



# HEIDENHAIN



## CNC PILOT 640

The Contouring Control for  
Lathes and Turning-Milling  
Machines

**Information for the  
Machine Tool Builder**

# Contouring control with drive system from HEIDENHAIN

## General information

### CNC PILOT 640

- Contouring control for **lathes and turning-milling machines**
- Suitable for horizontal and vertical lathes as well as vertical boring and turning mills
- Axes: Max. 24 control loops (22 control loops with functional safety (FS)), max. 8 NC axes per channel, max. 6 spindles in the overall system
- Multi-channel capability: up to 3 channels for asynchronous multi-slide machining
- Up to 3 principal axes (X, Z, and Y), B axis, closed-loop spindle and counter spindle, C1/C2 axis and driven tools
- 5-axis simultaneous machining (X, Z, Y, B, and C axes)
- Up to 3 programmable auxiliary axes (U, V, W) for control of steady rest, tailstock and counter spindle
- The position of a parallel secondary axis can be shown combined with its principal axis
- For operation with HEIDENHAIN inverter systems and preferably with HEIDENHAIN motors
- Uniformly digital with HSCI interface and EnDat interface
- 19" or 15.6" multi-touch display
- 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), turrets, or magazines



CNC PILOT 640  
with 15.6" multi-touch display

### System test

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

### Expendable parts

Controls from HEIDENHAIN include consumable parts, particularly the buffer battery, and fans.

### Standards

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

### 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 for the following control and NC software versions:

#### CNC PILOT 640 with NC software versions

688946-06 (export license required)

688947-06 (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 note also 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

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

# Overview tables

## Components

Control systems		19" design	15.6" design	Page
Main computer	For operating panel	MC 8532 (integrated multitouch display) or MC 6542	MC 8420T (integrated multitouch display)	16
	For electrical cabinet	MC 6441 or MC 6542		
Screen		BF 860 (integrated with MC 8532)		27
Operating panel		TE 745 T	TE 725 T FS	28
Machine operating panel		Integrated		
		PLB 6001 (HSCI adapter for OEM machine operating panel)		
Storage medium		CFR memory card		18
NC software license		On SIK component		18
Controller unit	6 control loops	CC 6106		22
	8 control loops	CC 6108		22
	10 control loops	CC 6110		22
	12 control loops	CC 6106 + CC 6106		22
	14 control loops	CC 6108 + CC 6106		22
	16 control loops	CC 6108 + CC 6108		22
	18 control loops	CC 6106 + CC 6106 + CC 6106 or CC 6110 + CC 6108		22
	20 control loops	CC 6110 + CC 6110		22
Voltage supply*)		PSL 130/ PSL 135		31
PLC inputs/ outputs <sup>1)</sup>	With HSCI interface	PL 6000 consisting of PLB 62xx basic module (system PL) or PLB 61xx (expansion PL) and I/O modules		29
		On UEC		23
Additional modules <sup>1)</sup>		CMA-H for analog axes/spindles in the HSCI system		33
		Modules for fieldbus systems		
Inverter systems		Compact inverters and modular inverters		*)
Inverters with integrated controller unit	4 control loops	UEC 111		23
		UMC 111		25
	5 control loops	UEC 112		23
	6 control loops	UEC 113		
Connecting cables		✓		48

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

<sup>1)</sup> May be necessary depending on the configuration

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

# Accessories

Accessories	CNC PILOT 640	Page
<b>Electronic handwheels</b>	<ul style="list-style-type: none"> <li>• <b>HR 510 FS</b> portable handwheel, or</li> <li>• <b>HR 520 FS</b> portable handwheel with display, or</li> <li>• <b>HR 550 FS</b> portable wireless handwheel with display, or</li> <li>• <b>HR 130</b> panel-mounted handwheel, or</li> <li>• up to three <b>HR 150</b> panel-mounted handwheels via HRA 110 handwheel adapter</li> </ul>	36
<b>Workpiece touch probes</b>	<ul style="list-style-type: none"> <li>• <b>TS 260</b><sup>1)</sup> touch trigger probe with cable connection, or</li> <li>• <b>TS 460</b><sup>1)</sup> touch trigger probe with radio or infrared transmission, or</li> <li>• <b>TS 740</b> touch trigger probe with infrared transmission</li> </ul>	34
<b>Tool touch probes</b>	With cuboid probe contact as accessory <ul style="list-style-type: none"> <li>• <b>TT 160</b> touch trigger probe, or</li> <li>• <b>TT 460</b> touch trigger probe with radio or infrared transmission</li> </ul>	35
<b>USB hub</b>	✓	80
<b>Programming station</b>	<b>DataPilot CP 640</b> Control software for PCs for programming, archiving, and training <ul style="list-style-type: none"> <li>• Full version for single user or network license</li> <li>• Demo version (free of charge)</li> </ul>	2)
<b>Auxiliary axis control</b>	<b>PNC 610</b>	42
<b>Industrial PC</b>	<b>ITC 860</b> – additional operating station; separate TE 7xx necessary <b>IPC 6641</b> – industrial PC for Windows <b>IPC 6490</b> – industrial PC for PNC 610	40
<b>Snap-on keys</b>	For the control For handwheels	46 44

<sup>1)</sup> New generation of touch probes

<sup>2)</sup> For more information, refer to the *Programming Station for Lathe Controls* brochure.

Accessories / Software	CNC PILOT 640	Page
<b>PLCdesign</b> <sup>1)</sup>	PLC development software	76
<b>TNCremo</b> <sup>2)</sup>	Data transfer software	80
<b>TNCremoPlus</b> <sup>2)</sup>	Data transfer software with “live” screen	80
<b>ConfigDesign</b> <sup>1)</sup>	Software for configuring the machine parameters	72
<b>TNCkeygen</b> <sup>1)</sup>	Software for enabling SIK options for a limited time, and for day-by-day access to the OEM area	18
<b>TNCscope</b> <sup>1)</sup>	Software for data recording	73
<b>DriveDiag</b> <sup>1)</sup>	Software for diagnosis of digital control loops	72
<b>TNCopt</b> <sup>1)</sup>	Software for putting digital control loops into service	73
<b>IOconfig</b> <sup>1)</sup>	Software for configuring PLC I/O and field-bus components	30
<b>TeleService</b> <sup>1)</sup>	Software for remote diagnostics, monitoring, and operation	73
<b>RemoTools SDK</b> <sup>1)</sup>	Function library for developing customized applications for communication with HEIDENHAIN controls	81
<b>TNCtest</b> <sup>1)</sup>	Software for creation and execution of acceptance tests	74
<b>TNCanalyzer</b> <sup>1)</sup>	Software for the analysis and evaluation of service files	74

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

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

# Specifications

Specifications	CNC PILOT 640	Page
<b>Axes</b>	Max. 24 control loops (22 control loops with functional safety (FS)), max. 8 NC axes per channel, max. 6 spindles in the overall system	62
Axes	Up to six closed-loop linear axes X, Z, U, V, W: Standard Y: Option	
B axis	Option	
C1/C2 axis	Option	
Synchronized axes	✓	
PLC axes	✓	
<b>Spindles</b>	Up to three closed-loop spindles: Main spindle Counter spindle Driven tool	64 65
Speed	Max. 60 000 rpm (with option 49 max. 120 000 rpm) for motors with one pole pair	64
Operating mode switchover	✓	64
Position-controlled spindle	✓	64
Oriented spindle stop	✓	64
Gear shifting	✓	64
<b>NC program memory</b>	1.8 GB	16
<b>Input resolution and display step</b>		62
Linear axes	X axis: 0.5 µm (diameter 1 µm) U,V, W, Y, Z axes: 1 µm	
Rotary axes	B, C1/C2 axis: 0.001°	
<b>Functional safety (FS)</b>	With FS components, SPLC, and SKERN	59
For applications up to	<ul style="list-style-type: none"> <li>• SIL 2 according to EN 61 508</li> <li>• Category 3, PL d as per EN ISO 13 849-1:2008</li> </ul>	
<b>Interpolation</b>		
Straight line	In 2 axes (maximum ±100 m); in 3 principal axes with option 70	
Circular	In 2 axes (radius max. 999 m); additional linear interpolation of the third axis with option 55 or option 70	
C1/C2 axis	Interpolation of X and Z linear axes with the C1/C2 axis (option 55)	
B axis	5-axis Interpolation between the X, Y, Z, B, and C axes (option 54)	
Multichannel machining	Up to three channels for asynchronous multi-slide machining (option 153)	63
<b>Axis feedback control</b>		67
With following error	✓	
With feedforward	✓	
With jerk limiting	✓	62
Maximum feed rate	$\frac{60000 \text{ rpm}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$ at $f_{\text{PWM}} = 5000 \text{ Hz}$	62
Constant surface speed	✓	

Specifications	CNC PILOT 640		Page
Input	mm/min or mm/revolution		
<b>Cycle times</b> of main computer	<b>MC</b>		68
Block processing	1.5 ms		
<b>Cycle times</b> of controller unit	<b>CC/UEC</b>		68
Path interpolation	3 ms		68
Fine interpolation	<i>Single speed:</i> 0.2 ms <i>Double speed:</i> 0.1 ms ( option 49)		
Position controller	<i>Single speed:</i> 0.2 ms <i>Double speed:</i> 0.1 ms ( option 49)		
Speed controller	<i>Single speed:</i> 0.2 ms <i>Double speed:</i> 0.1 ms ( option 49)		
Current controller	$f_{\text{PWM}}$ 3333 Hz 4000 Hz 5000 Hz 6666 Hz 8 000 Hz 10 000 Hz	$T_{\text{INT}}$ 150 $\mu\text{s}$ 125 $\mu\text{s}$ 100 $\mu\text{s}$ 75 $\mu\text{s}$ with option 49 60 $\mu\text{s}$ with option 49 50 $\mu\text{s}$ with option 49	
<b>Permissible temperature range</b>	Operation: In electrical cabinet: 5 °C to 40 °C In operating panel: 0 °C to 50 °C Storage: -20 to 60 °C		

# Interfacing to the machine

Interfacing to the machine	CNC PILOT 640	Page
<b>Error compensation</b>	✓	71
Linear axis error	✓	71
Nonlinear axis error	✓	71
Backlash	✓	71
Reversal spikes during circular movement	✓	71
Hysteresis	✓	71
Thermal expansion	✓	71
Static friction	✓	71
Sliding friction	✓	71
<b>Integrated PLC</b>	✓	75
Program format	Statement list	75
Program input at the control	✓	75
Program input by PC	✓	75
PLC memory	350 MB	75
PLC cycle time	9 ms to 30 ms (adjustable)	75
<b>PLC inputs/outputs</b>	A PLC system can consist of max. seven PLB 61xx and one TE 7x5T or one PLB 6001. A total maximum of 1000 inputs/outputs is supported.	29, 23
PLC inputs, DC 24 V	Via PL, UEC, UMC	29
PLC outputs, DC 24 V	Via PL, UEC, UMC	29
Analog inputs, $\pm 10$ V	Via PL	29
Inputs for PT 100 thermistors	Via PL	29
Analog outputs, $\pm 10$ V	Via PL	29
<b>PLC functions</b>	✓	75
PLC soft keys	✓	75
PLC positioning	✓	75
PLC basic program	✓	77
<b>Integration of applications</b>		76
High-level language programming	Python programming language used in combination with the PLC (option 46)	76
User interfaces can be custom-designed	Create specific user interfaces of the machine tool builder with the programming language Python. Programs up to a memory limit of 10 MB are enabled in standard mode. Additional enabling via option 46.	76

