HEIDENHAIN

TNC 620 HSCI

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

Information for the Machine Tool Builder

03/2019

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, of which up to 2 are configurable as spindles
- For operation with HEIDENHAIN inverter systems and preferably HEIDENHAIN motors
- Uniformly digital with HSCI interface and EnDat interface
- Compact size
- Storage medium: CompactFlash memory card
- Programming in HEIDENHAIN Klartext format or according to ISO
- Standard milling, drilling, and boring cycles
- Touch probe cycles
- Short block processing time (1.5 ms)

Version with touchscreen:
- 19-inch screen (vertical), keyboard, and main computer in one unit (MC 8410)
- Integration of the keyboard in the lower screen area
- Multi-touch operation
- MC 8410 is compatible in its installation dimensions with the MC 7410

Version with operating keys:
- 15-inch screen, keyboard, and main computer in one unit (MC 7410)
- Screen and main computer in one unit (MC 7420) and separate keyboard with integrated ASCII keys

System test

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

Parts subject to wear

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

Standards

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

Note

Microsoft, Windows 7, 8, 10 and Internet Explorer are registered trademarks of Microsoft Corporation. Intel, Intel 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
817600-06 (export license required)
817601-06 (no export license required)

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

Requirements

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

Functional safety (FS)

If no explicit distinction is made between standard and FS components (FS = functional safety), then the data and other information apply to both versions (e.g., TE 735, TE 735 FS)

Contents

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

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Screen		19-inch vertical touchscreen (for MC 8410) Integrated 15-inch screen (for MC 74x0)		
Keyboard		Integrated	**TE 720** or **TE 730** or **TE 735**	23
Machine operating panel		**PLB 600x** (HSCI adapter for OEM machine operating panel)		23
		MB 721	**MB 720**	27
Controller unit	6 control loops	**CC 6106**		19
Power supply[*)]		**PSL 130**		26
PLC inputs/ outputs[1)]	With HSCI interface	**PL 6000** consisting of PLB 62xx basic module (system PL) or PLB 61xx (extension PL) and I/O modules		24
		On UEC		19
		On UMC		21
Additional modules[1)]		**CMA-H** for analog axes/spindles in the HSCI system		28
		Modules for fieldbus systems		
Inverter systems		Compact inverters and modular inverters		*)
Inverters with integrated controller unit	4 control loops	**UEC 111**		19
		UMC 111		21
	5 control loops	**UEC 112**		19
	6 control loops	**UEC 113**		19
Connecting cables		✓		43

*) For further information, refer to the *Inverter Systems for HEIDENHAIN Controls* brochure
1) May be necessary depending on the configuration

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

Accessories

Accessory	TNC 620	Page
Electronic handwheels	• **HR 510 FS** portable handwheel, or • **HR 520 FS** portable handwheel with display, or • **HR 550 FS** portable wireless handwheel with display, or • **HR 130** panel-mounted handwheel, or • Up to three **HR 150** panel-mounted handwheels via HRA 110 handwheel adapter	31
Workpiece touch probes	• **TS 260** touch trigger probe with cable connection, or • **TS 460** touch trigger probe with radio and infrared transmission, or • **TS 740** touch trigger probe with infrared transmission	29
Tool touch probes	• **TT 160** touch trigger probe with cable connection, or • **TT 460** touch trigger probe with radio and infrared transmission, or	30
USB hub	✓	81
Programming station	Control software for PCs for programming, archiving, and training • Single-station license with original control keyboard • Single-station license with virtual keyboard • Network license with virtual keyboard • Demo version with virtual keyboard or PC keyboard—free of charge	
Auxiliary axis control	**PNC 610**	36
Industrial PC	**ITC 755** – additional operating station with touchscreen and ASCII keyboard **ITC 750** – additional operating station; separate TE 7xx necessary **IPC 6641** – industrial PC for Windows **IPC 6490/IPC 8420** – industrial PC for PNC 610	35
Snap-on keys	For controls and handwheels	39

Accessories / Software	TNC 620	Page
PLCdesign[1]	PLC development software	76
KinematicsDesign[1]	Software for creation of kinematic models	69
TNCremo[2], **TNCremoPlus**[2]	Data transfer software (TNCremoPlus with "live" screen)	81
ConfigDesign[1]	Software for configuring the machine parameters	72
CycleDesign[1]	Software for creating cycle structures	79
TNCkeygen[1]	Software for enabling SIK options for a limited time, and for single-day access to the OEM area	16
TNCscope[1]	Software for data recording	73
DriveDiag[1]	Software for diagnosis of digital control loops	72
TNCopt[1]	Software for putting digital control loops into service	73
IOconfig[1]	Software for configuring PLC I/O and fieldbus components	25
TeleService[1][3]	Software for remote diagnostics, monitoring, and operation	73
RemoTools SDK[1]	Function library for developing customized applications for communication with HEIDENHAIN controls	82
TNCtest[1]	Software for creation and execution of an acceptance test	74
TNCanalyzer[1]	Software for the analysis and evaluation of service files	74

[1] Available to registered customers for downloading from the Internet
[2] Available to all customers (without registration) for downloading from the Internet
[3] Software release module required

Specifications

Specifications	TNC 620	Page
Axes	8 control loops, of which up to 2 can be configured as spindles	57
Rotary axes	✓	
Synchronized axes	✓	
PLC axes	✓	
Main spindle	*Milling:* max. 2; second spindle can be controlled by PLC alternately with the first	60
Speed	Maximum of 60 000 rpm (with option 49: max. 120 000 rpm)*	60
Operating mode switchover	✓	60
Position-controlled spindle	✓	60
Oriented spindle stop	✓	60
Gear shifting	✓	60
NC program memory	1.8 GB	15
Input resolution and display step		57
Linear axes	0.1 µm, 0.01 µm with option 23	
Rotary axes	0.0001°, 0.00001° with option 23	
Functional safety (FS)	With FS components, SPLC and SKERN	53
For applications with up to	• SIL 2 as per EN 61508 • Category 3, PL d as per EN ISO 13849-1: 2008	
Interpolation		
Straight line	In 4 axes; in max. 5 axes with option 9	
Circular	In 2 axes; in 3 axes with option 8	
Helical	✓	
Axis feedback control		62
With following error	✓	
With feedforward	✓	
Axis clamping	✓	57
Maximum feed rate	$\frac{60000\ \text{rpm}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$ at f_{PWM} = 5000 Hz	57

* For motors with one pole pair

Specifications	TNC 620		Page
Cycle times of main computer	**MC**		63
Block processing	1.5 ms		64
Cycle times of controller unit	**CC/UEC/UMC**		63
Path interpolation	3 ms		63
Fine interpolation	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)		
Position controller	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)		
Speed controller	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)		
Current controller	f_{PWM} 3333 Hz 4000 Hz 5000 Hz 6666 Hz with option 49 8000 Hz with option 49 10 000 Hz with option 49	T_{INT} 150 µs 125 µs 100 µs 75 µs with option 49 62.5 µs with option 49 50 µs with 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	✓	70
Linear axis error	✓	70
Nonlinear axis error	✓	70
Backlash	✓	70
Reversal spikes during circular movement	✓	70
Hysteresis	✓	70
Thermal expansion	✓	70
Static friction	✓	70
Sliding friction	✓	70
Integrated PLC	✓	75
Program format	Statement list	75
Program input at the control	*MC 8410:* Via screen keyboard *MC 7410:* By external USB keyboard *MC 7420:* By TE 7xx	75
Program input via PC	✓	75
Symbolic PLC-NC interface	✓	75
PLC memory	350 MB	75
PLC cycle time	9 ms to 30 ms (adjustable)	75
PLC inputs/outputs	A PLC system can consist of max. seven PLB 61xx and max. two MB 7xx, one TE 7x5, or one PLB 600x. A total maximum of 1000 inputs/outputs is supported.	24, 19
PLC inputs, DC 24 V	Via PL, UEC, UMC	24
PLC outputs, DC 24 V	Via PL, UEC, UMC	24
Analog inputs, ± 10 V	Via PL	24
Inputs for PT 100 thermistors	Via PL	24
Analog outputs, ± 10 V	Via PL	24
PLC functions	✓	75
Small PLC window	✓	76
PLC soft keys	✓	76
PLC positioning	✓	76
PLC basic program	✓	78
Integration of applications		77
High-level language programming	Python programming language used in combination with the PLC (option 46)	77
User interfaces can be custom-designed	Create specific user interfaces of the machine tool builder with the programminFg language Python. The standard version provides 10 MB of memory for programs. Additional memory can be enabled via option 46.	77

Interfacing to the machine	TNC 620	Page
Commissioning and diagnostic aids		72
DriveDiag	Software for diagnosis of digital drive systems	72
TNCopt	Software for putting digital control loops into service	73
ConfigDesign	Software for creating the machine configuration	72
KinematicsDesign	Software for creating the machine kinematics, initialization of DCM	69
Integrated oscilloscope	✓	72
Trace function	✓	73
API DATA function	✓	73
Table function	✓	73
OLM (online monitor)	✓	73
Log	✓	73
TNCscope	✓	73
Bus diagnostics	✓	73
Data interfaces	✓	
Ethernet	2 x 1000BASE-T	80
USB	*Rear:* 4 x USB 3.0 *Front:* USB 2.0	80
V.24/RS-232-C	✓	80
Protocols		80
Standard data transmission	✓	80
Blockwise data transfer	✓	80
LSV2	✓	80

Encoder inputs		UEC 111	UEC 112	UEC 113	UMC 111	CC 6106	61
Position		4	5	6	-	6	61
	Incremental	1 V_{PP}					61
	Absolute	EnDat 2.2					61
Speed		4	5	6	4	6	61
	Incremental	1 V_{PP}					61
	Absolute	EnDat 2.2					61
Nominal-value outputs		UEC 111	UEC 112	UEC 113	UMC 111	CC 6106	61
PWM		-	-	-	-	6	18
Motor connections		4	5	6	4	-	18

User functions

User function	Standard	Option	TNC 620
Short description	✓		Basic version: 3 axes plus closed-loop spindle
		0/1	1st or 2nd additional axis for 4 or 5 axes plus spindle
	✓		Digital current and speed control
Program entry	✓		HEIDENHAIN Klartext
		42	Direct loading of contours or machining positions from DXF files and saving as Klartext contouring program or as point table
	✓		ISO *with MC 7410:* Soft keys or external USB keyboard; *with MC 7420:* internal ASCII keyboard
Position values	✓		Nominal positions for lines and arcs in Cartesian coordinates or polar coordinates
	✓		Incremental or absolute dimensions
	✓		Display and entry in mm or inches
Tool compensation	✓		Tool radius in the working plane and tool length
		21	Radius compensated contour look ahead for up to 99 blocks (M120)
		9	Three-dimensional tool-radius compensation for changing tool data without having to recalculate an existing program
Tool tables	✓		Multiple tool tables with any number of tools
Cutting data	✓		Automatic calculation of spindle speed, cutting speed, feed per tooth, and feed per revolution
Constant contour speed	✓		Relative to the path of the tool center
	✓		Relative to the tool's cutting edge
Parallel operation	✓		Creating a program with graphical support while another program is being run
3-D machining	✓		Motion control with smoothed jerk
		9	3-D tool compensation via surface-normal vectors
		9	Changing the tilt position with handwheel superimpositioning; maintaining the position of the tool point (TCPM)
		9	Keeping the tool normal to the contour
		9	Tool radius compensation normal to the tool direction
		9	Manual traverse in the active tool-axis system
Rotary table machining		8	Programming of cylindrical contours as if in two axes
		8	Feed rate in distance per minute
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 graphic support for workpiece drawings not dimensioned for NC
Fixed cycles	✓		Drilling, conventional and rigid tapping, rectangular and circular pockets
		19	Peck drilling, reaming, boring, counterboring, centering
		19	Milling internal and external threads
		19	Clearing level and oblique surfaces
		19	Multi-operation machining of straight and circular slots
		19	Multi-operation machining of rectangular and circular pockets, and rectangular and circular studs
		19	Cartesian and polar point patterns
		19	Contour train, contour pocket
		19	Contour slot with trochoidal milling
		19	Engraving cycle: Engrave text or numbers in a straight line or on an arc
		19	OEM cycles (special cycles developed by the machine tool builder) can be integrated

User function	Standard	Option	TNC 620
Program jumps	✓		Subprograms
	✓		Program-section repeats
	✓		Calling any program as a subprogram
Coordinate transformation	✓		Shifting, rotating, mirroring, scaling (axis-specific)
		8	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 available directly on the TNC
	✓		Graphical support for programming cycles
	✓		Comment and structure blocks in the NC program
CAD viewer	✓		Display of standardized CAD file formats on the TNC
Teach-In	✓		Actual positions can be transferred directly into the NC program
Test graphics Depictions		20	Graphical simulation before a program run, even while another program is running
		20	Plan view / projection in 3 planes / 3-D view, also in tilted working plane / 3-D line graphics
		20	Detail zoom
Programming graphics	✓		In Programming and Editing mode, the contours of entered NC blocks are rendered (2-D pencil-trace graphics), even while another program is running
Program-run graphics		20	Graphical simulation during real-time machining
Display modes		20	Plan view / projection in 3 planes / 3-D view
Machining time	✓		Calculation of machining time in the Test Run operating mode
	✓		Display of the current machining time in the Program Run operating modes
Returning to the contour	✓		Mid-program startup 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 saving any reference points
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	Calibrating the touch probe
		17	Compensation of workpiece misalignment, manual or automatic
		17	Reference-point setting, manual or automatic
		17	Automatic tool and workpiece measurement

User 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 a parallel axis included in the position display of the associated principal axis (sum display) Defining the principal and secondary axes in the NC program makes it possible to run programs on different machine configurations
Conversational languages	✓		English, German, Czech, French, Italian, Spanish, Portuguese, Dutch, Swedish, Danish, Finnish, Norwegian, Slovenian, Slovak, Polish, Hungarian, Russian (Cyrillic), Romanian, Turkish, Chinese (traditional and simplified), Korean

Options

Option number	Option	As of NC software 81760x-	ID	Comment	Page
0	Additional Axis 1	01	354540-01	Additional control loop 1	17
1	Additional Axis 2	01	353904-01	Additional control loop 2	17
8	Advanced Function Set 1	01	617920-01	**Rotary table machining** • Programming of cylindrical contours as if in two axes • Feed rate in distance per minute	57
				Coordinate transformation • Tilting the working plane, PLANE function	58
				Interpolation • Circular in 3 axes with tilted working plane	
9	Advanced Function Set 2	01	617921-01	**3-D machining** • 3-D tool compensation via surface normal vectors • Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point (TCPM = Tool Center Point Management) • Keeping the tool normal to the contour • Tool radius compensation normal to the tool direction • Manual traverse in the active tool-axis system **Interpolation** • Linear in more than 4 axes (export license required)	58
17	Touch probe functions	01	634063-01	**Touch probe cycles** • Compensation of workpiece misalignment, setting of presets Setting of presets • Automatic tool and workpiece measurement • Touch probe input enabled for non-HEIDENHAIN systems	79
18	HEIDENHAIN DNC	01	526451-01	Communication with external PC applications over COM component	82
19	Advanced programming features	01	628252-01	**FK free contour programming** **Fixed cycles** • Peck drilling, reaming, boring, counterboring, centering • Milling internal and external threads • Clearing level and oblique surfaces • Multi-operation machining of straight and circular slots • Multi-operation machining of rectangular and circular pockets • Cartesian and polar point patterns • Contour train, contour pocket—also with contour-parallel machining • Contour slot with trochoidal milling • Special cycles developed by the machine tool builder can be integrated	

Option number	Option	As of NC software 81760x-	ID	Comment	Page
20	Advanced graphic features	01	628253-01	**Program-verification graphics, program-run graphics** • Plan view, view in three planes, 3-D view	
21	Advanced Function Set 3	01	628254-01	**Tool compensation** • Radius-compensated contour look-ahead for up to 99 blocks (LOOK AHEAD) **3-D machining** • Superimposing handwheel positioning during program run	
22	Pallet management	01	628255-01	**Pallet management**	79
23	Display step	01	632986-01	**Display step** to 0.01 µm or 0.000 01°	57
24	Gantry axes	01	634621-01	Gantry axes in master-slave torque control	58
42	CAD import	05	526450-01	Importing of contours from 2-D and 3-D models, e.g. STEP, IGES, DXF	
46	Python OEM process	01	579650-01	Execute Python applications	77
48	KinematicsOpt	01	630916-01	Touch-probe cycles for the automated measurement of rotary axes	71
49	Double-speed axes	01	632223-01	Short control-loop cycle times for direct drives	63
93	Extended tool management	02	676938-01	Extended tool management	
133	Remote Desktop Manager	01	894423-01	Display and remote operation of external computer units (e.g., a Windows PC)	82
137	State Reporting	06	1232242-01	State Reporting Interface (SRI): provision of operating statuses	
141	Cross Talk Comp.	01	800542-01	CTC: Compensation of axis couplings	67
142	Pos. Adapt. Control	01	800544-01	PAC: Position-dependent adaptation of control parameters	67
143	Load Adapt. Control	01	800545-01	LAC: Load-dependent adaptation of control parameters	68
144	Motion adaptive control	01	800546-01	MAC: Motion-dependent adaptation of control parameters	68
145	Active chatter control	01	800547-01	ACC: Active suppression of chatter	65
146	Active vibration damping	01	800548-01	AVD: Active vibration damping	67
154	Batch process manager	05	1219521-01	Planning and executing multiple machining operations	59
155	Component Monitoring	06	1226833-01	Monitoring for component overloading and wear	

HSCI control components
Main computers

Main computer

The **MC 8410** and **MC 74xx** main computers feature:
- Intel Celeron 1047 processor (1.4 GHz, dual-core)
- 2 GB SDRAM main memory
- HSCI interface to the controller unit and to other control components
- USB 2.0 port with cover cap on front

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

Special features of the MC 8410:
- 19-inch screen (vertical), resolution: 1024 x 768 pixels
- Without feed-rate and spindle-speed potentiometers (potentiometers are integrated in the MB 721)
- Multi-touch operation
- ASCII keyboard integrated in the screen
- Software support as of 81760x-04 SP2

Special features of the MC 74x0
- 15-inch screen, resolution: 1024 x 768 pixels
- On MC 7410: TNC operating panel with hardware switches; without feed rate and spindle potentiometers (potentiometers are integrated in MB 721)
- On MC 7420: USB port for the TE operating panel

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 UEC/UMC)
- **MB 721** machine operating panel (integrated in TE 7x5) or **PLB 600x** HSCI adapter for the connection of an OEM machine operating panel

Interfaces

The standard main computers feature USB 3.0, RS-232-C/V.24 and Ethernet interfaces for use by the end user. Connection to PROFINET-IO or PROFIBUS-DP is possible via an additional module.

Power supply

Protective Extra Low Voltage (PELV) according to EN 61800-5-1 must be complied with by the power supply for the DC 24 V of the main computer and other HSCI components. It is supplied by the UEC controller unit. If the current consumption is greater than 3.5 A or a CC 6106 is used, then a PSL 130 power supply unit is also necessary.

Export version

Because the complete NC software is saved on the CFR storage medium, no export version is required for the main computer itself. Export versions are available only for the easily replaceable storage medium and the SIK component.

Versions

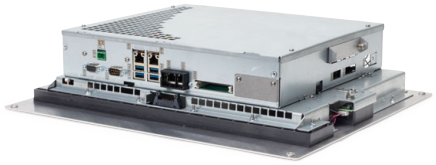
The MC 8410 and MC 74xx main computers are designed for direct installation in the operating panel. There are various versions:

- **Integrated** keyboard, touchscreen
  The MC 8410 features a 19" screen (vertical) with TNC keyboard and ASCII keyboard integrated in the screen
- **Integrated** keyboard, operating keys
  The MC 7410 main computer includes a 15-inch screen and TNC keyboard
- **Separate** keyboard
  The MC 7420 main computer features a 15" screen without TNC keyboard. A separate 15" TNC keyboard is required. Hence, the complete ASCII character set is available.

The MC 8410 main computer is supported by NC software 81760x-04 SP2 or later. The MC 74x0 main computer is supported by NC software 81760x-01 or later. These MCs cannot be run on earlier software versions.

The main computers feature the HEROS 5 operating system. Connection of the fieldbus systems is possible selectively via an appropriate additional module.

MC 8410



MC 7420

	Keyboard	Power consumption	Mass	
MC 7410	Integrated	52 W	7.8 kg	ID 1039531-11
MC 7420	Separate	52 W	6.5 kg	ID 1066650-xx
MC 8410	Integrated, touchscreen	52 W	8.6 kg	ID 1175057-xx

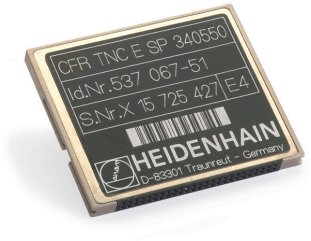
Options

The capabilities of the TNC 620 can also be adapted at a later time with options to meet new requirements. These options are described on page 13. They are enabled by entering keywords based on the SIK number and are saved in the SIK component. Please provide your SIK number when ordering new options.

Memory 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 CRF is compatible with the MCs described in the **Main computers** section.



CFR CompactFlash

CFR CompactFlash 8 GB

Free capacity for NC programs	1.8 GB
Free capacity for PLC programs	350 MB
Export license required	ID 1069906-06
No export license required	ID 1069906-56

SIK component

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

SIK component

The SIK component with the NC software license is available in various versions, depending on the enabled control loops and options. Additional control loops (up to 6) can be enabled later by entering a keyword. HEIDENHAIN provides the keyword, which is based on the SIK number.

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

Master keyword (general key)

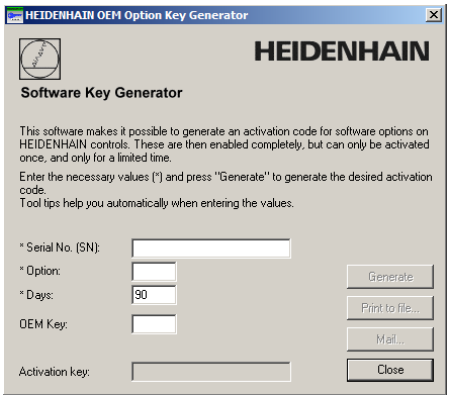
For the commissioning of the TNC 620, there is a master keyword (general key) that enables all options for a single 90-day period. After this period, only those options with the correct keywords will be active. The general key is activated via a soft key.

TNCkeygen (accessory)

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

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

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



NC software license and enabling of control loops

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 *ID 526924-51*	ID 526924-04 *ID 526924-54*	ID 526924-20 *ID 526924-70*	ID 526924-11 *ID 526924-61*	ID 526924-18 *ID 526924-68*
5	ID 526924-02 *ID 526924-52*	ID 526924-05 *ID 526924-55*	- -	ID 526924-12 *ID 526924-62*	ID 526924-13 *ID 526924-63*
6	ID 526924-03 *ID 526924-53*	ID 526924-06 *ID 526924-56*	- -	ID 526924-19 *ID 526924-69*	ID 526924-07 *ID 526924-57*

(Italics: Export version)

Enabling further control loops

Further 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

Controller unit

Controller unit

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

Single speed
Double speed

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

Cycle times

At f_{PWM}	Current controller	Speed controller		Position controller
		Single-speed	Double-speed[1)]	
3333 Hz	150 µs	300 µs	150 µs	Same as **speed controller**
4000 Hz	125 µs	250 µs	125 µs	
5000 Hz	100 µs	200 µs	100 µs	
6666 Hz[1)]	75 µs	150 µs	150 µs	
8000 Hz[1)]	60 µs	125 µs	125 µs	
10 000 Hz[1)]	50 µs	100 µs	100 µs	

[1)] Possible only with option 49

Number of control loops

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

Versions

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

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

CC 6106

The **CC 6106** controller unit includes:
- Position controller, speed controller, current controller
- HSCI interfaces
- PWM interfaces to the UM, UR, UE power modules
- Interfaces to the speed and position encoders
- Interfaces for power supply (via inverter)
- SPI interfaces for expansion modules (e.g., CMA-H)

	CC 6106
Digital control loops	Max. 6 (single speed)
Speed inputs	6 x 1 V_{PP} or EnDat 2.2
Position inputs	6 x 1 V_{PP} or EnDat 2.2
PWM outputs	6
Power consumption (without encoders)	25 W
Mass	4.1 kg
	ID 662636-xx

CC 6106

UEC 11x

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

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

Inverters
- Power electronics
- Connections for axis motors and spindle motor
- Braking resistor
- Connections for motor holding brakes
- Additional DC-link connection on the front for connection of a PSL 130

System PL (without EnDat support)
- Interfaces for one workpiece touch probe and one tool touch probe
- Integrated PLC (expandable with PL 61xx)
  UEC 11x: 38 free inputs, 23 free outputs (7 of which can be switched off)
- Configuration with IOconfig PC software

UEC 113

		UEC 111/UEC 112/UEC 113		
Controllers		4/5/6 digital control loops		
Speed inputs		4/5/6 x 1 V_{PP} or EnDat 2.2		
Position inputs		4/5/6 x 1 V_{PP} or EnDat 2.2		
Inverters		*2/3/4 axes*	*1 axis*	*Spindle*
Rated current I_N/ Maximum current I_{max}[1] at a PWM frequency of	**3333 Hz**	**6.0/12.0 A**	**9.0/18.0 A**	**24.0/36.0 A**
	4000 Hz	5.5/11.0 A	8.3/16.5 A	22.0/33.0 A
	5000 Hz	5.0/10.0 A	7.5/15.0 A	20.0/30.0 A
	6666 Hz	4.2/8.4 A	6.3/12.6 A	16.8/25.2 A
	8000 Hz	3.6/7.3 A	5.5/11.0 A	14.6/21.9 A
	10 000 Hz	3.0/6.0 A	4.6/9.2 A	12.2/18.3 A
Supply voltage		3AC 400 V (± 10 %); 50 Hz or 3AC 480 V (+6 %/–10 %); 60 Hz		
Rated power of DC link		**14 kW**		
Peak power[2] of DC link		18 kW / 25 kW		
Power loss at I_N		≈ 450 W		
DC-link voltage		DC 565 V		
Integral braking resistance[3]		2.1 kW / 27 kW		
Power supply unit for HSCI components		DC 24 V / 3.5 A		
Module width		150 mm		
Mass		≈ 14 kg		
Functional safety (FS)		-	✓	
UEC 111 **UEC 112** **UEC 113**		ID 1081002-xx ID 1081003-xx ID 828471-xx	ID 1075825-xx ID 1075826-xx ID 1038694-xx	

[1] Axis: 0.2 s cyclic duration factor for cycle duration of 10 s with 70 % rated current preload
Spindle: 10 s cyclic duration factor for cycle duration of 60 s with 70 % rated current preload

[2] 1st value: 40 % cyclic duration factor for cycle duration of 10 min (S6-40 %)
2nd value: 4 s cyclic duration factor for cycle duration of 20 s

[3] 1st value: Continuous power
2nd value: Peak power (1.5 % cyclic duration factor for cycle duration of 120 s)

UMC 11x FS

The UMC 111 FS is a compact inverter with integrated controller unit and PLC inputs/outputs. As opposed to the UEC, it is used exclusively for controlling axis motors and is powered by an external DC link. The UMC automatically enables the control loops needed for auxiliary axes. Further options are unnecessary.

