



# HEIDENHAIN



## TNC 640 HSCI

Contouring Control for  
Machining Centers and Milling/  
Turning Machines

**Information for the Machine  
Tool Builder**

# TNC contouring control with drive system from HEIDENHAIN

## General information

### TNC 640

- Contouring control for **milling and milling/turning machines**
- Up to 18 axes and closed-loop main spindle
- HEIDENHAIN inverter systems and motors recommended
- Uniformly digital with HSCI interface and EnDat interface
- TFT color flat-panel display, 19-inch or 15-inch
- Storage medium: HDR hard disk with 160 GB or SSDR solid state disk with 32 GB
- Programming in HEIDENHAIN conversational format or according to DIN/ISO
- Comprehensive cycle package for milling and turning operations
- Constant surface speed
- Tool-tip radius compensation
- Touch probe cycles
- FK free contour programming
- Special function for fast 3-D machining
- Short block processing time (0.5 ms)



### System test

Controls, motors and encoders from HEIDENHAIN are in most cases integrated as components in larger systems. In these cases, comprehensive tests of the complete system are required, irrespective of the specifications of the individual devices.

### Expendable parts

In particular the following parts in controls from HEIDENHAIN are subject to wear:

- Hard disk
- Buffer battery
- Fan

### Standards

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

### Note

Microsoft Windows, Windows 2000, Windows XP, Windows Vista, Windows 7 and the Internet Explorer are registered trademarks of Microsoft Corporation.

### Validity

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

**TNC 640 with NC software versions**  
340590-03 (export license required)  
340591-03 (no export license required)

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

### Prerequisites

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

### Functional safety

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 745, TE 745 FS).

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Please refer to the **page references** in the **tables** with the specifications.

# Overview tables

## Components

Control systems		15" design	19" design	Page
Main computer	For operating panel	MC 7522 (screen integrated) or MC 6542	MC 6542	15
	For electrical cabinet	MC 6541, MC 6542 or MC 6641	MC 6541, MC 6542 or MC 6641	
Storage medium	MC 7x22; MC 6x42	SSDR solid state disk		17
	MC 6x41	HDR hard disk		
NC software license		On SIK component		17
Visual display unit		BF 750 (integrated in MC 7x22)	BF 760	26
Operating panel		TE 720 or TE 730 or TE 735	TE 740 or TE 745	26
Machine operating panel		MB 720 (integrated in TE 735)	Integrated in TE 745	26
		PLB 6001 (HSCI adapter for OEM machine operating panel)		32
Controller unit	6 control loops	CC 6106		21
	8 control loops	CC 6108		21
	10 control loops	CC 6110		21
	12 control loops	CC 6106 + CC 6106		21
	14 control loops	CC 6108 + CC 6106		21
	16 control loops	CC 6108 + CC 6108		21
	18 control loops	CC 6106 + CC 6106 + CC 6106 or CC 6110 + CC 6108		21
	20 control loops	CC 6110 + CC 6110		21
Power supply <sup>1)</sup>		PSL 130 / PSL 135		31
PLC inputs/ outputs <sup>1)</sup>	With HSCI interface	PL 6000 consisting of PLB 62xx basic module (system PL) or PLB 61xx (expansion PL) and I/O modules		28
		On UEC		23
		On UMC		25
		Via CMD-H additional modules		
	With PROFIBUS-DP interface	PL 550 consisting of PLB 550 basic module and I/O modules		30
Additional module Depending on the configuration		CMA-H for analog axes/spindles in the HSCI system		33
		CMA-H for PT 100 and analog inputs		
		CMD-H for fast PLC inputs/outputs		
		Module for PROFIBUS-DP		
Inverter systems		Compact inverters and modular inverters		*)
Inverters with integrated controller unit	4 control loops	UEC 111		23
		UMC 111		25
	5 control loops	UEC 112		23
	6 control loops	UEC 113		
Connecting cable				44

\*) For further information, refer to the *Inverter Systems for HEIDENHAIN Controls* brochure

<sup>1)</sup> PL 6000, UEC or UMC necessary, because the MC does not have any PLC inputs/outputs or touch probe connections

# Accessories

Accessories	TNC 640	Page
<b>Electronic handwheels</b>	<ul style="list-style-type: none"> <li>• <b>HR 410</b> portable handwheel or</li> <li>• <b>HR 520</b> portable handwheel with display or</li> <li>• <b>HR 550 FS</b> portable wireless handwheel with display or</li> <li>• <b>HR 130</b> panel-mounted handwheel or</li> <li>• Up to three <b>HR 150</b> panel-mounted handwheels via HRA 110 handwheel adapter</li> </ul>	37
<b>Workpiece touch probes</b>	<ul style="list-style-type: none"> <li>• <b>TS 230</b> touch trigger probe with cable connection or</li> <li>• <b>TS 440</b> touch trigger probe with infrared transmission or</li> <li>• <b>TS 444</b> touch trigger probe with infrared transmission or</li> <li>• <b>TS 640</b> touch trigger probe with infrared transmission or</li> <li>• <b>TS 740</b> touch trigger probe with infrared transmission</li> </ul>	35
<b>Tool touch probes</b>	<ul style="list-style-type: none"> <li>• <b>TT 140</b> touch trigger probe with cable connection or</li> <li>• <b>TT 449</b> touch trigger probe with infrared transmission or</li> <li>• <b>TL Nano</b> laser system for contact-free workpiece measurement or</li> <li>• <b>TL Micro</b> laser system for contact-free workpiece measurement</li> </ul>	36
<b>USB hub</b>	✓	77
<b>Programming station</b>	Control software for PCs for programming, archiving, and training <ul style="list-style-type: none"> <li>• Single-station license with original control keyboard</li> <li>• Single-station license with virtual keyboard</li> <li>• Network license with virtual keyboard</li> <li>• Demo version with virtual keyboard or PC keyboard—free of charge</li> </ul>	*)
<b>Industrial PC</b>	<b>IPC 6641</b> —Industrial PC for Windows	40
<b>Snap-on keys</b>	For the control For the handwheel	42 41

\*) For more information, refer to the *Programming Station TNC* brochure.

Accessories / Software	TNC 640	Page
<b>PLCdesign<sup>1)</sup></b>	PLC development software	73
<b>KinematicsDesign<sup>1)</sup></b>	Software for creating kinematics and initializing DCM	65
<b>TNCremo<sup>2)</sup></b>	Data transfer software	77
<b>TNCremoPlus<sup>2)</sup></b>	Data transfer software with “live” screen	77
<b>ConfigDesign<sup>1)</sup></b>	Software for configuring the machine parameters	70
<b>CycleDesign<sup>1)</sup></b>	Software for creating cycle structures	75
<b>Software Key Generator<sup>1)</sup></b>	Software for enabling SIK options for a limited time	17
<b>TNCscope<sup>1)</sup></b>	Software for data recording	71
<b>DriveDiag<sup>1)</sup></b>	Software for diagnosis of digital control loops	70
<b>TNCopt<sup>1)</sup></b>	Software for putting digital control loops into service	70
<b>IOconfig<sup>1)</sup></b>	Software for configuring PLC I/O and PROFIBUS-DP components	29
<b>TeleService<sup>1)</sup></b>	Software for remote diagnostics, monitoring, and operation	71
<b>RemoTools SDK<sup>1)</sup></b>	Function library for developing customized applications for communication with HEIDENHAIN controls	78

<sup>1)</sup> Available to registered customers for downloading from the Internet

<sup>2)</sup> Available to all customers (without registration) for downloading from the Internet

# Specifications

Specifications	TNC 640	Page
<b>Axes<sup>1)</sup></b>	<b>Max. 18</b>	53
Rotary axes	Max. 3	
Synchronized axes	✓	
PLC axes	✓	
<b>Spindle</b>	<i>Milling:</i> max. 2; second spindle can be controlled alternately with the first <i>Turning:</i> 2 Milling spindle or lathe spindle activated via NC command	58
Spindle speed <sup>2)</sup>	Max. 60 000 min <sup>-1</sup>	58
Operating mode switchover	✓	58
Position-controlled spindle	✓	58
Oriented spindle stop	✓	58
Gear shifting	✓	58
<b>NC program memory</b>	MC 6x41: Approx. 144 GB on HDR hard disk MC 6542, MC 7x22: Approx. 21 GB on SSDR solid state disk	15
<b>Input resolution and display step</b>		53
Linear axes	0.1 µm, 0.01 µm with option 23	
Rotary axes	0.0001°, 0.00001° with option 23	
<b>Functional safety</b>	With FS components, SPLC and SKERN	50
For applications up to	<ul style="list-style-type: none"> <li>SIL 2 according to EN 61 508</li> <li>Category 3, PL d according to EN ISO 13 849-1: 2008</li> </ul>	
<b>Interpolation</b>	<b>MC</b>	
Straight line	In 4 axes; in 5 axes with option 9	*
Circle	In 2 axes; in 3 axes with option 8	*
Helix	✓	*
<b>Axis feedback control</b>		60
With following error	✓	
With feedforward	✓	
Axis clamping	✓	53
Maximum feed rate	$\frac{60000 \text{ min}^{-1}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$ at f <sub>PWM</sub> = 5000 Hz	53

Specifications	TNC 640		Page
<b>Cycle times</b> of main computer	<b>MC</b>		61
Block processing	0.5 ms		62
<b>Cycle times</b> of controller unit	<b>CC/UEC/UMC</b>		61
Path interpolation	3 ms		61
Fine interpolation	<i>Single speed:</i> 0.2 ms <i>Double speed:</i> 0.1 ms (option 49)		
Position controller	<i>Single speed:</i> 0.2 ms <i>Double speed:</i> 0.1 ms (option 49)		
Speed controller	<i>Single speed:</i> 0.2 ms <i>Double speed:</i> 0.1 ms (option 49)		
Current controller	$f_{\text{PWM}}$ 3333 Hz 4000 Hz 5000 Hz 6666 Hz 8000 Hz 10 000 Hz	$T_{\text{INT}}$ 150 $\mu\text{s}$ 125 $\mu\text{s}$ 100 $\mu\text{s}$ 75 $\mu\text{s}$ with option 49 60 $\mu\text{s}$ with option 49 50 $\mu\text{s}$ with option 49	
<b>Permissible temperature range</b>	Operation: In electrical cabinet: 5 °C to 40 °C In operating panel: 0 °C to 50 °C Storage: -20 °C to 60 °C		

- \*) For further information, refer to the *TNC 640* brochure (ID 892916-xx)
- 1) As ordered
- 2) On motors with two pole pairs

# Machine interfacing

Machine interfacing	TNC 640	Page
<b>Error compensation</b>	✓	66
Linear axis error	✓	66
Nonlinear axis error	✓	66
Backlash	✓	66
Reversal spikes with circular movement	✓	66
Hysteresis	✓	66
Thermal expansion	✓	66
Stick-slip	✓	66
Sliding friction	✓	66
<b>Integrated PLC</b>	✓	72
Program format	Statement list	72
Program input at the control	✓	72
Program input by PC	✓	72
Symbolic PLC-NC interface	✓	72
PLC memory	At least 1 GB	72
PLC cycle time	Typically 21 ms, adjustable	72
<b>PLC inputs/outputs<sup>1)</sup></b>	A PLC system can consist of max. seven PLB 61xx and max. two MB 7xx, TE 7x5 or PLB 6001. A total maximum of 1000 inputs/outputs is supported.	28, 23
	CMD-H, CMA-H additional modules	33
PLC inputs, 24 V DC <sup>1)</sup>	Via PL, UEC, UMC, CMD-H additional module	28
PLC outputs, 24 V DC <sup>1)</sup>	Via PL, UEC, UMC, CMD-H additional module	28
Analog inputs $\pm 10$ V	Via PL, CMA-H additional module	28
Inputs for PT 100 thermistors	Via PL, CMA-H additional module	28
Analog outputs $\pm 10$ V	Via PL	28
<b>PLC functions</b>	✓	72
Small PLC window	✓	72
PLC soft keys	✓	72
PLC positioning	✓	73
PLC basic program	✓	74
<b>Integration of applications</b>		73
High-level language programming	Python programming language used in combination with the PLC (option 46)	73
User interfaces can be custom-designed	Inclusion of specific user interfaces from the machine tool builder (option 46)	73

<sup>1)</sup> Further PLC inputs/outputs via PL 550 for connection to MC with PROFIBUS-DP additional module



Machine interfacing	TNC 640	Page
<b>Commissioning and diagnostic aids</b>		70
DriveDiag	Software for diagnosis of digital drive systems	70
TNCopt	Software for putting digital control loops into service	70
ConfigDesign	Software for creating the machine configuration	70
KinematicsDesign	Software for creating the machine kinematics, initialization of DCM	65
Integrated oscilloscope	✓	71
Trace function	✓	71
API DATA function	✓	71
Table function	✓	71
OnLine Monitor (OLM)	✓	70
Log	✓	71
TNCscope	✓	71
Bus diagnostics	✓	71
<b>Data interfaces</b>	✓	
Ethernet (1000BASE-T)	2	76
USB 3.0	✓	76
RS-232-C/V.24	✓	76
<b>Protocols</b>		76
Standard data transfer	✓	76
Blockwise data transfer	✓	76
LSV2	✓	76

<sup>1)</sup> Further PLC inputs/outputs via PL 550 for connection to MC with PROFIBUS-DP additional module

Encoder inputs		CC 6106	CC 6108	CC 6110	UEC 111	UMC 111	UEC 112	UEC 113	59
Position		6	8	10	4	-	5	6	59
	Incremental	1 V <sub>PP</sub>							59
	Absolute	EnDat 2.2							59
Shaft speed		6	8	10	4	4	5	6	59
	Incremental	1 V <sub>PP</sub>							59
	Absolute	EnDat 2.2							59
<b>Nominal-value outputs</b>		CC 6106	CC 6108	CC 6110	UEC 111	UMC 111	UEC 112	UEC 113	59
PWM		6	8	10	-	-	-	-	20
Motor connections		-	-	-	4	4	5	6	20

# User functions

User function	Standard	Option	TNC 640
<b>Brief description</b>	✓	0-7 77 78	Basic version: 3 axes plus spindle A total of 14 additional NC axes or 13 additional NC axes plus second spindle
	✓		Digital current and speed control
<b>Program entry</b>	✓ ✓	42	HEIDENHAIN conversational According to ISO Direct loading of contours or machining positions from DXF files and saving as conversational contouring programs, or as point tables
<b>Position entry</b>	✓ ✓ ✓		Nominal positions for lines and arcs in Cartesian coordinates or polar coordinates Incremental or absolute dimensions Display and entry in mm or inches
<b>Tool compensation</b>	✓ ✓	9	Tool radius in the working plane and tool length Radius-compensated contour look-ahead for up to 99 blocks (M120) Three-dimensional tool-radius compensation for changing tool data without having to recalculate an existing program
<b>Tool tables</b>	✓		Multiple tool tables with any number of tools
<b>Cutting data</b>	✓		Automatic calculation of spindle speed, cutting speed, feed per tooth and feed per revolution
<b>Constant contour speed</b>	✓ ✓		Relative to the path of the tool center Relative to the tool's cutting edge
<b>Parallel operation</b>	✓		Creating a program with graphical support while another program is being run
<b>3-D machining</b>	✓	9 9 9 9 9 9 92	Motion control with smoothed jerk 3-D tool compensation through surface normal vectors Tool center point management (TCPM): Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point Keeping the tool normal to the contour Tool radius compensation normal to the tool direction Manual traverse in the active tool-axis system Compensating form errors of tools with 3D-ToolComp
<b>Rotary table machining</b>		8 8	Programming of cylindrical contours as if in two axes Feed rate in distance per minute
<b>Turning</b>		50 50 50 50 50 50 50 50 50 50	Program-controlled switchover between milling and turning Constant surface speed Tool-tip radius compensation Cycles for roughing, finishing, recessing, thread turning and recess turning Updating of the workpiece blank during contour cycles Turning-specific contour elements for recesses and undercuts Orientation of the turning tool for outside or inside machining Inclined turning Speed limiting
<b>Contour elements</b>	✓ ✓ ✓ ✓ ✓ ✓ ✓	50 50	Straight line Chamfer Circular path Circle center Circle radius Tangentially connecting circular arc Corner rounding Recess Undercut

User function	Standard	Option	TNC 640
<b>Approaching and departing the contour</b>	✓ ✓		Via straight line: tangential or perpendicular Via circular arc
<b>Adaptive feed control</b>		45	AFC: Adaptive feed control adjusts the contouring feed rate to the current spindle power
<b>Collision monitoring</b>		40 40	Dynamic Collision Monitoring (DCM) Graphic depiction of the active collision objects
<b>FK free contour programming</b>	✓		FK free contour programming in HEIDENHAIN conversational format with graphic support for workpiece drawings not dimensioned for NC
<b>Program jumps</b>	✓ ✓ ✓		Subprograms Program-section repeat Calling any program as a subprogram
<b>Fixed cycles</b>	✓ ✓  50 50 50 ✓ 50 ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓		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 inside and outside threads Clearing level and oblique surfaces Multioperation 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
<b>Coordinate transformation</b>	✓	8	Datum shift, rotation, mirror image, scaling factor (axis-specific) Tilting the working plane, PLANE function
<b>Q parameters Programming with variables</b>	✓ ✓ ✓ ✓ ✓ ✓		Mathematical functions =, +, -, *, /, sin α, cos α, tan α, arc sin, arc cos, arc tan, a <sup>n</sup> , e <sup>n</sup> , ln, log, square root of a, square root of (a <sup>2</sup> + b <sup>2</sup> ) Logical operations (=, = /, <, >) Calculating with parentheses Absolute value of a number, constant π, negation, truncation of digits before/after decimal point Functions for calculation of circles Functions for text processing
<b>Programming aids</b>	✓ ✓ ✓ ✓ ✓ ✓		Calculator Complete list of all current error messages Context-sensitive help function for error messages TNCguide: The integrated help system. User information available directly on the TNC 640; context-sensitive Graphic support for programming cycles Comment and structure blocks in the NC program
<b>Teach-In</b>	✓		Actual positions can be transferred directly into the NC program
<b>Test graphics Display modes</b>	✓ ✓ ✓		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 Magnification of details
<b>3-D line graphics</b>	✓		For verification of programs created offline
<b>Programming graphics</b>	✓		In the Programming and Editing mode, the contour of the NC blocks is drawn on screen while they are being entered (2-D pencil-trace graphics), even while another program is running

User function	Standard	Option	TNC 640
<b>Program-run graphics Display modes</b>	✓ ✓		Graphic simulation during real-time machining Plan view / projection in 3 planes / 3-D view
<b>Machining time</b>	✓ ✓		Calculation of machining time in the Test Run operating mode Display of the current machining time in the Program Run operating modes
<b>Returning to the contour</b>	✓ ✓		Mid-program startup in any block in the program, returning the tool to the calculated nominal position to continue machining Program interruption, contour departure and return
<b>Datum management</b>	✓		One table for storing reference points
<b>Datum tables</b>	✓		Several datum tables for storing workpiece-related datums
<b>Pallet tables</b>	✓		Pallet tables (with as many entries as desired for the selection of pallets, NC programs and datums) can be machined workpiece by workpiece
<b>Parallel secondary axes</b>	✓ ✓ ✓		Compensating movement in the secondary axis U, V, W through the principal axis X, Y, Z Including movements of parallel axes 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
<b>Touch probe cycles</b>	✓ ✓ ✓ ✓	48	Touch probe calibration Compensation of workpiece misalignment, manual or automatic Datum setting, manual or automatic Automatic tool and workpiece measurement Automatic measurement and optimization of machine kinematics
<b>Conversational languages</b>	✓	41	English, German, Chinese (traditional, simplified), Czech, Danish, Dutch, Finnish, French, Hungarian, Italian, Polish, Portuguese, Russian (Cyrillic), Spanish, Swedish For more conversational languages, see Options, Page 13

# Options

Option number	Option	As of NC software 34059x-	ID	Comment
0	Additional axis	01	ID 354540-01	Additional control loop 1
1	Additional axis	01	ID 353904-01	Additional control loop 2
2	Additional axis	01	ID 353905-01	Additional control loop 3
3	Additional axis	01	ID 367867-01	Additional control loop 4
4	Additional axis	01	ID 367868-01	Additional control loop 5
5	Additional axis	01	ID 370291-01	Additional control loop 6
6	Additional axis	01	ID 370292-01	Additional control loop 7
7	Additional axis	01	ID 370293-01	Additional control loop 8
8	Software option 1	01	ID 617920-01	<b>Rotary table machining</b> <ul style="list-style-type: none"> <li>• Programming of cylindrical contours as if in two axes</li> <li>• Feed rate in distance per minute</li> </ul> <b>Coordinate transformation</b> <ul style="list-style-type: none"> <li>• Tilting the working plane, PLANE function</li> </ul> <b>Interpolation</b> <ul style="list-style-type: none"> <li>• Circular in 3 axes with tilted working plane</li> </ul>
9	Software option 2	01	ID 617921-01	<b>3-D machining</b> <ul style="list-style-type: none"> <li>• 3-D tool compensation through surface normal vectors</li> <li>• Tool center point management (TCPM): Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point</li> <li>• Keeping the tool normal to the contour</li> <li>• Tool radius compensation normal to the tool direction</li> <li>• Manual traverse in the active tool-axis system</li> </ul> <b>Interpolation</b> <ul style="list-style-type: none"> <li>• Linear in 5 axes (export license required)</li> </ul>
18	HEIDENHAIN DNC	01	ID 526451-01	Communication with external PC applications over COM component
23	Display step	01	ID 632986-01	<b>Display step</b> to 0.01 µm or 0.000 01°
40	DCM collision	02	ID 526452-01	Dynamic Collision Monitoring (DCM)
41	Additional language	01	ID 530184-01 ID 530184-02 ID 530184-04 ID 530184-06 ID 530184-08 ID 530184-09	Additional conversational language: Slovenian Slovak Norwegian Korean Turkish Romanian
42	DXF converter	02	ID 526450-01	Load and convert DXF contours
45	Adaptive feed control (AFC)	02	ID 579648-01	Adaptive feed control
46	Python OEM process	01	ID 579650-01	Python application on the iTNC
48	KinematicsOpt	01	ID 630916-01	Touch probe cycles for automatic measurement of rotary axes
49	Double-speed axis	01	ID 632223-01	Short control-loop cycle times for direct drives

Option number	Option	As of NC software 34059x-	ID	Comment
<b>50</b>	Turning	01	ID 634608-01	Turning functions <ul style="list-style-type: none"> <li>• Tool management for turning</li> <li>• Tool-tip radius compensation</li> <li>• Switching between milling and turning modes of operation</li> <li>• Lathe-specific contour elements</li> <li>• Package of turning cycles</li> </ul>
<b>77</b>	4 additional axes	01	ID 634613-01	4 additional control loops
<b>78</b>	8 additional axes	01	ID 634614-01	8 additional control loops
<b>93</b>	Extended tool management	01	ID 676938-01	Extended tool management
<b>101 - 130</b>	OEM option	02	ID 579651-01 to ID 579651-30	Options of the machine tool builder
<b>133</b>	Remote desk. manager	01	ID 894423-01	Display and remote operation of external computer units (e.g. a Windows PC)
<b>141</b>	Cross talk comp.	02	ID 800542-01	CTC: Compensation of axis couplings
<b>142</b>	Pos. adapt. control	02	ID 800544-01	PAC: Position-dependent adaptation of control parameters
<b>143</b>	Load adapt. control	02	ID 800545-01	LAC: Load-dependent adaptation of control parameters
<b>144</b>	Motion adaptive control	02	ID 800546-01	MAC: Motion-dependent adaptation of control parameters
<b>145</b>	Active chatter control	02	ID 800547-01	ACC: Active suppression of chatter
<b>146</b>	Active vibration damping	03	ID 800548-01	AVD: Active vibration damping

# HSCI control components

## Main computer

Main computer	<p>The <b>MC</b> main computers feature:</p> <ul style="list-style-type: none"><li>• Processor</li><li>• RAM memory</li><li>• HSCI interface to the CC 6xxx or UEC/UMC and to other control components</li><li>• HDL interface to the BF 7xx visual display unit (BF integrated in MC 7x22)</li><li>• USB 3.0 interface to the TE 7xx operating panel</li></ul> <p>To be ordered separately, and installed in the main computer by the OEM:</p> <ul style="list-style-type: none"><li>• <b>HDR</b> or <b>SSDR</b> storage medium with the NC software</li><li>• <b>SIK component</b> (System Identification Key) for enabling the control loops and software options</li></ul> <p>The following HSCI components are necessary for operation of the TNC 640:</p> <ul style="list-style-type: none"><li>• MC main computer</li><li>• Controller unit</li><li>• <b>PLB 62xx</b> PLC input/output unit (system PL; integrated in UEC/UMC)</li><li>• <b>MB 720</b> machine operating panel (integrated in TE 7x5) or <b>PLB 6001</b> HSCI adapter for connection of an OEM machine operating panel</li></ul>
Interfaces	<p>The standard MC main computers feature USB 3.0, RS-232-C/V.24 and Ethernet interfaces for use by the end user. Connection to PROFIBUS-DP is possible via an additional module.</p>
Power supply	<p>24 V DC of power are supplied to the main computer and other HSCI components by the PSL 13x supply unit. For the entire HSCI system, the 24 V DC NC supply voltage for the control components is required to be safely separated voltage (PELV). It must not be connected to the 24 V DC supply voltage for PLC components (e.g. holding brakes).</p>
Export version	<p>Because the entire NC software is saved on the memory card (HDR or SSDR), no export version is required for the main computer itself. Export versions are available only for the easily replaceable storage medium and the SIK component.</p>

Various versions of the MC main computer are available:

- For installation in the **operating panel**  
 The MC 7x22 and the BF visual display unit (15") form one unit, and are installed directly in the operating panel.  
 Advantage: except for the power supply line, only one HSCI connecting cable to the electrical cabinet is necessary.
- For installation in the **electrical cabinet**  
 The MC 6x41 is installed in the electrical cabinet. HSCI, USB and HDL cables to the operating panel are required as control lines.
- For installation in the **operating panel or electrical cabinet**  
 Because the SSDR solid state disk is used as a storage medium, the MC 6542 can be universally integrated. HSCI, USB and HDL cables to the operating panel are required as control lines.

The main computers listed are supported as of NC software 34059x-03. These MC main computers cannot be run on earlier software versions.



MC 6x41



MC 6542



MC 7x22 with main computer installed on the back

	To be installed in	Storage medium	Processor	RAM memory	Power loss	Weight	
MC 7522	Operating panel	SSDR	Intel Core i7-31.7 GHz 2 cores	2 GB	60 W	7.5 kg	ID 1071597-01
MC 6542	Operating panel or electrical cabinet	SSDR	Intel Core i7-31.7 GHz 2 cores	2 GB	48 W	4.0 kg	ID 1081188-01
MC 6541	Electrical cabinet	HDR	Intel Core i7-31.7 GHz 2 cores	2 GB	48 W	4.0 kg	ID 1081185-01
MC 6641	Electrical cabinet	HDR	Intel Core i7-32.1 GHz 4 cores	2 GB	75 W	4.0 kg	ID 811550-01



**Options**                   The capabilities of the TNC 640 can also be adapted retroactively 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 indicate 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. Depending on the main computer, the HDR hard disk or the SSDR solid state disk is used as a storage medium. The NC software is based on the HEIDENHAIN HEROS 5 operating system.

<b>HDR hard disk</b>	
Free capacity	144 GB
For main computer	MC 6541, MC 6641
Export license required	ID 617779-01
No export license required	ID 617779-51

<b>SSDR solid state disk</b>	
Free capacity	21 GB
For main computer	MC 6542, MC 7522
Export license required	ID 810288-01
No export license required	ID 810288-01



HDR hard disk



SSDR solid state disk

**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 in a special slot in the MC main computer.

The SIK component with the NC software license is available in various versions, depending on the enabled control loops and options. Further control loops – up to the maximum number available (see Controller Unit) – can be enabled later by entering a keyword. HEIDENHAIN provides the keyword, which is based on the SIK number.

When ordering, please indicate 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 service become necessary, the SIK component must be inserted in the replacement control to enable all required options.

**Master keyword (general key)**       There is a master keyword (general key) for putting the TNC 640 into service that will unlock all options for a duration of 90 days. After this period, only those options with the correct keywords will be active. The general key is activated via a soft key.



SIK component

Software Key Generator (accessory)

The PC software makes it possible to generate an activation code for software options on HEIDENHAIN controls. The selected option is enabled for a limited time (10 to 90 days). It can only be enabled once. You generate the desired activation code by entering the SIK number, the option to be enabled, the duration and a manufacturer-specific password. Option enabling is independent of the general key.



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

Active control loops	Recommended combinations						NC software license			
	CC 6106	CC 6108	CC 6110	2 x CC 6106	CC 6106 + CC 6108	2 x CC 6108	Without software option	Incl. option 1	Incl. options 1 + 2	Incl. options 1, 2 + 50
							SIK	SIK	SIK	SIK
4	✓						ID 674989-20 <i>ID 674989-70</i>	ID 674989-09 <i>ID 674989-59</i>	ID 674989-01 <i>ID 674989-51</i>	ID 674989-28 <i>ID 674989-78</i>
5	✓						ID 674989-24 <i>ID 674989-74</i>	ID 674989-17 <i>ID 674989-67</i>	ID 674989-02 <i>ID 674989-52</i>	ID 674989-29 <i>ID 674989-79</i>
6	✓						ID 674989-25 <i>ID 674989-75</i>	ID 674989-18 <i>ID 674989-68</i>	ID 674989-03 <i>ID 674989-53</i>	ID 674989-30 <i>ID 674989-80</i>
7		✓					ID 674989-26 <i>ID 674989-76</i>	ID 674989-19 <i>ID 674989-69</i>	ID 674989-04 <i>ID 674989-54</i>	ID 674989-31 <i>ID 674989-81</i>
8		✓					ID 674989-27 <i>ID 674989-77</i>	ID 674989-23 <i>ID 674989-73</i>	ID 674989-05 <i>ID 674989-55</i>	ID 674989-32 <i>ID 674989-82</i>
9			✓				Only through subsequent enabling of control loops (additional axes)		ID 674989-06 <i>ID 674989-56</i>	ID 674989-33 <i>ID 674989-83</i>
10			✓						ID 674989-07 <i>ID 674989-57</i>	ID 674989-34 <i>ID 674989-84</i>
11				✓					ID 674989-10 <i>ID 674989-60</i>	ID 674989-35 <i>ID 674989-85</i>
12				✓					ID 674989-11 <i>ID 674989-61</i>	ID 674989-36 <i>ID 674989-86</i>
13					✓				ID 674989-12 <i>ID 674989-62</i>	ID 674989-37 <i>ID 674989-87</i>
14					✓				ID 674989-13 <i>ID 674989-63</i>	ID 674989-38 <i>ID 674989-88</i>
15						✓			ID 674989-14 <i>ID 674989-64</i>	ID 674989-39 <i>ID 674989-89</i>
16						✓			ID 674989-15 <i>ID 674989-65</i>	ID 674989-40 <i>ID 674989-90</i>
17 - 20							Only through subsequent enabling of control loops (additional axes)			

(Italics: Export version)

### 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. Up to **20 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

# Controller unit

Controller unit

Due to the very short cycle times of the position, speed and current controllers, the controller units from HEIDENHAIN are equally suited for conventional drives, for direct drives (linear motors, torque motors) and for HSC spindles. They permit a high loop gain and short reaction times to changing machining forces, and so make the high contour accuracy and surface quality of the workpiece possible.

