



HEIDENHAIN



TNC 620 HSCI

For Gen 3 Drives

The Compact Contouring Control for Milling, Drilling, and Boring Machines

Information for the Machine Tool Builder

TNC contouring control with drive system from HEIDENHAIN

General information

- TNC 620**
- Compact contouring control for **milling, drilling, and boring machines**
 - Axes: 8 control loops, up to two of which are configurable as spindles
 - For operation with HEIDENHAIN inverter systems and ideally HEIDENHAIN motors
 - Uniformly digital with HSCI interface and EnDat interface
 - Compact size
 - CompactFlash memory card
 - Programming in HEIDENHAIN Klartext format or G-code (ISO)
 - Standard milling, drilling, and boring cycles
 - Touch probe cycles
 - Short block processing time (1.5 ms)
- 19-inch screen (portrait) design**
- Screen, keyboard, and main computer in one unit (MC 8410)
 - Integration of the keyboard in the lower screen area
 - Multi-touch operation
- 15-inch screen (landscape) design**
- Screen and main computer in one unit (MC 8420)
 - Separate keyboard unit
 - Multi-touch operation
- System test**
- Controls, power modules, motors, and encoders from HEIDENHAIN are usually integrated as components into complete systems. In such cases, comprehensive testing of the complete system is required, irrespective of the specifications of the individual devices.
- Parts subject to wear**
- Controls from HEIDENHAIN contain parts subject to wear, such as a backup battery and fan.
- Standards**
- Standards (ISO, EN, etc.) apply only where explicitly stated in the brochure.
- Note**
- Intel, Intel Xeon, Core, and Celeron are registered trademarks of Intel Corporation.
- Validity**
- The features and specifications described here apply to the following control and NC software versions:
- TNC 620 with NC software versions**
 817600-08 (export license required)
 817601-08 (no export license required)
- This brochure supersedes all previous editions, which thereby become invalid. **Subject to change without notice.**
- Requirements**
- Some of these specifications require particular machine configurations. Please also note that, for some functions, a special PLC program must be created by the manufacturer.
- Functional safety (FS)**
- If standard components and FS components (FS = Functional Safety) are not explicitly differentiated, then the information applies to both versions (e.g. TE 735, TE 735 FS).
- Components for which there is also a version with functional safety bear the identifier "(FS)" at the end of the product designation, e.g., UEC 3xx (FS)



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

Using this brochure

This brochure is purely a decision-making aid for selecting HEIDENHAIN components. Additional documentation is required for project development (see "Technical documentation", Page 102).

Overview tables

Components

Control systems		TNC 620	Page
Main computer		MC 8410 MC 8420	16
Storage medium		CFR memory card	18
NC software license		On SIK component	18
Multi-touch display		19-inch screen (portrait, 1024 x 1280 pixels) 15-inch screen (landscape, 1024 x 768 pixels)	
Keyboard		Integrated in screen TE 73x or TE 73x FS	20
Machine operating panel		PLB 6001, PLB 600x FS (HSCI adapter for OEM machine operating panel)	20
		MB 721, MB 721 FS MB 720, MB 720 FS	23
PLC inputs/outputs¹⁾	With HSCI interface	PL 6000 consisting of PLB 62xx basic module (system PL) or PLB 61xx (expansion PL) and I/O modules On UEC ²⁾ and UMC ³⁾	21
Additional modules¹⁾		CMA-H for analog axes/spindles in the HSCI system Modules for fieldbus systems	24
Connecting cables		✓	37

¹⁾ May be necessary depending on the configuration

²⁾ For more information, refer to the *Inverter Systems for Gen 3 Drives* brochure

³⁾ For more information, refer to the *Inverter Systems UV 1xx, UVR 1xx, UM 1xx, UEC 1xx, UE 2xx, UR 2xx* brochure

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

Accessories

Accessory	TNC 620	Page
Electronic handwheels	<ul style="list-style-type: none"> • HR 510, HR 510 FS portable handwheel, or • HR 520, HR 520 FS portable handwheel with display, or • HR 550 FS portable wireless handwheel with display, or • HR 130 panel-mounted handwheel 	25
Workpiece touch probes¹⁾	<ul style="list-style-type: none"> • TS 260 touch trigger probe with cable connection, or • TS 460 touch trigger probe with radio and infrared transmission, or • TS 750 touch trigger probe with cable connection • TS 150 touch trigger probe with cable connection • TS 740 touch trigger probe with infrared transmission 	
Tool touch probes¹⁾	<ul style="list-style-type: none"> • TT 160 touch trigger probe with cable connection, or • TT 460 touch trigger probe with radio and infrared transmission 	
Programming station²⁾	Control software for PCs for programming, archiving, and training <ul style="list-style-type: none"> • Single-station license with original control keyboard • Single-station license with virtual keyboard • Network license with virtual keyboard • Demo version with virtual keyboard or PC keyboard—free of charge 	
Auxiliary axis control	PNC 610	30
Industrial PC	ITC 755 ITC 750 IPC 306/IPC 6641 industrial PC for Windows IPC 6490/IPC 8420 industrial PC for PNC 610	28
Snap-on keys	For controls and handwheels	33

¹⁾ For more information, refer to the *Touch Probes* brochure

²⁾ For more information, refer to the *Programming Station for TNC Controls* brochure

Software tools	TNC 620	Page
PLCdesign¹⁾	PLC development software	70
KinematicsDesign¹⁾	Software for creation of kinematic models	63
TNCremo²⁾, TNCremoPlus²⁾³⁾	Data transfer software (TNCremoPlus with “live” screen)	75
ConfigDesign¹⁾	Software for configuring the machine parameters	66
CycleDesign¹⁾	Software for creating cycle structures	73
TNCkeygen¹⁾	Software for enabling SIK options for a limited time, and for single-day access to the OEM area	18
TNCscope¹⁾	Software for data recording	67
TNCopt¹⁾	Software for putting digital control loops into service	67
IOconfig¹⁾	Software for configuring PLC I/O and fieldbus components	22
TeleService¹⁾³⁾	Software for remote diagnostics, monitoring, and operation	68
RemoTools SDK¹⁾	Function library for developing customized applications for communication with HEIDENHAIN controls	76
TNCtest¹⁾	Software for creation and execution of an acceptance test	68
TNCanalyzer¹⁾	Software for the analysis and evaluation of service files	68

¹⁾ Available to registered customers for download from the Internet

²⁾ Available to all customers (without registration) for download from the Internet

³⁾ Software release module required

Specifications

Specifications	TNC 620	Page
Axes	8 control loops, of which up to 2 can be configured as spindles	50
Rotary axes	✓	
Synchronized axes	✓	
PLC axes	✓	
Main spindles	<i>Milling</i> : max. 2; second spindle can be controlled by PLC alternately with the first	53
Speed	Max. 60 000 rpm for motors with a single pole pair (with software option 49: max. 120 000 rpm)	53
Operating mode switchover	✓	53
Position-controlled spindle	✓	53
Oriented spindle stop	✓	53
Gear shifting	✓	53
NC program memory	7.7 GB	16
Input resolution and display step		50
Linear axes	Down to 0.01 µm	
Rotary axes	Down to 0.000 01°	
Functional safety (FS)	With FS components, SPLC, and SKERN	46
For applications with up to	<ul style="list-style-type: none"> SIL 2 as per EN 61508 Category 3, PL d as per EN ISO 13849-1: 2008 	
Interpolation		
Straight line	In 4 axes; in max. 5 axes with software option 9	
Circular	In 2 axes; in 3 axes with software option 8	
Helical	✓	
Axis feedback control		55
With following error	✓	
With feedforward	✓	
Axis clamping	✓	50
Maximum feed rate	$\frac{60000 \text{ rpm}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$ at $f_{\text{PWM}} = 5000 \text{ Hz}$	50

Specifications	TNC 620	Page																		
Cycle times of main computer	MC	55																		
Block processing	1.5 ms	57																		
Cycle times of controller unit	CC/UEC/UMC	55																		
Path interpolation	3 ms	55																		
Fine interpolation	<i>Single-speed</i> : 0.2 ms <i>Double-speed</i> : 0.1 ms (software option 49)																			
Position controller	<i>Single-speed</i> : 0.2 ms <i>Double-speed</i> : 0.1 ms (software option 49)																			
Speed controller	<i>Single-speed</i> : 0.2 ms <i>Double-speed</i> : 0.1 ms (software option 49)																			
Current controller	<table border="0"> <tr> <td>f_{PWM}</td> <td>T_{INT}</td> </tr> <tr> <td>3333 Hz</td> <td>150 µs</td> </tr> <tr> <td>4000 Hz</td> <td>125 µs</td> </tr> <tr> <td>5000 Hz</td> <td>100 µs</td> </tr> <tr> <td>6666 Hz with software option 49</td> <td>75 µs with software option 49</td> </tr> <tr> <td>8000 Hz with software option 49</td> <td>62.5 µs with software option 49</td> </tr> <tr> <td>10000 Hz with software option 49</td> <td>50 µs with software option 49</td> </tr> <tr> <td>13333 Hz with software option 49</td> <td>37.5 µs with software option 49</td> </tr> <tr> <td>16000 Hz with software option 49</td> <td>31.25 µs with software option 49</td> </tr> </table>	f_{PWM}	T_{INT}	3333 Hz	150 µs	4000 Hz	125 µs	5000 Hz	100 µs	6666 Hz with software option 49	75 µs with software option 49	8000 Hz with software option 49	62.5 µs with software option 49	10000 Hz with software option 49	50 µs with software option 49	13333 Hz with software option 49	37.5 µs with software option 49	16000 Hz with software option 49	31.25 µs with software option 49	
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13333 Hz with software option 49	37.5 µs with software option 49																			
16000 Hz with software option 49	31.25 µs with software option 49																			
Permissible temperature range	Operation: In electrical cabinet: 5 °C to 40 °C In operating panel: 0 °C to 50 °C Storage: -20 °C to 60 °C																			

Interfacing to the machine

Interfacing to the machine	TNC 620	Page
Error compensation	✓	64
Linear axis error	✓	64
Nonlinear axis error	✓	64
Backlash	✓	64
Reversal spikes during circular movement	✓	64
Hysteresis	✓	64
Thermal expansion	✓	64
Static friction	✓	64
Sliding friction	✓	64
Integrated PLC	✓	69
Program format	Statement list	69
Program input at the control	<i>MC 8410</i> : via screen keyboard <i>MC 8420</i> : via TE 73x or TE 73x FS	69
Program input via PC	✓	69
Symbolic PLC-NC interface	✓	69
PLC memory	4 GB	69
PLC cycle time	9 ms to 30 ms (adjustable)	69
PLC inputs/outputs	For the maximum configuration of the PLC system, see Page 45	21
PLC inputs, DC 24 V	Via PL, UEC, UMC	21
PLC outputs, DC 24 V	Via PL, UEC, UMC	21
Analog inputs ±10 V	Via PL	21
Inputs for PT 100 thermistors	Via PL	21
Analog outputs ±10 V	Via PL	21
PLC functions	✓	69
Small PLC window	✓	70
PLC soft keys	✓	70
PLC positioning	✓	70
PLC basic program	✓	72
Integration of applications		71
High-level language programming	Use of the Python programming language in conjunction with the PLC (software option 46)	71
User interfaces can be custom-designed	Creation of individualized user interfaces by the machine manufacturer with the Python programming language. Programs up to a memory limit of 10 MB are enabled in standard mode. More can be enabled via software option 46.	71

Interfacing to the machine	TNC 620	Page
Commissioning and diagnostic aids		66
TNCdiag	Software for the analysis of status and diagnostic information of digital drive systems	66
TNCopt	Software for putting digital control loops into service	67
ConfigDesign	Software for creating the machine configuration	66
KinematicsDesign	Software for creating the machine kinematics, initialization of DCM	63
Integrated oscilloscope	✓	66
Trace function	✓	67
API DATA function	✓	67
Table function	✓	67
OLM (online monitor)	✓	67
Log	✓	67
TNCscope	✓	67
Bus diagnostics	✓	68
Data interfaces	✓	
Ethernet	2 x 1000BASE-T	74
USB	<i>Rear</i> : 4 x USB 3.0 <i>Front</i> : may vary based on the component description	74
Protocols		74
Standard data transmission	✓	74
Blockwise data transfer	✓	74
LSV2	✓	74

Functions for the user

Function	Standard	Option	TNC 620
Short description	✓ ✓	0/1	Basic version: 3 axes plus closed-loop spindle 1st or 2nd additional axis for 4 or 5 axes plus spindle Digital current and speed control
Program entry	✓ ✓	42	HEIDENHAIN Klartext G-code (ISO) programming Direct loading of contours or machining positions from DXF files and saving as a conversational contouring program or as a point table
Position values	✓ ✓ ✓		Nominal positions for lines and arcs in Cartesian coordinates or polar coordinates Incremental or absolute dimensions Display and entry in mm or inches
Tool compensation	✓	21 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 later modification of tool data without the need for program recalculation
Tool tables	✓		Multiple tool tables with any number of tools
Cutting data	✓		Automatic calculation of spindle speed, cutting speed, feed per tooth, and feed per revolution
Constant contour speed	✓ ✓		Based on the path of the tool center point Based on the tool's cutting edge
Parallel operation	✓		Creating a program with graphical support while another program is being run
3D machining	✓	9 9 9 9 9 9	Motion control with smoothed jerk 3D tool compensation via surface-normal vectors Changing the tilt position with handwheel superimpositioning; maintaining the position of the tool point (TCPM) Keeping the tool perpendicular to the contour Tool radius compensation perpendicular to the tool direction Manual traverse in the active tool-axis system
Rotary table machining		8 8	Programming of contours for machining on a cylinder as if in two axes Feed rate in mm/min
Contour elements	✓ ✓ ✓ ✓ ✓ ✓ ✓		Straight line Chamfer Circular path Circle center Circle radius Tangentially connecting circular arc Corner rounding
Contour approach and departure	✓ ✓		Via straight line: tangential or perpendicular Via circular arc
FK free contour programming		19	FK free contour programming in HEIDENHAIN Klartext format with graphical support for workpiece drawings not dimensioned for NC
Fixed cycles	✓	19 19 19 19 19 19 19 19 19 19 19	Drilling, conventional and rigid tapping, rectangular and circular pockets Peck drilling, reaming, boring, counterboring, centering Milling internal and external threads Clearing level and oblique surfaces Complete machining of straight and circular slots Complete machining of rectangular and circular pockets, and rectangular and circular studs Cartesian and polar point patterns Contour train, contour pocket Contour slot with trochoidal milling Engraving cycle: engraving of text or numbers in a straight line or on an arc OEM cycles (special cycles developed by the machine manufacturer) can be integrated

Function	Standard	Option	TNC 620
Program jumps	✓ ✓ ✓		Subprograms Program-section repeat Any program as a subprogram
Coordinate transformation	✓	8	Shifting, rotating, mirroring, scaling (axis-specific) Tilting the working plane, PLANE function
Q parameters Programming with variables	✓ ✓ ✓ ✓ ✓		Mathematical functions: =, +, -, *, /, sin α , cos α , tan α , arc sin, arc cos, arc tan, a^n , e^n , ln, log, angle α from sin α and cos α , square root of a, square root of ($a^2 + b^2$) Logical operations (=, = /, <, >) Calculating with parentheses Absolute value of a number, constant π , negation, truncation of digits before or after the decimal point Functions for calculation of circles Functions for text processing
Programming aids	✓ ✓ ✓ ✓ ✓ ✓		Calculator Complete list of all current error messages Context-sensitive help function for error messages TNCguide: the integrated help system; user information is available directly on the TNC Graphical support for the programming of cycles Comment and structure blocks in the NC program
CAD viewer	✓		Display of standardized CAD file formats on the TNC
Teach-in	✓		Application of actual positions directly in the NC program
Program verification graphics Depictions		20 20 20	Graphical simulation of the machining sequence, even while another program is running Plan view / projection in 3 planes / 3D view, including in tilted working plane / 3D line graphics Detail zoom
Programming graphics	✓		In Programming and Editing mode, the contours of entered NC blocks are rendered (2D pencil-trace graphics), even while another program is running
Program-run graphics Display modes		20 20	Graphical depiction of the executed program Plan view / projection in 3 planes / 3D view
Machining time	✓ ✓		Calculation of machining time in the Test Run operating mode Display of the current machining time in the Program Run operating modes
Returning to the contour	✓ ✓		Mid-program startup in any block in the program, returning the tool to the calculated nominal position to continue machining Program interruption, contour departure, and return
Preset management	✓		For storing any presets
Datum tables	✓		Multiple datum tables for storing workpiece-specific datums
Pallet tables		22	Workpiece-oriented execution of pallet tables (with any number of entries for the selection of pallets, NC programs, and datums)
Touch probe cycles		17 17 17 17	Calibrating the touch probe Compensation of workpiece misalignment, manual or automatic Preset setting, manual or automatic Automatic tool and workpiece measurement

Function	Standard	Option	TNC 620
Parallel secondary axes	✓		Compensation of movement in the secondary axes U, V, W through the principal axes X, Y, Z
	✓		Movements of parallel axes included in the position display of the associated principal axis (sum display)
	✓		Defining the principal and secondary axes in the NC program enables execution on different machine configurations
Conversational languages	✓		English, German, Czech, French, Italian, Spanish, Portuguese, Dutch, Swedish, Danish, Finnish, Norwegian, Slovenian, Slovak, Polish, Hungarian, Russian (Cyrillic), Romanian, Turkish, Chinese (traditional and simplified), Korean

Software options

Option number	Software option	Starting with NC software 817600-817601-	ID	Comment	Page
0	Additional Axis 1	01	354540-01	Additional control loop 1	19
1	Additional Axis 2	01	353904-01	Additional control loop 2	19
2	Additional Axis 3	01	353905-01	Additional control loop 3	19
3	Additional Axis 4	01	367867-01	Additional control loop 4	19
8	Advanced Function Set 1	01	617920-01	Rotary table machining <ul style="list-style-type: none"> • Programming of contours for machining on a cylinder as if in two axes • Feed rate in mm/min 	50
				Coordinate transformations <ul style="list-style-type: none"> • Tilting the working plane, PLANE function 	51
				Interpolation <ul style="list-style-type: none"> • Circular in 3 axes with tilted working plane 	
9	Advanced Function Set 2	01	617921-01	3D machining <ul style="list-style-type: none"> • 3D tool compensation via surface normal vectors • Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point (TCPM = Tool Center Point Management) • Keeping the tool perpendicular to the contour • Tool radius compensation perpendicular to the tool direction • Manual traverse in the active tool-axis system Interpolation <ul style="list-style-type: none"> • Linear in more than 4 axes (export license required) 	51
17	Touch Probe Functions	01	634063-01	Touch probe cycles <ul style="list-style-type: none"> • Compensation of workpiece misalignment, setting of presets • Automatic tool and workpiece measurement • Touch probe input enabled for non-HEIDENHAIN systems • Automatically enabled upon connection of an SE 661 	73
18	HEIDENHAIN DNC	01	526451-01	Communication with external PC applications over COM component	76

Option number	Software option	Starting with NC software 817600-817601-	ID	Comment	Page
19	Advanced Programming Features	01	628252-01	FK free contour programming Fixed cycles <ul style="list-style-type: none"> • Peck drilling, reaming, boring, counterboring, centering • Milling internal and external threads • Clearing level and oblique surfaces • Complete machining of straight and circular slots • Complete machining of rectangular and circular pockets • Circular and linear point patterns • Contour train, contour pocket, including contour-parallel machining • Contour slot with trochoidal milling • Special cycles developed by the machine manufacturer can be integrated 	
20	Advanced Graphic Features	01	628253-01	Program-verification graphics, program-run graphics <ul style="list-style-type: none"> • Plan view, view in three planes, 3D view 	
21	Advanced Function Set 3	01	628254-01	Tool compensation <ul style="list-style-type: none"> • Radius-compensated contour look-ahead for up to 99 blocks (LOOK AHEAD) 3D machining <ul style="list-style-type: none"> • Superimposing handwheel positioning during program run 	
22	Pallet Management	01	628255-01	Pallet management	73
24	Gantry Axes	01	634621-01	Gantry axes via master-slave torque control	51
42	CAD Import	05	526450-01	Importing of contours from 2D and 3D models, e.g. STEP, IGES, DXF	
46	Python OEM Process	01	579650-01	Execution of Python applications	71
48	KinematicsOpt	01	630916-01	Touch-probe cycles for the automatic measurement of rotary axes	65
49	Double-Speed Axes	01	632223-01	Short control-loop cycle times for direct drives	56
56-61	OPC UA NC Server 1 to 6	08	1291434-01 to 1291434-06	Connection of an OPC UA application	77
93	Extended Tool Management	02	676938-01	Expanded tool management: <ul style="list-style-type: none"> • Tooling list (list of all tools of the NC program) • T usage sequence (sequence of all tools inserted during the program) 	
133	Remote Desk. Manager	01	894423-01	Display and remote operation of external computer units (e.g., a Windows PC)	76
137	State Reporting	06	1232242-01	State Reporting Interface (SRI): provision of operating statuses	68
141	Cross Talk Comp.	01	800542-01	CTC: compensation of axis couplings	60
142	Pos. Adapt. Control	01	800544-01	PAC: position-dependent adaptation of control parameters	61
143	Load Adapt. Control	01	800545-01	LAC: load-dependent adaptation of control parameters	59

Option number	Software option	Starting with NC software 817600-817601-	ID	Comment	Page
144	Motion Adapt. Control	01	800546-01	MAC: motion-dependent adaptation of control parameters	59
145	Active Chatter Control	01	800547-01	ACC: Active Chatter Control	58
146	Machine Vibration Control	08	800548-01	The following functions are part of Machine Vibration Control (MVC): <ul style="list-style-type: none"> • AVD (Active Vibration Damping): Active damping of vibrations in the control loop • FSC (Frequency Shaping Control): Reduction of vibration inducement by means of frequency-based feedforward control 	60
154	Batch Process Manager	05	1219521-01	Planning and executing multiple machining operations	52
155	Component Monitoring	06	1226833-01	Monitoring for component overloading and wear	63
160	Integrated FS: Basic	07	1249928-01	Enables functional safety and four safe control loops	46
161	Integrated FS: Full	07	1249929-01	Enables functional safety and the maximum number of safe control loops	46
162	Add. FS Ctrl. Loop 1	07	1249930-01	Additional control loop 1	46
163	Add. FS Ctrl. Loop 2	07	1249931-01	Additional control loop 2	46
164	Add. FS Ctrl. Loop 3	07	1249932-01	Additional control loop 3	46
165	Add. FS Ctrl. Loop 4	07	1249933-01	Additional control loop 4	46
166	Add. FS Ctrl. Loop 5	07	1249934-01	Additional control loop 5	46
167	Optimized Contour Milling	07	1289547-01	OCM: optimize roughing processes and fully utilize milling tools with the integrated cutting data calculator	58
169	Add. FS Full	08	1319091-01	Enabling of all FS axis options or control loops. Options 160 and 162 to 166 must already be set.	46

HSCI control components

Main computers

Main computer

The MC main computers feature the following:

- Intel Celeron 1047 processor (1.4 GHz, dual-core)
- Main memory: 4 GB RAM
- IP54 degree of protection (when installed)
- HSCI interface to the controller unit and to other control components

To be ordered separately and installed in the main computer by the OEM:

- **CFR** memory card with the NC software
- The **System Identification Key (SIK)** component for the enabling of control loops and software options

Special features of the MC 8410:

- 19-inch screen (portrait); resolution: 1024 x 1280 pixels
- Without feed-rate and spindle-speed potentiometers (potentiometers are integrated in the MB 721)
- Multi-touch operation
- ASCII keyboard integrated as screen keyboard
- Software support with 81760x-04 SP2 or later

Special features of the MC 8420:

- 15-inch screen (landscape), resolution: 1024 x 768 pixels
- Multi-touch operation
- Separate TE keyboard unit required
- Software support with 81760x-08 or later

The following HSCI components are necessary for operation of the TNC 620:

- MC main computer
- Controller unit
- **PLB 62xx** PLC I/O unit (system PL; integrated in UxC)
- **MB 72x** or **MB 72x FS** machine operating panel (integrated in TE 7x5) or **PLB 6001** or **PLB 600x FS** HSCI adapter for connecting an OEM machine operating panel

Interfaces

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

Export version

Because the complete NC software is on the CompactFlash Memory card (CFR), no export version is needed for the main computer itself. Only the easily replaceable storage medium and SIK component are available as export versions.

Gen 3 labels

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

Gen 3 ready

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

Gen 3 exclusive

Gen 3 exclusive: These components can be used only in systems with Gen 3 drives (UVR 3xx, UM 3xx, CC 3xx).

Versions

The main computers are designed for direct installation in the operating panel:

- **Integrated** keyboard:
The MC 8410 features a 19-inch multi-touch display (portrait) with TNC keyboard and ASCII keyboard integrated in the screen
- **Separate** keyboard:
The MC 8420 features a 15-inch multi-touch display (landscape). A separate 15-inch TNC keyboard is required. Hence, the complete ASCII character set is available.

The MC 8410 main computer is supported starting with NC software 81760x-04 SP2 or later; the MC 8420 main computer is supported starting with NC software 81760x-08 or later. Earlier software versions will not run on these MC main computers.