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

UMC 111 FS

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

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

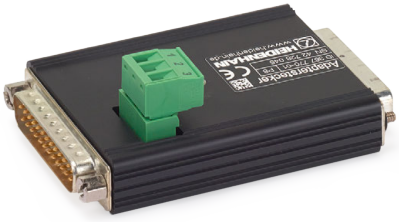
System PL (without EnDat support)
- Integrated PLC, expandable with PL 61xx
  UMC 111 FS: 38 free inputs, 28 free outputs (7 of which can be switched off)
  8 FS inputs, 8 FS outputs
- Configuration with IOconfig PC software

		UMC 111 FS
Controllers		4 digital control loops
Speed inputs		4 x 1 V_{PP} or EnDat 2.2
Inverters		*4 axes*
Rated current I_N/ Maximum current I_{max}[1] at a PWM frequency of	**3333 Hz**	**9.0/18.0 A**
	4000 Hz	8.3/16.5 A
	5000 Hz	7.5/15.0 A
	6666 Hz	6.3/12.6A
	8000 Hz	5.5/11.0 A
	10 000 Hz	4.6/9.2 A
Power loss at I_N		≈ 300 W
DC-link voltage		DC 565 V or DC 650 V
24 V PLC current consumption		DC 24 V / 2 A
Module width		150 mm
Mass		≈ 11 kg
UMC 111 FS		ID 664231-xx

[1] Axis: 0.2 s cyclic duration factor for cycle duration of 10 s with 70 % rated current preload
Spindle: 10 s cyclic duration factor for cycle duration of 60 s with 70 % rated current preload

Adapter connector for temperature sensor

The adapter connector makes it possible for applications with purely serial EnDat 2.2 encoders to connect an external KTY or PT 1000 temperature sensor (e.g. of linear and torque motors) and lead it to the speed encoder input of the controller unit.



The adapter connector can also be used in conjunction with encoders with EnDat02 or 1 V_{PP} interface. The adapter connector is plugged directly onto the speed encoder input (X15 to X20) of the controller unit.

KTY adapter connector ID 367770-xx
Mass ≈ 0.1 kg

Additional cables are required for the use of two or more adapter connectors on one controller unit because the connector for an external KTY or PT 1000 temperature sensor does not permit two or more adapter connectors in a row at the CC 61xx.

Adapter connector

	Encoders with EnDat interface (EnDat2.1, EnDat2.2)	**Encoders with 1 V_{PP} interface**
1 m cable	ID 336377-01	ID 312533-01
3 m cable	ID 336377-03	ID 312533-03

Keyboard

MB 720 machine operating panel

- For MC 7420
- Power supply: DC 24 V/≈ 4 W
- 36 exchangeable snap-on keys with status LED, freely definable via PLC (assignment as per PLC basic program: 12 axis keys, spindle start, spindle stop, 22 further function keys)
- Further operating elements: NC start[1)], NC stop[1)], emergency-stop key, control voltage On[1)], two bore holes for additional keys or keylock switches
- HSCI interface
- MB 720: 7 free PLC inputs and 5 free PLC outputs
  MB 720 FS: 4 free FS inputs and 5 free PLC outputs; additional dual-channel FS inputs for emergency stop and permissive buttons of the handwheel.
- To be able to continue to use the MB 720 (FS) machine operating panel with the MC 7410, the potentiometers on the MC 7410 (ID 1039531-11) must be retrofitted. Use the conversion kit ID 1198759-01.

[1)] Keys illuminated, addressable via PLC

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

MB 720

MB 721 machine operating panel

Same as the MB 720, except:

- Suitable for MC 8410 and MC 7410
- Changed front panel
- Three holes for additional push buttons or keylock switches

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

MB 721

TE 730 keyboard

- For MC 7420
- 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
- Touchpad

TE 730 ID 805489-xx
Mass ≈ 2.4 kg

TE 730

TE 720 keyboard

Same features as TE 730 but without touchpad

TE 720 ID 805488-xx

TE 735 keyboard unit with integrated machine operating panel

- For MC 7420
- 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

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

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

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

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

System PL with EnDat support

- Required once for each control system (except with UEC)
- Connections for TS and TT touch probes
- TS and TT touch probes with EnDat interface are supported
- Safety-relevant inputs/outputs
- *Without FS*: 12 free inputs, 7 free outputs
  With FS: 6 free FS inputs, 2 free FS outputs
- Compatible to the system PL
- The slots are fitted with cover strips, so no empty housings are needed
- Software support as of NC software 81760x-05

PLB 6204	for 4 I/O modules	ID 1129809-xx
PLB 6204 FS	for 4 I/O modules	ID 1129808-xx
PLB 6206	for 6 I/O modules	ID 1129812-xx
PLB 6206 FS	for 6 I/O modules	ID 1129811-xx
PLB 6208	for 8 I/O modules	ID 1129813-xx
PLB 6208 FS	for 8 I/O modules	ID 1129810-xx

Expansion PL

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

PLB 6104	for 4 I/O modules	ID 591828-xx
PLB 6104 FS	for 4 I/O modules	ID 590479-xx
PLB 6106	for 6 I/O modules	ID 630058-xx
PLB 6106 FS	for 6 I/O modules	ID 804755-xx
PLB 6108	for 8 I/O modules	ID 630059-xx
PLB 6108 FS	for 8 I/O modules	ID 804756-xx

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

I/O modules

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

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

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

PLA-H 08-04-04	Analog module for PL 6xxx with • 8 analog inputs, ± 10 V • 4 analog outputs, ± 10 V • 4 analog inputs for PT 100 thermistors	ID 675572-xx
Mass	≈ 0.2 kg	

IOconfig (accessory)

PC software for configuring HSCI and PROFIBUS components

Accessories
Power supply for HSCI components

PSL 13x

HEIDENHAIN offers the PSL 13x power supply unit in order to power the HSCI components. Either line voltage and DC-link voltage or only line voltage is provided to the PSL 13x. The PSL 13x provides the safely separated DC 24 V PELV NC power supply required for the HSCI components by EN 61800-5-1. The NC supply voltage and the PLC supply voltage are separated from each other by basic insulation.

Supply voltage
- PSL 13x (L1, L2): AC 400 V (360 V to 480 V), 50/60 Hz
- PSL 13x (DC-link voltage): DC 400 V to 750 V
- Power consumption ≤1000 W

Outputs
NC: DC 24 V/≤ 20 A (double insulation from line power)
DC 5 V/≤ 16 A (only for PSL 135) electrically connected with DC 24 V NC
PLC: DC 24 V/≤ 20 A (basic insulation from line power)
Total: ≤ 32 A/750 W

PSL 130

The **PSL 130** serves as a DC 24 V power supply unit for supplying the HSCI components. It is not necessary in connection with the UEC if the total current consumption of the connected HSCI components does not exceed 3.5 A.

HSCI components		**Current consumption DC 24 V NC**
Main computer	MC 7410, MC 7420, MC 8410	2.2 A
Machine operating panel	PLB 600x MB 7x0	0.2 A (without handwheel) 0.2 A (without handwheel)
Keyboard	TE 7x5 (MB integrated)	0.2 A (without handwheel)
PLC inputs/outputs	PLB 62xx PLB 61xx PLD PLA	0.3 A (without touch probe) 0.2 A 0.05 A 0.1 A
Handwheels	HR 520 HRA 551 FS + HR 550 FS HR 510 HR 130 HRA 110 + 3 x HR 150	0.05 A 0.5 A (while charging) 0.05 A 0.05 A 0.2 A
Touch probes	See specifications of the touch probes	

	Module width	**Degree of protection**	**Mass**	
PSL 130	50 mm	IP20	2.1 kg	ID 575047-xx

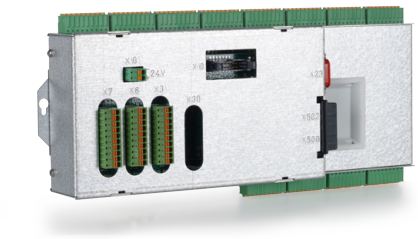
The UV(R) supply units currently available also feature an integrated power supply that provides DC 24 V to HSCI components.

HSCI adapter for OEM machine operating panel

PLB 600x

The PLB 600x HSCI adapter is required in order to connect an OEM-specific machine operating panel to the TNC 620. The spindle-speed and feed-rate override potentiometers of the TE 7xx and the HR handwheel are also connected to these adapters.

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



PLB 6001

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

Additional modules

Overview

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

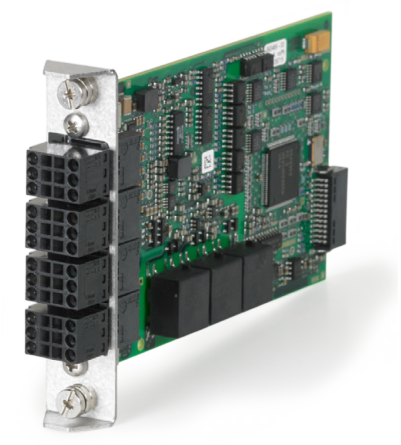
Module for analog axes

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

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

Additional module for analog axes/spindles:
- Expansion board for CC 61xx or UEC controller units
- 4 analog outputs, ±10 V for axes/spindle
- Spring-type plug-in terminals

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



CMA-H 04-04-00

Fieldbus systems

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

PROFIBUS-DP module

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

PROFIBUS-DP additional module ID 828539-xx

PROFINET-IO module

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

PROFINET-IO additional module ID 828541-xx

PROFINET-IO module

Combined PROFIBUS-DP/ PROFINET IO module

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

Additional module for PROFIBUS-DP and PROFINET-IO ID 1160940-xx

Combined module

Touch probes

Overview

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

Workpiece measurement

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

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

TS 260
TS 268

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

TS 260

Touch probe with **radio and infrared transmission** for machines with an automatic tool changer (for the appropriate transceiver, see page 30):

TS 460

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

TS 460

Touch probes with **infrared transmission** for machines with an automatic tool changer (for the appropriate transceiver, see page 30):

TS 642

Activation via switch in taper shank

TS 740

High probing accuracy and reproducibility, low probing force

Tool measurement

The touch probes for tool measurement from HEIDENHAIN are suited for probing stationary or rotating tools directly on the machine. The TNC 620 features standard cycles for the measurement of tool length and diameter, as well as of individual teeth. The TNC 620 automatically saves the measured tool dimensions in a tool table. It is also possible to measure tool wear between two machining steps. For the next machining operation, the TNC 620 automatically compensates for the tool dimensions or inserts a replacement tool (as when a tool breaks).

With the **TT touch trigger probes**, the disk-shaped probe contact is deflected from its resting position by contact with the stationary or rotating tool, and a trigger signal is transmitted to the TNC 620.

TT 160

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

TT 160

TT 460

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

Transceiver

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

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

SE 661

The following combinations are possible:

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

* With EnDat interface

Electronic handwheels

Overview

Support for electronic handwheels is standard on the TNC 620:
- One **HR 550 FS** wireless handwheel, or
- One **HR 510** or **HR 520** portable handwheel, or
- One **HR 130** panel-mounted handwheel, or
- Up to three **HR 150** panel-mounted handwheels via **HRA 110**

It is possible to operate up to five handwheels or handwheel adapters on a single TNC 620:
- One handwheel via the handwheel input of the main computer
- One handwheel each on up to four HSCI machine operating panels or the PLB 600x HSCI adapter

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

HR 510

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

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

HR 510

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

Mass ≈ 0.6 kg

HR 520

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

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

Mass ≈ 1 kg

HR 520

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

HR 550 FS

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

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

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

HR 550 FS with HRA 551 FS

HRA 551 FS

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

HRA 551 FS	ID 1119052-xx
Mass	≈ 1.0 kg

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

Connecting cables

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

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

See also *Cable overview* on Page 43.

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

HR 150

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

HR 150	Without detent	ID 540940-07
	With detent	ID 540940-06
Mass	≈ 0.7 kg	

HR 150

HRA 110

Handwheel adapter for connection of up to three **HR 150** panel-mounted handwheels and two step switches for axis selection and configuration of the subdivision factor. The first and second handwheels are assigned to axes 1 and 2. The third handwheel is assigned to the axes via a step switch or via machine parameters. The position of the second step switch is evaluated over the PLC (e.g., to select the subdivision factor).

HRA 110 ID 261097-xx
Mass ≈ 1.5 kg

HRA 110

Industrial PC

Additional operating station

The additional ITC operating stations (Industrial Thin Clients) from HEIDENHAIN are convenient solutions for the additional, decentralized operation of the machine or of machine units such as tool-changing stations. The remote operation strategy, which is tailored to the TNC 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&play principle, no configuration by the machine tool builder is necessary. With the standard configuration of the Ethernet interface at X116, the TNC 620 integrates the ITC into the system fully selfsufficiently.

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 755[1)]	ID 1039527-xx

With operating keys

The **ITC 750** (15-inch screen) and the TE 73x keyboard unit (to be ordered separately) together comprise a complete second operating system.

ITC 750[1)]	with 15″ screen for TE 73x ID 1039544-xx

[1)] No NRTL approval

IPC 6641 for Windows

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

Since Windows runs on the industrial PC, Windows has no effect on the NC machining process. The IPC is connected to the NC main computer via Ethernet. No second screen is necessary, since the Windows applications are displayed on the TNC 620's screen via remote accesses.

In addition to the IPC 6641 industrial PC, a separately ordered hard disk is required for operation. The operating systems Windows 7, 8, or 10 can be installed on this empty data medium.

IPC 6641	With 8 GB of RAM	ID 1039543-01
	With 16 GB of RAM	ID 1039543-02
	To be installed in	Electrical cabinet
	Processor	Intel Core i7-3 2.1 GHz, quad-core
	Mass	4.0 kg
HDR hard disk		ID 1074770-51
	Empty data carrier for Windows OS	
	Free capacity	≈ 160 GB

IPC 6641

Controlling of auxiliary axes

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. The standard PNC 610 features enabling for six PLC axes.

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.

Auxiliary computer

The IPC auxiliary computer features the following:
- Processor
- RAM memory
- HSCI interface to the CC 6xxx or UEC controller unit and to other control components
- USB 3.0 interface

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

The following HSCI components are required for operation of the TNC 620:
- IPC auxiliary computer
- Controller unit
- PLB 62xx PLC input/output unit (system PL; integrated in UEC/UMC)

Interfaces

The MC offers the end user USB 3.0, V.24/RS-232-C, and Ethernet interfaces. Connection to PROFINET-IO or PROFIBUS-DP is possible through an additional module.

Power supply

The DC 24 V power supply of the auxiliary computer and other HSCI components is provided through the PSL 13x supply unit with a supply voltage of 24 V-NC, or through the power supply of a UEC compact inverter. For the entire HSCI system, this DC 24 V-NC supply voltage is required to be safely separated voltage (PELV). It must not be connected to the DC 24 V supply voltage for PLC components (e.g., holding brakes).

Design

IPC 6490		ID 1039541-xx
	To be installed in	Electrical cabinet
	Processor	Intel Celeron Dual Core, 1.4 GHz
	RAM memory	2 GB
	Power consumption	48 W
	Mass	2.3 kg
IPC 8420		ID 1249510-xx
	Screen	15.6-inch, with touchscreen operation
	Installed in	Operating panel
	Processor	Intel Celeron Dual Core, 1.4 GHz
	RAM memory	2 GB
	Power consumption	48 W
	Mass	6.7 kg

Export version

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

Options

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

Option number	Option	ID	Remark	Page
18	HEIDENHAIN DNC	ID 526451-01	Communication with external PC applications over COM component	82
24	Gantry Axes	ID 634621-01	Gantry axes in master-slave torque control	58
46	Python OEM Process	ID 579650-01	Execute Python applications	77
135	Synchronizing Functions	ID 1085731-01	Expanded synchronization of axes and spindles	
141	Cross Talk Comp.	ID 800542-01	CTC: Compensation of axis couplings	67
142	Pos. Adapt. Control	ID 800544-01	PAC: Position-dependent adaptation of control parameters	67
143	Load Adapt. Control	ID 800545-01	LAC: Load-dependent adaptation of control parameters	68
144	Motion Adaptive Control	ID 800546-01	MAC: Motion-dependent adaptation of control parameters	68

Memory medium

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

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

SIK component

The SIK component contains the NC software license for the enabling of software options. It provides the main computer with an unambiguous ID code—the SIK number. The SIK component is ordered and shipped separately. It must be inserted into a 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

TNCkeygen (accessory)

TNCkeygen is a collection of PC software tools for generating enabling keys for HEIDENHAIN controls for a limited period of time see "TNCkeygen (accessory)", Page 17.

Snap-on keys for handwheels

Snap-on keys

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

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

Axis keys

Orange

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

Gray

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

Machine functions

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

Spindle functions

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

Other keys

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

Overview for HR 510 and HR 510 FS

Axis keys
Orange

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

Gray

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

Machine functions

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

Spindle functions

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

Other keys

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

Snap-on keys for controls

Snap-on keys

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

Overview of control keys

Keys
Orange

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

Gray

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

Machine functions

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

Spindle functions

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

Other keys

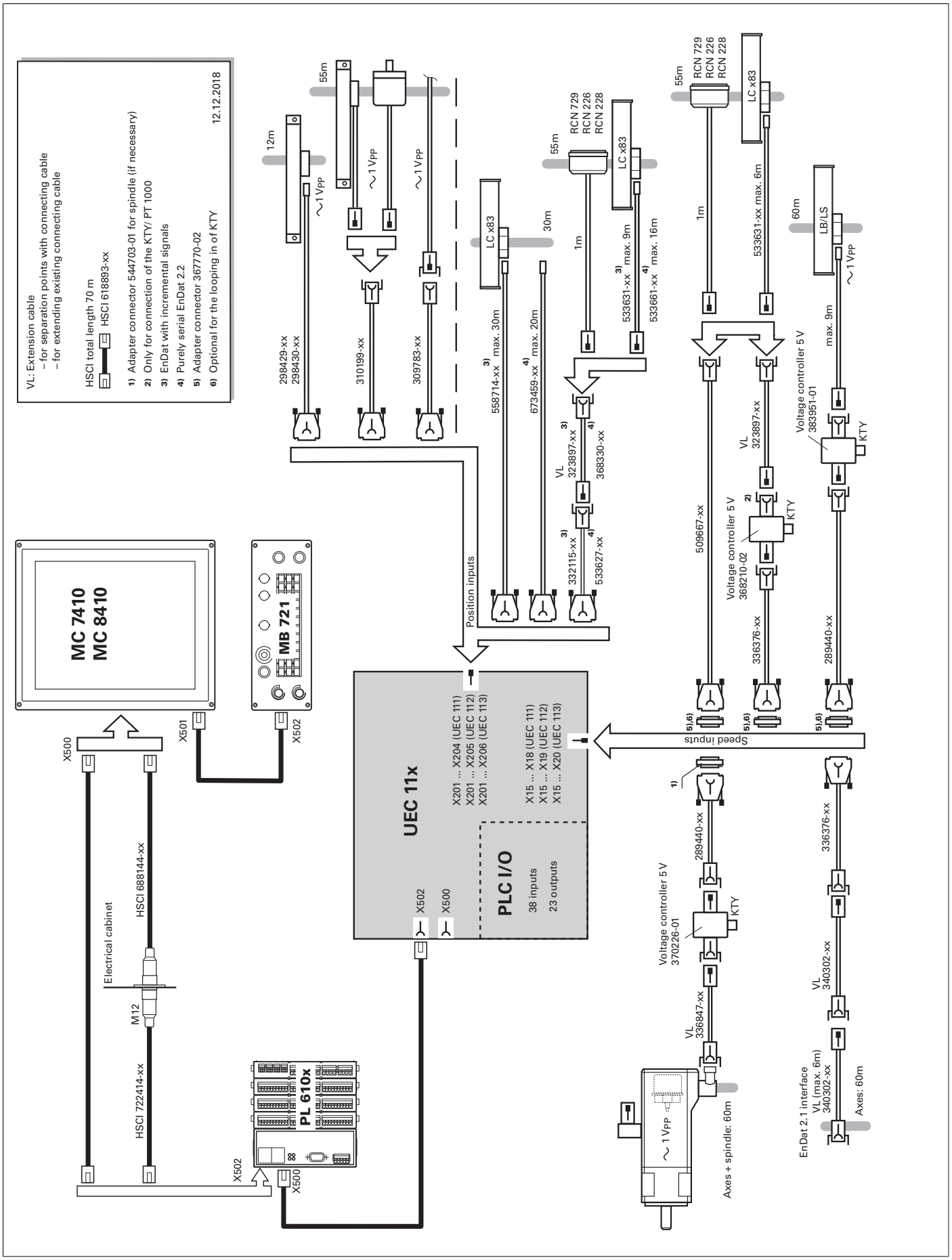
	ID 679843-15		ID 679843-39		ID 679843-97		Black ID 679843-E2
	ID 679843-17		ID 679843-41		ID 679843-98		ID 679843-E5
	Gray ID 679843-33		ID 679843-42		ID 679843-A7		ID 679843-F2
	Black ID 679843-34		Red ID 679843-45		ID 679843-A8		ID 679843-F4
	Orange ID 679843-35		ID 679843-58	–	Black ID 679843-D1	ENT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

Special keys

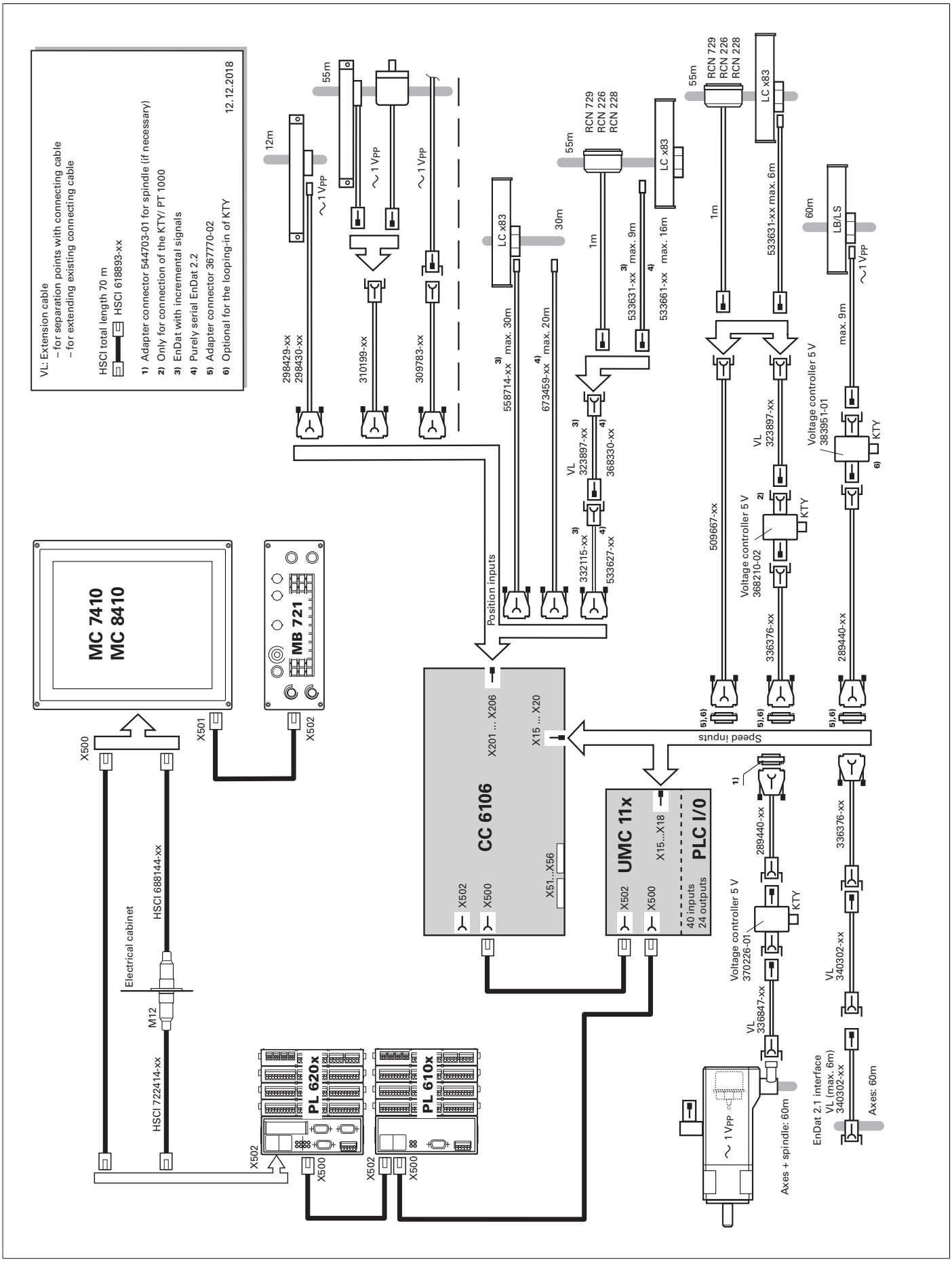
Snap-on keys can also be made with special key symbols for special applications. The laser labeling differs in appearance from the labeling of the standard keys. If you need keys for special applications, please consult your contact person at HEIDENHAIN.