Single speed  
Double speed

**Single-speed control loops** are usually sufficient for linear or torque motors and for conventional axes. **Double-speed control loops** (option 49) are preferred for HSC spindles and axes that are difficult to control. In the default setting, all axes are set to single speed. Each axis that is switched from single speed to double speed can reduce the number of available control loops by one. PWM frequencies greater than 5 kHz require double-speed control loops, for which option 49 must be enabled.

Cycle times

With $f_{PWM}$	Current controller	Speed controller		Position controller
		Single-speed	Double-speed	
3333 Hz	150 $\mu s$	300 $\mu s$	150 $\mu s$	Same as <b>speed controller</b>
4000 Hz	125 $\mu s$	250 $\mu s$	125 $\mu s$	
5000 Hz	100 $\mu s$	200 $\mu s$	100 $\mu s$	
6666 Hz <sup>1)</sup>	75 $\mu s$	150 $\mu s$	150 $\mu s$	
8000 Hz <sup>1)</sup>	60 $\mu s$	125 $\mu s$	125 $\mu s$	
10000 Hz <sup>1)</sup>	50 $\mu s$	100 $\mu s$	100 $\mu s$	

<sup>1)</sup> Possible only with option 49

Number of control loops

The number of enabled control loops depends on the SIK (see *Main computer*), or on additionally enabled control loops, which can also be ordered as needed later.

Versions

- Modular CC 61xx controller units with PWM interface to the inverters
- Compact UEC/UMC inverters with integrated controller unit

Controller units, main computers and inverters operate in any desired combination.

**CC 61xx**

- The **CC 61xx** controller units feature:
- Position controller, speed controller, current controller
  - HSCI interfaces
  - PWM interfaces to the UM, UR, UE power modules
  - Interfaces to the speed and position encoders
  - Interfaces for power supply (via inverter or PSL 135)
  - SPI interfaces for expansion modules (e.g. CMA-H)



CC 6110

	CC 6106	CC 6108	CC 6110
Digital control loops	Max. 6 (single speed)	Max. 8 (single speed)	Max. 10 (single speed)
Speed inputs	6 x 1 V <sub>pp</sub> or EnDat 2.2	8 x 1 V <sub>pp</sub> or EnDat 2.2	10 x 1 V <sub>pp</sub> or EnDat 2.2
Position inputs	6 x 1 V <sub>pp</sub> or EnDat 2.2	8 x 1 V <sub>pp</sub> or EnDat 2.2	10 x 1 V <sub>pp</sub> or EnDat 2.2
PWM outputs	6	8	10
Weight	4.1 kg	4.7 kg	4.8 kg
	ID 662636-xx	ID 662637-xx	ID 662638-xx

For more than 10 control loops, an HSCI line is used to combine the controller units. For example:

- CC 6106 + CC 6106** for up to 12 control loops
- CC 6106 + CC 6108** for up to 14 control loops
- CC 6110 + CC 6108** for up to 18 control loops

- Constraints:
- Max. 20 control loops for max. 18 axes + 2 spindles can be activated (second spindle can be controlled alternately with the first spindle).
  - Up to four drive-control motherboards are permissible in the HSCI system (CC 6106 has one motherboard, CC 6108/CC 6110 each has two motherboards).

**Ribbon cable for supply voltage**

Additional ribbon cables are necessary if multiple CC 6xxx units are combined.

Combination	Length	Dimension c	
2 x CC 6108, or 2 x CC 6110, or CC 6108 and CC 6110	300 mm <sup>1)</sup>	26.5 mm	ID 325816-22
2 x CC 6106	100 mm	31.5 mm	ID 325816-24

<sup>1)</sup> In order to reduce the voltage drop, the long ribbon cable is led doubled.

The short ribbon cables included in delivery are not necessary for combinations with CC 6108 and/or CC 6110. They are only necessary for connecting sockets X69 A and X69 B if the CC units are used separately.

For more information about connecting a CC 6xxx to a supply unit via ribbon cables, see the *Inverter Systems* brochure.



## UEC 11x

The UEC 11x compact inverters not only include the inverter, but also a controller with PLC inputs and outputs and an integrated braking resistor. They offer a complete solution for machines with a limited number of axes and low power demands.

### Controller

- Position controller, speed controller, current controller
- HSCI interface
- Interfaces to the speed and position encoders

### Inverter

- Power electronics
- Connections for axis motors and spindle motor
- Braking resistor
- Connections for motor holding brakes

### System PL

- Interfaces for one workpiece touch probe and one tool touch probe
- Integrated PLC (expandable with PL 61xx)
  - UEC 11x*: 38 free inputs, 23 free outputs (7 of which can be switched off)
  - UEC 11x FS*: 38 free inputs, 28 free outputs (7 of which can be switched off), 8 free FS inputs, 8 free FS outputs
- Configuration with IOconfig PC software

### DC-link connections

The UEC 111 and UEC 112 do not have any DC-link connection. On the UEC 111 FS, UEC 112 FS and UEC 113 (FS) an additional DC-link connection is located on the front panel for connection of a PSL 130.



UEC 111



UEC 113

		UEC 111/UEC 112/UEC 113		
<b>Controller</b>		4/5/6 digital control loops		
<b>Speed inputs</b>		4/5/6 x 1 V <sub>PP</sub> or EnDat 2.2		
<b>Position inputs</b>		4/5/6 x 1 V <sub>PP</sub> or EnDat 2.2		
<b>Inverter</b>		<i>2/3/4 axes</i>	<i>1 axis</i>	<i>Spindle</i>
<b>Rated current I<sub>N</sub>/maximum current I<sub>max</sub><sup>1)</sup> at a PWM frequency of</b>	<b>3333 Hz</b>	<b>6.0/12.0 A</b>	<b>9.0/18.0 A</b>	<b>24.0/36.0 A</b>
	4000 Hz	5.5/11.0 A	8.3/16.5 A	22.0/33.0 A
	5000 Hz	5.0/10.0 A	7.5/15.0 A	20.0/30.0 A
	6666 Hz	4.2/8.4 A	6.3/12.6 A	16.8/25.2 A
	8000 Hz	3.6/7.3 A	5.5/11.0 A	14.6/21.9 A
	10000 Hz	3.0/6.0 A	4.6/9.2 A	12.2/18.3 A
<b>Supply voltage<sup>2)</sup></b>		3 x 400 V AC (± 10 %); 50 Hz		
<b>Rated power of DC link</b>		<b>14 kW</b>		
<b>Peak power<sup>3)</sup> of DC link</b>		18 kW / 25 kW		
<b>Power loss at I<sub>N</sub></b>		~ 450 W		
<b>DC-link voltage</b>		565 V DC		
<b>Integral braking resistance<sup>4)</sup></b>		2.1 kW / 27 kW		
<b>Power pack for HSCI components</b>		24 V DC / 3.5 A		
<b>Module width</b>		150 mm		
<b>Weight</b>		~ 20 kg		
<b>Functional safety</b>		-	✓	
<b>UEC 111</b>		ID 625777-xx	ID 1075825-xx	
<b>UEC 112</b>		ID 625779-xx	ID 1075826-xx	
<b>UEC 113</b>		ID 828471-xx	ID 1038694-xx	

1) Axes: 0.2 s cyclic duration factor for duty cycle time of 10 s with 70 % rated current preload  
Spindle: 10 s cyclic duration factor for duty cycle time of 60 s with 70 % rated current preload

2) For UL certification: 3 x 480 V AC (+6%/-10%); 60 Hz

3) 1st value: 40 % cyclic duration factor for 10 minutes duty cycle time (S6-40 %)  
2nd value: 4 s cyclic duration factor for 20 seconds duty cycle time.

4) 1st value: Continuous duty  
2nd value: Peak power (1.5 % cyclic duration factor for 120 seconds duty cycle time).



## UMC 11x

The UMC 111 is a compact inverter with integrated controller unit and PLC inputs/outputs. As opposed to the UEC, it is used exclusively for controlling axis motors and is powered by an external DC link. The UMC automatically enables the control loops needed for auxiliary axes. No additional options are required.

Please note: The UMC does not increase the number of possible axes. Interpolation with NC axes is not possible.

### Controller

- Position controller, speed controller, current controller
- HSCI interface
- Interfaces to the speed encoders

### Inverter

- Power electronics
- Connections for axis motors
- Connections for motor holding brakes

### System PL

- Interfaces for one workpiece touch probe and one tool touch probe with signal transmission by cable
- Integrated PLC, expandable with PL 61xx  
*UMC 111*: 38 free inputs, 23 free outputs (7 of which can be switched off)  
*UMC 111 FS*: 38 free inputs, 28 free outputs (7 of which can be switched off)  
 8 FS inputs, 8 FS outputs
- Configuration with IOconfig PC software



UMC 111

		UMC 111
<b>Controller</b>		4 digital control loops
<b>Speed inputs</b>		4 x 1 V <sub>PP</sub> or EnDat 2.2
<b>Inverter</b>		4 axes
<b>Rated current I<sub>N</sub>/maximum current I<sub>max</sub><sup>1)</sup> at a PWM frequency of</b>	<b>3333 Hz</b>	<b>9.0/18.0 A</b>
	4000 Hz	8.3/16.5 A
	5000 Hz	7.5/15.0 A
	6666 Hz	6.3/12.6 A
	8000 Hz	5.5/11.0 A
	10000 Hz	4.6/9.2 A
<b>Power loss at I<sub>N</sub></b>		Approx. 300 W
<b>DC-link voltage</b>		565 V DC
<b>24 V PLC current consumption</b>		24 V DC / 2 A
<b>Module width</b>		150 mm
<b>Weight</b>		Approx. 11 kg
<b>UMC 111</b>		ID 736435-xx
<b>UMC 111 FS</b>		ID 664231-xx

<sup>1)</sup> Axes: 0.2 s cyclic duration factor for duty cycle time of 10 s with 70 % rated current preload  
 Spindle: 10 s cyclic duration factor for duty cycle time of 60 s with 70 % rated current preload

# 15" screen and keyboard

## BF 750 color flat-panel display

- Power supply: 24 V DC / approx. 50 W
- **15.1-inch**; 1024 x 768 pixels
- HDL interface to the MC 6xxx
- 8 horizontal soft keys, 6 vertical soft keys for PLC
- Soft-key row switchover
- Screen layout
- Operating mode switchover
- USB port with cover cap on front
- Integrated USB hub with four USB interfaces on the rear

**BF 750** ID 785080-01  
Weight Approx. 4 kg



BF 750

## TE 730 keyboard

- For BF 750 or MC 7522
- Axis keys
- The keys for axes IV and V are exchangeable snap-on keys.
- Contouring keys
- Operating mode keys
- ASCII keyboard
- Spindle-speed and feed-rate override potentiometers
- USB interface to the MC
- Touchpad

**TE 730** ID 805489-01  
Weight Approx. 4.2 kg



TE 730

## TE 720 keyboard

Same features as TE 730 but without touchpad

**TE 720** ID 805488-01

## TE 735 keyboard unit with integrated machine operating panel

- For BF 750 or MC 7522
- NC keyboard same as TE 730
- USB interface to the MC main computer
- Machine operating panel (same as MB 720)
- HSCI interface

**TE 735** ID 771898-01  
**TE 735 FS** ID 805493-01  
Weight Approx. 3.4 kg



TE 735

## MB 720 machine operating panel

- Power supply 24 V DC / approx. 4 W
- 36 exchangeable snap-on keys with status LEDs, freely definable via PLC
- Operating elements: 12 axis keys, 24 function keys, NC start<sup>1)</sup>, NC stop<sup>1)</sup>, spindle start, spindle stop (all snap-on keys), emergency stop button, control voltage on<sup>1)</sup>; 2 holes for additional keys or keylock switches
- HSCI interface
- MB 720: 7 free PLC inputs and 5 free PLC outputs  
MB 720 FS: 4 free FS inputs and 5 free PLC outputs; and dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

<sup>1)</sup> Keys illuminated, addressable via PLC

**MB 720** ID 784803-01  
**MB 720 FS** ID 805474-01  
Weight Approx. 1 kg



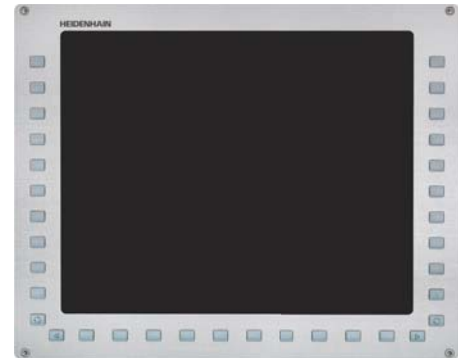
MB 720

# 19" screen and keyboard

## BF 760 color flat-panel display

- Power supply: 24 V DC/approx. 65 W
- **19-inch**; 1280 x 1024 pixels
- HDL interface to the MC 6xxx
- 10 horizontal NC soft keys, 8 + 10 vertical soft keys for PLC
- Soft-key row switchover
- Screen layout
- Operating mode switchover
- Integrated USB hub with six USB interfaces on the rear

**BF 760** ID 732589-01  
Weight Approx. 7.8 kg



BF 760

## TE 740 keyboard

- Suitable for BF 760 (19" design)
- Axis keys
- The keys for axes IV and V are exchangeable snap-on keys.
- Contouring keys
- Operating mode keys
- ASCII keyboard
- Spindle-speed, feed-rate and rapid-traverse override potentiometers
- USB interface to the MC main computer
- Touchpad
- USB port with cover cap on front

A PLB 6001 is required for connection of an OEM-specific machine operating panel.

**TE 740** ID 886546-01  
Weight Approx. 3.2 kg



TE 740

## TE 745 keyboard unit with integrated machine operating panel

Same as TE 740, but with integrated machine operating panel

- Power supply 24 V DC / approx. 4 W
- 36 exchangeable snap-on keys with status LEDs, freely definable via PLC
- Operating elements: 12 axis keys, 24 function keys, NC start<sup>1)</sup>, NC stop<sup>1)</sup>, spindle start, spindle stop, emergency stop button, control voltage on<sup>1)</sup>; 3 holes for additional keys or keylock switches
- Connection for HR handwheel
- HSCI interface
- TE 745: 7 free PLC inputs and 5 free PLC outputs  
TE 745 FS: 4 free FS inputs and 5 free PLC outputs; and dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

<sup>1)</sup> Keys illuminated, addressable via PLC

**TE 745** ID 679817-01  
**TE 745 FS** ID 805482-01  
Weight Approx. 4.3 kg



TE 745

# 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 **HSCI interface** available for 4, 6 or 8 I/O modules. They are mounted on standard NS 35 rails (DIN 46 227 or EN 50 022).

Supply voltage	24 V DC
Power consumption <sup>1)</sup>	Approx. 48 W at 24 V DC NC Approx. 21 W at 24 V DC PLC
Weight	0.36 kg (bare)

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

## System PL

- Necessary once for each control system (except with UEC)
- Includes connections for TS and TT touch probes, as well as TL
- Safety-relevant inputs/outputs
- *Without FS*: 12 free inputs, 7 free outputs  
*With FS*: 6 free FS inputs, 2 free FS outputs

<b>PLB 6204</b>	for 4 I/O modules	ID 591832-03
<b>PLB 6204 FS</b>	for 4 I/O modules	ID 586789-03
<b>PLB 6206</b>	for 6 I/O modules	ID 630054-03
<b>PLB 6206 FS</b>	for 6 I/O modules	ID 622721-03
<b>PLB 6208</b>	for 8 I/O modules	ID 630055-03
<b>PLB 6208 FS</b>	for 8 I/O modules	ID 620927-03

## Expansion PL

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

<b>PLB 6104</b>	for 4 I/O modules	ID 591828-03
<b>PLB 6104 FS</b>	for 4 I/O modules	ID 590479-03
<b>PLB 6106</b>	for 6 I/O modules	ID 630058-03
<b>PLB 6106 FS</b>	for 6 I/O modules	ID 804755-01
<b>PLB 6108</b>	for 8 I/O modules	ID 630059-03
<b>PLB 6108 FS</b>	for 8 I/O modules	ID 804756-01

Up to seven PLB 6xxx can be connected to the control. The maximum cable length results from the maximum permissible length of the HSCI chain of 70 m.

**I/O modules for HSCI**

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.

<b>PLD-H 16-08-00</b>	I/O module with 16 digital inputs and 8 digital outputs	ID 594243-02
<b>PLD-H 08-16-00</b>	I/O module with 8 digital inputs and 16 digital outputs	ID 650891-02
<b>PLD-H 08-04-00 FS</b>	I/O module with 8 digital FS inputs and 4 digital FS outputs	ID 598905-02
<b>PLD-H 04-08-00 FS</b>	I/O module with 4 digital FS inputs and 8 digital FS outputs	ID 727219-02

Total current	Outputs 1 to 7: $\leq 2$ A per output ( $\leq 8$ A simultaneously)
Power output	Max. 200 W
Weight	0.2 kg

<b>PLA-H 08-04-04</b>	Analog module for PL 6xxx with <ul style="list-style-type: none"><li>• 8 analog inputs, <math>\pm 10</math> V</li><li>• 4 analog outputs, <math>\pm 10</math> V</li><li>• 4 analog inputs for PT 100 thermistors</li></ul>	ID 675572-01
Weight	0.2 kg	

**Empty housing**

For unused slots ID 383022-11

**IOconfig (accessory)**

PC software for configuring HSCI and PROFIBUS components

# PL 550 PLC input/output system for PROFIBUS-DP

## PL 550

PLC inputs and outputs are also available via the external modular PL 550 PLC input/output system. It consists of a basic module and one or more I/O modules, and is connected to the MC main computer via the PROFIBUS-DP interface. The PLC I/O modules are configured with the PC software IOconfig. The additional module for PROFIBUS-DP (Page 34) must be installed in the MC before the PLB 550 is connected to the control.



PL 550

## Basic module

Basic module with PROFIBUS-DP interface  
The PLB 550 has slots for four I/O modules. It serves as a PROFIBUS slave. A total of 32 slaves can be connected to the MC with integrated PROFIBUS interface board (PROFIBUS single master). They are mounted on standard NS 35 rails (DIN 46 227 or EN 50 022).

<b>PLB 550</b>	ID 507872-01
Supply voltage	24 V DC
Power consumption	Approx. 20 W
Weight	0.36 kg (bare)

## I/O modules

The I/O modules consist of one module with digital inputs/outputs and one analog module. For partially occupied basic modules, the unused slots must be occupied by an empty housing.

<b>PLD 16-8</b>	ID 360916-11
I/O module for PL 5x0 with 16 digital inputs and 8 digital outputs.	
The maximum power output per module is 200 W. A load of up to 2 A can be placed on each output. No more than four outputs may be loaded with 2 A at any given time.	
Weight	0.2 kg

<b>PLA 4-4</b>	ID 366423-01
Analog module for PL 5x0 with 4 analog inputs for PT 100 thermistors	
4 analog inputs for $\pm 10$ V	
Weight	0.2 kg

## Empty housing

For unused slots	ID 383022-11
------------------	--------------

## IOconfig (accessory)

PC software for configuring HSCI and PROFIBUS components

# Accessories

## Power supply for HSCI components

### PSL 13x

To power the HSCI components, HEIDENHAIN offers the PSL 13x power supply unit. Either line voltage and DC-link voltage or only line voltage is provided to the PSL 13x. The PSL 13x provides the safely separated 24 V DC NC power supply required for the HSCI components by EN 61 800-5-1. The NC supply voltage and the PLC supply voltage are separated from each other by basic insulation.

Supply voltage	Line voltage 400 V AC $\pm$ 10% 50 Hz and DC-link voltage 400 V DC to 750 V DC Power consumption max. 1000 W
Outputs	NC: 24 V DC $\leq$ 20 A (double insulation from line power) 5 V DC $\leq$ 16 A (only for PSL 135) electrically connected with 24 V DC NC PLC: 24 V DC $\leq$ 20 A (basic insulation from line power) Total: Max. 32 A / 750 W



PSL 130

The **PSL 130** serves as a 24 V DC power supply unit for supplying the HSCI components. If a UEC controller unit is used, then the PSL 130 is not necessary if the total current consumption of the connected HSCI components does not exceed 3.5 A.

HSCI components		Current consumption 24 V DC NC
Main computer	MC 6541, MC 6542 MC 6641 MC 7522	2.0 A 3.2 A 2.5 A
Machine operating panel	PLB 6001 MB 7x0	0.2 A (without handwheel) 0.2 A (without handwheel)
Keyboard unit	TE 7x5 (MB integrated)	0.2 A (without handwheel)
PLC inputs/outputs	PLB 62xx PLB 61xx PLD PLA	0.3 A (without touch probe) 0.2 A 0.05 A 0.1 A
Visual display unit	BF 760	2.5 A
Handwheels	HR 520 HRA 551 FS + HR 550 FS HR 410 HR 130 HRA 110 + 3 x HR 150	0.05 A 0.5 A (during charging) 0.05 A 0.05 A 0.2 A
Touch probes	See specifications of the touch probes	

The **PSL 135** has an additional 5 V DC output and is therefore suited for supplying the CC controller unit and the MC main computer. It may be necessary for a double-row configuration.

	Module width	Degree of protection	Weight	
<b>PSL 130</b>	50 mm	IP 20	2.1 kg	ID 575047-04
<b>PSL 135</b>	50 mm	IP 20	2.5 kg	ID 627032-03

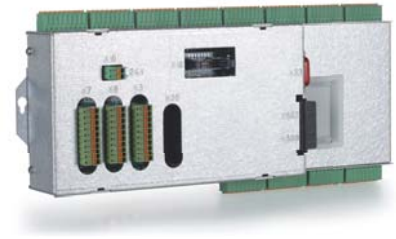
# HSCI adapter for OEM machine operating panel

## PLB 6001

The PLB 6001 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 this adapter.

- HSCI interface
- Connection for HR handwheel
- Inputs/outputs for keys/key illumination
  - Without FS:* Terminals for 72 inputs and 40 outputs
  - With FS:* Terminals for 36 FS inputs and 40 outputs
- Connection for spindle-speed, feed-rate and rapid-traverse overrides
- Screw fastening or top-hat-rail mounting
- Configuration of the PLC inputs/outputs with the IOconfig computer software

<b>PLB 6001</b>	ID 668792-01
<b>PLB 6001 FS</b>	ID 722083-01
Weight	Approx. 1.2 kg



PLB 6001



# Additional modules

## Overview

The additional modules are directly connected to the HSCI control system through a slot on the MC main computer, CC controller unit or UEC/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 connected to the HSCI control system through 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 only be accessed via the NC, and not via the PLC.

Additional module for analog axes/spindles

- Expansion board for CC 61xx or UEC controller units
- 4 analog outputs,  $\pm 10$  V for axes/spindle
- Spring-type plug-in terminals

**CMA-H 04-04-00**

ID 688721-01



CMA-H 04-04-00

## Module for fast digital PLC inputs/outputs

The CMD-H 24-12-00 additional module features 24 PLC inputs and 12 PLC outputs. The CMD-H is directly connected to the MC main computer through a slot. This eliminates the propagation times for HSCI transmission during the exchange of data, and makes fast PLC inputs/outputs possible without a propagation delay. The IOconfig 3.0 software (available as of the end of 2013) is required for configuration.

Additional module for digital PLC inputs/outputs

- Digital expansion board for the MC main computer
- 24 digital inputs, 24 V
- 8 digital outputs, 24 V, 150 mA
- 4 digital outputs, 24 V, 2 A
- Connection via 44-pin D-sub connector, triple-row

**CMD-H 24-12-00**

ID 810900-01

## Accessories

### Cable for CMD-H

ID 620320-xx

For connection to a terminal block; with one 44-pin D-sub connector, triple-row

## Module for analog PLC inputs

The CMA-H 02-00-04 additional module makes it possible to directly connect PT 100 thermistors to the MC main computer and can be used as an alternative to the PLA-H I/O module. The module also provides two analog  $\pm 10$  V inputs for the PLC. The IOconfig 3.0 software (available as of the end of 2013) is required for configuration.

Additional module for PT 100 and analog inputs

- Analog expansion board for the MC main computer
- 4 analog inputs for PT 100 thermistors
- 2 analog inputs  $\pm 10$  V
- Spring-type plug-in terminals

**CMA-H 02-00-04**

ID 743095-01

### **Module for PROFIBUS-DP**

An expansion board can be used to provide the TNC 640 with a PROFIBUS interface at any time. This makes the connection to a PROFIBUS-DP field bus system possible.

The PROFIBUS module is integrated in the control system by using a slot in the MC. The interface is configured with IOconfig.

Additional module for PROFIBUS-DP

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

**PROFIBUS-DP additional module** ID 828539-01



Module for PROFIBUS-DP

# 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. For more information on the touch probes, ask for our brochure titled *Touch Probes*.

## Workpiece measurement

The TS touch trigger probes have a stylus for probing workpieces. The HEIDENHAIN controls provide standard routines for datum setting and workpiece measurement and alignment. The touch probes are available with various taper shanks. Assorted styli are available as accessories.

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

TS 230

Touch probe for NC machines



TS 230

Touch probe with **infrared transmission** for machines with automatic tool change:

TS 440

Compact dimensions



TS 440

TS 444

Compact dimensions, battery-free—power supply through integrated air turbine generator over central compressed air supply

TS 640

Standard touch probe with wide-range infrared transmission and long operating time

TS 740

High probing accuracy and reproducibility, low probing force

SE trans-  
mitter-receiver unit

The infrared transmission is established between the TS touch probe and the SE transceiver unit. The following SE units can be combined with the TS touch probes:

**SE 640** for installation in the machine's working space

**SE 642** common SE for TS and TT 449; otherwise same as SE 640

**SE 540** for infrared transmission; for installation in the spindle head



SE 640

**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 has standard routines for measuring length and diameter of the tool as well as the individual teeth. The TNC 640 automatically saves the results of measurement in a tool table. It is also possible to measure tool wear between two machining steps. The TNC 640 compensates the changed tool dimensions automatically for subsequent machining or replaces the tool after a certain limit—as for example after tool breakage.

With the triggering **TT touch probes**, the disk-shaped contact plate is deflected from its rest position upon contact with a stationary or rotating tool, sending a trigger signal to the TNC 640 control.

TT 140                      Signal transmission to the control over connecting cable



TT 140

TT 449                      Signal transmission over infrared beam to SE 642 transmitter/  
receiver unit

TL Micro/TL Nano                      The **TL laser systems** operate without any contact. A laser beam probes the length, diameter or contour of the tool. Special measuring cycles in the TNC 640 evaluate the information.



# Electronic handwheels

## Overview

The standard TNC 640 supports the use of electronic handwheels.

- **HR 550 FS** wireless handwheel, or
- **HR 410** or **HR 520** portable handwheel, or
- **HR 130** panel-mounted handwheel
- Up to three **HR 150** panel-mounted handwheels via **HRA 110**

A handwheel or HRA handwheel adapter can be connected to the MB machine operating panel or the PLB 6001 adapter for HSCI. Handwheels with functional safety are cross-circuit proof thanks to the special permissive key logic.

## HR 410

Portable electronic handwheel with

- Keys for actual-position capture and the selection of 5 axes
- Keys for traverse direction and three preset feed rates
- Three keys with 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 *Snap-on keys*).

	Keys	Without detent	With detent
<b>HR 410</b>	FCT A, FCT B, FCT C	ID 296469-53	–
	Spindle right/left/stop	ID 296469-54	–
	NC start/stop, spindle start (for PLC basic program)	ID 296469-55	ID 535220-05
<b>HR 410 FS</b>	FCT A, FCT B, FCT C	ID 337159-11	ID 578114-01
	NC start/stop, spindle start (for PLC basic program)	ID 337159-21	ID 578114-11

Weight approx. 1 kg



HR 410

## HR 520

Portable electronic handwheel with

- Display for operating mode, actual position value, programmed feed rate and spindle speed, error messages
- Override potentiometer 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
<b>HR 520</b>	ID 670302-01	ID 670303-01
<b>HR 520 FS</b>	ID 670304-01	ID 670305-01

Weight approx. 1 kg



HR 520

## Mount for HR 520

For fastening on machine

ID 591065-02

## HR 550 FS

Electronic handwheel with wireless transmission. Display, operating elements and functions same as HR 520.

In addition:

- Functional safety
- Wireless transmission range up to 20 m (depending on environment)

<b>HR 550 FS</b>	Without detent	ID 598515-03
	With detent	ID 606622-03

<b>Replacement battery</b>	for HR 550 FS	ID 623166-xx
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HR 550 FS with HRA 551 FS

## HRA 551 FS

Handwheel mount for HR 550 FS

- For docking the HR 550 FS on the machine
- Integrated charger for HR 550 FS
- Connections to the control and the machine
- Integrated transmitter/receiver unit

<b>HRA 551 FS</b>	ID 731928-02
Weight	Approx. 1.0 kg

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

## Connecting cable

	For HR 410/ HR 520	For HR 410 FS/ HR 520 FS	For HR 550 FS with HRA 551 FS	
Connecting cable (spiral cable) to HR (3 m)	✓	✓	–	ID 312879-01
Connecting cable with metal armor	✓	✓	–	ID 296687-xx
Connecting cable without metal armor	✓	✓	✓	ID 296467-xx
Adapter cable for HR/HRA to MC	✓	✓	✓ <sup>1)</sup>	ID 296466-xx
Extension cable to adapter cable	✓	✓	✓ <sup>1)</sup>	ID 281429-xx
Adapter cable for HRA to MC	–	–	✓ <sup>2)</sup>	ID 749368-xx
Extension cable to adapter cable	–	–	✓ <sup>2)</sup>	ID 749369-xx
Dummy plug for standard handwheels	✓	–	–	ID 271958-03
Dummy plug for handwheels with FS	–	✓	✓	ID 271958-05

<sup>1)</sup> For cable lengths up to 20 m between MB and HRA 551 FS

<sup>2)</sup> For cable lengths up to 50 m between MB and HRA 551 FS

See also *Cable overview* on Page 44.