MC 8410

MC 8420

	Installation type	Storage medium	Processor	RAM	Power consumption ^{*)}	Mass	ID
MC 8410	Operating panel	CFR	Intel Celeron 1047 1.4 GHz, dual-core	4 GB	≈ 52 W	≈ 8.6 kg	1175057-xx
MC 8420	Operating panel	CFR	Intel Celeron 1047 1.4 GHz, dual-core	4 GB	≈ 43 W	≈ 6.5 kg	1318472-xx

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

Software options

Software options allow the performance of the TNC 620 to be adapted to one's actual needs at a later time. The software options are described on page 13. They are enabled by entering keywords based on the SIK number and are saved in the SIK component. Please provide the SIK number when ordering new options.

Storage medium

The storage medium is a CFR (= CompactFlash Removable) compact flash memory card. It contains the NC software and is used to store NC and PLC programs. The storage medium is removable and must be ordered separately from the main computer.

This CFR uses the fast SATA protocol (CFast). This CFR is compatible with the MCs described in the **Main computers** section.

CFR CompactFlash, 30 GB

Free PLC memory space	≈ 4 GB
Free NC memory space	≈ 7.7 GB
Export license required (NC-SW 817600-08)	ID 1069906-08
Export license not required (NC-SW 817601-08)	ID 1069906-58



CFR CompactFlash

SIK component

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

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

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

Master keyword (general key)

For putting the TNC 620 into service, there is a master keyword that enables all software options once for 90 days. After this period, the software options can be activated only with the correct keywords. The general key is activated via a soft key.

TNCkeygen (accessory)

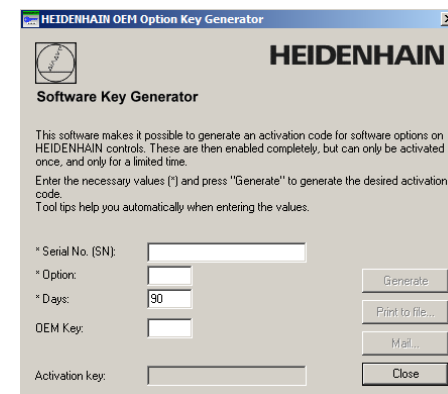
TNCkeygen is a collection of PC software tools for generating enabling keys for HEIDENHAIN controls for a limited period of time.

With the **OEM Key Generator**, you can generate enabling keys for software options by entering the SIK number, the software option to be enabled, the enabling period, and an OEM-specific password. This activation is limited to a period of 10 to 90 days. Each software option can be enabled only once; this is performed independently of the master keyword.

The **OEM daily key generator** generates an enabling key for the protected OEM area, thus granting the user access on the day it is generated.



SIK component



NC software license and enabling of control loops

Control loops	Without option	Incl. options 19 and 20	Incl. options 17, 19 and 20	Incl. options 19, 20 and 46	Incl. options 8, 19 and 20
4	ID 526924-01 <i>ID 526924-51</i>	ID 526924-04 <i>ID 526924-54</i>	ID 526924-20 <i>ID 526924-70</i>	ID 526924-11 <i>ID 526924-61</i>	ID 526924-18 <i>ID 526924-68</i>
5	ID 526924-02 <i>ID 526924-52</i>	ID 526924-05 <i>ID 526924-55</i>	- -	ID 526924-12 <i>ID 526924-62</i>	ID 526924-13 <i>ID 526924-63</i>
6	ID 526924-03 <i>ID 526924-53</i>	ID 526924-06 <i>ID 526924-56</i>	- -	ID 526924-19 <i>ID 526924-69</i>	ID 526924-07 <i>ID 526924-57</i>

(Italics: export version)

Enabling further control loops

Additional control loops can be enabled individually. Up to **8 control loops** are possible.

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

Keyboard

MB 720 machine operating panel

Gen3 ready

- Suitable for the MC 8420
- Supply voltage: DC 24 V/≈ 4 W
- 36 exchangeable snap-on keys with status LED, freely definable via PLC (assignment as per PLC basic program: 12 axis keys, spindle start, spindle stop, 22 further function keys)
- Further operating elements: NC start¹⁾, NC stop¹⁾, emergency-stop key, control voltage on¹⁾, two holes for additional keys or keylock switches
- HSCI interface
- MB 720: 8 free PLC inputs and 8 free PLC outputs
MB 720 FS: 4 free FS inputs and 8 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.

¹⁾ Illuminated keys, addressable via PLC

MB 720 ID 784803-xx
MB 720 FS ID 805474-xx
 Mass ≈ 1 kg

MB 721 machine operating panel

Gen3 ready

- Same as the MB 720, except:
- Suitable for the MC 8410
 - Changed front panel
 - 3 holes for additional buttons or keylock switches
 - Spindle-speed and feed-rate override potentiometers
 - USB port with cover cap

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

TE 730 keyboard

Gen3 ready

- For MC 8420
- 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 potentiometer
- USB interface to the MC main computer
- Touchpad

TE 730 ID 805489-xx
 Mass ≈ 2.4 kg

TE 735 keyboard with an integrated machine operating panel

Gen3 ready

- For MC 8420
- 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-xx
TE 735 FS ID 805493-xx
 Mass ≈ 3.4 kg



MB 720



MB 721



TE 730



TE 735

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

Basic modules with an **HSCI interface** exist for 4, 6, 8, and 10 modules. Fastening is performed on standard NS 35 rails (DIN 46227 or EN 50022).

Supply voltage DC 24 V
 Power consumption¹⁾ ≈ 48 W at DC 24 V NC
 ≈ 21 W at DC 24 V PLC
 Mass ≈ 0.36 kg (bare)

¹⁾ PLB 6xxx completely filled, incl. TS, TT

System PL with EnDat support

- Required once for each control system (except with UxC)
- Connections for TS and TT touch probes
- TS and TT touch probes with EnDat interface are supported
- *Without FS*: 12 free inputs, 7 free outputs
With FS: 6 free FS inputs, 2 free FS outputs
- Functional safety (FS) is enabled via SIK options 160 to 166
- Slots are equipped with cover strips

Gen3 ready

PLB 6204 For 4 I/O modules ID 1129809-xx
PLB 6206 For 6 I/O modules ID 1129812-xx
PLB 6208 For 8 I/O modules ID 1129813-xx
PLB 6210 For 10 I/O modules ID 1278136-xx

Gen3 exclusive

PLB 6204 FS For 4 I/O modules ID 1223032-xx
PLB 6206 FS For 6 I/O modules ID 1223033-xx
PLB 6208 FS For 8 I/O modules ID 1223034-xx
PLB 6210 FS For 10 I/O modules ID 1290089-xx

Expansion PL

Gen3 ready

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

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

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

I/O modules

Gen3 ready

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

PLD-H 16-08-00	I/O module with 16 digital inputs and 8 digital outputs	ID 594243-xx
PLD-H 08-16-00	I/O module with 8 digital inputs and 16 digital outputs	ID 650891-xx
PLD-H 08-04-00 FS	I/O module with 8 digital FS inputs and 4 digital FS outputs	ID 598905-xx
PLD-H 04-08-00 FS	I/O module with 4 digital FS inputs and 8 digital FS outputs	ID 727219-xx
PLD-H 04-04-00 HSLS FS	I/O module with 4 digital FS inputs and 4 high-side/low-side FS outputs	ID 746706-xx

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

PLA-H 08-04-04	Analog module for PL 6xxx with <ul style="list-style-type: none"> • 8 analog inputs, ±10 V • 4 analog outputs, ±10 V • 4 analog inputs for PT 100 thermistors 	ID 675572-xx
Mass		≈ 0.2 kg

I/O module for axis release

Gen3 exclusive

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

PAE-H 08-00-01	I/O module for enabling 8 axis groups	ID 1203881-xx
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IOconfig (accessory)

PC software for configuring HSCI and PROFIBUS components

Accessories**HSCI adapter for OEM machine operating panel****PLB 600x**

Gen3 ready

The PLB 600x HSCI adapter is required in order to connect an OEM-specific machine operating panel to the TNC 620.

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

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



PLB 6001

Additional modules

Gen3 ready

Module for analog axes

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

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

Additional module for analog axes/spindles:

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

CMA-H 04-04-00

ID 688721-xx



CMA-H 04-04-00

Fieldbus systems

An expansion board can be used to provide the TNC 620 with a PROFIBUS or PROFINET interface at any time. The modules are integrated into the control system through a slot on the MC. This makes the connection to an appropriate fieldbus system as a master possible. As of version 3.0, the interface is configured with IOconfig.

PROFIBUS DP module

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

PROFIBUS DP

ID 828539-xx



PROFIBUS DP module

PROFINET IO module

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

PROFINET IO

ID 828541-xx



PROFINET IO module

Combined PROFIBUS DP/PROFINET IO module

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

PROFIBUS DP and PROFINET IO

ID 1160940-xx



Combined module

Electronic handwheels

Gen3 ready

Overview

Support for electronic handwheels is standard on the TNC 620:

- **HR 550 FS** wireless handwheel, or
- Portable handwheel **HR 510**, **HR 510 FS** or **HR 520**, **HR 520 FS** or
- **HR 130** panel-mounted handwheel

Several handwheels can be operated on a single TNC 620:

- One handwheel via the handwheel input of the main computer (consider the interfaces of the given main computer)
- One handwheel each on HSCI machine operating panels or PLB 6001 or PLB 600x FS HSCI adapters (for the maximum number possible, see Page 45)

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

HR 510

Portable electronic handwheel with:

- Keys for actual-position capture and the selection of five axes
- Keys for traverse direction and three preset feed rates
- Three keys for machine functions (see below)
- Emergency stop button and two permissive buttons (24 V)
- Magnetic holding pads

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

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

Mass \approx 0.6 kg



HR 510

HR 520

Portable electronic handwheel with:

- Display for operating mode, actual position value, programmed feed rate and spindle speed, error messages
- Override potentiometers for feed rate and spindle speed
- Selection of axes via keys or soft keys
- Actual position capture
- NC start/stop
- Spindle on/off
- Keys for continuous traverse of the axes
- Soft keys for machine functions of the machine manufacturer
- Emergency stop button

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

Mass ≈ 1 kg



HR 520

Holder for HR 520

For attaching to a machine ID 591065-xx

HR 550 FS

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

In addition:

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

HR 550 FS	Without detent	ID 1200495-xx
	With detent	ID 1183021-xx

Replacement battery	For HR 550 FS	ID 623166-xx
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HR 550 FS with HRA 551 FS

HRA 551 FS

Handwheel holder for HR 550 FS

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

HRA 551 FS	ID 1119052-xx
Mass	≈ 1.0 kg

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

Connecting cables

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

¹⁾ For maximum cable lengths of 20 m between the MB and HRA 551 FS

²⁾ For maximum cable lengths of 50 m between the MB and HRA 551 FS

See also *Cable overview* on "Accessories".

HR 130

Panel-mounted handwheel with ergonomic control knob.

It is attached to the MB 7x0 or the TE 7x5 either directly or via an extension cable.

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



HR 130

Industrial PCs/ITC

Gen3 ready

Additional operating station

The additional ITC operating stations (Industrial Thin Client) from HEIDENHAIN are convenient solutions for the additional, decentralized operation of the machine or of machine units such as tool-changing stations. The remote operation strategy, which is tailored to the TNC 620, makes it very easy to connect the ITC over a standard Ethernet connection with a cable length of up to 100 m.

Connecting an ITC is very easy: as soon as the TNC 620 identifies an ITC, it provides it with a current operating system. After the ITC has been started, the complete content of the main screen is mirrored to the ITC's screen. As a result of this plug-and-play principle, no configuration by the machine manufacturer is necessary. With the standard configuration of the Ethernet interface at X116, the TNC 620 integrates the ITC into the system fully self-sufficiently.



ITC 755

With touchscreen

The **ITC 755** is a compact additional operating station for control systems with a 15-inch or 19-inch main screen. Along with the ASCII keyboard and touchscreen it also has the most important function keys of the TNC 620. The ITC 755 adjusts its resolution automatically to fit the size of the main screen. The soft keys are pressed on the touchscreen.

ITC 755¹⁾ ID 1039527-xx

With operating keys

The **ITC 750** (15-inch screen) and the keyboard unit (to be ordered separately) form a complete second operating station.

ITC 750¹⁾ With 15-inch display ID 1039544-xx
for the TE 73x

¹⁾ No NRTL approval

IPC 306 / IPC 6641 for Windows

With the help of the IPC 306 and IPC 6641 industrial PC, you can start and remotely operate Windows-based applications through the user interface of the TNC 620. The user interface is displayed on the control screen. Option 133 is required for this.

Since Windows runs on the industrial PC, it does not influence the NC machining process. The IPC is connected to the NC main computer via Ethernet. No second screen is necessary, since the Windows applications are displayed on the screen of the TNC 620 via remote accesses.

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

IPC 306	ID number	ID 1179966-xx
	Installation type	Electrical cabinet
	Mass	≈ 5.0 kg
	RAM	8 GB RAM
	Processor	Intel Xeon, 2.1 GHz, quad-core
	Power consumption	65 W
SSDR hard disk	ID number	ID 1282884-51
	Storage capacity	≈ 240 GB

IPC 6641	With 8 GB of RAM	ID 1039543-01
	With 16 GB of RAM	ID 1039543-02
	Mass	≈ 4.0 kg
	Installation type	Electrical cabinet
	Processor	Intel Core i7/3, 2.1 GHz, quad-core
	Power consumption	75 W
HDR hard disk	ID number	ID 1074770-51
	Storage capacity	≈ 320 GB



IPC 306



IPC 6641

Control of auxiliary axes

Gen3 ready

PNC 610

The PNC 610 auxiliary axis control is designed for controlling PLC axes independently of the TNC 620. The PNC 610 does not have an NC channel and thus cannot perform interpolating NC movements. With the IPC auxiliary computer, SIK, and CFR storage medium, the PNC 610 is a separate HSCI system, which can be expanded with HEIDENHAIN inverters. In the standard version the PNC 610 already includes six PLC axis releases as well as software option 46 (Python OEM Process). The PLC basic program contains a Python interface for pallet management that is adaptable by the machine manufacturer.

The system's design is identical to that of the TNC 620. All relevant HEIDENHAIN tools and a basic program can be used. The position information can be transmitted over PROFIBUS DP (optional), PROFINET IO (optional), or TCP/IP (integrated, system is not capable of real-time), regardless of the platform.



PNC 610 with IPC 8420

Auxiliary computer

The IPC auxiliary computer features the following:

- Processor
- RAM memory
- HSCI interface to the CC controller unit or to the UxC and to other control components
- USB 3.0 interfaces

The following components must be ordered separately by the OEM and installed in the auxiliary computer:

- CFR memory card with the NC software
- System Identification Key component (SIK) for enabling software options

The following HSCI components are required for operating the PNC 610:

- IPC auxiliary computer
- Controller unit
- PLB 62xx PLC I/O unit (system PL; integrated into UxC)

Interfaces

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

Design

IPC 6490	Part number	ID 1039541-xx
	Installation type	Electrical cabinet
	Mass	≈ 2.3 kg
	Power consumption	48 W
	RAM	2 GB
	Processor	Intel Celeron Dual Core, 1.4 GHz
IPC 8420	Part number	ID 1249510-xx
	Installation type	Operating panel
	Mass	≈ 6.7 kg
	Power consumption	48 W
	Screen	15.6-inch touchscreen (1366 x 768 pixels)
	RAM	2 GB
	Processor	Intel Celeron Dual Core, 1.4 GHz

Export version

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

Software options

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

Option number	Option	ID	Remark	Page
18	HEIDENHAIN DNC	526451-01	Communication with external PC applications over COM component	76
24	Gantry Axes	634621-01	Gantry axes in master-slave torque control	51
135	Synchronizing Functions	1085731-01	Expanded synchronization of axes and spindles	
141	Cross Talk Comp.	800542-01	CTC: compensation of axis couplings	60
142	Pos. Adapt. Control	800544-01	PAC: position-dependent adaptation of control parameters	61
143	Load Adapt. Control	800545-01	LAC: load-dependent adaptation of control parameters	59
144	Motion Adaptive Control	800546-01	MAC: motion-dependent adaptation of control parameters	59
160	Integrated FS: Basic	1249928-01	Enables functional safety and four safe control loops	46
161	Integrated FS: Full	1249929-01	Enables functional safety and the maximum number of safe control loops	46
162	Add. FS Ctrl. Loop 1	1249930-01	Additional control loop 1	46
163	Add. FS Ctrl. Loop 2	1249931-01	Additional control loop 2	46
164	Add. FS Ctrl. Loop 3	1249932-01	Additional control loop 3	46
165	Add. FS Ctrl. Loop 4	1249933-01	Additional control loop 4	46
166	Add. FS Ctrl. Loop 5	1249934-01	Additional control loop 5	46
169	Add. FS Full	1319091-01	Enabling of all FS axis options or control loops. Options 160 and 162 to 166 must already be set.	46

Storage medium

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

CFR CompactFlash, 30 GB	ID 1102057-59
No export license required	
NC software	817591-09
Free PLC memory space	4 GB
Free NC memory space	7.7 GB

SIK component

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

SIK component for PNC 610	ID 617763-53
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Snap-on keys for handwheels

Snap-on keys

The snap-on keys make it easy to replace the key symbols, thus allowing the HR handwheel to be adapted to different requirements. The snap-on keys are available in packs of five keys.

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

Axis keys Orange		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
			Black ID 330816-1Y		ID 330816-76		ID 330816-81		ID 330816-87
			Black ID 330816-30		ID 330816-77		ID 330816-82		ID 330816-88
		Black ID 330816-31		ID 330816-78		ID 330816-83		ID 330816-94	
		Black 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			Red ID 330816-08		ID 330816-40		Red ID 330816-47		ID 330816-48
			Green ID 330816-09		ID 330816-41		Green ID 330816-46		ID 385530-5X
Other keys			Black ID 330816-01		Red ID 330816-50		ID 330816-90		ID 330816-93
		Gray ID 330816-61		ID 330816-33		Black ID 330816-27		ID 330816-0Y	
		Green ID 330816-11		ID 330816-34		Black ID 330816-28		Black ID 330816-4M	
		Red ID 330816-12		ID 330816-13		Black ID 330816-29		ID 330816-3M	
		Green ID 330816-49		Green ID 330816-22		ID 330816-92		ID 330816-3N	

Overview for HR 510 and HR 510 FS

Axis keys Orange	ID 1092562-02	ID 1092562-05	ID 1092562-36	ID 1092562-08
	ID 1092562-03	ID 1092562-06	ID 1092562-09	
	ID 1092562-04	ID 1092562-07	ID 1092562-37	
Gray	ID 1092562-28	ID 1092562-31	ID 1092562-24	ID 1092562-27
	ID 1092562-29	ID 1092562-32	ID 1092562-25	
	ID 1092562-30	ID 1092562-33	ID 1092562-26	
Machine functions	Black ID 1092562-14	Black ID 1092562-15	Black ID 1092562-16	ID 1092562-42
	ID 1092562-43	ID 1092562-44		
Spindle functions	ID 1092562-18	ID 1092562-19	Green ID 1092562-22	Red ID 1092562-17
	Red ID 1092562-38	ID 1092562-41		
Other keys	Black ID 1092562-01	Green ID 1092562-23	ID 1092562-13	ID 1092562-35
	Green ID 1092562-20	ID 1092562-11	Black ID 1092562-10	Gray ID 1092562-39
	Red ID 1092562-21	ID 1092562-12	ID 1092562-34	Orange ID 1092562-40

Snap-on keys for the control

Snap-on keys

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

Overview of control 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 679843-53	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 679843-02		ID 679843-40	ID 679843-76	Black ID 679843-C7
ID 679843-16		Green ID 679843-56	Black ID 679843-95	ID 679843-D6
ID 679843-22		Red ID 679843-57	Black ID 679843-96	ID 679843-E3
ID 679843-23		+ ID 679843-59	Black 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		Red ID 679843-52		ID 679843-99
	ID 679843-19		ID 679843-48		ID 679843-65		Green ID 679843-D8
	ID 679843-20		ID 679843-49		Green ID 679843-71		ID 679843-F2
	ID 679843-21		ID 679843-50		ID 679843-72		
	ID 679843-46		ID 679843-51		Red ID 679843-89		

Other keys

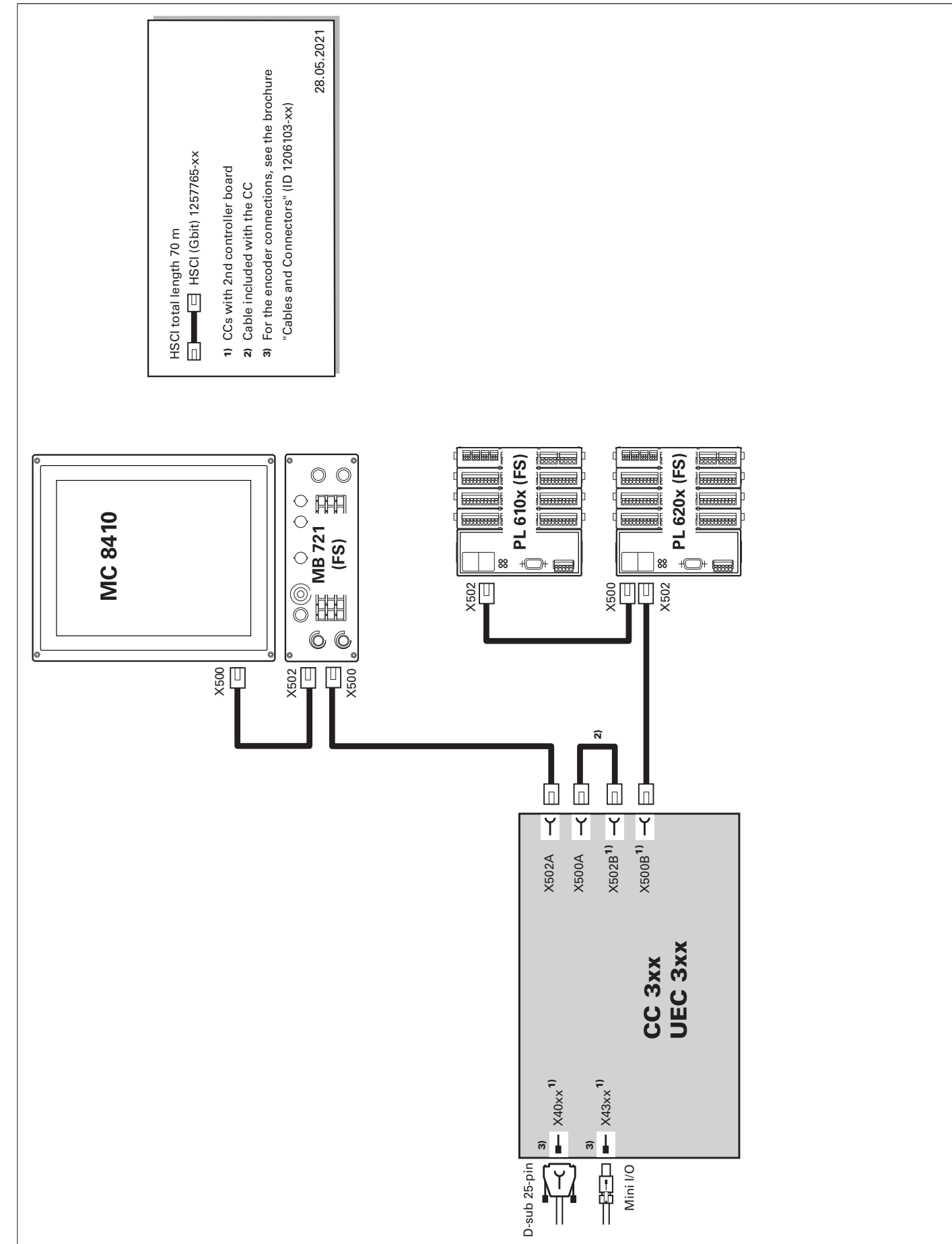
	ID 679843-15		ID 679843-39		ID 679843-97		Black ID 679843-E2
	ID 679843-17		ID 679843-41		ID 679843-98		ID 679843-E5
	Gray ID 679843-33		ID 679843-42		ID 679843-A7		ID 679843-F3
	Black ID 679843-34		Red ID 679843-45		ID 679843-A8		ID 679843-F4
	Orange ID 679843-35		ID 679843-58		Black ID 679843-D1	ENT	ID 679843-F5
	ID 679843-36		ID 679843-66		Black ID 679843-D2	PRT SC	ID 679843-F6
	ID 679843-37		ID 679843-75		ID 679843-D5		
	ID 679843-38		Green ID 679843-90		Red ID 679843-D7		

Special keys

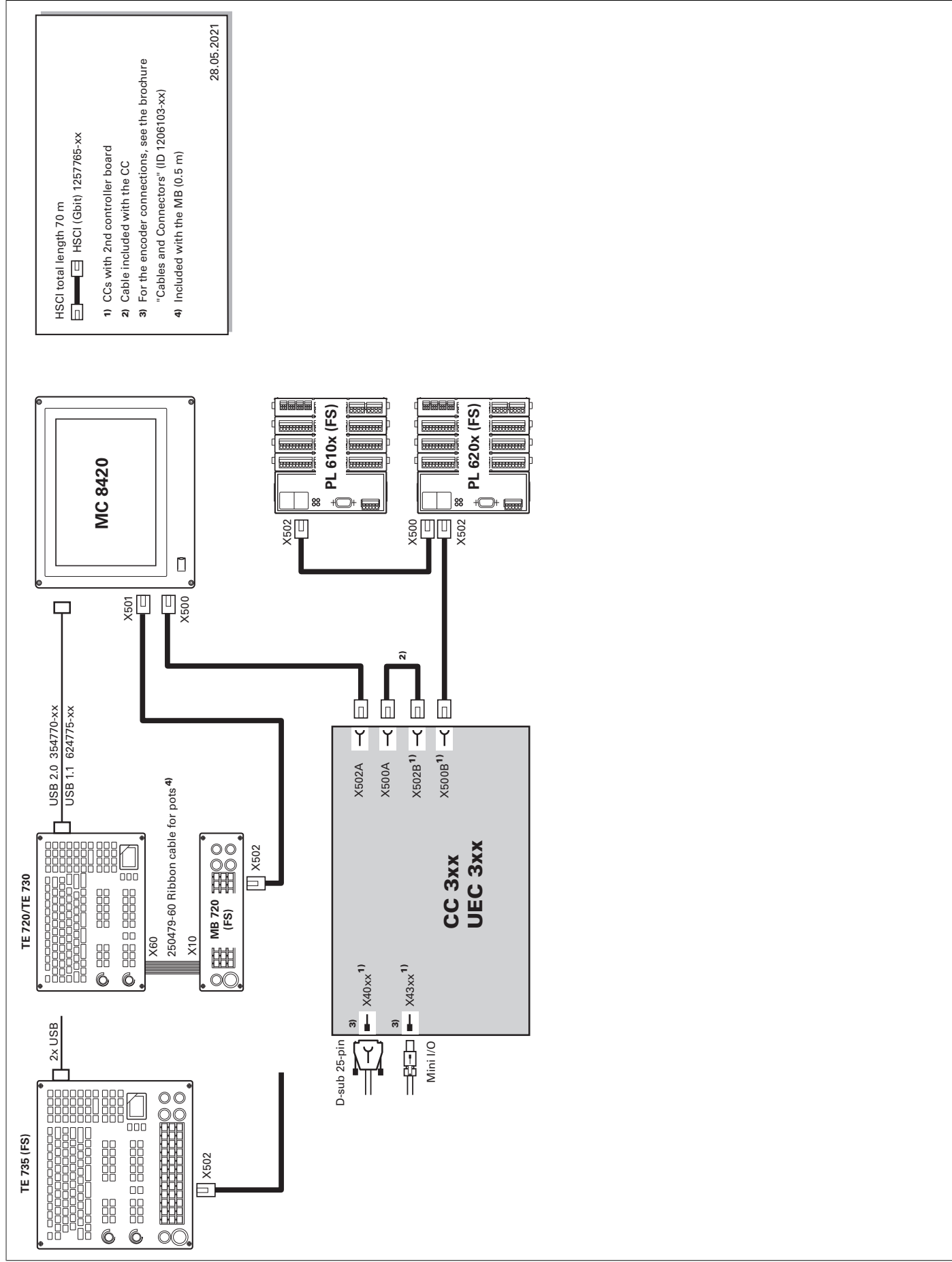
Snap-on keys can also be made with special key symbols for special applications. The laser labeling differs in appearance from the labeling of the standard keys. If you need keys for special applications, please consult your contact person at HEIDENHAIN.