Cable overview

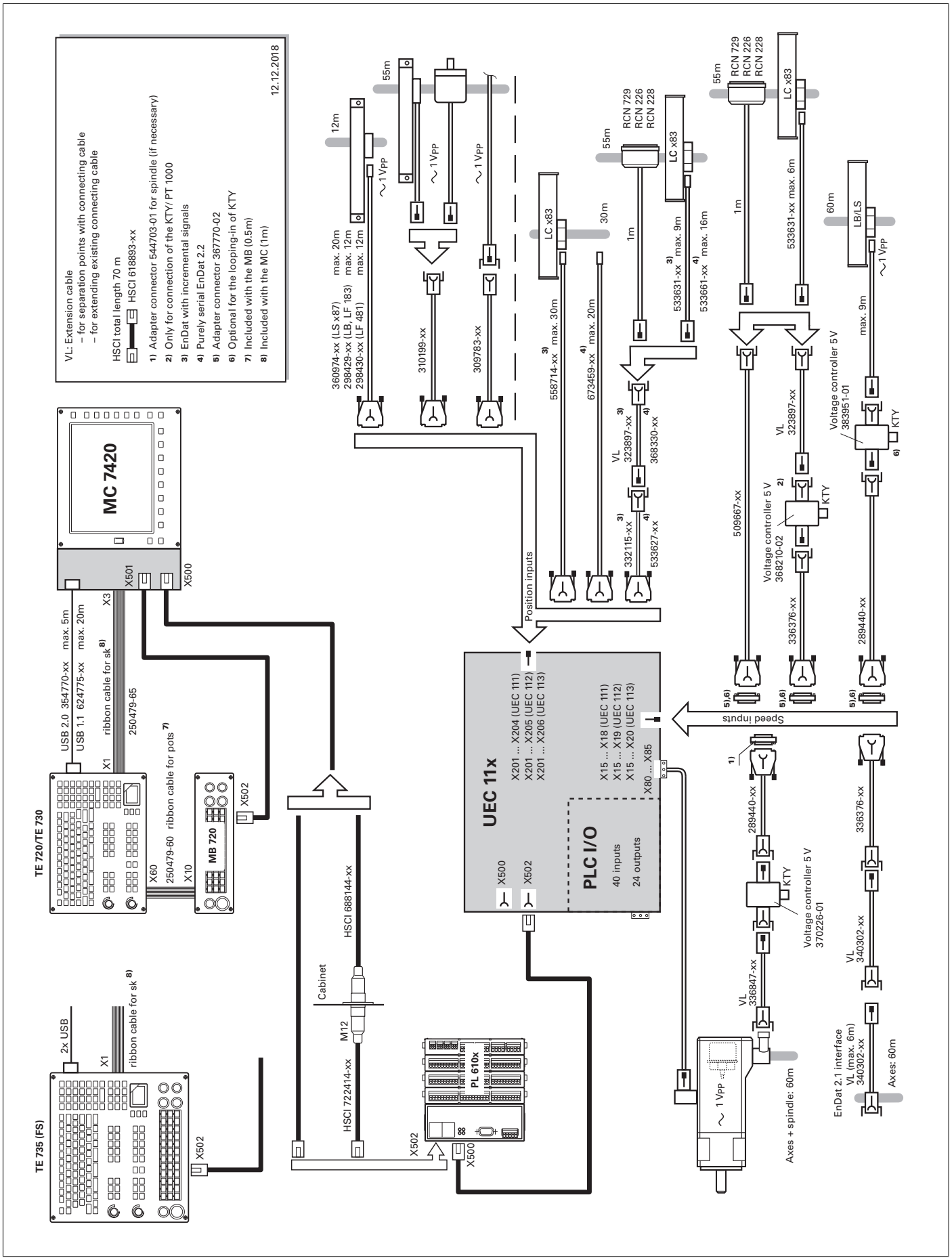
Control system with UEC 11x; integrated keyboard



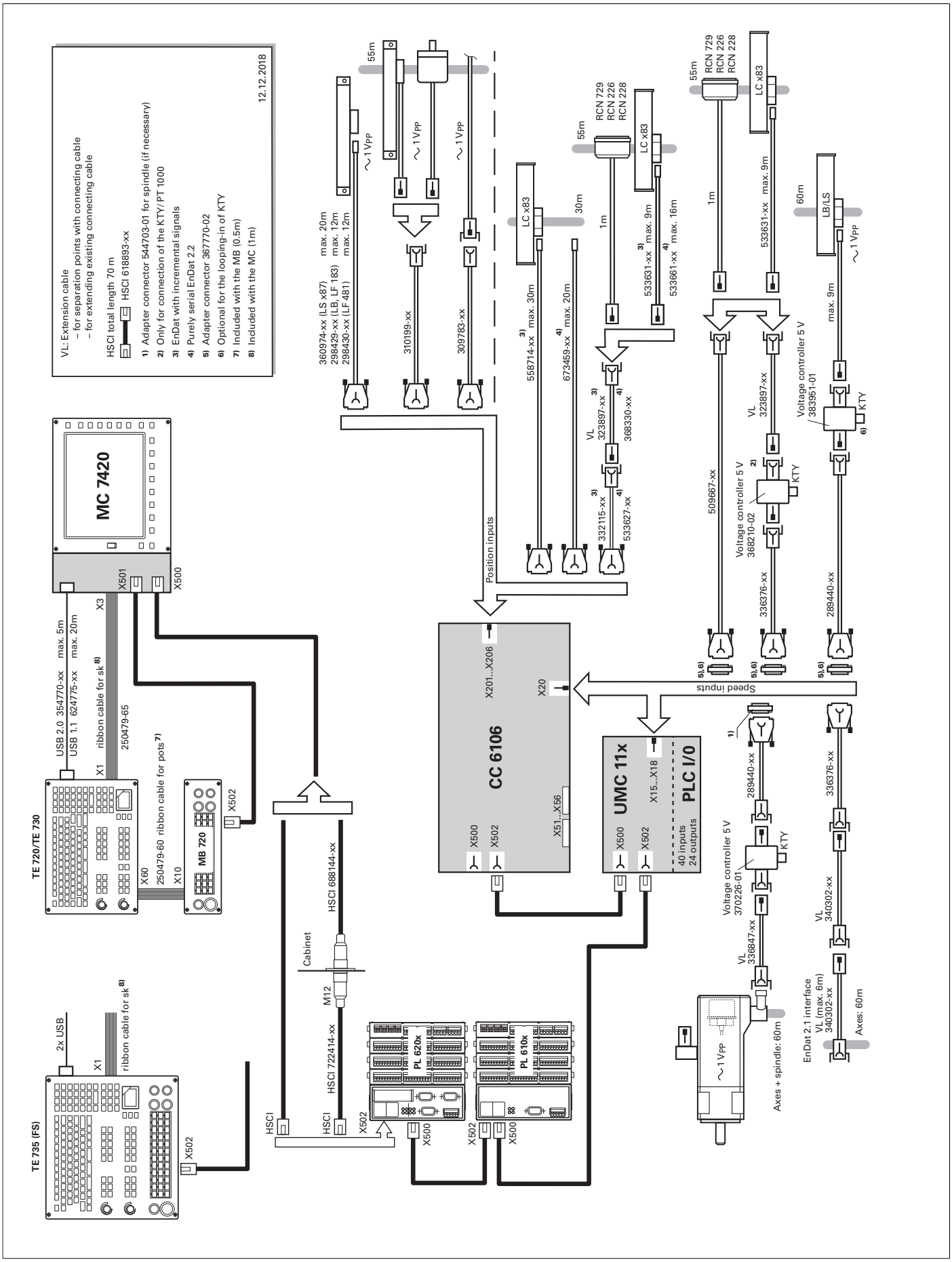
Control system with CC 6106; integrated keyboard



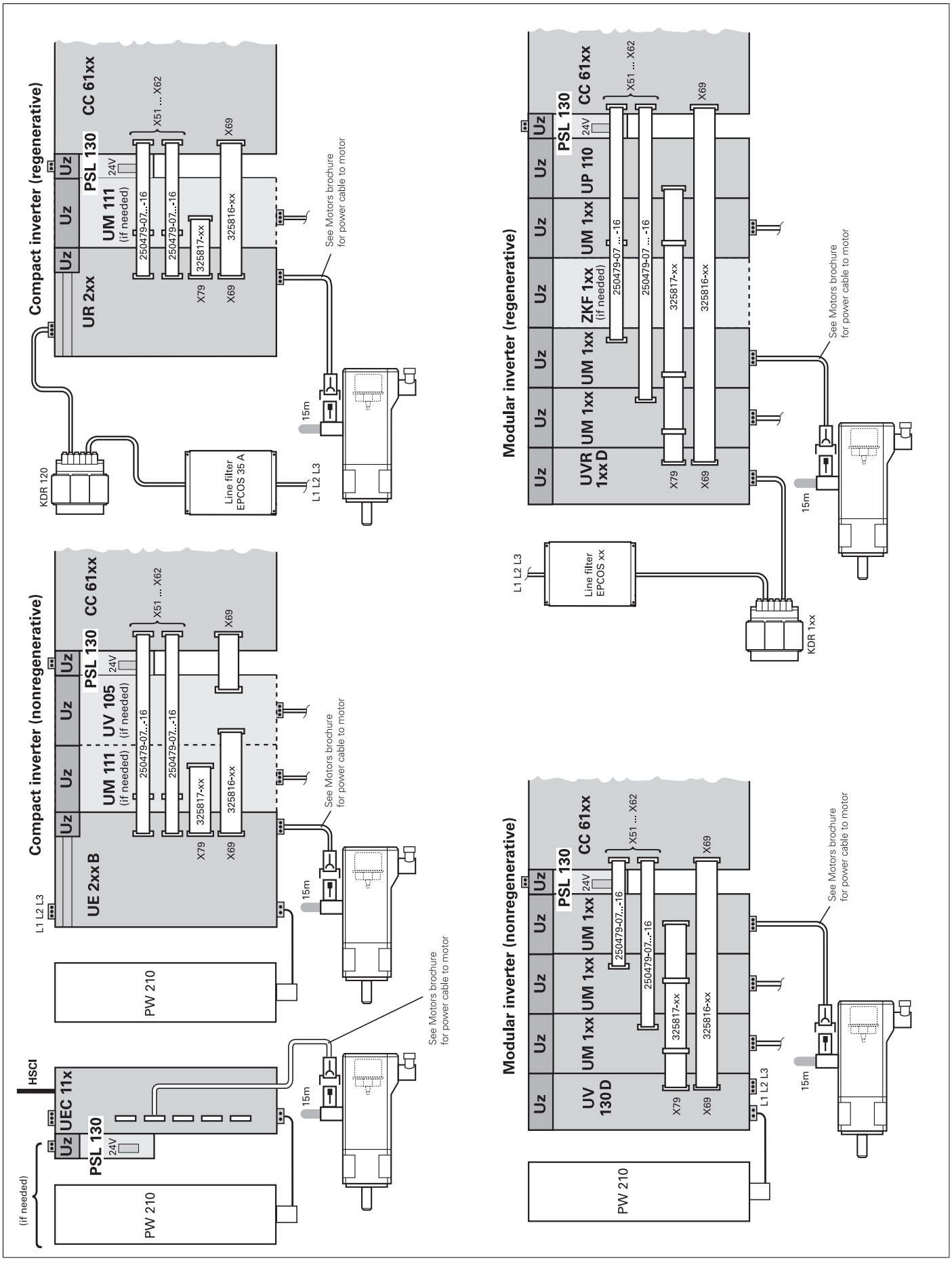
Control system with UEC 11x; separate keyboard



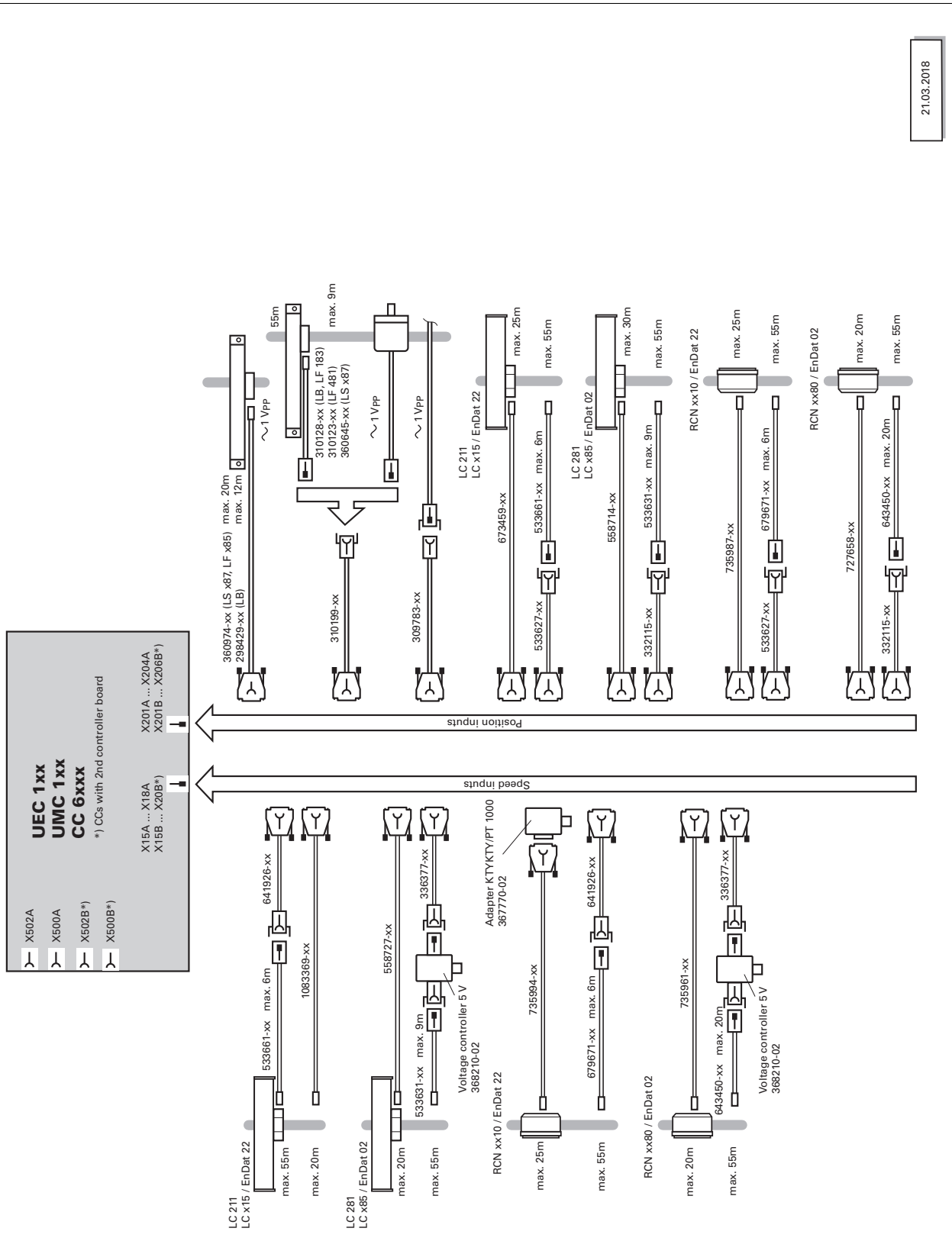
Control system with CC 6106; separate keyboard



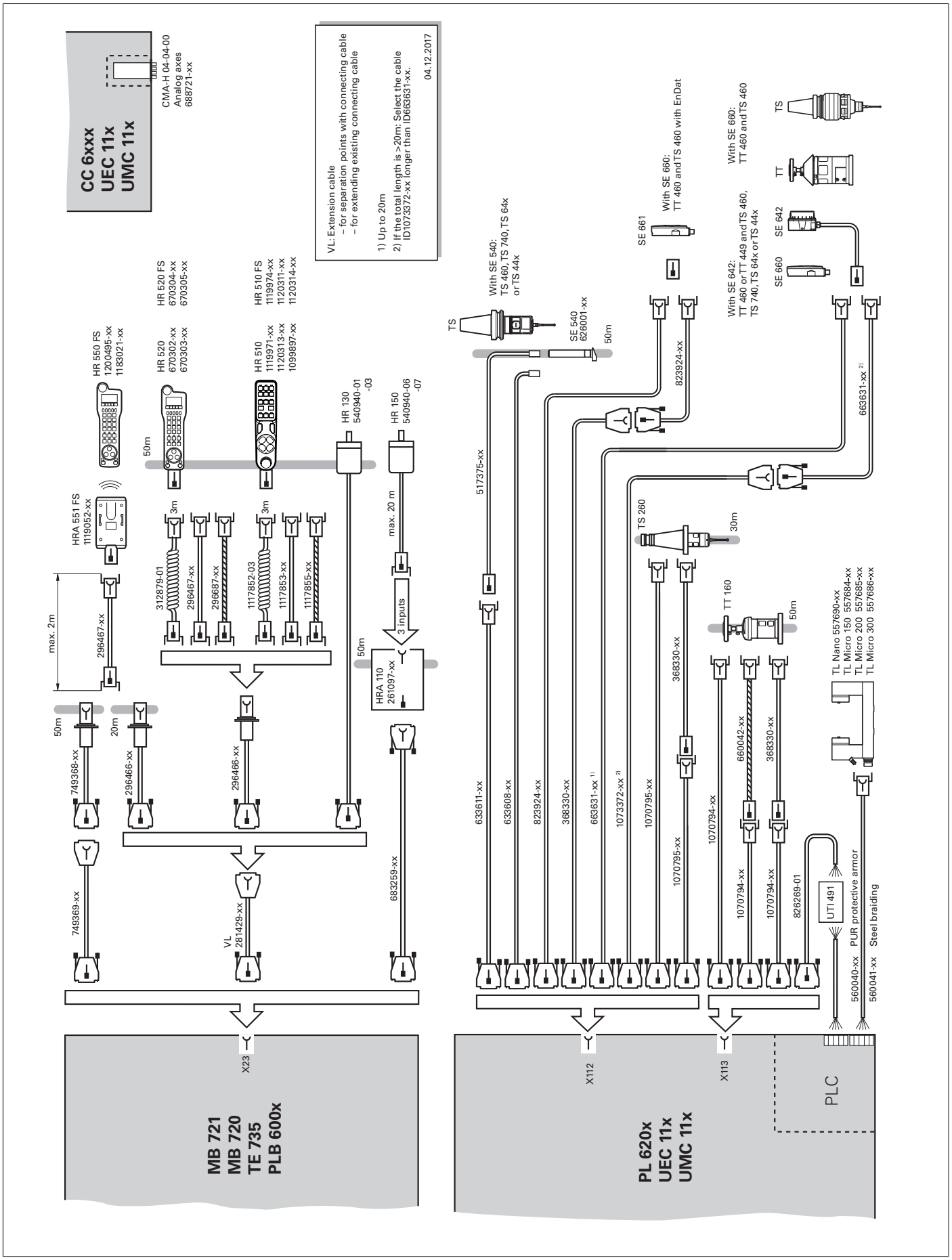
Inverter system



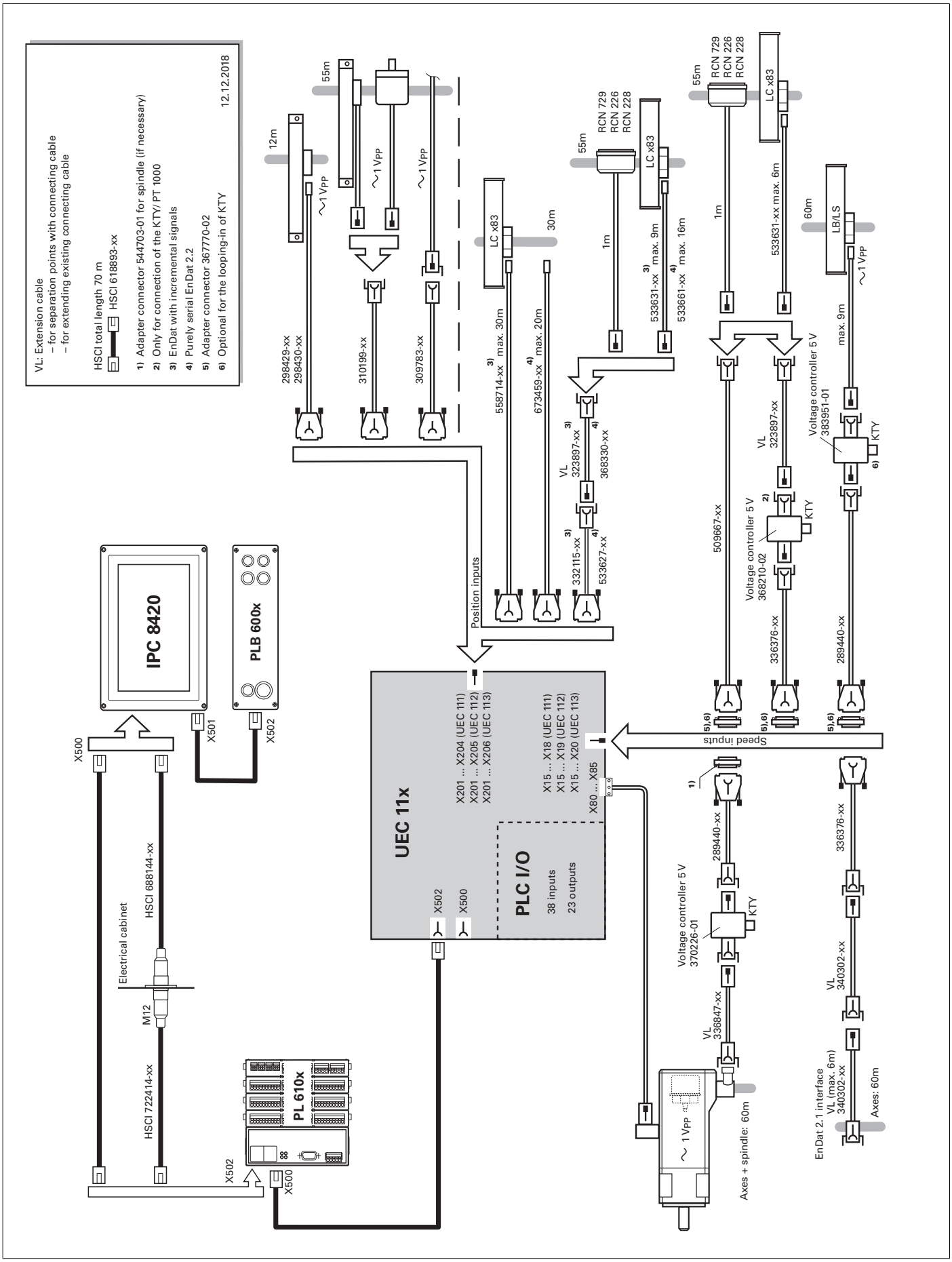
Encoders


21.03.2018
UEC 1xx
UMC 1xx
CC 6xxx
*) CCs with 2nd controller board
X502A
X500A
X502B*)
X500B*)
X15A ... X18A
X15B ... X20B*)
X201A ... X204A
X201B ... X206B*)
Position inputs
Speed inputs
360974-xx (LS x87, LF x85) max. 20m
298429-xx (LB) max. 12m
~ 1 VPP
55m
max. 9m
310128-xx (LB, LF 183)
310123-xx (LF 481)
360645-xx (LS x87)
310199-xx
309783-xx
LC 211
LC x15 / EnDat 22
673459-xx
max. 25m
533661-xx max. 6m
533627-xx
LC 281
LC x85 / EnDat 02
558714-xx
max. 30m
533631-xx max. 9m
332115-xx
RCN xx10 / EnDat 22
735987-xx
679671-xx max. 6m
533627-xx
RCN xx80 / EnDat 02
727658-xx
643450-xx max. 20m
332115-xx
641926-xx
533661-xx max. 6m
1083369-xx
max. 55m
max. 20m
558727-xx
336377-xx
533631-xx max. 9m
Voltage controller 5 V
368210-02
Adapter KTY/KTY/PT 1000
367770-02
735994-xx
679671-xx max. 6m
735961-xx
643450-xx max. 20m

Accessories



PNC 610 with UEC



Technical description
Digital control design

Uniformly digital

In the uniformly digital control design from HEIDENHAIN, all of the components are connected to each other via purely digital interfaces. The control components are connected via the HEIDENHAIN Serial Controller Interface (**HSCI**), the HEIDENHAIN real-time protocol for fast Ethernet. The encoders are connected over **EnDat 2.2**, the bidirectional interface from HEIDENHAIN. 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. For more information, refer to the *Uniformly Digital* Technical Information document.

HSCI

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

Main advantages of the control design with HSCI:
- Hardware platform for 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 the tried-and-tested PWM interface
- Large cable lengths in the entire system (HSCI segment up to max. 70 m)
- High number of possible control loops
- High number of PLC inputs/outputs
- Decentralized arrangement of the controller units

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

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

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

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

Control systems with integrated functional safety (FS)

Basic principle

With controls featuring integrated functional safety (FS) from HEIDENHAIN, it is possible to attain Safety Integrity Level 2 (SIL 2) in accordance with EN 61508, and Performance Level "d," Category 3, as per EN ISO 13849-1 (successor standard to EN 954-1). In these standards, the assessment of safety-related systems is based on, among other things, the failure probabilities of integrated components and subsystems. This modular approach aids the manufacturers of safety-related machines in implementing their systems, since they can then build upon prequalified subsystems. This design is taken into account for the TNC 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 the mutual comparison of the states and data of both channels. Therefore, the occurrence of a single error in the control does not result in a loss of the safety function.

Structure

The safety-related controls from HEIDENHAIN have a dual-channel design with mutual monitoring. The SPLC (safety-related PLC program) and SKERN (safety kernel software) software processes are the basis of the two redundant systems. The two software processes run on the MC main computer (CPU) and CC controller unit components. The dual-channel structure through MC and CC is continued in the PLB 6xxx FS input/output systems and the MB 72x FS. This means that all safety-relevant signals (e.g., permissive buttons and keys, door contacts, emergency stop button) are captured via two channels and are evaluated independently of each other by the MC and CC. The MC and CC use separate channels to also address the power modules and to stop the drives in case of an error.

Components

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

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

MB and TE

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

PLB

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

HR

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

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

Safety functions

The following safety functions are integrated into the hardware and software:

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

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

Activation of functional safety (FS)

If the control identifies a PLB 62xx FS in the system during booting, functional safety (FS) is activated.