**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.

<b>HR 130</b>	Without detent	ID 540940-03
	With detent	ID 540940-01
Weight	Approx. 0.7 kg	



HR 130

**HR 150**

Panel-mounted handwheel with ergonomic control knob for connection to the **HRA 110** handwheel adapter.

<b>HR 150</b>	Without detent	ID 540940-07
	With detent	ID 540940-06
Weight	Approx. 0.7 kg	



HR 150

**HRA 110**

Handwheel adapter for connection of up to three **HR 150** panel-mounted handwheels and two switches for axis selection and for selecting the interpolation factor. The first two handwheels are permanently assigned to axes 1 and 2. The third handwheel is assigned to the axes over a selection switch (accessory) or by machine parameters. The position of the second selection switch (accessory) is evaluated by the PLC, for example to set the proper interpolation.

<b>HRA 110</b>		ID 261097-04
Weight	Approx. 1.5 kg	
<b>Step switch</b>	With turning knob and cable	ID 270908-xx



HRA 110



Step switch

# Industrial PC

## IPC 6641 for Windows

With the IPC 6641 industrial PC you can start and remotely operate Windows-based applications via the TNC's user interface. The user interface is displayed on the control screen. Option 133 is required.

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

In addition to the IPC 6641 industrial PC, a separately ordered hard disk is required for operation. The operating systems Windows 7 or 8 can be installed on this empty data medium.

<b>IPC 6641</b>		ID 1039543-01
	To be installed in	Electrical cabinet
	Processor	Intel Core i7-3
		2.1 GHz 4 cores
	RAM memory	4 GB
	Weight	4.0 kg
<b>HDR hard disk</b>		ID 1074770-51
	Empty data carrier for Windows operating system	
	Free capacity	Approx. 160 GB









































































































IPC 6641



# Snap-on keys for HR

## Overview

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 5 keys.












Axis keys Orange		ID 330816-42		ID 330816-24		ID 330816-43		ID 330816-37
		ID 330816-26		ID 330816-36		ID 330816-38		
		ID 330816-23		ID 330816-25		ID 330816-45		
Gray		ID 330816-95		ID 330816-69		ID 330816-0W		ID 330816-0R
		ID 330816-96		ID 330816-0G		ID 330816-0V		ID 330816-0D
		ID 330816-97		ID 330816-0H		ID 330816-0N		ID 330816-0E
		ID 330816-98		ID 330816-71		ID 330816-0M		ID 330816-65
		ID 330816-99		ID 330816-72		ID 330816-67		ID 330816-66
		ID 330816-0A		ID 330816-63		ID 330816-68		ID 330816-19
		ID 330816-0B		ID 330816-64		ID 330816-21		ID 330816-16
		ID 330816-0C		ID 330816-18		ID 330816-20		ID 330816-0L
		ID 330816-70		ID 330816-17		ID 330816-0P		ID 330816-0K
Machine functions		ID 330816-0X		ID 330816-75		ID 330816-0T		ID 330816-86
		ID 330816-1Y		ID 330816-76		ID 330816-81		ID 330816-87
		ID 330816-30		ID 330816-77		ID 330816-82		ID 330816-88
		ID 330816-31		ID 330816-78		ID 330816-83		ID 330816-94
		ID 330816-32		ID 330816-79		ID 330816-84		ID 330816-0U
		ID 330816-73		ID 330816-80		ID 330816-89		ID 330816-91
		ID 330816-74		ID 330816-0S		ID 330816-85		ID 330816-3L
Spindle functions		ID 330816-08		ID 330816-40		ID 330816-47		ID 330816-48
		ID 330816-09		ID 330816-41		ID 330816-46		ID 385530-5X
Other keys		ID 330816-01		ID 330816-50		ID 330816-90		ID 330816-93
		ID 330816-61		ID 330816-33		ID 330816-27		ID 330816-0Y
		ID 330816-11		ID 330816-34		ID 330816-28		ID 330816-4M
		ID 330816-12		ID 330816-13		ID 330816-29		ID 330816-3M
		ID 330816-49		ID 330816-22		ID 330816-92		ID 330816-3N

# Snap-on keys for control







































## Overview

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 5 keys.










































### Keys Orange

	ID 679843-31		ID 679843-54		ID 679843-C8		ID 679843-D4
	ID 679843-32		ID 679843-55		ID 679843-C9		ID 679843-35
	ID 679843-53		ID 679843-88		ID 679843-D3		


















### Gray

	ID 679843-03		ID 679843-13		ID 679843-93		ID 679843-B9
	ID 679843-04		ID 679843-14		ID 679843-94		ID 679843-C1
	ID 679843-05		ID 679843-43		ID 679843-B1		ID 679843-C2
	ID 679843-06		ID 679843-44		ID 679843-B2		ID 679843-C3
	ID 679843-07		ID 679843-67		ID 679843-B3		ID 679843-C4
	ID 679843-08		ID 679843-68		ID 679843-B4		ID 679843-C5
	ID 679843-09		ID 679843-69		ID 679843-B5		ID 679843-D9
	ID 679843-10		ID 679843-70		ID 679843-B6		ID 679843-E1
	ID 679843-11		ID 679843-91		ID 679843-B7		
	ID 679843-12		ID 679843-92		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		ID 679843-C7
	ID 679843-16		ID 679843-56		ID 679843-95		ID 679843-D6
	ID 679843-22		ID 679843-57		ID 679843-96		ID 679843-E3
	ID 679843-23		ID 679843-59		ID 679843-A1		ID 679843-E4
	ID 679843-24		ID 679843-60		ID 679843-A2		ID 679843-E6
	ID 679843-25		ID 679843-61		ID 679843-A3		ID 679843-E7
	ID 679843-26		ID 679843-62		ID 679843-A4		ID 679843-E8
	ID 679843-27		ID 679843-63		ID 679843-A5		
	ID 679843-28		ID 679843-64		ID 679843-A6		
	ID 679843-29		ID 679843-73		ID 679843-A9		

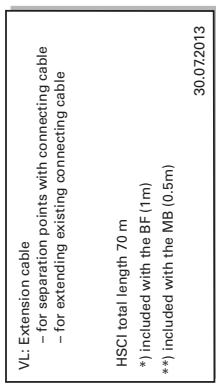
## Spindle functions

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

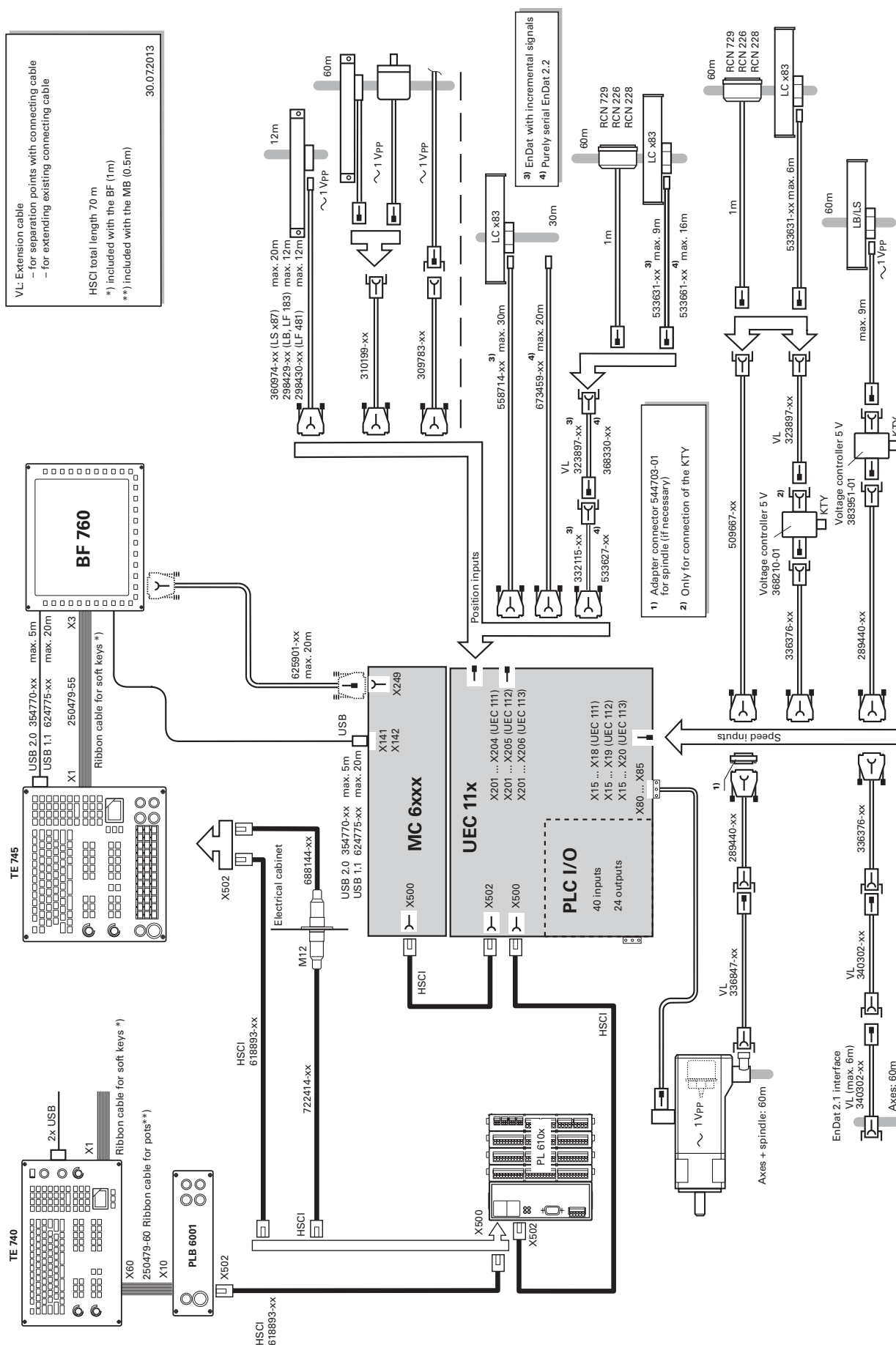
## Other keys

	ID 679843-15		ID 679843-39		ID 679843-90		ID 679843-D5
	ID 679843-17		ID 679843-41		ID 679843-97		ID 679843-D7
	ID 679843-33		ID 679843-42		ID 679843-98		ID 679843-E2
	ID 679843-34		ID 679843-45		ID 679843-A7		ID 679843-E5
	ID 679843-36		ID 679843-58		ID 679843-A8		
	ID 679843-37		ID 679843-66		ID 679843-D1		
	ID 679843-38		ID 679843-75		ID 679843-D2		

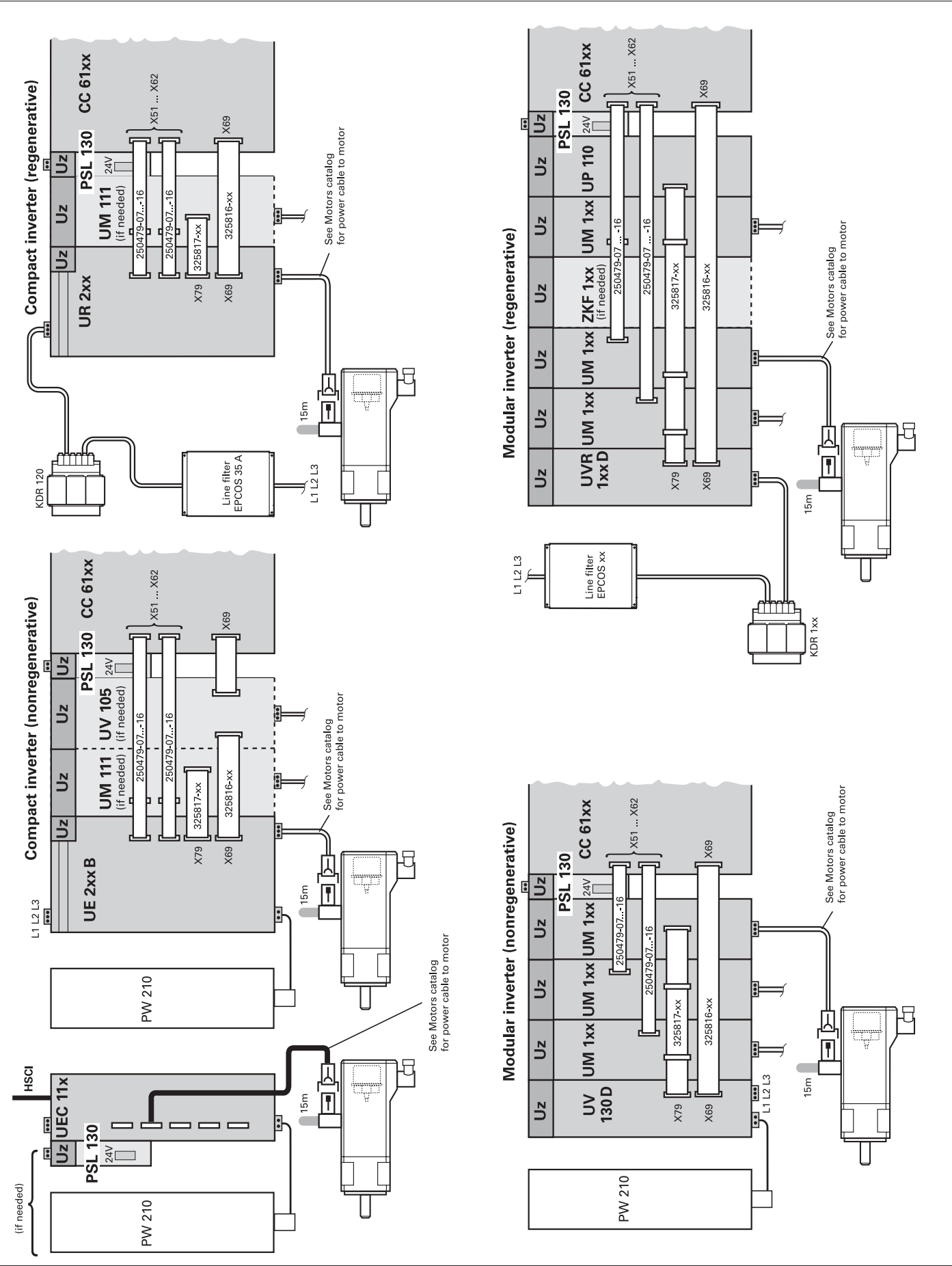
# Control systems with CC



# Control systems with UEC



Inverter system

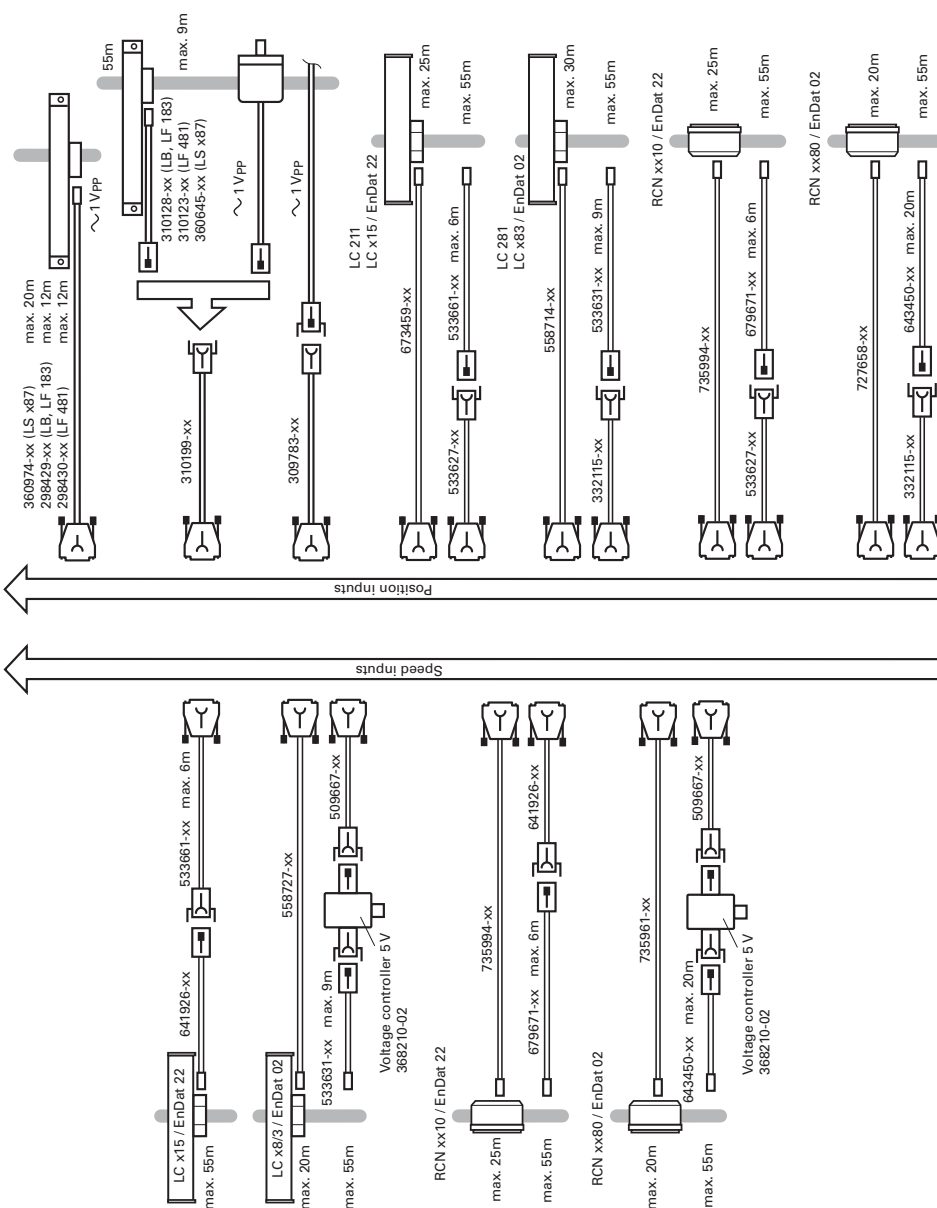


# Measuring devices

	X502A
	X500A
	X502B*)
	X500B*)

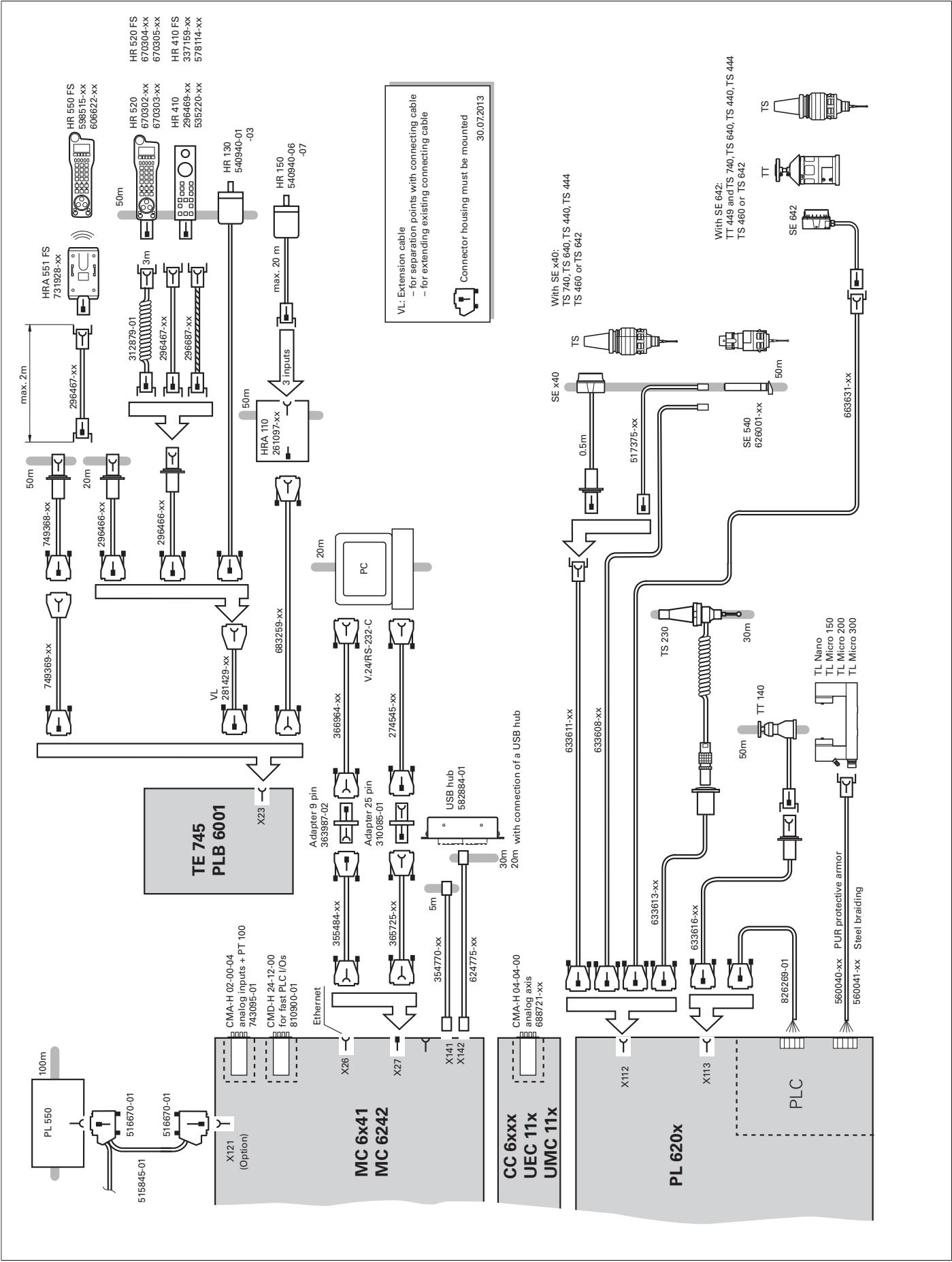
**UEC 1xx**  
**UMC 1xx**  
**CC 6xxx**  
 \*) CCs with 2nd controller board

X15A ... X18A	X201A ... X204A
X15B ... X20B*)	X201B ... X206B*)



29.07.2013

Accessories





# Technical description

## Digital control design

### Uniformly digital

In the uniformly digital control design from HEIDENHAIN, all components are connected to each other via purely digital interfaces: The control components are connected via **HSCI** (HEIDENHAIN Serial Controller Interface), the new real-time protocol from HEIDENHAIN for Fast Ethernet, and the encoders are connected via **EnDat 2.2**, the bidirectional interface from HEIDENHAIN. This achieves a high degree of availability for the entire system. It can be diagnosed and is immune to noise—from the main computer to the encoder. These outstanding properties of the uniformly digital design from HEIDENHAIN guarantee not only very high accuracy and surface quality, but rapid traverse speeds as well. Please refer to the *Uniformly Digital* Technical Information sheet for more detailed information.

### HSCI

HSCI, the HEIDENHAIN Serial Controller Interface, connects the main computer, controller(s) and other control components. HSCI is based on 100BaseT Ethernet hardware. A special interface component developed by HEIDENHAIN makes short cycle times for data transfer possible.

#### Main advantages of the control design with HSCI:

- Hardware platform for flexible and scalable control system (e.g. local axis systems)
- High noise immunity due to digital communication between components
- Hardware basis for the implementation of “functional safety”
- Simpler wiring (initial operation, configuration)
- Inverters remain connected via proven PWM interface
- Greater cable lengths in the entire system (HSCI up to 70 m)
- Number of control loops can be increased (up to 18 axes and alternatively two spindles)
- More PLC inputs and outputs
- Controller units can be installed elsewhere

CC or UEC controller units, up to nine PL 6000 PLC input/output modules, and machine operating panels (such as the MB 720 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 visual display unit and main computer is especially advantageous if the computer is housed in the operating panel. All that is required then is the power supply and an HSCI line to the controller in the electrical cabinet.

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

HSCI components		Maximum number	
MC	HSCI master	1 in the system	
CC, UEC, UMC	HSCI slave	4 drive-control motherboards (distributed to CC, UEC, UMC as desired)	
MB, PLB 6001	HSCI slave	2 in the system	
PLB 61xx, PLB 62xx	HSCI slave	7 in the system	
HR	On MB or PLB 6001	1 in the system	
PLD-H-xx-xx FS	In PLB 6xxx FS	10 in the system	Total maximum of 1000 inputs/outputs
PLD-H-xx-xx, PLA-H-xx-xx	In PLB 6xxx	25 in the system	

# Functional safety

## Basic principle

Controls from HEIDENHAIN with functional safety meet safety integrity level 2 (SIL 2) as per the EN 61 508 standard, as well as performance level d, category 3, as per EN ISO 13 849-1 (which replaced EN 954-1). These standards describe the assessment of safety-related systems, for example based on the failure probabilities of integrated components and subsystems. This modular approach helps the manufacturers of safety-related systems to implement their systems, because they can begin with subsystems that have already been qualified. Safety-related position encoders, the TNC 640 control and functional safety accommodate this concept. Two redundant safety channels that work independently of each other are the foundation for controls with functional safety. All safety-relevant signals are captured, processed and output via two channels. Errors are detected by mutual comparison of the states and data in the two channels. In this way, the occurrence of just one fault in the control does not lead to the safety functions being incapacitated.

## Structure

The safety-related controls from HEIDENHAIN have a dual-channel design with mutual monitoring. The SPLC (safety-related PLC program) and SKERN (safe core 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 (DSP) components. The dual-channel structure of the MC and CC is also used in the PLB 6xxx FS input/output systems and the MB 7xx FS machine operating panel. 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 may consist of only those safety-relevant components, including their variants, which HEIDENHAIN has approved for use! Control components with functional safety are recognizable by the suffix FS after the model designation, e.g. MB 720 FS.

## MB and TE

An MB machine operating panel with FS is indispensable for systems with functional safety. 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, a combination of hardware (FS and standard) is possible, but a PLB 62xx FS is essential.

## 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 in the hardware and software:
- Safe stop reactions (SS0, SS1, SS2)
  - Safe torque off (STO)
  - Safe operating stop (SOS)
  - Safely limited speed (SLS)
  - Safely limited position (SLP)
  - Safe brake control (SBC)
  - Safe operating modes in accordance with EN 12 417
    - 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. 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**
- If the control identifies a PLB 62xx FS in the system during booting, functional safety is activated.
- In this case, it is essential that the following prerequisites be fulfilled:
- Functional safety versions of 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

Functional safety cannot be activated or deactivated by parameter.

- More information**
- For more information on the topic of functional safety, 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.

# Operating system

## HEROS 5

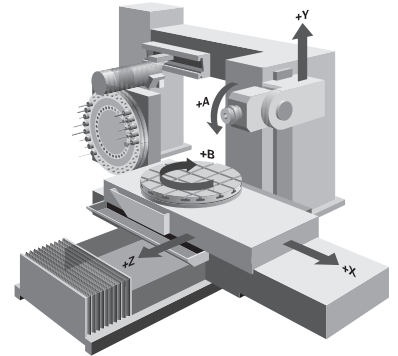
The TNC 640 works with the real-time operating system HEROS 5 (HEIDENHAIN Real-time Operating System). This future-oriented operating system features powerful functions:

- Display of **PDF files**. Drawings, work instructions, etc. can be opened directly on the control.
- Direct Internet access from the TNC 640 thanks to the **integrated browser**.
- You can open various **file formats** directly on the TNC 640 and also edit some of them with the appropriate editors:
  - Text files (.txt, .ini)
  - Graphic files (.gif, .bmp, .jpg, .png)
  - Tables (.xls, .csv)
  - Internet files (.html)
- Standardized **display format** for operating system dialogs

# Axes

## Linear axes

Depending on the options enabled, 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]  
–99 999.9999 to +99 999.9999 [mm] with option 23

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]  
–99 999.9999 to +99 999.9999 [mm] with option 23

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 by 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 [°]  
–99 999.9999 to +99 999.9999 [°] with option 23

Feed rate in degrees per minute [°/min]

Traverse range

–99 999.9999 to +99 999.9999 [°]  
–99 999.9999 to +99 999.9999 [°] with option 23

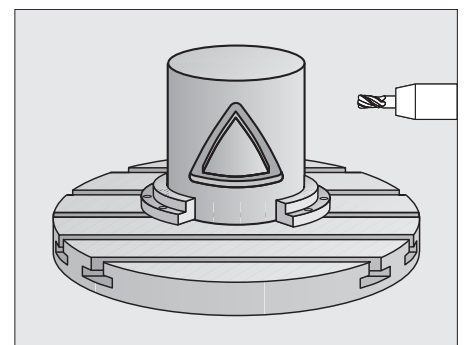
The machine tool builder defines the traverse range. The user can set additional limits to the traverse range if he wishes to reduce the working space. Various traverse ranges can be defined per axis using parameter sets (selection by PLC).

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*.

## Cylindrical surface interpolation (option 8)

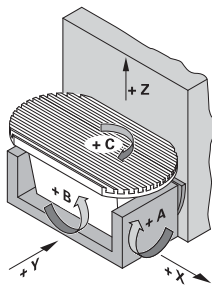
A contour defined in the working plane is machined on a cylindrical surface.



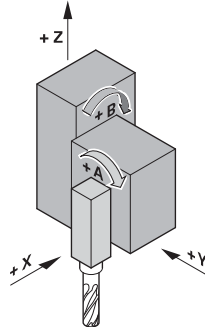
### Tilting the working plane (option 8)

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

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



Tilting table

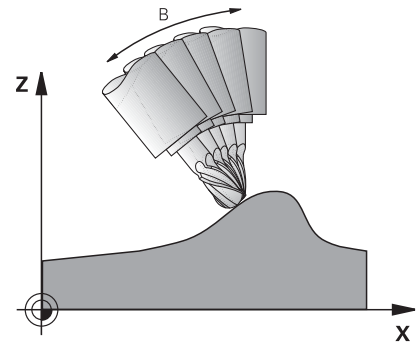


Swivel head

### 5-axis machining (option 9)

Tool Center Point Management (TCPM)

The offset of the tilting axes is compensated so that the tool tip remains on the contour. Handwheel commands can also be superimposed during machining without moving the tool tip from the programmed contour.

