HEIDENHAIN

TNC 640 HSCI

Gen 3

The Contouring Control for Milling Machines, Milling-Turning Machines, and Machining Centers

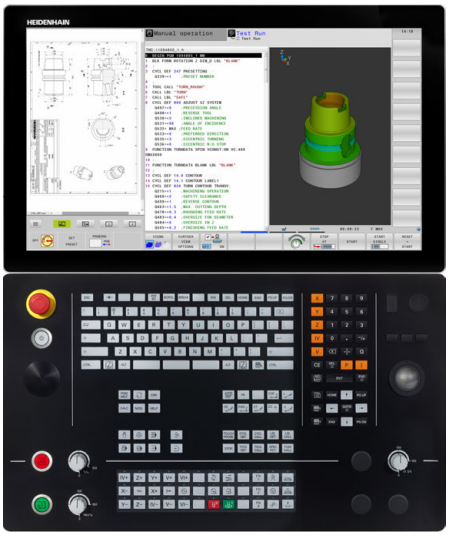
Information for the Machine Tool Builder

09/2019

TNC contouring control with drive system from HEIDENHAIN
General information

TNC 640

- Contouring control for **milling machines, milling-turning machines, and machining centers**
- Axes: up to 24 control loops (22 control loops with functional safety (FS)), of which up to 4 can be configured as spindles
- For operation with HEIDENHAIN inverter systems and preferably with HEIDENHAIN motors
- Uniformly digital with HSCI interface and EnDat interface
- Version with touch screen for multitouch operation
- Solid state drive (SSDR)
- Programming in HEIDENHAIN Klartext or G-code (ISO)
- Comprehensive cycle package for milling and turning operations
- Constant surface speed for turning operations
- Tool radius compensation
- Touch probe cycles
- Free contour programming (FK)
- Special function for fast 3-D machining
- Short block processing time (0.5 ms)



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 include parts subject to wear, particularly the backup battery and fans.

Standards

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

Note

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

Validity

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

TNC 640 with NC software versions
340590-10 (export license required)
340591-10 (no export license required)

This brochure supersedes all previous editions, which thereby become invalid. **Subject to change without notice.**

Requirements

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

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 360, TE 360 FS).

Use of this brochure

The purpose of this brochure is to help you select suitable components from HEIDENHAIN. Further documents are required for project planning (see "Technical documentation", Page 107).

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Overview tables
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NC software license		On **SIK component**			18
Monitor		–	**BF 860**	**BF 360**	22
Keyboard		–	**TE 745**	**TE 360**	
Machine operating panel		MB 721	Integrated in TE 745	Integrated in TE 360	22
		PLB 600x (HSCI adapter for OEM machine operating panel)			26
PLC inputs/outputs[1]	With HSCI interface	**PL 6000** consisting of PLB 62xx basic module (system PL) or PLB 61xx (expansion PL) and I/O modules			24
		On UEC			
		On UMC			
Additional modules[1]		**CMA-H** for analog axes/spindles in the HSCI system			27
		Modules for fieldbus systems			
Connecting cables					41

[1] May be necessary depending on the configuration

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	TNC 640	Page
Electronic handwheels	• **HR 510 FS** portable handwheel, or • **HR 520 FS** portable handwheel with display, or • **HR 550 FS** portable wireless handwheel with display, or • **HR 130** panel-mounted handwheel	30
Workpiece touch probes	• **TS 260** touch trigger probe with cable connection, or • **TS 460** touch trigger probe with radio and infrared transmission, or • **TS 740** touch trigger probe with infrared transmission	28
Tool touch probes	• **TT 160** touch trigger probe with cable connection, or • **TT 460** touch trigger probe with radio and infrared transmission, or	29
Programming station	Control software for PCs for programming, archiving, and training • Single-station license with original control keyboard • Single-station license with virtual keyboard • Network license with virtual keyboard • Demo version with virtual keyboard or PC keyboard—free of charge	
Auxiliary axis control	**PNC 610**	34
Industrial PC	**ITC 855/ITC 860**: additional operating station with touchscreen and integrated screen keyboard **IPC 306**: industrial PC for Windows **IPC 304/IPC 8420**: industrial PC for PNC 610	33
Camera system	**VS 101** camera system for monitoring the working space	36
Snap-on keys	For controls and handwheels	37

Accessories / Software	TNC 640	Page
PLCdesign[1]	PLC development software	78
KinematicsDesign[1]	Software for creation of kinematic models	69
M3D Converter[4]	Software for creation of high-resolution collision objects in M3D format	70
TNCremo[2], **TNCremoPlus**[2]	Data transfer software (TNCremoPlus with "live" screen)	83
ConfigDesign[1]	Software for configuring the machine parameters	74
CycleDesign[1]	Software for creating cycle structures	81
TNCkeygen[1]	Software for enabling SIK options for a limited time, and for single-day access to the OEM area	18
TNCscope[1]	Software for data recording	75
TNCopt[1]	Software for putting digital control loops into service	75
IOconfig[1]	Software for configuring PLC I/O and fieldbus components	25
TeleService[1][3]	Software for remote diagnostics, monitoring, and operation	75
RemoTools SDK[1]	Function library for developing customized applications for communication with HEIDENHAIN controls	84
virtualTNC[1][3]	Control component for virtual machines	84
TNCtest[1]	Software for creation and execution of an acceptance test	76
TNCanalyzer[1]	Software for the analysis and evaluation of service files	76

[1] Available to registered customers for download from the Internet
[2] Available to all customers (without registration) for download 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	TNC 640	Page
Axes	Max. of 24 control loops (22 control loops with functional safety (FS)), of which up to four can be configured as spindles	52
Rotary axes	Max. 3	
Synchronized axes	✓	
PLC axes	✓	
Main spindles	*Milling:* max. 4; second, third, and fourth spindle can be controlled alternately with the first *Turning:* max. 2 Milling spindle or lathe spindle activated via NC command	58
Speed	Maximum of 60 000 rpm (with option 49: max. 120 000 rpm)*	58
Operating mode switchover	✓	58
Position-controlled spindle	✓	58
Oriented spindle stop	✓	58
Gear shifting	✓	58
NC program memory	≈ 21 GB on the SSDR solid-state drive	16
Input resolution and display step		52
Linear axes	0.1 µm, 0.01 µm with option 23	
Rotary axes	0.0001°, 0.00001° with option 23	
Functional safety (FS)	With FS components, SPLC and SKERN	48
For applications with up to	• SIL 2 as per EN 61508 • Category 3, PL d as per EN ISO 13849-1: 2008	
Interpolation		
Straight line	In 4 axes; in max. 6 axes with option 9	
Circular	In 2 axes; in 3 axes with option 8	
Helical	✓	
Axis feedback control		60
With following error	✓	
With feedforward	✓	
Axis clamping	✓	52
Maximum feed rate	$\frac{60000\ \text{rpm}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$ at f_{PWM} = 5000 Hz	52

* For motors with one pole pair

Specifications	TNC 640	Page
Cycle times of main computer	**MC**	61
Block processing	0.5 ms	62
Cycle times of controller unit	**CC/UEC/UMC**	61
Path interpolation	3 ms	61
Fine interpolation	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)	
Position controller	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)	
Speed controller	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)	
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	TNC 640	Page
Error compensation	✓	71
Linear axis error	✓	71
Nonlinear axis error	✓	71
Backlash	✓	71
Reversal spikes during circular movement	✓	71
Hysteresis	✓	71
Thermal expansion	✓	71
Static friction	✓	71
Sliding friction	✓	71
Integrated PLC	✓	77
Program format	Statement list	77
Program input at the control	✓	77
Program input via PC	✓	77
Symbolic PLC-NC interface	✓	77
PLC memory	> 1 GB	77
PLC cycle time	9 ms to 30 ms (adjustable)	77
PLC inputs/outputs	A PLC system can consist of max. seven PLB 61xx and max. two MB 7xx, one TE 7x5, or one PLB 600x. A total maximum of 1000 inputs/outputs is supported.	24
PLC inputs, DC 24 V	Via PL, UEC, UMC	24
PLC outputs, DC 24 V	Via PL, UEC, UMC	24
Analog inputs, ±10 V	Via PL	24
Inputs for PT 100 thermistors	Via PL	24
Analog outputs, ±10 V	Via PL	24
PLC functions	✓	77
Small PLC window	✓	78
PLC soft keys	✓	78
PLC positioning	✓	78
PLC basic program	✓	80
Integration of applications		79
High-level language programming	Python programming language used in combination with the PLC (option 46)	79
User interfaces can be custom-designed	Create specific user interfaces of the machine tool builder with the programming language Python. The standard version provides 10 MB of memory for programs. Additional memory can be enabled via option 46.	79

Interfacing to the machine	TNC 640	Page
Commissioning and diagnostic aids		74
DriveDiag	Software for diagnosis of digital drive systems	74
TNCopt	Software for putting digital control loops into service	75
ConfigDesign	Software for creating the machine configuration	74
KinematicsDesign	Software for creating the machine kinematics, initialization of DCM	69
Integrated oscilloscope	✓	74
Trace function	✓	75
API DATA function	✓	75
Table function	✓	75
OLM (online monitor)	✓	75
Log	✓	75
TNCscope	✓	75
Bus diagnostics	✓	75
Data interfaces	✓	
Ethernet	2 x 1000BASE-T	82
USB	*Rear:* 4 x USB 3.0 *Front:* USB 2.0	82
V.24/RS-232-C	✓	82
Protocols		82
Standard data transmission	✓	82
Blockwise data transfer	✓	82
LSV2	✓	82

User functions

User function	Standard	Option	TNC 640
Short description	✓		Basic version: 3 axes plus closed-loop spindle
		0-7	A total of 14 additional NC axes or 13 additional NC axes plus second spindle
		77	
		78	
	✓		Digital current and speed control
Program entry	✓		HEIDENHAIN Klartext
	✓		According to ISO
		42	Direct loading of contours or machining positions from DXF files and saving as Klartext contouring programs, or as point tables
Position values	✓		Nominal positions for 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)
		9	Three-dimensional tool-radius compensation for the later changing of tool data without needing to recalculate the 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
	✓		Relative to the tool's cutting edge
Parallel operation	✓		Creating a program with graphical support while another program is being run
3-D machining	✓		Motion control with smoothed jerk
		9	3-D tool compensation via surface-normal vectors
		9	Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point (TCPM = Tool Center Point Management)
		9	Keeping the tool normal to the contour
		9	Tool radius compensation normal to the tool direction
		9	Manual traverse in the active tool-axis system
		92	3-D radius compensation depending on the tool's contact angle
Rotary table machining		8	Programming of cylindrical contours as if in two axes
		8	Feed rate in distance per minute
Turning		50	Program-controlled switchover between milling and turning
		50	Constant surface speed
		50	Tool radius compensation
		50	Cycles for roughing, finishing, recessing, thread turning, and recess turning
		50	Blank form updated in contour cycles
		50	Turning-specific contour elements for recesses and undercuts
		50	Orientation of the turning tool for outside or inside machining
		50	Inclined turning
		50	Speed limiting
		50	Eccentric turning (additionally required: option 135)
Contour elements	✓		Straight line
	✓		Chamfer
	✓		Circular path
	✓		Circle center
	✓		Circle radius
	✓		Tangentially connecting circular arc
	✓		Corner rounding
		50	Recess
		50	Undercut

User function	Standard	Option	TNC 640
Contour approach and departure	✓ ✓		Via straight line: tangential or perpendicular Via circular arc
Adaptive feed control		45	AFC: Adaptive Feed Control adjusts the contouring feed rate to the current spindle power
Collision monitoring		40 40 40	Dynamic Collision Monitoring (DCM) Graphic depiction of the active collision objects (high-resolution M3D format) Tool carrier monitoring
FK free contour programming	✓		FK free contour programming in HEIDENHAIN Klartext format with graphic support for workpiece drawings not dimensioned for NC
Program jumps	✓ ✓ ✓		Subprograms Program section repeat Calling any program as a subprogram
Fixed cycles	✓ ✓ ✓ ✓ ✓	 50 50 50 50 50+ 135 96	Drilling, tapping with a floating tap holder, rigid tapping Peck drilling, reaming, boring, counterboring, centering 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 internal and external threads Turning internal and external threads Hobbing Interpolation turning (not with functional safety (FS)) Clearing level and oblique surfaces Multi-operation machining of straight and circular slots Multioperation machining of rectangular and circular pockets Cartesian and polar point patterns Contour train, contour pocket Contour slot with trochoidal milling OEM cycles (special cycles developed by the machine tool builder) can be integrated Engraving cycle: Engrave text or numbers in a straight line or on an arc
Coordinate transformations	✓	 8 44	Shifting, rotating, mirroring, scaling (axis specific) Tilting the working plane, PLANE function *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 TNC 640; context-sensitive calling possible Graphic support for programming cycles Comment and structure blocks in the NC program
CAD viewer	✓		Display of standardized CAD file formats on the TNC
Teach-In	✓		Actual positions can be transferred directly into the NC program
Test graphics Depictions	✓ ✓		Graphic simulation before a program run, even while another program is running Plan view / projection in 3 planes / 3-D view, also in tilted working plane

User function	Standard	Option	TNC 640
	✓		Detail zoom
3-D line graphics	✓		For verification of programs created offline
Programming graphics	✓		In the Programming and Editing mode, the contours of the NC blocks are drawn on screen while they are being entered (2-D pencil-trace graphics), even while another program is running
Program-run graphics **Display modes**	✓ ✓		Graphic simulation during real-time machining Plan view / projection in 3 planes / 3-D view
Machining time	✓ ✓		Calculation of machining time in the Test Run operating mode Display of the current machining time in the Program Run operating modes
Returning to the contour	✓ ✓		Mid-program startup at any block in the program, and approach of the calculated nominal position for continued machining Program interruption, contour departure and approach
Preset management	✓		One table for storing 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 program, and datums)
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 makes it possible to run programs on different machine configurations
Touch probe cycles	✓ ✓ ✓ ✓	 48	Calibrating the touch probe Compensation of workpiece misalignment, manual or automatic Reference point setting, manual or automatic Automatic tool and workpiece measurement Automatic measurement and optimization of machine kinematics
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

Options

Option number	Option	As of NC software 34059x-	ID	Comment	Page
0	Additional Axis 1	01	354540-01	Additional control loop 1	20
1	Additional Axis 2	01	353904-01	Additional control loop 2	20
2	Additional Axis 3	01	353905-01	Additional control loop 3	20
3	Additional Axis 4	01	367867-01	Additional control loop 4	20
4	Additional Axis 5	01	367868-01	Additional control loop 5	20
5	Additional Axis 6	01	370291-01	Additional control loop 6	20
6	Additional Axis 7	01	370292-01	Additional control loop 7	20
7	Additional Axis 8	01	370293-01	Additional control loop 8	20
8	Advanced Function Set 1	01	617920-01	**Rotary table machining** • Programming of cylindrical contours as if in two axes • Feed rate in distance per minute	52
				Coordinate transformation • Tilting the working plane, PLANE function	53
				Interpolation • Circular in 3 axes with tilted working plane	
9	Advanced Function Set 2	01	617921-01	**3-D machining** • 3-D tool compensation via surface normal vectors • Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point (TCPM = Tool Center Point Management) • Keeping the tool normal to the contour • Tool radius compensation normal to the tool direction • Manual traverse in the active tool-axis system **Interpolation** • Linear in more than 4 axes (export license required)	53
18	HEIDENHAIN DNC	01	526451-01	Communication with external PC applications over COM component	84
40	DCM Collision	02	526452-01	Dynamic collision monitoring (DCM)	68
42	CAD Import	08	526450-01	Importing of contours from 2-D and 3-D models, e.g. STEP, IGES, DXF	
44	Global PGM Settings	05	576057-01	Global program settings	55
45	Adaptive Feed Control (AFC)	02	579648-01	Adaptive feed control	63
46	Python OEM Process	01	579650-01	Execute Python applications	79
48	KinematicsOpt	01	630916-01	Touch-probe cycles for the automated measurement of rotary axes	72
49	Double-Speed Axes	01	632223-01	Short control-loop cycle times for direct drives	61

Option number	Option	As of NC software 34059x-	ID	Comment	Page
50	Turning	01	634608-01	Turning functions • Tool management for turning • Tool-tip radius compensation • Switching between milling and turning modes of operation • Lathe-specific contour elements • Package of turning cycles	56
52	KinematicsComp	05	661879-01	Spatial compensation of errors in rotary and linear axes (export license required)	73
56 - 61	OPC UA NC Server	10	1291434-01 to 1291442-01	Connection of an OPC UA application	85
77	4 Additional Axes	01	634613-01	4 additional control loops	20
78	8 Additional Axes	01	634614-01	8 additional control loops	20
92	3D-ToolComp	07	679678-01	3-D radius compensation depending on the tool's contact angle (only with software option Advanced Function Set 2)	73
93	Extended Tool Management	01	676938-01	Extended tool management	
96	Adv. Spindle Interp.	05	751653-01	Additional functions for an interpolated spindle • Interpolation turning, coupling • Interpolation turning, contour finishing	
101 - 130	OEM option	02	579651-01 to 579651-30	Options of the machine tool builder	
131	Spindle Synchronism	05	806270-01	Synchronization of two or more spindles	84
133	Remote Desktop Manager	01	894423-01	Display and remote operation of external computer units (e.g., a Windows PC)	84
135	Synchronizing functions	04	1085731-01	Expanded synchronization of axes and spindles	54
136	Visual Setup Control	06	1099457-01	VSC: Camera-based monitoring of the setup situation	54
137	State Reporting	09	1232242-01	State Reporting Interface (SRI): provision of operating statuses	
141	Cross Talk Comp.	02	800542-01	CTC: Compensation of axis couplings	66
142	Pos. Adapt. Control	02	800544-01	PAC: Position-dependent adaptation of control parameters	66
143	Load Adapt. Control	02	800545-01	LAC: Load-dependent adaptation of control parameters	67
144	Motion Adaptive Control	02	800546-01	MAC: Motion-dependent adaptation of control parameters	67
145	Active Chatter Control	02	800547-01	ACC: Active suppression of chatter	64
146	Active Vibration Damping	04	800548-01	AVD: Active vibration damping	66
154	Batch Process Manager	05	1219521-01	Planning and executing multiple machining operations	55

Option number	Option	As of NC software 34059x-	ID	Comment	Page
155	Component Monitoring	09	1226833-01	Monitoring for component overloading and wear	
156	Grinding	10	1237232-01	Grinding function • Jig grinding • Switching between normal operation and dressing mode • Reciprocating stroke • Grinding cycles • Tool management for grinding and dressing	
157	Gear Cutting	09	1237235-01	Functions for the machining of gear teeth	
158	Advanced Function Set Turning	09	1237237-01	Extended turning cycles and functions	
160	Integrated FS: Basic	10	1249928-01	Enables functional safety and four safe control loops	48
161	Integrated FS: Full	10	1249929-01	Enables functional safety and maximum number of safe control loops (# 10)	48
162	Add. FS Ctrl. Loop 1	10	1249930-01	Additional control loop 1	48
163	Add. FS Ctrl. Loop 2	10	1249931-01	Additional control loop 2	48
164	Add. FS Ctrl. Loop 3	10	1249932-01	Additional control loop 3	48
165	Add. FS Ctrl. Loop 4	10	1249933-01	Additional control loop 4	48
166	Add. FS Ctrl. Loop 5	10	1249934-01	Additional control loop 5	48
167	Optimized Contour Milling	10	1289547-01	Enhance clearing processes	64

HSCI control components
Main computers

Main computer

The **MC 306** main computers feature:
- Intel Xeon E3 processor, 2.1 GHz, 4 cores, 6 MB cache
- RAM: 8 GB of ECC SDRAM
- HSCI interface to the controller unit and to other control components
- HDL2 interface for the BF 360 and BF 860 monitors (with electrical cabinet versions)
- 4 x USB 3.0 interface (e.g., with the TE 3xx operating panel)

To be ordered separately and installed in the main computer by the OEM:
- **SSDR** memory card with the NC software
- The **System Identification Key** (SIK) component for the enabling of control loops and software options

The following HSCI components are required for operation of the TNC 640:
- MC main computer
- Controller unit
- **PLB 62xx** PLC I/O unit (system PL; integrated in UxC)

Interfaces

For use by end users, the MC is equipped with the USB 3.0, and Ethernet interfaces. Connection to PROFINET DP or PROFIBUS IO is possible either via additional modules or by means of a combined PROFINET DP / PROFIBUS IO module.

Export version

Because the complete NC software is on the storage medium, no export version is required for the main computer itself. Only the easily replaceable storage medium and SIK component are available as an export version.

Gen 3 labels

The Gen 3 labels identify in which systems the control components can be used.

Gen 3 ready

Gen 3 ready: These components can be used both in systems with Gen 3 drives (UVR 3xx, UM 3xx, CC 3xx) and in systems with a Gen 2 inverter system (UVR 1xx, UE 2xx, UR 2xx, CC 61xx).

Gen 3 exclusive

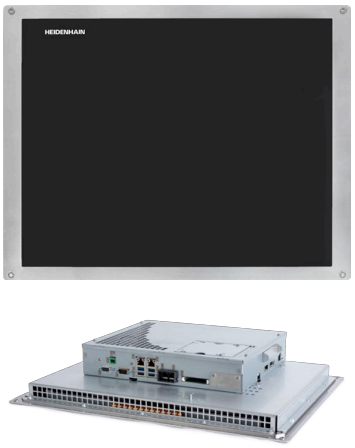
Gen 3 exclusive: These components can be used only in systems with Gen 3 drives (UVR 3xx, UM 3xx, CC 3xx) and are not supported in systems with a Gen 2 inverter system (UVR 1xx, UE 2xx, UR 2xx, CC 61xx).

Versions

Various versions of the MC main computer are available:

- For installation in the **electrical cabinet**
  The MC 306 is installed in the electrical cabinet. The operating panel requires HSCI, USB, and HDL2 cables as control lines
- For installation in the **operating panel** for touchscreen operation
  Together with the BF display unit, the MC 85x2 or MC 366 forms a unit that is integrated directly into the control panel. With the exception of the power supply line, only one HSCI connecting cable to the electrical cabinet is needed. These versions are downward compatible. The MC is equipped with the Core i7/3 processor, 1.7 GHz, with 4 GB RAM.

MC 8512 with main computer installed on the back



MC 8532 with main computer installed on the back

MC 366 with main computer installed on the back

Gen 3 ready

	Installed in	Power consumption*	Mass	ID
MC 306	Electrical cabinet	≈ 65 W	≈ 4 kg	1180045-xx
MC 8512	Operating panel	≈ 75 W	≈ 7.5 kg	1243919-xx
MC 8532	Operating panel	≈ 75 W	≈ 7.5 kg	1189190-xx
MC 366	Operating panel	≈ 65 W	≈ 10 kg	1246689-xx

* Test conditions: Windows 7 (64-bit) operating system, 100 % processor loading, no load on interfaces, no fieldbus module

MC 306

Options

The capabilities of the TNC 640 can also be adapted at a later time with options to meet new requirements. These options are described on page 13. They are enabled by entering keywords based on the SIK number and are saved in the SIK component. Please provide your SIK number when ordering new options.

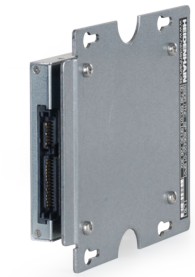
Storage medium

The storage medium is removable and must be ordered separately from the main computer. It contains the NC software 34059x-xx. The NC software is based on the HEIDENHAIN HEROS 5 operating system.

Gen 3 ready

SSDR solid state drive for the operating panel

Free capacity	21 GB
For main computer	MC 85x2
Export license required	ID 810288-10
No export license required	ID 810288-60



SSDR MC 85x2

Gen 3 exclusive

SSDR solid state drive for electrical cabinet

Free capacity	21 GB
For main computer	MC 306
Export license required	ID 1279027-10
No export license required	ID 1279027-60

SSDR MC 306

SIK component

The SIK component contains the **NC software license** for enabling control loops and software options. It gives the main computer 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.

SIK component

The SIK component with the NC software license is available in various versions, depending on the enabled control loops and options. Additional control loops can be enabled later by entering a keyword. HEIDENHAIN provides the keyword, which is based on the SIK number.

When ordering, please provide the SIK number of your control. When the keywords are entered in the control, they are saved in the SIK component. This enables and activates the options. Should servicing become necessary, the SIK component must be inserted into the replacement control in order to enable all of the required options.

Master keyword (general key)

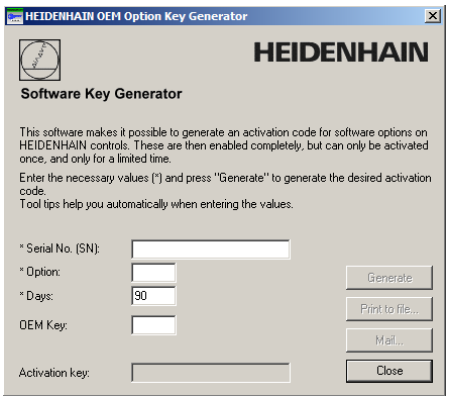
For the commissioning of the TNC 640, there is a master keyword (general key) that enables all options for a single 90-day period. After this period, only those options with the correct keywords will be active. The general key is activated via a soft key.

TNCkeygen (accessory)

TNCkeygen is a collection of PC software tools for generating enabling keys for HEIDENHAIN controls for a limited period of time.

With **OEM Key Generator**, you can generate enabling keys for software options by entering the SIK number, the option to be enabled, the duration, and a manufacturer-specific password. The enabling period is limited to 10 to 90 days. Each option can be enabled only once. This option enabling is independent of the general key.

The **OEM daily key generator** generates an enabling key for the protected OEM area. The operator is thereby given access to the area on the day the key was generated.