Cable overview

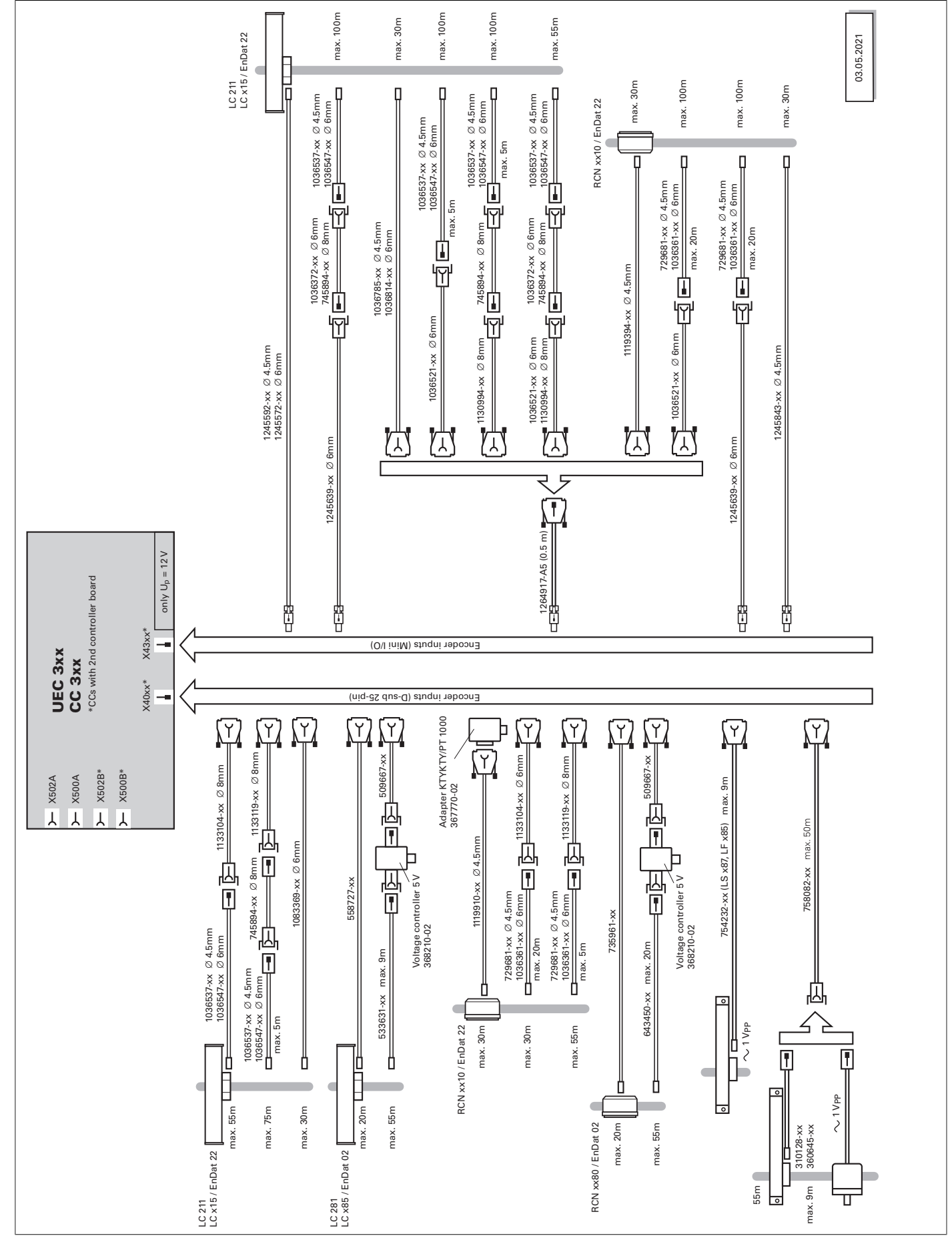
Control system with CC or UEC (integrated keyboard)

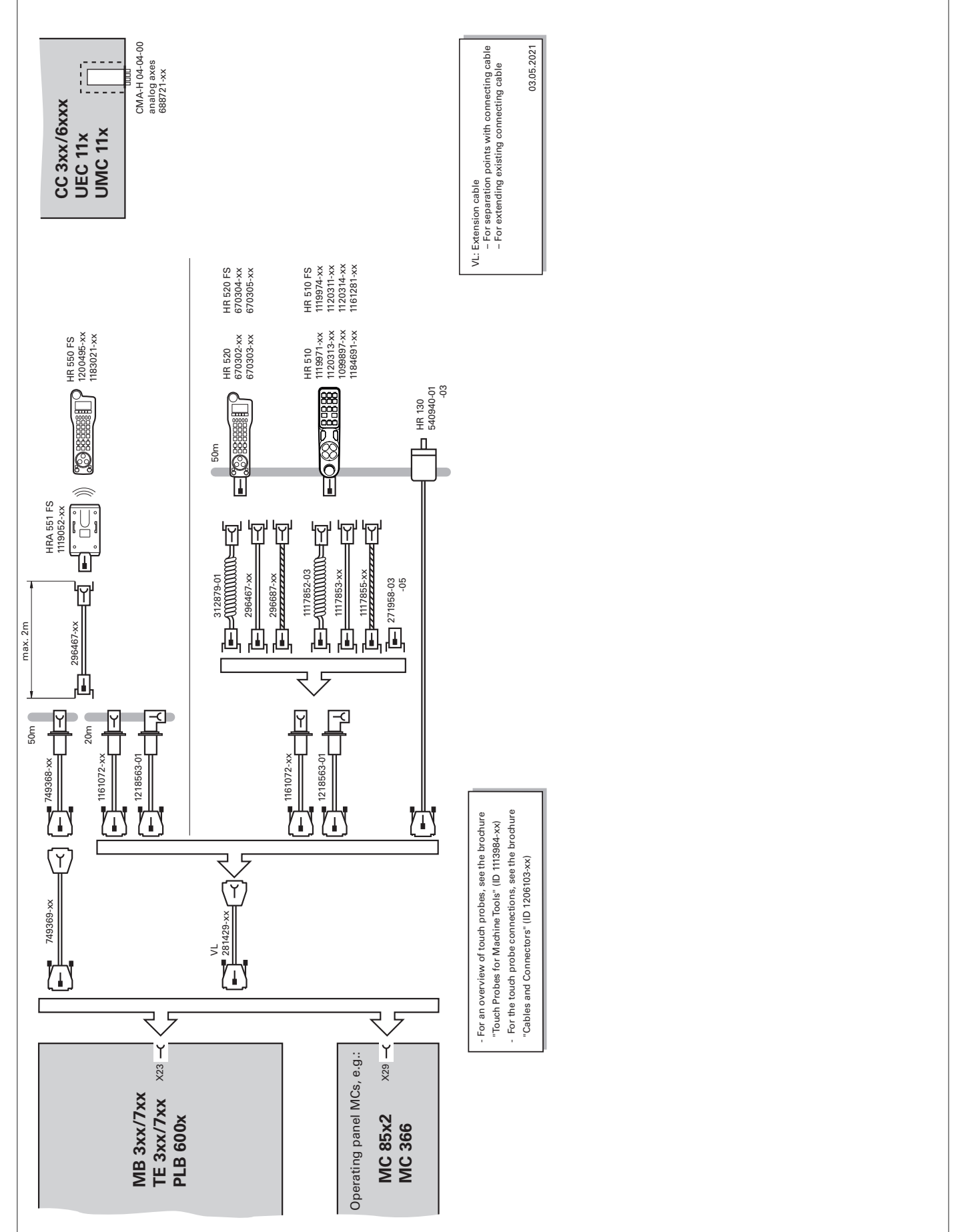
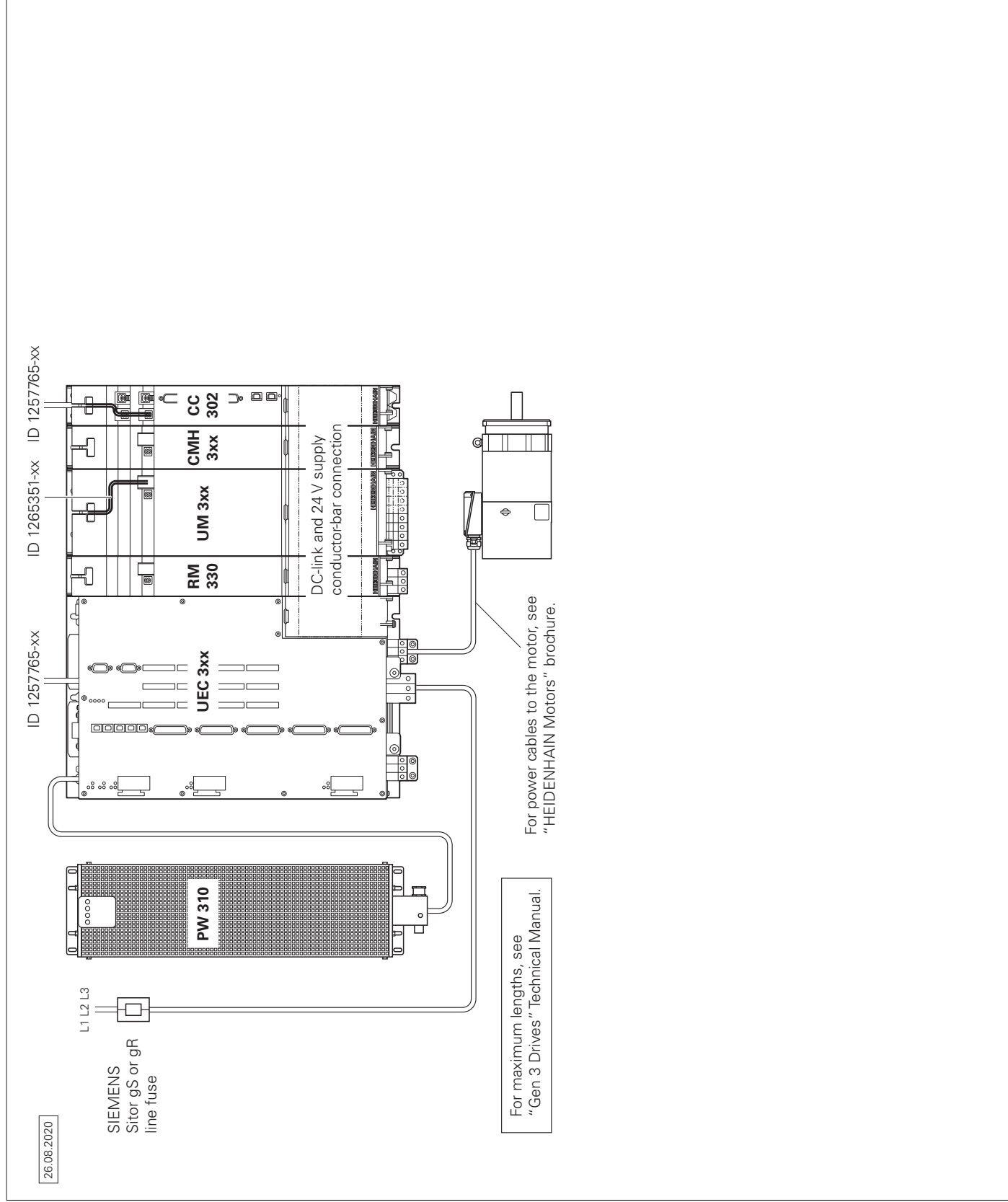


Control system with CC or UEC (separate keyboard)



Encoders





Technical description

Digital control design

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

Connection of the components:

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

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

Main advantages of the control design with HSCI:

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

CC or UEC controller units, up to nine PL 6000 PLC I/O modules, and machine operating panels (e.g., MB 72x from HEIDENHAIN) can be connected to the serial HSCI bus of the MC main computer. The HR handwheel is connected directly to the machine operating panel. The combination of monitor and main computer is especially advantageous if the computer is housed in the operating panel. Besides the power supply, all that is then required is an HSCI line to the controller unit in the electrical cabinet.

Maximum cable lengths for HSCI:

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

The order of the HSCI slaves can be freely chosen.

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

Gbit HSCI component		Maximum number in the control system
MC, IPC	HSCI master	1
CC, UEC	HSCI slave	5 ¹⁾
UVR	HSCI slave	4
MB, PLB 600x	HSCI slave	2
PLB 6xxx (integrated in UEC 3xx (FS))	HSCI slave	7
PLB 6xxx FS (integrated in UEC 3xx FS)	HSCI slave	2
HR		5
PLD-H xx-xx-xx FS	In PLB 6xxx FS	10 ²⁾
PLD-H xx-xx-xx, PLA-H xx-xx-xx	In PLB 6xxx (FS)	25 ²⁾
PAE-H xx-xx-xx	In PLB 62xx	13 ³⁾
UEC 3xx for external safety	HSCI slave (PAE module integrated)	13 ³⁾

¹⁾ Controller motherboards distributed to CC or UEC as desired.

Increased to five units as of NCK software 597110-15 (for more information on the NCK software, see the *Technical Manual* of the respective control).

²⁾ Maximum total of 1000 inputs/outputs

³⁾ Only in systems without integrated functional safety (FS)

Control systems with integrated functional safety (FS)

Basic principle With controls with integrated functional safety (FS) from HEIDENHAIN, Safety Integrity Level 2 (SIL 2) as per the standard EN 61508 and Performance Level "d" Category 3 as per EN ISO 13849-1 can be attained. In these standards, the assessment of safety-related systems is based on, among other things, the failure probabilities of integrated components and subsystems. This modular approach aids the manufacturers of safety-related machines in implementing their systems, since they can then build upon prequalified subsystems. This design is taken into account for the TNC 620 control, as well as for safety-related position encoders. Two redundant, mutually independent safety channels form the basis of the controls with functional safety (FS). All safety-relevant signals are captured, processed, and output via two channels. Errors are detected through a reciprocal data comparison of the two channels' states. Consequently, the occurrence of a single error in the control does not cause a loss in safety functionality.

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

Components In systems with functional safety, certain hardware components assume safety-relevant tasks. In systems with FS, only safety-relevant components are permitted to be used that, including their variant from HEIDENHAIN, are approved for this.

Control components with functional safety FS can be recognized based on the addition of "FS" after the type designation, e.g., MB 72x FS.

For a current list of the components approved for functional safety (FS), refer to *Functional safety (FS) supplement to the Technical Manual* (ID 1177599).

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

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

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

Safety functions Safety functions integrated into hardware and software:

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

Please note: Full functionality is not yet available for all machine types with functional safety (FS). Before planning a machine with functional safety (FS), please determine whether the current scope of features is sufficient for your machine design.

Activation of functional safety (FS) The following requirements are absolutely necessary:

- At least one PLB 62xx FS must be present in the system
- Safety-relevant control components in FS design (e.g., MB 72x FS, TE 735 FS, HR 550 FS)
- Safety-related SPLC program
- Configuration of safe machine parameters
- Wiring of the machine for systems with functional safety (FS)

Functional safety (FS) can be scaled via the software options 160 to 167 and 169 ("Software options"). Only the number of safe drive systems actually needed must be enabled.

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

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

Control systems with external safety

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

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

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

Operating system

HEROS 5 The TNC 620 and PNC 610 work with the real-time capable HEROS 5 operating system (HEIDENHAIN Realtime Operating System). This future-oriented operating system contains the following powerful functions as part of its standard repertoire:

Network

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

Safety

- Portscan (OEM): port scanner
- Firewall: protection against undesired network access
- SELinux: protection against unauthorized changes to system files
- Sandbox: running applications in separated environments

System

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

Tools

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

User administration

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

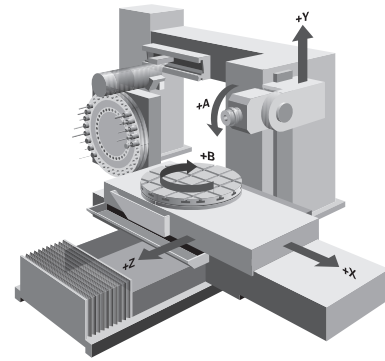
- Logging on to the control with a user account
- User-specific HOME folder for simplified data management
- Role-based access to the control and network data



*) Firefox is a registered trademark of the Mozilla Foundation

Axes

Linear axes Depending on its configuration, the TNC 620 can control linear axes with any axis designation (X, Y, Z, U, V, W, ...).



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

Feed rate override: 0 % to 150 %

Traverse range The machine manufacturer defines the traverse range. The user can additionally limit the range of traverse in order to limit the working space. Three different traverse ranges can be defined (selection via PLC).

Rotary axes The TNC 620 can control rotary axes with any axis designation (A, B, C, U, ...). Special parameters and PLC functions are available for rotary axes with Hirth coupling.

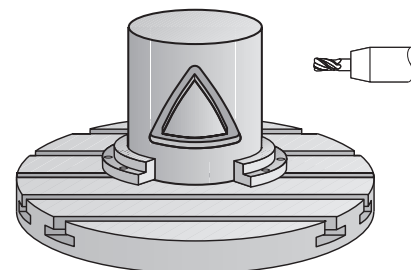
Display and programming 0° to 360° or

Feed rate in degrees per minute [°/min]

Traverse range The machine manufacturer defines the traverse range. The user can additionally limit the range of traverse in order to limit the working space. Various traverse ranges can be defined via parameter sets for each axis (selection via PLC).

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

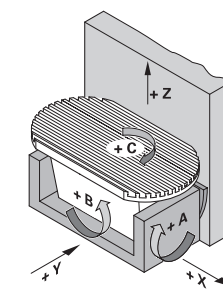
Cylinder surface interpolation (software option 8) A contour defined in the working plane is machined on a cylindrical surface.



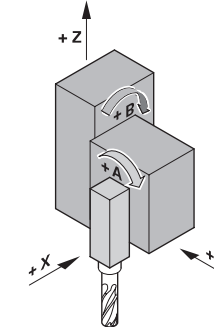
Tilting the working plane (software option 8)

The TNC 620 has special coordinate transformation cycles for controlling swivel heads and tilting tables. The tool lengths and offset of the tilting axes are compensated for by the TNC.

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



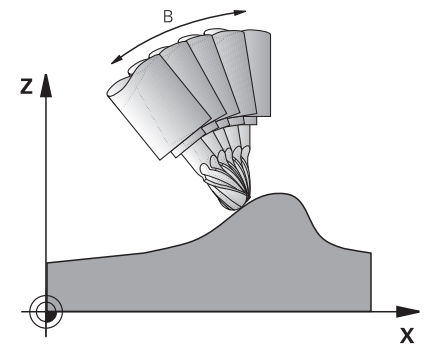
Tilting table



Swivel head

5-axis machining (software option 9)

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

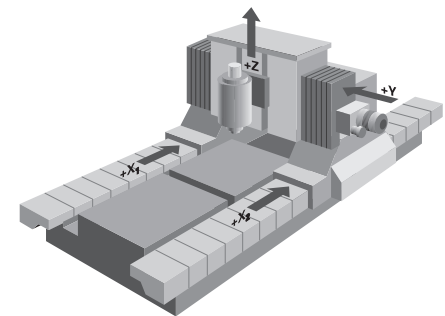


Synchronized axes (software option 24)

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

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

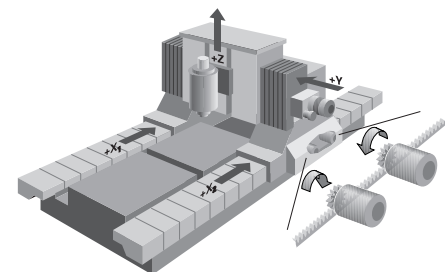
In the case of **gantry axes**, multiple gantry slave axes can be assigned to a single master axis. They may also be distributed to multiple controller units.



Torque control (software option 24)

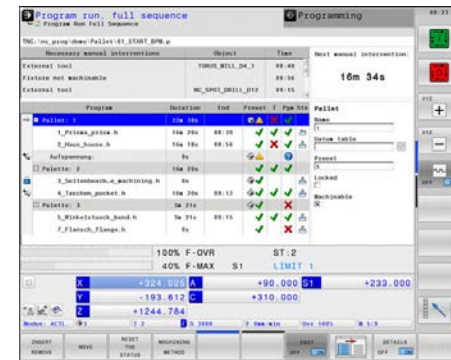
Torque control is used on machines with mechanically coupled motors, for which

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



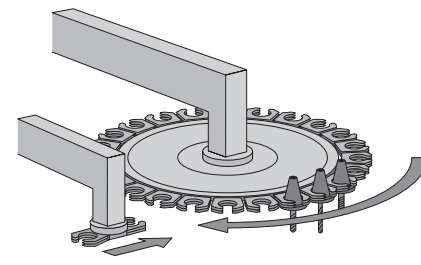
Batch Process Manager (software option 154)

Batch Process Manager provides functions for the planning and execution of multiple production jobs on the TNC. It makes it possible to easily edit pallets and to alter the sequence of pending jobs. Batch Process Manager also performs a duration calculation for all planned jobs or NC programs. It informs the user as to whether, for example, all NC programs can be executed without error or whether all required tools are available with sufficient tool life. Batch Process Manager thereby ensures the smooth execution of the planned jobs. Batch Process Manager also requires software option 22 (Pallet Management) to be enabled.



PLC axes

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



Spindle

Overview

The TNC 620 contouring control operates in conjunction with the HEIDENHAIN inverter systems with field-oriented control. As an alternative, an analog nominal speed value can be output.

Controller unit

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

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

With software option 49 (double speed), this frequency can be increased to up to 16 kHz for fast-turning spindles (e.g., HF spindles).

Maximum spindle speed

The maximum spindle speed is calculated as follows:

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

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

Operating mode switchover

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

Position-controlled spindle

The position of the spindle is monitored by the control.

Encoder

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

Tapping

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

Spindle orientation

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

Spindle override

0 % to 150 %

Gear ranges

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

Multiple main spindles

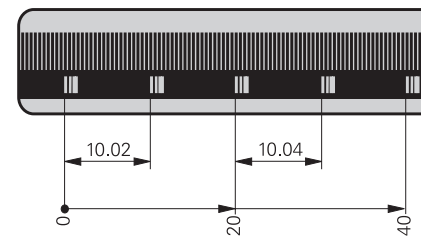
Up to two spindles can be controlled alternately. The spindles are switched by the PLC. One control loop is required for each active spindle.

