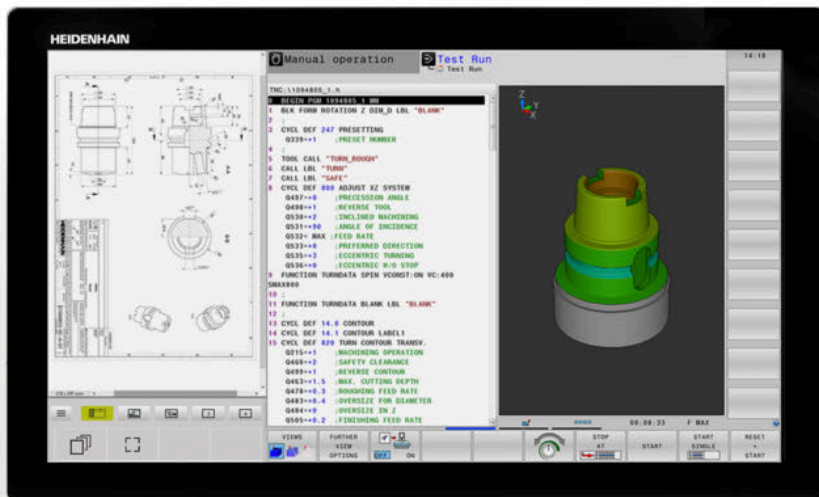




# HEIDENHAIN



## TNC 640

User's Manual  
Setup, Testing and Running  
NC Programs

NC Software  
34059x-18

English (en)  
10/2023







## Controls and displays

### Keys









If you are using a TNC 640 with touch control, you can replace some keystrokes with gestures.

**Further information:** "Operating the Touchscreen", Page 581






### Keys on the screen

Key	Function
	Select screen layout
	Toggle the display between machine operating mode, programming mode, and a third desktop
	Soft keys for selecting functions on screen
  	Switch the soft-key rows



### Alphabetic keyboard

Key	Function
  	File names, comments
  	ISO programming
	Select the next element; for example, an input field, button, or selection option
<b>SHIFT + TAB</b>	Select the previous element
	Open the <b>HEROS menu</b>
















### Machine operating modes

Key	Function
	Manual operation
	Electronic handwheel
	Positioning with Manual Data Input
	Program Run, Single Block
	Program Run, Full Sequence



### Programming modes

Key	Function
	Programming
	Test Run









### Entering and editing coordinate axes and numbers

Key	Function
 ... 	Select the coordinate axes or enter them in the NC program
 ... 	Numbers
 	Decimal separator / Reverse algebraic sign
 	Polar coordinate entry / Incremental values
	Q parameter programming / Q parameter status
	Capture actual position
	Skip dialog questions, delete words
	Confirm entry and resume dialog
	Conclude the NC block, end your input
	Clear entries or error message
	Abort dialog, delete program section











### Tool functions

Key	Function
	Define tool data in the NC program
	Call tool data







### Managing NC programs and files, control functions

Key	Function
	Select or delete NC programs or files, external data transfer
	Define program call, select datum and point tables
	Select MOD functions
	Display help text for NC error messages, call TNCguide
	Display all current error messages
	Show calculator
	Show special functions
	Currently not assigned










### Navigation keys

Key	Function
 	Position the cursor
	Go directly to NC blocks, cycles, and parameter functions
	Navigate to the beginning of a program or table
	Navigate to the end of the program or table row
	Navigate up one page
	Navigate down one page
	Select the next tab in forms
 	Up/down one dialog box or button



## Cycles, subprograms, and program-section repeats

Key	Function
	Define touch probe cycles
 	Define and call cycles
 	Enter and call subprograms and program section repeats
	Enter program stop in an NC program

## Programming path contours

Key	Function
	Contour approach and departure
	FK free contour programming
	Straight line
	Circle center/pole for polar coordinates
	Circular arc with center
	Circular arc with radius
	Circular arc with tangential transition
 	Chamfer/rounding arc

## Potentiometer for feed rate and spindle speed

Feed rate	Spindle speed
	

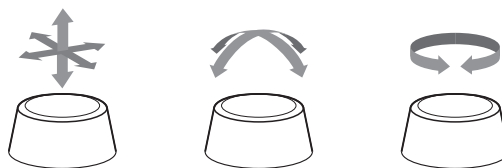
## 3D mouse

A HEIDENHAIN 3D mouse is available as a complement to the keyboard unit.

A 3D mouse allows you to manipulate objects as intuitively as if you were holding them in your hands.

This is made possible through simultaneous six-degree-of-freedom motion:

- 2D movement in the XY plane
- 3D rotation around the axes X, Y, and Z
- Zooming in or zooming out



These options increase the ease of use in the following applications in particular:

- CAD import
- Material removal simulation
- 3D applications of an external PC that you can use on the control based on software option **133 (Remote Desktop Manager)**

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# 1

## Basic Information

## 1.1 About this manual

### Safety precautions

Comply with all safety precautions indicated in this document and in your machine manufacturer's documentation!

Precautionary statements warn of hazards in handling software and devices and provide information on their prevention. They are classified by hazard severity and divided into the following groups:

#### **DANGER**

**Danger** indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **will result in death or severe injury**.

#### **WARNING**

**Warning** indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **could result in death or serious injury**.

#### **CAUTION**

**Caution** indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **could result in minor or moderate injury**.

#### **NOTICE**

**Notice** indicates danger to material or data. If you do not follow the avoidance instructions, the hazard **could result in property damage**.

### Sequence of information in precautionary statements

All precautionary statements comprise the following four sections:

- Signal word indicating the hazard severity
- Type and source of hazard
- Consequences of ignoring the hazard, e.g.: "There is danger of collision during subsequent machining operations"
- Escape – Hazard prevention measures

### Informational notes

Observe the informational notes provided in these instructions to ensure reliable and efficient operation of the software.

In these instructions, you will find the following informational notes:



The information symbol indicates a **tip**.

A tip provides important additional or supplementary information.



This symbol prompts you to follow the safety precautions of your machine manufacturer. This symbol also indicates machine-dependent functions. Possible hazards for the operator and the machine are described in the machine manual.



The book symbol indicates a **cross reference**.

A cross reference leads to external documentation for example the documentation of your machine manufacturer or other supplier.

### Have you found any errors or would you like to suggest changes?

We are continuously striving to improve our documentation for you. Please help us by sending your suggestions to the following e-mail address:

**[tnc-userdoc@heidenhain.de](mailto:tnc-userdoc@heidenhain.de)**

## 1.2 Control model, software and features

This manual describes functions for setting up the machine as well as for testing and running your NC programs. These functions are provided by controls as of the following NC software numbers.



HEIDENHAIN has simplified the version schema, starting with NC software version 16:

- The publication period determines the version number.
- All control models of a publication period have the same version number.
- The version number of the programming stations corresponds to the version number of the NC software.

Control model	NC software number
TNC 640	340590-18
TNC 640 E	340591-18
TNC 640 Programming Station	340595-18

The suffix E indicates the export version of the control. The following software option is unavailable or only available to a limited extent in the export version:

- Advanced Function Set 2 (option 9) limited to four-axis interpolation

The machine manufacturer adapts the usable features of the control to his machine by setting appropriate machine parameters. Some of the functions described in this manual may therefore not be among the features provided by the control on your machine tool.

Control functions that may not be available on your machine include:

- Tool measurement with the TT

In order to find out about the actual features of your machine, please contact the machine manufacturer.

Many machine manufacturers, as well as HEIDENHAIN, offer programming courses for the HEIDENHAIN controls. Participation in one of these courses is recommended to familiarize yourself thoroughly with the control's functions.



### User's Manual for Programming of Machining Cycles:

All functions provided by the machining cycles are described in the User's Manual for **Programming of Machining Cycles**. Please contact HEIDENHAIN if you need this User's Manual.  
ID: 1303406-xx



### User's Manual for Programming of Measuring Cycles for Workpieces and Tools:

All functions provided by the touch-probe cycles are described in the User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**. Please contact HEIDENHAIN if you need this User's Manual.  
ID: 1303409-xx

**User's Manuals for Klartext Programming and ISO Programming:**

All information regarding NC programming (except touch probe cycles and machining cycles) is provided in the User's Manuals for **Klartext Programming** and **ISO Programming**. Please contact HEIDENHAIN if you need these User's Manuals.

ID for Klartext Programming: 892903-xx

ID for ISO Programming: 892909-xx

## Software options

The TNC 640 features various software options, each of which can be enabled separately by your machine manufacturer. The respective options provide the functions listed below:

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### Additional Axis (option 0 to option 7)

<b>Additional axis</b>	Additional control loops 1 to 8
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### Advanced Function Set 1 (option 8)

<b>Advanced functions (set 1)</b>	<p><b>Machining with rotary tables</b></p> <ul style="list-style-type: none"> <li>■ Cylindrical contours as if in two axes</li> <li>■ Feed rate in distance per minute</li> </ul> <p><b>Coordinate conversions:</b> Tilting the working plane</p> <p><b>Interpolation:</b> Circular in 3 axes with tilted working plane</p>
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### Advanced Function Set 2 (option 9)

<b>Advanced functions (set 2)</b> Subject to export license	<p><b>3D machining:</b></p> <ul style="list-style-type: none"> <li>■ 3D tool compensation through surface-normal vectors</li> <li>■ Changing the swivel-head angle with the electronic handwheel during program run without affecting the position of the tool tip (TCPM = <b>T</b>ool <b>C</b>enter <b>P</b>oint <b>M</b>anagement)</li> <li>■ Keeping the tool normal to the contour</li> <li>■ Tool radius compensation normal to the tool direction</li> <li>■ Manual traverse in the active tool-axis system</li> </ul> <p><b>Interpolation:</b> Linear in more than 4 axes (subject to export license)</p>
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### HEIDENHAIN DNC (option 18)

Communication with external PC applications over COM component

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### DCM Collision (option 40)

<b>Dynamic Collision Monitoring</b>	<ul style="list-style-type: none"> <li>■ The machine manufacturer defines objects to be monitored</li> <li>■ Warning in Manual operation</li> <li>■ Collision monitoring in the Test Run mode</li> <li>■ Program interrupt in Automatic operation</li> <li>■ Includes monitoring of 5-axis movements</li> </ul>
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### CAD Import (option 42)

<b>CAD import</b>	<ul style="list-style-type: none"> <li>■ Support for DXF, STL, STEP and IGES</li> <li>■ Adoption of contours and point patterns</li> <li>■ Simple and convenient specification of presets</li> <li>■ Selecting graphical features of contour sections from conversational programs</li> </ul>
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**Global PGM Settings – GPS (option 44)**

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**Global program settings**

- Superimposition of coordinate transformations during program run
- Handwheel superimpositioning

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**Adaptive Feed Control – AFC (option 45)**

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**Adaptive Feed Control****Milling:**

- Recording the actual spindle power by means of a teach-in cut
- Defining the limits of automatic feed rate control
- Fully automatic feed control during program run

**Turning (option 50):**

- Cutting force monitoring during machining

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**KinematicsOpt (option 48)**

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**Optimizing the machine kinematics**

- Backup/restore active kinematics
- Test active kinematics
- Optimize active kinematics

---

**Turning (option 50)**

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**Milling and turning modes****Functions:**

- Switching between Milling/Turning mode of operation
- Constant surface speed
- Tool-tip radius compensation
- Turning-specific contour elements
- Turning cycles
- Eccentric Turning
- Cycle **880 GEAR HOBBING** (options 50 and 131)

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**KinematicsComp (option 52)**

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**Three-dimensional compensation**

Compensation of position and component errors

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**OPC UA NC Server (1 to 6) (options 56 to 61)**

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**Standardized interface**

The OPC UA NC Server provides a standardized interface (**OPC UA**) for external access to the control's data and functions.

These software options allow you to create up to six parallel client connections.

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**3D-ToolComp (option 92)**

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**3-D tool radius compensation depending on the tool's contact angle**

Subject to export license

- Compensate the deviation of the tool radius depending on the tool's contact angle
- Compensation values in a separate compensation value table
- Prerequisite: Working with surface-normal vectors (**LN** blocks option 9)

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### Extended Tool Management (option 93)

<b>Extended tool management</b>	Python-based expansion of tool management <ul style="list-style-type: none"> <li>■ Program-specific or pallet-specific usage sequence of all tools</li> <li>■ Program-specific or pallet-specific tooling list of all tools</li> </ul>
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### Advanced Spindle Interpolation (option 96)

<b>Interpolating spindle</b>	<b>Interpolation turning:</b> <ul style="list-style-type: none"> <li>■ Cycle <b>291 COUPLG.TURNG.INTERP.</b></li> <li>■ Cycle <b>292 CONTOUR.TURNG.INTRP.</b></li> </ul>
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### Spindle Synchronism (option 131)

<b>Spindle synchronization</b>	<ul style="list-style-type: none"> <li>■ Synchronization of milling spindle and turning spindle</li> <li>■ Cycle <b>880 GEAR HOBGING</b> (options 50 and 131)</li> </ul>
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### Remote Desktop Manager (option 133)

<b>Remote operation of external computer units</b>	<ul style="list-style-type: none"> <li>■ Windows on a separate computer unit</li> <li>■ Incorporated in the control's interface</li> </ul>
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### Synchronizing Functions (option 135)

<b>Synchronization functions</b>	<b>Real Time Coupling (RTC):</b> Coupling of axes
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### Cross Talk Compensation – CTC (option 141)

<b>Compensation of axis couplings</b>	<ul style="list-style-type: none"> <li>■ Determination of dynamically caused position deviation through axis acceleration</li> <li>■ Compensation of the TCP (<b>T</b>ool <b>C</b>enter <b>P</b>oint)</li> </ul>
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### Position Adaptive Control – PAC (option 142)

<b>Adaptive position control</b>	<ul style="list-style-type: none"> <li>■ Adaptation of the control parameters depending on the position of the axes in the working space</li> <li>■ Adaptation of the control parameters depending on the speed or acceleration of an axis</li> </ul>
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### Load Adaptive Control – LAC (option 143)

<b>Adaptive load control</b>	<ul style="list-style-type: none"> <li>■ Automatic determination of workpiece weight and frictional forces</li> <li>■ Adaptation of the control parameters depending on the current mass of the workpiece</li> </ul>
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### Active Chatter Control – ACC (option 145)

<b>Active chatter control</b>	Fully automatic function for chatter control during machining
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### Machine Vibration Control – MVC (option 146)

<b>Vibration damping for machines</b>	Damping of machine oscillations for improving the workpiece surface quality through the following functions: <ul style="list-style-type: none"> <li>■ Active Vibration Damping (<b>AVD</b>)</li> <li>■ Frequency Shaping Control (<b>FSC</b>)</li> </ul>
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**CAD Model Optimizer (option 152)**

<b>Optimization of CAD models</b>	Conversion and optimization of CAD models <ul style="list-style-type: none"> <li>■ Fixtures</li> <li>■ Workpiece blank</li> <li>■ Finished part</li> </ul>
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**Batch Process Manager (option 154)**

<b>Batch process manager</b>	Planning of production orders
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**Component Monitoring (option 155)**

<b>Component monitoring without external sensors</b>	Monitoring of configured machine components for overload
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**Grinding (option 156)**

<b>Jig grinding</b>	<ul style="list-style-type: none"> <li>■ Reciprocating stroke cycles</li> <li>■ Cycles for dressing</li> <li>■ Support of the "dressing tool" and "grinding tool" tool types</li> </ul>
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**Gear Cutting (option 157)**

<b>Machining gear systems</b>	<ul style="list-style-type: none"> <li>■ Cycle <b>285 DEFINE GEAR</b></li> <li>■ Cycle <b>286 GEAR HOBGING</b></li> <li>■ Cycle <b>287 GEAR SKIVING</b></li> </ul>
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**Turning v2 (option 158)**

<b>Mill-turning version 2</b>	<ul style="list-style-type: none"> <li>■ All functions of software option 50</li> <li>■ Cycle <b>882 SIMULTANEOUS ROUGHING FOR TURNING</b></li> <li>■ Cycle <b>883 TURNING SIMULTANEOUS FINISHING</b></li> </ul> <p>The advanced turning functions not only enable you to manufacture undercut workpieces but also to use a larger area of the indexable insert during the machining operation.</p>
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**Opt. contour milling (option 167)**

<b>Optimized contour cycles</b>	Cycles for machining any pockets and islands using trochoidal milling
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**Further options available**

HEIDENHAIN offers further hardware enhancements and software options that can be configured and implemented only by your machine manufacturer. This includes functional safety (FS), for example.

For more information, please refer to your machine manufacturer's documentation or the HEIDENHAIN brochure titled **Options and Accessories**.

ID: 827222-xx

**VTC User's Manual**

All functions of the software for the VT 121 vision system are described in the **VTC User's Manual**. Please contact HEIDENHAIN if you require a copy of this User's Manual.  
ID: 1322445-xx

**Intended place of operation**

The control complies with the limits for a Class A device in accordance with the specifications in EN 55022, and is intended for use primarily in industrially-zoned areas.

**Legal information**

The control software contains open-source software that is subject to special terms of use. These special terms of use have priority.

To call further information on the control:

- ▶ Press the **MOD** key
- ▶ Select the **General Information** group in the MOD menu
- ▶ Select the **License information** MOD function

Furthermore, the control software contains binary libraries of the **OPC UA** software from Softing Industrial Automation GmbH. For these libraries, the terms of use agreed upon between HEIDENHAIN and Softing Industrial Automation GmbH shall additionally apply and prevail.

When using the OPC UA NC server or DNC server, you can influence the behavior of the control. Therefore, before using these interfaces for productive purposes, verify that the control can still be operated without malfunctions or drops in performance. The manufacturer of the software that uses these communication interfaces is responsible for performing system tests.

## New functions 34059x-18



### Overview of new and modified software functions

Further information about the previous software versions is presented in the **Overview of New and Modified Software Functions** documentation. Please contact HEIDENHAIN if you need this documentation.

ID: 1322095-xx

### Further information: User's Manual for **Klartext Programming** or **ISO Programming**

- The **Pallet Management** software option (option 22) is available in the standard control version.
- Use the NC function **TRANS RESET** to reset all simple coordinate transformations simultaneously.
- The **FN 18: SYSREAD (D18)** functions have been extended:
  - **FN 18: SYSREAD (D18) ID10 NR10**: Counts the number of executions of the current program section
  - **FN 18: SYSREAD (D18) ID245 NR1**: Current nominal position of an axis (**IDX**) in the REF system
  - **FN 18: SYSREAD (D18) ID370 NR7**: Reaction of the control if a probing point is not reached during a programmable touch-probe cycle **14xx**
  - **FN 18: SYSREAD (D18) ID610**: Values of various machine parameters for **M120**
    - **NR53**: Radial jerk at normal feed rate
    - **NR54**: Radial jerk at high feed rate
  - **FN 18: SYSREAD (D18) ID630**: SIK information of the control
    - **NR3**: SIK generation **SIK1** or **SIK2**
    - **NR4**: Specifies whether and how often a software option (**IDX**) has been enabled on controls with **SIK2**
  - **FN 18: SYSREAD (D18) ID990 NR28**: Current tool spindle angle

- To install or update software version 18, a control with a hard disk size of at least 30 GB is required. The control also needs at least 4 GB RAM.
- The tool type **Side milling cutter (MILL\_SIDE)** has been added.  
**Further information:** "Available tool types", Page 163
- The **New Fixture** window allows combining several fixtures and saving them as a new fixture. This enables realizing and monitoring complex clamping situations.  
**Further information:** "Combining fixtures in the New Fixture window", Page 381
- In the HEROS settings, you can adjust the screen brightness of the control.
- In the **Screenshot settings** window you can define under which path and file name the control saves screenshots. The file name can contain a placeholder (e.g., %N for sequential numbering).  
**Further information:** "Overview of taskbar", Page 489
- In machine parameter **safeAbsPosition** (no. 403130), the machine manufacturer defines whether the **SLP** safety function is activated for an axis.  
If the **SLP** safety function is inactive, the axis is monitored by functional safety (FS) without a check after startup. The axis is identified by means of a gray warning triangle.  
**Further information:** "Functional safety (FS) status displays", Page 197

**Modified functions 34059x-18**

**Further information:** User's Manual for **Klartext Programming** or **ISO Programming**

- In the **TABDATA WRITE**, **TABDATA ADD** and **FN 27: TABWRITE** (ISO: **D27**) NC functions, you can enter values directly.
- If a component has not been configured or cannot be monitored, the control displays the corresponding machining operation in gray in the heatmap.
- **CAD Viewer** has been enhanced:
  - When you select contours and positions in **CAD Viewer**, you can rotate the workpiece using touch gestures. While you are using touch gestures, the control will not display any element information.
  - CAD Import (option 42) subdivides contours that are not located in the working plane, into individual sections. **CAD Viewer** creates straight lines **L** and circular arcs that are as long as possible.  
The resulting NC programs are often much shorter and clearer than NC programs generated by CAM. Thus, the contours are better suited for cycles, such as the OCM cycles (option 167).
  - CAD Import outputs the radii of the circular arcs as comments. At the end of the generated NC blocks, CAD Import displays the smallest radius to help you select the most suitable tool.
  - In the **Find circle centers by diameter range** window, you can filter the data by position depth values.
- If you create a table, and there is at least one prototype available for this file type, the control displays the window **Select table format**. The control also shows whether the prototype is defined in mm or inches. If the control shows both units of measure, you can select a unit of measure.  
The machine manufacturer defines the prototypes. If the prototype contains values, the control transfers these values to the newly created table.
- The **thread-turning tool** turning tool type includes the parameter **SPB-Insert** (option 50).  
**Further information:** "Tool data", Page 418
- The HEROS tool **Diffuse** has been added. You can compare and merge text files.  
**Further information:** "Overview of taskbar", Page 489
- The OPC UA NC Server has been enhanced as follows:
  - The **OPC UA NC Server** allows you to create service files.
  - The **OPC UA NC Server** supports the **Aes128Sha256RsaOaep** and **Aes256Sha256RsaPss** security policies.
  - You can validate 3D models for tool carriers.**Further information:** "OPC UA NC Server (options 56 to 61)", Page 571
- **PKI Admin** has been enhanced as follows:

- If an attempt to connect to the **OPC UA NC Server** (options 56 - 61) fails, the control will store the client certificate on the **Rejected** tab. You can transfer the certificate directly to the **Trusted** tab without the need to transfer the certificates manually to the control.
- **PKI Admin** now includes the **Advanced settings** tab. You can define whether the server certificate should contain static IP addresses and allow connections without an associated CRL file.

**Further information:** "PKI Admin", Page 577

**Further information:** "Overview of taskbar", Page 489

- The user administration has been enhanced as follows:
  - Your IT administrator can set up a function user to facilitate connectivity to the Windows domain.
  - If you have connected the control to the Windows domain, you can export the required configurations for other controls.

**Further information:** "Logon to Windows domain", Page 541

- The control uses an icon to indicate whether a connection configuration is secure or non-secure.

**Further information:** "Network configuration with Advanced Network Configuration", Page 519

- Machine parameter **CfgStretchFilter** (no. 201100) has been removed.

### **New cycle functions 34059x-18**

**Further information:** User's Manual for **Programming of Machining Cycles**

- Cycle **1274 OCM CIRCULAR SLOT** (ISO: **G1274**, option 167)  
This cycle allows you to define a circular slot that is then used as a pocket or boundary for face milling in conjunction with other OCM cycles.



### Changed cycle functions 34059x-18

**Further information:** User's Manual for **Programming of Machining Cycles**

**Further information:** User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**

- You can also define subcontours as **LBL** subprograms within the complex **SEL CONTOUR** contour formula.
- The machine manufacturer can hide the cycles **220 POLAR PATTERN** (ISO: **G220**) and **221 CARTESIAN PATTERN** (ISO: **G221**). We recommend using the **PATTERN DEF** function.
- The input value **1** has been added to parameter **Q515 FONT** in Cycle **225 ENGRAVING** (ISO: **G225**). Use this input value to select the **LiberationSans-Regular** font.
- In the following cycles, you can enter symmetrical tolerances "+-...." for the nominal dimensions:
  - Cycle **208 BORE MILLING** (ISO: **G208**)
  - **127x** (option 167) OCM standard figure cycles
- Cycle **287 GEAR SKIVING** (ISO: **G287**, option 157) has been extended:
  - When you program the optional parameter **Q466 OVERRUN PATH**, the control will optimize the approach and idle travel paths automatically. This will reduce machining times.
  - Two columns have been added to the prototype of the technology table:
    - **dk**: Angular offset of the workpiece in order to machine one side of the tooth flank only. This can be used to increase the surface quality.
    - **PGM**: Profile program for a custom tooth flank line, for example to realize crowning of the tooth flank.
  - After each step, the control displays the number of the current cut and the number of remaining cuts in a pop-up window.
- The machine manufacturer can configure a deviating automatic **LIFTOFF** for Cycles **286 GEAR HOBBIING** (ISO: **G286**, option 157) and **287 GEAR SKIVING** (ISO: **G287**, option 157).
- Cycle **800 ADJUST XZ SYSTEM** (ISO: **G800**, option 50) has been extended:
  - The input range of the parameter **Q497 PRECESSION ANGLE** has been extended from four to five decimal places.
  - The input range of the parameter **Q531 ANGLE OF INCIDENCE** has been extended from three to five decimal places.
- The control shows remaining residual material during turning cycles also with the machining operations **Q215=1** and **Q215=2**.
- In the touch probe cycles **14xx**, you can enter symmetrical tolerances "+-...." for the nominal dimensions.
- Cycle **441 FAST PROBING** (ISO: **G441**) now features the parameter **Q371 TOUCH POINT REACTION**. This parameter defines the reaction of the control in cases where the stylus is not deflected.
- Using the parameter **Q400 INTERRUPTION** in Cycle **441 FAST PROBING** (ISO: **G441**), you can define whether the control will interrupt program run and display a measuring log. The parameter is effective in conjunction with the following cycles:

- Cycle **444 PROBING IN 3-D** (ISO: **G444**)
- Touch-probe cycles **45x** for kinematics measuring
- Touch-probe cycles **46x** for calibrating the workpiece touch probe
- Touch-probe cycles **14xx** for determining a workpiece misalignment and for acquiring the preset
- Cycles **451 MEASURE KINEMATICS** (ISO: **G451**, option 48) and **452 PRESET COMPENSATION** (ISO: **452**, option 48) save the measured position errors of the rotary axes in the QS parameters **QS144** to **QS146**.
- Using the optional machine parameter **maxToolLengthTT** (no. 122607), the machine manufacturer defines a maximum tool length for tool touch probe cycles.
- Using the optional machine parameter **calPosType** (no. 122606), the machine manufacturer defines whether the position of parallel axes and changes in the kinematics should be considered for calibration and measuring. A change in kinematics might for example be a head change.

# 2

**First Steps**

## 2.1 Overview

This chapter is intended to help you quickly learn to handle the most important procedures on the control. For more information on the respective topic, see the section referred to in the text.

The following topics are included in this chapter:

- Switching on the machine
- Graphically testing the workpiece
- Setting up tools
- Workpiece setup
- Machining the workpiece



The User's Manuals for Klartext Programming and ISO Programming cover the following topics:

- Switching on the machine
- Programming the workpiece

## 2.2 Switching on the machine

### Acknowledging the power interruption and moving to the reference points

⚠ DANGER

**Caution: hazard to the user!**

Machines and machine components always pose mechanical hazards. Electric, magnetic, or electromagnetic fields are particularly hazardous for persons with cardiac pacemakers or implants. The hazard starts when the machine is powered up!

- ▶ Read and follow the machine manual
- ▶ Read and follow the safety precautions and safety symbols
- ▶ Use the safety devices

Refer to your machine manual.  
Switching on the machine and traversing the reference points can vary depending on the machine tool.

To switch on the machine:

- ▶ Switch on the power supply for the control and the machine
- ▶ The control starts the operating system. This process may take several minutes.
- ▶ The control will then display the "Power interrupted" message in the screen header.

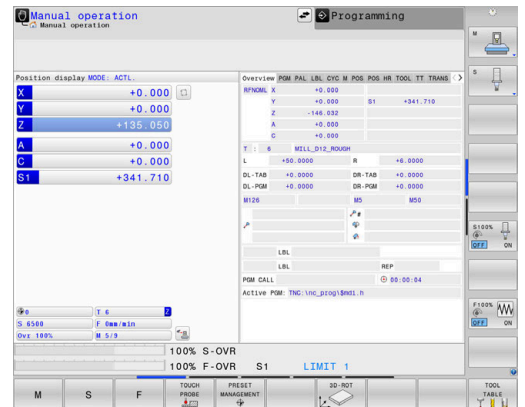
- CE

  - ▶ Press the **CE** key
  - ▶ The control compiles the PLC program.
- I

  - ▶ Switch on the machine control voltage
  - ▶ The control checks operation of the emergency stop circuit and goes into Reference Run mode.
- ▶ Cross the reference point manually in the prescribed sequence: For each axis press the **START** key. If you have absolute linear and angle encoders on your machine there is no need for a reference run
  - ▶ The control is now ready for operation in the **Manual operation** mode.

**Further information on this topic**

- Approaching reference points  
**Further information:** "Switch-on", Page 176
- Operating modes  
**Further information:** "Programming", Page 67



## 2.3 Graphically testing the workpiece

### Selecting the Test Run operating mode

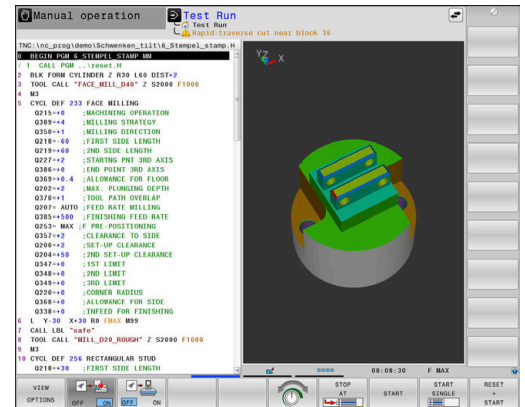
You can test NC programs in the **Test Run** operating mode:



- ▶ Press the operating mode key
- ▶ The control switches to the **Test Run** operating mode.

#### Further information on this topic

- Operating modes of the control  
**Further information:** "Modes of operation", Page 66
- Testing NC programs  
**Further information:** "Test run", Page 275



### Selecting the tool table

If you have not yet activated a tool table in **Test Run** mode, then you must carry out this step now.



- ▶ Press the **PGM MGT** key
- ▶ The control opens the file manager.



- ▶ Press the **SELECT TYPE** soft key
- ▶ The control shows a soft-key menu for selection of the file type to be displayed.



- ▶ Press the **DEFAULT** soft key
- ▶ The control shows all saved files in the right-hand window.



- ▶ Move the cursor to the left onto the directories



- ▶ Move the cursor to the **TNC:\table** directory



- ▶ Move the cursor to the right onto the files



- ▶ Position the cursor on the **TOOL.T** file (active tool table)



- ▶ Confirm with the **ENT** key
- ▶ **TOOL.T** is assigned the status **S** and is thus active for the **Test Run**.






- ▶ Press the **END** key to close the file manager




#### Further information on this topic

- Tool management  
**Further information:** "Entering tool data into the table", Page 142
- Testing NC programs  
**Further information:** "Test run", Page 275




## Selecting the NC program

- 
  - ▶ Press the **PGM MGT** key
  - > The control opens the file manager.
- 
  - ▶ Press the **LAST FILES** soft key
  - > The control opens a pop-up window with the most recently selected files.
  - ▶ Use the arrow keys to select the NC program that you want to test.
- 
  - ▶ Accept with the **ENT** key

## Selecting the screen layout and the view

- 
  - ▶ Press the **Screen layout** key
  - > The control displays all available alternatives in the soft-key row.
- 
  - ▶ Press the **PROGRAM + WORKPIECE** soft key
  - > In the left half of the screen the control shows the NC program; in the right half it shows the workpiece blank.
- 
  - ▶ Press the **VIEW OPTIONS** soft key

The control provides the following views:

Soft key	Function
	Plan view
	Projection in three planes
	3-D view

### Further information on this topic

- Graphic functions  
**Further information:** "Graphics ", Page 258
- Performing a test run  
**Further information:** "Test run", Page 275

## Starting the test run



- ▶ Press the **RESET + START** soft key
- > The control resets the previously active tool data.
- > The control simulates the active NC program up to a programmed interruption or to the program end.
- ▶ While the simulation is running, you can use the soft keys to change views



- ▶ Press the **STOP** soft key
- > The control interrupts the test run.



- ▶ Press the **START** soft key
- > The control resumes the test run after an interruption.

## Further information on this topic

- Performing a test run  
**Further information:** "Test run", Page 275
- Graphic functions  
**Further information:** "Graphics ", Page 258
- Adjusting the simulation speed  
**Further information:** "Setting the speed of the Test Run mode ", Page 264



## 2.4 Setting up tools

### Selecting the Manual operation mode

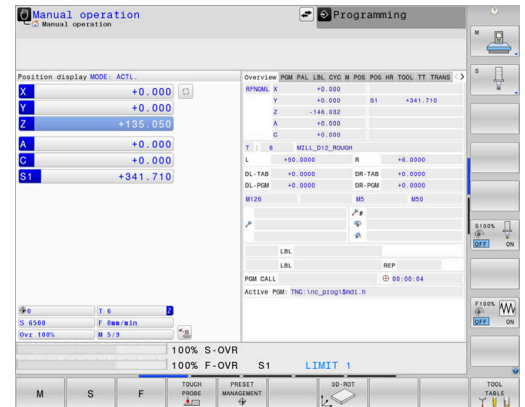
Tools are set up in the **Manual operation** mode:



- ▶ Press the operating mode key
- ▶ The control switches to the **Manual operation** mode.

#### Further information on this topic

- Operating modes of the control  
**Further information:** "Modes of operation", Page 66



### Preparing and measuring tools

- ▶ Clamp the required tools in their tool holders
- ▶ When measuring with an external tool presetter: Measure the tools, note down the length and radius, or transfer them directly to the machine through a transfer program
- ▶ When measuring on the machine: store the tools in the tool changer  
**Further information:** "Editing the TOOL\_P.TCH pocket table", Page 51

## Editing the TOOL.T tool table



Refer to your machine manual.

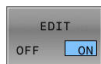
The procedure for calling the tool management may differ from that described below.

In the TOOL.T tool table (permanently stored under **TNC:\table\**), you can save tool data such as length and radius, as well as further tool-specific information that the control needs in order to execute a wide variety of functions.

To enter tool data in the tool table TOOL.T:



- ▶ Press the **TOOL TABLE** soft key
- ▶ The control shows the tool table.



- ▶ Set the **EDIT** soft key to **ON**
- ▶ With the upward or downward arrow keys you can select the tool number that you want to edit
- ▶ With the rightward or leftward arrow keys you can select the tool data that you want to edit



- ▶ Press the **END** key
- ▶ The control closes the tool table and saves the changes.

Y	Werkzeugname	L	R	R2	DL	DR
102		30	1	0	0	0
204		40	2	0	0	0
306		50	3	0	0	0
408		60	4	0	0	0
5010		80	5	0	0	0
6012		60	6	0	0	0
7014		70	7	0	0	0
8016		80	8	0	0	0
9018		90	9	0	0	0
10020		90	10	0	0	0
11022		90	11	0	0	0
12024		90	12	0	0	0
13026		90	13	0	0	0
14028		100	14	0	0	0
15030		100	15	0	0	0
16032		100	16	0	0	0
17034		100	17	0	0	0
18036		100	18	0	0	0
19038		100	19	0	0	0
20040		100	20	0	0	0
21042		100	5	5	0	0
22044		120	22	0	0	0
23046		120	23	0	0	0
24048		120	24	0	0	0
25050		120	25	0	0	0
26052		120	26	0	0	0

### Further information on this topic

- Operating modes of the control  
**Further information:** "Modes of operation", Page 66
- Working with the tool table  
**Further information:** "Entering tool data into the table", Page 142
- Working with tool management  
**Further information:** "Calling tool management", Page 159

## Editing the TOOL\_P.TCH pocket table



Refer to your machine manual.  
The function of the pocket table depends on the machine.

In the pocket table TOOL\_P.TCH (permanently saved under **TNC:\table\**) you specify which tools your tool magazine contains.

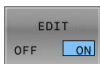
To enter data in the pocket table TOOL\_P.TCH:



- ▶ Press the **TOOL TABLE** soft key
- > The control shows the tool table.



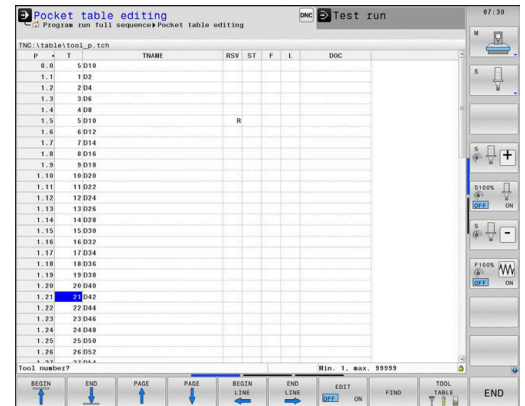
- ▶ Press the **POCKET TABLE** soft key
- > The control shows the pocket table.



- ▶ Set the **EDIT** soft key to **ON**
- ▶ With the upward or downward arrow keys you can select the pocket number that you want to edit
- ▶ With the rightward or leftward arrow keys you can select the data that you want to edit



- ▶ Press the **END** key



### Further information on this topic

- Operating modes of the control  
**Further information:** "Modes of operation", Page 66
- Working with the pocket table  
**Further information:** "Pocket table for tool changer", Page 148

## 2.5 Workpiece setup

### Selecting the correct operating mode

Workpieces are set up in the **Manual operation** or **Electronic handwheel** operating mode



- ▶ Press the operating mode key
- ▶ The control switches to the **Manual operation** mode.

#### Further information on this topic

- The **Manual operation** mode  
**Further information:** "Moving the machine axes", Page 181

### Clamping the workpiece

Mount the workpiece with a fixture on the machine table. If you have a 3-D touch probe on your machine, then you do not need to clamp the workpiece parallel to the axes.

If you do not have a 3-D touch probe available, you have to align the workpiece so that it is fixed with its edges parallel to the machine axes.

#### Further information on this topic

- Presetting with a 3-D touch probe  
**Further information:** "Presetting with a 3-D touch probe ", Page 243
- Presetting without 3-D touch probe  
**Further information:** "Presetting without a 3D touch probe", Page 212

### Presetting with a 3-D touch probe

#### Inserting a 3-D touch probe



- ▶ Select the **Positioning w/ Manual Data Input** operating mode



- ▶ Press the **TOOL CALL** key
- ▶ Enter the tool data



- ▶ Press the **ENT** key
- ▶ Enter the tool axis **Z**



- ▶ Press the **ENT** key







- ▶ Press the **END** key



- ▶ Press the **NC Start** key

**Setting a preset**

- 
  - ▶ Select the **Manual operation** mode
  
- 
  - ▶ Press the **TOUCH PROBE** soft key
  - > The control displays the available functions in the soft-key row.
  
- 
  - ▶ Set the preset at a workpiece corner, for example
  - ▶ Use the axis direction keys to position the touch probe near the first touch point on the first workpiece edge
  - ▶ Select the probing direction via soft key
  - ▶ Press the **NC Start** key
  - > The touch probe moves in the defined direction until it contacts the workpiece and then automatically returns to its starting point.
  - ▶ Use the axis direction keys to pre-position the touch probe near the second touch point on the first workpiece edge
  - ▶ Press the **NC Start** key
  - > The touch probe moves in the defined direction until it contacts the workpiece and then automatically returns to its starting point.
  - ▶ Use the axis direction keys to pre-position the touch probe near the first touch point on the second workpiece edge
  - ▶ Select the probing direction via soft key
  - ▶ Press the **NC Start** key
  - > The touch probe moves in the defined direction until it contacts the workpiece and then automatically returns to its starting point.
  - ▶ Use the axis direction keys to pre-position the touch probe near the second touch point on the second workpiece edge
  - ▶ Press the **NC Start** key
  - > The touch probe moves in the defined direction until it contacts the workpiece and then automatically returns to its starting point.
  - > The control then displays the coordinates of the measured corner point.
  
- 
  - ▶ Set to 0: Press the **SET PRESET** soft key
  - ▶ Press the **END** soft key to close the menu



**Further information on this topic**

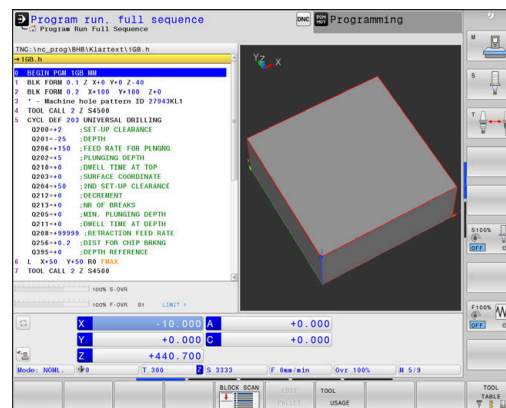
- Presetting
  - Further information:** "Presetting with a 3-D touch probe ", Page 243

## 2.6 Machining the workpiece

### Selecting the Program run, single block or Program run, full sequence operating mode

You can run NC programs either in the **Program run, single block** or the **Program run, full sequence** operating mode:



- 
  - ▶ Press the operating mode key
  - ▶ The control switches to the **Program run, single block** operating mode and runs the NC program block by block.
  - ▶ You have to confirm each NC block with the **NC Start** key
- 
  - ▶ Press the **Program run, full sequence** key
  - ▶ The control switches to the **Program run, full sequence** operating mode and runs the NC program, after pressing the NC start key, up to a program interruption or to the end of the program.




#### Further information on this topic

- Operating modes of the control  
**Further information:** "Modes of operation", Page 66
- Running NC programs  
**Further information:** "Program run", Page 282

### Selecting the NC program

- 
  - ▶ Press the **PGM MGT** key
  - ▶ The control opens the file manager.
- 
  - ▶ Press the **LAST FILES** soft key
  - ▶ The control opens a pop-up window with the most recently selected files.
  - ▶ If required, use the arrow keys to select the NC program you want to run. Load with the **ENT** key

### Starting an NC program

- 
  - ▶ Press the **NC Start** key
  - ▶ The control runs the active NC program.

#### Further information on this topic

- Running NC programs  
**Further information:** "Program run", Page 282

# 3

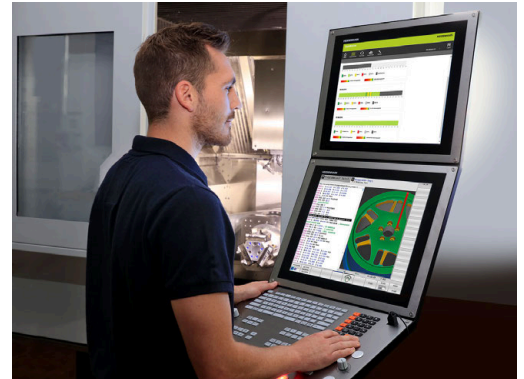
**Fundamentals**

### 3.1 The TNC 640

HEIDENHAIN TNC controls are workshop-oriented contouring controls that enable you to program conventional milling and drilling operations right at the machine in easy-to-use Klartext conversational language. They are designed for milling, drilling, and boring machines, as well as for machining centers, with up to 24 axes. You can also change the angular position of the spindle under program control.

An integrated hard disk provides storage for as many NC programs as you like, even if they were created off-line. For quick calculations you can call up the on-screen calculator at any time.

The keyboard and screen layout are clearly arranged in such a way that the functions are fast and easy to use.



#### HEIDENHAIN Klartext and ISO

HEIDENHAIN Klartext, the dialog-guided programming language for workshops, is an especially easy method of writing programs. Programming graphics illustrate the individual machining steps for programming the contour. If no NC-dimensioned drawing is available, then the FK free contour programming will help. Workpiece machining can be graphically simulated either during a test run or during a program run.

It is also possible to program in ISO format.

You can also enter and test one NC program while another NC program is machining a workpiece.

**Further information:** User's Manual for Klartext Programming or ISO Programming

#### Compatibility

NC programs created on HEIDENHAIN contouring controls (starting from the TNC 150 B) may not always run on the TNC 640. If the NC blocks contain invalid elements, the control will mark these as ERROR blocks or with error messages when the file is opened.



### Data security and data protection

The availability of data as well as their guaranteed confidentiality, integrity, and authenticity are decisive for your company's success. HEIDENHAIN therefore places the utmost importance on the protection of relevant data against loss, manipulation, and unauthorized publication.

To ensure that your data is protected actively on the control, HEIDENHAIN offers integrated, state-of-the-art software solutions.

Your control supports the following software solutions:

- **SELinux**  
**Further information:** "SELinux security software", Page 533
- **Firewall**  
**Further information:** "Firewall", Page 503
- Integrated browser  
**Further information:** "Displaying Internet files", Page 100
- Management of external access  
**Further information:** "Permitting or restricting external access", Page 458
- Monitoring of TCP and UDP ports  
**Further information:** "Portscan", Page 493
- Remote diagnosis  
**Further information:** "Secure Remote Access", Page 494
- User administration  
**Further information:** "User administration", Page 534

These solutions protect the control effectively, but cannot replace company-specific IT security and an integrated overall strategy. In addition to the solutions provided, HEIDENHAIN recommends implementing a company-specific security strategy. This way you ensure effective protection of your data and information, even after they have been exported from the control.

To ensure data security also in the future, HEIDENHAIN recommends informing yourself regularly about product updates and updating the software to the current version.

**⚠ WARNING**

**Caution: hazard to the user!**

Manipulated data records or software can lead to an unexpected behavior of the machine. Malicious software (viruses, Trojans, malware, or worms) can cause changes to data records and software.

- ▶ Check any removable memory media for malicious software before using them
- ▶ Start the internal web browser only from within the sandbox

### Virus scanners

Virus scanners can negatively affect the behavior of an NC control. Possible negative effects are feed rate drops or system crashes, for example. Such negative effects are unacceptable in numerical controls for machine tools. HEIDENHAIN therefore does not offer a virus scanner for the control and does not recommend using a virus scanner.

The control provides the following alternatives:

- **SELinux**
- **Firewall**
- **Sandbox**
- Locking from external access
- Monitoring of TCP and UDP ports

If properly configured, these options ensure extremely effective protection for the data of the control.

If you insist on using a virus scanner, you must operate the control in a protected network (with a gateway and a virus scanner). The subsequent installation of a virus scanner is not possible.

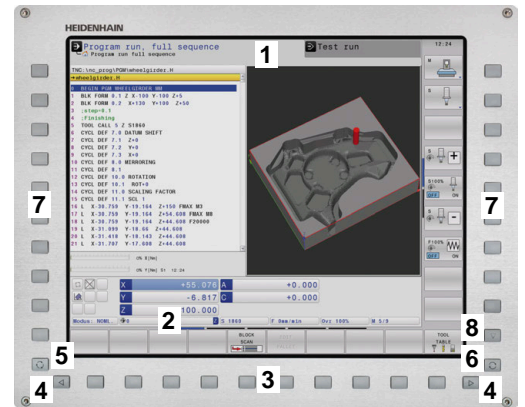
## 3.2 Visual display unit and operating panel

### Display screen

The control is shipped with a 24-inch touch screen or a 19-inch screen.

The figure at right shows the keys and controls on the VDU:

- 1 Header  
When the control is on, the screen displays the selected operating modes in the header: The machine operating mode at left and the programming mode at right. The currently active mode is displayed in the larger field of the header, where the dialog prompts and messages also appear (exception: if the control only displays graphics).
- 2 Soft keys  
In the footer the control indicates additional functions in a soft-key row. You can select these functions by pressing the keys immediately below them. The thin bars immediately above the soft-key row indicate the number of soft-key rows that can be called with the keys to the right and left that are used to switch the soft keys. The bar representing the active soft-key row is blue
- 3 Soft-key selection keys
- 4 Keys for switching the soft keys
- 5 Setting the screen layout
- 6 Key for switchover between machine operating modes, programming modes, and a third desktop
- 7 Soft-key selection keys for machine manufacturer's
- 8 Keys for switching the soft keys for machine manufacturer's



**i** If you are using a TNC 640 with touch control, you can replace some keystrokes with gestures.

**Further information:** "Operating the Touchscreen", Page 581

### Setting the screen layout

You select the screen layout yourself. In the **Programming** operating mode, for example, you can have the control show the NC program blocks in the left window while the right window displays programming graphics. You could also display the program structure in the right window instead, or display only the NC program blocks in one large window. The available screen windows depend on the selected operating mode.

Setting up the screen layout:

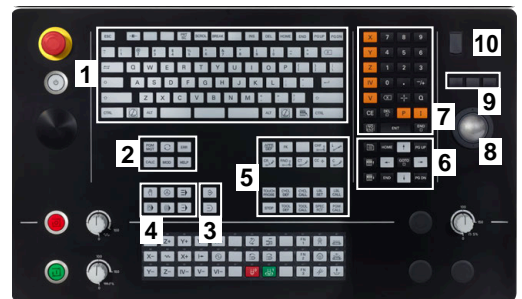
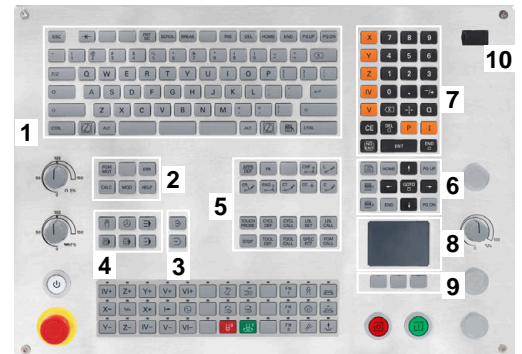
- ▶ Press the **screen layout** key: The soft-key row shows the available layout options  
**Further information:** "Modes of operation", Page 66
- ▶ Select the desired screen layout with a soft key



## Operating panel

The TNC 640 can be delivered with an integrated operating panel. The figure at top right shows the operating elements of the external operating panel:

- 1 Alphabetic keyboard for entering texts and file names, as well as for ISO programming
- 2
  - File manager
  - Calculator
  - MOD function
  - HELP function
  - Show error messages
  - Toggle between the operating modes
- 3 Programming modes
- 4 Machine operating modes
- 5 Initiating programming dialogs
- 6 Navigation keys and **GOTO** jump command
- 7 Numerical input and axis selection
- 8 Touchpad or trackball
- 9 Mouse buttons
- 10 USB connection



The functions of the individual keys are described on the inside front cover.



If you are using a TNC 640 with touch control, you can replace some keystrokes with gestures.

**Further information:** "Operating the Touchscreen", Page 581



Refer to your machine manual.

Some machine manufacturers do not use the standard HEIDENHAIN operating panel.

External keys e.g., **NC START** or **NC STOP**, are described in your machine manual.

## Cleaning

Switch the control off before cleaning the keyboard unit.

### NOTICE

#### Caution: danger of property damage

Incorrect cleaning agents and incorrect cleaning procedures can damage the keyboard unit or parts of it.

- ▶ Use permitted cleaning agents only
- ▶ Use a clean, lint-free cleaning cloth to apply the cleaning agent

The following cleaning agents are permitted for the keyboard unit:

- Cleaning agents containing anionic surfactants
- Cleaning agents containing nonionic surfactants

The following cleaning agents are prohibited for the keyboard unit:

- Cleaning agents for machines
- Acetone
- Aggressive solvents
- Abrasives
- Compressed air
- Steam cleaners



Wear operating gloves to prevent the keyboard unit from getting dirty.

If a trackball is embedded in the keyboard, you need to clean it only when it stops functioning properly.

To clean a trackball (if needed):

- ▶ Switch off the control
- ▶ Turn the pull-off ring by 100° in counterclockwise direction
- > Turning the removable pull-off ring moves it upwards out of the keyboard unit.
- ▶ Remove the pull-off ring
- ▶ Take out the ball
- ▶ Carefully remove sand, chips, or dust from the shell area



Scratches in the shell area may impair the functionality or prevent proper functioning.

- ▶ Apply a small amount of the cleaning agent onto a cleaning cloth
- ▶ Carefully wipe the shell area clean with the cloth until all smears or stains have been removed

### Exchanging keycaps

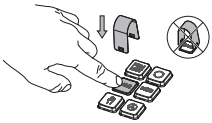
If you need replacements for the keycaps of the keyboard unit, contact HEIDENHAIN or the machine manufacturer.

**Further information:** "Keycaps for keyboard units and machine operating panels", Page 627



The IP54 protection rating cannot be guaranteed if the keyboard is missing any keys.

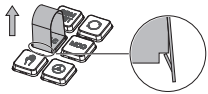
To exchange the keycaps:



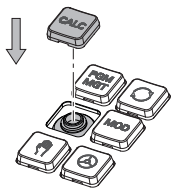
- ▶ Slide the keycap puller (ID 1394129-01) over the keycap until the grippers engage



Pressing the key will make it easier to apply the keycap puller.



- ▶ Pull off the keycap



- ▶ Place the keycap onto the seal and push it down



The seal must not be damaged; otherwise the IP54 protection rating cannot be guaranteed.

- ▶ Verify proper seating and correct functioning

## Extended Workspace Compact

The 24-inch screen provides additional screen workspace to the left of the control's user interface. The additional space enables you to open further applications in addition to the control's user interface so that you can simultaneously keep an eye on the machining process.

This layout is referred to as **Extended Workspace Compact** or **Side View** and provides many multi-touch functions.

In conjunction with the **Extended Workspace Compact** layout, the control provides the following display options:

- Splitting the screen into the control screen and an additional workspace for other applications
- Full-screen mode of the control's user interface
- Full-screen mode for applications

When you switch to full-screen mode, you can use the HEIDENHAIN keyboard for your external applications.



As an alternative, HEIDENHAIN offers a second screen for the control as **Extended Workspace Comfort**. **Extended Workspace Comfort** provides a full-screen view of the control and of an external application.

## Screen areas

**Extended Workspace Compact** is divided into the following areas:

### 1 JH Standard

The control's user interface is shown in this area.

### 2 JH Extended

This area provides configurable quick access to the following HEIDENHAIN applications:

- **HEROS menu**
- First workspace: machine operating mode (e.g., **Manual Operation**)
- Second workspace: programming operating mode (e.g., **Programming**)
- Third and fourth workspace: freely usable for applications such as the **CAD Converter**
- Collection of frequently used soft keys (called hot keys)



#### Benefits of JH Extended:

- Each operating mode has its own additional soft-key row
- Navigation through the various rows of HEIDENHAIN soft keys is no longer necessary

### 3 OEM

This area is reserved for applications defined or enabled by the machine manufacturer.

Possible contents of the **OEM** area:

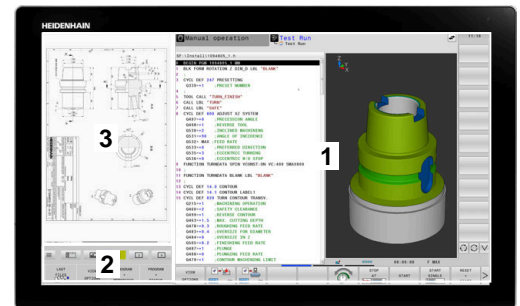
- Machine manufacturer's Python application for displaying functions and machine statuses
- Screen contents of an external PC displayed via **Remote Desktop Manager** (option 133)

**Further information:** "Remote Desktop Manager (option 133)", Page 474



With **Remote Desktop Manager** (software option 133), you can start additional applications (e.g., from a Windows PC), on your control and have your control display them in the additional workspace or in full-screen mode of **Extended Workspace Compact**.

In the optional machine parameter **connection** (no. 130001), the machine manufacturer defines the application to which the Side View will establish a connection.



## Focus control

You can toggle the keyboard focus between the control's user interface and the application being displayed in the Side View.

You have the following options for toggling the focus:

- Select the area where the respective application is shown
- Select the icon of that workspace

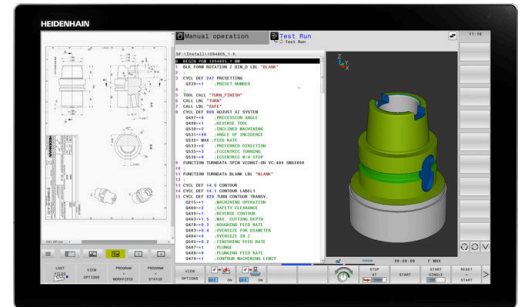


### Hot keys

The area **JH Extended** provides context-sensitive hot keys depending on the keyboard focus. Once the focus is on an application shown in the Side View, the hot keys provide functions for switching the view.

If more than one application is open in the Side View, you can toggle between the individual applications using the switchover icon.

You can exit full-screen mode at any time by pressing the screen switchover key or an operating-mode key on the keyboard unit.



### 3.3 Modes of operation

#### Manual Operation and El. Handwheel

In the **Manual operation** mode of operation, you can set up the machine. You can position the machine axes manually or incrementally, and you can set presets.

If option 8 is active, you can tilt the working plane.

The **Electronic handwheel** operating mode supports manual traverse of machine axes with the HR electronic handwheel.

#### Soft keys for selecting the screen layout

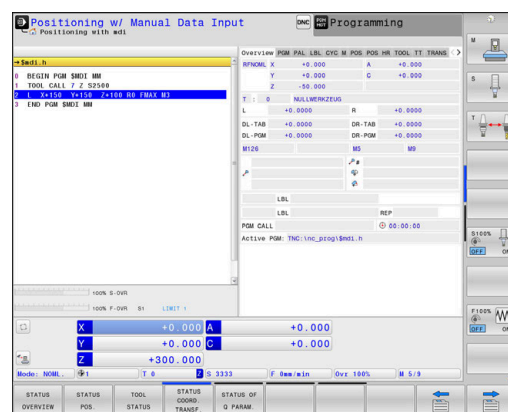
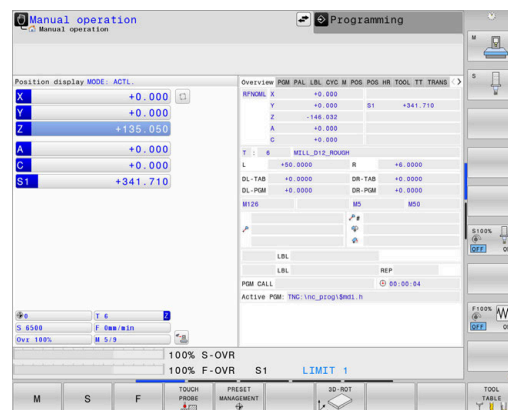
Soft key	Window
POSITION	Positions
POSITION + STATUS	Left: positions, right: status display
POSITION + WORKPIECE	Left: positions, right: workpiece
POSITION + MACHINE	Left: positions, right: collision objects and workpiece (option 40)

#### Positioning with Manual Data Input

This mode of operation is used for programming simple traversing movements, such as for face milling or pre-positioning.

#### Soft keys for selecting the screen layout

Soft key	Window
PGM	NC program
PROGRAM + STATUS	Left: NC program, right: status display
PROGRAM + WORKPIECE	Left: NC program, right: workpiece
PROGRAM + MACHINE	Left: NC program, right: collision objects and workpiece

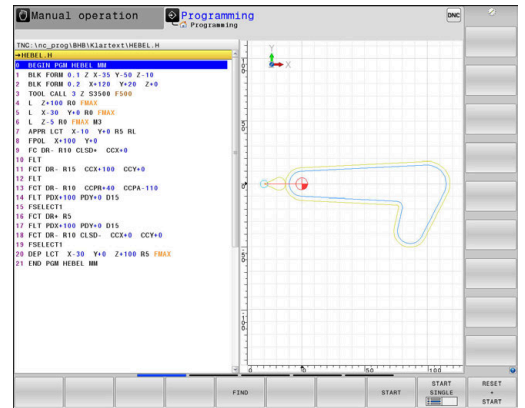


### Programming

In this mode of operation you create NC programs. The FK free programming feature, the various cycles and the Q parameter functions help you with programming and add necessary information. If desired, you can have the programming graphics show the programmed paths of traverse.

#### Soft keys for selecting the screen layout

Soft key	Window
PGM	NC program
PROGRAM + SECTS	Left: NC program, right: program structure
PROGRAM + GRAPHICS	Left: NC program, right: programming graphics

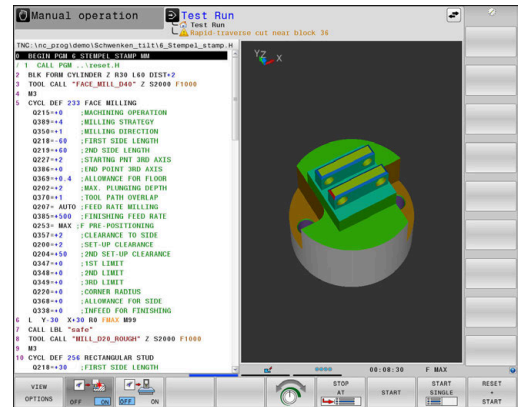


### Test Run

In the **Test Run** operating mode, the control simulates NC programs and program sections in order to check them for errors, such as geometrical incompatibilities, missing or incorrect data within the NC program, or violations of the working space. This simulation is supported graphically in different display modes.

#### Soft keys for selecting the screen layout

Soft key	Window
PGM	NC program
PROGRAM + STATUS	Left: NC program, right: status display
PROGRAM + WORKPIECE	Left: NC program, right: workpiece
WORKPIECE	Workpiece
PROGRAM + MACHINE	Left: NC program, right: collision objects and workpiece
MACHINE	Collision objects and workpiece



## Program Run, Full Sequence and Program Run, Single Block

In the **Program Run Full Sequence** operating mode, the control runs an NC program continuously to its end or to a manual or programmed stop. You can resume program run after an interruption.

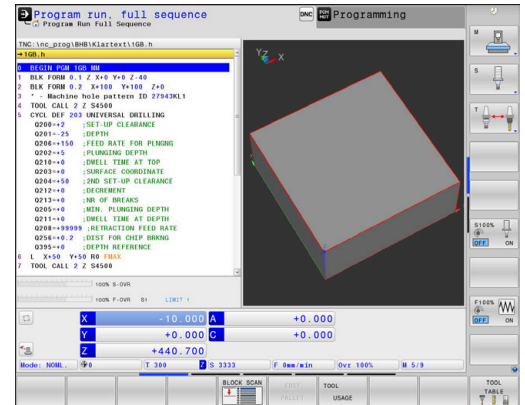
In the **Program Run Single Block** operating mode, you execute each NC block separately by pressing the **NC Start** key. With point pattern cycles and **CYCL CALL PAT**, the control stops after each point. The workpiece blank definition will be interpreted as a separate NC block.

### Soft keys for selecting the screen layout

Soft key	Window
PGM	NC program
PROGRAM + SECTS	Left: NC program, right: structure
PROGRAM + STATUS	Left: NC program, right: status display
PROGRAM + WORKPIECE	Left: NC program, right: workpiece
WORKPIECE	Workpiece
POSITION + MACHINE	Left: NC program, right: collision objects and workpiece
MACHINE	Collision objects and workpiece

### Soft keys for screen layout with pallet tables

Soft key	Window
PALLET	Pallet table
PROGRAM + PALLET	Left: NC program, right: pallet table
PALLET + STATUS	Left: pallet table, right: status display
PALLET + GRAPHICS	Left: pallet table, right: graphics
BPM	Batch Process Manager



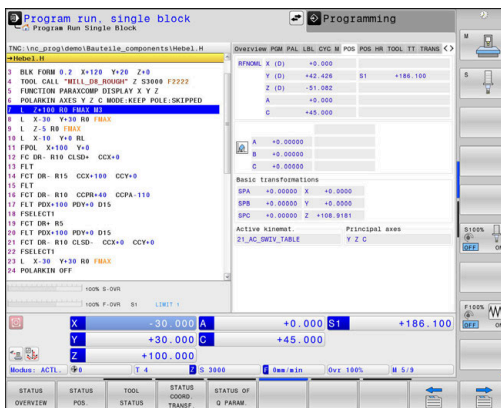
### 3.4 Status displays

#### General status display

The general status display in the lower part of the screen informs you of the current state of the machine. The control displays information about axes and positions, as well as technology values and icons for active functions.

The control displays the status in the following operating modes:

- Program run, single block
- Program run, full sequence
- Positioning w/ Manual Data Input



If the **GRAPHICS** screen layout is selected, the status display is not shown.

In the **Manual operation** and **Electronic handwheel** operating modes, the control shows the status display in the large window.

#### Axis display and position display





Refer to your machine manual. The sequence and number of displayed axes is defined by the machine manufacturer.

Icon	Meaning
<b>ACTL</b>	Position display mode (e.g., actual or nominal coordinates of the current position) <b>Further information:</b> "Selecting the position display", Page 449
<b>X Y Z</b>	Machine axes The selected axis is highlighted
<b>m</b>	The control displays auxiliary axes in lowercase letters
<b>X?</b>	Axis has not been homed
<b>X!</b>	Axis is not in safe operation or it is simulated
	Axis is locked
	Axis can be moved with the handwheel























The machine parameter **CfgPosDisplayPace** (no. 101000) defines the display accuracy by the number of decimal places.











### Preset and technology values

Symbol	Meaning
	Number and comment of the active preset from the preset table If the preset was set manually, the control displays the text <b>MAN</b> behind the symbol
<b>T</b>	Number of the active tool
<b>S</b>	Spindle speed S
<b>F</b>	Feed rate F The displayed feed rate in inches corresponds to one tenth of the effective value. If a feed-rate limit is active, the control displays an exclamation mark behind the feed rate-value. <b>Further information:</b> "Feed-rate limit F MAX", Page 195
<b>M</b>	Active M functions
	The spindle is controlled from within a cycle (e.g., during tapping)

### Icons for active functions

Icon	Meaning
	<b>RL</b> tool radius compensation is active The icon is transparent while the <b>BLOCK SCAN</b> function is active
	<b>RR</b> tool radius compensation is active While the <b>BLOCK SCAN</b> function is active, the icon is transparent
	<b>R+</b> tool radius compensation is active While the <b>BLOCK SCAN</b> function is active, the icon is transparent
	<b>R-</b> tool radius compensation is active While the <b>BLOCK SCAN</b> function is active, the icon is transparent
	3-D tool compensation is active While the <b>BLOCK SCAN</b> function is active, the icon is transparent
	A basic rotation is active in the active preset
	Axes are moving, taking the basic rotation into account
	A 3-D basic rotation is active in the active preset
	Axes are moving, taking the setting in the 3-D ROT menu into account

Icon	Meaning
	Axes are mirrored and moved
<b>TCPM</b>	The <b>M128</b> function or <b>TCPM FUNCTION</b> is active
	The function for traversing in the tool-axis direction is active
	No NC program selected, NC program reselected, NC program aborted via internal stop, or NC program terminated  In this state, the control has no modally effective program information (i.e., contextual reference), so that all actions are possible (e.g., cursor movements or modification of Q parameters).
	NC program started, execution runs  For safety reasons, the control permits no actions in this state.
	NC program stopped (e.g., in <b>Program run, full sequence</b> operating mode after pressing the <b>NC Stop</b> key)  For safety reasons, the control permits no actions in this state.
	NC program interrupted (e.g., in <b>Positioning w/ Manual Data Input</b> operating mode, following the error-free execution of an NC block)  In this state, the control permits various actions (e.g., cursor movements or the modification of Q parameters). These actions, however, may lead to the control losing the modally effective program information (i.e., the contextual reference). Loss of this contextual reference may result in undesired tool positions!  <b>Further information:</b> "Positioning w/ Manual Data Input operating mode", Page 311 and "Program-controlled interruptions", Page 287
	NC program aborted or terminated
	Turning mode is active
	Dressing mode is active
	The Dynamic Collision Monitoring function (DCM) is active
<b>AFC</b> 	The Adaptive Feed Control function (AFC) is active in teach-in cut mode

Icon	Meaning
	The Adaptive Feed Control function (AFC) is active in closed-loop mode
	The Active Chatter Control (ACC) function is active
	The pulsing spindle speed function is active
	The Global Program Settings function is active
	The active linear principal axes do not correspond to X, Y, and Z because the <b>PARAXMODE</b> or <b>POLARKIN</b> function is active.
	<div style="border: 1px solid black; padding: 5px;"> <p> An active <b>PARAXMODE</b> or <b>POLARKIN</b> icon hides the <b>PARAXCOMP DISPLAY</b> icon.</p> </div> <p>The <b>PARAXCOMP DISPLAY</b> function is active</p>
	<div style="border: 1px solid black; padding: 5px;"> <p> An active <b>PARAXMODE</b> or <b>POLARKIN</b> icon hides the <b>PARAXCOMP MOVE</b> icon.</p> </div> <p>The <b>PARAXCOMP MOVE</b> function is active</p>
<p> The order of icons can be changed with the optional <b>iconPrioList</b> machine parameter (no. 100813). Only the icons for control-in-operation (STIB) and DCM (option 40) are always visible and cannot be configured.</p>	

## Additional status displays

The additional status displays contain detailed information on program run. They can be called in all operating modes except for **Programming**. In the **Test Run** operating mode, only a limited status display is available.

### Activating the additional status display






- ▶ Display the soft-key row for screen layout



- ▶ Select the layout option for the additional status display
- ▶ In the right half of the screen, the control shows the **Overview** status form.




**Selecting an additional status display**

-  ▶ Toggle through the soft-key rows until the **STATUS** soft keys appear
-  ▶ Either select the additional status display directly with the soft key (e.g., positions and coordinates); or
-  ▶ Use the toggle soft keys to select the desired view


Select the status displays described below as follows:

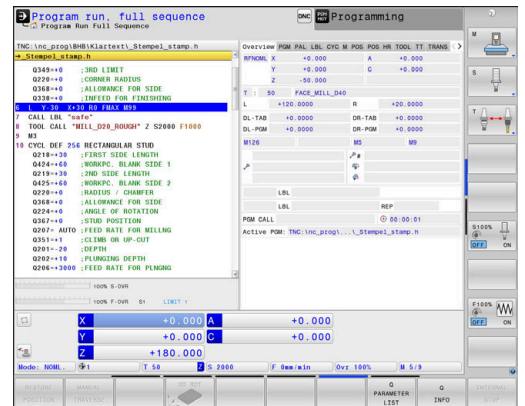
- Directly with the corresponding soft key
- Via the toggle soft keys
- Or by using the **next tab** key

 Please note that some of the status information described below is not available unless the associated software option is enabled on your control.

**Overview**

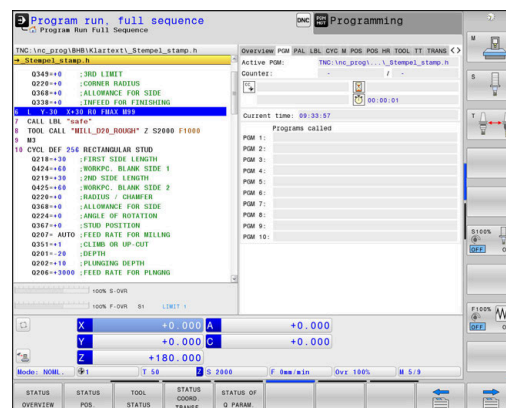
The control displays the **Overview** status form after startup if you selected the **PROGRAM STATUS** (or **POSITION STATUS**) screen layout. The overview form contains a summary of the most important status information, which you can also find on the various detail forms.

Soft key	Meaning
	Position display
	Possible additional information following the axis designations: <ul style="list-style-type: none"> <li>■ <b>(D): PARAXMODE DISPLAY</b> function active</li> <li>■ <b>(M): PARAXMODE MOVE</b> function active</li> </ul>
	Spindle position
	Depends on the machine parameter <b>spindleDisplay</b> (no. 100807)
	Tool information
	Active M functions
	Active coordinate transformations
	Active subprogram
	Active program-section repeat
	Name and path of called-up NC program
	Current machining time
	Name and path of the active main program



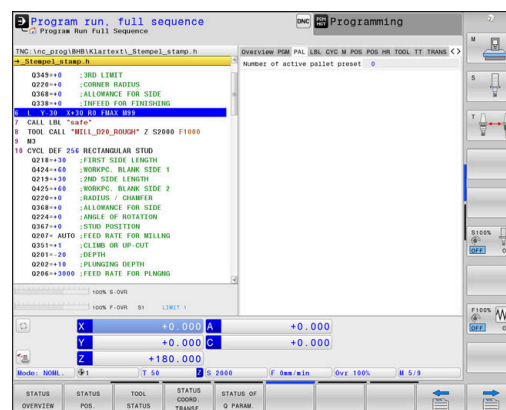
### General program information (PGM tab)

Soft key	Meaning
No direct selection possible	Name and path of the active main program
	Actual/nominal value counters
	Circle center CC (pole)
	Dwell time counter
	Current machining time
	Current time
	Called NC programs



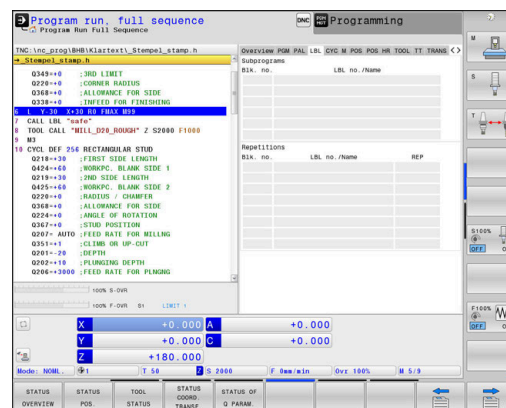
### Pallet information (PAL tab)

Soft key	Meaning
No direct selection possible	Number of the active pallet preset



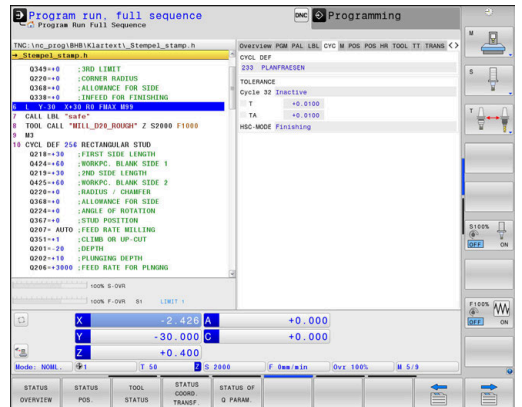
### Program-section repeats and subprograms (LBL tab)


Soft key	Meaning
No direct selection possible	Active program-section repeats with block number, label number, and number of programmed repeats/repeats yet to be run
	Active subprograms with number of block in which the subprogram was called and the label number that was called



**Information on standard cycles (CYC tab)**

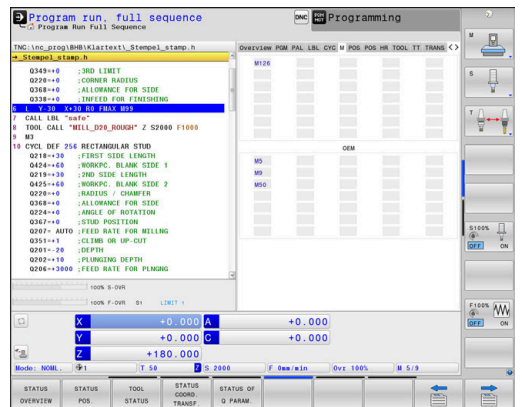
Soft key	Meaning
No direct selection possible	Active machining cycle
	Active path and angle tolerances
	Depending on which path and angle tolerances are active, the following values are displayed:
	<ul style="list-style-type: none"> <li>Values of cycle <b>32 TOLERANCE</b></li> <li>Values defined by the machine manufacturer</li> <li>Values limited by DCM</li> </ul>




 The tolerance limits imposed by DCM are configured by the machine manufacturer. If a tolerance is limited by DCM, the control displays a gray warning triangle as well as the limited values.

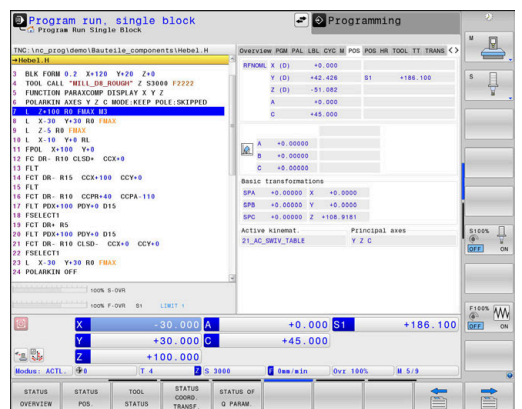
**Active M functions (miscellaneous functions, M tab)**

Soft key	Meaning
No direct selection possible	List of the active M functions with fixed functionality
	List of the active M functions that have been adapted by the machine manufacturer



**Positions and coordinates (POS tab)**

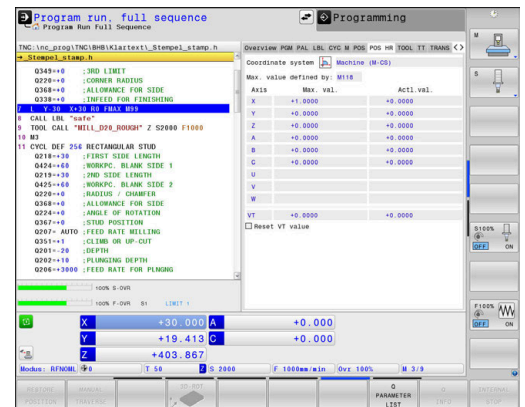
Soft key	Meaning
	Type of position display (e. g., actual position)
	Axis positions
	Spindle position
	Depends on the machine parameter <b>spindleDisplay</b> (no. 100807)
	Tilt angle of the working plane
	<b>OEM rotation</b>
	<b>Further information:</b> "Working plane coordinate system WPL-CS", Page 126
	Angle of basic transformations
	Active kinematics
	<b>Principal axes</b> if they have been defined using the <b>PARAXMODE</b> or <b>POLARKIN</b> function instead of the standard <b>XYZ</b> .



## Global Program Settings (POS HR tab)

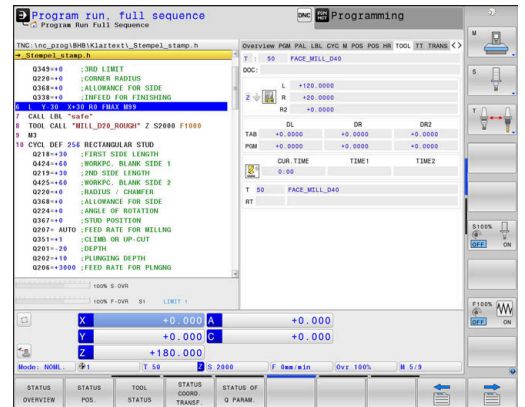
Soft key	Meaning
No direct selection possible	<p>Current values of <b>Handwheel superimp.</b></p> <ul style="list-style-type: none"> <li>Active coordinate system           <ul style="list-style-type: none"> <li>With <b>M118</b>: always the machine coordinate system</li> <li>Selectable with <b>GPS</b> (Global Program Settings)</li> </ul> </li> <li>Max. val. is defined by <b>M118</b> or <b>GPS</b></li> <li>Max. val. and Actl.val. of the selected axes</li> <li>Status of the <b>Reset VT value</b> function</li> </ul> <p><b>Further information:</b> "Global Program Settings (option 44)", Page 352</p>

**i** The values of all other settings provided by the Global Program Settingsfunction are displayed on the **GS** tab.



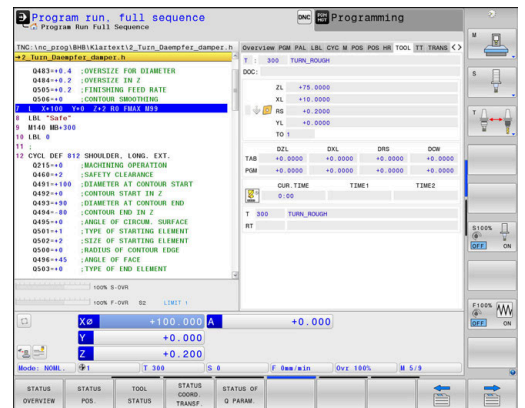
Information on the tools (TOOL tab)

Soft key	Meaning
TOOL STATUS	Display of active tool: <ul style="list-style-type: none"> <li>T: Tool number and tool name</li> <li>RT: Number and name of a replacement tool</li> </ul>
	Tool axis
	Tool length and tool radii
	Finishing allowances (delta values) from the tool table (TAB) and <b>TOOL CALL</b> (PGM)
	Tool life, maximum tool life (TIME 1) and maximum tool life for <b>TOOL CALL</b> (TIME 2)
	Display of programmed tool and replacement tool



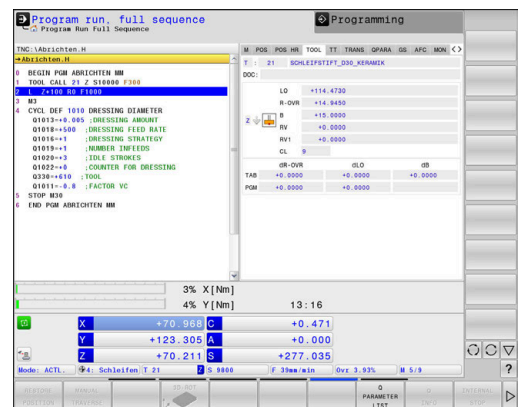
Display for turning tools (TOOL tab)

Soft key	Meaning
TOOL STATUS	Display of active tool: <ul style="list-style-type: none"> <li>T: Tool number and tool name</li> <li>RT: Number and name of a replacement tool</li> </ul>
	Tool axis
	Tool lengths, cutting-edge radius and tool orientation
	Finishing allowances (delta values) from the tool table (TAB) and <b>FUNCTION TURNDATA CORR</b> (PGM)
	Tool life, maximum tool life (TIME 1) and maximum tool life for <b>TOOL CALL</b> (TIME 2)
	Display of programmed tool and replacement tool



Display for grinding tools (TOOL tab)

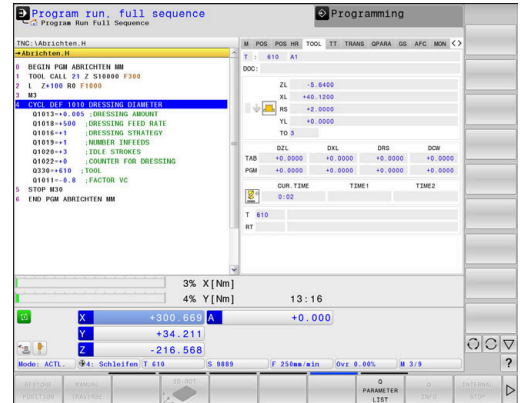
Soft key	Meaning
TOOL STATUS	Display of active tool: <ul style="list-style-type: none"> <li>T: Tool number and tool name</li> <li>DOC: Comment on the tool</li> </ul>
	Tool axis
	Tool dimensions and cutting edge (CL: for <b>Cutter Location</b> )
	Finishing allowances (delta values) from the tool table (TAB) and NC program (PGM)



Display for dressing tools (TOOL tab)

Soft key	Meaning
TOOL STATUS	Display of active tool: <ul style="list-style-type: none"> <li>T: Tool number and tool name</li> <li>DOC: Comment on the tool</li> </ul>
	Tool axis
	Tool dimensions and tool orientation (TO)

Soft key	Meaning
	Finishing allowances (delta values) from the tool table (TAB) and NC program (PGM)
	Tool life
	Display of programmed tool and replacement tool

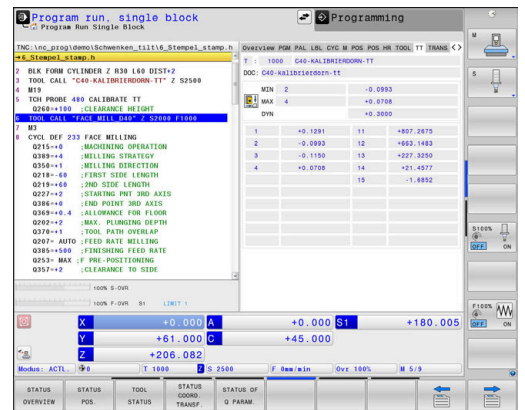


**Tool measurement (TT tab)**



The control displays this tab only if the function is active on your machine.

Soft key	Meaning
No direct selection possible	Active tool
	Minimum tilt angle (MIN) of the tool touch probe
	Maximum tilt angle (MAX) of the tool touch probe
	Tolerance for tilt angle (DYN)
	Measurement results of the cycle:



Field	Meaning
1	Tilt angle in the positive X direction
2	Tilt angle in the positive Y direction
3	Tilt angle in the negative X direction
4	Tilt angle in the negative Y direction
11	X position of tool touch probe in machine coordinate system (M-CS)
12	Y position of tool touch probe in machine coordinate system (M-CS)
13	Z position of tool touch probe in machine coordinate system (M-CS)
14	Diameter or edge length of probe contact
15	Angle of misalignment



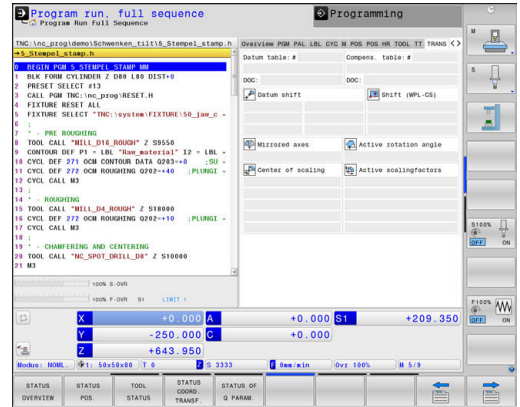
Your machine manufacturer defines the tolerance for the tilt angle in the optional machine parameter **tiltingTolerance** (no. 114319). The control will determine the tilt angle automatically only if a tolerance is defined.

Coordinate transformations

Soft key	Meaning
STATUS COORD. TRANSF.	Active transformations
	Name of active datum table, active datum number (#), comment from the active row of the active datum table ( <b>DOC</b> ) from Cycle <b>7</b>
	Active datum shift (Cycle <b>7</b> ); the control displays an active datum shift in up to 8 axes
	Name of active compensation table, active table number (#), comment from the active row of the active table ( <b>DOC</b> )
	Active shift in the working plane coordinate system <b>WPL-CS</b>
	Mirrored axes (Cycle <b>8</b> )
	Active angle of rotation (Cycle <b>10</b> )
	Active scaling factor (Cycle <b>11</b> ) / factors (Cycle <b>26</b> ); the control displays an active scaling factor in up to six axes.
	Scaling datum

**i** In the machine parameter **CfgDisplayCoordSys** (no. 127501) the machine manufacturer defines the coordinate system in which the status display shows an active datum shift.

**Further information:** User's Manual for **Programming of Machining Cycles**  
**Further information:** User's Manuals for Klartext Programming and ISO Programming



Display of Q parameters (QPARA tab)

Soft key	Meaning
STATUS OF Q PARAM.	Display the current values of the defined Q parameters

Display the character strings of the defined string parameters

**i** Press the **Q PARAMETER LIST** soft key. The control opens a pop-up window. For each parameter type (Q, QL, QR, QS), define the parameter numbers you wish to check. Separate single Q parameters with commas and connect sequential Q parameters with a hyphen (e.g., 1,3;200-208). The maximum number of characters per parameter type is 132.

The display in the **QPARA** tab always contains eight decimal places. The result of **Q1 = COS 89.999** is shown by the control as 0.00001745, for example. Very large and very small values are displayed by the control in exponential notation. The result of **Q1 = COS 89.999 \* 0.001** is shown by the control as +1.74532925e-08, where e-08 corresponds to the factor of 10<sup>-8</sup>.

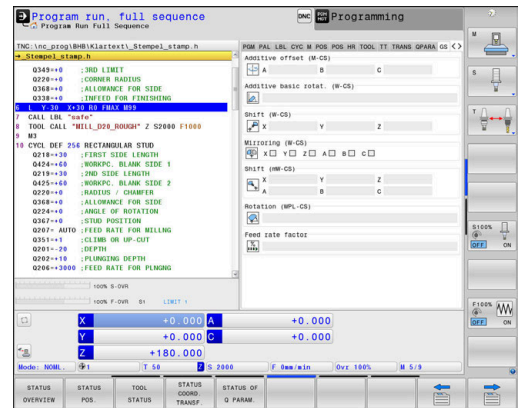
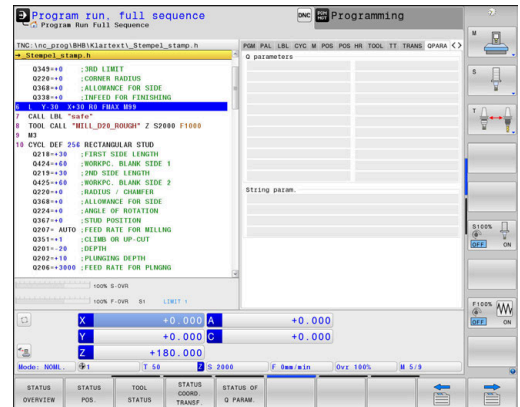
The display of QS parameters is restricted to the first 30 characters, i.e. the contents might be truncated.

Global Program Settings (GS tab, option 44)

**i** The control displays this tab only if the function is active on your machine.

Soft key	Meaning
No direct selection possible	Currently active values of the Global Program Settings function: <ul style="list-style-type: none"> <li>■ Additive offset (M-CS)</li> <li>■ Additive basic rotat. (W-CS)</li> <li>■ Shift (W-CS)</li> <li>■ Mirroring (W-CS)</li> <li>■ Shift (mW-CS)</li> <li>■ Rotation (WPL-CS)</li> <li>■ Feed rate factor</li> </ul>
	<b>Further information:</b> "Global Program Settings (option 44)", Page 352

**i** The control displays the values of the **Handwheel superimp.** setting on the **POS HR** tab.



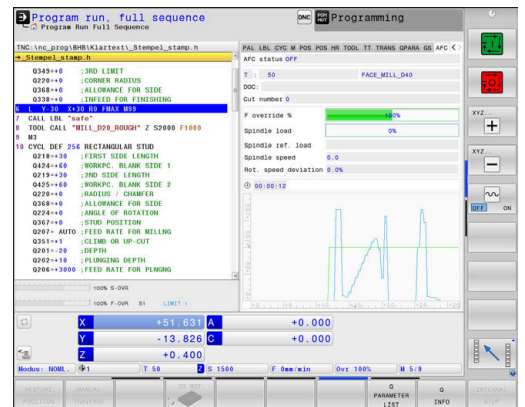


**Adaptive Feed Control (AFC tab, option 45)**



The control displays this tab only if the function is active on your machine.

Soft key	Meaning
No direct selection possible	Active tool (number and name)
	Cutting number
	Current factor of the feed-rate potentiometer in %
	Active spindle load in %
	Reference load of the spindle
	Current spindle speed
	Current deviation of the speed
	Current machining time
	Line diagram in which the current spindle load and the value commanded by the control for the feed-rate override are shown



**Monitoring of configured machine components (MON and MON Detail tabs, option 155)**



The control displays these tabs only if the software option has been enabled on your machine.

The machine manufacturer can define up to 20 components to be monitored by the control by means of component monitoring.

For any detected overload conditions, the machine manufacturer has configured component-specific automated responses (e.g., stop of the current execution).

**MON tab**

Soft key	Meaning
No direct selection possible	<b>MON status</b> Active if at least one monitoring component has been defined by the machine manufacturer

**Monitoring tasks:**

- All monitored components with their defined names and a color-coded status display
- Green: component works under conditions defined as safe
- Yellow: component works under warning zone conditions
- Red: Overload condition

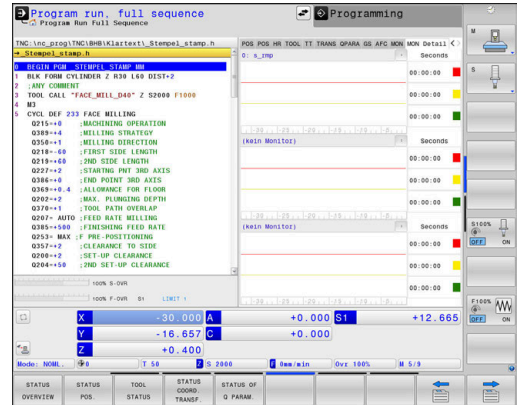
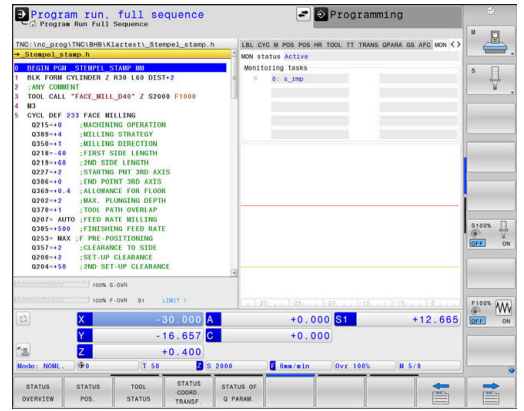
**Diagram:**

- Combined display of all monitoring tasks
- The red line shows the error limit defined by the machine manufacturer
- The yellow line shows the warning limit defined by the machine manufacturer
- The black line follows the condition of the component that is subjected to the highest load
  - Above the red line, as soon as at least one of the monitored components reaches the overload zone
  - Above the green line, as soon as at least one of the monitored components reaches the warning zone

**Diagram zones:**

- Area above the red line: overload zone
- Area between the red and green lines: warning zone
- Area below the green line: zone of conditions defined as safe

Alternatively, the machine manufacturer can define only warning limits or error limits. If no limits have been defined, the corresponding red or yellow line is not displayed.



**MON Detail tab**

Soft key	Meaning
No direct selection possible	Three identical areas for the display of detailed information related to three freely selectable monitored components.
	Use the selection menus above the diagrams for selection. Once you select a component, the display indicates its name and an index (order of definition).
	<p>Diagram:</p> <ul style="list-style-type: none"> <li>■ Individual view of the selected monitoring task</li> <li>■ The red line shows the error limit defined by the machine manufacturer</li> <li>■ The yellow line shows the warning limit defined by the machine manufacturer</li> <li>■ The black line corresponds to the current load condition</li> </ul> <p>Alternatively, the machine manufacturer can define only warning limits or error limits. If no limits have been defined, the corresponding red or yellow line is not displayed.</p>
	<p><b>Seconds:</b></p> <ul style="list-style-type: none"> <li>■ Individual display of the load duration</li> <li>■ Red: duration in the overload zone</li> <li>■ Yellow: duration in the warning zone</li> <li>■ Green: duration in the zone defined as safe</li> </ul>

**i** With **Component Monitoring** (option 155), the control provides automatic monitoring of configured machine components.

If configured correctly, the system will display warning messages indicating an imminent overload condition and error messages indicating that an overload condition was detected. By responding in time to these messages, you can take countermeasures to protect the machine components from damage.

If configured poorly, inappropriate error messages will impede or even prevent further work. In this case, you can use the machine parameter **CfgMonUser** (no. 129400) to influence the configured overload responses.

**Further information:** "List of user parameters", Page 600

## 3.5 File management

### Files

Files in the control	Type
<b>NC programs</b>	
in HEIDENHAIN format	.H
in ISO format	.I
<b>Compatible NC programs</b>	
HEIDENHAIN unit programs	.HU
HEIDENHAIN contour programs	.HC
<b>Tables for</b>	
Tools	.T
Tool changers	.TCH
Datums	.D
Points	.PNT
Presets	.PR
Touch probes	.TP
Backup files	.BAK
Dependent data (e.g. structure items)	.DEP
Freely definable tables	.TAB
Pallets	.P
Turning tools	.TRN
Tool compensation	.3DTC
<b>Texts as</b>	
ASCII files	.A
Text files	.TXT
HTML files, e.g. result logs of touch probe cycles	.HTML
Help files	.CHM
<b>CAD files as</b>	
ASCII files	.DXF .IGES .STEP

When you write an NC program on the control, you must first enter a program name. The control saves the NC program to the internal memory as a file with the same name. The control can also save texts and tables as files.

The control provides a special file management window in which you can easily find and manage your files. Here you can call, copy, rename and erase files.

You can manage an almost unlimited number of files with the control. The available memory is at least **21 GB**. A single NC program can be up to **2 GB** in size.



Depending on the setting, the control generates backup files with the file name extension \*.bak after editing and saving NC programs. This reduces the available memory space.

### File names

When you store NC programs, tables and texts as files, the control adds an extension to the file name, separated by a point. This extension indicates the file type.

File name	File type
PROG20	.H

File names, drive names and directory names on the control must comply with the following standard: The Open Group Base Specifications Issue 6 IEEE Std 1003.1, 2004 Edition (POSIX Standard).

The following characters are permitted:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c d e f g h i j  
k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9 \_ -

The following characters have special meanings:

Character	Meaning
.	The last period (dot) in a file name is the extension separator
\ and /	Directory separators
:	Separates the drive name from the directory

Do not use any other characters. This helps to prevent file transfer problems, etc.

**i** The names of tables and table columns must start with a letter and must not contain an arithmetic operator (e.g., +). Due to SQL commands, these characters can cause problems when data are input or read.

**i** The maximum permitted path length is 255 characters. The path length consists of the drive characters, the directory name and the file name, including the extension.

**Further information:** "Paths", Page 86

## Displaying externally generated files on the control

The control features several software tools which you can use to display the files shown in the table below. Some of the files can also be edited.

File types	Type
PDF files	pdf
Excel tables	xls
	csv
Internet files	html
Text files	txt
	ini
Graphic files	bmp
	gif
	jpg
	png

**Further information:** "Software tools for management of external file types", Page 97

## Directories

To ensure that you can easily find your NC programs and files, we recommend that you organize your internal memory into directories (folders). You can divide a directory into further directories, which are called subdirectories. With the **-/+** key or **ENT** you can show or hide the subdirectories.

## Paths

A path indicates the drive and all directories and subdirectories under which a file is saved. The individual names are separated by a backslash \.



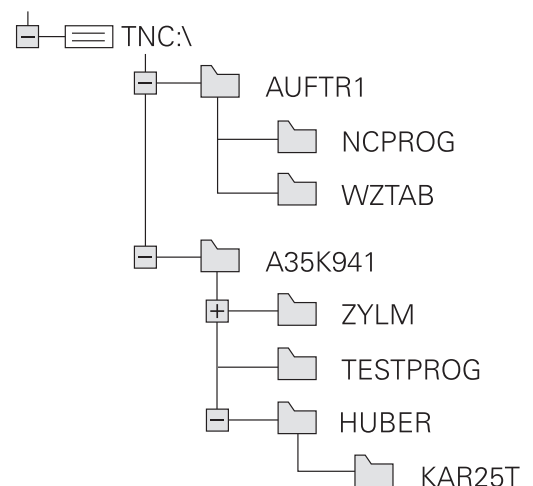
The maximum permitted path length is 255 characters. The path length consists of the drive characters, the directory name and the file name, including the extension.

### Example

The directory AUFTR1 was created on the **TNC** drive. Then, in the AUFTR1 directory, the directory NCPROG was created and the NC program PROG1.H was copied into it. The NC program now has the following path:

**TNC:\AUFTR1\NCPROG\PROG1.H**

The chart at right illustrates an example of a directory display with different paths.



### Calling the File Manager

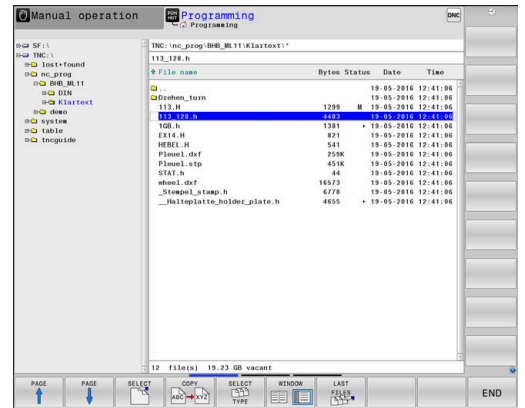


- ▶ Press the **PGM MGT** key
- ▶ The control displays the file management window (see figure for default setting. If the control displays a different screen layout, press the **WINDOW** soft key).

**i** If you exit an NC program by pressing the **END** key, the control opens the file manager. The cursor is on the NC program that was just closed.

If you press the **END** key again, the control opens the original NC program again with the cursor on the last selected line. With large files this behavior can cause a delay.

If you press the **ENT** key, the control always opens an NC program with the cursor on line 0.



The narrow window on the left shows the available drives and directories. Drives designate devices with which data are stored or transferred. A drive is the internal memory of the control. Other drives are the interfaces (RS232, Ethernet) to which you can connect a PC for example. A directory is always identified by a folder symbol to the left and the directory name to the right. Subdirectories are shown to the right of and below their parent directories. If there are subdirectories, you can show or hide them using the **-/+** key.

If the directory tree is longer than the screen, navigate using the scroll bar or a connected mouse.

The wide window on the right shows you all files that are stored in the selected directory. Each file is shown with additional information, illustrated in the table below.

display	Meaning
<b>File name</b>	File name and file type
<b>Bytes</b>	File size in bytes
<b>Status</b>	File properties:
E	The file has been selected in the <b>Programming</b> mode of operation
S	File is selected in the <b>Test Run</b> operating mode
M	The file is selected in a Program Run mode of operation
+	File has non-displayed dependent files with the extension DEP, e.g. with use of the tool usage test
	File is protected against erasing and editing
	File is protected against deletion and editing, because it is being run
<b>Date</b>	Date that the file was last edited
<b>Time</b>	Time that the file was last edited

**i** To display the dependent files, set the machine parameter **dependentFiles** (no. 122101) to **MANUAL**.

## Additional functions

### Protecting a file and canceling file protection

- ▶ Place the cursor on the file you want to protect



- ▶ Select the miscellaneous functions:  
Press the **MORE FUNCTIONS** soft key



- ▶ Activate file protection:  
Press the **PROTECT** soft key



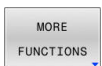
- ▶ The file is tagged with the "protected" symbol.



- ▶ Cancel file protection:  
Press the **UNPROTECT** soft key

### Selecting the editor

- ▶ Place the cursor on the file you want to open



- ▶ Select the additional functions:  
Press the **MORE FUNCTIONS** soft key

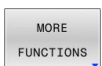


- ▶ Select the editor:  
Press the **SELECT EDITOR** soft key
- ▶ Mark the desired editor
  - **TEXT EDITOR** for text files (e.g., **.A** or **.TXT**)
  - **PROGRAM EDITOR** for NC programs **.H** and **.I**
  - **TABLE EDITOR** for tables (e.g., **.TAB** or **.T**)
  - **BPM EDITOR** for pallet tables **.P**
- ▶ Press the **OK** soft key

### Connecting and removing USB storage devices

The control automatically detects connected USB devices with a supported file system.

To remove a USB device:



- ▶ Move the cursor to the left-hand window
- ▶ Press the **MORE FUNCTIONS** soft key



- ▶ Remove the USB device

**Further information:** "USB devices on the control", Page 92



**ADVANCED ACCESS RIGHTS**

The **ADVANCED ACCESS RIGHTS** function can only be used in connection with user administration. This function requires the **public** directory.

**Further information:** "'public' directory", Page 566

Upon the first activation of user administration, the **public** directory below the **TNC:** drive will be connected.

**i** Access rights can only be defined for files located in the **public** directory.  
 For all files stored on the **TNC:** drive instead of the **public** directory, the **user** function user will automatically be assigned as the owner.

**Further information:** "'public' directory", Page 566

**Displaying hidden files**

The control hides system files, as well as files and folders whose name begins with a period.

**NOTICE**

**Caution: Possible loss of data!**

The control's operating system uses certain hidden folders and files. These folders and files are hidden by default. Any manipulation of the system data within the hidden folders might damage the control's software. If you save your own files to these folders, the system will create invalid paths.

- ▶ Always leave hidden folders and files hidden
- ▶ Do not use hidden folders and files for saving your own data

If required, you can show the hidden files and folders temporarily, e.g., if a file whose name begins with a period is transferred inadvertently.

To show hidden files and folders:



- ▶ Press the **MORE FUNCTIONS** soft key



- ▶ Press the **SHOW HIDDEN FILES** soft key
- ▶ The control displays the files and folders.

## Selecting drives, directories and files



- ▶ Call the file manager by pressing the **PGM MGT** key

Navigate with a connected mouse or use the arrow keys or the soft keys to move the cursor to the desired position on the screen:



- ▶ Moves the cursor from the left to the right window, and vice versa



- ▶ Moves the cursor up and down within a window



- ▶ Moves the cursor one page up or down within a window



### Step 1: Select drive

- ▶ Move the highlight to the desired drive in the left window



- ▶ Select a drive: Press the **SELECT** soft key, or



- ▶ Press the **ENT** key

### Step 2: Select a directory

- ▶ Move the highlight to the desired directory in the left window
- > The right-hand window automatically shows all files stored in the highlighted directory

**Step 3:** Select a file

- ▶ Press the **SELECT TYPE** soft key



- ▶ Press the **SHOW ALL** soft key
- ▶ Move the highlight to the desired file in the right window



- ▶ Press the **SELECT** soft key, or



- ▶ Press the **ENT** key
- ▶ The control opens the selected file in the operating mode from which you called the file manager.



If you enter the first letter of the file you are looking for in the file manager, the cursor automatically jumps to the first NC program with the same letter.

**Filtering the display**

To filter the displayed files:



- ▶ Press the **SELECT TYPE** soft key



- ▶ Press the soft key for the desired file type

Alternative:



- ▶ Press the **SHOW ALL** soft key
- ▶ The control displays all files in this folder.

Alternative:



- ▶ Use wildcards, such as **4\*.H**
- ▶ The control will show all files of file type .h whose name starts with 4.

Alternative:



- ▶ Enter the file name extension, e.g. **\*.H;\*.D**
- ▶ The control will show all files of file type .h and .d.

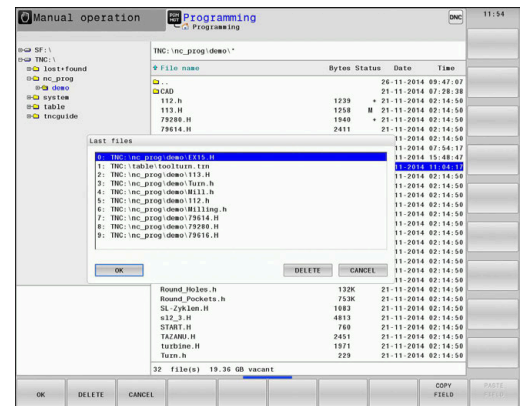
Any display filter you have set will remain effective even after a control restart,

## Choosing one of the last files selected

- ▶ Call the file manager: Press the **PGM MGT** key.
- ▶ Display the last ten files selected: Press the **LAST FILES** soft key

Press the arrow keys to move the cursor to the file you wish to select:

- ▶ Moves the cursor up and down within a window
- ▶ Select the file: Press the **OK** soft key, or
- ▶ Press the **ENT** key



**i** The **COPY FIELD** soft key allows you to copy the path of a marked file. You can reuse the copied path later (e.g., when calling a program with the **PGM CALL** key).

## USB devices on the control

**i** Use the USB port only for file transfer and backup. Before editing or running an NC program, save it to the hard disk of the control. This helps to avoid duplicate data maintenance and prevents potential problems resulting from data transfer during program run.

Backing up data from or loading onto the control is especially easy with USB devices. The control supports the following USB block devices:

- Floppy disk drives with FAT/VFAT file system
- Memory sticks with the FAT/VFAT or exFAT file system
- USB sticks with NTFS file system
- Hard disks with the FAT/VFAT file system
- CD-ROM drives with the Joliet (ISO 9660) file system

The control automatically detects these USB devices when they are plugged in. If the file system is not supported, the control issues an error message as soon as the stick is plugged in.

**i** If an error message is displayed when connecting a USB device, check the setting in the **SELinux** security software.  
**Further information:** "SELinux security software", Page 533

If the control displays the **USB: TNC does not support device** error message when using a USB hub, ignore and acknowledge the message with the **CE** key.

If the control repeatedly fails to detect a USB device with a file system supported by the control, connect another device to check the port. If this resolves the problem, use the properly working device.

**Working with USB devices**




**⚙️** Refer to your machine manual.  
 Your machine manufacturer can assign permanent names for USB devices.

The USB devices appear as separate drives in the directory tree, so you can use the file management functions described in the earlier chapters.

If a larger file is transferred to a USB device in the file manager, the control displays the **Write access on USB device** dialog until file transfer is completed. The dialog is closed with the **HIDE** soft key and file transfer is continued in the background. The control displays a warning until file transfer is completed.

**Removing USB devices**

To remove a USB device:

-  ▶ Move the cursor to the left-hand window
-  ▶ Press the **MORE FUNCTIONS** soft key
-  ▶ Remove the USB device

## Data transfer to or from an external data carrier



Before you can transfer data to an external data medium, you must set up the data interface.