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

Active control loops	Recommended combinations						NC software license			
	CC 306	CC 308	CC 310	CC 310 + CC 302	CC 306 + CC 308	2 x CC 308	Without software option	Incl. option 8	Incl. options 8 + 9	Incl. options 8 + 9 + 50
							SIK	SIK	SIK	SIK
4	✓						ID 674989-20 *ID 674989-70*	ID 674989-09 *ID 674989-59*	ID 674989-01 *ID 674989-51*	ID 674989-28 *ID 674989-78*
5	✓						ID 674989-24 *ID 674989-74*	ID 674989-17 *ID 674989-67*	ID 674989-02 *ID 674989-52*	ID 674989-29 *ID 674989-79*
6	✓						ID 674989-25 *ID 674989-75*	ID 674989-18 *ID 674989-68*	ID 674989-03 *ID 674989-53*	ID 674989-30 *ID 674989-80*
7		✓					ID 674989-26 *ID 674989-76*	ID 674989-19 *ID 674989-69*	ID 674989-04 *ID 674989-54*	ID 674989-31 *ID 674989-81*
8		✓					ID 674989-27 *ID 674989-77*	ID 674989-23 *ID 674989-73*	ID 674989-05 *ID 674989-55*	ID 674989-32 *ID 674989-82*
9			✓				Only through subsequent enabling of control loops (additional axes)		ID 674989-06 *ID 674989-56*	ID 674989-33 *ID 674989-83*
10			✓						ID 674989-07 *ID 674989-57*	ID 674989-34 *ID 674989-84*
11				✓					ID 674989-10 *ID 674989-60*	ID 674989-35 *ID 674989-85*
12				✓					ID 674989-11 *ID 674989-61*	ID 674989-36 *ID 674989-86*
13					✓				ID 674989-12 *ID 674989-62*	ID 674989-37 *ID 674989-87*
14					✓				ID 674989-13 *ID 674989-63*	ID 674989-38 *ID 674989-88*
15						✓			ID 674989-14 *ID 674989-64*	ID 674989-39 *ID 674989-89*
16						✓			ID 674989-15 *ID 674989-65*	ID 674989-40 *ID 674989-90*
17 – 24							Only through subsequent enabling of control loops (additional axes)			

(Italics: export version)

For a description of the CC 3xx controller units, please refer to the *Gen 3 Drives for HEIDENHAIN Controls* brochure.

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. No more than **24 control loops** are possible.

Control-loop groups	**Option**	
4 additional control loops	77	ID 634613-01
8 additional control loops	78	ID 634614-01

Individual control loops	**Option**	
1st additional control loop	0	ID 354540-01
2nd additional control loop	1	ID 353904-01
3rd additional control loop	2	ID 353905-01
4th additional control loop	3	ID 367867-01
5th additional control loop	4	ID 367868-01
6th additional control loop	5	ID 370291-01
7th additional control loop	6	ID 370292-01
8th additional control loop	7	ID 370293-01

Machine operating panel

MB 721 machine operating panel

- Supply voltage: DC 24 V/≈ 4 W
- 36 exchangeable snap-on keys with status LED, freely definable via PLC (assignment as per PLC basic program: 12 axis keys, spindle start, spindle stop, 22 further function keys)
- Further operating elements: NC start[1)], NC stop[1)], emergency-stop key, control voltage On[1)], two bore holes for additional keys or keylock switches
- HSCI interface
- MB 721: 8 free PLC inputs and 8 free PLC outputs
  MB 721 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)] Keys illuminated, addressable via PLC

MB 721	ID 1164974-xx
MB 721 FS	ID 1164975-xx
Mass	≈ 1.6 kg

MB 721

19-inch screen and keyboard

BF 860 screen

Gen 3 exclusive

- Supply voltage: DC 24 V/≈ 65 W
- **19-inch**; 1280 x 1024 pixels
- HDL2 interface to the MC in the electrical cabinet
- Integrated USB hub with 4 USB ports on the rear
- Display for multitouch operation

Via touchscreen operation
- Soft-key row switchover
- Screen layout
- Operating mode switchover

BF 860 ID 1244875-xx
Mass ≈ 7.1 kg

BF 860

TE 745 keyboard with integrated machine operating panel

Gen 3 ready

General features:
- Suitable for BF 860 (19-inch design)
- Axis keys
- The keys for axes IV and V are exchangeable snap-on keys
- Contouring keys
- Operating mode keys
- ASCII keyboard
- Spindle, feed-rate, and rapid-traverse override potentiometers
- USB interface to the MC main computer
- Touchpad
- USB port with cover cap on front

Technical characteristics:
- Supply voltage: DC 24 V/≈ 4 W
- 36 exchangeable snap-on keys with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindel stop, 22 other function keys)
- Further operating elements: NC start[1)], NC stop[1)], emergency-stop key, control voltage on[1)], two holes for additional keys or keylock switches
- Connection for HR handwheel
- HSCI interface
- TE 745: 8 free PLC inputs and 8 free PLC outputs
  TE 745 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)] Keys illuminated, addressable via PLC

TE 745 ID 679817-13
TE 745 FS ID 805482-13
Mass ≈ 4.3 kg

TE 745

24-inch screen and keyboard

BF 360 monitor

Gen 3 exclusive

- 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

Via touchscreen operation:
- Soft-key row switchover
- Screen layout
- Operating mode switchover

BF 360 ID 1275079-xx
Mass ≈ 9.5 kg

BF 360

TE 360 keyboard with integrated machine operating panel

Gen 3 ready

General features:
- Suitable for BF 360 (24-inch design)
- Axis keys
- The keys for axes IV and V are exchangeable snap-on keys
- Contouring keys
- Operating mode keys
- ASCII keyboard
- Spindle, feed-rate, and rapid-traverse override potentiometers
- USB interface to the MC main computer
- Trackball
- USB port with cover cap on front

Technical characteristics:
- Supply voltage: DC 24 V/≈ 4 W
- 36 exchangeable snap-on keys with status LED, freely definable via PLC
- 36 exchangeable snap-on keys with status LED, freely definable via PLC (assignment in accordance with PLC basic program: 12 axis keys, spindle start, spindle stop, 22 further function keys)
- Further operating elements: NC start[1)], NC stop[1)], emergency-stop key, control voltage on[1)], holes for additional keys or keylock switches
- Connection for HR handwheel
- HSCI interface
- TE 360: 8 free PLC inputs and 8 free PLC outputs
  TE 360 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)] Keys illuminated, addressable via PLC

Standard potentiometer layout:
TE 360 ID 1280184-xx
TE 360 FS ID 1275710-xx
Mass ≈ 5.8 kg

Alternative potentiometer layout:
TE 360 ID 1284265-xx
TE 360 FS ID 1284263-xx
Mass ≈ 5.8 kg

TE 360 with standard potentiometer layout

TE 360 with alternative potentiometer layout

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 software.

PLB 62xx

Basic modules

There are basic modules with the **HSCI interface** for 4, 6, or 8 modules. They are mounted on standard NS 35 rails (DIN 46227 or EN 50022).

Supply voltage	DC 24 V
Power consumption[1)]	≈ 48 W at DC 24 V NC ≈ 21 W at DC 24 V PLC
Mass	≈ 0.36 kg (bare)

[1)] PLB 6xxx completely filled, incl. TS, TT. For more details regarding power supply for DC 24 V NC, see *Power supply for HSCI components*.

System PL with EnDat support

- Required once for each control system (except with UEC)
- 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
- FS is enabled via SIK options
- Slots are equipped with cover strips

Gen3 ready

PLB 6204	For 4 I/O modules	ID 1129809-02
PLB 6206	For 6 I/O modules	ID 1129812-02
PLB 6208	For 8 I/O modules	ID 1129813-02

Gen3 exclusive

PLB 6204 FS	For 4 I/O modules	ID 1223032-xx
PLB 6206 FS	For 6 I/O modules	ID 1223033-xx
PLB 6208 FS	For 8 I/O modules	ID 1223034-xx

Expansion PL

Gen 3 ready

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

PLB 6104	For 4 I/O modules	ID 1129799-xx
PLB 6106	For 6 I/O modules	ID 1129803-xx
PLB 6108	For 8 I/O modules	ID 1129804-xx
PLB 6104 FS	for 4 I/O modules	ID 1129796-xx
PLB 6106 FS	for 6 I/O modules	ID 1129806-xx
PLB 6108 FS	for 8 I/O modules	ID 1129807-xx

Up to seven PLB 6xxx can be connected to the control.

I/O modules

Gen 3 ready

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.

PLD-H 16-08-00	I/O module with 16 digital inputs and 8 digital outputs	ID 594243-xx
PLD-H 08-16-00	I/O module with 8 digital inputs and 16 digital outputs	ID 650891-xx
PLD-H 08-04-00 FS	I/O module with 8 digital FS inputs and 4 digital FS outputs	ID 598905-xx
PLD-H 04-08-00 FS	I/O module with 4 digital FS inputs and 8 digital FS outputs	ID 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	ID 746706-xx

Total current	Outputs 0 to 7: ≤ 2 A per output (≤ 8 A simultaneously)
Power output	Max. 200 W
Mass	≈ 0.2 kg

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	ID 675572-xx
Mass	≈ 0.2 kg	

I/O module for axis release

Gen 3 exclusive

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

PAE-H 08-00-01	I/O module for the release of 8 axis groups	ID 1203881-xx

IOconfig (accessory)

PC software for configuring HSCI and PROFIBUS components

Accessories

HSCI adapter for OEM machine operating panel

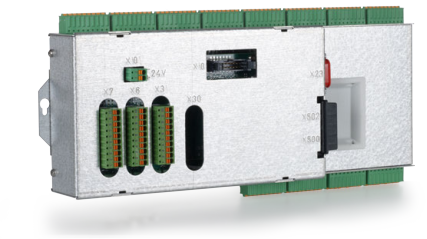
PLB 600x

Gen 3 ready

The PLB 600x HSCI adapter is required in order to connect an OEM-specific machine operating panel to the TNC 640. The spindle-speed and feed-rate override potentiometers of the TE 7xx and the HR handwheel are also connected to these adapters.

- HSCI interface
- Connection for HR handwheel
- Inputs/outputs for keys/key illumination
  PLB 6001: Terminals for 72 PLC inputs and 40 PLC outputs
  PLB 6001 FS: Terminals for 36 FS inputs and 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 computer software

PLB 6001	ID 668792-02
PLB 6001 FS	ID 722083-02
PLB 6002 FS	ID 1137000-02
Mass	≈ 1.2 kg



PLB 6001

Additional modules

Gen 3 ready

Overview

The additional modules are directly connected to the HSCI control system through a slot on the MC main computer, on the CC controller unit, or on the UEC or UMC inverter.

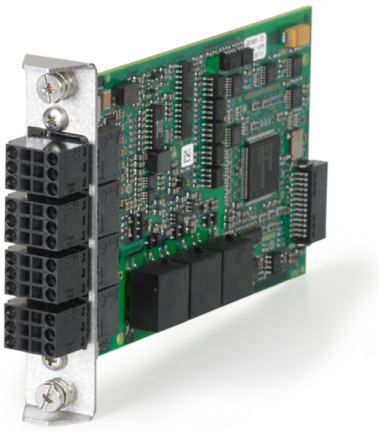
Module for analog axes

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 servo drives 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 CC 61xx 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 TNC 640 with a PROFIBUS or PROFINET interface at any time. The modules are integrated in the control system by using a slot on the MC. This makes the connection to an appropriate fieldbus system as master possible. As of version 3.0, the interface is configured with IOconfig.

PROFIBUS DP module

Additional module for PROFIBUS DP:
- Expansion board for the MC main computer
- Connection for 9-pin D-sub connector (female) to X121

Additional PROFIBUS DP module for the MC 85x2 and MC 366 ID 828539-xx
Additional PROFIBUS DP module for the MC 306 ID 1279074-xx

PROFIBUS-DP module

PROFINET IO module

Additional module for PROFINET IO:
- Expansion board for the MC main computer
- RJ45 connection at X621 and X622

Additional PROFINET IO module for the MC 85x2 and MC 366 ID 828541-xx
Additional PROFINET IO module for the MC 306 ID 1279077-xx

PROFINET-IO module

Combined PROFIBUS DP/ PROFINET IO module

Additional module for PROFIBUS DP and PROFINET IO:
- Expansion board for the MC main computer
- Connection for RJ45 connector to X621 (PROFINET IO) and M12 connector to X121 (PROFIBUS DP)
- Additionally connectable terminating resistor for PROFIBUS DP with front LED

Additional PROFIBUS DP and PROFINET IO module for the MC 85x2 and MC 366 ID 1160940-xx
Additional PROFIBUS DP and PROFINET IO modules for the MC 306 ID 1233765-xx

Combined module

Touch probes

Overview

Touch probes for tool and workpiece measurement are connected via the system PL 62xx or the UEC/UMC. These touch probes generate a trigger signal that saves the current position value to the NC. The EnDat interface makes touch probes intelligent and allows for greater convenience when connecting them to HEIDENHAIN controls. For more information on touch probes, please refer to the *Touch Probes for Machine Tools* brochure (ID 1113984).

Workpiece measurement

The TS touch trigger probes feature a stylus for probing workpieces. HEIDENHAIN controls feature standard routines for aligning and measuring workpieces, and for setting presets. The touch probes are available with various clamping shanks. Assorted styli are available as accessories.

Touch probes with **cable connection for signal transmission** for machines with manual tool change:

TS 260
TS 268

TS 260: new generation touch probe for NC machines
TS 268: like the TS 260, but with reduced deflection forces

TS 260

Touch probe with **radio and infrared transmission** for machines with an automatic tool changer (for the appropriate transceiver, see page 29):

TS 460

New generation touch probe with compact dimensions
- Hybrid technology: Signal transmission via radio and infrared signals
- Large transmission range and long operating time
- Mechanical collision protection and thermal decoupling
- With EnDat functionality

TS 460

Touch probes with **infrared transmission** for machines with an automatic tool changer (for the appropriate transceiver, see page 29):

TS 642

Activation via switch in taper shank

TS 740

High probing accuracy and reproducibility, low probing force

Tool measurement

The touch probes for tool measurement from HEIDENHAIN are suited for probing stationary or rotating tools directly on the machine. The TNC 640 features standard cycles for the measurement of tool length and diameter, as well as of individual teeth. The TNC 640 automatically saves the measured tool dimensions in a tool table. It is also possible to measure tool wear between two machining steps. For the next machining operation, the TNC 640 automatically compensates for the tool dimensions or inserts a replacement tool (as when a tool breaks).

With the **TT touch trigger probes**, the disk-shaped probe contact is deflected from its resting position by contact with the stationary or rotating tool, and a trigger signal is transmitted to the TNC 640.

TT 160

New generation touch probe; signal transmission to the control over connecting cable

TT 160

TT 460

New generation touch probe, with hybrid technology: signal transmission via radio or infrared beam (see below for the appropriate transceiver unit). Optionally available with EnDat functionality.

Transceiver

Gen 3 ready

Radio and infrared communication is established between the TS or TT touch probe and the SE transceiver.

SE 660 for radio and infrared transmission (hybrid technology); SE unit for both the TS 460 and TT 460;
SE 661 for radio and infrared transmission (hybrid technology); SE for both the TS 460 and TT 460; EnDat functionality for the transmission of the switching status, as well as for diagnostic information and additional data.
SE 540 for infrared transmission; for installation in the spindle head
SE 642 for infrared transmission; SE for both the TS and TT

SE 661

The following combinations are possible:

	SE 660	SE 661*	SE 540	SE 642
TS 460	Radio/infrared		Infrared	Infrared
TS 642	Infrared	–	Infrared	Infrared
TS 740	–		Infrared	Infrared
TT 460	Radio/infrared		Infrared	Infrared

* With EnDat interface

Electronic handwheels

Gen 3 ready

Overview

Support for electronic handwheels is standard on the TNC 640:
- One **HR 550 FS** wireless handwheel, or
- One **HR 510** or **HR 520** portable handwheel, or
- One **HR 130** panel-mounted handwheel, or
- Up to three **HR 150** panel-mounted handwheels via **HRA 110**

It is possible to operate up to five handwheels or handwheel adapters on a single TNC 640:
- One handwheel via the handwheel input of the main computer
- One handwheel each on up to four HSCI machine operating panels or the PLB 600x HSCI adapter

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

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 two permissive buttons (24 V)
- Magnetic holding pads

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

HR 510

	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 ≈ 0.6 kg

HR 520

Portable electronic handwheel with:
- Display for operating mode, actual position value, programmed feed rate and spindle speed, error messages
- 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

	Without detent	With detent
HR 520	ID 670302-xx	ID 670303-xx
HR 520 FS	ID 670304-xx	ID 670305-xx

Mass ≈ 1 kg

HR 520

Holder for HR 520 — For attaching to a machine — ID 591065-xx

HR 550 FS

Electronic handwheel with wireless transmission. Display, operating elements, and functions are like those of the HR 520

In addition:
- Functional safety (FS)
- Radio transmission range of up to 20 m (depending on environment)

HR 550 FS	Without detent	ID 1200495-xx
	With detent	ID 1183021-xx
Replacement battery	For HR 550 FS	ID 623166-xx

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

HRA 551 FS	ID 1119052-xx
Mass	≈ 1.0 kg

For more information, see the *HR 550 FS* Product Information sheet.

Connecting cables

	HR 510	HR 510 FS	HR 520	HR 520 FS	HR 550 FS with HRA 551 FS	
Connecting cable (spiral cable) to HR (3 m)	–	–	✓	✓	–	ID 312879-01
	✓	✓	–	–	–	ID1117852-03
Connecting cable with metal armor	–	–	✓	✓	–	ID 296687-xx
	✓	✓	–	–	–	ID 1117855-xx
Connecting cable without metal armor	–	–	✓	✓	✓ (max. 2 m)	ID 296467-xx
	✓	✓	–	–	–	ID 1117853-xx
Adapter cable for HR/HRA to MC, straight connector	✓	✓	✓	✓	✓[1]	ID 1161072-xx
Adapter cable for HR/HRA to MC, angled connector (1 m)	✓	✓	✓	✓	✓[1]	ID 1218563-01
Extension cable to adapter cable	✓	✓	✓	✓	✓[1]	ID 281429-xx
Adapter cable for HRA to MC	–	–	–	–	✓[2]	ID 749368-xx
Extension cable to adapter cable	–	–	–	–	✓[2]	ID 749369-xx
Adapter connector for handwheels without functional safety	✓	–	✓	–	–	ID 271958-03
Adapter connector for handwheels with functional safety	–	✓	–	✓	✓	ID 271958-05

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

See also *Cable overview* on Page 41.

HR 130

Panel-mounted handwheel with ergonomic control knob.
It is attached to the MB 7x0 or the TE 7x5 either directly or via an extension cable.

HR 130	Without detent	ID 540940-03
	With detent	ID 540940-01
Mass	≈ 0.7 kg	

HR 130

Industrial PC

Gen 3 ready

Additional operating station

The additional ITC operating stations (Industrial Thin Clients) 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 TNC 640, makes it very easy to connect the ITC over a standard Ethernet connection with a cable length of up to 100 m.

Connecting an ITC is very easy: as soon as the TNC 640 identifies an ITC, it provides it with a current operating system. After the ITC has been started, the complete content of the main screen is mirrored to the ITC's screen. As a result of this plug-and-play principle, no configuration by the machine tool builder is necessary. With the standard configuration of the Ethernet interface at X116, the TNC 640 integrates the ITC into the system fully self-sufficiently.

With touchscreen

The **ITC 860** (19-inch screen) and the keyboard unit (to be ordered separately) together comprise a complete second operating station. Along with the touchscreen, it also has the most important function keys of the control. The soft keys are pressed on the touchscreen.

ITC 860 ID 1174935-xx

ITC 860

Controlling of auxiliary axes

Gen 3 ready

PNC 610

The PNC 610 auxiliary axis control is designed for controlling PLC axes independently of the TNC 640. The PNC 610 does not have an NC channel and thus cannot perform interpolating NC movements. With the IPC auxiliary computer, SIK, and CFR storage medium, the PNC 610 is a separate HSCI system, which can be expanded with HEIDENHAIN inverters. The standard PNC 610 features enabling for six PLC axes.

The system's design is identical to that of the TNC 640. 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.

Auxiliary computer

The IPC auxiliary computer features the following:
- Processor
- RAM memory
- HSCI interface to the CC 3xx controller unit or to the UEC and to further control components
- USB 3.0 interface

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

The following HSCI components are required for operation of the TNC 640:
- IPC auxiliary computer
- Controller unit
- PLB 62xx PLC input/output unit (system PL; integrated in UEC/UMC)

Interfaces

For the end user, USB 3.0 and Ethernet interfaces are available on the MC. Connection to PROFINET IO or PROFIBUS DP is possible by means of an additional module.

Design

IPC 304		ID 1179965-xx
	To be installed in	Electrical cabinet
	Processor	Intel Celeron Dual Core, 1.6 GHz
	RAM memory	4 GB
	Power consumption	TBA W
	Mass	TBA kg
IPC 8420		ID 1249510-xx
	Screen	15.6-inch, with touchscreen operation
	To be installed in	Operating panel
	Processor	Intel Celeron Dual Core, 1.4 GHz
	RAM memory	2 GB
	Power consumption	48 W
	Mass	≈ 6.7 kg

Export version

Because the complete NC software is saved on the CFR CompactFlash storage medium, no export version is required for the main computer itself. The NC software of the PNC 610 needs no export license.

Options

The capabilities of the PNC 610 can also be adapted at a later time with options to meet new requirements. Options are enabled by entering keywords based on the SIK number, and are saved in the SIK component. Please indicate your SIK number when ordering new options.

Option number	Option	ID	Remark	Page
18	HEIDENHAIN DNC	526451-01	Communication with external PC applications over COM component	84
24	Gantry Axes	634621-01	Gantry axes in master-slave torque control	
46	Python OEM Process	579650-01	Execute Python applications	79
135	Synchronizing Functions	1085731-01	Expanded synchronization of axes and spindles	54
141	Cross Talk Comp.	800542-01	CTC: Compensation of axis couplings	66
142	Pos. Adapt. Control	800544-01	PAC: Position-dependent adaptation of control parameters	66
143	Load Adapt. Control	800545-01	LAC: Load-dependent adaptation of control parameters	67
144	Motion Adaptive Control	800546-01	MAC: Motion-dependent adaptation of control parameters	67
160	Integrated FS: Basic	1249928-01	Enables functional safety and four safe control loops	48
161	Integrated FS: Full	1249929-01	Additional control loop 1	48
162	Add. FS Ctrl. Loop 1	1249930-01	Additional control loop 2	48
163	Add. FS Ctrl. Loop 2	1249931-01	Additional control loop 3	48
164	Add. FS Ctrl. Loop 3	1249932-01	Additional control loop 4	48
165	Add. FS Ctrl. Loop 4	1249933-01	Additional control loop 5	48
166	Add. FS Ctrl. Loop 5	1249934-01	Additional control loop 5	48

Memory medium

The storage medium is a CFR (= CompactFlash Removable) compact flash memory card. It carries the NC software 817591-05. The storage medium is removable and must be ordered separately from the main computer. The NC software is based on the HEIDENHAIN HEROS 5 operating system.

CFR CompactFlash 8 GB ID 1102057-55
No export license required
Free capacity for PLC programs 350 MB

SIK component

The SIK component holds the NC software license for enabling software options. It gives the main computer an unambiguous ID code—the SIK number. The SIK component is ordered and shipped separately. It must be inserted into a special slot in the IPC auxiliary computer. The SIK component of the PNC can enable six axes. The enabling of up to the maximum number of ten axes must be performed via the UMC compact inverter.

SIK component for PNC 610 ID 617763-53

Camera system

Gen3 ready

VS 101

The VS 101 camera system, in conjunction with software option 136 Visual Setup Control, enables you to monitor the working space of the machine. The sealed and extremely sturdy VS 101 camera system is designed for integration into the machine's working space. The protective housing features a closing cover and connections for sealing air to prevent the camera optics from being damaged. The VS 101 camera system can be connected directly to the control's main computer over a Gigabit Ethernet interface.

VS 101

The camera system can be adapted using various lenses to the respective machine size. The proper lens selection depends on various factors. For more information, please contact HEIDENHAIN.

VS 101 ID 1137063-xx
Mass ≈ 2.3 kg

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. The snap-on keys are available in packs of five keys.

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	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

Snap-on keys for controls

Snap-on keys

The snap-on keys make it easy to replace the key symbols. In this way, the keyboard can be adapted to different requirements. The snap-on keys are available in packs of five keys.