Encoders

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

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

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



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

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

Absolute encoders With absolute encoders, the position information is contained in several coded tracks. Thus, an absolute reference is available immediately after switch-on. A reference-mark traverse is not necessary. Additional incremental signals are output for highly dynamic control loops.

EnDat interface The TNC 620 features the serial EnDat 2.2 interface (includes EnDat 2.1) for the connection of absolute encoders.

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

Encoder inputs Incremental and absolute linear, angle, or rotary encoders from HEIDENHAIN can be connected to all **position encoder** inputs of the controller unit.

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

Inputs	Signal level/ Interface ¹⁾	Input frequency ¹⁾	
		Position	Speed
Incremental signals	~1 V _{pp} EnDat 2.1	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.1 EnDat 2.2	–	–

¹⁾ Switchable

Digital servo control

Integrated inverter Position controllers, speed controllers, current controllers, and inverters are integrated into the TNC 620. HEIDENHAIN synchronous or asynchronous motors are connected to the TNC 620.

Axis feedback control The TNC 620 can control axes with servo lag or feedforward control. During roughing operations at high speeds, for example, you can switch to velocity semi-feedforward control via an OEM cycle in order to machine faster at reduced accuracy.

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

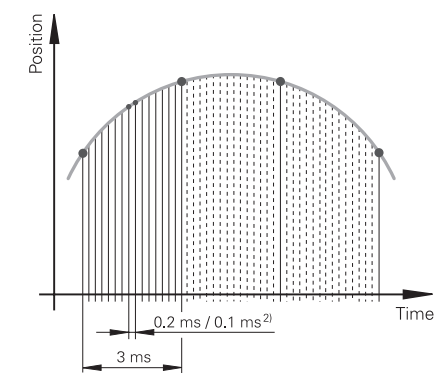
$$v = k_v \cdot s_a$$

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

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

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

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



	CC/UEC/UMC
Path interpolation	3 ms
Fine interpolation	0.2 ms/0.1 ms ¹⁾ at f _{PWM} = 5000 Hz
Position controller	0.2 ms/0.1 ms at f _{PWM} = 5000 Hz
Speed controller	0.2 ms/0.1 ms ¹⁾ at f _{PWM} = 5000 Hz
Current controller	0.1 ms at f _{PWM} = 5000 Hz

¹⁾ Double speed (with software option 49)

Axis clamping

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

Double speed control loops (software option 49)

Double-speed control loops permit higher PWM frequencies and shorter cycle times for the speed controller. This enables improved current control for spindles and higher controller performance for linear and torque motors.

Crossover Position Filter (CPF)

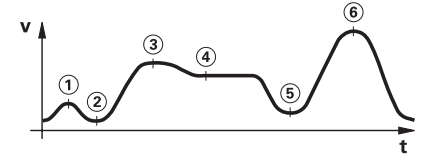
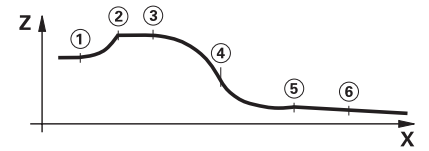
To increase the stability of the position control loop in systems with resonances, the position signal from the position encoder, which is filtered through a low-pass filter, is combined with the position signal from the motor speed encoder, which is filtered through a high-pass filter. This signal combination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

Fast contour milling

Short block processing time

The TNC 620 provides the following important features for fast contour machining.

The block processing time of the MC is 1.5 ms. This means that, during the execution of long programs from the hard drive, the TNC 620 can even mill contours approximated in 0.2 mm line segments at a feed rate of up to 8 m/min.



Look-ahead

The TNC 620 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.

Jerk

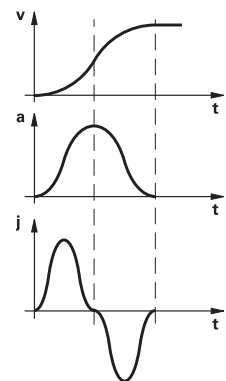
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

Jerk limiting

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

Smoothed jerk

The jerk is smoothed by nominal position value filters. The TNC 620 therefore mills smooth surfaces at the highest possible feed rate and yet keeps the contour accurate. The permitted tolerance is programmed by the user via a cycle. Special filters for HSC machining (HSC filters) can suppress machine-specific natural frequencies. The desired accuracy along with very high surface quality are attained.

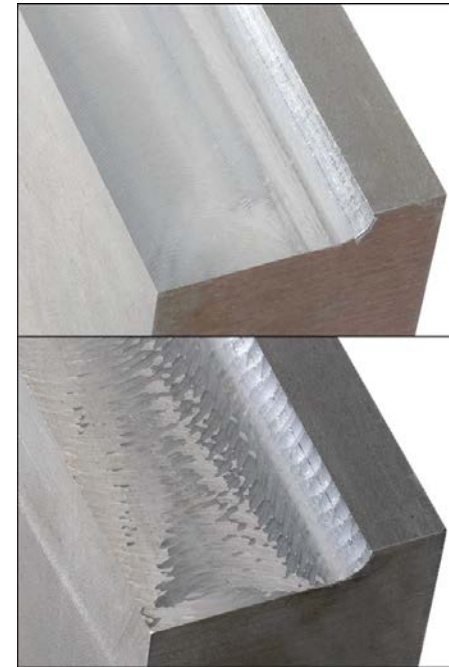


Advanced Dynamic Prediction (ADP)

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

Active Chatter Control (ACC, software option 145)

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



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

Optimized Contour Milling (OCM, software option 167)

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

Advantages of OCM over conventional machining:

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

Dynamic Precision



Overview

The umbrella term Dynamic Precision encompasses a number of HEIDENHAIN milling solutions that significantly improve the dynamic accuracy of a machine tool. The dynamic accuracy of machine tools can be seen in the errors at the tool center point (TCP). The size of these errors depends on the magnitudes of the motion (e.g., speed and acceleration, as well as jerk) and result from the vibrations of the machine components, among other things. Taken together, all of these errors are partially to blame for dimensional errors and faults on the surfaces of workpieces. They therefore have a decisive impact on quality and, in the event of quality-related scrap, on productivity as well.

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

The software options that make up Dynamic Precision can be deployed by the machine manufacturer both alone or in combination:

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

Load Adaptive Control (LAC, software option 143)

With LAC (software option 143), you can dynamically adjust controller parameters based 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 Load Adaptive Control (LAC) software option allows the control to automatically determine the current mass moment of inertia of the workpiece and the current frictional forces.

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

Motion Adaptive Control (MAC, software option 144)

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

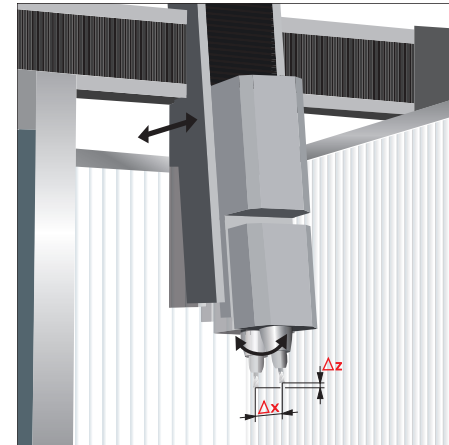
Cross Talk Compensation (CTC, software option 141)

CTC (software option 141) enables the compensation of dynamic position errors potentially arising from acceleration forces.

To increase productivity, machine tool users are asking for ever higher feed rates and accelerations, while at the same time they need to maintain the highest possible surface quality and accuracy, placing very special requirements on path control.

Highly dynamic acceleration processes introduce forces to the structure of a machine tool. They can deform parts of the machine and thereby lead to deviations at the tool center point (TCP). Besides deformation in the direction of the axis, the dynamic acceleration of an axis due to mechanical axis coupling can also result in the deformation of axes that are perpendicular to the direction of acceleration. The resulting position error at the TCP in the direction of the accelerated axis and lateral axes is proportional to the amount of acceleration.

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



Machine Vibration Control (MVC, software 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 motors. This results in vibrations, such as machine setup vibrations, that may reduce the attainable accuracy and surface quality of the workpieces. With Machine Vibration Control (MVC, software option 146), two functions that effectively suppress low-frequency vibrations are available.

Active Vibration Damping (AVD)

The AVD (Active Vibration Damping) controller function damps 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.

Frequency Shaping Control (FSC)

The FSC (Frequency Shaping Control) function suppresses the inducement of vibrations through a correspondingly filtered feedforward control. The improved rigidity attained can be used to increase the dynamic limit values (e.g. jerk), and therefore makes reduced machining times possible.

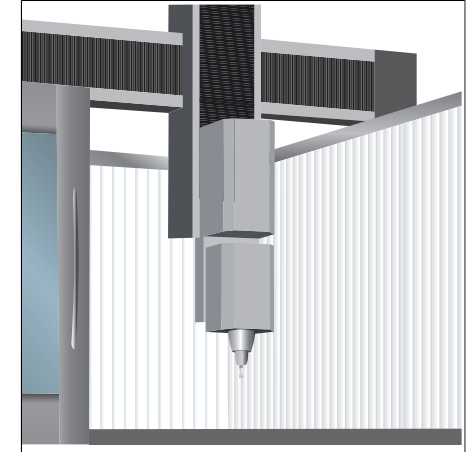
The combination of the two functions (AVD and FSC) optimizes the dynamics, surface quality, and productivity.

Position Adaptive Control (PAC, software option 142)

PAC (software option 142) permits the dynamic, position-dependent adaption of controller parameters based on the spatial position of the tool.

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

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



Monitoring functions

Description

During operation, the control monitors the following details*):

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

With EnDat 2.2 encoders:

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

In the event of hazardous errors, an emergency stop message is sent to the external electronics via the control-is-ready output, and the axes are brought to a stop. The correct connection of the TNC 620 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.

Context-sensitive help

A context-sensitive help function is available to the user via the HELP key or ERR key. In the event of an error message, the control displays the cause of the error and the possibilities for fixing it. The machine manufacturer can also implement this user support for PLC error messages.



KinematicsDesign (accessory)

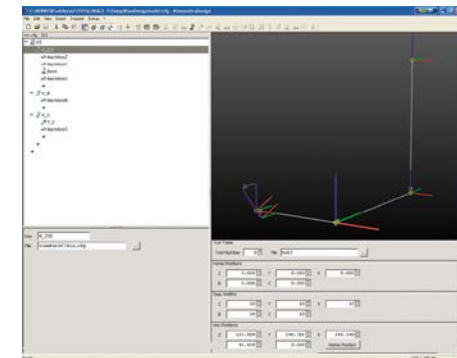
KinematicsDesign is a PC program for creating adaptable kinematic configurations. It supports the following:

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

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

If KinematicsDesign is connected to a control online (operation is also possible with the programming station software), then machine movements can be simulated when the axes are moved.

Visualization options range from a pure depiction of the transformation chain and a wire model all the way to the complete machine model.



Component Monitoring (software option 155)

The overloading of machine components is often the cause of expensive machine damage and unplanned production downtime. Component monitoring keeps the user informed about the current load on the spindle bearings and reacts upon exceedance of the specified limit values (e.g., with an NC stop).

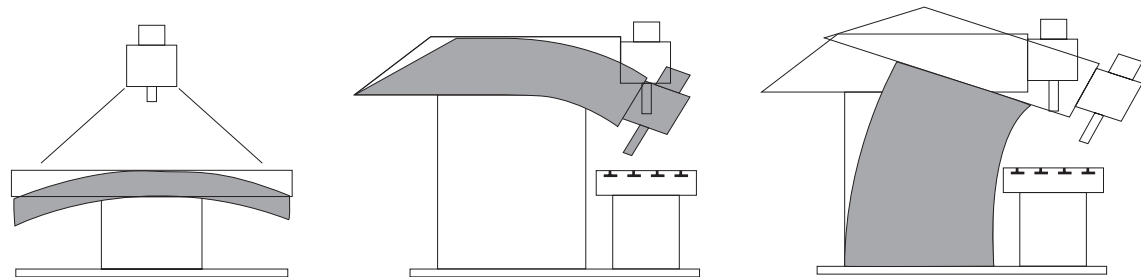
*1) No safety functions

Error compensation

Overview The TNC 620 automatically compensates for mechanical errors of the machine.

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

Nonlinear error The TNC 620 can compensate for ball-screw pitch errors and sag errors simultaneously. The compensation values are stored in a table. Nonlinear axis-error compensation also makes it possible to compensate for position-dependent backlash.



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

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

Reversal spikes In circular movements, reversal spikes can occur at quadrant transitions due to mechanical influences. The TNC 620 can compensate for these reversal spikes.

Static friction At very low feed rates, high static friction can cause the slide to stop and start repeatedly for short periods. This is commonly known as stick-slip. The TNC 620 can compensate for this problematic behavior.

Sliding friction Sliding friction is compensated for by the speed controller of the TNC 620.

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

The temperature is measured via thermistors connected to the analog inputs of the TNC 620. The PLC evaluates the temperature information and passes a compensation value to the NC.

KinematicsOpt (software option 48)

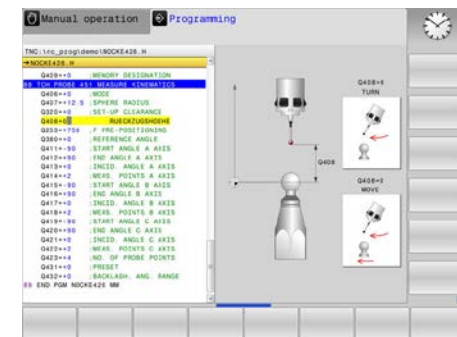
Using the KinematicsOpt function, machine manufacturers and end users can check the accuracy of rotary or swivel axes and compensate for possible displacements of the center of rotation of these axes. The deviations are automatically transferred to the kinematics description and can be taken into account in the kinematics calculation.

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

Calibration sphere (accessory)

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

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



Initial setup and diagnostic aids

Overview The TNC 620 provides comprehensive internal commissioning and diagnostic aids. It also includes highly effective PC software for diagnostics, optimization, and remote control.

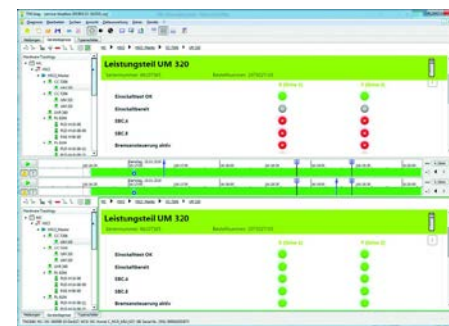
ConfigDesign (accessory) PC software for configuring the machine parameters

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

TNCdiag The HEIDENHAIN TNCdiag application evaluates the status and diagnostic information of HEIDENHAIN components (with an emphasis on the drive systems) and graphically images the data:

- Status and diagnostic information about the HEIDENHAIN components (drive electronics, encoders, input/output devices, etc.) connected to the control
- History of the recorded data
- Replaces DriveDiag for Gen 3 drives

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

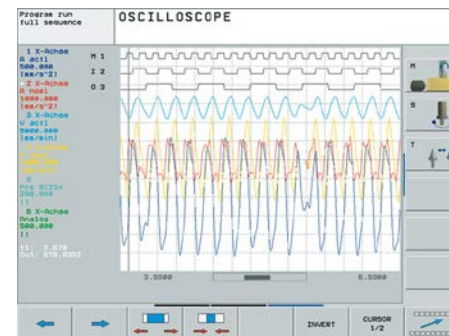


Oscilloscope The TNC 620 features an integrated oscilloscope. Both X/t and X/Y graphs are possible. The following characteristic curves can be recorded and stored in six channels:

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

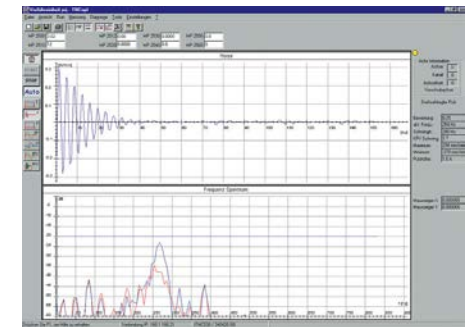
Logic signals Simultaneous graphical representation of the logic states of up to 16 operands (markers, words, inputs, outputs, counters, timers)

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



TNCOpt (accessory) PC software for commissioning digital control loops. Functions (among others):

- Initial setup of the current controller
- (Automatic) initial setup of the velocity controller
- (Automatic) optimization of sliding-friction compensation
- (Automatic) optimization of compensation for reversal spikes
- (Automatic) optimization of the k_v factor
- Circular interpolation test, contour test



Online Monitor (OLM) The online monitor is a component of the TNC 620 and is called with a code number. It supports commissioning and diagnosis of control components through the following:

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

TNCscope (accessory) PC software for transferring the oscilloscope files to a PC. With TNCscope you can record and save up to 16 channels simultaneously.

Note: The trace files are saved in the TNCscope data format.

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

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

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

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

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

Single station license ID 340449-xx

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

State Reporting (software option 137) With the State Reporting Interface (SRI) software option, HEIDENHAIN offers an interface for the simple provision of machine operating states for a higher-level machine data or production data acquisition system (MDA/PDA).

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

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

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

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

Function:

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

Integrated PLC

Overview The PLC program is created by the machine manufacturer either at the control (through an external PC keyboard with USB connection) 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 I/Os are available via the external PL 6000 and UxC. The PLC I/Os and the PROFINET IO or PROFIBUS DP-capable I/O system must be configured with the IOconfig PC software.

Format	Statement list
Memory	4 GB
Cycle time	9 ms to 30 ms (adjustable)
Command set	<ul style="list-style-type: none"> • Bit, byte, and word commands • Logical operations • Arithmetic commands • Comparisons • Bracketed terms • Jump commands • Subprograms • Stack operations • Submit programs • Timers • Counters • Comments • PLC modules • Strings

Encryption of PLC data The encrypted PLC partition (PLCE:) provides the machine manufacturer with a tool for preventing third parties from viewing or changing files. The files on the PLCE partition can be read only by the control itself or by using the correct OEM keyword. This ensures that proprietary know-how and special customer-specific solutions cannot be copied or changed.

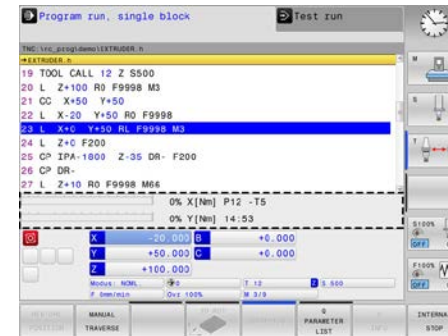
The machine manufacturer can also determine the size of the encrypted partition. This is not determined until the machine manufacturer creates the PLCE partition. Another advantage is that, in spite of the encryption, the data can be backed up from the control to a separate data medium (USB drive, network,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

PLC window

The TNC 620 can display PLC error messages in the dialog line during operation.

Small PLC window

The TNC 620 can show additional PLC messages and bar diagrams in the small PLC window.



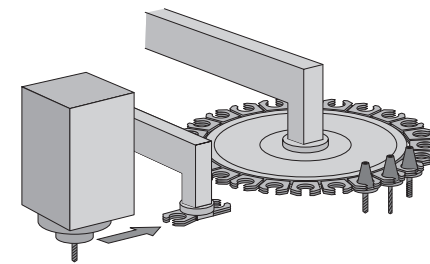
Small PLC window

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



PLC axes

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

PLCdesign (accessory)

PC software for PLC program development. The PC program **PLCdesign** can be used for easy creation of PLC programs. Extensive examples of PLC programs are included.

Functions:

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

Python OEM Process (software option 46)

The Python OEM Process software option gives the machine manufacturer a powerful tool for using a high-level, object-oriented programming language in the control (PLC). Python is an easy-to-learn script language supporting all necessary high-level language elements.

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

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

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



PLC basic program

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

Axes

- Control of analog axes
- Axes with clamping mode, central drive, and the Hirth grid
- Synchronized axes
- 3D head with C-axis mode
- Reference run, reference end position
- Axis lubrication

Spindles

- Control and orientation of the spindles
- Spindle clamping
- Alternative double-spindle operation
- Parallel spindle operation
- Conventional 2-stage gear system
- Wye/delta connection switchover (static, dynamic)

Tool changers

- Manual tool changer
- Tool changer with pick-up system
- Tool changer with dual gripper
- Tool changer with positively driven gripper
- Rotating tool magazine with closed-loop axis
- Rotating tool magazine with controlled axis
- Servicing functions for the tool changer
- Python tool management

Pallet changers

- Translational pallet changer
- Rotatory pallet changer
- Servicing functions for the pallet changer

Safety functions

- Emergency stop test (EN 13849-1)
- Brake test (EN 13849-1)
- Repeated switch-on test for a wireless handwheel

General functions

- Feed rate control
- Control of the coolant system (internal, external, air)
- Temperature compensation
- Activate tool-specific torque monitoring
- Hydraulic control
- Chip conveyor
- Indexing fixture
- Touch probes
- PLC support for handwheels
- Control of doors
- Handling of M functions
- PLC log
- Display and management of PLC error messages
- Diagnosis screen (Python)
- Python example applications
- Status display in the small PLC window

Interfacing to the machine

OEM cycles (software option 19)

The machine manufacturer 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. Complete tool management with tool life monitoring and replacement tool monitoring is carried out by the TNC 620.

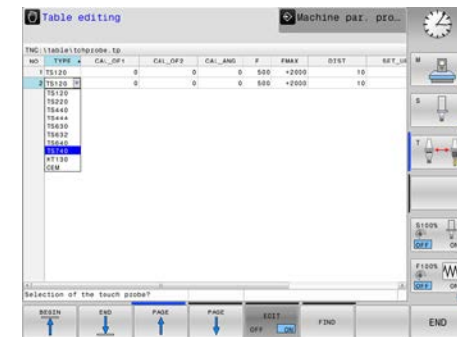
Tool calibration (software option 17)

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



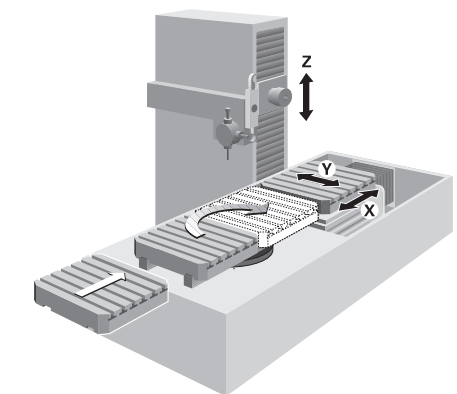
Touch-probe configuration (software option 17)

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 (software option 22)

Pallet feeding can be controlled via PLC axes. The user defines the pallet sequence, pallet presets, and workpiece presets in the pallet tables. The pallet tables are freely configurable; any information can be stored in the tables and called via the PLC.



Data transfer and communication

Data interfaces

Overview	The TNC 620 is connected to PCs, networks, and other data storage devices via data interfaces.
Ethernet	<p>The TNC 620 can be interconnected via the Ethernet interface. For connection to a data network, the control features a 1000BASE-T (twisted pair Ethernet) connection.</p> <p>Maximum transmission distance: Unshielded: 100 m Shielded: 400 m</p>
Protocol	The TNC 620 communicates using the TCP/IP protocol.
Network connection	<ul style="list-style-type: none">• NFS file server• Windows networks (SMB)
Data transfer speed	Approx. 400 to 800 Mbit/s (depending on the file type and network utilization)
Protocols	The TNC 620 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 for data backup. This method improves data security.
LSV2	Bidirectional transfer of commands and data as per DIN 66019. The data is divided into telegrams (blocks) and transmitted.
USB	The TNC 620 features USB ports for connecting standard USB devices such as a mouse, disk drive, etc. The MC units have four USB 3.0 ports. One of them leads to the TE, where a cover cap protects it from contamination. More USB 2.0 ports are in the integrated USB hub on the rear of the BF. The USB ports are rated for a maximum of 0.5 A.
USB cables	Cable length of up to 5 m ID 354770-xx Cable length of 6 m to 30 m with integrated amplifier; limited to USB 1.1 ID 624775-xx

Software for data transfer We recommend using HEIDENHAIN software to transfer files between the TNC 620 and a PC.

TNCremo (accessory) This PC software package supports the user in transferring data from the PC to the control. This software implements blockwise data transfer with block check characters (BCC).

Functions:

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

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

Additional functions:

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

TNCremoPlus

ID 340447-xx

Connected Machining

Overview

Connected Machining makes uniformly digital job management possible in networked manufacturing. You also profit from:

- Easy data usage
- Time-saving procedures
- Transparent processes

Remote Desktop Manager (software option 133)

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

Remote Desktop Manager ID 894423-xx

HEIDENHAIN DNC (software option 18)

The development environments on Windows operating systems are particularly well suited as flexible platforms for application development in order to handle the increasingly complex requirements of the machine's environment.