**Further information:** "Setting up data interfaces", Page 506



- ▶ Press the **PGM MGT** key



- ▶ Press the **WINDOW** soft key to select the screen layout for file transfer



- ▶ Use the arrow keys to move the cursor to the file you want to transfer



- ▶ The control moves the cursor up and down within a window.



- ▶ The control moves the cursor from the right to the left window, and vice versa.



If you wish to copy a file from the control to the external data carrier, move the cursor in the left window to the file to be transferred.

If you wish to copy from the external data medium to the control, move the cursor in the right window to the file to be transferred.



- ▶ Press the **SHOW TREE** soft key to select another drive or directory
- ▶ Use the arrow keys to select the desired directory



- ▶ Press the **SHOW FILES** soft key
- ▶ Use the arrow keys to select the desired file



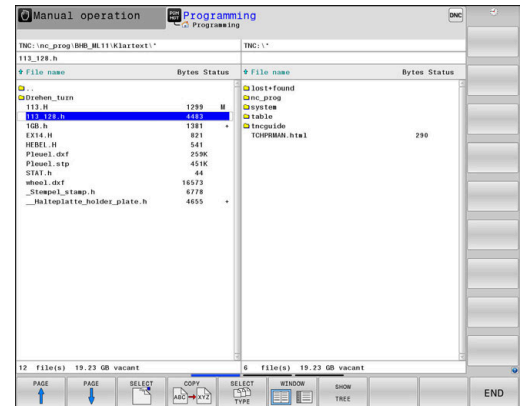
- ▶ Press the **COPY** soft key



- ▶ Confirm with the **ENT** key
- ▶ A status window appears on the control, informing about the copying progress.



- ▶ Alternative: Press the **WINDOW** soft key
- ▶ The control displays the standard file manager window again.



### Preventing incomplete NC programs

The control checks all NC programs for completeness before machining. The control displays a warning if the **END PGM** NC block is missing.

When you start the incomplete NC program in **Program run, single block** or **Program run, full sequence** operating mode, the control aborts with an error message.

Proceed as follows to edit the NC program:

- ▶ Select the NC program in **Programming** operating mode
  - ▶ The control opens the NC program and automatically adds the **END PGM** NC block.
  - ▶ Check the NC program, and complete it if necessary
- SAVE  
AS

  - ▶ Press the **SAVE AS** soft key
  - ▶ The control saves the NC program with the **END PGM** NC block that has been added.

### The control within the network

**i** Protect your data and the control by running the machines in a secure network.

You connect the control to the network via an Ethernet interface. On the control, you can define general network settings and connect network drives.

**Further information:** "Ethernet interface", Page 513

When the control is connected to a network and the file shares are connected, the control displays additional drives in the directory window. The functions for selecting a drive, copying files, etc. also apply to the network drives, provided that the corresponding permission is available.

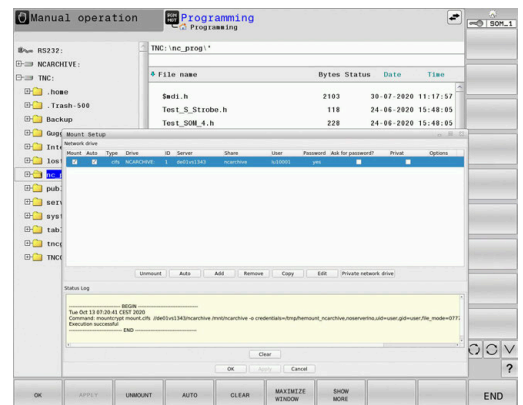
**i** The control logs any error messages that occur during network operation.

### NOTICE

#### Caution: Danger due to manipulated data!

If you execute NC programs directly from a network drive or a USB device, you have no control over whether the NC program has been changed or manipulated. In addition, the network speed can slow down the execution of the NC program. Undesirable machine movements or collisions may result.

- ▶ Copy the NC program and all called files to the **TNC:** drive



## Data backup

HEIDENHAIN recommends backing up new NC programs and files created on the control to a PC at regular intervals.

The free-of-charge **TNCremo** software from HEIDENHAIN is a simple and convenient method for backing up data stored on the control.

You can also backup files directly from the control.

**Further information:** "Backup and restore", Page 501

You additionally need a data medium on which all machine-specific data, such as the PLC program, machine parameters, etc., are stored. Ask your machine manufacturer for assistance, if necessary.

**i** Backing up all files of the internal memory can take several hours. If required, perform the backup during a time when you don't need the machine.  
Periodically delete files that are no longer required. This ensures that the control has enough memory available for system files, such as the tool table.

**i** HEIDENHAIN recommends having the hard disk inspected after three to five years. After this time, and depending on the operating conditions (e.g., vibration loads), you must expect increased failure rates.

## Importing a file from an iTNC 530

**⚙️** Refer to your machine manual.  
The machine manufacturer can adapt the **ADAPT NC PGM / TABLE** function.  
The machine manufacturer can define update rules that make it possible, for example, to automatically remove umlauts from tables and NC programs.

If you export a file from an iTNC 530 and import it into a TNC 640, depending on the file type you have to adapt its format and content before you can use the file.

The machine manufacturer defines which file types you will be able to import when using the **ADAPT NC PGM / TABLE** function. The control converts the contents of the imported file to a format valid for the TNC 640 and saves the changes to the selected file.

**Further information:** "Importing tool tables", Page 147



## Software tools for management of external file types

The software tools enable you to display or edit various externally created file types on the control.

File types	Description
PDF files (pdf)	Page 98
Excel spreadsheets (xls, csv)	Page 99
Internet files (htm, html)	Page 100
ZIP archives (zip)	Page 102
Text files (ASCII files, e.g. txt, ini)	Page 103
Video files (ogg, oga, ogv, ogx)	Page 103
Graphic files (bmp, gif, jpg, png)	Page 104



Files with the extensions pdf, xls, zip, bmp, gif, jpg and png must be transmitted in binary format from the PC to the control. Adapt the TNCremo software if required (menu item **Connection > Configuring a connection > Mode** tab).



If you are using a TNC 640 with touch control, you can replace some keystrokes with gestures.

**Further information:** "Operating the Touchscreen", Page 581

### Displaying PDF files

To open PDF files directly on the control:



- ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the directory in which the PDF file is saved
- ▶ Move the cursor to the PDF file



- ▶ Press the **ENT** key
- > The control opens the PDF file in its own application using the **PDF viewer** additional tool.



With the key combination ALT+TAB, you can always return to the control's user interface while leaving the PDF file open. Alternatively, you can also click the corresponding icon in the task bar to switch back to the user interface of the control.



If you position the mouse pointer over a button, a brief tool tip explaining the function of this button will be displayed. More information on how to use the **PDF viewer** is provided under **Help**.

To exit the **PDF viewer**:

- ▶ Use the mouse to select the **File** menu item
- ▶ Select the **Close** menu item
- > The control returns to the file manager.

If you are not using a mouse, close the **PDF viewer** as follows:



- ▶ Press the key for switching the soft keys
- > The **PDF viewer** opens the **File** select menu.





- ▶ Move the cursor to the **Close** menu item





- ▶ Press the **ENT** key
- > The control returns to the file manager.

**Displaying and editing Excel files**

To open and edit Excel files with the extension **xls**, **xlsx** or **csv** directly on the control:

-  ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the directory in which the Excel file is saved
- ▶ Move the cursor to the Excel file
-  ▶ Press the **ENT** key
- > The control opens the Excel file in its own application using the **Gnumeric** additional tool.




 With the key combination ALT+TAB, you can always return to the control's user interface while leaving the Excel file open. Alternatively, you can also click the corresponding icon in the task bar to switch back to the user interface of the control.

 If you position the mouse pointer over a button, a brief tool tip explaining the function of this button will be displayed. More information on how to use **Gnumeric** is provided under **Help**.

To exit **Gnumeric**:

- ▶ Use the mouse to select the **File** menu item
- ▶ Select **Close**
- > The control returns to the file manager.

If you are not using a mouse, close **Gnumeric** as follows:

-  ▶ Press the key for switching the soft keys
- > **Gnumeric** opens the **File** select menu.
-  ▶ Move the cursor to the **Close** menu item
-  ▶ Press the **ENT** key
- > The control returns to the file manager.

### Displaying Internet files

**i** The network must ensure protection against viruses and malicious software. The same applies to access to the Internet or other networks.

The protective measures for this network are the responsibility of the machine manufacturer and the respective network administrator, for example through a firewall.

To open Internet files with the extension **htm** or **html** directly on the control:

PGM  
MGT

- ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the directory in which the Internet file is saved

ENT

- ▶ Move the cursor to the Internet file
- ▶ Press the **ENT** key
- ▶ The control opens the Internet file in its own application using the **web browser** tool.

**i** With the key combination ALT+TAB, you can always return to the control's user interface while leaving the browser open. Alternatively, you can also click the corresponding icon in the task bar to switch back to the user interface of the control.

**i** If you position the mouse pointer over a button, a brief tool tip explaining the function of this button will be displayed. More information on how to use the **web browser** is provided under **Help**.

After starting the **web browser**, it checks at regular intervals whether updates are available.

You can update the **web browser** only if you deactivate the **SELinux** security software during this period and if a connection with the Internet is available.

**i** Reactivate **SELinux** again after the update.

To exit the **web browser**:

- ▶ Use the mouse to select the **File** menu item
- ▶ Select **Quit**
- > The control returns to the file manager.

If you are not using a mouse, close the **web browser** as follows:



- ▶ Press the soft-key switchover key: The **web browser** opens the **File** selection menu



- ▶ Move the cursor to the **Quit** menu item



- ▶ Press the **ENT** key
- > The control returns to the file manager.

### Working with ZIP archives

To open ZIP archives with the extension **zip** directly on the control:



- ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the directory in which the archive file is saved
- ▶ Move the cursor to the archive file



- ▶ Press the **ENT** key
- ▶ The control opens the archive file in its own application using **Xarchiver**.



With the key combination ALT+TAB, you can always return to the control's user interface while leaving the archive file open. Alternatively, you can also click the corresponding icon in the task bar to switch back to the user interface of the control.



If you position the mouse pointer over a button, a brief tool tip explaining the function of this button will be displayed. More information on how to use **Xarchiver** is provided under **Help**.

To exit **Xarchiver**:

- ▶ Use the mouse to select the **ARCHIVE** menu item
- ▶ Select the **Exit** menu item
- ▶ The control returns to the file manager.

If you are not using a mouse, close **Xarchiver** as follows:



- ▶ Press the key for switching the soft keys
- ▶ **Xarchiver** opens the **ARCHIVE** select menu.



- ▶ Move the cursor to the **Exit** menu item



- ▶ Press the **ENT** key
- ▶ The control returns to the file manager.

### Displaying or editing text files

Use the internal text editor to open and edit text files (ASCII files, e.g. with the extension **txt**). Proceed as follows:

PGM  
MGT

- ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the drive and the directory in which the text file is saved
- ▶ Move the cursor to the text file

ENT

- ▶ Press the **ENT** key
- ▶ The control opens the text file with the internal text editor.



Alternatively, you can also open the ASCII files using **Leafpad**. The shortcuts you are familiar with from Windows, which you can use to edit texts quickly (CTRL+C, CTRL+V,...), are available within **Leafpad**.



With the key combination ALT+TAB, you can always return to the control's user interface while leaving the text file open. Alternatively, you can also click the corresponding icon in the task bar to switch back to the user interface of the control.

To open **Leafpad**:

- ▶ Use the mouse to select the **Menu HEIDENHAIN** icon from the task bar
- ▶ Select the **Tools** and **Leafpad** menu items in the selection menu

To exit **Leafpad**:

- ▶ Use the mouse to select the **File** menu item
- ▶ Select the **Exit** menu item
- ▶ The control returns to the file manager.

### Displaying video files



This function must be enabled and adapted by the machine manufacturer.

To open video files with the extension **ogg**, **oga**, **ogv** or **ogx** directly on the control:

PGM  
MGT

- ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the directory in which the video file is saved
- ▶ Move the cursor to the video file

ENT

- ▶ Press the **ENT** key
- ▶ The control opens the video file in its own application.



The paid-for Fluendo Codec Pack is required for other formats, such as for MP4 files.



Any additional software will be installed by your machine manufacturer.

### Displaying graphics files

To open graphics files with the extension **bmp, gif, jpg** or **png** directly on the control:

PGM  
MGT

- ▶ Call the file manager: Press the **PGM MGT** key
- ▶ Select the directory in which the graphics file is saved
- ▶ Move the cursor to the graphics file

ENT

- ▶ Press the **ENT** key
- > The control opens the graphics file in its own application using the **Ristretto** software tool.



With the key combination ALT+TAB, you can always return to the control's user interface while leaving the graphics file open. Alternatively, you can also click the corresponding icon in the task bar to switch back to the user interface of the control.



More information on how to use **Ristretto** can be found under **Help**.



To exit **Ristretto**:

- ▶ Use the mouse to select the **File** menu item
- ▶ Select the **Exit** menu item
- > The control returns to the file manager.

If you are not using a mouse, close the **Ristretto** software tool as follows:



- ▶ Press the key for switching the soft keys
- > **Ristretto** opens the **File** selection menu.



- ▶ Move the cursor to the **Exit** menu item



- ▶ Press the **ENT** key
- > The control returns to the file manager.

## 3.6 Error messages and help system

### Error messages







#### Display of errors

The control displays error messages in the following cases, for example:

- Incorrect input
- Logical errors in the NC program
- Contour elements that are impossible to machine
- Incorrect use of touch probes
- Hardware updates

When an error occurs, the control displays it in the header.

The control uses the following icons and text colors for different error classes:

Icon	Text color	Error class	Meaning
	Red	Error Prompt	The control displays a dialog with several options you can select from. <b>Further information:</b> "Detailed error messages", Page 107
	Red	Reset error	The control must be restarted. This message cannot be cleared.
	Red	Error	To continue, you must clear this message. An error message can only be cleared after the cause has been eliminated.
	Yellow	Warning	You can continue without clearing the message. Most warnings can be cleared at any time; in some cases, the cause has to be eliminated first.
	Blue	Information	You can continue without clearing the message. You can clear the information at any time.
	Green	Note:	You can continue without clearing the message. The control displays the note until you press the next valid key.

The table rows are ordered by priority. The control displays a message in the header until it is cleared or replaced by a higher-priority message (higher error class).

The control displays long and multi-line error messages in abbreviated form. The complete information on all pending errors is shown in the error window.

An error message that contains an NC block number was caused by an error in the indicated NC block or in the preceding NC block.

#### Opening the error window

When you open the error window, the complete information on all pending errors will be shown.



- ▶ Press the **ERR** key
- > The control opens the error window and displays all accumulated error messages.

**Detailed error messages**

The control displays possible causes of the error and suggestions for solving the problem:

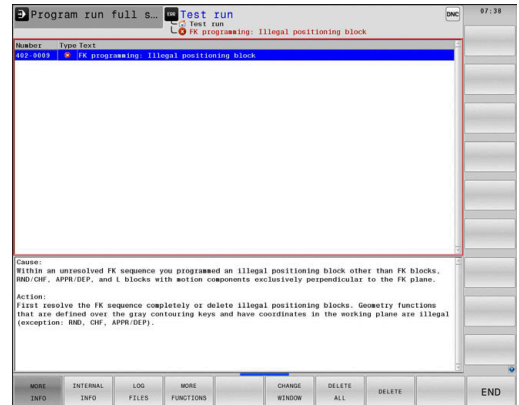
- ▶ Open the error window
- ▶ Position the cursor on the corresponding error message



- ▶ Press the **MORE INFO** soft key
- ▶ The control opens a window with information on the error cause and corrective action.



- ▶ Exit the info: Press the **MORE INFO** soft key again



**High-priority error messages**

When an error message occurs at switch-on of the control due to hardware changes or updates, the control will automatically open the error window. The control displays an error of the question type.

You can correct this error only by pressing the corresponding soft key to acknowledge the question. If necessary, the control continues the dialog until the cause or correction of the error has been clearly determined.

If a rare **processor check error** should occur, the control will automatically open the error window. You cannot correct such an error.

Proceed as follows:

- ▶ Shut down the control
- ▶ Restart

**INTERNAL INFO soft key**

The **INTERNAL INFO** soft key supplies information on the error message. This information is only required if servicing is needed.

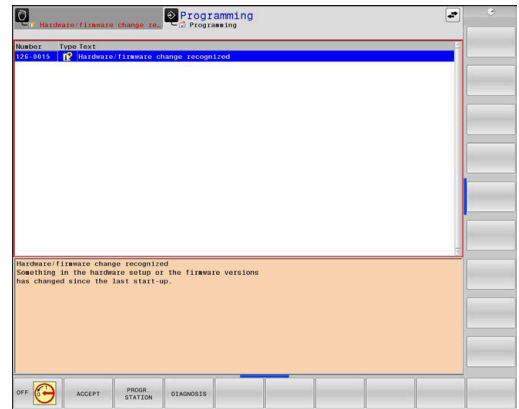
- ▶ Open the error window
- ▶ Position the cursor on the corresponding error message



- ▶ Press the **INTERNAL INFO** soft key
- ▶ The control opens a window with internal information about the error.







- ▶ Exit the detailed information: Press the **INTERNAL INFO** soft key again



### GROUPING soft key






If you activate the **GROUPING** soft key, the control displays all warnings and error messages with the same error number in the same line of the error window. This makes the list of messages shorter and easier to read.

To group the error messages:


-  ▶ Open the error window
-  ▶ Press the **MORE FUNCTIONS** soft key
-  ▶ Press the **GROUPING** soft key
  - > The control groups identical warnings and error messages.
  - > The number of occurrences of the individual messages is indicated in parentheses in the respective line.
-  ▶ Press the **GO BACK** soft key

### ACTIVATE AUTOMATIC SAVING soft key

The **ACTIVATE AUTOMATIC SAVING** soft key allows you to specify error numbers that cause the control to save a service file if an error with that number occurs.


-  ▶ Open the error window
-  ▶ Press the **MORE FUNCTIONS** soft key
-  ▶ Press the **ACTIVATE AUTOMATIC SAVING** soft key
  - > The control opens the **ACTIVATE AUTOMATIC SAVING** pop-up window.
  - ▶ Define the entries
    - **Error number:** Enter the desired error number
    - **active:** Enable this option to automatically create the service file
    - **Comment:** Enter a comment on this error number, if required
-  ▶ Press the **STORE** soft key
  - > If an error with the specified error number occurs, a service file will be saved automatically.
-  ▶ Press the **GO BACK** soft key


**Deleting errors**

 The control can automatically clear pending warning or error messages when an NC program is selected or restarted. The machine manufacturer specifies in the optional machine parameter **CfgClearError** (no. 130200) whether these messages will automatically be cleared.

The factory default setting of the control defines that warning and error messages in the **Test Run** and **Programming** operating modes will be cleared automatically from the error window. Messages issued in the machine operating modes will not be cleared.



**Clearing errors outside of the error window**


-  **CE**
- ▶ Press the **CE** key
  - ▶ The control clears the errors or notes being displayed in the header.

 In certain situations you cannot use the **CE** key for clearing the errors because the key is used for other functions.

**Clearing errors**





- ▶ Open the error window
- ▶ Position the cursor on the corresponding error message

-  **DELETE**
- ▶ Press the **DELETE** soft key
-  **DELETE ALL**
- ▶ As an alternative, clear all errors: Press the **DELETE ALL** soft key

 If the cause of the error has not been corrected, the error message cannot be cleared. In this case, the error message remains in the window.

**Error log**





The control stores errors occurred and important events (e.g., system start) in an error log. The capacity of the error log is limited. When the log is full, the control uses a second file. When this is also full, the first error log is deleted and newly written etc. If required, switch from **CURRENT FILE** to **PREVIOUS FILE** to view the history.

- ▶ Open the error window
  -  **LOG FILES** ▶ Press the **LOG FILES** soft key
  -  **ERROR LOG** ▶ Open the error log file: Press the **ERROR LOG** soft key
  -  **PREVIOUS FILE** ▶ Set the previous error log if required: Press the **PREVIOUS FILE** soft key
  -  **CURRENT FILE** ▶ Set the current error log if required: Press the **CURRENT FILE** soft key

The oldest entry is at the beginning of the log file, and the most recent entry is at the end.









### Keystroke log

The control stores each key pressed and important events (e.g., system start) in a keystroke log. The capacity of the keystroke log is limited. When the keystroke log is full, the control switches to a second keystroke log. When this is also full, the first keystroke log is deleted and newly written, etc. If required, switch from **CURRENT FILE** to **PREVIOUS FILE** to view the history of the inputs.

	▶ Press the <b>LOG FILES</b> soft key
	▶ Open the keystroke log file: Press the <b>KEYSTROKE LOG</b> soft key
	▶ Set the previous keystroke log if required: Press the <b>PREVIOUS FILE</b> soft key
	▶ Set the current keystroke log if required: Press the <b>CURRENT FILE</b> soft key

The control saves each key pressed during operation in a keystroke log. The oldest entry is at the beginning, and the most recent entry is at the end of the file.

### Overview of the keys and soft keys for viewing the log


Soft key/ Keys	Function
	Go to beginning of keystroke log
	Go to end of keystroke log
	Find text
	Current keystroke log
	Previous keystroke log
	Up/down one line
	Up/down one line
	Return to main menu

**Informational texts**

If an operating error occurred, e.g. pressing an impermissible key or entering a value outside of a validity range, the control displays an information text in the header to inform you of the operating error. The control deletes this information text with the next valid entry.





**Saving service files**

If necessary, you can save the current situation of the control and make it available to a service technician for evaluation. A group of service files is saved (error and keystroke logs as well as other files that contain information about the current status of the machine and the machining).

 In order to facilitate sending service files via email, the control will only save active NC programs with a size of up to 10 MB in the service file. If the NC program is larger, it will not be added to the created service file.



When the same name is entered several times in the **SAVE SERVICE FILES** function, the control saves up to five files and deletes the file with the oldest timestamp, as needed. Make a backup of the service files you created (e.g., by moving them to a different folder).

**Saving service files**

-  ▶ Open the error window
  
-  ▶ Press the **LOG FILES** soft key
  
-  ▶ Press the **SAVE SERVICE FILES** soft key  
 > The control opens a pop-up window in which you can enter a file name or a complete path for the service file.
  
-  ▶ Press the **OK** soft key  
 > The control saves the service file.

**Closing the error window**

To close the error window:

-  ▶ Press the **END** soft key
  
-  ▶ Alternative: Press the **ERR** key  
 > The control closes the error window.

## TNCguide: context-sensitive help

### Application

**i** Before you can use **TNCguide**, you need to download the help files from the HEIDENHAIN home page.

**Further information:** "Downloading current help files", Page 116

The **TNCguide** context-sensitive help system contains the user documentation in HTML format. To call **TNCguide**, press the **HELP** key. The control often immediately displays the information specific to the situation in which the help was called (context-sensitive call). If you are editing an NC block and press the **HELP** key, you are usually taken to the exact place in the documentation that describes the corresponding function.

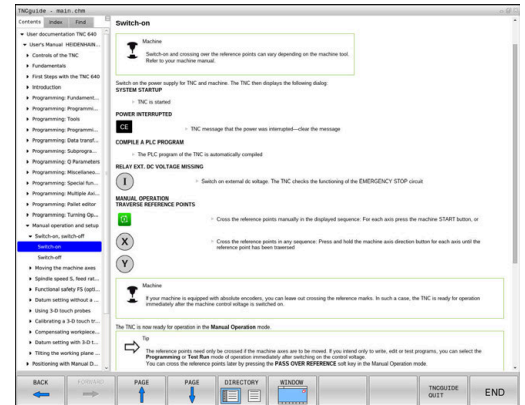
**i** The control tries to start **TNCguide** in the language that you have selected as the user interface language. If the required language version is not available, the control automatically uses the English version.

The following user documentation is available in **TNCguide**:

- User's Manual for Klartext Programming (**BHBKlartext.chm**)
- User's Manual for ISO programming (**BHBIso.chm**)
- User's Manual for Setup, Testing and Running NC Programs (**BHBoperate.chm**)
- User's Manual for Programming of Machining Cycles (**BHBcycle.chm**)
- User's Manual for Programming of Measuring Cycles for Workpieces and Tools (**BHBtchprobe.chm**)
- User's Manual for the **TNCdiag** application, if necessary (**TNCdiag.chm**)
- List of All Error Messages (**errors.chm**)

In addition, the **main.chm** "book" file is available, in which all existing .chm files are shown in one place.

**i** As an option, your machine manufacturer can embed machine-specific documentation in **TNCguide**. These documents then appear as a separate book in the **main.chm** file.





### Using TNCguide

#### Calling TNCguide

You have several options for starting **TNCguide**:

- Use the **HELP** key
- First click the help symbol in the lower right-hand corner of the screen, then click the appropriate soft key
- Open a help file (.chm file) via the file management. The control can open any .chm file, even if it is not saved in the control's internal memory

**i** On the Windows programming station, **TNCguide** is opened in the internally defined standard browser.

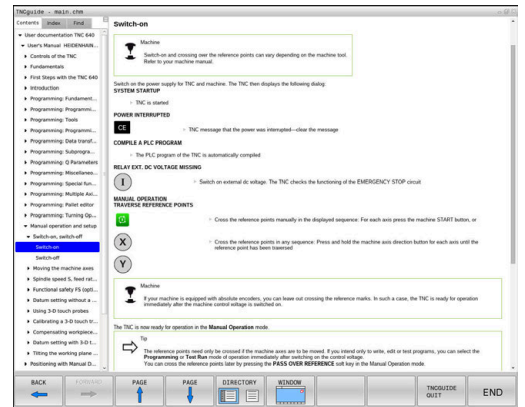
For many soft keys there is a context-sensitive call through which you can go directly to the description of the soft key's function. This functionality requires using a mouse.

Proceed as follows:

- ▶ Select the soft-key row containing the desired soft key
- ▶ Click with the mouse on the help symbol that the control displays just above the soft-key row
- > The mouse pointer turns into a question mark.
- ▶ Move the question mark to the soft key for which you want an explanation
- > The control opens **TNCguide**. If there is no entry point for the selected soft key, then the control opens the book file **main.chm**. You can search for the desired explanation using full text search or by using the navigation.

Even if you are editing an NC block, context-sensitive help is available:

- ▶ Select any NC block
- ▶ Select the desired word
- ▶ Press the **HELP** key.
- > The control opens the Help system and shows the description of the active function. This does not apply for miscellaneous functions or cycles from your machine manufacturer.



















### Navigating in TNCguide

It's easiest to use the mouse to navigate in **TNCguide**. A table of contents appears on the left side of the screen. Clicking on the rightward pointing triangle opens subordinate sections, and clicking on the respective entry opens the corresponding page. You can use it in the same way as Windows Explorer.

Linked text positions (cross references) are shown underlined and in blue. Clicking the link opens the associated page.

Of course you can also operate TNCguide through keys and soft keys. The following table contains an overview of the corresponding key functions.

Soft key/ Keys	Function
	<ul style="list-style-type: none"> <li>■ If the table of contents at left is active: Select the entry above it or below it</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the text window at right is active: Move the page downward or upward if texts or graphics are not shown completely</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the table of contents at left is active: Expand the table of contents</li> <li>■ If the text window at right is active: No function</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the table of contents at left is active: Collapse the table of contents</li> <li>■ If the text window at right is active: No function</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the table of contents at left is active: Use the cursor key to show the selected page</li> <li>■ If the text window at right is active: If the cursor is on a link, jump to the linked page</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the table of contents at left is active: Switch the tab between the display of the table of contents, display of the subject index, and the full-text search function and switching to the right side of the window</li> <li>■ If the text window at right is active: Jump back to the left side of the window</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the table of contents at left is active: Select the entry above it or below it</li> </ul>
	<ul style="list-style-type: none"> <li>■ If the text window at right is active: Jump to next link</li> </ul>
	Select the page last shown
	Page forward if you have used the <b>Select page last shown</b> function
	Go back one page
	Go forward one page

Soft key/ Keys	Function
	Display or hide table of contents
	Switch between full-screen display and reduced display. With the reduced display you can see some of the rest of the control window
	The focus is returned to the control application so that you can operate the control while <b>TNCguide</b> is open. If the full screen is active, the control reduces the window size automatically before the focus changes
	Exit <b>TNCguide</b>

### Subject index

The most important subjects in the Manual are listed in the subject index (**Index** tab). You can select them directly by mouse or with the arrow keys.

The left side is active.



- ▶ Select the **Index** tab
- ▶ Use the arrow keys or the mouse to select the desired keyword
- Alternative:
  - ▶ Enter the first few characters
  - ▶ The control synchronizes the subject index and creates a list in which you can find the subject more easily.
- ▶ Use the **ENT** key to call the information on the selected keyword

### Full-text search

On the **Find** tab, you can search all of **TNCguide** for a specific word.

The left side is active.



- ▶ Select the **Find** tab
- ▶ Activate the **Find:** entry field
- ▶ Enter the search word
- ▶ Press the **ENT** key
- ▶ The control lists all sources containing the word.
- ▶ Use the arrow keys to navigate to the desired source
- ▶ Press the **ENT** key to go to the selected source



The full-text search only works for single words. If you activate the **Search only in titles** function, the control searches only through headings and ignores the body text. To activate the function, use the mouse or select it and then press the space bar to confirm.

### Downloading current help files

You'll find the help files for your control software on the HEIDENHAIN website:

[http://content.heidenhain.de/doku/tnc\\_guide/html/en/index.html](http://content.heidenhain.de/doku/tnc_guide/html/en/index.html)

Navigate to the suitable help file as follows:

- ▶ TNC controls
- ▶ Series (e.g., TNC 600)
- ▶ Desired NC software number, such as TNC 640 (34059x-18)



HEIDENHAIN has simplified the version schema, starting with NC software version 16:

- The publication period determines the version number.
- All control models of a publication period have the same version number.
- The version number of the programming stations corresponds to the version number of the NC software.

- ▶ Select the desired language version from the **TNCguide online help (CHM files)** table
- ▶ Download the ZIP file
- ▶ Extract the ZIP file
- ▶ Move the extracted CHM files to the **TNC:\tncguide\en** directory or the respective language subdirectory on the control



When using **TNCremo** to transfer the CHM files to the control, select the binary mode for files with the **.chm** extension.

Language	TNC directory
German	TNC:\tncguide\de
English	TNC:\tncguide\en
Czech	TNC:\tncguide\cs
French	TNC:\tncguide\fr
Italian	TNC:\tncguide\it
Spanish	TNC:\tncguide\es
Portuguese	TNC:\tncguide\pt
Swedish	TNC:\tncguide\sv
Danish	TNC:\tncguide\da
Finnish	TNC:\tncguide\fi
Dutch	TNC:\tncguide\nl
Polish	TNC:\tncguide\pl
Hungarian	TNC:\tncguide\hu
Russian	TNC:\tncguide\ru
Chinese (simplified)	TNC:\tncguide\zh
Chinese (traditional)	TNC:\tncguide\zh-tw

<b>Language</b>	<b>TNC directory</b>
Slovenian	TNC:\tncguide\sl
Norwegian	TNC:\tncguide\no
Slovak	TNC:\tncguide\sk
Korean	TNC:\tncguide\kr
Turkish	TNC:\tncguide\tr
Romanian	TNC:\tncguide\ro

## 3.7 NC fundamentals

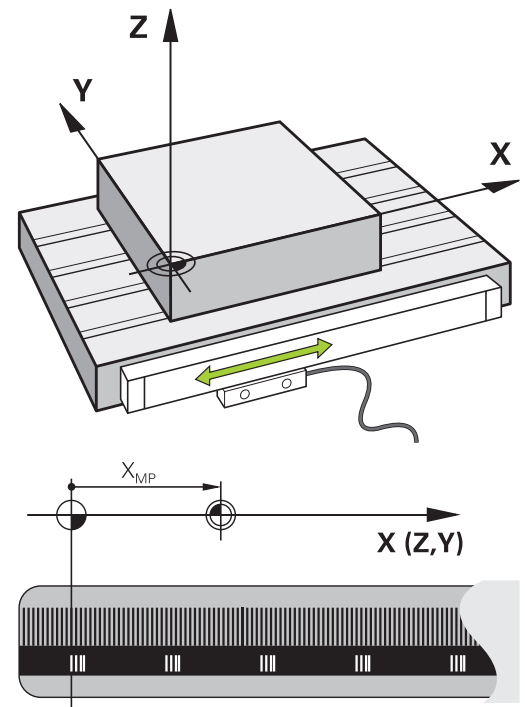
### Position encoders and reference marks

The machine axes are equipped with position encoders that register the positions of the machine table or tool. Linear axes are usually equipped with linear encoders, rotary tables and tilting axes with angle encoders.

When a machine axis moves, the corresponding position encoder generates an electrical signal. The control evaluates this signal and calculates the precise actual position of the machine axis.

If there is a power interruption, the calculated position will no longer correspond to the actual position of the machine slide. To recover this assignment, incremental position encoders are provided with reference marks. When a reference mark is crossed over, a signal identifying a machine-based reference point is transmitted to the control. This enables the control to re-establish the assignment of the displayed position to the current machine position. For linear encoders with distance-coded reference marks, the machine axes need to move by no more than 20 mm, for angle encoders by no more than 20°.

With absolute encoders, an absolute position value is transmitted to the control immediately upon switch-on. In this way the assignment of the actual position to the machine slide position is re-established directly after switch-on.

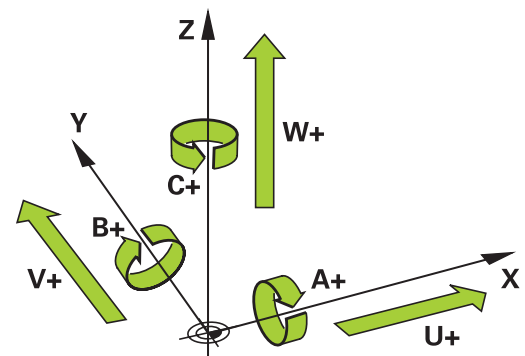


### Programmable axes

In the default setting, the programmable axes of the control are in accordance with the axis definitions specified in DIN 66217.

The designations of the programmable axes are given in the table below.

Main axis	Parallel axis	Rotary axis
X	U	A
Y	V	B
Z	W	C



Refer to your machine manual.

The number, designation and assignment of the programmable axes depend on the machine.

Your machine manufacturer can define further axes, such as PLC axes.

## Reference systems

For the control to move an axis in accordance with a defined path, it requires a **reference system**.

A paraxially mounted linear encoder on a machine tool serves as a simple reference system for linear axes. The linear encoder represents a **number ray**, a one-dimensional coordinate system.

To approach a point on the **plane**, the control requires two axes and therefore a reference system with two dimensions.

To approach a point in **space**, the control requires three axes and therefore a reference system with three dimensions. If these three axes are arranged perpendicularly to each other, this creates a **three-dimensional Cartesian coordinate system**.



According to the right-hand rule the fingertips point in the positive directions of the three principal axes.

For a point to be uniquely determined in space, a **coordinate origin** is needed in addition to the arrangement of the three dimensions. The common intersection serves as the coordinate origin in a 3-D coordinate system. This intersection has the coordinates **X+0, Y+0, and Z+0**.

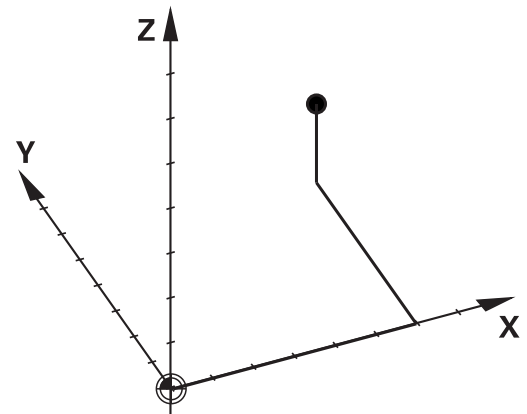
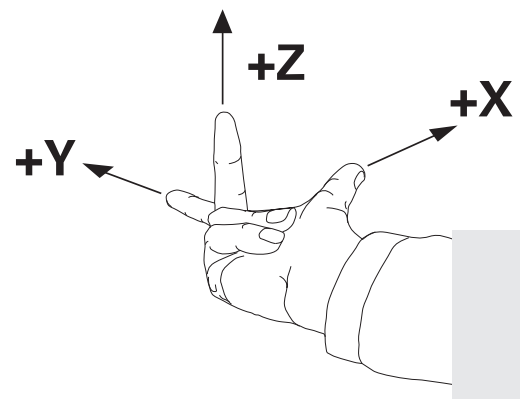
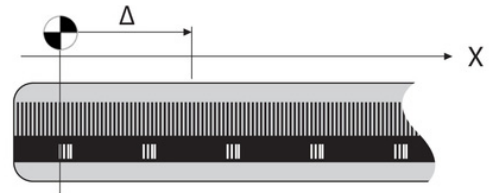
In order, for example, for the control to always perform a tool change at the same position, as well as always execute a machining operation referenced to the current workpiece position, the control must be able to differentiate between different reference systems.

The control differentiates between the following reference systems:

- Machine coordinate system M-CS:  
**M**achine **C**oordinate **S**ystem
- Basic coordinate system B-CS:  
**B**asic **C**oordinate **S**ystem
- Workpiece coordinate system W-CS:  
**W**orkpiece **C**oordinate **S**ystem
- Working plane coordinate system WPL-CS:  
**W**orking **P**lane **C**oordinate **S**ystem
- Input coordinate system I-CS:  
**I**nterface **C**oordinate **S**ystem
- Tool coordinate system T-CS:  
**T**ool **C**oordinate **S**ystem



All reference systems build upon each other. They are subject to the kinematic chain of the specific machine tool. The machine coordinate system is the reference system.



### Machine coordinate system M-CS

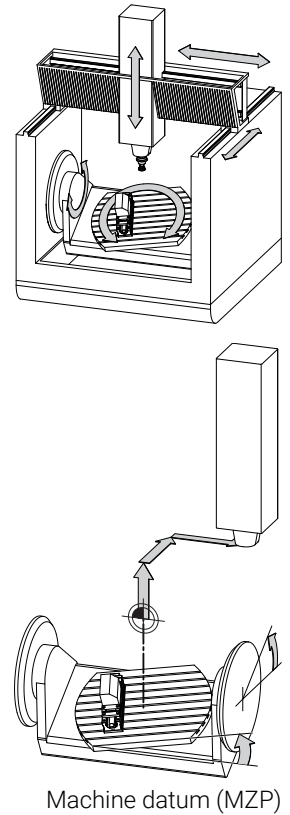
The machine coordinate system corresponds to the description of kinematics and therefore to the actual mechanical design of the machine tool.





Because the mechanics of a machine tool never precisely correspond to a Cartesian coordinate system, the machine coordinate system consists of several one-dimensional coordinate systems. These one-dimensional coordinate systems correspond to the physical machine axes that are not necessarily perpendicular to each other.

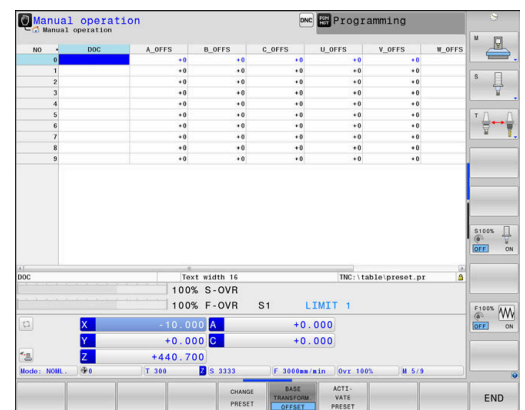
The position and orientation of the one-dimensional coordinate systems are defined with the aid of translations and rotations based on the spindle tip in the description of kinematics.

The position of the coordinate origin, the machine datum, is defined by the machine manufacturer during machine configuration. The values in the machine configuration define the zero positions of the encoders and the corresponding machine axes. The machine datum does not necessarily have to be located in the theoretical intersection of the physical axes. It can therefore also be located outside of the traverse range.

Because the machine configuration values cannot be modified by the user, the machine coordinate system is used for determining constant positions (e.g., the tool change point).



Soft key	Application
	The user can define shifts in the machine coordinate system according to the specific axis with use of the <b>OFFSET</b> values of the preset table.
	The user can define shifts of the rotary and parallel axes according to the specific axis with use of the datum table.
	The user can define shifts of the rotary and parallel axes according to the specific axis with use of the <b>TRANS DATUM</b> function.
	The machine manufacturer configures the <b>OFFSET</b> columns of the preset management in accordance with the machine.



**Further information:** "Preset management", Page 202



**NOTICE****Danger of collision!**

Your control may feature an additional pallet preset table, depending on the machine. In this table the machine manufacturer can define **OFFSET** values that take effect before the **OFFSET** values you specify in the preset table become effective. The **PAL** tab of the additional status display indicates whether a pallet preset is active, and which one. Since the **OFFSET** values of the pallet preset table are neither shown nor editable, there is a risk of collision during all movements!

- ▶ Refer to the machine manufacturer's documentation
- ▶ Use pallet presets only in conjunction with pallets
- ▶ Check the display of the **PAL** tab before you start machining

**i** The **Global Program Settings** function (option 44) additionally provides the **Additive offset (M-CS)** transformation for the tilting axes. This transformation is added to the **OFFSET** values from the preset table and pallet preset table.

**i** Another feature is **OEM-OFFSET**, which is available only to the machine manufacturer. **OEM-OFFSET** can be used to define additive axis shifts for rotary and parallel axes. The sum of all **OFFSET** values (from all the above **OFFSET** input options) results in the difference between the **ACTL.** position and the **RFACTL** position of an axis.

The control converts all movements in the machine coordinate system, independent of the reference system used for value input.

Example of a 3-axis machine tool with a Y axis as oblique axis, not arranged perpendicularly to the ZX plane:

- ▶ In the **Positioning w/ Manual Data Input** operating mode, run an NC block with **L IY+10**
- > The control determines the required axis nominal values from the defined values.
- > During positioning the control moves the **Y and Z** machine axes.
- > The **RFACTL** and **RFNOML** displays show movements of the Y axis and Z axis in the machine coordinate system.
- > The **ACTL.** and **NOML.** displays show only a movement of the Y axis in the input coordinate system.
- ▶ In the **Positioning w/ Manual Data Input** operating mode, run an NC block with **L IY-10 M91**
- > The control determines the required axis nominal values from the defined values.
- > During positioning the control moves only the **Y** machine axis.
- > The **RFACTL** and **RFNOML** displays show only a movement of the Y axis in the machine coordinate system.
- > The **ACTL.** and **NOML.** displays show movements of the Y axis and Z axis in the input coordinate system.

The user can program positions related to the machine datum (e.g., by using the miscellaneous function **M91**).

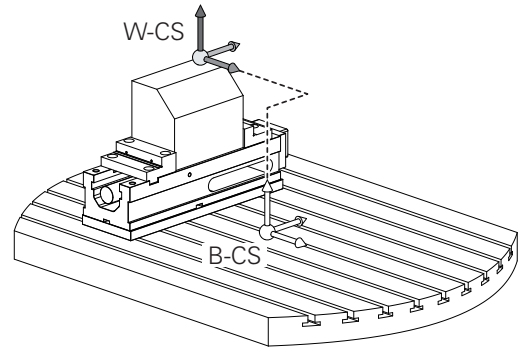
**Basic coordinate system B-CS**

The basic coordinate system is a 3-D Cartesian coordinate system. Its coordinate origin is the end of the kinematics model.

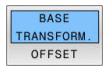
The orientation of the basic coordinate system in most cases corresponds to that of the machine coordinate system. There may be exceptions to this if a machine manufacturer uses additional kinematic transformations.

The kinematic model and thus the position of the coordinate origin for the basic coordinate system is defined by the machine manufacturer in the machine configuration. The user cannot modify the machine configuration values.


The basic coordinate system serves to determine the position and orientation of the workpiece coordinate system.

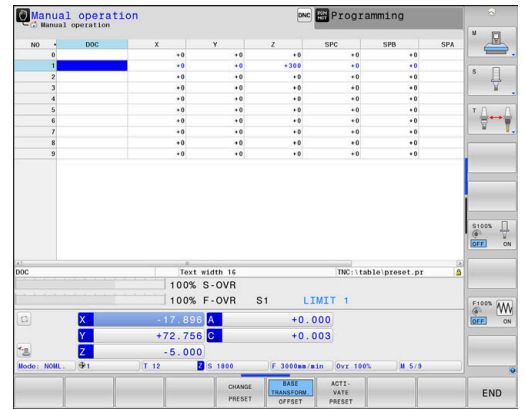


**Soft key      Application**



The user determines the position and orientation of the workpiece coordinate system by using a 3-D touch probe, for example. The control saves the values determined with respect to the basic coordinate system as **BASE TRANSFORM** values in the preset management.

 The machine manufacturer configures the **BASE TRANSFORM** columns of the preset management in accordance with the machine.



**Further information:** "Preset management", Page 202

**NOTICE**

**Danger of collision!**

Your control may feature an additional pallet preset table, depending on the machine. In this table the machine manufacturer can define **BASE TRANSFORM** values that take effect before the **BASE TRANSFORM** values you specify in the preset table become effective. The **PAL** tab of the additional status display indicates whether a pallet preset is active, and which one. Since the **BASE TRANSFORM** values of the pallet preset table are neither visible nor editable, there is danger of collision during all movements!

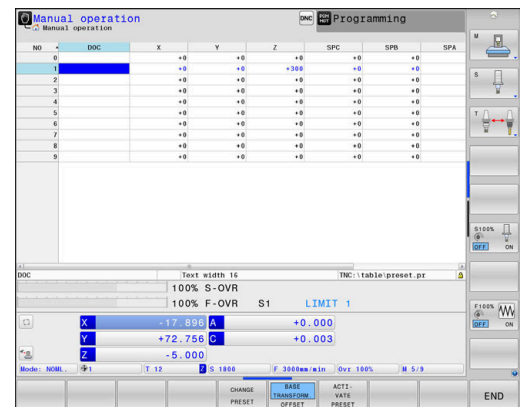
- ▶ Refer to the machine manufacturer's documentation
- ▶ Use pallet presets only in conjunction with pallets
- ▶ Check the display of the **PAL** tab before you start machining

### Workpiece coordinate system W-CS

The workpiece coordinate system is a 3-D Cartesian coordinate system. Its coordinate origin is the active reference point.

The position and orientation of the workpiece coordinate system depend on the **BASE TRANSFORM** values of the active line in the preset table.

Soft key	Application
	The user determines the position and orientation of the workpiece coordinate system by using a 3-D touch probe, for example. The control saves the values determined with respect to the basic coordinate system as <b>BASE TRANSFORM</b> values in the preset management.



**Further information:** "Preset management", Page 202



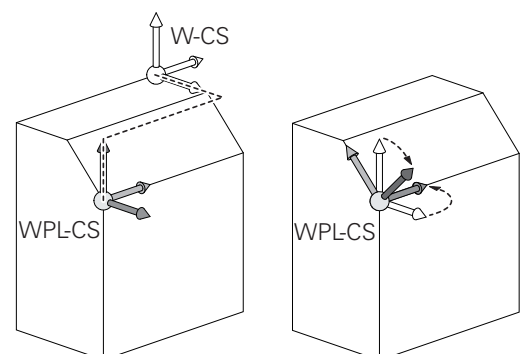
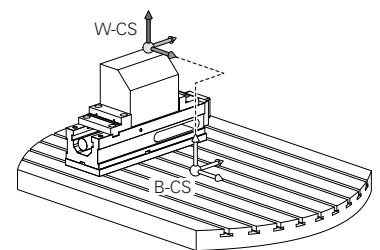
The **Global Program Settings** function (option 44) additionally provides the following transformations:

- The **Additive basic rotat. (W-CS)** is added to a basic rotation or a 3-D basic rotation from the preset table and the pallet preset table. The **Additive basic rotat. (W-CS)** is the first transformation that is possible in the workpiece coordinate system (W-CS).
- **Shift (W-CS)** is added to the shift (Cycle **7 DATUM SHIFT**) that is defined in the NC program before tilting the working plane.
- **Mirroring** is added to the mirroring (Cycle **8 MIRRORING**) that is defined in the NC program before tilting the working plane.
- The **Shift (mW-CS)** is effective in the "modified workpiece coordinate system" after applying the **Shift (W-CS)** or **Mirroring (W-CS)** transformations and before tilting the working plane.

In the workpiece coordinate system the user defines the position and orientation of the working plane coordinate system with use of transformations.

Transformations in the workpiece coordinate system:

- **3D ROT** functions
  - **PLANE** functions
  - Cycle **19 WORKING PLANE**
- Axes **X, Y, Z** of Cycle **7 DATUM SHIFT** or function **TRANS DATUM** (shifting **before** tilting the working plane)
- Columns **X, Y, Z** of the datum table (shifting **before** tilting the working plane)
- Cycle **8 MIRRORING** or **TRANS MIRROR** (mirroring **before** tilting the working plane)



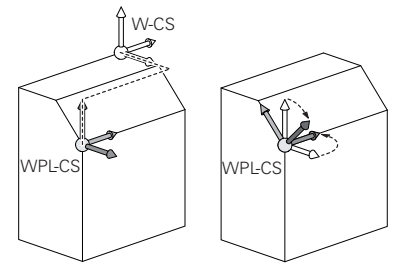
- i** The result of transformations built up on each other depends on the programming sequence.
- In every coordinate system, program only the specified (recommended) transformations. This applies to both setting and resetting the transformations. Any other use may lead to unexpected or undesired results. Please observe the following programming notes.
- Programming notes:
- Transformations (mirroring and shifting) that are programmed before the **PLANE** functions (except for **PLANE AXIAL**) will change the position of the tilt datum (origin of the working plane coordinate system WPL-CS) and the orientation of the rotary axes
    - If you just program a shift, then only the position of the tilt datum will change
    - If you just program mirroring, then only the orientation of the rotary axes will change
  - When used in conjunction with **PLANE AXIAL** and Cycle **19**, the programmed transformations (mirroring, rotation, and scaling) do not affect the position of the tilt datum or the orientation of the rotary axes

- i** Without active transformations in the workpiece coordinate system, the position and orientation of the working plane coordinate system and workpiece coordinate system are identical.
- There are no transformations in the workpiece coordinate system on 3-axis machine tools or with pure 3-axis machining. The **BASE TRANSFORM.** values of the active line of the preset table have a direct effect on the working plane coordinate system with this assumption.
- Other transformations are of course possible in the working plane coordinate system
- Further information:** "Working plane coordinate system WPL-CS", Page 126

### Working plane coordinate system WPL-CS

The working plane coordinate system is a 3-D Cartesian coordinate system.

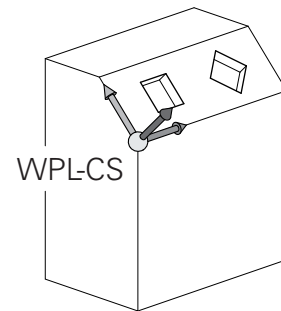
The position and orientation of the working plane coordinate system depend on the active transformations in the workpiece coordinate system.



**i** Without active transformations in the workpiece coordinate system, the position and orientation of the working plane coordinate system and workpiece coordinate system are identical.

There are no transformations in the workpiece coordinate system on 3-axis machine tools or with pure 3-axis machining. The **BASE TRANSFORM.** values of the active line of the preset table have a direct effect on the working plane coordinate system with this assumption.

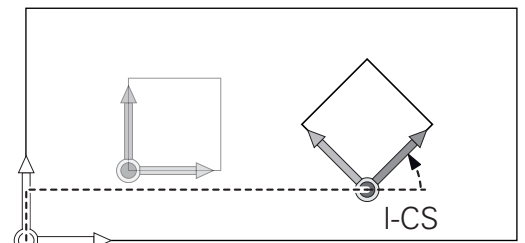
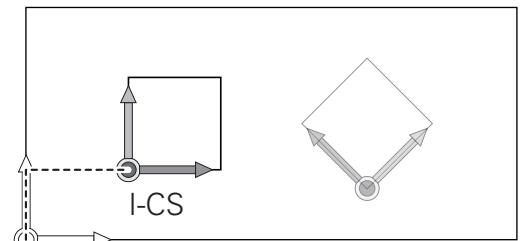
In the working plane coordinate system the user defines the position and orientation of the input coordinate system with use of transformations.



**i** The **Mill-Turning** function (option 50) additionally provides the **OEM rotation** and **precession angle** transformations.

- **OEM rotation** is available only to the machine manufacturer and takes effect before the **precession angle**
- The **precession angle** is defined in Cycles **800 ADJUST XZ SYSTEM**, **801 RESET ROTARY COORDINATE SYSTEM**, and **880 GEAR HOBBING**, and takes effect before the other transformations of the working plane coordinate system

The active values of the two transformations (if not equal to 0) are shown on the **POS** tab of the additional status display. Check the values also in milling mode because any active transformations will also remain active in that mode!



**i** Refer to your machine manual.

Your machine manufacturer can use the **OEM rotation** and **precession angle** transformations also without the **Mill-Turning** function (option 50).

Transformations in the working plane coordinate system:

- Axes **X, Y, Z** of Cycle **7 DATUM SHIFT** or of the **TRANS DATUM** function
- Cycle **8 MIRRORING** or **TRANS MIRROR** function
- Cycle **10 ROTATION** or **TRANS ROTATION** function
- Cycle **11 SCALING FACTOR** or **TRANS SCALE** function
- Cycle **26 AXIS-SPECIFIC SCALING**
- **PLANE RELATIVE**

**i** As a **PLANE** function, **PLANE RELATIVE** is effective in the workpiece coordinate system and aligns the working plane coordinate system.  
The values of additive tilting always relate to the current working plane coordinate system.

**i** The **Global Program Settings** function (option 44) additionally provides the **Rotation (WPL-CS)** transformation. This transformation is added to the rotation (Cycle **10 ROTATION**) that is defined in the NC program.

**i** The result of transformations built up on each other depends on the programming sequence.

**i** Without active transformations in the working plane coordinate system, the position and orientation of the input coordinate system and working plane coordinate system are identical.  
In addition, there are no transformations in the workpiece coordinate system on 3-axis machine tools or with pure 3-axis machining. The **BASE TRANSFORM.** values of the active line of the preset table have a direct effect on the input coordinate system with this assumption.

### Input coordinate system I-CS

The input coordinate system is a 3-D Cartesian coordinate system. The position and orientation of the input coordinate system depend on the active transformations in the working plane coordinate system.

**i** Without active transformations in the working plane coordinate system, the position and orientation of the input coordinate system and working plane coordinate system are identical.

In addition, there are no transformations in the workpiece coordinate system on 3-axis machine tools or with pure 3-axis machining. The **BASE TRANSFORM.** values of the active line of the preset table have a direct effect on the input coordinate system with this assumption.

With the aid of positioning blocks in the input coordinate system, the user defines the position of the tool and therefore the position of the tool coordinate system.

**i** The **NOML.**, **ACTL.**, **LAG**, and **ACTDST** displays are also based on the input coordinate system.

Positioning blocks in input coordinate system:

- Paraxial positioning blocks
- Positioning blocks with Cartesian or polar coordinates
- Positioning blocks with Cartesian coordinates and surface normal vectors
- Cycles

#### Example

```
7 X+48 R+
```

```
7 L X+48 Y+102 Z-1.5 R0
```

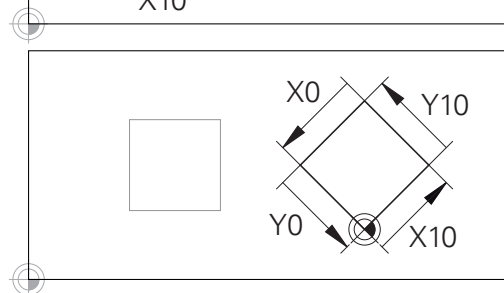
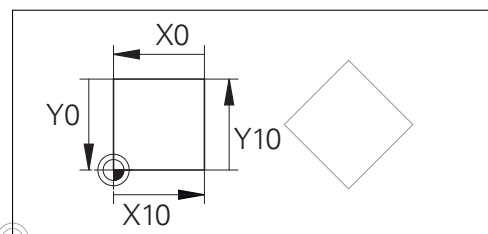
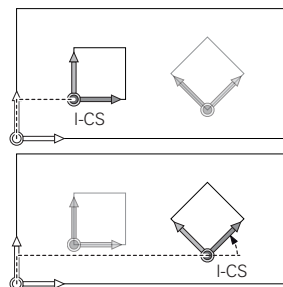
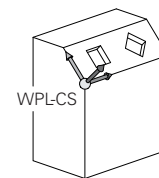
```
7 LN X+48 Y+102 Z-1.5 NX-0.04658107 NY0.00045007  
NZ0.8848844 R0
```

**i** The position of the tool coordinate system is determined by the Cartesian coordinates X, Y and Z also for positioning blocks with surface normal vectors.

In conjunction with 3-D tool compensation, the position of the tool coordinate system can be shifted along the surface normal vectors.

**i** Orientation of the tool coordinate system can be performed in various reference systems.

**Further information:** "Tool coordinate system T-CS", Page 129



A contour referencing the input coordinate system origin can easily be transformed any way you need.



**Tool coordinate system T-CS**

The tool coordinate system is a 3-D Cartesian coordinate system. Its coordinate origin is the tool reference point. The values of the tool table, **L** and **R** with milling tools and **ZL**, **XL** and **YL** with turning tools, reference this point.

**Further information:** "Entering tool data into the table", Page 142 and "Tool data", Page 418

**i** For Dynamic Collision Monitoring (option 40) to correctly monitor the tool, the values in the tool table must correspond to the actual dimensions of the tool.

In accordance with the values from the tool table, the coordinate origin of the tool coordinate system is shifted to the tool center point (TCP).

If the NC program does not reference the tool tip, the tool center point must be shifted. The required shift is implemented in the NC program using the delta values during a tool call.

**i** The position of the TCP as shown in the diagram is obligatory in conjunction with the 3D tool compensation.

**i** With the aid of positioning blocks in the input coordinate system, the user defines the position of the tool and therefore the position of the tool coordinate system.

If the **TCPM** function or miscellaneous function **M128** is active, the orientation of the tool coordinate system depends on the tool's current angle of inclination.

The user defines the tool's angle of inclination either in the machine coordinate system or in the working plane coordinate system.

Tool angle of inclination in the machine coordinate system:

**Example**

```
7 L X+10 Y+45 A+10 C+5 R0 M128
```

Tool angle of inclination in the working plane coordinate system:

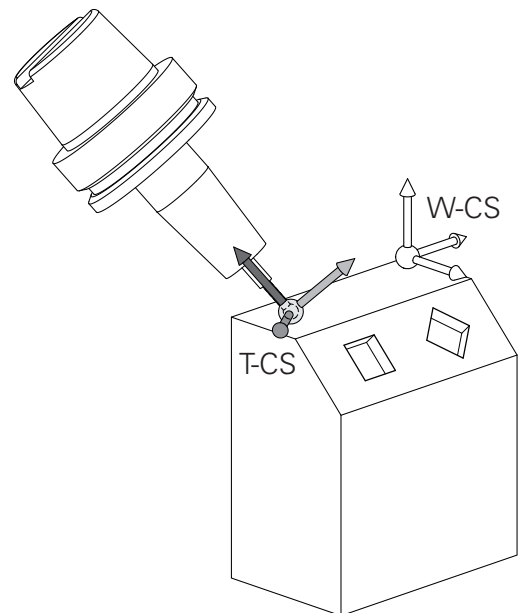
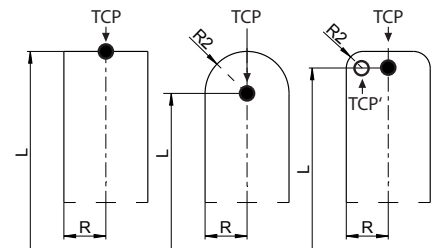
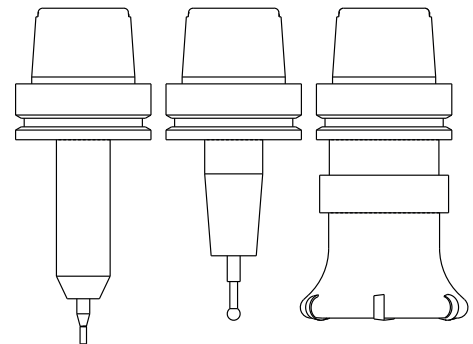
**Example**

```
6 FUNCTION TCPM F TCP AXIS SPAT PATHCTRL AXIS
```

```
7 L A+0 B+45 C+0 R0 F2500
```

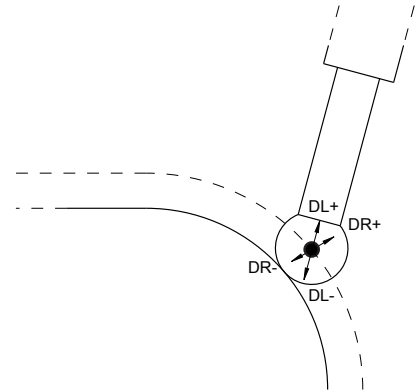
```
7 LN X+48 Y+102 Z-1.5 NX-0.04658107 NY0.00045007
  NZ0.8848844 TX-0.08076201 TY-0.34090025 TZ0.93600126 R0
  M128
```

```
7 LN X+48 Y+102 Z-1.5 NX-0.04658107 NY0.00045007
  NZ0.8848844 R0 M128
```



- i** With the shown positioning blocks with vectors, 3D tool compensation is possible with compensation values **DL**, **DR** and **DR2** from the **TOOL CALL** block or from the **.tco** compensation table.
- The methods of function of the compensation values depend on the type of tool.
- The control detects the various tool types with the columns **L**, **R** and **R2** of the tool table:
- $R2_{TAB} + DR2_{TAB} + DR2_{PROG} = 0$   
→ end mill
  - $R2_{TAB} + DR2_{TAB} + DR2_{PROG} = R_{TAB} + DR_{TAB} + DR_{PROG}$   
→ radius cutter or ball cutter
  - $0 < R2_{TAB} + DR2_{TAB} + DR2_{PROG} < R_{TAB} + DR_{TAB} + DR_{PROG}$   
→ corner-radius cutter or toroidal cutter

- i** Without the **TCPM** function or miscellaneous function **M128**, orientation of the tool coordinate system and input coordinate system is identical.



## 3.8 Accessories: HEIDENHAIN 3-D touch probes and electronic handwheels

### 3-D touch probes

Applications for HEIDENHAIN 3-D touch probes:

- Automatically align workpieces
- Quickly and precisely set presets
- Measure the workpiece during program run
- Measure and inspect tools



All functions provided by the touch-probe cycles are described in the User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**. Please contact HEIDENHAIN if you need this User's Manual. ID: 1303409-xx

#### Touch trigger probes TS 260, TS 460, TS 642, TS 740 and TS 760

The TS 248 and TS 260 touch probes are particularly cost-effective and transmit the trigger signals through a cable.

The wireless TS 642 and TS 740 touch probes as well as the smaller TS 460 and TS 760 touch probes are suitable for machines with tool changers. All of the above touch probes feature infrared signal transmission. The TS 460 and the TS 760 also support wireless transmission. The TS 460 offers optional collision protection.

HEIDENHAIN touch probes feature either a wear-resistant optical switch or several high-precision pressure sensors (TS 740 and TS 760) to detect stylus deflections. On deflection, a trigger signal is generated, which causes the control to store the current position of the touch probe as the actual value.



#### Tool touch probes TT 160 and TT 460

The TT 160 and TT 460 touch probes are designed for the efficient and precise measurement and inspection of tool dimensions.

The control offers cycles that enable you to determine the tool length and radius while the spindle is rotating or stationary. The tool touch probe features a particularly rugged design and a high degree of protection, which make it insensitive to coolants and swarf.

A wear-resistant optical switch generates the trigger signal. With the TT 160, signal transmission is by cable. The TT 460 supports infrared and radio transmission.



## HR electronic handwheels

Electronic handwheels facilitate manual traversing of the axis slides. A wide range of traverses per handwheel revolution is available. The portable HR 510, HR 520 and HR 550FS handwheels are available from HEIDENHAIN in addition to the HR 130 and HR 150 panel-mounted handwheels.

**Further information:** "Traverse with electronic handwheels", Page 183



Several electronic handwheels can also be connected simultaneously and used alternatively on controls with the (**HSCI**: HEIDENHAIN Serial Controller Interface) serial interface for control components. Configuration is performed via the machine manufacturer.



# 4

**Tools**

## 4.1 Tool data

### Tool number, tool name

Each tool is identified by a number between 0 and 32767. If you are working with tool tables, you can also enter a tool name for each tool. Tool names can have up to 32 characters.

**i** **Permitted characters:** # \$ % & , - \_ . 0 1 2 3 4 5 6 7 8 9 @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
The control automatically replaces lowercase letters with corresponding uppercase letters during saving.

**Impermissible characters:** <blank space> ! " ' ( ) \* + ; : < = > ? [ / ] ^ ` { | } ~

In conjunction with AFC (option 45), the following characters are not permitted in the tool name: # \$ % & , .

**Further information:** "Adaptive Feed Control (AFC) (option 45)", Page 336

The tool number 0 is automatically defined as the zero tool with the length L=0 and the radius R=0. In tool tables, tool T0 should also be defined with L=0 and R=0.

Assign unique tool names!

If the control, for example, finds multiple available tools in the tool magazine, it inserts the tool with the least remaining tool life.

- Tool that is in the spindle
- Tool that is in the magazine

**i** Refer to your machine manual.  
If there are multiple magazines, the machine manufacturer can specify the search sequence of the tools in the magazines.

- Tool that is defined in the tool table but is currently not in the magazine

If the control, for example, finds multiple available tools in the tool magazine, it inserts the tool with the least remaining tool life.

### Database ID

In a tool database for all machines, you can identify tools with unique database IDs (e.g., within a workshop). This allows you to coordinate the tools of multiple machines more easily.

The control does not allow a tool call with the database ID.

For indexed tools, you can define the database ID either only for the physically existing main tool or as an ID for the data record at each index.

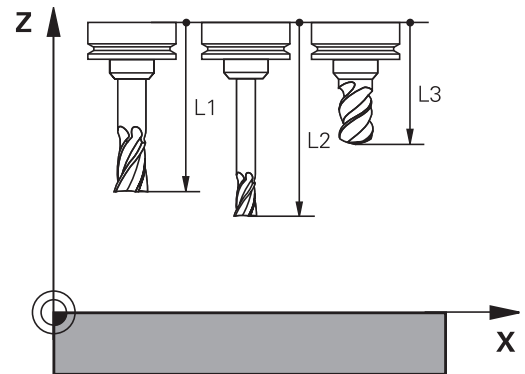
**Further information:** "Tool table fundamentals", Page 137

A database ID may contain a maximum of 40 characters and is unique in the tool management.

## Tool length L

Always enter the tool length **L** as an absolute value based on the tool reference point.

- i** The absolute tool length is essential for the control in order to perform numerous functions (e.g., material removal simulation or **Dynamic Collision Monitoring (DCM)**).  
The absolute length of the touch probe is always referenced to the tool reference point. The machine manufacturer usually defines the spindle nose as the tool reference point.



## Measuring the tool length

You can measure your tools in the machine (e.g., with a tool touch probe) or externally with a tool presetter. If such measurements are not possible, you can determine the tool length.

You have the following options for determining the tool length:

- With a gauge block
- With a calibration pin (inspection tool)

- i** Before you determine tool length, you have to set the preset in the spindle axis.

## Determining the tool length with a gauge block

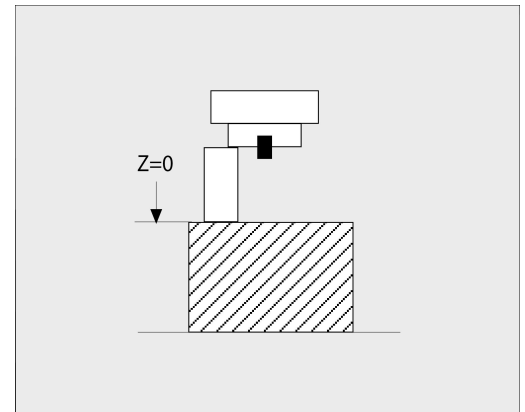
- i** You can only set the preset with a gauge block if the tool reference point is at the spindle nose.  
Place the preset on the surface you want to touch off with the tool. This surface might have to be created first.

To set the datum with a gauge block:

- ▶ Place the gauge block on the machine table
- ▶ Position the spindle nose next to the gauge block
- ▶ Gradually move in **Z+** direction until you can just slide the gauge block under the spindle nose
- ▶ Set the preset in **Z**

To determine the tool length:

- ▶ Insert the tool
- ▶ Touch off the surface
- ▶ The control displays the absolute tool length as the actual position in the position display.



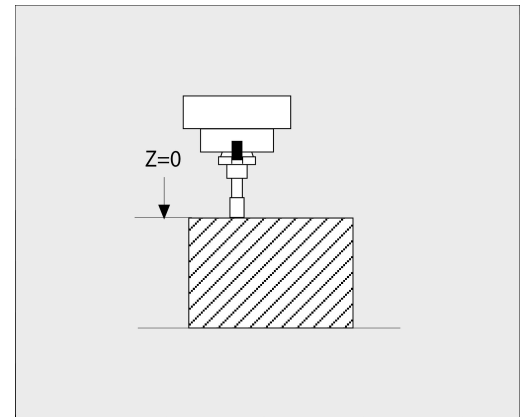
### Determining the tool length with a calibration pin and a tool setter

To set the preset with a calibration pin and a tool setter:

- ▶ Clamp the tool setter onto the machine table.
- ▶ Bring the flexible inner ring of the tool setter to the same height as the fixed outer ring.
- ▶ Set the gauge to 0
- ▶ Move the calibration pin onto the flexible inner ring.
- ▶ Set the preset in **Z**

To determine the tool length:

- ▶ Insert the tool
- ▶ Move the tool onto the flexible inner ring until the gauge displays 0.
- ▶ The control displays the absolute tool length as the actual position in the position display.





## Tool radius R

You can enter the tool radius R directly.

## Tool table fundamentals

You can define and store up to 32 767 tools and their tool data in a tool table.

You must use tool tables if:

- you wish to use indexed tools such as stepped drills with more than one length compensation value  
**Further information:** "Indexed tool", Page 138
- your machine has an automatic tool changer
- you want to apply fine roughing with Cycle **22**  
**Further information:** User's Manual for **Programming of Machining Cycles**
- you want to work with Cycles **251** to **254**  
**Further information:** User's Manual for **Programming of Machining Cycles**

### NOTICE

#### Caution: Data may be lost!

Deleting line 0 from the tool table will destroy the structure of the table. As a result, locked tools might no longer be recognized as locked and, consequently, the search for a replacement tool will not work, either. The problem cannot be solved by reinserting a line 0. The original tool table will be permanently damaged!

- ▶ Restore the tool table
  - Add a new line 0 to the defective tool table
  - Copy the defective tool table (e.g. toolcopy.t)
  - Delete the defective tool table (current tool.t)
  - Copy the copied tool table (toolcopy.t) as tool.t
  - Delete the copied tool table (toolcopy.t)
- ▶ Contact HEIDENHAIN Service (NC helpline)



All table names must start with a letter. Please keep this in mind when creating and managing additional tables.

You can select the table view with the **Screen Layout** key. You can choose between a list view and a form view.

Other settings, such as **SORT/ HIDE COLUMNS**, can be made after the file has been opened.

### Switching the tool table view

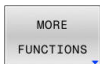
The control displays the tool table in combination with the position display or in full screen mode.

**i** Not in connection with extended tool management (option 93).

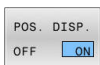
To switch the tool table view:



- ▶ Press the **TOOL TABLE** soft key



- ▶ Press the **MORE FUNCTIONS** soft key



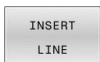
- ▶ Set the **POS. DISP.** soft key to **ON**
- ▶ The controls shows the position display.

### Indexed tool

Step drills, T-slot milling cutters, side milling cutters and, in general, all tools that require the input of multiple length and radius data cannot be fully defined in a single row of the tool table. Each row of the table permits the definition of one length and one radius.

In order to assign multiple compensation data to a tool (multiple tool table rows), add an indexed tool number (e.g., **T 5.1**) to an existing tool definition (**T 5**). Each additional row of the table thus comprises the original tool number, a period and an index (in ascending order from 1 to 9). The original tool table row contains the maximum tool length; the tool lengths in the subsequent table lines are given in descending order of their distance to the tool holder point.

To create an indexed tool number (table row):



- ▶ Open the tool table
- ▶ Press the **INSERT LINE** soft key
- ▶ The control opens the **Insert line** pop-up window
- ▶ In the **Number of new lines =** input field, enter the number of table rows to add
- ▶ Enter the initial tool number including the index in the **Tool number** entry field
- ▶ Confirm with **OK**
- ▶ The control adds the additional row to the tool table.

**i** If you are using the Extended Tool Management (option 93), you can insert an indexed tool by means of the **INSERT INDEX** soft key. The control generates the index continuously and adopts all values of the original tool.

**i** The **Dynamic Collision Monitoring (DCM)** function also uses the length and radius data for displaying the active tool and for collision monitoring. Incomplete or incorrect tool definitions may lead to premature or false collision warnings.

**Quick search for the tool name:**

If the **EDIT** soft key is set to **OFF**, you can search for a tool name. Proceed as follows:

- ▶ Enter the first few characters of the tool name (e.g., **MI**)
- > The control shows a dialog box with the entered text and jumps to the first match.
- ▶ Enter additional characters to narrow down the search result (e.g., **MILL**)
- ▶ If the control cannot find any more matches for the entered search string, you can press the last entered character (e.g., **L**) to jump between matches, as with the cursor keys.

The quick search can also be used for tool selection in the **TOOL CALL** block.








**Displaying only specific tool types (filter setting)**

- ▶ Press the **TABLE FILTER** soft key
- ▶ Select the desired tool type by soft key
- > The control displays only tools of the selected type.
- ▶ Cancel the filter: Press the **SHOW ALL** soft key



Refer to your machine manual.

The machine manufacturer adapts the features of the filter function to the requirements of your machine.

Soft key	Filter functions of the tool table
	Select the filter function
	Cancel the filter settings and show all tools
	Use the default filter
	Show all drills in the tool table
	Show all cutters in the tool table
	Show all taps/thread cutters in the tool table
	Show all touch probes in the tool table

### Hiding or sorting the tool table columns

You can adapt the layout of the tool table to your needs. Columns that are not to be displayed can be simply hidden:

- ▶ Press the **SORT/ HIDE COLUMNS** soft key
- ▶ Select the appropriate column name with the arrow key
- ▶ Press the **HIDE COLUMN** soft key to remove this column from the table view

You can also modify the sequence of columns in the table:

- ▶ You can also modify the sequence of columns in the table with the **Move before:** dialog. The entry highlighted in **Displayed columns:** is moved in front of this column

You can use a connected mouse or the navigation keys to move through the form.

Proceed as follows:



- ▶ Press the navigation keys to go to the input fields
- ▶ Use the arrow keys to navigate within an input field
- ▶ Press the **GOTO** key to open the selection menu



The function **freeze number of columns** enables you to determine how many columns (0-3) the control will freeze to the left border of the screen. These columns will remain visible when you navigate to the right within the table.

### Tool table for turning tools

When managing turning tools, other geometric descriptions than those for milling or drilling tools are required. To be able to execute tool radius compensation, for example, you have to define the tool radius. The control provides special tool management for turning tools to support this definition process.

**Further information:** "Tool data", Page 418

### Tool table for grinding tools

When managing grinding tools, other geometric descriptions than those for milling or drilling tools are required. The control provides special form-based tool management for grinding and dressing tools.

**Further information:** "Tools for grinding (Option 156)", Page 433










## Creating and activating an INCH-based tool table

**i** If you choose to switch the units for your control to **INCH**, the tool table unit of measure will not be adjusted automatically.

If you want to change the unit of measure in the table as well, you need to create a new tool table.

This applies to all tool tables, including the **toolturn.trn** table for turning tools. You can repeat the steps below for other tool tables as well.

To create and activate an **INCH**-based tool table:

- 
  - ▶ Select the **Positioning w/ Manual Data Input** operating mode
  - ▶ Call the zero tool (T0)
  - ▶ Restart the control
  - ▶ Do **not** acknowledge **Power interrupted** with **CE**
- 
  - ▶ Select the **Programming** operating mode
- 
  - ▶ Open the file manager
  - ▶ Open the **TNC:\table** folder
  - ▶ Rename the **tool.t** file, e.g. to **tool\_mm.t**
  - ▶ Create a new file and name it **tool.t**
- 
  - ▶ Select the **INCH** unit of measure
  - > The control opens the new, empty tool table.
- 
  - ▶ Append lines, e.g. 100 lines
  - > The control adds the lines
  - ▶ Position the cursor in column **L** of line **0**
  - ▶ Enter **0**
  - ▶ Position the cursor in column **R** of line **0**
  - ▶ Enter **0**
- 
  - ▶ Confirm your input
- 
  - ▶ Open the file manager
  - ▶ Open any NC program
- 
  - ▶ Select **Manual operation** mode
  - ▶ Acknowledge **Power interrupted** with **CE**
- 
  - ▶ Open the tool table
  - ▶ Review the tool table

**i** The preset table is another table whose unit of measure is not adjusted automatically.

**Further information:** "Creating and activating an INCH-based preset table", Page 203

## Entering tool data into the table

### Standard tool data

Parameter	Meaning	Dialog
T	Number by which the tool is called in the NC program (e.g.: 5, indexed: 5.2)	-
NAME	Name by which the tool is called in the NC program (max. 32 characters, all capitals, no spaces)	Tool name?
L	Tool length L	Tool length?
R	Tool radius R	Tool radius?
R2	Tool radius R2 for toroid cutters (only for 3D radius compensation or graphical representation of a machining operation with Ball-nose cutter)	Tool radius 2?
DL	Delta value for tool length L	Tool length oversize?
DR	Delta value for tool radius R	Tool radius oversize?
DR2	Delta value for tool radius R2	Tool radius oversize 2?
TL	Set tool lock ( <b>TL</b> : for <b>ToolLocked</b> )	Tool locked? Yes=ENT/No=NOENT
RT	Number of a replacement tool ( <b>RT</b> for <b>Replacement Tool</b> ) An empty field or input <b>0</b> means there is no replacement tool	Replacement tool?
TIME1	Maximum tool life in minutes. This function can vary depending on the individual machine tool. Your machine manual provides more information	Maximum tool age?
TIME2	Maximum tool life in minutes during a tool call: If the current tool age reaches or exceeds this value, the control inserts the replacement tool during the next <b>TOOL CALL</b> (with the tool axis specified)	Max. tool age for TOOL CALL?
CUR_TIME	The current tool age equals the time during which the tool is cutting a workpiece. The tool is cutting a workpiece when the spindle is switched on and the control moves the tool at the machining feed rate. The control counts this time automatically and enters the current tool age in minutes.  You can edit the tool age of an active tool during program run after you have inserted an indexable insert, for example. The control will directly apply the value to tool life monitoring.  The control updates the value cyclically during NC program run, as well as during a tool call and at the end of the program.	Current tool age?
TYP	Tool type: Press the <b>ENT</b> key to edit the field. The <b>GOTO</b> key opens a window in which you can select the tool type.  In the tool management, use the <b>SELECT</b> soft key to open the pop-up window. You can assign tool types to specify the display filter settings such that only the selected type is visible in the table	Tool type?
DOC	Comment on tool (max. 32 characters)	Tool description
PLC	Information on this tool that is to be sent to the PLC	PLC status?

Parameter	Meaning	Dialog
<b>LCUTS</b>	Tooth length of the tool By entering a value here, you can limit the infeed depth in the cycles	<b>Tooth length in the tool axis?</b>
<b>LU</b>	Usable length of the tool for drilling cycles and Cycles <b>25x</b> By entering a value here, you can limit the tool's plunging depth in the cycles. If used in conjunction with <b>RN</b> , then <b>LU</b> may also be greater than <b>LCUTS</b> .	<b>Usable length of the tool?</b>
<b>RN</b>	Neck radius for the exact definition of the tool for graphic simulation and collision monitoring (e.g., necks of end mills or side milling cutters) A neck radius <b>RN</b> that is shown in the graphic simulation is possible only if <b>LU &gt; LCUTS</b> .	<b>Neck radius of the tool?</b>
<b>ANGLE</b>	Maximum plunge angle of the tool for reciprocating plunge-cut in the cycles	<b>Maximum plunge angle?</b>
<b>TMAT</b>	Cutting material of the tool for the cutting data calculator	<b>Tool material?</b>
<b>CUTDATA</b>	Cutting data table for the cutting data calculator	<b>Cutting data table?</b>
<b>NMAX</b>	Limit the spindle speed for this tool. The programmed value is monitored (error message) as well as an increase in the shaft speed via the potentiometer. Function inactive: Enter -. <b>Input range:</b> 0 to +999 999; if function not active: enter -	<b>Maximum speed [rpm]</b>
<b>LIFTOFF</b>	Definition of whether the control should retract the tool in the direction of the positive tool axis at an NC stop in order to avoid leaving dwell marks on the contour. If <b>Y</b> is defined, the control retracts the tool from the contour, provided <b>M148</b> has been activated. <b>Further information:</b> "Lifting off the tool automatically from the contour at NC stop: M148", Page 323	<b>Retract allowed? Yes=ENT/ No=NOENT</b>
<b>TP_NO</b>	Reference to the number of the touch probe in the touch-probe table	<b>Number of the touch probe</b>
<b>T-ANGLE</b>	Point angle of the tool. Is used by Cycle <b>240</b> in order to calculate the centering depth from the diameter input	<b>Point angle</b>
<b>PITCH</b>	Thread pitch of the tool. Is used by Cycles <b>206</b> , <b>207</b> , and <b>208</b> . A positive algebraic sign means a right-hand thread.	<b>Tool thread pitch?</b>
<b>AFC</b>	Control setting for the adaptive feed control from the <b>AFC.TAB</b> . In the tool table, use the <b>SELECT</b> soft key to open the selection list. In the tool management, use the <b>SELECT</b> soft key and the <b>OK</b> soft key to confirm your selection. <b>Input range:</b> max. 10 characters	<b>Feedback-control strategy</b>

Parameter	Meaning	Dialog
<b>AFC-LOAD</b>	<p>Tool-dependent reference power for adaptive feed control (AFC).</p> <p>The input in percent refers to the rated spindle power.</p> <p>The control immediately uses the value given for feedback control, meaning a teach-in cut is dropped. The value should be previously determined with a teach-in cut.</p> <p><b>Further information:</b> "Recording a teach-in cut", Page 342</p>	<b>Reference power for AFC [%]</b>
<b>AFC-OVLD1</b>	<p>Cut-related tool wear monitoring for the adaptive feed control.</p> <p>The input in percent refers to the reference power. The value 0 deactivates the monitoring function. An empty field has no effect.</p> <p><b>Further information:</b> "Tool wear monitoring", Page 349</p>	<b>AFC overload warning level [%]</b>
<b>AFC-OVLD2</b>	<p>Cut-related tool load monitoring (tool breakage control) for the adaptive feed control.</p> <p>The input in percent refers to the reference power. The value 0 deactivates the monitoring function. An empty field has no effect.</p> <p>If this column contains a value, the control will ignore the column <b>AFC-OVLD1</b>.</p> <p><b>Further information:</b> "Tool load monitoring", Page 349</p>	<b>AFC overload switch-off level [%]</b>
<b>LAST_USE</b>	<p>The time at which the tool was last used</p> <p>The control updates the value cyclically during NC program run, as well as during a tool call and at the end of the program.</p>	<b>Date/time of last tool usage</b>
<b>PTYP</b>	<p>Tool type for evaluation in the pocket table</p> <p>Refer to your machine manual. Function is defined by the machine manufacturer!</p>	<b>Tool type for pocket table?</b>
<b>ACC</b>	<p>Activate or deactivate active chatter control for the respective tool (Page 350).</p> <p><b>Input range:</b> N (inactive) and Y (active)</p>	<b>ACC active? Yes=ENT/No=NOENT</b>
<b>KINEMATIC</b>	<p>Use the <b>SELECT</b> soft key to show the tool carrier kinematics. In the tool management, use the <b>SELECT</b> soft key and the <b>OK</b> soft key to adopt the file name and the path</p> <p><b>Further information:</b> "Assigning a tool carrier", Page 173</p>	<b>Tool-carrier kinematics</b>
<b>DR2TABLE</b>	<p>Use the <b>SELECT</b> soft key to show the list of error compensation tables and select the error compensation table (without extension and path).</p> <p>The error compensation tables are saved under TNC:  \system\3D-ToolComp.</p>	<b>Compensation val. table for DR2</b>
<b>OVRTIME</b>	<p>Time for exceeding the tool life in minutes</p> <p><b>Further information:</b> "Overtime for tool life", Page 153</p> <p>Refer to your machine manual. Function is defined by the machine manufacturer!</p>	<b>Tool life expired</b>



Parameter	Meaning	Dialog
RCUTS	<p>Front-face cutting width of the tool (e.g., for indexable inserts)</p> <p>Entering a value here influences helical and reciprocating plunging in Cycles <b>251</b>, <b>252</b>, and OCM.</p> <p><b>Further information:</b> User's Manual for <b>Programming of Machining Cycles</b></p>	Width of the indexable insert
DB_ID	<p>The database-ID allows you to identify a tool (e.g., within a tool management system by using client applications).</p> <p><b>Further information:</b> "Database ID", Page 134</p> <p>For indexed tools, HEIDENHAIN recommends that you assign the database ID to the main tool.</p>	ID for central tool management
R_TIP	Radius at the tool tip for exact definition of the tool for graphical simulation, automatic calculation within cycles and collision monitoring of tools such as countersinks.	Radius at the tip

#### Tool data for automatic tool measurement



Refer to your machine manual.

The machine manufacturer defines whether the **R-OFFS** offset will be taken into account for a tool with **CUT 0**.

Your machine manufacturer defines the default value for the **R-OFFS** and **L-OFFS** columns.

Parameter	Meaning	Dialog
CUT	Number of teeth (99 teeth maximum)	Number of teeth?
LTOL	Permissible deviation from tool length L for wear detection. If the entered value is exceeded, the control locks the tool (status <b>L</b> ). Input range: 0 to 5.0000 mm	Wear tolerance: length?
RTOL	Permissible deviation from tool radius R for wear detection. If the entered value is exceeded, the control locks the tool (status <b>L</b> ). Input range: 0 to 5.0000 mm	Wear tolerance: radius?
R2TOL	Permissible deviation from tool radius R2 for wear detection. If the entered value is exceeded, the control locks the tool (status <b>L</b> ). Input range: 0 to 0.9999 mm	Wear tolerance: Radius 2?
DIRECT	Cutting direction of the tool for measuring the tool during rotation	Cutting direction? M4=ENT/ M3=NOENT
R-OFFS	Length measurement: Offset between the center of the tool touch probe and the tool center	Tool offset: radius?
L-OFFS	Radius measurement: Tool offset between upper surface of tool touch probe and tool tip in addition to <b>offsetToolAxis</b>	Tool offset: length?
LBREAK	Permissible deviation from tool length <b>L</b> for breakage detection. If the entered value is exceeded, the control locks the tool (status <b>L</b> ). Input range: 0 to 9.0000 mm	Breakage tolerance: length?
RBREAK	Permissible deviation from tool radius R for breakage detection. If the entered value is exceeded, the control locks the tool (status <b>L</b> ). Input range: 0 to 9.0000 mm	Breakage tolerance: radius?



Description of the cycles for automatic tool measurement.

**Further information:** User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**

### Editing the tool tables

The tool table that is active during execution of the part program is designated TOOL.T and must be saved in the **TNC:\table** directory.

Other tool tables that are to be archived or used for test runs are given different file names with the extension .T. By default, for the **Test Run** and **Programming** operating modes, the control also uses the TOOL.T tool table. In the **Test Run** operating mode, press the **TOOL TABLE** soft key to edit it.

To open the tool table TOOL.T:

- ▶ Select any machine operating mode



- ▶ Select the tool table: Press the **TOOL TABLE** soft key



- ▶ Set the **EDIT** soft key to **ON**

T	NAME	L	R	R2	DL	DR
0	WALLENWKRZEUG	0	0	0	0	0
120		30	31	0	0	0
204		40	2	0	0	0
306		50	3	0	0	0
408		50	-4	0	0	0
5010		60	5	0	0	0
6012		60	6	0	0	0
7014		70	7	0	0	0
8016		80	8	0	0	0
9018		90	9	0	0	0
10010		90	10	0	0	0
11022		90	11	0	0	0
12024		90	12	0	0	0
13026		90	13	0	0	0
14028		100	14	0	0	0
15030		100	15	0	0	0
16032		100	16	0	0	0
17034		100	17	0	0	0
18036		100	18	0	0	0
19038		100	19	0	0	0
20040		100	20	0	0	0
21042		100	5	5	0	0
22044		120	22	0	0	0
23046		120	23	0	0	0
24048		120	24	0	0	0
25050		120	25	0	0	0
26052		120	26	0	0	0



If you edit the tool table, the selected tool is locked. If this tool is required in the NC program being used, the control shows the message: **Tool table locked**.

If a new tool is created, the length and radius columns remain empty until entered manually. An attempt to insert such a newly created tool will be aborted by the control and an error message will appear. This means you cannot insert a tool for which no geometry data are available yet.

To use the alphabetic keyboard or a connected mouse for navigation and editing:

- Arrow keys: move from one cell to the next
- ENT key: jump to the next cell; with selection fields: open the selection dialog
- Click a cell: move to the cell
- Double-click a cell: place the cursor in the cell; with selection fields: open the selection dialog

### Soft key      Editing functions of the tool table



Select the beginning of the table



Select the end of the table














Select the previous page in the table



Select the next page in the table



Find the text or number

Soft key	Editing functions of the tool table
	Go to beginning of line
	Go to end of line
	Copy active field
	Insert copied field
	Add the entered number of lines (tools) at the end of the table
	Insert a line with definable tool number
	Delete the current line (tool)
	Sort the tools according to the content of a column
	Select possible entries from a pop-up window
	Reset the value
	Place the cursor in the current cell

## Importing tool tables



Refer to your machine manual.

The machine manufacturer can adapt the **ADAPT NC PGM / TABLE** function.

The machine manufacturer can define update rules that make it possible, for example, to automatically remove umlauts from tables and NC programs.

If you export a tool table from an iTNC 530 and import it into a TNC 640, you have to adapt its format and content before you can use the tool table. On the TNC 640, you can adapt the tool table conveniently with the **ADAPT NC PGM / TABLE** function. The control converts the contents of the imported tool table to a format valid for the TNC 640 and saves the changes to the selected file.

Proceed as follows:

- ▶ Save the tool table of the iTNC 530 to the **TNC:\table** directory



- ▶ Select the **Programming** operating mode



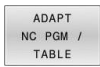
- ▶ Press the **PGM MGT** key



- ▶ Move the cursor to the tool table you want to import



- ▶ Press the **MORE FUNCTIONS** soft key



- ▶ Press the **ADAPT NC PGM / TABLE** soft key
- ▶ The control asks you whether you want to overwrite the selected tool table.
- ▶ Press the **CANCEL** soft key
- ▶ Alternative: Press the **OK** soft key to overwrite
- ▶ Open the converted table and check its contents
- ▶ New columns in the tool table are highlighted green.
- ▶ Press the **REMOVE UPDATE INFO** soft key
- ▶ The green columns are displayed in white again.



The following characters are permitted in the **Name** column of the tool table: # \$ % & , - . 0 1 2 3 4 5 6 7 8 9 @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z \_

During the import, commas will be converted to periods.

The control overwrites the active tool table when importing an external table with the same name. To prevent data loss, back up the original tool table before you start the import!

The procedure for copying tool tables using the file manager is described in the section on file management.

**Further information:** User's Manual for Klartext Programming or ISO Programming

When iTNC 530 tool tables are imported, all defined tool types are imported as well. Tool types not present are imported as type **Undefined**. Check the tool table after the import.

## Pocket table for tool changer



Refer to your machine manual.

The machine manufacturer adapts the features of the pocket table to the requirements of your machine.

You need a pocket table for automatic tool changing. You manage the assignment of your tool changer in the pocket table. The pocket table is in the **TNC:\table** directory. The machine manufacturer can amend the name, path, and content of the pocket table. If you wish, you can select different views using the soft keys in the **TABLE FILTER** menu.

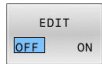
P	T	INAME	RSV	ST	F	L	DOC
0.0	5.010						
1.1	1.02						
1.2	2.04						
1.3	3.06						
1.4	4.08						
1.5	5.010		R				
1.6	6.012						
1.7	7.014						
1.8	8.016						
1.9	9.018						
1.10	10.020						
1.11	11.022						
1.12	12.024						
1.13	13.026						
1.14	14.028						
1.15	15.030						
1.16	16.032						
1.17	17.034						
1.18	18.036						
1.19	19.038						
1.20	20.040						
1.21	21.042						
1.22	22.044						
1.23	23.046						
1.24	24.048						
1.25	25.050						
1.26	26.052						
1.27	27.054						

**Editing a pocket table in a Program Run operating mode**

- ▶ Select the tool table: Press the **TOOL TABLE** soft key



- ▶ Press the **POCKET TABLE** soft key



- ▶ If required, set the **EDIT** soft key to **ON**














### Selecting a pocket table in Programming mode

To select the pocket table in the Programming operating mode:

PGM  
MGT

- ▶ Call the file manager: Press the **PGM MGT** key.
- ▶ Press the **SHOW ALL** soft key
- ▶ Select a file or enter a new file name
- ▶ Confirm your entry with the **ENT** key or the **SELECT** soft key

Parameter	Meaning	Dialog
<b>P</b>	Pocket number of the tool in the tool magazine	-
<b>T</b>	Tool number	<b>Tool number?</b>
<b>RSV</b>	Pocket reservation for box magazines	<b>Pocket reserv.: Yes = ENT / No = NO ENT</b>
<b>ST</b>	Special tool ( <b>ST</b> ); If your special tool blocks pockets in front of and behind its actual pocket, these additional pockets need to be locked in column L (status L).	<b>Special tool?</b>
<b>F</b>	The tool is always returned to the same pocket in the tool magazine	<b>Fixed pocket? Yes = ENT / No = NO ENT</b>
<b>L</b>	Locked pocket ( <b>L</b> : for <b>L</b> ocked)	<b>Pocket locked Yes = ENT / No = NO ENT</b>
<b>DOC</b>	Display of the comment to the tool from TOOL.T	-
<b>PLC</b>	Information on this tool pocket that is to be sent to the PLC	<b>PLC status?</b>
<b>P1 ... P5</b>	Function is defined by the machine manufacturer. The machine tool documentation provides further information	<b>Value?</b>
<b>PTYP</b>	Tool type. Function is defined by the machine manufacturer. The machine tool documentation provides further information	<b>Tool type for pocket table?</b>
<b>LOCKED_ABOVE</b>	Box magazine: Lock the pocket above	<b>Lock the pocket above?</b>
<b>LOCKED_BELOW</b>	Box magazine: Lock the pocket below	<b>Lock the pocket below?</b>
<b>LOCKED_LEFT</b>	Box magazine: Lock the pocket at left	<b>Lock the pocket at left?</b>
<b>LOCKED_RIGHT</b>	Box magazine: Lock the pocket at right	<b>Lock the pocket at right?</b>

Soft key	Editing functions for pocket tables
	Select the table start
	Select the table end
	Select the previous page in the table
	Select the next page in the table
	Reset pocket table Depends on optional machine parameter <b>enableReset</b> (no.106102)
<div style="border: 1px solid black; padding: 5px;"> <p> When using extended tool management, you can reset the pocket table only before acknowledging the power interruption.</p> <p><b>Further information:</b> "Tool management", Page 158</p> </div>	
	Reset tool number T column Depends on optional machine parameter <b>showResetColumnT</b> (no. 125303)
	Go to beginning of line
	Go to end of line
	Select a tool from the tool table: The control shows the contents of the tool table. Use the arrow keys to select a tool, press <b>OK</b> to transfer it to the pocket table
	Reset the value
	Place the cursor in the current cell
	Sort the view



Refer to your machine manual.  
The machine manufacturer defines the features, properties and designations of the various display filters.

## Tool change

### Automatic tool change



Refer to your machine manual.  
The tool change function can vary depending on the individual machine tool.

If your machine tool has automatic tool changing capability, the program run is not interrupted. When the control reaches a tool call with **TOOL CALL**, it replaces the inserted tool by another from the tool magazine.

### Automatic tool change if the tool life expires: M101



Refer to your machine manual.  
The function of **M101** can vary depending on the individual machine tool.

When the specified tool life has expired, the control can automatically insert a replacement tool and continue machining with it. Activate the miscellaneous function **M101** for this. **M101** is reset with **M102**.

If you do not define a replacement tool in the **RT** column and call the tool via its tool name, the control will switch to a tool with the same name once the maximum tool age **TIME2** has been reached.

Enter the respective tool life after which machining is to be continued with a replacement tool in the **TIME2** column of the tool table. In the **CUR\_TIME** column the control enters the current tool life.

If the current tool life is higher than the value entered in the **TIME2** column, a replacement tool will be inserted at the next possible point in the program no later than one minute after expiration of the tool life. The change is made only after the NC block has been completed.

## NOTICE

### Danger of collision!

During an automatic tool change with **M101**, the control always retracts the tool in the tool axis first. There is danger of collision when retracting tools for machining undercuts, such as side milling cutters or T-slot milling cutters!

- ▶ Use **M101** only for machining operations without undercuts
- ▶ Deactivate the tool change with **M102**

After the tool change the control positions the tool according to the following logic, unless otherwise specified by the machine manufacturer:

- If the target position in the tool axis is below the current position, the tool axis is positioned last
- If the target position in the tool axis is above the current position, the tool axis is positioned first



### Prerequisites for a tool change with M101



As replacement tools, use only tools with the same radius. The control does not automatically check the radius of the tool.

If you want the control to check the radius of the replacement tool, enter **M108** in the NC program.

The control performs the automatic tool change at a suitable point in the program. The automatic tool change is not performed:

- During execution of machining cycles
- While radius compensation (**RR/RL**) is active
- Directly after an approach function **APPR**
- Directly before a departure function **DEP**
- Directly before and after **CHF** and **RND**
- During execution of macros
- During execution of a tool change
- Directly after a **TOOL CALL** or **TOOL DEF**
- During execution of SL cycles

### Overtime for tool life



This function must be enabled and adapted by the machine manufacturer.

The tool condition at the end of planned tool life depends on e.g. the tool type, machining method and workpiece material. In the **OVRTIME** column of the tool table, enter the time in minutes for which the tool is permitted to be used beyond the tool life.

The machine manufacturer specifies whether this column is enabled and how it is used during tool search.

### Tool usage test

#### Requirements



Refer to your machine manual.  
The tool-usage-test function must be enabled by your machine manufacturer.



The tool usage test function is not available for turning tools.

To conduct a tool usage test, you must activate **Create tool usage files** in the MOD menu.

**Further information:** "Generating a tool usage file", Page 458

### Generating a tool usage file

Depending on the setting in the MOD menu, you have the following options for generating the tool usage file:

- Simulate the complete NC program in the **Test Run** operating mode
- Completely run the NC program in the **Program Run, Full Sequence/Single Block** operating modes
- In the **Test Run** operating mode, press the **GENERATE TOOL USAGE FILE** soft key (also possible without simulation)

The tool usage file generated is in the same directory as the NC program. It contains the following information:

Column	Meaning
<b>TOKEN</b>	<ul style="list-style-type: none"> <li>■ <b>TOOL</b>: Tool usage time per tool call. The entries are listed in chronological order.</li> <li>■ <b>TTOTAL</b>: Total usage time of a tool</li> <li>■ <b>STOTAL</b>: Call of a subprogram. The entries are listed in chronological order.</li> <li>■ <b>TIMETOTAL</b>: The total machining time of the NC program is entered in the <b>WTIME</b> column. In the <b>PATH</b> column the control saves the path name of the corresponding NC program. The <b>TIME</b> column shows the sum of all <b>TIME</b> entries (feed time without rapid traverse movements). The control sets all other columns to 0</li> <li>■ <b>TOOLFILE</b>: In the <b>PATH</b> column, the control saves the path name of the tool table with which you conducted the test run. This enables the control during the actual tool usage test to detect whether you performed the test run with TOOL.T</li> </ul>
<b>TNR</b>	Tool number (-1: Tool not inserted yet)
<b>IDX</b>	Tool index
<b>NAME</b>	Tool name from the tool table
<b>TIME</b>	Tool usage time in seconds (feed time without rapid traverse movements)
<b>WTIME</b>	Tool-usage time in seconds (total usage time between tool changes)
<b>RAD</b>	<b>Tool radius R + Oversize of tool radius DR</b> from the tool table. (in mm)
<b>BLOCK</b>	Block number in which the <b>TOOL CALL</b> block was programmed
<b>PATH</b>	<ul style="list-style-type: none"> <li>■ <b>TOKEN = TOOL</b>: Path name of the active main program or subprogram</li> <li>■ <b>TOKEN = STOTAL</b>: Path name of the subprogram</li> </ul>
<b>T</b>	Tool number with tool index

Column	Meaning
<b>OVRMAX</b>	Maximum feed rate override that occurred during machining. The control enters the value 100 (%) during the test run
<b>OVRMIN</b>	Minimum feed rate override that occurred during machining. The control enters the value -1 during the test run
<b>NAMEPROG</b>	<ul style="list-style-type: none"> <li>■ 0: The tool number is programmed</li> <li>■ 1: The tool name is programmed</li> </ul>

The control saves the tool usage times in a separate file with the extension **pgmname.H.T.DEP**. This file is not visible unless the machine parameter **dependentFiles** (no. 122101) is set to **MANUAL**

There are two ways to run a tool usage test for a pallet file:

- If the cursor in the pallet file is on a pallet entry, the control runs the tool usage test for the entire pallet.
- If the cursor in the pallet file is on a program entry, the control runs the tool usage test only for the selected NC program.

### Using a tool usage test

Before starting a program in the **Program Run, Full Sequence/ Single Block** operating modes, you can check whether the tools being used in the selected NC program are available and have sufficient remaining tool life. The control then compares the actual tool-life values from the tool table with the nominal values from the tool usage file.

- |                       |  |
|-----------------------|--|
| TOOL<br>USAGE         | ▶ Press the <b>TOOL USAGE</b> soft key   |
| TOOL<br>USAGE<br>TEST | ▶ Press the <b>TOOL USAGE TEST</b> soft key<br>> The control opens the <b>Tool usage test</b> pop-up window indicating the result of the usage test. |
| OK                    | ▶ Press the <b>OK</b> soft key<br>> The control closes the pop-up window.  |
| ENT                   | ▶ Alternative: Press the <b>ENT</b> key  |

You can query the tool usage test with the **FN 18 ID975 NR1** function.

## 4.2 Touch probe table

### Application

The touch probe table **tchprobe.tp** defines the touch probe and data for the touching process, e.g. the probe feed rate. If you use several touch probes, you can save separate data for each touch probe.

### Description of function


#### NOTICE

##### Danger of collision!

The control cannot protect L-shaped styli from collisions using Dynamic Collision Monitoring DCM (option 40). When using a touch probe with an L-shaped stylus there is a risk of collision!

- ▶ Carefully run in the NC program or program section in the **Program Run Single Block** operating mode
- ▶ Watch out for possible collisions!

The touch probe table contains the parameters below:

Parameter	Meaning	Input
NO	Sequential number of touch probe This number assigns the touch probe in tool table column <b>TP_NO</b> to the data.	1...99
TYPE	<b>Selection of the touch probe?</b> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> The TS 642 touch probe makes the following values available:</p> <ul style="list-style-type: none"> <li>■ <b>TS642-3</b>: The touch probe is activated by a conical switch. This mode is not supported.</li> <li>■ <b>TS642-6</b>: The touch probe is activated by an infrared signal. Select this mode.</li> </ul> </div>	TS120, TS220, TS249, TS260, TS440, TS444, TS460, TS630, TS632, TS640, TS642-3, TS642-6, TS649, TS740, KT130, OEM
CAL_OF1	<b>TS center misalignmt. ref. axis? [mm]</b>	-99999.9999...+99999.9999
CAL_OF2	<b>TS center misalignmt. aux. axis? [mm]</b> Offset of the touch probe axis to the spindle axis in the secondary axis	-99999.9999...+99999.9999
CAL_ANG	<b>Spindle angle for calibration?</b>	0.0000...+359.9999
F	<b>Probing feed rate? [mm/min]</b> F can never be greater than defined in the optional machine parameter <b>maxTouchFeed</b> (no. 122602).	0...+9999
FMAX	<b>Rapid traverse in probing cycle? [mm/min]</b> Feed rate at which the control pre-positions the touch probe and positions it between the measuring points	+10...+99999
DIST	<b>Maximum measuring range? [mm]</b> If the stylus is not deflected in a probing process within the defined value, the control will issue an error message.	0.00100...+99999.99999

Parameter	Meaning	Input
<b>SET_UP</b>	<b>Set-up clearance? [mm]</b> Distance of touch probe from the defined touch point when pre-positioning The smaller this value is, the more exactly you must define the touch point position. Safety clearances defined in the touch probe cycle are added to this value.	<b>0.00100...+99999.99999</b>
<b>F_PREPOS</b>	<b>Pre-position at rapid? ENT/NOENT</b> Speed for pre-positioning: <ul style="list-style-type: none"> <li>■ Pre-positioning with speed from <b>FMAX: FMAX_PROBE</b></li> <li>■ Pre-positioning with machine rapid traverse: <b>FMAX_MACHINE</b></li> </ul>	<b>FMAX_PROBE, FMAX_MACHINE</b>
<b>TRACK</b>	<b>Probe oriented? Yes=ENT/No=NOENT</b> <ul style="list-style-type: none"> <li>■ <b>ON:</b> The control orients the touch probe in the defined probing direction. In this way, the stylus is always deflected in the same direction, improving measuring accuracy.</li> <li>■ <b>OFF:</b> The control will not orient the touch probe.</li> </ul> If you change the <b>TRACK</b> parameter, you must recalibrate the touch probe.	<b>ON, OFF</b>
<b>SERIAL</b>	<b>Serial number?</b> The control automatically edits this parameter of touch probes with an EnDat interface.	<b>Text width 15</b>
<b>REACTION</b>	<b>Reaction? EMERGSTOP=ENT/NCSTOP=NOENT</b> As soon as touch probes with a collision protection adapter detect a collision, they react by resetting the ready signal. Reaction to resetting the ready signal: <ul style="list-style-type: none"> <li>■ <b>NCSTOP:</b> Interrupt NC program</li> <li>■ <b>EMERGSTOP:</b> Emergency stop, quick braking of the axes</li> </ul>	<b>NCSTOP, EMERGSTOP</b>
<b>STYLUS</b>	<b>Shape of the stylus</b>	<b>SIMPLE, L-TYPE</b>

## Editing the touch probe table

To edit the touch probe table:



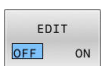
- ▶ Press the **Manual operation** key



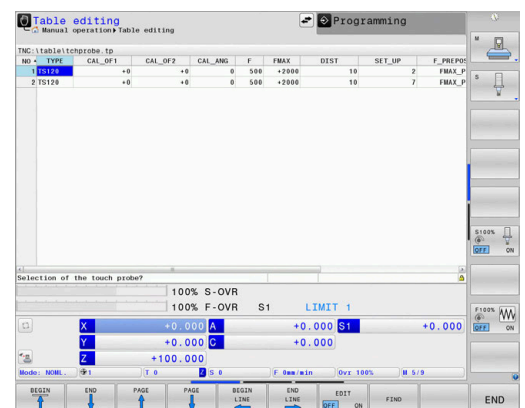
- ▶ Press the **TOUCH PROBE** soft key
- ▶ The control displays a soft key row for edge finder functions.



- ▶ Press the **TCH PROBE TABLE** soft key
- ▶ The control opens the touch probe table.



- ▶ Set the **EDIT** soft key to **ON**
- ▶ Select the desired value
- ▶ Perform desired changes



You can also edit the touch probe table values in the tool management.

## 4.3 Tool management

### Basics



Refer to your machine manual.

Tool management is a machine-dependent function, which may be partly or completely deactivated. The machine manufacturer defines the exact range of functions.

