

MTX 14VRS

Standard NC Operation

Application Description
R911342632

Edition 08



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1 About this documentation

Editions of this documentation

Edition	Release date	Note
01	2014-08	First edition
02	2016-06	New chapter "NC simulation" New chapter "Multitouch user interface"
03	2016-09	Additions in chapter "NC-Simulation"
04	2017-01	Chapter "NC simulation" removed Changes in chapter "Multitouch user interface"
05	2017-10	Chapter "I-Remote" replaced by "Remote support" GNP removed
06	2018-03	Chapter "Multitouch user interface" removed
07	2019-11	Chapter chapter 9.7 "PLC variable list" on page 227 revised (Defdb00191994) chapter 6.2 "NC program creation" on page 117 extended by a new NC editor for big programs (WP-00077353)
03	2021-03	chapter 11.3 "Operating the encryption program" on page 300 : Screenshots of the MTxCrypt program updated (Defdb00209176)

Tab. 1-1: Change record

1.1 Validity of the documentation

Overview on target groups and product phases

The following graphic refers to the bordered activities, product phases and target groups of the present documentation.

Example: The target group "Programmer" can execute the "Configuration" in the product phase "Engineering" using this documentation.

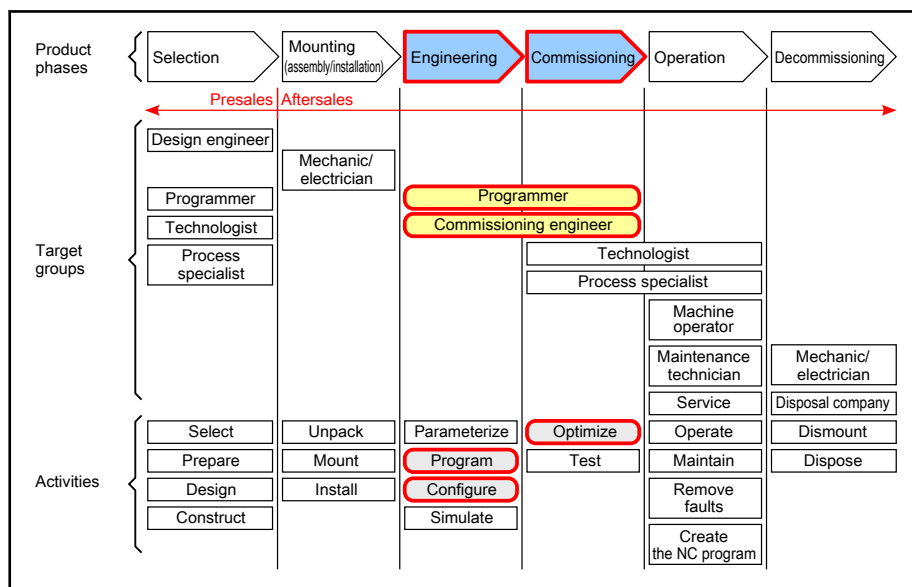


Fig. 1-1: Assigning this documentation to the target groups, product phases and target group activities

Target group This documentation is intended for users commissioning an MTX control. Apart from a complete overview, configuration of the axes and the user interface as well as the PLC data are described.

This documentation supports the user during the following phases:

- Engineering
- Commissioning

1.2 Purpose

This documentation describes the operation of the standard user interface of the MTX NC control.

This documentation is a component of the full documentation for the MTX.

1.3 Structure

The document is structured according to the procedures. The description of the individual functions corresponds to their operation. General operating instructions come first.

1.4 Notation, fonts, symbols

The following notations are used in this documentation to actuate operating elements (buttons, keys):

Keys on the keyboard and on the operator panel

Keys on the keyboard and on the operator panel are shown in angled brackets <>, e.g. pressing the enter key by <Enter>.

Keys that have to be pressed **in sequence** are separated by a comma, e.g. <1>, <2>, <Enter>.

Keys that have to be pressed **simultaneously** are combined using a plus symbol, e.g. <Ctrl>+<Alt>+<Del> or <Shift>+<Enter>.

Buttons on the user interface

Buttons in the dialogs of the user interface are highlighted by quotation marks, e.g. "OK" or "Cancel".

Menu sequences

To display menus, the individual sequential menu items are highlighted in bold and connected by triangles. For example, to go to the "Save" menu sub-item in the "File" menu: **File ► Save**.

1.5 Prerequisites

To operate the standard user interface of MTX according to this documentation, the control has to be configured and commissioned.

The default settings of the dialogs as delivered are described. For further configurations, refer to the "IndraMotion MTX 14VRS Commissioning", DOK-MTX***-STARTUP*V14-CORS-EN-P documentation.

1.6 Required and supplementing documentation MTX

1.6.1 Selection/compilation

Documentation titles with type codes and part numbers

MTX 14VRS System Description DOK-MTX***-SYS*DES*V14-PRRS-EN-P, R911342640 This documentation describes the MTX control. It includes the designs, technical data, interfaces as well as the configuration of the control components.
MTX 14VRS SafeLogic System Overview DOK-MTX***-SL**SYS*V14-PRRS-EN-P, R911341698 This documentation describes the use of the safety control SafeLogic in the MTX.

Tab. 1-2: MTX documentation overview - Selecting/composing

1.6.2 Configuration

Documentation titles with type codes and part numbers

MTX 14VRS Machine Parameters DOK-MTX***-MA*PAR**V14-RERS-EN-P, R911342630 This documentation describes structure and the adjustment of available parameters of the MTX. It also includes the functions of the NC configurator and its operation.
MTX 14VRS PLC interface DOK-MTX***-PLC*INT*V14-PRRS-EN-P, R911342622 This documentation describes the interface signals and the program function blocks for the integrated PLC.
MTX 14VRS Functional Description - Basics DOK-MTX***-NC*F*BA*V14-RERS-EN-P, R911342626 This documentation describes the basic functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
MTX 14VRS Functional Description - Extension DOK-MTX***-NC*F*EX*V14-RERS-EN-P, R911342628 This documentation describes the extended functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
MTX 14VRS Functional Description - Special Functions DOK-MTX***-NC*F*SP*V14-RERS-EN-P, R911342624 This documentation describes the special functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
MTX Free Form Surface Milling DOK-MTX***-FREEFORM***-APRS-EN-P, R911341435 This documentation describes the free form surface milling process with the MTX control. CNC programs generated by a CAD/CAM system are used as basis for the entire process. Overview over the following topics: Description of the MTX or CNC function for freeform surface milling, strategy during the NC parameterization process, boundary conditions when generating CNC programs with CAM software.
MTX Conversion of MTX Projects DOK-MTX***-PROCONV****-PRRS-EN-P, R911342484 This documentation provides support during the conversion of MTX 1.x projects to MTX 2G. This project planning manual provides information on how to convert a project and identifies potential difficulties during the conversion.

Tab. 1-3: MTX documentation overview - Configuring

1.6.3 Commissioning

Documentation titles with type codes and part numbers

IndraWorks 13VRS Simulation DOK-IWORKS-SIMU****V13-APRS-EN-P, R911339256 This documentation describes the functions of the simulation components View3D, virtual control panel, virtual control and its operation in IndraWorks.
MTX 14VRS Commissioning DOK-MTX***-STARTUP*V14-CORS-EN-P, R911342620 This documentation describes the commissioning of the MTX control. Apart from a complete overview, commissioning and configuration of the axes and the user interface as well as the PLC data are described.
IndraWorks 14VRS Basis Libraries IndraLogic 2G DOK-IL*2G*-BASLIB**V14-LIRS-EN-P, R911343920 This documentation describes the system-comprehensive PLC libraries.
IndraWorks 14VRS Field Buses DOK-IWORKS-FB*****V14-APRS-EN-P, R911341485 This documentation describes the field bus and local periphery connections supported by the XLC, MLC and MTX systems. The focus of this documentation lies in the configuration, parameterization, commissioning and diagnostics of different periphery connections. It is the basis for the online help.
IndraWorks 14VRS WinStudio 7.4 DOK-IWORKS-WINSTUD*V14-APRS-EN-P, R911341585 This "User Manual and Technical Reference Book" supports the user in achieving the best results with the "Rexroth WinStudio"™ software. The document provides technical information and step-by-step instructions to create web-enabled HMI/SCADA programs.
IndraWorks 14VRS Software Installation DOK-IWORKS-SOFTINS*V14-CORS-EN-P, R911344286 This documentation describes the IndraWorks installation.
IndraWorks 14VRS Engineering DOK-IWORKS-ENGINEE*V14-APRS-EN-P, R911343566 This documentation describes the use of IndraWorks in which the engineering tools are integrated. It includes instructions on how to work with IndraWorks and how to operate the oscilloscope function.
IndraWorks 12VRS FDT Container DOK-IWORKS-FDT*CON*V12-APRS-EN-P, R911334398 This documentation describes the IndraWorks FDT Container functionality. It includes the activation of the functionality in the project and working with DTMs.
IndraWorks 14VRS PLC Programming System IndraLogic 2G DOK-IWORKS-IL2GPRO*V14-APRS-EN-P, R911343571 This documentation describes the PLC programming tool IndraLogic 2G and its use. The documentation includes the basic use, first steps, visualization, menu items and editors.
IndraWorks 14VRS HMI DOK-IWORKS-HMI*****V14-APRS-EN-P, R911343569 This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.

Tab. 1-4: MTX documentation overview - Commissioning

1.6.4 Operation

Documentation titles with type codes and part numbers

MTX 09VRS Shop Floor Programming Turning and Milling DOK-MTX***-SF*PROG*V09-AWxx-EN-P, R911324377 This documentation describes the operation and programming of the graphic NC programming of turning and milling as well as the workpiece simulation.
MTX 12VRS Block Pre-Run DOK-MTX***-BLK*RUN*V12-APRS-EN-P, R911334379 This documentation explains to the machine manufacturer how to setup the "Block pre-run" function at the machine for the end user.
MTX 14VRS Programming Manual DOK-MTX***-NC**PRO*V14-RERS-EN-P, R911342634 This documentation describes the standard programming of the MTX control. Apart from the basics of NC programming, the use of NC functions according to DIN 66025 as well as the NC functions with high-level language syntax and CPL functions are described.
MTX 14VRS Standard NC Operation DOK-MTX***-NC*OP***V14-APRS-EN-P, R911342632 This documentation describes the operation of the standard user interface of the NC control of the MTX. It includes the operation of the interface, the NC program development as well as the tool management.
MTX 14VRS Multitouch DOK-MTX***-MULTI***V14-APRS-EN-P, R911384735 The Multitouch user interface of the NC control MTX is described in this documentation.
MTX 14VRS Standard NC Cycles DOK-MTX***-NC*CYC**V14-PRRS-EN-P, R911342638 This documentation describes the application of the standard cycles of the different technologies for the MTX control.
MTX 14VRS NC Simulation DOK-MTX***-NC*SIM**V14-APRS-EN-P, R911379629 This documentation describes the NC simulation for the MTX control.

xx Corresponding edition
Tab. 1-5: MTX documentation overview - Operating

1.6.5 OEM Engineering

Documentation titles with type codes and part numbers

MTX 13VRS Automation Interface DOK-MTX***-AUT*INT*V13-APRS-EN-P, R911337274 This documentation describes the script-based access to IndraWorks project data via the interface of the Automation Interface. Different objects including code examples are described. The Automation Builder is also described in this manual.
MTX 14VRS OPC Communication DOK-MTX***-OPC*COM*V14-PRRS-EN-P, R911342636 This documentation describes the syntax and the structure of the items for the communication with Bosch Rexroth devices.
IndraWorks OPC UA Communication DOK-IWORKS-OPC*UA*****-APRS-EN-P, R911379309 This documentation describes the OPC UA communication of the MLC and MTX control systems.

Tab. 1-6: MTX documentation overview - OEM engineering

1.6.6 AddOns

Documentation titles with type codes and part numbers

MTX 11VRS Action Recorder DOK-MTX***-ACR*****V11-APxx-EN-P, R911329943 This documentation describes the MTX action recorder. It includes the installation and commissioning as well as interface signals, application and operation.
MTX 14VRS Efficiency Workbench MTX cta, MTX ega DOK-MTX***-EWB*****V14-APRS-EN-P, R911343916 This documentation describes the mode of operation and the area of application of the analysis tool MTX cta and MTX ega.
MTX Remote Condition Monitoring DOK-MTX***-RCM*****V01-APRS-EN-P, R911334383 This documentation describes the operation of the Remote Condition Monitoring System.
MTX visIREC User Documentation DOK-MTX***-VISIREC*V01-APRS-EN-P, R911344242 This documentation describes the analysis tool visIREC used to optimize the free form surface milling process. 2D or 4D display of path-related data. 2D or 4D display of coordinate-related data. Analysis of critical areas (path and orientation deviation). Comparing the programmed NC blocks to the interpolated NC blocks.

xx Corresponding edition
Tab. 1-7: MTX documentation overview - AddOns

1.7 Information representation

1.7.1 Safety instructions

If there are safety instructions in the documentation, they contain certain signal words (Danger, Warning, Caution, Notice) and sometimes a safety alert symbol (according to ANSI Z535.6-2006).

The signal word draws attention to the safety instruction and indicates the risk potential.

The signal graphics (warning triangle with exclamation mark), added in front of the signal words Danger, Warning and Caution refers to hazards to persons.

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 can occur.

NOTICE

In case of non-compliance with this safety instruction, material or property damage may occur.

1.7.2 Symbols used

Note Notes are represented as follows:



This is a note for the user.

Tip Tips are represented as follows:



This is a tip for the user.

1.7.3 Names and abbreviations

Term	Explanation
Zeroing	Setting the value to 0
CANopen	Field bus
CNC	Computerized Numerical Control
CPL	Customer Programming Language
DeviceNet	Field bus
Ethernet	Communication interface
IWE	IndraWorks Engineering
IWO	IndraWorks Operation
OWG	Optical waveguide
NC	Numerical Control
OEM	Original Equipment Manufacturer
PROFIBUS-DP	Field bus
Sercos	Field bus

Tab. 1-8: Terms and abbreviations

1.7.4 Customer feedback

Customer requests, comments or suggestions for improvement are of great importance to us. Please email your feedback on the documentations to Feedback.Documentation@boschrexroth.de. Directly insert comments in the electronic PDF document and send the PDF file to Bosch Rexroth.

2 Important instructions on use

2.1 Intended use

2.1.1 Introduction

Bosch Rexroth products are developed and manufactured according to the state-of-the-art. The products are tested prior to delivery to ensure operating safety and reliability.

The products may only be used as intended. If they are not used as intended, situations occur that result in damage to property or injury to persons.



Bosch Rexroth shall not assume any warranty, liability or payment of damages in case of damage resulting from a non-intended use of the products; the use shall solely bear all risks from unintended use of the products.

Before using Bosch Rexroth products, the following requirements have to be met to guarantee the intended use of the products:

- Anybody handling Bosch Rexroth products in any way is obliged to read and consent to the relevant safety instructions and the intended use.
- Hardware products may not be altered and have to remain in their original state; i.e. no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not install damaged or defective products or use them in operation.
- It has to be ensured that the products have been installed as described in the relevant documentation.



Ensure that the data present in the control or entered or read in by the user is correct before applying it to exclude unwanted axis motion. It can be the following invalid or old data:

- Part programs
- ZO tables
- Compensation tables
- Tool tables
- Permanent CPL variables
- Remanent PLC data
- Permanent system data

2.1.2 Areas of use and application

The MTX control is used to

- program contour and machining technology (path feed, spindle speed, tool change) of a workpiece.
- guide 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 - together with the actual CNC - control the machining process as a whole and also monitors this process with regard to technical safety.

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

The CNC system MTX provides the perfect CNC system solution for cutting and forming for the following technologies:

- Rotate
- Milling
- Drilling
- Grinding
- Bending
- Nibbling
- Punching
- Contour cutting
- Handling

2.2 Unintended use

Using the CNC system MTX outside the above-referenced areas of application or under operating conditions other than the conditions described in the documentation and the specified technical data, is defined as "unintended use".

The CNC system MTX must not be used if ...

- it is subjected to operating conditions not corresponding to the specified ambient conditions. Operation under water, under extreme temperature fluctuations or under extreme maximum temperatures is prohibited.
- Furthermore, the CNC system MTX shall not be used for applications not expressly approved of by Bosch Rexroth. Therefore, please read the information given in the general safety instructions!
- The CNC system MTX may not be used in systems or machines connected to the internet via an unsecure network connection. Otherwise, malfunctions or a control failure can result due to unauthorized access.

3 Operating elements

3.1 Control panel and Keyboard

The following figures show a typically used control panel and an ASCII keyboard.



Fig. 3-1: Control panel

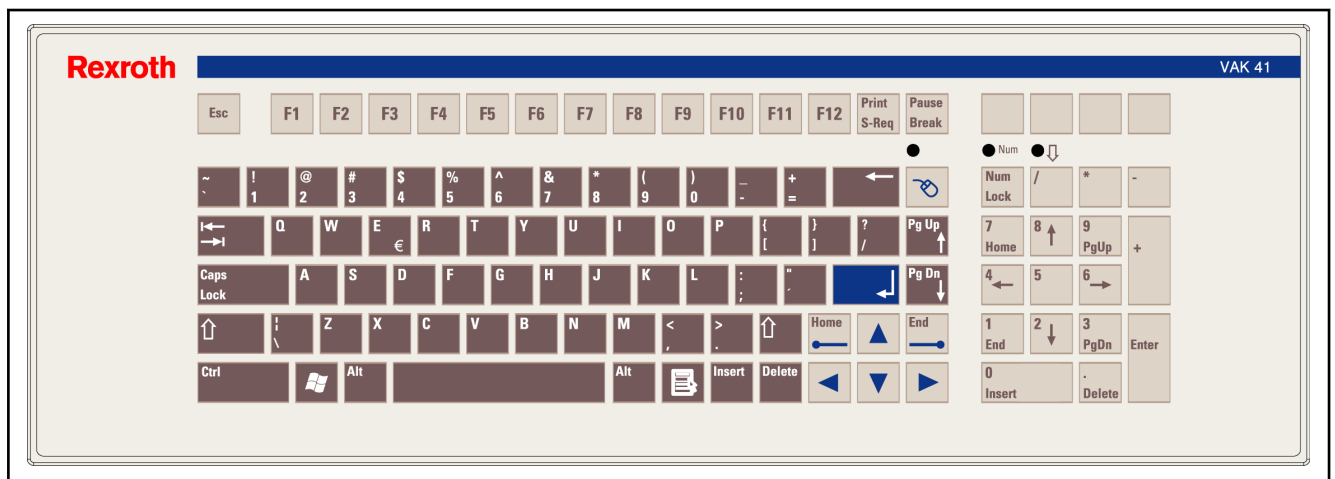


Fig. 3-2: Foil keyboard

3.2 Machine control panel

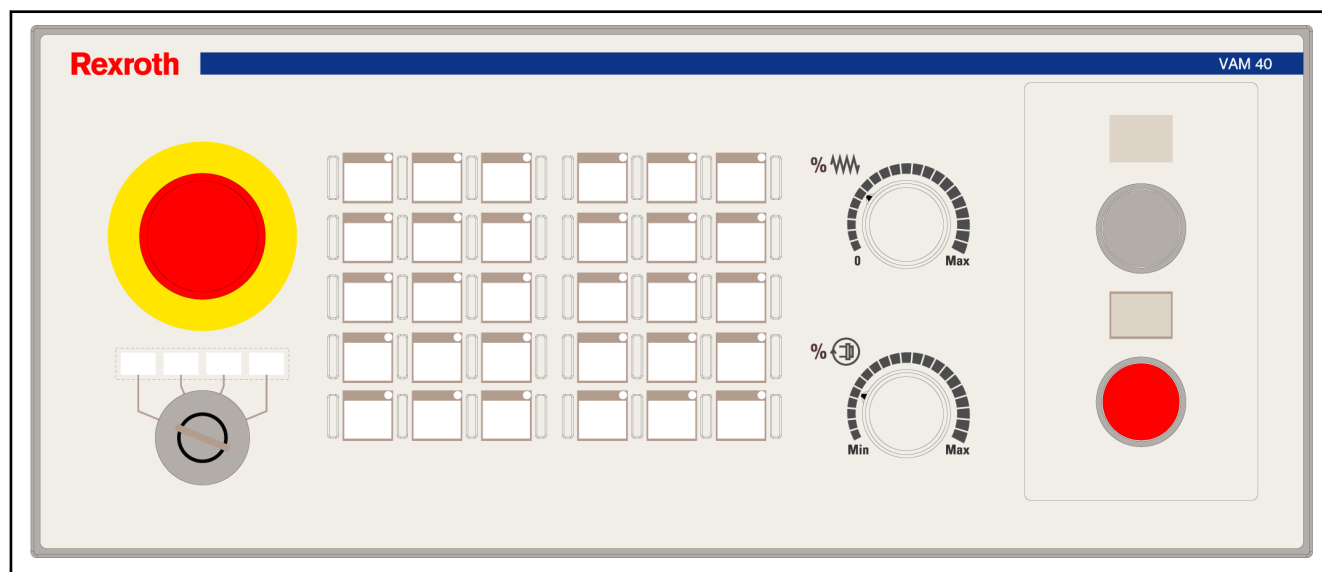
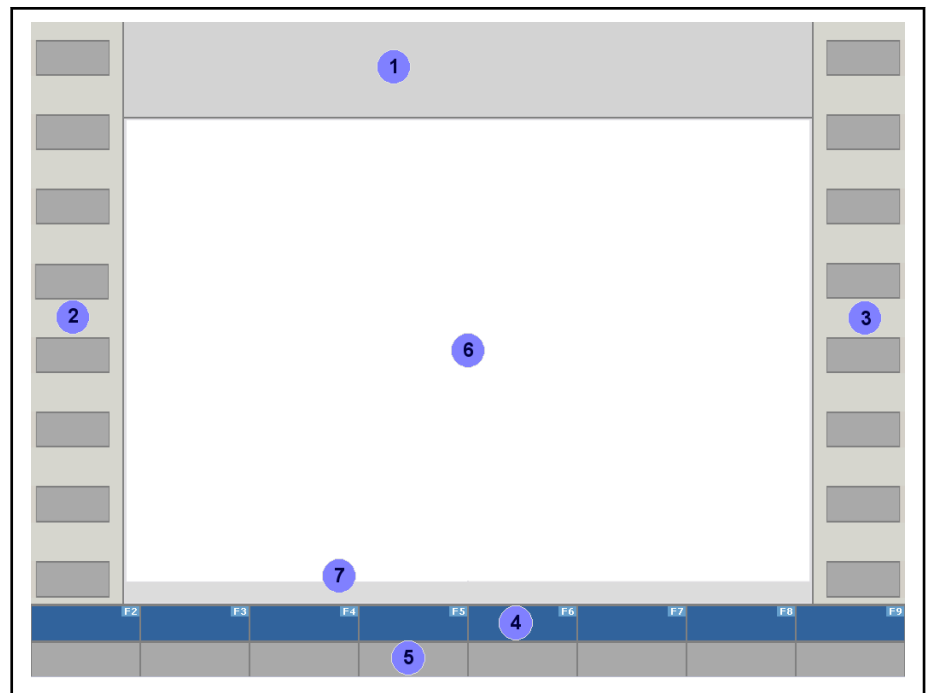


Fig. 3-3: Machine control panel

3.3 Basic screen layout

The screen is divided into operating elements, the machine status area and the application area with an integrated status line.



- (1) Machine status area
- (2) M-key visualization - left side, primarily assigned with NC functions (e.g. switching between operation modes)
- (3) M-key visualization - right side, primarily assigned with machine functions (e.g. axis selection for jogging)
- (4) F-key visualization - assigned with applications and functions to operate the interface (e.g. editors)
- (5) OP-key visualization - assigned with functions to switch between operating areas
- (6) Application area
- (7) Status bar

Fig. 3-4: Screen structure

3.4 Operating areas and OP Keys

The complete functionality of the MTX user interface are divided into eight task-oriented operating areas.

There are specific applications within these operating areas.

Each application is assigned to one operating area. This assignment can be changed via the configuration (see MTX documentation "Commissioning").

Each operating area has a start application that cannot be terminated.

The operating area "Machine" is always active after control startup.

Operating elements

Operating area	OP-key	Start application	Applications	More functions
Prepare	<OP2>	Screen with label and "Preparation" icon	No functionality in the default interface.	
Machine	<OP3>	Basic NC screen • Axis position display • NC Program section display • etc.	Basic NC screen Overview on active corrections Program selection Editor of active program Editor of active D-corrections Editor of active zero offsets Editor of active NC variables Block pre-run/block search Two-channel display NC Analyzer Adjustment screens	Reset channel System control reset NC Analyzer Switching coordinate systems Switching position display
Program	<OP4>	MTX Navigator: Directory and file navigator	MTX Navigator NC program editor Editor D-corrections Zero offset editor Placements editor Editor SD definition	
Tool management	<OP5>	Tool list	Tool list Tool editor	
System	<OP6>	Channel dialog	Channel dialog Switching NC channels	
Maintenance (option)	<OP7>	Screen with label and "Maintenance" icon	Circularity test Project selection	Calling IndraWorks Engineering Calling remote support (option) Logging users in/out Exiting IndraWorks Archiving device data
Production data	<OP8>	Screen with label and "Production data" icon	No functionality in the default interface.	Can be projected by OEM.
Diagnostics	<OP9>	Diagnostic overview	Diagnostic overview Logbook PLC ↔ NC interface DP diagnostics Variable parameters Action Recorder MTX system status	Diagnostic filter Clearing errors Detailed view on errors

Tab. 3-1: Operating areas

Each operating area is assigned to an <OP>-key.



Fig. 3-5: OP-keys

Switching between operating areas

It is switched via <OP>-keys.

Press an <OP>-key to activate the operating area, i.e. the latest application used of this operating area is moved to the foreground.

If the operating area was not active, the start application is called.

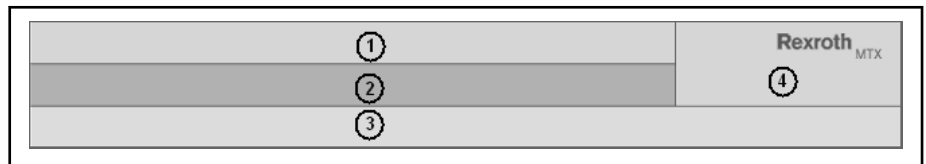
Switching between applications within the operating area

Within the operating area, press the corresponding <OP>-key to switch between the already open applications of this operating area.

3.5 Machine status area

3.5.1 Layout of the machine status area

General information



- (1) Channel-comprehensive control states
- (2) Channel states
- (3) Diagnostic messages (two lines)
- (4) Logo and animation for interface waiting states

Fig. 3-6: Structure of the machine status area

Channel-comprehensive control states

Structure and contents

The first machine status area displays control-comprehensive states.



Fig. 3-7: Control states

Channel states

Structure and contents

The second machine status area displays the states to operate the selected channel.

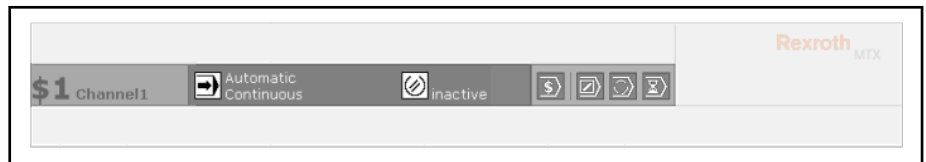


Fig. 3-8: Channel states

"Options" dialog

Double-click on this section to open an "Options" dialog. Adaptations for the machine status area can be made in this dialog.

- Hide and change logo
- Insert additional control
- Change design
- Enter user texts for channels and machine

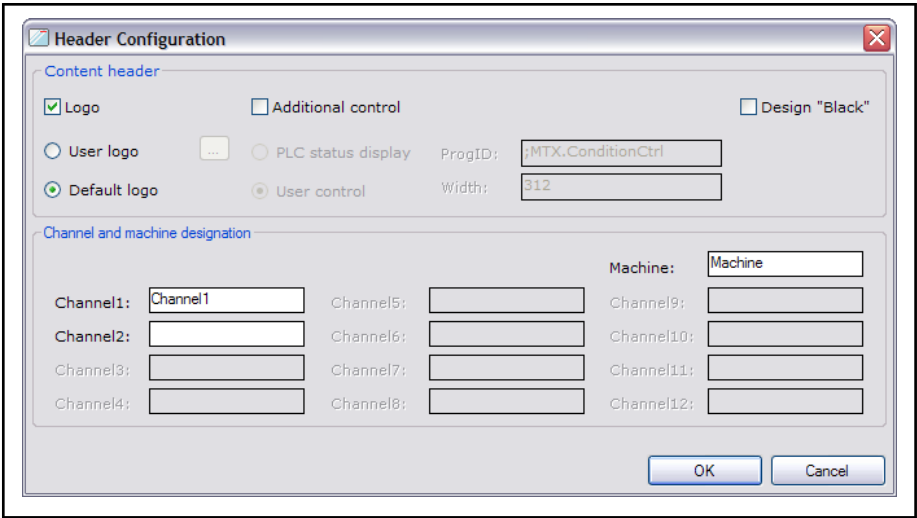


Fig. 3-9: "Options" dialog

Diagnostic messages

Structure and contents

An "Options" dialog (double-click the text line) can be used to select the content of the diagnostic lines from the following categories:

- Setup diagnostics
- Errors (red background)
- Notes (green background)
- Warnings (yellow background)
- Start conditions.

The current date and time are also shown in the first line.

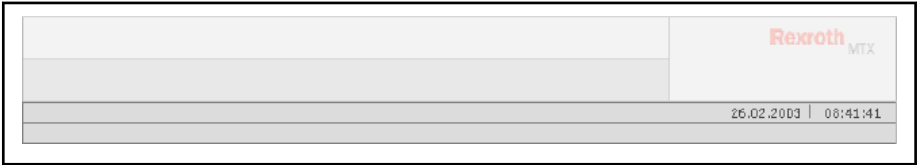


Fig. 3-10: Diagnostic messages

The following table contains a description of the message symbols displayed depending on the configuration.

Description	Icon	Explanation
Errors		The message indicates an error.
Warning		The message indicates a warning.
Note		The message indicates a note.

Tab. 3-2: Message symbols

Logo area

Structure and contents

In addition to the "Rexroth MTX" logo, the logo area contains an animation started in the waiting state of the interface (e.g. while opening an editor) and an animation activated when the action recorder starts recording.



Fig. 3-11: Logo area

The NC kernel diagnostic monitor and the system load display can be indicated via the logo.

NC kernel: Diagnostic monitor

The NC kernel diagnostic monitor displays the load distribution of the individual NC kernel task. Thus, it can be efficiently identified if there is a system overload due to an incorrect user configuration or programming.

The diagnostic monitor is displayed when double-clicking on the logo.

The "Diagnostic monitor" function can either be linked via a shortcut or a function key.

The load distribution of the following tasks is displayed in %:

- Interpolation and Sercos (IPO)
- PLC runtime
- NC and CPL block processing (SAV/CPL)
- Free capacity (IDLE)
- Remaining time of all remaining tasks such as the communication, database accesses, file server (REST).

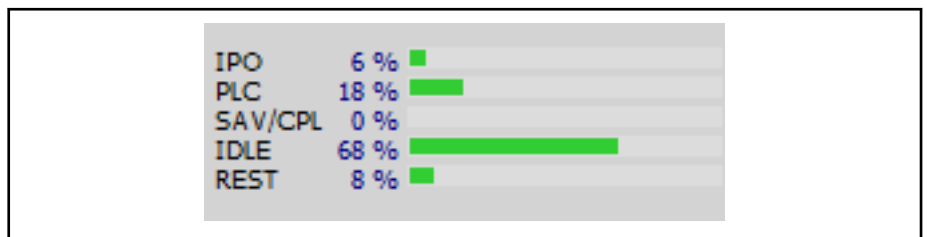


Fig. 3-12: Diagnostic monitor



The NC kernel diagnostic monitor can negatively affect the runtime behavior of the operating machine. Thus, the diagnostic tool is to be switched off after the commissioning. A corresponding note is cyclically output in the status line.

System load display

The system load display is shown when double-clicking on the diagnostic monitor.

The complete CPU load, the complete memory load and the CPU load of the IndraWorks Operation are shown in this display.

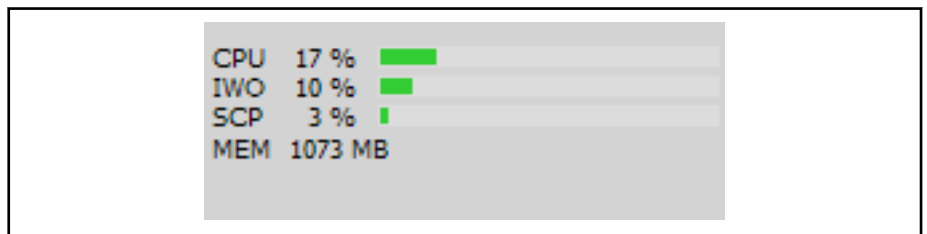


Fig. 3-13: System load display

Double-click again to show the logo again.

Parameter name	Description
IconPath	Absolute folder path in which all icons are stored. The path has to follow the Windows® convention. Example "C:\My Documents\My Icons" IndraWorks path tags, e.g. "%activehmi-config%" or "%startup%" can also be used. Example "%activehmi-config%\MyIcons" If this parameter does not contain a valid folder or if it is empty, the icon search order is as follows: 1. %activehmi-config% 2. %config%
IconWidth	Width of the icon in [pixels]
IconHeight	Height of the icon in [pixels]
IconCount	Number of icons in the display
IconGroup	Activation of icon grouping. Distance between icon groups in [pixels]. The icons can be grouped optically. The number of icons has to be divisible completely by the grouping. Otherwise, grouping is ineffective. Example: IconCount=10; IconGroup =2
IconGroupDistance	If grouping is effective. Specification of grouping distance or distance between groups
IconsPerRow	Number of icons per row. Example: IconCount = 20; IconPerRow = 10; -> display has 2 rows with 10 icons each
FlashSlow	Flashing period 1 in [ms]
FlashFast	Flashing period 2 in [ms]
PLCStructVar	IndraLogic 2G: Complete path as follows: "Namespace.Variable". Example: Application.PLC_MAIN.sysConditionCtrl
PLCBitmapVar	Structural element for icon assignment
PLCPropertyVar	Structural element for color assignment

Tab. 3-3: Parameter

Example:

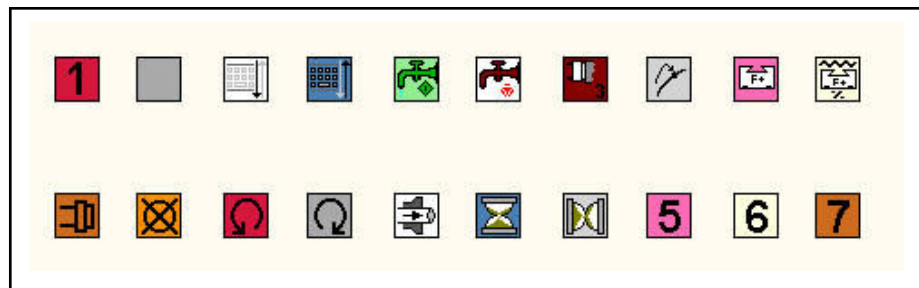


Fig. 3-15: Icons in the header

3.6.3 Icon assignment table

The icons are specified using their icon ID. Each icon has a file name (token) and (optionally) a tooltip. The tooltip is not language-dependent and is displayed if the mouse is not located on the icon.

Values between {1.. 255} are valid as icon ID. A value of {0} means "no icon".

Program:

```
...
  <!--Icon Definitions (1-255)-->
  <Icons>
    <Icon ID="1" Token="ICBedUm0.gif" ToolTip=""/>
    <Icon ID="2" Token="ICBedUmA.gif" ToolTip=""/>
    <Icon ID="3" Token="ICColnAc.gif" ToolTip=""/>
    <Icon ID="4" Token="ICColOff.gif" ToolTip=""/>
    <Icon ID="5" Token="ICFut3.gif" ToolTip=""/>
    <Icon ID="6" Token="ICFut3BU.gif" ToolTip=""/>
    <Icon ID="7" Token="ICFut3G.gif" ToolTip=""/>
    <Icon ID="8" Token="ICFut4.gif" ToolTip=""/>
    <Icon ID="9" Token="ICFut4BU.gif" ToolTip=""/>
    <Icon ID="10" Token="ICFut4G.gif" ToolTip=""/>
  </Icons>
...
```

3.6.4 Icon background display

The icon backgrounds are specified using their ID. Either enter an RGB value in HEX "RRGGBB" (e.g. D3D3D3) or a value from the .NET enumerator "KnownColor" (e.g. "DarkRed").



The background color applies only to icons in ".gif" format.

Program:

```
...
  <!--Icon Color Definitions (0-15)-->
  <IconColors>
    <Color ID="0" Value="D3D3D3"/>
    <Color ID="1" Value="LightGreen"/>
    <Color ID="2" Value="LightYellow"/>
    <Color ID="3" Value="DarkRed"/>
    <Color ID="4" Value="DarkOrange"/>
    <Color ID="5" Value="BlueViolet"/>
    <Color ID="6" Value="DarkGray"/>
    <Color ID="7" Value="Cornsilk"/>
    <Color ID="8" Value="SteelBlue"/>
    <Color ID="9" Value="HotPink"/>
    <Color ID="10" Value="White"/>
    <Color ID="11" Value="Chocolate"/>
    <Color ID="12" Value="Brown"/>
    <Color ID="13" Value="Crimson"/>
    <Color ID="14" Value="Black"/>
    <Color ID="15" Value="White"/>
  </IconColors>
...
```


3.6.5 Icon Interface in PLC program

Display and properties of the icons are controlled by a fixed data definition in the PLC user program.

The icon interface in the PLC is a one-dimensional `ARRAY[1..n]` of `STRUCT`. Array index 1 to n corresponds to the n placeholder (=IconCount).

The placeholders are numbered from left to right.

Example:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

Tab. 3-4: Numbering the icons

Each of these n array elements is defined as structure of two bytes: One byte for the selection of the display (255 possible icons for placeholder) and the other byte for the properties of the icon (background color, flashing frequencies). The **variable name** is defined using the configuration file in the value "PLCStructVar". The same applies to the element identifiers for **ID** "PLCBit-mapVar" and for **Properties** "PLCPropertyVar".

PLC structure field declaration

Program:

```
TYPE sysConditionCtrl_Type :
STRUCT
    ID:      BYTE;
    Properties:  BYTE;
END_STRUCT
```

The array has to be declared in the range of the global data in the section `VAR_GLOBAL`.

PLC structure field variable

Program:

```
VAR_GLOBAL
sysConditionCtrl:  ARRAY[1..20] OF sysConditionCtrl_Type;
```

The icons are programmed in a program or function block. This is specified by the user.

Structural element "ID"

Value	Note
0	Do not display any icon (background color active)
1...255	Display icon ID 1 to 255

Tab. 3-5: ID

Structural element "Properties"

Value	Note
0..15	Background color ID (bit 0,1,2,3)
16	Icon flashes with "FlashSlow" period (bit 4)
32	Icon flashes with "FlashFast" period (bit 5)

Tab. 3-6: Properties



If both flash frequencies are selected, the flash period applies as defined in "FlashFast".

Example:

Placeholder 4 should display icon 78. It should also flash at 1 Hz and have a yellow background color.

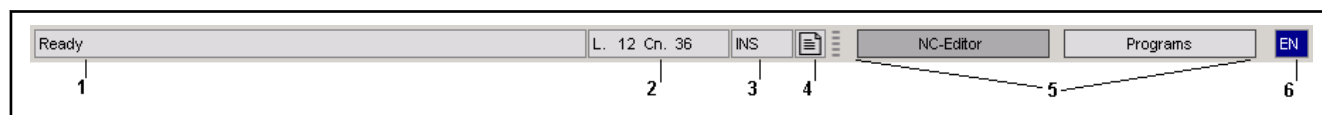
Beispiel *Program:*

```
sysConditionCtrl[4].Bitmap:= 78; (* Icon 4: Display of map 78 *)
sysConditionCtrl[4].Property:= 18; (* Icon 4: Property yellow and flashing, 2+16=18*)
```

3.7 Status Bar

3.7.1 Structure of the status bar

General information



- 1 Status field
- 2 Line/column field
- 3 Insertion/overwrite mode
- 4 Status symbol field
- 5 System area: Simultaneously opened applications of this operating area
- 6 Set language

Fig. 3-16: Overview on the status line

The status line is divided into two areas:

- User-dependent area in which the data of the currently visible application is shown
- System area in which the global information on the operating area is displayed.

Application-dependent area

The application-dependent area consists of up to four panels whose content is determined by the corresponding application. A description of the content can be found in the corresponding application.

In general, the application-dependent area is divided into the following fields:

- Status field [1]
This field displays status messages (gray), information messages (green) and error messages (red).
This standard field exists in each application.
- Line/column field [2]
This field displays the current line and column of an editor. Additional text can be shown in other applications.
This field does not exist in every application.
- Insertion/overwrite mode [3]
For editors, this area shows whether you are in "Insertion" or "Overwrite" mode. Another text can be shown in other applications.
This field does not exist in every application.
- Status symbol field [4]
A status can be indicated here using a symbol.
This field does not exist in every application.

System area

The system area displays the following information:

- List of open applications in this operating area [5]
All open applications are displayed. The corresponding window can be activated by clicking the corresponding field.
- Currently set language [6]

3.7.2 Function of the status field

The status field displays simple status messages

In addition, extended information can be displayed, e.g. if an action could not be carried out, since certain boundary conditions were not complied with.

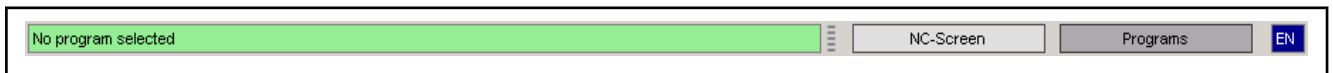


Fig. 3-17: Status line with information message

In case of other errors, an error message is displayed.

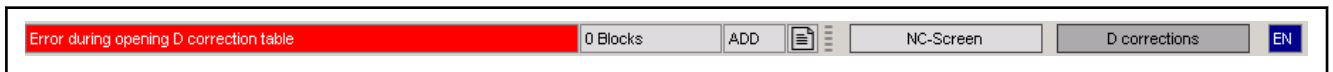


Fig. 3-18: Status line with error message

In addition, there is also a status line with an advanced error message.



Fig. 3-19: Status line with advanced error message

The advanced error information can be retrieved by clicking the info symbol or by pressing the "Info" key.

4 General operation and visualization

4.1 Visualization symbols

The following table shows and describes the symbols that are displayed.

Description	Icon	Explanation
Errors		The symbol indicates that an NC error or a ProVi error has occurred
Warning		The symbol indicates that an NC warning or a ProVi warning has occurred
		The symbol indicates that, after a change in the configuration system, a system reset or system restart is required to apply the changes
		The symbol indicates conflicting versions between the interface and NC kernel
Note		The symbol indicates that an NC note or a ProVi note has been reported
Complete lock		This symbol indicates that the axis output is inhibited for all NC channels
System waiting mode		This symbol indicates that at least one NC channel is in waiting state (sum signal)
Remote support		Remote support inactive
		Remote support active
Winlock		Winlock active
		Winlock inactive
Visualization data		This symbol indicates that new visualization data is available that is applied when restarting IndraWorks Operation
Connection state This symbol shows the connection state between user interface and control.		Online
		Insecure connection
		Connection aborted
		Communication server (SCP server) failed

General operation and visualization

Description	Icon	Explanation
PLC error status		PLC in Stop status
		The symbol indicates that there is no symbol table
		The symbol indicates that the PLC program is changed online
Network state		The symbol indicates that a network exists and that all devices operate correctly
		The symbol indicates that a network exists and that at least one device is not on-line or is signaling a warning
		The symbol indicates that a network exists and that at least one device is signaling an error
Secondary mode The suboperation modes of the machine operation mode "Automatic" are shown as symbol and text.		Continuous block
		Single block
		Single step
		Program block
		Leaving the contour
		Return to contour
		Block pre-run
		NC-Analyzer step mode
The suboperation modes of the machine operation mode "Manual operation (setup)" are shown as symbol and text.		Approach reference point
		Jog
		Jog WCS
		There is no secondary mode in the machine operation mode "MDI". Only the symbol is shown

Description	Icon	Explanation
Channel state The status of the active NC channel is shown as symbol and text in this area.		Ready
		Running
		Stop
		Prepared
		Interrupted
		Inactive
		Reset
Test mode (dry run)		The symbol indicates that a channel-specific test function (dry run), test feeding and/or test rapid traverse is active
Channel settings		The signal indicates that the "Optional stop" function is active
		The signal indicates that the "Block skip (M01)" function is active
Channel in wait state		Wait states that cannot be specified by a separate bitmap are displayed using this bitmap This bitmap is also shown if more than one waiting state has occurred. All waiting states that have occurred are displayed in the tooltip by hovering the mouse over the symbol or by pressing the F-key in the channel dialog
		Dwell time
		Auxiliary function subject to acknowledgement
		Block transfer inhibit
		Channel feed = 0
		Program stop (M0/M1)
		Feed hold
		Feed inhibit

Tab. 4-1: Visualization symbols

4.2 Basic NC screen

4.2.1 Overview

Different screens with window splits are available for the NC screen of the MTX NC screen. The contents of these partial windows can be assigned to user-defined displays.

By default, the Bosch Rexroth process displays are located here. These can be freely configured in the IndraWorks Engineering and adapted to the specific machine configurations.

The corresponding user rights are necessary for the configuration.

The Bosch Rexroth process displays are provided with machine-dependent as well as purely interface-related parameters for an individual configuration.

- **Machine parameters** are set in the NC configurator in the IndraWorks Engineering.
- **Interface parameters** are set in the options dialog of the relevant displays in the IndraWorks Operation.



For more information about the NC screen configuration, refer to "MTX Commissioning".

4.2.2 Position display

Display content

The position display displays axis data. A maximum of 8 axes per channel is supported.

WCS			Command	End position	Dist. to go
X1		mm	0.000	0.000	0.000
Y1		mm	0.000	0.000	0.000
Z1		mm	0.000	0.000	0.000
Z2		mm	0.000	0.000	0.000
A1		°	0.000	0.000	0.000
B1		°	0.000	0.000	0.000
B2		°	0.000	0.000	0.000
Y2		a mm	0.000	0.000	0.000

Fig. 4-1: Position display

Column selection

The columns and variants are selected using the variant editor of the options dialog. Variants with the following column data can be defined.

- Command position
- End position
- Distance to go
- Program
- Lag
- Actual position
- \$ Command position (= channel position during system axis coupling)
- Command velocity (only ACS)
- Command speed (only ACS; available only for asynchronous, endlessly turning round axes, otherwise 0)

- Actual speed (only ACS; available only for asynchronous, endlessly turning round axes, otherwise 0)
- Max. Velocity (only ACS)



The display supports a maximum of 10 variants.

If a date is not available, "—" is displayed.

The following table contains a description of the symbols displayed.

	Icon	Description	Note
Coordinate system symbols	ACS	Axis coordinate system	
	MCS	Machine coordinate system	
	BCS	Basic coordinate system	
	WCS	Tool coordinate system	
Position symbols		Axis is not referenced	The reference position of the axis is not known
		Axis is in position	The axis is located in the given position window. This symbol is only shown if the reference position of the axis is known.
Channel assignment symbols	1...12	Channel number	
	a	Asynchronous axis	
	S	Spindle	
	ŝ	Spindle inactive	
	x	Axis not defined	
Unit symbols	mm	Metric	
	Inch	Non-metric	
	o	Degree	
	∅	Diameter programming	
	#	Place programming	
	-	None	

Tab. 4-2: Displayed symbols

Coordinates

The following figure shows an overview of the coordinates / axis positions that can be displayed.

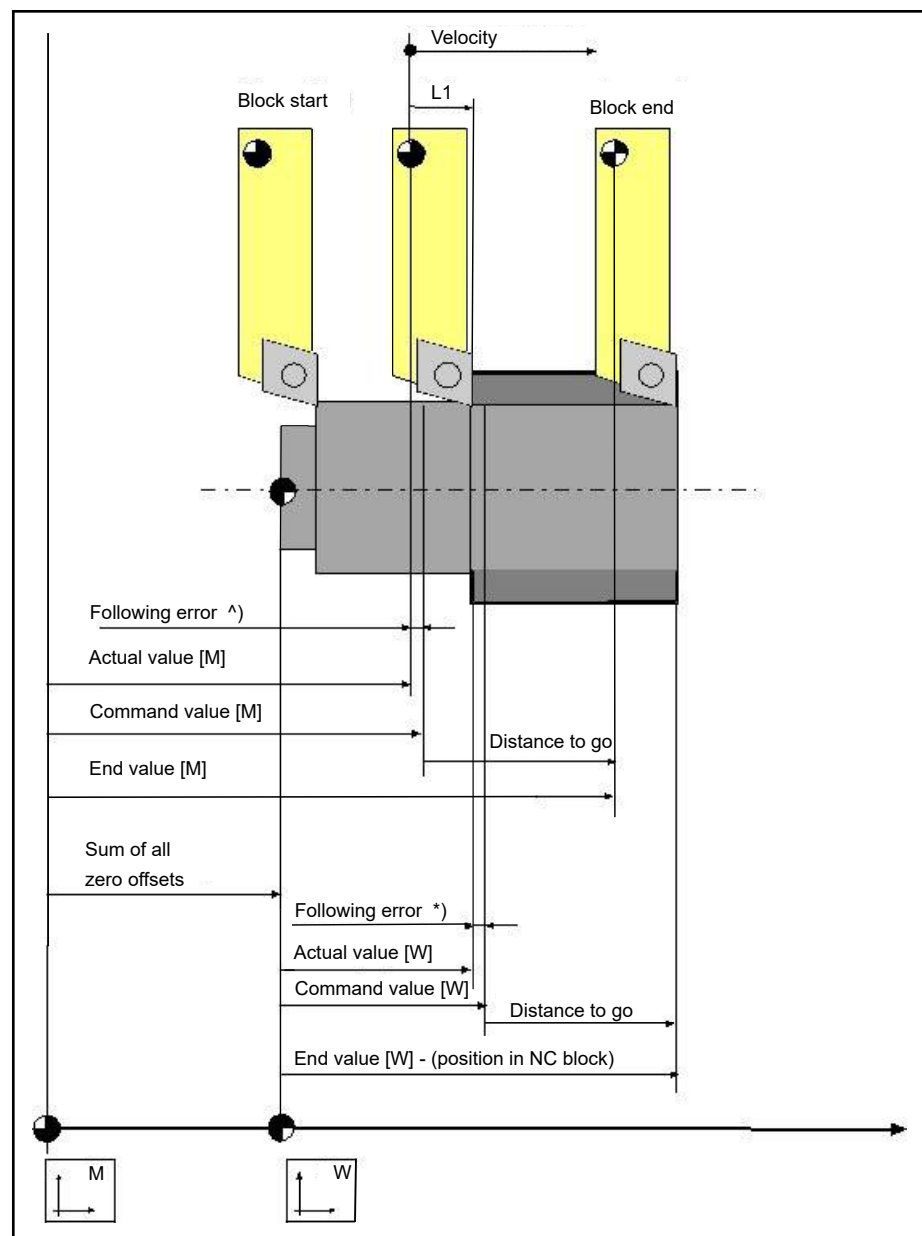


Fig. 4-2: Coordinates

Coordinate systems

The following figure shows an overview of the coordinate systems that can be displayed.

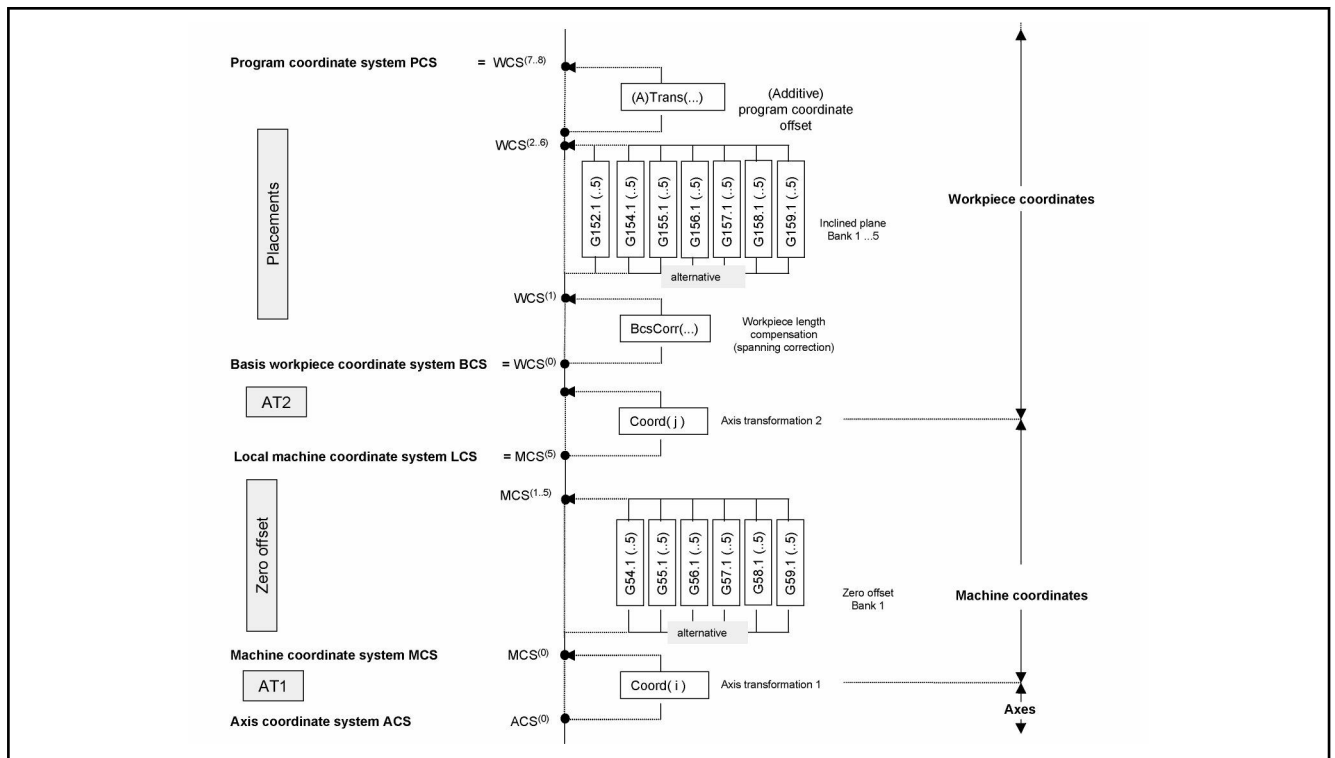


Fig. 4-3: Coordinate systems

4.2.3 Technology display

Display content

The technology display is used to show feed and spindle information. A maximum of 8 spindles per channel is supported.

[inch]		Program	Command	Override	Gear
F	inch/min	0.00	0.00	50%	--
S1	1/min	0.0	0.0	100%	1
S2	1/min	0.0	0.0	100%	1

Fig. 4-4: Technology display

Column selection

The columns and variants are selected using the variant editor of the options dialog. Variants with the following column data can be defined.

- Program value
- Command values
- Override
- Maximum override
- Actual value
- Gear level
- Spindle position
- Spindle power
- Spindle torque
- Spindle group



The display supports a maximum of 10 variants.
If a date is not available, "—" is displayed.

The following table contains a description of the symbols displayed.

	Icon	Description	Note
Feed symbols		G01	Feed
		G00	Rapid traverse
		G02	Circular interpolation right
		G03	Circular interpolation, counter-clockwise
		G33	Thread cutting
Spindle symbols		M3	Clockwise rotation
		M13	Clockwise rotation, coolant switched on
		M4	Counterclockwise rotation
		M14	Counterclockwise rotation, coolant switched on
		M5	Spindle stop
		M19	Spindle orientation (positioning mode)
Gear symbols		Manual	
		Automatic	
		Idle	

Tab. 4-3: Displayed symbols

4.2.4 Drive configuration for spindle torque and performance

The display of spindle torque and performance is done using the Sercos parameters S-0-0084 "Torque/power actual value" and S-0-0382 "Intermediate circuit performance".

These are read either using the cyclic drive telegram (see also S-0-0016 "Config. list drive telegram") or directly using the service channel from the drive.

The configuration using the cyclic telegram should be used preferably so that the service channel is not overloaded unnecessarily.

- In order to activate the transmission in the **cyclic telegram**, the Sercos configuration files, e.g. "p2ispiXX.scs" (spindle) or "p2icaxXX.scs" (spindle c-axis) have to be adapted correspondingly.

Thus, the Sercos parameters S-0-0084 and S-0-0382 have to be implemented in S-0-0016:

```
S-0-0016 = (S-0-0084, S-0-0382, ...); Torque/force
feedback value, DC bus power
```

Within the MTX, S-0-0016 is currently limited to five signals max.

If safety technology is used, five signals might not be sufficient.

In this case, the service channel executes the transfer.

- Transmission using the **service channel** is activated automatically by switching on the spindle display (technology display) in the operation desktop or by retrieving the Motion Control services

```
MCODS(111,...) => Spindle power
```

```
MCODS(110,...) => Spindle torque
```

active.

The following Sercos parameters are used to display the spindle torque and the performance:

- **S-0-0092:**

Max. torque (torque/force limit bipolar) in [%].

S-0-0092 generally results from the combination of motor and amplifier (value in the drive). In the options dialog of the technology display, one value [in (%)] can be specified for every spindle if this value corresponds to the full scale deflection of the bar. Thus, an optimum deflection range can be set for each spindle for the spindle torque bar.

- **S-0-0158:**

Max. performance (performance threshold Px) in [W].

The value is to be set valid in the p2-scs files when commissioning the spindle. S-0-0158 should be set to 1.5 times to the value of the nominal output.



The spindle service does not provide any values in the c-axis operation.



If the drive does not support the parameters S-0-0382 or S-0-0084 (e.g. Servodyn-D), a value of 0 is always displayed.

4.2.5 Program section display

Display content

The program section display shows the program section of a running NC program.



Fig. 4-5: Program section display

Program symbols The following table describes the program symbols displayed.

Icon	Description	Note
	Active NC-program line	Indicates the NC command line currently processed by the NC

Tab. 4-4: Program symbols

Displaying macro contents If an NC macro was programmed in the NC block, currently hidden contents can be shown by pausing the NC program, focusing the display and pressing the <Display macro contents> button. The NC macros are displayed in color. If the program is continued or the <Hide macro contents> button is confirmed, the NC macro is hidden again.

	To generally show the NC macro contents in the display, you have to have the authorization for "Display macro contents". Whether the content of certain NC macros really becomes visible, can be specified with read-only rights (technology protection). For additional information, please refer to the respective documentation.

4.2.6 Program nesting display

Display content

The program nesting display shows the subroutine nesting, including the retrieving of the line numbers and the active NC block.

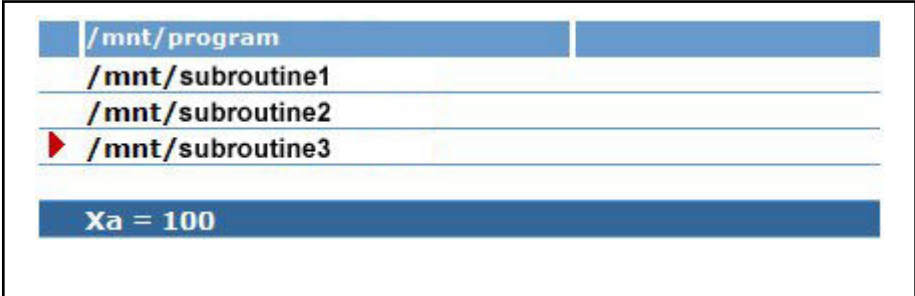


Fig. 4-6: Program nesting display

Program symbols The following table describes the program symbols displayed.

Icon	Description	Note
	Active subroutine	Indicates the subroutine currently processed by the NC

Tab. 4-5: Program symbols

4.2.7 ZO display

Display content

The ZO display shows the zero offsets (ZO), including the ZO table name.

Offsets	G53.1	G53.2	G53.3	G53.4	G53.5
/database/ZO1.zot					

Fig. 4-7: ZO display

4.2.8 ZO table display

Display content

The ZO table display shows the axis zero point table values and their sum values.

Offset page		X1	Y1	Z1
G53.1	ZO1.zot	0.000	0.000	0.000
G53.2	--	0.000	0.000	0.000
G53.3	--	0.000	0.000	0.000
G53.4	--	0.000	0.000	0.000
G53.5	--	0.000	0.000	0.000
Sum	--	0.000	0.000	0.000

Fig. 4-8: ZO table display

4.2.9 Placement display

Display content

The placement display shows active placements, including the placement table name.

Placements	G153.1	G153.2	G153.3	G153.4

Fig. 4-9: Placement display

4.2.10 Placement table display

Display content

The placement table display shows the placement table, the BCR correction and its sum values, including the placement table name.

PLT.Page		X	Y	Z	Phi [°]	Theta [°]	Psi [°]
	PMT01.pmt	0.000	0.000	0.000	0.000	0.000	0.000
G153.1	--	0.000	0.000	0.000	0.000	0.000	0.000
G153.2	--	0.000	0.000	0.000	0.000	0.000	0.000
G153.3	--	0.000	0.000	0.000	0.000	0.000	0.000
G153.4	--	0.000	0.000	0.000	0.000	0.000	0.000
G153.5	--	0.000	0.000	0.000	0.000	0.000	0.000

Fig. 4-10: Placement table display

4.2.11 Tool display

Display content

The Tool display is used to show tools, including the D-correction table path.

TL-Active	TL-presel.	curr.edge	D-Number
		ED0	D0
/database/DC1.dct			

Fig. 4-11: Tool display

Column selection

The columns and variants are selected using the variant editor of the options dialog. Variants with the following data can be defined:

- Tool active
- Tool name active tool
- Tool type active tool
- Preselected tool
- Tool name preselected tool
- Tool type preselected tool
- Active tool edge
- D-number index
- D-length correction L1
- D-length correction L2
- D-length correction L3
- D-radius correction R
- D-edge position
- Tool length correction L1
- Tool length correction L2
- Tool length correction L3
- Tool radius correction R
- Tool edge position
- Tool Euler angle phi
- Tool Euler angle theta
- Tool Euler angle psi



The display supports a maximum of 10 variants.
If a date is not available, "—" is displayed.

4.2.12 Tool correction display

Display content

The tool correction display shows the D-correction, tool name, tool type, external tool values and cumulative correction values.

G48	G40		L1	L2	L3
TL-Active			0.000	0.000	0.000
D-Active	DC1.dct		0.000	0.000	0.000
Sum	--		0.000	0.000	0.000
TL-presel.			--	--	--

Fig. 4-12: Tool correction display properties



The names of the active and preselected tools are extracted from the tool database. To display the active tool, it is imperative to set the active flag in the database from the PLC or the NC.

Column selection

The columns and variants are selected using the variant editor of the options dialog. Variants with the following column data can be defined.

- Length correction L1
- Length correction L2
- Length correction L3
- Radius correction R
- Euler angle phi
- Euler angle theta
- Euler angle psi
- Edge position
- Active tool edge
- Tool type



The display supports a maximum of 10 variants.
If a data is not available, "--" is displayed.

4.2.13 Tool correction register display

Display content

The tool correction register display shows all the tool correction registers for all tool edges.

Edge	L1	L2	L3	R
ED01	0.000	0.000	0.000	0.000
ED02	0.000	0.000	0.000	0.000
ED03	0.000	0.000	0.000	0.000
ED04	0.000	0.000	0.000	0.000
ED05	0.000	0.000	0.000	0.000
ED06	0.000	0.000	0.000	0.000
ED07	0.000	0.000	0.000	0.000
ED08	0.000	0.000	0.000	0.000
ED09	0.000	0.000	0.000	0.000
ED10	0.000	0.000	0.000	0.000
ED11	0.000	0.000	0.000	0.000
ED12	0.000	0.000	0.000	0.000
ED13	0.000	0.000	0.000	0.000
ED14	0.000	0.000	0.000	0.000
ED15	0.000	0.000	0.000	0.000
ED16	0.000	0.000	0.000	0.000

Fig. 4-13: Tool correction register display

Column selection

The columns and variants are selected using the variant editor of the options dialog. Variants with the following column data can be defined.

- Length correction L1
- Length correction L2
- Length correction L3
- Radius correction R
- Euler angle phi
- Euler angle theta
- Euler angle psi
- Edge position



The display supports a maximum of 10 variants.
If a date is not available, "—" is displayed.

4.2.14 Precision correction display

Display content

The precision correction display is used to display the precision corrections and compensations effective in the ACS.

- Command position
- Actual position
- Temperature NC
- Spindle pitch
- Sag



The display supports a maximum of 10 variants.
If a date is not available, "—" is displayed.

4.2.15 Online correction display

Display content

The online correction display is used to display the precision corrections and compensations acting in the WCS.

- Command position
- Handwheel

4.2.16 G-code display

Display content

The G-code display shows active G-codes.

G80	G01	G17	G90	G94	G09
G62	G48	G40	G43	G45	G71
OVE					

Fig. 4-14: G-code display

4.2.17 M-code display

Display content

The M-code display shows active auxiliary functions (M-codes).



Fig. 4-15: M-code display

4.2.18 Input assistance display

Display content

The input assistance display shows active input assistances.

Concerns:

- Rotation (ROT)
- Pole definition (PLS)
- Mirroring (MIR)
- Shift (SHT)
- Scaling factor (SCL)

$\alpha [^\circ] = -090.999$	X	Y	Z	VA
PLS	5.000	-10.000	0.000	0.000
SHT	0.000	2.500	0.000	0.000
MIR	1	0	1	0
SCL	-1.123	1.000	-1.000	1.000

Fig. 4-16: Input help display

4.2.19 Program coordinate display

Display content

The program coordinate display shows active program coordinates.

Concerns:

- Trans (TRS)
- ATrans (ATR)

	X	Y	Z	VA
TRS	0.000	0.000	0.000	0.000
ATR	0.000	0.000	0.000	0.000
[Total]	0.000	0.000	0.000	0.000

Fig. 4-17: Program coordinate display

4.2.20 System message display

Display content

The System message display shows system messages.

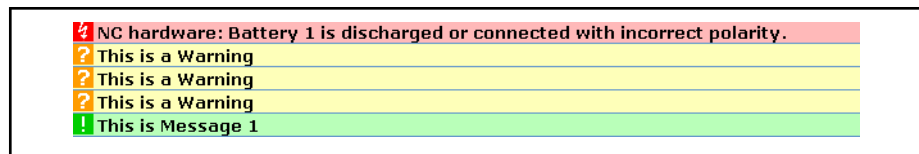


Fig. 4-18: System message display

4.3 Two-channel display

4.3.1 Use

Integration of the Two-Channel Display in IndraWorks Operation

A display that is vertically divided shows process data and status information for 2 selected channels.

The display thus allows the user to see 2 channels at once.

One channel is selected as the active channel, reacting to the use of F-and M-keys.

The display is assigned to the operating area <OP3> "Machine". Press <F8> and <F9> to start the application.

Menu and title are hidden.

The display is an application which runs in parallel to the NC screen for a channel.

It is possible to switch quickly between single-channel and two-channel display by pressing <OP3> "Machine".

The functions of the F-keys depend on the NC operation mode and can be configured in IndraWorks Engineering.



Fig. 4-19: Arrangement of the display

4.3.2 Principal display structure

Structure of the two-channel display

The display consists of 2 NC partial screens displaying process data in their partial windows. Each of these NC partial screens is assigned with a machine status area displaying the status information of the channel.

The structure of the NC partial screens and the content of the partial windows depends on the NC operation mode.

General operation and visualization

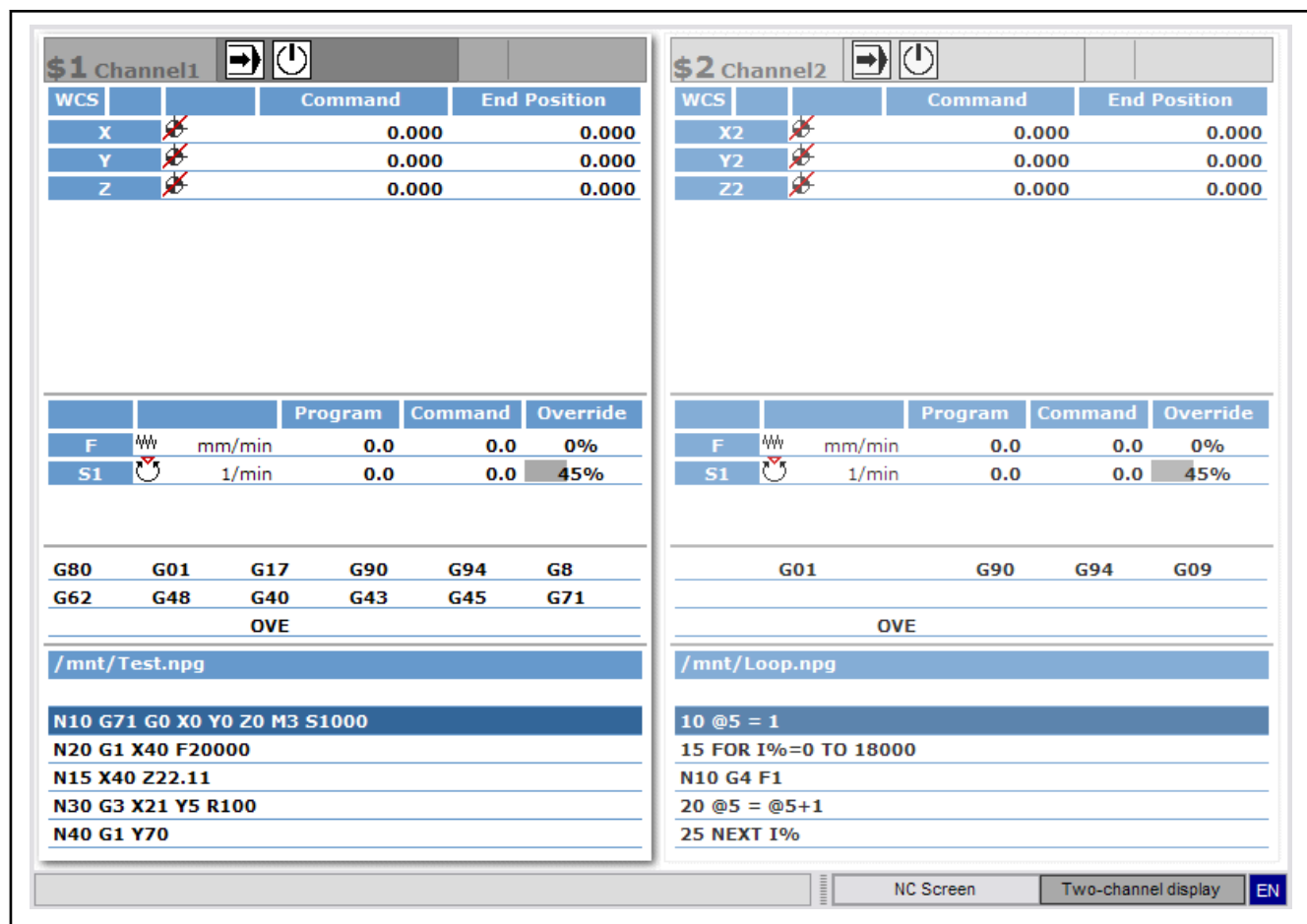


Fig. 4-20: Structure of the display

- Active and passive channel** The active channel is marked visually with 3-D shadows and a machine status area with dark shades of grey.
- The passive channel is displayed dimmed and the machine status area in lighter shades of grey.
- Operation modes** For each of the 3 operation modes "Automatic", "Manual" and "MDI" a partial screen is shown, optimized specially for two-channel display.
- As for the NC screen for one channel, the content can be configured in IndraWorks Engineering.

Partial screens

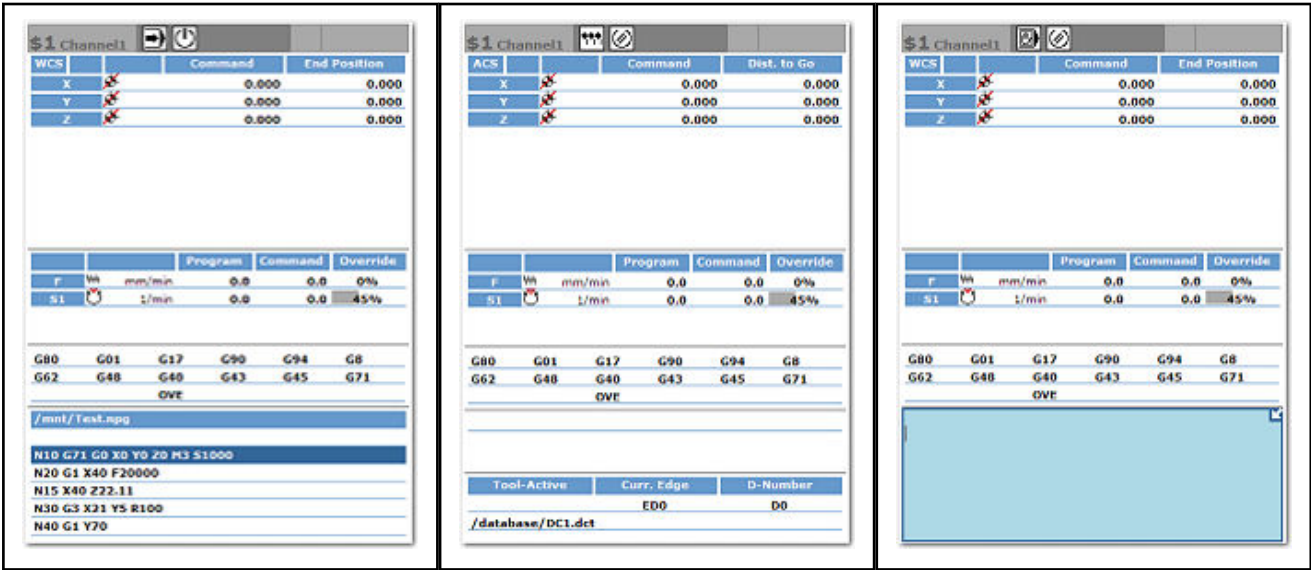


Fig. 4-21: Automatic

Fig. 4-22: Manual

Fig. 4-23: MDI

Tab. 4-6: Overview partial screens

4.3.3 Operation and navigation

Operation takes place as for the NC screen for one channel.

Active and passive channel The F-and M-keys work for the active channel.

Press <F5> to exchange the active and the passive channel. All keys work for the new active channel.

Operating-mode-dependent F-keys Depending on the 3 operation modes "Automatic", "Manual" and "MDI", different F-keys are displayed.

The F-keys can be configured in IndraWorks Engineering.

Partial-window-dependent F-keys If the focus is placed on a partial window of the active channel, for instance the MDI Editor window, the F-keys pertaining to this partial window are displayed.

Channel selection Press <F6 Channel selection...> to open a dialog for the selection of the channel for the left and right sides.

Any change of the active channels always has an effect on the whole interface.

The active channel can also be selected via <OP6> "System".

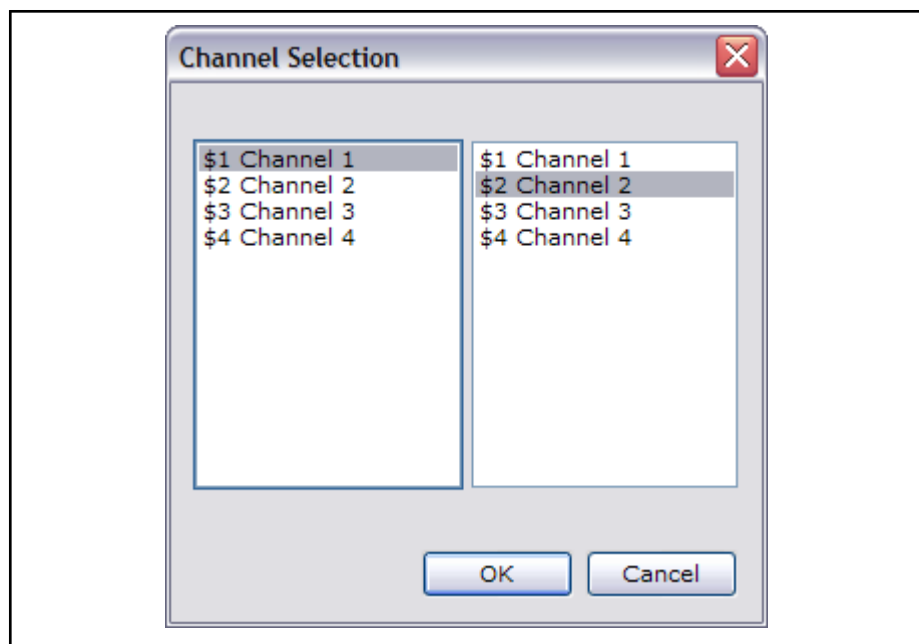


Fig. 4-24: Channel selection

Options Pressing <F8> "Additional functions" and <F5> "Options" opens a dialog to configure the dimming of the passive channel.

It is possible to switch off the dimming.

When the dimming is activated, it is possible to differentiate between dark and light and to set the degree of dimming.

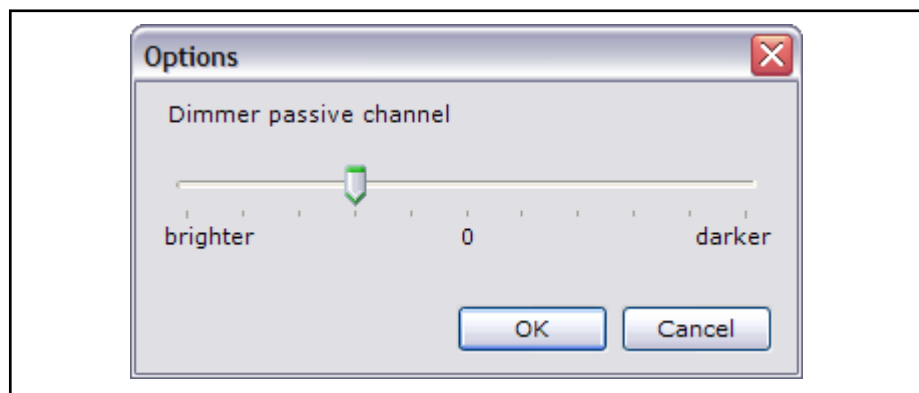


Fig. 4-25: Options

4.4 MTX Navigator

4.4.1 General information

Characteristics of the MTX Navigator

The MTX Navigator is a directory and file navigator. It visualizes the directory and file structure of the NC control with reference to the Windows Explorer.

This navigator is provided in IndraWorks Operation as well as in IndraWorks Engineering to navigate in the NC file system.

Tree + list In the "Tree+List" characteristic, the directory structure is shown as tree on the left. The subdirectories and files are listed on the right.

This is used in IndraWorks Operation as well as in IndraWorks Engineering.

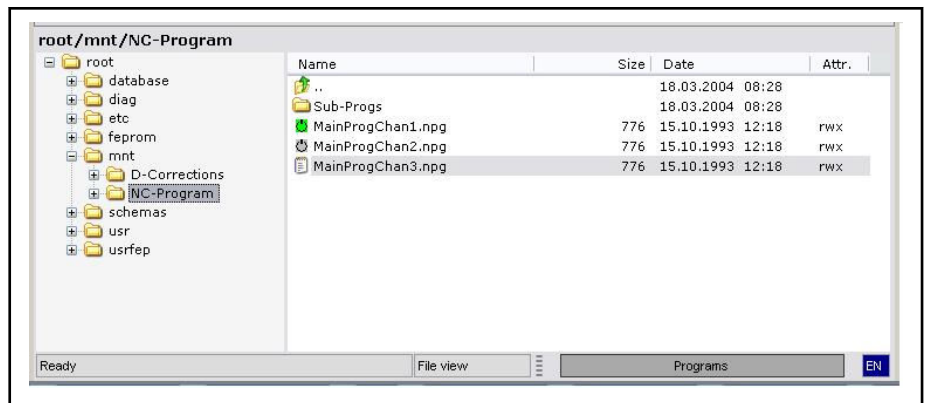


Fig. 4-26: MTX Navigator in the characteristic "Tree + List" of IndraWorks Operation

List The subdirectories and the files are listed in the "List". This representation is only used in the "program selection" ([chapter "Context-dependent functions of the MTX Navigator" on page 46](#)) in IndraWorks Operation.

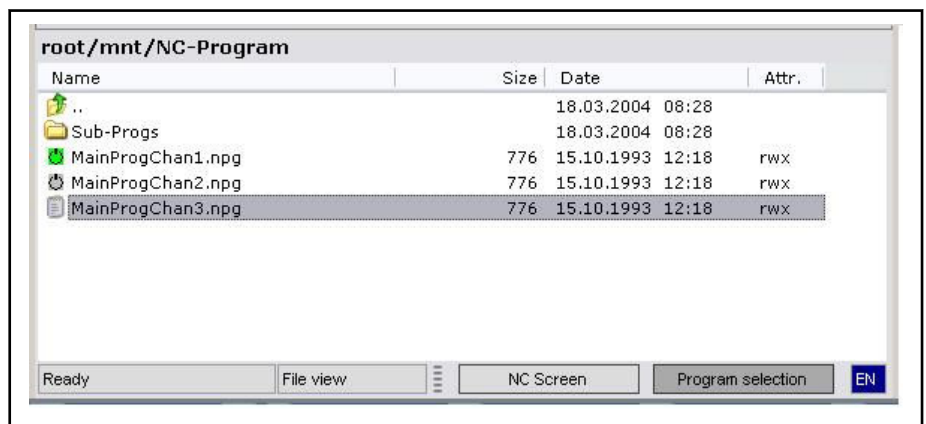


Fig. 4-27: MTX Navigator in the characteristic "List" from IndraWorks Operation

Object types Basically every following object type named in the tree as well as in the list of the MTX Navigator can be provided with its individual context menu and individual assignments of the function keys and the menu bar. This causes a change in the assignment of the function keypad and the characteristics of the menu bar or the context menu when changing between tree and list or selecting another object type.

The following object types are distinguished:

- the folder "root" in the tree  root (Root = the root directory)
- all other folders in the tree
- the return flag in the list  ..
- all other folders in the list
- all files of the list
- the list

Status bar In the status bar, the currently selected object (directory or file) is visualized. If the focus is on a directory in the tree,

- the number of the objects (directories and files) and
- the sum of the sizes of all files

which are directly below the selected directory are shown.

The status bar in IndraWorks Operation is - as shown in [fig. 4-26 " MTX Navigator in the characteristic "Tree + List" of IndraWorks Operation" on page 45](#) - located directly below the navigator. In IndraWorks Engineering, the general status bar of IndraWorks Engineering is used.



In IndraWorks Engineering, the status display is deleted automatically after 10 seconds.

Context-dependent functions of the MTX Navigator

The MTX Navigator in IndraWorks Operation is used in two different operating areas:

- In the operating area "Program"
- In the operating area "Machine"

Additionally, the navigator is also used in IndraWorks Engineering.

According to the context, the navigator provides different functions.

Context program The instance of this context is always activated as soon as the operating area "Program" is called in IndraWorks Operation. In this case, the navigator is the basic application for this operating area.

In this context, the navigator provides all functions for file editing.

The characteristic of the navigator is always "Tree+List" and cannot be switched.

Context: Program selection The instance of this context is called and started with the operation mode "Automatic" via the <F2> "Program Selection" function in the operating area "Machine" of IndraWorks Operation. This function is not provided in other operation modes.

In this context, the MTX Navigator provides - apart from the general functions (see [chapter "General functions" on page 48](#)) - the functionalities for the program selection.

By default, the MTX Navigator is started in this context with the characteristic "List". However, the user can switch between both characteristics "Tree+List" and "List".

Context Engineering The instance of this context is called in IndraWorks Engineering via the "NC File System" node below the "Motion" node.

In this context, the navigator provides all functions for file editing.

The characteristic of the navigator is always "Tree+List" and cannot be switched.

4.4.2 Operation

General information

This section describes the different operating possibilities of the MTX Navigator.

The operation in different contexts proceeds on the assumption of different entering media. The interface is partially operated via mouse (operating areas "Program" and in IndraWorks Engineering) and partially via keyboard (operating area "Machine"). However, an operation with the keyboard is always possible. In certain areas, operation with the mouse is easier.

Context menu For entries with an own context menu, right-click or press <Shift>+<F10> to display it.

Within the context menu, the user can highlight an entry with the mouse, the cursor buttons or by entering the underlined or the first letter and can execute it via <Enter> or the mouse. Via <ESC> or by clicking outside the context menu, it can be closed again without executing any action.

Menu bar	The menu bar can contain individual entries with regard to the currently focused object type of the MTX Navigator. The entries can be selected and activated via mouse or after pressing <F10> or <Alt>+<Letter> as for the context menus.
F-key bar	The function key bar is only available in IndraWorks Operation. It is located at the lower margin of the user interface and consists of buttons which represent the function keys <F2> to <F9>. These buttons can be triggered via left-click button or by pressing the corresponding function key. The assignment of the individual buttons in the MTX Navigator depends on the currently focused object type.

Toggling between tree and list

Switch the entry focus between tree and list either by pressing <Tab> or selecting the desired object with the mouse. It is important, since keyboard entries always refer to the currently focused entry. To navigate in the list and if the focus is currently on the tree, only press <Tab> to focus in the list. The tree entry is then focused again with the <Tab> key.

Navigating in the tree

Keyboard or mouse can be used to navigate in the tree. Individual folders can be directly clicked on for highlighting. Click on the plus or minus sign at the left side of a folder or double-click on a folder to open or close the folder.

The cursor keys are intended to navigate via keyboard, whereas the folder currently highlighted can be opened with <CursorRight> and closed with <CursorLeft>.

Folders are placed one position upwards or downwards by the cursor keys <CursorUp> and <CursorDown>.

Additionally, it can be jumped directly to the folders by entering the first sign of the node name. Ambiguities result in a jump to the next appropriate folder.

Use the keys <PgUp>, <PgDn>, <Pos1> and <End> to jump one screen page upwards or downwards or to the first or last folder in the tree.

When pressing <Backspace>, the highlighting moves to the respective superordinate folder in case the latter exists.

Navigating in the list

In the list, entries (folder, files or return label) are selected via the keys <CursorUp> and <CursorDown> or by the mouse. Use the keys <CursorLeft> and <CursorRight> to shift the list section horizontally. Press "Enter" or double-click to trigger the predefined command of the currently highlighted entry:

- Entry = Return label ⇒ change to next higher level.
- Entry = Folder ⇒ it is placed and displaced in the corresponding directory.
- Entry = File ⇒ function assigned to the file type (e.g. open editor) is executed.

Change to the next higher level as shown in the tree view via <Backspace>.

Press <Ctrl>+<A> to highlight all entries of the list (multiple selection). Use the keys <Shift> and <Ctrl> together with the <Space> key, to select or deselect areas of entries or several individual entries.

Press <PgUp>, <PgDn>, <Pos1> and <End> to jump one screen page up or down or to the first or last entry in the list.

The columns of the list can be maximized or minimized by the mouse. A column can be "hidden" by completely pushing together the column with the mouse. To re-open these hidden columns later on, move the mouse from the right to the corresponding column separator and zoom out the column to the right while keeping the left mouse button pressed.

Sorting column and direction can only be changed by clicking one or multiple times on the corresponding column head. A little triangle highlights the current sorting column and indicates the selected sorting direction, whereas the apex of the triangle shows in the direction of the ascending values.



In spite of sorting, the order of the following groupings is always maintained:

- The return label is always at the top.
 - Afterwards, all directories are shown.
 - The last group is the group of the files.
-

The MTX Navigator saves all column widths as well as the sorting column and the sorting direction. This data is always saved on the hard disk when the navigator is left and exited.

4.4.3 Functions

General functions



General functions do not depend on the context!

Placing file filter

Use the filter dialog to exclude certain data types from the display in the list. Thus, the selection of the files can be limited.

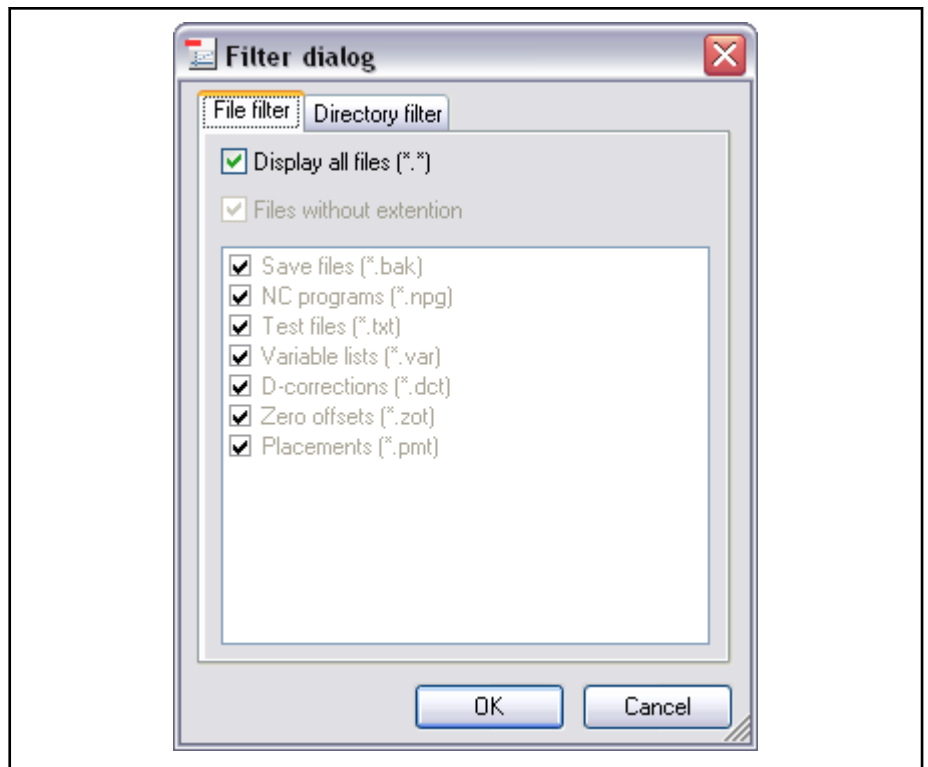


Fig. 4-28: Filter dialog for files

Only files which correspond to the file types selected in the dialog are shown. All other files are not displayed. In the example above, only NC programs are displayed.