The flexibility of the PC software and the large selection of ready-to-use software components and standard tools in the development environment enable you to develop PC applications of great use to your customers in a very short time, for example:

- Error reporting systems that, for example, send the customer a text message to his cell phone reporting problems on the currently running machining process
- Standard or customer-specific PC software that decidedly increases process reliability and equipment availability
- Software solutions controlling the processes of manufacturing systems
- Information exchange with job management software

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

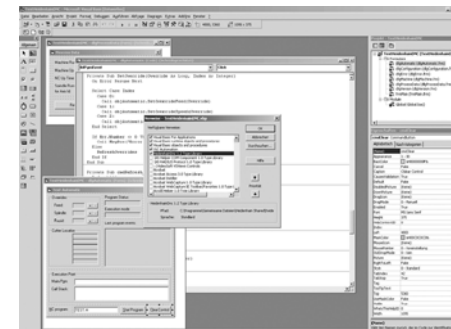
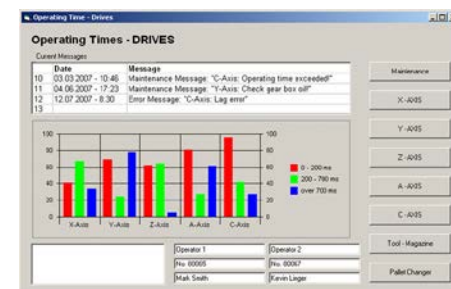
RemoTools SDK (accessory)

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

RemoTools SDK ID 340442-xx

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

connected + machining



OPC UA NC Server (software option 18)

The Open Platform Communications Unified Architecture (OPC UA) standard has emerged in recent years as a well-established interface for secure and reliable data exchange in industrial environments. The new HEIDENHAIN OPC UA NC Server software option makes this forward-looking interface available on the TNC 640. OPC UA features cross-operating system capability: along with the widespread Windows systems, OPC UA also allows Linux-based systems or Apple computers with macOS*, for example, to be connected to the HEIDENHAIN control.

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

The HEIDENHAIN OPC UA NC Server supports the following OPC UA services:

- Reading and writing variables
- Subscribing to value changes
- Executing methods
- Subscribing to events

With Sign&Encrypt, HEIDENHAIN ensures that even the standard solution provides state-of-the-art IT security:

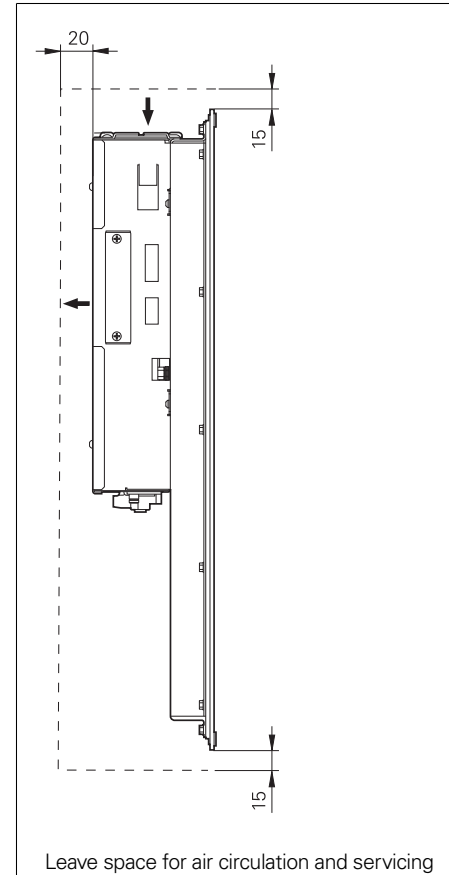
- SecurityMode: Sign&Encrypt
- Cryptographic algorithm: Basic256Sha256 (recommendation of OPC Foundation) – X.509 Certificates
- User authentication through X.509 certificates

* Apple and macOS are trademarks of Apple Inc.

Mounting information

Clearances and mounting

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



Mounting and electrical installation Observe the following points during mounting and electrical connection:

- National regulations for low-voltage installations at the operating site of the machine or components
- National regulations regarding interference and noise immunity at the operating site of the machine or components
- National regulations regarding electrical safety and operating conditions at the operating site of the machine or components
- Specifications for the installation position
- Specifications of the Technical Manual

Degrees of protection The following components fulfill the requirements for IP54 (dust protection and splash-proof protection):

- Display unit (when properly installed)
- Keyboard unit (when properly installed)
- Machine operating panel (when properly installed)
- Handwheel

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

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

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

Likely sources of interference Interference is produced by capacitive and inductive coupling into electrical conductors or into device connections, caused by, e.g.:

- Strong magnetic fields from transformers or electric motors
- Relays, contactors, and solenoid valves
- High-frequency equipment, pulse equipment, and stray magnetic fields from switch-mode power supplies
- Power lines and leads to the above equipment

Protective measures

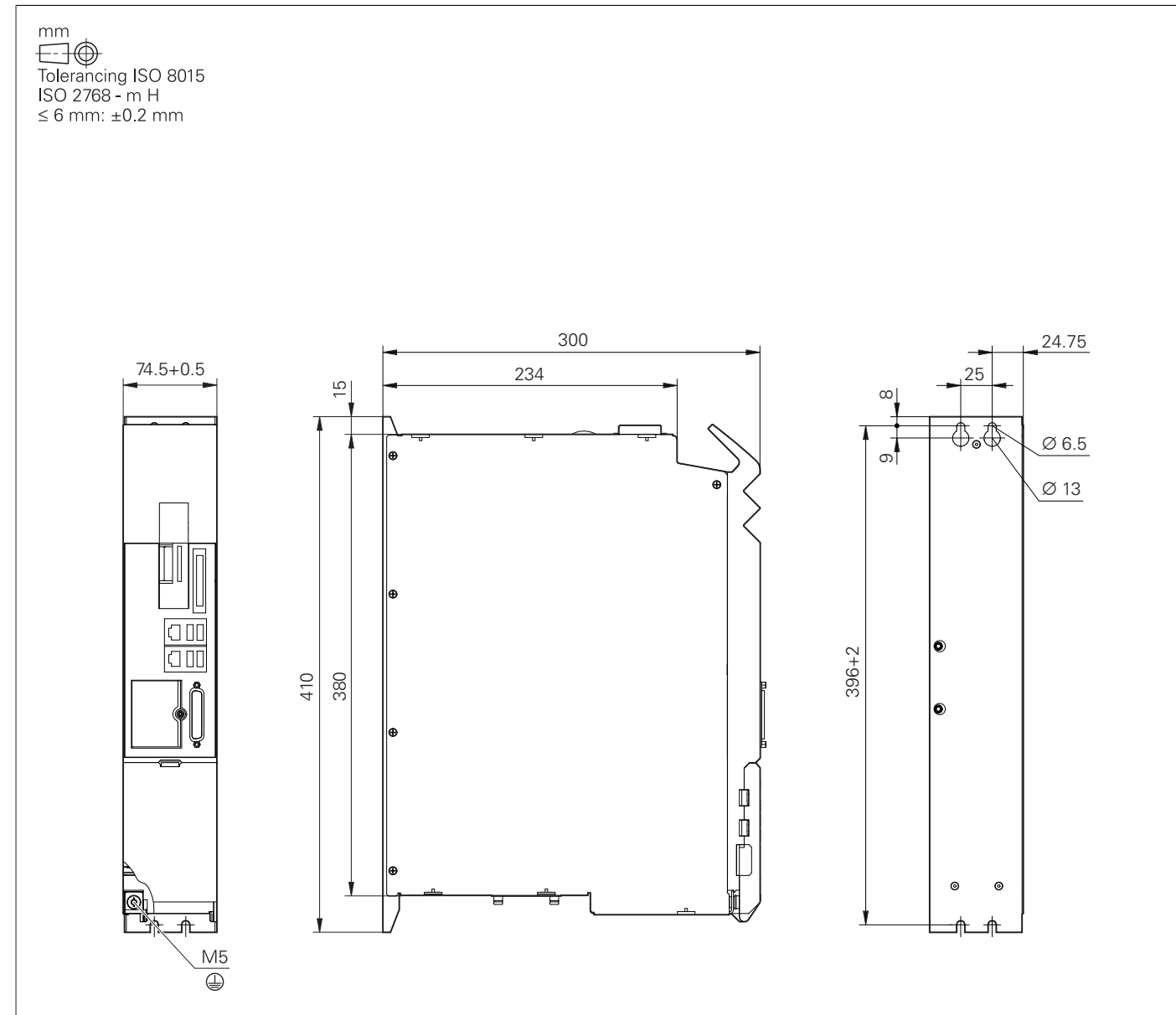
- Ensure that the MC, CC, and signal lines are at least 20 cm away from interfering devices
- Minimum distance of 10 cm between MC, CC, and signal lines to cables carrying interfering signals (in metal cable ducts, a grounded separation wall suffices for decoupling)
- Shielding according to EN 50178
- Use equipotential bonding lines in accordance with the grounding diagram (comply with the Technical Manual of your control).
- Use only genuine HEIDENHAIN cables and connecting elements