In tool management, your machine manufacturer can provide a wide range of functions for tool handling. Examples:

- Display and editing of all tool data from the tool table, the turning tool table and the touch probe table
- Easily readable and adaptable representation of the tool data in fillable forms
- Any description of the individual tool data in the new table view
- Mixed representation of data from the tool table and the pocket table
- Fast sorting of all tool data by mouse
- Use of graphic aids, e.g. color coding of tool or magazine status
- Copying and pasting of all tool data pertaining to a tool
- Graphic depiction of tool type in the table view and in the detail view for a better overview of the available tool types

The Expanded Tool Management (option 93) additionally provides:

- Program-specific or pallet-specific usage order of all tools
- Program-specific or pallet-specific tooling list of all tools



- If you edit a tool in tool management, the selected tool is locked. If this tool is required in the NC program being used, the control shows the message: **Tool table locked.**

- When using extended tool management, you can reset the pocket table only before acknowledging the power interruption.

**Further information:** "Pocket table for tool changer", Page 148

T	T1	NAME	P1	T1	POO	MAGAZINE	Tool life	REMAINING LIFE
1		MILL_D0_FINISH	0	1		Main Magazine	Not monitored	0
2		MILL_D4_ROUGH	0	2		Main Magazine	Not monitored	0
3		MILL_D8_ROUGH	0	3		Main Magazine	Not monitored	0
4		MILL_D8_ROUGH	0	4		Main Magazine	Not monitored	0
5		MILL_D12_ROUGH	0	5		Main Magazine	Not monitored	0
6		MILL_D12_ROUGH	0	6		Main Magazine	Not monitored	0
7		MILL_D14_ROUGH	0	7		Main Magazine	Not monitored	0
8		MILL_D14_ROUGH	0	8		Main Magazine	Not monitored	0
9		MILL_D18_ROUGH	0	9		Main Magazine	Not monitored	0
10		MILL_D20_ROUGH	0	10		Main Magazine	Not monitored	0
11		MILL_D20_ROUGH	0	11		Main Magazine	Not monitored	0
12		MILL_D24_ROUGH	0	12		Main Magazine	Not monitored	0
13		MILL_D28_ROUGH	0	13		Main Magazine	Not monitored	0
14		MILL_D28_ROUGH	0	14		Main Magazine	Not monitored	0
15		MILL_D32_ROUGH	0	15		Main Magazine	Not monitored	0
16		MILL_D32_ROUGH	0	16		Main Magazine	Not monitored	0
17		MILL_D34_ROUGH	0	17		Main Magazine	Not monitored	0
18		MILL_D34_ROUGH	0	18		Main Magazine	Not monitored	0
19		MILL_D38_ROUGH	0	19		Main Magazine	Not monitored	0
20		MILL_D40_ROUGH	0	20		Main Magazine	Not monitored	0
21		MILL_D8_FINISH	0	21		Main Magazine	Not monitored	0
22		MILL_D8_FINISH	0	22		Main Magazine	Not monitored	0
23		MILL_D8_FINISH	0	23		Main Magazine	Not monitored	0
24		MILL_D8_FINISH	0	24		Main Magazine	Not monitored	0
25		MILL_D12_FINISH	0	25		Main Magazine	Not monitored	0
26		MILL_D12_FINISH	0	26		Main Magazine	Not monitored	0

### Calling tool management



Refer to your machine manual.  
The procedure for calling the tool management may differ from that described below.



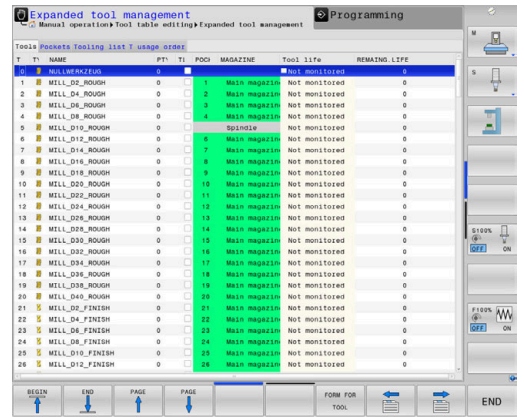
▶ Select the tool table: Press the **TOOL TABLE** soft key



▶ Scroll through the soft-key row



▶ Press the **TOOL MANAGEMENT** soft key  
▶ The control switches to the new table view.



### Tool management view

In the new view, the control presents all tool information in the following four tabs:

- **Tools:** Tool-specific information
- **pockets:** Pocket-specific information

The Expanded Tool Management (option 93) additionally provides:
















- **Tooling list:** List of all tools in the NC program that is selected in the Program Run mode (only if you have already created a tool usage file)  
**Further information:** "Tool usage test", Page 153
- **T usage order:** List of the sequence of all tools that are inserted in the NC program selected in the Program Run mode (only if you have already created a tool usage file)  
**Further information:** "Tool usage test", Page 153



If a pallet table is selected in the Program Run operating mode, the **Tooling list** and **T usage order** are calculated for the entire pallet table.

## Editing tool management

The tool management can be operated by mouse or with the keys and soft keys:

Soft key	Editing functions for tool management
	Select the table start
	Select the table end
	Select the previous page in the table
	Select the next page in the table
	Call the form view of the marked tool. Alternative function: Press the <b>ENT</b> key
	Changing tab: <b>Tools</b> and <b>pockets</b> Option 93 additionally provides: <b>Tooling list</b> and <b>T usage order</b>
	Search function: Here you can select the column to be searched and then the search term either from a list or by entering it
	Import tools
	Export tools
	Delete marked tools
	Add several lines at end of table
	Update table view
	Show the programmed tools column (if the <b>Pockets</b> tab is active)
	Define the settings: <ul style="list-style-type: none"> <li>■ <b>SORT COLUMN</b> active: Click the column header to sort the content of the column</li> <li>■ <b>SHIFT COLUMN</b> active: The column can be moved by drag and drop</li> </ul>
	Reset the manually changed settings (move columns) to the original condition







You can edit the tool data only in the form view. To activate the form view, press the **FORM FOR TOOL** soft key or the **ENT** key for the currently highlighted tool.

If you use the tool management without a mouse, then you can activate and deactivate functions with the **-/+** key.












In the tool management, use the **GOTO** key to search for the tool number or pocket number.

In addition, you can perform the following functions by mouse:

- Sorting function: You can sort the data in ascending or descending order (depending on the active setting of the soft key) by clicking a column of the table head.
- Arrange columns. You can arrange the columns in any sequence you want by clicking a column of the table head and then moving it with the mouse key pressed down. The control does not save the current column sequence when you exit the tool management (depending on the active setting of the soft key).
- Show miscellaneous information in the form view: The control displays tool tips when you leave the mouse pointer on an active entry field for more than a second and when you have set the **EDIT ON/OFF** soft key to **ON**

### Editing with active form view

If the form view is active, the following functions are available to you:

Soft key	Editing functions, form view
	Select the tool data of the previous tool
	Select the tool data of the next tool
	Select previous tool index (only active if indexing is enabled)
	Select the next tool index (only active if indexing is enabled)
	Open a pop-up window for selection (only available for selection fields)
	Discard all changes made since the form was called
	Calculate the measured values of tool compensation (only active for turning tools)
	Add tool index
	Delete tool index
	Copy the tool data of the selected tool
	Insert the copied tool data in the selected tool

**Deleting marked tool data**

Using this function you can simply delete tool data that you no longer need.

Follow the steps outlined below for deleting:

- ▶ In the tool management you use the arrow keys or mouse to mark the tool data that you wish to delete
- ▶ Press the **DELETE MARKED TOOLS** soft key
- ▶ The control shows a pop-up window listing the tool data to be deleted.
- ▶ Press the **EXECUTE** soft key to start the deletion procedure
- ▶ The control shows a pop-up window with the deletion status.
- ▶ Terminate the delete process by pressing the **END** key or soft key

**NOTICE**

**Caution: Data may be lost!**

The **DELETE MARKED TOOLS** function permanently deletes the tool data. The data is not automatically backed up by the control (e.g., to a recycle bin) before being deleted. The data is irreversibly deleted by this function.





- ▶ Regularly back up important data to external drives





















- i** The tool data of tools still stored in the pocket table cannot be deleted. The tools must be removed from the magazine first.
- Make sure to keep the tool table as short and clear as possible so that it does not impair the computing speed of your control. Use a maximum of 10,000 tool entries in tool management. For example, you can delete all unused tool numbers; tool numbers need not be sequential.



**Available tool types**

- i** In tool management, the control only displays the input fields related to the selected tool type.

The tool management displays the various tool types with an icon. The following tool types are available:

Icon	Tool type	Tool type number
	Undefined,****	99
	Milling cutter,MILL	0
	Roughing cutter,MILL_R	9
	Finishing cutter,MILL_F	10

Icon	Tool type	Tool type number
	Face milling cutter, MILL_FACE	14
	Ball-nose cutter, BALL	22
	Toroid cutter, TORUS	23
	Chamfer mill, MILL_CHAMFER	24
	Side milling cutter, MILL_SIDE	25
	Drill, DRILL	1
	Tap, TAP	2
	Center drill, CENT	4
	Turning Tool, TURN	29
	Touch probe, TCHP	21
	Ream, REAM	3
	Countersink, CSINK	5
	Piloted counterbore, TSINK	6
	Boring tool, BOR	7
	Back boring tool, BCKBOR	8
	Thread mill, GF	15
	Thread mill w/ countersink, GSF	16
	Thread mill w/ single thread, EP	17
	Thread mill w/ indxbl insert, WSP	18
	Thread milling drill, BGF	19

Icon	Tool type	Tool type number
	Circular thread mill,ZBGF	20
	Grinding tool	30
	Dressing tool	31

## Importing and exporting tool data

### Importing tool data



Refer to your machine manual.

The machine manufacturer can define update rules that make it possible, for example, to automatically remove umlauts from tables and NC programs.

Using this function you can simply import tool data that you have measured externally on a presetting device, for example. The file to be imported must have the CSV format (**c**omma **s**eparated **v**alue).

**CSV** files are text files designed for the exchange of data with a simple structure. Accordingly, the import file must have the following structure:

- **Line 1:** In the first line you define the column names in which the data defined in the subsequent lines is to be placed. The column names are separated with a comma.
- **Other lines:** All the other lines contain the data that you wish to import into the tool table. The order of the data must match the order of the column names in Line 1. The data is separated by commas, decimal numbers are to be defined with a decimal point.

Follow the steps outlined below for importing:

- ▶ Copy the tool table to be imported to the **TNC:\system\tooltab** directory on the hard disk of the control
- ▶ Start expanded tool management
- ▶ Press the **TOOL IMPORT** soft key in the tool management
- > The control shows a pop-up window with the CSV files that are saved in the **TNC:\system\tooltab** directory
- ▶ Use the arrow keys or mouse to select the file to be imported and confirm with the **ENT** key
- > The control shows a pop-up window with the content of the CSV file
- ▶ Start the import procedure with the **EXECUTE** soft key.



- The CSV file to be imported must be stored in the **TNC: \system\tooltab** directory.
- If you import the tool data of existing tools (whose numbers are in the pocket table) the control issues an error message. You can then decide whether to skip this data record or insert a new tool. The control inserts a new tool into the first empty line of the tool table.
- If the imported CSV file contains unknown table columns, the control displays a message during import. An additional note informs you that the data will not be transferred.
- Make sure that the column designations have been specified correctly.  
**Further information:** "Entering tool data into the table", Page 142
- You can import any tool data, the associated data record does not have to contain all the columns (or data) of the tool table.
- The column names can be in any order, the data must be defined in the corresponding order.

#### Example

T,L,R,DL,DR	Line 1 with column names
4,125.995,7.995,0,0	Line 2 with tool data
9,25.06,12.01,0,0	Line 3 with tool data
28,196.981,35,0,0	Line 4 with tool data

### Exporting tool data

Using this function you can simply export tool data to read it into the tool database of your CAM system, for example. The control stores the exported file in the CSV format (**c**omma **s**eparated **v**alue). **CSV** files are text files designed for the exchange of data with a simple structure. The export file has the following structure:

- **Line 1:** In the first line the control stores the column names of all the relevant tool data to be defined. The column names are separated from each other by commas.
- **Further lines:** All the other lines contain the data of the tools that you have exported. The order of the data matches the order of the column names in Line 1. The data is separated by commas, the control outputs decimal numbers with a decimal point.

Follow the steps outlined below for exporting:

- ▶ In the tool management you use the arrow keys or mouse to mark the tool data that you wish to export
- ▶ Press the **EXPORT TOOL** soft key
- > The control shows a pop-up window
- ▶ Enter a name for the CSV file and confirm it with the **ENT** key
- ▶ Start the export procedure with the **EXECUTE** soft key
- > The control shows a pop-up window with the status of the export process
- ▶ Terminate the export process by pressing the **END** key or soft key



By default the control stores the exported CSV file in the **TNC:\system\tooltab** directory.

## 4.4 Tool carrier management

### Fundamentals

You can create and manage tool carriers using the tool carrier management. The control factors the tool carriers into the calculations.



Refer to your machine manual.  
This function must be enabled and adapted by the machine manufacturer.  
The machine manufacturer defines the insertion point for the tool carrier.

On 3-axis machines, tool carriers of right-angled angle heads are useful for machining in the tool axes **X** and **Y**, as the control takes the dimensions of the angle heads into account.

In the **Test Run** operating mode, you check the tool carriers for collisions with the workpiece.

**Further information:** "Monitoring for collisions", Page 266

Along with the **Advanced Function Set 1** software option (option 8), you can tilt the working plane to the angle of the removable angle heads and thus keep working with the **Z** tool axis.

Along with the **Dynamic Collision Monitoring** software option (option 40), you can monitor every tool carrier and thus prevent it from colliding with fixtures or machine components.

You must carry out the following steps so that the control can factor the tool carriers into the calculations:

- Saving tool carrier templates
- Parameterizing tool carriers
- Assign the tool carrier



If you are using M3D or STL files instead of parameterized tool carriers, the first two steps are not required.



Even if the inch unit of measure is active in the control or NC program, the control will interpret dimensions of 3D files in mm.



## Saving tool carrier templates

Many tool carriers only differ from others in terms of their dimensions, but their geometric shape is identical. HEIDENHAIN provides ready-to-use tool carrier templates so that you need not design all tool carriers yourself. Tool carrier templates are 3D models with fixed geometries but editable dimensions.

The tool carrier templates must be saved in **TNC:\system\Toolkinematics** and have the extension **.cft**.

Sample files for tool carrier templates are available on the programming station in the **TNC:\system\Toolkinematics** folder.

**i** If the tool carrier templates are not available on your control, please download the data you require from:  
**HEIDENHAIN NC solutions**

**i** If you need further tool carrier templates, please contact your machine manufacturer or third-party vendor.

**i** The tool carrier templates may consist of several sub-files. If the sub-files are incomplete, the control will display an error message.  
**Do not use incomplete tool carrier templates!**










## Parameterizing tool carriers

Before the control can factor the tool carrier into the calculations, you must give the tool carrier templates the actual dimensions. These parameters are entered in the additional **ToolHolderWizard** tool.

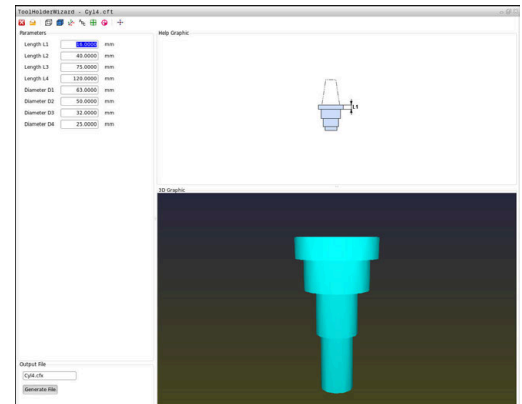
Save the parameterized tool carriers with the extension **.cfx** under **TNC:\system\Toolkinematics**.

The additional **ToolHolderWizard** tool is mainly operated with the mouse. Using the mouse, you can also set the desired screen layout by drawing a line between the areas **Parameter**, **Help graphics**, and **3-D graphics** by holding down the left mouse button.

The following icons are available in the additional **ToolHolderWizard** tool:

Icon	Function
	Close the additional tool
	Open file
	Switch between wire frame model and solid object view
	Switch between shaded and transparent view
	Display or hide transformation vectors
	Show or hide names of collision objects
	Display or hide test points
	Show or hide measurement points
	Return to starting view of the 3-D model

**i** If the tool carrier template does not contain any transformation vectors, names, test points, or measurement points, then the additional **ToolHolderWizard** tool does not execute any function when the corresponding icons are activated.



### Parameterizing tool carrier templates in Manual operation mode

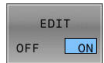
To parameterize a tool carrier template and save these parameters:



- ▶ Press the **Manual operation** key



- ▶ Press the **TOOL TABLE** soft key



- ▶ Press the **EDIT** soft key



- ▶ Move the cursor to the **KINEMATIC** column



- ▶ Press the **SELECT** soft key



- ▶ Press the **TOOL HOLDER WIZARD** soft key
- > The control opens the additional **ToolHolderWizard** tool in a pop-up window.



- ▶ Press the **OPEN FILE** icon
- > The control opens a pop-up window.
- ▶ Select the desired tool carrier template using the preview screen
- ▶ Press the **OK** button
- > The control opens the selected tool carrier template.
- > The cursor goes to the first parameterizable value.
- ▶ Adjust values
- ▶ Enter the name for the parameterized tool holder in the **Output file** area
- ▶ Press the **GENERATE FILE** button
- ▶ If required, reply to the message on the control
- ▶ Press the **CLOSE** icon
- > The control closes the additional tool



### Parameterizing tool carrier templates in Programming operating mode

Proceed as follows to parameterize tool carrier templates and save these parameters:



- ▶ Press the **Programming** key



- ▶ Press the **PGM MGT** key
- ▶ Select the path **TNC:\system\Toolkinematics**
- ▶ Select the tool carrier template
- > The control opens the additional **ToolHolderWizard** tool with the selected tool carrier template.
- > The cursor goes to the first parameterizable value.
- ▶ Adjust values
- ▶ Enter the name for the parameterized tool holder in the **Output file** area
- ▶ Press the **GENERATE FILE** button
- ▶ If required, reply to the message on the control
- ▶ Press the **CLOSE** icon
- > The control closes the additional tool



## Assigning a tool carrier

To allow the control to factor a tool carrier into calculations, you must assign the tool carrier to a tool and **call the tool again**.

**i** Parameterized tool carriers can consist of several subfiles. If the subfiles are incomplete, the control will display an error message.

**Only use fully parameterized tool carriers, error-free STL files or M3D files.**

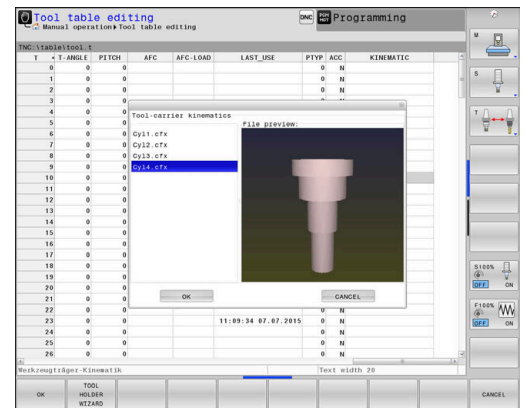
Tool carriers in STL format must meet the following requirements:

- Max. 20 000 triangles
- Triangular mesh forms a closed shell

If an STL file does not meet the requirements of the control, then the control issues an error message.

For tool carriers, the same requirements with respect to STL and M3D files apply as for fixtures.

**Further information:** "Using fixtures in STL format", Page 376



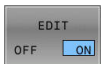
To assign a tool carrier to a tool:



- ▶ Operating mode: Press the **Manual operation** key



- ▶ Press the **TOOL TABLE** soft key



- ▶ Press the **EDIT** soft key



- ▶ Move the cursor to the **KINEMATIC** column of the required tool



- ▶ Press the **SELECT** soft key
- ▶ The control opens a pop-up window with the available tool carriers.
- ▶ Select the desired tool carrier using the preview
- ▶ Press the **OK** soft key
- ▶ The control copies the name of the selected tool carrier to the **KINEMATIC** column.



- ▶ Exit the tool table



# 5

**Setup**

## 5.1 Switching on/off

### Switch-on

#### DANGER

##### Caution: hazard to the user!

Machines and machine components always pose mechanical hazards. Electric, magnetic, or electromagnetic fields are particularly hazardous for persons with cardiac pacemakers or implants. The hazard starts when the machine is powered up!

- ▶ Read and follow the machine manual
- ▶ Read and follow the safety precautions and safety symbols
- ▶ Use the safety devices



Refer to your machine manual.

Switching on the machine and traversing the reference points can vary depending on the machine tool.

Switch the machine and the control on as follows:

- ▶ Switch on the power supply for the control and the machine
- > The control displays the switch-on status in the subsequent dialogs.
- > If booting was successful, the control displays the **Stromunterbrechung** dialog

**CE**

- ▶ Press the **CE** key to clear the message
- > The control displays the **Compiling PLC program** dialog; the PLC program is compiled automatically
- > The control displays the **Switch on external dc voltage** dialog



- ▶ Switch on the machine control voltage
- > The control carries out a self-test.

If the control does not register an error, it displays the **Traverse reference points** dialog.

If the control registers an error, it issues an error message.

#### NOTICE

##### Danger of collision!

When the machine is switched on, the control tries to restore the switch-off status of the tilted plane. This is prevented under certain conditions. For example, this applies if axis angles are used for tilting while the machine is configured with spatial angles, or if you have changed the kinematics.

- ▶ If possible, reset tilting before shutting the system down
- ▶ Check the tilted condition when switching the machine back on



### Checking the axis position



This section applies only to machine axes with EnDat encoders.

If the actual axis position after the machine has been switched on does not match the shutdown position, the control displays a pop-up window.

- ▶ Check the axis position of the affected axis
- ▶ If the current axis position matches that proposed in the display, confirm with **YES**

### NOTICE

#### Danger of collision!

Failure to notice deviations between the actual axis positions and those expected by the control (saved at shutdown) can lead to undesirable and unexpected axis movements. There is risk of collision during the reference run of further axes and all subsequent movements!

- ▶ Check the axis positions
- ▶ Only confirm the pop-up window with **YES** if the axis positions match
- ▶ Despite confirmation, at first only move the axis carefully
- ▶ If there are discrepancies or you have any doubts, contact your machine manufacturer

## Traverse reference points

If the control performs the self-test successfully, it then displays the **Traverse reference points** dialog.



Refer to your machine manual.

Switching on the machine and traversing the reference points can vary depending on the machine tool.

If your machine is equipped with absolute encoders, you can leave out crossing the reference points.



If you intend only to edit or graphically simulate NC programs, you can select the **Programming** or **Test Run** operating mode immediately after switching on the control voltage, without needing to home the axes.

You can neither set a preset nor modify a preset via the preset table without having homed the axes. The control issues the **Traverse reference points** message.

You can traverse the reference points later. For this purpose, press the **PASS OVER REFERENCE** soft key in **Manual operation** mode.

Cross the reference points manually in the displayed sequence:



- ▶ For each axis press the **NC START** key, or
- > The control is now ready for operation in the **Manual operation** operating mode.

As an alternative you can cross the reference points in any sequence:



- ▶ Press and hold the axis direction key for each axis until the reference point has been traversed



- > The control is now ready for operation in the **Manual operation** operating mode.

**Crossing the reference point in a tilted working plane**

If the **Tilt working plane** (option 8) function was active before the control was shut down, then the control will automatically reactivate this function after the restart. This means that movements via the axis keys take place in the tilted working plane.

Before traversing the reference points, you must deactivate the **Tilt working plane** function; otherwise, the control will interrupt the process with a warning. You can also home axes that are not activated in the current kinematic model without needing to deactivate **Tilt working plane**, such as a tool magazine.

**Further information:** "To activate manual tilting", Page 254

**NOTICE****Danger of collision!**

The control does not automatically check whether collisions can occur between the tool and the workpiece. Incorrect pre-positioning or insufficient spacing between components can lead to a risk of collision when referencing the axes.

- ▶ Pay attention to the information on the screen
- ▶ If necessary, move to a safe position before referencing the axes
- ▶ Watch out for possible collisions



If the machine does not have any absolute encoders, the position of the rotary axes must be confirmed. The position shown in the pop-up window is the last position before the control was shut down.

## Switching off



Refer to your machine manual.  
Deactivation is a machine-dependent function.

To prevent data from being lost on switch-off, you need to shut down the operating system of the control as follows:



- ▶ Operating mode: Press the **Manual operation** key



- ▶ Press the **OFF** soft key



- ▶ Confirm with the **SHUT DOWN** soft key
- ▶ When the control displays the message **Now you can switch off** in a pop-up window, you may switch off the power supply to the control

### NOTICE

#### Caution: Data may be lost!

The control must be shut down so that running processes can be concluded and data can be saved. Immediate switch-off of the control by turning off the main switch can lead to data loss regardless of the control's status!

- ▶ Always shut down the control
- ▶ Only operate the main switch after being prompted on the screen

## 5.2 Moving the machine axes

### Note



Refer to your machine manual.

Movement of the axes via the axis direction keys can vary depending on the machine.

### Moving the axis with the axis direction keys



- ▶ Operating mode: Press the **Manual operation** key



- ▶ Press the axis-direction key and hold it down as long as you wish the axis to move



- ▶ Alternatively, move the axis continuously: Press and hold the axis-direction key and press the **NC Start** key



- ▶ To stop: Press the **NC Stop** key

You can move several axes at a time with these two methods. The control then shows the feed rate. You can change the feed rate at which the axes are moved with the **F** soft key.










**Further information:** "Spindle speed S, feed rate F and miscellaneous function M", Page 193

If a moving task is active on the machine, the control displays the **control in operation** symbol.

## Incremental jog positioning

Incremental jog positioning allows you to move a machine axis by a preset distance.

The input range for the infeed is from 0.001 mm to 10 mm.

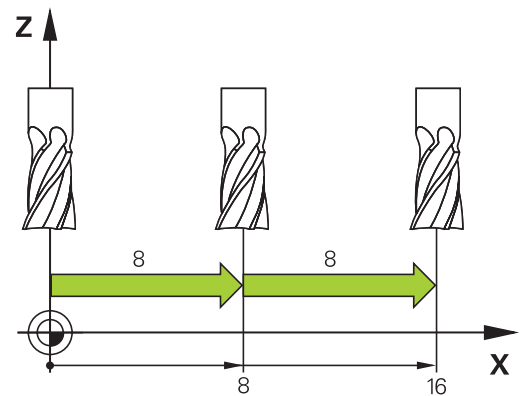
- 
  - ▶ Operating mode: Press the **Manual operation** or **Electronic handwheel** key
- 
  - ▶ Shift the soft-key row
- 
  - ▶ Select incremental jog positioning: Switch the **INCREMENT** soft key to **ON**
- 
  - ▶ Enter the infeed of the **linear axes**
  - ▶ Confirm with the **CONFIRM VALUE** soft key
- 
  - ▶ Or confirm with the **ENT** key
- 
  - ▶ Use the arrow keys to position the cursor on the **rotary axis**
- 
  - ▶ Enter the infeed of the **rotary axes**
  - ▶ Confirm with the **CONFIRM VALUE** soft key
- 
  - ▶ Or confirm with the **ENT** key
- 
  - ▶ Confirm with the **OK** soft key
  - ▶ The jog increment is active.
  - ▶ The control displays the set values in the upper area of the screen.

### Canceling incremental jog positioning

- 
  - ▶ Set the **INCREMENT** soft key to **OFF**



If you are in the **Jog increment** menu, you can switch off incremental jog positioning with the **SWITCH OFF** soft key.



## Traverse with electronic handwheels

### **⚠ DANGER**

#### **Caution: hazard to the user!**

Unsecured connections, defective cables, and improper use are always sources of electrical dangers. The hazard starts when the machine is powered up!

- ▶ Devices should be connected or removed only by authorized service technicians
- ▶ Only switch on the machine via a connected handwheel or a secured connection

The control supports traversing with the following electronic handwheels:

- HR 510: Simple handwheel without display, data transmission via cable
- HR 520: Handwheel with display, data transmission via cable
- HR 550FS: Handwheel with display, data transmission via radio

In addition, the control still supports the cable-bound handwheels HR 410 handwheel (without display) and HR 420 handwheel (with display).



Refer to your machine manual.  
Your machine manufacturer can make additional functions of the HR 5xx handwheels available.



If you wish to use the function **Handwheel superimp.** in virtual tool axis **VT**, an HR 5xx handwheel is recommended.  
**Further information:** "Virtual tool axis (VT)(Option 44)", Page 321

The HR 520 and HR 550FS portable handwheels feature a display that allows the control to show different types of information. In addition, you can use the handwheel soft keys for important setup functions (e.g., setting of presets or entering and running M functions).

As soon as you have activated the handwheel with the handwheel activation key, the operating panel is locked. The control shows this status in a pop-up window on the screen.



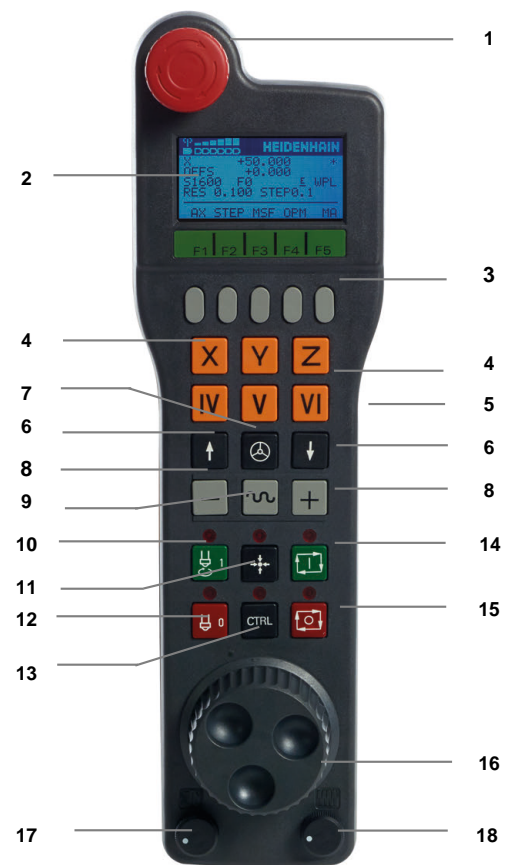
If more than one handwheel is connected to a control, the handwheel key is not available on the operating panel. Activate or deactivate the handwheel via the handwheel key on the handwheel. An active handwheel must be deactivated before another handwheel can be selected.



Refer to your machine manual.

This function must be enabled and adapted by the machine manufacturer.

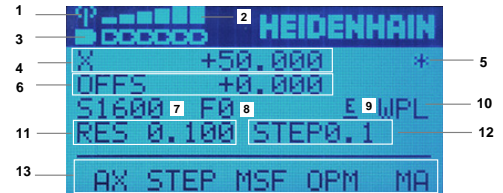
- 1 **EMERGENCY STOP** key
- 2 Handwheel display for status and for selecting functions
- 3 Soft keys
- 4 Axis keys; can be exchanged by the machine manufacturer depending on the axis configuration
- 5 Permissive button
- 6 Arrow keys for defining handwheel sensitivity
- 7 Handwheel activation key
- 8 Key for traverse direction of the selected axis
- 9 Rapid traverse superimposing for the axis direction key
- 10 Spindle switch-on (machine-dependent function, key can be exchanged by the machine manufacturer)
- 11 **Generate NC block** key (machine-dependent function, key can be exchanged by the machine manufacturer)
- 12 Spindle switch-off (machine-dependent function, key can be exchanged by the machine manufacturer)
- 13 **CTRL** key for special functions (machine-dependent function, key can be exchanged by the machine manufacturer)
- 14 **NC Start** key (machine-dependent function, key can be exchanged by the machine manufacturer)
- 15 **NC Stop** key (machine-dependent function, key can be exchanged by the machine manufacturer)
- 16 Handwheel
- 17 Spindle speed potentiometer
- 18 Feed rate potentiometer
- 19 Cable connection; not required for the HR 550FS wireless handwheel





### Handwheel display

- 1 Only with the HR 550FS wireless handwheel:** Shows whether the handwheel is in its docking station or whether radio mode is active
- 2 Only with the HR 550FS wireless handwheel:** Display of field strength, six bars = maximum field strength
- 3 Only with HR 550FS radio handwheel:** Charging state of battery, six bars = maximum charge. A bar moves from the left to the right during recharging
- 4 X+50.000:** Position of the selected axis
- 5 \*:** Control in operation; program run has been started or axis is in motion
- 6 OFFS +0.000:** Offset values from M118 or from the Global Program Settings (option 44)
- 7 S1000:** Current spindle speed
- 8 F0:** Feed rate at which the selected axis is moving  
The control displays the current contouring feed rate while the program is running.
- 9 E:** Error message  
If an error message appears on the control, the handwheel display shows the **ERROR** message for three seconds. Then the letter **E** is shown in the display as long as the error is pending on the control.
- 10 WPL:** 3-D-ROT function is active  
Depending on the settings in the 3-D ROT menu, the following is displayed:
  - **VT:** The function for traversing in the tool axis direction is active
  - **WP:** Basic rotation function is active
- 11 RES 0.100:** Active handwheel resolution. Path traversed by the selected axis with one handwheel revolution
- 12 STEP ON or OFF:** Incremental jog active or inactive. If the function is active, the control additionally displays the current traversing step
- 13** Soft-key row: Selection of various functions, described in the following sections



### Special features of the HR 550FS wireless handwheel

#### **⚠ DANGER**

##### **Caution: hazard to the user!**

Wireless handwheels, due to their rechargeable batteries and the influence of other wireless devices, are more susceptible to interference than cable-bound connections are. Ignoring the requirements for and information about safe operation leads to endangerment of the user, for example during installation or maintenance work.

- ▶ Check the radio connection of the handwheel for possible overlapping with other wireless devices
- ▶ Switch off the wireless handwheel and the handwheel holder after an operating time of 120 hours at the latest so that the control can run a functional test when it is restarted
- ▶ If more than one wireless handwheel is being used in a workshop, then ensure an unambiguous assignment between the handwheels and the handwheel holders (such as with color-coded stickers)
- ▶ If more than one wireless handwheel is being used in a workshop, then ensure an unambiguous assignment between the handwheels and the respective machine (such as with a functional test)

The HR 550FS wireless handwheel features a rechargeable battery. The battery starts charging when you place the handwheel into the holder.

The HRA 551 FS handwheel holder and the HR 550FS handwheel together form one functional unit.

The HR 550FS can be operated by battery for up to eight hours before it needs recharging. A completely discharged handwheel takes approx. three hours for a full charge. When you do not use the HR 550FS, always place it into the handwheel holder. This charges the handwheel battery constantly and a direct connection with the emergency-stop circuit is provided.

As soon as the handwheel is in its holder, it switches internally to cable operation. This means you can still use it even if the handwheel is fully discharged. The functions are the same as with wireless operation.

- i** Clean the contacts of the handwheel holder and handwheel regularly to ensure their proper functioning.

The transmission range is amply dimensioned. If you happen to get close to the limit of the transmission range, for example with very large machines, the HR 550FS sets off a vibrating alarm that is reliably noticed. If this happens you must reduce the distance to the handwheel holder in which the radio receiver is integrated.



**NOTICE****Caution: Danger to the tool and workpiece!**

The wireless handwheel triggers an emergency stop reaction if the radio transmission is interrupted, the battery is fully empty, or if there is a defect. Emergency stop reactions during machining can cause damage to the tool or workpiece.

- ▶ Place the handwheel in the handwheel holder when it is not in use
- ▶ Keep the distance between the handwheel and the handwheel holder small (pay attention to the vibration alarm)
- ▶ Test the handwheel before machining

If the control has triggered an emergency stop you must reactivate the handwheel. Proceed as follows:



- ▶ Press the **MOD** key
- > The control opens the MOD menu.
- ▶ Select the **Machine settings** group



- ▶ Press the **SET UP WIRELESS HANDWHEEL** soft key
- > The control opens a pop-up window for configuring wireless handwheels.
- ▶ Press the **Start handwheel** button to reactivate the wireless handwheel
- ▶ Select the **END** button

The MOD menu includes a function for initial operation and configuration of the handwheel.

**Further information:** "Configuring the HR 550\FS radio handwheel", Page 466

### Selecting the axis to be moved

You can directly use the axis keys to activate the main axes X, Y, Z, and three other axes that can be defined by the machine manufacturer. Your machine manufacturer can also place the virtual axis VT directly on one of the free axis keys. If the virtual axis VT is not on one of the axis keys, proceed as follows:

- ▶ Press the handwheel soft key **F1 (AX)**
- > The control shows all active axes on the handwheel display. The currently active axis flashes.
- ▶ Select the desired axis with the **F1 (->)** or **F2 (-<)** soft keys and confirm with the **F3 (OK)** handwheel soft key



Refer to your machine manual.

Machine manufacturers can also configure the lathe spindle in turning mode (option 50) as a selectable axis.

### Setting the handwheel sensitivity

The handwheel sensitivity specifies the distance an axis moves per handwheel revolution. The handwheel sensitivity results from the defined handwheel speed of the axis and the speed level used internally by the control. The speed level describes a percentage of the handwheel speed. The control calculates a specific handwheel sensitivity value for each speed level. The resulting handwheel sensitivity values are directly selectable with the handwheel arrow keys (only if incremental jog is not active).

Taking the example of a defined handwheel speed of 1, the following handwheel sensitivity values result from the speed levels for the respective units of measure:

Resulting handwheel sensitivity levels in mm/revolution and degrees/revolution:

0.0001/0.0002/0.0005/0.001/0.002/0.005/0.01/0.02/0.05/0.1/0.2/0.5/1

Resulting handwheel sensitivity levels in inches/revolution:

0.000127/0.000254/0.000508/0.00127/0.00254/0.00508/0.0127/0.0254/0.0508/0.127/0.254/0.508

### Examples for resulting handwheel sensitivity values:

Defined handwheel speed	Speed level	Resulting handwheel sensitivity
10	0.01%	0.001 mm/revolution
10	0.01%	0.001 degrees/revolution
10	0.0127%	0.00005 inches/revolution

**Moving the axes**

- ▶ Activate the handwheel: Press the handwheel key on the HR 5xx:
- ▶ You can now operate the control only via the HR 5xx. The control displays a pop-up window with this information on the screen.
- ▶ Select the desired operating mode with the **OPM** soft key as needed

- ▶ Press and hold the permissive button as needed



- ▶ Use the handwheel to select the axis to be moved. Select the additional axes with the soft keys as needed



- ▶ Move the active axis in the positive direction with the + key, or



- ▶ Move the active axis in the negative direction with the - key



- ▶ Deactivate the handwheel: Press the handwheel key on the HR 5xx
- ▶ Now you can operate the control via the operating panel again.

**Potentiometer settings**

0.00005 inches/revolution

**NOTICE****Caution: Possible damage to the workpiece!**

When toggling between the machine operating panel and the handwheel, the feed rate may be reduced. This can cause visible marks on the workpiece.

- ▶ Make sure to retract the tool before toggling between the handwheel and the machine operating panel.

The settings of the feed-rate potentiometer on the handwheel may differ from those on the machine operating panel. When you activate the handwheel, the control automatically activates the feed-rate potentiometer of the handwheel. When you deactivate the handwheel, the control automatically activates the feed-rate potentiometer of the machine operating panel.

In order to make sure that the feed rate does not increase while you switch between the potentiometers, the feed rate is either frozen or reduced.

If the feed rate before switching is higher than the feed rate after switching, the control automatically reduces the feed rate to the smaller value.

If the feed rate before switching is less than the feed rate after switching, the control automatically freezes the feed rate. In this case, you must turn the feed-rate potentiometer back to the previous value because the activated feed-rate potentiometer will only then be effective.

### Incremental jog positioning

With incremental jog positioning the control moves the currently active handwheel axis by a preset increment defined by you:

- ▶ Press the handwheel soft key **F2 (STEP)**
- ▶ Activate incremental jog positioning: Press the handwheel soft key 3 (**ON**)
- ▶ Select the desired jog increment by pressing the **F1** or **F2** key. The smallest possible increment is 0.0001 mm (0.00001 inches). The largest possible increment is 10 mm (0.3937 inches).
- ▶ Confirm the selected jog increment by pressing the soft key 4 (**OK**)
- ▶ Use the **+** or **-** handwheel key to move the active handwheel axis in the corresponding direction

**i** If you press and hold the **F1** or **F2** key, the control will increase the counting increment by a factor of 10 each time it reaches a decimal value of 0.  
By additionally pressing the **CTRL** key, you can increase the counting increment by a factor of 100 when pressing **F1** or **F2**.

### Entering miscellaneous functions M

- ▶ Press the handwheel soft key **F3 (MSF)**
- ▶ Press the handwheel soft key **F1 (M)**
- ▶ Select the desired M function number by pressing the **F1** or **F2** key
- ▶ Execute the M miscellaneous function by pressing the **NC Start** key

### Entering the spindle speed S

- ▶ Press the handwheel soft key **F3 (MSF)**
- ▶ Press the handwheel soft key **F2 (S)**
- ▶ Select the desired spindle speed by pressing the **F1** or **F2** key
- ▶ Activate the new spindle speed S with the **NC Start** key

**i** If you press and hold the **F1** or **F2** key, the control will increase the counting increment by a factor of 10 each time it reaches a decimal value of 0.  
By additionally pressing the **CTRL** key, you can increase the counting increment by a factor of 100 when pressing **F1** or **F2**.

### Entering the feed rate F

- ▶ Press the handwheel soft key **F3 (MSF)**
- ▶ Press the handwheel soft key **F3 (F)**
- ▶ Select the desired feed rate by pressing the **F1** or **F2** key
- ▶ Load the new feed rate F with the handwheel soft key **F3 (OK)**



If you press and hold the **F1** or **F2** key, the control will increase the counting increment by a factor of 10 each time it reaches a decimal value of 0.

By additionally pressing the **CTRL** key, you can increase the counting increment by a factor of 100 when pressing **F1** or **F2**.

### Setting a preset



Refer to your machine manual.

The machine manufacturer can disable presetting in individual axes.

- ▶ Press the handwheel soft key **F3 (MSF)**
- ▶ Press the handwheel soft key **F4 (PRS)**
- ▶ If necessary, select the axis in which the preset will be set
- ▶ Zero the axis with the handwheel soft key **F3 (OK)** or set the desired value with the handwheel soft keys **F1** and **F2**, and then confirm with the handwheel soft key **F3 (OK)**. By additionally pressing the **CTRL** key, you can increase the counting increment to 10

### Switching between operating modes

The handwheel soft key **F4 (OPM)** allows you to use the handwheel to switch the operating mode if the current status of the control permits a change in operating mode.

- ▶ Press the handwheel soft key **F4 (OPM)**
- ▶ Select the desired operating mode by handwheel soft key
  - MAN: **Manual operation**
  - MDI: **Positioning w/ Manual Data Input**
  - SGL: **Program run, single block**
  - RUN: **Program run, full sequence**

### Generating a complete traversing block



Refer to your machine manual.

Your machine manufacturer can assign any function to the **Generate NC block** handwheel key.

- ▶ Select the **Positioning w/ Manual Data Input** operating mode
- ▶ If necessary, use the arrow keys on the control's keyboard to select the NC block after which the new positioning block should be inserted
- ▶ Activate the handwheel
- ▶ Press the **Generate NC block** key on the handwheel
- ▶ The control inserts a complete traversing block containing all axis positions selected through the MOD function.

### Functions in the Program Run operating modes

You can use the following functions in Program Run operating modes:

- The **NC Start** key (**NC Start** handwheel key)
- The **NC Stop** key (**NC Stop** handwheel key)
- After you have pressed the **NC Stop** key: Internal stop (handwheel soft keys **MOP** and then **Stop**)
- After you have pressed the **NC Stop** key: Manual traverse of axes (handwheel soft keys **MOP** and then **MAN**)
- Return to the contour after axes were manually traversed during a program interruption (handwheel soft keys **MOP** and then **REPO**). The handwheel soft keys, which function similarly to the screen soft keys, are used for operating.  
**Further information:** "Returning to the contour", Page 301
- Switch on/off the "Tilt working plane" function (handwheel soft keys **MOP** and then **3D**)



## 5.3 Spindle speed S, feed rate F and miscellaneous function M

### Application

In the **Manual operation** and **Electronic handwheel** operating modes, you can enter the spindle speed S, feed rate F, and the M functions (miscellaneous functions) with soft keys.

**Further information:** "Entering miscellaneous functions M and STOP", Page 315



Refer to your machine manual.

The machine manufacturer defines which miscellaneous functions are available on the machine and which are allowed in the **Manual operation** mode.

### Enter values

#### Spindle speed S, miscellaneous function M

To enter the spindle speed:



- ▶ Press the **S** soft key
- ▶ The control shows the **Spindle speed S =** dialog in a pop-up window.



- ▶ Enter **1000** (spindle speed)
- ▶ Press the **NC start** key to load the value

To start the spindle rotation with the specified speed **S**, use an **M** function. The **M** function value can be entered in the same way. The control shows the current spindle speed in the status display. If the spindle speed is less than 1000, the control also shows a decimal place that has been entered.

### Feed rate F

To enter the feed rate:



- ▶ Press the **F** soft key
- > The control opens a pop-up window.
- ▶ Enter the desired feed rate



- ▶ Confirm with the **ENT** key

The following is valid for feed rate F:

- If you enter  $F=0$ , then the feed rate that the machine manufacturer has defined as minimum feed rate is active
- If the feed rate you entered exceeds the maximum value that has been defined by the machine manufacturer, then the value defined by the machine manufacturer is active
- F is retained even after a power interruption
- The control displays the contouring feed rate as follows:
  - If **3D ROT** is active, the contouring feed rate is displayed if multiple axes are moving
  - If **3D ROT** is inactive, the feed-rate display remains empty when more than one axis is moved simultaneously
  - If a handwheel is active, the control shows the contouring feed rate during program run.

The control shows the current feed rate in the status display.

- If the feed rate is less than 10, the control also shows one decimal place (if one was entered).
- The control displays two decimal places if the feed rate is less than 1.

### Changing the spindle speed and feed rate

With the potentiometers you can vary the spindle speed **S** and feed rate **F** from 0 % to 150 % of the set value.

The feed-rate potentiometer only reduces the programmed feed rate and not the feed rate calculated by the control.



The override for spindle speed is only functional on machines with infinitely variable spindle drive.



## Feed-rate limit F MAX



Refer to your machine manual.  
The feed-rate limit depends on the machine.

The **F MAX** soft key enables you to reduce the feed rate for all operating modes. The reduction applies to all rapid traverse and feed rate movements. The value you enter remains active after switch-off or switch-on.

If a feed-rate limit is active, the control displays an exclamation mark behind the feed rate-value in the status display.

**Further information:** "General status display", Page 69

The **F MAX** soft key is available in the following operating modes:

- **Program run, single block**
- **Program run, full sequence**
- **Positioning w/ Manual Data Input**

### Procedure

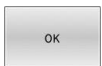
To activate the feed-rate limit F MAX:



- ▶ Operating mode: Press the **Positioning w/ Manual Data Input** key



- ▶ Set the **F MAX** soft key to **ON**



- ▶ Enter the desired maximum feed rate
- ▶ Press the OK soft key
- ▶ The control displays an exclamation mark behind the feed rate-value in the status display.

## 5.4 Integrated Functional Safety (FS)

### General information

Machine tools with HEIDENHAIN controls may be equipped with integrated functional safety (FS) or with external safety. This chapter refers exclusively to machines with integrated functional safety (FS).



Refer to your machine manual.  
Your machine manufacturer adapts the HEIDENHAIN safety system to your machine.

Every machine tool user is exposed to certain risks. While protective devices can prevent access to dangerous locations, the user must also be able to work on the machine without this protection (e.g., guard door opened).

The HEIDENHAIN safety design enables the setup of a system that fulfills the requirements of **Performance Level d, Category 3** in accordance with **DIN EN ISO 13849-1** and **SIL 2 in accordance with IEC 61508 (DIN EN 61508-1)**.

It provides safety-related operating modes, as per **DIN EN ISO 16090-1** (previously DIN EN 12417). Comprehensive operator protection can thus be implemented.

The basis of the HEIDENHAIN safety design is the dual-channel processor structure, which consists of the main computer (MC) and one or more drive controller modules (CC).

Safety-relevant errors always lead to **safe stopping of all drives** through **defined stop reactions**.

Defined safety functions are triggered and safe operating statuses are achieved via dual-channel safety-relevant inputs and outputs, which have an influence on the process in all operating modes.

In this chapter you will find explanations of the functions that are additionally available on a control with functional safety (FS).

## Safety functions





To ensure that the requirements for operator protection are met, integrated functional safety (FS) provides standardized safety functions. The machine manufacturer uses the standardized safety functions for implementing functional safety (FS) for the machine in question.

You can track the active safety functions in the axis status of functional safety (FS).

Description	Meaning	Short description
<b>SS0, SS1, SS1D, SS1F, SS2</b>	Safe Stop	Safe stopping of drives using different methods
<b>STO</b>	Safe Torque Off	The power supply to the motor is interrupted. Provides protection against unexpected start of the drives
<b>SOS</b>	Safe Operating Stop	Safe operating stop. Provides protection against unexpected start of the drives
<b>SLS</b>	Safely Limited Speed	Safely limited speed. Prevents the drives from exceeding the specified speed limits when the protective door is opened
<b>SLP</b>	Safely Limited Position	Safely limited position. Monitors safe axes to keep them within the limit values of a defined area
<b>SBC</b>	Safe Brake Control	Dual-channel control of the motor holding brakes



## Functional safety (FS) status displays

The control indicates the active safety-related operating mode by an icon in the vertical soft-key row:

Icon	Safety-related operating mode	Short description
 <b>SOM_1</b>	<b>SOM_1</b> operating mode active	Safe operating mode 1: Automatic mode, production mode
 <b>SOM_2</b>	<b>SOM_2</b> operating mode active	Safe operating mode 2: Setup mode
 <b>SOM_3</b>	<b>SOM_3</b> operating mode active	Safe operating mode 3: Manual intervention; only for qualified users
 <b>SOM_4</b>	<b>SOM_4</b> operating mode active This function must be enabled and adapted by the machine manufacturer.	Safe operating mode 4: Advanced manual intervention, process monitoring, only for qualified users

## General status display

On a control with functional safety (FS), the status display contains additional safety-related information. The control displays the active operating states of the speed **S** and feed rate **F** elements in the general status display.

Icon	Meaning
	Feed status when stopped
	Spindle status when stopped

Icon	Meaning
	Safe axis (not tested)

**Additional status display**

The **FS** tab in the additional status display provides the following information:



**Information on functional safety (FS tab)**

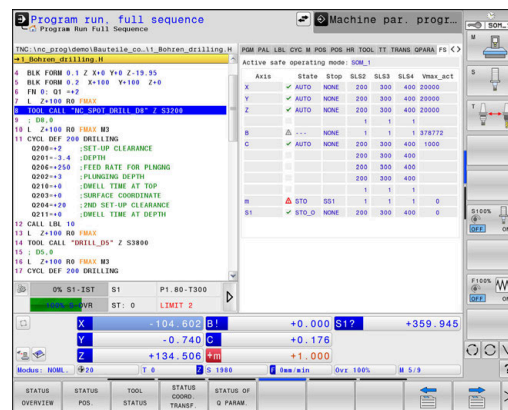
Soft key	Meaning
No direct selection possible	A safety-related operating mode is active

FS information:


Field	Meaning
<b>Axis</b>	Axes of the active kinematics
<b>State</b>	Active safety function
<b>Stop</b>	Stop reaction
<b>SLS2</b>	Maximum speed or feed-rate values for <b>SLS</b> in the <b>SOM_2</b> operating mode
<b>SLS3</b>	Maximum speed or feed-rate values for <b>SLS</b> in the <b>SOM_3</b> operating mode
<b>SLS4</b>	Maximum speed or feed-rate values for <b>SLS</b> in the <b>SOM_4</b> operating mode This function must be enabled and adapted by the machine manufacturer.
<b>Vmax_act</b>	Currently valid speed or feed-rate limit These are either values from the <b>SLS</b> settings or from the SPLC If values are greater than 999 999, the control displays <b>MAX</b> .

The control indicates the test status of the axes by means of an icon:

Icon	Meaning
	The axis has been tested or does not need to be tested.
	The axis has not been tested, but must be tested to ensure safe operation. <b>Further information:</b> "Testing the axis positions", Page 200



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Icon	Meaning
	<p>The axis is not monitored by functional safety (FS) or is not configured as a safe axis.</p> <p>The axis is monitored by functional safety (FS), but the <b>SLP</b> safety function is deactivated.</p> <p>In machine parameter <b>safeAbsPosition</b> (no. 403130), the machine manufacturer defines whether the <b>SLP</b> safety function is activated for an axis.</p>

## Testing the axis positions



Refer to your machine manual.

This function must be adapted by your machine manufacturer.

The machine manufacturer defines the behavior of speed-controlled FS-NC axes while the guard door is open in the machine parameter **speedPosCompType** (no. 403129).

The machine manufacturer can allow, for example, switching-on of the spindle and thus enable scratching of the workpiece while the guard door is open.

After switch-on, the control checks whether the position of an axis matches the position directly after shutdown. If a deviation occurs or functional safety (FS) detects that a change has been made, this axis is marked on the position display. The control displays a red warning triangle in the status display.

Axes that are marked can no longer be moved while the door is opened. In such cases you must approach a test position for the axes in question.

Proceed as follows:

- ▶ Select the **Manual operation** operating mode
- ▶ Press the **MOVE TO INSPECTION POSITION** soft key
- > The control displays the axes that have not been tested.
- ▶ Press the **SELECT AXIS** soft key
- ▶ Select the desired axis by soft key, if required
- ▶ Or press the **POSIT. LOGIC** soft key
- ▶ Press the **NC start** key
- > The axis moves to the test position.
- > After the test position has been reached, the control issues a message.
- ▶ Press the **permissive button** on the machine operating panel
- > The control displays the axis as a tested axis.
- ▶ Repeat this procedure for all axes that you want to move to the test position

### NOTICE

#### Danger of collision!

The control does not automatically check whether collisions can occur between the tool and the workpiece. Incorrect pre-positioning or insufficient spacing between components can lead to a risk of collision while approaching the test positions.

- ▶ If necessary, move to a safe position before approaching the test positions
- ▶ Watch out for possible collisions



Refer to your machine manual.

The location of the test position is specified by your machine manufacturer.



## Activating feed-rate limits



Refer to your machine manual.  
This function must be adapted by your machine manufacturer.

With this function, you can prevent the SS1 reaction (safe stopping of drives) from being triggered when the guard door is opened.

If you press the **F LIMITED** soft key, the control will limit the speed of the axes and of the spindle(s) to the values defined by the machine manufacturer. The limitation depends on the safe SOM\_x operating mode selected with the aid of the keylock switch.

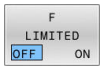
If SOM\_1 is active, the axes and spindles are brought to a stop, because only then will you be allowed to open the guard doors in SOM\_1.



- ▶ Select the **Manual operation** mode



- ▶ Shift the soft-key row



- ▶ Switch on/off feed rate limit

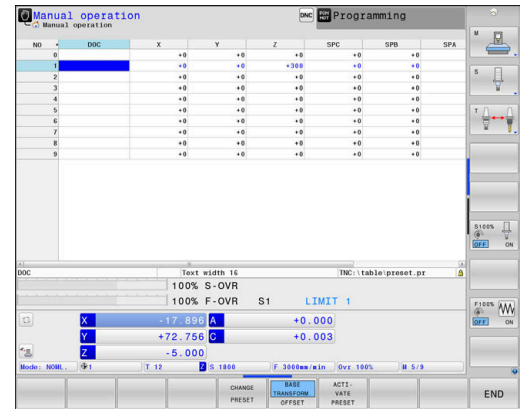
## 5.5 Preset management

### Note



It is essential that you use the preset table in the following cases:

- If your machine is equipped with rotary axes (tilting table or swivel head) and you work with the **Tilt working plane** (option 8) function
- If your machine is equipped with a spindle-head changing system
- If up to now you have been working with older controls with REF-based datum tables
- You wish to machine several identical workpieces that are aligned differently



The preset table can contain any number of rows (presets). To optimize the file size and the processing speed, only use as many rows as you need to manage your presets.

For safety reasons, new rows can be inserted only at the end of the preset table.



Refer to your machine manual.

The machine manufacturer specifies the default values to be used for each column of a new line.

### Presets and pallet presets

If you work with pallets, please note that the presets stored in the preset table are relative to an activated pallet preset.









**Further information:** "Pallets", Page 383

## Creating and activating an INCH-based preset table

**i** If you choose to switch the units for your control to **INCH**, the preset table unit of measure will not be adjusted automatically.

If you want to change the unit of measure in the table as well, you need to create a new preset table.

To create and activate an **INCH**-based preset table:

-  ▶ Select the **Programming** operating mode
-  ▶ Open the file manager
- ▶ Open the **TNC:\table** folder
- ▶ Rename the **preset.pr** file, e.g. to **preset\_mm.pr**
- ▶ Create a new file and name it **preset\_inch.pr**
-  ▶ Select the **INCH** unit of measure
- > The control opens the new, empty preset table.
- > The control displays an error message related to a missing prototype file.
- ▶ Delete the error message
-  ▶ Append lines, e.g. 10 lines
- > The control adds the lines
- ▶ Position the cursor in the **ACTNO** column of line **0**
- ▶ Enter **1**
-  ▶ Confirm your input
-  ▶ Open the file manager
- ▶ Rename the **preset\_inch.pr** file to **preset.pr**
-  ▶ Select the **Manual operation** mode
-  ▶ Open Preset management
- ▶ Review the preset table

**i** The tool table is another table where the unit of measure is not adjusted automatically.

**Further information:** "Creating and activating an INCH-based tool table", Page 141

## Saving presets in the table



Refer to your machine manual.

The machine manufacturer can disable presetting in individual axes.

The machine manufacturer can define a different path for the preset table.

In the optional machine parameter **initial** (no. 105603), the machine manufacturer defines a default value for every column of a new row.

The preset table has the name **PRESET.PR**, and is saved in the **TNC:\table\** directory by default.

**PRESET.PR** is editable in the **Manual operation** and **Electronic handwheel** modes only if the **CHANGE PRESET** soft key was pressed. You can open the **PRESET.PR** preset table in the **Programming** operating mode but not edit it.

There are several methods for saving presets and basic rotations in the preset table:

- Manual input
- Using the touch probe cycles in the **Manual operation** and **Electronic handwheel** operating modes
- Using touch probe cycles **400 to 405**, **14xx** and **410 to 419** in automatic mode

**Further information:** User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**



Operating notes:

- In the 3D ROT menu, you can specify that the basic rotation is also effective in the **Manual Operation** mode.  
**Further information:** "To activate manual tilting", Page 254
- When presetting, the positions of the tilting axes must match the tilted situation.
- The behavior of the control during presetting depends on the setting in the optional machine parameter **chkTiltingAxes** (no. 204601).
- **PLANE RESET** does not reset the active 3-D ROT.
- In row 0 the control always saves the preset that you most recently set manually via the axis keys or via soft key. If the preset set manually is active, the control displays the text **PR MAN(0)** in the status display.

## Copying the preset table

Copying the preset table into another directory (for data backup) is permitted. Write-protected lines are also write-protected in the copied tables.

Do not change the number of lines in the copied tables! If you want to reactivate the table, this may lead to problems.

To activate the preset table copied to another directory you have to copy it back.

If you select a new preset table, you need to reactivate the preset.

### Manually saving the presets in the preset table

Proceed as follows in order to save presets in the preset table:



- ▶ Select the **Manual operation** mode



- ▶ Move the tool slowly until it touches (scratches) the workpiece surface, or position the measuring dial correspondingly



- ▶ Press the **PRESET MANAGEMENT** soft key
- > The control opens the preset table and positions the cursor in the line of the active preset.



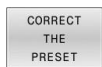
- ▶ Press the **CHANGE PRESET** soft key
- > The control displays all available input options in the soft-key row.



- ▶ Select the line in the preset table that you want to change (the line number is the preset number)









- ▶ If needed, select the column in the preset table that you want to change
















- ▶ Use the soft keys to select one of the available input options

## Input options

Soft key	Function
	Directly transfer the actual position of the tool (the measuring dial) as the new preset: This function only saves the preset in the axis in which the cursor is currently positioned
	Assign any value to the actual position of the tool (the measuring dial): This function only saves the preset in the axis in which the cursor is currently positioned. Enter the desired value in the pop-up window
	Incrementally shift a preset already stored in the table: This function only saves the preset in the axis in which the cursor is currently positioned. Enter the desired compensation value with the correct sign in the pop-up window. If inch display is active: Enter the value in inches, and the control will internally convert the entered value to mm
	Directly enter the new preset without calculation of the kinematics (axis-specific). Only use this function if your machine has a rotary table, and you want to set the preset to the center of the rotary table by entering 0. This function only saves the value in the axis in which the cursor is currently positioned. Enter the desired value in the pop-up window. If inch display is active: Enter the value in inches, and the control will internally convert the entered value to mm
	Select the <b>BASE TRANSFORM./OFFSET</b> view. The default view <b>BASE TRANSFORM.</b> shows the X, Y, and Z columns. Depending on the machine, the columns SPA, SPB, and SPC are displayed in addition. The control saves the basic rotation here (with the Z tool axis the control uses the SPC column). The <b>OFFSET</b> view shows the offset values for the preset.
	Write the currently active preset to a selectable line in the table: This function saves the preset in all axes, and then activates the appropriate line in the table automatically. If inch display is active: Enter the value in inches, and the control will internally convert the entered values to mm

**Editing the preset table**

<b>Soft key</b>	<b>Editing function in table mode</b>
	Select the table start
	Select the table end
	Select the previous page in the table
	Select the next page in the table
	Select the functions for entry of presets
	Choose between showing the Basic Transformation or the Axis Offset
	Activate the preset of the selected line of the preset table
	Add several lines at end of table
	Copy the field that is currently highlighted
	Insert the copied field
	Reset the selected line: The control enters - into all columns.
	Insert a line as last line in the table
	Delete the last line in the table

## Protecting presets from being overwritten

You can use the **LOCKED** column to protect any lines in the preset table from being overwritten. The write-protected lines are color-highlighted in the preset table.

If you want to overwrite a write-protected line with a manual touch probe cycle, confirm with **OK** and enter the password (where password-protected).




### NOTICE

#### Caution: Data may be lost!

Lines that were locked with the **LOCK / UNLOCK PASSWORD** function can be unlocked only with the selected password. Forgotten passwords cannot be reset. This means that locked lines would be locked permanently. The preset table would thus no longer be fully usable.

- ▶ Prefer the alternative function **LOCK / UNLOCK**
- ▶ Note down your passwords



Proceed as follows to protect a preset from being overwritten:

- 
  - ▶ Press the **CHANGE PRESET** soft key
- 
  - ▶ Select the **LOCKED** column
- 
  - ▶ Press the **EDIT CURRENT FIELD** soft key

Protection for a preset without using a password:

- 
  - ▶ Press the **LOCK / UNLOCK** soft key
  - > The control writes an **L** in the **LOCKED** column.

Use a password to protect a preset:

- 
  - ▶ Press the **LOCK / UNLOCK PASSWORD** soft key
  - ▶ Enter the password in the pop-up window
- 
  - ▶ Confirm with the **OK** soft key or with the **ENT** key:
  - > The control writes **###** in the **LOCKED** column.



**Canceling write-protection**

To edit a line you have previously write-protected:



- ▶ Press the **CHANGE PRESET** soft key



- ▶ Select the **LOCKED** column



- ▶ Press the **EDIT CURRENT FIELD** soft key

Preset protected without a password:

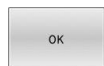


- ▶ Press the **LOCK / UNLOCK** soft key
- > The control cancels the write-protection.

Preset protected with a password:



- ▶ Press the **LOCK / UNLOCK PASSWORD** soft key



- ▶ Enter the password in the pop-up window
- ▶ Confirm with the **OK** soft key or with the **ENT** key
- > The control cancels the write-protection.

## Activating a preset

### Activating a preset in the Manual operation mode

#### NOTICE

##### Caution: Significant property damage!

Undefined fields in the preset table behave differently from fields defined with the value **0**: Fields defined with the value **0** overwrite the previous value when activated, whereas with undefined fields the previous value is kept. If the previous value is kept, there is a danger of collision!

- ▶ Before activating a preset, check whether all columns contain values.
- ▶ For undefined columns, enter values (e.g., **0**)
- ▶ As an alternative, have the machine manufacturer define **0** as the default value for the columns



##### Operating notes:

- When activating a preset from the preset table, the control resets any active datum shift, mirroring, rotation, or scaling factor.
- On the other hand, the **Tilt working plane** function (Cycle **19** or **PLANE**) remains active.
- If you edit the value of the **DOC** column, then the preset must be reactivated. Only then does the control apply the new value.



- ▶ Select the **Manual operation** mode



- ▶ Press the **PRESET MANAGEMENT** soft key



- ▶ Select the preset number that you want to activate



- ▶ Or, with the **GOTO** key, select the preset number that you want to activate



- ▶ Confirm with the **ENT** key



- ▶ Press the **ACTI- VATE PRESET** soft key



- ▶ Confirm activation of the preset
- ▶ The control sets the display and the basic rotation.



- ▶ Exit the preset table

**Activating a preset in an NC program**

Use Cycle **247** or the **PRESET SELECT** function in order to activate presets from the preset table during a program run.

In Cycle **247**, you can specify the number of the preset to be activated. With the **PRESET SELECT** function, you can specify the number of the preset or the entry in the **Doc** column that you want to activate.

**Further information:** User's Manual for **Programming of Machining Cycles**

## 5.6 Presetting without a 3D touch probe

### Note

When presetting, you set the control display to the coordinates of a known workpiece position.



All manual probe functions are available with a 3-D touch probe.

**Further information:** "Presetting with a 3-D touch probe ", Page 243







Refer to your machine manual.

The machine manufacturer can disable presetting in individual axes.





### Preparation

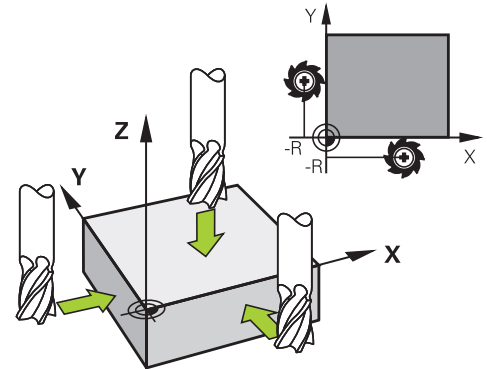
- ▶ Clamp and align the workpiece
- ▶ Insert the zero tool with known radius into the spindle
- ▶ Ensure that the control is showing the actual positions

## Presetting with an end mill

-  ▶ Select **Manual operation** mode
-  ▶ Move the tool slowly until it touches (scratches) the workpiece surface
-  ▶
-  ▶

Setting a preset in an axis:

-  ▶ Select the axis
  - ▶ The control opens the **PRESETTING Z=** dialog window
-  ▶ Alternative: Press the **SET PRESET** soft key
  - ▶ Select the axis via soft key
-  ▶ Zero tool in spindle axis: Set the display to a known workpiece position (here, 0) or enter the thickness  $d$  of the shim. In the tool axis: Consider the tool radius
-  ▶



Repeat the process for the remaining axes.

If the tool in the tool axis has already been set, set the display of the tool axis to the length  $L$  of the tool or enter the sum  $Z=L+d$ .



### Operating notes:

- The control automatically saves the preset set with the axis keys in row 0 of the preset table.
- If the machine manufacturer has locked an axis, then you cannot set a preset in that axis. The soft key for that axis is then not visible.
- The behavior of the control during presetting depends on the setting in the optional machine parameter **chkTiltingAxes** (no. 204601).

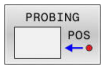
## Using touch probe functions with mechanical probes or measuring dials

If you do not have an electronic 3-D touch probe on your machine, you can also use all the previously described manual touch probe functions (exception: calibration function) with mechanical probes or by simply touching the workpiece with the tool.

**Further information:** "Using a 3-D touch probe ", Page 215

In place of the electronic signal generated automatically by a 3-D touch probe during probing, you can manually initiate the trigger signal for capturing the **probing position** by pressing a key.

Proceed as follows:



- ▶ Select any touch probe function by soft key
- ▶ Move the mechanical probe to the first position to be captured by the control.



- ▶ To capture the position: Press the **Actual-position-capture** soft key
- > The control saves the current position.
- ▶ Move the mechanical probe to the next position to be captured by the control.



- ▶ To capture the position: Press the **Actual-position-capture** soft key
- > The control saves the current position.
- ▶ If required, move to additional positions and capture as described previously
- ▶ **Preset:** In the menu window, enter the coordinates of the new preset, confirm with the **SET PRESET** soft key, or write the values to a table
- Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224
- Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** key



If you try to set a preset in a locked axis, the control will issue either a warning or an error message, depending on what the machine manufacturer has defined.

## 5.7 Using a 3-D touch probe

### Introduction

The behavior of the control during preset setting depends on the setting in the optional machine parameter **chkTiltingAxes** (no. 204601):

- **chkTiltingAxes: NoCheck** The control does not check whether the current coordinates of the rotary axes (actual positions) agree with the tilt angles that you defined.
- **chkTiltingAxes: CheckIfTilted** With an active tilted working plane, the control checks during presetting in the X, Y and Z axes whether the current coordinates of the rotary axes match the tilt angles that you defined (3D ROT menu). If the positions do not match, the control opens the **Working plane is inconsistent** menu.
- **chkTiltingAxes: CheckAlways** With an active tilted working plane, the control checks during presetting in the X, Y, and Z axes whether the current coordinates of the rotary axes match. If the positions do not match, the control opens the **Working plane is inconsistent** menu.






Operating notes:

- If the checking function is off, the **PL** and **ROT** probing functions use a rotary axis position that is equal to 0 in their calculations.
- Always set a preset in all three principal axes. This clearly and correctly defines the preset. That way you also taken into account possible deviations resulting from the tilting of the axes.
- The control issues an error message if you do not use a 3D touch probe for presetting and the positions do not match.

If the machine parameter has not been set, the control checks as if **chkTiltingAxes: CheckAlways** were set

### Behavior with tilted axes

If the positions do not match, the control opens the **Working plane is inconsistent** menu.

Soft key	Function
	In the 3D ROT menu, the control sets <b>Manual Operation 3-D ROT</b> to <b>Active</b> . The linear axes move in a tilted working plane. <b>Manual Operation 3-D ROT</b> remains active until you set it to <b>Inactive</b> .
	The control ignores the tilted working plane. The preset defined applies only to this tilted condition.
	The control positions the rotary axes as specified in the 3-D ROT menu and sets <b>Manual Operation 3-D ROT</b> to <b>Active</b> . <b>Manual Operation 3-D ROT</b> remains active until you set it to <b>Inactive</b> .

### Aligning the rotary axes

#### NOTICE

#### Danger of collision!

The control does not check for collisions before aligning the rotary axes. Danger of collision if there is no pre-positioning movement.

- ▶ Move to a safe position before the alignment

To align the rotary axes:

- ▶ Press the **ALIGN ROT. AXES** soft key
- ▶ Define the feed rate, if required
- ▶ Specify tilting, if required
  - **NO SYM**
  - **SYM +**
  - **SYM -**
- ▶ Select the positioning behavior
- ▶ Press the **NC Start** key
- ▶ The control aligns the axes. The Tilt working plane function becomes active for this.

**i** Tilting can only be selected if you have set **Manual Operation 3-D ROT** to **active**.

**Further information:** "To activate manual tilting", Page 254



## Overview











Refer to your machine manual.  
The control must be specifically prepared by the machine manufacturer for the use of a 3D touch probe.



HEIDENHAIN guarantees the proper operation of the touch probe cycles only in conjunction with HEIDENHAIN touch probes.

The following touch probe cycles are available in the **Manual operation** mode:

Soft key	Function	Page
	Calibrating the 3-D Touch Probe	226
	Measuring a 3-D basic rotation by probing a plane	239
	Measuring a basic rotation using a line	236
	Setting the preset on any axis	244
	Setting a corner as preset	245
	Setting a circle center as preset	246
	Setting the centerline as preset	249
	Touch probe system data management	156



Operating notes:

- While touch probe functions are being executed, the control temporarily disables the **Global Program Settings**.
- In turning mode you can use all manual touch probe functions, except the **Probe in plane** and **Intersection probing** cycles. In turning mode, the measured values of the X axis equate to diameter values.
- To use the touch probe in Turning mode, you must calibrate the touch probe separately in Turning mode. As the factory default setting of the rotary spindle may vary between Milling Mode and Turning mode, you must calibrate the touch probe without any center offset. You can create additional tool data for the touch probe, e.g. as an indexed tool.
- If the function for orienting the spindle to the programmed probe direction is active, the number of spindle revolutions is limited when the guard door is open. In some cases, the direction of spindle rotation will change and positioning will not always follow the shortest path.
- If no tool touch probe is inserted, the actual position can be captured with **NC START**. The control displays a warning that no probing movement is carried out in that case.



**Further information:** User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**

### Traverse movements with a handwheel with display

With a handwheel with display, it is possible to transfer control to the handwheel during a manual touch probe cycle.

Proceed as follows:

- ▶ Start the manual touch probe cycle
- ▶ Position the touch probe at a position near the first touch point
- ▶ Probe the first touch point
- ▶ Activate the handwheel on the handwheel
- > The control shows the **Handwheel active** pop-up window.
- ▶ Position the touch probe at a position near the second touch point
- ▶ Deactivate the handwheel on the handwheel
- > The control closes the pop-up window.
- ▶ Probe the second touch point
- ▶ If necessary, set the preset
- ▶ End the probing function



If the handwheel is active, you cannot start the touch probe cycles.

## Suppressing touch probe monitoring

### Suppressing touch probe monitoring

If the control does not receive a stable signal from the touch probe, the **TCH PROBE MONITOR OFF** soft key is displayed.

Proceed as follows to deactivate touch-probe monitoring:



- ▶ Select **Manual operation** mode



- ▶ Press the **TCH PROBE MONITOR OFF** soft key
- ▶ The control disables touch-probe monitoring for 30 seconds.
- ▶ If required, move the touch probe so that the control receives a stable signal from it.

As long as touch-probe monitoring is switched off, the control displays the error message

**The touch probe monitor is deactivated for 30 seconds.** This error message remains active only for 30 seconds.



If the touch probe sends a stable signal within the 30 seconds, then touch-probe monitoring reactivates itself automatically and the error message is cleared.

### NOTICE







#### Danger of collision!

While touch-probe monitoring is deactivated, the control will not perform collision checking. Thus, you must ensure that the touch probe can be positioned safely. There is a risk of collision if you choose the wrong direction of traverse!

- ▶ Carefully move the axes in the **Manual operation** operating mode

## Functions in touch probe cycles

Soft keys that are used to select the probing direction or a probing routine are displayed in the manual touch probe cycles. The soft keys displayed vary depending on the respective cycle:

Soft key	Function
	Select the probing direction
	Capture the actual position
	Probe hole (inside circle) automatically
	Probe stud (outside circle) automatically
	Probe a model circle (center point of several elements)
	Select a paraxial probing direction for probing of holes, studs and model circles

**Automatic probing routine for holes, studs, and circular patterns****NOTICE****Danger of collision!**

The control does not perform an automatic collision check with the stylus. During automatic probing procedures the control positions the touch probe to the probing positions automatically. There is a risk of collision if pre-positioning was not correct or if obstacles have been ignored.

- ▶ Program a suitable pre-position
- ▶ Use safety clearances to take obstacles into account

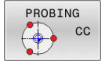
If you use a probing routine for automatic probing of a hole, stud, or a circular pattern, the control opens a form with the required entry fields.

**Input fields in the Measure stud and Measure hole forms**

<b>Input field</b>	<b>Function</b>
<b>Stud diameter? or Hole diameter</b>	Diameter of probe contact (optional for holes)
<b>Safety clearance?</b>	Distance to the probe contact in the plane
<b>Incr. clearance height?</b>	Positioning of touch probe in spindle axis direction (starting from the current position)
<b>Starting angle?</b>	Angle for the first probing operation (0° = positive direction of principal axis, i.e. in X+ for spindle axis Z). All other probe angles result from the number of touch points.
<b>Number of touch points?</b>	Number of probing operations (3 to 8)
<b>Angular length?</b>	Probing a full circle (360°) or a circle segment (angular length < 360°)

Automatic probing routine:

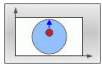
► Pre-position touch probe



- Select the probing function: Press the **PROBING CC** soft key



- Hole should be probed automatically: Press the **HOLE** soft key



- Select paraxial probing direction



- Start probing function: Press the **NC Start** key
- The control carries out all pre-positioning and probing processes automatically.

The control approaches the position at the feed rate **FMAX** defined in the touch probe table. The defined probing feed rate **F** is used for the actual probing operation.



Operating and programming notes:

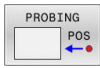
- Before starting an automatic probing routine, you need to preposition the touch probe near the first touch point. Offset the touch probe by approximately the safety clearance opposite to the probing direction. The safety clearance is derived from the sum of the values in the touch-probe table and in the entry form.
- For inside circles with large diameters, the control can also position the touch probe on a circular arc at the feed rate **FMAX**. This requires that you enter a safety clearance for prepositioning and the hole diameter in the input form. Position the touch probe inside the hole at a position that is offset by approximately the safety clearance from the wall. Take the starting angle of the first probing process into account in pre-positioning; for example, at a starting angle of 0° the control will first probe in the positive direction of the reference axis.
- After the last touching process and if the opening angle contains the value 360°, the control positions the workpiece touch probe back to the position it had prior to starting the probing function.

## Selecting the probing cycle

- ▶ Select the **Manual operation** or **Electronic handwheel** mode of operation



- ▶ Select the probing functions: Press the **TOUCH PROBE** soft key



- ▶ Select the touch probe cycle by pressing the appropriate soft key, for example **PROBING POS**
- ▶ The control displays the associated menu.



Operating notes:

- When you select a manual probing function, the control opens a form displaying all data required. The content of the forms varies depending on the respective function.
- You can also enter values in some of the fields. Use the arrow keys to switch to the desired input field. You can position the cursor only in fields that can be edited. Fields that cannot be edited are dimmed.

## Recording measured values from the touch probe cycles



Refer to your machine manual.

The control must be specially prepared by the machine manufacturer for use of this function.

After executing the respective touch-probe cycle, the control writes the measured values to the TCHPRMAN.html file.

If you have not defined a path in the machine parameter **FN16DefaultPath** (no. 102202), the control will store the TCHPRMAN.html file directly under **TNC:**.



Operating notes:

- If you run several touch probes cycles in a row, the control stores the measured values below each other.

## Writing measured values from the touch probe cycles to a datum table



If you want to save measured values in the workpiece coordinate system, use the **ENTRY IN DATUM TABLE** function. If you want to save measured values in the basic coordinate system, use the **ENTRY IN PRESET TABLE** function.

**Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225

With the **ENTRY IN DATUM TABLE** soft key, the control can write the values measured during any touch-probe cycle to a datum table:

- ▶ Select any probing function
- ▶ Enter the desired coordinates for the datum in the designated input boxes (depends on the touch probe cycle being run)
- ▶ Enter the datum number in the **Number in table?** input field
- ▶ Press the **ENTRY IN DATUM TABLE** soft key
- > The control saves the datum in the indicated datum table under the entered number.



## Writing measured values from the touch probe cycles to the preset table

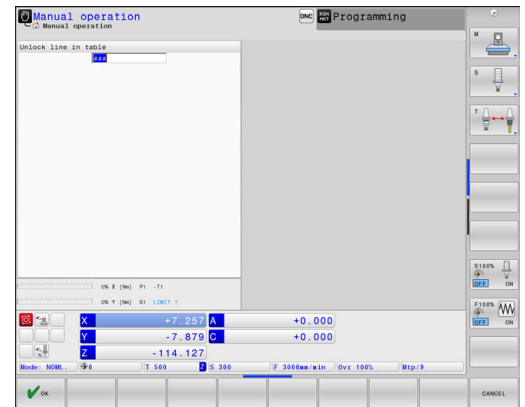
**i** If you want to save measured values in the basic coordinate system, use the **ENTRY IN PRESET TABLE** function. If you want to save measured values in the workpiece coordinate system, use the **ENTRY IN DATUM TABLE** function.

**Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224

With the **ENTRY IN PRESET TABLE** soft key, the control can write the values measured during any touch probe cycle to the preset table. The measured values are then stored referenced to the machine coordinate system (REF coordinates). The preset table has the name PRESET.PR, and is saved in the TNC:\table\ directory.

- ▶ Select any probe function
- ▶ Enter the desired coordinates for the preset in the designated input boxes (depends on the touch probe cycle being run)
- ▶ Enter the preset number in the **Number in table?** input field
- ▶ Press the **ENTRY IN PRESET TABLE** soft key
- > The control opens the **Overwrite active preset?** menu.
- ▶ Press the **OVERWRITE PRESET** soft key
- > The control saves the preset in the preset table under the entered number.
  - Preset number does not exist: The control does not save the line until the **CREATE LINE** soft key has been pressed (Create line in table?)
  - Preset number is protected: Press the **ENTRY IN LOCKED LINE** soft key to overwrite the active preset
  - Preset number is password-protected: Press the **ENTRY IN LOCKED LINE** soft key and enter the password to overwrite the active preset

**i** The control displays a note if a table row cannot be written to because of disabling. The probing function itself is not interrupted.



## 5.8 Calibrating 3-D touch probes

### Introduction

The touch probe must be calibrated in order to enable determining precisely the actual switching point of a 3D touch probe. Otherwise, the control cannot ascertain exact measuring results.

During 3D calibration, the angle-dependent deflection behavior of a workpiece touch probe is determined in any probing direction (#92 / #2-02-1). Even if there is no exact radial or axial deflection of the workpiece touch probe, you will obtain precise measuring results with the 3D calibration.



Operating notes:

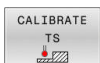
- Always calibrate the touch probe again in the following cases:
  - Initial configuration
  - Broken stylus
  - Stylus replacement
  - Change in the probe feed rate
  - Irregularities caused, for example, when the machine heats up
  - Change of active tool axis
- When you press the **OK** soft key after calibration, the calibration values are applied to the active touch probe. The updated tool data then become immediately effective and it is not necessary to repeat the tool call.

During calibration, the control finds the effective length of the stylus and the effective radius of the ball tip. To calibrate the 3D touch probe, clamp a ring gauge or a stud of known height and known radius to the machine table.

The control provides calibration cycles for calibrating the length and the radius:







- ▶ Press the **TOUCH PROBE** soft key



- ▶ Display the calibration cycles: Press **CALIBRATE TS**
- ▶ Select the calibration cycle

### Calibration cycles

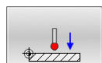
Soft key	Function	Page
	Calibrating the length	227
	Measure the radius and the center offset using a calibration ring	228
	Measure the radius and the center offset using a stud or a calibration pin	228
	Measure the radius and the center offset using a calibration sphere 3D calibration (option 92)	228

### Calibrating the effective length

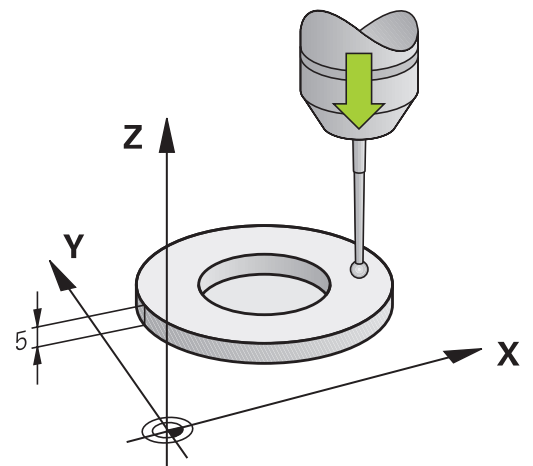
**i** HEIDENHAIN guarantees the proper operation of the touch probe cycles only in conjunction with HEIDENHAIN touch probes.

**⚙** The effective length of the touch probe is always referenced to the tool reference point. The tool reference point is often on the spindle nose, the face of the spindle. The machine manufacturer may also place the tool reference point at a different point.

- ▶ Set the preset in the spindle axis such that the following applies to the machine table:  $Z = 0$



- ▶ Select the calibrating function for the touch probe length: Press the **TS calibration of tool length** soft key
- ▶ The control displays the current calibration data.
- ▶ **Datum for length?**: Enter the height of the ring gauge in the menu window
- ▶ Move the touch probe to a position just above the ring gauge
- ▶ To change the traverse direction (if necessary), press a soft key or an arrow key
- ▶ Probe surface: Press **NC Start** key
- ▶ Check results
- ▶ Press the **OK** soft key for the values to take effect
- ▶ Press the **CANCEL** soft key to terminate the calibrating function.
- ▶ The control logs the calibration process in the TCHPRMAN.html file.



## Calibrating the effective radius and compensating center misalignment

**i** HEIDENHAIN guarantees the proper operation of the touch probe cycles only in conjunction with HEIDENHAIN touch probes.

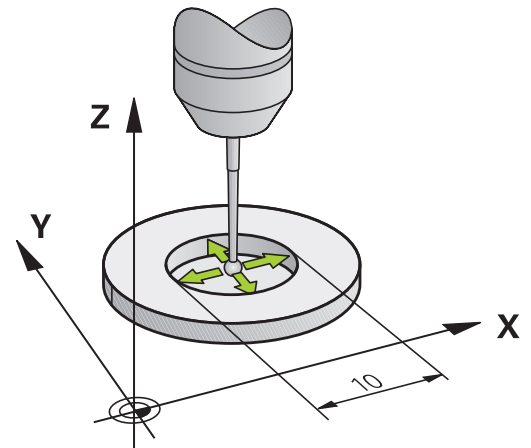
When calibrating the ball-tip radius, the control executes an automatic probing routine. In the first run the control finds the midpoint of the calibration ring or pin (approximate measurement) and positions the touch probe in the center. Then, in the actual calibration process (fine measurement), the radius of the ball tip is ascertained. If the touch probe allows probing from opposite orientations, the center offset is determined during another cycle.

The property of whether or how your touch probe can be oriented is predefined for HEIDENHAIN touch probes. Other touch probes are configured by the machine manufacturer.

After the touch probe is inserted, the touch probe axis normally needs to be aligned exactly with the spindle axis. The calibrating function can determine the misalignment between touch probe axis and spindle axis by probing from opposite orientations (180°-rotation) and computes the compensation.

**i** The center offset can be determined only with a suitable touch probe.

If you want to calibrate using the outside of an object, you need to pre-position the touch probe above the center of the calibration sphere or calibration pin. Ensure that the probing points can be approached without collisions.



The calibration routine varies depending on how your touch probe can be oriented:

- No orientation possible, or orientation in only one direction: The control executes one approximate and one fine measurement, and then ascertains the effective ball-tip radius (column R in tool.t).
- Orientation possible in two directions (e.g., HEIDENHAIN touch probes with cable): The control executes one approximate and one fine measurement, rotates the touch probe by 180°, and then executes another probing routine. The center offset (CAL\_OF in tchprobe.tp) is determined in addition to the radius by probing from opposite orientations.
- Any orientation possible (e.g., HEIDENHAIN touch probes with infrared transmission): The control executes one approximate and one fine measurement, rotates the touch probe by 180°, and then executes another probing routine. The center offset (CAL\_OF in tchprobe.tp) is determined in addition to the radius by probing from opposite orientations.

### Calibration using a calibration ring

Proceed as follows for manual calibration using a calibration ring:



- ▶ In the **Manual operation** mode, position the ball tip inside the bore of the ring gauge
- ▶ Select the calibrating function: Press the **Calibration of a TS in a ring** soft key
- > The control displays the current calibration data.
- ▶ Enter the diameter of the ring gauge
- ▶ Enter the start angle
- ▶ Enter the number of touch points
- ▶ Probe: Press the **NC Start** key
- > The 3D touch probe probes all required touch points in an automatic probing routine and calculates the effective ball-tip radius. If probing from opposite orientations is possible, the control calculates the center offset.
- ▶ Check results
- ▶ Press the **OK** soft key for the values to take effect
- ▶ Press the **END** soft key to terminate the calibrating function.
- > The control logs the calibration process in the TCHPRMAN.html file.

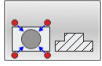


Refer to your machine manual.

In order to be able to determine ball-tip center misalignment, the control needs to be specially prepared by the machine manufacturer.

### Calibrating with a stud or calibration pin

Proceed as follows for manual calibration with a stud or calibration pin:



- ▶ In the **Manual operation** mode, position the ball tip above the center of the calibration pin
- ▶ Select the calibrating function: Press the **TS calibration on stud** soft key
- ▶ Enter the outside diameter of the stud
- ▶ Enter the safety clearance
- ▶ Enter the start angle
- ▶ Enter the number of touch points
- ▶ Probe: Press the **NC Start** key
- > The 3D touch probe probes all required touch points in an automatic probing routine and calculates the effective ball-tip radius. If probing from opposite orientations is possible, the control calculates the center offset.
- ▶ Check results
- ▶ Press the **OK** soft key for the values to take effect
- ▶ Press the **END** soft key to terminate the calibrating function.
- > The control logs the calibration process in the TCHPRMAN.html file.

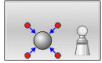


Refer to your machine manual.

In order to be able to determine ball-tip center misalignment, the control needs to be specially prepared by the machine manufacturer.

### Calibration using a calibration sphere

Proceed as follows for manual calibration using a calibration sphere:



- ▶ In the **Manual operation** mode, position the ball tip above the center of the calibration sphere
- ▶ Select the calibrating function: Press the **Calibration of TS on a sphere** soft key
- ▶ Enter the outside diameter of the ball
- ▶ Enter the safety clearance
- ▶ Enter the start angle
- ▶ Enter the number of touch points
- ▶ Select Length measurement, if applicable
- ▶ If necessary, input the reference for the length
- ▶ Probe: Press the **NC Start** key
- > The 3D touch probe probes all required touch points in an automatic probing routine and calculates the effective ball-tip radius. If probing from opposite orientations is possible, the control calculates the center offset.
- ▶ Check results
- ▶ Press the **OK** soft key for the values to take effect
- ▶ Press the **END** soft key to terminate the calibrating function or enter the number of probing points for 3D calibration
- > The control logs the calibration process in the TCHPRMAN.html file.



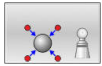
Refer to your machine manual.

In order to be able to determine ball-tip center misalignment, the control needs to be specially prepared by the machine manufacturer.

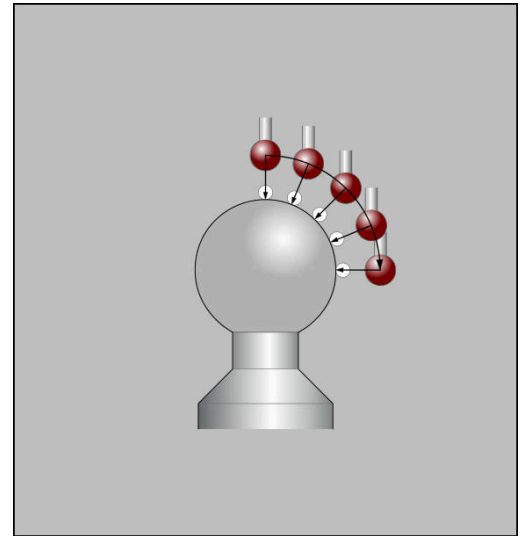
### 3D calibration with a calibration sphere (option 92)

In addition to calibrating with a calibration sphere, the control also enables the touch probe to be calibrated dependent on the angle. For this purpose the control probes the calibration sphere in a quarter circle in the perpendicular. The 3D calibration data specifies the deflection behavior of the touch probe in any probing direction.

The **3D-ToolComp** software option (option 92) is required for this.



- ▶ Execute calibration using a calibration sphere
- ▶ Enter the number of touch points
- ▶ Press the **NC Start** key
- ▶ The 3D touch probe probes all required touch points in an automatic probing routine.
- ▶ Press the **OK** soft key.
- ▶ Press the **END** soft key to terminate the calibrating function.
- ▶ The control saves the deviations in a compensation value table under **TNC:\system \3D-ToolComp**.



The control creates a specific table for each calibrated touch probe. In the tool table the **DR2TABLE** column is automatically referenced to this.

### Calibrating an L-shaped stylus

Before you calibrate an L-shaped stylus you first must define the parameters in the touch probe table. Based on these approximate values, the control can align the touch probe during the calibration and determine the actual values.

At first, define the following parameters in the touch probe table:

Parameter	Value to be defined
<b>CAL_OF1</b>	Length of extension The extension is the angled length of the L-shaped stylus.
<b>CAL_OF2</b>	0
<b>CAL_ANG</b>	Spindle angle at which the extension is parallel to the main axis For this, manually position the extension in the direction of the main axis and read the value from the position display.

After the calibration, the control overwrites the previously defined values in the touch probe table with the determined values.

**Further information:** "Touch probe table", Page 156

While calibrating the touch probe, ensure that the feed rate override is 100%. That way you can always use the same feed rate for the subsequent probing processes as was used for the calibration. Hence, you can exclude inaccuracies during the probing caused by modified feed rates.



## Displaying calibration values

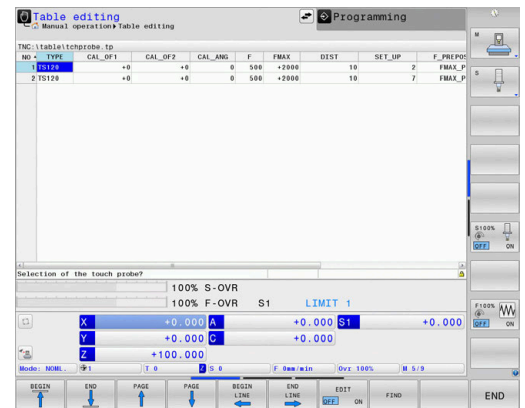
The control saves the effective length and effective radius of the touch probe in the tool table. The control saves the touch probe center offset to the touch probe table in the columns **CAL\_OF1** (main axis) and **CAL\_OF2** (secondary axis). You can display the values on the screen by pressing the **TCH PROBE TABLE** soft key.

**Further information:** "Touch probe table", Page 156

During calibration, the control automatically creates the TCHPRMAN.html log file to which the calibration values are saved.



Ensure that the tool number in the tool table and the touch-probe number of the touch-probe table match. This is regardless of whether you want to use a touch-probe cycle in automatic mode or in **Manual operation** mode.



## 5.9 Compensating workpiece misalignment with 3-D touch probe

### Introduction

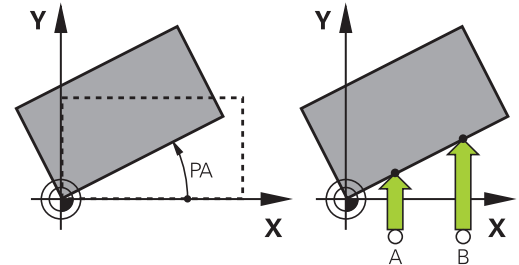


Refer to your machine manual.

It depends on the machine whether you can compensate workpiece misalignment with an offset (angle for table rotation).



HEIDENHAIN guarantees the proper operation of the touch probe cycles only in conjunction with HEIDENHAIN touch probes.



The control compensates workpiece misalignment either mathematically by computing a basic rotation (angle of basic rotation) or by an offset (angle for table rotation)

For this purpose, the control sets the rotation angle to the desired angle with respect to the reference axis in the working plane.

**Basic rotation:** The control interprets the measured angle as rotation around the tool direction, and saves the values in the columns SPA, SPB, or SPC of the preset table.

**Offset:** The control interprets the measured angle as a shift in each axis in the machine coordinate system, and saves the values in the columns A\_OFFS, B\_OFFS, or C\_OFFS of the preset table.

In order to identify the basic rotation or offset, probe two points on the side of the workpiece. The sequence in which you probe the points influences the calculated angle. The measured angle is measured from the first to the second touch point. You can also determine the basic rotation or offset using holes or studs. In this case, however, a consistent working plane is required. When calculating the basic rotation, the system uses the input coordinate system (I-CS).

**To determine the basic rotation in an actively tilted working plane, please remember:**

- If the current coordinates of the rotary axes and the defined tilt angles (3-D ROT menu) match, the working plane is consistent. Thus, the basic rotation is calculated in the input coordinate system (I-CS), based on the tool axis.
- If the current coordinates of the rotary axes and the defined tilt angles (3-D ROT menu) do not match, the working plane is inconsistent. Thus, the basic rotation is calculated in the workpiece coordinate system (W-CS), based on the tool axis.

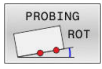


Operating and programming notes:

- Select the probe direction perpendicular to the angle reference axis when measuring workpiece misalignment.
- To ensure that the basic rotation is calculated correctly during program run, program both coordinates of the working plane in the first positioning block.
- You can also use a basic rotation in conjunction with the **PLANE** function (except for **PLANE AXIAL**). In this case first activate the basic rotation and then the **PLANE** function.
- You can also activate a basic rotation or offset without probing a workpiece. To do so, enter a value in the corresponding input field and press the **SET BASIC ROTATION** or **SET TABLE ROTATION** soft key.
- The behavior of the control during presetting depends on the setting in the **chkTiltingAxes** machine parameter (no. 204601).

**Further information:** "Introduction", Page 215

## Measuring a basic rotation



- ▶ Press the **Probe rotation** soft key
- > The control opens the **Probing of rotation** menu.
- ▶ The following input fields are displayed:
  - **Angle of basic rotation**
  - **Offset of rotary table**
  - **Number in table?**
- > The control displays any current basic rotation or offset in the input field.
- ▶ Position the touch probe at a position near the first touch point
- ▶ Select the probe direction or probing routine by soft key
- ▶ Press the **NC Start** key
- ▶ Position the touch probe at a position near the second touch point
- ▶ Press the **NC Start** key
- > The control determines the basic rotation and offset and displays them.
- ▶ Press the **SET BASIC ROTATION** soft key
- ▶ Press the **END** soft key

The control logs the probing process in TCHPRMAN.html.

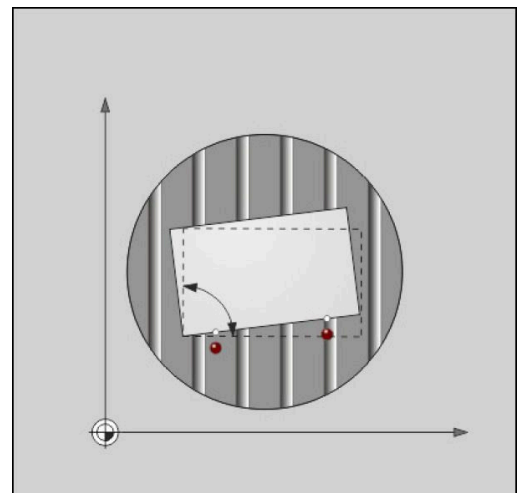
## Saving the basic rotation in the preset table

- ▶ After the probing process, enter the preset number to which the control is to save the active basic rotation in the **Number in table?** input field
- ▶ Press the **BASIC ROT. IN PRESET TBL** soft key
- > If appropriate, the control opens the **Overwrite active preset?** menu.
- ▶ Press the **OVERWRITE PRESET** soft key
- > The control saves the basic rotation in the preset table.

## Compensation of workpiece misalignment by rotating the table

There are three possibilities for compensating workpiece misalignment by rotating the table:

- Aligning the rotary table
- Setting the table rotation
- Saving the table rotation in the preset table



### Aligning the rotary table

You can compensate the ascertained misalignment by positioning the rotary table.

**i** Pre-position all axes before rotating the table, in order to preclude collisions resulting from compensating movements. The control additionally outputs a warning before table rotation.

- ▶ Press the **ALIGN ROT. TABLE** soft key after the probing procedure
- > The control opens the warning.
- ▶ Clear with the **OK** soft key if needed
- ▶ Press the **NC Start** key
- > The control aligns the rotary table.

### Setting the table rotation

You can define a manual preset in the axis of the rotary table.

- ▶ Press the **SET TABLE ROTATION** soft key after the probing procedure
- > If a basic rotation is already set, the control opens the **Reset basic rotation?** menu.
- ▶ Press the **DELETE BASIC ROT.** soft key
- > The control deletes the basic rotation from the preset table, and inserts the offset.
- ▶ Or press **KEEP BASIC ROT.**
- > The control inserts the offset in the preset table, and the basic rotation also remains.

### Saving table rotation in the preset table

You can save the misalignment of the rotary table in any row of the preset table. The control stores the angle in the offset column of the rotary table, e.g. in the C\_OFFS column for a C axis.

- ▶ Press the **TABLE ROT. IN PRESET TBL** soft key after the probing procedure
- > If appropriate, the control opens the **Overwrite active preset?** menu.
- ▶ Press the **OVERWRITE PRESET** soft key
- > The control saves the offset in the preset table.

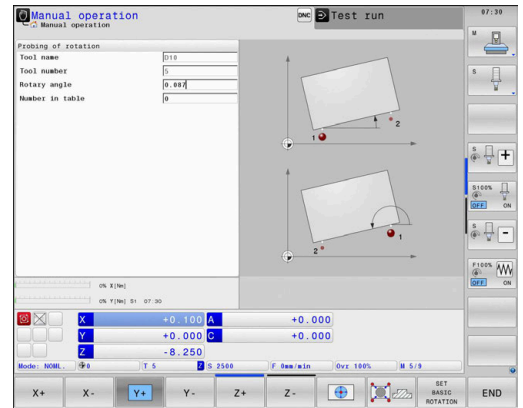
You may have to change the view in the preset table with the **BASE TRANSFORM./OFFSET** soft key for this column to be displayed.

## Showing basic rotation and offset

If you select the **PROBING ROT** function, the control displays the active angle of the basic rotation in the **Angle of basic rotation** input field and the active offset in the **Offset of rotary table** input field.

In addition, the control shows the basic rotation and the offset on the **STATUS POS.** tab of the **PROGRAM STATUS** screen layout.

When the control moves the machine axis in accordance with the basic rotation, a symbol for the basic rotation is shown in the status display.



## Rescinding basic rotation or offset

- ▶ Select the probe function by pressing the **PROBING ROT** soft key
- ▶ Enter the **Angle of basic rotation: 0**
- ▶ Alternative: Enter the **Offset of rotary table: 0**
- ▶ Press the **SET BASIC ROTATION** soft key to confirm
- ▶ Alternative: Apply with the **SET TABLE ROTATION** soft key
- ▶ Terminate the probing function: Press the **END** soft key

## Determining a 3-D basic rotation

You can measure the inclined position of any tilted surface by probing three positions. The **Probe in plane** function enables you to measure this inclined position and save it as a 3-D basic rotation in the preset table.

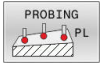


Operating and programming notes:

- The sequence and position of the touch points determines how the control will calculate the orientation of the plane.
- With the first two points, you specify the direction of the reference axis. Define the second point in the positive direction of the desired reference axis. The position of the third point determines the direction of the minor axis and of the tool axis. Define the third point in the positive Y axis of the desired workpiece coordinate system.
  - 1st point is on the reference axis
  - 2nd point is on the reference axis, in a positive direction from the first point
  - 3rd point is on the minor axis, in a positive direction of the desired workpiece coordinate system

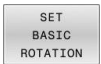
The optional entry of a reference angle enables you to define the nominal direction of the probed plane.

## Procedure



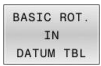
- ▶ Select the probing function: press the **PROBING PL** soft key
- ▶ The control displays the current 3-D basic rotation.
- ▶ Position the touch probe near the first touch point
- ▶ Select the probing direction or probing routine by soft key
- ▶ Start probing: press the **NC Start** key
- ▶ Position the touch probe near the second touch point
- ▶ Start probing: press the **NC Start** key
- ▶ Position the touch probe near the third touch point
- ▶ Start probing: press the **NC Start** key.
- ▶ The control measures the 3-D basic rotation and displays the values for SPA, SPB, and SPC in relation to the active coordinate system.
- ▶ If required, enter the reference angle

Activate 3-D basic rotation:



- ▶ Press the **SET BASIC ROTATION** soft key

Save the 3-D basic rotation to the preset table:



- ▶ Press the **BASIC ROT. IN PRESET TBL** soft key




- ▶ Terminate the probing function: press the **END** soft key

The control saves the 3-D basic rotation in the SPA, SPB, and SPC columns of the preset table.

## Displaying 3-D basic rotation

If a 3-D basic rotation is saved in the active preset, the control shows

the  symbol for the 3-D basic rotation in the status display. The control moves the machine axes according to the 3-D basic rotation.



### Aligning the 3-D basic rotation

If your machine has two rotary axes and the probed 3-D basic rotation is activated, you can use the rotary axes to align the 3-D basic rotation.





#### NOTICE

##### Danger of collision!

The control does not check for collisions before aligning the rotary axes. Danger of collision if there is no pre-positioning movement.


- ▶ Move to a safe position before the alignment

Proceed as follows:

- |   |   |
|---|---|
|    | <ul style="list-style-type: none"> <li>▶ Press the <b>ALIGN ROT. AXES</b> soft key</li> <li>&gt; The control displays the calculated axis angles.</li> <li>&gt; In the help graphic, the control displays a warning note pointing to the danger of collision when tilting.</li> </ul> |
|   | <ul style="list-style-type: none"> <li>▶ Enter a feed rate</li> <li>▶ Select a solution where necessary</li> <li>&gt; The control activates the 3-D rotation and updates the axis-angle display.</li> </ul>   |
|  | <ul style="list-style-type: none"> <li>▶ Select the positioning behavior</li> </ul>   |
|  | <ul style="list-style-type: none"> <li>▶ Press the <b>NC Start</b> key</li> <li>&gt; The control aligns the axes. The Tilt working plane function becomes active for this.</li> </ul>   |

After aligning the plane, you can align the reference axis with the **Probing rot** function.

### Canceling a 3-D basic rotation

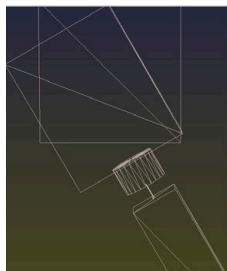
- |   |  |
|---|--|
|  | <ul style="list-style-type: none"> <li>▶ Select the probing function: press the <b>PROBING PL</b> soft key</li> <li>▶ Enter 0 for all angles</li> <li>▶ Press the <b>SET BASIC ROTATION</b> soft key</li> <li>▶ Terminate the probing function: press the <b>END</b> soft key</li> </ul> |
|---|--|

## Comparison of offset and 3D basic rotation

The following example shows how the two functions differ.

### Offset

Initial state



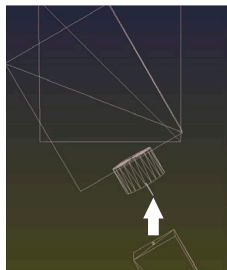
Position display:

- Actual position
- **B = 0**
- **C = 0**

Preset table:

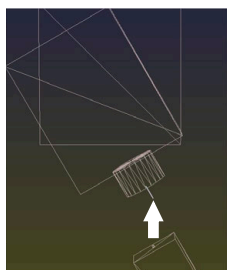
- **SPB = 0**
- **B\_OFFS = -30**
- **C\_OFFS = +0**

Movement in +Z without tilting



Movement in +Z with tilting

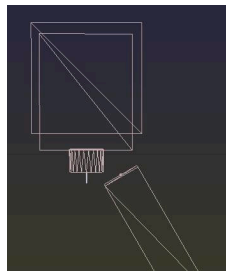
**PLANE SPATIAL** with **SPA+0 SPB+0 SPC+0**



- > The orientation **is not correct!**

### 3D basic rotation

Initial state



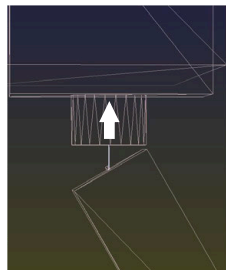
Position display:

- Actual position
- **B = 0**
- **C = 0**

Preset table:

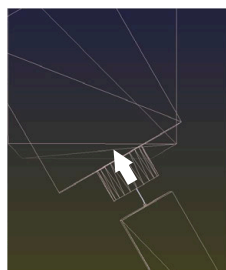
- **SPB = -30**
- **B\_OFFS = +0**
- **C\_OFFS = +0**

Movement in +Z without tilting



Movement in +Z with tilting

**PLANE SPATIAL** with **SPA+0 SPB+0 SPC+0**



- > The orientation is correct!
- > The next machining step will be **correct**.



HEIDENHAIN recommends using 3D basic rotation because of its greater flexibility.