Overview of control keys

Keys
Orange

V	ID 679843-31	A	ID 679843-54	X	ID 679843-C8	U	ID 679843-D4
IV	ID 679843-32	W	ID 679843-55	B	ID 679843-C9		
Z	ID 679843-53	C	ID 679843-88	Y	ID 679843-D3		

Gray

X+	ID 679843-03	VI+	ID 679843-13	Y+	ID 679843-93	Z−	ID 679843-B9
X−	ID 679843-04	VI−	ID 679843-14	Y−	ID 679843-94	Z+	ID 679843-C1
Y+	ID 679843-05	Y−	ID 679843-43	B−	ID 679843-B1	X−	ID 679843-C2
Y−	ID 679843-06	Y+	ID 679843-44	B+	ID 679843-B2	X+	ID 679843-C3
Z+	ID 679843-07	C+	ID 679843-67	U−	ID 679843-B3	X+	ID 679843-C4
Z−	ID 679843-08	C−	ID 679843-68	U+	ID 679843-B4	X−	ID 679843-C5
IV+	ID 679843-09	A+	ID 679843-69	Y−	ID 679843-B5	X−	ID 679843-D9
IV−	ID 679843-10	A−	ID 679843-70	Y+	ID 679843-B6	X+	ID 679843-E1
V+	ID 679843-11	Z+	ID 679843-91	W−	ID 679843-B7		
V−	ID 679843-12	Z−	ID 679843-92	W+	ID 679843-B8		

Machine functions

	ID 679843-01		ID 679843-30		ID 679843-74		ID 679843-C6
	ID 679843-02		ID 679843-40		ID 679843-76	FCT C	Black ID 679843-C7
	ID 679843-16		Green ID 679843-56	FCT A	Black ID 679843-95	SPEC FCT	ID 679843-D6
	ID 679843-22		Red ID 679843-57	FCT B	Black ID 679843-96		ID 679843-E3
	ID 679843-23	+	ID 679843-59		Black ID 679843-A1	FCT RC	ID 679843-E4
FN 1	ID 679843-24	−	ID 679843-60	FN 4	ID 679843-A2		ID 679843-E6
FN 2	ID 679843-25		ID 679843-61	FN 5	ID 679843-A3		ID 679843-E7
FN 3	ID 679843-26		ID 679843-62		ID 679843-A4		ID 679843-E8
	ID 679843-27	FCT	ID 679843-63		ID 679843-A5		
	ID 679843-28		ID 679843-64		ID 679843-A6		
	ID 679843-29		ID 679843-73		ID 679843-A9		

Spindle functions

	ID 679843-18		ID 679843-47		Red ID 679843-52		ID 679843-99
	ID 679843-19		ID 679843-48		ID 679843-65		Green ID 679843-D8
	ID 679843-20		ID 679843-49		Green ID 679843-71		ID 679843-F3
	ID 679843-21		ID 679843-50		ID 679843-72		
	ID 679843-46		ID 679843-51		Red ID 679843-89		

Other keys

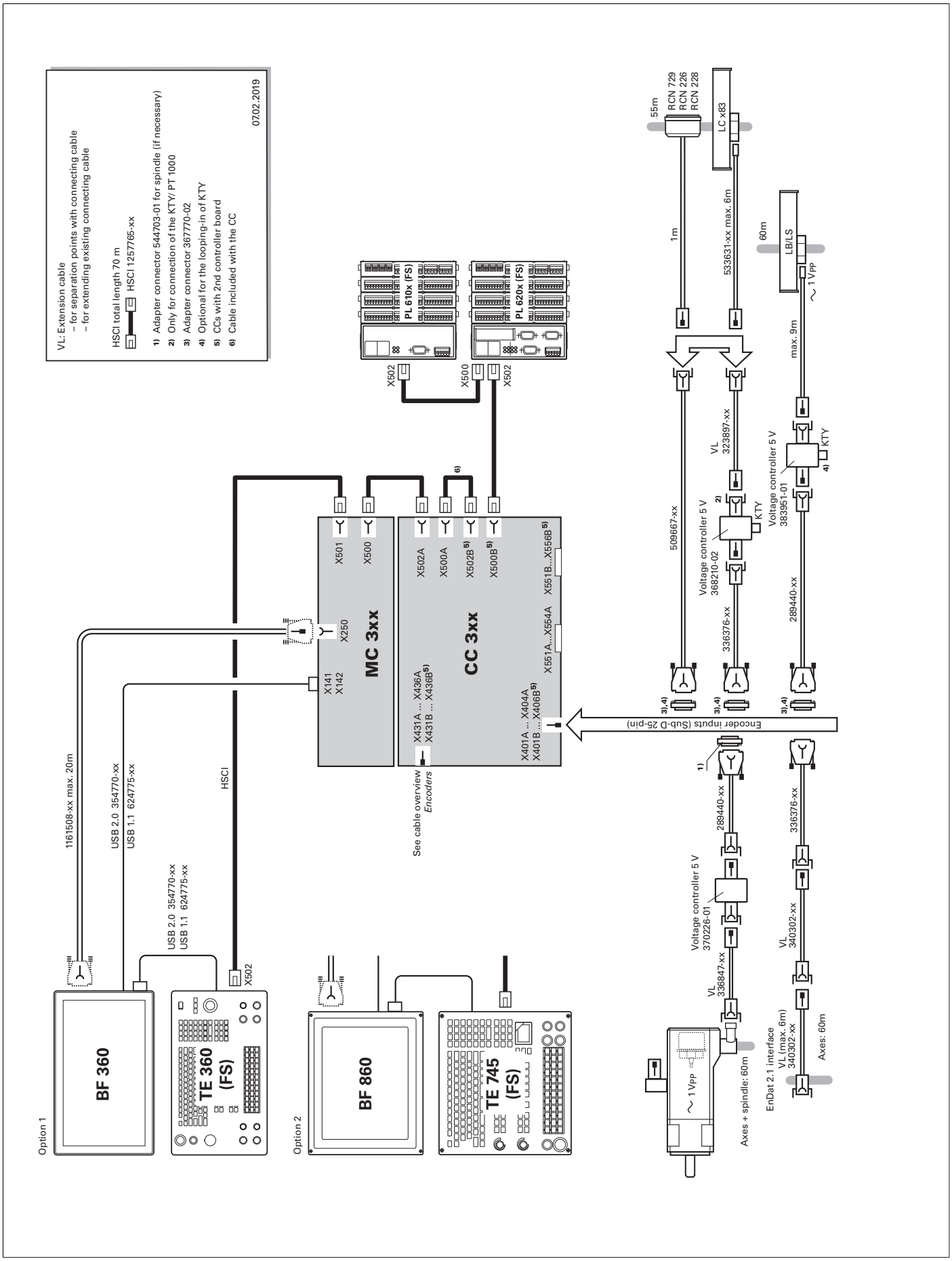
	ID 679843-15		ID 679843-39		ID 679843-97		Black ID 679843-E2
	ID 679843-17		ID 679843-41		ID 679843-98		ID 679843-E5
	Gray ID 679843-33		ID 679843-42		ID 679843-A7		ID 679843-F2
	Black ID 679843-34		Red ID 679843-45		ID 679843-A8		ID 679843-F4
	Orange ID 679843-35		ID 679843-58	–	Black ID 679843-D1	ENT	ID 679843-F5
	ID 679843-36		ID 679843-66	+	Black ID 679843-D2	PRT SC	ID 679843-F6
	ID 679843-37		ID 679843-75	0	ID 679843-D5		
	ID 679843-38	NC I	Green ID 679843-90	NC 0	Red ID 679843-D7		

Special keys

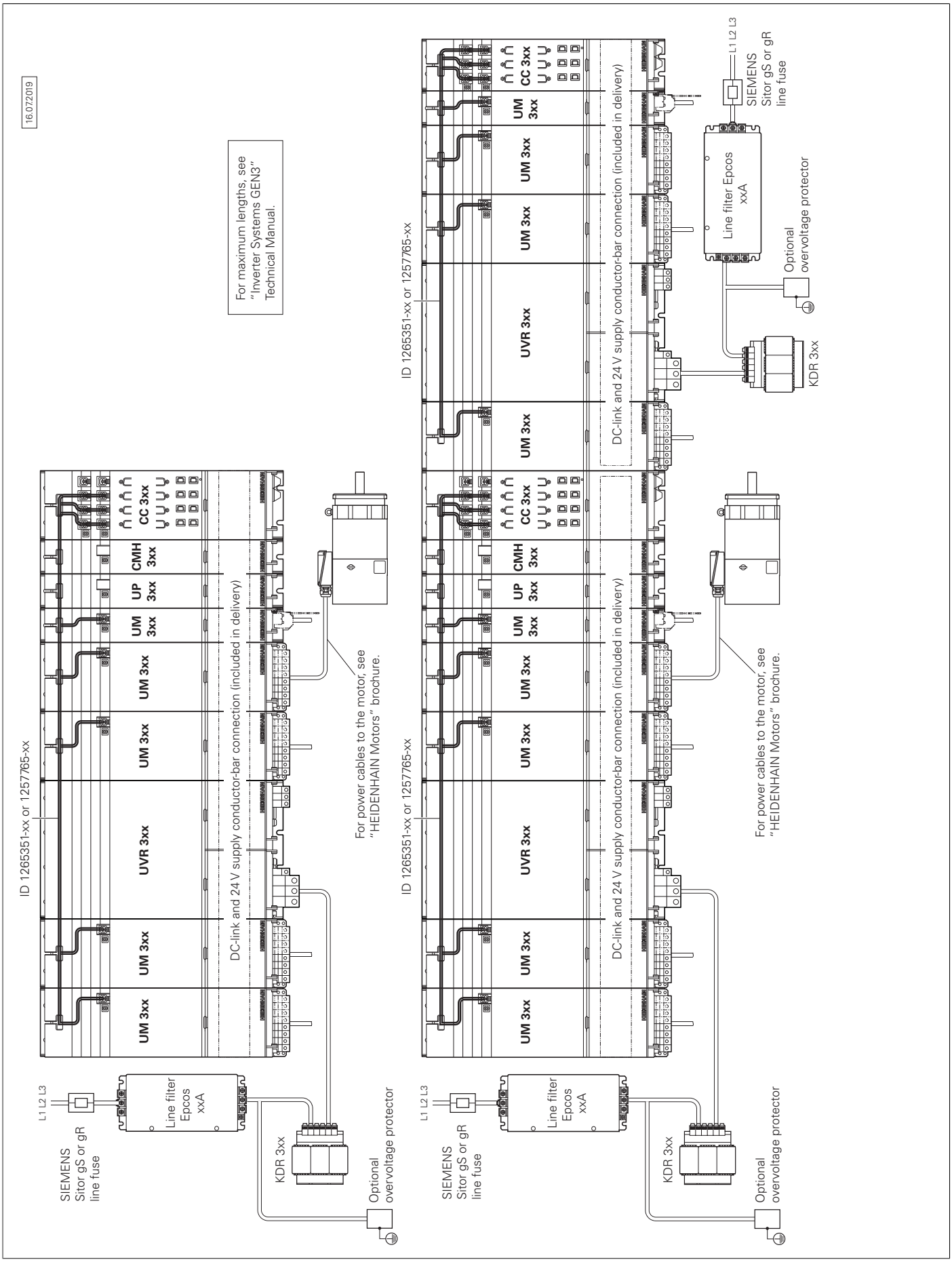
Snap-on keys can also be made with special key symbols for special applications. The laser labeling differs in appearance from the labeling of the standard keys. If you need keys for special applications, please consult your contact person at HEIDENHAIN.

Cable overview

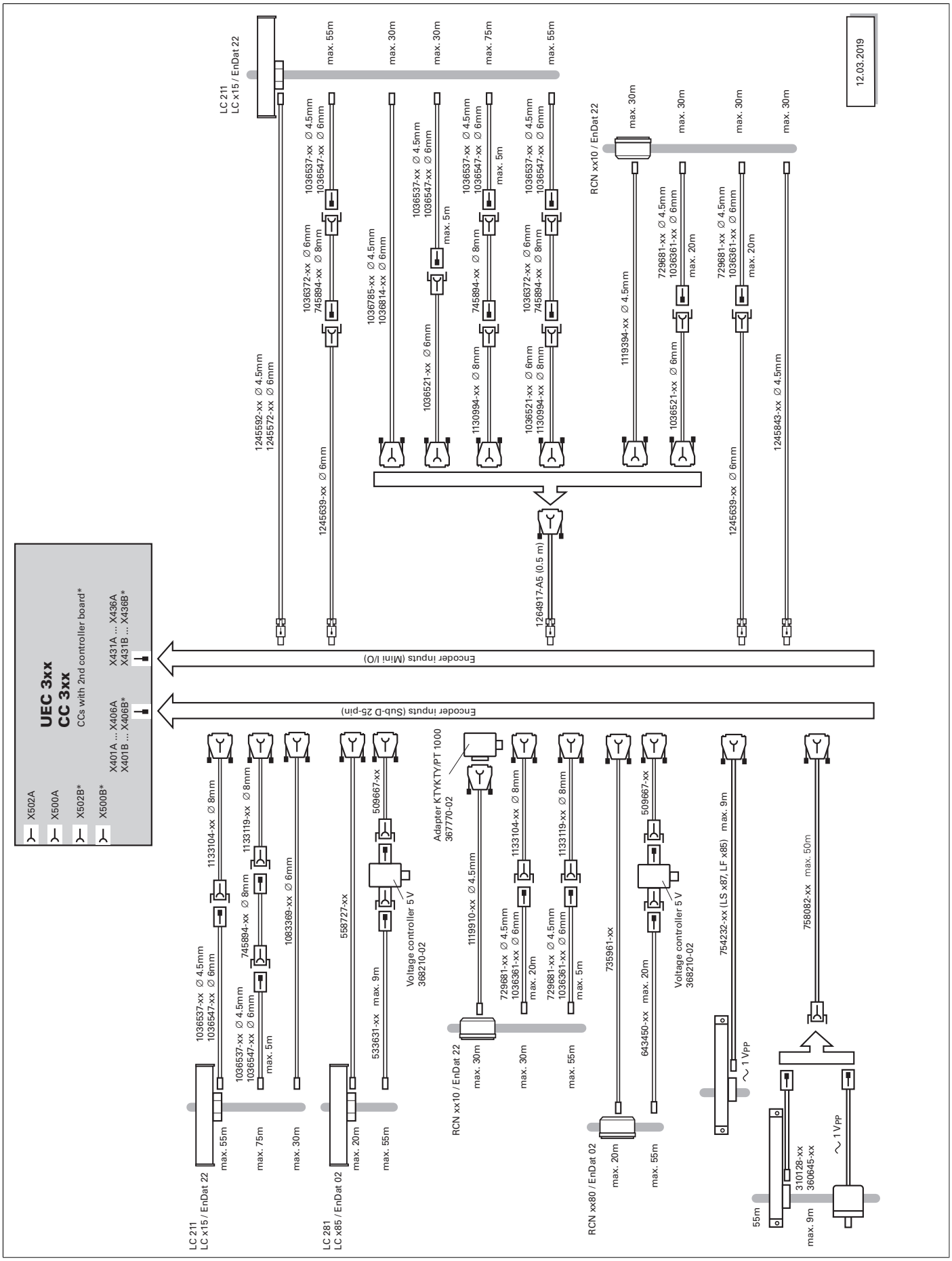
Control systems with CC



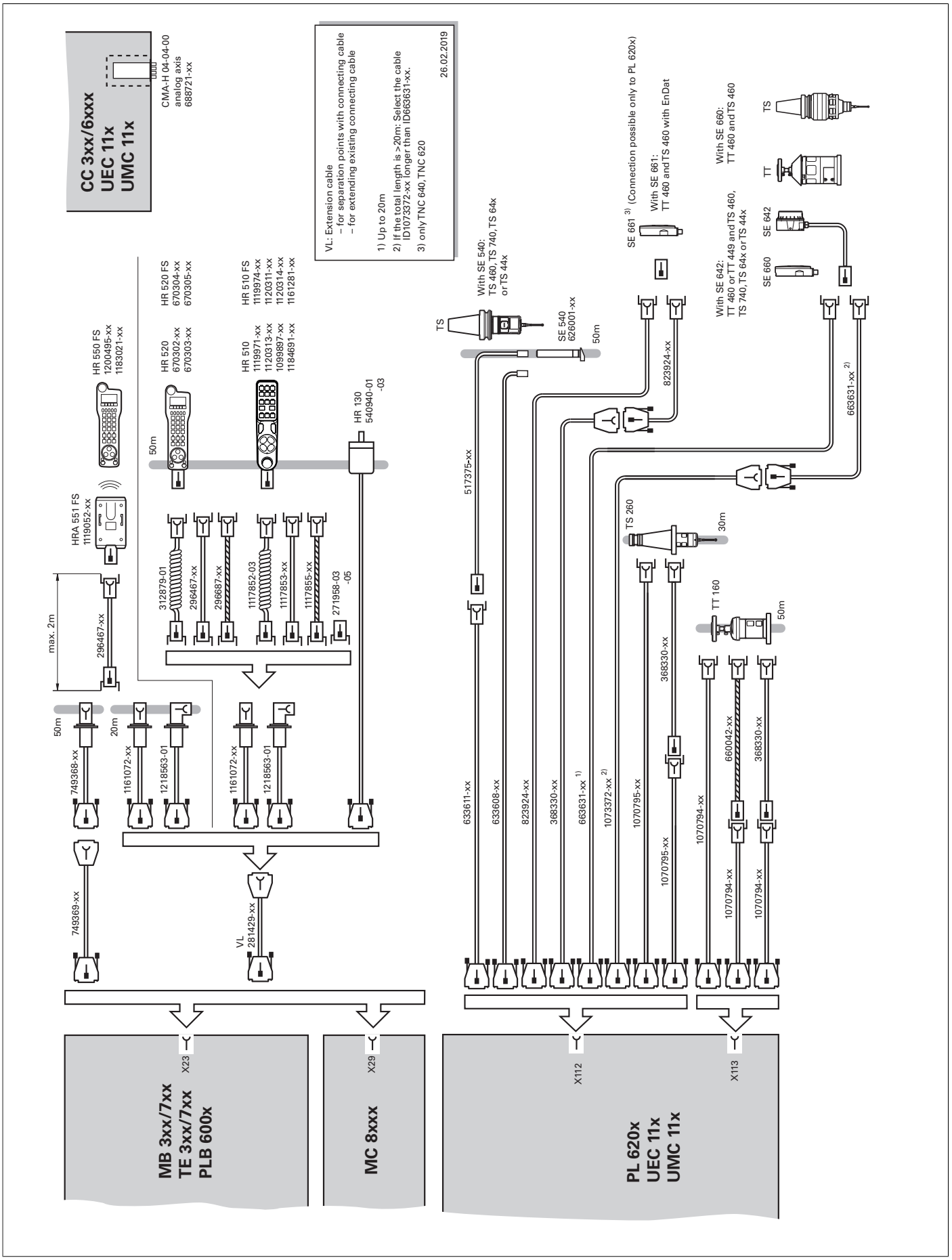
Inverter system



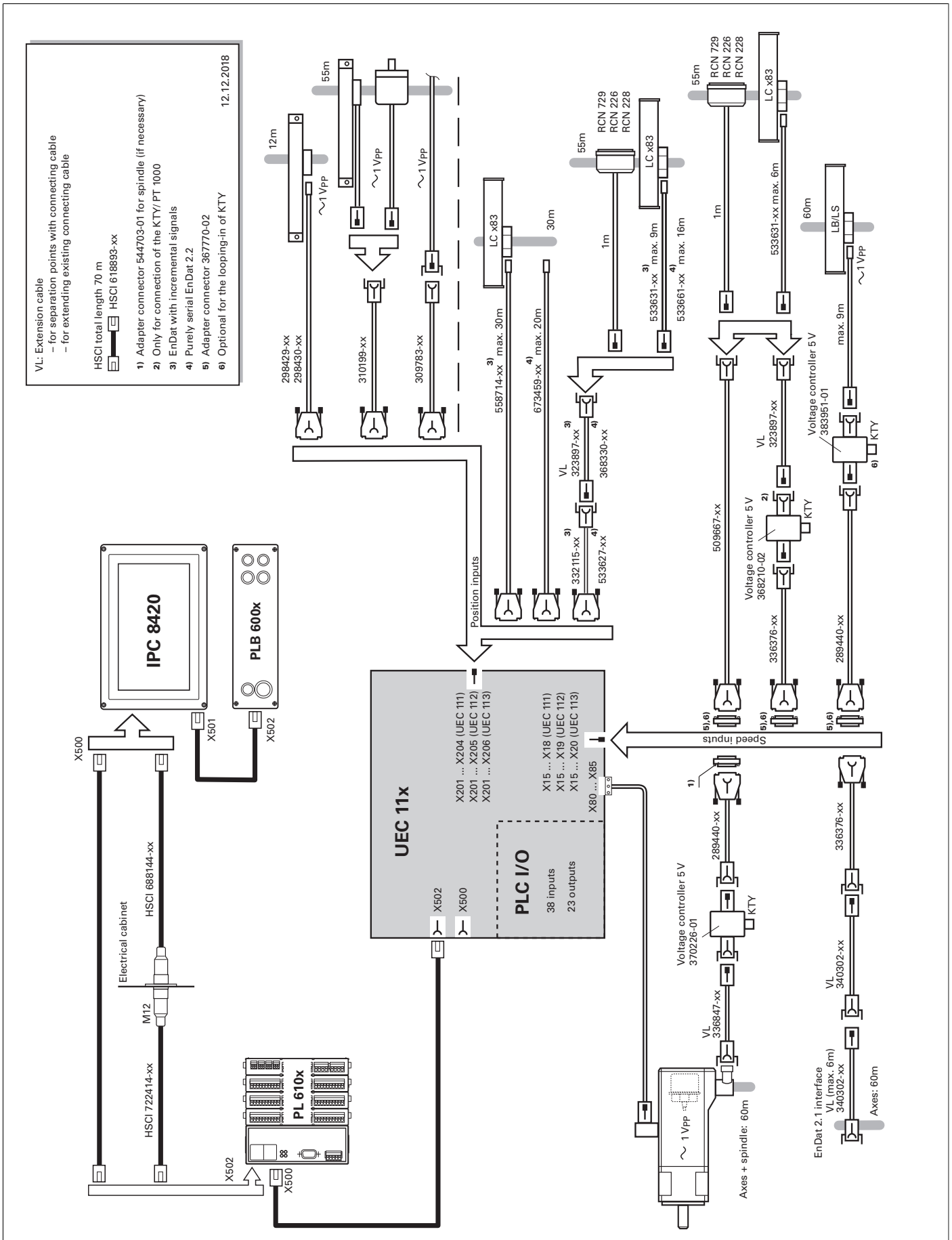
Encoders


UEC 3xx
CC 3xx
CCs with 2nd controller board*
X502A
X500A
X502B*
X500B*
X401A ... X406A
X401B ... X406B*
X431A ... X436A
X431B ... X436B*
Encoder inputs (Mini I/O)
Encoder inputs (Sub-D 25-pin)
12.03.2019
LC 211
LC x15 / EnDat 22
1245592-xx ∅ 4.5mm
1245572-xx ∅ 6mm
1245639-xx ∅ 6mm
1036372-xx ∅ 6mm
745894-xx ∅ 8mm
1036537-xx ∅ 4.5mm
1036547-xx ∅ 6mm
1036785-xx ∅ 4.5mm
1036814-xx ∅ 6mm
1036521-xx ∅ 6mm
1130994-xx ∅ 8mm
1264917-A5 (0.5 m)
RCN xx10 / EnDat 22
1119394-xx ∅ 4.5mm
729681-xx ∅ 4.5mm
1036361-xx ∅ 6mm
1245843-xx ∅ 4.5mm
max. 55m
max. 30m
max. 75m
max. 5m
max. 20m
LC 211
LC x15 / EnDat 22
1036537-xx ∅ 4.5mm
1036547-xx ∅ 6mm
1133104-xx ∅ 8mm
1133119-xx ∅ 8mm
1083369-xx ∅ 6mm
LC 281
LC x85 / EnDat 02
558727-xx
533631-xx
509667-xx
Voltage controller 5 V
368210-02
max. 9m
Adapter KTYKTY/PT 1000
367770-02
1119910-xx ∅ 4.5mm
RCN xx10 / EnDat 22
RCN xx80 / EnDat 02
735961-xx
643450-xx
754232-xx (LS x87, LF x85)
max. 9m
1 VPP
758082-xx
max. 50m
55m
310128-xx
360645-xx

Accessories



PNC 610 with UEC



Technical description
Digital control design

Uniformly digital

In the uniformly 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 uniformly digital design from HEIDENHAIN guarantee very high accuracy and surface finish quality, combined with high traversing speeds.

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

HSCI

HSCI, the HEIDENHAIN Serial Controller Interface, connects the main computer, controller(s), and other control components. The connection between two HSCI components is also 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 enables short cycle times for data transfer.

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 (commissioning, configuration)
- Inverter connection via a digital optical fiber cable connection
- Large cable lengths in the entire system (HSCI segment up to max. 70 m)
- 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 (e.g., MB 72x from HEIDENHAIN) 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 one HSCI segment: 70 m
- For up to 12 HSCI slaves: 290 m (total of HSCI segments)
- For up to 13 HSCI slaves (maximum configuration): 180 m (total of HSCI segments)

The maximum permissible number of individual HSCI participants is listed below.

HSCI components		**Maximum number**	
MC/IPC	HSCI master	1 in the system	
CC, UEC, UMC	HSCI slave	4 controller motherboards (distributed to CC, UEC, UMC as desired)	
MB, PLB 600x	HSCI slave	2 in the system	
PLB 61xx, PLB 62xx	HSCI slave	7 in the system	
HR	On MB and/or PLB 600x	5 in the system	
PLD-H-xx-xx-xx FS	In PLB 6xxx FS	10 in the system	Total maximum of 1000 inputs/outputs
PLD-H-xx-xx-xx, PLA-H-xx-xx-xx	In PLB 6xxx	25 in the system	

Control systems with integrated functional safety (FS)

Basic principle

With controls featuring integrated functional safety (FS) from HEIDENHAIN, it is possible to attain Safety Integrity Level 2 (SIL 2) in accordance with EN 61508, and Performance Level "d," Category 3, as per EN ISO 13849-1 (successor standard to EN 954-1). 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 the TNC 640 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 the mutual comparison of the states and data of both channels. Therefore, the occurrence of a single error in the control does not result in a loss of the safety function.

Structure

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 are 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 structure through MC and CC is continued in the PLB 6xxx FS input/output systems and the MB 720 FS. This means that all safety-relevant signals (e.g., permissive buttons and keys, door contacts, emergency stop button) 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 drives in case of an error.

Components

In systems with functional safety, certain hardware components assume safety-relevant tasks. Systems with FS must consist of only those safety-relevant components, including their variants, which HEIDENHAIN has approved for use!

Control components with functional safety are indicated by the suffix "FS" following the model designation (e.g., MB 72x FS).

MB and TE

An MB machine operating panel with functional safety (FS) 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

FS handwheels are required in systems with functional safety because only they have the required cross-circuit-proof permissive buttons.

For a current list of components approved for FS, see the *Functional Safety FS* Technical Manual.

Safety functions

The following safety functions are integrated into the 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

Please note:
The complete feature content is not yet available for all machine types with functional safety (FS). Before planning a machine with functional safety, please inform yourself of whether the current scope of features suffices for your machine design.

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 the safety-related control components (e.g., TE 745 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 scalable via software options. Only the number of safe drive systems actually needed must be enabled:

Option number	Option	As of NC-SW	Description	ID
160	Integrated FS: Basic	10	Enables functional safety and 4 safe control loops	1249928-01
161	Integrated FS: Full	10	Enables functional safety and the maximum number of safe control loops (≥ 10)	1249929-01
162	Add. FS Ctlr. Loop 1	10	Additional control loop 1	1249930-01
163	Add. FS Ctlr. Loop 2	10	Additional control loop 2	1249931-01
164	Add. FS Ctlr. Loop 3	10	Additional control loop 3	1249932-01
165	Add. FS Ctlr. Loop 4	10	Additional control loop 4	1249933-01
166	Add. FS Ctlr. Loop 5	10	Additional control loop 5	1249934-01

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.

For more information

For more information on the topic of functional safety (FS), refer to the Technical Information documents *Safety-Related Control Technology for Machine Tools* and *Safety-Related Position Encoders*.

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, with which up to eight axis groups can be individually controlled.

Operating system

HEROS 5

The TNC 640 and 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
- Sandbox: running applications in separated environments

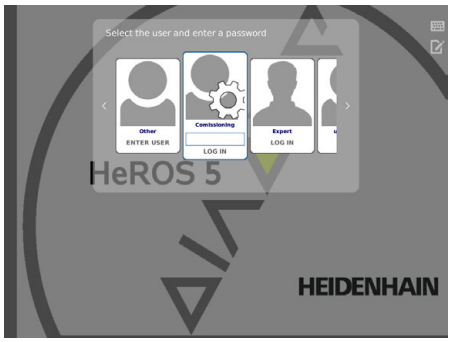
System
- Backup/Restore: function for backing-up and restoring the control
- HELogging: evaluation and creation of log files
- Perf2: system monitor
- User administration: define users with different roles and access permissions

Tools
- Web browser: Firefox®*
- Document Viewer: display PDF, TXT, XLS, 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 tying of permissions to user roles, access rights can be tailored to the given responsibilities of each operator.