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

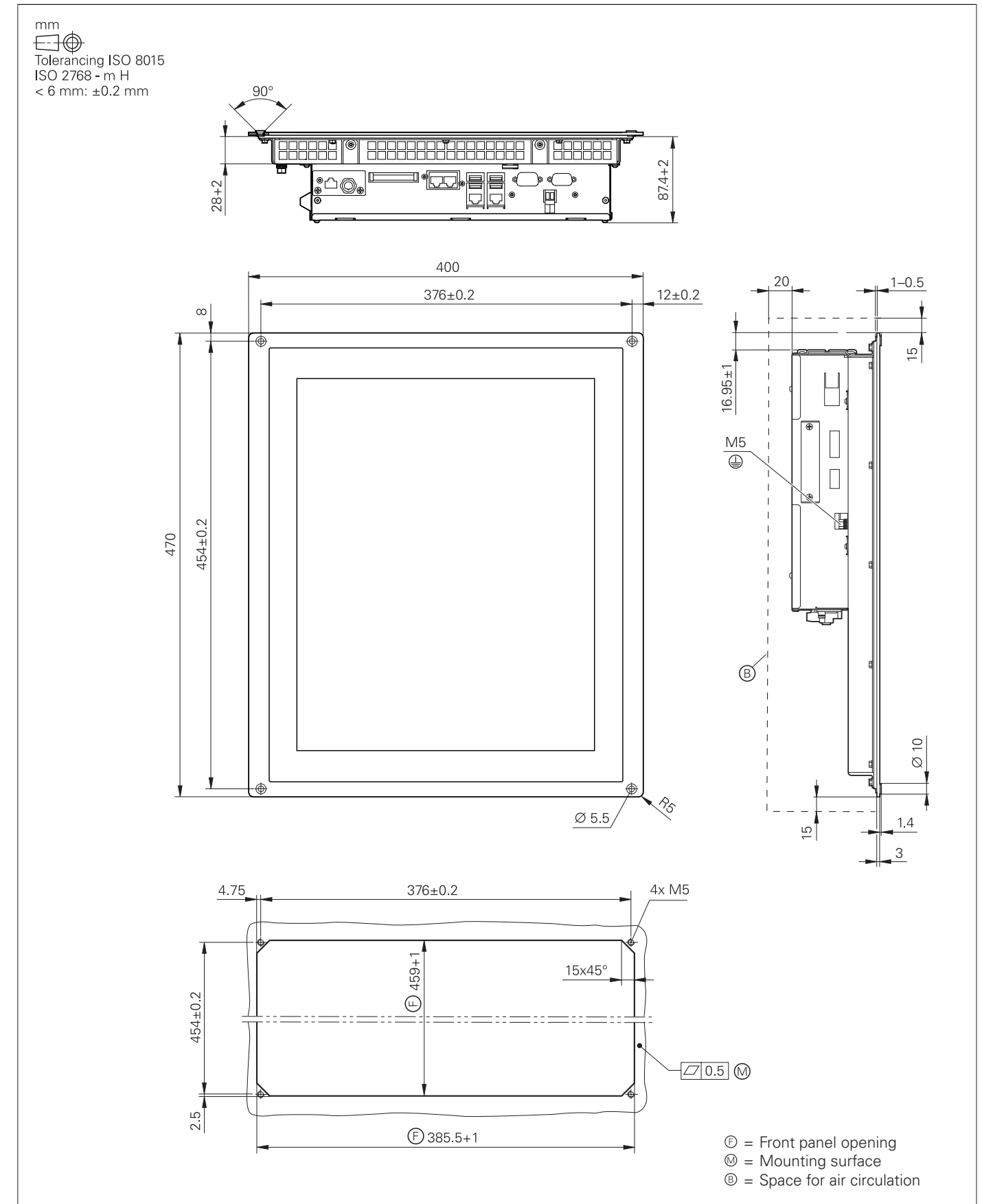
Key dimensions

Main computer

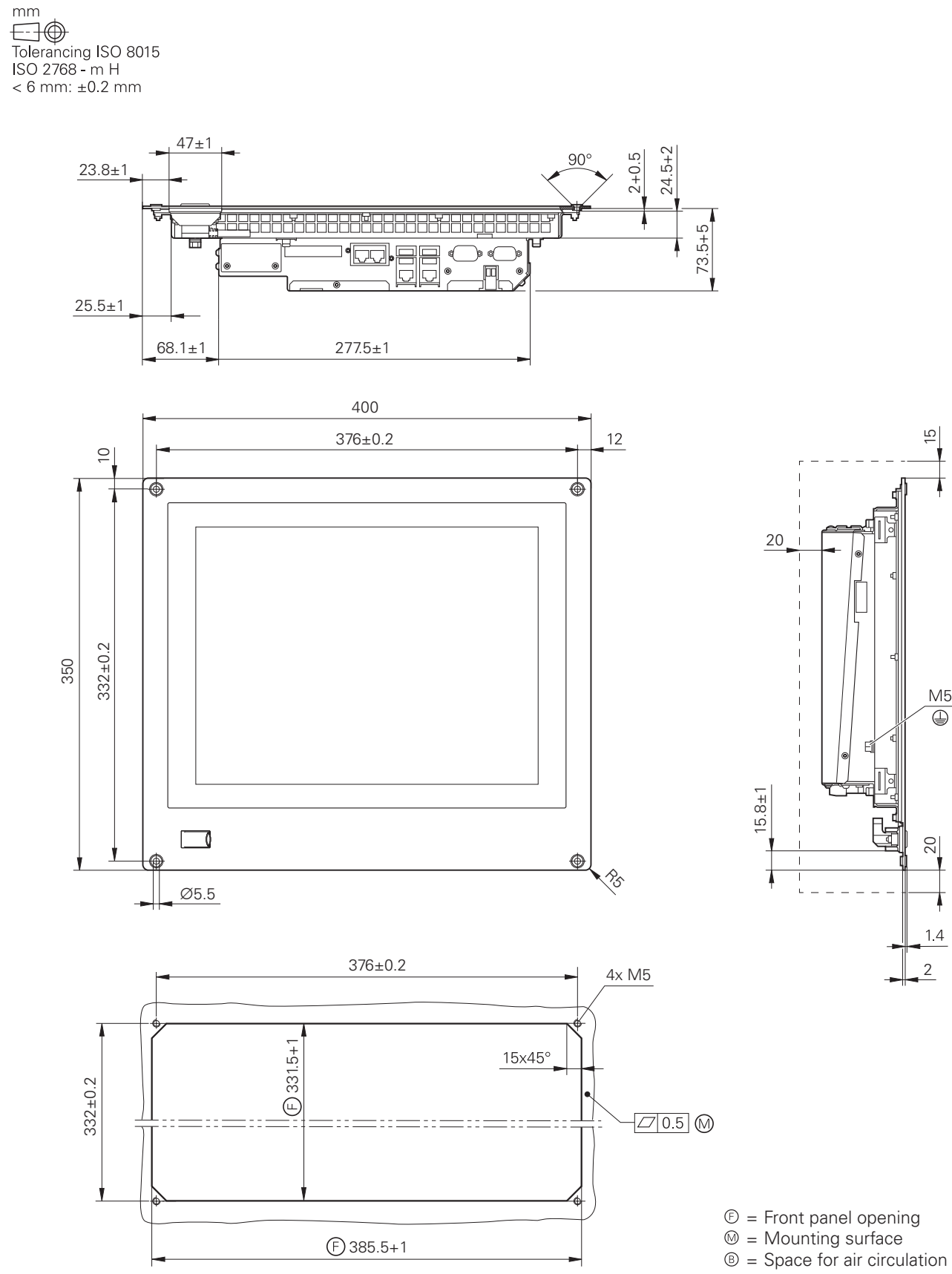
MC 306, IPC 306



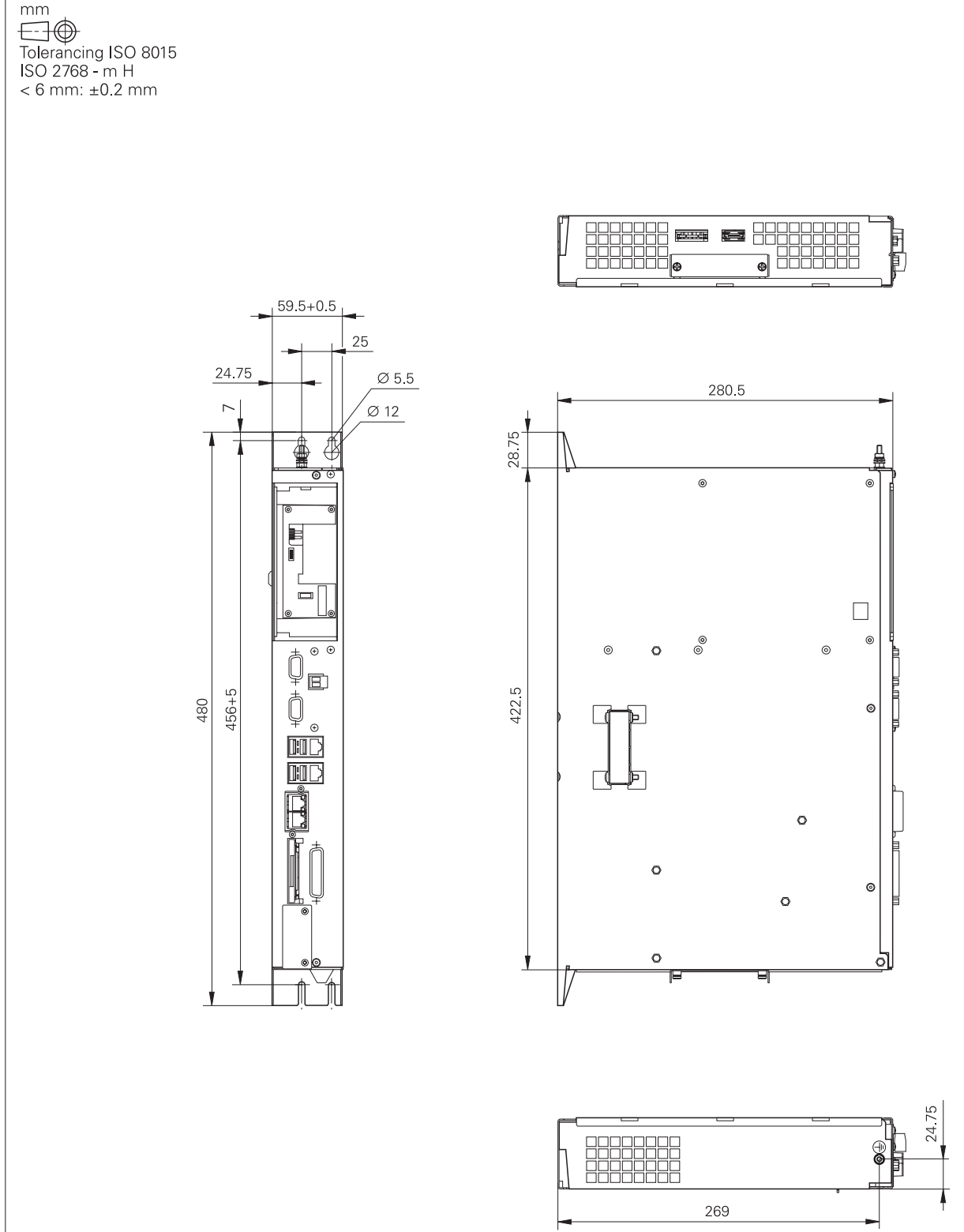
MC 8410



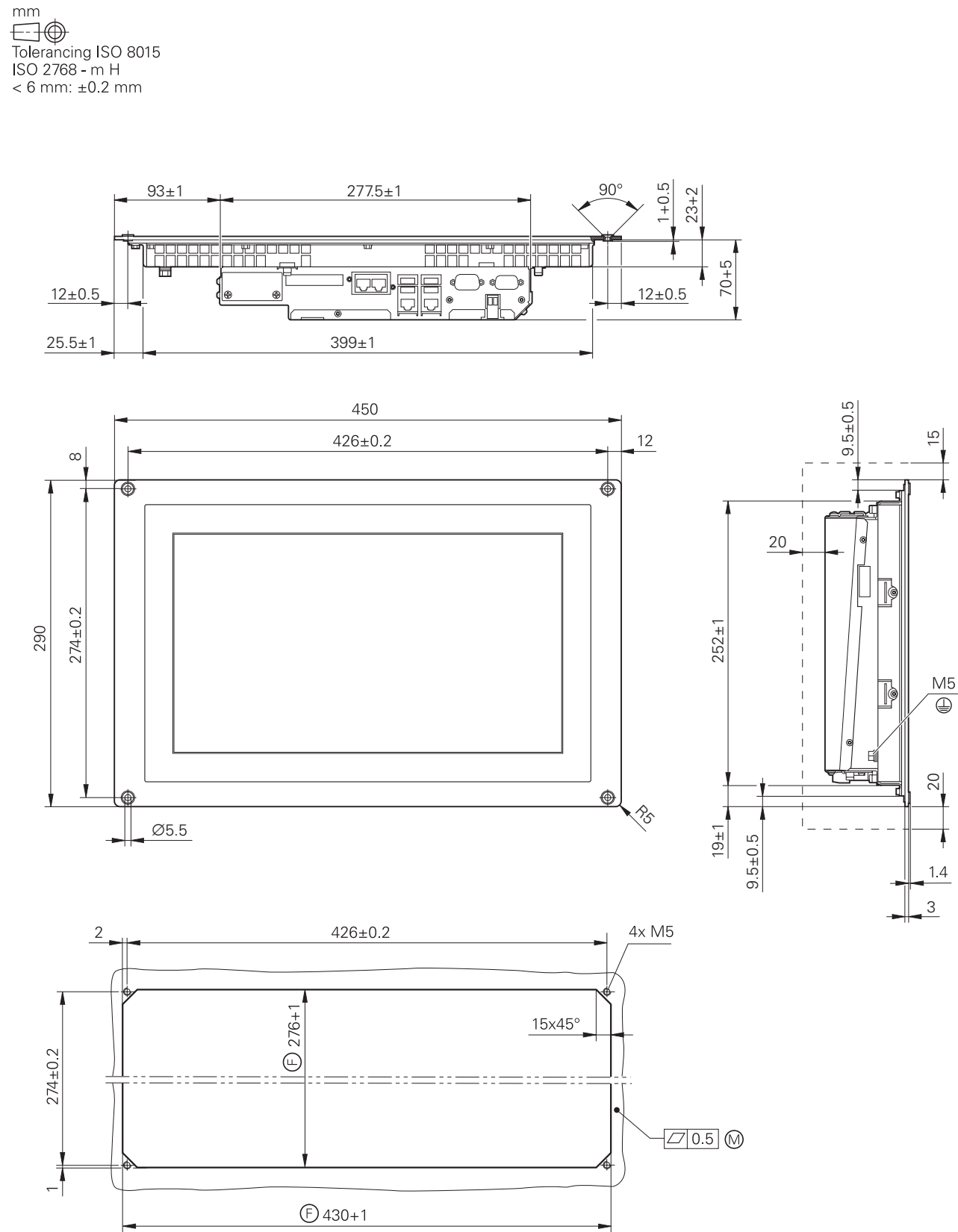
MC 8420



IPC 6641

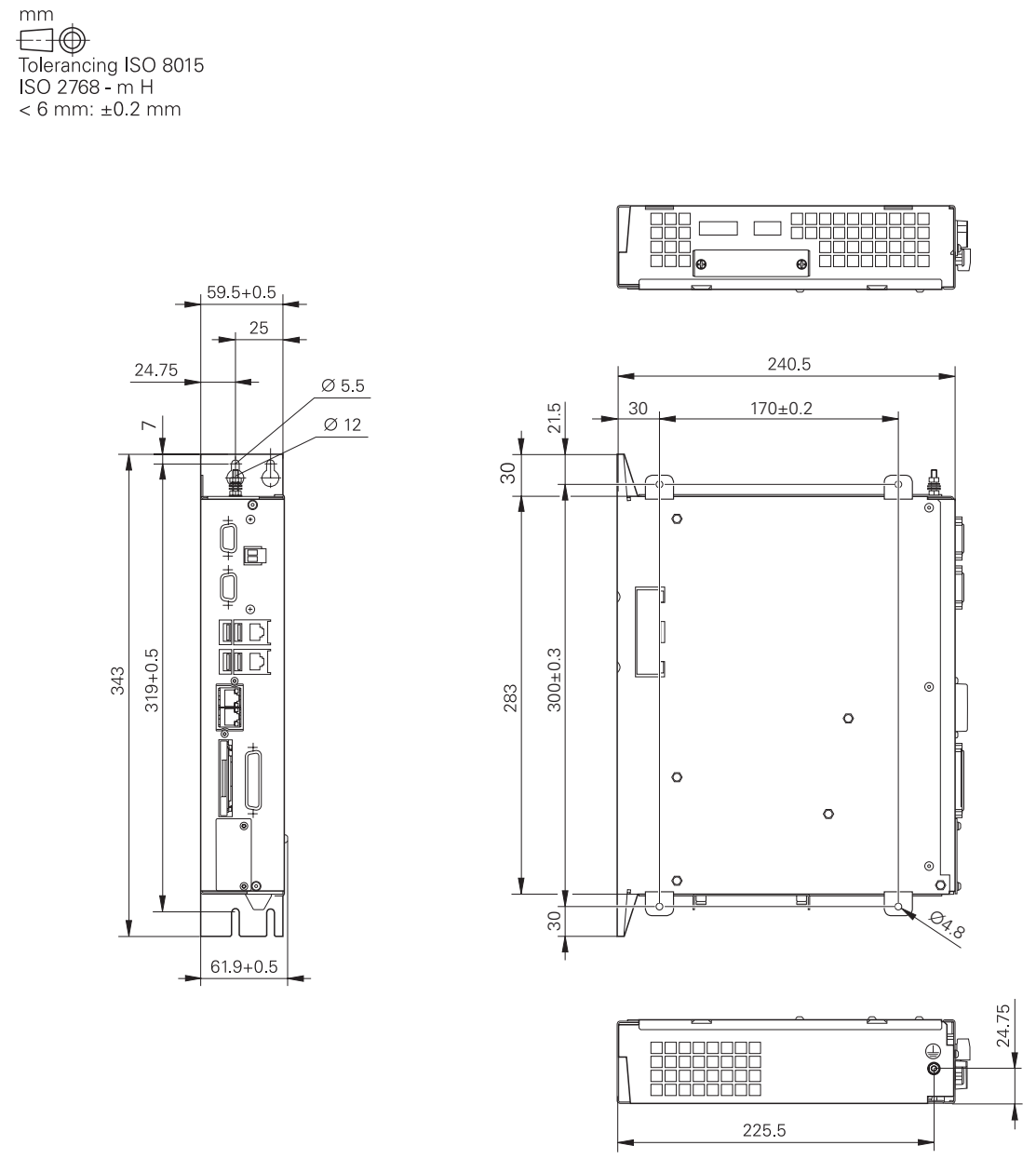


IPC 8420



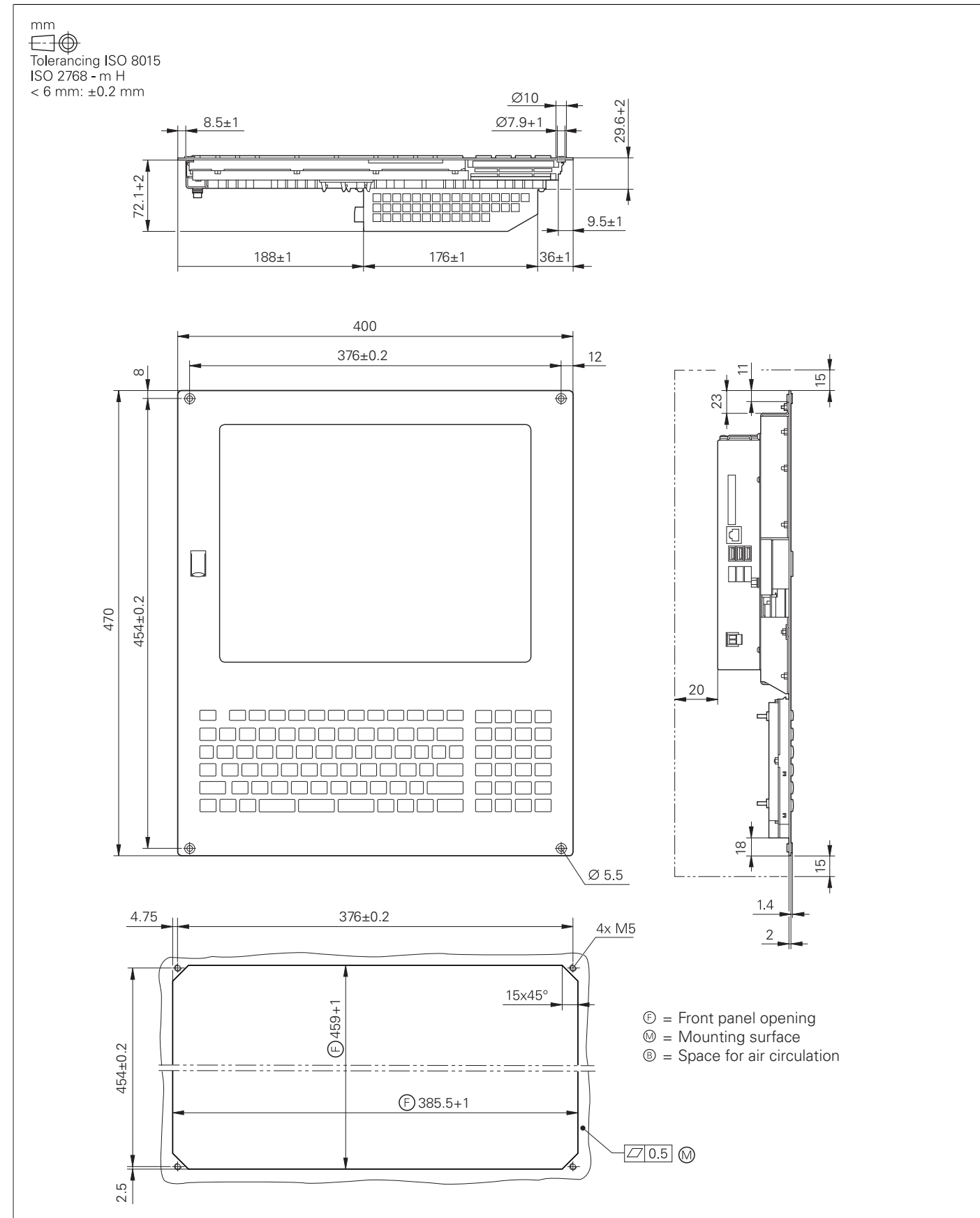
- ⊕ = Front panel opening
- Ⓜ = Mounting surface
- Ⓟ = Space for air circulation