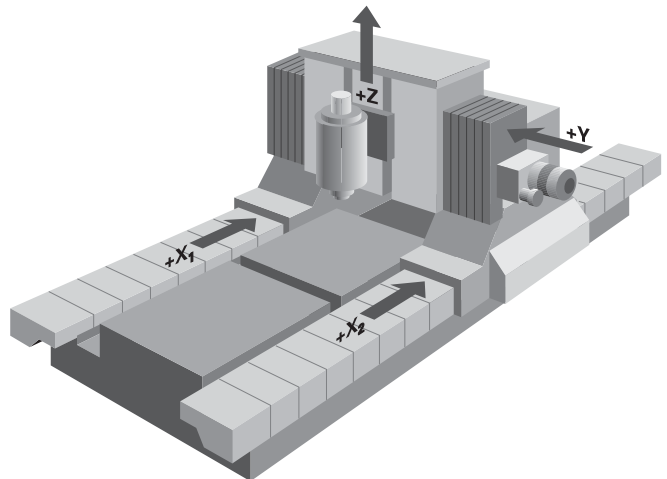


### Synchronized axes

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.

With **gantry axes** more than one slave axis can be assigned to one master gantry axis. They may also be distributed to several controller units.

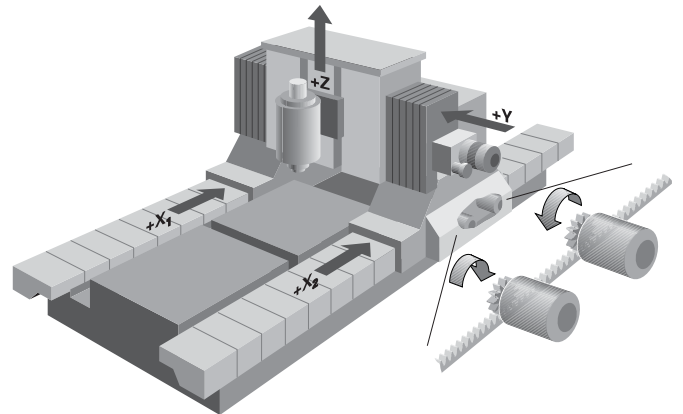


### Torque control

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

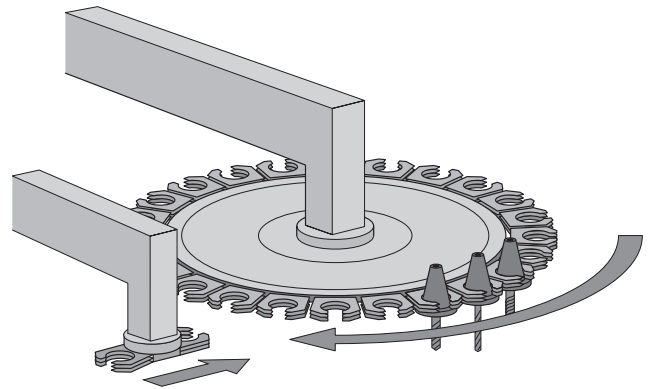
- a defined distribution of drive torque is desired,
- or
- parts of the controlled system show a backlash effect that can be eliminated by "tensioning" the servo drives. (e.g. toothed racks)

For torque control, the master and slave must be on the same motherboard (DSP). Depending on the controller unit being used, up to five slave axes can be configured for each master in this manner.



### PLC axes

Axes can be controlled by the PLC. They are programmed through M functions or OEM cycles. The PLC axes are positioned independently of the NC axes and are therefore designated as asynchronous axes.

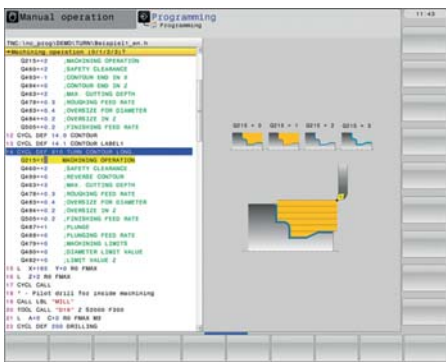


# Turning

## 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 conversational format. Rotationally symmetric contours are produced during turning operations. The preset must be in the center of the lathe spindle for this.

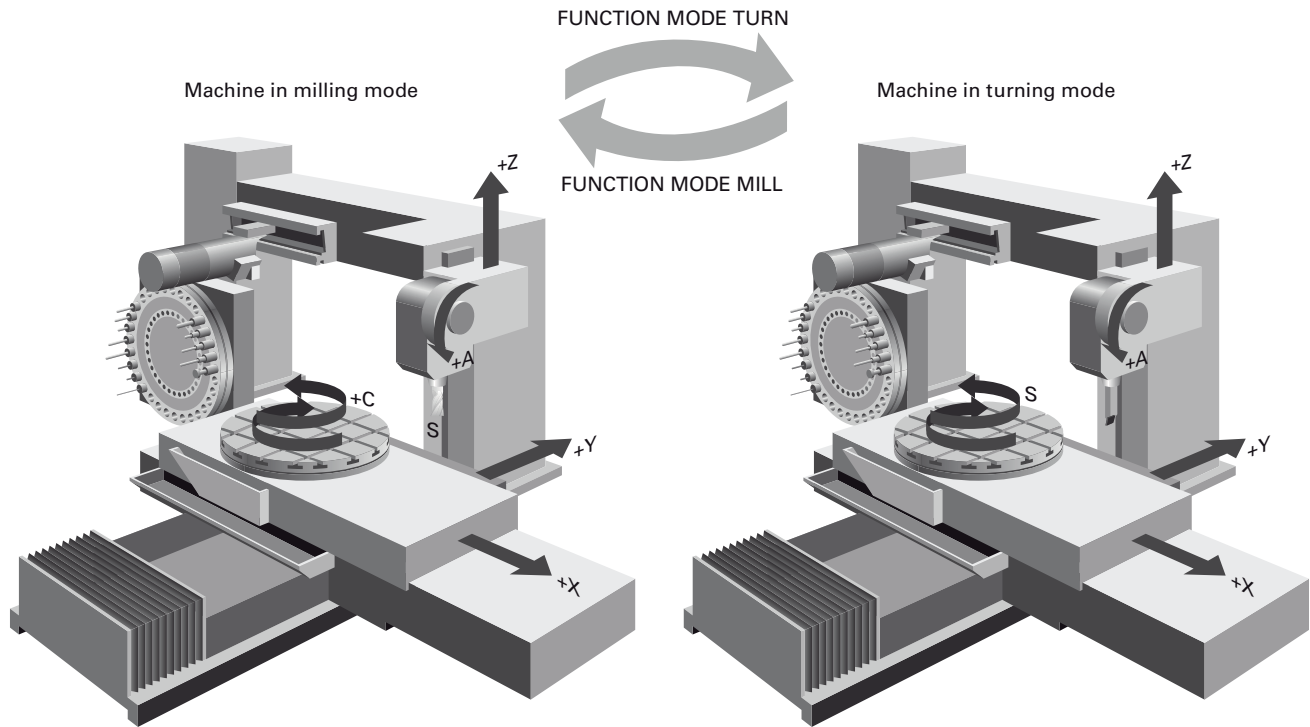
In turning mode, the rotary table serves as the lathe spindle, while the milling spindle with the tool remains stationary. Machines for milling and turning must fulfill special demands. A basic prerequisite is a machine designed with high rigidity, in order to ensure a low oscillation tendency even when the machine table (acting as lathe spindle) is turning at high speeds.



## Toggling between milling and turning modes

When switching between turning and milling modes, the TNC switches the diameter programming on or off, respectively, selects the XZ plane as working plane for turning, and shows whether it is in milling or turning mode in the status display.

The machine operator uses the NC commands FUNCTION MODE TURN and FUNCTION MODE MILL to toggle between milling and turning modes. The machine-specific procedures necessary here are realized via OEM macros. In these macros the machine tool builder specifies, for example, which kinematics model is active for the milling or turning mode, and which axis and spindle parameters are in effect. Since the FUNCTION MODE TURN and FUNCTION MODE MILL commands are independent of the type of machine, NC programs can be exchanged between different types of machines.





## **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, 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 determine an unbalance of the rotary table by measuring the effects of the centrifugal forces on neighboring linear axes. A rotary table positioned via a linear axis would be ideal for this. For other machine designs, measurement of the unbalance via external sensors is appropriate.

The TNC 640 features the following functions:

- **Calibration of the unbalance**

A calibration cycle ascertains the unbalance behavior of the rotary table. This unbalance calibration is generally performed by the machine tool builder before he ships the machine. During execution of the calibration cycle, the TNC generates a table describing the unbalance behavior of the rotary table.

- **Balancing**

After the workpiece blank to be turned has been clamped, the machine operator can use a measuring cycle to determine the current unbalance. During balancing, the TNC assists the machine operator by indicating the mass and position of the balancing weights.

- **Unbalance monitoring**

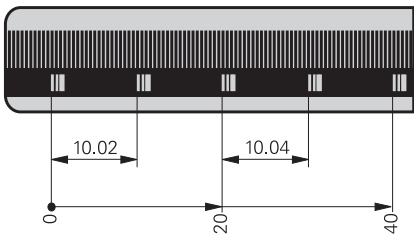
The TNC constantly monitors the momentary unbalance during machining. An NC stop is triggered if a specified limit value is exceeded.

# Spindle

<b>Overview</b>	The TNC 640 contouring control is used in connection with the HEIDENHAIN inverter systems with field-oriented control. As an alternative, an analog nominal speed value can be output.
<b>Controller unit</b>	With the CC controller units and the UEC/UMC inverters, a PWM basic frequency can be set for each controller assembly (e.g. 4 kHz). Possible basic frequencies are 3.33 kHz, 4 kHz or 5 kHz. The <b>Double Speed</b> option (option 49) can double this frequency for high-speed spindles (e.g. 8 kHz for HF spindles). See <i>Technical Manual</i> .
Controller groups	For example with CC 6106 1: X51 + X52 2: X53 + X54 3: X55 + X56
<b>Maximum spindle speed</b>	<p>The maximum spindle speed is calculated as follows:</p> $n_{\max} = \frac{f_{\text{PWM}} \cdot 60000 \text{ min}^{-1}}{\text{NPP} \cdot 5000 \text{ Hz}}$ <p><math>f_{\text{PWM}}</math> = PWM frequency in Hz <math>\text{NPP}</math> = No. of pole pairs</p>
<b>Operating mode switchover</b>	For controlling the spindle (e.g. for wye/delta connection), different parameter sets can be stored. You can switch between the parameter sets in the PLC.
<b>Position-controlled spindle</b>	The position of the spindle is monitored by the control.
Encoder	HEIDENHAIN rotary encoder with sinusoidal voltage signals (1 V <sub>pp</sub> ) or EnDat interface.
<b>Tapping</b>	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.
<b>Oriented spindle stop</b>	With a position-controlled spindle, the spindle can be positioned exactly to 0.1°.
<b>Spindle override</b>	0 to 150%
<b>Gear ranges</b>	A specific nominal speed can be defined for each gear range. The gear code is output via the PLC.
<b>Second spindle</b>	Up to two spindles can be alternately controlled. You can switch from spindle 1 to spindle 2 through the PLC. Because the second spindle is controlled instead of an axis, the number of available axes is reduced by one.

# Encoders

Overview	For speed and position control of the axes and spindle, HEIDENHAIN offers both incremental and absolute encoders.
Incremental encoders	Incremental encoders have as measuring standard a grating consisting of alternate lines and spaces. Relative movement between the scanning head and the scale causes output of sinusoidal scanning signals. The measured value is calculated from these signals.
Reference mark	When the machine is switched on, the machine axes need to traverse a reference mark to establish an accurate connection between measured value and 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.
Reference mark evaluation	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 levels ~1 V <sub>pp</sub> are suitable for connection to HEIDENHAIN numerical controls.
Absolute encoders	With absolute encoders, the position information is contained in several coded tracks. Thus, an absolute reference is available immediately after switch-on. Reference-mark traverse is not necessary. Additional incremental signals are output for highly dynamic control loops.
EnDat interface	<p>The TNC 640 features the serial EnDat 2.2 interface (includes EnDat 2.1) for the connection of absolute encoders.</p> <p><b>Note:</b> 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.</p>
Encoder inputs	<p>Incremental and absolute linear, angle or rotary encoders from HEIDENHAIN can be connected to all <b>position encoder</b> inputs of the controller unit.</p> <p>Incremental and absolute rotary encoders from HEIDENHAIN can be connected to all <b>speed encoder</b> inputs of the controller unit.</p>



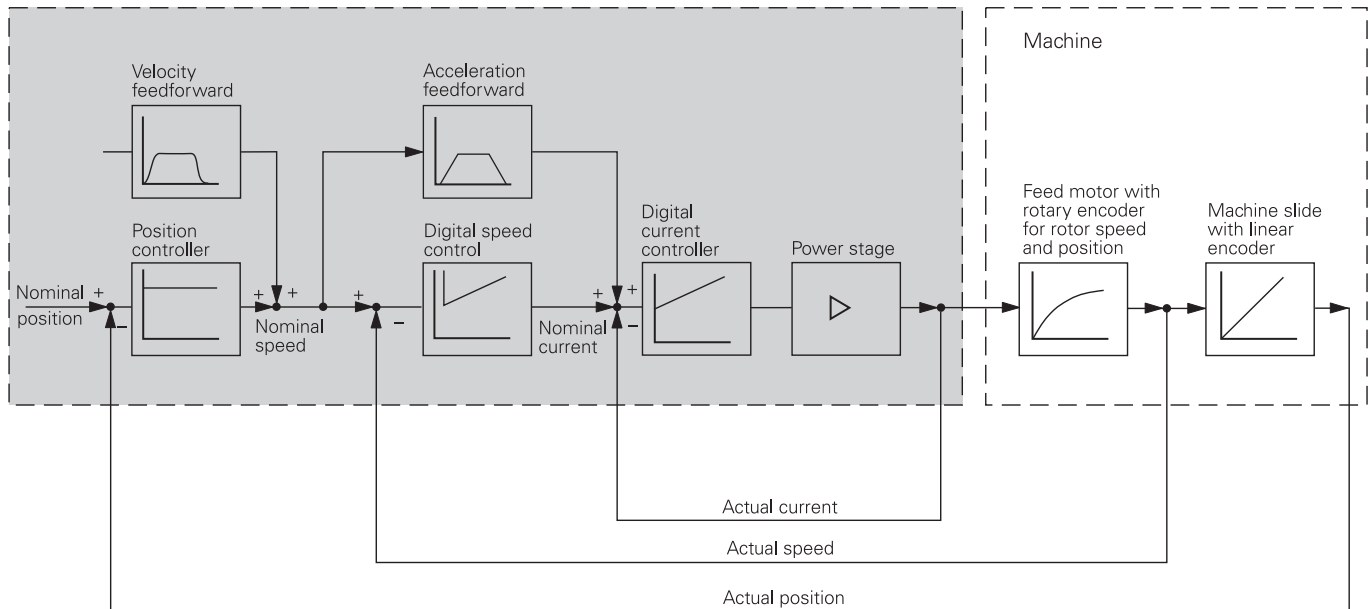
Inputs	Signal level/ Interface <sup>1)</sup>	Input frequency <sup>1)</sup>	
		Position	Shaft speed
Incremental signals	~1 V <sub>pp</sub>	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.2 <sup>2)</sup> /02	–	–
Incremental signals	~1 V <sub>pp</sub>	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.2 <sup>2)</sup> /22	–	–

1) Switchable  
2) Includes EnDat 2.1

# 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.

## Servo control 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

## Servo control with feedforward

Feedforward means that the speed and the acceleration are adjusted to fit the machine. Together with the values calculated from the following error, it forms the nominal value. This greatly reduces the following error (to within a few  $\mu\text{m}$ ).

## 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.

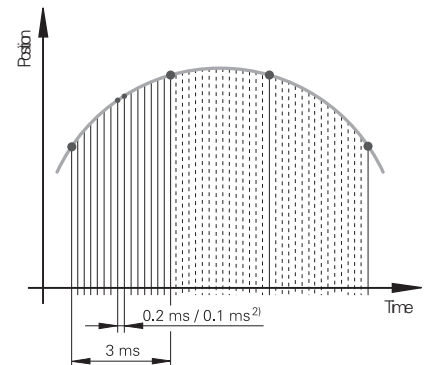
### Control loop cycle times

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 between 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 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 current value is compared to the calculated nominal current value.

	CC/UEC/UMC
<b>Path interpolation</b>	3 ms
<b>Fine interpolation</b>	0.2 ms/0.1 ms <sup>1)</sup>
<b>Position controller</b>	0.2 ms/0.1 ms <sup>2)</sup>
<b>Speed controller</b>	0.2 ms/0.1 ms <sup>1)</sup>
<b>Current controller</b>	0.1 ms at $f_{PWM} = 5000$ Hz

1) Double-speed (with option 49) without position encoder

2) Single-speed/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 as well as shorter cycle times of the speed controller. This makes improved current control for spindles possible, and also higher control performance for linear and torque motors.

### Jerk

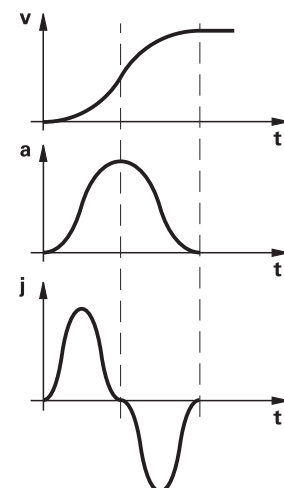
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

### Jerk limiting

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

### Jerk smoothing

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.

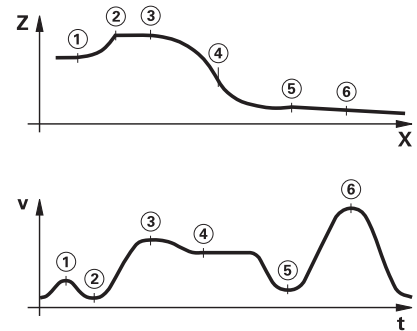


# Fast contour milling

## Short block processing time

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

The block processing time of the MC 6xxx 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

The TNC 640 calculates the geometry ahead of time in order to adjust the feed rate (max. 5000 blocks). In this way directional changes are detected in time to accelerate or decelerate the appropriate NC axes.

## Advanced Dynamic Prediction (ADP)

The Advanced Dynamic Prediction feature (ADP) expands the conventional look-ahead of the permissible maximum feed rate profile and makes optimized motion control possible to produce clean surfaces and perfect contours. ADP shows its strengths 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 negatively influence the machining process through various factors such as short step-like contours, coarse chord tolerances and heavily rounded end-point coordinates. Through an improved reaction to such influence quantities and the exact fulfillment of dynamic machine parameters, ADP not only improves the surface quality of the workpiece, it also optimizes the machining time.

## Dynamic Efficiency

With the concept of Dynamic Efficiency, HEIDENHAIN offers innovative TNC functions that help the user to make heavy machining and roughing more efficient while also enhancing its process reliability. Dynamic Efficiency permits higher removal rates and therefore increases productivity without making the user resort to special tools. At the same time, it prevents any tool overloading and the concomitant premature cutter wear. Dynamic Efficiency comprises three software TNC functions:

- **Active Chatter Control (ACC):** This option reduces chatter tendencies and permits greater infeeds
- **Adaptive Feed Control (AFC):** This option controls the feed rate depending on the machining situation
- **Trochoidal milling:** A function for the roughing of slots and pockets that eases the load on the tool

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.

dynamic + efficiency

### Adaptive Feed Control (AFC) (option 45)

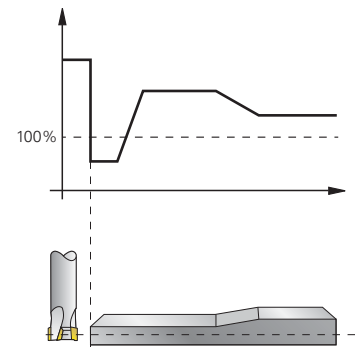
With Adaptive Feed Control (AFC), the contouring feed rate is regulated depending on the respective spindle power in percent.

Benefits of adaptive feed control:

- Optimization and reduction of machining time
- Tool monitoring
- 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
- Already existing NC programs can be used

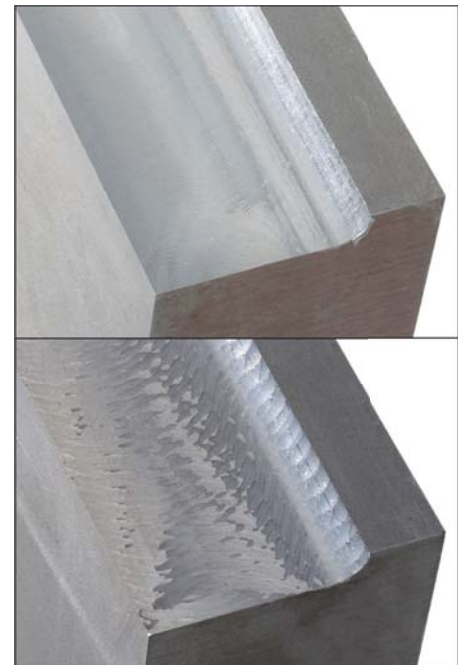
Restrictions:

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



### Active Chatter Control (ACC) (option 145)

Strong milling forces come into play during heavy machining—roughing at high cutting speed. Depending on the tool spindle speed, the resonances in the machine tool and the chip volume (metal-removal rate during milling), the tool can sometimes begin to “chatter.” This chattering places heavy strain on the machine, and causes ugly marks on the workpiece surface. The tool, too, is subject to heavy and irregular wear from chattering. In extreme cases it can result in tool breakage. To reduce the inclination to chattering, HEIDENHAIN now offers an effective antidote with the Active Chatter Control (ACC) option. The use of this option is particularly advantageous during heavy cutting. ACC makes substantially higher metal removal rates possible—depending on the machine model the metal removal rate increases by 25 % and more. You reduce the mechanical load on the machine and increase the life of your tools at the same time.



Top: Part milled with ACC

Bottom: Part milled without ACC

# Monitoring functions

## Description

During operation the control monitors:

- Amplitude of the encoder signals
- Edge separation of the encoder signals
- Absolute position for encoders with distance-coded reference marks
- Current position (following error monitoring)
- Actual path traversed (movement monitoring)
- Position deviation at standstill
- Nominal speed value
- Checksum of safety-related functions
- Supply voltage
- Buffer battery voltage
- Operating temperature of the MC and CPU
- Run time of the PLC program
- Motor current and temperature
- Temperature of power module
- DC-link voltage

With EnDat 2.2 encoders:

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

In the case 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)

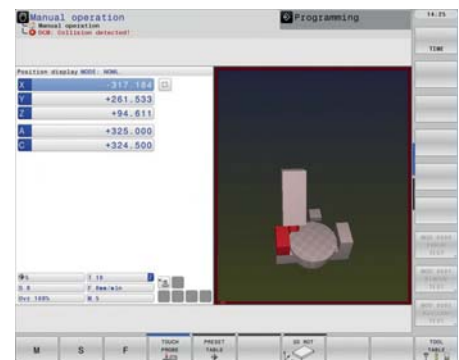
The TNC features a Dynamic Collision Monitoring (DCM) software option for cyclically monitoring the working space of the machine for possible collisions with machine components. The machine manufacturer must define three-dimensional collision objects within the working space of the machine that are to be monitored by the TNC during all machine motions, including those made by swivel heads and tilting tables. 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 machine components concerned are shown in red color in the machine display. Dynamic collision monitoring is active in both the manual operating modes as well as the machine operating modes, and is indicated by a symbol in the operating mode display.

Please note:

- Only the machine manufacturer can define collision objects (including clamping fixtures).
- Collisions between machine components (such as swivel heads) and the workpiece cannot be detected.
- Collision objects are not transformed automatically into rotationally symmetric objects in turning mode.
- In servo-lag operation (no feedforward), DCM is inactive.
- Checking for collision is not possible in the Test Run mode.

Collision monitoring also protects fixtures and tool carriers from collisions.

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







# Error compensation

## Overview

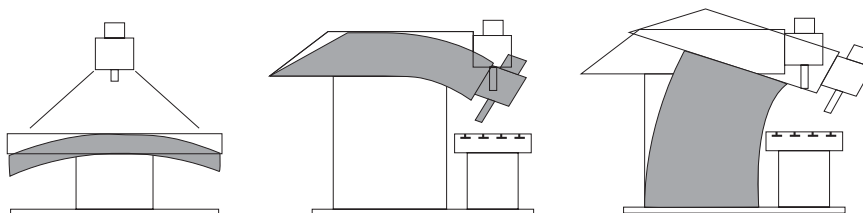
The TNC 640 automatically compensates mechanical errors on the machine.

## 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.



## Backlash

The play between table movement and rotary encoder movement on 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.

## Stick-slip

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 problem condition.

## Sliding friction

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

## Thermal expansion

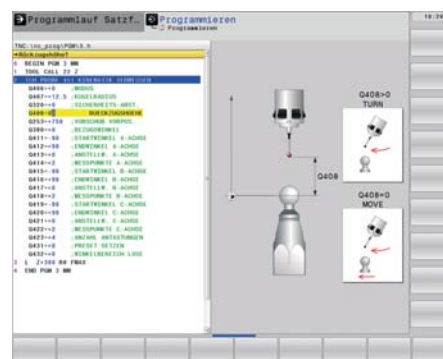
To compensate thermal expansion, the machine's expansion behavior must be known.

The temperature can be recorded via thermistors connected to the analog inputs of the TNC 640. The PLC evaluates the temperature information and transfers 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 results of measurement 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:

<b>KKH 100</b>	Height 100 mm	ID 655475-02
<b>KKH 250</b>	Height 250 mm	ID 655475-01



**Dynamic Precision**

The hypernym Dynamic Precision stands for a number of HEIDENHAIN solutions for milling that dramatically improve the dynamic accuracy of a machine tool. The dynamic accuracy of machine tools can be seen in position errors at the Tool Center Point (TCP), which depend on the motion quantities such as velocity and acceleration (also jerk) and result from vibrations of machine components and other causes. All the deviations are together responsible for dimensional errors and faults in the workpiece surface. They therefore have a decisive influence on quality and, when poor-quality parts are scrapped, also on productivity.

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. That 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 in 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

**dynamic** + **precision**

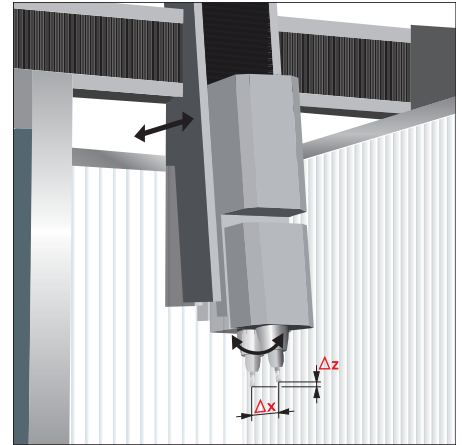
**Cross Talk Compensation (CTC)**  
(option 141)

CTC (option 141) makes it possible to compensate dynamic position deviations that can occur with the use of coupled axes.

To increase productivity, machine tool users are asking for ever higher feed rates and acceleration values, 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 axis direction, the dynamic acceleration of an axis due to mechanical axis coupling can also result in 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 the control option CTC.



**Active Vibration Damping (AVD)**  
(option 146)

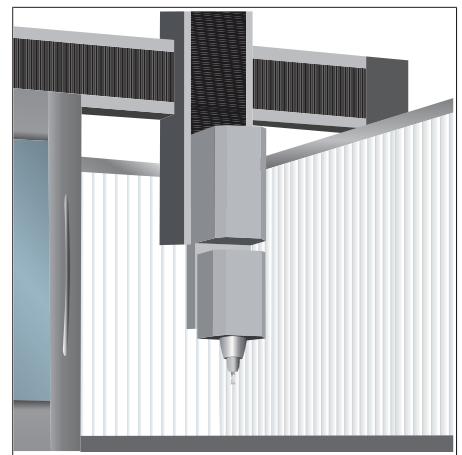
The high dynamics of modern machine tools lead to deformations in the machine base, frame and drive train during acceleration and deceleration of the feed drives. This results in vibrations, such as machine setup vibrations, that may reduce the attainable accuracy and surface quality of the workpieces. 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)

Option 142, PAC, permits 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 machine's dynamic possibilities, you can use the PAC option (Position Adaptive Control) to change machine parameters depending on position. This makes it possible to assign the respectively optimal loop gain to defined support 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 option (Load Adaptive Control) enables the control to automatically ascertain the workpiece's current mass moment of inertia and the friction 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 adjustment of machine parameters by the PAC option, the MAC option (Motion Adaptive Control) also provides a way to change machine parameter values depending on other input quantities such as velocity, following error or acceleration of a drive. Through this motion-dependent adaptation of the control parameters it is possible, for example, to realize a velocity-dependent adaptation of the control loop gain on motors whose stability changes through the various traversing velocities.

**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 actual position value. This results in a significant increase in the possible position controller gain ( $k_v$  factor). The filter separation frequency is set specifically for each axis via machine parameters. The CPF can be used only in dual-encoder systems, i.e. on drive motors with speed encoder and position encoder.

# Commissioning and diagnostic aids

## Overview

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

## ConfigDesign (accessory)

PC software for configuring the machine parameters

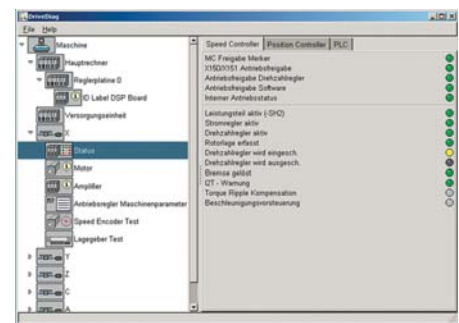
- Machine-parameter editor for the control; all support information; additional data and input limits are shown for each parameter
- Configuration of machine parameters
- Comparison of parameters from different controls
- Importing of service files: easy testing of machine parameters in the field
- Rule-based 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 proper function of motors and inverters, of position encoders and speed encoders

DriveDiag can be called directly from the control via the Diagnosis soft key. It is also available for downloading as PC software (accessory) from the HESIS Web Including FileBase on the Internet. End users have read-access, whereas the code number for the machine tool builder gives access to comprehensive testing possibilities with DriveDiag.

