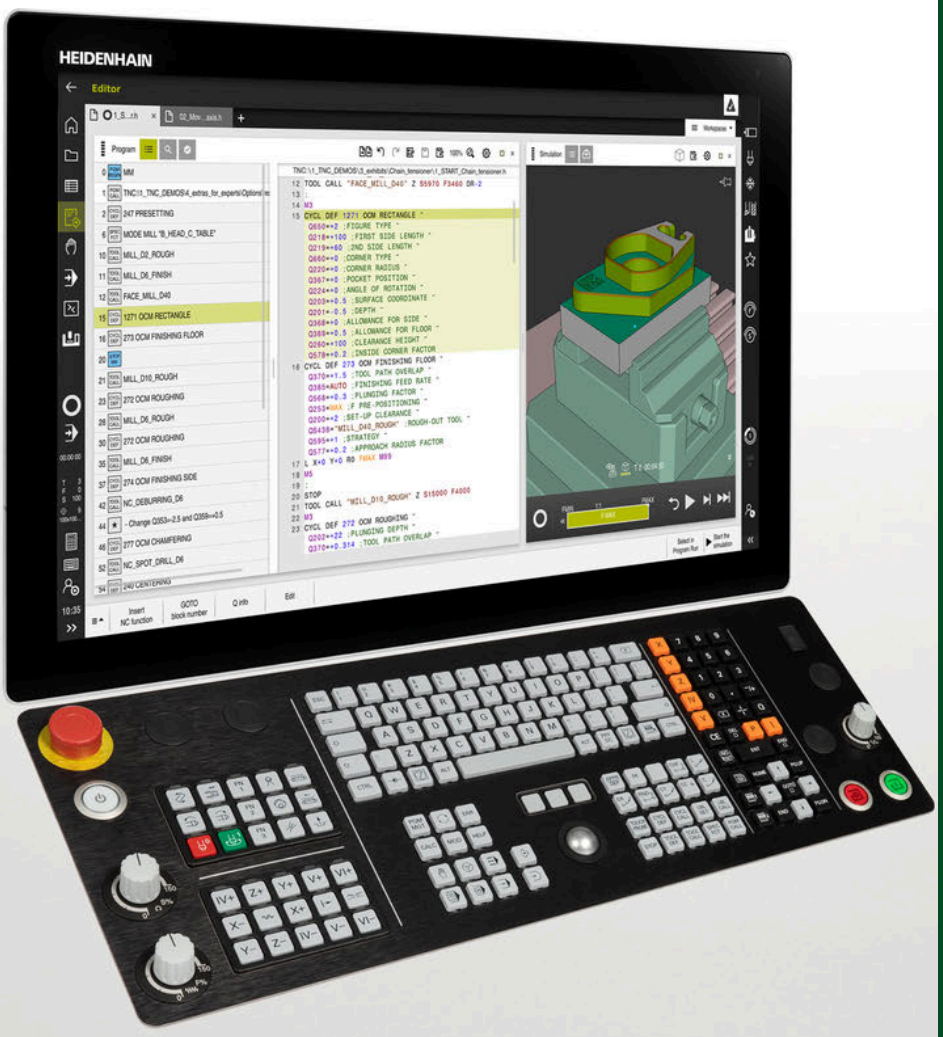
HEIDENHAIN



TNC7
TNC7 basic

Contouring Controls for Milling Machines, Milling-Turning Machines and Machining Centers

Information for Machine Manufacturers

10/2024

General information

System test

Controls, power modules, motors and encoders from HEIDENHAIN are usually integrated as components into complete systems. In such cases, comprehensive testing of the complete system is required, irrespective of the specifications of the individual devices.

Parts subject to wear

Controls from HEIDENHAIN contain parts subject to wear, such as a backup battery and fan.

Standards

Standards (ISO, EN, etc.) apply only where explicitly stated in the catalog.

Note

Intel, Intel Xeon, Core, and Celeron are registered trademarks of Intel Corporation.

Validity

The features and specifications described here apply for the following control and NC software versions:

TNC7/TNC7 basic with NC software versions
817620-18 (requires an export license in accordance with Annex I of the EU Dual-Use Regulation)
817621-18 (not covered by Annex I of the EU Dual-Use Regulation)

Requirements

Some of these specifications require particular machine configurations. Please note also that, for some functions, a special PLC program must be created.

Functional safety (FS)

If no explicit distinction is made between standard and FS components (FS = functional safety), then the data and other information apply to both versions (e.g., TE 361, TE 361 FS).

Components for which there is also a version with functional safety bear the identifier "(FS)" at the end of the product designation (e.g., UEC 3xx (FS)).

Use of this brochure

This brochure is a decision-making aid for selecting HEIDENHAIN components. Further documents are required for project planning (see "Technical documentation", Page 125).

Software options

Software options are functions that are integrated in the control and that allow you to tailor the feature range of the TNC7/TNC7 basic to your actual requirements, including at a later time. Some options, however, must be adapted by the machine manufacturer. Options are conveniently enabled via a keyword. The software options are saved on the SIK plug-in board. The TNC7/TNC7 basic can be operated with the present SIK or, in the future, with the new SIK2. For more information about software options, hardware enhancements and software (PC tools), see the *Options and Accessories for TNC Controls* brochure (ID 827222).

Availability of SIK2

TNC7	NC software version 81762x-18 SP1 and later
TNC7 basic	NC software version 817621-18 SP1 and later

Table of contents

Please note the page references in the tables with the specifications.

TNC contouring controls with drive system from HEIDENHAIN

TNC7 Contouring control designed for complex machining centers with functions for milling, turning and grinding	**TNC7 basic** Contouring control for milling, drilling and boring machines, and machining centers (4+1 and 3+2 machining)
Up to 24 control loops, including up to 4 of them as spindles	Up to 8 control loops, including up to 2 of them as spindles

- For operation with HEIDENHAIN inverter systems and ideally with HEIDENHAIN motors
- Fully digital with HSCI interface and EnDat interface
- Intuitive multi-touch operational design
- Leading-edge functions combined with the familiarity of HEIDENHAIN Klartext: graphical programing allows beginners and experts alike to rapidly program complex workpieces
- Graphically supported alignment of workholding equipment
- Integrated process monitoring
- New, intuitive machine setup with smart probing functions
- Easy operating solutions for everyday production tasks, including complete integration of program testing with high-resolution simulation of the machining process in the Editor operating mode
- Short block processing time (< 0.5 ms)

Overview tables
Components

Control systems	**TNC7**		**TNC7 basic**	**Page**
	24-inch design	19-inch design	16-inch design	
Main computer	For operating panel			
	MC 366 (Full HD, 1920 x 1080 pixels)	**MC 356** (Full HD, 1920 x 1080 pixels)	**MC 345** (Full HD, 1920 x 1080 pixels)	19
	For electrical cabinet			
	MC 306		–	
Storage medium	**SSDR** or **CFR (CFAST)**		**CFR (CFAST)**	21
NC software license	**SIK component**			22
Monitor	**BF 360** or integrated in MC (Full HD, 1920 x 1080 pixels)	Integrated in MC	Integrated in MC	24
Keyboard	**TE 361** and **TE 361 FS**	**TE 350** and **TE 350 FS**	**TE 340** and **TE 340 FS**	
Machine operating panel	Integrated in TE	Integrated in TE or **MB 350** or **MB 350 FS**	Integrated in TE or **MB 340** or **MB 340 FS**	24
	PLB 600x (HSCI adapter for OEM machine operating panel)			33
PLC inputs/outputs[1]	**PL 6000** consisting of PLB 62xx basic module (system PL) or PLB 61xx (expansion PL) and I/O modules			31
	On UEC and UMC			
Additional modules[1]	**CMA-H** for analog axes/spindles in the HSCI system			34
	Modules for fieldbus systems			
Inverter systems[2]	Compact inverters and modular inverters			
Connecting cables				50

[1] May be necessary depending on the configuration
[2] For more information, refer to the *Inverter Systems for Gen 3 Drives* brochure (ID 1303180-xx)

Please note: The MC main computer does not have any PLC inputs/outputs. Therefore one PL 6000, UEC or UMC is necessary for each control. They feature safety-relevant inputs/outputs as well as the connections for touch probes.

Accessories

Accessory	TNC7	TNC7 basic	Page
Electronic handwheels	• **HR 510, HR 510 FS** portable handwheel • **HR 520, HR 520 FS** portable handwheel with display • **HR 550 FS** portable wireless handwheel with display • **HR 130** panel-mounted handwheel • **HR 180** (up to three panel-mounted handwheels via HRA 180 handwheel adapter)		35
Override controller	**OC 310** endlessly rotating operating element with additional functions		30
Workpiece touch probes[1]	• **TS 460, TS 760** triggering touch probes with radio or infrared transmission • **TS 260, TS 750, TS 150** touch trigger probes with cable connection		
Tool touch probes[1]	• **TT 160** triggering touch probe with cable connection • **TT 460** touch trigger probe with radio or infrared transmission		
Programming station[2]	Control software for PCs for programming, archiving, and training • Single-station license with original control operating panel • Single-station license with operation via virtual keyboard • Network license with operation via virtual keyboard • Demo version with virtual keyboard or PC keyboard—free of charge		
Auxiliary axis control	**PNC 610**		41
Industrial PC	**ITC 362, ITC 362, ITC 352** (additional operating station with touchscreen), **ITC 342** (also as application panel)		39
Vision systems[3]	**VT121, VT 122, VTC** vision systems for tool inspection		
Snap-on keys	For controls and handwheels		44

[1] For more information, see the *Touch Probes for Machine Tools* brochure (ID 1113984-xx)
[2] For more information, see the *Programming Station for TNC Controls* brochure (ID 825930-xx)
[3] For more information, go to *www.heidenhain.com* on the Internet

PC tools	TNC7	TNC7 basic	Page
PLCdesign[1]	PC tool for PLC program development		91
KinematicsDesign[1]	PC tool for creation of kinematic models		83
M3D converter[4]	PC tool for creation of high-resolution collision objects in M3D format		83
TNCremo[2], **TNCremoPlus**[2][3]	PC tool for data transfer (TNCremoPlus with “live” screen)		95
ConfigDesign[1]	PC tool for configuring the machine parameters		87
CycleDesign[1]	PC tool for creating cycle structures		94
TNCscope[1]	PC tool for data recording		87
TNCopt[1]	PC tool for setting up digital control loops		87
IOconfig[1]	PC tool for configuring PLC I/O and fieldbus components		32
RemoteAccess[1][3]	PC tool for remote diagnostics, monitoring and operation		88
RemoTools SDK[1]	Function library for developing customized applications for communication with HEIDENHAIN controls		96
virtualTNC[1][3]	Control component for virtual machines		96
TNCtest[1]	PC tool for creating and performing acceptance tests		89
TNCanalyzer[1]	PC tool for analyzing and evaluating servicing files		89

[1] Available to registered customers for downloading from the Internet
[2] Available to all customers (without registration) for downloading from the Internet
[3] Software release module required
[4] Included in the KinematicsDesign installation package with version 3.1 or later (software release module required)

Specifications

Specifications	TNC7	TNC7 basic	Page
Axes	Up to 24 control loops, of which up to 4 can be configured as spindles	Up to 8 control loops, of which up to 2 can be configured as spindles	64
Rotary axes	Max. 3		
Synchronized axes	✓		
PLC axes	✓		
Main spindle	Milling		
	Max. 4; second, third and fourth spindle can be controlled by PLC alternately with the first	Max. 2; second spindle can be controlled by PLC alternately with the first	71
	Turning		
	Max. 2; milling spindle or lathe spindle activated via NC command	–	
Speed	Max. 60 000 rpm for motors with a single pole pair (with the Double Speed Axes software option: max. 120 000 rpm)		71
Operating mode switchover	✓		71
Position-controlled spindle	✓		71
Oriented spindle stop	✓		71
Gear shifting	✓		71
NC program memory	≈ 21.7 GiB (with 60 GB CFR)		19
	≈ 7.7 GiB (with 30 GB CFR)		
	≈ 189 GiB (with 240 GB SSDR)	–	
Input resolution and display step			64
Linear axes	Down to 0.01 µm		
Rotary axes	Down to 0.000 01°		
Functional safety (FS)	With FS components, SPLC and SKERN		60
For applications with up to	• SIL 2 as per EN 61508 • Category 3, PL d as per EN ISO 13849-1: 2008		
Interpolation	In 4 axes		
	In up to 6 axes with the Advanced Function Set 2 software option (the NC software requires an export license in accordance with Annex I of the EU Dual-Use Regulation)		
Circular	In 2 axes; in 3 axes with the Advanced Function Set 1 software option		
Helical	✓		

Specifications	TNC7	TNC7 basic	Page
Axis feedback control			73
With servo lag	✓		
With feedforward	✓		
Axis clamping	✓		64
Maximum feed rate	$\frac{60000\ \text{rpm}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$ at f_{PWM} = 5000 Hz		64
Cycle times of main computer	**MC**		74
Block processing	< 0.5 ms		75
Cycle times of controller unit	**CC/UEC/UMC**		74
Path interpolation	3 ms		74
Fine interpolation	Applies to f_{PWM} = 5 kHz	*Single-speed:* 0.2 ms *Double-speed:* 0.1 ms (Double Speed Axes software option)	
Position controller			
Speed controller			
Current controller	**f_{PWM}** 3333 Hz 4000 Hz 5000 Hz	**T_{INT}** 150 µs 125 µs 100 µs	
	With the Double Speed Axes software option		
	6666 Hz 8 000 Hz 10 000 Hz 13 333 Hz 16 000 Hz	75 µs 62.5 µs 50 µs 37.5 µs 31.25 µs	
Permissible temperature range	Operation: In electrical cabinet: 5 °C to 40 °C In operating panel: 0 °C to 50 °C Storage: –20 °C to 60 °C		

Interfacing to the machine

Interfacing to the machine	TNC7	TNC7 basic	Page
Error compensation	✓		85
Linear axis error	✓		85
Nonlinear axis error	✓		85
Backlash	✓		85
Reversal spikes during circular movement	✓		85
Hysteresis	✓		85
Thermal expansion	✓		85
Static friction	✓		85
Sliding friction	✓		85
Dynamic compliance during acceleration phases	✓		79
Volumetric compensation with KinematicsComp	✓		86
Integrated PLC	✓		90
Program format	Statement list		90
Program input at the control	✓		90
Program input by PC	✓		90
Symbolic PLC-NC interface	✓		90
PLC memory	≈ 4 GiB		90
PLC cycle time	9 ms to 30 ms (adjustable)		90
PLC inputs/outputs	For the maximum configuration of the PLC system, see Page 58		31
PLC inputs, DC 24 V	Via PL, UEC, UMC		31
PLC outputs, DC 24 V	Via PL, UEC, UMC		31
Analog inputs ±10 V	Via PL		31
Inputs for PT 100 thermistors	Via PL		31
Analog outputs ±10 V	Via PL		31
PLC functions	✓		90
PLC soft keys	✓		90
PLC positioning	✓		90
PLC basic program	✓		93
Integration of applications			91
High-level language programming	Use of the Python programming language in conjunction with the PLC (Python OEM Process software option)		91
User interfaces can be custom-designed	Creation of individualized user interfaces by the machine manufacturer with the Python programming language with Qt/QML. Programs up to a memory limit of 10 MB are enabled in standard mode. More can be enabled via the Python OEM Process software option.		91

Interfacing to the machine	TNC7	TNC7 basic	Page
Setup and diagnostic aids			87
TNCdiag	Software for the analysis of status and diagnostic information of digital drive systems		87
TNCopt	Software for putting digital control loops into service		87
ConfigDesign	Software for creating the machine configuration		87
KinematicsDesign	Software for creating the machine kinematics, initialization of DCM		83
Integrated oscilloscope	✓		87
Trace function	✓		88
API DATA function	✓		88
Table function	✓		88
OLM (online monitor)	✓		88
Log	✓		88
TNCscope	✓		87
Bus diagnostics	✓		89
Data interfaces	✓		
Ethernet	✓		95
USB	✓		95
Protocols			95
Standard data transmission	✓		95
Blockwise data transfer	✓		95

Functions for the user

Function*		TNC7	TNC7 basic
Short description	✓	Basic version: 3 axes plus closed-loop spindle	
	O	20 additional NC axes or, for example, 19 additional NC axes plus second spindle	4 additional NC axes or 3 additional axes plus second spindle
	✓	Digital current and speed control	
Program entry	✓	HEIDENHAIN Klartext	
	O	Direct loading of contours or machining positions from CAD files and saving as Klartext contouring program or point table	
	✓	Programming of contours graphically, and saving as Klartext program	
Position values	✓	Nominal positions for straight lines and arcs in Cartesian coordinates or polar coordinates	
	✓	Incremental or absolute dimensions	
	✓	Display and entry in mm or inches	
Tool compensation	✓	Tool radius in the working plane, and tool length	
	✓	Radius-compensated contour look-ahead for up to 99 blocks (M120)	O
	O	Three-dimensional tool-radius compensation for changing tool data without having to recalculate an existing program	
Tool tables	✓	Multiple tool tables with any number of tools	
Cutting data	✓	Automatic calculation of spindle speed, cutting speed, feed per tooth, and feed per revolution	
Constant contour speed	✓	Relative to the path of the tool center point	
	✓	Based on the tool's cutting edge	
Parallel operation	✓	Creating a program with graphical support while another program is being run	
3D machining	✓	Motion control with smoothed jerk	
	O	3D tool compensation via surface-normal vectors	
	O	Changing the swivel-head angle with the electronic handwheel during program run without affecting the tool tip position (TCPM = Tool Center Point Management)	
	O	Keeping the tool perpendicular to the contour	
	O	Tool radius compensation normal to the tool direction	
	O	Manual traverse in the active tool-axis system	
	O	3D radius compensation depending on the tool's contact angle	–
Rotary table machining	O	Programming of contours on an unrolled cylinder surface	
	O	Feed rate in mm/min	

*) ✓ = function available as a standard feature; O = function available as a software option

Function*		TNC7	TNC7 basic
Turning	O	• Program-controlled switchover between milling and turning • Constant cutting speed • Tool-tip radius compensation • Cycles for roughing, finishing, recessing, thread cutting, and recess turning • Blank form updated in contour cycles • Turning-specific contour elements for recesses and undercuts • Orientation of the turning tool for outside or inside machining • Inclined turning • Speed limiting • Eccentric turning (additionally required: the Synchronizing Functions software option)	–
Contour elements	✓	Straight line	
	✓	Chamfer	
	✓	Circular path	
	✓	Circle center	
	✓	Circle radius	
	✓	Tangentially connecting circular arc	
	✓	Corner rounding	
	O	Recess/Undercut	–
Contour approach and departure	✓	Via straight line: tangential or perpendicular	
	✓	Via circular arc	
Adaptive feed control	O	AFC adapts the contouring feed rate to the current spindle power	
Collision monitoring	O	Dynamic Collision Monitoring (DCM) • Graphic depiction of the active collision objects (high-resolution M3D format) • Tool carrier monitoring • Fixture monitoring	
	O	Dynamic Collision Monitoring Version 2 (DCM v2) Expansion of the functions of the Collision Monitoring software option with the following enhancements • Graphically supported alignment of workholding equipment • Defining a reduced minimum distance between fixture and tool • 3D tool models (ToolShape)	
Process monitoring	O	Process Monitoring: detect deviations in a machining process from a reference operation and react accordingly	–
Graphical programming	✓	Faster programming of complex workpieces	
Program jumps	✓	Subprograms	
	✓	Program-section repeat	
	✓	Any program as a subprogram	

*) ✓ = function available as a standard feature; O = function available as a software option

Function*		TNC7	TNC7 basic
Fixed cycles	✓	Drilling, tapping with a floating tap holder, rigid tapping	
	✓	Peck drilling, reaming, boring, counterboring, centering	
	O	• Area clearance cycles, longitudinal and transverse, paraxial and contour-parallel • Recessing cycles, radial/axial • Radial/axial recess turning cycles (combined recessing and roughing motion)	–
	✓	Milling of internal and external threads	
	O	Turning of internal and external threads	–
	O	Cycles for hobbing and skiving	
	O	Simultaneous turning (roughing and finishing) for turning operations	
	O	Interpolation turning	
	O	Functions for grinding	
	✓	Clearing level and oblique surfaces	
	✓	Multi-operation machining of straight and circular slots	
	✓	Multi-operation machining of rectangular and circular pockets	
	✓	Cartesian and polar point patterns and point patterns for DataMatrix code	
	✓	Contour train, contour pocket	
	✓	Contour slot with trochoidal milling	
	✓	OEM cycles (special cycles developed by the machine manufacturer) can be integrated	
	✓	Engraving cycle: engrave text or numbers in a straight line or on an arc	
	O	OCM cycles (Optimized Contour Milling): optimization of roughing processes	
Coordinate transformations	✓	Shifting, rotating, mirroring, scaling (axis-specific)	
	O	Tilting the working plane, PLANE function	
	O	*Manually definable:* shifts, rotations, and handwheel superimpositioning can be manually defined via global program settings	–
Q parameters Programming with variables	✓	Mathematical functions =, +, –, *, /, sin α, cos α, tan α, arc sin, arc cos, arc tan, a^n, e^n, ln, log, square root of a, square root of $(a^2 + b^2)$	
	✓	Logical operations (=, = /, <, >)	
	✓	Calculating with parentheses	
	✓	Absolute value of a number, constant π, negation, truncation of digits before or after the decimal point	
	✓	Functions for calculation of circles	
	✓	Functions for text processing	
Programming aids	✓	Calculator	
	✓	Complete list of all current error messages	
	✓	Context-sensitive help function for error messages	
	✓	TNCguide: the integrated help system; user information directly available on the TNC7/TNC7 basic; context-sensitive calling possible	
	✓	Graphical support for the programming of cycles	
	✓	Comment and structure blocks in the NC program	
CAD viewer	✓	Display of standardized CAD file formats on the TNC7/TNC7 basic	

*) ✓ = function available as a standard feature; O = function available as a software option

Function*		TNC7	TNC7 basic
CAD Model Optimizer	O	Converting and optimizing CAD models	
Teach-in	✓	Application of actual positions directly in the NC program	
Test graphics Depictions	✓	Graphic simulation before a program run, even while another program is running	
	✓	Plan view / projection in 3 planes / 3D view, also in tilted working plane	
	✓	Detail zoom	
3D line graphics	✓	For verification of programs created offline	
Program-run graphics Display modes	✓	Graphic simulation during real-time machining	
	✓	Plan view / projection in 3 planes / 3D view	
Machining time	✓	Calculation of machining time in the Editor operating mode	
	✓	Display of the current machining time in the Program Run operating modes	
Returning to the contour	✓	Mid-program startup in any block in the program, returning the tool to the calculated nominal position to continue machining	
	✓	Program interruption, contour departure and return	
Preset management	✓	One table for saving any reference points (presets)	
Datum tables	✓	Multiple datum tables for storing workpiece-specific datums	
Pallet tables	✓	Workpiece-oriented execution of pallet tables (with any number of entries for the selection of pallets, NC programs, and datums)	
	O	Planning the production process with Batch Process Manager	
Parallel secondary axes	✓	Compensation of movement in the secondary axes U, V, W through the principal axes X, Y, Z	–
	✓	Movements of parallel axes included in the position display of the associated principal axis (sum display)	–
	✓	Defining the principal and secondary axes in the NC program enables execution on different machine configurations	–
Touch probe cycles	✓	Touch probe calibration	O
	✓	Manual or automatic compensation of workpiece misalignment	O
	✓	Manual or automatic preset setting	O
	✓	Automatic tool and workpiece measurement	O
	O	Automatic measurement and optimization of machine kinematics	
	O	Compensation table for multiple kinematics models	
	O	Cycle for measurement of turning tools	–
Model Aided Setup	O	Graphically supported setup	
Conversational languages	✓	English, German, Czech, French, Italian, Spanish, Portuguese, Dutch, Swedish, Danish, Finnish, Norwegian, Slovenian, Slovak, Polish, Hungarian, Russian (Cyrillic), Romanian, Turkish, Chinese (traditional and simplified), Korean	

*) ✓ = function available as a standard feature; O = function available as a software option

Software options

Option number SIK	Option number SIK2	Software option	ID SIK/ SIK2	Description	TNC7 [1]	TNC7 basic [2]	Page
0	6-01-1 *)	Control Loop Qty.	354540-01/ 1395883-01	Additional control loop	16	18	23
1			353904-01/ 1395883-01		16	18	23
2			353905-01/ 1395883-01		16	18	23
3			367867-01/ 1395883-01		16	18	23
4			367868-01/ 1395883-01		16	–	23
5			370291-01/ 1395883-01		16	–	23
6			370292-01/ 1395883-01		16	–	23
7			370293-01/ 1395883-01		16	–	23
8	1-01-1	Adv. Function Set 1	617920-01/ 1395831-01	Rotary table machining • Programming of cylindrical contours as if in two axes • Feed rate in mm/min	16	18	64
				Coordinate transformations • Tilting the working plane, PLANE function	16	18	65
				Interpolation • Circular in 3 axes with tilted working plane	16	18	
9	4-01-1	Adv. Function Set 2	617921-01/ 1395875-01	**Simultaneous machining** TNC7: 6 axes (requires an export license in accordance with Annex I of the EU Dual-Use Regulation) TNC7 basic: up to 4 axes • Programming the position of the tool independent of the tool orientation (TCPM = Tool Center Point Management, TNC7 basic: in up to 4 axes) • Using vectors to program the tool orientation • 3D tool compensation through surface normal vectors • Tool radius compensation perpendicular to the tool direction at any tool orientation • Manual moving of axes in the active tool coordinate system	16	18	65
17	1-05-1	Touch Probe Functions[3]	634063-01/ 1395851-01	Touch probe cycles • Workpiece misalignment compensation, preset setting • Automatic tool and workpiece measurement • Touch-probe input enabling for non-HEIDENHAIN systems • Automatically enabled upon connection of an SE 661	16	18	94
18	3-03-1	HEIDENHAIN DNC	526451-01/ 1395874-01	Communication with external PC applications over COM component	16	18	96

*) Can be ordered multiple times in the desired quantity. The control automatically takes all enablings into account.
1) NC SW 81762x- and later
2) NC SW 817621- and later
3) Standard feature of the TNC7

Option number		Software option	ID	Description	TNC7 [1]	TNC7 basic [2]	Page
SIK	SIK2		SIK/ SIK2				
21	4-02-1	Adv. Function Set 3[3]	628254-01 1395876-01	Tool compensation • Radius-compensated contour look-ahead for up to 99 blocks (LOOK AHEAD) 3D machining • Superimposing handwheel positioning during program run	16	18	
40	5-03-1	Collision Monitoring	526452-01/ 1395882-01	Dynamic Collision Monitoring (DCM) for defining machine components as collision objects. The TNC7/TNC7 basic monitors the defined collision objects during all machine movements. • Graphic depiction of the active collision objects (high-resolution M3D format) • Tool carrier monitoring • Fixture monitoring	16	18	82
42	1-03-1	CAD Import	526450-01/ 1395847-01	Importing of contours from 2D and 3D models (e.g., STEP, IGES, DXF)	16	18	
44	1-06-1	Global PGM Settings	576057-01/ 1395852-01	Global Program Settings (GPS)	16	–	66
45	2-31-1	Adaptive Feed Contr.	579648-01/ 1395871-01	Adaptive Feed Control (AFC)	16	18	76
46	7-01-1	Python OEM Process	579650-01/ 1395889-01	Execution of Python applications	16	18	91
48	2-01-1	KinematicsOpt	630916-01/ 1395856-01	Touch-probe cycles for the automatic measurement of rotary axes	16	18	85
49	6-02-1	Double Speed Axes	632223-01/ 1395884-01	Short control-loop cycle times for direct drive motors	16	18	74
50	4-03-1	Turning	634608-01/ 1395877-01	Turning functions (mill-turning) • Turning tool management • Tool radius compensation • Switching between milling and turning mode • Turning-specific contour elements • Turning cycle package	16	–	67
52	2-04-1	KinematicsComp	661879-01/ 1395859-01	Spatial compensation of errors in rotary and linear axes (requires an export license in accordance with Annex I of the EU Dual-Use Regulation)	16	–	86
56 to 61	3-02-1*)	OPC UA NC Server	1291434-01 to 1291434-06/ 1395873-01	Connection of an OPC UA application. Enabling of up to 6 connections. Each software option enables one client connection each. Several parallel connections require the use of multiple software options.	16	18	97
77	6-01-1	4 Additional Axes	634613-01/ 1395883-01	Four additional control loops	16	18	23
78	6-01-1	8 Additional Axes	634614-01/ 1395883-01	Eight additional control loops	16	–	23
92	2-02-1	3D-ToolComp	679678-01/ 1395857-01	3D radius compensation based on the contact angle (only with the Advanced Function Set 2 software option)	16	–	86

*) Can be ordered multiple times in the desired quantity. The control automatically takes all enablings into account.
1) NC SW 81762x- and later
2) NC SW 817621- and later
3) Standard feature of the TNC7

Option number		Software option	ID	Description	TNC7 [1]	TNC7 basic [2]	Page
SIK	SIK2		SIK/ SIK2				
93	2-03-1	Ext. Tool Management	676938-01/ 1395858-01	Expanded tool management: • Tooling list (list of all tools of the NC program) • T usage sequence (sequence of all tools inserted during the program)	16	18	
96	7-04-1	Adv. Spindle Interpol.	751653-01/ 1395892-01	Additional function for an interpolated spindle • Interpolation turning, coupling • Interpolation turning, contour finishing	16	–	
131	7-02-1	Spindle Synchronism	806270-01/ 1395890-01	Synchronization of two or more spindles	16	–	96
133	3-01-1	Remote Desk. Manager	894423-01/ 1395872-01	Display and operation of external computer units (e.g., a Windows PC)	16	18	96
135	7-03-1	Synchronizing Functions	1085731-01/ 1395891-01	Advanced synchronization of axes and spindles	16	–	66
140	5-03-2	Collision Monitoring v2	1353266-01/ 1395882-02	Dynamic Collision Monitoring version 2 includes all functions of the Collision Monitoring software option. In addition, this software option offers the following range of functions: • Graphically supported alignment of workholding equipment • Defining a reduced minimum distance between fixture and tool • 3D tool models (ToolShape)	16	18	82
141	2-20-1	Cross Talk Comp.	800542-01/ 1395862-01	CTC: compensation of axis couplings	16	18	79
142	2-21-1	Position Adapt. Contr.	800544-01/ 1395863-01	PAC: position-dependent adaptation of control parameters	16	18	80
143	2-22-1	Load Adapt. Contr.	800545-01/ 1395864-01	LAC: load-dependent adaptation of control parameters	16	18	78
144	2-23-1	Motion Adapt. Contr.	800546-01/ 1395865-01	MAC: motion-dependent adaptation of control parameters	16	18	79
145	2-30-1	Active Chatter Contr.	800547-01/ 1395870-01	ACC: Active Chatter Control	16	18	77
146	2-24-1	Machine Vibr. Contr.	800548-01/ 1395869-01	Damping of machine oscillations to improve workpiece surfaces. The following functions are part of Machine Vibration Control (MVC): • AVD (Active Vibration Damping): Active damping of vibrations in the control loop • FSC (Frequency Shaping Control): Reduction of vibration inducement by means of frequency-based feedforward control	16	18	80

*) Can be ordered multiple times in the desired quantity. The control automatically takes all enablings into account.
1) NC SW 81762x- and later
2) NC SW 817621- and later
3) Standard feature of the TNC7

Option number		Software option	ID	Description	TNC7 [1]	TNC7 basic [2]	Page
SIK	SIK2		SIK/ SIK2				
152	1-04-1	CAD Model Optimizer	1353918-01/ 1395849-01	Conversion and optimization of CAD models • Fixtures • Workpiece blank • Finished part	16	18	83
154	2-05-1	Batch Process Mngr.	1219521-01/ 1395860-01	Batch Process Manager for easy planning and execution of multiple production jobs	16	18	64
155	5-02-1	Component Monitoring	1226833-01/ 1395881-01	Monitoring for component overloading and wear	16	18	84
156	4-04-1	Grinding	1237232-01/ 1395878-01	Grinding and dressing functions • Jig grinding • Switching between normal operation and dressing mode • Reciprocating stroke • Grinding cycles • Tool management for grinding and dressing	16	–	69
157	4-05-1	Gear Cutting	1237235-01/ 1395879-01	Functions for the machining of gear teeth	16	–	68
158	4-03-2	Turning v2	1359635-01/ 1395877-02	Turning functions (mill-turning version 2) • Includes all functions of the Turning software option plus cycles for simultaneous roughing and finishing	16	–	68
159	1-09-1	Model Aided Setup	1364052-01/ 1395855-01	Graphically supported setup	17	18	70
160	6-30-1	Integrated FS: Basic	1249928-01/ 1395886-01	Enables functional safety and four safe control loops	16	18	60
161	6-30-2	Integrated FS: Full	1249929-01/ 1395887-01	Enables functional safety and the maximum number of safe control loops	16	18	60
162 to 166	6-30-2*)	FS Control Loop Qty.	1249930-01 to 1249934-01/ 1395887-01	Additional safe control loop 1 to 5	16	18	60
167	1-02-1	Opt. Contour Milling	1289547-01/ 1395833-01	OCM: optimize roughing processes and fully utilize milling tools with the integrated cutting data calculator	16	18	77
168	5-01-1	Process Monitoring	1302488-01/ 1395880-01	Reference-based monitoring of the machining process	16	–	84
169	6-30-2	FS Control Loop Qty.	1319091-01/ 1395887-01	Enables all FS axis options or control loops. The Integrated FS: Basic software option as well as options 162 to 166 (6-30-2) must already be set.	16	18	60

*) Can be ordered multiple times in the desired quantity. The control automatically takes all enablings into account.
1) NC SW 81762x- and later
2) NC SW 817621- and later
3) Standard feature of the TNC7

HSCI control components
Main computer

Main computer

TNC7	TNC7 basic
The MC main computers feature the following: • Dual RAM • Gbit HSCI interface to the controller unit and to other control components • HDL2 interface to the BF monitor (with electrical cabinet versions) • Four USB 3.0 ports (e.g., to the TE 361 operating panel)	
• Intel high-level processor	• Intel mid-level processor
To be ordered separately and installed in the main computer by the OEM: • The **System Identification Key** (SIK) component for enabling control loops and software options	
• **SSDR** or **CFR (CFast)** storage medium with the NC software	• **CFR (CFast)** storage medium with the NC software
The following HSCI components are required for operation: • MC main computer • Controller unit • **PLB 62xx** or **PLB 62xx FS** PLC I/O unit (system PL; integrated in UxC)	
• TE 350, TE 350 FS or TE 361, TE 361 FS with integrated machine operating panel or MB 350, MB 350 FS	• TE 340, TE 340 FS with integrated machine operating panel or MB 340, MB 340 FS

Interfaces

The MC main computers are equipped with USB 3.0 and Ethernet ports. Connection to PROFIBUS DP or PROFINET IO is optionally possible via the individual additional modules or a combined PROFIBUS DP / PROFINET IO module.

Export license

The main computer is not covered by Annex I of the EU Dual-Use Regulation. Only the easily replaceable storage medium might require an export license in accordance with Annex I of the EU Dual-Use Regulation, depending on the software version.

Versions

TNC7	TNC7 basic
Various versions of the MC main computer are available: • Installation into the **operating panel**: The MC main computer and the BF monitor form a single unit that is installed directly into the operating panel. With the exception of the power supply line, only one HSCI connecting cable to the electrical cabinet is needed.	
• Installation into the **electrical cabinet**: The MC 306 main computer is installed in the electrical cabinet. HSCI, USB, and HDL2 cables to the operating panel are required as control lines.	–

MC 366 with main computer installed on the back (TNC7)

MC 306 (TNC7)

MC 345 (TNC7 basic)

	Installation type	Storage medium	Processor	RAM	Power consumption*)	Mass	ID
TNC7							
MC 306	Electrical cabinet	SSDR or CFR (CFast)	Intel high-level CPU	8 GB	≈ 65 W	≈ 4.2 kg	1180045-xx
MC 366[1)]	Operating panel (24-inch)	SSDR or CFR (CFast)	Intel high-level CPU (var. -02)	8 GB	≈ 75 W	≈ 9.9 kg	1246689-02
MC 366 with TNC7 logo[1)]	Operating panel (24-inch)	SSDR or CFR (CFast)	Intel high-level CPU	8 GB	≈ 75 W	≈ 10 kg	1246689-03
MC 356[1)]	Operating panel (19-inch)	SSDR or CFR (CFast)	Intel high-level CPU	8 GB	≈ 85 W	≈ 5 kg	1372539-01
TNC7 basic							
MC 345[1)]	Operating panel (16-inch)	CFR (CFast)	Intel mid-level CPU	8 GB	≈ 70 W	≈ 6.6 kg	1398470-01

*) Test conditions: Windows 7 (64-bit) operating system, 100% processor load, interfaces not loaded, no fieldbus module

1) Fulfills IP54 when installed

Software options

Software options allow the performance of the control to be adapted to one's actual needs at a later time. The software options are described on page 15. They are enabled by entering keywords based on the SIK number, and are saved in the SIK component. The SIK number must therefore be provided when ordering new options.