In this case, it is essential that the following prerequisites be fulfilled:

- FS version of safety-relevant control components (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

Functional safety (FS) cannot be activated or deactivated by parameter.

For more information

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

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

Control systems with external safety

Basic principle

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

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

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

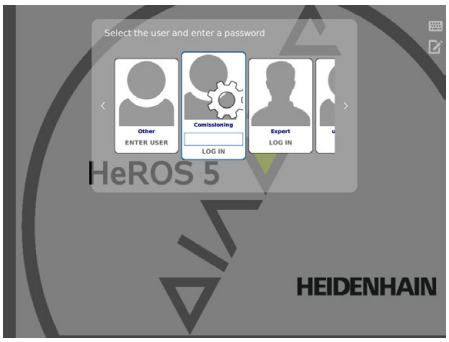
System
- Backup/Restore: function for backing-up and restoring the control
- HELogging: evaluation and creation of log files
- Perf2: system monitor
- User administration: define users with different roles and access permissions

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

User administration

The improper operation of a control often leads to unplanned machine downtime and costly scrap. The user administration feature can significantly improve process reliability through the systematic avoidance of improper operation. Through the configurable tying of permissions to user roles, access rights can be tailored to the given responsibilities of each operator.

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

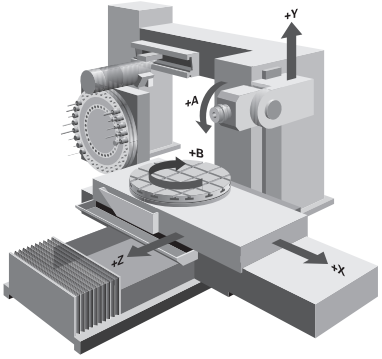


* Firefox is a registered trademark of the Mozilla Foundation

Axes

Linear axes

The TNC 620 can control linear axes with any axis designation (X, Y, Z, U, V, W, ...).



Display and programming

–99 999.9999 to +99 999.9999 [mm]
–99 999.99999 to +99 999.99999 [mm] with option 23

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

Feed rate override: 0 % to 150 %

Traverse range

–99 999.9999 to +99 999.9999 [mm]
–99 999.99999 to +99 999.99999 [mm] with option 23

The machine tool builder defines the traverse range. The user can set additional limits to the traverse range if he wishes to reduce the working space. Three different traverse ranges can be defined (selection 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
–99 999.9999 to +99 999.9999 [°]
–99 999.99999 to +99 999.99999 [°] with option 23

Feed rate in degrees per minute [°/min]

Traverse range

–99 999.9999 to +99 999.9999 [°]
–99 999.99999 to +99 999.99999 [°] with option 23

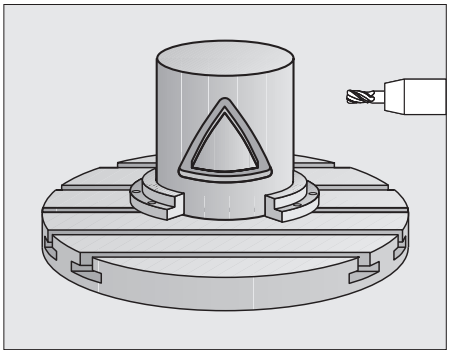
The machine tool builder defines the traverse range. The user can set additional limits to the traverse range if he wishes to reduce the working space. Various traverse ranges can be defined per axis using parameter sets (selection by PLC).

Free rotation

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

Cylinder surface interpolation (option 8)

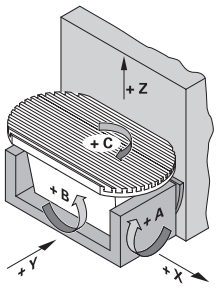
A contour defined in the working plane is machined on a cylindrical surface.



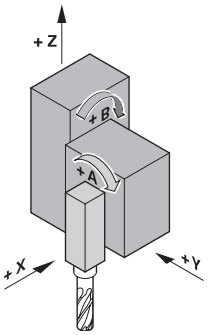
Tilting the working plane (option 8)

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

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



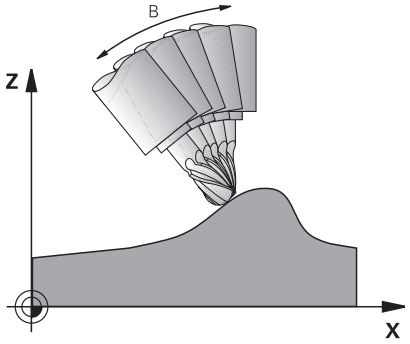
Tilting table



Swivel head

5-axis machining (option 9)

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

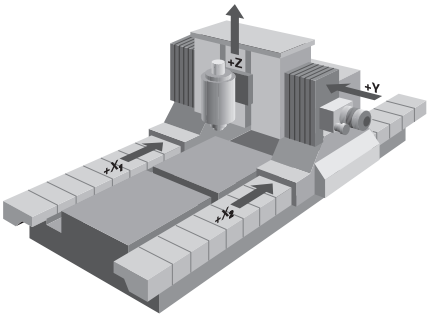


Synchronized axes (option 24)

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.

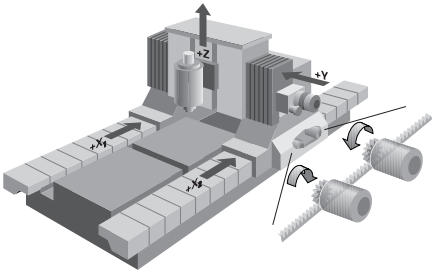
In the case of **gantry axes**, multiple gantry slave axes can be assigned to a single master axis. They may also be distributed to multiple controller units.



Torque control (option 24)

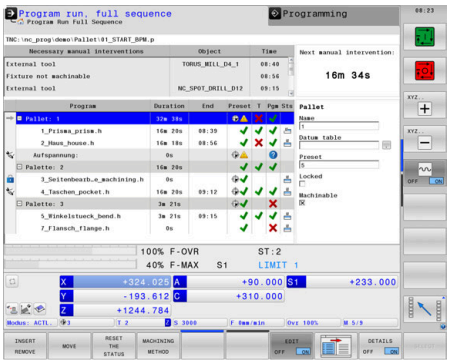
Torque control is used on machines with mechanically coupled motors, for which

- 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 servo drives (e.g. toothed racks).



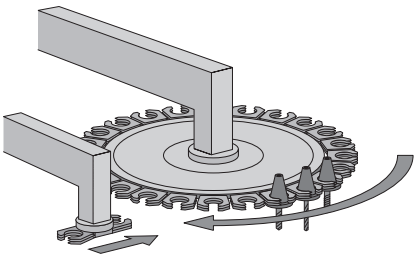
Batch Process Manager (option 154)

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



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 is used in conjunction with the HEIDENHAIN inverter systems with field-oriented control. As an alternative, an analog nominal speed value can be output.

Controller unit

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

Controller groups

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

Maximum spindle speed

The maximum spindle speed is calculated as follows:

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

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

Operating mode switchover

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

Position-controlled spindle

The position of the spindle is monitored by the control.

Encoder

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

Tapping

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

Spindle orientation

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

Spindle override

0 % to 150 %

Gear ranges

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

Multiple main spindles

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

Encoders

Overview

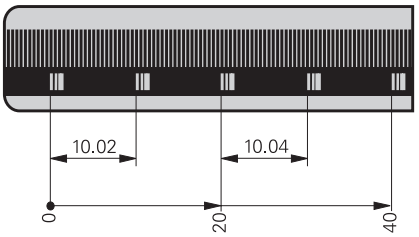
For speed and position control of the axes and spindle, HEIDENHAIN offers both incremental and absolute encoders.

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

When the machine is switched on, the machine axes need to traverse a reference mark for an accurate reference to be established between the measured value and the machine position. For encoders with distance-coded reference marks, the maximum travel until automatic reference mark evaluation for linear encoders is only 20 mm or 80 mm, depending on the model, or 10° or 20° for angle encoders.



Evaluation of reference marks

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

Output signals

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

Absolute encoders

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

EnDat interface

The TNC 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.

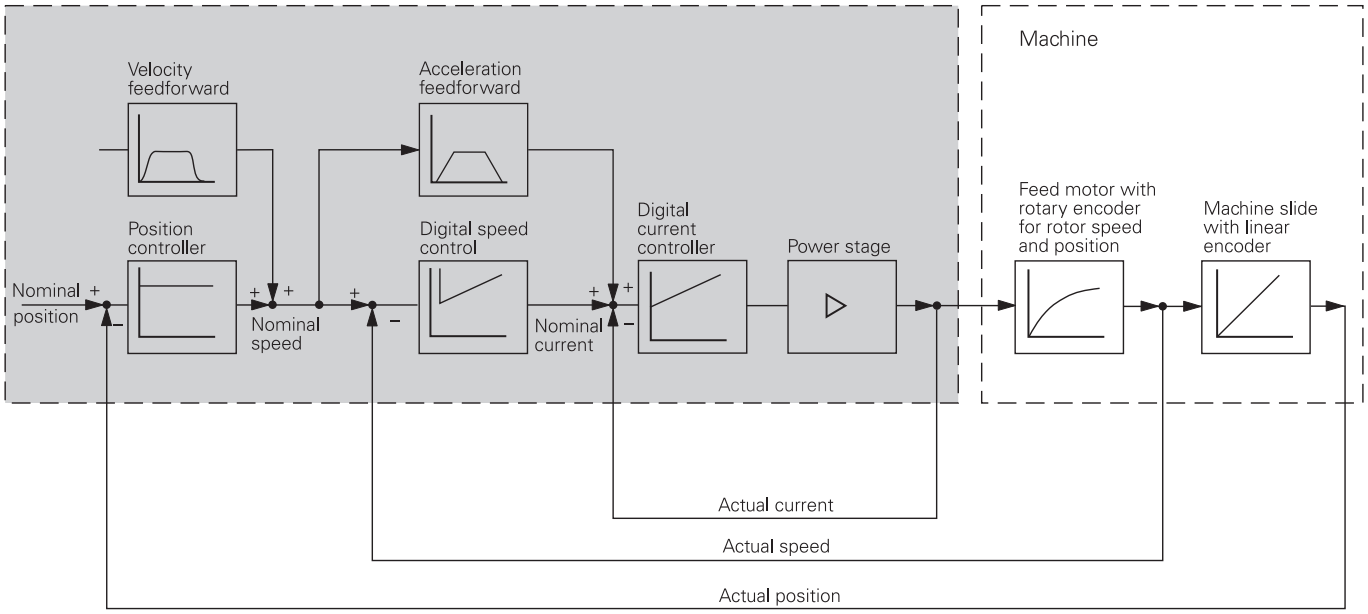
Inputs	**Signal level/ Interface[1)]**	**Input frequency[1)]**	
		Position	**Speed**
Incremental signals	~1 V_{PP} EnDat 2.1	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.1 EnDat 2.2	–	–

[1)] Switchable

Digital servo control

Integrated inverter

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



Axis feedback control

The TNC 620 can be operated with following error or feedforward control. During roughing operations at high speeds, for example, you can switch to velocity semi-feedforward control via an OEM cycle in order to machine faster at reduced accuracy.

Operation with following error

The term "following error" denotes the distance between the momentary nominal position and the actual position of the axis. The velocity is calculated as follows:

$v = k_v \cdot s_a$

v = Velocity
k_v = Position loop gain
s_a = Following error

Operation with feedforward control

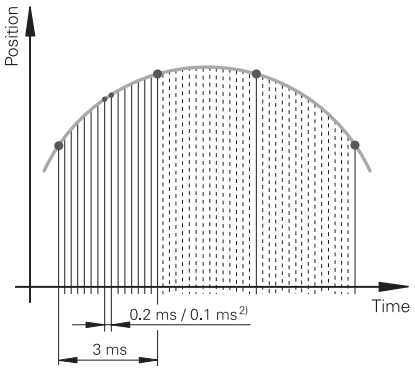
Feedforward means that a given velocity and acceleration are adapted to the machine. Together with the values calculated from the following error, this given velocity and acceleration becomes the nominal value. A much lower following error thereby manifests itself (in the range of only a few microns).

Compensation of torque ripples

The torque of synchronous, torque, and linear motors is subject to periodic oscillations, one cause of which can be permanent magnets. The amplitude of this torque ripple depends on the motor design, and under certain circumstances can have an effect on the workpiece surface. After the axes have been commissioned with the TNCopt software, the Torque Ripple Compensation (TRC) of the CC 61xx or UEC 11x can be used to compensate it.

Control loop cycle times

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



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

[1)] Double speed (with option 49)

Axis clamping

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

Double-speed control loops (option 49)

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

Crossover Position Filter (CPF)

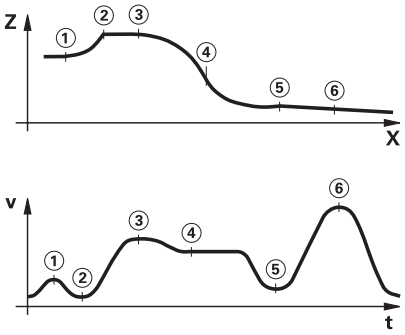
To increase the stability of the position control loop in systems with resonances, the position signal from the position encoder, which is filtered through a low-pass filter, is combined with the position signal from the motor speed encoder, which is filtered through a high-pass filter. This signal combination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

Fast contour milling

Short block processing time

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

The block processing time of the MC 8410 or MC 7410 is 1.5 ms. This means that the TNC 620 is able to run long programs from the hard disk, even with contours approximated with linear segments as small as 0.2 mm, at a feed rate of up to 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

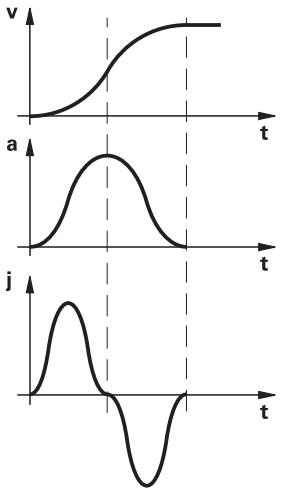
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

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 operator programs the permissible tolerance in a cycle. Special filters for HSC machining (HSC filters) can specifically suppress the natural frequencies of an individual machine. The desired accuracy and a very high surface quality are attained.

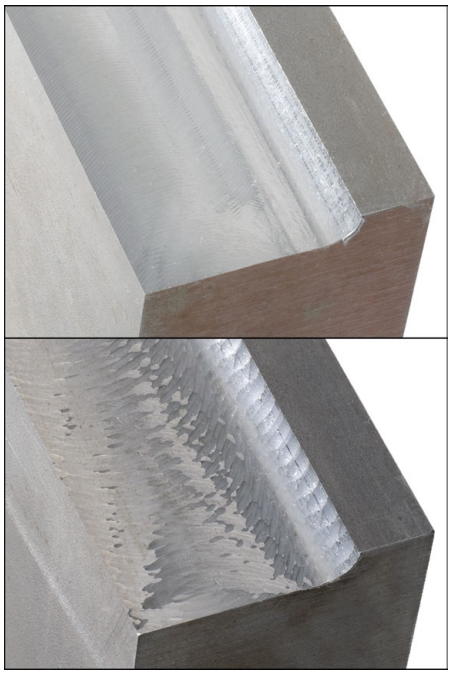


Advanced Dynamic Prediction (ADP)

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

Active Chatter Control (ACC) (option 145)

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



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

Dynamic Precision

Overview

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

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

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

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

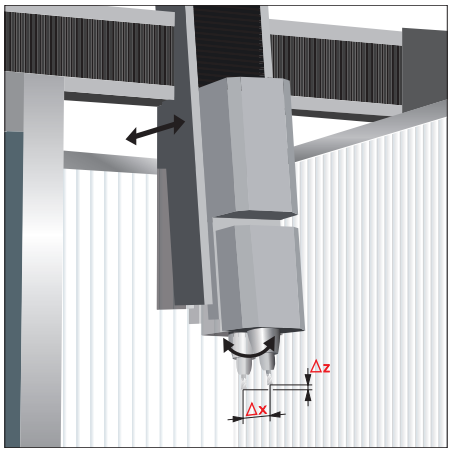
Cross Talk Compensation (CTC) (option 141)

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

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

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

If the dynamic position error as a function of the axis acceleration is known, this acceleration-dependent error can be compensated with the CTC option (Cross Talk Compensation) in order to prevent negative effects on the surface quality and accuracy of the workpiece. Often, the resulting error at the TCP depends not only on the acceleration but also on the position of the axes in the working space. This can also be compensated by CTC.



Active Vibration Damping (AVD) (option 146)

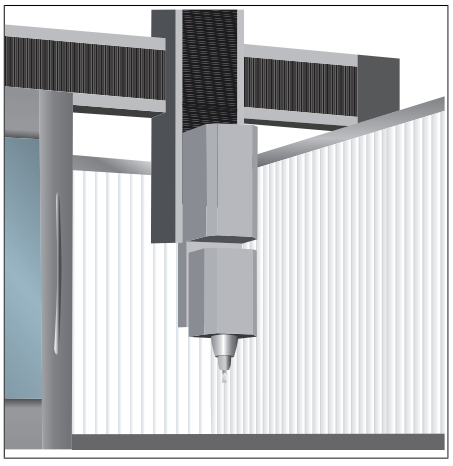
The high dynamics of modern machine tools lead to deformations in the machine base, frame, and drive train during acceleration and deceleration of the feed drives. This results in vibrations, such as machine setup vibrations, that may reduce the attainable accuracy and surface quality of the workpieces.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

Position Adaptive Control (PAC) (option 142)

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

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

To exploit the potential of the machine's dynamics, you can use the Position Adaptive Control (PAC) option to change machine parameters based on position. This makes it possible to assign the respective optimal loop gain to defined interpolation points. Additional position-dependent filter parameters can be defined in order to further increase control loop stability.



Load Adaptive Control (LAC) (option 143)

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

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

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

Motion Adaptive Control (MAC) (option 144)

In addition to the position-dependent adaptation of control parameters through the PAC option, the Motion Adaptive Control (MAC) option also provides a means of changing machine parameters based on other input quantities, such as speed, following error, or drive acceleration. Through this motion-dependent adaptation of the control parameters, a speed-dependent adaptation of the k_V factor can be implemented for drive systems whose stability changes due to the different traversing speeds.

Monitoring functions

Description

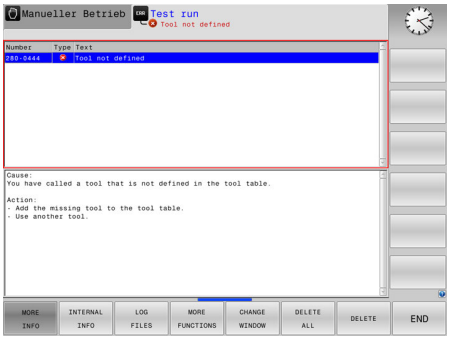
During operation the control monitors the following details*:
- Amplitude of the encoder signals
- Edge separation of the encoder signals
- Absolute position from encoders with distance-coded reference marks
- Current position (following error monitoring)
- Actual distance traversed (movement monitoring)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

With EnDat 2.2 encoders:
- The CRC checksum of the position value
- EnDat alarm Error1→ EnDat status alarm register (0xEE)
- EnDat alarm Error2
- Edge speed of 5 µs
- Transmission of the absolute position value on the time grid

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

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



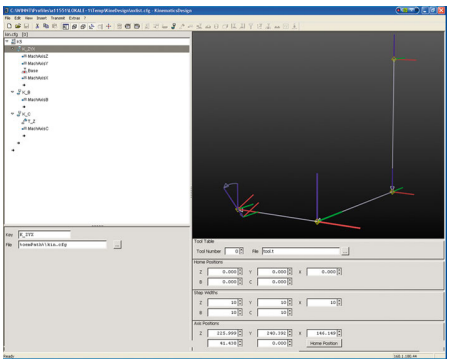
KinematicsDesign (accessory)

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

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

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

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



* No safety functions

Error compensation

Overview

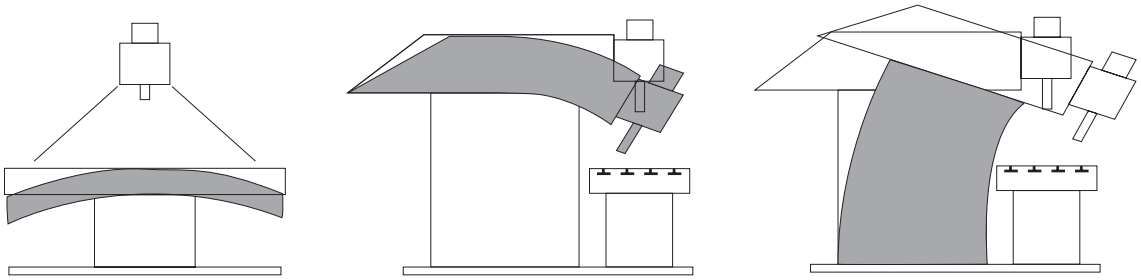
The TNC 620 automatically compensates mechanical errors of the machine.

Linear error

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

Nonlinear error

The TNC 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 in length measurements by spindle and rotary encoder. This backlash is outside the controlled system.

Hysteresis

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

Reversal spikes

In circular movements, reversal spikes can occur at quadrant transitions due to mechanical influences. The TNC 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

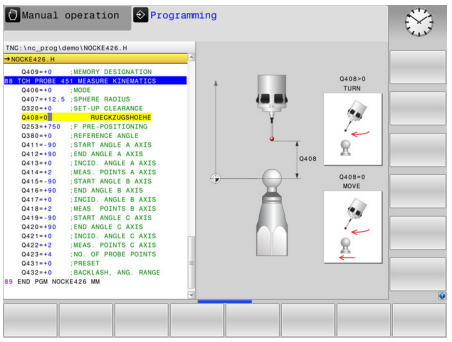
To compensate for thermal expansion, the machine's expansion behavior must be known.

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

KinematicsOpt (option 48)

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

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



Calibration sphere (accessory)

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

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

Commissioning 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

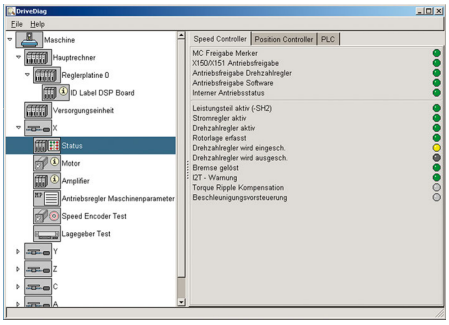
- Stand-alone machine-parameter editor for the control; all support information, additional data, and input limits are shown for the parameters
- Configuration of machine parameters
- Comparison of parameters from different controls
- Importing of service files: easy testing of machine parameters in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

DriveDiag

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

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

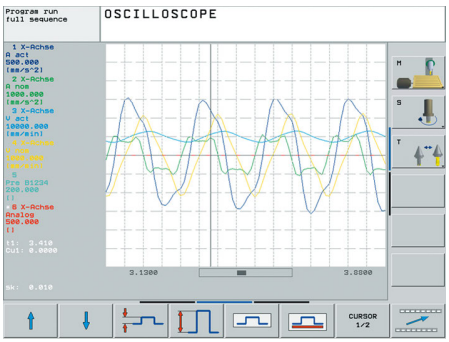
DriveDiag can be called immediately at the control through the diagnostics soft key. End users have read-access, whereas the code number for the machine tool builder gives access to comprehensive testing possibilities with DriveDiag.



Oscilloscope

The TNC 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:

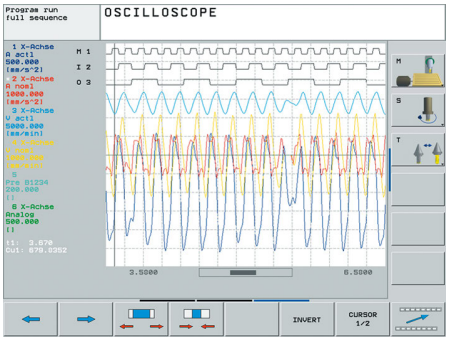
- Actual value and nominal value of the axis feed rate
- Contouring feed rate
- Nominal and actual position
- Following error of the position controller
- Nominal and actual values for speed, acceleration, and jerk
- Content of PLC operands
- Encoder signal (0°–A) and (90°–B)
- Difference between position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



Logic signals

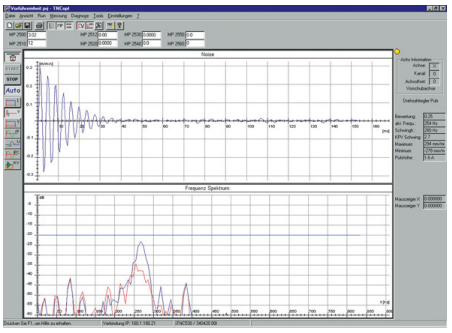
Simultaneous graphic representation of the logic states of up to 16 operands (markers, words, inputs, outputs, counters, timers)

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



TNCopt (accessory)

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



Online Monitor (OLM)

The online monitor is a component of the TNC 620 and is called over a code number. It supports commissioning and diagnosis of control components through the following:
- Display of control-internal variables for axes and channels
- Display of controller-internal variables (if a CC is present)
- Display of hardware signal states
- Various trace functions
- Activation of spindle commands
- Enabling of control-internal debug outputs

TNCscope (accessory)

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

API DATA

The API DATA function enables the control to display the states or contents of the symbolic API markers and API double words. This function requires that your PLC program use the symbolic memory interface.
Note: The API DATA function does not provide usable display values with the iTNC 530-compatible memory interface (API 1.0)

Table function

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

Trace function

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

Log

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

TeleService (accessory)

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

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

Bus diagnosis

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

TNCtest

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

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

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

TNCanalyzer

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

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

Integrated PLC

Overview

The PLC program is created by the machine manufacturer either at the control (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 inputs and outputs are available via the external PL 6000 PLC input/output systems or the UEC 11x. The PLC inputs/outputs and the PROFINET IO or PROFIBUS DP-capable I/O system must be configured with the IOconfig PC software.