Interfacing to the machine	CNC PILOT 640	Page
<b>Commissioning and diagnostic aids</b>		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
Integrated oscilloscope	✓	72
Trace function	✓	73
API DATA function	✓	73
Table function	✓	73
OLM (online monitor)	✓	73
Log	✓	73
TNCscope	✓	73
Bus diagnostics	✓	73
<b>Data interfaces</b>	✓	
Ethernet	2 x 1000BASE-T	79
USB	Rear: USB 3.0 Front: USB 2.0	79
RS-232-C	✓	79
<b>Protocols</b>		79
Standard data transfer	✓	79
Blockwise data transfer	✓	79
LSV2	✓	79

Encoder inputs		CC 6106	CC 6108	CC 6110	UEC 111	UMC 111	UEC 112	UEC 113	66
Position		6	8	10	4	-	5	6	66
	Incremental	1 V <sub>PP</sub>							66
	Absolute	EnDat 2.2							66
Speed		6	8	10	4	4	5	6	66
	Incremental	1 V <sub>PP</sub>							66
	Absolute	EnDat 2.2							66
<b>Nominal-value outputs</b>		CC 6106	CC 6108	CC 6110	UEC 111	UMC 111	UEC 112	UEC 113	66
PWM		6	8	10	-	-	-	-	21
Motor connections		-	-	-	4	4	5	6	21

# User functions

User function	Standard	Option	CNC PILOT 640
<b>Short description</b>	✓	0-6 55+0-6 70+0-6 54+0-6 94+0-6 132+0-6	Basic version: X and Z axis, main spindle Driven tool and auxiliary axes (U, V, W) C axis and driven tool Y axis B axis Parallel axes U, V, W (display function and compensation) Counter spindle Digital current and speed control
<b>Operating modes</b>			
<b>Manual operation</b>	✓		Manual slide movement through axis-direction keys, intermediate switch, or electronic handwheels
	✓	11	Graphic support for entering and running cycles without saving the machining steps in alternation with manual machine operation Thread reworking (thread repair) in a second workpiece setup
<b>Teach-in mode</b>		8	Sequential linking of fixed cycles, whereby each cycle is run immediately after input or is graphically simulated and subsequently saved
<b>Program run</b>	✓	9 8	All are possible in single-block and full-sequence modes DIN PLUS programs smart.Turn programs Cycle programs
<b>Setup functions</b>	✓ ✓ ✓ ✓ ✓ ✓	17 17 17	Setting the workpiece datum Defining the tool-change point Defining the protection zone Defining machine dimensions Manual programs Tool measurement by touching the workpiece Tool measurement with a TT tool touch probe Tool measurement with an optical gauge. Workpiece measurement with a TS workpiece touch probe
<b>Programming</b>			
<b>Cycle programming</b>		8 8 8 8 8 8 8 8 8+55 8+55 8+55 8+55 8+55 8+55 8 8 8 8+9	Turning cycles for simple and complex contours, and contours described with ICP Contour-parallel turning cycles Recessing cycles for simple or complex contours, as well as contours defined with ICP Repetitions with recessing cycles Recess turning cycles for simple and complex contours, and contours described with ICP Undercut and parting cycles Engraving cycles Threading cycles for single or multi-start longitudinal, taper, or API threads, and threads with variable pitch Cycles for axial and radial drilling, pecking and tapping operations with the C axis Thread milling with the C axis Axial and radial milling cycles for slots, figures, single and centric polygon surfaces, and for complex contours described with ICP for machining with the C axis Helical slot milling (multi-start) with the C axis Deburring of ICP contours Linear and circular patterns for drilling, boring, and milling operations with the C axis Context-sensitive help graphics Transfer of cutting values from technology database Use of DIN macros in cycle programs Conversion of cycle programs to smart.Turn programs

User function	Standard	Option	CNC PILOT 640
<b>Interactive Contour Programming (ICP)</b>		8/9	Contour definition with linear and circular contour elements
		8/9	Immediate display of entered contour elements
		8/9	Calculation of missing coordinates, intersections, etc.
		8/9	Graphic display of all solutions for selection by the user if more than one solution is possible
		8/9	Chamfers, rounding arcs, and undercuts available as form elements
		8/9	Input of form elements immediately during contour creation or later by superimposition
		8/9	Changes to existing contours can be programmed
		8/9	Machining attributes available for individual contour elements
		8/9+55	C-axis machining on face and lateral surface: – Description of individual holes and hole patterns (only in smart.Turn) – Description of figures and figure patterns for milling (only in smart.Turn) – Creation of freely definable milling contours
		9+70	Y-axis machining on the XY and ZY planes (only in smart.Turn): – Description of individual holes and hole patterns – Description of figures and figure patterns for milling – Creation of freely definable milling contours
		8/9+55+70+132	Programming of the rear face for full-surface machining with the C and Y axes
		8/9+42	DXF import: Import of contours for lathe and milling operations
<b>smart.Turn programming</b>		9	The basis is the "unit," which is the complete description of a machining block (geometry, technology and cycle data)
		9	Dialog boxes divided into overview and detail forms
		9	Fast navigation between the fillable forms and input groups via the "smart" keys
		9	Context-sensitive help graphics
		9	Start unit with global settings
		9	Transfer of global values from the start unit
		9	Transfer of cutting values from technology database
		9	Units for all turning and recessing operations for simple contours and ICP contours
		9+55/70	Units for boring, drilling, and milling operations with the C or Y axis for holes, milling contours, and drilling and milling patterns that are simple or that have been programmed with ICP
		9+55	Activating/deactivating special units for the C axis; subroutines and section repeats
		9+55/70	Verification graphics for the blank and finished part, as well as for C and Y axis contours
		9	Turret assignment and other setup information in the smart.Turn program
		9	Parallel programming
		9	Parallel simulation
<b>TURN PLUS</b>		63	Automatic smart.Turn program generation with – Automatic tool selection – Automatic turret assignment – Automatic calculation of cutting data – Automatic generation of machining sequence in all working planes, also for C-axis machining (with option 55) and Y-axis machining (with option 70) – Automatic cutting limitation through chucking equipment – Automatic generation of work blocks for rechucking for turning with counter spindles – Automatic generation of work blocks for rear-face machining (with option 132)

User function	Standard	Option	CNC PILOT 640
<b>DIN PLUS programming</b>	✓ ✓ ✓ ✓  ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	   55 70   131/132 132  8/9  9	Programming in DIN 66025 format Expanded command format (IF ... THEN... ELSE ...) Simplified geometry programming (calculation of missing data) Powerful fixed cycles for area clearance, recessing, recess turning, and thread machining Powerful fixed cycles for boring, drilling, and milling with the C axis Powerful fixed cycles for boring, drilling, and milling with the Y axis Subprograms Technology functions for full-surface machining: – Moving to a fixed stop – Parting control – Spindle synchronization – Converting and mirroring – Mechatronic tailstock Programming with variables Contour description with ICP Program verification graphics for workpiece blank and finished part Turret assignment and other setup information in the DIN PLUS program Conversion of smart.Turn units into DIN PLUS command sequences Parallel programming Parallel simulation
<b>Simulation</b>	✓ ✓  ✓ ✓ ✓ ✓ ✓ ✓ ✓	   55  54   132	Graphic simulation of the cycle process, or of the cycle, smart.Turn or DIN PLUS program Display of the tool paths as pencil-trace or cutting-path graphics; special identification of the rapid traverse paths Machining simulation (2-D material-removal graphic) Side or face view, or 2-D view of cylindrical surface for verification of C-axis machining Display of programmed contours View of the tilted plane (B-axis machining) View of face and YZ plane for verification of Y-axis machining Three-dimensional display of the workpiece blank and finished part Simulation of mirrored contours for rear-face machining Shifting and magnifying functions Block scan in the simulation
<b>B-axis machining</b>	✓	54  54	Machining with the B axis Tilting the working plane Rotating the machining position of the tool
<b>Eccentric machining</b>		135 135	Cycles for eccentric turning and for the manufacture of oval and polygonal contours Superimpositioning of traverse movements of the X and Y axes synchronous to the rotational motion of the spindle
<b>Machining time analysis</b>	✓ ✓ ✓		Calculation of machining times and idle times Consideration of switching commands triggered by the CNC Representation of time per individual cycle or per tool change
<b>Load monitoring</b>		151	Load monitoring for machining processes – Detection of tool wear and breakage – Display of workload values

User function	Standard	Option	CNC PILOT 640
<b>Tool database</b>	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	10       10	For 250 tools For 999 tools Tool description can be entered for every tool Automatic inspection of tool-tip position with respect to the contour Compensation of tool-tip position in the X/Y/Z plane High-precision correction via handwheel, compensation values applied to the tool table Automatic tool-tip and cutter radius compensation Tool monitoring for lifetime of the insert (tool tip) or the number of workpieces produced Tool monitoring with automatic tool change after expiration of tool life Management of multipoint tools (multiple inserts or reference points) Support of quick-change systems
<b>Technology database</b>		8/9  8/9 8/9 8/9 10	Access to cutting data after definition of workpiece material, cutting material, and machining mode. The CNC PILOT 640 distinguishes between 16 machining modes. Each workpiece-material/tool-material combination includes the cutting speed, the main and secondary feed rates, and the infeed for the 16 machining modes Automatic determination of the machining modes from the cycle or the machining unit The cutting data are entered in the cycle or in the unit as default values. 9 workpiece-material/tool-material combinations (144 entries) 62 workpiece-material/tool-material combinations (992 entries)
<b>User management</b>	✓		Configurable tying of permissions to user roles – Login at the control with a user account – User-specific HOME folder for simplified data management – Role-based access to the control and the network data
<b>Conversational languages</b>	✓		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 688946- 688947-	ID	Comment	Page
0	Additional Axis 1	01	354540-01	Additional control loop 1	20
1	Additional Axis 2	01	353904-01	Additional control loop 2	20
2	Additional Axis 3	01	353905-01	Additional control loop 3	20
3	Additional Axis 4	01	367867-01	Additional control loop 4	20
4	Additional Axis 5	01	367868-01	Additional control loop 5	20
5	Additional Axis 6	01	370291-01	Additional control loop 6	20
6	Additional Axis 7	01	370292-01	Additional control loop 7	20
7	Additional Axis 8	03	370293-01	Additional control loop 8	20
8	Teach-in	01	632226-01	<b>Cycle programming</b> <ul style="list-style-type: none"> <li>• Contour description with ICP</li> <li>• Cycle programming</li> <li>• Technology database with 9 workpiece-material/tool-material combinations</li> </ul>	
9	smart.Turn	01	632227-01	<b>smart.Turn</b> <ul style="list-style-type: none"> <li>• Contour description with ICP</li> <li>• Programming with smart.Turn</li> <li>• Technology database with 9 workpiece-material/tool-material combinations</li> </ul>	
10	Tools and Technology	01	632228-01	<b>Tools and technology</b> <ul style="list-style-type: none"> <li>• Tool database expanded to 999 entries</li> <li>• Technology database expanded to 62 workpiece-material/tool-material combinations</li> <li>• Tool life monitoring with exchange tools</li> </ul>	
11	Thread Recutting	01	632229-01	<b>Threads</b> <ul style="list-style-type: none"> <li>• Thread recutting</li> <li>• Handwheel superimposition during thread cutting</li> </ul>	
17	Touch Probe Functions	01	632230-01	<b>Tool measurement and workpiece measurement</b> <ul style="list-style-type: none"> <li>• Determining tool-setting dimensions with a tool touch probe</li> <li>• Determining tool-setting dimensions with an optical gauge</li> <li>• Automatic workpiece measurement with a workpiece touch probe</li> </ul>	
18	HEIDENHAIN DNC	01	526451-01	Communication with external PC applications over COM component	81
24	Gantry Axes	01	634621-01	Gantry axes in master-slave torque control	63
42	DXF Import	01	632231-01	<b>DXF import:</b> Import of DXF contours	
46	Python OEM Process	01	579650-01	Python application on the control	76
49	Double-Speed Axes	01	632223-01	Short control-loop cycle times for direct drives	21
54	B-Axis Machining	01	825742-01	<b>B axis:</b> Tilting the working plane, rotating the machining position of the tool	63
55	C-Axis Machining	01	633944-01	<b>C-axis machining</b>	64
63	TURN PLUS	01	825743-01	<b>TURN PLUS</b> Automatic generation of smart.Turn programs	
70	Y-Axis Machining	01	661881-01	<b>Y-axis machining</b>	