Add file filter The list in the filter dialog for files can be extended by the "Add filter" function. This function is called via the context menu (right mouse button) of the list.

Delete file filter Entries from the list can be deleted in the file filter dialog. Note that only the elements added by the user can be deleted. The extension specified by the installation cannot be deleted.

This function is called via the context menu (right mouse button) of the file filter list.

Set editor Use this function to enable a user-defined editor for a certain file extension to be used when opening a file with this extension. By default, an internal ASCII editor is used unless a special editor was assigned.

This function is called via the context menu (right mouse button) of the file filter list.



This function is only available in IndraWorks Engineering.

Setting directory filter Use the filter dialog to exclude certain default directories of the control from the display in the tree. Thus, the selection of the directories can be limited.

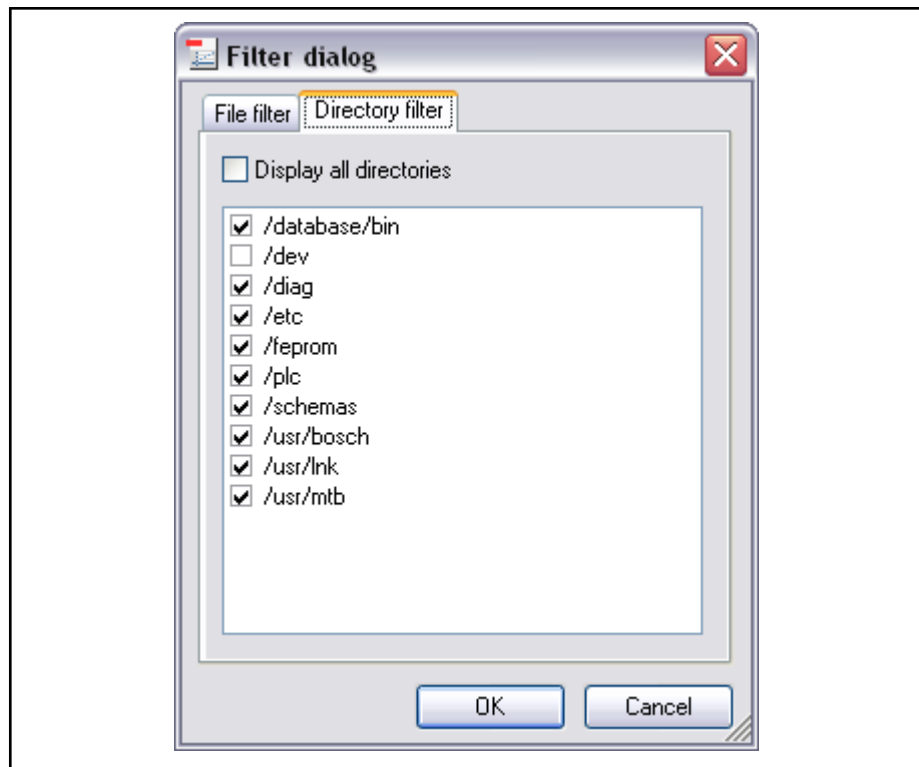


Fig. 4-29: Filter dialog for directories

All connected directories and the directories selected in the directory dialog (including mount directories) are always shown.

Add directory filter

The list of the directories in the standard can be extended using the function "Add directory filter". In this case, it is possible to include subdirectories in the list as well. Furthermore, individual directories can be deleted from the list via the context menu.

Properties of the directory

The "Properties" dialog shows the following directory information:

- Directory name → can be changed
- Location of the directory
- File system in which the directory is located
- Assigned memory of the file system
- Free memory of the file system
- Memory capacity of the file system
- Creation date of the directory
- The attributes of the directory

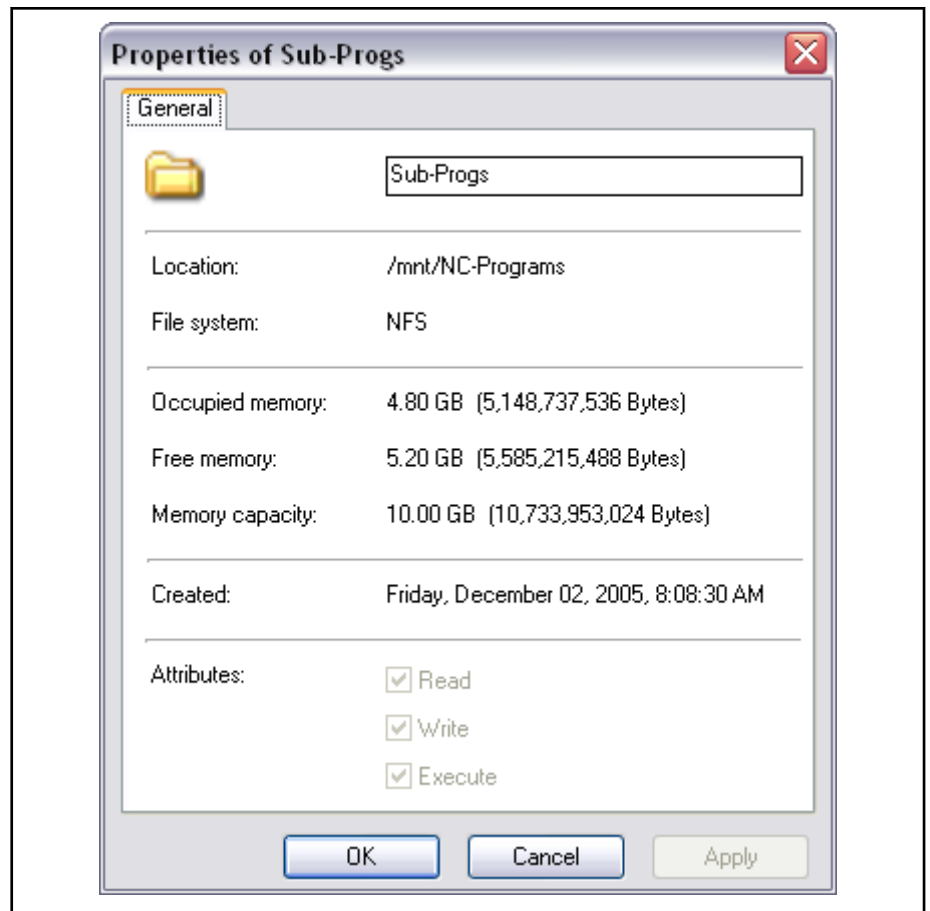


Fig. 4-30: "Properties" dialog of the directory



The attributes of the directory cannot be changed on the mount directory!

Properties of a File

The "Properties" dialog shows the following file information:

- File name → can be changed
- Location of the file
- File system in which the file is located
- File size
- Creation date, change date and date of last access
- File attributes

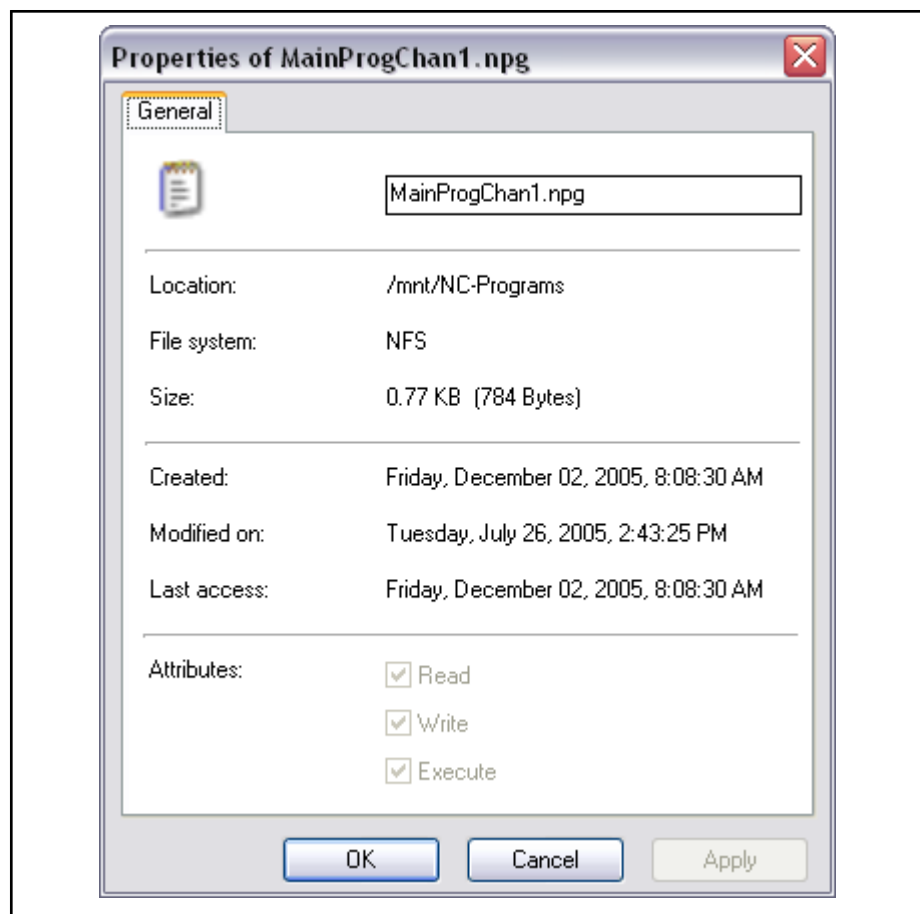


Fig. 4-31: "Properties" dialog of the file



The attributes of a file cannot be changed on the mount directory!

Importing directories/files

The user can use the "Import" dialog to import directories and/or files from the Windows file system into the file system of the NC kernel. The import function is only activated if the focus is on a directory (also the "root" directory). It is not significant whether it is in the tree or in the list. If several objects are selected in the list, the import function is deactivated. If the focus is on the "empty" list, the import function is activated.

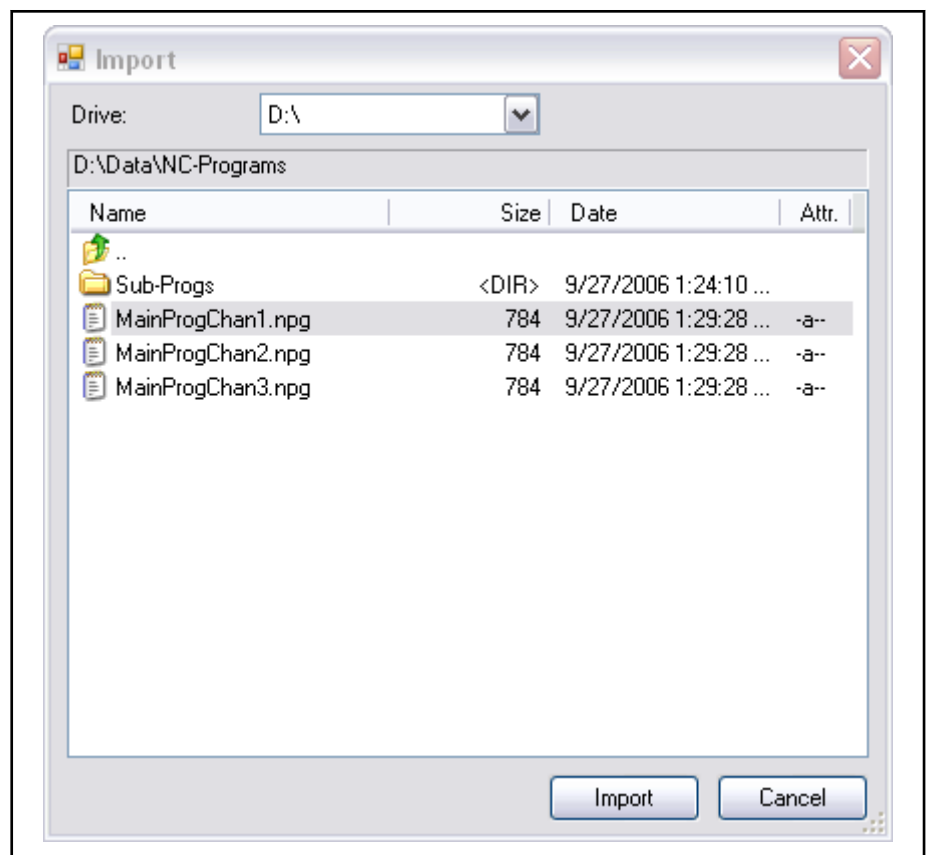


Fig. 4-32: "Import" dialog

- During the first call after the MTX Navigator start, "C:" is set as default drive. . The last selected directory is placed as default directory for every following call (as long as the user interface was not closed)
- Several files and/or directories can be highlighted and imported. After pressing the "Import" button, all selected objects (files/directories and subdirectories and files) are copied to the selected directory in the MTX Navigator.
- If a file with the same name already exists in the target directory, the user is asked whether he would like to overwrite or cancel the copying process for this file.
- The dialog can be used with the keyboard (i.e., no mouse is needed)!

Exporting directories/files

With the export function, directories and/or files are copied from the file system of the NC kernel to a Windows directory selected by the user. The export function is active under the following conditions:

- Not the node "root" is selected in the tree, but another directory.
- In the list, one or several file(s) / directory/is is/are selected.



Fig. 4-33: "Export" dialog

In this dialog, the user selects the target directory in which the selected files/directories are copied from the MTX Navigator.

If the element (file/directory) to be exported already exists in the target directory, it is overwritten without prompt.

Furthermore, the dialog provides the possibility to create a new subfolder which can immediately be selected as target directory.

Program selection functions

Link NC program	If this function is selected in the function key bar, the selected NC program is automatically linked in case of a program selection.
Show tree	This function is used to switch the view of the MTX Navigator between Tree +List.
Cancel selection	This function closes the program selection without an NC program being selected.
Confirm selection	This function executes a program selection with the selected NC program. The selected NC program is visualized in the NC block display (operating screen machine).



All selected NC programs are marked with an individual symbol in the list of the MTX Navigator.

- Selected NC programs in the current channel contain a "green" symbol. 
- Selected NC programs in non-selected channels contain a "gray" symbol. 

Directory functions

These are functions which can only be used for directories (folders). These functions can only be called if a folder object is focused in the tree or in the list.



The directory functions are only active in the context "Program" or in IndraWorks Engineering.

New -> Directory

Use this function to create a new subdirectory in the currently selected directory. When this function is activated, a dialog is opened. Enter the name of the new subdirectory into this dialog. The maximum length of a directory name within the directory system of the NC kernel is limited to 30 characters. On the mount directory, the maximum length for a directory corresponds to the Windows conventions.



Fig. 4-34: Dialog: Create new directory

- "OK" closes the dialog and creates the directory.
- "Cancel" closes the dialog and does not create a new directory.
- If no name is entered and "Ok" is pressed, an error message is output.
- If the name already exists in the directory, an error message is shown.
- If the directory name has more than 30 characters and the file is in the directory system of the NC kernel, an error message is shown.

Delete

The current directory and all contained subdirectories and files are deleted. The deletion has to be confirmed by the user:

Yes The directory is deleted

No Deletion is canceled

It is possible to highlight several directories and/or files in the list (multiple selection) and delete them afterwards.

During deletion, a status box is shown visualizing the progress at deletion.



The root directory cannot be deleted!

Rename

Use this function to rename the currently selected directory. When this function is activated, a dialog is opened. The user has to enter the name of the new directory into this dialog. The default assignment in the input field is the current directory name. The maximum length of a name in the directory system of the NC kernel is limited to 30 characters. On the mount directory, the maximum length for a directory corresponds to the Windows conventions.



Fig. 4-35: Dialog: Rename directory

- "OK" closes the dialog and renames the directory.

- "Cancel" closes the dialog and the directory is not renamed.
- If no name is entered and "Ok" is pressed, an error message is output.
- If the name entered already exists in the directory, an error message is shown.
- If the directory name has more than 30 characters and this directory is in the directory system of the NC kernel, an error message is shown.



The root directory cannot be renamed!

In case of multiple selection, directories cannot be renamed.

Copy Use this function to save the currently selected directory in the clipboard. This function is required for the "Insert (Directory)" function. Only if an element of the "Directory" type is in the clipboard, the function "Insert (Directory)" is activated and can be selected by the user.

With each new copying, the current content of the clipboard is overwritten!



- The "root" directory cannot be copied!
- The return label cannot be copied!
- A multiple selection of directories in the list is possible.

Insert This function requires an element of the type "Directory" in the clipboard. Only in this case, this function is active and can be executed by the user.

When the function is selected, the program determines the source directory from the clipboard and copies the latter with all its subdirectories and files to the currently selected target directory.

If a subdirectory with the same name of the directory to be copied already exists in the target directory, the user has to decide whether the current directory is to be overwritten or whether the insertion is to be canceled using a dialog.

When inserting a directory with more than 30 characters from the Windows file system into the file system of the NC kernel, an error message is output.

Cut Basic function like "Copy"!

In addition, the source directory is deleted after insertion into another directory via the function "Insert (Directory)".

File functions

These are functions which can only be used for files. These functions are only activated if one or several files are selected in the list. In case of multiple selection, some functions are not activated!



File functions are only activated in the context "Program" or in IndraWorks Engineering.

New This allows to create a new file of a certain type.

The following types are provided:

- NC programs
- NC variable list
- D-corrections
- Zero offsets
- Placements

- Text file

After selecting one of these types, the corresponding editor is started automatically. It is used to create and edit the file.

Delete This function deletes the currently selected file. The deletion has to be confirmed by the user:

Yes The file is deleted.

No Deletion is canceled.



When deleting, a multiple selection is possible. In this case, all selected files are deleted!

Selected, i.e. active NC programs cannot be deleted.

Edit When operating this function, the data type of the selected file calls the corresponding editor and loads the selected file.

If the data type of the selected files is unknown, the NC program editor is started in IndraWorks Operation and a simple ASCII editor is started in IndraWorks Engineering. This editor is part of the MTX Navigator.



In case of multiple selection, files cannot be edited.

Rename This function renames the currently selected file. When this function is activated, a dialog is opened. The user has to enter the new file name into this dialog. The default assignment in the input field is the current file name. The maximum length of a name is limited to 30 characters. On the mount directory, the maximum length for a file corresponds to the Windows conventions.



Fig. 4-36: Dialog "Rename file"

- "OK" closes the dialog and the file is renamed.
- "Cancel" closes the dialog, but the file is not renamed.
- If no name is entered and "Ok" is pressed, an error message is output.
- If the name entered already exists in the directory, an error message is shown.
- If the file name has more than 30 characters and this file is in the directory system of the NC kernel, an error message is shown.



- In case of multiple file selection, the "Rename" function is disabled.
- Selected, i.e. active NC programs may not be renamed.

Copy This function is used to save the currently selected file in the clipboard. This function is required for the function "Insert (File)". Only if an element of type "File" is in the clipboard, the function "Insert (File)" is activated and can be selected by the user.

With each new copying, the current content of the clipboard is overwritten!



- A multiple selection of files in the list is possible.
- A mixed multiple selection of directories and files in the list is also possible.

Insert This function requires an element of the type "File" in the clipboard. Only in this case, this function is active and can be executed by the user.

When the function is selected, the program determines the source file from the clipboard and copies the latter to the currently selected target directory.

If a file with the same name of the file to be copied already exists in the target directory, the file name is prefixed by the text "Copy of" if source and target directory are identical. If both directories are different, the user is asked whether the file is to be overwritten in the target directory.

Cut Basic function like "Copy"!

In addition, the source file is deleted after being inserted into another directory using the function "Insert (File)"!

Search functions

Find The "Search" function can be used to search for files in the file system of the NC kernel and in all mounted directories of the Windows file system or on a Compact Flash (CF) card of a controller-based control.

This function is only activated if the focus is on a directory (folder) of the tree (also the "root" directory) or the list. If several objects are selected in the list, the search function is deactivated.



The search function can be used in IndraWorks Engineering and in both IndraWorks Operation contexts.

If the "Search" function is called in a directory (folder), the following dialog is displayed:

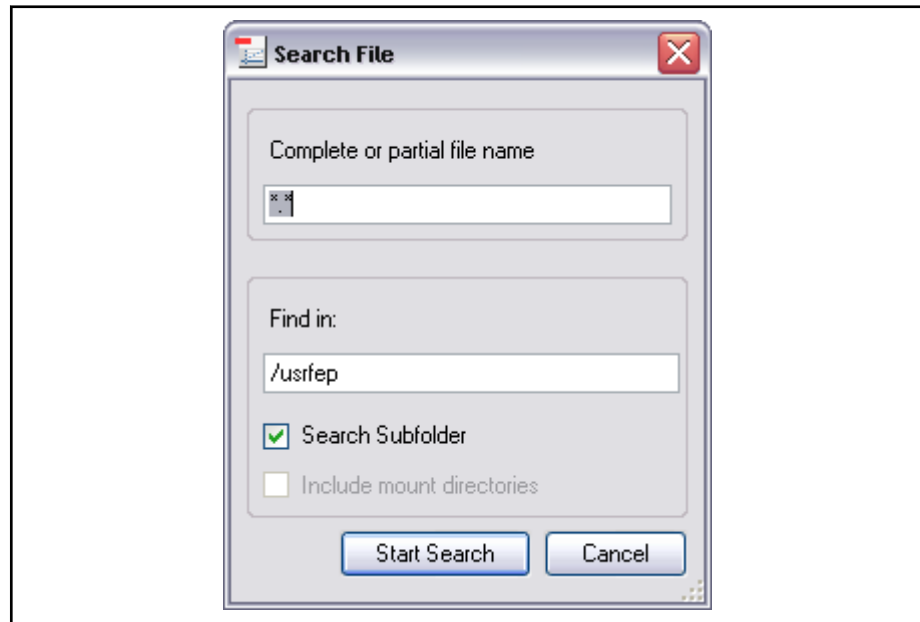


Fig. 4-37: "Search File" dialog

To search for certain files, the following settings can be made:

- Entry of a file name combined with a placeholder "*"
 - *.* - Search for all files (default setting)

- **<FileName>.<ext>** - Search for a certain file
- ***.<ext>** - Search for all files with a certain extension
- **<FileName>.*** - Search for files with a certain name and any extension
- **<FileName>*.*** - Search for files starting with certain characters and any extension
- **<FileName>*.<ext>** - Search for files starting with certain characters and with certain extension
- **Entering a path**
In the "Find in" field, the path of the focused directory is applied when opening the dialog. This search path can be manually adjusted by the user. It has to be observed that a valid (existing) path is entered. If the path is invalid, searching is aborted with an error.
- **Search Subfolder**
This checkbox can be used to limit the file search to the specified directory or to include all subdirectories (default setting).
- **Include mount directories**
Select this checkbox only if the selected directory is root ("/"), since only "root" can be provided with one or several mount directories and subdirectories.

If the search is started, all files with the set specifications are searched. While searching, a progress bar is displayed. At the end of the search, the node "Search Results" is newly created and automatically selected in the tree. Are files found in the list are displayed with their complete path. These are "links" to the original files.

Functions of the "Search Results" node

Generally, the search result remains until a new search is started or explicitly completed by the user. The advantage is that it can be switched any number of times between the individual directories of the NC file system and the search result without losing the search result as it is common for other browsers. The disadvantage is that updates such as modifications or deletion of original files made after the search cannot be seen in the search result list.

Repeat search	This function starts the previous search again without displaying the search dialog. This function is especially useful if the original files were modified after the search but the search result should be up-to-date.
Complete search	This function deletes the search result list (list of links to the files found) and the "Search Results" node.

Functions of the elements (links) in the search result list

Go to	This function switches the directory to the original file and focuses it. The "Search Results" node remains.
Available file functions	The number of available file functions on the elements of the search result list is limited to the following functionalities: • Delete - To delete the original file as well as the link from the search list. • Export - To export the original file. • Properties - To visualize the properties of the original file. All other file functions are not activated for elements of the search result list.

4.5 Winlock

4.5.1 General information

Winlock is a software component that is started by the user interface preventing unauthorized users from switching between programs (<Alt>+<Tab>) and from accessing the Windows operating system (desktop, Start menu, taskbar).

Authorized users require the user right "Access to operating system functions".



Winlock is activated automatically by activating the user management.

4.5.2 Active Winlock

If Winlock is active, the following operations are locked:

- Switching between programs using <Alt>+<Tab>
- Displaying the Windows Start menu with <Ctrl>+<Esc> or with the Windows keys
- Moving the user interface to the background using <Alt>+<Tab>
- Closing the user interface
- Minimizing and restoring the user interface
- Operating the Windows taskbar and Windows Desktop

In addition, the following buttons are deactivated in the Windows Security dialog which is displayed by pressing the key combination <Ctrl>+<Alt>+<Del>:

- Lock computer
- Logoff
- Shut down
- Change password
- Task Manager

Every time the IndraWorks users log in or log out, the required authorization is checked again and the functions mentioned above are disabled or enabled.

An icon in the header displays if Winlock is active (see header).

4.5.3 Deactivating Winlock

Winlock is deactivated when an authorized user logs in.

4.5.4 Closing the user interface

When an attempt is made to close the user interface, it is checked whether the logged-in IndraWorks user has the required authorization. If not, the user interface cannot be closed and a corresponding message window is displayed.

4.6 Overview on active corrections

4.6.1 Use

All correction values used in the NC are displayed in different screens.

The application comprises four screens with the following displays

- Correction overview 1
 - Zero offsets
 - Tool corrections
- Correction overview 2
 - Input tools
 - Program coordinates
 - Placements
- Tool correction register
- Precision corrections

Integration of the application
"Overview on active corrections" in
the operating desktop

The display is assigned to the operating area <OP3> "Machine". Pressing <F4> "Overview on active corrections" starts the application.

The display is an application with an individual F-key assignment.

Menu and title are hidden.

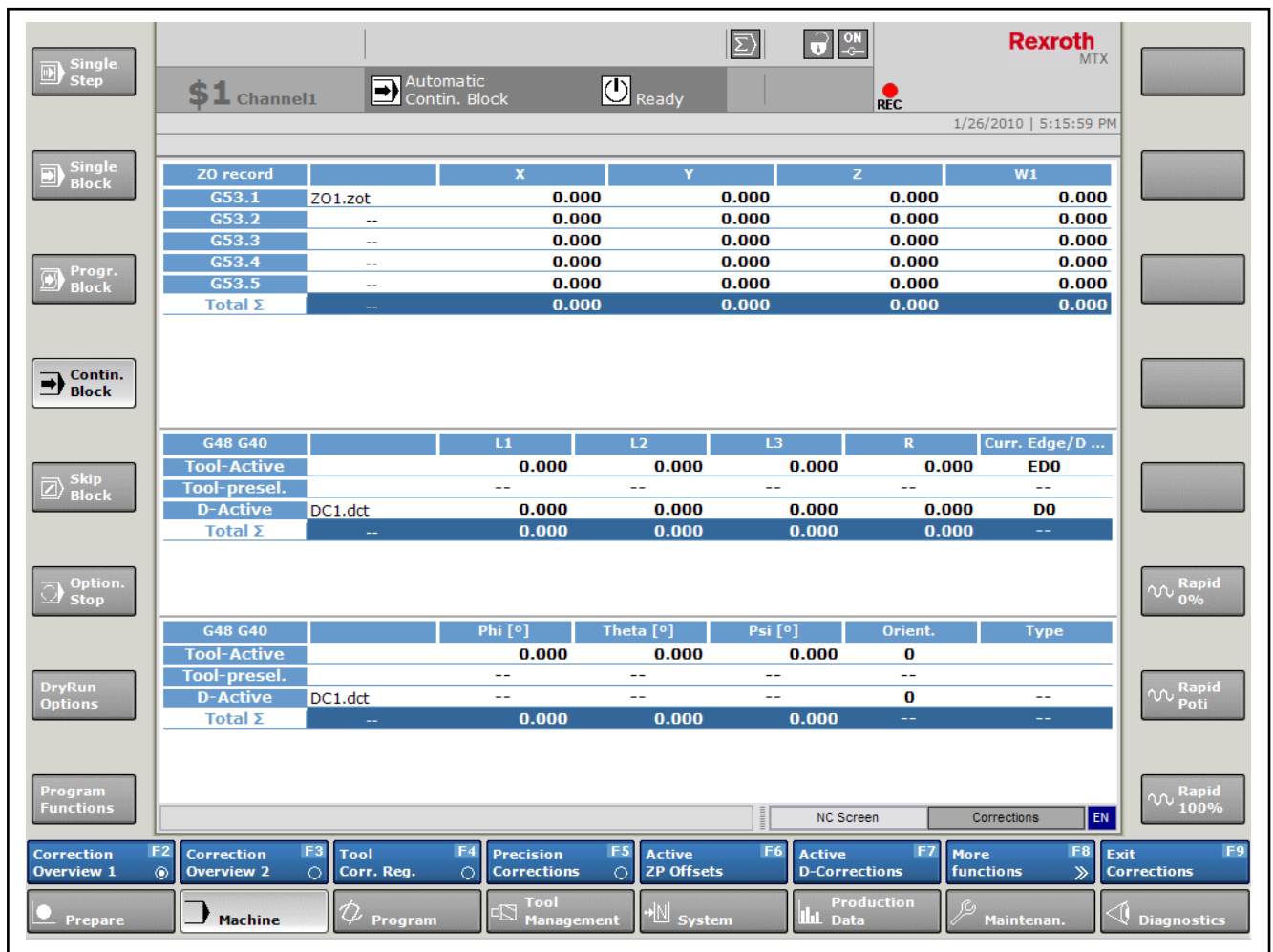


Fig. 4-38: Overview on active corrections

4.6.2 Principle structure of the application: Overview on active corrections

Screens The application comprises the following four screens

- Correction overview 1
- Correction overview 2

- Tool correction register
 - Precision corrections
- Correction overview 1** This screen comprises the following displays
- Active zero point offsets
 - Active tool corrections

Z0 record		X	Y	Z	W1
G53.1	Z01.zot	0.000	0.000	0.000	0.000
G53.2	--	0.000	0.000	0.000	0.000
G53.3	--	0.000	0.000	0.000	0.000
G53.4	--	0.000	0.000	0.000	0.000
G53.5	--	0.000	0.000	0.000	0.000
Total Σ	--	0.000	0.000	0.000	0.000

G48 G40		L1	L2	L3	R	Curr. Edge/D ...
Tool-Active		0.000	0.000	0.000	0.000	ED0
Tool-presel.	--	--	--	--	--	--
D-Active	DC1.dct	0.000	0.000	0.000	0.000	D0
Total Σ	--	0.000	0.000	0.000	0.000	--

G48 G40		Phi [°]	Theta [°]	Psi [°]	Orient.	Type
Tool-Active		0.000	0.000	0.000	0	--
Tool-presel.	--	--	--	--	--	--
D-Active	DC1.dct	--	--	--	0	--
Total Σ	--	0.000	0.000	0.000	--	--

Fig. 4-39: Correction overview 1

- Correction overview 2** This screen comprises the following displays
- Active input tools
 - Rotation angle (ROT)
 - Pole definition (PLS)
 - Shift (SHT)
 - Mirroring active (MIR)
 - Scaling factor (SCL)
 - Active program coordinates
 - TRANS
 - ATRANS
 - Active placements

ROT = 0.000	X	Y	Z	W1
PLS	0.000	0.000	0.000	0.000
SHT	0.000	0.000	0.000	0.000
MIR	0	0	0	0
SCL	1.000	1.000	1.000	0.000

	X	Y	Z	W1
TRS	0.000	0.000	0.000	0.000
ATR	0.000	0.000	0.000	0.000
Total Σ	0.000	0.000	0.000	0.000

PMT record	X	Y	Z	Phi [°]	Theta [°]	Psi [°]
BCR	0.000	0.000	0.000	0.000	0.000	0.000
G153.1	--	0.000	0.000	0.000	0.000	0.000
G153.2	--	0.000	0.000	0.000	0.000	0.000
G153.3	--	0.000	0.000	0.000	0.000	0.000
G153.4	--	0.000	0.000	0.000	0.000	0.000
G153.5	--	0.000	0.000	0.000	0.000	0.000
Total Σ	--	0.000	0.000	0.000	0.000	0.000

Fig. 4-40: Correction overview 2

Tool correction register

This screen comprises the following display

- Content of the complete tool correction register across all edges

	L1	L2	L3	R	Orient.
ED01	0.000	0.000	0.000	0.000	0
ED02	0.000	0.000	0.000	0.000	0
ED03	0.000	0.000	0.000	0.000	0
ED04	0.000	0.000	0.000	0.000	0
ED05	0.000	0.000	0.000	0.000	0
ED06	0.000	0.000	0.000	0.000	0
ED07	0.000	0.000	0.000	0.000	0
ED08	0.000	0.000	0.000	0.000	0
ED09	0.000	0.000	0.000	0.000	0
ED10	0.000	0.000	0.000	0.000	0
ED11	0.000	0.000	0.000	0.000	0
ED12	0.000	0.000	0.000	0.000	0
ED13	0.000	0.000	0.000	0.000	0
ED14	0.000	0.000	0.000	0.000	0
ED15	0.000	0.000	0.000	0.000	0
ED16	0.000	0.000	0.000	0.000	0

Fig. 4-41: Tool correction register

Precision corrections

This screen comprises the following displays

- Active precision corrections effective in the coordinate system ACS
 - Temperature compensation NC
 - Lead screw compensation
 - Sag (cross compensation)
- Active online corrections in the coordinate WCS
 - Handwheel

Precision correction (...)	X	Y	Z	W1
Command position	200.0000	87.8000	0.0000	0.0000
Actual	0.0000	0.0000	0.0000	0.0000
--	--	--	--	--
NC Temperature	0.0000	0.0000	0.0000	0.0000
Spindle pitch	0.0000	0.0000	0.0000	0.0000
Sag	0.0000	0.0000	0.0000	0.0000
Offset	0.0000	0.0000	0.0000	0.0000

Online correction (WC...	X	Y	Z	W1
Command position	200.0000	87.8000	0.0000	0.0000
--	--	--	--	--
Handwheel	0.0000	0.0000	0.0000	0.0000

Fig. 4-42: Precision corrections

4.6.3 Operation and navigation

The operation is executed via F-keys.

Switching between the screens

It is switched between the four screens using <F2>, <F3>, <F4> and <F5>.

Basic level of F-keys

Apart from the shift keys for the four screens, there are further important functions in the basic level related to the corrections.

- <F2>: Opening the screen "Correction overview 1"
- <F3>: Opening the screen "Correction overview 2"
- <F4>: Calling the screen "Tool correction register"
- <F5>: Calling the screen "Precision corrections"
- <F6>: Opening the editor for "active zero point offsets"
- <F7>: Opening the editor for "active D-corrections"
- <F8>: Additional functions (second level)
- <F9>: Application "Complete"

F-keys: Additional functions

This level contains additional functions.

- <F2>: "Reset channel" function
- <F3>: "Reset system" function
- <F7>: Focus partial window
- <F8>: Return to basic level

4.7 NC simulation

For more information about the NC simulation, refer to the MTX documentation "NC Simulation".

5 Operation modes

5.1 Automatic

5.1.1 Single block

In secondary operation mode "Single block", individual blocks of a main program or subroutine or of a user cycle are executed after the  "Start" button on the machine operating panel is pressed.

5.1.2 Single step

In secondary operation mode "Single step", individual blocks of a main program or subroutine and of a user cycle are executed after the  "Start" button on the machine operating panel is pressed. As the "single block", but additionally with the compensation blocks inserted by the NC (e.g. to enable the cutter radius compensation) or with the NC-internal cycles.

5.1.3 Program block

In secondary operation mode "Program block", individual blocks of a main program or a subroutine are executed each time that the  "Start" button on the machine operating panel is pressed. The blocks are executed individually as in "MDI". Block preview is not possible!

5.1.4 Continuous block

In normal mode, programs are executed in "Continuous block" . I.e., the program is processed continuously with NC start.

5.1.5 Block search/Block pre-run

Overview

The functions "block search" and "block pre-run" simplify the testing and positioning of NC programs.

Structure of the screen layout

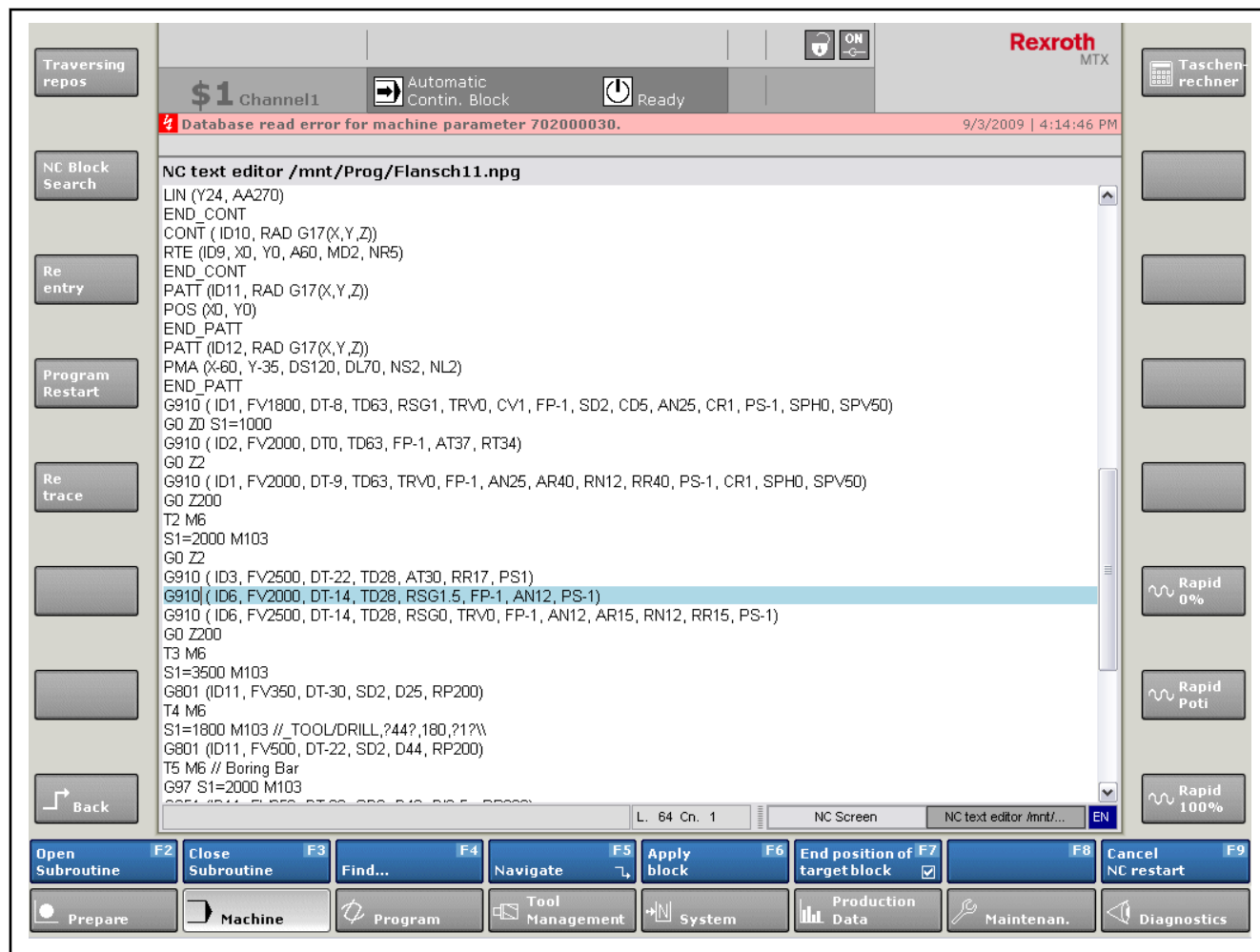


Fig. 5-1: Screen layout of block search/block pre-run

The "Block search" or the "Block pre-run" screen visualizes the selected NC program with related subroutines. If "Block search" or "Block pre-run" was started once before for this program, the previous target block is highlighted.

Header

The header shows the name of the application "Block search" or "Block pre-run" and the name of the NC program including the path specification.

Main area

The main area of the "Block search" or "Block pre-run" screen displays the selected NC program/subroutine.

Status bar

The status bar is divided into several areas:

- Information area
- Sequential number of the selected line
- Open applications
- Current language

Information area	Information texts and error messages can be displayed in the "info area" during operation.
Line number	The sequential number of the selected line is shown in the second area. The column is not assigned.



The fields "Open applications" and "Current language" are assigned by the system. If subroutines are branched, these are also entered as "Open applications". In this case, the applications cannot be toggled. Otherwise, the relationship of the programs get lost.

Functional scope of the block search

The block search provides the possibility to start NC processing within the selected main NC program. This function acts like an absolute jump from the program start to the target block. The selected program has to be at program start.

Using the long cursor, the operator selects the desired target block to which it is to be jumped from the program start.

After having triggered "NC start", the NC begins the program processing based on the current machine and control states and starting at this block. Afterwards, it is switched to a special NC screen. The previous blocks are not executed or taken into account.

Starting the application The default M-key assignment is the "Block search" key in the "Program functions" level

When "Block search" is called, the selected NC program is displayed.

The cursor is normally located on the first block in the displayed NC program. If the program has already been processed previously in the block search, the previously selected block is highlighted.

Block search to main block Generally, the block search is used to position and start a main block that contains all required geometric and technological data for a continued program operation, especially the tool replacement.

Block search on auxiliary block The block search can also be used to position and start any NC block (auxiliary block). Therefore, the operator has to set the required geometric and technological data in "MDI mode" before.

Thus, the conditions required on the machine for the actual entry block can be set up.

Selecting the target block The target block of the displayed NC program can be selected with the cursor keys.



Note that the selected NC block number must not exist several times in the NC program. The system jumps to the block number found first.

Starting the block search Press the F-key "Apply block" to start the block search and to close the application.

Functional scope of the block pre-run

Block pre-run is a function to test and position NC programs so that the operating procedure can be started at any block in the NC program/subroutine. Block pre-run is an extension of the NC function "Block search".

Block pre-run is used to create the required states in the control and at the machine. The block pre-run requires a specified target block. The target block can be located within the selected NC program as well as within a subroutine.

In the function "Block search", program processing begins at the target block that is a freely selectable program block. Until then, from the first program block up to the block in front of the target block, the program blocks are processed logically with axis output as well as help functions blocked. Processing and executing NC instructions starts with the target block.



There are still restrictions for the "Block pre-run" function. Also refer to the manual "Functional Description", chapter "Block Pre-Run".

Starting the application	The default M-key assignment is the "Block pre-run" key in the "Program functions" level When calling the block pre-run, the selected NC program is displayed. The cursor is normally located on the first block in the displayed NC program. If the program has already been processed previously in the block search, the previously selected block is highlighted.
Opening the subroutine	Use the F-key "Open subroutine" to display the corresponding subroutine if a subroutine call was written in the selected block. If the selected block does not contain a subroutine call, this is displayed by an information text.
Closing the subroutine	Use the F-key "Close subroutine" to close the open subroutine and to return to the calling program. An information text is displayed if no subroutines are open anymore (that means returning is not possible anymore).
Applying the block	Use the F-key "Apply block" to start the block pre-run, close the application and show the adjustment screen.
End position of the target block	At block pre-run, the starting position for the following axis adjustment between the initial position and the end position of the target block can be selected. The end position of the target block (ticked) can also be the return position from a subroutine of the target block.

Function keys in the applications "Block search" and "Block pre-run"

The following table lists the F-key assignment of the applications "Block search" or "Block pre-run":

Functions in the main level	The following functions can be found on the first level of the F-keypad: • <F2>: "Open subroutine" • <F3>: "Close subroutine" • <F4>: A dialog to enter a character string to be searched in the complete program opens. It can be selected between upper case or lower case as well as the direction of the search. Replacement is not possible • <F5>: A subsequent level is opened where more functions are grouped • <F6>: "Apply block" • <F7>: "End position of the target block" (only for block pre-run) • <F8>: The function "Block search" or "Block search" is cancelled
Functions in the Navigation level	The "Navigate" level provides the following functions: • <F2>: The long cursor jumps to the beginning of the file • <F3>: The long cursor jumps to the end of the file • <F4>: The cursor jumps to the next word. If the line is exited, the long cursor also jumps to the new line • <F5>: The cursor jumps to the previous word. If the line is exited, the long cursor also jumps to the new line

- <F9>: Return to main level

Returning to contour with block pre-run

Overview	Returning to contour with block pre-run after program abort provides the option of continuing the processing of the NC program with as little effort as possible, if it reached or exceeded a defined and programmed NC block (returning to contour block). Define a returning to contour block by programming the NC function "ReentContBlk()", (short form "RCB()") in the NC program.
Application	If an NC program is aborted during processing, processing is to begin at a predefined position immediately. Reasons for an abort can be tool rupture, power failure, NC control error, etc. In these cases, the NC programmer can determine where (NC block) a repositioning in the NC program is reasonable. This block is marked with "RCB(1)" in the NC program. If the NC program is aborted after this block, returning to contour with block search is possible.



Returning to contour with block search after a program abort is only possible in the operation mode "Continuous block".

The function "Returning to contour with block pre-run" can be projected to a free F- or M-key. The function to be projected is "Re-entry".

The default M-key assignment is the "Re-entry" key in the "Program functions" level

After program abort, the "Return to contour" function can be initiated after making the machine ready for start. If no re-entry point is programmed or if it was deleted by "RCB(0)", a corresponding message is issued. If another NC program was selected in the meantime, this function can also not be started.

If a re-entry point was programmed, but the NC program edits, the "Re-entry" function can be called. Only when starting the block pre-run function, an error message is issued and the function is aborted.

The "Return to contour" function cannot be called without a selected NC program.

Adjustment

General information

After the computation, the NC-internally calculated states (positions, speed, G-codes etc.) do not correspond to the ones at the machine in a real situation.

The operator has to change the real situation by an adjustment program and manual entries (manual data input) so that it corresponds to the calculated state.

The following data has to be adjusted:

- Axes
- Spindles
- Auxiliary functions
- NC functions
- Tools

Adjustment sequence after computation:

- Adjustment program - InitAdjust
- Manual adjustment via manual data input of NC blocks
- Action block (optional)
- Adjustment program - TargetAdjust (optional)

Operation modes

- Approaching motion
- Program entry (target block)

Adjustment screens

The adjustment state is visualized via adjustment screens.

Overview screen

The screen is displayed in the operation mode "Block pre-run" after the computation started.

The total adjustment state of the respective data type is displayed as adjustment symbol next to the partial window. The adjustment symbol signals that the adjustment has not yet been carried out. The symbol is removed after a successful adjustment.

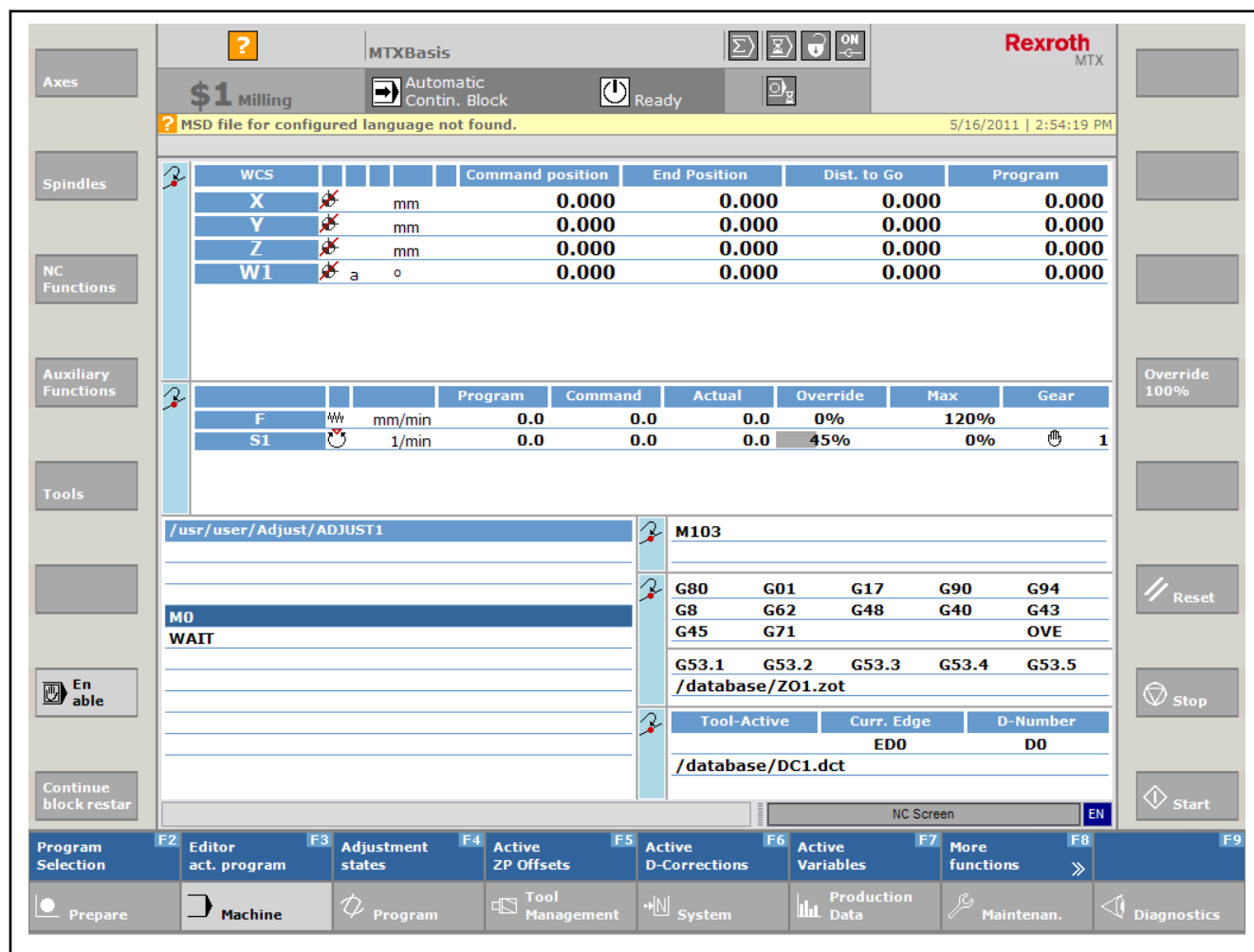


Fig. 5-2: Overview screen after the start of the adjustment program

When all data is adjusted, the adjustment screen is replaced by the automatic screen. Machining the workpiece is continued.

Applying adjustment screens

Detailed information on the adjustment can be found in the adjustment screens for the individual data types. The adjustment screens are summarized in one application and can be opened with <F4> or via the machine keys <L1> to <L5>.

The application comprises five adjustment screens:

- Axes
- Spindles

- NC functions
- Auxiliary functions
- Tools

Use the keys <F2> to <F6> or the machine keys <L1> to <L5> to switch between the screens. Exit the application with <F9>.

If all data is adjusted, the application is automatically closed.

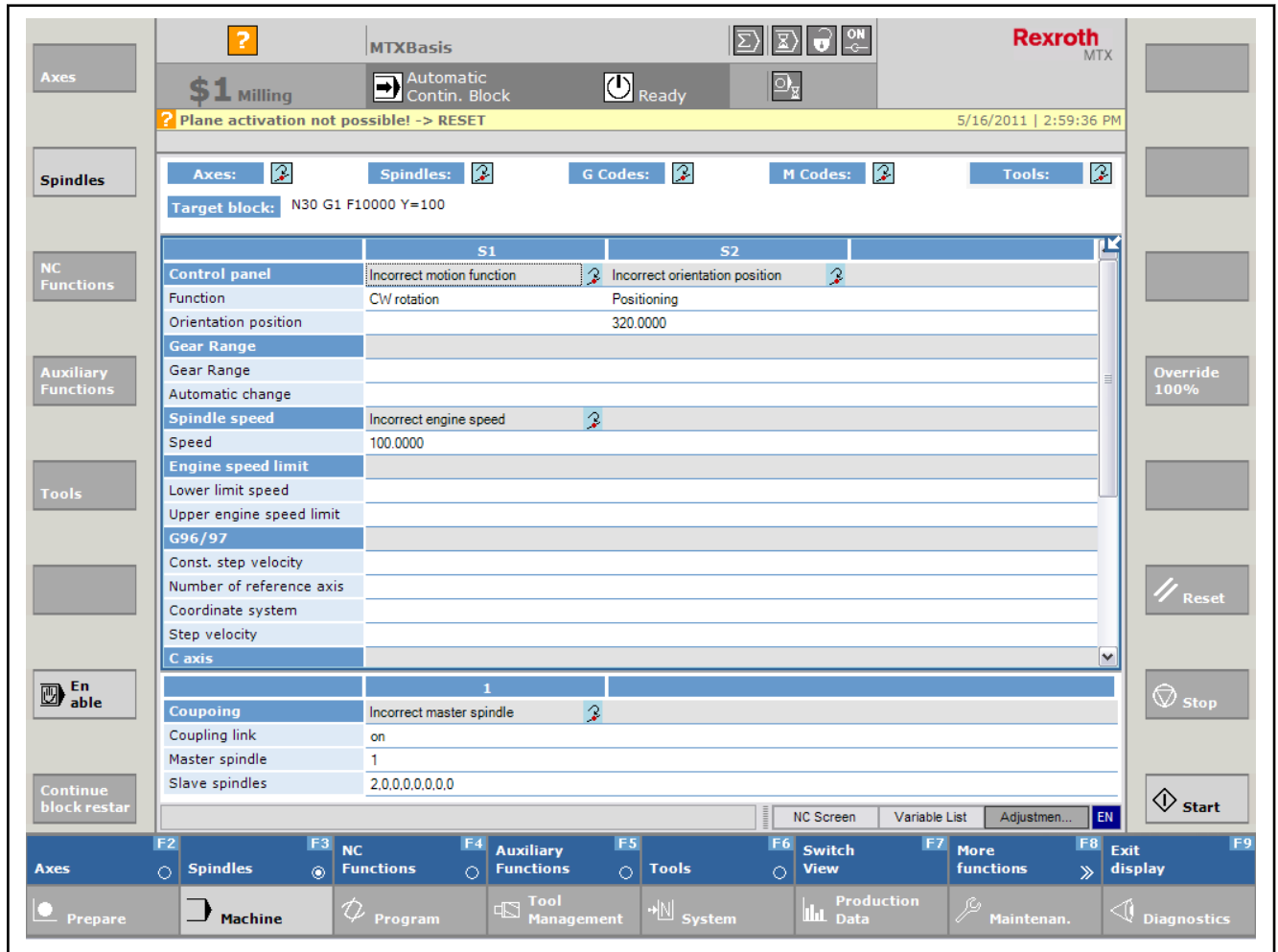


Fig. 5-3: Adjustment screens

Adjustment screen: Axes

The screen comprises two partial windows. The upper partial window displays the total adjustment information of all data types and the target block for a better overview.

The lower partial window visualizes the adjustment state of each individual axis as table.

There are two views (switching via <F7>):

- The adjustment information and the expected command values are shown in their interrelation.
- All adjustment information is displayed as compressed and the expected command value for the adjustment is shown depending on the focused line of the adjustment information.

All functions to be adjusted have to be provided with an adjustment symbol. The adjustment reason is given as text

If the x-axis position has to be adjusted for example, this is shown by the "Incorrect position" text. The command value indicates the requested position.

A maximum of five axes can be shown side by side. In case of more than five axes, a scrollbar is shown.

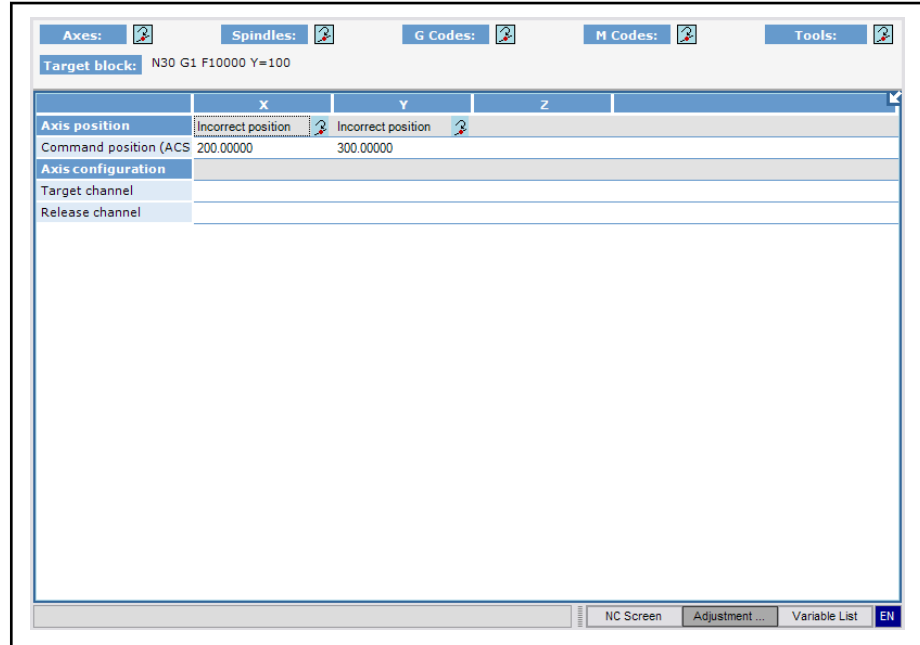


Fig. 5-4: Adjustment screen: Axes

If a successful adjustment, the adjustment symbols and the text are removed from the table.

Adjustment screen: Spindles

The screen comprises three partial windows. The upper partial window displays the total adjustment information of all data types and the target block for a better overview.

The partial window in the middle visualizes the adjustment state of each individual axis as spindle.

There are two views (switching via <F7>):

- The adjustment information and the expected command values are shown in their interrelation.
- All adjustment information is displayed as compressed and the expected command value for the adjustment is shown depending on the focused line of the adjustment information.

All functions to be adjusted have to be provided with an adjustment symbol. The adjustment reason is given as text

If the spindle S1 rotates to the wrong direction for example, this is indicated by the text "Incorrect motion function". The command value indicates the requested direction.

Up to three spindles can be shown side by side. In case of more than three spindles, a scrollbar is shown.

The lower partial window visualizes the adjustment state of each the spindle couplings. If no spindle coupling is active, the lower partial window is hidden.

	S1	S2
Control panel	Incorrect motion function	Incorrect orientation position
Function	CW rotation	Positioning
Orientation position		320.0000
Gear Range		
Gear Range		
Automatic change		
Spindle speed	Incorrect engine speed	
Speed	100.0000	
Engine speed limit		
Lower limit speed		
Upper engine speed limit		
G96/97		
Const. step velocity		
Number of reference axis		
Coordinate system		
Step velocity		
C axis		
Coupling	Incorrect master spindle	
Coupling link	on	
Master spindle	1	
Slave spindles	2,0,0,0,0,0,0,0	

NC Screen Variable E... Adjustmen... EN

Fig. 5-5: Adjustment screen: Spindles (all command values)

	S1	S2
Control panel	Incorrect motion function	Incorrect orientation position
Function	CW rotation	Positioning
Orientation position		320.0000
Gear Range		
Gear Range		
Automatic change		
Spindle speed	Incorrect engine speed	
Speed	100.0000	
Engine speed limit		
Lower limit speed		
Upper engine speed limit		
G96/97		
Const. step velocity		
Number of reference axis		
Coordinate system		
Step velocity		
C axis		
Coupling	Incorrect master spindle	
Coupling link	on	
Master spindle	1	
Slave spindles	2,0,0,0,0,0,0,0	

NC Screen Variable E... Adjustmen... EN

Fig. 5-6: Adjustment screen: Spindles (compact)

If a successful adjustment, the adjustment symbols and the text are removed from the table.

Adjustment screen: NC Functions

The screen comprises two partial windows. The upper partial window displays the total adjustment information of all data types and the target block for a better overview.

The lower partial window visualizes the adjustment state of each NC function group. In the individual columns, the NC function group, all respective functions, the actual function and the command function are displayed. If the NC function has to be adjusted, this is signaled behind the actual function.

Operation modes

Group	NC functions	Actual	command
1	CTA		
2	SME, SMD		
3	G80, G81, G82, G83, G84, G85, G86, G87, G88, G89, G693, G694, G695, G371, G372, G373...	G80	G80
4	G00, G01, G2, G3, G5, G10, G11, G12, G13, G301, G33, G06, G73, G200	G01	G00
5	G408, G608, G508, G09, CFD, LNU, LND, SNU, SND, S2U, S2D, G8, CVP	G8	G8
6	G90, G189, G91	G90	G90
7	G17, G18, G19, G20, G16	G17	G18
8	G94, G93, G95	G94	G94
9	OVD, OVE, G66	OVE	OVE
10	G71, G70	G71	G71
11	KVP		
12	FFW		
13	AAC		
14	G35, G34, G134, G234	G35	G35
15	G61, G62	G62	G62
16	PAC		
17	G79, G78	G79	G79
18	G48, G47	G48	G48
19	G53.1, G54.1, G55.1, G56.1, G57.1, G58.1, G59.1, G52.1	G53.1	G53.1
20	G53.2, G54.2, G55.2, G56.2, G57.2, G58.2, G59.2, G52.2	G53.2	G53.2

Fig. 5-7: Adjustment screen: NC Functions

After a successful adjustment of the NC function (actual function = command function), the adjustment symbol is removed from the table.

Adjustment screen: Auxiliary Functions

The screen comprises two partial windows. The upper partial window displays the total adjustment information of all data types and the target block for a better overview.

The lower partial window visualizes the adjustment state of each auxiliary function group. In the individual columns, the auxiliary function group, all respective functions, the actual function and the command function are displayed. If an adjustment of the auxiliary function is necessary, this is signaled behind the actual function.

Group	Auxiliary Functions	Actual	command
1	M103, M104, M105, M119	M103	
2	M203, M204, M205, M219		
3	M303, M304, M305, M319		
4	M403, M404, M405, M419		
5	M436, M437		
6	M434, M435		
7	M9, M108, M109		
8	M208, M209		
9	M407, M409		
10	M454, M455		
11	M492, M493		
12	T		

Fig. 5-8: Adjustment screen: Auxiliary Functions

Adjustment screen: Tools

After a successful adjustment of the auxiliary function (actual function = command function), the adjustment symbol is removed from the table.

The screen comprises two partial windows. The upper partial window displays the total adjustment information of all data types and the target block for a better overview.

The lower partial window visualizes the adjustment state of the active tool, the preselected tool, the D-correction and the edge. The individual states indicate actual and command state. If an adjustment is necessary, this is signaled behind the actual state.

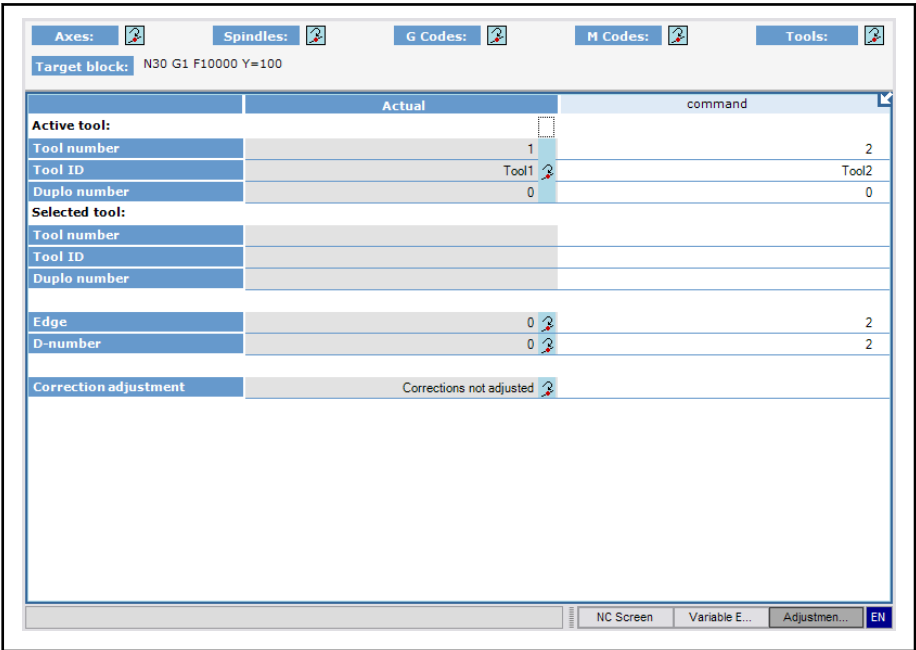


Fig. 5-9: Adjustment screen: Tools

After a successful adjustment, the adjustment symbols are removed from the table.

Manual data input

After processing the adjustment program (InitAdjust), manual data inputs can be programmed to manually adjust NC functions.

Enabling manual data input

Manual data inputs can only be programmed if the function is enabled by the operator.

This is executed using the M-key <L7> "Enable manual data input". The feedback is optically executed via the key state.

MDI editor

If the manual data input is enabled, the block progress display is automatically replaced by the MDI editor in the overview adjustment screen after the completion of the adjustment program (InitAdjust).

As for the "MDI" mode, the operator can now enter an NC block, transfer it to the NC and process it with the key "NC start" (machine panel).



When entering manual data input blocks, the same restrictions apply as for the MDI editor. Furthermore, no CPL elements and no subroutine calls can be entered.

Completing manual data input

Without previous NC block entry, the next NC start calls the action block and the adjustment program (TargetAdjust) if these are parameterized.

The manual input is completed. The manual data input editor in the adjustment screen is replaced by the block progress bar.

5.1.6 Leaving the contour the contour/returning to the contour

Overview

The "Leaving contour" function is required if the execution of the part program or a block sequence is to be interrupted in the "MDI block input". After leaving the contour, the work required for the program interruption can be executed.

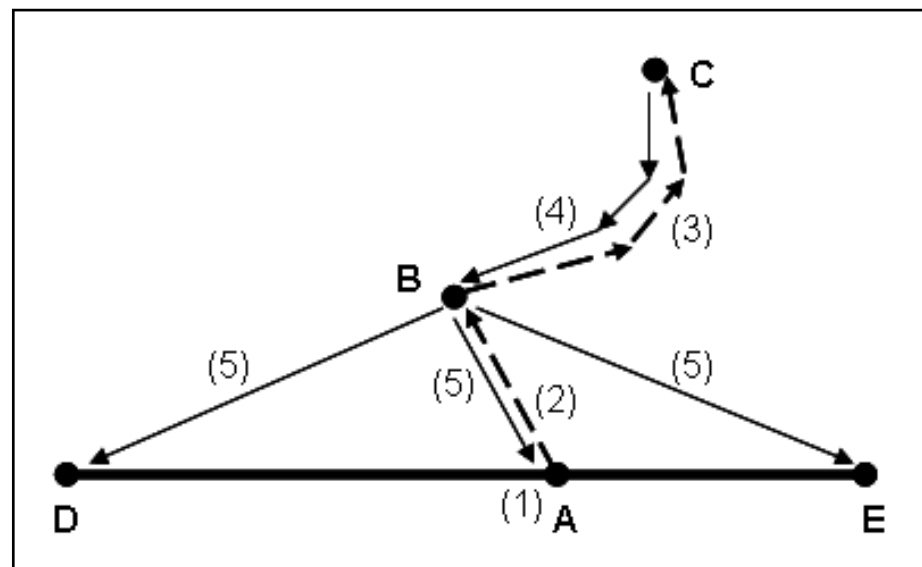
Subsequently, the contour can be approached again and the part program can continue to be executed in block sequence.

Program interruption is required for:

- Tool rupture
- Manual workpiece and tool measurement
- Visual inspections, etc.

It is returned using various strategies:

- Return to contour mode
 - Automatic approach in "Continuous block"
 - Automatic approach in "Single block"
 - Tangential approach (repositioning)
 - Direct approach
 - Approach using return program
- Point of return
 - At the point of interruption
 - At the start of the interrupted block
 - At the end of the interrupted block



A	Point of interruption
B	Placement point
C	Leaving position
D	Start of block
E	End of block

Fig. 5-10: Principle of leaving/returning to contour

Operating steps

	 Processing has to be interrupted before leaving the contour!
Feed hold	Press the "Feed hold" button on the machine panel. Processing the part program is interrupted. The position where the axes come to a standstill is called the point of interruption (1).
Program functions	Press the M-key <L8> "Program functions". A new M-key level with the following functions is displayed on the left side: • <L1>: Leaving and returning to contour • <L2>: Block search • <L3>: Re-entry • <L4>: Block pre-run • <L5>: Retracing • <L6>: Manual data input • <L8>: return
Leaving the contour	Press the M-key <L1>. The operation mode "Leaving the contour" is displayed in the machine status area. The position display has three columns: • "Command position" • "Point of interruption" • "Distance to go" The active command position is used as the point of interruption. A new M-key level with functions for returning and tap options is displayed on the left side. A new M-key level with the corresponding axis selection is displayed on the right side. The text "Move axes with jog keys away from the contour" is displayed in the status line.
Axis selection	Use the right M-key to select the axes for the jog motion. Use the left M-key to select the jog option.
Jogging to placement point	The end point of the first jog motion is saved as a preset placement point to return to contour (2).
Jogging to leaving position	The leaving position is approached using additional jog motions. The path is recorded as long as jogging continues. Each jog motion is automatically saved as NC block in a return program (3).
Returning to contour	Recording of the path is completed using the M-key <L2> "Return to contour".
	 From now on, any positions at the machine can be approached via jog motion without additional values being recorded.
	Between leaving and returning, the work requiring an interruption of the program (e.g. manual tool replacement) can be performed. The operation mode "Return to contour" is displayed in the machine status area.

A new M-key level with functions to select the return to contour mode and the return to contour strategy is displayed on the left side.

In the status line, the text "Recording completed! Start returning!" is displayed.

Defining strategy

Selection of the return to contour mode and return to contour strategy using M-keys:

- <L1>: Return to contour mode – Continuous block
- <L2>: Return to contour mode – Single block
- <L3>: Tangential approach
- <L4>: Direct approach
- <L5>: Approach via return program (path)
- <L6>: Point to return to contour – Beginning of block
- <L7>: Point to return to contour – Point of interruption
- <L8>: Point of return to contour - End of block

Returning to placement point in the mode "Continuous block"

Before actually returning to contour, "NC start" is used to process the return program up to the placement point (4).

Returning to placement point in the mode "Single block"

Before actually returning to contour, "NC start" is used to process every block of the return program up to the placement point (4).

Tangential approach

<L3> opens a dialog in which the function is activated and the radius is entered in inch or mm depending on G70/71.

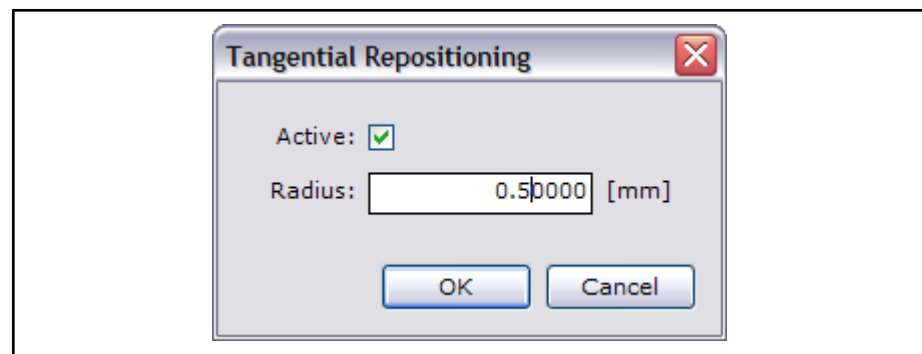


Fig. 5-11: "Tangential approach" dialog

Direct approach of placement point

If direct approach is selected, it is moved from point C to point B directly without return program.

Continuing processing

Depending on the strategy, "NC start" is used to approach the point of return and to continue processing (5). The display switches to the automatic screen with the corresponding M-keys.



- Returning to contour in more than one channel at the same time is not possible.
- Returning to contour is impossible during tapping (G63).
- After an interruption, the spindle is to be manually stopped and restarted.
- Returning to contour during a CPL waiting state is possible only after the waiting state.

5.1.7 Overwriting

Operating steps



Before overwriting, processing has to be interrupted, channel state has to be "stop"!

- Feed hold** The "Feed hold" key at the machine panel interrupts the processing of the part program.
- Program functions** The M-key level with the following functions is called via the M-key <L8> "Program functions":
- <L1>: Leaving and returning to contour
 - <L2>: Block search
 - <L3>: Re-entry
 - <L4>: Block pre-run
 - <L5>: Retracing
 - <L6>: Manual data input
 - <L8>: return
- Manual data input** Press the M-key <L6> and the block progress display in the NC screen is replaced by the manual input editor.
- As for the "MDI" mode, the operator can now enter an NC block, transfer it to the NC and process it with the key "NC start" (machine panel).
- Local and/or modal NC functions as well as axis motions can be programmed in the NC block.



When entering manual data input blocks, the same restrictions apply as for the MDI editor. Jumps and calls of subroutines with parameters are not permitted in Manual Data Input (MDI) blocks because "linking" is not supported before the MDI block is executed. However, it is possible to call a local subroutine.

- Continuing program** Then, more NC blocks can be specified and processed in the MDI editor.
- An "NC start" (machine panel) without previous input of an NC block causes the part program to continue.
- The MDI editor in the NC screen is replaced by the block progress display.

5.1.8 Complete lock

Operating steps



If one or multiple channels are not in the "ready" state or "inactive", the function cannot be enabled or disabled!

- DryRun options** The M-key level with the following functions is called via the M-key <L7> "DryRun options":
- <L1>: Complete lock
 - <L3>: Test feed
 - <L4>: Test rapid traverse
 - <L7>: Options
 - <L8>: return

Complete lock Press the M-key <L1> to block the axis output for all channels. The key is shown as active and a corresponding symbol is shown in the machine state display.

Press the key again to cancel the complete lock. A dialog is displayed indicating that the system has to be reset to apply the axis position. The system reset is triggered after acknowledging the dialog with <Yes>.

Options Use <L7> to call the dialog to set the test feed and the test rapid traverse.

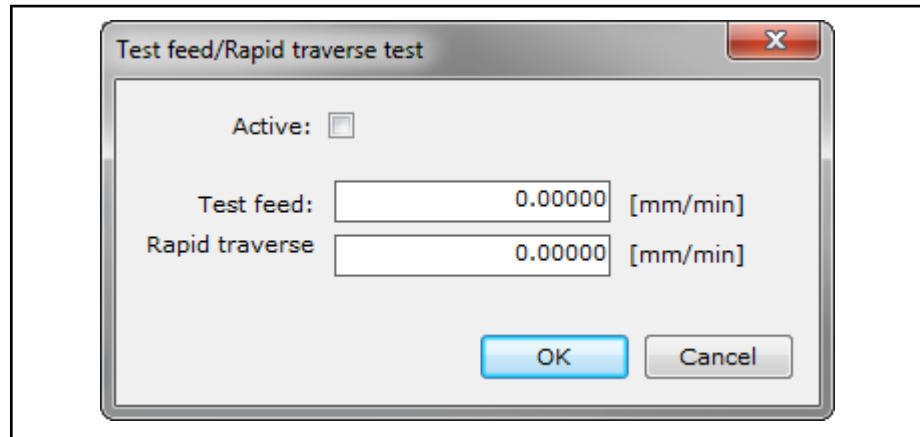


Fig. 5-12:

Select "active" to activate the feeds via the <L3> and <L4> M-keys.

5.2 MDI - Manual data input

5.2.1 MDI editor

The MDI editor (MDI = **M**anual **D**ata **I**nterface) is used to transfer one or multiple NC blocks to the NC and to process them by pressing "Start".



Prerequisites (interlocks) for the MDI mode have to be made in the PLC program. The "MDI" mode and the NC status "inactive" are required.



Fig. 5-13:

MDI mode and status



Jump instructions, loops and accesses to local and global CPL variables are invalid in Manual Data Input (MDI) blocks, since "linking" is not supported before the MDI block execution.

In the standard model, a separate complete NC screen in which the focus is already on the window "MDI block input", and thus the MDI editor, is opened when the "MDI" mode is activated.

Transferring an NC block from the MDI editor to the NC (<F4> "Apply MDI block") and <F2> "Reset channel" are protected by the user management.

The MDI editor can process up to 100 NC blocks. If the number of lines exceeds the number that can be displayed in the MDI editor, a scroll bar is displayed for orientation purposes. The number of blocks in the MDI editor is checked during pasting from the clipboard and when <F4> "Apply MDI block" is pressed. If the number of NC blocks exceeds 100, a note is displayed in

the status line while pasting from the clipboard (<Ctrl>+<V>). When <F4> is pressed, a message window with the number of permitted and existing blocks is displayed.

The MDI editor can assume two different states:

- Editing permitted:
Light blue background to enable all ordinary keyboard shortcuts of the editors (<Ctrl>+<C>, <Ctrl>+<V>, <Ctrl>+<X> etc.).
The control is in the "Inactive" state.
- Editing is not permitted:
Gray background.
The control is in the "Ready", "Running", "Stopped" states or in an error state.

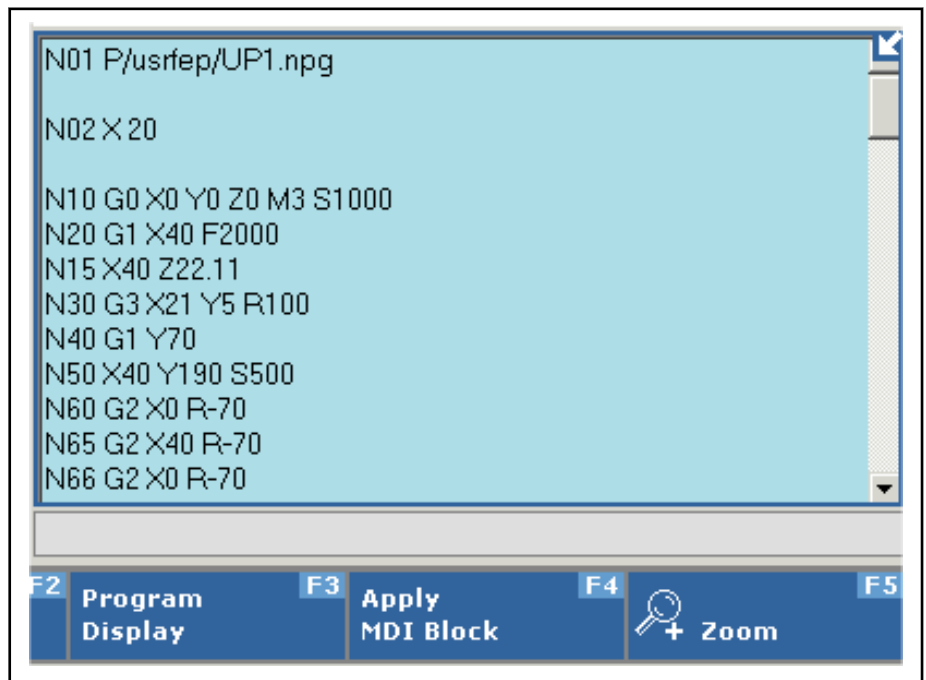


Fig. 5-14: Editing permitted

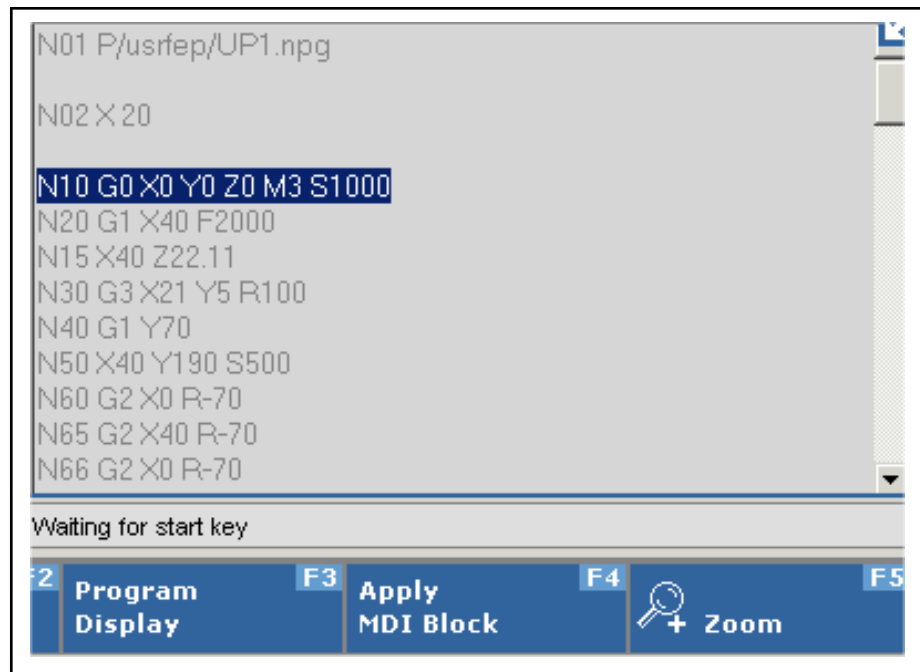


Fig. 5-15: Editing not permitted

F-keys of the MDI editor:

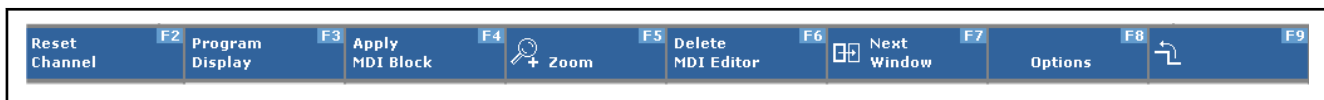


Fig. 5-16: F-keys of the MDI editor

- <F2>** Channel reset. All modal states go to their initial values.
- <F3>** The NC program display is called instead of the MDI editor in the same window. This is necessary if a subroutine is called as the MDI block and the block sequence in the subroutine is to be followed. Press <F3> to leave the block display and return to the MDI editor.
- <F4>** Activation (i.e. transfer to the NC) of the NC block focused in the MDI editor. If several blocks are focused, this block is enabled by NC blocks.
- <F5>** Content of MDI editor is deleted.
- <F6>** Zoom; the MDI editor requires the entire space between the M-keys, F-keys and the header. This is especially important for the BTV 16 if editing is to take place in existing MDI blocks before processing again.
- <F7>** The MDI editor loses the focus. The next partial window is focused.
- <F8>** An "Options" dialog is opened, see [fig. 5-17 "Options" dialog for the MDI editor](#) on page 83.
- <F9>** The MDI editor loses the focus. The main F-key level of the NC screen becomes active. The second main F-key level (<F8> and then <F7>) can be used to set the focus again to the MDI editor.

5.2.2 Options

An "Options" dialog can be used to modify the behavior of the MDI editor.

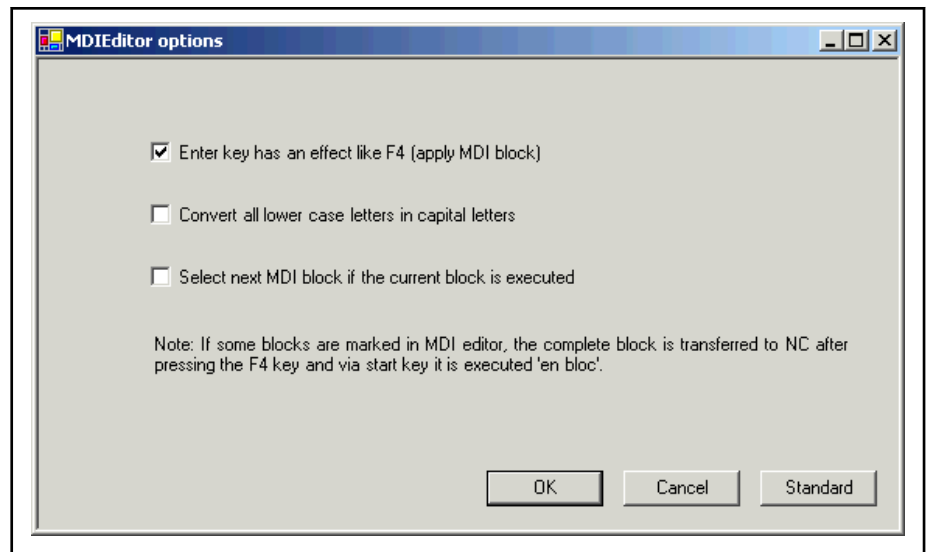


Fig. 5-17: "Options" dialog for the MDI editor

It means:

- <Enter> is like <F4> (Apply MDI block):
 - <Enter> triggers the "Apply MDI block" function (default setting).
 - <Enter> operates with the normal line feed function in the MDI editor.
- Converting all lower-case letters into capitals:
 - Conversion "ON".
 - Conversion "OFF" (default setting).



All lower-case letters are converted in the MDI editor. The option cannot be used for subroutines called with path information, transformations or if axis names contain lower-case letters for example.

- Automatically preselect the next MDI block when the current block is processed:
 - If the processed MDI block is not the last NC block in the MDI editor, the next NC block is automatically preselected after the MDI block is executed (corresponds to "Single block").
 - Do not automatically preselect the next MDI block (default setting).
- The "Note" is for the MDI editor user to inform on the possibility of processing a block of NC blocks.



A block of NC blocks is always processed "en block" (similar to "Continuous block") in the NC.

5.2.3 Processing an MDI Block

Procedure for processing a block:

1. Enter the block in the MDI editor.
2. With <F4> or <Enter>, the block is applied to the NC. The control is in "Ready" state and the block is highlighted. Editing is no longer possible. The text "Waiting for Start button" is displayed in the status line (see [fig. 5-15 "Editing not permitted" on page 82](#)).

3. The MDI block is processed after pressing "Start".
 - If the block was successfully processed by the NC, the control returns to the status "inactive". The next block can now be edited.
 - If the NC detects an error in the block, the error symbol is set in the header and the text "Reset channel" is displayed in the status line. The error can only be recovered by resetting the channel.

5.2.4 Processing multiple MDI blocks

Processing single blocks

"ON" is a prerequisite for the option: "Preselect next MDI block automatically as soon the current block is processed".

- Up to 100 MDI blocks remain in the MDI editor. The cursor can be placed on one of these blocks.
- Press <F4> to apply the block on which the cursor is placed to the NC. Behavior as above.
- The MDI block is processed after pressing "Start". Behavior as above.
- If the processed block is not the latest one in the MDI editor, the next block is immediately transferred to the NC. The "Start" button can be immediately pressed again.
- Press <F2> "Reset channel" to complete this cycle before the last block in the MDI editor is processed. The cursor remains on the latest block highlighted.



"Channel reset" changes the modal NC states.

Processing one block of NC blocks

Several NC blocks can be highlighted in the MDI editor using the mouse or <Shift> + <Arrow>. Only interrelated sections of blocks can be highlighted.

- Press <F4> to apply all focused blocks to the NC. The first of these selected blocks is highlighted. The entire block of the selected NC blocks receives a different font color. Editing is no longer possible. The text "Waiting for Start button" is displayed in the status line.

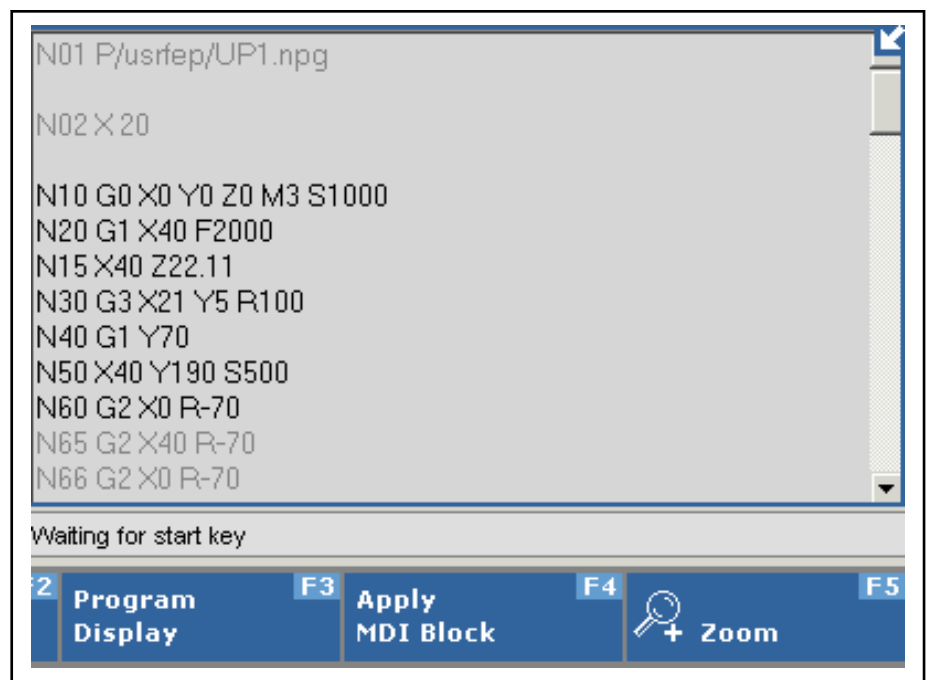


Fig. 5-18: Processing one block of the NC blocks

- All highlighted MDI blocks are processed "en block" after pressing "Start" (analog to "continuous block"). The modal states remain after the block processing.
- After all blocks are processed, the NC is in the "inactive" state. The cursor is located at the end of the highlighted block.

5.2.5 Processing a subroutine

Subroutines permitting all types of NC commands, i.e. also CPL instructions and calls of subroutines with parameters, can be called in the MDI blocks.

Example to call a subroutine: "N01 P/usrfepUP1.npg".

The subroutines are processed in "Continuous block" mode. To follow block processing, press <F3> to activate the program display in the same window (see [fig. 5-19 " NC block display" on page 86](#)).

There is a special feature for the state of the program display after processing a subroutine. The latest block of the subroutine remains active in the display until a new block transferred to the NC is activated with "Start". That means the newly transferred block is first highlighted in the MDI editor when the "Start" button was pressed.

The following applies to modal subroutines:

Both activation and call via additional traversing motions can occur only within a subroutine. Otherwise, an error message on a missing link table is issued.