- 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

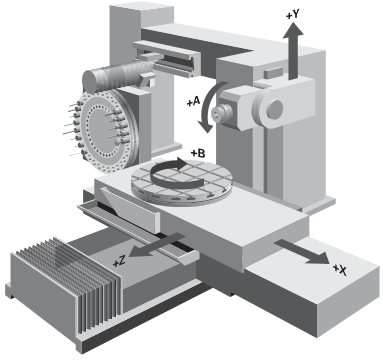


* Firefox is a registered trademark of the Mozilla Foundation

Axes

Linear axes

The TNC 640 can control linear axes with any axis designation (X, Y, Z, U, V, W, ...).



Display and programming

–99 999.9999 to +99 999.9999 [mm]

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

Feed rate override: 0 % to 150 %

Traverse range

–99 999.9999 to +99 999.9999 [mm]

The machine tool builder defines the traverse range. The user can set additional limits to the traverse range if he wishes to reduce the working space. Three different traverse ranges can be defined (selection via PLC).

Rotary axes

The TNC 640 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
–99 999.9999 to +99 999.9999 [°]

Feed rate in degrees per minute [°/min]

Traverse range

–99 999.9999 to +99 999.9999 [°]

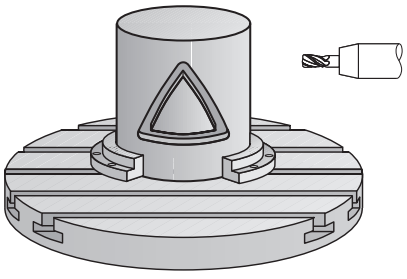
The machine tool builder defines the traverse range. The user can set additional limits to the traverse range if he wishes to reduce the working space. Various traverse ranges can be defined via parameter sets for each axis (selection via PLC).

Free rotation

For milling-turning operations, the rotary axis can be started via the PLC with a defined feed rate. For functions specific to milling-turning machines, see *Turning operations*.

Cylinder surface interpolation (option 8)

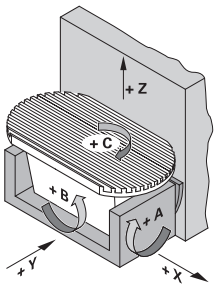
A contour defined in the working plane is machined on a cylindrical surface.



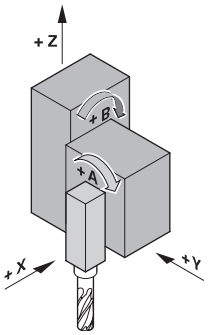
Tilting the working plane (option 8)

The TNC 640 has special coordinate transformation cycles for controlling swivel heads and tilting tables. The tool lengths and offset of the tilting axes are compensated by the TNC.

The TNC can manage more than one machine configuration (e.g., different swivel heads).



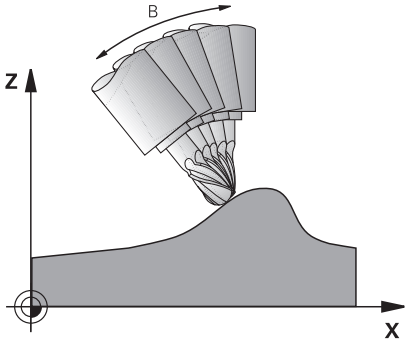
Tilting table



Swivel head

5-axis machining (option 9)

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.

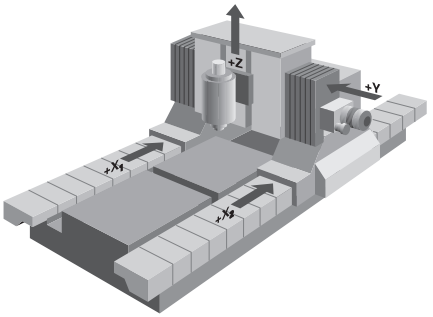


Synchronized axes

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.

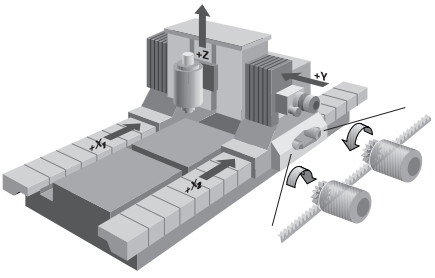


Torque control

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

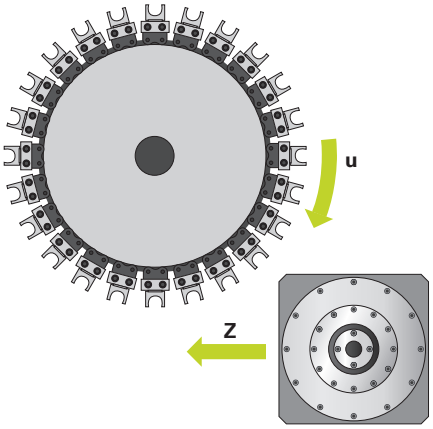
- a defined distribution of drive torque is desired, or
- parts of the controlled system show a backlash effect that can be eliminated by "tensioning" the servo drives (e.g. toothed racks).

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.



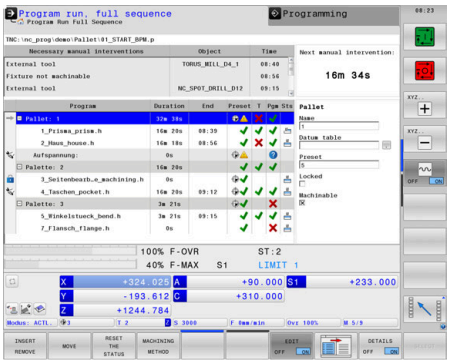
Real-time coupling function (option 135)

The real-time coupling function (synchronizing functions) 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 enables you to realize complex simultaneous movements of several NC or PLC axes. The mutual dependence of the axes is defined in mathematical formulas.



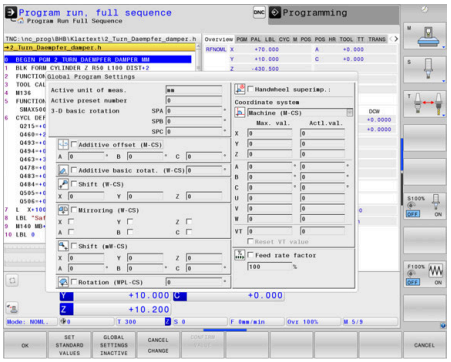
Batch Process Manager (option 154)

Batch Process Manager provides functions for the planning and execution of multiple production jobs on the TNC. It makes it possible to easily edit pallets and to alter the sequence of pending jobs. Moreover, Batch Process Manager performs a look-ahead calculation for all planned jobs or NC programs and informs the operator about whether all of the NC programs can be executed error-free, for example, or whether all necessary tools are available with sufficient service life. Batch Process Manager thereby ensures the smooth execution of the planned jobs. The Batch Process Manager option requires option 93 (Extended Tool Management) and option 22 (Pallet Management) to also be enabled.



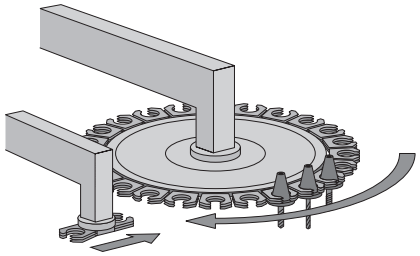
Global PGM Settings (option 44)

The functions provided by global program settings 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 TNC 640 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

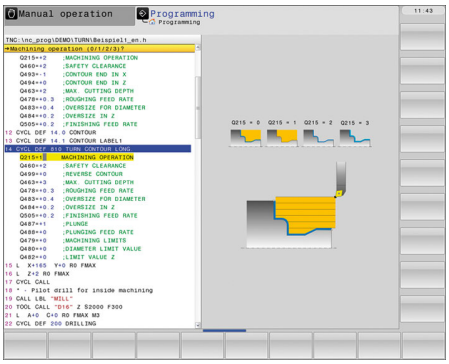
Axes can be defined as PLC axes. Programming is performed through M functions or OEM cycles. The PLC axes are positioned independently of the NC axes and are therefore designated as asynchronous axes.



Turning

Performing turning operations (option 50)

The TNC 640 supports machines that can perform a combination of milling and turning operations in a single setup. It offers the operator a comprehensive package of cycles for both types of operations, which are programmed in HEIDENHAIN's workshop-oriented Klartext format. Rotationally symmetric contours are produced during turning operations. The preset must be in the center of the lathe spindle for this.

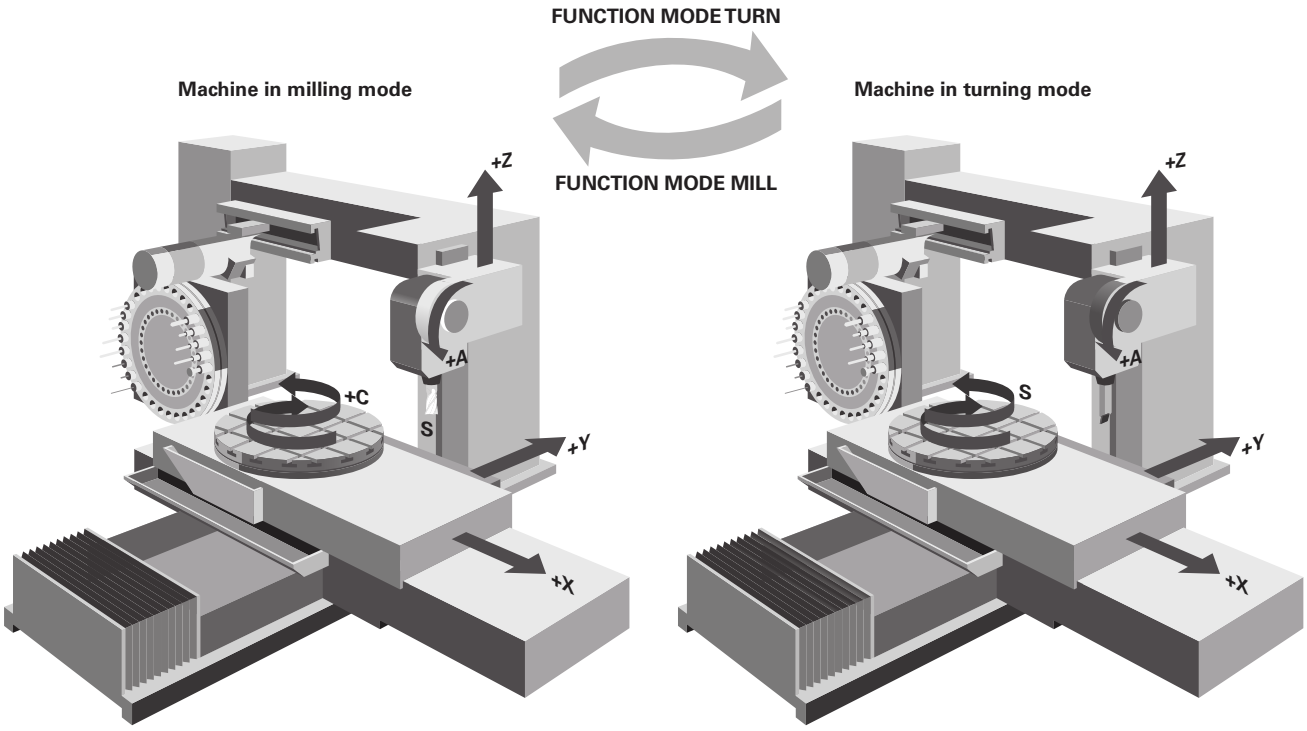


In turning mode, the rotary table serves as the lathe spindle, while the milling spindle with the tool remains stationary. Milling-turning machines are subject to special demands. A basic prerequisite is a machine designed with high rigidity so as to ensure a low oscillation tendency even when the machine table (acting as a lathe spindle) is turning at high speeds.

Toggling between milling and turning modes

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

The machine operator executes the switch between turning and milling mode using 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 TNC 640 provides a further way of performing turning operations on a milling machine. A longitudinal turning tool, for example, is mounted on the facing slide and is 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 TNC 640 in any inclination (PLANE functions). In addition, numerous useful turning functions are available, such as constant surface speed. The use of facing slides requires option 50 for turning to be enabled on the TNC 640.

Measuring the unbalance – balancing

An important and basic prerequisite 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, thereby influencing the accuracy of the runout.

An unbalance of the rotary table can endanger the machine operator, as well as lower the quality of the workpiece and reduce the machine's lifetime.

The TNC 640 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 TNC 640 features 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 TNC generates a table describing the unbalance behavior of the rotary table.
- **Balancing**
  After clamping a workpiece to be turned, the machine operator can determine the current unbalance by means of a measuring cycle. During balancing, the TNC assists the machine operator by indicating the mass and position of the balancing weights.
- **Unbalance monitoring**
  During the machining operation, the TNC continually monitors the unbalance. An NC stop is triggered if a specified limit value is exceeded.

Spindle

Overview

The TNC 640 contouring control is used 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 UEC/UMC inverters, a fundamental PWM frequency can be set for each controller assembly (e.g., 4 kHz). Possible fundamental frequencies are 3.33 kHz, 4 kHz, or 5 kHz. The **Double Speed** option (option 49) allows this frequency to be increased to up to 16 kHz for high-speed spindles (e.g., for HF spindles). See the *Technical Manual*.

Controller groups

For example with CC 6106
1: X51 + X52
2: X53 + X54
3: X55 + X56

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 floating tap holder. For tapping without 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 ranges

A separate nominal speed is defined for each gear range. The gear code is output via the PLC.

Multiple main spindles

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

Spindle synchronism (option 131)

The spindle synchronization option synchronizes the shaft speeds of two or more spindles. Spindle synchronization is also possible with a transmission ratio or a defined offset.

Encoders

Overview

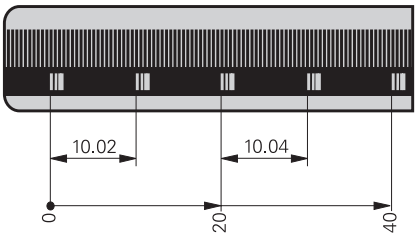
For speed and position control of the axes and spindle, HEIDENHAIN offers both incremental and absolute encoders.

Incremental encoders

Incremental encoders have as their measuring standard a grating consisting of alternating 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

When the machine is switched on, the machine axes need to traverse a reference mark for an accurate reference to be established between the measured value and the machine position. For encoders with distance-coded reference marks, the maximum travel until automatic reference mark evaluation 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. A reference-mark traverse is not necessary. Additional incremental signals are output for highly dynamic control loops.

EnDat interface

The TNC 640 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 assignment 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 all **position encoder** inputs of the controller unit.

Incremental and absolute rotary encoders from HEIDENHAIN can be connected to all **speed encoder** inputs of the controller unit.

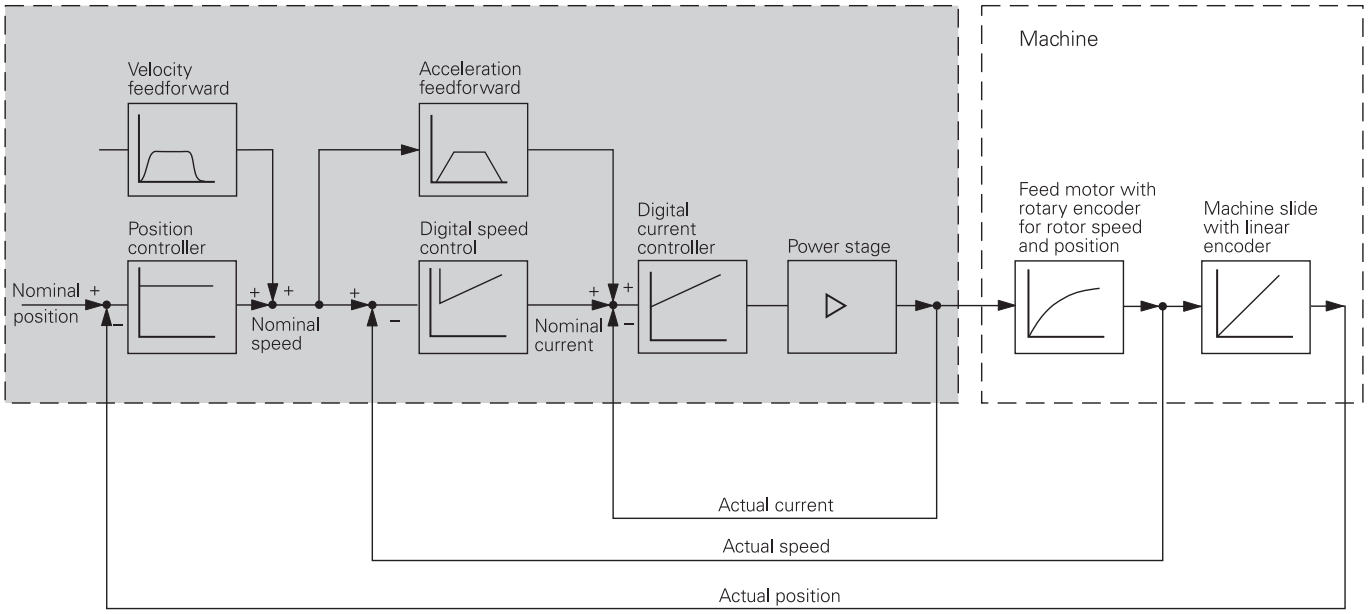
Inputs	**Signal level/ Interface**[1]	**Input frequency**[1]	
		Position	**Speed**
Incremental signals	~1 V_{PP} EnDat 2.1	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.1 EnDat 2.2	–	–

[1] Switchable

Digital servo control

Integrated inverter

Position controllers, speed controllers, current controllers, and inverters are integrated in the TNC 640. HEIDENHAIN synchronous or asynchronous motors are connected to the TNC 640.



Axis feedback control

The TNC 640 can be operated with following error or feedforward control. During roughing operations at high speeds, for example, you can switch to velocity semi-feedforward control via an OEM cycle in order to machine faster at reduced accuracy.

Operation with following error

The term "following error" 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 = Following error

Operation with feedforward control

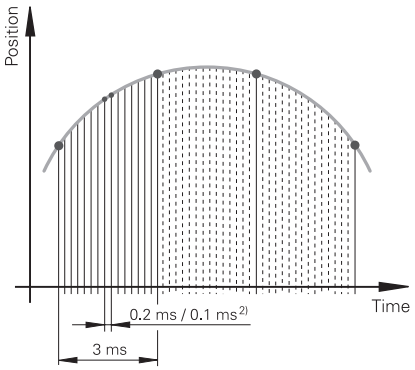
Feedforward means that a given velocity and acceleration are adapted to the machine. Together with the values calculated from the following error, this given velocity and acceleration becomes the nominal value. A much lower following error thereby manifests itself (in the range of only a few microns).

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. After the axes have been commissioned with the TNCopt software, the Torque Ripple Compensation (TRC) of the CC 61xx or UEC 11x can be used to compensate it.

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 **speed controller cycle time** is defined as 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	3 ms
Fine interpolation	0.2 ms/0.1 ms[1)] at f_{PWM} = 5000 Hz
Position controller	0.2 ms/0.1 ms at f_{PWM} = 5000 Hz
Speed controller	0.2 ms/0.1 ms[1)] at f_{PWM} = 5000 Hz
Current controller	0.1 ms at f_{PWM} = 5000 Hz

[1)] Double speed (with option 49)

Axis clamping

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

Double-speed control loops (option 49)

Double-speed control loops permit higher PWM frequencies and 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)

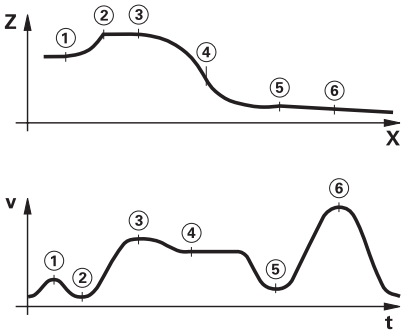
To increase the stability of the position control loop in systems with resonances, the position signal from the position encoder, which is filtered through a low-pass filter, is combined with the position signal from the motor speed encoder, which is filtered through a high-pass filter. This signal combination 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 on drive motors with speed and position encoders.

Fast contour milling

Short block processing time

The TNC 640 provides the following important features for fast contour machining.

The block processing time of the MC is 0.5 ms. This means that the TNC 640 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 up to 24 m/min.



Look-ahead

For feed rate adaptation, the TNC 640 performs a precalculation of the geometry (max. 5000 blocks). In this way, directional changes are detected in time to accelerate or decelerate the appropriate NC axes.

Jerk

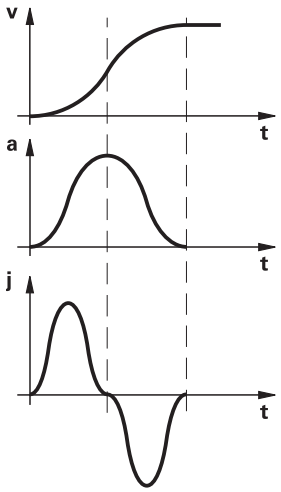
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

Jerk limiting

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

Smoothed jerk

The jerk is smoothed by nominal position value filters. The TNC 640 therefore mills smooth surfaces at the highest possible feed rate and yet keeps the contour accurate. The operator programs the permissible tolerance in a cycle. Special filters for HSC machining (HSC filters) can specifically suppress the natural frequencies of an individual machine. The desired accuracy and a very high surface quality are attained.



Advanced Dynamic Prediction (ADP)

The Advanced Dynamic Prediction (ADP) function enhances the conventional 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.

Dynamic Efficiency

Overview

With the concept of Dynamic Efficiency, HEIDENHAIN offers innovative TNC functions that help the user make heavy machining and roughing more efficient while also enhancing its 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.

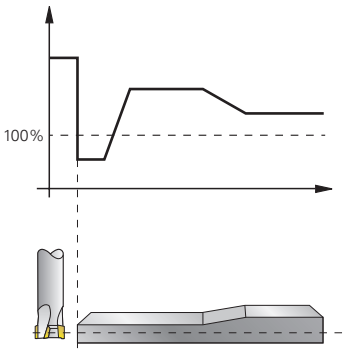
Dynamic Efficiency comprises three software functions:

- **Active Chatter Control** (ACC): This option reduces chatter tendencies and permits greater feed rates and infeeds
- **Adaptive Feed Control** (AFC): The AFC option controls the feed rate depending on the machining situation
- **Trochoidal milling**: A function for the roughing of slots that eases the load on the tool
- **Optimized Contour Milling** (OCM): With this option, you can machine pockets and islands of any shape while reducing tool wear thanks to highly efficient trochoidal milling.

Each solution in itself offers decisive advantages in the machining process. But the combination of these TNC features, in particular, exploits the potential of the machine and tool and at the same time reduces the mechanical load.

Adaptive Feed Control (AFC) (option 45)

With Adaptive Feed Control (AFC), the contouring feed rate is controlled depending on the respective spindle power in percent.



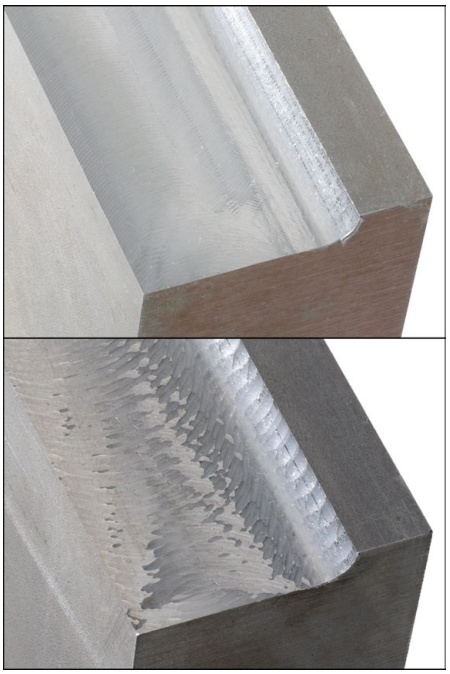
Benefits of adaptive feed control:

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

Active Chatter Control (ACC) (option 145)

During heavy machining (roughing at high cutting power), strong milling forces arise. Depending on the tool spindle speed, the resonances in the machine tool, and the chip volume (metal-removal rate during milling), the phenomenon known as "chatter" may occur. Chatter subjects the machine to heavy strain and causes ugly marks on the workpiece surface. The tool, too, undergoes heavy and irregular wear due to chatter, even breaking in extreme cases. To reduce chatter tendencies, HEIDENHAIN offers an effective option with its Active Chatter Control (ACC) solution. This option is particularly advantageous during heavy machining. ACC enables substantially higher cutting performance: depending on the machine model, the metal removal rate can be increased by 25 % or more. Thus, you can reduce the load on your machine while simultaneously increasing the life of your tools.



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

Optimized Contour Milling (OCM) (option 167)

With Optimized Contour Milling (OCM), 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 of OCM over conventional machining:
- Reduced thermal load on the tool
- Superior chip removal
- Uniform tool-workpiece contact
- Higher possible cutting parameters
- Higher removal rates
- No need for adjustments by the machine tool builder

Dynamic Precision

Overview

The umbrella 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 the errors at the tool center point (TCP). The size of these errors depends on the magnitudes of the motion (e.g., speed and acceleration, as well as jerk) and result from the vibrations of the machine components, among other things. 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.

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. This saves time and money in production.

The machine tool builder can use the options comprised by Dynamic Precision either individually or in combination:

- **CTC**: Compensates acceleration-dependent position errors at the tool center point, thereby increasing accuracy during acceleration phases
- **AVD**: Active vibration damping improves surfaces
- **PAC**: Position-dependent adaptation of control parameters
- **LAC**: Load-dependent adaptation of control parameters enhances accuracy regardless of load and aging
- **MAC**: Motion-dependent adaptation of control parameters

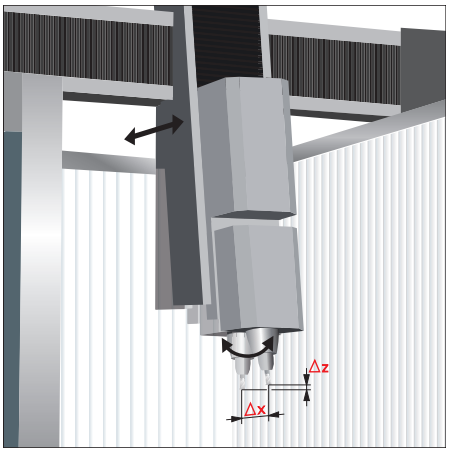
Cross Talk Compensation (CTC) (option 141)

CTC (option 141) makes it possible to compensate dynamic position errors that are caused by acceleration forces.

To increase productivity, machine tool users are asking for ever higher feed rates and accelerations, while at the same time they need 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). Besides deformation in the direction of the axis, the dynamic acceleration of an axis due to mechanical axis coupling can also result in the deformation of axes that are perpendicular to the direction of acceleration. 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 error as a function of the axis acceleration is known, this acceleration-dependent error can be compensated with the CTC option (Cross Talk Compensation) in order to prevent 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 by CTC.