Option number	Option	As of NC software 688946-688947-	ID	Comment	Page
<b>77</b>	4 Additional Axes	03	634613-01	4 additional control loops	20
<b>78</b>	8 Additional Axes	03	634614-01	8 additional control loops	20
<b>94</b>	Parallel Axes	01	679676-01	Support of parallel axes (U, V, W) Combined display of principal axes and secondary axes	
<b>101 - 130</b>	OEM option	01	579651-01 to 579651-30	Options of the machine tool builder	
<b>131</b>	Spindle Synchronism	01	806270-01	<b>Synchronization</b> (of two or more spindles)	65
<b>132</b>	Counter Spindle	01	806275-01	<b>Counter spindle</b> (spindle synchronism, rear-face machining)	64
<b>133</b>	Remote Desktop Manager	04	894423-01	Display and operation of external computer units (e.g. a Windows PC)	81
<b>135</b>	Synchronizing Functions	03	1085731-01	Expanded synchronization of axes and spindles	63
<b>143</b>	Load Adapt. Control	01	800545-01	LAC: Load-dependent adaptation of control parameters	71
<b>151</b>	Load Monitoring	03	1111843-01	Monitoring of the tool load	70
<b>153</b>	Multichannel	05	1217032-01	Multi-channel capability: up to three channels for asynchronous multi-slide machining	63

# HSCI control components

## Main computer

### Main computer

The **MC** main computers feature:

- Processor
- RAM memory
- HSCI interface to the controller unit and to other control components
- HDL interface to the BF display unit for electrical cabinet versions
- 4 x USB 3.0 interface, e.g. to the TE 7x5 T (FS) keyboard unit

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

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

The following HSCI components are necessary for operation of the CNC PILOT 640:

- MC main computer
- Controller unit
- PLC **PLB 62xx** I/O unit (system PL; integrated in UxC)
- **TE 7x5T** keyboard unit with integrated machine operating panel

### Interfaces

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

### Power supply

DC 24 V of power are supplied to the main computer and other HSCI components by the PSL 13x power supply unit with the supply voltage 24 V-NC. 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). This PLC 24 V is a supply voltage with basic insulation, which is why it must not be connected to other such voltages or mixed with safely separated electric circuits.

### Export version

Because the entire NC software is saved on the memory card (CFR), 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

Various versions of the MC main computer are available:

- For installation in the **operating panel**  
Together with the BF display unit, the MC 8420T (15.6") or MC 8532 (19") form a unit that is installed directly into the control panel  
The benefit: except for the power supply line, only one HSCI connecting cable to the electrical cabinet is necessary
- For installation in the **electrical cabinet**  
The MC 6x4x is installed in the electrical cabinet. HSCI, USB, and HDL cables to the operating panel are required as control lines
- For installation in the **operating panel or electrical cabinet**  
Because the CFR memory card is used as a storage medium, the MC 6542 can be universally integrated. HSCI, USB, and HDL cables to the operating panel are required as control lines

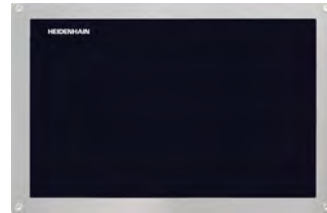
The MC 6441 main computer is supported as of NC software 68894x-02, and the MC 6542 main computer as of NC software 68894x-03. The MC 8420T and MC 8532 main computers are supported starting as of NC software 68894x-05. Earlier software versions do not run on these MC main computers.



MC 6x41



MC 6x42



MC 8420T with main computer installed on the back



MC 8532 with main computer installed on the back

	To be installed in	Memory medium	Processor	RAM memory	Power consumption*	Mass	ID
<b>MC 6441</b>	Electrical cabinet	CFR	Intel Celeron 1047, 1.4 GHz, dual-core	2 GB	≈ 40 W	≈ 4.0 kg	1054739-xx
<b>MC 6542</b>	Electrical cabinet	CFR	Intel Core i7-3 1.7 GHz, dual-core	4 GB	≈ 48 W	≈ 4.0 kg	1081188-xx
<b>MC 8420T</b>	Operating panel	CFR	Intel Celeron 1047, 1.4 GHz, dual-core	2 GB	≈ 43 W	≈ 6.7 kg	1213689-xx
<b>MC 8532</b>	Operating panel	CFR	Intel Core i7-3 1.7 GHz, dual-core	4 GB	≈ 75 W	≈ 7.5 kg	1189190-xx

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

**Options**

The capabilities of the CNC PILOT 640 can also be adapted retroactively with options to meet new requirements. These options are described on page 14. They are enabled by entering keywords based on the SIK number, and are saved in the SIK component. Please indicate your SIK number when ordering new options.

**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) for short access times, and is compatible with the MC 8420T and MC 7410T. It is compatible with the MCs described in the **Main computer** section.



CFR CompactFlash

<b>CFR CompactFlash 8 GB</b>	
Free capacity for NC programs	1.8 GB
Free capacity for PLC programs	350 MB
Export license required	ID 1075088-06
No export license required	ID 1075088-56

**SIK component**

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



SIK component

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

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

**Master keyword (General Key)**

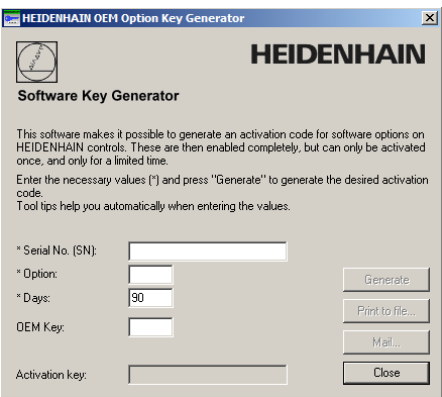
For commissioning the CNC PILOT 640, a general key can be used that will unlock all control loop options for a duration of 90 days. After this period, only those options with the correct keywords will be active. The general key is activated via a soft key.

**TNCkeygen (accessory)**

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

**OEM Key Generator** is used to 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 only be enabled once. Option enabling is independent of the general key.

The **OEM daily key generator** generates an enabling key for the protected area of the machine tool builder. This grants the operator access to the area on the day the key was generated.



## NC software license and enabling of control loops

There are always three control loops enabled in the basic version. The controller unit must be designed for the corresponding number of activated control loops. Maximum numbers:

- UEC 111: 4 control loops
- UEC 112: 5 control loops
- CC 6106/UEC 113: 6 control loops
- CC 6108: 8 control loops
- CC 6110: 10 control loops

You can find the usual SIK combinations in the following table. Other versions are available upon request.

SIK with software license and enabling for		SIK
Control loops	Included options	
3	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> </ul>	ID 686002-01 ID 686002-51*
	<ul style="list-style-type: none"> <li>• Teach-in (option 8)</li> <li>• smart.Turn (option 9)</li> <li>• Thread Recutting (option 11)</li> <li>• C-Axis Machining (option 55)</li> </ul>	ID 686002-10 ID 686002-60*
4	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> <li>• C-Axis Machining (option 55)</li> </ul>	ID 686002-03 ID 686002-53*
5	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> <li>• C-Axis Machining (option 55)</li> </ul>	ID 686002-04 ID 686002-54*
5	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> <li>• C-Axis Machining (option 55)</li> <li>• Y-Axis Machining (option 70)</li> </ul>	ID 686002-62
6	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> <li>• C-Axis Machining (option 55)</li> <li>• Y-Axis Machining (option 70)</li> </ul>	ID 686002-05 ID 686002-55*
6	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> <li>• C-Axis Machining (option 55)</li> <li>• Counter Spindle (option 132)</li> </ul>	ID 686002-63
7	<ul style="list-style-type: none"> <li>• smart.Turn (option 9)</li> <li>• C-Axis Machining (option 55)</li> <li>• Y-Axis Machining (option 70)</li> <li>• Counter Spindle (option 132)</li> </ul>	ID 686002-64

\* Export version

**Enabling further control loops**

Further control loops can be enabled either as groups or individually. The combination of control-loop groups and individual control loops makes it possible to enable any number of control loops. No more than 24 control loops (22 control loops with functional safety (FS)) are possible.