PLC programming

Format	Statement list
Memory	350 MB
Cycle time	9 ms to 30 ms (adjustable)
Command set	• Bit, byte, and word commands • Logical operations • Arithmetic commands • Comparisons • Bracketed terms • Jump commands • Subprograms • Stack operations • Submit programs • Timers • Counters • Comments • PLC modules • Strings

Encryption of PLC data

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

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

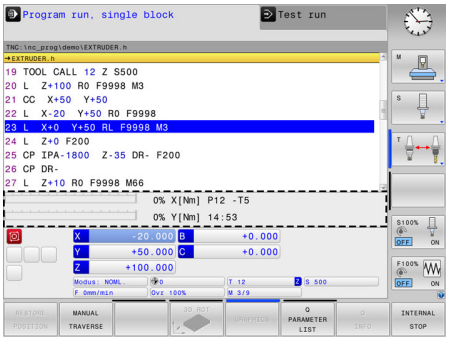
The machine tool builder can also determine the size of the encrypted partition. This is not determined until the machine tool builder creates the PLCE partition. Another advantage is that, in spite of the encryption, the data can backed up from the control to a separate data medium (USB drive, network,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

PLC window

The TNC 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.



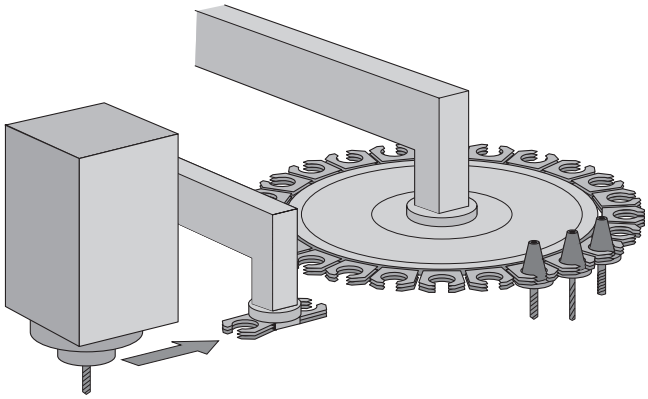
Small PLC window

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 with the product.

Functions:

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

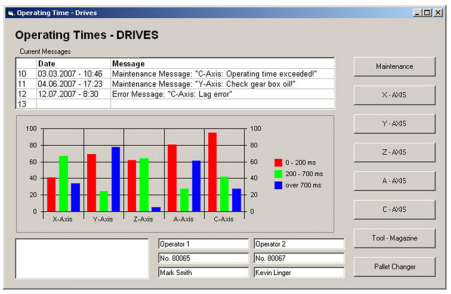
Python OEM Process (option 46)

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

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

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

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



PLC basic program

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

These essential functions are covered by the PLC basic program:

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

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

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

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

Safety functions
- Emergency stop test (EN 13849-1)
- Brake test (EN 13849-1)
- Repeated switch-on test for new generation of handwheel

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

Interfacing to the machine

OEM cycles (option 19)

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

CycleDesign (accessory)

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

Tool management

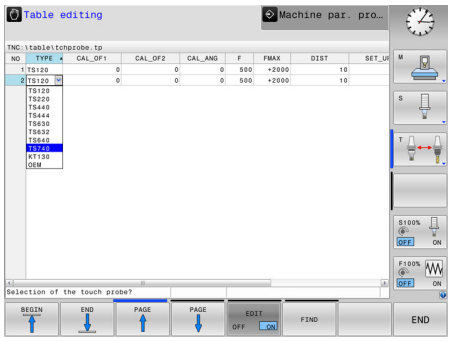
With integral PLC, the tool changer is moved either via proximity switch or as a controlled axis. Tool management including tool life monitoring and replacement tool monitoring is carried out by the TNC 620.

Tool calibration (option 17)

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

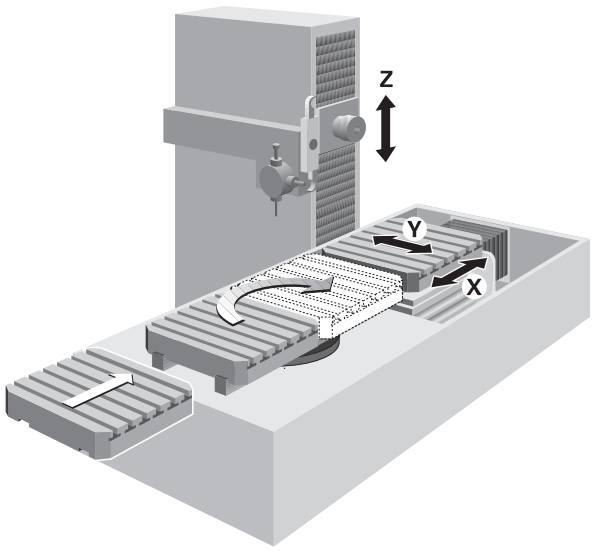
Touch-probe configuration (option 17)

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 (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	The TNC 620 can be interconnected via the Ethernet interface. For connection to the data network, the control features a 1000BASE-T (twisted pair Ethernet) connection. Maximum transmission distance: Unshielded: 100 m Shielded: 400 m
Protocol	The TNC 620 communicates using the TCP/IP protocol.
Network connection	• NFS file server • Windows networks (SMB)
Data transmission speed	Approx. 400 to 800 Mbps (depending on file type and network utilization)
RS-232-C/V.24	Data interface according to DIN 66 020 or EIA standard RS-232-C. Maximum transmission distance: 20 m
Data transmission speed	115 200; 57 600; 38 400; 19 200; 9600; 4800; 2400; 1200; 600; 300; 150; 110 bps
Protocols	The TNC 620 can transfer data using various protocols.
Standard data transmission	The data is transferred character by character. The number of data bits, stop bits, the handshake, and character parity must be set by the user.
Blockwise data transfer	The data is transferred blockwise. A block check character (BCC) is used for data backup. This method improves data security.
LSV2	Bidirectional transfer of commands and data as per DIN 66 019. The data is divided into telegrams (blocks) and transmitted.
USB	The TNC 620 features USB ports for the connection of standard USB devices, such as a mouse, drives, etc. On the back panel of the MC 8xxx and MC 6xxx there are four USB 3.0 ports. One of them leads to the TE, where a cover cap protects it from contamination. More USB 2.0 ports are in the integrated USB hub on the rear of the BF. The USB ports are rated for a maximum of 0.5 A.
USB cables	Cable length of up 5 m ID 354770-xx Cable length of 6 m to 30 m with integrated amplifier; limited to USB 1.1. ID 624775-xx

USB hub

If you need further USB ports or if the supply current is not sufficient, a USB hub is required. The USB hub from HEIDENHAIN offers four free USB 2.0 ports.

USB hub ID 582884-xx
Power supply: DC 24 V/max. 300 mA

Cover

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

Cover ID 508921-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 helps the user to transfer data from the PC to the control. The software transfers data blockwise with block check characters (BCC).

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

TNCremoPlus (accessory)

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

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

TNCremoPlus ID 340447-xx

Connected Machining

Overview

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

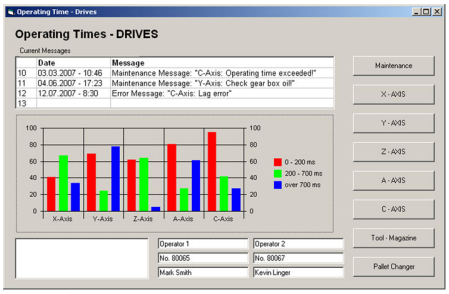
- Easy data usage
- Time-saving procedures
- Transparent processes

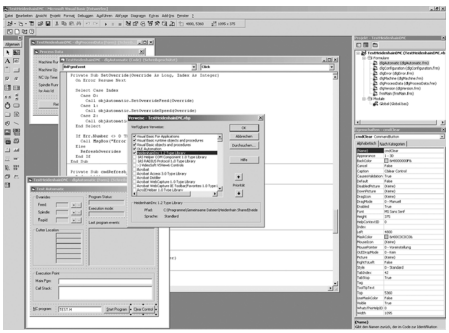
Remote Desktop Manager (option 133)

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

Remote Desktop Manager	ID 894423-xx

HEIDENHAIN DNC (option 18)





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

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

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

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

RemoTools SDK (accessory)

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

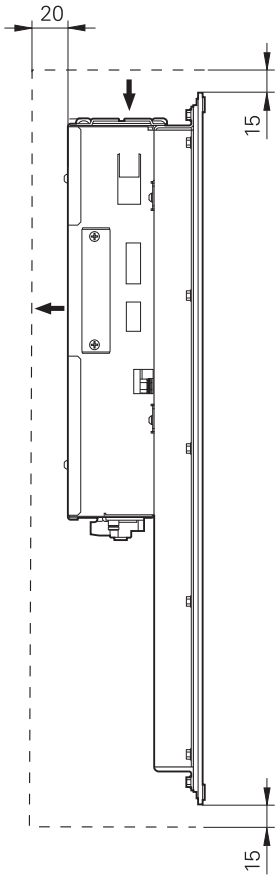
RemoTools SDK	ID 340442-xx

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

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.



Leave space for air circulation and servicing

Mounting and electrical installation

Observe the following points during mounting and electrical connection:

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

Degrees of protection

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

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

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

Electromagnetic compatibility

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

Intended place of operation

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

Likely sources of interference

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

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

Protective measures

- Ensure that the MC, CC, and signal lines are at least 20 cm away from interfering devices
- Ensure that the MC, CC, and signal lines are at least 10 cm away from cables carrying interfering signals
- Shielding according to EN 50178
- Use equipotential bonding lines according to the grounding plan. Please refer to the Technical Manual of your control
- Use only genuine HEIDENHAIN cables and connecting elements

Installation elevation

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

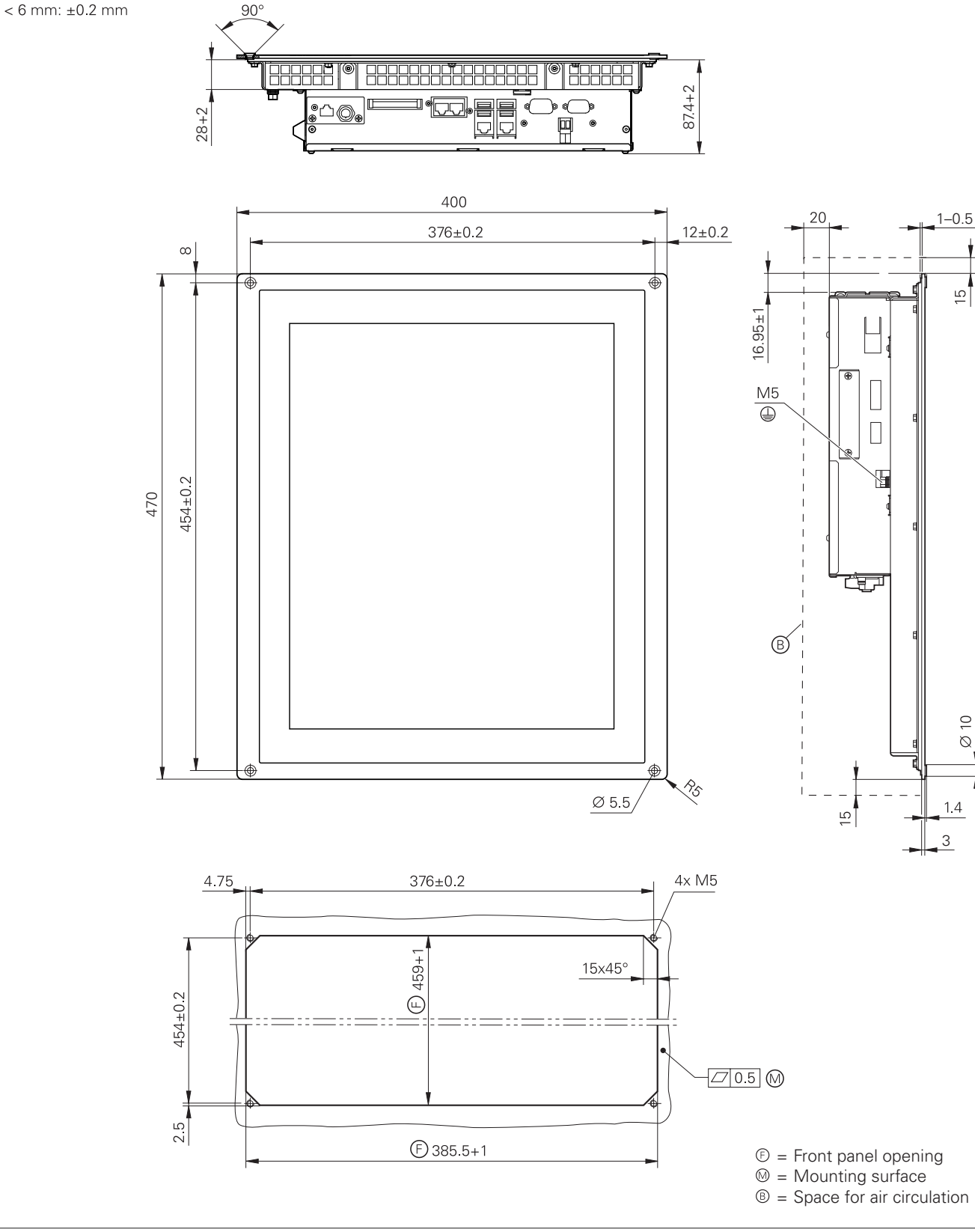
Overall dimensions

Main computer

MC 8410

mm

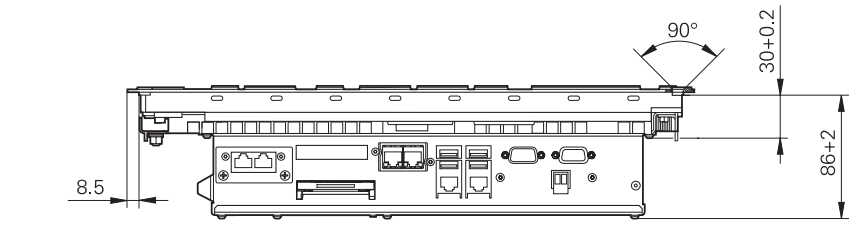
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

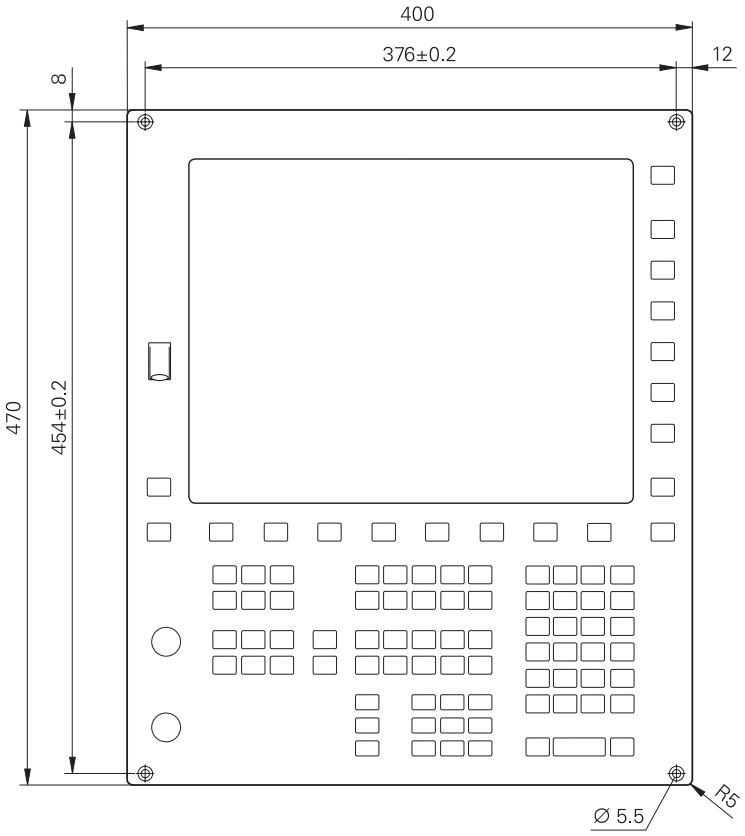


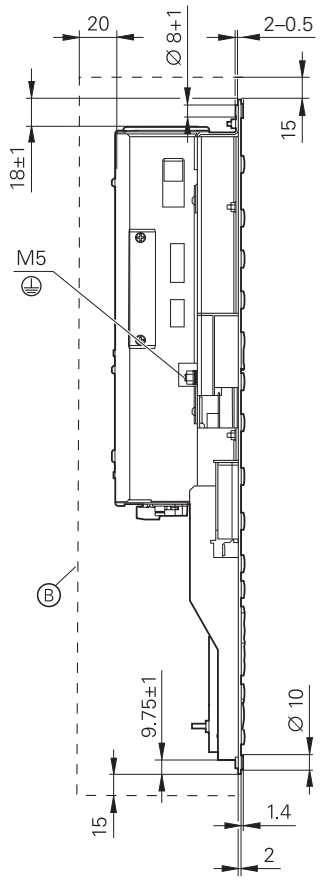
MC 7410

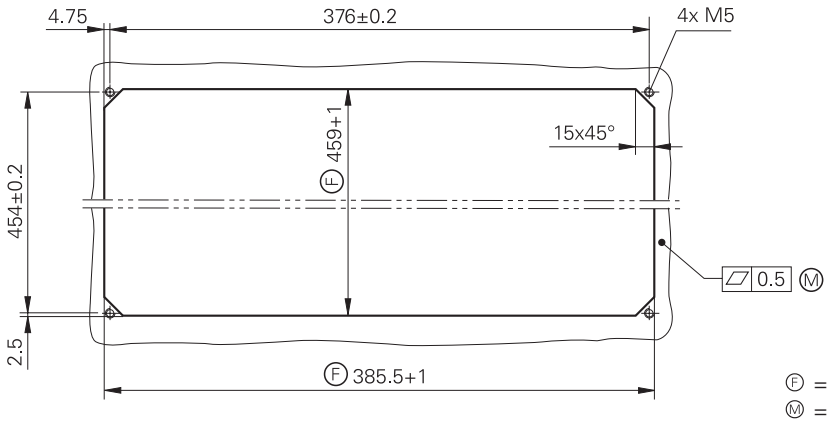
mm

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



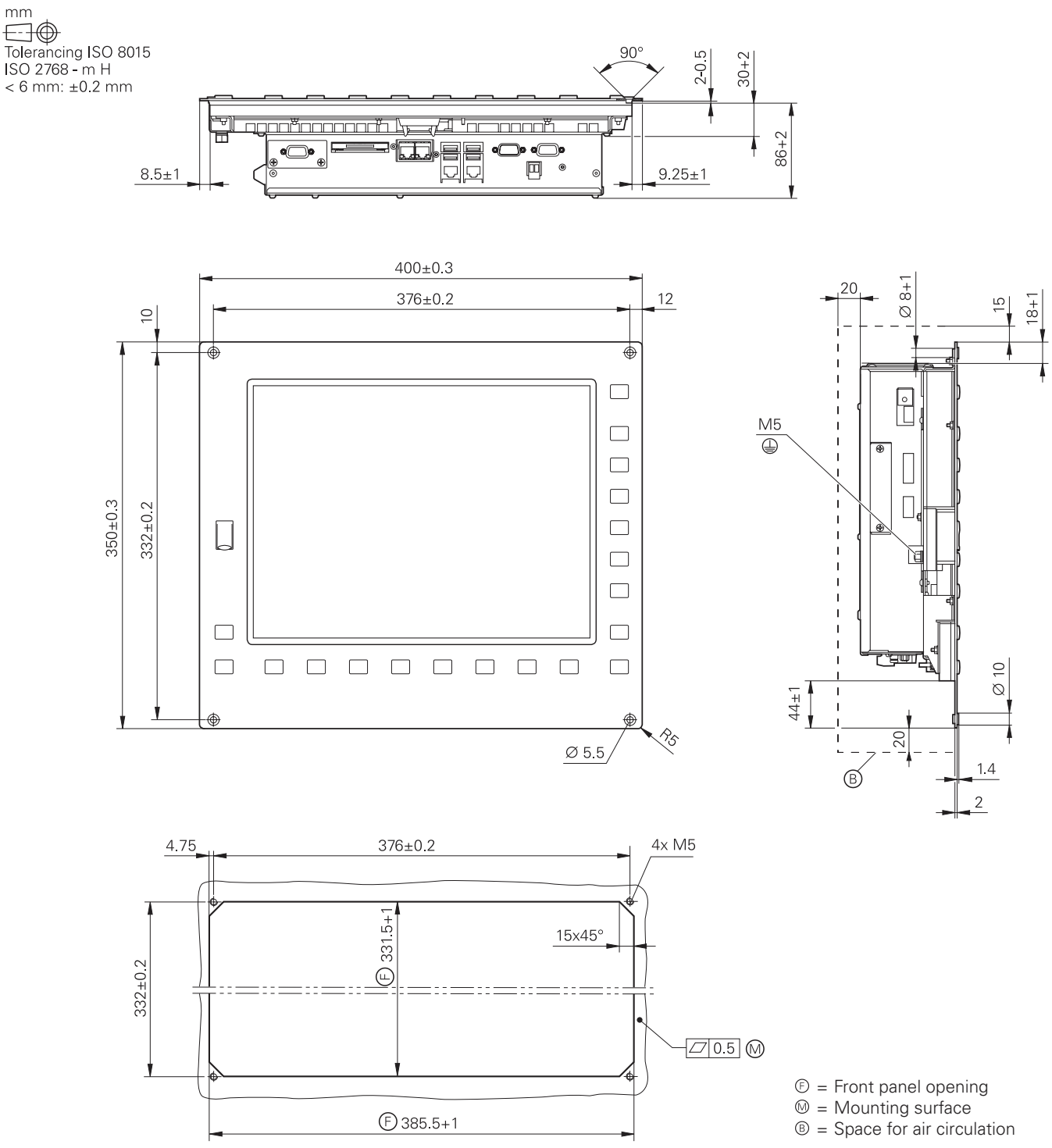






Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

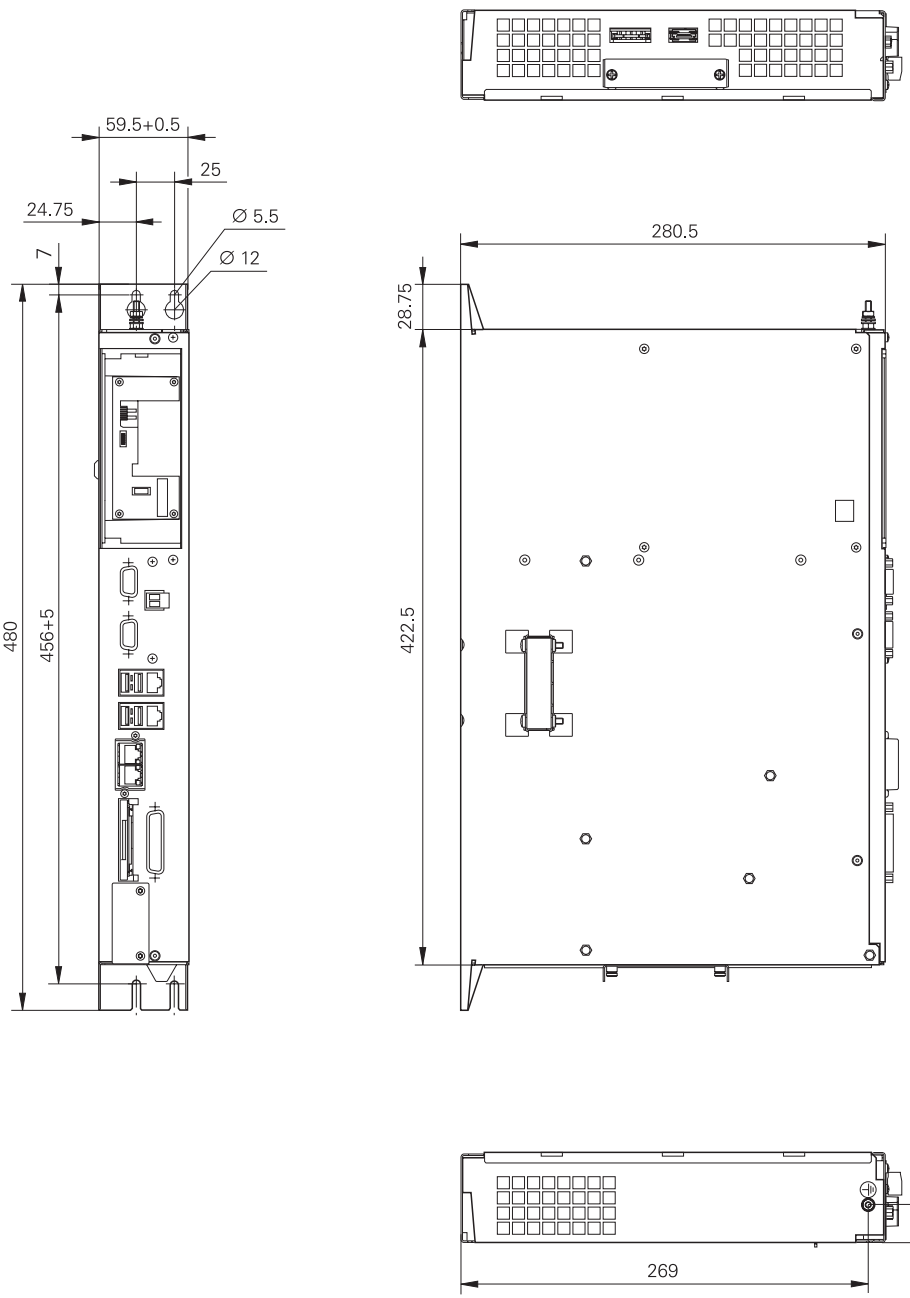
MC 7420


mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm
90°
2-0.5
30+2
86+2
8.5±1
9.25±1
400±0.3
376±0.2
12
10
350±0.3
332±0.2
Ø 5.5
R5
20
Ø 8+1
15
18+1
M5
44±1
Ø 10
20
1.4
2
B
4.75
376±0.2
4x M5
332±0.2
F 331.5+1
15x45°
0.5
M
F 385.5+1
F = Front panel opening
M = Mounting surface
B = Space for air circulation