Storage medium

The storage medium is removable and must be ordered separately from the main computer. It contains the NC software 81762x-xx. The NC software is based on the HEIDENHAIN HEROS 5 operating system.

TNC7

	Operating panel			Electrical cabinet		
	SSDR	CFR (CFast)		SSDR	CFR (CFast)	
	240 GB	60 GB	30 GB	240 GB	60 GB	30 GB
Free PLC memory space	≈ 4 GiB	≈ 4 GiB	≈ 4 GiB	≈ 4 GiB	≈ 4 GiB	≈ 4 GiB
Free NC memory space	≈ 189 GiB	≈ 21.7 GiB	≈ 7.7 GiB	≈ 189 GiB	≈ 21.7 GiB	≈ 7.7 GiB
For main computer	MC 356 and MC 366 (MC 366 without logo starting with var. -02)	MC 356 and MC 366		MC 306		
Requires an export license in accordance with Annex I of the EU Dual-Use Regulation	1356155-1x	1397531-1x	1404408-1x	1356152-1x	1397531-1x	1404408-1x
Not covered by Annex I of the EU Dual-Use Regulation	1356155-6x	1397531-6x	1404408-6x	1356152-6x	1397531-6x	1404408-6x

TNC7 basic

	Operating panel	
	CFR (CFast)	
	60 GB	30 GB
Free PLC memory space	≈ 4 GiB	≈ 4 GiB
Free NC memory space	≈ 21.7 GiB	≈ 7.7 GiB
Not covered by Annex I of the EU Dual-Use Regulation	1397531-6x	1404408-6x

SSDR for operating panel

SSDR MC 306

SIK component

The SIK component (SIK or SIK2) contains the **NC software license** for enabling control loops and software options. It provides the main computer with an unambiguous ID code—the SIK number. The SIK component is ordered and shipped separately. It must be inserted into a slot provided for it in the MC main computer.

The SIK component with the NC software license exists in different versions based on the enabled control loops and software options. Additional control loops and software options can be enabled at a later time by entering a keyword (SIK) or by activating an enabling file (SIK2) on the control. HEIDENHAIN will give you the keyword or the enabling file based on your SIK number.

When ordering, please provide the SIK number of your control. When the keywords are entered on the control, or when the enabling file is activated, this action is saved in the SIK component, thereby enabling and activating the software options. Should servicing become necessary, the SIK component must be inserted into the replacement control in order to enable all of the required software options.

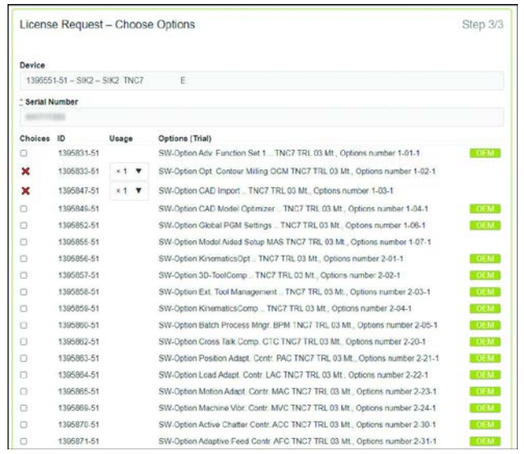
The TNC7 and the TNC7 basic can be operated with the SIK used until now as well as with the new SIK2. The SIK2 is inserted just like the SIK, but offers the following advantages:

- Simpler option activation via an enabling file
- Simultaneous enabling of several options
- Counting options, such as for control loops
- Web application for the temporary activation of trial options by the machine manufacturer

SIK2 component

SIK2

With the **HEIDENHAIN-Portal-License Key** web application, an enabling file for the enabling of software options is transmitted to the control. Multiple options can thus be enabled simultaneously.



NC software license and enabling of control loops depending on the CC

SIKs for the TNC7/TNC7 basic are created **on demand**. Groups of part numbers were prepared as follows for this. Please refer to your contact person at HEIDENHAIN as needed.

TNC7

	SIK	SIK2
Variants for using software options to enable functional safety for Gen 3 components	ID 1359069-xx	ID 1396551-xx
Variants identical to ID 674989-xx for the following safety designs: Gen 3 drives external safety, and 1xx inverter systems for integrated and external safety	ID 1359639-xx	ID 1426883-xx

TNC7 basic

	SIK	SIK2
Contains the NC software license for enabling control loops and software options	ID 1396589-xx	ID 1409641-xx

Enabling further control loops

Further control loops can be enabled either as groups or individually. The combination of control-loop groups and individual control loops makes it possible to enable any number of control loops. On the TNC7, up to 24 control loops are possible. On the TNC7 basic, up to 8 control loops are possible.

SIK

Software option	TNC7	TNC7 basic	SIK ID
Control-loop groups			
77	4 additional control loops		634613-01
78	8 additional control loops	–	634614-01
Individual control loops			
0	1st Additional Control Loop		354540-01
1	2nd Additional Control Loop		353904-01
2	3rd Additional Control Loop		353905-01
3	4th Additional Control Loop		367867-01
4	5th Additional Control Loop	–	367868-01
5	6th Additional Control Loop	–	370291-01
6	7th Additional Control Loop	–	370292-01
7	8th Additional Control Loop	–	370293-01

SIK2

With a SIK2, the Control Loop Quantity software option (ID 1395883-01) can be ordered multiple times, with the desired quantity. The control automatically takes all enablings into account.

24-inch screen and keyboard unit (TNC7)

BF 360 monitor

- Supply voltage: DC 24 V/≈ 35 W
- **24-inch**; 1920 x 1024 pixels
- HDL2 interface to the MC in the electrical cabinet
- Integrated USB hub with 4 USB ports on the rear
- Display for multi-touch operation
- Fulfills IP54 when installed

BF 360 ID 1275079-xx
Mass ≈ 8.6 kg

BF 360

TE 361 keyboard unit with an integrated machine operating panel

General data:
- Suitable for BF 360, MC 366 and ITC 362
- All keycaps are exchangeable
- USB interface to the MC main computer
- USB port with cover cap
- Trackball

TE 361

Control keyboard (long stroke):
- Alphabetic keyboard block
- Axis input and value input block
- Programming block
- Operating modes block
- Operating aids block
- Navigation block

Specifications:
- Supply voltage: DC 24 V/≈ 4 W
- Fulfills IP54 when installed (all keycaps must be in place)
- Integrated machine operating panel with 30 exchangeable, freely assignable keycaps with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindle stop, 16 further function keys)
- Other operating elements: NC start key[1)], NC stop key[1)], control voltage on/off key[1)], emergency stop button
- Override potentiometers for feed rate, rapid traverse, and spindle speed (all override potentiometers are fitted with an adapter so that they can be mounted in any 22.5 mm opening)
- 4 free openings (22.5 mm) for operating elements with a mounting diameter of 22.3 mm
- Interface for HR handwheel
- HSCI interface (Gbit HSCI)
- TE 361: 8 free PLC inputs and 8 free PLC outputs
  TE 361 FS: 4 free FS inputs and 8 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

[1)] Illuminated keys, addressable via PLC

TE 361 ID 1313011-xx
TE 361 FS ID 1326583-xx
Mass ≈ 3.9 kg

19-inch design: keyboard unit and machine operating panel (TNC7)

TE 350 keyboard unit with an integrated machine operating panel

TE 350

General data:
- Suitable for MC 356 and ITC 352
- All keycaps are exchangeable
- USB interface to the MC main computer
- USB port with cover cap
- Trackball

Control keyboard (long stroke):
- Alphabetic keyboard block
- Axis input and value input block
- Programming block
- Operating modes block
- Operating aids block
- Navigation block

Specifications:
- Supply voltage: DC 24 V/≈ 4 W
- Fulfills IP54 when installed (all keycaps must be in place)
- Integrated machine operating panel with 30 exchangeable, freely assignable keycaps with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindle stop, 16 further function keys)
- Other operating elements: NC start key[1)], NC stop key[1)], control voltage on/off key[1)], emergency stop button
- Override potentiometers for feed rate, rapid traverse, and spindle speed (all override potentiometers are fitted with an adapter so that they can be mounted in any 22.5 mm opening)
- 4 free openings (22.5 mm) for operating elements with a mounting diameter of 22.3 mm
- Interface for HR handwheel
- HSCI interface (Gbit HSCI)
- TE 350: 8 free PLC inputs and 8 free PLC outputs
  TE 350 FS: 4 free FS inputs and 8 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

[1)] Illuminated keys, addressable via PLC

TE 350 ID 1370209-xx
TE 350 FS ID 1370220-xx
Mass ≈ 4.1 kg

MB 350 machine operating panel

General data:
- Suitable for MC 356 and ITC 352
- All keycaps are exchangeable
- USB port with cover cap

MB 350

Specifications:
- Supply voltage: DC 24 V/≈ 4 W
- Fulfills IP54 when installed (all keycaps must be in place)
- 30 exchangeable, freely assignable keycaps with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindle stop, 16 further function keys)
- Other operating elements: NC start key[1], NC stop key[1], control voltage on/off key[1], emergency stop button
- Override potentiometers for feed rate, rapid traverse, and spindle speed (all override potentiometers are fitted with an adapter so that they can be mounted in any 22.5 mm opening)
- 5 free openings (22.5 mm) for operating elements with a mounting diameter of 22.3 mm
- Interface for HR handwheel
- HSCI interface (Gbit HSCI)
- MB 350: 8 free PLC inputs and 8 free PLC outputs
  MB 350 FS: 4 free FS inputs and 8 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

[1] Illuminated keys, addressable via PLC

MB 350	ID 1372719-xx
MB 350 FS	ID 1374704-xx
Mass	≈ 2.2 kg

16-inch design: keyboard unit and machine operating panel (TNC7 basic)

TE 340 keyboard unit with an integrated machine operating panel

General data:
- Suitable for MC 345 and ITC 342
- All keycaps are exchangeable
- USB interface to the MC main computer
- USB port with cover cap
- Trackball

Control keyboard (long stroke):
- Alphabetic keyboard block
- Axis input and value input block
- Programming block
- Operating modes block
- Operating aids block
- Navigation block

TE 340

Specifications:
- Supply voltage: DC 24 V/≈ 4 W
- Fulfills IP54 when installed (all keycaps must be in place)
- Integrated machine operating panel with 30 exchangeable, freely assignable keycaps with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindle stop, 16 further function keys)
- Other operating elements: NC start key[1], NC stop key[1], control voltage on/off key[1], emergency stop button
- Override potentiometers for feed rate and spindle speed (the override potentiometers are fitted with an adapter so that they can be mounted in any 22.5 mm opening)
- 4 free openings (22.5 mm) for operating elements with a mounting diameter of 22.3 mm
- Interface for HR handwheel
- HSCI interface (Gbit HSCI)
- TE 340: 8 free PLC inputs and 8 free PLC outputs
  TE 340 FS: 4 free FS inputs and 8 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

[1] Illuminated keys, addressable via PLC

TE 340	ID 1320800-xx
TE 340 FS	ID 1352798-xx
Mass	≈ 3.68 kg

MB 340 machine operating panel

General data:
- Suitable for MC 345 and ITC 342
- All keycaps are exchangeable
- USB port with cover cap

MB 340

Specifications:
- Supply voltage: DC 24 V/≈ 4 W
- Fulfills IP54 when installed (all keycaps must be in place)
- 30 exchangeable, freely assignable keycaps with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindle stop, 16 further function keys)
- Other operating elements: NC start key[1], NC stop key[1], control voltage on/off key[1], emergency stop button
- Override potentiometers for feed rate and spindle speed (the override potentiometers are fitted with an adapter so that they can be mounted in any 22.5 mm opening)
- 4 free openings (22.5 mm) for operating elements with a mounting diameter of 22.3 mm
- Interface for HR handwheel
- HSCI interface (Gbit HSCI)
- MB 340: 8 free PLC inputs and 8 free PLC outputs
  MB 340 FS: 4 free FS inputs and 8 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

[1] Illuminated keys, addressable via PLC

MB 340	ID 1388531-xx
MB 340 FS	ID 1388532-xx
Mass	≈ 1.94 kg

Keycap puller and installation kit

Keycap puller

Tool for exchanging the keycaps of the following keyboard units and machine operating panels. ID 1394129-xx

Keyboard units						Machine operating panels	
TE 340	TE 340 FS	TE 350	TE 350 FS	TE 361	TE 361 FS	MB 3x0	MB 3x0 FS

Optional installation kit

Accessory kit for fastening with mounting braces (set of 6 pieces; mounting width: 100 mm).
Up to six mounting braces can be attached.

Main computer	Monitor	Keyboard unit	Operating station	Machine operating panel	ID
• MC 366	• BF 360	–	• ITC 362	–	1257299-xx
• MC 356 • MC 345	–	• TE 361 (FS) • TE 350 (FS) • TE 340 (FS)	• ITC 352 • ITC 342	• MB 350 • MB 340	1278826-xx

OC 310 override controller

OC 310

The OC 310 override controller is an endlessly rotating operating element with additional functions compared to a usual override potentiometer. In connection with the **Conditional stop** function, the OC 310 provides for intuitive, convenient and one-handed initial NC program execution. You can define breakpoints in the NC program at which the control will stop during program run (such as before a tilting function, when the tool is changed, or when the machining feed rate changes to rapid traverse, etc.).

- Dial for manipulating the feed rate and/or rapid traverse
- Integrated, green backlit NC Start button for starting NC programs
- Definition of conditional stops in the NC program through breakpoints
- Resume the NC program by increasing the override
- Multicolor LED ring indicating the override value:
  - 0%: not illuminated
  - > 0% to 99.5%: white
  - 100%: green
  - > 100.5%: blue
- Receive tactile feedback through vibration, such as for:
  - Minimum feed rate
  - Maximum feed rate
  - 100% feed rate
  - Occurrence of conditional stop
- The OC 310 can detect whether it is turned down with a sudden jerk, and then automatically sets the override value to 0%, even if the override controller has not reached that position
- IP54 when installed

OC 310 ID 1410803-xx
Mass ≈ 0.14 kg

Requirements

	TNC7		TNC7 basic	
NC software	81762x-18 and later		817621-18 and later	
Keyboard unit	TE 350	ID 1370209-02 and later	TE 340	ID 1320800-02 and later
	TE 350 FS	ID 1370220-02 and later	TE 340 FS	ID 1352798-02 and later
	TE 361	ID 1313011-03 and later		
	TE 361 FS	ID 1326583-03 and later		
Machine operating panel	MB 350	ID 1372719-xx	MB 340	ID 1388531-xx
	MB 350 FS	ID 1374704-xx	MB 340 FS	ID 1388532-xx

PL 6000 PLC input/output systems with HSCI

PL 6000

The PLC inputs and outputs are available via external modular PL 6000 PLC input/output systems. They consist of a basic module and one or more input/output modules. A total maximum of 1000 inputs/outputs is supported. The PL 6000 units are connected to the MC main computer via the HSCI interface. The PL 6000 units are configured with the IOconfig PC tool.

PLB 62xx

Basic modules

Basic modules with an **HSCI interface** exist for 4, 6, 8, and 10 modules. A standard NS 35 rail (DIN 46227 or EN 50022) is used for fastening.

Supply voltage: 24 V DC

System PL with EnDat support

- Required once for each control system (except with UxC)
- Connections for TS and TT touch probes
- TS and TT touch probes with EnDat interface are supported
- *Without FS*: 12 free inputs, 7 free outputs
  With FS: 6 free FS inputs, 2 free FS outputs
- Functional safety (FS) is enabled via SIK options. (See the software options on page 15)
- Slots are equipped with cover strips

Component		ID	Mass	Power consumption
PLB 6204	For 4 I/O modules	1129809-xx	0.60 kg	5 W
PLB 6206	For 6 I/O modules	1129812-xx	0.75 kg	
PLB 6208	For 8 I/O modules	1129813-xx	0.91 kg	
PLB 6210	For 10 I/O modules	1278136-xx	1.01 kg	

Component		ID	Mass	Power consumption
PLB 6204 FS	For 4 I/O modules	1223032-xx	0.60 kg	6 W
PLB 6206 FS	For 6 I/O modules	1223033-xx	0.75 kg	
PLB 6208 FS	For 8 I/O modules	1223034-xx	0.91 kg	
PLB 6210 FS	For 10 I/O modules	1290089-xx	1.01 kg	

Expansion PL

For connection to the system PL to increase the number of PLC inputs/outputs.

Component		ID	Mass	Power consumption
PLB 6104	For 4 I/O modules	1129799-xx	0.45 kg	3.5 W
PLB 6106	For 6 I/O modules	1129803-xx	0.53 kg	
PLB 6108	For 8 I/O modules	1129804-xx	0.61 kg	4 W

Component		ID	Mass	Power consumption
PLB 6104 FS	For 4 I/O modules	1129796-xx	0.45 kg	3.5 W
PLB 6106 FS	For 6 I/O modules	1129806-xx	0.53 kg	
PLB 6108 FS	For 8 I/O modules	1129807-xx	0.61 kg	4 W

I/O modules

There are I/O modules with digital and analog inputs and outputs. For partially occupied basic modules, the unused slots must be occupied by an empty housing.

Component		ID	Mass	Power consumption
PLD-H 16-08-00	I/O module with 16 digital inputs and 8 digital outputs	594243-xx	0.18 kg	1 W
PLD-H 08-16-00	I/O module with 8 digital inputs and 16 digital outputs	650891-xx		
PLD-H 08-04-00 FS	I/O module with 8 digital FS inputs and 4 digital FS outputs	598905-xx		
PLD-H 04-08-00 FS	I/O module with 4 digital FS inputs and 8 digital FS outputs	727219-xx		
PLD-H 04-04-00 HSLS FS	I/O module with 4 digital FS inputs and 4 high-side/low-side FS outputs	746706-xx		
PLA-H 08-04-04	Analog module for PL 6xxx with • 8 analog inputs, ±10 V • 4 analog outputs, ±10 V • 4 analog inputs for PT 100 thermistors	675572-xx		4 W

I/O module for axis enabling

Axis-enabling module for external safety. In combination with the PLB 620x without FS.

Component		ID	Mass	Power consumption
PAE-H 08-00-01	I/O module for the enabling of 8 axis groups	1203881-xx	0.17 kg	1 W

IOconfig (accessory)

PC tool for configuring HSCI and PROFIBUS components.

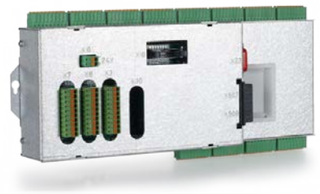
Accessories

HSCI adapter for OEM machine operating panel

PLB 600x

The PLB 600x HSCI adapter is required in order to connect an OEM-specific machine operating panel to the TNC7/TNC7 basic.

- HSCI interface
- Connection for HR handwheel
- Inputs and outputs for keys and key illumination
  - *PLB 6001*: Terminals for 72 PLC inputs / 40 PLC outputs
  - *PLB 6001 FS*: Terminals for 36 FS inputs / 40 PLC outputs
  - *PLB 6002 FS:* Terminals for 4 FS inputs, 64 PLC inputs, and 40 PLC outputs
- Screw fastening or top-hat-rail mounting
- Configuration of the PLC inputs/outputs with the IOconfig PC tool



PLB 6001

PLB 6001	ID 668792-xx
PLB 6001 FS	ID 722083-xx
PLB 6002 FS	ID 1137000-xx
Mass	0.94 kg

Additional modules

Module for analog axes

Digital drive designs sometimes also require analog axes or spindles. The additional module CMA-H 04-04-00 (Controller Module Analog—HSCI) makes it possible to integrate analog drive systems in an HSCI system.

The CMA-H is integrated into the HSCI control system via a slot on the underside of the CC or UEC. Every controller unit has slots for two boards. The CMA-H does not increase the total number of available axes: every analog axis used reduces the number of available digital control loops by one. Analog control loops also need to be enabled on the SIK. The analog control-loop outputs can be accessed only via the NC, not via the PLC.

Additional module for analog axes/spindles:
- Expansion board for the CC or UEC controller units
- 4 analog outputs, ±10 V for axes/spindle
- Spring-type plug-in terminals

CMA-H 04-04-00 ID 688721-xx

CMA-H 04-04-00

Fieldbus systems

An expansion board can be used to provide the TNC7/TNC7 basic with a PROFIBUS or PROFINET interface at any time. The modules are integrated into the control system through a slot on the MC. This makes the connection to an appropriate fieldbus system as master possible. The interface is configured with IOconfig (version 3.0 or higher).

PROFIBUS DP module

- Expansion board for the MC main computer
- Connection for 9-pin D-sub connector (female) to X121

MC 3xx (MC 366 with var. -02 and later) ID 1279074-xx

PROFIBUS DP module

PROFINET IO module

- Expansion board for the MC main computer
- RJ45 connection at X621 and X622

MC 3xx (MC 366 with var. -02 and later) ID 1279077-xx

PROFINET IO module

Combined PROFIBUS DP/ PROFINET IO module

- Expansion board for the MC main computer
- RJ45 connection at X621 (PROFINET IO) and M12 connector at X121 (PROFIBUS DP)
- Additionally connectable terminating resistor for PROFIBUS DP with front LED

MC 3xx (MC 366 with var. -02 and later) ID 1233765-xx

Combined module

Electronic handwheels

Overview

The TNC7/TNC7 basic supports the use of electronic handwheels:
- **HR 550 FS** wireless handwheel or
- **HR 510, HR 510 FS** or **HR 520, HR 520 FS** portable handwheel or
- **HR 130** panel-mounted handwheel or
- Up to three **HR 180** panel-mounted handwheels via the **HRA 180** adapter

Several handwheels can be operated on a single TNC7/TNC7 basic:
- One handwheel at X23 per machine operating panel (integrated in the TE keyboard) or per PLB 600x HSCI adapter for OEM machine operating panels; for the maximum number possible, see Page 59

The mixed operation of handwheels with and without display is not possible. Handwheels with functional safety (FS) are cross-circuit-proof due to special permissive-button logic.

Standards

The devices fulfill the requirements of standard IEC 61010-1 only if the power to the peripheral devices is supplied from a secondary circuit with current limitation as per IEC 61010-1[3rd Ed.], Section 9.4 or with power limitation as per IEC 62368-1[2nd Ed.], Section 6.2.2.5 PS2, or from a Class 2 secondary circuit as specified in UL1310.

In place of IEC 61010-1[3rd Ed.], Section 9.4, the corresponding sections of standards DIN EN 61010-1, EN 61010-1, UL 61010-1, and CAN/CSA-C22.2 No 61010-1 can be applied; in place of IEC 62368-1[2nd Ed.], Section 6.2.2.5, the corresponding sections of standards DIN EN 62368-1, EN 62368-1, UL 62368-1, CAN/CSA-C22.2 No. 62368-1 can be applied.

HR 510

Portable electronic handwheel with
- Keys for actual-position capture and the selection of five axes
- Keys for traverse direction and three preset feed rates
- Three keys for machine functions (see below)
- Emergency stop button and permissive buttons
- Magnetic holding pads

All keys are designed as snap-on keys and can be replaced with other symbols (see *Overview for the HR 510* in *Snap-on keys for the HR*).

Handwheel	Keys	Without detent	With detent
HR 510	NC start/stop, spindle start (for basic PLC program)	ID 1119971-xx	ID 1120313-xx
	FCT A, FCT B, FCT C	ID 1099897-xx	–
	Spindle right/left/stop	ID 1184691-xx	–
HR 510 FS	NC start/stop, spindle start (for basic PLC program)	ID 1120311-xx	ID 1161281-xx
	FCT A, FCT B, FCT C	–	ID 1120314-xx
	Spindle start, FCT B, NC start	–	ID 1119974-xx

Mass: 0.49 kg

HR 520
HR 520 FS
HR 550 FS

Portable electronic handwheels with:
- Display (six-line, monochrome) for the operating mode, actual position value, programmed feed rate, spindle speed, error messages, and soft-key functions (HR 550 FS: battery warning/ charge indicator and field strength)
- Override potentiometers for feed rate and spindle speed
- Selection of axes via keys or soft keys
- Actual position capture
- NC start/stop
- Spindle on/off
- Keys for continuous traverse of the axes
- Soft keys for machine functions of the machine manufacturer
- Emergency stop button and permissive buttons
- 6 exchangeable snap-on keys for PLC functions
- Magnetic holding pads for fastening
- HR 550 FS: vibration alarm when leaving the radio range

Handwheel	Without detent	With detent
HR 520	ID 670302-xx	ID 670303-xx
HR 520 FS functional safety (FS)	ID 670304-xx	ID 670305-xx
Holder	ID 591065-xx	

Mass: 0.62 kg

Handwheel	Without detent	With detent
HR 550 FS functional safety (FS) and radio transmission (range up to 20 m)	ID 1200495-xx	ID 1183021-xx
Replacement battery	ID 623166-xx	

Mass: 0.73 kg

HR 520

HR 550 FS with HRA 551 FS

HRA 551 FS

Handwheel holder for HR 550 FS
- For docking the HR 550 FS onto the machine
- Integrated battery charger for HR 550 FS
- Connections to the control and the machine
- Integrated transceiver
- HR 550 FS magnetically held to front of HRA 551 FS

Handwheel holder	
HRA 551 FS	ID 1119052-xx

Mass: 0.7 kg

For more information, see the *HR 550 FS* Product Information document (ID 636227-xx).

Cables

	HR 510	HR 510 FS	HR 520	HR 520 FS	HR 550 FS with HRA 551 FS	ID
Connecting cable (spiral cable) to HR (3 m)	–	–	✓	✓	–	312879-01
	✓	✓	–	–	–	1117852-03
Connecting cable with metal armor	–	–	✓	✓	–	296687-xx
	✓	✓	–	–	–	1117855-xx
Connecting cable without metal armor	–	–	✓	✓	✓ (max. 2 m)	296467-xx
	✓	✓	–	–	–	1117853-xx
HR adapter cable to MC, straight connector	✓	✓	✓	✓	✓[1]	1161072-xx
HR adapter cable to MC, angled connector (1 m)	✓	✓	✓	✓	✓[1]	1218563-01
Extension cable to adapter cable	✓	✓	✓	✓	✓[1]	281429-xx
Adapter cable for HRA to MC	–	–	–	–	✓[2]	749368-xx
Extension cable to adapter cable	–	–	–	–	✓[2]	749369-xx
Adapter connector for handwheels without functional safety	✓	–	✓	–	–	271958-03
Adapter connector for handwheels with functional safety	–	✓	–	✓	✓	271958-05

[1] For maximum cable lengths of up to 20 m between the MB and HRA 551 FS
[2] For maximum cable lengths of up to 50 m between the MB and HRA 551 FS

HR 130

Panel-mounted handwheel with ergonomic control knob and serial output signal. Like the other electronic handwheels, it is attached to the handwheel interface X23 either directly or via an extension cable.

Handwheel	Without detent	With detent
HR 130	ID 540940-03	ID 540940-01

Mass: ≈ 0.34 kg

HR 180

Panel-mounted handwheel with ergonomic control knob for connection to the **HRA 180** handwheel adapter (output signal: 1 V_{PP}; line count: 5000; 12-pin M23 connector (male)).

Handwheel	Without detent	With detent
HR 180	ID 540940-17	ID 540940-16

Mass: ≈ 0.36 kg

Panel-mounted handwheel with ergonomic control knob for connection to a **position encoder input** (output signal: 1 V_{PP}; line count: 1000; 12-pin M23 coupling (male)).

Handwheel	With detent
HR 180	ID 540940-08

Mass: ≈ 0.36 kg

HRA 180

The HRA 180 handwheel adapter makes it possible to connect up to three HR 180 panel-mounted handwheels to the control's serial handwheel input at X23.

Handwheel adapter	
HRA 180	ID 1395422-xx

Mass: ≈ 0.7 kg

Additional operating station with touchscreen

The additional ITC operating stations (Industrial Thin Client) from HEIDENHAIN are convenient solutions for the additional, decentralized operation of the machine or of machine units such as tool-changing stations. The remote operation strategy, which is tailored to the TNC7/TNC7 basic, makes it very easy to connect the ITC over a standard Ethernet connection with a cable length of up to 100 m. All ITCs fulfill IP54 when installed.

Connecting an ITC is very easy: as soon as the TNC7/TNC7 basic identifies an ITC, it provides it with a current operating system. After booting of the ITC, the complete content of the control's screen is mirrored 1:1 on the ITC's screen.

The **ITC 362**, **ITC 352** and **ITC 342** and the separately orderable keyboard unit together form a complete, second operating station.

The **ITC 342** can be configured as an application panel. This makes implementation of operating stations easy, such as for tools.

ITC 342

	ITC 362	ITC 352	ITC 342
Screen (Full HD, 1920 x 1080 pixels)	24-inch touchscreen	19-inch touchscreen	16-inch touchscreen
Power supply	24 V NC		
Processor	Intel low-level		
RAM	2 GB		
Power consumption	50 W	45 W	35 W
Mass	8.6 kg	5.7 kg	4.3 kg
ID	1346871-xx	1374639-xx	1354570-xx

IPC 306 for Windows

With the IPC 306 industrial PC, you can start and remotely operate Windows-based applications via the user interface of the TNC7/ TNC7 basic. The user interface is displayed on the control screen. The Remote Desktop Manager software option is required for this.

Since Windows runs on the industrial PC, it does not influence the NC machining process. The IPC is connected to the NC main computer via Ethernet. No second screen is necessary, since the Windows applications are displayed on the screen of the TNC7/ TNC7 basic via remote accesses.

Along with the industrial PC, a separately orderable hard disk is required for operation. Windows 8 or 10 can be installed on the empty data carrier as the operating system.

IPC 306

IPC 306	
Installation type	Electrical cabinet
RAM	8 GB RAM
Processor	Intel high-level
Power consumption	60 W
Mass	3.9 kg
ID	1179966-xx
SSDR solid-state memory	
Storage capacity	240 GB
ID	1282884-51
HDMI adapter cable for initial setup	
ID	1333118-01

Control of auxiliary axes

PNC 610

The PNC 610 auxiliary axis control is a concept for controlling PLC axes independently of the TNC7/TNC7 basic. The PNC 610 does not have an NC channel and thus cannot perform interpolating NC movements. With the IPC auxiliary computer, SIK, and CFR (CFast) storage medium, the PNC 610 is a separate HSCI system, which can be expanded with HEIDENHAIN inverters. In the standard version the PNC 610 already includes six PLC axis enablings as well as the Python OEM Process software option. The PLC basic program contains a Python interface for pallet management that is adaptable by the machine manufacturer.

All relevant HEIDENHAIN tools and a basic program can be used. The position information can be transmitted over PROFIBUS DP (optional), PROFINET IO (optional), or TCP/IP (integrated, system is not capable of real-time), regardless of the platform.

PNC 610 with IPC 8420

Auxiliary computer

The IPC auxiliary computer features the following:
- Intel mid-level processor
- RAM main memory
- HSCI interface to the CC controller unit or to the UxC and to other control components
- USB 3.0 ports

The following components must be ordered separately by the OEM and installed in the auxiliary computer:
- CFR (CFast) memory card with the NC software
- System Identification Key component (SIK) for enabling software options

The following HSCI components are required for operating the PNC 610:
- IPC auxiliary computer
- Controller unit
- PLB 62xx PLC I/O unit (system PL; integrated in UxC)

Interfaces

USB 3.0 and Ethernet are available on the MC. Connection to PROFINET IO or PROFIBUS DP is possible via an additional module.

Design

IPC 6490	
Installation type	Electrical cabinet
RAM	2 GB SDRAM
Processor	Intel Celeron dual-core
Power consumption	20 W
Mass	≈ 2.3 kg
ID	1039541-xx

IPC 8420	
Installation type	Operating panel (IP54 when installed)
Screen	15.6-inch touchscreen (1366 x 768 pixels)
RAM	2 GB SDRAM
Processor	Intel Celeron 1047 CPU, 1.4 GHz, dual-core
Power consumption	43 W
Mass	≈ 6.7 kg
ID	ID 1249510-xx

Export license

The NC software of the PNC 610 is not covered by Annex I of the EU Dual-Use Regulation.

Software options

The performance of the PNC 610 can also be adapted to the actual requirements at a later time through software options. Software options are enabled and saved in the SIK component through the entry of keywords based on the SIK number. Please provide the SIK number when ordering new options.

Option number	Option	ID	Comment	Page
18	HEIDENHAIN DNC	526451-01	Communication with external PC applications over COM component	96
24	Gantry Axes	634621-01	Gantry axes via master-slave torque control	65
135	Synchronizing Functions	1085731-01	Advanced synchronization of axes and spindles	66
141	Cross Talk Comp.	800542-01	CTC: compensation of axis couplings	79
142	Position Adapt. Contr.	800544-01	PAC: position-dependent adaptation of control parameters	80
143	Load Adapt. Contr.	800545-01	LAC: load-dependent adaptation of control parameters	78
144	Motion Adapt. Contr.	800546-01	MAC: motion-dependent adaptation of control parameters	79
160	Integrated FS: Basic	1249928-01	Enables functional safety and four safe control loops	60
161	Integrated FS: Full	1249929-01	Enables functional safety and the maximum number of safe control loops	60
162	Add. FS Ctrl. Loop 1	1249930-01	Additional control loop 1	60
163	Add. FS Ctrl. Loop 2	1249931-01	Additional control loop 2	60
164	Add. FS Ctrl. Loop 3	1249932-01	Additional control loop 3	60
165	Add. FS Ctrl. Loop 4	1249933-01	Additional control loop 4	60
166	Add. FS Ctrl. Loop 5	1249934-01	Additional control loop 5	60
169	Add. FS Full	1319091-01	Enables all FS axis options or control loops. Software options 160 as well as 162 to 166 must already be set.	60

Storage medium

The storage medium is a CFR (CFast) memory card. It contains the NC software and must be ordered separately from the main computer. The NC software is based on the HEIDENHAIN HEROS 5 operating system.

CompactFlash CFR (CFast) 30 GB	
Export license	Not covered by Annex I of the EU Dual-Use Regulation
NC software	817591-xx
Free PLC memory space	4 GiB
Free NC memory space	7.7 GiB
ID	1102057-xx

SIK component

SIK NC-software license for PNC 610	
Export license	Not covered by Annex I of the EU Dual-Use Regulation
Software option	Python OEM Process already included
Active control loops	6
Interpolation	≤ 4 axes
Installation	In MC main computer
ID	617763-53

Snap-on keys for handwheels

Snap-on keys

The snap-on keys make it easy to replace the key symbols. In this way, the HR handwheel can be adapted to different requirements.