Active Vibration Damping (AVD) (option 146)

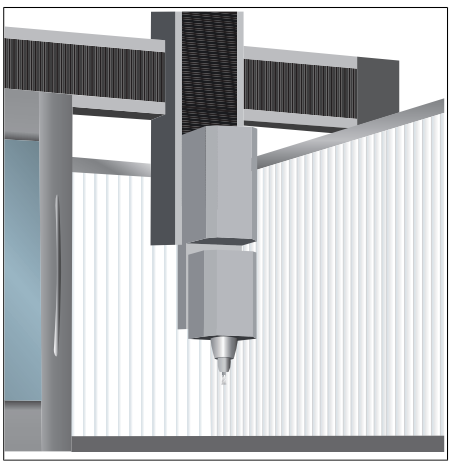
The high dynamics of modern machine tools lead to deformations in the machine base, frame, and drive train during acceleration and deceleration of the feed drives. This results in vibrations, such as machine setup vibrations, that may reduce the attainable accuracy and surface quality of the workpieces. The Active Vibration Damping (AVD) controller function dampens the especially critical low-frequency oscillations and optimizes the control behavior of the affected axis at the same time so that high-accuracy workpieces with increased surface quality can also be produced at high feed rates. The improved rigidity attained can be used to increase the dynamic limit values (e.g., jerk), and therefore makes reduced machining times possible.

Position Adaptive Control (PAC) (option 142)

PAC (option 142) permits a dynamic and position-dependent adaptation of controller parameters depending on the position of the tool in space.

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 exploit the potential of the machine's dynamics, you can use the Position Adaptive Control (PAC) option to change machine parameters based on position. This makes it possible to assign 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.



Load Adaptive Control (LAC) (option 143)

LAC (option 143) enables you to adapt controller parameters dynamically depending on the load or friction.

The dynamic behavior of machines with rotary tables can vary depending on the mass moment of inertia of the fixed workpiece. The LAC (Load Adaptive Control) option enables the control to automatically ascertain the current workpiece mass moment of inertia as well as current frictional forces.

In order to optimize changed control behavior at differing loads, adaptive feedforward controls can exploit data on acceleration, holding torque, static friction, and friction at high shaft speeds.

Motion Adaptive Control (MAC) (option 144)

In addition to the position-dependent adaptation of control parameters through the PAC option, the Motion Adaptive Control (MAC) option also provides a means of changing machine parameters based on other input quantities, such as speed, following error, or drive 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.

Monitoring functions

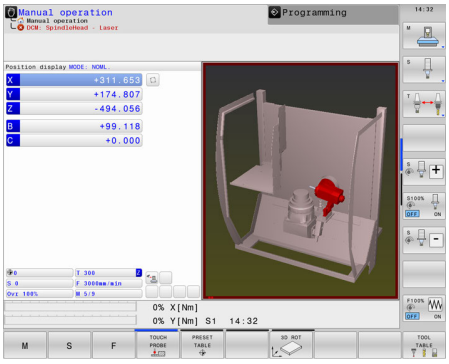
Description

During operation the control monitors the following details*:
- Amplitude of the encoder signals
- Edge separation of the encoder signals
- Absolute position from encoders with distance-coded reference marks
- Current position (following error monitoring)
- Actual distance traversed (movement monitoring)
- Position deviation at standstill
- Nominal speed value
- Checksum of safety-related functions
- Supply voltage
- Voltage of the backup battery
- Operating temperature of the MC and CPU
- Run time of the PLC program
- Motor current / motor temperature
- Temperature of the power module
- DC-link voltage

With EnDat 2.2 encoders:
- The 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 TNC 640 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.

Dynamic Collision Monitoring (DCM) (option 40)



With the Dynamic Collision Monitoring (DCM) software option, the TNC cyclically monitors the working space of the machine for possible collisions between machine components. To this end, the OEM must define three-dimensional collision objects in the working space that are to be monitored by the TNC 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 TNC 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.

Please note:
- Collision objects (including fixtures) are defined exclusively by the OEM
- The collision of machine parts (e.g., the swivel head) with the workpiece cannot be detected
- Collision objects are not automatically transformed into rotationally symmetric objects in turning mode
- In servo-lag operation (no feedforward), DCM is inactive
- It is not possible to check for collisions in Test Run mode

Collision monitoring also protects fixtures and tool carriers from collisions.

The 3-D collision objects are created with the KinematicsDesign commissioning software.

With the TNC 640, collision objects can also be transferred to the control in M3D format from standard CAD models (e.g., STL).

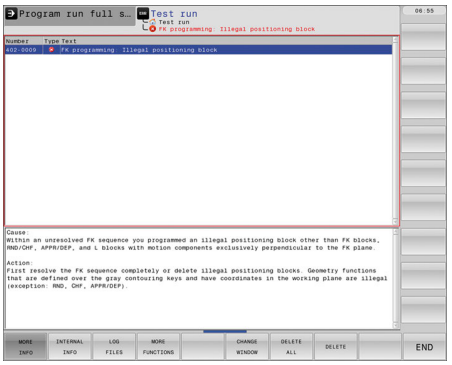
* No safety functions

Advantages of the M3D format:

- Simple data transfer from already available CAD models
- Fully detailed illustration of machine components
- Greater exploitation of the working space

Context-sensitive help

The HELP and ERR keys provide the user with context-sensitive help. This means that in the event of an error message, the control displays information on the cause of the error and proposes solutions. The machine tool builder can also use this function for PLC error messages.



KinematicsDesign (accessory)

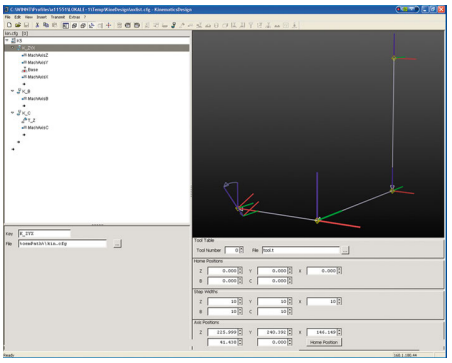
KinematicsDesign is a PC program for creating adaptable kinematic configurations. It supports the following:

- Complete kinematic configurations
- Transfer of configuration files between control and PC
- Description of tool-carrier kinematics

Kinematic descriptions created for the iTNC 530 can also be transferred into kinematic descriptions for the TNC 640/620/320/128.

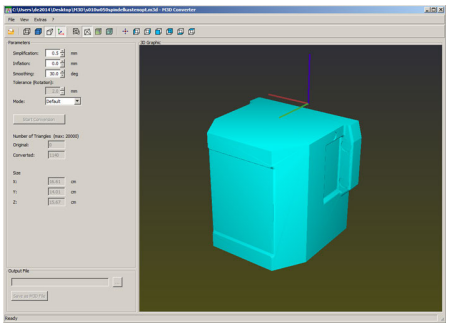
If KinematicsDesign is connected to a control online (operation is also possible with the programming station software), then machine movements can be simulated, and the axes are moved. Together with the TNC 640, KinematicsDesign simulates the working space when DCM is active, and collisions that occur, or machine components in danger of collision, are displayed in a color that you define.

The visualization possibilities range from the pure depiction of the transformation chain and a wire model to a depiction of the entire working space.



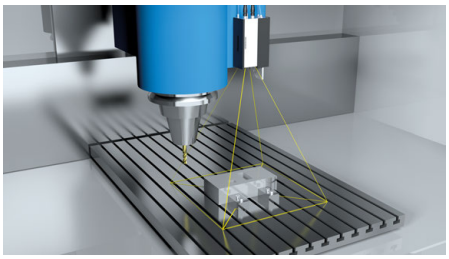
M3D Converter

With the TNC 640, you can transfer collision objects out of a CAD file and integrate them into the machine kinematics using the M3D format. 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 the CAD data of 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 (ID 1124969-01).



VSC – camera-based working-space monitoring (option 136)

With the Visual Setup Control option (VSC), the TNC can automatically monitor the current setup or machining situation during program run. With this option, reference photos are taken by the VS 101 camera system for the first parts of a series, which are then compared with the photos of the subsequent parts. User-friendly cycles enable you to specify several places in the NC program at which the control conducts an optical comparison of the actual and desired conditions. If an error is detected, the TNC reacts as previously chosen by the user.



Error compensation

Overview

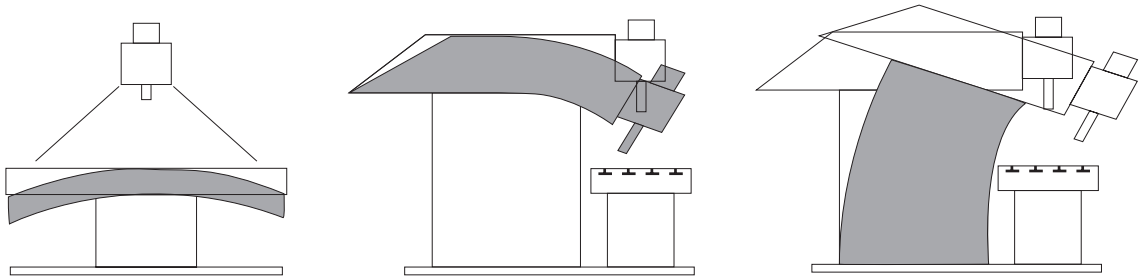
The TNC 640 automatically compensates mechanical errors of the machine.

Linear error

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

Nonlinear error

The TNC 640 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 table movement and rotary encoder movement during direction changes can be compensated in length measurements by spindle and rotary encoder. This backlash is outside the controlled system.

Hysteresis

The hysteresis between table movement and motor movement is also compensated 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 TNC 640 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 TNC 640 can compensate for this problematic behavior.

Sliding friction

Sliding friction is compensated for by the speed controller of the TNC 640.

Thermal expansion

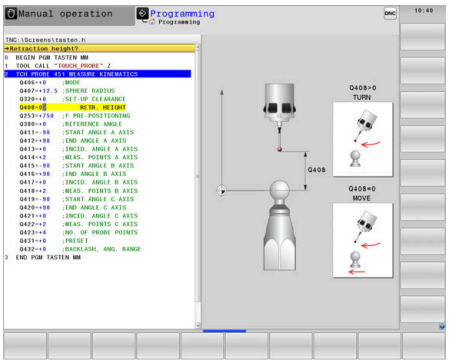
To compensate for thermal expansion, the machine's expansion behavior must be known.

The temperature is ascertained by thermistors connected to the analog inputs of the TNC 640. The PLC evaluates the temperature information and passes the compensation value to the NC.

KinematicsOpt (option 48)

Using the KinematicsOpt function, machine tool builders or end users 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 measurement results are the same regardless of whether the axis is a rotary table, a tilting table, or a swivel head.



Calibration sphere (accessory)

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

KKH 100	Height: 100 mm	ID 655475-02
KKH 250	Height: 250 mm	ID 655475-01

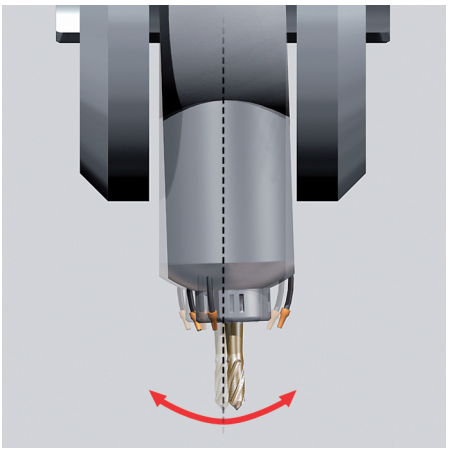
KinematicsComp (option 52)

Increasingly stringent requirements on workpiece tolerances constantly increase the demands placed on the precision of a machine tool. However, components of the machine tool inevitably show imperfections that are, for example, caused by manufacturing or installation 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 errors there are. The use of mechanical means to cope with these problems requires considerable effort, particularly in the field of 5-axis machining, or if large machines with parallel axes are involved.

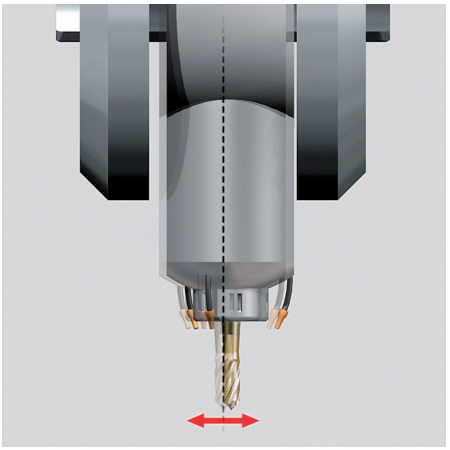
The KinematicsComp software option allows the OEM to store a comprehensive description of the machine errors in the control. KinematicsComp then automatically compensates for the position error that results from static errors of the physical machine axes (volumetric compensation). The positions of all rotary and linear axes, as well as the current tool length, are included in the calculation. KinematicsComp can continue to be used to define position-dependent temperature compensation. The required data are supplied by multiple sensors located at representative positions 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.

The KinematicsComp option cannot be enabled for the export versions.



Fault characteristics according to ISO 230-1: EBA



Fault characteristics according to ISO 230-1: EXA

3D-ToolComp (option 92)

3D-ToolComp is a three-dimensional tool radius compensation depending on the tool's contact angle for compensating 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 any 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 software option Advanced Function Set 2 must be enabled. These compensation values will only be taken into account during probing with a touch probe if new probing cycles (e.g., Cycle 444) that have been prepared for this purpose are used.

Commissioning and diagnostic aids

Overview

The TNC 640 provides comprehensive internal commissioning and diagnostic aids. It also includes highly effective PC software for diagnostics, optimization, and remote control.

ConfigDesign (accessory)

PC software for configuring the machine parameters

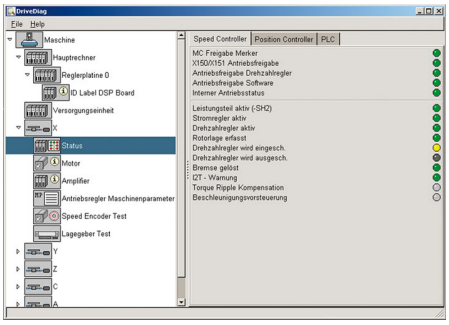
- Stand-alone machine-parameter editor for the control; all support information, additional data, and input limits are shown for the parameters
- Configuration of machine parameters
- Comparison of parameters from different controls
- Importing of service files: easy testing of machine parameters in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

DriveDiag

DriveDiag permits quick and easy troubleshooting of the drives. The following diagnostic functions are available:

- Reading and displaying the electronic ID labels of QSY motors with EQN 13xx or ECN 13xx as well as the inverter modules UVR 1xxD and UM 1xxD
- Displaying and evaluating the internal control conditions and the status signals of the inverter components
- Displaying the analog values available to the drive controller
- Automatic test for the proper functioning of motors and inverters, as well as of position and speed encoders

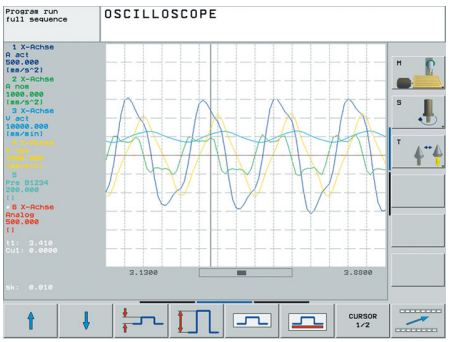
DriveDiag can be called immediately at the control through the diagnostics soft key. End users have read-access, whereas the code number for the machine tool builder gives access to comprehensive testing possibilities with DriveDiag.



Oscilloscope

The TNC 640 features an integrated oscilloscope. Both X/t and X/Y graphs are possible. The following characteristic curves can be recorded and stored in six channels:

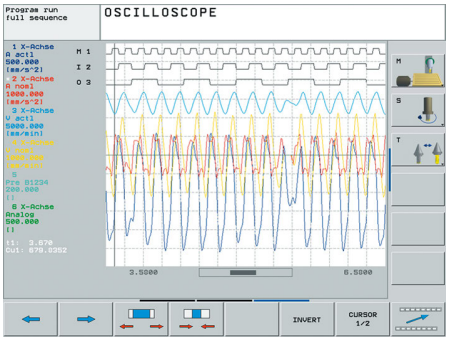
- Actual value and nominal value of the axis feed rate
- Contouring feed rate
- Nominal and actual position
- Following error of the position controller
- Nominal and actual values for speed, acceleration, and jerk
- Content of PLC operands
- Encoder signal (0°–A) and (90°–B)
- Difference between position and speed encoder
- Nominal velocity value
- Integral-action component of the nominal current value
- Torque-determining nominal current value



Logic signals

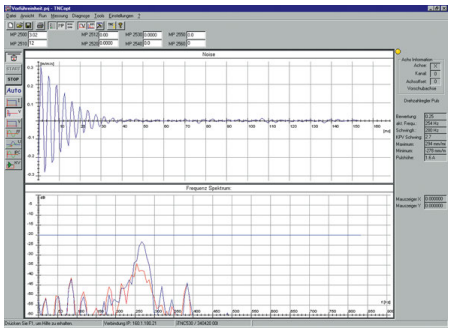
Simultaneous graphic representation of the logic states of up to 16 operands (markers, words, inputs, outputs, counters, timers)

- Marker (M)
- Input (I)
- Output (O)
- Timer (T)
- Counter (C)
- IpoLogic (X)



TNCopt (accessory)

PC software for commissioning digital control loops.
Functions (among others):
- Commissioning the current controller
- Commissioning the velocity controller (automatic)
- (Automatic) optimization of sliding-friction compensation
- (Automatic) optimization of compensation for reversal spikes
- Optimization of the k_V factor (automatic)
- Circular interpolation test, contour test



Online Monitor (OLM)

The online monitor is a component of the TNC 640 and is called over a code number. It supports commissioning and diagnosis of control components through the following:
- 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 of control-internal debug outputs

TNCscope (accessory)

PC software for transferring the oscilloscope files to a PC. With TNCscope you can record and save up to 16 channels simultaneously.
Note: The trace files are saved in the TNCscope data format.

API DATA

The API DATA function enables the control to display the states or contents of the symbolic API markers and API double words. This function requires that your PLC program use the symbolic memory interface.

Note: The API DATA function does not provide usable display values with the iTNC 530-compatible memory interface (API 1.0)

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.

TeleService (accessory)

PC software for remote diagnostics, remote monitoring, and remote operation of the control. For more information, please ask for the *Remote Diagnosis with TeleService* Technical Information sheet.

Single station license		ID 340449-xx
Network license	For 14 workstations	ID 340454-xx
	For 20 workstations	ID 340455-xx

Bus diagnosis

In Diagnosis mode, the structure of the connected bus systems as well as the details of the connected components can be displayed in a clearly laid out screen.

TNCtest

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

The TNCtest and TestDesign program packages can be used to plan and perform acceptance tests for machine tools with HEIDENHAIN controls. The acceptance tests are planned with TestDesign and run with TNCtest.

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

TNCanalyzer

The TNCanalyzer application from HEIDENHAIN provides for simple and intuitive evaluation of service files and log files.

Function:
- Loading of service 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 PLC development software **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 inputs and outputs are available via the external PL 6000 PLC input/output systems or the UEC 11x. The PLC inputs/outputs and the PROFINET IO or PROFIBUS DP-capable I/O system must be configured with the IOconfig PC software.

PLC programming

Format	Statement list
Memory	Min. 1 GB
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

The encrypted PLC partition (PLCE:) provides the machine tool builder with a tool for preventing third parties from viewing or changing files.

The files on the PLCE partition can be read only by the control itself or by using the correct OEM keyword. This ensures that proprietary know-how and special customer-specific solutions cannot be copied or changed.

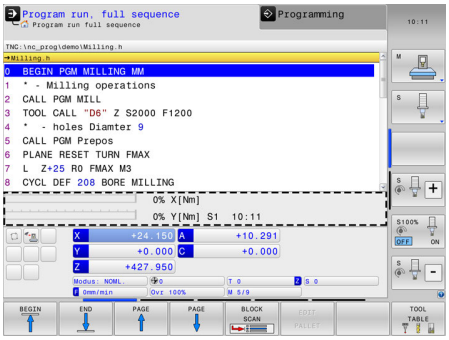
The machine tool builder can also determine the size of the encrypted partition. This is not determined until the machine tool builder creates the PLCE partition. Another advantage is that, in spite of the encryption, the data can backed up from the control to a separate data medium (USB drive, network, e.g. through TNCremo) and later restored. You need not enter the password, but the data cannot be read until the keyword is supplied.

PLC window

The TNC 640 can display PLC error messages in the dialog line during operation.

Small PLC window

The TNC 640 can show additional PLC messages and bar diagrams in the small PLC window.

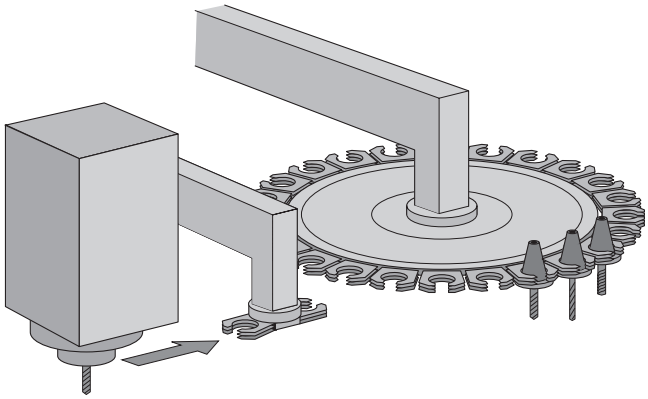


PLC soft keys

The machine manufacturer can display his 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 software for PLC program development.
The PC program **PLCdesign** can be used for easy creation of PLC programs. Extensive examples of PLC programs are included with the product.

Functions:

- Easy-to-use text editor
- Menu-guided operation
- Programming of 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

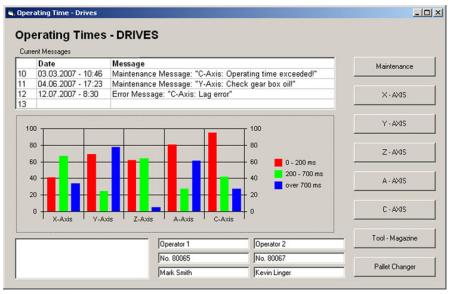
Python OEM Process (option 46)

The Python OEM Process option is an effective tool for the machine tool builder to use an object-oriented high-level programming language in the control (PLC). Python is an easy-to-learn script language that supports the use of all necessary high-level language elements.

Python OEM Process can be used universally for machine functions and complex calculations, as well as to display special user interfaces. User-specific or machine-specific solutions can be efficiently implemented. Numerous libraries on the basis of Python and GTK are available, regardless of whether you want to create special algorithms for special functions, or separate solutions such as an interface for machine maintenance software.

The applications you create can be included via the PLC in the familiar PLC windows, or they can be displayed in separate free windows that can be expanded to the control's full screen size.

Simple Python scripts (e.g., for display masks) can also be executed without enabling Python OEM Process (software option 46). For this function, 10 MB of dedicated memory is reserved. For more information, refer to the *Python in HEIDENHAIN Controls* Technical Manual.



PLC basic program

The PLC basic program serves as a basis for adapting the control to the requirements of the respective machine. It can be downloaded from the Internet.

These essential functions are covered by the PLC basic program:

Axes
- Control of analog and digital axes
- Axes with clamping mode
- Axes with central drive
- Axes with Hirth grid
- Synchronized axes
- 3-D head with C-axis mode
- 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 new generation of handwheel

General functions
- Feed rate control
- Control of the coolant system (internal, external, air)
- Toggling between milling and turning modes
- Temperature compensation
- Activation of 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
- Diagnostics screen (Python)
- Python example applications
- Status display in the small PLC window

Interfacing to the machine

OEM cycles

The machine tool builder can create and store his own cycles for recurring machining tasks. These OEM cycles are used in the same way as standard HEIDENHAIN cycles.

CycleDesign (accessory)

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

Tool management

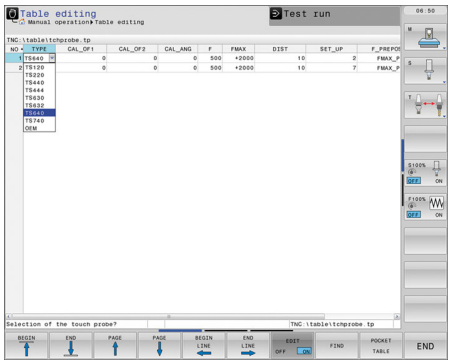
With integral PLC, the tool changer is moved either via proximity switch or as a controlled axis. Tool management including tool life monitoring and replacement tool monitoring is carried out by the TNC 640.

Tool calibration

Tool touch probes can be measured and checked with the **TT** tool touch probe system (accessory). Standard cycles for automatic tool measurement are available in the control. The control calculates the probing feed rate and the optimal spindle speed. The measured data are stored in a tool table.

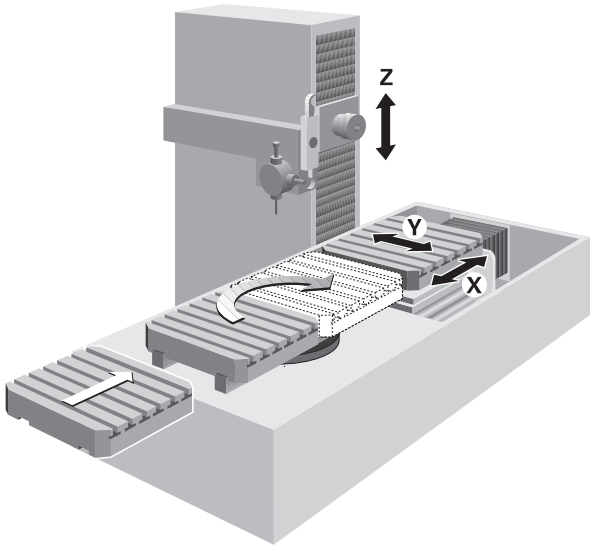
Touch-probe configuration

All touch-probe data can be configured conveniently through a table. All HEIDENHAIN touch probe systems are preconfigured and can be selected through a drop-down menu.



Pallet management

Pallet feeding can be controlled via PLC axes. The user defines 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 TNC 640 is connected to PCs, networks, and other data storage devices via data interfaces.
Ethernet	The TNC 640 can be interconnected via the Ethernet interface. 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
Protocol	The TNC 640 communicates using the TCP/IP protocol.
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 TNC 640 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 is transferred blockwise. A block check character (BCC) is used for data backup. This method improves data security.
LSV2	Bidirectional transfer of commands and data as per DIN 66019. The data is divided into telegrams (blocks) and transmitted.
USB	The TNC 640 features USB interfaces for the connection of standard USB devices such as a mouse, hard drive, etc. On the back of the MC 85x2 and MC 3xx there are four USB 3.0 ports. One of them leads to the TE, 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 of up 5 m ID 354770-xx Cable length of 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 TNC 640 and a PC.