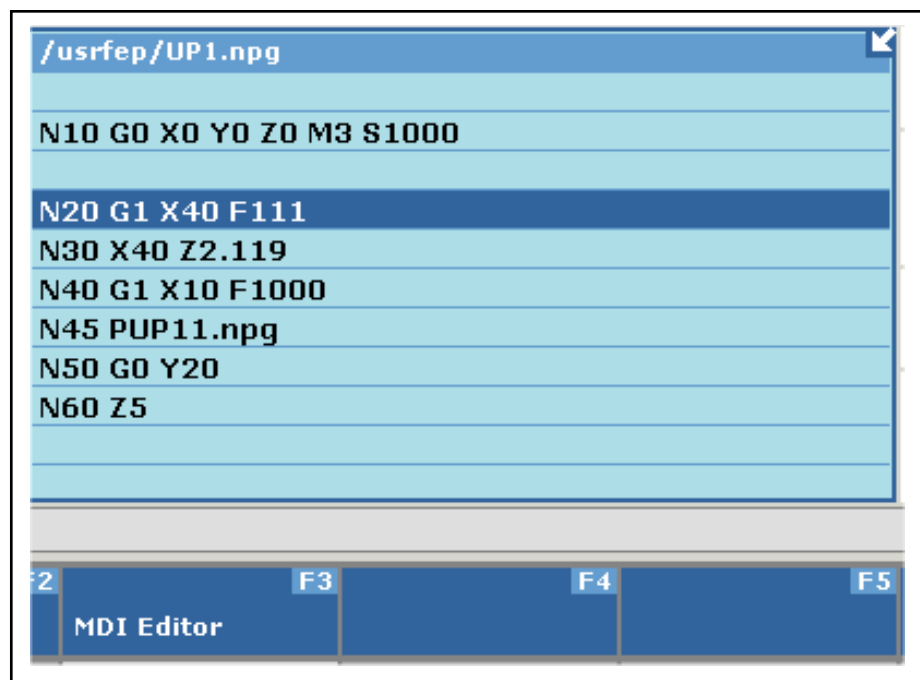


Fig. 5-19: NC block display

5.2.6 Applying NC blocks from the MDI editor to NC program

To apply NC blocks from the MDI editor to an NC program or to apply parts of an NC program to the MDI editor, an NC program has to be opened in the "Program" operating area using the NC editor, as it has to be an NC screen in the "Machine" operating area using the MDI editor. The NC blocks are exchanged by highlighting the desired blocks, saving them to the clipboard (<Ctrl>+<C>) and inserting them to the desired location in the MDI editor with <Ctrl>+<V>.

5.2.7 Leaving and returning in MDI

The leaving and automatic returning in the "automatic" mode is also available in the "MDI block input" mode.

Press the M-key <L1> "Leaving and returning" to start the function. Operation and display are identical to the "automatic" mode.

5.3 Manual mode

5.3.1 Secondary modes

In the standard, the following secondary modes can be selected via M-keys:

- "Homing"
- "Jog"
- "Jogging in coordinates"

5.3.2 Jog options

The following jog options can be set in the standard via M-keys:

- Continuous jogging
- Jogging 1:
- Jogging 0.1:
- Jogging 0.01:

- Jogging 0.001:

5.3.3 Functions in manual mode

Setting the reference position to zero

"Zero reference position" screen

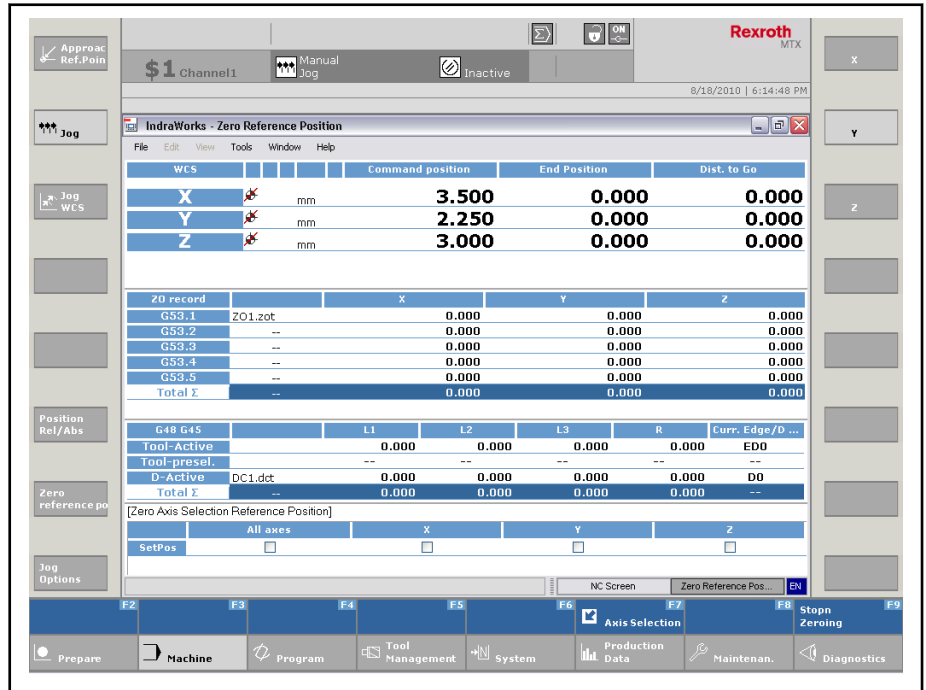


Fig. 5-20: "Zero Reference Position" screen

The "Zero Reference Position" screen is used to set the reference position to zero with the displays of the current axis positions, zero point offsets and tool corrections. By default, the screen is opened in the operation mode "Jog" via M-keys **Secondary mode\Zero reference position**.

F-keypad

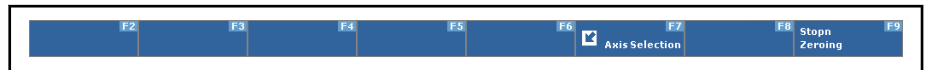


Fig. 5-21: F-keypad of the "Zero Reference Position" screen

- <F7>: Focuses the display control "Zero axis selection reference position"
- <F9>: Closes the active screen



The asynchronous subroutine (Asup) 8 is currently reserved to implement the setting up functions such as "Zero reference position". To avoid program conflicts, the Asup 8 may not be used for individual NC programs by the user.



In the MACODA parameter 3080 00001 "NCO/FileOrg/SrchPathSubProg" (search path for subroutines), the search paths "usrfep" and "usr/bosch" have to be entered, since the NC program was stored to set up functions or the NC program is program-internally written for "Zero reference position".

Control "Zero axis selection reference position"



Fig. 5-22: Control "Zero axis selection reference position"

The decisive display control of the "Zero Reference Position" screen is the control "Zero axis selection reference position". It is used to display and select the axes to be zeroed and for the command call for zeroing. It is focused by default.

F-keypad

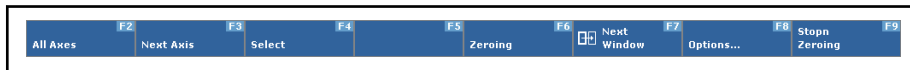


Fig. 5-23: F-keypad of the control "Zero Axis Selection Reference Position"

- <F2>: Selects/deselects all axes
- <F3>: Focuses the selection of the next axis
- <F4>: Selects/deselects the focused axis
- <F6>: Calls the command for zeroing
- <F7>: Focuses the next display control
- <F8>: Opens the "Options" dialog of the control
- <F9>: Closes the active screen

"Options" dialog "Properties - Zero axis selection reference position"

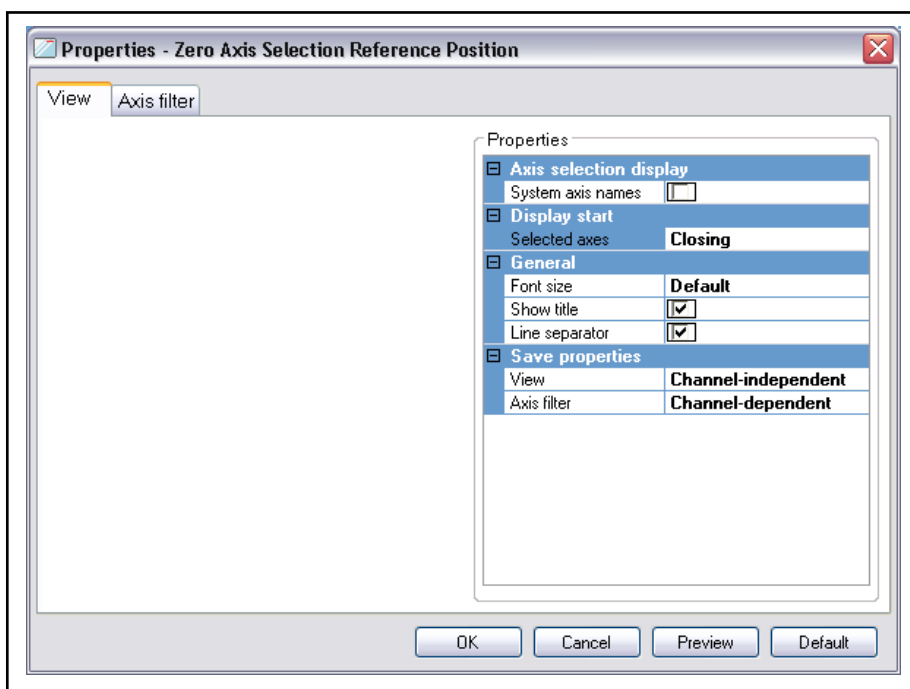


Fig. 5-24: "Options" dialog of the control "Zero Axis Selection Reference Position"

The "Options" dialog of the control "Zero Axis Selection Reference Position" contains the two tabs "View" and "Axis Filter".

Additionally, it includes the following buttons:

OK Exits the dialog and the set properties are applied.

Cancel Exits the dialog and the changed properties are discarded. If the "Preview" function was called by the user, the temporarily changed display representation is reset again.

Preview Directly changes the set view and axis filter properties temporarily in the display.

Default Sets the properties to its values in the displayed tab.
"View" tab The "View" tab includes the configurable properties influencing the display representation.

Properties (default values are displayed in bold)

	Name	Values	Description
Axis selection Display	System axis names	{Yes, No }	Specifies whether the system axis names are to be displayed in brackets behind the channel axis names. The parameter is only effective if the channel axis name differs from the system axis name.
General information	Font size	{ Default , 8,... ..16}	Specifies the font size of the display. The "Default" value stands for the perfect font size.
	Display title	{ Yes , No}	Specifies whether the title of the display is to be displayed.
	Line separator	{ Yes , No}	Specifies whether a line separator is to be displayed.
Display start	Selected axes	{ as completed , none, all}	Specifies the axes automatically selected when starting the display.
Properties Storage	View	{channel-dependent, channel-independent }	Specifies how the properties should be saved for the view.
	Axis filter	{ channel-dependent , channel-independent}	Specifies how the properties should be saved for the axis filter.

Tab. 5-1: *Configurable display properties of the control "Zero Axis Selection Reference Position"*



To change the properties, the user has to have the user right "Machine - NC screen\Configuration".

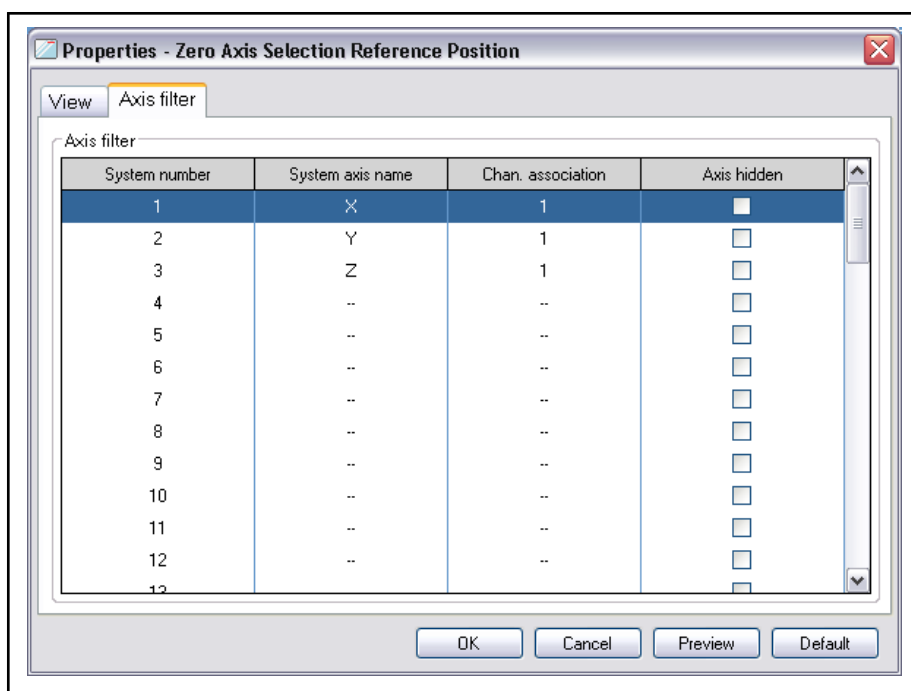
"Axis filter" tab

Fig. 5-25: The "Axis filter" tab in the "Options" dialog of the control "Zero Axis Selection Reference Position"

In the "Axis filter" tab, the three important characteristics "System number", "System axis name" and "Chan. association" are displayed for all axes that can be parameterized. In the "Axis hidden", column, the user can hide or show the channel-respective axes in the axis selection display by selection/deselection.



When showing an axis in the display, the axis is automatically selected.



To change the properties, the user has to have the user right "Machine - NC screen \ Zero Reference Position - Axis filter".

Probing the zero point**Overview on probing the zero point**

The function "Probe zero point" is in the standard or after converting old projects. It is in the operating area "Prepare" and can be called via <F2>.

The "Probe zero point" function allows the user to determine the zero point values (G54 to G59) for the respective axes by an experimental "probing" of a tool at a workpiece and to apply the result to the CNC. This results in a direct relation between the zero point determination, the workpiece dimensions and the tool correction values of the active tool.

Tool correction types

The zero point can be determined using the four different tool correction types (drilling tools, milling tools, turning tools and angle head tools) with the help of a touch probe.

Correction types

CT:	Description:
1	Drilling tools
2	Milling tools
3	Lathe tools
4	Angle-head tools
0	Touch probe

*Tab. 5-2: Tool correction types***Axes and planes**

The zero points for the channel axes (ChAx[1...6]) defined in the machine parameters can be determined.

Axis definitions

Macoda number:	Name:	Example:
701000010	Axis name	X, Y, Z, A, B, C
701000030	Axis description	Main axis X, Y, Z, A, B, C

Tab. 5-3: Machine parameters

The planes G17, G18 and G19 are supported for "G47(ActPlane)". In case of a changed length correction values assignment by machine parameters "G47()", these are considered by the program. A changed assignment of length correction values by the NC program e.g.: "G47 (-Z)", the respective settings have to be adjusted accordingly in the "Determine zero point" function to calculate the desired values.



If no tool is active, the length correction values are not considered for calculation.

The radius correction values of an active tool are always considered for calculation in the active level.

Variants when probing the zero point

The values that should be considered for calculation can be preselected via the operating screen.

Settings:

- With or without tool correction values
- With or without D-correction values
- with or without active zero point offsets of the other zero offset banks
- edge position 0 (only for turning tools with angle head tools)
- Two-point sampling

**The following applies when calculating the zero point value:**

{...}^{*} ± result of parenthesized expression has an impact on the following operation sign:

- If {...} ≤ 0 follows +
- If {...} > 0 follows -

Operation modes

Calculating the zero point offset value (with drilling tool)

Setting								Axis group		Calculation	
KT	Tool corr.	D- corr.	Two- sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI 0	= XYZ	ABC	Calculation rule	Rel. tool/ D-corr.
1				-	-	-	-	x	x	ZPO = IW - ABS	-
	x					x	-	x		ZPO = IW - ABS - L3	L3
	x				x		-	x		Not possible	-
	x			x			-	x			
	x			-	-	-	-		x	ZPO = IW - ABS - DL3	L3
		x				x	-	x			
		x			x		-	x		Not possible	-
		x		x			-	x			
		x		-	-	-	-		x	ZPO = IW - ABS - DL3 - L3	L3
	x	x				x	-	x			
	x	x			x		-	x		Not possible	-
	x	x		x			-	x			
	x	x		-	-	-	-		x		
			x	-	-	-	-	x	x		

IW

Applied actual value

IW1

Applied actual value in point 1

IW2

Applied actual value in point 2

ZO

Current or modified zero offset

ABS

Entered distance value

Ln

Length geometry value (n=1,2,3)

R

Radius geometry value

DLn

D-correction value Ln (n=1,2,3)

DR

D-correction value R

(x)

Edge position 0 required

KT

Correction type of the used tool

||

Logic OR

&&

Logic AND

Tab. 5-4:

Variant zero point measurement with drilling tool

Calculating the zero point offset value (with milling tool)

Setting								Axis group		Calculation	
KT	Tool corr.	D- corr.	Two- sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI 0	XYZ	ABC	Calculation rule	Rel. tool/ D-corr.
2				-	-	-	-	x	x	ZPO = IW - ABS	-
	x					x	-	x		ZPO = IW - ABS - L3	L3
	x				x		-	x		ZPO = IW - ABS - R	R
	x			x			-	x			
	x			-	-	-	-		x	Not possible	-
		x				x	-	x		ZPO = IW - ABS - DL3	L3
		x			x		-	x		ZPO = IW - ABS - DR	R
		x		x			-	x			
		x		-	-	-	-		x	Not possible	-
	x	x				x	-	x		ZPO = IW - ABS - DL3 - L3	L3
	x	x			x		-	x		ZPO = IW - ABS - DR- R	R
	x	x		x			-	x			
	x	x		-	-	-	-		x	Not possible	
			x	x			-	x		ZPO = (IWP1 + IWP2) / 2R	
			x		x		-	x			
			x			x	-	x		Not possible	
			x	-	-	-	-		x	ZPO = (IWP1 + IWP2) / 2R	

IW

Applied actual value

IW1

Applied actual value in point 1

IW2

Applied actual value in point 2

ZO

Current or modified zero offset

ABS

Entered distance value

Ln

Length geometry value (n=1,2,3)

R

Radius geometry value

DLn

D-correction value Ln (n=1,2,3)

DR

D-correction value R

(x)

Edge position 0 required

KT

Correction type of the used tool

||

Logic OR

&&

logic AND

Tab. 5-5:

Variant zero point measurement with milling tool

Operation modes

Calculating the zero point offset value (with lathe tool)

Setting								Axis group		Calculation		
KT	Tool corr.	D- corr.	Two- sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI 0	= XYZ	ABC	Calculation rule	Rel. tool/ D-corr.	
3				x			-	x		ZPO = IW - ABS	-	
					x		-	x				
						x	-	x		Not possible		
				-	-	-	-		x			
	x			x				x		ZPO = IW - ABS - L1	L1	
	x			x			x	x		ZPO = { IW - ABS - L1 } [±] ± R	L1 R	
	x				x			x		ZPO = IW - ABS - L2	L2	
	x				x		x	x		ZPO = { IW - ABS - L2 } [±] ± R	L2 R	
	x					x		x		Not possible	-	
	x			-	-	-	-		x			
		x		x					x		ZPO = IW - ABS - DL1	L1
		x		x				x	x		ZPO = { IW - ABS - DL1 } [±] ± DR	L1 R
		x			x				x		ZPO = IW - ABS - DL2	L2
		x			x			x	x		ZPO = { IW - ABS - DL2 } [±] ± DR	L2 R
		x					x		x		Not possible	-
		x		-	-	-	-			x		
	x	x		x					x		ZPO = IW - ABS - DL1 - L1	L1
	x	x		x				x	x		ZPO = { IW - ABS - DL1 - L1 } [±] ± (DR + R)	L1 R
	x	x				x			x		ZPO = IW - ABS - DL2	L2
	x	x				x		x	x		ZPO = { IW - ABS - DL2 - L2 } [±] ± (DR + R)	L2 R
	x	x					x		x		Not possible	-
	x	x		-	-	-	-			x		
			x	-	-	-	-					

IW
 IW1
 IW2
 ZO
 ABS

Applied actual value
 Applied actual value in point 1
 Applied actual value in point 2
 Current or modified zero offset
 Entered distance value

Ln	Length geometry value (n=1,2,3)
R	Radius geometry value
DLn	D-correction value Ln (n=1,2,3)
DR	D-correction value R
(x)	Edge position 0 required
KT	Correction type of the used tool
 	Logic OR
&&	Logic AND

Tab. 5-6: Variant zero point measurement with lathe tool

Calculating the zero point offset value (with lathe tool)

Setting								Axis group		Calculation	
KT	Tool corr.	D-corr.	Two-sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI = 0	XYZ	ABC	Calculation rule	Rel. tool/ D-corr.
0				-	-	-	-	x	x	ZPO = IW - ABS	-
	x			-	-	-	-	x	x	Not possible	
		x		x			-	x		ZPO = IW - ABS - DL1	L1
		x			x		-	x		ZPO = IW - ABS - DL2	L2
		x				x	-	x		ZPO = IW - ABS - DL3	L3
		x		-	-	-	-		x	Not possible	-
	x	x		-	-	-	-	x	x		
			x	-	-	-	-	x	x	ZPO = (IWP1 + IWP2) / 2	

IW	Applied actual value
IW1	Applied actual value in point 1
IW2	Applied actual value in point 2
ZO	Current or modified zero offset
ABS	Entered distance value
Ln	Length geometry value (n=1,2,3)
R	Radius geometry value
DLn	D-correction value Ln (n=1,2,3)
DR	D-correction value R
(x)	Edge position 0 required
KT	Correction type of the used tool
 	Logic OR
&&	logic AND

Tab. 5-7: Variants zero point probing without tool

Operation modes

Calculating the zero point offset value (with angle-head tool)

Setting								Axis group		Calculation	
KT	Tool corr.	D- corr.	Two- sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI 0	= XYZ	ABC	Calculation rule	Rel. tool/ D-corr.
4				x			-	x		ZPO = IW - ABS	-
					x		-	x			
						x	-	x			
				-	-	-	-		x		
	x			x			(x)	x		ZPO = { IW - ABS - L1 } [*] ± R	L1 R
	x				x		(x)	x		ZPO = { IW - ABS - L2 } [*] ± R	L2 R
	x					x	(x)	x		ZPO = IW - ABS - L3	L3
	x			-	-	-	-		x	Not possible	-
		x		x			(x)	x		ZPO = { IW - ABS - DL1 } [*] ± DR	L1 R
		x			x		(x)	x		ZPO = { IW - ABS - DL2 } [*] ± DR	L2 R
		x				x	(x)	x		ZPO = IW - ABS - DL3	L3
		x		-	-	-	-		x	Not possible	-
	x	x		x			(x)	x		ZPO = { IW - ABS - DL1 - L1 } [*] ± (DR + R)	L1 R
	x	x			x		(x)	x		ZPO = { IW - ABS - DL2 - L2 } [*] ± (DR + R)	L2 R
	x	x				x	(x)	x		ZPO = IW - ABS - DL3 - L3	L3
	x	x		-	-	-	-		x	Not possible	-
			x	x			(x)	x		ZPO = (IWP1 + IWP2) / 2 - L1	L1
			x		x		(x)	x		ZPO = (IWP1 + IWP2) / 2 - L2	L2
			x			x	-	x		Not possible	-
			x	-	-	-	-		x	ZPO = (IWP1 + IWP2) / 2	

IW

IW1

IW2

ZO

ABS

Ln

R

DLn

Applied actual value

Applied actual value in point 1

Applied actual value in point 2

Current or modified zero offset

Entered distance value

Length geometry value (n=1,2,3)

Radius geometry value

D-correction value Ln (n=1,2,3)

DR	D-correction value R
(x)	Edge position 0 required
KT	Correction type of the used tool
	Logic OR
&&	logic AND

Tab. 5-8: Variant zero point measurement with angle-head tool

Screen structure

General screen structure

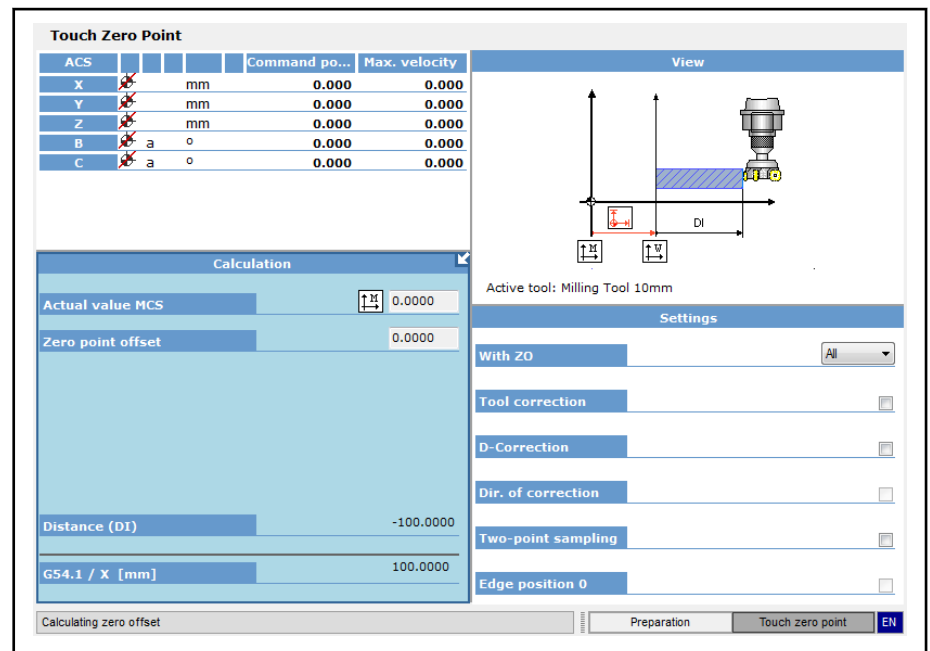


Fig. 5-26: General screen structure

The screen is divided into four windows "Searched zero point offset", "View, Calculation" and "Settings". All elements that can be set on the screen have to be operated via TAB and CURSOR keys, F-keys or mouse.

A focused window is highlighted in color. At the same time, the respective F-key level is enabled. The "View" window cannot be focused and is not provided with an assigned F-key level.

If the "Calculation" window is focused, the "Searched zero point offset" window is replaced by the "Position display" window. This allows observing the current position values without switching to the NC screen.

To select the individual zero offset banks another window is displayed.

To determine a direction of correction deviating from the machine data, another window is displayed.

"Searched zero point offset" window

Searched zero point offset	
Zero point offset	G55 ▾
Zero Point Bench	1 ▾
Axis	X ▾
Plane	G17 ▾
Tool type	Milling tool ▾

Fig. 5-27: Searched zero point offset

The following setting can be made in this window:

- Zero offset (G54-G59),
- Zero offset bank (bank 1-5)
- Axis of the zero offset

The selection of the zero offset banks and the axes, is influenced by determinations in the machine parameters. Furthermore, it can be set whether sampling should be executed from two sides.

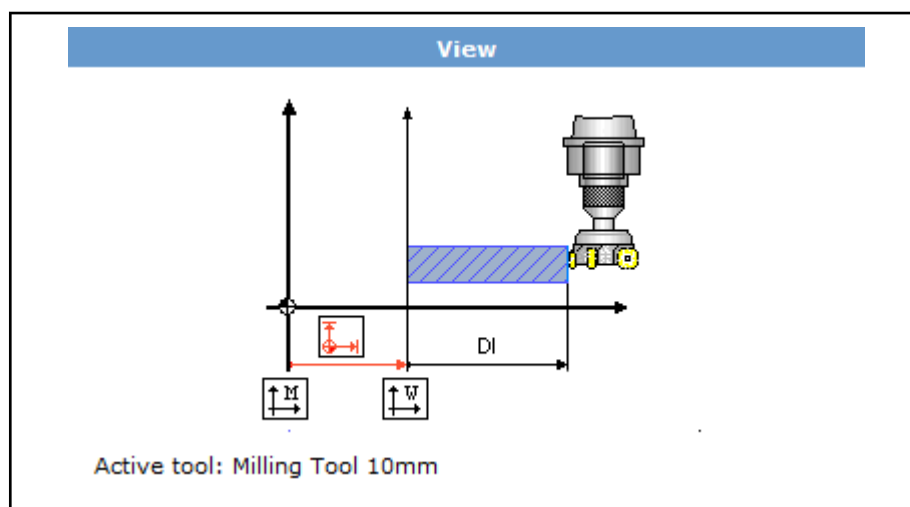
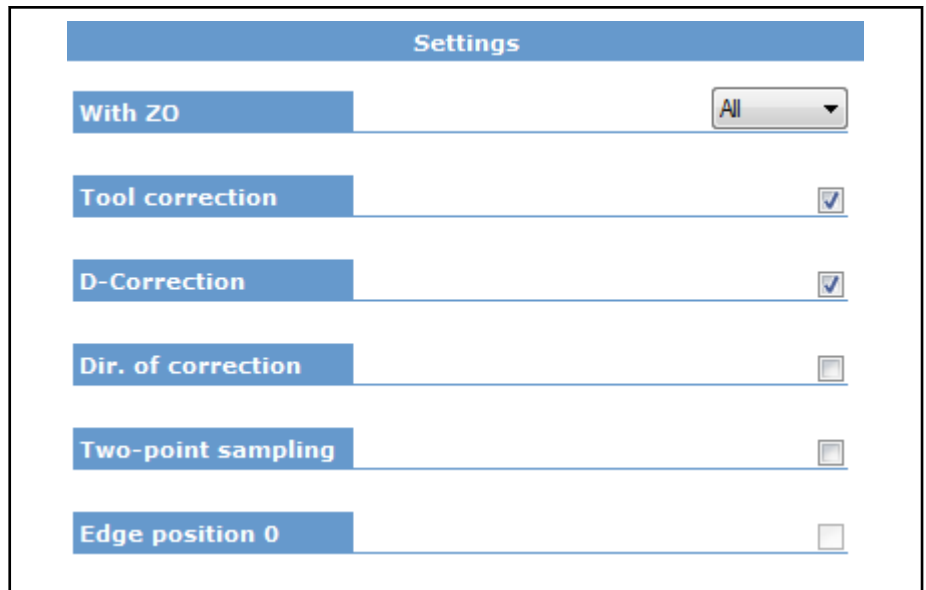
"View" window

Fig. 5-28: View

This window displays the selected dimensional chain of tool and workpiece. This window cannot be focused. In case of setting changes in other windows, it is refreshed.

"Settings" window


Settings	
With ZO	All ▼
Tool correction	☒
D-Correction	☒
Dir. of correction	☐
Two-point sampling	☐
Edge position 0	☐

Fig. 5-29: Settings

In this window, the different variants to probe the zero point can be set. The settings in this window are shown the best possible in the "View" window.

As tool type, the active tool is automatically set. Only if no active tool is available, this setting can be changed.

When determining the zero point with ZO, "All, Selection and None" are distinguished. At "Selection", another window is displayed used to select which zero offsets from which zero offset banks should be calculated.

Optionally, the active tool corrections and the active D-corrections can be used for calculation.

The direction of calculating the tool corrections and D-corrections is generally carried out according to the settings in the machine parameters. This presetting can be changed via "Dir. of correction". Therefore, another window is displayed in which the respective settings can be made.

For turning tools and angle head tools, it can also be measured with the edge position 0. During the measurement, the edge radius or the D-correction value of the edge radius are considered.

"Active ZPO bank" window

Fig. 5-30: "Active ZO bank"

In this window, the active zero point offsets of the other zero offset banks can be selected/deselected individually.

"Direction of correction" window

Fig. 5-31: Direction of correction

In this window, changes in the direction of correction of the length correction values (tool corrections and D-corrections) can be set. The calculation specified by the machine parameters is preset.



Settings outside the active plane have to be used with utmost care!

"Calculation" window

Calculation		
Actual value MCS		0.0000
Zero point offset		0.0000
Tool correction [ED1]	L1+R	0.0000
D-Correction [D1]	DL1+DR	0.0000
Distance (DI)		-100.0000
G54.1 / X [mm]		100.0000

Fig. 5-32: Calculation

In this window, the values are displayed according to their settings and the result is shown. Entering a distance can modify the result. The calculated value is written to the CNC with "Save ZO".

If the variant "Two-sided touching" is set, the "Calculation" window as well as the respective F-key level are adjusted to these conditions.

Calculation	
Actual value MCS	 0.0000
Actual value 2 MCS	 0.0000
G54.1 / X [mm]	0.0000

Fig. 5-33: Two-point sampling

Operate Probe zero point

Opening the function

Operation modes

The "Probe zero point" function can be configured as MTX function. It can be assigned as key on any configurable panel (F-keys or M-keys).

An assignment under the "Prepare" operating range is reasonable.

F-keys: Zero point probing

Windows	Searched zero point offset	Settings	Active ZO	Direction of correction	Calculation	Calculation for two-point probing
<F2>	Select Next ZPO in the selection box	Select With ZPO in the selection box	Calculate With ZPO bank 1	G47ActPlane active plane set		
<F3>	Select Next ZPO bank in the selection box	Calculation With tool correction yes <--> no, checkbox	Calculate With ZPO bank 2	G47 () set according to machine parameters	Apply actual value stop <--> start actual value display	Apply actual value 1 stop <--> start actual value 1 display
<F4>	Select Next axis in the drop-down menu	Calculation With D-correction yes <--> no, checkbox	Calculate With ZPO bank 3	Calculation L1 fixedly set	Probe left <--> right Tool position left <--> right	Apply actual value 2 stop <--> start actual value 2 display
<F5>	Select Next plane in the selection box	Set 2-point sampling checkbox yes <--> no	Calculate With ZPO bank 4	Calculation L2 fixedly set	Value input distance Specify additional value for calculation	
<F6>	Select Next tool type in the selection box	Set Edge position 0 checkbox yes <--> no	Calculate With ZPO bank 5	Calculation L3 fixedly set	ZO direct input no calculation with the directly specified ZO value	ZO direct input no calculation with the directly specified ZO value
<F7>	Calculate "Calculation" window	Calculate "Calculation" window	Calculate "Calculation" window	Calculate "Calculation" window	Save ZO in CNC	Save ZO in CNC
<F8>	Focus next window	Focus next window	Focus next window	Focus next window	Focus next window	Focus next window
<F9>	Exit Probe zero point	Exit Probe zero point	Exit Probe zero point	Exit Probe zero point	Exit Probe zero point	Close

Tab. 5-9: Function key assignment when probing a zero point

Saving data

When saving data, a message is output in the status bar:

- A green line "ZO was saved" if saved successfully.
- A red line "Error when saving" if saving was not successful

Additionally, the changed zero offset becomes immediately effective if the value was saved.

Probing the tool

Overview on "Probe tool"



The function "Probe tool" is in the standard or after converting old projects. It is in the operating area "Prepare" and can be called via <F3>.

The "Probe tool" function allows the user to determine the tool correction values (L1, L2, L3 and R) for the active tool by an experimental "probing" of a

tool at a workpiece and to apply the result to the database and to the tool correction register of the CNC. This results in a direct relation between the zero point, the workpiece dimensions and the tool correction values of the active tool.



Tool measurement is only possible for the active tool and the active edge.



The asynchronous subroutine (Asup) 8 is currently reserved to implement the setting up functions such as "Zero reference position". To avoid program conflicts, the Asup 8 may not be used for individual NC programs by the user.



In the MACODA parameter 3080 00001 "NCO/FileOrg/SrchPathSubProg"(search path for subroutines), the search path "usr/bosch" has to be entered since the NC program for "writing tool data in the correction register" is program-internally saved there.

Tool correction types

Tool measurement can be executed using the tool correction types 1 to 4 (drilling tools, milling tools, turning tools and angle head tools). For tools of type 4, the edge position 0 is a prerequisite.

Correction types

CT:	Description:
1	Drilling tools
2	Milling tools
3	Lathe tools
4	Angle-head tools

Tab. 5-10: Tool correction types

Axes and planes

The tool geometry for the channel axes (ChAx[1...6]) defined in the machine parameters can be determined.

Axis definitions

Macoda number:	Name:	Example:
701000010	Axis name	X, Y, Z, A, B, C
701000030	Axis description	Main axis X, Y, Z, A, B, C

Tab. 5-11: Machine parameters

The planes G17, G18 and G19 are supported. Irrespective of the assignment of the length correction values set by the machine parameter "G47()" or by the NC program, the values determined are assigned according to the active plane.

Variants when touching the tool

The values that should be considered for calculation can be preselected via the operating screen.

Settings:

- with or without D-correction values
- with or without active zero point offsets of the other zero offset banks
- Two-point sampling

Operation modes



The following applies when calculating the tool correction value:

{...}^{*} ± result of parenthesized expression has an impact on the following operation sign:

- If {...} ≤ 0 follows +
- If {...} > 0 follows -

Calculating the tool correction value (with drilling tool)

Setting								Calculation	
KT	ZO	D-corr.	Two-sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI = 0	Calculation rule	Value
1						x		L3 = IW - ABS	L3
				x				Not possible	
					x			Not possible	
	x					x		L3 = IW - ZO - ABS	
	x			x				Not possible	
	x				x			Not possible	
		x				x		L3 = IW - DL3 - ABS	
		x		x				Not possible	
		x			x			Not possible	
	x	x				x		L3 = IW - ZO - DL3 - ABS	
	x	x		x				Not possible	
	x	x			x			Not possible	

IW	Applied actual value
IW1	Applied actual value in point 1
IW2	Applied actual value in point 2
ZO	Current or modified zero offset
ABS	Entered distance value
Ln	Length geometry value (n=1,2,3)
R	Radius geometry value
KT	Correction type of the used tool
(x)	Edge position 0 required
 	Logic OR
&&	logic AND

Tab. 5-12: Variant tool measurement with drilling tool

Calculating the tool correction value (with drilling tool)

Setting								Calculation	
KT	ZO	D-corr.	Two-sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI = 0	Calculation rule	Value
2						x		L3 = IW - ABS	L3
	x					x		L3 = IW - ZO - ABS	
		x				x		L3 = IW - DL3 - ABS	
	x	x				x		L3 = IW - ZO - DL3 - ABS	
				x				R = IW - ABS	R
					x			R = IW - ZO - ABS	
	x			x				R = IW - ZO - ABS	
	x				x			R = IW - ZO - ABS	
		x		x				R = IW - DR - ABS	
		x			x			R = IW - DR - ABS	
	x	x		x				R = IW - ZO - DR - ABS	
	x	x			x			R = IW - ZO - DR - ABS	
			x	x				R = (IW1 - IW2 - ABS) / 2	
			x		x			R = (IW1 - IW2 - ABS) / 2	

IW Applied actual value
IW1 Applied actual value in point 1
IW2 Applied actual value in point 2
ZO Current or modified zero offset
ABS Entered distance value
Ln Length geometry value (n=1,2,3)
R Radius geometry value
KT Correction type of the used tool
(x) Edge position 0 required
|| Logic OR
&& logic AND

Tab. 5-13: Variants tool measurement with milling tool

Operation modes

Calculating the tool correction value (with lathe tool)

Setting								Calculation	
KT	ZO	D-corr.	Two-sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI = 0	Calculation rule	Value
3				x				$L1 = IW - ABS$	L1
				x			x	$L1 = \{ IW - ABS \}^* \pm R$	
	x			x				$L1 = IW - ZPO - ABS$	
	x			x			x	$L1 = \{ IW - ZO - ABS \}^* \pm R$	
		x		x				$L1 = IW - DL1 - ABS$	
		x		x			x	$L1 = \{ IW - DL1 - ABS \}^* \pm (R + DR)$	
	x	x		x				$L1 = IW - ZO - DL1 - ABS$	
	x	x		x			x	$L1 = \{ IW - ZO - DL1 - ABS \}^* \pm (R + DR)$	
					x			$L2 = IW - ABS$	L2
					x		x	$L2 = \{ IW - ABS \}^* \pm R$	
	x				x			$L2 = IW - ZPO - ABS$	
	x				x		x	$L2 = \{ IW - ZPO - ABS \}^* \pm R$	
		x			x			$L2 = IW - DL2 - ABS$	
		x			x		x	$L2 = \{ IW - DL2 - ABS \}^* \pm (R + DR)$	
	x	x			x			$L2 = IW - ZO - DL2 - ABS$	
	x	x			x		x	$L2 = \{ IW - ZO - DL2 - ABS \}^* \pm (R + DR)$	
						x		Not possible	(R)

IW
 IW1
 IW2
 ZO
 ABS
 Ln
 R
 KT
 (x)
 ||
 &&

Applied actual value
 Applied actual value in point 1
 Applied actual value in point 2
 Current or modified zero offset
 Entered distance value
 Length geometry value (n=1,2,3)
 Radius geometry value
 Correction type of the used tool
 Edge position 0 required
 Logic OR
 logic AND

Tab. 5-14: Variants tool measurement with lathe tool

Calculating the tool correction value (with angle-head tool)

Setting								Calculation	
KT	ZO	D-corr.	Two-sided	G17 && X G18 && Z G19 && Y	G17 && Y G18 && X G19 && Z	G17 && Z G18 && Y G19 && X	ORI = 0	Calculation rule	Value
4				x			(x)	$L1 = \{ IW - ABS \}^* \pm R$	L1
	x			x			(x)	$L1 = \{ IW - ZO - ABS \}^* \pm R$	
		x		x			(x)	$L1 = \{ IW - DL1 - ABS \}^* \pm (R + DR)$	
	x	x		x			(x)	$L1 = \{ IW - ZO - DL1 - ABS \}^* \pm (R + DR)$	
					x		(x)	$L2 = \{ IW - ABS \}^* \pm R$	L2
	x				x		(x)	$L2 = \{ IW - ZPO - ABS \}^* \pm R$	
		x			x		(x)	$L2 = \{ IW - DL2 - ABS \}^* \pm (R + DR)$	
	x	x			x		(x)	$L2 = \{ IW - ZO - DL2 - ABS \}^* \pm (R + DR)$	
						x	(x)	$L3 = IW - ABS$	L3
	x					x	(x)	$L3 = IW - ZO - ABS$	
		x				x	(x)	$L3 = IW - DL3 - ABS$	
	x	x				x	(x)	$L3 = IW - ZO - DL3 - ABS$	
			x	x			(x)	$R = (IW1 - IW2 - ABS) / 2 $	R
			x		x		(x)		

IW

Applied actual value

IW1

Applied actual value in point 1

IW2

Applied actual value in point 2

ZO

Current or modified zero offset

ABS

Entered distance value

Ln

Length geometry value (n=1,2,3)

R

Radius geometry value

KT

Correction type of the used tool

(x)

Edge position 0 required

||

Logic OR

&&

logic AND

Tab. 5-15:

Variants tool measurement with angle-head tool

Screen structure

General screen structure

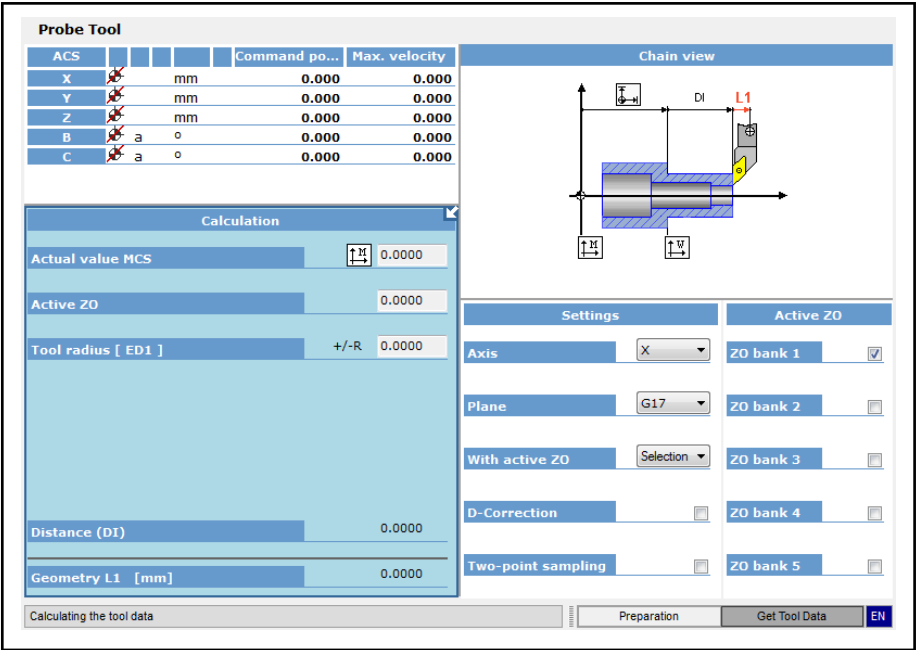


Fig. 5-34: General screen structure

The screen is divided into four windows "Active tool", Chain view", "Calculation" and "Settings". All elements that can be set on the screen have to be operated via TAB and CURSOR keys, F-keys or mouse.

A focused window is highlighted in color. At the same time, the respective F-key level is enabled. The "Chain view" window cannot be focused and is not provided with an assigned F-key level.

If the "Calculation" window is focused, the "Active tool" window is replaced by the "Position display" window. This allows observing the current position values without switching to the NC screen.

To select the individual zero offset banks another window is displayed.

"Active tool" window

Active tool	
Active tool	Turning Tool 100
Tool type	Turning tool
Tool number	2
Edge number	1
Edge position	0

Fig. 5-35: Tool active

The window indicates the active tool data. No settings can be made. No F-key level is assigned to the window.

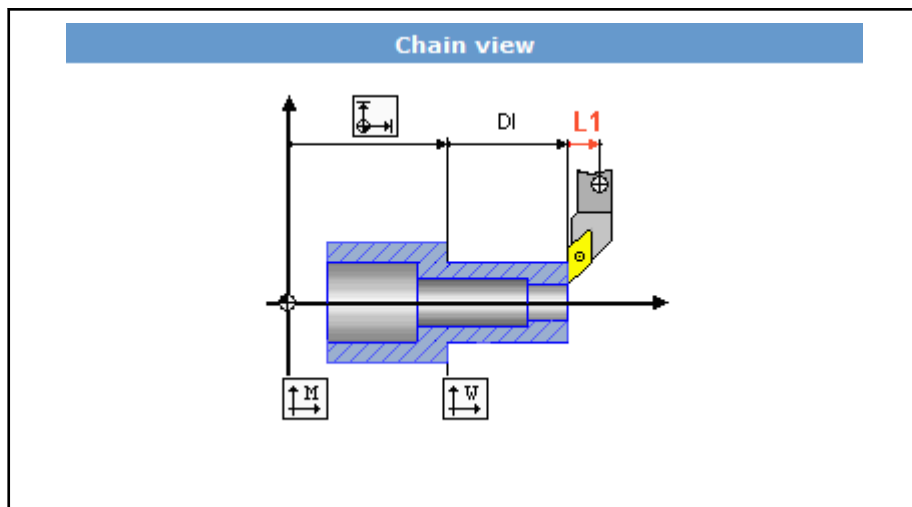
"Chain view" window

Fig. 5-36: "Chain view "

This window displays the selected dimensional chain of tool and workpiece. This window cannot be focused. In case of setting changes in other windows, it is refreshed.

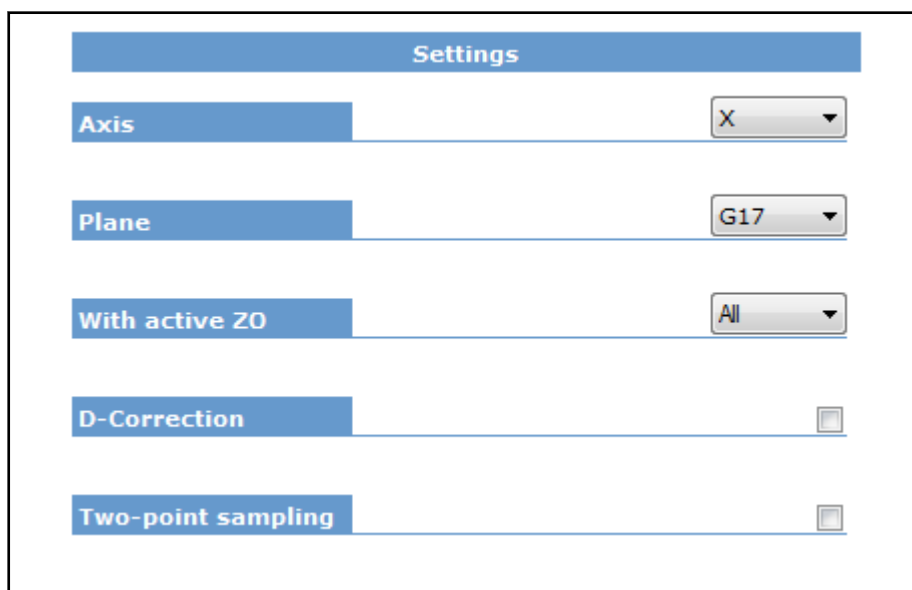
"Settings" window

Fig. 5-37: Settings

In this window, the different variants for the tool measurement can be set. The settings in this window are shown as far as possible in the "Chain view" window.

The tool correction value to be measured is selected by the selection of axis and plane.

During tool measurement with active ZO, "All, Selection and None" are distinguished. At "Selection", another window is displayed used to select from which zero banks the active zero offsets should be considered for calculation.

Optionally, the active D-correction can be selected for calculation.

"Active ZPO bank" window

Fig. 5-38: "Active ZO bank"

In this window, the active zero point offsets of the other zero offset banks can be selected/deselected individually.

"Calculation" window

Fig. 5-39: Calculation

In this window, the values are displayed according to their settings and the result is shown. Entering a distance can modify the result. The calculated value is written to the CNC with "Save ZO".

If the variant "Two-sided touching" is set, the "Calculation" window as well as the respective F-key level are adjusted to these conditions.

Calculation	
Actual value MCS	 0.0000
Actual value 2 MCS	 0.0000
Distance (DI)	100.0000
Geometry L1 [mm]	0.0000

Fig. 5-40: Two-point sampling

Operating the "Probe tool"

Opening the function

The "Tool measurement" function can be configured as MTX function. It can be assigned as key on any configurable panel (F-keys or M-keys).

An assignment under the "Prepare" operating range is reasonable.

Function keys "Touch tool"

Windows	Settings	Active ZO	Calculation	Calculation for 2-point sampling
<F2>	Set Next axis in the selection box	Calculation With ZPO bank 1 yes <--> no, checkbox		
<F3>	Set Next level in the selection box	Calculation With ZO bank 2 yes <--> no, checkbox	Apply actual value stop <--> start actual value display	Apply actual value 1 stop <--> start actual value 1 display
<F4>	Set With active ZPO in the selection box	Calculation With ZPO bank 3 yes <--> no, checkbox		Apply actual value 2 stop <--> start actual value display
<F5>	Calculation With D-correction yes <--> no, checkbox	Calculation With ZPO bank 4 yes <--> no, checkbox	Value input distance Specify additional value for calculation	
<F6>	Set 2-point sampling checkbox yes <--> no	Calculation With ZPO bank 5 yes <--> no, checkbox	Tool data direct input No calculation with the directly specified values	Tool data direct input No calculation with the directly specified values

Windows	Settings	Active ZO	Calculation	Calculation for 2-point sampling
<F7>	Measure "Calculation" window	Measure "Calculation" window	Save tool data in CNC and database	Save tool data in CNC and database
<F8>	Focus next window	Focus next window	Focus next window	Focus next window
<F9>	Exit Complete tool measurement	Exit Complete tool measurement	Exit Complete tool measurement	Exit Complete tool measurement

Tab. 5-16: Function key assignment when probing a zero point

Saving data When saving data, a message is output in the status bar:

- A green line "Tool data was saved" if saved successfully.
- A red line "Error when saving" if saving was not successful

Measurement

General information

A detailed description of this function can be found in "Rexroth IndraMotion MTX 13VRS Measuring Functions" (DOK-MTX***-MES*FUN*V13-APRS-EN-P), chapter "Manual Measurement".

Calibrating the probe

Functions The following functions are provided:

Calibrate workpiece probe

- at a known point
- in an adjusting ring

Probing the zero point

Functions The following functions are provided:

Probe workpiece zero point

- Point
- Corner
- Boring
- Circular spigot
- Groove
- Land
- Rectangular pocket
- Rectangular pin
- Rotary axis

Preparation The probe has to be loaded via MDI before using the described measuring functions.

Only a single calibrated ball is used in the measurement program. The tool edge and the tool length compensation assigned to the ball have to be enabled before starting the measurement.

The probe has to be enabled before jogging to ensure an active collision monitoring during jogging.

- Sequence**
1. Press the OP key "Prepare" in the "Manual" operation mode.
 2. Press the F-key of the measuring task group ("Probe zero point", "Calibrate probe" etc.).

3. Use the left M-keys to select the measuring task.
4. In case of many measuring tasks, a zero point can be included in the chain dimensioning or a zero point is the objective for storing the result. In these cases, keys are available to select a zero point table. Select the zero point table using <F5> "Select Table". See the following information.
5. The input table is completed with the parameter values required for the measuring task. The displayed graphics provides support and can change after an input.



The key <F2> "Start Program" is enabled after all required parameters have been entered and only in the "Jog" mode and starts the measurement.

6. Before starting the measurement, check the initial position or a safe initial position has to be manually approached (see graphics).



Only now press <F2> "Start Program" to apply the parameters in the NC. The parameters are then available for the next measuring task.

7. Execute the program with NC start. The message "Program is running" is displayed.

Some measuring function required multiple manual positioning between the measuring steps (e.g. zero point probe rotary axis or probing at an internal contour with obstacle). The different initial positions for the measuring steps are displayed by the number 1 to 2 or 1 to 4 in the graphics. The first initial position for point 6 is the number 1. At each measuring step, the program stops and the operator is prompted to manually approach the next position. The respective positions have to correspond to the displayed graphics with regard to axis direction and sequence. After the next position has been set, execute NC start again. Repeat until all measuring steps have been executed.

8. After the measuring steps and calculations have been completed, the program stops and the measuring result is displayed. The result is applied after actuating NC start again.

Zero point table

Select a zero point table with <F5> "Select Table".

The name of the selected zero point table is displayed in the "selected zero point table" field in the position display.

The active zero point table is set to the selected zero point table with <F6> "apply current table".

The axis names in the zero point table have to correspond to the configured axis names.

Position display

Display the current position values and the zero point table instead of a supported text using <F7> "Position Display". In case of a changed zero point table, the position and zero point table display is automatically displayed.

Spindle orientation

In case of measuring task with alternating probing in positive and negative axis direction, the probe can be turned in the new measuring direction by means of spindle orientation so that the switching offset (calibration value) does not affect the measurement result. This procedure is called reversal measurement and facilitates accurate measurement even if a non-calibrated probe is used.

The spindle is only oriented in case of an active edge number 1. In case of a cross probe, it is assumed that the foremost calibrating ball is assigned to edge 1. Only for this edge, the reversal measurement can be performed.

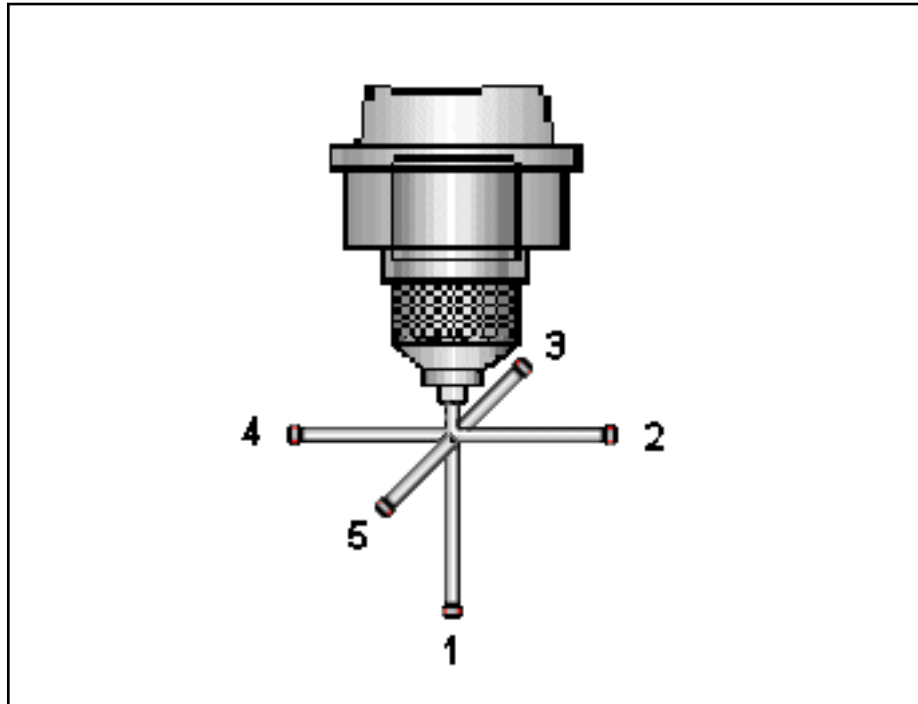


Fig. 5-41: Edge numbers at the cross probe

Inclined plane

The dialog "Inclined plane" contains functions for probing a level and swiveling in the measured level.

Call The dialog is called using <F6> "Inclined plane" in the operating area <OP2>"Prepare"

Toggle between the functions "Swiveling G230" and "Measuring for G230" using the M-keys <ML1> and <ML2>.

Functions The following functions are provided:

Inclined plane

- Probe plane manually - for cycle G230 Swiveling
- G230 Swiveling in measured plane

- Procedure**
1. Press the OP key "Prepare" in the "Manual" operation mode.
 2. Press <F7> "Inclined plane".
 3. Use the left M-key for selecting "Probe plane for cycle G230 Swiveling" (probing for G230). For this function, a plane is determined by probing three points.
 4. The input table is completed with the parameter values.



The key <F2> "Start Program" is enabled after all required parameters have been entered and only in the "Jog" mode and starts the measurement.

5. Before starting the measurement, check the initial position or a safe initial position has to be manually approached (see graphics).



Only now press <F2> "Start Program" to apply the parameters in the NC. The parameters are then available for the next measuring task.

6. Execute the program with NC start. The message "Program is running" is displayed.
At each point to be probed, the program stops and the operator is prompted to manually approach the next position. The respective positions have to correspond to the displayed graphics with regard to axis direction and sequence. After the next position has been set, execute NC start again. Repeat until all measuring steps have been executed.
7. Use the left M-keys to select "G230 Swivel in probed plane" (G230).
A reduced input mask is displayed for swiveling, only containing the specifications for a previously probed plane.
8. The input table is completed with the parameter values.



The key <F2> "Start Program" is enabled after all required parameters have been entered and only in the "Jog" mode and starts the measurement.

9. Prior to executing the cycle, check the initial position or manually approach a save initial position.



Only now press <F2> "Start Program".

Executing the cycle

User cycles

In the operating area, <OP2>"Prepare", the key <F5> is not assigned in a new project. The key is reserved for cycles and functions the user wants to execute in the operating mode "Jog". Many non-modal cycles (standard cycles, user and machine operator cycles) and DIN block sequences for which an input mask has been defined can be assigned to the key.

Call

The dialog is called using <F5> (user-defined name) in the operating area <OP2>"Prepare".

If several input masks have been assigned to the function key, the cycle can be selected in the upper check box.

After all mandatory parameters have been entered, <F2> "Start Program" becomes active.



Press <F2> "Start Program" to immediately execute the cycle. Only cycles developed as manual functions stop before the first motion and report information for the user. Thus, travel to a safe initial position first.

Configuring the executable cycles

How to configure the key Execute (user) cycle:

1. Create an input mask for a user cycle. For a description, refer to the MTX document "Commissioning". Chapter "NC cycle input mask"

If the input mask cannot be inserted in an NC program, assign the group names `_NOINSERT` and `_NOCORR` (`//%GROUP% _NOINSERT _NOCORR ...`) (amongst potential other groups).

Operation modes

- Open the project in IndraWorks Engineering and in the Project Explorer, click on <Visualization device>/Screen frame/F-panels/OPPPreparation.
- In the F-panel editor, select <F5> and enter a name under "Text". In "Function selection", select "Execute cycle".

Under "SignatureOrName", specify which input mask(s) is/are to be called. How to call an input mask:

- Select a cycle in the drop-down menu
- Enter a group name (technology group), e.g. GRAVE for engraving.
- Enter several group names. Group names are divided by spaces (e.g. MYGROUP1 MYGROUP2).

Several groups can also be defined using placeholders. The question mark (?) stands for exactly one character, the asterisk (*) for an arbitrary or empty string (e.g. MYGROUP* and comprises the groups MYGROUP, MYGROUP1 and MYGROUP11. MYGROUP?? MYGROUP?? would only call MYGROUP11 out of the groups mentioned above

- Enter a cycle signature (e.g. G201)
- Enter the signatures of several cycle that are to be separated by commas (e.g. G201, G202). No placeholders are available for signatures
- If not signature or group is specified, the group SETUP is selected by default

- Transmit and refresh the visualization data.

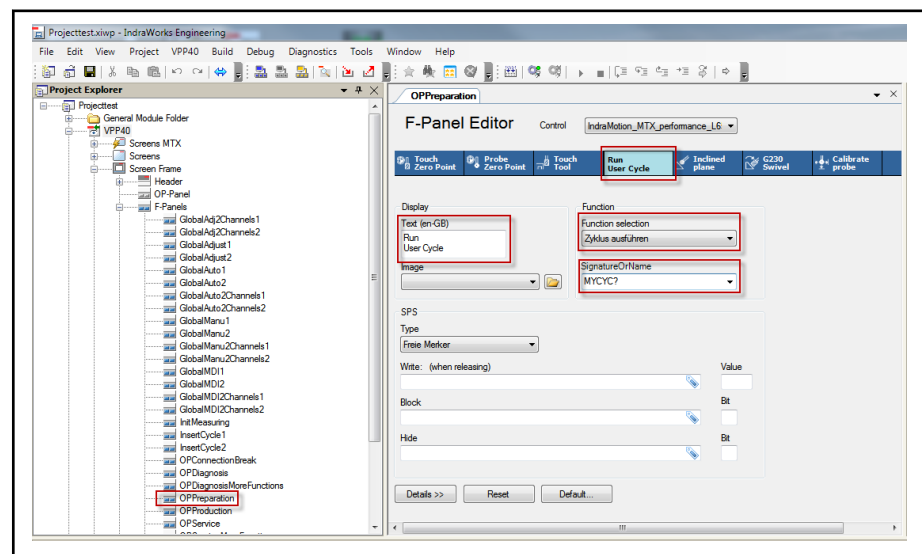


Fig. 5-42: Configuring an F-key using the function "Execute cycle".

Swiveling (G230)

A detailed description of this function can be found in the MTX document "Standard NC Cycles", chapter "G230 Swiveling". The function corresponds to the F-key configuration "Execute cycle" (function selection) and the signature G230 and thus, the complete parameter scope of the cycle Swiveling.

Special characteristics for manual swiveling



Press <F2> "Start Program" to immediately execute the cycle, including possible motions.

6 Programming

6.1 Overview

This chapter describes the NC program creation.

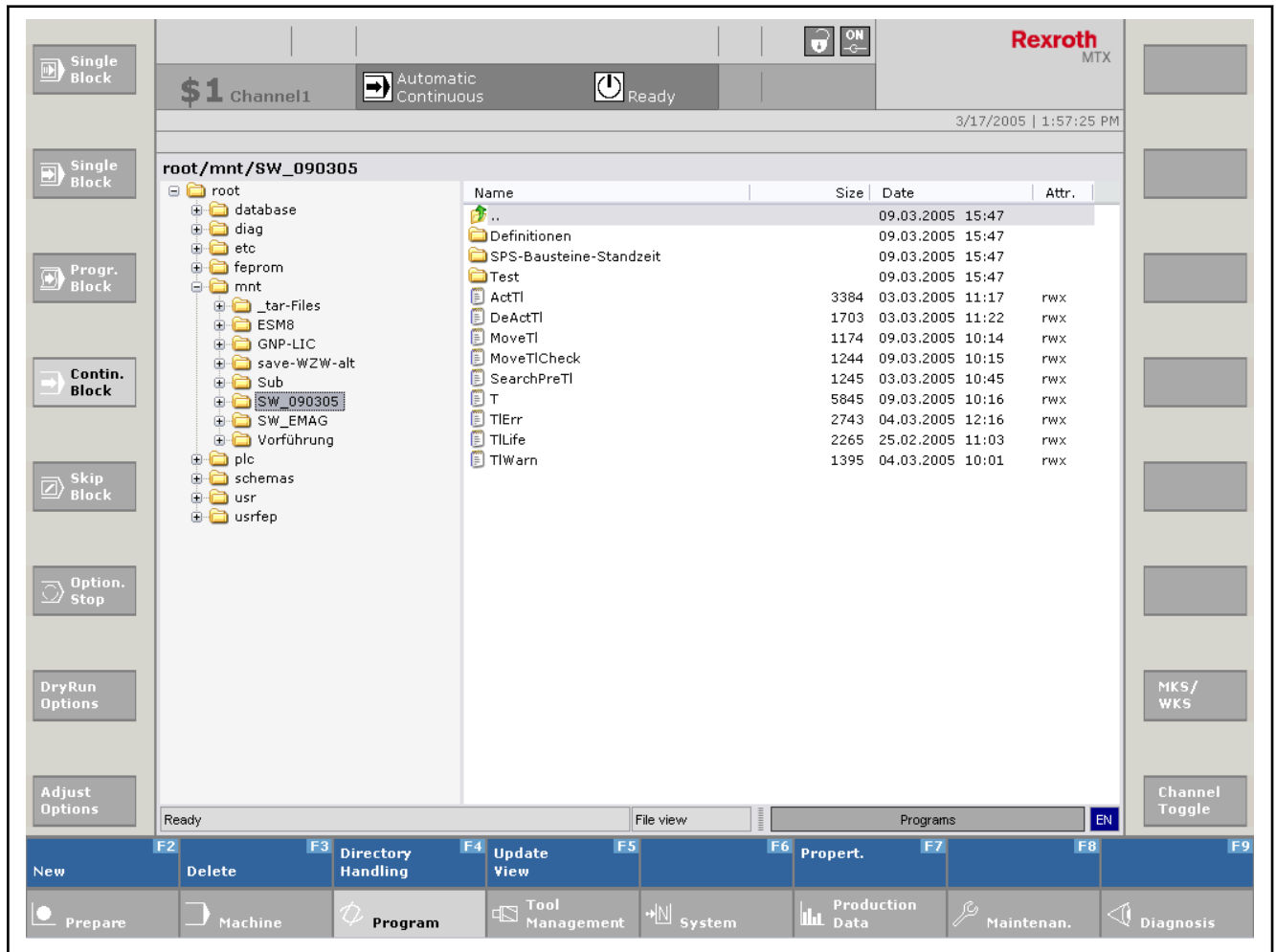


Fig. 6-1: "Programming" operating area

6.2 NC program creation

6.2.1 Overview

Editor types The editor to edit NC programs and other texts is provided in two variants:

1. Editor to edit small files
2. Editor to edit large files

An adjustable limit value is used to differ between small and large files.

The limit value for the file size can be configured in the "Editor options" dialog (see [Tab Editor type, page 131](#)).



As the editor to edit large files is only provided with a limited functionality, not all menu functions are available.

The editor to edit small files is also provided in two variants called "editor types" in the following:

- **NC program editor** with unlimited functionality to edit NC programs
- **Text editor** with limited functionality

Due to its functional limitations, the editor for large files is called text editor in the following.

Selecting the editor type for new files

For new files, the menu navigation is the decisive factor whether to open either the text editor or the NC program editor.

Selecting the editor type for existing files

The editor to edit existing files is selected automatically. The selection criteria for small files is the size of the file to be edited and the preselection "Text editor" or "NC program editor"

The preselection (whether the NC program editor or the text editor is used) is made in the "Editor options" dialog (see [Tab "Editor type, page 131"](#)).

To change non-ASCII-files, the text editor is always opened.



If the editor for large files was enabled for editing, "Editor for large files with reduces functionality ready" is displayed in the status line.

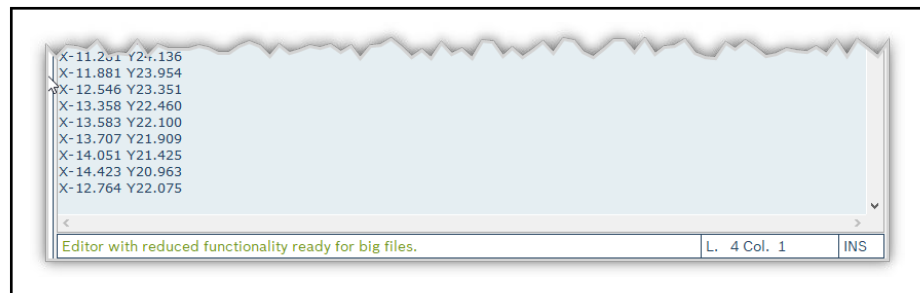


Fig. 6-2: Information in the status line

Differences

The NC program editor is primarily used for programming. It can exclusively edit ASCII files. In contrast, the text editor can also edit Unicode and UTF8 files.

The NC program editor is equipped with the following additional functions compared to a simple editor:

- Syntax highlighting (colored highlighting of block components)
- Fully automatic and continuous numbering for DIN and CPL blocks that does not change jumps to block numbers
- Integration of input assistance for NC cycles

Commonalities

The editor types do not differ in the remaining functions and characteristics:

- Basic mechanisms to avoid loss of data (BAK files)
- Full navigation on part program errors not influenced by insertions and deletion of texts
- Navigation: Character by character, word by word, line by line, start, end and via search function
- Scroll function via scrollbar, scrolling by using "Drag with one finger", cursor positioning and keys
- Highlighting: Character by character, word by word, line by line
- Integrated program selection after saving an active NC program

	• The editors can be opened multiple times, but only one time per file. This restriction does also apply across operating areas • New files are saved in ASCII format
Editor commands	Commands can be selected via: • Function keys • Hotkeys The editor complies with the Windows standard with regard to the usual shortcuts (selecting, block commands, search, etc.).
Syntax highlighting	The syntax highlighting of the NC program editor displays NC block components in different colors according to their syntactic meaning and their error status. The following is distinguished: • NC words • Parameter lists of instructions and subroutines in DIN context • Comments and notes • CPL instructions • Label declarations • Jump commands (conditional/unconditional jump) • Macros
User management	To edit and to reselect a program, the respective user rights are required. If the user does not have these editing rights, the program can exclusively be opened in read-only mode. If user rights are missing, a user can log in again with sufficient rights.
Active NC program	If the NC screen or the MTX Navigator opens the active program, the program is automatically selected again after the "Save query" (answer "Yes") and the "Reselection query" (answer "Yes"). It is verified that the requirements for reselection are fulfilled. If the reselection query is not answered with "Yes", the program is not saved and is thus not selected. If a reselection is impossible (channel active), the channel can be reset and thus saving and reselection can be repeated.
Cursor position after opening	After opening an active NC program, the cursor is located on the block currently processed in the NC kernel and this line is highlighted. If the editor is opened in a collision message of the NC simulation, the current cursor position indicates the NC block causing the collision. In case the error of an error occurring in the error or a warning (part program error), the cursor is placed on the current error.

6.2.2 Functions under file

File - New

Hotkeys	<Ctrl>+<N>
	This function opens a new empty NC program.
Procedure	A new empty NC program is opened. The program that was currently edited remains open.

File - Open...

Hotkeys	<Ctrl>+<O>
	This function opens an existing NC program or a text file.

- Procedure** A file selection dialog is displayed to select the file to be edited. The currently edited document remains open.

File - Save

Hotkeys <Ctrl>+<S>

Saves the document in the file system of the MTX and empties the internal error list of the editor.

- Procedure** If the document was newly created, the file selection dialog is displayed to specify a new file name and to determine the storage location.

At the NC program editor, the identifier is preset to "NPG_ <time stamp>" (year/month/day_hour/minute/second) and can be modified by the user. The file extension is set to ".npg" by default (for the "NC program"). Analogously, the default names are pre-assigned with "TXT_..." and the extension with ".txt". **Cancel** aborts the "Save" function. When **Save** is pressed, the file is saved under the identifier shown.

File - Save as...

This function saves the document in the MTX file system under a new name. The editor remains open.

- Procedure** A file selection dialog is displayed to determine file name and memory location.

The file name is pre-assigned with the current name and can be changed by the user. **Cancel** aborts the "Save As" function. When **Save** is pressed, the program is saved to the NC program directory under the identifier shown. A message is issued if the same path and name for saving are specified. The existing file is overwritten by confirming the message with "Overwrite". "No" allows to navigate again in the file selection dialog.

File - Print...

Hotkeys <Ctrl>+<P>

This function prints the open document.

- Procedure** A dialog to set up the page is displayed, followed by the print preview. The number of pages per sheet can be set. The zoom icon can adjust the size accordingly. The print dialog can be closed with **Exit**. <Tab> is used to navigate in this dialog if no mouse is available.

Go to the menu bar, under **File ► Print Settings...** to open the "Print Settings" dialog to configure header and footer.

Currently, the following variables can be used:

Variable	Description
PRINT_DATE	Printing date
PRINT_TIME	Printing time
COMPUTER_NAME	Current computer name
CURRENT_PAGE_NO	Current page number
CURRENT_USER	Current user name
SOFTWARE_VERSION	Software version information

Tab. 6-1: Variables for header and footer

To improve clarity, the meaning can be written in front of each variable.

Example:

Variable description

Entering a parameter: Printing date: #PRINT_DATE#

File - Exit NC editor

	This function closes the editor. The editor is immediately closed if no changes have to be saved in the document or if a later empty document is present.
Procedure for a new document	For a newly created document, the "Save query" is prompted. An already pre-assigned file name according to the editor type can be seen. Button description: • Yes saves the document. A file selection dialog follows to enter identifier and storage location. Save in the file selection finally creates or replaces a file. Return to the editor with Cancel. • No discards the content and closes the editor. • Cancel returns to the editor without saving.
Procedure for a changed document	If a previously existing document containing unsaved changes is edited, a dialog prompts to decide whether to save the changes made: • Yes: If the document to be saved is an active NC program and the reselection prompt is confirmed with Yes, the file is saved, the main program is selected and the editor is closed. No returns to the editor without saving. An inactive program is immediately saved and the editor is then closed. • No discards all changes and closes the editor. • Cancel returns to the editor without saving.

File - Exit all NC editors

	This function closes all open NC editors.
Procedure (for each editor window)	If an editor contains unsaved changes, a dialog is displayed, as in "Exit NC-Editor", prompting to decide whether to save the changes. Name and storage location are additionally prompted for new documents.

6.2.3 Functions under edit

Edit - Undo

Hotkeys	<Ctrl>+<Z>
	This function allows to undo the latest editing steps. With this function, the modifications of individual lines can be undone (delete line, insert line, editing procedures within a line, cutting, pasting and deleting blocks covering one or more lines).

Edit - Redo

Hotkeys	<Ctrl>+<Y>
	This function allows to redo editing steps which have been undone.

Edit - Cut (Block)

Hotkeys	<Ctrl>+<X>
	The area selected is copied to the clipboard and deleted in the document.

Edit - Copy (Block)**Hotkeys** <Ctrl>+<C>

The highlighted area is copied to the clipboard.

Edit - Insert (Block)**Hotkeys** <Ctrl>+<V>

The text in the clipboard is pasted into the document at the current cursor position.

Edit - Select line

The current line is selected.

Edit - Select all**Hotkeys** <Ctrl>+<A>

The entire document is selected.

6.2.4 Functions under navigate**Edit - Find...****Hotkeys** <Ctrl>+<F>

Can find a specified character string in the complete document. Upper and lower case as well as the search direction can be selected.

If **Replace** is pressed after a character string is entered, the string can be replaced by another one. If the "Find" dialog is closed, continue to search in the document using the hotkey <Ctrl>+<R>.**Edit - Next error**

Moves the cursor to the next registered error and highlights the text passage. Additionally, the corresponding error message is displayed in the status bar. The error message can be hidden with <Esc>.

The function is only available if at the moment of opening the editor, present errors/warnings for this program or new errors are registered after saving with reselection.

Edit - Previous error

Moves the cursor to the previously registered error and highlights the text passage. Additionally, the corresponding error message is displayed in the status bar. The error message can be hidden with <Esc>.

The function is only available if at the moment of opening the editor, present errors/warnings for this program or new errors are registered after saving with reselection.

Edit - Go to beginning of file (BoF)**Hotkeys** <Ctrl>+<Home>

Moves the cursor to the beginning of the file.

Edit - Go to end of file**Hotkeys** <Ctrl>+<End>

Moves the cursor to the end of the file.



There are a number of additional positioning, selecting, blocking and editing functions only available as hotkeys. Only the most important functions are explained.

6.2.5 Functions of the input support

Input support - NC cycle

Overview

To program cycle calls and other DIN code instructions, the NC editor is provided with an input tool - the **input masks** - especially useful for a comfortable parameter input. Input masks are tables to identify and change sizes. The input is supported by graphics, text information and a formula interpreter and secured by a parameter validation. One output format belongs to each input mask. That output format is used to link the parameters to a syntactic unit and it is the link between program text and input table.

For more detailed information on the input masks, refer to the "Commissioning" MTX documentation, chapter "Defining input dialogs".

Inserting NC cycles

The <F2> "NC cycles" key branches into subordinate F-keypad levels to be primarily used to insert NC cycle calls.

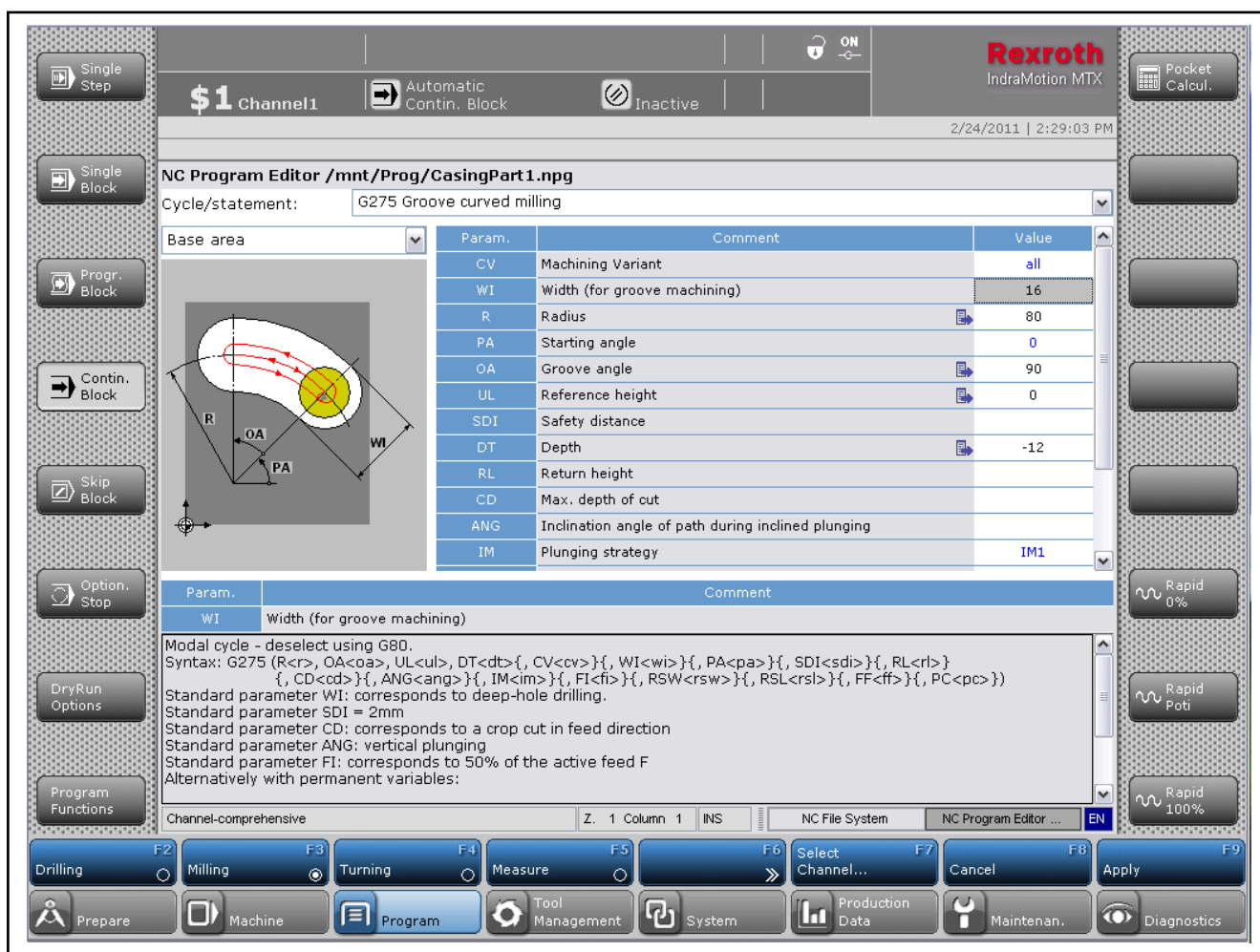


Fig. 6-3: Input assistance - Inserting an NC cycle

Variable menu structure

The input masks for insertion are provided in groups generally grouped according to topics and technological point of views (see MTX documentation "Commissioning", chapter "Properties of an input mask (grouping)"). This re-

duces the menu scope. A channel-related reduction of the menu scope is also possible. The menu structure - especially the F-key arrangement - can be configured (see MTX documentation "Commissioning", chapter "F-Keys of the input support"). To generally or partially hide the input masks and to affect the mask sequence, refer to the chapter [Options - Adjusting the input assistance...](#), page 129.

Even though the menu structure is variable, there are specific rules and function keys that are always available:

- A subset of cycles (one or several groups) is selected via function keys that are provided with a radio button functionality.
- Up to two F-panels - the left and right half of the menu - are intended for the group selection. If the menu is split in two, there are two function keys <>>> and <>>> to switch between these levels.
- If the channel-specific hiding of input masks is set up, the function key <F7> is displayed. If no channel is assigned to the program (see MTX documentation "Programming Manual", section "Channel ID"), this key becomes active. After pressing the key, a dialog is displayed to select the desired channel the menu is to be composed for or the menu composition can be selected "across channels".

The selected channel remains its validity in all menus to insert via input masks and when inserting NC block sequences. It is displayed in the status bar.

- The F-key <F8> discards all entered parameters and causes a return to the editor view.
- The F-key <F9> transmits the call with the current parameter values to the program and returns to the editor view as well. It is not checked whether all mandatory parameters have been filled out.

Online help Each input mask can be assigned to a chapter in an online help. The chapter can be displayed with <F1>.

Input support - NC cycle correction

Correcting with an input mask The key <F3> does not only correct cycle calls, but also all instructions programmable with input masks.

Input mask selection For correction purposes, the input mask - with the output format and parameters including their value ranges matching the block component parts best at the cursor position in the program - is selected. For multi-line output format, lines in front and behind can also be used for correction. There are two exceptions:

- There are multiple input masks equivalent in their matching with the program text. In this case, a dialog is displayed to select the respective input mask.
- There is not matching input mask for the program content at the cursor position. The last operating step is ignored and a respective message is displayed in the status bar.



- When starting the correction, the cursor may not be set on an empty line and a comment line. This even applies if this line is part of the output format of an input mask. Position the cursor on a line with DIN code.
- There is no value pre-assignment during correction.
- When correcting modal cycle calls, the standard parameters are not considered. That means that the standard values are not displayed in case of empty parameters and that parameters matching with the standard are not always applied to the program.
- Hiding input masks (see [Availability tab, page 129](#)) is not active during correction.

Input support - Instructions

With <F5>, function comments for the NC such as tool descriptions can be inserted using input masks.

Input Support - Calculator...

The dialog "Calculations and tables" is activated with <F6>. See chapter [10.7 Calculations and tables, page 270](#).

Input Support - NC block sequences

Overview

Use this function to insert any number of previously defined blocks into the NC program. NC block sequences can be created across channels or channel-dependently. The channel reference is only a classification criterion for the block sequences.

Programming

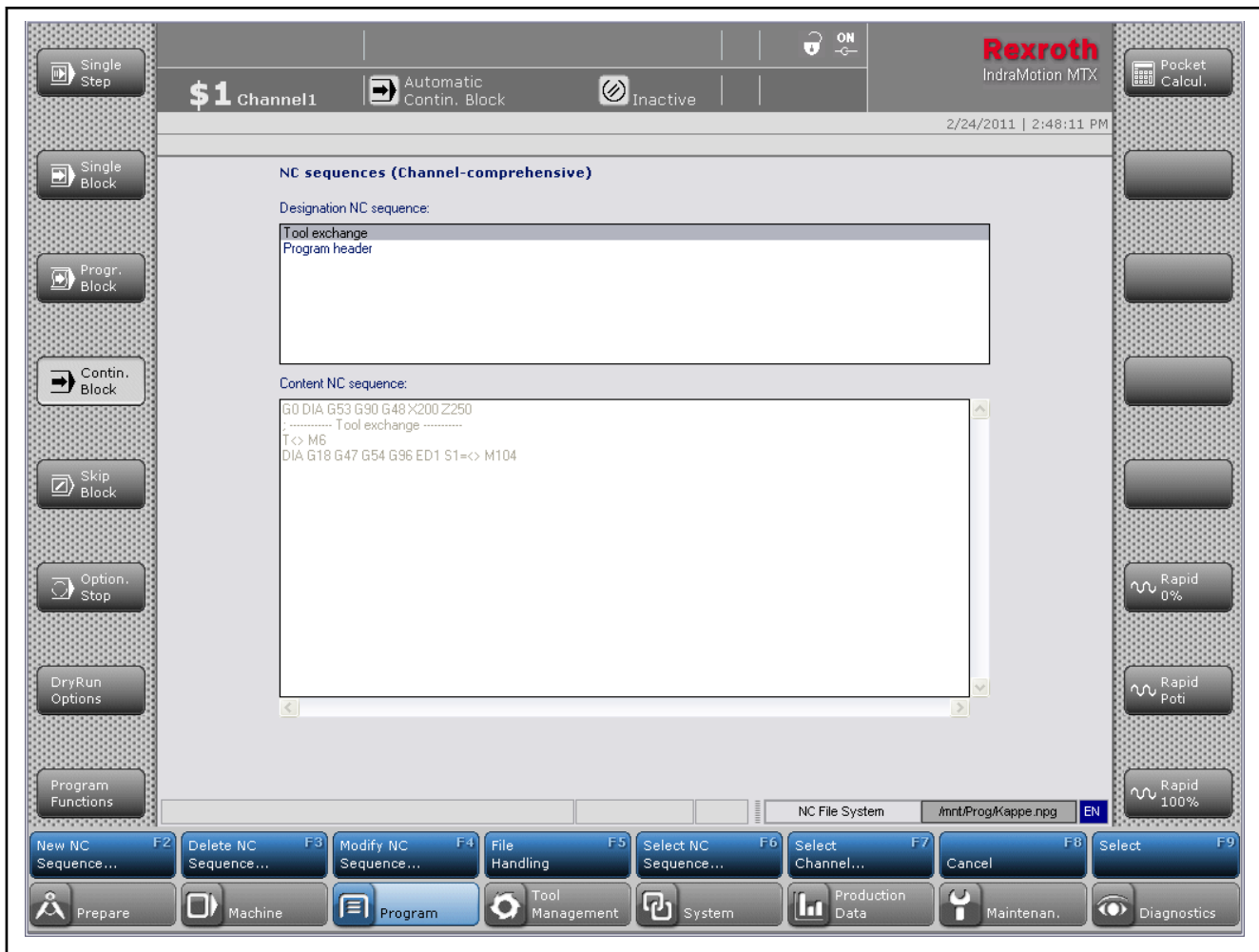


Fig. 6-4: Input assistance - NC block sequences

Channel selection when opening

When opening the NC block sequences, the following channel is selected by default:

- The channel assigned to the channel (see MTX documentation "Programming Manual", section "Channel ID")
- the (valid) channel selected with <F7> or
- "across channels"

Functions of the first F-keypad level**New definition**

Press <F2> to define new block sequences. A dialog window opens. Enter the designation of the NC sequence into the upper space and the respective content into the lower space. The content can comprise any number of blocks.

Language-dependent texts can be used in the designation and in the NC block content (comments). Instead of a text in one language or NC sequence content or NC sequence ID, e.g. "Z333 (pallet change)", a language-dependent text can also be entered by referencing via a token number %TNxxxx%, e.g.: "Z333 (%TN7%)". For this purpose, it is required to specify the text belonging to the token in the file under C:\My Documents\All Users\Application Data\Rexroth\IndraWorks\Project\<Visualization Device>\user\config\MTXNCSequenceUser_yy.txt (yy=language ID, e.g.: En for English, DE for

German, etc.). A maximum of ten tokens are allowed per line. Click on **Info** to display this information.

The new block sequence is always inserted into the designation list in front of the position selected with <F6> "Selected position". Confirm the NC sequence with **OK**. Exit the process with <Esc> or **Cancel**.

Delete With <F3>, the selected sequence can be deleted. The selected NC sequence with designation and content is displayed. Confirm deletion with **OK**. Exit the process with <ESC> or **Cancel**.

Modify With <F4>, existing block sequences can be edited. The menu navigation is as for "New definition".



All changes in the NC sequences have to be backed up in IndraWorks Engineering. Go to **Visualization Data ► Load changes from operating station**.

File handling With <F5>, a new F-keypad level for file operations is opened.

Selection With <F6>, the NC sequence can be selected. A newly created sequence is always inserted in front of the selected sequence.

Select channel... Switch between channel-comprehensive and channel-dependent sequences with <F7>. If it is selected across channels or an existing channel is selected and then a sequence inserted, this new setting also applies when inserting via input masks as long as no channel number assigned to the program impedes this new setting.

Cancel Exit the process and return to the NC editor via <F8> or <Esc>.

Apply Press <F9> to copy the selected block sequence to the last cursor position in the NC program. Return to the editor view.

Functions of the second F-keypad level

Copy/Cut With <F2> "Copy" or <F3> "Cut", all NC block sequences of the selected channel are put into buffer storage. After they have been "pasted", the sources of the NC block sequences that were edited with "Cut" are deleted.

Export With <F5>, all of the NC block sequences of the selected channel are placed into a file, which can be saved as desired.

Import With <F6>, a file saved using "Export" can be pasted back into the selected channel as NC block sequences.

Select channel Switch between channel-comprehensive and channel-dependent sequences with <F7>.

Delete With <F8>, the NC block sequences of the selected channel are permanently removed.



All changes in the NC sequences have to be backed up in IndraWorks Engineering. Go to **Visualization Data ► Load changes from operating station**.

Back With <F9>, return to the first F-keypad level.