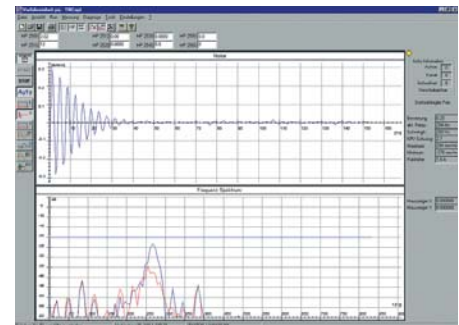


## TNCopt (accessory)

PC software for commissioning digital control loops

Functions:

- Commissioning the current controller
- (Automatic) commissioning of the speed controller
- (Automatic) optimization of sliding-friction compensation
- (Automatic) optimization of the reversal-spike compensation
- (Automatic) optimization of  $k_v$  factor
- Circular interpolation test, contour test



## Requirements

DriveDiag and TNCopt place the following demands on the PC:

- Windows 2000/XP/Vista/7 operating system
- At least 15 MB of free hard-disk space
- Serial or Ethernet interface

## Online Monitor (OLM)

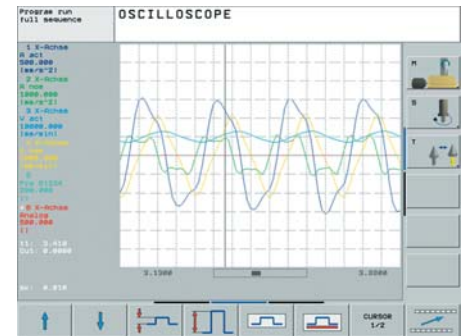
The online monitor is a component part of the TNC 640 and is called over a code number. It supports commissioning and diagnosis of control components by:

- Display of control-internal variables for axes and channels
- Display of controller-internal variables (if a CC is present)
- Display of hardware signal states
- Various trace functions
- Activation of spindle commands
- Enabling control-internal debug outputs

## 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:

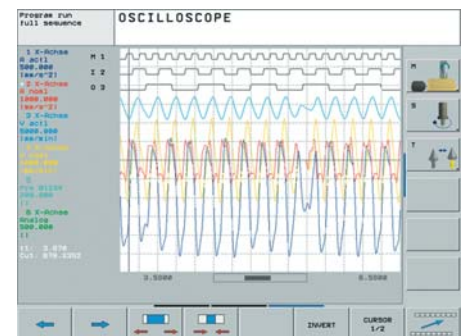
- Actual value and nominal value of the axis feed rate
- Contouring feed rate
- Nominal and actual position
- Following error of the position controller
- Nominal values for speed, acceleration and jerk
- Content of PLC operands
- Encoder signal (0° – A) and (90° – B)
- Difference between position and 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)
- IpoLogik (X)



## 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 HEX or decimal code. The active lines of the statement list are marked.

## Log

For the purposes 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.

## Bus diagnosis

In Diagnosis mode, the structure of the HSCI/PROFIBUS system as well as the details of the HSCI/PROFIBUS components can be displayed in a clearly laid out screen. For HSCI components this is possible even to the level of individual terminals.



# Integrated PLC

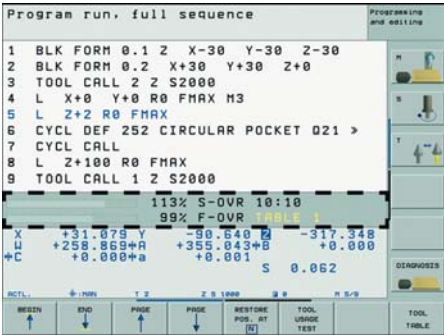
**Overview** The PLC program is created by the machine manufacturer either at the control or with the PLC development software **PLCdesign** (accessory). Machine-specific functions are activated and monitored via the PLC inputs/outputs. The number of PLC inputs/outputs required depends on the complexity 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 PROFIBUS-DP-capable I/O system must be configured with the IOconfig PC software.

PLC programming	Format	Statement list
	Memory	At least 1 GB
	Cycle time	Typically 21 ms, adjustable
	Command set	<ul style="list-style-type: none"><li>• Bit, byte and word commands</li><li>• Logical operations</li><li>• Arithmetic commands</li><li>• Comparisons</li><li>• Nested calculations (parentheses)</li><li>• Jump commands</li><li>• Subprograms</li><li>• Stack operations</li><li>• Submit programs</li><li>• 952 timers</li><li>• 48 counters</li><li>• Comments</li><li>• PLC modules</li><li>• 100 strings</li></ul>

**PLC window** PLC error messages can be displayed by the TNC in the dialog line during operation.

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



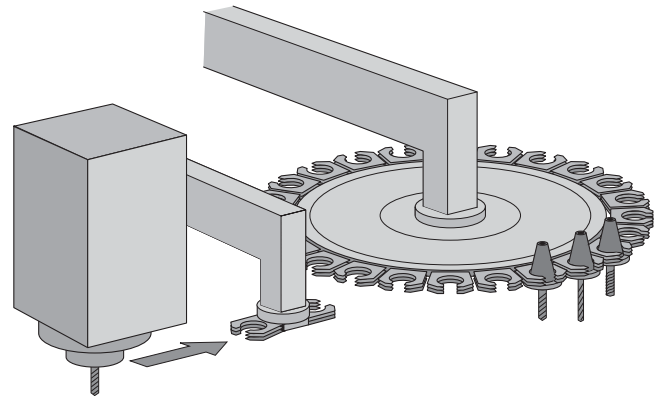
Small PLC window

**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 be also positioned via the PLC. PLC positioning of the NC axes cannot be superimposed on NC positioning.



## PLC axes

Axes can be controlled by the PLC. They are programmed by 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. Comprehensive examples of PLC programs are included with the product.

Functions:

- Easy-to-use text editor
- Menu-guided operation
- Programming of symbolic operands
- Modular programming method
- "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

PC requirements:

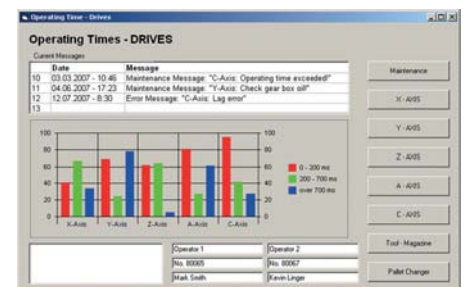
- Windows 2000/XP/Vista/7 operating system
- At least 20 MB free memory on the hard disk
- Serial interface; Ethernet interface recommended
- Internet Explorer

## 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 universally used 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 created 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.



## **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:

- Controlling all axes
- Clamped axes
- Homing the axes; reference end positions
- Positioning the axes after reference run
- Compensating the axis temperature
- Assigning the C axis as lathe spindle
- Feed rate control
- Controlling and orienting the spindle
- Activating tool-specific torque monitoring
- Tool changer
- Pallet changer (translational, rotatory, setup functions)
- Vertical PLC soft-key row
- Support for 19" screens
- Displaying and managing PLC error messages
- Status display in the small PLC window
- Hydraulic control
- Control of the coolant system (internal, external, air)
- M functions
- Lubrication
- Chip conveyor
- Operation of the second spindle alternately with the first
- Wye/delta connection switchover (static, dynamic)
- S-coded spindle
- 3-D head with C-axis operation
- Positioning the spindle as an axis
- Operation with clamped axes
- Axes with central drive
- Axes with Hirth grid
- Indexing fixture
- PLC log
- Touch probes
- PLC support for handwheels
- Control of doors

# 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.

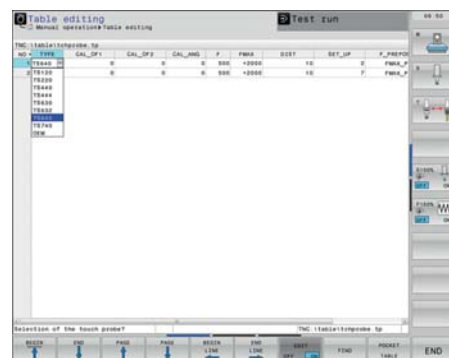
## Tool measurement

Tools can be measured and checked using the **TT** or **TL** tool touch probes (accessory). The control features standard cycles for automatic tool measurement. The control calculates the probing feed rate and the optimal spindle speed. The measured data is stored in a tool table.



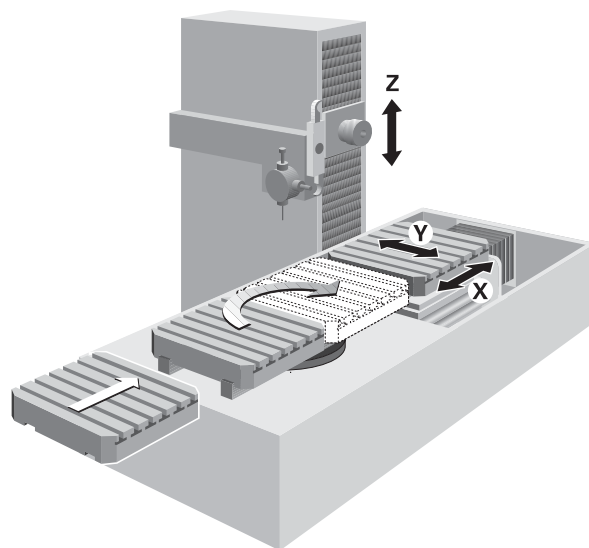
## Touch-probe configuration

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 movement can be controlled via PLC axes. The order of movement, as well as pallet and workpiece datums, must be defined in the pallet table by the user. The pallet tables are freely configurable, which means that any information can be stored in the tables and called up later by the PLC.



# 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. The control features a 1000BASE-T (Twisted Pair Ethernet) connection to the data network.		
	Maximum transmission distance: Unshielded 100 m Shielded 400 m		
Protocol	The TNC 640 communicates using the TCP/IP protocol.		
Network connection	<ul style="list-style-type: none"><li>• NFS file server</li><li>• Windows networks (SMB)</li></ul>		
Data transfer rate	Approx. 400 to 800 Mbit/s (depending on file type and network utilization)		
RS-232-C/V.24	Data interface according to DIN 66 020 or EIA standard RS-232-C. Maximum transmission distance: 20 m		
Data transfer rate	115 200; 57 600; 38 400; 19 200; 9600; 4800; 2400; 1200; 600; 300; 150; 110 Bit/s		
Protocols	The TNC 640 can transfer data using various protocols.		
Standard data transfer	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 to ensure data integrity. This method improves data security.		
LSV2	Bidirectional transfer of commands and data as per DIN 66 019. Before being transferred the data are split into telegrams (blocks).		
Adapter block	For connecting the interface to the electrical cabinet or operating panel		
	RS-232-C/V.24 adapter	9-pin	ID 363987-02
		25-pin	ID 310085-01
USB	The MC 7xxx features two USB 3.0 ports for the connection of standard USB devices, such as the mouse, drives, etc. One of them is led to the BF or TE. There the user has an easily accessible USB interface. The integrated USB hub on the rear of the screen has further USB ports. The USB ports are rated for a maximum of 0.5 A.		
USB cable	Cable length up to 5 m	ID 354770-xx	
	Cable length 6 m to 30 m with integrated amplifier; USB 1.1.	ID 624775-xx	

## USB hub

If you need further USB ports or if the supply current is not sufficient, a USB hub is required. The USB hub from HEIDENHAIN offers four free USB ports.

### USB hub

ID 582884-02

Power supply 24 V DC / max. 300 mA



## Cover

The USB hub can be installed in the operating panel in such a way that two USB ports can be accessed from the outside. An optionally available cover cap can be used to protect the ports from contamination.

### Cover

ID 508921-01

## Software for data transfer

To transfer files between the TNC 640 and PC, we recommend using HEIDENHAIN software.

### 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

Requirements:

- Windows 2000/XP/Vista/7 operating system
- At least 10 MB free hard-disk space
- Serial or Ethernet interface

### TNCremoPlus (accessory)

In addition to the features you are already familiar with 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.

### TNCremoPlus

ID 340447-xx

### Remote Desktop Manager (option 133)

Remote operation and display of external computer units via Ethernet connection (e.g. to a Windows PC). The information is displayed on the control's screen.

Remote desktop manager

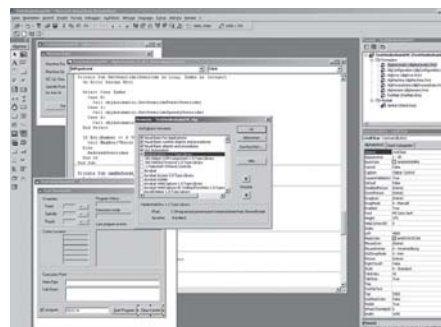
ID 894423-01

# DNC applications

## Overview

The development environments on Windows operating systems are particularly well suited as flexible platforms for application development in order to come to terms with the increasingly complex requirements of the machine's environment. The flexibility of the PC software and the large selection of ready-to-use software components and standard tools in the development environment enable you to develop PC applications of great use to your customers in a very short time, for example:

- Error reporting systems that, for example, send 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 security and equipment availability
- Software solutions controlling the processes of manufacturing systems
- Information exchange with job management software



## HEIDENHAIN DNC (option 18)

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 components and the ActiveX control for integration of the DNC functions in development environments.

### RemoTools SDK

ID 340442-xx

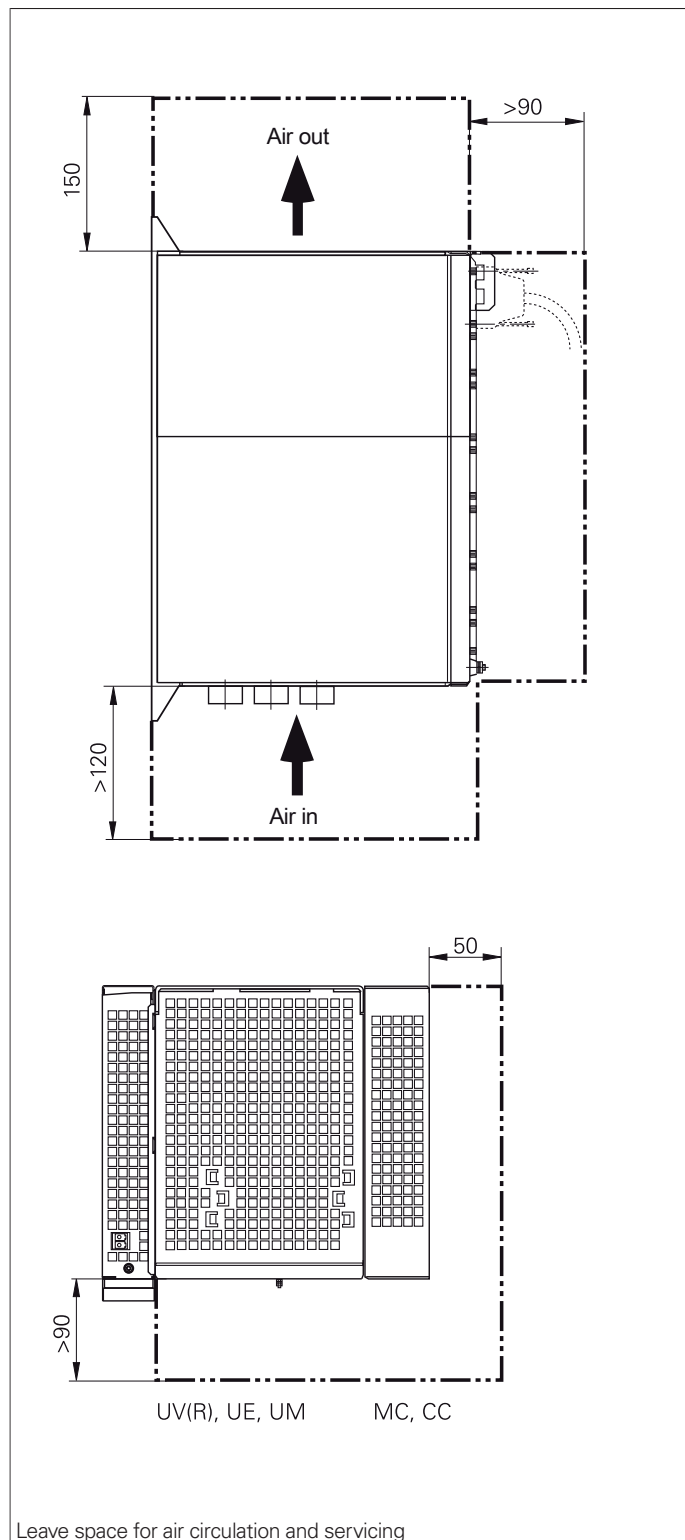
For more information, refer to the *HEIDENHAIN DNC* brochure.

# Mounting information

## Clearances and mounting

### Proper minimum clearance

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



### Mounting and electrical installation

Remember the following during mounting and electrical installation:

- National regulations for power installations
- Interference and noise immunity
- Operating conditions
- Mounting attitude

**Degrees of protection**

The following components fulfill the requirements for IP 54 (dust protection and splash-proof protection):

- Visual 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 IP 54 (dust and splash-proof protection) in order to fulfill the requirements of contamination level 2. All components of the OEM operating panel must also comply with protection class IP 54, 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

- Keep a minimum distance of 20 cm from the MC, CC and its leads to devices that carry interference signals
- Keep a minimum distance of 10 cm from the MC, CC and its leads to cables that carry interference signals. For cables in metallic ducting, adequate decoupling can be achieved by using a grounded separation shield.
- Shielding according to EN 50 178
- Use equipotential bonding conductors with a cross section of 6 mm<sup>2</sup>
- Use only genuine HEIDENHAIN cables and connecting elements



# Overall dimensions

## Main computer

MC 6541, MC 6641, IPC 6641

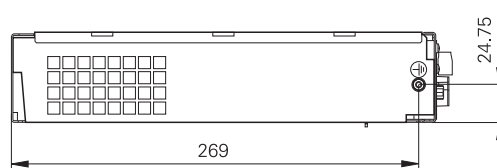
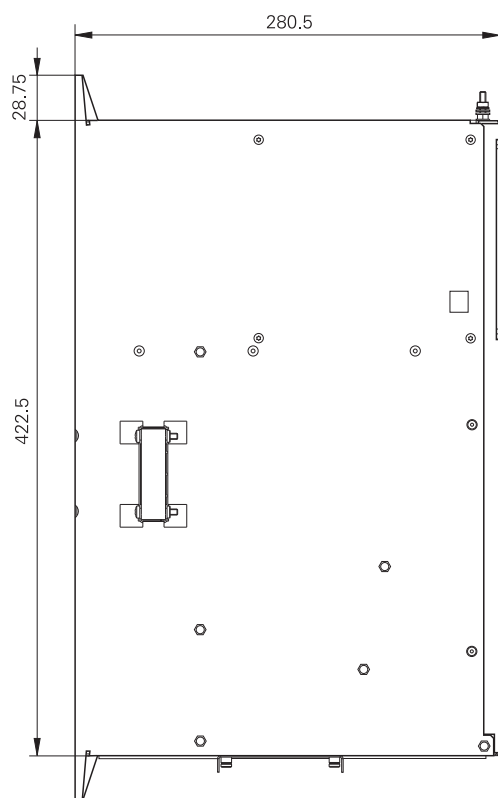
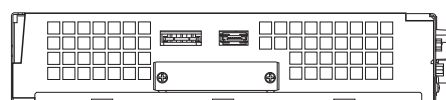
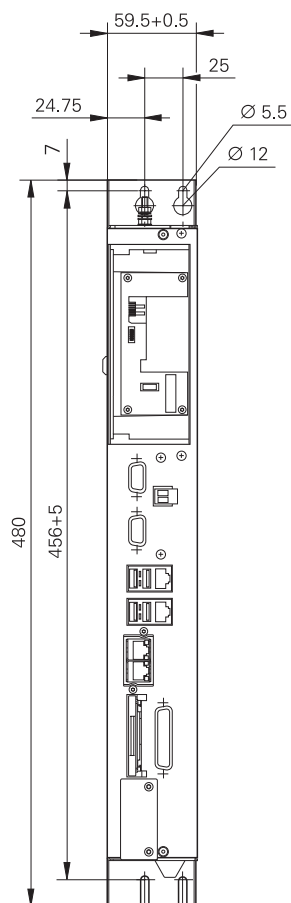
mm



Tolerancing ISO 8015

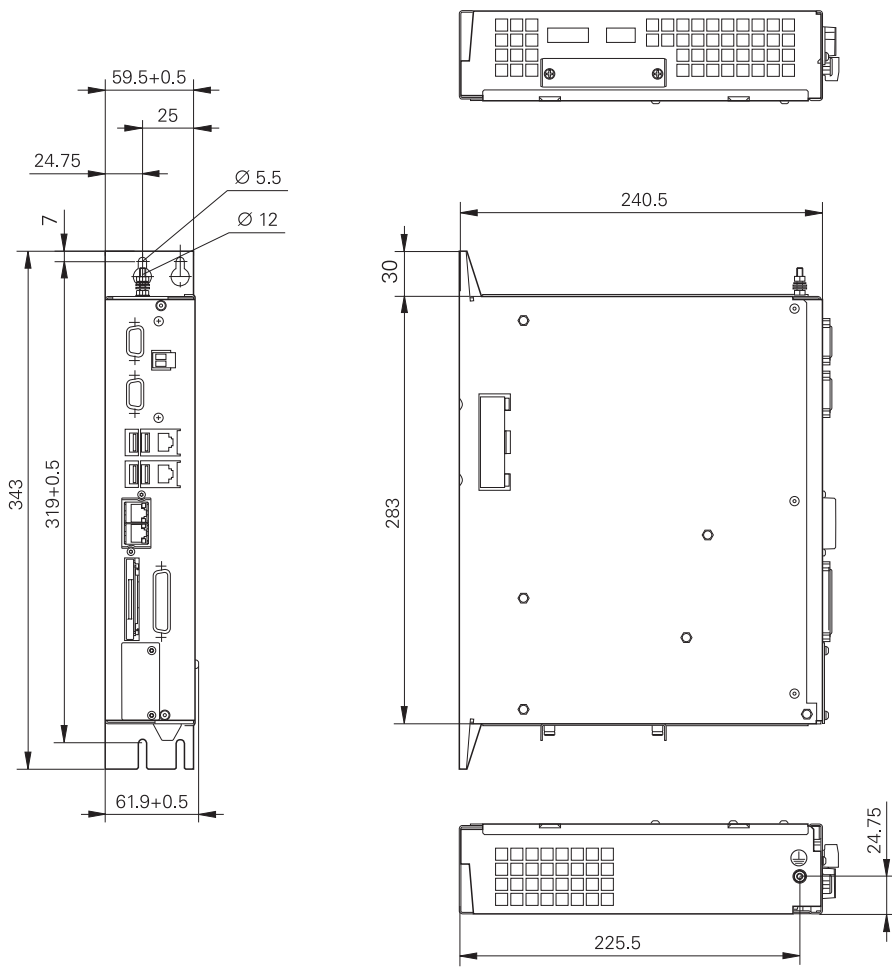
ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



MC 6542

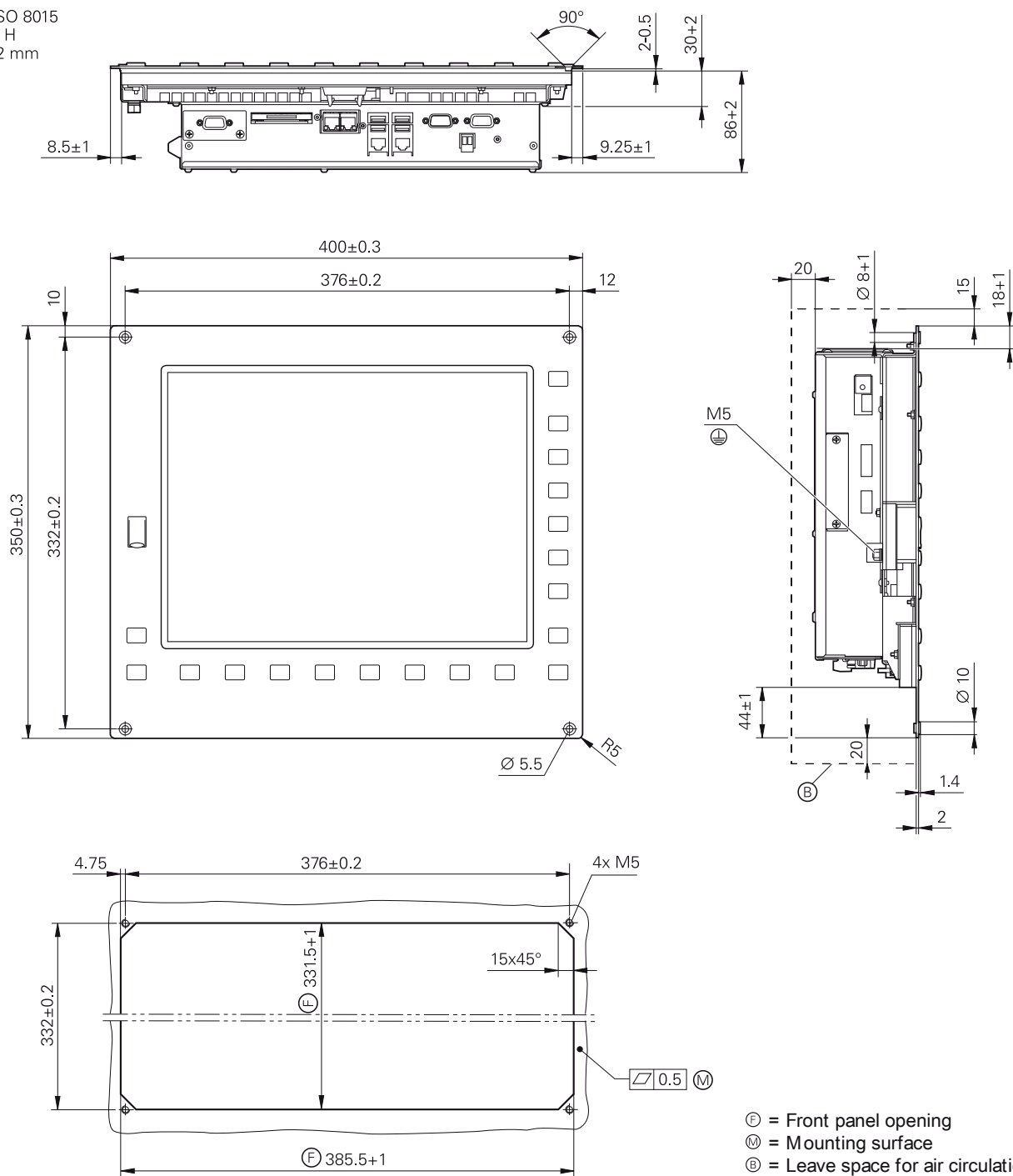
mm  
Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm: ±0.2 mm



# MC 7522

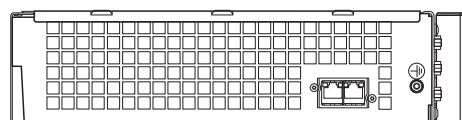


Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm:  $\pm 0.2$  mm




## CC 6106

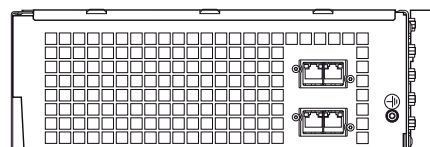
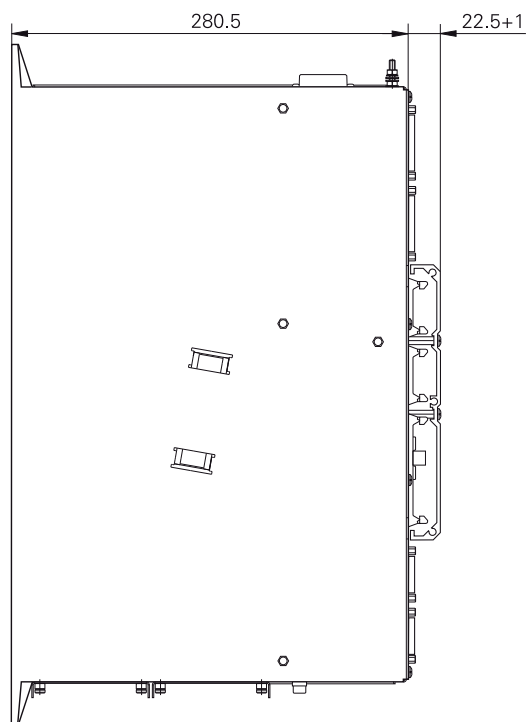
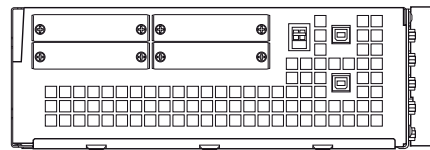
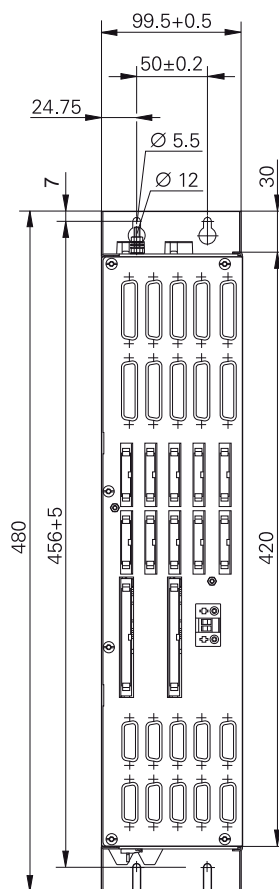
< 6 mm:  $\pm 0.2$  mm



