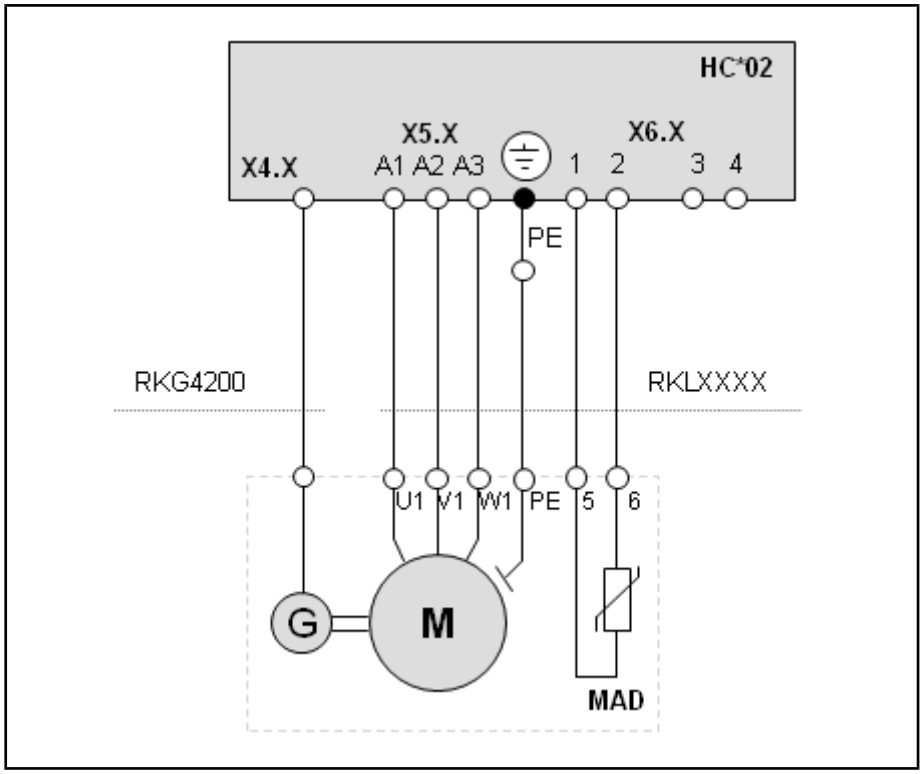
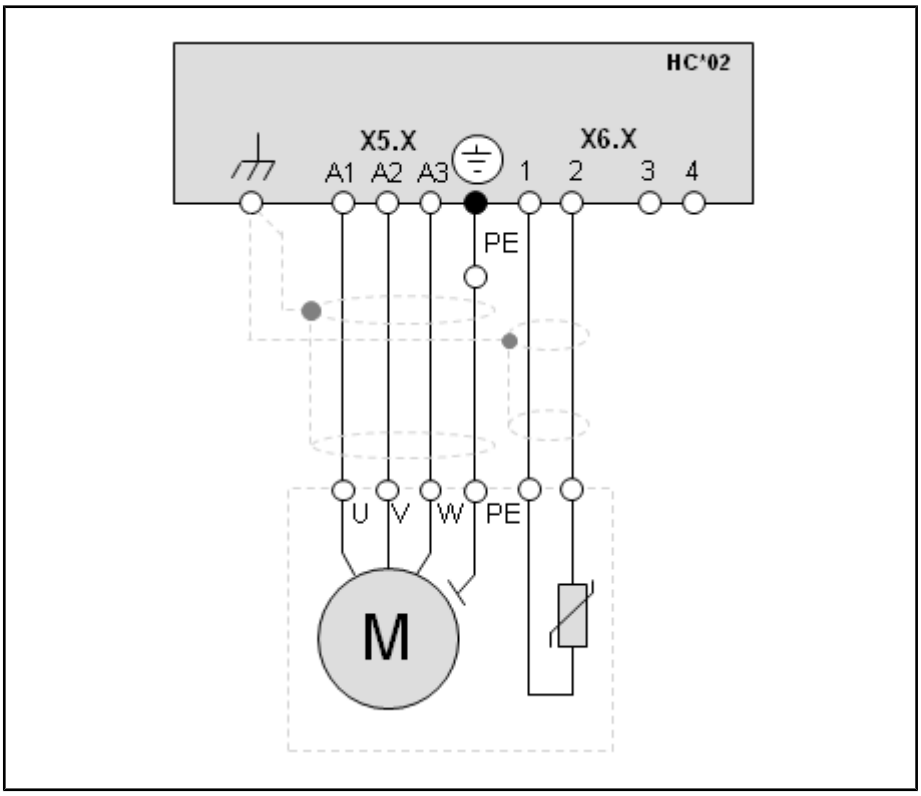


Fig.4-15: Connecting an MAD main spindle motor to the MTX micro-c

- An encoder connection point X4 and a temperature monitoring connection point X6 are automatically allocated to each motor connection point X5. The following applies: X5.1 → X4.1 → X6.1, X5.2 → X4.2 → X6.2.
- We strongly recommend that you use the Rexroth encoder cable RKG4200 for connecting the motor encoder.
- We also strongly recommend that you use the Rexroth motor cable RKL for connecting the motors. The shield is connected via the shield connection points XS2 (tube clips).
- The maximum length of the connecting cables, which may not be exceeded, is 40 m.
- Contacts 3 and 4 of terminal X6 are provided for activating an external spindle brake. Please observe the instructions in chapter "Activating an External Holding Brake" on page 43.

Connecting Standard Asynchronous Motors

Connection points X5.1 and X5.2 allow operation of standard asynchronous motors as spindle motors in encoderless mode (open loop). This is achieved by the integrated frequency converter function of the HC*02.



M Standard asynchronous motor

Fig.4-16: Connecting a standard asynchronous motor to the MTX micro-c

- A temperature monitoring connection point X6 is automatically allocated to each motor connection point X5. The following applies: X5.1 → X6.1, X5.2 → X6.2.
  - The cables used for connecting the motor and the temperature sensor may only be shielded cables. The shield is connected via the shield connection points XS2 (tube clips). We recommend that you use Rexroth RKL high-performance cables.
  - The maximum length of the connecting cables is 40 m.
  - Contacts 3 and 4 of terminal X6 are provided for activating an external spindle brake. Please observe the instructions in chapter "Activating an External Holding Brake" on page 43.

⚠ CAUTION **Motor activation faults may result in material damage!**

The standard motors must meet the requirements for the "rate of voltage rise at the motor output" in converter mode. Otherwise, the motor insulation may be damaged.

Connecting an Optional Encoder (X8)

The encoder connection point X8 is provided for connection of an optional encoder, e.g., as a spindle encoder at turning machines. This interface is designed for connection of a multitude of encoder types.

- 1Vpp, sine wave encoder, with reference track, 12 V and 5 V supply
- 1Vpp, sine wave encoder, EnDat2.1, 12 V and 5 V supply
- 1Vpp, sine wave encoder, HIPERFACE®, 12 V and 5 V supply
- TTL encoder, with reference track, 5 V supply
- Encoder according to EnDat2.2 specification

Pin	Signal	Pin	Signal
1	GND Shield	9	R +
2	A +	10	R -
3	A -	11	+ 12V
4	GND Encoder	12	+ 5V
5	B +	13	Enc Clock +
6	B -		TTL B +
7	Enc Data +	14	Enc Clock -
	TTL A +		TTL B -
8	Enc Data -	15	n.c.
	TTL A -		

Fig.4-17: Assignment of the ES interface of the MTX micro-c

- Please only use shielded cables according to the Rexroth specification applicable for connecting external encoders. This specification can be found in the following documentation: DOK-INDRV*-HCQ-T+HMQ-T-PR01-EN-P.
- The maximum length of the encoder cable is 40 m.
- We recommend that you use Rexroth encoder cables RKG for connecting external encoders.
- We recommend that you use encoders of type Rexroth GDS02.1-2048-14V-H12.0 and GDM02.1-2048-14V-H12.0, each with a resolution of 2048 pixels, as spindle encoders for turning machines. The required encoder cable is RKG0036.

⚠ CAUTION **Wrong handling may result in material damage!**

Only connect and disconnect the plugs to and from the encoder and connection point X8 while the supply voltage is turned off!

Selecting and Connecting the Hardware

Connecting the Servo Motors

MSK and QSK motors can be connected as servo motors (or spindle motors) to terminals X5.1 – X5.4. These motors provide maximum convenience on commissioning because the parameters are already saved in the motor encoder and are read in automatically.

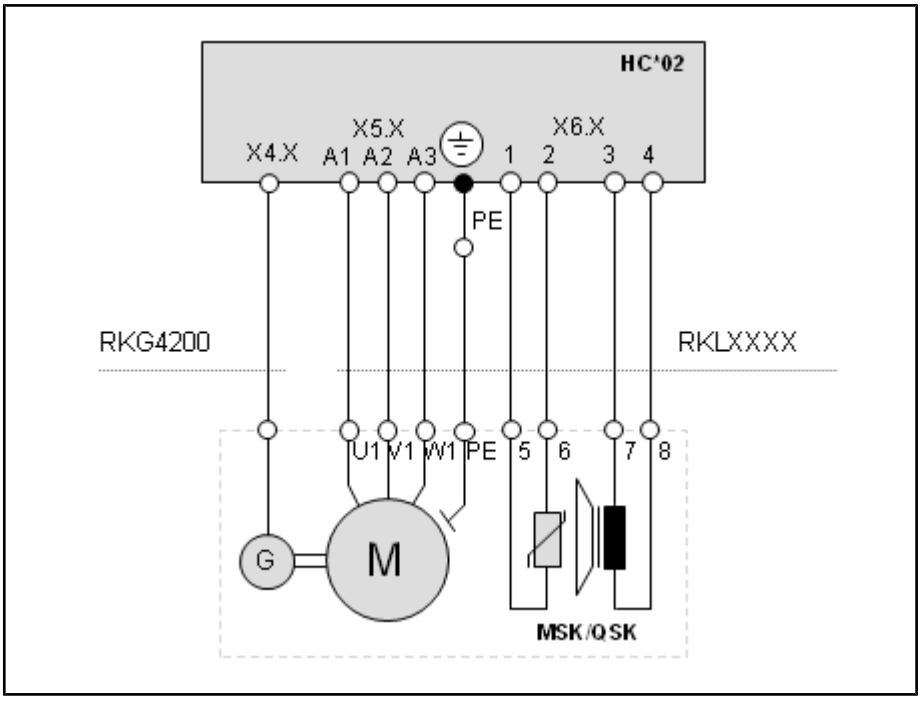


Fig.4-18: Connecting an MSK/QSK motor to the MTX micro-c

- An encoder connection point X4 and a temperature monitoring connection point X6 are automatically allocated to each motor connection point X5. The following applies: X5.1 → X4.1 → X6.1, … X5.4 → X4.4 → X6.4.
- We recommend that you use the Rexroth encoder cable RKG4200 for connecting the motor encoder.
- We also recommend that you use the Rexroth motor cable RKL for connecting the motors. The shield is connected via the shield connection points XS2 (tube clips).
- The maximum length of the connecting cables is 40 m.
- The motor holding brake (X6.X terminals 3, 4) is optionally available.

⚠ DANGER **The descent of a vertical axis may result in fatal injuries!**

- The maximum holding torque that can be applied by the optional holding brake of the MSK/QSK motors is the nominal motor torque.
- The motor holding brake alone cannot be used as a holding brake for the purpose of personal protection.
- If the holding torque is higher, use must be made of a suitable external brake.

Activating an External Holding Brake

To secure vertical axes or to connect a spindle brake, an external holding brake can be connected to each X6 terminal. As is the case with the motor brake, this brake will also be automatically controlled by the MTX micro-c.

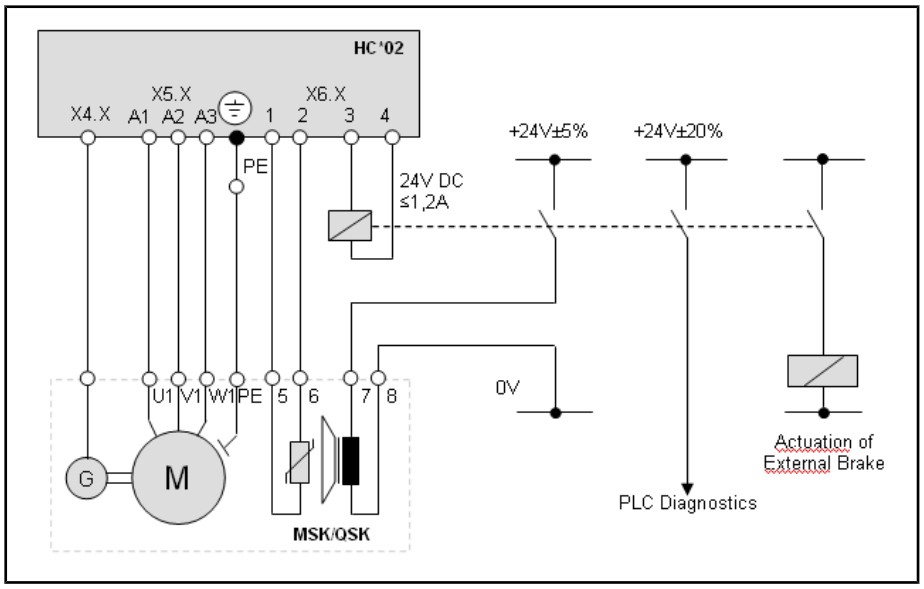


Fig.4-19: Activating an external holding brake

- The maximum current that can be used to activate the external holding brake is 24 V DC 1.2 A. We recommend that you activate the external brake by a relay.
- The maximum switching frequency of the brake is 0.5 Hz.
- Switching of the external axis should be diagnosed in the PLC program. Travel commands with applied brake must be avoided by setting the PLC axis interface signal qAx_DrvLock.

⚠ DANGER **The descent of a vertical axis may result in fatal injuries!**

- The maximum holding torque that can be applied by the optional holding brake of the MSK/QSK motors is the nominal motor torque.
- The motor holding brake alone cannot be used as a holding brake for the purpose of personal protection.
- If the holding torque is higher, use must be made of a suitable external brake.

Selecting and Connecting the Hardware

Digital Input and Output Signals

In the basic device, the MTX micro-c features 32 digital inputs (24 V DC) and 16 digital outputs (24 V DC, 500 mA). The number of I/Os can be extended to a maximum of 96 inputs and 48 outputs by means of 2 optional modules DEA40.1 (with 32 I/16 O each). A defined address is assigned to each digital output in the system PLC program.

MTX micro Inputs & Outputs				
Conn.	Pin	PLC Address	Symbol	Comment
X81	1	%QX11.0	Q11_0	X81-1 Mains contactor
	2	%QX11.1	Q11_1	X81-2
	3	%QX11.2	Q11_2	X81-3
	4	%QX11.3	Q11_3	X81-4
	5	%QX11.4	Q11_4	X81-5
	6	%QX11.5	Q11_5	X81-6
	7	%QX11.6	Q11_6	X81-7
	8	%QX11.7	Q11_7	X81-8
X82	1	%QX10.0	Q10_0	X82-1
	2	%QX10.1	Q10_1	X82-2
	3	%QX10.2	Q10_2	X82-3
	4	%QX10.3	Q10_3	X82-4
	5	%QX10.4	Q10_4	X82-5
	6	%QX10.5	Q10_5	X82-6
	7	%QX10.6	Q10_6	X82-7
	8	%QX10.7	Q10_7	X82-8
X83	1	%IX13.0	I13_0	X83-1
	2	%IX13.1	I13_1	X83-2
	3	%IX13.2	I13_2	X83-3
	4	%IX13.3	I13_3	X83-4
	5	%IX13.4	I13_4	X83-5
	6	%IX13.5	I13_5	X83-6
	7	%IX13.6	I13_6	X83-7
	8	%IX13.7	I13_7	X83-8
X84	1	%IX12.0	I12_0	X84-1
	2	%IX12.1	I12_1	X84-2
	3	%IX12.2	I12_2	X84-3
	4	%IX12.3	I12_3	X84-4
	5	%IX12.4	I12_4	X84-5
	6	%IX12.5	I12_5	X84-6
	7	%IX12.6	I12_6	X84-7
	8	%IX12.7	I12_7	X84-8
X85	1	%IX11.0	I11_0	X85-1
	2	%IX11.1	I11_1	X85-2
	3	%IX11.2	I11_2	X85-3
	4	%IX11.3	I11_3	X85-4
	5	%IX11.4	I11_4	X85-5
	6	%IX11.5	I11_5	X85-6
	7	%IX11.6	I11_6	X85-7
	8	%IX11.7	I11_7	X85-8
X86	1	%IX10.0	I10_0	X86-1 E-Stop O.K.
	2	%IX10.1	I10_1	X86-2 Probe 1
	3	%IX10.2	I10_2	X86-3 Probe 2
	4	%IX10.3	I10_3	X86-4
	5	%IX10.4	I10_4	X86-5
	6	%IX10.5	I10_5	X86-6
	7	%IX10.6	I10_6	X86-7
	8	%IX10.7	I10_7	X86-8

I/O Module 1				
Conn.	Pin	PLC Address	Symbol	Comment
X71	1	%QX21.0	Q21_0	X71-1
	2	%QX21.1	Q21_1	X71-2
	3	%QX21.2	Q21_2	X71-3
	4	%QX21.3	Q21_3	X71-4
	5	%QX21.4	Q21_4	X71-5
	6	%QX21.5	Q21_5	X71-6
	7	%QX21.6	Q21_6	X71-7
	8	%QX21.7	Q21_7	X71-8
X72	1	%QX20.0	Q20_0	X72-1
	2	%QX20.1	Q20_1	X72-2
	3	%QX20.2	Q20_2	X72-3
	4	%QX20.3	Q20_3	X72-4
	5	%QX20.4	Q20_4	X72-5
	6	%QX20.5	Q20_5	X72-6
	7	%QX20.6	Q20_6	X72-7
	8	%QX20.7	Q20_7	X72-8
X73	1	%IX23.0	I23_0	X73-1
	2	%IX23.1	I23_1	X73-2
	3	%IX23.2	I23_2	X73-3
	4	%IX23.3	I23_3	X73-4
	5	%IX23.4	I23_4	X73-5
	6	%IX23.5	I23_5	X73-6
	7	%IX23.6	I23_6	X73-7
	8	%IX23.7	I23_7	X73-8
X74	1	%IX22.0	I22_0	X74-1
	2	%IX22.1	I22_1	X74-2
	3	%IX22.2	I22_2	X74-3
	4	%IX22.3	I22_3	X74-4
	5	%IX22.4	I22_4	X74-5
	6	%IX22.5	I22_5	X74-6
	7	%IX22.6	I22_6	X74-7
	8	%IX22.7	I22_7	X74-8
X75	1	%IX21.0	I21_0	X75-1
	2	%IX21.1	I21_1	X75-2
	3	%IX21.2	I21_2	X75-3
	4	%IX21.3	I21_3	X75-4
	5	%IX21.4	I21_4	X75-5
	6	%IX21.5	I21_5	X75-6
	7	%IX21.6	I21_6	X75-7
	8	%IX21.7	I21_7	X75-8
X76	1	%IX20.0	I20_0	X76-1
	2	%IX20.1	I20_1	X76-2
	3	%IX20.2	I20_2	X76-3
	4	%IX20.3	I20_3	X76-4
	5	%IX20.4	I20_4	X76-5
	6	%IX20.5	I20_5	X76-6
	7	%IX20.6	I20_6	X76-7
	8	%IX20.7	I20_7	X76-8

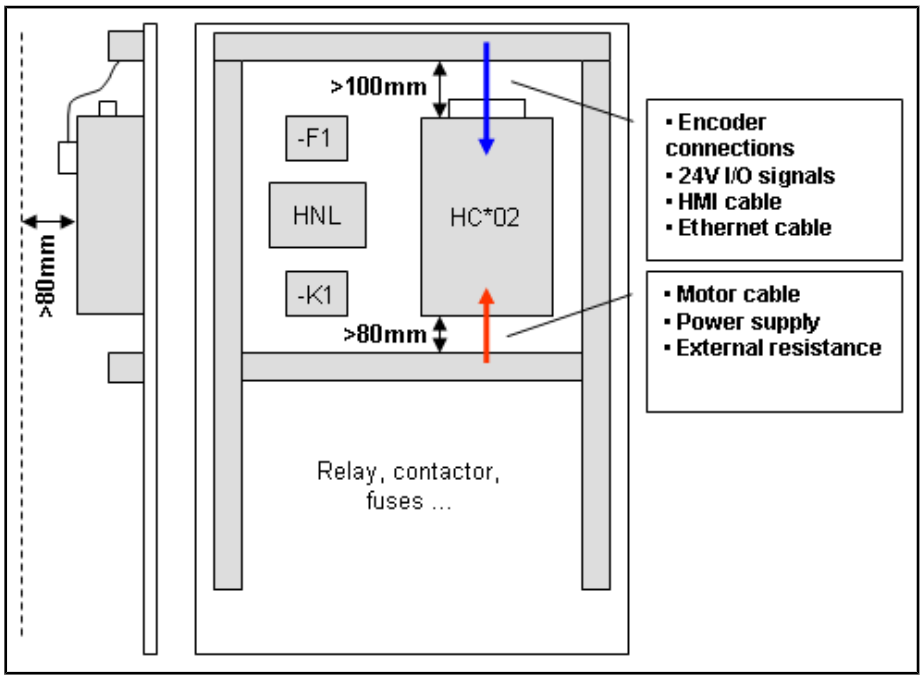
I/O Module 2				
Conn.	Pin	PLC Address	Symbol	Comment
X71	1	%QX31.0	Q31_0	X71-1
	2	%QX31.1	Q31_1	X71-2
	3	%QX31.2	Q31_2	X71-3
	4	%QX31.3	Q31_3	X71-4
	5	%QX31.4	Q31_4	X71-5
	6	%QX31.5	Q31_5	X71-6
	7	%QX31.6	Q31_6	X71-7
	8	%QX31.7	Q31_7	X71-8
X72	1	%QX30.0	Q30_0	X72-1
	2	%QX30.1	Q30_1	X72-2
	3	%QX30.2	Q30_2	X72-3
	4	%QX30.3	Q30_3	X72-4
	5	%QX30.4	Q30_4	X72-5
	6	%QX30.5	Q30_5	X72-6
	7	%QX30.6	Q30_6	X72-7
	8	%QX30.7	Q30_7	X72-8
X73	1	%IX33.0	I33_0	X73-1
	2	%IX33.1	I33_1	X73-2
	3	%IX33.2	I33_2	X73-3
	4	%IX33.3	I33_3	X73-4
	5	%IX33.4	I33_4	X73-5
	6	%IX33.5	I33_5	X73-6
	7	%IX33.6	I33_6	X73-7
	8	%IX33.7	I33_7	X73-8
X74	1	%IX32.0	I32_0	X74-1
	2	%IX32.1	I32_1	X74-2
	3	%IX32.2	I32_2	X74-3
	4	%IX32.3	I32_3	X74-4
	5	%IX32.4	I32_4	X74-5
	6	%IX32.5	I32_5	X74-6
	7	%IX32.6	I32_6	X74-7
	8	%IX32.7	I32_7	X74-8
X75	1	%IX31.0	I31_0	X75-1
	2	%IX31.1	I31_1	X75-2
	3	%IX31.2	I31_2	X75-3
	4	%IX31.3	I31_3	X75-4
	5	%IX31.4	I31_4	X75-5
	6	%IX31.5	I31_5	X75-6
	7	%IX31.6	I31_6	X75-7
	8	%IX31.7	I31_7	X75-8
X76	1	%IX30.0	I30_0	X76-1
	2	%IX30.1	I30_1	X76-2
	3	%IX30.2	I30_2	X76-3
	4	%IX30.3	I30_3	X76-4
	5	%IX30.4	I30_4	X76-5
	6	%IX30.5	I30_5	X76-6
	7	%IX30.6	I30_6	X76-7
	8	%IX30.7	I30_7	X76-8

Fig.4-20: Assignment of the digital inputs and outputs of the MTX micro-c

- Inputs X83.1, X83.2 as well as X86.1 to X86.3 and output X81.1 are reserved for the system PLC program.
- Inputs X86.1 (%IX10.0) to X86.4 (%IX10.3) are what are called "fast inputs". These inputs can be directly processed in position loop clock.
- Inputs X86.2 and X86.3 should be kept free for the use of touch probes, even if the machine is not equipped with touch probes.

Setting up the Control Cabinet

The following instructions on setting up the control cabinet should be followed to ensure undisturbed operation of the MTX micro-c. The arrangement of the components was based on the discharge of the developing power losses, on the prevention of faults due to electromagnetic influence, and on the position of the connection points.



-F1	Line fuse
HNL	Line reactor
-K1	Line contactor

Fig.4-21: Recommended arrangement of components in the control cabinet

- Run cables and lines for control signals and power signals in separate cable ducts.
- Use shielded Rexroth cables and lines for connecting motors and encoders.
- Make absolutely sure that you adhere to the grounding concept and specifically that you use a low-resistance protective conductor connection.
- It is only allowed to install the HC*02 in a vertical position (G1).

⚠ DANGER **Hot parts with temperatures higher than 105 °C may result in material damage!**

- Keep the specified minimum distances from other components.
- Materials present above the devices may only be materials which are incombustible and insensitive to the high temperatures that occur.

5 Software Installation and Basic Projects

5.1 Installing IndraWorks Engineering

5.1.1 Prerequisites

Hardware Requirements

The following hardware requirements must be met for installation of IndraWorks Engineering on the PC:

- IBM-compatible PC, Pentium III or later
- CPU clock frequency: 933 MHz
- Main memory: 512 MB
- Graphics resolution at least:
  - 800x600 pixels
  - Color depth: 16 bits
- DVD drive
- Ethernet interface

Software Requirements

At least Microsoft Windows XP with ServicePack 2 is required for operation.

5.1.2 Installing the Software

The figure below shows how to install the software step by step:

1. Insert the DVD. The installation wizard should be started automatically. If not, start the installation wizard by double-clicking the "setup.exe" file.
2. Select the installation language (the further description following below is based on English as the installation language).
3. Select "New Installation".
4. Select "IndraMotion MTX micro Engineering".
5. Enter a valid software license code. The code is specified on a separate license sheet (SWL-IWORKS-MTX-10VRS-D0-MICRO).
6. After successful verification of the license, continue with "Next".
7. Continue with "Next". This will open a PDF file containing the current release notes. Read and close the PDF file. Then continue to install the software.
8. Accept the "Licence Agreement" to continue.
9. You can then enter your name and company.
10. If necessary, select a different installation folder.
11. Click on "Install" to start installing the files.
12. After successful installation, click on "Finish". This will open a window prompting you to restart the PC.

    After the PC has been restarted, system files will be updated and the registrations required will be made. This completes the installation. You can now start IndraWorks Engineering.

Software Installation and Basic Projects

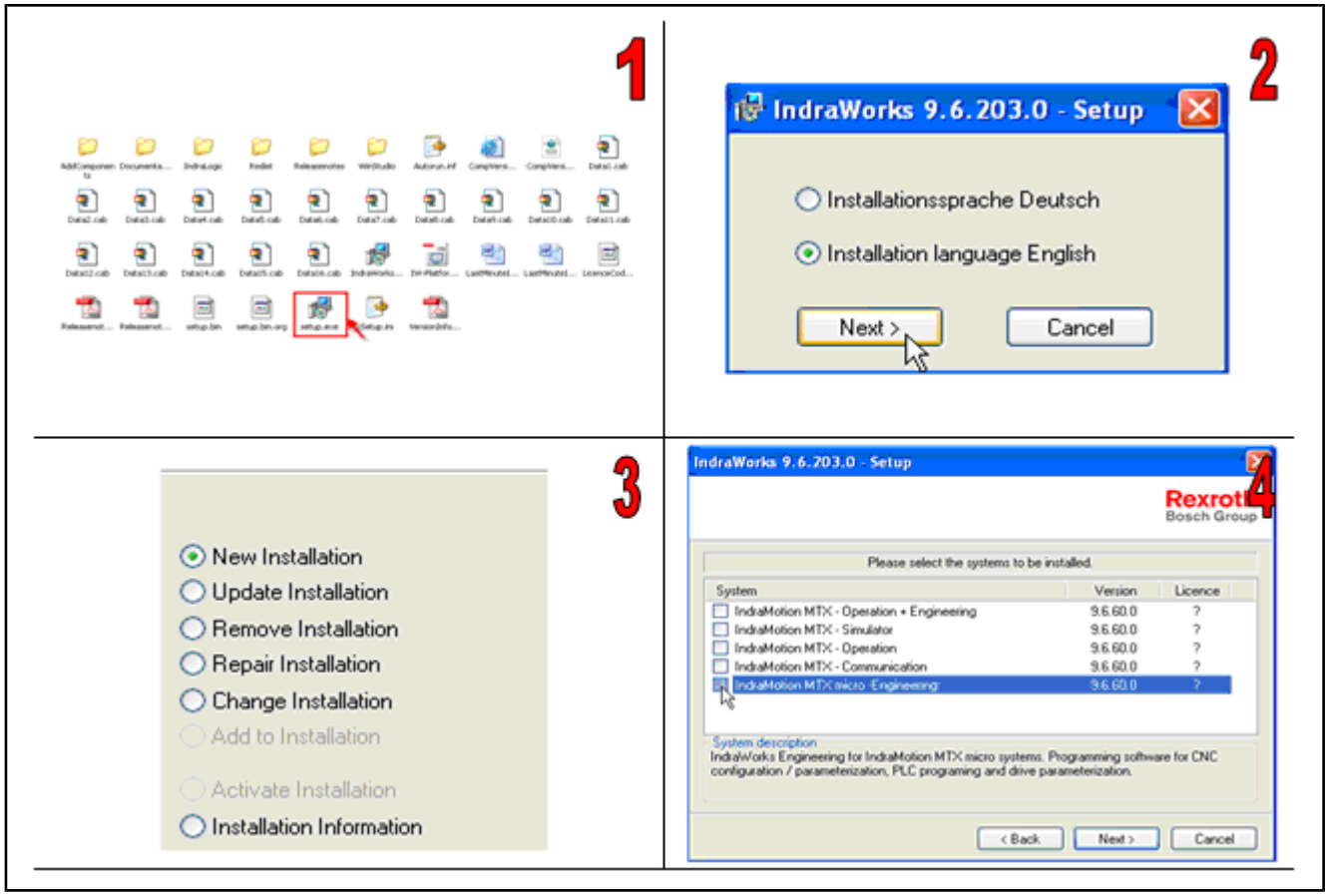


Fig.5-1: Installing IndraWorks Engineering

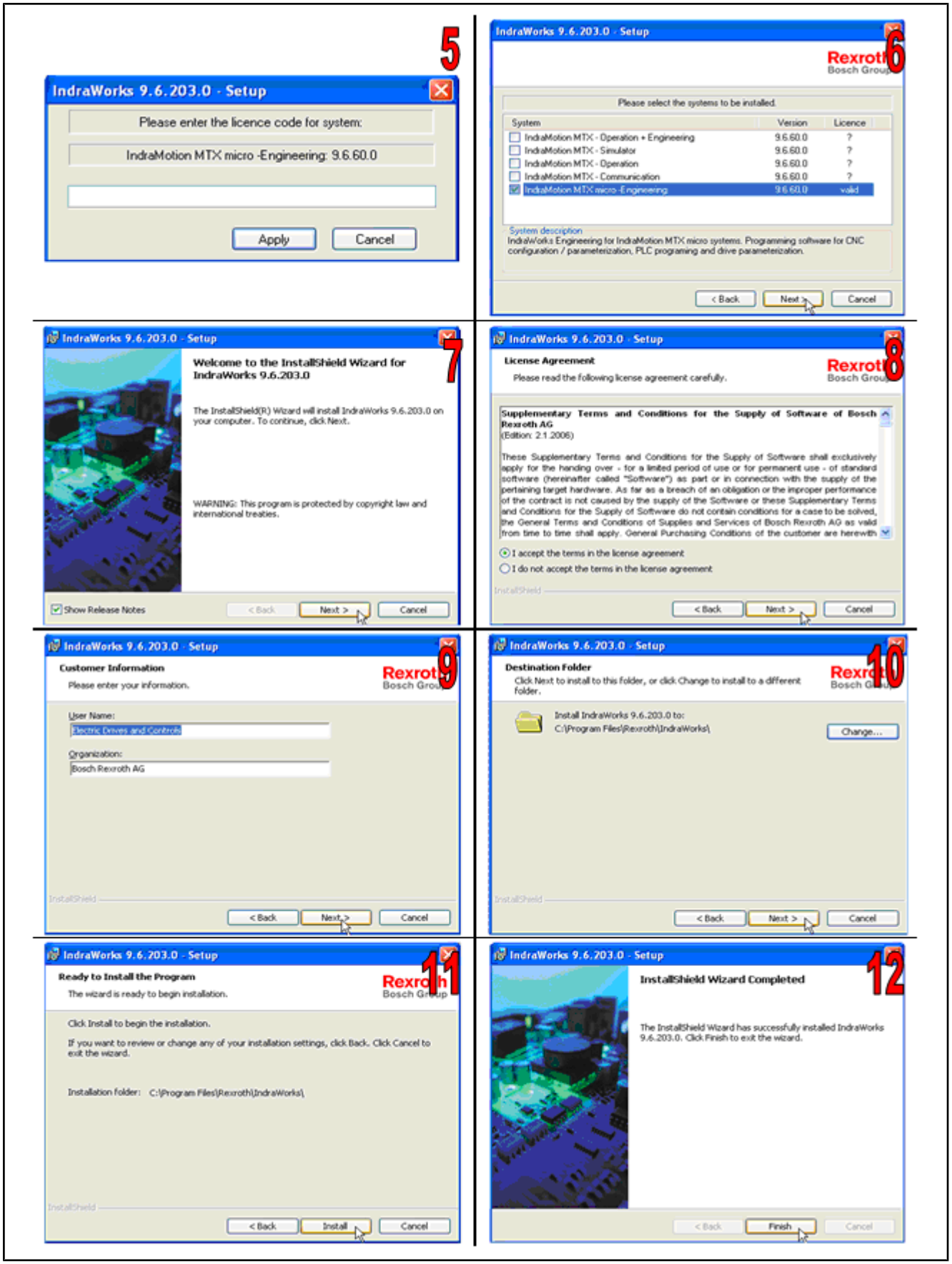


Fig.5-2: Installing IndraWorks Engineering

5.2 Creating a New Project

The software provides several basic projects to allow the user to create a new machine project. A basic project contains the system PLC program and the CNC parameters for the currently selected machine type.

Presently, 3 basic projects are available:

- For milling machines: BasicProject_Milling
- For turning machines: BasicProject_Turning_1_Spindle
- For turning centers: BasicProject_Turning_2_Spindle

☞ The current basic projects can be downloaded from the Rexroth Automation Portal. After having logged in, follow the links to "MTX micro" and to "Product Support" where you can find the basic projects in the "MTX micro Library".

www.boschrexroth.com/portal

To create a new machine project, proceed as follows:

1. In order to restore a basic project, select **Project – Restore…** from the main menu.
2. Select "Restore from file system" and click on "Next>>".
3. Select the archive on the next page. The "…" button allows you to browse for the archive. The basic projects available during installation are filed in the "C:\Program Files\Rexroth\IndraWorks\Projects" directory. After having selected the archive, click on "Next>>".
4. Select the directory where you wish to create the project. Click on "Next>>".
5. Click on "Finish" to start restoring the project from the archive. After having restored the project, the display will show the results.
6. To open the project, select **File – Open – Project…** from the menu.
7. Select the project just restored and confirm your selection with "Open". The project will now be downloaded.
8. The Project Explorer displays the project.

☞ We recommend that you rename the project after having created it. To do this, click on the "root node" of the project (here: Milling_3Ax_1Sp_10V02.117). Then press "F2" and enter a new name for the project.

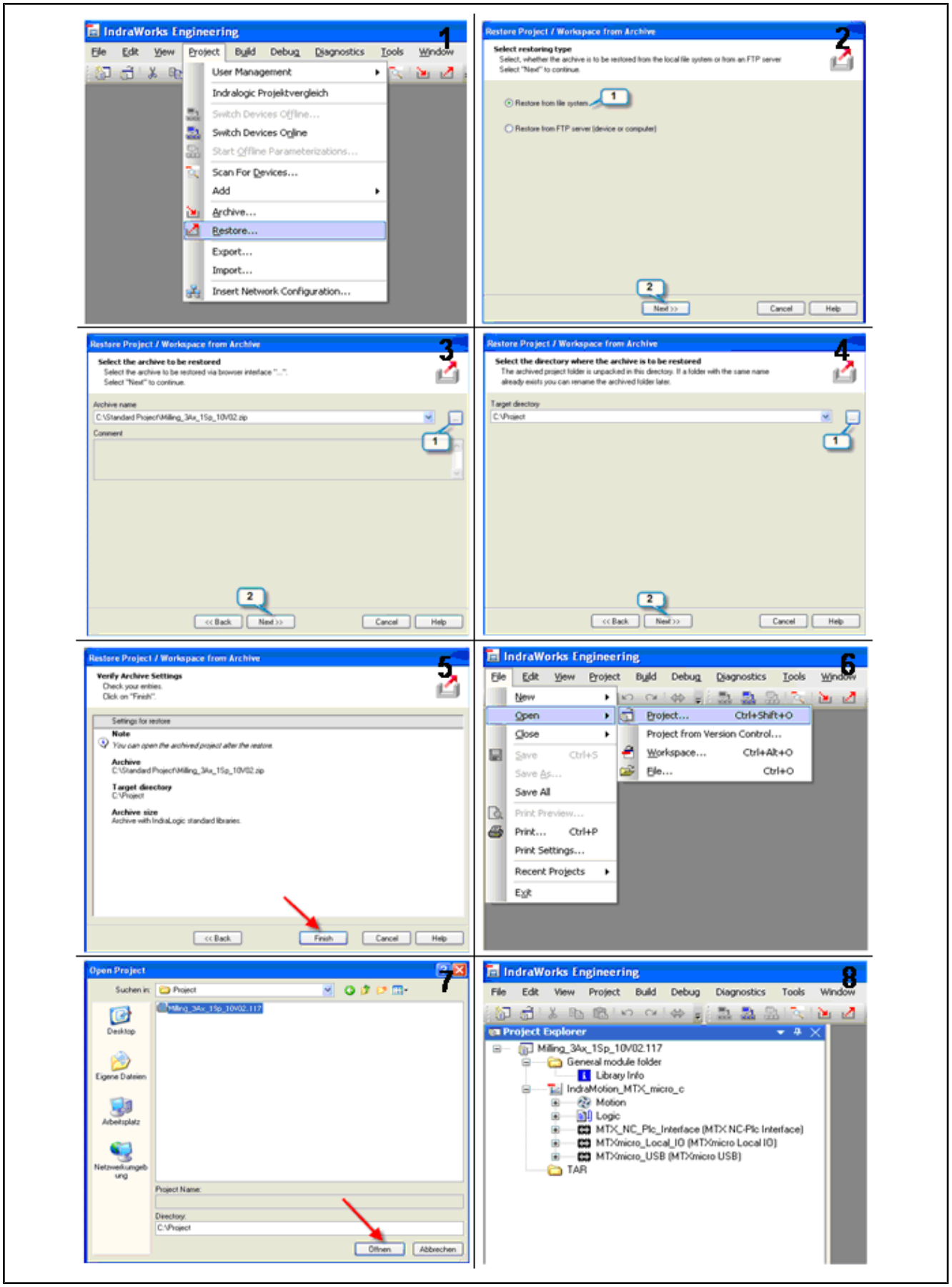


Fig.5-3: Restoring basic projects

5.3 Setting Communication Parameters

5.3.1 General

Communication between the MTX micro and a PC requires the Ethernet interface of the MTX micro. Communication between IndraWorks Engineering and the MTX micro can only be established after the necessary settings have been made on the control and the PC.