Input support - Toleranced dimension

The dialog "Calculations and tables" is activated with <F8>. In the calculator, the tab "Toleranced dimension" is selected automatically. See chapter [10.7 Calculations and tables, page 270](#).

6.2.6 Functions under “Tools”

NC block numbering

A starting block number can be specified. All NC blocks are renumbered with the preselected step width.

The original block numbers remain in the NC program editor if these numbers are used for targets of conditioned and unconditioned program jumps. Adapt them manually if required.

CPL block numbering

A starting block number can be specified. All CPL blocks are renumbered with the preselected increment.

Tools- Step width block number...

The desired step width can be selected for automatic block numbering from 1 to 100. This applies to the numbering of NC and CPL blocks.

Automatic NC block numbering On/Off

Automatic NC block numbering is switched on or off. It is only effective if a program is written continuously or if blocks are inserted. NC block numbers of the current and the next (continuous) block are used. Insert either with the preselected step width or - if there is a continuous block - with a smaller step width if required.

Automatic CPL block numbering On/Off

Automatic CPL block numbering is switched on or off.

It is only effective if a program is written continuously or if blocks are inserted. CPL block numbers of the current and the next (continuous) block are used. Insert either with the preselected step width or - if there is a continuous block - with a smaller step width if required.

Options

General information

Under <Options>, make settings for the NC editor, for its integrated tools "Input support".

Tabs	There are four individual dialogs with tabs on which the settings or adaptations belonging together are grouped.
Operating keys	Five operating keys are provided at the bottom of the tabs. These keys are the same for all tabs.
OK	Applies all current settings and closes the dialog.
Cancel	Cancel or <Esc> discards all settings made, since the "Options" dialog was opened and all settings made since the last time the Apply button was used. The dialog is closed.
Apply	Saves all settings made so far (concerns all tabs). The settings can then not be discarded anymore.
Reset	Enables the Bosch Rexroth default settings assigned to the tab currently active.
Help	Displays the chapter belonging to the tab in the online help.
User management	All settings in the "Options" dialogs are subject to verification by user management. Settings can only be made after successful login and provided the

user has the right to change the option in question. If the current user rights are insufficient, the system requests a new login.

Options - Adjust input assistance...

"Availability" tab

Settings

The availability or the hiding of the input masks can be set. It is represented in tree structure. Each node can either be ticked ("available") or the tick can be removed ("hidden").

The availability can be set for:

- a whole group of input masks (see MTX documentation "Commissioning", chapter "Properties of an input mask (grouping)"). All input masks assigned to this group can be completely shown or hidden. The availability can also be set channel by channel via the context menu of the group nodes.
- An individual input mask.
- A specified channel under which the input mask is to be shown or hidden.
- For a function key. All groups assigned to the F-key via the group filter are shown or hidden. The F-key nodes are only displayed after switching to the F-key view.

The input support adjustment applies to the active project (active operating station).

However, the function keys cannot be configured in this dialog. This configuration is made in IndraWorks Engineering. Refer to MTX documentation "Commissioning", chapter "F-Keys of the input assistance".

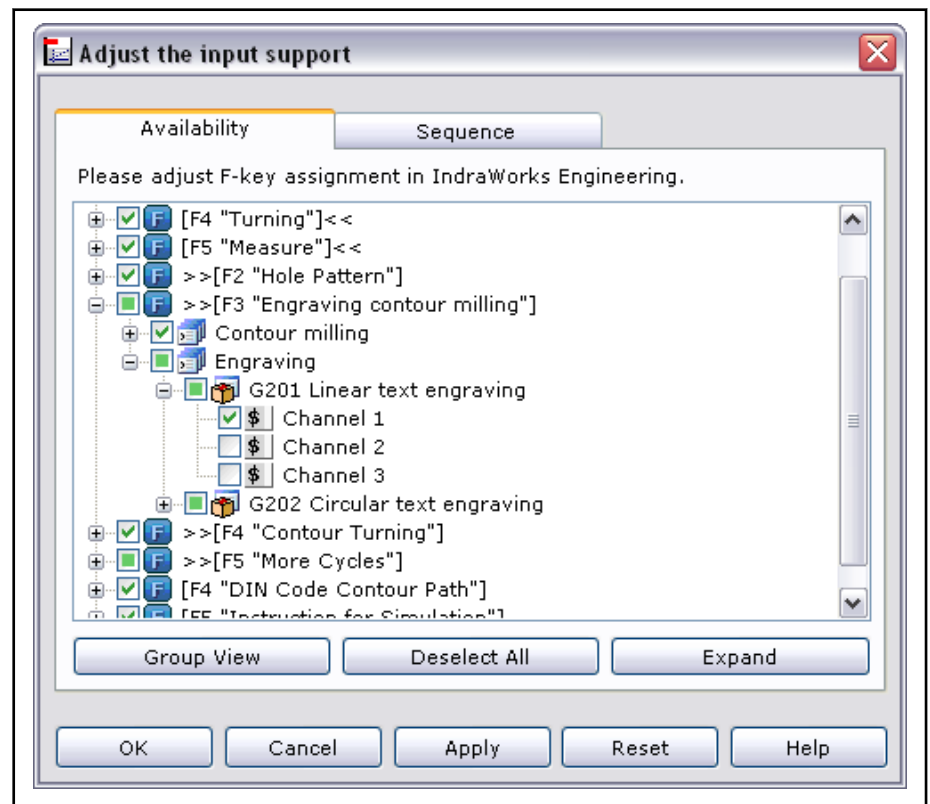


Fig. 6-5: Dialog: Adjust the input assistance ["Availability" tab (F-key view)]

Operation Click on the node to select or deselect this and all nodes located below. Since the input masks are provided with a group characteristic of origin apart from the thematic/technological group, a click also affects the other branches of the tree.

Go to the context menu of the group node for an easy channel-related hiding of a complete group.

Switch between the F-key view and group view using the keys **F-Key View** and **Group View** respectively. The F-key view shows the current menu structure.

Use the tooltips and other display elements visualizing the following information:

- F-key node: Panel name, configurability and current group filter. "<<" indicates that this F-key belongs to the left half of the menu, ">>" to the right half.
- Group node: Group name.
- Mask node: Signature. Icons with a "little man" indicate the group feature "Input mask of the user".

Select all ticks all nodes and **Deselect All** removes them again.

Expand opens all nodes **Collapse** hides all subordinate nodes.

Reset selects all input masks except examples.



- To adjust the availability of the input masks, the user right under "MTX Functions" --> "Program - NC editor" --> "Input mask selection" is sufficient.
 - Backup the settings in IndraWorks Engineering. Go to **Visualization Data ► Load changes from operating station**.
-

Validity of settings The new settings are applied immediately on the other tab of the dialog and they also apply for the editor when pressing **OK** or **Apply**.

"Sequence" tab

Settings The sequence, in which the input masks for insertion in the menu are listed, can be adjusted. For this purpose, all masks in a list, which are not generally hidden, are displayed. The actual sequence in the menu results from the viewing of the masks that remain due to the respective group filter and the channel-related hiding.

The set sequence within a group can also be judged in the "Availability" tab.

The input support adjustment applies to the active project (active operating station).

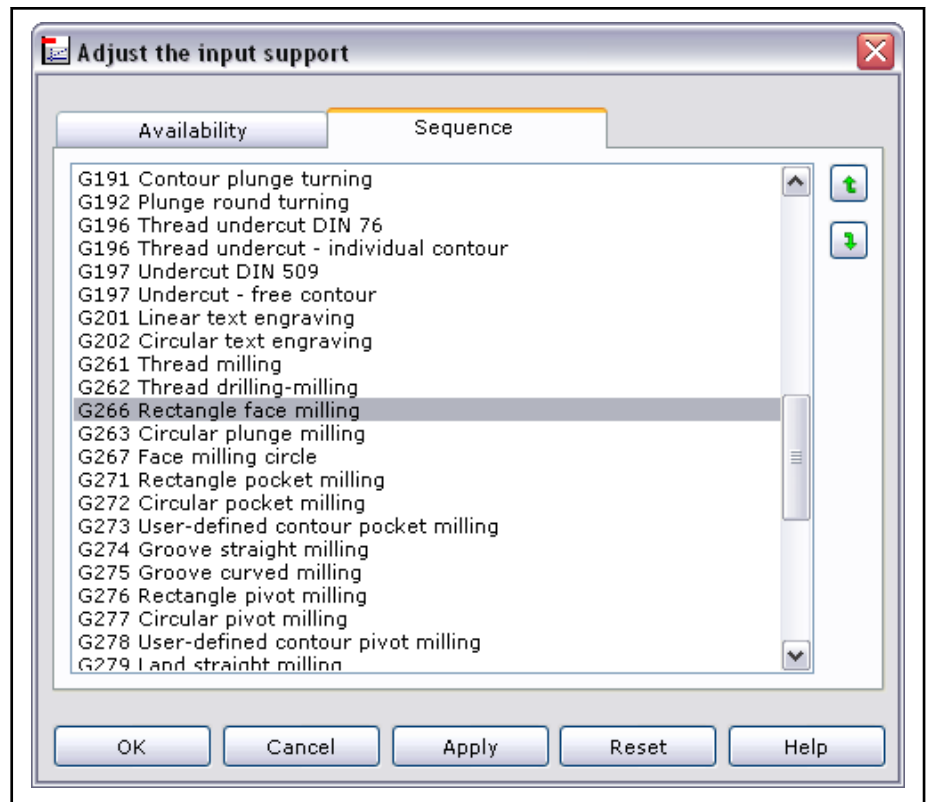


Fig. 6-6: Dialog: Adjust the input assistance ("Sequence" tab)

Operation

The two buttons with the symbols  and  move the selected input mask up or down.

Reset rearranges the signatures in alphabetical order. G- and M-commands are ascendingly sorted with regard to their numbers.



- To adjust the sequence of the input masks, the user right under "MTX Functions" --> "Program - NC editor" --> "Input mask selection" is sufficient.
- Backup the settings in IndraWorks Engineering. Go to **Visualization Data** ► **Load changes from operating station**

Validity of settings

The new settings are applied immediately on the other tab of the dialog and they also apply for the editor when pressing **OK** or **Apply**.

Options - Editor options...

"Editor type" tab

Settings

The criteria when to open an existing file of the NC program editor or when to use the text editor are specified on this tab. For the editor types, refer to [6.2.1 Overview, page 117](#).

The settings are assigned to the logged in Windows user.

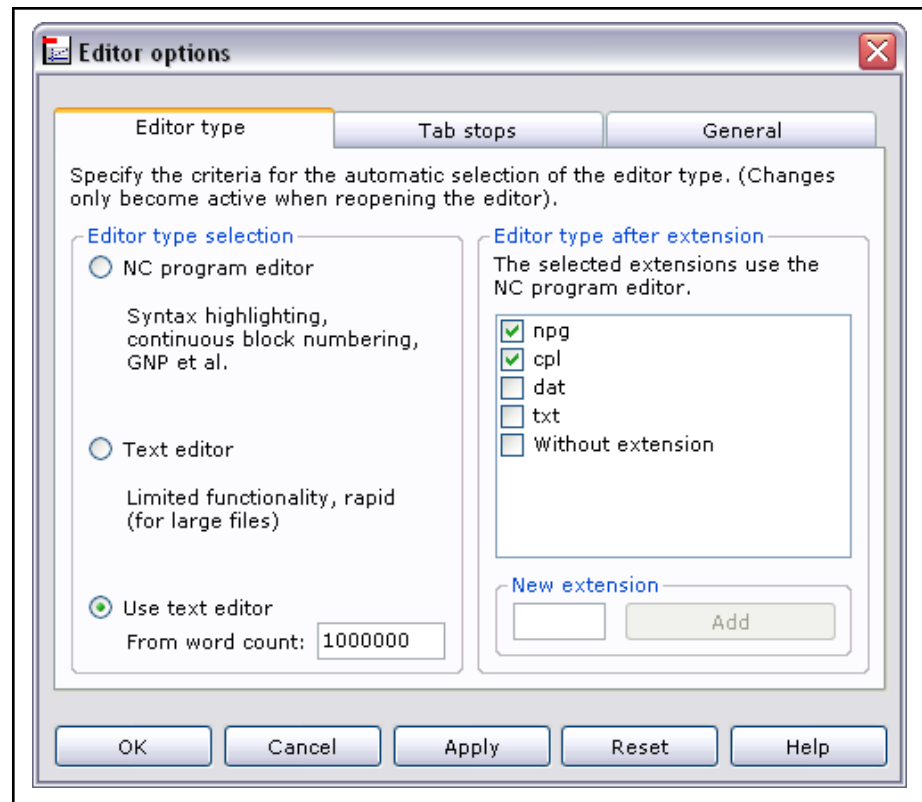


Fig. 6-7: Dialog: Editor options ("Editor type" tab)

Operation First decide when the NC program editor is to be used. Then, specify it under "Editor type selection":

- **NC program editor** enables the NC program editor if the file has a certain extension.
- **Text editor** enables the text editor in any case.
- **Use text editor from word count** enables the NC program editor if a file does not exceed a certain size and if it is provided with a certain extension. Specify the file size in the following text field.

If the text editor is not to be used exclusively, specify the number of extensions to be used for the NC program editor under "Editor type after extension". To add an extension that has not yet been displayed, enter the extension in the text field under "New extension" and click on **Add**.



To change the editor options, the user right under "MTX Functions" --> "Program - NC editor" --> "Edit NC program" is sufficient.

Validity of settings The new settings become only effective when opening the existing file for the next time.

"Tab stops" tab

Settings This tab defines up to ten individual tab positions. A default tab width applies for all remaining tab positions.

The settings are assigned to the logged in Windows user.

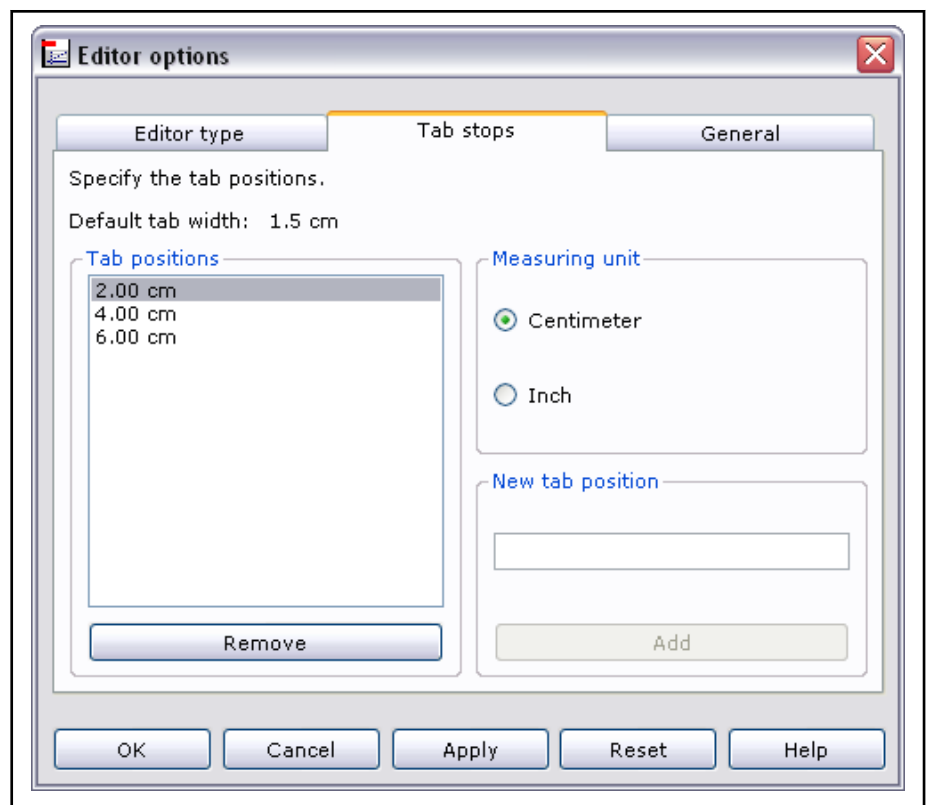


Fig. 6-8: Dialog: Editor options ("Tab stops" tab)

- Operation**
- To add a new tab position, enter a distance in the input field under "New tab position". If required, switch to the desired measuring unit with **Centimeter** or **Inch**. Then click on **Add**.
- To delete a tab position, select it and then click on **Remove**.
- Reset** deletes all specified positions.



To change the editor options, the user right under "MTX Functions" --> "Program - NC editor" --> "Edit NC program" is sufficient.

- Validity of settings**
- The new settings apply immediately in the current editor and in the other editors after opening them.

"General" tab

- Settings**
- Make different settings on this tab in the following areas:
- **Bak file:** Specifies whether the editor backs up the original file content in another file before saving a file whose file name is extended with ".bak" compared to the current name.
 - **Font:** A new font can be selected due to a new size or another style.
 - **Block numbering:** The following can be specified:
 - Step width
 - Starting block number of NC blocks
 - Starting block number of CPL blocks
 - Whether NC blocks are automatically numbered upon insertion (**NC blocks**)
 - Whether CPL blocks are automatically numbered at insertion (**CPL blocks**)

The settings are assigned to the logged in Windows user.

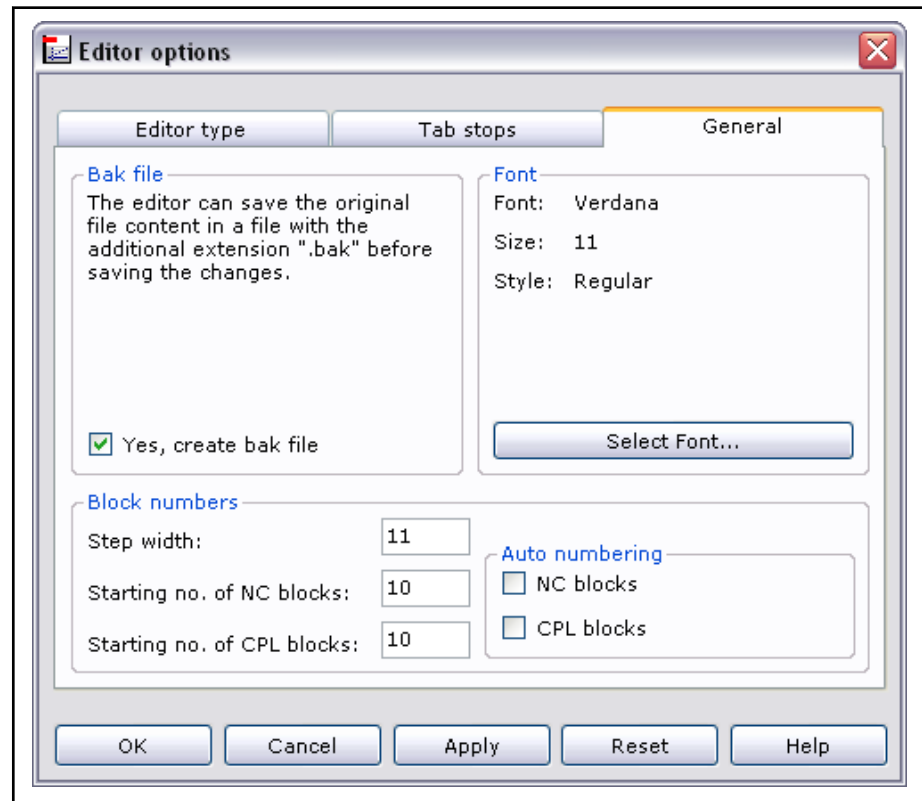


Fig. 6-9: Editor options - "General" tab



To adjust the sequence of the input masks, the user right under "MTX Functions" --> "Program - NC editor" --> "Edit NC program" is sufficient.

Validity of settings The new settings apply immediately in the current editor and in the other editors after opening them.

The block numbers and the step widths are initial values when renumbering. They are not overwritten while renumbering (see entries under [6.2 Functions under Tools, page 117](#)).

6.2.7 Online help: NC programming instructions

Finding a help chapter Open the online help with <F1>. It is searched for a section in the help that correlates with the word (rules on word separation according to the NC syntax) at the cursor position. If the cursor position points to a parameter list, it is tried to find the call name on the left of the parameter list. To avoid the algorithm to determine a keyword, the text to be found had to be highlighted before.

If the word searched for cannot be found, an introduction chapter of the programming manual is displayed. The manual search for the desired information can start from there.

6.2.8 Interruption of the connection

If the connection to the control system is interrupted, all NC Editors are closed. If edited data has not been saved at this point in time, the files are saved on the hard disk under the same name (including the path) in the di-

rectory "Own Documents/SaveXXXXXXX". XXXXXXXX stands for the abbreviation of the current date (year/month/day).

Example:

Save20050614 corresponds to the 14th of June 2005. After the connection has been restored, the saved files can be copied to a mount directory of the control system using the Windows Explorer.

6.3 Variable editor

6.3.1 Overview

Variable editor

The variable editor visualizes the following variables:

- Permanent variables (@)
- Definable permanent variables (@)
- System data (SD)

Screen layout

Structure

The variable editor consists of the columns "Name", "Value" and "Comment".

In the "Edit online" mode under the operating area "Machine" <OP3>, the columns "Name", "Value" (control), "Value" (list) and comment are displayed.

Header

In the header, it is distinguished between

- "Variablen editor"
 - freely editable list in the operating area "Program" <OP4> and in the mode "Edit online" under the operating area "Machine" <OP3>.
- "Variable list"
 - only the variable values can be edited under the operating area "Machine" <OP3>. No variables can be added or deleted.

Either the list name including the path specification is displayed in brackets or when displaying the list of all variables in the "Complete list".

Main area

The variables are displayed in a list in the main area of the variable editor.

Variable lists

List storage and list access

There are two types of variable lists:

- Display of all variables in the system (complete list).
- Display of a self-defined subset of variables

Display of all variables

An internal list of all existing variables is created. It is displayed in operating area "Machine OP3" <OP3>.

Display of a subset of variables

If a subset of the existing variables is to be displayed, a list of variables is first created.

It is called in the operating area "Program" <OP4>, F-key <New>, F-key <Variable list>.

A self-edited list can be stored in the file system of the control.

If the list should be declared as "active list", there are the following options:

- In case of an opened list via the F-key <Activate variable list>
- Select the list in the MTX Navigator and via the F-keys <F7>"Variable functions", <F3> "Activate variable list".

A variable list is declared as active if it communicates with the control and displays its current values.

The data type of a list can be identified by the file extension of the list name (*.var).



The active list is opened (all or some variables) by default in the operating area "Machine" <OP4> with the F-key <Active variables>.

6.3.2 Operating active list

Value entry

Navigation and cell selection

To enter a variable value, the desired entry cell of the value first has to be selected as follows:

- Click on the desired cell with the mouse or
- Navigate with the <cursor> keys until the desired cell is selected.

The selected cell has a dark blue background color.

Editing values

Starting the edit mode

Switch to the editing mode of the selected cell with one of the following actions:

- Entering a value or a character using the keyboard
- or -
- Pressing <Enter>
- or -
- Double-clicking on the cell

A flashing input cursor in the respective cell indicates the editing mode.

Applying a value

Apply an edited value with one of the following actions:

- Pressing <Enter>
- or -
- Pressing the <Tab> key
- or -
- Pressing a <Cursor> key
- or -
- Clicking on another cell with the mouse.

In the variable list, under the "Machine" <OP3> operating area, the entered value is directly written into the control after the value was applied.



If an incorrect value is entered, an error message is displayed in the status line and the selected cell remains in the editing mode. The entered value can be discarded or written again after the correction.

Discarding value entry

The editing mode can be closed any time with <Esc>.

The original value is retained in the list.

Function keys in the active variable list

Overview

The following table lists all functions of the active variable list under the operating area "Machine" <OP3>:

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Main level	File	Edit online*	Navigate	Activating complete list	Update SD structures**	Options...**	Additional functions	End variable list
2. Main level	Save system data	Load system data		Default column division			Return	
File		Open...	Save*	Save As...*	Print...		Exit all var. editors	Return
Navigate				BoF	EoF			Return
Edit online*	Add line	Delete line	Insert line	Copy	Paste			Complete editing

* This function is not provided when displaying all variables (complete list).

** This function is only provided when displaying all variables (complete list).

Tab. 6-2: Function keys in the active variable list

Describing the functions

1. Main level

The functions in the first main level <F2>, <F3>, <F4> and <F8> are provided with a subordinated F-keypad in which more subfunctions are grouped.

<F5> The current list is closed and opened in the complete list.

The complete list is the active variable list.

<F6> If new variables were defined or variable definitions were modified, this function must be executed again.

<F7> An "Options" dialog is opened.

Here, the variable types to be displayed can be specified.

The settings in the "Options" only influence the complete list.

The selected variable types are displayed in the header.

<F9> The variable list is closed.



If a comment was edited or the list was changed in the "Edit on-line" mode, the dialog **Save** is called.

2. Main level

- <F2> All SD variables are updated and saved. The memory location is selected via a "Save As" dialog. The file extension is "*.sds". This allows loading these saved values back into the control system at a later point in time.
- <F3> Load a saved SD variable file into the control. It is selected via an **Open** dialog.
- <F5> If the column division was changed, this function can restore the original division.

File

- <F3> An already edited variable list can be opened via an **Open** dialog. Thus, it becomes the active variable list.
 - <F4> The current list is saved after the query about the current control values. The variable editor remains open.
 - <F5> The current list including the current control values can be saved under a different name. The variable list remains open. A **Save As...** dialog opens that can be used to navigate correspondingly.
- Edited comments are saved.



The functions "Save" and "Save As..." are not available if the complete list is displayed.

- <F6> The active list can be printed. Before printing, all the variables in the list are updated. The following columns are printed: "Name", "Value" and "Comment".
- <F8> All open variables are closed.

Editing Online

- <F2> A new line is added at the end of the list.
- <F3> The line selected is removed.
- <F4> A new line is inserted behind the selected line.
- <F5> The content of the selected cell is copied into the clipboard.
- <F6> The content of the clipboard is inserted into the selected cell.
- <F9> The "Edit online" mode is closed. A query is sent whether the list should be saved. Select whether the control values or the list values should be saved.

Navigate

- <F5> Navigation to the 1st line in the list.
- <F6> Navigation to the last line in the list.

Function keys in the variable editor

Overview

The following table lists all the functions of the variable editor:

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1st Main Level	Add line	Delete line	Insert line	Activating complete list	Activate variable list	Write variable values	Additional functions	Close variable editor
2nd main level	File	Edit	Navigate	Default column division	Apply value from control		Return	Close variable editor
File	New...	Open...	Save	Save As...	Print...		Exit all variable editors	Return
Edit				Copy	Paste			Return
Navigate				BoF	EoF			Return

Tab. 6-3: Function keys in the variable editor

Calling the variable editor

Opening an existing variable list

Calling from the MTX Navigator

Any existing variable list can be opened via the MTX Navigator in the operating area "Program" <OP4>.

1. Call the MTX Navigator in the operating area "Program" <OP4>.
2. Open the desired variable list (file extension ".var") as follows:
 - Double-click on the list name with the mouse
- or -
 - Select the list name and press <F6>
- or -
 - Select the list name and use the context menu to select the menu item "Edit"
- or -
 - Select the list name and press <Enter>.

The selected variable list is opened in the variable editor.

Calling the variable editor

Any existing variable list can be directly opened from an already started variable editor.

1. Press <F8> to switch to the 2nd main level and press <F2> to switch to the file functions.
2. Press the <F3> function key.
A dialog opens in which the desired variable list can be selected.
3. Confirm the selection of the variable list with "OK".

Another variable list editor with the selected variable list opens.

Creating a new variable list

Calling from the MTX Navigator

1. Select the directory in which the new variable list is to be created in the MTX Navigator using the mouse or the <Cursor> keys.
2. Press <F2 New> and then <F6> in the sublevel of the F-keypad or
In the context menu, select menu item **New, Variable list**.

A dialog for creating a new variable list opens.

- Calling the variable editor**
1. Press <F8> to switch to the 2nd main level and press <F2> to switch to the file functions.
 2. Press <F2>.
 3. Enter the name of the variable list.
By default, an automatically generated list name is shown "VAR_ <DateStamp>" (year/month/day_hour/minute_second).
 4. Close the dialog with "OK".

A variable list is created and opened in the variable list editor.

Describing the functions

1st main level

This chapter only describes functions that have not already been described under the Variable Lists section.

Activating complete list The current list is closed and the complete list becomes the active variable list.

Activate variable list The current list is closed and becomes the active variable list.

Write variable values After confirming a prompt, the values of the opened list are transferred to the control.

In case of error, a list with the occurring errors is displayed.

If no error occurs, a respective note is displayed in the status line.

Exiting variable editor Data that has not been saved is saved after the "Save" prompt. If a newly edited file is exited, the **Save as...** dialog opens after the "Save query" has been answered. Navigate to the desired storage location.

2. Main level

This chapter only describes functions that have not already been described under the Variable Lists section.

Apply value from control The current variable value is read from the control and entered under "Value" in the list for the selected line of the list.

Benefits of the Intellisense control

Working with the Intellisense function To add the new CPL variables/system variables, use the Intellisense function . After any character has been entered, an Intellisense dialog is displayed providing the option to select the variable type "@" or "SD". After selecting the type, a list of all basis variables is displayed. It can be navigated within the Intellisense dialog with the keys <CursorUp><CursorDown>, <PageUp><PageDown> or with the mouse. Confirm selections using <Enter> or by double-clicking. If the selected variable is an array or a structure, a list of elements of the next level is displayed after entering "point". If there is no further level, the Intellisense dialog does not appear.

Special features:

When entering related arrays or structures, it is possible to enter only the first part or parts of the name. The other elements of this variable or structure are then automatically entered in the list.

Example:

Intellisense function

Array name:

SD.Sys_VAR; the Intellisense control displays SD.Sys_VAR[1,1,1] and the following elements.

The entire array is input by deleting the indices (new name: SD.Sys_VAR) and completing the entry.

Structure name:

SD.Sys_SearchRun[1] also indicates the Intellisense function.

Since this is the first part of the variables, it can be confirmed with <Enter>. All associated elements are inserted.

Structure name:

SD.Sys_SearchRun[1] also indicates the Intellisense function.

A further selection is displayed when a point is entered. An element is selected. If <Enter> is pressed now, only the corresponding subset of the structure is inserted.



If the help of the Intellisense function is not required, it can be hidden via <Esc>.

Activating a list using the Navigator

It is possible to use the navigator to quickly activate a variable list. Navigate to a file with the extension "*.var" and press the F-key "Variable functions". The required function can be called in the subsequent level.

It is differentiated between:

- Activating complete list
The complete list is activated. When changing to the operating area "Machine", this list is displayed by pressing the F-key "Active variables".
- Activate variable list
The selected list is activated. When switching to the "Machine" operating area, this list is displayed by pressing the F-key "Active variables".
- Write variable values
After confirming a prompt, the values of the selected list are transferred to the control.
In case of error, a list with the occurring errors is displayed.
If no error occurs, a respective note is displayed in the status line.

Configuring functions to quickly activate variable lists

The configuration of fast functions to quickly activate variable lists is carried out in IndraWorks Engineering (commissioning). The functions can be applied to both F-keys and M-keys. To do this, the "Variables" function is assigned to one key. Either a path or a specific list can be entered in text field "Path or list name". If only one list is entered, it is displayed as soon as the key is pressed. If a path is entered, a list of all the variable lists existing in this path is shown when the key is pressed. When a list is selected, it is immediately displayed.

Interruption of connection

If the connection to the control is interrupted, all variable editors are closed. If edited data has not been saved at this point in time, the files are saved on the hard disk under the same name (including the path) in the directory

"c:\SaveXXXXXXXXX".

"XXXXXXX" stands for the abbreviation of the current date (year/month/day).

Example:

20050614 corresponds to June 14, 2005.

After the connection has been restored, the saved files can be copied to a mount directory of the control using the Windows Explorer.

6.4 Editor to define SD variables

6.4.1 Use

This application is used to comfortably define SD variables. The variable definition is stored in files of type SDDefxxx.xml.

The defined variables are available in the control if the definition files are saved in one of these directories:

- Root directory of the control
- /feprom
- /usrfep

Changes in definition files become only effective after an NC restart.

Integration of the editor to define SD variables in the operating desktop

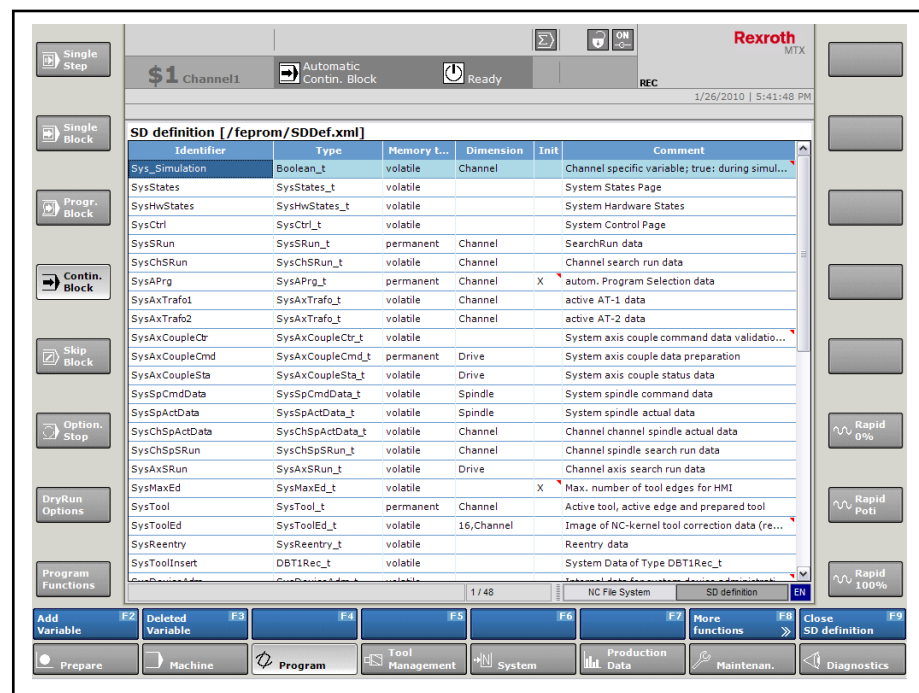


Fig. 6-10: Integration of the definition of SD variables in the operating desktop

The display is an application with an individual F-key assignment.

Menu and title are hidden.

The editor to define SD variables is assigned to the operating area "<OP4> Program". The call can also be carried out via the MTX Navigator.

- Open existing file
 - Select SDDefxxx.xml with <cursor> keys, <F6>"Edit"
 - or -

- Double-click on the file "SDDefxxx.xml" with the mouse
- Create new file
 - Select directory, <F2 New>"New", <F8> "More functions", <F3> "SD definition"
 - or –
 - context menu of the directory (left mouse button), New, SD definition

6.4.2 General structure of the editor to define SD variables

Editor structure

The screenshot shows a window titled "SD definition [/feprom/SDDef.xml]". It contains a table with the following columns: Identifier, Type, Memory t..., Dimension, Init, and Comment. The table lists various system data variables such as Sys_Simulation, SysStates, SysHwStates, SysCtrl, SysSRun, SysChSRun, SysAPrg, SysAxTrafo1, SysAxTrafo2, SysAxCoupleCtr, SysAxCoupleCmd, SysAxCoupleSta, SysSpCmdData, SysSpActData, SysChSpActData, SysChSpSRun, SysAxSRun, SysMaxEd, SysTool, SysToolEd, SysReentry, and SysToolInsert. Each row provides details about the variable's type, memory, dimension, and initialization.

Identifier	Type	Memory t...	Dimension	Init	Comment
Sys_Simulation	Boolean_t	volatile	Channel		Channel specific variable; true: during simul...
SysStates	SysStates_t	volatile			System States Page
SysHwStates	SysHwStates_t	volatile			System Hardware States
SysCtrl	SysCtrl_t	volatile			System Control Page
SysSRun	SysSRun_t	permanent	Channel		SearchRun data
SysChSRun	SysChSRun_t	volatile	Channel		Channel search run data
SysAPrg	SysAPrg_t	permanent	Channel	X	autom. Program Selection data
SysAxTrafo1	SysAxTrafo_t	volatile	Channel		active AT-1 data
SysAxTrafo2	SysAxTrafo_t	volatile	Channel		active AT-2 data
SysAxCoupleCtr	SysAxCoupleCtr_t	volatile			System axis couple command data validation...
SysAxCoupleCmd	SysAxCoupleCmd_t	permanent	Drive		System axis couple data preparation
SysAxCoupleSta	SysAxCoupleSta_t	volatile	Drive		System axis couple status data
SysSpCmdData	SysSpCmdData_t	volatile	Spindle		System spindle command data
SysSpActData	SysSpActData_t	volatile	Spindle		System spindle actual data
SysChSpActData	SysChSpActData_t	volatile	Channel		Channel channel spindle actual data
SysChSpSRun	SysChSpSRun_t	volatile	Channel		Channel spindle search run data
SysAxSRun	SysAxSRun_t	volatile	Drive		Channel axis search run data
SysMaxEd	SysMaxEd_t	volatile		X	Max. number of tool edges for HMI
SysTool	SysTool_t	permanent	Channel		Active tool, active edge and prepared tool
SysToolEd	SysToolEd_t	volatile	16,Channel		Image of NC-kernel tool correction data (re...
SysReentry	SysReentry_t	volatile			Reentry data
SysToolInsert	DBT1Rec_t	volatile			System Data of Type DBT1Rec_t

Fig. 6-11: Editor structure

The editor consists of a list with six columns:

- Identifier
- Type
- Memory type
- Dimension
- Init
- Comment

Input options in the individual columns

Each column has its individual input options. There are freely editable input fields and predefined selection lists.

- Identifier
 - Freely editable SD variable name.
- Type
 - Selection from a list of all data types defined in the schema files.
- Memory type
 - Selection between volatile and permanent.
- Dimension
 - Selection between Channel, Drive and Spindle or
 - freely editable dimension.

- Init (no entry)
 - Information whether there is an initialization value defined for the variable in the "SDdatxxx.xml" file.
- Comment
 - freely editable comment

More Information If there is further information on cell contents, the cell is marked with a red triangle. The information is displayed when moving over the element with the mouse or selecting the cell with the <cursor> keys via tooltips.

2 options for further information

- Text for column width too long

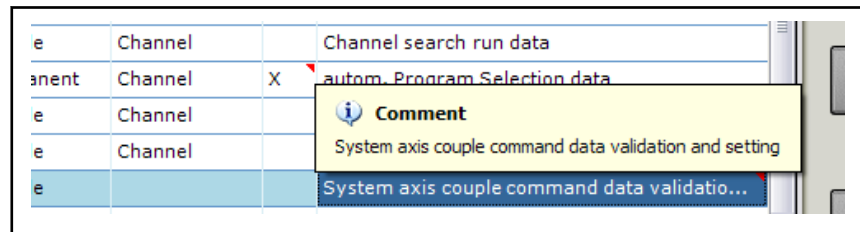


Fig. 6-12: Text for column width too long

- Display of the initialization values in the "Init" column

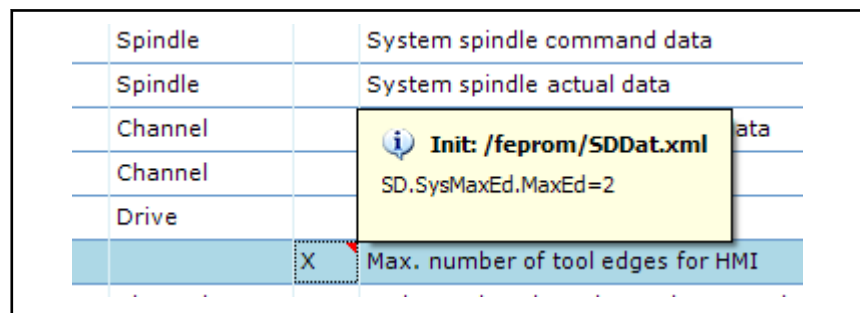


Fig. 6-13: Display of the initialization value

Error display Already defined variables referring to a type that is not available in the schema files anymore are colored in red. If the incorrect line is focused, an error message is displayed in the status line.

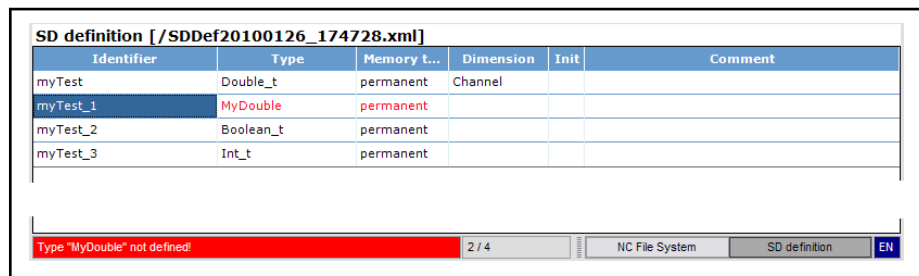


Fig. 6-14: Type not defined

6.4.3 Operation and navigation

It is operated via F-keys and cursor keys.

The cursor keys are used to navigate between the cells within the list.

Focused editable cells are colored in dark blue

An editable cell becomes an input field by:

- Entering a value
- Pressing <Enter>

- Double-clicking with the mouse

Basic level of F-keys The most important functions are contained in the basic level.

<F2> Add variable	<F3> Delete variable	<F4>	<F5>	<F6>	<F7>	<F8> More func- tions...	<F9> Close SD defi- nition
Add line for new variable	Delete focused line					Additional functions (second level)	Close applica- tion

Tab. 6-4: Basic level of F-keys

F-keys: Additional functions This level contains additional functions for the list management.

<F2> File	<F3>	<F4>	<F5>	<F6>	<F7>	<F8> Return	<F9>
Subsequent level: file						Return to basic level	

Tab. 6-5: F-keys: Additional functions

F-keys, file level The functions for the file handling are included in this level.

<F2>	<F3>	<F4> Save	<F5> Save As...	<F6> Print	<F7>	<F8>	<F9> Return
		Save file	File Save As under (differ- ent directory, different name)	Print file			Back in level, more func- tions

Tab. 6-6: F-keys, file level

Close, save, NC restart When closing the application, the file is saved after prompt. If the list is in-
complete, an error box is displayed and the incorrect lines are colored in red.

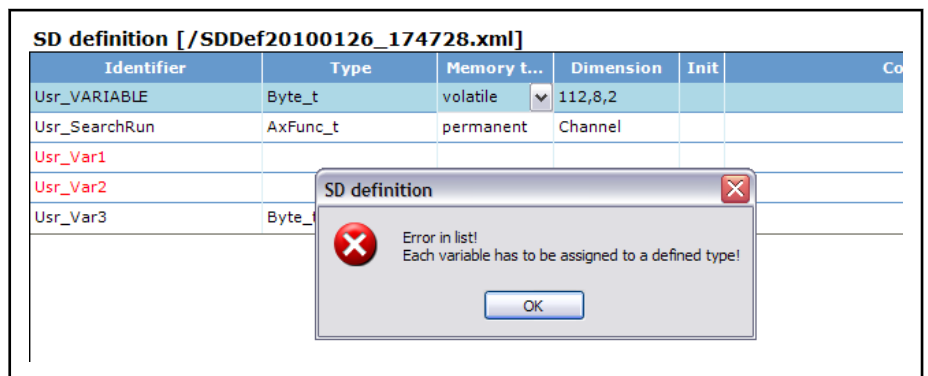


Fig. 6-15: List incorrect

Since changes in the SDDef file only become effective after an NC restart, the NC restart is automatically provided after saving the file.

"Save As" dialog To save the file under a different name or under a different directory, use the dialog **Save As**.

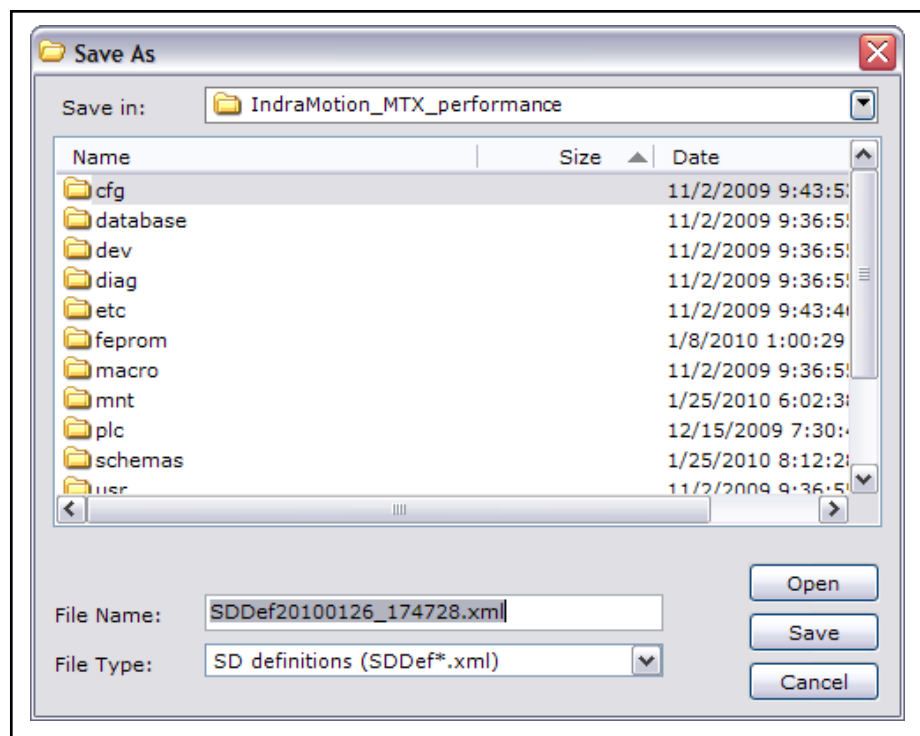


Fig. 6-16: Save As...

6.5 D-corrections, zero offsets and placements

6.5.1 Overview

Editors for NC data

The acronym "Table editors" summarizes the editors of the following NC data types:

- D-corrections
- Zero offsets
- Placements

Table editors visualize and to enter correction data of the individual NC data tables.

Screen layout

Structure

All table editors have a similar screen layout and similar operation.

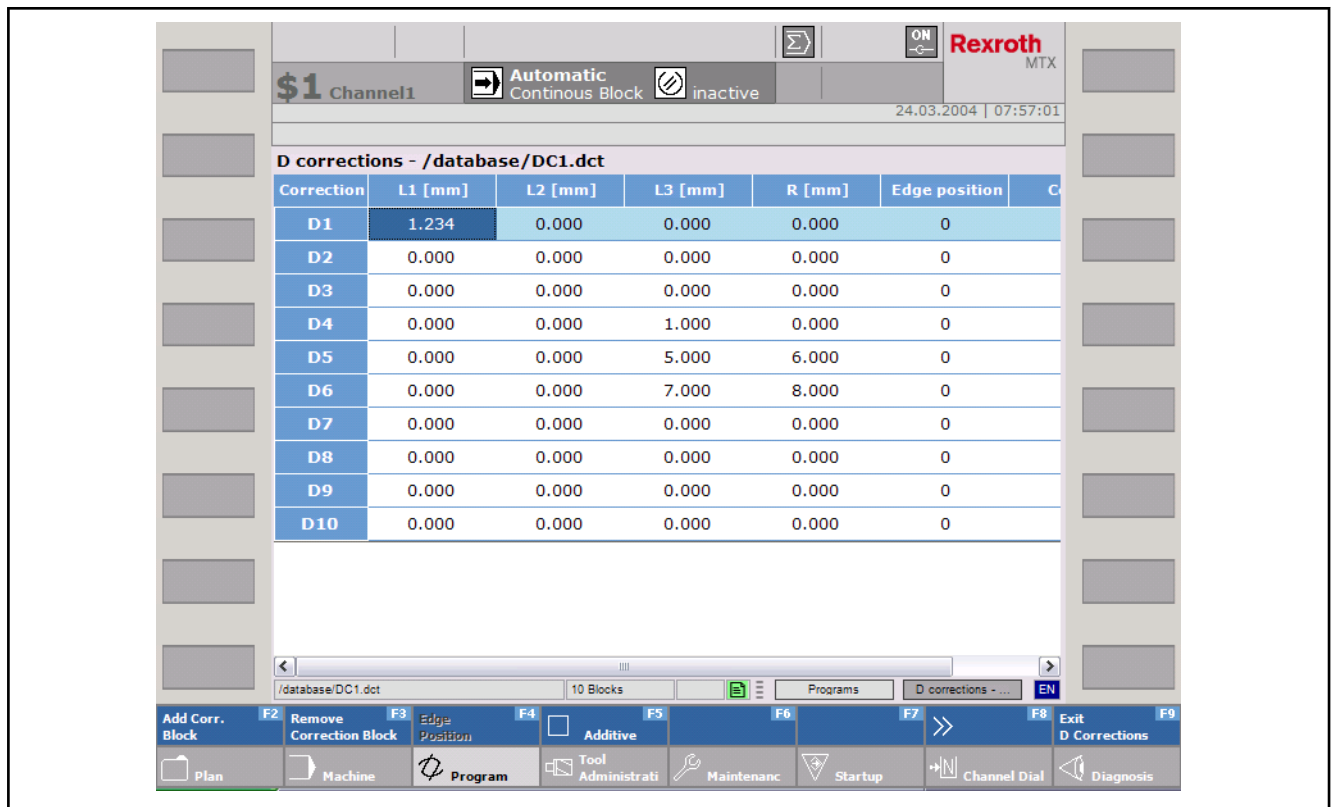


Fig. 6-17: Screen layout of a table editor

Title line

The title line displays the name of the table editor used, the directory and the file name of the table.

Main area

Correction values of an NC data table can be displayed and modified in the main area of the table editor.

The correction blocks of an NC data table are displayed in the lines of the table and the respective values of a correction block are shown in the columns of the table.

Status line

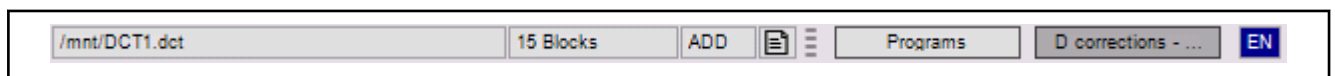


Fig. 6-18: Status line in the table editor

The status line of the table editors is divided into various areas:

- Information area
- Number of data blocks
- Additive value input
- Table active
- List of open windows in this operating area
- Current language

Info area

By default, the info area displays the table name including the path specification for the open table. Information texts and error messages can also be displayed during operation.

Number of data blocks	The number of displayed correction data blocks is shown in the second field.
Additive value input	The mode "Additive value input" is indicated in the third field by the text "ADD" (see chapter "Additive value input" on page 149).
Table active	A green symbol in the forth status field indicates the active table. Otherwise, the symbol is gray.



The fields "Open windows" and "Current language" are assigned by the system.

NC data tables

File storage and file access

NC data tables store data in the file system of the NC kernel. The table editors directly access the tables in the NC kernel. If correction values are modified using the table editor, these modifications are immediately written to the corresponding table in the NC kernel.

If correction values in the NC data tables are modified (e.g. using the CPL program), all table editors currently accessing the corresponding NC data table are notified. This ensures that the table editors always show the current correction values.



Values written to the active table are valid for the next access of the NC block preparation!

Table templates

A table template for each data type is in the "/database/" directory. These table templates are used to generate additional NC data tables.



If no other NC data table has been activated using an NC program, the table templates are active.

Data type	Template
D-corrections (.dct)	/database/DC1.dct
Zero offsets (.zot)	/database/ZO1.zot
Placements (.pmt)	/database/PM1.pmt

Tab. 6-7: Table templates

Table names

The data type of a table can be determined based on the file extension of the table name.

Data type	File extension
D-corrections	Dct (D correction table)
Zero offsets	Zot (z ero offset table)
Placements	Pmt (p lacement table)

Tab. 6-8: File extensions of tables

6.5.2 Operating

Value input

Navigating and selecting cells

To enter a correction value, the desired entry cell of the value first has to be selected as follows:

- Click on the desired cell.
- or -
- Navigate with the <cursor> keys until the desired cell is selected.
- or -
- Navigate via F-keys (see also [chapter "Function keys in the Table Editor" on page 150](#)).

The selected cell has a dark blue background color.

Editing values

Start editing mode

Switch to the editing mode of the selected cell with one of the following actions:

- Enter a value or a character using the keyboard.
- or -
- Pressing <Enter>.
- or -
- Double-click the cell.

A flashing input cursor in the respective cell indicates the editing mode.

Applying a value

Apply an edited value with one of the following actions:

- Pressing <Enter>.
- or -
- Pressing <Tab>.
- or -
- Pressing a <Cursor> key.
- or -
- Clicking on another cell with the mouse.

After applying the value, the entered value is directly written to the NC data table in the NC kernel.



If an incorrect value is entered, an error message is displayed in the status line and the selected cell remains in the editing mode. The entry can be cancelled or the value can be written again after the input correction.

Canceling value input

Cancel the editing mode at any time as follows:

Pressing <Esc>.

The original value is retained in the table.

Additive value input

The "Additive value input" mode is used to enter correction values added to the existing value.

Activating or deactivating the additive value input

"Additive value input" can be activated/deactivated as follows:

Press <F5 Additive> repeatedly until the desired mode is active.

A checkmark on the F-key indicates that the "Additive value input" mode is active.



The "Additive value input" is not intended for all cells. Whether "Additive value input" is active for the selected cell is indicated by the text "ADD" in the status line.

Subtracting values

To subtract a value from an existing value, enter a value with a leading minus sign when "Additive value input" is active.

Arithmetic operations

Simple arithmetic operations with several levels of parentheses can also be carried out when entering data in the "Additive value input" mode.

Function keys in the Table Editor

General information

The following table lists all general functions of table editors:

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level								Exit editor
2. Level	File...	Edit...	Navigate...			Tools...		Exit editor
File	New...	Open...		Save as...	Print		Exit all editors	
Edit	Undo	Restore		Copy	Paste			
Navigate	Find...	Find more	Replace	BoF	EoF	Previous value	Next value	
Tools							Options...	

Tab. 6-9: Function keys in the table editor

Functions on the main level

The functions on the main level (first level) of F-keys are explained in the description of the corresponding table editor.

Changing the level

Switch between the first and the second level of the F-keypad using <F8>.

The key  switches to the second level and  returns to the first level.

Exit editor

Pressing <F9> exits the table editor.

Functions on the second level of the F-keypad

The following functions can be found on the second level of the F-keypad:

- File
- Edit
- Navigate
- Tools
- Exit editor

All functions of the second level, with the exception of "Exit editor", have a subordinate F-keypad in which additional subfunctions are grouped.

File

- <F2 New>** This is used to create a new table and to display it in a new table editor. Amongst other things, a name for the new table has to be entered in a dialog .
- <F3 Open>** This is used to open a new table editor with the given table name.
- <F5 Save as>** The current table can be saved under a different name. In doing so, the table editor remains open.
- <F6 Print>** The print dialog for printing the current table is opened.
- <F8 Exit all editors>** <Exit all editors> is used to exit all open table editors of the corresponding data type (D-corrections, zero offsets or placements).

Edit

- <F5 Copy>** The contents of the selected cell are copied into the clipboard.
- <F6 Paste>** The contents of the clipboard are pasted into the selected cell. The selected cell enters the editing mode; this prevents the pasted value from being immediately transferred to the NC. Pressing the <Return> key adopts the value and transfers it to the NC. Pasting can be cancelled with <Esc> if the cell is in editing mode.

Navigate

- <F5 Start of file>** The cursor jumps to the beginning of the table (line 1, column 1).
- <F6 End of file>** The cursor jumps to the end of the table (last line).
- <F7 Previous value>** The cursor jumps to the cell to the left of the selected cell. If the cursor is at the beginning of a line, it jumps to the last column of the previous line.
- <F8 Next value>** The cursor jumps to the cell to the right of the selected cell. If the cursor is at the end of a line, it jumps to the first column of the next line.

Tools

This is used to open an F-keypad containing additional functions of the corresponding table editor.

6.5.3 Zero point offsets

General information on zero offsets

The zero offset editor is used for visualization and to enter the zero point values of individual axes. A comment with a maximum of 32 characters can be assigned to each correction value. If the offset applies to a specific channel only, this is displayed in an additional title line.

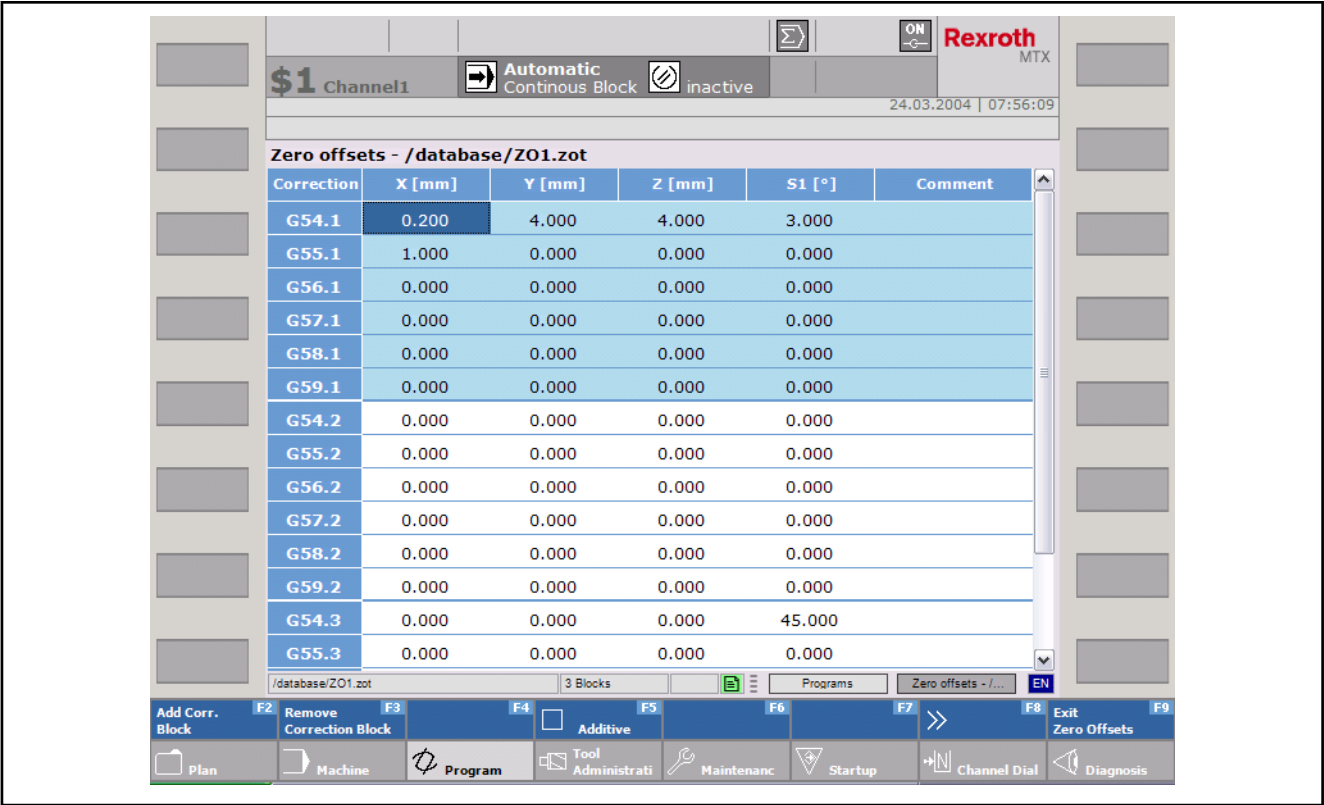


Fig. 6-19: Zero offset editor

- Number of correction banks

A zero offset table can contain a maximum of 5 correction banks, each of which contains offset values G54.x to G59.x.
- Axes

A zero offset table can contain a maximum of 64 axes.
- Measuring unit of the table (mm/ inch)

The measuring unit of a zero offset table can be detected by the column headers of the axes ([mm] or [inch] for linear axes, [°] for rotary axes).
- The measuring unit of a zero offset table is already determined from parameter 9020 00010 of the configuration data during the creation of the table and is stored with the table.
- Number of decimal places

The number of decimal points displayed is specified by the parameters 6020 00021 and 6020 00022 in the configuration data.

Zero offset editor

Operating the zero offset editor

Only the functions that affect the zero offset editor are described here. The general operation of a table editor is described in [chapter 6.5.2 "Operating" on page 149](#).

Function keys in the zero offset editor

The following table shows all function keys of the zero offset editor:

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level	Add correction record	Remove correction record		Additive				Exit zero points
2. Level	File...	Edit...	Navigate...			Tools...		Exit zero points
File	New...	Open...		Save as...	Print		Exit zero offsets	
Edit	Undo	Restore		Copy	Paste			
Navigate	Find...	Find next	Replace	BoF	EoF	Previous value	Next value	
Tools	Insert axis...	Delete axis	Edit axis				Options...	

Tab. 6-10: Function keys in the zero offset editor

Calling the zero offset editor

Open existing zero offset table

Open any existing zero offset table in the operating area "Program OP4" using the MTX-Navigator or directly from an already started zero offset editor.

To open a zero offset table from the MTX-Navigator:

1. Call the MTX-Navigator in the operating area "Program OP4".
2. Open the desired zero offset table (file ending .zot) as follows:
 - Double-click on the table name with the mouse.
 - or -
 - Select the table name and press <F6 Edit>.
 - or -
 - Select the table name and select the menu item **Edit** via the context menu.
 - or -
 - Select the table name and press <Enter>.

The selected zero offset table opens in the zero offset editor.

To open an existing zero offset table from an already started zero offset editor:

1. Press <F8> to switch to the second F-keypad level and click on <F2 File...> to switch to the file functions.
 2. Press <F3 Open....>.
- A dialog opens in which the desired zero offset table can be selected.
3. Confirm the selection of the zero offset table with "OK".

Another zero offset editor with the selected zero point table opens.

Opening active zero offset table

The active zero offset table can be opened via the NC screen in the operating area "Machine <OP3>".

1. Open the NC screen in the operating area "Machine <OP3>".
2. Press <F5 Active zero points>.

The zero offset editor with the active zero offset table opens.



If no zero offset table is active, a corresponding message is displayed in the status line of the NC screen.

Creating a new zero offset table

Create a new zero offset table either using the MTX-Navigator or via an already open zero offset editor. By default, a newly created zero offset table has one correction record.

Calling from the MTX Navigator

1. Select the directory, in which the new zero offset table is to be created, in the MTX Navigator using the mouse or the cursor keys.
2. Press <F2 New> and <F7 Zero offsets> in the sublevel of the F-keypad.

- or -

Select the menu item **New ► Zero offsets** in the context menu.

A dialog (see [fig. 6-20 "Dialog to create a new zero offset table" on page 154](#)) opens to create a new zero offset table (continue with point 3).

Calling from the zero offset editor

1. Press <F8> to switch to the second F-keypad level and press <F2 File...> to switch to the file functions.
2. Press the <F2 New...> key.

A dialog opens to create a new zero offset table (see [fig. 6-20 "Dialog to create a new zero offset table" on page 154](#)).

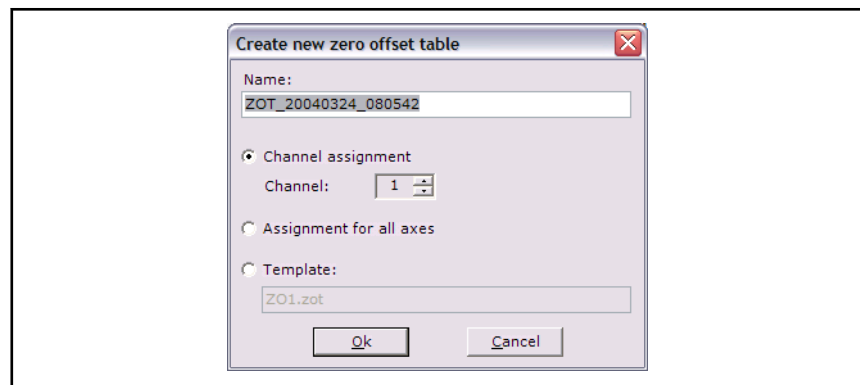


Fig. 6-20: Dialog to create a new zero offset table

The following options are available when creating a new zero offset table:

- All channel axes of a channel (Channel assignment):
A zero offset table with the axes of the selected channel is created.
- All system axes (Assignment for all axes):
The created zero offset table contains all the configured axes of the system.
- Using an existing table (template):
Any zero offset table can be specified as template to create a new table.

3. Enter the name of the zero offset table. An automatically generated table name is displayed as default
4. If several channels are configured, select the desired channel with the "Channel axes" selection field.

- or -

- Select system axes ("Assignment for all axes").
- or -
- Use an existing table as template for a new table (see ["Using table templates" on page 155](#)).

5. Close the dialog with "OK".

A zero offset table with the selected configuration is created and opened in the zero offset editor.

Using table templates

Proceed as follows to use any zero offset table as template:

1. Open the **New** dialog (see [fig. 6-20 "Dialog to create a new zero offset table" on page 154](#)) as described above.
2. If necessary, enter a new name for the zero offset table.
3. Select "Template" in the **New** dialog.

The input field for the name of the template (default: "ZO1.zot") is enabled. If the default "ZO1.zot" is not used, a name with the path specification of another zero offset table can be entered. If a table name is entered without path specification, it is searched for the template in the path "/database".

4. Confirm entry with "OK".

The new table opens in the zero offset editor. The number of correction banks and correction values is applied from the given template.

Functions on the main level of the zero offset editor

<F2 Add correction record>

<F2 Insert correction record> can be used to add new zero point data blocks to the table. New data blocks are attached at the end of the table.



Zero offset data blocks are continuously numbered (correction record 1-5).

<F3 Remove correction record>

<F3 Remove correction record> removes the last zero offset data block.

Additive value input

"Additive value input" can be used to enter correction values to be added to the existing value (see [chapter "Value input" on page 149](#)).

Menu: Tools

<F2 Insert axis>

<F2 Insert axis> inserts a new axis at any location.

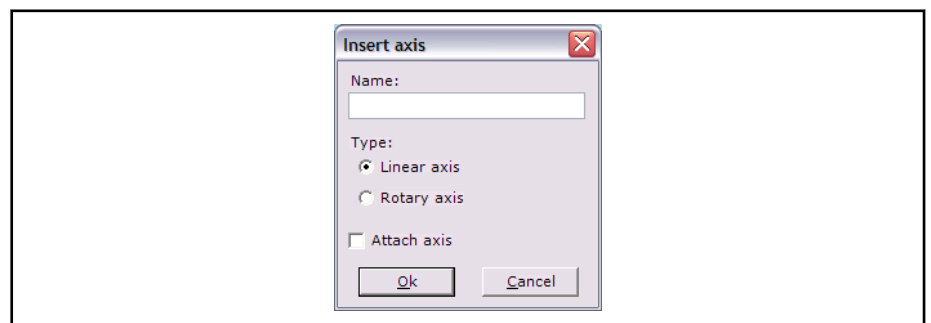


Fig. 6-21: Dialog to insert a new axis

1. Select the axis in front of which the new axis is to be inserted (i.e. any cell of the axis has to be selected).
2. Press <F2 Insert axis>.

The selected axis is highlighted. The dialog **Insert Axis** opens (see [fig. 6-21 "Dialog to insert a new axis" on page 155](#)).
3. Enter the axis name (maximum of 8 characters).

4. Select the axis type "Linear axis" or "Rotary axis".
5. If necessary, specify a special channel ("0" for all)
6. If the axis is to be attached, select "Attach axis" as well.
7. Complete the entry with "Ok".

The new axis is inserted according to the settings.



- To attach the new axis at the end, select any cell.
- Cancel the **Insert axis** dialog at any time with <Cancel>.

<F3 Delete axis>

Deletes an axis from the zero offset table.

1. Select the desired axis (i.e. any cell of the axis has to be selected).
2. Press the <F3 Delete axis> key.

The selected axis is highlighted and a safety prompt about the deletion of the axis is displayed.

3. Confirm deletion with "Yes".

The selected axis is deleted.

- or -

Cancel deletion with "No".

The "Delete axis" function is cancelled.

<F4 Edit axis>

Change axis name and axis type of an axis with <F4 Axis>.

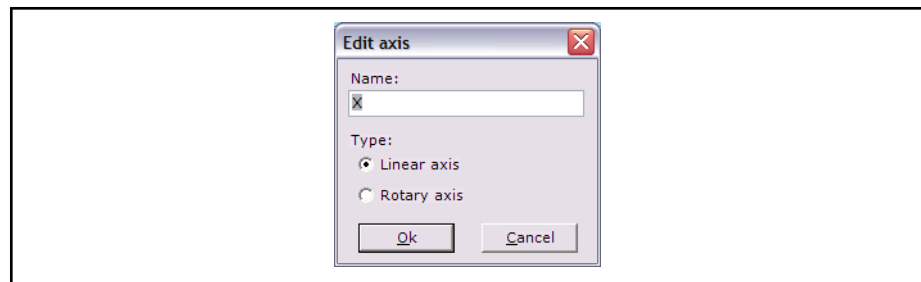


Fig. 6-22: Dialog to edit an axis

1. Select the desired axis (i.e. any cell of the axis has to be selected).
2. Press <F4 Edit axis>.

The selected axis is highlighted and a dialog **Edit axis** to change axis name and axis type is displayed (see [fig. 6-22 "Dialog to edit an axis" on page 156](#)).

3. Edit the axis name if necessary.
4. Select a new axis type if necessary.
5. Specify a special channel ("0" for all) if necessary.
6. Complete the editing with "Ok".

Changes to the axis become immediately visible in the table.



- Cancel the "Edit axis" dialog at any time with "Cancel".

6.5.4 D-corrections

General information on D-corrections

The D-correction editor can display and change the length correction values L1, L2, L3, the radius correction value R and the edge position for the various

D-correction data blocks. In addition, a comment with a maximum of 32 characters can be assigned to each correction block.

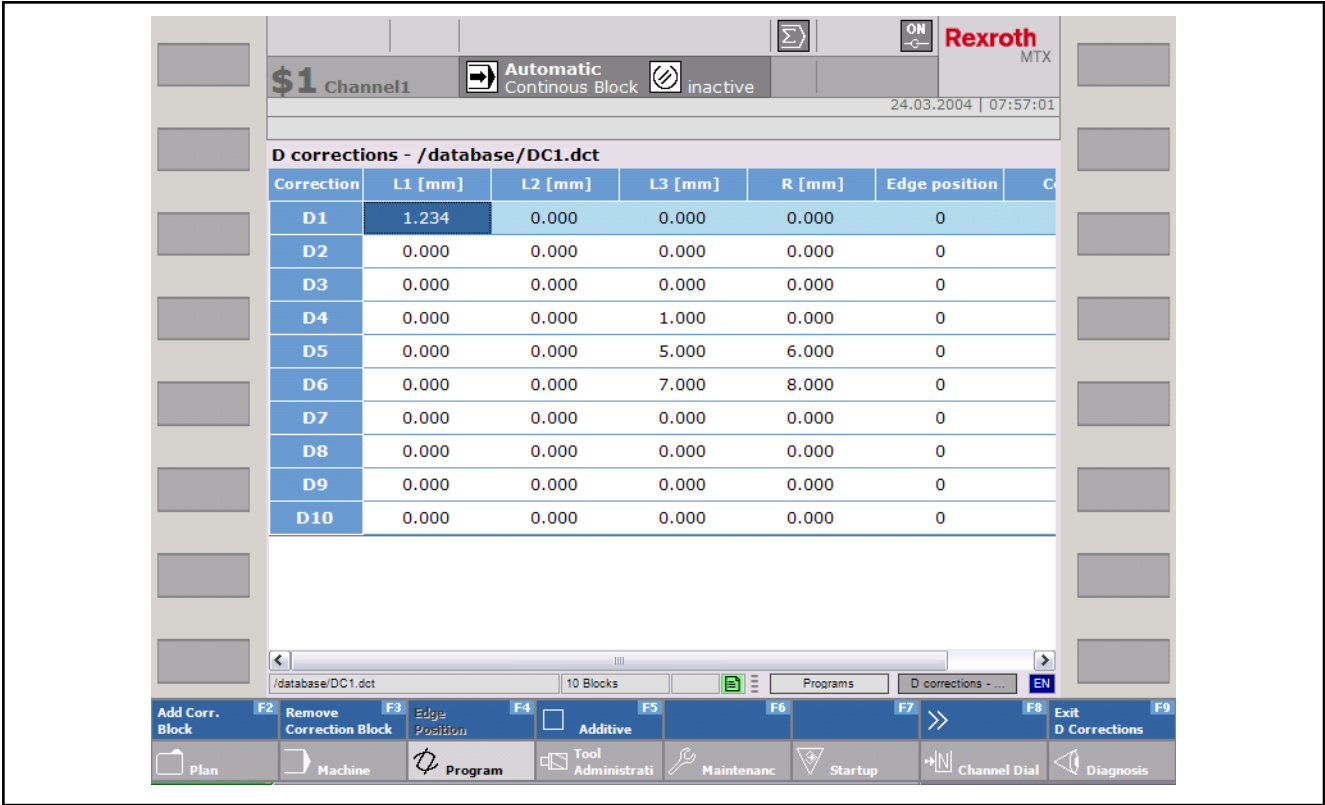


Fig. 6-23: D-correction editor

Number of correction blocks A D-correction table can contain a maximum of 99 D-correction data blocks (D1-D99). The number of D-correction tables is unlimited.

Measuring unit of the table (mm/ inch) The measuring unit of a D-correction table can be determined based on the column headers of L1, L2, L3 and R ([mm] or [inch]).



The measuring unit of a D-correction table is already determined from the parameter 9020 00010 of the configuration data during the creation of the table and is stored with the table.

Number of decimal places The number of decimal points displayed is specified by the parameters 6020 00021 and 6020 00022 in the configuration data.

Operating the D-correction editor

General information

Only the functions affecting the D-correction editor are described. The general operation of a table editor is described in [chapter 6.5.2 "Operating" on page 149](#).

Function keys in the D-correction editor

The following table shows all function keys of the D-correction editor:

F-keypad level	<F2>	<F3>	F4	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level	Add correction block	Remove correction block		Additive				Exit D-corrections
2. Level	File...	Edit...	Navigate...					Exit D-corrections
File	New...	Open...		Save as...	Print		Exit zero offsets	
Edit	Undo	Restore		Copy	Paste			
Navigate	Find...	Find next	Replace	BoF	EoF	Previous value	Next value	
Tools							Options...	

Tab. 6-11: Function keys in the D-correction editor

Calling the D-correction editor

Open existing D-correction table

Open any existing D-correction table in the operating area "Program OP4" via the MTX-Navigator or directly from an already started D-correction editor.

To open a D-correction table from the MTX-Navigator:

1. Call the MTX-Navigator in the operating area "Program <OP4>".
2. Open the desired D-correction table (file extension.dct) as follows:
Double-click on the table name with the mouse.
- or -
Select the table name and press <F6 Edit>.
- or -
Select the table name and select the menu item **Edit** via the context menu.
- or -
Select the table name and press <Enter>.

The selected D-correction table opens in the D-correction editor.

To open an existing D-correction table from an already started D-correction editor:

1. Switch to the second F-keypad level with <F8> and switch to the file functions with <F2 File...>.
2. Press <F3 Open....>.
A dialog opens to select the desired D-correction table.
3. Confirm the selection of the D-correction table with "OK".
Another D-correction editor with the selected D-correction table opens.

Opening active D-correction table

Open the active D-correction table in the operating area "Machine <OP3>" via the NC screen.

1. Open the NC screen in the operating area "Machine <OP3>".
2. Press the <F6 Active D-corrections> key.

The D-correction editor with the active D-correction table opens.



If no D-correction table is active, a corresponding message is displayed in the status line of the NC screen.

Creating a new D-correction table

Create a new D-correction table either via the MTX Navigator or an already open D-correction editor. A newly created D-correction table has one D-correction "D1" by default. Alternatively, any D-correction table can be used as template to create a new table.

Calling from the MTX Navigator

1. Select the directory - in which the new D-correction table is to be created - in the MTX Navigator. Use the mouse or the <cursor> keys.
2. Press <F2 New> and then <F6 D-corrections> in the sublevel of the F-keypad.

- or -

Select the menu item **New ► D-Corrections** in the context menu.

A dialog (see [fig. 6-24 "Dialog to create new D-correction table" on page 159](#)) opens to create a new D-correction table (continue with point 3).

Calling from the D-correction editor

1. Press <F8> to switch to the second F-keypad level and click on <F2 File...> to switch to the file functions.
2. Press the <F2 New...> key.

A dialog opens to create creating a new D-correction table (see [fig. 6-24 "Dialog to create new D-correction table" on page 159](#)).

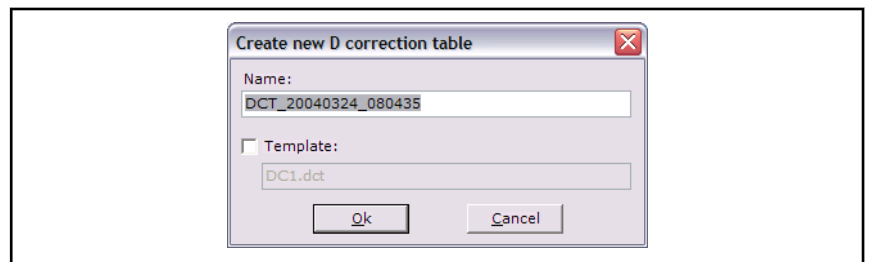


Fig. 6-24: Dialog to create new D-correction table

3. Enter the name of the D-correction table. An automatically generated table name is displayed as default
4. Close the dialog with "OK".

A D-correction table is created and opened in the D-correction editor.

Using table templates

Proceed as follows to use any D-correction table as template:

1. Open the **New** dialog (see [fig. 6-24 "Dialog to create new D-correction table" on page 159](#)) as described above.
2. If necessary, enter a new name for the D-correction table.
3. Select "Template" in the **New** dialog.

The input field for the name of the template (default: "DC1.dct") is enabled. If the default template "DC1.dct" is not used, a name with the path specification of another D-correction table can be entered.

If a table name is entered without path specification, it is searched for the template in the path "/database".

4. Confirm entry with "OK".

The new table opens in the D-correction editor. The number of D-correction blocks and D-correction values is assumed from the given template.

Functions on the main level of the D-correction editor

<F2 Insert correction block> With <F2 Insert correction block>, new D-correction data blocks can be added. New data blocks are attached at the end of the table.

 D-correction data blocks are assigned continuously (D1-D99).

<F3 Remove correction block> <F3 Delete correction bank> is used to remove the last placement data block.
Additive value input <Additive value input> can be used to enter D-correction values added to the existing value (see section [chapter "Value input" on page 149](#)).

6.5.5 Placements

General information on placements

The placement editor is used to display and enter offset values (X, Y, Z) and turning angles (phi, theta, psi). A comment with a maximum of 32 characters can be assigned to each correction value.

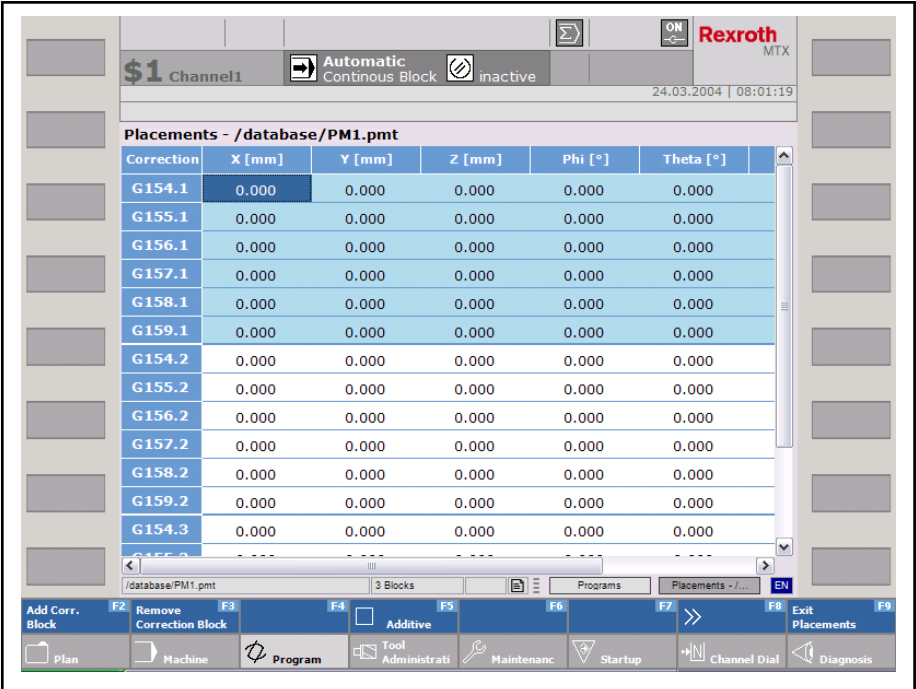


Fig. 6-25: Placement editor

Number of correction banks A placement table can contain a maximum of five correction banks, each of which contains offset values G154.x to G159.x.

Measuring unit of the table (mm/ inch) The measuring unit of a placement table can be determined based on the column headers of X, Y and Z ([mm] or [inch]). The turning angles phi, theta and psi have the unit [°].

 The measuring unit of a D-correction table is already determined from the parameter 9020 00010 of the configuration data during the creation of the table and it is stored with the table.

Number of decimal points The number of decimal points displayed is specified by the parameters 6020 00021 and 6020 00022 in the configuration data.

Operating the placement editor

General information

Only the functions affecting the placement editor are described. The general operation of a table editor is described in [chapter 6.5.2 "Operating" on page 149](#).

Function keys in the placement editor

The following table shows all function keys of the placement editor:

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level	Add correction record	Remove correction record		Additive				Exit placements
2. Level	File...	Edit...	Navigate...					Exit placements
File	New...	Open...		Save as...	Print		Exit all placements	
Edit	Undo	Restore		Copy	Paste			
Navigate	Find...	Find next	Replace	BoF	EoF	Previous value	Next value	

Tab. 6-12: Function keys in the placement editor

Calling the placement editor

Opening existing placement table

Open any existing placement table in the operating area "Program <OP4>" via the MTX-Navigator or directly from an already started placement editor.

To open a placement table from the MTX-Navigator:

1. Call the MTX-Navigator in the operating area "Program <OP4>".
2. Open the desired placement table (file extension.pmt) as follows:
 - Double-click on the table name with the mouse.
- or -
 - Select the table name and press <F6 Edit>.
- or -
 - Select the table name and select the menu item **Edit** via the context menu.
- or -
 - Select the table name and press <Enter>.

The new placement table is opened in the placement editor.

To open an existing placement table from an already started placement editor:

1. Switch to the second F-keypad level with <F8> and press <F2 File...> to switch to the file functions.
2. Press <F3 Open....>.

A dialog opens to select the desired placement table.

3. Confirm the selection of the placement table with "OK".

A second placement editor with the selected placement table opens.



If the entered name of the placement table does not exist, a corresponding error message is displayed in the status line.

Opening active placement table

Open the active placement table via the NC screen in the operating area "Machine <OP3>" via a key to be configured by the user.

1. Open the NC screen in the operating area "Machine <OP3>".
2. Press <Fx Active placements>.

The placement editor with the active placement table opens.



If no placement table is active, a corresponding message is displayed in the status line of the NC screen.

Changes in the placements become only active after reselection of the placement table or after program restart.

Creating a new placement table

Create a new placement table either via the MTX Navigator or via an already open placement editor. By default, a newly created placement table has one correction record. Alternatively, any placement table can be used as template to create a new table.

Calling from the MTX Navigator

1. Select the directory in which the new placement table is to be created in the MTX Navigator using the mouse or arrow keys.
2. Press <F2 New> and then <F8 Placements> in the sublevel of the F-keypad.

- or -

Select the menu item **New ► Placements** in the context menu.

A dialog opens (see [fig. 6-26 "Dialog to create a new placement table" on page 162](#)) to create a new placement table (continue with point 3).

Calling from the placement editor

1. Switch to the second F-keypad level with <F8> and press <F2 File...> to switch to the file functions.
2. Press the <F2 New...> key.

A dialog opens to create a new placement table (see [fig. 6-26 "Dialog to create a new placement table" on page 162](#)).

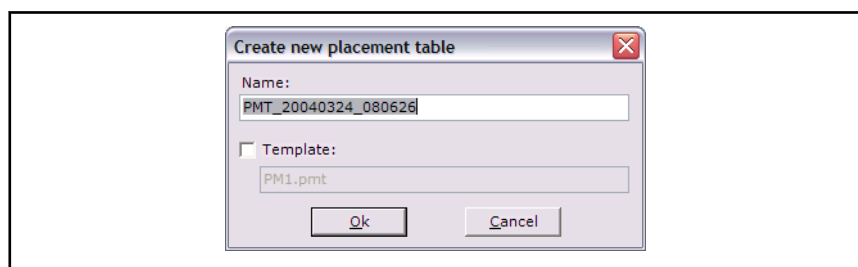


Fig. 6-26: Dialog to create a new placement table

3. Enter the name of the placement table. An automatically generated table name is displayed as default
4. Close the dialog with "OK".

A placement table is created and opened in the placement editor.

Using table templates

Proceed as follows to use any placement table as template:

1. Open the **New** dialog (see [fig. 6-26 "Dialog to create a new placement table" on page 162](#)) as described above.
2. If necessary, enter a new name for the placement table.
3. Select "Template" in the **New** dialog.

The input field for the name of the template (default:"PM1.pmt") is enabled. If the default template "PM1.pmt" is not to be used, a name with the path specification of another placement table can be entered. If a table name is entered without path specification, it is searched for the template in the path "/database".

4. Confirm entry with "OK".

The new table opens in the placement editor. The number of correction banks and correction values is applied from the given template.

Functions on the main level of the placement editor

<F2 Add correction record>

<F2 Insert correction record> can be used to add new placement data blocks to the table. New data blocks are attached at the end of the table.



Placement data blocks are continuously numbered (correction bank 1-5).

<F3 Remove correction record>

<F3 Delete correction record> is used to remove the last placement data block.

Additive value input

<Additive value input> can be used to enter correction values to be added to the existing value (see [chapter "Value input" on page 149](#)).

7 Tool management

7.1 Overview

7.1.1 General information

Managing tool data is of high significance for the control of machine tools. Among other things, the tool data contains the:

- Tool identification
- Correction value calculation
- Tool life management
- Type definition

In MTX CNC system, the tool data blocks are divided into two parts:

- System data for the unique identification of tools
- User tool data for application-specific tool data

When the "Tools" operating area is activated, the tool list defined as the start list is displayed first. The information required is saved in file **"ToolManagementApp.xml"** and in the referenced list configuration files. From this list, F- or M-key functions can be used to retrieve additional configured list displays. Furthermore, the list configuration (display method) or the list query (content) can be changed. To completely edit a data block, the tool editor can be retrieved from the tool list of the selected entry.

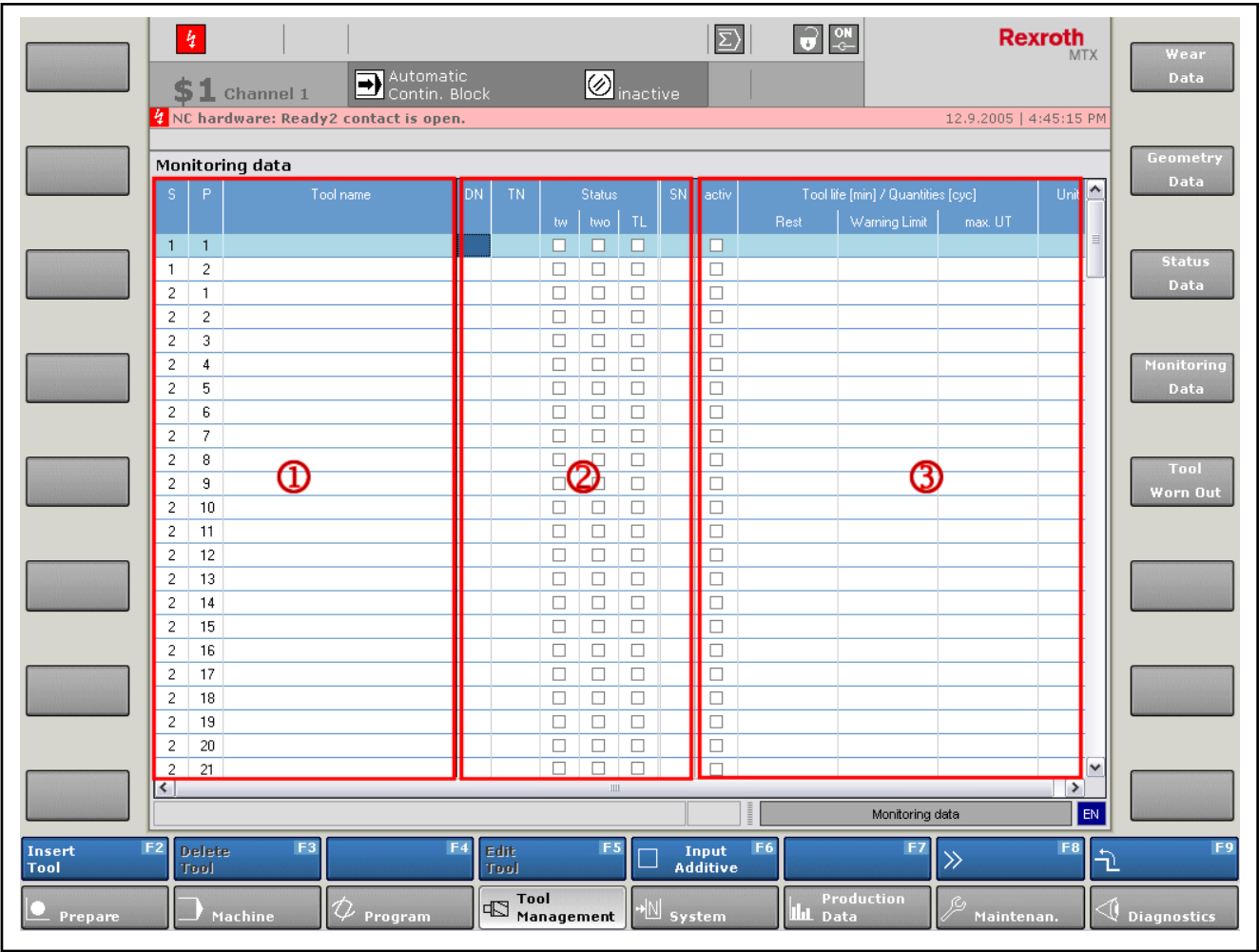
7.1.2 Data management

The data of the external tool corrections is managed in a database. The database is subdivided into database tables. Currently, two database tables are available. By default, database table 1 is used to manage data of the external tool corrections. Accordingly, database table 2 is available to manage pallet data for example.