IPC 6490

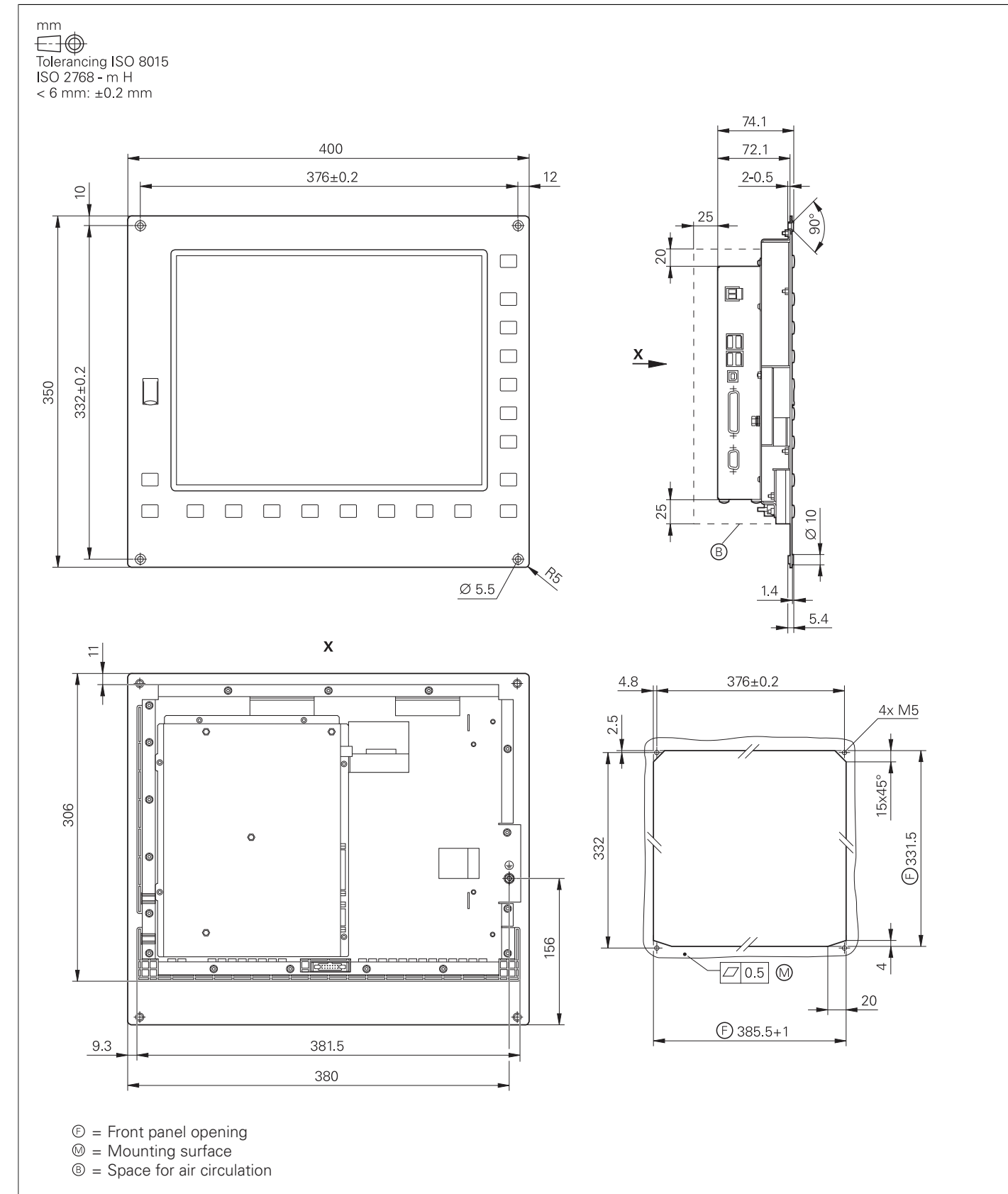


Operating panel, screen, and keyboard


ITC 755

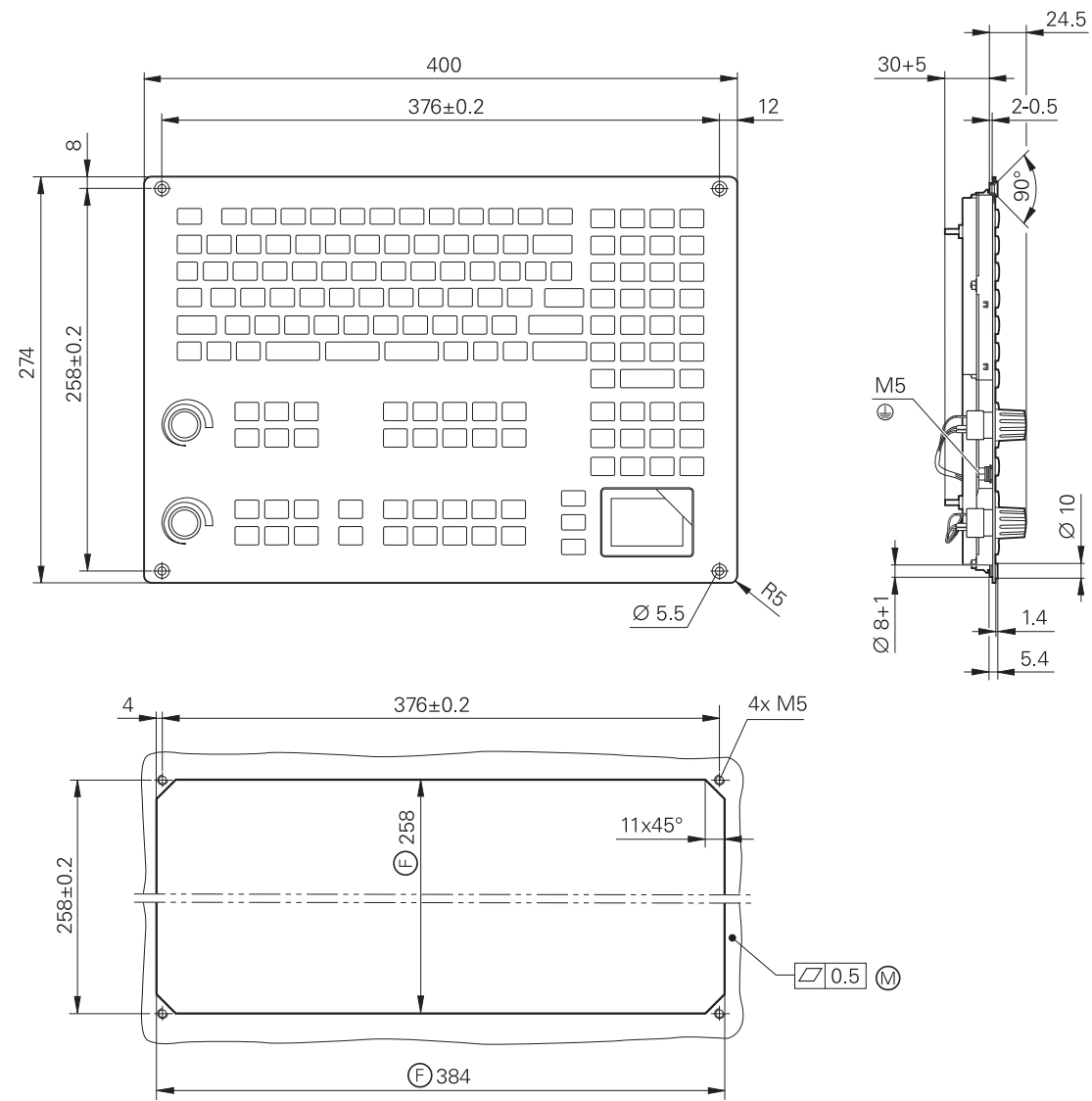


ITC 750




TE 730

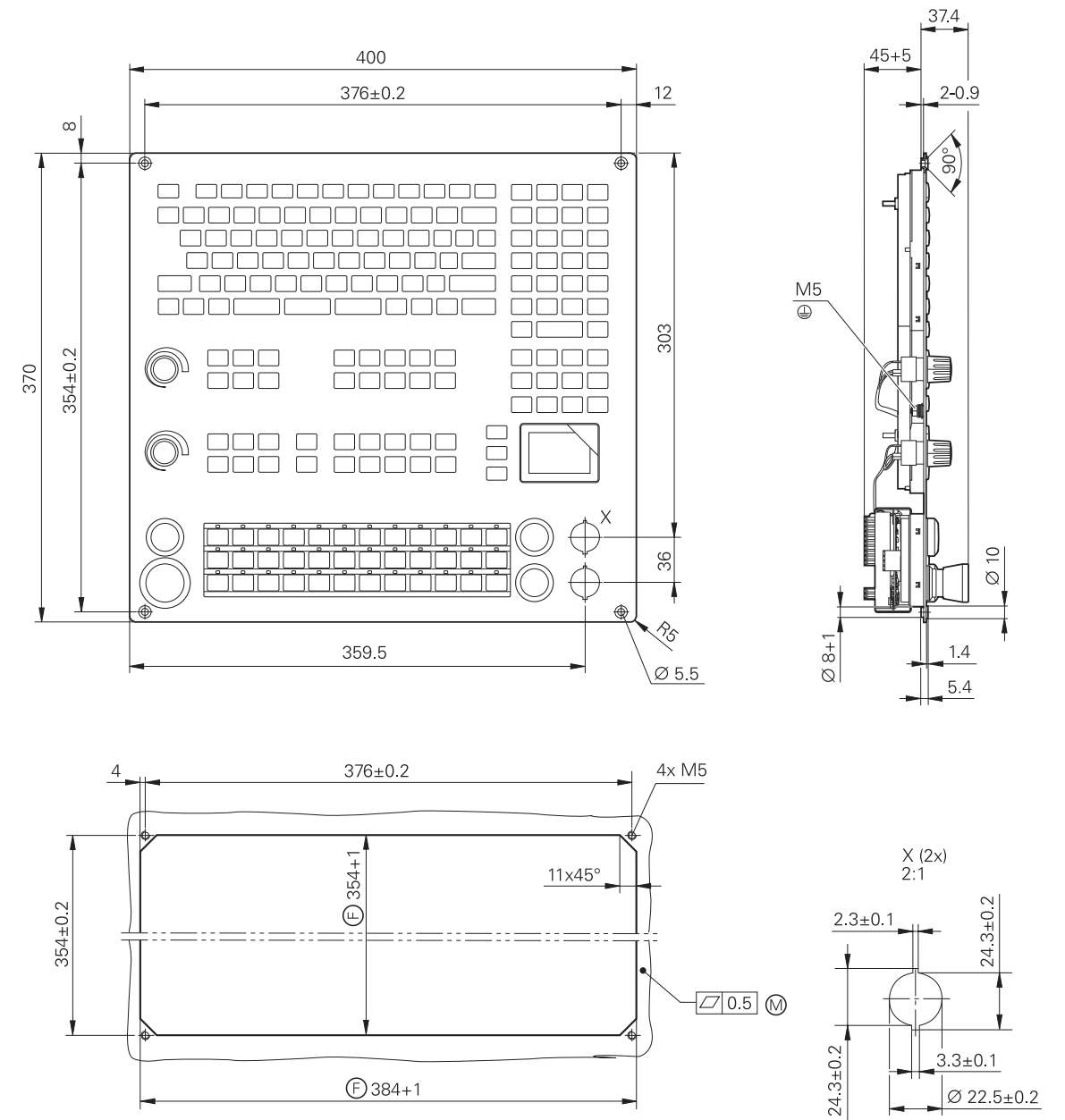
mm

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



Ⓢ = Front panel opening
 Ⓜ = Mounting surface

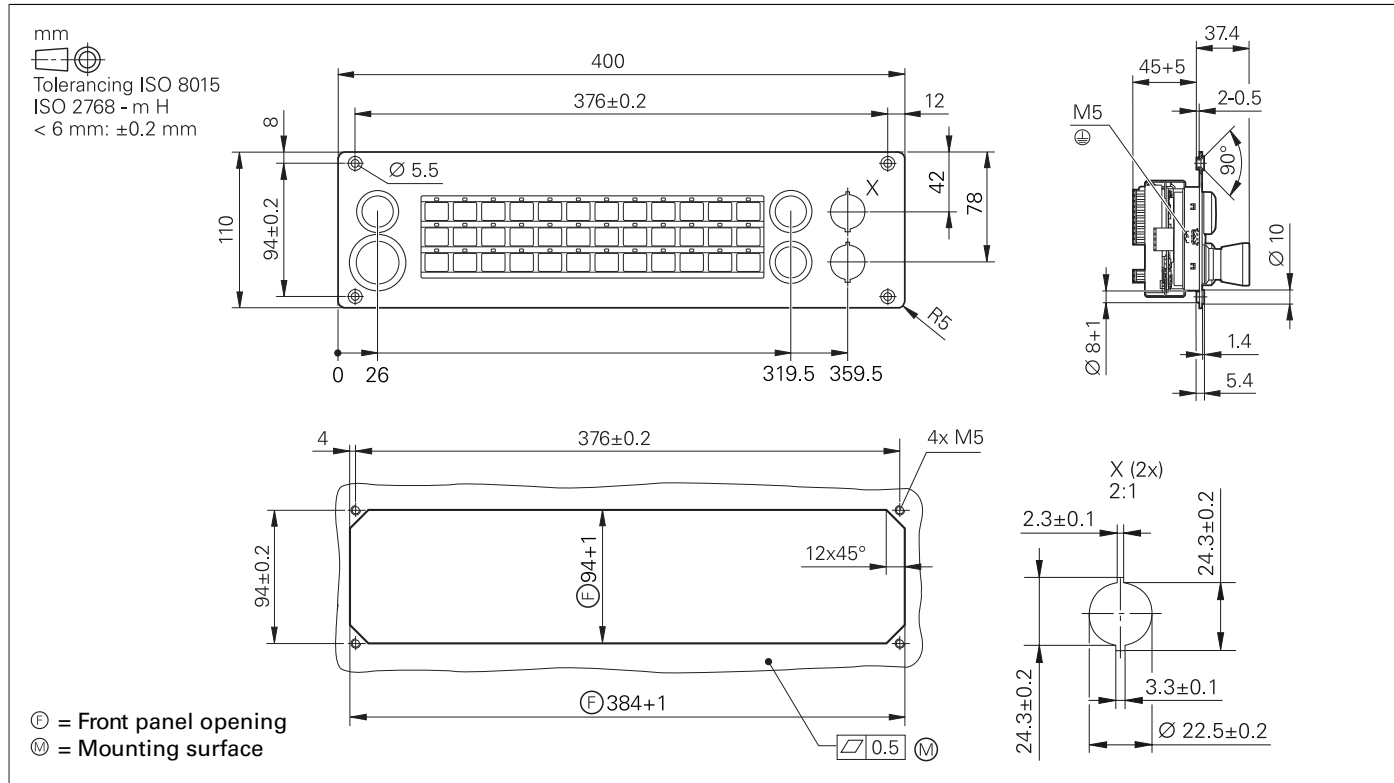
TE 735, TE 735 FS

mm

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

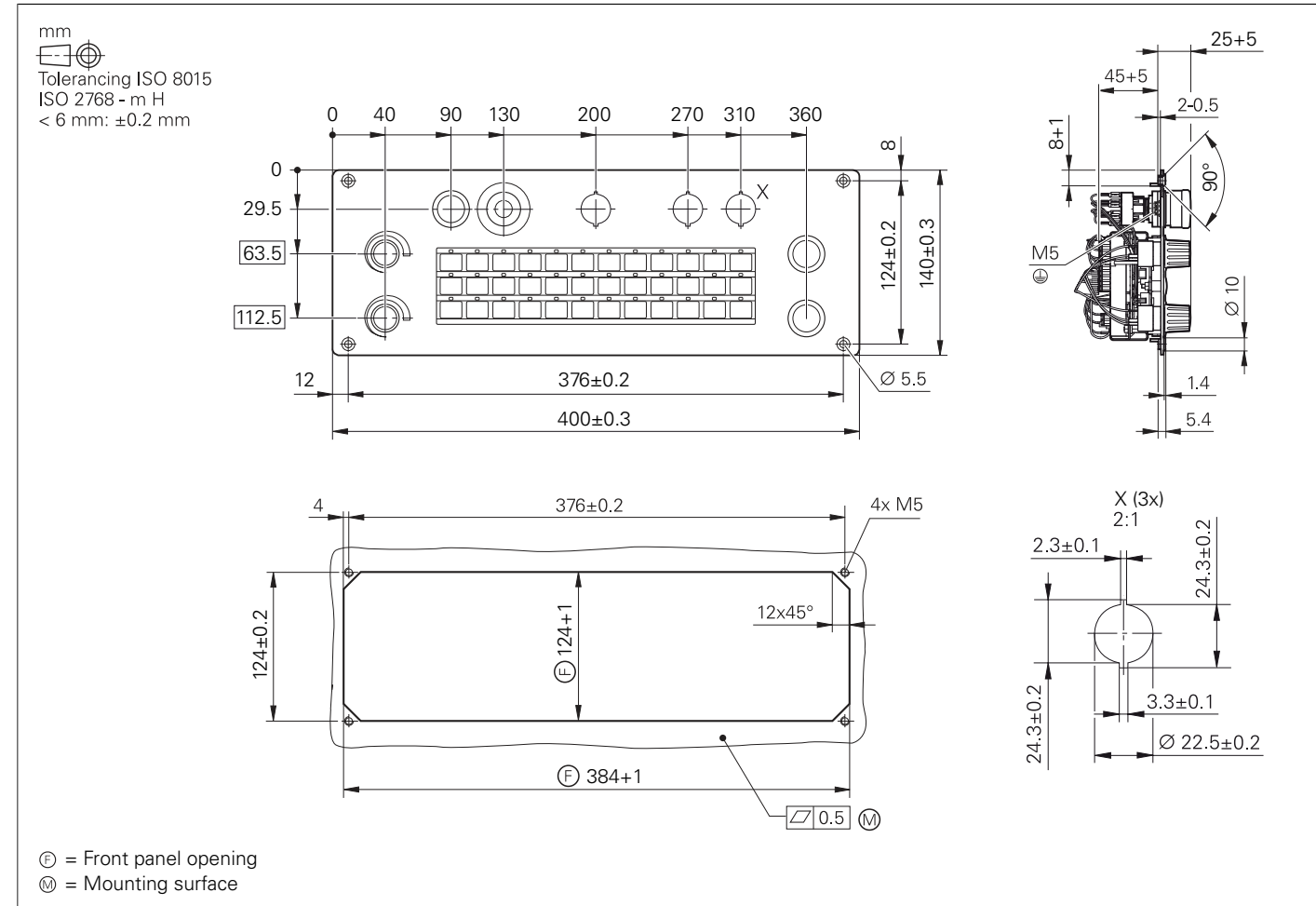


Ⓢ = Front panel opening
 Ⓜ = Mounting surface

MB 720, MB 720 FS

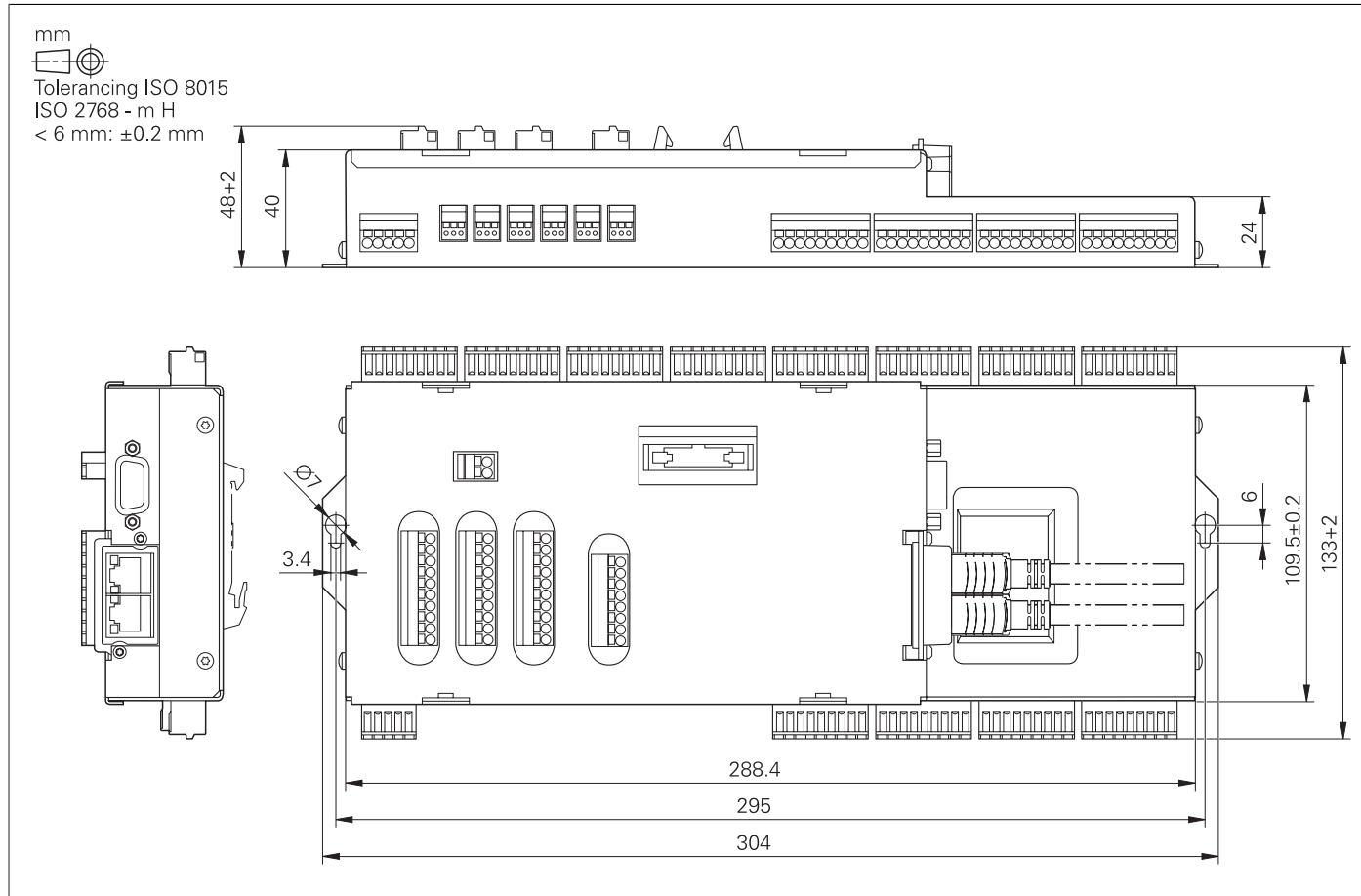


MB 721, MB 721 FS

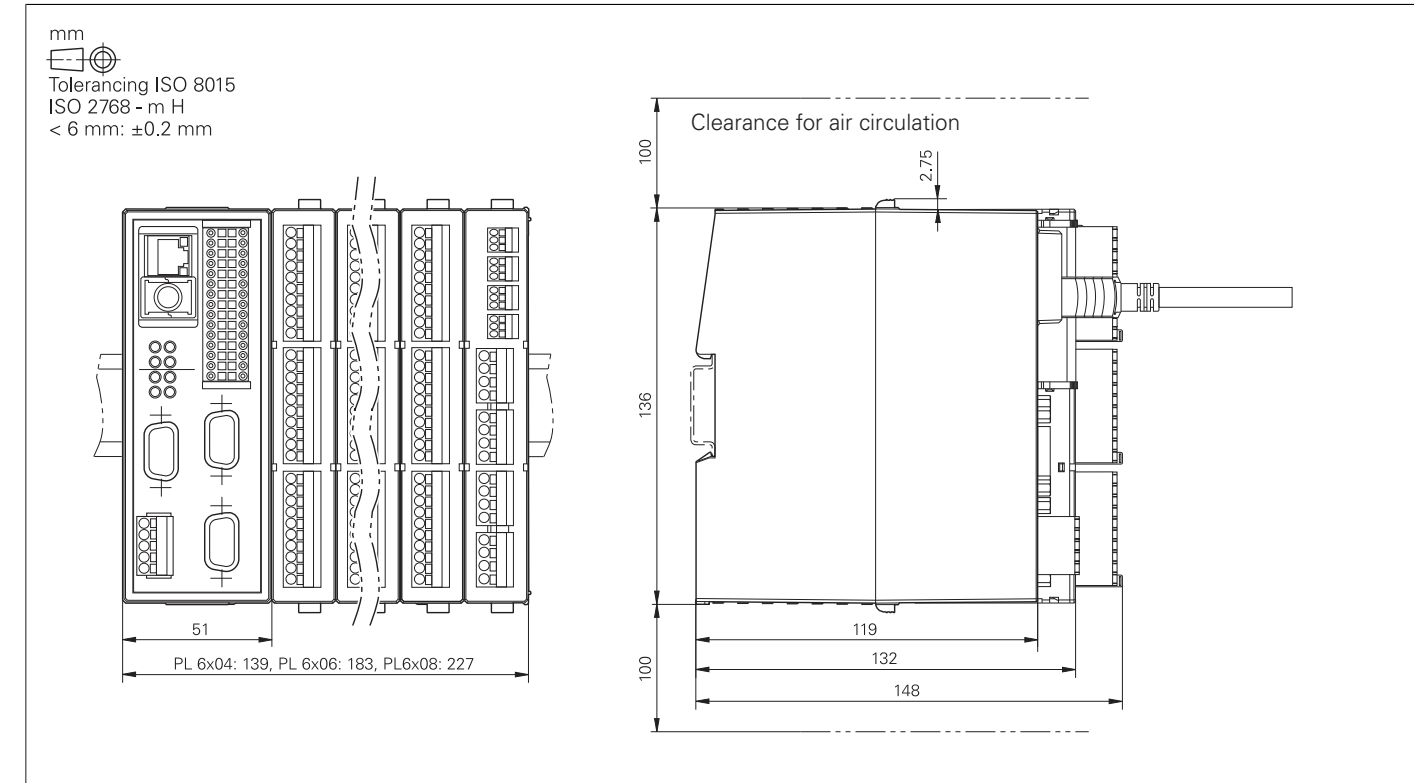


PLC inputs and outputs

PLB 6001, PLB 600x FS

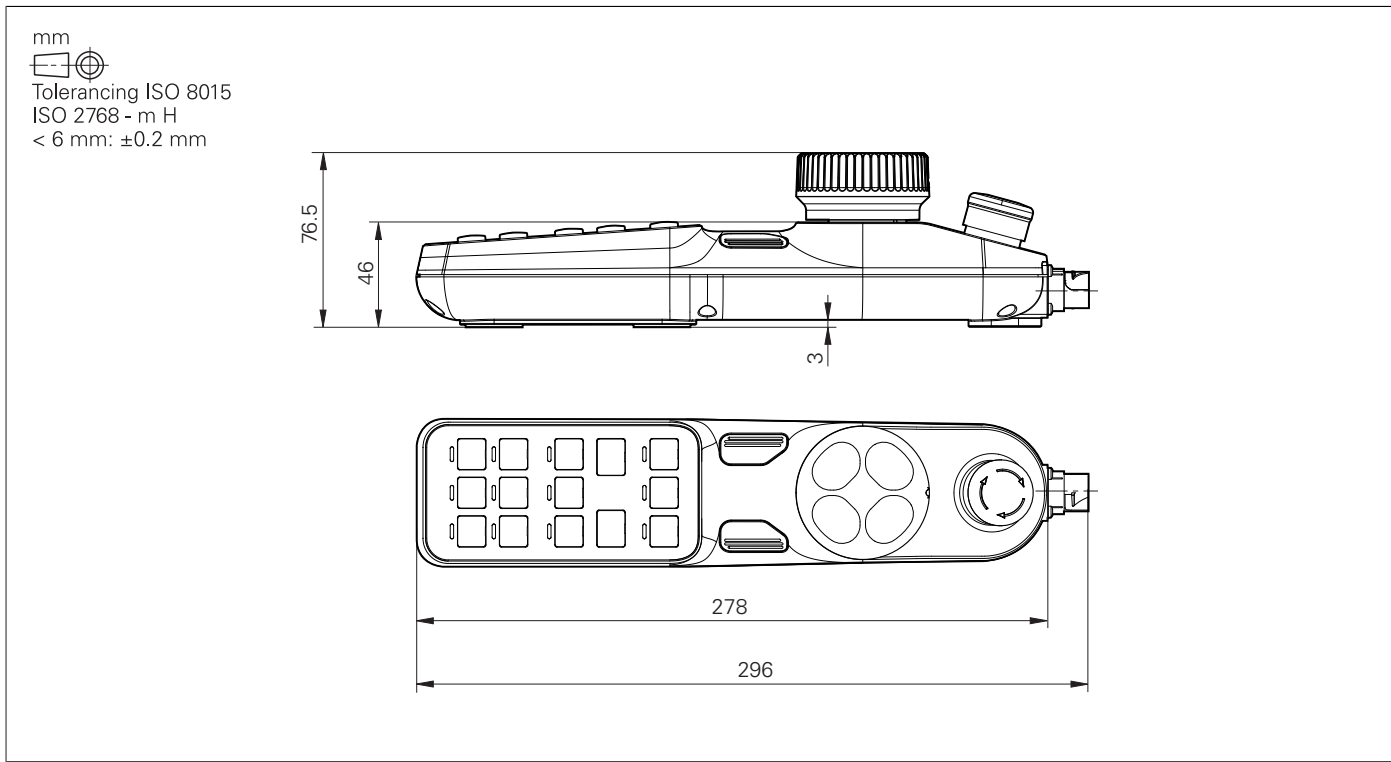


PL 6000 (PLB 62xx, PLB 61xx)