TNCremo (accessory)

This PC software package helps the user to transfer data from the PC to the control. The software transfers data blockwise with block check characters (BCC).

Functions:
- Data transfer (also blockwise)
- Remote control (only serial)
- File management and data backup of the control
- Reading out the log
- Print-out of screen contents
- Text editor
- Managing more than one machine

TNCremoPlus (accessory)

In addition to the features already familiar from TNCremo, TNCremoPlus can also transfer the current content of the control's screen to the PC (live screen). This makes it very simple to monitor the machine.

Additional functions:
- Interrogation of DNC data (NC uptime, machine uptime, machine running time, spindle running time, pending errors, data from the data servers—e.g., symbolic PLC operands)
- Targeted overwriting of tool data using the values of a tool presetter

TNCremoPlus ID 340447-xx

Connected Machining

Overview

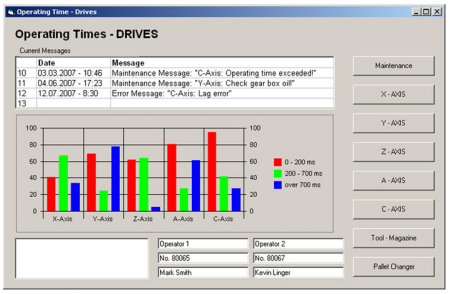
Connected Machining makes uniformly digital job management possible in networked manufacturing. You also profit from:
- Easy data usage
- Time-saving procedures
- Transparent processes

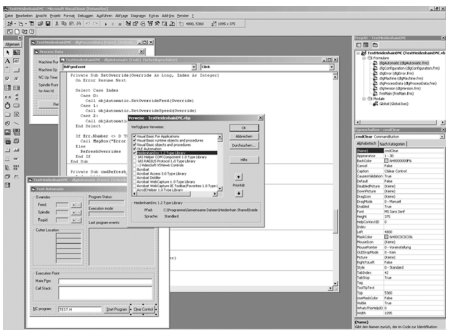
Remote Desktop Manager (option 133)

Remote control and display of external computers over an Ethernet connection (e.g., Windows PC). The information is displayed on the control's screen. Remote Desktop Manager allows you to access important applications, such as CAD/CAM applications or order management, from the control.

Remote Desktop Manager	ID 894423-xx

HEIDENHAIN DNC (option 18)





The development environments on Windows operating systems are particularly well suited as flexible platforms for application development in order to handle 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 the customer a text message to his 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 job 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

For more information, refer to the *HEIDENHAIN DNC* brochure.

virtualTNC (accessory)

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

Single station license		ID 1113933-02
Network license	For one work station	ID 1122145-02
	For 14 workstations	ID 1113935-02
	For 20 workstations	ID 1113936-02

For more information, refer to the *HEIDENHAIN DNC* brochure.

OPC UA NC Server (option 18)

The Open Platform Communications Unified Architecture (OPC UA) standard has established itself in recent years as an interface for the secure and reliable exchange of data in industrial environments. The new option called HEIDENHAIN OPC UA NC Server makes this leading-edge interface available on the TNC 640. OPC UA is independent of the operating system and allows you to connect the HEIDENHAIN control to the widely-used Windows systems as well as to Linux-based systems or Apple computers with macOS, for example.

Numerous developer toolkits are available for OPC UA. RemoTools SDK is not needed. The standardized protocol, the free selection of the toolkit, and the application-oriented HEIDENHAIN information model enable the development of highly customized applications with a significantly reduced time-to-market in addition to the development of standard software.

The HEIDENHAIN OPC UA NC Server supports the following OPU UA services:
- Reading and writing variables
- Subscribing to value changes
- Executing methods
- Subscribing to events

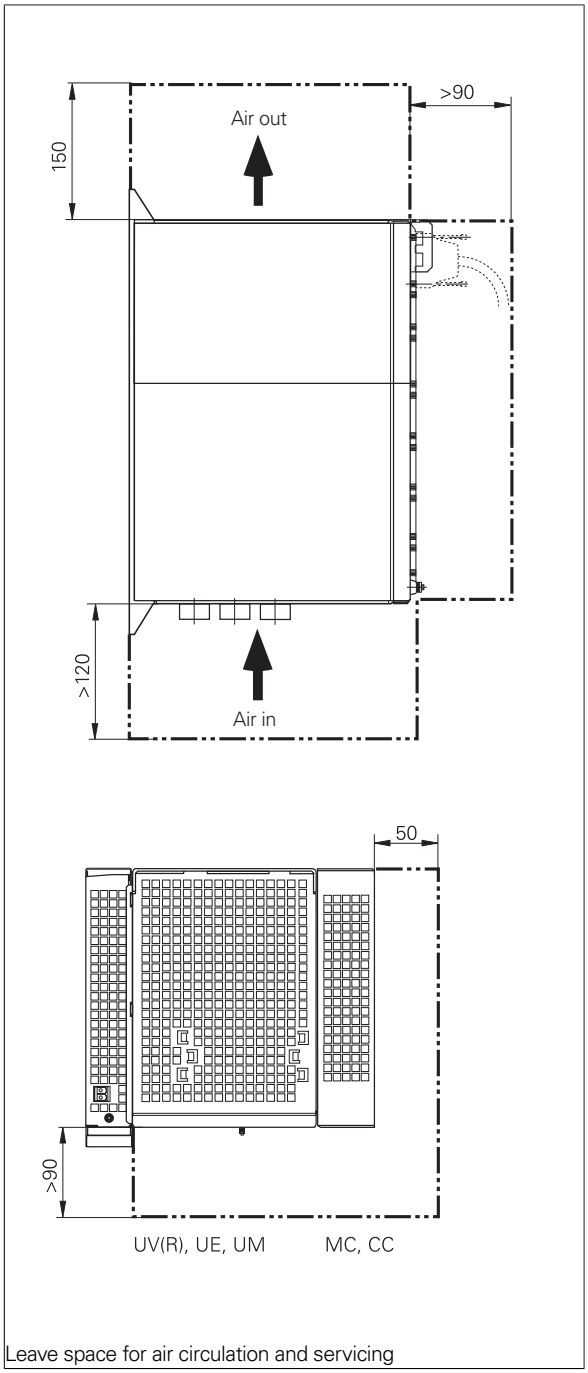
With Sign&Encrypt, HEIDENHAIN ensures that even the standard solution provides state-of-the-art IT security:
- SecurityMode: Sign&Encrypt
- Cryptographic algorithm: Basic256Sha256 (recommendation of OPC Foundation) – X.509 Certificates

Mounting information
Clearances and mounting

Proper minimum clearance

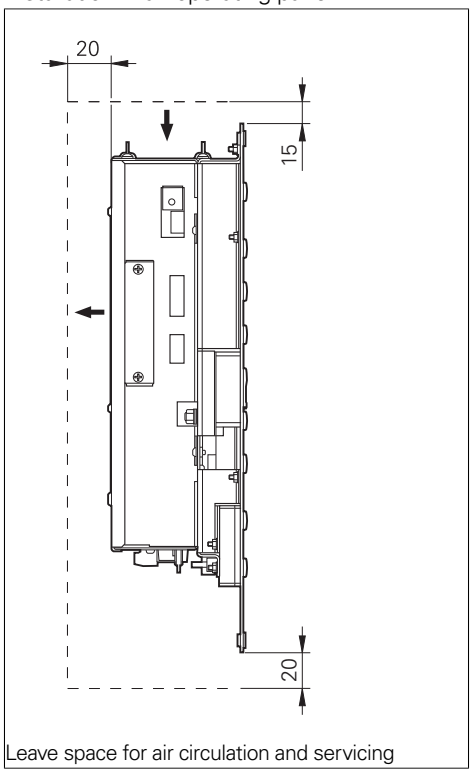
When mounting the control components, please observe proper minimum clearances and space requirements, as well as length and position of the connecting cables.

Installation in an electrical cabinet



Leave space for air circulation and servicing

Installation in an operating panel



Leave space for air circulation and servicing

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 position
- 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)
- Machine operating panel (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 comply with protection class IP54, 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

This unit fulfills the requirements for EN 50370-1 and is intended for operation in industrially zoned areas.

Likely sources of interference

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

Protective measures

- Ensure that the MC, CC, and signals lines are at least 20 cm away from interfering devices
- Ensure that the MC, CC, and signals lines are at least 10 cm away from cables carrying interfering signals. For cables in metallic ducting, adequate decoupling can be achieved by using a grounded separation shield.
- Shielding according to EN 50178
- Use equipotential bonding lines according to the grounding plan. Please refer to the Technical Manual of your control.
- Use only genuine HEIDENHAIN cables and connecting elements

Installation elevation

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

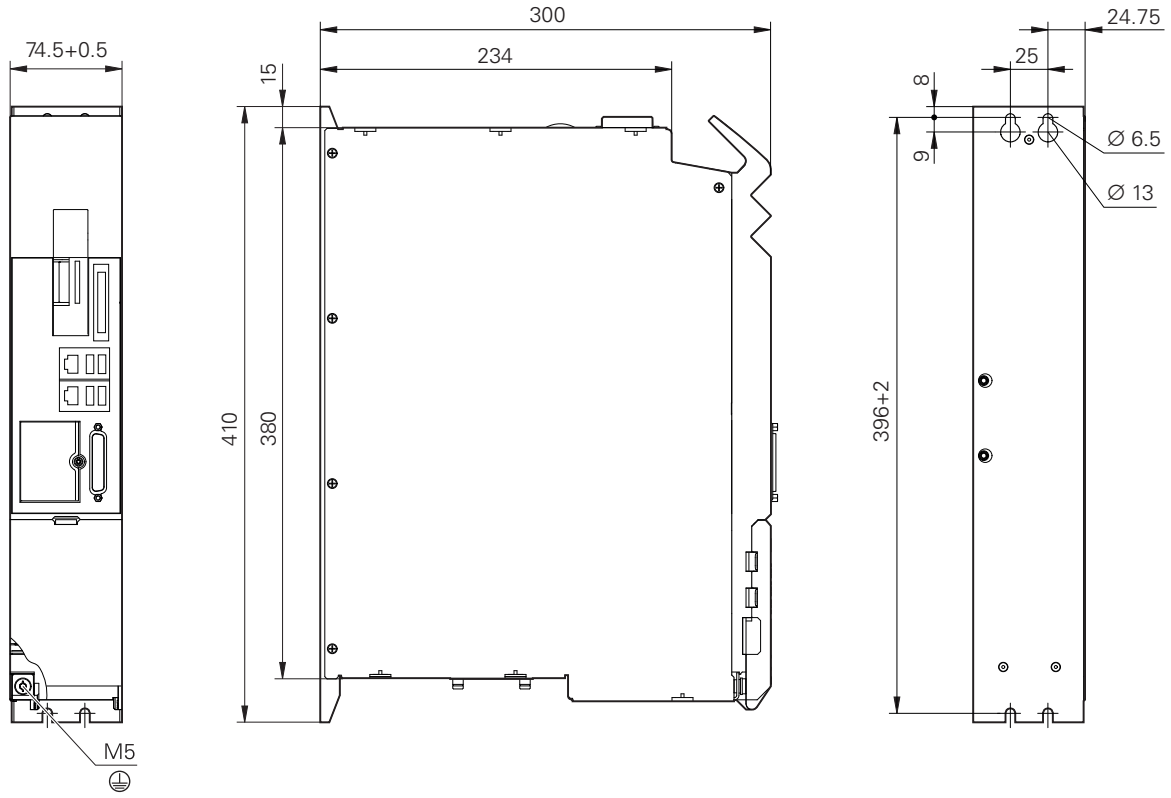
Overall dimensions

Main computer

MC 3xx, IPC 3xx

mm

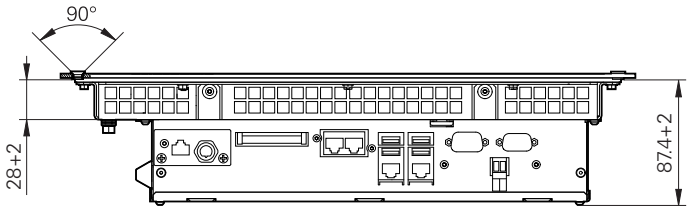
Tolerancing ISO 8015
ISO 2768 - m H
≤ 6 mm: ±0.2 mm

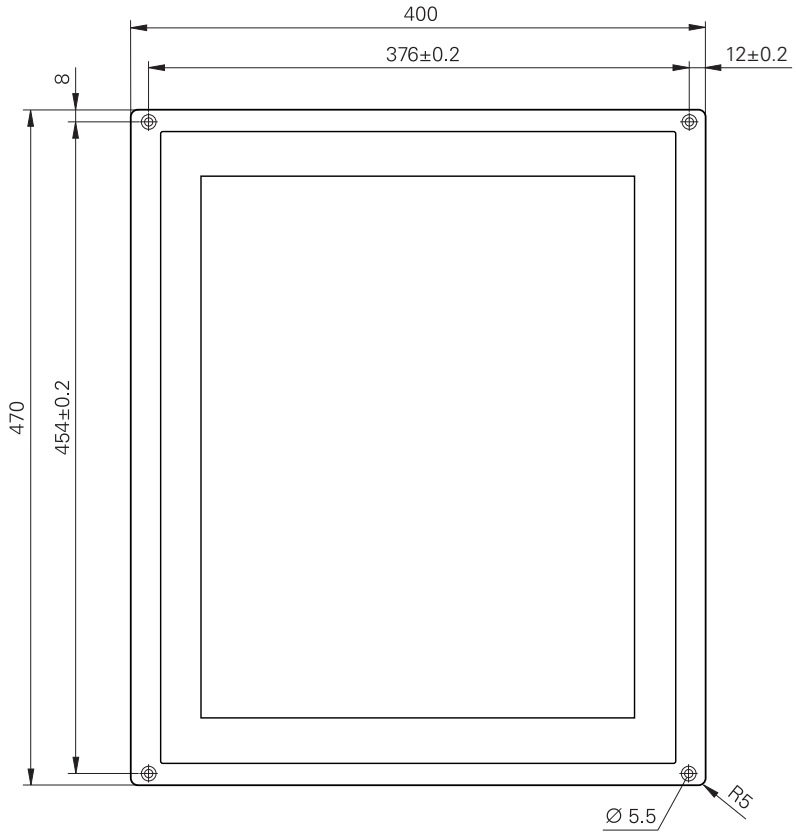


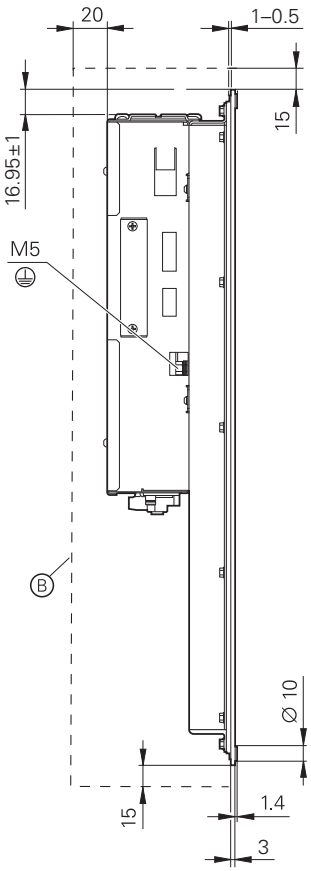
MC 8512

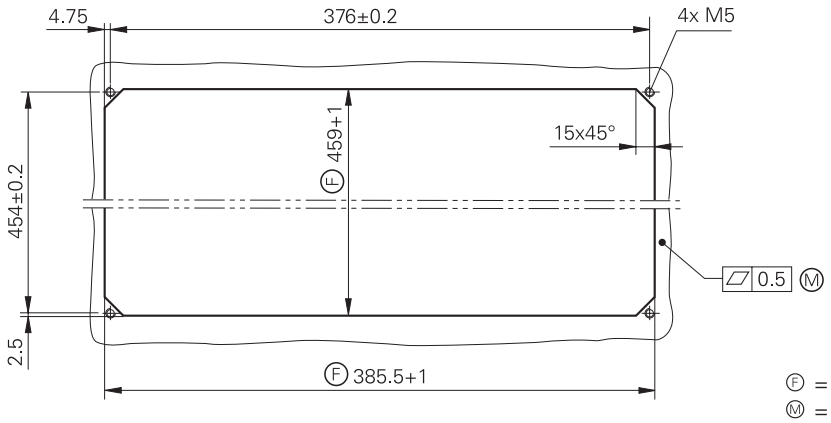
mm

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







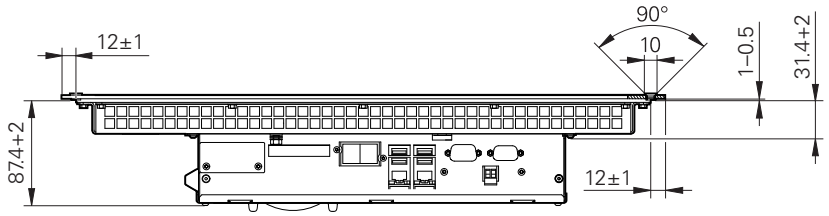


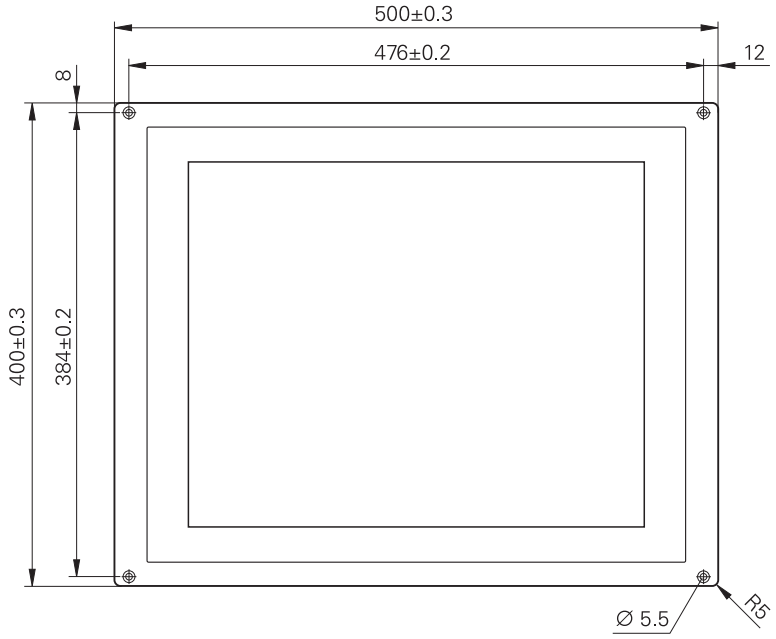
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

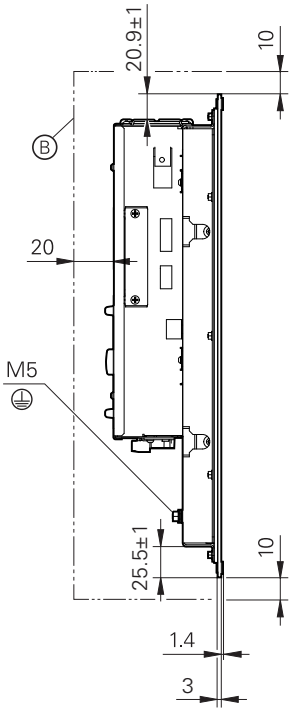
MC 8532

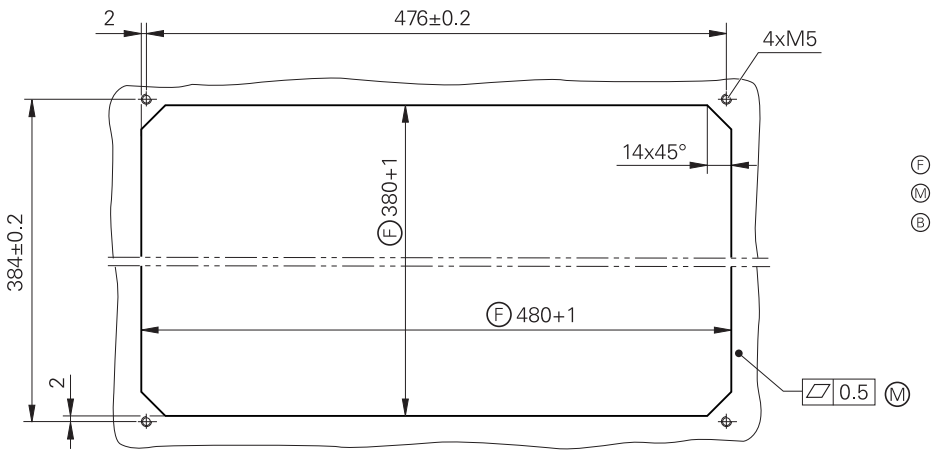
mm

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







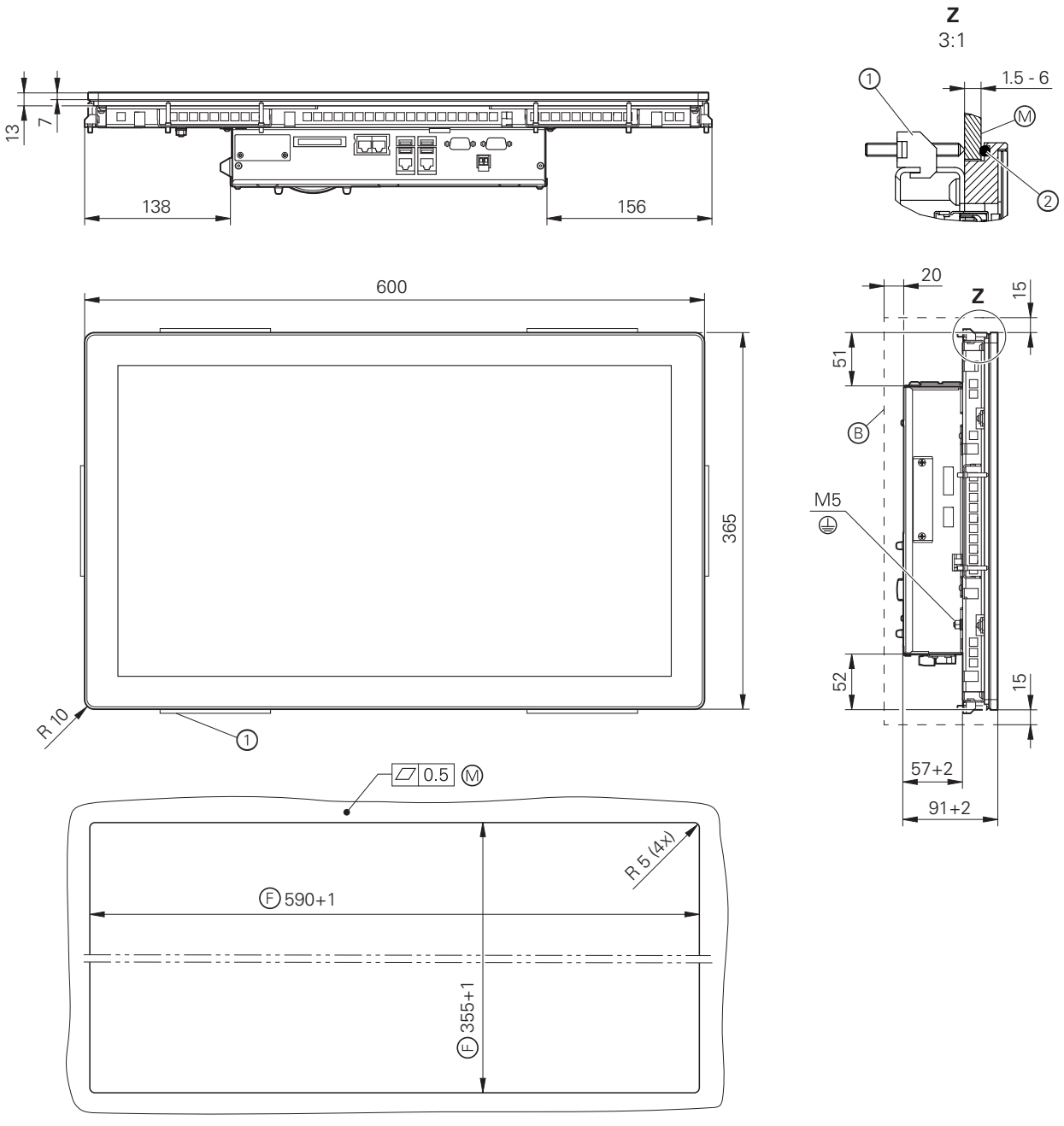


Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

MC 366

mm

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

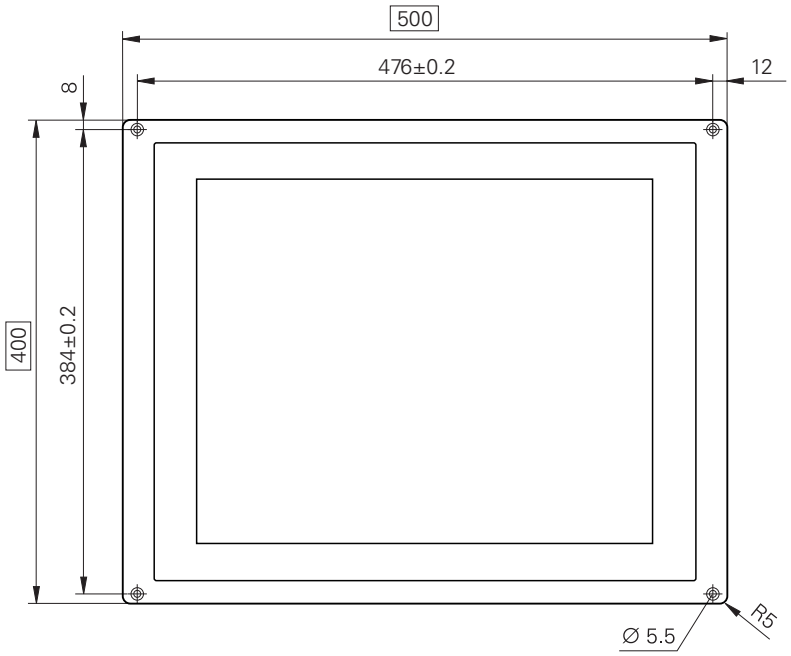


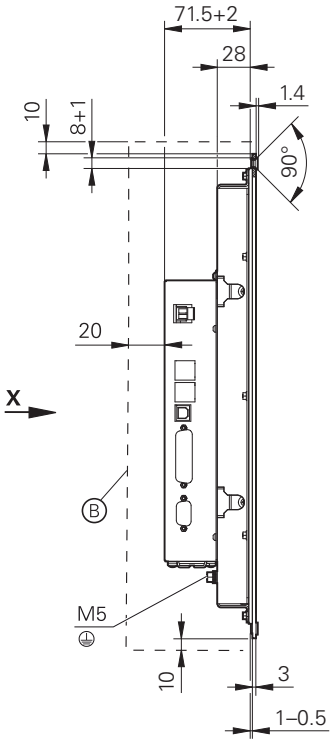
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M4 setscrews with hexagon socket and cone point
2 = O-ring cord, EPDM