Control-loop groups	Option	
4 additional control loops	77	ID 634613-01
8 additional control loops	78	ID 634614-01
Individual control loops	Option	
1st additional control loop	0	ID 354540-01
2nd additional control loop	1	ID 353904-01
3rd additional control loop	2	ID 353905-01
4th additional control loop	3	ID 367867-01
5th additional control loop	4	ID 367868-01
6th additional control loop	5	ID 370291-01
7th additional control loop	6	ID 370292-01
8th additional control loop	7	ID 370293-01

# Controller unit

## Controller unit

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

Single speed  
Double speed

**Single-speed control loops** are usually sufficient for linear or torque motors and for conventional axes. **Double-speed control loops** 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 $f_{\text{PWM}}$	Current controller	Speed controller		Position controller
		Single-speed	Double-speed <sup>1)</sup>	
3333 Hz	150 $\mu\text{s}$	300 $\mu\text{s}$	150 $\mu\text{s}$	Same as <b>speed controller</b>
4000 Hz	125 $\mu\text{s}$	250 $\mu\text{s}$	125 $\mu\text{s}$	
5000 Hz	100 $\mu\text{s}$	200 $\mu\text{s}$	100 $\mu\text{s}$	
6666 Hz <sup>1)</sup>	75 $\mu\text{s}$	150 $\mu\text{s}$	150 $\mu\text{s}$	
8000 Hz <sup>1)</sup>	60 $\mu\text{s}$	125 $\mu\text{s}$	125 $\mu\text{s}$	
10 000 Hz <sup>1)</sup>	50 $\mu\text{s}$	100 $\mu\text{s}$	100 $\mu\text{s}$	

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

Number of control loops

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

Versions

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

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

CC 61xx

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



CC 6110

	CC 6106	CC 6108	CC 6110
Digital control loops	Max. 6 (single speed)	Max. 8 (single speed)	Max. 10 (single speed)
Speed inputs	6 x 1 V <sub>PP</sub> or EnDat 2.2	8 x 1 V <sub>PP</sub> or EnDat 2.2	10 x 1 V <sub>PP</sub> or EnDat 2.2
Position inputs	6 x 1 V <sub>PP</sub> or EnDat 2.2	8 x 1 V <sub>PP</sub> or EnDat 2.2	10 x 1 V <sub>PP</sub> or EnDat 2.2
PWM outputs	6	8	10
SPI expansion slots	2	4	4
Power consumption (without encoders)	25 W	35 W	40 W
Mass	4.1 kg	4.7 kg	4.8 kg
	ID 662636-xx	ID 662637-xx	ID 662638-xx

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

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

Constraints:

- Max. 24 control loops (22 control loops with functional safety (FS)), max. 8 NC axes per channel, max. 6 spindles in the overall system
- Maximum of 4 controller motherboards are permissible in the HSCI system (CC 6106 contains one motherboard, CC 6108/CC 6110 each have two)

## Ribbon cables for supply voltage

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

Combination	Length	Dimension c	
<b>2 x CC 6108, or 2 x CC 6110, or CC 6108 and CC 6110</b>	160 mm <sup>1)</sup>	26.5 mm	ID 325816-22
<b>2 x CC 6106</b>	110 mm	31.5 mm	ID 325816-24

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

With a combination of CC 6108 and/or CC 6110, the short ribbon cables included in delivery are not needed. They are only necessary for connecting sockets X69 A and X69 B if the CC units are used separately.

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



## UEC 11x

The UEC 11x compact inverters not only include the inverter, but also a controller with PLC inputs and outputs and an integrated braking resistor. They 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		
<b>Controllers</b>		4/5/6 digital control loops		
<b>Speed inputs</b>		4/5/6 x 1 V <sub>pp</sub> or EnDat 2.2		
<b>Position inputs</b>		4/5/6 x 1 V <sub>pp</sub> or EnDat 2.2		
<b>Inverters</b>		2/3/4 axes	1 axis	Spindle
<b>Rated current I<sub>N</sub>/</b> <b>Maximum current I<sub>max</sub><sup>1)</sup></b> <b>at a PWM frequency of</b>	<b>3333 Hz</b>	<b>6.0/12.0 A</b>	<b>9.0/18.0 A</b>	<b>24.0/36.0 A</b>
	4000 Hz	5.5/11.0 A	8.3/16.5 A	22.0/33.0 A
	5000 Hz	5.0/10.0 A	7.5/15.0 A	20.0/30.0 A
	6666 Hz	4.2/8.4 A	6.3/12.6 A	16.8/25.2 A
	8000 Hz	3.6/7.3 A	5.5/11.0 A	14.6/21.9 A
	10 000 Hz	3.0/6.0 A	4.6/9.2 A	12.2/18.3 A
<b>Supply voltage</b>		3AC 400 V (± 10 %); 50 Hz or 3AC 480 V (+6 %/–10 %); 60 Hz		
<b>Rated power of DC link</b>		<b>14 kW</b>		
<b>Peak power<sup>2)</sup> of DC link</b>		18 kW / 25 kW		
<b>Power loss at I<sub>N</sub></b>		≈ 450 W		
<b>DC-link voltage</b>		DC 565 V		
<b>Integral braking resistance<sup>3)</sup></b>		2.1 kW / 27 kW		
<b>Power supply unit for HSCI components</b>		DC 24 V / 3.5 A		
<b>Module width</b>		150 mm		
<b>Mass</b>		≈ 14 kg		
<b>Functional safety (FS)</b>		-	✓	
<b>UEC 111</b>		ID 1081002-xx	ID 1075825-xx	
<b>UEC 112</b>		ID 1081003-xx	ID 1075826-xx	
<b>UEC 113</b>		ID 828471-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.

### 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

		UMC 111 FS
<b>Controllers</b>		4 digital control loops
<b>Speed inputs</b>		4 x 1 V <sub>pp</sub> or EnDat 2.2
<b>Inverters</b>		4 axes
<b>Rated current I<sub>N</sub>/Maximum current I<sub>max</sub><sup>1)</sup> at a PWM frequency of</b>	<b>3333 Hz</b>	<b>9.0/18.0 A</b>
	4000 Hz	8.3/16.5 A
	5000 Hz	7.5/15.0 A
	6666 Hz	6.3/12.6 A
	8000 Hz	5.5/11.0 A
	10 000 Hz	4.6/9.2 A
<b>Power loss at I<sub>N</sub></b>		≈ 300 W
<b>DC-link voltage</b>		DC 565 V or DC 650 V
<b>24 V PLC current consumption</b>		DC 24 V / 2 A
<b>Module width</b>		150 mm
<b>Mass</b>		≈ 11 kg

<sup>1)</sup> 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<sub>pp</sub> 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 <sub>pp</sub> interface
1 m cable	ID 336377-01	ID 312533-01
3 m cable	ID 336377-03	ID 312533-03

# 19" screen and keyboard

## BF 860 screen

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

Via touchscreen operation

- Soft-key row switchover
- Selectable screen layout
- Operating mode switchover

**BF 860** ID 1169174-xx  
Mass ≈ 7.1 kg



BF 860

## TE 745T

- Appropriate for MC 8532 or BF 860 (19-inch design)
- Editing keys
- Operating mode keys
- Numeric keypad
- ASCII keyboard
- Spindle-speed, feed-rate, and rapid-traverse override potentiometers
- Three holes for additional buttons or keylock switches
- Touchpad and navigation keys
- Electronic handwheel
- USB interface to the MC main computer
- USB port with cover cap on front

Integrated machine operating panel with:

- Power supply: DC 24 V / ≈ 4 W
- 36 exchangeable snap-on keys with status LED, of which 22 are not labeled and are freely definable via the PLC
- Operating elements include keys that are preassigned according to PLC basic program: Control voltage on<sup>1)</sup>; NC start<sup>1)</sup>; NC stop<sup>1)</sup>; emergency stop; six axis keys; rapid traverse key; spindle start; spindle stop; spindle jog; spindle change key; feed rate stop
- Connection for HR handwheel (due to the internal connector layout, no additional handwheels can be connected)
- HSCI interface
- Seven free PLC inputs and five free PLC outputs

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

**TE 745T** ID 801306-xx  
Mass ≈ 4.5 kg



TE 745T

# Keyboard suitable for 15.6-inch screen

## TE 725T FS

- Suitable for MC 8420
- Numeric keypad
- ASCII keyboard
- Spindle-speed and feed-rate override potentiometers
- Two holes for additional keys or keylock switches
- USB interface to the MC main computer

Integrated machine operating panel with:

- Power supply: DC 24 V /  $\approx 4$  W
- 36 exchangeable snap-on keys with status LED, of which 22 are not labeled and are freely definable via the PLC
- Operating elements include keys that are preassigned according to PLC basic program: Control voltage on<sup>1)</sup>; NC start<sup>1)</sup>; NC stop<sup>1)</sup>; emergency stop; six axis keys; rapid traverse key; spindle start; spindle stop; spindle jog; spindle change key; feed rate stop
- Connection for HR handwheel
- HSCI interface
- Four free PLC inputs for FS and five free PLC outputs
- Additionally, two-channel FS inputs for EMERGENCY STOP and permissive buttons of handwheel

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

**TE 725T FS<sup>2)</sup>**    Without handwheel; with                    ID 1211940-xx  
   connection for handwheel

Mass                     $\approx 3.1$  kg

<sup>2)</sup> Version without functional safety (FS) available upon request



TE 725T FS

# PL 6000 PLC input/output systems with HSCI

## PL 6000

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



PLB 62xx

## Basic modules

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

Supply voltage	DC 24 V
Power consumption <sup>1)</sup>	≈ 48 W at DC 24 V-NC ≈ 21 W at DC 24 V-PLC
Mass	0.36 kg (bare)

<sup>1)</sup> 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

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

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

## System PL with EnDat support

- Required once for each control system (except with UEC)
- Connections for TS and TT touch probes, as well as TL
- 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 68894x-05

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

**Expansion PL**

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

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

<b>PLD-H 16-08-00</b>	I/O module with 16 digital inputs and 8 digital outputs	ID 594243-xx
<b>PLD-H 08-16-00</b>	I/O module with 8 digital inputs and 16 digital outputs	ID 650891-xx
<b>PLD-H 08-04-00 FS</b>	I/O module with 8 digital FS inputs and 4 digital FS outputs	ID 598905-xx
<b>PLD-H 04-08-00 FS</b>	I/O module with 4 digital FS inputs and 8 digital FS outputs	ID 727219-xx
<b>PLD-H 04-04-00 HSLS FS</b>	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: $\leq 2$ A per output ( $\leq 8$ A simultaneously)
Power output	Max. 200 W
Mass	$\approx 0.2$ kg

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

**Empty housing**

For unused slots of the system PL ID 383022-xx

**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 61 800-5-1. The NC supply voltage and the PLC supply voltage are separated from each other by basic insulation.

Supply voltage	<ul style="list-style-type: none"> <li>PSL 13x (L1, L2): AC 400 V (360 V to 480 V), 50/60 Hz</li> <li>PSL 13x (DC-link voltage): DC 400 V to 750 V</li> <li>Power consumption ≤1000 W</li> </ul>
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 6441 MC 6542 MC 8532 MC 8420T	1.7 A 2.0 A 3.1 A 1.8 A
Machine operating panel	PLB 600x	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
Screen	BF 860	1.9 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	

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

	Module width	Degree of protection	Mass	
<b>PSL 130</b>	50 mm	IP20	2.1 kg	ID 575047-xx
<b>PSL 135</b>	50 mm	IP20	2.5 kg	ID 627032-xx

The current UV(R) supply units 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 CNC PILOT 640. The spindle-speed and feed-rate override potentiometers of the TE 7xx and the HR handwheel are also connected to these adapters.

- HSCI interface
- Connection for HR handwheel
- Inputs/outputs for keys/key illumination  
Terminals for 72 PLC inputs and 40 PLC outputs
- Screw fastening or top-hat-rail mounting
- Configuration of the PLC inputs/outputs with the IOconfig computer software

<b>PLB 6001</b>	ID 668792-xx
<b>PLB 6001 FS</b>	ID 722083-xx
<b>PLB 6002 FS</b>	ID 1137000-xx
Mass	≈ 1.2 kg



PLB 6001

# Additional modules

## Overview

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

Additional module for analog axes/spindles:

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

### CMA-H 04-04-00

ID 688721-xx

CMA-H 04-04-00



## Fieldbus systems

An expansion board can be used to provide the CNC PILOT 640 with a PROFIBUS or PROFINET interface at any time. The modules are integrated in the control system by using a slot on the MC. This makes the connection to an appropriate fieldbus system as master possible. As of version 3.0, the interface is configured with IOconfig.