## 5.10 Presetting with a 3-D touch probe

### Overview







Refer to your machine manual.

The machine manufacturer can disable presetting in individual axes.

If you try to set a preset in a locked axis, the control will issue either a warning or an error message, depending on what the machine manufacturer has defined.

The following soft-key functions are available for setting a preset on an aligned workpiece:

Soft key	Function	Page
	Setting a preset in any axis	244
	Setting a corner as preset	245
	Setting a circle center as preset	246
	Setting the center line as preset	249



With an active datum shift, the determined value is referenced to the active preset (possibly a manual preset defined in the **Manual operation** mode). The datum shift is taken into account in the position display.

### Presetting with active TCPM

Active TCPM is taken into account during preset setting. While the TCPM is active, probing of positions is thus even possible if the position resulting from the **Tilt working plane** function is inconsistent with the current position of the rotary axes.

**Further information:** "Using a 3-D touch probe", Page 215

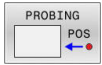


A 3-D calibration of the touch probe is necessary to obtain exact probing results.

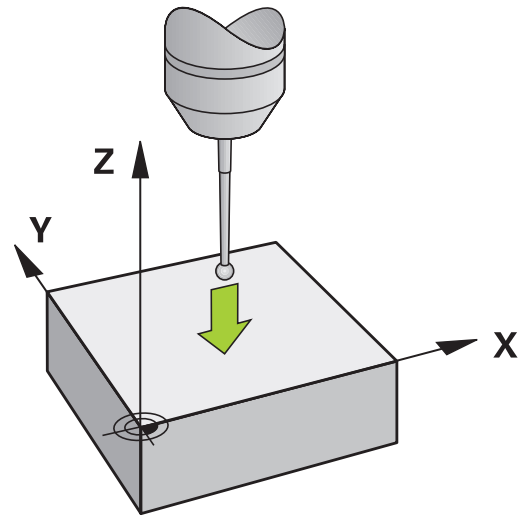
**Further information:** "Calibration using a calibration sphere", Page 231

## Presetting on any axis

**i** HEIDENHAIN guarantees the proper operation of the touch probe cycles only in conjunction with HEIDENHAIN touch probes.



- ▶ Select the probing function: Press the **POSITION PROBING** soft key
- ▶ Move the touch probe to a position near the touch point
- ▶ Select the axis and probing direction, e.g. Probe in direction Z-
- ▶ Probe: Press the **NC Start** key
- ▶ **Preset**: Enter the nominal coordinate
- ▶ Apply with the **SET PRESET** soft key  
**Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224  
**Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** soft key



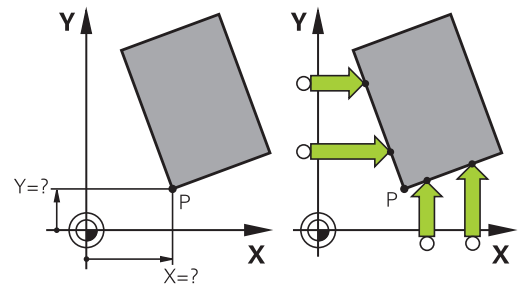
## Corner as preset



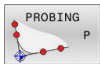
Refer to your machine manual.  
It depends on the machine whether you can compensate workpiece misalignment with an offset (angle for table rotation).



HEIDENHAIN guarantees the proper operation of the touch probe cycles only in conjunction with HEIDENHAIN touch probes.



The manual "Corner as preset" probing function identifies the angle and intersection of two straight lines.



- ▶ Select the probing function: Press the **PROBING P** soft key
- ▶ Position the touch probe near the first touch point on the first workpiece edge
- ▶ Select the probe direction by soft key
- ▶ Probe: Press the **NC Start** key
- ▶ Position the touch probe near the second touch point on the same workpiece edge
- ▶ Probe: Press the **NC Start** key
- ▶ Position the touch probe near the first touch point on the second workpiece edge
- ▶ Select the probe direction by soft key
- ▶ Probe: Press the **NC Start** key
- ▶ Position the touch probe near the second touch point on the same workpiece edge
- ▶ Probe: Press the **NC Start** key
- ▶ **Preset:** Enter the X and Y coordinates of the preset in the menu window
- ▶ Apply with the **SET PRESET** soft key  
**Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224  
**Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** soft key

**i** You can determine the intersection of two straight lines using holes or studs and set it as a preset.

The **ROT 1** soft key activates the angle of the first straight line as basic rotation or as offset and the **ROT 2** soft key activates the angle or offset of the second straight line.

If you activate the basic rotation, the control automatically writes the positions and the basic rotation to the preset table.

If you activate the offset, the control automatically writes the positions and the offset or only the positions to the preset table.

### Circle center as preset

With this function, you can set the preset at the center of bore holes, circular pockets, cylinders, studs, circular islands, etc.

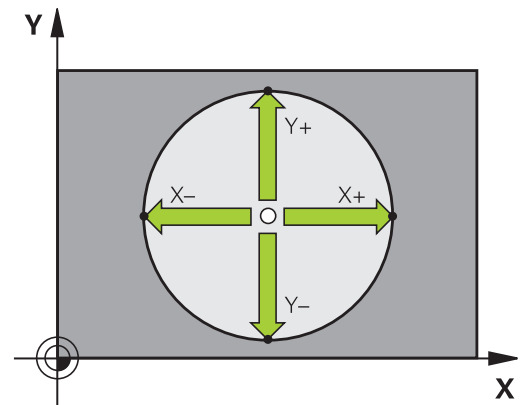
#### Inside circle:

The control probes the inside wall of a circle in all four coordinate axis directions.

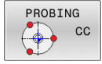
For incomplete circles (circular arcs) you can choose the appropriate probing direction.



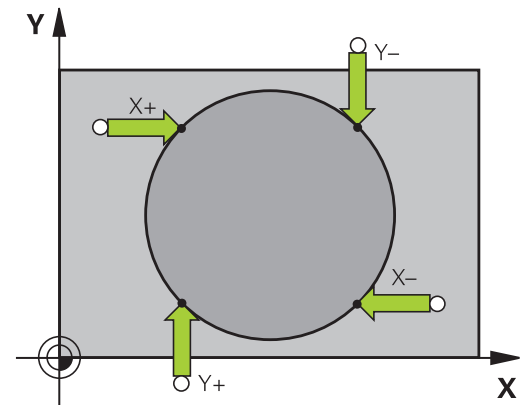
- ▶ Position the touch probe approximately in the center of the circle
- ▶ Select the probing function: Press the **PROBING CC** soft key
- ▶ Select the soft key for the desired probing direction
- ▶ Probe: Press the **NC Start** key. The touch probe probes the inside wall of the circle in the selected direction. Repeat this process. After the third probing process, you can have the control calculate the center (four touch points are recommended)
- ▶ Terminate the probing procedure and switch to the evaluation menu: Press the **EVALUATE** soft key
- ▶ **Preset:** Enter the X and the Y coordinates of the center of the circle in the menu window.
- ▶ Apply with the **SET PRESET** soft key  
**Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224  
**Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** soft key



**i** The control needs at least three touch points to calculate outside or inside circles, e.g. with circle segments. More precise results are obtained with four touch points. If possible, always pre-position the touch probe to the center.

**Outside circle:**

- ▶ Position the touch probe at a position near the first touch point outside of the circle
- ▶ Select the probing function: Press the **PROBING CC** soft key
- ▶ Select the soft key for the desired probing direction
- ▶ Probe: Press the **NC Start** key. The touch probe probes the inside wall of the circle in the selected direction. Repeat this process. After the third probing process, you can have the control calculate the center (four touch points are recommended)
- ▶ Terminate the probing procedure and switch to the evaluation menu: Press the **EVALUATE** soft key
- ▶ **Preset:** Enter the coordinates of the preset
- ▶ Apply with the **SET PRESET** soft key  
**Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224  
**Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** soft key



Once the probing routine is completed, the control displays the current coordinates of the circle center and the circle radius.

### Setting the preset using multiple holes or circular studs

The manual **Circular pattern** probing function is part of the **Cir** probing function. Individual circles can be measured with paraxial probing operations.

A second soft-key row provides the soft key **PROBING CC (circular pattern)** for using multiple holes or circular studs to set the datum. You can set the intersection of three or more elements to be probed as a preset.

### Setting the preset in the intersection of multiple holes or circular studs:

- ▶ Pre-position touch probe

Select the **Probing CC** probing function

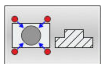


- ▶ Select the probing function: Press the **PROBING CC** soft key

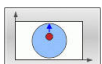


- ▶ Press the **PROBING CC (probing of circular pattern)** soft key

Probe a circular stud



- ▶ Circular stud should be probed automatically: Press **Stud** soft key



- ▶ Enter starting angle or select using soft key

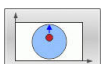


- ▶ Start probing function: Press the **NC Start** key

Probe the hole.



- ▶ Hole should be probed automatically: Press the **Hole** soft key



- ▶ Enter starting angle or select using soft key

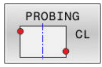


- ▶ Start probing function: Press the **NC Start** key

- ▶ Repeat the probing procedure for the remaining elements
- ▶ Terminate the probing procedure and switch to the evaluation menu: Press the **EVALUATE** soft key
- ▶ **Preset:** Enter the X and the Y coordinates of the center of the circle in the menu window.
- ▶ Apply with the **SET PRESET** soft key  
**Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224  
**Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** soft key



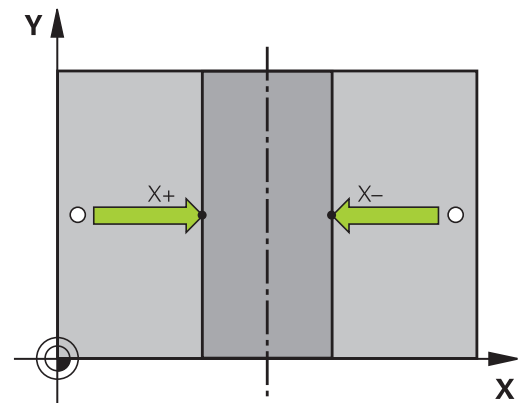
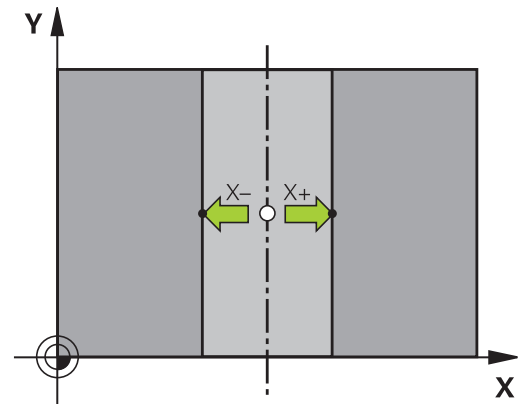
## Setting a center line as preset



- ▶ Select the probing function: Press the **PROBING CL** soft key
  - ▶ Position the touch probe at a position near the first touch point
  - ▶ Select the probing direction by soft key
  - ▶ Probe: Press the **NC Start** key
  - ▶ Position the touch probe at a position near the second touch point
  - ▶ Probe: Press the **NC Start** key
  - ▶ **Preset:** Enter the coordinates of the preset in the menu window, confirm with the **SET PRESET** soft key, or write the value to a table
- Further information:** "Writing measured values from the touch probe cycles to a datum table", Page 224
- Further information:** "Writing measured values from the touch probe cycles to the preset table", Page 225
- ▶ Terminate the probing function: Press the **END** soft key



If you desire, then after the second touch point you can change the position of the centerline in the evaluation menu, and thus the axis for setting the preset. Use the soft keys to choose between principal axis, secondary axis, and tool axis. This way you can determine the positions once, and then store them in the principal axis as well as in the secondary axis.



## Measuring workpieces with a 3-D touch probe

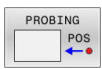
You can also use the touch probe in the **Manual operation** and **Electronic handwheel** operating modes to perform simple measurements on the workpiece. Numerous programmable touch-probe cycles are available for more complex measuring tasks.

### Further information: User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**

With a 3-D touch probe you can determine:

- Position coordinates, and from them,
- Dimensions and angles on the workpiece

### Finding the coordinates of a position on an aligned workpiece



- ▶ Select the probing function: Press the **PROBING POS** soft key
- ▶ Move the touch probe to a position near the touch point
- ▶ Select the probing direction and the axis to which the coordinates relate: Use the corresponding soft keys to select
- ▶ Start the probing process: Press the **NC Start** key
- ▶ The control shows the coordinates of the touch point as preset.

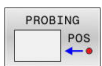
### Finding the coordinates of a corner point on the working plane

Find the coordinates of the corner point.

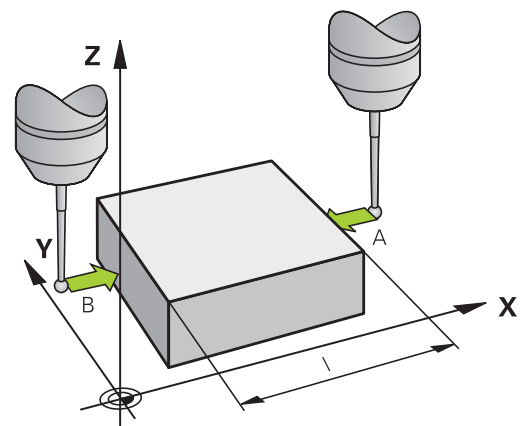
**Further information:** "Corner as preset", Page 245

The control displays the coordinates of the probed corner as preset.

### Measuring workpiece dimensions



- ▶ Select the probing function: Press the **PROBING POS** soft key
- ▶ Position the touch probe at a position near the first touch point A
- ▶ Select the probing direction by soft key
- ▶ Probe: Press the **NC Start** key
- ▶ If you need the current preset later, write down the value that appears in the display
- ▶ Preset: Enter **0**.
- ▶ Cancel the dialog: Press the **END** key
- ▶ Select the probing function again: Press the **PROBING POS** soft key
- ▶ Position the touch probe at a position near the second touch point B
- ▶ Select the probe direction with the soft keys: Same axis but from the opposite direction
- ▶ Probe: Press the **NC Start** key
- ▶ The **Measured value** display shows the distance between the two points on the coordinate axis.



### Resetting to the preset that was active before the length measurement

- ▶ Select the probing function: Press the **PROBING POS** soft key
- ▶ Probe the first touch point again
- ▶ Set the preset to the value that you wrote down previously
- ▶ Cancel the dialog: Press the **END** key

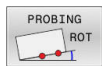
### Measuring angles

You can use the 3-D touch probe to measure angles in the working plane. You can measure

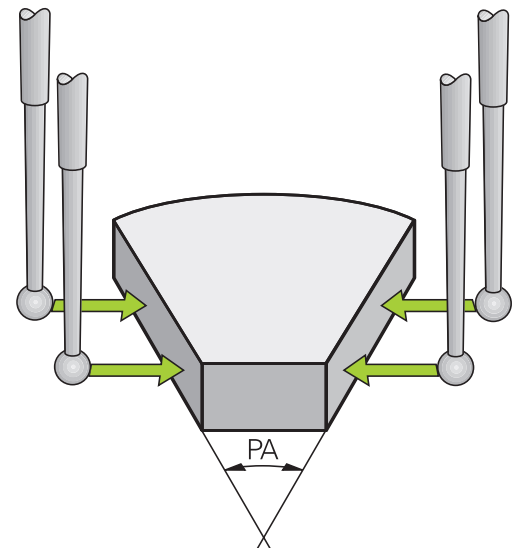
- The angle between the angle reference axis and a workpiece edge; or
- the angle between two sides

The measured angle is displayed as a value of max. 90°.

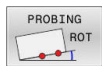
### Finding the angle between the angle reference axis and a workpiece edge



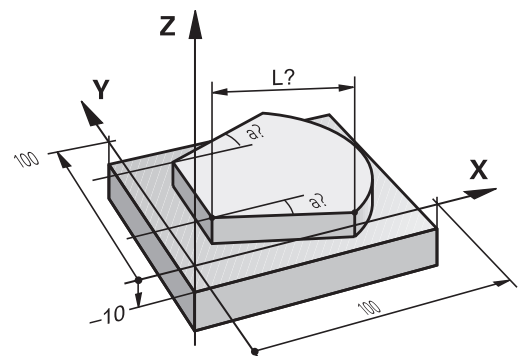
- ▶ Select the probe function by pressing the **PROBING ROT** soft key
- ▶ Rotation angle: If you wish to restore the current basic rotation later, note the value that appears under Rotation Angle
- ▶ Perform a basic rotation with the workpiece edge to be compared  
**Further information:** "Compensating workpiece misalignment with 3-D touch probe", Page 234
- ▶ Press the **PROBING ROT** soft key to display the angle between the angle reference axis and the workpiece edge as the rotation angle
- ▶ Cancel the basic rotation, or restore the previous basic rotation
- ▶ Set the rotation angle to the value that you previously wrote down



### Measuring the angle between two workpiece edges



- ▶ Select the probe function by pressing the **PROBING ROT** soft key
- ▶ Rotation angle: If you wish to restore the current basic rotation later, note the value that appears under Rotation Angle
- ▶ Perform a basic rotation with the workpiece edge to be compared  
**Further information:** "Compensating workpiece misalignment with 3-D touch probe", Page 234
- ▶ Probe the second edge in the same way as for a basic rotation, but do not set the rotation angle to 0
- ▶ Press the **ROTATION PROBING** soft key to display the angle PA between the workpiece edges as the rotation angle
- ▶ Cancel the basic rotation, or restore the previous basic rotation by setting the rotation angle to the value that you wrote down previously



## 5.11 Tilting the working plane (option 8)

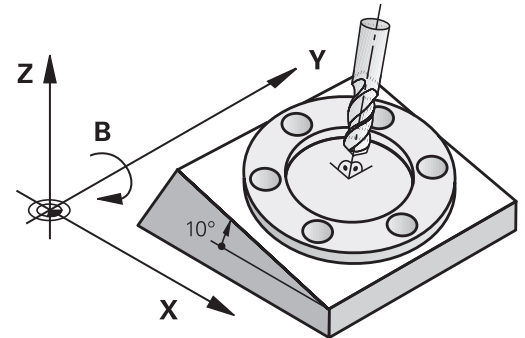
### Application, function



Refer to your machine manual.

The **Tilt working plane** functions are adapted to the control and the machine tool by the machine manufacturer.

The machine manufacturer also specifies whether the programmed angles are interpreted by the control as coordinates of the rotary axes (axis angles) or as angular components of a tilted plane (spatial angles).



The control supports the tilting functions on machine tools with swivel heads and/or tilting tables. Typical applications are, for example, oblique holes or contours in an oblique plane. The working plane is always tilted relative to the active datum. The program is written as usual for machining in a main plane, such as the X/Y plane, but is executed in a plane that is tilted relative to the main plane.

There are three functions available for tilting the working plane:

- Manual tilting with the **3-D ROT** soft key in the **Manual operation** and **Electronic handwheel** operating modes  
**Further information:** "To activate manual tilting", Page 254
- Tilting under program control, Cycle **19 WORKING PLANE** in the NC program  
**Further information:** User's Manual for **Programming of Machining Cycles**
- Tilting under program control, **PLANE** function in the NC program  
**Further information:** User's Manual for Klartext Programming or ISO Programming

The control functions for tilting the working plane are coordinate transformations. The working plane is always perpendicular to the direction of the tool axis.

### Machine types

When tilting the working plane, the control differentiates between two machine types:

#### Machine with tilting table

- You must bring the workpiece into the desired position for machining by positioning the tilting table accordingly, for example with an L block.
- The position of the transformed tool axis **does not change** relative to the machine coordinate system. Thus if you rotate the table—and therefore the workpiece—by 90° for example, the coordinate system **does not rotate**. If you press the Z+ axis direction key in the **Manual operation** mode, the tool moves in Z + direction.
- When calculating the active (transformed) coordinate system, the control considers only the mechanically influenced offsets of the particular tilting table (the translational components).

#### Machine with swivel head

- You must bring the tool into the desired position for machining by positioning the swivel head accordingly, for example with an L block
- The position of the tilted (transformed) tool axis changes relative to the machine coordinate system. Thus if you rotate the swivel head of your machine—and therefore the tool—in the B axis by +90° for example, the coordinate system also rotates. If you press the Z+ axis direction key in the **Manual operation** mode, the tool moves in the X+ direction of the machine coordinate system.
- When calculating the active coordinate system, the control considers both the mechanically influenced offsets of the particular swivel head (the translational components) as well as offsets caused by tilting of the tool (3-D tool length compensation).



The control only supports the **Tilt working plane** function in combination with spindle axis Z.

### Position display in a tilted system

The positions displayed in the status window (**ACTL.** and **NOML.**) are referenced to the tilted coordinate system.

In the machine parameter **CfgDisplayCoordSys** (no. 127501) the machine manufacturer defines the coordinate system in which the status display shows an active datum shift.

### Limitations on working with the tilting function

- The **Actual-position capture** function is not allowed if the Tilt working plane function is active
- PLC positioning (determined by the machine tool builder) is not possible.

## To activate manual tilting



- ▶ Press the **3D ROT** soft key
- ▶ The control opens the **Tilt working plane** pop-up window.



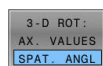
- ▶ Use the arrow keys to position the cursor on the desired function
  - **Manual Operation Tool Axis**
  - **Manual Operation 3-D ROT**
  - **Manual Operation Basic Rotation**



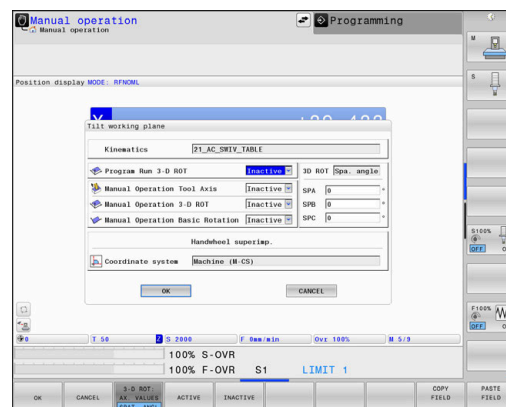
- ▶ Press the **ACTIVE** soft key



- ▶ If required, use the arrow keys to position the cursor on the desired rotary axis



- ▶ If necessary, press the **3-D ROT: AX. VALUES SPA. ANGL** soft key
- ▶ The control now displays the spatial angle entry fields.
- ▶ If required, enter the tilting angle
- ▶ Press the **END** key
- ▶ The entry is complete.




After setting the function **Manual Operation 3-D ROT** to **Active**, the **3-D ROT: AX. VALUES SPA. ANGL** soft key allows toggling between axis values and spatial angles.

## Manual Operation Tool Axis



Refer to your machine manual.  
Your machine manufacturer enables this function.


If the Traverse in Tool Axis function is active, then the control displays the  icon in the status display.

You can move only in the direction of the tool axis. The control locks all other axes.

The traverse movement is active in the **T-CS** tool coordinate system.

**Further information:** "Tool coordinate system T-CS", Page 129

## Manual Operation 3-D ROT

If the 3D-ROT function is active, then the control displays the  icon in the status display.


All axes move in a tilted working plane.

If a basic rotation or 3D basic rotation has additionally been saved to the preset table, then it will automatically be taken into account.


The traversing movements are active in the **WPL-CS** working plane coordinate system.

**Further information:** "Working plane coordinate system WPL-CS", Page 126

### Manual Operation Basic Rotation

If the basic rotation function is active, then the control displays the  icon in the status display.

If a basic rotation or a 3D basic rotation has already been saved to the preset table, then the control additionally displays the corresponding icon.

 If the **Manual Operation Basic Rotation** function is active, then an active basic rotation or 3D basic rotation is taken into account during manual movement of the axes. The control displays two icons in the status display.


The axis movements take effect in the **W-CS** workpiece coordinate system.

**Further information:** "Workpiece coordinate system W-CS", Page 124


### Program Run 3-D ROT

When activating the **Tilt working plane** function for the **Program run** operating mode, the entered angle of rotation applies starting from the first NC block of the NC program to be run.

If you use Cycle **19 WORKING PLANE** or the **PLANE** function in the NC program, then the angular values defined there become active. The control will reset the entered angular values to 0.

 The control uses the following **transformation types** for tilting:

- **COORD ROT**
  - if a **PLANE** function was previously executed with **COORD ROT**
  - after **PLANE RESET**
  - with corresponding configuration of the machine parameter **CfgRotWorkPlane** (no. 201200) by the machine manufacturer
- **TABLE ROT**
  - if a **PLANE** function was previously executed with **TABLE ROT**
  - with corresponding configuration of the machine parameter **CfgRotWorkPlane** (no. 201200) by the machine manufacturer

 A tilted working plane will remain active even after a control restart.

**Further information:** "Crossing the reference point in a tilted working plane", Page 179

### Deactivating manual tilting

To deactivate, set the desired function to **Inactive** in the **Tilt working plane** menu.

Even if the **3D ROT** dialog in the **Manual operation** operating mode is set to **Active**, resetting the tilting (**PLANE RESET**) with an active basic transformation will still work correctly.

## Setting the tool-axis direction as the active machining direction



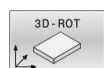
Refer to your machine manual.

Your machine manufacturer enables this function.

Using this function in the **Manual operation** and **Electronic handwheel** operating modes, you can move the tool in the direction in which the tool axis is currently pointed using the axis-direction keys or the handwheel.

Use this function if

- You want to retract the tool in the direction of the tool axis during suspension of a 5-axis machining program
- You want to machine with an inclined tool using the handwheel or the axis direction keys in Manual Operation mode



- ▶ To select manual tilting, press the **3-D ROT** soft key.



- ▶ Use the cursor keys to move the cursor to the **Manual Operation Tool Axis** menu item




- ▶ Press the **ACTIVE** soft key



- ▶ Press the **END** key

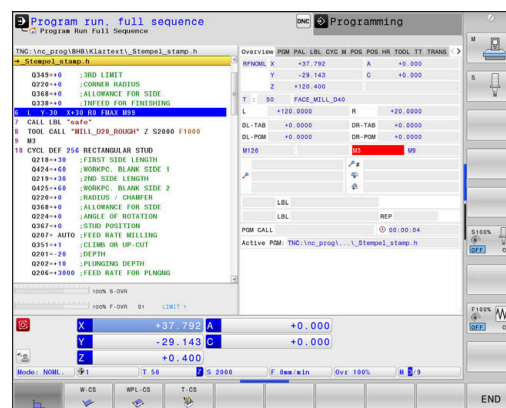
To deactivate, set the **Manual Operation Tool Axis** menu item in the Tilt working plane menu to **Inactive**.

The  icon appears in the status display when the Move in tool axis direction function is active.

## Setting a preset in a tilted coordinate system

After you have positioned the rotary axes, set the preset in the same manner as for a non-tilted system. The behavior of the control during presetting depends on the setting in the optional machine parameter **chkTiltingAxes** (no. 204601):

**Further information:** "Introduction", Page 215





# 6


## Testing and Running

## 6.1 Graphics

### Application

The control graphically simulates a machining operation in the following operating modes:

- **Manual operation**
- **Program run, single block**
- **Program run, full sequence**
- **Test Run**
- **Positioning w/ Manual Data Input**

 In the **Positioning w/ Manual Data Input** operating mode, the workpiece blank that is currently active in the **Program Run, Full Sequence/Single Block** operating mode is shown.


The graphic depicts the workpiece as if it were being machined with tool.


If you select the **PROGRAM + MACHINE** screen layout, the control displays the defined workpiece, the collision objects, and a tool.

If a tool table is active, the control also takes the entries in columns **L, R, LCUTS, LU, RN, T-ANGLE, R\_TIP** and **R2** into consideration.

The control will not show a graphic if

- no NC program is selected
- a screen layout without graphics was selected
- the current NC program has no valid workpiece blank definition
- with blank form definition with a subprogram, the BLK FORM block was not yet run

 The simulation of NC programs with 5-axis machining or tilted machining might run at reduced speed. In the **Graphic settings** group of the MOD menu, you can decrease the **Model quality** and thus increase the speed of simulation.  
**Further information:** "Graphic settings", Page 452

 If you are using a TNC 640 with touch control, you can replace some keystrokes with gestures.  
**Further information:** "Operating the Touchscreen", Page 581

## View options

Display the **VIEW OPTIONS** as follows:

- ▶ Select the desired operating mode
- ▶ Press the **VIEW OPTIONS** soft key








The available soft keys depend on the following settings:

- The selected screen layout  
You can select the screen layout with the **SCREEN LAYOUT** key.
- The selected view  
You can select the view with the **VIEW** soft key.
- The selected model quality  
You can select the model quality in the **Graphic settings** group of the MOD menu.

The control provides the following **VIEW OPTIONS**:

Soft key	Function
	Show the collision objects and the workpiece
	Show the workpiece
	Show the tool <b>Further information:</b> "Tool", Page 261
	Show the tool paths <b>Further information:</b> "Tool", Page 261
	Select the view <b>Further information:</b> "View", Page 262
	Reset the tool paths
	Reset the workpiece blank
	Show the workpiece blank frame
	Highlight the workpiece edges on 3-D model
	Show the STL file of the finished part <b>Further information:</b> User's Manual for <b>Klartext Programming</b> or <b>ISO Programming</b>
	Show the block numbers of the tool paths
	Show the end points of the tool paths

Soft key	Function
	Show the workpiece in color
	Remove the chips Parts of the workpiece material that are cut off by machining will be removed from the graphics.
	Reset the tool paths
	Rotate and zoom the workpiece <b>Further information:</b> "Rotating, zooming and moving a graphic", Page 263
	Shift the sectional plane in the projection in three planes <b>Further information:</b> "Shifting the sectional plane", Page 265



#### Operating notes:

- The **clearPathAtBlk** machine parameter (no. 124203) allows you to specify whether the tool paths are cleared with a new BLK FORM in **Test Run** operating mode.
- If points were output incorrectly by the postprocessor, machining marks may occur on the workpiece. To recognize these unwanted machining marks in time (prior to machining), you can test externally created NC programs for corresponding irregularities by displaying the tool paths.
- The control saves the state of the soft keys in non-volatile memory.

## Tool

### Displaying the tool

If the **L** and **LCUTS** columns are defined in the tool table, the tool is graphically displayed.

**i** A realistic tool simulation may require additional definitions (e.g., in the columns **LU** and **RN** for tool neck surfaces).

**Further information:** "Entering tool data into the table", Page 142




The control displays the tool in various colors:

- Turquoise: tool length
- Red: length of cutting edge and tool is engaged
- Blue: length of cutting edge and tool is retracted

**i** If the **ZL** and **XL** columns are defined in the turning tool table, the indexable insert is displayed and the base body is shown schematically.

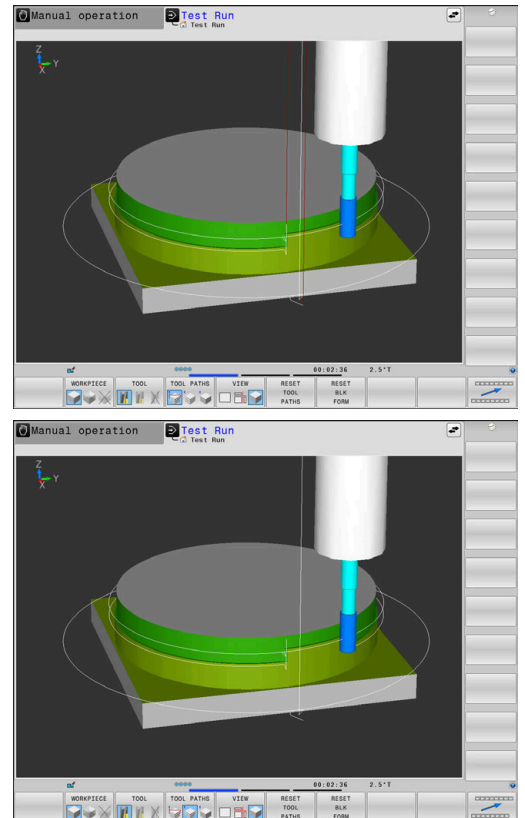
### Showing the tool paths

The control displays the following types of movement:

Soft key	Function
	Movements at rapid traverse and at the programmed feed rate
	Movements at the programmed feed rate
	No movements




**i** If you move at rapid traverse inside a workpiece, both the movement and the workpiece are shown in red at the respective location.

**i** The control shows the crosshatching and the yellow tool paths in the 3D view at all times, independent of model quality and display mode for the tool paths.



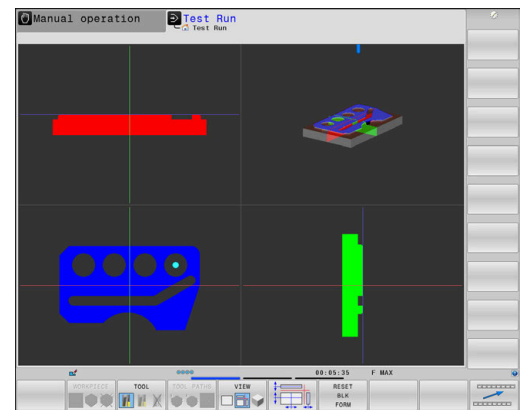
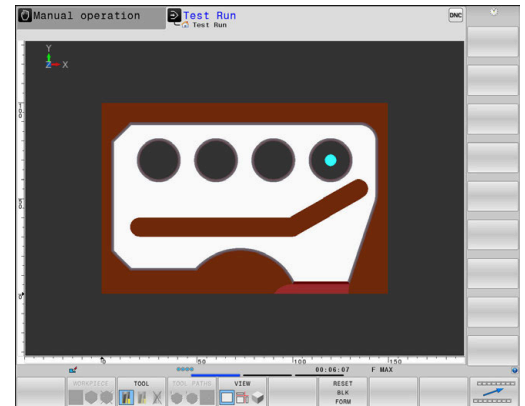
## View

The control provides the following views:

Soft key	Function
	Plan view
	Projection in three planes
	3-D view

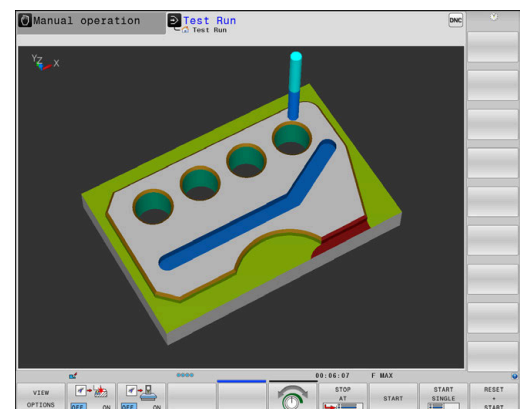
### Projection in three planes

The simulation shows three sectional planes and a 3-D model, similar to a technical drawing.



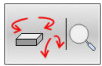
### 3-D view

The high-resolution 3-D view enables you to display the surface of the machined workpiece in greater detail. Using a simulated light source, the control creates realistic light and shadow conditions.



### Rotating, zooming and moving a graphic

Proceed as follows to rotate a graphic, for example:



- ▶ Select functions for rotating and zooming
- > The control displays the following soft keys.

Soft key		Function
		Rotate in 5° steps about the vertical axis
		Tilt in 5° steps about the horizontal axis
		Enlarge the graphic stepwise
		Reduce the graphic stepwise
		Reset the graphic to its original size and angle
		Move the graphic upward or downward
		Move the graphic to the left or right
		Reset the graphic to its original position and angle





You can also use the mouse to change the graphic display. The following functions are available:

- ▶ In order to rotate the model shown in three dimensions, hold down the right mouse button and move the mouse. If you simultaneously press the shift key, you can only rotate the model horizontally or vertically
- ▶ To shift the model shown: Hold the center mouse button or mouse wheel down and move the mouse. If you simultaneously press the shift key, you can only shift the model horizontally or vertically
- ▶ To zoom in on a certain area: Mark a zoom area by holding the left mouse button down.
- > After you release the left mouse button, the control zooms in on the defined area.
- ▶ To rapidly magnify or reduce any area: Rotate the mouse wheel backwards or forwards
- ▶ To return to the standard display: Press the shift key and simultaneously double-click with the right mouse key. The rotation angle is maintained if you only double-click with the right mouse key



## Setting the speed of the Test Run mode

**i** The most recently set speed stays active until a power interruption. After the control has been started, the speed is set to MAX.

After you have started a program, the control displays the following soft keys with which you can set the simulation speed:


Soft key	Functions
	Test the NC program with the speed that will be used when actually running the program (programmed feed rates will be taken into account)
	Increase the simulation speed incrementally
	Decrease the simulation speed incrementally
	Test run at the maximum possible speed (default setting)

You can also set the simulation speed before you start a program:

-  ▶ Select the function for setting the simulation speed
-  ▶ Select the desired function by soft key, e.g. incrementally increasing the simulation speed

## Repeating graphic simulation

A part program can be graphically simulated as often as desired. To do so you can reset the graphic to the workpiece blank.

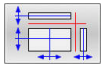
Soft key	Function
	Show the unmachined workpiece blank



## Shifting the sectional plane

The default setting of the sectional plane is selected so that it lies in the working plane in the center of the workpiece blank and in the tool axis on the top surface of the workpiece blank.

Proceed as follows to move the sectional plane:



- ▶ Press the soft key for **shifting the sectional plane**
- > The control displays the following soft keys:

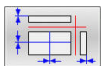
Soft key	Function
	Shift the vertical sectional plane to the right or left
	Shift the vertical sectional plane forward or backward
	Shift the horizontal sectional plane upwards or downwards

The position of the sectional planes is visible during shifting. The shift remains active, even if you activate a new workpiece blank.

## Resetting sectional planes

The shifted sectional plane also remains active for a new workpiece blank. The sectional plan is automatically reset when the control is restarted.

Proceed as follows to move the sectional plane to the default position:



- ▶ Press the soft key for **resetting the sectional planes** soft key

## 6.2 Monitoring for collisions

### Application

Extended collision monitoring is available in the **Test Run** operating mode.

The control issues a warning in the following events:

- Collisions between the tool holder and the workpiece
- Collisions between the tool and the workpiece
  - The control also considers inactive steps of a stepped tool.
- During material removal at rapid traverse

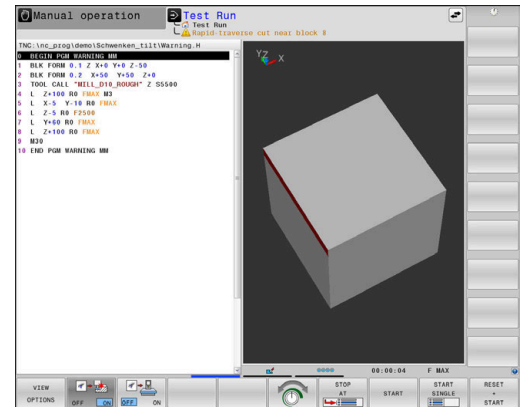


- Extended collision monitoring helps you reduce the risk of collision. However, the control cannot consider all possible constellations during operation.
- The **Advanced checks** function in the simulation uses the information from the workpiece blank definition for workpiece monitoring. Even if several workpieces are clamped in the machine, the control can monitor only the active workpiece blank!

**Further information:** User's Manual for **Klartext Programming**

- The **DCM** (Dynamic Collision Monitoring) software option shows collisions between tools or tool holders and fixtures or machine components.

**Further information:** "Dynamic Collision Monitoring (option 40)", Page 326



To activate extended collision monitoring:



- ▶ Set the soft key to **ON**
- > The control performs extended collision monitoring during a test run.

## 6.3 Measurement of machining time

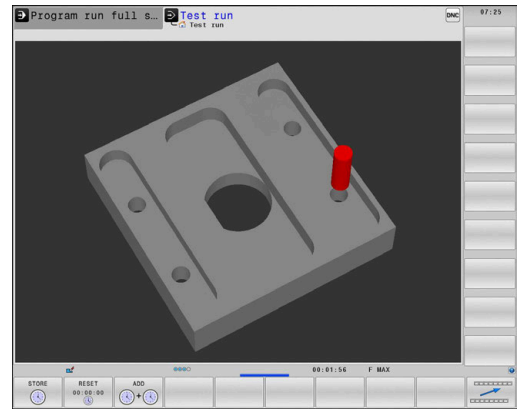
### Application

#### Machining time in the Test Run operating mode

The control calculates the duration of the tool movements and displays this as machining time in the test run. The control takes feed movements and dwell times into account.



The control does not dwell during the program test, but adds the dwell times to the machining time.




The time determined by the control is only of limited value for calculating the machining time because it does not take any machine-dependent time intervals (e.g., for tool changes) into consideration.



**i** The machining times determined using the graphic simulation do not correspond to the actual machining times. Reasons for this during combined milling-turning operations include the switching of operating modes.

Proceed as follows to select the stopwatch function:

-  ▶ Select the stopwatch function
-  ▶ Select the desired function by soft key, e.g. saving the displayed time

Soft key	Stopwatch functions
	Save the displayed time
	Display the sum of saved time and displayed time
	Clear the displayed time

#### Machining time in the machine operating modes

Time display from program start to program end. The timer stops whenever machining is interrupted.

## 6.4 Showing the workpiece blank in the working space

### Application

In **Test Run** operating mode, you can graphically check the position of the workpiece blank and the preset in the working space of the machine. The graphics show the preset that has been set in the NC program using Cycle **247**. If you have not defined a preset in the NC program, then the graphic shows the active preset on the machine.

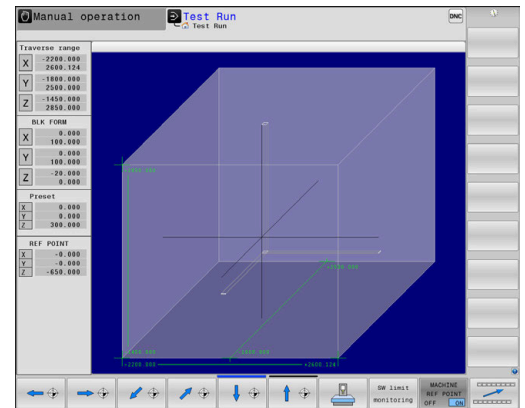
A transparent cuboid represents the workpiece blank. Its dimensions are shown in the **BLK FORM** table. The control takes over the dimensions from the workpiece blank definition of the selected NC program.








For a test run it normally does not matter where the workpiece blank is located within the working space. If you activate **BLANK IN WORK SPACE** working space monitoring, you must graphically shift the workpiece blank so that it lies within the working space. Use the soft keys shown in the table.




In addition, you can use the current machine status for the **Test Run** operating mode.

The current machine status includes the following:

- active machine kinematics
- active traverse ranges
- active machining modes
- active working spaces
- active preset



Soft key	Function
 	Shift the workpiece blank in positive or negative X direction
 	Shift the workpiece blank in positive or negative Y direction
 	Shift the workpiece blank in positive or negative Z direction
	Use the current machine status
ACTIVE TRAVERSE RANGES	Display the current traverse range
SELECT TRAVERSE RANGE	Selecting the traverse range The ranges of traverse are configured by the machine manufacturer.

Soft key	Function
	Switch on/off the monitoring function
	Display the machine preset
	Set the principal axis values of the active preset to 0 for the simulation



For blank in work space, the control depicts the **BLK FORM** only schematically.

- With **BLK FORM CYLINDER**, a cuboid is depicted as the workpiece blank
- With **BLK FORM ROTATION**, no workpiece blank is depicted

## 6.5 Measuring

### Application

In the **Test Run** operating mode, you can use the **MEASURING** soft key to display the following information:

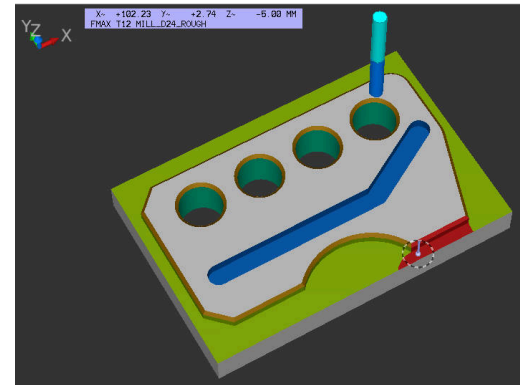
- Approximated coordinates as XYZ values with reference to workpiece coordinate system **W-CS**

**Further information:** "Workpiece coordinate system W-CS", Page 124
- Optional display
  - FMAX: If the control machines at the maximum feed rate.
  - Threads: If a thread cutting cycle has been programmed. (Option 50)
  - Residual material: If a contour follow-up has been programmed. (Option 50)
- Tool number
- Tool name

Proceed as follows to select the measuring function:



- ▶ Set the **MEASURING** soft key to **ON**
- ▶ Position the mouse pointer on the respective position
- ▶ The control displays the positioning ball icon and the surface orientation with a black and white circle and a perpendicular line on it.
- ▶ The corresponding information is displayed in a blue text field.



The **MEASURING** soft key is available in the following views:

- Plan view
- 3-D view

**Further information:** "View", Page 262

## 6.6 Optional program-run interruption

### Application



Refer to your machine manual.

The behavior of this function varies depending on the respective machine.

The control optionally interrupts program run at NC blocks in which an M1 has been programmed. If you use M1 in the **Program run** operating mode, the control does not switch off the spindle or the coolant.



- ▶ Set the **M01** soft key to **OFF**
- > The control does not interrupt the **Program run** or **Test Run** at NC blocks that contain an M1.



- ▶ Set the **M01** soft key to **ON**
- > The control interrupts the **Program run** or **Test Run** at NC blocks with M1.

## 6.7 Skipping NC blocks

You can have NC blocks skipped in the following operating modes:

- **Test Run**
- **Program run, full sequence**
- **Program run, single block**
- **Positioning w/ Manual Data Input**



Operating notes:

- This function does not work for **TOOL DEF** blocks.
- After a power interruption the control returns to the most recently selected setting.
- The setting of the **HIDE** soft key is only effective in the respective operating mode.

### Test Run and Program Run

#### Application

In **Test Run** or **Program Run, Full Sequence/Single Block** operating mode, the control can skip over NC blocks that you have preceded by a slash (/):



- ▶ Set the **HIDE** soft key to **ON**
- > The control skips the NC blocks.



- ▶ Set the **HIDE** soft key to **OFF**
- > The control runs or tests the NC blocks.

#### Procedure

You can optionally hide NC blocks.

To hide NC blocks in the **Programming** mode:



- ▶ Select the desired NC block



- ▶ Press the **INSERT** soft key
- > The control inserts a slash (/).

To show NC blocks again in the **Programming** mode:



- ▶ Select the hidden NC block



- ▶ Press the **REMOVE** soft key
- > The control removes the slash (/).



## Positioning w/ Manual Data Input

### Application



In order to skip NC blocks in the **Positioning w/ Manual Data Input** operating mode, you need an alphabetic keyboard.

In **Positioning w/ Manual Data Input** operating mode, you can have the control skip NC blocks that have been marked correspondingly. Proceed as follows:



- ▶ Set the **HIDE** soft key to **ON**
- > The control skips the NC blocks.



- ▶ Set the **HIDE** soft key to **OFF**
- > The control runs the NC blocks.

### Procedure

To hide NC blocks in the **Positioning w/ Manual Data Input** operating mode:



- ▶ Select the desired NC block



- ▶ Press the **/** key on the alphabetic keyboard
- > The control inserts a slash (*/*).

To show NC blocks again in the **Positioning w/ Manual Data Input** operating mode:



- ▶ Select the hidden NC block



- ▶ Press the **Backspace** key
- > The control removes the slash (*/*).

## 6.8 Exporting a finished part

### Application

In the **Test Run** operating mode, the **EXPORT WORKPIECE** soft key allows you to export the current status of the material removal simulation as a 3D model in STL format.

The file size depends on the complexity of the geometry.

**i** You can use the exported STL files as a workpiece blank in the NC program of a subsequent machining step, for example.

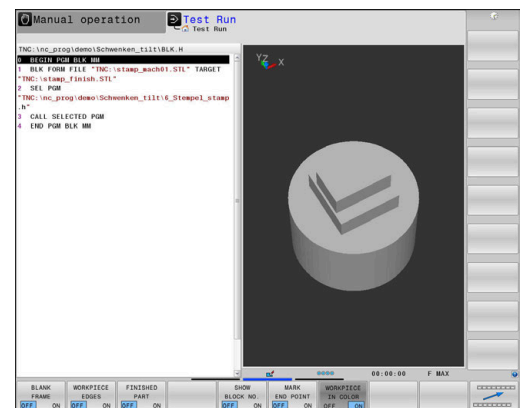
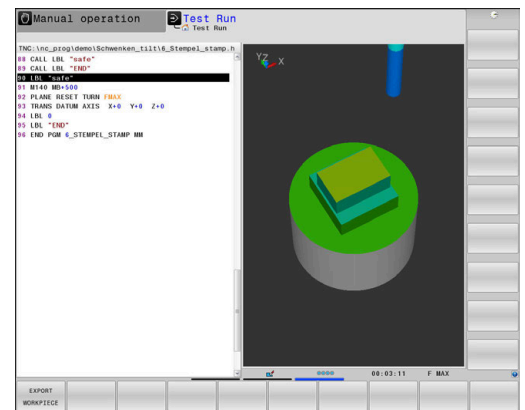
**Further information:** User's Manual for **Klartext Programming** or **ISO Programming**

To export a 3-D model:

- ▶ Set the motion simulation to the desired status

EXPORT  
WORKPIECE

- ▶ Press the **EXPORT WORKPIECE** soft key
- ▶ The control opens a pop-up window.
- ▶ Enter the desired file name
- ▶ Select the desired target directory
- ▶ Activate **OPTIMIZED** as needed (option 152)
- ▶ The control simplifies the STL file when saving it.
- ▶ Confirm the data entered



### Optimized STL file output (option 152)

If you set **OPTIMIZED** to ON, the control exports a simplified STL file. During this process, the control removes unnecessary triangles and simplifies the 3D model to max. 20 000 triangles. You can use the simplified STL file within **BLK FORM FILE** without any additional adaptation.

**Further information:** User's Manual for **Klartext Programming**

## 6.9 Test run

### Application

The simulation of NC programs and program sections in **Test Run** operating mode helps you to detect programming errors, as well as collisions and interruptions during program run, before the actual machining process. The motion simulation enables the visual inspection of both the machining result and the machine movements.

The control helps you detect the following problems:

- Programming errors
  - Geometrical incompatibilities
  - Missing data
  - Impossible jumps
  - Material removal at rapid traverse
- Machining errors
  - Usage of locked tools
  - Violation of the machine's working space
  - Collisions between the tool shank or tool holder and the workpiece
  - Collisions between the tools or tool holders and fixtures or machine components (option 40)

The following functions and information are available:

- Block-by-block simulation
- Cancellation of test at any NC block
- Hiding or skipping of NC blocks
- Determined machining time
- Additional status display
- Graphic display



The graphical representation functions and the quality of the represented model depend on the settings in the **Graphic settings** MOD function.

**Further information:** "Graphic settings", Page 452

**Keep the following in mind when performing a test run**

With cuboid workpiece blanks, the control starts a test run after a tool call at the following position:

- In the working plane in the center of the defined **BLK FORM**
- In the tool axis, 1 mm above the **MAX** point defined in the **BLK FORM**

With rotationally symmetrical workpiece blanks, the control starts a test run after a tool call at the following position:

- In the machining plane at the position X=0, Y=0
- In the tool axis 1 mm above the defined workpiece blank

The **FN 27: TABWRITE** and **FUNCTION FILE** functions are only considered in the **Program run, single block** and **Program run, full sequence** operating modes.

**NOTICE****Danger of collision!**

In the **Test Run** operating mode, the control does not take all axis movements of the machine into consideration (e.g., PLC positioning movements as well as movements from tool-change macros and M functions). Thus, the test might be performed without errors, but later operation will deviate from these results. Danger of collision during machining!

- ▶ Test the NC program at the later machining position (**BLANK IN WORK SPACE**)
- ▶ Program a safe intermediate position after the tool change and before repositioning
- ▶ Carefully test the NC program in the **Program run, single block** operating mode
- ▶ If possible, use the **Dynamic Collision Monitoring (DCM)** function

**NOTICE****Danger of collision!**

If you simulate an NC program that includes SQL commands, the control might overwrite table values. Overwriting table values might result in incorrect positioning of the machine. There is a danger of collision.

- ▶ Program NC programs in such a way that SQL commands are not executed during simulation
- ▶ Use **FN18: SYSREAD ID992 NR16** to check whether the NC program is active in a different operating mode or in **Simulation**



Refer to your machine manual.

Your machine manufacturer can also define a tool-change macro for the **Test Run** operating mode. This macro will simulate the exact behavior of the machine.

In doing so, the machine manufacturer often changes the simulated tool change position.

## Test run execution

**i** For the test run, you must activate a tool table (status S). Select a tool table via the file manager in the **Test Run** operating mode.

For turning tools you can select a turning tool table with the extension .trn, which is compatible with the selected tool table. To do this, the turning tools must match in both selected tables.

You can select any preset table (status S) for the test run.

Once you press the **RESET + START** soft key in the **Test Run** operating mode, the control automatically uses the active preset from the machine operating modes for simulation. This preset remains selected when starting the test run until you define another preset in the NC program. The control reads all other defined presets from the preset table selected for the test run.

With the **BLANK IN WORK SPACE** function, you can activate workspace monitoring for the test run.

**Further information:** "Showing the workpiece blank in the working space ", Page 268








- ▶ Operating mode: Press the **Test Run** key



- ▶ Call the file manager with the **PGM MGT** key and select the file you wish to test

The control then displays the following soft keys:

Soft key	Function
	Reset the blank form, reset the previous tool data and test the entire NC program
	Test the entire NC program
	Test each NC block individually
	Executes the <b>Test Run</b> until NC block N
	Stop test run (this soft key only appears if you have started the test run)

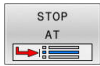
You can interrupt and continue the test run at any time, even within machining cycles. In order to continue the test, the following actions must not be performed:

- Selecting another NC block with the arrow keys or the **GOTO** key
- Making changes to the NC program
- Selecting another NC program

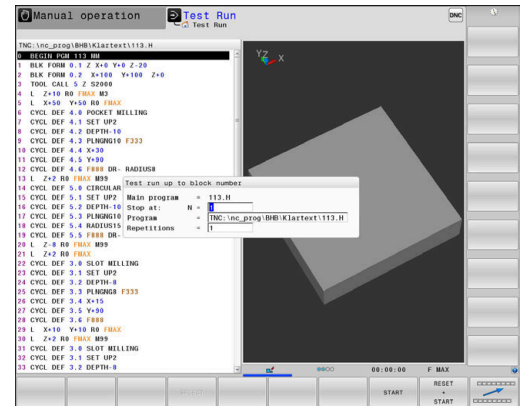
## Executing a Test Run up to a certain NC block

With the **STOP AT** function the control executes a **Test Run** up to the NC block with block number **N**.

To stop the **Test Run** at the desired NC block:



- ▶ Press the **STOP AT** soft key
- ▶ **Stop at: N** = Enter the block number at which the simulation should stop
- ▶ Enter the **Program** name of the NC program containing the NC block with the selected block number
- ▶ The control shows the name of the selected NC program.
- ▶ If the simulation is to be stopped in an NC program that has been called using, for example, **CALL PGM**, then enter this name.
- ▶ **Repetitions** = If **N** is located in a program-section repeat, enter the number of repeats that you want to run.  
Default 1: The control stops before **N** is simulated



## Possibilities in stopped condition

If you interrupt the **Test Run** with the **STOP AT** function, you have the following possibilities in this stopped condition:

- Enable or disable **NC block skip**
- **Optional program stop** enable or disable
- Modify graphics resolution and model
- Modify the NC program in the **Programming** operating mode

If you modify the NC program in the **Programming** operating mode, the simulation behaves as follows:



- Modification before the interruption point: The simulation restarts at the beginning
- Modification after the interruption point: Positioning at the interruption point is possible with **GOTO**

## Using the GOTO key




### Jumping with the GOTO key

Use the **GOTO** key to jump to a specific location in the NC program, regardless of the active operating mode.

Proceed as follows:

-  ▶ Press the **GOTO** key
- ▶ The control opens a pop-up window.
- ▶ Enter a number
-  ▶ Select the jump statement by soft key, e.g. move down the number of lines entered

The control provides the following options:

Soft key	Function
	Move up the number of lines entered
	Move down the number of lines entered
	Jump to the block number entered





Use the **GOTO** function only during programming and testing of NC programs. Use the **Block scan** function during program run.

**Further information:** "Starting the NC program at any point: Block scan", Page 295

### Quick selection with the GOTO key

With the **GOTO** key, you can open the Smart Select window that makes it easy for you to select special functions or cycles.

To select special functions:

-  ▶ Press the **SPEC FCT** key
-  ▶ Press the **GOTO** key
- ▶ The control displays a pop-up window showing a structural view of the special functions
- ▶ Select the desired function

### Further information: User's Manual for **Programming of Machining Cycles**

#### Opening the selection window with the GOTO key

When the control provides a selection menu, you can use the **GOTO** key to open the selection window. This allows you to view the available entries.



## Scrollbar

Screen content can be shifted with the mouse using the scrollbar at the right edge of the program window. In addition, the size and position of the scrollbar indicates program length and cursor position.

## 6.10 Program run

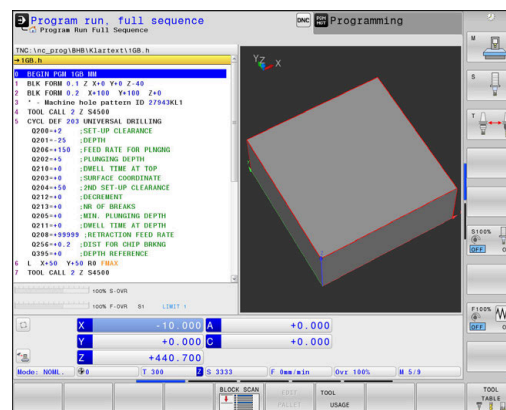
### Application

In the **Program run, full sequence** operating mode, the control executes an NC program continuously to its end or up to a program stop.

In the **Program run, single block** operating mode, the control executes each NC block individually after pressing the **NC Start** key. With point pattern cycles and **CYCL CALL PAT**, the control stops after each point. The workpiece blank definition will be interpreted as a separate NC block.

You can use the following control functions in the **Program run, single block** and **Program run, full sequence** operating modes:

- Interrupt program run
- Start the program run from a certain NC block
- Skip NC blocks
- Edit the tool table TOOL.T
- Edit the active datum table or compensation table
- Checking and changing Q parameters
- Superimpose handwheel positioning
- Functions for graphic simulation
- Additional status display



### NOTICE

#### Caution: Danger due to manipulated data!

If you execute NC programs directly from a network drive or a USB device, you have no control over whether the NC program has been changed or manipulated. In addition, the network speed can slow down the execution of the NC program. Undesirable machine movements or collisions may result.

- ▶ Copy the NC program and all called files to the **TNC:** drive

### Running an NC program

#### Preparation

- ▶ Clamp the workpiece to the machine table
- ▶ Set a preset
- ▶ Select the necessary tables and pallet files (status M)
- ▶ Select the NC program (status M)



Operating notes:

- You can change the feed rate and spindle speed using the potentiometers.
- You can reduce the feed rate using the **FMAX** soft key. This reduction affects all rapid traverse and feed movements, even after the control has been restarted.

#### Program Run, Full Sequence

- ▶ Start the NC program with the **NC Start** key

## Program Run, Single Block

- ▶ Start each NC block of the NC program individually with the **NC Start** key

## Structuring NC programs

### Definition and applications

The control enables you to comment NC programs in structuring blocks. Structuring blocks are texts with up to 252 characters and are used as comments or headlines for the subsequent program lines.

With the aid of appropriate structuring blocks, you can organize long and complex NC programs in a clear and comprehensible manner.

This function is particularly convenient if you want to change the NC program later. Structuring blocks can be inserted into the NC program at any point.

Structure blocks can also be displayed in a separate window, and be edited or added to, as desired. Use the appropriate screen layout for this.

The control manages the inserted structure items in a separate file (extension: .SEC.DEP). This speeds navigation in the program structure window.

The **PROGRAM SECTS** screen layout can be selected in the following operating modes:

- **Program run, single block**
- **Program run, full sequence**
- **Programming**

### Displaying the program structure window / Changing the active window



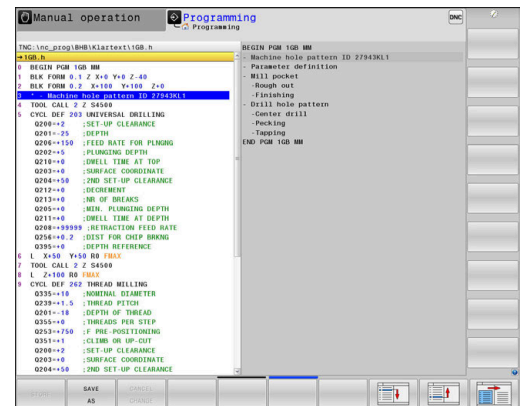
- ▶ Display structure window: For this screen layout press the **PROGRAM SECTS** soft key



- ▶ Change the active window: Press the **CHANGE WINDOW** soft key

### Selecting blocks in the program structure window

If you are scrolling through the program structure window block by block, the control at the same time automatically moves the corresponding NC blocks in the program window. This way you can quickly skip large program sections.



## Checking and changing Q parameters

### Procedure

You can check Q parameters in all operating modes, and also edit them.

- ▶ If you are in a program run, interrupt it if required (e.g. by pressing the **NC STOP** key and the **INTERNAL STOP** soft key) or stop the test run



- ▶ To call the Q parameter functions, press the **Q INFO** soft key or the **Q** key
- ▶ The control lists all of the parameters and their corresponding current values.
- ▶ Use the arrow keys or the **GOTO** key to select the desired parameter.
- ▶ If you want to change the value, then press the **EDIT CURRENT FIELD** soft key, enter the new value, and confirm with the **ENT** key
- ▶ If you want to leave the value unchanged, then press the **PRESENT VALUE** soft key or close the dialog with the **END** key



If you want to check or edit local, global or string parameters, press the **SHOW PARAMETERS Q QL QR QS** soft key. The control then displays the specific parameter type. The functions previously described also apply.

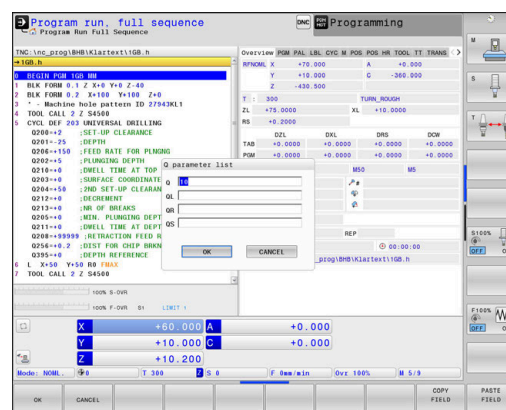
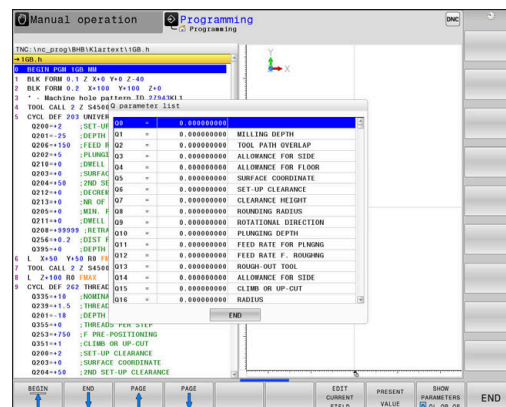
While the control is executing an NC program, you cannot edit the variables using the **Q parameter list** window. Changes are only possible while program run has been interrupted or aborted.

This status is reached after an NC block has been executed, for example in **Program run, single block**

The following Q and QS parameters cannot be edited in the **Q parameter list** window:

- Variable range from 100 to 199, because there might be interferences with special functions in the control.
- Variable range from 1200 to 1399, because there might be interferences with machine manufacturer-specific functions.

All of the parameters with displayed comments are used by the control within cycles or as transfer parameters.



You can have Q parameters also be displayed in the additional status display in all operating modes (except **Programming** mode).

- ▶ If needed, interrupt the program run (e.g., by pressing the **NC STOP** key and the **INTERNAL STOP** soft key), or stop the test run



- ▶ Display the soft key row for screen layout



- ▶ Select the layout option for the additional status display
- > In the right half of the screen, the control shows the **Overview** status form.



- ▶ Press the **STATUS OF Q PARAM.** soft key



- ▶ Press the **Q PARAMETER LIST** soft key.
- > The control opens a pop-up window.
- ▶ For each parameter type (Q, QL, QR, QS), define the parameter numbers you wish to check. Separate single Q parameters with a comma, and connect sequential Q parameters with a hyphen, e.g. 1,3,200-208. The input range per parameter type is 132 characters



The display in the **QPARA** tab always contains eight decimal places. The result of **Q1 = COS 89.999** is shown by the control as 0.00001745, for example. Very large or very small values are displayed by the control in exponential notation. The result of **Q1 = COS 89.999 \* 0.001** is shown by the control as +1.74532925e-08, where e-08 corresponds to the factor of 10<sup>-8</sup>.

## Interrupting, stopping or canceling a program

There are several ways to stop a program run:

- Interrupt program run (e.g., with the miscellaneous function **M0**)
- Stop the program run (e.g., with the **NC Stop** key)
- Stop the program run (e.g., with the **NC Stop** key in connection with the **INTERNAL STOP** soft key)
- Terminate program run (e.g., with the miscellaneous functions **M2** or **M30**)

The control shows the current program run status in the status display.

**Further information:** "General status display", Page 69

In contrast to a stopped run, an interrupted, aborted (terminated) program run enables certain actions by the user, including the following:

- Selecting an operating mode
- Checking Q parameters and changing these if necessary using the **Q INFO** function
- Changing the setting for the optional programmed interruption with **M1**
- Changing the setting for the programmed skipping of NC blocks with **/**



Upon major errors, the control automatically aborts program run (e.g., during a cycle call with stationary spindle).

### Program-controlled interruptions

You can set interruptions directly in the NC program. The control interrupts the program run in the NC block containing one of the following inputs:

- Programmed stop **STOP** (with and without miscellaneous function)
- Programmed stop **M0**
- Conditional stop **M1**

### NOTICE

#### Danger of collision!

Certain manual interactions may lead to the control losing the modally effective program information (i.e., the contextual reference). Loss of this contextual reference may result in unexpected and undesirable movements. There is a risk of collision during the subsequent machining operation!

- ▶ Do not perform the following interactions:
  - Cursor movement to another NC block
  - The jump command **GOTO** to another NC block
  - Editing an NC block
  - Modifying the values of variables by using the **Q INFO** soft key
  - Switching the operating modes
- ▶ Restore the contextual reference by repeating the required NC blocks

### Manual program interruption

While an NC program is being executed in the **Program run, full sequence** operating mode, select the **Program run, single block** operating mode. The control interrupts the machining process at the end of the current machining step.

### Aborting program run



- ▶ Press the **NC Stop** key
- > The control does not finish the current NC block.
- > The control shows the icon for stopped status in the status display.
- > Actions such as a change of operating mode are not possible.
- > The program can be resumed with the **NC Start** key.



- ▶ Press the **INTERNAL STOP** soft key



- > The control briefly shows the icon for program cancellation in the status display.



- > The control shows the icon for the exited inactive status in the status display.
- > Actions such as a change of operating mode are available again.

## Compensations during program run

### Application

During the program run, you can access the programmed compensation tables and the active datum table. You can also make changes to these tables. The changes only become effective after activating the compensation again.

### Functionality

A datum table can be activated by using the **SEL TABLE** function within an NC program. The datum table remains active until you select a new one.

### Further information: User's Manual for **Klartext Programming**

The control displays the following information on the **TRANS** tab of the additional status display:

- Name and path of the active datum table
- Active datum number
- Comment from the **DOC** column of the active datum number

Correction tables can be activated by using the **SEL CORR-TABLE** function in the NC program.

### Further information: User's Manual for **Klartext Programming**



### Activating tables manually

**i** If you work without **SEL TABLE**, you must activate the desired datum table or compensation table in the **Program run, single block** or **Program run, full sequence** operating mode.

To activate a table in the **Program run, full sequence** operating mode:



- ▶ Change to the **Program run, full sequence** operating mode.



- ▶ Press the **PGM MGT** key
- ▶ Select the desired table
- ▶ The control activates the table for program run and marks the file with the **M** status.

### Editing a compensation table during program run

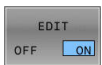
To edit a compensation table in the Program Run operating mode:



- ▶ Press the **OPEN COMPENS. TABLES** soft key



- ▶ Press the soft key for the desired table (e.g., **DATUM TABLE**)
- ▶ The control opens the active datum table.



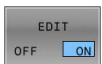
- ▶ Set the **EDIT** soft key to **ON**
- ▶ Select the desired value
- ▶ Edit the value

**i** The changed data do not take effect until after the compensation has been activated again.

### Transferring the actual position into the datum table

In the datum table, you can enter the current tool position in the respective axis by using the **ACTUAL POSITION CAPTURE** key.

The current tool position can be transferred into the datum table as follows:



- ▶ Set the **EDIT** soft key to **ON**
- ▶ Select the desired value



- ▶ Press the **ACTUAL POSITION CAPTURE** key
- ▶ The control now loads the current position into the selected axis.








**i** After you have changed a value in a datum table, you must save the change with the **ENT** key. Otherwise, the change will not be taken into account when the NC program is executed.

A datum change will only become effective after you have called Cycle **7** or **TRANS DATUM** again.

## Moving the machine axes during an interruption

While a program run is interrupted, you can move the axes manually. If, at the time of the interruption, the **Tilt working plane** function (option 8) is active, then the **3-D ROT** soft key becomes available.

In the **3-D ROT** menu, you can choose between the following functions:

Soft key	Status display icon	Function
	No icon	You can move the axes in the machine coordinate system (M-CS). <b>Further information:</b> "Machine coordinate system M-CS", Page 120
		You can move the axes in the workpiece coordinate system (W-CS). <b>Further information:</b> "Workpiece coordinate system W-CS", Page 124
		You can move the axes in the working-plane coordinate system (WPL-CS). <b>Further information:</b> "Working plane coordinate system WPL-CS", Page 126
		You can move the axes in the tool coordinate system (T-CS). The control locks the other axes. <b>Further information:</b> "Tool coordinate system T-CS", Page 129



Refer to your machine manual.

Your machine manufacturer enables the function for traversing in the tool-axis direction.

## NOTICE

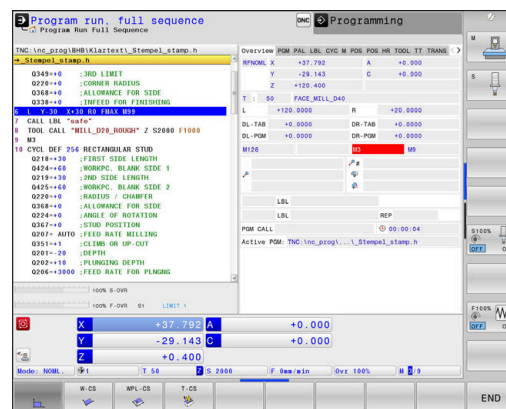
### Danger of collision!

During a program interruption, you can move the axes manually (e.g., in order to retract from a hole when the working plane is tilted). Selecting an incorrect **3D ROT** setting or moving the tool in the wrong direction involves risk of collision!

- ▶ It is better to use the **T-CS** function
- ▶ Check the direction of movement
- ▶ Move at slow feed rate

## Modifying the preset during an interruption

If you modify the active preset during an interruption, resuming the program run is only possible with **GOTO** or mid-program startup at the interruption point.



**Example: Retracting the spindle after tool breakage**

- ▶ Interrupt machining
- ▶ Enable the axis-direction keys: Press the **MANUAL TRAVERSE** soft key
- ▶ Move the machine axes with the axis direction keys



Refer to your machine manual.

On some machines, you may have to press the **NC Start** key after the **MANUAL TRAVERSE** soft key to enable the axis-direction keys.

**Resuming program run after an interruption**

The control saves the following data during a program interruption:

- The last tool that was called
- Current coordinate transformations (e.g., datum shift, rotation, mirroring)
- The coordinates of the circle center that was last defined

The control uses the stored data for returning the tool to the contour after manual machine axis positioning during an interruption (**RESTORE POSITION** soft key).



Operating notes:

- The saved data remains active until it is reset (e.g., by selecting a program).
- If you interrupt an NC program using the **INTERNAL STOP** soft key, you have to start machining at the start of the program or by using the **BLOCK SCAN** function.
- For program interruptions within program-section repeats or subprograms, you have to use the **BLOCK SCAN** function for re-entering at the point of interruption.
- With machining cycles, mid-program startup is always executed at the start of the cycle. If you interrupt a program run during a machining cycle, the control repeats machining steps already carried out after a block scan.

**Resuming the program run with the NC Start key**

You can resume program run by pressing the **NC Start** key if the NC program was stopped in one of the following ways:

- Press the **NC Stop** key
- Programmed interruption

**Resuming program run after an error**

With an erasable error message:

- ▶ Remove the cause of the error
- ▶ Clear the error message from the screen: Press the **CE** key
- ▶ Restart the program, or resume program run where it was interrupted

## Retraction after a power interruption



Refer to your machine manual.  
Your machine manufacturer configures and enables the **Retraction** mode of operation.

With the **Retraction** mode of operation you can disengage the tool from the workpiece after an interruption in power.

If you activated a feed rate limit before a power failure, this is still active. You can deactivate the feed-rate limit using the **CANCEL THE FEED RATE LIMITATION** soft key.

The **Retraction** mode of operation is selectable in the following conditions:

- Power interrupted
- No control voltage for the relay
- Traversing the reference points

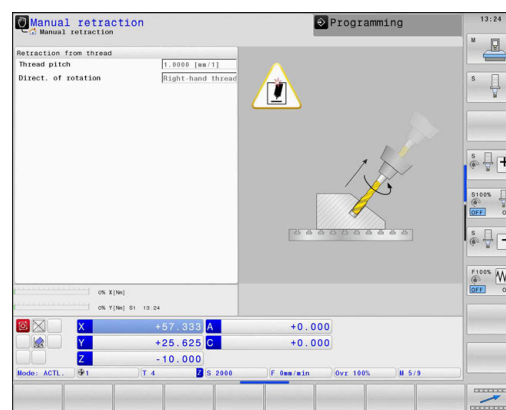
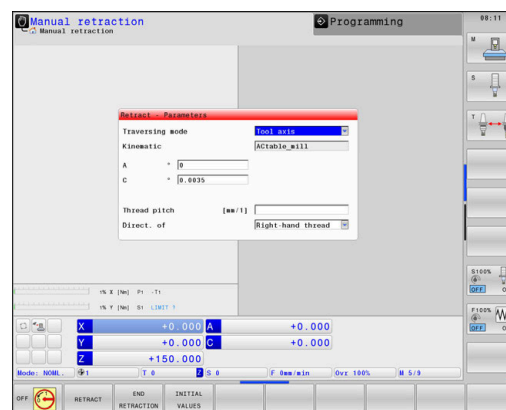
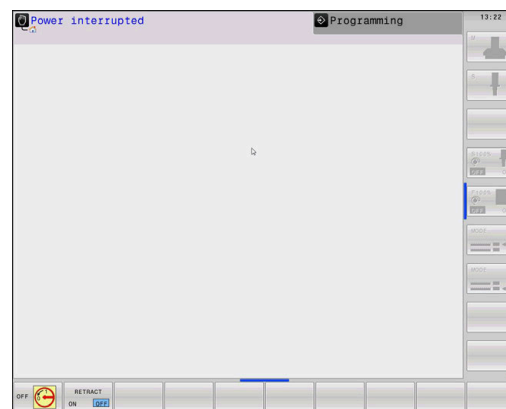
The **Retraction** operating mode offers the following modes of traverse:

Mode	Function
Machine axes	Movement of all axes in the machine coordinate system
Tilted system	Movement of all axes in the active coordinate system Effective parameters: Position of the tilting axes
Tool axis	Movements of the tool axis in the active coordinate system
Thread	Movements of the tool axis in the active coordinate system with compensating movement of the spindle Effective parameters: Thread pitch and direction of rotation



If the **Tilt working plane** function (option 8) is enabled on your control, then the **Tilted system** traverse mode is also available.

The control selects the mode of traverse and the associated parameters automatically. If the traverse mode or the parameters have not been correctly preselected, you are able to reset them manually.



**NOTICE****Caution: Danger to the tool and workpiece!**

A power failure during the machining operation can cause uncontrolled “coasting” or braking of the axes. In addition, if the tool was in effect prior to the power failure, then the axes cannot be referenced after the control has been restarted. For non-referenced axes, the control takes over the last saved axis values as the current position, which can deviate from the actual position. Thus, subsequent traverse movements do not correspond to the movements prior to the power failure. If the tool is still in effect during the traverse movements, then the tool and the workpiece can sustain damage through tension!

- ▶ Use a low feed rate
- ▶ Please keep in mind that the traverse range monitoring is not available for non-referenced axes

**Example**

The power failed while a thread cutting cycle in the tilted working plane was being performed. You have to retract the tap:

- ▶ Switch on the power supply for control and machine
- > The control starts the operating system. This process may take several minutes.
- > The control will then display the **Power interrupted** message in the screen header.



- ▶ Activate the **Retraction** mode: Press the **RETRACT** soft key
- > The control displays the message **Retraction selected**



- ▶ Confirm the power interruption: Press the **CE** key
- > The control compiles the PLC program.



- ▶ Switch on the machine control voltage
- > The control checks the functioning of the EMERGENCY STOP circuit. If there is at least one non-referenced axis, you will have to compare the displayed position values with the actual axis values and confirm that they are correct. If required, follow the dialog.

- ▶ Check the preselected traverse mode: If required, select **THREAD**
- ▶ Check the preselected thread pitch: If required, enter the thread pitch
- ▶ Check the preselected direction of rotation: if needed, select the turning direction of the thread  
 Right-handed thread: the main spindle turns clockwise when moving into the workpiece, counter-clockwise when retracting from it; left-handed thread: main spindle turns counter-clockwise when moving into the workpiece and clockwise when retracting from it



- ▶ Activate retraction: Press the **RETRACT** soft key

- ▶ Retraction: Retract the tool with the axis direction keys or the electronic handwheel  
 Axis key Z+: Retraction from the workpiece  
 Axis key Z-: Moving into the workpiece



- ▶ Exit retraction: Return to the original soft-key level



- ▶ End the **Retraction** operating mode: Press the **END RETRACTION** soft key
- > The control checks whether the **Retraction** operating mode can be ended. If necessary, follow the dialog.

- ▶ Answer confirmation request: If the tool was not correctly retracted, press the **NO** soft key. If the tool was correctly retracted, press the **YES** soft key.
- > The control hides the **Retraction selected** dialog.
- ▶ Initialize the machine: If required, traverse the reference points
- ▶ Establish the desired machine condition: If required, reset the tilted working plane

## Starting the NC program at any point: Block scan



Refer to your machine manual.

The **BLOCK SCAN** function must be enabled and configured by the machine manufacturer.

The **BLOCK SCAN** function allows you to start an NC program at any desired NC block. The control factors workpiece machining up to this NC block into the calculations.

If the NC program was interrupted under the following conditions, the control saves the interruption point:

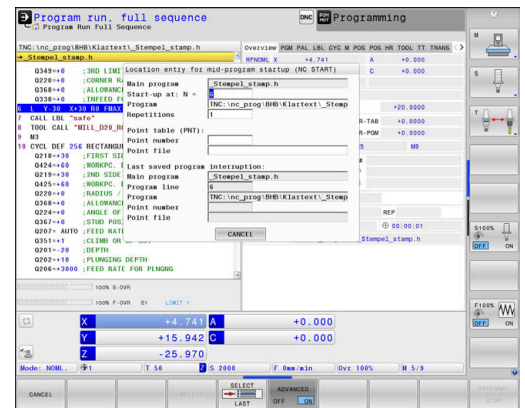
- The **INTERNAL STOP** soft key
- Emergency stop
- Power failure

If, while restarting, the control finds a saved point of interruption, then it outputs a message. You can then execute a block scan directly to the point of interruption.

You have the following options for a block scan:

- Block scan in the main program, with repetitions if necessary
- Multi-level block scan in subprograms and touch probe cycles
- Block scan in a point table
- Block scan in pallet programs

At the start of the block scan, the control resets all data, as when selecting an NC program. During the block scan, you can switch between **Program Run Full Sequence** and **Program Run Single Block**.



### NOTICE

#### Danger of collision!

The **Block scan** function skips over the programmed touch probe cycles. As a result, the result parameters contain no values or, possibly, incorrect values. If the subsequent machining operation uses these result parameters, then there is a risk of collision!

- ▶ Use the **Block scan** function in multiple steps



The **BLOCK SCAN** function must not be used in conjunction with the following functions:

- Touch probe cycles **0**, **1**, **3**, and **4** during the block scan search phase

### Procedure for simple block scan



The control only displays the dialogs required by the process in the pop-up window.



- ▶ Press the **BLOCK SCAN** soft key
- > The control shows a pop-up window with the active main program.
- ▶ **Start-up at: N =**: Enter the number of the NC block where you wish to enter the NC program
- ▶ **Program**: Check the name and path of the NC program containing the NC block, or enter with the **SELECT** soft key
- ▶ **Repetitions**: If the NC block is located within a program section repeat, enter the number of the repetition that should be run next.
- ▶ Press the **ADVANCED** soft key if needed



- ▶ If needed, press the **SELECT LAST BLOCK** soft key in order to select the last saved interruption



- ▶ Press the **NC Start** key
- > The control starts the block scan, calculates until the entered NC block, and shows the next dialog.

If you changed the machine status:



- ▶ Press the **NC Start** key
- > The control restores the machine status (e.g., TOOL CALL or M functions and shows the next dialog).

If you changed the axis positions:



- ▶ Press the **NC Start** key
- > The control approaches the specified positions in the specified sequence and shows the next dialog.

Approach axes in individually selected sequence:

**Further information:** "Returning to the contour", Page 301



- ▶ Press the **NC Start** key
- > The control resumes execution of the NC program.



### Example of simple block scan



Even after an internal stop, the control shows the number of repetitions on the Overview tab of the status display.

After an internal stop, you would like to start in NC block 12 in the third machining operation of LBL 1.

Enter the following data in the pop-up window:

- **Start-up at: N =12**
- **Repetitions 3**

### Procedure for multi-level block scan

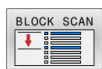
If you, for example, start in a subprogram that is called several times by the main program, then use the multi-level block scan. For this purpose, jump in the main program to the desired subprogram call. With the **CONTINUE BLOCK SCAN** function, you can jump further from this position.



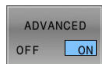
Operating notes:

- The control only displays the dialogs required by the process in the pop-up window.
- You can also continue the **BLOCK SCAN** without restoring the machine status and the axis position of the first startup point. For this, press the **CONTINUE BLOCK SCAN** soft key before confirming the restoration with the **NC Start** key.

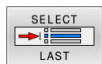
Block scan to the first start-up point:



- ▶ Press the **BLOCK SCAN** soft key
- ▶ Enter the first NC block where you wish to start



- ▶ Press the **ADVANCED** soft key if needed



- ▶ If needed, press the **SELECT LAST BLOCK** soft key in order to select the last saved interruption



- ▶ Press the **NC Start** key
- > The control starts the block scan and calculates until the entered NC block.

If the control should restore the machine status of the entered NC block:



- ▶ Press the **NC Start** key
- > The control restores the machine status (e.g., TOOL CALL, M functions).

If the control should restore the axis positions:



- ▶ Press the **NC Start** key
- > The control moves in the specified sequence to the specified positions.

If the control should run the NC block:



- ▶ Select the **Program Run Single Block** operating mode if required



- ▶ Press the **NC Start** key
- > The control runs the NC block.

Block scan to the next start-up point:



- ▶ Press the **CONTINUE BLOCK SCAN** soft key
- ▶ Enter the NC block where you wish to start

If you changed the machine status:



- ▶ Press the **NC Start** key

If you changed the axis positions:



- ▶ Press the **NC Start** key

If the control should run the NC block:



- ▶ Press the **NC Start** key
- ▶ Repeat these steps if required to jump to the next start-up point

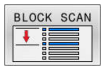


- ▶ Press the **NC Start** key
- > The control resumes execution of the NC program.

### Example of multi-level block scan

You run a main program with several subprogram calls in the NC program Sub.h. You work with a touch probe cycle in the main program. You use the result of the touch probe cycle later for positioning.

After an internal stop you wish to start up in NC block 8 in the second call of the subprogram. This subprogram call is in NC block 53 of the main program. The touch probe cycle is in NC block 28 of the main program (i.e., before the desired start-up point).



- ▶ Press the **BLOCK SCAN** soft key
- ▶ In the pop-up window enter the following data:
  - **Start-up at: N =28**
  - **Repetitions 1**



- ▶ Select the **Program Run Single Block** operating mode if required



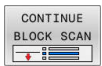
- ▶ Press the **NC Start** key until the control runs the touch probe cycle
- > The control saves the result.



- ▶ Press the **CONTINUE BLOCK SCAN** soft key
- ▶ In the pop-up window enter the following data:
  - **Start-up at: N =53**
  - **Repetitions 1**



- ▶ Press the **NC Start** key until the control runs the NC block
- > The control jumps into the subprogram Sub.h.







- ▶ Press the **CONTINUE BLOCK SCAN** soft key
- ▶ In the pop-up window enter the following data:
  - **Start-up at: N =8**
  - **Repetitions 1**



- ▶ Press the **NC Start** key until the control runs the NC block
- > The control continues to run the subprogram and then returns to the main program.

### Block scan in a point table

If you start in a point table called by the main program, use the **ADVANCED** soft key.

- 
  - ▶ Press the **BLOCK SCAN** soft key
  - > The control shows a pop-up window.
- 
  - ▶ Press the **ADVANCED** soft key
  - > The control expands the pop-up window.
  - ▶ **Point number**: Enter the row number of the point table you start with
  - ▶ **Point file**: Enter the name and path of the point table
- 
  - ▶ If required, press the **SELECT LAST BLOCK** soft key in order to select the last saved interruption
- 
  - ▶ Press the **NC Start** key

If you would like to use the block scan function to start in a point pattern, then proceed just as you would for starting in the point table. Enter the desired point number in the **Point number** input field. The first point in the point pattern has the point number **0**.

### Block scan in pallet programs





With the pallet management, you can also use the **BLOCK SCAN** function in conjunction with pallet tables.

If you interrupt the processing of pallet tables, the control always suggests the previously selected NC block of the interrupted NC program for the **BLOCK SCAN** function.



For **BLOCK SCAN** in pallet tables, you also define the **Pallet line** input field. The input refers to the line in the **NR** pallet table. This input is always required as an NC program may occur several times in a pallet table.

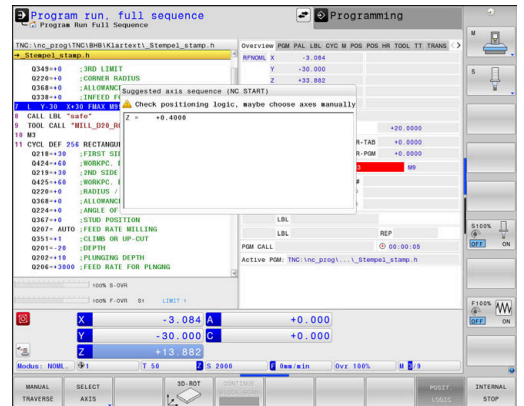
If you use the block scan to start in a pallet table, the control will always execute the chosen row in the pallet table as a workpiece-oriented process. After the pallet table line selected in **BLOCK SCAN**, the control resumes machining according to the defined machining method.

- 
  - ▶ Press the **BLOCK SCAN** soft key
  - > The control opens a pop-up window.
  - ▶ **Pallet line**: Enter the row number of the pallet table
  - ▶ Enter the **Repetitions** if the NC block is located within a program section repeat
- 
  - ▶ Press the **ADVANCED** soft key if required
  - > The control expands the pop-up window.
- 
  - ▶ Press the **SELECT LAST BLOCK** soft key to select the last saved interruption
- 
  - ▶ Press the **NC Start** key

### Returning to the contour

With the **RESTORE POSITION** function, the control moves the tool to the workpiece contour in the following situations:

- Return to the contour after the machine axes were moved during a program interruption that was not performed with the **INTERNAL STOP** function.
- Return to the contour after a block scan (e.g., after an interruption with **INTERNAL STOP**)
- Depending on the machine, if the position of an axis has changed after the control loop has been opened during a program interruption



### Procedure

To approach the contour:



- ▶ Press the **RESTORE POSITION** soft key
- ▶ Restore the machine status, if required

Approach the axes in the sequence shown by the control:



- ▶ Press the **NC Start** key

Approach the axes according to individually selected sequence:



- ▶ Press the **SELECT AXIS** soft key
- ▶ Press the soft key of the first axis
- ▶ Press the **NC Start** key



- ▶ Press the soft key of the second axis
- ▶ Press the **NC Start** key



- ▶ Repeat the process for all axes

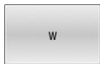
**i** If the tool is located in the tool axis below the position to be approached, then the control offers the tool axis as the first traverse direction.

### Procedure for manual axes

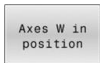
Manual axes are non-driven axes that need to be positioned by the machine operator.

If the axes to be returned to the contour include manual axes, the control does not display a sequence for approaching. The control automatically displays the soft keys of the available axes.

To return to the contour:



- ▶ Press the soft key of the manual axis
  
- ▶ Position the manual axis to the value shown in the dialog
- > When a manual axis with encoder has reached the position, the control automatically removes the value from the dialog.



- ▶ Press the soft key of the manual axis again
- > The control saves the position.



When all manual axes available have been positioned, the control suggest a sequence for positioning the remaining axes.

In the machine parameter **restoreAxis** (no. 200305), the machine manufacturer defines in which sequence of axes the control approaches the contour again.

## 6.11 Running CAM programs

If you create NC programs externally using a CAM system, you should pay attention to the recommendations detailed below. This will enable you to optimally use the powerful motion control functionality provided by the control and usually create better workpiece surfaces with shorter machining times. Despite high machining speeds, the control still achieves a very high contour accuracy. The basis for this is the HEROS 5 real-time operating system in conjunction with the **ADP** (Advanced Dynamic Prediction) function of the TNC 640. This enables the control to also efficiently process NC programs with high point densities.

### From 3-D model to NC program

Here is a simplified description of the process for creating an NC program from a CAD model:

- ▶ **CAD: Model creation**  
Construction departments prepare a 3-D model of the workpiece to be machined. Ideally the 3-D model is designed for the center of tolerance.
- ▶ **CAM: Path generation, tool compensation**  
The CAM programmer specifies the machining strategies for the areas of the workpiece to be machined. The CAM system uses the surfaces of the CAD model to calculate the paths of the tool movements. These tool paths consist of individual points calculated by the CAM system so that each surface to be machined is approximated as nearly as possible while considering chord errors and tolerances. This way, a machine-neutral NC program is created, known as a CLDATA file (cutter location data). A postprocessor generates a machine- and control-specific NC program, which can be processed by the CNC control. The postprocessor is adapted according to the machine tool and the control. The postprocessor is the link between the CAM system and the CNC control.
- ▶ **Control: Motion control, tolerance monitoring, velocity profile**  
The control uses the points defined in the NC program to calculate the movements of each machine axis as well as the required velocity profiles. Powerful filter functions then process and smooth the contour so that the control does not exceed the maximum permissible path deviation.
- ▶ **Mechatronics: Feed control, drive technology, machine tool**  
The motions and velocity profiles calculated by the control are realized as actual tool movements by the machine's drive system.



## Considerations required for post processor configuration

### Take the following points into account with post processor configuration:

- Always set the data output for axis positions to at least four decimal places. This way you improve the quality of the NC data and avoid rounding errors, which can result in defects visible to the naked eye on the workpiece surface. Output of five decimal places may achieve improved surface quality for optical components as well as components with very large radii (i.e. small curvatures), for example molds for the automotive industry
- Always set the data output for the machining of surface normal vectors (LN blocks, only Klartext conversational programming) to exactly seven decimal places
- Avoid using successive incremental NC blocks because this may lead to the tolerances of the individual NC blocks being added together in the output
- Set the tolerance in Cycle **32** so that in standard behavior it is at least twice as large as the chord error defined in the CAM system. Also note the information describing the functioning of Cycle **32**
- If the chord error selected in the CAM program is too large, then, depending on the respective curvature of a contour, large distances between NC blocks can result, each with large changes of direction. During machining this leads to drops in the feed rate at the block transitions. Recurring and equal accelerations (i.e. force excitation), caused by feed-rate drops in the heterogeneous NC program, can lead to undesirable excitation of vibrations in the machine structure.
- You can also use arc blocks instead of linear blocks to connect the path points calculated by the CAM system. The control internally calculates circles more accurately than can be defined via the input format
- Do not output any intermediate points on exactly straight lines. Intermediate points that are not exactly on a straight line can result in defects visible to the naked eye on the workpiece surface
- There should be exactly one NC data point at curvature transitions (corners)
- Avoid sequences of many short block paths. Short paths between blocks are generated in the CAM system when there are large curvature transitions with very small chord errors in effect. Exactly straight lines do not require such short block paths, which are often forced by the continuous output of points from the CAM system
- Avoid a perfectly even distribution of points over surfaces with a uniform curvature, since this could result in patterns on the workpiece surface
- For 5-axis simultaneous programs: avoid the duplicated output of positions if they only differ in the tool's angle of inclination
- Avoid the output of the feed rate in every NC block. This would negatively influence the control's velocity profile



- If a subprogram call and a subprogram definition are separated by multiple NC blocks, program execution might be interrupted due to the calculation effort. Use the following options to avoid problems such as dwell marks due to interruptions:
  - Put subprograms that define retraction positions at the beginning of the program. Thus, the control "knows" where to find the subprogram when it is called later.
  - Use a separate NC program for machining positions or coordinate transformations. This ensures that the control simply needs to call that program when safety positions and coordinate transformations are required in the NC program.

#### Useful configurations for the machine tool operator:

- In order to enable a realistic graphic simulation, use 3-D models in STL format as a workpiece blank and finished part
- In order to improve the structure of large NC programs, use the control's structuring function
- Use the control's commenting function in order to document NC programs
- Use the comprehensive cycles of the control available for the machining of holes and simple pocket geometries

#### Further information: User's Manual for **Programming of Machining Cycles**

- For fits, output the contours with **RL/RR** tool radius compensation. This makes it easy for the machine operator to make necessary compensations
- Separate feed rates for pre-positioning, machining, and downfeeds, and define them via Q parameters at the beginning of the program

#### Example: Variable feed rate definitions

1 Q50 = 7500	FEED RATE FOR POSITIONING
2 Q51 = 750	FEED RATE FOR PLUNGING
3 Q52 = 1350	FEED RATE FOR MILLING
...	
25 L Z+250 R0 FMAX	
26 L X+235 Y-25 FQ50	
27 L Z+35	
28 L Z+33.2571 FQ51	
29 L X+321.7562 Y-24.9573 Z+33.3978 FQ52	
30 L X+320.8251 Y-24.4338 Z+33.8311	
...	

## Please note the following for CAM programming

### Adapting chord errors



Programming notes:

- For finishing operations, do not set the chord error in the CAM system to a value greater than 5  $\mu\text{m}$ . In Cycle **32**, use an appropriate tolerance factor **T** of 1.3 to 3.
- For roughing operations, the total of the chord error and the tolerance **T** must be less than the defined machining oversize. In this way you can avoid contour damage.
- The specific values depend upon the dynamics of your machine.

Adapt the chord error in the CAM program, depending on the machining:

#### ■ Roughing with preference for speed:

Use higher values for the chord error and the matching tolerance value in Cycle **32**. Both values depend on the oversize required on the contour. If a special cycle is available on your machine, use the roughing mode. In roughing mode the machine generally moves with high jerk values and high accelerations

- Normal tolerance in Cycle **32**: Between 0.05 mm and 0.3 mm
- Normal chord error in the CAM system: Between 0.004 mm and 0.030 mm

#### ■ Finishing with preference for high accuracy:

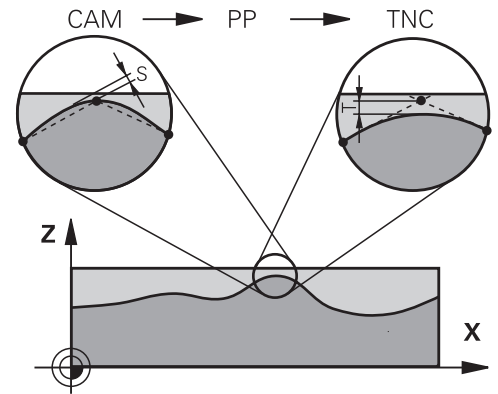
Use smaller values for the chord error and a matching low tolerance in Cycle **32**. The data density must be high enough for the control to detect transitions and corners exactly. If a special cycle is available on your machine, use the finishing mode. In finishing mode the machine generally moves with low jerk values and low accelerations

- Normal tolerance in Cycle **32**: Between 0.002 mm and 0.006 mm
- Normal chord error in the CAM system: Between 0.001 mm and 0.004 mm

#### ■ Finishing with preference for high surface quality:

Use small values for the chord error and a matching larger tolerance in Cycle **32**. The control is then able to better smooth the contour. If a special cycle is available on your machine, use the finishing mode. In finishing mode the machine generally moves with low jerk values and low accelerations

- Normal tolerance in Cycle **32**: Between 0.010 mm and 0.020 mm
- Normal chord error in the CAM system: Approx. 0.005 mm



### Further adaptations

Take the following points into account with CAM programming:

- For slow machining feed rates or contours with large radii, define the chord error to be only one-third to one-fifth of tolerance **T** in Cycle **32**. Additionally, define the maximum permissible point spacing to be between 0.25 mm and 0.5 mm. The geometry error or model error should also be specified to be very small (max. 1 µm).
- Even at higher machining feed rates, point spacings of greater than 2.5 mm are not recommended for curved contour areas
- For straight contour elements, one NC point at the beginning of a line and one NC point at the end suffice. Avoid the output of intermediate positions
- In programs with five axes moving simultaneously, avoid large changes in the ratio of path lengths in linear and rotational blocks. Otherwise large reductions in the feed rate could result at the tool reference point (TCP)
- The feed-rate limitation for compensating movements (e.g. via **M128 F...**) should be used only in exceptional cases. The feed-rate limitation for compensating movements can cause large reductions in the feed rate at the tool reference point (TCP).
- NC programs for 5-axis simultaneous machining with spherical cutters should preferably be output for the center of the sphere. The NC data are then generally more uniform. In Cycle **32**, you can additionally set a higher rotary axis tolerance **TA** (e.g., between 1° and 3°) for an even more constant feed-rate curve at the tool center point (TCP).
- For NC programs for 5-axis simultaneous machining with toroid cutters or spherical cutters, where the NC output is for the south pole of the sphere, choose a lower rotary axis tolerance. 0.1° is a typical value. However, the maximum permissible contour damage is the decisive factor for the rotational axis tolerance. This contour damage depends on the possible tool tilting, tool radius and engagement depth of the tool.  
With 5-axis hobbing with an end mill, you can calculate the maximum possible contour damage T directly from the cutter engagement length L and permissible contour tolerance TA:  
 $T \sim K \times L \times TA$  with  $K = 0.0175 [1/^\circ]$   
Example: L = 10 mm, TA = 0.1°: T = 0.0175 mm

## Possibilities for intervention on the control

Cycle **32 TOLERANCE** is available for influencing the behavior of CAM programs directly on the control. Please note the information describing the functioning of Cycle **32**. Also note the interactions with the chord error defined in the CAM system.

**Further information:** User's Manual for **Programming of Machining Cycles**



Refer to your machine manual.

Some machine manufacturer provide an additional cycle for adapting the behavior of the machine to the respective machining operation (e.g., Cycle **332** Tuning). Cycle **332** can be used to modify filter settings, acceleration settings, and jerk settings.

### Example

```
34 CYCL DEF 32.0 TOLERANCE
```

```
35 CYCL DEF 32.1 T0.05
```

```
36 CYCL DEF 32.2 HSC MODE:1 TA3
```

## ADP motion control



This function must be enabled and adapted by the machine manufacturer.

An insufficient quality of data in NC programs created on CAM systems frequently causes inferior surface quality of the milled workpieces. The **ADP** (Advanced Dynamic Prediction) feature expands the conventional look-ahead of the permissible maximum feed rate profile and optimizes the motion control of the feed axes during milling. This enables clean surfaces with short machining times to be cut, even with a strongly fluctuating distribution of points in adjacent tool paths. This significantly reduces or eliminates the reworking complexity.





These are the most important benefits of ADP:

- Symmetrical feed-rate behavior on forward and backward paths with bidirectional milling
- Uniform feed rate curves with adjacent cutter paths
- Improved reaction to negative effects (e.g. short, step-like contours, coarse chord tolerances, heavily rounded block end-point coordinates) in NC programs generated by CAM systems
- Precise compliance to dynamic characteristics even in difficult conditions

## 6.12 Functions for program display

### Overview

In the **Program Run Single Block** and **Program Run Full Sequence** operating modes, the control displays the following soft keys for displaying the NC program in pages:

Soft key	Function
	Go back one screen in the NC program
	Go forward one screen in the NC program
	Select start of program
	Select end of program

## 6.13 Automatic program start

### Application



Refer to your machine manual.

The control must be specially prepared by the machine manufacturer for use of the automatic program start function.

### **⚠ DANGER**

#### Caution: hazard to the user!

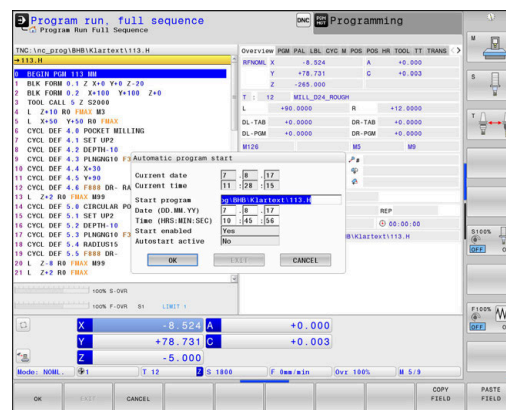
The **AUTOSTART** function automatically starts the machining operation. Open machines with unsecured work envelopes pose a huge danger for the machine operator.

- ▶ Use the **AUTOSTART** function exclusively on enclosed machines

In a Program Run operating mode, you can use the **AUTOSTART** soft key to define a specific time at which the NC program that is currently active in this operating mode is to be started:



- ▶ Display window for setting the starting time
- ▶ **Time (h:min:sec):** Time of day at which the NC program is to be started
- ▶ **Date (DD.MM.YYYY):** Date at which the NC program is to be started
- ▶ To activate the start, press the **OK**



## 6.14 Positioning w/ Manual Data Input operating mode

The **Positioning w/ Manual Data Input** operating mode is particularly convenient for simple machining operations or for pre-positioning the tool. It enables you to write a short NC program, depending on machine parameter **programInputMode** (no. 101201), in Klartext format or in ISO format and execute it immediately. The NC program is stored in a file named \$MDI.

You can use the following functions for example:

- Cycles
- Radius compensation
- Program section repetitions
- Q parameters

The additional status display can be activated in the **Positioning w/ Manual Data Input** operating mode.

### NOTICE

#### Danger of collision!

Certain manual interactions may lead to the control losing the modally effective program information (i.e., the contextual reference). Loss of this contextual reference may result in unexpected and undesirable movements. There is a risk of collision during the subsequent machining operation!

- ▶ Do not perform the following interactions:
  - Cursor movement to another NC block
  - The jump command **GOTO** to another NC block
  - Editing an NC block
  - Modifying the values of variables by using the **Q INFO** soft key
  - Switching the operating modes
- ▶ Restore the contextual reference by repeating the required NC blocks

## Positioning with manual data input (MDI)



- ▶ Select **Positioning w/ Manual Data Input** operating mode

- ▶ Program the desired available function



- ▶ Press the **NC Start** key

- ▶ The control executes the highlighted NC block.

**Further information:** "Positioning w/ Manual Data Input operating mode", Page 311



Operating and programming notes:

- The following functions are not available in the **Positioning w/ Manual Data Input** operating mode:
  - FK free contour programming
  - Program call
    - **CALL PGM**
    - **SEL PGM**
    - **CALL SELECTED PGM**
  - Programming graphics
  - Program-run graphics
- Using the **SELECT BLOCK, CUT OUT BLOCK** etc. soft keys you can also conveniently and rapidly reuse program sections from other NC programs.
 

**Further information:** User's Manuals for Klartext Programming and ISO Programming
- You can control and modify Q parameters with the **Q PARAMETER LIST** and **Q INFO** soft keys.
 

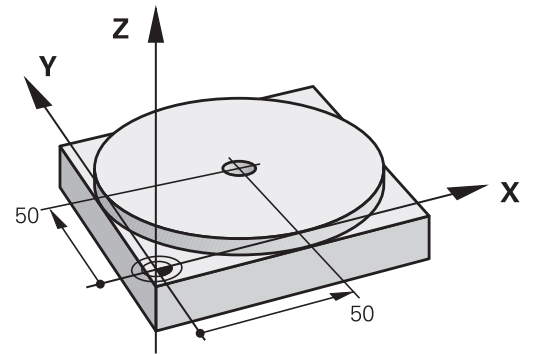
**Further information:** "Checking and changing Q parameters", Page 284



**Example**






A hole with a depth of 20 mm is to be drilled into a single workpiece. After clamping and aligning the workpiece and setting the preset, you can program and execute the drilling operation with a few lines of programming.

First you pre-position the tool above the workpiece with straight-line blocks and position with a safety clearance of 5 mm above the hole. Then drill the hole with Cycle **200 DRILLING**.







<b>0 BEGIN PGM \$MDI MM</b>	
<b>1 TOOL CALL 1 Z S2000</b>	Call the tool: tool axis Z, spindle speed 2000 rpm
<b>2 L Z+200 R0 FMAX</b>	Retract the tool (F MAX = rapid traverse)
<b>3 L X+50 Y+50 R0 FMAX M3</b>	Move the tool at F MAX to a position above the hole, spindle on
<b>4 CYCL DEF 200 DRILLING</b>	Define the cycle
<b>Q200=5 ;SET-UP CLEARANCE</b>	Set-up clearance of the tool above the hole
<b>Q201=-20 ;DEPTH</b>	Hole depth (algebraic sign=working direction)
<b>Q206=250 ;FEED RATE FOR PLNGNG</b>	Feed rate for drilling
<b>Q202=5 ;PLUNGING DEPTH</b>	Depth of each infeed before retraction
<b>Q210=0 ;DWELL TIME AT TOP</b>	Dwell time after every retraction in seconds
<b>Q203=-10 ;SURFACE COORDINATE</b>	Coordinate of the workpiece surface
<b>Q204=20 ;2ND SET-UP CLEARANCE</b>	Set-up clearance of the tool above the hole
<b>Q211=0.2 ;DWELL TIME AT DEPTH</b>	Dwell time in seconds at the hole bottom
<b>Q395=0 ;DEPTH REFERENCE</b>	Depth referenced to the tool tip or the cylindrical part of the tool
<b>5 CYCL CALL</b>	Call the cycle
<b>6 L Z+200 R0 FMAX M2</b>	Retract the tool
<b>7 END PGM \$MDI MM</b>	End of program

### Example: Remove workpiece misalignment on a machine with a rotary table



- ▶ Use a 3-D touch probe to carry out a basic rotation  
**Further information:** "Compensating workpiece misalignment with 3-D touch probe ", Page 234
  - ▶ Write down the rotation angle and cancel the basic rotation
- |   |   |
|---|---|
|  | ▶ Select the operating mode: Press the <b>Positioning w/ Manual Data Input</b> key                                |
|  | ▶ Select the rotary table axis, enter the rotation angle and feed rate you wrote down, e.g. <b>L C +2.561 F50</b> |
|  |   |
|  | ▶ Conclude entry  |
|  | ▶ Press the <b>NC Start</b> key: The rotation of the table corrects the misalignment                              |

### Saving NC programs from \$MDI

The \$MDI file is intended for short NC programs that are only needed temporarily. Nevertheless, you can store an NC program, if necessary, by proceeding as follows:

- |   |  |
|---|--|
|  | ▶ Operating mode: Press the <b>Programming</b> key |
|  | ▶ Call the file manager: Press <b>PGM MGT</b> key. |
|  | ▶ Move the highlight to the <b>\$MDI</b> file      |
|  | ▶ Copy the file: Press the <b>COPY</b> soft key    |

#### DESTINATION FILE =

- ▶ Enter the name under which you want to save the current contents of the \$MDI file, e.g. **Hole**
- |   |   |
|---|---|
|  | ▶ Press the <b>OK</b> soft key.                           |
|  | ▶ To exit the file manager, press the <b>END</b> soft key |

## 6.15 Entering miscellaneous functions M and STOP

### Fundamentals

With the control's miscellaneous functions—also called M functions—you can affect:

- the program run, e.g. a program interruption
- the machine functions, such as switching spindle rotation and coolant supply on and off
- the path behavior of the tool

You can enter up to four M (miscellaneous) functions at the end of a positioning block or in a separate NC block. The control displays the following dialog question: **Miscellaneous function M ?**

You usually enter only the number of the miscellaneous function in the programming dialog. With some miscellaneous functions, the dialog is extended so that you can enter the required parameters for this function.