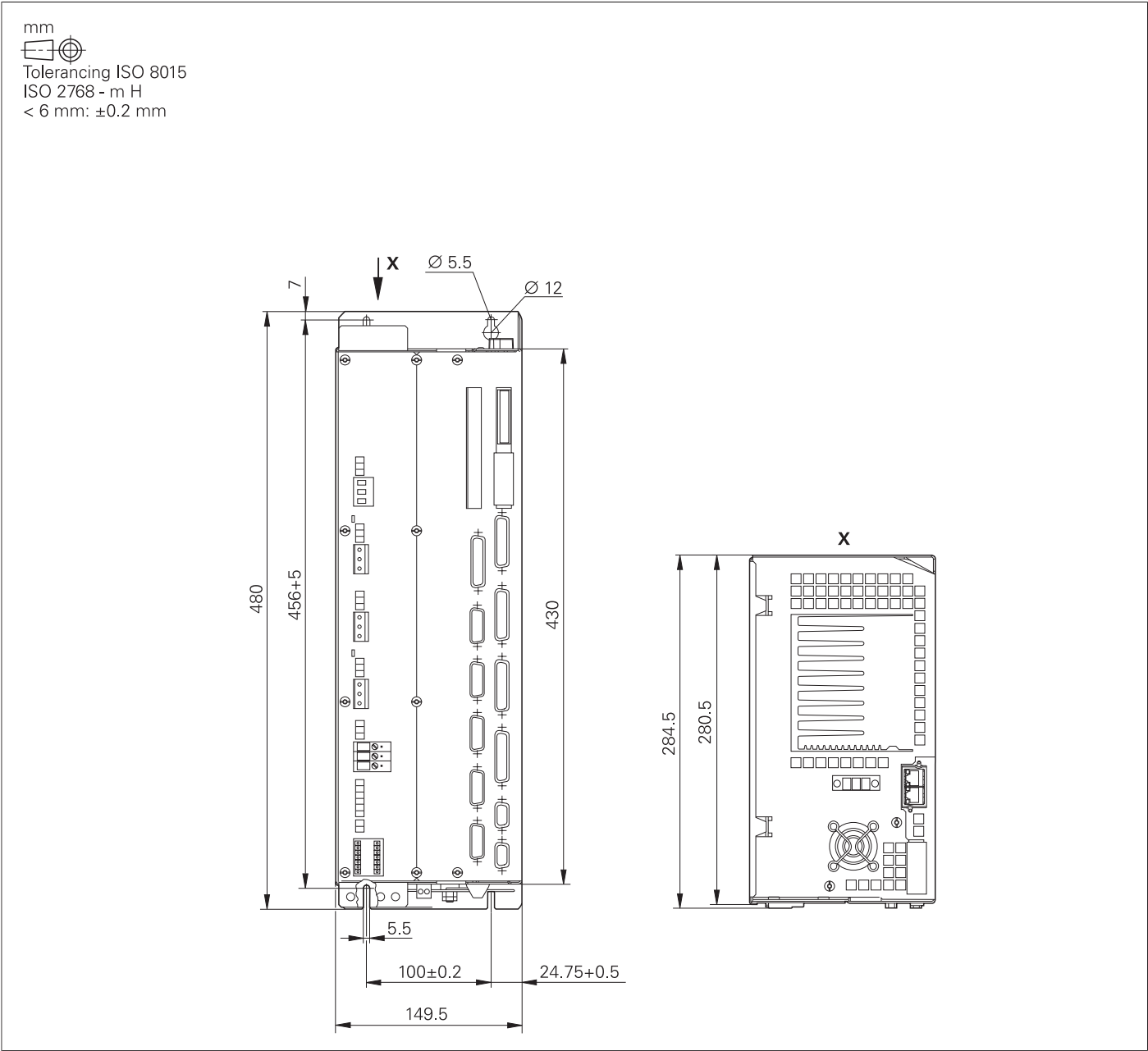
**CC 6108, CC 6110**

mm  
  
Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm:  $\pm 0.2$  mm

CC 6108: 8 control loops  
CC 6110: 10 control loops



UEC 111, UEC 112, UEC 113



## UMC 111

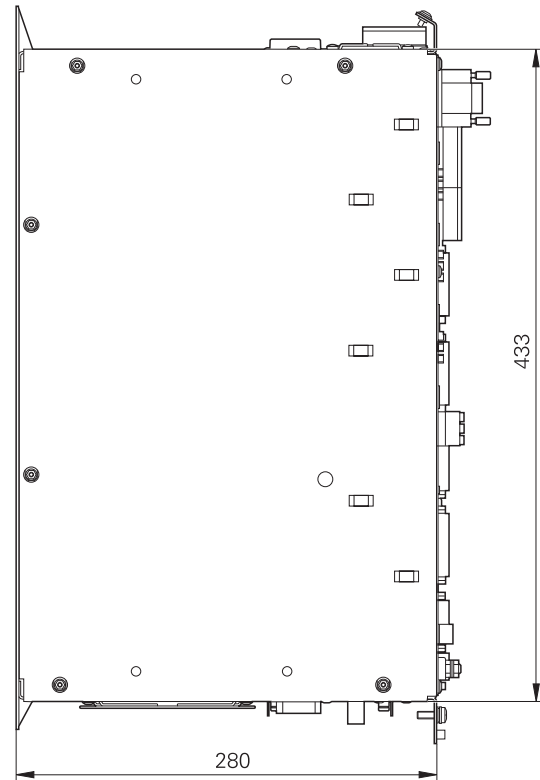
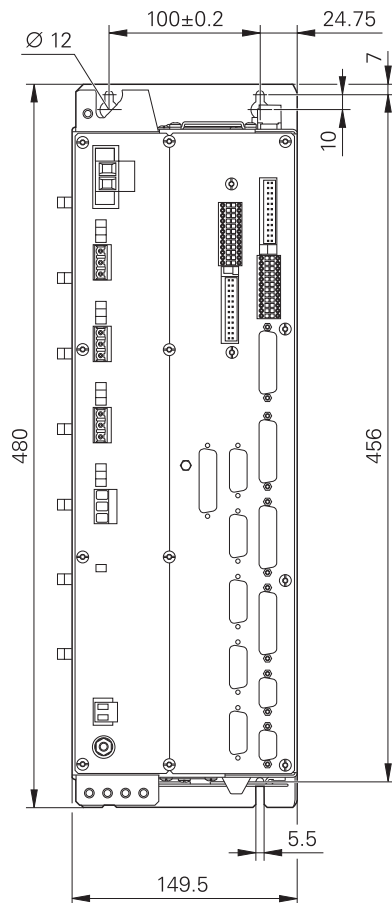
mm



Tolerancing ISO 8015


ISO 2768 - m H

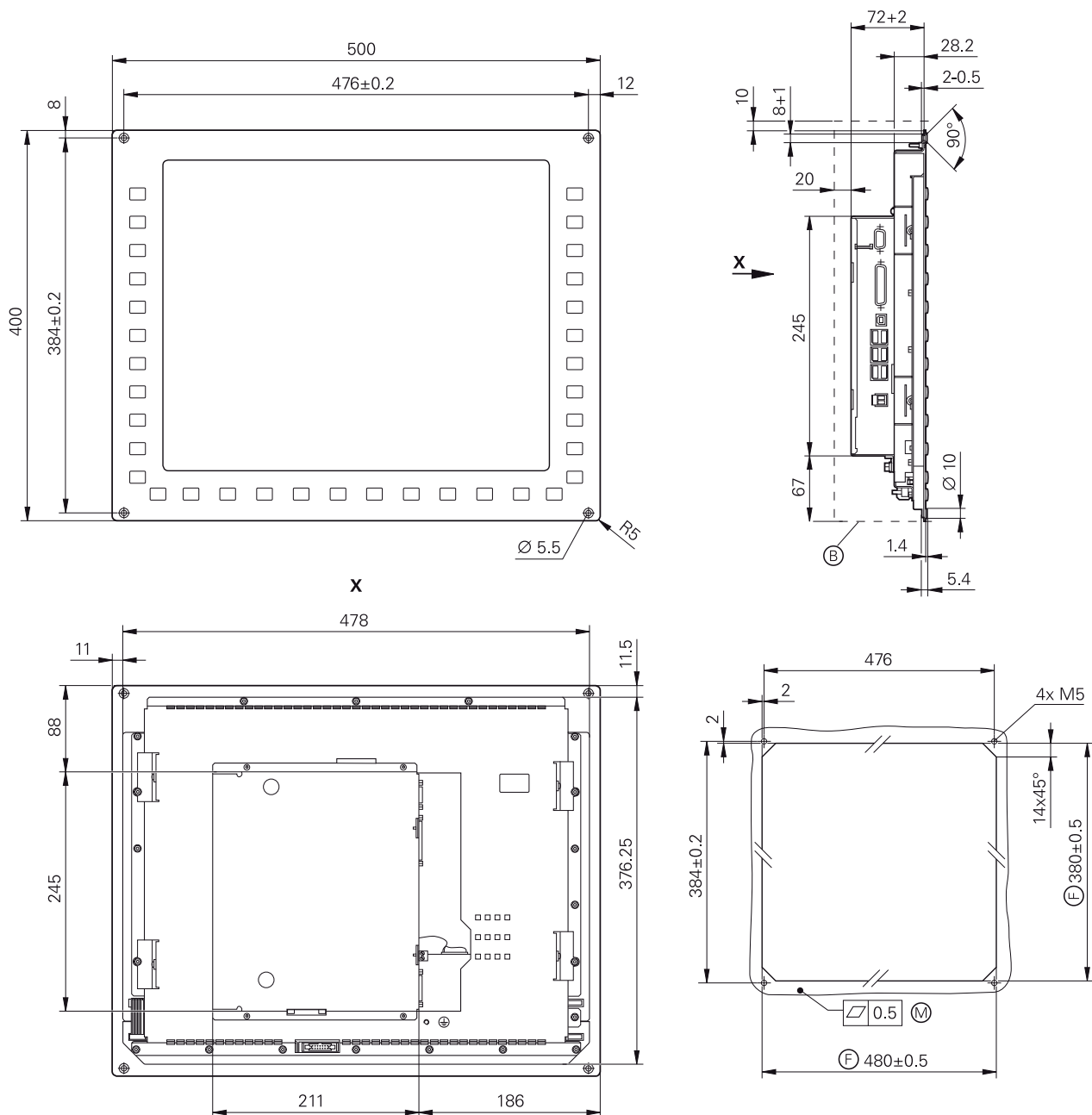
< 6 mm:  $\pm 0.2$  mm



## Monitor and keyboards

**BF 760**

mm  
  
 Tolerancing ISO 8015  
 ISO 2768 - m H  
 < 6 mm:  $\pm 0.2$  mm



(F) = Front panel opening  
 (M) = Mounting surface  
 (B) = Leave space for air circulation



# TE 740

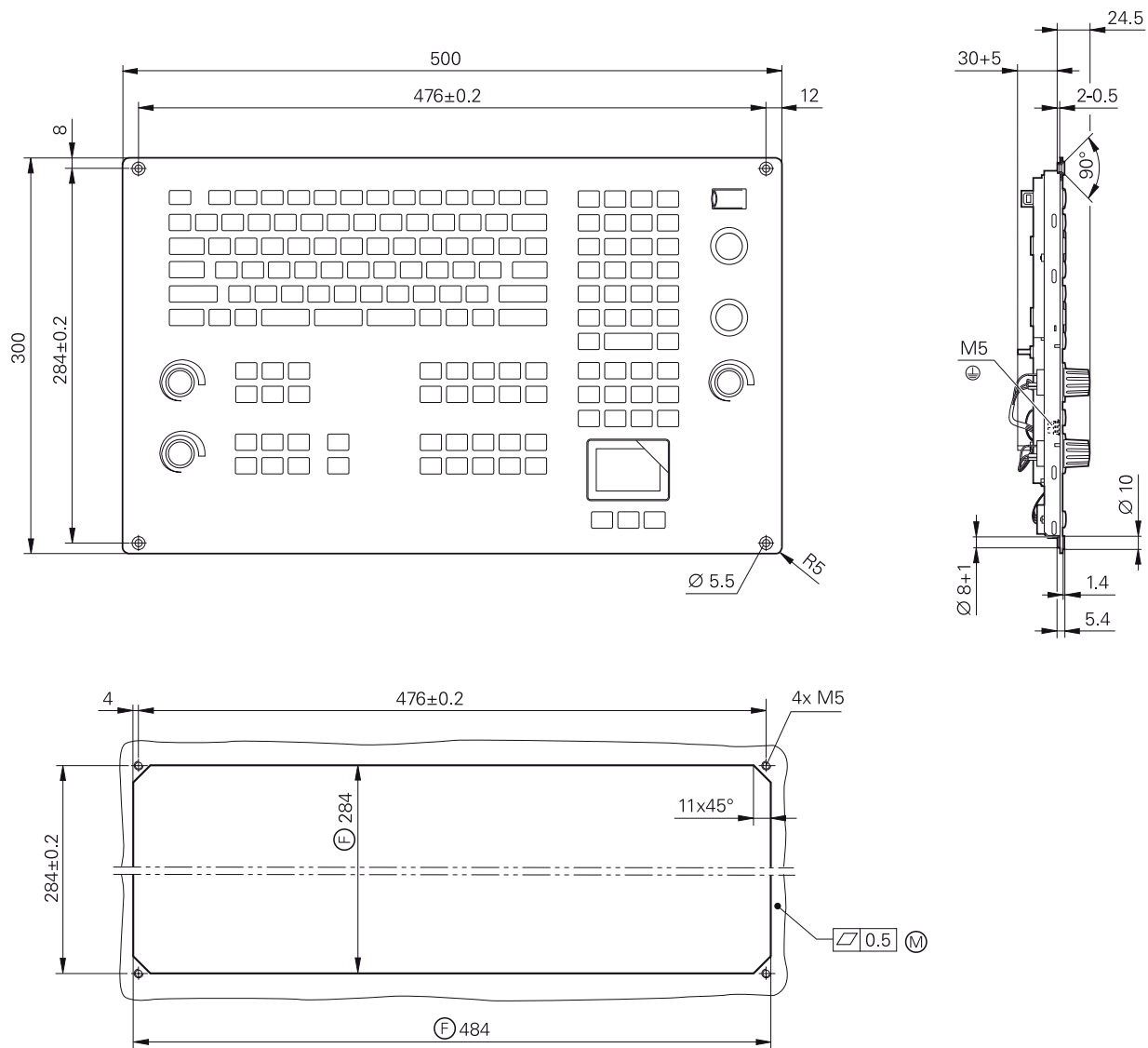
mm



Tolerancing ISO 8015

ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm

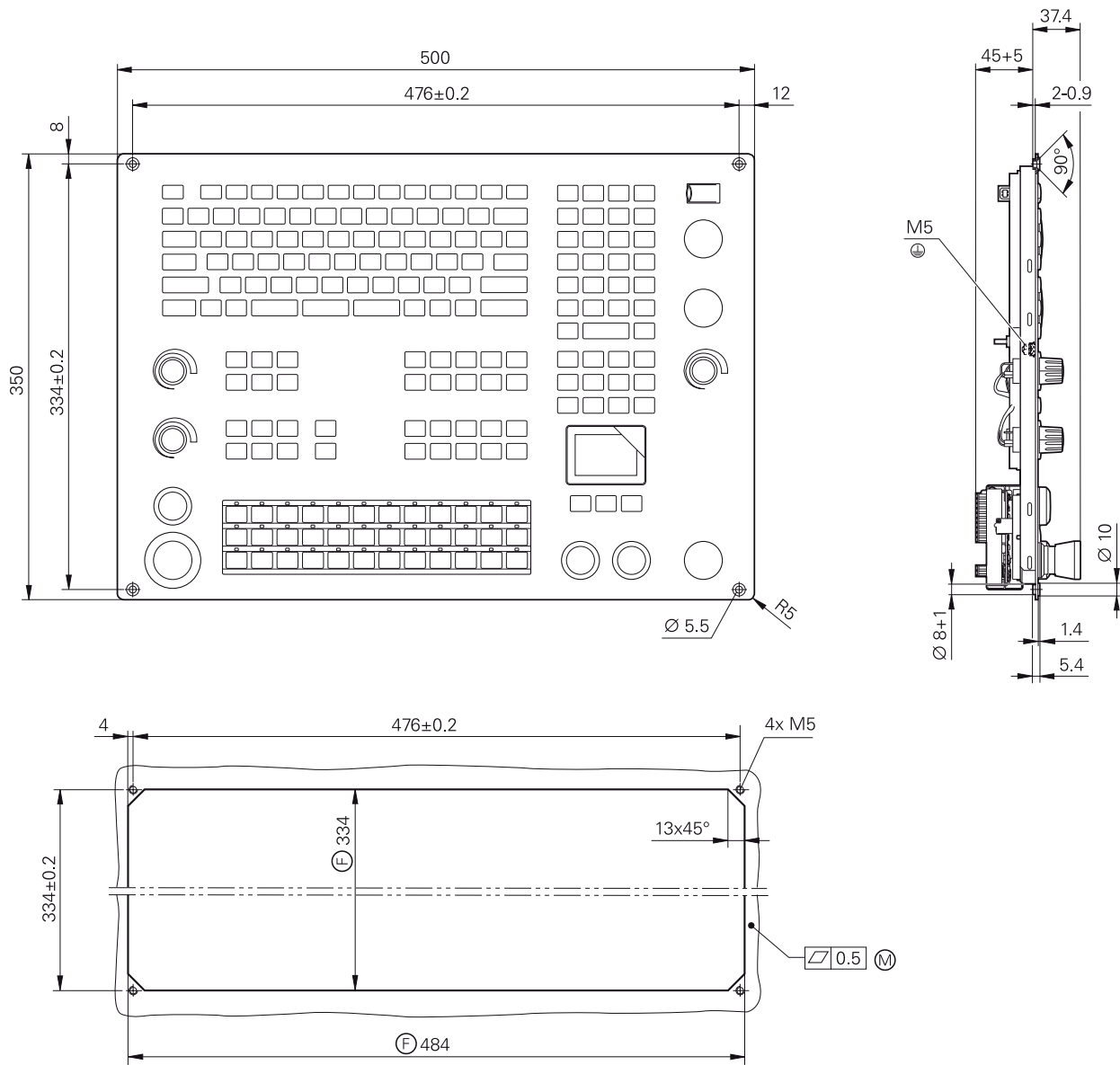


⊕ = Front panel opening

⊙ = Mounting surface


TE 745

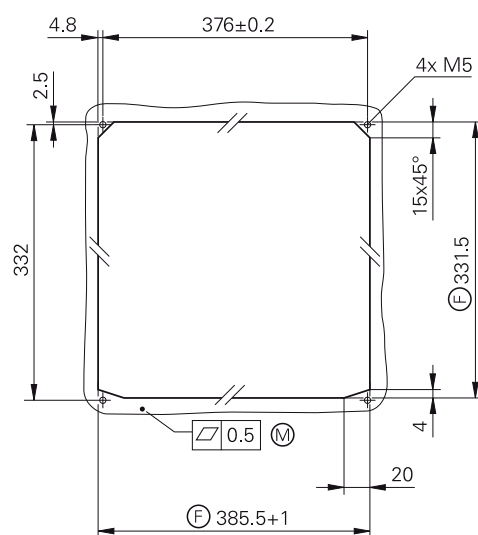
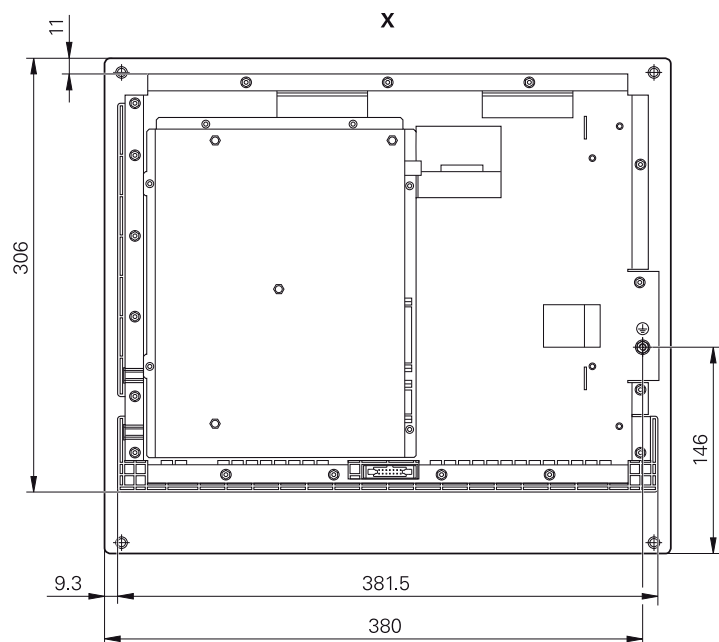
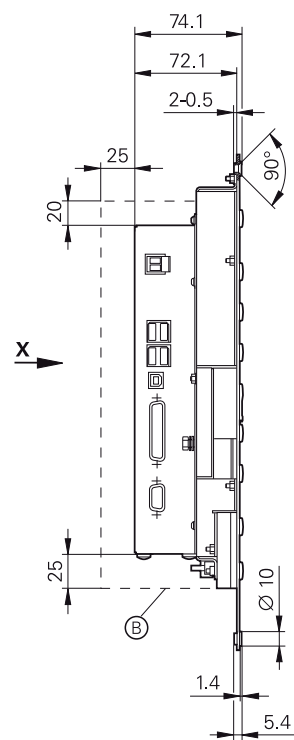
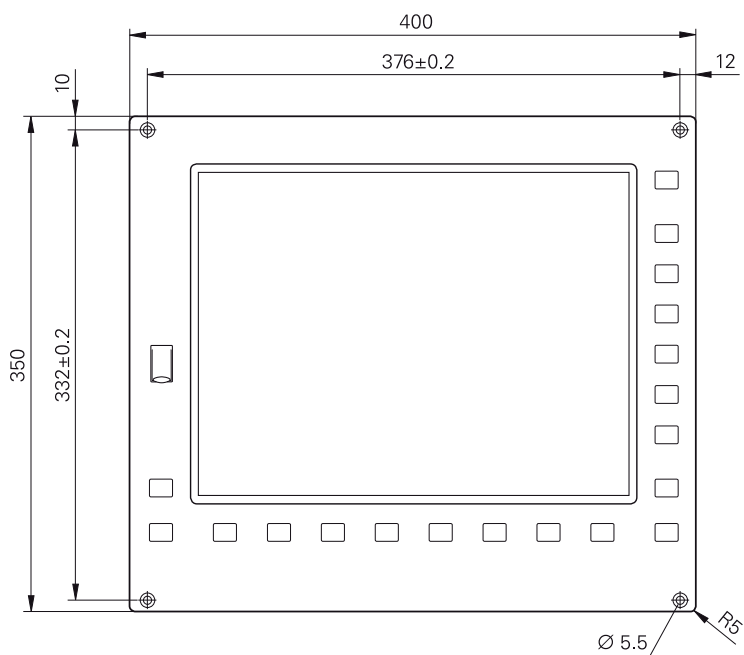
mm  
Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm: ±0.2 mm



Ⓢ = Front panel opening  
Ⓜ = Mounting surface

# BF 750

mm  
  
 Tolerancing ISO 8015  
 ISO 2768 - m H  
 < 6 mm:  $\pm 0.2$  mm

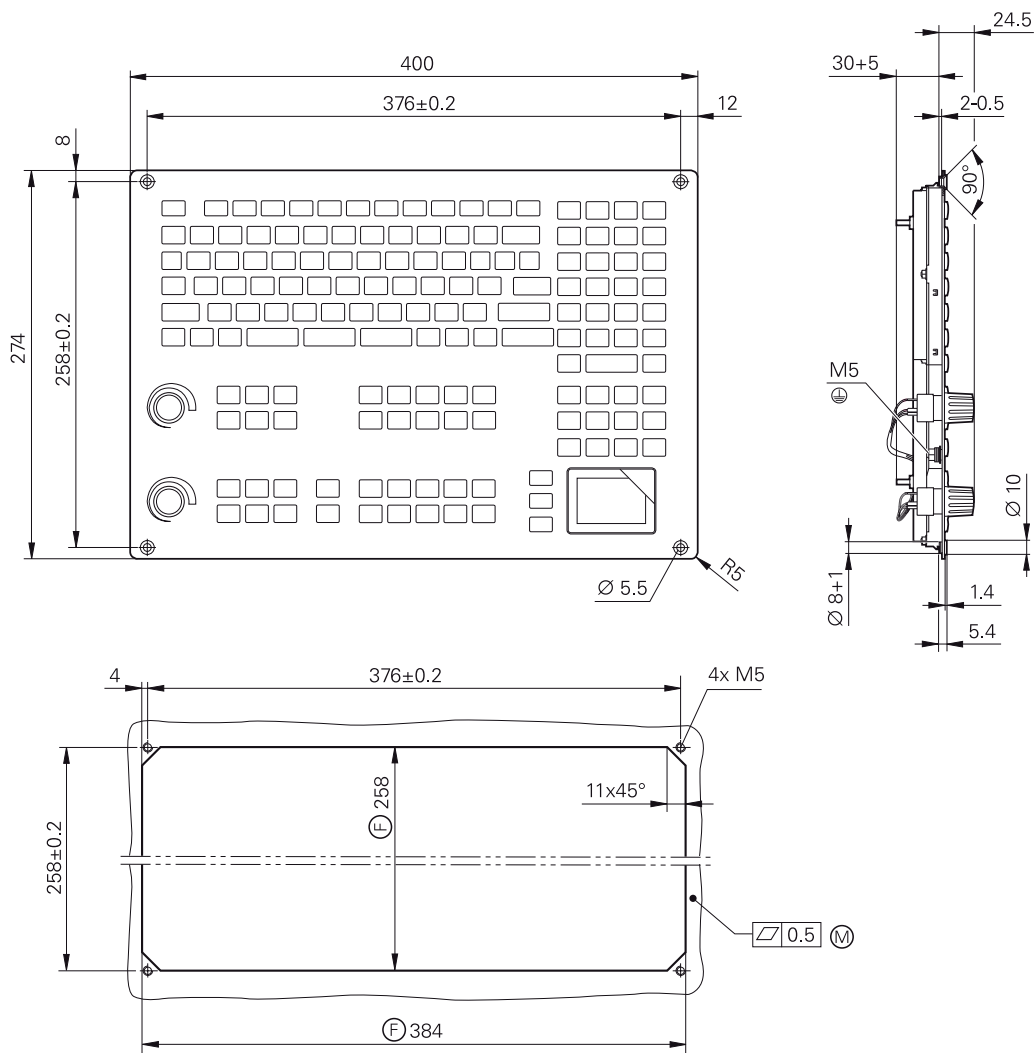


- ⊕ = Front panel opening
- Ⓜ = Mounting surface
- Ⓟ = Leave space for air circulation

TE 720, TE 730


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

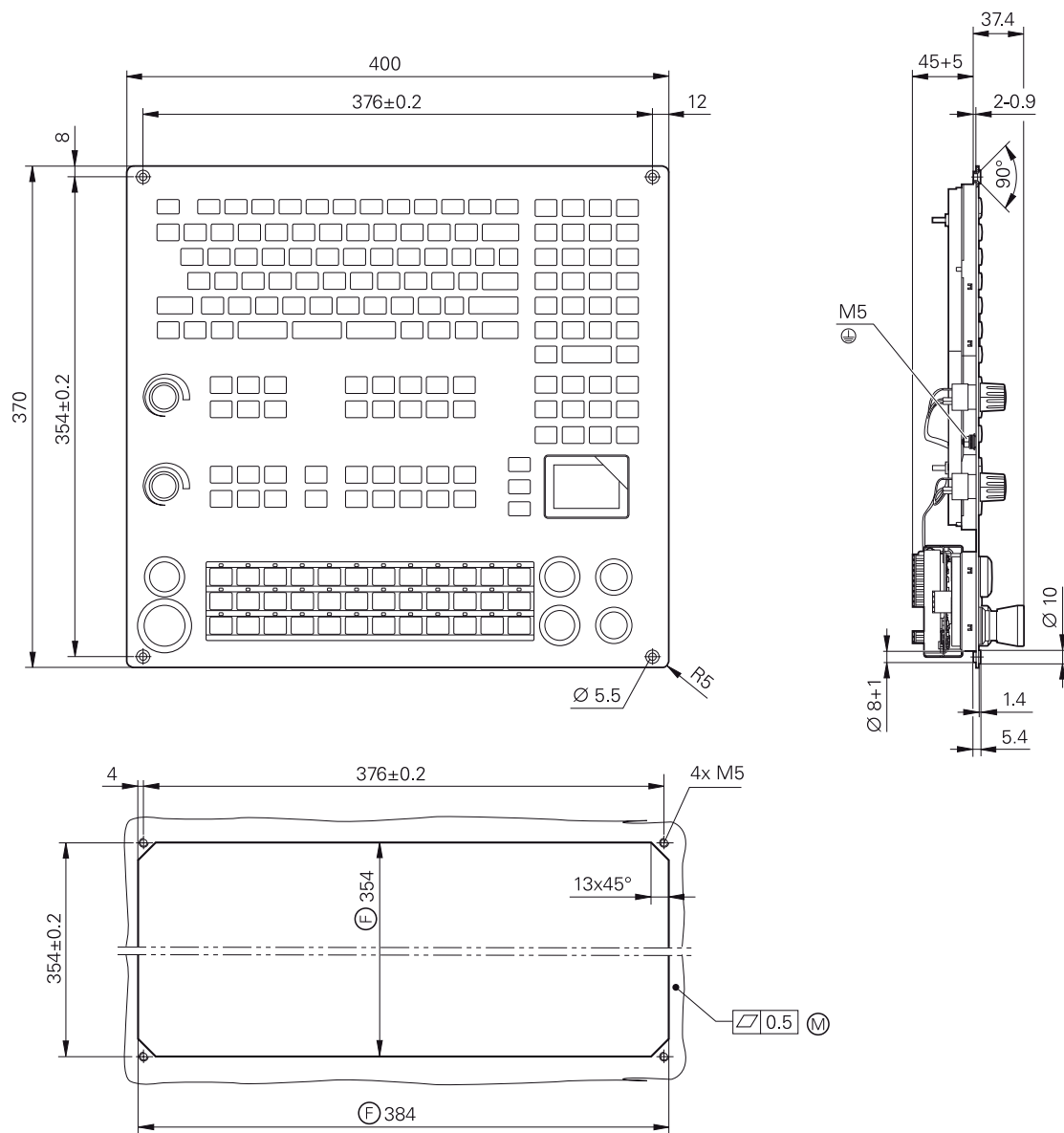
TE 720 B: Without touchpad  
TE 730 B: With touchpad