Operating panel, screen, and keyboard

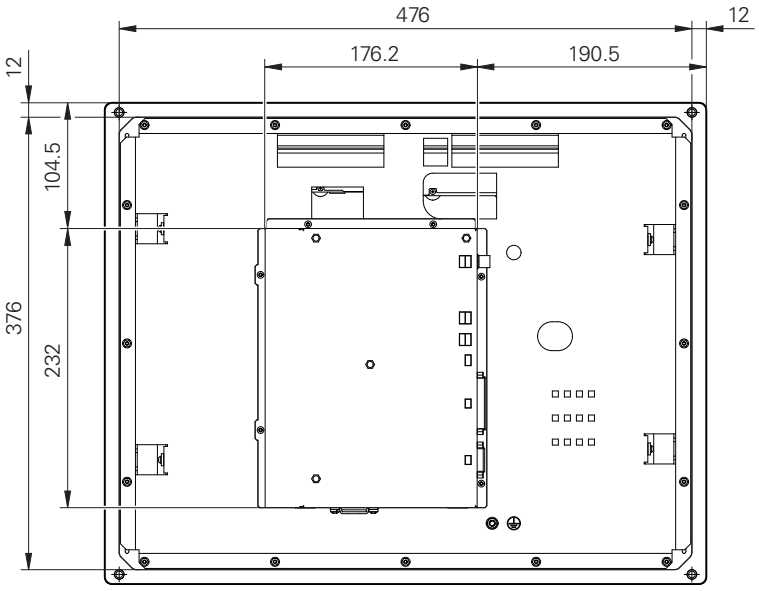
BF 860, ITC 860

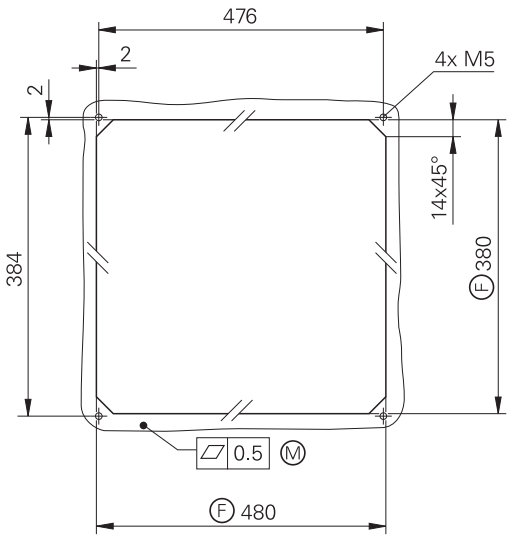
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm





X



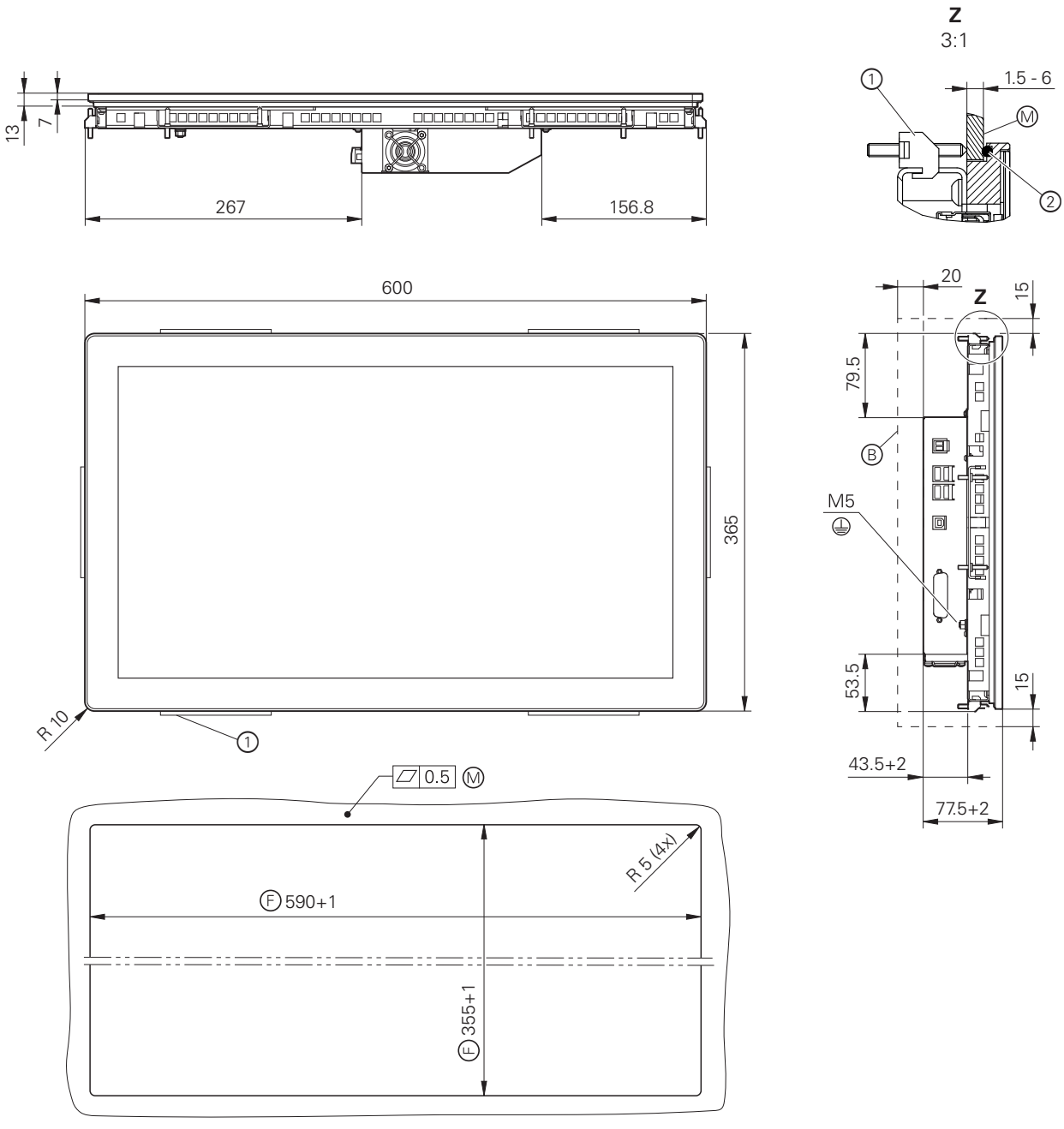


Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

BF 360

mm

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

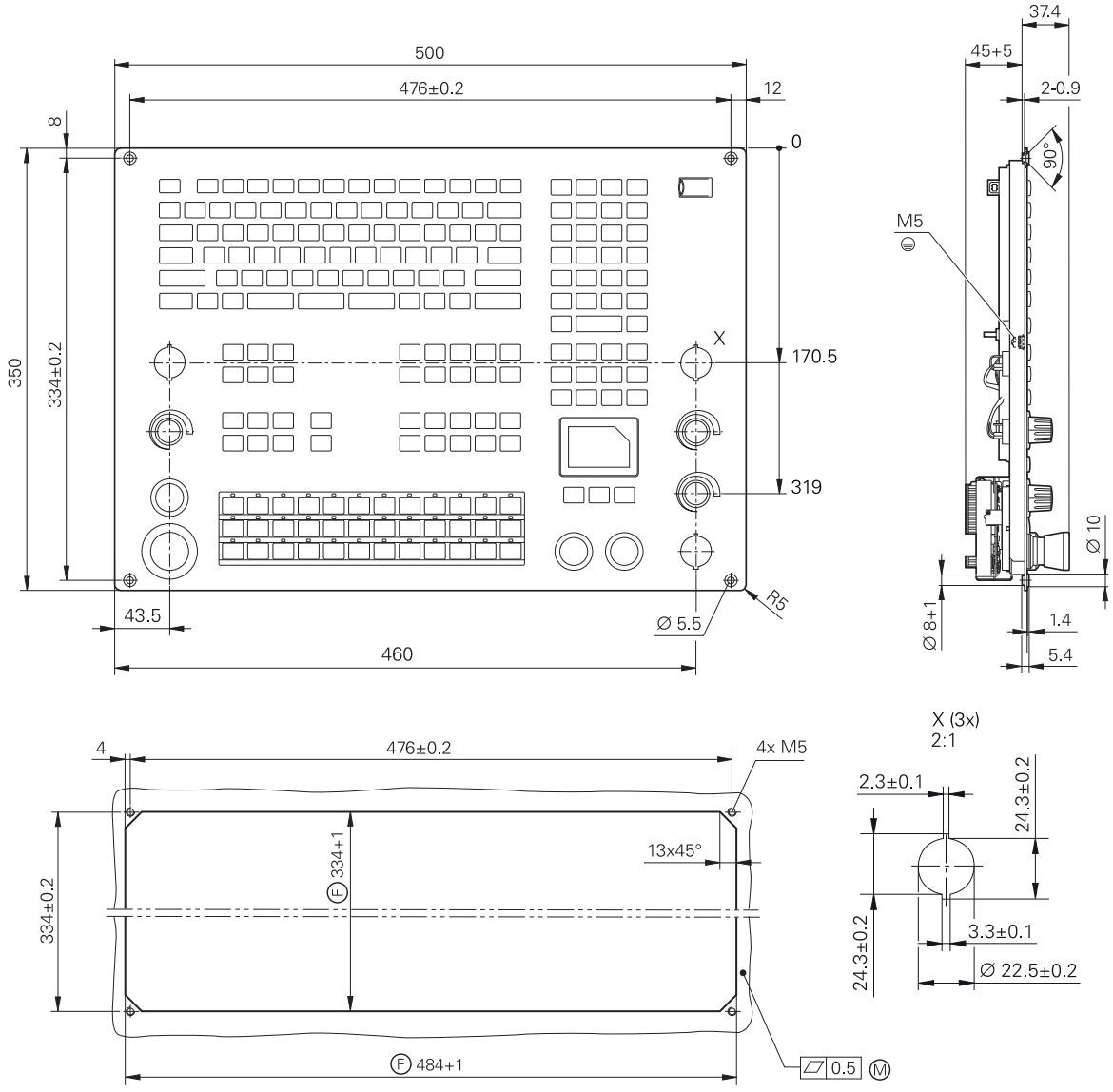


Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation
1 = Holding clamp (6x), each with two M4 setscrews with hexagon socket and cone point
2 = O-ring cord, EPDM

TE 745

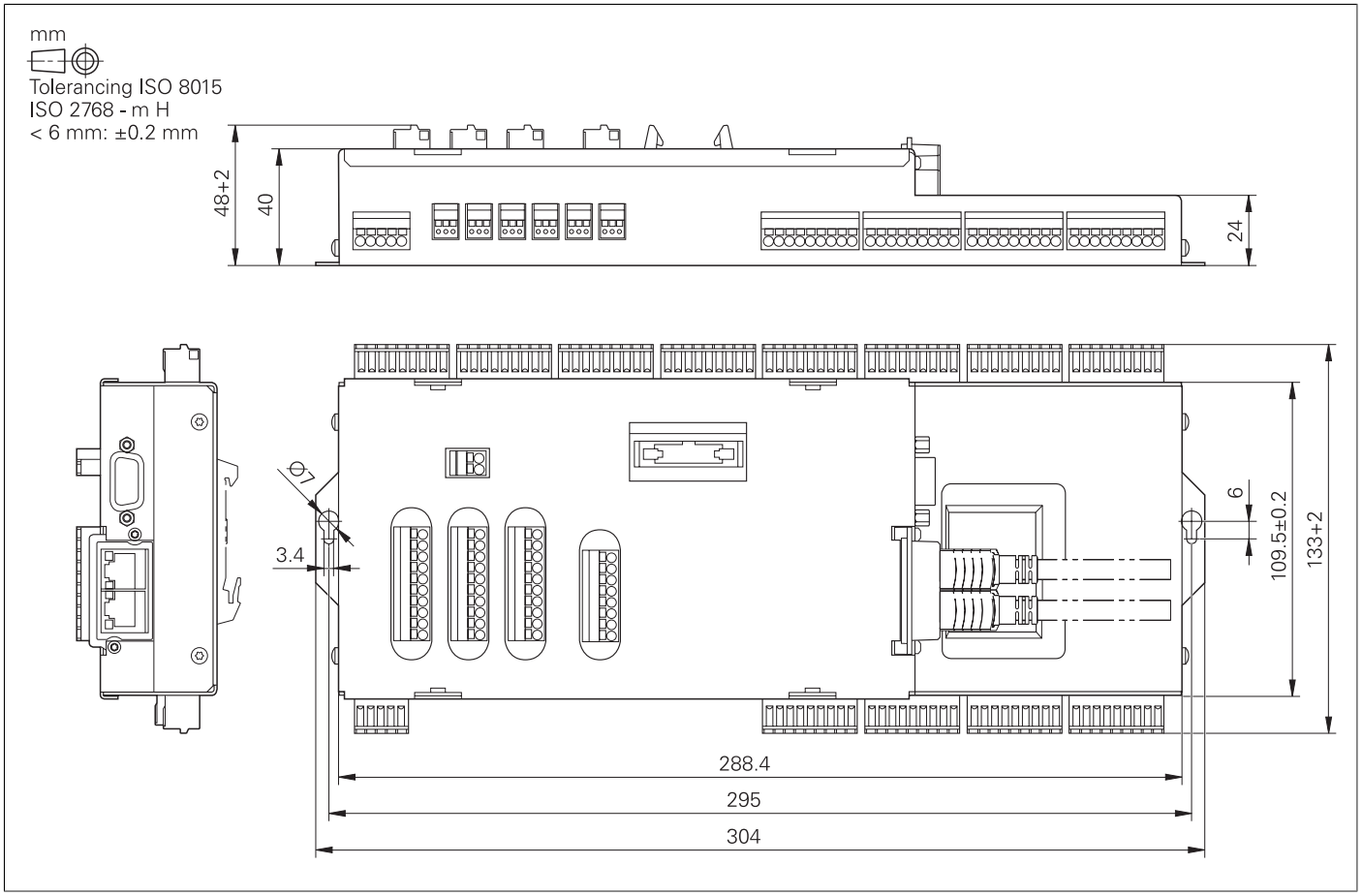
mm

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



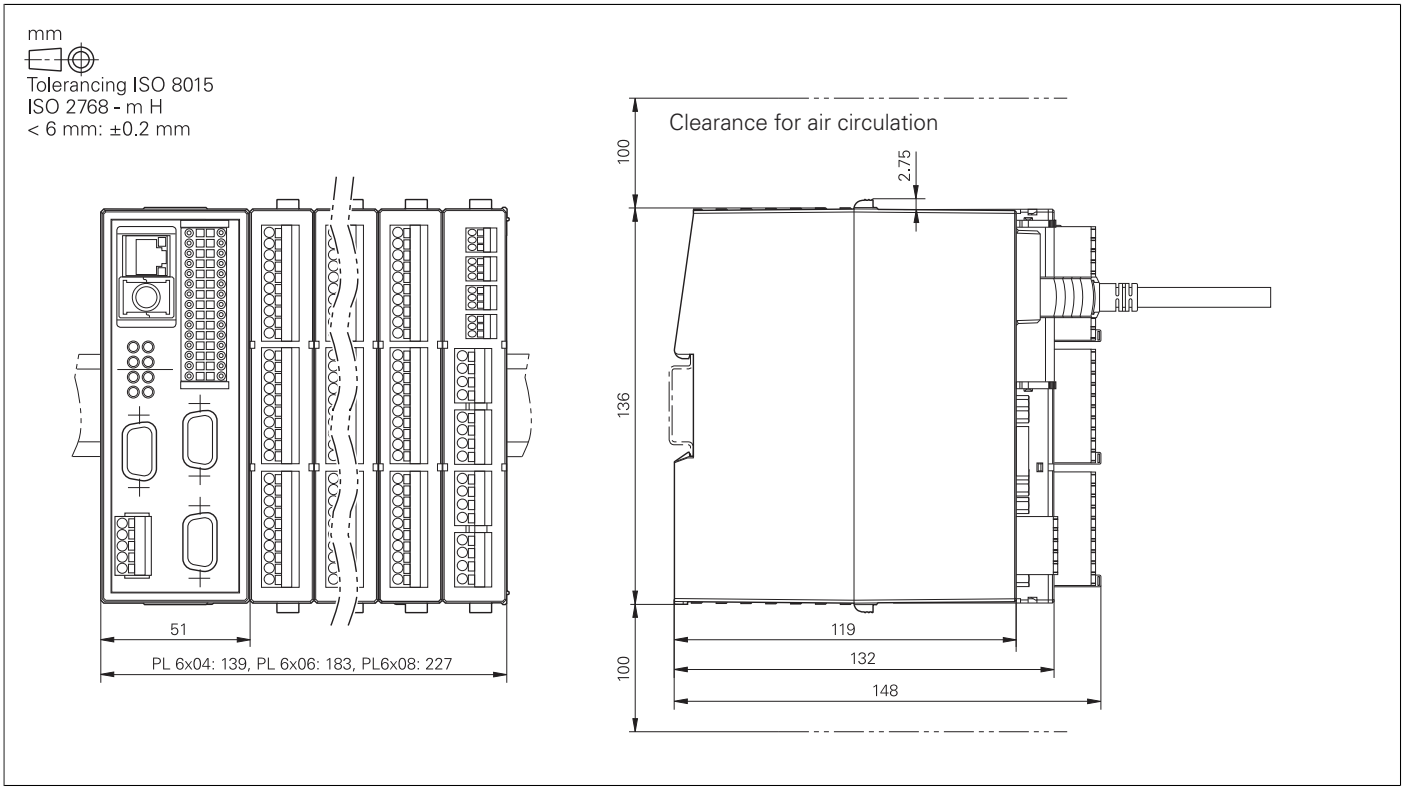
Ⓕ = Front panel opening
Ⓜ = Mounting surface

PLB 600x


mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm
48+2
40
24
Ø7
3.4
6
109.5±0.2
133+2
288.4
295
304

PLC inputs and outputs

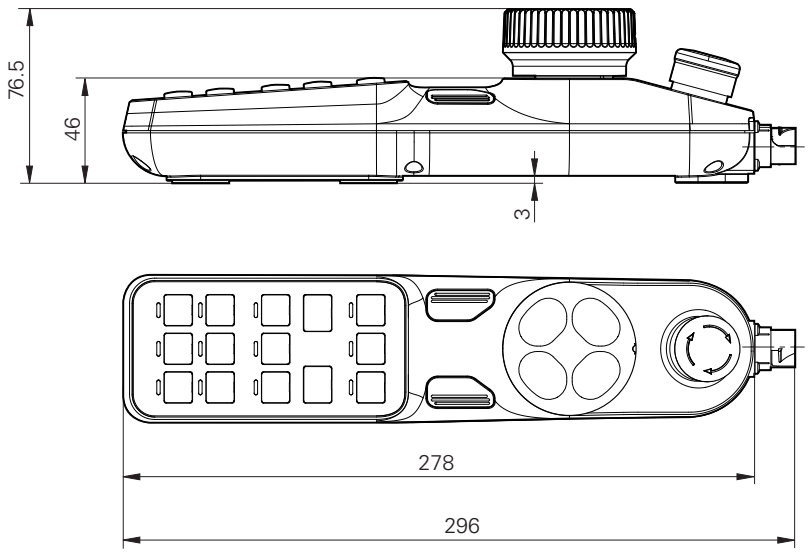
PL 6000 (PLB 62xx, PLB 61xx)