The network connection between the PC and the MTX micro can be established in various ways. The settings required for your particular case may be different from the settings shown here. This is particularly applicable if you operate the MTX micro on a network. In such a case, please consult your network administrator.

The further description following below is based on a direct connection between the PC and the MTX micro, e.g., via an Ethernet crossover cable.

5.3.2 Setting the IP Address of the MTX micro in the IndraWorks Project

The default IP address for the MTX micro set in the basic project is "192.168.142.250". The address can be checked at the "IndraMotion_MTX_micro_c" node. This address is also set in the control on delivery of the MTX micro.

The IP address in the project and in the control connected to the PC must be identical. We recommend that you leave the "192.168.142.250" default address setting.

Fig.5-4: IP address in the project

5.3.3 Setting the IP Address on the MTX micro

Select the "Maintain" operating area on the HMI control panel. This will display the screen with the currently set "IP Address". If the settings are different from

- IP Address → 192.168.142.250
- Subnet Mask → 255.255.255.0

then these settings must be changed.

Setting the user

You can only change the communication settings, if you have logged in as an authorized user.

Proceed as follows:

1. Select "Login" (F2).

2. Select "MTB" or "Developer" (F3 or F4).
3. Enter the correct password for the user (default setting in the basic project: no password).
4. After having pressed "Enter" to confirm, the current "MTB" or "Developer" user is displayed.

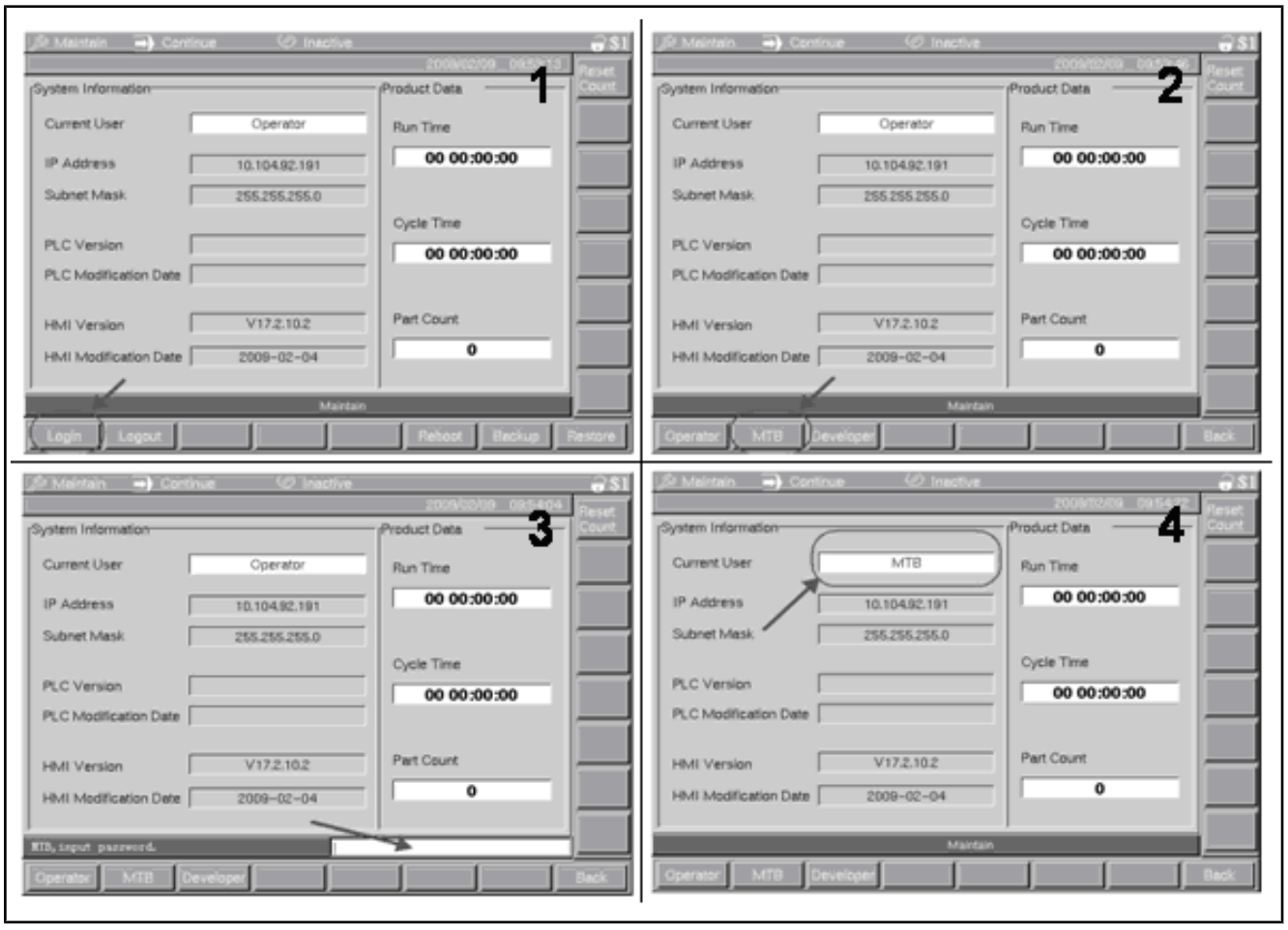


Fig.5-5: Changing the user (to set the address)

Setting the IP address

The IP address of the MTX micro must be identical with the IP address in the project. The following settings should be made:

- IP Address → 192.168.142.250
- Subnet Mask → 255.255.255.0
- Gateway → 0.0.0.0

The gateway address is only required for operation in a network. If there is a direct connection to the PC, address 0.0.0.0 is used.

1. Select the "System" operating area on the HMI control panel, then "Option" (F8).
2. Select "SetIP" (F3), enter "192.168.142.250" in the input field, and press Enter to confirm.
3. „Select "etMask" (F4), enter "255.255.255.0" in the input field, and press Enter to confirm.
4. Select "GateWay" (F5), enter "0.0.0.0" in the input field, and press Enter to confirm.
5.

Turn the MTX micro off and on again to apply the settings.

6. After the system has been restarted, the configured IP address is displayed in the "Maintain" operating area.

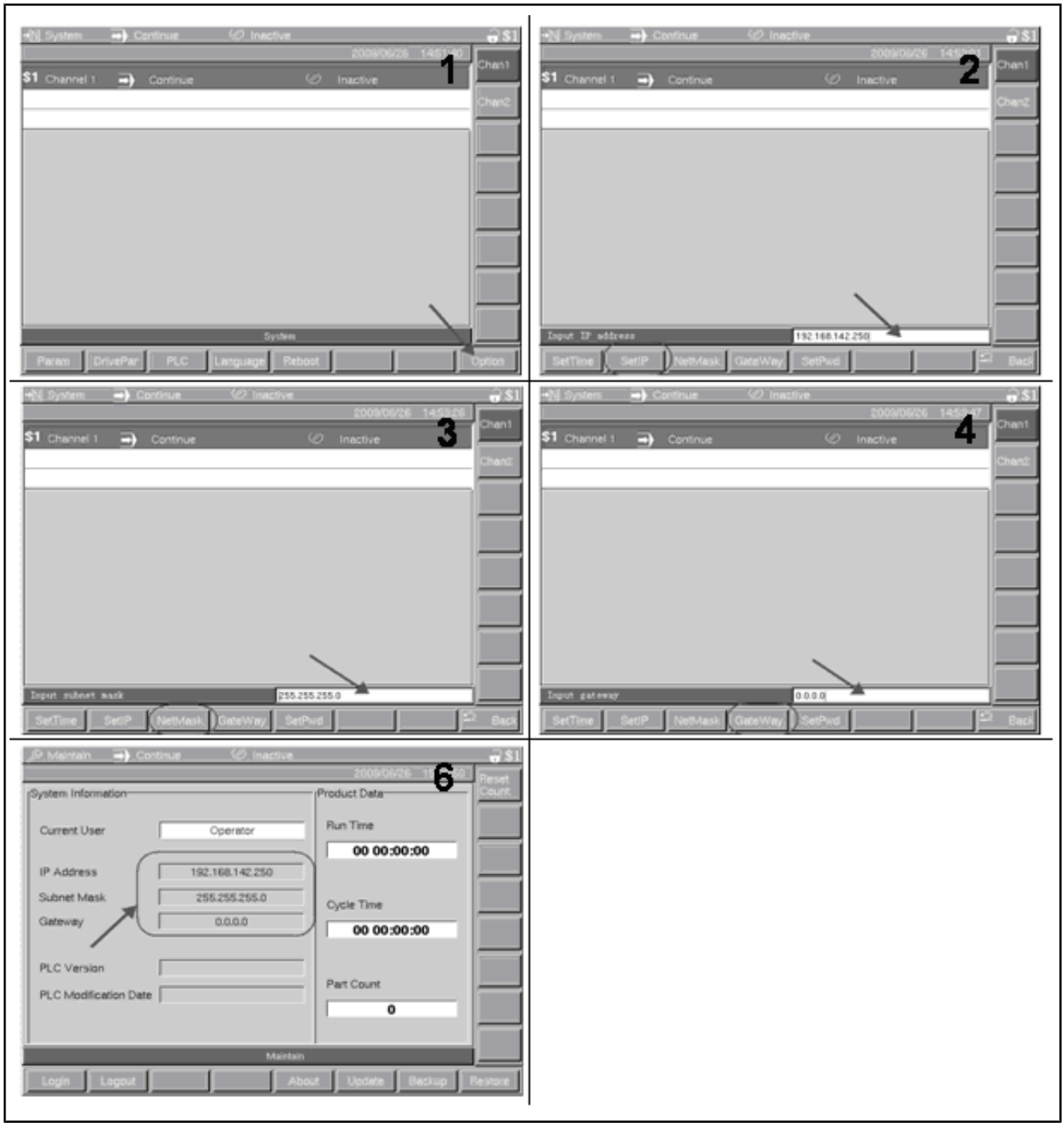


Fig.5-6: Configuring the IP address of the MTX micro

5.3.4 Setting the IP Address of the PC

The PC must have its IP address in the same network segment as the MTX micro. To achieve this, a fixed address is set. The first 3 digits always corre-

spond to the IP address of the MTX micro. The subnet mask is the same as that of the MTX micro. We recommend the following settings:

- IP Address → 192.168.142.251
- Subnet Mask → 255.255.255.0
- Standard gateway → no entries

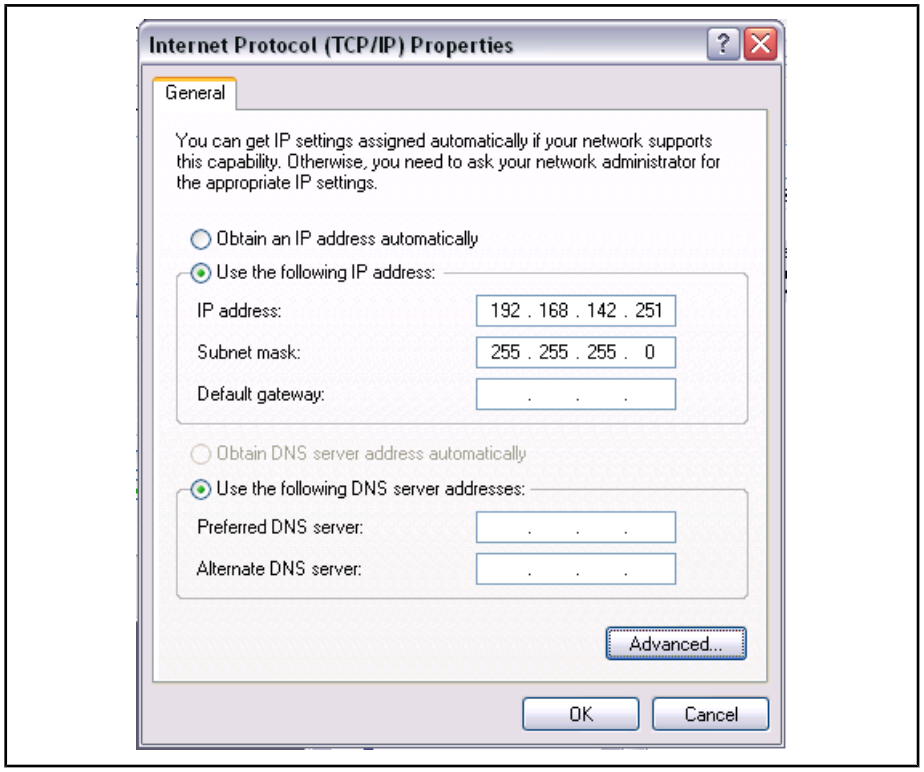


Fig.5-7: Configuring the IP address in the PC

To ensure that the IP address is used, you should restart the PC after having set the address. Do not forget to change the address again before connecting the PC to a different network.

We recommend that you note down the original network settings of the PC before changing them.

Original PC settings:

- IP Address →__ .__ .__ .__
- Subnet Mask →__ .__ .__ .__
- Standard gateway →__ .__ .__ .__

5.3.5 Testing the Communication

After having configured the IP address, you can carry out a communication test. The following figure shows the steps required for testing communication between the system and the PC.

1. After a project has been opened, communication mode initially is set to "offline". For example, the "NC configuration" and "NC file system" nodes are gray, i.e., "inactive".
2. Click on the icon (blue) to switch communication with the MTX micro to online.
3. Communication with the MTX micro is checked.

4. After having switched communication to online, the "NC configuration" and "NC file system" nodes are activated.

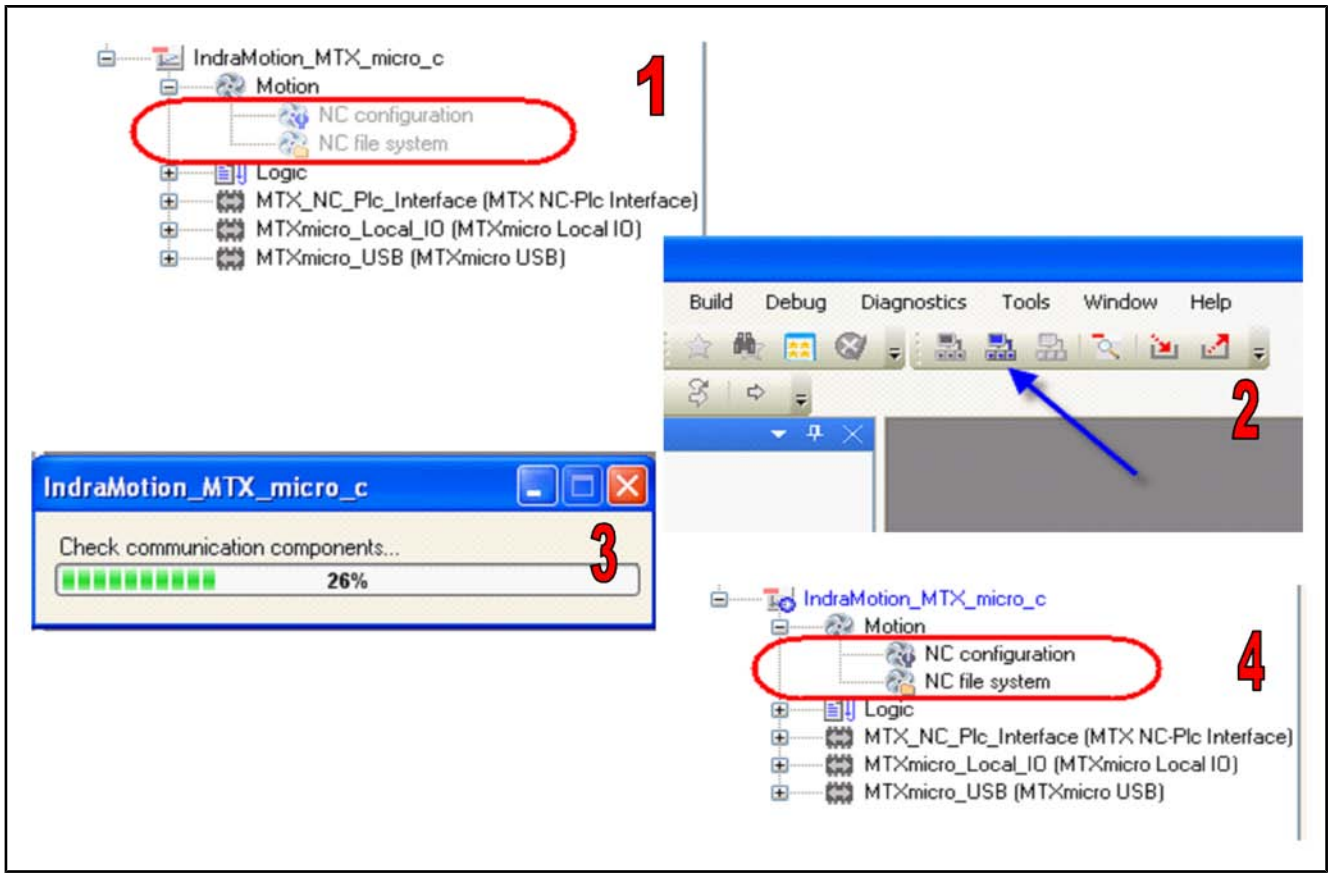


Fig.5-8: Switching communication with the MTX micro to online

5.3.6 Errors in Communication with the MTX micro

If communication with the MTX micro is disturbed on switching to online mode, the following dialog will be displayed:

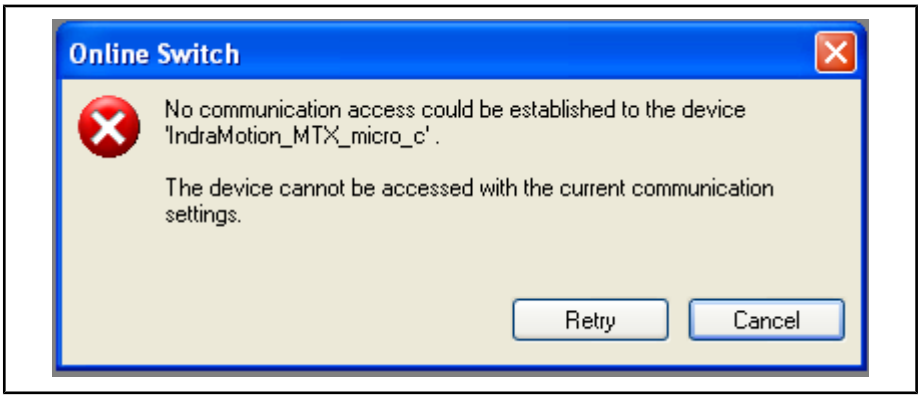


Fig.5-9: Communication error

Possible remedies:

1. Check whether the Ethernet cable is properly connected.
2. Use an Ethernet crossover cable if your PC does not support the "Auto-sensing" function.
3. Check the settings of the IP addresses of the PC and the MTX micro once more.

4. Turn the PC and the MTX micro off and on again.

5.4 Downloading the CNC Configuration Data

After communication has been successfully established, the CNC parameters of the basic project must be downloaded to the MTX micro. To do this, extract these parameters from an archive ("TAR File") which is an integral part of the basic project. Proceed as shown in the figure below.

1. Select the "IndraMotion_MTX_micro_c" node. Right-click on this node and select "Restore…" and "Control Data…" from the context menu.
2. Select the archive to be downloaded by clicking on the button to the right of the input field.
3. The archives are filed in the default project in the >Project Directory>\TAR directory.
4. Activate all restore checkboxes and confirm with "Next>>".
5. Activate all checkboxes and confirm with "Next>>".
6. Check your entries and start restoration by clicking on "Finish".
7. Restoration comprises 3 phases, and the control repeatedly restarts accordingly.
8. This dialog shows the successful restoration of the CNC configuration data.

After the NC parameters have been restored, the MTX micro must be turned off and on again twice. This initializes the parameters of the NC and the connected drives.

Software Installation and Basic Projects

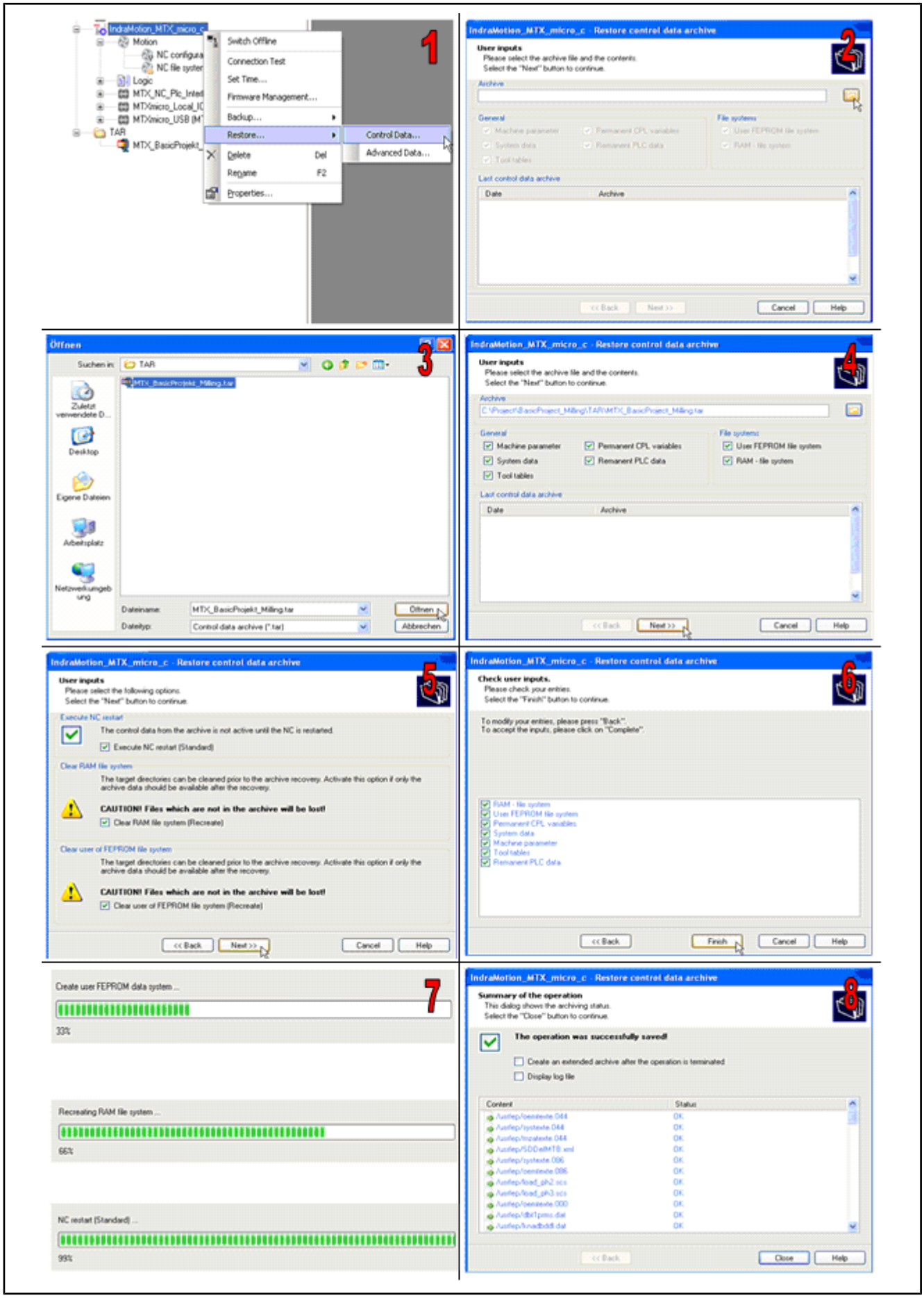


Fig.5-10: Downloading the CNC configuration data

6 PLC Startup

6.1 Downloading the PLC System Program

After the communication parameters have been set and the parameters of the basic project have been downloaded, the PLC system program must first be downloaded. Proceed as follows:

1. Compile the program with "Build – Build Application".
2. The message window is opened during compilation. The display shows information on the compilation progress.
3. After completed compilation, transfer the program to the control with "Debug – Login to Application". After the transfer has been completed successfully, the programming system is in online mode.
4. Start the program with "Debug – Start Application" in the final step. The system program is now running.

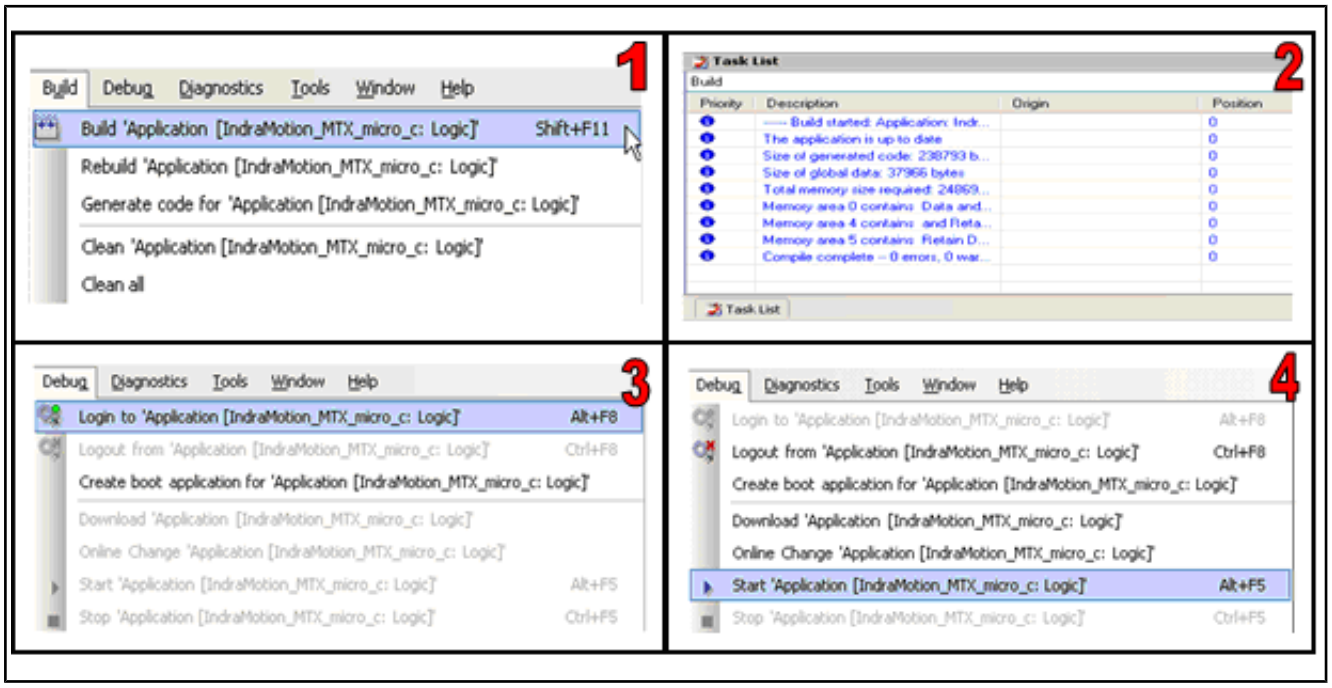


Fig.6-1: Downloading the PLC system program

PLC Startup

6.2 PLC System Program Structure

6.2.1 Overview

The PLC system program has a clear structure. The most essential elements are the following:

1. The "_OEM" folder is provided for the programs and function blocks of the machine manufacturer. This folder is empty on delivery.
2. The "_System" folder is reserved for interfaces, programs and data structures of the system program.
3. The global variables of the system are defined (declared) in the "_System_Variables" list. These global variables can be used in any program and/or function block. More global variables are declared in the "MT_MTXmicro_Tech" library.
4. The "I_O_VARIABLES" list contains all digital inputs and outputs of the MTX micro (see also: chapter "Configuration Instructions").
5. All programs are called from the "_prMAIN" main program. The main program is called and processed cyclically (every 20 ms).
6. The "Library Manager" contains the system libraries.
7. The chronological run of the PLC program is controlled in the "Task Configuration".

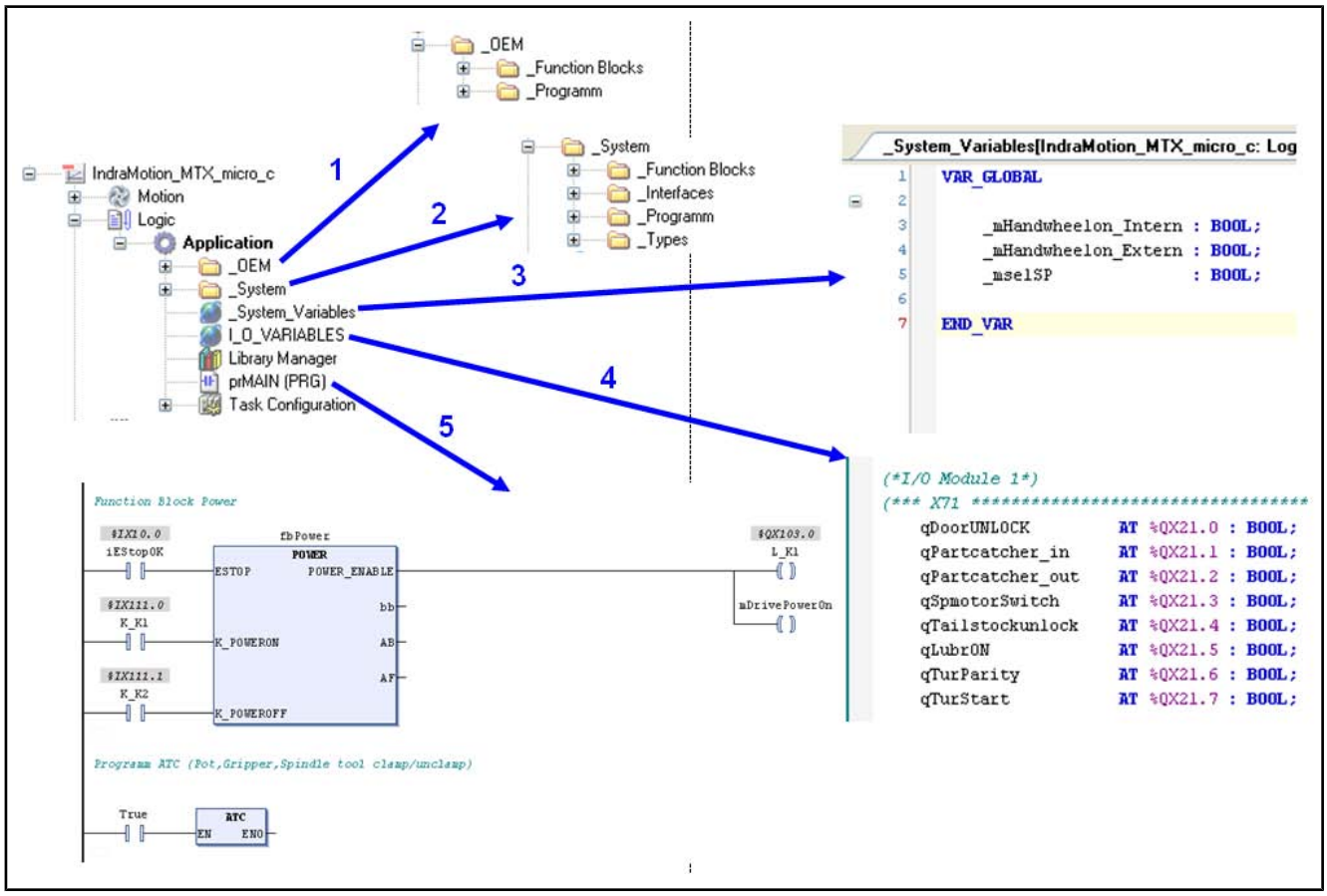


Fig.6-2: Overview of the system PLC program structure

The settings in the "Task Configuration" and "Library Manager" areas should not be changed.

6.2.2 prMAIN Main Program

"prMAIN" is the main program of the system program, from which all programs and function blocks are called. On delivery, power supply activation and the interfaces to the CNC, the axes and the HMI are already programmed ready for turn-on.

Extensions to the system program made by the user are also called from the main program. We recommend that you create the appropriate subroutines which you can then call from prMAIN.

The following figure shows the data structure provided and potential extensions. The user should not delete the system programs and system function blocks called in prMAIN.

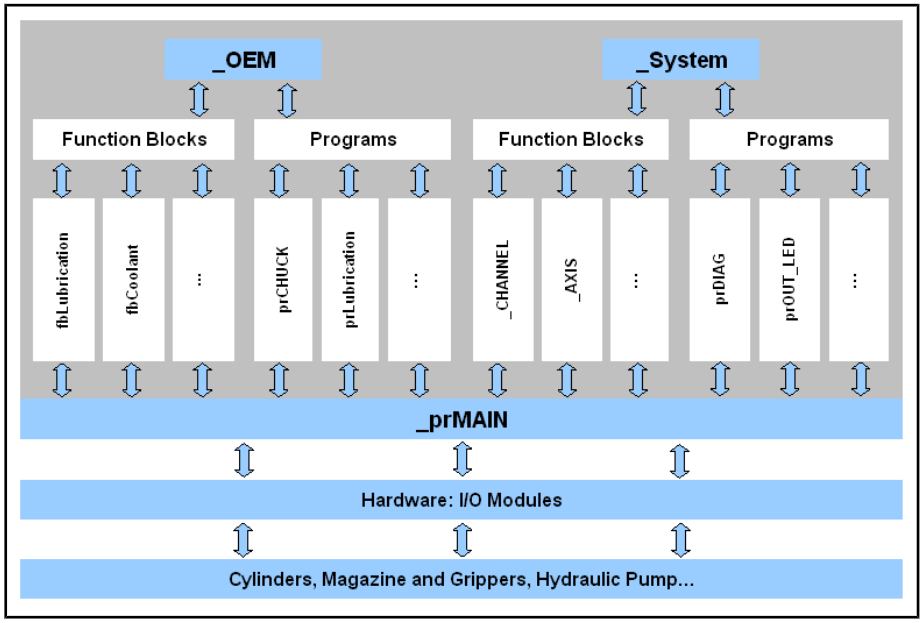


Fig.6-3: Structure of the prMAIN main program

The following table shows the function blocks and programs in prMAIN for the various basic projects. The function blocks are delivered along with the system program in the "MT_MTXmicro _Tech" library.

				Name	Function
prMAIN	General		Function blocks	_POWER	Drive enable ON/OFF
				_CHANNEL	Channel interface
				_AXIS	Axis interface
			Programs	prDIAG	Diagnostic interface
				prLED	HMI LEDs control
				prToolmanagement	Tool management program
	Project-specific	Milling machine	Function blocks	VDP80_MILLING	VDP80 interface milling
				SPINDLE_C_AXIS	Spindle with C-axis function
			Programs		
		Turning machine 1 Spindle	Function blocks	_VDP80_TURN	VDP80 interface turning
				_SPINDLE_C_AXIS	Spindle with C-axis function
			Programs		
		Turning machine 2 Spindles	Function blocks	_VDP80_TURN	VDP80 interface turning
			Programs	prSpindle	Sub program spindle 1+2 control

Fig.6-4: prMAIN function blocks

PLC Startup

6.3 Auxiliary Functions

6.3.1 General

Auxiliary functions are used in the NC program or in "MDI" mode in order to activate, deactivate or change functions on the machine and/or to transfer numerical values by means of the PLC.

Examples are the cooling lubricant system, clamping devices or PLC-controlled tool changers.

Auxiliary functions must always be acknowledged. That means that the NC program stops running until the PLC has acknowledged execution of the function.

6.3.2 Auxiliary Function Types

The IndraMotion MTX micro features several auxiliary functions. A total of 9 auxiliary function types are defined with the basic project. These are:

- M0…M299, bit auxiliary functions for switching functions
- T, integer auxiliary function for tool commands
- S1..S2, float auxiliary functions for spindle commands
- H1..H5, integer auxiliary function for any use desired

The exchange of information with the PLC is achieved via flags. The bit auxiliary functions have exactly one bit in the PLC program assigned to each function. The integer and float auxiliary functions each have 4 bytes for the transfer of the value and one bit for acknowledging the value in the PLC program. The following table shows the addresses and symbols for the auxiliary functions:

Name	Class	Start Address (Byte)	PLC Marker	
M	Bit-coded Channel-dependent	4100	%MX4100.0 ⋮ %MX4137.3	Ch1_M000 ⋮ Ch1_M299
T	Integer Channel-dependent	4200	%MX4200.0 %MB4204	iCh1_TNr_Ack iCh1_TNr
S1	Float Channel-dependent	4400	%MX4400.0 %MB4404	iSP1_Ack iSP1_Val
S2	Float Channel-dependent	4408	%MX4408.0 %MB4412	iSP2_Ack iSP2_Val
H1	Integer Channel-dependent	4300	%MX4300.0 %MB4304	H1_Ack H1_Val
H2	Integer Channel-dependent	4308	%MX4308.0 %MB4312	H2_Ack H2_Val
H3	Integer Channel-dependent	4316	%MX4316.0 %MB4320	H3_Ack H3_Val
H4	Integer Channel-dependent	4324	%MX4324.0 %MB4328	H4_Ack H4_Val
H5	Integer Channel-dependent	4332	%MX4332.0 %MB4336	H5_Ack H5_Val

Fig.6-5: Auxiliary function types

6.3.3 Output and Acknowledgement Behavior

All auxiliary functions of an NC block are simultaneously output to the PLC program. This takes place at the beginning of a block and is followed by traversing motions if any have been programmed. The position of the auxiliary function within the block is of no relevance. At the end of the NC block, the control waits until all auxiliary functions that were output have been acknowledged before it starts processing the next NC block. For this reason, the acknowledgement order is not essential.