## PROFIBUS-DP module

Additional module for PROFIBUS-DP:

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

### PROFIBUS-DP additional module

ID 828539-xx



PROFIBUS-DP module

## PROFINET-IO module

Additional module for PROFINET-IO:

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

### 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 also makes their connection to HEIDENHAIN controls even easier. More information on touch probes can be found in the *Touch Probes for Machine Tools* brochure (ID 1113984).

## Workpiece measurement

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

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

TS 260 New generation touch probe for NC machines



TS 260

Touch probe with **radio and infrared transmission** for machines with automatic tool change (see page 35 for the appropriate transceiver unit):

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
- Optionally with EnDat functionality



TS 460 with cylindrical shank

Touch probes with **infrared transmission** for machines with automatic tool change (see page 35 for the appropriate transceiver unit):

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 CNC PILOT 640 has standard cycles for the measurement of tool length and diameter as well as of individual teeth. The CNC PILOT 640 automatically saves the results of measurement in the tool table. It is also possible to measure tool wear between two machining steps. The CNC PILOT 640 automatically compensates the tool dimensions for the subsequent operation, or—just like when a tool breaks—it inserts a replacement tool. The CNC PILOT 640 automatically compensates the tool dimensions for the subsequent operation.

With the triggering **TT touch probes**, the cuboid probe contact is deflected from its resting position by contact with the stationary or rotating tool and a trigger signal is transmitted to the CNC PILOT 640.

TT 160

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



TT 160 with a cuboid probe contact

TT 460

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

Cuboid probe  
contact

The standard TT tool touch probes include a disk-shaped probe contact. For use with lathes, it must be replaced by the cuboid probe contact.

**Transceiver unit**

The radio or infrared transmission is established between the TS or TT touch probe and the SE transceiver unit

- 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 unit for both the TS 460 and TT 460; EnDat functionality for transmission of switching status as well as diagnostic and additional data.
- SE 540** for infrared transmission; integration in the spindle head
- SE 642** for infrared transmission; shared SE for TS and TT



SE 661

The following combinations are possible:

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

\* With EnDat interface

# Electronic handwheels

## Overview

- Support of electronic handwheels is standard on the CNC PILOT 640
- One **HR 550 FS** radio 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 CNC PILOT 640:
- One handwheel via the handwheel input of the main computer
  - One handwheel each on up to four HSCI machine operating panels or the PLB 600x HSCI adapter

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

## HR 510

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

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

	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 510

**HR 520**

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

	Without detent	With detent
<b>HR 520</b>	ID 670302-xx	ID 670303-xx
<b>HR 520 FS</b>	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 like HR 520

In addition:

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

<b>HR 550 FS</b>	Without detent	ID 1200495-xx
	With detent	ID 1183021-xx
<b>Replacement battery</b>	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 on the machine
  - Integrated battery charger for HR 550 FS
  - Connections to the control and the machine
  - Integrated transmitter/receiver unit
  - 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	✓	✓	✓	✓	✓ <sup>1)</sup>	ID 1161072-xx
Adapter cable for HR/ HRA to MC, angled connector (1 m)	✓	✓	✓	✓	✓ <sup>1)</sup>	ID 1218563-01
Extension cable to adapter cable	✓	✓	✓	✓	✓ <sup>1)</sup>	ID 281429-xx
Adapter cable for HRA to MC	–	–	–	–	✓ <sup>2)</sup>	ID 749368-xx
Extension cable to adapter cable	–	–	–	–	✓ <sup>2)</sup>	ID 749369-xx
Adapter connector for handwheels without functional safety	✓	–	✓	–	–	ID 271958-03
Adapter connector for handwheels with functional safety	–	✓	–	✓	–	ID 271958-05

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

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

See also *Cable overview* on Page 48.

## HR 130

Panel-mounted handwheel with ergonomic control knob.  
It is attached to the TE 7x5T either directly or via an extension  
cable.

<b>HR 130</b>	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.

<b>HR 150</b>	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 switches for axis selection and for selecting the subdivision factor. The first and second handwheels are assigned to axes 1 and 2. The third handwheel is assigned to the axes over a selection switch or by machine parameters. The position of the second step switch is evaluated over the PLC, for example to select the subdivision factor.

<b>HRA 110</b>		ID 261097-xx
Mass	≈ 1.5 kg	



HRA 110

# Industrial PC

## Additional operating station

The ITC (industrial thin clients) additional operating stations from HEIDENHAIN are convenient solutions for an additional, remote station for operating the machine or a machine unit, such as a tool-changing station. The remote operation strategy, which is tailored to the CNC PILOT 640, makes it very easy to connect the ITC over a standard Ethernet connection with a cable length of up to 100 m.

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

With touchscreen

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

**ITC 860**<sup>1)</sup> ID 1174935-xx



ITC 860

With soft keys

The **ITC 750** (15-inch screen) or the **ITC 760** (19-inch screen) and the keyboard unit (to be ordered separately) together each comprise a complete second operating station. It is operated in a manner identical to the control.

**ITC 750**<sup>1)</sup> with 15" screen ID 1039544-xx  
for TE 73x  
**ITC 760**<sup>1)</sup> with 19" screen ID 827086-xx  
for TE 74x

<sup>1)</sup> No NRTL approval

**IPC 6641  
for Windows**

With the IPC 6641 industrial PC you can start and remotely operate Windows-based applications via the CNC PILOT 640'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 CNC PILOT 640'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.

<b>IPC 6641</b>	To be installed in	ID 1039543-xx
	Processor	Electrical cabinet Intel Core i7-3 2.1 GHz, quad-core
	RAM memory	8 GB or 16 GB
	Mass	4.0 kg

<b>HDR hard disk</b>		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 a concept for controlling PLC axes independently of the CNC PILOT 640. The PNC 610 has no NC channel and therefore cannot execute interpolated movements. Together with the IPC 6490 operating station, an SIK, and a CFR card as memory medium, the PNC 610 is a separate HSCI system that can be expanded with HEIDENHAIN inverters. The setup of this system is identical to the CNC PILOT 640. All relevant HEIDENHAIN tools and a basic program can be used. The position information can be transmitted over PROFIBUS-DP (optional), PROFINET-IO (optional), or TCP/IP (integrated, system is not capable of real-time), regardless of the platform.

The IPC 6490 auxiliary computer has no connection for a BF display unit.

Auxiliary computer

The IPC 6490 auxiliary computer includes 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 necessary for operation of the CNC PILOT 640:

- IPC 6490 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 to the auxiliary computer and other HSCI components is provided by the PSL 13x supply unit or by the power supply of a UEC compact converter. 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). This DC 24 V PLC is a supply voltage for electric circuits with basic insulation that must not be connected to each other or mixed with safely separated electric circuits.

Design

For installation in the electrical cabinet. The listed auxiliary computer is not supported until NC software 817591-05.

**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

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	
24	Gantry Axes	ID 634621-01	Gantry axes in master-slave torque control	63
46	Python OEM Process	ID 579650-01	Execute Python applications	76
135	Synchronizing Functions	ID 1085731-01	Expanded synchronization of axes and spindles	
143	Load Adapt. Control	ID 800545-01	LAC: Load-dependent adaptation of control parameters	71

## Memory medium

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

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

## SIK component

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

**SIK component for PNC 610** ID 617763-53

## TNCkeygen (accessory)

TNCkeygen is a collection of PC software tools for generating time-limited enabling keys for HEIDENHAIN controls; see "TNCkeygen (accessory)", Page 18.











# 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 5 keys.

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

### Axis keys Orange

	ID 330816-42		ID 330816-24		ID 330816-43		ID 330816-37
	ID 330816-26		ID 330816-36		ID 330816-38		
	ID 330816-23		ID 330816-25		ID 330816-45		

### Gray

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





















### Machine functions

	ID 330816-0X		ID 330816-75		ID 330816-0T		ID 330816-86
	Black ID 330816-1Y		ID 330816-76		ID 330816-81		ID 330816-87
	Black ID 330816-30		ID 330816-77		ID 330816-82		ID 330816-88
	Black ID 330816-31		ID 330816-78		ID 330816-83		ID 330816-94
	Black ID 330816-32		ID 330816-79		ID 330816-84		ID 330816-0U
	ID 330816-73		ID 330816-80		ID 330816-89		ID 330816-91
	ID 330816-74		ID 330816-0S		ID 330816-85		ID 330816-3L

### Spindle functions











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

### Other keys











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	Green ID 330816-11		ID 330816-34		Black ID 330816-28		Black ID 330816-4M
	Red ID 330816-12		ID 330816-13		Black ID 330816-29		ID 330816-3M
	Green ID 330816-49		Green ID 330816-22		ID 330816-92		ID 330816-3N

## Overview for HR 510 and HR 510 FS







Axis keys  
Orange

	ID 1092562-02		ID 1092562-05		ID 1092562-36		ID 1092562-08
	ID 1092562-03		ID 1092562-06		ID 1092562-09		
	ID 1092562-04		ID 1092562-07		ID 1092562-37		







Gray

	ID 1092562-28		ID 1092562-31		ID 1092562-24		ID 1092562-27
	ID 1092562-29		ID 1092562-32		ID 1092562-25		
	ID 1092562-30		ID 1092562-33		ID 1092562-26		













Machine  
functions

	Black ID 1092562-14		Black ID 1092562-15		Black ID 1092562-16		ID 1092562-42
	ID 1092562-43		ID 1092562-44				

Spindle  
functions

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

Other keys

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











# Snap-on keys for 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 5 keys.

## Overview of control keys










































Keys  
Orange

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



















Gray

	ID 679843-03		ID 679843-13		ID 679843-93		ID 679843-B9
	ID 679843-04		ID 679843-14		ID 679843-94		ID 679843-C1
	ID 679843-05		ID 679843-43		ID 679843-B1		ID 679843-C2
	ID 679843-06		ID 679843-44		ID 679843-B2		ID 679843-C3
	ID 679843-07		ID 679843-67		ID 679843-B3		ID 679843-C4
	ID 679843-08		ID 679843-68		ID 679843-B4		ID 679843-C5
	ID 679843-09		ID 679843-69		ID 679843-B5		ID 679843-D9
	ID 679843-10		ID 679843-70		ID 679843-B6		ID 679843-E1
	ID 679843-11		ID 679843-91		ID 679843-B7		
	ID 679843-12		ID 679843-92		ID 679843-B8		































Machine  
functions

	ID 679843-01		ID 679843-30		ID 679843-74		ID 679843-C6
	ID 679843-02		ID 679843-40		ID 679843-76		Black ID 679843-C7
	ID 679843-16		Green ID 679843-56		Black ID 679843-95		ID 679843-D6
	ID 679843-22		Red ID 679843-57		Black ID 679843-96		ID 679843-E3
	ID 679843-23		ID 679843-59		Black ID 679843-A1		ID 679843-E4
	ID 679843-24		ID 679843-60		ID 679843-A2		ID 679843-E6
	ID 679843-25		ID 679843-61		ID 679843-A3		ID 679843-E7
	ID 679843-26		ID 679843-62		ID 679843-A4		ID 679843-E8
	ID 679843-27		ID 679843-63		ID 679843-A5		
	ID 679843-28		ID 679843-64		ID 679843-A6		
	ID 679843-29		ID 679843-73		ID 679843-A9		