IPC 6641

mm

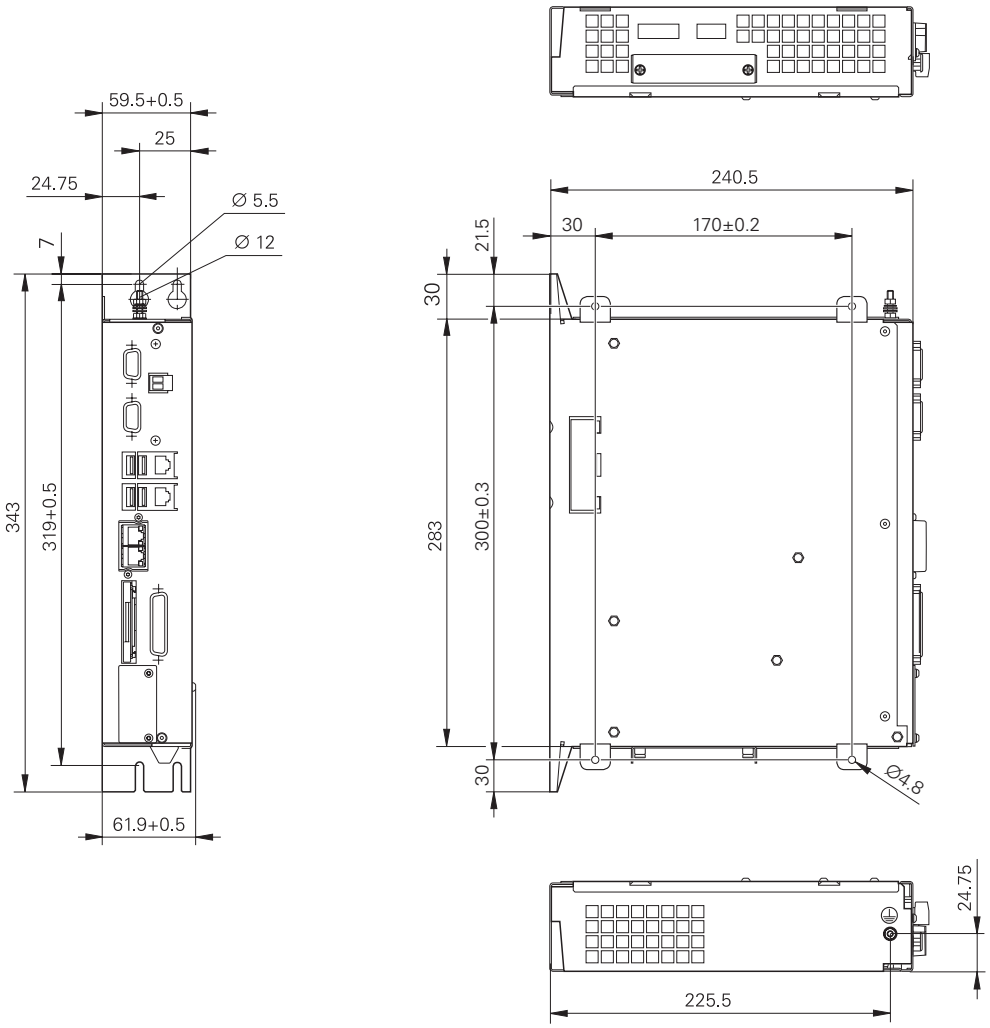
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



IPC 6490

mm

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

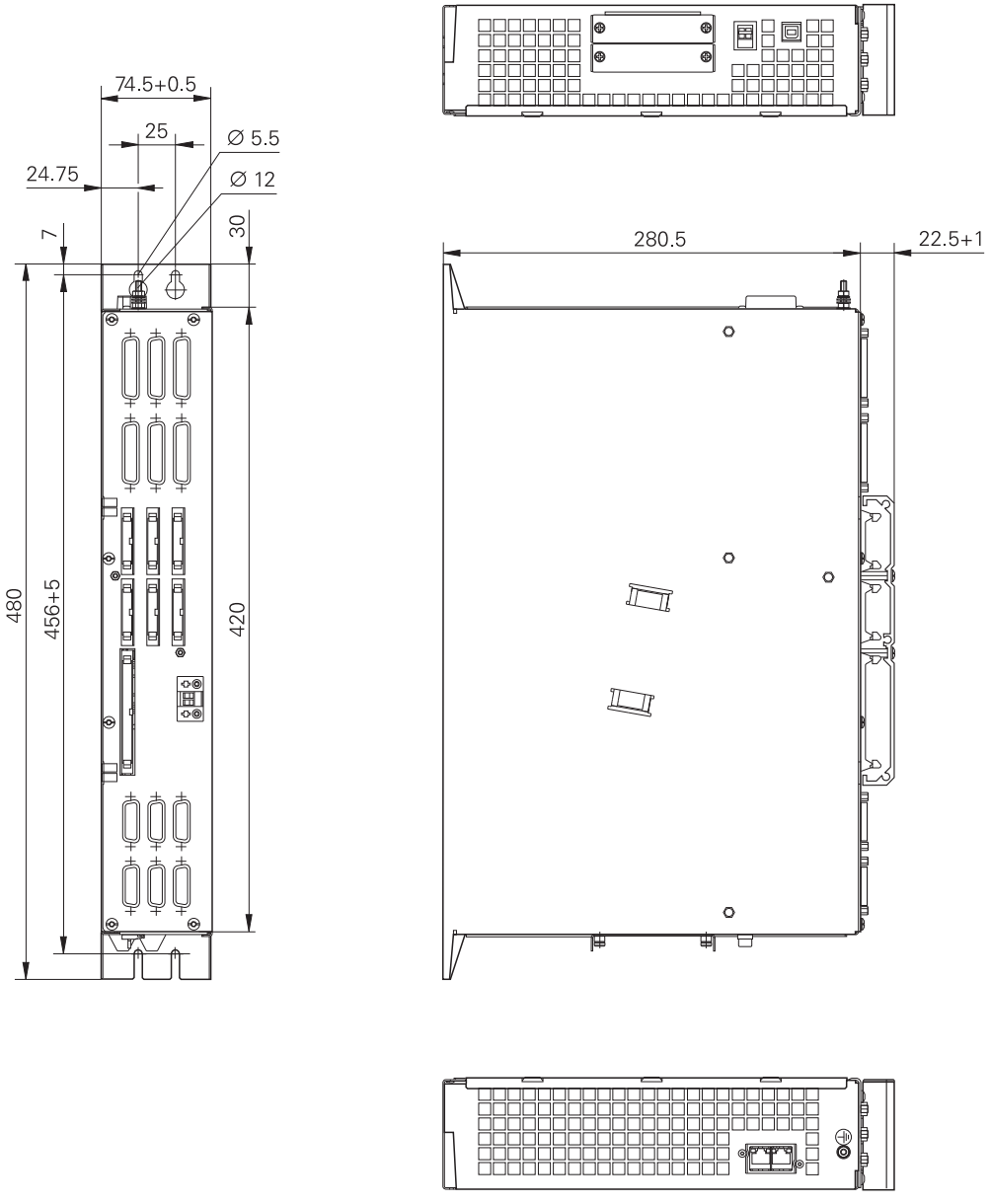


Controller unit

CC 6106

mm

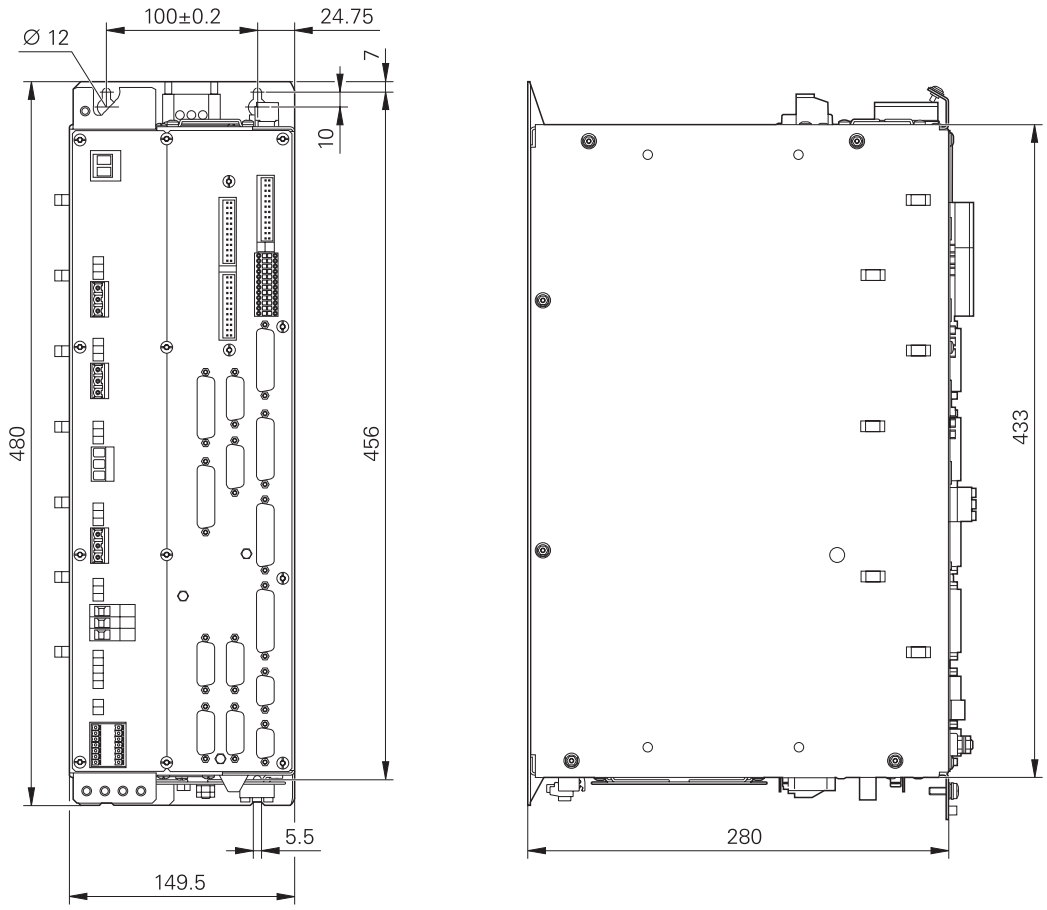
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



UEC 111, UEC 112, UEC 113

mm

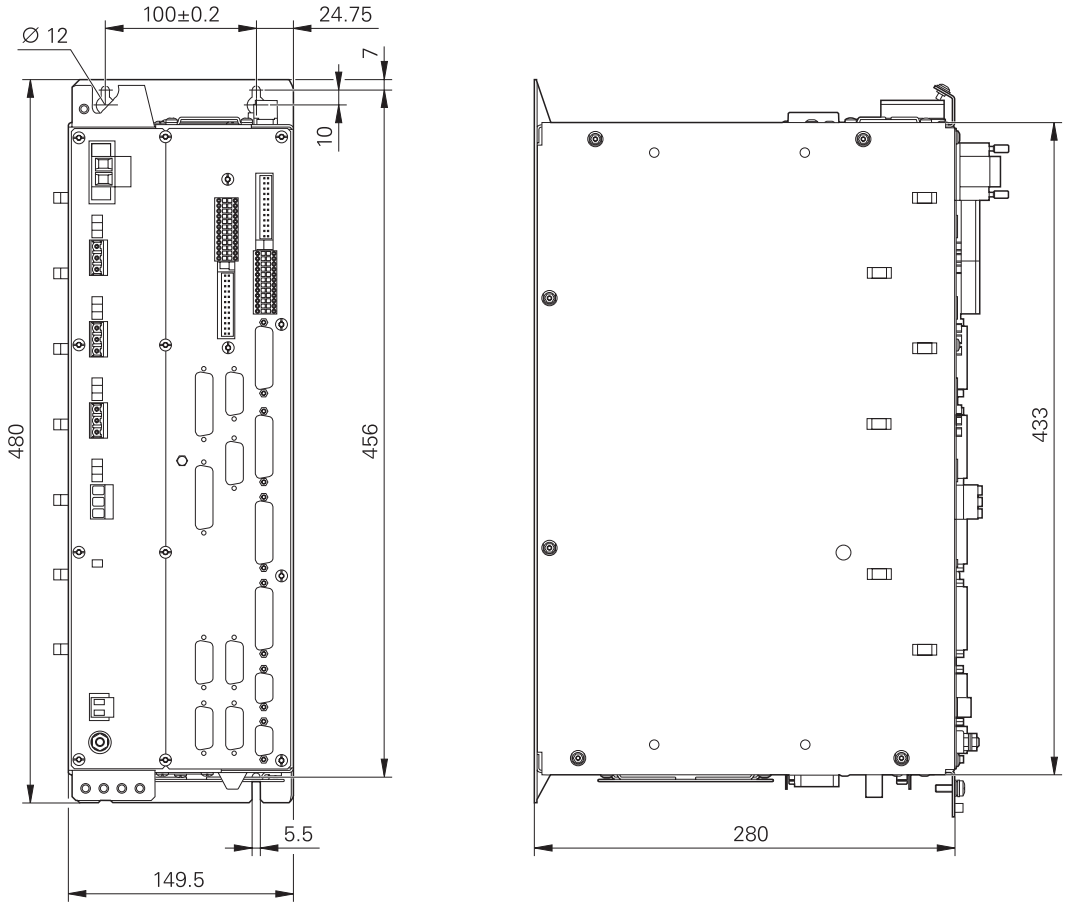
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



UMC 111 FS

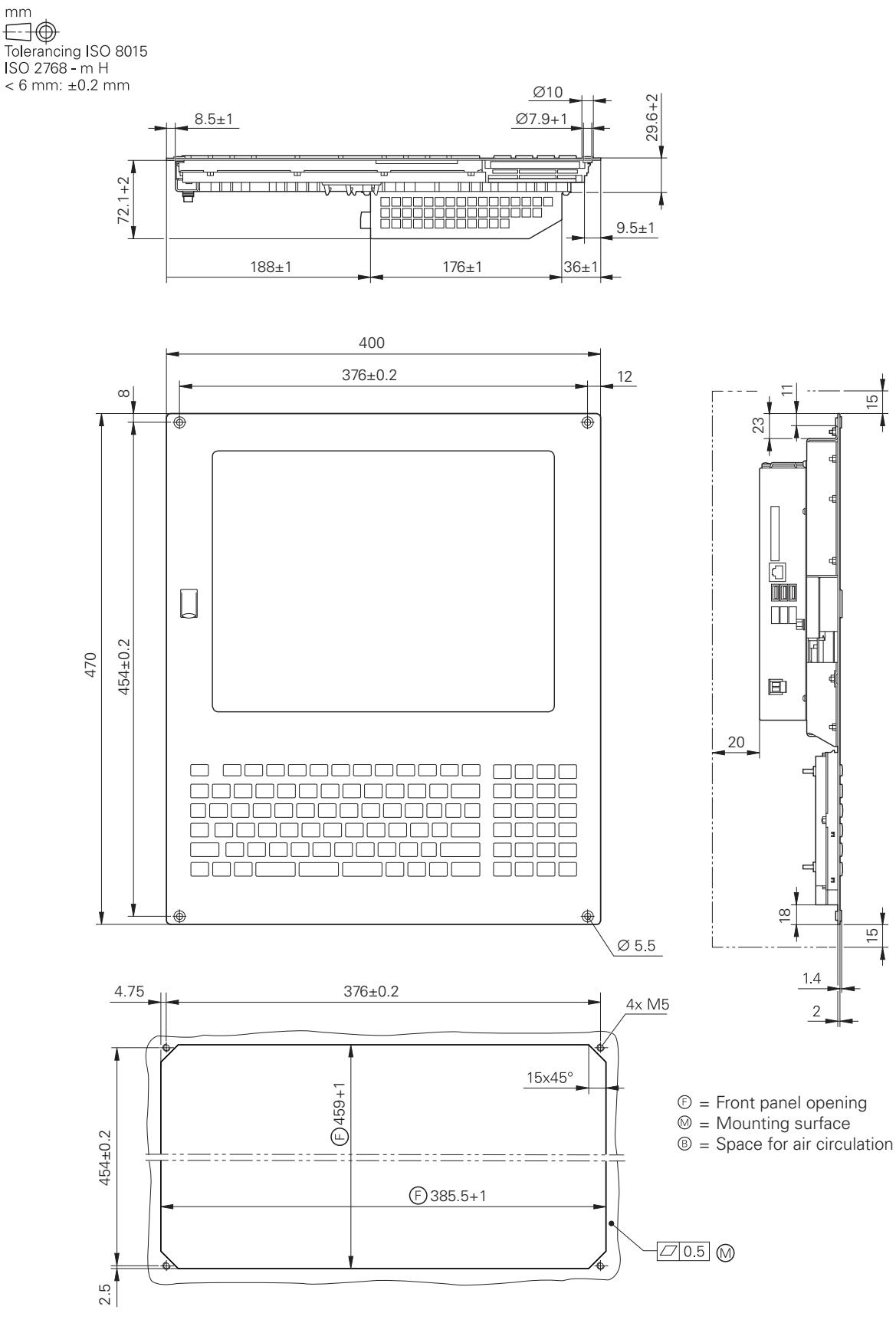
mm

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



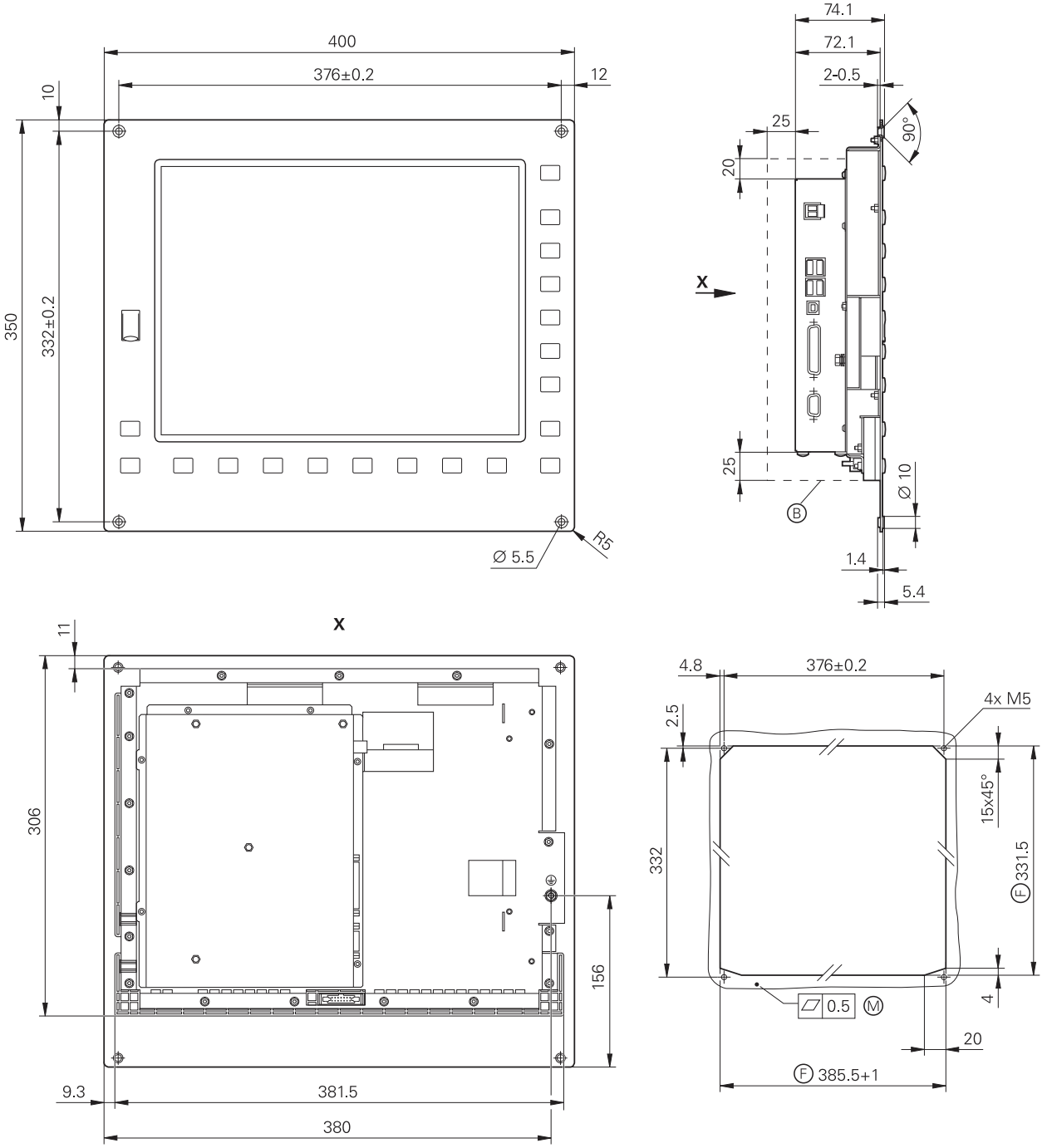
Operating panel, screen, and keyboard

ITC 755



ITC 750

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



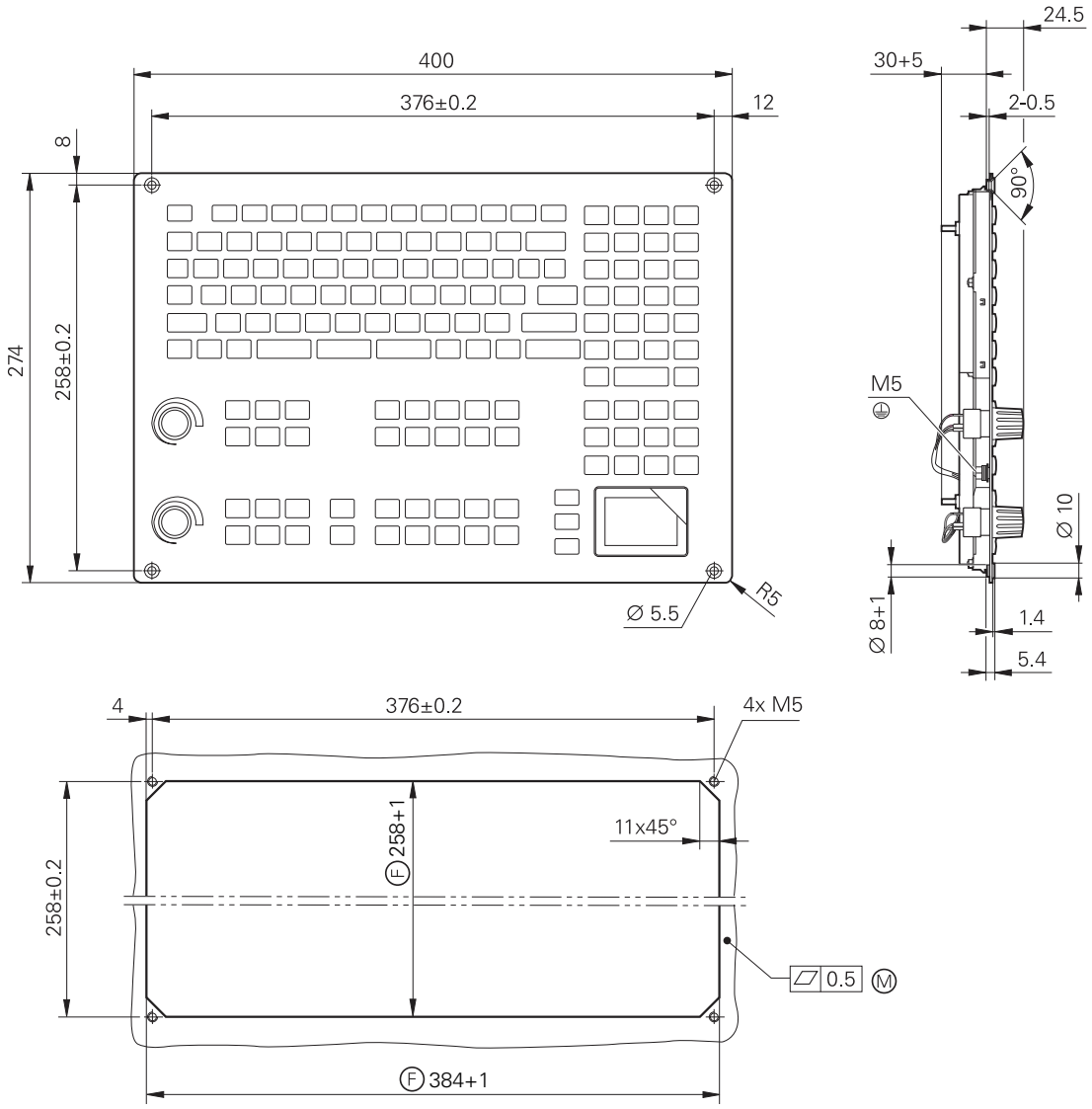
Ⓕ = Front panel opening
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