In the **Manual operation** and **Electronic handwheel** operating modes, the M functions are entered with the **M** soft key.

### Effectiveness of miscellaneous functions

Some miscellaneous functions take effect at the start of the NC block and others at the end, regardless of the sequence in which they were programmed.

Miscellaneous functions come into effect in the NC block in which they are called.

Some miscellaneous functions are effective block-by-block, i.e. only in the NC block in which the miscellaneous function has been programmed. When a miscellaneous function takes effect modally, you have to cancel this miscellaneous function again in a subsequent NC block (e.g., by using **M9** to switch off coolant that was switched on with **M8**). If miscellaneous functions are still active at the end of the program, the control will rescind the miscellaneous functions.




If multiple M functions were programmed in a single NC block, the execution sequence is as follows:

- M functions taking effect at the start of the block are executed before those taking effect at the end of the block
- If all M functions are effective at the start or end of the block, execution takes place in the sequence as programmed

### Entering a miscellaneous function in a STOP block

If you program a **STOP** block, the program run or test run is interrupted at the block, e.g. for a tool inspection. You can also enter an M (miscellaneous) function in a **STOP** block:

-  **STOP**
- ▶ To program an interruption of program run, press the **STOP** key
  - ▶ Enter a miscellaneous function **M** if required

### Example

87 STOP

## 6.16 Miscellaneous functions for program run inspection, spindle and coolant

### Overview



Refer to your machine manual.

The machine manufacturer can influence the behavior of the miscellaneous functions described below.

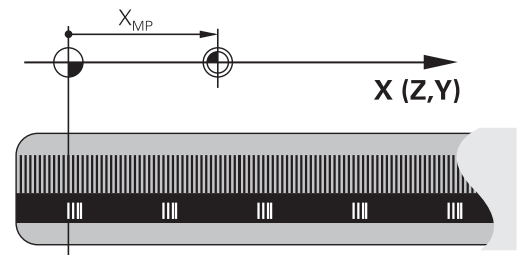
M	Effect	Effective at block	Start	End
<b>M0</b>	Program STOP Spindle STOP			■
<b>M1</b>	Optional program STOP Spindle STOP if necessary Coolant OFF if necessary (function defined by the machine tool builder)			■
<b>M2</b>	STOP program run Spindle STOP Coolant off Return jump to block 0 Clear status display Functional scope depends on machine parameter <b>resetAt</b> (no. 100901)			■
<b>M3</b>	Spindle ON clockwise		■	
<b>M4</b>	Spindle ON counterclockwise		■	
<b>M5</b>	Spindle STOP			■
<b>M8</b>	Coolant ON		■	
<b>M9</b>	Coolant OFF			■
<b>M13</b>	Spindle ON clockwise Coolant ON		■	
<b>M14</b>	Spindle ON counterclockwise Coolant ON		■	
<b>M30</b>	Same as M2			■

## 6.17 Miscellaneous functions for coordinate entries

### Programming machine-referenced coordinates: M91/M92

#### Scale datum

On the scale, a reference mark indicates the position of the scale datum.



#### Machine datum

The machine datum is required for the following tasks:

- Define the axis traverse limits (software limit switches)
- Approach machine-referenced positions (such as tool change positions)
- Set a workpiece preset

The distance in each axis from the scale datum to the machine datum is defined by the machine manufacturer in a machine parameter.

#### Standard behavior

The control references the coordinates to the workpiece datum.

**Further information:** "Presetting without a 3D touch probe", Page 212

#### Behavior with M91 – Machine datum

If you want the coordinates in a positioning block to be referenced to the machine datum, enter M91 into these NC blocks.

**i** If you program incremental coordinates in an NC block with the miscellaneous function **M91**, then these coordinates are relative to the last position programmed with **M91**. If the active NC program does not contain a position programmed with **M91**, the coordinates reference the current tool position.

The coordinate values on the control's screen are referenced to the machine datum. Switch the display of coordinates in the status display to REF.

**Further information:** "Status displays", Page 69

### Behavior with M92 – Additional machine reference point



Refer to your machine manual.

In addition to the machine datum, the machine manufacturer can also define an additional machine-based position as a reference point (machine preset).

For each axis, the machine manufacturer defines the distance between the machine preset and the machine datum.

If you want the coordinates in positioning blocks to be based on the machine preset, enter M92 into these NC blocks.



Radius compensation remains the same in blocks that are programmed with **M91** or **M92**. The tool length will **not** be taken into account.

### Effect

M91 and M92 are effective only in the blocks in which M91 and M92 have been programmed.

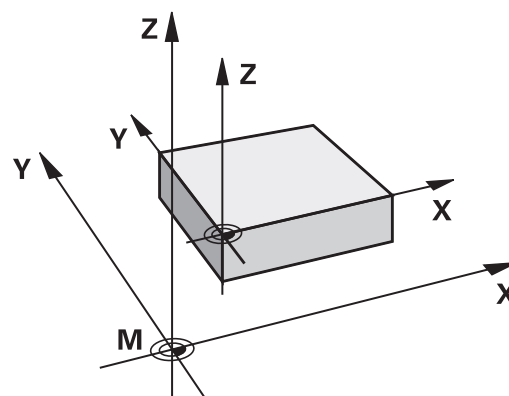
M91 and M92 take effect at the start of block.

### Workpiece preset

If you want the coordinates to always be referenced to the machine datum, you can inhibit presetting for one or more axes.

If presetting is inhibited for all axes, the control does not display the **SET PRESET** soft key in the **Manual operation** operating mode.

The figure shows coordinate systems with the machine and workpiece datum.



### M91/M92 in the Test Run mode

In order to be able to graphically simulate M91/M92 movements, you need to activate working space monitoring and display the workpiece blank referenced to the defined preset.

**Further information:** "Showing the workpiece blank in the working space", Page 268

## Moving to positions in a non-tilted input coordinate system with a tilted working plane: M130

### Standard behavior with a tilted working plane

The control references the coordinates in the positioning blocks to the tilted working plane coordinate system.

**Further information:** "Working plane coordinate system WPL-CS", Page 126

### Behavior with M130

Despite an active tilted working plane, the control references the coordinates in straight line blocks to the non-tilted input coordinate system.

**M130** ignores only the **Tilt working plane** function, but takes into account active transformations before and after tilting. This means that, when calculating the position, the control considers the axis angles of the rotary axes that are not in their zero position.

**Further information:** "Input coordinate system I-CS", Page 128

### NOTICE

#### Danger of collision!

The miscellaneous function **M130** is in effect only blockwise. The control executes the subsequent machining operations in the tilted working plane coordinate system **WPL-CS** again. Danger of collision during machining!

- ▶ Use the simulation to check the sequence and positions

### Programming notes

- The function **M130** is allowed only if the **Tilt working plane** function is active.
- If the function **M130** is combined with a cycle call, the control will interrupt machining with an error message.

### Effect

**M130** functions blockwise in straight-line blocks without tool radius compensation.

## 6.18 Miscellaneous functions for path behavior

### Superimposing handwheel positioning during program run: M118

#### Standard behavior



Refer to your machine manual.  
Your machine manufacturer must have prepared the control for this function.

In the Program Run operating modes, the control moves the tool as defined in the NC program.

#### Behavior with M118

**M118** permits manual corrections by handwheel during the program run. For this purpose, you program **M118** and enter an axis-specific value (linear or rotary axis).



- The **M118** handwheel superimpositioning function can only be used at a standstill when combined with the **Dynamic Collision Monitoring (DCM)** function.  
In order to use **M118** without restrictions, either deselect the **Dynamic Collision Monitoring (DCM)** function using the soft key from the menu or activate a kinematics model without collision objects (CMOs).
- **M118** cannot be used with clamped axes. If you want to use **M118** with axes that are clamped then you must unclamp them first.

#### Input

If you enter **M118** in a positioning block, the control continues the dialog for this block by prompting you for the axis-specific values. Use the orange axis keys or the alphabetic keyboard for entering the coordinates.

#### Effect

To cancel handwheel positioning, program **M118** once again without coordinate input or end the NC program with **M30 / M2**.



If the program aborts, handwheel positioning will also be canceled.

**M118** becomes effective at the start of the block.



**Example**

You want to be able to use the handwheel during program run to move the tool in the working plane X/Y by  $\pm 1$  mm and in the rotary axis B by  $\pm 5^\circ$  from the programmed value:

```
L X+0 Y+38.5 RL F125 M118 X1 Y1 B5
```



When programmed in an NC program, **M118** is always effective in the machine coordinate system.

If the Global Program Settings option (option 44) is active, the function **Handwheel superimposed** is effective in the last selected coordinate system. The coordinate system active for the function Handwheel superimposed is shown on the **POS HR** tab of the additional status display.

The **POS HR** tab also indicates whether the **Max. val.** have been defined via **M118** or via the Global Program Settings.

**Further information:** "Handwheel superimp.", Page 364

The function **Handwheel superimposed** is also effective in the **Positioning w/ Manual Data Input** operating mode!

**Virtual tool axis (VT)(Option 44)**

Refer to your machine manual.

Your machine manufacturer must have prepared the control for this function.

With the virtual tool axis, you can also traverse with the handwheel in the direction of an inclined tool on a machine with swivel heads. To traverse in a virtual tool axis direction, select the **VT** axis on the display of your handwheel.

**Further information:** "Traverse with electronic handwheels", Page 183

When using an HR 5xx handwheel, you can select the virtual axis directly with the orange **VI** axis key, if necessary.

In conjunction with the **M118** function, it is also possible to carry out handwheel superimpositioning in the currently active tool axis direction. For this purpose, program at least the spindle axis with its permitted range of traverse in the **M118** function (e.g. **M118 Z5**) and select the **VT** axis on the handwheel.


## Deleting basic rotation: M143

### Standard behavior

The basic rotation remains in effect until it is reset or is overwritten with a new value.

### Behavior with M143


The control deletes a basic rotation from the NC program.

 The function **M143** is not permitted with mid-program startup.

### Effect

**M143** is effective only from the NC block in which it is programmed.

**M143** becomes effective at the start of the block.

 **M143** clears the entries from the **SPA**, **SPB** and **SPC** columns in the preset table. When the corresponding line is reactivated, the basic rotation is **0** in all columns.

## Lifting off the tool automatically from the contour at NC stop: M148

### Standard behavior

In case of an NC stop, the control stops all traverse movements. The tool stops moving at the point of interruption.

### Behavior with M148



Refer to your machine manual.

This function must be configured and enabled by your machine manufacturer.

In machine parameter **CfgLiftOff** (no. 201400), the machine manufacturer defines the path the tool is supposed to traverse for a **LIFTOFF** command. You can also use machine parameter **CfgLiftOff** to deactivate the function.

Set the **Y** parameter in the **LIFTOFF** column of the tool table for the active tool. The control then retracts the tool from the contour by 2 mm max. in the direction of the tool axis.

**Further information:** "Entering tool data into the table", Page 142

**LIFTOFF** takes effect in the following situations:

- An NC stop triggered by you
- An NC stop triggered by the software, e.g. if an error occurred in the drive system
- When a power interruption occurs



When lifting the tool off with **M148**, the control will not necessarily lift it off in the tool axis direction.

The control uses the **M149** function to deactivate the **FUNCTION LIFTOFF** function without resetting the liftoff direction. If you program **M148**, the control will automatically liftoff the tool in the direction defined by the **FUNCTION LIFTOFF** function.

### Effect

**M148** remains in effect until deactivated with **M149** or **FUNCTION LIFTOFF RESET**.

**M148** becomes effective at the start of the block, **M149** at the end of the block.



# 7

## Special Functions

## 7.1 Dynamic Collision Monitoring (option 40)

### Function



Refer to your machine manual.

The machine manufacturer needs to adapt the **Dynamic Collision Monitoring (DCM)** function to the control.

The machine manufacturer can define machine components and minimum distances that are to be monitored by the control during all machine movements. If two objects monitored for collision come within a defined minimum distance of each other, the control generates an error message and terminates the movement.

The control can display the defined collision objects graphically in all Machine operating modes and in the **Test Run** operating mode.

**Further information:** "Graphic display of the collision objects", Page 328

The control also monitors the active tool for collision and displays the situation graphically. The control always assumes cylindrical tools. The control likewise monitors stepped tools according to their definition in the tool table.

The control takes into account the following definitions from the tool table:

- Tool lengths
- Tool radii
- Tool oversizes
- Tool carrier kinematics

### NOTICE

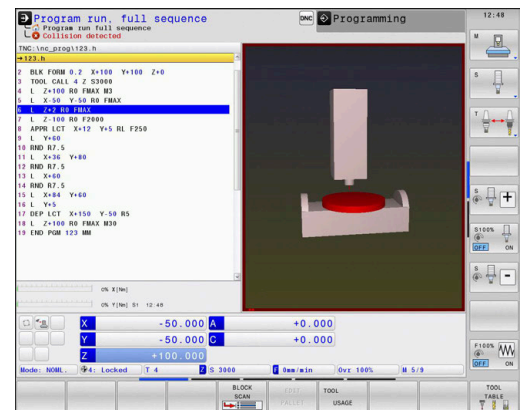
#### Danger of collision!

Even if **Dynamic Collision Monitoring (DCM)** is active, the control does not automatically monitor the workpiece for collisions, be it with the tool or with other machine components. There is a danger of collision during machining!

- ▶ Check the machining sequence using a graphic simulation
- ▶ Perform a Test Run with extended collision monitoring
- ▶ Carefully test the NC program or program section in **Program run, single block** operating mode

Collision monitoring is activated separately for the following operating modes:

- **Program Run**
- **Manual Operation**
- **Test Run**



**NOTICE****Danger of collision!**

If the **Dynamic Collision Monitoring (DCM)** function is inactive, the control does not perform any automatic collision checking. This means that movements that might cause collisions will not be prevented. There is a danger of collision during all movements!

- ▶ Make sure to activate collision monitoring whenever possible
- ▶ Make sure to always re-activate collision monitoring after a temporary deactivation
- ▶ With collision monitoring deactivated, carefully test the NC program or program section in the **Program run, single block** operating mode

**Generally valid constraints:**

- The **Dynamic Collision Monitoring (DCM)** function helps to reduce the danger of collision. However, the control cannot consider all possible constellations during operation.
- The control can protect only those machine components from collision that your machine manufacturer has defined correctly with regard to dimensions, orientation, and position.
- The control can only monitor tools for which you have defined **positive tool radii** and **positive tool lengths** in the tool table.
- **DL** and **DR** tool oversizes from the tool table are taken into account by the control. Tool oversizes from the **TOOL CALL** block are not accounted for.
- For certain tools (such as face milling cutters), the radius that would cause a collision can be greater than the value defined in the tool table.
- When a touch probe cycle starts, the control no longer monitors the stylus length and ball-tip diameter so that you can also probe collision objects.

## Graphic display of the collision objects

Activate the graphic display of the collision objects as follows:

- ▶ Select the desired operating mode



- ▶ Press the **Screen layout** key



- ▶ Select the desired screen layout



If required, you can adapt the display of the collision objects using the soft keys.

Modify the graphic display of the collision objects as follows:

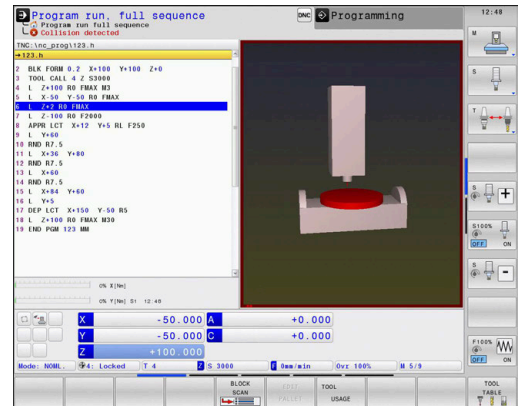


- ▶ Press the **VIEW OPTIONS** soft key
- ▶ Modify the graphic display of the collision objects  
**Further information:** "View options", Page 259

You can also use the mouse to change the display of the collision objects.

The following functions are available:

- ▶ In order to rotate the model shown in three dimensions you hold the right mouse button down and move the mouse. If you simultaneously press the shift key, you can only rotate the model horizontally or vertically.
- ▶ To shift the model shown: Hold the center mouse button or the wheel button down and move the mouse. If you simultaneously press the shift key, you can only shift the model horizontally or vertically.
- ▶ To zoom in on a certain area: Mark a zoom area by holding the left mouse button down.
- ▶ After you release the left mouse button, the control zooms in on the defined area.
- ▶ To rapidly magnify or reduce any area: Rotate the mouse wheel backwards or forwards.
- ▶ To return to the standard display: Press the shift key and simultaneously double-click with the right mouse key. The rotation angle is maintained if you only double-click with the right mouse key.





## Collision monitoring in the manual operating modes

In the **Manual operation** and **Electronic handwheel** operating modes, the control stops the movement if two objects monitored for collision approach each other within a minimum distance. In this case, the control displays an error message naming the two objects causing collision.



Refer to your machine manual.

The machine manufacturer can define the minimum distance between two collision-monitored objects.

Before the collision warning, the control dynamically reduces the feed rate of the movements to ensure that the axes stop in good time before a collision.

If you have selected a screen layout in which the collision objects are on the right, then the control additionally marks the colliding objects in red.



When a collision warning has been issued, machine movements via the axis direction keys or the handwheel are only possible if they increase the distance between the collision objects.

With active collision monitoring and a simultaneous collision warning, no movements are permitted that reduce the distance or leave it unchanged.

**Further information:** "Activating and deactivating collision monitoring", Page 332



Note the general limitations of the **Dynamic Collision Monitoring (DCM)** function.

**Further information:** "Function", Page 326

## Collision monitoring in the Test Run operating mode

In the **Test Run** operating mode, you can perform collision monitoring of an NC program prior to execution. The control stops the simulation in case of a collision and displays an error message indicating the two objects that would cause the collision.

If you have selected a screen layout in which the collision objects are on the right, then the control additionally marks the colliding objects in red.

HEIDENHAIN recommends the use of Dynamic Collision Monitoring (DCM) in the **Test Run** operating mode only as an add-on to collision monitoring in the Machine operating mode.



Extended collision monitoring shows the collisions between the workpiece and the tools or tool holders.

**Further information:** "Monitoring for collisions", Page 266

### Please note in the Test Run operating mode

To obtain a simulation result that is similar to execution, the following aspects must match:

- Preset
- Basic rotation
- Offsets of each axis
- Tilting condition
- Activated kinematic model

The control automatically adopts the preset table, but you have to select the preset in the simulated NC program.

In addition, you can assume the current machine status for the **Test Run** operating mode.

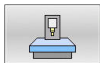
The current machine status includes the following:

- active machine kinematics
- active traverse ranges
- active machining modes
- active working spaces
- active preset

To load the current machine status:



- ▶ Press the **BLANK IN WORK SPACE** soft key



- ▶ Press the **Load machine status** soft key
- ▶ The control simulates the current machine status.

In a simulation, the following aspects may differ from the actual machine or may not be available at all:

- The simulated tool change position may differ from the one in the machine operating mode.
- Changes in the kinematics may have a delayed effect in the simulation.
- PLC positioning movements are not displayed in the simulation.
- Global program settings and handwheel superimposition are not available.
- Pallet handling is not available in the simulation
- Traverse range limits from the MOD function are not available



Note the general limitations of the **Dynamic Collision Monitoring (DCM)** function.

**Further information:** "Function", Page 326

### Activating collision monitoring in the simulation

To activate Dynamic Collision Monitoring in the **Test Run** operating mode:



- ▶ Select the **Test Run** operating mode



- ▶ Press the **Collision Monitoring ON** soft key

You can toggle collision monitoring only after the simulation has been stopped.

### Collision monitoring in the Program Run operating modes

In the **Positioning w/ Manual Data Input**, **Program Run Single Block**, and **Program run, full sequence** operating modes, the control stops the program run before an NC block in which two objects monitored for collision would approach each other within a distance of less than 5 mm is executed. In this case, the control displays an error message naming the two objects causing collision. If you have selected a screen layout in which the collision objects are on the right, then the control additionally marks the colliding objects in red.

#### NOTICE

##### Danger of collision!

The machine manufacturer has various options for configuring Dynamic Collision Monitoring (DCM (option 40)). Depending on the machine, the control can continue with the NC program without an error message despite the detected collision. The control stops the tool at the last position without a collision and continues the NC program from this position. This configuration of DCM results in movements that are not defined in the program.

**This behavior occurs no matter whether collision monitoring is active or inactive.** There is a danger of collision during these movements!

- ▶ Refer to your machine manual.
- ▶ Check the behavior at the machine.

**Constraints with program run:**

- For tapping with a floating tap holder, only the home position of the floating tap holder is taken into account by the **Dynamic Collision Monitoring (DCM)** function.
- The **Handwheel superimp. M118** can only be used in combination with the active **Dynamic Collision Monitoring (DCM)** function when program run has been stopped.
- The **Dynamic Collision Monitoring (DCM)** function cannot be used in combination with the **M118** and additionally **TCPM** and **M128** functions.
- If functions or cycles require multiple axes to be coupled (e.g. for eccentric turning), the control cannot perform collision monitoring.
- If at least one axis operates with following error or is not referenced, the control cannot perform collision monitoring.



Note the general limitations of the **Dynamic Collision Monitoring (DCM)** function.

**Further information:** "Function", Page 326

## Activating and deactivating collision monitoring

In some cases it is necessary to temporarily deactivate collision monitoring:

- To reduce the distance between two objects monitored for collision
- To prevent stops during program runs

### NOTICE

#### Danger of collision!









If the **Dynamic Collision Monitoring (DCM)** function is inactive, the control does not perform any automatic collision checking. This means that movements that might cause collisions will not be prevented. There is a danger of collision during all movements!

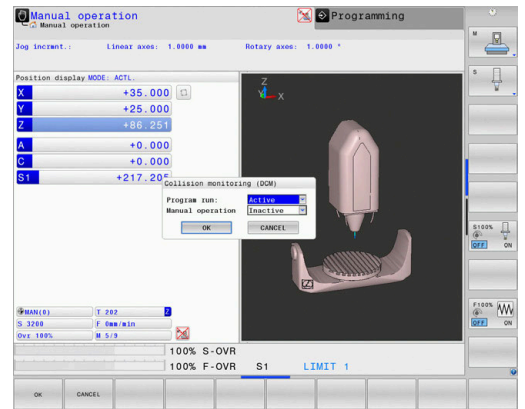
- ▶ Make sure to activate collision monitoring whenever possible
- ▶ Make sure to always re-activate collision monitoring after a temporary deactivation
- ▶ With collision monitoring deactivated, carefully test the NC program or program section in the **Program run, single block** operating mode

You have the following possibilities:

- Permanently manually activating and deactivating collision monitoring
- Temporarily activating and deactivating collision monitoring in the NC program




**Permanently manually activating and deactivating collision monitoring**

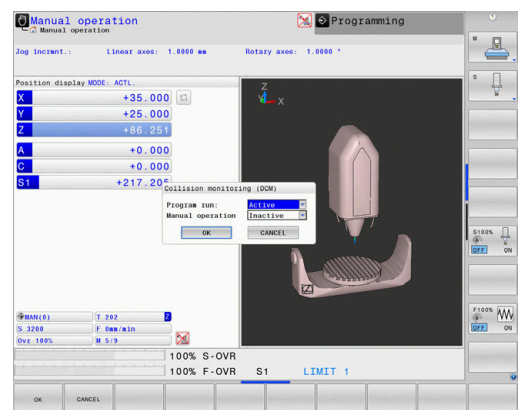
-  ▶ Operating mode: Press the **Manual operation** or **Electronic handwheel** key
- 
-  ▶ Shift the soft-key row if necessary
-  ▶ Press the **COLLISION** soft key
-  ▶ Select the operating modes for which the modification should apply:
  - **Program run: Positioning w/ Manual Data Input, Program run, single block and Program run, full sequence**
  - **Manual operation: Manual operation and Electronic handwheel**
-  ▶ Press the **Go to** soft key
-  ▶ Select the condition for which the selected operating modes should apply:
  - **Inactive:** Deactivate collision monitoring
  - **Active:** Activate collision monitoring
-  ▶ Press the **OK** soft key



**Symbols**

Icons in the status display show the condition of collision monitoring:

Icon	Function
	Collision monitoring active
	Collision monitoring is not available
	Collision monitoring is inactive



## Activating and deactivating collision monitoring in the NC program

In some cases it is necessary to temporarily deactivate collision monitoring:

- To reduce the distance between two objects monitored for collision
- To prevent stops during program runs

### NOTICE

#### Danger of collision!

If the **Dynamic Collision Monitoring (DCM)** function is inactive, the control does not perform any automatic collision checking. This means that movements that might cause collisions will not be prevented. There is a danger of collision during all movements!

- ▶ Make sure to activate collision monitoring whenever possible
- ▶ Make sure to always re-activate collision monitoring after a temporary deactivation
- ▶ With collision monitoring deactivated, carefully test the NC program or program section in the **Program run, single block** operating mode

### Temporarily activating and deactivating collision monitoring via program control

- ▶ Open the NC program in **Programming** operating mode
- ▶ Place the cursor at the desired position (e.g., before Cycle **800**) to enable eccentric turning

- ▶ Press the **SPEC FCT** key
- ▶ Press the **PROGRAM FUNCTIONS** soft key
- ▶ Shift the soft-key row
- ▶ Press the **FUNCTION DCM** soft key
- ▶ Select the condition with the corresponding soft key:
  - **FUNCTION DCM OFF**: This NC command temporarily deactivates collision monitoring. The deactivation is effective only until the end of the main program or until the next **FUNCTION DCM ON**. When another NC program is called, DCM is active again.
  - **FUNCTION DCM ON**: This NC command cancels an existing **FUNCTION DCM OFF**.



The settings applied with the **FUNCTION DCM** function are only effective in the active NC program.

After terminating the program run or selecting a new NC program, the settings made for **Program run** and **Manual operation** with the **COLLISION** soft key become effective again.

**Further information:** "Activating and deactivating collision monitoring", Page 332

## 7.2 Adaptive Feed Control (AFC) (option 45)

### Application



This function must be enabled and adapted by the machine manufacturer.

Your machine manufacturer may also specify whether the spindle power or any other value is used as input quantity by the control.

After enabling the Turning software option (option 50), AFC allows monitoring tool wear and tool load even while in turning mode.



Adaptive feed control is not intended for tools with diameters less than 5 mm. If the rated power consumption of the spindle is very high, the limit diameter of the tool may be larger.

Do not work with adaptive feed control in operations in which the feed rate and spindle speed must be adapted to each other, such as tapping.

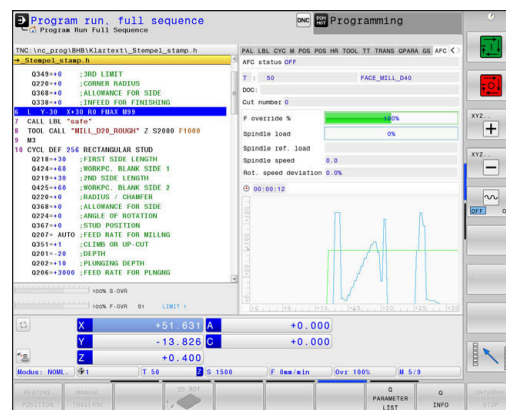
In adaptive feed control the control automatically controls the feed rate during NC program run as a function of the current spindle power. The spindle power required for each machining step is to be determined in a teach-in cut and saved by the control in a file belonging to the NC program. At the start of each machining step, usually when the spindle is switched on, the control controls the feed rate so that it remains within the limits that you have defined.



If the cutting conditions do not change, you can define the spindle power consumption, which has been determined in a teach-in cut, as permanent tool-dependent reference power. Use the **AFC-LOAD** column in the tool table to do this. If you enter a value manually in this column, the control does not execute any more teach-in cuts.

This makes it possible to avoid negative effects on the tool, the workpiece, and the machine that might be caused by changing cutting conditions. Cutting conditions are changed particularly by:

- Tool wear
- Fluctuating cutting depths that occur especially with cast parts
- Fluctuating hardness caused by material flaws





Adaptive feed control (AFC) has the following advantages:

- Optimization of machining time  
By controlling the feed rate, the control tries to maintain the previously recorded maximum spindle power or the reference power specified in the tool table (**AFC-LOAD** column) during the entire machining time. It shortens the machining time by increasing the feed rate in machining zones with little material removal.
- Tool monitoring  
If the spindle power exceeds the recorded or specified maximum value (**AFC-LOAD** column of the tool table), the control decreases the feed rate until the reference spindle power is reached again. If the maximum spindle power is exceeded during machining and at the same time the feed rate falls below the minimum that you have defined, the control reacts by shutting down. This helps to prevent further damage after a tool breaks or is worn out.
- Protection of the machine's mechanical elements  
Timely feed rate reduction and shutdown reactions help to avoid machine overload.

### Defining basic AFC settings

In the **AFC.tab** table, you define the feed-rate control settings to be used by the control. This table must be saved in the **TNC:\table** directory.

The data in this table are default values that, during a teach-in cut, are copied into an associated dependent file of the relevant NC program. The values are the basis for feedback control.

**i** If you define a tool-specific reference power in the **AFC-LOAD** column in the tool table, the control will create the associated dependent file for the respective NC program without a teach-in cut. The file is created shortly before feedback control becomes effective.

### Overview

Enter the following data in the table:

Column	Function
NR	Sequential row number in the table (has no other functions)
AFC	Name of the control setting. Enter this name in the <b>AFC</b> column of the tool table. It specifies the assignment of control parameters to the tool
FMIN	Feed rate at which the control will perform an overload reaction. Enter the value in percent of the programmed feed rate. Input range: 50% to 100%
FMAX	Maximum feed rate within the material up to which the control can automatically increase the feed rate. Enter the value in percent of the programmed feed rate
FIDL	Feed rate for traverse if the tool is outside of the material (feed rate in the air). Enter the value in percent of the programmed feed rate
FENT	Feed rate for traverse when the tool moves into or out of the material. Enter the value in percent of the programmed feed rate. Maximum input value: 100%
OVLD	<p>Desired reaction of the control to overload:</p> <ul style="list-style-type: none"> <li>■ <b>M</b>: Execution of a macro defined by the machine manufacturer</li> <li>■ <b>S</b>: Immediate NC stop</li> <li>■ <b>F</b>: Execute NC stop when the tool is no longer in the material</li> <li>■ <b>E</b>: Just display an error message on the screen</li> <li>■ <b>L</b>: Disable active tool</li> <li>■ -: No overload reaction</li> </ul> <p>If the maximum spindle power is exceeded for more than one second and the feed rate falls below the defined minimum while feedback control is active, the control will conduct an overload reaction.</p> <p>In conjunction with the cut-related tool wear monitoring function, the control will evaluate only the options <b>M</b>, <b>E</b>, and <b>L</b>!</p> <p>For tool-load monitoring with the column <b>AFC_OVLD2</b>, this parameter has no function.</p> <p><b>Further information:</b> "Tool wear monitoring", Page 349</p>
POUT	Spindle power at which the control is to detect that the tool moves out of the workpiece. Enter the value in percent of the learned reference load. Recommended input value: 8%
SENS	Sensitivity (aggressiveness) of feedback control. A value between 50 and 200 can be entered. 50 is for slow feedback control, 200 for a very aggressive feedback control. An aggressive feedback control responds quickly and significantly changes the values, but it tends to overshoot. Recommended value: 100
PLC	Value that the control will transfer to the PLC at the beginning of a machining step. The machine manufacturer defines the function, so please refer to your machine manual.

### Creating the AFC.TAB table

If the **AFC.TAB** table does not yet exist, you need to create it.

**i** In the **AFC.TAB** table you can define as many control settings (lines) as desired.

If there is no AFC.TAB table in the **TNC:\table** directory, the control uses a permanently defined, internal control setting for the teach-in cut. If, alternatively, a tool-dependent reference power value exists, the control uses it immediately. HEIDENHAIN recommends using the AFC.TAB table in order to ensure safe and well-defined operation.

To create the AFC.TAB table:

- ▶ Select the **Programming** operating mode
- ▶ Press the **PGM MGT** key to select the file manager
- ▶ Select the **TNC:** drive
- ▶ Select the **table** directory
- ▶ Create a new **AFC.TAB** file
- ▶ Confirm with the **ENT** key
- > The control displays a list with table formats.
- ▶ Select the **AFC.TAB** table format and confirm with the **ENT** key
- > The control creates the table that contains the control settings.

### Programming AFC

#### NOTICE

#### Caution: Danger to the tool and workpiece!

If you activate the **FUNCTION MODE TURN** machining mode, the control will clear the current **OVLD** values. This means that you need to program the machining mode before the tool call! If the programming sequence is not correct, no tool monitoring will take place, which might result in damage to the tool or workpiece!

- ▶ Program the **FUNCTION MODE TURN** machining mode before the tool call

To program the AFC functions for starting and ending the teach-in cut:

- ▶ Press the **SPEC FCT** key
- ▶ Press the **PROGRAM FUNCTIONS** soft key
- ▶ Press the **FUNCTION AFC** soft key
- ▶ Select the function

The control provides several functions that enable you to start and stop AFC:

- **FUNCTION AFC CTRL:** The **AFC CTRL** function activates feedback control mode starting with this NC block, even if the learning phase has not been completed yet.
- **FUNCTION AFC CUT BEGIN TIME1 DIST2 LOAD3:** The control starts a sequence of cuts with active **AFC**. The changeover from the teach-in cut to feedback control mode begins as soon as the reference power has been determined in the teach-in phase, or once one of the **TIME**, **DIST** or **LOAD** conditions has been met.
  - With **TIME**, you define the maximum duration of the teach-in phase in seconds.
  - **DIST** defines the maximum distance for the teach-in cut.
  - With **LOAD**, you can set a reference load directly. If you enter a reference load > 100%, the control automatically limits the value to 100%.
- **FUNCTION AFC CUT END:** The **AFC CUT END** function deactivates AFC control.



The **TIME**, **DIST** and **LOAD** defaults are modally effective. They can be reset by entering **0**.



You can define a feedback-control reference power with the **AFC LOAD** tool table column and the **LOAD** input in the NC program. You can activate the **AFC LOAD** value via the tool call and the **LOAD** value with the **FUNCTION AFC CUT BEGIN** function.

If you program both values, the control will use the value programmed in the NC program!

### Opening the AFC table

With a teach-in cut, the control at first copies the basic settings for each machining step, as defined in the AFC.TAB table, to a file called **<name>.H.AFC.DEP**. The string **<name>** is identical to the name of the NC program for which you have recorded the teach-in cut. In addition, the control measures the maximum spindle power consumed during the teach-in cut and saves this value to the table.

You can change the **<name>.H.AFC.DEP** file in **Programming** operating mode.

If necessary, you can even delete a machining step (entire line) there.



The **dependentFiles** machine parameter (no. 122101) must be set to **MANUAL** so that you can view the dependent files in the file manager.

In order to edit the **<name>.H.AFC.DEP** file, you must first configure the file manager to display all file types (**SELECT TYPE** soft key).

**Further information:** "Files", Page 84

## Recording a teach-in cut

### Requirements

Remember the following before you record a teach-in cut:

- If required, adapt the control settings in the AFC.TAB table
- Enter the desired control setting for all tools in the **AFC** column of the tool table TOOL.T
- Select the NC program for teach-in
- Activate the **AFC** function by soft key

**Further information:** "Activating and deactivating AFC",  
Page 346

With a teach-in cut, the control at first copies the basic settings for each machining step, as defined in the AFC.TAB table, to a file called **<name>.H.AFC.DEP**.

The string **<name>** is identical to the name of the NC program for which you have recorded the teach-in cut. In addition, the control measures the maximum spindle power consumed during the teach-in cut and saves this value to the table.


**i** If you enter a tool-dependent reference power using the **AFC-LOAD** column, the control stops executing teach-in cuts. The control immediately uses the specified value for feedback control. You determine the value for the tool-specific reference power once in advance with a teach-in cut. If the cutting conditions change (for example, if the workpiece material changes), carry out a new teach-in cut.


**i** You can define a feedback-control reference power with the **AFC LOAD** tool table column and the **LOAD** input in the NC program. You can activate the **AFC LOAD** value via the tool call and the **LOAD** value with the **FUNCTION AFC CUT BEGIN** function.

If you program both values, the control will use the value programmed in the NC program!

Each row in the <name>.H.AFC.DEP file stands for a machining section, that you start with **FUNCTION AFC CUT BEGIN** and complete with **FUNCTION AFC CUT END**. You can edit all data of the <name>.H.AFC.DEP file for optimization purposes. If you have optimized the values from the AFC.TAB table, the control places a \* in front of these control settings in the AFC column.

**Further information:** "Defining basic AFC settings", Page 337  
 Besides the data from the AFC.TAB table, the control also saves the following additional information in the <name>.H.AFC.DEP file:

Column	Function
NR	Number of the machining step
TOOL	Number or name of the tool with which the machining step was performed (not editable)
	<div style="border: 1px solid black; padding: 5px;">  In conjunction with AFC (option 45), the following characters are not permitted in the tool name: # \$ &amp; , .                 </div>
IDX	Index of the tool with which the machining step was performed (not editable)
N	Difference for tool call: <ul style="list-style-type: none"> <li>■ <b>0</b>: Tool was called by its tool number</li> <li>■ <b>1</b>: Tool was called by its tool name</li> </ul>
PREF	Reference load of the spindle. The control measures the value in percent with respect to the rated spindle power
ST	Status of the machining step: <ul style="list-style-type: none"> <li>■ <b>L</b>: In the next program run, a teach-in cut is recorded for this machining step. The control overwrites any existing values in this row</li> <li>■ <b>C</b>: The teach-in cut was completed successfully. The next program run can be conducted with automatic feed control</li> </ul>
AFC	Name of the control setting

 Refer to your machine manual.  
 The functions for starting and ending a machining step are machine-dependent.  
 You can teach any number of machining steps for a tool. Your machine manufacturer will either make a function available for this, or will integrate this possibility in the functions for switching on the spindle.

**Operating notes:**

- When you are performing a teach-in cut, the control shows the spindle reference power determined until this time in a pop-up window.
- You can reset the reference power in milling mode at any time by pressing the **PREF RESET** soft key. The control will then start a new teach-in phase.
- When you record a teach-in cut, the control internally sets the spindle override to 100%. Then you can no longer change the spindle speed.
- During the teach-in cut, you can influence the measured reference load by using the feed rate override to make any changes to the contouring feed rate.
- In a milling operation, you do not have to run the entire machining step in learning mode. If the cutting conditions do not change significantly, you can switch to control mode immediately. Press the **EXIT LEARNING** soft key, and the status changes from **L** to **C**.
- You can repeat a teach-in cut as often as desired. Manually change the status from **ST** back to **L**. If the programmed feed rate value is far too high and forces you to sharply decrease the feed rate override during the machining step, you will have to repeat the teach-in cut.
- If the determined reference load is greater than 2%, the control changes the status from teach-in (**L**) to controlling (**C**). Adaptive feed control is not possible for smaller values.
- In **FUNCTION MODE TURN** machining mode, the minimum reference load is 5%. Even if the control determines lower values, it will still use this minimum reference load. Thus, the overload limits (indicated as percentage values) are based on a minimum reference load of at least 5%.



**Selecting the AFC table**

To select and, if required, edit the **<name>.H.AFC.DEP** file:



- ▶ Select the **Program run, full sequence** operating mode



- ▶ Shift the soft-key row



- ▶ Press the **AFC SETTINGS** soft key
- ▶ Make optimizations if required



Note that the **<name>.H.AFC.DEP** file is locked against editing as long as the NC program **<name>.H** is running. The control does not remove the editing lock until one of the following functions has been executed:

- **M02**
- **M30**
- **END PGM**

You can also change the **<name>.H.AFC.DEP** file in **Programming** mode. If necessary, you can even delete a machining step (entire line) there.



The **dependentFiles** machine parameter (no. 122101) must be set to **MANUAL** so that you can view the dependent files in the file manager.

In order to edit the **<name>.H.AFC.DEP** file, you must first configure the file manager to display all file types (**SELECT TYPE** soft key).

**Further information:** "Files", Page 84

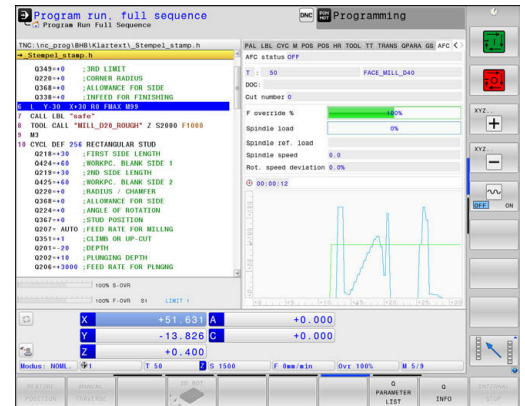
## Activating and deactivating AFC

### NOTICE

#### Caution: Danger to the tool and workpiece!

As soon as the AFC function is deactivated, the control immediately switches back to the programmed machining feed rate. If AFC decreased the feed rate (e.g. due to wear) before it was deactivated, the control accelerates the feed rate up to the programmed value. This applies regardless of how the function is deactivated (e.g. feed rate potentiometer). This acceleration may result in damages to the tool or the workpiece!

- ▶ If the feed rate is about to fall below the **FMIN** value, stop the machining operation (instead of deactivating the **AFC** function)
- ▶ Define the overload response for cases in which the feed rate falls below the **FMIN** value



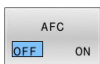
- ▶ Press the **Program run, full sequence** key



- ▶ Shift the soft-key row



- ▶ To activate adaptive feed control: Set the soft key to **ON**—the control displays the AFC icon in the position display  
**Further information:** "Status displays", Page 69



- ▶ To deactivate adaptive feed control: Set the soft key to **OFF**





## Operating notes:

- If Adaptive Feed Control is active in **Control** mode, the control executes a shutdown response independent of the programmed overload response.
  - If, with the reference spindle load, the value falls below the minimum feed factor
  - If the programmed feed rate falls below the 30% threshold
- If you do not explicitly deactivate adaptive feed control using the soft key, this function remains active. The control remembers the setting of the soft key even if the power is interrupted.
- If Adaptive Feed Control is active in **Control** mode, the control internally sets the spindle override to 100%. Then you can no longer change the spindle speed.
- If Adaptive Feed Control is active in **Control** mode, the control assumes the value from the feed rate override function.
  - Increasing the feed-rate override has no influence on the control.
  - If you decrease the feed-rate override by more than **10%** with respect to the maximum setting, the control switches adaptive feed control off. In this case, the control displays a window to inform you.
- In NC blocks containing **FMAX**, the adaptive feed control is **not active**.
- Mid-program startup is allowed during active feed control. The control takes the cutting number of the startup block in account.

The control shows various pieces of information in the additional status display when adaptive feed control is on.

**Further information:** "Additional status displays", Page 72

In addition, the control shows the  or  icon in the position display.

## Log file

The control stores various pieces of information for each machining step of a teach-in cut in the **<name>.H.AFC2.DEP** file. **<name>** is the name of the NC program for which you have recorded the teach-in cut. During adaptive control, the control updates the data and performs various evaluations. The following data will be saved in this table:

Column	Function
<b>NR</b>	Number of the machining step
<b>TOOL</b>	Number or name of the tool with which the machining step was performed
<b>IDX</b>	Index of the tool with which the machining step was performed
<b>SNOM</b>	Nominal spindle speed [rpm]
<b>SDIFF</b>	Maximum difference of the spindle speed in % of the nominal speed
<b>CTIME</b>	Machining time (tool in effect)
<b>FAVG</b>	Average feed rate (tool in effect)
<b>FMIN</b>	Smallest occurring feed factor. The control shows the value as a percentage of the programmed feed rate
<b>PMAX</b>	Maximum recorded spindle power during machining. The control shows the value as a percentage of the spindle's rated power
<b>PREF</b>	Reference load of the spindle. The control shows the value as a percentage of the spindle's rated power
<b>OVLD</b>	Overload reaction performed by the control: <ul style="list-style-type: none"> <li>■ <b>M</b>: A macro defined by the machine manufacturer has been run</li> <li>■ <b>S</b>: Immediate NC stop was conducted</li> <li>■ <b>F</b>: NC stop was performed once the tool was no longer in the material</li> <li>■ <b>E</b>: An error message was displayed</li> <li>■ <b>L</b>: The current tool was locked</li> <li>■ <b>-</b>: There was no overload response</li> </ul>
<b>BLOCK</b>	Block number at which the machining step begins



During feedback control, the control determines the current machining time as well as the resulting time saving in percent. The control enters the results of the evaluation between the key words **total** and **saved** in the last line of the log file. Where the time balance is positive, the percentage value is also positive.

Proceed as follows to select the **<name>.H.AFC2.DEP** file:



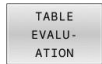
- ▶ Operating mode: Press the **Program run, full sequence** key



- ▶ Shift the soft-key row



- ▶ Press the AFC Settings soft key



- ▶ Show the log file

## Tool wear monitoring

Activate cut-related tool wear monitoring by entering a value not equal to 0 in the **AFC-OVLD1** column in the tool table.

The control offers tool wear and tool load monitoring even in turning mode (option 50).

The overload response depends on the **AFC.TAB** column **OVLD**.

In conjunction with cut-related tool wear monitoring, the control only evaluates the options **M**, **E**, and **L** in the **OVLD** column. The following responses are possible:

- Pop-up window
- Lock current tool
- Insert replacement tool



If the **AFC.TAB** columns **FMIN** and **FMAX** each have a value of 100 %, adaptive feed control is deactivated but cut-related tool wear monitoring remains active.

**Further information:** "Entering tool data into the table", Page 142 and Page 337

## Tool load monitoring

Activate cut-related tool load monitoring (tool breakage control) by entering a value not equal to 0 in the **AFC-OVLD2** column in the tool table.

The control offers tool wear and tool load monitoring even in turning mode (option 50).

As overload response, the control always executes a machining stop and locks the momentary tool.



If the **AFC.TAB** columns **FMIN** and **FMAX** each have a value of 100%, adaptive feed control is deactivated but cut-related tool load monitoring remains active.

**Further information:** "Entering tool data into the table", Page 142 and Page 337

## 7.3 Active Chatter Control (ACC) (option 145)

### Application



This function must be enabled and adapted by the machine manufacturer.

Strong forces come into play during roughing (power milling). Depending on the tool spindle speed, the resonances in the machine tool and the chip volume (metal-removal rate during milling), the machine can sometimes begin to **chatter**. This chattering places heavy strain on the machine, and causes ugly marks on the workpiece surface. The tool, too, is subject to heavy and irregular wear from chattering. In extreme cases it can result in tool breakage. In order to reduce a machine's tendency to chatter, HEIDENHAIN offers an effective control function known as Active Chatter Control (**ACC**). The use of this control function is particularly advantageous during heavy machining. ACC makes substantially higher metal removal rates possible. Depending on the type of machine, the metal-removal rate can often be increased by more than 25%. You reduce the mechanical load on the machine and increase the life of your tools at the same time.




ACC was developed especially for roughing and heavy machining and is particularly effective in this area. You need to conduct appropriate tests to see whether ACC will also be advantageous on your machine and with your tool.

## Activating ACC

To activate ACC:

- In the TOOL.T tool table, set column **ACC** to **Y**
- Specify the number of cutting edges for your tool in column **CUT** of the TOOL.T tool table
- Switch on the spindle
- The tooth engagement frequency must be between 20 and 150 Hz

If ACC is active, the control shows the  icon in the position display.

To activate/deactivate ACC temporarily for the machine mode:



- ▶ Operating mode: Press the **Program run, full sequence, Program run, single block** or **Positioning w/ Manual Data Input** key



- ▶ Shift the soft-key row



- ▶ Activate ACC: Set the soft key to **ON**
- ▶ The control displays the ACC icon in the position display.

**Further information:** "Status displays", Page 69



- ▶ To deactivate ACC: Set the soft key to **OFF**

## 7.4 Global Program Settings (option 44)

### Application



Refer to your machine manual.

Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.

The **Global Program Settings** function, which is mainly used in large-scale mold making, is available in the **Program run, full sequence** and **Program run, single block** operating modes, as well as in **Positioning with MDI**. They allow you to define various coordinate transformations and settings without having to edit the NC program. All settings have a global effect and are superimposed on the selected NC program.

The **Global Program Settings** functions and its sub-functions are active in all operating modes and are persistent across reboots of the control.

**Further information:** "Activating and deactivating a function", Page 354

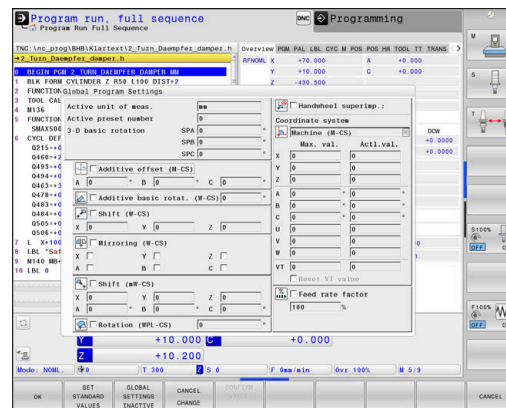


Refer to your machine manual.

Your machine manufacturer specifies whether the **Global Program Settings** function also influences the manual cycles of the **Manual operation** mode.

The **Global Program Settings** function comprises the following setting options:

Icon	Function	Description
	<b>Additive offset (M-CS)</b>	Page 357
	<b>Additive basic rotat. (W-CS)</b>	Page 358
	<b>Shift (W-CS)</b>	Page 359
	<b>Mirroring (W-CS)</b>	Page 360
	<b>Shift (mW-CS)</b>	Page 361
	<b>Rotation (WPL-CS)</b>	Page 362
	<b>Handwheel superimp.</b>	Page 364
	<b>Feed rate factor</b>	Page 367







## Operating notes:

- In the fillable form the control grays out all axes that are not active on your machine.
- Entered values (e.g., offset values or values for **Handwheel superimp.**) are defined in the unit of measure (mm or inches) selected in the position display. Angles are always entered in degrees.
- While touch probe functions are being executed, the control temporarily disables the **Global Program Settings**.
- If you want to use **Handwheel superimp.** while machining with **Dynamic Collision Monitoring (DCM)**, then the control must be in a stopped or interrupted state.

**Further information:** "General status display", Page 69  
As an alternative, you can deactivate **Dynamic Collision Monitoring (DCM)**.

**Further information:** "Activating and deactivating collision monitoring", Page 332

## Activating and deactivating a function

The **Global Program Settings** functions and its sub-functions are active in all operating modes and are persistent across reboots of the control.

As soon as any settings option of the **Global Program Settings** function is activated, the control shows the following icon in the position display:

Before machining you can use the form to activate or deactivate any of the setting options of the **Global Program Settings** function that have been enabled by the machine manufacturer.

If you have interrupted program run, you can also use the form to activate or deactivate **Handwheel superimp.** and **Feed rate factor** during machining.

**Further information:** "Interrupting, stopping or canceling a program", Page 286

Once you restart the NC program, the control immediately applies the values you have defined. If necessary, the control approaches the new position via the menu for returning.

**Further information:** "Returning to the contour", Page 301



Refer to your machine manual.

The machine manufacturer can provide functions that you can use to set or reset **Handwheel superimp.** and **Feed rate factor** under program control (e.g., M functions or manufacturer cycles).

You can use Q-parameter functions to query the status of the **Global Program Settings** function.

**Further information:** User's Manuals for Klartext Programming and ISO Programming

## Fillable form

Active setting options of the **Global Program Settings** function are highlighted white in the form. Inactive setting options remain dimmed.

If more than one settings option for coordinate transformation (left half of the form) is active, the sequence of effect is shown using yellow numbers and arrows.



The information area (top of left half of the form) and the setting options in the right half of the form are not considered for the sequence of effect, since they do not result in any coordinate transformations.

As soon as any setting option of the **Global Program Settings** function is activated, the control displays a warning message if an NC program is selected in the file manager.

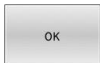
You can then simply acknowledge the message with **OK** or call the form directly with **CHANGE DATA**.

### Activating Global Program Settings

**i** All changes must be confirmed with the **OK** soft key.  
Otherwise, the control discards the changes when closing the form (e.g., by pressing the **END** key).



- ▶ Press the **GLOBAL SETTINGS** soft key
- > The control opens the form with the following elements:
  - Check boxes (e.g., for the settings options)
  - Input fields for the entry of values
  - Selection menu of coordinate systems for **Handwheel superimp.**
- ▶ Use form elements to activate a settings option  
**Further information:** "Using the form", Page 356



- ▶ Press the **OK** soft key
- > The control applies the settings and closes the form

### Deactivating Global Program Settings

**i** All changes must be confirmed with the **OK** soft key!  
Otherwise, the control discards the changes when closing the form (e.g., by pressing the **END** key).



- ▶ After selecting the NC program, press the **CHANGE DATA** soft key



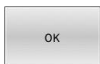
- ▶ Alternative: If the NC program is already open, press the **GLOBAL SETTINGS** soft key

> The control opens the form



















- ▶ Press the **GLOBAL SETTINGS INACTIVE** soft key in order to deactivate all setting options

- ▶ Alternative: Use form elements to deactivate a settings option  
**Further information:** "Using the form", Page 356



- ▶ Press the **OK** soft key
- > The control applies the settings and closes the form

## Using the form

Operating element	Function
 	Jump to next setting option; if the setting option is already activated, jump to the next element
 	Jump to the previous setting option; if the setting option is already activated, jump to the previous element
	Activate or deactivate a selected check box (marked by a jump)
<b>Space</b>	
	Expand or collapse the selection menu
	Navigate in the selection menu
	
 	Confirm the selection in the selection menu (and collapse the menu)
	Confirm the entries and close the form
	Reset the entire form (exception: coordinate system selection for <b>Handwheel superimp.</b> )
	Deactivate all setting options without resetting other elements, such as values of input fields
	Activate the most recently defined settings After a restart of the control, you need to activate individual settings options using the form elements.
	Discard all changes made since the form was last called
	Apply actual values of <b>Handwheel superimp.</b> to the shifts Prerequisite: The coordinate systems for <b>Handwheel superimp.</b> and for <b>Displacement</b> are the same



You can also easily navigate through the form with a mouse.

## Information area

The form for the **Global Program Settings** function has an information area located in its upper left half. It contains the following:

- **Active unit of meas.:** Unit of measurement for entering values  
**Further information:** "Setting the unit of measure ", Page 451
- **Active preset number:** Preset management row  
**Further information:** "Activating a preset", Page 210
- **3-D basic rotation:** Spatial angle from preset management  
**Further information:** "General status display", Page 69, and Page 234

Active unit of meas.	<input type="text" value="mm"/>
Active preset number	<input type="text" value="1"/>
3-D basic rotation	SPA <input type="text" value="0"/> °
	SPB <input type="text" value="0"/> °
	SPC <input type="text" value="0"/> °

## Additive offset (M-CS)



Refer to your machine manual.

Your machine manufacturer can disable individual setting options within the **Global Program Settings** function. Axes that are not included in the kinematics description always appear dimmed and are therefore not editable!

Additive offset (M-CS)					
A	<input type="text" value="0"/> °	B	<input type="text" value="0"/> °	C	<input type="text" value="0"/> °

The **Additive offset (M-CS)** option in the **Global Program Settings** function provides a coordinate transformation in the M-CS machine coordinate system.

**Further information:** "Machine coordinate system M-CS", Page 120

The additive offset of the **Global Program Settings** function takes effect on an axis-by-axis basis. This value is added to the corresponding axis-specific offset from **Preset management**.

**Further information:** "Saving presets in the table", Page 204



The machine manufacturer uses the optional machine parameter **presetToAlignAxis** (no. 300203) to define for each axis how the control is to interpret offsets in the following NC functions:

## Control display

- Both the additive offset of the **Global Program Settings** function and the offsets from **Preset management** affect the actual position display.
- The general status display shows the following icons:

**For offsets from Preset management, no icon is displayed.**



Active additive offsets (default icon of **Global Program Settings** function)

- The additive offset values are displayed on the **GS** tab of the additional status display. **Offsets from Preset management are exclusively displayed in Preset management.**

## Example:

Increase traverse path:

- Machine with AC fork head
- Eccentric tool holder (outside the rotation center of the C axis)
- The machine parameter **presetToAlignAxis** (no. 300203) for the C axis is set to **FALSE**

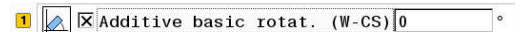
- Traverse path is increased by means of a 180° rotation of the C axis
- Rotation is achieved by means of the **Additive offset (M-CS)** option
  - ▶ Open the **Global Program Settings** function
  - ▶ Activate the **Additive offset (M-CS)** setting option with C = 180°
  - ▶ If necessary, add an **L C+0** positioning movement to the NC program
  - ▶ Reselect the NC program
- > The control considers the 180° rotation for all C-axis positioning movements.
- > The control takes the modified tool position into account.
- > The position of the C axis does not affect the preset position. The preset remains unchanged.

### Additive basic rotat. (W-CS)



Refer to your machine manual.

Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.






The **Additive basic rotat. (W-CS)** setting option of the **Global Program Settings** function provides a coordinate transformation in the workpiece coordinate system (W-CS).

**Further information:** "Workpiece coordinate system W-CS", Page 124

The additive basic rotation of the **Global Program Settings** function is active after the basic rotation or basic 3D rotation and thus is based on this movement. This means that the value is not simply added to the SPC value of **Preset management**.

**Further information:** "Determining a 3-D basic rotation", Page 239 and Page 236

### Control display

- Like the basic rotation from **Preset management** (SPC column), the additive basic rotation of the **Global Program Settings** function does not affect the actual position display.
- The general status display shows the following icons:
  -  Active basic rotation from **Preset management**
  -  Active basic 3-D rotation from **Preset management**
  -  Additive basic rotation active (default icon of the **Global Program Settings** function)
- The control displays the additive basic rotation values on the **GS** tab of the additional status display, and the values from **Preset management** can be found on the **POS** tab.

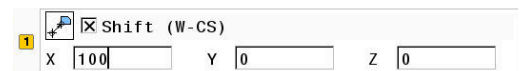
**Example:**

Rotate the CAM output by  $-90^\circ$ :

- CAM output for gantry-type milling machines with a large range of traverse of the Y axis
  - Available machining center with a limited range of traverse of the Y axis (X axis has the required range of traverse)
  - The workpiece blank is clamped with a  $90^\circ$  rotation (long side parallel to the X axis)
  - Thus, the NC program must be rotated by  $90^\circ$  (algebraic sign depends on the preset position)
  - The  $90^\circ$  rotation is compensated for by means of the **Additive basic rotat. (W-CS)** setting option
- ▶ Open the **Global Program Settings** function
- ▶ Activate the **Additive basic rotat. (W-CS)** setting option, specifying  $90^\circ$
- ▶ Select NC program
- > The control considers the  $90^\circ$  rotation for all axis positioning movements.

**Shift (W-CS)**

Refer to your machine manual.  
Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.




The **Shift (W-CS)** settings option of the **Global Program Settings** function provides a coordinate transformation in the W-CS workpiece coordinate system.

**Further information:** "Workpiece coordinate system W-CS", Page 124

The **Shift (W-CS)** settings option of the **Global Program Settings** function takes effect on an axis-by-axis basis. The value is added to the shift that takes place **before** the machining plane is tilted as defined in the NC program (e.g., Cycle **7 DATUM SHIFT**).

**Control display**

- Unlike a datum shift in the NC program, the **Shift (W-CS)** settings option of the **Global Program Settings** function affects the actual position display.
- The general status display shows the following icons:
  - No icon is displayed for shifts defined in the NC program.**
  -  **Shift (W-CS)** active (default icon of the **Global Program Settings** function)
- The **Shift (W-CS)** values are displayed on the **GS** tab of the additional status display, and the values from the NC program on the **TRANS** tab.

**Example:**

Determining the workpiece position using the handwheel:

- Rework required on a tilted surface
- Workpiece clamped and roughly oriented
- Basic rotation and preset in the plane have been measured
- Z coordinate must be defined with the handwheel due to the presence of a free-form surface
- ▶ Open the **Global Program Settings** function
- ▶ Activate **Handwheel superimp.** with the **Workpiece (W-CS)** coordinate system
- ▶ Determine the workpiece surface by scratching, using the handwheel
- ▶ Transfer the determined value to **Shift (W-CS)** by pressing the **CONFIRM VALUE** soft key
- ▶ Starting an NC program
- ▶ Activate **Handwheel superimp.** with the **Workpiece (WPL-CS)** coordinate system
- ▶ Determine the workpiece surface by scratching, using the handwheel for fine adjustment
- ▶ Select NC program
- > The control takes the **Shift (W-CS)** into account.
- > The control uses the current values from **Handwheel superimp.** in the **Workpiece (WPL-CS)** coordinate system.

**Mirroring (W-CS)**

Refer to your machine manual.

Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.

Axes that are not included in the kinematics description always appear dimmed and are therefore not editable!



The **Mirroring (W-CS)** settings option of the **Global Program Settings** function provides a coordinate transformation in the W-CS workpiece coordinate system.

**Further information:** "Workpiece coordinate system W-CS", Page 124

The **Mirroring (W-CS)** settings option of the **Global Program Settings** function takes effect on an axis-by-axis basis. The value is added to the mirroring that takes place **before** the machining plane is tilted as defined in the NC program (e.g., Cycle **8 MIRROR IMAGE**).



If **PLANE** functions or the **TCPM** function are used with spatial angles, the rotary axes are mirrored accordingly along with the mirrored main axes. This always creates the same constellation, regardless of whether the rotary axes were marked in the form.

With **PLANE AXIAL**, the mirroring of rotary axes is irrelevant.

For the **TCPM** function with axis angles, all axes to be mirrored must be marked explicitly in the form.



**Control display**

- Like a shift in the NC program, the **Mirroring (W-CS)** of the **Global Program Settings** function has no effect on the actual position display.
- The general status display shows the following icons:



Mirroring in the NC program active



**Mirroring (W-CS)** function active (default icon of the **Global Program Settings** function)

- The **Mirroring (W-CS)** values are displayed on the **GS** tab of the additional status display, and the values from the NC program on the **TRANS** tab.

**Example:**

Mirroring the CAM output:

- CAM output for right mirror cover
- The workpiece datum is centered on the workpiece blank
- NC program set to the center of the ball-nose cutter and **TCPM** function with spatial angles
- The left mirror cover is to be machined (X-axis mirroring)
- ▶ Open the **Global Program Settings** function
- ▶ Activate **Mirroring (W-CS)** with marked X
- ▶ Run the NC program
- The control takes the **Mirroring (W-CS)** value for the X axis and the required rotary axes into account.

**Shift (mW-CS)**



Refer to your machine manual.  
Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.

Shift (mW-CS)					
X	-10	Y	0	Z	0
A	0	B	0	C	0


The Shift (mW-CS) setting option of the **Global Program Settings** function provides a coordinate transformation in the mW-CS (modified workpiece coordinate system).

The W-CS workpiece coordinate system is modified if **Shift (W-CS)** or **Mirroring (W-CS)** is active. Without this preceding coordinate transformation, the Shift (mW-CS) would be active directly in the W-CS workpiece coordinate system and would thus be identical to **Shift (W-CS)**.

**Further information:** "Workpiece coordinate system W-CS", Page 124

The Shift (mW-CS) of the **Global Program Settings** function takes effect on an axis-by-axis basis. The value is added to the shift that takes place **before** the machining plane is tilted as defined in the NC program (e.g., Cycle **7 DATUM SHIFT**), the same way as it is done for an active **Shift (W-CS)**.

### Control display

- Unlike a datum shift in the NC program, the Shift (mW-CS) of the **Global Program Settings** function has an effect on the actual position display.
- The general status display shows the following icons:
  - No icon is displayed for shifts defined in the NC program.**
  -  Shift (mW-CS) function active (default icon of the **Global Program Settings** function)
- The Shift (mW-CS) values are displayed on the **GS** tab of the additional status display, and the values from the NC program on the **TRANS** tab.

### Example:

Mirroring the CAM output:

- CAM output for right mirror cover
- The workpiece datum is located in the left front corner of the workpiece blank.
- NC program set to the center of the ball-nose cutter and **TCPM** function with spatial angles
- The left mirror cover is to be machined (X-axis mirroring)
  - ▶ Open the **Global Program Settings** function
  - ▶ Activate **Mirroring (W-CS)** with marked X
  - ▶ Enter and activate Shift (mW-CS) to shift the workpiece datum in the mirrored coordinate system
  - ▶ Run the NC program
  - > The control takes the **Mirroring (W-CS)** value for the X axis and the required rotary axes into account.
  - > The control takes the modified position of the workpiece datum into account.

### Rotation (WPL-CS)



Refer to your machine manual.

Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.



The **Rotation (WPL-CS)** option of the **Global Program Settings** function provides a coordinate transformation in the WPL-CS working plane coordinate system.

**Further information:** "Working plane coordinate system WPL-CS", Page 126

The **Rotation (WPL-CS)** option of the **Global Program Settings** function is effective **after** tilting the working plane and thus is based on this movement. The value is added to the rotation defined in the NC program (e.g., Cycle **10 ROTATION**).

**Control display**

- Like a rotation in the NC program, the **Rotation (WPL-CS)** option of the **Global Program Settings** function has no effect on the actual position display.

- The general status display shows the following icons:

**No icon is displayed for rotations in the NC program.**



Active **Rotation (WPL-CS)** (default icon of **Global Program Settings** function)





- The **Rotation (WPL-CS)** values are displayed on the **GS** tab of the additional control status display, and the values from the NC program on the **TRANS** tab.

## Handwheel superimp.



Refer to your machine manual.  
Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.

The **Handwheel superimp.** option of the **Global Program Settings** function enables the axes to be moved in superimposition during the execution of an NC program. The coordinate system effective for **Handwheel superimp.** can be selected from the **Coordinate system** selection menu.

Icon	Function
	<b>Handwheel superimp.</b> is effective in the machine coordinate system M-CS <b>Further information:</b> "Machine coordinate system M-CS", Page 120
	<b>Handwheel superimp.</b> is effective in the workpiece coordinate system W-CS <b>Further information:</b> "Workpiece coordinate system W-CS", Page 124
	<b>Handwheel superimp.</b> is effective in the modified workpiece coordinate system mW-CS <b>Further information:</b> "Shift (mW-CS)", Page 361
	<b>Handwheel superimp.</b> is effective in the working plane coordinate system WPL-CS <b>Further information:</b> "Working plane coordinate system WPL-CS", Page 126



If no coordinate system transformations were activated using either the NC program or the **Global Program Settings** function, **Handwheel superimp.** is effective in the same way in all coordinate systems.

## NOTICE


### Danger of collision!

The coordinate system chosen in the selection menu also takes effect on **Handwheel superimp.** with **M118**, even if the Global Program Settings function (GPS) is not active. There is a risk of collision during the execution of **Handwheel superimp.** and the subsequent machining operations!

- ▶ Before exiting the form, always make sure to select the **Machine (M-CS)** coordinate system
- ▶ Test the behavior at the machine

Handwheel superimp.:

**Coordinate system**

 Machine (M-CS) ▼

	Max. val.	Act1. val.
X	10	0
Y	10	2.56
Z	0	0
A	0	0
B	0	0
C	0	0
U	0	0
V	0	0
W	0	0
VT	0	0

Reset VT value

By entering values in the **Max. val.** column, you define which axes may be moved using the handwheel and the maximum path by which they may be moved. Since the input value applies to both directions (both positive and negative), the maximum path is double the input value.

In the **Actl.val.** column, the control displays the path traversed using the handwheel for each axis.

The **Actl.val.** column can also be edited manually. However, if you enter a value that exceeds the current **Max. val.**, it will be impossible to activate the value. The wrong value will be highlighted in red. Furthermore, the control displays a warning message and prevents you from closing the form.

If the **Actl.val.** column contains a value when you activate the function, the control will use the menu for returning to move to the new position.

**Further information:** "Returning to the contour", Page 301



Using the **CONFIRM VALUE** soft key, you can confirm the axis-specific values from the **Actl.val.** column to the shift values defined in the **Global Program Settings** function. This transfer is only possible for the main axes. In addition, the coordinate systems must match.

**Further information:** "Shift (W-CS)", Page 359 and Page 361

When the values are applied, the control resets the input fields of the **Actl.val.** column.

If you apply the values more than once, the control will sum up the shift values.

## NOTICE

### Danger of collision!

When both methods for **Handwheel superimp.** with **M118** and with the Global Program Settings GPS are active at the same time, the definitions influence each other, depending on their sequence of activation. There is a risk of collision during the execution of **Handwheel superimp.** and the subsequent machining operations!

- ▶ Use only one method for **Handwheel superimp.**
- ▶ Preferably use the **Handwheel superimp.** option of the **Global Program Settings** function
- ▶ Test the behavior at the machine

HEIDENHAIN does not recommend using both methods for **Handwheel superimp.** at the same time. If **M118** cannot be removed from the NC program, you should at least activate **Handwheel superimp.** from GPS prior to selecting the program. This ensures that the control uses the GPS function rather than **M118**.



Operating notes:

- In the fillable form the control grays out all axes that are not active on your machine.
- Entered values (e.g., shift values and values for **Handwheel superimp.**) are defined in the unit of measure (mm or inches) selected for the position display. Angles are always entered in degrees.
- If you want to use **Handwheel superimp.** while machining with an active **Dynamic Collision Monitoring (DCM)** function, the control must be either in an interrupted or in a stopped state.

**Further information:** "General status display", Page 69  
As an alternative, you can deactivate the **Dynamic Collision Monitoring (DCM)** function.

**Further information:** "Activating and deactivating collision monitoring", Page 332

### Control display

- Both methods of **Handwheel superimp.** have an effect on the actual position display.
- The general status display shows the following icons:

**No icon is displayed for the M118 function.**



Active **Handwheel superimp.** (default icon of **Global Program Settings** function)

- The control displays the values of the two methods for **Handwheel superimp.** on the **POS HR** tab of the additional status display.
- The control indicates on the **POS HR** tab whether the Max. val. have been defined via M118 or the Global Program Settings.

### Virtual tool axis VT

You can also carry out **Handwheel superimp.** in the currently active tool axis direction. Here, the current tool axis is the virtual axis **VT**, which does not correspond to the original tool axis direction **Z**. For activating this function, the **VT (Virtual Tool axis)** line is available in the form.

Values traversed with the handwheel in a virtual axis remain active in the default setting (check box unchecked), including after a tool change. The **Reset VT value** function allows you to change this behavior.

The virtual axis **VT** is frequently needed for machining operations with inclined tools (e.g., for manufacturing oblique holes without using a tilted working plane).



**Handwheel superimp.** in virtual axis direction **VT** requires none of the **PLANE** functions nor the **TCPM** function.


**Display of the virtual tool axis (VT)**

**Handwheel superimp.** must be activated with **VT** > 0 for the control to display values.

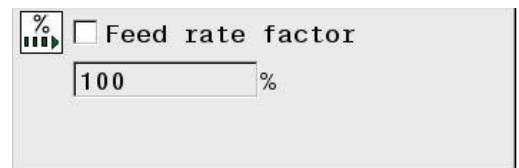
The values of the virtual tool axis **VT** are displayed on the **POS HR** tab of the additional status display.

If you have defined the virtual tool axis in the machine parameter **axisDisplay** (no. 100810), the control also displays the **VT** axis in the position display.


**Feed rate factor**




Refer to your machine manual.  
Your machine manufacturer can disable individual setting options within the **Global Program Settings** function.



The **Feed rate factor** option of the **Global Program Settings** function allows you to modify the current machining feed rate. The input corresponds to a percentage. Input range: 1% to 1000%




The current machining feed rate results from the programmed feed rate and the current setting of the feed rate potentiometer.



The **Feed rate factor** option of the **Global Program Settings** function has no influence on a programmed rapid traverse (**FMAX**).  
All feed rates can jointly be limited using the feed rate limit (**F MAX** soft key). The **Feed rate factor** option of the **Global Program Settings** function has no influence on the limited feed rate!  
**Further information:** "Feed-rate limit F MAX", Page 195

**Control display**

- The general status display shows the following icons and information:
  - Ovr**      Result of the feed rate potentiometer setting  
**No icon and no value are displayed for the feed rate limit (F MAX soft key).**
  -       Active **Feed rate factor** (default icon of **Global Program Settings** function)
  - F**      Result of all modifications = Current feed rate
- The control displays the value of the **feed rate factor** on the **GS** tab of the additional status display.

## 7.5 Defining a counter

### Application



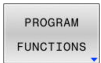
Refer to your machine manual.  
Your machine manufacturer enables this function.

With the **FUNCTION COUNT** NC function, you control a counter from within the NC program. This counter allows you, for example, to define a target count up to which the control is to repeat the NC program.

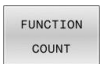
To program this behavior:



- ▶ Show the soft-key row for special functions



- ▶ Press the **PROGRAM FUNCTIONS** soft key



- ▶ Press the **FUNCTION COUNT** soft key

### NOTICE

#### Caution: Data may be lost!

Only one counter can be managed by the control. If you execute an NC program that resets the counter, any counter progress of another NC program will be deleted.

- ▶ Please check prior to machining whether a counter is active.
- ▶ If necessary, note down the counter value and enter it again via the MOD menu after execution.



You can engrave the current counter reading with Cycle **225 ENGRAVING**.

**Further information:** User's Manual for **Programming of Machining Cycles**

#### Effect in the Test Run operating mode

You can simulate the counter in the **Test Run** operating mode. Only the counter reading you have defined directly in the NC program is active. The counter reading in the MOD menu remains unaffected.

#### Effect in the Program Run Single Block and Program Run Full Sequence operating modes

The counter reading from the MOD menu is only active in the **Program Run Single Block** and **Program Run Full Sequence** operating modes.

The counter reading remains the same after a restart of the control.



## Defining FUNCTION COUNT

The **FUNCTION COUNT** NC function provides the following counter functions:

Soft key	Function
FUNCTION COUNT INC	Increase the counter by 1
FUNCTION COUNT RESET	Reset the counter
FUNCTION COUNT TARGET	Define the target count to be reached Input value: 0 to 9999
FUNCTION COUNT SET	Assign a defined value to the counter Input value: 0 to 9999
FUNCTION COUNT ADD	Increase the counter by a defined value Input value: 0 to 9999
FUNCTION COUNT REPEAT	Repeat the NC program from the label if the defined target count has not been reached yet

### Example

<b>5 FUNCTION COUNT RESET</b>	Reset the counter reading
<b>6 FUNCTION COUNT TARGET10</b>	Enter the target number of parts to be machined
<b>7 LBL 11</b>	Enter the jump label
<b>8 L ...</b>	Machining operation
<b>51 FUNCTION COUNT INC</b>	Increment the counter reading
<b>52 FUNCTION COUNT REPEAT LBL 11</b>	Repeat the machining operations if more parts are to be machined
<b>53 M30</b>	
<b>54 END PGM</b>	

## 7.6 Fixture management

### Fundamentals of fixtures

You can integrate fixtures as 3D models in the control in order to represent clamping situations for simulation or execution.

When DCM is active, the control checks during simulation or machining if the fixture collides (option 40).

**i** Even if the inch unit of measure is active in the control or NC program, the control will interpret dimensions of 3D files in mm.

**⚙️** Refer to your machine manual.  
This function must be enabled and adapted by the machine manufacturer.  
Using an "insertion point," the machine manufacturer defines the preset for positioning the fixtures.  
The insertion point is often at the end of the kinematic chain (e.g., at the center of a rotary table).  
For information about the position of the insertion point, please refer to your machine manual.

### NOTICE

#### Danger of collision!



The setup situation defined for fixture monitoring must match the actual machine status. Otherwise, there is a risk of collision.

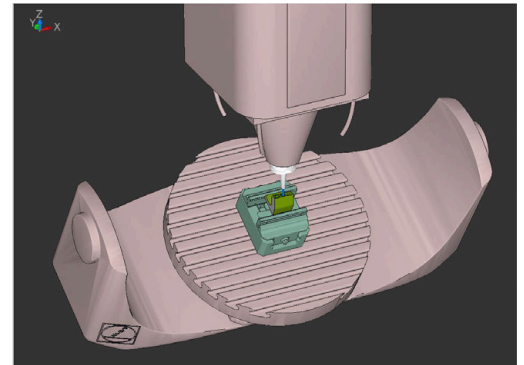
- ▶ Measure the position of the fixture in your machine
- ▶ Use the measured values for positioning the fixture
- ▶ Test the NC programs in **Test Run** operating mode

Prerequisites for importing fixtures:

- The kinematics must be specially prepared by your machine manufacturer
- The fixture file must be available in a suitable format

### Overview

Soft key	Function	Meaning
	<b>SELECT FIXTURE</b>	Integrate the fixture in a suitable format: <ul style="list-style-type: none"> <li>■ CFG file <b>Further information:</b> "Using a fixture in CFG format", Page 372</li> <li>■ M3D or STL file <b>Further information:</b> "Direct use of 3D models as fixtures", Page 376</li> </ul>
	<b>RESET FIXTURE</b>	Deselect the fixture <b>Further information:</b> "Deselecting a fixture from the material removal simulation", Page 372



**Programming notes:**

- When using a CAM system, use a postprocessor to output the fixture situation.
- Create a central directory for your fixtures (e.g., **TNC:\system\Fixture**).
- HEIDENHAIN recommends storing variants of recurring setup situations suitable for standard workpiece sizes in the control (e.g., vise with different jaw opening widths).  
By storing multiple fixtures, you can choose the appropriate fixture for your machining operation without needing to configure it.

**Application****Selecting a fixture for motion simulation**

When DCM is active, the control checks during simulation or machining if the fixture collides (option 40).

In the machine operating modes and in the **Test Run** operating mode, you can load different fixtures independently of each other.

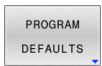
To load a fixture:



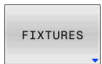
- ▶ Select the **Programming** operating mode



- ▶ Press the **SPEC FCT** key



- ▶ Press the **PROGRAM DEFAULTS** soft key



- ▶ Press the **FIXTURES** soft key



- ▶ Press the **SELECT FIXTURE** soft key
- > The control opens the **FIXTURE SELECT** dialog.



- ▶ Press the **SELECT FILE** soft key
- > The control opens a selection window.
- ▶ Using the selection menu, select **All files** in the **Files of type:** field
- ▶ Select the desired fixture file:
  - **Further information:** "Using a fixture in CFG format", Page 372
  - **Further information:** "Direct use of 3D models as fixtures", Page 376
- ▶ Select **OK**
- > The control loads the fixture.

### Loading the setup situation from the machine operating modes

As an alternative to the programmed selection of a fixture, you can also load the current setup situation from the machine operating modes.

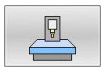
To load an existing setup situation from the machine operating modes:



- ▶ Select the **Test Run** operating mode



- ▶ Press the **BLANK IN WORK SPACE** soft key



- ▶ Press the **LOAD CURRENT MACHINE STATUS** soft key
- ▶ The control loads the current setup situation.



If no fixture is selected in the machine operating modes, this situation can also be loaded in order to deselect a fixture that is active in the **Test Run** operating mode.

### Deselecting a fixture from the material removal simulation

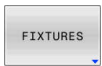
To deselect a fixture from the simulation:



- ▶ Press the **SPEC FCT** key



- ▶ Press the **PROGRAM DEFAULTS** soft key



- ▶ Press the **FIXTURES** soft key



- ▶ Press the **RESET FIXTURE** soft key
- ▶ The control deletes the fixture from the simulation.

### Using a fixture in CFG format

CFG files are configuration files. You can integrate the STL and M3D files available in a CFG file. This enables you to map complex setups.

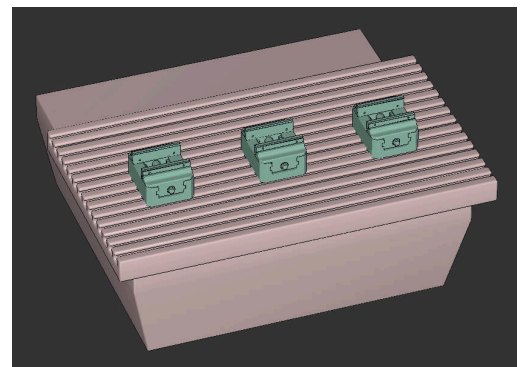
CFG files provide the following options for fixtures:

- Definition of fixtures directly in the CFG file using geometric shapes  
**Further information:** "Defining geometric shapes", Page 374
- Definition of fixtures using external 3D models  
**Further information:** "Integrating 3D models", Page 375
- Creating complex fixtures by combining fixtures with the **Combine fixtures** function  
**Further information:** "Combining fixtures in the New Fixture window", Page 381

Example of calling a CFG file in an NC program:

```
FIXTURE SELECT "3_VISES.CFG"
```

**Further information:** "Application", Page 371



### Creating a CFG file

To create a CFG file:

- ▶ Select the directory in which you want to create the new file
- ▶ Position the cursor in the right window
- ▶ Press the **NEW FILE** soft key
- ▶ Enter the file name with the extension CFG
- ▶ Confirm your input
- ▶ The control creates the CFG file.



### Editors

When you open a CFG file, the control first displays a pop-up window. In this window, you can select which editor you want to use for editing the CFG file.



HEIDENHAIN recommends that you use **KinematicsDesign** to configure and edit CFG files. Errors are easier to detect and fix thanks to the graphic support functionality.

**Further information:** "Creating fixtures in CFG format with KinematicsDesign", Page 374

The control offers the following editors for editing CFG files:

- **KinematicsDesign**
  - Editing of fixtures with graphic support
  - Feedback in case of incorrect entries
  - Integration of transformations
  - Addition of new elements
    - 3D model (M3D or STL files)
    - Cylinder
    - Prism
    - Cuboid
    - Truncated cone
    - Hole
- **Combine fixtures**
  - Creating complex fixtures by combining fixtures
  - Defining variable transformations
- **Leafpad**
  - Search function for texts
  - Editing of fixtures without graphic support
- **Diffuse tool**
  - Search function for texts
  - Comparison of two CFG files
  - Transfer of contents between the files
  - Editing of fixtures without graphic support

## Creating fixtures in CFG format with KinematicsDesign

### Editing CFG files with KinematicsDesign

To edit a CFG file with **KinematicsDesign**:

- ▶ Open the CFG file
- > The control opens the **Application?** window.
- ▶ Select **KinematicsDesign**
- ▶ Press **OK**
- > The control opens **KinematicsDesign**.

### Creating a fixture entry with a collision object

To create a fixture entry with a collision object:



- ▶ Select **Insert chucking equipment**
- > **KinematicsDesign** creates a new fixture entry within the CFG file.
- ▶ Enter a **keyname** for the fixture (e.g., **clamping jaw**)
- ▶ Confirm your input
- > **KinematicsDesign** loads the input.



- ▶ Move cursor down one level



- ▶ Select **Insert collision object**
- ▶ Confirm your input
- > **KinematicsDesign** creates a new collision object.

## Defining geometric shapes

**KinematicsDesign** allows you to define various geometric shapes. You can construct simple fixtures by combining several geometric shapes.

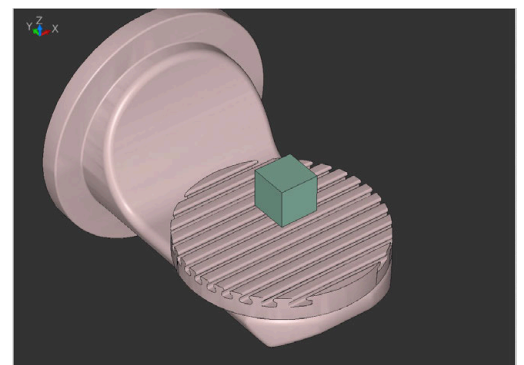
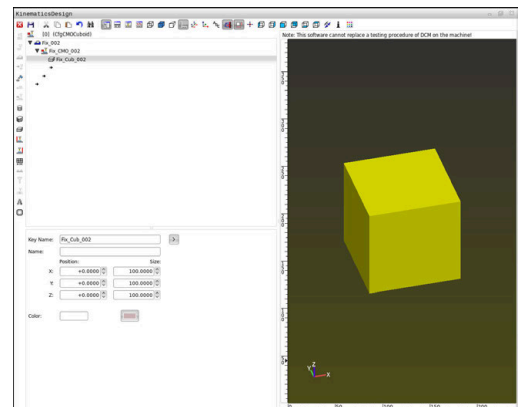


You can also combine geometric shapes that were created in **KinematicsDesign** with available 3D models.

**Further information:** "List of CFG functions", Page 377

To define a geometric shape:

- ▶ Create a fixture entry with a collision object
- ⇒ Select the cursor key beneath the collision object
- ▶ Select the desired geometric shape (e.g., a cuboid)
- ▶ Define the position of the cuboid (e.g., **X = 0, Y = 0, Z = 0**)
- ▶ Define the dimensions of the cuboid (e.g., **X = 100, Y = 100, Z = 100**)
- ▶ Confirm your input
- > The control displays the defined cuboid in the graphic.



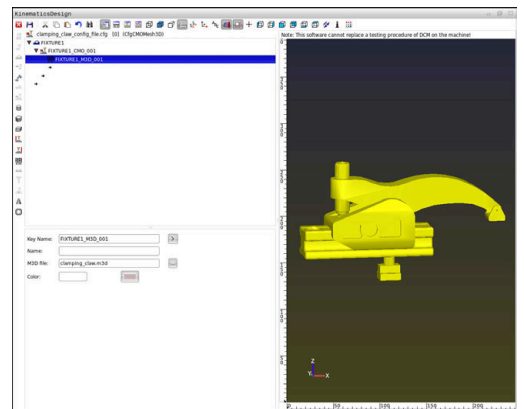
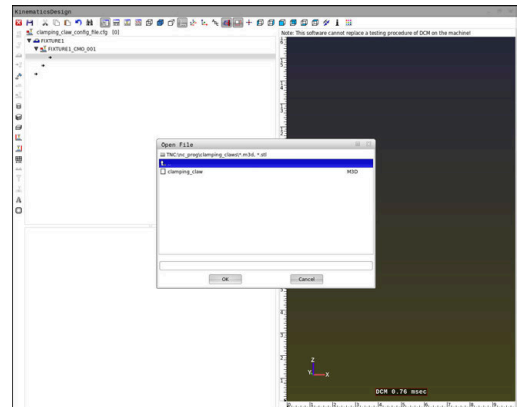
### Integrating 3D models

Prerequisite for integrating 3D models in CFG files:

- The integrated 3D models meet the requirements of the control  
**Further information:** "Direct use of 3D models as fixtures", Page 376

To integrate a 3D model as a fixture:

- ▶ Create a fixture entry with a collision object
  - ➔ Select the cursor key beneath the collision object
- ▶ Select **Insert 3D model**
- ▶ The control opens the **Open File** window.
- ▶ Select the desired STL or M3D file
- ▶ Press **OK**
- ▶ The control integrates the selected file and displays the file in the graphic window.

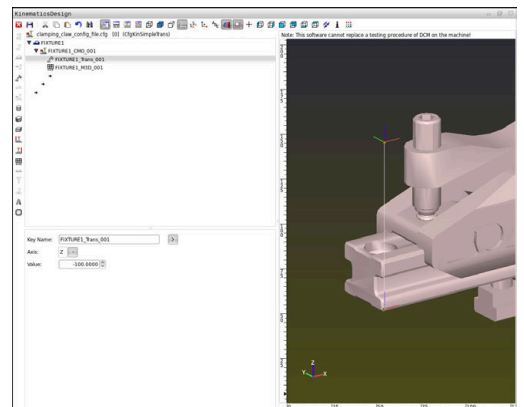


### Fixture placement

You can place the integrated fixture at any position (e.g., for correcting the orientation of an external 3D model). For this purpose, insert transformations for all axes you wish to use.

To position a fixture with **KinematicsDesign**:

- ▶ Define the fixture
  - **Further information:** "Defining geometric shapes", Page 374
  - **Further information:** "Integrating 3D models", Page 375
- ▶ Select the cursor key beneath the element to be positioned
- ▶ Select **Insert transformation**
- ▶ Enter a **key name** for the transformation (e.g., **Z shift**)
- ▶ Select the **axis** for the transformation (e.g., **Z**)
- ▶ Select the **value** for the transformation (e.g., **100**)
- ▶ Confirm your input
- ▶ **KinematicsDesign** inserts the transformation.
- ▶ **KinematicsDesign** depicts the transformation in the graphic.



**i** If one of the transformations contains the ? character in the key, you can enter the value of the transformation within the **Combine fixtures** function. This allows easy positioning of clamping jaws, for example.

## Direct use of 3D models as fixtures

### Orientation of fixture files

You can choose any orientation of the fixture model in the CAD system, and therefore the orientation does not always match the orientation of the fixture in the machine.

Notes on orienting fixture files

- Note the orientation of the coordinate system in the CAD system. Use the CAD system to adapt the orientation of the coordinate system to the desired orientation of the fixture in the machine.
- Define the coordinate origin in the CAD system such that the fixture can be directly attached to the point of insertion of the kinematics.



If you need to make corrections, you have to use a CFG file for entering them directly into the control.

**Further information:** "Using a fixture in CFG format", Page 372

### Using fixtures in STL format

Prerequisites for STL file fixture import:

- Max. 20 000 triangles
- Triangular mesh forms a closed shell

With the software option CAD Model Optimizer (option 152), you can adapt STL files that do not meet the requirements and then use them for fixtures.

**Further information:** User's Manual for **Klartext Programming**

STL files allow you to map both individual components and entire assemblies as an immobile fixture. The STL format is useful, in particular, for datum clamping systems and recurring setups.

If an STL file does not meet the requirements of the control, then the control issues an error message.

Example of calling an STL file in an NC program:

```
FIXTURE SELECT "JAW_CHUCK.STL"
```

### Using fixtures in M3D format

In order to use an M3D file as a fixture, you need to use the M3D Converter software to create and check the file.

The M3D Converter can generate M3D files from the following file types:

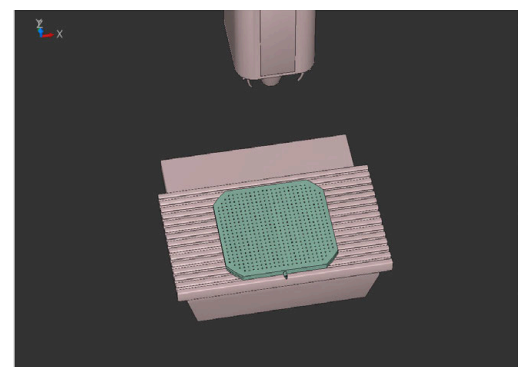
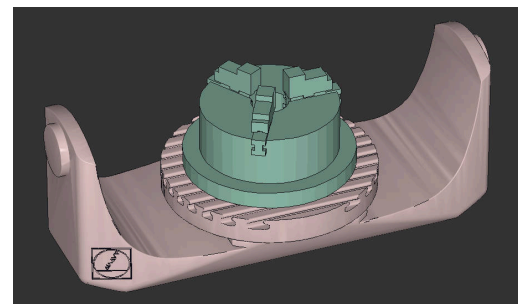
- STL
- STEP (STP)

M3D is a file type designed by HEIDENHAIN. The paid-for M3D Converter software from HEIDENHAIN allows you to check incorrect 3D models and simplify them so that they can be used as fixtures. Due to their conversion, M3D files can be loaded faster by the control than STL files.

Example of calling an M3D file in an NC program:

```
FIXTURE SELECT "DEVICE.M3D"
```

**Further information:** "Application", Page 371





## List of CFG functions

### General information

You can integrate both STL files and M3D files into CFG files more than once.

**i** HEIDENHAIN recommends that you use **KinematicsDesign** to edit fixtures.

### CFG functions

Each element is assigned its own **key**. A **key** must be unambiguous and unique, meaning that it must not occur more than once in the description of a fixture. Based on the **key**, the elements are referenced to each other.

The following functions are available if you wish to use CFG functions to describe a fixture in the control:

Function	Description
<pre>CfgCMOMesh3D(key:="Fixture_body", filename:="1.STL",name:=" ")</pre>	<p>Definition of fixture component</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>i</b> You can also enter an absolute path for the defined fixture component (e.g., <b>TNC:\nc_prog\1.STL</b>)</p> </div>
<pre>CfgKinSimpleTrans(key:="XShiftFixture", dir:=X,val:=0)</pre>	<p>Shift in X axis</p> <p>Inserted transformations, such as a shift or rotation, are effective for all of the elements following in the kinematic chain.</p>
<pre>CfgKinSimpleTrans(key:="CRot0", dir:=C,val:=0)</pre>	<p>Rotation in C axis</p>
<pre>CfgCMO ( key:="fixture", primitives:= ["XShiftFixture","CRot0", "Fixture_body"], active :=TRUE, name :=" ")</pre>	<p>Describes all of the transformations contained in the fixture. The parameter <b>active := TRUE</b> activates collision monitoring for the fixture.</p> <p>The <b>CfgCMO</b> contains collision objects and transformations. The fixture is combined based on the arrangement of the different transformations. Here, the transformation <b>XShiftFixture</b> shifts the center of rotation of the transformation <b>CRot0</b>.</p>
<pre>CfgKinFixModel(key:="Fix_Model", kinObjects:=["fixture"])</pre>	<p>Fixture designation</p> <p><b>CfgKinFixModel</b> contains one or more <b>CfgCMO</b> elements.</p>

## Geometric shapes

You can add simple geometric objects to your collision object either directly in the CFG file or by using **KinematicsDesign**.

All integrated geometric shapes are subelements of the higher-order **CfgCMO**, in which they are listed as **primitives**.

The following geometric objects are available:

Function	Description
<code>CfgCMOCuboid ( key:="FIXTURE_Cub", vertex:= [ 0, 0, 0 ], edgeLengths:= [0, 0, 0], name:="" )</code>	Definition of a cuboid
<code>CfgCMOCylinder ( key:="FIXTURE_Cyl", dir:=Z, bottomCenter:= [0, 0, 0], radius:=0, height:=0, name:="" )</code>	Definition of a cylinder
<code>CfgCMOPrism ( key:="FIXTURE_Prism_002", height:=0, polygonX:=[], polygonY:=[], name:="", origin:= [ 0, 0, 0 ] )</code>	Definition of a prism A prism is described by entering the height and several polygonal lines.

## CFG syntax elements

The following syntax elements are used within the various CFG functions:

Function	Description
<code>key:= ""</code>	Name of the function
<code>dir:= ""</code>	Direction of a transformation (e.g., <b>X</b> )
<code>val:= ""</code>	Value
<code>name:= ""</code>	Name displayed if a collision occurs (optional input)
<code>filename:= ""</code>	File name
<code>vertex:= [ ]</code>	Position of a cube
<code>edgeLengths:= [ ]</code>	Dimensions of a cuboid
<code>bottomCenter:= [ ]</code>	Center of a cylinder
<code>radius:= [ ]</code>	Radius of a cylinder
<code>height:= [ ]</code>	Height of a geometric object
<code>polygonX:= [ ]</code>	Line of a polygon in X
<code>polygonY:= [ ]</code>	Line of a polygon in Y
<code>origin:= [ ]</code>	Starting point of a polygon

### Example:

Shifting the selected fixture component by 10 mm in the X axis

```
CfgKinSimpleTrans(key:="XShiftFixture",dir:=X,val:=10)
```

### Example:

Rotation of the selected fixture component by 45° in the C axis

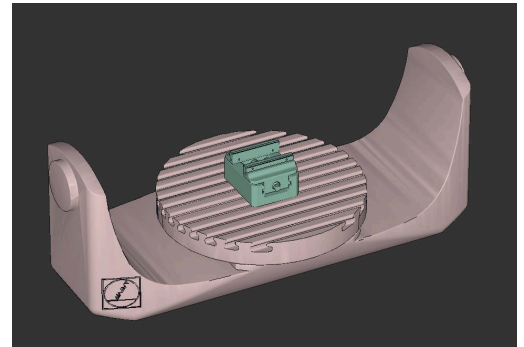
```
CfgKinSimpleTrans(key:="CRot45",dir:=C,val:=45)
```

### Example: CFG description of a vise

As an alternative to using **KinematicsDesign**, you can also create fixture files directly from the CAM system or by using the appropriate code in a text editor.

**Further information:** "Using a fixture in CFG format", Page 372

The example below describes the syntax of a CFG file for a vise with two movable jaws.



#### Files used

Various STL files are used to describe the vise. Since the jaws of the vise are dimensionally identical, they are defined using the same STL file.

Code	Explanation
<pre>CfgCMOMesh3D (key:="Fixture_body",  filename:="vice_47155.STL",  name:=" ")</pre>	Body of the vise
<pre>CfgCMOMesh3D (key:="vice_jaw_1",  filename:="vice_jaw_47155.STL",  name:=" ")</pre>	First jaw of the vise
<pre>CfgCMOMesh3D (key:="vice_jaw_2",  filename:="vice_jaw_47155.STL",  name:=" ")</pre>	Second jaw of the vise

#### Definition of jaw opening width

In this example, the opening width of the vise is defined using two mutually dependent transformations.

Code	Explanation
<pre>CfgKinSimpleTrans (key:="TRANS_opening_width",  dir:=Y, val:=-60)</pre>	Jaw opening width of the vise in Y direction: 60 mm
<pre>CfgKinSimpleTrans (key:="TRANS_opening_width_2",  dir:=Y, val:=30)</pre>	Position of the first jaw of the vise in Y direction: 30 mm

### Positioning of the fixture within the working space

The defined fixture components are positioned using various transformations.

#### Code

```
CfgKinSimpleTrans (key:="TRANS_X", dir:=X, val:=0)
CfgKinSimpleTrans (key:="TRANS_Y", dir:=Y, val:=0)
CfgKinSimpleTrans (key:="TRANS_Z", dir:=Z, val:=0)
CfgKinSimpleTrans (key:="TRANS_Z_vice_jaw",
dir:=Z, val:=60)
CfgKinSimpleTrans (key:="TRANS_C_180",
dir:=C, val:=180)
CfgKinSimpleTrans (key:="TRANS_SPC", dir:=C, val:=0)
CfgKinSimpleTrans (key:="TRANS_SPB", dir:=B, val:=0)
CfgKinSimpleTrans (key:="TRANS_SPA", dir:=A, val:=0)
```

#### Explanation

Positioning of the fixture components  
In this example, a rotation by 180° is inserted for rotating the defined jaw of the vise. This is necessary because the same initial model is used for both jaws of the vise.  
The rotation inserted applies to all components following in the transformation chain.

### Description of the fixture

You need to combine all objects and transformations in the CFG file in order to ensure that the fixture is correctly depicted in the simulation.

#### Code

```
CfgCMO (key:="FIXTURE", primitives:= [
"TRANS_X",
"TRANS_Y",
"TRANS_Z",
"TRANS_SPC",
"TRANS_SPB",
"TRANS_SPA",
"Fixture_body",
"TRANS_Z_vice_jaw",
"TRANS_opening_width_2",
"vice_jaw_1",
"TRANS_opening_width",
"TRANS_C_180",
"vice_jaw_2" ], active:=TRUE, name:="")
```

#### Explanation

Combining the transformations and objects contained in the fixture

### Fixture designation

You need to assign a designation to the combined fixture.

#### Code

```
CfgKinFixModel (key:="FIXTURE1",
kinObjects:=["FIXTURE"])
```

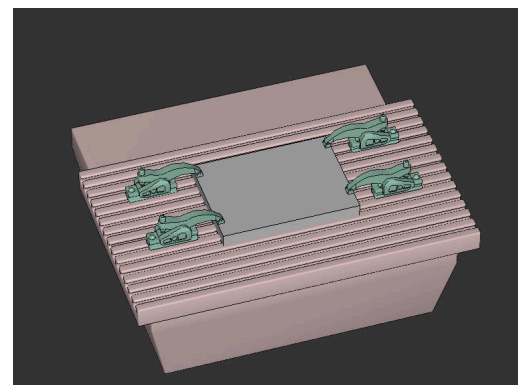
#### Explanation

Designation of the combined fixture

### Examples provided in NC Solutions

Example files for setups used in everyday manufacturing are provided in the NC database of the Klartext Portal:

#### HEIDENHAIN NC solutions



## Combining fixtures in the New Fixture window

### Application

The **New Fixture** window allows combining several fixtures and saving them as a new fixture. This enables realizing and monitoring complex clamping situations.

### Related topics

- Fundamentals of fixtures
  - Further information:** "Fixture management", Page 370
- Integrating fixtures into the NC program
  - Further information:** "Application", Page 371

### Requirement

- Fixtures of suitable format:
  - STL file
    - 20,000 triangles maximum
    - Triangular mesh forms a closed shell
  - CFG file
  - M3D file

### Description of function

To navigate to this function:

#### Tools ► Combine fixtures

The control also makes this function available as a selection option for opening CFG files.

The **Add fixture** button selects all required fixtures one by one.

If one of the transformations contains the **?** character in the key, you can enter the value of the transformation within the **Combine fixtures** function. This allows easy positioning of clamping jaws, for example.

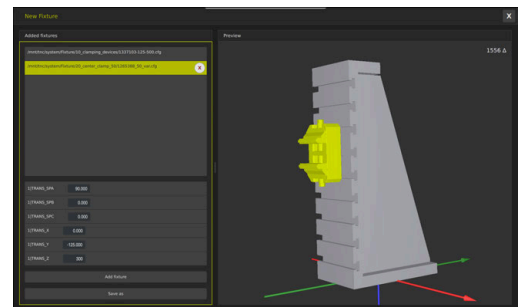
The control displays a preview of the combined fixture and the total number of all triangles.

The **Save as** button saves the combined fixture as a CFG file.

### Notes

- For optimum performance, HEIDENHAIN recommends that combined fixtures contain no more than 20,000 triangles.
- If the position or the size of a fixture must be adapted, use **KinematicsDesign**.

**Further information:** "Creating fixtures in CFG format with KinematicsDesign", Page 374



Combined fixture with variable transformations



# 8

**Pallets**

## 8.1 Pallet management

### Application



Refer to your machine manual.

Pallet table management is a machine-dependent function. The standard functional range is described below.

Pallet tables (.p) are mainly used in machining centers with pallet changers. The pallet tables call the different pallets (PAL), fixtures (FIX) optionally, and the associated NC programs (PGM). The pallet tables activate all defined presets and datum tables.

Without a pallet changer, you can use pallet tables to successively run NC programs with different presets with just one press of **NC Start**.



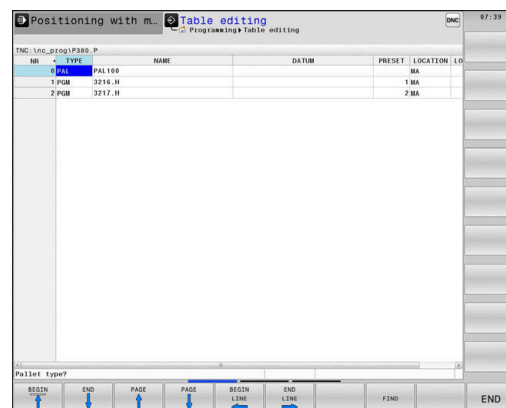
The file name of a pallet table must always begin with a letter.

### Columns of the pallet table

The machine manufacturer defines a pallet table prototype that you can choose when you create a pallet table. The control shows all existing prototypes in the **Select table format** window.

The prototype can include the following columns:

Column	Meaning	Field type
<b>NR</b>	The control creates the entry automatically. The entry is required for the <b>Line number</b> input field of the <b>BLOCK SCAN</b> function.	Mandatory field
<b>TYPE</b>	The control differentiates between the following entries <ul style="list-style-type: none"> <li>■ <b>PAL</b> Pallet</li> <li>■ <b>FIX</b> Fixture</li> <li>■ <b>PGM</b> NC program</li> </ul> Select the entries using the <b>ENT</b> key and the arrow keys or by soft key.	Mandatory field
<b>NAME</b>	File name The machine manufacturer specifies the names for pallets and fixtures, if applicable, whereas you define program names. You must specify the complete path if the NC program is not saved in the directory of the pallet table.	Mandatory field
<b>DATUM</b>	Datum You must specify the complete path if the datum table is not saved in the folder of the pallet table. You activate datums from a datum table in the NC program using Cycle <b>7</b> .	Optional field This entry is only required if a datum table is used.
<b>PRESET</b>	Workpiece preset Enter the preset number of the workpiece.	Optional field





Column	Meaning	Field type
<b>LOCATION</b>	Location of the pallet The entry <b>MA</b> indicates that there is a pallet or fixture in the working space of the machine and can be machined. Press the <b>ENT</b> key to enter <b>MA</b> . Press the <b>NO ENT</b> key to remove the entry and thus suppress machining.	Optional field If the column exists, the entry is mandatory.
<b>LOCK</b>	Row locked Using an <b>*</b> you can exclude the row of the pallet table from execution. Press the <b>ENT</b> key to identify the row with the entry <b>*</b> . Press the <b>NO ENT</b> key to cancel the lock. You can lock the execution for individual NC programs, fixtures or entire pallets. Unlocked rows (e.g., PGM) in a locked pallet are also not executed.	Optional field
<b>PALPRES</b>	Number of the pallet preset	Optional field This entry is only required if pallet presets are used.
<b>W-STATUS</b>	Execution status	Optional field This entry is only required for tool-oriented machining.
<b>METHOD</b>	Machining method	Optional field This entry is only required for tool-oriented machining.
<b>CTID</b>	ID for mid-program startup	Optional field This entry is only required for tool-oriented machining.
<b>SP-X, SP-Y, SP-Z</b>	Clearance height in the linear axes X, Y, and Z	Optional field
<b>SP-A, SP-B, SP-C</b>	Clearance height in the rotary axes A, B, and C	Optional field
<b>SP-U, SP-V, SP-W</b>	Clearance height in the parallel axes U, V, and W	Optional field
<b>DOC</b>	Comment	Optional field
<b>COUNT</b>	<b>Number of operations</b> For rows of the <b>PAL</b> type: Current actual value for the pallet counter nominal value defined in the <b>TARGET</b> column. For rows of the <b>PGM</b> type: Value indicating by how much the pallet counter actual value will be incremented after the execution of the NC program.	Optional field
<b>TARGET</b>	<b>Total number of operations</b> Nominal value for the pallet counter in rows of the <b>PAL</b> type The control repeats the NC programs of this pallet until the nominal value has been reached.	Optional field




















You can remove the **LOCATION** column if you are only using pallet tables in which the control is to machine all rows.

**Further information:** "Inserting or deleting columns",  
Page 389

### Editing a pallet table

When you create a new pallet table, it is empty at first. Using the soft keys, you can insert and edit rows.

Soft key	Editing function
	Select the table start
	Select the table end
	Select the previous page in the table
	Select the next page in the table
	Insert as last row in the table
	Delete the last row in the table
	Add several rows at end of table
	Copy the current value
	Insert the copied value
	Select beginning of line
	Select end of line
	Find text or value
	Sort or hide table columns
	Edit the current field
	Sort by column contents
	Miscellaneous functions (e.g., saving)
	Open file path selection

## Selecting a pallet table

To select a pallet table or create a new pallet table:



- ▶ Switch to the **Programming** mode or a program run mode



- ▶ Press the **PGM MGT** key

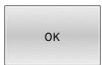
If no pallet tables are shown:



- ▶ Press the **SELECT TYPE** soft key
- ▶ Press the **SHOW ALL** soft key
- ▶ Select a pallet table with the arrow keys, or enter a name for a new pallet table (**.p**)



- ▶ Confirm with the **ENT** key
- ▶ The control opens the **Select table format** window.



- ▶ Select table format
- ▶ Press the **OK** soft key
- ▶ Select unit of measure **MM** or **INCH**, if necessary
- ▶ The control opens the pallet table.



The control displays whether the prototype is defined to use mm or inches as unit of measure. If the control displays both units of measure, you can select one of them.