7.1.3 Screen layout

Structure of the tool list

All tool lists show a number of tool data blocks resulting from the list definition as table. The data of a data block is shown in a group of lines consisting of one or more lines (also called a partial list or a sublist) in the tool list. The tool data is always displayed according to location, i.e. each partial list is an (occupied or unoccupied) tool location. Depending on the list definition, tool lists can differ according to number and properties of the displayed data blocks and according to their method of display and the contained data elements.



- 1
- Fixed table area
- 2
- Frozen table area
- 3
- Scrollable area

Fig. 7-1: Screen layout of a tool list

Functions of the table areas.

Fixed table area:	no cursor navigation possible	Always visible
Frozen table area:	Cursor navigation possible	Always visible
Scrollable table area:	Cursor navigation possible	not always visible

Structure of the tool editor

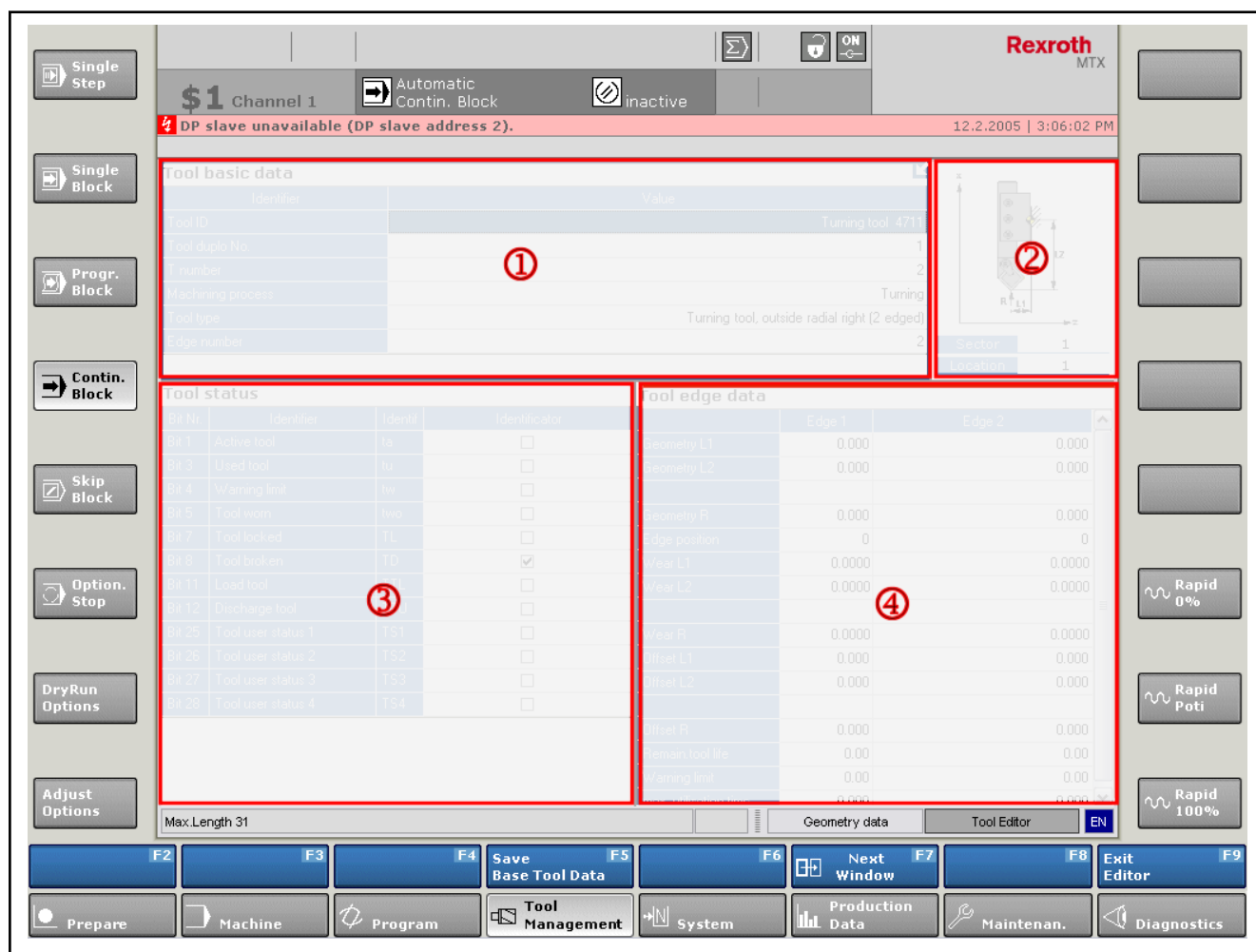
Overview

Like the NC main screens, the tool editors functions as ACI application (Active-Container-Interface).

This means

- It is freely configurable
- It contains several data containers which in turn can contain several controls.

- The controls can also be configured.
- The navigation of the cursor, and thus the editing, only takes place in the focused container.



- 1 Basic data container (contains 1 control)
- 2 Bitmap container
- 3 Status and tool data container (contains two controls)
- 4 Service life container (contains two controls)

Fig. 7-2: Container layout of the tool editor

Title

The name of the tool list or the control is displayed in the title.

Main area (tool list)

Data elements of a tool data table can be displayed and modified in the main area of the tool list.

The tool data blocks of a tool data table are displayed in the lines/line groups (partial lists) of the table.

The main area can be divided into three parts in the tool list configuration (see Fig. 7-1 Screen layout of a tool list, page 166):

1. Fixed, non-editable table area:

This table area contains data that cannot be edited and which is used to identify the data blocks.

2. Frozen, editable table area:

This table area contains data that can be edited and which is nevertheless used to identify the data blocks. Thus, they always have to be visible.

3. Scrollable table area:

This part of the table contains all other data that can be edited.

The two fixed table areas are to be kept as small as possible so that extensive scrolling is prevented.

Status line



Fig. 7-3: Status line in the tool list display

The status line of the tool list display is divided into several areas:

- Information area
- Additive value input
- List of open windows in this operating area
- Current language

Information area

If a limit value is defined for the tool data element selected in the list using cursor navigation, the input limits are displayed in the information area.

Limit values can be defined as follows:

- Data element-related in a scheme and/or
- Tool **and** data element-related in the list configuration

Absolute, additive, diameter value input

The mode "Additive value input" is shown in the second field by the text "ADD" (see [chapter Additive value input, page 169](#)).

The mode "Absolute value input" is shown in the second field by the text "ABS".

The mode "Diameter value input" is shown in the second field by the text "DIA" (see [Diameter input, page 169](#)).



The fields "Open windows" and "Current language" are assigned by the system.

7.2 Operation

7.2.1 Value input

Navigating and selecting cells

To enter a correction value, the following options are available to select the desired input cell:

- Click on the desired cell.
- Navigate with the <cursor> keys until the desired cell is selected.

The selected cell has a dark blue background color.

The selected partial list can be detected by the light blue background color.

Editing values

Start editing mode

Switch to the editing mode of the selected cell with one of the following actions:

- Entering a value or a character using the keyboard

- Pressing <Enter>
- Double-clicking on the cell

A flashing input cursor in the respective cell indicates the editing mode.

Applying value

Apply an edited value with one of the following actions:

- Pressing <Enter>
- Pressing <Tab>.
- Pressing a <Cursor> key.
- Clicking on another cell with the mouse.

After applying the value, the entered value is directly written to the NC data table in the NC kernel.



If an incorrect value is entered, an error message is displayed in the status line and the selected cell remains in the editing mode. The entry can be cancelled or the value can be written again after the input correction.

Canceling the value input

The editing mode can be cancelled at any time as follows:

- Pressing <Esc>.

The original value is retained in the table.

Conditional editability

During the editor/list configuration, it is possible to define the editability of a data element depending on an additional process variable.

Example:

Conditional editability

Depending on data element BQ2 - bit 0 (Tool active), the editing of selected tool data can be prohibited.

Additive value input

The "Additive value input" mode is used to enter correction values added to the existing value.

Activating or deactivating the additive value input

The "additive value input" can be activated/deactivated as follows:

- Press <F6> repeatedly until the desired mode is active.
- or set/reset menu function **Edit ► Additive**.

A checkmark on the F-key indicates that the "Additive value input" mode is active.

Diameter input

If input mode "Additive" is activated and if diameter input for the selected data element in the scheme was permitted using the data attribute "ETA = DI" and if the ID for diameter input (ToolCatalog/TITech/TIType/CoTo/DIA) was set in the tool catalog for the tool to be edited, the additive value is input as diameter value, i.e. half of the input value is added.



The additive value input is not intended for every cell; it can be specified in the scheme file. Whether Additive value input is active for the selected cell is indicated by the text "ADD" in the status line.

Subtracting values

To subtract a value from an existing value, enter a value with a leading minus sign when "Additive value input" is active.

Arithmetic operations Simple arithmetic operations with several levels of parentheses can also be carried out when entering data in the "Additive value input" mode.

7.2.2 Function keys in the tool management

When the "Tools" operating range is entered, the first level of the F-key level of the tool list is retrieved as uppermost F-keypad (default condition). The first level is defined in the file "HMI.FKeys.ToolmanList3.xml", the second level in the file "HMI.FKeys.ToolmanList2.xml". Both can be modified by the user in the F-key configurator of IndraWorks Engineering.

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level	Insert tool	Delete tool		Edit tool	Input additive	Filter active		Sector selection
2. Level	Export list	Import list	Import tool	Define filter				Sector selection

Tab. 7-1: Function keys in the tool table editor

Press <F8> to switch between the levels.

Press <F9> to activate the user-configurable F-keypad for the sector selection:

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. level	Sector 1	Sector 2	Sector 3	All tools				

Tab. 7-2: User function keys in the tool management

It is also possible to define your own user screen as the entry screen for the operating area. Upon delivery, it is entered directly via the latest selected tool list.

7.2.3 M-Keys for tool list display

In the default configuration, all list displays have their own M-keypads with the following functions:

M-key	Function
<R1>	Wear data display
<R2>	Geometry data display
<R3>	Status data display
<R4>	Monitoring data display
<R5>	Worn tools with wear data display

Tab. 7-3: M-key assignment for tool list

M-keys can be configured in the following files in IW Engineering:

Right M-keypad:	HMI.MKeys.MTXToolList_R.Visu.xml HMI.MKeys.MTXToolList_R.xml
Left M-keypad:	HMI.MKeys.MTXToolList_L.Visu.xml HMI.MKeys.MTXToolList_L.xml

Tab. 7-4: M-key definitions in the tool editor

If no M-keypads were assigned to the tool list definition, "global" M-keys become effective.

7.2.4 Tool list display

List contents

Here, 'list content' is understood to be the selection of the indicated tool data blocks.

The query definitions in the "ToolManagementApp.xml" file specify the data blocks to be displayed in a tool list.

In the MTX, the F- or M-keys can be freely assigned to up to 16 predefined list displays in the F- or M-key configurator. Additional list displays are possible, but not provided in the configuration dialog. They have to be entered manually into the configuration file of the corresponding F-keypads or M-keypads

(see definition "HMI.Fkeys.ToolmanApp1.xml" above).

Channel-dependent tool list display

The tool list can be visualized with regard to the channel.

Thus, use "ChannelQuery" for the database query of the list.

This query can be defined in the query configurator in IndraWorks Engineering. An individual query is defined for each channel read at channel switching results in a new channel-dependent tool list display.

A channel-dependent list is labeled by default in the list title by the addition "**(active channel)**".

Channel-dependent tool list display

The tool list can be visualized channel-dependently.

Thus, use "ChannelQuery" for the database query of the list.

This query can be defined in the query configurator in IndraWorks Engineering. An individual query is defined for each channel read at channel switching results in a new channel-dependent tool list display.

A channel-dependent list is labeled by default in the list title by the addition "**(active channel)**".

Display formats

The list structure is controlled by a tool list configuration file entered into the "ULCConfigFile" data element of the corresponding action definition in the "ToolManagementApp.xml" file. Upon delivery, the configuration file "MTX.Toolman.ToolListConfiguration.xml" is always assigned to the tool lists.

By default, the tool lists have the following display formats:

- Geometry list
- Wear list
- Tool life list
- Status list
- List of worn tools displayed as a service life list.

As opposed to all other lists that display all tools of the selected sectors, this list contains a special query definition to select worn tools.

Highlighted format

It is possible to highlight tool data blocks in the tool list depending on a process variable. Any number of formats is possible

Example:

Highlighted format

1. BQ2 - bit 0 (Tool active) background color 1

- 2. BQ2 - bit 4 (Tool worn) background color 2
- 3. etc.

Bitmap format It is possible to display the values of process variables as bitmap in the tool list.
Example:

Bitmap format

A bitmap is assigned to the value of K1 (sector number) using an assignment table.

Value	Bitmap	Description
1		Spindle
2		Grippers
3		Magazine
4		Turret
99		Cabinet

Tab. 7-5: Example of the bitmap table

Both display formats are shown in the figure.

Geometry data (Sector 1)													
S	P	Tool Name	DN	TN	Status			SN	Geometry				
					tw	two	TL		L1	L2	L3	R	O
1	1	Milling Tool 1045	3	20	☐	☒	☐	1			0.000	0.000	
								2			0.000	0.000	
1	2	Milling Tool 1045	2	20	☐	☒	☐	1			0.000	0.000	
								2			0.000	0.000	
1	3												
1	4												
1	5	Drilling Tool 15mm	2	1	☐	☐	☐	1			1000.000		
1	6	Turning Tool 1024	10	1	☐	☐	☐	1	11.000	9.000		0.000	0
1	7	Cut Tool 1000	11	1	☐	☐	☒	1			0.000	4.000	
1	8	TTg	1	30	☐	☐	☐	1	0.000	112.000		90.000	0
								2	0.000	111.000		90.000	0
1	9	Engraving Tool 10	1	40	☐	☐	☐	1			1.000	80.000	
1	10	Stepdrill 10-20 mm	1	50	☐	☐	☐	1			0.000		
								2			0.000		
1	11												
1	12												
1	13	Milling Tool 1045	2	20	☐	☒	☐	1			0.000	0.000	
								2			0.000	0.000	
1	14												
1	15												
1	16												
1	17												

Fig. 7-4: Geometry data display

List content:

Column	Displayed Data element	Always visible	Can be edited	Special features	Area
1	Sector	yes	no		Fixed
2	Place	yes	no		
3	Tool name	yes	no		
4	Duplo number	yes	yes		Frozen
5	T number	yes	yes		
6	Status	-	-	Main column	
6.1	Warning limit reached	yes	no	Checkbox display	
6.2	Tool worn	yes	no		
6.3	Tool locked	yes	yes		
7	Empty column	-	-	Dividing line	
8	Tool edge number	yes	no	Sublines are displayed depending on the value	

Tool management

Column	Displayed Data element	Always visible	Can be edited	Special features	Area
9	Geometry	-	-	Main column	Scrollable
9.1	L1 value	no	yes	Only displayed if the tool and the tool edge exist and if the value is relevant for this type	
9.2	L2 value	no	yes		
9.3	L3 value	no	yes		
9.4	Radius value	no	yes		
9.5	Edge position	no	yes		
10	Empty column	-	-	Dividing line	
11	Tool type	no	no	As bitmap	

Tab. 7-6: Contents of geometry list

Wear data

S	P	Tool name	DN	TN	Status			SN	Wear				
					tw	two	TL		L1	L2	L3	R	
1	1	Turning tool 4711	1	2	☐	☐	☐	1	0.000	0.000		0.000	
					2	0.000	0.000		0.000				
1	2	Turning tool 4711	2	2	☐	☐	☐	1	0.000	0.000		0.000	
								2	0.000	0.000		0.000	
2	1	C-drill 10	1	3	☐	☐	☐	1			0.000		
2	2	C-drill 10	2	3	☐	☐	☐	1			0.000		
2	3	Turn right 12.3	2	4	☐	☐	☐	1	0.000	0.000		0.000	
2	4				☐	☐	☐						
2	5				☐	☐	☐						
2	6				☐	☐	☐						
2	7	C-drill 10	3	3	☐	☐	☐	1			0.000		
2	8	Turn right 12.3	1	4	☐	☐	☐	1	0.000	0.000		0.000	
2	9				☐	☐	☐						
2	10	angular Cut 23.7	1	6	☐	☐	☐	1			0.000	0.000	
2	11				☐	☐	☐						
2	12	Stepdrill 2-3-2	1	7	☐	☐	☐	1			0.000		
								2			0.000		
2	13				☐	☐	☐						
2	14				☐	☐	☐						
2	15				☐	☐	☐						
2	16				☐	☐	☐						
2	17				☐	☐	☐						
2	18				☐	☐	☐						

Wear data

EN

Fig. 7-5: Wear data display

List content:

Column	Displayed data element	Always visible	Can be edited	Special features	Area
1	Sector	yes	no		Fixed
2	Place	yes	no		
3	Tool name	yes	no		

Column	Displayed data element	Always visible	Can be edited	Special features	Area
4	Duplo number	yes	yes		Frozen
5	T number	yes	yes		
6	Status	-	-	Main column	
6.1	Warning limit reached	yes	no	Checkbox display	
6.2	Tool worn	yes	no		
6.3	Tool locked	yes	yes		
7	Empty column	-	-	Dividing line	
8	Tool edge number	yes	no	Sublines are displayed depending on the value	
9	Wear	-	-	Main column	Scrollable
9.1	L1 value	no	yes	Only displayed if the tool and the tool edge exist and if the value is relevant for this type	
9.2	L2 value	no	yes		
9.3	L3 value	no	yes		
9.4	Radius value	no	yes		

Tab. 7-7: Contents Wear list

Tool management

Monitoring data													
S	P	Tool name	DN	TN	Status			SN	activ	Tool life [min] / Quantities [cyc]			Unit
					tw	two	TL			Rest	Warning Limit	max. UT	
1	1	Turning tool 4711	1	2	☐	☐	☐	1	☐	0.00	0.00	0.00	
					2	☐	0.00	0.00	0.00				
1	2	Turning tool 4711	2	2	☐	☐	☐	1	☐	0.00	0.00	0.00	
								2	☐	0.00	0.00	0.00	
2	1	C-drill 10	1	3	☐	☐	☐	1	☐	0.00	0.00	0.00	
2	2	C-drill 10	2	3	☐	☐	☐	1	☐	0.00	0.00	0.00	
2	3	Turn right 12.3	2	4	☐	☐	☐	1	☐	0.00	0.00	0.00	
2	4				☐	☐	☐		☐				
2	5				☐	☐	☐		☐				
2	6				☐	☐	☐		☐				
2	7	C-drill 10	3	3	☐	☐	☐	1	☐	0.00	0.00	0.00	
2	8	Turn right 12.3	1	4	☐	☐	☐	1	☐	0.00	0.00	0.00	
2	9				☐	☐	☐		☐				
2	10	angular Cut 23.7	1	6	☐	☐	☐	1	☐	0.00	0.00	0.00	
2	11				☐	☐	☐		☐				
2	12	Stepdrill 2-3-2	1	7	☐	☐	☐	1	☐	0.00	0.00	0.00	
					2	☐	0.00	0.00	0.00				
2	13				☐	☐	☐		☐				
2	14				☐	☐	☐		☐				
2	15				☐	☐	☐		☐				
2	16				☐	☐	☐		☐				
2	17				☐	☐	☐		☐				
2	18				☐	☐	☐		☐				

Monitoring data

EN

Fig. 7-6: Service life data display

List content:

Column	Displayed data element	Always visible	Can be edited	Special features	Area
1	Sector	yes	no		Fixed
2	Place	yes	no		
3	Tool name	yes	no		
4	Duplo number	yes	yes		Frozen
5	T number	yes	yes		
6	Status	-	-	Main column	
6.1	Warning limit reached	yes	no	Checkbox display	
6.2	Tool worn	yes	no		
6.3	Tool locked	yes	yes		
7	Empty column	-	-	Dividing line	
8	Tool edge number	yes	no	Sublines are displayed depending on the value	

Column	Displayed data element	Always visible	Can be edited	Special features	Area
9	Enabling monitoring	no	yes	Checkbox display	Scrollable
10	Service life/ number of pieces	-	-	Main column	
10.1	Remaining service life	no	yes	Only displayed if the tool and the tool edge exist and if the value is relevant for this type	
10.2	Warning limit	no	yes		
10.3	Max. Service life	no	yes		
9.4	Time unit	no	yes		

Tab. 7-8: Contents Service life list

Status data																				
S	P	Tool name	DN	TN	Tool status												Location status			
					ta	tu	tw	two	TL	TD	TTL	TTU	TS1	TS2	TS3	TS4	PB	PS1	PS2	PS3
1	1	Turning tool 4711	1	2	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	
1	2	Turning tool 4711	2	2	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	1	C-drill 10	1	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	2	C-drill 10	2	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	3	Turn right 12.3	2	4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	4				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	5				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	6				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	7	C-drill 10	3	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	8	Turn right 12.3	1	4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	9				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	10	angular Cut 23.7	1	6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	11				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	12	Stepdrill 2-3-2	1	7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	13				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	14				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	15				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	16				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	17				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	18				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

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Fig. 7-7: Status list display

List content:

Column	Displayed data element	Always visible	Can be edited	Special features	Area
1	Sector	yes	no		Fixed
2	Place	yes	no		
3	Tool name	yes	no		

Tool management

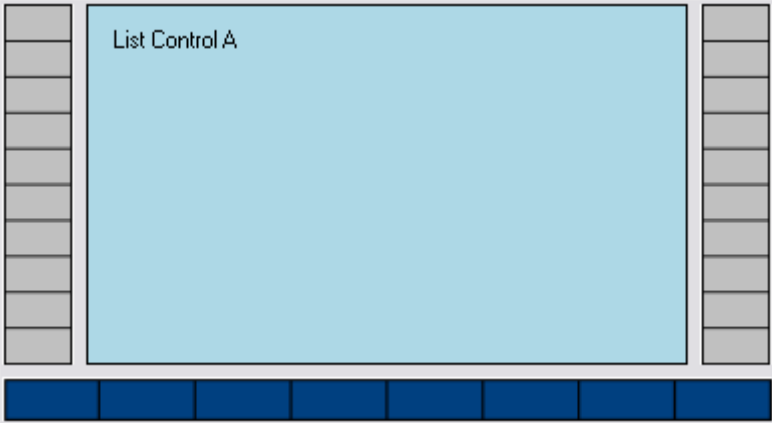
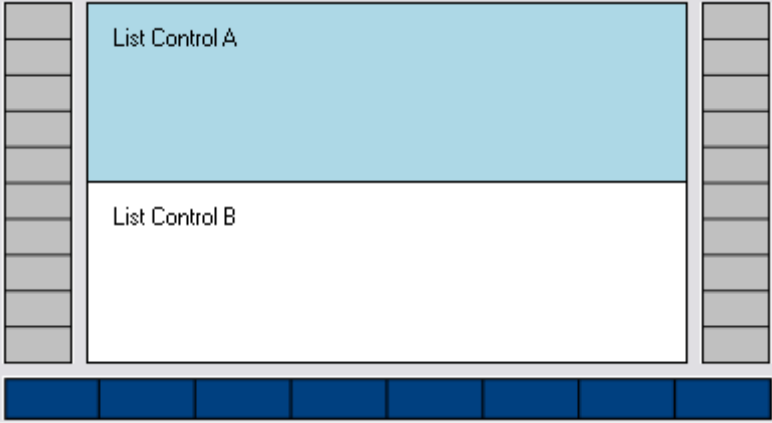
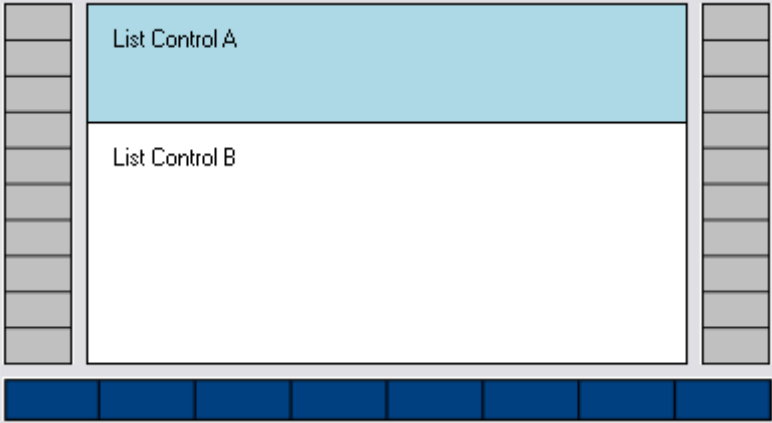
Column	Displayed data element	Always visible	Can be edited	Special features	Area
4	Duplo number	yes	yes		Frozen
5	T number	yes	yes		
6	Tool status	-	-	Main column	Scrollable
6.1	Tool active (ta)	yes	no	Checkbox display	
6.2	Tool used (tu)	yes	no		
6.3	Warning limit reached (tw)	yes	no		
6.4	Tool worn (two)	yes	no		
6.5	Tool blocked (TB)	yes	yes		
6.6	Tool defective (TD)	yes	yes		
6.7	(TTL)	yes	yes		
6.8	(TTU)	yes	yes		
6.9-6.12	Tool user status	yes	yes		
7	Location status	-	-	Main column	
7.1	Location blocked (PB)	yes	yes	Checkbox display	
7.2-7.4	Location user status	yes	yes		

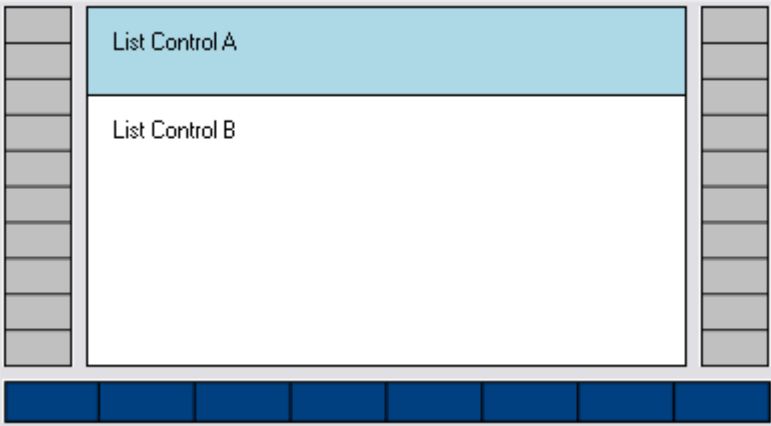
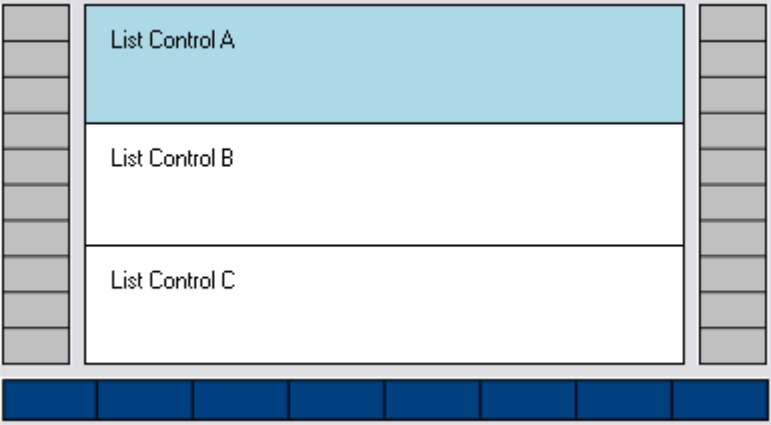
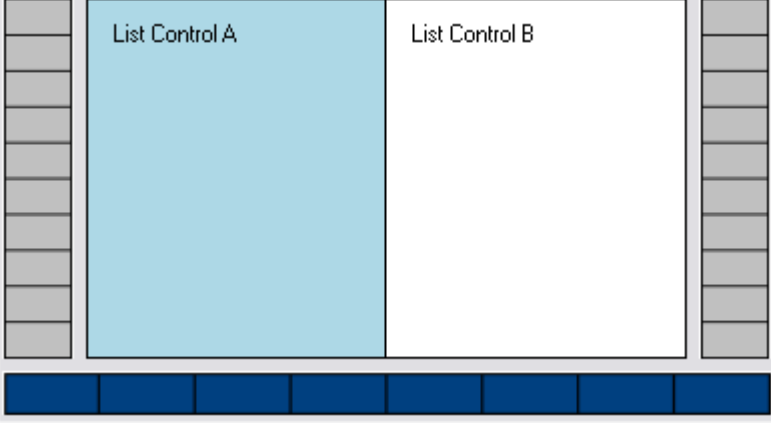
Tab. 7-9: Contents of the status list

Displaying multiple lists in one screen

Several differently configured lists can be displayed in one tool management screen.

One of the following display variants can be selected when configuring the screen. The dimensions of the lists cannot be modified.

Variant	Screen layout
	Displaying a list as full screen (Standard version)
	Horizontal 1:1
	Horizontal 1:2

Variant	Screen layout
 The diagram shows a screen layout with a light blue header bar at the top containing the text 'List Control A'. Below this is a larger white rectangular area containing the text 'List Control B'. The entire content area is flanked by vertical grey bars on both sides, each consisting of eight rectangular segments. At the bottom of the screen is a dark blue horizontal bar divided into eight segments.	Horizontal 1:3
 The diagram shows a screen layout with a light blue header bar at the top containing the text 'List Control A'. Below this are two stacked white rectangular areas, the top one containing 'List Control B' and the bottom one containing 'List Control C'. The content area is flanked by vertical grey bars on both sides, each with eight segments. A dark blue horizontal bar with eight segments is at the bottom.	Horizontal 1:1:1
 The diagram shows a screen layout with a light blue rectangular area on the left containing 'List Control A' and a white rectangular area on the right containing 'List Control B'. The content is flanked by vertical grey bars on both sides, each with eight segments. A dark blue horizontal bar with eight segments is at the bottom.	Vertical 1:1

Tab. 7-10: *Displaying multiple lists*
The following figure shows an application example of a tool management screen with two tables.

Monitoring data (Spindle 1)

Tool Name	DN	TN	Status	SN	Active	Tool Life [min] / Quantities [cyc]			Unit
Type			tw	two	TL		Rem	Warning Limit	max. UT
Milling Tool	234	235	☐	☐	☐	1	0.00	3.00	0.00
			☐	☐	☐	2	0.00	0.00	0.00
			☐	☐	☐	3	0.00	0.00	0.00

Monitoring data (Magazine)

S	P	Tool Name	DN	TN	Status	SN	Active	Tool Life [min] / Quantities [cyc]			Unit
					tw	two	TL		Rem	Warning Limit	max. UT
2	1	drilling tool	234	44	☐	☐	☐	1	0.00	1.00	0.00
2	2				☐	☐	☒	1	88555.00	12.00	500000.00 min
2	3	plain milling cutter	37	37	☐	☐	☒	1	123342.00	234.00	123344.00 min
2	4	drilling tool	12	12	☐	☐	☐	1			
2	5				☐	☐	☐				
2	6	cutter head D120	44	8	☐	☐	☐	1	0.00	1.10	0.00
2	7	cutter head D120	44	8	☐	☐	☐	1	0.00	1.20	0.00
2	8	common tool	123	123	☐	☒	☐	1	1244.00	55.00	40.00
					☐	☐	☐	2	1243.00	40.00	25.00
2	9	crosshead (powered)	23	23	☐	☐	☐	1	0.00	1.60	0.00
					☐	☐	☐	2	0.00	0.00	0.00
2	10				☐	☐	☐				
2	11				☐	☐	☐				

Functions in the tool list display

- <F2>** Calling the tool editor to create a new tool data block. Use the mouse in the taskbar to return to the tool list. However, the taskbar cannot be edited, since the database remains blocked. The list can be only edited after closing the new tool editor.
- In the default configuration, the function can also be retrieved using the menu function **Edit ► Add tool**.
- <F5>** Calling the tool editor to edit an existing tool data block. Use the taskbar to return to the tool list. The database does not remain locked. However, the <F5> function can be called again only after the tool editor is exited.
- In the default configuration, the function can also be called using the menu function **Edit ► Edit tool**.
- <F3>** By confirming <F3>, the tool data block can be deleted in the database.
- In the default configuration, the function can also be called using the menu function **Edit ► Delete tool**.

Fig. 7-8: Tool management screen with two tables (screen layout, horizontal 1:2)

Functions in the tool list display

The functions of the F-keys are described in the corresponding table editor.

- <F2>** Calling the tool editor to create a new tool data block. Use the mouse in the taskbar to return to the tool list. However, the taskbar cannot be edited, since the database remains blocked. The list can be only edited after closing the new tool editor.

In the default configuration, the function can also be retrieved using the menu function **Edit ► Add tool**.

- <F5>** Calling the tool editor to edit an existing tool data block. Use the taskbar to return to the tool list. The database does not remain locked. However, the <F5> function can be called again only after the tool editor is exited.

In the default configuration, the function can also be called using the menu function **Edit ► Edit tool**.

- <F3>** By confirming <F3>, the tool data block can be deleted in the database.

In the default configuration, the function can also be called using the menu function **Edit ► Delete tool**.



The <F3> function resets all data elements indicated in the data scheme as tool data, i.e.

- "0" is written to numerical values
- Boolean values are set to "FALSE"
- An "empty string" is written to strings.

This function also exists as PLC function.

<F4> The following box to select the sector and location provides a free data block/tool storage position as target position to offset a tool data block.

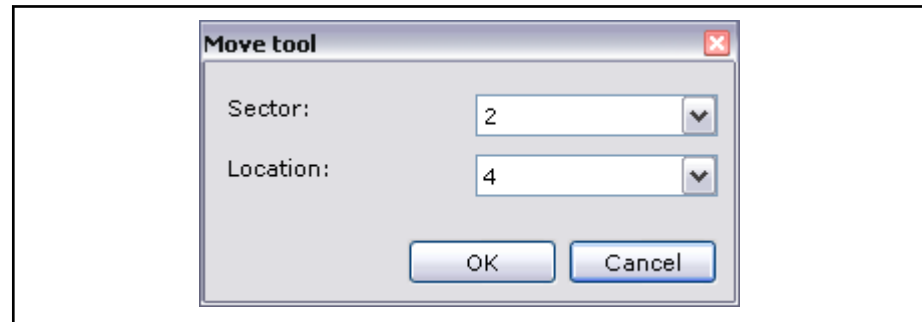


Fig. 7-9: Selection box with sector/location to offset a tool

In the default configuration, the function can also be called using the menu function **Edit ► Offset tool**.



The "Offset tool" function moves all data elements indicated in the data scheme as tool data to an available location in the database table.

This function also exists as PLC function.

Copying tool Via the menu bar **Edit ► Copy tool**, the "Copy tool" function can be activated as a pure interface function. The following box to select the sector and location provides a free data block/tool storage position as target position for the duplicated tool.

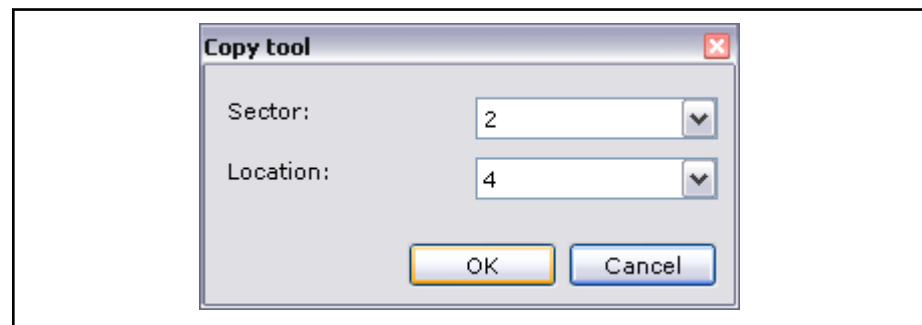


Fig. 7-10: Selection box: Copy sector/location to copy a tool

In the default configuration, the function can also be called using the menu function **Edit ► Copy tool**.



The "Copy tool" function duplicates all data elements indicated in the data scheme as tool data to an available location in the database table.

This function also exists as PLC function.

Sorting tool list The following setting dialog can be used to configure and activate list sorting according to three decreasingly prioritized sorting criteria. For multiline sort-

ing columns within one sublist, the corresponding subline to be sorted can be specified. At the same time, this dialog can also be used to restore the original "unsorted" list display.

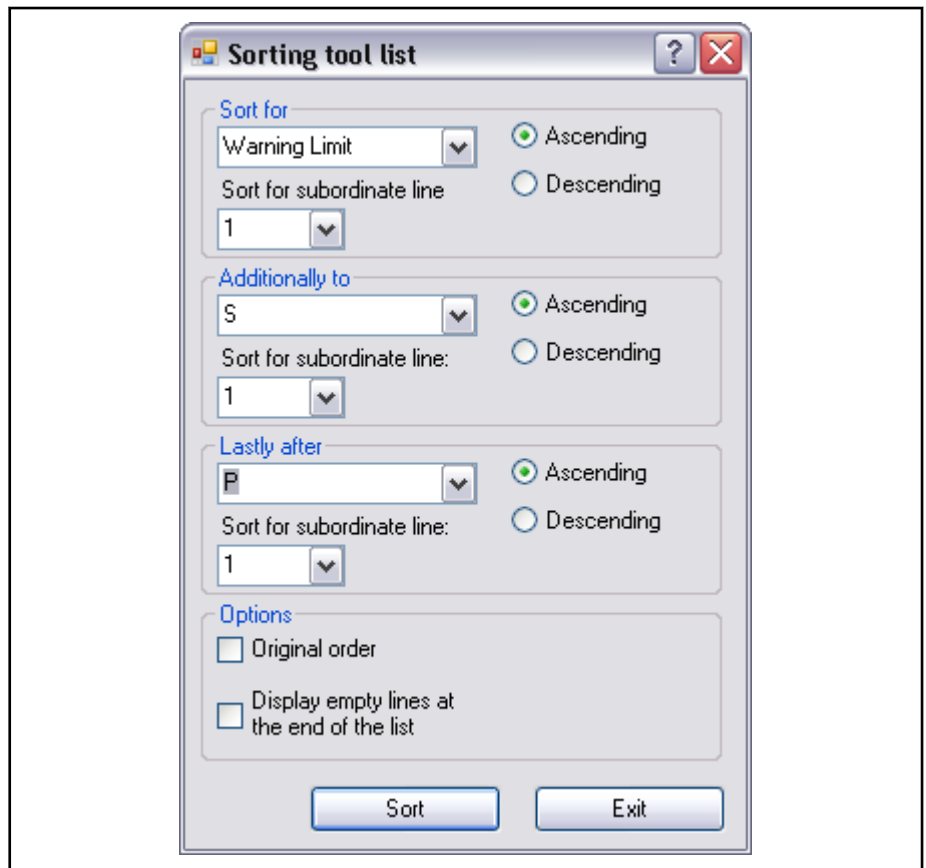


Fig. 7-11: Setting dialog to sort the tool list

In the example, the tool list is sorted first according to the T-number, then according to the sector number and then according to the location number, each in ascending order.

Empty locations are shown at the end of the list.

If the "Original order" checkbox is activated, sorting is switched off.

In the default configuration, the function can also be called using the menu function **Edit ► Sort tool list**.



Dynamic updating of the sorting order is executed in the list display after value modification. To accomplish this, the sorting dialog has to be called again.

Filter active (F7)

The list display can be filtered according to the condition defined in the setting dialog.

A filtered list is indicated in the list title by "(*)".

In the default configuration, the function can also be called using the menu function **Edit ► Filter active**.



The function is only active if a filter condition was activated before.

Define filter (F5)

The list display can be filtered according to the header data elements:

Tool management

K1:	Sector
K2:	Place
SKQ:	Tool name
IKQ1:	Duplo number
IKQ2:	Tool type
IKQ3:	Tool number
IQ1:	Reserve 1
IQ2:	Reserve 2
IQ3:	Reserve 3
BQ1:	Place status
BQ2:	Tool status

The data elements used in the basic query of the current list configuration cannot be filtered. Thus, these data elements are grayed out in the filter definition dialog.

The individually selected filter conditions are like an AND operation.

The filter settings can be adjusted in the following setting dialog.

Fig. 7-12: Setting dialog to filter the tool list

In the default configuration, the function can also be called using the menu function **Edit ► Define filter**.



A filter condition becomes only active if at least one checkbox was selected in the dialog.

- <F2> During a tool (list) export, it can be selected between the following export functions in a selection dialog:
- Exporting a single data block
 - Exporting the entire database table
 - Exporting the currently shown list
 - Exporting a self-defined selection of sectors

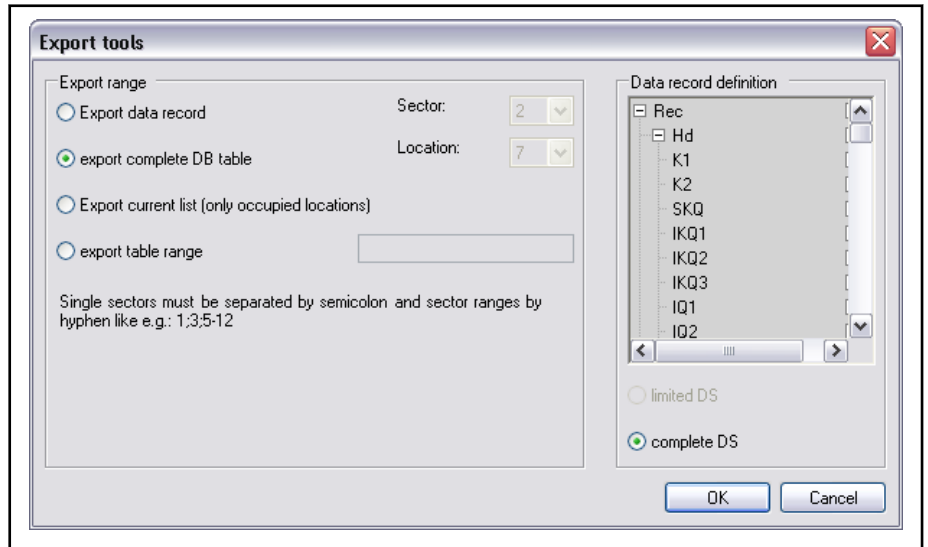


Fig. 7-13: Selection dialog of the export function

After entering a file name in the file selection dialog, a TLD file is written to the NC file system (for example, a mount directory).

This file can also be saved as .xml file or without extension.

In the default configuration, the function can also be called using the menu function **Edit ► Export list**.

- <F4> A single tool data block can be imported using the <F4> function. This data block can be deleted from the tool file found in the file selection dialog .
- If this file was created using the export mode "Export single data block", the selection list naturally contains only one data block.

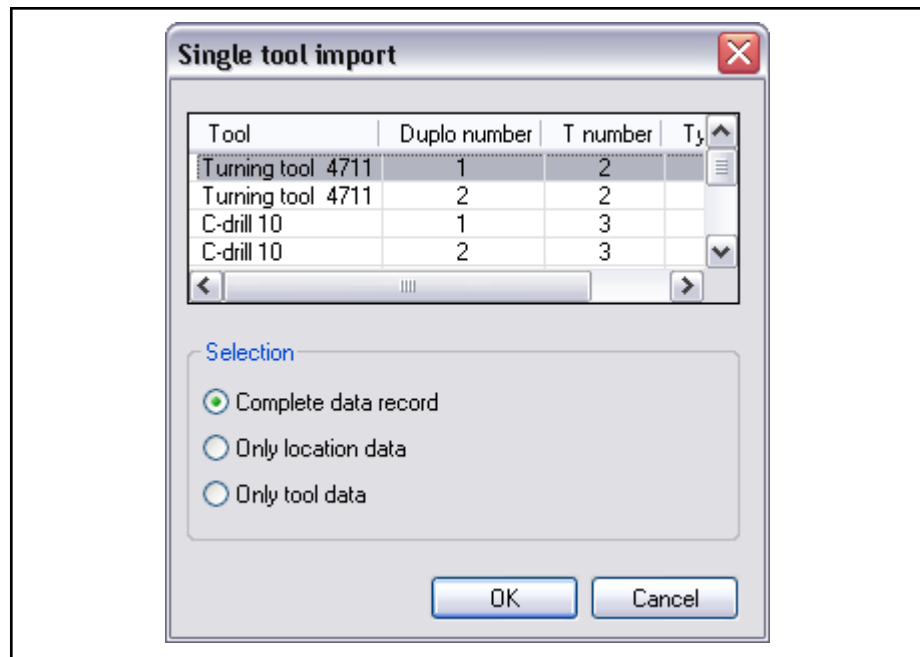


Fig. 7-14: Selection dialog "Single tool import" function

In the default configuration, the function can also be called using the menu function **Edit ► Import single tool**.

<F3> After selecting an XML file in the NC file system (for example, a mount directory), the file is read and then written to the database table. The user can decide which data is to be imported in the following dialog:

- All data of the data block
- Only tool data
- Only location data

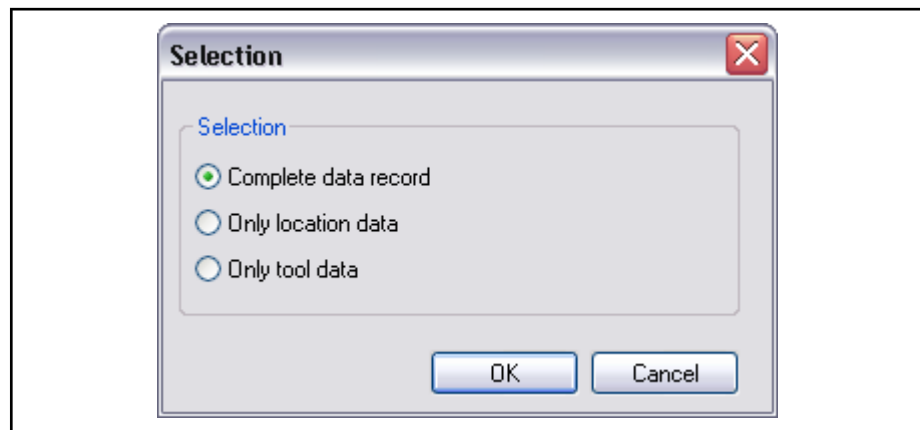


Fig. 7-15: Selection dialog for the Import function

In the default configuration, the function can also be called using the menu function **Edit ► Import list**.



When importing a tool list, ensure that the XML document file to be read is suitable for the configuration of the database table in terms of the number of sectors and locations and the data structure.

Opening a post import function	It is possible to follow the import of a tool list with a configurable handling routine for all imported data blocks.
	This post import function can be set in the file "ToolManagementConfig.xml".
<F8>	Toggle between the first and the second level of the F-keypad using <F8>.
	The key  switches to the second level and  returns to the first level.
Returning to main level	Press  to go to the superordinate level of the tool list display.
	This key level can be defined by the user and permits switching between various list displays.
Number of decimals	The number of displayed decimals is specified by the list/editor configuration.
Additive value input	"Additive value input" can be used to enter correction values to be added to the existing value (see chapter 7.2.1 "Value input" on page 168).
Calling next list	When displaying several lists, changing between these lists can be executed via the configurable F-key function "TL_ActivateNextList".
Exiting view	A screen, additionally defined to the default tool management application by the user, can be exited using the configurable F-key function <Close active screen>. This is not possible for the default tool management application. After the tool management has been called once, this screen remains active until the user interface is closed (exception: closing the application via the menu function Window ▶ Window ▶ Close window).
Printing	The edited list can be printed. All data, comments and headlines in the list are printed. The table areas that are always displayed are also printed on each page. In the default configuration, the function can also be called using the menu function Edit ▶ Print tool list. Sequence: A dialog to set up the page is displayed, followed by the NC program in a print preview. The number of pages per sheet can be set. The zoom icon can adjust the size accordingly. The print dialog can be closed with "Exit". <Tab> is used to navigate in this dialog if no mouse is available. Set up page: Header and footer can be configured in the global options under Tool ▶ Options ▶ General ▶ Print. Currently, the following variables can be used: • Current page number • Doc_Name • Doc_Type • Print_Date • Print_Time • Device_Name • Editor The remaining variables cannot be analyzed. To improve clarity, the meaning can be written in front of each variable. Example: Input of a parameter: Date of printing:#PRINT_DATE#

7.2.5 Tool editors

Differences in behavior between adding and editing

Adding a tool When adding a tool, the entire data block is first edited offline, i.e. without accessing data on the control. When the data block is edited completely, the user is requested to decide whether to transfer the data block to the control.

When a new tool data block is created, the tool catalog for the new tool can be used to select a tool type from a list of predefined tool types. If a basic data block for this tool type exists in the catalog, the basic data block is used to initialize the data block. For more detailed information, refer to the following chapter.

Editing a tool When "editing a tool", the modified data is immediately written to the tool database of the control. Therefore, there is no query as when adding a tool.

Container contents

As can be seen in [fig. 7-2Container layout of the tool editor, page 167](#), the tool editor is structured in a number of display containers to be configured.

The number, arrangement, size and content of the containers can be configured. The content is defined via the assigned controls.

A separate F-key panel can be assigned to each control.

However, these panels cannot be edited in the F-key configurator. They can be found in predefined F-key files.

It can be configured in IndraWorks Engineering.

Upon delivery, the tool editor is configured as follows:

Container No. in the figure	Control	Contents
1	Basic data	Tool name
		Duplo no.
		T. No.
		Tool technology
		Tool type
		Edge number
2	Bitmap and sector/location display	Tool type as bitmap
		Sector no.
		Loc. no.
3	Location and tool status	Tool status bits: 1;3;4;5;7;8;11;12;
		User status bits: 25;26;27;28
		Location status bit:
		2

Container No. in the figure	Control	Contents
3	User tool data	Description
		Time unit
		Tool life
		Old sector
		Old location
		Technology date 1
		Technology date 2
4	Tool edge data	Geometry L1
		Geometry L2
		Geometry L3
		Geometry radius
		Edge position
		Wear L1
		Wear L2
		Wear L3
		Wear radius
		Offset L1
		Offset L2
		Offset L3
		Offset radius
		Remaining service life
		Warning limit
4	Geometry limits	Max L1 value
		Min L1 value
		Max value L2
		Min value L2
		Max value L3
		Min value L3
		Max radius value
		Min radius value

Tab. 7-11: Editor data

Basic data

Identifier	Value
Tool ID	Turning tool 4711
Tool duplo No.	2
T number	2
Machining process	Turning
Tool type	Turning tool, outside radial right (2 edged)
Edge number	2

Fig. 7-16: Display of tool basic data

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level				Basic data data	Change type ON / OFF	Next Windows		Editor close

Tab. 7-12: Function keys of the tool editor (display of tool basic data)

Position and tool status data

Bit Nr.	Identifier	Identif	Identificator
Bit 1	Active tool	ta	☐
Bit 3	Used tool	tu	☐
Bit 4	Warning limit	tw	☐
Bit 5	Tool worn	two	☐
Bit 7	Tool locked	TL	☐
Bit 8	Tool broken	TD	☒
Bit 11	Load tool	TTL	☐
Bit 12	Discharge tool	TTU	☐
Bit 25	Tool user status 1	TS1	☐
Bit 26	Tool user status 2	TS2	☐
Bit 27	Tool user status 3	TS3	☐
Bit 28	Tool user status 4	TS4	☐

Fig. 7-17: Tool status display

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. level		Next Display		Basic data data		Next Windows		Editor close

Tab. 7-13: Function keys of the tool editor (tool status display)

User tool data

Identifier	Value
Description	new Tool
Time unit	min 
Tool life	0.00
Old sector	0
Old location	0
Tech. Date 1	0.00
Tech. Date 2	0.00

Fig. 7-18: Tool data display

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. level		Next Display		Basic data data		Next Windows		Editor close

Tab. 7-14: Function keys of the tool editor (tool data display)

Technology data

Identifier		SN	Value
Diameter	d		0.000
Minor diameter	ds		0.000
Chamfer length	lfc		0.000
Max. plunging depth	tl		0.000
Usable length	lu		0.000
Orientation angle	tal		0.000
Apical angle	tac		0.000
Number of teeth	nt		0

Fig. 7-19: Technology data display

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. level		Next Display			Input Additive	Next Windows		Editor close

Tab. 7-15: Function keys of the tool editor (technology data display)

Tool edge data

	Edge 1	Edge 2
Geometry L1	0.000	0.000
Geometry L2	0.000	0.000
Geometry R	0.000	0.000
Edge position	0	0
Wear L1	0.0000	0.0000
Wear L2	0.0000	0.0000
Wear R	0.0000	0.0000
Offset L1	0.000	0.000
Offset L2	0.000	0.000
Offset R	0.000	0.000
Remain. tool life	0.00	0.00
Warning limit	0.00	0.00
max. utilization time	0.000	0.000

Fig. 7-20: Tool edge data display

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. level		Next Display		Basic data data	Input Additive	Next Windows		Editor close

Tab. 7-16: Function keys of the tool editor (edge data display)

Geometry limit values

		Edge 1	Edge 2
L1	Max value	0.000	0.000
	Min value	0.000	0.000
L2	Max value	0.000	0.000
	Min value	0.000	0.000
R	Max value	0.000	0.000
	Min value	0.000	0.000

Fig. 7-21: Display of limit value data

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. level		Next Display		Basic data data	Input Additive	Next Windows		Editor close

Tab. 7-17: Function keys of the tool editor (limit data display)

Bitmap display

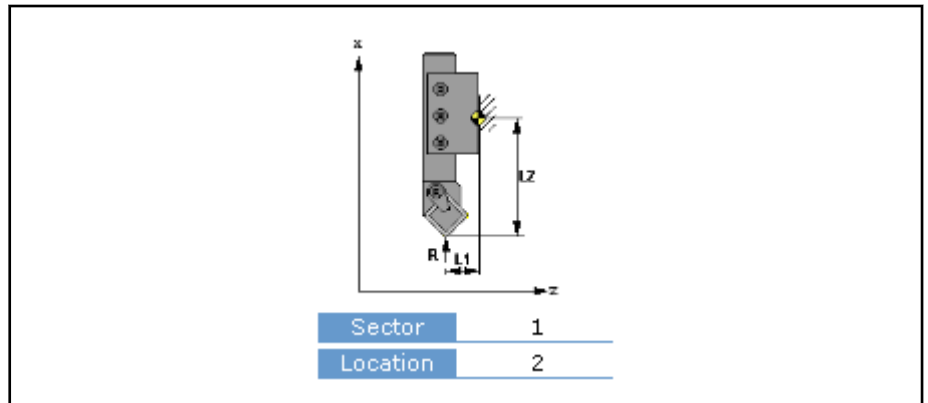


Fig. 7-22: Bitmap and memory location display

It is not possible to enter values into this data container.

F-keypad level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level				Basic data data		Next Windows		Editor close

Tab. 7-18: Function keys of the tool editor (bitmap display)

Functions in the tool editor

- <F7>** Since the tool editor consists of several data containers, navigation to edit these data is possible only within the focused data container. This function allows the focus to be switched to the next data container.
- <F3>** If the highlighted data container contains several controls, this function can be used to move the next display control to the foreground.
- <F5>** This function is available only for editing an already existing tool. It can be used to specifically switch type modification on and off.



When the tool type is changed, all user data is deleted (all data under DBT1/Rec/UD).

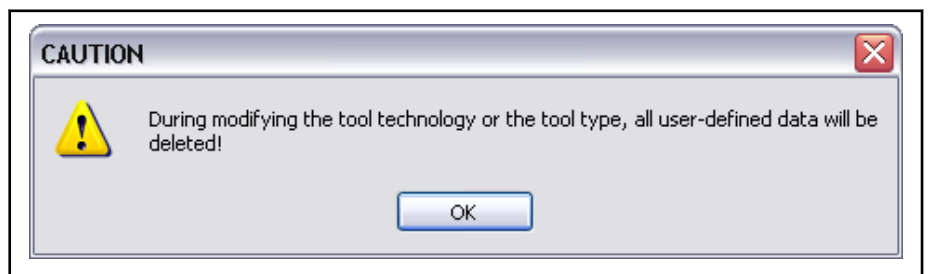


Fig. 7-23: Caution - Data is deleted

- <F5>** This function is only available if a basic data control is activated. It permits influencing a tool basic data block belonging to the current tool type by applying the data block of the current tool as new basic data block to the tool catalog.
The basic data block is part of the IndraWorks project.
The following message is intended to explain the effects of the function when it is continuously worked with the tool catalog.

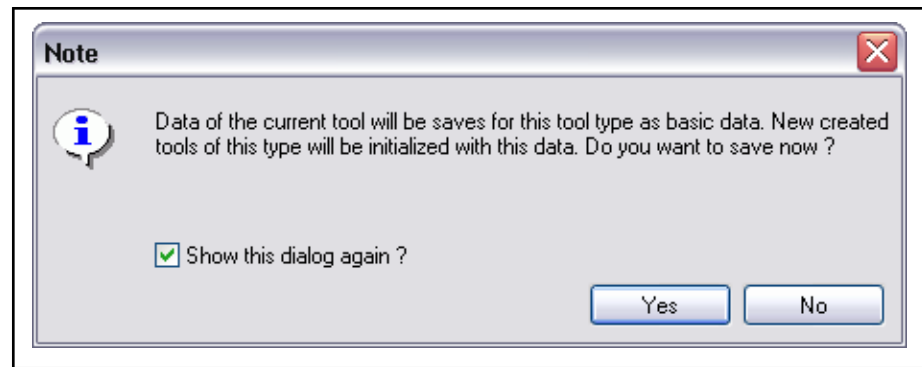


Fig. 7-24: Message when saving basic tool data

If the checkbox for "Always show this dialog " is deselected, this message is no longer displayed during the current interface session.

<F5> <F5> can be used to enter correction values to be added to the existing value (see [chapter 7.2.1 Value Input, page 168](#)). This F-key is a toggle key to switch between the two input modes "Additive" and "Absolute".

M-keys in the tool editor

When "editing the tool", separate M-keypads with the following functions are provided in the default configuration:

Next tool (R8) This function is used to search the visible area of the tool memory in the tool list for the next tool and then to show its data.

Previous tool (L8) This function is used to search the visible area of the tool memory in the tool list for the previous tool and then to show its data.

When "adding a tool", empty M-keypads become active in the default configuration.

M-keys can be configured in IndraWorks Engineering:

8 System switching

8.1 Channel dialog

8.1.1 Usage

The channel dialog has two tasks:

- Switching between operation and display channels
- Display the selected channel information of all channels of a control (channel overview).

Channels hidden via the configuration are not shown.

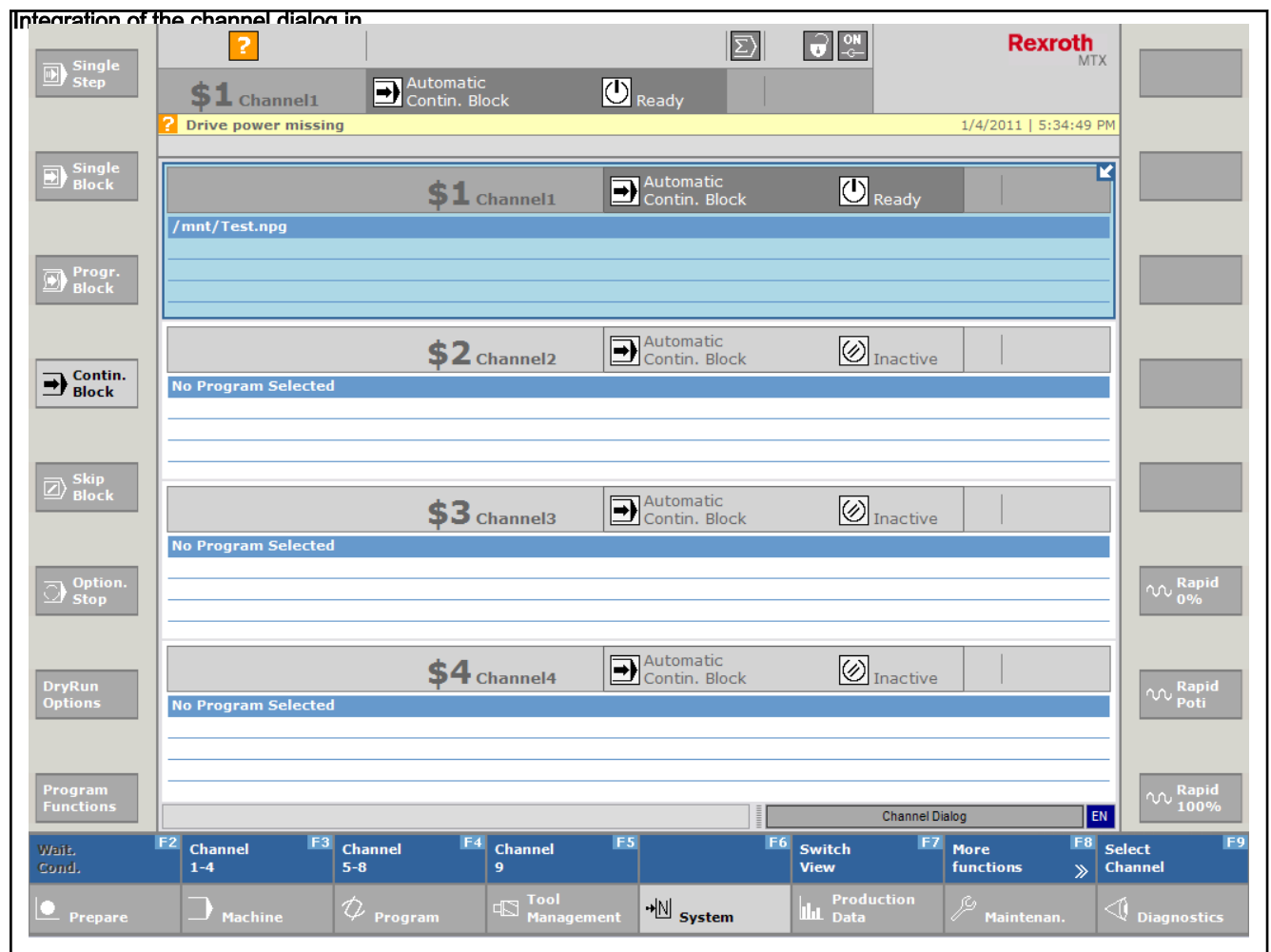


Fig. 8-1: Channel dialog in the user interface

The channel dialog is an application with individual F-key assignment.

The menu and the headline are hidden.

The channel dialog is opened via the <OP6> "System" key.

The M-keys act as "global M-keys" on the channel that is displayed in the machine status area (active channel).

8.1.2 General structure of the channel dialog

Depending on the number of channels, two displaying variants are possible. Switching is accomplished via <F7>.

Structure of the default channel dialog

If more channels exist than can be displayed in the default setting, a compact display is also provided.

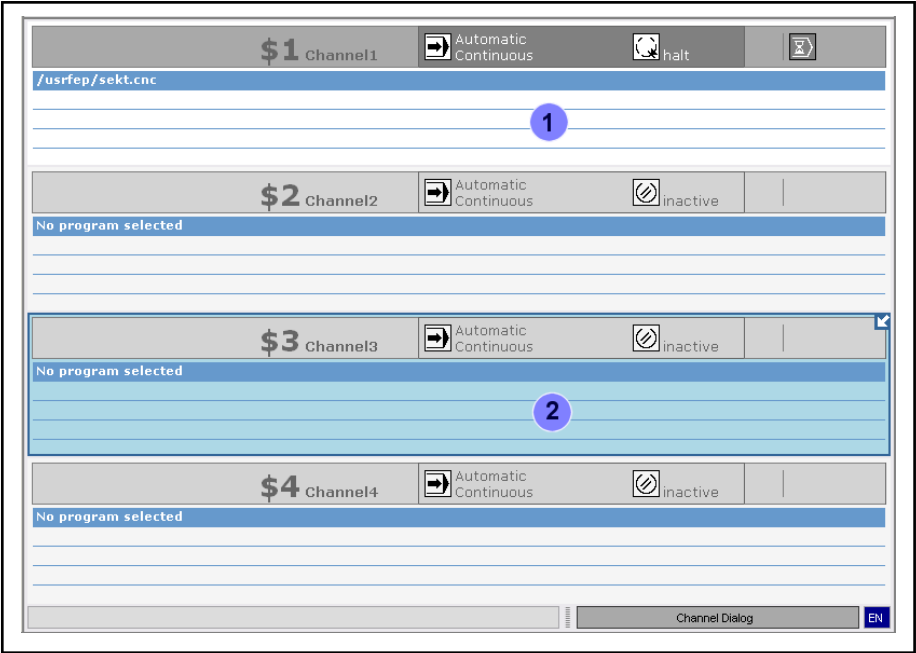


Fig. 8-2: Default structure of the channel dialog

The default channel dialog shows three to four channel windows at the same time (depending on the screen resolution).

Structure of the compact channel dialog

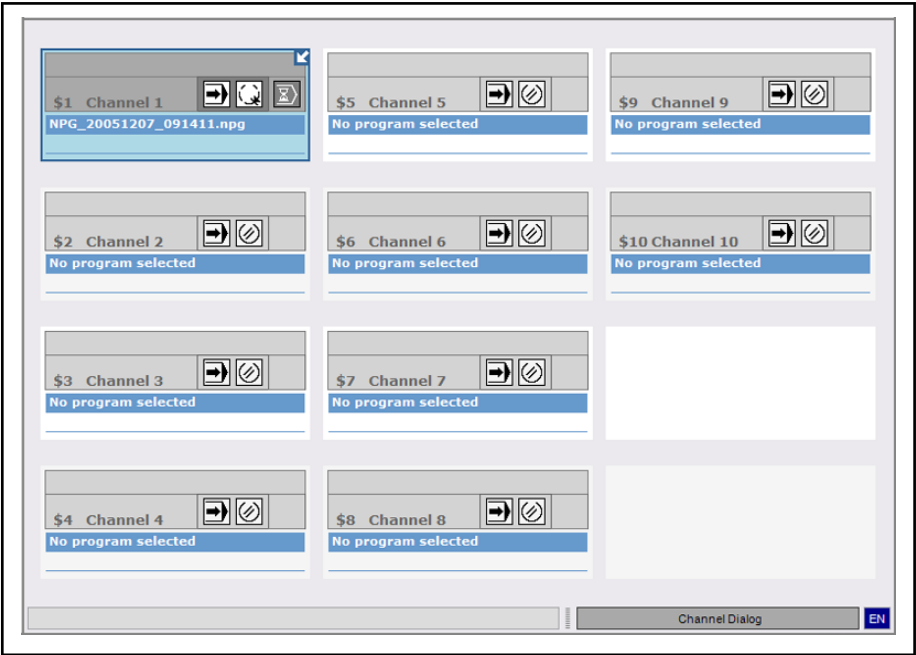


Fig. 8-3: Compact structure of channel dialog

The compact channel dialog displays eight to twelve channel windows at the same time (depending on the screen resolution).

If fewer channels are configured in the system, the channel windows remain empty.



The compact channel dialog is possible with more than 4 channels.

The active channel is highlighted within the channel dialog (1).

The focus is always on one channel window. F-keys act on this window. It is marked by a light blue background and a dark blue frame (2).

When the channel dialog is called, the active channel is focused.

The representation variant selected last is maintained after the control is switched off.

Structure of the default channel window

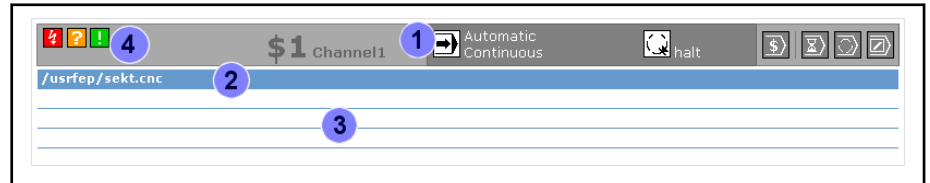


Fig. 8-4: Default channel window

Structure of the compact channel window

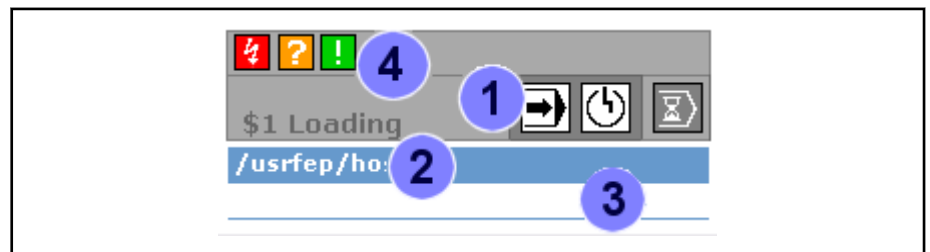


Fig. 8-5: Compact channel window

Each channel window contains:

- Channel information (1)
- Errors, warnings and notes of the channel (cancellation of the sum signal for the machine status area) (4)
- Display of the active NC program name (2)
- Display of the last NC notes (3)

Structure of the default channel information



Fig. 8-6: Default channel information

The default channel information has the same structure and contents as the channel-specific part of the machine status area.

Structure of the compact channel information



Fig. 8-7: Channel information

In the compact display, the channel information does not show any text for the operation mode and the channel status.

The states "Test mode", "Optional stop" and "Skip NC block" are not shown in this display.

8.1.3 Channel waiting states

Display of the Channel Waiting States

System switching

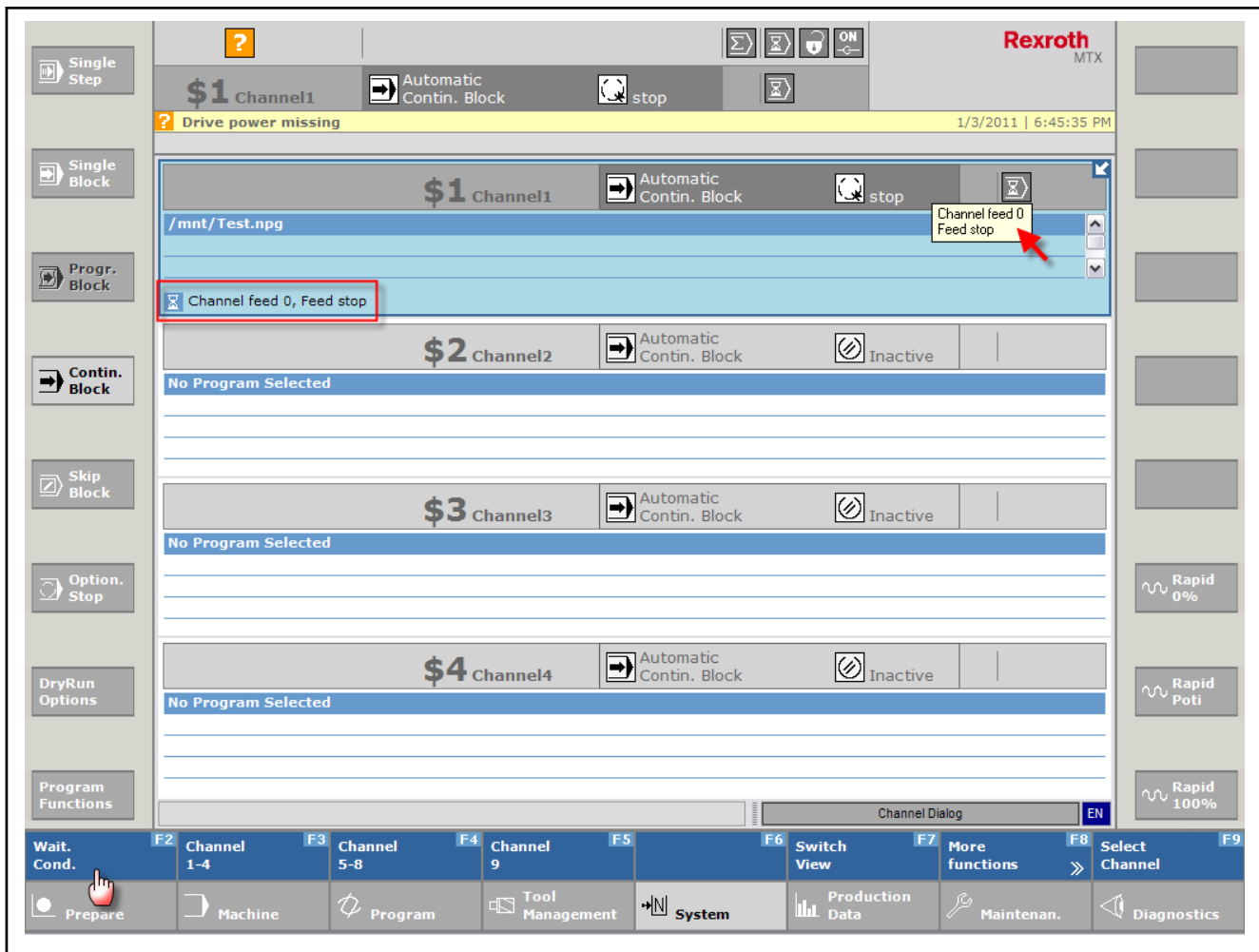


Fig. 8-8: Display of the channel waiting states

If a channel is in waiting state, the display of the NC notes are reduced and a line with the active waiting states is displayed.

In the compact representations, it is possible that not all existing waiting states can be displayed in one line. In this case, all channel waiting states are displayed in a "tooltip" with <F2> by moving the mouse over the symbol. The "tooltip" appears for approx. 10 seconds.

Waiting for bit event (channel synchronization)

If the channel waits for a bit event, the logic of the bit events programmed in the NC program is displayed additionally. The bits set are highlighted in blue. "|" stands for OR and "&" for AND.

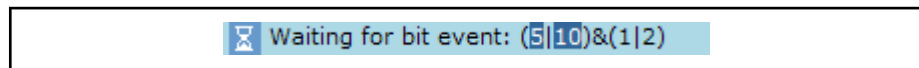


Fig. 8-9: Display of the waiting state: Bit event

An overview on the state of all 96 bits can be retrieved under <F8> "More functions", <F2> "Bit events". In this display, the bits set are highlighted in blue.

Bit event overview					
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6
Bit 7	Bit 8	Bit 9	Bit 10	Bit 11	Bit 12
Bit 13	Bit 14	Bit 15	Bit 16	Bit 17	Bit 18
Bit 19	Bit 20	Bit 21	Bit 22	Bit 23	Bit 24
Bit 25	Bit 26	Bit 27	Bit 28	Bit 29	Bit 30
Bit 31	Bit 32	Bit 33	Bit 34	Bit 35	Bit 36
Bit 37	Bit 38	Bit 39	Bit 40	Bit 41	Bit 42
Bit 43	Bit 44	Bit 45	Bit 46	Bit 47	Bit 48
Bit 49	Bit 50	Bit 51	Bit 52	Bit 53	Bit 54
Bit 55	Bit 56	Bit 57	Bit 58	Bit 59	Bit 60
Bit 61	Bit 62	Bit 63	Bit 64	Bit 65	Bit 66
Bit 67	Bit 68	Bit 69	Bit 70	Bit 71	Bit 72
Bit 73	Bit 74	Bit 75	Bit 76	Bit 77	Bit 78
Bit 79	Bit 80	Bit 81	Bit 82	Bit 83	Bit 84
Bit 85	Bit 86	Bit 87	Bit 88	Bit 89	Bit 90
Bit 91	Bit 92	Bit 93	Bit 94	Bit 95	Bit 96

Fig. 8-10: Dialog: Overview on bit events

8.1.4 Operation and navigation

Operation is carried out via F-keys, <cursor> keys and <Enter>.

A channel window is always selected. The F-keys act on this channel window.

The channel is highlighted using the <cursor> keys or by clicking the mouse.

Basic level of the F-keys

The most important functions are in the basic level.

If there is not enough space to display channels, extra F-keys are displayed. These can be used to quickly switch between the blocks.

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
Waiting states	Channel a - b	Channel c - d	Channel e - f	Channel g-h	Switch view	More functions...	Apply channel
Display all waiting states via tooltip	Display the first block of channels (optional)	Display the second block of channels (optional)	Display the third block of channels (optional)	Display the fourth block of channels (optional)	Switching between normal and compact view	Additional functions (2nd level)	Focused channel becomes active

Tab. 8-1: Basic level of the F-keys

Pressing <Enter> or <F9> applies the focused channel as active channel and switches immediately to the "Machine" operating area.

F-keys, additional functions

This level contains additional functions.

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
Bit events					Channel filter...	Return	
Display of the overview on all bit events					Display of the channel filter dialog	Return to basic level	

Tab. 8-2: F-keys, additional functions

Channel filter Individual channels can be hidden from the display via the channel filter dialog. This function is only effective in the channel dialog.

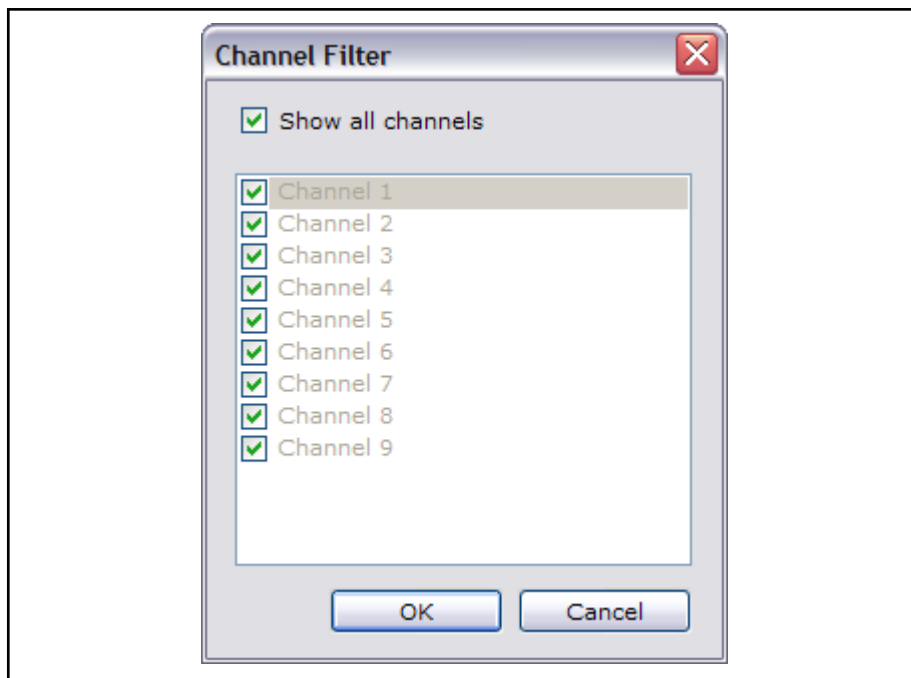


Fig. 8-11: Dialog: Channel filter

9 Diagnostics

9.1 Diagnostic display

9.1.1 Overview

Press <OP9> to activate the diagnostic display.



The delivery scope of IndraWorks HMI depends on the installed control system. In contrast to the fact that the MTX CNC system provides template screens to operate NC machines, only the key<OP9> is assigned a diagnostic call for MLC/ILC.

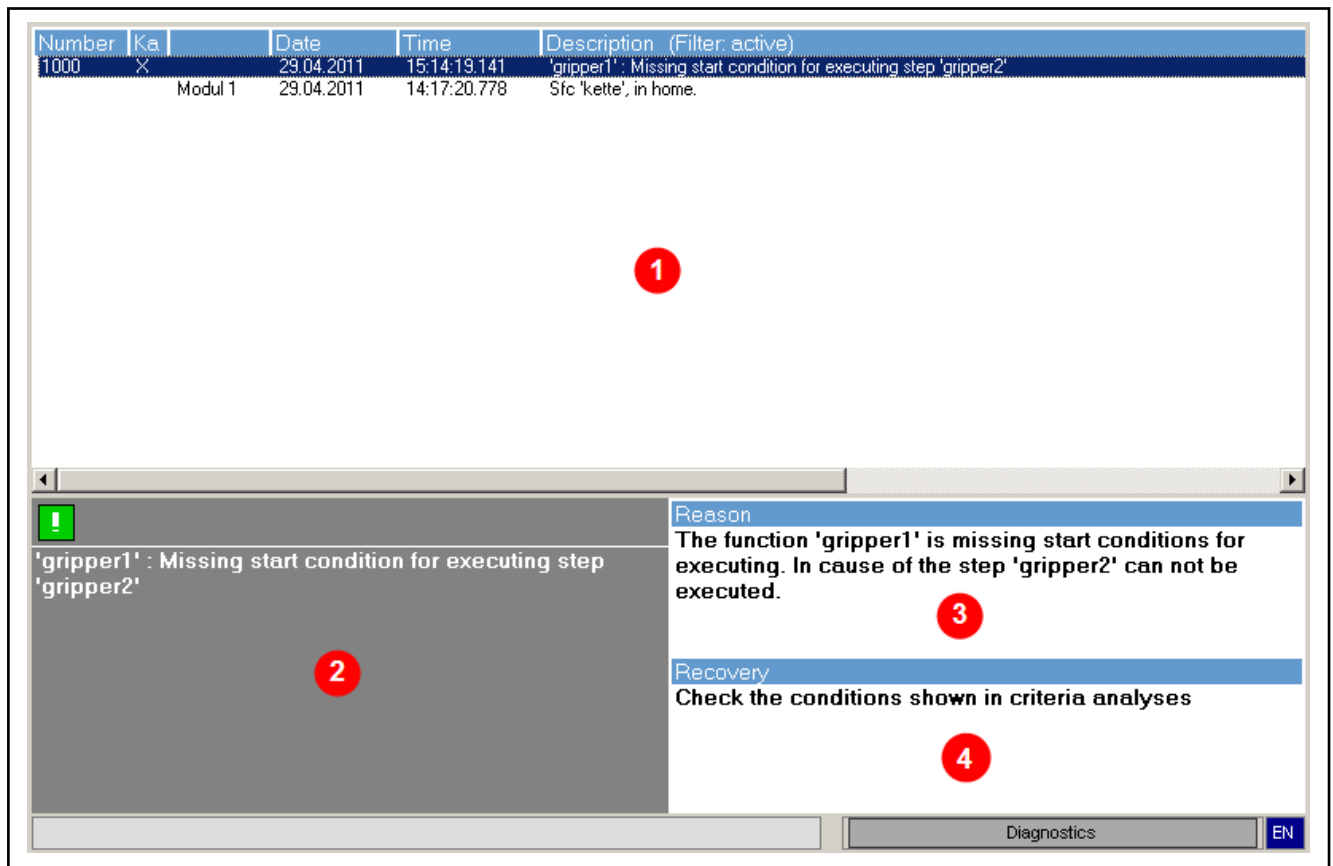


Fig. 9-1: Start screen of the diagnostics

The start screen of the diagnostics is divided into four areas:

Message list field ①

The diagnostic messages of the assigned control (see header) are displayed here. Listed are:

- the message number
- the existence of criteria analysis data (CA)
- the module number for ProVi messages of the channel number for MTX messages
- the time stamp of occurrence
- the brief description entered by the user

Short info ②

Display of the short text of the selected message. A symbol represents the message type:

- Errors
- Warning
- Message
- Setup diagnostics
- Startup prerequisite

More information: Cause ③

Representation of the extended information. User texts are saved there which explain the cause of the message in detail.

More information: Recovery ④

Display for notes on problem recovery.

9.1.2 Filter

Errors, warnings and messages can be filtered via <F1> in the diagnostic display. The active filtering is shown by the F-key labeling:

Press <F1> to subsequently switch to the different filter modes:

- **All <F1>**
No filtering. All diagnostic messages are displayed
- **Error <F1>**
Only messages of the "Error" type are displayed
- **Warning <F1>**
Only messages of the "Warning" type are displayed
- **Message <F1>**
Only messages of the "Message" type are displayed

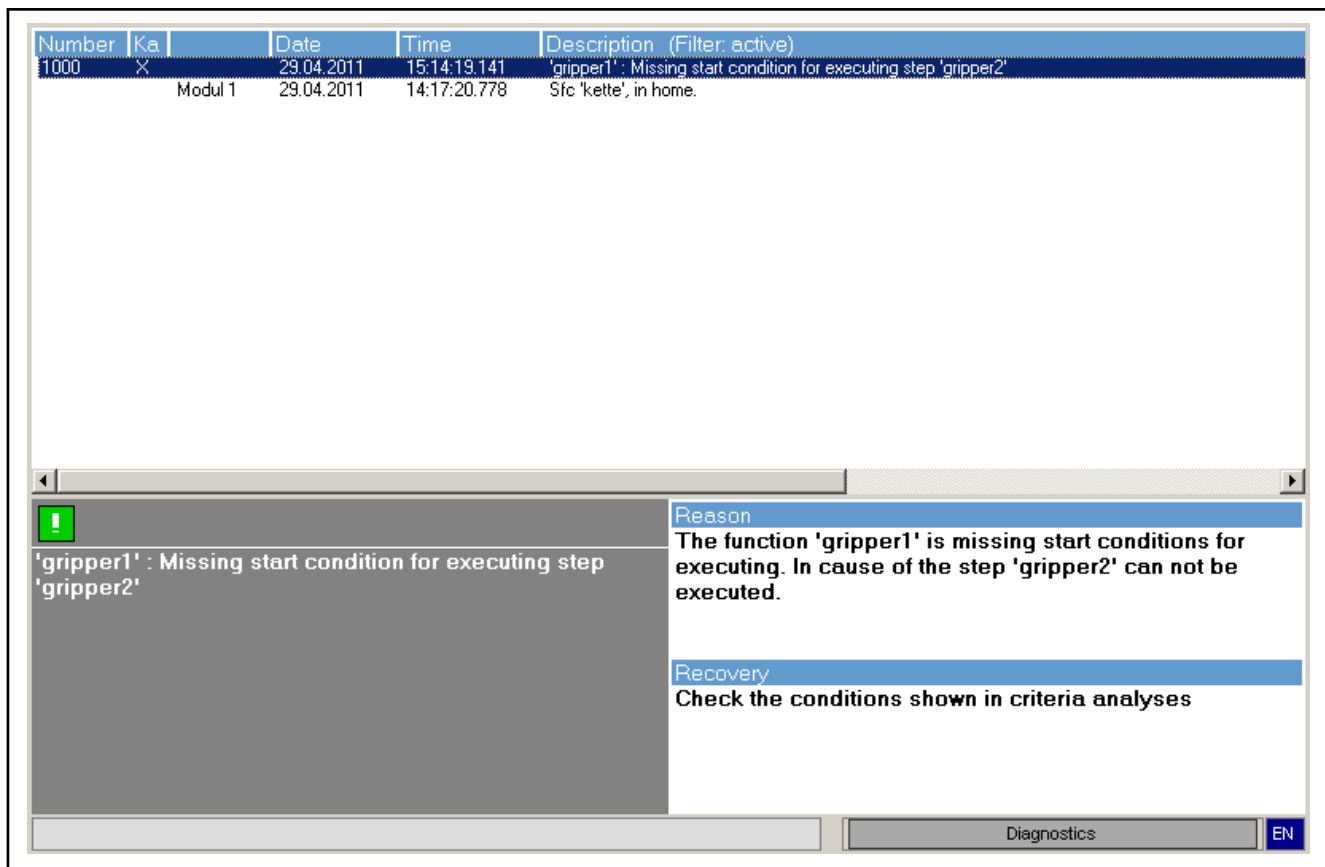


Fig. 9-2: Diagnostic display filtered according to errors

In the example above, the "error" filter is active, so that only messages with error characteristics are displayed.

9.1.3 Detailed view

Press <F2> to switch between the detailed view and the overview.

The selected message is prepared and displayed with additional information in the detailed view.

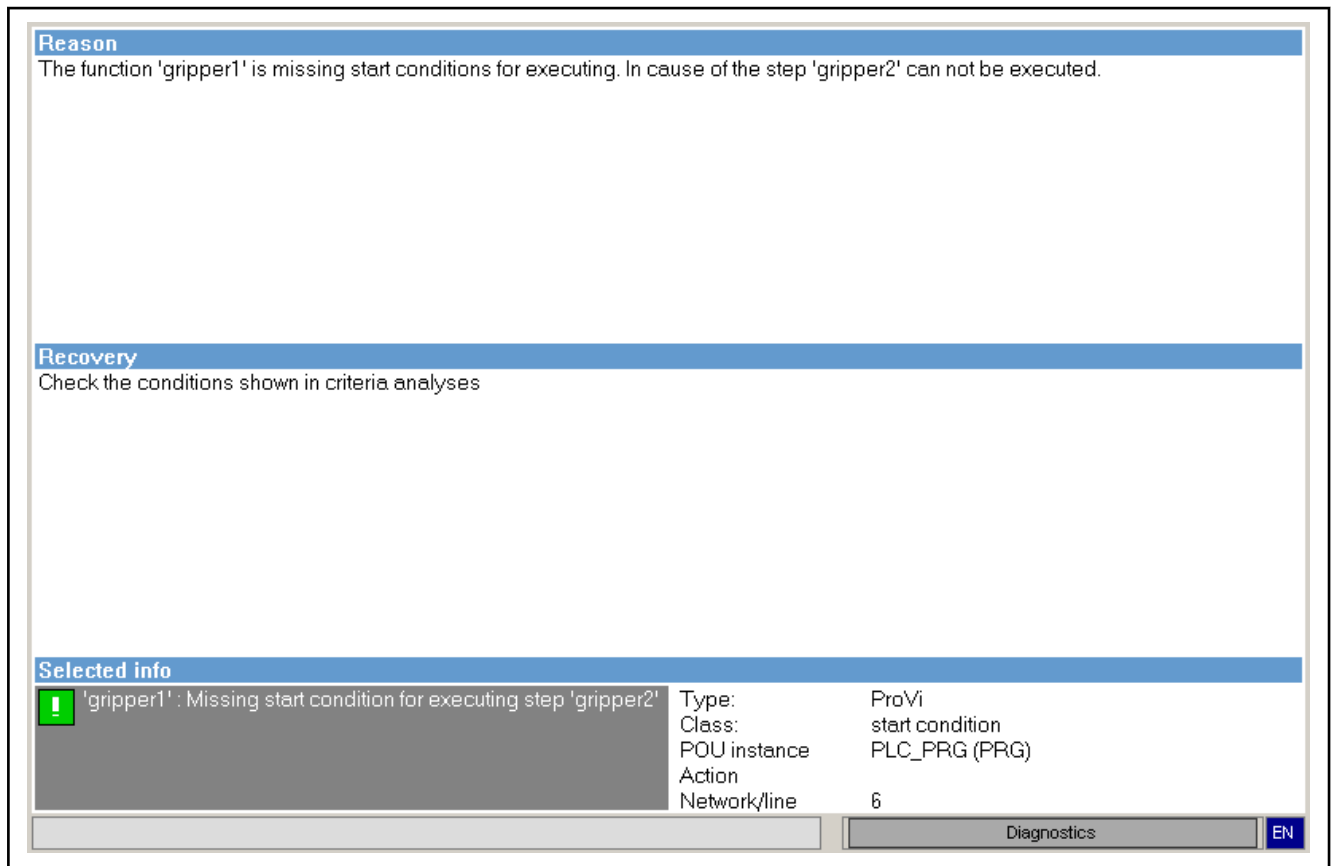


Fig. 9-3: Detailed view of the diagnostics

The windows "Cause" and "Recovery" are zoomed windows of the windows already existing in the overview.