The behavior will be illustrated in more detail by way of an example. The following NC blocks are to be processed:

Program:

```
N100 G01 X200 F2000

N101 M10 G01 X220 M11 H1=10

N102 G01 X200
```

1. The NC moves the X-axis to position X=200 in block N100.
2. Then block N101 is activated, and the NC outputs all auxiliary functions. In the PLC program, bits Ch1_M010, Ch1_M011 and H1_Ack are set to "True", and H1_Val is set to value "10".
3. Then the X-axis is moved to position X=220.
4. Once position X=200 has been reached, the NC waits for the acknowledgement of all auxiliary functions. This requires that the PLC sets bits Ch1_M010, Ch1_M011 and H1_Ack to "False".
5. After all auxiliary functions have been acknowledged, the NC moves the X-axis to position X=200.

6.3.4 Programming the Auxiliary Functions in the PLC

The following figures shows how the bit auxiliary functions M and the integer auxiliary functions H are programmed in the PLC program.

Auxiliary function M

Programming of the M auxiliary functions will be shown by the example of the "Tool Pot" tool swiveling device. The device is swiveled out by entering M80 in the NC program and back in by entering M86.

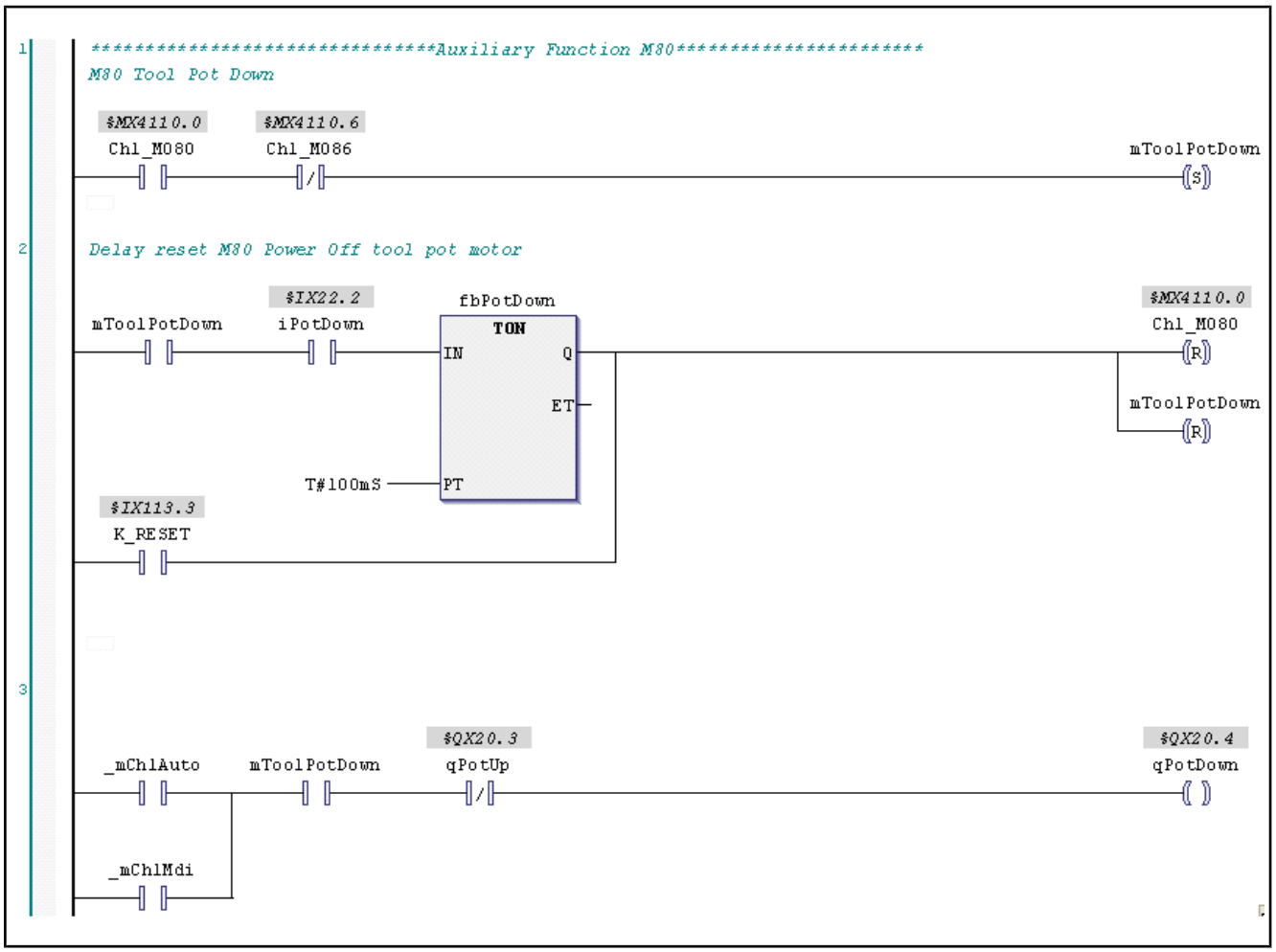


Fig.6-6: Programming the auxiliary function M

The auxiliary function Ch1_M80 is read in network 1. If this function is set (by the NC processing M80) and the counterfunction M86 is not set, an "mToolPotDown" flag is set to True. This flag controls the swiveling motion of the device.

The auxiliary function M80 is acknowledged in network 2. To achieve this, the PLC evaluates the "iPotDown" input signal with a TON delay. Once the signal for 100 ms is set to "True", M80 is acknowledged by resetting bit Ch1_M80. Flag "mToolPotDown" is also reset at the same time.

Using flag "mToolPotDown", network 3 controls the swivel-out motion of the device via the "qPotDown" output.

Auxiliary functions H

The H auxiliary functions can be used to transfer numerical values from the NC program to the PLC. This will be shown by the example of the "command pressure". A value of 50 is transferred to the PLC by entering H1=50 in the NC program.

PLC Startup

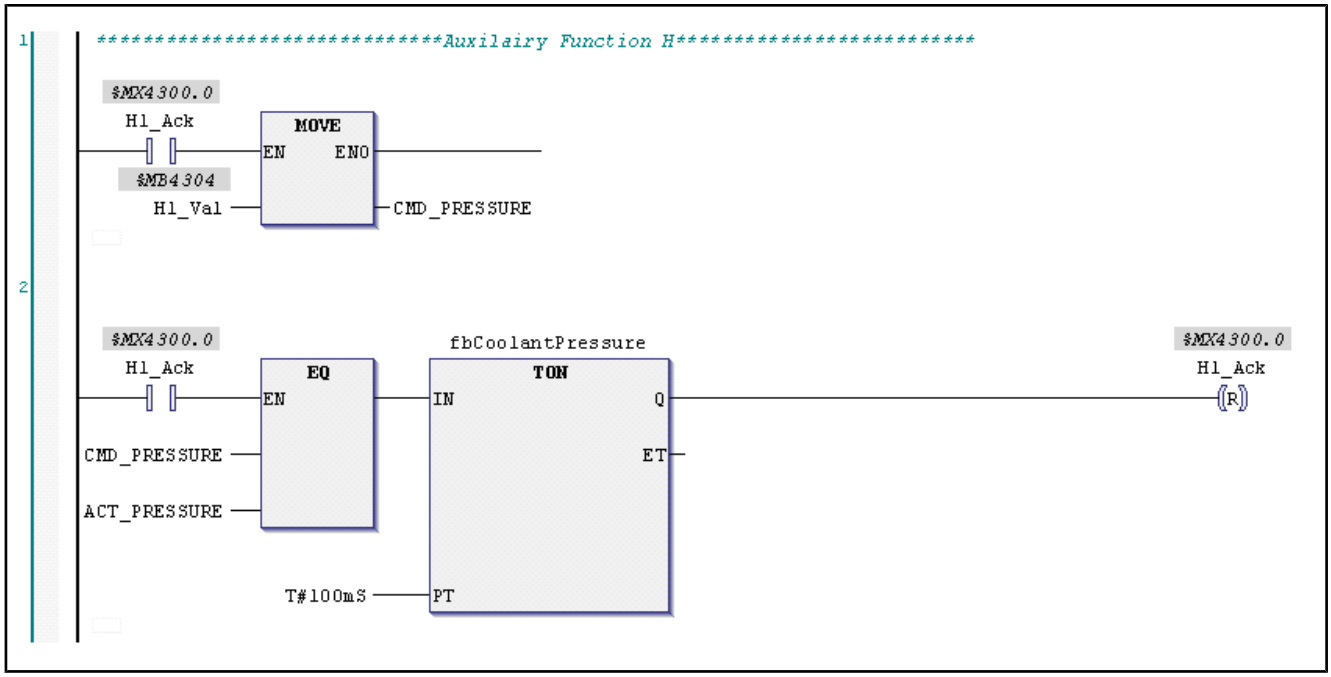


Fig.6-7: Programming the auxiliary function H1

Bit H1_Ack of the auxiliary function H1 is read out in network 1. The CNC sets this bit to True as soon as a new value is output. If bit H1_Ack = True, the new transferred value of the auxiliary function H1_Val is written to the PLC variable CMD_PRESSURE (INT).

Network 2 serves to acknowledge the auxiliary function. In the example, the system is to wait after the output until the pressure has reached the required value of 50. Once this value has been reached, the auxiliary function is acknowledged by resetting bit H1_Ack.

6.3.5 Auxiliary Function Groups

Auxiliary function groups are required for representing the current auxiliary functions on the HMI. The auxiliary function that was the last to be output is shown of each defined group. The figure shows an example where functions M3, S10 and T1 were the last to be output in their particular groups.

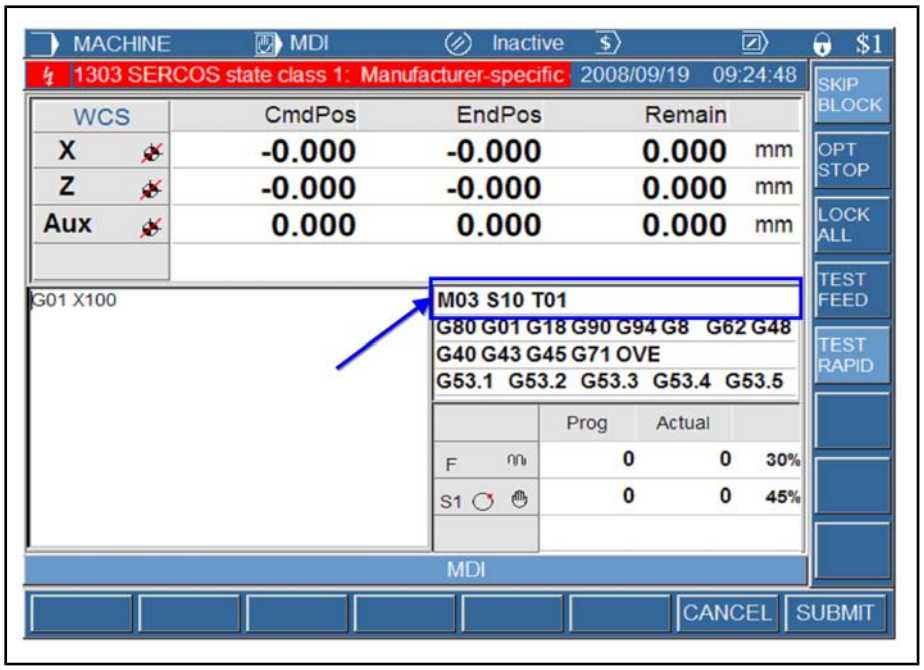


Fig.6-8: Displaying the auxiliary functions on the HMI

The MTX micro allows defining up to 64 auxiliary function groups and assigning up to 15 auxiliary functions to each of these groups. The basic projects are configured as shown in the figure below. Groups 1–14 should not be changed.

Description	1	2	3	4	5	6	7	8	9	10	11	12	13
Auxiliary function group 1 - Spindle 1 M-Codes	A:	M3	M4	M5	M13	M14	M19	M103	M104	M105	M113	M114	M119
Auxiliary function group 2 - Spindle 1 S-Value	A:	S	S1=										
Auxiliary function group 3 - Spindle 1 Gear Change	A:	M40	M41	M42	M43	M44	M48	M140	M141	M142	M143	M144	M148
Auxiliary function group 4 - Spindle 2 M-Codes	A:	M203	M204	M205	M213	M214	M219						
Auxiliary function group 5 - Spindle 2 S-Value	A:	S2=											
Auxiliary function group 6 - Spindle 2 Gear Change	A:	M240	M241	M242	M243	M244	M248						
Auxiliary function group 7 - T Code	S:	T											
Auxiliary function group 8 - Aux Func H1	A:	H1=											
Auxiliary function group 9 - Aux Func H2	A:	H2=											
Auxiliary function group 10 - Aux Func H3	A:	H3=											
Auxiliary function group 11 - Aux Func H4	A:	H4=											
Auxiliary function group 12 - Aux Func H5	A:	H5=											
Auxiliary function group 13 - Program Stop	S:	M0	M1	M2	M30								
Auxiliary function group 14 - Coolant	S:	M7	M8	M9									
Auxiliary function group 15 - Part Change	S:	M60											

Fig.6-9: Default assignment of auxiliary function groups

If you wish to have the auxiliary functions M80 and M86 (and therefore the previously programmed state of the swiveling device) displayed on the HMI, you must enter these two functions in a common group.

Example 301001014 = S:, M80, M86

PLC Startup

6.3.6 Special Auxiliary Functions

The MTX micro features some auxiliary functions with a special function. These functions are permanently assigned to a specific M-code and cannot be changed.

M0	Stops program	
	Effect	· Stops NC program · Stops machine motion after block execution and · Reports the channel-related interface signal "Program Stop M0".
	Programming	M0
M1	Stops program conditionally	
	Effect	· Stops NC program · Stops machine motion after the block execution if the channel-related interface signal "Conditioned Stop" is pending. (Selection from HMI)
	Programming	M1
M3, M103, M203 M13,, M113, M213	Spindle CW rotation "M3, M103, M203" Spindle CW rotation and coolant ON "M13, M113, M213"	
	Effect	· Starts - in relation to the "Tool to tool" angle - A spindle CW rotation · Deletes a position control enabled by "Align/position spindle".
	Programming	M3 Has an effect on the 1st spindle group M103 Has an effect on the 1st spindle M203 Has an effect on the 2nd spindle M13 Has an effect on the 1st spindle group. Additionally, coolant on. M113 Has an effect on the 1st spindle . Additionally, coolant on. M213 Has an effect on the 2nd spindle. Additionally, coolant on.
M4, M104, M204 M14, M114, M214	Spindle CCW rotation "M4, M104, M204" Spindle CCW rotation and coolant ON "M14, M114, M214"	
	Effect	· Starts - in relation to the "Tool to tool" angle - A spindle CCW rotation · Deletes a position control enabled by "Align/position spindle".
	Programming	M4 Has an effect on the 1st spindle group M104 Has an effect on the 1st spindle M204 Has an effect on the 2nd spindle M14 Has an effect on the 1st spindle group. Additionally, coolant on. M114 Has an effect on the 1st spindle. Additionally, coolant on. M214 Has an effect on the 2nd spindle. Additionally, coolant on.
M5, M105, M205	Spindle Stop	
	Effect	· Stops spindle(s) · Deletes position control enabled by "Align/position spindle".
	Programming	M5 Has an effect on the 1st spindle group M105 Has an effect on the 1st spindle M205 Has an effect on the 2nd spindle
M6	Calling NC program TCH	
	Effect	· Calling the main program of tool change (TCH).
	Programming	M6
M19, M119, M219	Position/align spindle	
	Effect	The spindle positions itself to a definable position in the position control.
	Programming	M19 Spindle group 1: all spindles position to their reference angle M119 1. Position spindle to reference angle M219 2. Position spindle to reference angle M19s<angle> Spindle group 1: all spindles position to <angle> M119 s1=<angle> 1. Position spindle to its <angle> M219 s2=<angle> 2. Position spindle to its <angle> <angle> Desired absolute spindle position in degree.
M30	Exit program	
	Effect	Exits program processing - transition to state "Ready"
	Programming	M30

Fig.6-10: Special functions with M-codes

In addition to the special M-codes, there are the following defined auxiliary functions:

T The T-function starts the tool search and the preparation in the PLC.

S1, S2 The S1, S2 functions serve to program the speed command value for spindles 1 and 2 and to automatically transfer the value to the spindle.

S The S-function has the same behavior as the S1 function, with S200 corresponding to S1=200.

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6.4 Diagnostics (Machine Status Display)

6.4.1 General

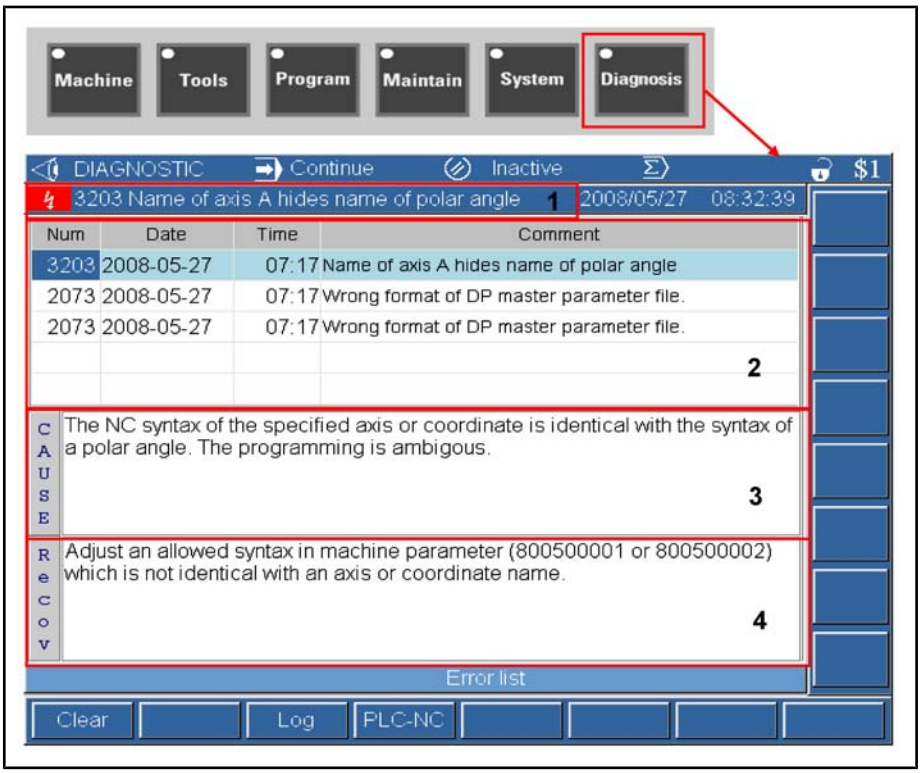
Errors, warnings and messages displayed in plaintext during ongoing operation help to reduce standstill and startup times. The machine status display (MSD) allows generation of a total of 2048 messages from the PLC program. The NC user interface signals the corresponding diagnostics to the user in plaintext. Each diagnostics message is controlled by a separate message bit in the PLC program. The MTX micro-c saves the displayed MSD diagnostics messages in a logbook in the CNC. A diagnostics message can be displayed as

- an error (red),
- a warning (yellow), or
- a note (green) on the user interface.

6.4.2 MSD Message Display

Currently existing messages are displayed in the diagnostics bar on the HMI screen (1). This bar is visible on all screens. If active at the same time, several messages are displayed alternately in the diagnostics bar.

The "Diagnosis" operating area displays all active messages and more detailed diagnostics texts relating to these messages.



1: Diagnostic bar in the header
2: List of active diagnostics messages
3: Text describing the cause of the message selected under 2
4: Text describing a remedy for the message selected under 2

Fig.6-11: Diagnostics message display on the HMI

6.4.3 Message Classification

If a specific machine status occurs, there should also be a specific reaction. The MTX micro-c features such an option of classifying the MSD messages.

The number of the message (1–2048) defines the reaction of the CNC to this message.

Class	First message	Last message	CNC Reaction
Emergency stop	401	600	Immediate stop of all axes movements, switching mains contactor off after stop
Immediate stop	601	800	Immediate stop of all axes movements
End of cycle stop	801	1000	Stop program when M30 was reached
Drive lock, drive 1	1001	1040	Lock drive 1 movements, Immediate stop of active movements
Drive lock, drive 2	1041	1080	Lock drive 2 movements, Immediate stop of active movements
Drive lock, drive 3	1081	1120	Lock drive 3 movements, Immediate stop of active movements
Drive lock, drive 4	1121	1160	Lock drive 4 movements, Immediate stop of active movements
Drive lock, drive 5	1161	1180	Lock drive 5 movements, Immediate stop of active movements
Drive lock, drive 6	1181	1200	Lock drive 6 movements, Immediate stop of active movements
Message	1201	2048	No reaction

Fig.6-12: MTX micro-c message classes

Message numbers 1 to 400 are reserved to the system PLC program and may not be programmed!

Active message classes are determined by the "MTXmicro_Diag" function block in the prDiag PLC program. A global flag is output for each message class.

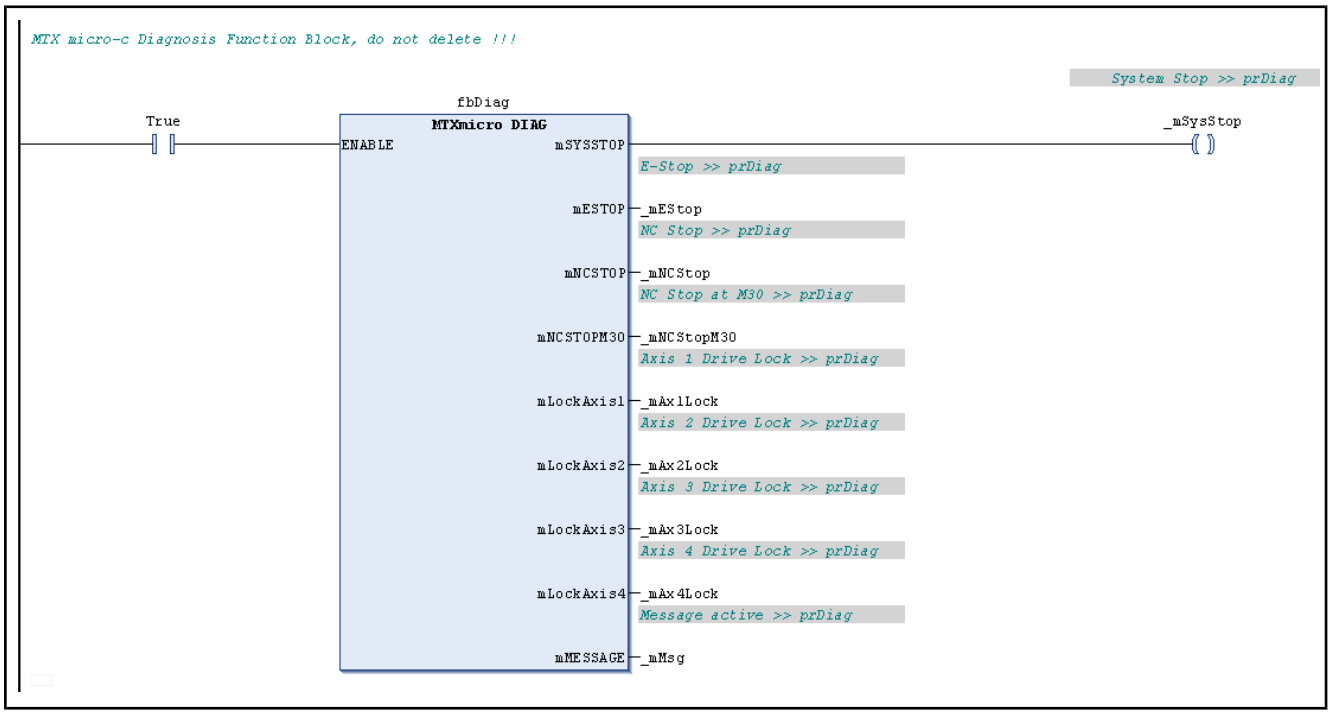


Fig.6-13: prDiag with MTXmicro_DIAG function block

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- The PLC program allows read access to the flags of the MTXmicro_DIAG function block (e.g., _mEStop).
- Write access is not allowed!

6.4.4 Programming the Messages

An MSD message is active as long as the corresponding message bit of the MSD interface is set to TRUE. The following figure shows several options of programming a message.

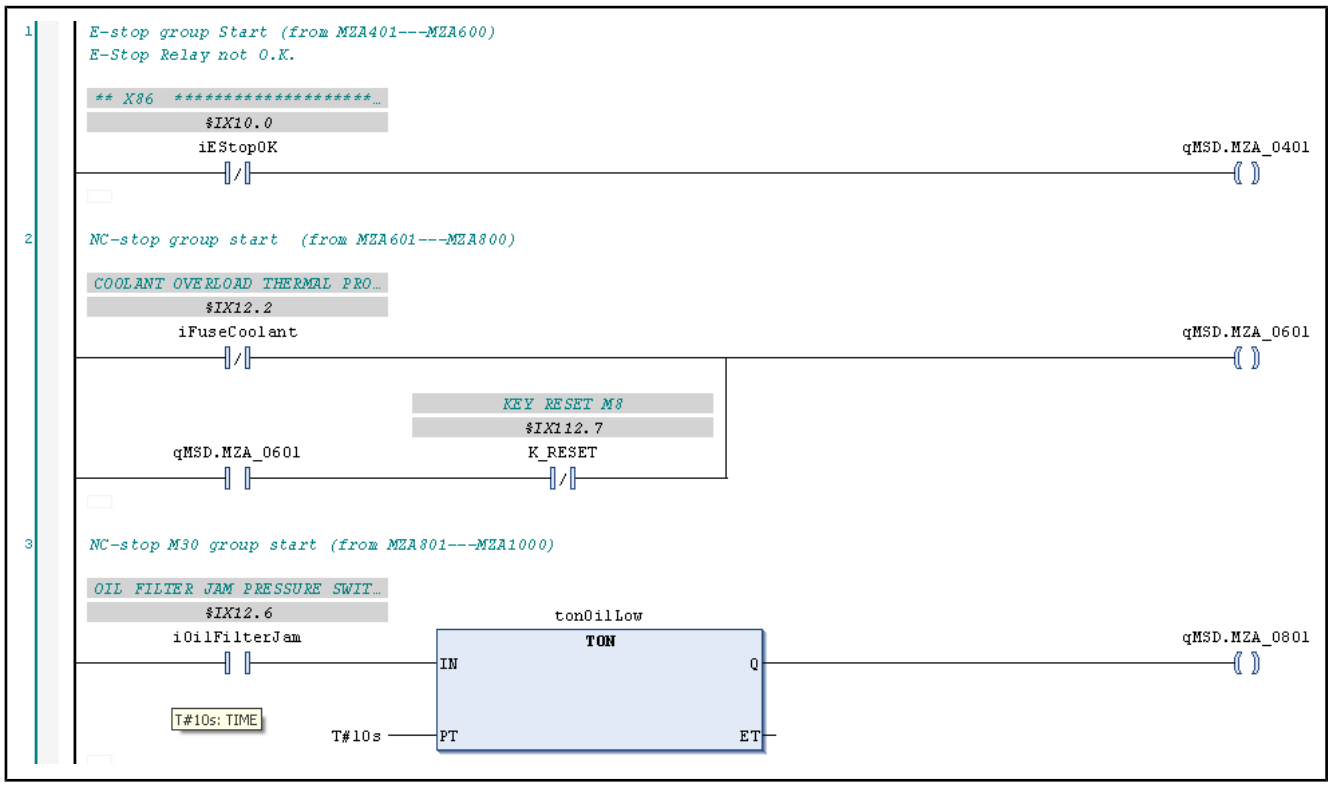


Fig.6-14: Programming the MSD messages

Network 1 generates the E-stop message 401 if iEStopOK = FALSE. If iFuse-Coolant = False, an NC stop message 601 is generated. This message remains active until the Reset key is actuated. Network 3 generates an NC stop M30 message if the iOilFilterJam input is set to TRUE for at least 10 s.

An MSD message can always be programmed at any point in the PLC user program. We recommend that you program an MSD message in the "prDiag" program because this considerably facilitates finding the message.

6.4.5 Managing the Message Texts

Message texts are saved in ASCII files in the file system of the CNC. One file is created for each language. The file name is mzatexte.xxx, with xxx standing for the language of the message file. The file storage location is /usrfep.

Language	MZA file extension
German	.049
English	.044
Chinese	.086
French	.033
Italian	.039

Fig.6-15: MSD file names

A total of 2048 messages can be defined. Each message is assigned a serial number from 1 to 2048. The list of messages can contain gaps.

The messages are distinguished as follows:

- Machine errors have an ID of E
- Machine warnings have an ID of W
- Machine notes have an ID of M

There is a message text for every message; optionally, a cause-and-remedy text can also be defined. The length of each message text is limited to 128 characters.

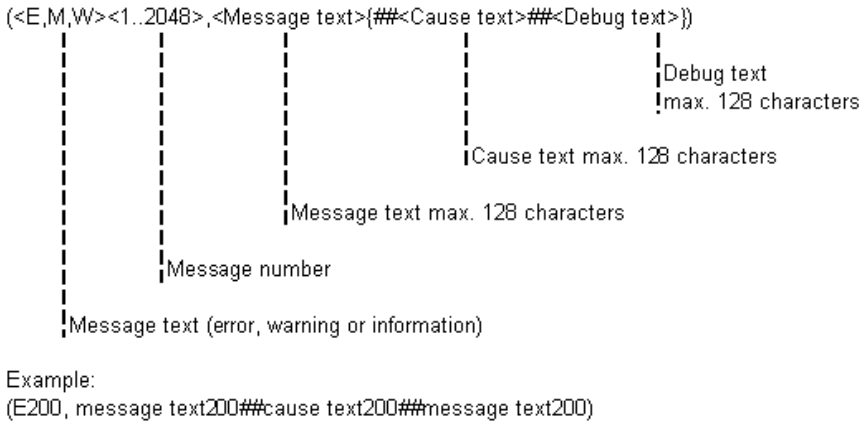


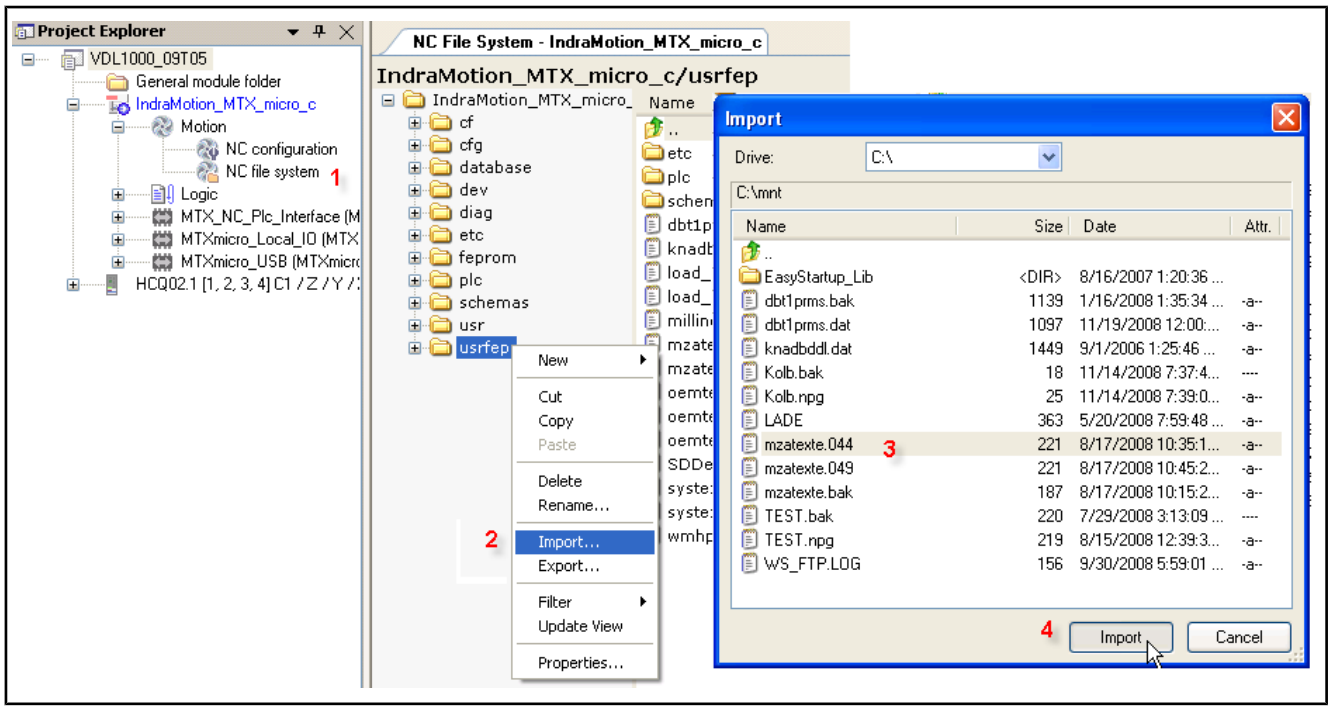
Fig.6-16: mzatexte file structure

- Texts which cannot be displayed in the ASCII character set can be entered in UTF8 character coding. When using the UTF8 format, the text length is shorter for up to 2/3 of the displayable characters corresponding to the coding effort.
- UTF-8 files are saved to the notepad. Select UTF-8 as coding in the "Save As..." dialog. The characters will then be saved in UTF-8 format. Caution: The NC editor can only edit ASCII files. These files must be edited externally via the notepad and then be copied to the system.

PLC Startup

6.4.6 Importing the Message File

We recommend that you create the mzatexte.xxx file using an external editor (utf8 format) and then transfer it to the CNC file system using IndraWorks Engineering.



1: Double-click on the NC file system to open it.
2: Select the /usrfep directory and double-click on "Import…".
3: Select an mzatexte.xxx file to be imported to the hard disk.
4: Click on Import.

Fig.6-17: Importing the mzatexte.044 message file

7 NC Parameterization

7.1 Introduction

This chapter describes how to parameterize the NC. It is assumed that the NC parameters have already been downloaded correctly (TAR file, see chapter 1.4).

If the appropriate IndraWorks basic project was used, most of the NC parameters are already preset correctly. The only adjustments that must still be made refer to velocities, travel ranges, etc.

We nevertheless recommend that you check and, if necessary, adjust the NC parameters mentioned in this chapter.

NC Parameterization

7.2 NC Configuration / Parameter Editor

7.2.1 Introduction

The NC is parameterized via the NC configuration.

This requires that the NC be switched to online mode. This is indicated by IndraMotion_MTX-micro_c being displayed in blue along with the online icon.

Fig.7-1: Online icon

Proceed as follows:

1. Open the IndraMotion_MTX_micro_c node in the active IndraWorks project.
2. Open the Motion node.
3. Open the NC configuration (double-click).

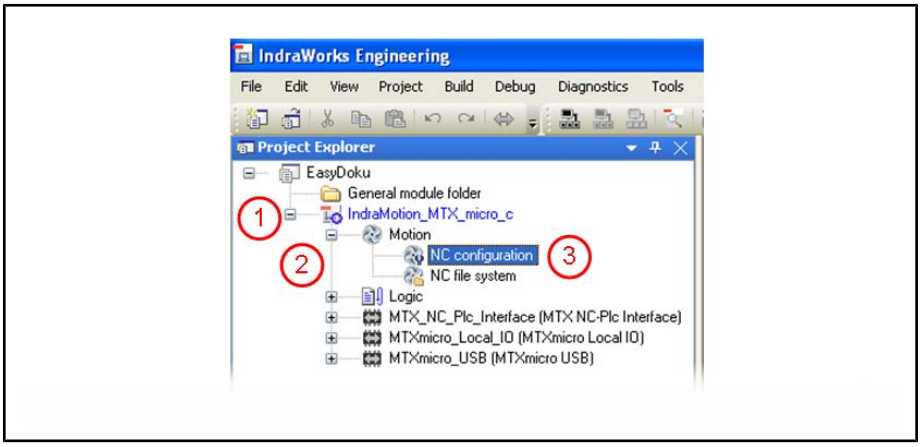
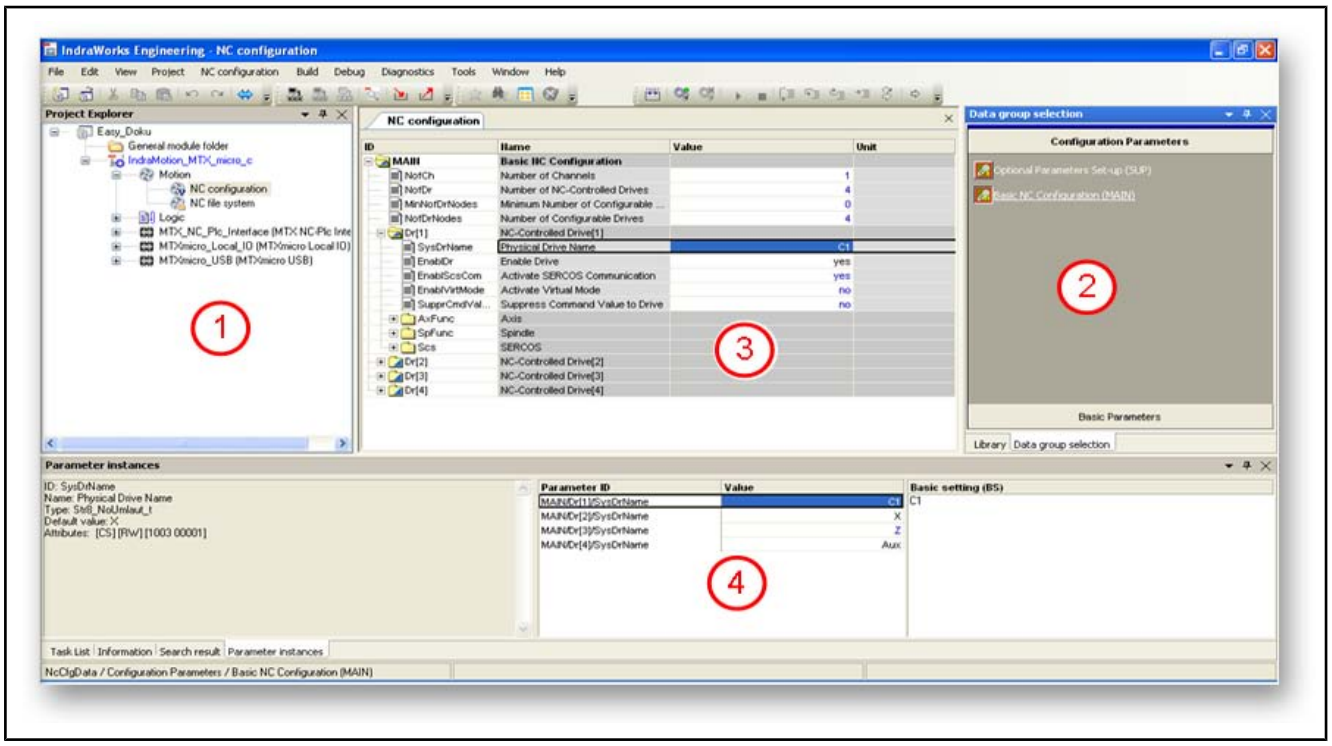


Fig.7-2: Opening the NC configuration

7.2.2 Basic Layout

After the NC configuration has been opened for the first time, the basic layout displays the Basic NC Configuration (MAIN). Otherwise, the previous setting is displayed.