You can select either a list view or form view using the **Screen Layout** key.

## Inserting or deleting columns

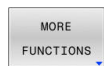


This function is not enabled until the code number **555343** is entered.

Depending on the configuration, a newly created pallet table may not contain all columns. For tool-oriented machining, for example, you need columns that you have to insert first.

To insert a column in an empty table:

- ▶ Open the pallet table



- ▶ Press the **MORE FUNCTIONS** soft key



- ▶ Press the **EDIT FORMAT** soft key
- ▶ The control opens a pop-up window displaying the available columns



- ▶ Using the arrow keys, select the desired column.
- ▶ Press the **INSERT COLUMN** soft key



- ▶ Press the **ENT** key

You can remove the column with the **DELETE COLUMN** soft key.

## Executing a pallet table

**i** A machine parameter defines whether the control is to execute the pallet table blockwise or continuously.

To execute a pallet table:



- ▶ Select the **Program run, full sequence** or **Program run, single block** operating mode



- ▶ Press the **PGM MGT** key

If no pallet tables are shown:



- ▶ Press the **SELECT TYPE** soft key
- ▶ Press the **SHOW ALL** soft key
- ▶ Select a pallet table with the arrow keys
- ▶ Confirm with the **ENT** key



- ▶ Select the screen layout, if necessary



- ▶ Execute with the **NC Start** key

To check the NC program content before execution:

- ▶ Select pallet table
- ▶ With the arrow keys, select the NC program you would like to check



- ▶ Press the **OPEN THE PROGRAM** soft key
- ▶ The control displays the selected NC program on the screen.



- ▶ Scroll through the NC program with the arrow keys

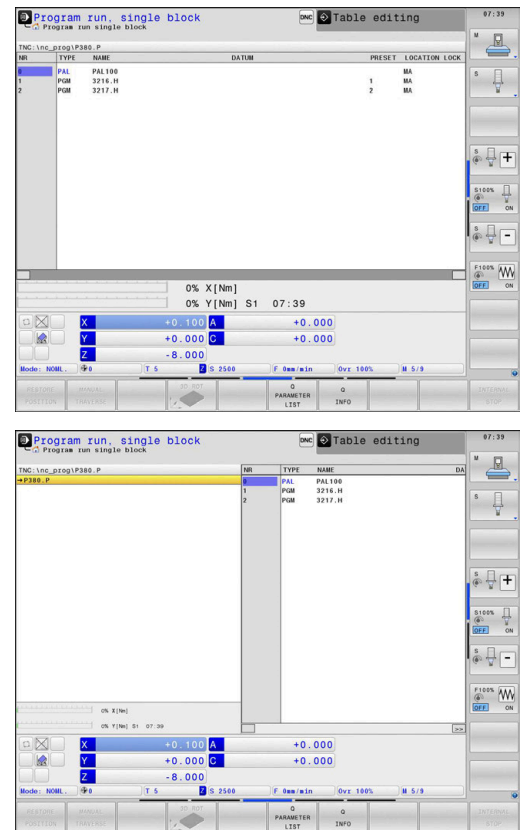


- ▶ Press the **END PGM PAL** soft key
- ▶ The control returns to the pallet table.

**i** A machine parameter defines how the control is to react after an error.

### Screen layout when executing the pallet table

If you want to see the NC program content and the content of the pallet table at the same time, select the **PALLET PROGRAM** screen layout. During execution, the control then shows NC program blocks to the left and the pallet to the right.



### Editing pallet tables

If the pallet table is active in the **Program run, full sequence** or **Program run, single block** operating mode, the soft keys for modifying the table in the **Programming** operating mode are inactive.

You can modify this table with the **EDIT PALLET** soft key in the **Program run, single block** or **Program run, full sequence** operating mode.

### Block scan in a pallet table

With the pallet management you can also use the **BLOCK SCAN** function in conjunction with pallet tables.

If you interrupt the execution of a pallet table, the control always suggests the previously selected NC block of the interrupted NC program for the **BLOCK SCAN** function.

**Further information:** "Block scan in pallet programs", Page 300

### Pallet counter

You can define a pallet counter on the control. This allows you to define the number of parts produced variably (e.g., in case of pallet handling with automatic workpiece change).

To do this, define a nominal value in the **TARGET** column of the pallet table. The control repeats the NC programs of this pallet until the nominal value is reached.

By default, every processed NC program raises the actual value by 1. If, for example, an NC program produces several workpieces, define the value in the **COUNT** column of the pallet table.

**Further information:** "Application", Page 384

## 8.2 Pallet preset management

### Fundamentals



Refer to your machine manual.

This function must be enabled and adapted by the machine manufacturer.

Changes to the pallet preset table must always be made in agreement with your machine tool builder!

The pallet preset table is available to you in addition to the workpiece preset table (**preset.pr**). The workpiece presets refer to an activated pallet preset.

The control shows the active pallet preset in the status display on the PAL tab.

### Application

Pallet presets are an easy way to compensate, for example, for mechanical differences between individual pallets.

You can also completely align the coordinate system to the pallet by, for example, positioning the pallet preset in the center of a clamping tower.

If the pallet preset changes, you need to reset the workpiece preset.

**Further information:** "Preset management", Page 202

### Using pallet presets

If you want to use pallet presets, insert the **PALPRES** column in the pallet table.

Enter the preset number from the pallet preset table into this column. Usually, you always want to change the pallet preset when you insert a new pallet, i.e. in the PAL type lines of the pallet table.

### NOTICE

#### Danger of collision!

Despite a basic rotation based on the active pallet preset, the control does not display an icon in the status display. There is a risk of collision during all subsequent axis movements!

- ▶ If necessary, check the active pallet preset in the **PAL** tab
- ▶ Check the traverse movements of the machine
- ▶ Use pallet presets only in conjunction with pallets



## 8.3 Tool-oriented machining

### Fundamentals of tool-oriented machining

#### Application



Refer to your machine manual.  
Tool-oriented machining is a machine-dependent function.  
The standard functional range is described below.

Tool-oriented machining allows you to machine several workpieces together even on a machine without pallet changer, which reduces tool-change times.

#### Limitation

### NOTICE

#### Danger of collision!

Not all pallet tables and NC programs are suitable for tool-oriented machining. With tool-oriented machining, the control no longer executes the NC programs continuously, but divides them at the tool calls. The division of the NC programs allows functions that were not reset to be effective across programs (machine states). This leads to a danger of collision during machining!

- ▶ Consider the stated limitations
- ▶ Adapt pallet tables and NC programs to the tool-oriented machining
  - Reprogram the program information after each tool in every NC program (e.g. **M3** or **M4**).
  - Reset special functions and miscellaneous functions before each tool in every NC program (e. g., **Tilt the working plane** or **M138**)
- ▶ Carefully test the pallet table and associated NC programs in the **Program run, single block** operating mode

The following functions are not permitted:

- FUNCTION TCPM, M128
- M144
- M101
- M118
- Changing the pallet preset

The following functions require special attention, particularly for mid-program startup:

- Changing the machine statuses with a miscellaneous function (e.g. M13)
- Writing to the configuration (e.g. WRITE KINEMATICS)
- Traverse range switchover
- Cycle **32**
- Cycle **800** (option 50)
- Tilting the working plane

### Pallet table columns for tool-oriented machining

Unless the machine manufacturer has made a different configuration, you need the following additional columns for tool-oriented machining:

Column	Meaning
<b>W-STATUS</b>	<p>The machining status defines the machining progress. Enter BLANK for an unmachined (raw) workpiece. The control changes this entry automatically during machining.</p> <p>The control differentiates between the following entries</p> <ul style="list-style-type: none"> <li>■ BLANK / no entry: Workpiece blank, requires machining</li> <li>■ INCOMPLETE: Partly machined, requires further machining</li> <li>■ ENDED: Machined completely, no further machining required</li> <li>■ EMPTY: Empty space, no machining required</li> <li>■ SKIP: Skip machining</li> </ul>
<b>METHOD</b>	<p>Indicates the machining method</p> <p>Tool-oriented machining is also possible with a combination of pallet fixtures, but not for multiple pallets.</p> <p>The control differentiates between the following entries</p> <ul style="list-style-type: none"> <li>■ WPO: Workpiece oriented (standard)</li> <li>■ TO: Tool oriented (first workpiece)</li> <li>■ CTO: Tool oriented (further workpieces)</li> </ul>
<b>CTID</b>	<p>The control automatically generates the ID number for mid-program startup with block scan. If you delete or change the entry, mid-program startup is no longer possible.</p>
<b>SP-X, SP-Y, SP-Z, SP-A, SP-B, SP-C, SP-U, SP-V, SP-W</b>	<p>The entry for the clearance height in the existing axes is optional.</p> <p>You can enter safety positions for the axes. The control only approaches these positions if the machine manufacturer processes them in the NC macros.</p>

## Sequence of tool-oriented machining

### Requirements

Requirements for tool-oriented machining:

- The machine manufacturer must define a tool-change macro for tool-oriented machining
- The tool-oriented machining methods TO and CTO have to be defined in the pallet table
- The NC programs are using the same tools to at least some extent
- The W-STATUS of the NC programs permits further machining

### Sequence

- 1 The entries TO and CTO tell the control that tool-oriented machining is in effect for these rows of the pallet table
- 2 The control executes the NC program with the entry TO up to the TOOL CALL
- 3 The W-STATUS changes from BLANK to INCOMPLETE and the control enters a value into the CTID field
- 4 The control executes all other NC programs with the entry CTO up to the TOOL CALL
- 5 The control uses the next tool for the following machining steps if one of the following situations applies:
  - The next table row contains the entry PAL
  - The next table row contains the entry TO or WPO
  - There are rows in the table that do not yet contain the entry ENDED or EMPTY
- 6 The control updates the entry in the CTID field with each machining operation
- 7 If all table rows of the group contain the entry ENDED, the control processes the next rows of the pallet table

### Resetting the machining status

If you want to start machining again, change the W-STATUS to BLANK or remove the previous input.

If you change the status in the PAL line, all FIX and PGM lines below this line are automatically changed, too.

## Mid-program startup with block scan

You can also return to a pallet table after an interruption. The control can show the rows and the NC block at which the interruption occurred.

If you use the block scan to start in a pallet table, the control will always execute the chosen row in the pallet table as a workpiece-oriented process.

After a block scan, the control can resume tool-oriented machining if the tool-oriented machining method TO and CTO is defined in the subsequent rows.

### Keep the following in mind for mid-program startup

- The entry in the CTID field remains there for two weeks. After this time, mid-program startup is no longer possible.
- Do not change or delete the entry in the CTID field.
- The data from the CTID field become invalid after a software update.
- The control saves the preset numbers for mid-program startup. If you change this preset, machining is shifted, too.
- Mid-program startup is no longer possible after editing an NC program within tool-oriented machining.

The following functions require special attention, particularly for mid-program startup:

- Changing the machine statuses with a miscellaneous function (e.g. M13)
- Writing to the configuration (e.g. WRITE KINEMATICS)
- Traverse range switchover
- Cycle **32** Tolerance
- Cycle **800**
- Tilting the working plane

## 8.4 Batch Process Manager (option 154)

### Application



Refer to your machine manual.  
Your machine manufacturer configures and enables the **Batch Process Manager** function.

**Batch Process Manager** enables you to plan production orders on a machine tool.

You save the planned NC programs in a job list. You use **Batch Process Manager** to open the job list.

The following information is displayed:

- Whether the NC program is free of errors
- Run time of the NC programs
- Availability of the tools
- Times at which manual interventions at the machine are necessary



The tool usage test function has to be enabled and switched on to ensure you get all information!

**Further information:** "Tool usage test", Page 153

### Fundamentals

**Batch Process Manager** is available in the following operating modes:

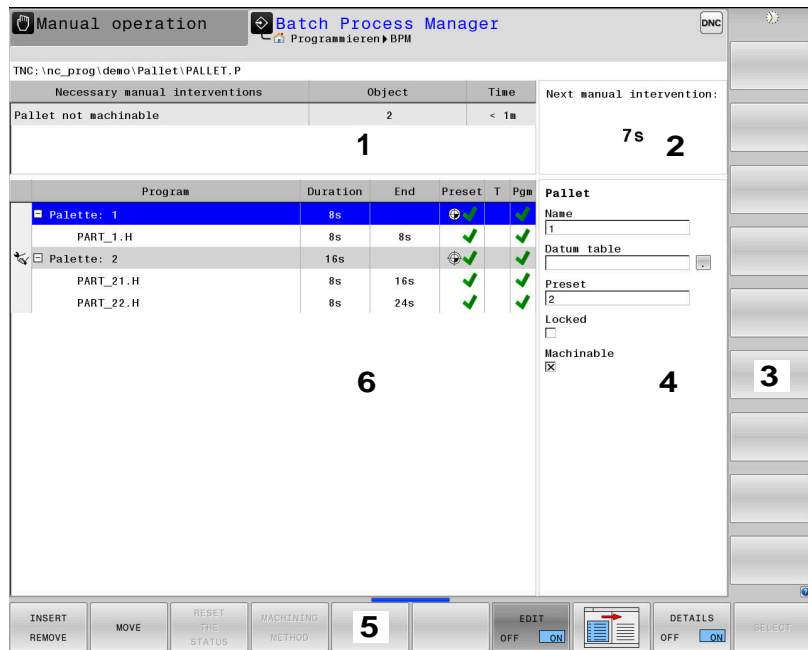
- **Programming**
- **Program run, single block**
- **Program run, full sequence**

In the **Programming** operating mode you can create and edit the job list.

The job list is executed in the **Program run, single block** and **Program run, full sequence** operating modes. Changes are possible only to a limited extent.

## Screen display

If you open **Batch Process Manager** in the **Programming** operating mode, the following screen layout is displayed:



- 1 Displays all required manual interventions
- 2 Displays the next manual intervention
- 3 Displays any current soft keys provided by the machine manufacturer
- 4 Displays the editable entries in the row highlighted in blue
- 5 Displays the current soft keys
- 6 Displays the job list





## Columns in the job list

Column	Meaning
No column name	Status of the <b>Pallet, Fixture</b> or <b>Program</b>
<b>Program</b>	Name or path of the <b>Pallet, Fixture</b> or <b>Program</b> Information about the pallet counter: <ul style="list-style-type: none"> <li>■ For rows of the <b>PAL</b> type: Current actual value (<b>COUNT</b>) and defined nominal value (<b>TARGET</b>) of the pallet counter.</li> <li>■ For rows of the <b>PGM</b> type: Value indicating by how much the actual value will be incremented after the execution of the NC program.</li> </ul> Machining method: <ul style="list-style-type: none"> <li>■ Workpiece-oriented machining</li> <li>■ Tool-oriented machining</li> </ul>
<b>Duration</b>	Run time in seconds This column is shown only if you have a 19-inch screen.

Column	Meaning
End	End of the run time <ul style="list-style-type: none"> <li>■ Time in <b>Programming</b> mode</li> <li>■ Actual time in <b>Program run, single block</b> and <b>Program run, full sequence</b> modes</li> </ul>
Preset	Status of the workpiece preset
T	Status of the inserted tools
Pgm	Status of the NC program
Sts	Machining status


The status of the **Pallet**, **Fixture** and **Program** is shown by means of symbols in the first column.

The symbols have the following meaning:

Icon	Meaning
	<b>Pallet</b> , <b>Fixture</b> or <b>Program</b> is locked
	<b>Pallet</b> or <b>Fixture</b> is not enabled for machining
	This line is currently being executed in <b>Program run, single block</b> or <b>Program run, full sequence</b> operating mode and cannot be edited
	In this line, the program was interrupted manually



In the **Program** column, the machining method is indicated by means of symbols.






The symbols have the following meaning:

Icon	Meaning
No symbol	Workpiece-oriented machining
	Tool-oriented machining <ul style="list-style-type: none"> <li>■ Start</li> <li>■ End</li> </ul>

The status is shown by means of symbols in the **Preset**, **T** and **Pgm** columns.

The symbols have the following meaning:





Icon	Meaning
	Test completed
	Collision checking completed Program simulation with active <b>Dynamic Collision Monitoring (DCM)</b> (option 40)

Icon	Meaning
	Test failed (e.g., because of expired tool life, danger of collision)
	Test not yet completed
	Incorrect program structure (e.g., pallet does not contain any subprograms)
	Workpiece preset is defined
	Check input You can assign a workpiece preset either to the pallet or to all NC subprograms.

- i** Operating notes:
- In **Programming** operating mode, the **T** column is always empty because the control first checks the status in the **Program run, single block** and **Program run, full sequence** operating modes.
  - If the tool usage test function is not enabled or is not switched on for your machine, then no icon is shown in the **Pgm** column
- Further information:** "Tool usage test", Page 153

In the **Sts** column, the machining status is indicated by means of symbols.

The symbols have the following meaning:

Icon	Meaning
	Workpiece blank, machining required
	Partially machined, requires further machining
	Completely machined, no further machining required
	Skip machining

- i** Operating notes:
- The machining status is automatically adjusted during machining
  - The **Sts** column is shown in **Batch Process Manager** only if the pallet table contains the **W-STATUS** column
- Further information:** "Tool-oriented machining", Page 393



## Opening Batch Process Manager



Refer to your machine manual.  
 In machine parameter **standardEditor** (no. 102902), your machine manufacturer specifies the standard editor used by the control.

### Programming operating mode

If the control does not open the pallet table (.p) in Batch Process Manager as a job list:

- ▶ Select the desired job list



- ▶ Shift the soft-key row



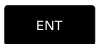
- ▶ Press the **MORE FUNCTIONS** soft key



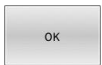
- ▶ Press the **SELECT EDITOR** soft key
- ▶ The control opens the **Select editor** pop-up window.



- ▶ Select **BPM-EDITOR**



- ▶ Confirm with the **ENT** key



- ▶ Alternative: Press the **OK** soft key
- ▶ The control opens the job list in **Batch Process Manager**.

### Program run, single block and Program run, full sequence operating modes

If the control does not open the pallet table (.p) in Batch Process Manager as a job list:



- ▶ Press the **Screen layout** key



- ▶ Press the **BPM** key
- ▶ The control opens the job list in **Batch Process Manager**.

















### Soft keys

The following soft keys are available:



Refer to your machine manual.  
 The machine manufacturer can configure his own soft keys.

Soft key	Function
	Collapse or expand tree structure
	Edit opened job list

Soft key	Function
	Shows the soft keys <b>INSERT BEFORE</b> , <b>INSERT AFTER</b> and <b>REMOVE</b>
	Move line
	Select line
	Cancel marking
	Insert a new <b>Pallet, Fixture</b> or <b>Program</b> before the cursor position
	Insert a new <b>Pallet, Fixture</b> or <b>Program</b> after the cursor position
	Delete line or block
	Switch active windows
	Select possible entries from a pop-up window
	Reset the machining status to workpiece blank
	Select workpiece-oriented or tool-oriented machining
	Perform collision checking (Option 40) <b>Further information:</b> "Dynamic Collision Monitoring (option 40)", Page 326
	Abort collision checking (Option 40)
	Collapse or expand necessary manual interventions
	Open Extended Tool Management
	Interrupt machining



Operating notes:

- The **TOOL MANAGEMENT, COLLISION CHECKING, ABORT COLLISION MONITORING** and **INTERNAL STOP** soft keys are only available in the **Program run, single block** and **Program run, full sequence** operating modes.
- If the pallet table contains the **W-STATUS** column, the **RESET THE STATUS** soft key is available.
- If the pallet table contains the **W-STATUS, METHOD**, and **CTID** columns, the **MACHINING METHOD** soft key is available.

**Further information:** "Tool-oriented machining",  
Page 393

## Creating a job list

You can only create a new job list in the file manager.



The file name of a job list must always begin with a letter.



- ▶ Press the **Programming** key



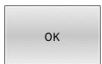
- ▶ Press the **PGM MGT** key
- > The control opens the file manager.



- ▶ Press the **NEW FILE** soft key



- ▶ Enter the file name with extension (**.p**)
- ▶ Confirm with the **ENT** key
- > The control opens the **Select table format** window.



- ▶ Select table format
- ▶ Press the **OK** soft key
- ▶ Select unit of measure **MM** or **INCH**, if necessary
- > The control opens the job list in **Batch Process Manager**.



- ▶ Press the **INSERT REMOVE** soft key



- ▶ Press the **INSERT AFTER** soft key
- > The control displays the various types on the right-hand side.
- ▶ Select the desired type
  - **Pallet**
  - **Fixture**
  - **Program**
- > The control inserts an empty line in the job list.
- > The control shows the selected type on the right-hand side.
- ▶ Define the entries
  - **Name:** Enter the name directly or select one by means of the pop-up window, if there is one
  - **Datum table:** Enter the datum directly, where applicable, or select one by means of the pop-up window
  - **Preset:** Enter the workpiece preset directly, where applicable
  - **Locked:** The selected line is excluded from machining
  - **Machinable:** The selected line is enabled for machining
- ▶ Confirm your entries by pressing the **ENT** key.



- ▶ Repeat the steps if required





- ▶ Press the **EDIT** soft key

## Editing a job list

You can edit a job list in the **Programming**, **Program run, single block**, and **Program run, full sequence** operating modes.

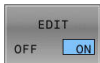


Operating notes:

- If a job list is selected in the **Program run, single block** or **Program run, full sequence** operating mode, it is not possible to edit the job list in the **Programming** operating mode.
- The possibilities of changing a job list during machining are limited, because the control defines a protected area.
- NC programs in the protected area are shown in light gray.
- If you edit the job list, the Collision checking completed  status is reset to Check completed .

To edit a line in the job list in **Batch Process Manager**:

- ▶ Open the desired job list



- ▶ Press the **EDIT** soft key



- ▶ Place the cursor on the desired line (e.g., **Pallet**)
- > The control displays the selected line in blue.
- > The control displays the editable entries on the right-hand side.

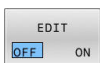


- ▶ Press the **CHANGE WINDOW** soft key, if necessary
- > The control switches the active window.
- ▶ The following entries can be changed:

- **Name**
- **Datum table**
- **Preset**
- **Locked**
- **Machinable**



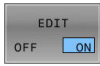
- ▶ Confirm the edited entries by pressing the **ENT** key.
- > The control adopts the changes.



- ▶ Press the **EDIT** soft key

To move a line in the job list in **Batch Process Manager**:

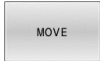
- ▶ Open the desired job list



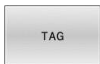
- ▶ Press the **EDIT** soft key



- ▶ Place the cursor on the desired line (e.g., **Program**)
- > The control displays the selected line in blue.



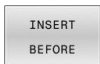
- ▶ Press the **MOVE** soft key



- ▶ Press the **TAG** soft key
- > The control highlights the line in which the cursor is positioned.



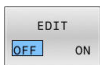
- ▶ Place the cursor on the desired position.
- > When the cursor is placed at a suitable position, the control shows the **INSERT BEFORE** and **INSERT AFTER** soft keys.



- ▶ Press the **INSERT BEFORE** soft key
- > The control inserts the line at the new position.



- ▶ Press the **GO BACK** soft key



- ▶ Press the **EDIT** soft key

# 9

**Turning**

## 9.1 Turning operations on milling machines (option 50)

### Introduction

Depending on the machine and kinematics, it is possible to perform both milling and turning operations on milling machines. A workpiece can thus be machined completely on one machine, even if complex milling and turning applications are required.

In a turning operation, the tool is in a fixed position, whereas the rotary table and the clamped workpiece rotate.

Depending on the machining direction and task, turning applications can be subdivided into different production processes, e.g.:

- Longitudinal turning
- Face turning
- Recess turning
- Thread cutting



The control provides several cycles for each of the various production processes.

**Further information:** User's Manual for **Programming of Machining Cycles**

On the control, you can simply switch between milling and turning mode within your NC program. In turning mode, the rotary table serves as lathe spindle, whereas the milling spindle with the tool is fixed. This way, it is possible to machine rotationally symmetric contours. The tool reference point must always be at the center of the lathe spindle.

When managing turning tools, other geometric descriptions than those for milling or drilling tools are required. To execute a tool-tip radius compensation, for example, the definition of the cutting-edge radius is required. The control provides a special tool table for turning tools. In tool management, the control displays only the required tool data for the current tool type.

**Further information:** "Tool data", Page 418

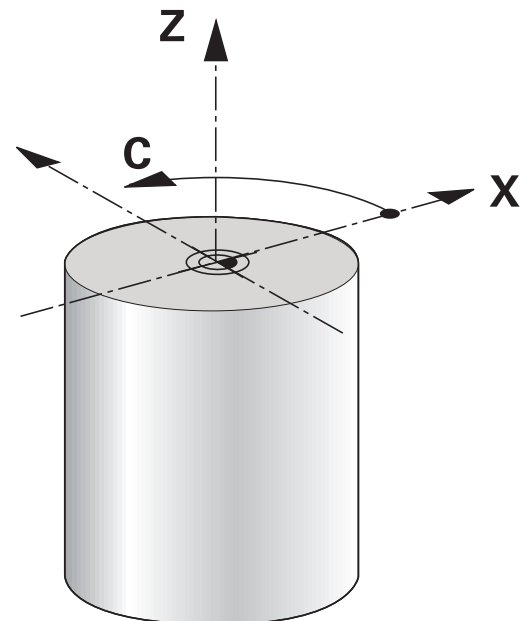
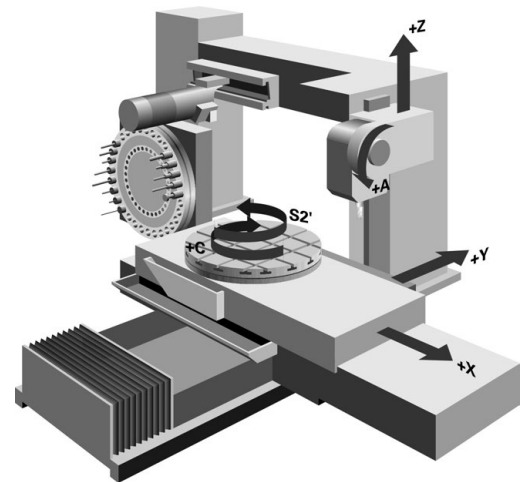
Different cycles are available for machining. These can also be used with additionally inclined rotary axes.

**Further information:** User's Manual for **Klartext Programming**

### Coordinate plane of turning operations

The assignment of the axes with turning is defined so that the X coordinates describe the diameter of the workpiece and the Z coordinates the longitudinal positions.

Machining is thus always done in the **ZX** working plane. The machine axes to be used for the required movements depend on the respective machine kinematics and are determined by the machine manufacturer. This makes NC programs with turning functions largely exchangeable and independent of the machine model.





## Tool radius compensation TRC

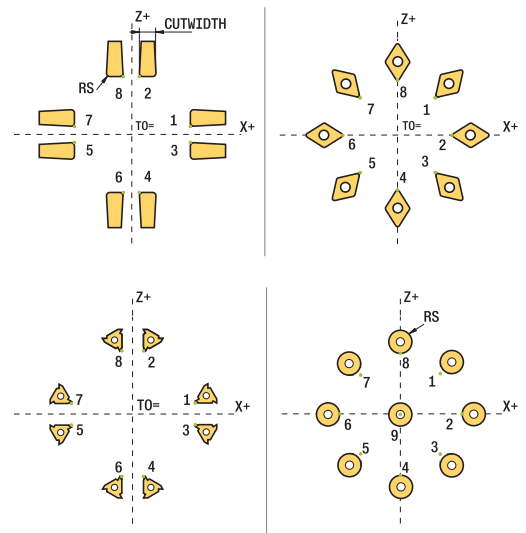
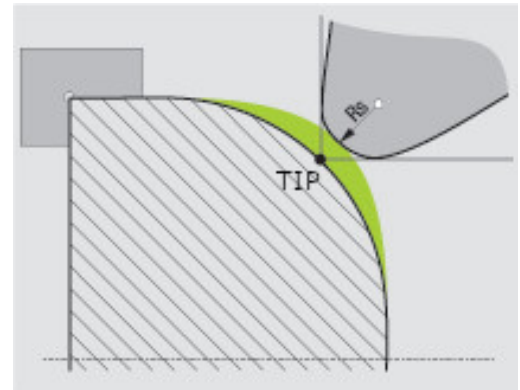
The tip of a lathe tool has a certain radius **RS**. By default, programmed paths refer to the theoretical tool tip (i.e., the longest measured values ZL, XL and YL). When you machine tapers, chamfers and radii, the cutter radius **RS** causes deviations at the contour. The tool tip radius compensation prevents such deviations.

The control determines the theoretical cutting point based on the longest measured values **ZL, XL** and **YL**.

In the turning cycles, the control automatically carries out tool radius compensation. In specific traversing blocks and within programmed contours, activate TRC with **RL** or **RR**.

The control checks the cutting geometry with the point angle **P-ANGLE** and the setting angle **T-ANGLE**. Contour elements in the cycle are processed by the control only as far as this is possible with the specific tool.

The control displays a warning when residual material is left behind due to the angle of the secondary cutting edges. You can suppress this warning with the machine parameter **suppressResMatWar** (no. 201010).

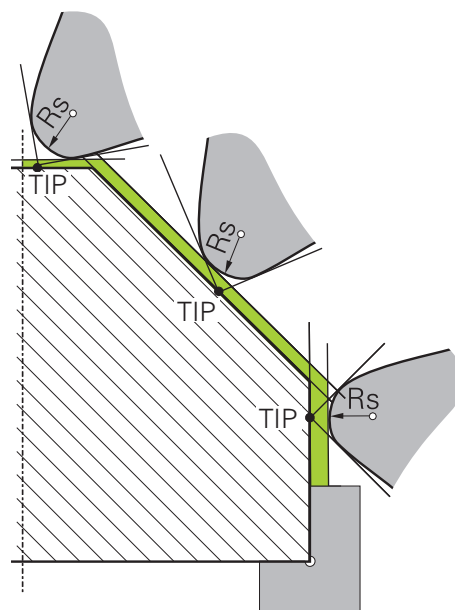


### Programming notes:

- The direction of the radius compensation is not clear when the tool-tip position (**TO=2, 4, 6, 8**) is neutral. In this case, TRC is only possible within fixed machining cycles.
- Tooth radius compensation is also possible during inclined machining.
- Active miscellaneous functions limit the possibilities here:
- With **M128** tool-tip radius compensation is possible only in combination with machining cycles
  - **M144** or **FUNCTION TCPM** with **REFPNT TIP-CENTER** also allows tooth radius compensation with all positioning blocks (e.g., with **RL/RR**)

### Theoretical tool tip

The theoretical tool tip is active in the tool coordinate system. When the tool is inclined, the position of the tool tip rotates with the tool.

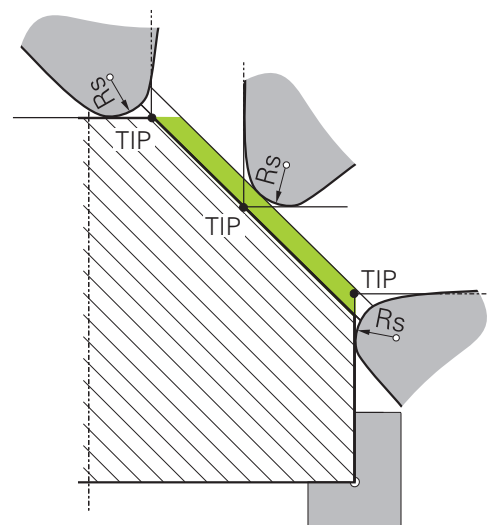


### Virtual tool tip

To activate the virtual tool tip, use **FUNCTION TCPM** with the **REFPNT TIP-CENTER** selection item. Correct tool data are required for calculating the virtual tool tip.

The virtual tool tip is active in the workpiece coordinate system. When the tool is inclined, the virtual tool tip remains unchanged as long as the tool orientation **TO** is the same. The control automatically switches the status display **TO** and thus also the virtual tool tip if the tool leaves the angle range valid for **TO 1**, for example.

The virtual tool tip enables you to perform inclined paraxial longitudinal and transverse machining operations with high contour accuracy even without radius compensation.



## 9.2 Basic functions (option 50)

### Switching between milling and turning mode




Refer to your machine manual.

The machine manufacturer configures and enables turning and switchover of the machining modes.

To switch between milling and turning operations, you must switch to the specific mode.

You can switch these operating modes with the NC functions **FUNCTION MODE TURN** and **FUNCTION MODE MILL**.

If turning mode is active, the control displays a corresponding icon in the status display.

Icon	Mode
	Turning mode active: <b>FUNCTION MODE TURN</b>
No icon	Milling mode active: <b>FUNCTION MODE MILL</b>

When the operating modes are switched, the control executes a macro that defines the machine-specific settings for the specific operating mode.

With the NC functions **FUNCTION MODE TURN** and **FUNCTION MODE MILL** you can activate a machine kinematic model that the machine manufacturer has defined and saved in the macro.

### **WARNING**

#### **Caution: Danger to the operator and machine!**

Very high physical forces are generated during turning, for example due to high rotational speeds and heavy or unbalanced workpieces. Incorrect machining parameters, neglected unbalances or improper fixtures lead to an increased risk of accidents during machining!

- ▶ Clamp the workpiece in the spindle center
- ▶ Clamp workpiece securely
- ▶ Program low spindle speeds (increase as required)
- ▶ Limit the spindle speed (increase as required)
- ▶ Eliminate unbalance (calibrate)



Programming notes:




- If the functions **Tilt working plane** (option 8) or **TCPM** (option 9) are active, you cannot switch the machining mode.
- In turning mode, no coordinate conversion cycles are permitted except for the datum shift.
- The orientation of the tool spindle (spindle angle) depends on the machining direction. The tool tip is aligned to the center of the turning spindle for outside machining. For inside machining, the tool points away from the center of the turning spindle.
- The direction of spindle rotation must be adapted when the machining direction (outside/inside machining) is changed.
- During turning, the cutting edge and the center of the turning spindle must be at the same level. During turning, the tool therefore has to be pre-positioned to the Y coordinate of the turning-spindle center.
- By means of M138, you can select the rotary axes for M128 and TCPM.




Operating notes:

- The preset must be in the center of the turning spindle in turning mode.
- In turning mode, diameter values are displayed on the X axis position display. The control then shows an additional diameter symbol.
- In turning mode, the spindle potentiometer is active for the turning spindle (rotary table).
- In turning mode you can use all manual touch probe functions, except the **Probe in plane** and **Intersection probing** cycles. In turning mode, the measured values of the X axis equate to diameter values.
- You can also use the smartSelect function to define the turning functions.
- In turning mode, the **SPA**, **SPB** and **SPC** transformations from the preset table are not permitted. If you activate one of these transformations while executing the NC program in turning mode, the control will display the **Transformation not possible** error message.

### Specifying the machining mode

-  ▶ Show the soft-key row with special functions
-  ▶ Press the **FUNCTION MODE** soft key
-  ▶ Function for machining mode: Press the **TURN** (Turning) or **MILL** (Milling) soft key

If the machine manufacturer has enabled the selection of kinematic models:

-  ▶ Press the **SELECT KINEMATICS** soft key
- ▶ Select the desired kinematics

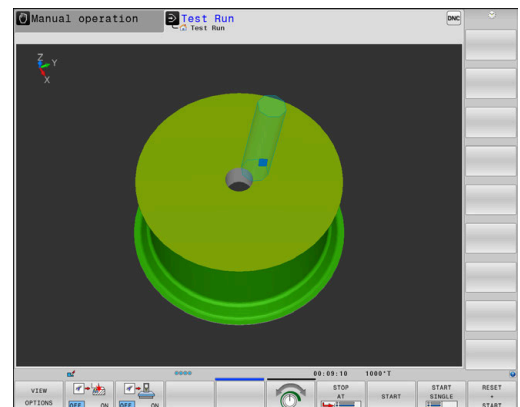
### Example

11 FUNCTION MODE TURN "AC_TABLE"	Activate turning mode
12 FUNCTION MODE TURN	Activate turning mode
13 FUNCTION MODE MILL "B_HEAD"	Activate milling mode

### Graphic display of turning operations

You can simulate turning operations in **Test Run** mode. The requirement for this is a workpiece blank definition suitable for the turning process and option number 20.

**i** The machining times determined using the graphic simulation do not correspond to the actual machining times. Reasons for this during combined milling-turning operations include the switching of operating modes.



## 9.3 Unbalance functions (option 50)

### Unbalance in turning operations

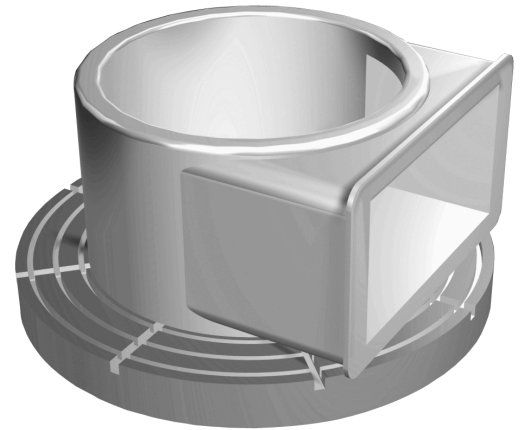
#### General information



Refer to your machine manual.

Unbalance functions are not required and available on all machine tool types.

The unbalance functions described here are basic functions that are set up and adapted to the machine by the machine manufacturer. The scope and effect of the described functions may therefore vary from machine to machine. The machine manufacturer may also provide different unbalance functions.



In a turning operation, the tool is in a fixed position, whereas the rotary table and the clamped workpiece rotate. Depending on the size of the workpiece, the mass that is set in rotation can be very large. As the workpiece rotates, it creates an outward centrifugal force.

The centrifugal force that occurs basically depends on the rotational speed, the mass and the unbalance of the workpiece. A body with an uneven mass distribution that is put into rotary motion produces an unbalance. If the mass object is rotating, this creates outward-acting centrifugal forces. If the rotating mass is evenly distributed, the centrifugal forces cancel each other out.

The unbalance is significantly influenced by the structural shape of the workpiece (e.g. an asymmetric pump housing) and by the fixtures. Because these conditions can often not be changed, compensate any existing unbalance by clamping a balancing weight.

The controls provides the **MEASURE UNBALANCE** cycle for this purpose. The cycle determines the existing unbalance and calculates the mass and position of the required balancing mass.

In the NC program, Cycle **892 CHECK UNBALANCE** checks whether the entered parameters are exceeded.

#### **⚠ WARNING**

##### **Caution: Danger to the operator and machine!**

Very high physical forces are generated during turning, for example due to high rotational speeds and heavy or unbalanced workpieces. Incorrect machining parameters, neglected unbalances or improper fixtures lead to an increased risk of accidents during machining!

- ▶ Clamp the workpiece in the spindle center
- ▶ Clamp workpiece securely
- ▶ Program low spindle speeds (increase as required)
- ▶ Limit the spindle speed (increase as required)
- ▶ Eliminate unbalance (calibrate)



Operating notes:

- The rotation of the workpiece creates centrifugal forces that lead to vibration (resonance), depending on the unbalance. This vibration has a negative effect on the machining process and reduces the tool life.
- The removal of material during machining will change the mass distribution within the workpiece. This generates the unbalance, which is why an unbalance test is recommended even between the machining steps.

### Unbalance monitor function

The Unbalance Monitor function monitors the unbalance of a workpiece in turning mode. If a maximum unbalance limit specified by the machine manufacturer is exceeded, the control issues an error message and initiates an emergency stop.

The control automatically activates the Unbalance Monitor function when you switch to turning mode. The unbalance monitor is active until you switch back to milling mode.



**Further information:** User's Manual for **Programming of Machining Cycles**





## Measure Unbalance cycle

**i** This cycle can only be run in turning mode. Activate **FUNCTION MODE TURN** beforehand.

To ensure maximum safety and minimum strain on the machine and workpiece during turning, you should check the unbalance of the clamped workpiece and compensate it with a balancing weight. The controls provides the **MEASURE UNBALANCE** cycle for this purpose.

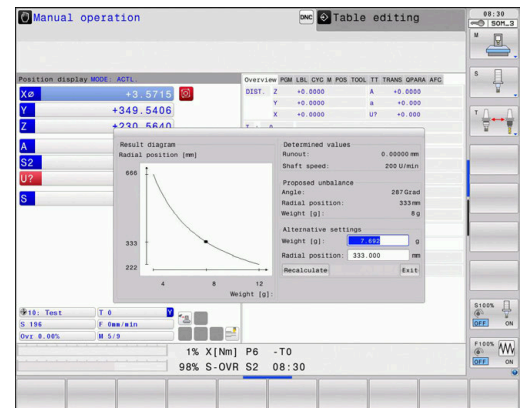
The **MEASURE UNBALANCE** cycle determines the unbalance of the workpiece and calculates the mass and position of a balancing mass.

To determine the unbalance:

-  ▶ Switch the soft-key row in the **Manual Operation** operating mode
-  ▶ Press the **MANUAL CYCLES** soft key
-  ▶ Press the **TURNING** soft key
-  ▶ Press the **MEASURE UNBALANCE** soft key
- ▶ Enter the speed for unbalance detection
- ▶ Press NC start
- ▶ The cycle starts rotating the table at a low speed and gradually increases the speed up to the defined value.
- ▶ The control displays a window that shows the calculated mass and radial position of the balancing mass.

If you wish to use a different radial position or mass for the balancing mass, you can overwrite one value and have the other value recalculated automatically.

- i** Operating notes:
- To compensate for an unbalance, several balancing weights at different positions may be required.
  - After clamping a balancing weight, the unbalance must be checked again in a measurement.





## Calibrate Unbalance cycle

### NOTICE

#### Danger of collision!

Changes to the calibration data can lead to undesired behavior. It is not recommended that the machine operator or NC programmer use the **CALIBRATE UNBALANCE** cycle. There is risk of collision during the execution of the function and during the subsequent processing!

- ▶ Use the function only in consultation with the machine manufacturer
- ▶ Refer to the machine manufacturer's documentation

The unbalance calibration is performed by the machine manufacturer before shipping the machine. With unbalance calibration, the rotary table is operated at various speeds with a defined weight mounted at a defined radial position. The measurement is repeated with different weights.

## 9.4 Tools in turning mode (option 50)

### Tool call

Just as in Milling mode, turning tools are called with the **TOOL CALL** function. You merely have to enter the tool number or tool name in the **TOOL CALL** block.



You can call and insert a turning tool both in Milling mode and in Turning mode.

### Tool selection in the pop-up window

If you open a pop-up window for tool selection, the control marks all tools available in the tool magazine green.

In addition to the tool number and tool name, the control also shows the **ZL** and **XL** columns from the turning tool table.

### Example

11 FUNCTION MODE TURN	Turning mode selection
12 TOOL CALL "TRN_ROUGH"	Tool call
...	

### Tool data

You define turning-specific tool data in the turning tool table **TOOLTURN.TRN**.

The tool number in column **T** refers to the number of the turning tool in **TOOL.T**. Geometry values such as **L** and **R** from the **TOOL.T** are not effective with turning tools.



The tool number in **TOOLTURN.TRN** must match the tool number of the turning tool in **TOOL.T**. If you enter or copy a new line you can then enter the corresponding number.

The control saves the active tool length of a turning tool to the **Q** parameter **Q114**.

In addition you must identify turning tools in the tool table **TOOL.T** as turning tools. For this, in column **TYP** select the tool type **TURN** for the appropriate tool. If you require additional geometric data for a tool you can create further indexed tools for this.

You should give other tool tables that are to be archived or used for test runs different file names of your choice with the extension **.TRN**.

To open the turning tool table:



- ▶ Select the machine operating mode (e.g. **Manual operation**)



- ▶ Press the **TOOL TABLE** soft key



- ▶ Press the **TURNING TOOLS** soft key



- ▶ Edit the turning tool table: Set the **EDIT** soft key to **ON**


T	NAME	ZL	XL	YL	DZL	DXL
S1		75	10	0	0	0
S2		75	10	0	0	0
S3		70	0	0	0	0
		120	10	0	0	0

**Tool data in the turning tool table**

Below the table window the control displays dialog text, unit specification and input range for the specific input field.



In tool management, the control only displays the input fields related to the selected tool type.

Parameter	Meaning	Input
T	Tool number: Must match the tool number of the turning tool in TOOL.T	-
NAME	Tool name: The control automatically takes on the tool name if you select the turning tool table in the tool table	<b>Input range: 32 characters max., only capital letters, no blanks</b>
ZL	Tool length 1 (Z direction)	<b>-99999.9999 to +99999.9999</b>
XL	Tool length 2 (X direction)	<b>-99999.9999...+99999.9999</b>
YL	Tool length 3 (Y direction)	<b>-99999.9999 to +99999.9999</b>
DZL	Delta value of tool length 1 (Z direction) is added to ZL	<b>-99999.9999 to +99999.9999</b>
DXL	Delta value of tool length 2 (X direction) is added to XL	<b>-99999.9999 to +99999.9999</b>
DYL	Delta value of tool length 3 (Y direction) is added to YL	<b>-99999.9999 to +99999.9999</b>
RS	Cutting edge radius: if contours were programmed with radius compensation <b>RL</b> or <b>RR</b> , the control takes the cutting edge radius into account in turning cycles, and performs cutting radius compensation	<b>-99999.9999 to +99999.9999</b>
DRS	Delta value for tool tip radius: Cutter radius oversize is added to RS.	<b>-999.9999 to +999.9999</b>
TO	Tool orientation: from the tool orientation, the control determines the position of the tool tip and, depending on the selected tool type, additional information such as the tool angle direction, position of the tool reference point, etc. This information is necessary, for example, for calculating the cutting radius compensation, milling cutter radius compensation, plunge angle, etc. <b>Further information:</b> User's Manual for Programming and Testing	<b>1...19</b>
	 Refer to your machine manual. The control displays the tool orientations that are possible for each tool type. The machine manufacturer can change this assignment.	
<b>Angle of orientation</b>	Spindle orientation angle: angle of the indexable insert to the main axis	<b>-360.0 to +360.0</b>
<b>SPB-INSERT</b>	Angular offset for recessing and threading tools, spatial angle B	<b>-90.0 to +90.0</b>
<b>T-ANGLE</b>	Setting angle for roughing and finishing tools	<b>0.0000 to +179.9999</b>
<b>P-ANGLE</b>	Point angle for roughing and finishing tools	<b>0.0000 to +179.9999</b>

Parameter	Meaning	Input
<b>CUTLENGTH</b>	Length of the cutting edge of a turning or recessing tool. The control monitors the length of the cutting edge in turning cycles that include the <b>Roughing MACHINING OPERATION</b> .  If the cutting depth defined in the turning cycle is greater than the length of the cutting edge defined in the tool table, the control issues a warning. In this case, the cutting depth will be reduced automatically in the machining cycle.	<b>0.0000 to +99999.9999</b>
<b>CUTWIDTH</b>	Cutting width of a turning or recessing tool	<b>0.0000 to +99999.9999</b>
<b>DCW</b>	Oversize f. recessing tool width	<b>-99999.9999 to +99999.9999</b>
<b>TYPE</b>	Type of turning tool: Roughing tool <b>ROUGH</b> , finishing tool <b>FINISH</b> , thread tool <b>THREAD</b> , recessing tool <b>RECESS</b> , button tool <b>BUTTON</b> , groove turning tool <b>RECTURN</b>	<b>ROUGH, FINISH, THREAD, RECESS, BUTTON, RECTURN</b>

#### Tool data required for automatic tool measurement

Cycle **485 MEASURE LATHE TOOL** enables the automatic measurement of turning tools.

**i** You need a tool touch probe with a cuboid probe contact in order to use Cycle **485 MEASURE LATHE TOOL**.

The cycle takes into account the following entries from the turning tool table:

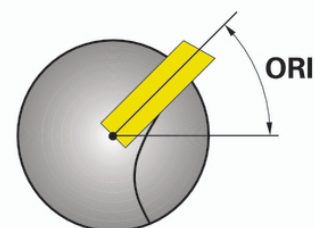
- **ZL**: tool length 1
- **XL**: tool length 2
- **DZL**: delta value for tool length 1
- **DXL**: delta value for tool length 2
- **RS**: cutting radius
- **TO**: tool orientation
- **ORI**: orientation angle of the spindle
- **TYPE**: type of turning tool

**Further information:** User's Manual for **Programming of Measuring Cycles for Workpieces and Tools**

#### Orientation angle

With the spindle orientation angle **ORI** you define the angle position of the milling spindle for the turning tool.

- i** Operating notes:
- The correct spindle angle is not only crucial for machining, but also for tool measurement.
  - The correct angle of orientation and the desired tool orientation of every newly defined tool should be checked.



### Calculating the tool compensation

The measured compensation values **DXL** and **DZL** of a turning tool can be manually compensated in the tool management. The control automatically converts the input data into the tool coordinate system.











Refer to your machine manual.

Tool management is a machine-dependent function, which may be partly or completely deactivated. The machine manufacturer defines the exact range of functions.

Parameter	Meaning	Input
<b>Compens. value WPL-Z</b>	Measured error of the workpiece in Z direction	<b>-99999.9999...+99999.9999</b>
<b>Compensation ØWPL-X</b>	Measured error of the workpiece in X direction (diameter)	<b>-99999.9999...+99999.9999</b>
<b>Inclination angle β</b>	Inclination angle during machining	<b>0.0000 to +179.9999</b>
<b>Reverse the tool</b>	Definition of whether the turning tool was used in a rotated position in the tool spindle.	-
<b>Current value of DZL</b>	Current calculated value for the tool	-
<b>Current value of DXL</b>	Current calculated value for the tool	-
<b>New value of DZL</b>	New calculated value for the tool	-
<b>New value of DXL</b>	New calculated value for the tool	-

## Procedure

To modify the compensation values, proceed as follows:

- 
  - ▶ Select any machine operating mode (e.g., **Manual operation**)
- 
  - ▶ Press the **TOOL TABLE** soft key
- 
  - ▶ Press the **TOOL MANAGEMENT** soft key
- 
  - ▶ Press the **FORM FOR TOOL** soft key
- 
  - ▶ Set the **EDIT** soft key to **ON**
- 
  - ▶ Use the arrow keys to select the **DXL** or **DZL** input field
- 
  - ▶ Press the **CALCULATE TOOL COMPENSTN.** soft key
    - > The control opens a pop-up window.
    - > Enter the compensation values
  - ▶ Press the **APPLY** soft key, if necessary
    - > The control loads the compensation values. You can then enter further compensation values.
- 
  - ▶ Press the **OK** soft key
    - > The control closes the pop-up window and saves the new compensation values to the tool table.



The control can describe the **DXL** and **DZL** columns using the touch probe cycles.

**Further information:** User's Manual for Measuring Cycles for Workpieces and Tools

## Example

Input:

- **Compens. value WPL-Z:** 1
- **Compensation ØWPL-X:** 1
- **Inclination angle β:** 90
- **Reverse the tool:** Yes

Result:

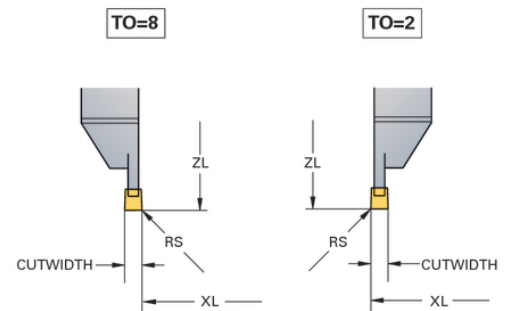
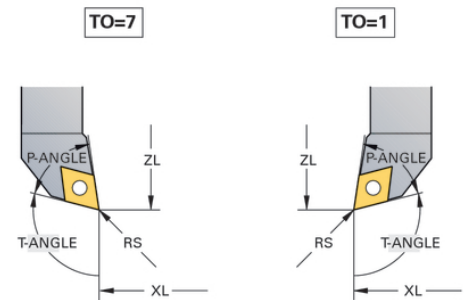
- **DZL:** +0.5
- **DXL:** +1

**Tool data for turning tool**

Parameter	Meaning	Input
ZL	Tool length (#1)	Required
XL	Tool length (#2)	Required
YL	Tool length (#3)	Optional
DZL	Wear compensation <b>ZL</b>	Optional
DXL	Wear compensation <b>XL</b>	Optional
DYL	Wear compensation <b>YL</b>	Optional
RS	Cutting radius	Required
TO	Tool orientation	Required
<b>Angle of orientation</b>	Orientation angle	Required
<b>T-ANGLE</b>	Tool angle	Required
<b>P-ANGLE</b>	Point angle	Required
TYPE	Tool type	Required

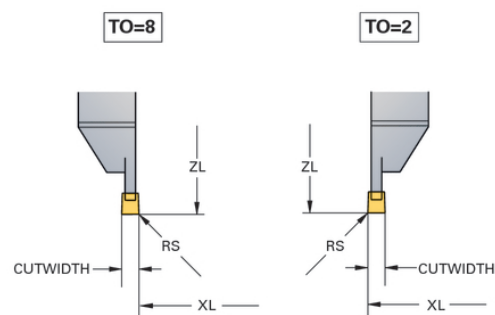
**Tool data for recessing tools**

Parameter	Meaning	Input
ZL	Tool length 1	Required
XL	Tool length 2	Required
YL	Tool length 3	Optional
DZL	Wear compensation <b>ZL</b>	Optional
DXL	Wear compensation <b>XL</b>	Optional
DYL	Wear compensation <b>YL</b>	Optional
RS	Cutting radius	Required
TO	Tool orientation	Required
ORI	Angle of orientation	Required
<b>CUTWIDTH</b>	Width of the recessing tool	Required
<b>SPB-INSERT</b>	Angular offset	Required
<b>DCW</b>	Oversize f. recessing tool width	Optional
TYPE	Tool type	Required



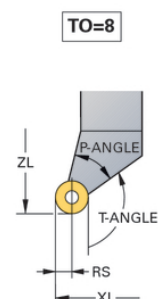
### Tool data for groove turning tools

Parameter	Meaning	Input
ZL	Tool length (#1)	Required
XL	Tool length (#2)	Required
YL	Tool length (#3)	Optional
DZL	Wear compensation <b>ZL</b>	Optional
DXL	Wear compensation <b>XL</b>	Optional
DYL	Wear compensation <b>YL</b>	Optional
RS	Cutting radius	Required
TO	Tool orientation	Required
<b>Angle of orientation</b>	Orientation angle	Required
CUTLENGTH	Cutting length of recessing tool	Required
CUTWIDTH	Width of the recessing tool	Required
SPB-INSERT	Angular offset	Required
DCW	Oversize f. recessing tool width	Optional
TYPE	Tool type	Required



### Tool data for button tools

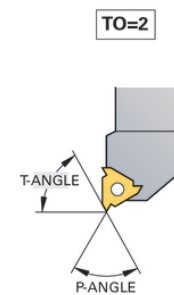
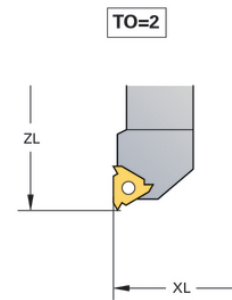
Parameter	Meaning	Input
ZL	Tool length (#1)	Required
XL	Tool length (#2)	Required
YL	Tool length (#3)	Optional
DZL	Wear compensation <b>ZL</b>	Optional
DXL	Wear compensation <b>XL</b>	Optional
DYL	Wear compensation <b>YL</b>	Optional
RS	Cutting radius	Required
TO	Tool orientation	Required
<b>Angle of orientation</b>	Orientation angle	Required
T-ANGLE	Tool angle	Required
P-ANGLE	Point angle	Required
TYPE	Tool type	Required





**Tool data for threading tools**

Parameter	Meaning	Input
<b>ZL</b>	Tool length (#1)	Required
<b>XL</b>	Tool length (#2)	Required
<b>YL</b>	Tool length (#3)	Optional
<b>DZL</b>	Wear compensation <b>ZL</b>	Optional
<b>DXL</b>	Wear compensation <b>XL</b>	Optional
<b>DYL</b>	Wear compensation <b>YL</b>	Optional
<b>TO</b>	Tool orientation	Required
<b>Angle of orientation</b>	Orientation angle	Required
<b>T-ANGLE</b>	Tool angle	Required
<b>P-ANGLE</b>	Point angle	Required
<b>SPB-INSERT</b>	Angular offset	Required
<b>TYPE</b>	Tool type	Required

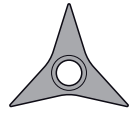


**Example: FreeTurn tool (option 50)**

You need the following tool data for a FreeTurn tool:



Integrating information about the point angles **P-ANGLE** and the tool length **ZL** (for example, **FT1\_35-35-35\_100**) into the tool name is recommended.



FreeTurn tool with three finishing teeth

Icon and parameter	Meaning	Intended use
<b>ZL</b>	Tool length 1	The tool length <b>ZL</b> equals the total tool length, relating to the tool carrier preset.
<b>XL</b>	Tool length 2	The tool length <b>XL</b> equals the difference between the spindle center and the tool tip of the tooth. <b>XL</b> must always be defined as a negative value with FreeTurn tools.
<b>YL</b>	Tool length 3	The tool length <b>YL</b> is always 0 with FreeTurn tools.
<b>RS</b>	Cutting radius	You can take the radius <b>RS</b> from the tool catalog.
<b>TYPE</b>	Lathe tool type	You select between a rough-turning tool ( <b>ROUGH</b> ) and finishing tool ( <b>FINISH</b> ).
<b>TO</b>	Tool orientation	The tool orientation <b>TO</b> is always 18 with FreeTurn tools. 
<b>ORI</b>	Angle of orientation	The angle of orientation <b>ORI</b> defines the offset of the single teeth with respect to one another. If the first tooth has the value 0, define the second tooth of symmetrical tools at 120 and the third tooth at 240.
<b>P-ANGLE</b>	Point angle	You can get the point angle <b>P-ANGLE</b> from the tool catalog.
<b>CUTLENGTH</b>	Cutting-edge length	You can get the tooth length <b>CUTLENGTH</b> from the tool catalog.
	Toolcarrier kinematics	Using the optional tool-carrier kinematics, the control can monitor the tool for collisions, for example. Assign the same kinematics to each single tooth.

## Tool compensation in the NC program

With **FUNCTION TURNDATA CORR** you can define additional compensation values for the active tool. In the **TURNDATA CORR FUNCTION** you can enter delta values for tool lengths in the X direction **DXL** and in the Z direction **DZL**. The compensation values have an additive effect on the compensation values from the turning tool table.

With **FUNCTION TURNDATA CORR-TCS** you can define a cutter radius oversize **DRS**. This enables you to program an equidistant contour oversize. **DCW** allows you to compensate the recessing width of a recessing tool.

**FUNCTION TURNDATA CORR** is always effective for the active tool. A renewed **TOOL CALL** deactivates compensation again. When you exit the NC program, the control automatically resets the compensation values.

When you exit the NC program (e.g. with PGM MGT), the control automatically resets the compensation values.

When you enter the **FUNCTION TURNDATA CORR** function, you can define where tool compensation will be active using soft keys:

- **FUNCTION TURNDATA CORR-TCS**: Tool compensation is active in the tool coordinate system
- **FUNCTION TURNDATA CORR-WPL**: Tool compensation is active in the workpiece coordinate system



- The control shows delta values from the tool management graphically in the simulation. For delta values from the NC program or from compensation tables, the control changes only the position of the tool in the simulation.

The values of the function **FUNCTION TURNDATA CORR** take the effect of delta values from the NC program.

- Tool compensation **FUNCTION TURNDATA CORR-TCS** is always active in the tool coordinate system, even during inclined machining.



During interpolation turning, the functions **FUNCTION TURNDATA CORR** and **FUNCTION TURNDATA CORR-TCS** are not active.

If you want to compensate for a turning tool in Cycle **292 CONTOUR.TURNG.INTRP.**, compensation needs to be performed in the cycle or in the tool table.

**Further information:** User's Manual for **Programming of Machining Cycles**

### Defining the tool compensation

To define tool compensation in the NC program:

SPEC  
FCT

- ▶ Press the **SPEC FCT** key

TURNING  
PROGRAM  
FUNCTIONS

- ▶ Press the **TURNING PROGRAM FUNCTIONS** soft key

FUNCTION  
TURNDATA

- ▶ Press the **FUNCTION TURNDATA** soft key

TURNDATA  
CORR

- ▶ Press the **TURNDATA CORR** soft key



As an alternative to tool compensation with **TURNDATA CORR**, you can use compensation tables.

**Further information:** User's Manual for **Klartext Programming** or **ISO Programming**

### Example

```
21 FUNCTION TURNDATA CORR-TCS:Z/X DZL:0.1 DXL:0.05
```

```
...
```

# 10

**Grinding**

## 10.1 Grinding operations on milling machines (option 156)

### Introduction



Refer to your machine manual.

Grinding must be configured and enabled by your machine manufacturer. Some functions and cycles may not be available on your machine tool.

Special types of milling machines allow performing both milling and grinding operations. A workpiece can thus be machined completely on one machine, even if complex milling and grinding operations are required.

The term grinding encompasses many types of machining that differ in quite a few respects, e.g.:

- Jig grinding
- Cylindrical grinding
- Surface grinding



The TNC 640 currently features jig grinding.




### Grinding tools

When managing grinding tools, other geometric descriptions than those for milling or drilling tools are required. The control provides special form-based tool management for grinding and dressing tools.

If grinding is enabled on your milling machine, (option 156), the dressing function is also available. This means that you can shape or resharpen the grinding wheel in the machine.

**Further information:** "Entering tool data", Page 434

## Jig grinding

 The control provides various cycles for the specific jig grinding or dressing movements.

**Further information:** User's Manual for **Programming of Machining Cycles**

Jig grinding is the grinding of a 2D contour. The tool movement in the plane is optionally superimposed by a reciprocation movement along the active tool axis.

On a milling machine, jig grinding will mainly be used for finishing a pre-machined contour with a grinding tool. There is not much of a difference between jig grinding and milling. Instead of a milling cutter, a grinding tool is used, such as a grinding pin or a grinding wheel. Jig grinding produces more precise results and a better surface quality than milling.

Machining is performed in milling mode, i.e. with **FUNCTION MODE MILL**.

Grinding cycles provide special movements for the grinding tool. A stroke or oscillating movement, the so-called reciprocating stroke, is superimposed with the movement in the working plane.

Grinding is also possible with a tilted working plane. The tool reciprocates along the active tool axis in the current working plane coordinate system (**WPL-CS**).


### Reciprocating stroke

For jig grinding, the movement of the tool in the plane can be superimposed by a stroke movement, the so-called reciprocating stroke. The superimposed stroke movement is applied in the active tool axis.

You define an upper and a lower stroke limit and can start and stop the reciprocating stroke and reset the corresponding values. The reciprocating stroke is active until you stop it. **M2** or **M30** will stop the reciprocating stroke automatically.

The control provides cycles for defining, starting, and stopping reciprocating strokes.

As long as the reciprocating stroke is active in a started NC program, you cannot select the **Manual Operation** or **Positioning w/ Manual Data Input** operating mode.

 Operating notes:

- The reciprocating stroke continues to be effective during a programmed stop with **M0** and in **Program run, single block** operating mode even after the end of an NC block.
- The control does not support block scans while the reciprocating stroke is active.



Refer to your machine manual.

Your machine manufacturer can define which override is to be effective for the reciprocating stroke movement.

### Graphic display of the reciprocating stroke

The graphic simulation in the **Program run, single block** and **Program run, full sequence** operating modes shows the superimposed stroke movement.

### Structure of the NC program

An NC program for grinding is structured as follows:

- Dressing of the grinding tool, if required
- Defining the reciprocating stroke
- If necessary, explicitly starting the reciprocating stroke
- Moving along the contour
- Stopping the reciprocating stroke

You can use specific machining cycles (e.g., cycles for grinding, for machining pockets or studs, or SL cycles) to define the contour.

With a grinding tool, the control behaves in the same way as with a milling cutter.

- If no cycle has been programmed and a contour is being ground whose smallest inside radius is smaller than the tool radius, the control will display an error message.
- If you machine with SL cycles, only those areas will be ground that are suitable for the given tool radius. In this case, the resulting contour will not be completely finished and may need to be reworked.

**Further information:** User's Manual for **Programming of Machining Cycles**

### Compensation in the grinding process

In order to achieve the required precision, you can use compensation tables during jig grinding.

**Further information:** User's Manual for **Klartext Programming**



## 10.2 Tools for grinding (Option 156)

### Grinding tool

In tool management, a special **grinding tool** tool type is available. You can call a grinding tool with **TOOL CALL**.

#### Example

```
5 TOOL CALL "GRIND" Z S15000 F200
```

The **DL** and **DR** compensation values are not compatible with grinding tools. If you program **DL** or **DR**, the control will display an error message.

For tool compensation, the control will automatically apply the compensation values stored in tool management. If you need to correct the grinding process, make sure to use the compensation tables.

**Further information:** User's Manual for **Klartext Programming** or **ISO Programming**

### Cutting edges of a grinding tool

Each grinding tool has several cutting edges, each with its own orientation and edge radius compensation. Select the desired cutting edge with Cycle **1030 ACTIVATE WHEEL EDGE**.

For jig grinding, orientation 9 is mainly used. This orientation corresponds to the cutting edge of a milling cutter. For dressing, other wheel edges will be required as well. If you do not select a cutting edge, the control will automatically select orientation 9 for the grinding tool.

**Further information:** User's Manual for **Programming of Machining Cycles**

### Dressing tool

In tool management, a special **dressing tool** tool type is available. Define the dressing tool in tool management and call it with **TOOL CALL**.

Depending on the dressing tool, you need to specify a rotational speed when calling the tool.



Refer to your machine manual.

The dressing tool will not be mounted to the spindle. You need to mount the dressing tool manually to a pocket defined by the machine manufacturer. Additionally, you must define the tool in the pocket table.

**Further information:** "Pocket table for tool changer", Page 148

If you require additional geometric data for a dressing tool, you can create further indexed tools for it.

## Entering tool data

Define the specific data of grinding and dressing tools in the form-based tool management.

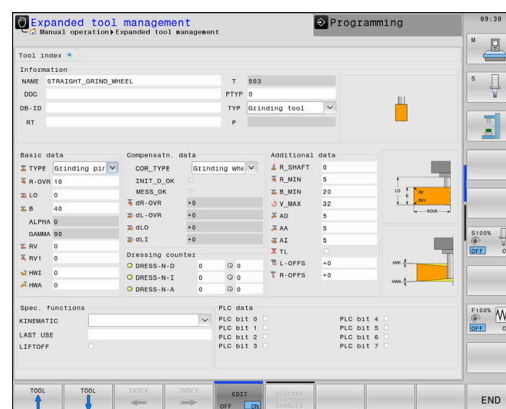
The control stores the tool data automatically in the **TOOLGRIND.GRD** file (for grinding tools) and in the **TOOLDRESS.DRS** file (for dressing tools).

### NOTICE

#### Danger of collision!

In the tool management form, the control displays only the parameters relevant to the selected tool type. The tool tables contain locked parameters that are for internal consideration only. If you edit these additional parameters manually, tool data might no longer correctly match each other. There is a risk of collisions during subsequent movements!

- ▶ Edit the tools in the tool management form



To open tool management:



- ▶ Select the machine operating mode, e.g. **Manual operation**



- ▶ Press the **TOOL TABLE** soft key



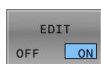
- ▶ Press the **TOOL MANAGEMENT** soft key

You must indicate the tool type of grinding and dressing tools.

Proceed as follows:



- ▶ Press the **FORM FOR TOOL** soft key



- ▶ Press the **EDIT** soft key
- ▶ Enter the tool type.
- ▶ The control displays the form for the specific tool data.

**General tool data**

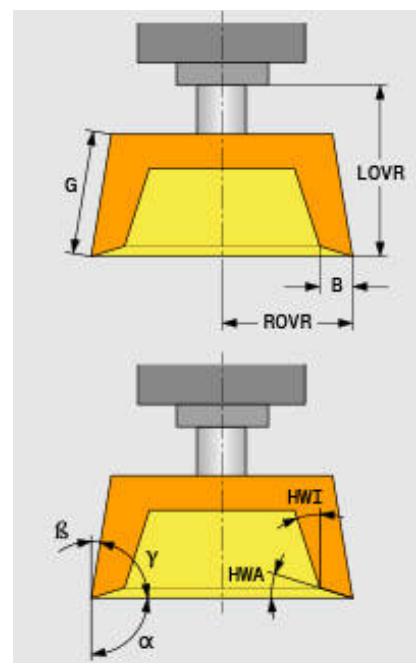
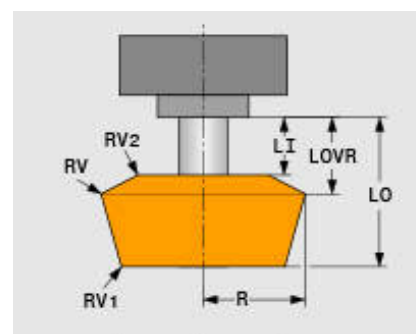
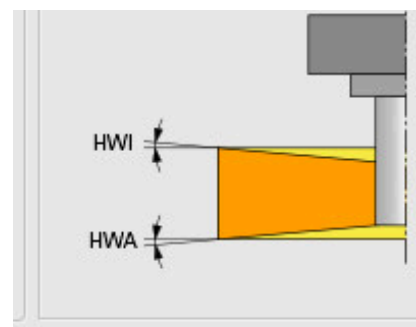
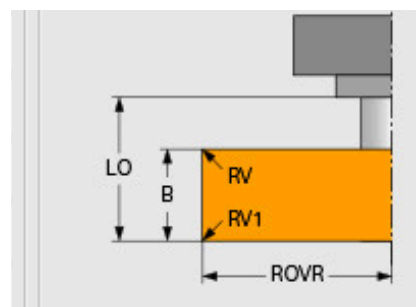
<b>Parameter</b>	<b>Meaning</b>	<b>Input</b>
<b>T</b>	Number by which the tool is called in the NC program (e.g.: 5, indexed: 5.2)	-
<b>NAME</b>	Name by which the tool is called in the NC program	<b>Input range: 32 characters max., only capital letters, no blanks</b>
<b>DOC</b>	Comment on the tool	<b>32 characters</b>
<b>PTYP</b>	Tool type for evaluation in the pocket table Refer to your machine manual. Function is defined by the machine manufacturer!	<b>0 to 99</b>
<b>TL</b>	Set tool lock ( <b>TL</b> for <b>T</b> ool <b>L</b> ocked)	<b>Tool locked? Yes=ENT/No=NOENT</b>
<b>P</b>	Pocket number of the tool in the tool magazine	-
<b>RT</b>	Number of a replacement tool ( <b>RT</b> for <b>R</b> eplacement <b>T</b> ool) An empty field or input <b>0</b> means there is no replacement tool	<b>0 to 32767</b>
<b>PLC data</b>	Information on this tool that is to be sent to the PLC	<b>PLC bits 0 to 8</b>

### Tool data for grinding tools



In tool management, the control only displays the input fields related to the selected tool type.

Parameter	Meaning
<b>TYPE</b>	Type of grinding tool: <ul style="list-style-type: none"> <li>■ Grinding pin (cylindrical), PIN</li> <li>■ Grinding pin (conical), CONE</li> <li>■ Cup wheel, CUP</li> <li>■ Straight wheel, CYLINDER</li> <li>Currently no function</li> <li>■ Slant wheel, ANGULAR</li> <li>Currently no function</li> <li>■ Facing wheel, FACE</li> <li>Currently no function</li> </ul>
<b>R-OVR</b>	Radius
<b>L-OVR</b>	Overhang
<b>LO</b>	Overall length
<b>LI</b>	Length to the inner edge
<b>B</b>	Width
<b>G</b>	Depth
<b>R_SHAFT</b>	Radius of the tool shank
<b>ALPHA</b>	Angle for the slant
<b>GAMMA</b>	Angle for the corner
<b>RV</b>	Radius at the edge of <b>L-OVR</b>
<b>RV1</b>	Radius at the edge of <b>LO</b>
<b>RV2</b>	Radius at the edge of <b>LI</b>
<b>COR_TYPE</b>	Correction method You can choose between the following compensation methods: <ul style="list-style-type: none"> <li>■ Grinding wheel with compensation, <b>COR_TYPE_GRINDTOOL</b> Compensation method with material removal at grinding tool</li> <li>■ Dressing tool with wear, <b>COR_TYPE_DRESSTOOL</b> Compensation method with material removal at dressing tool</li> </ul>
<b>Further information:</b> User's Manual for <b>Klartext Programming</b>	
<b>INIT_D_OK</b>	Initial dressing performed
<b>MESS_OK</b>	Grinding tool measured
<b>T-DRESS</b>	Tool number of the dresser
<b>DR_OVR</b>	Radius compensation value



Parameter	Meaning
DL_OVR	Compensation value for the overhang
DLO	Compensation value for the total length
DLI	Compensation value for the length to the inner edge
HWI	Angle for the relief cut on the inner side
HWA	Angle for the relief cut on the outer side
RMIN	Min. permissible radius
BMIN	Min. permissible width
VMAX	Maximum permissible cutting speed

**Additional data for dressing**

For grinding tools to be dressed, you need to define the following additional tool data:

Parameter	Meaning
AD	Retraction amount at the diameter
AA	Retraction amount at the outer edge
AI	Retraction amount at the inner edge

The dressing cycles automatically use these retraction amounts. There is no need to define approach or departing movements for the dressing contour.







Parameter	Meaning
DRESS-N-D	Dressing counter Diameter dressing
DRESS-N-I	Dressing counter Inner edge dressing
DRESS-N-A	Dressing counter Outer edge dressing

The left-hand side displays the nominal values programmed in the dressing cycle. The nominal value defines how often a dressing cycle will be called without being executed by the control.

The right-hand side displays the actual values, i.e. how often the dressing cycle has been skipped. You can change the actual value manually.

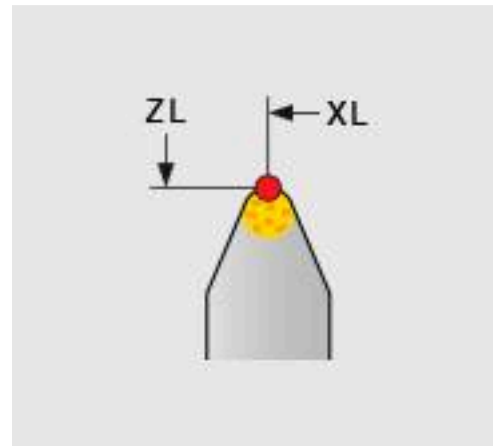
If the actual value and the nominal value are identical, the control will run the dressing cycle and delete the actual value.

 AD	0
 AA	0
 AI	0

Dressing counter			
 DRESS-N-D	0		0
 DRESS-N-I	0		0
 DRESS-N-A	0		0

**Tool data for dressing tools**

Parameter	Meaning
ZL	Tool length 1 (Z direction)
XL	Tool length 2 (X direction)
YL	Tool length 3 (Y direction)
RS	Cutting radius
CUTWIDTH	Width of tooth This is available only with the dressing tool types below: <ul style="list-style-type: none"> <li>■ <b>Stationary dresser (flat), FIXFLAT</b></li> <li>■ <b>Rotating dresser (flat), ROTFLAT</b></li> </ul>
TYPE	Type of dressing tool: <ul style="list-style-type: none"> <li>■ <b>Stationary dresser (with radius), FIXRADIUS</b></li> <li>■ <b>Horn-type dresser, HORNED</b> Currently no function</li> <li>■ <b>Rotating dresser (with radius), ROTRADIUS</b></li> <li>■ <b>Stationary dresser (flat), FIXFLAT</b></li> <li>■ <b>Rotating dresser (flat), ROTFLAT</b></li> </ul>
TO	Tool orientation
DZL	Oversize for tool length 1 (Z direction)
DXL	Oversize for tool length 2 (X direction)
DYL	Oversize for tool length 3 (Y direction)
DRS	Cutting radius oversize



## Grinding tool setup

HEIDENHAIN recommends the following sequence for grinding tool setup. It ensures that the control acquires the correct tool data to maintain the required grinding precision.



Depending on the tool to be used, you do not need to perform each step.

### NOTICE

#### Danger of collision!

Changing or deleting grinding tool data directly in the tool table can result in undefined states at the machine. Incomplete tool definitions may lead to collisions between the tool and machine components or the workpiece!

- ▶ Make sure to adhere to the sequence when setting up grinding tools
- ▶ Only create grinding tools in tool management
- ▶ You can adjust the tool data using compensation in the cycles

To set up a grinding tool:

- ▶ Enter the basic data for the grinding wheel in tool management  
**Further information:** "Defining the basic data of the grinding wheel", Page 440
- ▶ Alternatively, use Cycle **1032 GRINDING WHL LENGTH COMPENSATION** and Cycle **1033** for an entry in the tool table **GRINDING WHL RADIUS COMPENSATION**
- ▶ Initial dressing  
**Further information:** "Initial dressing", Page 440
- ▶ The control enables the checkbox for **INIT\_D** in tool management.
- ▶ Measure the grinding wheel  
**Further information:** "Measuring the grinding wheel", Page 441



Grinding tools that do not need dressing, such as diamond grinding wheels, can be measured directly. The control applies the compensations to the basic data.  
The **INIT\_D** and **MESS\_OK** flags are irrelevant in this case.

### Defining the basic data of the grinding wheel

If the grinding wheel has not been created on the machine yet, the control requires its basic data first. You can either enter this data manually in tool management or have the grinding wheel measured in the machine.

If you enter the basic data manually, make sure not to enable the **INIT\_D** checkbox. If the **INIT\_D** flag is set, you cannot edit the basic data. While you can remove the checkmark manually, it is not possible to set it manually.



If you use Cycle **1032 GRINDING WHL LENGTH COMPENSATION** to enter the basic data, the cycle will automatically delete any existing compensation values and set the required tool data.

**Further information:** User's Manual for **Programming of Machining Cycles**

### NOTICE

#### Danger of collision!

For dressing, the basic data defines the distance between the dressing tool and the grinding tool. If the measured values are not accurate, especially if they are too small, a collision might occur during the first dressing run because the actual dressing value is larger than the programmed one.

- ▶ When manually inputting the basic values, enter values that are slightly larger than the measured ones
- ▶ Alternatively, have the grinding tool measured in the machine. The values are automatically entered in tool management

### Initial dressing

Dressing a grinding tool for the first time is referred to as initial dressing. If a tool has not been dressed yet, the **INIT\_D** flag is not set in tool management.

The relation between the grinding wheel and the dressing tool is not accurate before initial dressing. If you defined the grinding wheel larger than it is, the first dressing strokes will be performed in the air.

The control only considers the basic data of the grinding wheel for dressing.

Continue dressing until the programmed dressing amounts have actually been removed. Only then, the basic data of the grinding wheel match the dressing system used.

**Further information:** User's Manual for **Programming of Machining Cycles**

**Further information:** User's Manual for **Klartext Programming** or **ISO Programming**

After dressing, the basic data you entered no longer match the actual measured values at the grinding tool. Correct this difference by measuring the grinding tool again after the dressing procedure.

Basic data	
TYPE	Grinding pir
R-OVR	10
LO	0
B	40
ALPHA	0
GAMMA	90
RV	0
RV1	0
HWI	0
HWA	0

Compensation data	
COR_TYPE	Grinding whe
INIT_D_OK	<input type="checkbox"/>
MESS_OK	<input type="checkbox"/>



### Measuring the grinding wheel

If you performed initial dressing, the actual grinding tool dimensions probably no longer match the basic data. For this reason, have the grinding tool measured again.

To enter the correct compensation values into tool management, use Cycles **1032 GRINDING WHL LENGTH COMPENSATION** and **1033 GRINDING WHL RADIUS COMPENSATION**. After initial dressing, the control will only change the compensation values in order to avoid altering the relations to be used for further dressing procedures.



Refer to your machine manual.

The control can set the **MESS\_OK** flag, depending on how you measured the grinding tool. This flag indicates that the tool has been measured after initial dressing.

**Further information:** User's Manual for **Programming of Machining Cycles**

MESS_OK	<input type="checkbox"/>
dR - OVR	+0
dL - OVR	+0
dLO	+0



# 11

**MOD Functions**

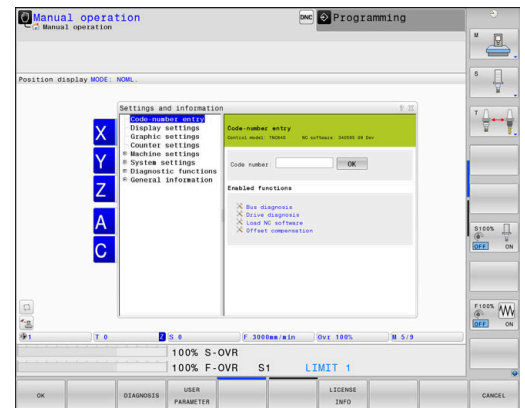
## 11.1 MOD function

The MOD functions provide additional input possibilities and displays. In addition, you can enter code numbers to enable access to protected areas.

### Selecting MOD functions

To open the MOD menu:

- ▶ Press the **MOD** key
- ▶ The control opens a pop-up window displaying the available MOD functions.



### Changing the settings

Navigation in the MOD menu is possible with the mouse and the alphabetic keyboard alike.

- ▶ Use the tab key to switch from the input area in the right window to the group and function selections in the left window
- ▶ Select the desired MOD function
- ▶ Switch to the input field with the tab key or ENT key
- ▶ Enter the required value for the function and confirm with **OK** or make a selection and confirm with **Apply**

**i** If there are multiple possible settings available, then you can show the selection box by pressing the **GOTO** key. Select the desired setting with the **ENT** key. If you do not wish to change the setting, close the window with the **END** key.

### Exiting MOD functions

To exit the MOD menu:

- ▶ Press the **END** soft key or the **END** key
- ▶ The control closes the pop-up window.

## Overview of MOD functions

The following groups with subordinate areas and functions are available independently of the selected operating mode:

### Code-number entry

- Code number

### Display settings

- Position display
- Measuring unit (mm/inch) for position display
- Program entry for MDI
- Show time of day
- Show the info line

### Graphic settings

- Model type
- Model quality

### Counter settings

- Momentary count
- Target value for counter

### Machine settings

- Kinematics
- Traverse limits
- Tool-usage file
- External access
- Set up wireless handwheel
- Set up touch probes

### System settings

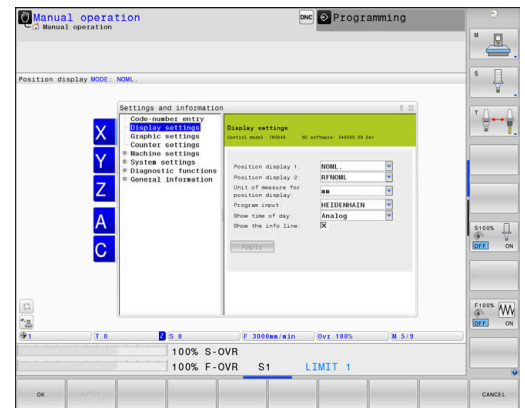
- Set the system time
- Define the network connection
- Network: IP configuration

### Diagnostic functions

- Bus diagnosis
- TNCdiag
- Drive diagnosis
- Hardware configuration
- HEROS information

### General Information

- Version information
- Info about machine manufacturer
- Machine information
- License information
- Machine times



The **Info about machine manufacturer** area is available after the machine manufacturer has defined the machine parameter **CfgOemInfo** (no. 131700).

The **Machine information** area is available after the machine operator has defined the machine parameter **CfgMachineInfo** (no. 131600).

## 11.2 Displaying software numbers

### Application

In the **Version Information** MOD area of the **General Information** group, the control displays the following information on the software:

- **Control model:** Designation of the control (managed by HEIDENHAIN)
- **NC-SW:** Number of the NC software (managed by HEIDENHAIN)
- **NCK:** Number of the NC software (managed by HEIDENHAIN)
- **PLC-SW:** Number or name of the PLC software (managed by the machine manufacturer)

Your machine manufacturer can add further software numbers, e.g. from a connected camera.

## 11.3 Entering the code number

### Application

The control requires a code number for the following functions:

Function	Code number
Select user parameters	123
Configuration of Ethernet interface	NET123
Enabling of special functions during Q-parameter programming	555343
Resetting active code numbers	0

The control shows in the code number dialog whether CAPS LOCK is active.

### Functions provided to the machine manufacturer by the code number dialog

The two soft keys **OFFSET ADJUST** and **UPDATE DATA** are shown in the MOD menu of the control.

The **OFFSET ADJUST** soft key enables automatic determination and subsequent saving of an offset voltage required for analog axes.



Refer to your machine manual.

This function may only be used by trained personnel!

The **UPDATE DATA** soft key enables the machine manufacturer to install software updates on the control.

### NOTICE

#### Caution: Data may be lost!

Not following the instructions when installing updates can cause a loss of data.

- ▶ Always follow the instructions when installing software updates!
- ▶ Refer to your machine manual.

## 11.4 Loading the machine configuration

### Application

#### NOTICE

**Caution: Data may be lost!**

The **RESTORE** function irrevocably overwrites the current machine configuration with the backup files. The control does not perform an automatic backup before the **RESTORE** function is executed. The current files are thus permanently lost.

- ▶ Perform a backup of the current machine configuration prior to the **RESTORE** function
- ▶ Use the function only in consultation with the machine manufacturer

Your machine tool builder can provide you with a backup including a machine configuration. After entering the **RESTORE** keyword, you can restore the backup on your machine or programming station.

To restore a backup:

- ▶ Select the **Code-number entry** MOD function
- ▶ Enter the **RESTORE** keyword
- ▶ Press the **OK** soft key
- ▶ Select the backup file in the control's file manager (e.g., BKUP-2013-12-12\_.zip)
- > The control opens the pop-up window for the backup.
- ▶ Press Emergency Stop
- ▶ Press the **OK** soft key
- > The control starts restoring the backup.



## 11.5 Selecting the position display

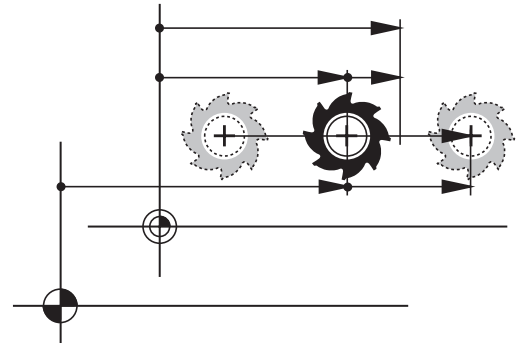
### Application



In the **Display settings** group, you can influence the display of the coordinates for **Manual operation** mode as well as for the **Program run, full sequence** and **Program run, single block** operating modes:


The figure on the right shows the different tool positions:

- Initial position
- Target position of the tool
- Workpiece datum
- Machine datum

You can select the following coordinates for the control's position displays:



Display	Function
NOML	Nominal position: The value currently commanded by the control
	<div style="border: 1px solid black; padding: 5px;"> <p> The NOML and ACTL displays differ solely with regard to following error.</p> </div>
ACTL	Actual position; current tool position
	<div style="border: 1px solid black; padding: 5px;"> <p> Refer to your machine manual. Your machine manufacturer defines whether the ACTL and NOML display deviates from the programmed position by the DL oversize of the tool call.</p> </div>
REF ACTL	Reference position; actual position relative to the machine datum
REF NOML	Reference position; nominal position relative to the machine datum
LAG	Servo lag; difference between nominal and actual positions
ACTDST	<p>Distance remaining to the programmed position in the input coordinate system; difference between actual and target positions</p> <p>Examples with Cycle <b>11</b>:</p> <ul style="list-style-type: none"> <li>▶ Scaling factor 0.2</li> <li>▶ L IX+10</li> <li>&gt; The ACTDST display shows 10 mm.</li> <li>&gt; The scaling factor does not have any influence.</li> </ul> <p>Examples with Cycle <b>11</b> and tilted working plane:</p> <ul style="list-style-type: none"> <li>▶ Tilt A by 45°</li> <li>▶ Scaling factor 0.2</li> <li>▶ L IX+10</li> <li>&gt; The ACTDST display shows 10 mm.</li> <li>&gt; The scaling factor and the tilt do not have any influence.</li> </ul>

Display	Function
REFDST	<p>Distance remaining to the programmed position in the machine coordinate system; difference between actual and target positions</p> <p>Examples with Cycle <b>11</b>:</p> <ul style="list-style-type: none"> <li>▶ Scaling factor 0.2</li> <li>▶ L IX+10</li> <li>&gt; The REFDST display shows 2 mm.</li> <li>&gt; The scaling factor has an effect on the distance and thus on the display.</li> </ul> <p>Examples with Cycle <b>11</b> and tilted working plane:</p> <ul style="list-style-type: none"> <li>▶ Tilt A by 45°</li> <li>▶ Scaling factor 0.2</li> <li>▶ L IX+10</li> <li>&gt; The REFDST display shows 1.4 mm in the X and Z axes.</li> <li>&gt; The scaling factor and the tilt have an effect on the distance and thus on the display.</li> </ul>
M118	<p>Traverse paths that were executed with handwheel superimpositioning function (<b>M118</b>)</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> The <b>HR POS</b> tab of the additional status display (additional <b>VT</b> display) should be used for handwheel superimpositioning of the <b>Global Program Settings</b> function.</p> </div>

With the **Position display 1** MOD function, you can select the position display in the status display.

With the **Position display 2** MOD function, you can select the position display in the additional status display.

## 11.6 Setting the unit of measure

### Application

Use the **Unit of measure for position display** MOD function in the **Display settings** group to set the coordinate display to mm or inches.

- Metric system: e.g. X = 15.789 (mm), the value is displayed to 3 decimal places
- Inch system: e.g. X = 0.6216 (inches), the value is displayed to 4 decimal places

If the display in inches is active, the control also displays the feed rate in inches/min. In an inch-based program, you must multiply the feed rate by 10 before entering it.

## 11.7 Graphic settings

Use the **Simulation parameters** MOD function in the **Graphic settings** group to select the model type and model quality.




To define the graphic settings:

- ▶ Select the **Graphic settings** group in the MOD menu
- ▶ Select **Model type**
- ▶ Select **Model quality**
- ▶ Press the **APPLY** soft key
- ▶ Press the **OK** soft key.
- > The control saves the selected settings.

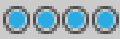
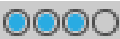
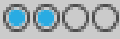

In the **Test Run** operating mode, the control displays the icons of the active graphic settings.

In the **Simulation parameters** MOD function, the following settings are available:

### Model type

Icon	Choice	Properties	Application
	3-D	Very true to detail, heavy time and processor consumption	Milling with undercuts, milling-turning operations
	2.5 D	Fast	Milling without undercuts
	No model	Very fast	Line graphics

### Model quality

Icon	Choice	Properties
	Very high	<ul style="list-style-type: none"> <li>■ High data transfer rate</li> <li>■ Accurate display of the tool geometry</li> <li>■ Block end points and block numbers can be displayed</li> </ul>
	High	<ul style="list-style-type: none"> <li>■ High data transfer rate</li> <li>■ Accurate display of the tool geometry</li> </ul>
	Medium	<ul style="list-style-type: none"> <li>■ Medium data transfer rate</li> <li>■ Approximation of the tool geometry</li> </ul>
	Low	<ul style="list-style-type: none"> <li>■ Low data transfer rate</li> <li>■ Less accurate approximation of the tool geometry</li> </ul>

**Aspects to be observed with the Graphic settings**

Besides the MOD settings, the NC program has a great influence on the simulation result. Setting the highest model quality and using a 5-axis simultaneous program with many very short NC blocks might slow down the simulation.

Setting a low model quality, in turn, may lead to a distorted simulation result because very short NC blocks become invisible due to the low resolution.

HEIDENHAIN recommends the following settings:

- Fast visualization of a 3-axis program or test of an NC program for feasibility
  - **Model type:** 2.5-D
  - **Model quality:** medium
- Test of the NC program by means of the graphic simulation
  - **Model type:** 3-D
  - **Model quality:** very high

## 11.8 Setting the counter




The **Counter** MOD function in the **Counter settings** group allows you to change the current counter reading (actual value) and the target value (nominal value).

To define the counter:

- ▶ Select the **Counter settings** group in the MOD menu
- ▶ Define the **Momentary count**
- ▶ Define the **PGM for counter**
- ▶ Press the **APPLY** soft key
- ▶ Press the **OK** soft key
- > The control saves the selected settings.

The control applies the defined values to the status display.

The following soft keys are available in the **Counter** MOD functions:

Soft key	Function
	Reset count
	Increase count
	Lower count

You can also enter the values directly with a connected mouse.

**Further information:** "Defining a counter", Page 368

## 11.9 Changing the machine settings

### Selecting the kinematics



Refer to your machine manual.  
The **Kinematics** function will be configured and enabled by your machine manufacturer.

#### NOTICE

##### Danger of collision!

All stored kinematics can also be selected as active machine kinematics. By this means, all manual movements and machining operations are executed using the selected kinematics. All subsequent axis movements pose a risk of collision!

- ▶ Use the **Kinematics** function exclusively in the **Test Run** operating mode
- ▶ Use the **Kinematics** function for selecting the active machine kinematics only if required

The **Kinematics** MOD function in the **Machine settings** group allows you to select different kinematics as machine kinematics for the test run. You can use this function to test NC programs whose kinematics does not match the active machine kinematics.

The various kinematics must be defined and enabled by the machine manufacturer. When you select a kinematics for the test run, the machine kinematics remains unaffected.

To change the kinematics:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **Kinematics** function
- ▶ Select the desired kinematics for the **SIM** channel
- ▶ Press the **APPLY** soft key
- ▶ Press the **OK** soft key
- > The control saves the selected kinematics for the **Test Run** operating mode.



Ensure that you have selected the correct kinematics in the Test Run operating mode for checking your workpiece.

## Entering traverse limits



Refer to your machine manual.  
Your machine manufacturer configures and enables the **Traverse limits** function.

The **Traverse limits** MOD function in the **Machine settings** group enables you to limit the actually usable traverse path within the maximum range of traverse. Thus, you can define traverse limits on each axis (e.g., to protect an indexing head from collision).

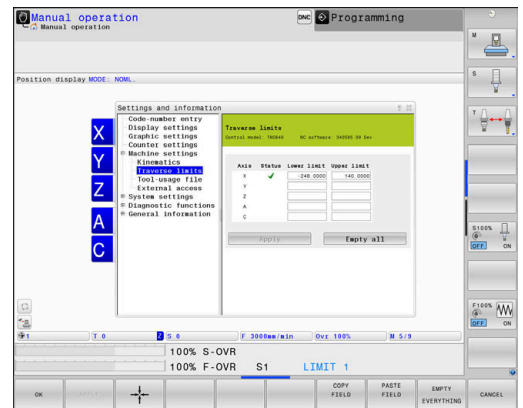
To define traverse limits:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **Traverse limits** function
- ▶ Define a value in the **Lower limit** or **Upper limit** column  
or
- ▶ Apply the current position by pressing the **ACTUAL POSITION CAPTURE** soft key
- ▶ Press the **APPLY** soft key
- > The control validates the defined values.
- ▶ Press the **OK** soft key
- > The control saves the defined traverse limits.



Operating notes:

- The protection zone becomes active automatically as soon as you have set a valid traverse limit in an axis. The settings are kept even after the control has been restarted.
- The only way to deactivate the traverse limits is to delete all values or to press the **EMPTY EVERYTHING** soft key.





**Software limit switch with modulo axes**

If you set software limit switches for modulo axes, make sure to comply with the following basic conditions:

- The lower limit is greater than  $-360^\circ$  and less than  $+360^\circ$
- The upper limit is not negative and less than  $+360^\circ$
- The lower limit is not greater than the upper limit
- The difference between the upper and the lower limit is less than  $360^\circ$

If these conditions are not met, you will not be able to move the modulo axis. The TNC 640 displays an error message.

If modulo limit switches are active, a movement is allowed if the target position or an equivalent position is within the allowed range. Equivalent positions are positions that differ from the target positions by an offset of  $n \cdot 360^\circ$  (where  $n$  is any integer). The direction of motion is derived automatically because there is always only one equivalent position that the axis can move to—with the exception described below.

**Example:**

For the modulo axis C, the limit switches have been set to  $-80^\circ$  and  $+80^\circ$ . The axis is at  $0^\circ$ . If you program **L C+320** now, the C axis will move to  $-40^\circ$ .

If an axis is positioned outside the limit switch range, it can only be moved towards the nearer limit switch.

**Example:**

The limit switches have been set to  $-90^\circ$  and  $+90^\circ$ . The C axis is at  $-100^\circ$ .

In this case, the C axis must move in the positive direction with its next movement so that moving by **L C+15** works, while **L C-15** would result in a limit switch violation.

**Exception:**

The axis is positioned exactly in the middle of the forbidden range. Thus, the distance to both limit switches is the same. In this case, the movement can go to either direction. This results in the special situation that the axis can move to two equivalent positions if the target position is within the allowed range. In this case, the axis will be moved to the nearer equivalent position, i.e. the shorter path is used. If both equivalent positions are equidistant (i.e.,  $180^\circ$  away), the control selects the direction of motion according to the programmed value.

**Example:**

The limit switches have been set to  $C-90^\circ$ ,  $C+90^\circ$  and the axis is at  $180^\circ$ .

If you program **L C+0**, the C axis will move to 0. The same is true when programming **L C-360**, etc. However, if you program **L C+360** (or **L C+720**, etc.), then the C axis will move to  $360^\circ$ .

## Generating a tool usage file



Refer to your machine manual.  
The tool-usage-test function must be enabled by your machine manufacturer.

Using the **Tool-usage file** MOD function in the **Machine settings** group, you can define whether the control never, once, or always creates a tool usage file. The settings for the test run and the program run operating modes must be defined separately.

To change the settings in the tool usage file:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **Tool-usage file** function
- ▶ Select the setting for **Program Run, Full Sequence/Single Block**
- ▶ Select the setting for **Test Run**
- ▶ Press the **APPLY** soft key
- ▶ Press the **OK** soft key
- > The control saves the defined settings.

## Permitting or restricting external access



Refer to your machine manual.  
The machine manufacturer can configure the external access options.  
Depending on the machine, you can grant or restrict access for an external diagnostics or commissioning software application using the **TNCOPT** soft key.

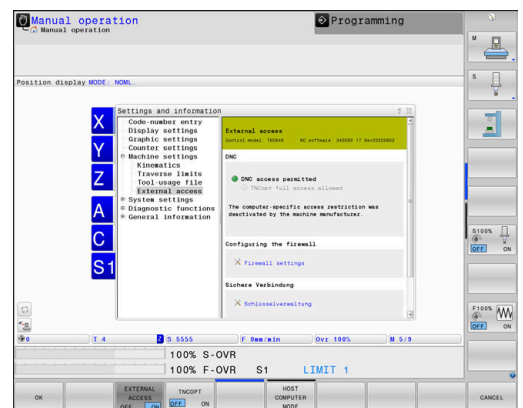
The **External access** MOD function in the **Machine settings** group allows you to permit or block access to the control. After blocking external access, you can no longer connect with the control. In that case, it is also no longer possible to exchange data through a network or a serial connection, (e.g., with the **TNCremo** software).

To block external access:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **External access** function
- ▶ Set the **EXTERNAL ACCESS ON/OFF** soft key to **OFF**
- ▶ Press the **OK** soft key
- > The control saves the settings.



Once the control is accessed externally, the following icon appears:



**Computer-specific access control**

If your machine manufacturer has set up computer-specific access control (machine parameter **CfgAccessControl** no. 123400), you can permit access for up to 32 connections authorized by you.

To create a new connection:

- ▶ Press the **ADD NEW** soft key
- > The control opens an input window for you to enter the connection data.

**Access settings**

Host name	Host name of the external computer
Host IP	Network address of the external computer
Description	Additional information The text is shown in the overview list.

**Type:**

Ethernet	Network connection
Com 1	Serial interface 1
COM 2	Serial interface 2

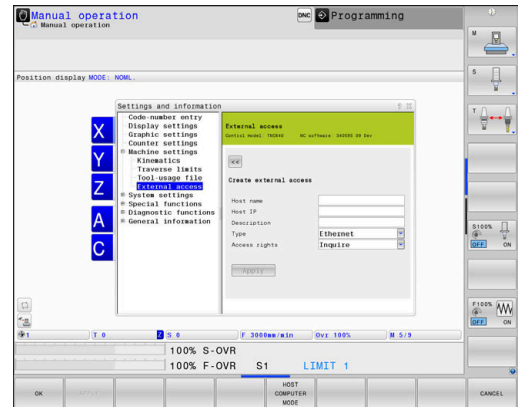
**Access rights:**

Inquire	For external access, the control opens a query dialog
Deny	Do not permit network access
Permit	Permit network access without query

**i** When user administration is active, you can set up only secure network connections via SSH. The control automatically disables the LSV2 connections via the serial interfaces (COM1 and COM2) and the network connections without user authentication.

If user administration is inactive, the control also automatically blocks non-secure LSV2 or RPC connections. In the optional machine parameters **allowUnsecureLsv2** (no. 135401) and **allowUnsecureRpc** (no. 135402), the machine manufacturer can define whether the control will permit non-secure connections. These machine parameters are included in the **CfgDncAllowUnsecur** (no. 135400) data object.

If you assign the **Inquire** access right to a connection, and if access is gained from this address, then the control opens a pop-up window.



You must decide if you permit or deny external access in the dialog:

External access	Permission
Yes	Permit once
Always	Permit continuously
Never	Deny continuously
No	Deny once



In the overview list, an active connection is shown with a green symbol. Connections without access rights are shown gray in the overview list.

### Host computer operation



Refer to your machine manual. This function must be enabled and adapted by the machine manufacturer.

With the **HOST COMPUTER MODE** soft key you can transfer the command to an external host computer (e.g., in order to run NC programs).

The requirements to be met for starting host computer mode include the following:

- Dialogs, such as **GOTO** or **Block scan**, are closed
- No program run is active
- Handwheel is inactive

To start the host computer mode:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **External access** function
- ▶ Press the **HOST COMPUTER MODE** soft key
- > The control shows an empty screen with the **Host computer is active** pop-up window.



Your machine manufacturer can specify that the host computer mode can automatically be activated externally.

To exit the host computer mode:

- ▶ Press the **HOST COMPUTER MODE** soft key again
- > The control closes the pop-up window.

### Allowing a secure connection

The **KEY MANAGEMENT** soft key opens the **Certificate and keys** window. This window can be used to define settings for secure connections via SSH.

**Further information:** "User authentication from external applications", Page 557

## 11.10 Setting up touch probes

### Introduction



Refer to your machine manual.

In the machine parameter **CfgHardware** (no. 100102), the machine manufacturer decides if the control shows or hides the touch probes in the **Device configuration** window.

The control allows you to set up and manage multiple touch probes. Depending on the type of touch probe, you have the following options for setting it up:

- TT tool touch probe with radio transmission: Setup via MOD function
- TT tool touch probe with cable or infrared transmission: Setup via MOD function or entry in machine parameters
- TS 3-D touch probe with radio transmission: Setup via MOD function
- 3-D TS touch probe with cable or infrared transmission: Setup via MOD function, tool management, or touch probe table

**Further information:** "Touch probe table", Page 156

You can set up touch probes with the **Set up touch probes** MOD function in the **Machine settings** group.

To open the **Set up touch probes** MOD function:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **Set up touch probes** function
- > The control opens a pop-up window for device configuration on the third desktop.

## Setting up a touch probe with radio transmission



Refer to your machine manual.

In order for the control to recognize the touch probe with radio transmission, you will require an **SE 661** transceiver with EnDat interface.

In the **Set up touch probes** MOD function, the left-hand side of the screen shows the touch probes that have already been configured. If you are unable to see all of the columns, you can shift the view with the scroll bar or shift the dividing line between the left and right sides of the screen using the mouse.

To set up a new wireless touch probe:

- ▶ Place the cursor on the row of the **SE 661**
- ▶ Select the radio channel



- ▶ Press the **CONNECT NEW TCH PROBE** soft key
- > The control displays the next steps in the dialog
- ▶ Follow the instructions in the dialog:
  - Remove the battery from the touch probe
  - Insert the battery into the touch probe
- > The control connects to the touch probe and creates a new row in the table

## Setting up a touch probe from within the MOD function

You can set up a 3-D touch probe with cable or with infrared transmission either in the touch probe table, in tool management, or in the **Set up touch probes** MOD function.

You can also define tool touch probes via the machine parameter **CfgTT** (No. 122700).

In the **Set up touch probes** MOD function, the left-hand side of the screen shows the touch probes that have already been configured. If not all of the columns are visible, you can shift the view with the scroll bar or move the dividing line between the left and right sides of the screen using the mouse.

### Setting up a 3-D touch probe

To set up a new touch probe:



- ▶ Press the **CREATE TS ENTRY** soft key
- > The control creates a new row in the table.
- ▶ If necessary, highlight the row with the cursor
- ▶ Enter the touch probe data on the right side
- > The control saves the entered data in the touch probe table.

### Setting up a tool touch probe

To set up a tool touch probe:



- ▶ Press the **CREATE TT ENTRY** soft key
- > The control opens a pop-up window.
- ▶ Enter a unique name for the touch probe
- ▶ Press the **OK** soft key
- > The control creates a new row in the table.
- ▶ If necessary, highlight the row with the cursor
- ▶ Enter the touch probe data on the right side
- > The control saves the entered data in the machine parameters.

## Touch probe with radio transmission configuration

In the **Set up touch probes** MOD function, the control displays information on each touch probe at the right-hand side of the screen. Some of this information is also visible and configurable for infrared touch probes.

Tab	TS 3-D touch probe	TT tool touch probe
Work data	Data from the touch probe table	Data from the machine parameters
Project information	Connection data and diagnostics functions	Connection data and diagnostics functions

You can change the data from the touch probe table by selecting the row with the cursor and overwriting the current value.

You can change the machine parameters only after first entering the code number.

### Changing properties




To change the characteristics of a touch probe:

- ▶ Place the cursor on the row for the touch probe
- ▶ Select the "Properties" tab
- > The control shows the properties of the selected touch probe.
- ▶ Change the properties as desired per soft key

You have the following options depending on the row on which the cursor is located:

Soft key	Function
SELECT DEFLECTION	Select the probe signal
SELECT CHANNEL	Select the radio channel Select the channel with the best radio transmission and pay attention to overlaps with other machines or wireless handwheels.
CHANGE CHANNEL	Change the radio channel
REMOVE TCH. PROBE	Delete the touch probe data The control deletes the entry from the MOD function and the touch probe table or from the machine parameters.
EXCHANGE TCH. PROBE	Save a new touch probe in the current row The control automatically overwrites the serial number of the replaced touch probe with the new number.



Soft key	Function
	Select the SE transceiver
	Select the strength of the infrared signal You only need to change the signal strength if there is interference.
	Select the strength of the radio signal You only need to change the signal strength if there is interference.

The **Switching on/off** connection setting is preset based on the type of touch probe. Under **Deflection**, you can select how the touch probe is to transmit the signal when probing.

Deflection	Meaning
IR	Infrared probe signal
Radio	Radio probe signal
Radio + IR	The control selects the probe signal

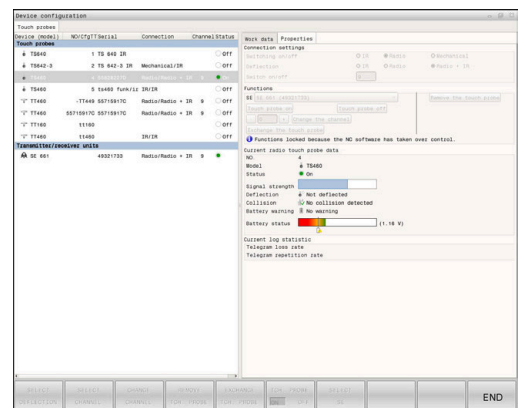
You can activate the touch probe per soft key in the "Properties" tab (e.g., in order to test the radio connection)

**i** If you activate the touch probe's radio connection manually per soft key, then the signal remains unchanged even after a tool change. You must deactivate the radio connection manually again.

**Current radio touch probe data**

The control displays the following information in the "Current radio touch probe data" area:

Display	Meaning
NO.	Number in the touch probe table
Type	Type of touch probe
Status	Touch probe active or inactive
Signal strength	Display of the signal strength in the bar graphic The control shows the currently best-known connection as a complete bar
Deflection	Stylus deflected or not deflected
Collision	Collision or no collision recognized
Battery status	Display of the battery quality If the charge is less than the displayed bar, then the control outputs a warning.



## 11.11 Configuring the HR 550FS radio handwheel

### Application

**i** This setup dialog is managed by the HEROS operating system.  
After you have changed the conversational language on your control, you need to restart the control to enable the new language.