Electronic handwheels

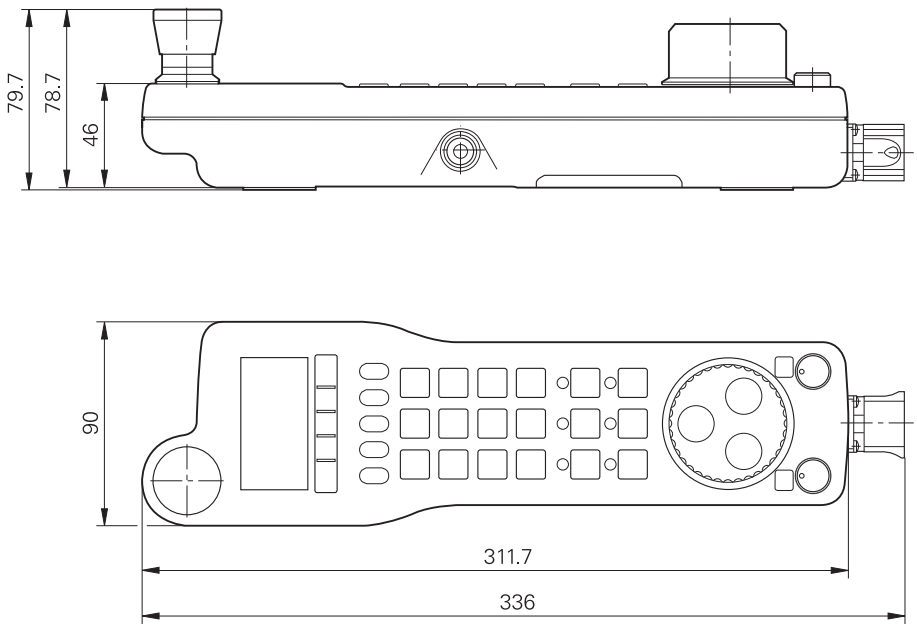
HR 510, HR 510 FS

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



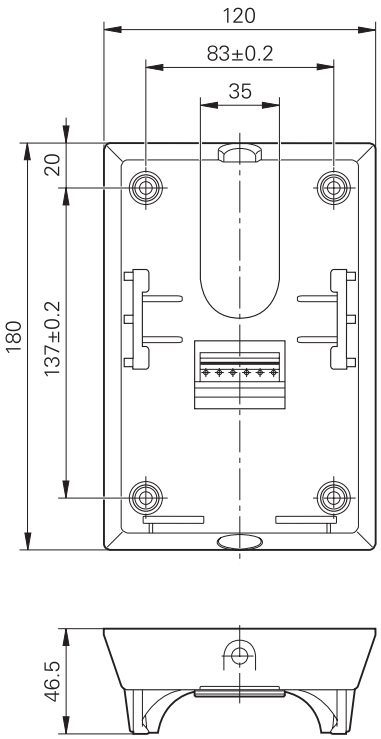
HR 520, HR 520 FS

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



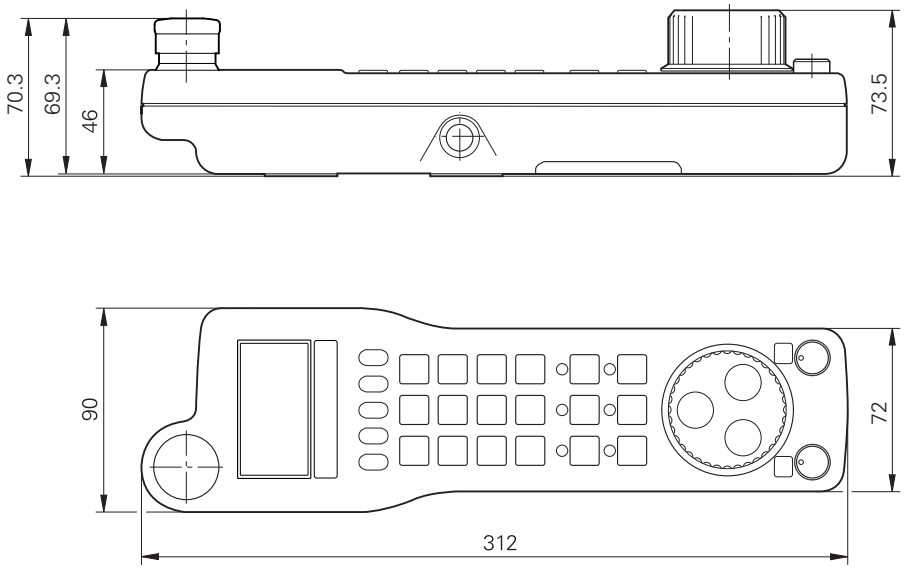
Holder for HR 520, HR 520 FS

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

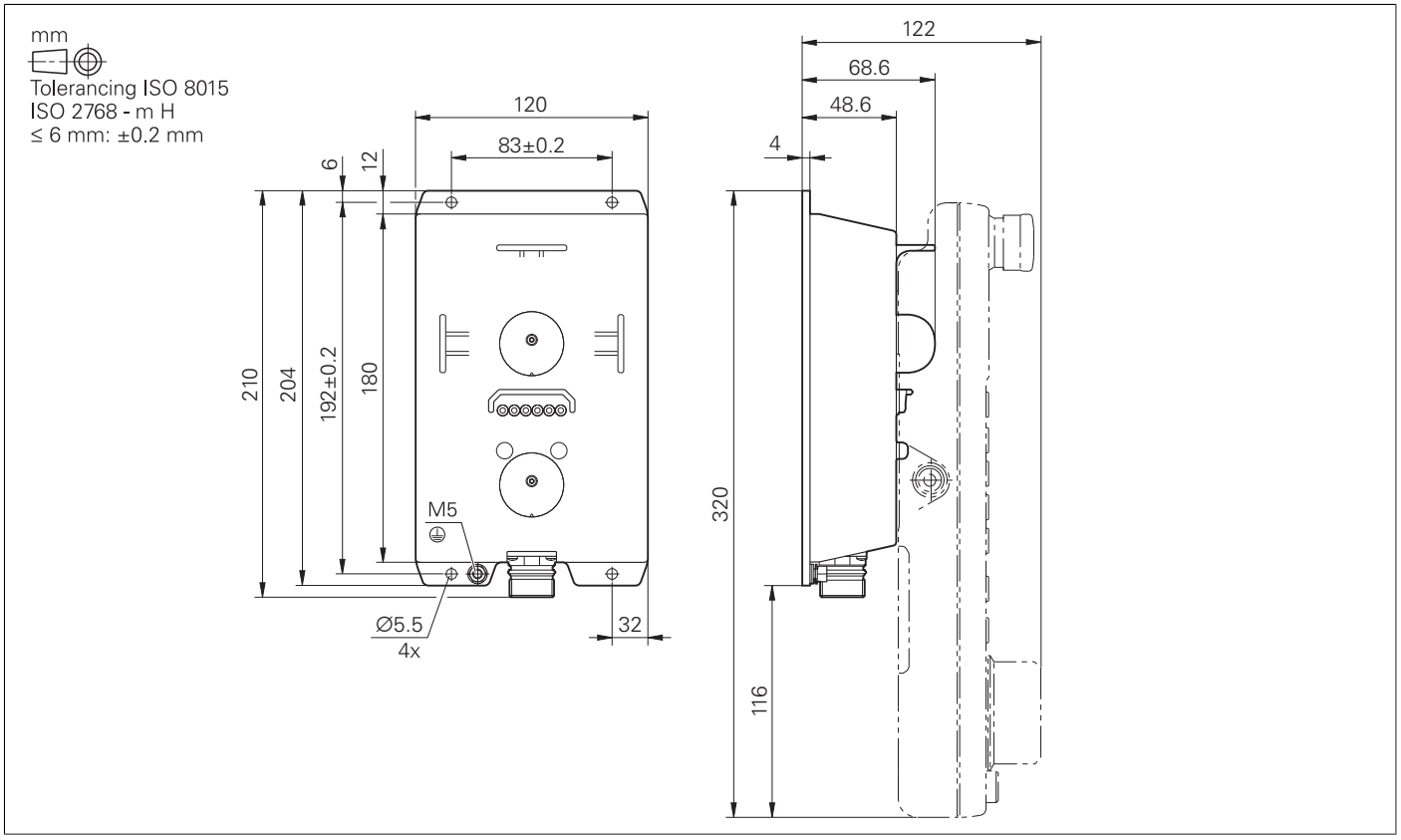


HR 550 FS

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



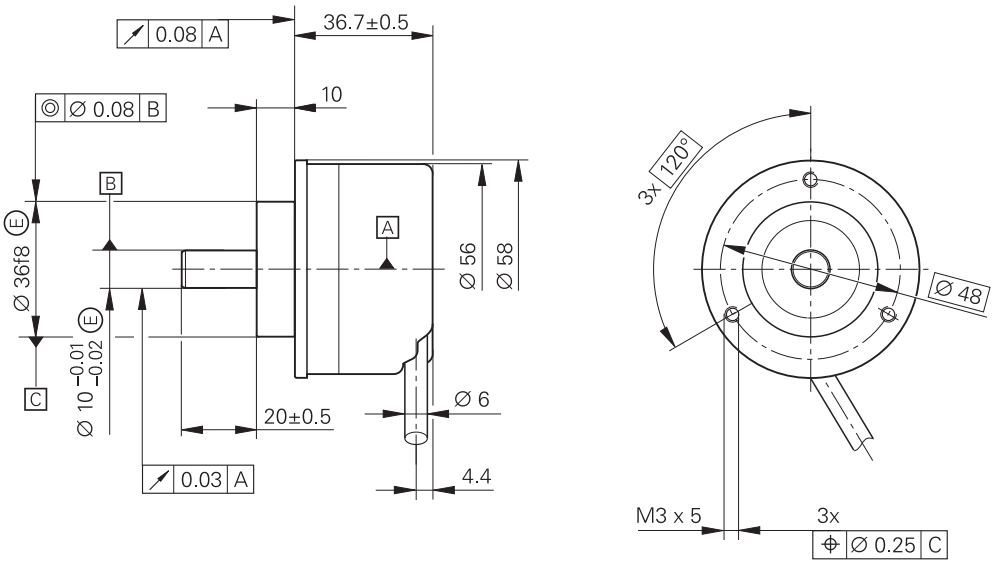
HRA 551 FS

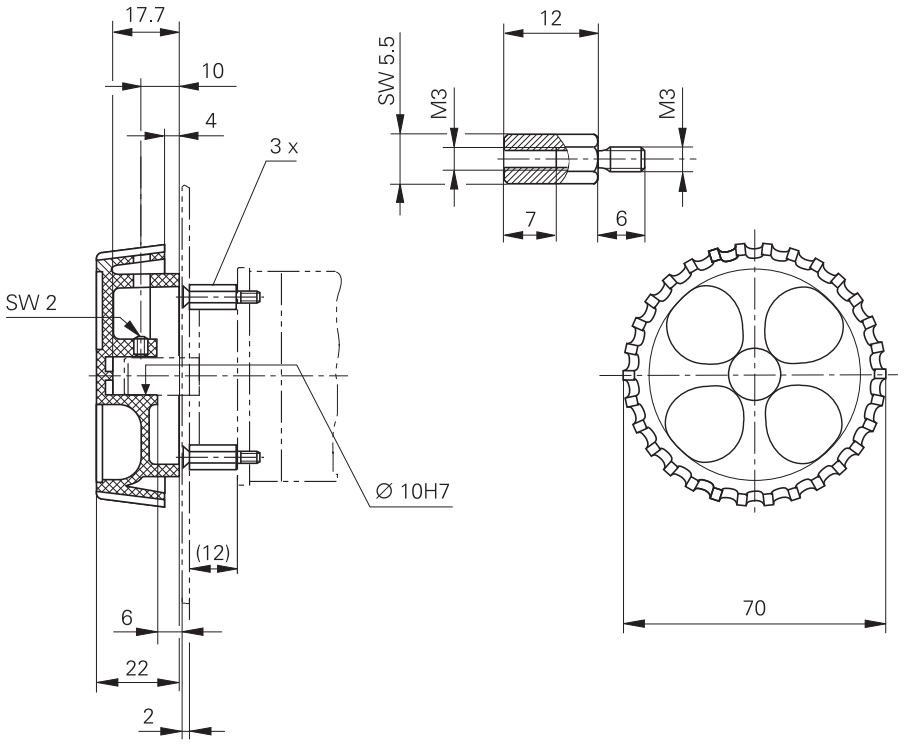

mm
Tolerancing ISO 8015
ISO 2768 - m H
≤ 6 mm: ±0.2 mm
120
83±0.2
6
12
210
204
192±0.2
180
M5
Ø5.5
4x
32
122
68.6
48.6
4
320
116

HR 130

mm

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

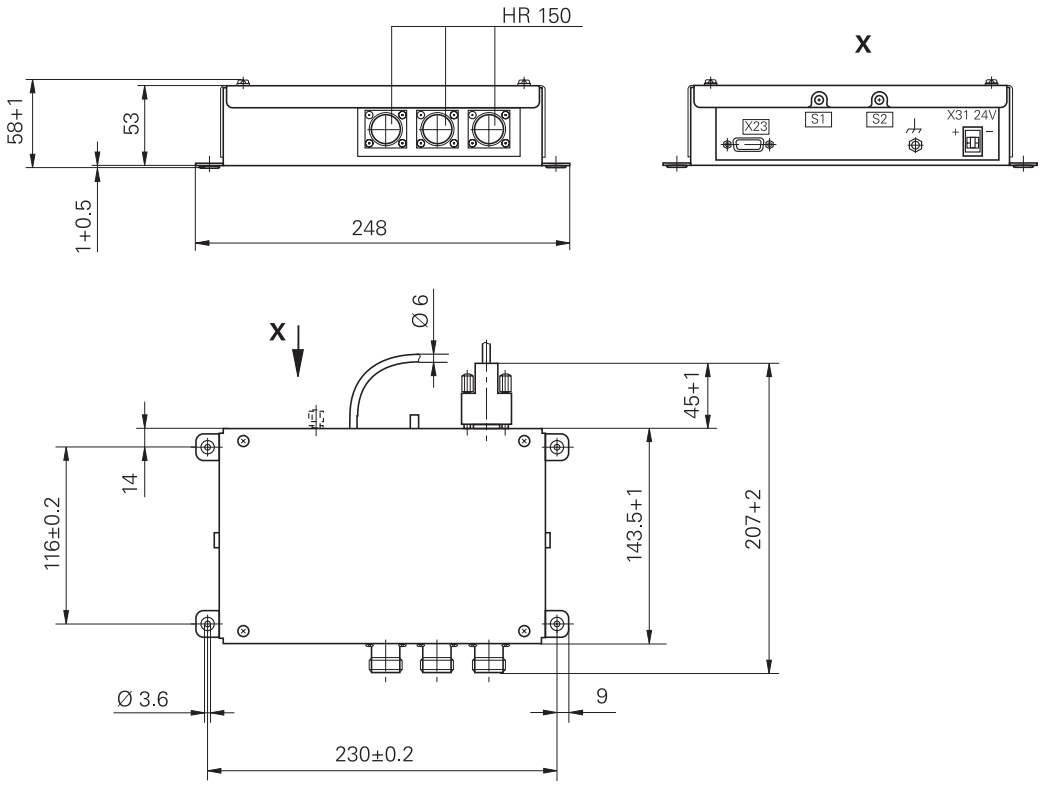




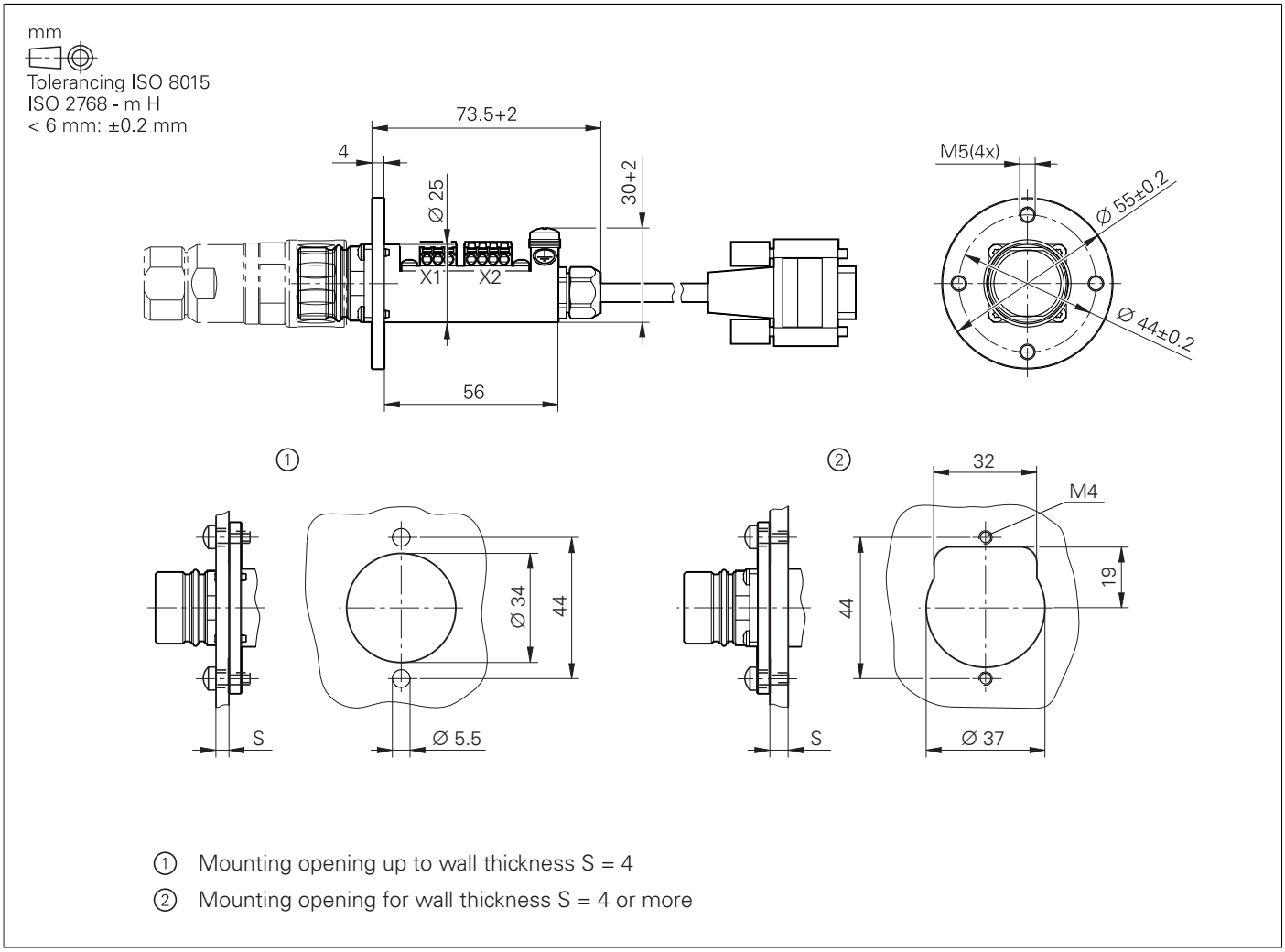
HRA 110

mm

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

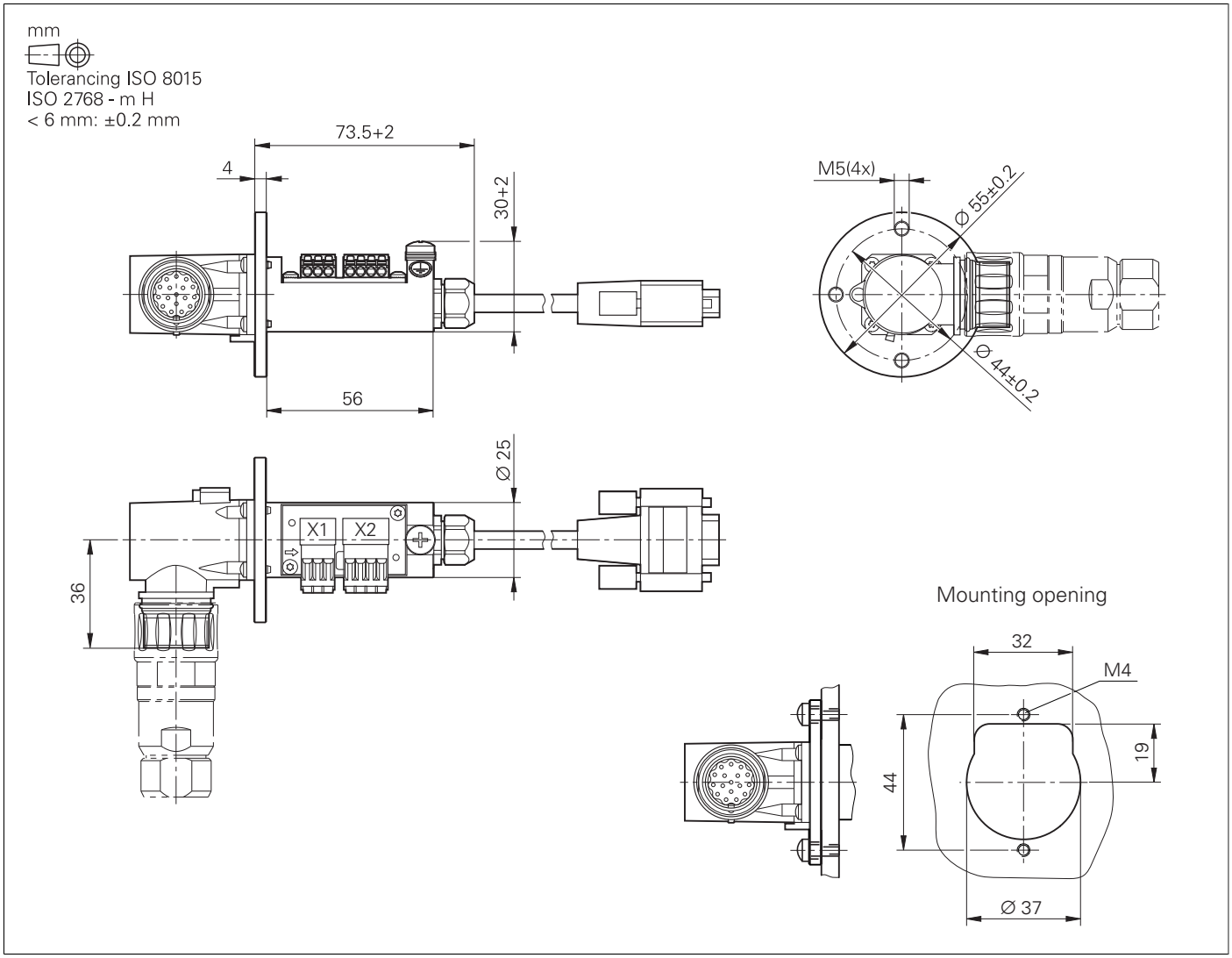


Adapter cable for handwheels (straight)



HR/HRA adapter cable to MC (straight connector)

Adapter cable for handwheels (angled)

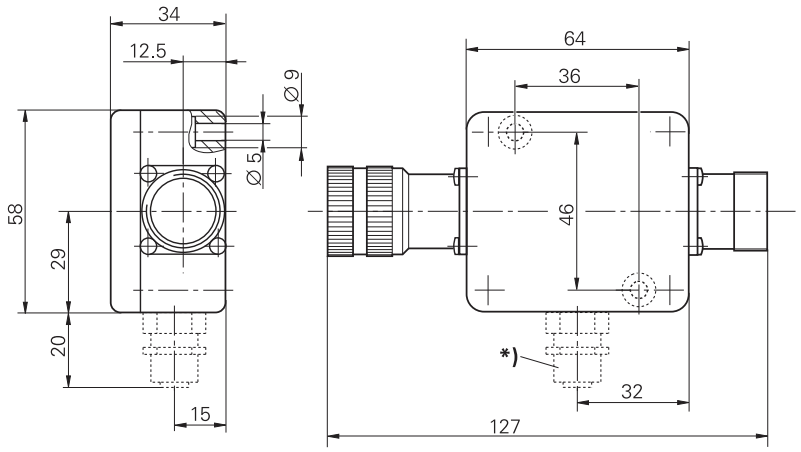


Adapter cable for HR/HRA to MC (angled connector)

Interface accessories

Line-drop compensator for encoders with EnDat interface

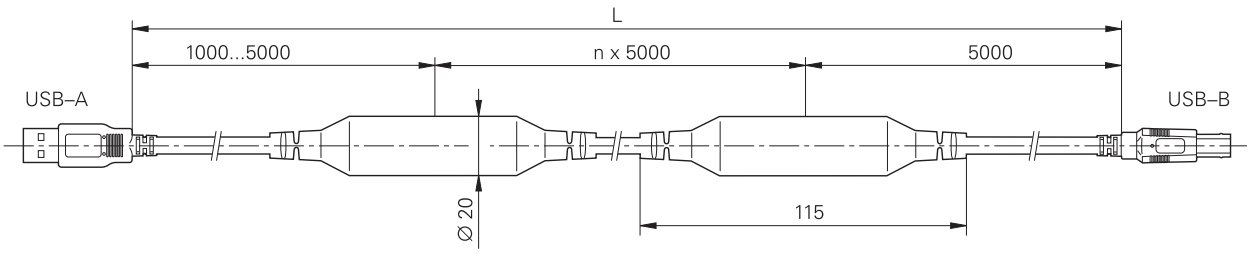
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



*) Connection to KTY

USB extension cable with hubs

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

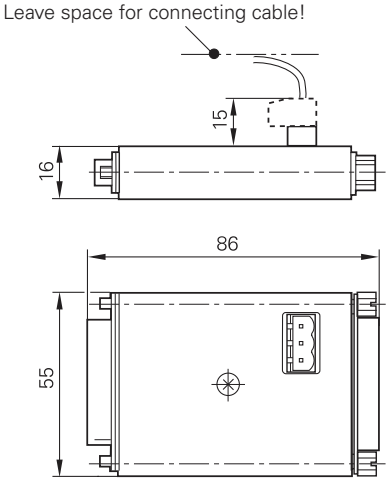


n = 0 ... 4
L = Ordering length

KTY adapter connector

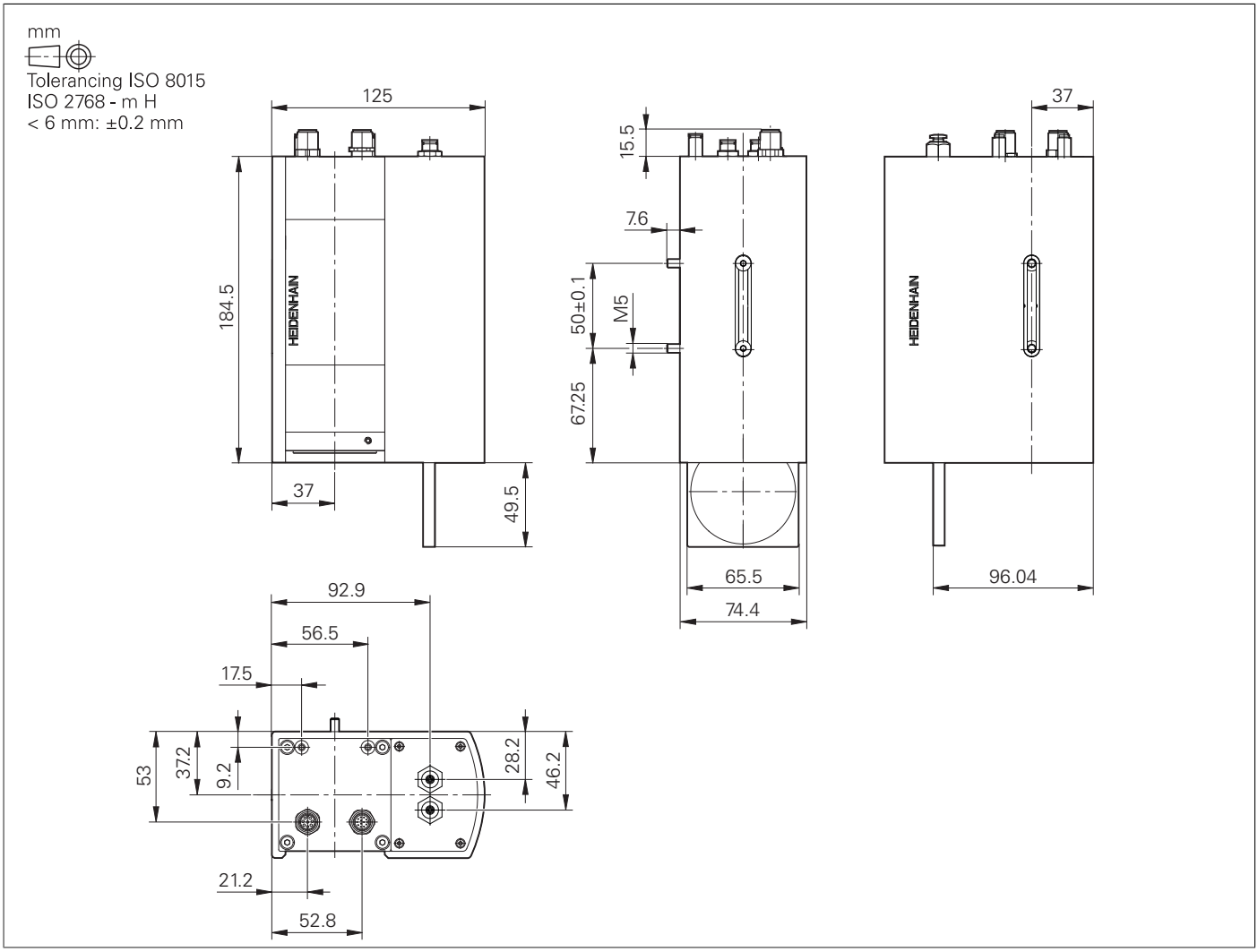
mm

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



Camera system

VS 101



General information
Documentation

Technical documentation	• **TNC 640** Technical Manual	ID 892899-xx; in PDF format on HESIS-Web including Filebase
	• **PNC 610** Technical Manual	ID 1191125-xx; in PDF format on HESIS-Web including Filebase
	• **Inverter Systems and Motors** Technical Manual	ID 208962-xx; in PDF format on HESIS-Web including Filebase
	• **Gen 3 Drives** Technical Manual	ID 1252650-xx; in PDF format on HESIS-Web including Filebase
	• **Functional Safety FS** Technical Manual	ID 749363-xx; in PDF format on HESIS-Web including Filebase
	• **TS 260** Mounting Instructions	ID 808652-9x
	• **TS 460** Mounting Instructions	ID 808653-9x
	• **TS 740** Mounting Instructions	ID 632761-9x
	• **TT 160** Mounting Instructions	ID 808654-xx
	• **TT 460** Mounting Instructions	ID 808655-xx
User documentation	**TNC 640**	
	• **HEIDENHAIN Klartext Programming** User's Manual	ID 892903-xx
	• **Cycle Programming** User's Manual	ID 892905-xx
	• **DIN/ISO Programming** User's Manual	ID 892909-xx
	Miscellaneous	
	• **TNCremo** User's Manual	As integrated help
	• **TNCremoPlus** User's Manual	As integrated help
	• **PLCdesign** User's Manual	As integrated help
	• **CycleDesign** User's Manual	As integrated help
	• **IOconfig** User's Manual	As integrated help
	• **KinematicsDesign** User's Manual	As integrated help
	• **M3D Converter** User's Manual	As integrated help
Other documentation	• **TNC 640** brochure	ID 892916-xx
	• **Functions of the TNC 640** brochure	ID 1110731-xx
	• **Touch Probes** brochure	ID 1113984-xx
	• **Inverter Systems** brochure	ID 622420-xx
	• **Motors** brochure	ID 208893-xx
	• **RemoTools SDK virtualTNC** brochure	ID 628968-xx
	• **Remote Diagnosis with TeleService** Product Overview	ID 348236-xx
	• **Touch Probes** DVD	ID 344353-xx
	• Programming station DVD; **TNC 640 demo version**	ID 1114029-xx
	• **HR 550FS** Product Information document	PDF
	• **Safety-Related Control Technology** Technical Information document	PDF
	• **Safety-Related Position Measuring Systems** Technical Information document	PDF
	• **Uniformly Digital** Technical Information document	PDF
Safety parameters	For HEIDENHAIN products (such as control components, encoders, or motors), the safety characteristics (such as failure rates or statements on fault exclusion) are available on product-specific request from your HEIDENHAIN contact person.	
Basic circuit diagram	More information on basic circuit diagrams can be requested from your HEIDENHAIN contact person.	

Service and training

Technical support

HEIDENHAIN offers the machine manufacturer technical support to optimize the adaptation 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 service engineers are available by phone if you have any questions regarding adaptation or malfunctions:

NC support	+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de
PLC programming	+49 8669 31-3102 E-mail: service.plc@heidenhain.de
NC programming	+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de
Encoders / machine calibration	+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de
APP 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 courses

HEIDENHAIN provides technical customer training in the following subjects:

- NC programming
- PLC programming
- TNC optimization
- TNC servicing
- Encoder servicing
- Special training for specific customers

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.de EN ▶ Company ▶ Contact ▶ HEIDENHAIN worldwide

Subject index

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