More information on the messages is displayed in the "Selected information" window. Different additional information is displayed according to the message types (e.g. ProVi).

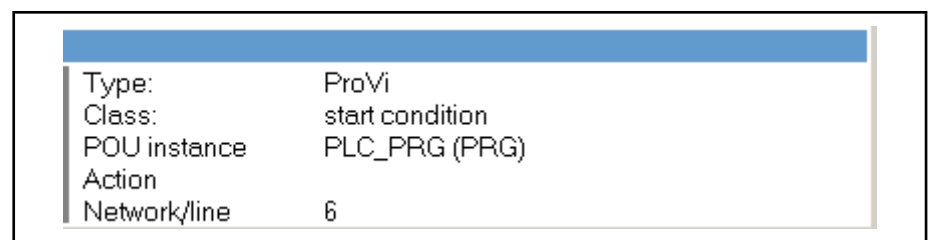


Fig. 9-4: Additional information for a ProVi message

The additional information describes the ProVi message type and its origin in the program.

The cursor or navigation keys can be used to scroll through messages of the filtered overview list.

<F7> is used to switch the overview presentation.

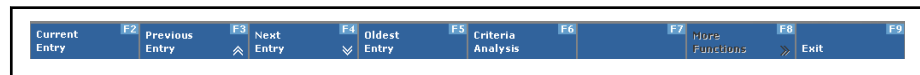


Fig. 9-5: Navigation keys for a detailed view of the diagnostic messages

9.1.4 HTML information

The cause information and the recovery information for a ProVi message cannot only be provided as text, but also as HTML. The HTML link is displayed in the area of the recovery text of the overview. By selecting the ProVi message and <F3> "Detail", the content of the specified file is part of the detailed view.

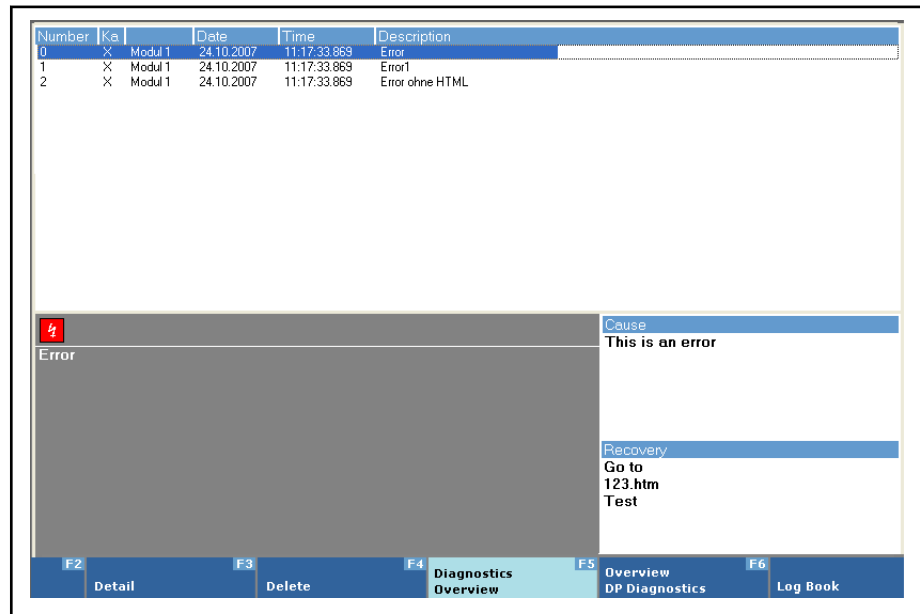


Fig. 9-6: Overview in the operating area "Diagnostics with HTML information"

The areas "Cause" and "Recovery" in the detailed view with HTML information are replaced by an HTML site. An F-panel is shown for the detailed view with HTML information. The four F-keys in the F-panel are used to scroll the HTML site. The F-panel used to navigate between the individual diagnostics can be reached via a second F-panel level. If the detailed view is called including the HTML information of the diagnostic overview, the panel to scroll the HTML site is displayed. The panel for navigation can be reached by switching the level. If the detailed view is called including the HTML information (e.g. by Next, Previous...), the navigation panel and the panel to scroll can still be reached via the level change.

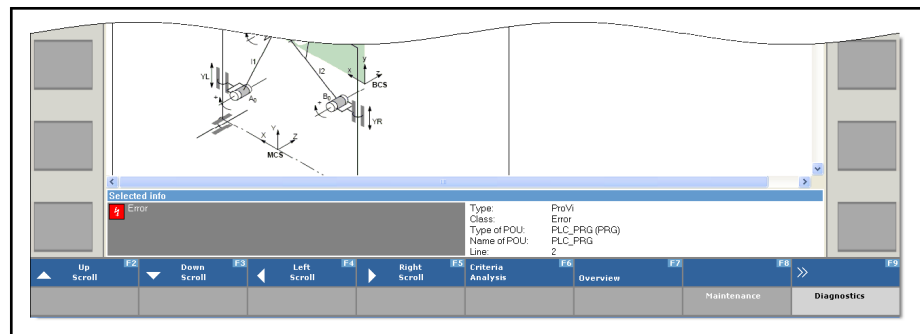


Fig. 9-7: Detailed view with HTML information (panel level HTML sites)

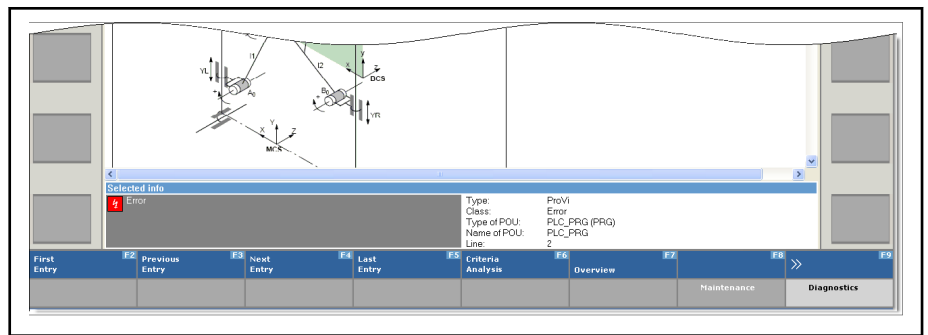


Fig. 9-8: Detailed view with HTML information (panel level diagnostic messages)



Level switching  is only enabled if the ProVi message contains HTML information.

If the HTML file was not found, a default site with the message "<Path>\<File-Name> was not found" is output.

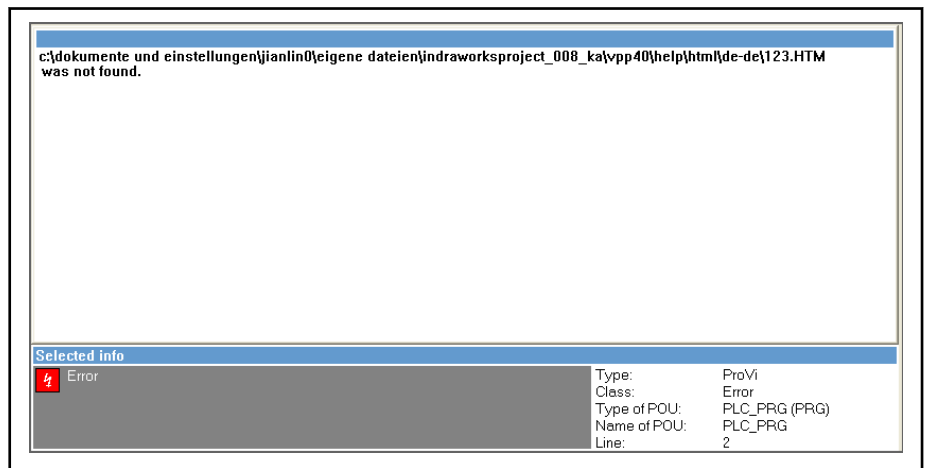


Fig. 9-9: Detailed view in the operating area Diagnostics - "File not found"

9.1.5 Connection interruption

If the communication to the control is interrupted, no diagnostic messages can be displayed. This is for example the case if the connecting cable was removed. The display of the diagnostic messages is deleted when the connection is interrupted. As soon as the connection is established again, the display updates automatically.

9.2 Logbook

9.2.1 Overview

The logbook is embedded in the diagnostic screen. After opening the diagnostic overview <F9>, press <F7> to change to logbook.

Diagnostics

Number	Ka		Date	Time	Description
1000	X		17.07.2007	11:48:01.962	'greifer1': Missing Start Condition to execute the step 'Greifer2_Zu'
1003	X	Modul 1	17.07.2007	11:48:01.961	'greifer1': the endpositions '%IX50.0; Greifer 1 offen' and '%IX50.1; Greifer 1 geschlossen' are not
	X	Modul 1	16.07.2007	18:16:40.569	Sfc 'Hub-Quer-Einheit erster Teile-Aufsetzer ', missing Startcondition
	X	Modul 1	16.07.2007	18:16:40.569	Sfc 'Hub-Quer-Einheit dritter Teile-Aufsetzer ', missing Startcondition
	X	Modul 2	16.07.2007	18:16:40.569	Sfc 'PR_HBQ_2', missing Startcondition

'greifer1': Missing Start Condition to execute the step 'Greifer2_Zu'

Cause

The working on release is missing to the function 'greifer1' for the execution, thus the step 'Greifer2_Zu' cannot be worked on

Recovery

Check the conditions, which are shown in the criteria analysis

Fig. 9-10: Basic diagnostic screen

9.2.2 Selecting Logbook

Opening logbook

Logbooks are configured in IndraWorks Engineering. As many logbooks as desired can be combined with any controls. If more than one logbook has been configured, a selection dialog opens when the logbook (<F7> key) is called.

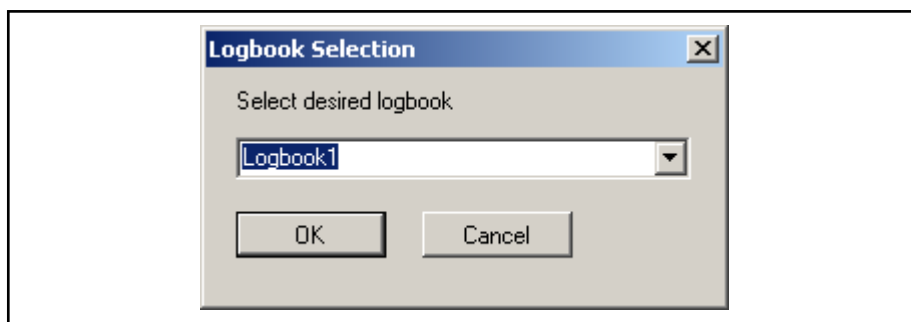


Fig. 9-11: Logbook selection dialog

If only one logbook is configured, the selection dialog is not displayed and the logbook is immediately activated.

If no logbook is configured at all, a warning is displayed.

Logbook functions

With <F5> "Selection", a logbook can be selected. With <F9>, the logbook display is closed and it is returned to the diagnostic overview.

Comes	Goes	Number		Source	Text
17.07.2007 07:37:11		1000		IndraLogic_L40...	'greifer1': Missing Start Condition to execute the s
17.07.2007 07:37:11		1003	Modul 1	IndraLogic_L40...	no text available for message no 1003.
	17.07.2007 07:37:07	1000		IndraLogic_L40...	'greifer1': Missing Start Condition to execute the s
17.07.2007 07:37:07		1001	Modul 1	IndraLogic_L40...	no text available for message no 1001.
	17.07.2007 07:36:36	1003	Modul 1	IndraLogic_L40...	no text available for message no 1003.
16.07.2007 20:16:40			Modul 2	IndraLogic_L40...	Sfc 'PR_HBQ_2', missing Startcondition
16.07.2007 20:16:40			Modul 1	IndraLogic_L40...	Sfc 'Hub-Quer-Einheit dritter Teile-Aufsetzer ', mis
16.07.2007 20:16:40			Modul 1	IndraLogic_L40...	Sfc 'Hub-Quer-Einheit erster Teile-Aufsetzer ', mis
16.07.2007 18:16:40			Modul 2	IndraLogic_L40...	Sfc 'PR_HBQ_2', missing Startcondition
16.07.2007 18:16:40			Modul 1	IndraLogic_L40...	Sfc 'Hub-Quer-Einheit dritter Teile-Aufsetzer ', mis
16.07.2007 18:16:40			Modul 1	IndraLogic_L40...	Sfc 'Hub-Quer-Einheit erster Teile-Aufsetzer ', mis
16.07.2007 18:16:20		1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:16:14	16.07.2007 18:16:20	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:16:07	16.07.2007 18:16:14	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:16:01	16.07.2007 18:16:07	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:15:55	16.07.2007 18:16:01	1001	Modul 1	IndraLogic_L40...	no text available for message no 1001.
16.07.2007 18:15:49	16.07.2007 18:15:55	1001	Modul 1	IndraLogic_L40...	no text available for message no 1001.
16.07.2007 18:15:43	16.07.2007 18:15:49	1001	Modul 1	IndraLogic_L40...	no text available for message no 1001.
16.07.2007 18:15:37	16.07.2007 18:15:43	1001	Modul 1	IndraLogic_L40...	no text available for message no 1001.
16.07.2007 18:15:30	16.07.2007 18:15:37	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:15:24	16.07.2007 18:15:30	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:15:18	16.07.2007 18:15:24	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:15:12	16.07.2007 18:15:18	1000	Modul 1	IndraLogic_L40...	ProVi Info zu Msg1000
16.07.2007 18:15:06	16.07.2007 18:15:12	1001	Modul 1	IndraLogic_L40...	no text available for message no 1001.

Text
'greifer1': Missing Start Condition to execute the step 'Greifer2_Zu'
Source
IndraLogic_L40_DP_1

Fig. 9-12: Selecting a logbook

9.2.3 Deleting Logbook

Press <F4> "Delete" to activate the delete function. This deletes all messages displayed with the currently set filters. The display is updated after completed deletion.

9.2.4 Updating Display

The logbook screen displays the messages statically. Press <F6> "Update" to update the screen.

9.2.5 Export

Press <F2> "Export" to show the "Export" dialog.

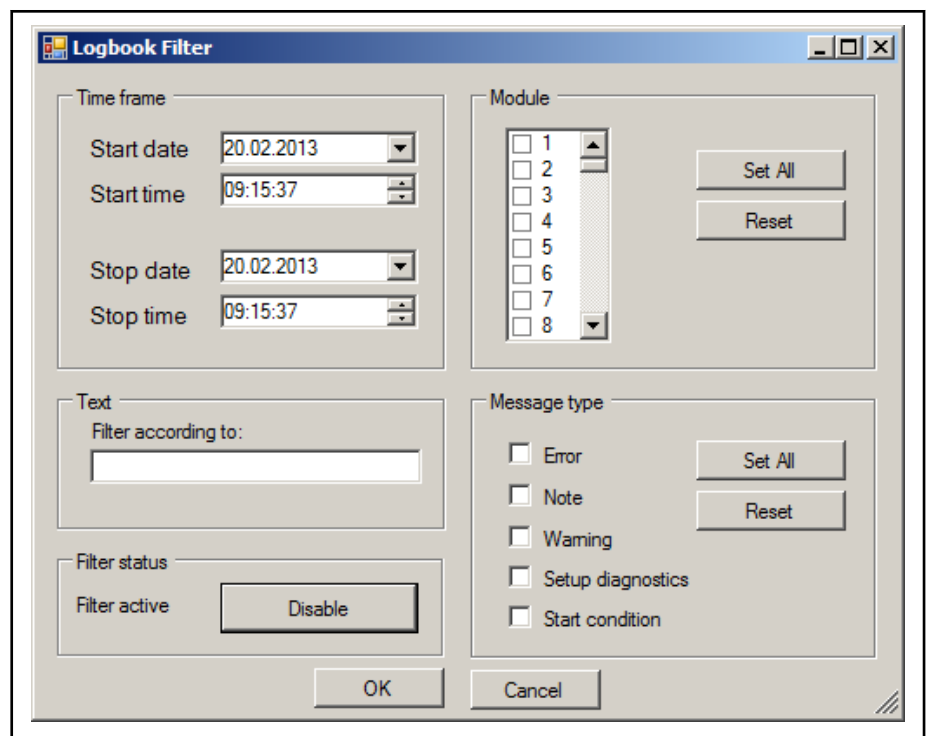


Fig. 9-14: Example: Filter dialog

The Filter dialog allows to limit the selection list of logbook messages.

Enter the start time and end time in the "Time frame" field. Only messages within this time period are displayed.

The "Source" field defines the control whose messages are considered.

Define the module numbers and the type of messages that are included in the log in "Module" and/or "Message type". The five message classes and the 99 modules may be combined in any way.

In the "Text" field, the messages available are searched for a defined text. Only messages within the text specified are displayed.

Enable or disable the filter with the **Enable** and/or **Disable** button.

Pressing **OK** enables the filters.

All settings are deleted when IndraWorks Operation is closed and the filter is disabled by default.

9.3 Field bus diagnostics

The field bus diagnostic display is embedded in the general representation of the diagnostics. The bus states of a Profibus DP connected to the control are displayed in the field bus diagnostics. Two views are available. The overview display provides an overview of the field buses configured in IndraWorks Engineering. The detailed view contains more detailed information about the individual bus devices selected in the overview.

The field bus diagnostics is called in two steps from the basic diagnostics view. In the first step, the key assignment of the function keys is switched using <F8>.

Diagnostics

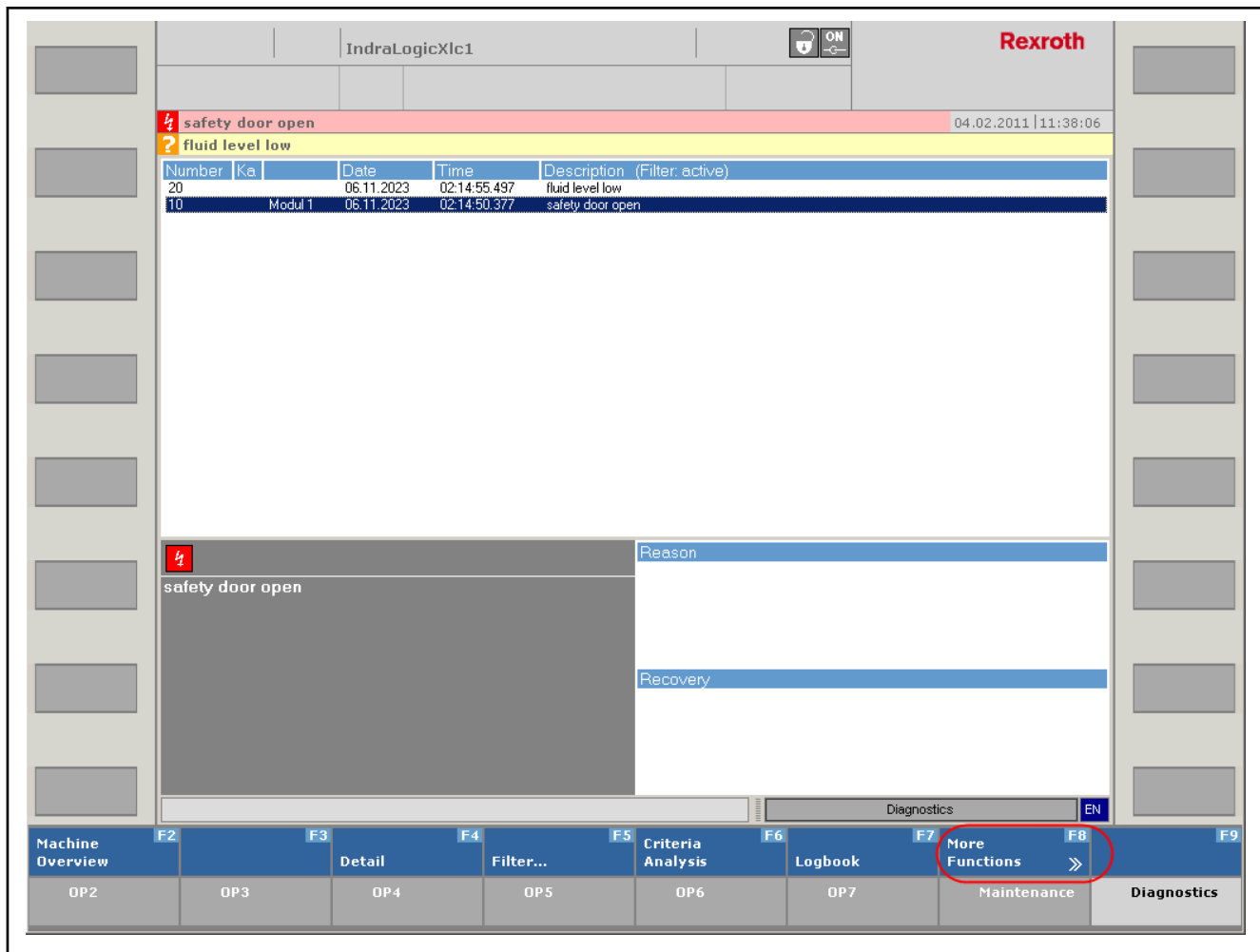


Fig. 9-15: Start screen of the diagnostics

Subsequently, the field bus diagnostics is called using <F2>.

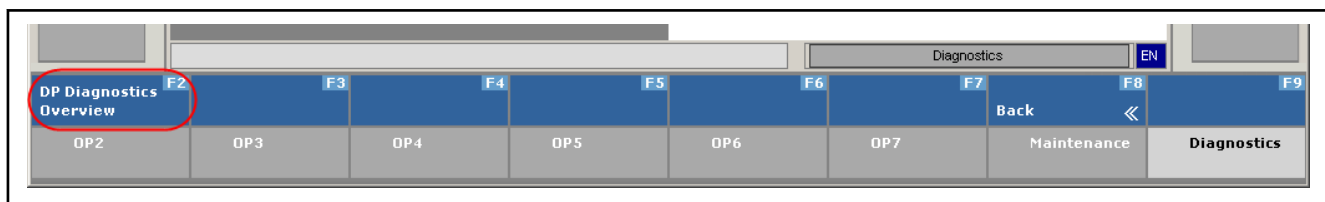


Fig. 9-16: Switched function key assignment in the diagnostic overview

After calling the field bus diagnostics, an overview of the currently configured Profibus DP is displayed.

The window is divided into three areas:

- In the upper area, the bus master state, the name of the control as well as the ident number are displayed
- In the center part of the screen contains the legend of the DP slave states as well as an overview of the number of the failed and the mal-functioning slaves
- In the lower part of the screen, the current bus configuration including all slaves is displayed. Each slave is displayed with the bus address and its current state

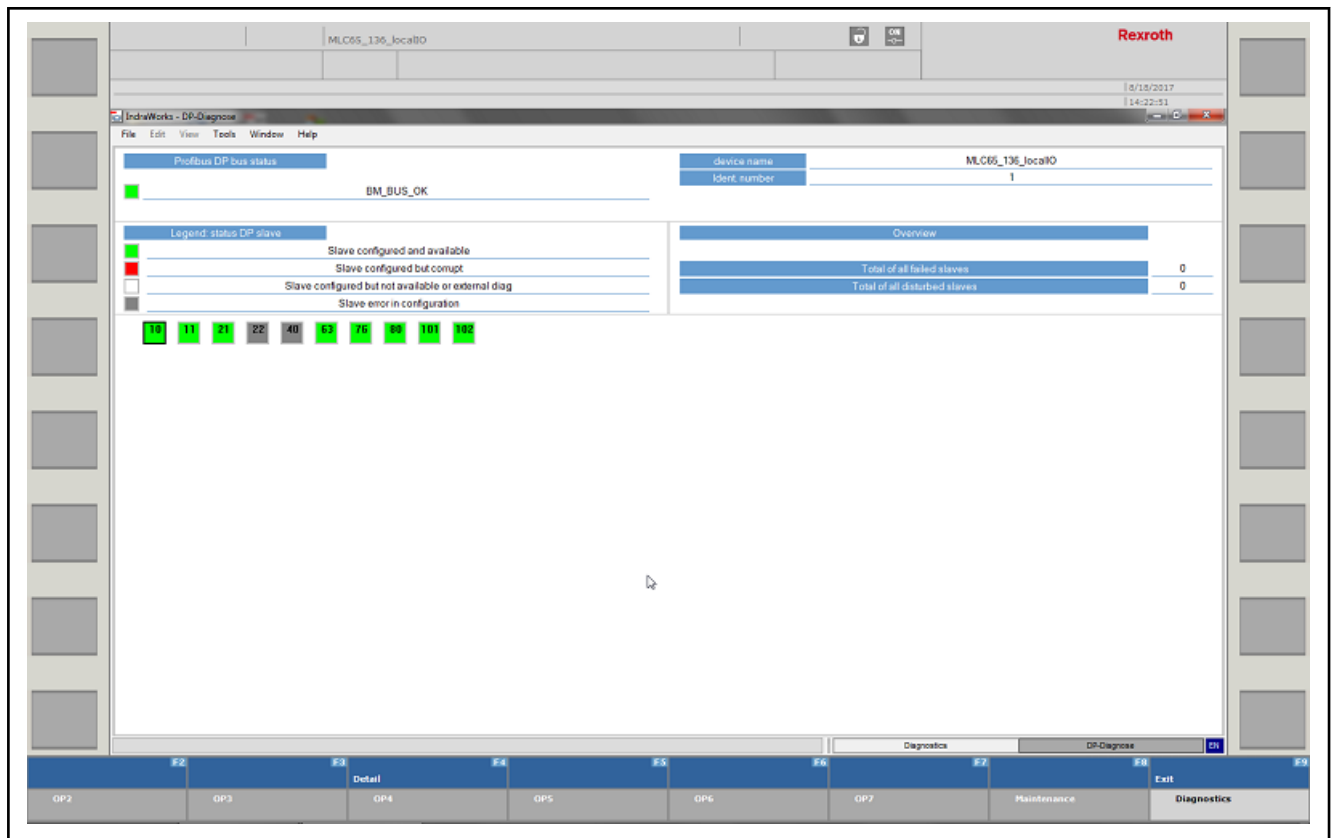


Fig. 9-17: Overview Profibus DP diagnostics

For more information about each bus device, refer to the detailed view. The detailed view is available for each slave and is displayed for the selected (black frame) bus device. Select the slave using the mouse or arrow keys. Open the detailed view using <F4>.

Once activated, the detailed view is displayed on the center and lower area of the overview screen. The representation provides information about the current bus device state, the slave address, the ident number and the status of the station. An error number transmitted by the control as well as the hexadecimal coded channel error text is displayed depending on the bus device.

Diagnostics



Fig. 9-18: Detailed view of a bus device

To access the detailed view of another slave, the user does not have to go back to the overview but can toggle between the detailed views of the bus devices using <F2> to <F5>.

Go back to the overview with <F9>. This key closes the detailed diagnostic view.

9.4 NC PLC interface signals

9.4.1 Use

The "Interface signals" display shows the status of all input and output signals of the internal interface between NC and PLC.

The signals are arranged according to the following signal groups:

- Global signals
- Channel signals
- Axis signals
- Spindle signals

The signals are arranged byte by byte in a group and displayed in plain text (logical name, description of signal). Signals, currently logically true, are inversely displayed (i.e. highlighted in dark blue).

Arrangement of the interface signals on the operating desktop

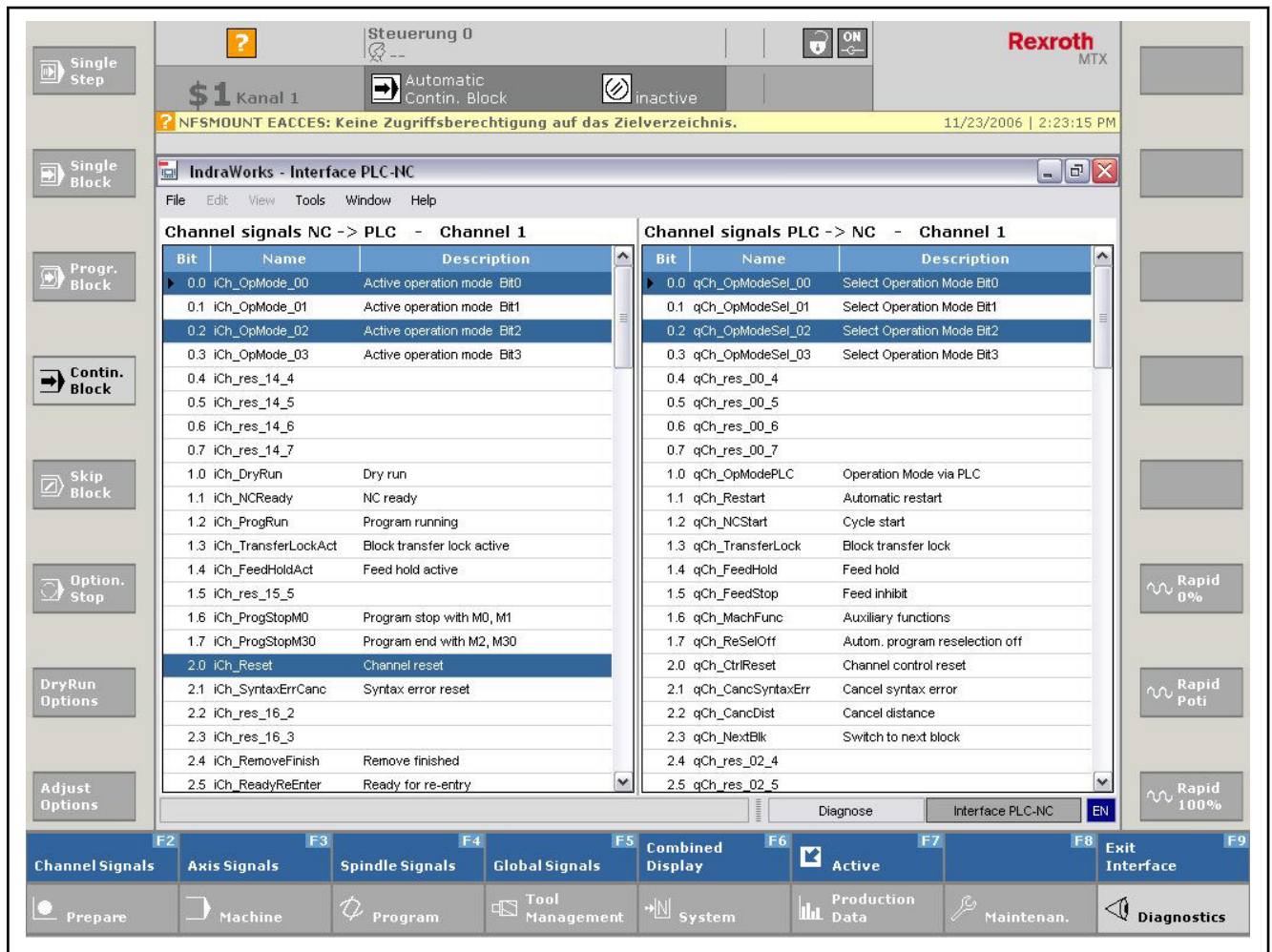


Fig. 9-19: Interface signals in the user interface

The display of the interface signals is an application with individual F-key assignment.

Menu and title are hidden.

The interface signals are assigned to the operating area "Diagnostics" <OP9>. Press <F8> to start the application.

9.4.2 Basic structure of the interface signal display

Structure of the interface signals display

Bit	Name	Description
0.0	iCh_OpMode_00	Active operation mode Bit0
0.1	iCh_OpMode_01	Active operation mode Bit1
0.2	iCh_OpMode_02	Active operation mode Bit2
0.3	iCh_OpMode_03	Active operation mode Bit3
0.4	iCh_res_14_4	
0.5	iCh_res_14_5	
0.6	iCh_res_14_6	
0.7	iCh_res_14_7	
1.0	iCh_DryRun	Dry run
1.1	iCh_NCRReady	NC ready
1.2	iCh_ProgRun	Program running
1.3	iCh_TransferLockAct	Block transfer lock active
1.4	iCh_FeedHoldAct	Feed hold active
1.5	iCh_res_15_5	
1.6	iCh_ProgStopM0	Program stop with M0, M1
1.7	iCh_ProgStopM30	Program end with M2, M30
2.0	iCh_Reset	Channel reset
2.1	iCh_SyntaxErrCanc	Syntax error reset
2.2	iCh_res_16_2	
2.3	iCh_res_16_3	
2.4	iCh_RemoveFinish	Remove finished
2.5	iCh_ReadyReEnter	Ready for re-entry
2.6	iCh_ReEnterAct	Reenter active
2.7	iCh_Retract	
3.0	iCh_ASub1	Asynchronous subprogramm 1

Bit	Name	Description
0.0	qCh_OpModeSel_00	Select Operation Mode Bit0
0.1	qCh_OpModeSel_01	Select Operation Mode Bit1
0.2	qCh_OpModeSel_02	Select Operation Mode Bit2
0.3	qCh_OpModeSel_03	Select Operation Mode Bit3
0.4	qCh_res_00_4	
0.5	qCh_res_00_5	
0.6	qCh_res_00_6	
0.7	qCh_res_00_7	
1.0	qCh_OpModePLC	Operation Mode via PLC
1.1	qCh_Restart	Automatic restart
1.2	qCh_NCStart	Cycle start
1.3	qCh_TransferLock	Block transfer lock
1.4	qCh_FeedHold	Feed hold
1.5	qCh_FeedStop	Feed inhibit
1.6	qCh_MachFunc	Auxiliary functions
1.7	qCh_ReSelOff	Autom. program reselection off
2.0	qCh_CtrlReset	Channel control reset
2.1	qCh_CancSyntaxErr	Cancel syntax error
2.2	qCh_CancDist	Cancel distance
2.3	qCh_NextBlk	Switch to next block
2.4	qCh_res_02_4	
2.5	qCh_res_02_5	
2.6	qCh_RetCont	Return to contour
2.7	qCh_Retract	Fast retract (G33)
3.0	qCh_ASub1	Asynchronous subprogramm 1

Fig. 9-20: Structure of the interface signal display

The display consists of two lists.

The list on the left shows the NC → PLC signals and the right list shows the PLC → NC signals for the selected signal group.

Each line of the list visualizes a signal. The signal numbering in the list starts with 0.0.

The focused list is indicated by a blue frame.

Press <F6> to open a list display to which the user can assign any combination of signal types.

9.4.3 Operation and navigation

Use F-keys and <Cursor> keys for the operation.

Use the <cursor> keys to scroll within the list.

The <cursor> keys always act on the focused list.

Basic level of F-keys

On the basic level, the signal group can be selected, a list can be focused and the application can be closed.

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
Channel Signals	Axis Signals	Spindle Signals	Global Signals	Combined Display	List Focus		Exit Bit interface

Tab. 9-1: Basic level of F-keys

When a signal group is selected, the list is automatically focused and the corresponding F-key pads are shown.

F-keys: Channel signals

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
Channel +	Channel -			Channel Selection	Change focus		Basic Level

Tab. 9-2: F-keys: Channel signals

Press <F2> or <F3> to display the interface of the next/previous channel.

Press <F6> to display a dialog for the channel selection.

Press <F7> to switch the focus between the lists.

Press <F9> to jump back to the basic level.

F-keys: Axis signals

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
Axis +	Axis -			Axis Selection	Focus Change		Basic Level

Tab. 9-3: F-keys: Axis signals

Press <F2> or <F3> to display the interface of the next/previous axis.

Press <F6> to display a dialog for the axis selection.

Press <F7> to switch the focus between the lists.

Press <F9> to jump back to the basic level.

F-keys: Spindle signals

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
Spindle +	Spindle -			Spindle Selection	Focus Change		Basic Level

Tab. 9-4: F-keys: Spindle signals

Press <F2> or <F3> to display the interface of the next/previous spindle.

Press <F6> to display a dialog for the spindle selection.

Press <F7> to switch the focus between the lists.

Press <F9> to jump back to the basic level.

F-keys: Global signals

<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
					Focus Change		Basic Level

Tab. 9-5: F-keys: Global signals

Press <F7> to switch the focus between the lists.

Press <F9> to jump back to the basic level.

F-keys: Combined display

In the combined display, <F8> is additionally assigned to the "Signal type selection" function. Press this key to open a dialog in which the signal types for the left and right list can be selected.

9.5 Variable and parameter lists

9.5.1 Use

The application shows selected variables and parameters in a preconfigured list of 22 lines and 5 columns.

Diagnostics

The values of these variables and parameters can be changed online within the list.

Categories and subcategories

Categories and subcategories of variables and parameters are shown in the following table.

Symbol	Category	Subcategory
	NC variables	CPL variables SD variables
	PLC variables	All data types such as Bool, integer etc.
	Machine parameters	All parameter types Such as axis parameters, spindle parameters, channel parameters
	Drive parameters	Data Status

Tab. 9-6: Categories and subcategories

Arrangement of the variable and parameter lists in IndraWorks Operation

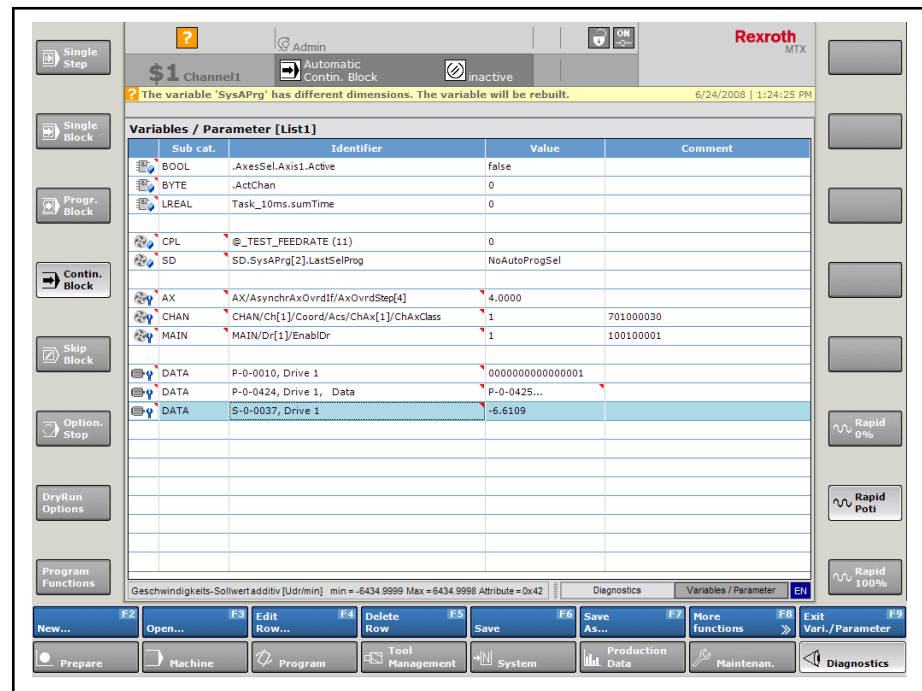


Fig. 9-21: Arrangement of the variable and parameter lists in IndraWorks Operation

The application has an own F-key assignment.

Menu and title are hidden.

The variable and parameter lists are assigned to operating area "Diagnostics" <OP 9>. Press <F9> to start the application.

9.5.2 Basic structure of the variable and parameter lists

Structure of the list display

[illegible]

Fig. 9-22: Structure of the list display

The screen consists of a list with the following five columns:

- Category (symbol representation)
- Subcategory
- Identifier
- Value
- Comment

Each of the 22 lines can be assigned to a variable or parameter.

More Information

If there is further information on cell contents, the cell is marked with a red triangle. The information is displayed when moving over the element with the mouse or selecting the cell with the cursor keys via tooltips and status bar.

Machine parameters contain the following further information:

- Macoda ID
- Parameter name

SD.SysAPrg[2].LastSelProg	NoAutoProgSel	
AX/AsynchrAxOvrddIf/AxOvrddStep[4]	701000030	Axis Classification
CHAN/Ch[1]/Coord/Acs/ChAx[1]/ChAxClass	1	701000030
MAIN/Drf11/EnablDr	1	100100001

Fig. 9-23: Display of further information on machine parameters

Drive parameters contain the following further information:

- Parameter name
- Unit
- Minimum value
- Maximum value
- Attribute

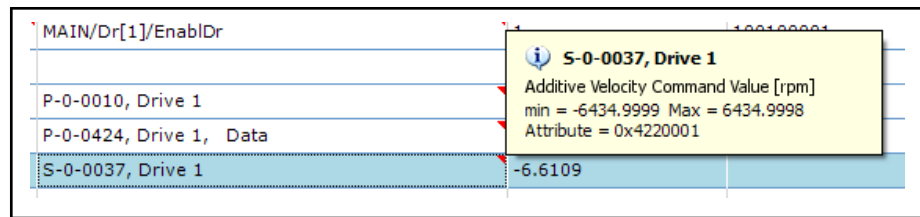


Fig. 9-24: Display of further information on drive parameters

If the text in a line is too long, it is cut off ("...") and labeled and displayed as further information.

If a variable or parameter is entered into the list but no longer in the active project, the value is labeled with "???" and referred to in the further information.

9.5.3 Operating and navigation

It is operated via F-keys and cursor keys.

The cursor keys are used to navigate between the cells within the list.

Entry of values Focused editable cells are dark blue.

An editable cell becomes an input field by entering a value. Press <Return> or double-click to confirm.

The entered value is applied with <Return> and transferred to the NC, PLC or drive.



Machine parameters:

For some machine parameters, the change is only applied after "NC restart" or "System reset". A corresponding note is given via a flashing symbol in the machine status area and a message in the status line. A key to trigger the function is available under "Additional functions".

PLC variables:

PLC variables are written once. PLC variables can only be forced in IndraWorks Engineering!

Incorrect entries are marked by the red color of the input field as well as by a message in the status line.

Cancel the value input with <Esc>.

Basic level of F-keys The basic level contains the key functions to create and manage the list.

<F2 New...>	<F3 Open...>	<F4 Edit line...>	<F5 Delete line>	<F6 Save>	<F7 Save As...>	<F8 Additional functions...>	<F9 End vari./parameter>
Create a new list	Open an existing list from the active project	Select a variable or a parameter via browser dialog	Delete line	Save the current list in the active project	Save the current list under a different name in the active project	Additional functions (second level)	Close application

Tab. 9-7: Basic level of F-keys

F-keys: Additional functions This level contains additional functions for the list management.

<F2 Ex- port...>	<F3 Im- port...>	<F4 Delete lists...>	<F5>	<F6 Reset function>	<F7 Informa- tion → Com- ment>	<F8 Return>	<F9>
Export the ac- tive list into the file sys- tem of the PC	Import a list from the file system of the PC	Delete lists from the ac- tive project		If required, it is assigned with "NC re- start" or "Sys- tem reset" to activate modi- fied machine parameters	Apply further information into the com- ment cell	Return to basic level	

Tab. 9-8: F-keys: Additional functions

Variable browser

The variable browser is intended to select the corresponding variable or parameter for the display of the selected line of the list.

Category, subcategory, variables and parameters are displayed as tree in the variable browser.

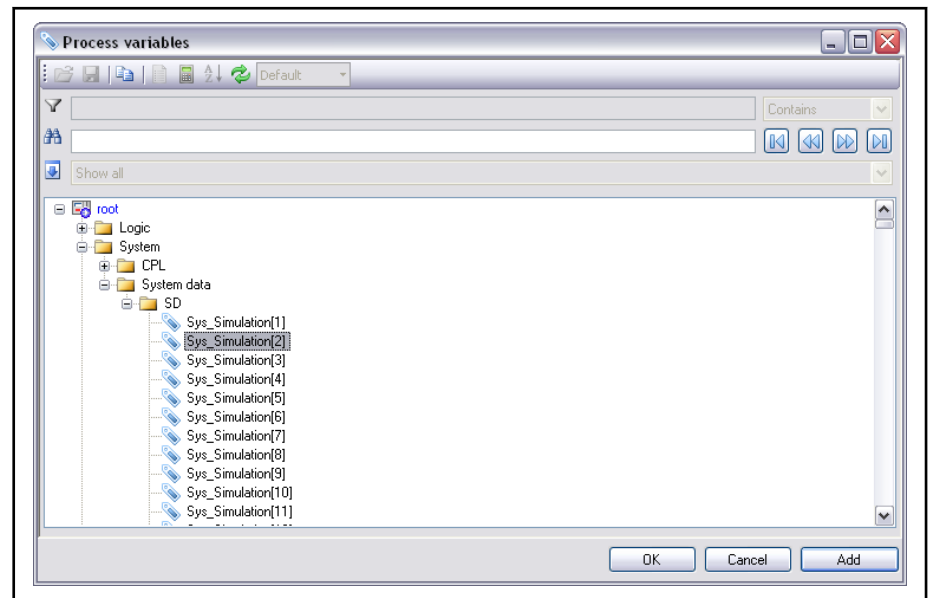


Fig. 9-25: Variable browser

Variables or parameters are selected by navigating in the tree. Facilitate the search by using filter and search functions.

List parameters of the drives are defined further by an additional dialog.

Press "Add" to apply the variable or parameter to the list. The next empty line is focused and the variable browser remains open.

"OK" applies the variable or parameter to the list and the variable browser is closed.

"Cancel" closes the variable browser without applying the values.

Open, Save As, Delete dialog

The lists created are stored in the active project:

"...\ProjectName\VisualizationName\user\config\VarParLists".

The "Open", "Save" and "Delete" dialogs are intended for file management. The **Open** dialog is shown in the figure. The **Save As** and **Delete** are similar.

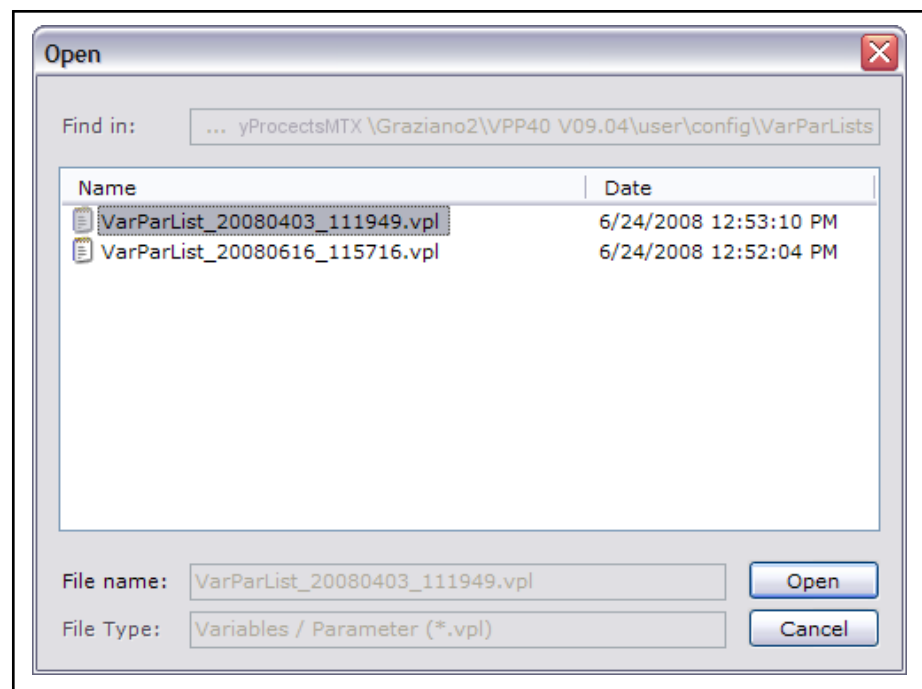


Fig. 9-26: "Open" dialog

"Import" and "Export" dialog

The lists can be exported from the active project to the file system of the PC and imported from the file system to the active project.

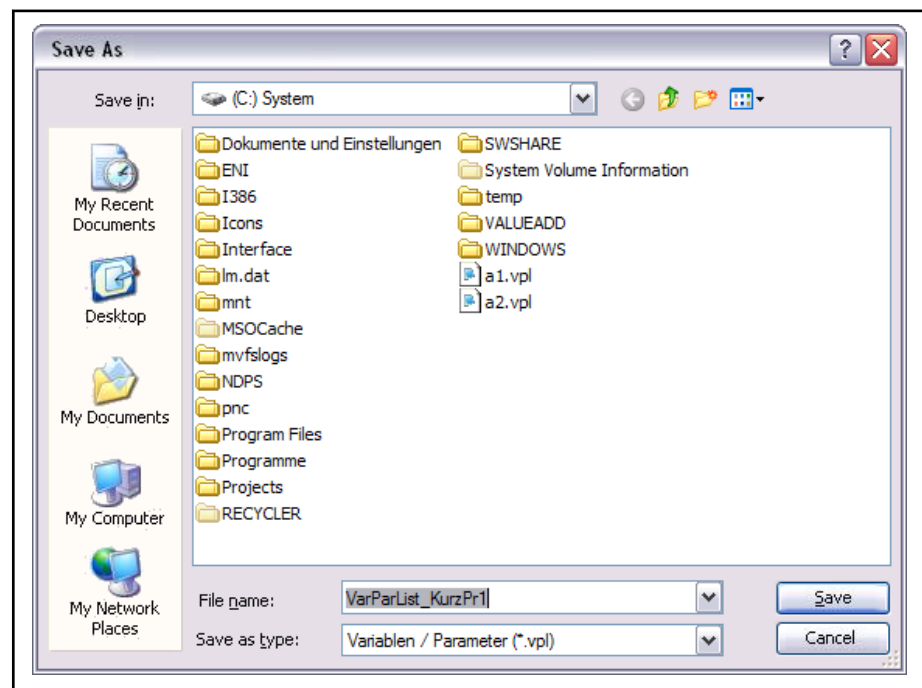


Fig. 9-27: "Export" dialog

9.6 MTX system status

9.6.1 Introduction

The MTX system status is a commissioning and diagnostic application for PC-based MTX controls.

This application controls, monitors and visualizes the state of the following component groups:

- IndraMotion MTX standard L45
- IndraMotion MTX performance L65
- IndraMotion MTX advanced L85

The MTX system status is embedded in the diagnostic display and can be opened via <F5> after calling the diagnostic display with <OP9>.

After calling the application, it is displayed as shown below.

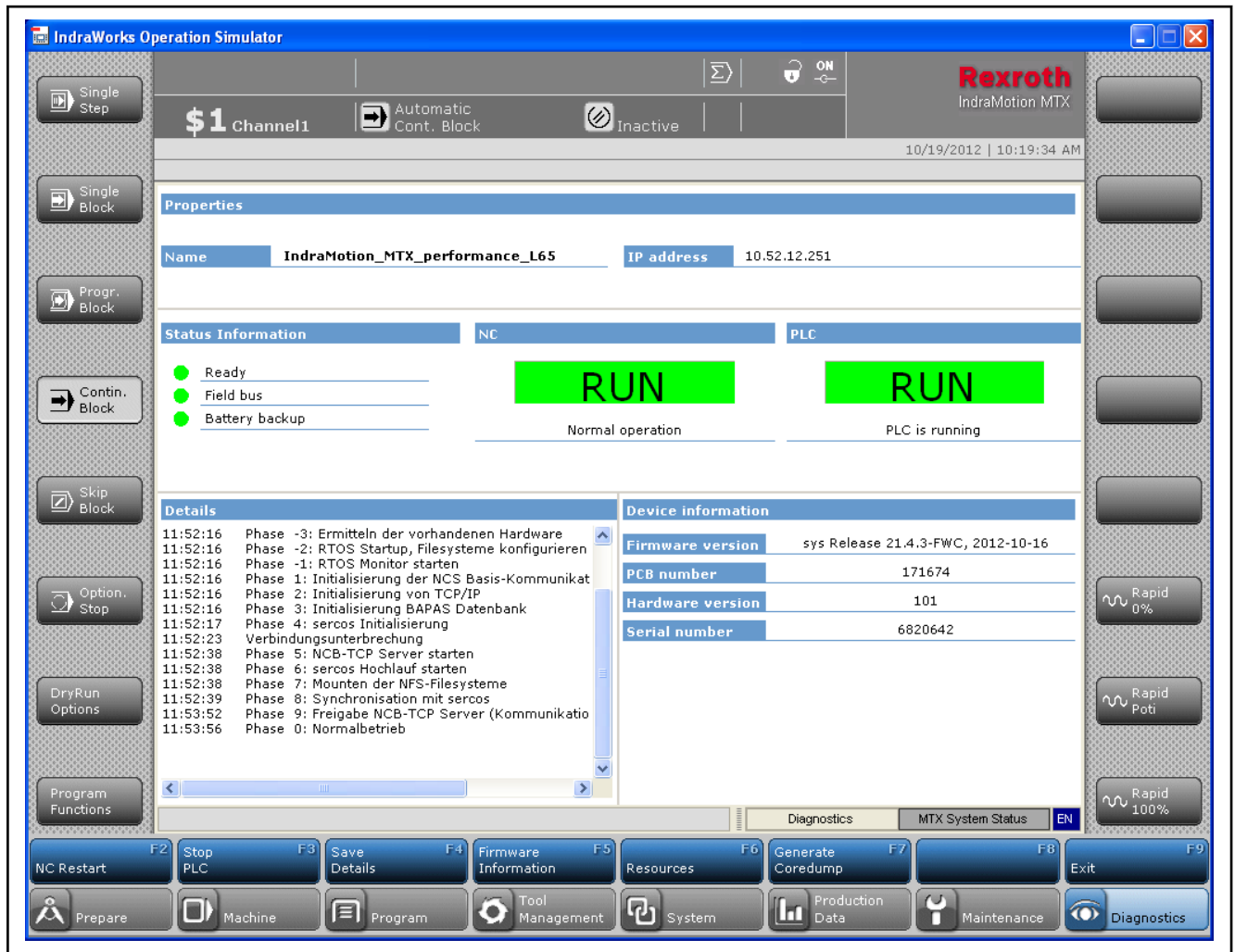


Fig. 9-28: MTX System Status

The MTX system status is divided into three sections.

In the upper section "Properties", find general information on:

- Name:
The name configured for the respective control in the IndraWorks Engineering is displayed.
- IP address:
The IP address entered into the network configuration is displayed.

The middle section displays the following:

- Status Information:

The status information of the control is displayed via red and green LEDs (see [chapter 9.6.2 "Status information" on page 222](#)).

- **NC:**
In this section, the NC information is displayed (see [chapter 9.6.3 "NC" on page 222](#)).
 - **PLC:**
In this section, the PLC information is displayed (see [chapter 9.6.4 "PLC" on page 223](#)).
- The lower section is split in two:
- The results of the last control restart executed with this application are displayed on the left (see [chapter 9.6.5 "Saving details" on page 223](#)).
 - The device information is displayed on the right.

9.6.2 Status information

The status information of the control is displayed using red and green LEDs:

- **Ready**
Green LED = Ready signal is 1
Red LED = Ready signal is 0
Grey LED = Ready signal is not supported by the control
- **Field bus**
Green LED = Field bus function ok
Red LED = Problem with field bus
- **Backup battery**
green LED = Correct buffer battery state
Red LED = Buffer battery discharged or buffer battery not available

9.6.3 NC

The NC display in the middle section is provided with the following:

- **NC status field:**
This field visualizes the current NC status which is displayed in color and short form. The used abbreviations are described in [chapter 9.6.8 "Startup configuration" on page 225](#). This field is flashing during control startup.
- **Information field with detailed status description:**
The abbreviations in the status field are explained in this field.

Use <F2> to execute an NC restart. Use this F-key to open the following dialog. In this dialog, the startup mode [chapter 9.6.8 "Startup configuration" on page 225](#) can be specified for a restart.

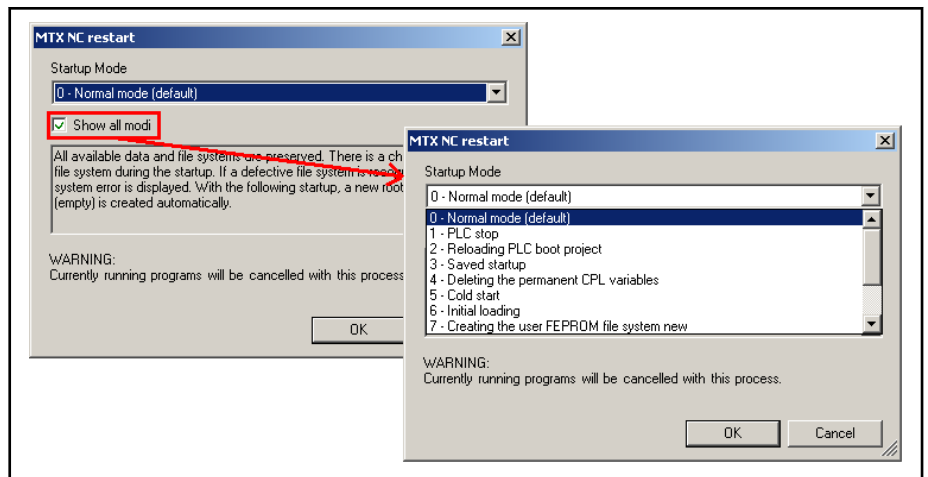


Fig. 9-29: MTX NC restart

If the checkbox "Show all modes" is not selected, the user can only choose between three modes.

0	Normal mode (default)
6	Bootstrapping
7	Recreating the user FEPRM file system.

9.6.4 PLC

The PLC display in the middle section is provided with the following:

- PLC status field:**

This field visualizes the current PLC status displayed in color and short form.

 - "RUN" is displayed on green background during normal mode.
 - If the PLC is at rest, "STOP" is displayed on red background.
- Information field with detailed status description:**

The abbreviations in the status field are explained in this field. The following long names exist:

 - RUN = PLC is running
 - STOP = PLC is at standstill

If the PLC is running, use <F3> to stop the PLC (and vice versa).

9.6.5 Saving details

The results of the last control restart **executed with this application** are visualized in the lower section on the left. Date, time, phase and their meanings are displayed. The display is refreshed after each restart.

If required, this information can be saved in a "*.log" file with <F4>. The path under which the file is to be saved is arbitrary. The application saves this information under the default name "Details.log".

9.6.6 Firmware information

Use <F5> to open a window with the following data:

- Software version of the MTX kernel
- Software version of the subsystems
- Version information on the Windows software components

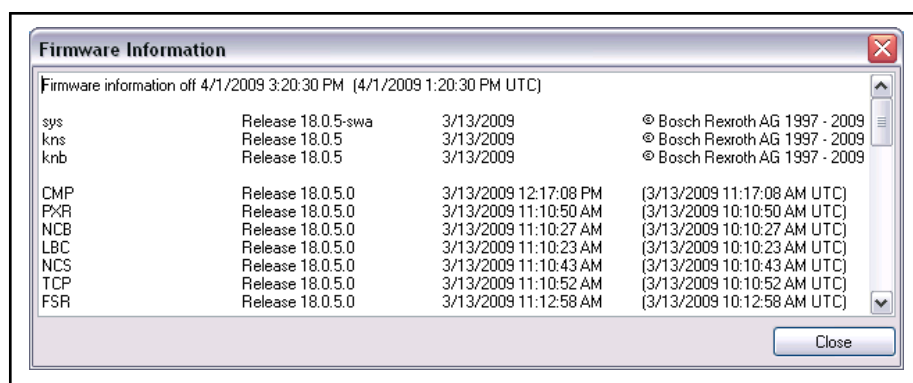


Fig. 9-30: Information on the Firmware

Software version of the MTX kernel

Returns information on the general software version of the MTX kernel as well as a copyright message (version of the basic software and the customer upgrades).

Software version of the subsystems

Provides information on software versions of the subsystems in the MTX kernel. The following data is provided for each subsystem:

- Subsystem name
- Release number
- Time stamp

Windows software components

Provides version information on the Windows software components which (under Windows) provide the communication interface for the MTX kernel. This includes:

- the NCS interface (ncstyp3.dll),
- the text management (tsvtyp3.dll),
- the logical device MTX (SCPBrickDevice.dll, SCPBrickComponent.dll) and
- FIS (FisServer.dll).

The following data is provided for each component:

- Subsystem name
- Release number
- Time stamp

9.6.7 Resources

The current memory allocation is embedded into the diagnostic display and can be opened with <F7>.

The following information is visualized:

- Permanent CPL variables
- persistent SD data
- Used memory of the RAM file system

The bar visualizes the memory consumption in per cent. For detailed information, go to the tooltips of the corresponding bars.

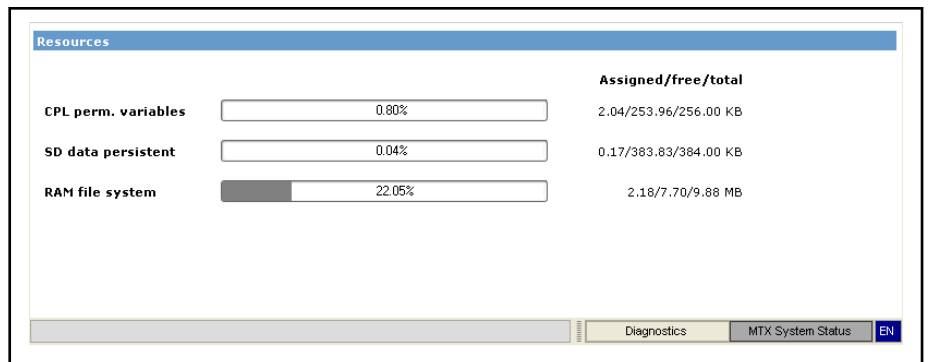


Fig. 9-31: Resources

9.6.8 Startup configuration

Startup

MTX starts while switching on the control or while triggering an NC restart. The startup occurs synchronized in 12 phases displayed in the MTX system status:

P: -3	Determining the existing hardware
P: -2	RTOS startup, configuring file systems
P: -1	Starting RTOS monitor
P: 1	Initializing basic NCS communication
P: 2	Initializing TCP/IP
P: 3	Initializing BAPAS database
P: 4	Sercos initialization
P: 5	Starting NCB-TCP server
P: 6	Starting Sercos startup
P: 7	Mounting NFS file systems
P: 8	Synchronization with Sercos
P: 9	Enabling NCB-TCP server (communication with user interface)
RUN	Normal operation

Tab. 9-9: Display of startup phases

Startup mode

The startup mode determines the behavior of the MTX at startup. The startup mode changes are applied at next startup.

Startup mode	Meaning
0	Normal operation All existing data and file systems are retained. The root file system is checked at startup. If a defective file system is detected, a critical system error is displayed. A new (empty) root file system is automatically created during the next startup.
1	PLC stop The behavior corresponds to startup mode 0 with the difference that the PLC remains in the STOP state and the PLC user program is not processed.
2	Reloading the PLC boot project The PLC boot project is loaded from the user FEPROM. Any PLC boot project that exists in the root file system is discarded. Otherwise, the behavior corresponds to the startup mode 0.
3	Save startup In rare cases, due to faulty machine parameter specifications, a control startup can be impossible. Startup mode 3 carries out a startup in this error situation irrespective of the set machine parameters. A startup with the minimum configuration is executed. The machine parameters set are ignored. After the startup, the invalid machine parameter settings can be corrected and a new startup with Startup mode 0 can be carried out.
4	Deleting permanent CPL variables The permanent CPL variables are deleted. Otherwise, the behavior would correspond to Startup mode 0.
5	Cold start The power-up management logic is not run through. Otherwise, the behavior corresponds to startup mode 0.
6	Bootstrap A new root file system is created. As a result, all old file system data is lost. If an intact user FEPROM file system exists, the PLC boot project and the configuration data are loaded from there.
7	Recreating the user FEPROM file system The user FEPROM is created again. As a result, all old file system data is lost. This is required for example if a user FEPROM file system is defective. The root file system is retained. The permanent CPL variables are deleted.
9	Debug mode This is normally for debugging if the control does not automatically boot after a reset. After the basic monitor is initialized, the boot loader is activated and the subsystems are automatically loaded.
10	Debug mode (without automatic loading) After the basic monitor initialization, the boot loader is activated. Further loading can take place via TCP/IP.

Startup mode	Meaning
11	Debug mode (without activating the boot loader) The basic monitor is initialized. Further loading can take place via TCP/IP.
15	Debug mode (basic monitor start) Only the basic monitor is activated.

Tab. 9-10: Startup mode

9.7 PLC variable list

9.7.1 Use

The "PLCListView" application visualizes PLC variables located in a file in the IndraLogic export format "XML".



No variable structures are visualized.

The variables can be inputs, outputs and internal variables ("flags").

They are displayed in a list. They can be displayed in different ways (filtered, classified, etc.).

The values are displayed in different formats (binary, decimal, hex.).

The application supports the detailed view of each variable and provides the option to write and fix it in position. Writing and fixing is protected against unauthorized access via the user management.

Additionally, a comfortable search function with additional filters and an individual result list is provided.

Variables can be highlighted via selection functions. They can be saved as new file and opened separately later on (grouping).

A counting function to display value changes can be enabled for commissioning purposes.

The following PLC variable categories are displayed:

	Input
	Output
	Flag



Only default types (BOOL, BYTE, INT, REAL, ...) are displayed as flags. Structures and arrays are hidden.

Diagnostics

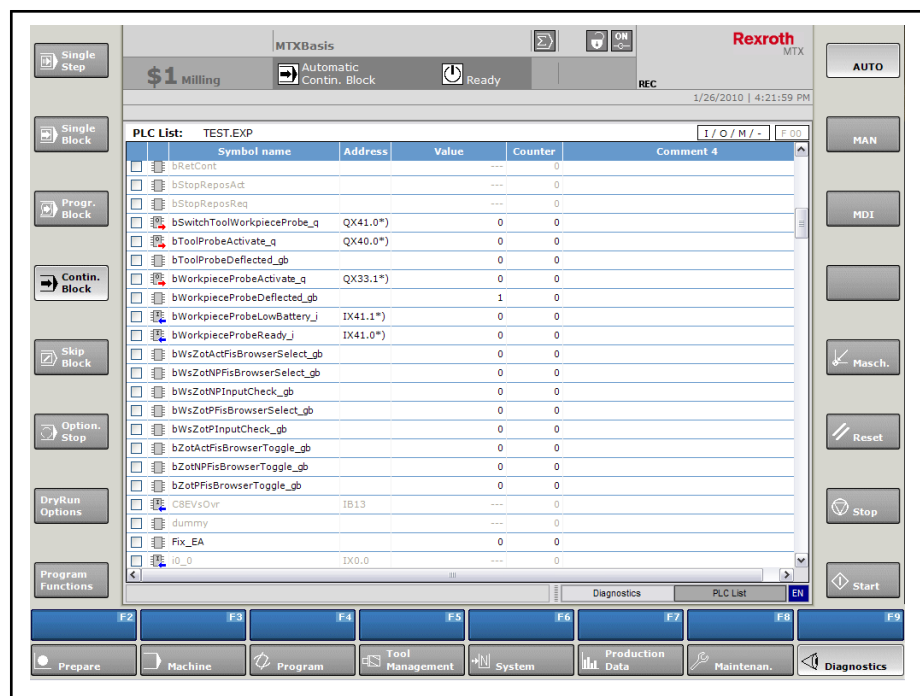
Integration of the PLC variable list
in IndraWorks Operation

Fig. 9-32: Integration of the PLC variable list in IndraWorks Operation

The display is an application with individual F-key assignment.

Menu and title are hidden.

The PLC variable list is not part of the default user interface. This application must be configured on a function key and assigned to an operating area by OEM using IndraWorks Engineering.

9.7.2 General structure of the PLC variable list

Structure of the list display

PLC List: TEST.EXP		I/O/M/- F 00			
	Symbol name	Address	Value	Counter	Comment 4
☐	bMZA_W_i		0	0	
☐	bMZA_W_q		0	0	
☐	bPlcInit		---	0	
☒	bProbeDeflected_i	IX41.2*)	0	0	
☐	bRefMissing		---	0	
☐	bRenishawNCStop_gb		0	0	
☐	bRetCont		---	0	
☐	bStopReposAct		---	0	
☐	bStopReposReq		---	0	
☒	bSwitchToolWorkpieceProbe_q	QX41.0*)	0	0	
☒	bToolProbeActivate_q	QX40.0*)	0	0	
☐	bToolProbeDeflected_gb		0	0	
☒	bWorkpieceProbeActivate_q	QX33.1*)	0	0	
☐	bWorkpieceProbeDeflected_gb		1	0	
☒	bWorkpieceProbeLowBattery_i	IX41.1*)	0	0	
☒	bWorkpieceProbeReady_i	IX41.0*)	0	0	
☐	bWsZotActFisBrowserSelect_gb		0	0	
☐	bWsZotNPfisBrowserSelect_gb		0	0	
☐	bWsZotNPinputCheck_gb		0	0	
☐	bWsZotPFisBrowserSelect_gb		0	0	
☐	bWsZotPIinputCheck_gb		0	0	
☐	bZotActFisBrowserToggle_gb		0	0	

Fig. 9-33: Structure of the list display

The list header contains three types of information:

- List name

- Active filter
- Fixing status

The PLC variable list consists of seven columns:

- Checkbox for selection (grouping, saving)
- Category (symbol representation)
- PLC variable name
- Absolute address
- Variable values
- Modification counter
- Comment



Variables that are not in the symbol tables, are displayed in grey and "--" is indicated as value.

9.7.3 Operation and navigation

The operation is executed via F-keys and cursor keys.

The cursor keys are used to navigate between the cells within the list.

F-keys: Basic level The basic level contains the key functions to create and manage the list.

F	F	F	F	F	F	F	F
Filter	Sort	Format	Comment	Details	Find	More functions	End PLC list
Call sublevel "Filter"	Call sublevel "Sort"	Call sublevel "Format"	Call sublevel "Comment"	Opens a status dialog with all detailed information on the variable selected	Call sublevel "Find"	More functions (second level)	Application complete

Tab. 9-11: F-keys: Basic level

F-keys: Filter level This level contains all filter functions.

F2	F3	F4	F5	F6	F7	F8	F9
Inputs	Outputs	Flag	Show selection	Save selection	Selection delete all	Selection set all	Back
Filter acc. to inputs	Filter acc. to outputs	Filter acc. to flags	Display only selected variables	Save selection in export file	Cancel selection for all variables	Set selection for all variables	Back to basic level

Tab. 9-12: F-keys: Filter level

F-keys: Sort level This level contains all sorting functions.

Diagnostics

F2 as list order	F3 Symbol name A -> Z	F4 Symbol name Z -> A	F5 Absolute address 0 -> 9	F6 Absolute address 9 -> 0	F7	F8	F9 Back
Sort acc. to occurrence in export file	Sort in ascending order acc. to symbol name	Sort in descending order acc. to symbol name	Sort in ascending order acc. to address	Sort in descending order acc. to address			Back to basic level

Tab. 9-13: F-keys: Sort level

F-keys: Format level This level contains all formatting functions.

F2 as data type	F3 Binary	F4 Decimal	F5 Hex	F6	F7	F8	F9 Back
Format - control-internal data type	Format - binary value	Format - decimal value	Format - hexadecimal value				Back to basic level

Tab. 9-14: F-keys: Format level

F-keys: Comment level The displayed comment can be selected in this level.

F2 Comment 1	F3 Comment 2	F4 Comment 3	F5 Comment 4	F6	F7	F8	F9 Back
Display: Comment 1	Display: Comment 2	Display: Comment 3	Display: Comment 4				Back to basic level

Tab. 9-15: F-keys: Format level

F-keys: Find level This level contains all search functions.

F2 Search down	F3 Search up	F4 Symbol name	F5 Address	F6 Comment	F7 Show hits	F8	F9 Back
Search down from cursor position	Search up from cursor position	Activate/deactivate search in the Symbol Name column	Activate/deactivate search in the Address column	Activate/deactivate search in the Comment column	Shows only matches in an extra list		Back to basic level

Tab. 9-16: F-keys: Find level

F-keys: Additional functions This level contains additional functions for the list management.

F2 Open list...	F3 Open default list	F4 Change value	F5	F6 Modification counter active	F7 Modification counter: single reset	F8 Back	F9
Open export file	Open default list	Call sublevel "Change value"		Activation/Deactivation of the modification counter	Resets an individual modification counter	Back to basic level	

Tab. 9-17: F-keys: Additional functions

F-keys: Change level value This level comprises all functions required for the value input.

F2 Enable: Write value	F3	F4 Enable: Fix value	F5 Cancel individ- ual fixing	F6 Cancel all fix- ings	F7 Show fixing	F8	F9 Back
Allows writing the selected variables		Allows fixing the selected variables	Cancels fixing the selected variables	Cancels all fixings	Displays only fixed variables		Back to basic level

Tab. 9-18: F-keys: Change level value

Displaying details

Selecting the "Details" function separates the screen in two partial windows. The upper window displays the list as before.

The lower window displays an overview on all information of the selected variable.

The display format for the value can be selected freely and irrespective of the list display.

Fig. 9-34: Partial window: Details

Write value

The "Enable: Write value" function can only be selected if the user is authorized.

Selecting the function separates the screen in two partial windows.

The upper window displays the list as before.

The lower window displays an overview on all information of the selected variable. In input fields for the value input is enabled for editing.

The input format for the value can be selected freely and irrespective of the list display.

The entered value is applied with **OK** and transferred to the PLC.

Fig. 9-35: Write value

Incorrect entries are marked with the red color of the entry field as well as by a message in the status line.

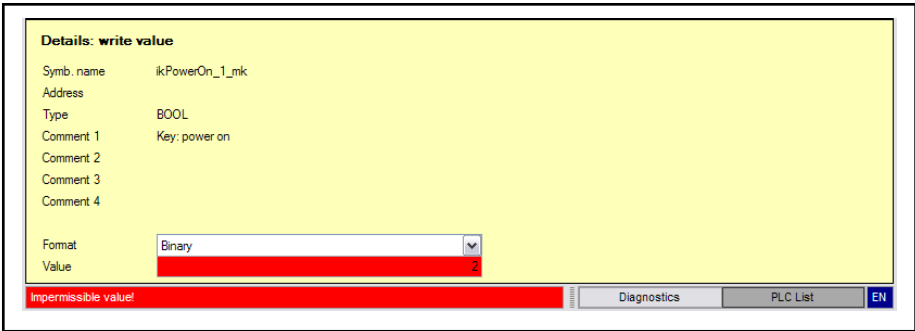


Fig. 9-36: Incorrect input

Esc cancels the value input and the current variable value is indicated in the input field.

Fixing value The "Enable: Fixing value" function can only be selected under the following conditions:

- The user has to be authorized
- There have to be the respective prerequisites in the PLC program (function blocks).

Selecting the function separates the screen in two partial windows. The upper window displays the list as before.

The lower window displays an overview on all information of the selected variable. In input fields for the value input is enabled for editing.

In contrast to the "Enable: Write value" function, the value is fixed in the PLC and cannot be overwritten by the PLC program.

The input format for the value can be selected freely and irrespective of the list display.

The entered value is applied with **OK** and transferred to the PLC. In the list, the fixed variable is stored in red background color. The number of fixed variables is display in the list header.

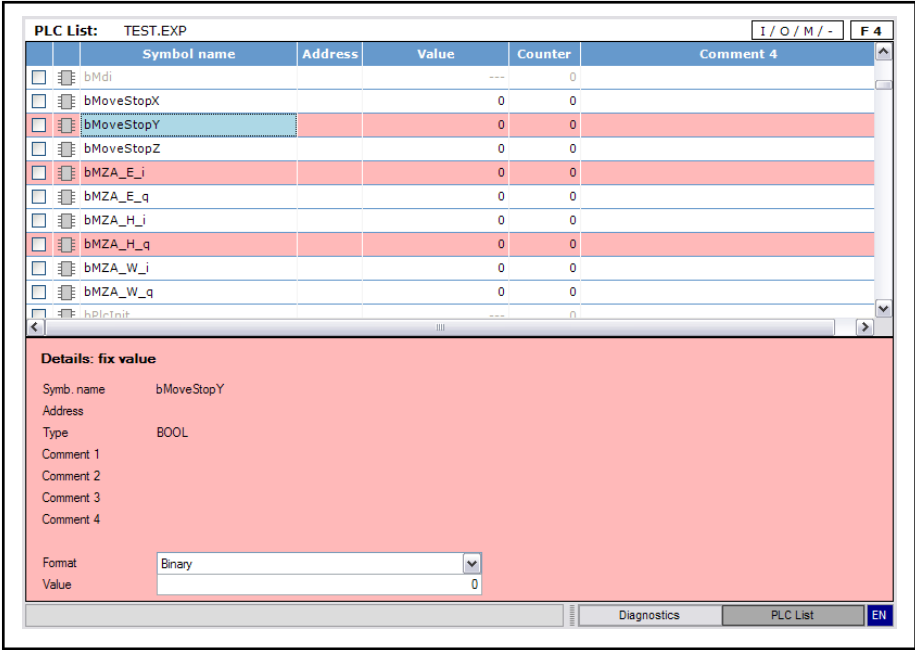


Fig. 9-37: Fixing value

Incorrect entries are marked by the red color of the input field as well as by a message in the status line.

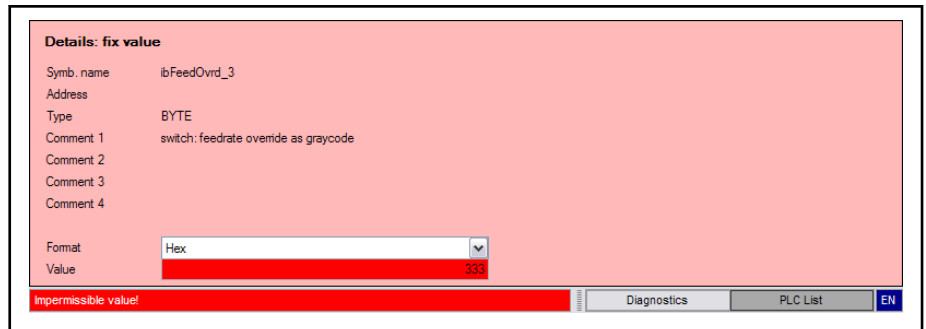


Fig. 9-38: Incorrect input

Esc cancels the value input and the current variable value is indicated in the input field.

The fixing can be canceled as follows:

- For the individual variable via the "Cancel individual fixing" function
- For all variables via the "Cancel all fixings" function
- PLC reset

Dialog "Open" and "Save"

The dialogs "Open" and "Save" are used for the file management of PLC lists in the IndraLogic export format "XML".

The lists created are stored in the active project: "...\\ProjectName\\Name Visualization\\user\\config\\PLCLists".

PLC lists can be created by selecting certain variables from the list displayed. The variable is selected with the **space bar** or by one of the functions of the F-key level "Filter".

The "Save selection" function is displayed in the "Save As" dialog and the variables selected are saved as individual list.

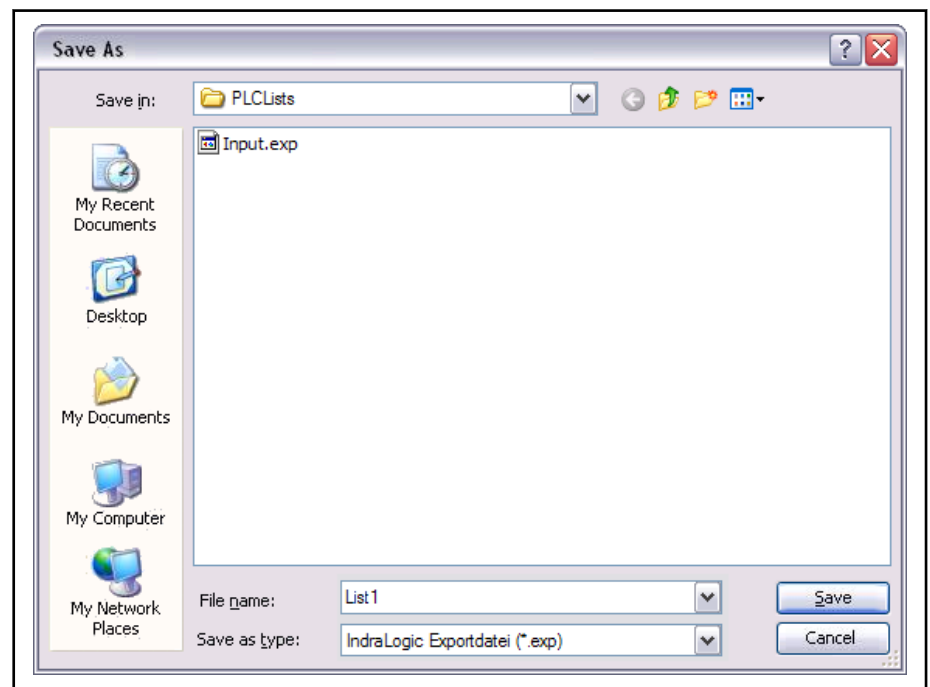


Fig. 9-39: Save as...

The "Open" dialog is displayed when selecting the "Open list..." function. This dialog can be used to select an already saved PLC list in the IndraLogic export format "XML".

This dialog is structured like the "Save As" dialog.

9.8 Sercos diagnostics

9.8.1 Use

The application shows an overview over all Sercos devices in a list comprising 9 columns. The information facilitates faster diagnostics for Sercos ring problems.

Arrangement of the Sercos diagnostics on the operating desktop



Fig. 9-40: Arrangement of the Sercos diagnostics on the operating desktop

The display is an application with individual F-key assignment.

Menu and title are hidden.

The Sercos diagnostics is assigned to the operation mode "OP 9 Diagnostics". The application is started by pressing <F8> "Additional functions" and <F7> "Sercos diagnostics".

9.8.2 Basic structure of the Sercos diagnostics

Structure of the list display

sercos Diagnostics								
Addr	Axis	Type	1	2	Error 1	Error 2	Status	Diagnostics
		Master (P1)	P	S		0		sercos phase: 2
5		Drive	■	■	0	0	OK	Communication phase 2
4		Drive	■	■	0	0	OK	Communication phase 2
3	Z	Drive	■	■	0	0	OK	Communication phase 2
2	Y	Drive	■	■	0	0	OK	Communication phase 2
1	X	Drive	■	■	1	0	OK	Communication phase 2
		Master (P2)	P	S				

Fig. 9-41: Structure of the list display

The screen consists of a list with the following 9 columns:

- Address
- Axis
- Type
- 2 columns to represent the topology
- 2 columns error counter
- Status
- Diagnostics

A line is assigned to each Sercos device. The control (master) contains a line at the start and at the end of the list for both connections P1 and P2.

Address Display of the Sercos address set at the device.

Axis Display of the axis name assigned to a drive via the machine parameters of the control.

This column does not contain any information for master and I/Os.

Type Display of the Sercos device type - Master, I/O or drive.

Basics for this information: Parameter S-0-1302.00.01, bit 16-30.

Topology Display of the topology of all Sercos devices between the connection P1 and P2 of the control. Icons represent the signal flow. Possible topologies: ring, double line, line.

If a connection is established from P1 to the 1st device, from the 1st to the 2nd device..., from the nth device to P2, it is a ring.

If the ring is interrupted at any position, a double line is generated.

If only P1 or P2 is connected to the devices, a line is generated.

Basics for this information: Parameter S-0-1045, bit 10-13.

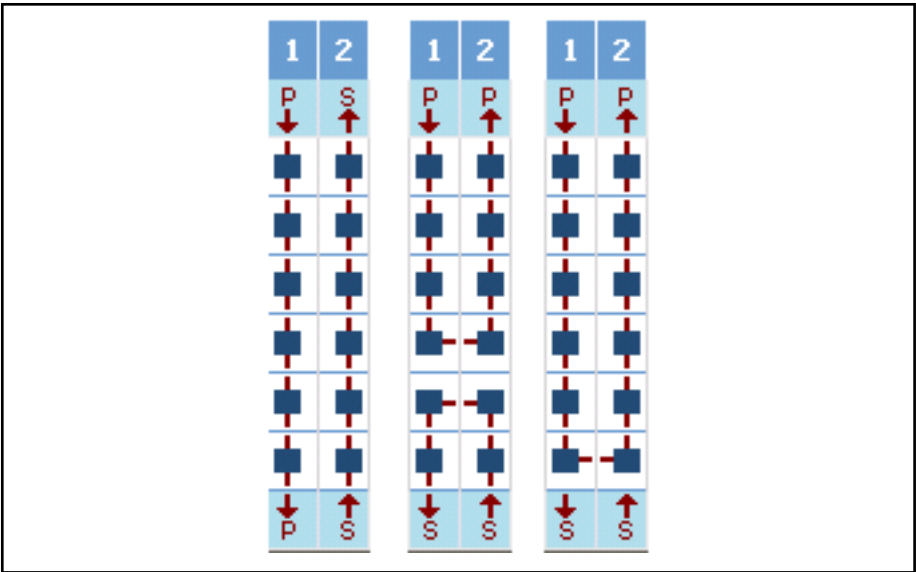


Fig. 9-42: Ring, double line, line

Error counter Display of the error counter for Port 1 and 2 of all devices.
The basis for this information is parameter S-0-1035.0.1. If this parameter is not implemented, S-0-1035 is read. In this case, a red triangle is displayed in the cell. When hovering over the cell or when selecting the cell using the cursor keys, a tooltip providing information is displayed.

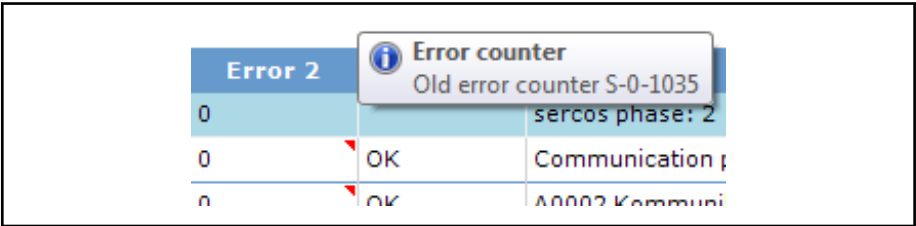


Fig. 9-43: Tooltip

The basis for the error counter of the control is the CPL variable @_SERCOS_TELERR.

Status Display of the status information of the Sercos device - OK, warning, error.
The basis for this information is parameter S-0-0390, bit 16-19.

Diagnostics Display of the diagnostic message of the Sercos device.
The basis for this information is parameter S-0-0095.
In the first line (Master P1), the Sercos phase is displayed.

9.8.3 Operation and navigation

The operation is executed via F-keys and cursor keys.
The cursor keys are used to navigate between the cells within the list.

F-keys In the F-key level, only F9 closes the application.

10 Extended functionality

10.1 The NC-Analyzer

10.1.1 Overview

Purpose of the NC-Analyzer

The NC-Analyzer can be used to test NC programs and find programming errors.

The NC-Analyzer is part of the MTX interface.

Properties of the NC-Analyzer

The NC-Analyzer

- is applicable to programs in CPL format (Customer Programming Language) and DIN 66025 format
- includes subroutine programming
- includes editor functions for executable programs
- supports all CPL variable formats
- supports multidimensional CPL variables (arrays)
- supports local, global as well as permanent variables
- can set breakpoints on NC blocks (up to 20 active at the same time)
- can set breakpoints on variables
- can change variables values at program runtime
- can automatically watch up to 40 active variables at the same time

Error search in the program

The NC-Analyzer answers for example the following questions:

- Where did the error occur for the first time in the program?
- What are the effects of the error on the program?
- What are the effects on other variables or program parts?
- How severe is the error for the program?

The NC-Analyzer allows to systematically select all relevant variables and track their contents step by step at program runtime.

Setting breakpoints allows the program to stop at user-defined points at runtime to request the values of individual variables and to check monitored variables for their contents.

At a breakpoint, other values can be assigned to each variable. This facilitates the testing of a different processing scenario in the program. In case of an incorrect variable assignment by the program, this variable can be experimentally assigned with the "correct" value.

The nested structure of main programs and subroutines can be seen and monitored in the "Stack" window.

User-specific messages (MSG, GMSG,...) in the "Output" window can be used to test the program run.

10.1.2 Starting the NC-Analyzer

Starting the NC-Analyzer

The NC-Analyzer is started in the default start screen via the second F-key level with <F4>.

The NC-Analyzer can also be configured in the user screens on the F-keys or M-keys.

The NC-Analyzer uses a configuration file. A default setting is used at first call or by default. Subsequently, individual configuration files can be created and used for the start.

When starting the NC-Analyzer, the waiting dialog "Connecting" is displayed first and the NC status is displayed. The second dialog, "Waiting" is displayed.

If no connection exists, the Operation desktop is closed and the NC-Analyzer cannot be started. If the connection is lost while the NC-Analyzer is running, the NC-Analyzer separates and closes.



The waiting dialog "Waiting" is displayed on the screen only in case of a channel change, searching on the NC file system, etc.

Workspace

The "Save Workspace" function saves all relevant setting data of an NC-Analyzer session:

- Name of the active CPL or DIN program
- Active breakpoints in the main program and the subroutines (only active breakpoints can be saved)
- List of the monitored variables

Saving workspace

In the topmost F-key level, press <F3 Save Workspace>. The "File" dialog opens and the configuration path of the user is selected by default. Any required path and/or file name can be entered.

Active breakpoints and all variables to be monitored are stored in the workspace file.

Loading workspace

If the workspace to be loaded contains variables in the "Watch" window, these are loaded if:

- the program selected in the NC corresponds to the program name saved in the workspace and
- the variables still exist in the program.

If the workspace contains breakpoints, these are loaded if:

- the program selected in the NC corresponds to the program name saved in the work program and
- the program was not edited in the meantime and if
- The analyzer mode is activated.

When the NC-Analyzer is running, it is possible at all times to start an existing configuration file and transfer their settings if the NC program, to which the configuration file refers to, is loaded. Otherwise, a messages is displayed that all breakpoints stored in the configuration file are not loaded.