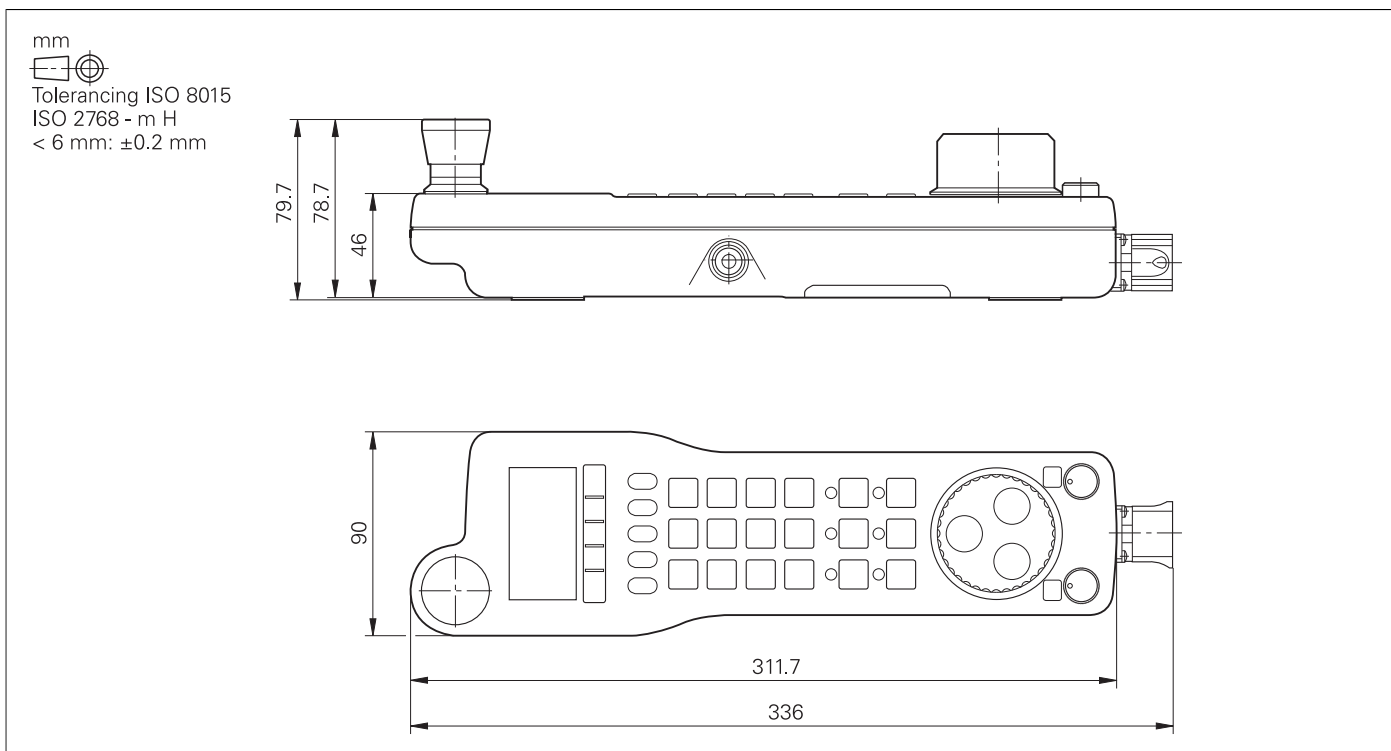


Electronic handwheels

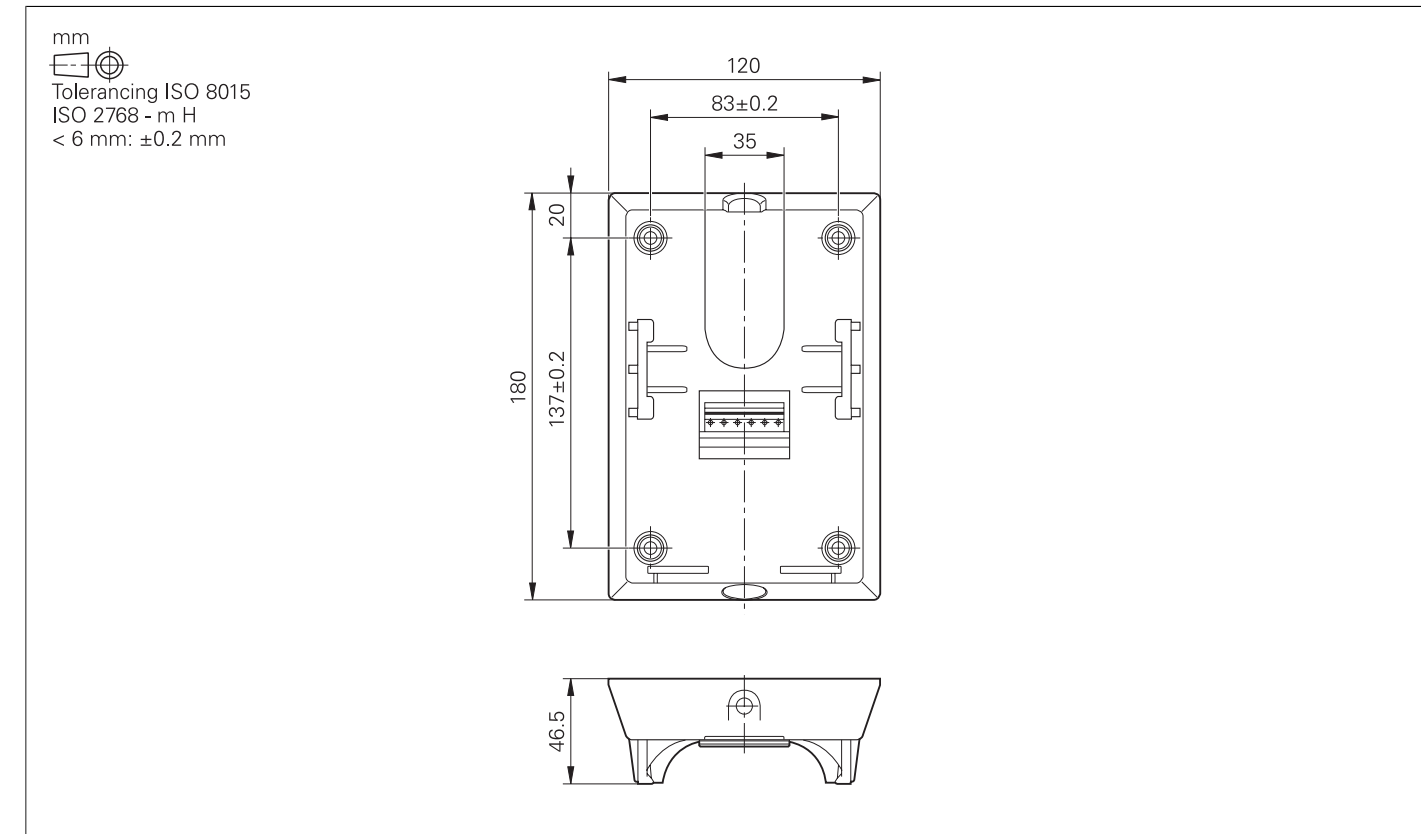
HR 510, HR 510 FS



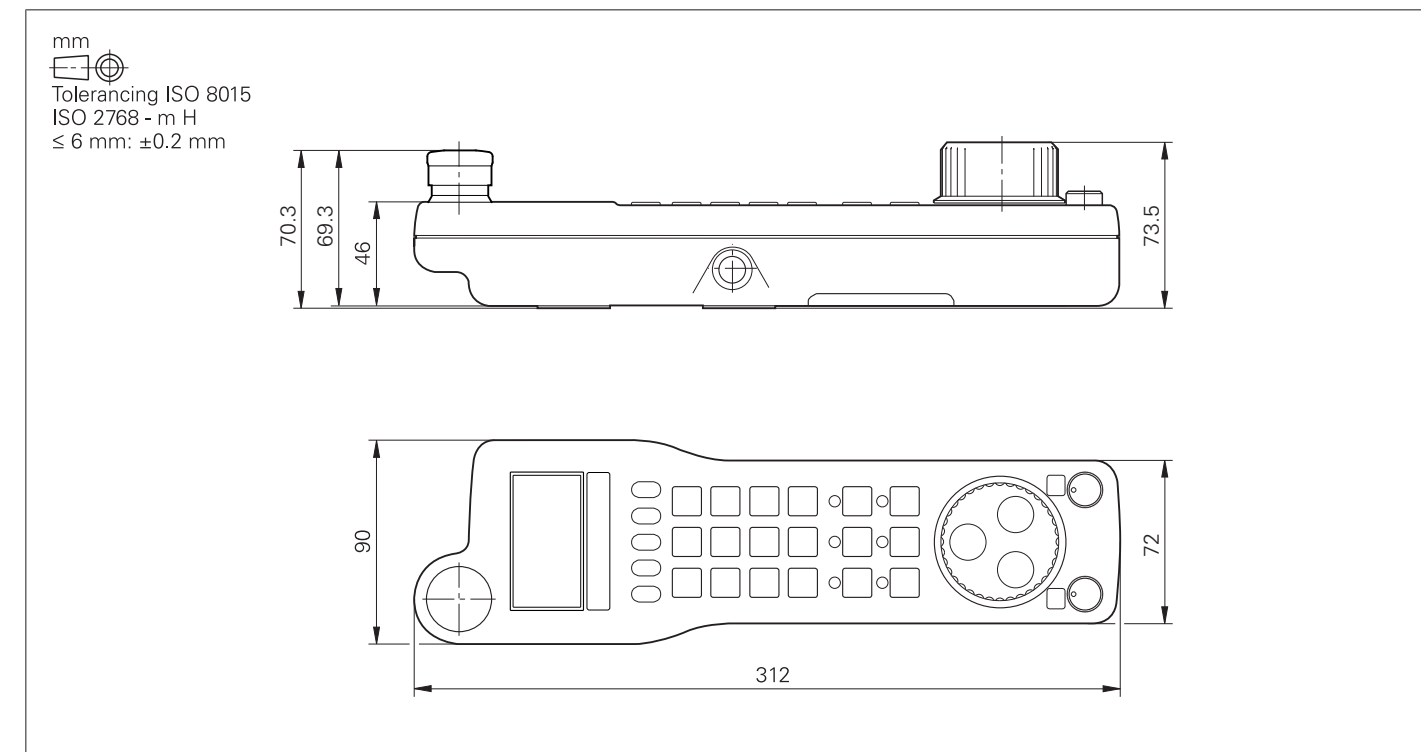
HR 520, HR 520 FS



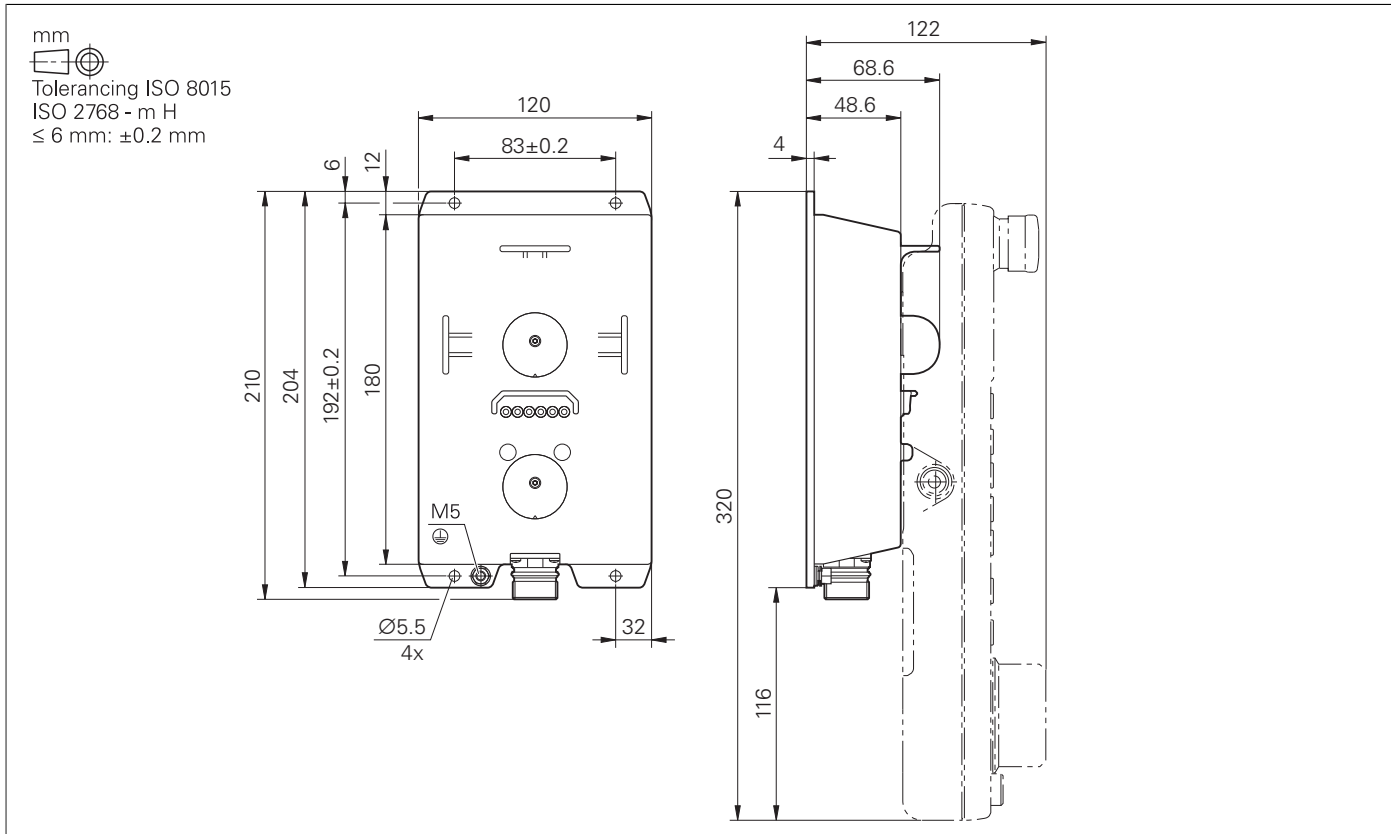
Holder for HR 520, HR 520 FS



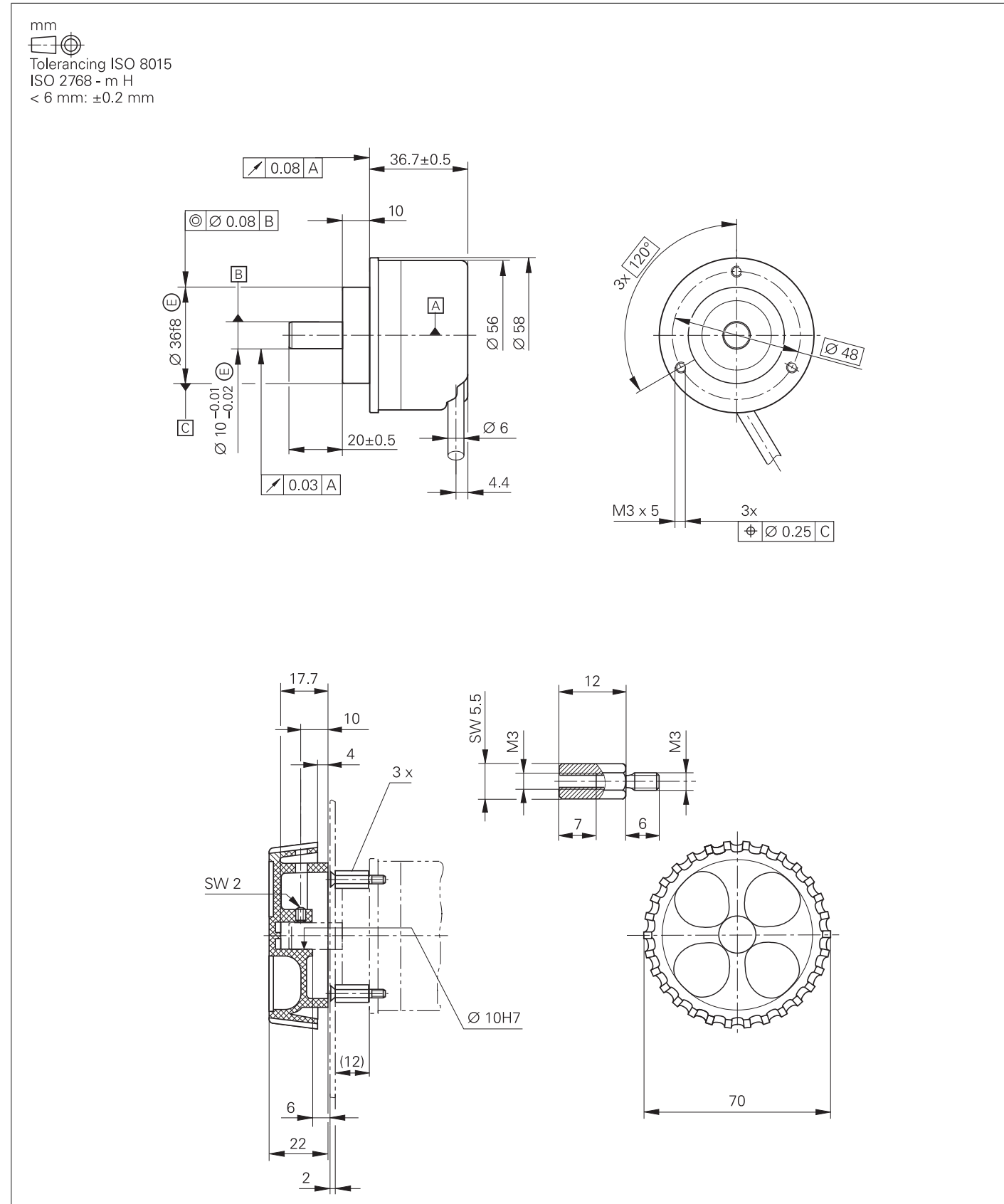
HR 550 FS



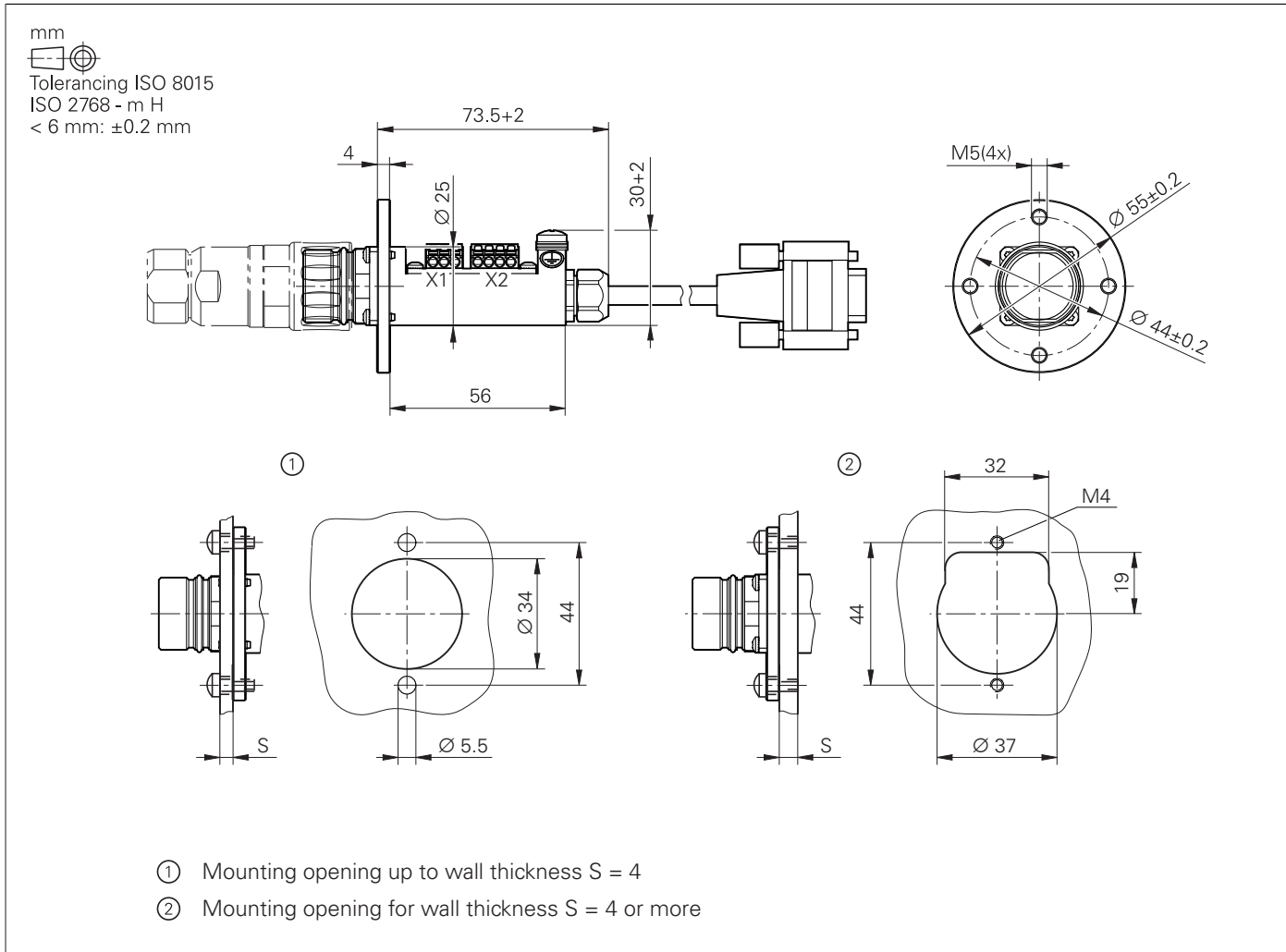
HRA 551 FS



HR 130

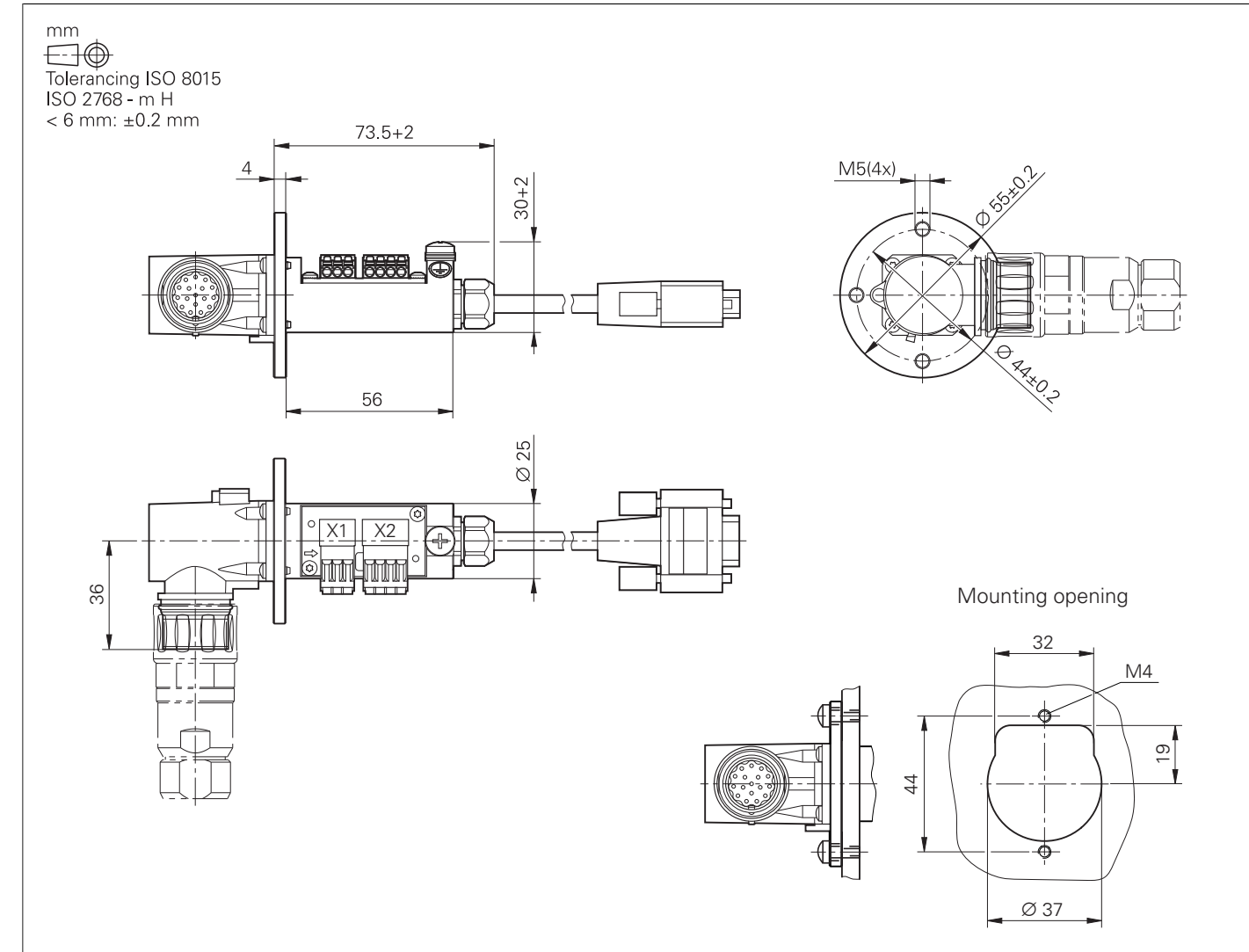


Adapter cable for handwheels (straight)



HR/HRA adapter cable to MC (straight connector)

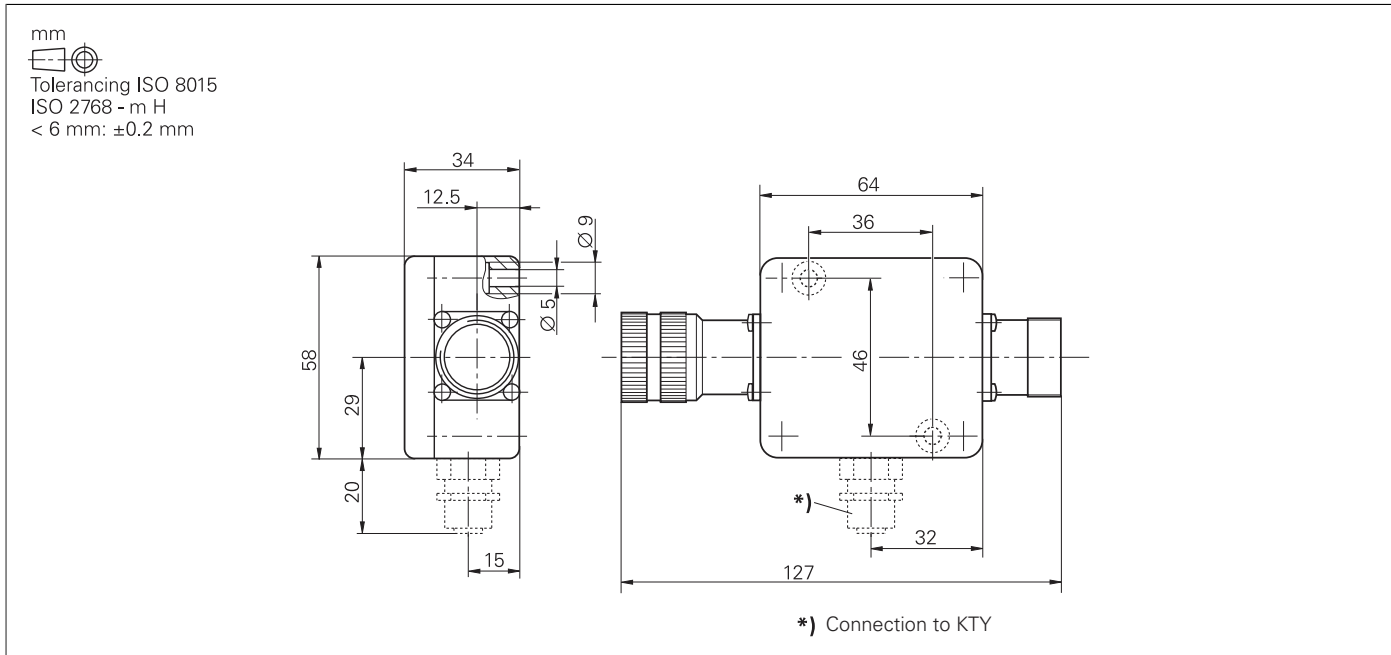
Adapter cable for handwheels (angled)



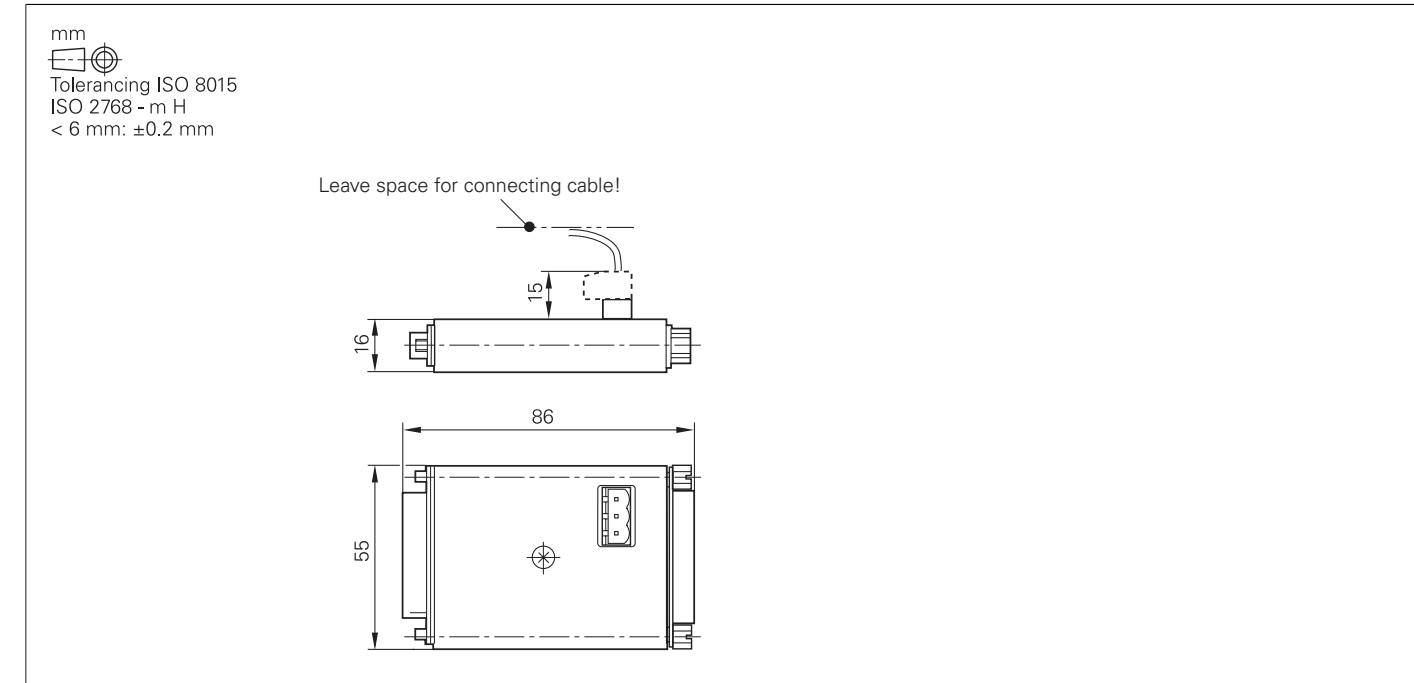
Adapter cable for HR/HRA to MC (angled connector)

Interface accessories

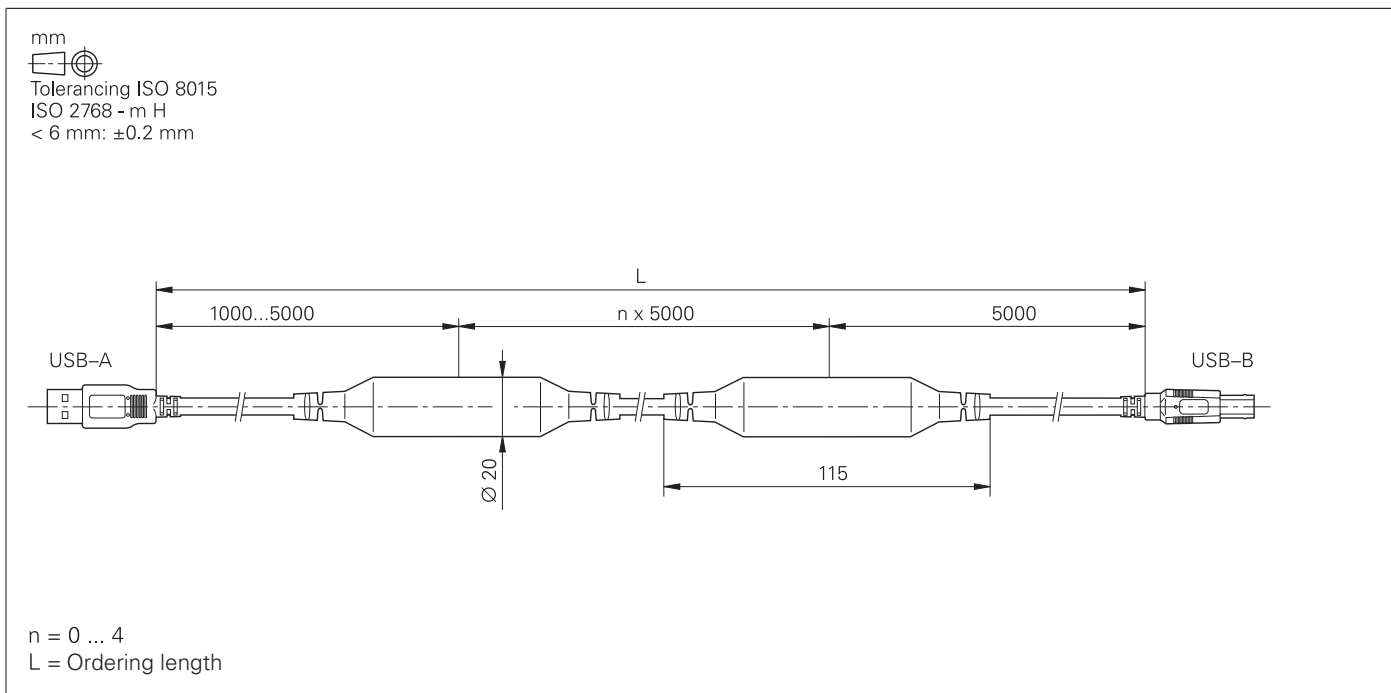
Line-drop compensator for encoders with EnDat interface



KTY adapter connector



USB extension cable with hubs



General information

Documentation

Technical documentation	Technical Manuals (PDF format on HESIS-Web including Filebase)	
	<ul style="list-style-type: none"> • TNC 620 ID 1098989 • PNC 610 ID 1191125 • 1xx Inverter Systems ID 208962 • Gen 3 Drives ID 1252650 • Functional Safety (FS) ID 749363 • Functional Safety (FS) Supplement to the Technical Manual ID 1177599 • Python in HEIDENHAIN Controls ID 757807 	
User documentation	User's Manuals	
	<p><i>TNC 620</i></p> <ul style="list-style-type: none"> • Klartext Conversational Programming ID 1096883-xx • Setup, Testing, and Running NC Programs ID 1263172-xx • Cycle Programming ID 1096886-xx • ISO Programming ID 1096887-xx <p><i>General</i></p> <ul style="list-style-type: none"> • TNCremo Integrated help • TNCremoPlus Integrated help • PLCdesign Integrated help • CycleDesign Integrated help • IOconfig Integrated help • KinematicsDesign Integrated help 	
Other documentation	Brochures	
	<ul style="list-style-type: none"> • TNC 620 ID 896140-xx • Touch Probes ID 1113984-xx • Inverter Systems for Gen 3 Drives ID 1303180-xx • Motors ID 208893-xx • RemoTools SDK virtualTNC ID 628968-xx • Programming Station for TNC Controls ID 825930-xx <p>Product Information documents</p> <ul style="list-style-type: none"> • HR 550 FS ID 636227-xx <p>Product Overviews</p> <ul style="list-style-type: none"> • Remote Diagnosis with TeleService ID 348236-xx <p>DVDs</p> <ul style="list-style-type: none"> • Touch Probes ID 344353-xx • Programming Station: TNC 320, TNC 620 (Demo Version) ID 741708-xx 	
Safety parameters	For HEIDENHAIN products (such as control components, encoders, or motors), the safety characteristics (such as failure rates or statements on fault exclusion) are available on product-specific request from your HEIDENHAIN contact person.	
Basic circuit diagram	More information on basic circuit diagrams can be requested from your HEIDENHAIN contact person.	

Service and training

Technical support	HEIDENHAIN offers the machine manufacturer technical support to optimize the adaptation of the control to the machine, including on-site support.
Exchange control	In the event of a malfunction, HEIDENHAIN guarantees the timely shipment of an exchange control (usually within 24 hours in Europe).
Helpline	Our customer service technicians are available for questions regarding adaption or in the event of malfunctions:
NC support (initial configuration/optimization, field service/troubleshooting)	+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de
PLC/Python programming Functional safety (FS)	+49 8669 31-3102 E-mail: service.plc@heidenhain.de
NC/Cycle programming and kinematics	+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de
Encoders / machine calibration	+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de
Application programming	+49 8669 31-3106 E-mail: service.app@heidenhain.de
	If you have questions about repairs, spare parts, or exchange units, please contact our Service department:
Customer service, Germany	+49 8669 31-3121 E-mail: service.order@heidenhain.de
Customer service, international	+49 8669 31-3123 E-mail: service.order@heidenhain.de
Machine calibration	On request, HEIDENHAIN engineers will calibrate your machine's geometry (e.g., with a KGM grid encoder).
Technical courses	HEIDENHAIN provides technical customer training in the following subjects: <ul style="list-style-type: none"> • NC programming • PLC programming • TNC optimization • TNC servicing • Encoder servicing • Special training for specific customers

For more information on dates or registration:

Technical training courses in Germany	+49 8669 31-3049 E-mail: mtt@heidenhain.de
Technical training courses outside of Germany	www.heidenhain.com EN ► Service & Support ► Technical training

Other HEIDENHAIN controls

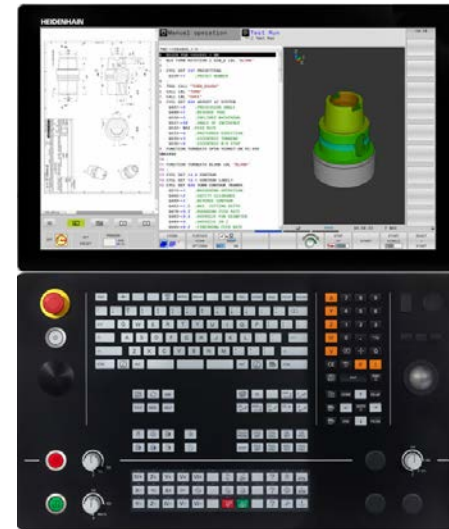
Examples

TNC 640

Information:

TNC 640 brochure

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



MANUALplus 620

Information:

MANUALplus 620 brochure

- Compact contouring control for **CNC and cycle lathes**
- Axes: max. 10 control loops, of which up to 6 are configurable as spindles
- Suitable for horizontal and vertical lathes as well as vertical boring and turning mills
- Up to 3 principal axes (X, Z, and Y), B axis, closed-loop spindle and counter spindle, C1/C2 axis, and driven tools
- Up to 3 programmable auxiliary axes (U, V, W) for control of steady rest, tailstock, and counter spindle
- The position of a parallel secondary axis can be shown combined with its principal axis
- Compact design: screen and main computer in one unit
- For operation with HEIDENHAIN inverter systems and ideally with HEIDENHAIN motors
- Uniformly digital with HSCI interface and EnDat interface
- 15.6-inch multi-touch display with 1366 × 768 pixels
- Integration of a virtual keypad on the right side of the display
- Installation dimensions of MC 8420T compatible to MC 7410T
- CFR CompactFlash memory card (CFast)
- Programming of turning, drilling, and milling operations with smart.Turn, according to DIN or via cycles
- TURN PLUS for automated smart.Turn program generation
- ICP free contour programming for turning and milling contours
- For simple tool holders (multifix), tool turrets, or tool magazines



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For complete and further addresses see www.heidenhain.com

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