TE 720, TE 730

mm

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

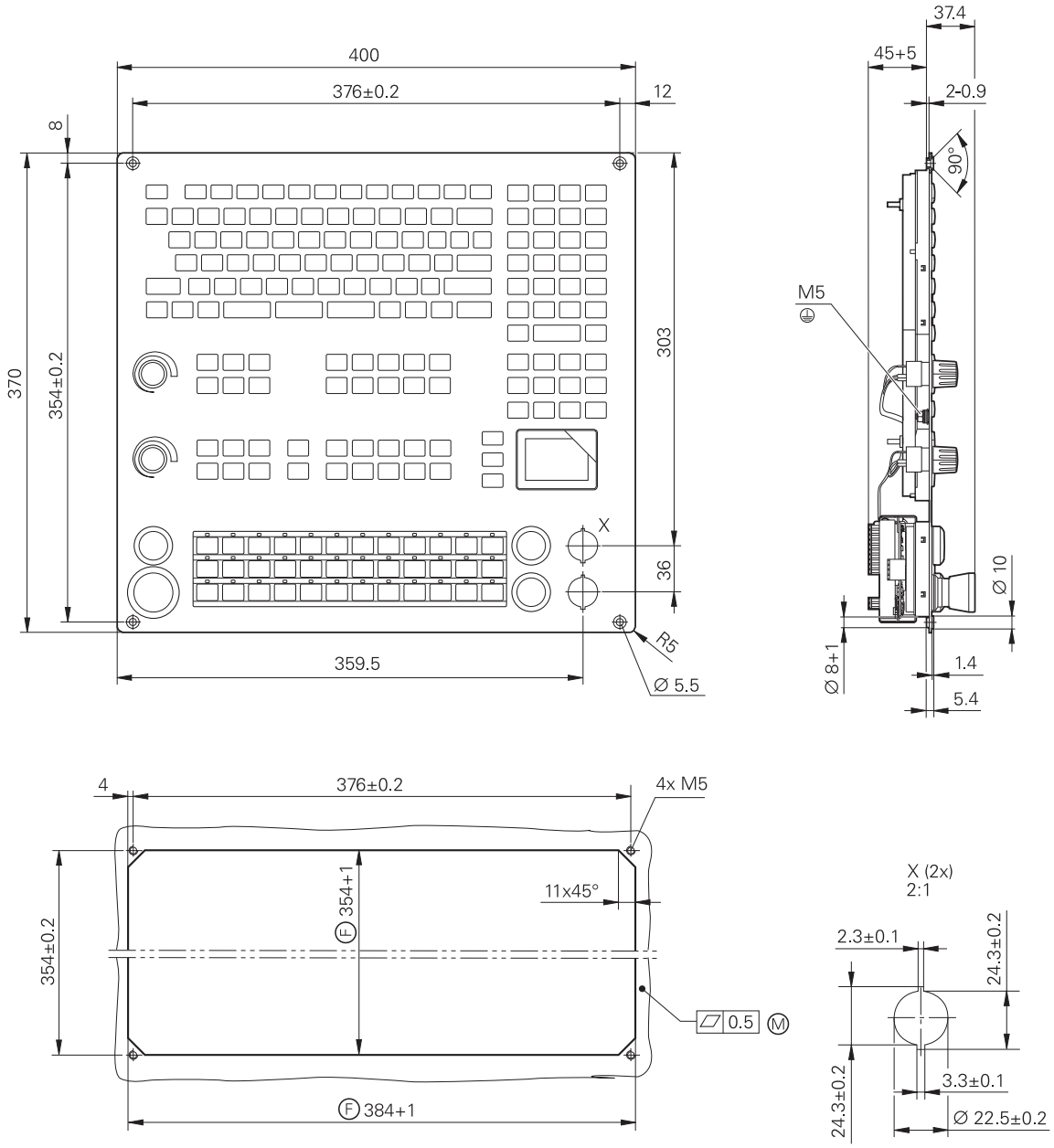
TE 720 B: Without touchpad
TE 730 B: With touchpad



Ⓕ = Front panel opening
Ⓜ = Mounting surface

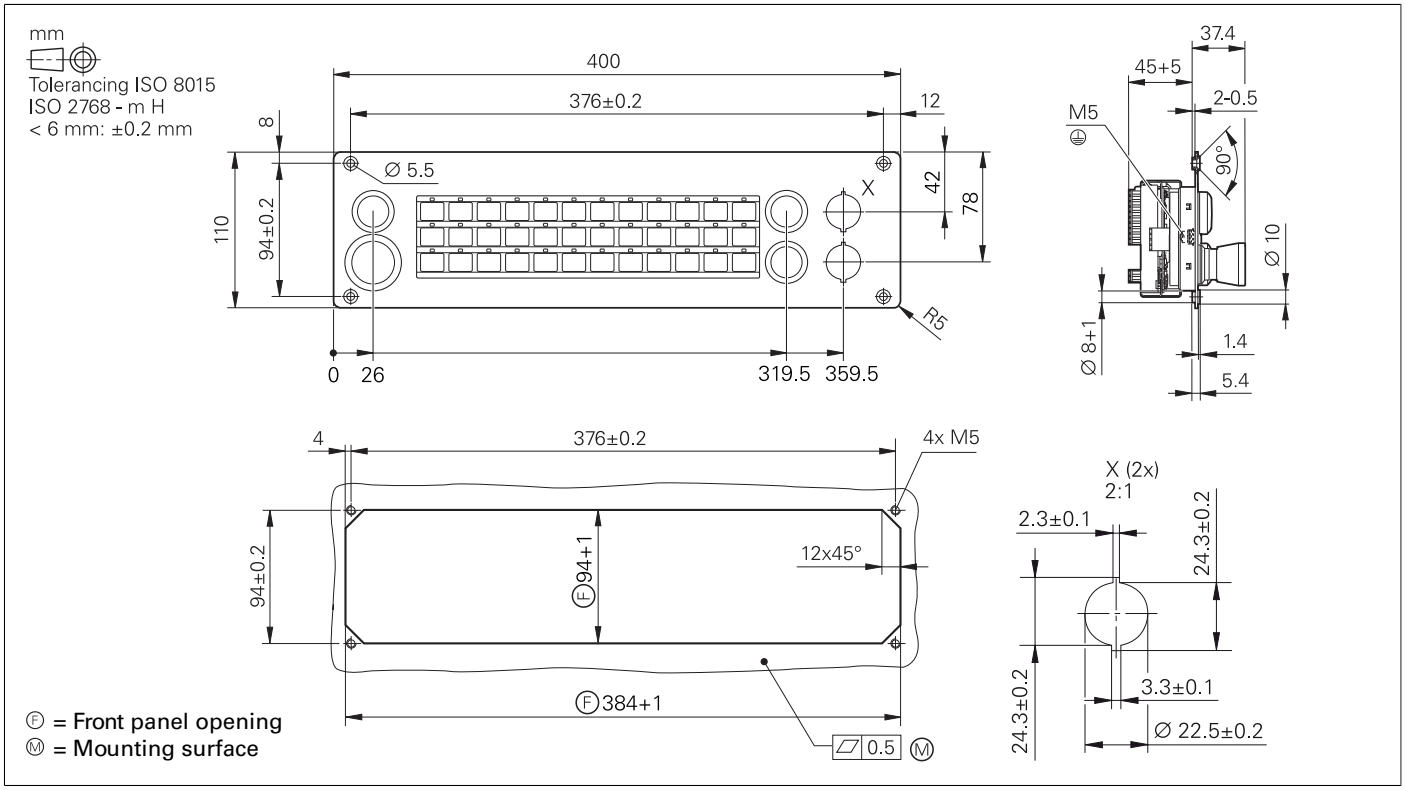
TE 735

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



Ⓕ = Front panel opening
Ⓜ = Mounting surface

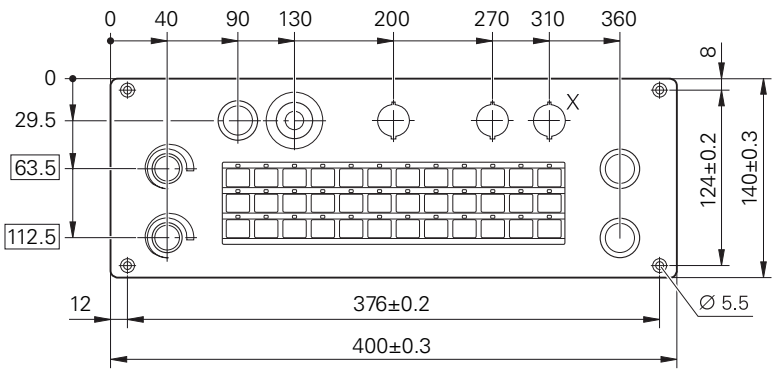
MB 720

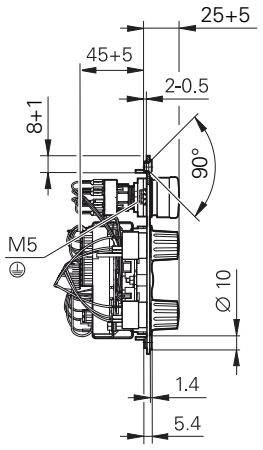

mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm
400
376±0.2
12
8
Ø 5.5
X
42
78
110
94±0.2
R5
0
26
319.5
359.5
37.4
45+5
2-0.5
M5
90°
Ø 10
Ø 8+1
1.4
5.4
4
376±0.2
4x M5
94±0.2
Ⓕ94+1
12x45°
Ⓕ384+1
0.5
Ⓜ
X (2x)
2:1
2.3±0.1
24.3±0.2
3.3±0.1
Ø 22.5±0.2
Ⓕ = Front panel opening
Ⓜ = Mounting surface

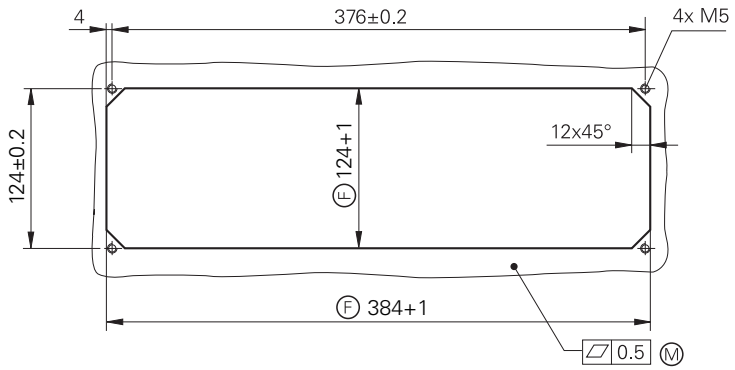
MB 721

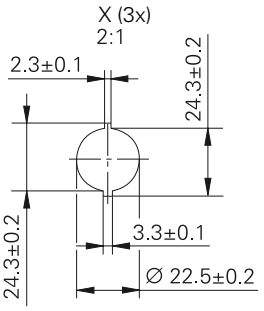
mm

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



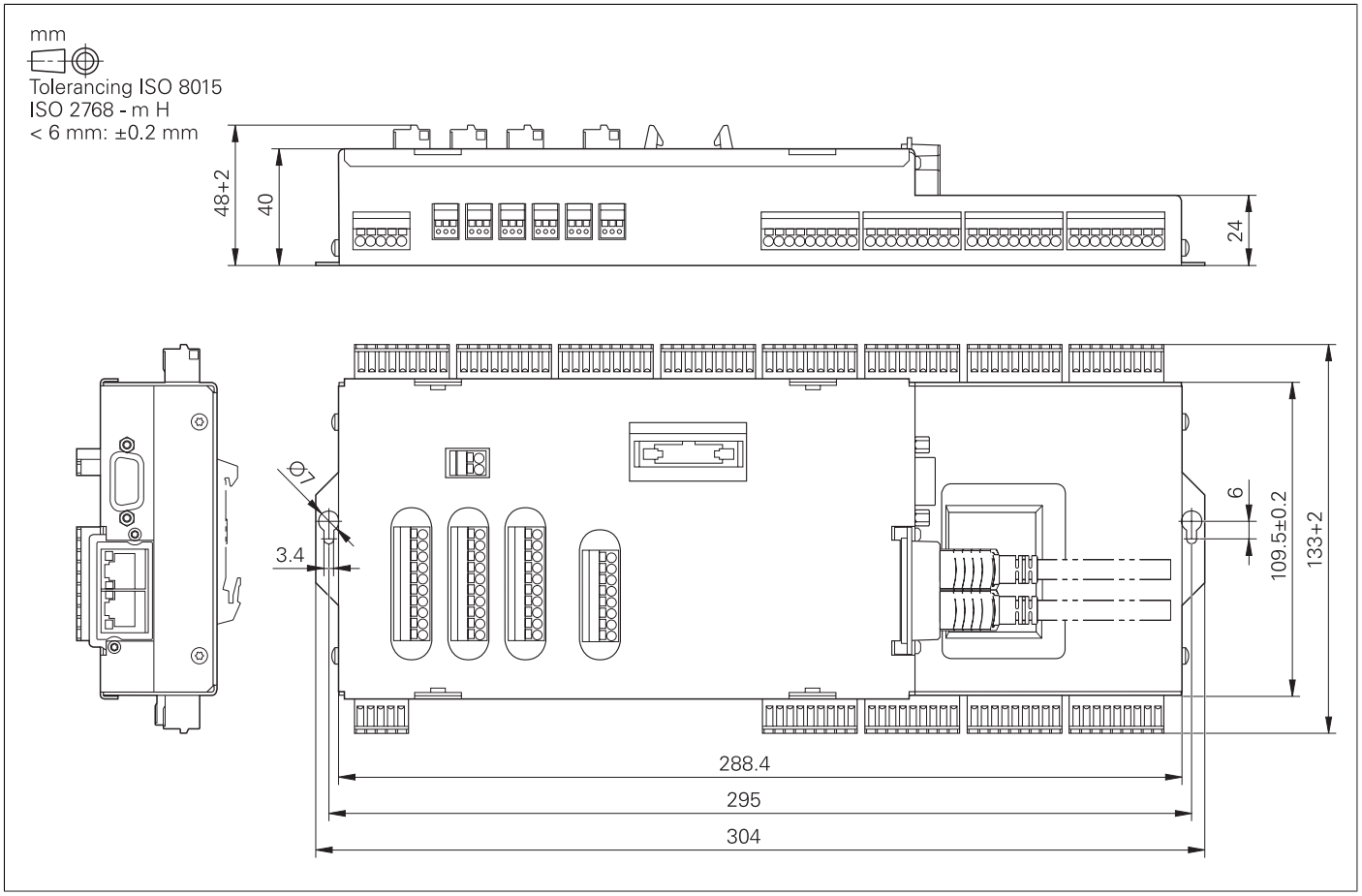






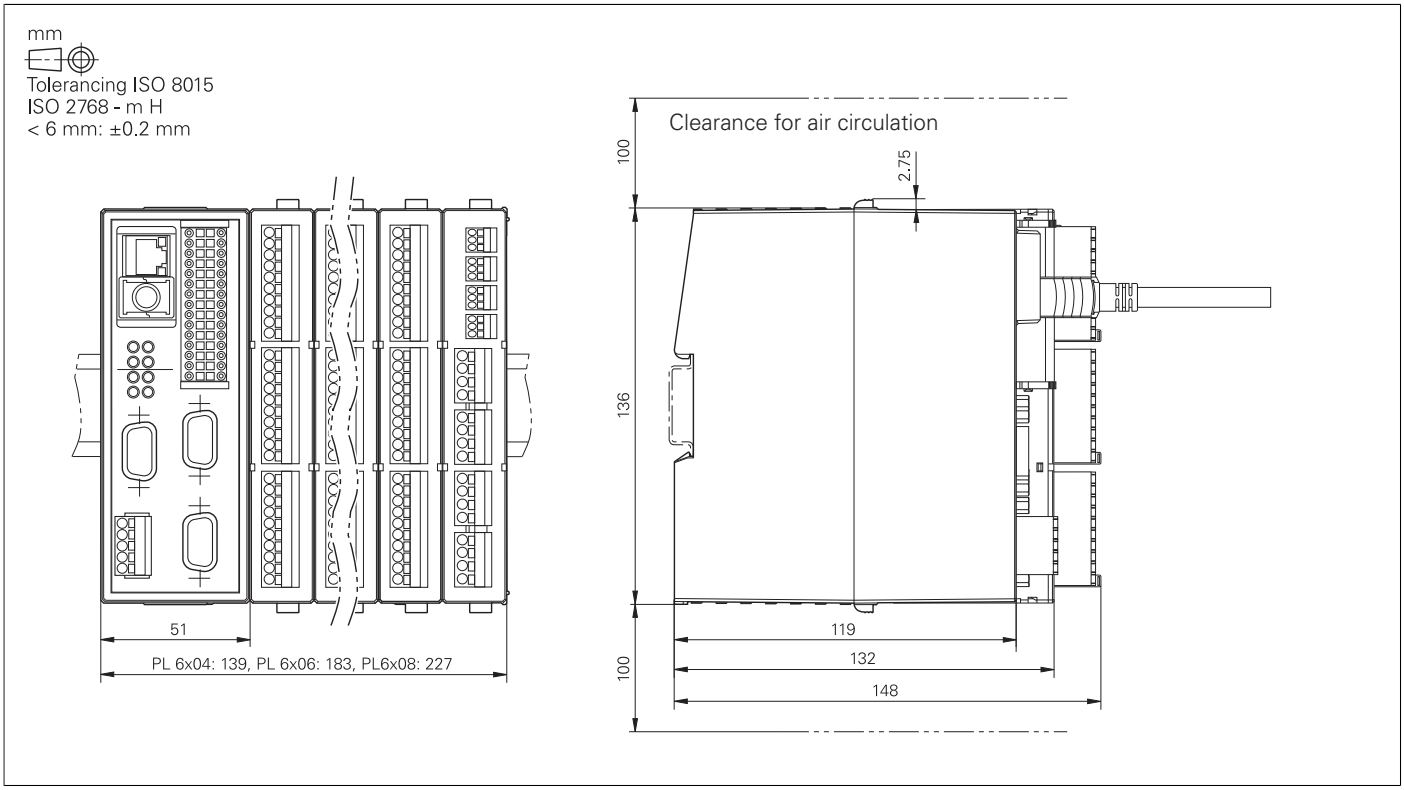
Ⓕ = Front panel opening
Ⓜ = Mounting surface

PLB 600x


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

PLC inputs and outputs

PL 6000 (PLB 62xx, PLB 61xx)

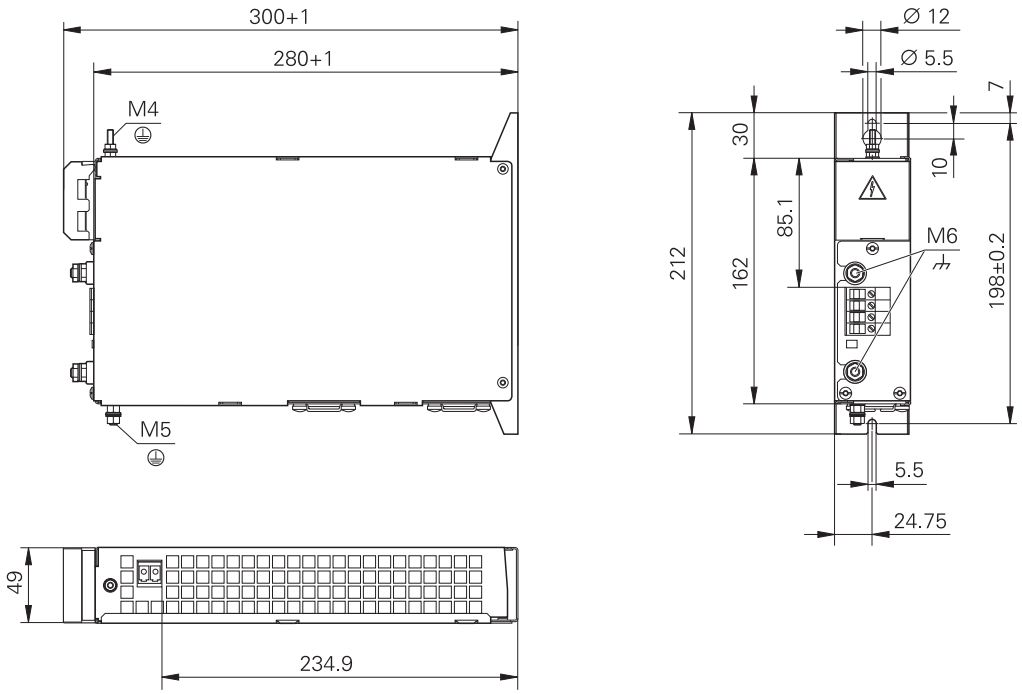


Power supply units

PSL 130

mm

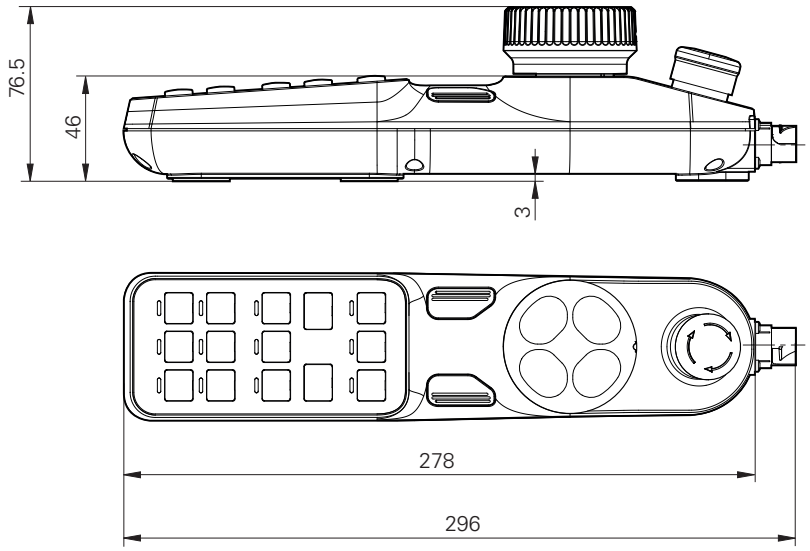
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



Electronic handwheels

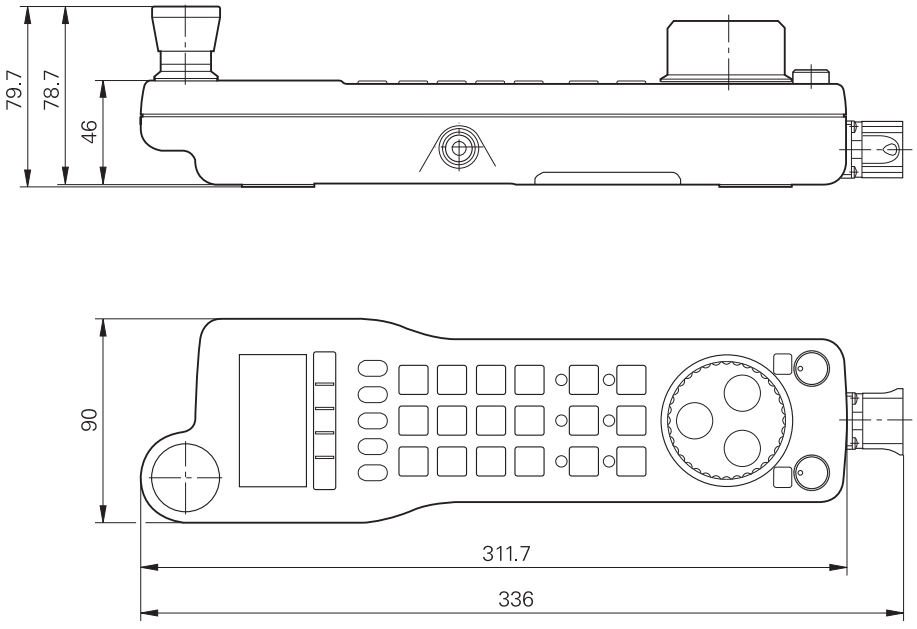
HR 510, HR 510 FS

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



HR 520, HR 520 FS

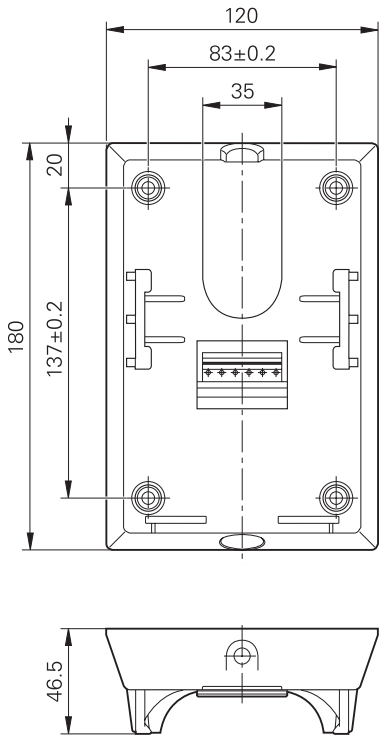
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



Holder for HR 520, HR 520 FS

mm

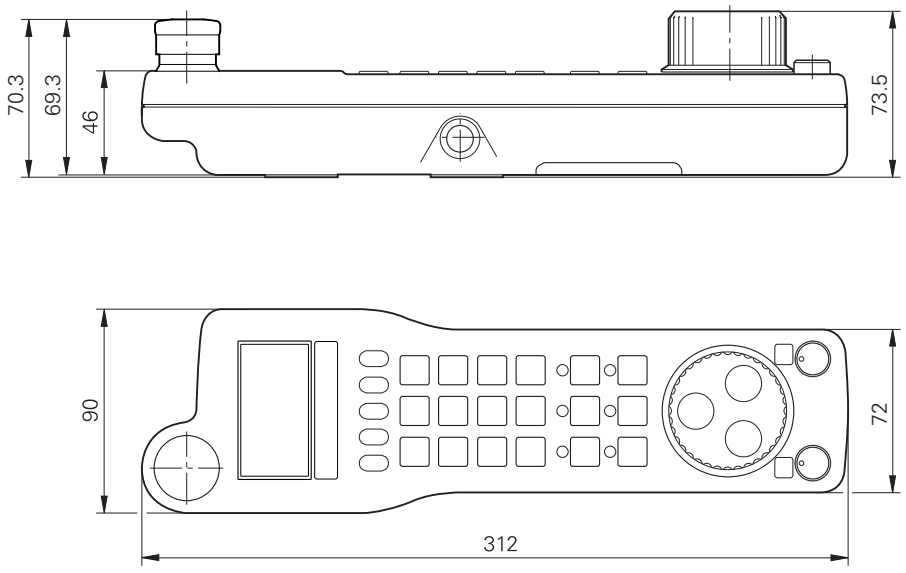
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