**Loss of data!**

When a different configuration file is loaded, previous changes in the NC-Analyzer are lost.

10.1.3 User interface

Overview

The NC-Analyzer window contains the following different sections:

- Title bar, header information and status line
- Workspace to visualize the program data and possible entries
- F-keypad

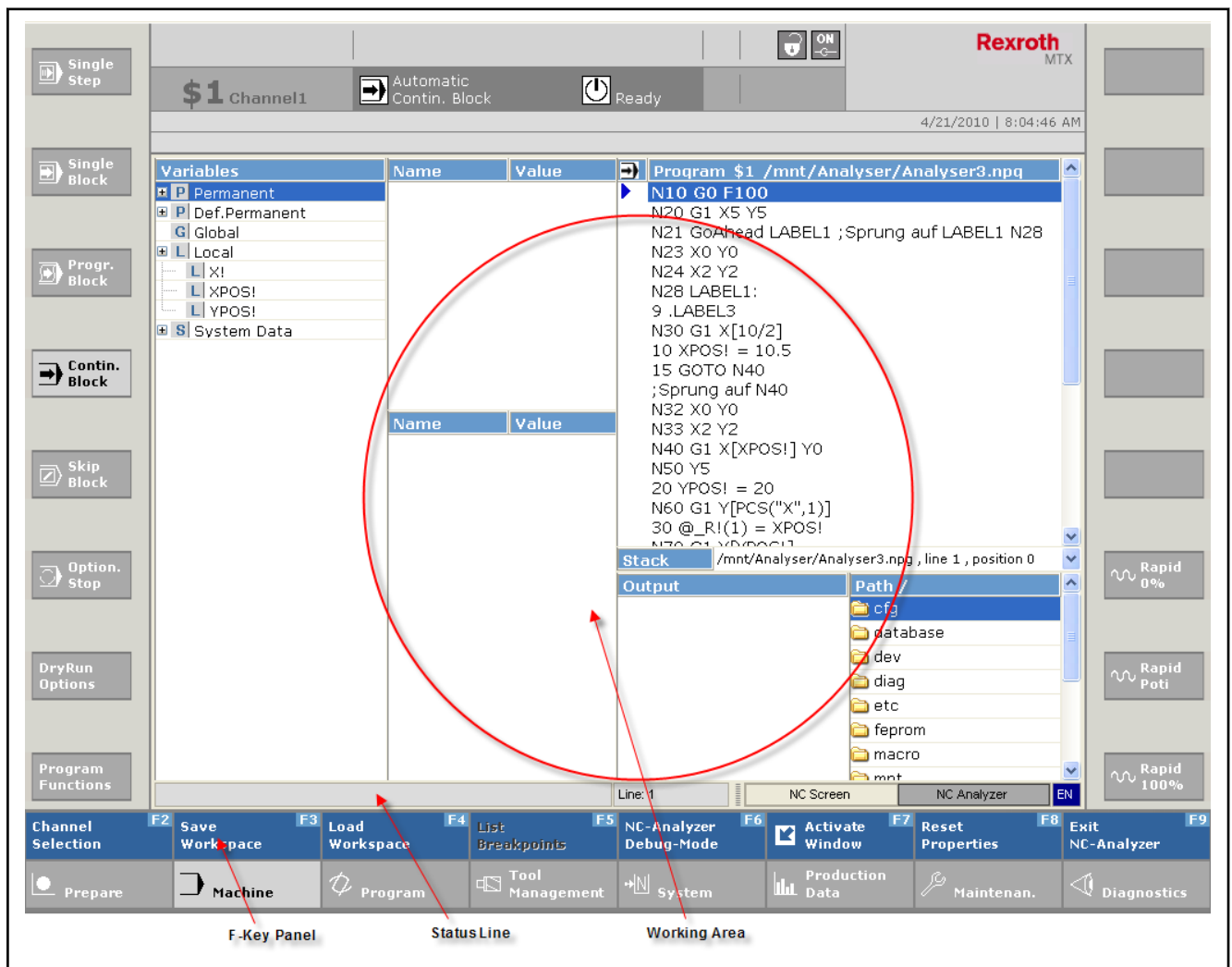


Fig. 10-1: Overview on the NC-Analyzer

Status line

The status line displays the following information depending on the activity of the different windows of the NC-Analyzer:

- **Line number**,
the current line number within the NC program.
- **Channel number**,

the number of the currently active channel.

- The active applications.

Header information

The header of the program window displays:

- **Channel number**, the number of the currently active channel.
- **Current operation mode as icon.**
- Name and path of the program displayed.

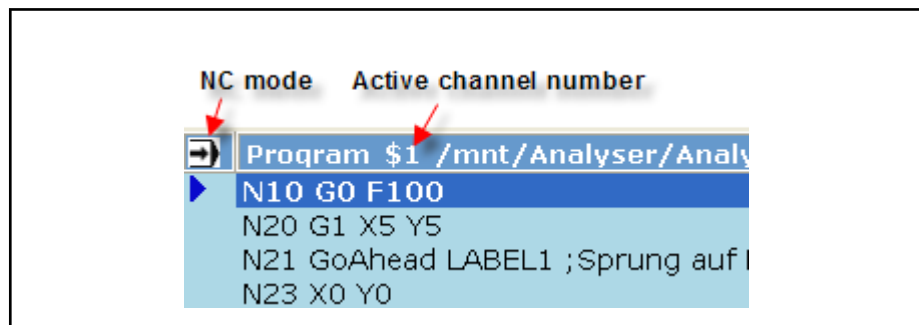


Fig. 10-2: Header program window

Workspaces

In the workspace, the NC-Analyzer displays the program data in different windows.

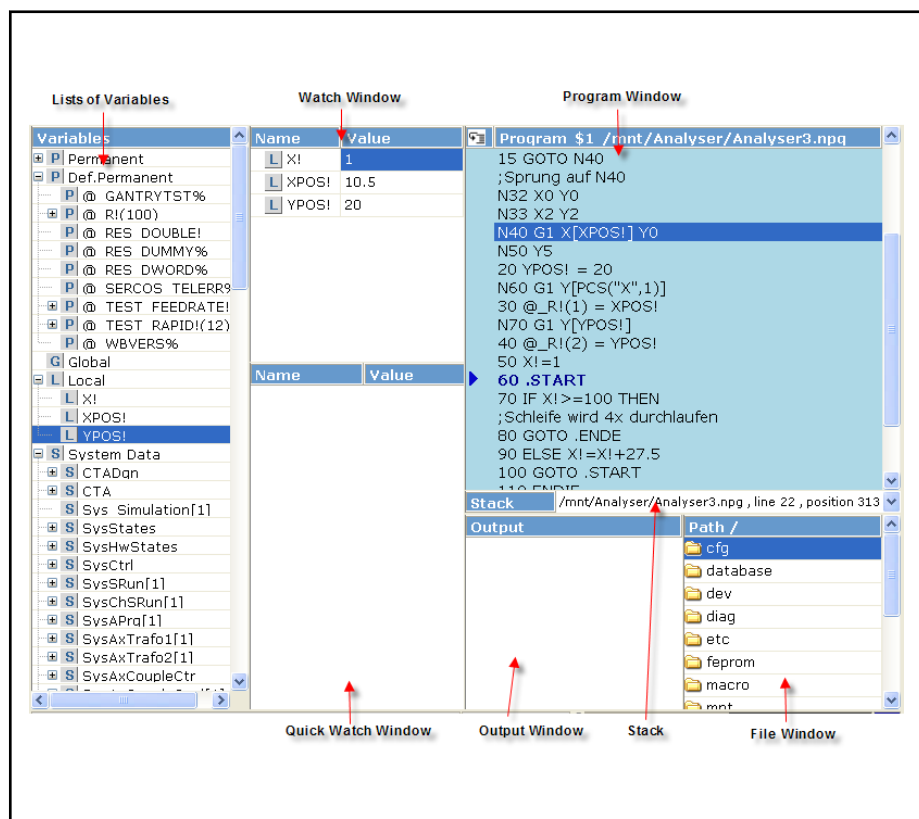


Fig. 10-3: Workspace of the NC-Analyzer

The individual windows of the workspace are activated via F-keys. Due to the different functions of the windows, the F-keypad below the workspace also changes.

No.	Window in NC-Analyzer	Function	Possible inputs
1	Variables	<i>Displays all CPL variables in tree structure according to the following groups:</i> • Permanent • Defines permanently • Global • Local • System variables	Select variables to be monitored. They are displayed in the "Watch" window.
2	Watch	Monitor variables: List of selected variables. The current values are displayed in the "Watch values" window.	Deletion of variables that are not to be monitored any longer.
3	Watch values	Display and refresh values: Display of variable values from the "Watch" window at program runtime.	Editing variable values (except simple string variables) at program runtime.
4	Program	Program window: <i>Displayed are:</i> • The operation mode as icon, the channel (\$x) as well as the program name including the path • Program code • The block processed at runtime • Breakpoints Read-protected programs are not displayed.	• Find Text • Set, delete, activate and deactivate breakpoints
5	Quick Watch	Display current variable value: List of selected variables. The current values are displayed in the "Quick Watch values" window. The values are not updated. In the next NC step, the Quick Watch window is cleared.	Deletion of variables that are not to be monitored any longer.
6	Quick Watch values	Display current values: Display the variable values from the "Quick Watch" window at program runtime.	Editing variable values (except simple string variables) at program runtime.
7	Stack	Select subroutine: Displays the subroutine nesting of the selected NC program.	Selection of a subroutine from the currently active subroutine structure.
8	Output	Status display: Display of messages (MSG, GMSG, etc.) and errors on the NC program and the NC-Analyzer.	Deletion of displays.
9	File	File system: Display of the file system of the control.	Selection of a program to be displayed in the "Program" window (this is no program selection in the control).

F-key pads

Below the workspace, eight F-keys are allocated to be operated with the mouse or the function keys <F2> ... <F9>:

Extended functionality

- Active keys are shown with white lettering.
- Keys that are inactive, e.g. due to a configured option, are grayed out.

The assignment of the F-keys change depending on the active window in the workspace (see the following figure).

Select a window by:

- via mouse click
- via F-key (<F7> "Next window" to browse through the windows one by one
- via F-key <F2> "Navigation" in the lower F-keypad, a certain window can be selected.

F-key level	<F2>	<F3>	<F4>	<F5>	<F6>	<F7>	<F8>	<F9>
1. Level	Channel selection	Save workspace	Load workspace	Breakpoint list	Debug mode / reset mode	Enable window	Reset properties	Close Analyzer
Variable level	Navigation	Set breakpoint	QuickWatch	Add to watch	Zoom +/-	Next Window	Extend/close substructure	Back
Watch/QuickWatch level	Navigation	Edit variable	Delete watch	Delete all variables	Zoom +/-	Next Window	Extend/close substructure	Back
1. Program level	Navigation	Set/delete breakpoint	Activate/deactivate breakpoint	Continue step mode/mode	Zoom +/-	Next Window	Next level	Back
2. Program level	Find...	Delete all breakpoints	Activate all breakpoints		Open subroutine	Open active program	One level back	Back
Stack level	Navigation			Go to Start	Zoom +/-	Next Window	Extend/close stack	Back
Output level	Navigation		Delete output		Zoom +/-	Next Window		Back
File level	Navigation	Subdirectory	Superordinate directory	Display file	Zoom +/-	Next Window	Update files	Back

Finding Text

The "Program" window can find an alphanumeric character string in the displayed NC program on the second level via the F-key (<F2 Find>).

Resetting the window properties

The changeable window width can be reset any time to the fixedly stored values using the mouse. With <F8> in the topmost F-keypad, the default values can be enabled again.

Resetting the window properties does not affect breakpoints or selected variables.

10.1.4 Operating principle of the NC-Analyzer

General information

The following summary shows the workflow for working with the NC-Analyzer:

Cont. no.	Procedure
1	Selecting program
2	Start NC-Analyzer
3	Loading configuration file (optional)
4	Selecting channel (optional)
5	Navigation to the faulty program part or possibly to the subroutine in the NC-Analyzer
6	Setting breakpoints at possible error locations
7	Selecting variables for monitoring
8	Start NC program
9	Monitoring the values of the selected variables and error analysis
10	Error clearance of the respective program parts in the control editor
11	Testing the program regarding error recovery ... and whether more errors are present
12	Save configuration (settings) or any subsequent NC-Analyzer sessions

Selecting the program

Open the program selection using the OP key "Machine" and the F-key <F2>. The NC program to be processed is selected.

- Only one program can be edited at a time.
- To edit a program, the file attribute of the program has to be configured accordingly. In the "File" window, each file is prefixed with a symbol for the file attribute.
- The program displayed in the NC-Analyzer can be edited there only if it is active in the selected control and the configured channel.
- If the selected program is edited in the control, all changes also become active immediately in the NC-Analyzer (incl. watched variables and sub-routines).



Loss of data!

- If a different program is selected for processing, it is also loaded into the NC-Analyzer at the same time. Changes in the previous program are lost.
- The command "Reset channel" in the control means that breakpoints and monitored variables are lost.

Channel selection

The F-key <F2> can be used to switch the channel in the NC-Analyzer.

Processing the NC program using NC-Analyzer

After selecting the program, start the NC-Analyzer.

Starting the NC-Analyzer mode

The NC program must not be started yet.

Press the F-key <F6> to start the NC-Analyzer. The F-key switches to "Restore operation mode".

As information, the header of the interface shows the new operation mode **"NC-Analyzer program"**.

Analyzer setting:

- NC analyzer single step:
If the analyzer mode is active, select the "Program" window and enable the single step mode with <F5>. The program is run step by step, i.e. after each step, "NC start" has to be pressed to continue the program.
- Continue NC-Analyzer:
Activate the "Program" window. Press the F-key <F5 >. The F-key switches to "Debug single block".
The program is processed in "Continuous block mode" until it meets a breakpoint, where it stops the program sequence. After the stop, the program can be continued with "NC start" if no error is pending.

Start NC program Press "NC start". The selected program is started or continued after stopping the program sequence according to the analyzer mode set.

Following deselection and reselection of an NC program, the analyzer mode needs to be reset.

Terminating the analyzer mode The Analyzer mode is closed by the F-key <F6> in the topmost F-keypad level. The previously set operation mode is displayed in the header.

Displaying the NC program

"Program" window The "Program" window of the NC analyzer always shows the currently selected NC program unless a different file was selected for display in the **File** window.

If no NC program is selected in the NC, the **Program** window remains empty.

"File" window **Selecting the program in the stack:**

The "File" window displays the file system of the control. Each file located there can be displayed via the file selection in the "Program" window.

Only active programs can be edited with the NC-Analyzer.

There are the following options in the "File" window to go to the desired program:

- via the mouse
- via the F-key <F3> " Subdirectory"
- <F4> "Superordinate directory"

<F8 > "Update files" updates the directory content.

If the cursor is positioned on a file, this file can be displayed via the F-key <F5>

- or -

"double-click" to display the file in the program window.



To display the program in the **Program** window, the file attribute "Read" (r) has to be set.

The selected NC program can be accessed again via the **Stack** window.

Selecting the subroutine in the stack:

The stack allows to access subroutines organized in a nesting depth of seven with regard to a main program.

The subroutine can be displayed in the current structure if it was stopped by an error, "M0" or an active breakpoint. In this case, the execution of all other programs, which have called the subroutine, are interrupted.

The names of all active programs in the call structure are shown in the "Stack" window. A program can be selected and displayed with <F5> in the "Program" window.

In the selected program, it is now possible to monitor local variables and to set new breakpoints if required. The call structure in the stack provides information on the program nesting used to call the selected program.

Activate the "Stack" window.

Use <F8> "Extend start stack" or <F8> "Close start stack") to open/close the nesting levels caused by the main program and subroutine calls.

Select one of the programs (subroutines) in the "Stack" window and press the F-key <F5>.

The last "calling" active program has an arrow in the currently processed program block in which the block processing is pending.

Navigating in subroutines

Navigating in active subroutines is also possible in the "Program" window. After the program selection, it can be jumped immediately to a subroutine used. Therefore, activate the "Program" window. Use the <cursor> keys or the mouse to position on an NC block containing a subroutine call. Switch to the next F-keypad level and press the F-key <F6> to display the subroutine. If there is no subroutine call in the block, a corresponding message is displayed. With <F7>, navigate back to the active program.

Setting and editing breakpoints

Breakpoints can be used in different channels in the NC analyzer in DIN and CPL programs. The breakpoint is a stop point at which block processing stops in continuous block operation. At this point, it is possible to check variable values and change them if required.

The breakpoint is displayed as a circle icon at the NC block before which the NC-Analyzer is to stop.

The variable information in the "Values" window refers to all blocks processed until the breakpoint.

All following blocks, including the block in front of the breakpoint are not yet included in the program processing.

Breakpoints are used for:

- Testing explicit locations in the program if the actual error cause is not known
- Testing nested subroutines if the error cause is to be searched there

The following table shows the control options of breakpoints:

Breakpoint	Effect	F-keys
Set	The breakpoint is set and active; the NC-Analyzer stops before an NC block marked by that breakpoint.	Set breakpoint
Delete	Breakpoint is completely removed.	Delete breakpoint
Deactivating	The breakpoint set has no function and does not stop the program. The marking remains.	Deactivate breakpoint
Activating	Activates an inactive breakpoint again. The NC-Analyzer stops before an NC block marked by a breakpoint.	Activate breakpoint

Breakpoint	Effect	F-keys
Delete (all breakpoints)	All breakpoints of the program displayed in the "Program" window are completely removed.	Delete all breakpoints
Deactivating (all breakpoints)	All set breakpoints of the program displayed in the "Program" window are without function. The markings remain.	Deactivate all breakpoints
Activating (all breakpoints)	All inactive breakpoints are activated again. The NC-Analyzer stops in front of all NC blocks marked with breakpoints	Activate all breakpoints
Back up	Back up all breakpoint positions for later editing with the corresponding reproducibility.	Save workspace

Setting and Activating Breakpoints

The number of active breakpoints is limited to 20. A breakpoint can be set at any required NC block of the program and/or subroutine in different channels. If 20 breakpoints are set, any new breakpoints are disabled. Additionally, a message is displayed.

After deactivation of one of the 20 breakpoints, an inactive breakpoint can be activated or a new active breakpoint can be set.

The color of the circle icon indicates whether the breakpoint is active (red) or inactive (white).

- Select the "Program" window.
- Use the <arrow> keys or the mouse cursor in the "Program" window to select the program block at which to set a breakpoint. To set the breakpoint, press the F-key <F3> or left-click once on the left margin. A red point is displayed (breakpoint set and activated). Click on the red point for a second time to deactivate the breakpoint
- or -
the F-key <F4>.



Breakpoints can only be set to active or can be activated in the "NC-Analyzer mode". Otherwise, an error message is displayed and the breakpoint is set to inactive (white).



Breakpoints are not considered if they are set in a line in which there is "ELSE" or "ENDIF"

Setting and Deactivating Breakpoints

Activating the "Program" window.

To deactivate a breakpoint, press the F-key <F4>

- or -

press once on the red circle with the cursor.

If there are several breakpoints in the program, they can all be deleted together with the F-key <F4> in the second F-keypad.

To delete a breakpoint, press the F-key <F3> or double-click on the red circle with the cursor.

If there are several breakpoints in the program, they can all be deleted together with F-key <F3> in the second F-keypad.



The deactivation and deletion of all breakpoints refers only to the program shown in the **Program** window.

Listing all existing breakpoints:

<F5 > in the global F-keypad level opens a dialog. This dialog contains a summary and the status of the breakpoints of all programs and the respective subroutines:

- Channel assignment of the selected program(s)
- Position (position of the line marked with a breakpoint related to the beginning of the program)
- Name and path of the program containing breakpoints

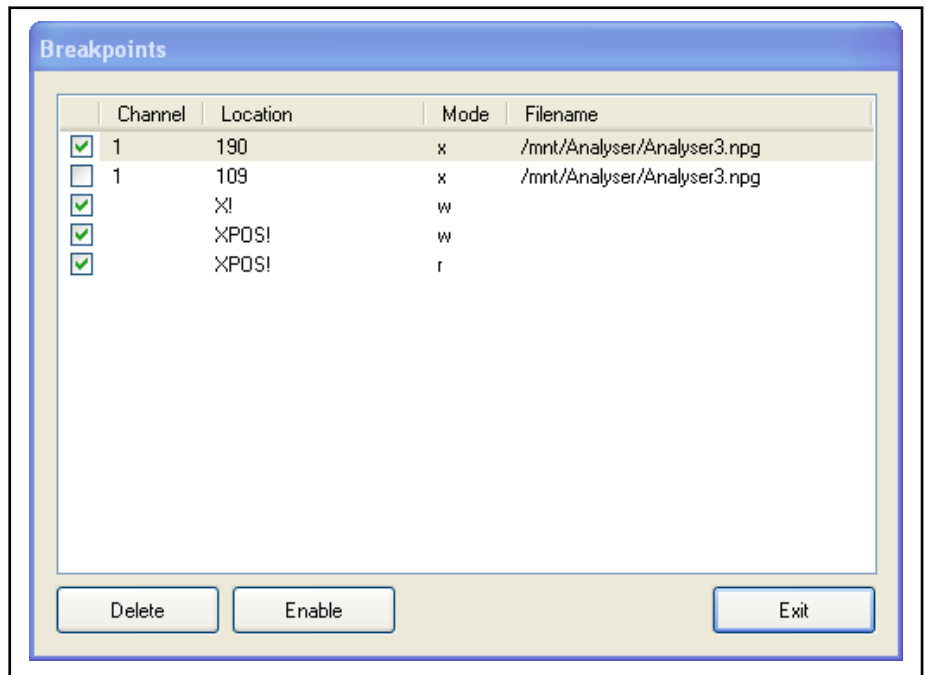


Fig. 10-4: "Breakpoints" dialog

Additionally, the "Breakpoints" menu is enabled, disabled and deleted.

Loading active breakpoints from the configuration file

If there are active breakpoints in the NC-Analyser workspace of a respective NC program and you want to load these into the NC-Analyser (with <F4> in the topmost F-keypad level), the NC-Analyser mode has to be active.

Otherwise, the breakpoints stored are set to inactive.

Monitoring and editing variables

It can be checked for individual program variables whether the logical value assignment was carried out correctly by the program.

Variable groups:

- Permanent variables
- Definable permanent variables
- Global variables
- Local variables
- System data

The variable groups are listed in the "Variables" window.

Displaying individual variables

When a program is selected, all variables in the program are automatically classified according to the variable groups mentioned above and placed in the respective group.

Click on <+> or use the arrow keys <->/<-> or the F-key <F8> to expand or collapse the list.

If the cursor is on one of the expanded variables, the previously grayed out F-keys <Set breakpoint>, <Quick watch> or <Add to watch> become active.

Variables to be monitored:

The NC-Analyzer uses the following variables to watch the values of variables:

- Watch: Permanent watching at write operations.
- Quick Watch: One-time query of the variable value

Quick Watch list:

Quick Watch indicates the current variable value. The display is removed immediately after continuing or starting a program in the "Quick Watch values" window, as the value of the variables is only of interest in a certain position within the program. For this purpose, set a breakpoint at the required position.

Watch list:

This list keeps the values of the variables updated.

Adding variables

The watch list in the "Watch/Quick watch" window consists of selected variables.

The variables are displayed in the order in which they were added to the list. The list can be extended or reduced by adding or removing variables.

The variables to be added to the "Watch/Quick watch" window for watching and the information filtered out depend on the respective problem in the program.

Arrays can either be completely or partially transferred to the "Watch" window.

Restriction:

A maximum of 40 variables can be taken in the Watch list at the same time. If you try to add more variables to the list, a warning message is displayed. Already existing variables need to be deleted first before new ones can be added.

Deleting variables from the Watch list

Activate the "Watch/Quick watch" window, highlight the variable to be deleted and remove it with the F-key <F4>.

Press <F5> to delete all variables in the window.

Editing variable values

Individual variable values or characters of a string can be changed during the program test.



CPL string constants (such as A\$) cannot be changed.

Procedure:

- Activate the "Watch values" window or "Quick Watch values" window
- Select the variable to be edited
- Confirm with <F3> " Edit variable"
- Enter the new value and confirm

A wrong entry is answered with a warning message.



The value "NUL" is assigned to a variable if the content was deleted with <Backspace> or <Delete> and no new characters or values were entered.

The value "NUL" cannot be assigned to permanent variables.

Breakpoints on variables

If a breakpoint is set on a variable, the execution of the NC program is stopped in the following cases:

- If the program line which contains operations with this variable is reached.
- If the value of the variables changes, for instance by setting values in the NC program.

The variables on which a breakpoint has been set are shown in the **List breakpoints** dialog.

For each variable, two modifications can be configured:

- "Write" mode
- "Read-only" mode

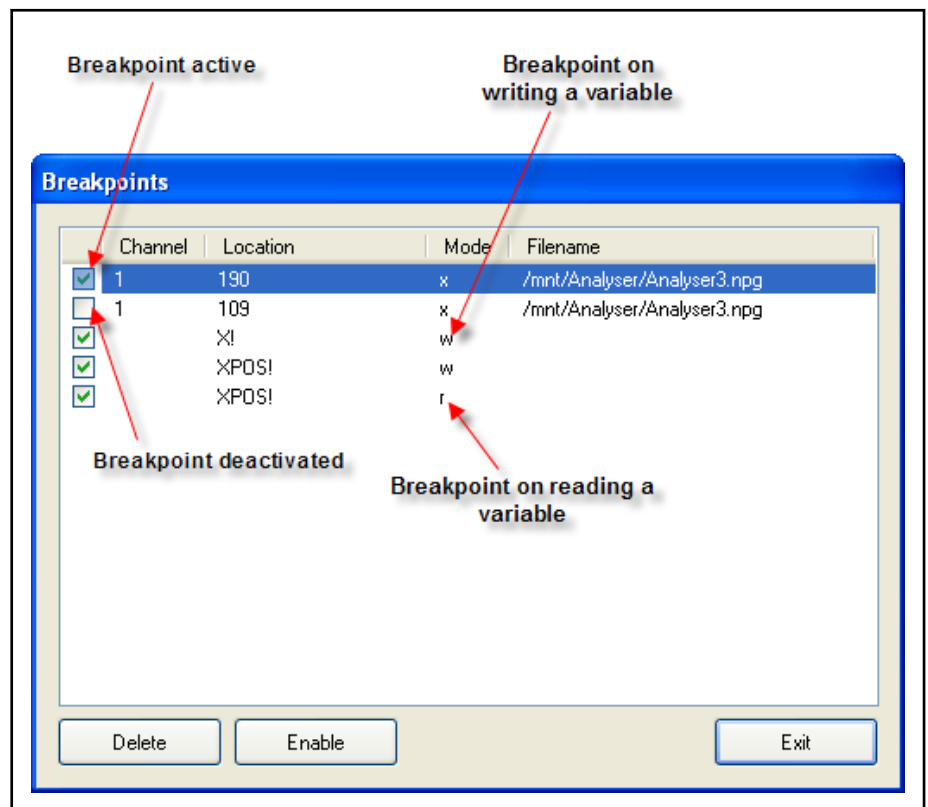


Fig. 10-5: Breakpoints on variables

In "Read" mode, the program execution is stopped when the variable has been read, for instance in the NC program (visible in the "Program window").

The following message box informs the user of a program interruption triggered by a breakpoint on a variable:

(#121) The breakpoint on the variable <VariableName> has been reached. Access mode: Write!

(#122) The breakpoint on the variable <VariableName> has been reached. Access mode: Read-only!

Once this box is confirmed, the program execution continues.

If a variable is an array, the breakpoint can also be set to such a variable.

The program execution is interrupted in two cases:

- By reaching an NC block using an element of this array.
- By changing the value of an element of the array.



A breakpoint can be set only on the whole array, not on an individual element.



Breakpoints on variables are not considered if they are not used in a single-line CPL loop.

Example: Breakpoint on variable #FIELD is not effective:

```
7 FOR I%= 1 TO 3 #FIELD(I%)= I% NEXT I%
```

If it is a multi-line loop, it is jumped to the breakpoint on the variable #FIELD:

```
7 FOR I%= 1 TO 3
8 #FIELD(I%)= I%
9 NEXT I%
```

Special aspect when working with breakpoints on permanent variables:

Permanent variables (permanent and permanently-defined variables) are not used in the NC program. However, if a breakpoint is set on such a variable, the execution of the NC program is interrupted if the value of this variable changes. This may be carried out either by the NC or in the editing mode with the help of the NC-Analyzer.

Breakpoints on variables have an effect on the available number of the variables to be watched in "Watch mode". For example, if there are 10 active breakpoints on variables, the user cannot set more than 30 variables in "Watch mode".

If the available number of active breakpoints on variables is exceeded, a warning message is displayed on the screen.

To set a breakpoint on a variable, the following steps have to be carried out:

- Activate the "Variables window" via "Navigation" or "Next window"
- To select individual elements of variable structures, use the F-key <F8>.
- The access mode for the breakpoint is defined in the opening "Breakpoint" dialog. The "Write mode" is set by default

To activate a breakpoint on a variable or change its access mode, open the "Breakpoint" dialog. Use the "Dialog" buttons to make changes.

Example:

```
18 B=1
19 A=0
20 A=B+5
21 A=7
22 A=10
23 C=A
```

In "Write" mode, the value of variables A is updated every time the variable gets a new value in each line.

In "Read-only" mode, however, only the display of the variables A in line 23 is updated, as the value is read in this line only.

Messages in the "Output" window

Displaying messages

When working with the NC-Analyzer, messages of the NC and the NC-Analyzer are displayed in the "Output" window. This is important, since an error is often displayed by an NC runtime error message. In the "Output" window, an NC error is displayed only with its error number. More information can be obtained in the operating area "Diagnostics" of the standard user interface of the control.

The "Output" window displays all messages of the control with text and symbol:

- Error
- Warnings
- Notes (PRN#(0,...), MSG , GMSG)

In case of errors and warnings, the color of the symbols shows whether the message:

- is pending: Background color of the symbol: red
- is deleted or has already been read: Background color of the symbol: blue

Deleting messages in the "Output" window

Activating the "Output" window. Delete all messages with the F-key <F4>.

Active program after abort

If an active program is terminated due to an error, the NC-Analyzer can be used to perform a static inventory of the variables used for all active programs. With the stack, local variable states in subroutines can be checked as they were valid at the time of the subroutine call.

To perform this inventory, the interrupted program still needs to be selected in the NC.

Breakpoints cannot be set in this state because the Analyzer mode is not active in the NC-Analyzer. If you try to switch to Analyzer mode, an error message is displayed:

Start NC-Analyzer

- Starting the NC Analyzer
- *Selecting the channel with the incorrect program*
 - The location at which the NC program was stopped due to an error is shown in the "Program" window of the NC-Analyzer.
 - The call structure (in case of a possible subroutine nesting in the NC program) is shown in the "Stack" window
 - Subroutines can be selected in the "Stack" window and displayed via the F-key <F5> in the "Program" window to analyze their program variables.

The error can often be found only with this information.

At least, the incorrect program section is known which can be analyzed in the Analyzer mode.

Testing the program

Before further machining, the program should once again be tested on error absence in the program. The NC-Analyzer can be a very helpful tool here as well, since the values of the variables used can be called at any time during the program execution.

Messages of the NC-Analyzer

System and user messages of the NC analyzer are shown in popup windows with error text classification.

Type	Class	Description
System error_ • Error • Critical error	Fatal system error* → Critical error	Internal error causing operation stop of the control. The NC-Analyzer closes automatically after confirmation.
	Low-priority system error* → Error	Internal error causing a part of the control not being functional anymore. The user can decide whether to continue working with the NC-Analyzer.
Warning	System warning	Warning from a part of the NC-Analyzer, e.g. loading the configuration data was not possible.
by the user program Information: • General	System information	such as number of breakpoints exceeded.
	Programmed note	Programmed notice from the NC program: • (MSG) • PRN'(0,...)
Input error	Operating errors	such as variable value invalid

*) In case of system errors, service has to be notified as well if necessary.

Tab. 10-1: Error classes: NC-Analyzer

User reactions to errors and messages

The following measures can be cases in case of information, messages, warnings and "low-priority" system errors:

- Discard messages or errors as long as it is still possible to work with the NC-Analyzer or as long as information on error recovery is provided.
- Restart the interface
- Contact service

In case of "critical" system errors, the only options left may be:

- Restart the interface
- Contact service

Error messages

Error message number and message text number	Cause	Recommended to the user
Messages about the attempt to enter some incorrect values		
(#9) Invalid value	Input value of the edited variable does not correspond to the variable type	Enter a value that corresponds to the required variable type. (See also CPL programming manual).

Error message number and message text number	Cause	Recommended to the user
The value NUL cannot be allocated to a permanent CPL variable. The old value is restored.	The value NUL cannot be allocated to a permanent CPL variant.	Enter a valid value for the permanent CPL variant or apply the old value.
Messages about some unauthorized user actions		
(#8) File is write-protected.	Attempt to save a write-protected file.	Continue. (It is not possible to save write-protected files).
(#23) It is not possible to set the current variable value. (IVariable::SetVarValue)	Attempt to edit an individual element of a CPL constant.	Continue.
(#86) It is not possible to set the current variable value. (IVariable::UndefVar)	Attempt to edit a complete CPL constant.	Continue.
(#43) It is not possible to set the Dry Run mode. (IDryRunMode::SetDryRunMode)	Attempt to cancel the DryRunMode while the NC-Emulator is running.	Continue since the DryRunMode is always set when the NC-Emulator is running.
Messages regarding problems when setting breakpoints and variables for monitoring purposes		
(#12) The number of breakpoints is restricted. It is not possible to activate a breakpoint or set a new one.	The number of breakpoints was exceeded.	Delete or deactivate either one or several active breakpoints.
(#2) It is not possible to perform the requested operations in the "Breakpoint" dialog.	Attempt to activate breakpoints of an inactive program using the " Breakpoints " dialog.	Continue or select the program with the breakpoint(s) desired as active and execute the desired action.
	Attempt to modify the access mode of breakpoints on variables of an inactive flow program.	Continue or select the program with the breakpoint(s) desired as active and execute the desired action.
(#14) It is not possible to create or activate a breakpoint.	Attempt to set a breakpoint in the inactive flow program.	The breakpoint remains inactive (even if the flow program becomes active).
(#89) It is not possible to activate a breakpoint or to set an active breakpoint because the current NC mode is not the NC-Analyzer mode.	Attempt to either activate or set an active breakpoint if the NC-Analyzer mode was not set.	Set the NC-Analyzer mode . Execute the desired actions with breakpoints.
	Attempt to set the active breakpoint in the inactive program. NC-Analyzer mode was not set.	Select the desired program as active one. Set the NC-Analyzer mode . Carry out the desired actions with breakpoint(s).
(#92) It is not possible to set an active breakpoint because the Dry Run mode is not set.	Attempt to set the active breakpoint using the mouse if DryRunMode was not set.	Set DryRunMode (NC-Analyzer mode should also be set). Then set the breakpoint.

Extended functionality

Error message number and message text number	Cause	Recommended to the user
(#13) The number of variables to be watched and breakpoints on variables are restricted. It is currently not possible to select another variable for asynchronous monitoring or to set a breakpoint on a variable.	The number of monitored variables or breakpoints on variables was exceeded.	Delete as many variables from the list of asynchronous monitoring as necessary. Delete or deactivate as many breakpoints on the variables as necessary.
Messages to reach breakpoints on variables		
(#121) The breakpoint on the variable "Variable name" has been reached. The access mode is: Write!	Interruption of program execution at breakpoint.	Continue.
(#122) The breakpoint on the variable "Variable name" has been reached. The access mode is: Read-only!	Interruption of program execution at breakpoint.	Continue.
Messages regarding problems when loading information from the configuration file		
(#88) It is not possible to set one or more breakpoints after loading a configuration file. The breakpoints are deleted from the list of breakpoints.	No active NC program when loading information from the configuration file.	Loading information from the configuration file only after selection of a flow program.
	NC-Analyzer mode was not set.	Set the NC-Analyzer mode . (DryRunMode should also be set). Loading information from the configuration file.
	The configuration file was written while working with another flow program.	Continue (information on breakpoints from this configuration file is lost). If information on breakpoints just written in the configuration file - used to start the application - has to be saved, save the configuration file under a different name to still use it without closing the application. It is recommended to compile the configuration files for specified NC programs and to start the programs only with their individual configuration files. (The flow program name can for example be used as the configuration file name: TEST.CPL test.cld). This message does not appear if this recommendation is followed.
	The NC program was changed after the configuration file has been saved.	Continue (information on breakpoints from this configuration file is lost).

Error message number and message text number	Cause	Recommended to the user
(#90) When loading a configuration file, it is not possible to set active breakpoints because the Dry Run mode is not set.	DryRunMode was not set.	Set DryRunMode and click on the General Inhibit button. (NC Analyzer Mode should also be set). Loading information from the configuration file.
Messages regarding connection problems with the NC		
(#20) The number of variables cannot be determined. (IVariable::GetNumberOfVariable)	Timeout too short.	Close and restart the application.
(#22) The current variable value cannot be determined. (IVariable::GetVarValue)	Timeout too short.	Close and restart the application.
(#28) The current NC state cannot be determined. (INcsChannel::GetNc-State)	Timeout too short.	Close and restart the application.
(#32) The current NC mode cannot be determined. (INcsChannel::GetNcMode)	Timeout too short.	Close and restart the application.
(#50) The depth of the call stack cannot be determined. (IProgChain::GetProgChainDeep)	Timeout too short.	Close and restart the application.
(#51) The parameters of a subroutine cannot be determined. (IProgChain::GetSubProgLevel)	Timeout too short.	Close and restart the application.
(#80) The connection to the NC was interrupted.	The connection to the NC was interrupted.	Close the application, restart it and reestablish the connection.
(#69) Failed to establish a connection to the NC. (INcConnect::Connect)	Failed to establish a connection to the NC.	Close the application, restart it and reestablish the connection.
(#33) The requested NC mode cannot be set. (INcsProcess::SetOpMode)	NC mode was changed (e.g. by another application).	Continue and set the desired NC mode after a new selection and after starting the required flow program.

Tab. 10-2: Message reasons are: either OLE errors, software problems of the NC application or MTX-Analyzer application or installation problems

Abbreviations

NC

Numerical Control (System)

CNC	Computerized Numerical Control
CPL	Customer Programming Language
PC	Personal Computer
DDP	Desktop Development Platform
SCP	Scalable Communication Platform

10.2 EnergyMonitor

10.2.1 Overview

Purpose of EnergyMonitor

With the EnergyMonitor, the energy consumption of a machine and individual function modules (electrical drives and ancillary components, such as hydraulic pumps, coolant/lubricant pumps, etc.) can be tallied and monitored over defined time periods.

The EnergyMonitor is part of the MTX interface.

EnergyMonitor properties

The EnergyMonitor shows the energy consumption:

- For the last 10 measurements in the form of a bar chart
- Of individual drives
- Of individual ancillary components

Components

The EnergyMonitor consists of the following sections:

- Header
- Main screen
- Function key bars

10.2.2 Commissioning the EnergyMonitor

Requirements

The EnergyMonitor obtains the data it displays from the PLC function block "MT_4EEGuiMonitor". The relevant function block has to be integrated and assigned in the PLC program for this purpose see (PLC Programming Guide).

10.2.3 Working with the EnergyMonitor

Starting the EnergyMonitor

The EnergyMonitor is started from Production Data by pressing <F2>. The EnergyMonitor can also be mapped to F keys or M keys on user screens.

Total energy consumption

After opening the EnergyMonitor, the last 10 energy measurements are shown in a bar chart, whereby the latest measurement is always shown on the right side. Each individual measurement shows the consumption percentage of the Sercos drives, as well as the ancillary components entered. If necessary, pressing <F2> can optionally display the duration of measurement. This is very helpful for monitoring in Production/Part Manufacturing, in particular. Functions for running/disabling energy and time measurements can optionally be mapped to the M keys.

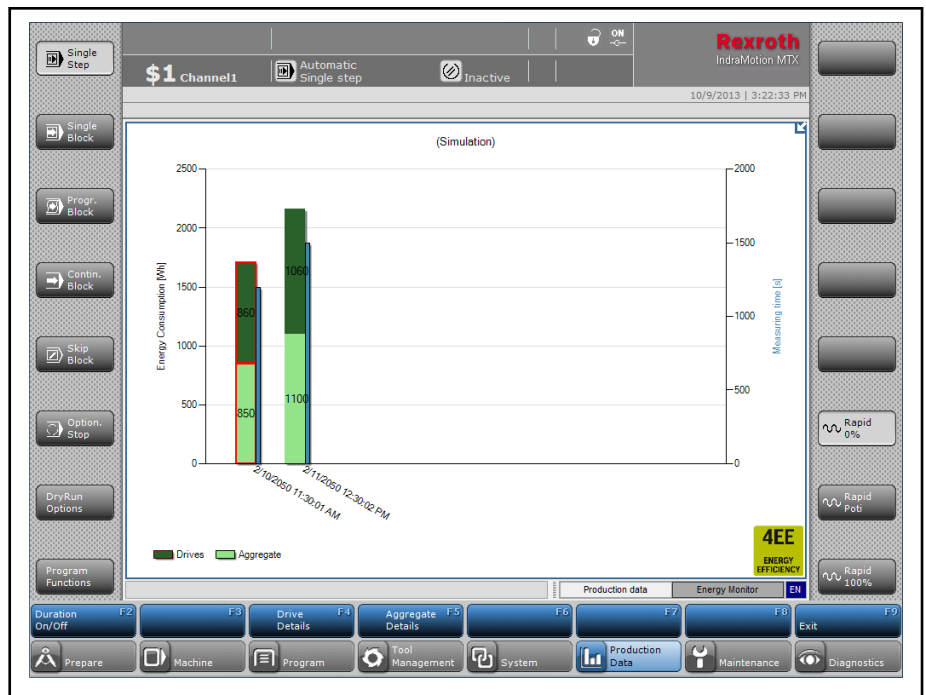


Fig. 10-6: Total energy consumption

The individual energy measurements can be selected from the menu with the arrow keys. If necessary, the selected measurement can be analyzed in greater detail. Pressing <F4> shows the energy consumption of the individual drives, and <F5> the energy consumption of the individual ancillary components in detail.

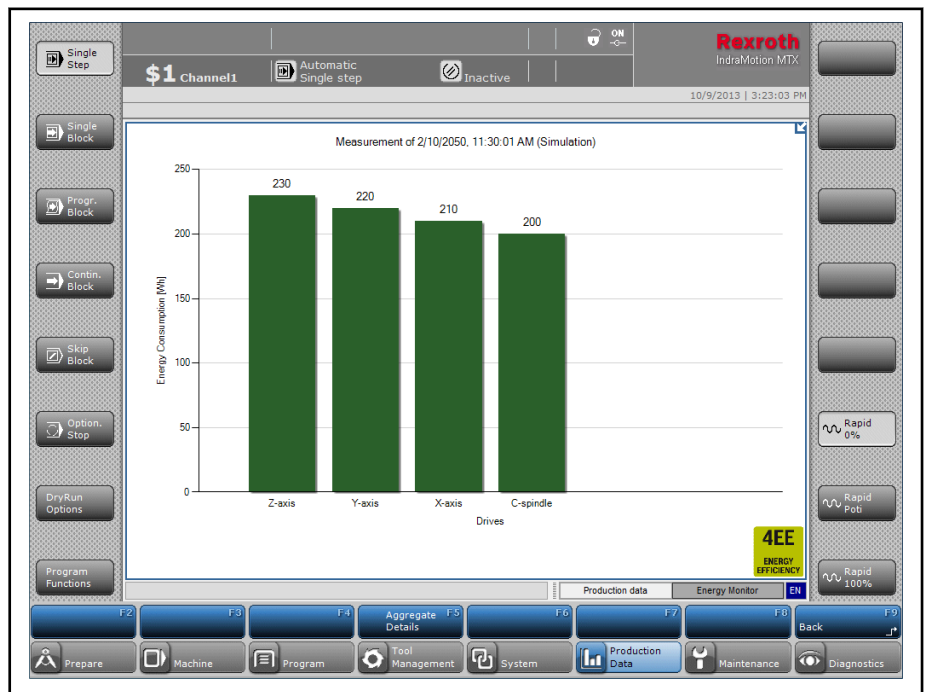


Fig. 10-7: Energy consumption of drives

Energy consumption of drives

Pressing <F4> opens the menu for displaying the energy consumption of the individual Sercos drives. The energy consumption bars for the individual drives can be accessed from the menu with the arrow keys.

Energy consumption of ancillary components

Pressing <F5> opens the menu for displaying the energy consumption of the individual ancillary components. The energy consumption bars for the individual ancillary components can be accessed from the menu with the arrow keys.

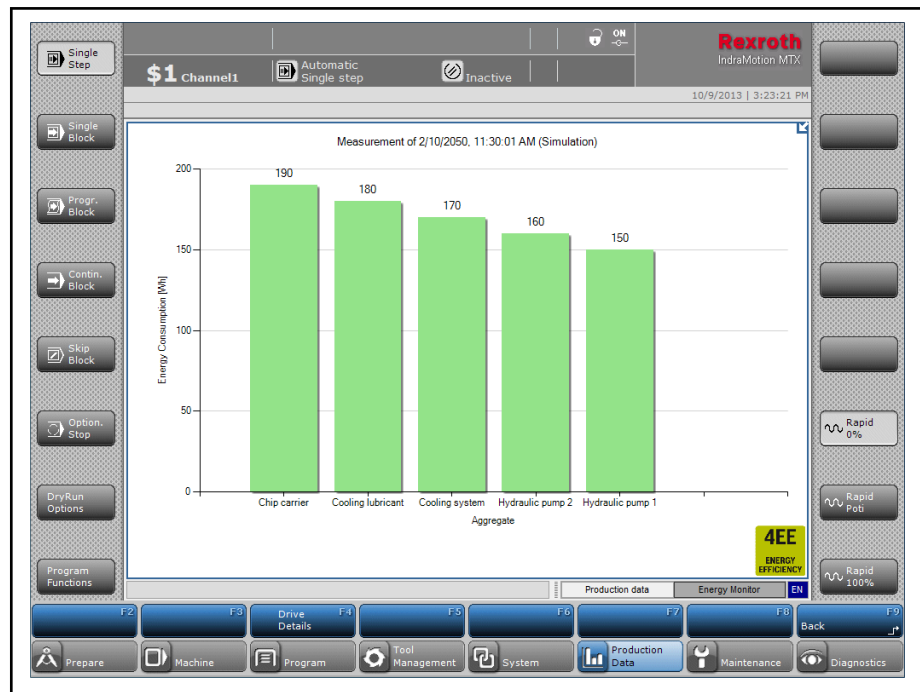


Fig. 10-8: Energy consumption of ancillary components

10.3 PowerMonitor

10.3.1 Overview

Purpose of the PowerMonitor

With the PowerMonitor, the power consumption (effective power) of a machine and individual function modules (electrical drives and ancillary components, such as hydraulic pumps, coolant/lubricant pumps, etc.) can be observed and monitored.

The PowerMonitor is part of the MTX interface.

PowerMonitor properties

The PowerMonitor shows:

- The overall power of the machine in either a chronologically variable bar chart or in a timeline
- The output power of the individual drives
- The output power of the individual ancillary components

Components

The PowerMonitor consists of the following sections:

- NC main screen subwindow
- Function key bars

10.3.2 Commissioning the PowerMonitor

Requirements

The PowerMonitor obtains the data it displays from the PLC function block "MT_4EEGuiMonitor". The relevant function block has to be integrated and assigned in the PLC program for this purpose see (PLC Programming Guide).

The PowerMonitor also has to be configured on the default main screen. To do this, first open the PowerMonitor from the default main screen via the second F key level after selecting the program display window with <F7> and <F3>, display the configuration menu with <F8>, and then edit the configuration menu according to the following subchapters.

Configuring the PowerMonitor - General information

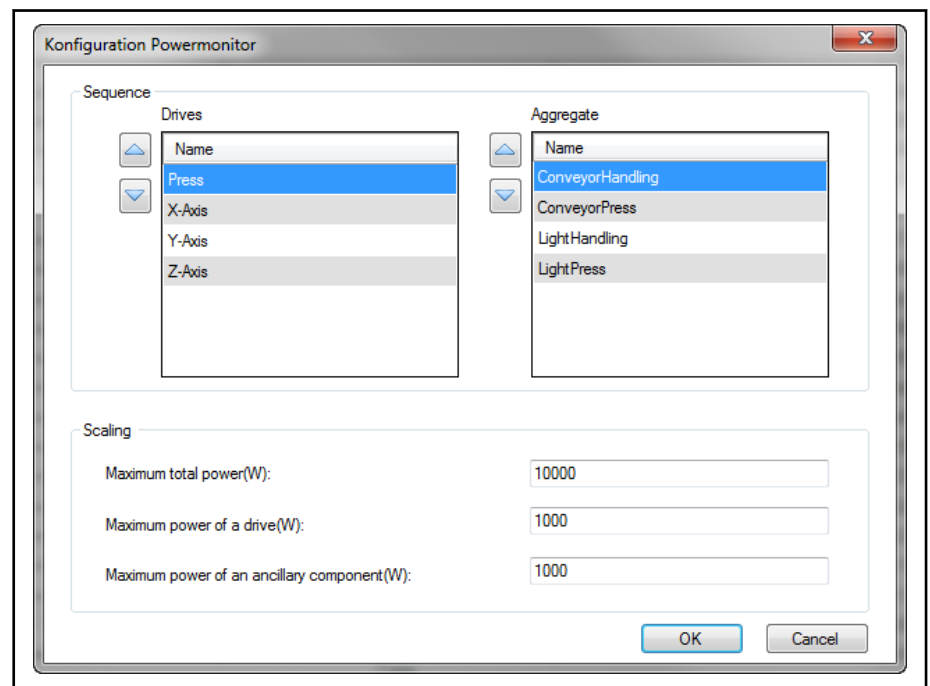


Fig. 10-9: Configuring the PowerMonitor - General information

Enter the maximum total drive power, the maximum single drive power, and the maximum output power for each individual ancillary component under "General". The display order of the drives and ancillary components can also be specified for the various power displays by using the arrow keys here as desired.

10.3.3 Working with the PowerMonitor

Starting the PowerMonitor

The PowerMonitor can be displayed as needed from the default main screen via the second F key level with <F7> and <F3>.

The PowerMonitor can also be mapped to F keys or M keys on user screens.

Overall power



Fig. 10-10: Overall power (as timeline)

The overall power of the machine can be displayed in either a chronologically variable bar chart or in a timeline. Both display types show both the consumption of the drives and the consumption of the ancillary components. Pressing <F2> switches between the two displays.

Output power of the drives

Pressing <F4> opens the power display menu for the individual Sercos drives. The power bars for the individual drives can be accessed from the menu with the arrow keys.

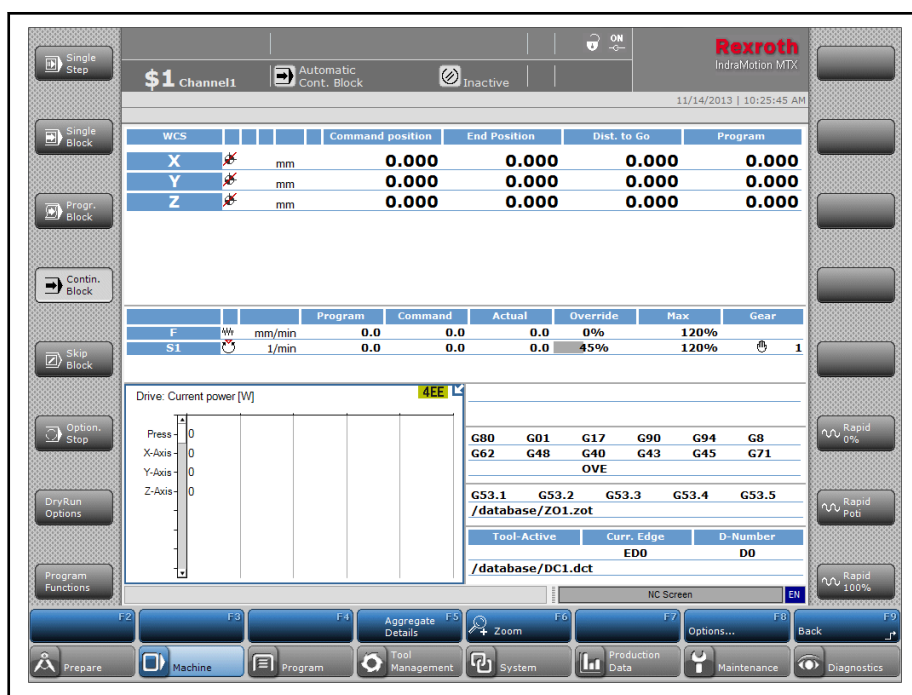


Fig. 10-11: Output power of the drives

Output power of the ancillary components

Pressing <F5> opens the power display menu for the individual ancillary components. The power bars for the individual ancillary components can be accessed from the menu with the arrow keys.



Fig. 10-12: Output power of the ancillary components

Zoom

If necessary, pressing <F6> enlarges each display. This is especially recommended for displaying the individual output power stats for the drives as well as for the individual ancillary components.

Pressing <F6> again restores the original display size.

10.4 EnergyManagement

10.4.1 Overview

Purpose of EnergyManagement

With the EnergyManagement, control and status data can be followed at the machine and component level. It can also monitor the statuses of each event and energy saving functions.

The EnergyManagement is part of the MTX interface.

EnergyManagement properties

The EnergyManagement has the following screens:

- Machine information
- Component information
- Events
- Energy saving functions (for individual components incl. those in the machine)
- Dead time/energy mode specification

Components

The EnergyManagement screens can be found under **Production Data ▶ EnergyManagement**.

10.4.2 Working with the EnergyManagement (dead time or energy mode)

Requirements

The dead time/energy mode can be specified under Production Data. To do this, open the "Dead Time or Energy Mode" window with <F7>.

Specifying the dead time or the energy mode

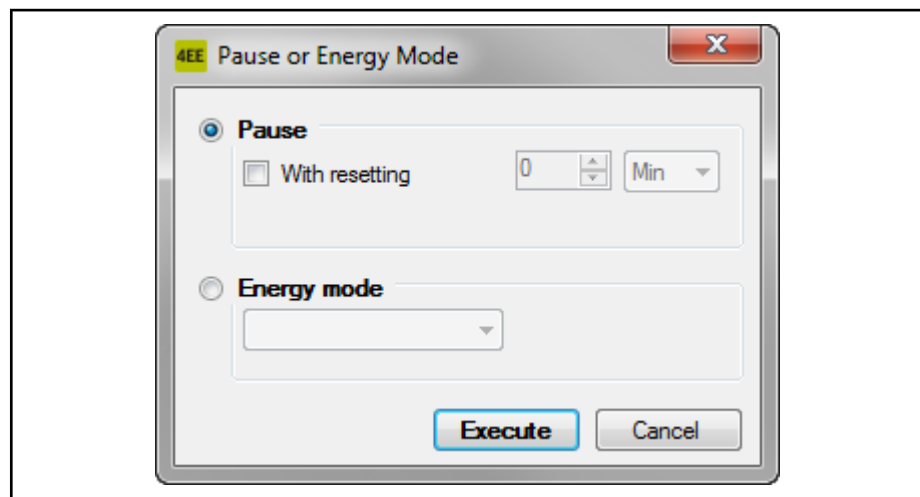


Fig. 10-13: Configuring "Dead Time or Energy Mode" window

Either a dead time or an energy mode can be specified in the window. If a break is desired, the checkbox can be used to select dead time with or without restart. If dead time with restart is selected, the system automatically switches to energy mode "Operational" once the dead time has elapsed.

10.4.3 Working with the EnergyManagement

Machine information

Pressing <F2> opens the menu for displaying the machine information.

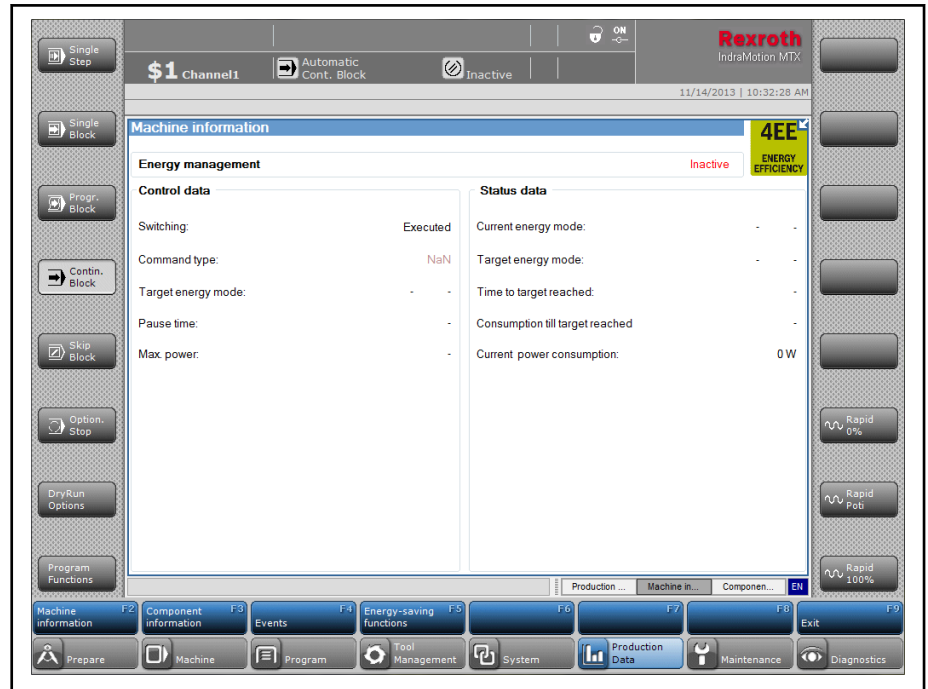


Fig. 10-14: Machine information

The menu shows both the control data and status data for the machine.

The control data contains the following items:

- "Switching" shows whether or not energy mode switching is active
- "Command type" indicates the type of specification (direct specification of a desired energy mode or dead time with or without restart)
- "Target energy mode" specifies the energy mode to be initiated, provided the command type is a direct energy mode specification
- "Dead time" shows the duration of dead time. It is used in the Energy-Management to calculate the target energy mode

The EnergyManagement displays the following for the machine under the status data:

- "Current energy mode" shows the active energy mode of the machine
- "Target energy mode" specifies the energy mode that the EnergyManagement has calculated. It is possible that this is not the same as the target energy mode specified by the user (on the left side). In these instances, another, higher-priority specification is typically pending (e.g., from an MES system)
- "Time to target mode" shows the time left before switching
- "Consumption to target mode" shows the energy consumption left before switching
- "Current power consumption" indicates the average output power of the active energy mode

Component information

Pressing <F3> opens the menu for displaying the component information.

Extended functionality

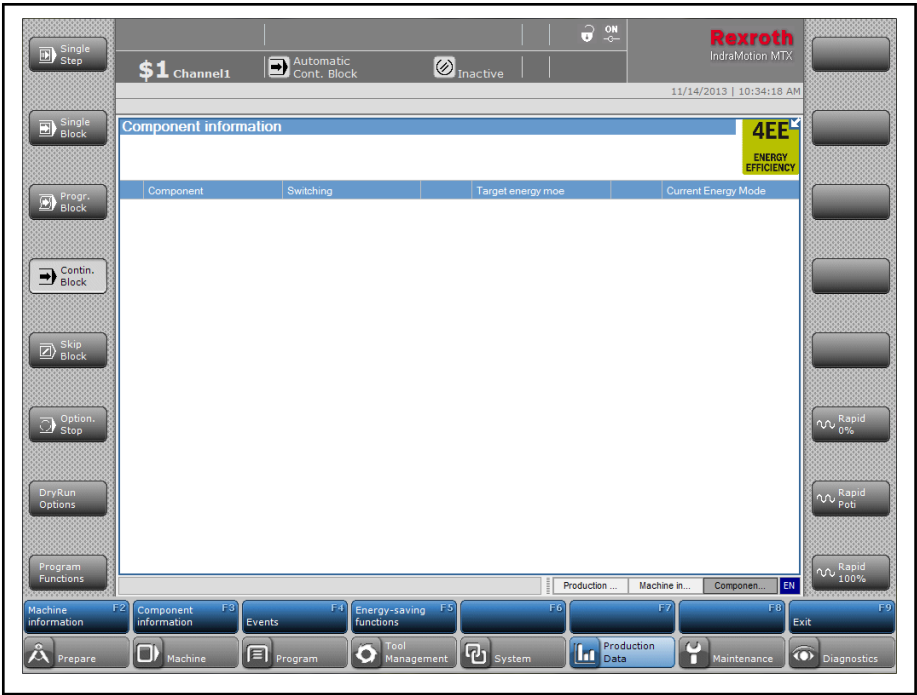


Fig. 10-15: Component information

The menu shows whether or not the mode for each component has to be switched, as well as the assigned target energy mode incl. current energy mode.

Events

Pressing <F4> opens the menu for displaying events.

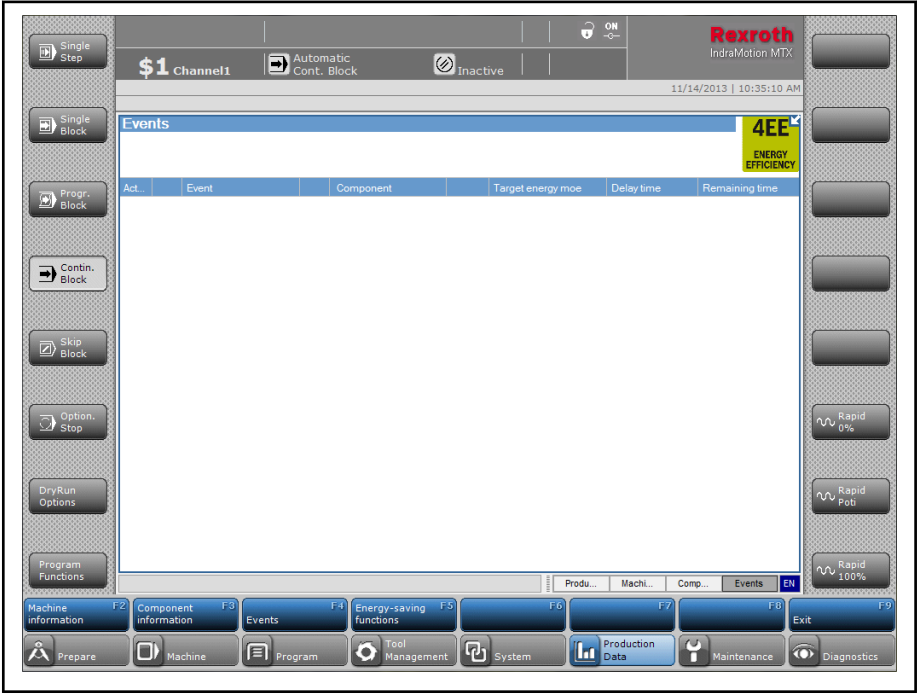


Fig. 10-16: Events

The menu shows whether or not each event is active, as well as the assigned target energy mode incl. delay time and remaining time until the event becomes active.

Energy saving functions

Pressing <F5> opens the menu for displaying the energy saving functions.



Fig. 10-17: Energy saving functions

The menu shows each energy saving function, the components to which they belong, and the partial load operation.

10.5 Circle test

10.5.1 Use

During the evaluation of machine tools, the accuracy attained by the machined parts is especially important in addition to the performance and an environmental friendly behavior.

To continuously ensure the accuracy of machine tools down to a few hundredths or thousandths of millimeters, the machine or the machining center is measured with the circle test in regular intervals.

On one hand, the history of the machines is documented as of the time of acceptance; on the other hand, measuring enables preventive maintenance.

The circle test contains the following functions:

- Generation of an NC test program after the selection of 2 axes each of the active channel and further specifications on the definition of the traversing motions
- Display of the machine state for the circle test
- Measurement start
- Display measuring results after traversing motion
- Analyze and backup measuring results
- Display of old measurements with the possibility to compare them with the current measuring results

10.5.2 Operation

The circle test is started in the operating range "Maintenance" via <F6>.

For projects created with older versions, the F-key is not assigned and has to be configured first. For instructions, see [chapter 10.5.3 "Configuring the circle test on F-keys"](#) on page 268.

The following user screen is visible after calling the circle test:

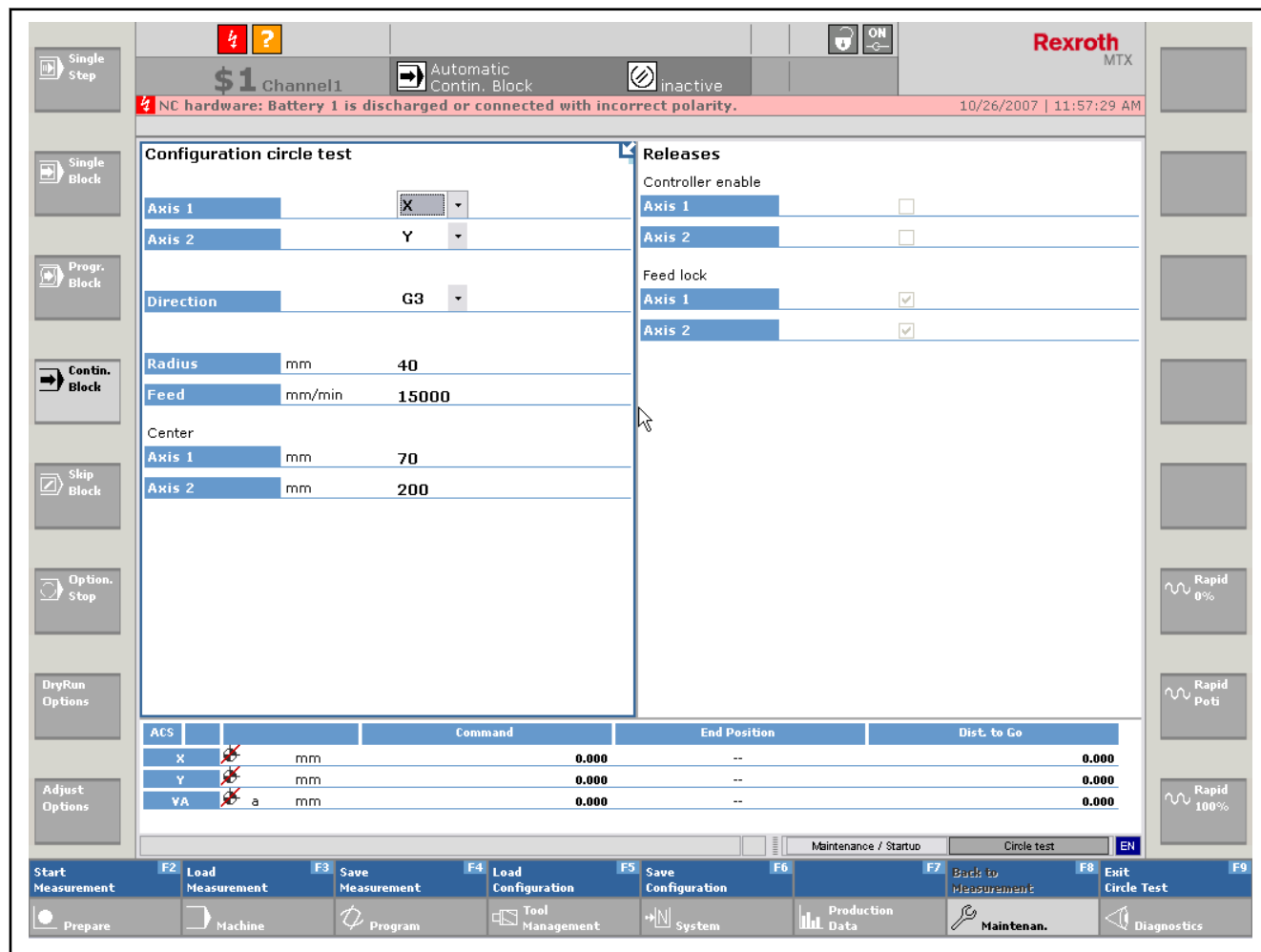


Fig. 10-18: Overview on the circle test

Test execution

Precondition: The machine has to be in Automatic mode!

1. Select axes.
2. Determine rotational direction, feed, circle center and diameter.
3. Start circle test with <F2>.

The necessary NC program is generated and loaded automatically.

4. After the circle test has been started, start the NC program.
5. The test is executed automatically. After the result has been displayed, either the analysis can be executed or the test can be restarted.

For a better evaluation, it can be zoomed within the circle diagram. Therefore, click on the left mouse button in the left upper corner and drag it to the lower right while keeping the button pressed. To see the complete curve again, press <F7> "Header zoom", then <F8> "Zoom 1:1".

Changing scaling To show the deviation of the actual curve from the command curve, this deviation is deliberately exaggerated. To obtain an impression of the qualitative deviation, so-called scaling rings drawn with an adjustable distance (scaling) are inserted. If this scaling is modified, the curve is recalculated and then redrawn. The curve is always displayed in such a manner that all measuring values are located within the screen area. This results in a relatively large scaling in case of large deviations.

The result can be documented via <F6> "Print result".

The following possibilities are available as F-key on the result page:

- <F2> Start and stop measurement.
- <F3> Load measurement
It loads a completed measurement with all settings related to axis selection, feed and radius.
- <F4> Save measurement
It saves a completed measurement with all settings related to axis selection, feed and radius.
- <F5> Load measurement
It loads a measurement to the current measurement to compare them with each other. The scaling of the measurement loaded is adapted to the current measurement.
- <F6> Print result
Calling print preview. The document can be printed. The configuration data is also printed.
- <F7> Zoom
It changes to another F-keypad "Zoom"
- <F8> Back to configuration
It changes back to the configuration screen.
- <F9> Quadrant - error correction
It opens the "Quadrant error correction" dialog

There are the following possibilities in the zoom area:

- <F3> Select curve
It switches between the two loaded curves.
- <F4> Cursor backward
It can move the cursor backward in the zoomed curve with regard to time.
- <F5> Cursor forward
It can move the cursor forward in the zoomed curve with regard to time.
- <F7> Zoom level back
It shows the zoom area selected before.
- <F8> Zoom 1:1
Shows the whole measurement on the screen.
- <F9> Back to the default F-keys.

Quadrant error correction This dialog is used to enter the drive parameters P435 - P439 for error correction at the quadrant intersections of the circle. To change the parameters,

the drive has to be in "Closed loop" and the optional servo package needs to be switched on.

The following quadrant error correction dialog opens:

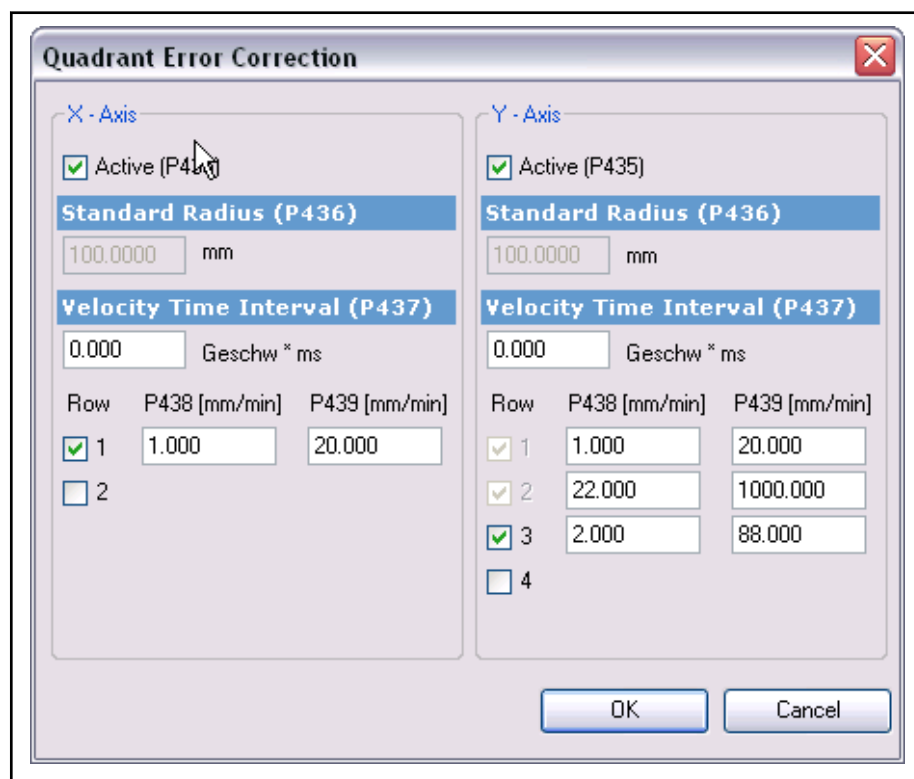


Fig. 10-19: Quadrant error correction

10.5.3 Configuring the circle test on F-keys

The circle test was not called in earlier projects. Proceed as follows to call it via F-keys:

1. The following line has to be entered into the file HMI.ScreenData.XML:
`<ScreenInfo Name="MtxCircularTest" ScreenType="MtxCircularTestApplication" Visible="true">`
2. Find an empty F-key in the Engineering desktop and assign the "Circle test" function to it (see IndraWorks documentation).
3. Assign the circle test to an operating area.

In IndraWorks Engineering, open the HMI node context menu in the EDT and call "Update HMI data". The entry for the circle test is shown in the screen list.

The screen can also be assigned to the desired operating area.

Go to the OP-panel editor, open the operating range editor and move the circle test screen from the left into the right list.

10.6 Remote support

10.6.1 Use

With the help of the function "Remote support", it is now possible to access remote machine tool control systems and to execute diagnostics or maintenance.

The remote support software consists of the following components:

1. UltraVNC server on the MTX control system.
2. UltraVNC viewer on the remotely-controlled "service PC".
3. Optional: Mirror Driver (can be installed additionally on the device that is remotely supported to decrease the CPU load)

All components have to be installed on the devices involved.



For more detailed information on the installation of the UltraVNC, refer to the documentation "UltraVNC Installation Instructions".

To use the remote support functions on the CNC system MTX, you need the following user rights:

- You have to be logged in as main user or administrator in Microsoft Windows™.
- The user currently logged in to IndraWorks has to have the "remote support" user authorization.



To remotely support with UltraVNC, a TCP/IP connection has to be possible between the PCs involved via the port 5900.

10.6.2 Operating

General information

Under <OP8> "Maintenance", <F2>, a dialog to activate and deactivate the remote support function is available in the MTX user interface.



For more detailed information on the UltraVNC, refer to the documentation "UltraVNC Installation Instructions".

Dialog to activate and deactivate

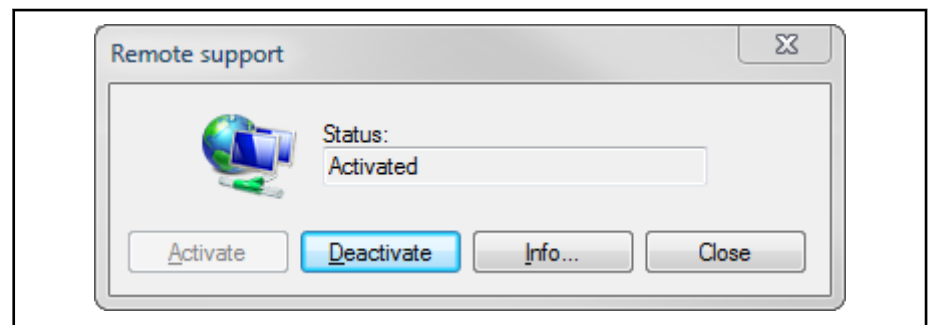


Fig. 10-20: Dialog to activate and deactivate

Activating

This function activates the remote support software, i.e. this machine tool control PC can be accessed from a service PC with installed remote support control software.

Deactivate:

This function deactivates the remote support software.

The machine tool control PC cannot be accessed via the remote support.

10.6.3 Display in the machine status area

The status of the remote support is displayed within the machine status area.

"Remote support active" The status "Remote support active" is displayed in the machine status area by the symbol .

"Remote support inactive" The status "Remote support inactive" is displayed in the machine status area by the symbol .

10.6.4 Related documentation

For more information on the remote support, refer to the documentation "IndraWorks 14VRS Remote Support" (DOK-IWORKS-REMOTE**V14-APRS-EN-E).

10.7 Calculations and tables

10.7.1 Introduction

Purpose of the calculator

The dialog "Calculations and tables", shortly called "Calculation", is a means for performing calculations and for looking for values in tables that are frequently needed, especially in the creation of part programs (thread table, fit sizes). It is a modal dialog exclusively available in the IndraWorks Operation of the CNC system MTX.



No warranty is assumed for the correctness of all table values.

Within this dialog, there is a calculator for general calculations and different calculation forms are provided for frequently recurring geometric and technological calculations.

Depending on the calling dialog, the calculator disposes of a possibility to directly insert the result in the entry field last focused. Apart from that, the result can be directly used at any place by inserting the content of the clipboard.

Setup

The calculator is only available in IndraWorks Operation if it has been set up.

Shortcut Showing the calculator by a shortcut is most frequently used to call a calculator. Particularly in dialogs - if they are prepared for that purpose - shortcuts are the option for calling.

Start IndraWorks Operation. Use the menu bar (display it with <Alt> +<M>, if required) and subsequently select **Tools ► Options....** In the dialog shown, open the node "General" and select "Keyboard". Under "Categories:", select the entry "MTX functions" and under "Commands" the entry "Calculator". Set the entry focus to the field "Press key combination:" and press the desired shortcut (key combination). The "Assign" button activates the shortcut in connection with "OK" and/or "Accept".

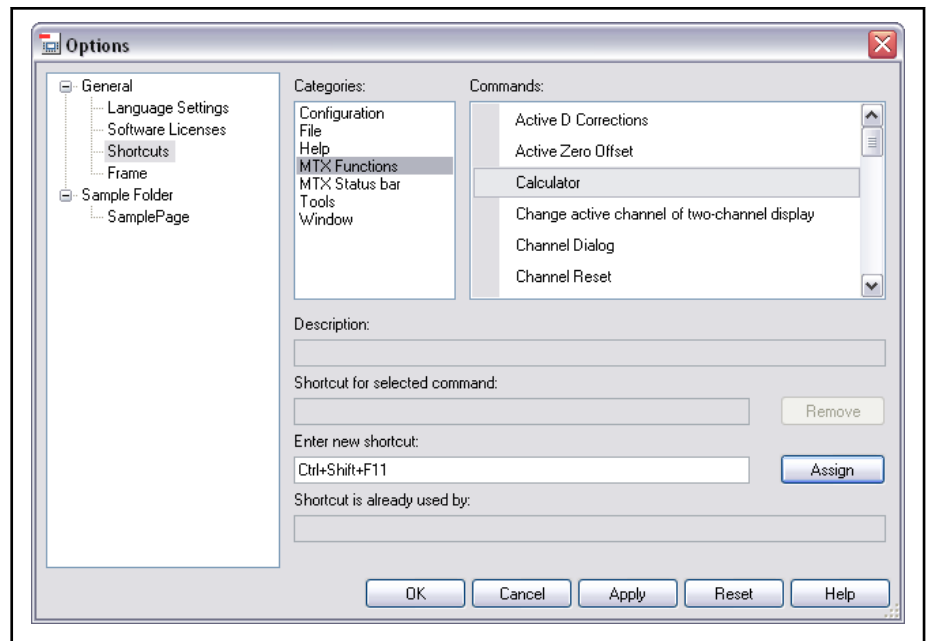


Fig. 10-21: Setting up a shortcut to call the calculator

The defined shortcut is project-independent and applies to the respective installation of the user interface.

Function key

In addition to the shortcut, you can optionally set up F-keys and/or M-keys to activate the "Calculations and tables" dialog via buttons. For this setting, the IndraWorks Engineering is to be used and the active project is to be adjusted accordingly. As graphics on the configured keys, the "Calc.gif" file can be used.

Extended functionality

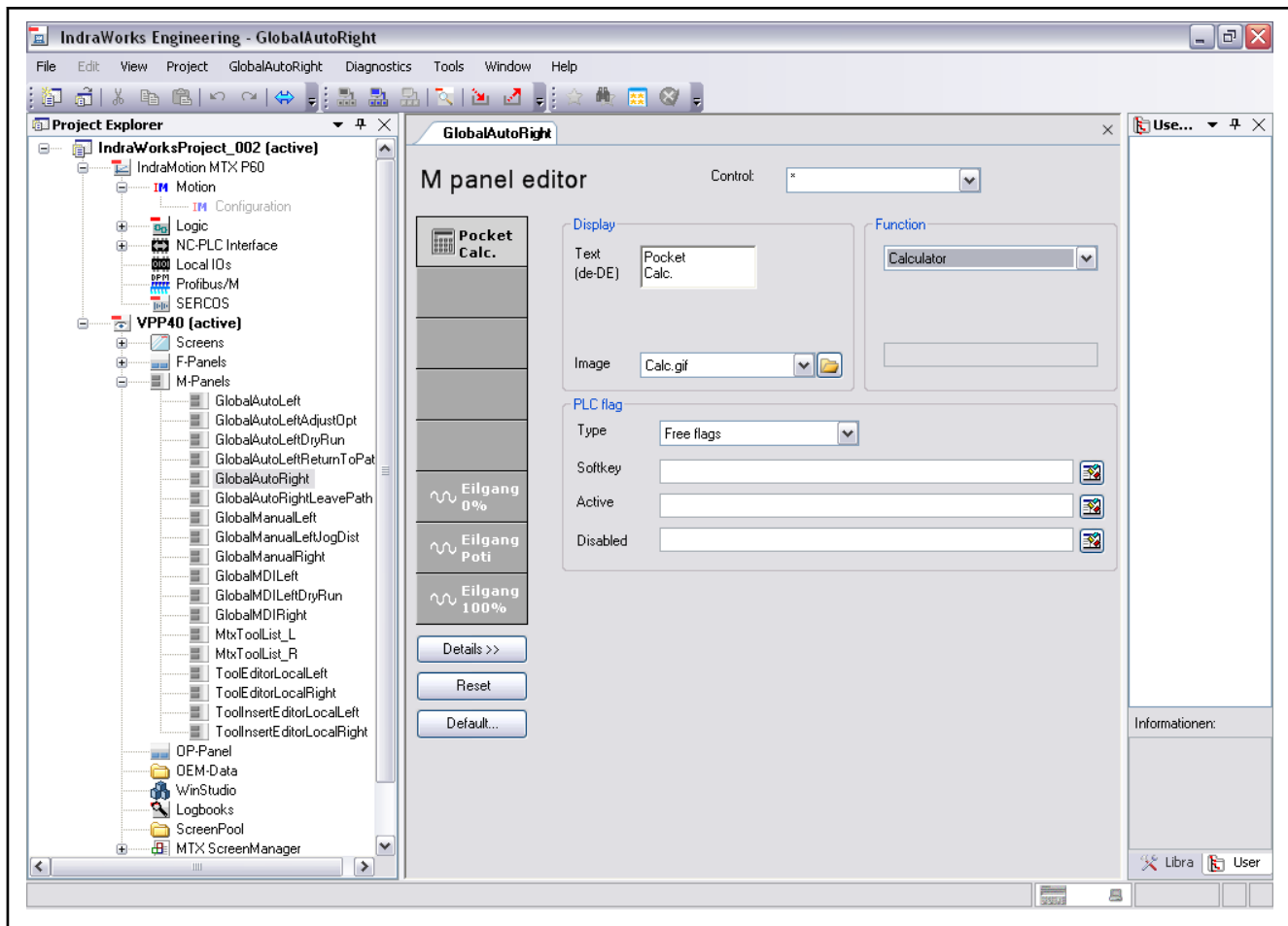


Fig. 10-22: Setting up an M-key to call the calculator

Operating and inserting values

Possibilities of inserting results

There are two possibilities to transfer results to input fields and/or editors:

- Paste from the clipboard
- Direct pasting to an editing field when closing the calculator

Pasting from the clipboard

If a value shown in the calculator is selected for transfer by using the "Copy" key, it is automatically available for pasting at any place in the clipboard, irrespective whether within or outside the calculator after closing it (e.g. in an editor). The result is pasted using <Ctrl>+<V> and/or an equivalent F-key to paste from the clipboard. The usage of the clipboard is the most universal operation to transfer a result and is generally possible in all text editors and text fields. This method of pasting is **always available**.

Direct pasting

The direct pasting of values reduces the number of operations and presumes the following:

- The text field, into which the result is to be pasted, received the entry focus before opening of the calculator,
- The calculator is called using a shortcut
- The dialog, into which the result is to be pasted, was prepared for direct pasting

The possibility to directly paste the value is always available if the calculator dialog displays one button with "OK" and one with "Cancel". The possibility to directly enter a value can be seen from the layout of the calculator dialog.

OK	"OK" inserts the selected results or also several values shown on a calculation form and closes the dialog (direct paste). "OK" is disabled as long as no result has been selected and/or an entry error is pending.
Cancel	"Cancel" closes the calculator without directly inserting a result afterwards. If a result has been selected by "Copy" in advance, it can be pasted from the clipboard.
Close	The "Close" button is shown if the pasting is only possible via the clipboard. It closes the "Calculator" dialog.
Calculation	If an input field in the calculation forms is edited, the fields mathematically depending on this field are automatically emptied. From this temporary emptying, you can very well see the mathematical relations of the individual variables. Calculation of the depending variables from the specifications is initiated with the return key (<Enter>). With the calculator, you can also use the result key (<=> key or shortcut <=>).
Correcting errors	Incorrect entries that are pointed out by a display or an error field can generally (except for the calculator) be corrected by an immediate text field change or by discarding the latest entry using <Esc>.
Selecting a result	After the calculation, the calculation forms (again except for the calculator) show several numerical values that can be considered for the result transfer. The desired result must be selected using "Copy" on the right (for the calculator the "COPY" key). You can also set the focus into the respective text field and copy the value displayed there using <Ctrl>+<C>. It is also possible to select one part of the shown content by marking it in advance. The selection by copying the value enables the "OK" button for direct pasting. Calculation forms without buttons allow for the analysis of all visible and relevant values in the target dialog and their recording (insertion) as entries.
Inserting the result	As described above, direct insertion is initiated using the "OK" button if available. Otherwise, insert the clipboard content.

10.7.2 Calculator

Overview

Application target	Operation and layout of the implemented calculator are based on devices as they are used in schools and offices. The capacity is tailored to the requirements in the technical area, particularly the part programming, and thus lies between a simple standard calculator and a scientific calculator.
Layout	The calculator is located in the "Calculator" tab. It has a result display, status displays and a keyboard with a classification into: • Operating and function keys with double assignment • Keys for the memory • Numeric keypad • Keys for the arithmetic operators (basic arithmetic operations)

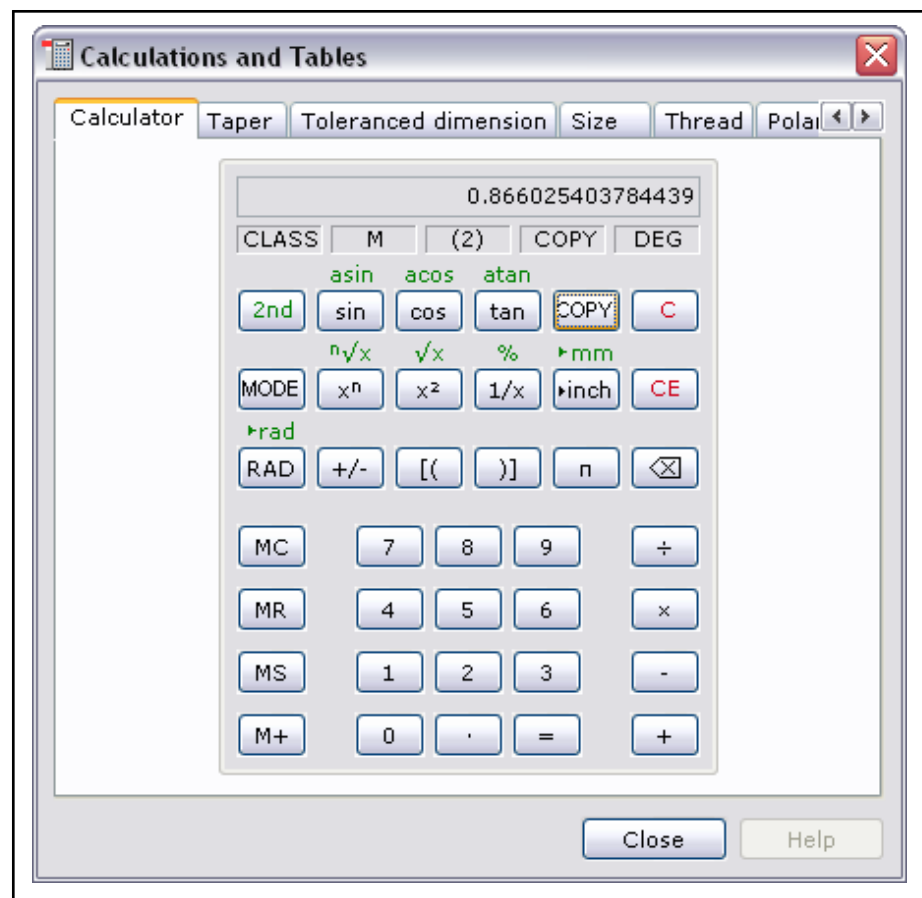


Fig. 10-23: Calculator layout (standard operation mode)

Operating modes

Modes The calculator disposes of three operation modes:

- standard
- Text entry
- hybrid

You can switch between the operation modes using the "MODE" key. The active mode is shown in the left status field and after switch-over is displayed as clear text in the display field. In order to activate a certain mode, the specified key must be pressed repeatedly, if necessary.

Classic operating mode

The classic operation mode corresponds to the operation of a usual pocket calculator, i.e. it is based on the operation using the visible keys.

This operation mode is pre-set in the first use and can be used in a particularly effective way if there is a mouse. An operation without mouse is supported by numerous shortcuts.

The classic operation mode can be detected in the status display from the information "CLASS".

Operating mode text entry

The operation mode "Enter text" changes the result display into an editable text field for entering arithmetic expressions. At the same time, all function and operator keys as well as the operating keys that are only relevant for the classic mode are enabled. Thus, this mode provides an entry medium for texts that are interpreted and calculated as arithmetic expressions.