Overview for HR 520, HR 520 FS, and HR 550 FS

Axis keys
Orange

A	ID 330816-42	X	ID 330816-24	U	ID 330816-43	IV	ID 330816-37
B	ID 330816-26	Y	ID 330816-36	V	ID 330816-38		
C	ID 330816-23	Z	ID 330816-25	W	ID 330816-45		

Gray

A–	ID 330816-95	V+	ID 330816-69	X–	ID 330816-0W	Y+	ID 330816-0R
A+	ID 330816-96	W–	ID 330816-0G	X+	ID 330816-0V	Y–	ID 330816-0D
B–	ID 330816-97	W+	ID 330816-0H	X–	ID 330816-0N	Y+	ID 330816-0E
B+	ID 330816-98	IV–	ID 330816-71	X+	ID 330816-0M	Z–	ID 330816-65
C–	ID 330816-99	IV+	ID 330816-72	Y–	ID 330816-67	Z+	ID 330816-66
C+	ID 330816-0A	X–	ID 330816-63	Y+	ID 330816-68	Z–	ID 330816-19
U–	ID 330816-0B	X+	ID 330816-64	Y–	ID 330816-21	Z+	ID 330816-16
U+	ID 330816-0C	X–	ID 330816-18	Y+	ID 330816-20	Z–	ID 330816-0L
V–	ID 330816-70	X+	ID 330816-17	Y–	ID 330816-0P	Z+	ID 330816-0K

Machine functions

SPEC FCT	ID 330816-0X	FN 3	ID 330816-75		ID 330816-0T		ID 330816-86
SPEC FCT	Black ID 330816-1Y	FN 4	ID 330816-76		ID 330816-81		ID 330816-87
FCT A	Black ID 330816-30	FN 5	ID 330816-77		ID 330816-82		ID 330816-88
FCT B	Black ID 330816-31		ID 330816-78		ID 330816-83		ID 330816-94
FCT C	Black ID 330816-32		ID 330816-79		ID 330816-84		ID 330816-0U
FN 1	ID 330816-73		ID 330816-80		ID 330816-89		ID 330816-91
FN 2	ID 330816-74		ID 330816-0S		ID 330816-85		ID 330816-3L

Spindle functions

	Red ID 330816-08		ID 330816-40		Red ID 330816-47		ID 330816-48
	Green ID 330816-09		ID 330816-41		Green ID 330816-46		ID 385530-5X

Other keys

	Black ID 330816-01		Red ID 330816-50		ID 330816-90		ID 330816-93
	Gray ID 330816-61		ID 330816-33		Black ID 330816-27	0	ID 330816-0Y
NC I	Green ID 330816-11		ID 330816-34		Black ID 330816-28		Black ID 330816-4M
NC 0	Red ID 330816-12		ID 330816-13		Black ID 330816-29		ID 330816-3M
	Green ID 330816-49		Green ID 330816-22		ID 330816-92		ID 330816-3N

Overview for HR 510 and HR 510 FS

Axis keys
Orange

A	ID 1092562-02	X	ID 1092562-05	U	ID 1092562-36	IV	ID 1092562-08
B	ID 1092562-03	Y	ID 1092562-06	V	ID 1092562-09		
C	ID 1092562-04	Z	ID 1092562-07	W	ID 1092562-37		

Gray

X+	ID 1092562-28	Y–	ID 1092562-31	IV+	ID 1092562-24	V–	ID 1092562-27
X–	ID 1092562-29	Z+	ID 1092562-32	IV–	ID 1092562-25		
Y+	ID 1092562-30	Z–	ID 1092562-33	V+	ID 1092562-26		

Machine functions

FCT A	Black ID 1092562-14	FCT B	Black ID 1092562-15	FCT C	Black ID 1092562-16		ID 1092562-42
	ID 1092562-43		ID 1092562-44				

Spindle functions

	ID 1092562-18		ID 1092562-19		Green ID 1092562-22		Red ID 1092562-17
	Red ID 1092562-38		ID 1092562-41				

Other keys

	Black ID 1092562-01	NC I	Green ID 1092562-23		ID 1092562-13		ID 1092562-35
	Green ID 1092562-20		ID 1092562-11		Black ID 1092562-10		Gray ID 1092562-39
	Red ID 1092562-21		ID 1092562-12		ID 1092562-34		Orange ID 1092562-40

Keycaps for keyboard units and machine operating panels

Keycaps

The keycaps make it easy to replace the key symbols, thus allowing the keyboard to be adapted to different requirements.

Overview of control keys

The keycaps with IDs 12869xx-xx and 1344337-xx are suitable for use on the following keyboard units and machine operating panels: TE 361, TE 361 FS, TE 350, TE 350 FS, TE 340, TE 340 FS, MB 350, MB 350 FS, MB 340, MB 340 FS

Keycaps for alphabetic keyboard

	ESC	! 1	@ 2	# 3	$ 4	% 5	^ 6	& 7	* 8
ID 1286909	-08	-09	-10	-11	-12	-13	-14	-15	-16

	(9	) 0	_ -	+ =	Q	W	E	R	T
ID 1286909	-17	-18	-19	-20	-21	-22	-23	-24	-25

	Y	U	I	O	P	{ [	}]	| \	A
ID 1286909	-26	-27	-28	-29	-30	-31	-32	-33	-34

	S	D	F	G	H	J	K	L	: ;
ID 1286909	-35	-36	–	-38	-39	–	-41	-42	-43
ID 1344337*)	–	–	-01*)	–	–	-02*)	–	–	–

*) With tactile mark

	" '	~ `	Z	X	C	V	B	N	M
ID 1286909	-44	-45	-46	-47	-48	-49	-50	-51	-52

	< ,	> .	? /			ALT	PRT SC		
ID 1286909	-53	-54	-55	-56	-57	-58	-59	-60	

ID 1286911	-02	-03	-04	-05	

ID 1286914	-03	

		CTRL	
ID 1286915	-02	-03	

ID 1286917	-01	

Keycaps for operating aids

	PGM MGT		ERR	CALC	MOD	HELP	
ID 1286909	-61	-62	-63	-64	-65	-66	

Keycaps for operating modes

ID 1286909	-67	-68	-69	-70	-71	-72	-73	-74	

Keycaps for programming

	APPR DEP	FK	CHF	L	CR	RND	CT	CC	C
ID 1286909	-75	-76	-77	-78	-79	-80	-81	-82	-83

	TOUCH PROBE	CYCL DEF	CYCL CALL	LBL SET	LBL CALL	STOP	TOOL DEF	TOOL CALL	PGM CALL
ID 1286909	-84	-85	-86	-87	-88	-89	-90	-91	-93

	SPEC FCT								
ID 1286909	-92								

Keycaps for axis input and value input

	X	Y	Z	A	B	C	U	V	W
	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
ID 1286909	-94	-95	-96	-4K	-4Y	-4L	-5K	-98	-4Z

	7	8	9	4	5	1	2	3	0
ID 1286909	-0B	-0C	-0D	-0E	–	-0G	-0H	-2L	-2M
ID 1344337*)	–	–	–	–	-03*)	–	–	–	–

*) With tactile mark

	IV			ESC	INS				DEL
	Orange								
ID 1286909	-97	-0N	-3S	-4S	-4T	-3R	-3T	-3U	-3V

	.	-/+		Q	CE	DEL	NO ENT	END	
ID 1286909	-0K	-0L	-0M	-2N	-0P	-2P	-0R	-0S	-3N

	>>		P	I					
			Orange	Orange					
ID 1286909	-3W	-3P	-99	-0A					

	ENT	
ID 1286914	-04	

Keycaps for navigation

		HOME	PG UP		GOTO		END	PG DN	
ID 1286909	-0T	-0U	-0V	-0W	–	-0Y	-0Z	-1A	
ID 1344337*)	–	–	–	–	-04*)	–	–	–	

*) With tactile mark

ID 1344337*)	-06	-07

*) With tactile mark

Keycaps for machine functions

	IV+	Z+	Y+	V+	VI+	X+			Y–
ID 1286909	-1D	-1E	-1F	-1G	-1H	-1K	-1L	-4X	-1N
	IV–	VI–			FN 1				
ID 1286909	-1P	-1R	-1S	-1T	-1U	-1V	-1W	-1X	-1Y
	FN 2			FN 3			Red	Green	X–
ID 1286909	-1Z	-2A	-2B	-2C	-2D	-2E	-2H	-2K	-2R
		Z–	V–	+	–				
ID 1286909	–	-2T	-2U	-2Z	-3A	-3E	-3F	-3G	-3H
ID 1344337*)	-05*)	–	–	–	–	–	–	–	–

*) With tactile mark

						C+		C–	
ID 1286909	-3L	-3M	-3X	-3Y	-3Z	-4A	-4B	-4C	-4D
	W+	W–		A+	A–	B+	B–		
			Red					Red	Red
ID 1286909	-4E	-4F	-4H	-4M	-4N	-4P	-4R	-4U	-06
	Green	U–	U+			FN 4	FN 5		
ID 1286909	-07	-5A	-5B	-5C	-5D	-4V	-4W	-5E	-5H
ID 1286909	-5F	-5G	-2Y	-3K	-4G	-2V	-2W	-2X	
ID 1344337*)	–	–	-08*)	–	–	–	–	–	

*) With tactile mark

Other keycaps

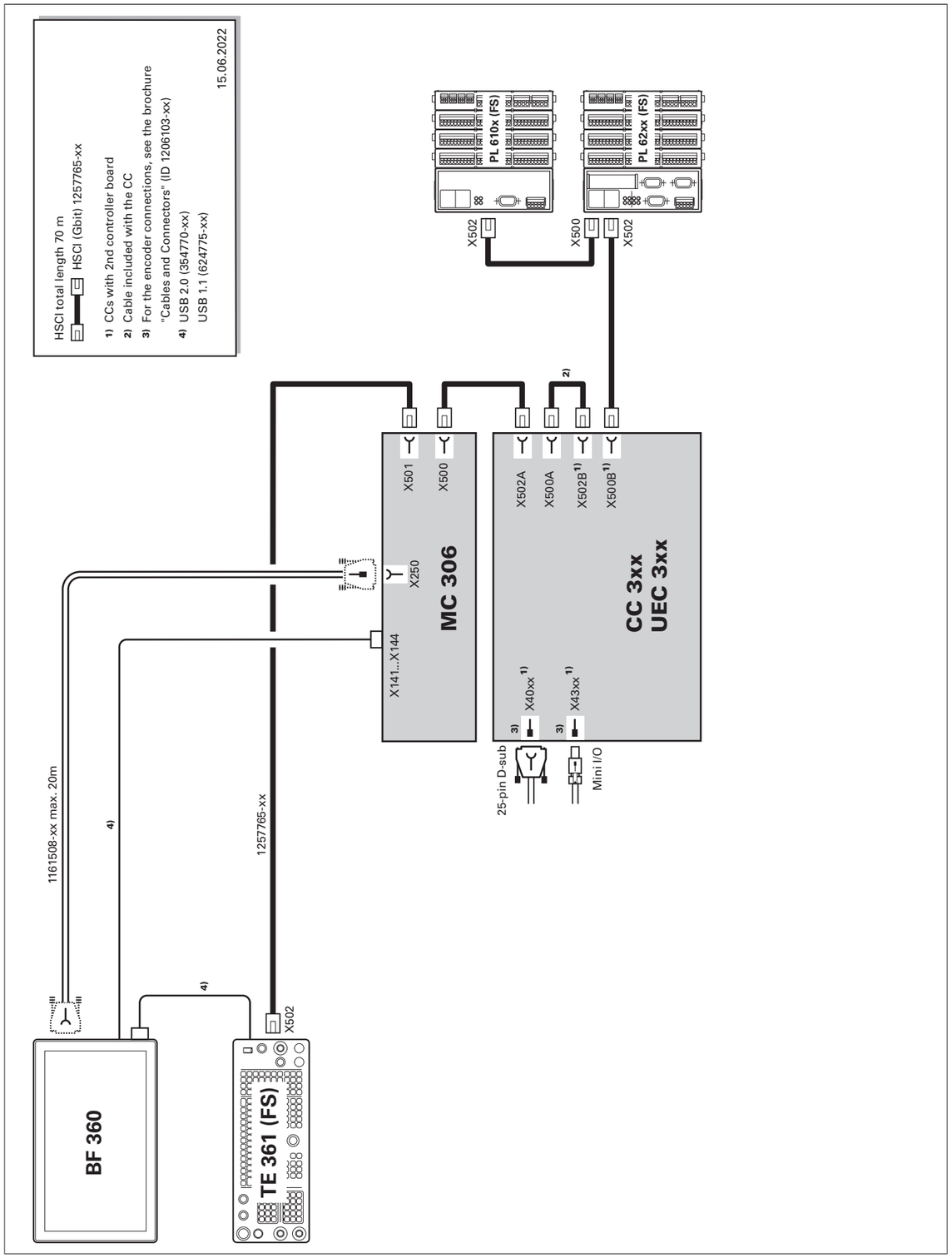
			Orange	Green	Red				
ID 1286909	-01	-02	-05	-03	-04	–	–	–	–

Special keys

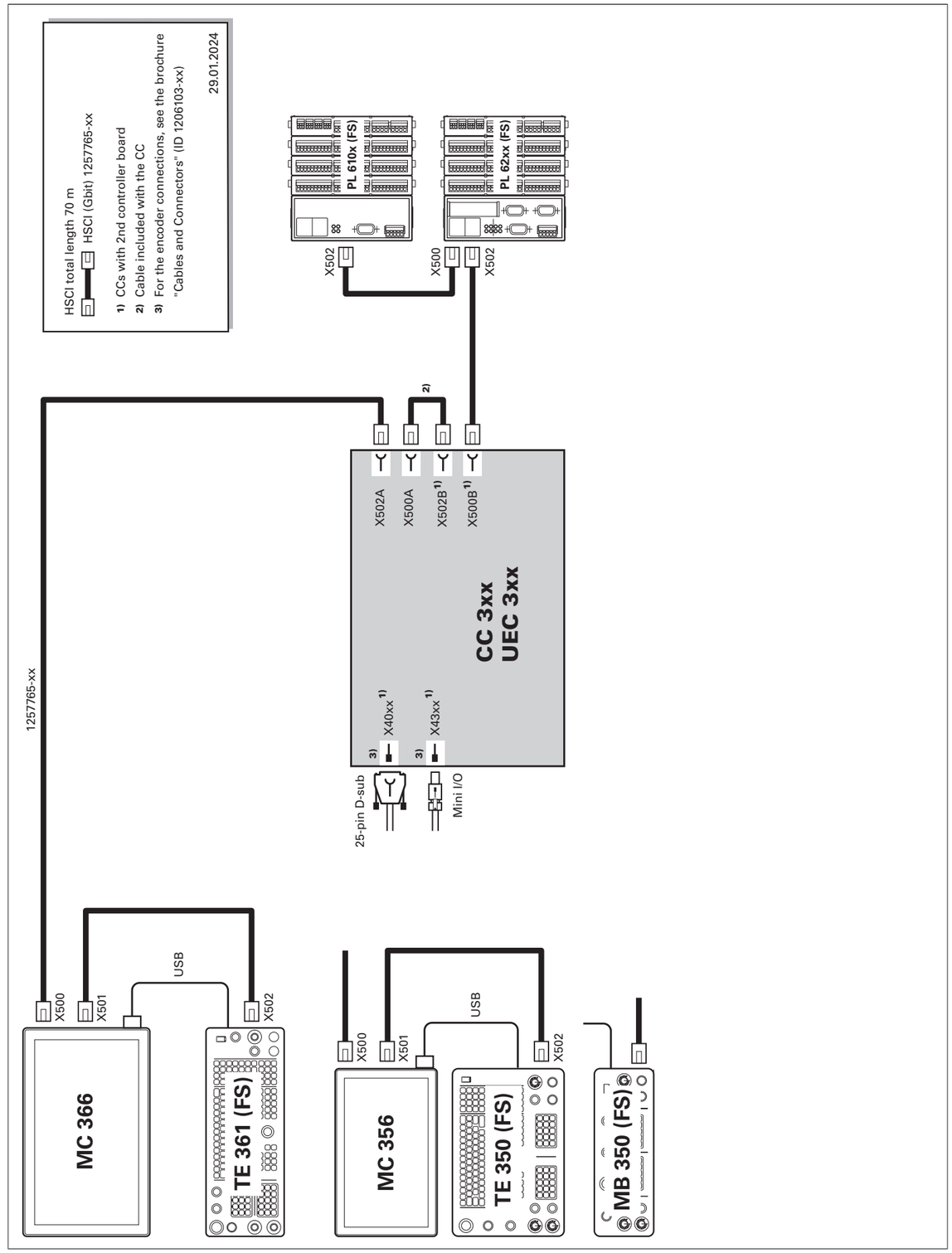
Keycaps can also be made with special key symbols for special applications. If you need keys for special applications, please consult your contact person at HEIDENHAIN.

Cable overview (examples)

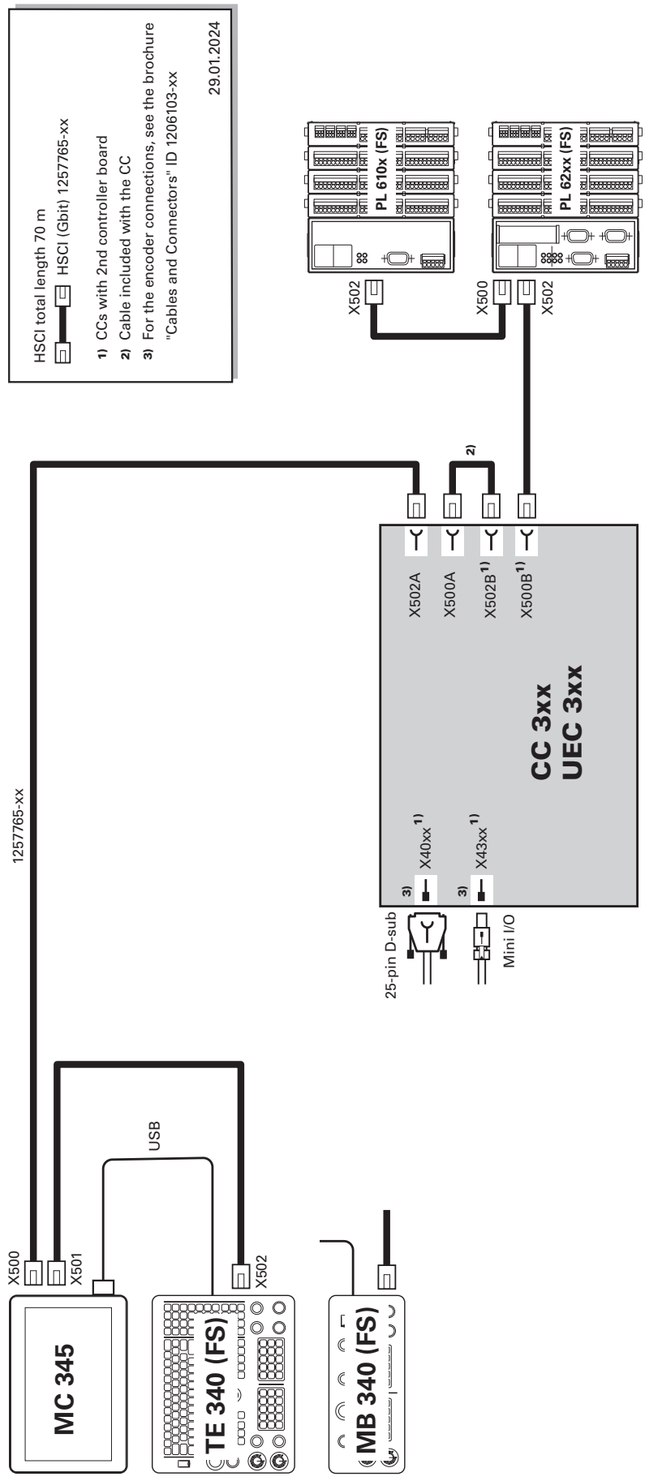
TNC7: Control systems with CC or UEC (MC in electrical cabinet)



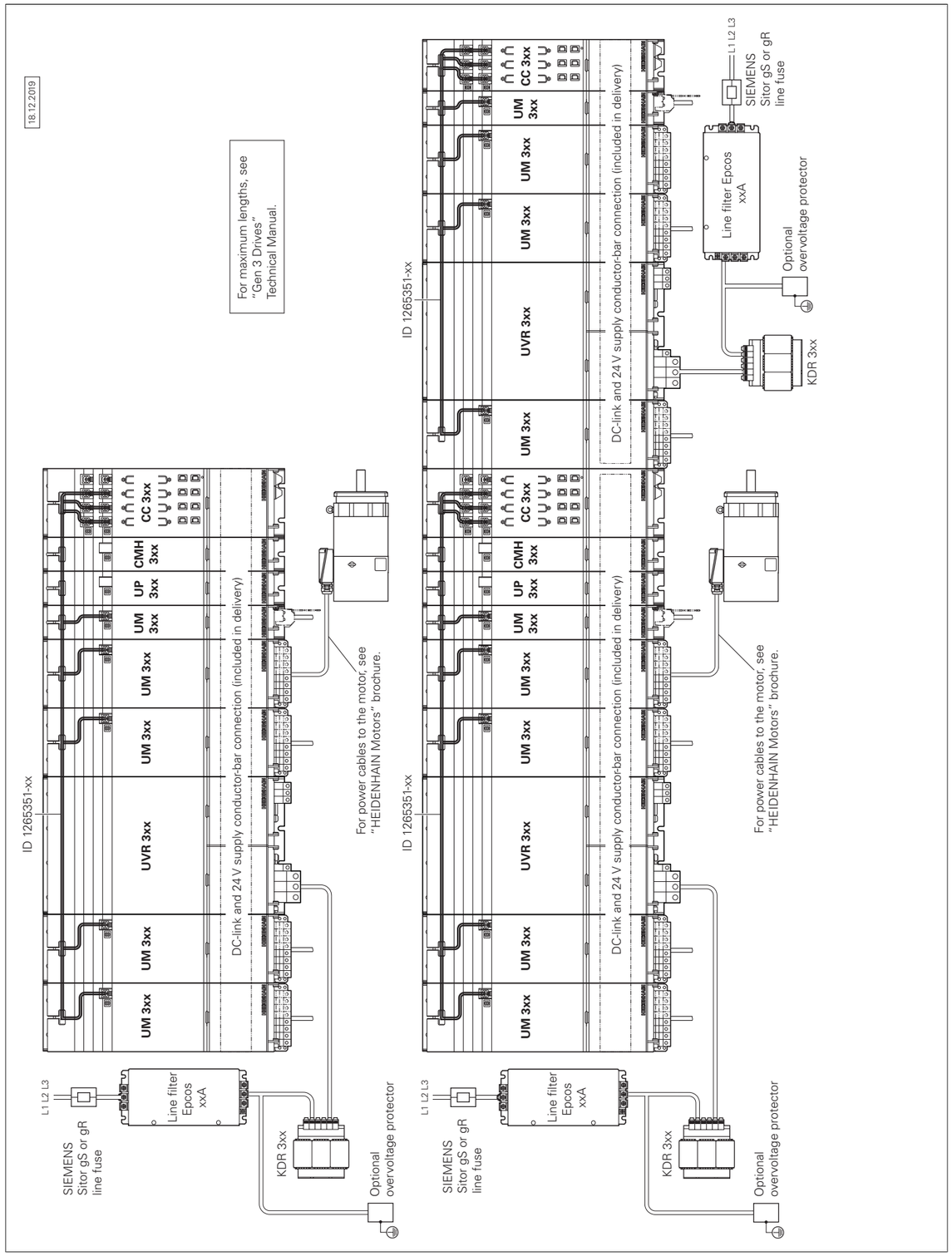
TNC7: Control system with CC or UEC (MC in operating panel)

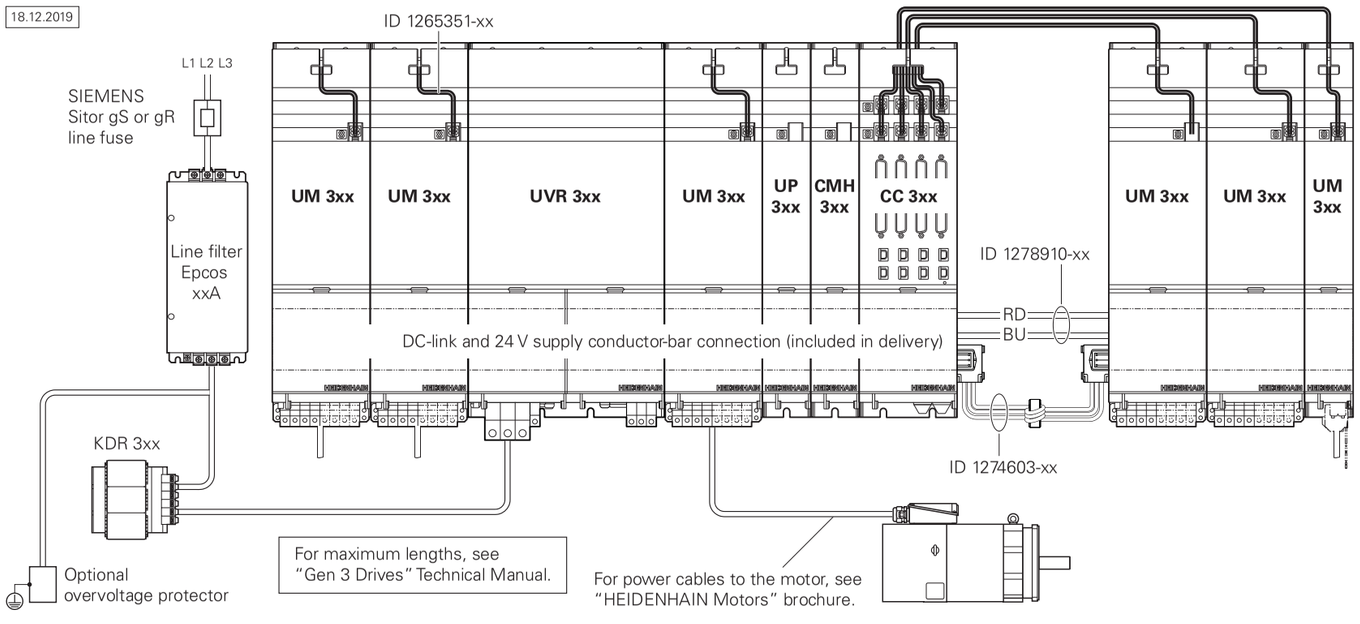


TNC7 basic: Control system with CC or UEC (MC in operating panel)



Inverter system

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SIEMENS
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line fuse
Line filter
Epcos
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UM 3xx
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UVR 3xx
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UP 3xx
CMH 3xx
CC 3xx
UM 3xx
UM 3xx
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RD
BU
DC-link and 24 V supply conductor-bar connection
KDR 3xx
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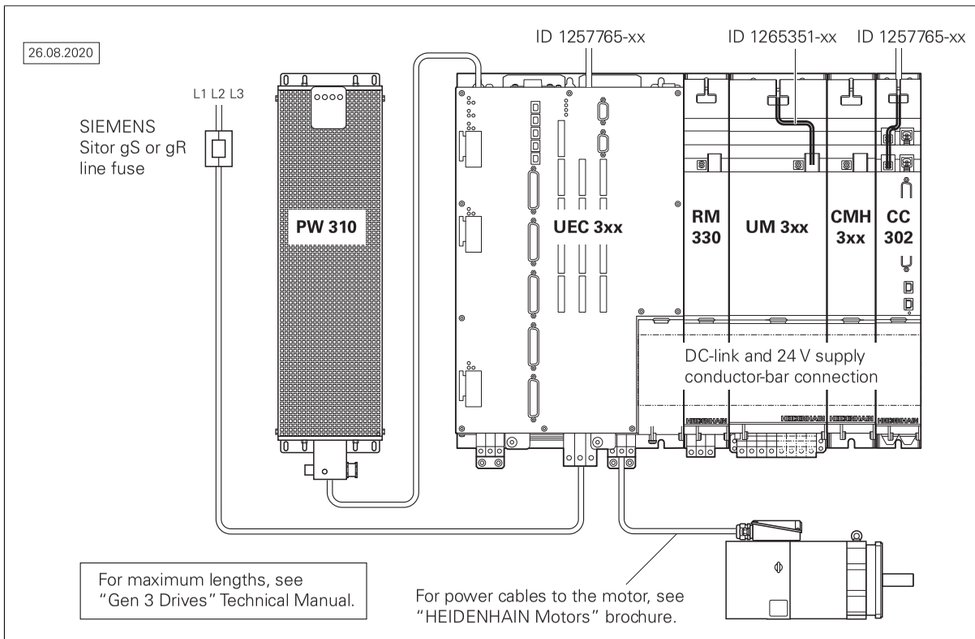
Optional
overvoltage protector
For maximum lengths, see
“Gen 3 Drives” Technical Manual.
For power cables to the motor, see
“HEIDENHAIN Motors” brochure.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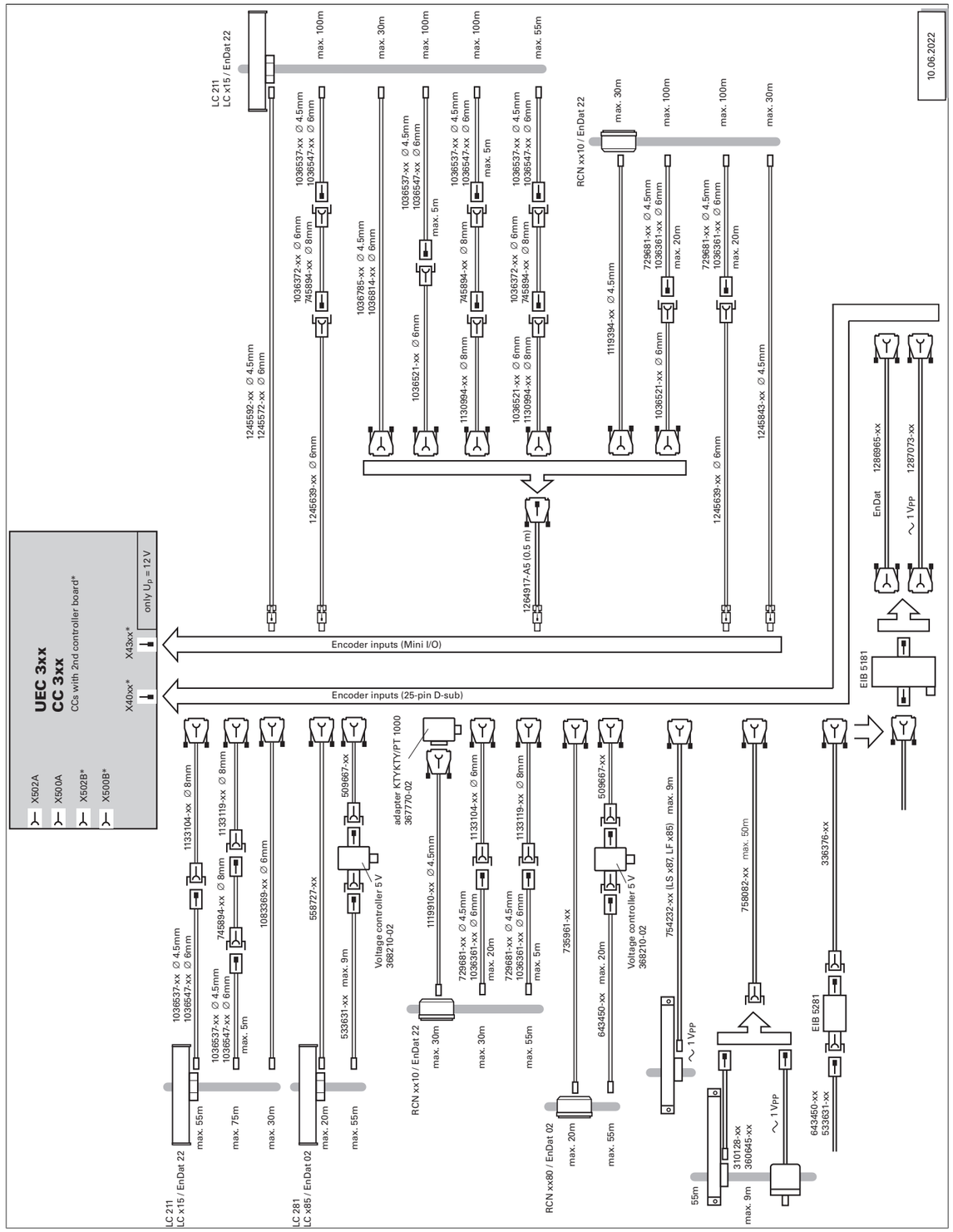
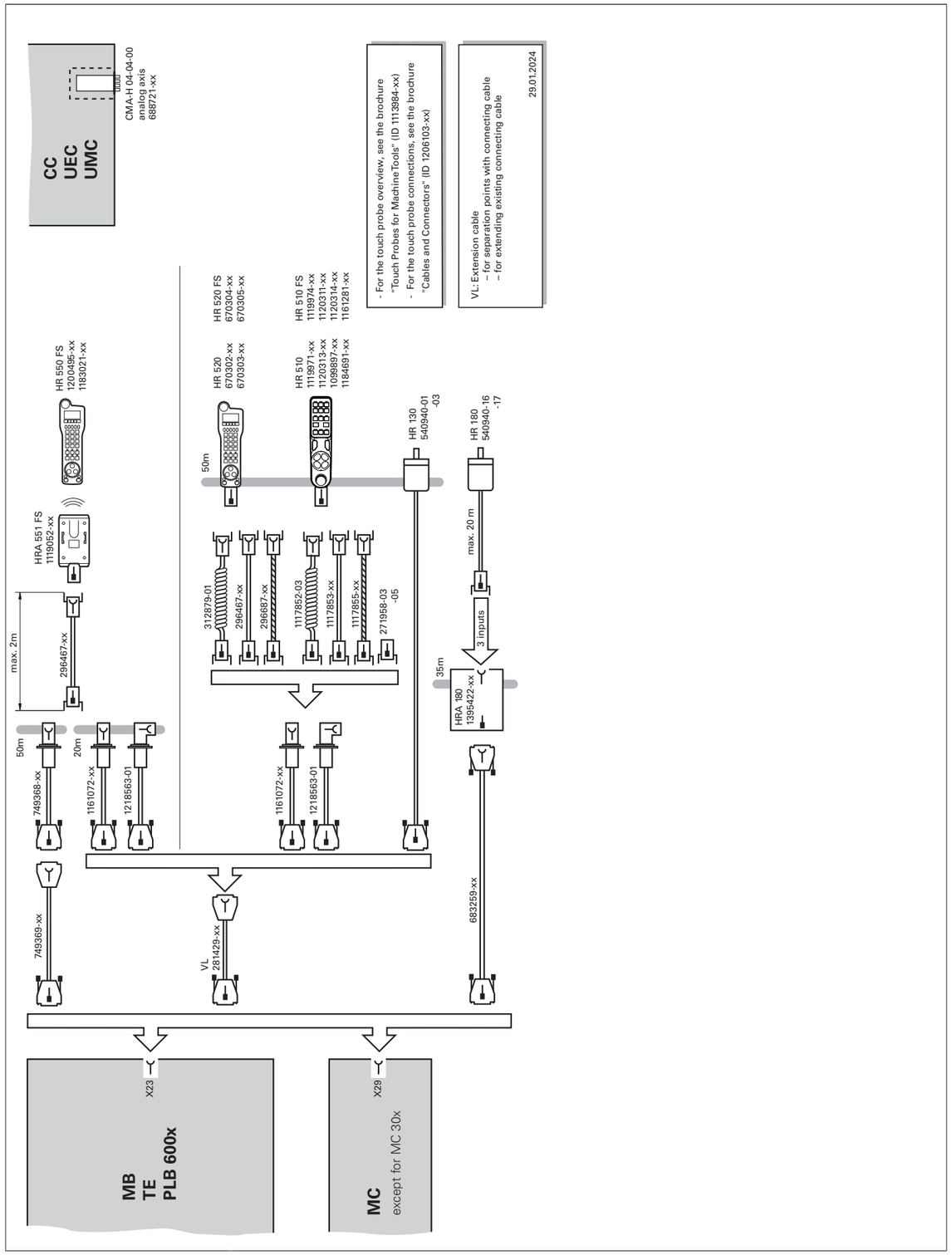
L1 L2 L3
SIEMENS
Sitor gS or gR
line fuse
PW 310
UEC 3xx
RM 330
UM 3xx
CMH 3xx
CC 302
DC-link and 24 V supply
conductor-bar connection
For maximum lengths, see
“Gen 3 Drives” Technical Manual.
For power cables to the motor, see
“HEIDENHAIN Motors” brochure.

Encoders



Accessories



Technical description
Digital control design

Fully digital

In the fully digital control design from HEIDENHAIN, all of the components are connected with each other via purely digital interfaces. A high degree of availability for the entire system, from the main computer to the encoder, is thereby achieved, with the system being diagnosable and immune to noise. The outstanding characteristics of the fully digital design from HEIDENHAIN guarantee very high accuracy and surface finish quality, combined with high traversing speeds.

Connection of the components:
- Control components via **HSCI** (HEIDENHAIN Serial Controller Interface), the HEIDENHAIN real-time protocol for Gigabit Ethernet
- Encoders via the **EnDat 2.2** bi-directional interface from HEIDENHAIN
- Power modules via digital optical fiber cables

HSCI

HSCI, the HEIDENHAIN Serial Controller Interface, connects the main computer, controller(s), and other control components. The connection between two HSCI components is referred to as an HSCI segment. HSCI communication in Gen 3 control systems is based on Gigabit Ethernet hardware. All HSCI components and HSCI cables must therefore be Gigabit-capable. A special interface component developed by HEIDENHAIN makes short cycle times for data transfer possible.