Use the **SET UP WIRELESS HANDWHEEL** soft key to configure the HR 550FS wireless handwheel. The following functions are available:

- Assigning the handwheel to a specific handwheel holder
- Setting the transmission channel
- Analyzing the frequency spectrum for determining the optimum transmission channel
- Selecting transmitter power
- Statistical information on the transmission quality

**i** Any changes or modifications that were not expressly approved by the party responsible for conformity could void your authority to operate the device.

This device complies with Part 15 of the FCC Rules and the RSS standard(s) of Industry Canada for license-exempt equipment.

Operation is subject to the following conditions:

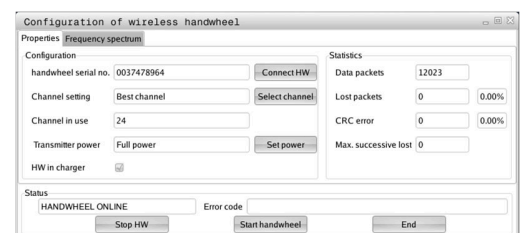
- 1 The device must not cause any harmful interference.
- 2 The device must be tolerant to any interferences it receives, including interference that might impair its operation.

### Assigning the handwheel to a specific handwheel holder

To assign a handwheel to a specific handwheel holder, the handwheel holder must be connected to the control hardware.

To assign a handwheel to a specific handwheel holder:

- ▶ Place the handwheel in the handwheel holder
- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Press the **SET UP WIRELESS HANDWHEEL** soft key
  - > The control opens a pop-up window.
  - ▶ Select the **Connect HW** button
  - > The control saves the serial number of the inserted wireless handwheel and displays it in the configuration window to the left of the **Connect HW** button.
  - ▶ Select the **END** button
  - > The control saves the configuration.

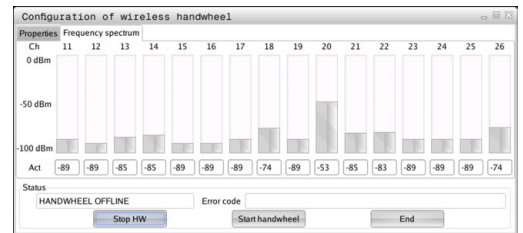
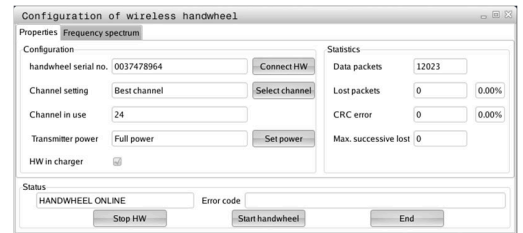


## Setting the transmission channel

If the wireless handwheel is started automatically, then the control tries to select the transmission channel that provides the best transmission signal.

To manually set the radio channel:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Press the **SET UP WIRELESS HANDWHEEL** soft key
- > The control opens a pop-up window.
- ▶ Select the **Frequency spectrum** tab
- ▶ Select the **Stop HW** button
- > The control stops the connection to the wireless handwheel and determines the current frequency spectrum for all 16 available channels.
- ▶ Note the number of the channel with the least amount of radio traffic (smallest bar)
- ▶ Select the **Start handwheel** button
- > The control restores the connection to the wireless handwheel.
- ▶ Select the **Properties** tab
- ▶ Select the **Select channel** button
- > The controls shows all available channel numbers
- ▶ Select the number of the channel with the least amount of radio traffic
- ▶ Select the **END** button
- > The control saves the configuration.

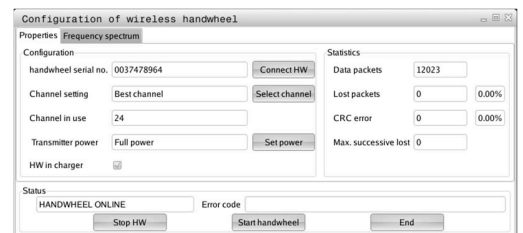


## Selecting the transmitter power

**i** A reduction in transmission power decreases the range of the wireless handwheel.

To set the transmitter power of the handwheel:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Press the **SET UP WIRELESS HANDWHEEL** soft key
- > The control opens a pop-up window.
- ▶ Select the **Set power** button
- > The control displays the three available power settings.
- ▶ Select the desired transmitter power setting
- ▶ Select the **END** button
- > The control saves the configuration.



## Statistics

To display the statistical data:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Press the **SET UP WIRELESS HANDWHEEL** soft key
- The control opens a pop-up window.

Under **Statistics**, the control displays information about the transmission quality.

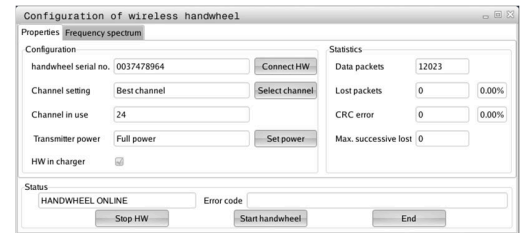
If the received signal quality is impaired and no longer ensures a perfect, safe stop of the axes, the wireless handwheel will perform an emergency stop.

A high value under **Max. successive lost** is an indication of a limited quality of reception. If the control repeatedly displays values greater than 2 during normal operation of the wireless handwheel within the desired range of use, there is a high risk of undesired disconnection.

If this occurs, try to improve the transmission quality by selecting a different channel or by increasing the transmitter power.

**Further information:** "Setting the transmission channel", Page 467

**Further information:** "Selecting the transmitter power", Page 467



## 11.12 Changing the system settings

### Set the system time

With the **Set the system time** MOD function in the **System settings** group, you can set the time zone, date, and time manually or by means of an NTP server synchronization.

To set the system time manually:

- ▶ Select the **System settings** group in the MOD menu
- ▶ Press the **SET DATE/ TIME** soft key
- > The control opens a pop-up window.
- ▶ In the **Time zone** area, select the desired time zone
- ▶ Press the **NTP off** soft key, if necessary
- > The control enables the **Set the time manually** check box.
- ▶ Change the date and time, if required
- ▶ Press the **OK** soft key
- > The control saves the settings.

To set the system time using a NTP server:

- ▶ Select the **System settings** group in the MOD menu
- ▶ Press the **SET DATE/ TIME** soft key
- > The control opens a pop-up window.
- ▶ In the **Time zone** area, select the desired time zone
- ▶ Press the **NTP on** soft key, if necessary
- > The control enables the **Synchronize the time over NTP server** check box.
- ▶ Enter the host name or the URL of an NTP server
- ▶ Press the **Add** soft key
- ▶ Press the **OK** soft key
- > The control saves the settings.

## 11.13 Diagnostic functions

### Bus diagnosis



This function is protected by a code number.  
Only use this function after consultation with your machine manufacturer.

The **Diagnostic functions** group of the **Bus diagnosis** MOD area allows the machine manufacturer to retrieve the bus system data.

### TNCdiag



Only use this function after consultation with your machine manufacturer.

The control displays status and diagnostic information of HEIDENHAIN components in the **Diagnostic functions** group of the **TNCdiag** MOD area.



For more information, please refer to the **TNCdiag** documentation.

### Hardware configuration



Only use this function after consultation with your machine manufacturer.

In the **Diagnostic functions** group of the **Hardware configuration** MOD area, the control displays the nominal and actual hardware configurations in the **HwViewer**.

If the control detects a hardware change, it automatically opens the error window. The soft keys displayed there allow you to open the **HwViewer**.

The changed hardware component is color-highlighted.

### HeROS information

In the **Diagnostic functions** group of the **HeROS information** MOD area, the control displays details on the operating system.

Besides the information on the control type and the software version, this MOD area also shows the current CPU and memory usage values.

## 11.14 Displaying operating times

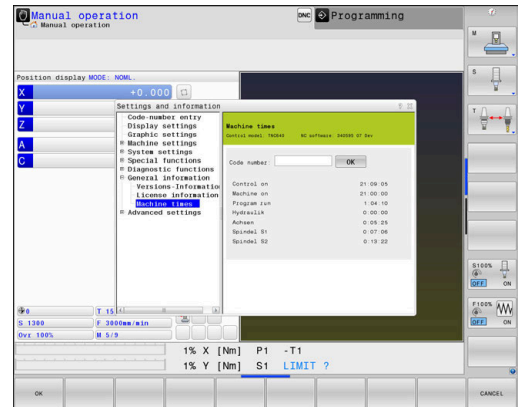
### Application

In the **General Information** group of the **MACHINE TIMES** MOD area, the control displays the following operating times:

Operating time	Meaning
<b>Control on</b>	Operating time of the control since being put into service
<b>Machine on</b>	Operating time of the machine tool since being put into service
<b>Program run</b>	Duration of controlled operation since being put into service



Refer to your machine manual.  
The machine manufacturer can provide further operating time displays.







# 12

**HEROS Functions**

## 12.1 Remote Desktop Manager (option 133)

### Introduction

**Remote Desktop Manager** enables you to display external computer units on the control screen that are connected via Ethernet, and to operate them via the control. You can also start programs specifically under HEROS or display web pages of an external server.

HEIDENHAIN offers you the IPC 6641 as a Windows computer. With the IPC 6641 Windows computer, you can start and operate Windows-based applications directly from within the control.

The following connection options are available:

- **Windows Terminal Service (RemoteFX):** Displays the desktop of a remote Windows computer on the control
- **VNC:** Connection to an external computer. Displays the desktop of a remote Windows, Apple, or Unix computer on the control
- **Switch-off/restart of a computer:** Configure automatic shutdown of a Windows computer
- **World Wide Web:** Available only to authorized specialists
- **SSH:** Available only to authorized specialists
- **XDMCP:** Available only to authorized specialists
- **User-defined connection:** Available only to authorized specialists



HEIDENHAIN assures a functioning connection between HEROS 5 and the IPC 6641.

No guarantee is given for other combinations and connections.



If you are using a TNC 640 with touch control, you can replace some keystrokes with gestures.

**Further information:** "Operating the Touchscreen", Page 581

## Configuring a connection: Windows Terminal Service (RemoteFX)

### Configuring an external computer



You do not need additional software for your external computer to connect to the Windows Terminal Service.

To configure the external computer (e.g., in Windows 7 operating systems):






- ▶ Press the Windows Start button and select **Control Panel** on the Start menu.
- ▶ Select **System and Security**
- ▶ Select **System**
- ▶ Select **Remote settings**
- ▶ Under **Remote Assistance**, enable **Allow Remote Assistance connections to this computer**
- ▶ Under **Remote Desktop**, select **Allow connections from computers running any version of Remote Desktop**
- ▶ Press **OK** to confirm your settings

### Configuring the control

To configure the control:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select **Remote Desktop Manager**
- ▶ The control opens **Remote Desktop Manager**.
- ▶ Press **New connection**
- ▶ Press **Windows Terminal Service (RemoteFX)**
- ▶ The control opens the **Selection of server operating sys.** pop-up window.
- ▶ Select the desired operating system
  - Win XP
  - Win 7
  - Win 8.X
  - Win 10
  - Another Windows
- ▶ Press **OK**
- ▶ The control opens the **Edit the connection** pop-up window.
- ▶ Define the connection settings

Setting	Meaning	Input
Connection name	Name of the connection in <b>Remote Desktop Manager</b>	Required
	<div style="border: 1px solid black; padding: 5px;"> <p><b>i</b> You can use the following characters in the name of the connection:  A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c d e  f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9 _  When you edit an existing connection, the control will automatically delete all impermissible characters from the name.</p> </div>	
Restarting after end of connection	Behavior after disconnection: <ul style="list-style-type: none"> <li>■ Always restart</li> <li>■ Never restart</li> <li>■ Always after an error</li> <li>■ Ask after an error</li> </ul>	Required
Automatic starting upon login	Connection is automatically established during control startup	Required
Add to favorites	Connection icon in the task bar: <ul style="list-style-type: none"> <li>▶ Single click with the left mouse button</li> <li>&gt; The control switches to the desktop of the connection.</li> <li>▶ Single click with the right mouse button</li> <li>&gt; The control displays the connection menu.</li> </ul>	Required
Move to the following workspace	Number of the desktop for the connection, desktops 0 and 1 being reserved for the NC software Default setting: Third desktop	Required
Release USB mass memory	Permit access to connected USB mass memory devices	Required
Private connection	Connection can be seen and used only by its creator	Required
Computer	Host name or IP address of the external computer HEIDENHAIN recommends the following setting for the IPC(6641): <b>IPC6641.machine.net</b> The host name <b>IPC6641</b> must be assigned to the IPC in the Windows operating system for this setting.	Required
	<div style="border: 1px solid black; padding: 5px;"> <p><b>i</b> The <b>.machine.net</b> code is very important in this context. When <b>.machine.net</b> is specified, the control automatically searches the Ethernet interface <b>X116</b>, and not the interface <b>X26</b>—this reduces the time needed for access.</p> </div>	
User name	Name of the user	Required
Password	Password of the user	Required
Windows domain	Domain of the external computer	Optional
Full-screen mode or User-defined window size	Size of the connection window	Required

Setting	Meaning	Input
<b>Multimedia enhancements</b>	Enables hardware acceleration when playing videos Certain formats (e.g., MP4 files) require the paid Fluendo Codec Pack	Optional
	 Any additional software will be installed by your machine manufacturer.	
<b>Touchscreen input</b>	Enables operation of multitouch systems and applications	Optional
<b>Encryption</b>	Sets the encryption that is appropriate for the selected Windows system	Required
	 If you activate the <b>Encryption</b> function, you need to remove the <b>-sec-tls -sec-nla</b> entries from the <b>Additional options</b> input field. If problems occur, try to set up a connection with the encryption function deactivated. The Windows log files are required for analysis.	
<b>Color depth</b>	Setting for the display of the external system on the control	Required
<b>Locally effective keys</b>	Shortcuts for automatically switching to the next active connection and workspace or desktop Default setting: <ul style="list-style-type: none"> <li>■ <b>Super_R</b> corresponds to the right DIADUR key and switches between the active connections</li> <li>■ <b>F12</b> switches between the workspaces or desktops</li> </ul>	Required
	 Touchscreens no longer include an <b>F12</b> key. Here, the vacant key between <b>PGM MGT</b> and <b>ERR</b> is used to switch the workspaces or desktops.	
	It is possible to adjust the default settings or to make additional entries	
<b>Max. connection time (seconds)</b>	Waiting time for connection If this timeout is exceeded, the connection could not be established	Required
<b>Additional options</b>	Available only to authorized specialists Additional command lines with transfer parameters	Required
	 If you activate the <b>Encryption</b> function, you need to remove the <b>-sec-tls -sec-nla</b> entries from the <b>Additional options</b> input field.	
<b>Pass USB devices through</b>	Passing the USB devices (e.g., 3D mouse for operating CAD programs) connected to the control through to the Windows computer This requires installation of the Eltima EveUSB software on the Windows computer.	Optional
	 All USB devices that have been passed through are not available on the control while the connection to the Windows computer is active.	

For integrating the IPC 6641, HEIDENHAIN recommends the use of a RemoteFX connection.

When using a RemoteFX connection, the screen of the external computer is not mirrored, as with VNC. Instead, a separate desktop is opened. The desktop that is active on the external computer when establishing the connection is then locked and the user is logged off. This prevents two users from accessing the control simultaneously.

## Configuring a connection: VNC

### Configuring an external computer

**i** You need an additional VNC server for your external computer when trying to connect to VNC.  
Install and configure the VNC server, e.g. the TightVNC server, before configuring the control.

### Configuring the control

To configure the control:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select **Remote Desktop Manager**
- > The control opens **Remote Desktop Manager**.
- ▶ Press **New connection**
- ▶ Press **VNC**
- > The control opens the **Edit the connection** pop-up window.
- ▶ Define the connection settings

Setting	Meaning	Input
<b>Connection name:</b>	Name of the connection in <b>Remote Desktop Manager</b>	Required
	<div style="border: 1px solid black; padding: 10px;"> <p><b>i</b> You can use the following characters in the name of the connection: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9 –</p> <p>When you edit an existing connection, the control will automatically delete all impermissible characters from the name.</p> </div>	
<b>Restarting after end of connection:</b>	Behavior after disconnection: <ul style="list-style-type: none"> <li>■ Always restart</li> <li>■ Never restart</li> <li>■ Always after an error</li> <li>■ Ask after an error</li> </ul>	Required
<b>Automatic starting upon login</b>	Connection is automatically established during control startup	Required
<b>Add to favorites</b>	Connection icon in the task bar: <ul style="list-style-type: none"> <li>▶ Single click with the left mouse button</li> <li>&gt; The control switches to the desktop of the connection.</li> <li>▶ Single click with the right mouse button</li> <li>&gt; The control displays the connection menu.</li> </ul>	Required
<b>Move to the following workspace</b>	Number of the desktop for the connection, desktops 0 and 1 being reserved for the NC software Default setting: Third desktop	Required
<b>Release USB mass memory</b>	Permit access to connected USB mass memory devices	Required
<b>Private connection</b>	Connection can only be seen and used by its creator	Required

Setting	Meaning	Input
<b>Calculator</b>	Host name or IP address of the external computer. In the recommended configuration of the IPC 6641, the IP address 192.168.254.3 is used.	Required
<b>User name:</b>	Name of the user to be logged on	Required
<b>Password</b>	Password for connecting to the VNC server	Required
<b>Full-screen mode or User-defined window size:</b>	Size of the connection window	Required
<b>Permit further connections (share)</b>	Additionally grant other VNC connections access to the VNC server	Required
<b>View only</b>	In display mode, the external computer cannot be operated	Required
Entries in the <b>Advanced options</b> area	Available only to authorized specialists	Optional



If you use **Extended Workspace Compact**, select the **Extended Workspace, Compact** function to enable the corresponding configuration for your connection.

By selecting the **Extended Workspace, Compact** function, you automatically adapt the connections to the additional workspace.

**Further information:** "Extended Workspace Compact", Page 63

With VNC, the screen of the external computer is mirrored directly. The active desktop at the external computer is not locked automatically.

With a VNC connection, it is also possible to completely shut down the external computer via the Windows menu. As the computer cannot be rebooted via a connection, it must actually be switched off and on again.

## Shut down or restart external computer

### NOTICE

#### Caution: Data may be lost!


If you do not shut down external computers properly, data may be irreversibly damaged or deleted.

- ▶ Configure the automatic shutdown of the Windows computer

To configure the control:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select **Remote Desktop Manager**
- > The control opens **Remote Desktop Manager**.
- ▶ Press **New connection**
- ▶ Press **Switch-off/restart of a computer**
- > The control opens the **Edit the connection** pop-up window.
- ▶ Define the connection settings



Setting	Meaning	Input
Connection name:	Name of the connection in <b>Remote Desktop Manager</b>	Required
	<div style="border: 1px solid black; padding: 5px;"> <p> You can use the following characters in the name of the connection:  A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c  d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9  –</p> <p>When you edit an existing connection, the control will automatically delete all impermissible characters from the name.</p> </div>	
Restarting after end of connection:	Not necessary with this connection	–
Automatic starting upon login	Not necessary with this connection	–
Add to favorites	<p>Connection icon in the taskbar:</p> <ul style="list-style-type: none"> <li>▶ Single click with the left mouse button</li> <li>&gt; The control switches to the desktop of the connection.</li> <li>▶ Single click with the right mouse button</li> <li>&gt; The control displays the connection menu.</li> </ul>	Required
Move to the following workspace	Not active with this connection	–
Release USB mass memory	Not advisable with this connection	–
Private connection	Connection can be seen and used only by its creator	Required
Calculator	Host name or IP address of the external computer. In the recommended configuration of the IPC 6641, the IP address 192.168.254.3 is used.	Required
User name	User name to be used for establishing the connection	Required
Password	Password for connecting to the VNC server	Required
Windows domain:	Domain of the target computer, if required	Optional
Max. waiting time (seconds):	<p>A shutdown of the control causes the Windows computer to shut down as well.</p> <p>Before the control displays the message <b>Now you can switch off.</b>, it waits for <b>&lt;Timeout&gt;</b> seconds. While waiting, the control checks whether the Windows computer is still accessible (port 445).</p> <p>If the Windows computer is switched off before the <b>&lt;Timeout&gt;</b> seconds have expired, the control will wait no longer.</p>	Required
Additional waiting time:	<p>Waiting time after the Windows computer has stopped being accessible.</p> <p>Windows applications may delay the shutdown of the computer after port 445 has been closed.</p>	Required
Force	<p>Close all programs on the Windows computer, even if dialogs are still open.</p> <p>If <b>Force</b> is not selected, Windows waits up to 20 seconds. This delays the shutdown process or the Windows computer is switched off before Windows has shut down.</p>	Required
Restart	Reboot the Windows computer	Required

Setting	Meaning	Input
<b>Run during restart</b>	Reboot the Windows computer when the control reboots. Effective only if the control is rebooted using the shutdown icon at the bottom right in the taskbar or if it is rebooted as a result of a change in the system settings (e.g. network settings).	Required
<b>Run during switch-off</b>	The Windows computer is switched off when the control shuts down (no reboot). This is the standard scenario. Even the <b>END</b> key will then no longer trigger a reboot.	Required
Entries in the <b>Advanced options</b> area	Available only to authorized specialists	Optional

### Starting and stopping the connection

Once a connection has been configured, this connection is shown as an icon in the **Remote Desktop Manager** window. When you highlight a connection, the **Start the connection** and **Terminate the connection** menu items become selectable.

If the desktop of the external connection or the external computer is active, all inputs from the mouse and the alphabetic keyboard are transmitted there.

When the HEROS 5 operating system is shut down, the control automatically terminates all connections. Please note, however, that only the connection is terminated, whereas the external computer or the external system is not shut down automatically.

**Further information:** "Shut down or restart external computer", Page 480

To switch between the third desktop and the control interface:

- Use the right DIADUR key on the alphabetic keyboard
- Use the taskbar
- Use the operating mode key

## Exporting and importing connections

The **Export the connections** and **Import connections** functions allow you to save and restore the connections of **Remote Desktop Manager**.



To create and edit public connections when user administration is active, you need the HEROS.SetShares role. Users without this role are able to start and terminate public connections, but can only import, create, and edit private connections.

To export a connection:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select **Remote Desktop Manager**
- > The control opens **Remote Desktop Manager**.
- ▶ Select the desired connection
- ▶ Select the right arrow symbol in the menu bar
- > The control displays a selection menu.
- ▶ Select **Export the connections**
- > The control opens a pop-up window.
- ▶ Define the name of the saved file
- ▶ Select the target file
- ▶ Select **Save**
- > The control saves the connection data under the name defined in the pop-up window

To Import a connection:

- ▶ Open **Remote Desktop Manager**
- ▶ Select the right arrow symbol in the menu bar
- > The control displays a selection menu.
- ▶ Select **Import connections**
- > The control opens a pop-up window.
- ▶ Select file
- ▶ Select **Open**
- > The control creates the connection under the name that was defined originally in **Remote Desktop Manager**.

## Private connections

Every user can create private connections by means of the user administration. A private connection can only be seen and used by the user who created it.



- If you create private connections before user administration was activated, these connections are no longer available when user administration is active.

Change private connections to public connections or export the connections before activating user administration.



- To create and edit public connections, you need the HEROS.SetShares right. Without this right, users are able to start and terminate public connections but they can import, create, and edit only private connections.

**Further information:** "Definition of roles", Page 552

To create a private connection:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select **Remote Desktop Manager**
- > The control opens **Remote Desktop Manager**.
- ▶ Select **New connection**
- ▶ Select the desired connection (e.g., **Switch-off/restart of a computer**)
- > The control opens the **Edit the connection** pop-up window.
- ▶ Define the connection settings
- ▶ Select **Private connection**
- ▶ Press **Ok**
- > The control creates a private connection.

The control uses an icon to identify private connections:

Icon	Meaning
	Public connection
	Private connection

You can save the connections individually with the **Export the connections** function.

**Further information:** "Exporting and importing connections",  
Page 483

When user administration is active, the control saves the private connections in the user's **HOME:** directory. If you create a backup with the **NC/PLC Backup** HEROS function, the control also saves the private connections. You can choose whether the control is to save the **HOME:** directory for the current user or for all users.

## 12.2 Software tools for ITCs

The following software tools allow you to apply various settings for the touch screens on connected ITCs.

ITCs are industrial PCs without their own memory media, and therefore they do not have their own operating system. This feature is what makes ITCs different from IPCs.

ITCs are frequently used with large machinery (e.g., as a clone of the actual control system).



Refer to your machine manual.

The machine manufacturer defines and configures the display and function of the connected ITCs and IPCs.

Additional tool	Application
ITC Calibration	4-point calibration
ITC Gestures	Configuration of gesture control
ITC Touchscreen Configuration	Selection of touch sensitivity



The software tools for the ITCs are only provided by the control in the taskbar with connected ITCs.

### ITC Calibration

Using the **ITC Calibration** software tool, you align the position for the mouse cursor displayed with the actual movement position of your finger.

Calibration using the additional **ITC Calibration** tool is recommended in the following cases:

- After replacing the touchscreen
- When changing the touchscreen position (parallax error due to modified point of view)

For calibration:

- ▶ Start the tool in control using the task bar
- > The ITC opens the calibration screen with four touch points in the corners of the screen
- ▶ Touch the four touch points shown one after the other
- > The ITC closes the calibration screen once calibration has been successfully completed

### ITC Gestures

Using the **ITC Gestures** software tool, the machine manufacturer configures the gesture control on the touch screen.



Refer to your machine manual.

This function may only be used with the permission of your machine manufacturer.

### ITC Touchscreen Configuration

Using the **ITC Touchscreen Configuration** software tool, you can select the touch sensitivity of the touch screen.

The ITC gives you the following options:

- **Normal Sensitivity (Cfg 0)**
- **High Sensitivity (Cfg 1)**
- **Low Sensitivity (Cfg 2)**

Use the **Normal Sensitivity (Cfg 0)** setting by default. If you have difficulties with this setting when wearing gloves, select the **High Sensitivity (Cfg 1)** setting.



If the touchscreen of the ITC is not protected against splash water, select the **Low Sensitivity (Cfg 2)** setting. This stops the ITC interpreting drops of water as touches.

For configuration:

- ▶ Start the tool in control using the task bar
- > The ITC opens a pop-up window with three options
- ▶ Select Touch Sensitivity
- ▶ Press the **OK** button
- > The ITC closes the pop-up window

## 12.3 Window manager



Refer to your machine manual.

The machine manufacturer determines the scope of function and behavior of the window manager.

The control features the Xfce window manager. Xfce is a standard application for UNIX-based operating systems, and is used to manage graphical user interfaces. The following functions are possible with the window manager:

- Display a taskbar for switching between various applications (user interfaces)
- Manage an additional desktop, on which special applications from your machine manufacturer can run
- Control the focus between NC software applications and those of the machine manufacturer
- You can change the size and position of pop-up windows. It is also possible to close, minimize and restore pop-up windows



The control shows a star in the upper left of the screen if an application of the window manager or the window manager itself has caused an error. In this case, switch to the window manager and correct the problem. If required, refer to your machine manual.

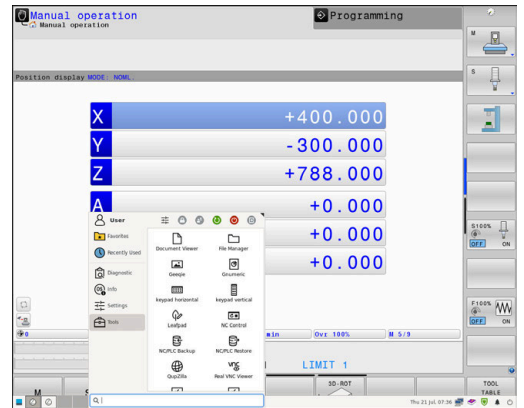


### Overview of taskbar

In the taskbar, you can choose different workspaces by mouse click. The control provides the following workspaces:

- Workspace 1: Active machine operating mode
- Workspace 2: Active programming operating mode
- Workspace 3: CAD Viewer or applications of the machine manufacturer (optionally available)
- Workspace 4: Display and remote control of external computer units (option 133) or applications of the machine manufacturer (optionally available)


You can also select other applications from the taskbar which you have started in addition to the control software, e.g. **TNCguide**.



**i** All open applications to the right of the green HEIDENHAIN icon can be moved between the workspaces any way you desire by pressing and holding the left mouse button.

Click the green HEIDENHAIN icon to open a menu in which you can get information, make settings or start applications.

Area	Function
Header	<ul style="list-style-type: none"> <li>■ User name <b>Further information:</b> "Current User", Page 568</li> <li>■ User-specific settings</li> <li>■ Lock display Only if user administration is active</li> <li>■ Switch users Only if user administration is active</li> <li>■ Restart</li> <li>■ Shut down</li> <li>■ Log out Only if user administration is active <b>Further information:</b> "Switching or logging out users", Page 564</li> </ul>
Navigation	<ul style="list-style-type: none"> <li>■ Favorites</li> <li>■ Recently used</li> </ul>

Area	Function
Diagnostic	<ul style="list-style-type: none"> <li>■ <b>GSmartControl</b>: Available only to authorized specialists</li> <li>■ <b>HeLogging</b>: Define settings for internal diagnostic files</li> <li>■ <b>HeMenu</b>: Available only to authorized specialists</li> <li>■ <b>perf2</b>: Check processor load and process load</li> <li>■ <b>Portscan</b>: Test active connections <b>Further information:</b> "Portscan", Page 493</li> <li>■ <b>Portscan OEM</b>: Available only to authorized specialists</li> <li>■ <b>Terminal</b>: Enter and execute console commands</li> <li>■ <b>TNCdiag</b>: Evaluates status and diagnostic information of HEIDENHAIN components with a focus on the drives and presents it graphically</li> </ul> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;">  If you want to use <b>TNCdiag</b>, contact your machine manufacturer.     </div> <ul style="list-style-type: none"> <li>■ <b>TNCscope</b> Software for data recording</li> </ul>

Area	Function
<b>Settings</b>	<ul style="list-style-type: none"> <li>■ <b>Adjust screen brightness:</b> Adjust screen brightness</li> <li>■ <b>Screensaver:</b> Configure the screensaver <b>Further information:</b> "Screensaver with lockout", Page 564</li> <li>■ <b>Current User</b> <b>Further information:</b> "Current User", Page 568</li> <li>■ <b>Date/Time:</b> Set date and time</li> <li>■ <b>Firewall:</b> Configure the firewall <b>Further information:</b> "Firewall", Page 503</li> <li>■ <b>HePacketManager:</b> Available only to authorized specialists</li> <li>■ <b>HePacketManager Custom:</b> Available only to authorized specialists</li> <li>■ <b>Language/Keyboards:</b> Select system dialog language and keyboard version—the control overwrites the user interface language setting when starting with the language setting of the machine parameter <b>CfgDisplayLanguage</b> (no. 101300)</li> <li>■ <b>Network:</b> Define network settings <b>Further information:</b> "Ethernet interface ", Page 513</li> <li>■ <b>OEM Function Users:</b> Edit machine manufacturer function user <b>Further information:</b> "HEIDENHAIN function users", Page 551</li> <li>■ <b>OPC UA NC Server Connection Assistant:</b> Establish an <b>OPC UA</b> connection</li> <li>■ <b>OPC UA NC Server License:</b> <b>OPC UA</b> license settings <b>Further information:</b> "<b>OPC UA NC Server</b> (options 56 to 61)", Page 571</li> <li>■ <b>PKI Admin</b> <b>Further information:</b> "PKI Admin", Page 577</li> <li>■ <b>Printer:</b> Configure and manage printer <b>Further information:</b> "Printer", Page 495</li> <li>■ <b>Screenshot Config</b> In the <b>Screenshot settings</b> window you can define under which path and file name the control saves screenshots. The file name can contain a placeholder (e.g., %N for sequential numbering).</li> <li>■ <b>SELinux:</b> Define safety software for Linux-based operating systems <b>Further information:</b> "SELinux security software", Page 533</li> <li>■ <b>Shares:</b> Connect and manage external network drives <b>Further information:</b> "Settings for network drives", Page 525</li> <li>■ <b>UserAdmin:</b> Configure user administration <b>Further information:</b> "Configuring user administration", Page 535</li> <li>■ <b>VNC:</b> Define the setting for external software accessing the control, e.g., for maintenance procedures (Virtual Network Computing) <b>Further information:</b> "VNC", Page 498</li> <li>■ <b>WindowManagerConfig:</b> Available only to authorized specialists</li> </ul>
<b>Info</b>	<ul style="list-style-type: none"> <li>■ <b>About HeROS:</b> Open information about the operating system of the control</li> <li>■ <b>About Xfce:</b> Open information on the Window manager</li> </ul>

Area	Function
Tools	<ul style="list-style-type: none"> <li>■ <b>Switch-off:</b> Shut down the control <b>Further information:</b> "Switching or logging out users", Page 564</li> <li>■ <b>Screenshot:</b> Create screenshots</li> <li>■ <b>File Manager:</b> Available only to authorized specialists</li> <li>■ <b>Diffuse Merge Tool:</b> Compare and merge text files</li> <li>■ <b>Document Viewer:</b> Display and print files (e.g., PDF files)</li> <li>■ <b>Geeqie:</b> Open, manage, and print graphics</li> <li>■ <b>Gnumeric:</b> Open, edit, and print tables</li> <li>■ <b>IDS Camera Manager:</b> Manage cameras connected to the control</li> <li>■ <b>keypad horizontal:</b> Open virtual keyboard</li> <li>■ <b>keypad vertical:</b> Open virtual keyboard</li> <li>■ <b>Leafpad:</b> Open and edit text files</li> <li>■ <b>NC Control:</b> Start or stop the NC software independently of the operating system</li> <li>■ <b>NC/PLC Backup:</b> Create backup file <b>Further information:</b> "Backup and restore", Page 501</li> <li>■ <b>NC/PLC Restore:</b> Restore backup file <b>Further information:</b> "Backup and restore", Page 501</li> <li>■ <b>QupZilla:</b> Alternative web browser for touch operation</li> <li>■ <b>Real VNC Viewer:</b> Define the setting for external software accessing the control (e.g., for maintenance purposes (Virtual Network Computing))</li> <li>■ <b>Remote Desktop Manager</b> (option 133) <b>Further information:</b> "Remote Desktop Manager (option 133)", Page 474</li> <li>■ <b>Ristretto:</b> Open graphics</li> <li>■ <b>Secure Remote Access</b> <b>Further information:</b> "Secure Remote Access", Page 494</li> <li>■ <b>Combine fixtures</b> <b>Further information:</b> "Combining fixtures in the New Fixture window", Page 381</li> <li>■ <b>TNCguide:</b> Call the help system</li> <li>■ <b>TouchKeyboard:</b> Open keyboard for touch operation</li> <li>■ <b>Web Browser:</b> Start the web browser</li> <li>■ <b>Xarchiver:</b> Extract or compress directories</li> </ul>
Searching	Full-text search of individual functions



The applications available under **Tools** can be started directly by selecting the corresponding file type in the control's file manager.

**Further information:** "Software tools for management of external file types", Page 97

## Portscan

The PortScan function allows the cyclic or manual searching for all open, incoming TCP and UDP listen ports on the system. All ports found are compared with whitelists. If the control finds a non-listed port it shows a corresponding pop-up window.

The **HEROS menu Diagnostic** menu contains the **Portscan** and **Portscan OEM** applications for this purpose. **Portscan OEM** is only executable after entering the machine manufacturer password.

The **Portscan** function searches for all open, incoming TCP and UDP ports on the system and compares them to four whitelists stored in the system:

- System-internal whitelists **/etc/sysconfig/portscan-whitelist.cfg** and **/mnt/sys/etc/sysconfig/portscan-whitelist.cfg**
- Whitelist for ports for machine manufacturer-specific functions (e.g., for Python applications, external applications): **/mnt/plc/etc/sysconfig/portscan-whitelist.cfg**
- Whitelist for ports with customer-specific functions: **/mnt/tnc/etc/sysconfig/portscan-whitelist.cfg**

For each entry, the whitelist specifies the type of port (TCP/UDP), the port number, the providing program, and optional comments. If the automatic port scan function is active, only ports listed in the whitelists can be open. Non-listed ports trigger a notification window.

The result of the scan is saved to a log file (LOG:/portscan/scanlog and LOG:/portscan/scanlogevil) and, if new ports are found that are not listed in one of the whitelists, these are displayed.

### Starting Portscan manually

To manually start **Portscan**:

- ▶ Open the task bar at the bottom edge of the screen  
**Further information:** "Window manager", Page 488
- ▶ Press the green HEIDENHAIN button to open the **HEROS menu**
- ▶ Select the **Diagnostic** menu item
- ▶ Select the **Portscan** menu item
- ▶ The control opens the **HeRos Portscan** pop-up window.
- ▶ Press the **Start** button

### Cyclically starting Portscan

To automatically start the Portscan cyclically:

- ▶ Open the task bar at the bottom edge of the screen
- ▶ Press the green HEIDENHAIN button to open the **HEROS menu**
- ▶ Select the **Diagnostic** menu item
- ▶ Select the **Portscan** menu item
- ▶ The control opens the **HeRos Portscan** pop-up window.
- ▶ Press the **Automatic update on** button
- ▶ Set the time interval with the slider

## Secure Remote Access

### Application

**Secure Remote Access** SRA allows you to set up an encrypted connection between a PC and your control via the Internet. SRA allows the control to be displayed and operated on a PC, such as for service trainings or remote maintenance.

### Related topics

- VNC settings

**Further information:** "VNC", Page 498

### Requirements

- Existing Internet connection

**Further information:** "Network configuration with Advanced Network Configuration", Page 519

- The following settings in the **VNC settings** window:
  - **Enable RemoteAccess and IPC** check box is active
  - In the **Enabling other VNC** area, the **Inquire** or **Permitted** check box is active

**Further information:** "VNC", Page 498

- PC with paid RemoteAccess software including the extension **Secure Remote Access**

### HEIDENHAIN website



For more information, refer to the integrated help system of RemoteAccess.

You can open the context-sensitive help function of the RemoteAccess software by pressing the **F1** key.

### Description of function

To navigate to this function:

#### Tools ▶ Secure Remote Access

The PC provides a ten-digit session ID for you to enter in the **HEIDENHAIN Secure Remote Access** window.

SRA enables connection via an VPN server.

In the **Extended** area, the control shows the progress of the connection setup.

The **HEIDENHAIN Secure Remote Access** window provides the following buttons:

Button	Function
<b>Connect</b>	The control starts the connection with the entered session ID.
<b>Update</b>	<p>The control manually searches for updates for SRA.</p> <p>The control automatically searches for available updates when you open the <b>HEIDENHAIN Secure Remote Access</b> window.</p> <p>If an update is available, you can install it. The control restarts during the update.</p>
<b>Config.</b>	The control opens the <b>Network settings</b> window. Only for network specialists
<b>Show log</b>	The control opens the log files of the SRA.

### Notes

If, in the **VNC settings** window, you set the **Enabling other VNC** setting to **Inquire**, you can permit or deny any connection.

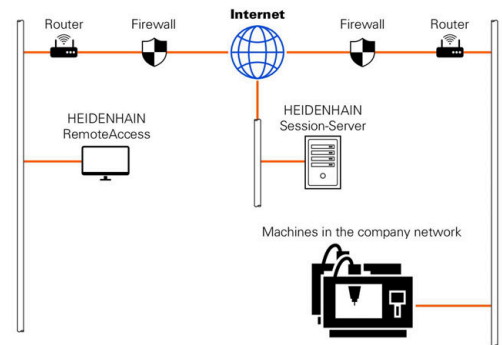
### Printer

The **Printer** function in the **HEROS menu** enables you to add and manage printers.









#### Displaying the printer settings

To open the printer settings:

- ▶ Open the taskbar at the bottom edge of the screen
- ▶ Press the green HEIDENHAIN button to open the **HEROS menu**
- ▶ Select the **Settings** menu item
- ▶ Select the **Printer** menu item
- > The control opens the **Herros Printer Manager** dialog.



**Overview of the soft keys**

Soft key	Function	Meaning
	<b>CREATE</b>	Creates a printer
	<b>CHANGE</b>	Adapts the properties of the selected printer
	<b>COPY</b>	Creates a copy of the selected printer Initially, the copy has the same properties as the copied printer. This can be useful for printing both portrait and landscape formats on the same printer
	<b>DELETE</b>	Deletes the selected printer
	<b>UP</b>	Selects a printer
	<b>DOWN</b>	
	<b>STATUS</b>	Displays the status information of the selected printer
	<b>PRINT A TEST PAGE</b>	Prints a test page on the selected printer

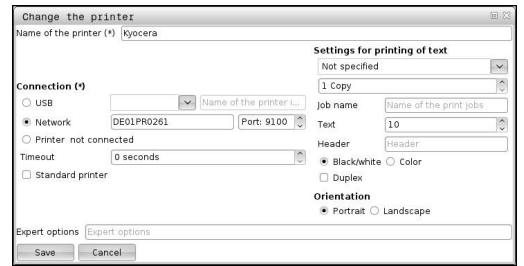


**Creating a printer**

To create a new printer:

- ▶ Enter the printer name in the name dialog
- ▶ Select **CREATE**
- > The control creates a new printer.
- ▶ Press the **CHANGE** soft key
- > The control opens the **Change the printer** dialog.

For each printer, the following properties can be set:



Setting	Meaning
<b>Name of the printer</b>	Customize the printer name
<b>Connection</b>	Select the connection <ul style="list-style-type: none"> <li>■ <b>USB</b> – Assign the USB connection here. The control automatically displays the name.</li> <li>■ <b>Network</b> – Enter the network name or the IP address of the printer here. In addition, specify the port of the network printer here (default: 9100)</li> <li>■ <b>Printer %1 not connected</b></li> </ul>
<b>Timeout</b>	Delays the printing process The control delays the printing process by the pre-set number of seconds after the last change has been made to the file to be printed in <b>PRINTER:</b> Use this setting if the file to be printed is populated with FN functions (e.g., when probing).
<b>Standard printer</b>	Select the default printer When creating the first printer, this setting is automatically entered.
<b>Settings for printing of text</b>	These settings are applicable when printing text documents: <ul style="list-style-type: none"> <li>■ Paper size</li> <li>■ Number of copies</li> <li>■ Job name</li> <li>■ Font size</li> <li>■ Header</li> <li>■ Print options (black and white, color, duplex)</li> </ul>
<b>Orientation</b>	Portrait or landscape for all printable files
<b>Expert options</b>	Available only to authorized specialists

**Requirements for the connected printer**

The connected printer must be PostScript-enabled.

The control can communicate only with printers that understand PostScript emulation such as KPDL3. With some printers, the PostScript emulation can be set in the printer menu.

To change the printer settings:

- ▶ Select the printer menu
- ▶ Select printing settings
- ▶ Select KPDL for the emulation
- ▶ Confirm if required

## Print

Print options:

- Copying the file to be printed into the **PRINTER** drive:  
The file to be printed is automatically forwarded to the default printer and deleted from the directory after the print job is complete.  
You may also copy the file into the printer sub-directory if you wish to use a printer other than the default printer.
- Using the FN 16: F-PRINT function

Printable files:

- Text files
- Graphic files
- PDF files

## VNC

Use the **VNC** function to configure the behavior of the various VNC clients. This includes, for example, operation via soft keys, mouse, and the alphabetic keyboard.

The control provides the following options:

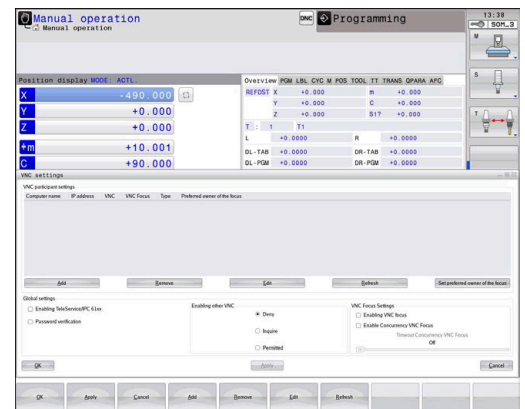
- List of permitted clients (IP address or name)
- Password for the connection
- Additional server options
- Additional settings for assigning the focus



Refer to your machine manual.

For multiple clients or operating units, the focus assignment procedure depends on the design and the operating situation of the machine.

This function must be adapted by your machine manufacturer.



### Opening the VNC settings

To open the **VNC settings**:




- ▶ Open the task bar at the bottom edge of the screen
- ▶ Press the green HEIDENHAIN button to open the **HEROS menu**
- ▶ Select the **Settings** menu item
- ▶ Select the **VNC** menu item
- > The control opens the **VNC settings** pop-up window.

The control provides the following options:

- Add: Add new VNC viewer/client
- Remove: Deletes the selected client. Only possible with manually entered clients.
- Edit: Edit the configuration of the selected client
- Update: Updates the display. Required with connection attempts during which the dialog is open.

### VNC settings

Dialog	Option	Meaning
VNC participant settings	Computer name	IP address or computer name
	VNC	Connection of the client to the VNC viewer
	VNC Focus	The client participates in the focus assignment
	Type	<ul style="list-style-type: none"> <li>■ Manual Manually entered client</li> <li>■ Denied This client is not permitted to connect</li> <li>■ Enable TeleService and IPC Client via TeleService connection</li> <li>■ DHCP Other computer that obtains an IP address from this computer</li> </ul>
Firewall warning		<p>Warnings and information about if the VNC protocol has not been authorized for all VNC clients due to firewall settings on the control.</p> <p><b>Further information:</b> "Firewall", Page 503.</p>
Global settings	Enable RemoteAccess and IPC	Connection is always permitted
	Password verification	The client must enter a password for verification. If this option is active, the password must be entered when the connection is made.

Dialog	Option	Meaning
Enabling other VNC	Deny	Access generally denied to all other VNC clients.
	Inquire	During connection attempts a corresponding dialog is opened.
	Permitted	Access is generally granted to all other VNC clients.
VNC Focus Settings	Enabling VNC focus	Enable focus assignment for this system. Otherwise there is no central focus assignment. In the default setting, the focus is actively reassigned by the owner of the focus by clicking the focus symbol. This means that the owner of the focus must first release the focus by clicking the focus symbol before any other client can retrieve the focus.
	Enable Concurrency VNC Focus	In the default setting, the focus is actively reassigned by the owner of the focus by clicking the focus symbol. This means that the owner of the focus must first release the focus by clicking the focus symbol before any other client can retrieve the focus. If concurrency focus is selected, any client can retrieve the focus at any time without having to wait for the current owner of the focus to release it.
	Timeout Concurrency VNC Focus	Time period within which the current owner of the focus can object to the focus being withdrawn or can prevent the reassignment of the focus. If a client requests the focus, a dialog in which the reassignment of focus can be refused appears on all clients' screens.
Focus symbol		Current status of VNC focus on the respective client: Focus is owned by other client. Mouse and alphabetic keyboard are disabled.
		Current status of VNC focus on respective client: Focus is owned by current client. Entries can be made.
		Current status of VNC focus on the respective client: Request by the owner of the focus to give the focus to another client. Mouse and alphabetic keyboard are disabled until the focus is assigned unambiguously.

If **Enable Concurrency VNC Focus** is selected, a pop-up window appears. This dialog allows you to deny the focus change to the requesting client. If you fail to do so, the focus changes to the requesting client after the set time limit.



Enable the **Enabling VNC focus** check box only in connection with HEIDENHAIN devices provided especially for this purpose (e.g., ITC industrial computers).

## Backup and restore

With the **NC/PLC Backup** and **NC/PLC Restore** functions, you can back up and restore individual folders or the entire **TNC:** drive. You can save the backup files locally, on a network drive, or to USB storage devices.

The backup program generates a \*. **tncbck** file that can also be processed by the PC tool TNCbackup (part of TNCremo). The Restore program can restore these files as well as those from existing TNCbackup programs. If you select a \*. **tncbck** file in the File Manager of the control, the **NC/PLC Restore** program will be launched automatically.

Backup and restore is subdivided into several steps. Navigate between these steps with the **FORWARD** and **BACK** soft keys. Specific actions for steps are selectively displayed as soft keys.

### Open NC/PLC Backup or NC/PLC Restore

To open the function:

- ▶ Open the task bar at the bottom edge of the screen
- ▶ Press the green HEIDENHAIN button to open the **HEROS menu**
- ▶ Select the **Tools** menu item
- ▶ Open the **NC/PLC Backup** or **NC/PLC Restore** menu item
- > The control opens the pop-up window.

### Backing up data

To back-up the control data:

- ▶ Select **NC/PLC Backup**
- ▶ Select type
  - Back up the **TNC:** drive
  - Back up the directory tree: Select the directory for backup in the file management
  - Backup machine configuration (for machine manufacturer only)
  - Complete backup (for machine manufacturer only)
  - Comment: Freely configurable comment for the backup
- ▶ Select the next step with the **FORWARD** soft key
- ▶ Stop the control if required with the **STOP NC SOFTWARE** soft key
- ▶ Define the exclusion rules
  - User preset rules
  - Write own rules to the table
- ▶ Select the next step with the **FORWARD** soft key
- > The control generates a list of files for backing up.
- ▶ Check the list. Deselect files if necessary.
- ▶ Select the next step with the **FORWARD** soft key
- ▶ Enter the name of the backup file
- ▶ Select the storage path
- ▶ Select the next step with the **FORWARD** soft key
- > The control generates the backup file.
- ▶ Confirm with the **OK** soft key
- > The control concludes the backup process and restarts the NC software.

## Restore data

### NOTICE

#### Caution: Data may be lost!

When you restore data (Restore function), any existing data will be overwritten without a confirmation prompt. Existing data is not automatically backed up by the control before running the restore process. Power failures or other problems can interfere with the data restore process. As a consequence, data may be irreversibly damaged or deleted.

- ▶ Before starting the data restore process, make a backup of the existing data

To restore data:

- ▶ Select **NC/PLC Restore**
- ▶ Select the archive to be restored
- ▶ Select the next step with the **FORWARD** soft key
- > The control generates a list of files for restoring.
- ▶ Check the list. Deselect files if necessary.
- ▶ Select the next step with the **FORWARD** soft key
- ▶ Stop the control if required with the **STOP NC SOFTWARE** soft key
- ▶ Extract the archive
- > The control restores the files.
- ▶ Confirm with the **OK** soft key
- > The control restarts the NC software.




## 12.4 Firewall


### Application

You have the possibility to set up a firewall for the primary network interface of the control and a sandbox, if needed. You can configure it so that incoming network traffic is blocked and/or a message is displayed, depending on the sender and the service.

The firewall cannot be started for the secondary network interface of the control (i.e., the machine network).

If you activate the firewall, the control displays a corresponding icon at the bottom right in the taskbar. The symbol changes depending on the safety level that the firewall was activated with, and informs about the level of the safety settings:

Icon	Meaning
	No firewall protection yet although it has been activated according to the configuration. This can happen, for example, if a dynamic IP address is used in the network interface configuration, but the DHCP server has not yet assigned such an address.
	Firewall active with medium security level
	Firewall is activated with a high security level All services except for SSH are blocked.

 Have your network specialist check and, if necessary, change the standard settings.

### Configuring the firewall

To configure the firewall:



- ▶ Open the task bar at the bottom edge of the screen
- ▶ Press the green HEIDENHAIN button to open the **HEROS menu**
- ▶ Select the **Settings** menu item
- ▶ Select the **Firewall** menu item
- > The control opens the **Firewall settings** dialog.

Activate the firewall with the pre-set default settings:

- ▶ Set the **active** option for switching on the firewall
- ▶ Press the **Set standard values** button
- ▶ Confirm the changes with the **Apply** function
- > The control activates the default settings recommended by HEIDENHAIN.
- ▶ Exit the dialog with the **OK** function

### Firewall settings

Setting	Meaning
Active	Switch the firewall on or off

Setting	Meaning
Interface	<p>Select the interface</p> <p>Selection of the <b>eth0</b> interface usually corresponds to X26 of the MC main computer. <b>eth1</b> corresponds to X116.</p> <p>You can check the interfaces in the network settings on the Interfaces tab. For main computer units with two Ethernet interfaces, the DHCP server for the machine network is active for the second, non-primary, interface by default. With this setting, the firewall cannot be activated for <b>eth1</b> because the firewall and DHCP server mutually exclude each other.</p>
Report other inhibited packets	<p>Activate the firewall with a high security level</p> <p>All services except for SSH are blocked.</p>
Inhibit ICMP echo answer	<p>If this option is set, the control no longer responds to a PING request</p>
Service	<p>This column contains the short names of the services that are configured with this dialog. For the configuration, it is not important here whether the services themselves have been started.</p> <ul style="list-style-type: none"> <li>■ <b>DNC</b> designates the service the DNC server provides via the RPC protocol for external applications that were developed with the RemoTools SDK (port 19003)</li> </ul> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p> For more detailed information, consult the RemoTools SDK manual.</p> </div> <ul style="list-style-type: none"> <li>■ <b>LDAPS</b> includes the server on which the user data and the user administration configuration are saved.</li> <li>■ <b>LSV2</b> includes the functionality for <b>TNCremo</b>, Teleservice, and other HEIDENHAIN PC Tools (port 19000)</li> </ul> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p> When user administration is active, you can set up only secure network connections via SSH. The control automatically disables the LSV2 connections via the serial interfaces (COM1 and COM2) and the network connections without user authentication.</p> <p>If user administration is inactive, the control also automatically blocks non-secure LSV2 or RPC connections. In the optional machine parameters <b>allowUnsecureLsv2</b> (no. 135401) and <b>allowUnsecureRpc</b> (no. 135402), the machine manufacturer can define whether the control will permit non-secure connections. These machine parameters are included in the <b>CfgDncAllowUnsecur</b> (no. 135400) data object.</p> </div> <ul style="list-style-type: none"> <li>■ <b>OPC UA</b> designates the service provided by the <b>OPC UA NC Server</b> (port 4840)</li> <li>■ <b>SMB</b> only refers to incoming SMB connections (i.e., if a Windows share is created on the NC). Outgoing SMB connections (i.e., if a Windows share is connected to the NC) are not affected by this setting.</li> <li>■ <b>SSH</b> stands for the Secure Shell protocol (port 22). As of HEROS 504, LSV2 can be executed securely via this SSH protocol while user administration is active.</li> </ul> <p><b>Further information:</b> "User authentication from external applications", Page 557</p> <ul style="list-style-type: none"> <li>■ <b>VNC</b> protocol means access to the screen contents. If you block this service, the screen content can no longer be accessed, not even with the Teleservice programs from HEIDENHAIN (e.g., to create a <b>Screenshot</b>) In this case, the HEROS VNC configuration dialog shows a warning that <b>VNC</b> is disabled in the firewall.</li> </ul>



Setting	Meaning
Method	<p>Configure accessibility</p> <p>Under <b>Method</b>, you can configure whether the service is accessible:</p> <ul style="list-style-type: none"> <li>■ <b>Prohibit all</b>, cannot be accessed by anyone</li> <li>■ <b>Permit all</b>, can be accessed by everyone</li> <li>■ <b>Permit some</b>, can be accessed only by individual clients</li> </ul> <p>If you set <b>Permit some</b>, you must also specify the computer that you wish to grant access to the respective service. If you do not specify anything under <b>Computer</b>, the setting <b>Prohibit all</b> will automatically become active when the configuration is saved.</p>
Log	<p>If <b>Log</b> is active, the control outputs a <b>red</b> message when a network packet for this service has been blocked. The control shows a blue message when a network packet for this service has been accepted.</p>
Calculator	<p>If you have selected the <b>Permit some</b> setting under <b>Method</b>, specify the computers here.</p> <p>The computers can be entered with their IP addresses or with a host name. Separate multiple computers by commas. If you use a host name, the system checks upon closing or saving the dialog whether this host name can be translated into an IP address. If this is not the case, an error message is displayed and the dialog will not terminate.</p> <p>If you specify a valid host name, this host name is translated into an IP address each time the control is started. If a computer that was entered with its name changes its IP address, you may have to restart the control or formally change the firewall configuration. In this case, the control uses the new IP address for a host name in the firewall.</p>
Advanced options	These settings are only intended for your network specialists
Set standard values	Reset the settings to the default values recommended by HEIDENHAIN

## 12.5 Setting up data interfaces

### Serial interfaces on the TNC 640

The TNC 640 automatically uses the LSV2 transmission protocol for serial data transfer. All parameters of the LSV2 protocol are invariably fixed except for the baud rate in the machine parameter **baudRateLsv2** (no. 106606).



When user administration is active, you can set up only secure network connections via SSH. The control automatically disables the LSV2 connections via the serial interfaces (COM1 and COM2) and the network connections without user authentication.

If user administration is inactive, the control also automatically blocks non-secure LSV2 or RPC connections. In the optional machine parameters **allowUnsecureLsv2** (no. 135401) and **allowUnsecureRpc** (no. 135402), the machine manufacturer can define whether the control will permit non-secure connections. These machine parameters are included in the **CfgDncAllowUnsecur** (no. 135400) data object.

### Application

The machine parameter **RS232** (no. 106700) allows you to define another transmission type (interface). The settings described below are effective only for the respective newly defined interface.

To set up a data interface:



- ▶ Press the **MOD** key
- ▶ Enter the code number 123
- ▶ Define an interface in the machine parameter **RS232** (no. 106700)

### Setting the RS-232 interface

To set up the RS 232 interface:

- ▶ Open the **RS232** folder
- > The control displays setting options with the following machine parameters.

#### Set BAUD RATE (baud rate no. 106701)

Use the BAUD RATE to set the data transfer rate.

Enter a value between 110 and 115,200 baud.

### Set protocol (protocol no. 106702)

The communications protocol controls the data flow of a serial transmission.



Please note:

- The **BLOCKWISE** setting designates a type of data transfer in which the data is transferred grouped in blocks.
- The **BLOCKWISE** setting does **not** correspond to the data reception in blocks and the simultaneous execution of older controls in blocks. This function is no longer available for current controls.

Setting	Data transmission protocol
STANDARD	Standard data transmission Line-by-line transmission
BLOCKWISE	Packet-based data transfer
RAW_DATA	Transfer without protocol Transmission of characters only

### Set data bits (dataBits no. 106703)

By setting the data bits you define whether a character is transmitted with 7 or 8 data bits.

### Check parity (parity no. 106704)

The parity bit defines whether transmission errors are checked.

The parity bit can take three different forms:

Setting	Meaning
NONE	No parity There is no error detection.
EVEN	Even parity There is an error if the receiver detects an uneven number of bits in his evaluation.
ODD	Odd parity There is an error if the receiver detects an even number of bits in his evaluation.

### Set stop bits (stopBits no. 106705)

The start bit and one or two stop bits enable the receiver to synchronize each transmitted character during serial data transmission.

### Set handshake (flowControl no. 106706)

By handshaking, two devices control data transfer between them. A distinction is made between software handshaking and hardware handshaking.

Setting	Meaning
NONE	No data flow control Handshake is not active
RTS_CTS	Hardware handshaking Transmission stopped by RTS active
XON_XOFF	Software handshaking Transfer stopped by DC3 (XOFF) active

### File system for file operation (fileSystem no. 106707)

In **fileSystem** you define the file system for the serial interface. If you require no special file system, this machine parameter is not needed.

Setting	Meaning
EXT	Minimum file system for printers or non-HEIDENHAIN transmission software. It corresponds to the EXT1 and EXT2 operating modes on older HEIDENHAIN controls.
FE1	Communication with the TNCserver PC software or an external floppy disk unit

### Block check character (bccAvoidCtrlChar no. 106708)

The BCC is a block check character. The BCC is optionally added to a transfer block to simplify error detection.

Setting	Meaning
TRUE	Ensures that the BCC does not correspond to a control character.
FALSE	Function not active

### Condition of RTS line (rtsLow no. 106709)

This optional parameter determines the level of the RTS line in the idle state.

Setting	Meaning
TRUE	The level is <b>low</b> in the idle state
FALSE	The level is <b>high</b> in the idle state

### Define behavior after receipt of ETX (noEotAfterEtx no. 106710)

This optional parameter sets whether an EOT character (End of Transmission) is to be transmitted after receiving an ETX character (End of Text).

Setting	Meaning
TRUE	The EOT character is not transmitted.
FALSE	The control transmits the EOT character.

### Settings for transmission of data using TNCserver

When transmitting data with the TNCserver PC software, the machine parameter **RS232** (no. 106700) must be set to the settings below:

Parameters	Selection
Data transfer rate in baud	Has to match the setting in TNCserver
Data transmission protocol	BLOCKWISE
Data bits in each transferred character	7 bits
Type of parity checking	EVEN
Number of stop bits	1 stop bit
Type of handshake	RTS_CTS
File system for file operations	FE1

### HEIDENHAIN data transfer software

#### Application

HEIDENHAIN offers the TNCremo software for connecting a Windows PC to a HEIDENHAIN control in order to transfer data.

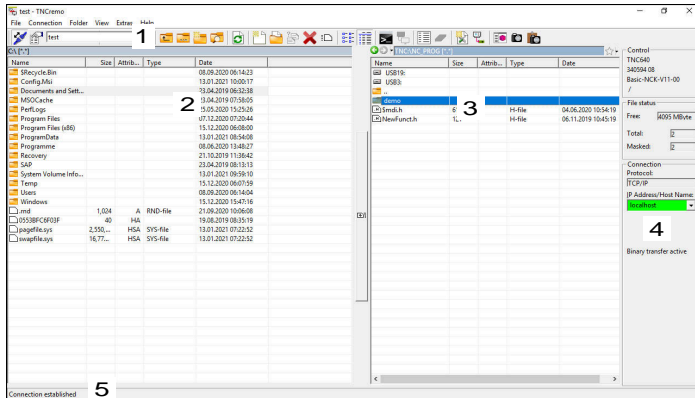
#### Prerequisites

System requirements for TNCremo:

- PC operating system:
  - Windows 8
  - Windows 10
- PC RAM: 2 GB
- Free PC hard-disk space: 15 MB
- A network connection to the control

## Functionality

The TNCremo data transfer software provides the following areas:



- 1 **Toolbar**  
This area provides the most important TNCremo functions.
- 2 **File list of PC**  
In this area, TNCremo displays all of the folders and files of the connected drive (e.g., hard disk of a Windows PC or a USB flash drive).
- 3 **File list of control**  
In this area, TNCremo displays all of the folders and files of the connected drive of the control.
- 4 **Status display**  
In the status display, TNCremo shows information about the current connection.
- 5 **Connection status**  
The connection status indicates whether a connection is currently active.



For more information, refer to the integrated help system of TNCremo.

You can open the context-sensitive help function of the TNCremo software by pressing the **F1** key.

## Installing TNCremo

To install TNCremo on a PC:

- ▶ Start the SETUP.EXE installation program from the Explorer
- ▶ Follow the installer instructions

## Starting TNCremo

To start TNCremo in Microsoft Windows 10:

- ▶ Press the Windows key
- ▶ Select the HEIDENHAIN folder
- ▶ Select TNCremo
- or
- ▶ Double-click the TNCremo desktop icon

## Configuring a connection

Before connecting to the control, you need to configure a connection.

To configure a connection:

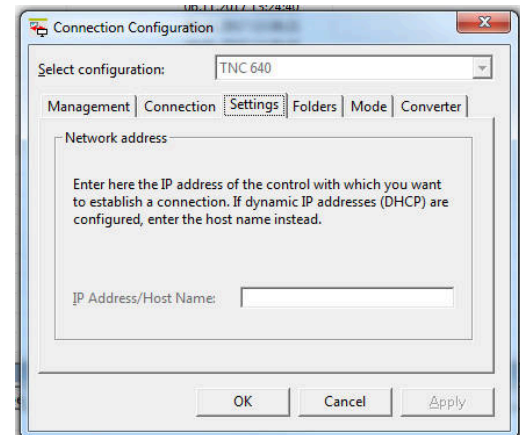


- ▶ Press the **Configure** button
- ▶ TNCremo opens the **Connection configuration** window.
- ▶ Select the **Management** tab
- ▶ Select **New...**
- ▶ TNCremo opens the **New configuration** window.
- ▶ Enter the connection name
- ▶ Press **OK**
- ▶ TNCremo automatically opens the **Connection** tab.
- ▶ Select the **Type of connection**



If you use the default type of connection, a network connection (TCP/IP) is set up over the Ethernet interface.

- ▶ Select the **Settings** tab
- ▶ Enter the **IP address/Host name** of the control
- ▶ Select **OK**
- ▶ TNCremo saves the configuration.



## Establishing a connection to the control

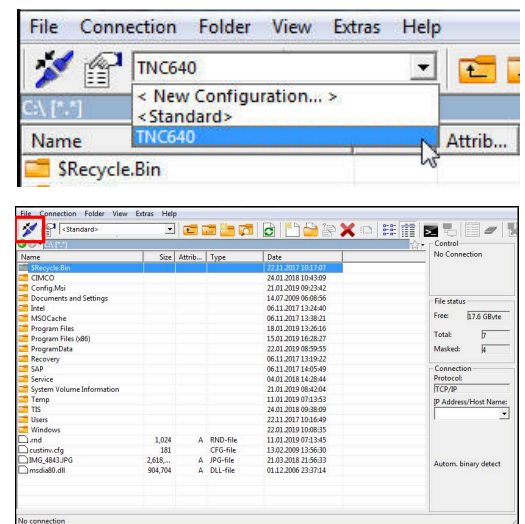
Once you have configured a connection, you can connect your PC to the control.

To set up a connection to the control:

- ▶ Select the configured connection in the selection menu



- ▶ Select the **Set up connection** icon
- ▶ The connection to the control will be established.



### Switching the drive

You can switch the PC drive or the control drive that is shown in TNCremo.

To switch the shown drive:

- ▶ Select the PC's file list or the control's file list



- ▶ Select the **Change folder/drive** icon
- > TNCremo opens a pop-up window.
- ▶ Select the desired drive in the selection menu
- ▶ Select **OK**
- > TNCremo displays the selected drive.

### Notes

- When user administration is active, you can set up only secure network connections via SSH. The control automatically disables the LSV2 connections via the serial interfaces (COM1 and COM2) and the network connections without user authentication.  
If user administration is inactive, the control also automatically blocks non-secure LSV2 or RPC connections. In the optional machine parameters **allowUnsecureLsv2** (no. 135401) and **allowUnsecureRpc** (no. 135402), the machine manufacturer can define whether the control will permit non-secure connections. These machine parameters are included in the **CfgDncAllowUnsecur** (no. 135400) data object.
- You can download the current version of the TNCremo software from the **HEIDENHAIN website** for free.



## 12.6 Ethernet interface

### Introduction

The control is provided with an Ethernet interface as a standard feature so that you can integrate it into a network as a client.

The control transfers data via the Ethernet interface using the following protocols:

- **CIFS** (common internet file system) or **SMB** (server message block)  
The control supports versions 2, 2.1 and 3 of these protocols.
- **NFS** (network file system)  
The control supports versions 2 and 3 of this protocol.

**i** ■ Protect your data and the control by running the machines in a secure network.

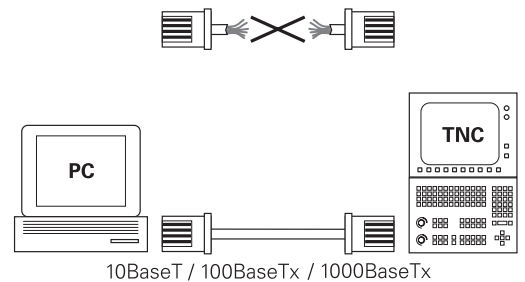
■ To avoid security gaps, prefer the current versions of the **SMB** and **NFS** protocols.

### Connection possibilities

You can integrate the Ethernet interface of the control into the network or connect it directly to a PC through the RJ45 connection X26. The connection is electrically isolated from the control electronics.

Use a Twisted Pair cable to connect the control to your network.

**i** The maximum cable length permissible between the control and a node depends on the quality grade of the cable, the sheathing, and the type of network.



### Ethernet connection icon

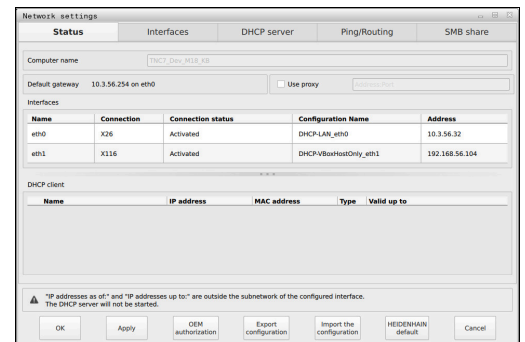
Icon	Meaning
	<p>Ethernet connection</p> <p>The control displays the icon at the bottom right in the taskbar.</p> <p><b>Further information:</b> "Overview of taskbar", Page 489</p> <p>When you click the icon, the control opens a pop-up window. The pop-up window contains the following information and functions:</p> <ul style="list-style-type: none"> <li>■ Connected networks You can disconnect the network connection. Select the network name to reconnect.</li> <li>■ Available networks</li> <li>■ VPN connections Currently no function</li> </ul>

## The Network settings window

In the **Network settings** window you define the settings for the control's Ethernet interface.



Have a network specialist configure the control.



### Status tab

The **Status** tab contains the following information and settings:

Domain	Information or Setting
Domain	The control displays the name under which the control is visible in the company network. You can change the name.
Default gateway	The control shows the default gateway and the Ethernet interface being used.
Use proxy	You can define the <b>address</b> and the <b>port</b> of a proxy server in the network.
Interfaces	<p>The control shows an overview of available Ethernet interfaces. If there is no network connection, the table is empty.</p> <p>The control displays the following information in the table:</p> <ul style="list-style-type: none"> <li>■ <b>Name</b> (e.g., <b>eth0</b>)</li> <li>■ <b>Connection</b> (e.g., <b>X26</b>)</li> <li>■ <b>Connection status</b> (e.g., <b>CONNECTED</b>)</li> <li>■ <b>Configuration Name</b> (e.g., <b>DHCP</b>)</li> <li>■ <b>Address</b> (e.g., <b>10.7.113.10</b>)</li> </ul> <p><b>Further information:</b> "The Interfaces tab", Page 516</p>

Domain	Information or Setting
<b>DHCP client</b>	<p>The control displays an overview of the devices that have received a dynamic IP address in the machine network. If there are no connections to other network components of the machine network, the table is empty.</p> <p>The control displays the following information in the table:</p> <ul style="list-style-type: none"> <li>■ <b>Name</b> Host name and connection status of the device. The control shows the following connection status: <ul style="list-style-type: none"> <li>■ Green: Connected</li> <li>■ Red: No connection</li> </ul> </li> <li>■ <b>IP address</b> Dynamically assigned IP address of the device</li> <li>■ <b>MAC address</b> Physical address of the device</li> <li>■ <b>Type</b> Type of connection The control displays the following connection types: <ul style="list-style-type: none"> <li>■ <b>TFTP</b></li> <li>■ <b>DHCP</b></li> </ul> </li> <li>■ <b>Valid up to</b> Time until which the IP address is valid without being renewed</li> </ul> <p>The machine manufacturer can make settings for these devices. Refer to your machine manual.</p>

### The Interfaces tab

The control displays the available Ethernet interfaces on the **Interfaces** tab.

The **Interfaces** tab contains the following information and settings:

Column	Information or Setting
<b>Name</b>	The control displays the name of the Ethernet interface. You can activate or deactivate the connection by means of a toggle switch.
<b>Connection</b>	The control displays the number of the network connection.
<b>Connection status</b>	<p>The control displays the connection status of the Ethernet interface.</p> <p>The following connection statuses may be displayed:</p> <ul style="list-style-type: none"> <li>■ <b>CONNECTED</b> Connected</li> <li>■ <b>DISCONNECTED</b> Connection separated</li> <li>■ <b>CONFIGURING</b> The IP address is being fetched from the server</li> <li>■ <b>NOCARRIER</b> No cable present</li> </ul>
<b>Configuration Name</b>	<p>You can execute the following functions:</p> <ul style="list-style-type: none"> <li>■ Select a profile for the Ethernet interface In the factory default setting, two profiles are available: <ul style="list-style-type: none"> <li>■ <b>DHCP-LAN</b>: Settings for the standard interface for a standard company network</li> <li>■ <b>MachineNet</b>: Settings for the second, optional Ethernet interface; for configuration of the machine network</li> </ul> </li> <li>■ Reconnect the Ethernet interface with <b>Reconnect</b></li> <li>■ Edit the selected profile</li> </ul> <p><b>Further information:</b> "Network configuration with Advanced Network Configuration", Page 519</p>



- If you have changed the profile of an active connection, the control will not update the profile being used. Reconnect the corresponding interface with **Reconnect**.
- The control exclusively supports the **Ethernet** connection type.

### The DHCP server tab

The machine manufacturer can use the **DHCP server** tab in the control to configure a DHCP server in the machine network. Using this server, the control can establish connections with other network components of the machine network (e.g., with industrial computers).

Refer to your machine manual.

### The Ping/Routing tab

You can check the network connection on the **Ping/Routing** tab.

The **Ping/Routing** tab contains the following information and settings:

Domain	Information or Setting
<b>Ping</b>	<p><b>Address:Port</b> and <b>Address:</b></p> <p>You can enter the IP address of the computer and possibly the port number for checking the network connection.</p> <p>Entry: Four numerical values separated by dots and, if necessary, a port number separated by a colon (e.g., <b>10.7.113.10:22</b>)</p> <p>As an alternative, you can enter the name of the computer whose connection you want to check.</p> <p>Starting and stopping the test</p> <ul style="list-style-type: none"> <li>■ <b>Start</b> button: starts the test The control displays status information in the ping field.</li> <li>■ <b>Stop</b> button: stops the test</li> </ul>
<b>Routing</b>	The control displays status information of the operating system about the current routing for network administrators.

### The SMB share tab

The **SMB share** tab is included only in connection with a VBox programming station.

When the check box is active, the control releases areas or partitions protected by a code number for the Explorer of the Windows PC used, e.g. **PLC**. You can activate or deactivate the check box only by using the machine manufacturer code number.

In the **TNC VBox Control Panel**, select a drive letter within the **NC share** tab for displaying the selected partition and then connect the drive with **Connect**. The host displays the partitions of the programming station.



**Further information:** Programming station for milling controls

You download the documentation together with the programming station software.

### Opening the Network settings window

To open the general network settings:

- ▶ Press the **MOD** key
- ▶ Enter the code number NET123.
- ▶ Press the **PGM MGT** key
- ▶ Press the **NET** soft key
- ▶ Press the **CONFIGURE NETWORK** soft key
- > The control opens the **Network settings** window.

### Exporting and importing a network profile

To export a network profile:

- ▶ Opening the **Network settings** window
- ▶ Select **Export configuration**
- > The control opens a window.
- ▶ Select the storage location for the network profile (e.g., **TNC:/etc/sysconfig/net**)
- ▶ Select **Open**
- ▶ Select the desired network profile
- ▶ Select **Export**
- > The control saves the network profile.



You can't export **DHCP** or **eth1** profiles.

To import an exported network profile:

- ▶ Open the **Network settings** window
- ▶ Select **Import the configuration**
- > The control opens a window.
- ▶ Select the storage location of the network profile
- ▶ Select **Open**
- ▶ Select the desired network profile
- ▶ Press **OK**
- > The control opens a window with a prompt.
- ▶ Press **OK**
- > The control imports and activates the selected network profile.
- ▶ You might need to restart the control



Use the **HEIDENHAIN presets** button to import the default values of the network settings.

### Notes

- Preferably restart the control after making changes in the network settings.
- The HEROS operating system manages the **Network settings** window. You must restart the control in order to change the HEROS conversational language.

**Further information:** "Changing the HEROS conversational language", Page 579

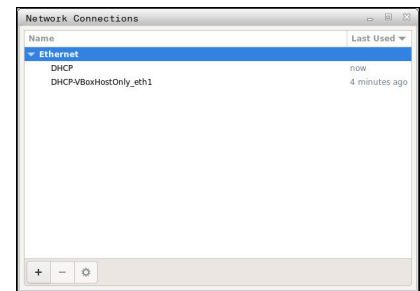
## Network configuration with Advanced Network Configuration

### Application

Use the **Advanced Network Configuration** to add, edit or remove profiles for the network connection.

### Description of function




When you select the **Advanced Network Configuration** application in the HEROS menu, the control opens the **Network Connections** window.





The **Network Connections** window

Symbols in the **Network connections** window

The following symbols are shown in the **Network Connections** window:

Icon	Function
	Add network connection
	Remove network connection
	Edit network connection The control opens the <b>Editing network connection</b> window. <b>Further information:</b> "The Editing network connection window", Page 520

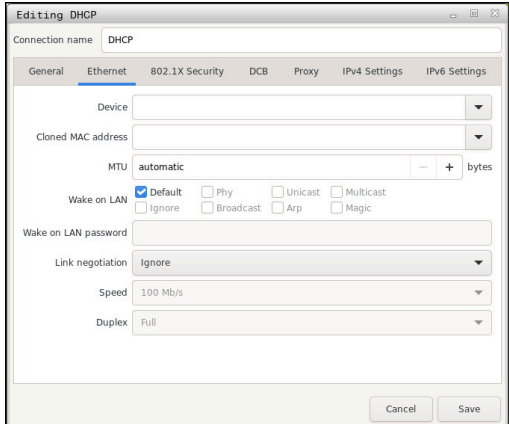
When a connection is active, the control displays a symbol in the header:

Icon	Meaning
	<b>Secure connection configuration</b> External access to the control is active; all connections are using a secure connection configuration.
	<b>Non-secure connection configuration</b> An external access to the control is active but at least one connection is using a non-secure connection configuration.

**Further information:** "Display screen", Page 59

### The Editing network connection window

In the **Editing network connection** window, the control shows the connection name of the network connection in the upper area. You can change the name.



The Editing network connection window



The **General** tab

The **General** tab contains the following settings:

Setting	Meaning
<b>Connect automatically</b>	<p>If you are using several profiles, you can define an order of priority for the connection here.</p> <p>The control connects the network with the highest priority first.</p> <p>Input: <b>-999...999</b></p>
<b>All users may connect to this network</b>	<p>Here you can enable the selected network for all users.</p>
<b>Automatically connect to VPN when using this connection</b>	<p>Currently no function</p>
<b>Bonded connections:</b>	<p>Currently no function</p>

The **Ethernet** tab

The **Ethernet** tab contains the following settings:

Setting	Meaning
<b>Service:</b>	<p>Here you can select the Ethernet interface.</p> <p>If you do not select an Ethernet interface, this profile can be used for any Ethernet interface.</p> <p>Selection by means of a selection window</p>
<b>Cloned MAC address:</b>	Currently no function
<b>_MTU:</b>	<p>Here you can define the maximum package size in bytes.</p> <p>Input: <b>Automatic, 1... 10000</b></p>
<b>_Private key password:</b>	Currently no function
<b>Wake-on-LAN password</b>	Currently no function
<b>Link negotiation</b>	<p>Here you have to configure the settings for the Ethernet connection:</p> <ul style="list-style-type: none"> <li>■ <b>Ignore</b> Retain the configurations already existing on the device.</li> <li>■ <b>Automatic</b> The speed and duplex settings are configured automatically for the connection.</li> <li>■ <b>Manual</b> Configure the speed and duplex settings for the connection manually.</li> </ul> <p>Selection by means of a selection window</p>
<b>Speed</b>	<p>Here you have to select the speed settings:</p> <ul style="list-style-type: none"> <li>■ <b>10 Mb/s</b></li> <li>■ <b>100 Mb/s</b></li> <li>■ <b>1 Gb/s</b></li> <li>■ <b>10 Gb/s</b></li> </ul> <p>Only if <b>Link negotiation</b> has been selected <b>Manual</b></p> <p>Selection by means of a selection window</p>
<b>Full duplex</b>	<p>Here you have to select the duplex setting:</p> <ul style="list-style-type: none"> <li>■ <b>Half</b></li> <li>■ <b>Full</b></li> </ul> <p>Only if <b>Link negotiation</b> has been selected <b>Manual</b></p>

<b>Setting</b>	<b>Meaning</b>
The <b>802.1X Security</b> tab Currently no function	Selection by means of a selection window
The <b>DCB</b> tab Currently no function	
The Proxy tab Currently no function	

The **IPv4 Settings** tab

The **IPv4 Settings** tab contains the following settings:

Setting	Meaning
<b>_Method:</b>	<p>Here you have to select a network connection method:</p> <ul style="list-style-type: none"> <li>■ <b>Automatic (DHCP)</b> If the network uses a DHCP server for IP address assignment</li> <li>■ <b>Automatic (DHCP) addresses only</b> If the network uses a DHCP server for IP address assignment, but you are assigning the DNS server manually</li> <li>■ <b>Manual</b> Assign the IP address manually</li> <li>■ <b>Link-Local Only</b> Currently no function</li> <li>■ <b>Shared to other computers</b> Currently no function</li> <li>■ <b>Disabled</b> Deactivate IPv4 for this connection</li> </ul>
<b>Automatic, addresses only</b>	<p>Here you can add static IP addresses that will be set up in addition to the IP addresses that are assigned automatically.</p> <p>Only with <b>_Method: Manual</b></p>
<b>Additional DNS servers:</b>	<p>Here you can add the IP addresses of DNS servers that are used to resolve computer names.</p> <p>Separate multiple IP addresses by commas.</p> <p>Only with <b>_Method: Manual</b> and <b>Automatic (DHCP) addresses only</b></p>
<b>Additional search domains:</b>	<p>Here you can add domains used by computer names.</p> <p>Separate multiple domains by commas.</p> <p>Only with <b>_Method: Manual</b></p>
<b>DHCP client ID:</b>	Currently no function
<b>Require IPv4 addressing for this connection to complete</b>	Currently no function

The **IPv6 Settings** tab

Currently no function

## Settings for network drives

**i** Have a network specialist configure the control.

You can connect network drives to the control. If the control is connected to a network and the file shares are connected, the control displays additional drives in the directory window of the file management

In the **Network drive** area of the **Mount Setup** window, the control shows a list of all defined network drives and the status of each drive.

You can define any number of network drives, but only seven can be connected at a time

In the **Status Log** area, the control shows status information and error messages.

### Open settings

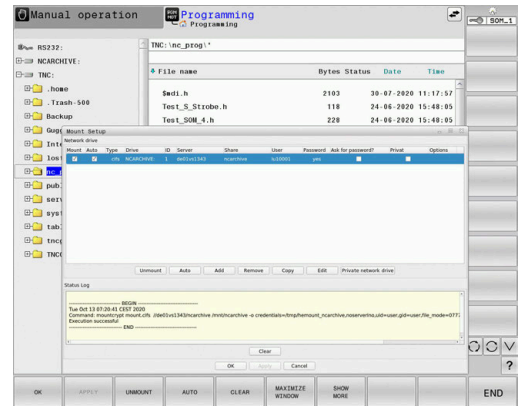
To open the settings for network drives:

- PGM MGT










▶ Press the **PGM MGT** key
  
- NET

▶ Press the **NET** soft key
  
- DEFINE NETWORK CONNECTN.

▶ Press the **DEFINE NETWORK CONNECTN.** soft key
- ▶ The control opens the **Mount Setup** window.



### Overview of the soft keys

Soft key	Button	Meaning
	<b>Mount</b>	Connect a network drive The control ticks the check box in the <b>Mount</b> column when there is an active connection.
	<b>Unmount</b>	Disconnect a network drive
	<b>Auto</b>	Automatically connect the network drive whenever the control is switched on The control ticks the check box in the <b>Auto</b> column when there is an automatic connection.
	<b>Add</b>	Define a new network drive
	<b>Remove</b>	Delete an existing network drive
	<b>Copy</b>	Copy a network drive
	<b>Edit</b>	Editing a network drive
	<b>Clear</b>	Delete the contents of the <b>Status Log</b> area
	<b>Private network drive</b>	User-specific network drive when user administration is active The control ticks the check box in the <b>Privat</b> column when there is a user-specific connection.

### Adding a network drive

#### Requirements

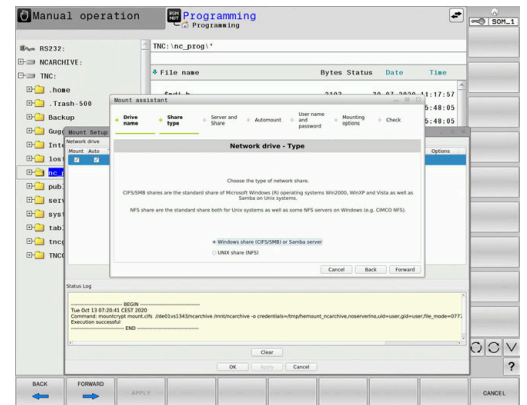
Prerequisites for connecting a network drive:

- Connection with the network
- The control must reach the server in the network
- The credentials and the drive path are known

#### Adding a network drive

To add a network drive:

- ▶ Select **Add**
- > The control opens the **Mount assistant** window.
- ▶ Define the settings on the individual tabs
- ▶ Select **Forward** after each tab
- ▶ On the **Check** tab, check the settings
- ▶ Select **Apply**
- > The control connects the network drive.



#### Settings for the network drive

The control guides you through the settings with the **Mount assistant**.

Tab	Setting
Drive name	<ul style="list-style-type: none"> <li>■ <b>Drive name:</b> Network drive name shown in the file management of the control The names must be all uppercase letters, terminated by a colon (:).</li> <li>■ <b>Private network drive</b> With user administration active, the connection is only visible to the user who created it.</li> </ul> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>i</b> To create and edit public connections, you need the HEROS.SetShares right. Without this right, users are able to start and terminate public connections but can create and edit only private connections. <b>Further information:</b> "Definition of roles", Page 552</p> </div>
Share type	<p>Transfer protocol</p> <ul style="list-style-type: none"> <li>■ <b>Windows share (CIFS/SMB) or Samba server</b></li> <li>■ <b>UNIX share (NFS)</b></li> </ul>

Tab	Setting
Server and Share	<ul style="list-style-type: none"> <li>■ <b>Server name:</b> Server name or IP address of network drive</li> <li>■ <b>Share name:</b> Designation used to share the folder accessed by the control</li> </ul>
Automount	<p><b>Connect automatically (not possible with the "Ask for password?" option)</b></p> <p>The control connects the network drive automatically during the starting process.</p>
User name and password (only with Windows share)	<ul style="list-style-type: none"> <li>■ <b>Single Sign On</b> With user administration active, the control automatically connects an encrypted network drive when the user logs in.</li> <li>■ <b>Windows user name:</b></li> <li>■ <b>Ask for password? (not possible with the "Connect automatically" option)</b> Select whether a password is required upon connecting.</li> <li>■ <b>Password</b></li> <li>■ <b>Password verification</b></li> </ul>
Mounting options	<p><b>Parameters for mount option "-o":</b></p> <p>Auxiliary parameters for the connection</p>
Check	<p>The control displays a summary of the defined settings.</p> <p>You can check the settings and save them with <b>Apply</b>.</p>



**Examples of Mounting options**

Enter options without a space, only separated by a comma

**Options for NFS**

Example	Meaning
rsize=8192	Packet size in bytes for data reception Input range 512 to 8192
wsize=4096	Packet size in bytes for data transmission Input range 512 to 8192
soft,timeo=3	Conditional Mount Time in tenths of a second after which the control will repeat the attempt
nfsvers=2	Protocol version

**i** If you use the CIMCO NFS software, you must set this option. CIMCO NFS supports NFS only up to version 2.

**Options for SMB**

Example	Meaning
domain=xxx	Name of the domain HEIDENHAIN recommends not to include the domain in the user name, but rather specify it as an option.
vers=3.1.1	Protocol version
sec=ntlmssp	Authentication method ntlm Use this option if the control displays the <b>Permission denied</b> error message upon connecting.

**i** To avoid security gaps, prefer the current versions of the **SMB** and **NFS** protocols.  
Depending on the software status of the control, the network drive may require an older protocol version. In this case, you may change the protocol version with the **vers=** auxiliary parameter. Contact your network specialist.

## 12.7 File transfer with SFTP (SSH File Transfer Protocol)

### Application

SFTP (SSH File Transfer Protocol) provides a secure way to connect client applications to the control and to transfer files at high speed from a PC to the control. The connection is routed via an SSH tunnel.

### Related topics

- User administration  
**Further information:** "User administration", Page 534
- Principle of the SSH connection  
**Further information:** "User authentication from external applications", Page 557
- Firewall settings  
**Further information:** "Firewall", Page 503

### Requirements

- PC software TNCremo with version 3.3 or higher is installed  
**Further information:** "HEIDENHAIN data transfer software", Page 509
- **SSH** service is permitted in the firewall of the control  
**Further information:** "Firewall", Page 503

### Description of function

SFTP is a secure transmission protocol supported by various operating systems for client applications.

To set up the connection, you need a key pair consisting of a public and a private key. You transfer the public key to the control and assign it to a user through the user administration. The private key is required by the client application to set up a connection to the control.

HEIDENHAIN recommends using the CreateConnections application to generate the key pair. CreateConnections is installed together with the PC software TNCremo with version 3.3 and higher. CreateConnections lets you transfer the public key directly to the control and assign it to a user.

You can also use other software to generate the key pair.

## Setting up an SFTP connection with CreateConnections

For an SFTP connection using CreateConnections, the following are required:

- Connection with secure protocol, such as **TCP/IP Secure**
- User name and password of the desired user are known



When you transfer the public key to the control, you must enter the user's password twice.  
If user administration is inactive, the user **user** is logged in. The password for the user **user** is **user**.

To set up an SFTP connection with CreateConnections:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select **Settings**
- ▶ Select **Current User**
- > The control opens the **Active user** window.
- ▶ Select **Certificate and keys**
- > The control opens a pop-up window.
- ▶ Select the **Allow password authentication** check box
- ▶ Select **Store and restart server now**
- ▶ Create a key pair with CreateConnections and transfer it to the control



For more information, refer to the integrated help system of TNCremo.  
You can open the context-sensitive help function of the TNCremo software by pressing the **F1** key.

- ▶ Deactivate the check box **Allow password authentication**
- ▶ Select **Store and restart server now**
- ▶ Select **END**
- ▶ Select **Close**
- > The control closes the **Active user** window.
- ▶ Transfer the private key to the client application
- ▶ Connect the client application to the control



Please note the documentation of the client application.


## Notes

- When user administration is active, you can set up only secure network connections via SSH. The control automatically disables the LSV2 connections via the serial interfaces (COM1 and COM2) and the network connections without user authentication. If user administration is inactive, the control also automatically blocks non-secure LSV2 or RPC connections. In the optional machine parameters **allowUnsecureLsv2** (no. 135401) and **allowUnsecureRpc** (no. 135402), the machine manufacturer can define whether the control will permit non-secure connections. These machine parameters are included in the **CfgDncAllowUnsecur** (no. 135400) data object.
- During the connection, the rights of the user to whom the used key is assigned are active. The directories and files displayed, as well as the access options, vary depending on the permissions.
- You can also transfer a public key to the control by using a USB device or network drive. In this case, you do not need to activate the **Allow password authentication** check box.
- In the **Certificate and keys** window, you can select a file with additional public SSH keys in the **Externally administered SSH key file** area. This allows you to use SSH keys without having to transfer them to the control.

## 12.8 SELinux security software


**SELinux** is an extension for Linux-based operating systems. **SELinux** is an additional security software in the sense of Mandatory Access Control (MAC) and protects the system against the execution of unauthorized processes or functions, and therefore against viruses and other malware.

MAC means that every action must be explicitly permitted, otherwise it will not be executed by the control. The software is intended as protection in addition to the normal access restriction in Linux. Certain processes and actions can only be executed if the standard functions and access control of **SELinux** permit it.

 The SELinux installation of the control has been prepared to permit running only programs installed with the HEIDENHAIN NC software. Other programs cannot be run with the standard installation.

The access control of **SELinux** under HEROS 5 is regulated as follows:

- The control executes only applications that are installed with the HEIDENHAIN NC software
- Files in connection with the security of the software (**SELinux** system files, HEROS 5 boot files, etc.), may only be modified by programs that have been selected explicitly.
- New files generated by other programs must never be executed
- USB data carriers cannot be deselected
- There are only two processes that are permitted to execute new files:
  - Starting a software update: A software update from HEIDENHAIN can replace or change system files
  - Starting the SELinux configuration: The configuration of **SELinux** is usually password-protected by your machine manufacturer; refer to the relevant machine manual.

 HEIDENHAIN recommends activating **SELinux** because it provides additional protection against attacks from outside.

## 12.9 User administration

### Introduction



Refer to your machine manual.

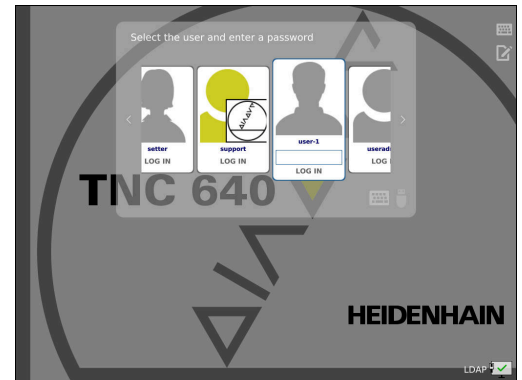
Some user administration areas are configured by the machine manufacturer.

User administration is inactive in the control's factory default setting. This status is called **legacy mode**. In **legacy mode**, the control's behavior is identical to that of older software versions without user administration.

It is not mandatory that you use user administration, but it is essential for the implementation of an IT security system.

User administration supports you in the following fields of security, based on the requirements of the IEC 62443 series of standards:

- Application security
- Network security
- Platform security



User administration enables you to define users with different access rights.

The following options are available for saving your user data:

- **Local LDAP database**
  - Using user administration on one single control
  - Setting up a central LDAP server for more than one control
  - Exporting an LDAP server configuration file if the exported database is to be used by more than one control

**Further information:** "Local LDAP database", Page 539
- **LDAP on remote computer**
  - Importing an LDAP server configuration file

**Further information:** "LDAP on remote computer", Page 540
- **Connection to Windows domain**
  - Integrating user administration on more than one control
  - Using different roles on different controls

**Further information:** "Logon to Windows domain", Page 541



Parallel operation of Windows users and users from an LDAP database is possible.

## Configuring user administration

**i** If you used **Remote Desktop Manager** to establish private connections before user administration was activated, these connections are no longer available after the activation of user administration.

Save your private connections before activating user administration.

**Further information:** "Remote Desktop Manager (option 133)", Page 474

User administration is inactive in the control's factory default setting. This status is called **Legacy-Mode**.

User administration needs to be configured before you can use it.

Perform the following steps for configuration:

- 1 Calling user administration
- 2 Activating user administration
- 3 Creating a **useradmin** user
- 4 Setting up a database
- 5 Creating further users

**Further information:** "Creating further users", Page 545

### Calling user administration

To call user administration:

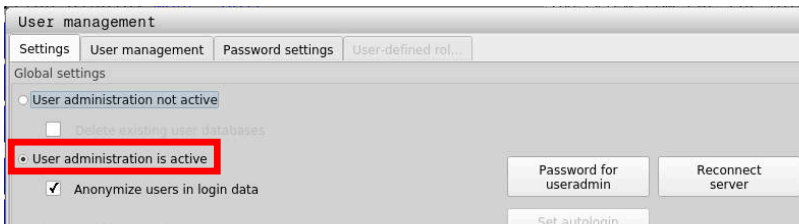
- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select the **Settings** menu item
- ▶ Select the **UserAdmin** menu item
- > The control opens the **User administration** window.

**i** You can exit the **User administration** window after each configuration step.  
If you exit the **User administration** window directly after having activated user administration, the control will prompt you for a restart once.

### Activating user administration

To activate user administration:

- ▶ Call user administration
- ▶ Press the **User administration active** soft key
- > The control shows the message **Password for user 'useradmin' missing**.



The purpose of the **Anonymize users in log data** function is data privacy; this function is active by default. While this function is active, user data in all log files of the control will be anonymized.

### NOTICE

#### Caution: Unwanted data transfer is possible!

If you deactivate the **Anonymize users in log data** function, the system will show personalized user data in all control log files. If servicing becomes necessary or if the log files need to be transmitted for another reason, the contracting party will be able to view this user data. In this case, it is your responsibility to ensure that all required data protection provisions have been made at your company.

- ▶ Retain or reactivate the active status of the **Anonymize users in log data** function



### Deactivating user administration

If you deactivate user administration, the control saves all configured users. Thus they will be available again when user administration is reactivated.

If you want to delete the configured users upon deactivation, you need to set this explicitly when deactivating user administration.

User administration can only be deactivated by the following function users:

- **useradmin**
- **OEM**
- **SYS**

**Further information:** "HEIDENHAIN function users", Page 551

To deactivate user administration:

- ▶ Log in as the appropriate function user
- ▶ Call user administration
- ▶ Select **User administration inactive**
- ▶ If necessary, check **Delete existing user databases** to delete any configured users and user-specific directories



- ▶ Press the **APPLY** soft key



- ▶ Press the **END** soft key
- > The control opens the **System reboot required** window.
- ▶ Select **Yes**
- > The control triggers a restart.

### Creating a useradmin function user

After user administration has been activated once, create the **useradmin** function user.

The **useradmin** user is comparable to the local administrator of a Windows system.

To create the **useradmin** user:

- ▶ Select **Password for useradmin**
- > The control opens the **Password for user 'useradmin'** pop-up window.
- ▶ Set the password for the **useradmin** user
- ▶ Select **Set new password**
- > The control shows the message **Settings and password for 'useradmin' were changed.**

**i** For reasons of security, passwords should comply with the following criteria:

- Eight characters minimum
- Letters, numbers, and special characters
- Avoid using whole words or a sequence of characters (e.g., Anna or 123)

If you want to use special characters, pay attention to the keyboard layout. HEROS assumes a US keyboard, the NC software assumes a HEIDENHAIN keyboard. External keyboards can be freely configured.

The **useradmin** account provides the following functions:

- Creating databases
- Assigning the password data
- Activating the LDAP database
- Exporting LDAP server configuration files
- Importing LDAP server configuration files
- Emergency access if the user database was destroyed
- Retroactive change of the database connection
- Deactivating user administration

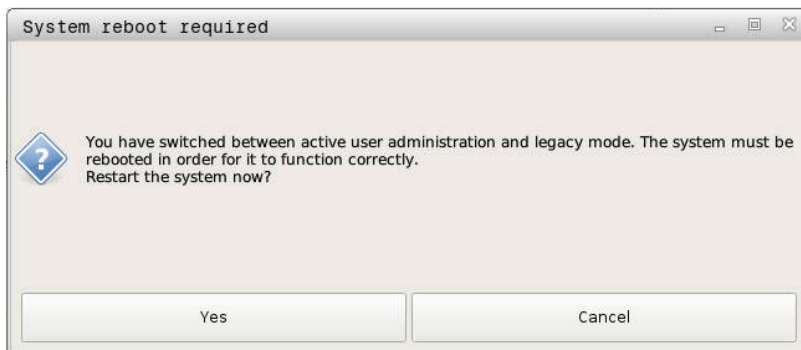
**i** The **useradmin** user automatically receives the HEROS.Admin role. This allows him to manage users in user administration, provided that he knows the LDAP database password. The **useradmin** user is a function user who has been pre-defined by HEIDENHAIN. You can neither add roles to function users, nor delete their roles.

HEIDENHAIN recommends permitting more than one person to access an account with the HEROS.Admin role. This ensures that necessary changes to user administration can also be made in the administrator's absence.

### Setting up a database

To set up the database:

- ▶ Select the database for saving the user data
- ▶ Set up a database
- ▶ Press the **APPLY** soft key
- ▶ Press the **END** soft key
- > The control opens the **System reboot required** window.
- ▶ Press **Yes** to restart the system
- > The control restarts.



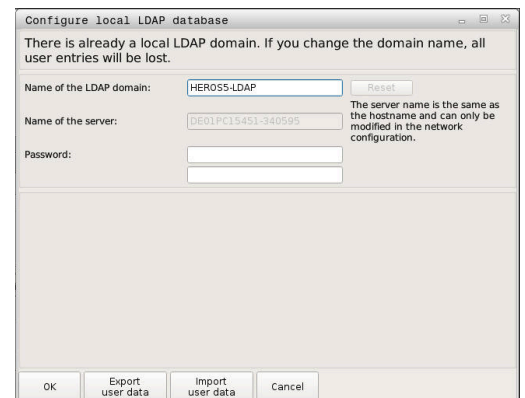
### Local LDAP database

Before you can use the **Local LDAP database** function, the following requirements must be met:

- The user administration is active
- The **useradmin** user has been configured

To set up a **Local LDAP database**:

- ▶ Call the user administration
- ▶ Select the **LDAP user database** function
- > The control enables the dimmed area for editing the LDAP user database.
- ▶ Select the **Local LDAP database** function
- ▶ Select the **Configuration** function
- > The control opens the **Configure local LDAP database** window.
- ▶ Enter the name of the **LDAP domain**
- ▶ Enter the password
- ▶ Repeat the password
- ▶ Press the **OK** soft key
- > The control closes the **Configure local LDAP database** window.



**i** Before you can start editing the user administration, the control prompts you to enter the password of your local LDAP database.  
Passwords must not be trivial and must be known only to the administrators.

**Further information:** "Creating further users", Page 545

**i** If the host name or domain name of the control changes, you need to reconfigure the local LDAP databases.

## LDAP on remote computer

### Requirements

Before you can use the **LDAP on remote computer** function, the following requirements must be met:

- User administration is active
- The **useradmin** user has been configured
- An LDAP database has been set up in the company network
- A server configuration file of an existing LDAP database must be stored on the control or on a PC in the network
- The PC with the existing configuration file is running.
- The PC with the existing configuration file is accessible in the network

### Providing a server configuration file

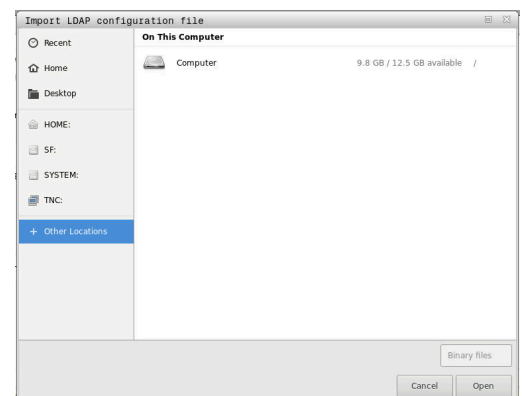
Provide a server configuration file for an LDAP database as follows:

- ▶ Call the user administration
- ▶ Select the **LDAP user database** function
- > The control enables the dimmed area for editing the LDAP user database.
- ▶ Select the **Local LDAP database** function
- ▶ Select the **Export server configuration** function
- > The control opens the **Export LDAP configuration file window**.
- ▶ Enter the name for the server configuration file into the name field
- ▶ Save the file to the desired folder
- > The server configuration file was exported successfully.

### Using the LDAP database on another computer

To use the **LDAP on remote computer** function:

- ▶ Call the user administration
- ▶ Select the **LDAP user database** function
- > The control enables the dimmed area for editing the LDAP user database.
- ▶ Select the **LDAP on remote computer** function
- ▶ Select the **Import server configuration** function
- > The control opens the **Import LDAP configuration file window**.
- ▶ Select the existing configuration file
- ▶ Select **FILE**
- ▶ Press the **APPLY** soft key
- > The configuration file was imported.



## Logon to Windows domain

### Prerequisites

Before you can use the **Connection to Windows domain** function, the following requirements must be met:

- User administration is active
- The **useradmin** user has been configured
- There is a Windows Active Domain Controller in the network
- The domain controller is accessible in the network
- Organizational unit for HEROS roles known
- For logon with computer account:
  - You have access to the password of the domain controller
  - You have access to the user interface of the domain controller or you are supported by an IT administrator
- For logon with function user:
  - User name of the function user
  - Password of the function user

### Joining a Windows domain with a computer account

To join a Windows domain with a computer account:

- ▶ Call the user administration
- ▶ Select the **Connection to Windows domain** function
- ▶ Select the **Join Active Directory domain (with computer account)** check box
- ▶ Select the **Find domain** function



Use the **Configuration** function to define various settings of your connection:

- Use the **Map SIDs to Unix UIDs** check box to select whether Windows SIDs are automatically mapped to Unix UIDs
- Use the **Use LDAPs** check box to select LDAP or secure LDAPs. For LDAPs, define whether or not the secure connection verifies a certificate
- Define a special group of Windows users to whom you want to restrict the connection to this control
- Modify the organizational unit in which the HEROS role names are stored
- Change the prefix in order to manage users from different workshops, for example. Each prefix given to a HEROS role name can be changed (e.g., HEROS hall 1 and HEROS hall 2)
- Modify the separator within the HEROS role names

- ▶ Press the **APPLY** soft key
- > The control opens the **Connect to domain** window.



The **Organizational unit for computer account:** function allows you to specify in which of the already existing organizational units you want to create the access, such as

- ou=controls
- cn=computers

The values you enter must match the conditions of the domain. The terms are not exchangeable.

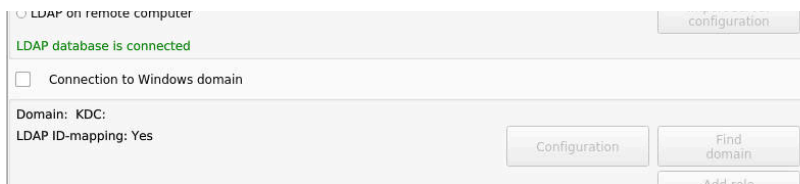
- ▶ Enter the user name of the domain controller
- ▶ Enter the password of the domain controller
- > The control connects to the Windows domain found.
- > The control checks whether all of the required roles have been created in the domain as groups.



If not all of the required roles have been created in the domain as groups, the control issues a warning. If the control issues a warning, proceed in one of the two following ways:

- ▶ Press the **Add role definition** soft key
  - Select the **Add** function
    - You can enter the roles directly into the domain in this case.
  - Press **Export**
    - With this function, you can export the roles to a file in .ldif format.

- > All of the required roles have been created in the domain as groups.



### Joining a Windows domain with a function user

To join a Windows domain with a function user:

- ▶ Opening the **User administration** window
- ▶ Select **Connection to Windows domain**
- ▶ Select the **Active Directory with function user** check box
- ▶ Select **Find domain**
- > The control selects a domain.
- ▶ Select **Configuration**
- ▶ Check the data for **Domain name:** and **Key Distribution Center (KDC):**
- ▶ Enter **Organizational unit for HEROS roles:**
- ▶ Enter the user name and password of the function user
- ▶ Press **OK**
- ▶ Select **APPLY**
- > The control connects to the Windows domain found.
- > The control checks whether all of the required roles have been created in the domain as groups.

### Creating groups

There are the following ways to create groups corresponding to the different roles:

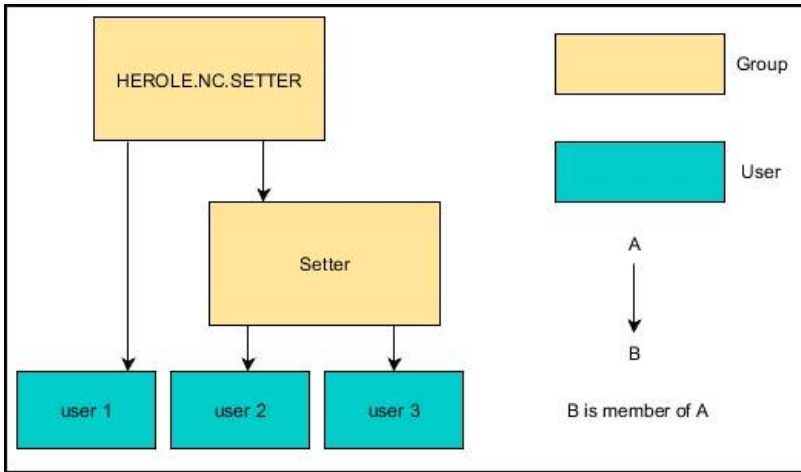
- Automatically when entering the Windows domain by specifying a user with administrator rights
- By importing an import file in .ldif format to the Windows server

The Windows administrator must add the users manually to the roles (security groups) on the domain controller.

Two suggestions describing how the groups can be structured by the Windows administrator are given by below.