## Spindle functions

	ID 679843-18		ID 679843-47		Red ID 679843-52		ID 679843-99
	ID 679843-19		ID 679843-48		ID 679843-65		Green ID 679843-D8
	ID 679843-20		ID 679843-49		Green ID 679843-71		ID 679843-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		ID 679843-F5
	ID 679843-36		ID 679843-66		Black ID 679843-D2		ID 679843-F6
	ID 679843-37		ID 679843-75		ID 679843-D5		
	ID 679843-38		Green ID 679843-90		Red ID 679843-D7		

## Special keys

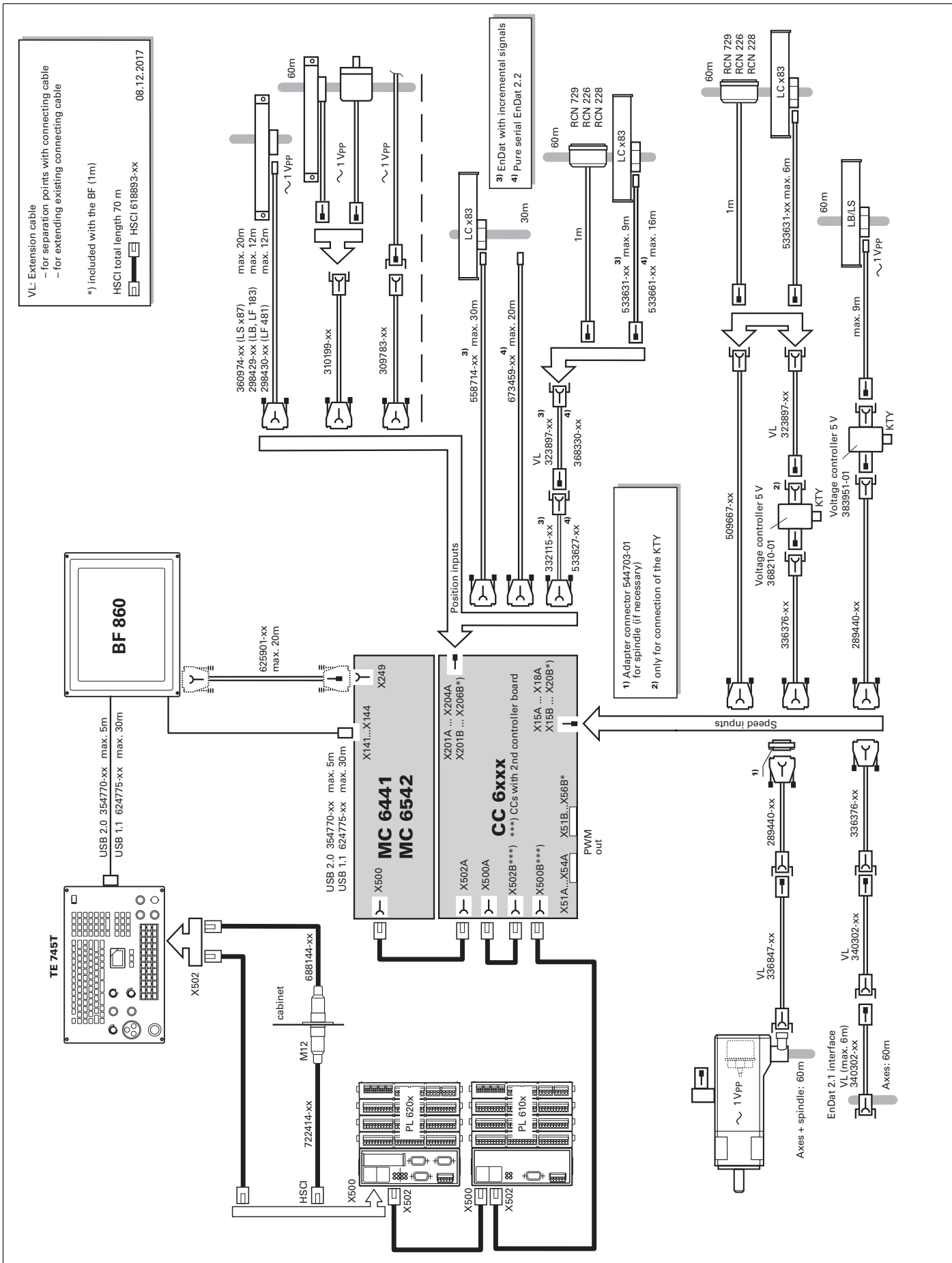
Snap-on keys with customized symbols for special applications can also be manufactured. The laser labeling differs optically from the labeling of the standard keys. If you need keys for special applications, please consult your contact person at HEIDENHAIN.

## Control system with UEC (MC in electrical cabinet)

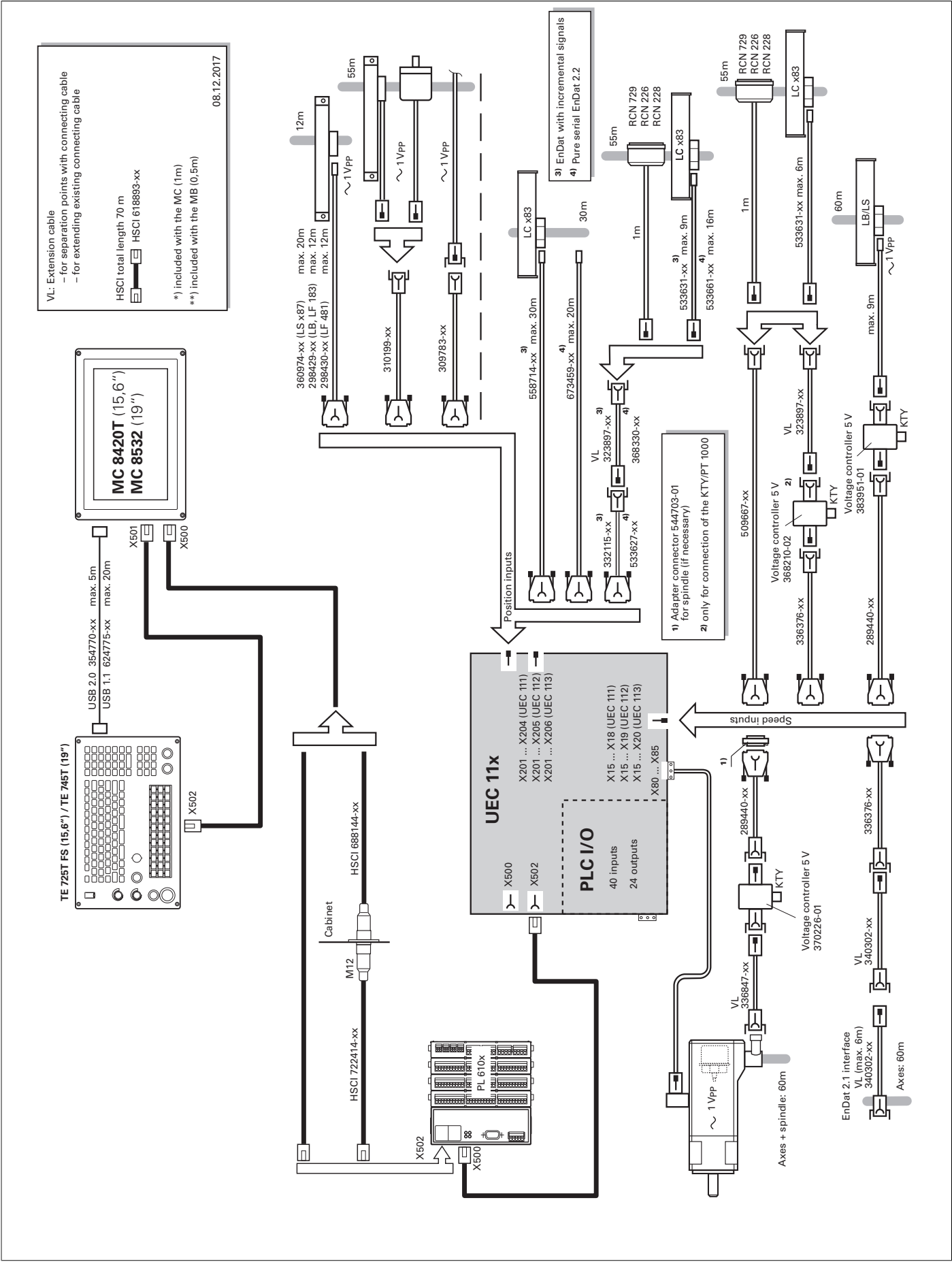
## Control system with UEC (MC in electrical cabinet)



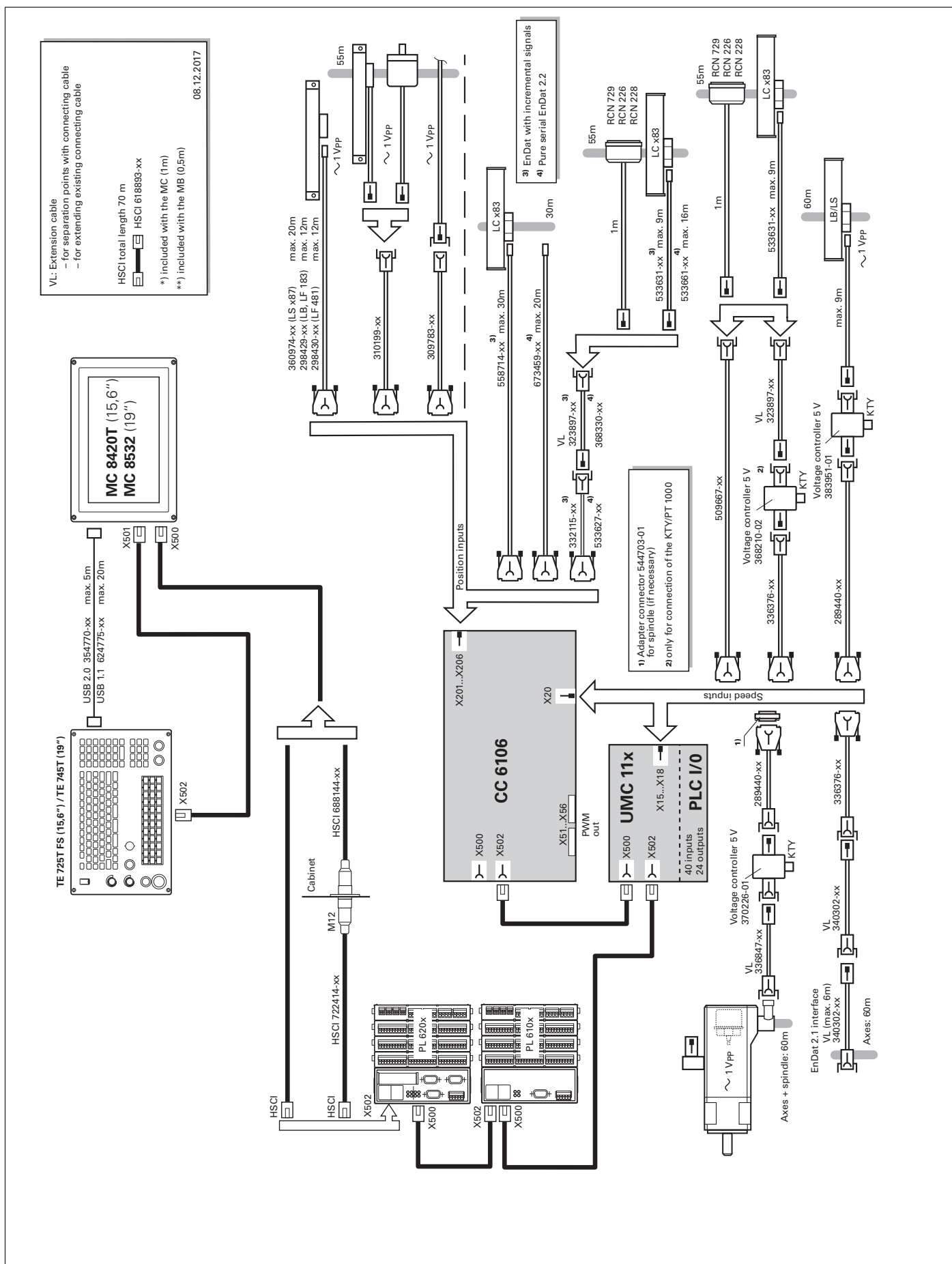
## Control system with CC (MC in electrical cabinet)