1: Project Explorer
2: Parameter groups
3: Working area/parameter editor
4: Quick editor

Fig.7-3: Basic NC configuration screen

If you wish to restore the basic NC configuration layout, proceed as follows:

1. Window
2. Reset Windows Layout
3. View
4. Selection Window

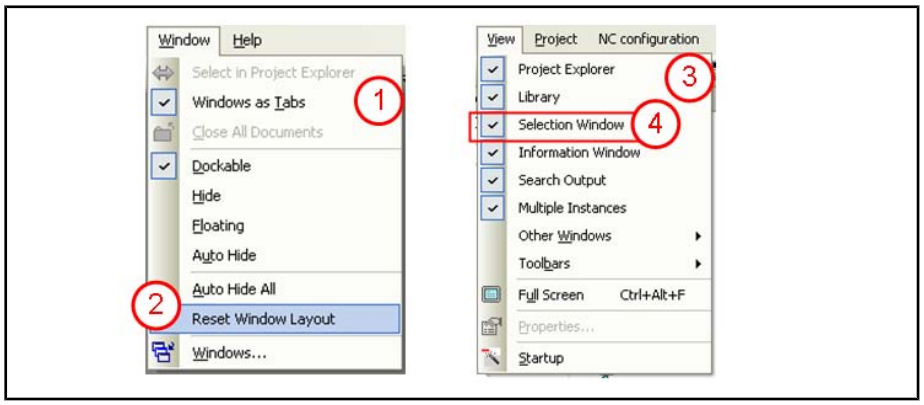


Fig.7-4: Restoring the basic setting of the IndraWorks layout for parameterizing the NC

NC Parameterization

7.2.3 Parameter Groups

There are two main NC parameter groups, i.e., configuration parameters and basic parameters.

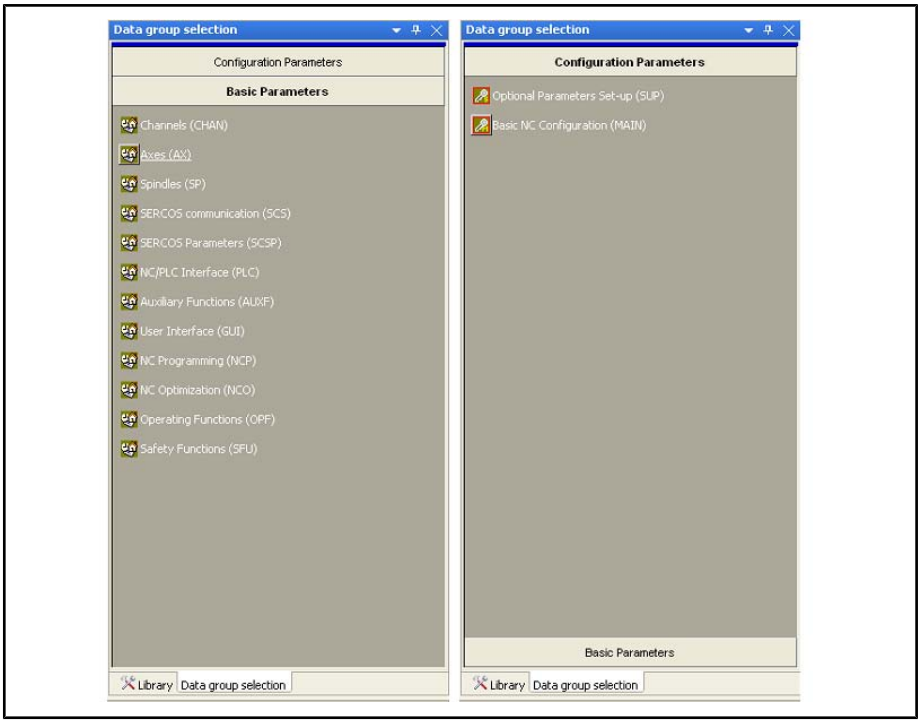


Fig.7-5: Parameter groups

7.2.4 Quick Editor

Use the XXX-box to simplify the display and accelerate editing.

Proceed as follows:

1. Select Physical Drive Name. The selected line is highlighted with borders and blue coloring.
2. All drives for this parameter are listed in the bottom area. The selected parameter can be edited for all axes in this window.

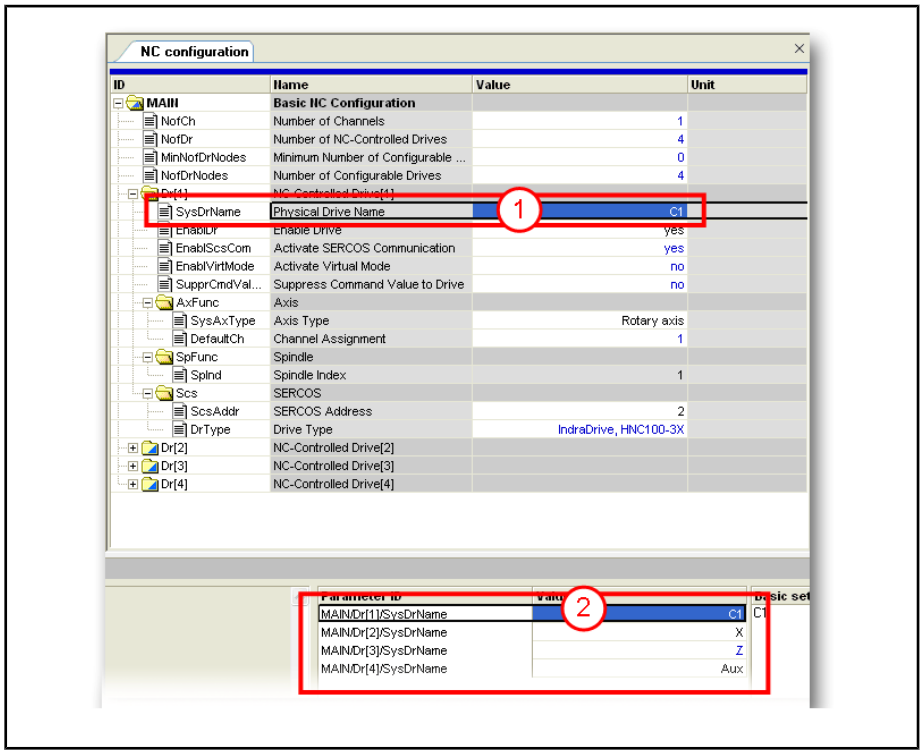


Fig.7-6: Parameterization window

This procedure applies to all NC parameters.

NC Parameterization

7.2.5 Parameter Description / Help

Parameters are explained under Information.

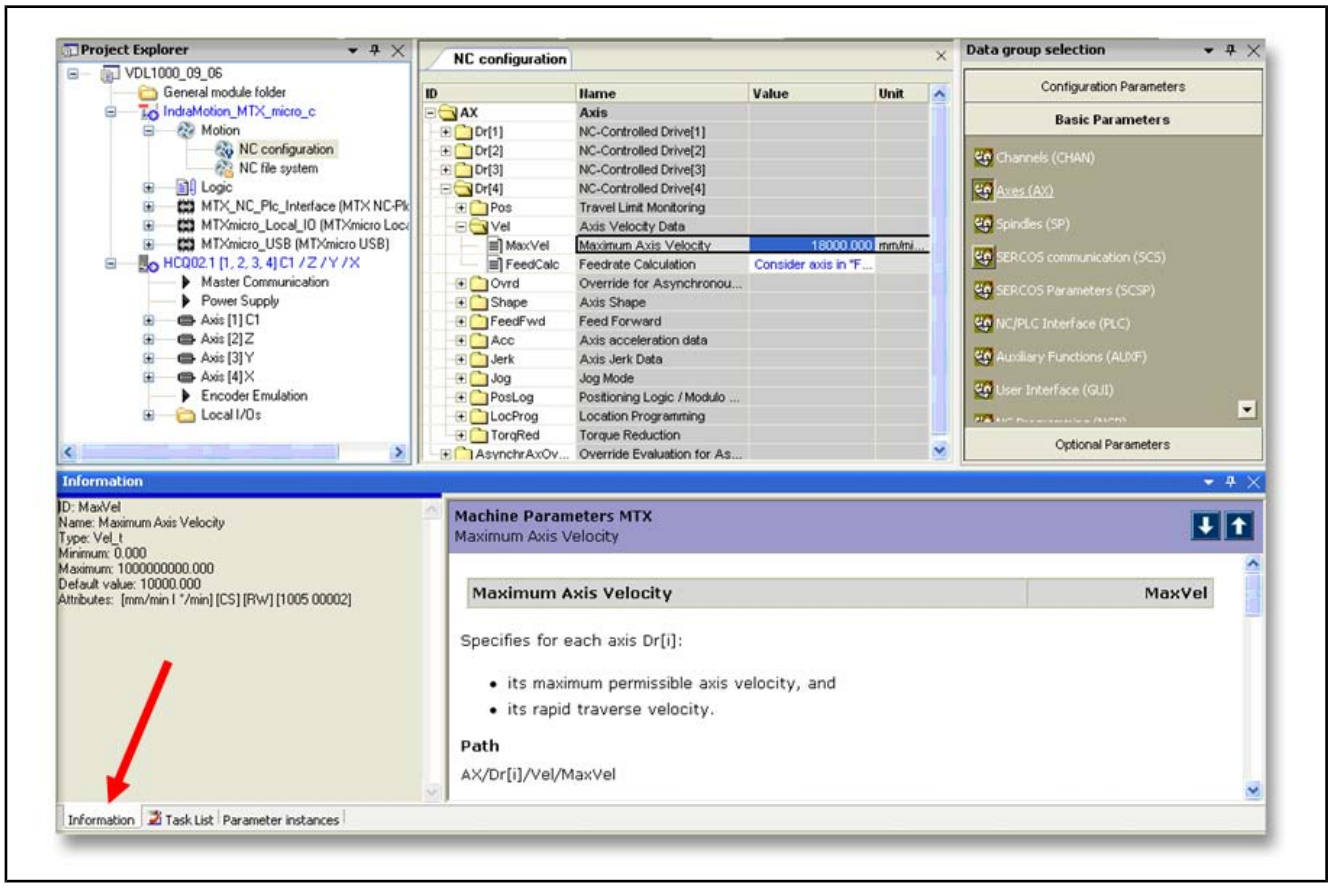


Fig.7-7: Parameter description and help

7.3 Basic Configuration

7.3.1 Introduction

The basic setting of the machine is made and/or checked in the configuration parameters.

Proceed as follows:

1. Configuration Parameters
2. Basic NC Configuration (MAIN)

Checking the drive assignment

Open nodes Dr[1] to Dr[4].

Check the assignment of the drives to your machine (see Fig.: 4-2).

1. Number of NofCh channels (usually one channel)
2. Number of NofDr NC axes (4 in case of HCQ and 3 in case of HCT controllers)
3. Number of NofDrNodes drives
4. Node SpFunc indicates that this drive is a spindle.

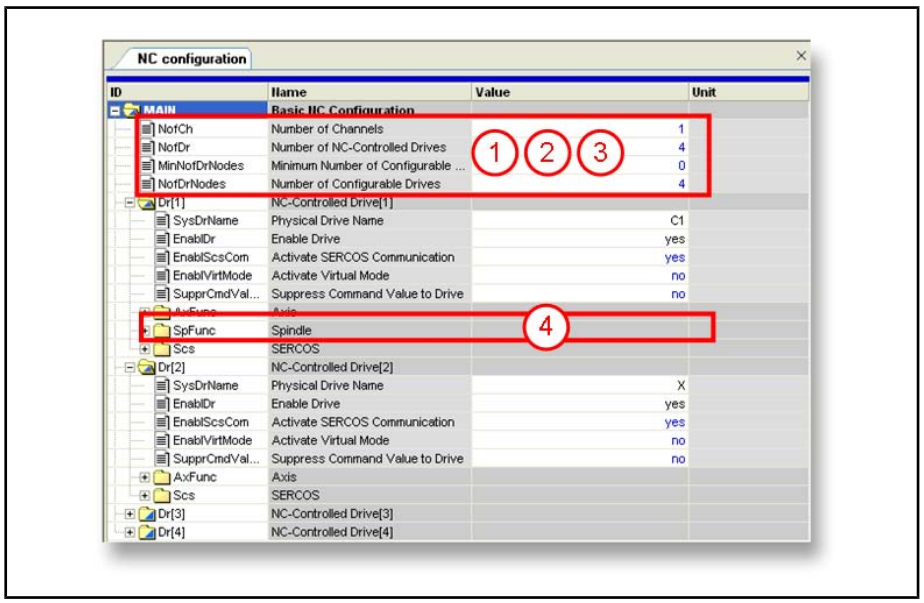


Fig.7-8: MAIN

Open all nodes in the first drive DR[1].

Check the assignment of the drive to your machine.

1. Physical axis name SysDrName
2. Linear / rotary axis SysAxType
3. SERCOS address ScsAddr

NC Parameterization

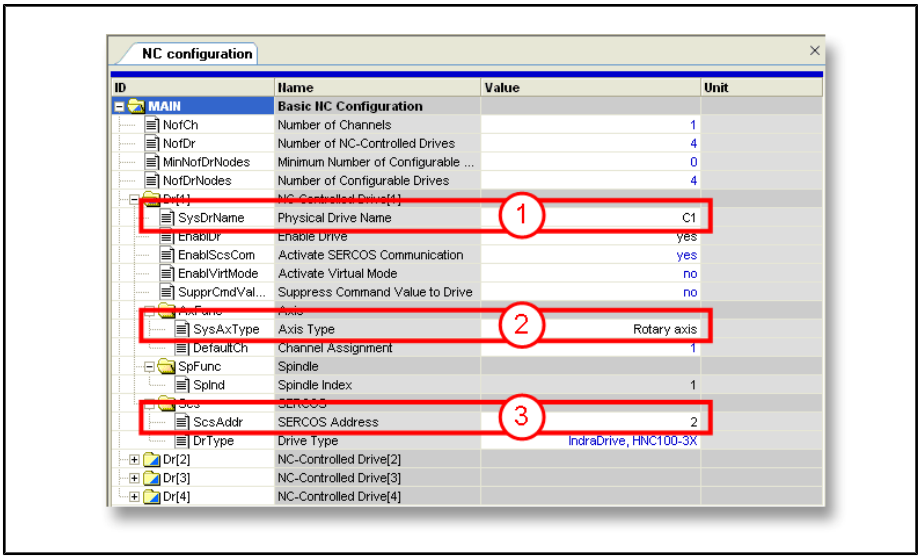


Fig.7-9: Basic configuration

Basic setting

Check the basic setting of the machine.

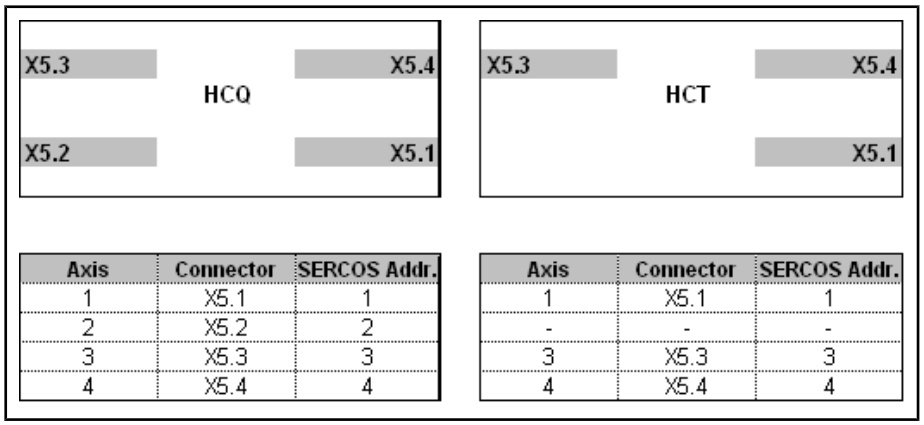
Name	Path
Number of Channels	MAIN/NofCh
Number of NC-Controled Drives	MAIN/NofDr
Number of Configurable Drives	MAIN/NofDrNodes
Physical Drive Name	MAIN/Dr[i]/SysDrName
Axis Type	MAIN/Dr[i]/AxFunc/SysAxType
SERCOS Address	MAIN/Dr[i]/Scs/ScsAddr

Fig.7-10: Basic parameter setting

Most of these parameters are already set if you use the basic projects.

7.3.2 Assigning the Axes to the Drives

The system axes are assigned to the drives of the HCQ02 and HCT02 drive controllers by assigning the SERCOS address in the NC configuration. The SERCOS addresses are permanently assigned to the drives. The assignments are shown in the following figure.



Axis	Connector	SERCOS Addr.
1	X5.1	1
2	X5.2	2
3	X5.3	3
4	X5.4	4

Axis	Connector	SERCOS Addr.
1	X5.1	1
-	-	-
3	X5.3	3
4	X5.4	4

Fig.7-11: Relation between drive, connection and SERCOS address

The following axis configurations are defined in the basic projects:

Milling Machine (HCQ) - Milling

System Axis	Phys. Name	SERCOS Addr.	Connection
Dr[1]	C1	1	X5.1
Dr[2]	X	3	X5.3
Dr[3]	Y	4	X5.4
Dr[4]	Z	2	X5.2

Turning Center (HCQ) - Turning with 2 Spindles

System Axis	Phys. Name	SERCOS Addr.	Connection
Dr[1]	C1	1	X5.1
Dr[2]	C2	2	X5.2
Dr[3]	X	3	X5.3
Dr[4]	Z	4	X5.4

Turning Machine (HCT) - Turning with 1 Spindle

System Axis	Phys. Name	SERCOS Addr.	Connection
Dr[1]	C1	1	X5.1
Dr[2]	X	3	X5.3
Dr[3]	Z	4	X5.4
Dr[4]	-	-	-

Fig.7-12: Axis configurations of default projects

NC Parameterization

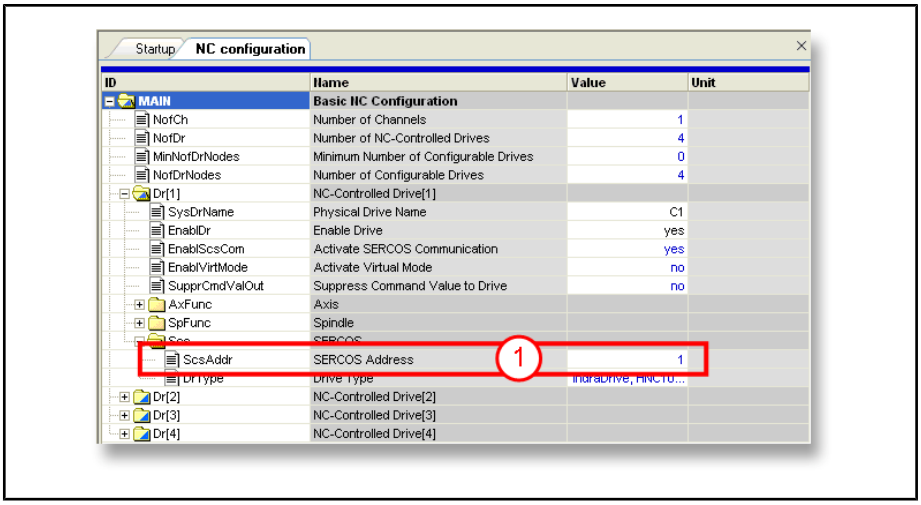


Fig.7-13: Parameter axis assignment

The axis is assigned to a specific connection by changing the SERCOS address (MAIN/Dr[i]/Scs/ScsAddr).

Parameters for linear axes

Now set the travel range limits, the velocity and the acceleration.

Relations are shown in the following figures:

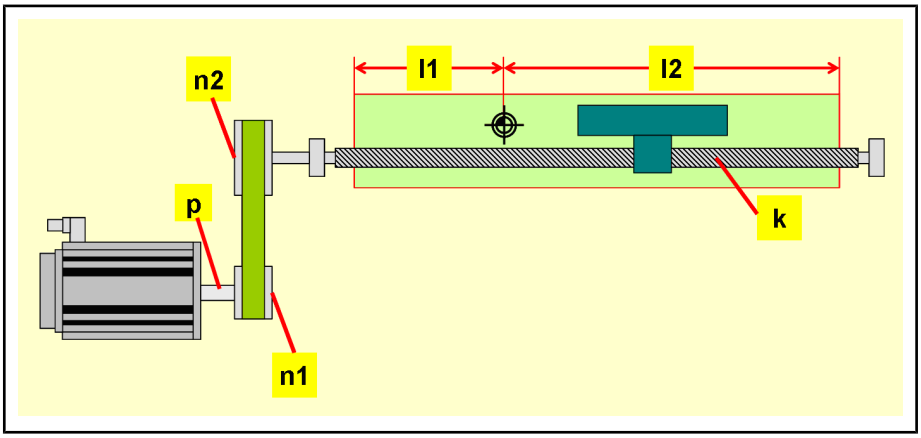


Fig.7-14: Schematic diagram 1

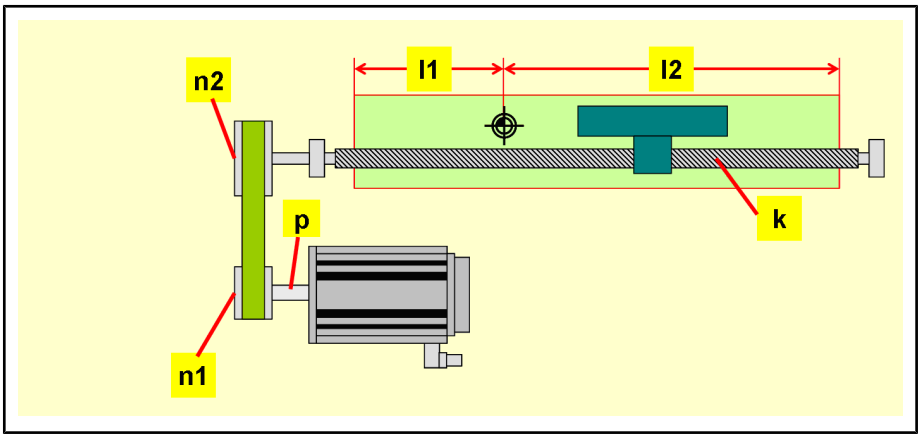


Fig.7-15: Schematic diagram 2

Name	Path	
Positive travel limit	AX/Dr[i]/Pos/TrvLim[1..2]/PoTrvLim	I1
Negative travel limit	AX/Dr[i]/Pos/TrvLim[1..2]/NeTrvLim	I2
Maximum axis velocity	AX/Dr[i]/Vel/MaxVel	
Maximum axis acceleration	AX/Dr[i]/Acc/MaxAxAcc	

Fig.7-16: NC parameter axes

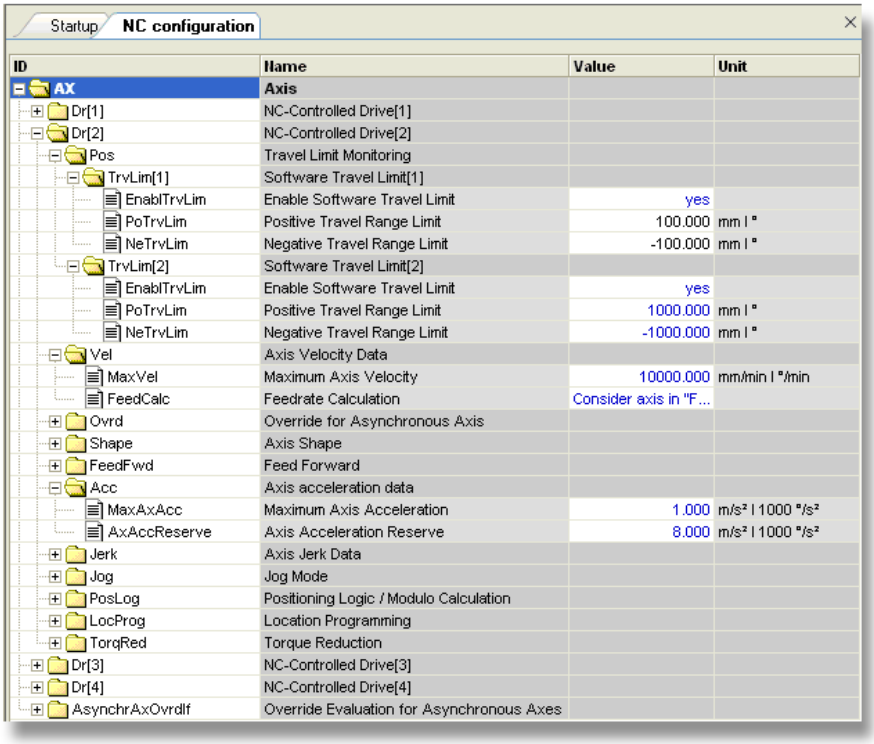


Fig.7-17: Parameter setting for axes: travel range, velocity, acceleration

Two travel range limits TrvLim[1] and TrvLim[2] can be defined for each axis. Switching between these two travel ranges can be controlled via the PLC. If you need only one travel range, we recommend that you set the two travel ranges to the same limits.

Setting of the parameters for the gear (n1, n2), spindle pitch (k) and position polarity (p) is explained in chapter 8 "Commissioning the Drives" on page 89.

Setting the spindle parameters

To set the spindle parameters, you must first decide whether you need a spindle or a spindle C-axis. The basic projects of the MTXmicro each feature preconfigured spindle C-axes. You should define a pure spindle only if there is no position encoder available for the spindle.

When do you need a spindle C-axis?

A turning machine needs a spindle C-axis if one of the following functions is required:

- Face transformation COORD(3))
- Cylinder jacket transformation (COORD(1..2))
- Thread cutting (G33)

A spindle C-axis is required on a milling machine or on the tool spindle of a turning machine for the following functions:

- Tapping without compensating chuck (G63)

Selecting the spindle

To select the spindle, the drive type must be changed in the NC configuration under "SpFunc". Select the appropriate drive for configuration, right-click on the drive, select "Modify into" from the context menu, and continue with "SpFunc".

Selecting the spindle C-axis

If you wish to modify a spindle into a spindle C-axis, select "AxFunc/SpFunc" from the context menu.

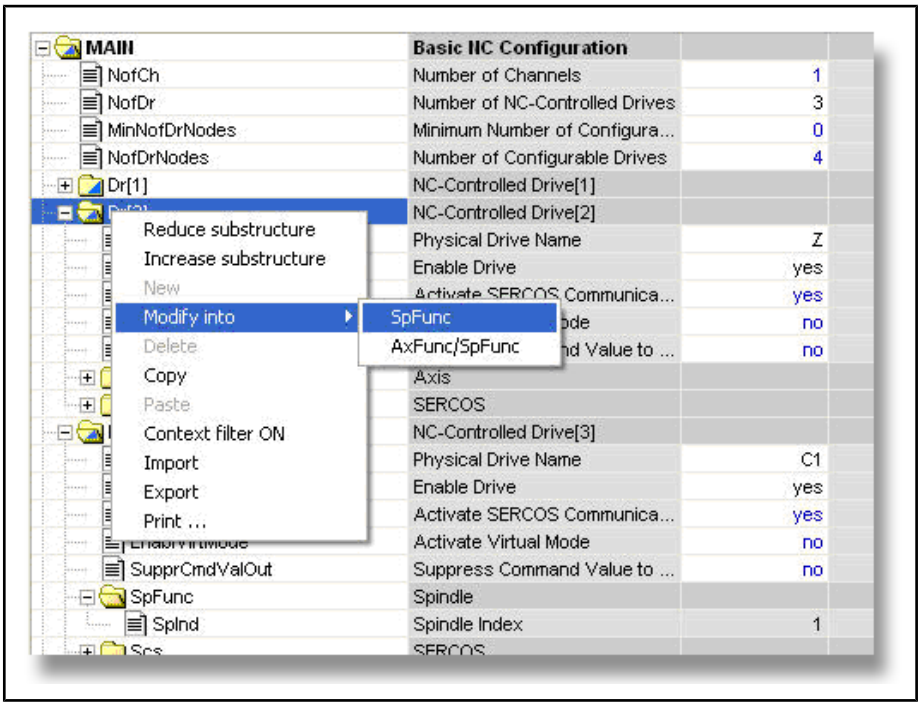


Fig.7-18: Defining a drive as spindle / spindle C-axis

Spindle index and system axis index

Basic settings for the spindles are made in the "SP" and "SCSP" data groups. In the SP data group, the decisive parameterization factor is the spindle index. This index is automatically assigned when a spindle or spindle C-axis is created. Spindle index 1 is assigned to the spindle having the lowest system axis index, spindle index 2 to the spindle with the next higher system axis index.

Example:

A system comprises 4 system axes Dr[1] X; Dr[2] Z, Dr[3] C1, Dr[4] C2. Axes X, Z are linear axes; C1 is a spindle C-axis; C2 is a spindle.

System Axis	Type	Phys. Name	SCSP	Ax	Sp
Dr[1]	AxFunc	X	SCSP[1]	Ax[1]	-
Dr[2]	AxFunc	Z	SCSP[2]	Ax[2]	-
Dr[3]	AxFunc/SpFunc	C1	SCSP[3]	Ax[3]	Sp[1]
Dr[4]	SpFunc	C2	SCSP[4]	-	Sp[2]

Fig.7-19: Relation between axis index and spindle index

The figure above shows the relation for the example, with spindle index Sp[1] being automatically assigned to the system axis Dr[3] and index Sp[2] to Dr[4].

Parameterizing spindle functions

First parameterize the spindle functions for each spindle in the SP data group.

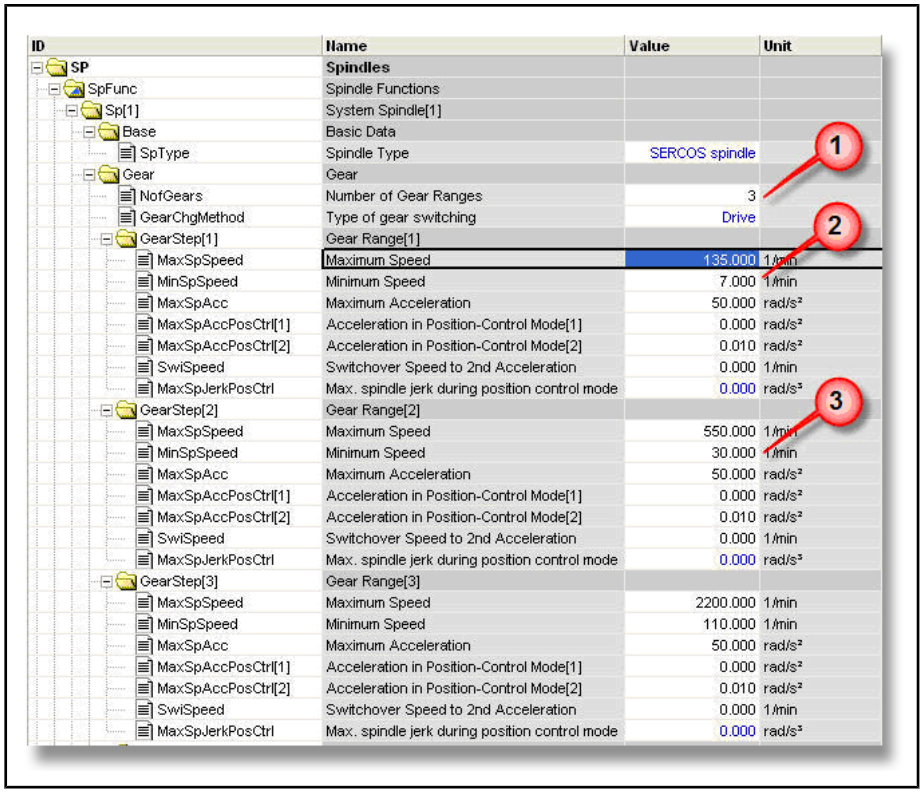


Fig.7-20: Basic spindle function settings

Set the following parameters:

1. NofGears – number of the gear stages required (1 without gear)
2. Define the following parameters for each gear stage:
   - MaxSpSpeed – maximum speed
   - MinSpSpeed – minimum speed
   - MaxSpAcc – maximum acceleration
3. If the spindle is to be able of "tapping without compensating chuck (G63)", make the following setting:
   - MaxSpAccPosCtrl[1] – acceleration in position control mode; recommended: 50% MaxSpAcc

Speed window

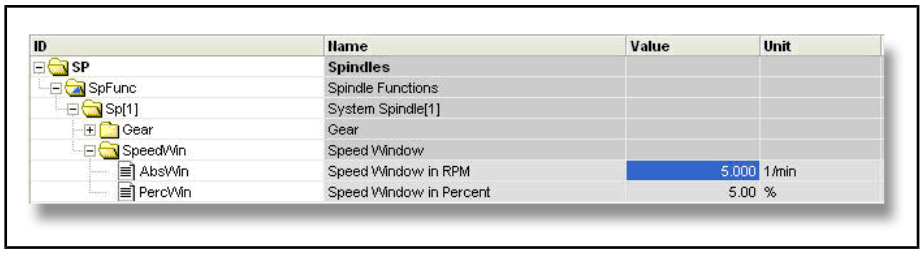


Fig.7-21: Setting the speed window

Then set the speed windows for the "Speed reached" bit. Both windows are effective at the same time, with the percent window PercWin acting in high speed ranges and the absolute window AbsWin in low speed ranges.

Recommendation: AbsWin = 5.0, PercWin = 5.0

NC Parameterization

Gear ratios

Each gear stage has a parameter set assigned to it in the drive, with the index of the parameter ParSet [ ] corresponding to the previously defined gear stage GearStep [ ].

The following applies: GearStep[1] → ParSet[1], GearStep[2] → ParSet[2]

Configuring gear switching in the drive

Gear switching must also be configured in the drive itself. This can be achieved in the "Parameter Set Switching" dialog in the IndraWorks-Drive. The number of parameter blocks (1) and the parameter groups (2) are directly specified by the CNC. The parameter block can be copied by clicking on the "Copy parameter set 0 to" button (3).

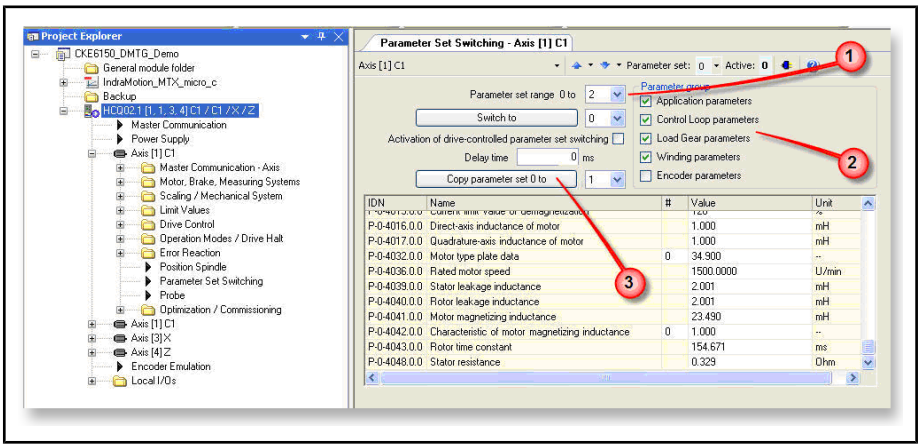


Fig.7-22: Configuring parameter block switching

The "Activation of drive-controlled parameter block switching" checkbox may not be activated.

We recommend that you proceed as follows to commission a gear:

1. Enter the data of the gear stages in the NC configuration.
2. Program the gear switching in the PLC.
3. Commission the spindle motor in gear stage 1 (optimize, if necessary).
4. Copy parameter block 0 (gear stage 1) to parameter block 1. **Then turn off/on.**
5. Switch the gear to gear stage 2 (e.g., M42).
6. Commission the spindle motor in gear stage 2 (optimize).

Repeat steps 4 to 6 for each gear stage.

For more information on gear switching in the PLC, please refer to the MTX-PLC-CNC Interface description.

8 Commissioning the Drives

8.1 Displaying the Drives

To display the drives, proceed as follows:

1. Set the focus on the "IndraMotion_MTX_micro_c" node of the Project Explorer, double-click and select "Show Drives" from the context menu that appears.
2. The drives are displayed in the "Drives" node of the Project Explorer.

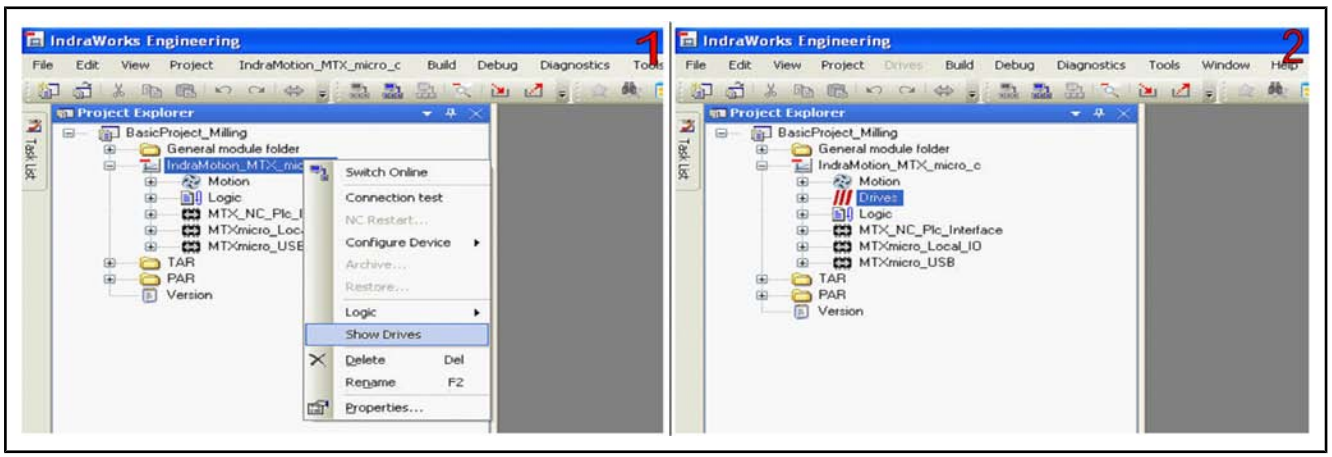


Fig.8-1: Displaying drives

Commissioning the Drives

8.2 Initializing the Drive Parameters

8.2.1 Loading the Basic Parameters

At first, the basic parameters must be loaded for all drives. To achieve this, the drives must be switched to parameterization mode (phase 2). Proceed as follows:

1. Click on <Maintain>☐<F2> (Login).
2. Select <MTB> as user.
3. Enter the password for the <MTB> user.
4. Press <Enter>. The HMI shows "MTB" as Current User.
5. Click on <System>☐<F2> (DrivePar).
6. Click on the <Phase 2> M-key. The drive will be set to phase 2 after a few seconds.