⊕ = Front panel opening  
Ⓜ = Mounting surface

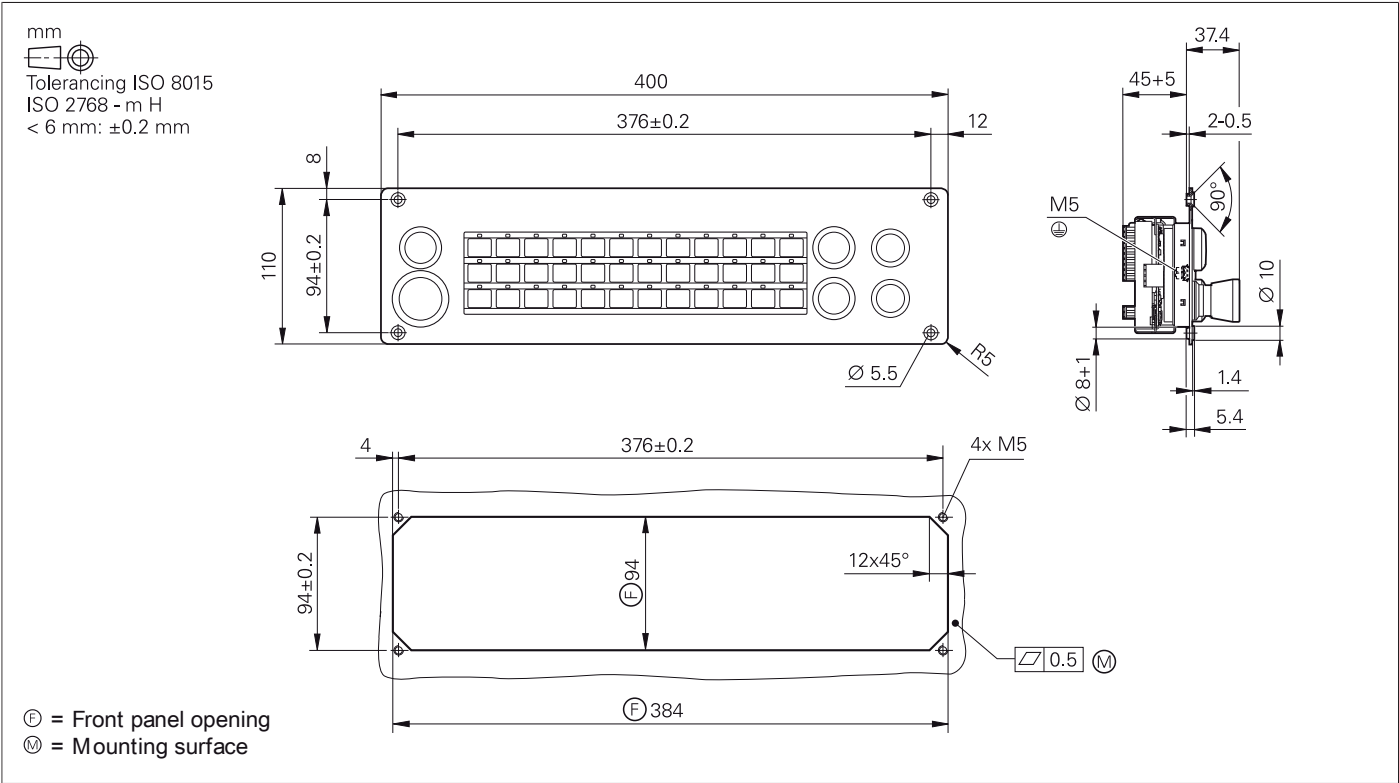
# TE 735

mm  
  
Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm:  $\pm 0.2$  mm

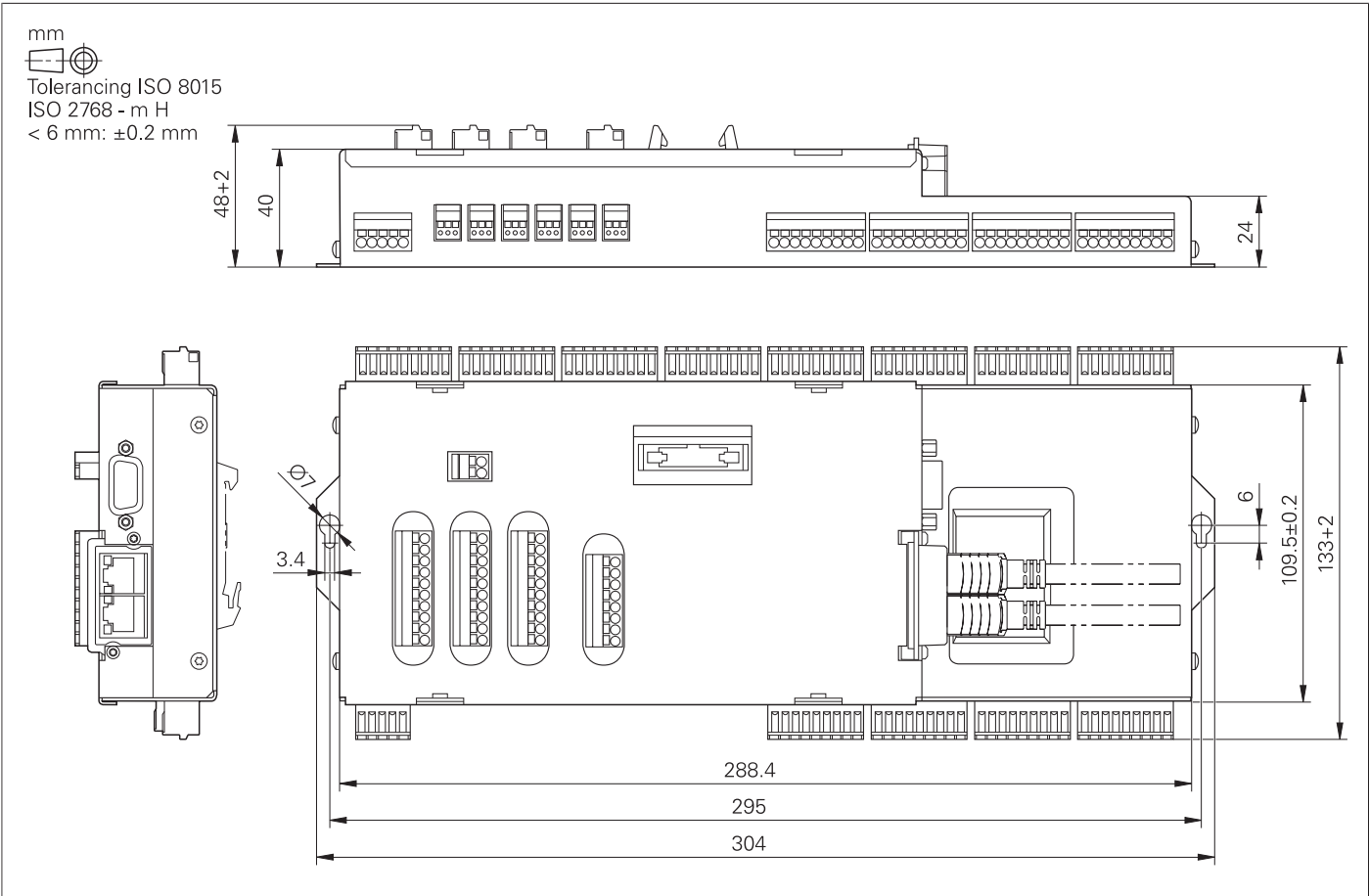


Ⓕ = Front panel opening  
Ⓜ = Mounting surface

MB 720

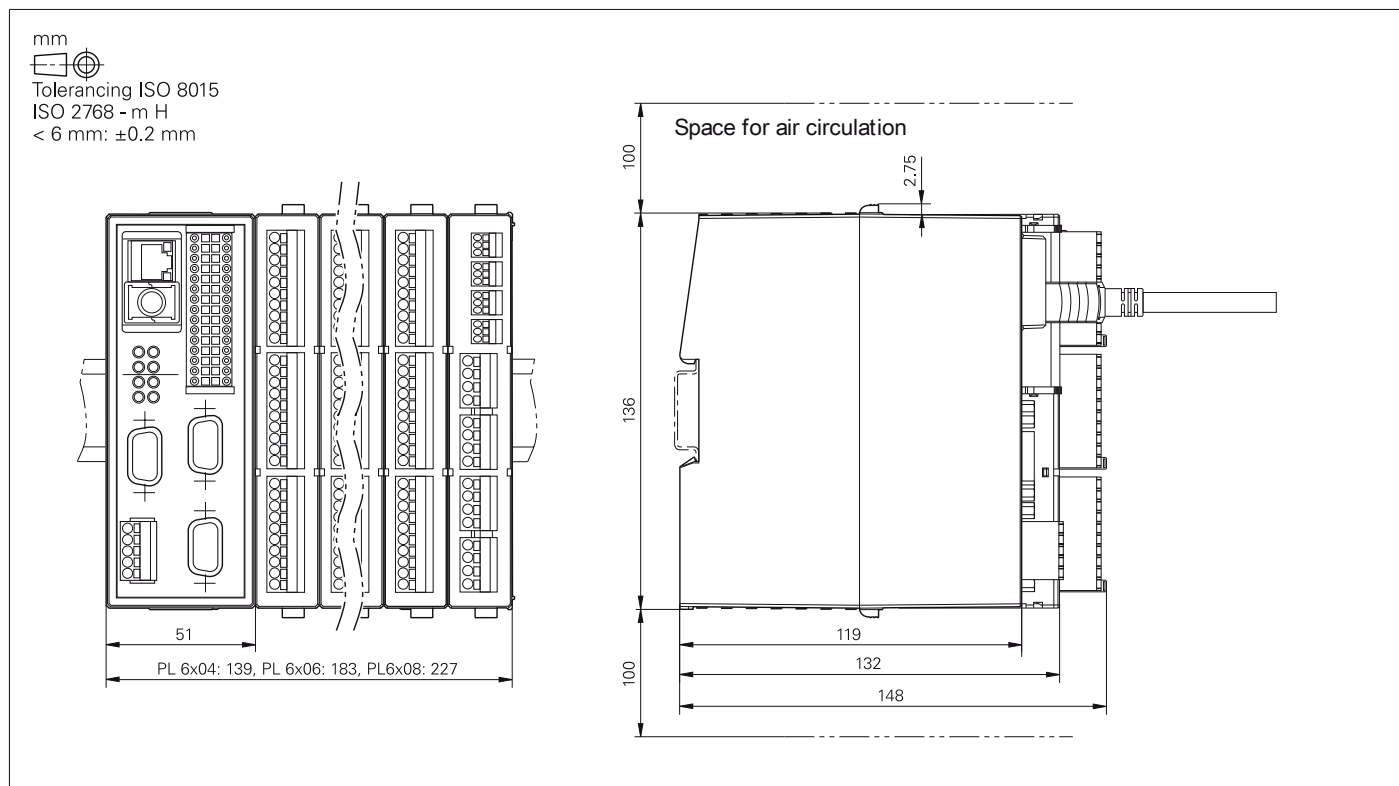


PLB 6001

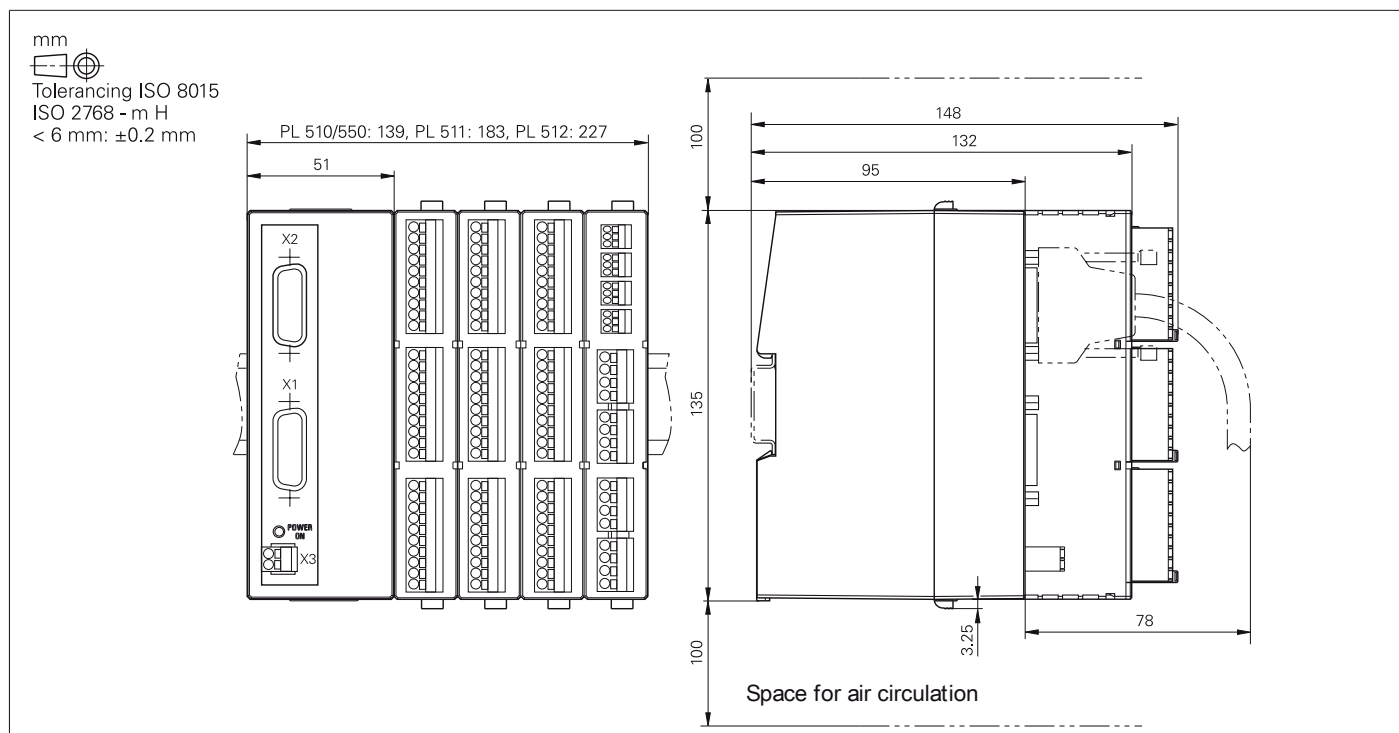


# PLC inputs and outputs

## PL 6000 (PLB 62xx, PLB 61xx)

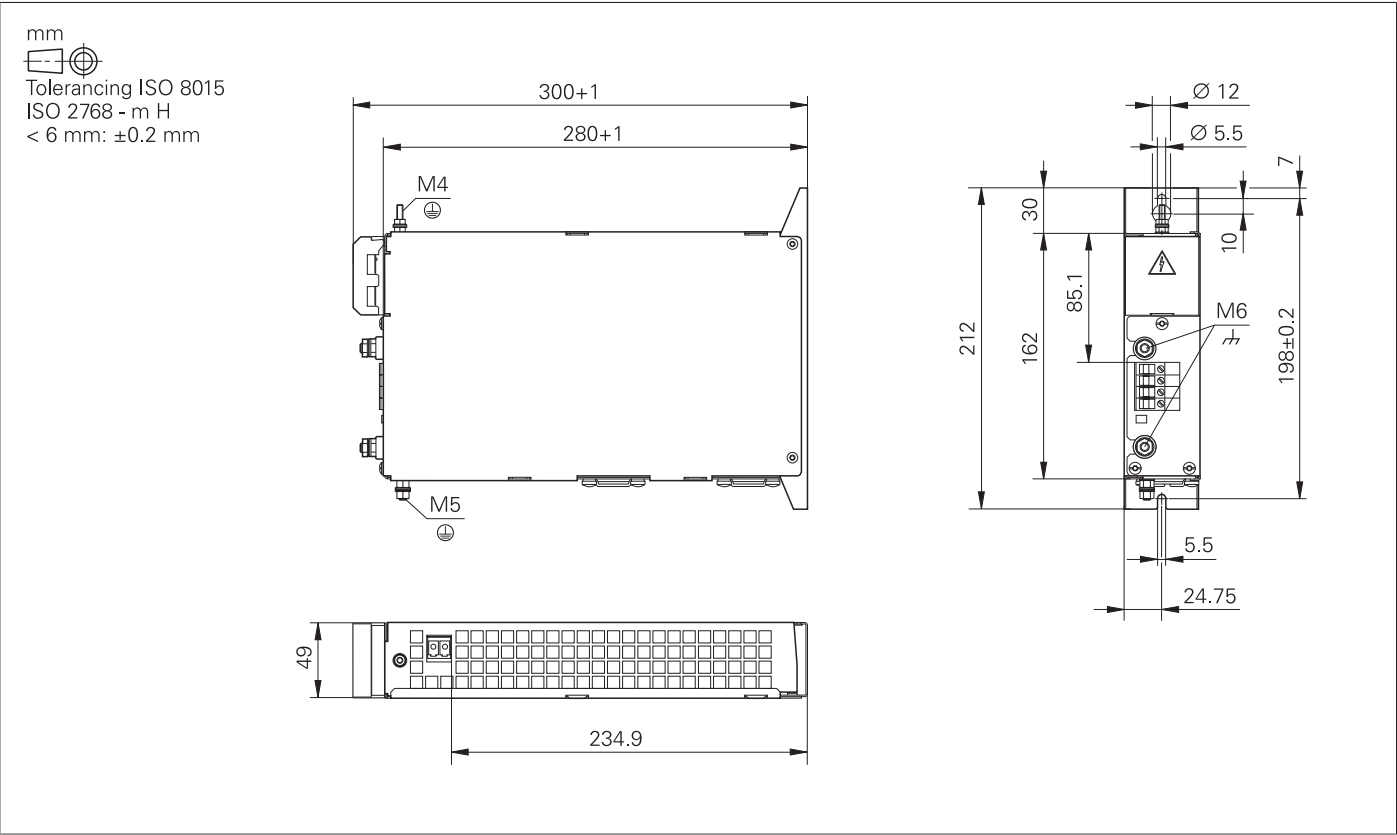


## PL 550

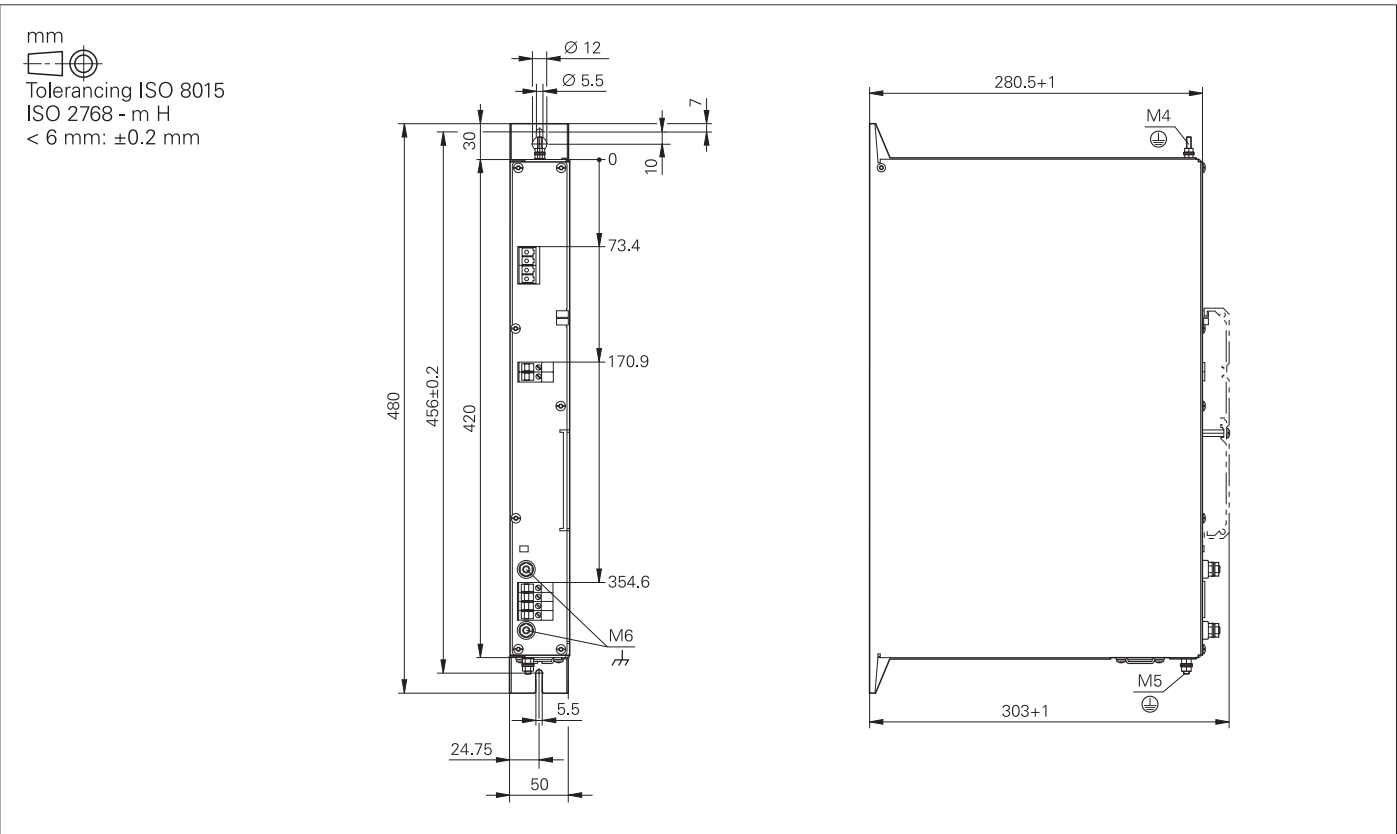


# Power supply units

## PSL 130



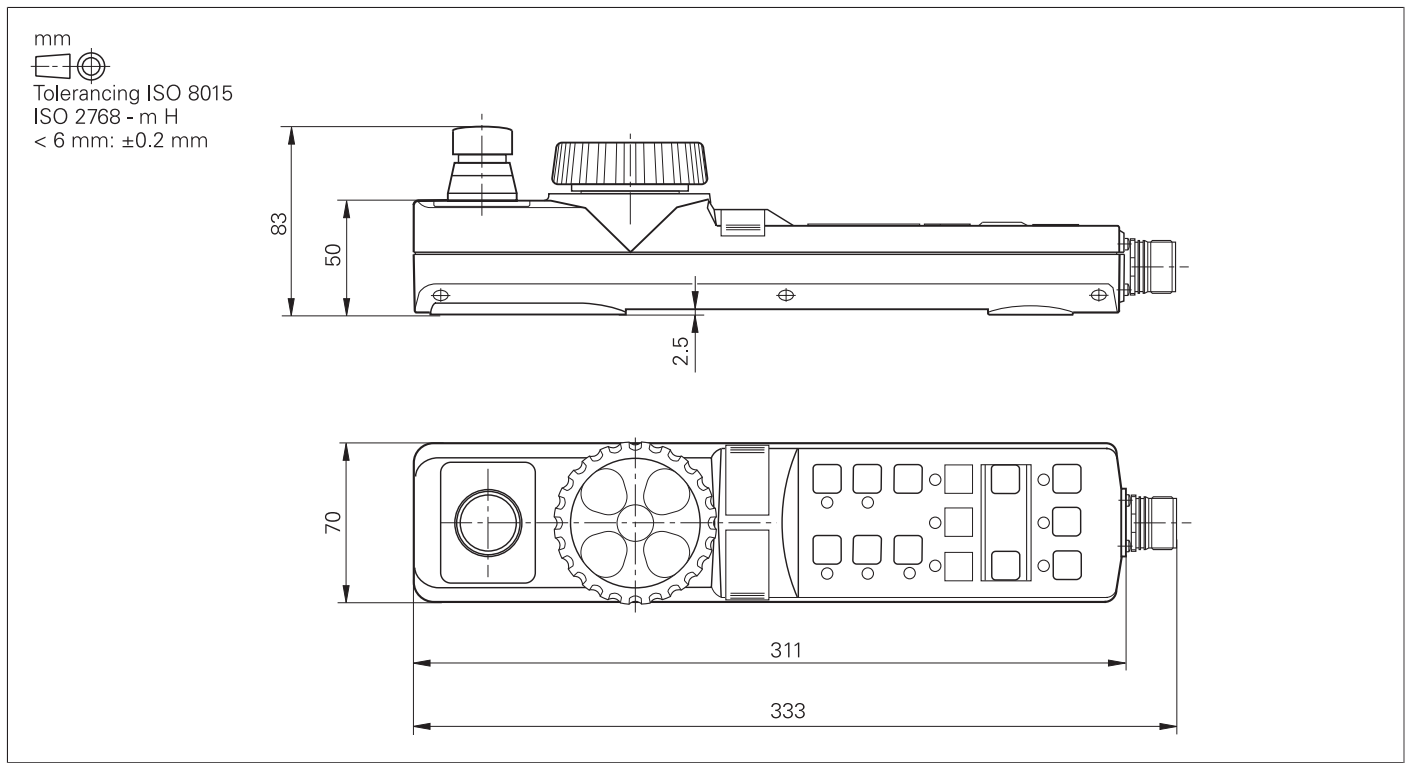
## PSL 135



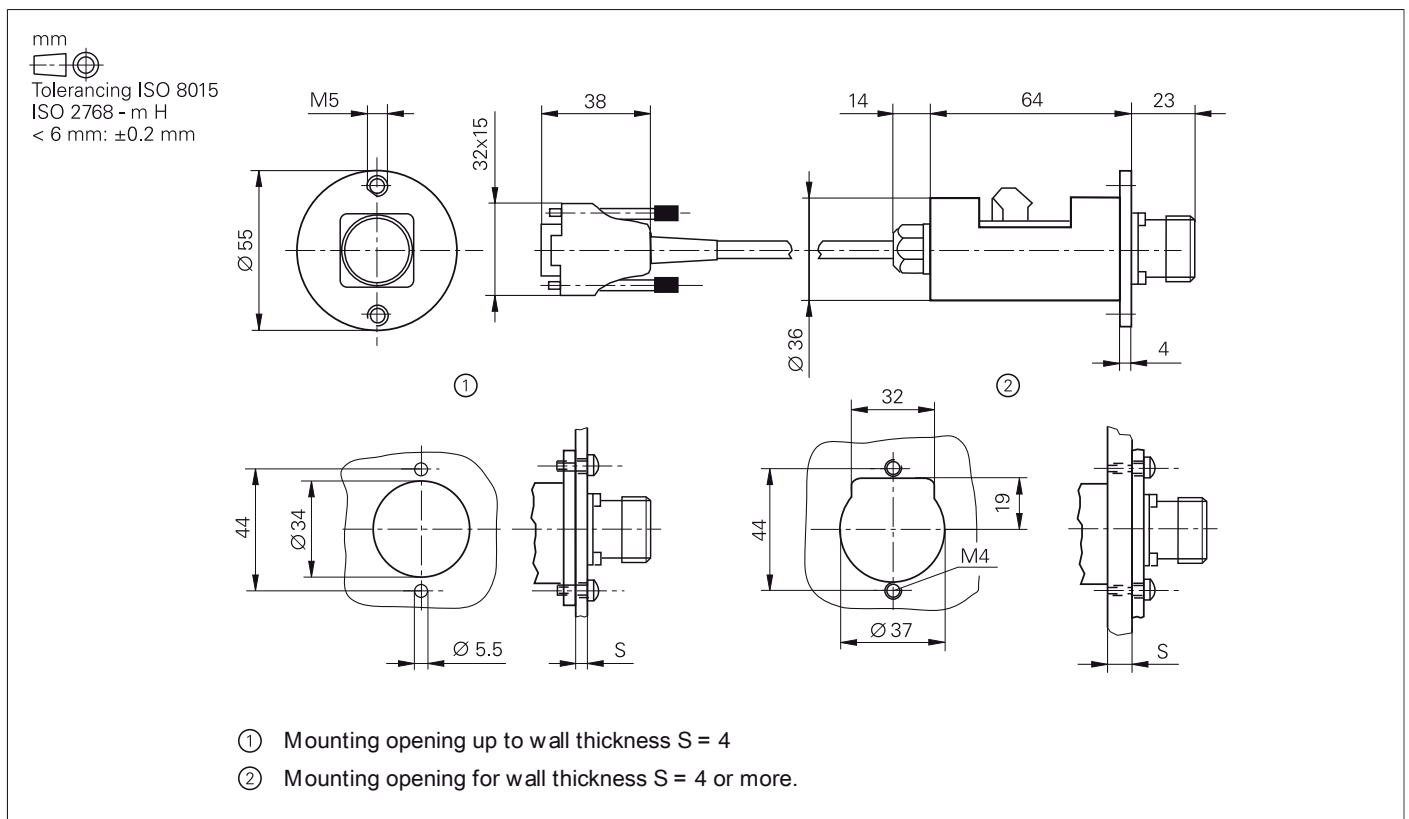


# Electronic handwheels

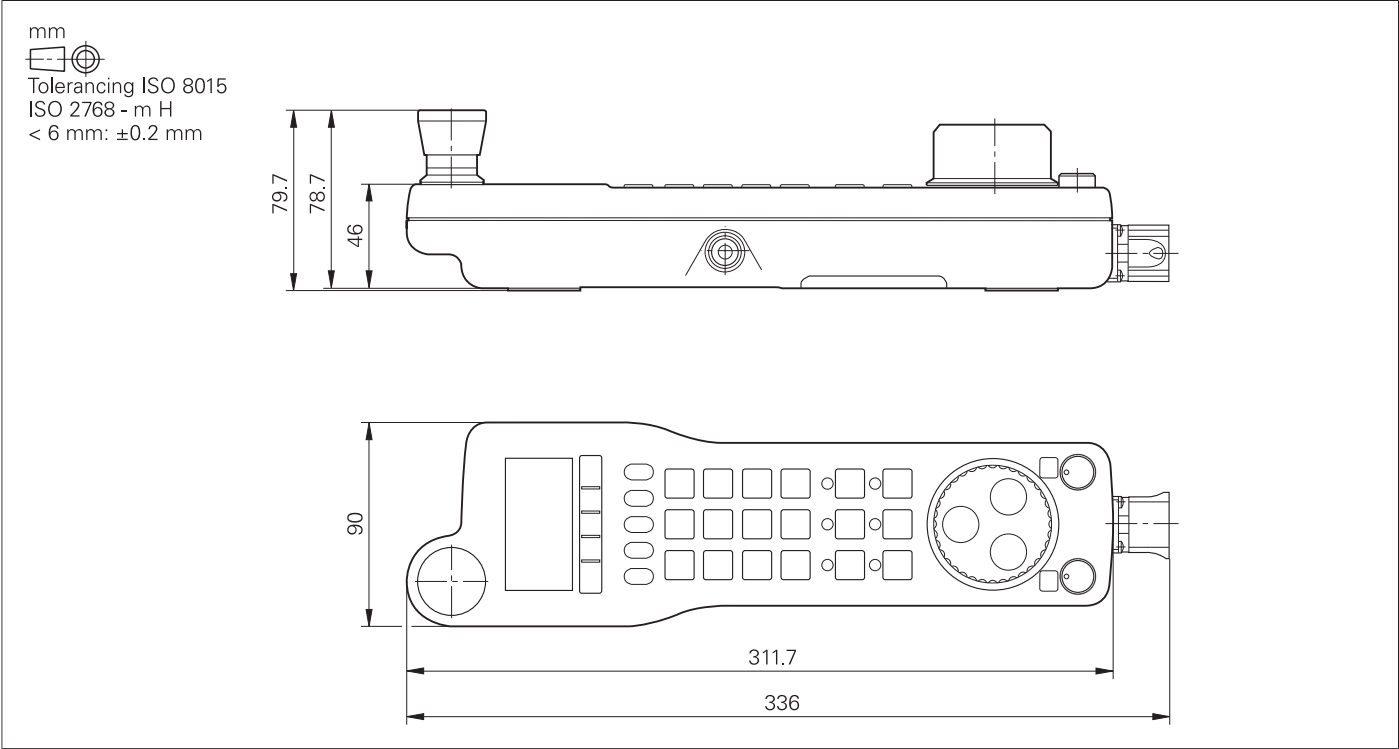
## HR 410



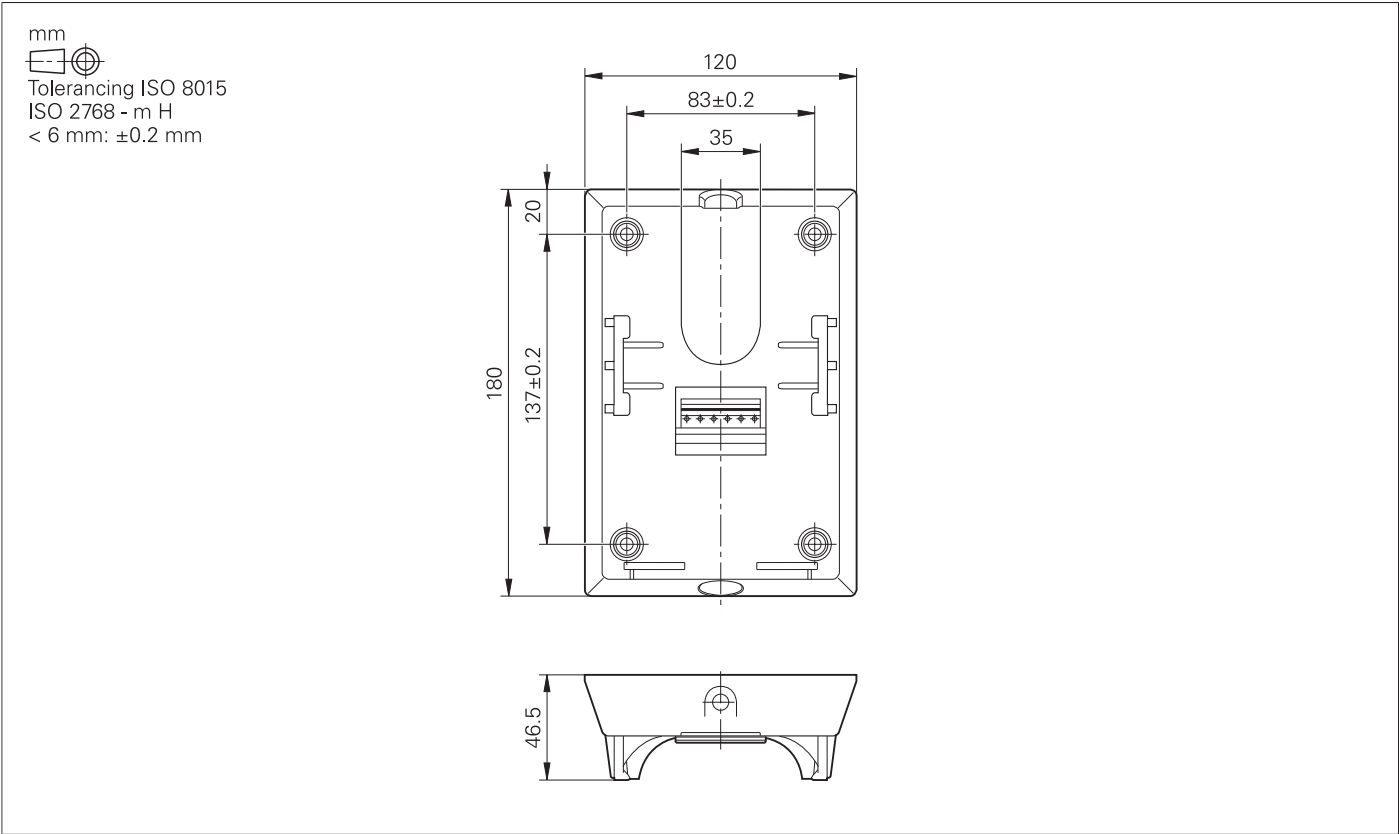
## Adapter cable for HR 410 and HR 520



HR 520



Mount for HR 520

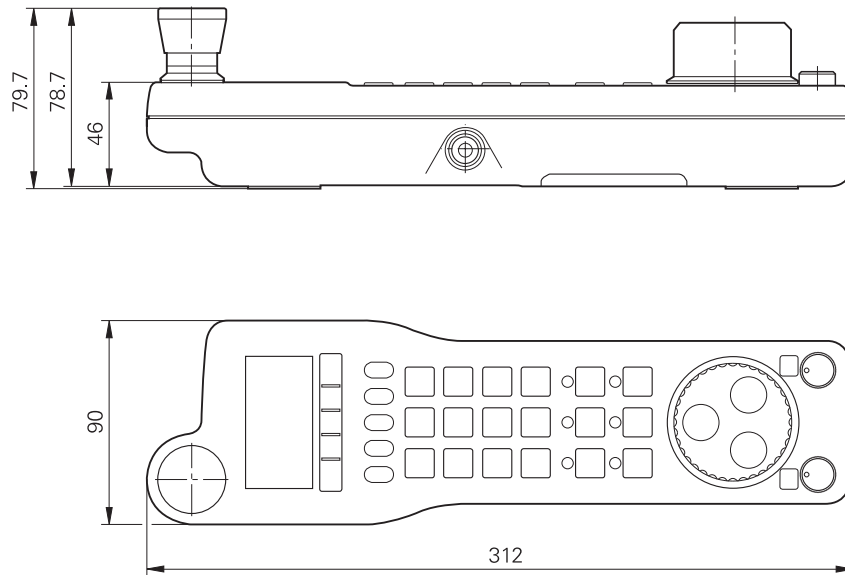


## HR 550 FS

mm



Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm:  $\pm 0.2$  mm

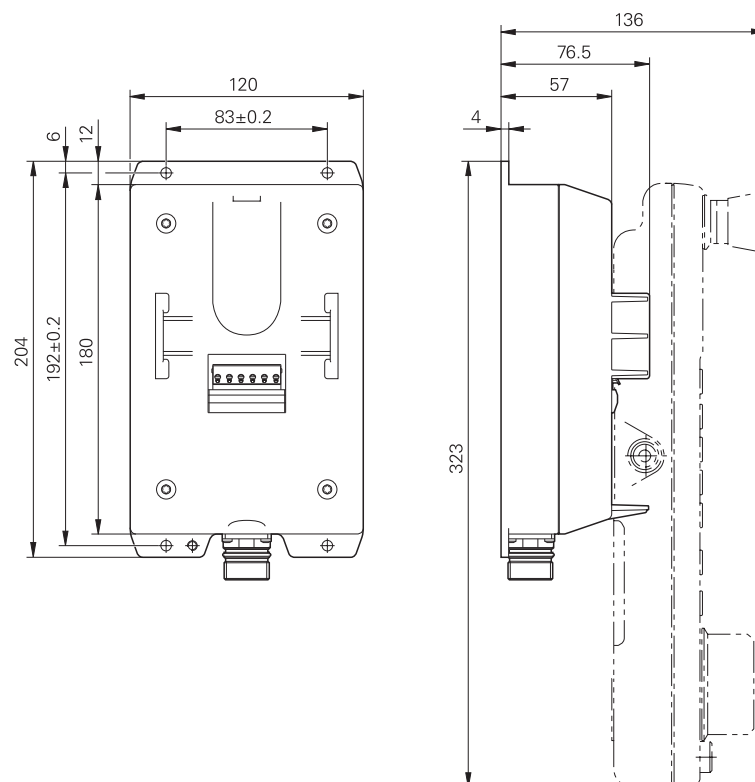


## HRA 551 FS

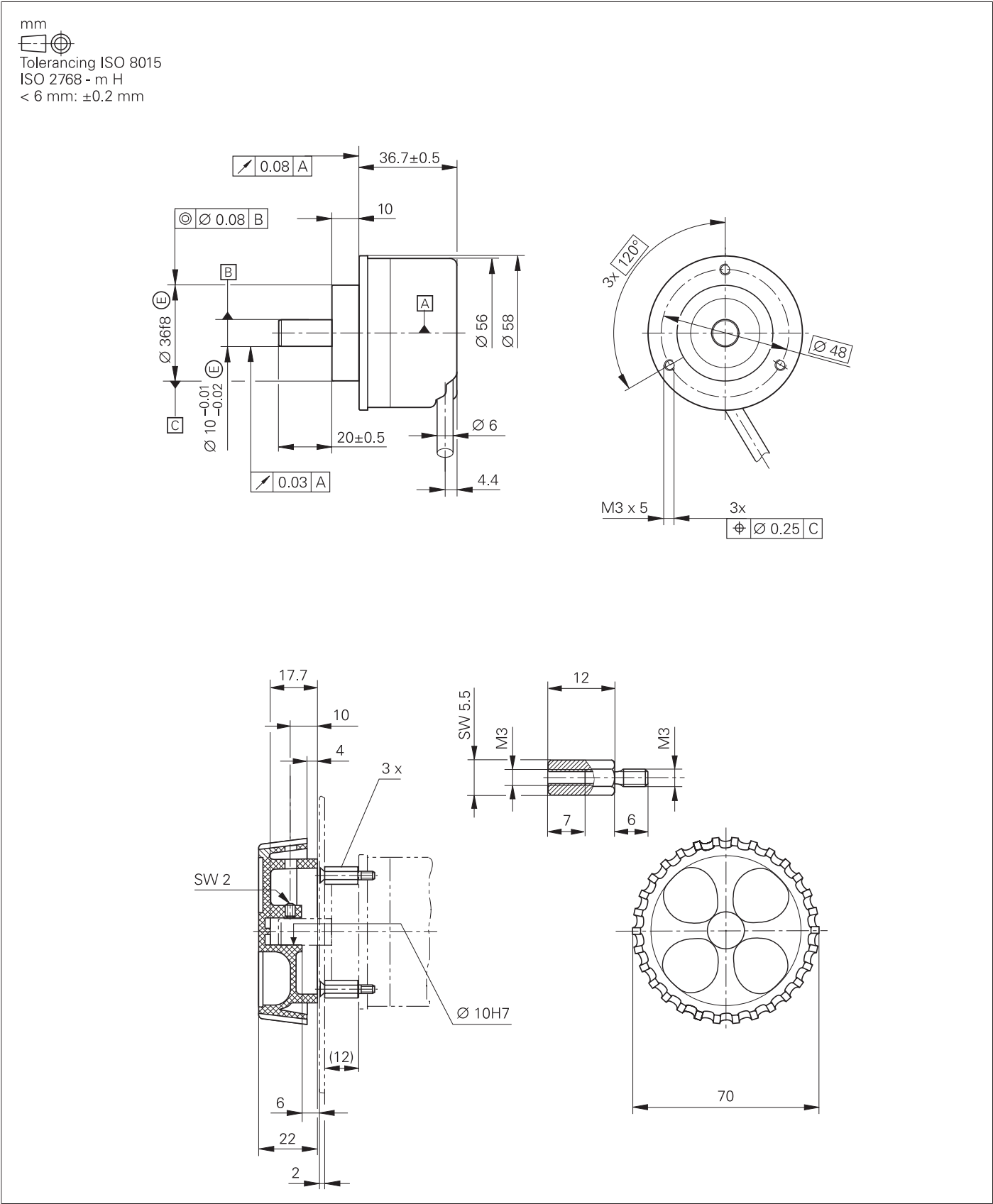
mm



Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm:  $\pm 0.2$  mm



HR 130, HR 150 with control knob



mm  
 Tolerancing ISO 8015  
 ISO 2768 - m H  
 < 6 mm:  $\pm 0.2$  mm

HR 150

58+1  
 53  
 1+0.5  
 248

X

X23  
 S1  
 S2  
 X31 24V  
 +

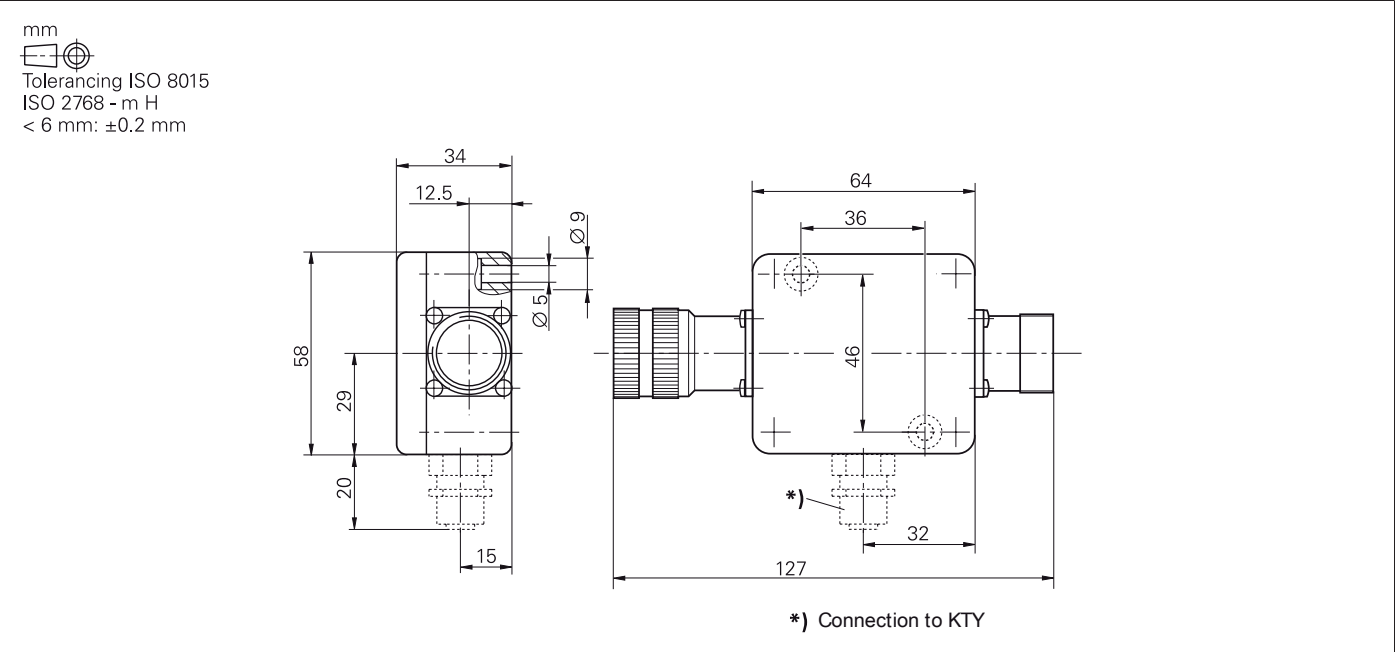
X

Ø 6  
 45+1  
 116±0.2  
 14  
 143.5+1  
 207+2  
 Ø 3.6  
 230±0.2  
 9

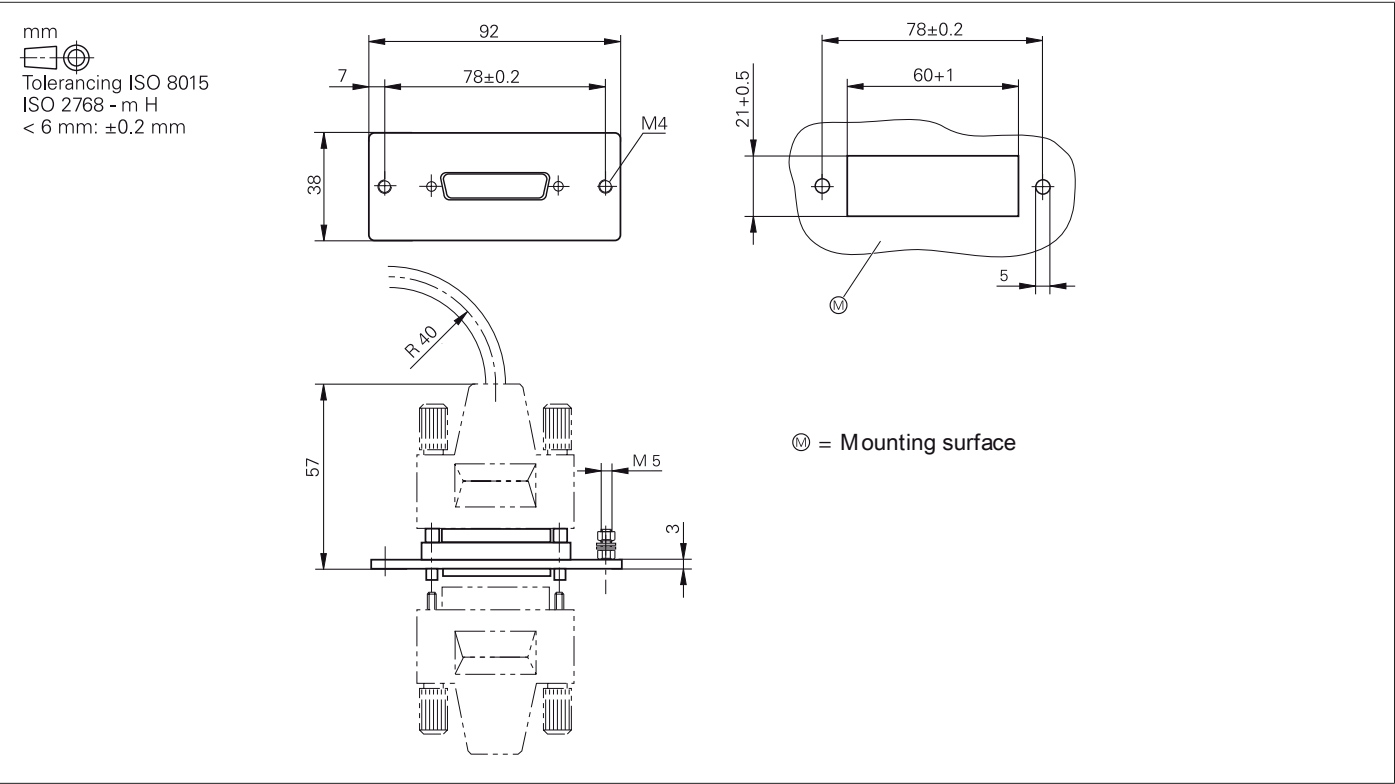
[illegible]

# Interface accessories

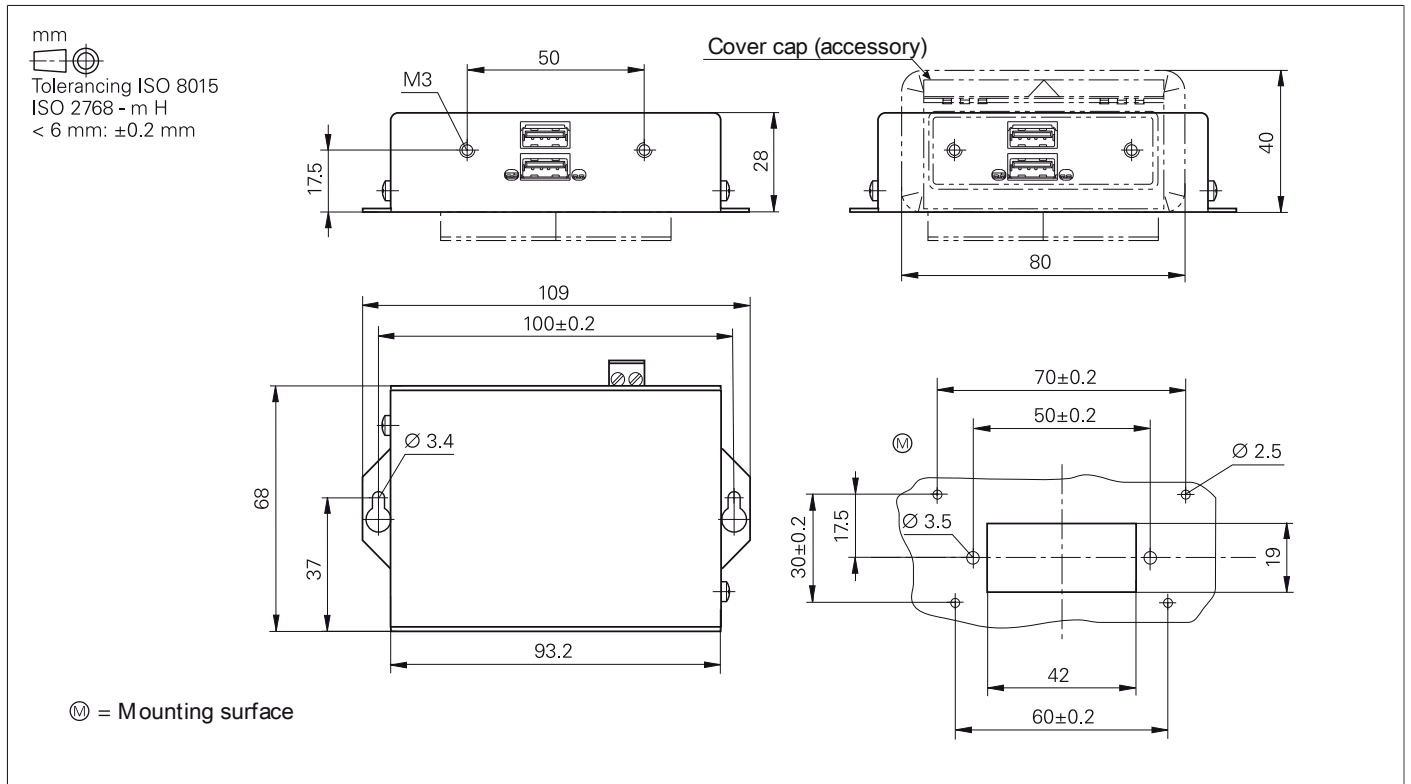
## Line-drop compensator for encoders with EnDat interface



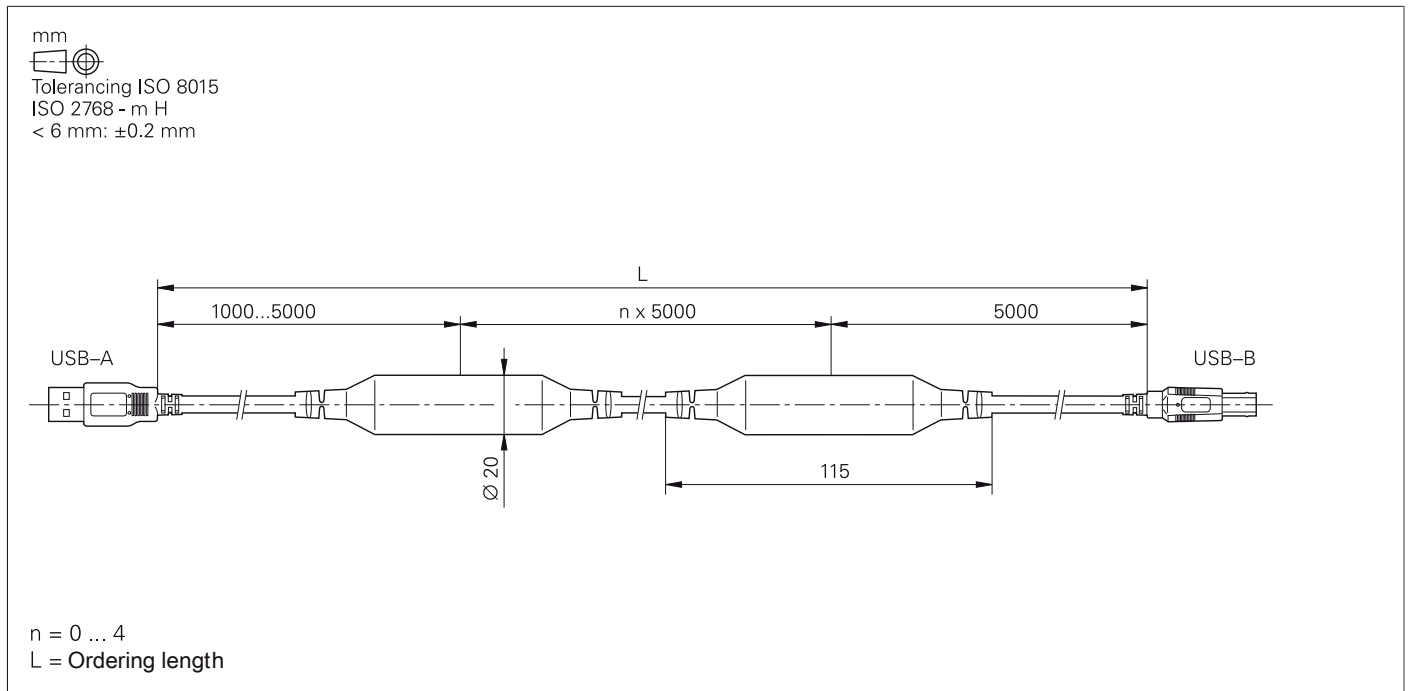
## RS-232-C adapter



## USB hub



## USB extension cable with hubs



# General information

## Documentation

Technical documentation	<ul style="list-style-type: none"> <li>• <b>TNC 640</b> Technical Manual</li> <li>• <b>Inverter Systems and Motors</b> Technical Manual</li> <li>• <b>Functional Safety</b> Technical Manual</li> <li>• <b>TS 230</b> Mounting Instructions</li> <li>• <b>TS 440</b> Mounting Instructions</li> <li>• <b>TS 444</b> Mounting Instructions</li> <li>• <b>TS 640</b> Mounting Instructions</li> <li>• <b>TS 740</b> Mounting Instructions</li> <li>• <b>TT 140</b> Mounting Instructions</li> <li>• <b>TT 449</b> Mounting Instructions</li> </ul>	ID 892899-xx; in PDF format on HESIS-Web including Filebase ID 208962-xx ID 749363-xx ID 312821-91 ID 632756-9x ID 632757-9x ID 632760-9x ID 632761-9x ID 297510-xx ID 664914-xx
User documentation	<b>TNC 640</b> <ul style="list-style-type: none"> <li>• <b>Conversational Programming</b> User's Manual</li> <li>• <b>Touch Probe Cycles</b> User's Manual</li> <li>• <b>DIN/ISO</b> User's Manual</li> </ul> <b>Miscellaneous</b> <ul style="list-style-type: none"> <li>• <b>TNCremo</b> User's Manual</li> <li>• <b>TNCremoPlus</b> User's Manual</li> <li>• <b>PLCdesign</b> User's Manual</li> <li>• <b>CycleDesign</b> User's Manual</li> <li>• <b>IOconfig</b> User's Manual</li> <li>• <b>KinematicsDesign</b> User's Manual</li> </ul>	ID 892903-xx ID 892905-xx ID 892909-xx  As integrated help As integrated help As integrated help As integrated help As integrated help As integrated help