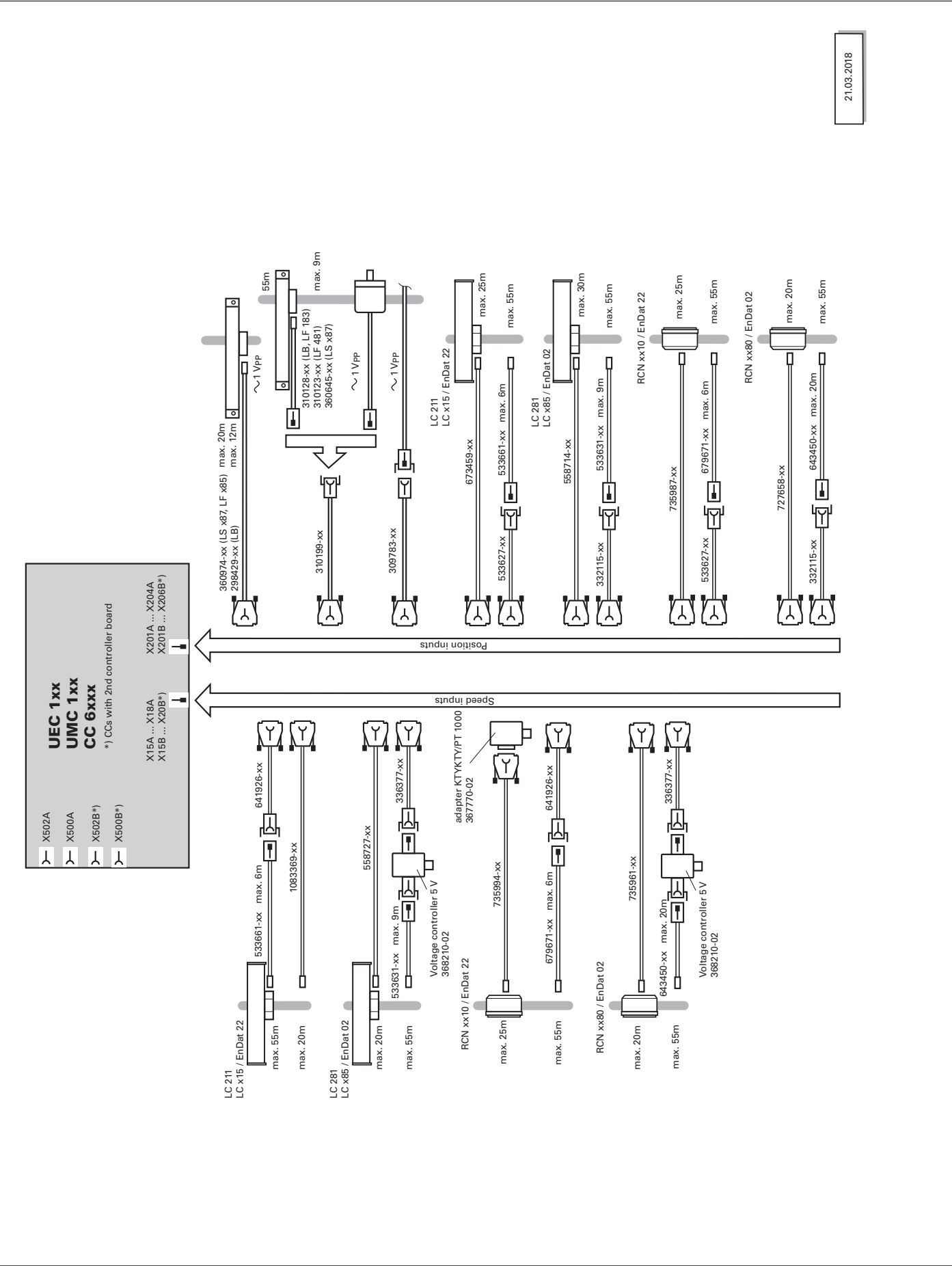


Control system with UEC (MC in operating panel)