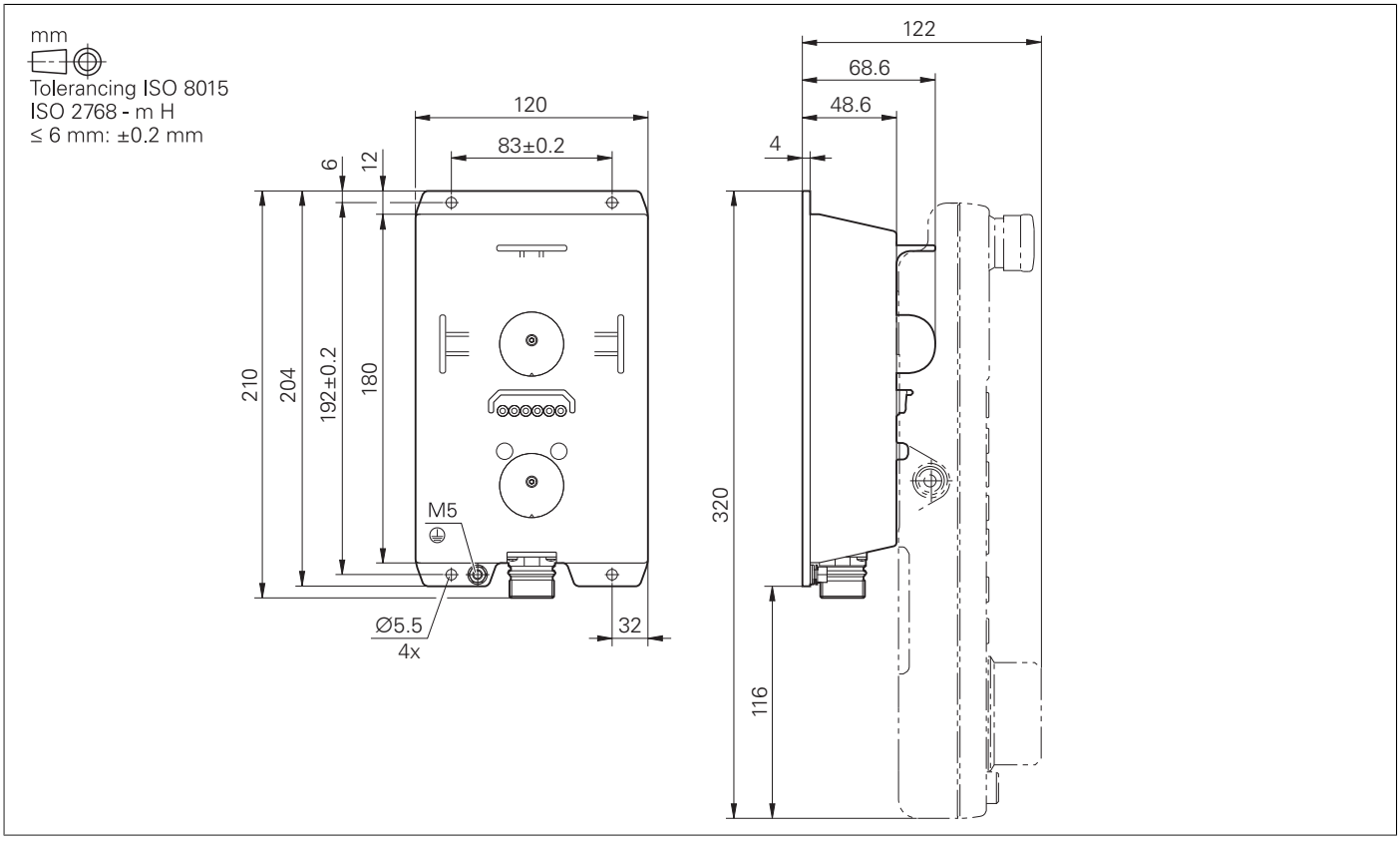
HR 550 FS

mm

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



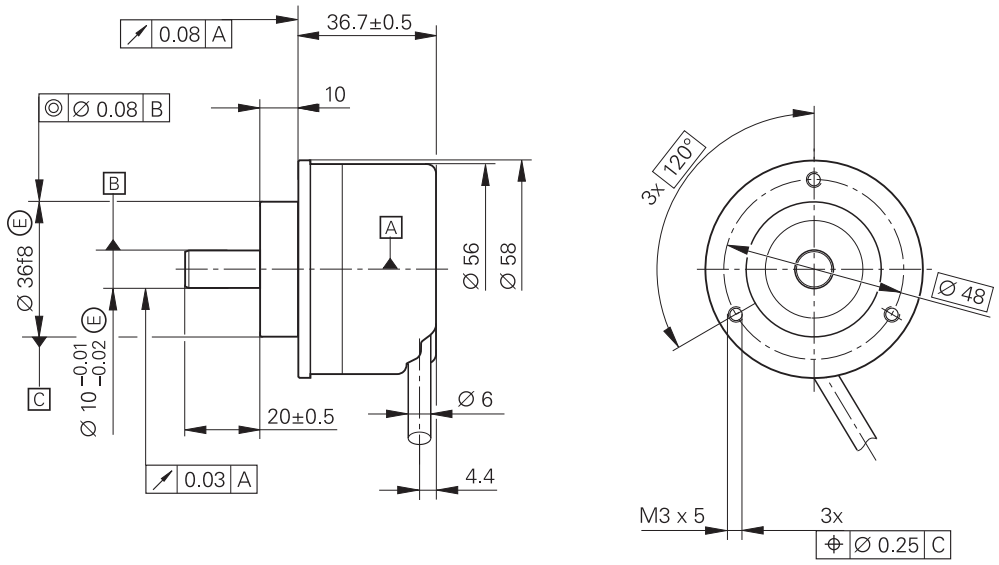
HRA 551 FS

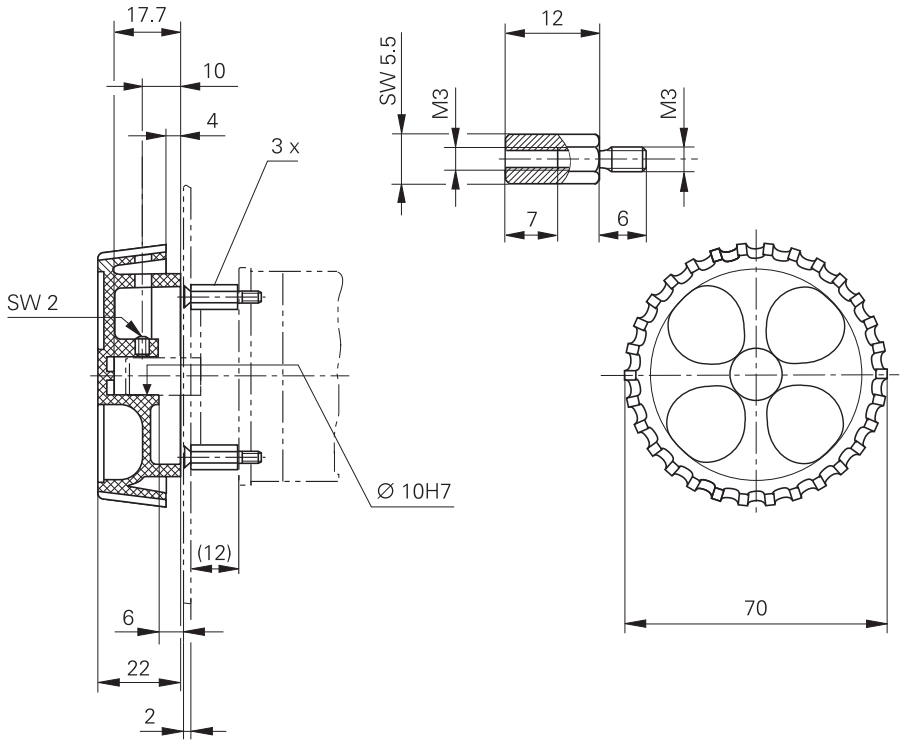

mm
Tolerancing ISO 8015
ISO 2768 - m H
≤ 6 mm: ±0.2 mm
120
83±0.2
6
12
210
204
192±0.2
180
M5
Ø5.5
4x
32
122
68.6
48.6
4
320
116

HR 130, HR 150 with control knob

mm

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

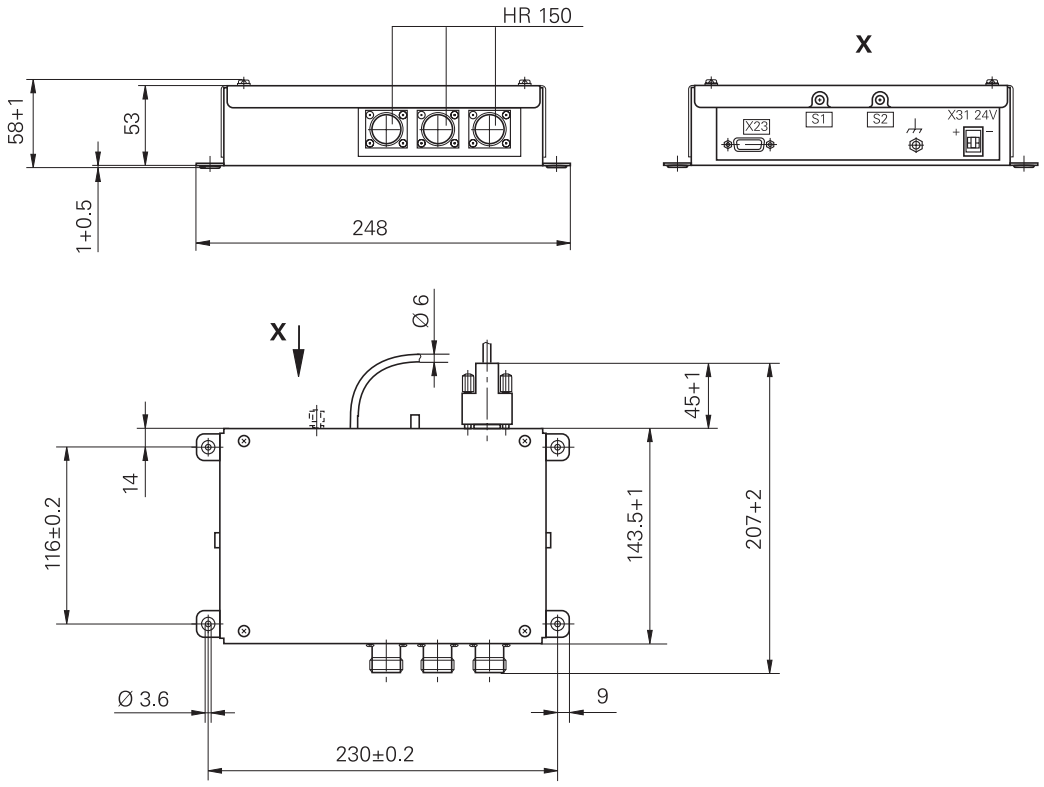




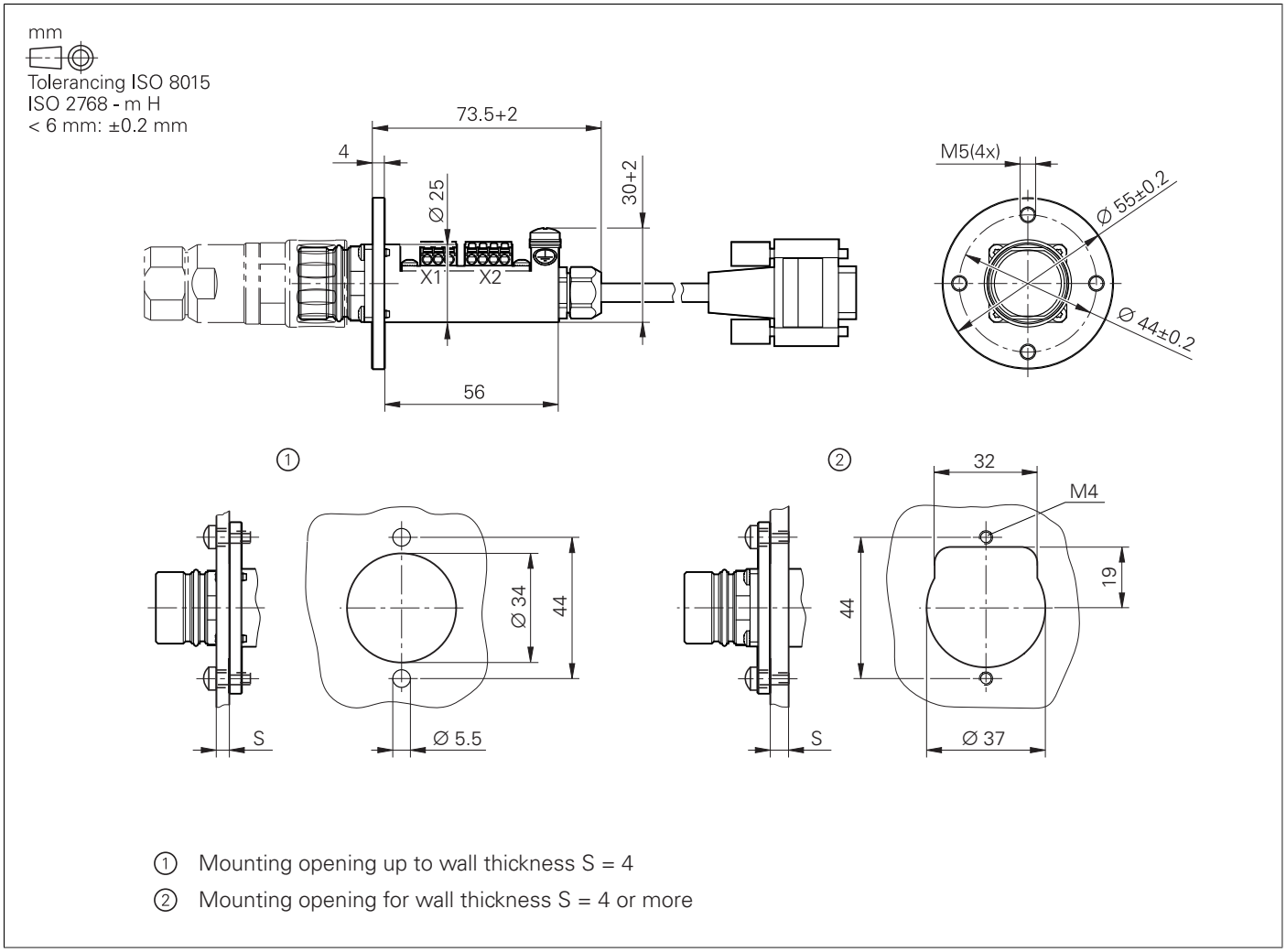
HRA 110

mm

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

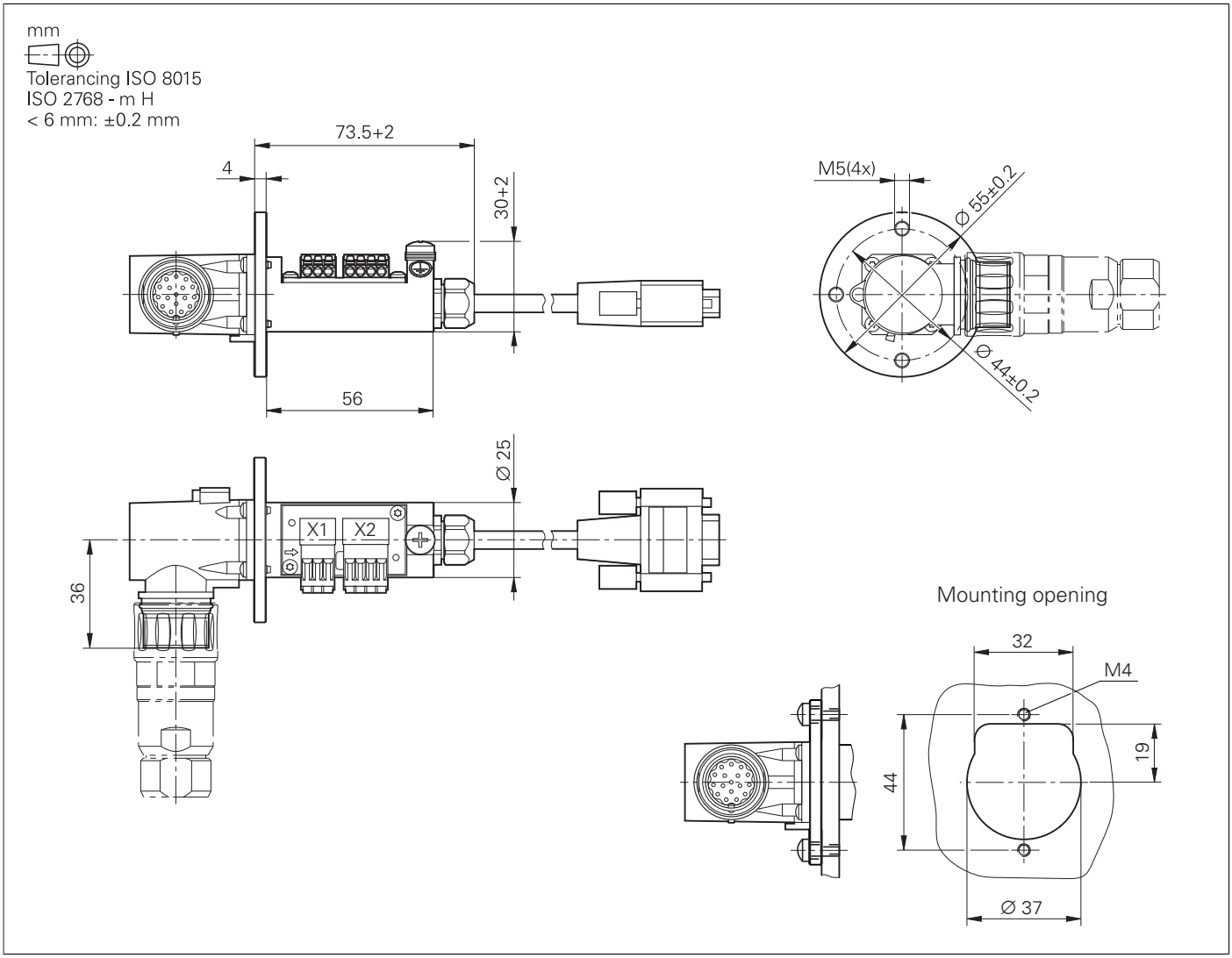


Adapter cable for handwheels (straight)



HR/HRA adapter cable to MC (straight connector)

Adapter cable for handwheels (angled)

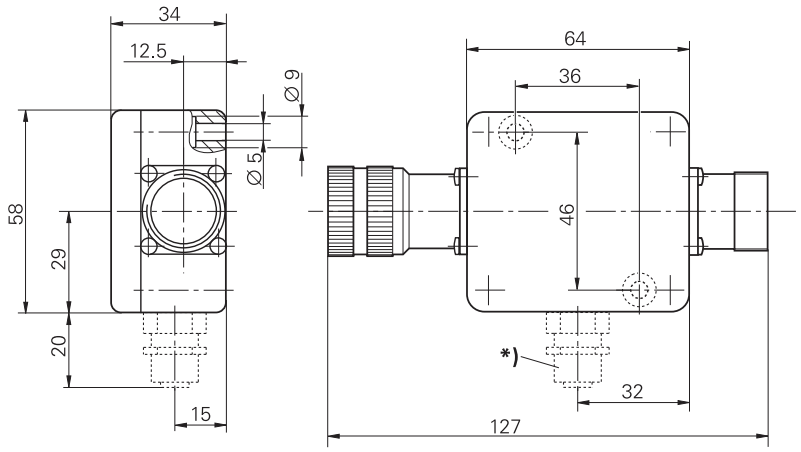


Adapter cable for HR/HRA to MC (angled connector)

Interface accessories

Line-drop compensator for encoders with EnDat interface

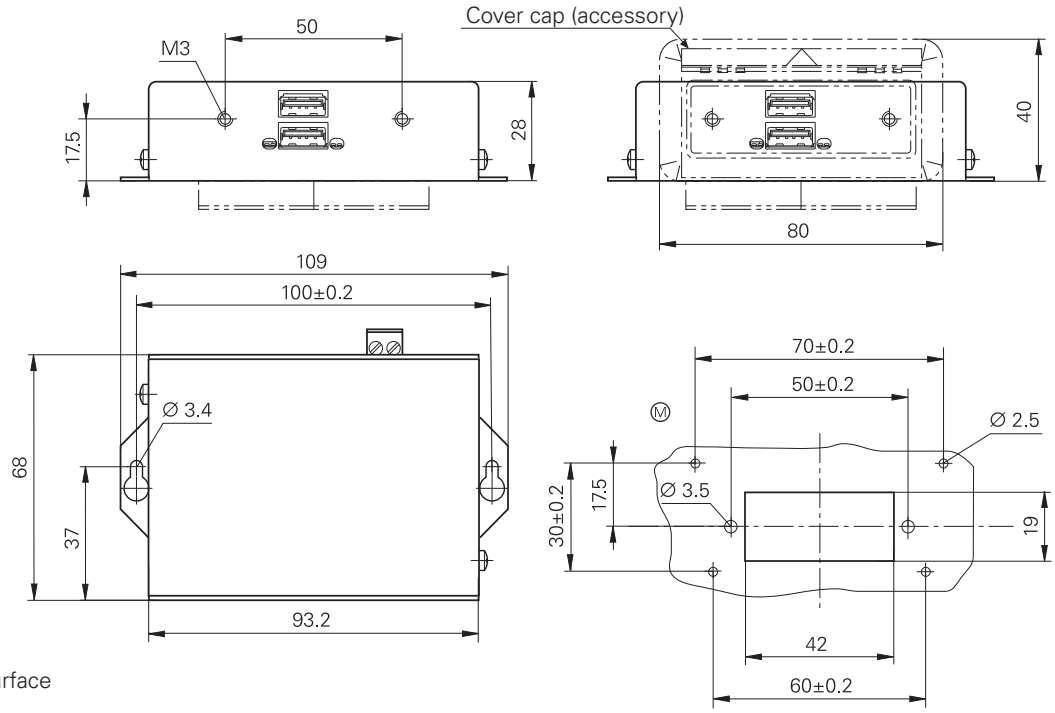
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



*) Connection to KTY

USB hub

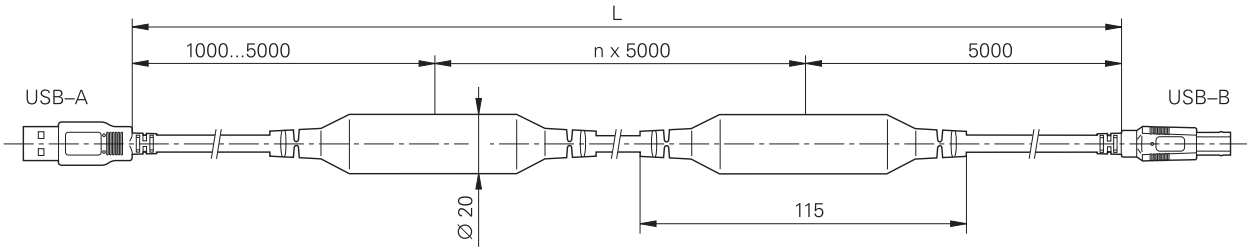
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



Ⓜ = Mounting surface

USB extension cable with hubs

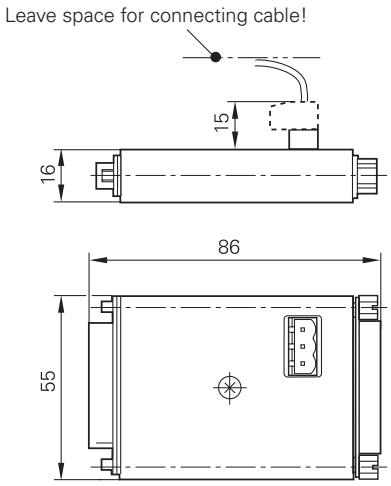
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



n = 0 ... 4
L = Ordering length

KTY adapter connector

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



General information
Documentation

Technical documentation	• **TNC 620** Technical Manual	ID 1098989-xx; in PDF format on HESIS-Web including Filebase
	• **PNC 610** Technical Manual	ID 1191125-xx; in PDF format on HESIS-Web including Filebase
	• **Inverter Systems and Motors** Technical Manual	ID 208962-xx; in PDF format on HESIS-Web including Filebase
	• **Functional Safety FS** Technical Manual	ID 749363-xx; in PDF format on HESIS-Web including Filebase
	• **TS 260** Mounting Instructions	ID 808652-9x
	• **TS 460** Mounting Instructions	ID 808653-9x
	• **TS 740** Mounting Instructions	ID 632761-9x
	• **TT 160** Mounting Instructions	ID 808654-xx
	• **TT 460** Mounting Instructions	ID 808655-xx
User documentation	**TNC 620**	
	• **HEIDENHAIN Klartext Programming** User's Manual	ID 1096883-xx
	• **Cycle Programming** User's Manual	ID 1096886-xx
	• **DIN/ISO Programming** User's Manual	ID 1096887-xx
	Miscellaneous	
	• **TNCremo** User's Manual	As integrated help
	• **TNCremoPlus** User's Manual	As integrated help
	• **PLCdesign** User's Manual	As integrated help
	• **CycleDesign** User's Manual	As integrated help
	• **IOconfig** User's Manual	As integrated help
	• **KinematicsDesign** User's Manual	As integrated help
Other documentation	• **TNC 620** brochure	ID 896140-xx
	• **Touch Probes** brochure	ID 1113984-xx
	• **Inverter Systems** brochure	ID 622420-xx
	• **Motors** brochure	ID 208893-xx
	• **RemoTools SDK virtualTNC** brochure	ID 628968-xx
	• **Remote Diagnosis with TeleService** Product Overview	ID 348236-xx
	• **Touch Probes** DVD	ID 344353-xx
	• Programming station DVD; **TNC 320, TNC 620 demo version**	ID 741708-xx
	• **HR 550FS** Product Information document	PDF
	• **Safety-Related Control Technology** Technical Information document	PDF
	• **Safety-Related Position Measuring Systems** Technical Information document	PDF
	• **Uniformly Digital** Technical Information document	PDF
Safety parameters	For HEIDENHAIN products (such as control components, encoders, or motors), the safety characteristics (such as failure rates or statements on fault exclusion) are available on product-specific request from your HEIDENHAIN contact person.	
Basic circuit diagram	More information on basic circuit diagrams can be requested from your HEIDENHAIN contact person.	

Service and training

Technical support

HEIDENHAIN offers the machine manufacturer technical support to optimize the adaptation of the control to the machine, including on-site support.

Exchange control

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

Helpline

Our service engineers are available by phone if you have any questions regarding adaptation or malfunctions:

NC support	+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de
PLC programming	+49 8669 31-3102 E-mail: service.plc@heidenhain.de
NC programming	+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de
Encoders / machine calibration	+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de
APP programming	+49 8669 31-3106 E-mail: service.app@heidenhain.de

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

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

Machine calibration

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

Technical courses

HEIDENHAIN provides technical customer training in the following subjects:

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

For more information on dates or registration:

Technical training courses in Germany	+49 8669 31-3049 E-Mail: mtt@heidenhain.de
Technical training courses outside of Germany	www.heidenhain.de EN ▶ Company ▶ Contact ▶ HEIDENHAIN worldwide

Other HEIDENHAIN controls
Examples

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 preferably with HEIDENHAIN motors
- Uniformly digital with HSCI interface and EnDat interface
- 15.6-inch multi-touch display with 1366 × 768 pixels
- Integration of the keyboard on the right side of the display
- Installation dimensions of MC 8420T compatible to MC 7410T
- Storage medium: CFR CompactFlash memory card (CFast) with 8 GB
- 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

Subject index

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