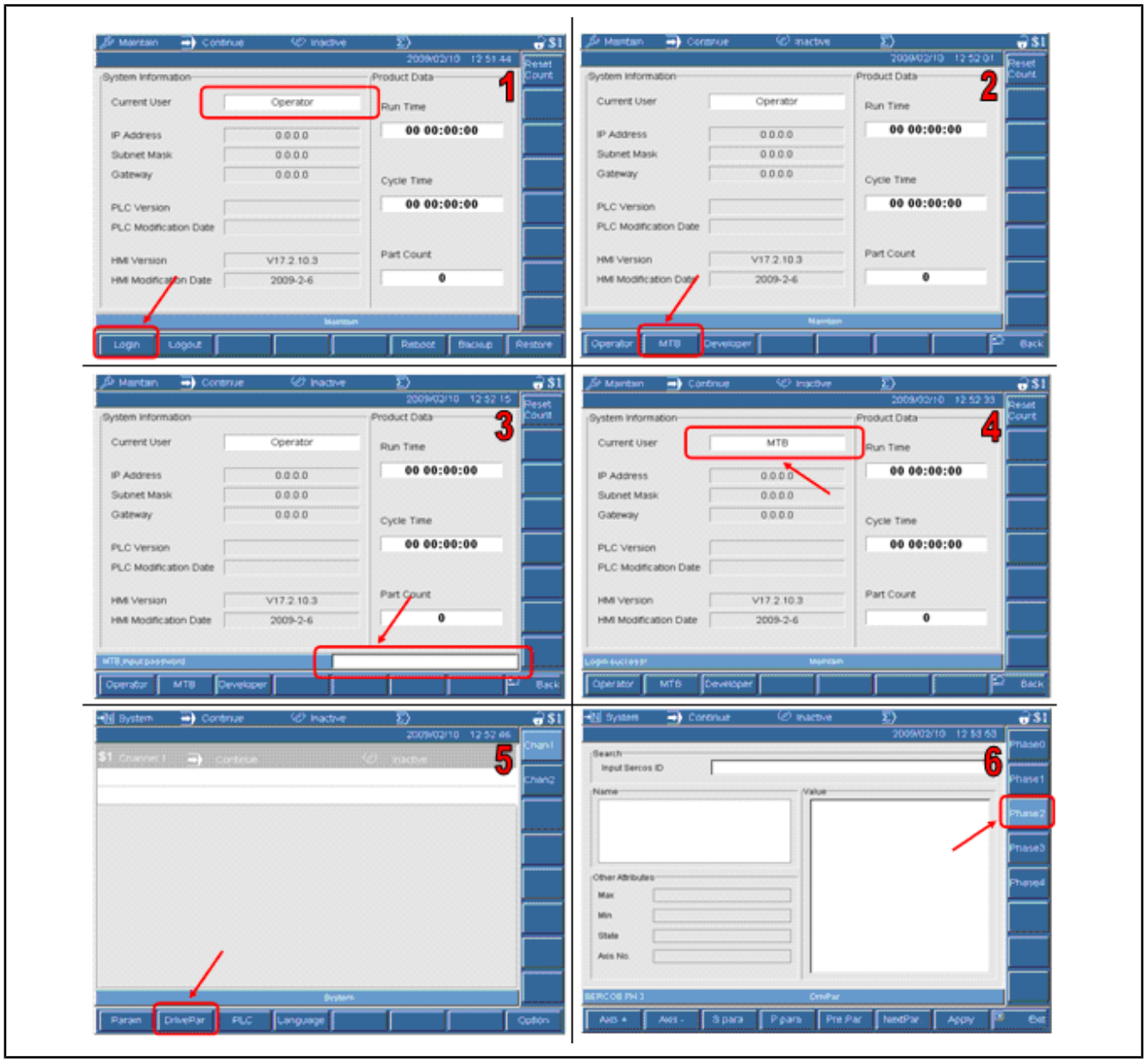


Fig.8-2: Switching a drive to phase 2

You can now load the basic parameter block of the drive.

To do this, proceed as follows in IndraWorks Engineering:

1. Set the focus on the "IndraMotion_MTX_micro_c" node of the Project Explorer, double-click and select "Show Online" from the context menu that appears.
2. If the HCQ (or HCT) drive is shown on a blue or red background, the drives are switched to online mode.
3. Set the focus on the node of an axis of the Project Explorer,e.g. "Axis[X]", right-click and select "Parameters→Load Basic Parameters…" from the context menu that appears.
4. Click on "Carry out" to load the basic parameters.
5. After "Load Basic Parameters" has been completed successfully, click on "Close" to finish the process.

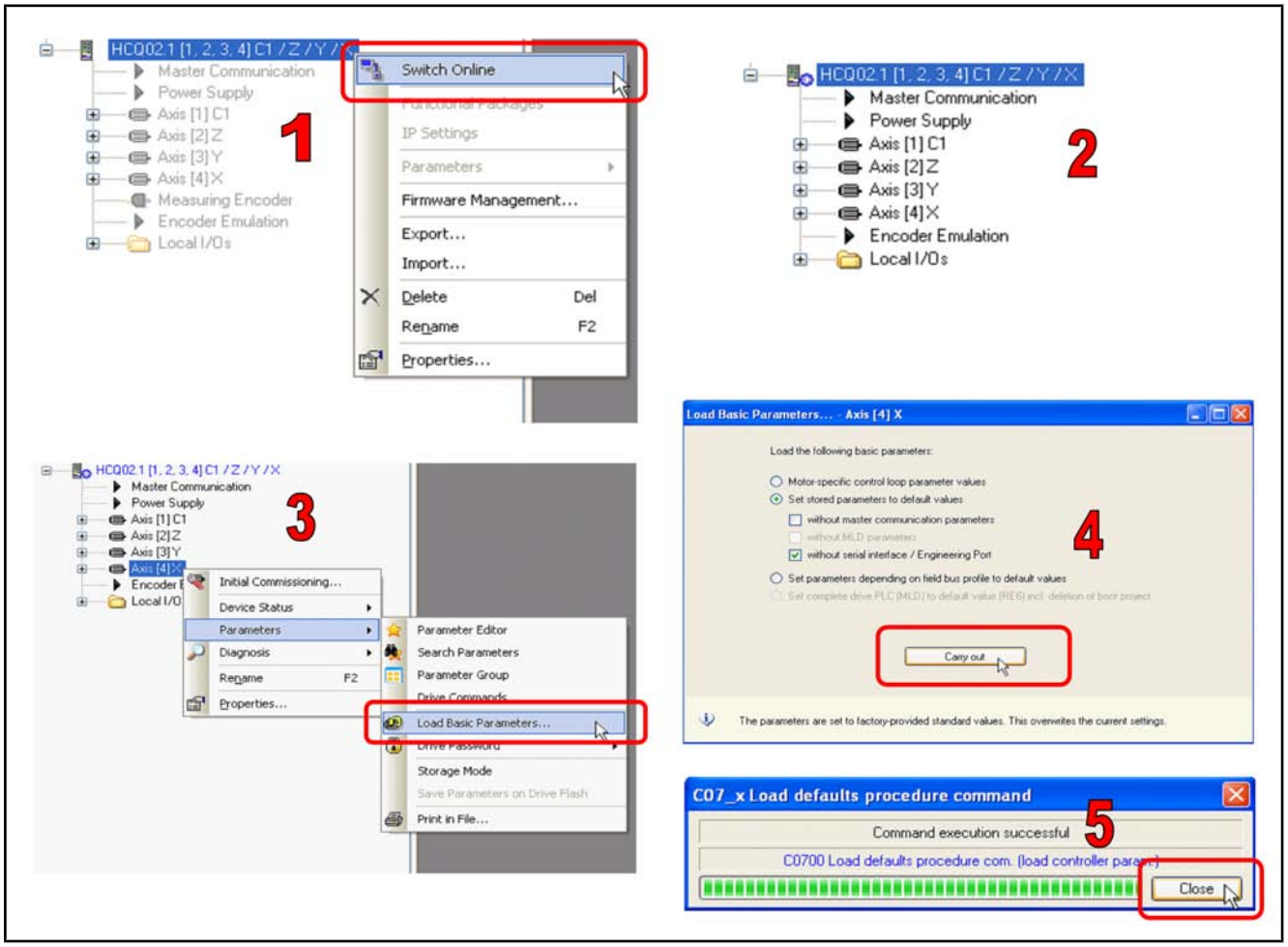


Fig.8-3: Loading basic parameters

- Steps 3, 4, 5 are required for each axis.
- Please wait for approx. 1 minute before loading the basic parameters of the next axis.
- After the basic parameters have been loaded for all axes, the machine must be turned off and on again.

Commissioning the Drives

8.3 Adjusting the Basic Setting of the Drive

After the basic parameters of the drives have been loaded, there are a few essential parameters that must first be set.

Linear axis

1. Feed constant: distance traveled by the axis while the motor shaft makes one revolution.
2. If a mechanical gear is installed between the motor and the load, the gear ratio must be entered via "Input revolutions of load gear n1" and "Output revolutions of load gear n2".

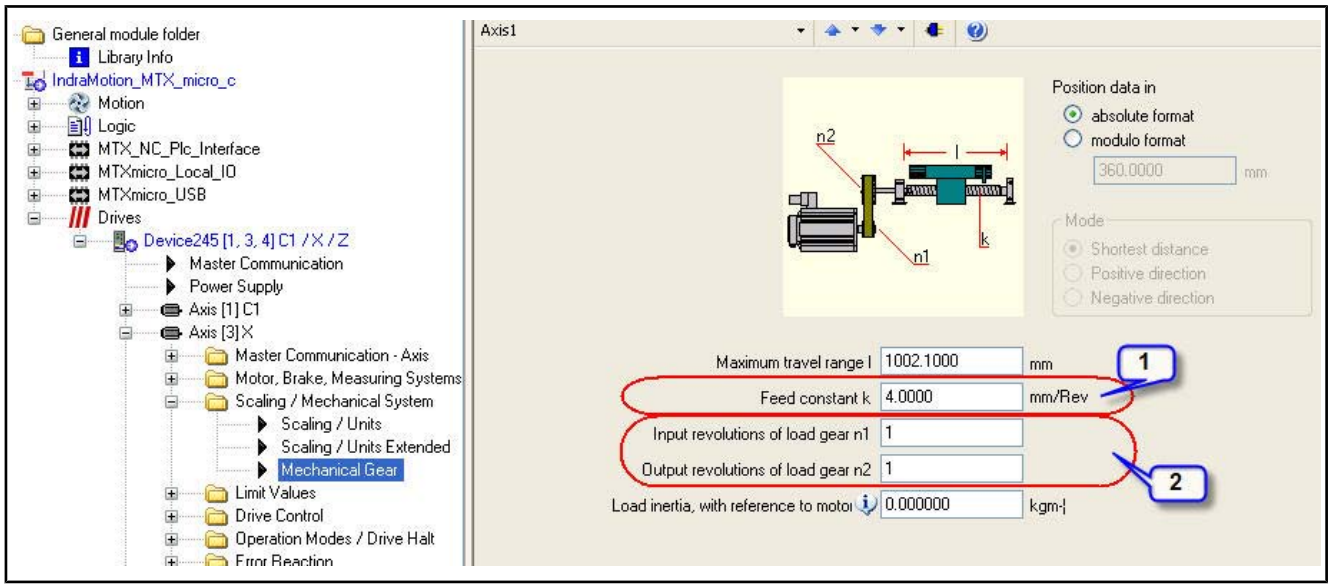


Fig.8-4: Basic setting of the axis – linear axis

Rotary axis, spindle

There is no feed constant for rotary axes and spindles so that only one load gear must be defined.

1. "Input revolutions of load gear n1" and "Output revolutions of load gear n2"
2. Please note that the gear stages must each be entered separately for spindles with gearshift unit.

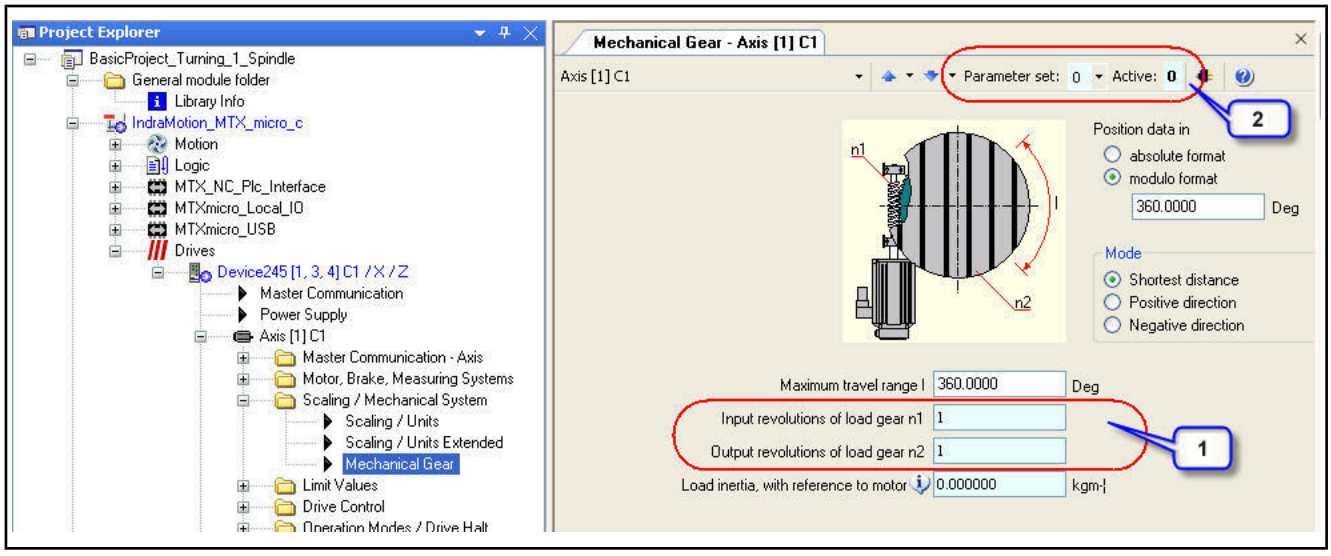


Fig.8-5: Basic setting of the spindle – mechanical gear

Axes, spindles

1. Negation of position, velocity and torque/force data: This parameter allows you to reverse the direction of rotation of the motor. If an axis moves in the – direction while it is jogged in + direction, "yes" must be selected here.

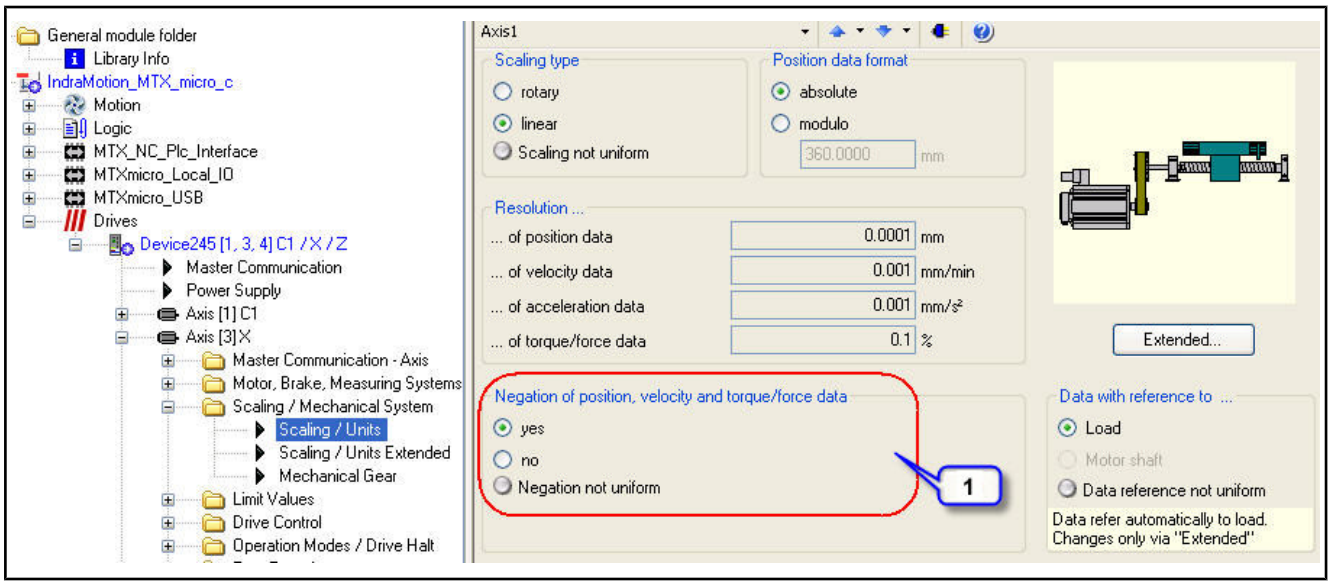


Fig.8-6: Basic setting of the axis and spindle – scaling/units

8.4 Optimizing the Drive Parameters

8.4.1 General

After the basic drive parameters have been loaded, the controller parameters should be adjusted to the mechanics of the machine. This optimizes the control behavior of the drive. This step is only required for prototype machines. Serial machines can be operated with the optimized parameters. Proceed as follows:

1. Prepare the optimization
   - Test connection on/off.
   - Test the E-stop.
   - Jog the axis.
   - Move the axis approximately to the center of the travel range.
2. Start the "Easy Startup Mode" of the drive.
3. Optimize the velocity control loop.
   - Measure the possible bandwidth.
   - Set the Kp and Tn parameters.
   - Check the settings of the velocity control loop.
4. Exit the "Easy Startup Mode" of the drive.
5. Optimize the position control loop.
   - Set the Kv parameter.
   - Set the acceleration feedforward.
   - Set the jerk limitation.

☞ After the drive has been optimized, the machine must be turned off and on again.

☞ Axes and spindles require optimization of the velocity and the position control loops. Please note that the gear stages must each be optimized separately for spindles with gear switching.

8.4.2 Optimizing the Velocity Control Loop

Determining Resonances and Measuring the Bandwidth

The velocity control loop can only be optimized after existing resonance frequencies have been determined. These frequencies are eliminated by corresponding filters in the drive. Proceed as follows to determine the resonances:

1. Set the value of "Speed loop smoothing time constant" in the "Velocity Control Loop Filter" dialog to 0.

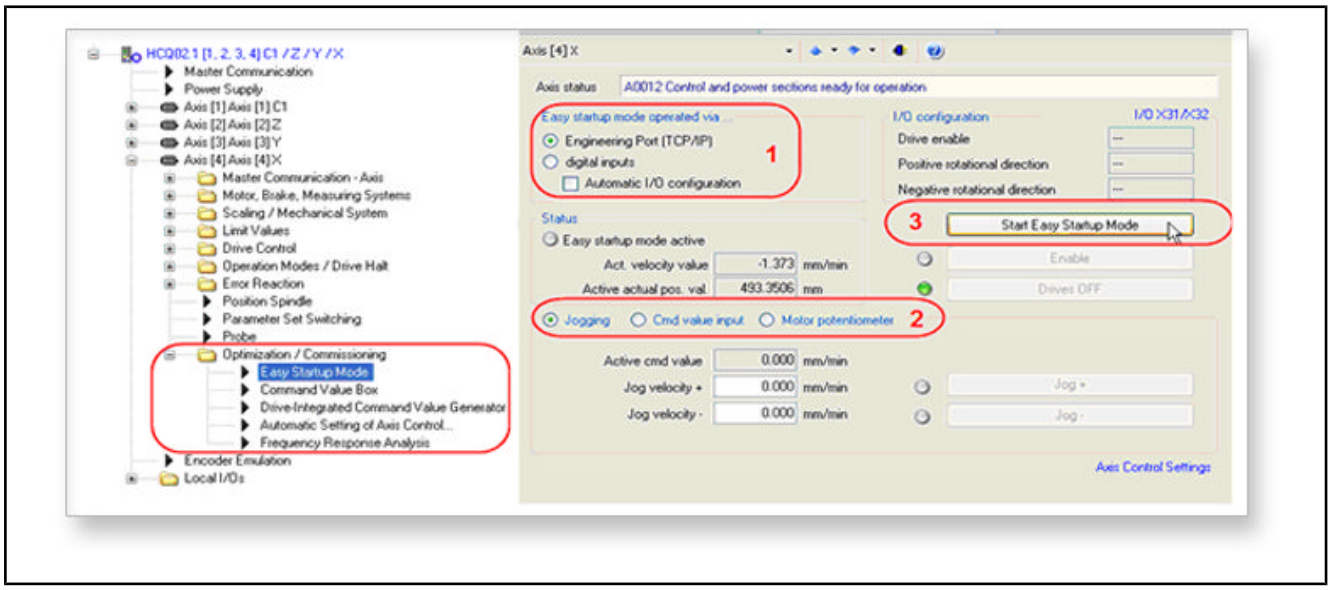


Fig.8-7: Entering the value of "Speed loop smoothing time constant"

2. Start the Easy Startup Mode.
   - 1: Select Engineering Port (TCP/IP).
   - 2: Select Jogging.
   - 3: Select Start Easy Startup Mode.

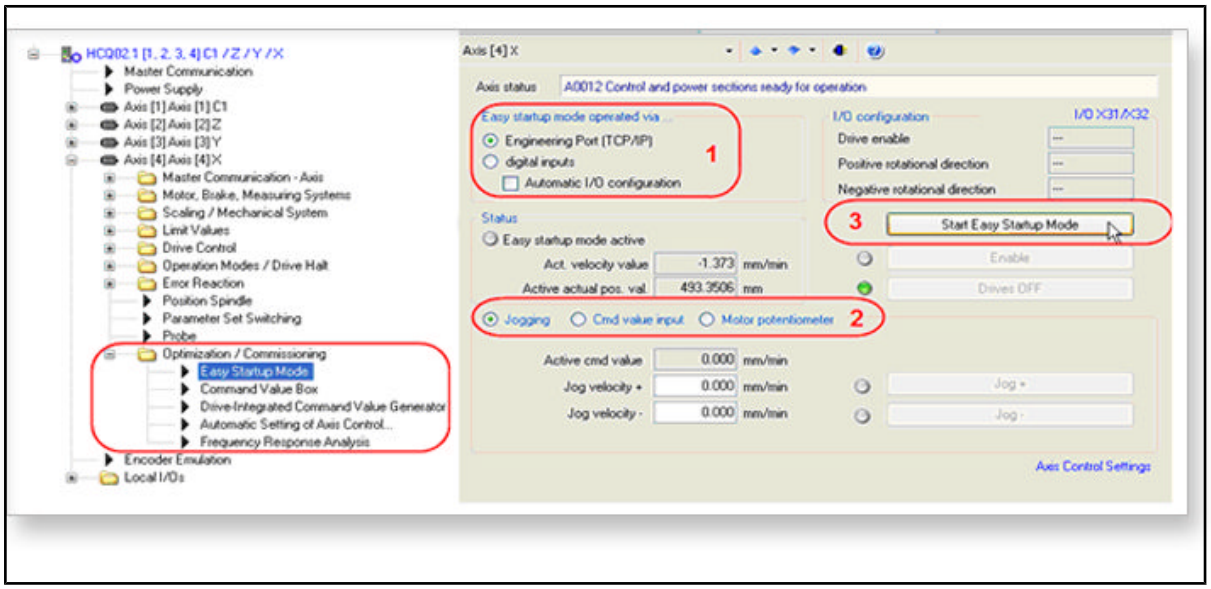


Fig.8-8: Easy Startup Mode

3. Start "Frequency Response Analysis".
   - a) Select "Frequency response of speed loop" (1).

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- b) Correct the "Amplitude" value which should not exceed the recommended value (2).
- c) Turn on power to the drives.
- d) Click on "Enable" (3).
- e) Click on "Start Measurement" (4).
- f) After completed measurement, click on "Display Result Graphically" (5).

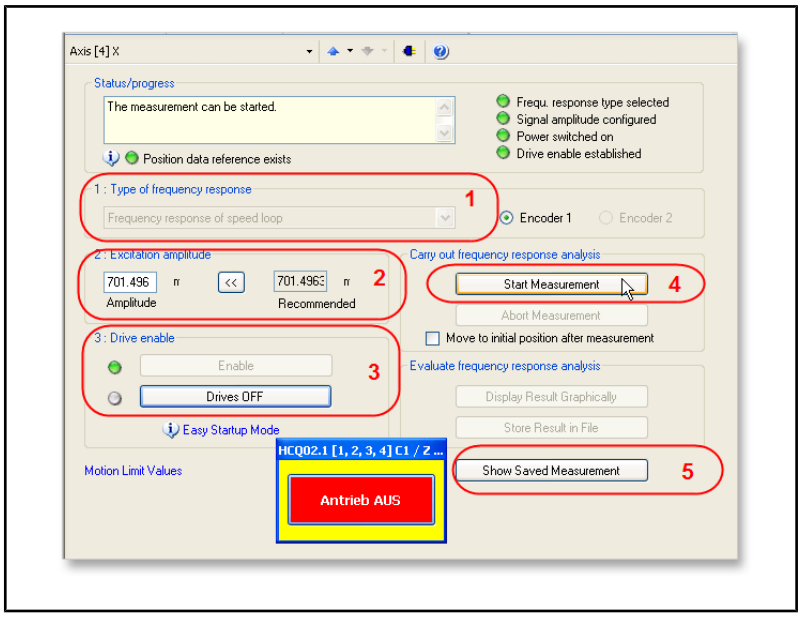

Fig.8-9: Frequency response analysis

4. Fig. 8-10 shows the amplitude and phase responses determined after the measurement of the frequency response. Two resonance points have been determined at 63 Hz and 899 Hz.

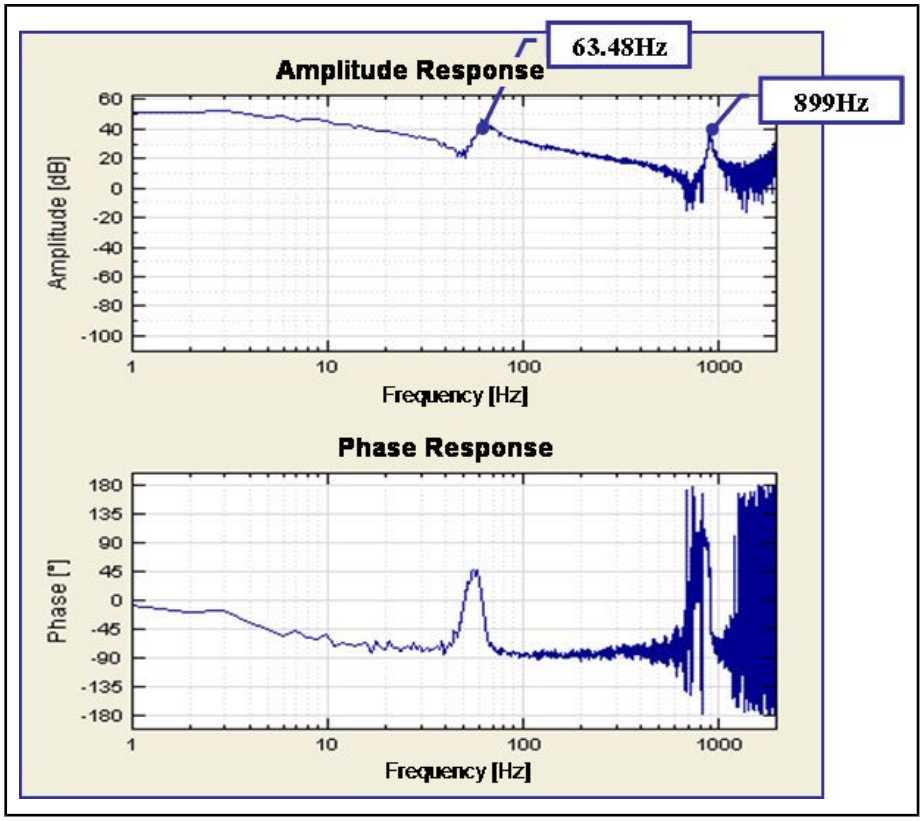

Fig.8-10: Resonance frequency in the system

Resonance points with an overshoot of less than 5 dB and/or with a frequency less than 300 Hz cannot be filtered. Such resonance points are compensated by an optimal setting of the velocity loop.

The resonance point at 899 Hz can be eliminated by a band-stop filter.

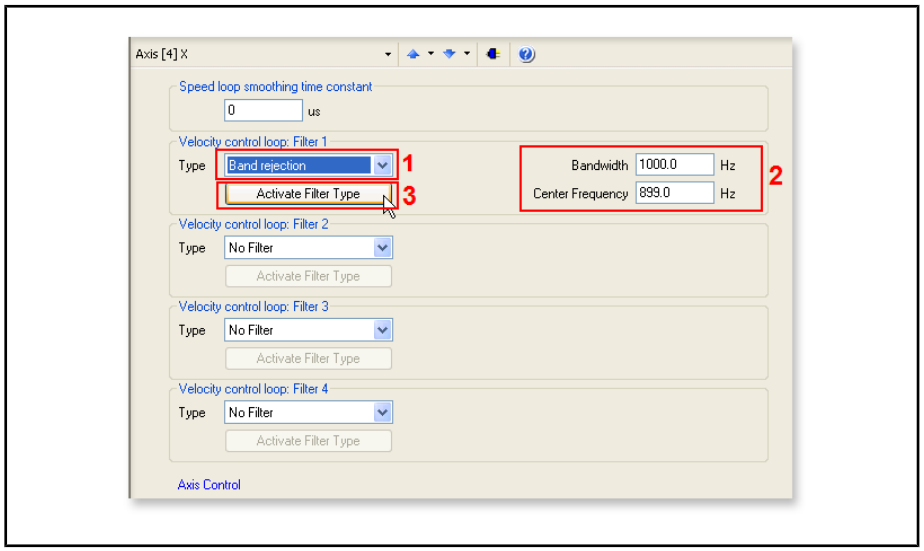

Fig.8-11: Setting filters

The maximum number of independent filters that can be set for each axis is 4. Typical filter types are "band pass" for filtering a frequency range and "low pass" for filtering all frequencies below a blocking frequency. Proceed as follows to set a filter:

- 1: Select "band rejection" or "low pass".

- 2: Enter the resonance frequency determined in the measurement in the "Center Frequency" box (here: 900 Hz). The value entered in the "Bandwidth" box defines the width of the filtered frequency band. The value selected in the example is 1000 Hz. The filter operates within a range from 400 Hz to 1400 Hz. The strongest filtering is achieved for interfering frequencies around 900 Hz.
- 3: Click on "Activate Filter Type" to activate the filter.

☞ Repeat the measurement of the frequency response to check the effectiveness of the filter settings. Overshoots and phase shifts should be reduced or should have disappeared completely.

8.4.3 Determining the Kp and Tn Parameters

The velocity loop is a PI controller. This PI controller requires determination of the gain (Kp) and the integral action time (Tn). Enter these parameters in the "Axis Control Settings" dialog. The "Frequency Response Analysis" must be started after each change as described above, until the optimal settings have been found.

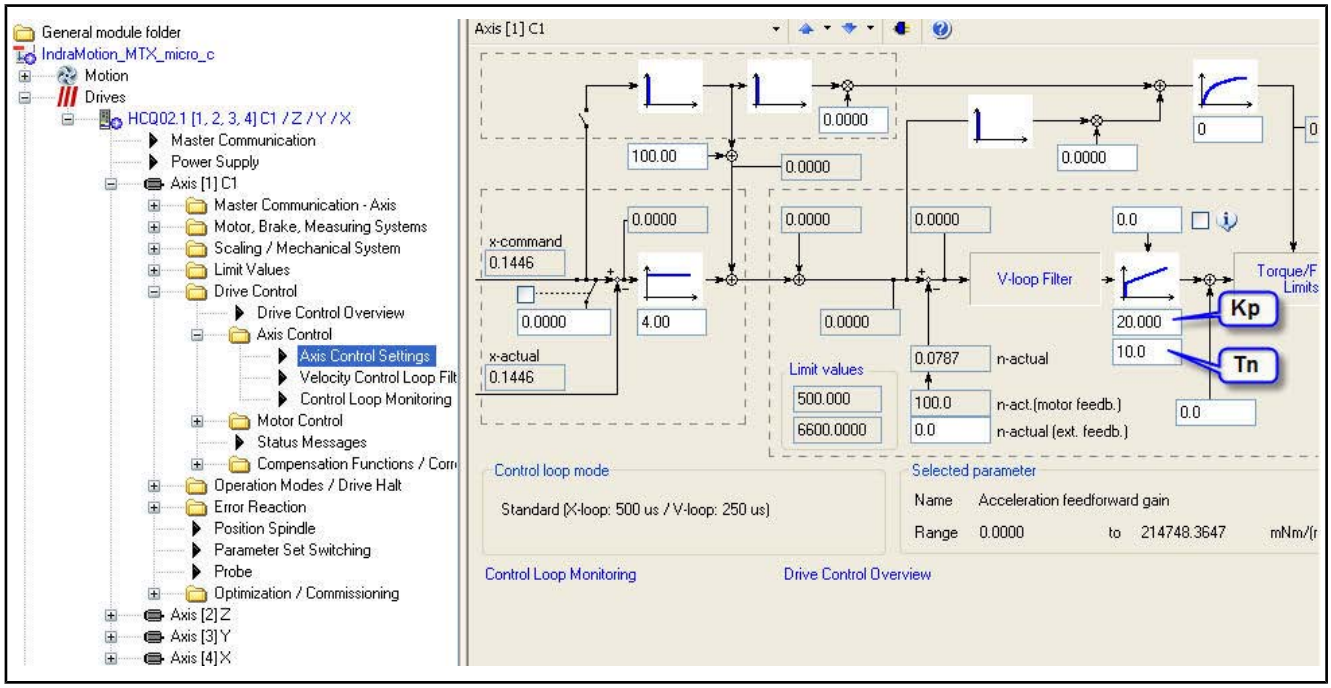

Fig.8-12: Setting Kp and Tn

Proceed as follows to set the parameters:

1. First set the integral action time Tn = 0. Then slowly increase the gain Kp. Repeat the measurement of the frequency response of the controller after each increase. The optimal Kp value has been found if the amplitude response does not show any overshoot of more than 3 dB and the phase shift at the –3 dB point of the amplitude response is not less than –130 degrees at the same time.

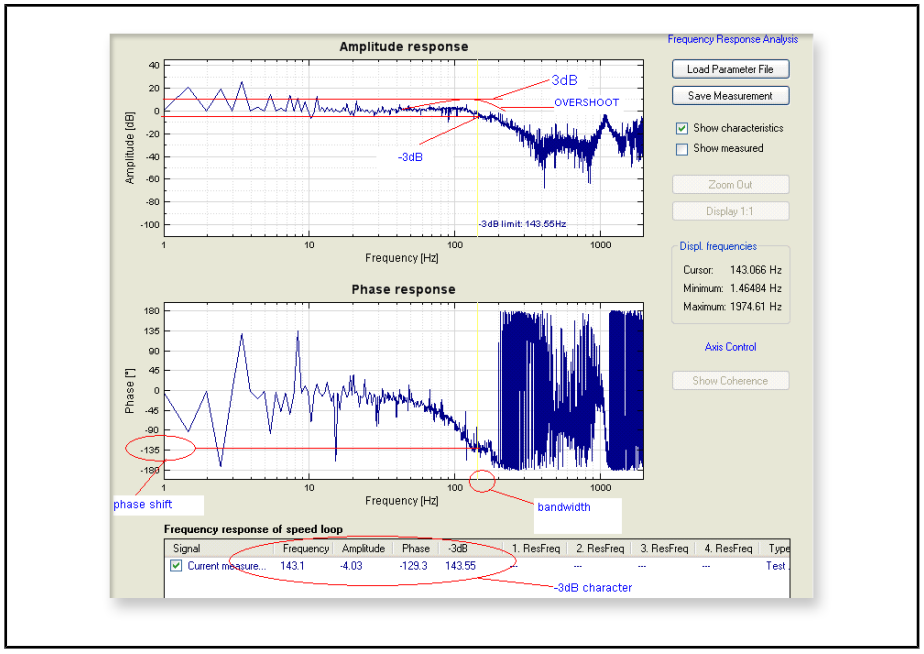

Fig.8-13: Show characteristics

2. After having determined Kp, increase the value of Tn. The following figure shows an example of the different amplitude characteristics. We recommend that you set the amplitude characteristic between 0 dB and no more than 3 dB overshoot. Greater oscillations in the system, if any, can be corrected by changing Tn.

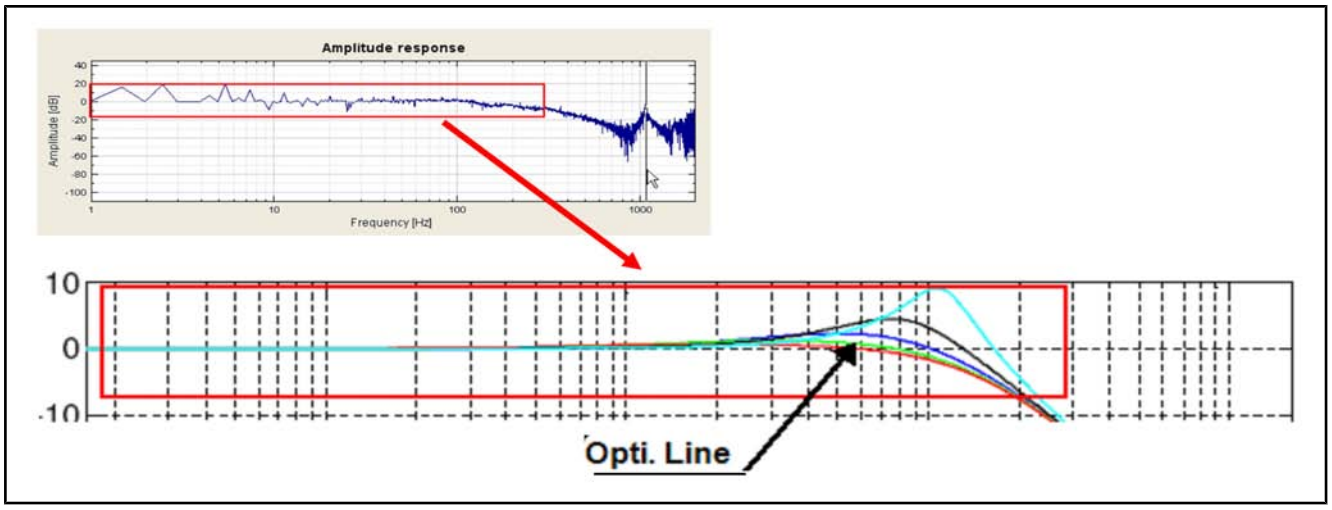

Fig.8-14: Stable system, depending on Tn

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8.4.4 Recording the Jump Response of the Velocity Loop

After the Kp and Tn values have been set, the jump response of the controller is recorded to check and/or further optimize the settings.