Main advantages of the control design with HSCI:
- Hardware platform for a flexible and scalable control system (e.g., decentralized axis systems)
- High noise immunity due to digital communication between components
- Hardware basis for implementing functional safety
- Simple wiring (initial setup, configuration)
- Inverters connected via digital optical fiber cables
- Long line lengths in the overall system
- High number of possible control loops
- High number of PLC inputs/outputs
- Decentralized arrangement of the controller units

CC or UEC controller units, up to nine PL 6000 PLC I/O modules, and machine operating panels can be connected to the serial HSCI bus of the MC main computer. The HR handwheel is connected directly to the machine operating panel. The combination of monitor and main computer is especially advantageous if the computer is housed in the operating panel. Besides the power supply, all that is then required is an HSCI line to the controller unit in the electrical cabinet.

Maximum cable lengths for HSCI:
- For an HSCI segment: 70 m
- For up to 12 HSCI slaves: 290 m (total of all HSCI segments)
- For up to 13 HSCI slaves (maximum configuration): 180 m (total of all HSCI segments)

The order of the HSCI slaves can be freely chosen.

HSCI master

HSCI component	Function	1xx inverters	Gen 3 drives
MC, IPC	HSCI master	1	1
Maximum number of HSCI masters		1	1

HSCI slave

HSCI component	Function	1xx inverters	Gen 3 drives
CC 61xx UEC 1xx[2], UMC 1xx[2] CC 3xx	HSCI slave	4 controller motherboards[1]	6 controller motherboards[1]
UxC 3xx[2]	HSCI slave	–	Integrated safety 6 controller motherboards[1]
			External safety 1 (because only one PAE module permitted)
UVR 3xx	HSCI slave	–	5
PLB 62xx (FS) PLB 61xx (FS)	HSCI slave	8[3] of which up to 4 MB/TE/PLB 600x	10[3] of which up to 4 MB/TE/PLB 600x
MB (FS) / TE (FS) PLB 600x (FS)	HSCI slave		
Maximum number of HSCI slaves		12	21

[1] Distributed to CC, UEC, UMC as desired
[2] The UxC compact inverters are logically considered to be two HSCI participants. One participant is the integrated control-loop board, and the other participant is the integrated PLB.
[3] The number of inputs and outputs is limited to 1000 terminals. Dual-channel FS inputs count as one input. Read-back internal outputs are not counted. Certain inputs and outputs that are used only within the system are counted.

Control systems with integrated functional safety (FS)

Basic principle

With controls with integrated functional safety (FS) from HEIDENHAIN, Safety Integrity Level 2 (SIL 2) as per the standard EN 61508 and Performance Level "d"Category 3 as per EN ISO 13849-1 can be attained. In these standards, the assessment of safety-related systems is based on, among other things, the failure probabilities of integrated components and subsystems. This modular approach aids the manufacturers of safety-related machines in implementing their systems, since they can then build upon prequalified subsystems. This design is taken into account for in the TNC7/TNC7 basic control, as well as for safety-related position encoders. Two redundant, mutually independent safety channels form the basis of the controls with functional safety (FS). All safety-relevant signals are captured, processed, and output via two channels. Errors are detected through a reciprocal data comparison of the two channels' states. Consequently, the occurrence of a single error in the control does not cause a loss in safety functionality.

Design

The safety-related controls from HEIDENHAIN have a dual-channel design with mutual monitoring. The SPLC (safety-related PLC program) and SKERN (safety kernel software) software processes form the basis of the two redundant systems. The two software processes run on the MC main computer (CPU) and CC controller unit components. The dual-channel configuration through the MC and CC is continued in the PLB 6xxx FS I/O systems and the MB machine operating panel with FS (e.g., MB integrated in TE 361FS). This means that all safety-relevant signals (e.g., permissive buttons, door contacts, emergency stop buttons) are captured via two channels, and are evaluated independently of each other by the MC and CC. The MC and CC use separate channels to also address the power modules, and to stop the motors in the event of an error.

Components

In systems with functional safety, certain hardware components assume safety-relevant tasks. In systems with FS, only safety-relevant components (including their HEIDENHAIN variant) that are approved for this are permitted.

Control components with functional safety (FS) are recognizable by the suffix FS after the model designation (e.g., TE 361FS).

For a current list of the components approved for functional safety (FS), refer to *Functional safety (FS) supplement to the Technical Manual* (ID 1423840).

MB and TE

An MB machine operating panel with functional safety is indispensable for systems with FS. Only on such a machine operating panel do all keys have a dual-channel design. Axes can be moved without additional permissive keys.

PLB

In systems with functional safety (FS), a combination of hardware (FS and standard) is possible, but a PLB 62xx FS is mandatory.

HR

In systems with functional safety (FS), FS handwheels are required because they are the only ones equipped with the required cross-circuit-proof permissive buttons.

Safety functions

Safety functions integrated into hardware and software:
- Safe stop reactions (SS0, SS1, and SS2)
- Safe torque off (STO)
- Safe operating stop (SOS)
- Safely limited speed (SLS)
- Safely limited position (SLP)
- Safe brake control (SBC)
- Safe operating modes
  - Operating mode 1: Automated or production mode
  - Operating mode 2: Set-up mode
  - Operating mode 3: Manual intervention
  - Operating mode 4: Advanced manual intervention, process monitoring

Activation of functional safety (FS)

The following requirements are absolutely necessary:
- At least one PLB 62xx FS must be present in the system
- FS version of safety-relevant control components (e.g., TE 361 FS, HR 550 FS)
- Safety-related SPLC program
- Configuration of safe machine parameters
- Wiring of the machine for systems with functional safety (FS)

Functional safety (FS) is scaled via software options (see Page 15). Only the number of safe drive systems actually needed must be enabled.

For every active drive that is assigned to a safe axis group, a safe control loop must be enabled. The control will otherwise display an error message.

Further information

For details, see the *Functional Safety FS* Technical Manual. Your contact person at HEIDENHAIN will be glad to answer any questions concerning controls with functional safety (FS).

Control systems with external safety

Basic principle

In control systems without integrated functional safety (FS), no integrated safety functions, such as safe operating modes, safe speed monitoring, or safe operating stop, are available. Such functions must be implemented entirely with the help of external safety components.

Control systems without integrated functional safety (FS) solely support the realization of the safety functions STO (safe torque off: dual-channel interruption of the motor power supply) and SBC (safe brake control: dual-channel triggering of the motor holding brakes). The dual-channel redundancy of the functions must be realized by the OEM through appropriate wiring.

Design

In control systems with external safety, a special PL module for the dual-channel triggering of STO and SBC is absolutely necessary. This module is the PAE-H 08-00-01 (see Page 32), with which up to eight axis groups can be individually controlled.

Operating system

HEROS 5

The TNC7/TNC7 basic and the PNC 610 work with the real-time capable HEROS 5 operating system (HEIDENHAIN Realtime Operating System). This future-oriented operating system contains the following powerful functions as part of its standard repertoire:

Network
- Network: management of network settings
- Remote Desktop Manager: management of remote applications
- Printer: management of printers
- Shares: management of network shares
- VNC: virtual network computing server

Safety
- Portscan (OEM): port scanner
- Firewall: protection against undesired network access
- SELinux: protection against unauthorized changes to system files

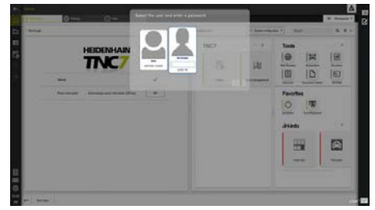
System
- Backup/Restore: function for backing-up and restoring the software on the control
- HELogging: evaluation and creation of log files
- Perf2: system monitor
- User administration: define users with different roles and access permissions

Tools
- Web browser: Firefox®*)
- Document Viewer: display PDF, TXT, XLSX and JPEG files
- File Manager: file explorer for managing files and memory media
- Gnumeric: spreadsheet calculations
- Leafpad: text editor for creating notes
- Ristretto: display of image files
- Orage Calendar: simple calendar function
- Screenshot: creation of screendumps
- Totem: media player for playing audio and video files

User administration

The improper operation of a control often leads to unplanned machine downtime and costly scrap. The user administration feature can significantly improve process reliability through the systematic avoidance of improper operation. Through the configurable linkage of rights with user roles, access can be tailored to the activities of the respective user.

- Logging on to the control with a user account
- User-specific HOME folder for simplified data management
- Role-based access to the control and network data

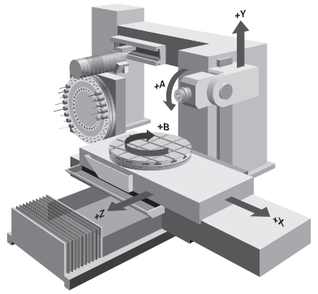


*) Firefox is a registered trademark of the Mozilla Foundation

Axes

Linear axes

Depending on its configuration, the TNC7/TNC7 basic can control linear axes with any axis designation (X, Y, Z, U, V, W, ...).



Display and programming

Feed rate in mm/min relative to the workpiece contour, or mm per spindle revolution

Feed rate override: 0% to 150%

Rotary axes

The TNC7/TNC7 basic can control rotary axes with any axis designation (A, B, C, U, ...). Special parameters and PLC functions are available for rotary axes with Hirth coupling.

Display and programming

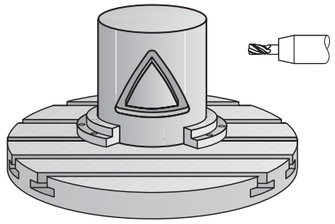
0° to 360° or feed rate in degrees per minute [°/min]

Traverse range

The machine manufacturer defines the traverse range for linear and rotary axes. The user can additionally limit the range of traverse in order to limit the working space. Various traverse ranges can be defined per axis using parameter sets (selection by PLC).

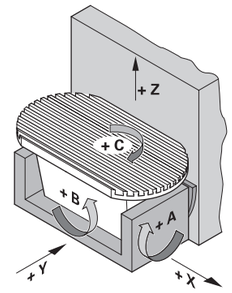
Adv. Function Set 1 (software option)

Cylinder surface interpolation: A contour defined in the working plane is machined on a cylindrical surface.

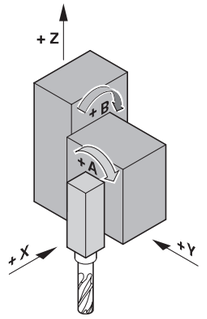


Adv. Function Set 1 (software option)

Tilting the working plane, PLANE function: The TNC7/TNC7 basic has special coordinate transformation cycles for controlling swivel heads and tilting tables. The tool lengths and the offset of the tilting axes are compensated for by the TNC7/TNC7 basic. The TNC7/TNC7 basic can manage more than one machine configuration (e.g., different swivel heads).



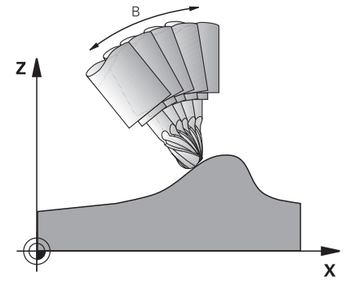
Tilting table



Swivel head

Adv. Function Set 2 (software option)

Tool Center Point Management (TCPM): The offset of the tilting axes is compensated for in a manner such that the position of the tool tip relative to the contour is maintained. Even during machining, handwheel positioning commands can be superimposed such that the tool tip remains on the programmed contour.

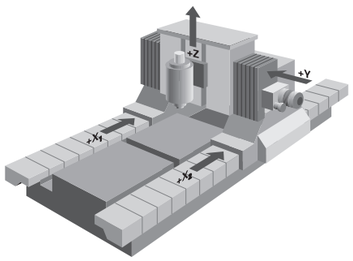


Synchronized axes

Synchronized axes move in synchronism and are programmed with the same axis designation.

With HEIDENHAIN controls, parallel axis systems (gantry axes) such as on portal-type machines or tilting tables can be moved synchronously to each other through high-accuracy and dynamic position control.

In the case of **gantry axes**, multiple gantry slave axes can be assigned to a single master axis. They may also be distributed to multiple controller units.

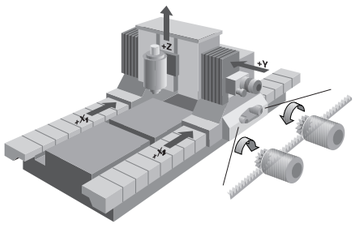


Torque control

Torque control is used on machines with mechanically coupled motors, for which

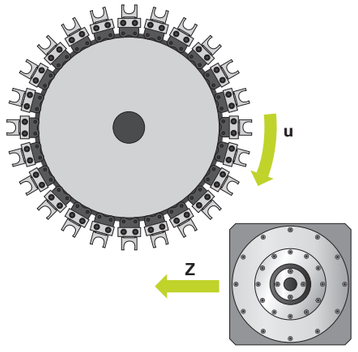
- a defined distribution of drive torque is desired, or
- parts of the controlled system show a backlash effect that can be eliminated by "tensioning" the motors (e.g., toothed racks).

For torque control, the master and slave must be on the same controller motherboard. Depending on the controller unit being used, up to five slave axes can thereby be configured for each master.



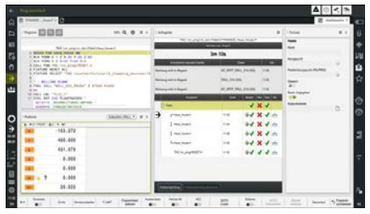
Synchronizing Functions (software option) (TNC7)

Advanced synchronization of axes and spindles: The Synchronizing Functions software option allows the cyclic calculation of a position offset for an axis from the actual and nominal values of any other axes in the system.
This function allows complex, simultaneous movements of multiple NC or PLC axes to be implemented. The interdependencies of the axes are defined in mathematical formulas.



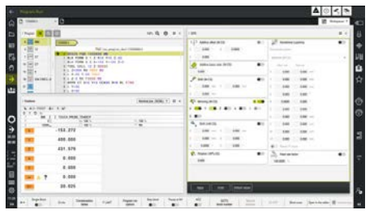
Batch Process Manager (software option)

Planning and execution of multiple production jobs: The Batch Process Manager software option ("Batch Process Mngr.", or BPM) provides functions for the planning and execution of multiple production jobs on the TNC7/TNC7 basic. These functions make it possible to easily edit pallets and to alter the sequence of pending jobs. A duration calculation for all planned jobs or NC programs is also performed. You are informed as to whether, for example, all NC programs can be executed without error or whether all required tools are available with sufficient tool life. The Batch Process Manager software option thereby ensures the smooth execution of the planned jobs.



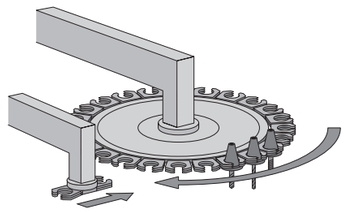
Global PGM Settings (software option) (TNC7)

Global program settings (GPS): The functions provided by the Global Program Settings software option allow adaptation of the machining process without changing the original NC program. This makes it easy to mirror axes or activate additional offsets, for example.
The TNC7 also provides the ability to use handwheel superimpositioning in various coordinate systems and utilize virtual tool axes. This function is typically employed in toolmaking and mold manufacturing.



PLC axes

Axes can be defined as PLC axes. Programming is performed through M functions or OEM cycles. The PLC axes are positioned independently of the NC axes and are therefore designated as asynchronous axes.

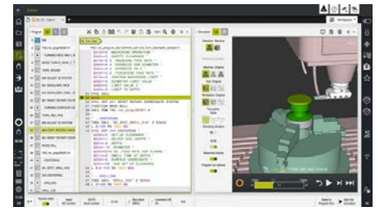


Turning operations (TNC7)

Turning (software option)

Performing turning operations: The TNC7 supports machines that can perform a combination of milling and turning operations in a single setup. It offers a comprehensive package of cycles for both types of operations, which are programmed in HEIDENHAIN's shopfloor-oriented Klartext format. Rotationally symmetric contours are produced during turning operations. The preset must be in the center of the lathe spindle for this.

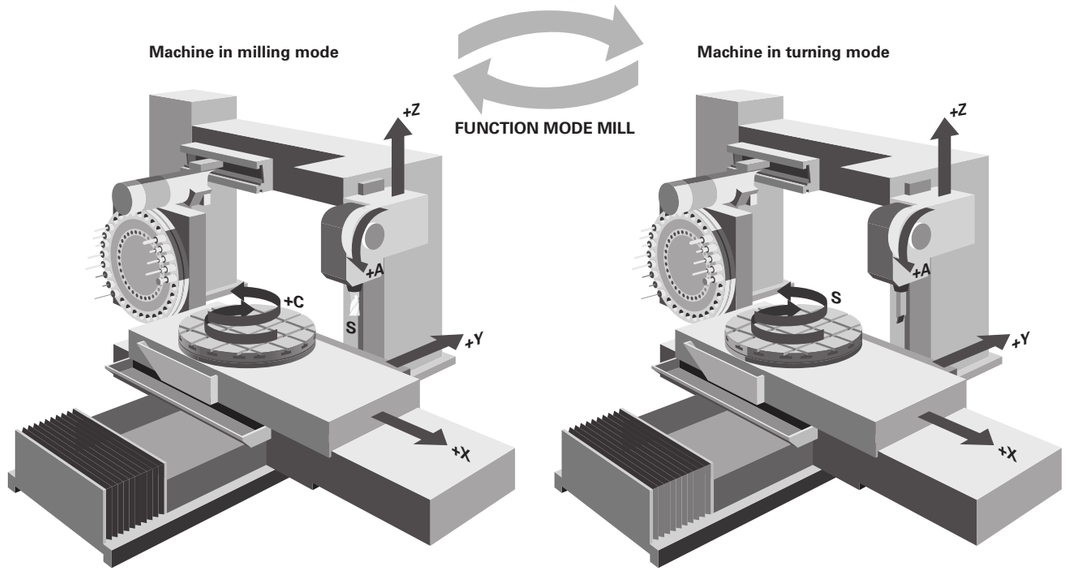
In turning mode, the rotary table serves as workspindle, while the milling spindle with the tool does not rotate. Milling-turning machines are subject to special demands. A basic requirement is a machine designed with high rigidity so as to ensure a low oscillation tendency even when the machine table (acting as lathe spindle) is turning at high speeds.



Toggling between milling and turning modes

When switching between between milling and turning mode, the TNC7 switches diameter programming on or off, selects the XZ working plane for turning, and displays "Milling" or "Turning" mode in the status display.

You switch between turning and milling mode with the NC command FUNCTION MODE TURN or FUNCTION MODE MILL. The machine-specific procedures necessary for this are realized via OEM macros. In these macros, the OEM defines, for example, which kinematic model is active for the turning or milling operation, and which axis and spindle parameters take effect in milling or turning mode. Because the FUNCTION MODE TURN and FUNCTION MODE MILL commands are independent of the machine model, NC programs can be exchanged between different types of machines.



Support for facing slides (facing heads)

With complete support for facing slides, the TNC7 provides an additional way of performing turning operations on a milling machine. A longitudinal turning tool, for example, can be mounted to the facing slide and called with a TOOL CALL block. Even complex turning operations are programmed with familiar ease using cycles. Machining operations with the facing slide can be carried out with the TNC7 in any inclination (PLANE functions). In addition, numerous useful turning functions, such as constant cutting speed, are available. The use of facing slides requires enabling of the Turning software option on the TNC7.

Measuring unbalance and balancing

An important and basic requirement for turning operations is that the radial runout of the workpiece has been balanced. Both the machine (rotary table) and the workpiece must be balanced before machining. If the clamped workpiece has an unbalance, undesirable centrifugal forces can result, influencing the accuracy of the runout.

An unbalance on the rotary table can endanger the safety of the user and has a negative effect on the quality of the workpiece and the service life of the machine.

The TNC7 can detect an unbalance in the rotary table based on the effects of the centrifugal forces on neighboring linear axes. To this end, the rotary table should ideally be positioned via a linear axis. For other machine designs, unbalance detection by means of external sensors lends itself as a solution.

The TNC7 offers the following functions:

- **Unbalance calibration**
  A calibration cycle determines the unbalance behavior of the rotary table. This unbalance calibration is generally performed by the OEM before the machine is shipped. During execution of the calibration cycle, the TNC7 generates a table describing the unbalance behavior of the rotary table.
- **Balancing**
  After the blank to be turned has been set up, you can ascertain the unbalance using a measuring cycle. During balancing, the TNC7 assists you by displaying the mass and position of the balancing weights.
- **Unbalance monitoring**
  During the machining operation, the TNC7 continually monitors the unbalance. An NC stop is triggered if a specified limit value is exceeded.

Turning v2 (software option) (TNC7)

Mill-turning, version 2: The Turning v2 software option includes all functions of the Turning software option.

In addition, the Turning v2 software option offers the following advanced turning functions:

- Cycle 882 SIMULTANEOUS ROUGHING FOR TURNING
- Cycle 883 TURNING SIMULTANEOUS FINISHING

The advanced turning functions make it possible, for example, to rough and finish complex contours in one run to avoid optical transitions, to produce workpieces with undercuts, and to better utilize indexable inserts. Furthermore, the TNC7 makes it possible to define FreeTurn tools and to use them, for example, for inclined or simultaneous turning operations. FreeTurn tools are lathe tools that are equipped with multiple cutting edges. Depending on the variant, a single FreeTurn tool may be capable of axis-parallel and contour-parallel roughing and finishing. Thanks to the use of FreeTurn tools, fewer tool changes are required, reducing the machining time.

Gear Cutting (software option) (TNC7)

Gear manufacturing: The Gear Cutting software option provides user-friendly cycles for the economical production of external and internal gear teeth. The hobbing and skiving cycles enable the complete machining of high-quality gear teeth in a single setup, including static shifting for prolonged tool life and synchronous shifting for the production of helical gear teeth.

The Gear Cutting software option includes the following cycles:

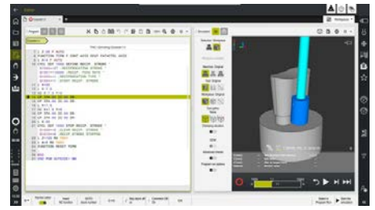
- Cycle 285 DEFINE GEAR for specifying the gear geometry
- Cycle 286 GEAR HOBBING
- Cycle 287 GEAR SKIVING

The Gear Cutting software option expands the scope of functionality of milling machines with rotary tables even without the Turning and Turning v2 software options.

Grinding and dressing functions (TNC7)

Grinding (software option)

The TNC7 also lets you perform grinding operations on your machine. Cycles for jig grinding and dressing facilitate programming of the respective function with great convenience. In addition, the TNC7 can superimpose a tool-axis reciprocating stroke onto programmed movements. Optimized tool management assists you during every process, including grinding and dressing. The TNC7 is therefore the ideal basis for attaining the highest degree of surface quality and accuracy in your applications.



Jig grinding: With its Grinding software option, the TNC7 supports jig grinding technology for the fine machining of 2D contours.

Grinding operations are programmed with the familiar HEIDENHAIN Klartext dialog guidance. Convenient cycles are available to you. Instead of a milling cutter, jig grinding employs a grinding tool (e.g., grinding pin) for material removal. Since machining is performed in milling mode, no separate operating mode is needed.

A stroke movement or reciprocating movement in the tool axis can be activated by means of a cycle. There is also the capability of dressing or truing-up grinding tools inside the machine.

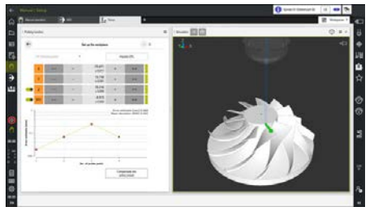
Grinding open and closed contours: You have the option of superimposing a tool-axis reciprocating stroke onto the tool's motion. Special cycles allow you to define, start, and stop the reciprocating stroke. The reciprocating stroke enables uniform wear on the grinding tool and precise geometries on ground surfaces.

Dressing: Dressing cycles allow you to "true up" grinding tools inside the machine. During dressing, the grinding tool is machined with a special dressing tool. Klartext cycles are available for dressing the grinding tool's diameter or profile.

Graphically supported setup

Model Aided Setup (software option)

Graphical 6D workpiece setup: For single parts and small lot sizes without a special holder, the position of the workpiece blank almost always needs to be ascertained before machining. With this intuitive probing function, the TNC7/TNC7 basic offers the possibility of setting up workpieces quickly, easily and safely with graphic guidance.



The exact position of the workpiece blank is measured in the machine's working space and reported to the control. This graphically supported measurement can be used for any workpieces. An accurate 3D model is all that is needed. You can simplify and clean up the 3D model of the workpiece using the CAD Model Optimizer software option, in order to create a valid STL file for the measurement procedure. The simulation view depicts a 3D model of the workpiece blank in the machine's working space. After the model has been roughly aligned manually, a green arrow indicates that the model is ready to be probed.

The axis keys or the electronic handwheel are used to position the touch probe to the blank in order to record the touch points. The control automatically selects the probing direction. All of the six degrees of freedom can thus be measured with only one single function. During the entire setup process, the control informs you about the quality of the probing points for determining the position and orientation of the workpiece. You thus quickly see when the measurement of the actual position and orientation of the workpiece is complete.

The user can also move the rotary axes during the setup procedure in order to probe undercuts, inclined surfaces, or rounded surfaces, for example. This allows the user to align even complex workpiece blanks relative to pre-machined features, such as is needed for mold repair or 3D-printed workpiece blanks.

Spindle

Overview

The TNC7/TNC7 basic contouring control operates in conjunction with the HEIDENHAIN inverter systems with field-oriented control. As an alternative, an analog nominal speed value can be output.

Controller unit

With the CC controller units and the UxC inverters, a fundamental PWM frequency can be set for each output. In this case, every output can have its own fundamental PWM frequency (e.g., with the CC 306: X551 = 4 kHz, X552 = 5 kHz, etc.).

Possible fundamental frequencies are 3.33 kHz, 4 kHz, or 5 kHz.

With the Double Speed Axes software option this frequency can be increased to up to 16 kHz for fast-turning spindles (e.g., HF spindles).

Maximum spindle speed

The maximum spindle speed is calculated as follows:

$$n_{max} = \frac{f_{PWM} \cdot 60000\ rpm}{NPP \cdot 5000\ Hz}$$

f_{PWM} = PWM frequency in Hz
NPP = Number of pole pairs

Operating mode switchover

For controlling the spindle, different parameter sets can be saved for closed-loop control (e.g., for wye or delta connections). You can switch between the parameter sets in the PLC.

Position-controlled spindle

The position of the spindle is monitored by the control.

Encoder

HEIDENHAIN rotary encoder with sinusoidal voltage signals (1 V_{PP}) or EnDat interface.

Tapping

There are special cycles for tapping with or without a floating tap holder. For tapping without a floating tap holder, the spindle must be operated under position control.

Spindle orientation

With a position-controlled spindle, the spindle can be positioned exactly to 0.1°.

Spindle override

0% to 150%

Gear stages

A specific nominal speed can be defined for each gear stage. The gear code is output via the PLC.

Multiple main spindles

Up to 4 spindles can be controlled alternately. The spindles are switched by the PLC. One control loop is required for each active spindle.

Spindle Synchronism (software option)

Synchronization of spindles: The Spindle Synchronism software option allows the speed of two spindles to be synchronized (the TNC7 can also synchronize more than two). Spindle synchronization is also possible with a transmission ratio or a defined offset.

Encoders

Overview

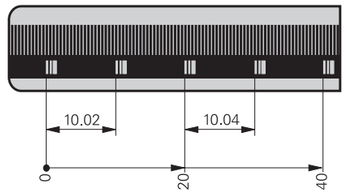
For speed and position control of the axes and spindle, HEIDENHAIN offers both incremental and absolute encoders.

Incremental encoders

Incremental encoders have as measuring standard a grating consisting of alternate lines and spaces. Relative movement between the scanning head and the scale causes the output of sinusoidal scanning signals. The measured value is calculated by counting the signals.

Reference mark

After the machine has been switched on, the relationship between the measured value and the machine position must be established by traversing the reference marks. For encoders with distance-coded reference marks, the maximum travel until automatic reference mark storage for linear encoders is only 20 mm or 80 mm, depending on the model, or 10° or 20° for angle encoders.



Evaluation of reference marks

The routine for traversing the reference marks can also be started for specific axes via the PLC during operation (reactivation of parked axes).

Output signals

Incremental encoders with sinusoidal output signals with ~ 1 V_{PP} levels are suitable for connection to HEIDENHAIN numerical controls.

Absolute encoders

With absolute encoders, the position information is contained in several coded tracks. Thus, an absolute reference is available immediately after switch-on. Reference-mark traverse is not necessary. For cyclical closed-loop operation, position information from incremental signals can be used, or from serial absolute signals (EnDat 2.2) with very short cycles.

EnDat interface

The TNC7/TNC7 basic features the serial EnDat 2.2 interface (includes EnDat 2.1) for the connection of absolute encoders.

Note: The EnDat interface on HEIDENHAIN encoders differs in its pin layout from the interface on Siemens motors with integrated absolute ECN/EQN rotary encoders. Special adapter cables are available.

Encoder inputs

Incremental and absolute linear, angle, or rotary encoders from HEIDENHAIN can be connected to the **encoder** inputs of the controller unit (only purely serial encoders with EnDat 2.2 can be connected to mini-IO connectors).

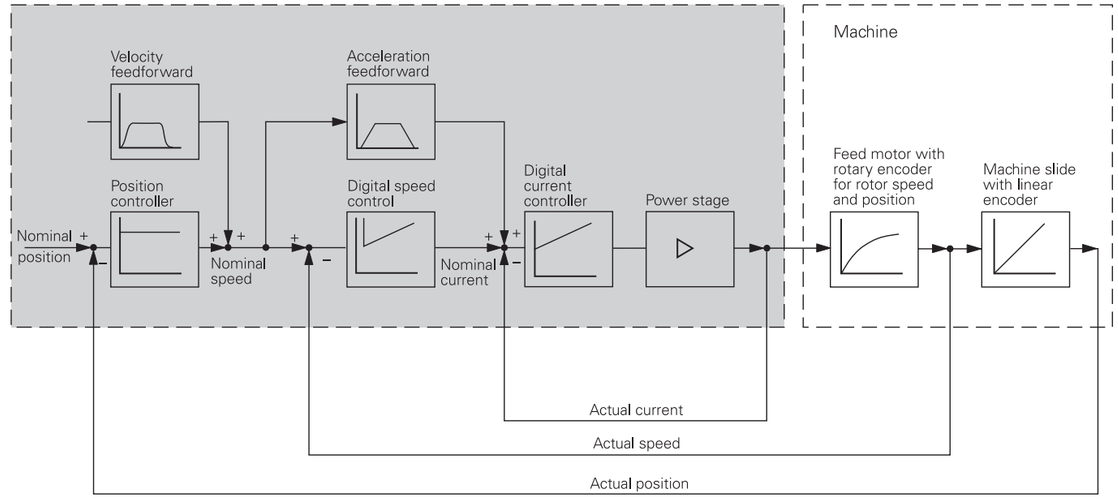
Channel inputs	**Signal level/ Interface[1)]**	**Input frequency[1)]**	
		Position	**Speed**
Incremental signals	~1 V_{PP} EnDat 2.1	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.1 EnDat 2.2	–	–

[1)] Switchable

Digital servo control

Integrated inverter

HEIDENHAIN synchronous or asynchronous motors are connected to the TNC7/TNC7 basic.



Axis feedback control

The TNC7/TNC7 basic can be operated with feedforward control or servo lag.

Operation with feedforward control

Feedforward means that a given velocity and acceleration are adapted to the machine. Together with the values calculated from the servo lag, this given velocity and acceleration becomes the nominal value. A much lower servo lag thereby manifests itself.

Operation with servo lag

The term “servo lag” denotes the distance between the momentary nominal position and the actual position of the axis. The velocity is calculated as follows:

$v = k_v \cdot s_a$

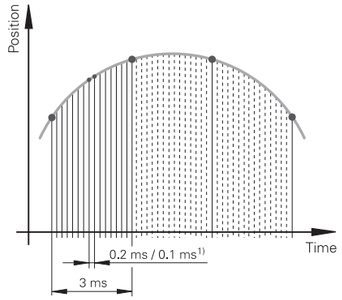
v = Velocity
k_v = Position loop gain
s_a = Servo lag

Compensation of torque ripples

The torque of synchronous, torque, and linear motors is subject to periodic oscillations, one cause of which can be permanent magnets. The amplitude of this torque ripple depends on the motor design and, under certain circumstances, can have an effect on the workpiece surface. During initial configuration of the axes with TNCopt, this torque ripple can be compensated for by means of the Torque Ripple Compensation (TRC) function of the CC or UEC.

Control-loop cycle times

The cycle time for **path interpolation** is defined as the time interval during which interpolation points on the path are calculated. The cycle time for **fine interpolation** is defined as the time interval during which interpolation points are calculated that lie within the interpolation points calculated for path interpolation. The **cycle time for the position controller** is defined as the time interval during which the actual position value is compared to the calculated nominal position value. The **cycle time for the speed controller** is the time interval in which the actual speed value is compared to the calculated nominal speed value. The **cycle time for the current controller** is defined as the time interval during which the actual value of the electrical current is compared to the calculated nominal value of the electrical current.



	CC/UEC/UMC
Path interpolation	See values at Page 7
Fine interpolation	
Position controller	
Speed controller	
Current controller	

Clamping of axes

The control loop can be opened through the PLC in order to clamp specific axes.

Double Speed Axes (software option)

Short control-loop cycle times: The Double Speed Axes software option permits higher PWM frequencies as well as shorter cycle times for the speed controller. This enables improved current control for spindles and higher controller performance for linear and torque motors.

Crossover Position Filter (CPF)

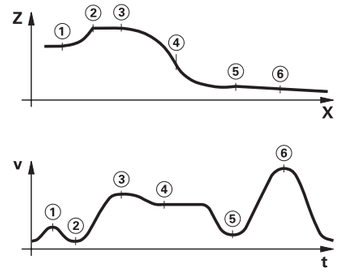
To increase the stability of the position control loop in systems with resonances, the position signal from the position encoder, which is filtered through a low-pass filter, is combined with the position signal from the motor speed encoder, which is filtered through a high-pass filter. This signal combination is made available to the position controller as the actual position value. The possible position controller gain (k_V factor) is increased significantly by this. The filter separation frequency is set specifically for each axis via machine parameters. The CPF can be used only in dual-encoder systems; i.e., on motors with a speed encoder and position encoder.

Fast contour milling

Short block processing time

The TNC7/TNC7 basic provides the following important features for fast contour machining.

The block processing time of the MC is less than 0.5 ms. This means that the TNC7/TNC7 basic is able to run long programs from the hard disk, even with contours approximated with linear segments as small as 0.2 mm, at a feed rate of over 24 m/min.



Look-ahead

The TNC7/TNC7 basic calculates the geometry ahead of time in order to adjust the feed rate (for up to 5000 blocks). In this way, directional changes are detected in time to accelerate or decelerate the appropriate NC axes.

Jerk

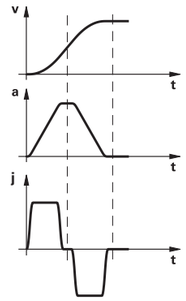
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

Jerk limiting

To prevent machine oscillations, the jerk is limited to attain optimum path control.

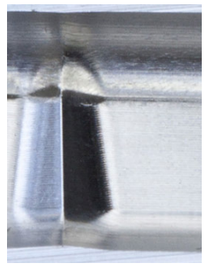
Smoothed jerk

The jerk is smoothed by nominal position value filters. The TNC7/TNC7 basic therefore mills smooth surfaces at the highest possible feed rate and yet keeps the contour accurate. You program the permitted tolerance via a cycle. Special filters for HSC machining (HSC filters) can suppress machine-specific natural frequencies. The desired accuracy along with very high surface quality is attained.



Advanced Dynamic Prediction (ADP)

The Advanced Dynamic Prediction (ADP) function enhances the look-ahead of the permissible maximum feed rate profile, thereby enabling optimized motion control for clean surface finishes and perfect contours. The strengths of ADP are evident, for example, during bidirectional finish milling through symmetrical feed behavior on the forward and reverse paths as well as through particularly smooth feed rate curves on parallel milling paths. NC programs that are generated on CAM systems have a negative effect on the machining process due to various factors such as short, step-like contours; coarse chord tolerances; and heavily rounded end-point coordinates. Through an improved response to such factors and the exact adherence to dynamic machine parameters, ADP not only improves the surface quality of the workpiece but also optimizes the machining time.