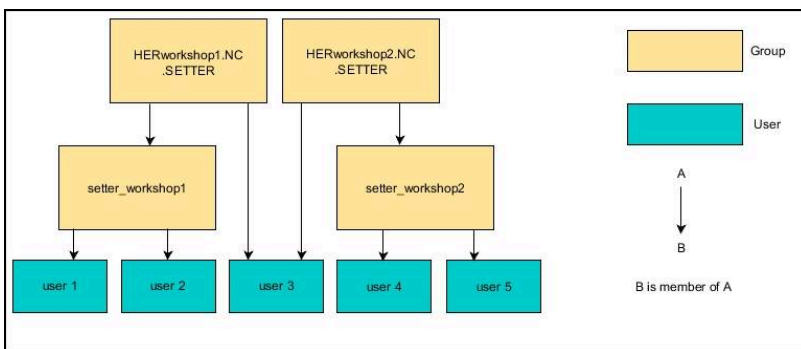
**Example 1**

The user is a direct or indirect member of the respective group:



**Example 2**

Users from various sectors (workshops) are members of groups with different prefixes:





### Exporting and importing a Windows configuration file

If you have connected the control to the Windows domain, you can export the required configurations for other controls.

To export the Windows configuration file:

- ▶ Open the **User administration** window
- ▶ Select **Connect to Windows domain**
- ▶ Select **Export the Windows config.**
- > The control opens the **Export the Windows domain configuration** window.
- ▶ Select the directory for the file
- ▶ Enter the name for the file
- ▶ Select the **Export the function user's password?** check box, if required
- ▶ Select **Export**
- > The control saves the Windows configuration as a BIN file.

To import the Windows configuration file of another control:

- ▶ Open the **User administration** window
- ▶ Select **Connect to Windows domain**
- ▶ Select **Import the Windows config.**
- > The control opens the **Import the Windows domain configuration** window.
- ▶ Select the existing configuration file
- ▶ Select the **Import the function user's password?** check box, if required
- ▶ Select **Import**
- > The control adopts the configurations for the Windows domain.

### Creating further users

Before you can create further users, the following requirements must be met:

- User administration has been configured
- LDAP database has been selected and configured



The **User administration** tab is only active for the following databases:

- **Local LDAP database**
- **LDAP on remote computer**

If **Connection to Windows domain** is used, you need to configure the users in the Windows domain.

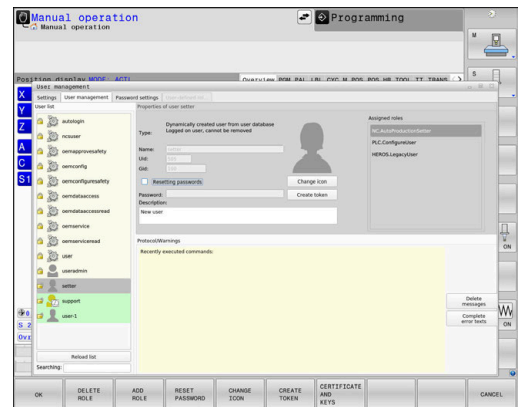
**Further information:** "Logon to Windows domain",  
Page 541

### Open the User administration tab

To manage users:

- ▶ Call user administration
- ▶ Select the **User administration** tab
- ▶ Press the **EDIT ON** soft key
- The control prompts you to enter the password of the user database, if applicable.
- After you have entered the password, the control opens the **User administration** menu.

You can edit the existing users or create new users.



### Creating a new user

To create a new user:

- ▶ Press the **Create new user** soft key
- ▶ The control opens a window for creating a user.
- ▶ Enter the user name
- ▶ Enter the password for the user

**i** The user must change the password when logging in for the first time.  
**Further information:** "Login to user administration", Page 561

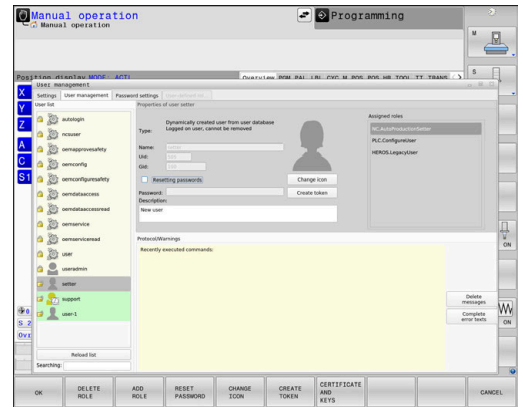
- ▶ Create a user description, if desired
- ▶ Press the **Add role** soft key
- ▶ In the selection window, select the roles corresponding to the user  
**Further information:** "Definition of roles", Page 552
- ▶ Press the **Add** soft key

**i** Two additional soft keys are available in the menu:

- **Add external login**  
 Adds Remote.HEROS.Admin in place of HEROS.Admin, for example.  
 This role is only enabled for remote logon to the system.
- **Add local login**  
 Adds Local.HEROS.Admin in place of HEROS.Admin, for example.  
 This role is only enabled for local logon at the control's screen.

- ▶ Press the **CLOSE** soft key
- ▶ The control closes the window for creating a user.
- ▶ Press the **OK** soft key
- ▶ Press the **APPLY** soft key
- ▶ The control adopts the changes.
- ▶ Press the **END** soft key
- ▶ The control closes user administration.

**i** If you have not restarted your control after configuring the database, the control prompts you to restart for the changes to take effect.  
**Further information:** "Configuring user administration", Page 535



## Adding profile images

You can optionally also assign images to the users. The **Default user icons**: from HEIDENHAIN are available for this purpose. You can also load your own images in JPEG or PNG format to the control. Then you can use these image files as profile images.

To define profile images:

- ▶ Log on a user with the HEROS.Admin role, e.g. **useradmin**
- ▶ **Further information:** "Login to user administration", Page 561
- ▶ Call user administration
- ▶ Select the **User administration** tab
- ▶ Press the **Edit user** soft key
- ▶ Press the **Change icon** soft key
- ▶ Select the desired image in the menu
- ▶ Press the **Choose icon** soft key
- ▶ Press the **OK** soft key
- ▶ Press the **APPLY** soft key
- > The control adopts the changes.



You can also directly add profile images when creating the users.

## Password settings in user administration

### The Password settings tab

Users with the HEROS.Admin role can specify exact requirements for user passwords on the **Password settings** tab.

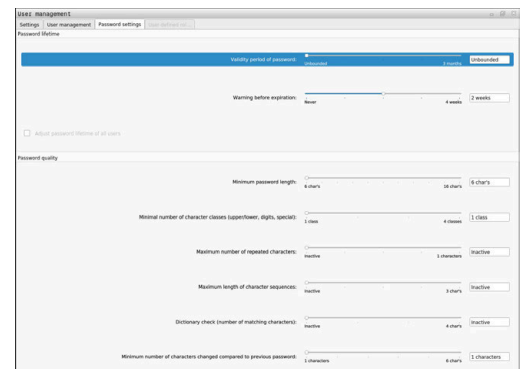
**Further information:** "Rights", Page 555



If you do not comply with the requirements defined here when creating your password, the control will issue an error message.

To open the **Password settings** tab:

- ▶ Log on as a user with HEROS.Admin role
- ▶ Call user administration
- ▶ Select the **Password settings** tab
- ▶ Press the **EDIT ON** soft key
- > The control opens the **Enter password of LDAP database** window.
- ▶ Enter password
- > The control releases the **Password settings** tab for editing.

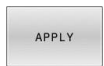


### Defining password settings

The control allows you to configure user password requirements by setting various parameters.

To edit the parameters:

- ▶ Open the **Password settings** tab
- ▶ Select the desired parameter
- > The control highlights the selected parameter in blue.
- ▶ Set the desired parameter using the slider
- > The control shows the selected parameter in the display field.



- ▶ Press the **APPLY** soft key
- > The control applies the change.

The following parameters are available:

#### Password lifetime

- **Validity period of password:**  
Here, you can indicate how long the password can be used.
- **Warning before expiration:**  
From the defined time, a warning will be issued that the password will soon expire.

#### Password quality

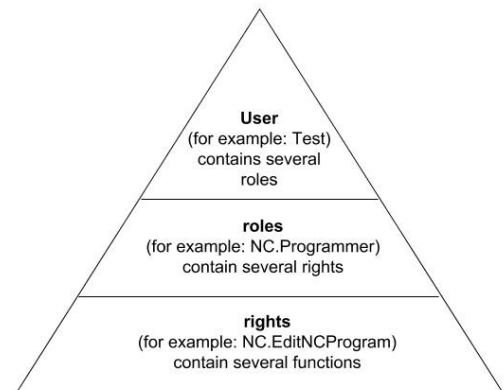
- **Minimum password length:**  
Here, you can indicate the minimum password length.
- **Minimal number of character classes (upper/lower, digits, special):**  
Here, you can indicate the minimum number of different character classes required in the password.
- **Maximum number of repeated characters:**  
Here, you can indicate the maximum number of identical successive characters in the password.
- **Maximum length of character sequences:**  
Here, you can indicate the maximum length of the character sequences to be used in the password (e.g., 123).
- **Dictionary check (number of matching characters):**  
Here, you can enable a check whether the password contains known words and specify the allowed number of meaningful characters.
- **Minimum number of characters changed compared to previous password:**  
Here, you can specify how many characters in the new password must be different from the previous one.

## Access rights

The user administration is based on the Unix rights management. Access to the control is controlled by means of rights.

The user administration differentiates between the following terms:

- User
- Roles
- Rights



## User

A user can be pre-defined in the control or he can be defined by the end user.

The user administration offers the following types of users:

- Function users pre-defined by HEIDENHAIN
  - **Further information:** "HEIDENHAIN function users", Page 551
- Function users pre-defined by the machine manufacturer
- Self-defined users

A user contains all the roles that have been assigned to him.



Your machine manufacturer defines function users who are required for specific tasks such as machine maintenance. Depending on the task assigned, you can use one of the pre-defined function users or you have to create a new user. The access rights of HEIDENHAIN function users are already pre-defined in the control's factory default setting.

## Roles

Roles consist of a combination of rights that cover certain functions provided by the control.

- **Operating system roles:**
- **NC operator roles:**
- **Machine tool builder (PLC) roles:**

All of these roles are pre-defined in the control.

You can assign more than one role to a user.

## Rights

Rights consist of a combination of functions that cover a task area of the control, e.g. editing the tool table.

- HEROS rights
- NC rights
- PLC rights (machine manufacturer)

If more than one role is assigned to a user, he will be granted all rights contained in these roles.



Ensure that every user is assigned all access rights he needs. The access rights result from the actions a user performs on the control.

## HEIDENHAIN function users

HEIDENHAIN function users are pre-defined users that are automatically created upon activation of user administration. Function users cannot be changed.

HEIDENHAIN provides four different function users in the control's factory default setting.

### ■ **oem**

The **oem** function user is intended for the machine manufacturer. The **oem** function user allows you to access the **PLC:** drive of the control.

### ■ **Function users defined by the machine manufacturer**



Refer to your machine manual.

The users defined by the machine manufacturer can differ from those pre-defined by HEIDENHAIN.

The machine manufacturer's function users can already be active in **legacy mode** and replace code numbers.

By entering code numbers or passwords that replace code numbers, you can temporarily enable rights of **oem** function users.

**Further information:** "Current User", Page 568

### ■ **sys**

The **sys** function user allows you to access the **SYS:** drive of the control. This function user is reserved for use by HEIDENHAIN service personnel.

### ■ **user**

In **legacy mode**, the **user** function user is automatically logged on to the system during control startup. When user administration is active, the **user** function user has no effect. The logged-on user of the type **user** cannot be changed in **legacy mode**.

### ■ **useradmin**

The **useradmin** function user is automatically created upon activation of user administration. The **useradmin** function user allows you to configure and edit user administration.

## Definition of roles

HEIDENHAIN combines several rights for individual task areas to roles. Different pre-defined roles that you can use to assign rights to your users are available. The tables below describe the individual rights of the different roles.

**i** Every user should have at least one role from the operating system area and at least one role from the programming area.

You can enable a role either for local login or for remote login. With local login, the user directly logs on to the control at the control's screen. A remote login (DNC) is a connection via SSH.

You can therefore also make the rights of a user dependent on the access used to operate the control.

If a role is only enabled for local login, Local. is added to the role name (e.g., Local.HEROS.Admin instead of HEROS.Admin).

If a role is only enabled for remote login, Remote. is added to the role name (e.g., Remote.HEROS.Admin instead of HEROS.Admin).

Advantages of classification in roles:

- Simplified administration
- Different rights are compatible between different software versions of the control and different machine manufacturers.

**i** Various applications require access to certain interfaces. Where required, the administrator also needs to set up rights to access the required interfaces as well as rights to access certain functions and additional programs. These rights are granted by the **Operating system roles**:

**i** The following contents can change in the following software versions of the control:

- HEROS role names
- Unix groups
- Basic ID number



**Operating system roles:**

Role	Privileges		
	HEROS role name	UNIX group	Basic ID number
HEROS.RestrictedUser	Role for a user with minimum rights on the operating system.		
	<ul style="list-style-type: none"> <li>■ HEROS.MountShares</li> <li>■ HEROS.Printer</li> </ul>	<ul style="list-style-type: none"> <li>■ mnt</li> <li>■ lp</li> </ul>	<ul style="list-style-type: none"> <li>■ 335</li> <li>■ 9</li> </ul>
HEROS.NormalUser	Role for a normal user with limited rights on the operating system.		
	This role grants the rights of the RestrictedUser role, as well as the following rights:		
HEROS.LegacyUser	With the <b>LegacyUser</b> role, the behavior regarding the operating system of the control is identical to that of older software versions without user administration. User administration remains active.		
	This role grants the rights of the NormalUser role, as well as the following rights:		
HEROS.LegacyUserNoC- trfct	This role determines the rights for remote log-in when user administration is disabled (e.g., via SSH). The control assigns this role automatically.		
	This role grants the rights of the LegacyUser role, with the exception of the following right:		
HEROS.Admin	The configuration of the network and the configuration of the user administration are some of the rights granted by this role.		
	This role grants the rights of the <b>LegacyUser</b> role, as well as the following rights:		

## NC operator roles:

Role	Privileges		
	HEROS role name	UNIX group	Basic ID number
NC.Operator	This role allows you to run NC programs.		
	■ NC.OPModeProgramRun	■ NCOpPgmRun	■ 302
NC.Programmer	This role grants the rights of NC programming.		
	This role grants the rights of the Operator role, as well as the following rights:		
	■ NC.EditNCProgram	■ NCEdNCProg	■ 305
	■ NC.EditPalletTable	■ NCEdPal	■ 309
	■ NC.EditPresetTable	■ NCEdPreset	■ 308
	■ NC.EditToolTable	■ NCEdTool	■ 306
	■ NC.OPModeMDi	■ NCOpMDI	■ 301
	■ NC.OPModeManual	■ NCOpManual	■ 300
NC.Setter	This role allows you to edit the pocket table.		
	This role grants the rights of the Programmer role, as well as the following rights:		
	■ NC.ApproveFsAxis	■ NCApproveFsAxis	■ 319
	■ NC.EditPocketTable	■ NCEdPocket	■ 307
	■ NC.SetupDrive	■ NCSetupDrv	■ 315
	■ NC.SetupProgramRun	■ NCSetupPgRun	■ 303
NC.AutoProductionSetter	This role allows you to execute all NC functions, including programming a scheduled NC program start.		
	This role grants the rights of the Setter role, as well as the following rights:		
	■ NC.ScheduleProgramRun	■ NCSchedulePgRun	■ 304
NC.LegacyUser	With the <b>LegacyUser</b> role, the control's behavior regarding NC programming is identical to that of older software versions without user administration. User administration remains active. The <b>LegacyUser</b> has the same rights as the AutoProductionSetter.		
NC.AdvancedEdit	This role allows you to use special functions of the NC and table editors.		
	■ Special functions of Q parameter programming and editing the table header		
	Replacement for code number <b>555343</b>		
	■ NC.EditNCProgramAdv	■ NCEditNCPgmAdv	■ 327
	■ NC.EditTableAdv	■ NCEditTableAdv	■ 328
NC.RemoteOperator	This role allows you to start NC programs from an external application.		
	■ NC.RemoteProgramRun	■ NCRemotePgmRun	■ 329

**Machine manufacturer (PLC) roles:**

Role	Privileges		
	HEROS role name	UNIX group	Basic ID number
PLC.ConfigureUser	This roles grants the rights on code number <b>123</b> .		
	■ NC.ConfigUserAdv	■ NCConfigUserAdv	■ 316
	■ NC.SetupDrive	■ NCSetupDrv	■ 315
PLC.ServiceRead	This role allows read-only access during servicing.		
	This role can be used to display various types of diagnostic information		
	■ NC.Data.AccessServiceRead	■ NCDAServiceRead	■ 324



Refer to your machine manual.

The machine manufacturer can adapt the PLC roles.

When the **Machine manufacturer (PLC) roles:** are adapted by the machine manufacturer, the following contents may change:

- The names of the roles
- The number of roles
- The functionality of the roles

**Rights**

The table below lists all of the individual rights.

**Rights:**

HEROS role name	Description
HEROS.Printer	Data output to network printers
HEROS.PrinterAdmin	Configuration of network printers
HEROS.ReadLogs	Currently no function
NC.OPModeManual	Operating the machine in the <b>Manual Operation</b> and <b>Electronic handwheel</b> operating modes.
NC.OPModeMDi	Working in the <b>Positioning w/ Manual Data Input</b> operating mode.
NC.OpModeProgramRun	Execution of NC programs in the <b>Program Run Full Sequence</b> or <b>Program run, single block</b> operating mode.
NC.SetupProgramRun	Probing in the <b>Manual Operation</b> and <b>Electronic handwheel</b> operating modes. Using the <b>AFC</b> and <b>ACC</b> functions.
NC.ScheduleProgramRun	Programming a scheduled NC program start
NC.EditNCProgram	Editing NC programs
NC.EditToolTable	Editing the tool table
NC.EditPocketTable	Editing the pocket table
NC.EditPresetTable	Editing the preset table
NC.EditPalletTable	Editing pallet tables
NC.SetupDrive	Adjustment of drives by the end user
NC.ApproveFsAxis	Confirming test position of safe axes
NC.EditNCProgramAdv	Additional NC functions

HEROS role name	Description
NC.EditTableAdv	Additional table programming functions (e.g., editing of the table head)
HEROS.SetTimezone	Adjustment of date and time, time zone and time synchronization via NTP and the <b>HEROS menu</b> .
HEROS.SetShares	Configuration of public network drives mounted on the control
HEROS.MountShares	Connecting and disconnecting network shares with the control
HEROS.SetNetwork	Configuration of network and relevant settings for data security
HEROS.BackupUsers	Data backup on the control—for all users configured on the control
HEROS.BackupMachine	Backup and restoring data of the entire machine configuration
HEROS.UserAdmin	Configuration of user administration on the control This includes creating, deleting, and configuring local users
HEROS.ControlFunctions	Control function of the operating system <ul style="list-style-type: none"> <li>■ Auxiliary functions, such as starting and stopping NC software</li> <li>■ Telemaintenance</li> <li>■ Advanced diagnostic functions, such as log data</li> </ul>
HEROS.SWUpdate	Installation of software updates for the control
HEROS.VMSharedFolders	Access to shared folders of a virtual machine Only relevant when running a programming station within a virtual machine
NC.RemoteProgramRun	NC program start from an external application (e.g., via the DNC interface)
NC.ConfigUserAdv	Configuration access to the contents that have been enabled through code number <b>123</b>
NC.DataAccessServiceRead	Read-only access to the <b>PLC:</b> drive during servicing
NC.OpcUaOEMConfigured-DataRead	Read-access through OPC UA NC Server to data defined by the machine manufacturer

## Enabling Autologin

If the **Autologin** function is enabled, during startup the control automatically logs on a selected user without the need to enter a password.

As opposed to the **legacy mode**, this enables you to restrict a user's rights without entering a password.

For further authorizations, the control still requires an authentication to be entered.

In order to enable **Autologin**, the following requirements must be met:

- User administration has been configured
- The user for **Autologin** has been defined

To enable the **Autologin** function:

- ▶ Call user administration
- ▶ Select the **Settings** tab
- ▶ Press the **Global settings** soft key
- ▶ Select the **Enable autologin** check box
- > The control opens a window for selecting the user.
- ▶ Select the user
- ▶ Enter the user's password
- ▶ Press the **OK** soft key

## User authentication from external applications

### Introduction

If user administration is active, external applications also need to authenticate a user so that the suitable rights can be assigned.

For DNC connections using the RPC or LSV2 protocol, the connection is routed through an SSH tunnel. This method assigns the remote user to a user set up on the control, granting the remote user this user's rights.

**i** The the encryption used with the SSH tunnel protects the communication from attackers.

**i** For OPC UA connections, a stored user certificate is used for authentication.

**Further information:** "OPC UA NC Server (options 56 to 61)", Page 571

### Concept of transmission through an SSH tunnel

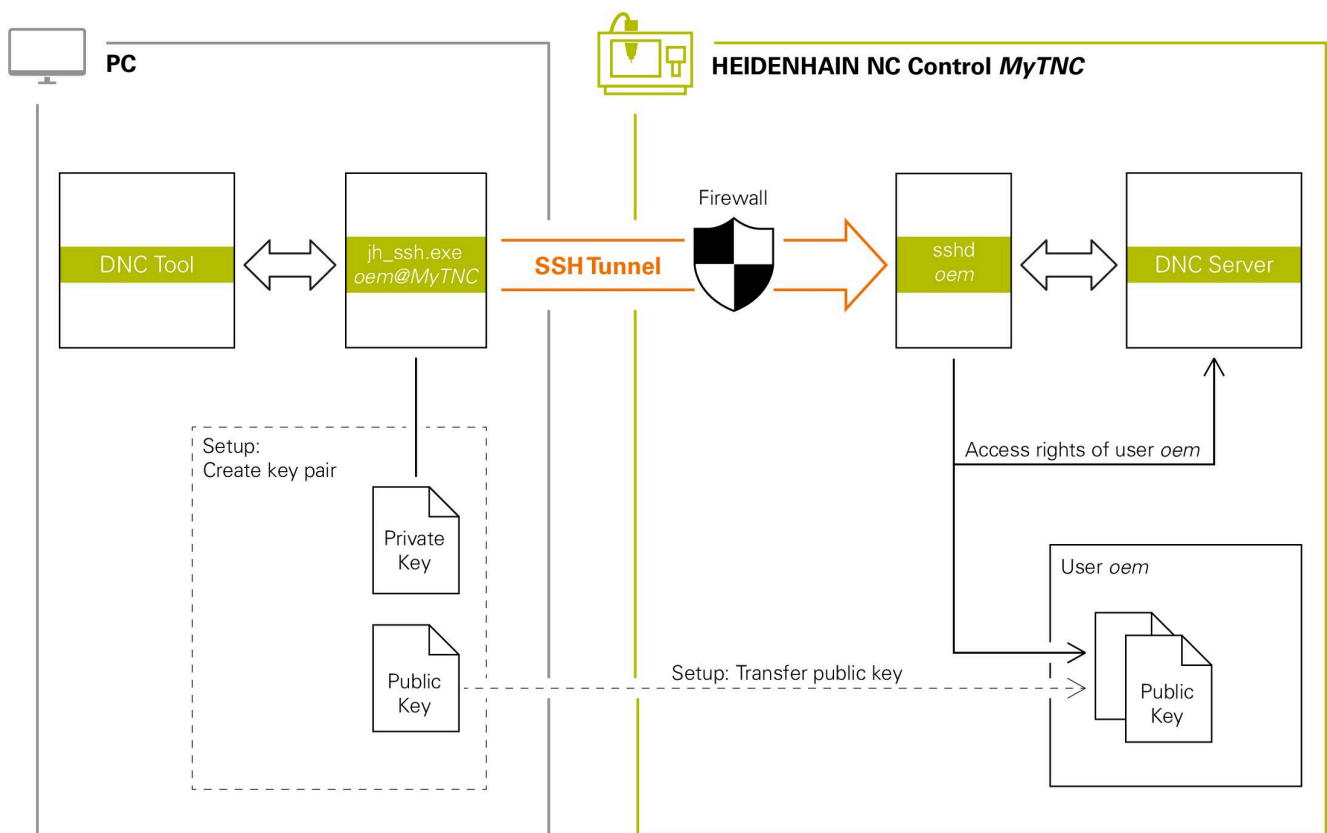
Prerequisites:

- TCP/IP network
- The remote computer acts as SSH client
- The control acts as SSH server
- Key pair consisting of
  - Private key
  - Public key

An SSH connection is always set up between an SSH client and an SSH server.

A key pair is used to protect the connection. This key pair is generated on the client. The key pair consists of a private key and a public key. The private key remains with the client. During setup, the public key is transferred to the server and assigned to a certain user.

The client tries to connect to the server using the pre-defined user name. The server can use the public key to verify that the requester of the connection holds the associated private key. If yes, the server accepts the SSH connection and assigns it to the user that has been used for the login. Communication can then be "tunneled" through this SSH connection.



### Use in external applications

**i** When user administration is active, you can set up only secure network connections via SSH. The control automatically disables the LSV2 connections via the serial interfaces (COM1 and COM2) and the network connections without user authentication.

If user administration is inactive, the control also automatically blocks non-secure LSV2 or RPC connections. In the optional machine parameters **allowUnsecureLsv2** (no. 135401) and **allowUnsecureRpc** (no. 135402), the machine manufacturer can define whether the control will permit non-secure connections. These machine parameters are included in the **CfgDncAllowUnsecur** (no. 135400) data object.

**Further information:** "Serial interfaces on the TNC 640", Page 506

The PC tools available from HEIDENHAIN, such as TNCremo with version **v3.3** or higher, provide all functions for setting up, establishing, and managing secure connections through an SSH tunnel.

When the connection is set up, the required key pair is generated in TNCremo and the public key is transferred to the control.

**i** Once the connection configurations have been set up, they can be shared among all HEIDENHAIN PC tools for establishing a connection.

This also applies to applications that are using the HEIDENHAIN DNC component from RemoTools SDK for communication. There is no need to adapt existing customer applications.

**i** In order to expand the connection configuration using the associated **CreateConnections** tool, you need to update to **HEIDENHAIN DNC v1.7.1**. A modification of the application source code is not required.

### Setting up and removing a secure connection

To set up a secure connection for the logged-on user:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **External access** function
- ▶ Press the **Key management** soft key
- > The control opens the **Certificate and keys** window.
- ▶ Select the **Allow password authentication** function
- ▶ Press the **Store and restart server now** soft key
- ▶ Use **TNCremo** to set up the secure connection (TCP secure).



For details, refer to the integrated help system of TNCremo.

- > The public key has been stored on the control by TNCremo.



In order to ensure maximum security, deactivate the **Allow password authentication** function after the public key has been stored.

- ▶ Deselect the **Allow password authentication** function
- ▶ Press the **Store and restart server now** soft key
- > The control has adopted your changes.



- In addition to using the PC tools for setup with password authentication, you can also import the public key into the control by using a USB stick or a network drive.
- In the **Certificate and keys** window, you can select a file with additional public SSH keys in the **Externally administered SSH key file** area. This allows you to use SSH keys without having to transfer them to the control.

To delete a key in the control so that a user can no longer use the secure connection:

- ▶ Select the **Machine settings** group in the MOD menu
- ▶ Select the **External access** function
- ▶ Press the **Key management** soft key
- > The control opens the **Certificate and keys** window.
- ▶ Select the key to be deleted
- ▶ Press the **Delete SSH key** soft key
- > The control deletes the selected key.



### Disabling insecure connections in the firewall

The DNC protocols LSV2 and RPC should be blocked in the firewall to ensure that the use of secure connections provides a real IT security advantage for the control.

This requires that the following parties change to secure connections:

- Machine manufacturers with all external applications (e.g., pick-and-place robots)



If the additional application is connected via **machine network X116**, there is no need to switch to an encrypted connection.

- Users with custom external applications

If you have ensured that the connections of all parties are secure, the LSV2 and RPC DNC protocols can be blocked in the **Firewall**.

To block the notifications in the firewall:

- ▶ Press the **DIADUR** key to open the **HEROS menu**
- ▶ Select the **Settings** menu item
- ▶ Select the **Firewall** menu item
- ▶ Select the **Prohibit all** method for **DNC** and **LSV2**
- ▶ Select the **Apply** function
- > The control saves your changes.
- ▶ Close the window with **OK**

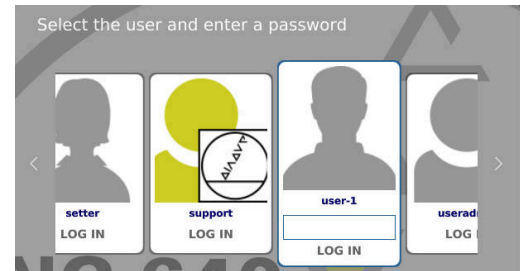
### Login to user administration

The control displays the Login dialog in the following cases:

- After the **User logout** function has been executed
- After the **Switch user** function has been executed
- After the screen has been locked by the **screensaver**
- Immediately after control startup if user administration is active and **Autologin** is not enabled

The login dialog provides the following options:

- Users who logged in at least once
- Other** user



### Logging in a user for the first time

To log in as a user for the first time, you need to use the **Other** input field.

To log in as a user with the **Other** option for the first time:

- ▶ Select **Other** in the login dialog
- > The control enlarges the user icon you selected.
- ▶ Enter the user name
- ▶ Enter the user's password
- > The control opens a window with the **Password expired** message. **Change the password now.**
- ▶ Enter the current password
- ▶ Enter a new password
- ▶ Repeat the new password
- > The control uses the new user to log you in.
- > The user is shown in the login dialog.

### Logging in a known user with password

To log in as a user who is displayed in the login dialog:

- ▶ Select the respective user in the login dialog
- > The control enlarges the user icon you selected.
- ▶ Enter the user password
- > The control uses the selected user to log you in.



The control shows in the Login dialog whether CAPS LOCK is active.

### Logging in a user with token

To log in as a user with a token:

- ▶ Hold the token close to the reader
- ▶ Enter PIN, if required
- > The control uses the selected user to log you in.
- ▶ Remove the token from the reader

### Password requirements

- i** For reasons of security, passwords should comply with the following criteria:
- Eight characters minimum
  - Letters, numbers, and special characters
  - Avoid using whole words or a sequence of characters (e.g., Anna or 123)

Keep in mind that an administrator can define the requirements to be met by a password. The password requirements include:

- Minimum length
- Minimum number of different types of characters
  - Capital letters
  - Small letters
  - Numbers
  - Special characters
- Maximum length of character strings (e.g., 54321 = string of five characters)
- The number of characters must match the dictionary check
- Minimum number of characters changed compared to previous password

If the new password does not meet the requirements, an error message will be issued. This means that you have to enter a different password.

- i** Administrators can specify the expiration of passwords. If you do not change your password within the valid period, you will no longer be able to log on as that user. In this case, an administrator needs to reset the user password before you can log on again.
- ▶ Change your password at regular intervals
- Further information:** "Changing the current user's password", Page 569
- ▶ Take note of the password change warnings

## Switching or logging out users

Use the **Switch-off** HEROS menu item or the icon of the same name at bottom right in the menu bar to open the **Switch off and restart** window.

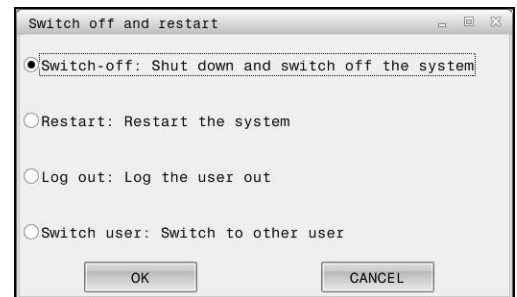
The control provides the following options:

- **Switch-off:**
  - The control stops and ends all additional programs and functions
  - The system is shut down
  - The control is switched off
- **Restart:**
  - The control stops and ends all additional programs and functions
  - The system is restarted
- **Log out:**
  - The control ends all additional programs
  - The user is logged out
  - The login window appears

**i** To continue, you need to log in a new user and enter his password.  
The NC program continues running under the previously logged-on user.

- **Switch user:**
  - The login window appears
  - The user is not logged out

**i** You can close the login window with **Cancel** without entering a password.  
All additional programs and the NC programs started by the logged-on user continue running.

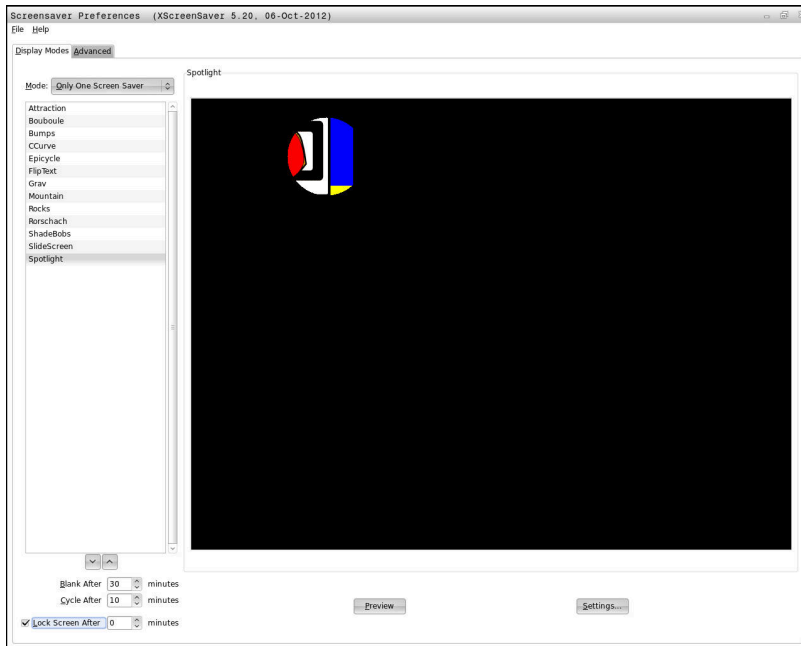


## Screensaver with lockout

You can use the screensaver to lock the control. NC programs that have already been started continue running during this period.

**i** You need to enter a password to unlock the screensaver again.

**Further information:** "Login to user administration", Page 561



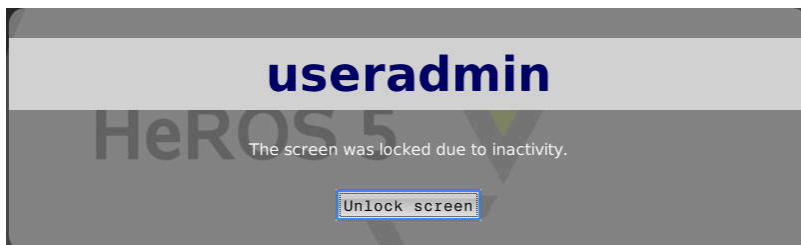
To access the screensaver settings in the **HEROS menu**:

- ▶ Press the **DIADUR** key to open the **HEROS menu**
- ▶ Select the **Settings** menu item
- ▶ Select the **Screensaver** menu item

The screensaver provides the following options:

- Use the **Blank After** setting to define after how many minutes the screensaver should turn on.
- Use the **Lock Screen After** setting to activate the lock with password protection.
- The time value behind **Lock screen after** defines the delay after which the lock will take effect after the screensaver has been turned on. A value of **0** means that the lock becomes effective immediately after the screensaver has been turned on.

When the lock is active and you use one of the input devices (for example, by moving the mouse), the screensaver disappears. The control displays a lock screen instead.

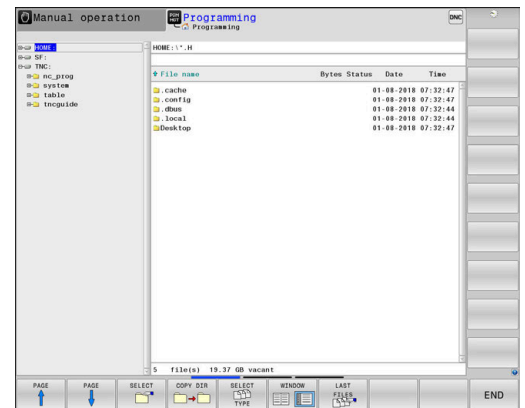


Use **Unlock screen** or **Enter** to open the login window again.

## HOME directory

When user administration is active, a private **HOME:** directory, to which you can save your private programs and files, is available to every user.

The **HOME:** directory can be viewed by the respectively logged-in users as well as users with the HEROS.Admin role.

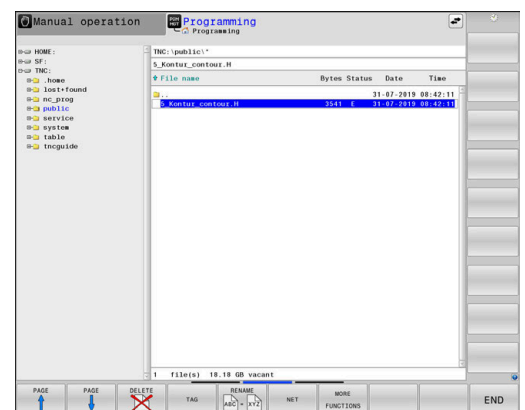


## 'public' directory

### public directory

Upon the first activation of user administration, the **public** directory below the **TNC:** drive will be connected.

The **public** directory can be accessed by any user.



## Setting advanced file access rights

In order to control the use of individual files in the **public** directory, HEIDENHAIN provides the **ADVANCED ACCESS RIGHTS** function that allows you to restrict access on a file level.

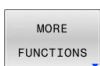
To call the **ADVANCED ACCESS RIGHTS** function:



- ▶ Select the **Programming** operating mode



- ▶ Press the **PGM-MGT** key
- ▶ Switch to horizontal soft-key row 2



- ▶ Press the **MORE FUNCTIONS** soft key
- ▶ Switch to horizontal soft-key row 2



- ▶ Press the **ADVANCED ACCESS RIGHTS** soft key
- ▶ The control opens the **Set advanced access rights** window.

**Setting file access rights**

If you transfer files to the **public** directory or create files there, the control considers the logged-in user as the file owner. The owner can control access to his own files.

**i** Access rights can only be defined for files located in the **public** directory.  
 For all files stored on the **TNC:** drive instead of the **public** directory, the **user** function user will automatically be assigned as the owner.




You can specify the access rights for the following users:

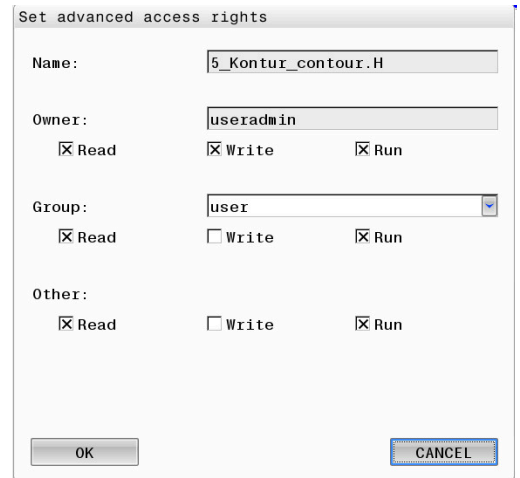
- **Owner:**  
The person who owns the file
- **Group:**  
A selected Linux group or users with a specific HEIDENHAIN access right
- **Other:**  
All users not belonging to the previously selected Linux group or not having the specified HEIDENHAIN access right.

You can set access rights as follows:

- **Read**  
The file can be viewed
- **Write**  
The file can be edited
- **Run**  
The file can be executed

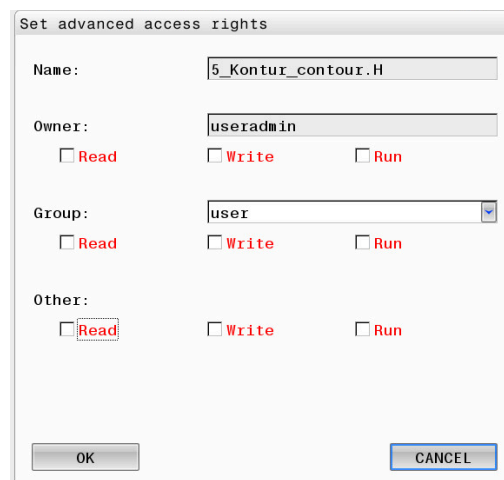
Using the soft keys in the **Set advanced access rights** window, you can select or deselect all access rights for the users:

-  ▶ Select or deselect all access rights for **Owner:**
-  ▶ Select or deselect all access rights for the **Group:**
-  ▶ Select or deselect all access rights for **Other:**



To select the access rights for a group:

- ▶ Call the **ADVANCED ACCESS RIGHTS** function
- ▶ Select the desired group in the selection menu
- ▶ Select or deselect the access rights as required
- > Any changes made are highlighted in red.
- ▶ Press **OK**
- > The changes made to access rights are applied.



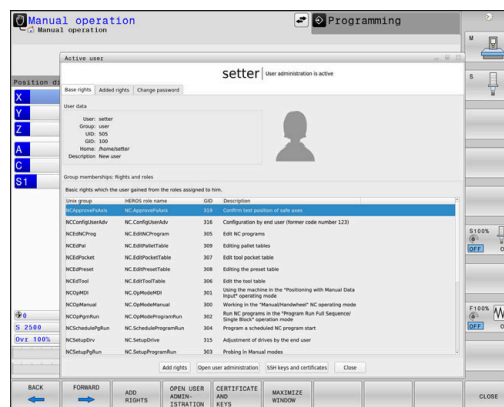
## Current User

With **Current User**, you can view the group rights of the currently logged-on user in the **HEROS** menu.



In legacy mode, the **user** function user is automatically logged on to the system during control startup. When user administration is active, the **user** function user has no effect.

**Further information:** "HEIDENHAIN function users", Page 551



To call the **Current User**:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select the **Settings** menu item
- ▶ Select the **Current User** menu icon

## Temporarily changing the current user's rights

User administration allows you to temporarily increase the current user's rights by adding the rights of a user you selected.

To temporarily increase a user's rights:

- ▶ Call **Current User**
- ▶ Press the **Add rights** soft key
- ▶ Select the user
- ▶ Enter the user's user name
- ▶ Enter the selected user's password
- > The control temporarily increases the logged-on user's rights by adding the rights of the user specified in **Add rights**.



You can temporarily enable the rights of **oem** function users. For this purpose, enter the appropriate code number or the password defined by the machine manufacturer.

You have the following options to remove the rights that have temporarily been added:

- Enter the code number **0**
- User logout
- Press the **Remove added rights** soft key



To select the **Remove added rights** soft key:

- ▶ Call **Current User**
- ▶ Select the **Added rights** tab
- ▶ Press the **Remove added rights** soft key

### Changing the current user's password

In the **Current User** menu item, you can change the current user's password.

To change the current user's password:

- ▶ Call **Current User**
- ▶ Select the **Change password** tab
- ▶ Enter the old password
- ▶ Press the **Verify old password** soft key
- > The control checks whether you have correctly entered your old password.
- > If the password is correct, the fields **New password** and **Repeat password** are enabled.
- ▶ Enter a new password
- ▶ Repeat the new password
- ▶ Press the **Set new password** soft key
- > The control compares the requirements defined for passwords by the administrator to the password you entered.
- Further information:** "Login to user administration", Page 561
- > The message **Password was changed successfully** appears.

### Defining login with token

The control also permits login with a token. This ensures secure login without the user having to enter a password.



Refer to your machine manual.

The machine manufacturer must prepare the machine for use with a token. For example, an appropriate reader must be mounted on the machine.

In the **Current User** menu item, you can define login with a token for the current user.

To create a token:

- ▶ Call **Current User**
- ▶ Select **Create token**
- ▶ Select the type of token with **Switch type**, if required
- ▶ Enter the user's password
- ▶ Enter PIN, if required
- ▶ Hold the token close to the reader
- ▶ Select **Reload list**
- ▶ Choose a token from the list
- ▶ Select **Start writing**
- ▶ Enter PIN, if defined
- > The control starts the write process.

- ▶ Hold the token close to the reader until the end of the write process
- > When writing is complete, the control shows a message.

**Delete token** allows you to delete the created token and use password entry again.

## Dialog for requesting additional rights

If you do not have the rights required for a specific **HEROS menu** item, the control opens the window for requesting additional rights:

In this window, you can temporarily obtain more rights by adding another user's rights.

In the **Users that have this right:** field, the control lists all existing users that have the right to use this function.



If **Connection to Windows domain** is used, only users that were recently logged on are shown in the selection menu.

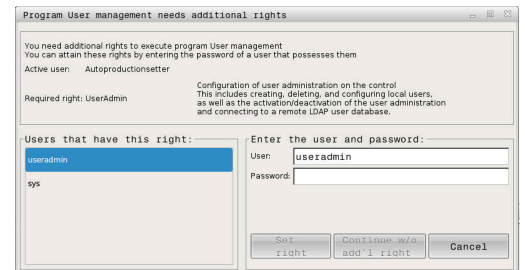
To attain the rights of users that are not shown, enter their user data. The control will then recognize those users that are contained in the user database.

### Obtaining more rights

To temporarily add another user's rights to your rights:

- ▶ Select the user whose rights you need
- ▶ Enter the user's name
- ▶ Enter the user's password
- ▶ Press the **Set right** soft key
- > The control adds the entered user's rights to your rights.

**Further information:** "Current User", Page 568



## 12.10 OPC UA NC Server (options 56 to 61)

### Introduction

Open Platform Communications Unified Architecture (OPC UA) describes a collection of specifications. These specifications are used to standardize machine-to-machine communication (M2M) in the field of industrial automation. OPC UA enables the data exchange across operating systems between products from different manufacturers, e.g. between a HEIDENHAIN control system and third-party software. Thus, OPC UA has become the data exchange standard for secure, reliable, manufacturer- and platform-independent industrial communication over the last years.

For OPC UA-based communication, the HEIDENHAIN control provides the **OPC UA NC Server**. For each OPC UA client to be connected, you need one of the six available software options (56 to 61).

Both standard and custom software can be used with the **OPC UA NC Server**. Compared to other established interfaces, significantly less development effort is required for OPC UA connection, thanks to the uniform communication technology.

The **OPC UA NC Server** allows you to access the data and functions of the HEIDENHAIN NC information model exposed in the server address space.

The control supports the following OPC UA functions:

- Write and read variables
- Subscribe to value changes
- Run methods
- Subscribe to events
- Creation of service files
- Read and write tool data (the corresponding right is required)
- File system access to the **TNC:** drive
- File system access to the **PLC:** drive (the corresponding right is required)
- Validation of 3D models for tool carriers

**Further information:** "Tool management", Page 158

**Further information:** "Application development", Page 575

## IT Security

In 2016, the German Federal Office for Information Security (BSI) published a security analysis related to **OPC UA**. The security analysis was updated in 2022. The specification analysis performed by the BSI determined that **OPC UA** provides a high level of security as compared to most other industrial protocols.

HEIDENHAIN follows the BSI recommendations and provides SignAndEncrypt, which exclusively features up-to-date IT security profiles. For this purpose, OPC UA-based industrial applications and the **OPC UA NC Server** exchange certificates for authentication. In addition, any transferred data is encrypted. This effectively prevents messages between the communication partners from being intercepted or altered.

Among others, the HEROS **Connection Assistant** function supports you when setting up the certificates.

**Further information:** "Setting up the connection", Page 573

## Machine configuration

The **OPC UA NC Server** enables OPC UA client applications to query general machine information, such as the year of construction of the machine or its location.

The following machine parameters are available for the digital identification of your machine:

- For users: **CfgMachineInfo** (no. 131700)
- For the machine tool manufacturer: **CfgOemInfo** (no. 131600)



If the machine parameters contain entries, the **Info about machine manufacturer** and **Machine information** areas are available in the **MOD** dialog of the **General Information** group.

## Setting up the connection

### Easy configuration with the Connection Assistant

For quick and easy setup of an OPC UA client application, you can use the **OPC UA NC Server connection assistant** window. This assistant guides you through the steps that are required to connect an OPC UA client application to the control.

The assistant features the following steps:

- Export **OPC UA NC Server** certificates
- Import the certificates of the OPC UA client application
- Assign each of the available **OPC UA NC Server** software options to an OPC UA client application
- Import user certificates
- Assign user certificates to users
- Configure the firewall

**i** The **OPC UA NC Server connection assistant** also helps you create test or sample certificates for users and the OPC UA client application. Do not use the user and client application certificates created at the control for other purposes than development at the programming station.

**i** If at least one software option is active for the OPC UA NC Server, the control will generate the server certificate as a part of a self-generated certificate chain during the first start-up.  
The client application or the manufacturer of the application creates the client certificate.  
The user certificate is linked to the user account. Please contact your IT department.

### Complex configuration with separate HEROS functions

Besides the simple setup with the **Connection Assistant**, the control provides separate HEROS functions for complex configurations:

#### ■ PKI Admin

With **PKI Admin** you can manage digital certificates in the control. A digital certificate allows its owner to encrypt, sign and authenticate the communication. The **OPC UA NC Server** is one of the applications whose Public Key Infrastructure (**PKI**) can be configured with the **PKI Admin** function of HEROS. After launching the HEROS **PKI Admin** function and selecting the **OPC UA NC Server** application, you can use the extended functionality.

**Further information:** "PKI Admin", Page 577

#### ■ Current User and UserAdmin

Each user of an OPC UA client application uses a certificate for authentication. For linking the certificates with users, the HEROS **Current User** or **UserAdmin** functions are available.

**Further information:** "User administration", Page 534

#### ■ OPC UA NC Server

The **OPC UA NC Server** function of HEROS includes a dialog named **License Settings** for managing the assignment of the active software options 56 to 61.



Before a certificate will be available for activation in the selection area of the **License Settings** dialog, you must import the corresponding certificate of a OPC UA client application with the HEROS **PKI Admin** function or the **Connection Assistant**.

#### ■ Firewall

Make sure to configure your firewall accordingly so that the connection of OPC UA applications with the **OPC UA NC Server** will not be blocked.

**Further information:** "Firewall", Page 503

## Application development

OPC UA is a manufacturer/platform-independent, open communication standard. For this reason, an OPC UA client SDK is not included in the **OPC UA NC Server**.

### HEIDENHAIN information model

A separate **Companion Specification** document is available that describes the information model supported by the **OPC UA NC Server**.



#### OPC UA NC Server information model

The specification for the **OPC UA NC Server** is described in the **Information Model** interface documentation. This document is available only in English.

ID: 1309365-xx



The **OPC UA NC Server Information Model** interface documentation is provided at:

- **OPC UA NC Server Interface Documentation**

### Technical notes

In order to establish a connection, the OPC UA client must support a **security policy** and authentication method used by the **OPC UA NC Server**.

The **OPC UA NC Server** has the following end point configuration:

- **Security Mode: SignAndEncrypt**
- **Algorithm:**
  - **Basic256Sha256**
  - **Aes128Sha256RsaOaep**
  - **Aes256Sha256RsaPss**
- **User Authentication: X509 certificates**



The end point configuration including the URL, which depends on the server host name, is displayed on the last page of the **Connection Assistant**.

The so-called user certificate can be assigned to a user in user administration.

## Access to directories

The **OPC UA NC Server** enables read and write access to the **TNC:** and **PLC:** drives.



During access, the permissions of the user to which the certificate used is linked are active. The directories and files displayed, as well as the access options, vary depending on the permissions.

If user administration is active, the private data of others users cannot be accessed.

**Further information:** "User administration", Page 534

The following actions are permitted:

- Creation and deletion of folders
- Reading, editing, copying, moving, creating, and deleting of files.

While the NC software is running, the files referenced in the following machine parameters are locked against write access:

- Tables referenced by the machine manufacturer in the machine parameter **CfgTablePath** (no. 102500)
- Files referenced by the machine manufacturer in the machine parameter **dataFiles** (no. 106303, branch **CfgConfigData** no. 106300)

The **OPC UA NC Server** enables access to the control even if the NC software is switched off. As long as the operating system is active, you can create and transmit service files, for example.

### NOTICE

#### Caution: potential damage to property!

The control does not automatically back up the files before editing or deletion. Files that are missing cannot be restored. The removal or editing of system-relevant files, such as the tool table, can negatively affect the control functions.

- ▶ System-relevant files must be edited only by authorized specialists



## PKI Admin

The **OPC UA NC Server** requires three different types of certificates. The server and the client need two of them, the application instance certificates, in order to establish a secure connection. The third certificate (user certificate) is required for authorization and for starting a session with specific user permissions.

**i** If at least one software option is active for the OPC UA NC Server, the control will generate the server certificate as a part of a self-generated certificate chain during the first start-up.

The client application or the manufacturer of the application creates the client certificate.

The user certificate is linked to the user account. Please contact your IT department.

The control automatically generates a two-level certificate chain referred to as the **Chain of Trust** for the server. This certificate chain consists of a self-signed root certificate (including a **revocation list**) and a certificate for the server that is created on the basis of the root certificate.

The client certificate must be added on the **Trusted** tab of the **PKI Admin** function.

All other certificates should be added on the **Issuers** tab of the **PKI Admin** function for verification of the entire certificate chain.

**i** Server certificates created automatically before software version 34059x-10 SP2 are newly created in a software update and the expiration date is modified. The new certificates must be made available to the client applications.

### User certificate

The control uses the HEROS functions **Current User** or **UserAdmin** for administration of the user certificate. When you initiate a session, the rights of the associated internal user are active.

To assign a user certificate to a user:

- ▶ Open the **Current User** HEROS function
- ▶ Select **SSH keys and certificates**
- ▶ Press the **Import certificate** soft key
- > The control opens a pop-up window.
- ▶ Select the certificate
- ▶ Select **Open**
- > The control imports the certificate.
- ▶ Press the **Use for OPC UA** soft key

### Self-generated certificates

You can also create and import all of the required certificates yourself.

Self-generated certificates must fulfill the following requirements:

- General requirements
  - File format: \*.der
  - Signature with hash SHA256
  - Validity period of at most 5 years is recommended
- Client certificates
  - Host name of the client
  - Application URI of the client
- Server certificates
  - Host name of the control
  - Application URI of the server according to the following structure:  
urn:<hostname>/HEIDENHAIN/OpcUa/NC/Server
  - Validity period of 20 years maximum

## 12.11 Changing the HEROS conversational language

The HEROS conversational language is internally based on the NC conversational language. Therefore the **HEROS menu** and the control cannot permanently be set to two different conversational languages.

When you change the NC conversational language, the HEROS conversational language will only reflect this change after a restart of the control.



With the optional machine parameter **applyCfgLanguage** (no. 101305), you define the behavior of the control if the NC conversational language and in the HEROS conversational language do not match.

The following link provides information on how to change the NC conversational language:

**Further information:** "List of user parameters", Page 600

### Changing the language layout of the keyboard

You can change the language layout of the keyboard for HEROS applications.

Proceed as follows to change the language layout of the keyboard for HEROS applications:

- ▶ Select the HEROS menu icon
- ▶ Select **Settings**
- ▶ Select **Language/Keyboards**
- > The control opens the **helocale** window.
- ▶ Select the **Keyboards** tab
- ▶ Select the desired keyboard layout
- ▶ Select **Apply**
- ▶ Press **OK**
- ▶ Select **Apply**
- > The changes are applied.



# 13

**Operating the  
Touchscreen**

## 13.1 Display unit and operation

### Touchscreen



Refer to your machine manual.  
This function must be enabled and adapted by the machine manufacturer.

The touchscreen is distinguished by a black frame and the lack of soft-key selection keys.

As an alternative, the TNC 640 has its operating panel integrated in the screen.

- 1 Header  
When the control is on, the screen displays the selected operating modes in the header.
- 2 Soft-key row for the machine manufacturer
- 3 Soft-key row  
The control shows further functions in a soft-key row. The active soft-key row is shown as a blue bar.
- 4 Integrated operating panel
- 5 Setting the screen layout
- 6 Switchover between machine operating modes, programming modes, and a third desktop



### Operation and cleaning

Touchscreens can even be operated with dirty hands, as long as the touch sensors are able to detect the skin resistance. Small amounts of liquid do not affect the function of the touchscreen, but large amounts may cause incorrect entries.

Switch off the control before cleaning the touchscreen. As an alternative, you can use the touchscreen cleaning mode.

**Further information:** "Touchscreen Cleaning", Page 596

Do not apply the cleaning agent directly to the screen, but slightly dampen a clean, lint-free cleaning cloth with it.

The following cleaning agents are permitted for the screen:

- Glass cleaner
- Foaming screen cleaners
- Mild detergents

The following cleaning agents are prohibited for the screen:

- Aggressive solvents
- Abrasives
- Compressed air
- Steam cleaners



- Touchscreens are sensitive to electrostatic charges from the user. Dissipate the static charge by touching metallic, grounded objects or wear ESD clothing.
- Wear operating gloves to prevent the screen from getting dirty.
- You can operate the touchscreen with special touchscreen operating gloves.

### Operating panel

Depending on the control model, the control can still be operated through the external operating panel. Touch operation with gestures works as well.

If you have a control with integrated operating panel, the following description applies:

### Integrated operating panel

The operating panel is integrated in the screen. The content of the operating panel changes depending on the current operating mode.

- 1 Area for showing the following:
  - Alphabetic keyboard
  - **HEROS** menu
  - Potentiometer for the speed of simulation (only in the **Test Run** operating mode)

- 2 Machine operating modes

- 3 Programming modes

The control shows the active operating mode, to which the screen is switched, with a green background.

The control shows the operating mode in the background through a small white triangle.

- 4
  - File manager
  - Calculator
  - MOD function
  - HELP function
  - Show error messages

- 5 Shortcut menu

Depending on the operating mode, you'll find the most important functions here at a glance.

- 6 Initiating programming dialogs (only in the **Programming** and **Positioning w/ Manual Data Input** operating modes)

- 7 Numerical input and axis selection


- 8 Navigation

- 9 Arrows and the jump statement **GOTO**

- 10 Task bar




**Further information:** "Icons of the taskbar", Page 595

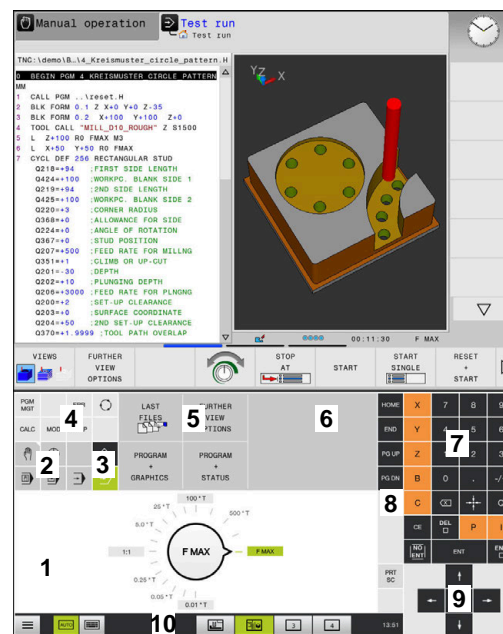
In addition, the machine manufacturer supplies a machine operating panel.

 Refer to your machine manual.  
External keys e.g., **NC START** or **NC STOP**, are described in your machine manual.

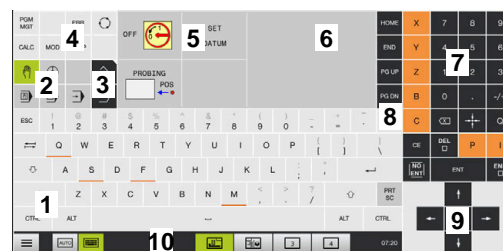
### Basic operation

The following keys, for example, can easily be replaced by hand gestures:

Key	Function	Gesture
	Switching between operating modes	Tap on the operating mode in the header
	Shift the soft-key row	Swipe horizontally over the soft-key row
	Soft-key selection keys	Tap on the function in the touchscreen



Operating panel of the Test Run mode








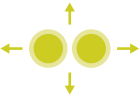


Operating panel in the Manual Operation mode



## 13.2 Gestures




### Overview of possible gestures

The screen of the control is multi-touch capable. That means that it can distinguish various gestures, including with two or more fingers at once.

Symbol	Gesture	Meaning
	Tap	A brief touch by a finger on the screen
	Double tap	Two brief touches on the screen
	Long press	Continuous contact of fingertip on the screen
<p><b>i</b> If you do not stop holding, the control will automatically cancel the holding gesture after approximately ten seconds. Permanent actuation is thus not possible.</p>		
	Swipe	Flowing motion over the screen
	Drag	A combination of long-press and then swipe, moving a finger over the screen when the starting point is clearly defined
	Two-finger drag	A combination of long-press and then swipe, moving two fingers in parallel over the screen when the starting point is clearly defined
	Spread	Two fingers long-press and move away from each other
	Pinch	Two fingers move toward each other

## Navigating in the table and NC programs

You can navigate in an NC program or a table as follows:

Symbol	Gesture	Function
	Tap	Mark the NC block or table line Stop scrolling
	Double tap	Activate the table line
	Swipe	Scroll through the NC program or table



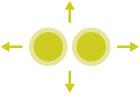


### Operating the simulation

The control offers touch operation with the following graphics:

- Programming graphics in the **Programming** operating mode.
- 3-D view in the **Test Run** operating mode.
- 3D view in the **Program Run Single Block** operating mode.
- 3-D view in the **Program Run Full Sequence** operating mode.
- Kinematics view


### Rotating, zooming, or moving a graphic

The control supports the following gestures:

Symbol	Gesture	Function
	Double tap	Set the graphic to its original size
	Drag	Rotate the graphic (only 3-D graphics)
	Two-finger drag	Move graphics
	Spread	Magnify the graphic
	Pinch	Reduce the graphic



### Measuring a graphic

If you have activated measurement in the **Test Run** operating mode, the following additional function is available:

Symbol	Gesture	Function
	Tap	Select the measuring point

## Using the HEROS menu




To use the **HEROS menu** menu:

Symbol	Gesture	Function
	Tap	Select the application
	Long press	Open the application

### Operating the CAD viewer




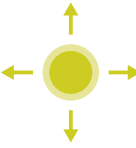
The control also supports touch operation for working with **CAD Viewer**. You have various gestures available depending on the operating mode.

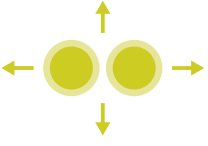
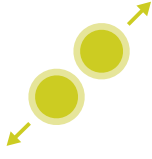
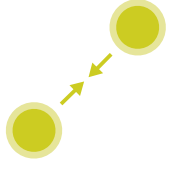
To be able to use all applications, first use the icon to select the desired function:

Icon	Function
	Default setting
	<b>Add</b> Works in the selection mode like a pressed <b>Shift</b> key
	<b>Remove</b> Works in the selection mode like a pressed <b>CTRL</b> key

### Layer setting mode and specifying the workpiece preset






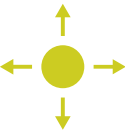
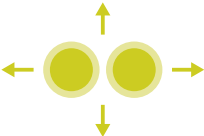
The control supports the following gestures:

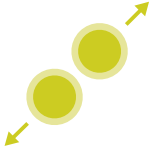
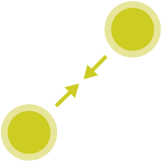
Symbol	Gesture	Function
	Tap on an element	Show element information Specify the workpiece preset
	Double-tap on the background	Set the graphic or 3-D model to its original size
	Activate <b>Add</b> and double-tap on the background	Reset the graphic or 3-D model to its original size and angle
	Drag	Rotate the graphic or 3-D model (only in the Layer Setting mode)

Symbol	Gesture	Function
	Two-finger drag	Move a graphic or 3-D model
	Spread	Enlarge a graphic or 3-D model
	Pinch	Reduce a graphic or 3-D model

**Selecting a contour**

The control supports the following gestures:



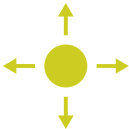


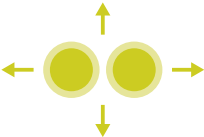
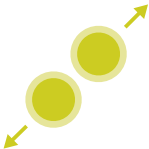
Symbol	Gesture	Function
	Tap on an element	Select element
	Tap on an element in the list-view window	Select or deselect an element
	Activate <b>Add</b> and tap on an element	Part, shorten, or lengthen an element
	Activate <b>Remove</b> and tap on an element	Deselect an element
	Double-tap on the background	Reset the graphic to its original size
	Swipe over an element	Show a preview of selected elements Show element information
	Two-finger drag	Move graphics

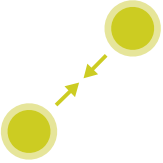
Symbol	Gesture	Function
	Spread	Magnify the graphic
	Pinch	Reduce the graphic



### Selecting machining positions

The control supports the following gestures:

Symbol	Gesture	Function
	Tap on an element	Select element Select an intersection
	Double-tap on the background	Reset the graphic to its original size
	Swipe over an element	Show a preview of selected elements Show element information
	Activate <b>Add</b> and drag	Spread a fast selection area
	Activate <b>Remove</b> and drag	Spread an area for deselection of elements
	Two-finger drag	Move graphics
	Spread	Magnify the graphic

Symbol	Gesture	Function
	Pinch	Reduce the graphic

### Saving elements and switching to the NC program

When you tap on the appropriate icons, the controls saves the selected elements.








You can switch back to the **Programming** operating mode in the following ways:

- Press the **Programming** key  
The control switches to the **Programming** mode of operation.
- Closing **CAD Viewer**  
The control automatically switches to the **Programming** operating mode.
- Use the task bar to leave **CAD Viewer** open on the third desktop  
The third desktop stays active in the background

### 13.3 Functions in the taskbar

#### Icons of the taskbar

The taskbar provides you with the following icons:

Icon	Function
	Opening the <b>HEROS menu</b>
	Automatically show and hide the alphabetic keyboard
	Always show the alphabetic keyboard
	Workspace 1: Select the active machine mode
	Workspace 2: Select the active programming mode
	Workspace 3: Select the CAD viewer, DXF converter or applications of the machine manufacturer (optionally available)
	Workspace 4: Select the display and remote control of external computer units (option 133) or applications of the machine manufacturer (optionally available)







#### Functions in the HEROS menu

Using the **Menu** icon on the taskbar, you can open the HEROS menu through which you can find information, make settings, or start applications.

**Further information:** "Overview of taskbar", Page 489

When the **HEROS menu** is open, the following icons are available:

Icon	Function
	Return to main menu
	Show active applications
	Show all applications

 If you have set the view to active applications, you can close specific applications as in a task manager.

## Touchscreen Configuration

With the **Touchscreen Configuration** function you can define the properties of the screen.

### Adjusting sensitivity

To set the sensitivity:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select the **Touchscreen Configuration** menu item
- > The control opens a pop-up window.
- ▶ Select the sensitivity
- ▶ Confirm with **OK**

### Display of the touch points

To show or hide the touch points:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select the **Touchscreen Configuration** menu item
- > The control opens a pop-up window.
- ▶ Select the **Show Touch Points** display
  - **Disable Touchfingers** to hide the touch points
  - **Enable Single Touchfingers** to show the touch point
  - **Enable Full Touchfingers** to show the touch points of all fingers involved
- ▶ Confirm with **OK**

## Touchscreen Cleaning

With the **Touchscreen Cleaning** function you can lock the screen in order to clean it.

### Activating the cleaning mode

To activate the cleaning mode:

- ▶ Press the **DIADUR** key to open the **HEROS menu** menu
- ▶ Select the **Touchscreen Cleaning** menu item
- > The control locks the screen for 90 seconds.
- ▶ Clean the screen

To stop the cleaning mode:

- ▶ Pull the displayed sliders apart at the same time

# 14

**Tables and  
Overviews**

## 14.1 Machine-specific user parameters

### Application

The parameter values are entered in the **configuration editor**.



Refer to your machine manual.

- The machine manufacturer can make additional machine-specific parameters available as user parameters, so that you can configure the functions that are available.
- The machine manufacturer can adapt the structure and contents of the user parameters. The display on your machine may be different.

The machine parameters are grouped as parameter objects in a tree structure in the configuration editor. Each parameter object has a name (e.g. **Settings for screen displays**) that gives information about the parameters it contains.

### Calling the configuration editor

Proceed as follows:



- ▶ Press the **MOD** key










- ▶ Select the **Code-number entry** function, if necessary
- ▶ Enter the code number **123**






- ▶ Confirm with the **ENT** key
- ▶ The control displays the list of available parameters in the tree view.


### Depiction of the parameters

The icon at the beginning of each line in the parameter tree shows additional information about this line. The icons have the following meanings:

-  Branch exists but is closed
-  Branch is open
-  Empty object, cannot be opened
-  Initialized machine parameter
-  Uninitialized (optional) machine parameter
-  Can be read but not edited
-  Can neither be read nor edited

The folder icon indicates the object type:

-  Key (group name)
-  List
-  Entity (parameter object)


 The icons of parameters and objects that are not yet active appear dimmed. These can be activated with the **MORE FUNCTIONS** and **INSERT** soft keys.

### Changing the parameters

Proceed as follows:

- ▶ Find the desired parameter
- ▶ Edit the value
- ▶ Press the **END** soft key to close the configuration editor
- ▶ Press the **SAVE** soft key to save the changes



 The control saves a change list of the last 20 changes to the configuration data. To undo changes, select the corresponding line and press the **MORE FUNCTIONS** and **CANCEL CHANGE** soft keys.

### Changing the display of the parameters

You can change the display of the existing parameters in the configuration editor for the machine parameter. By default, the parameters are displayed with short, explanatory texts.

To display the actual system names of the parameters:

Proceed as follows in order to have the actual system names of the parameters be shown:



- ▶ Press the **Screen layout** key



- ▶ Press the **SHOW SYSTEM NAME** soft key

Follow the same procedure to return to the standard display.

### Displaying help texts

The **HELP** key enables you to call a help text for each parameter object or attribute.

If the help text does not fit on one page (1/2 is then displayed at the upper right, for example), press the **HELP PAGE** soft key to scroll to the second page.

The control displays other information (e.g. unit of measurement, initial value, selection list) in addition to the help text. If the selected machine parameter matches a parameter in the previous control model, the corresponding MP number is displayed.

### List of user parameters



Refer to your machine manual.

- The machine manufacturer can make additional machine-specific parameters available as user parameters, so that you can configure the functions that are available.
- The machine manufacturer can adapt the structure and contents of the user parameters. The display on your machine may be different.



---

**Parameter settings**


---

## DisplaySettings

Settings for screen display

Display sequence and rules for axes

[0] to [23]: depends on the available axes

Key name of an object in CfgAxis

**Key name of the axis to be displayed**

Axis designation

**Axis designation to be used in place of the key name**

Display rule for the axis

**ShowAlways****IfKinem****IfKinemAxis****IfNotKinemAxis****Never**

Display sequence and rules for axes in the REF display

[0] to [23]: depends on the available axes

**See display sequence and rules for axes**

Type of position display in the position window

**NOML****ACTL****REF ACTL****REF NOML****LAG****ACTDST****REFDST****M118**

Type of position display in the status display

**NOML****ACTL****REF ACTL****REF NOML****LAG****ACTDST****REFDST****M118**

Definition of decimal separator for position display

**. point****, comma**

Display of the feed rate in the Manual Operation and El. Handwheel modes of operation

**at axis key: Display the feed rate only if axis-direction key is pressed**

---

**Parameter settings**

---

**always minimum: Always display the feed rate**

Display of spindle position in the position display

**during closed loop: Display spindle position only if spindle is in position feedback control**  
**during closed loop and M5: Display spindle position if spindle is in position feedback control and with M5**

**during closed loop or M5 or tapping: Display spindle position if spindle is in position feedback control, with M5 and in spindle jog operation**

Locking of PRESET MANAGEMENT soft key

**TRUE: Access to the preset table is locked**

**FALSE: The preset table can be accessed by soft key**

Font size for program display

**FONT\_APPLICATION\_SMALL**

**FONT\_APPLICATION\_MEDIUM**

Sequence of icons in the display

[0] to [19]: depends on the activated options

**e.g., S\_PULSE**

Settings for display behavior: depends on the machine manufacturer

**Entered by the machine manufacturer**

Display setting for unchecked axes

**ValuesRedColor: Red coloring of unchecked axes**

**SymbolNearAxisName: Caution symbol next to the axis letter**

---

---

**Parameter settings**


---

## DisplaySettings

Display step for the individual axes

List of all available axes

Display step for position display in mm or degrees

**0.1**

**0.05**

**0.01**

**0.005**

**0.001**

**0.0005**

**0.0001**

**0.00005**

**0.00001**

**0.000005**

**0.000001**

Display step for position display in inches

**0.005**

**0.001**

**0.0005**

**0.0001**

**0.00005**

**0.00001**

**0.000005**

**0.000001**

---

DisplaySettings

Definition of the unit of measure valid for the display

Unit of measure for display in the user interface

**metric: Use the metric system**

**inch: Use the inch system**

---

DisplaySettings

Format of the NC programs and cycle display

Program entry in HEIDENHAIN Klartext or in DIN/ISO

**HEIDENHAIN: Klartext language for entering the program in Positioning with Manual Data Input operating mode**

**ISO: G codes for entering the program in Positioning with Manual Data Input operating mode**

---

---

**Parameter settings**


---

## DisplaySettings

Definition of the NC and PLC conversational languages

NC conversational language

**ENGLISH**

**GERMAN**

**CZECH**

**FRENCH**

**ITALIAN**

**SPANISH**

**PORTUGUESE**

**SWEDISH**

**DANISH**

**FINNISH**

**DUTCH**

**POLISH**

**HUNGARIAN**

**RUSSIAN**

**CHINESE**

**CHINESE\_TRAD**

**SLOVENIAN**

**KOREAN**

**NORWEGIAN**

**ROMANIAN**

**SLOVAK**

**TURKISH**

Load the language of the NC control

**FALSE: Upon startup of the control, the language of the HEROS operating system is used**

**TRUE: Upon startup of the control, the language from the machine parameters is used**

PLC conversational language

**See NC conversational language**

PLC error message language

**See NC conversational language**

Language for online help

**See NC conversational language**

---

## DisplaySettings

Behavior during control start-up

Acknowledge the "Power interrupted" message

**TRUE: Start-up of the control is not continued until the message has been acknowledged**

**FALSE: The Power interrupted message does not appear**

---

---

**Parameter settings**


---

## DisplaySettings

Display mode for time of day

Selection of display mode

**Analog****Digital****Logo****Analog and logo****Digital and logo****Analog on logo****Digital on logo**


---

DisplaySettings

Link row on/off

Display settings for link row

**OFF: Switch off the information line in the operating-mode line****ON: Switch on the information line in the operating-mode line**


---

DisplaySettings

Settings for 3-D simulation graphics

Model type of the 3-D simulation graphics

**3-D: Model depiction for complex machining operations with undercuts (compute-intensive)****2.5-D: Model depiction for 3-axis operations****No Model: Model depiction is deactivated**

Model quality of the 3-D simulation graphics

**very high: High resolution; the block end points can be depicted****high: High resolution****medium: Medium resolution****low: Low resolution**

Reset tool paths in new BLK form

**ON: With new BLK form in Test Run, the tool paths are reset****OFF: With new BLK form in Test Run, the tool paths are not reset**

Write graphics journal files after restart

**OFF: Do not generate journal data****ON: Generate journal data after a restart for diagnostic purposes**


---

DisplaySettings

Position display settings

Position display with TOOL CALL DL

**As Tool Length: The programmed oversize DL is considered to be the change in tool length for display of the workpiece-based position****As Workpiece Oversize: The programmed oversize DL is considered to be the workpiece oversize for display of the workpiece-based position**

---

## Parameter settings

---

### DisplaySettings

#### Table editor setting

Behavior when deleting tools from the pocket table

**DISABLED: Deletion of tool is not possible**

**WITH\_WARNING: Tool deletion is possible, but must be confirmed**

**WITHOUT\_WARNING: Tool deletion is possible without warning**

Behavior when deleting a tool's index entries

**ALWAYS\_ALLOWED: Deletion of index entries is always possible**

**TOOL\_RULES: The behavior depends on the setting of the parameter "Behavior when deleting tools from the pocket table"**

Show the RESET COLUMN T soft key

**TRUE: The soft key is displayed. All tools can be deleted from the tool memory by the user**

**FALSE: The soft key is not displayed**

---

### DisplaySettings

Setting the coordinate systems for the display

Coordinate system for the datum shift

**WorkplaneSystem: Datum is displayed in the system of the tilted plane, WPL-CS**

**WorkpieceSystem: Datum is displayed in the workpiece coordinate system, W-CS**

---

---

**Parameter settings**


---

## DisplaySettings

## GPS display settings

Show offset in the GPS dialog

**OFF: The offsets are not shown in the GPS dialog****ON: The offsets are shown in the GPS dialog**

Show an additive basic rotation in the GPS dialog

**OFF: Do not show the additive basic rotation in the GPS dialog****ON: Show the additive basic rotation in the GPS dialog**

Show shift of W-CS in the GPS dialog

**OFF: Do not show the shift of W-CS in the GPS dialog****ON: Show the shift of W-CS in the GPS dialog**

Show mirroring in the GPS dialog

**OFF: Do not show mirroring in the GPS dialog****ON: Show mirroring in the GPS dialog**

Show shift of mW-CS in the GPS dialog

**OFF: Do not show the shift of mW-CS in the GPS dialog****ON: Show the shift of mW-CS in the GPS dialog**

Show rotation in the GPS dialog

**OFF: Do not show the rotation in the GPS dialog****ON: Show the rotation in the GPS dialog**

Show feed rate in the GPS dialog

**OFF: Do not show the feed rate in the GPS dialog****ON: Show the feed rate in the GPS dialog**

M-CS coordinate system is selectable

**OFF: M-CS coordinate system is not selectable****ON: M-CS coordinate system is selectable**

W-CS coordinate system is selectable

**OFF: W-CS coordinate system is not selectable****ON: W-CS coordinate system is selectable**

mM-CS coordinate system is selectable

**OFF: mM-CS coordinate system is not selectable****ON: mM-CS coordinate system is selectable**

WPL-CS coordinate system is selectable

**OFF: WPL-CS coordinate system is not selectable****ON: WPL-CS coordinate system is selectable**

The U axis can be selected

**ON: The U axis can be selected**

---

**Parameter settings**

---

**OFF: The U axis cannot be selected**

The V axis can be selected

**ON: The V axis can be selected**

**OFF: The V axis cannot be selected**

The W axis can be selected

**ON: The W axis can be selected**

**OFF: The W axis cannot be selected**

---

**PalletSettings**

Behavior of the pallet control cycle

Activate reaction to program check and tool check

**Never: No checking for faulty program or tool calls**

**OnFailedPgmCheck: Check for faulty program calls**

**OnFailedToolCheck: Check for faulty tool calls**

Effect of program check or tool check

**SkipPGM: Skip faulty programs**

**SkipFIX: Skip fixture setups that contain faulty programs**

**SkipPAL: Skip pallets that contain faulty programs**

---



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**Parameter settings**


---

## ProbeSettings

Configuration of the tool calibration

TT140\_1

M function for spindle orientation

**-1: Spindle orientation directly by NC****0: Function inactive****1 to 999: Number of the M function for spindle orientation**

Probing routine

**MultiDirections: Probing from multiple directions****SingleDirection: Probing from one direction**

Probing direction for tool radius measurement: Depends on the tool axis

**X\_Positive, Y\_Positive, X\_Negative, Y\_Negative, Z\_Positive, Z\_Negative**

Distance from lower edge of tool to upper edge of stylus

**0.001 to 99.9999 [mm]**

Rapid traverse in probing cycle

**10 to 300 000 [mm/min]**

Probing feed rate during tool measurement

**1 to 30 000 [mm/min]**

Calculation of the probing feed rate

**ConstantTolerance: Calculation of the probing feed rate with constant tolerance****VariableTolerance: Calculation of the probing feed rate with variable tolerance****ConstantFeed: Constant probing feed rate**

Speed determination method

**Automatic: Automatically determine the speed****MinSpindleSpeed: Use the minimum spindle speed**

Maximum permissible surface speed of the tool edge (milling tool circumference)

**1 to 129 [m/min]**

Maximum permissible speed for tool measurement

**0 to 1000 [rpm]:**

First maximum permissible measurement error during tool measurement

**0.001 to 0.999 [mm]**

Second maximum permissible measurement error during tool measurement

**0.001 to 0.999 [mm]**

NC stop during tool check

**True: When the breakage tolerance is exceeded, the NC program is stopped****False: The NC program is not stopped**

---

**Parameter settings**


---

NC stop during tool measurement

**True: When the breakage tolerance is exceeded, the NC program is stopped**

**False: The NC program is not stopped**

Change the tool table during tool check and tool measurement

**AdaptOnMeasure: The table is changed after tool measurement**

**AdaptOnBoth: The table is changed after tool check and tool measurement**

**AdaptNever: The table is not changed after tool check and tool measurement**

---

**ProbeSettings**

Configuration of a round stylus

TT140\_1

Coordinates of the stylus center

**[0]: X coordinate of the stylus center with respect to the machine datum [mm]**

**[1]: Y coordinate of the stylus center with respect to the machine datum [mm]**

**[2]: Z coordinate of the stylus center with respect to the machine datum [mm]**

Set-up clearance above the stylus for pre-positioning

**0.001 to 99 999.9999 [mm]**

Safety zone around the stylus for pre-positioning: Set-up clearance in the plane perpendicular to the tool axis

**0.001 to 99 999.9999 [mm]**

---

**ProbeSettings**

Configuration of a rectangular stylus

TT140\_1

Coordinates of the stylus center

**[0]: X coordinate of the stylus center with respect to the machine datum [mm]**

**[1]: Y coordinate of the stylus center with respect to the machine datum [mm]**

**[2]: Z coordinate of the stylus center with respect to the machine datum [mm]**

Set-up clearance above the stylus for pre-positioning

**0.001 to 99 999.9999 [mm]**

Safety zone around the stylus for pre-positioning: Set-up clearance in the plane perpendicular to the tool axis

**0.001 to 99 999.9999 [mm]**

---

---

**Parameter settings**


---

## ChannelSettings

## CH\_NC

## Active kinematics

Kinematics to be activated

**List of machine kinematics**

The kinematics to be activated during control start-up

**List of machine kinematics**

## Specify the behavior of the NC program

Reset the machining time when program starts

**True: Machining time is reset****False: Machining time is not reset**

PLC signal for the number of the pending fixed cycle

**Depends on the machine manufacturer**

PLC signal for type of current cycle execution

**0: If no machining cycle is currently being performed****1: During pre-positioning****2: During actual machining**

## Geometrical tolerances

Permissible deviation of circle radius between circle end point and circle starting point

**0.0001 to 0.016 [mm]**

Permissible error in successive threads: Permissible deviation of the dynamically smoothed contour from the programmed thread contour

**0.0001 to 999.9999 [mm]**

Reserve for retraction movements: Distance to limit switch or collision object with M140 MB MAX

**0.0001 to 10 [mm]**

## Configuration of machining cycles

Overlap factor for pocket milling: Path overlap for Cycle 4 POCKET MILLING and Cycle 5 CIRCULAR POCKET

**0.001 to 1.414**

Traverse after machining a contour pocket

**PosBeforeMachining: Tool moves to the same position as before the cycle was machined****ToolAxClearanceHeight: Position the tool axis to clearance height**Display the **Spindle ?** error message if M3/M4 is not active**On: Issue error message****Off: No error message**

---

**Parameter settings**


---

Display the **Enter depth as negative**

**On: Issue error message**

**Off: No error message**

Behavior when moving to wall of slot in the cylinder surface

**LineNormal: Approach on a straight line**

**CircleTangential: Approach**

M function for spindle orientation in machining cycles

**-1: Spindle orientation directly by NC**

**0: Function inactive**

**1 to 999: Number of the M function for spindle orientation**

Do not show **Plunging type is not possible** error message

**On: Error message is not displayed**

**Off: Error message is displayed**

Behavior of M7 and M8 with Cycles 202 and 204

**TRUE: At the end of Cycles 202 and 204, the status of M7 and M8 is restored to that before the cycle call**

**FALSE: At the end of Cycles 202 and 204, the status of M7 and M8 is not restored automatically**

Automatic feed rate reduction after attaining SMAX

**100: Feed rate reduction is deactivated [%]**

**0 < factor < 100: Feed rate reduction is activated. Minimum feed rate in percent of the programmed feed rate in the turning cycle [%]**

Do not show the **Residual material** warning

**Never: The warning is always displayed**

**NCOOnly: The warning is suppressed during program run**

**Always: The warning is never displayed**

Special spindle parameters

Potentiometer for feed rate during thread cutting

**SpindlePotentiometer: During thread cutting, the potentiometer is effective for the spindle-speed override. The potentiometer for the feed-rate override is disabled**

**FeedPotentiometer: During thread cutting, the potentiometer is effective for the feed-rate override. The potentiometer for the spindle-speed override is not active**

Waiting time at reversal point in thread base: The spindle stops for this time at the bottom of the thread before starting again in the opposite direction of rotation

**-999999999 to 999999999 [s]**

Advanced switching time of spindle: The spindle is stopped for this period of time before reaching the bottom of the thread.

**-999999999 to 999999999 [s]**

---

**Parameter settings**

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Limitation of spindle speed with Cycles 17, 207, and 18

**TRUE: With small thread depths, the spindle speed is limited so that it runs at constant speed approx. 1/3 of the time**

**FALSE: No limitation of the spindle speed**

---

---

## Parameter settings

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Settings for the NC editor

Generate backup files

**TRUE: Generate backup file after editing NC programs**

**FALSE: Do not generate backup file after editing NC programs**

Behavior of the cursor after deletion of lines

**TRUE: Cursor is placed on the preceding line after deletion (behavior of iTNC)**

**FALSE: Cursor is placed on the following line after deletion**

Behavior of the cursor on the first or last line

**TRUE: Cursor jumps from end to beginning of program**

**FALSE: Cursor is not allowed to jump from end to beginning of program**

Line break on blocks with more than one line

**ALL: Always display all lines**

**ACT: Only display the lines of the active block completely**

**NO: Only display all lines when block is edited**

Activate help graphics when entering cycle data

**TRUE: Always display help graphics during input**

**FALSE: Only display help graphics when the CYCLE HELP soft key is set to ON. The CYCLE HELP OFF/ON soft key is displayed in Programming operating mode after pressing the "Screen layout" key**

Behavior of the soft-key row after entering a cycle

**TRUE: The cycle soft-key row remains active after a cycle definition**

**FALSE: The cycle soft-key row is hidden after a cycle definition**

Confirmation request when deleting a block

**TRUE: Display confirmation request when deleting an NC block**

**FALSE: Do not display confirmation request when deleting an NC block**

Line number up to which a test of the NC program is to be run: Program length for which the geometry is to be checked

**100 to 100000**

ISO programming: Increments for creation of ISO blocks in the program

**0 to 250**

Specify programmable axes

**TRUE: Use the specified axis configuration**

**FALSE: Use the default axis configuration XYZABCUVW**

Behavior of paraxial positioning blocks

**TRUE: Paraxial positioning blocks enabled**

**FALSE: Paraxial positioning blocks disabled**

---

**Parameter settings**

---

Line number up to which identical syntax elements are searched for: Search for selected elements with up or down cursor keys

**500 to 400000**

Hide FUNCTION PAARAXCOMP/PARAXMODE

**FALSE: PARAXCOMP and PARAXMODE functions permitted**

**TRUE: PARAXCOMP and PARAXMODE functions blocked**

---

File management settings

Display of dependent files

**MANUAL: Dependent files are displayed**

**AUTOMATIC: Dependent files are not displayed**

---

Settings for tool usage file

Timeout for creation of tool-usage files

**1 to 500 [min]**

Create tool-usage file for NC program

**NotAutoCreate: Do not create a tool usage list when a program is selected**

**OnProgSelectionIfNotExist: When a program is selected, create a list if does not yet exist**

**OnProgSelectionIfNecessary: When a program is selected, create a list if it does not yet exist or is obsolete**

**OnProgSelectionAndModify: When a program is selected, create a list if it does not yet exist, is obsolete, or the program is changed**

Create a pallet usage file

**NotAutoCreate: Do not create a tool usage list when a pallet is selected**

**OnProgSelectionIfNotExist: When a pallet is selected, a list is created if it does not yet exist**

**OnProgSelectionIfNecessary: When a pallet is selected, a list is created if it does not yet exist or is obsolete**

**OnProgSelectionAndModify: When a pallet is selected, a list is created if it does not yet exist, is obsolete, or the program is changed**

---

Paths for the end user

List of drives or directories: These machine parameters are effective only for a Windows programming station

**Drives or directories entered here are shown in the control's file manager**

FN 16 output path for execution

**Path for FN 16 output when no path is defined in the NC program**

FN 16 output path for the Programming and Test Run operating modes

**Path for FN 16 output when no path is defined in the NC program**

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## Parameter settings

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### serialInterfaceRS232

Data record belonging to the serial port

Release of the RS-232-C/V.24 interface in the file manager

**TRUE: Drive RS232: It is displayed and you can copy files via this interface**

**FALSE: The drive is not displayed**

Data transfer rate for LSV2 communication in baud

**BAUD\_110**

**BAUD\_150**

**BAUD\_300**

**BAUD\_600**

**BAUD\_1200**

**BAUD\_2400**

**BAUD\_4800**

**BAUD\_9600**

**BAUD\_19200**

**BAUD\_38400**

**BAUD\_57600**

**BAUD\_115200**

Definition of data blocks for the serial ports

RS-232

Data transfer rate in baud

**BAUD\_110**

**BAUD\_150**

**BAUD\_300**

**BAUD\_600**

**BAUD\_1200**

**BAUD\_2400**

**BAUD\_4800**

**BAUD\_9600**

**BAUD\_19200**

**BAUD\_38400**

**BAUD\_57600**

**BAUD\_115200**

Data transfer protocol

**STANDARD: Standard data transfer. Data transferred line-by-line**

**BLOCKWISE: Packet-based data transfer, ACK/NAK protocol. The control characters ACK (Acknowledge) and NAK (not Acknowledge) are used to control block-wise data transfer.**

**RAW\_DATA: Data transferred without protocol. Transfer of characters without control characters. Protocol intended for transfer of data of the PLC.**

Data bits in each transferred character

**7 bits: 7 data bits are transferred for each character transferred**



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**Parameter settings**

---

**8 bits: 8 data bits are transferred for each character transferred**

Type of parity checking

**NONE: No parity****EVEN: Even parity****ODD: Odd parity**

Number of stop bits

**1 stop bit: 1 stop bit is appended after each transferred character.****2 stop bits: 2 stop bits are appended after each transferred character.**

Specify type of handshake:

**NONE: No data-flow check. Handshake not active****RTS\_CTS: Hardware handshaking; transfer stop is active through RTS****XON\_XOFF: Software handshake; transfer stop by DC3 (XOFF) active**

File system for file operation via serial interface

**EXT: Minimum file system to be used for non-HEIDENHAIN devices, such as printers, punches, or PCs with other data transfer software****FE1: Use this setting for communication with the external HEIDENHAIN Floppy Disk Unit FE 4xx or for communication with the HEIDENHAIN PC software TNCserver.**

Block Check Character (BCC) is not a control character

**TRUE: Ensures that the check sum does not correspond to a control character****FALSE: Function not active**

Status of the RTS line

**TRUE: The idle state of the RTS line is logical LOW****FALSE: The idle state of the RTS line is logical HIGH**

Define behavior after receipt of ETX

**TRUE: No EOT control character is sent after reception of an ETX control character.****FALSE: The control sends an EOT control character after reception of an ETX control character.****Further information:** "Serial interfaces on the TNC 640", Page 506**Further information:** User's Manual for **Setup, Testing and Running NC Programs**

---

monitoring (component monitoring)

Monitoring settings for the user

Perform configured error reaction

**TRUE: Error reaction is performed****FALSE: Error reaction is not performed**

Display warning for the component monitor

**TRUE: Warnings are displayed****FALSE: Warnings are not displayed**

---

---

**Parameter settings**

---

General machine information provided by the operator: Information retrievable via an interface

**Custom name (nickname) of the machine**

**Inventory number or ID**

**Photo or image of the machine**

**Machine location**

**Department or division**

**Responsible for the machine**

**Contact e-mail address**

**Contact telephone number**

## 14.2 Pin layout and cables for data interfaces

### V.24/RS-232-C interface for HEIDENHAIN devices



The interface complies with the requirements of EN 50178 for Secure separation from the power grid.

Control		25-pin: VB 274545-xx			9-pin: VB 366964-xx		
Male	Assignment	Male	Color	Female	Female	Color	Female
1	Do not assign	1	White/Brown	1	1	Red	1
2	RXD	3	Yellow	2	2	Yellow	3
3	TXD	2	Green	3	3	White	2
4	DTR	20	Brown	8	4	Brown	6
5	Signal GND	7	Red	7	5	Black	5
6	DSR	6		6	6	Violet	4
7	RTS	4	Gray	5	7	Gray	8
8	CTR	5	Pink	4	8	White/Green	7
9	Do not assign	8	Violet	20	9	Green	9
Housing	External shield	Housing	External shield	Housing	Housing	External shield	Housing

### Ethernet interface RJ45 socket

Maximum cable length:

- 100 m unshielded
- 400 m shielded

Pin	Signal
1	TX+
2	TX-
3	RX+
4	Vacant
5	Vacant
6	RX-
7	Vacant
8	Vacant

## 14.3 Specifications

### Explanation of symbols


**Further information:**

TNC 640 brochure, ID: 892916-xx

TNC 640 HSCI brochure, ID: 896020-xx

- Standard function
- Axis option
- 1** Advanced Function Set 1
- 2** Advanced Function Set 2
- x** Software option, except Advanced Function Set 1 and Advanced Function Set 2

### Specifications

<b>Components</b>	<ul style="list-style-type: none"> <li>■ Main computer</li> <li>■ Operating panel</li> <li>■ Screen with soft keys or touchscreen</li> </ul>
<b>Program memory</b>	<ul style="list-style-type: none"> <li>■ Minimum 21 GB</li> </ul>
<b>Input resolution and display step</b>	<ul style="list-style-type: none"> <li>■ As fine as 0.01 µm for linear axes</li> <li>■ As fine as 0.000 01° for rotary axes</li> </ul>
<b>Input range</b>	<ul style="list-style-type: none"> <li>■ Maximum 999 999 999 mm or 999 999 999°</li> </ul>
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>■ Linear in 4 axes</li> <li>■ Linear in 6 axes max. (option 9)</li> <li>■ Circular in 2 axes</li> <li>■ Circular in 3 axes (option 8)</li> <li>■ Helical: superimposition of circular and straight paths</li> </ul>
<b>Block processing time</b> 3-D straight line without radius compensation	<ul style="list-style-type: none"> <li>■ 0.5 ms</li> </ul>
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>■ Position-loop resolution: signal period of the position encoder/4096</li> <li>■ Position controller cycle time: 200 µs (100 µs with option 49)</li> <li>■ Speed controller cycle time: 200 µs (100 µs with option 49)</li> <li>■ Current controller cycle time: minimum 100 µs (minimum 50 µs with option 49)</li> </ul>
<b>Spindle speed</b>	<ul style="list-style-type: none"> <li>■ max. 100 000 rpm (with 2 pole pairs)</li> </ul>
<b>Error compensation</b>	<ul style="list-style-type: none"> <li>■ Linear and nonlinear axis errors, backlash, reversal peaks during circular movements, thermal expansion</li> <li>■ Static friction, sliding friction</li> </ul>

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**Specifications**

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**Data interfaces**

- One each: RS-232-C/V.24 max. 115 kbit/s
- Extended data interface with LSV-2 protocol for remote operation of the control through the data interface with the TNCremo or TNCremoPlus software
- 2 x Gigabit Ethernet interface 1000BASE-T
- 5 USB ports: 1 front USB 2.0 port and 4 rear USB 3.0 ports)
- x** HEIDENHAIN-DNC for communication between a Windows application and TNC (DCOM interface)
- x** OPC UA NC Server  
Stable and reliable interface for the connection of leading-edge industrial applications

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**Ambient temperature**

- Operation: +5 °C to +40 °C
- Storage: -20 °C to +60 °C

### Input formats and units of control functions

<b>Positions, coordinates, circle radii, chamfer lengths</b>	-99 999.9999 to +99 999.9999 (5, 4: number of digits before and after the decimal point) [mm]
<b>Tool numbers</b>	0 to 32 767.9 (5, 1)
<b>Tool names</b>	32 characters, enclosed by quotation marks in <b>TOOL CALL</b> block. Permitted special characters: # \$ % & . , - _
<b>Detail values for tool compensation</b>	-99.9999 to +99.9999 (2, 4) [mm]
<b>Spindle speeds</b>	0 to 99 999.999 (5, 3) [rpm]
<b>Feed rates</b>	0 to 99 999.999 (5, 3) [mm/min] or [mm/tooth] or [mm/1]
<b>Dwell time in Cycle 9</b>	0 to 3600.000 (4, 3) [s]
<b>Thread pitch in various cycles</b>	-99.9999 to +99.9999 (2, 4) [mm]
<b>Angle for spindle orientation</b>	0 to 360.0000 (3, 4) [°]
<b>Angle for polar coordinates, rotation, tilting the working plane</b>	-360.0000 to 360.0000 (3, 4) [°]
<b>Polar coordinate angles for helical interpolation (CP)</b>	-5400.0000 to 5400.0000 (4, 4) [°]
<b>Datum numbers in Cycle 7</b>	0 to 2999 (4, 0)
<b>Scaling factor in Cycles 11 and 26</b>	0.000001 to 99.999999 (2, 6)
<b>Miscellaneous functions M</b>	0 to 9999 (4, 0)
<b>Q parameter numbers</b>	0 to 1999 (4, 0)
<b>Q parameter values</b>	-999 999 999.999999 to +999 999 999.999999 (9, 6)
<b>Surface-normal vectors N and T with 3-D compensation</b>	-9.99999999 to +9.99999999 (1, 8)
<b>Labels (LBL) for program jumps</b>	0 to 65535 (5, 0)
<b>Labels (LBL) for program jumps</b>	Any text string in quotes ("")
<b>Number of program-section repeats REP</b>	1 to 65 534 (5, 0)
<b>Error number for Q parameter function FN 14</b>	0 to 1199 (4, 0)

## User functions

User functions	Standard	Option	Meaning
<b>Short description</b>	✓		Basic version: 3 axes plus closed-loop spindle
		0-7 77 78	A total of 14 additional NC axes or 13 additional NC axes plus second spindle
	✓		Digital current and speed control
<b>Program entry</b>	✓		In HEIDENHAIN Klartext format and ISO (G codes)
		42	Importing of contours or machining positions from CAD files (STP, IGS, DXF) and saving them as a Klartext contour program or Klartext point table
<b>Position entry</b>	✓		Nominal positions for lines and arcs in Cartesian coordinates or polar coordinates
	✓		Incremental or absolute dimensions
	✓		Display and entry in mm or inches
<b>Tool compensation</b>	✓		Tool radius in the working plane and tool length
	✓		Radius-compensated contour look-ahead for up to 99 NC blocks (M120)
		9	Three-dimensional tool-radius compensation for changing tool data without having to recalculate an existing NC program
<b>Tool tables</b>	✓		Multiple tool tables with any number of tools
<b>Constant contour speed</b>	✓		With respect to the path of the tool center
	✓		With respect to the cutting edge
<b>Parallel operation</b>	✓		Creating an NC program with graphical support while another NC program is being run
<b>3D machining</b>	✓		Motion control with highly smoothed jerk
		9	3D tool compensation through surface-normal vectors
		9	Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool location point, i.e. the tool tip or tool center point (TCPM = tool center point management)
		9	Keeping the tool normal to the contour
		9	Tool radius compensation perpendicular to traversing and tool direction
		92	3D radius compensation depending on the tool's contact angle
<b>Rotary table machining (Advanced Function Set 1)</b>		8	Programming of cylindrical contours as if in two axes
		8	Feed rate in distance per minute

User functions	Standard	Option	Meaning	
<b>Contour elements</b>	✓		Straight line	
	✓		Chamfer	
	✓		Circular path	
	✓		Circle center	
	✓		Circle radius	
	✓		Tangentially connected arc	
	✓		Rounded corners	
<b>Approaching and departing the contour</b>	✓		Via straight line: tangential or perpendicular	
	✓		Via circular arc	
<b>FK free contour programming</b>	✓		FK free contour programming in HEIDENHAIN Klartext format with graphic support for workpiece drawings not dimensioned for NC	
<b>Program jumps</b>	✓		Subprograms	
	✓		Program section repeats	
	✓		Calling any NC program	
<b>Machining cycles</b>	✓		Cycles for drilling, and conventional and rigid tapping	
	✓		Cycles for pecking, reaming, boring, and counterboring	
	✓		Cycles for milling internal and external threads	
	✓		Roughing and finishing rectangular and circular pockets	
	✓		Roughing and finishing rectangular and circular studs	
	✓		Point patterns for circles, lines, and DataMatrix codes	
	✓		Cycles for clearing level and inclined surfaces	
	✓		Cycles for milling linear and circular slots	
	✓		Engraving	
	✓		Contour pocket	
	✓		Contour train	
			50	Cycles for turning operations
			158	
		156	Cycles for jig grinding and dressing	
✓			OEM cycles (special machining cycles developed by the machine manufacturer) can also be integrated	
<b>Coordinate transformation</b>	✓		Datum shift, rotation, mirroring	
	✓		Scaling factor (axis-specific)	
		8	Tilting the working plane (Advanced Function Set 1)	



User functions	Standard	Option	Meaning
<b>Q parameters</b>	✓		Mathematical functions: =, +, -, *, sin $\alpha$ , cos $\alpha$ , root
Programming with variables	✓		Logical operations (=, $\neq$ , <, >)
	✓		Calculating with parentheses
	✓		tan $\alpha$ , arc sin, arc cos, arc tan, $a^n$ , $e^n$ , ln, log, absolute value of a number, constant $\pi$ , negation, truncation of digits before or after the decimal point
	✓		Functions for calculation of circles
	✓		Functions for text processing
<b>Programming aids</b>	✓		Calculator
	✓		Color highlighting of syntax elements
	✓		Complete list of all current error messages
	✓		Context-sensitive help function
	✓		Graphic support for the programming of cycles
	✓		Comment and structure blocks in the NC program
<b>Teach-In</b>	✓		Actual positions can be transferred directly to the NC program
<b>Test graphics</b>	✓		Graphic simulation before a program run, even while another NC program is being run
Display modes	✓		Plan view / projection in 3 planes / 3D view / 3D line graphic
	✓		Detail enlargement
<b>Programming graphics</b>	✓		In the Programming mode, the contours of the NC blocks are drawn on screen while they are being entered (2D pencil-trace graphics), even while another NC program is being run
<b>Program-run graphics</b>	✓		Graphic simulation of real-time machining in plan view / projection in 3 planes / 3D view
<b>Machining time</b>	✓		Calculation of machining time in the <b>Test Run</b> operating mode
	✓		Display of the current machining time in the Program Run operating modes
<b>Preset management</b>	✓		For saving any datums
<b>Returning to the contour</b>	✓		Block scan in any NC block in the NC program, returning the tool to the calculated nominal position to continue machining
	✓		NC program interruption, contour departure and return
<b>Datum tables</b>	✓		Multiple datum tables for storing workpiece-specific datums
<b>Touch probe cycles</b>	✓		Calibrating the touch probe
	✓		Compensation of workpiece misalignment, manual or automatic
	✓		Presetting, manual or automatic
	✓		Automatically measuring workpieces
	✓		Cycles for automatic tool measurement
	✓		Cycles for automatic kinematics measurement



For a detailed overview of the user functions, see the brochure for the TNC 640. You can find the brochures related to the product range of CNC controls in the download area of the HEIDENHAIN website.

## Accessories

### Accessories






<b>Electronic handwheels</b>	<ul style="list-style-type: none"> <li>■ HR 510: Portable handwheel</li> <li>■ HR 550FS: Portable radio handwheel with display</li> <li>■ HR 520: Portable handwheel with display</li> <li>■ HR 130: Panel-mounted handwheel</li> <li>■ HR 150: Up to three panel-mounted handwheels via handwheel adapter HRA 110</li> </ul>
<b>Touch probes</b>	<ul style="list-style-type: none"> <li>■ TS 248: workpiece touch trigger probe with cable connection</li> <li>■ TS 260: workpiece touch trigger probe with cable connection</li> <li>■ TS 460: workpiece touch trigger probe with infrared or radio transmission</li> <li>■ TS 642: workpiece touch trigger probe with infrared transmission</li> <li>■ TS 740: high-precision workpiece touch trigger probe with infrared transmission</li> <li>■ TS 760: high-precision workpiece touch trigger probe with infrared and radio transmission</li> <li>■ TT 160: tool touch trigger probe</li> <li>■ TT 460: tool touch trigger probe with infrared transmission</li> </ul>

### Keycaps for keyboard units and machine operating panels

The keycaps with ID 679843-xx are suitable for use on the following keyboard units and machine operating panels:

- TE 360 (FS)
- TE 7xx (FS)
- MB 72x (FS)

#### Keycaps for alphabetic keyboard

								
ID 679843	-	-	-	-F4	-	-	-F6	-


#### Keycaps for operating aids

						
ID 679843	-	-36	-	-	-	-










#### Keycaps for operating modes

								
ID 679843	-	-	-66	-	-	-	-	-





**Keycaps for NC dialog**

	
ID 679843	-D6

**Keycaps for axis input and value input**

									
	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
ID 679843	-C8	-D3	-53	-32	-31	-	-	-54	-88







































































									
ID 679843	-	-	-	-	-	-E2	-	-	-

				
	-	Orange	Orange	Orange
ID 679843	-	-55	-C9	-D4

**Keycaps for navigation**

		
ID 679843	-42	-41









**Keypcaps for machine functions**



ID 679843	 IV+	 Z+	 Y+	 V+	 VI+	 X+			 Y-
	-09	-07	-05	-11	-13	-03	-16	-17	-06
ID 679843	 IV-	 VI-			 FN 1				
	-10	-14	-23	-22	-24	-29	-02	-21	-20
ID 679843	 FN 2			 FN 3			 Red	 Green	 X-
	-25	-28	-01	-26	-27	-30	-57	-56	-04
ID 679843		 Z-	 V-	 +	 -				
	-15	-08	-12	-59	-60	-40	-73	-76	-74
ID 679843						 C+		 C-	
	-C6	-75	-46	-47	-F2	-67	-51	-68	-99
ID 679843	 W+	 W-	 Red	 A+	 A-	 B+	 B-	 Red	 Red
	-B8	-B7	-45	-69	-70	-B2	-B1	-52	-18
ID 679843	 Green	 Red	 Red						
	-19	-	-	-	-	-	-	-	-
ID 679843				 Y-	 Y+	 Z+	 Z-	 Y'	 Y'
	-	-	-	-43	-44	-91	-92	-93	-94
ID 679843	 U-	 U+	 Y-	 Y+	 Z+	 Z-	 X-	 X+	 X'
	-B3	-B4	-B5	-B6	-B9	-C1	-C2	-C3	-C4
ID 679843	 U-	 U+	 Y-	 Y+	 Z+	 Z-	 X-	 X+	 X'
	-C5	-D9	-E1	-61	-62	-63	-64	-A2	-A3
ID 679843	 FCT A	 FCT B		 FCT C					
	-95	-96	-A1	-C7	-A4	-A5	-A6	-A9	-E3

									
ID 679843	-E4	-E6	-E7	-E8	-48	-49	-50	-65	-71 Green

									
ID 679843	-D8 Green	-90 Green	-89 Red	-D7 Red	-72	-F3	-97	-98	-E5

**Other keycaps**

									
ID 679843	-33	-34	-35 Orange	- Green	- Red	-38	-39	-A7	-A8

		
ID 679843	-D5	-F5

**i** If you need keycaps with additional symbols, please contact HEIDENHAIN.

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# HEIDENHAIN

## DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

FAX +49 8669 32-5061

info@heidenhain.de

**Technical support** FAX +49 8669 32-1000

**Measuring systems** ☎ +49 8669 31-3104  
service.ms-support@heidenhain.de

**NC support** ☎ +49 8669 31-3101  
service.nc-support@heidenhain.de

**NC programming** ☎ +49 8669 31-3103  
service.nc-pgm@heidenhain.de

**PLC programming** ☎ +49 8669 31-3102  
service.plc@heidenhain.de

**APP programming** ☎ +49 8669 31-3106  
service.app@heidenhain.de

www.heidenhain.com

www.klartext-portal.com

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## Touch probes and vision systems

HEIDENHAIN provides universal, high-precision touch probe systems for machine tools, for example for the exact determination of workpiece edge positions and for tool measurement. Proven technology, such as a wear-free optical sensor, collision protection, or integrated blower/flusher jets for cleaning the measuring point ensure the reliability and safety of the touch probes when measuring workpieces and tools. For even higher process reliability, the tools can be monitored conveniently with the vision systems and tool-breakage sensor from HEIDENHAIN.



For more details on touch probes and vision systems:

[www.heidenhain.com/products/touch-probes-and-vision-systems](http://www.heidenhain.com/products/touch-probes-and-vision-systems)