First select the "Square-wave signal" in the "Drive Integrated Command Value Generator" dialog. Define the value of the amplitude according to Kp. In general, we recommend that a value between 1000 mm/min and 2000 mm/min be selected for axes and a value between 10 rpm and 20 rpm for spindles. Select S-0-0037 from the "Target parameter" box. Then select "periodic signal generation".

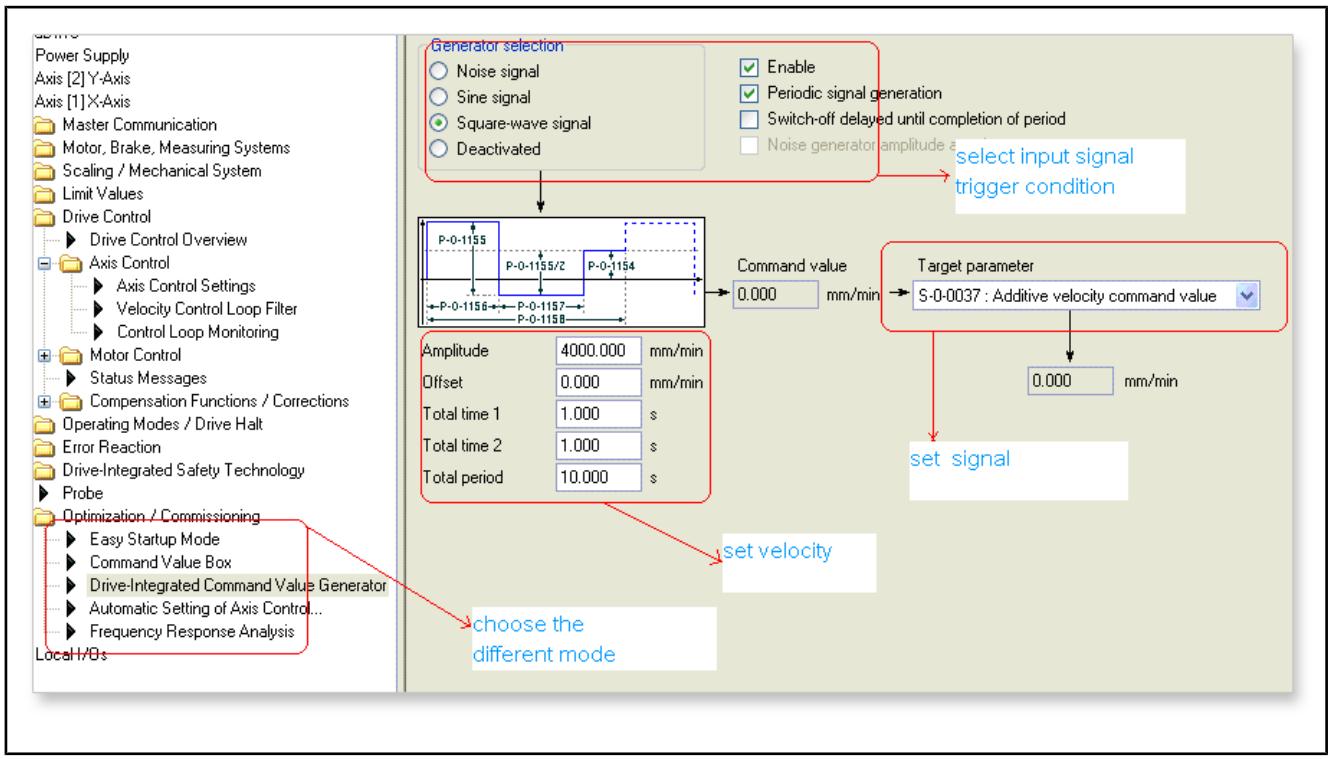

Fig.8-15: Drive-integrated Command Value Generator

Open the "Oscilloscope" on the Engineering Desktop under "Diagnostics". Then configure the "Recording time" and the "Memory depth" according to the values in the "Drive-integrated Command Value Generator". Select "Configure" and set "Trigger", "Trigger signal", "Threshold value", and "Edge" accordingly. Select the signals to be measured by clicking on "Signals". A maximum of 4 signals can be measured at the same time. The signals required in the example are S-0-0040 (Velocity feedback value), S-0-0084 (Torque/force feedback value) and S-0-0189 (Following distance).

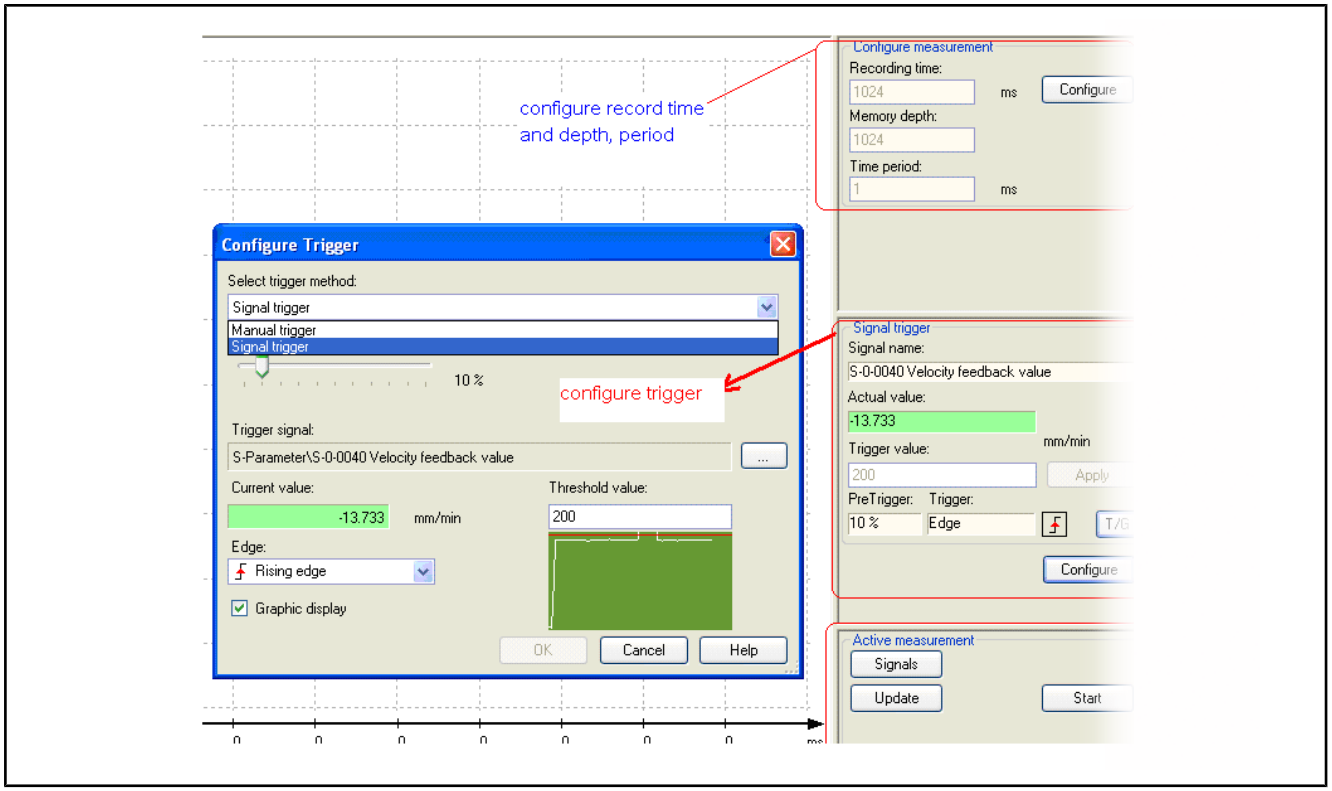

Fig.8-16: Configuring the signal trigger in the oscilloscope

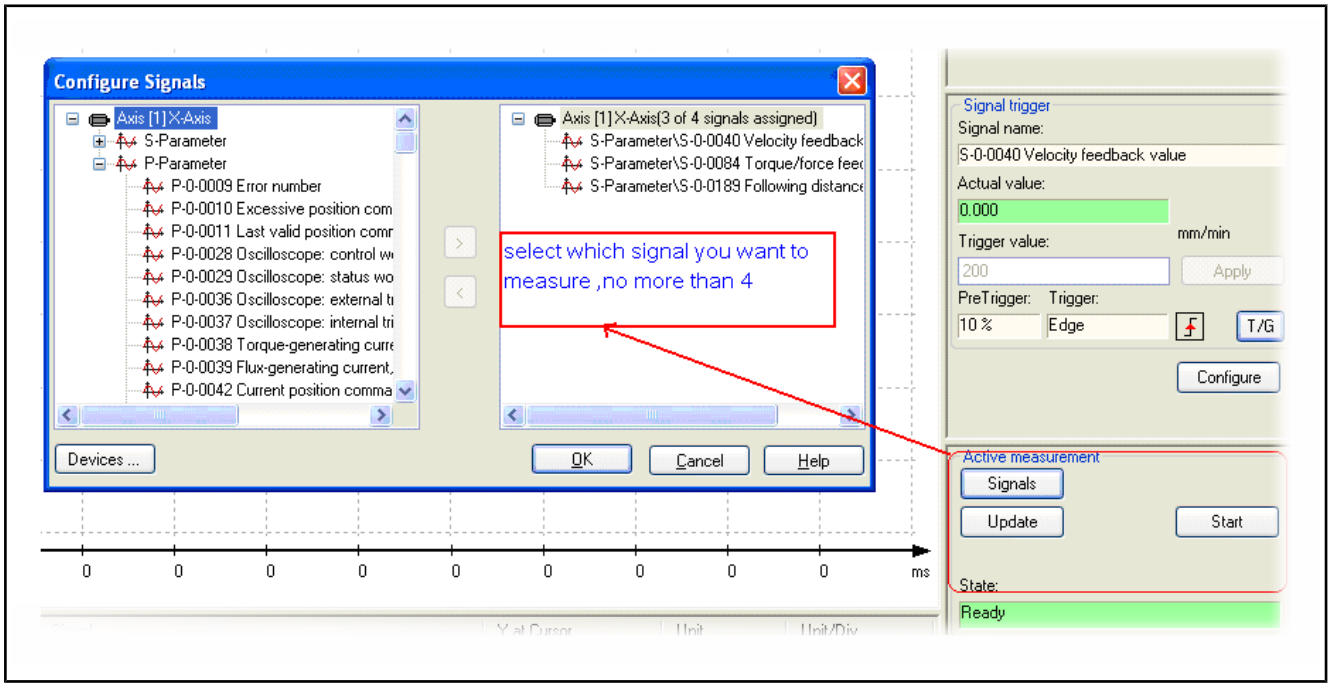

Fig.8-17: Configuring the signal in the oscilloscope

After having completed the signal configuration, click on "Start". Then activate the "Enable" checkbox in the "Drive-integrated Command Value Generator" dialog (see window in Fig. 8-15). The axis is now moving with a defined velocity and period, and all selected signals will be automatically measured by the oscilloscope. See the figure below.

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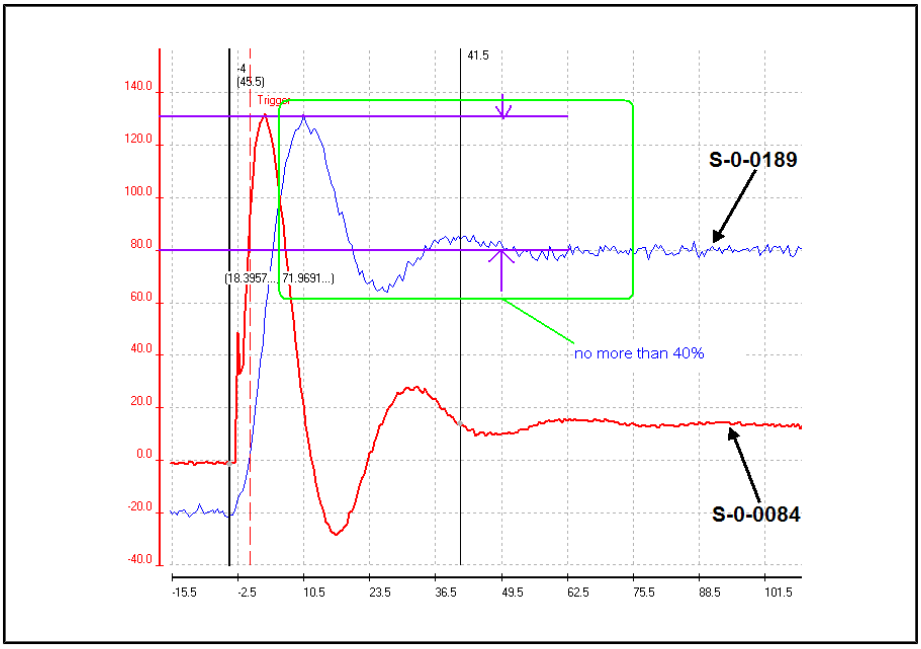

Fig.8-18: Evaluating the oscilloscope

If the overshoot of the velocity feedback value is not higher than 40%, the system is stable. If the overshoot is higher, the Kp and Tn parameters must be changed once more.

8.4.5 Optimizing the Position Control Loop

The Kv (S-0-0104), acceleration feedforward (S-0-0348) and the jerk limitation (MaxAxJerk) parameters are the relevant parameters for optimizing the position control loop. At first, the drive parameters are set, then the jerk limitation is determined. The drive parameters can be found in the "Axis Control Settings" dialog.

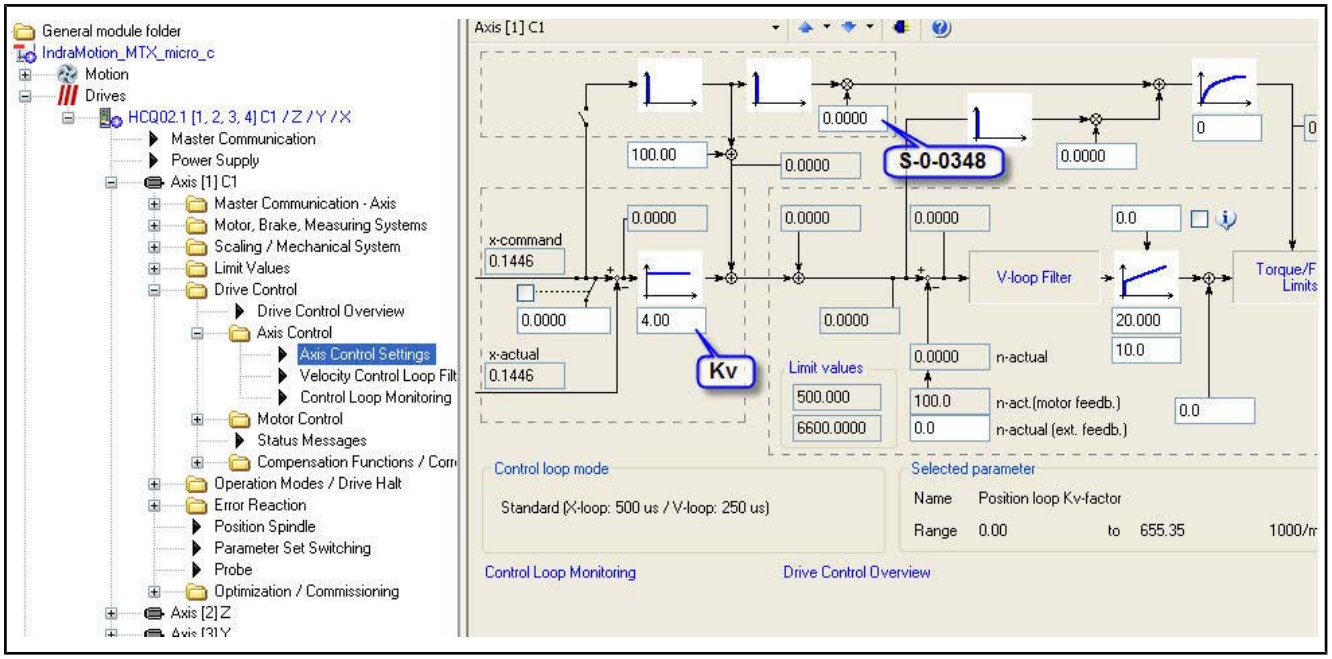

Fig.8-19: Setting the Kv and feedforward parameters

To optimize the position control loop, oscillate the axis cyclically between two positions using an NC program. Change the Kv and feedforward parameters during the traversing motion of the axis and observe its behavior with the oscilloscope. Make sure that the jerk limitation is turned off with the JKC(0) command and the feedforward is turned on with the FFW(<axis name>1) command.

Example for the x-axis

```
N05 G90 G0 X500
N10 JKC(0) FFW(X1) G9 G1 G91 X50 F5000
N20 G4 F5
N30 G91 X-50
N40 G4 F5
N50 GoTo N10
```

Fig.8-20: NC program

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8.4.6 Setting the Kv Parameter

First optimize the Kv factor S-0-0104. Using the NC program, measure the following distance S-0-0189 with the oscilloscope. Increase the value of Kv as long as necessary for the torque signal to show an oscillation. To ensure system stability, set Kv to half the value occurring when the torque starts to oscillate. See the following example: The Kv factor is increased from 1 to 8, and the following distance is measured from 0.07 mm to 0.03 mm.

1. Kv = 1 , max. following distance (S-0-0189) = 0.07 mm
2. Kv = 2 , max. following distance (S-0-0189) = 0.06 mm
3. Kv = 4 , max. following distance (S-0-0189) = 0.04 mm
4. Kv = 6 , max. following distance (S-0-0189) = 0.03 mm
5. Kv = 8 , max. following distance (S-0-0189) = 0.03 mm

Since the torque signal (S-0-0084) shows an oscillation with a setting of Kv = 8, the Kv value is set to 50% of the maximum value determined, i.e., Kv = 4.

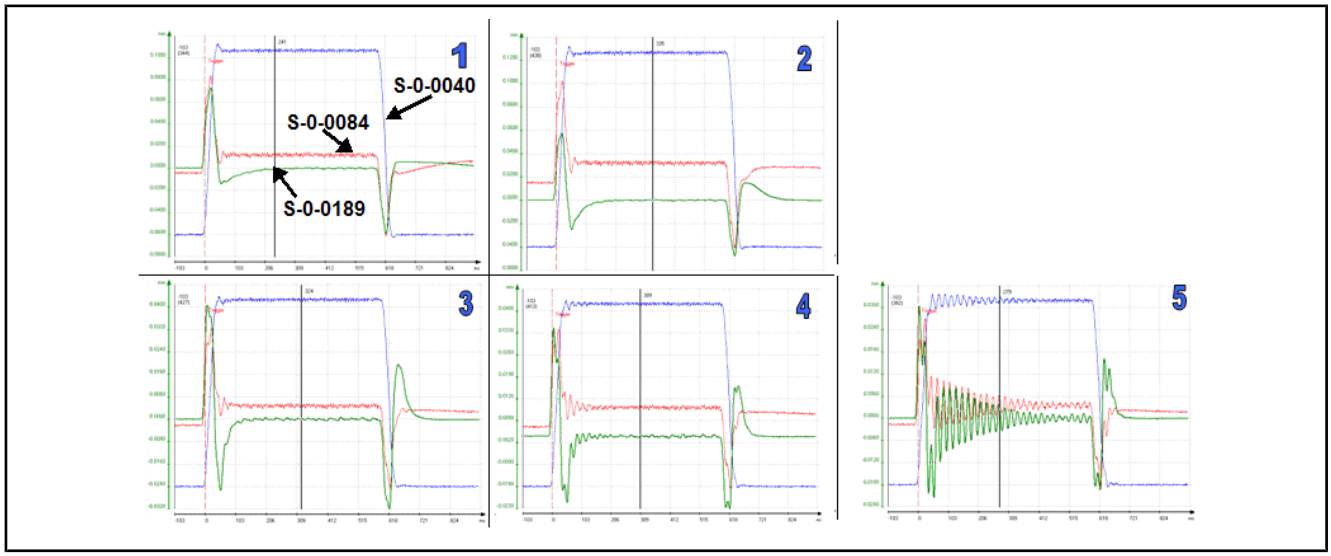

Fig.8-21: Setting the Kv factor

8.4.7 Setting the Acceleration Feedforward

The acceleration feedforward is set to achieve better dynamic properties after the Kv factor has been set. The NC program is again used to measure the following distance S-0-0189. Increase the value of the acceleration feedforward S-0-0348 as long as the maximum occurring following distance decreases.

Prior to optimization, the maximum occurring following distance S-0-0189 = 0.04 mm. Please note the change in the following distance while the value of the acceleration feedforward is slowly increased.

1. S-0-0348 = 2, max. following distance (S-0-0189) = 0.034 mm
2. S-0-0348 = 4, max. following distance (S-0-0189) = 0.028 mm
3. S-0-0348 = 6, max. following distance (S-0-0189) = 0.022 mm
4. S-0-0348 = 8, max. following distance (S-0-0189) = 0.016 mm
5. S-0-0348 = 10, max. following distance (S-0-0189) = 0.013 mm

The effect of the acceleration feedforward starts to have a negative effect at a value of 10. For this reason, the optimal value here is 8.

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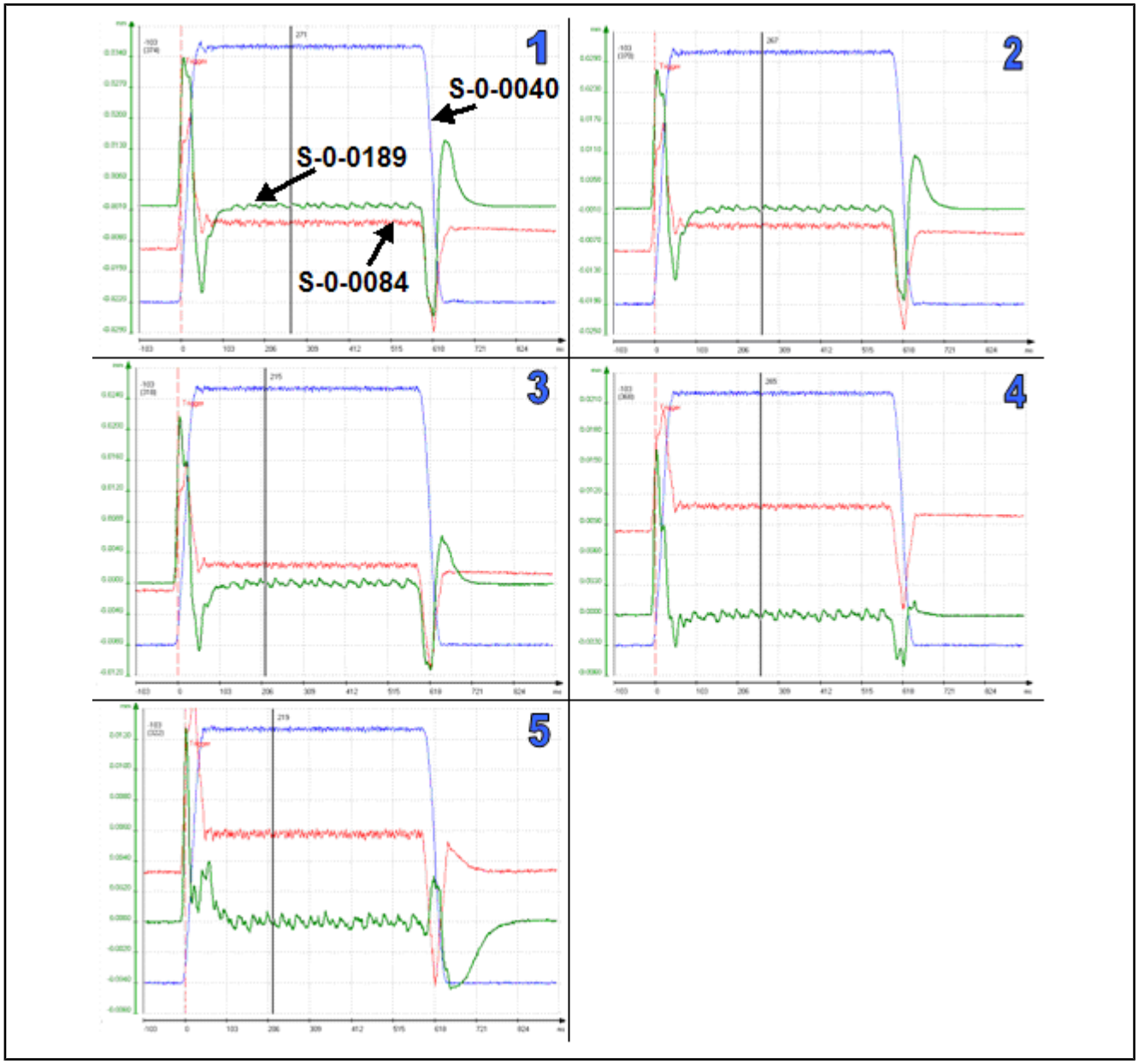

Fig.8-22: Setting the acceleration feedforward

8.4.8 Determining the Maximum Axis Jerk Value

The jerk limitation function of the control reduces the jerk occurring when the velocity is changed. This in turn reduces the peak load of the mechanics and the drive components. At the same time, the excitation of the system to oscillate is reduced. To be able to parameterize the jerk limitation, the maximum possible jerk value of an axis must be determined.

This is most easily achieved by determining the value graphically by means of the oscilloscope. Select a positioning operation of the NC program and zoom the acceleration out of standstill. Then measure the time T from standstill to the point in time when the velocity changes linearly. Determine the velocity V that is reached at this time. Calculate the maximum axis jerk using the formula "$J = V/T^2$". Fig. 1-20 illustrates this procedure.

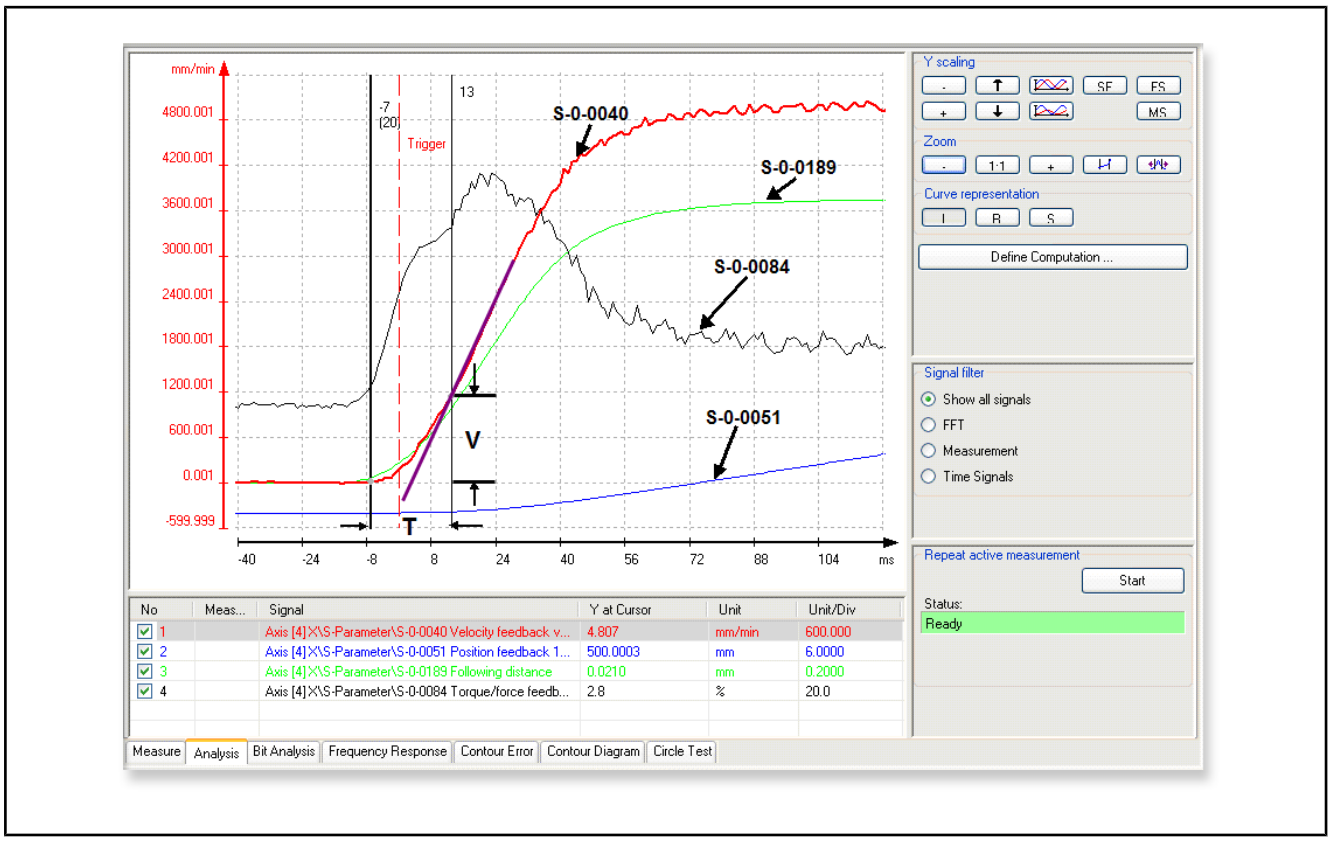

Fig.8-23: Determining the axis jerk

The value set in the CNC should be 10% higher than the calculated value. If, e.g., a value of 60 was calculated, 66 should be set.

Now enter the value increased by 10% in relation to the calculated value in the "Maximum Axis Jerk" CNC parameter for this axis. Additionally set "Axis Jerk Reserve" to half the value of "Maximum Axis Jerk". Restart the CNC to activate the settings.

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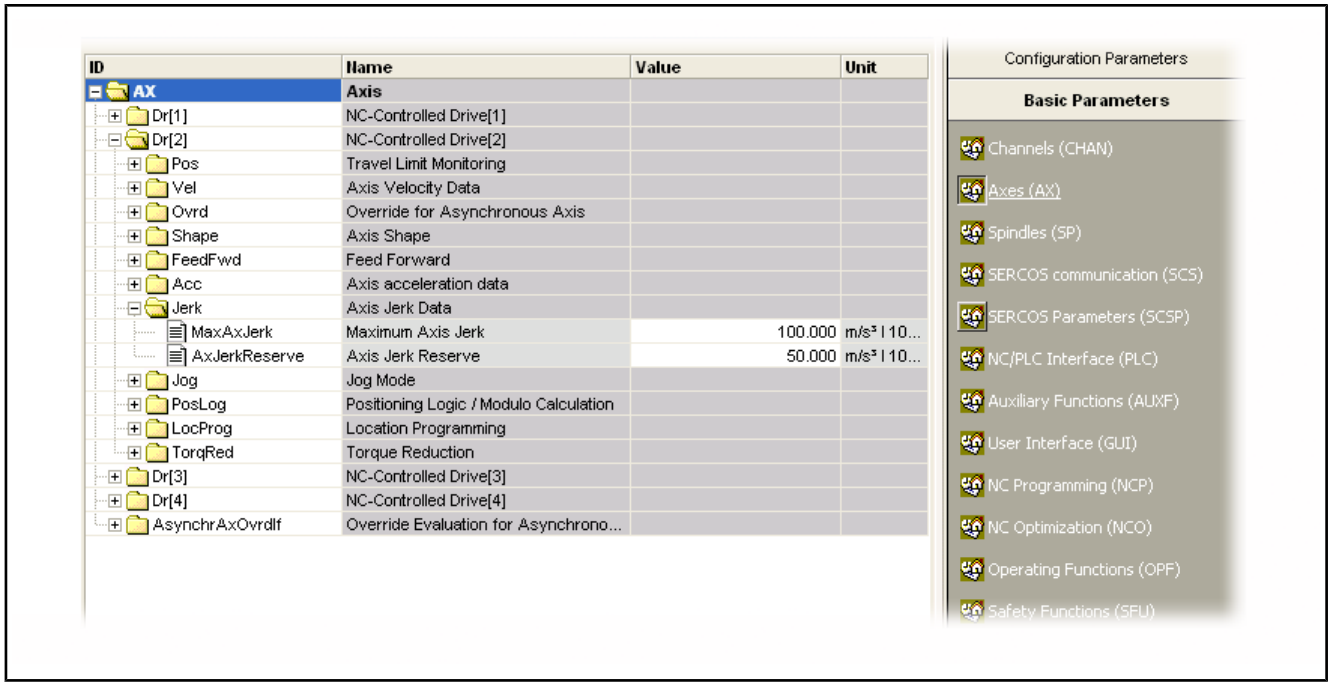

Fig.8-24: Entering the axis jerk

After having restarted the NC, restart the NC program with the changed "JKC(<axis name>1)" NC command. While traversing the axis, you can observe that the jerk occurring when the velocity is changed has now been reduced. In the example below, the X-axis is moved in the following NC program.

Example for the x-axis

```
N05 G90 G0 X500
N10 JKC(X1) FFW(X1) G9 G1 G91 X50 F5000
N20 G4 F5
N30 G91 X-50
N40 G4 F5
N50 GoTo N10
```

Fig.8-25: NC program with activated axis jerk limitation

Optimization of the axis is now completed. The operation must be repeated for the other axes and spindles.

9 Operating the IndraMotion MTX micro

9.1 HMI Control Panels VDP80

To facilitate the operation of turning and milling machines, the HMI control panels VDP80 are available for the IndraMotion MTX micro. In addition to the screen, these control panels feature all elements required for executing the standard functions of a machine. The HMI software, the PLC functions and the elements of the control panel are harmonized with each other such that the machine can be operated intuitively. The control panels differ in their screen size and some of the control elements.

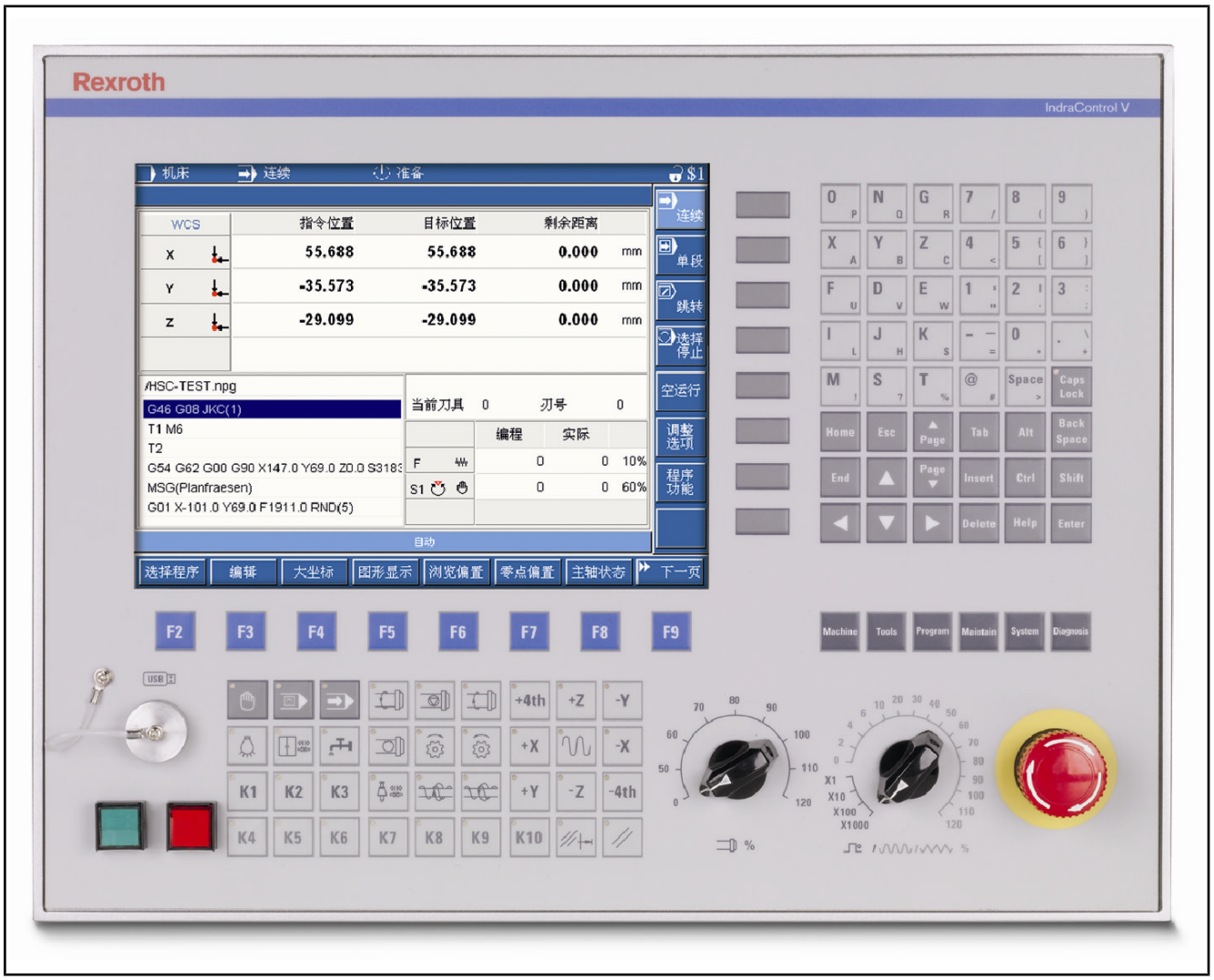

Fig.9-1: VDP80 control panel – milling machine

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Fig.9-2: VDP80 control panel – turning machine

The basic layout of the control panels is shown in the following figure. There are 4 main groups (with red borders). Groups 1 to 3 are used to operate the HMI software, and group 4 serves to execute the PLC functions of the machine.