Part milled with ADP

Part milled without ADP

Dynamic Efficiency

dynamic + efficiency

Overview

With the concept of Dynamic Efficiency, HEIDENHAIN offers innovative functions that help you make heavy machining and roughing more efficient while also enhancing process reliability. Dynamic Efficiency permits higher removal rates and therefore increases productivity. At the same time, it prevents any tool overloading and the concomitant premature cutter wear.

The Optimized Contour Milling software option ("Opt. Contour Milling", also OCM) led the Dynamic Efficiency package of functions to the second generation.

Dynamic Efficiency Generation 2 covers four software options:
- **Adaptive Feed Control (AFC)** controls the feed rate depending on the machining situation.
- **Active Chatter Control (ACC)** reduces chatter tendencies and thus permits higher feed rates and greater infeeds
- **Trochoidal milling** for the roughing of slots and pockets eases the load on the tool (standard feature of the TNC7/TNC7 basic).
- **Optimized Contour Milling (OCM)** allows pockets and islands of any shape to be machined with low tool wear using the highly efficient trochoidal milling method.

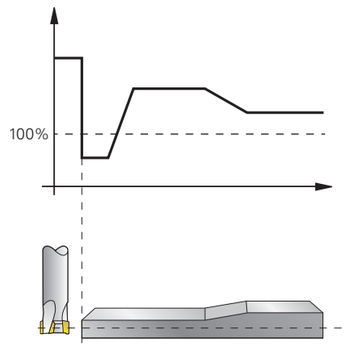
Individually, each of these solutions delivers key improvements to the machining process. But in combination, these software options functions bring out the full potential of the machine and tool while reducing the mechanical load.

Adaptive Feed Control (software option)

Adaptive Feed Control (AFC): With this software option, the feed rate is controlled in relation to the respective spindle power (as a percentage).

Benefits
- Optimization and reduction of machining time
- Prevention of subsequent damage through tool monitoring
- Automatic insertion of a replacement tool when the tool is worn (machine-dependent function)
- Protection of the machine mechanics
- Documentation by capturing and saving the learning and process data
- Integrated NC function, and therefore an alternative to external software solutions

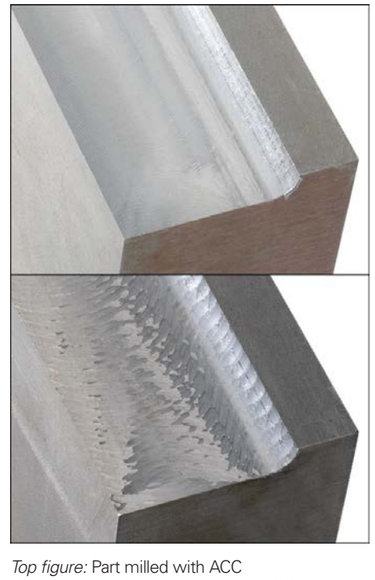
Restrictions:
The AFC software option cannot be used for analog spindles or in volts-per-hertz control mode.



Active Chatter Control (software option)

Active Chatter Control (ACC): Strong milling forces arise during heavy machining (roughing at high cutting speed). Depending on the tool spindle speed, the resonances in the machine tool, and the chip volume (metal-removal rate during milling), a phenomenon known as "chatter" may occur. Chatter induces heavy strain on the machine and causes ugly marks on the workpiece surface. Tool wear is also accelerated and less evenly distributed. In extreme cases, the tool may even break.

To reduce chatter susceptibility, HEIDENHAIN offers an effective remedy through the Active Chatter Control software option. Its use has particularly positive effects in the realm of heavy machining. With Active Chatter Control you achieve substantially higher cutting performance: depending on the machine model, the metal removal rate may increase by 25% or more. At the same time, you reduce strain on the machine and increase tool life.

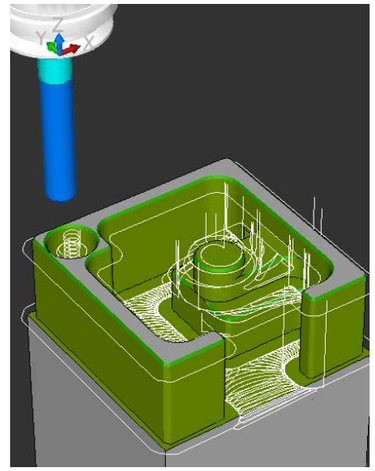


Top figure: Part milled with ACC
Bottom figure: Part milled without ACC

Optimized Contour Milling (software option)

Optimized Contour Milling (OCM): With this software option ("Opt. Contour Milling"), you can machine pockets and islands of any shape while reducing tool wear thanks to highly efficient trochoidal milling. You simply program the contour as usual directly in Klartext or make use of the convenient CAD Import function. The control then automatically calculates the complex movements required for trochoidal milling.

Advantages over conventional machining:
- Reduced thermal load on the tool
- Superior chip removal
- Uniform cutting conditions
- Higher possible cutting parameters
- Higher removal rates
- No need for adjustments by the machine manufacturer
- Cutting data calculator for the automatic calculation of cutting values



Dynamic Precision

dynamic + precision

Overview

The term Dynamic Precision encompasses a number of HEIDENHAIN milling solutions that significantly improve the dynamic accuracy of a machine tool. The dynamic accuracy of machine tools can be seen in position errors at the tool center point (TCP). The size of these errors depends on motion quantities such as velocity and acceleration (also jerk) and are caused, in part, by vibrations of machine components. Taken together, all of these errors are partially to blame for dimensional errors and faults on the surfaces of workpieces. They therefore have a decisive impact on quality and, in the event of quality-related scrap, on productivity as well.

The functions of the Machine Vibration Control (MVC) software option ("Machine Vibr. Contr.") and the expanded functions of the Motion Adaptive Control (MAC) software option ("Motion Adapt. Contr.") characterize the second generation of Dynamic Precision.

Because the stiffness of machine tools is limited for reasons of design and economy, problems such as compliance and vibration within the machine design are very difficult to avoid. Dynamic Precision counteracts these problems with intelligent control technology to enable designers to further improve the quality and dynamic performance of machine tools. As a result, production time and cost are reduced.

You can deploy the software options that make up Dynamic Precision Generation 2 both alone or in combination:

- **Load Adaptive Control** ("Load Adapt. Contr.", or LAC) compensates for load-induced deviations at the tool, thus guaranteeing high accuracy regardless of the load or aging.
- **Motion Adaptive Control** ("Motion Adapt. Contr.", or MAC) changes machine settings based on the momentary speed, thus improving the dynamic performance.
- **Cross Talk Compensation** ("Cross Talk Comp.", or CTC) compensates for acceleration-dependent position errors at the tool center point, making increased accuracy during acceleration phases possible.
- **Machine Vibration Control** ("Machine Vibr. Contr.", or MVC) damps machine oscillations to improve workpiece surface quality through the following functions:
  - Active Vibration Damping (AVD): active damping of vibrations in the control loop
  - Frequency Shaping Control (FSC): reduction of vibration inducement by means of frequency-based feedforward control
- **Position Adaptive Control** ("Position Adapt. Contr.", or PAC) compensates for position-induced deviations at the tool and thus increases accuracy and dynamic performance of the machine.

Load Adaptive Control (software option)

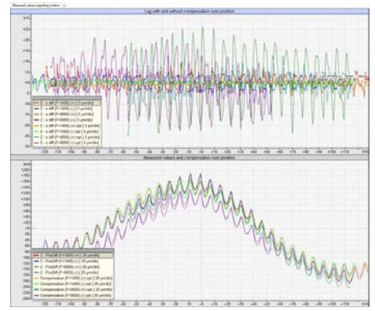
Load Adaptive Control (LAC): The dynamic behavior of machines with rotary tables can vary depending on the mass moment of inertia of the fixed workpiece. With the LAC software option, you can dynamically adjust controller parameters based on the load or friction. The TNC7/TNC7 basic is then capable of automatically determining the current mass moment of inertia of the workpiece and the current frictional forces.

In order to optimize changed control behavior at differing loads, various controller parameters (e.g., loop gains, and feedforward controls for acceleration, holding torque, static friction, and friction at high shaft speeds) can be adapted to the currently active load.

Motion Adaptive Control (software option)

Motion Adaptive Control (MAC): Along with the load-based modification of machine parameters through the LAC software option, the MAC software option allows machine parameters to be changed based on their initial values, such as speed, servo lag, or acceleration. Through this motion-dependent adaptation of the control parameters, a speed-dependent adaptation of the k_V factor can be implemented for drive systems whose stability changes due to the different traversing speeds.

The MAC software option was enhanced with the adaptive gear-error compensation of Dynamic Precision Generation 2. Surface quality problems often do not arise from machine resonances but rather from transmission errors in mechanical components of the feed drive systems. Transmission elements in the machine tool's power train, such as a rack and pinion, often cause unwanted shading on the workpiece surface. This results in cost-intensive rework, particularly in tool and mold making. The active gear-error compensation minimizes these periodic interferences.

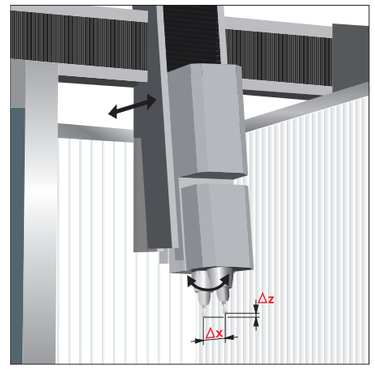


Cross Talk Compensation (software option)

Cross Talk Compensation (CTC): The CTC software option enables the compensation of dynamic position errors potentially arising from acceleration forces.

To increase productivity, machine tool users ask for ever higher feed rates and acceleration values, while at the same time needing to maintain the highest possible surface quality and accuracy, placing very special requirements on path control.

Highly dynamic acceleration processes introduce forces to the structure of a machine tool. They can deform parts of the machine and thereby lead to deviations at the tool center point (TCP). The dynamic acceleration of an axis causes not only axial deformations but also deformations that are lateral to the direction of acceleration (due to mechanical axis couplings). The resulting position error at the TCP in the direction of the accelerated axis and lateral axes is proportional to the amount of acceleration.



If the dynamic position errors relative to the axis acceleration are known, then these acceleration-dependent errors can be compensated for by the CTC software option in order to avoid negative effects on the surface quality and accuracy of the workpiece. Often, the resulting error at the TCP depends not only on the acceleration but also on the position of the axes in the working space. This can also be compensated for by CTC.

Machine Vibration Control (software option)

Machine Vibration Control (MVC): The high dynamics of modern machine tools lead to deformations in the machine base, frame, and drive train during acceleration and deceleration of the feed motors. This results in vibrations, such as machine setup vibrations, that may reduce the attainable accuracy and surface quality of the workpieces. With the MVC software option, two functions that effectively suppress low-frequency vibrations are available.

Active Vibration Damping (AVD)

The Active Vibration Damping (AVD) controller function increases dynamic rigidity and damps the especially critical low-frequency oscillations. At the same time, it optimizes the control behavior of the affected axis so that high-accuracy workpieces with excellent surface quality can also be produced at high feed rates.

Frequency Shaping Control (FSC)

The Frequency Shaping Control (FSC) function suppresses the inducement of low-frequency oscillations through a specific feedforward control. This can be used to increase dynamic limit values (e.g., jerk), and therefore make reduced machining times possible.

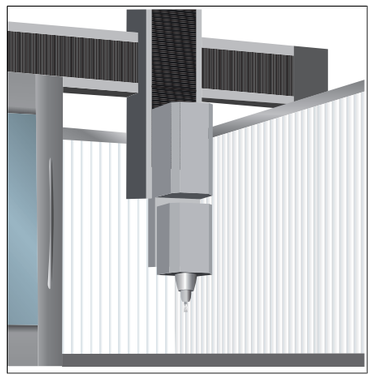
The combination of the two functions (AVD and FSC) optimizes the dynamics, surface quality, and productivity.

Position Adaptive Control (software option)

Position Adaptive Control (PAC): The PAC software option permits the dynamic, position-dependent adaption of controller parameters based on the spatial position of the tool.

The specifics of a machine's kinematics cause a unique position of the axes' center of gravity in the working space. This results in a variable dynamic behavior of the machine, which can negatively influence the control's stability depending on the axis positions.

To take full advantage of the machine's dynamic performance, the PAC software option enables changes to machine parameters based on position, thus permitting assignment of the respective optimal loop gain to defined interpolation points. Additional position-dependent filter parameters can be defined in order to further increase control loop stability.



Monitoring functions

Description

Monitoring functions*) — During operation the TNC7/TNC7 basic monitors the following details, among others:

- Amplitude of encoder signals
- Edge separation of encoder signals
- Absolute position for encoders with distance-coded reference marks
- Current position (servo lag monitoring)
- Actual path traversed (movement monitoring)
- Position deviation at standstill
- Nominal speed value
- Checksum of safety-related functions
- Supply voltage
- Voltage of the buffer battery
- Operating temperature of MC and CPU
- Run time of PLC program
- Motor current / motor temperature
- Temperature of power module
- DC-link voltage
- Difference between position and speed encoder (PosDiff)
- Serial connection of all devices in the HSCI chain
- Quality of optical connections between CC and UM
- Voltages of the main power supply
- Utilization of the 24 V supply

With EnDat 2.2 encoders:

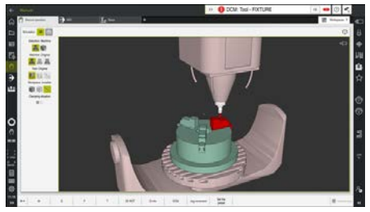
- CRC checksum of the position value
- EnDat alarm Error1→ EnDat status alarm register (0xEE)
- EnDat alarm Error2
- Edge speed of 5 µs
- Transmission of the absolute position value on the time grid

In the event of hazardous errors, an EMERGENCY STOP message is sent to the external electronics via the control-is-ready output, and the axes are brought to a stop. The correct connection of the TNC7/TNC7 basic in the machine's EMERGENCY STOP loop is checked when the control system is switched on. In the event of an error, the control displays a message in plain language.

*) No safety functions

Collision Monitoring (software option)

Dynamic Collision Monitoring (DCM): With the Collision Monitoring software option, the TNC7/TNC7 basic cyclically monitors the working space of the machine for possible collisions between machine components. To this end, you must define three-dimensional collision objects in the working space that are to be monitored by the TNC7/TNC7 basic during all machine movements, including those of the swivel head and tilting table. If two objects monitored for collision come within a defined distance of each other, the TNC7/TNC7 basic outputs an error message. At the same time, the affected machine components are shown in red in the machine image. Collision monitoring is active in the manual operating modes and in the machine operating modes, and is indicated by a symbol in the operating mode line.



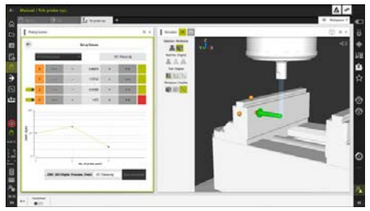
Collision monitoring also protects fixtures and tool carriers from collisions. The 3D collision objects are configured with the KinematicsDesign PC tool. With the TNC7/TNC7 basic, collision objects can also be transferred in M3D format from standard CAD models to the control (see Page 83).

Advantages of the M3D format:
- Simple data transfer from already available CAD models
- Fully detailed illustration of machine components
- Greater exploitation of the machine's workspace

Please note:
- The collision of machine parts (for example, the swivel head) with the workpiece cannot be detected
- Collision objects are not automatically transformed into rotationally symmetric objects in turning mode
- Collision Monitoring (DCM) is not active in servo-lag operation (no feedforward)

Collision Monitoring v2 (software option)

Dynamic Collision Monitoring (DCM) version 2: This option includes all functions of the Collision Monitoring software option. It also enables collision monitoring of workholding equipment thanks to graphically supported alignment of the fixtures. Furthermore, if DCM v2 monitoring is active, machining right up to the fixture (distance = 0) is possible.



Benefits
- Effective during program run and MDI
- In the NC syntax, you define the monitored distance from the fixture, including the holder
- The DCM safety clearance for machine components is unchanged; the new feature applies only to fixtures

A fixture that has been set up accurately is essential for machining close to the workpiece. With the **Set up fixtures** function you determine the position of a 3D model in the **Simulation** workspace, matching the real fixture in the machine envelope. After setting up the fixture, the TNC7/TNC7 basic considers it in DCM.

3D tool models (ToolShape)

The Collision Monitoring v2 software option offers the possibility of integrating 3D tool models of any tool shapes as STL files.

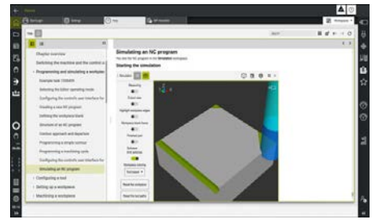
Benefits
- Ability to protect tools of any shape from collisions with fixtures and machine components
- Realistic material-removal simulation
- Use of tools with any measuring point, such as for measuring the rear cutting edge of backward deburrers

Import function of the OPC UA NC Server

The collision protection provided by Collision Monitoring v2 is only as good as the data for the models of the collision objects. For reliable machine operation, the digital data must match the physical reality. The import function of the OPC UA NC Server provides tool presetters and tool databases with functions for importing the 3D models of the tool and tool holder directly into the control. The model validation feature checks the 3D models during importing, thus ensuring maximum reliability of Collision Monitoring v2 and the simulation.

Interactive help area

If you require assistance, an interactive help area is available with user documentation and tutorial videos from HEIDENHAIN on many topics regarding NC controls.



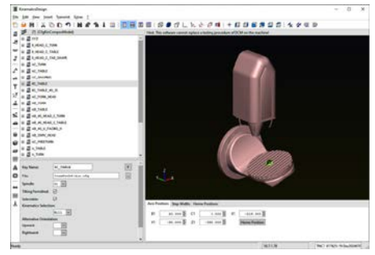
You can use this modern HTML5 area to integrate your own (machine-specific) contents.
- Modern design and appearance of the contents
- Full touch capability
- Support for videos, animations, etc.

CAD Model Optimizer (software option)

Conversion and optimization of CAD models: The CD Model Optimizer software option gives you the power to simplify and heal 3D models, and thus create valid STL files for collision monitoring or workpiece blanks for simulation. You load the output model into the CAD viewer. The 3D mesh function simplifies the model and autonomously corrects errors such as small holes in the solid model or self-intersecting lines on a surface. The result is a valid STL file that can be used for various functions of the control.

KinematicsDesign (accessory)

KinematicsDesign is a PC tool for creating adaptable kinematic configurations. It supports:
- Complete kinematic configurations
- Transfer of configuration files between control and PC
- Description of tool-carrier kinematics

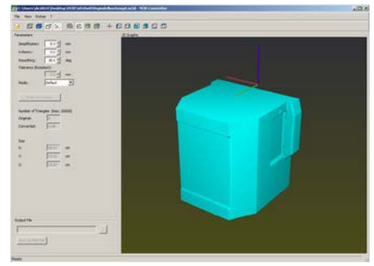


If KinematicsDesign is connected to a control online (operation is also possible with the programming station software), then machine movements can be simulated when the axes are moved. Together with the TNC7/TNC7 basic, KinematicsDesign simulates the working space when collision monitoring is active (whether through the Collision Monitoring software option, or Collision Monitoring v2), and collisions that occur—as well as machine components that are in danger of collision—are displayed in a color that you define.

Visualization options range from a pure depiction of the transformation chain and a wire model all the way to the complete machine model. The KinematicsDesign PC tool is also available on the TNC7/TNC7 basic. The KinematicsDesign version on the TNC7/TNC7 basic assists you in optimizing, adjusting and changing the kinematics of your machine. The working space and the collision objects of the active kinematics can be displayed and edited. The range of features of the version installed on the control is restricted to the features required by the control. Thanks to tool tips that appear when you move the pointer over the options, the software is self-explaining.

M3D Converter (accessory)

The TNC7/TNC7 basic lets you import collision objects from a CAD file and incorporate them as M3D data into the machine kinematics.



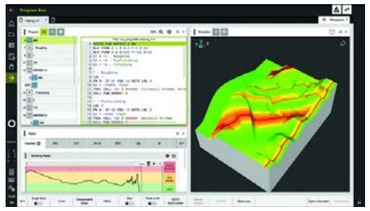
The M3D data format from HEIDENHAIN permits an especially finely detailed depiction of high-resolution collision objects. The M3D converter, which is capable of performing tasks such as checking, repairing, simplifying, merging, and optimizing CAD data for collision objects, is used to generate the M3D data.

As an independent PC tool, the M3D converter is part of the KinematicsDesign installation package (as of version 3.1). The M3D converter requires a software release module.

M3D Converter software release module ID 1124969-01

Component Monitoring (software option)

Component monitoring: The overloading of machine components is often the cause of expensive machine damage and unplanned production downtime. Component Monitoring keeps you informed about the current loading of the spindle bearings and reacts if the specified limit values are exceeded; for example, with an NC stop. The MONITORING HEATMAP function allows you, from the NC program, to color the real-time machining simulation with the status of a monitoring task. That way the workpiece shows you where a component was subject to a strong load.



During their lifecycle, the machine components which are subject to loads (e.g., guides, ball screws, etc.) become worn and thus the quality of the axis movements deteriorates. This, in turn, affects production quality.

With the Component Monitoring software option and a cycle, the TNC7/TNC7 basic is able to measure the current condition of the machine. As a result, any deviations from the machine's shipping condition due to wear and aging can be measured. You can read and evaluate the data, and react with predictive maintenance, thereby avoiding unplanned machine downtimes.

Process Monitoring (software option) (TNC7)

Process monitoring: The Process Monitoring software option can detect deviations of the current machining process from one or multiple reference machining processes, and respond to them. With the aid of monitoring tasks, the TNC7 compares the signal curve of the execution of an NC program with one or more reference machining processes. The control detects whether the signal exceeds the configured monitoring tunnel, and initiates the respectively configured reaction, such as an NC stop or disabling of the tool. This can prevent damage from resulting. If the appropriate equipment and materials are in place, then the subsequent machining job can be executed.

The TNC7 uses process monitoring to detect disturbances in the machining process, e.g.:

- Tool breakage
- Incorrect or missing pre-machining of the workpiece
- Changed position or size of the workpiece blank
- Wrong material (e.g., aluminum instead of steel)

Error compensation

Overview

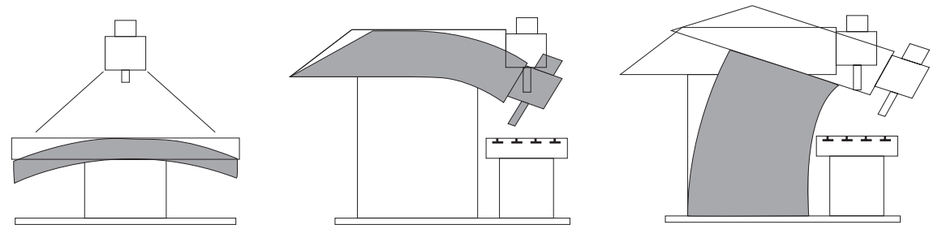
The TNC7/TNC7 basic automatically compensates for mechanical errors of the machine.

Linear error

Linear error can be compensated for over the entire travel range for each axis.

Nonlinear error

The TNC7/TNC7 basic can compensate for ball-screw pitch errors and sag errors simultaneously. The compensation values are stored in a table. Nonlinear axis-error compensation also makes it possible to compensate for position-dependent backlash.



Backlash

The play between the table movement and rotary encoder movement on direction changes can be compensated for in length measurements by the spindle and rotary encoder. This backlash is outside the controlled system.

Hysteresis

The hysteresis between the table movement and motor movement is also compensated for in direct length measurements. In this case the hysteresis is within the controlled system.

Reversal spikes

In circular movements, reversal spikes can occur at quadrant transitions due to mechanical influences. The TNC7/TNC7 basic can compensate for these reversal spikes.

Static friction

At very low feed rates, high static friction can cause the slide to stop and start repeatedly for short periods. This is commonly known as stick-slip. The TNC7/TNC7 basic can compensate for this problem condition.

Sliding friction

Sliding friction is compensated for by the speed controller of the TNC7/TNC7 basic.

Thermal expansion

To compensate for thermal expansion, the machine's expansion behavior must be known.

The temperature is measured via thermistors connected to the analog inputs of the TNC7/TNC7 basic. The PLC evaluates the temperature information and passes a compensation value to the NC.

KinematicsOpt (software option)

Automated measurement of rotary axes: Using the KinematicsOpt software option, you can check the accuracy of rotary or swivel axes, and compensate for possible displacements of the center of rotation of these axes. The deviations are automatically transferred to the kinematics description and can be taken into account in the kinematics calculation.

In order to measure the rotary axes, you must attach a calibration sphere (e.g., KKH 100 or KKH 250 from HEIDENHAIN) at any position on the machine table. A HEIDENHAIN touch probe uses a special cycle to probe this calibration sphere, and measures the rotary axes of the machine fully automatically. But first you define the resolution of the measurement and define for each rotary axis the range that you want to measure. The measuring process is the same, regardless of whether the rotary axis is a rotary table, tilting table, or a swivel head.

Calibration sphere (accessory)

HEIDENHAIN offers calibration spheres as accessories for the measurement of rotary axes with the KinematicsOpt software option:

KKH 80	Height: 80 mm	ID 655475-03
KKH 250	Height: 250 mm	ID 655475-01

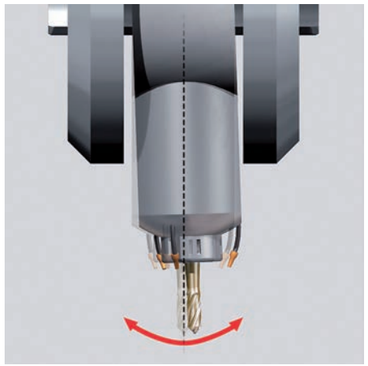
KinematicsComp (software option) (TNC7)

Spatial compensation of errors in rotary and linear axes: Increasingly stringent requirements on workpiece tolerances constantly increase the demands placed on the precision of a machine tool. However, components of machine tools inevitably show imperfections that are, for example, caused by manufacturing or assembly or result from elastic deformation. This is the reason why the commanded tool position and orientation are not always reached exactly everywhere in the working space. The more axes a machine has, the more sources of error there are. The use of mechanical means to cope with these problems requires considerable effort, particularly in the field of 5-axis machining, or when large machines with parallel axes are involved.

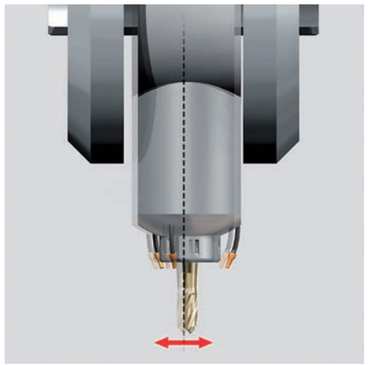
The KinematicsComp software option allows you to save a comprehensive description of the machine errors in the control. KinematicsComp then automatically compensates for the position error that results from static errors of the physical machine axes (volumetric compensation). The positions of all rotary and linear axes, as well as the current tool length, are included in the calculation.

KinematicsComp can be used to define position-dependent temperature compensation, where the required data is supplied by several sensors located at relevant points on the machine.

For example, the spatial errors of the tool tip can be measured with a laser tracer or laser interferometer. However, multidimensional tables for component errors make it possible to use measured data directly for compensation without building a model. PLC variables as initial values for formulas and multidimensional tables make it easy to enter parameters for powerful compensation, for example, for various thermal conditions or load situations.



Fault characteristics according to ISO 230-1: EBA



Fault characteristics according to ISO 230-1: EXA

3D-ToolComp (software option) (TNC7)

3D radius compensation based on the contact angle (only with the Advanced Function Set 2 software option): On the TNC7, the 3D-ToolComp software option provides 3D tool radius compensation irrespective of the tool's angle of contact, thus allowing for the compensation of tool form errors. A compensation-value table is used to define angle-dependent delta values. These delta values define the deviation of a tool from its ideal circular form or the deviation in a touch probe's switching behavior. For use with a tool, this function requires surface normal vectors in the NC program, for which the Advanced Function Set 2 software option must be enabled. During probing with a touch probe, these compensation values are taken into account only in appropriately prepared probing cycles (e.g., Cycle 444).

Initial setup and diagnostic aids

Overview

The TNC7/TNC7 basic provides internal commissioning and diagnostic aids.

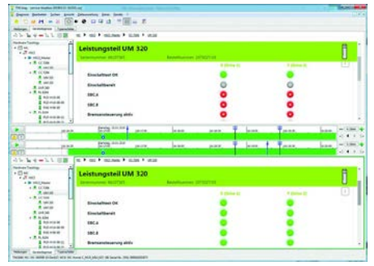
ConfigDesign (accessory)

PC tool for configuring the machine parameters:
- Stand-alone machine-parameter editor for the TNC7/TNC7 basic; all support information, additional data, and input limits are shown for the parameters
- Configuration of machine parameters
- Comparison of machine parameters from different controls
- Importing of service files: easy testing of machine parameters in the field
- Rule-based creation and management of machine configurations for multiple controls (together with PLCdesign)

TNCdiag

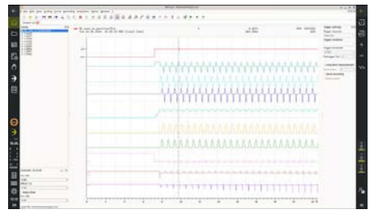
The HEIDENHAIN TNCdiag application evaluates the status and diagnostic information of HEIDENHAIN components (with an emphasis on the drive systems) and graphically images the data:
- Status and diagnostic information about the HEIDENHAIN components (drive electronics, encoders, input/output devices, etc.) connected to the control
- History of the recorded data

Note: TNCdiag comes in a PC version for the analysis of servicing files and in a control version for the display of live data.



Oscilloscope (TNCscope on the control)

The TNC7/TNC7 basic features an integrated oscilloscope, with which up to 64 channels containing up to 50 million measuring points in total can be recorded and stored simultaneously. It offers the same evaluation possibilities as the TNCscope external PC tool: X/Y graph, FFT, derivation, integration, low-pass filter, removal of oversampling or the constant component, or entry of one's own formula.
- Actual value and nominal value of the axis feed rate
- Contouring feed rate
- Nominal and actual position
- Servo lag of the position controller
- Nominal and actual values for speed, acceleration and jerk
- Content of PLC operands (markers, words, inputs, outputs, counters, timers)
- Encoder signal (0° – A) and (90° – B)
- Difference between position and speed encoder
- Nominal velocity value
- Integral-action component of the nominal current value
- Torque-determining nominal current value

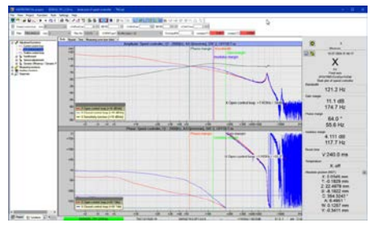


TNCscope (accessory)

PC tool for transmitting the oscilloscope files to a PC.
The functionality is largely the same as the integrated TNCscope on the TNC7/TNC7 basic. It can also record and store up to 64 channels, but there is no restriction to 50 million measuring points over all channels.
Note: The trace files are saved in the TNCscope data format.

TNCopt (accessory)

PC tool for initial setup of digital control loops.
Functions (among others):
- (Automatic) initial setup of the control loops (current, speed, position)
- (Automatic) optimization of various feedforward controls
  - Reversal peaks
  - Friction parameters, acceleration feedforward control
  - Torsion compensation
- (Automatic) system identification
- Circular form test, contour test
- Working space scan, 3D workspace inspector



Online Monitor (OLM)

The online monitor is a component part of the TNC7/TNC7 basic and is called with a code number.
It supports initial setup and diagnosis of control components by:
- Display of control-internal variables for axes and channels
- Display of controller-internal variables (if a CC is present)
- Display of hardware signal states
- Various trace functions
- Activation of spindle commands
- Enabling control-internal debug outputs

API DATA

With the API DATA function, the TNC7/TNC7 basic displays the states or contents of the symbolic API markers and API double words.

Table function

The current conditions of the markers, words, inputs, outputs, counters, and timers are displayed in tables. The conditions can be changed through the keyboard.

Trace function

The current content of the operands and the accumulators is shown in the statement list in each line in hexadecimal or decimal code. The active lines of the statement list are marked.

Log

For the purpose of error diagnostics, all error messages and keystrokes are recorded in a log. The entries can be read using the **PLCdesign** or **TNCremo** software for PCs.

RemoteAccess (accessory)

PC tool for remote diagnostics, monitoring and operation.

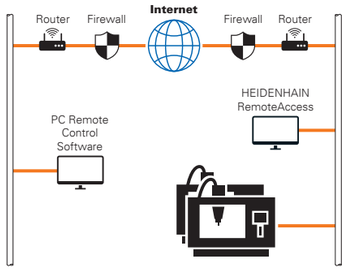
RemoteAccess grants quick and easy access to HEIDENHAIN controls that are installed within the same local network (intranet).

RemoteAccess offers the following functions:
- Display of the control's user interface on the PC
- Operating the control directly through the live view as well as with the integrated keyboard
- Automatic integration of HEIDENHAIN PC tools
- Can be enhanced with OEM-specific applications

Single station license ID 1339577-01
Network license (14 stations) ID 1339577-02
Network license (20 stations) ID 1339577-03

Secure Remote Access (SRA)

The optional Secure Remote Access enhancement makes it possible to establish an encrypted connection with a HEIDENHAIN control via the Internet. This connection is end-to-end encrypted. Once the SRA connection has been set up, RemoteAccess behaves like a local network connection. This connection can be used by HEIDENHAIN PC tools and by any other PC application.



Possible applications when using SRA:
- User support
- Online training courses
- Diagnostics, remote maintenance and online support
- Secure Internet connection as the basis for other OEM services

Export license required
The Secure Remote Access expansion requires an export license in accordance with Annex I of the EU Dual-Use Regulation. A valid export license is mandatory for operating this application outside of the EU or with partners outside of the EU.

License model
The expansion is offered as a software subscription with a two-year license period. The license term is automatically renewed for twelve months unless the contract is terminated with at least three months' notice. The license requires a HEIDENHAIN Portal account.

Scope of delivery
A license key is included in order to enable the Secure Remote Access expansion. During activation in the HEIDENHAIN Portal, the license key is assigned to the registered user.

Secure Remote Access (SRA) ID 1356741-01
Software subscription (2-year license term)

Bus diagnosis

In Diagnosis mode, the structure of the connected bus systems as well as the details of the connected components can be shown in an intuitive manner.

TNCtest and TestDesign (accessory)

Acceptance tests on machine tools with external or integrated functional safety (FS) must be conducted reproducibly and verifiably.

The TNCtest and TestDesign program package for PCs can be used to plan and perform acceptance tests for machine tools with HEIDENHAIN controls. TestDesign is software for designing acceptance tests, and TNCtest serves to perform them.

The TNCtest programs are designed to provide support during acceptance testing, provide required information, and perform automatic configuration, as well as record data and evaluate the data semiautomatically. A tester (user) must evaluate manually whether a test case passed or failed.

TNCanalyzer (accessory)

The PC tool TNCanalyzer provides for simple and intuitive evaluation of servicing and log files:

- Loading of servicing and log files
- Analysis of temporal sequences and static states
- Filters and search functions
- Data export (HELogger, CSV, and JSON formats)
- Definition of application-specific analysis profiles
- Preconfigured analysis profiles
- Graphic display of signals via TNCscope
- Interaction with other tools that are intended for the display of special sections of the service file

Integrated PLC

Overview

The PLC program is created by the machine manufacturer either at the control or with the PC tool **PLCdesign** (accessory). Machine-specific functions are activated and monitored via the PLC inputs/outputs. The number of PLC inputs/outputs required depends on the complexity of the machine.

PLC inputs/ outputs

PLC I/Os are available via the external PL 6000 and UxC. The PLC I/Os and the PROFINET IO or PROFIBUS DP-capable I/O system must be configured with the PC tool IOconfig.

PLC programming

Format	Statement list
Memory	4 GiB
Cycle time	9 ms to 30 ms (adjustable)
Command set	• Bit, byte, and word commands • Logical operations • Arithmetic commands • Comparisons • Bracketed terms • Jump commands • Subprograms • Stack operations • Submit programs • Timers • Counters • Comments • PLC modules • Strings

Encryption of PLC data

With the encrypted PLC partition (PLCE:) you have a tool for effectively preventing third parties from viewing or modifying files. The files on the PLCE partition can only be read by the control itself or by using the correct OEM keyword. This ensures that proprietary expertise and special customer-specific solutions cannot be copied or changed.