The text entry is recommended for more complex expressions as the expression can be completely seen and checked before the calculation. Re-calculations as they are often necessary in the classic mode can mostly be omitted. The text entry is particularly suitable for an operation without mouse. The text mode is moreover advantageous in recurring expressions with changing numbers. For this purpose, the last expression should be copied into the display using the clipboard and the new operands should then be entered by editing.

The text entry can be detected from the status display "TEXT".

Operating mode Hybrid

The "Hybrid" operation mode combines the classic and the text entry mode. After calculation of a result and after pressing the delete key "C", it is decided by means of the following operating step in which form - classic or text entry - the following calculation will be performed. If the entry focus is set to the display field and entries are made there, the text entry mode is activated. If, however, operating keys are actuated or shortcuts are used while the entry focus is **not** on the display, this behavior will activate the classic operation by means of keys.

The hybrid mode spares the explicit switching between the modes. It can be detected from the status display "HYBR".

Working in the classic operating mode

Performing a calculation

Numerical entry

Numbers are entered as follows:

- Enter the numbers and the decimal separator in the order from left to right. A leading zero in front of the decimal separator does not have to be entered.
- For the numerical entry, the numbers <0> to <9> are available as shortcuts. The decimal separator can be entered using the "point" or "comma" key. You can also use the numeric keypad if the <Num> key has been pressed in advance.
- A negative sign can only be entered if the display does not equal zero. For the change of sign, you can use the "+/-" key and/or the shortcut <F9>.
- No switch from the floating point representation (i.e. the decimal point separates the fraction from the integer) to the exponential representation (mantissa followed by the exponent of the power of ten) by operation is not intended. An operand is always entered in the floating point representation. Calculation results with very large and very small amounts can be shown in exponential notation ($x \times 10^y$ is shown as xEy, e.g. 4.56E-07).

Simple calculation

Simple calculations in the basic arithmetic operations are performed as follows:

1. Enter the first operand as described.
2. Click on "+" in order to add, on "-" in order to subtract, on "x" in order to multiply and on "÷" in order to divide.
The specified operators can also be entered using the numeric keypad and the shortcuts <+>, <->, <*> and </>.
3. Enter the next operand.
4. Enter more operators and operands, if applicable.

After another operator has been entered, the interim result is shown in the display.

5. Click on the result key ("="). You can also use the <Return> key, the <Enter> key or the shortcut <=>.
6. After the calculation, the result is available for the automatic insertion. For this purpose, the dialog must show one "OK" button and one "Cancel" button. In order to be able to transfer the result using the clipboard, you must press the "COPY" key. The status display now shows "COPY" - evidence that a value has been saved to the clipboard and that it currently still complies with the display.

Priority rules and brackets

The calculator considers the operators' priority. For an order deviating from the priority rules, brackets have to be used. For this purpose, the keys "[(" and ")]" and/or the shortcuts for the left bracket <(>, <[>, <{> and <}>, <]>, <}> for the right bracket are available. The number of currently open brackets is shown in the central status display.

When entering a right bracket, the interim result of the expression in brackets is shown.

You can use brackets as often as you want and open as many brackets as you want.

Example:

Brackets and priority of operations

$2+8 \times 3=$ is to be calculated. Complying with the priority rules, $2+(8 \times 3)=26$ is calculated. To calculate $(2+8) \times 3=30$, put the addition in brackets.

Continuous calculation

You can at any time use the displayed result of a calculation as first operand for the next calculation. Thus, entry of the first operand is omitted. You can use this procedure in many cases instead of brackets.

Functions

The functions always use the displayed value as argument and immediately show the function value. I.e., the Reverse Polish Notation applies to functions, i.e. the order argument and then the function itself.

Example:

Functions

The sine of 30° is to be calculated.

For this purpose, you enter "3" "0" "sin" "=" and get 0.5.

If the argument is an expression, set the argument in brackets.

In the example $\sin(28+4.5)$, enter "•" [" "2" "+" 8" "+" "4" "•" "5" "]" "sin".

Second key assignment

The function keys are assigned twice. Usually, the second key assignment is the corresponding reverse function of the first level assignment. The second key assignment is activated using the "2nd" key whereas the labeling changes, as well. The second key assignment will only be valid for one click or one shortcut. The second key assignment can also be activated by keeping the <shift> key pressed.

Example:

Second key assignment with functions

The arc sine of 0.5 is to be calculated.

Enter "•" "5" "2nd" "asin" "=" and you get 30.

Trigonometric functions	The trigonometric functions either work with degree measure or radian measure (radian). The currently active unit can be seen in the status display. "DEG" stands for degree, "RAD" for radian. You can switch between the angle units by using the <RAD> and/or <DEG> keys. Switchover of the angle unit is accompanied by a new labeling of the function keys relating to the angle unit according to the new status.
Conversion between degree measure and radian measure	You can convert a display value into degree or radian as follows: 1. Adjust the currently set angle unit to the unit that you associate with the display value. For converting a value from degree into radian, click on "RAD", otherwise on "DEG". 2. Now press "2nd" and "►rad" or "►deg" for the actual conversion. As for each other function, the result is displayed immediately.
Calculation of percentage	Using the key sequence "2nd" "%", the displayed figure is converted from a figure into a percentage by dividing it by 100. If "%" is pressed after an arithmetic operation, additions, reductions and percentages can be calculated as follows: • Adding an addition, i.e. addition of n% to x: x "+" n "%" "=" • Settling a reduction, i.e. subtraction of n% from x: x "-" n "%" "=" • Multiplication by a percentage, multiplication of x by n%: x "x" n "%" "=" • Division by a percentage, i.e. division of x by n%: x "÷" n "%" "=".
Exponentiation and extraction of roots with any exponent	As opposed to squaring and extracting the square root, the exponentiation and root extraction with any exponent do not constitute a function. The exponentiation/root extraction is an operator analog to those for the basic arithmetic operations and for the performance, you need a first and a second operand. In the exponentiation, the first operand is the base and the second one the exponent. In the root extraction, the operands are called "radicand" and "exponent of a root". For the exponentiation x^n, you enter x "x^n" n, for the root $\sqrt[n]{x}$ analogously x "2nd" "$\sqrt[n]{x}$" n. Here, you can use brackets, as well if the operands consist of an expression.
Mathematic constants	In the classic operation mode, the calculator only offers the constant π (Pi) that can be activated using the "π" key or the <P> shortcut.
Errors and correction of entries	
Errors	Errors in the calculation can be caused by: • an undefined operation • a function call with an inadmissible argument • by a number overflow in the final or an interim result In all these situations, "Error" is displayed in the display in order to signal the error status. Subsequently, delete the error before continue working.

Resetting	The calculator including the stored interim results and the repetition memory is reset using the <C> key or the <Del> shortcut. The same operation is to be used for deleting an error. The reset will not influence the memory or the set modes.
Delete the display value	Using the <CE> key, the display value is deleted without the interim results and the entered operands being lost. After the <CE> key resetting the display to "0", continue by once again entering the operand.
Overwriting an operator	Operators that have been entered wrongly by accident cannot be deleted. It is, however, possible to enter the correct modifier directly after having entered the wrong one. Thus, the operator is overwritten. This correction possibility applies to "+", "-", "x", "÷" "x" and "√x".
Deleting a character	The numbers and the decimal separator shown in the display can be deleted individually from right to left using the "⌫" key. The related shortcut is the <backspace> key (<Backspace>).
Repeating calculations	
Repeating the last operation	You can repeat the last operation of a simple calculation several times in form of the continued calculation without having to enter the last operand and the last operator repeatedly. For this, proceed as follows: 1. Enter the first operand 2. Press the operator key 3. Enter the second operand 4. Press "=" 5. Press "=" as often as you want to repeat the operation <i>Example:</i> Repeating the last operation 3 is to be subtracted from 8 two times, i.e. $8-3-3=2$. For performing the calculation press "8" "-" "3" "=" "=".
Repeating the last operands	If in a simple calculation, the second operand is not specified, the display value will be used as second operand. <i>Example:</i> Repeating the last operand The third power of (-2), i.e. $(-2)^3$ is to be calculated. In this connection, $(-2) \times (-2) \times (-2)$ is to be used. For this purpose, you enter "2" "+/-" "x" "=" "=".
Using shortcuts	
For most of the calculator's keys, there are also shortcuts.  The shortcuts in the following table show the characters visible on the computer keyboard. In this connection, the arrangement of the characters on the keyboard has not been considered. I.e. in order to enter them, single characters must be activated while simultaneously pressing a modifier key like the <shift key>, <Alt> or <Alt Gr>. The modifier keys are not listed in the table unless a capital letter is required.	

Description	Key	Shortcut
Second keypad	"2nd"	<Shift key> (keep it pressed)
Sine	"sin"	<S>
Arcus sine	"2nd" "asin"	<Shift key>+<S>
Cosine	"cos"	<C>
Arcus cosine	"2nd" "acos"	<Shift key>+<C>
Hyperbolic tangent	"tan"	<T>
Arcus tangent	"2nd" "atan"	<Shift key>+<T>
Copying the display value	"COPY"	<Ctrl>+<C>
Reset	"C"	<Del>
nth power	"x^n"	<^>
Square root	"√x"	<@>
Reciprocal	"1/x"	<r>
Percent	"%"	<%>
Changing the sign	"+/-"	<F9>
Left bracket	"["	"(" - or - "[" - or - "{"
Right bracket	"]]"	")" - or - "]]" - or - "}"
Pi	"π"	<P>
Delete the last character		<Backspace> (Backspace)
Numbers 0...9	"0"... "9"	<0>...<9>
Decimal separator	"."	<.> - or - <,>
Division	"÷"	</>
Multiplication	"x"	<*>
Subtraction	"_"	<->

Description	Key	Shortcut
Addition	"+"	<+>
Calculate	"="	<=> - or - <Return key> - or - <Enter>

Tab. 10-3: Calculator shortcuts



The return key is the shortcut for performing the calculation. Consequently, clicking on a focused key of the calculator using the return key or <enter> is **not** possible. For clicking, you can only use the left mouse button and the <space> key.

Working in the text entry operating mode

Layout in the text entry operating mode

In the text entry operation mode, all keys for entering operands and operators as well as for performing functions are not available. Instead, the display field can be edited in order to there enter the characters of the expression to be calculated.

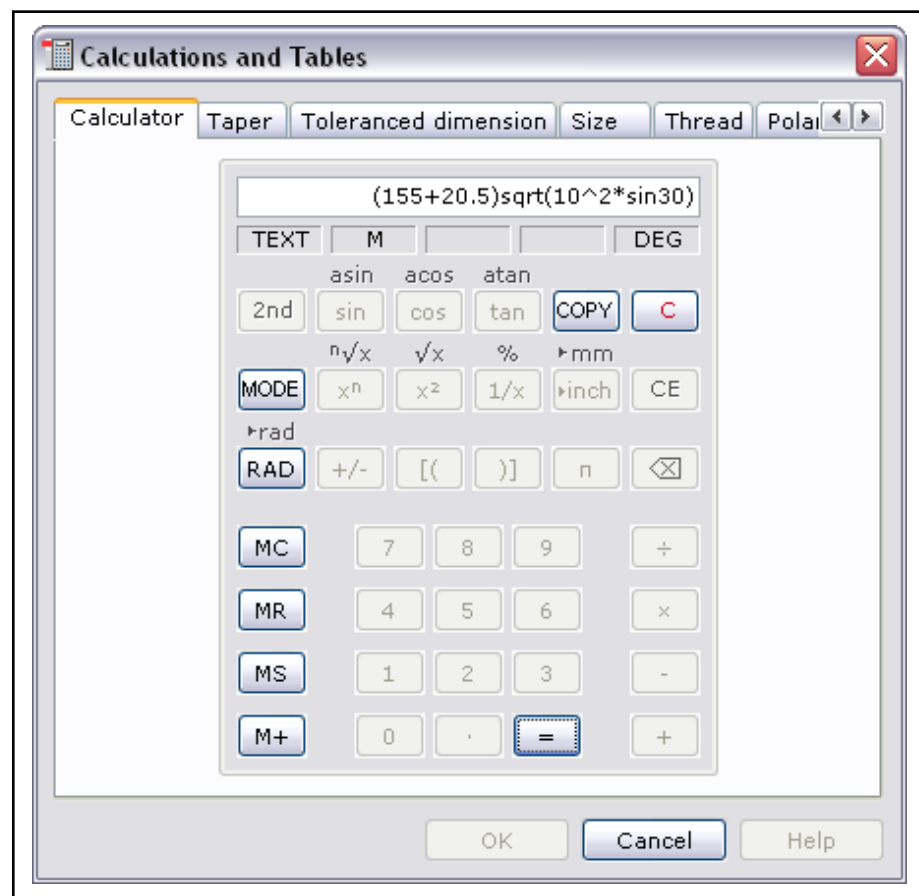


Fig. 10-24: Calculator in the text entry operation mode

Performing a calculation

Entering an expression	In the beginning, the focus must be set to the text field (display). The expression is entered using the keyboard. Alternatively, the expression can be inserted from the clipboard using the <Ctrl>+<V> shortcuts. The expression must comply with the syntax rules listed in the following sections.
Calculating expression	Click on the result key ("="). You can also use the <Return> key, the <Enter> key or the shortcut <=>.
Trigonometric functions	The trigonometric functions either work with degree or radian. The currently active unit can be seen in the status display. "DEG" stands for degree, "RAD" for radian. You can switch between the angle units by using the <RAD> and/or <DEG> keys. An expression with several trigonometric functions in which both angle units are used simultaneously cannot be calculated directly.

Syntax for expressions

Basics	The syntax for mathematical expressions largely complies with the CPL language (Customer Programming Language). Apart from that, there are only a few extensions and some programming aids. The syntax generally applies to all text entry fields for numerical values in IndraWorks Operation if they are connected to the interpretation of expressions as well as within the "Calculations and tables" dialog.
General rules	In general, the following applies: • The entry logic corresponds to the algebraic notation whereas the order of the operators is considered. • Upper and lower cases can be used arbitrarily. • An expression may include any number of spaces at any position. The spaces will be ignored.
Format for numbers	To the format of numbers, the following applies: • As decimal separator both, the point and the comma can be used. • Leading zeros in front of the decimal separator can be omitted (e.g. - .668 instead of -0.668). • A positive sign can generally be omitted. A negative sign must be written whereas here, brackets around the negative figure - as it is usual as opposed to arithmetic - can be omitted (e.g. -3.2*-4 instead of (-3.2)*(-4), SIN-30 instead of SIN(-30)). It must, however, generally be noted in the single case that the operators for addition and subtraction are identical with the signs and that the operators must generally be maintained. • Numbers can also be written down in exponential notation. The mantissa is to be followed by an "E" or an "e" introducing the exponent. The mantissa may contain a decimal separator. The exponent must be integer and must not include a decimal separator (examples: -13.783E-10, .55e+4 and 2,345E12).
Operators	The following operators can be used in expressions: • Addition: + • Subtraction: - • Multiplication: *

- Division: /
- Power: ^



- The operator for the multiplication can be omitted in front of function names, in front of constants and after brackets (e.g. $5(3.4-66)$ instead of $5*(3.4-66)$, $(3120+750).5$ instead of $(3120+750)*.5$, $-50\text{SIN}30$ instead of $-50*\text{SIN}30$). The asterisk must, however, not be omitted if it is followed by a sign (e.g. $(22-1.5)*-30$ must not be simplified and become $(22-1.5)-30$).
- For roots $\sqrt[n]{x}$, you have to switch to the power with the reciprocal radicand as exponent $x^{(1/n)}$. For the square root, you can also use the "SQRT" function.

Priority rules and brackets

The interpretation of the expressions complies with the priority rules for operators.

The order of the calculation applies (with decreasing priority):

1. Function call (with succeeding argument)
2. Power
3. Multiplication and division
4. Addition and subtraction.

Operations with operators equal with regard to the order are calculated in the order from left to right.

If for the calculation, an order deviating from these rules is to be used, brackets must be set around the preferred part of the expression. In this connection, only round brackets are admissible. You can use as many brackets as you want and open as many brackets within one expression as you want, however always in pairs, i.e. one left bracket and then one right bracket per level. Deviation from the parity of the brackets can be seen in the central status display.

Example:

Fraction

$$\frac{ab}{cd}$$

In case of a fraction such as $\frac{ab}{cd}$ there are often errors as multiplication and division are of the same priority and thus performed from left to right. Numerator and denominator must, however, in each case be calculated from the quotient.

Without brackets. i.e. $a*b/c*d$, the calculation according to the priority rules would incorrectly be $(a*b)/c)*d$.

Apart from the expression $(a*b)/(c*d)$ exactly converted into the syntax, the following expressions would lead to the correct result, as well:

$a*b/(c*d)$ and $a*b/c/d$.

Functions and constants

Functions

The following functions can be used within one expression:

Name	Description	Value range of the argument	Value range of the function value
ABS	Absolute value	Rational number	$y \geq 0$
ACOS	Arcus cosine	$-1 \leq x \leq 1$	$0 \leq y \leq 180$ and/or π
ASIN	Arcus sine	$-1 \leq x \leq 1$	$-90 \leq y \leq 90$ or $-\pi/2 \leq y \leq \pi/2$
ATAN	Arcus tangent	rational number	rational number
COS	Cosine	rational number	$-1 \leq y \leq 1$
INT	Conversion to an integer by cutting off the decimal fraction	rational number	Integer number
ROUND	Rounding up or down to the next integer. With a decimal fraction of exactly 0.5, the next even number is returned	rational number	Integer number
SIN	Sine	rational number	$-1 \leq y \leq 1$
SQRT	Square root	$x \geq 0$	$y \geq 0$
TAN	Hyperbolic tangent	$x \neq n \cdot 90$ or $x \neq n \cdot \pi/2$ with $n \neq 0$	rational number

Tab. 10-4: Compilation of the implemented functions

Function call A function call always consists of the function name followed by the argument. In this connection, the argument does not have to be put into brackets, also if it has a sign unless it is an expression.

Constants You can fall back on the value of mathematical and other constants using their constant names.

The following constants are available:

Name	Description	Value
PI	Constant π	3.14159265358979
KI	Conversion factor from inch to mm	25.4 [mm/inch]

Tab. 10-5: Compilation of the implemented constants

Correcting entries

Errors Errors in the calculation can be caused by:

- an undefined operation
- a function call with an inadmissible argument
- by a number overflow in the final or in interim result
- brackets that are not arranged equally
- Syntax error

With all these causes, "Error" is displayed in the display in order to signal the error status. Afterwards, reset the calculator before continuing.

Extended functionality

Resetting If the calculator is in an error condition, the latter can be deleted using the <C> key. <C> can also be used for deleting the display field. The <Del> shortcut that can alternatively be used in the mode will in the text entry operation mode only take effect if the entry focus is not on the display field. Otherwise, <Del> will only delete one character or selected text.

Editing expression Before the calculation, the expression can be modified arbitrarily and in an unlimited manner by means of editing using the keyboard. For the deletion, the <backspace> and the <Del> key are available.

Working in the hybrid operating mode

Layout in the Hybrid operating mode

In the hybrid operation mode, the calculator sometimes looks like in the classical mode and sometimes like in the text mode. In the classical form, the display field cannot be edited and all keys are enabled. In the text mode form, the display field can be edited and all keys for the entry are disabled. After reset ("C" key) and the calculation ("=" key), the calculator is in an interim condition in which all keys are enabled and the display field can be edited.

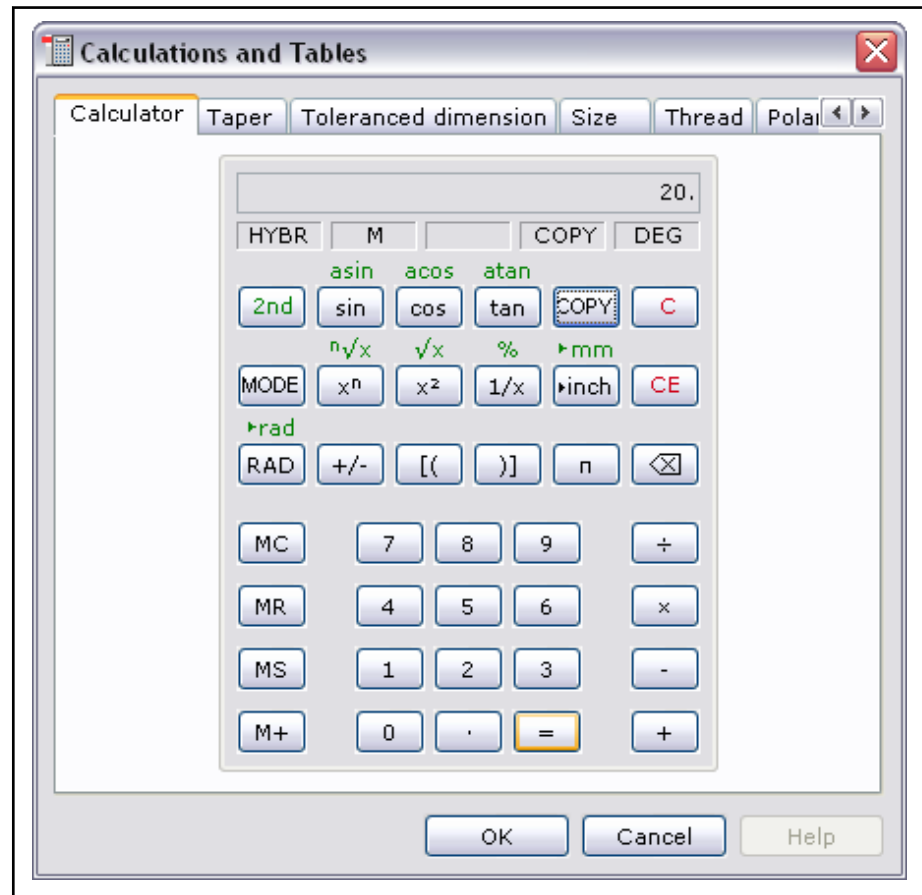


Fig. 10-25: Calculator in the hybrid operation mode (classical form)

Which of the two forms - classical or text entry - will finally be active in the entry is only decided by the following entry. The form determined in this connection is maintained until the result is shown or a reset is performed.

Performing a calculation

Calculating in the classic design

In order to use the classic design, i.e. operation by means of keys in the hybrid mode, click on an entry key (numbers, functions, brackets). Alternatively, press the shortcut of an entry key whereas the focus must **not** be on the dis-

play field. After the first entry, the display field is provided with the edit protection (gray background).

The entry must be completed as described under the classical operation mode.

**Calculating in the classic design:
Text entry**

In order to achieve the text entry design in the hybrid mode, the focus must be set into the display field. The first modification of the text by editing changes the calculator's design. Afterwards, all entry keys will be disabled.

The entry must be completed as described under the text output operation mode.

Calculating result

Click on the result key ("="). You can also use the <Return> key, the <Enter> key or the shortcut <=>.

Working with RAM

General information on the memory

By means of the memory, numbers from the display can be buffered in all operation modes and called for further use.

The content of the memory is neither influenced by closing the "Calculations and Tables" dialog nor by a reset.

Whether the memory is currently containing a number can be detected from an "M" in the status display.

Using the memory

You can work with the memory as follows:

- In order to save a displayed number click on "MS".
- In order to call a saved number back into the display, click on "MR".
- The memory is deleted using "MR".
- In order to add a displayed number to the number in the memory, click on "M+". Using "MR", the achieved sum can be displayed.

10.7.3 Taper calculations

Overview

Tasks

Taper calculations are often necessary in turning.

The following tasks can be solved using this calculation form:

- Conversion between the taper relation and the setting angle (half taper angle) in both directions
- Calculation of the diameters at the taper ends with given taper relation/setting angle

Layout

The form for taper calculations can be found on the "Taper" tab.

The form provides editable text fields for the numerical values. Behind the text fields that are in the fore and can be considered for a value transfer, buttons for copying purposes are located.

Calculations and Tables

Calculator **Taper** Toleranced dimension Size Thread Polar

Diagram: A tapered cylinder with top diameter $D2$, bottom diameter $D1$, length L , and taper angle $\alpha/2$. The taper relation is $1:X$.

Fields and values:

- Taper relation (X):
- Setting angle ($\alpha/2$) [$^\circ$]:
- Taper length (L):
- Small diameter (D1):
- Large diameter (D2):

Buffer: 11.6

Fig. 10-26: Form for taper calculations

Performing taper calculations

Converting taper per unit in angle

If the taper relation is given, then you can calculate the setting angle. The numerical value X must be entered into the first text field ($X > 0$). Alternatively to a number, you can also specify an expression (see [Syntax for expressions](#)) or a standardized taper relation.

Standardized taper relations:

- Morse tapers MK0, MK1, MK2, MK3, MK4, MK5 and MK6
- Steep tapers SK30, SK40, SK50 and SK60

Using the return key or by changing the focus, you can initiate the calculation. The setting angle is displayed in the two text fields located below in $^\circ$, as decimal figure as well as in arc minutes and arc seconds.

Converting angle in taper per unit

If you want to determine the taper relation from a setting angle, you must enter the setting angle ($0 < \alpha/2 < 90^\circ$) in the second or third text field, depending on the question whether the angle is specified decimally or in degrees, minutes and seconds. The entry field for the decimal specification also accepts an expression.

After the calculation that can be initiated using the return key or by changing the focus, the taper relation will be shown in the first text field.

Determining big diameter

To determine the large diameter $D2$, the taper relation or the setting angle have to be entered, as have the taper length and the small diameter. The order is of no importance. If the focus leaves the field of the last entry or if return is pressed after the last entry, the large diameter can be seen from the last text field.

Determining small diameter To determine the large diameter D1, taper relation/setting angle and the taper length have to be specified in any order. Finally, the large diameter D2 is entered. If afterwards, the focus leaves the entry field and/or if now, the return key is pressed, the small diameter will appear in the last but one text field.

Errors

Error causes	Errors are caused in the entry of values and/or expressions. The following causes can be considered: • Inadmissible mathematical operations • Syntax error • Exceedance of a value range
Error display	In the lower part of the form, an error message is displayed, either with reference to the violated value range or as format error. The focus is automatically reset to the faulty entry field.
Error recovery	Using the <Esc> key, you can reject the latest entry or edit the entry field specified in the error message.

10.7.4 Toleranced dimension table

Overview

Tasks	The toleranced dimension table allows for the determination of an allowance for a given nominal size and the tolerance field as it can be found as measure in a drawing. The table is based on the preference tolerances from DIN ISO 286 and/or DIN 7154 and DIN 7155 for the hole basis system and/or the shaft basis system in the nominal size range from 1 to 500 mm. The following allowances (in mm) are shown: • Upper deviation • Medium allowance • Lower deviation
Layout	The form for the toleranced dimension table is located on the "Toleranced dimension" tab.

Calculations and Tables

Calculator Taper Toleranced dimension Size Thread Polar

Preference tolerances acc. to DIN ISO 286

[mm]

Nominal size (D) and tolerance field: 50 j6

Upper allowance (U): 50.011 Copy

Medium allowance (M): 50.003 Copy

Lower allowance (L): 49.995 Copy

Buffer: 50.003

OK Cancel Help

Fig. 10-27: Form for using the tolerance dimension table

Preference tolerances

The following tolerance fields are listed for shafts:

a11, c11, d9, e8, f7, f8, g6, h5, h6, h9, h11, j6, k6, n5, m6, n6, r5, r6, s6, s8, u8, x8, and x11.

The following tolerance fields are listed for holes:

A11, C11, D10, E9, F7, F8, G6, G7, H6, H7, H8, H11, J6, J7, K7, M6, M7, N6, N7, P6, R7, S7, X9 and X11.

Finding an allowance**Entering nominal size and tolerance field**

Enter the nominal size followed by the tolerance field. In this connection, spaces are admissible. Expressions are not allowed.

Example:

Allowances for a boring: 60 H6

Allowances for a shaft: 22.5 f8

Using the return key or by changing the focus, the determination of the allowance is initiated.

Transferring the allowance

Select one of the three listed allowances and press "Copy".

Errors**Error causes**

The following causes in the entry can be considered:

- Invalid specification
- Nominal size outside the range from 1 to 500 mm

- You have tried to determine a non-preference tolerance

Error display

With all error causes, a uniform error message is displayed in the lower part of the form. The focus is automatically reset to the entry field.

Debugging

Using the <Esc> key, you can reject the latest entry or edit the entry field.

10.7.5 Circumferential calculations

Overview

Tasks

The circumferential calculation is most often used for programming radial processing types if programming takes place in a coordinate system to be transformed - here the unwinding - and the positions on the circumference are available as angles. With a given reference diameter (unwinding diameter), you can fulfill the following tasks:

- Conversion of an angular pitch into a circumferential coordinate
- Conversion of a circumferential coordinate into an angular pitch

Layout

The form for circumferential calculations is located on the tab labeled with "Circumference".

The form provides editable text fields for the numerical values. Behind the text fields that are in the fore and can be considered for a value transfer, buttons for copying purposes are located.

The screenshot shows a software window titled "Calculations and Tables" with a close button (X) in the top right corner. It contains several tabs: "Calculator", "Taper", "Toleranced dimension", "Size" (which is selected and highlighted in yellow), "Thread", and "Polar" with left and right arrow buttons. The "Size" tab displays a diagram of a cylinder with a diameter D and an angle α on its circular face. Below the diagram is a rectangular block with a vertical dimension Y . To the right of the diagram are three input fields: "Reference diameter (D):" with the value "50", "Angle (α) [°]:" with the value "60", and "Circumference coordinate (Y):" with the value "26.17994". Each input field has a "Copy" button to its right. At the bottom left of the dialog, the text "Buffer: 26.17994" is displayed. At the bottom right, there are three buttons: "OK", "Cancel", and "Help".

Fig. 10-28: Form for circumference calculations

Performing circumference calculations

Calculating the circumferential coordinate	For calculating the circumferential coordinate, the reference diameter and the angular pitch must be entered in any order. Mathematical expressions are allowed in every entry field (see Syntax for expressions). If the focus leaves the field of the last entry or if return is pressed after the last entry, the circumferential coordinate can be seen from the last text box.
Calculating the angle	If the angular pitch is to be determined, enter the reference diameter and the circumferential coordinate into the corresponding fields in any order. If the focus leaves the field of the last entry or if return is pressed after the last entry, the related angle can be seen from the central text field.

Errors

Error causes	Errors are caused in the entry. The following causes can be considered: • Inadmissible mathematical operations • Syntax error
Error display	In case of an error, an error message is displayed in the lower part of the form referring to a format error. The focus is automatically reset to the faulty entry field.
Debugging	Using the <Esc> key, you can reject the latest entry or edit the entry field specified in the error message.

10.7.6 Thread table

Overview

Tasks	The thread table makes almost all thread dimensions available whereas different types of cylindrical threads have been considered. The table supports you in: • The programming of thread cutting processes (external/internal) • The programming of tapping • The determination of the pre-drilling diameter • The description of a thread cutting tool for the simulation The thread table only returns length dimensions in mm.
Layout	The tab for the thread table is labeled with "Thread". The form provides combo and text boxes for the thread selection. Behind the text fields that are in the fore and can be considered for a value transfer, buttons for copying purposes are located.

Calculations and Tables

Calculator Taper Toleranced dimension Size **Thread** Polar

[mm]

Nut

60°

Bolt

Thread type: Metric ISO fine thread DIN 13

Thread size: M24x1.5

Nominal diameter (D): 24

Pitch(P): 1.5

Core diameter (D1): 22.376

Core diameter (d3): 22.16

Depth of thread (H1): 0.812

Depth of thread (h3): 0.92

Pre-drilling diameter: 22.5

Rounding (R): 0.217

OK Cancel Help

Fig. 10-29: Form for thread table



If the thread table form is displayed without "Copy" keys, all relevant thread dimensions in the calling dialog will be entered at the corresponding positions using the "OK" key.

Finding thread parameters

Standardized thread

Finding the information on a standardized thread that is listed in the table:

1. Select the thread type in the upper combo box.
2. Select the thread size in the upper combo box.
3. Take the desired dimensions from the boxes located below. The "--" display means that the information concerned is not available in the table.

Special threads

If a thread is not in the table, proceed as follows:

1. Select the thread type in the upper combo box.
2. Enter the nominal/external diameter. Here, expressions are allowed (see [Syntax for expressions](#)).
3. Enter the pitch. Expressions are allowed.
4. Take the desired dimensions from the boxes located below. The "--" display means that the information concerned is not available in the table and/or that the information cannot be calculated from the thread dimensions.

Errors

Error causes

Errors are caused in the entry of values and/or expressions.

The following causes can be considered:

- Inadmissible mathematical operations
- Syntax error
- The exceedance of a value range ($P \leq 0$, $D \leq 0$)

Error display An error field is displayed. The focus is automatically reset to the faulty entry field.

Debugging Using the <Esc> key, you can reject the latest entry or edit the entry field specified in the error message.

10.7.7 Polar coordinates

Overview

Tasks The "Polar coordinates" tab supports you in the calculation of chamfers and/or not axially parallel paths or other coordinates (e.g. centers of circles) if the Cartesian coordinates are not given. Apart from that, distances between points and the ascent angle of a straight line through two given points can be determined.

This calculation form covers the following tasks:

- Calculation of the Cartesian coordinates of a point from its polar coordinates (radius and angle)
- Calculation of the polar coordinates of a point from its Cartesian coordinates
- Calculation of a polar coordinate and a Cartesian coordinate if one polar coordinate and one Cartesian coordinate are given

In all calculations, the location of the pole (origin of the polar coordinate system) is regarded as being given in Cartesian coordinates.

Layout The form for the calculations of the working values can be found on the "Polar c." tab.

The form provides editable text fields for the numerical values. Behind the text fields that are in the fore and can be considered for a value transfer, buttons for copying purposes are located. The pushbuttons labeled ">>" and "<<" allow for switching between the specification in absolute Cartesian coordinates and increments. By checking the box in front of "Turning", you activate the turning coordinate system with the vertical axis in the diameter unit.

Calculations and Tables

Taper Toleranced dimension Size Thread **Polar c.** F, S

Horizontal pole (Xp): 20

Vertical pole (Yp): 40

Angle coordinate (ϕ): 305.68533 Copy

Radius (R): 60 Copy

Horizontal Cartesian (Xk): 55 Copy

Vertical Cartesian (Yk): -8.73397 Copy

☒ Turning

Buffer: -8.73397

Another Solution

OK Cancel Help

Fig. 10-30: Polar coordinates form

Conversion between Cartesian and polar coordinates

Calculating Cartesian coordinates

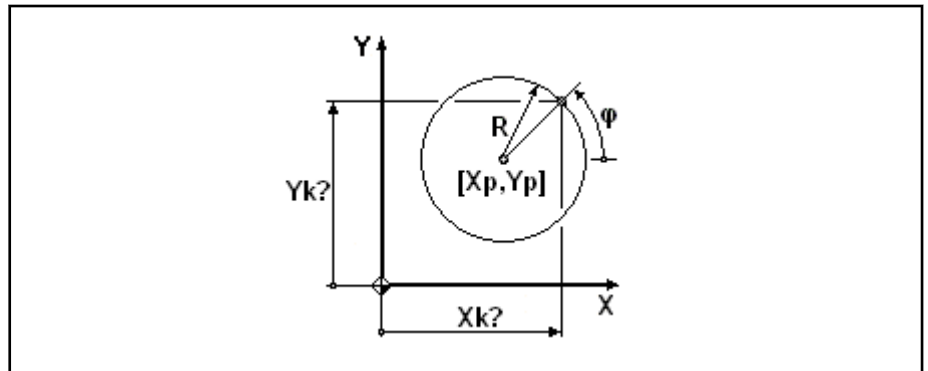


Fig. 10-31: Calculating Cartesian coordinates from polar coordinates

You can calculate the Cartesian coordinates from the polar coordinates as follows:

1. Ensure that the coordinate system on which your calculation is based is activated. For diameter programming check "Turning".
2. Enter the pole coordinates. As in all entry fields, expressions are allowed (see [Syntax for expressions](#)).
3. Enter the angle coordinate and the radius in the provided fields. The order of the entry is of no importance.
4. Initiate the calculation using the return key or by changing the focus.

Extended functionality

Calculating polar coordinates

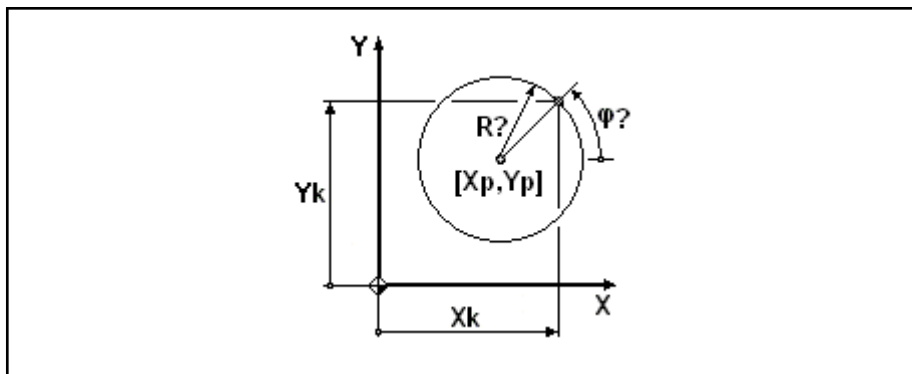


Fig. 10-32: Calculation of polar coordinates from Cartesian coordinates

You can calculate the polar coordinates from Cartesian coordinates as follows:

1. Ensure that the coordinate system on which your calculation is based is activated. For diameter programming check "Turning".
2. Enter the pole coordinates. As in all entry fields, expressions are allowed.
3. Enter the horizontal and the vertical Cartesian coordinates in any order. If only the distance of the point to the pole is known, activate ">>" in order to switch over to the incremental entry. Enter the distance with sign and always as radius dimension.
4. Initiate the calculation using the return key or by changing the focus.

Trigonometric calculations

Calculating a Cartesian coordinate and the radius

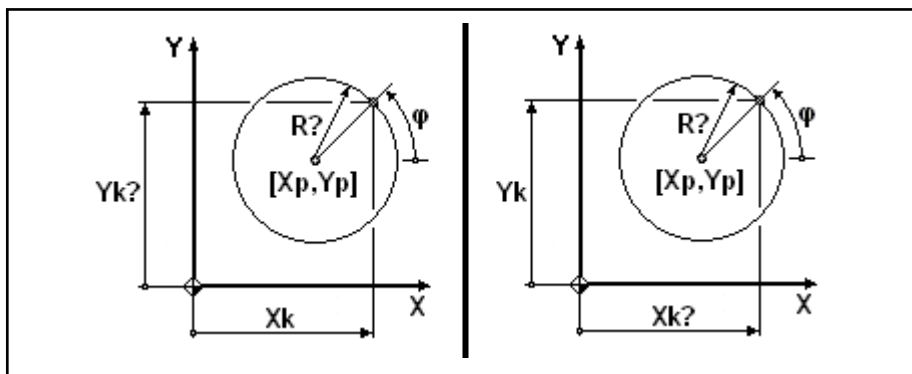


Fig. 10-33: Calculating a Cartesian coordinate and the radius

The specified calculation from an angle coordinate or a Cartesian coordinate is performed as follows:

1. Ensure that the coordinate system on which your calculation is based is activated. For diameter programming check "Turning".
2. Enter the pole coordinates. As in all entry fields, expressions are allowed (see [Syntax for expressions](#)).
3. Enter the angle coordinate in the provided field.
4. Enter the given horizontal and/or vertical Cartesian coordinate. If only the distance of the point to the pole is known, activate ">>" in order to switch over to the incremental entry. Enter the distance with sign and always as radius dimension.
5. Initiate the calculation using the return key or by changing the focus.

Calculating a Cartesian coordinate and the angle coordinate

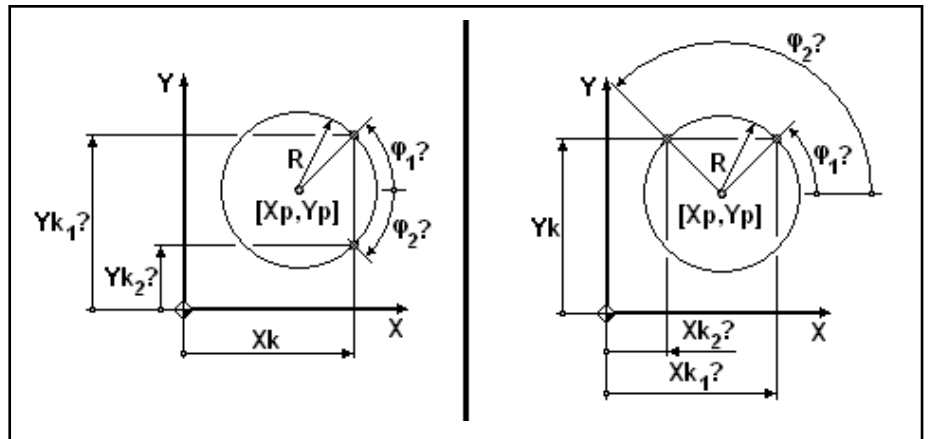


Fig. 10-34: Calculation of a Cartesian coordinate and the angle coordinate

The specified calculation from a radius and a Cartesian coordinate is performed as follows:

1. Ensure that the coordinate system on which your calculation is based is activated. For diameter programming check "Turning".
2. Enter the pole coordinates. As in all entry fields, expressions are allowed.
3. Enter the radius in the provided field.
4. Enter the given horizontal and/or vertical Cartesian coordinate. If only the distance of the point to the pole is known, activate ">>" in order to switch over to the incremental entry. Enter the distance with sign and always as radius dimension.
5. Initiate the calculation using the return key or by changing the focus.
6. In this task, there are usually two solutions. By activating the "Another solution" pushbutton, switch over to the desired one, if necessary.

Errors

Error causes	The following error causes can be considered: • Inadmissible mathematical operations • Syntax error • Exceedance of a value range • The entry values do not allow for the geometric calculation
Error display	In the bottom left corner of the form, an error message with the corresponding reference to the error cause is displayed. In value range and format errors, the focus is automatically reset into the field of the latest entry.
Debugging	Using the <Esc> key, you can reject the latest entry or edit the entry field specified in the error message. If the error has occurred in the geometric calculation, the error can also be removed by changing another entry field.



An error state in the geometric calculation may occur more often in repeated calculations of identical tasks after the first given parameter of the next calculation has been recorded. The interim condition before completion of all new entries can hardly be avoided and gives no cause for concern.

10.7.8 Calculations on speed and feed

Overview

Tasks Calculations on speed and feed, shortly called working values, are very often necessary in the part programming with machining, particularly if working values are taken from tables and must be converted to the respective situation. This calculation form covers the following tasks:

- Conversion between cutting velocity and speed with known diameter in both directions
- Conversion between feed velocity and feed per tooth and/or rotation with known speed in both directions
- Conversion of operate values between the metric and the Anglo-American metric system

Layout The form for the calculations of the working values can be found on the "F,S" tab.

The form provides editable text fields for the numerical values. Behind the text fields that are in the fore and can be considered for a value transfer, buttons for copying purposes are located.

Fig. 10-35: Form for calculations on speed and feed

Calculating the cutting velocity/speed

Calculating speed The speed can be calculated as follows:

1. Ensure that the metric system suitable for your entries is active. For the Anglo-American metric system, "Metric system Inch" must be checked.

2. Enter the diameter and the cutting velocity in the provided fields. In this connection, expressions are allowed (see [Syntax for expressions](#)). The order of the entry is of no importance.
3. Initiate the calculation using the return key or by changing the focus.
4. If conversion into the other metric system is necessary, activate "Metric system Inch".

Calculating cutting velocity

The cutting velocity can be calculated as follows:

1. Ensure that the metric system suitable for your entries is active. For the Anglo-American metric system, "Metric system Inch" must be checked.
2. Enter the diameter and the speed in the provided fields. In this connection, expressions are allowed. The order of the entry is of no importance.
3. Initiate the calculation using the return key or by changing the focus.
4. If conversion into the other metric system is necessary, activate "Metric system Inch".

Feed calculations**Calculating the feed**

The feed can be calculated as follows:

1. Ensure that the metric system suitable for your entries is active. For the Anglo-American metric system, "Metric system Inch" must be checked.
2. Enter the speed. If the speed is not known, it is to be calculated from the cutting velocity. Refer to [Calculating the cutting velocity/speed](#).
3. Enter the number of teeth 1 if you want to get the feed per rotation; otherwise, enter the number of teeth of the tool.
4. Enter the feed speed.
5. Initiate the calculation using the return key or by changing the focus.
6. If conversion into the other metric system is necessary, activate "Metric system Inch".

Calculating feed velocity

The feed speed can be calculated as follows:

1. Ensure that the metric system suitable for your entries is active. For the Anglo-American metric system, "Metric system Inch" must be checked.
2. Enter the speed. If the speed is not known, it is to be calculated from the cutting velocity. Refer to [Calculating the cutting velocity/speed](#).
3. Enter the number of teeth 1 if you know the feed per rotation; otherwise, enter the number of teeth of the tool.
4. Enter the feed.
5. Initiate the calculation using the return key or by changing the focus.
6. If conversion into the other metric system is necessary, activate "Metric system Inch".

Errors**Error causes**

Errors are caused in the entry of values and/or expressions. The following causes can be considered:

- Inadmissible mathematical operations
- Syntax error
- Exceedance of a value range

- Error display** In the lower part of the form, an error message is displayed, either with reference to the violated value range or as format error. The focus is automatically reset to the faulty entry field.
- Debugging** Using the <Esc> key, you can reject the latest entry or edit the entry field specified in the error message.

11 NC program encryption

11.1 Overview

The NC program encryption is intended to protect technological knowledge against unauthorized access.

The user can make cycles, part programs or subroutines unreadable via an encryption mechanism.

The original text has to be backed up as unencrypted version outside the NC file system to remain available for the author.

It is encrypted outside the control system via a program sent upon delivery.

After loading the encrypted data to the control after the encryption, they are invisibly decrypted during processing.

The encryption program allows implicitly to provide the data with a copy protection. In this case, the encrypted NC programs can only be processed on the selected control.

Furthermore, an encryption comment can be entered during the encryption which can then be displayed in the operating area Programs in the file property dialog to re-identify the encrypted program.



An emulation is required to process encrypted programs.

The NC program compiler function has to be disabled.

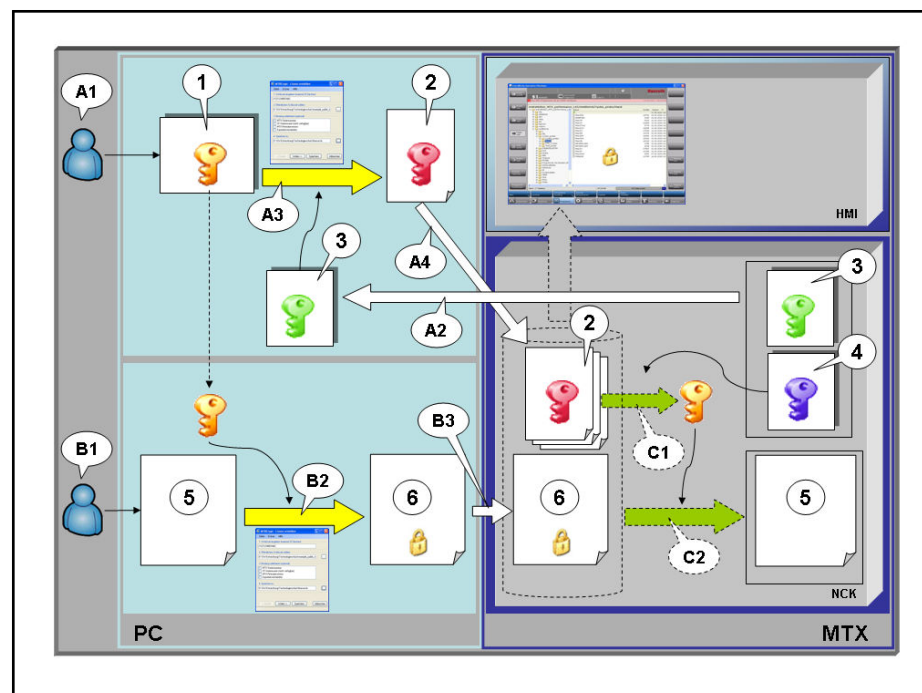
11.2 Basic procedure

[fig. 11-1 "Principle of program decryption" on page 300](#) shows the basic procedure of a program encryption.

Two steps are required to prepare the program encryption:

1. Generating the key **(A)** (one time only)
2. Program encryption **(B)**

NC program encryption



- A1 First step of key generation: Generating the SK
 A2 Second step of key generation: Transmitting the PK to the PC
 A3 Third step of key generation: Generating the CK
 A4 Fourth step of key generation: Transmitting the CK to the control
 B1 First step of program encryption: Generating the NC program
 B2 Second step of program encryption: Encrypting the NC program
 B3 Third step of program encryption: Transferring the encrypted NC program to the control
 C1 internal decryption of CK
 C2 internal decryption of NC program
 1 symmetric key (SK)
 2 coded key (CK) - Multiple storage possible
 3 public key (PK)
 4 private key
 5 unencrypted or decrypted NC program
 6 encrypted NC program

Fig. 11-1: Principle of program encryption

The programs are stored in the result as encrypted files in the file system. They are coded with a symmetric code. The symmetric code is also stored as file in the file system of the control. It was coded with an asymmetric procedure.

Generation and transfer of the coded key are unique.

NC programs have to be encrypted and transferred for each program.

11.3 Operating the encryption program

The encryption program provided upon delivery can be installed separately on any PC.

The user can thus generate a coded key as well as encrypt NC program parts to be protected.

Both encryption results have to be subsequently transferred from this PC to the control.

Apart from the optional use of the copy protection, the generation of the coded key is unique.

However, the encryption of NC programs can be required multiple times (depending on the processing stage).

It is also possible to store multiple coded keys in the control.

Opening the encryption program

Call the encryption program via the start menu **Programs** ► **Rexroth** ► **IndraWorks...** ► **MTXTools** ► **FileEncryption**.

Key generation

The second tab in the dialog for program encryption is used to generate the coded key in the control.

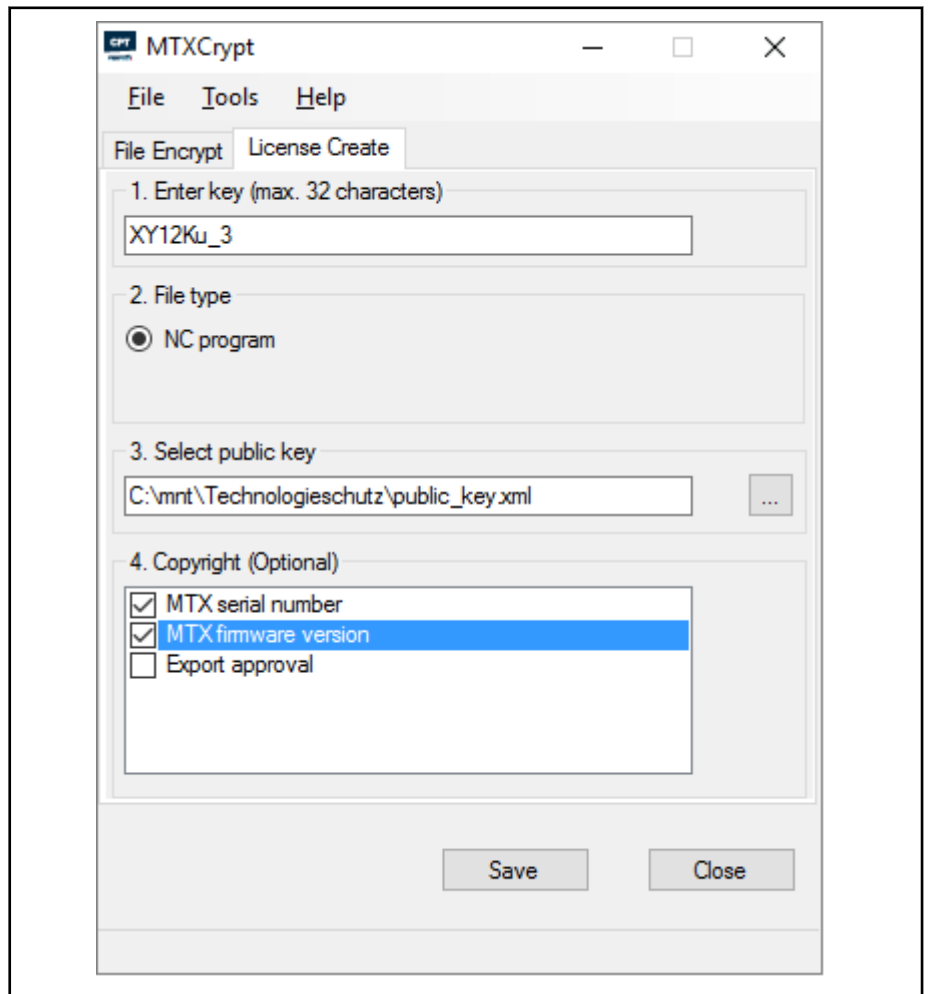


Fig. 11-2: Dialog for the key generation

Proceed as follows to generate a coded key:

1. Generate a symmetric key as password with up to 32 characters.
You are responsible for managing multiply-defined keys.
refer to [fig. 11-1 "Principle of program decryption" on page 300 \(A1\)](#)
2. Define the storage location of the public key the user read out from the control.
The public key is a file with the name "public_key.xml" in the "root" directory of the control.

NC program encryption

refer to [fig. 11-1 "Principle of program decryption" on page 300](#) (A2)

3. Optional definition of copy protection bindings.
4. Define the storage location for the coded key on the PC.
5. Generate and store the coded key on the PC.

refer to [fig. 11-1 "Principle of program decryption" on page 300](#) (A3)

6. Transfer the coded key to the control.

The coded key is a file with any file name and the extension ".lic". The file has to be stored in the control directory "root" or in "usrfep".



Multiple different keys can be stored.

Search order in case of keys with identical file names: 1. "root" and 2. "usrfep".

refer to [fig. 11-1 "Principle of program decryption" on page 300](#) (A4)

7. Restart NC

The copy protection can be bound to:

- the serial number of the control
- the number of the CF card
- the MTX firmware version
- the export approval

Thus, the user can fixedly bind an NC Program to one or multiple machines. If the copy protection binding is abandoned, the encrypted NC program can be copied to other machines together with the coded key.

Program encryption

The first tab of the dialog is used for program encryption.

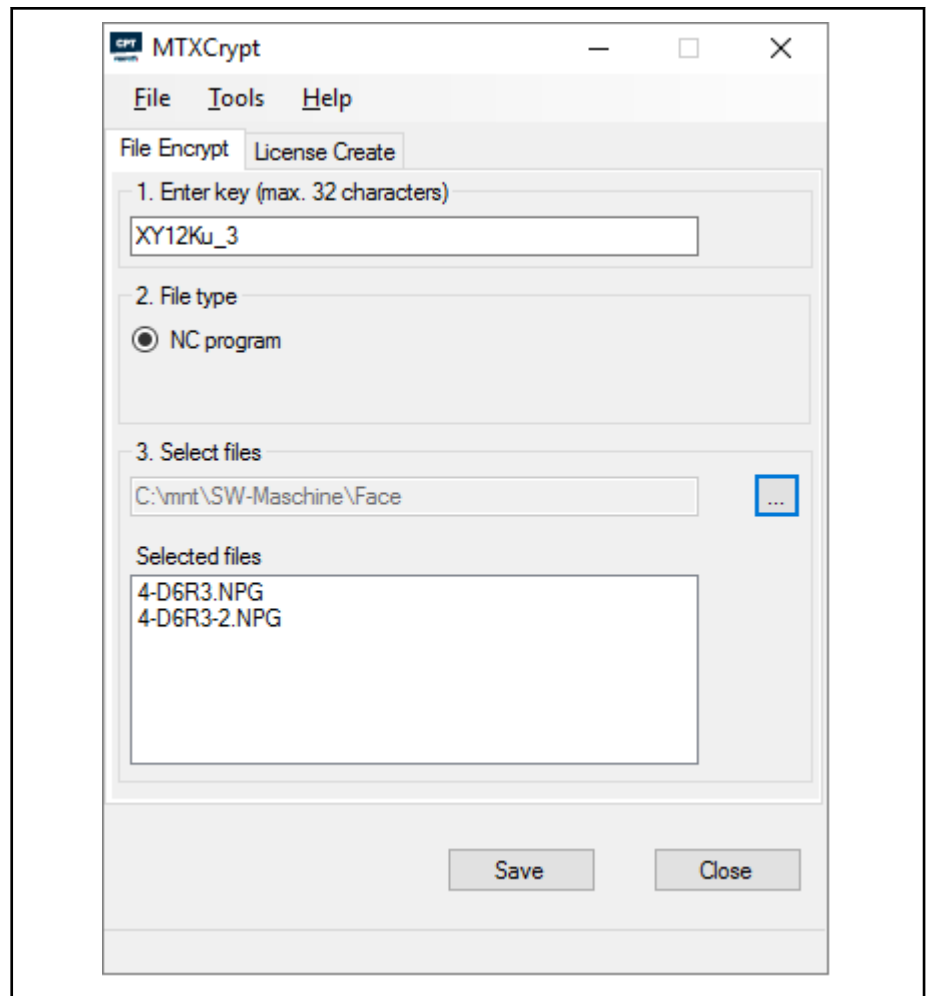


Fig. 11-3: Dialog for the program encryption

Proceed as follows when encrypting an NC program:

1. Create an NC program intended for encryption.
Define the storage location of the NC program.
refer to [fig. 11-1 "Principle of program decryption" on page 300 \(B1\)](#)
2. Enter the previously defined and already coded and stored symmetric key into the control.
3. Provide the storage location of the NC program to the encryption program using a "Find File" dialog.
Multiple times can be simultaneously provided for encryption.
4. Defining the storage location of the encrypted program on the PC.
5. Optionally, an encryption comment can be entered.
6. Generating and storing the encrypted program on the PC.
refer to [fig. 11-1 "Principle of program decryption" on page 300 \(B2\)](#)
7. Transferring the encrypted program to the control.
refer to [fig. 11-1 "Principle of program decryption" on page 300 \(B3\)](#)



An encrypted program can only be interpreted internally by the control using the private and the coded key.

There is no encryption possible on the PLC or the user interface.

The user is responsible for managing the unencrypted source programs.

Entering an encryption comment

After pressing <Save>, the dialog to enter an encryption comment is displayed.

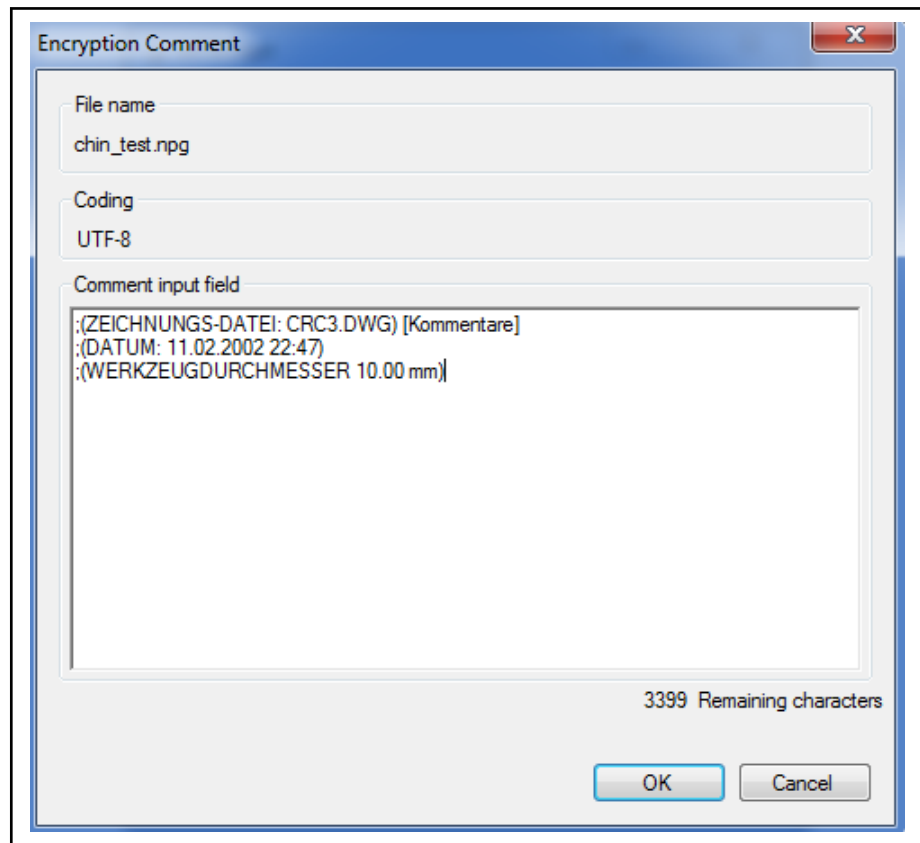


Fig. 11-4: Dialog to enter an encryption comment

The input is optional. Press <Cancel>, to cancel the encryption operation and to return to the calling page.

The checkbox in the lower part of the dialog window is only displayed if several programs have been selected for encryption. It also facilitates applying the encryption comment for all programs without calling this dialog again.



The first consecutive comment block in the NC program is a comment suggestion and can be changed within the framework of the visualized specifications.

11.4 Handling encrypted programs in the control

Encrypted programs are labeled in the file header and cannot neither be read in the user interface of the control nor on the PC.

When using encrypted programs, all visual applications of the control output a message that the program is not encrypted and cannot be displayed.

If an encrypted program is selected for processing without activating the corresponding key in the control, the following is displayed in the message line of the header "No valid key for encrypted file <PathName>".

The key has subsequently to be transferred to the control and the control has to be reset. (refer to [chapter 11.3 "Operating the encryption program" on page 300](#))

11.5 Displaying the encryption comment

In the "Program" operating area, an encryption comment entered during the encryption can be displayed via the file property dialog in the MTX Navigator.

Opening the encryption comment

1. <OP4>"Program"
2. Searching and selecting the encrypted program in the list display of the MTX Navigator
3. Opening the menu function **Properties...**
4. Selecting the display page **Additional information**

In the properties dialog, the comment defined in the encryption dialog is displayed.



If there is no encryption comment, the message "Encryption information could not be found!" is displayed.

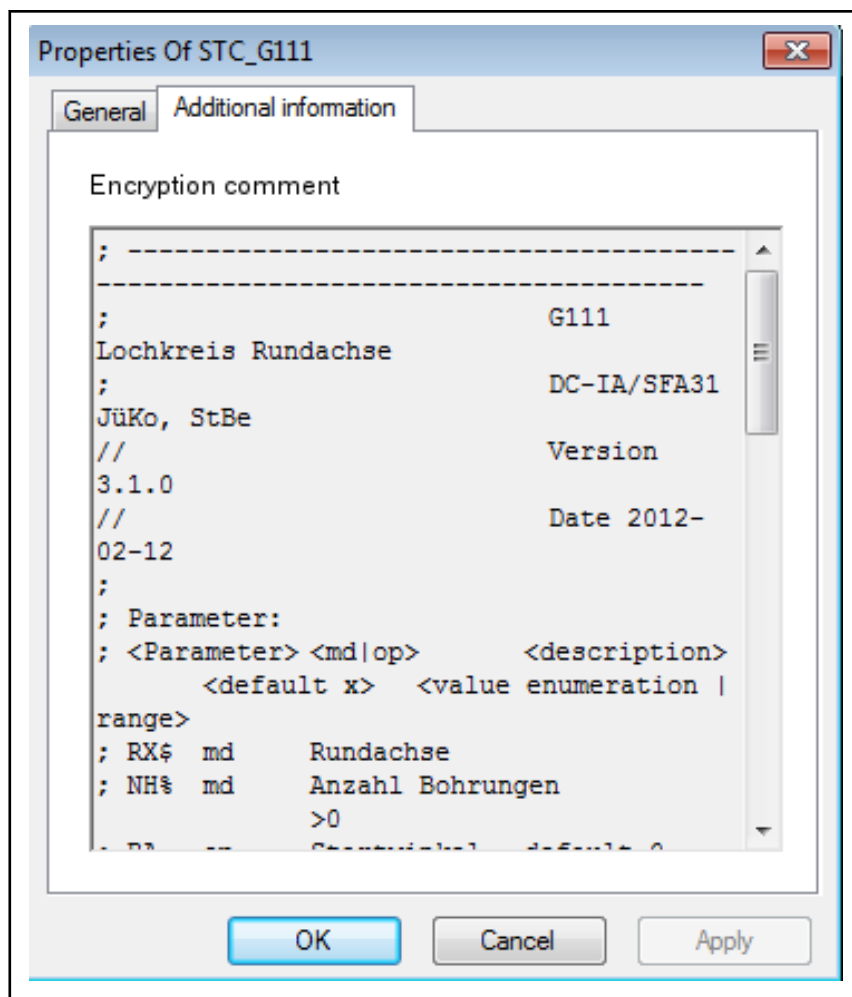


Fig. 11-5:

11.6 Language selection

Select another language via the menu **Tools ► Language**. The active language is labeled in the selection menu.

12 DXF import

12.1 Application

The DXF import can automatically convert the contour of a workpiece from an AutoCAD drawing in DXF format to NC code. The generated contour description is saved in an NPG file and can be directly used in the MTX control. The DXF import compiles the selected contour to the widespread DIN 66025 blocks (G-code).



The DXF import supports the DXF files up to the version AC1021. This corresponds to the AutoCAD release 2007/08.

The present documentation is intended to simplify the contour extraction from a DXF file. The chapter is structured to represent the consecutive required machining steps.

1. Loading DXF file
2. Defining basic settings
3. **Optional:** Display optimization
4. Determining the coordinate reference point
5. Selecting contour with starting point definition
6. Generating NC code (acc. to DIN 66025) and backing up the result file



Only one NC code can be generated for a coherent contour using this operating sequence.



The program supports the NC technologies turning and milling. The following basic elements can be selected as contour from the DXF format:

- LINE (straight line)
- CIRCLE (full circle)
- ARC (arc)

These three primitives completely define the geometry of a workpiece in all technical drawings.

12.2 Opening the DXF file

There are different ways to open the DXF file. Depending on the operating type, the following variants are available:

- Via the menu items **File ► Open**
- Via the shortcut <CTRL+O>
- Via the toolbar
- Via the F-key <F2> "Open"

Each of the listed operating actions calls the same dialog used to select the corresponding file.

After loading the file, its content is graphically displayed on the screen (see [chapter 12.2 "Opening the DXF file" on page 307](#)).



Fig. 12-1: DXF drawing

12.3 Basic settings

To define the basic settings of the DXF import, open the following dialog.

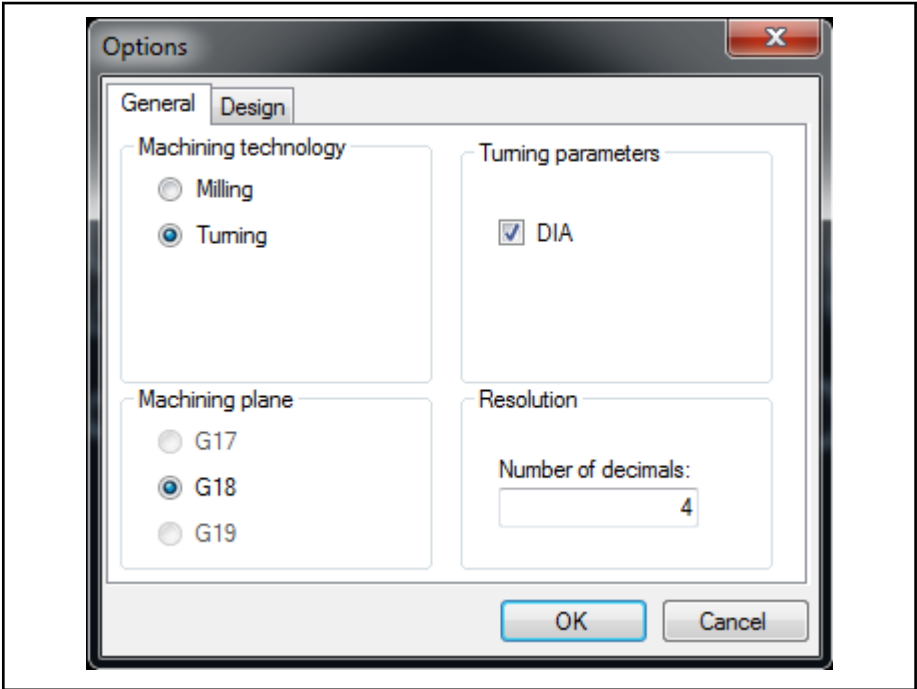


Fig. 12-2: Dialog to define the basic settings

The following settings can be made in this dialog:

Process parameter	Parameters	Remarks
Machining technology	Milling	
	Turning	

Process parameter	Parameters	Remarks
Machining plane	G17	
	G18	Fixedly set when turning
	G19	
Turning parameters	DIA: Yes/No	Diameter machining Only permitted for turning
Resolution	Number of decimal places	
Background color of the drawing level		
F-keypad	Display: Yes/No	
The dialog can be called:		
• Via <F3> "Settings" • Via the menu items Tools ► Options		

12.4 Optimizing representation

Different functions to optimize the representation are available for a fast and simple contour selection.

Setting the layer

In addition to the workpiece geometry, the DXF drawings contain several elements that are not required for the contour selection such as dimensionings, tables and labels. The DXF import can hide unimportant information on the layer setting.



The layer is selected with regard to the creator of the drawing.

- Via the menu items **View ► Select Plane** or
- press <F7> "Select Plane"

to display the active layers of the drawing and to select them.

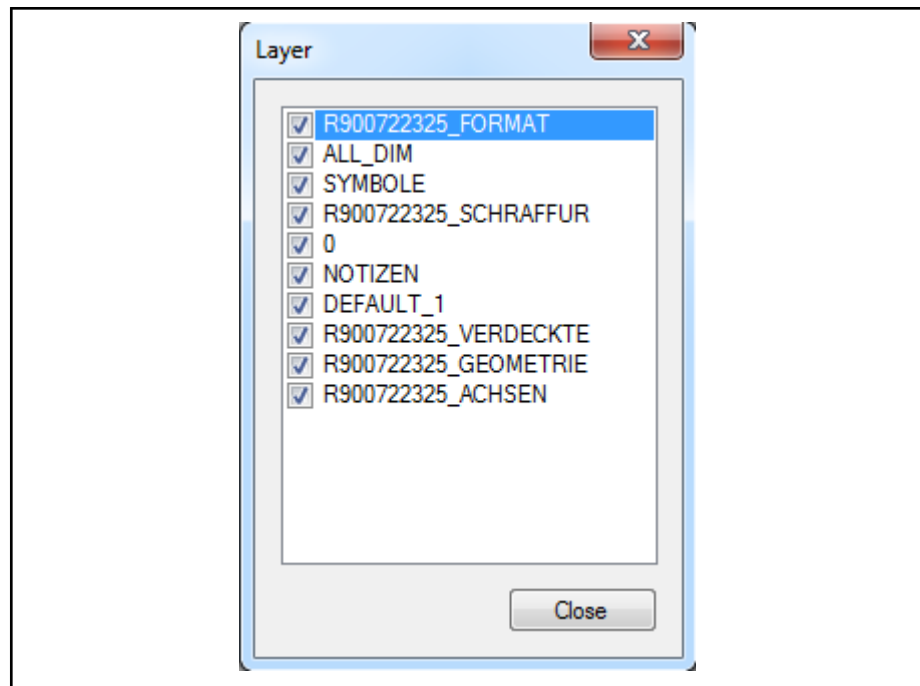


Fig. 12-3: Dialog: Level



The layers can be shown or hidden by selecting their names in the open window. The representation is automatically updated in the background.

Showing and hiding dimensioning

If the drawing has a dimensioning level, it can be shown or hidden via the toolbar button <Show/Hide Dimensioning>.

Zoom

The zoom function is used to freely scale the drawing. This function can be accessed as follows:

- Via the menu items **View ► Zoom In** or **Zoom Out**,
- Via the toolbar button <Zoom in> <Zoom out>
- Press the <+> key to zoom in and <-> to zoom out
- Use the F-key shortcut <F5> "View" and then <F5> "Zoom in" or <F6> "Zoom out" or
- Via the mouse wheel



Note that the scaling of the image refers to the center point of the window. The current cursor position is the reference point for the zoom function when using the mouse wheel. In case of the "Keyboard Navigation", the scaling also refers to the position of the mouse pointer.

Displacing

To improve the editing of a selected part of the drawing, the image area can be moved in any direction. This can be performed as follows:

- Cursor keys <Up>, <Down>, <Left>, <Right>
- Right-click and move it with the mouse



Keep the right mouse button pressed. Move the image area in the selected direction at the same time. The activation of the moving function is displayed via a cursor as long as the right mouse button is pressed.

Adjusting window This function allows to perfectly adjust the window section to the original size of the drawing.

The function can be called as follows:

- Use the F-key shortcut <F5> "View" and then <F4> "Adjust Window"
- Via the menu items **View ► Adjust Window**
- Via the shortcut <CTRL> and <F>
- Via the toolbar button <Adjust Windows>

Coordinate window The "coordinate window" function is intended to display and change the coordinates of each contour element. Thus, small errors and inadequacies in the drawing can be corrected using this function.

The display dialog can be used to show and hide the following operating actions:

- <F6> "Coordinate Window"
- Menu items **View ► Coordinate Window**
- Toolbar button <Coordinate Window>

After calling the function for the first time, the following dialog is displayed indicating that an element has to be selected.

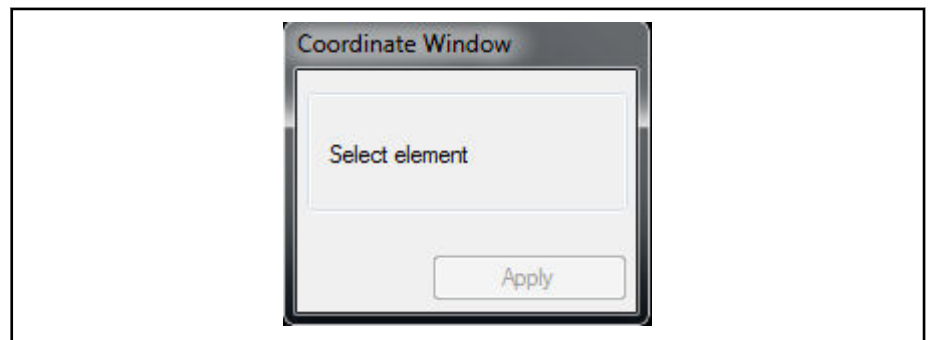


Fig. 12-4: Select element

Depending on the type of the selected element, the following window types are displayed:

- Element type "Line"

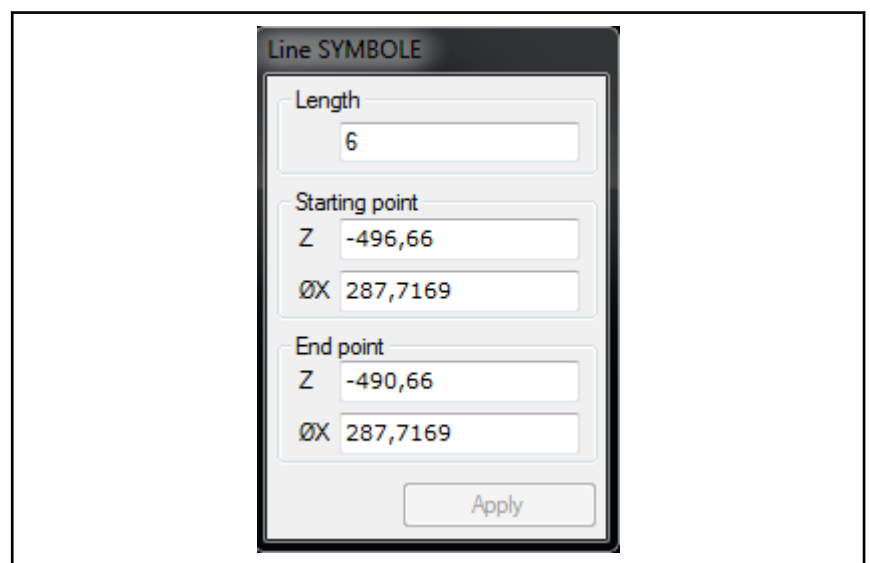


Fig. 12-5: Coordinate window "Line"

- Element type "Circle"

Fig. 12-6: Coordinate window "Circle"

- Element type "Arc"

Fig. 12-7: Coordinate window "Arc"

Deleting irrelevant drawing elements

Use either the function **Part Element Selection** or **Selection of Elements** to highlight irrelevant drawing elements for the contour definition and to subsequently delete them via <Del>.



Deleted elements can only be restored by reloading the file.

12.5 Determining the coordinate reference point

Defining coordinate reference point

The coordinate reference point can be newly determined as follows:

- Use the F-key shortcut <F4> "Edit" and then <F4> "Coordinate system" and <F3> "Define Zero Point"
- Via the menu items **Edit ► Coordinate System ► Define Zero Point**
- Via the toolbar button <Define zero point>

It can be implemented as follows:

Starting point element	The starting point of the selected element is the new reference point
End point element	The end point of the selected element is the new reference point
Center point element	The center point of the selected element is the new reference point
Mouse position	The new reference point is set to the current mouse cursor position.
Intersection element	The next intersection of the selected element is the new reference point
Point entry	A dialog to enter the coordinates of the new reference point is called.



If all contour elements are very close to each other, use the zoom function.

To reset the reference point (corresponds to the zero point of the drawing), use the "Default Start Point" function.

The "Zero Point Definition" remains active until it is replaced by calling another function.

Resetting coordinate reference point

Use this function to reset the coordinate reference point to the position defined in the drawing.

This function can be called via the following operating actions:

- Use the F-key shortcut <F4> "Edit" and then <F4> "Coordinate System" or <F4> "Reset Starting Point"
- Via the menu items **Edit ► Coordinate System ► Reset Zero Point**
- Via the toolbar button <Reset zero point>

12.6 Determining the starting point of the contour

The determination of the starting point of the contour defines the starting position of the contour machining.

Prerequisite: The determined contour starting point is a prerequisite to the automated generation of the NC code.



The contour starting point can be defined at any visible intersection of basic elements.

Determining starting point of contour

To determine the starting point of the contour, the "Set Contour Start Point" function has to be selected. This function can be accessed as follows:

- Via the menu items **Edit ► Contour**
- Via the toolbar

- Via <F4> "Edit", then <F3> "Contour" and <F4> "Set Cont. Start Point". When the function is enabled, the mouse pointer changes to a - cursor.



Select the contour starting point to allow a collision-free approach to the workpiece.

If all contour elements are very close to each other, use the zoom function.

If the contour starting point is to be reset, the selected point is to be selected again.

"Set Contour Start Point" remains enabled until it is replaced by calling another function.

12.7 Selecting the contour

12.7.1 General information

Selecting the basic drawing elements defines the contour for later processing. The DXF import provides different selection methods.

The determination of the starting point of the contour defines the starting position of the contour machining. The determined contour starting point is a prerequisite to generate the NC code.

12.7.2 Manual contour selection

The DXF import provides two options for the manual contour selection. The first option is to highlight a complete object. The second option allows the selection of partial lines and partial circles located between specified intersections.



Expand a selection area by keeping the left mouse button pressed. Elements completely located in this section are all subsequently highlighted.



If all contour elements are very close to each other, use the zoom function.

To deselect the selected contour element, select the selected object again.

The corresponding selection function remains active until it is replaced by calling another function.

The methods for the manual contour selection are called:

- Via the F-key shortcut <F4> "Edit" and then <F3> "Contour" or <F3> "Contour Selection"
- Via the menu items **Edit ► Contour ► Contour Selection**
- Via the toolbar button <Contour Selection>

Selecting complete elements

This variant is a default selection method. The objects saved in the DXF file as basic elements are selected.

This function is called via the subfunction **Selection of Elements**.



All visible elements as well as their parts between the intersections can be selected.

Note that:

- there are no gaps between contour elements (a selected contour has to be closed from the starting point to the end point).
- each contour element has exactly two neighboring elements. An exception occurs if it is the first or the last element of the defined contour.
- the determined contour starting point has to be in contact with one contour element.

Part element selection

Use the described function to select element parts not separately saved as drawing objects. The part element selection mode can be used to select the following possible parts of an object:

- Partial object between two intersections
- Partial object between one intersection and one end point of the same object

This function is called via the subfunction **Part Element Selection**.

Starting point definition

This function is used for the manual contour definition. In case of the automatic contour tracking, the starting point is determined at the beginning of the contour definition. The starting point can subsequently only be changed by resetting the contour definition.

This function can be called via the following operating actions:

- Via the F-key shortcut <F4> "Edit" and then <F3> "Contour" or <F4> "Define Contour Starting Point"
- Via the menu items **Edit ► Contour ► Define Contour Starting Point**
- Via the toolbar button <Define Contour Starting Point>

The contour starting point can be determined via the corresponding subfunctions **End Point Element** or **Starting Point Element** of a selected element.

12.7.3 Automatic contour tracking

When the contour is tracked, possible following elements of a selected contour element are provided to the operator.

This function can be called via the following operating actions:

- Via the F-key shortcut <F4> "Edit" and then <F3> "Contour" and <F3> "Contour Selection" and the corresponding subfunction <F5> "Start Contour Tracking, Left" or <F6> "Start Contour Tracking, Right"
- Via the toolbar button <Contour Tracking>

Proceed with the following steps:

1. Start contour tracking
2. Determine the direction of contour tracking. This defines the contour starting point automatically

The first contour element is selected and possible following elements are highlighted.

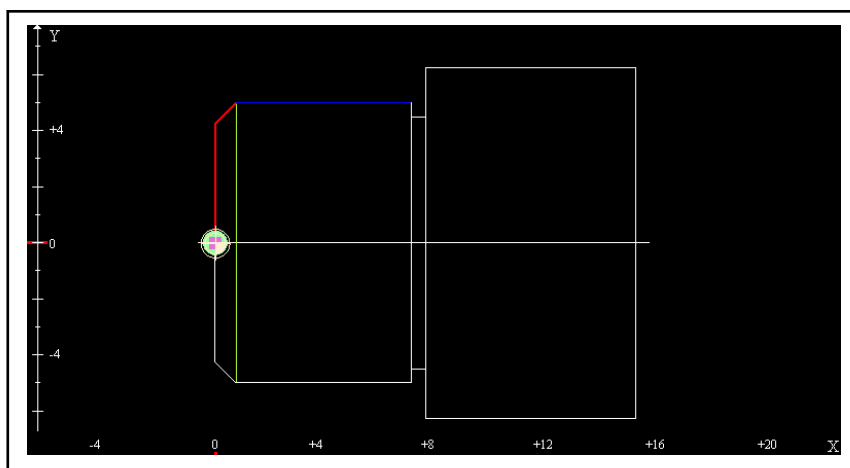


Fig. 12-8: Contour tracking

3. Select the following element

The next contour element is selected. This step can be repeated until all required elements are highlighted.

4. Stop the contour definition

The selected contour elements are presented as element chain. The contour definition is then completed.

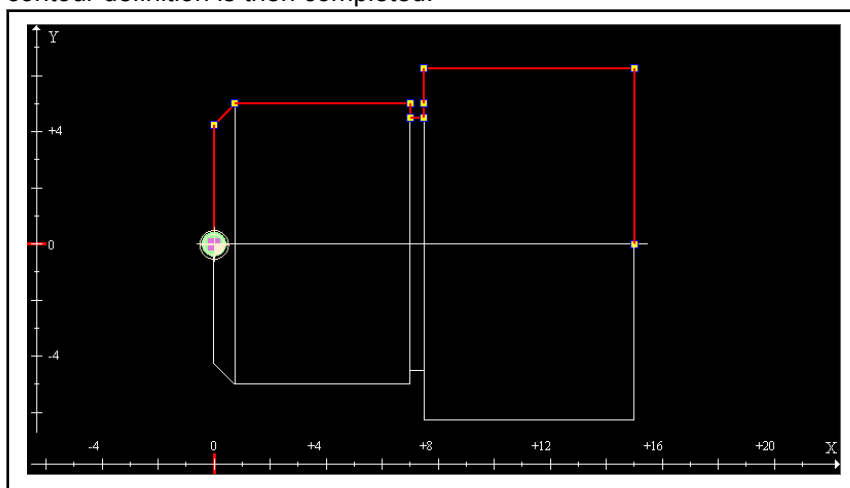


Fig. 12-9: Element chain

5. Start the DIN G-code generation

12.7.4 Resetting the contour

The function allows to reset the selected contour elements and can be called via the following operating actions:

- Via the F-key shortcut <F4> "Edit" and then <F3> "Contour" or <F5> "Reset Contour"
- Via the menu items **Edit** ► **Contour** ► **Reset Contour**
- Via the toolbar button <Reset contour>

12.8 Generating NC code

With the DXF import, the contour is compiled as NC blocks and these are saved in an NPG file.

Prerequisite:

- At least one contour element has to be selected.
- The contour starting point has to be determined.
- The contour starting point has to be in contact with one contour element. The point of contact is located at the end or starting point of the contour element.
- The contour element chain may not be interrupted (the select total contour may not have any gaps).
- One contour element has two neighboring elements. An exception occurs if it is the first or the last element of the defined contour.



If this is not possible, the automatic NC code generation has to be performed in multiple steps.

Calling the NC code generation

- Via the menu items **Generate ► DIN G-Code**
- Via the toolbar <DIN G-Code>
- Via the F-key <F8> "DIN G-code"

Saving result

The function first opens a "Save As" dialog to define the storage location.

The result is subsequently visualized via a standard editor for checking purposes.

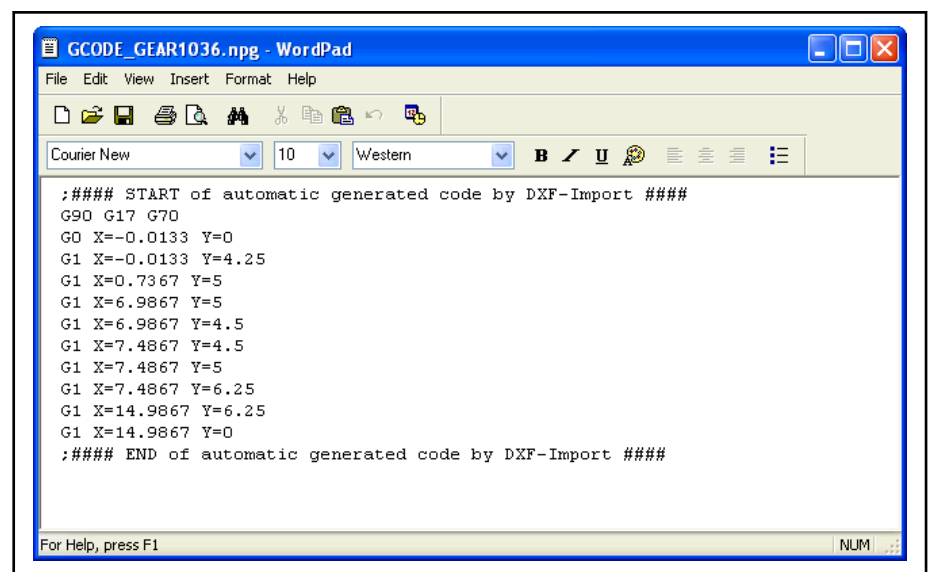


Fig. 12-10: Visualizing NC code generation

The output file can subsequently be edited using the NC editor in IndraWorks after importing them into the control.

12.9 Language selection

Select another installed language via the menu items **Tools ► Language**.

13 Appendix

13.1 Keyboard shortcuts

The implemented shortcuts for special editing functions are shown. They correspond to the Windows standard.

Key / shortcuts	Explanation
<Home>	Moves the cursor to the beginning of the line.
<End>	Moves the cursor to the end of the line.
<Ctrl>+<C>	Copies the selection into the clipboard.
<Ctrl>+<X>	Cuts the selection and moves it to the clipboard.
<Del>	Deletes the selection or the character.
<Backspace>	Deletes the selection or the character to the left of the cursor.
<Enter>	Inserts a line.
Double-click	Highlights a word at the current cursor position in the editor view.
<Ctrl>+<End>	Moves the cursor to the end of the file.
<Ctrl>+<Shift>+<End>	Extends the selection to the end of the file.
<Ctrl>+<Home>	Moves the cursor to the beginning of the file.
<Ctrl>+<Shift>+<Home>	Extends the selection to the beginning of the file.
<Ins>	Switches between pasting and replacing text.
<Shift>+<Home>	Extends the selection to the beginning of the current line.
<CursorDown>	Moves down the cursor by one line.
<Shift>+<CursorDown>	Extends the selection downwards by one line.
<Shift>+<End>	Extends the selection to the end of the current line.
<CursorUp>	Moves up the cursor by one line.
<Shift>+<CursorUp>	Extends the selection upwards by one line.
<PgDn>	Moves down the cursor by one page.
<Shift>+<PgDn>	Extends the selection downwards by one page.
<PgUp>	Moves up the cursor by one page.
<Shift>+<PgUp>	Extends the selection upwards by one page.
<Ctrl>+<V>	Pastes the clipboard content at the current position.
<Ctrl>+<A>	Highlights the entire document.
<Ctrl>+<CursorDown>	Moves the content of the window down by one line.
<Ctrl>+<CursorUp>	Moves the content of the window up by one line.
<Ctrl>+<Del>	Deletes one word to the right of the cursor.
<Ctrl>+<R>	Find Next

Appendix

<Ctrl>+<Backspace>	Deletes one word to the left of the cursor.
<Ctrl>+<CursorLeft>	Moves the cursor to the left by one word.
<Ctrl>+<Shift>+<CursorLeft>	Extends the selection to the left by one word.
<Ctrl>+<CursorRight>	Moves the cursor to the right by one word.
<Ctrl>+<Shift>+<CursorRight>	Extends the selection to the right by one word.
<Ctrl>+<Z>	Undoes the last action (modification of one or more lines).
<Ctrl>+<Y>	Redoes the action cancelled last.
<Ctrl>+<F>	Searches the indicated text.
<Ctrl>+<R>	Find Next

Tab. 13-1: *Shortcuts for special editor functions*

14 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. You can contact us **24/7**.

Service Germany Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Phone:	+49 9352 40 5060
Fax:	+49 9352 18 4941
E-mail:	service.svc@boschrexroth.de
Internet:	http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

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

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

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

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Notes

Notes

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