Other documentation	<ul style="list-style-type: none"> <li>• <b>TNC 640</b> brochure</li> <li>• <b>Touch Probes</b> brochure</li> <li>• <b>Inverter Systems</b> brochure</li> <li>• <b>Motors</b> brochure</li> <li>• <b>HEIDENHAIN DNC</b> brochure</li> <li>• <b>Remote Diagnosis with TeleService</b> Product Overview</li> <li>• <b>Touch Probes</b> CD-ROM</li> <li>• <b>TNC 640 Programming Station Demo Version</b> CD-ROM</li> <li>• <b>HR 550 FS</b> Product Information</li> <li>• Technical Information: <b>Safety-Related Control Technology</b></li> <li>• Technical Information: <b>Safety-Related Position Measuring Systems</b></li> <li>• Technical Information: <b>Uniformly Digital</b></li> </ul>	ID 892916-xx ID 208951-xx ID 622420-xx ID 208893-xx ID 628968-xx ID 348236-xx ID 344353-xx ID 825164-xx PDF PDF  PDF  PDF



# Service and training

<b>Technical support</b>	HEIDENHAIN offers the machine manufacturer technical support to optimize the adaptation of the TNC to the machine, including on-site support.										
<b>Replacement control system</b>	In the event of a fault, HEIDENHAIN guarantees the rapid supply of a replacement control system (usually within 24 hours in Europe).										
<b>Hotline</b>	Our service engineers are naturally at your disposal by telephone if you have any questions on the interfacing of the control or in the event of faults.  <table><tr><td><b>TNC support</b></td><td>+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de</td></tr><tr><td><b>PLC programming</b></td><td>+49 8669 31-3102 E-mail: service.plc@heidenhain.de</td></tr><tr><td><b>NC programming</b></td><td>+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de</td></tr><tr><td><b>Measuring systems</b></td><td>+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de</td></tr><tr><td><b>Lathe controls</b></td><td>+49 8669 31-3105 E-mail: service.lathe-support@heidenhain.de</td></tr></table>	<b>TNC support</b>	+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de	<b>PLC programming</b>	+49 8669 31-3102 E-mail: service.plc@heidenhain.de	<b>NC programming</b>	+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de	<b>Measuring systems</b>	+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de	<b>Lathe controls</b>	+49 8669 31-3105 E-mail: service.lathe-support@heidenhain.de
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<b>Lathe controls</b>	+49 8669 31-3105 E-mail: service.lathe-support@heidenhain.de										
<b>Machine calibration</b>	On request, HEIDENHAIN engineers will calibrate your machine's geometry, e.g. with a KGM grid encoder.										
<b>Seminars</b>	HEIDENHAIN provides technical customer training in the following subjects: <ul style="list-style-type: none"><li>• NC programming</li><li>• PLC programming</li><li>• TNC optimization</li><li>• TNC service</li><li>• Encoder service</li><li>• Special training for specific customers</li></ul> <p>For more information on dates, registration, etc. call in Germany: +49 8669 31-2293 or 31-1695 +49 8669 31-1999 E-mail: mtt@heidenhain.de www.heidenhain.de</p>										

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