When you create the encrypted PLCE partition you also freely determine its size. Another advantage is that, in spite of the encryption, the data can backed up from the control to a separate data medium (USB drive or network, e.g., through TNCremo) and later restored. You need not enter the password for this action, but the data cannot be made visible unless the keyword is supplied.

PLC window

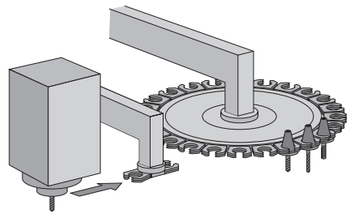
The TNC7/TNC7 basic can display PLC error messages in the dialog line during operation.

PLC soft keys

You can display your own PLC soft keys in the vertical soft-key row on the screen.

PLC positioning

All closed-loop axes can also be positioned via the PLC.
PLC positioning of the NC axes cannot be superimposed on NC positioning.



PLC axes

Axes can be defined as PLC axes. They are programmed by means of M functions or OEM cycles. The PLC axes are positioned independently of the NC axes.

PLCdesign (accessory)

PC tool for PLC program development.
PLCdesign can be used for easy creation of PLC programs. It comes with an extensive selection of sample PLC programs.

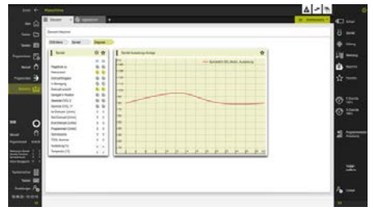
Functions:
- User-friendly text editor
- Menu-guided operation
- Programming with symbolic operands
- Modular programming techniques
- "Compiling" and "linking" of PLC source files
- Operand commenting, creation of the documentation file
- Comprehensive help system
- Data transfer between the PC and control
- Creation of PLC soft keys

Python OEM Process (software option)

Executing Python applications: The Python OEM Process software option gives you a powerful tool for using a high-level, object-oriented programming language in the control (PLC).

Simple Python scripts can also be executed without enabling the Python OEM Process software option. 10 MB of dedicated memory are reserved for this function. For more information, refer to the *Python in HEIDENHAIN Controls* Technical Manual (ID 757807).

The TNC7/TNC7 basic provides you with entirely new ways of designing intuitive, task-oriented, customized user interfaces and integrating them seamlessly into the layout of the control. Not only are comprehensive embedding options, Python 3, and the Qt graphics library available, but also a package of functions developed separately by HEIDENHAIN, called "HEIDENHAIN Controls".



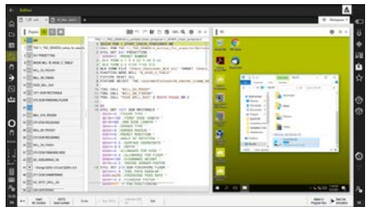
With HEIDENHAIN Controls you can easily customize the user interface of the TNC7/TNC7 basic as desired.

HEIDENHAIN Controls provides you with the following benefits:
- Graphical elements in the new HEIDENHAIN design
- Automatic design update after an NC software update
- Advanced touch operation with context-sensitive screen keyboards
- Minimized development effort in switching from GTK to Qt
- Standardized fonts and colors

Embedded Workspace

The TNC7/TNC7 basic offers you the possibility of seamlessly embedding remote desktops or applications as a workspace or separate operating mode directly in the user interface of the TNC7/TNC7 basic. The workspaces support responsive design and are therefore able to display the content in an optimized way in the display areas selected by the user. Enabling of the Remote Desktop Manager software option is required for this.

Embedding options:
- Remote Desktop: Displays a remote Windows desktop via RDP
- RemoteX: Displays an X window of a remote Linux application.



Remote Desktop (RDP)

RemoteX

The TNC7/TNC7 basic enables the output of NC and OEM dialogs on an external HEIDENHAIN ITC.

Application examples:
- Tool management
- Pallet management
- OEM operating mode for further automation tasks

PLC basic program

The PLC basic program serves as the basis for adapting the TNC7/TNC7 basic to the requirements of the respective machine model. It can be downloaded from the Internet. These essential functions are covered by the PLC basic program:

Axes	• Control of analog axes • Axes with clamping mode, central drive, and the Hirth grid • Synchronized axes • Reference run, reference end position • Axis lubrication
Spindles	• Control and orientation of the spindles • Spindle clamping • Alternative double-spindle operation • Parallel spindle operation • Conventional 2-stage gear system • Wye/delta connection switchover (static, dynamic)
Tool changers	• Manual tool changer • Tool changer with pick-up system • Tool changer with dual gripper • Tool changer with positively driven gripper • Rotating tool magazine with closed-loop axis • Rotating tool magazine with controlled axis • Servicing functions for the tool changer • Python tool management
Pallet changers	• Translational pallet changer • Rotatory pallet changer • Servicing functions for the pallet changer
Safety functions	• Emergency stop test (EN 13849-1) • Brake test (EN 13849-1) • Repeated switch-on test for a wireless handwheel
General functions	• Feed rate control • Control of the coolant system (internal, external, air) • Toggling between milling and turning modes • Temperature compensation • Activate tool-specific torque monitoring • Hydraulic control • Chip conveyor • Indexing fixture • Touch probes • PLC support for handwheels • Control of doors • Handling of M functions • PLC log • Display and management of PLC error messages • Diagnosis screen (Python) • Python example applications

Interfacing to the machine

OEM cycles

You can create and store your own cycles for recurring machining tasks. You use these OEM cycles in the same way as standard HEIDENHAIN cycles.

CycleDesign (accessory)

The soft-key structure for the cycles is managed using the PC tool **CycleDesign**. In addition, CycleDesign can be used to store help graphics and soft keys in BMP format in the TNC7/TNC7 basic. Graphic files can be compressed to ZIP format to reduce the amount of memory used.

Tool management

With integral PLC, the tool changer is moved either via proximity switch or as a controlled axis. Complete tool management with tool life monitoring and replacement tool monitoring is carried out by the TNC7/TNC7 basic.

Touch Probe Functions

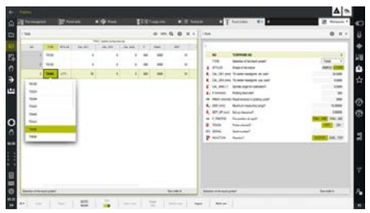
Tool measurement: With the TT tool touch probes (accessory), tools can be measured and inspected. Standard cycles for automatic tool measurement are available in the control. The TNC7/TNC7 basic calculates the probing feed rate and the optimal spindle speed. The measured data are stored in a tool table.

TNC7	TNC7 basic
Standard feature	Software option: Touch Probe Functions

Touch Probe Functions

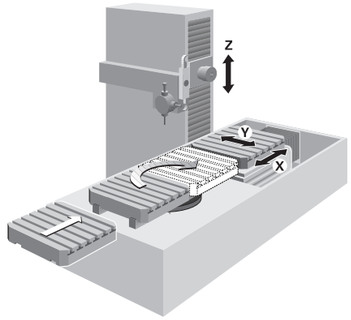
Touch probe configuration: All touch-probe data can be configured conveniently through the touch-probe table. All HEIDENHAIN touch probes are preconfigured and can be selected through a drop-down menu.

TNC7	TNC7 basic
Standard feature	Software option: Touch Probe Functions



Pallet management

Pallet insertions can be controlled via PLC axes. You define the pallet sequence, pallet presets, and workpiece presets in the pallet tables. The pallet tables are freely configurable; any information can be stored in the tables and called via the PLC. Pallet table execution can be workpiece- or tool-oriented.



Data transfer and communication
Data interfaces

Overview

The TNC7/TNC7 basic is connected to PCs, networks, and other data storage devices via data interfaces.

Ethernet

Using the Ethernet data interface, you can network the TNC7/TNC7 basic based on the TCP/IP protocol. For connection to the data network, the control features a 1000BASE-T (twisted pair Ethernet) connection.

Maximum transmission distance:
Unshielded: 100 m
Shielded: 400 m

Network connection
- NFS file server
- Windows networks (SMB)

Data transmission speed

Approx. 400 to 800 Mbit/s (depending on file type and network utilization)

Protocols

The TNC7/TNC7 basic can transfer data using various protocols.

Standard data transmission

The data is transferred character by character. The number of data bits, stop bits, the handshake, and character parity must be set by the user.

Blockwise data transfer

The data are transferred blockwise. A block check character (BCC) is used for data backup. This method improves data security.

OPC UA NC Server

Connection of an OPC UA application

USB

The TNC7/TNC7 basic features USB ports for connecting standard USB devices such as a mouse, disk drive, etc. The MCs have four USB 3.0 ports. One of them leads to the TE keyboard unit or MB machine operating panel, where a cover cap protects it from contamination. More USB 2.0 ports are in the integrated USB hub on the rear of the BF. The USB ports are rated for a maximum of 0.5 A.

USB cables

Cable length up to 5 m	ID 354770-xx
Cable length 6 m to 30 m with integrated amplifier; limited to USB 1.1	ID 624775-xx

Software for data transfer

We recommend using HEIDENHAIN software to transfer files between the TNC7/TNC7 basic and a PC.

TNCremo (accessory)

This PC tool supports the user in transmitting data from the PC to the TNC7/TNC7 basic. **TNCremo** executes blockwise data transmission with block check characters (BCC).

Functions:
- Data transfer (including blockwise)
- Remote control (only serial)
- File management and data backup of the control
- Reading the log
- Printing screen contents
- Text editor
- Management of multiple machines

TNCremoPlus (accessory)

In addition to the features already familiar from TNCremo, TNCremoPlus offers the possibility of transmitting the current content of the TNC7/TNC7 basic's screen to the PC (live screen). This makes it very simple to monitor the machine.

Additional functions:
- Interrogation of control information (NC up time, machine up time, machine running time, spindle running time, pending errors, data from the data servers—e.g., symbolic PLC operands)
- Overwriting of specific tool data based on values from a tool presetter

TNCremoPlus ID 340447-xx

Connected Machining

connected + machining

Overview

Connected Machining makes fully digital job management possible in networked manufacturing. You also profit from:
- Ease of data usage
- Time-saving procedures
- Transparent processes

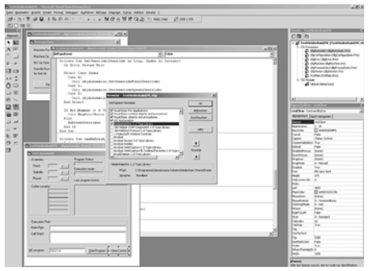
Remote Desktop Manager (software option)

Display and remote operation of external computer units: With the Remote Desktop Manager software option it is possible to operate external computer units (such as Windows PCs) remotely via Ethernet. The information is displayed on the screen of the TNC7/TNC7 basic. That way you can, for example, access important applications, such as CAD/CAM applications or order management, directly from the TNC7/TNC7 basic.

HEIDENHAIN DNC (software option)

Communication with external PC applications: The development environments on Windows operating systems are particularly well suited as flexible platforms for application development in order to come to terms with the increasingly complex requirements of the machine's environment.

The flexibility of the PC software and the large selection of ready-to-use software components and standard tools in the development environment enable you to develop PC applications of great use to your customers in a very short time, for example:
- Error reporting systems that, for example, send a text message to the customer's cell phone reporting problems on the currently running machining process
- Standard or customer-specific PC software that decidedly increases process reliability and equipment availability
- Software solutions controlling the processes of manufacturing systems
- Information exchange with order management software



The HEIDENHAIN DNC software interface is an attractive communication platform for this purpose. It provides all the data and configuration capabilities needed for these processes so that an external PC application can evaluate data from the control and, if required, influence the manufacturing process.

RemoTools SDK (accessory)

To enable you to use HEIDENHAIN DNC effectively, HEIDENHAIN offers the RemoTools SDK development package. It contains the COM component and the ActiveX control for integration of the DNC functions in development environments.

RemoTools SDK		ID 340442-xx

virtualTNC (accessory)

The **virtualTNC** control software is a control component for virtual machines for machine simulations, and is available through the HEIDENHAIN DNC interface.

Single-station license		ID 1113933-xx
Network license	For one workstation	ID 1122145-xx
	For 14 workstations	ID 1113935-xx
	For 20 workstations	ID 1113936-xx

For more information about RemoTools SDK and virtualTNC, refer to the *RemoTools SDK virtualTNC* document (ID 628968-xx).

OPC UA NC Server (software option)

Connection of an OPC UA application: The OPC UA standard (Open Platform Communications Unified Architecture) has established itself as an interface for the secure and reliable exchange of data in industrial environments. The HEIDENHAIN OPC UA NC Server software option makes this forward-looking interface available on the TNC7/TNC7 basic. OPC UA features cross-operating system capability: along with the widespread Windows systems, OPC UA also allows Linux-based systems or Apple computers with macOS*, for example, to be connected to the HEIDENHAIN control.

Up to six connections can be enabled. Each software option enables one client connection each. Several parallel connections require the use of multiple OPC UA NC Server software options.

Numerous developer toolkits are available for OPC UA. RemoTools SDK is not needed. Thanks to the standardized protocol, the freedom to choose the toolkit, and the application-oriented HEIDENHAIN information model, highly individualized applications and standard software can be developed with significantly reduced time to market.

The HEIDENHAIN OPC UA NC Server supports the following OPC UA services:
- Reading and writing variables
- Interface for accessing tool data of the TNC7/TNC7 basic
- Subscribing to value changes
- Executing methods
- Subscribing to events

With Sign&Encrypt, HEIDENHAIN ensures that even the standard solution provides state-of-the-art IT security:
- SecurityMode: Sign&Encrypt
- Cryptographic algorithm: Basic256Sha256 (recommended by the OPC Foundation) – X.509 Certificates
- User authentication through X.509 certificates

* Apple and macOS are trademarks of Apple Inc.

Mounting information
Clearances and mounting

Proper minimum clearance

When installing the control components and power modules, take note of the minimum spacing, space needed for servicing, and the appropriate length and location of the connecting cables as detailed in the Technical Manual of the TNC7/TNC7 basic.

Mounting and electrical installation

Observe the following points during mounting and electrical connection:
- National regulations for low-voltage installations at the operating site of the machine or components
- National regulations regarding interference and noise immunity at the operating site of the machine or components
- National regulations regarding electrical safety and operating conditions at the operating site of the machine or components
- Specifications for the installation location
- Specifications of the Technical Manual

Degrees of protection

The following components fulfill the requirements for IP54 (dust protection and splash-proof protection):
- Display unit (when properly installed)
- Keyboard unit (when properly installed)
- Handwheel

All electric and electronic control components must be installed in an environment (e.g., electrical cabinet, housing) that fulfills the requirements of protection class IP54 (dust and splash-proof protection) in order to fulfill the requirements of pollution degree 2. All components of the OEM operating panel must also have an IP54 rating, just like the HEIDENHAIN operating panel components.

Electromagnetic compatibility

Protect your equipment from interference by observing the rules and recommendations specified in the Technical Manual.

Intended place of operation

The devices comply with EN 50370-1 and EN 61800-3, and are intended for use in industrially zoned areas.

Likely sources of noise

Interference is produced by capacitive and inductive coupling into electrical conductors or into device connections. This is caused, for example, by:
- Strong magnetic fields from transformers or electric motors
- Relays, contactors, and solenoid valves
- High-frequency equipment, pulse equipment, and switch-mode power supplies
- Power lines and leads to the above equipment

Protective measures

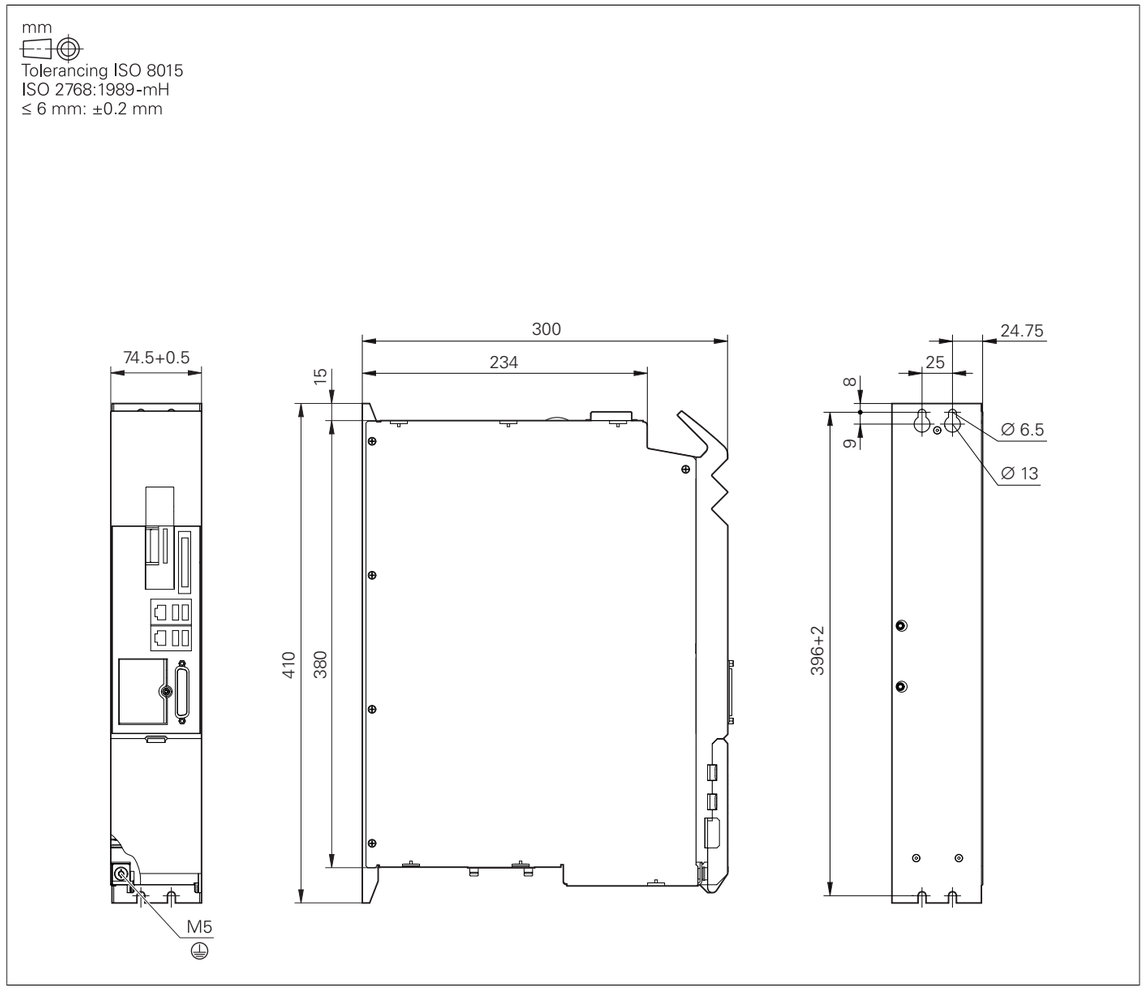
- Ensure that the MC, CC, and signal lines are at least 20 cm away from interfering devices
- Minimum distance of 10 cm between MC, CC, and signal lines to cables carrying interfering signals (in metal cable ducts, a grounded separation wall suffices for decoupling)
- Shielding by means of closed, grounded metal enclosures (e.g., an electrical cabinet)
- Use equipotential bonding lines in accordance with the grounding diagram (comply with the Technical Manual of your control)
- Use only genuine HEIDENHAIN cables and connecting elements

Installation elevation

The maximum elevation for installation of HEIDENHAIN control components (MC, CC, PLB, MB, TE, BF, IPC, etc.) is 3000 m above sea level.

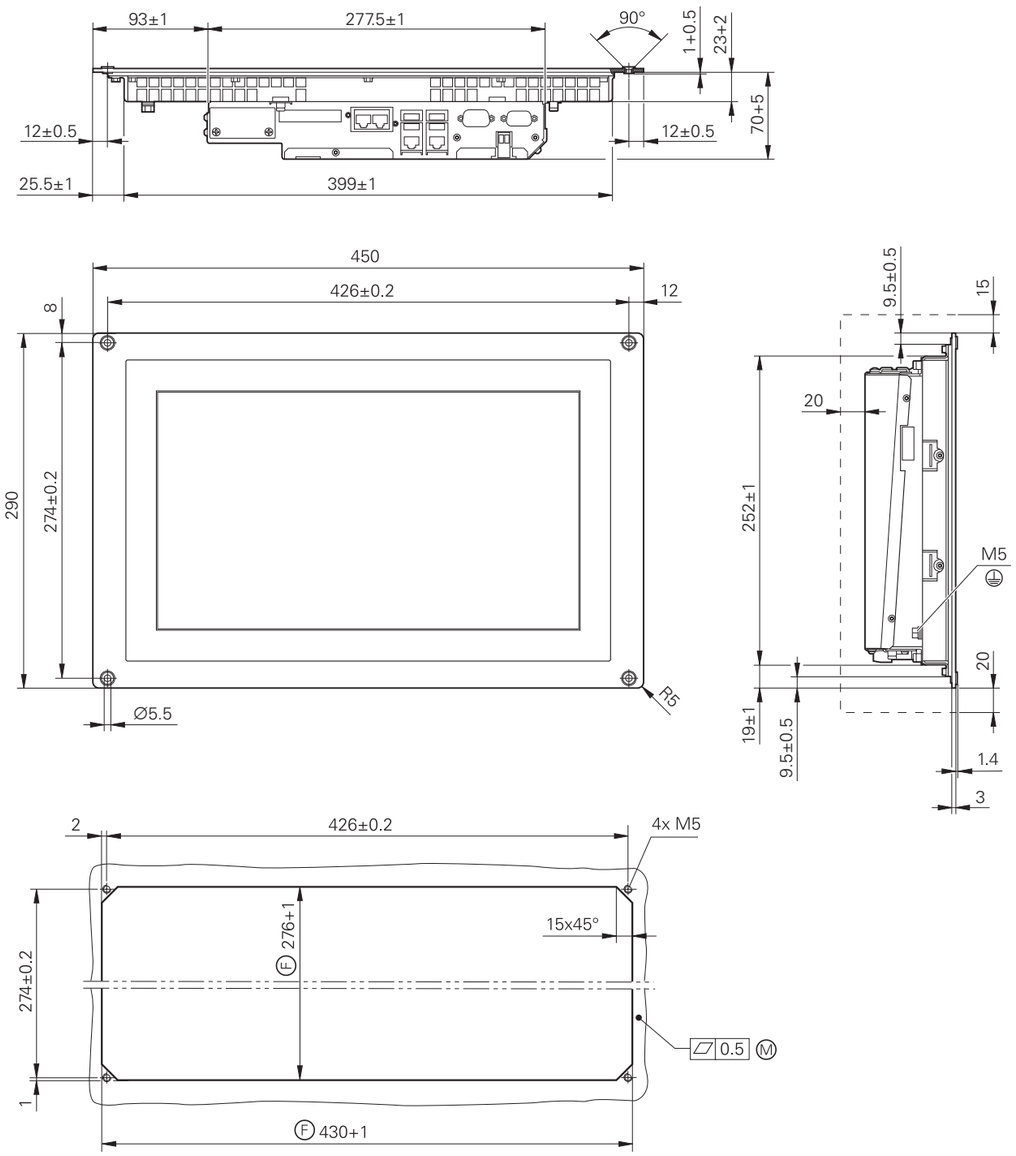
Key dimensions
Main computer

MC 306, IPC 306



IPC 8420

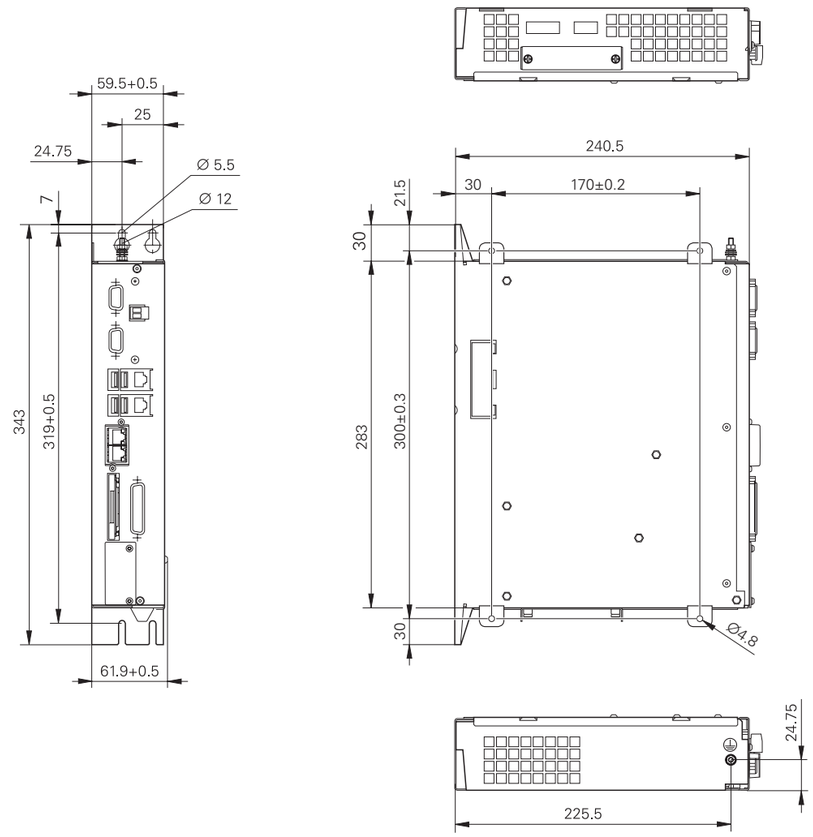
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



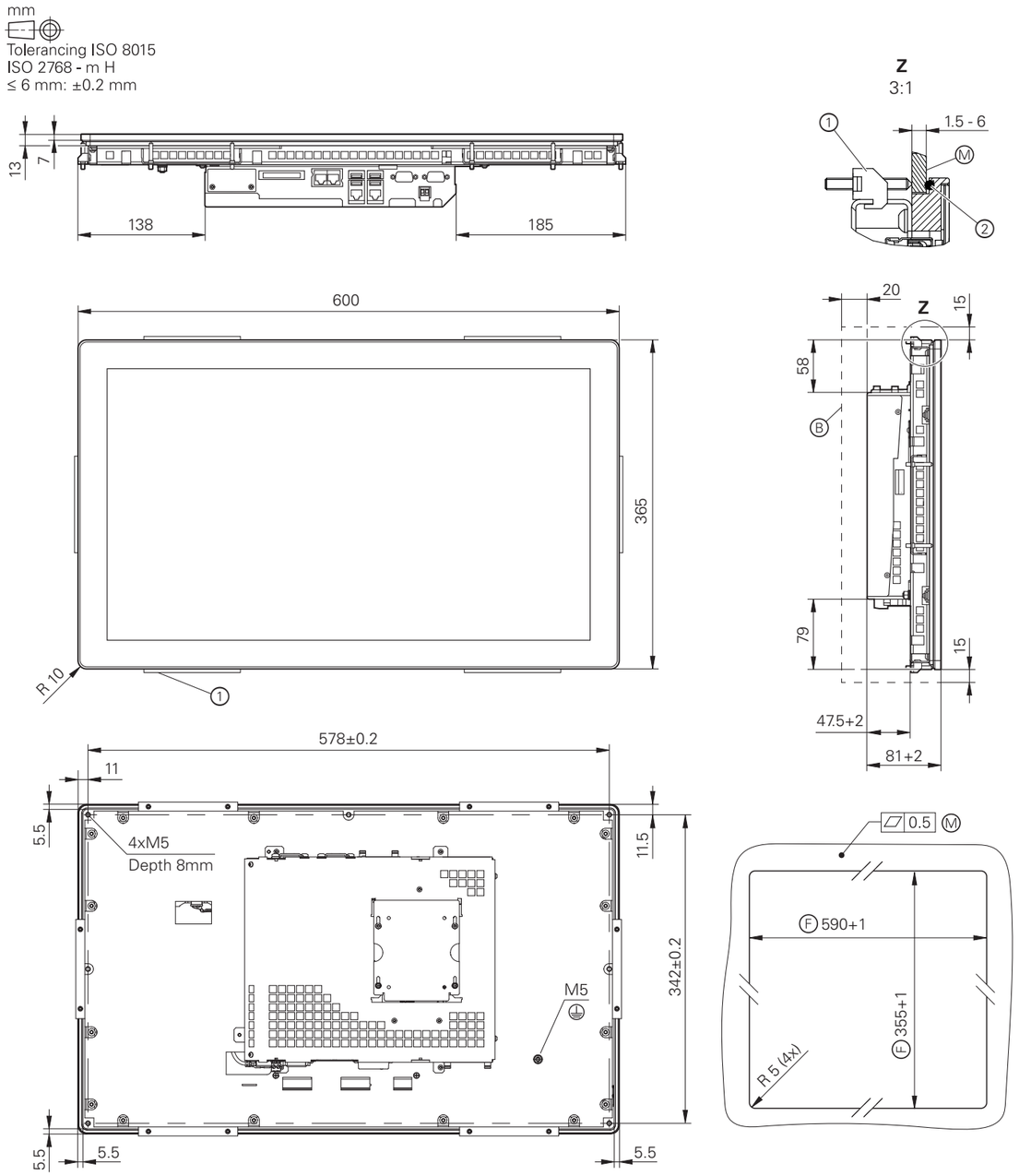
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

IPC 6490

mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

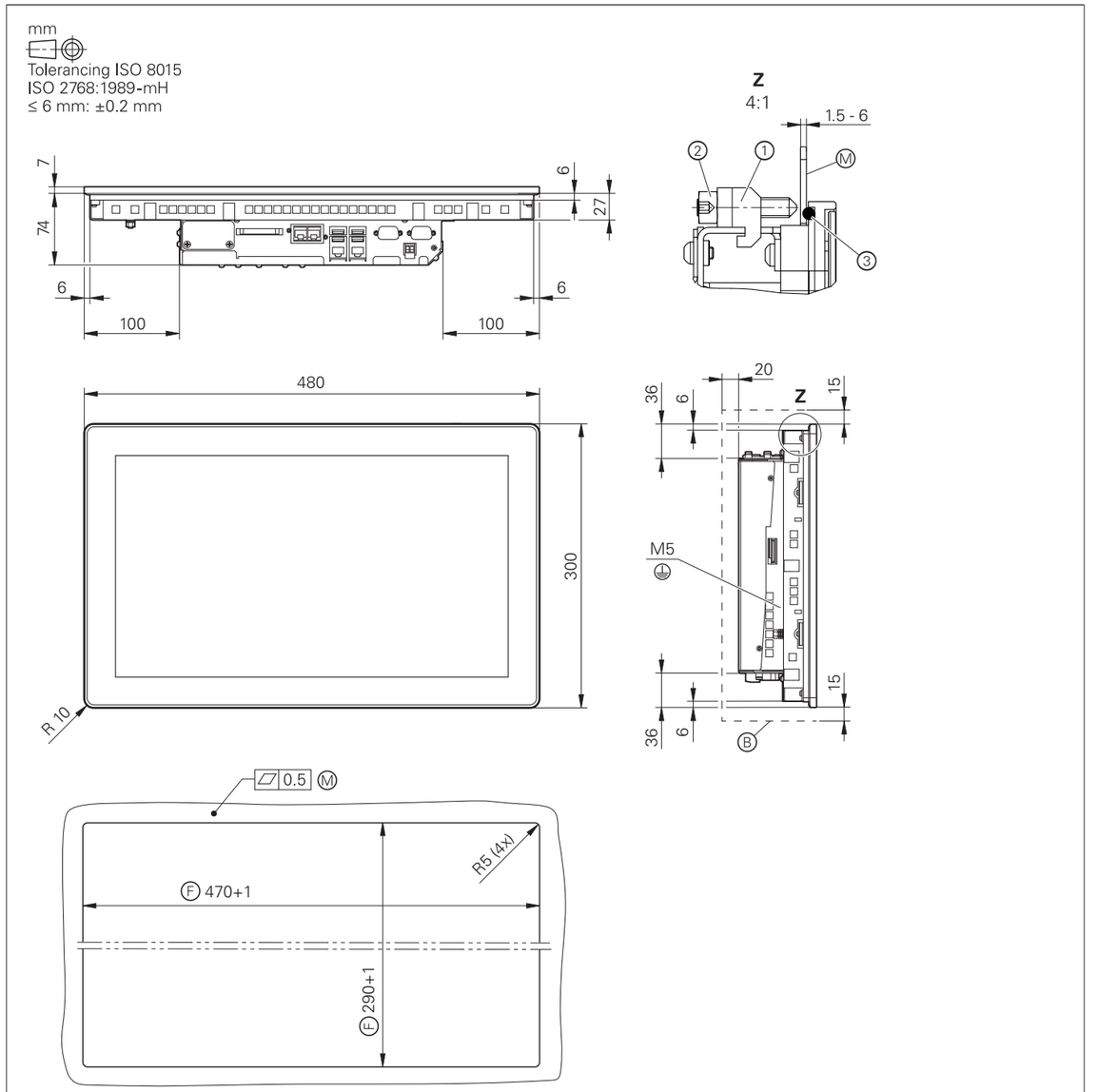


MC 366 (TNC7)



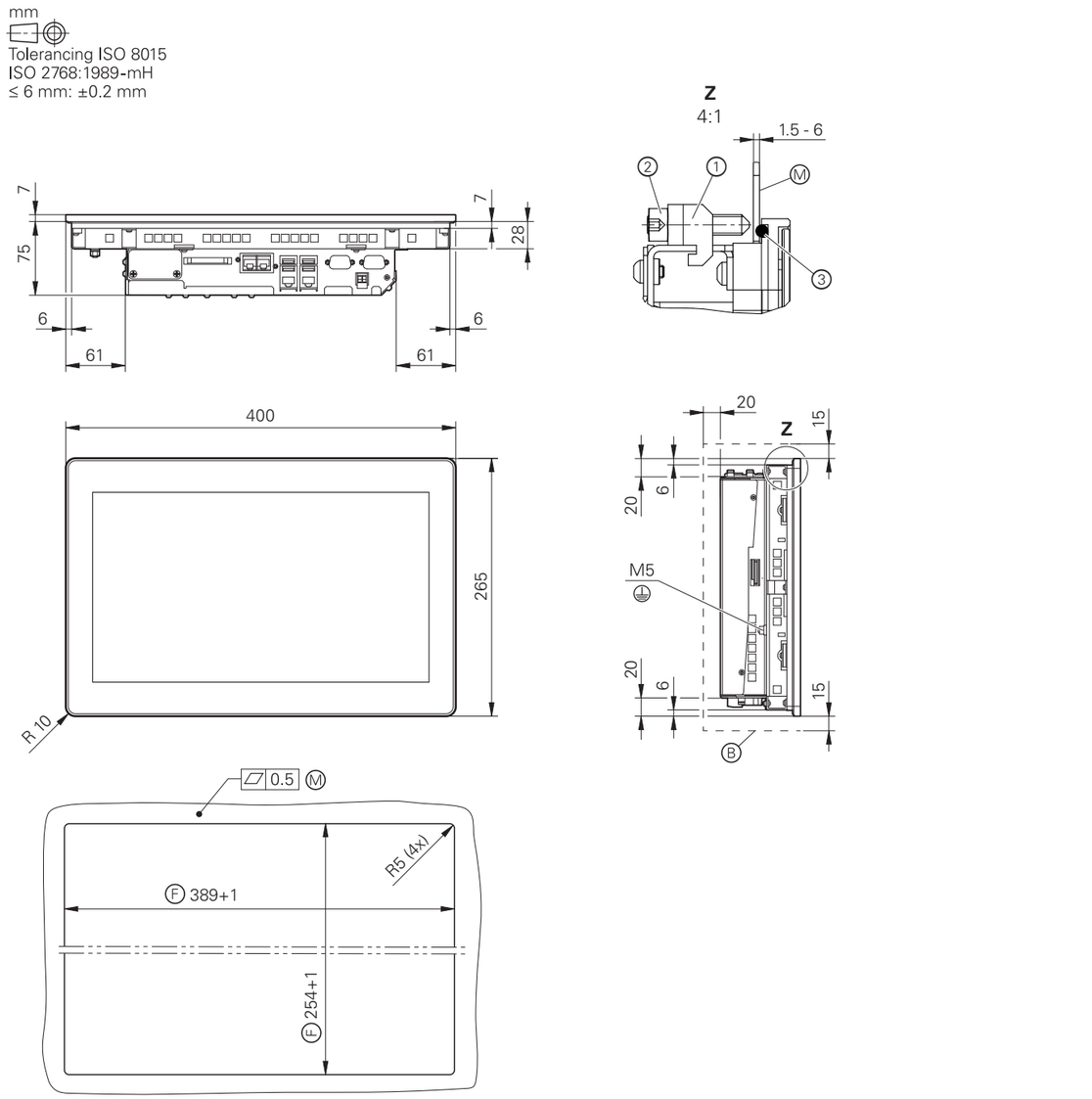
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M4 setscrews with hexagon socket and cone point
2 = O-ring cord, EPDM