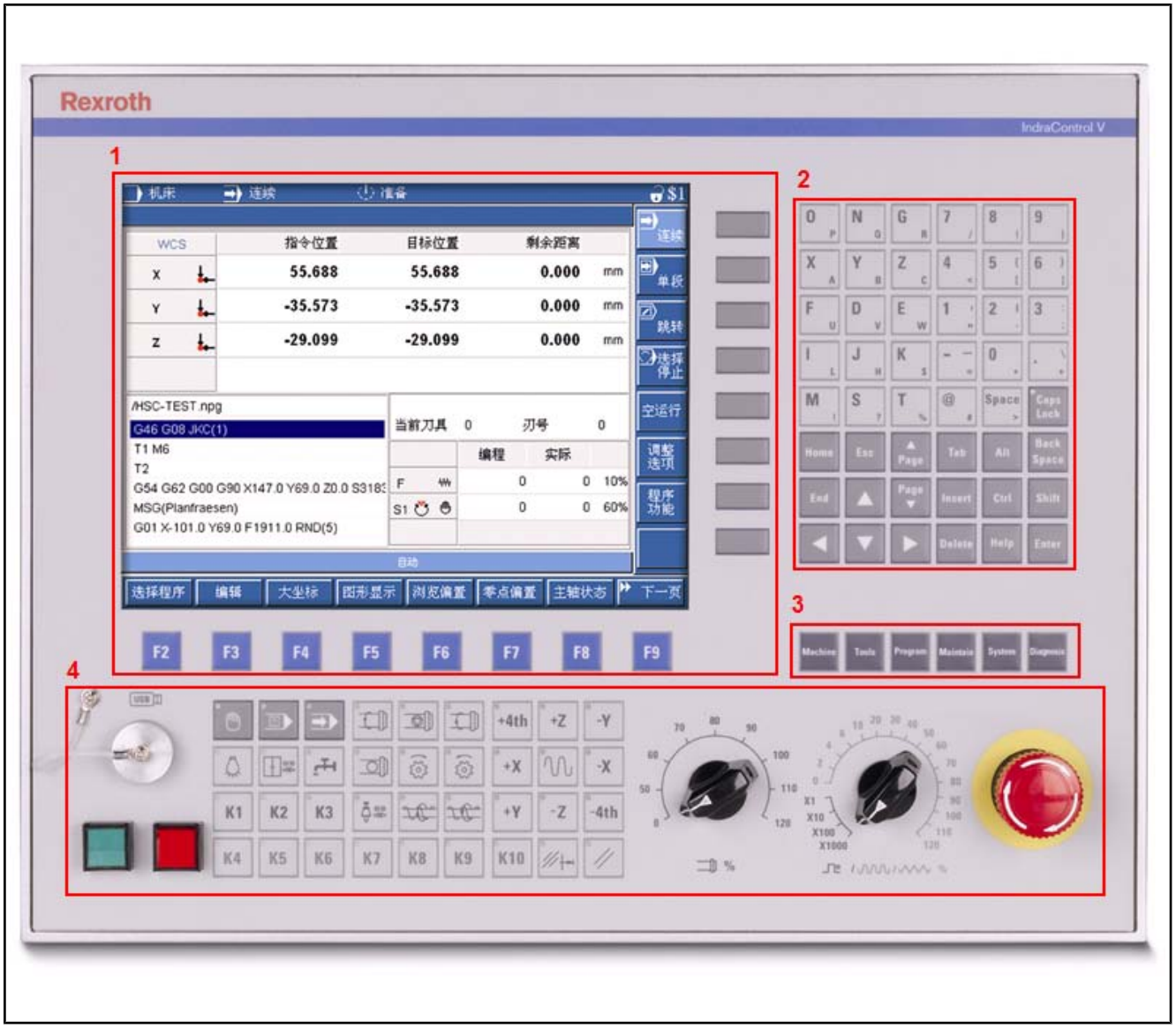

Fig.9-3: Layout of the VDP80 HMI control panel (milling)

Screen with function and machine keys (1)

Group 1 comprises the screen with the function keys (F-keys) below the screen and the machine keys (M-keys) to the right of the screen. The F-keys allow operation of the currently selected screen. The M-keys allow execution of the machine or control functions referring to this screen.

ASCII keypad (2)

The ASCII keypad can be used to enter values and programs as well as to select input fields (e.g., using the arrow keys). Each key may have up to three assignments. To activate the second key level, press the <Shift> key together with the key to be pressed. To activate the third key level, press the <Alt> key together with the key to be pressed.

Example: Pressing key <1> together with <Shift> will produce ". Pressing key <1> together with <Alt> will produce '.

Selecting the operating area (3)

The operating area keys allow you to quickly switch between screens with different tasks.

Example: While entering the program, you wish to quickly switch from the program editor to the tools list (Tools) and back (Program).

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Operating area	Tasks
Machine	Operation in Manual, MDI, Automatic modes Input of zero point offsets Input of variable values
Tools	Input of tool corrections Tool management
Program	Creating, editing and managing NC programs Copying the programs from and to the USB stick
Maintain	Displaying the cycle time and the parts counter User login / logout Backup of parameters and programs System information (e.g., software version)
System	Selecting the active CNC channel Setting CNC and drive parameters Setting the user management Setting the communication parameters
Diagnosis	Displaying current diagnostic messages Displaying the log of the diagnostic messages Displaying the state of the CNC-PLC interface Displaying the state of the digital PLC inputs and outputs

Fig.9-4: Operating areas

Machine control panel (4)

The machine control panel provides the E-stop pushbutton, the override switches, the PLC control keys, and the USB interface. The control panel for the turning machine additionally incorporates a handwheel and an axis selector switch. Most of the functions of the PLC keys are already assigned. The keys labeled K1..K10 (K1..K6 for turning machines) can be used as desired. The most important elements for operating the machine will be described in the sections below.

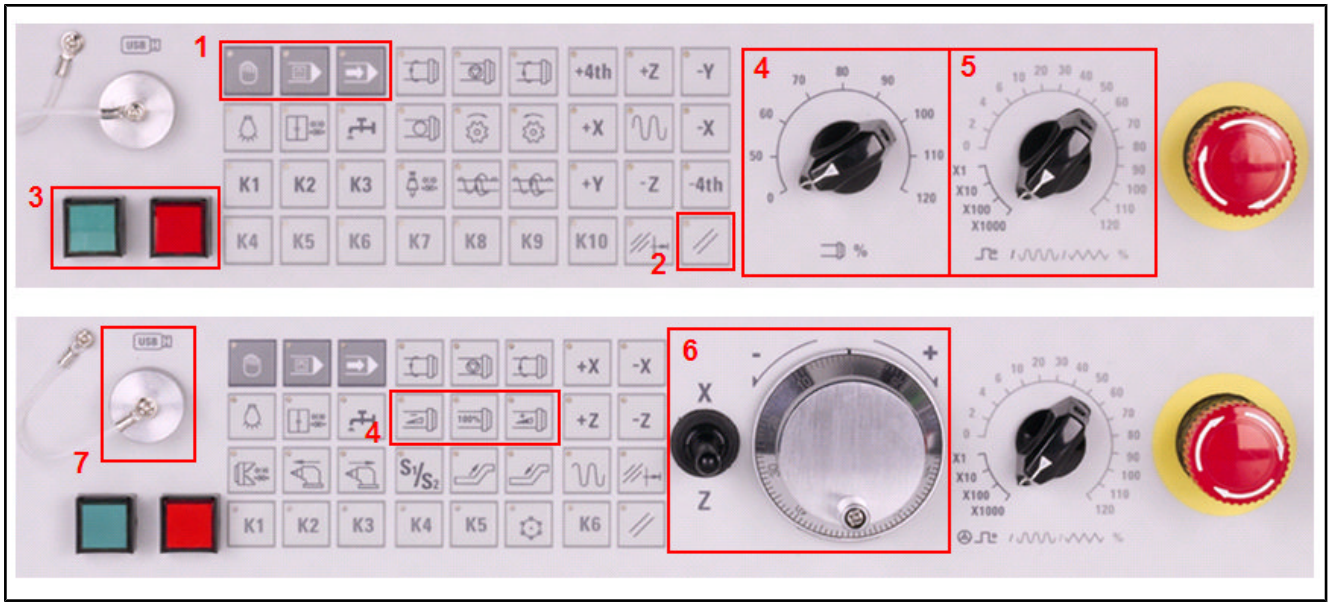

Fig.9-5: Milling (top) and turning (bottom) machine control panels

NC operation mode selection (1)

These 3 keys allow selection of the current NC operation mode. The <hand> key to the left selects manual mode, and the key in the middle <MDI> selects manual data input mode. The <auto> key to the right selects automatic mode for processing NC programs.

NC reset (2)

The reset key deletes existing errors and triggers the <home position> in all NC channels. The <reset> key also stops rotating spindle drives!

NC start / stop (3)

The green key to the left <NC start> starts the NC in order to start selected programs in automatic mode, to cancel an NC stop, and to process the NC blocks selected in MDI mode. If it is ready for start, the start key flashes; if an NC program or block is processed, it emits steady light. The red key to the right <NC stop> stops processing of running NC programs or NC blocks. In case of an NC stop, it emits steady light.

Spindle override (4)

The spindle override switches or spindle override keys (on turning machine panels only) affect the spindle speed in all operation modes. The override can be set within a range from 45% to 120%. The central key is used to set the override to 100%.

Feed override (5)

The feed override switch has several functions. It allows setting the override for feed and rapid traverse in all operation modes and selecting the step size for jog mode and handwheel in manual mode.

Handwheel (6)

The integrated handwheel (on turning machine panels only) is used in manual mode. This requires that handwheel mode be selected with the <HandW> M-key on the Manual screen. Then the axis to be moved can be selected with the axis selector switch to the left of the handwheel.

USB port (7)

The USB port can be used to exchange data via commercially available USB sticks. NC programs can be copied and data backups can be made. This port is not suitable for large-size USB hard disks and keyboards, mice, etc. After connection of the USB stick, the /usb directory will be available.

The USB stick should contain only a limited number of files and folders. Otherwise, there may be delays during use of the USB port.

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9.2 HMI Software

9.2.1 General

The IndraMotion MTX micro is delivered along with HMI software that has been adjusted to the operation of turning or milling machines. Depending on the basic project selected, the screens are automatically configured and displayed.

9.2.2 User Interface Layout

The basic layout of the operating screens will be illustrated by the example of the basic Automation screen.

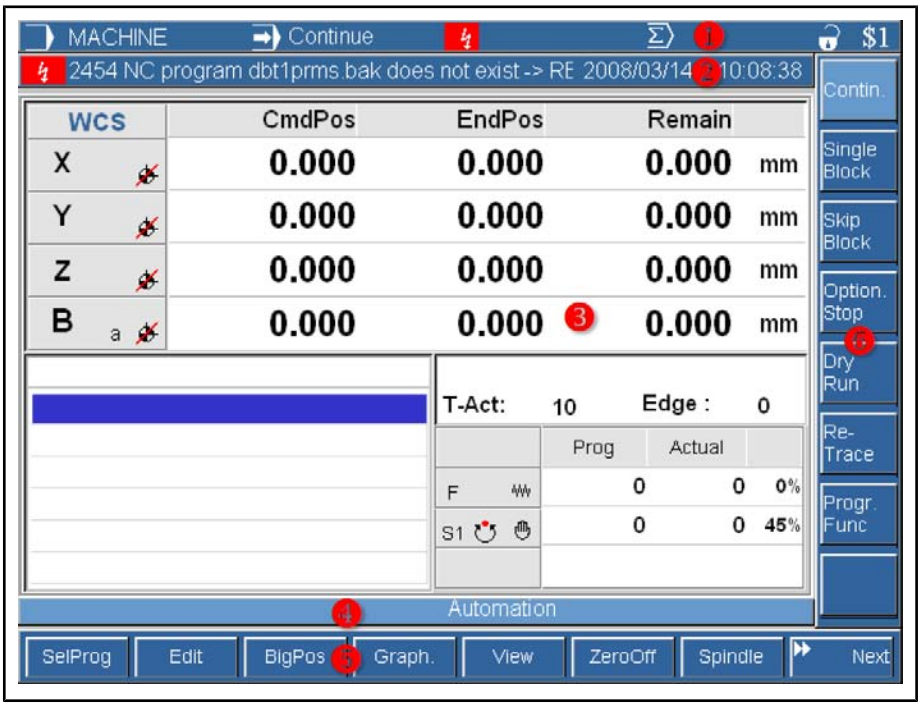

Fig.9-6: Operating screen example – Automation screen

Machine status (1) The topmost bar of all screens displays the current operating area (MACHINE), the NC operation mode (Continue), the diagnostic status (red arrow = an error is present), the channel status (here: General Inhibit), the current user status (lock), and the current channel number ($1).

Diagnostics (2) The diagnostics bar shows the currently present messages in plaintext scrolling across the screen. It additionally displays the current date and time.

Working area (3) The working area displays the current screen. In the example, this is the basic Automation screen with axis position display, tool display, as well as program and technology display.

Status bar (4) The status bar shows status messages of the operating software and, additionally, the name of the current screen (Automation).

F-keys (5) The function keys are provided for operating the current screen and opening other operating screens of the current operating area.

M-keys (6) The machine keys allow execution of control functions referring to the current screen. In the case shown, it is possible to select the Automatic suboperation mode (Continuous or Single Block).

9.2.3 Basic HMI Software Functions

Editing Parameters

Often, it is necessary to change parameters which are presented in the form of a table.

@3%	32	@18%	0
@4%	0	@19%	0
@5%	0	@20%	0
@6%	0	@21%	0
@7%	0	@22%	0
@8%	0	@23%	0
@9%	0	@24%	0

Fig.9-7: Example table (NC variables list)

The values are always edited as follows:

1. Place the focus on the value to be edited using the cursor keys (▲, ►, ▼, ◄).
2. Switch to edit mode by pressing the <Enter> key.
3. Enter or change the value.
4. Apply the value by pressing the <Enter> key. Edit mode is exited automatically.

☞ If tables extend beyond the screen page shown, use the <Page ▲> and <Page ▼> keys to move to the desired page of the table.

Text Editor

The text editor is used to create, edit and save ASCII text files and, above all, NC programs.

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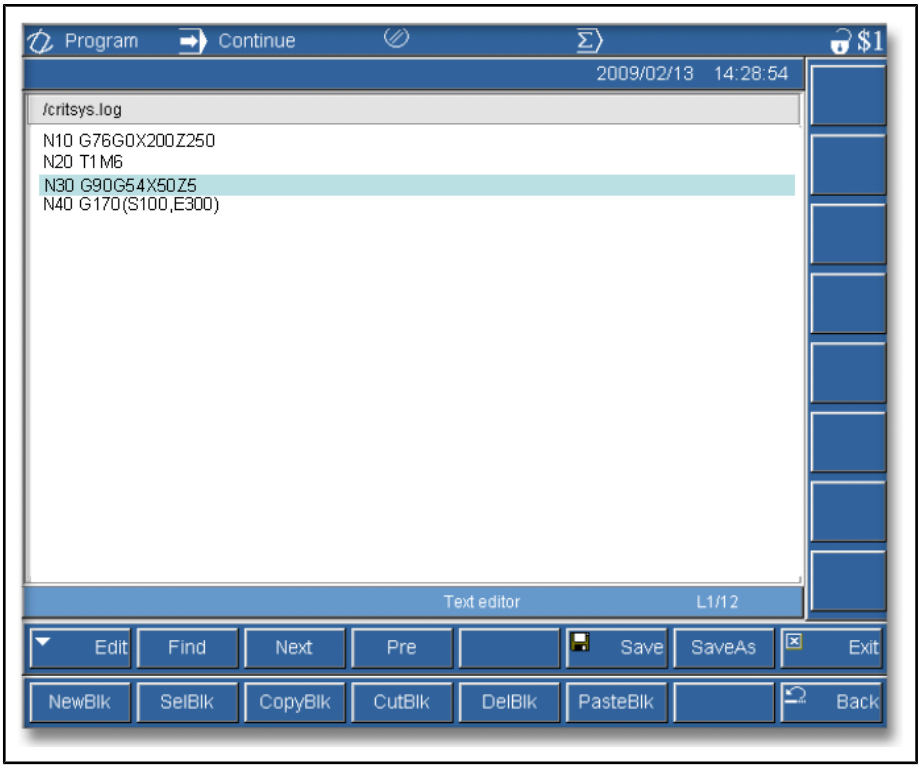

Fig.9-8: Text editor

Operation of the text editor is similar to that of editors known from the PC. Enter the desired data using the ASCII keyboard and press <Enter> to move to a new line. Move the cursor with the cursor keys (▲, ►, ▼, ◄).

Search function

The <Find> (F3) function allows searching for text passages (e.g., block number, positions) in the open file. The <Next> (F4) and <Pre> (F5) functions position the cursor to the next or previous search result, respectively.

Shortcuts

Useful shortcuts are available for the text editor. The related function is executed when both keys are simultaneously pressed on the control panel:

- <Ctrl>+<Home> → positions the cursor to the beginning of the file
- <Ctrl>+<End> → positions the cursor to the end of the file
- <<Ctrl>+<Del> → deletes the line where the cursor is placed
- <Ctrl>+<Ins> → inserts a blank line at the cursor position

Editing functions

The <Edit> (F2) function opens another F-key row providing copy, cut and paste editing functions. These functions can only be used within the open file.

File Management

All NC programs and other user data, e.g., diagnostic texts, are stored in ASCII files in the file system of the IndraMotion MTX micro.

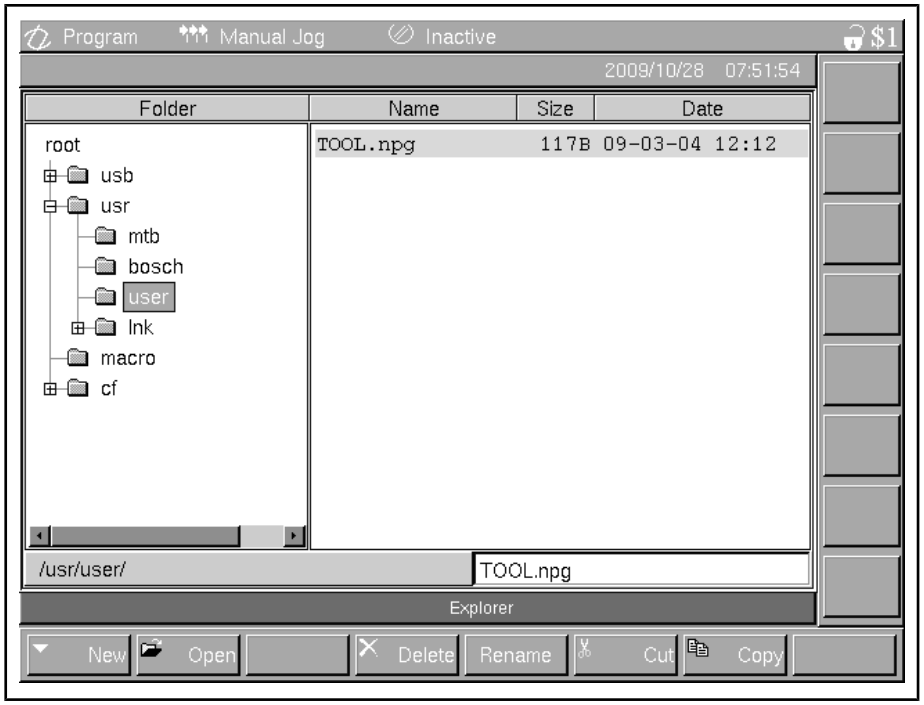

Fig.9-9: File system navigator

Open the <Program> operating area to create new files or edit existing files. This automatically opens the navigator shown in the figure above. Operation of the navigator is similar to that known from the PC programs. The left-hand window shows the file system in a tree, and the right-hand window shows the files of the currently selected directory. The bottom bar displays the current directory and can be used to enter, e.g., a file name.

Selecting a directory

To select a directory, move to the file tree by pressing <TAB>. To open a directory node (+), either wait for approx. 2 s after having placed the focus on it or press <Enter>. Select the desired directory using the cursor keys (▲, ►, ▼, ◄). The right-hand window automatically shows the contents of the directory.

Creating a new program

Press <New> (F2) to create a new program after having selected the directory. Then press <NCProg> (F3) to open the text editor for an NC program.

Editing a program

To open an existing file, move to the files list by pressing <TAB>. Select the file using the cursor keys (▲, ►, ▼, ◄). To open the file, either press <Open> (F3) or simply <Enter>. This automatically opens the appropriate editor.

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9.2.4 Important Operating Screens

Manual Operation Mode

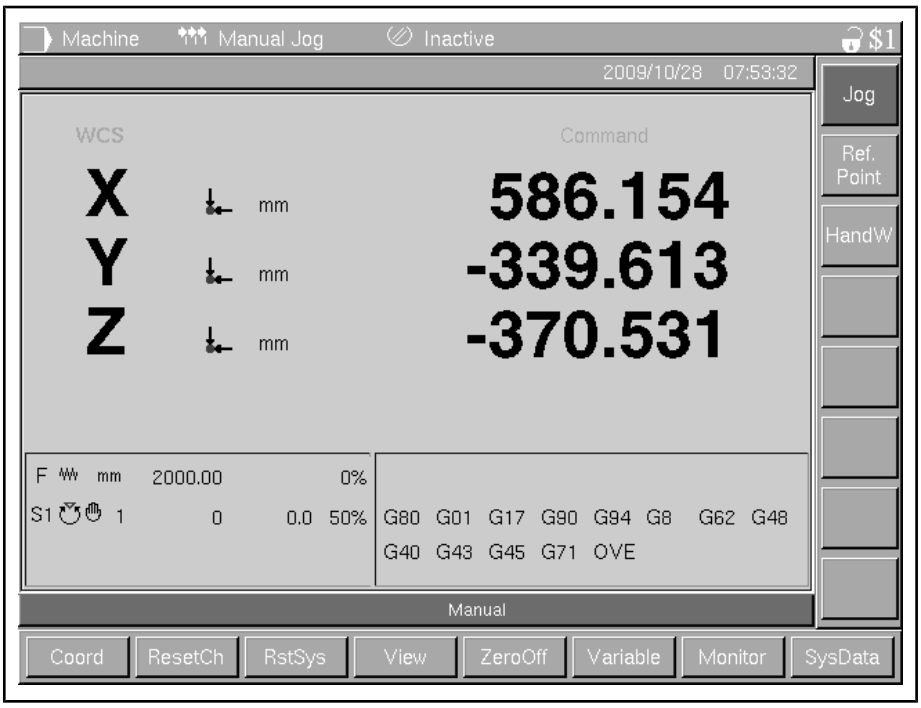

Fig.9-10: Manual screen

The screen is opened by selecting the <Hand> key. It features the jog, move to reference point and handwheel mode functions. To select the functions, press the corresponding machine keys.

Manual Data Input Mode (MDI)

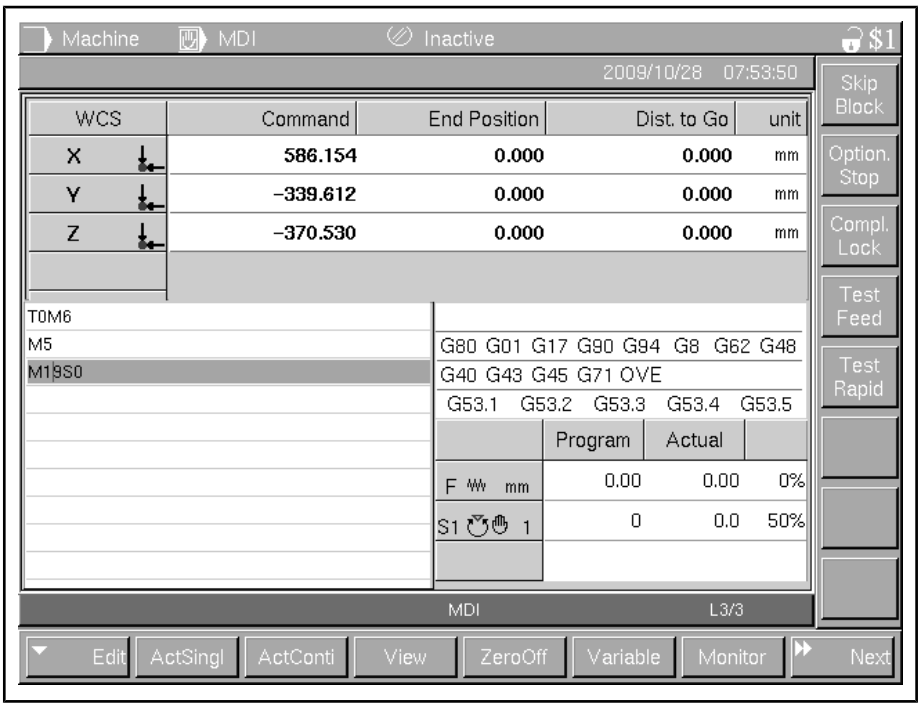

Fig.9-11: MDI screen

Press the <MDI> key to activate the screen. MDI blocks can be entered in the editor field to the left and processed separately <F3> or continuously <F4>.

Automatic Operation Mode

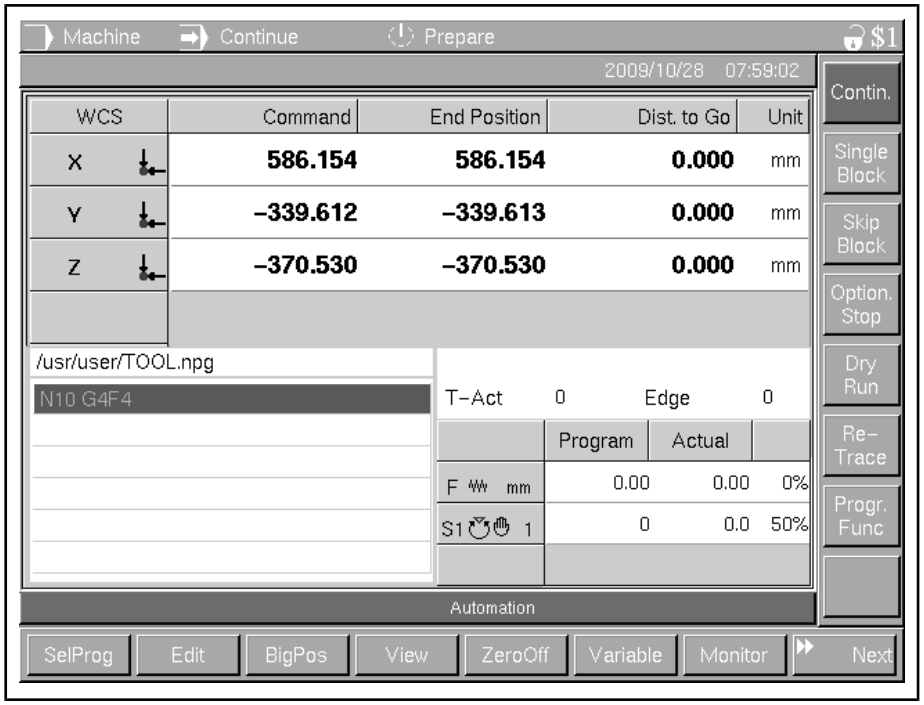

Fig.9-12: Automation screen

Press the <Auto> key to switch to automatic mode and activate the screen. Press <F2> to start the NC program selection. After having selected the desired program with the cursor keys (▲, ▼) and <TAB> if necessary, press <Enter> to activate the program. Provided the program is faultless and power is turned on, press the <NC Start> key to start processing the program. Press <F3> to edit the active NC program.

Operating the IndraMotion MTX micro

Managing Tools

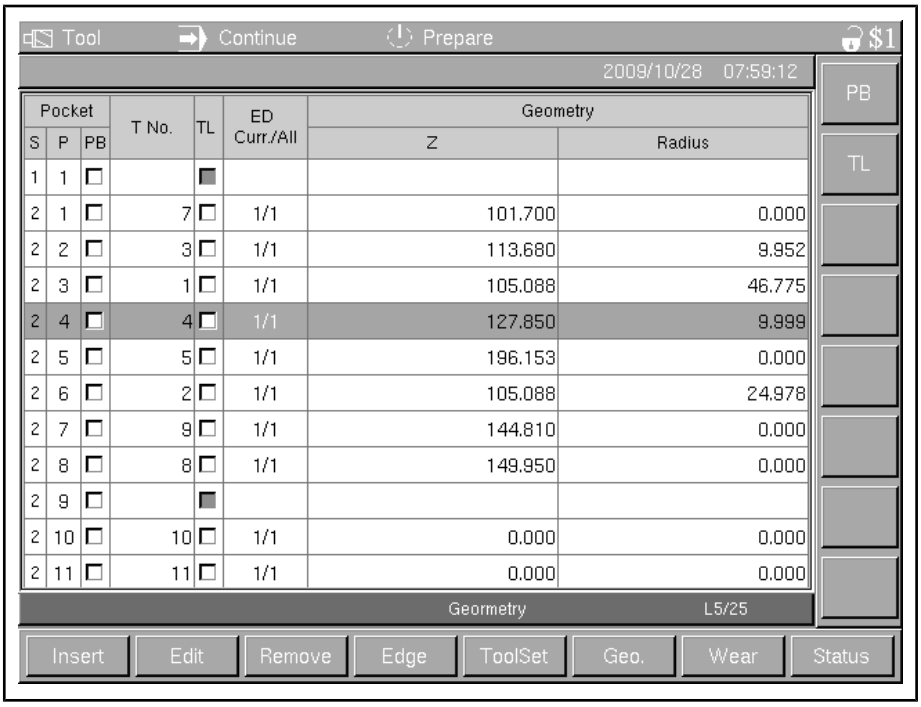

Fig.9-13: Tools list – milling example

The tools list shows all tool storage locations and the currently available tools of the machine. Geometry and wear data is available for no more than two edges of each tool, and status data is also displayed. The tool data can be quickly edited in the list. To do this, select the desired field using the cursor keys and press <Enter> to switch to edit mode. Edit the value and press <Enter> to apply it. The tool editor which can be opened with <F3> provides an overview of all tool data for a selected tool.

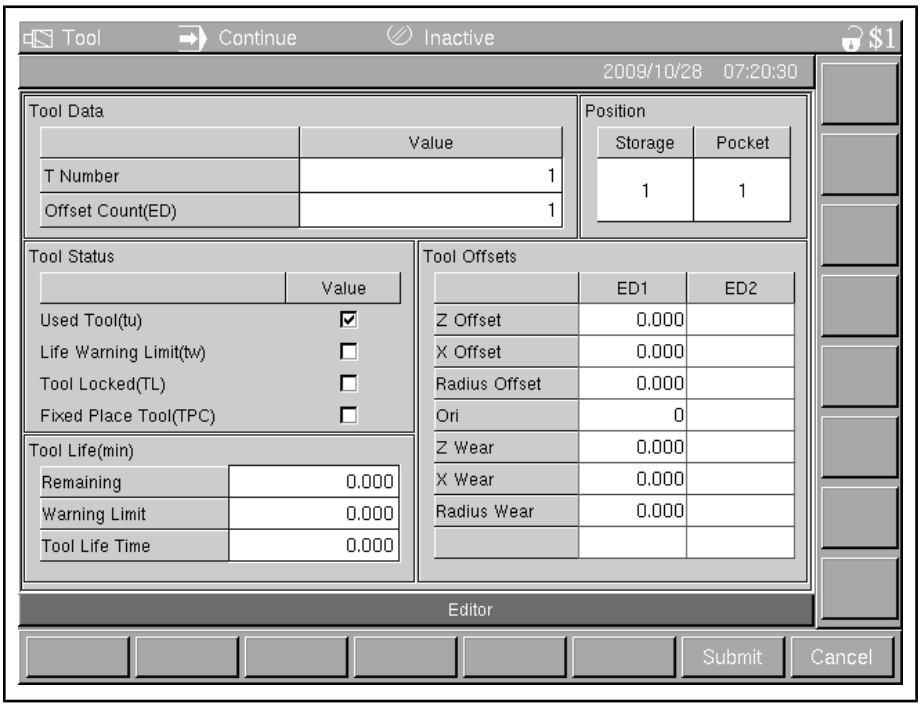

Fig.9-14: Tool editor – turning example

The tool editor also allows creating a new tool. To do this, select an empty tool memory using the cursor keys and open the editor by pressing <F2>. At least one tool number (T Number) must be assigned.

Diagnostic

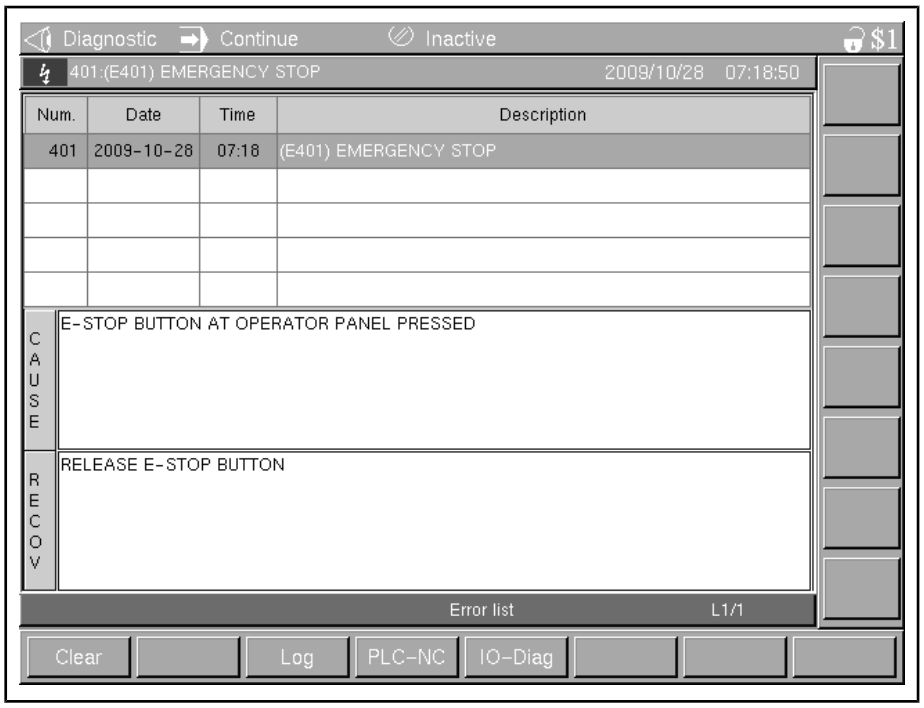

Fig.9-15: Diagnostic messages

The diagnostic screen displays a list of current diagnostic messages. It also shows the number, time of appearance and the message text for each message. The lower area shows the cause and the recovery text for each message that has been selected with the cursor keys.

The error messages are entered in a logbook which can be opened with <F4>.

Operating the IndraMotion MTX micro

9.2.5 Editing Parameters

All CNC and drive parameters can be edited using the HMI software.

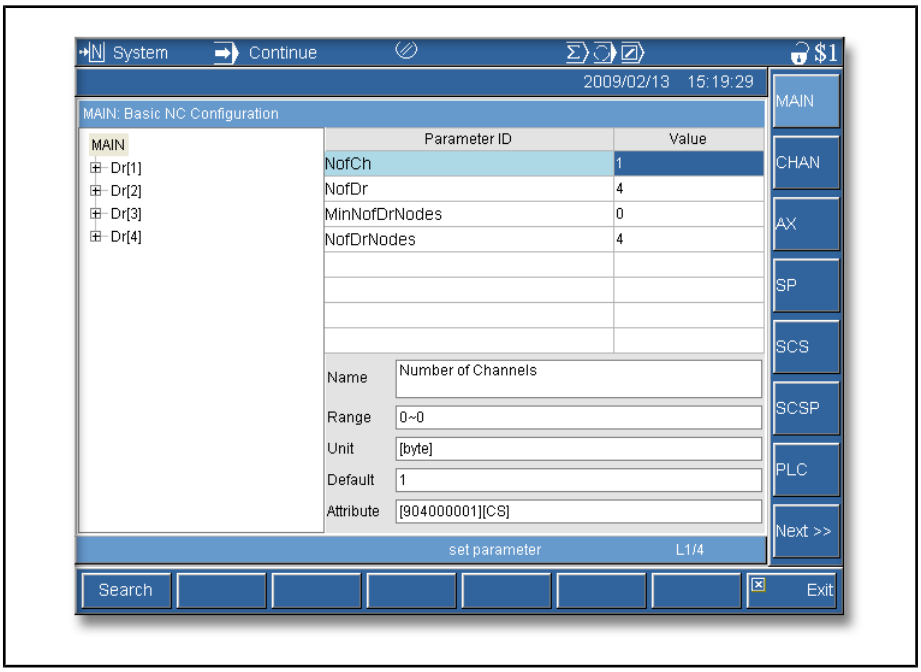

Fig.9-16: CNC parameter editor

Editing CNC parameters

Proceed as follows to edit a CNC parameter:

1. Log in as OEM or Developer user.
2. Open the <System> operating area.
3. Press <F2> (Param).
4. Select the parameter type (e.g., AX for axis parameter) using the machine keys.
5. Select the desired parameter using the cursor keys.
6. Press <Enter> to switch to edit mode.
7. Restart the system after having made your changes.

Editing drive parameters

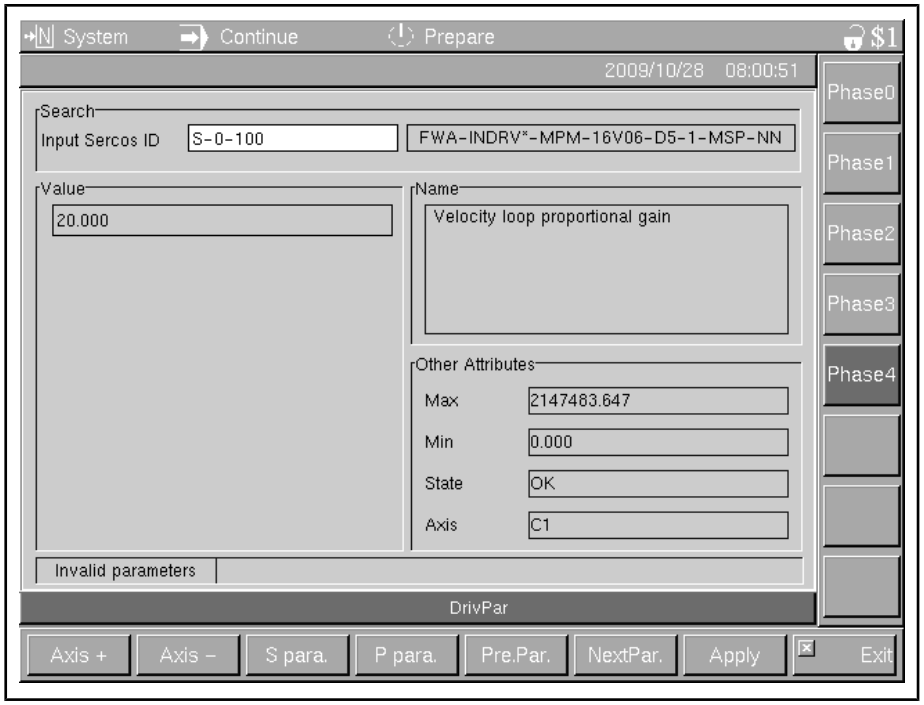

Fig.9-17: Drive parameter editor

Proceed as follows to edit a drive parameter:

1. Log in as OEM or Developer user.
2. Open the <System> operating area.
3. Press <F3> (DrivePar).
4. Press <TAB> to move to the parameter number input field.
5. Enter the desired parameter number (e.g., S100 or P12).
6. If necessary, switch the drive phase to <Phase2> using the machine keys.
7. Edit the parameter.
8. Switch the drive phase back to <Phase4>.