MC 356 (TNC7)



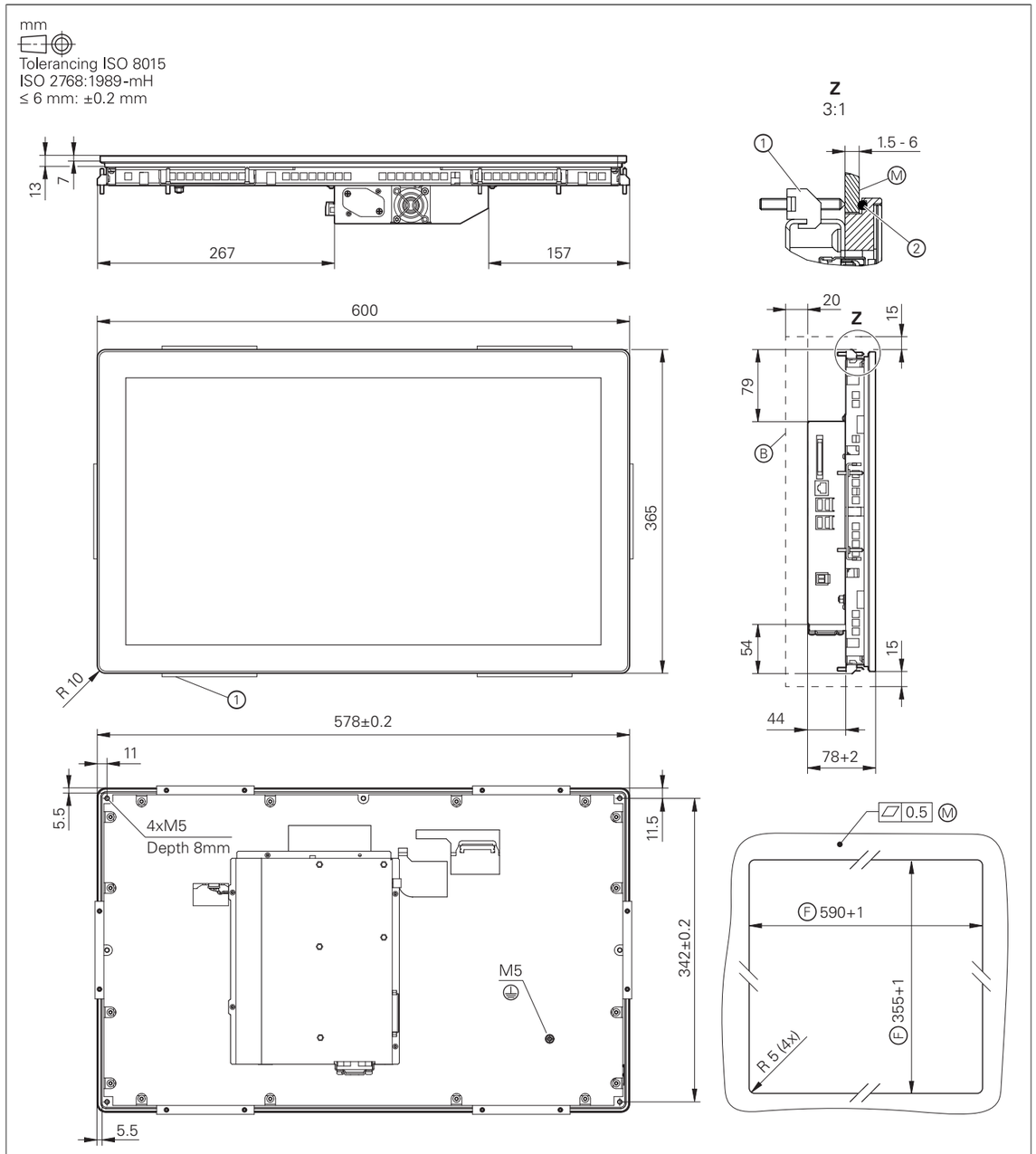
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M5 setscrews with hexagon socket and cone point (M_d = 0.4 – 0.5 Nm)
2 = Nut M5
3 = O-ring cord, EPDM

MC 345 (TNC7 basic)



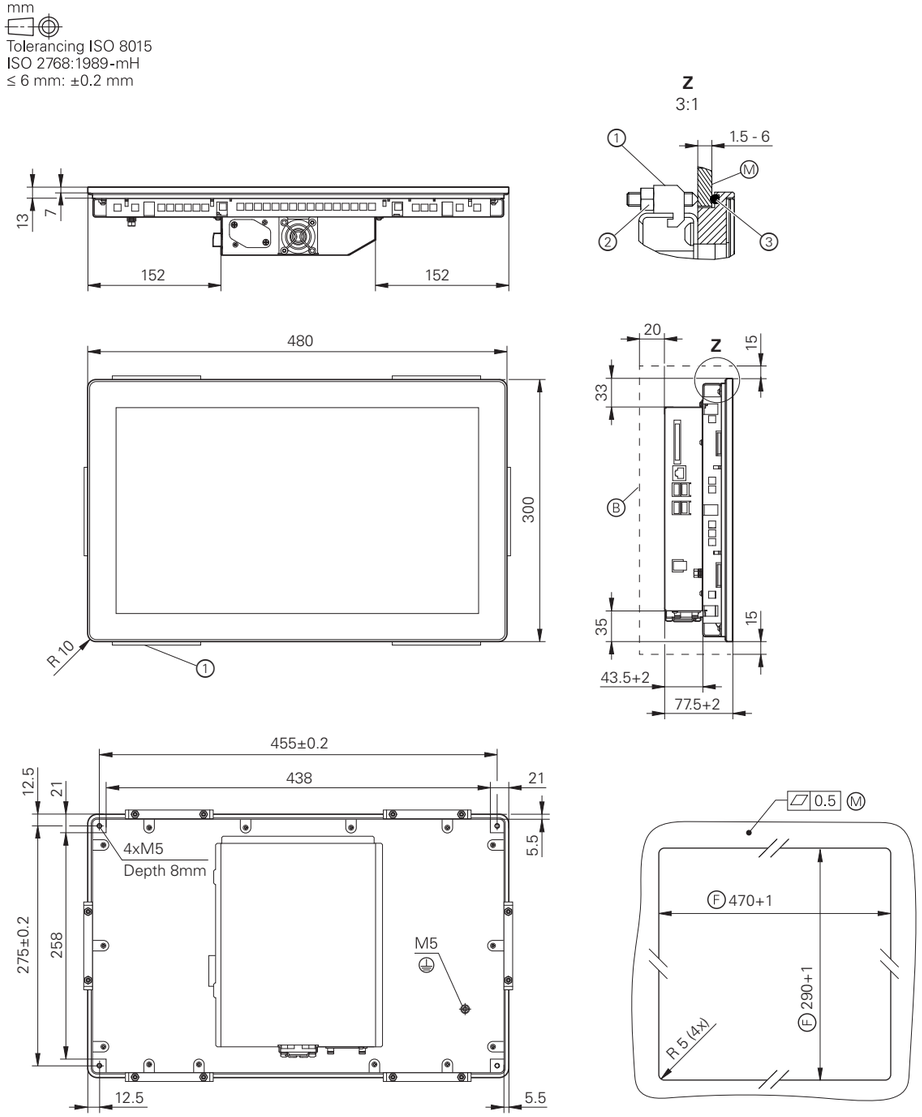
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M5 setscrews with hexagon socket and cone point (M_d = 0.4 – 0.5 Nm)
2 = Nut M5
3 = O-ring cord, EPDM

BF 360, ITC 362



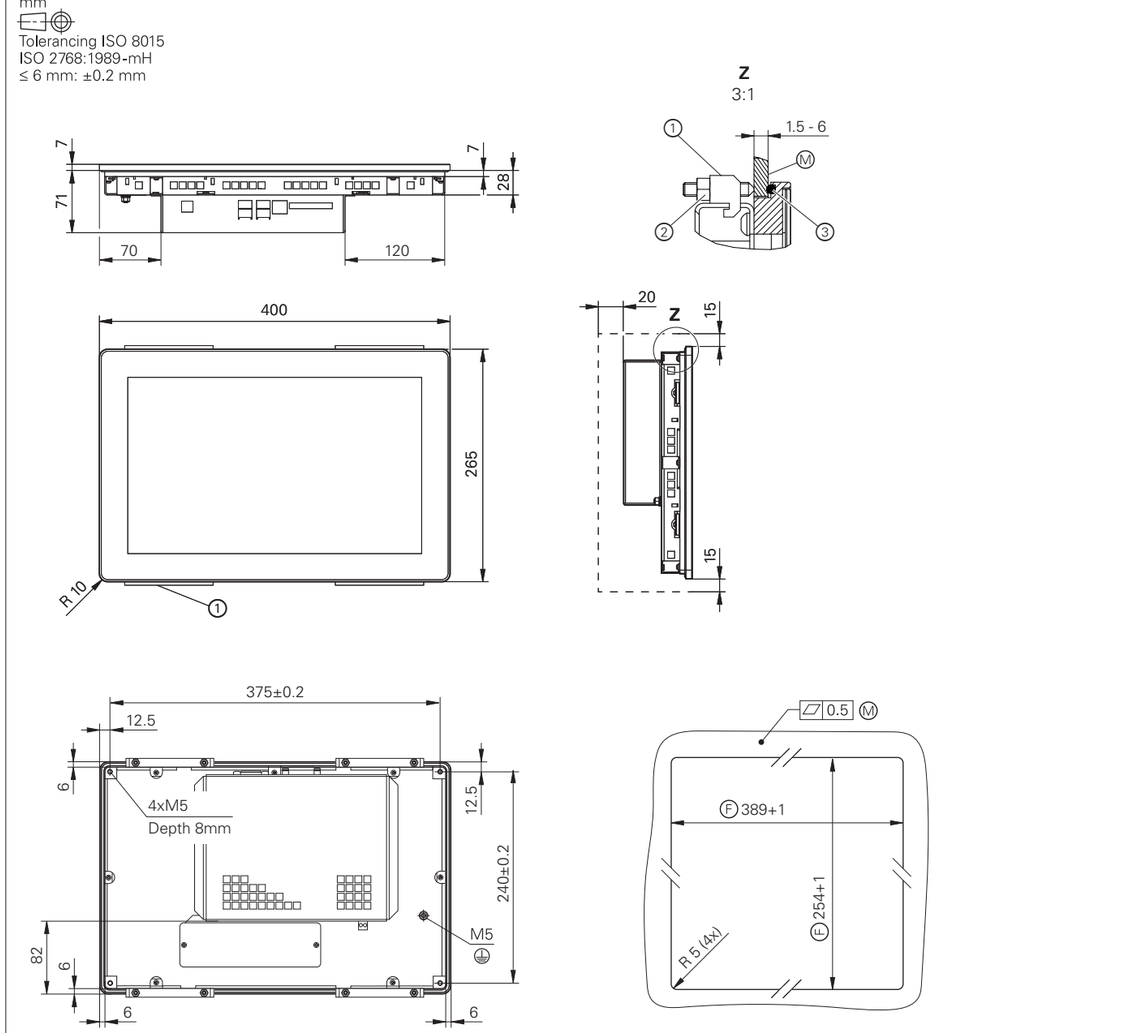
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Mounting brace (6x), each with two M4 setscrews with hexagon socket and centering cone (M_d = 0.4 – 0.5 Nm)
2 = O-ring cord, EPDM

ITC 352



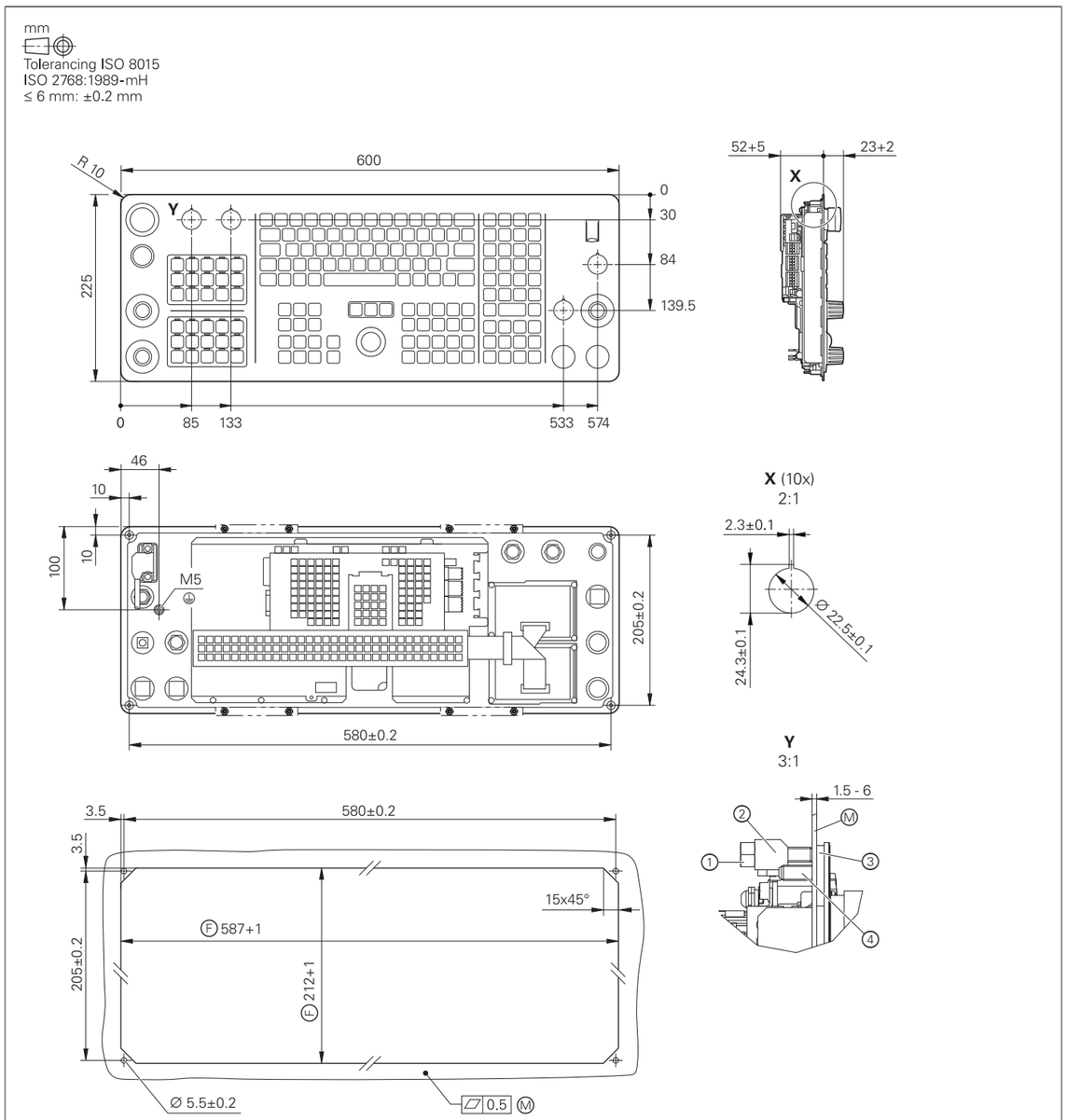
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M4 setscrews with hexagon socket and cone point (M_d = 0.4 – 0.5 Nm)
2 = Nut M5
3 = O-ring cord, EPDM

ITC 342



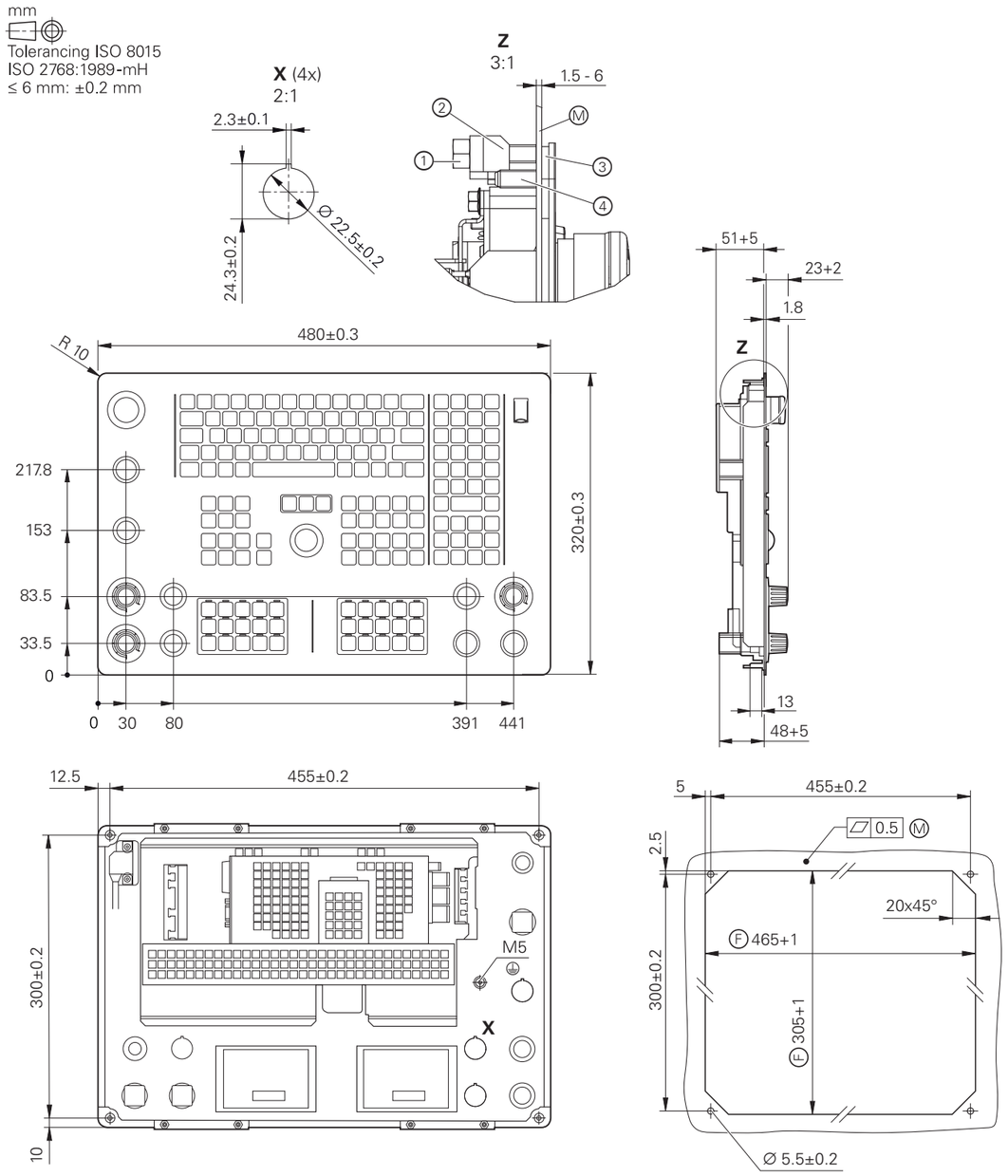
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M4 setscrews with hexagon socket and cone point
2 = Nut M5
3 = O-ring cord, EPDM

TE 361, TE 361 FS (TNC7)



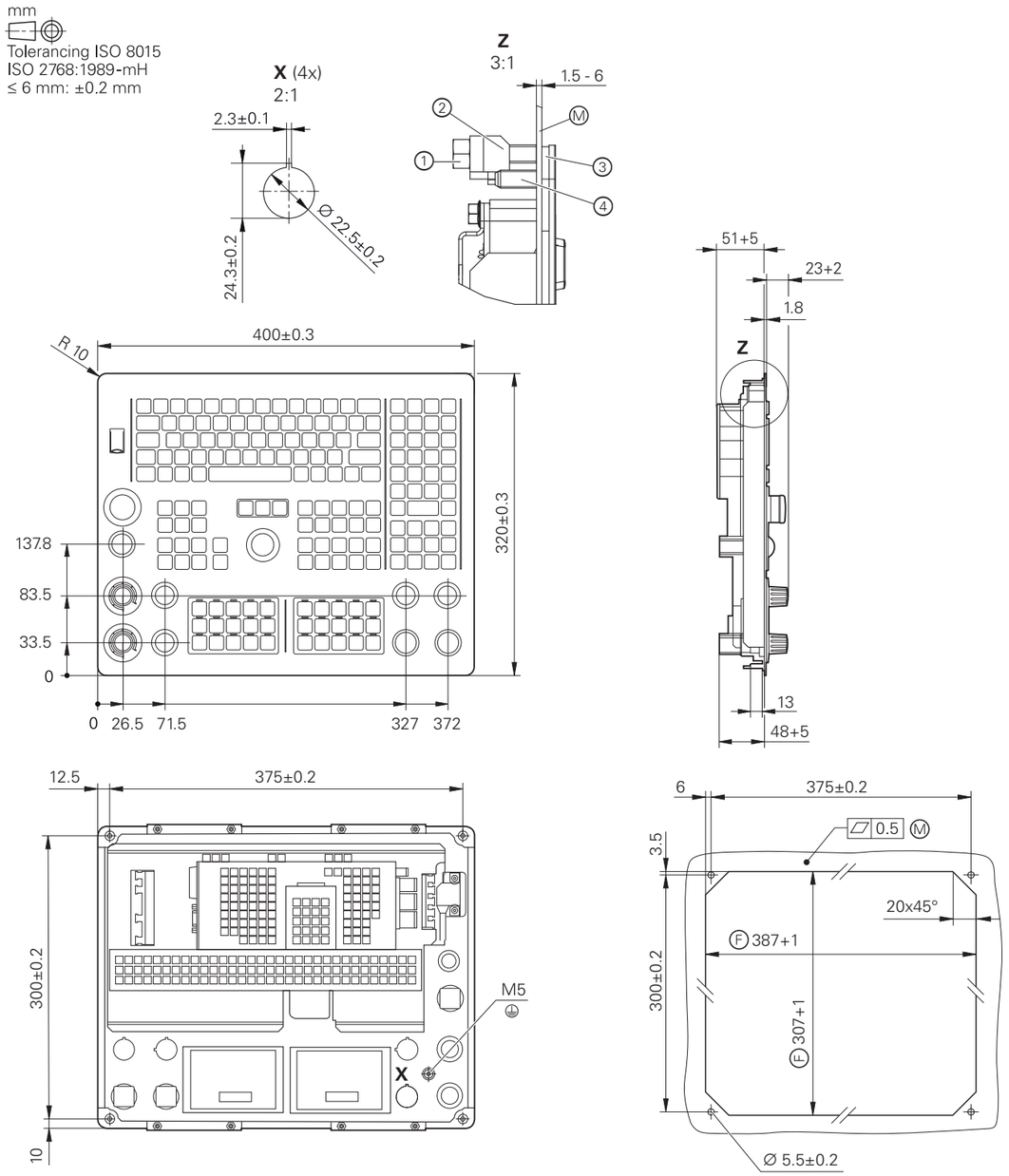
Ⓕ = Front panel cutout
Ⓜ = Mounting surface
1 = Nut M5
2 = Optional mounting braces (6x), each with two M5 setscrews with hexagon socket and centering cone (M_d = 0.4 – 0.5 Nm)
3 = Seal
4 = Weld stud with external thread M5 (4x)

TE 350, TE 350 FS (TNC7)



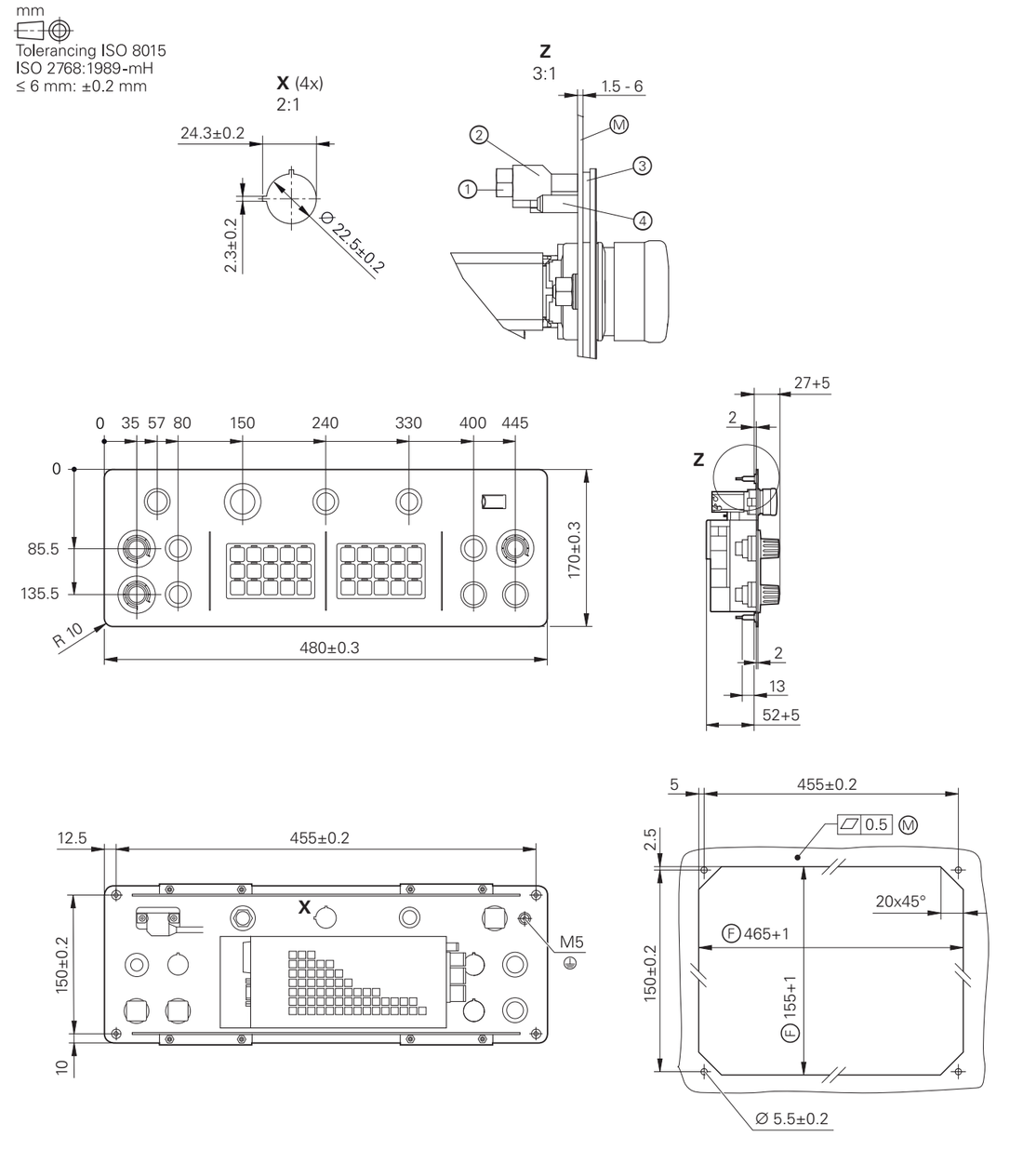
Ⓕ = Front panel cutout
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Nut M5
2 = Optional mounting braces (6x), each with two M5 setscrews with hexagon socket and centering cone (Md = 0.4 – 0.5 Nm)
3 = Seal
4 = Weld stud with external thread M5 (4x)

TE 340, TE 340 FS (TNC7 basic)



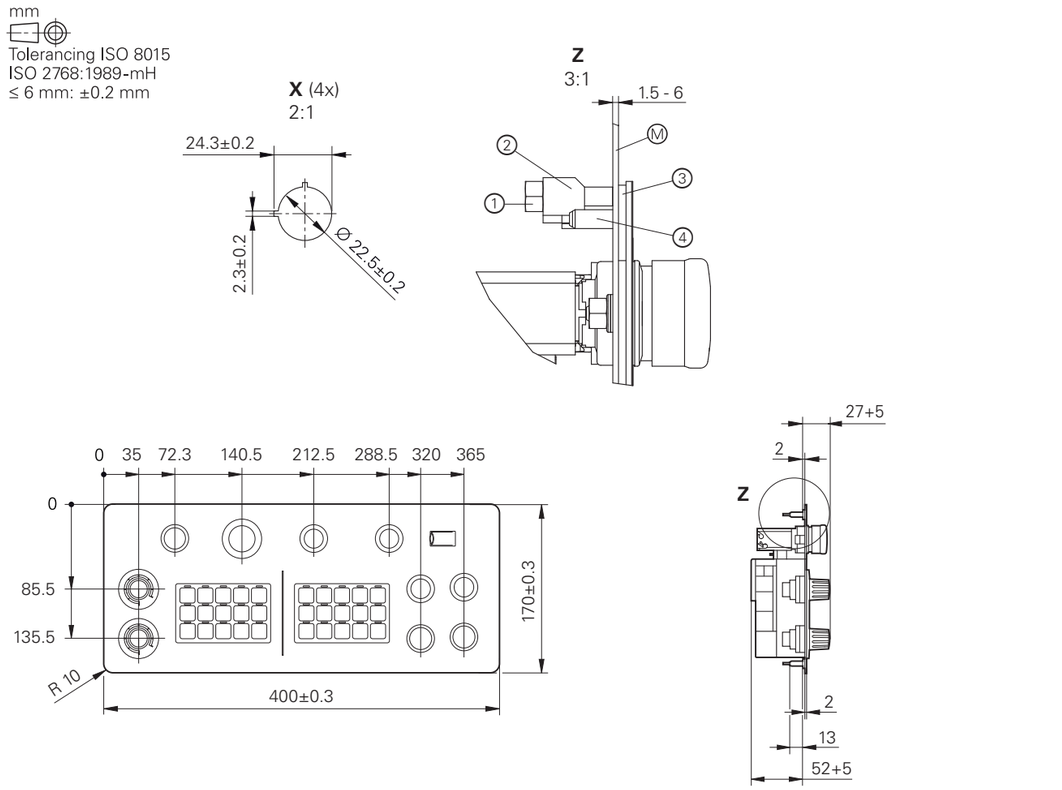
Ⓕ = Front panel cutout
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Nut M5
2 = Optional mounting braces (6x), each with two M5 setscrews with hexagon socket and centering cone (Md = 0.4 – 0.5 Nm)
3 = Seal
4 = Weld stud with external thread M5 (4x)

MB 350, MB 350 FS (TNC7)



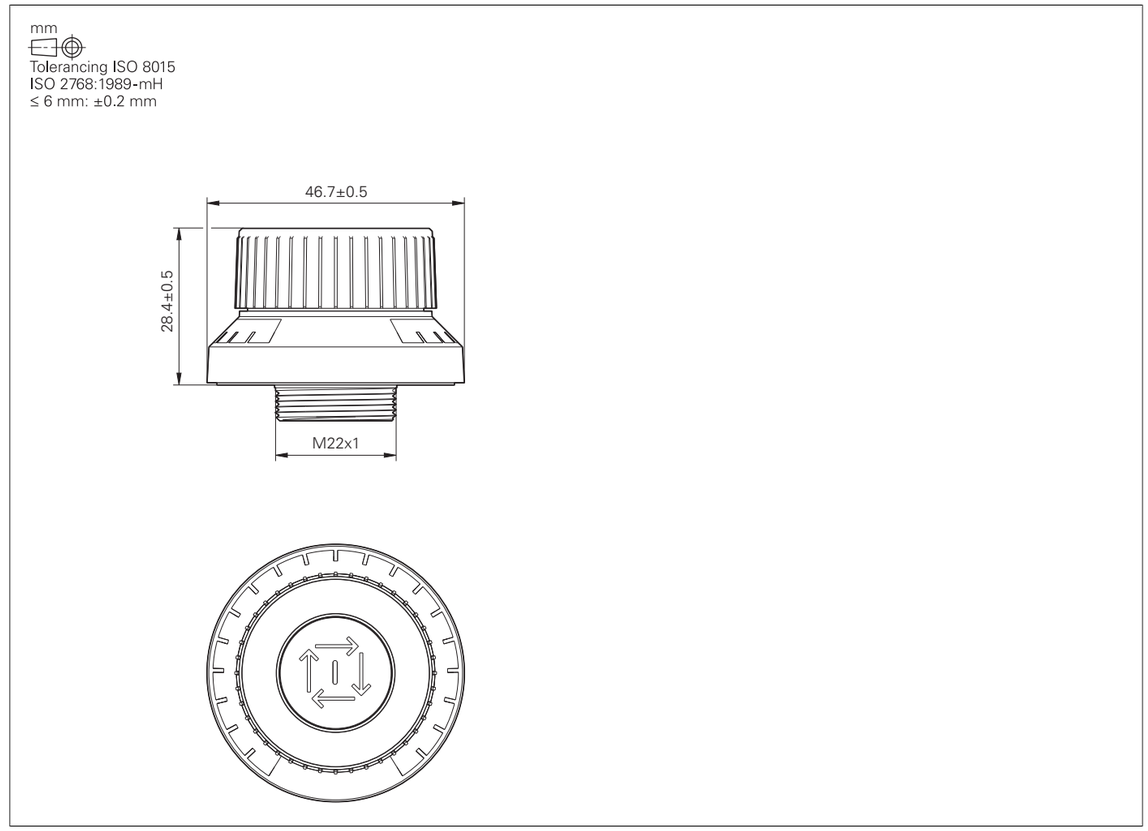
Ⓕ = Front panel cutout
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Nut M5
2 = Optional mounting braces (6x), each with two M5 setscrews with hexagon socket and centering cone (Md = 0.4 – 0.5 Nm)
3 = Seal
4 = Weld stud with external thread M5 (4x)

MB 340, MB 340 FS (TNC7 basic)

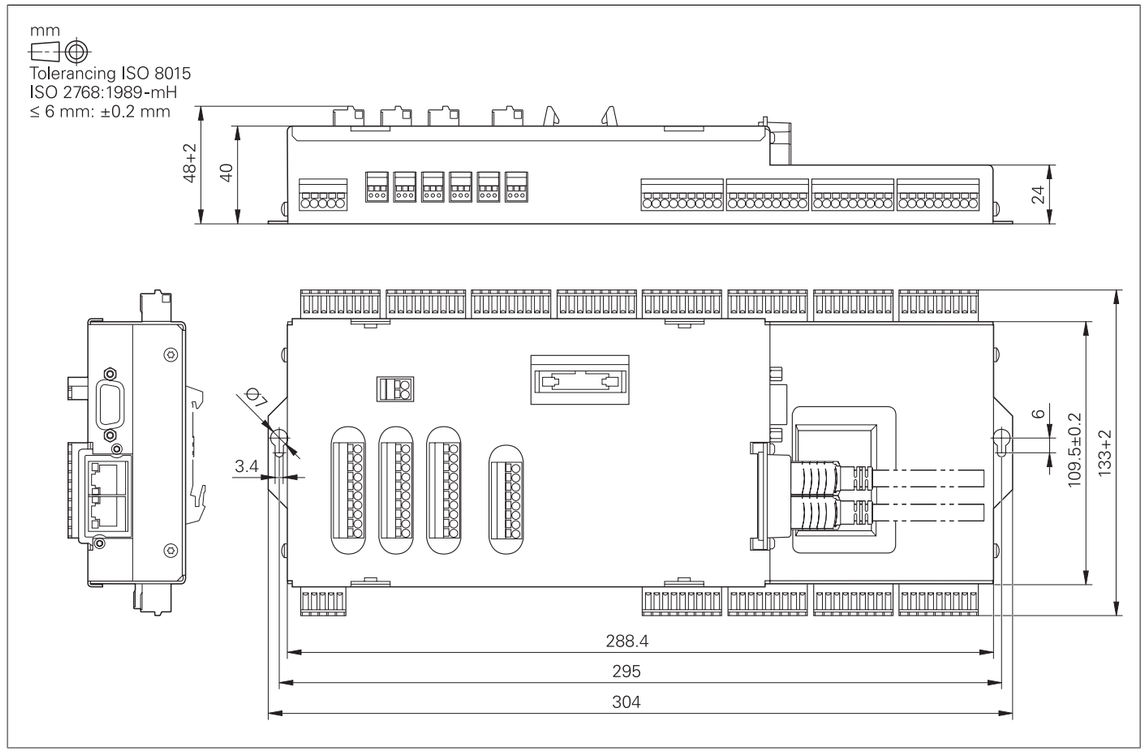


Ⓕ = Front panel cutout
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Nut M5
2 = Optional mounting braces (6x), each with two M5 setscrews with hexagon socket and centering cone (Md = 0.4 – 0.5 Nm)
3 = Seal
4 = Weld stud with external thread M5 (4x)

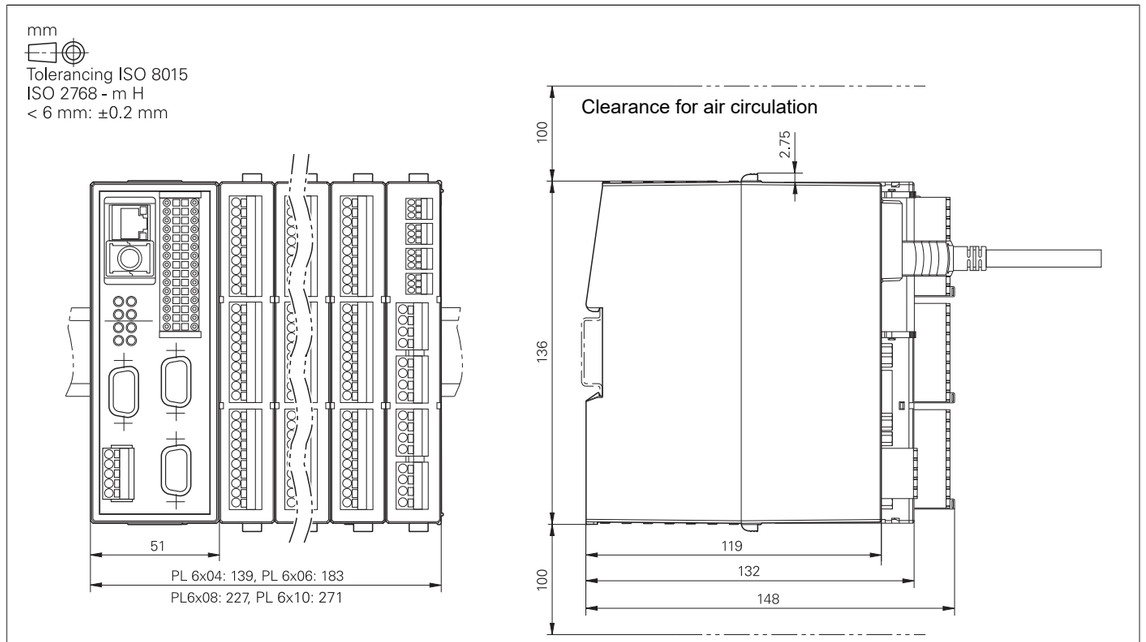
OC 310



PLB 6001, PLB 600x FS



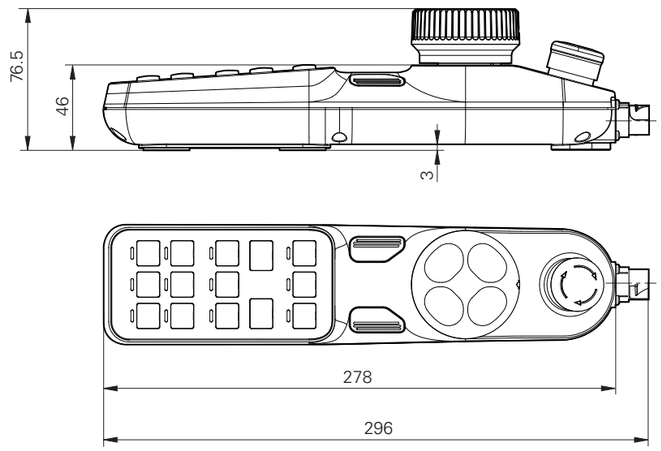
PL 6000, PLB 62xx, PLB 61xx



Electronic handwheels

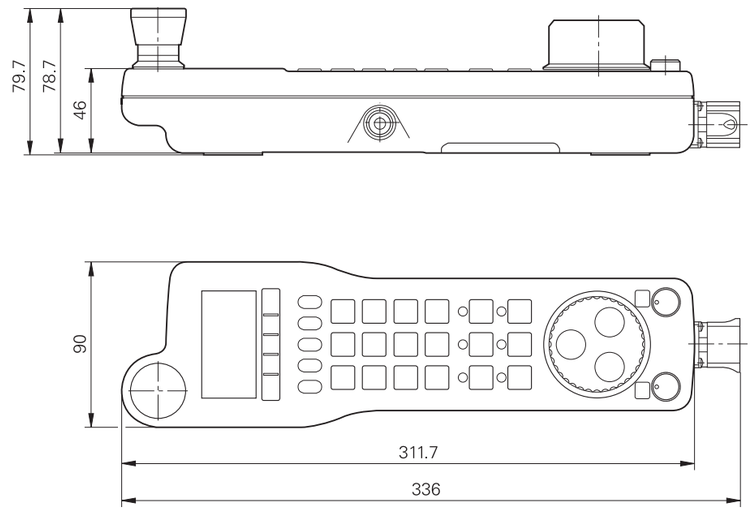
HR 510, HR 510 FS

mm
Tolerancing ISO 8015
ISO 2768:1989-mH
≤ 6 mm: ±0.2 mm



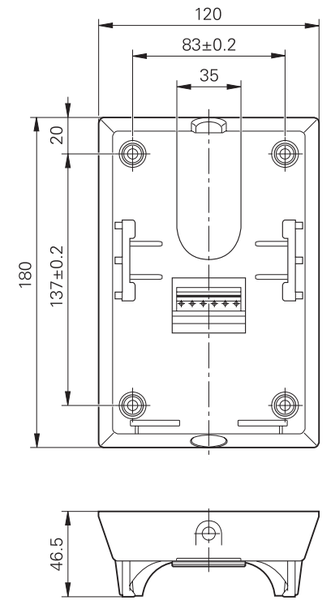
HR 520, HR 520 FS

mm
Tolerancing ISO 8015
ISO 2768:1989-mH
≤ 6 mm: ±0.2 mm



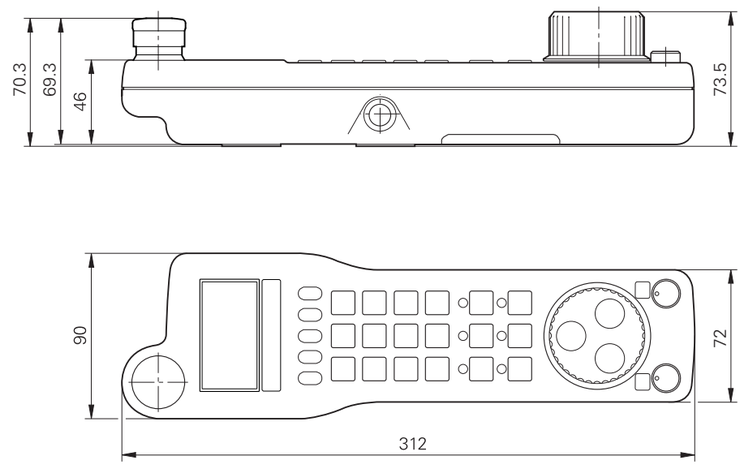
Holder for HR 520, HR 520 FS

mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

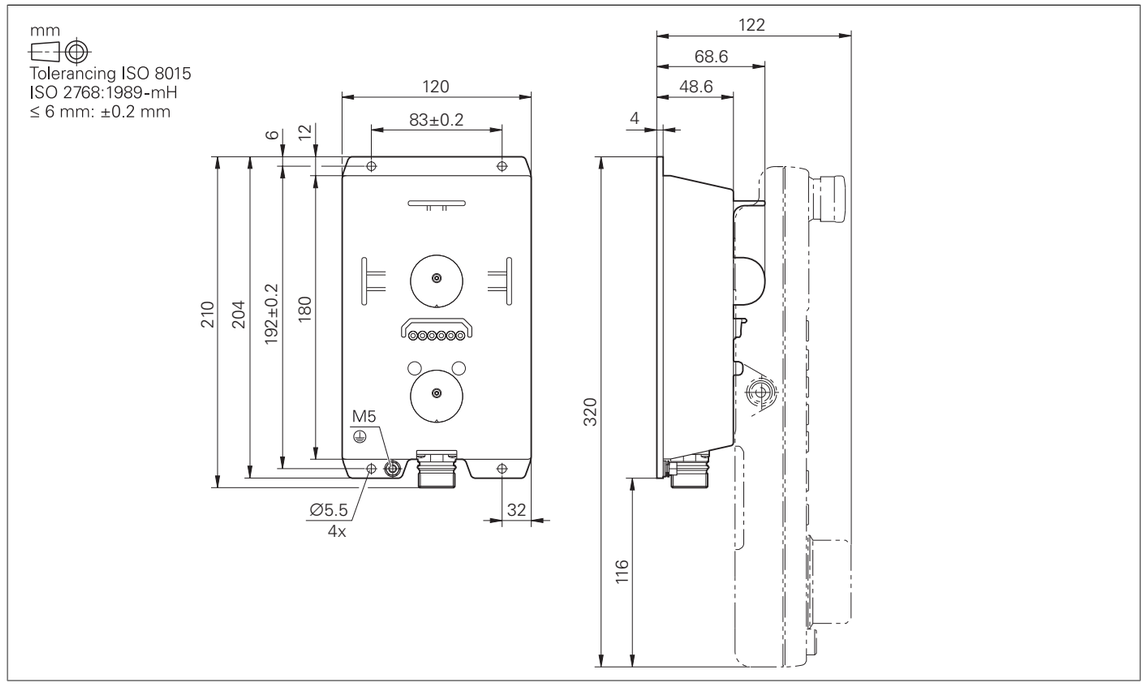


HR 550 FS

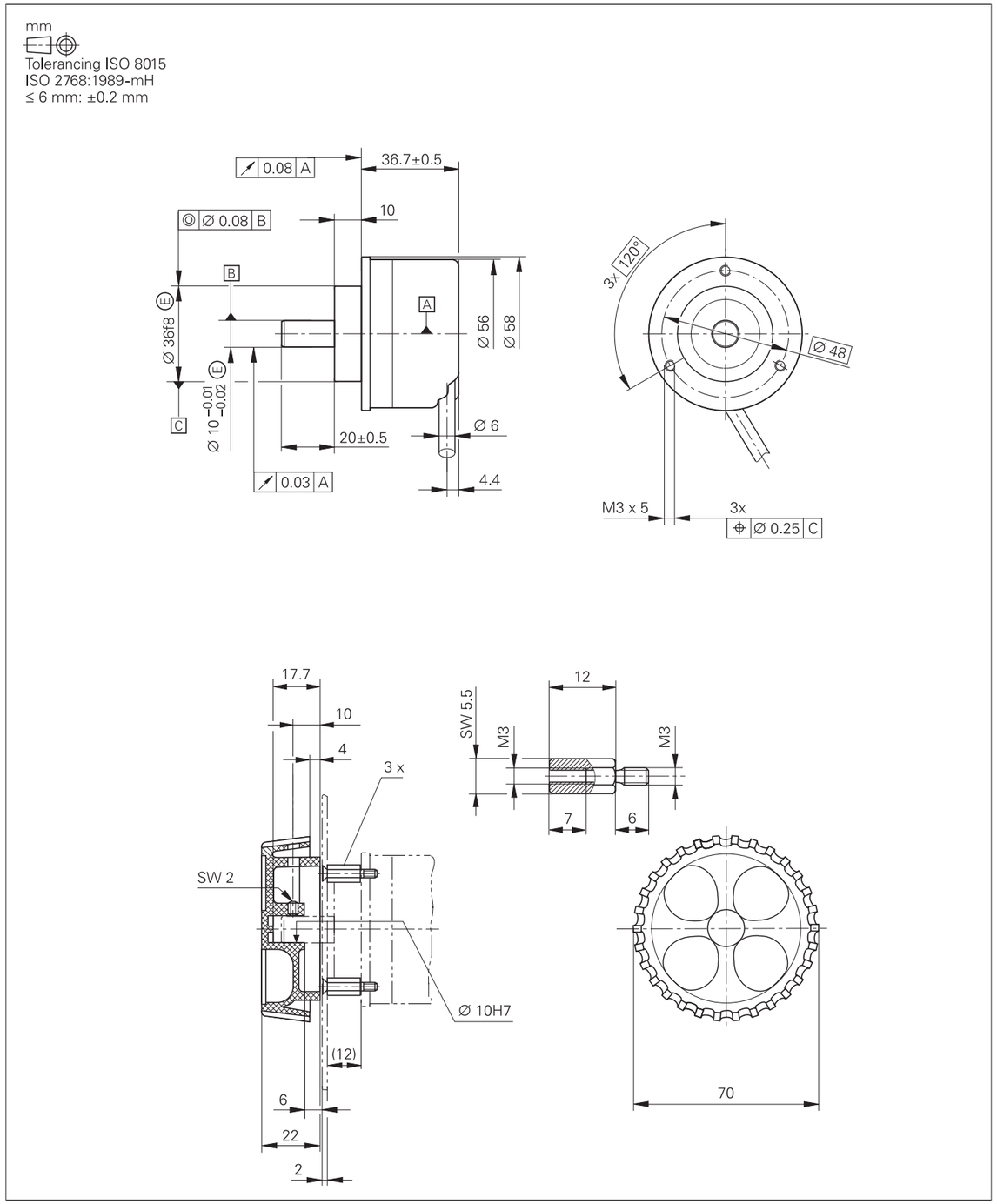
mm
Tolerancing ISO 8015
ISO 2768:1989-mH
≤ 6 mm: ±0.2 mm



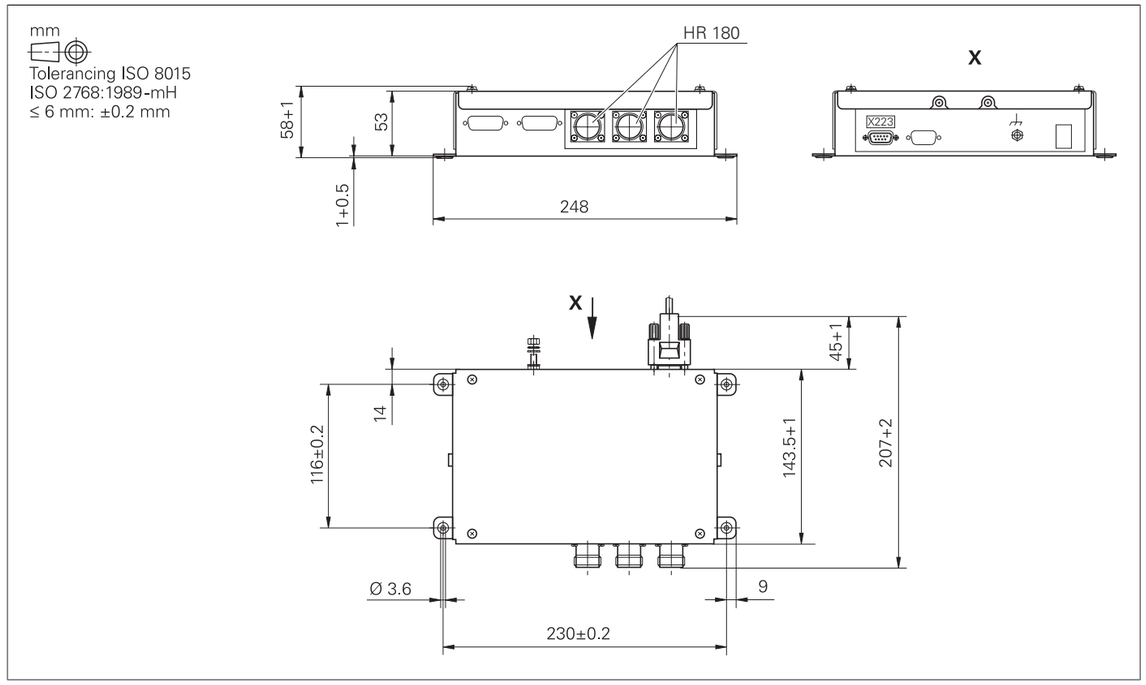
HRA 551 FS



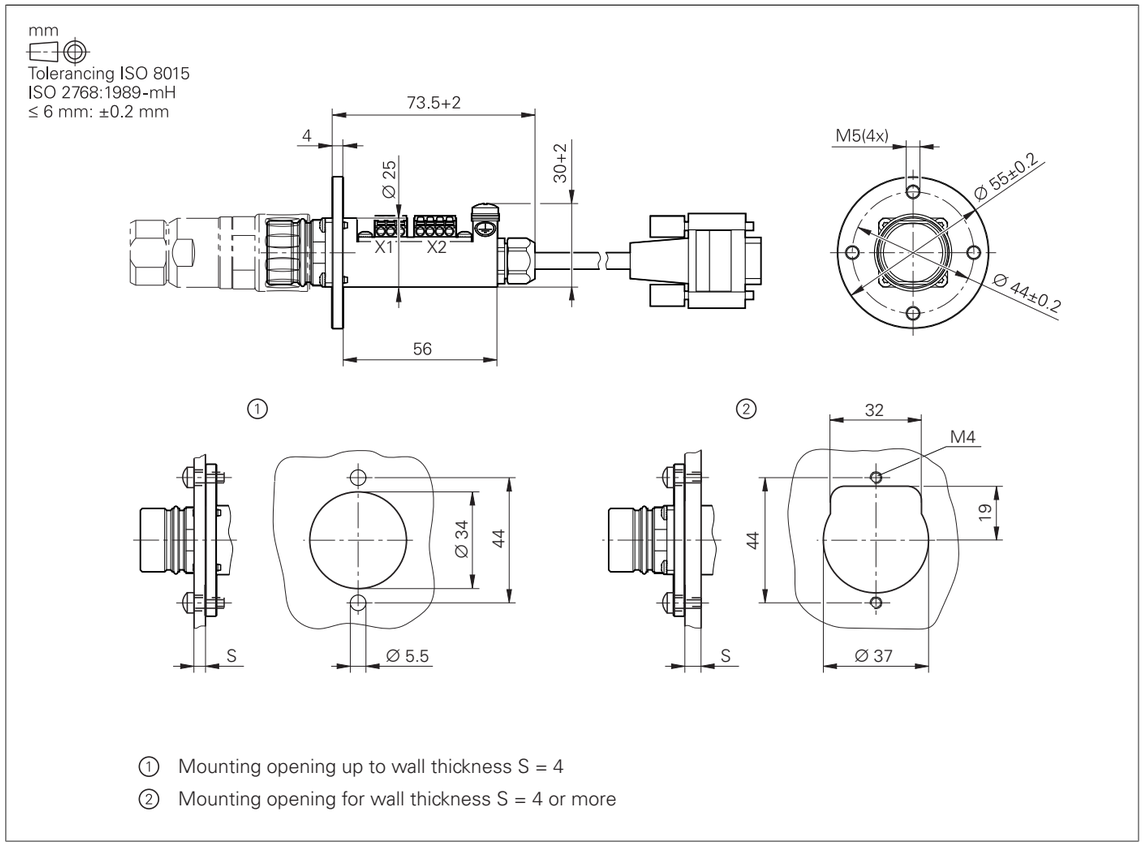
HR 130, HR 180



HRA 180



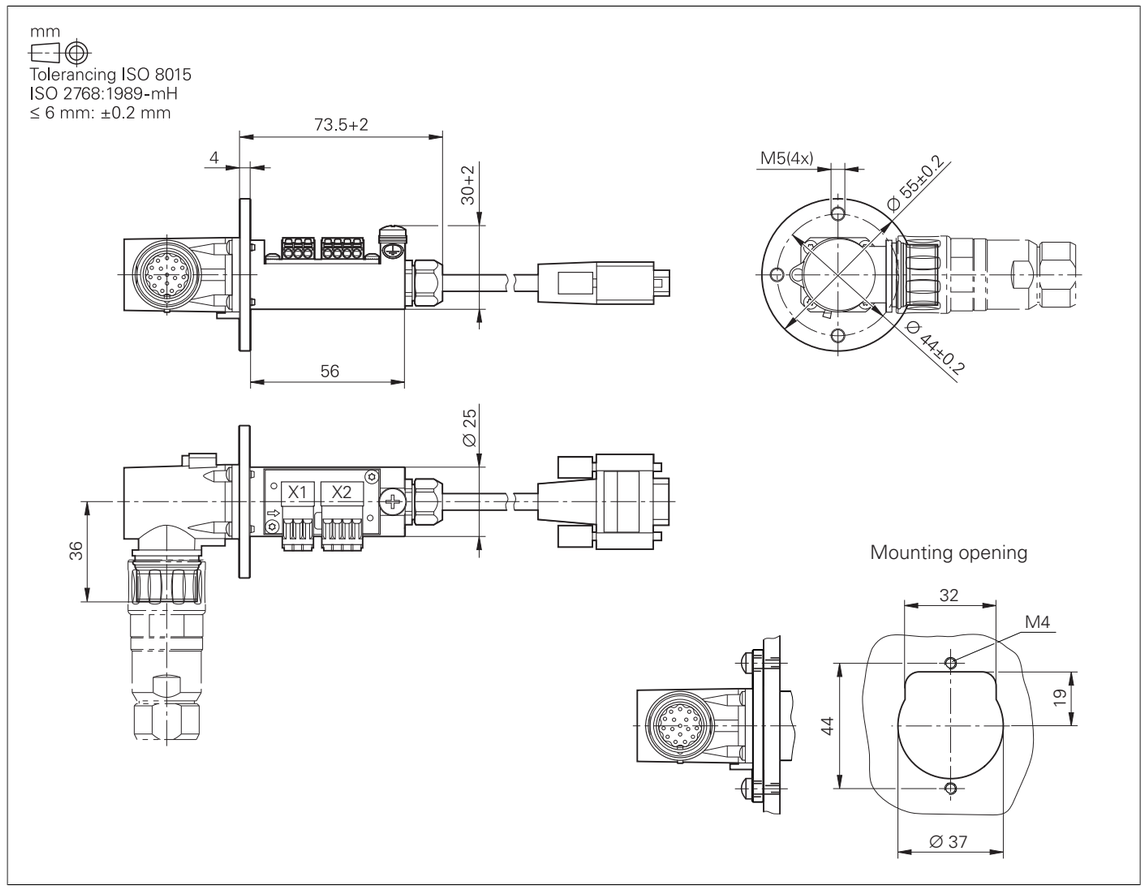
Adapter cable for handwheels (straight)



① Mounting opening up to wall thickness S = 4
② Mounting opening for wall thickness S = 4 or more

HR/HRA adapter cable to MC (straight connector)

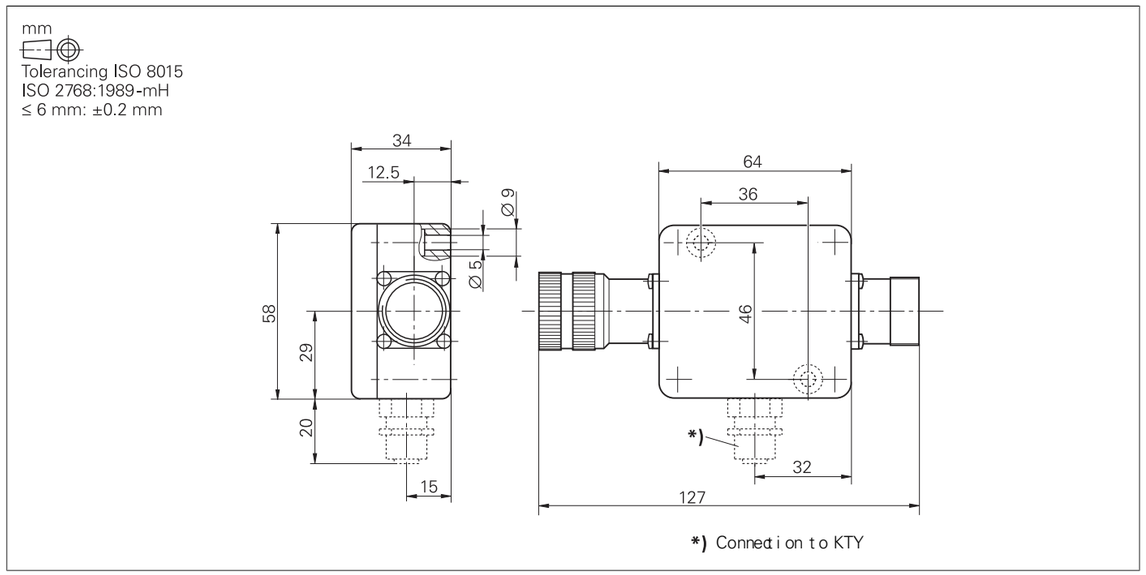
Adapter cable for handwheels (angled)



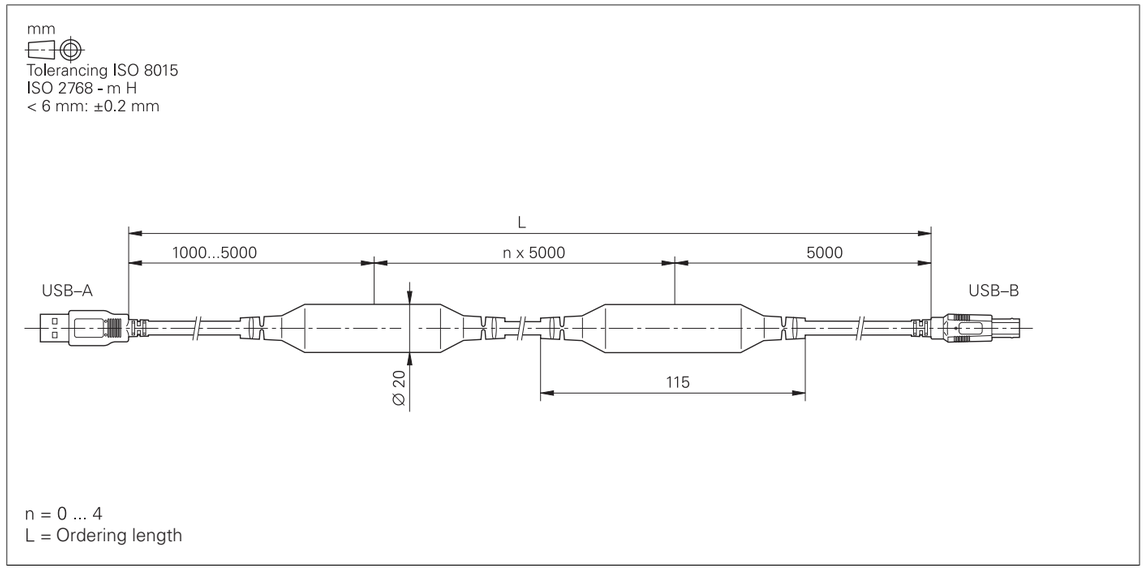
Adapter cable for HR/HRA to MC (angled connector)

Interface accessories

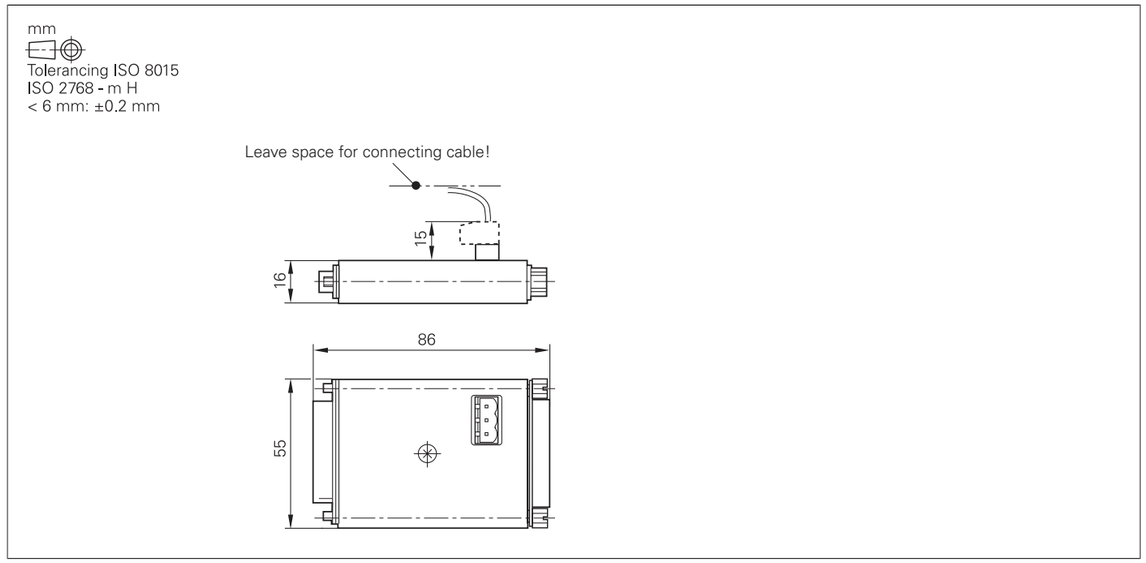
Line-drop compensator for encoders with EnDat interface



USB extension cable with hubs



KTY adapter connector



General information
Documentation

Technical documentation

Technical Manuals
(PDF format on HESIS-Web including Filebase)

• TNC7, TNC7 basic	ID 1364558
• PNC 610	ID 1191125
• Inverter Systems for Gen 3 Drives	ID 1252650
• Functional Safety (FS)	ID 749363
• Functional Safety (FS) Supplement to the Technical Manual	ID 1423840
• Python in HEIDENHAIN Controls	ID 757807
• OPC UA NC Server	ID 1309365
• Motors	ID 1296230
• Control Components	ID 1418899
• Service Manual for TNC7	ID 1425970

User documentation

User's Manuals
TNC7:

• Setup and Program Run	ID 1358774-xx
• Programming and Testing	ID 1358773-xx
• Machining Cycles	ID 1358775-xx
• Measuring Cycles for Workpieces and Tools	ID 1358777-xx
• Complete edition	ID 1369999

User's Manuals
TNC7 basic:

• Setup and Program Run	ID 1410286-xx
• Programming and Testing	ID 1409856-xx
• Machining Cycles	ID 1410289-xx
• Measuring Cycles for Workpieces and Tools	ID 1410290-xx
• Complete edition	ID 1411730

General:

• TNCremo	Integrated help
• TNCremoPlus	Integrated help
• PLCdesign	Integrated help
• CycleDesign	Integrated help
• IOconfig	Integrated help
• KinematicsDesign	Integrated help
• M3D converter	Integrated help
• RemoteAccess	Integrated help

Other documentation

Brochures

• TNC7	ID 1384156-xx
• TNC7 basic	ID 1440309-xx
• Functions of the TNC7 — Comparison with the TNC 640	ID 1387017-xx
• Touch Probes	ID 1113984-xx
• Inverter Systems for Gen 3 Drives	ID 1303180-xx
• Motors	ID 208893-xx
• RemoTools SDK virtualTNC	ID 628968-xx
• Options and Accessories for TNC Controls	ID 827222-xx

Booklets

• HR 550 FS	ID 636227
• OPC UA NC Server	ID 1355797-xx

Programming station

To find the programming station software, drivers for the software security module (USB dongle) and the related documentation, visit the Downloads area of the HEIDENHAIN website.

Without the software security module (USB dongle), the programming station software runs as a demo version (with limitations).

For more information, please ask your contact person at HEIDENHAIN.

Brochure

• Programming Station for TNC Controls	ID 825930-xx

Safety parameters

The safety parameters must be calculated for every machine (e.g., as per EN ISO 13849-1), with the assemblies being used taken into account. HEIDENHAIN provides relevant documents containing the failure rates.

Registered customers will find the safety parameters for the Gen 3 drives with external and built-in functional safety (FS) in the HESIS including Filebase.

Non-registered customers will receive the documents upon request from their HEIDENHAIN contact persons. Documents for older inverter systems are available only upon request.

The following documents can be downloaded via the Filebase:

Document	ID
System Description and Failure Rates – Supplement to the Technical Manuel – Gen 3 Drives – PFH values for controls	1312624
System Description and Failure Rates – Supplement to the Technical Manual – MTTF values for emergency stop buttons and permissive buttons	815683
System Description and Failure Rates – Supplement to the Technical Manual – Failure rates of HEIDENHAIN motors	1029960

Basic circuit diagram

More information on basic circuit diagrams can be requested from your HEIDENHAIN contact person.

Service and training

Technical support

HEIDENHAIN offers technical support to machine manufacturers in order to optimize the interfacing of the control to the machine, including on-site support.

Exchange control

In the event of a malfunction, HEIDENHAIN guarantees the timely shipment of an exchange control (usually within 24 hours in Europe).

Helpline

Our customer service technicians are available for questions regarding adaption or in the event of malfunctions:

NC support (initial configuration/optimization, field service/troubleshooting)	+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de
PLC/Python programming Functional safety (FS)	+49 8669 31-3102 E-mail: service.plc@heidenhain.de
NC/Cycle programming and kinematics	+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de
Encoders and machine calibration	+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de
Application programming	+49 8669 31-3106 E-mail: service.app@heidenhain.de

If you have questions about repairs, spare parts, or exchange units, please contact our Service department:

Customer service, Germany	+49 8669 31-3121 E-mail: service.order@heidenhain.de
Customer service, international	+49 8669 31-3123 E-mail: service.order@heidenhain.de

Machine calibration

On request, HEIDENHAIN engineers will calibrate your machine's geometry (e.g., with a KGM grid encoder).

Technical training courses

HEIDENHAIN provides technical customer training in the following subjects:
- NC programming
- PLC programming
- TNC optimization
- TNC servicing
- Encoder servicing
- Customized training

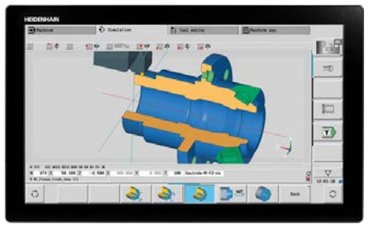
For more information on dates or registration:	
Technical training courses in Germany	+49 8669 31-3049
	E-mail: mtt@heidenhain.de
Technical training courses outside of Germany	www.heidenhain.com EN ▶ Service & Support ▶ Technical training

Other HEIDENHAIN controls
Examples

CNC PILOT 640

Information:
CNC PILOT 640 brochure

- Contouring control for **lathes, turning-milling machines and high-performance turning centers**
- Suitable for horizontal and vertical lathes as well as vertical boring and turning mills
- Axes: max. 24 control loops; max. 8 NC axes per channel; max. 6 spindles in the overall system
- Up to 3 channels for asynchronous multi-slide machining
- Up to 3 principal axes (X, Z, and Y), B axis, closed-loop spindle and counter spindle, C1/C2 axis and driven tools
- 5-axis simultaneous machining (X, Z, Y, B, and C axes)
- Up to 3 programmable auxiliary axes (U, V, W) for control of steady rest, tailstock and counter spindle
- The position of a parallel secondary axis can be shown combined with its principal axis
- For operation with HEIDENHAIN inverter systems and ideally with HEIDENHAIN motors
- Fully digital with HSCI interface and EnDat interface
- 24-inch or 15.6-inch multitouch screen
- Storage medium: CFR CompactFlash memory card (CFast)
- Programming of turning, drilling, and milling operations with smart.Turn, according to DIN, or via cycles
- TURN PLUS: automated smart.Turn program generation
- ICP free contour programming for turning and milling contours
- For simple tool holders (multifix), turrets, or magazines



CNC PILOT 640 with
24-inch multitouch screen

MANUALplus 620

Information:
MANUALplus 620 brochure

- Compact contouring control for **CNC and cycle lathes**
- Suitable for horizontal and vertical lathes as well as vertical boring and turning mills
- Axes: max. 10 control loops, of which up to 6 can be configured as spindles
- Up to 3 principal axes (X, Z, and Y), B axis, closed-loop spindle and counter spindle, C1/C2 axis, and driven tools
- Up to 3 programmable auxiliary axes (U, V, W) for control of steady rest, tailstock, and counter spindle
- The position of a parallel secondary axis can be shown combined with its principal axis
- Compact design: screen and main computer in one unit
- For operation with HEIDENHAIN inverter systems and ideally with HEIDENHAIN motors
- Fully digital with HSCI interface and EnDat interface
- 15.6-inch multi-touch display with 1366 × 768 pixels
- Integration of the keyboard on the right side of the display
- Storage medium: CFR CompactFlash memory card (CFast)
- Programming of turning, drilling, and milling operations with smart.Turn, according to DIN, or via cycles
- TURN PLUS: automated smart.Turn program generation
- ICP free contour programming for turning and milling contours
- For simple tool holders (multifix), turrets, or magazines

Subject index

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HEIDENHAIN

Mastering nanometer accuracy

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