Operating the IndraMotion MTX micro

9.2.6 User Management

The HMI software features a user management which can be used to control the rights to operation and the rights to edit data. There are 4 user levels:

- Guest: can select and start NC programs, but is not allowed to edit programs or parameters.
- Operator: same as guest, but is additionally allowed to edit programs and tools.
- OEM: same as operator, but is additionally allowed to save and backup data and edit parameters.
- Developer: no restrictions.

Logging in as user

To log in as user, open the <Maintain> operating area, press <F2> and select the user level <F2>, <F3>, or <F4>. When prompted to do so, enter the password of the user level. It is not necessary to log in as a guest.

Logging out as user

If you wish to return to the guest user, open the <Maintain> operating area and press <F3>. Restart the control to automatically move to the guest account.

Changing the password

To change a password, log in as user as described above, open the <System> operating area, select <F9>, and press <F6> to start the change. When prompted to do so, enter the old password and then the new password twice.

☞ On delivery, passwords are not assigned to the operator, OEM and developer user levels. We strongly recommend that you create the appropriate passwords.

10 Data Backup and Serial Commissioning

10.1 Data Backup

10.1.1 General

After the machine has been put into commission, the project data should be backed up. The data backup can be made both in IndraWorks Engineering and directly on the machine control panel.

Data backup of individual files

We recommend that you make a data backup with IndraWorks Engineering in the commissioning phase and if you wish to store individual parts of the project. In addition to making a complete backup of the project data, you can also store the drive parameters, the CNC parameters and the PLC program in separate files and reload them separately as well.

Complete backup

Data backup on the machine control panel is made via the USB port and stores the complete user data. This is particularly reasonable after commissioning has been completed and to back up the data at the end customer's. In this case, the data backup procedure is much easier "Single Button Backup" than with IndraWorks Engineering.

10.1.2 Data Backup with IndraWorks Engineering

Proceed as follows to back up the project data:

1. Select **Project – Archive…** from the main menu.
2. Define a name for the archive and, if necessary, a comment and a password (continue with "Next >>").
3. Select a storage location for the archive by activating the "Store Archive on File System" checkbox. Deactivate the "Store Archive on FTP Server" checkbox.
4. 4. In the next step, define the data to be filed to the archive in addition to the PLC program. This requires that you click on the "IndraMotion_MTX_micro_c" node in the left-hand window. The following data can be selected from the right-hand window:
   - Control data – to back up CNC parameters and programs
   - Extended data – to back up additional files
   - Drive data – to back up drive parameters
5. Confirm your selection, and the screen will display a summary of the data to be backed up. Click on "Finish" to start archiving. After archiving has been completed, the screen will again show a summary.

☞ Chapter 5.2 contains a detailed description of how to restore an archive.

Data Backup and Serial Commissioning

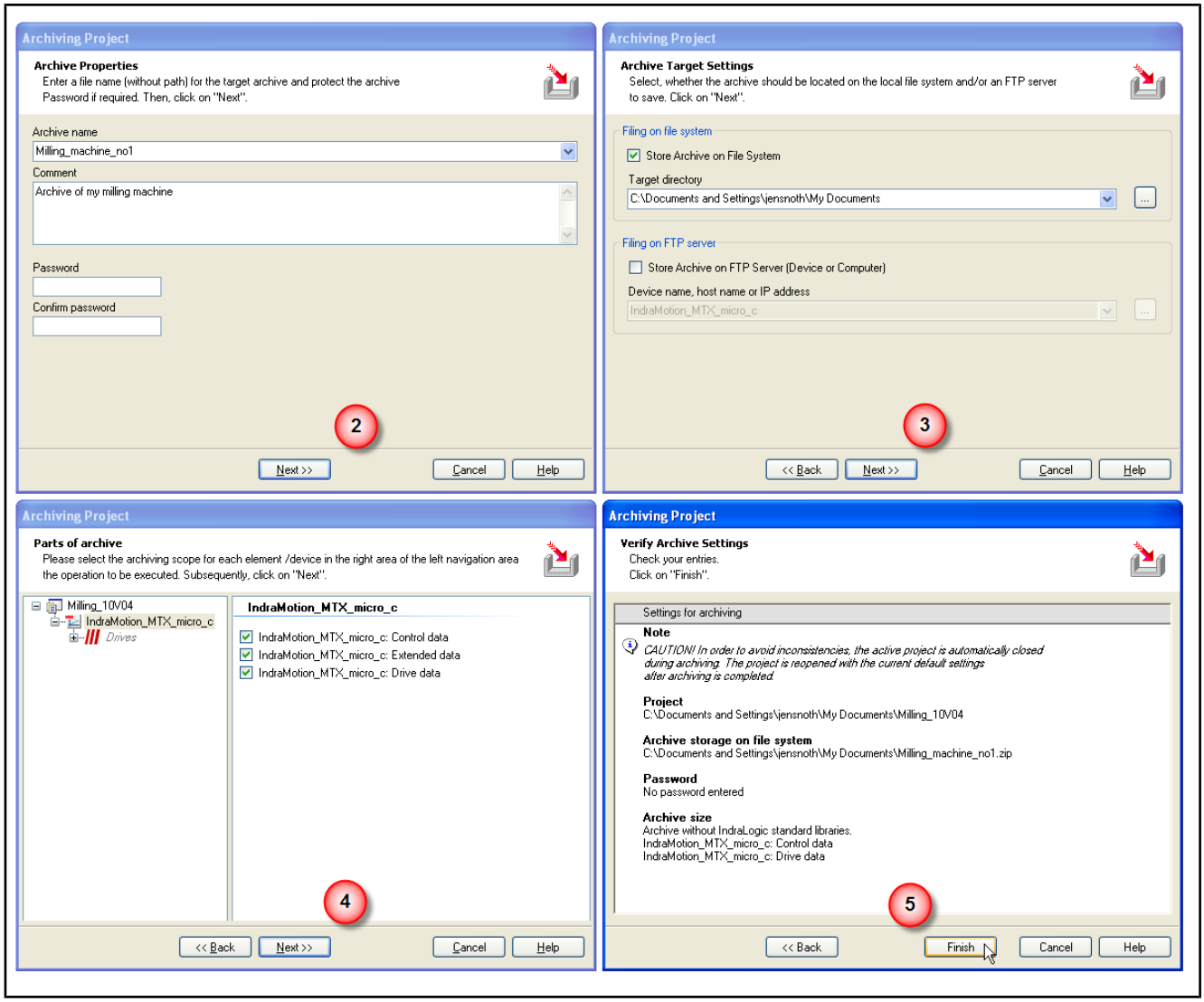

Fig.10-1: Archiving procedure in IndraWorks Engineering

10.1.3 Data Backup with the HMI Software

The HMI software offers a convenient tool for making a backup of all user data of a machine.

Making a data backup on the USB stick

Proceed as follows to make the data backup:

1. Insert an USB stick into the port on the VDP80 control panel. After it has been registered by the system, an appropriate message is displayed.
2. Open the <Maintain> operating area.
3. Press the <F8> (Backup) key.
4. Wait until the "Backup done" message appears, which may take up to 15 minutes.
5. Disconnect the USB stick.

The data is stored to the "/Backup" directory on the USB stick. The data backup contains all user data: CNC and drive parameters, CNC programs (except for /cf and /mnt directories), PLC program, zero points and CNC variables, as well as tool data.

☞ Any data backup already filed on the USB stick will be overwritten without any prompt.

Restoring data from USB stick

Proceed as follows to restore data from a USB stick:

1. Insert an USB stick containing the data backup into the port on the VDP80 control panel. After it has been detected by the system, an appropriate message is displayed.
2. Open the <Maintain> operating area.
3. Press the <F9> (Restore) key.
4. Wait until the "Restore done" message appears, which may take up to 15 minutes.
5. Disconnect the USB stick.
6. Switch the control off and on again. In exceptional cases, it may be required to switch the control off a second time until all parameters are active and the control starts without error message.

☞ The data of the control is completely overwritten during the restore procedure. Please check beforehand whether there is data that is still required.

10.1.4 Serial Commissioning

The data backup and restore operations are excellently suited for serial commissioning of machines.

After the prototype machine has been commissioned, the data is stored to a USB stick. This data backup is used to restore the data for all serial machines. It is even possible to manage several data backups by copying or renaming the "/Backup" directory on the USB stick.

☞ At present, IndraWorks Engineering does not allow downloading the data backup from a USB stick.

11 Annex

11.1 Wiring Diagrams

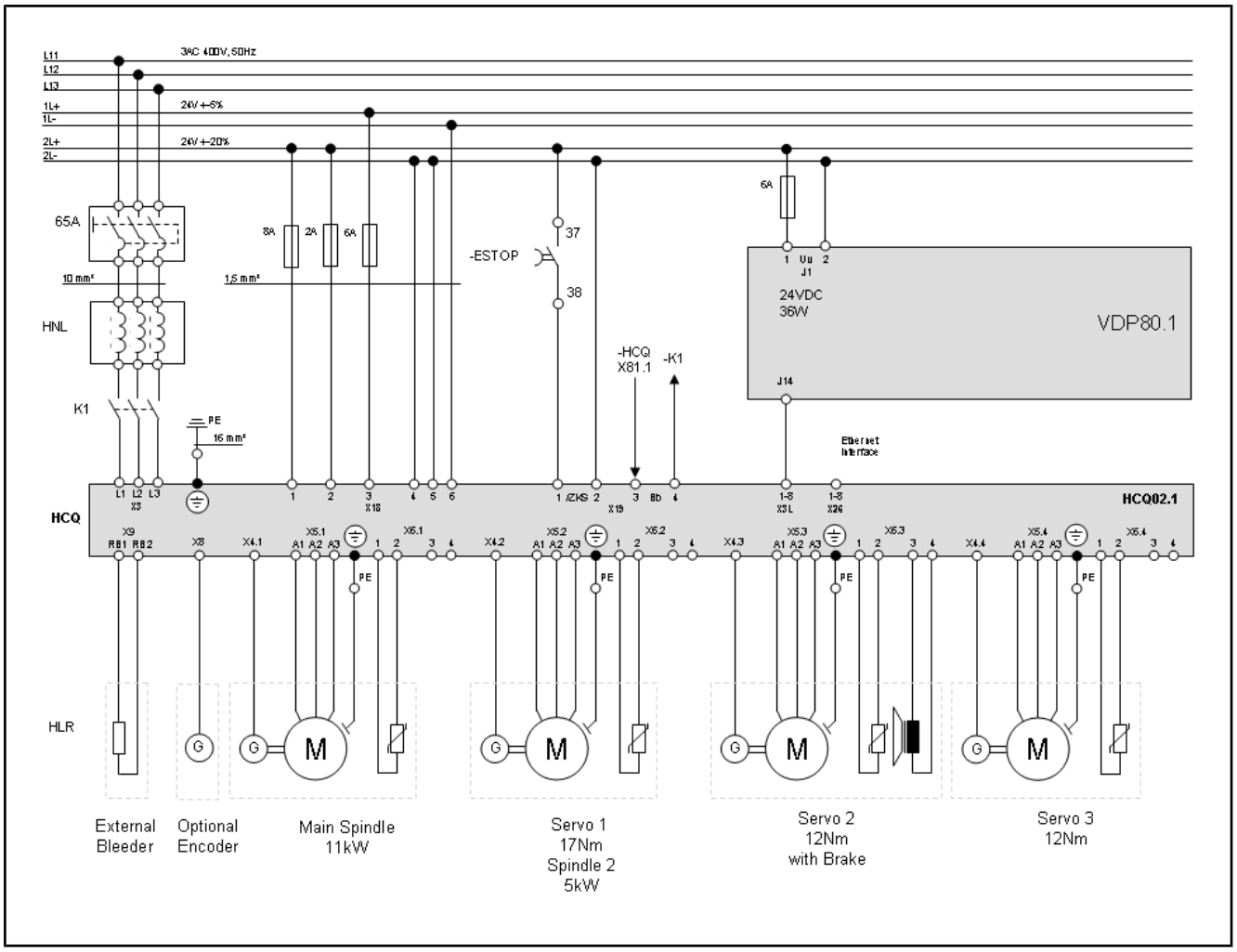

Fig.11-1: Wiring diagram for MTX micro-c with HCQ (4-axis configuration)

Annex

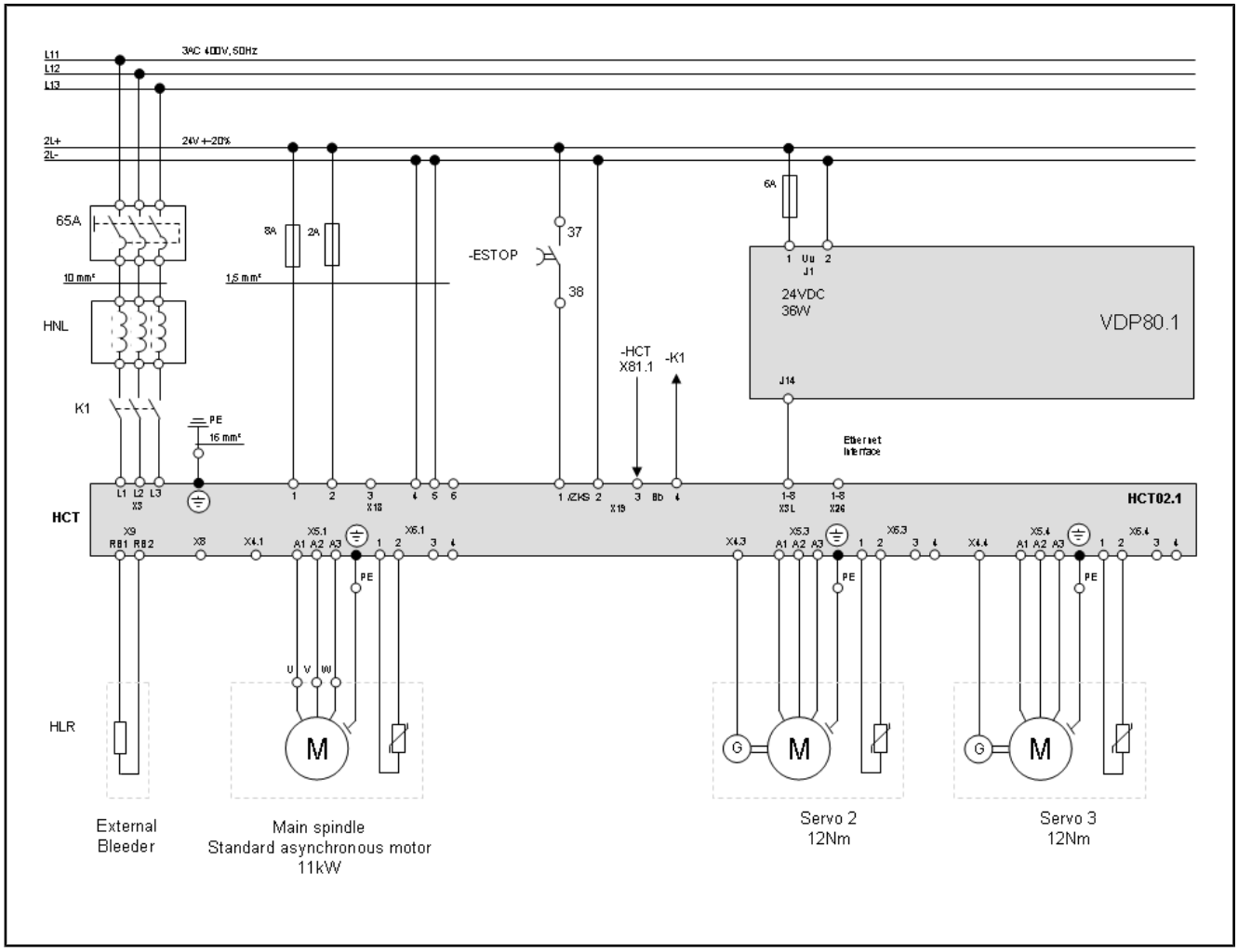

Fig.11-2: Wiring diagram for MTX micro-c with HCT (3-axis configuration)

11.2 Parameter Lists

11.2.1 NC Configuration

Parameter	Description	Milling	Turning 1 Spindle	Turning 2 Spindles
100100001	Drive function type	4,1,1,1	4,1,1	4,4,1,1
100100010	Virtual drive	0,0,0,0	0,0,0	0,0,0,0
100300001	Phys.axis name	C1,X,Y,Z	C1,X,Z	C1,C2,X,Z
100300002	Channel assignment	0,1,1,1	0,1,1	0,0,1,1
100300004	Axis motion type	2,1,1,1	2,1,1	2,2,1,1
100300005	Positioning logic	1	1	1
100300007	Min. axis shape	10	10	10
100300008	Axis shape	20	20	20
100300009	Lagless traveling	1,1,1,1	1,1,1	1,1,1,1
100300010	Torque reduction	1.0,1.0,1.0,1.0	1.0,1.0,1.0	1.0,1.0,1.0
100300011	Probe edge 1 positive/negative	0,0,0,0	0,0,0	0,0,0,0
100300012	Probe available	0,0,0,0	0,0,0	0,0,0,0
100300013	Probe edge 2 positive/negative	0,0,0,0	0,0,0	0,0,0,0
100300030	Fixed stop can be activated	0,0,0,0	0,0,0	0,0,0,0
100300031	Torque limit value at fixed stop	0,20,20,20	0,20,20	0,20,20
100300032	Monitoring window for fixed stop	0.1,0.1,0.1,0.1	0.1,0.1,0.1	0.1,0.1,0.1,0.1
100300050	Positioning logic switchable via NC	0	0	0
100300055	Number of Hirth positions	0	0	0
100300056	Position programming for Hirth axes	1,1,1,1	1,1,1	1,1,1,1
100500002	Max. axis velocity	10000	10000	10000
100500003	Jog velocity slow	18000,2000,2000,2000	18000,2000,2000	18000,18000,2000,2000
100500005	Jog velocity fast	36000,5000,5000,5000	36000,5000,5000	36000,36000,5000,5000
100500006	Jog velocity slow rapid traverse	72000,10000,10000,10000	72000,10000,10000	72000,72000,10000,10000
100500030	Traveling to fixed stop: max. axis velocity	0,500.0,500.0,500.0	0,500.0,500.0	0,500.0,500.0
101000001	Max. axis acceleration	1.0,1.0,1.0,1.0	1.0,1.0,1.0	1.0,1.0,1.0
101000002	Jog acceleration	0.5,0.5,0.5,0.5	0.5,0.5,0.5	0.5,0.5,0.5
101000012	Axis acceleration reserve	8.0,8.0,8.0,8.0	8.0,8.0,8.0	8.0,8.0,8.0,8.0
101000013	Axis jerk reserve	50.0,50.0,50.0,50.0	50.0,50.0,50.0	50.0,50.0,50.0
101000020	Maximum axis jerk	100.0,100.0,100.0,100.0	100.0,100.0,100.0	100.0,100.0,100.0
101000030	Traveling to fixed stop: max. axis accel.	0.1,0.1,0.1,0.1	0.1,0.1,0.1	0.1,0.1,0.1
102000001	Axis end position 1 positive	1000	1000	1000
102000002	Axis end position 1 negative	-1000	-1000	-1000
102000003	Axis end position 2 positive	1000	1000	1000
102000004	Axis end position 2 negative	-1000	-1000	-1000
104000008	Gear switching type	0	0	0
104000010	Number of gear stages	1	1	1
104000011	Minimum speed of gear stage	0	0	0
104000012	Maximum speed of gear stage	1000	1000	1000
104000031	Maximum acceleration of gear stage	100	100	100
104000051	Acceleration of position controller	0	0	0
104000055	Max. jerk in position control (G63) rad/s³	0.0	0.0	0.0
104000020	Speed reaches window rpm	2.0	2.0	2.0,2.0
104000021	Speed reaches window %	0.0	0.0	0.0,0.0
104000041	Spindle override	0	0	0
104000042	Max. spindle override	150	150	150,15

Fig.11-3: NC parameter list

Annex

Parameter	Description	Milling	Turning 1 Spindle	Turning 2 Spindle
105000002	SERCOS communication active	1,1,1,1	1,1,1	1,1,1,1
105000004	SERCOS address	1,3,4,2	1,3,4	1,2,3,4
105000031	SERCOS transmitting power	1	1	1
105000032	SERCOS baud rate	16	16	16
201000100	Position switch point 1..64	0	0	0
201000110	Position of position switch point 1..64	0	0	0
201000120	Monitoring the position switch point 1..64	1	1	1
201000130	Monitoring the position switch point of rotator	0	0	0
309000003	Non-modal M-functions (M codes)	6,0,0,0,0,0,0,0	0	0
309000004	Non-modal M-functions (UP names)	TCH,,,,,,,,	,	,
309000005	Cycles (G-codes)	G80,G81...	G80,G81...	G80,G81...
309000006	Cycles (UP names)	<AUS>,REX_G801...	<AUS>,REX_G801...	<AUS>,REX_G801...
309000007	Cycles (number of parameters)			
701000030	Axis significance	300,1,2,3	300,1,3	300,999,1,3
701000110	Channel axis for G96	1	1	1
703000010	Channel override (feed)	0	0	0
703000012	Maximum channel override	150	150	150
703000210	Max. path acceleration	10	10	10
703000220	Max. path deceleration	10	10	10
703000310	Minimum angle for axis jump	0	0	0
705000320	Shape order G8	20	20	20
705000330	Minimum shape order G8,G9	10	10	10
705000340	Shape order G9	20	20	20
705000600	Thread: controlled spindle programming type	?,?,?	?,?,?	?,?,?
705000610	Thread: jump velocity mm/min	1.000.000	1.000.000	1.000.000
705000615	Thread: acceleration m/s²	0.00	0.00	0.00
705000620	Thread: brake acceleration m/s²	0.00	0.00	0.00
705000640	Thread: enable rapid return	0	1	1
705000645	Thread: rapid return of axes	0	2,03	3,04
705000650	Thread: rapid return path and direction	0.00,0.00	0.00,0.00	0.00,0.00
705001310	Assignment of tool length corrections	1,2,3	1,2,3	1,2,3
706000010	State after startup			
706000020	State after reset	G1G17G90G71G94G8G62G164G48G79G40CLN(CollErr2)G140OVEG53G153BCR()D0TRS()G43ATR()G45ZOS(1)DCS(1)FFW()AAC()PAC()SHT()SCL()MIR()PLS()ROT()PMD()G80RND()F0CRD()#Reset: #SysRes:DAX	G1G18G90G71G95G8G62G164G47(Z,X)G79G40CLNG43G45G140OVEG53G153ED1DIA()BCR()D0TRS()ATR()ZOS(1)DCS(1)FFW(1)AAC()PAC()SHT()SCL()MIR()PLS()ROT()PMD()G80RND()F0CRD()#Reset: #SysRes:DAX	G1G18G90G71G95G8G62G164G47(Z,X)G79G40CLNG43G45G140OVEG53G153ED1DIA()BCR()D0TRS()ATR()ZOS(1)DCS(1)FFW(1)AAC()PAC()SHT()SCL()MIR()PLS()ROT()PMD()G80RND()F0CRD()#Reset: #SysRes:DAX
706000110	Look-Ahead: total number of blocks	300	300	300
706000120	Look-Ahead: maximum block number	10,0,10,5,5	10,0,10,5,5	10,0,10,5,5
706000130	Look-Ahead: block segmentation in percent	30,5,35,15,15	30,5,35,15,15	30,5,35,15,15
706000410	Automatic program reselection	1	1	1
707000010	Memory for CPL programs	4096,2048	4096,2048	4096,2048
800500001	Syntax angle 1	ALPHA	ALPHA	ALPHA
800500002	Syntax angle 2	BETA	BETA	BETA
904000001	Number of channels	1	1	1
906000001	Handwheel parameters, number of pulses	100,1	100,1	100,1

Fig.11-4: NC parameter list

11.2.2 PLC CNC Interfaces

Start Addresses

PLC - Start Addresses						
	Inputs		Outputs		Marker	
Variable	Start Byte	Size (Bytes)	Start Byte	Size (Bytes)	Start Byte	Size (Bytes)
Hardware I/O						
Digital I/Os	10	12	10	6	-	-
USB I/Os	100	32	100	16	-	-
CNC Interface						
General Interface	1000	4	1000	4	-	-
Channel Interface	1100	14*	1100	14*	-	-
Axes Interface	1200	12*	1200	12*	-	-
Spindle Interface	1300	12*	1300	12*	-	-
MSD Interface			1400	256	-	-
Auxiliary Functions						
M-Functions Ch1	-	-	-	-	4100	37*
T-Functions Ch1	-	-	-	-	4200	4*
H-Functions	-	-	-	-	4300	20
S-Functions	-	-	-	-	4400	4*
Markers	8kByte					
User markers	-	-	-	-	0	3072
System markers	-	-	-	-	3072	4096

Fig.11-5: PLC start addresses

Annex

I/O Addresses

MTX micro Inputs & Outputs				
Terminal	Pin	PLC Address	Symbol	Comment
X81	1	%QX11.0	Q11_0	X81-1 Mains contactor
	2	%QX11.1	Q11_1	X81-2
	3	%QX11.2	Q11_2	X81-3
	4	%QX11.3	Q11_3	X81-4
	5	%QX11.4	Q11_4	X81-5
	6	%QX11.5	Q11_5	X81-6
	7	%QX11.6	Q11_6	X81-7
	8	%QX11.7	Q11_7	X81-8
X82	1	%QX10.0	Q10_0	X82-1
	2	%QX10.1	Q10_1	X82-2
	3	%QX10.2	Q10_2	X82-3
	4	%QX10.3	Q10_3	X82-4
	5	%QX10.4	Q10_4	X82-5
	6	%QX10.5	Q10_5	X82-6
	7	%QX10.6	Q10_6	X82-7
	8	%QX10.7	Q10_7	X82-8
X83	1	%IX13.0	I13_0	X83-1
	2	%IX13.1	I13_1	X83-2
	3	%IX13.2	I13_2	X83-3
	4	%IX13.3	I13_3	X83-4
	5	%IX13.4	I13_4	X83-5
	6	%IX13.5	I13_5	X83-6
	7	%IX13.6	I13_6	X83-7
	8	%IX13.7	I13_7	X83-8
X84	1	%IX12.0	I12_0	X84-1
	2	%IX12.1	I12_1	X84-2
	3	%IX12.2	I12_2	X84-3
	4	%IX12.3	I12_3	X84-4
	5	%IX12.4	I12_4	X84-5
	6	%IX12.5	I12_5	X84-6
	7	%IX12.6	I12_6	X84-7
	8	%IX12.7	I12_7	X84-8
X85	1	%IX11.0	I11_0	X85-1
	2	%IX11.1	I11_1	X85-2
	3	%IX11.2	I11_2	X85-3
	4	%IX11.3	I11_3	X85-4
	5	%IX11.4	I11_4	X85-5
	6	%IX11.5	I11_5	X85-6
	7	%IX11.6	I11_6	X85-7
	8	%IX11.7	I11_7	X85-8
X86	1	%IX10.0	I10_0	X86-1 E-Stop O.K.
	2	%IX10.1	I10_1	X86-2 Probe 1
	3	%IX10.2	I10_2	X86-3 Probe 2
	4	%IX10.3	I10_3	X86-4
	5	%IX10.4	I10_4	X86-5
	6	%IX10.5	I10_5	X86-6
	7	%IX10.6	I10_6	X86-7
	8	%IX10.7	I10_7	X86-8

I/O Module 1				
Terminal	Pin	PLC Address	Symbol	Comment
X71	1	%QX21.0	Q21_0	X71-1
	2	%QX21.1	Q21_1	X71-2
	3	%QX21.2	Q21_2	X71-3
	4	%QX21.3	Q21_3	X71-4
	5	%QX21.4	Q21_4	X71-5
	6	%QX21.5	Q21_5	X71-6
	7	%QX21.6	Q21_6	X71-7
	8	%QX21.7	Q21_7	X71-8
X72	1	%QX20.0	Q20_0	X72-1
	2	%QX20.1	Q20_1	X72-2
	3	%QX20.2	Q20_2	X72-3
	4	%QX20.3	Q20_3	X72-4
	5	%QX20.4	Q20_4	X72-5
	6	%QX20.5	Q20_5	X72-6
	7	%QX20.6	Q20_6	X72-7
	8	%QX20.7	Q20_7	X72-8
X73	1	%IX23.0	I23_0	X73-1
	2	%IX23.1	I23_1	X73-2
	3	%IX23.2	I23_2	X73-3
	4	%IX23.3	I23_3	X73-4
	5	%IX23.4	I23_4	X73-5
	6	%IX23.5	I23_5	X73-6
	7	%IX23.6	I23_6	X73-7
	8	%IX23.7	I23_7	X73-8
X74	1	%IX22.0	I22_0	X74-1
	2	%IX22.1	I22_1	X74-2
	3	%IX22.2	I22_2	X74-3
	4	%IX22.3	I22_3	X74-4
	5	%IX22.4	I22_4	X74-5
	6	%IX22.5	I22_5	X74-6
	7	%IX22.6	I22_6	X74-7
	8	%IX22.7	I22_7	X74-8
X75	1	%IX21.0	I21_0	X75-1
	2	%IX21.1	I21_1	X75-2
	3	%IX21.2	I21_2	X75-3
	4	%IX21.3	I21_3	X75-4
	5	%IX21.4	I21_4	X75-5
	6	%IX21.5	I21_5	X75-6
	7	%IX21.6	I21_6	X75-7
	8	%IX21.7	I21_7	X75-8
X76	1	%IX20.0	I20_0	X76-1
	2	%IX20.1	I20_1	X76-2
	3	%IX20.2	I20_2	X76-3
	4	%IX20.3	I20_3	X76-4
	5	%IX20.4	I20_4	X76-5
	6	%IX20.5	I20_5	X76-6
	7	%IX20.6	I20_6	X76-7
	8	%IX20.7	I20_7	X76-8

I/O Module 2				
Terminal	Pin	PLC Address	Symbol	Comment
X71	1	%QX31.0	Q31_0	X71-1
	2	%QX31.1	Q31_1	X71-2
	3	%QX31.2	Q31_2	X71-3
	4	%QX31.3	Q31_3	X71-4
	5	%QX31.4	Q31_4	X71-5
	6	%QX31.5	Q31_5	X71-6
	7	%QX31.6	Q31_6	X71-7
	8	%QX31.7	Q31_7	X71-8
X72	1	%QX30.0	Q30_0	X72-1
	2	%QX30.1	Q30_1	X72-2
	3	%QX30.2	Q30_2	X72-3
	4	%QX30.3	Q30_3	X72-4
	5	%QX30.4	Q30_4	X72-5
	6	%QX30.5	Q30_5	X72-6
	7	%QX30.6	Q30_6	X72-7
	8	%QX30.7	Q30_7	X72-8
X73	1	%IX33.0	I33_0	X73-1
	2	%IX33.1	I33_1	X73-2
	3	%IX33.2	I33_2	X73-3
	4	%IX33.3	I33_3	X73-4
	5	%IX33.4	I33_4	X73-5
	6	%IX33.5	I33_5	X73-6
	7	%IX33.6	I33_6	X73-7
	8	%IX33.7	I33_7	X73-8
X74	1	%IX32.0	I32_0	X74-1
	2	%IX32.1	I32_1	X74-2
	3	%IX32.2	I32_2	X74-3
	4	%IX32.3	I32_3	X74-4
	5	%IX32.4	I32_4	X74-5
	6	%IX32.5	I32_5	X74-6
	7	%IX32.6	I32_6	X74-7
	8	%IX32.7	I32_7	X74-8
X75	1	%IX31.0	I31_0	X75-1
	2	%IX31.1	I31_1	X75-2
	3	%IX31.2	I31_2	X75-3
	4	%IX31.3	I31_3	X75-4
	5	%IX31.4	I31_4	X75-5
	6	%IX31.5	I31_5	X75-6
	7	%IX31.6	I31_6	X75-7
	8	%IX31.7	I31_7	X75-8
X76	1	%IX30.0	I30_0	X76-1
	2	%IX30.1	I30_1	X76-2
	3	%IX30.2	I30_2	X76-3
	4	%IX30.3	I30_3	X76-4
	5	%IX30.4	I30_4	X76-5
	6	%IX30.5	I30_5	X76-6
	7	%IX30.6	I30_6	X76-7
	8	%IX30.7	I30_7	X76-8

Fig.11-6: Inputs and outputs

Annex

Auxiliary Functions

BYTE	PLC Address	Symbol	Comment
4100	%MX4100.0	Ch1_M000	Channel 1 Function M0
	%MX4100.1	Ch1_M001	Channel 1 Function M1
	%MX4100.2	Ch1_M002	Channel 1 Function M2
	%MX4100.3	Ch1_M003	Channel 1 Function M3
	%MX4100.4	Ch1_M004	Channel 1 Function M4
	%MX4100.5	Ch1_M005	Channel 1 Function M5
	%MX4100.6	Ch1_M006	Channel 1 Function M6
	%MX4100.7	Ch1_M007	Channel 1 Function M7
4101	%MX4101.0	Ch1_M008	Channel 1 Function M8
	%MX4101.1	Ch1_M009	Channel 1 Function M9
	%MX4101.2	Ch1_M010	Channel 1 Function M10
	%MX4101.3	Ch1_M011	Channel 1 Function M11
	%MX4101.4	Ch1_M012	Channel 1 Function M12
	%MX4101.5	Ch1_M013	Channel 1 Function M13
	%MX4101.6	Ch1_M014	Channel 1 Function M14
	%MX4101.7	Ch1_M015	Channel 1 Function M15
4102	%MX4102.0	Ch1_M016	Channel 1 Function M16
	%MX4102.1	Ch1_M017	Channel 1 Function M17
	%MX4102.2	Ch1_M018	Channel 1 Function M18
	%MX4102.3	Ch1_M019	Channel 1 Function M19
	%MX4102.4	Ch1_M020	Channel 1 Function M20
	%MX4102.5	Ch1_M021	Channel 1 Function M21
	%MX4102.6	Ch1_M022	Channel 1 Function M22
	%MX4102.7	Ch1_M023	Channel 1 Function M23
...			
		.	
4136	%MX4136.0	Ch1_M288	Channel 1 Function M288
	%MX4136.1	Ch1_M289	Channel 1 Function M289
	%MX4136.2	Ch1_M290	Channel 1 Function M290
	%MX4136.3	Ch1_M291	Channel 1 Function M291
	%MX4136.4	Ch1_M292	Channel 1 Function M292
	%MX4136.5	Ch1_M293	Channel 1 Function M293
	%MX4136.6	Ch1_M294	Channel 1 Function M294
	%MX4136.7	Ch1_M295	Channel 1 Function M295
4137	%MX4137.0	Ch1_M296	Channel 1 Function M296
	%MX4137.1	Ch1_M297	Channel 1 Function M297
	%MX4137.2	Ch1_M298	Channel 1 Function M298
	%MX4137.3	Ch1_M299	Channel 1 Function M299
	%MX4137.4	-	-
	%MX4137.5	-	-
	%MX4137.6	-	-
	%MX4137.7	-	-

Fig.11-7: M-functions

Annex

PLC Address	Symbol	Comment	Length
%MX4200.0	iCh1_TNr_Ack	Channel 1 T-function acknowledgement	1 Bit
%MB4204	iCh1_TNr_Val	Channel 1 T-function value	4 Byte
%MB4205			
%MB4206			
%MB4207			
%MX4208.0	iCh2_TNr_Ack	Channel 2 T-function acknowledgement	1 Bit
%MB4212	iCh2_TNr_Val	Channel 2 T-function value	4 Byte
%MB4213			
%MB4214			
%MB4215			
%MX4300.0	H1_Ack	Auxiliary H1function acknowledgement	1 Bit
%MB4304	H1_Val	Auxiliary H1 function value	4 Byte
%MB4305			
%MB4306			
%MB4307			
%MX4308.0	H2_Ack	Auxiliary H2 function acknowledgement	1 Bit
%MB4312	H2_Val	Auxiliary H2 function value	4 Byte
%MB4313			
%MB4314			
%MB4315			
%MX4316.0	H3_Ack	Auxiliary H3 function acknowledgement	1 Bit
%MB4320	H3_Val	Auxiliary H3 function value	4 Byte
%MB4321			
%MB4322			
%MB4323			
%MX4324.0	H4_Ack	Auxiliary H4 function acknowledgement	1 Bit
%MB4328	H4_Val	Auxiliary H4 function value	4 Byte
%MB4329			
%MB4330			
%MB4331			
%MX4332.0	H5_Ack	Auxiliary H5 function acknowledgement	1 Bit
%MB4336	H5_Val	Auxiliary H5 function value	4 Byte
%MB4337			
%MB4338			
%MB4339			
%MX4400.0	iSp1_Ack	Spindle 1 S-code acknowledgement	1 Bit
%MB4404	iSp1_Val	Spindle 1 programmed S-Code	4 Byte
%MB4405			
%MB4406			
%MB4407			
%MX4408.0	iSp2_Ack	Spindle 2 S-code acknowledgement	1 Bit
%MB4412	iSp2_Val	Spindle 2 programmed S-code	4 Byte
%MB4413			
%MB4414			
%MB4415			

Fig.11-8: Additional auxiliary functions

12 Service and Support

Our service helpdesk at our headquarters in Lohr, Germany and our worldwide service will assist you with all kinds of enquiries. You can reach us **around the clock - even on weekend and on holidays**.

	Helpdesk	Service Hotline Worldwide
Phone	**+49 (0) 9352 40 50 60**	Outwith Germany please contact our sales/service office in your area first. For hotline numbers refer to the sales office addresses on the Internet.
Fax	**+49 (0) 9352 40 49 41**	
E-mail	service.svc@boschrexroth.de	
Internet	http://www.boschrexroth.com You will also find additional notes regarding service, maintenance (e.g. delivery addresses) and training.	

Preparing Information

For quick and efficient help please have the following information ready:

- Detailed description of the fault and the circumstances
- Information on the type plate of the affected products, especially type codes and serial numbers
- Your phone, fax numbers and e-mail address so we can contact you in case of questions.

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Notes

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R911332281

Printed in Germany
DOK-MTXMIC-EASY*******-CO04-EN-P