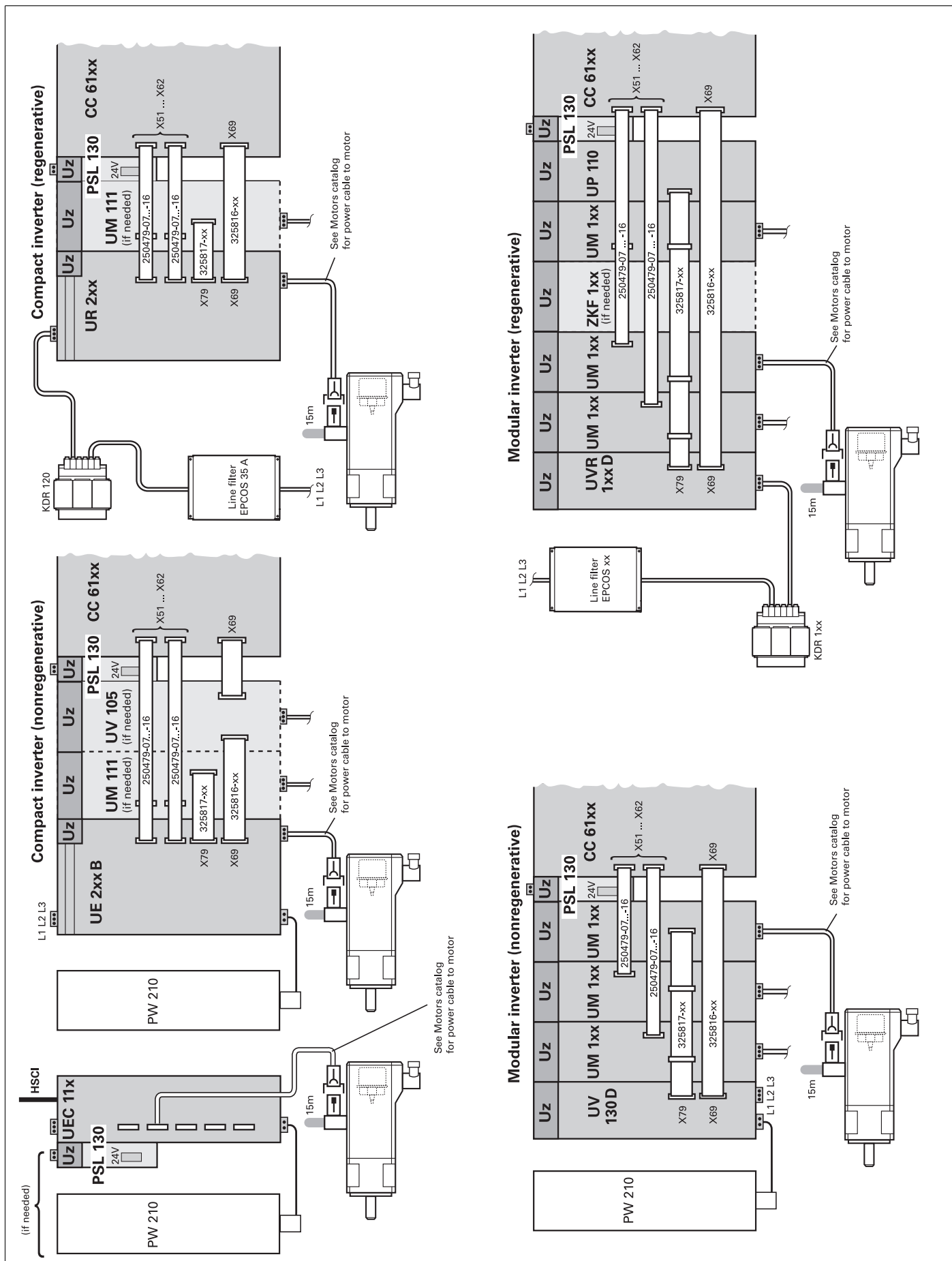


## Control system with CC (MC in operating panel)

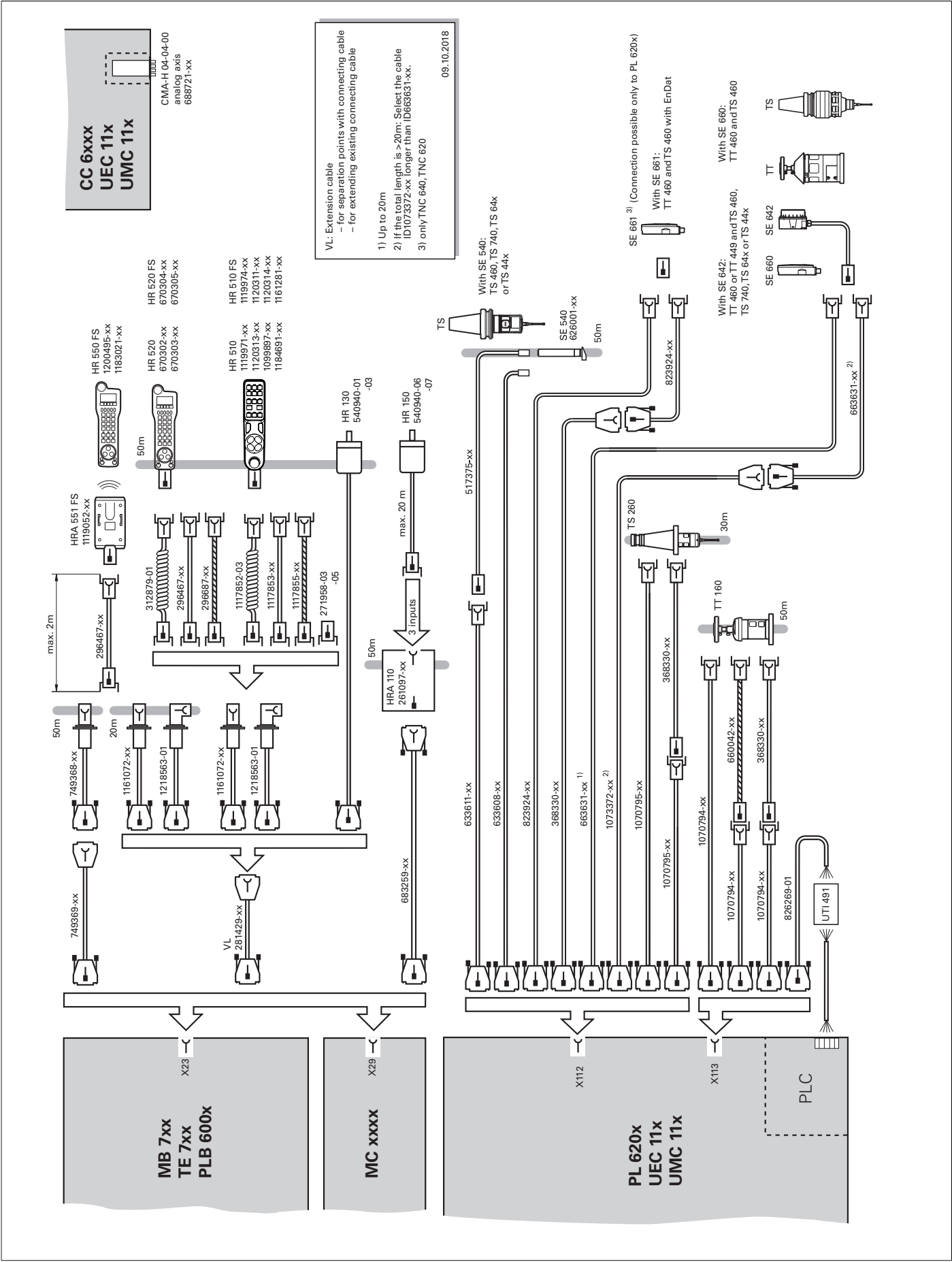




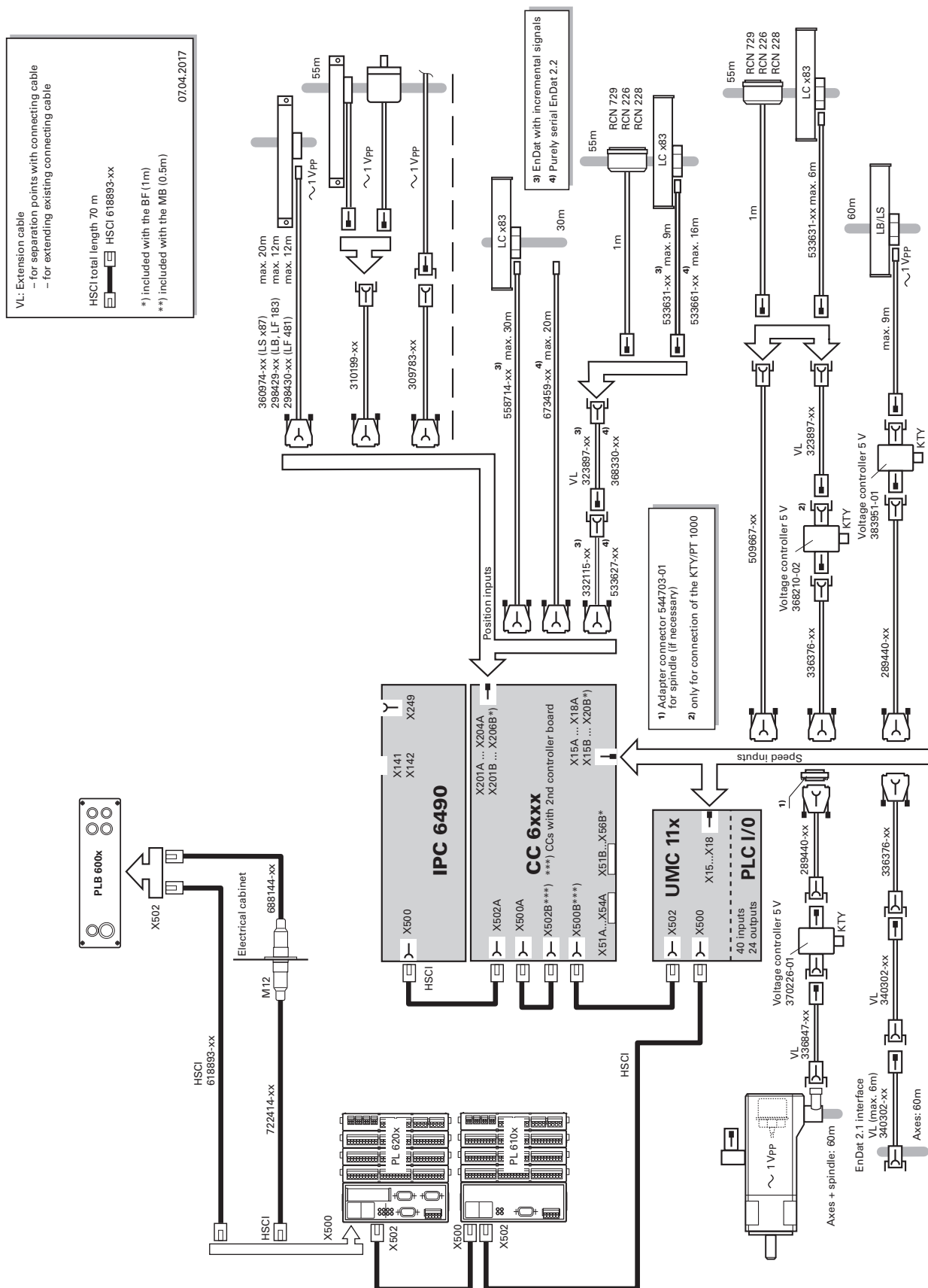
# Inverter system



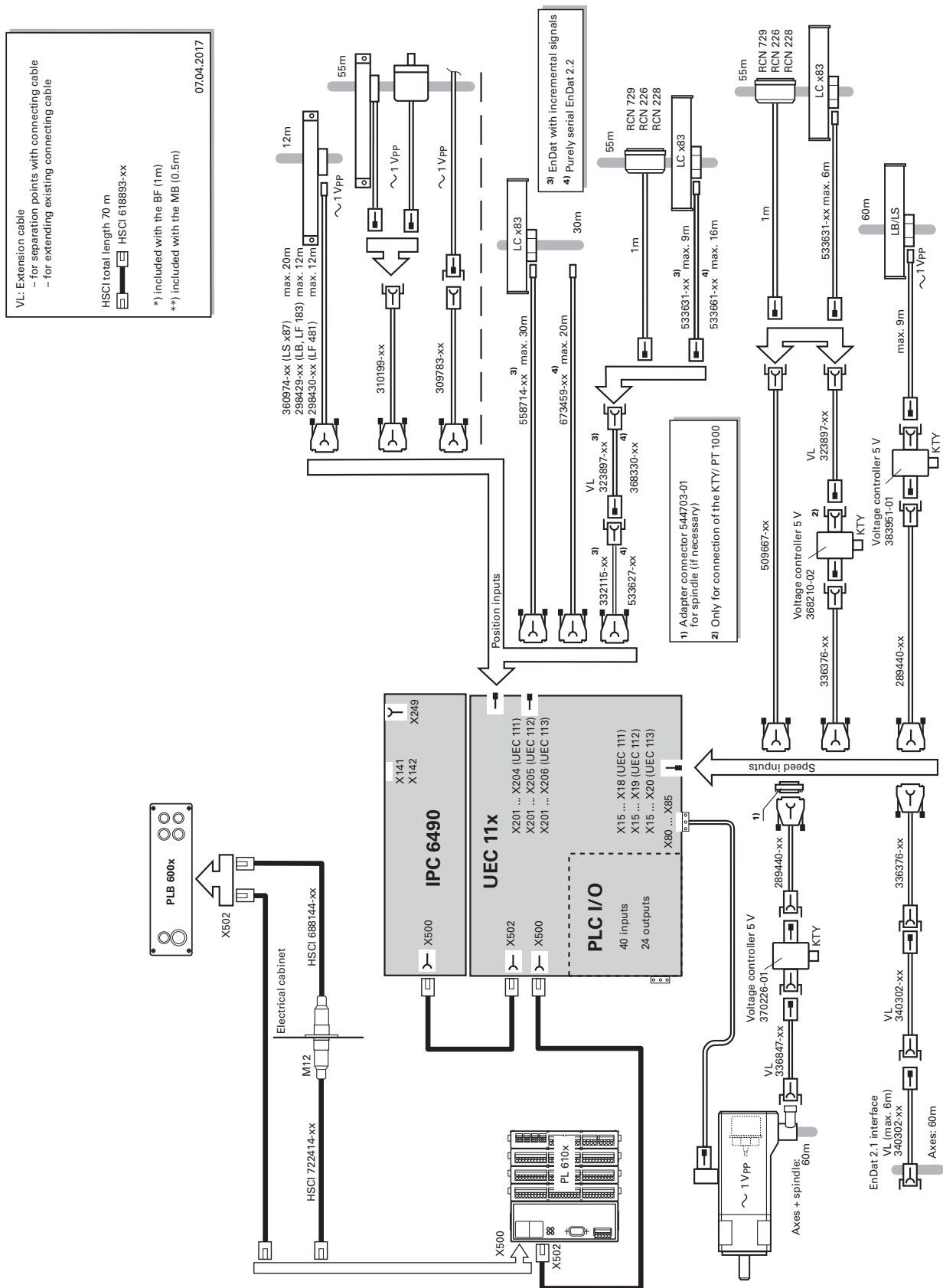
Accessories



PNC 610 with CC



## PNC 610 with UEC



# Technical description

## Digital control design

### Uniformly digital

In the HEIDENHAIN uniformly digital control solution, all components are connected over purely digital interfaces: the control components over **HSCI** (HEIDENHAIN Serial Controller Interface), the new HEIDENHAIN real-time protocol for Fast Ethernet, and the encoders over **EnDat 2.2**, the bidirectional interface from HEIDENHAIN. This achieves a high degree of availability for the entire system. It can be diagnosed and is immune to noise—from the main computer to the encoder. The outstanding characteristics of the uniformly digital solution from HEIDENHAIN guarantee very high accuracy and surface definition together with high traversing speeds. Please refer to the *Uniformly Digital* Technical Information sheet for more detailed information.

### HSCI

HSCI, the HEIDENHAIN Serial Controller Interface, connects the main computer, controller(s), and other control components. The connection between two HSCI components is also 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)
- Inverters connected via proven 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
- Controller units can be installed elsewhere

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 visual display unit and main computer is especially advantageous if the computer is housed in the operating panel. All that is required then is the power supply and an HSCI line to the controller in the electrical cabinet.

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.

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

# Functional safety (FS)

<b>Basic principle</b>	Controls with functional safety (FS) from HEIDENHAIN fulfill the safety integrity level 2 (SIL 2) as per EN 61 508 and the performance level “d” category 3 as per EN ISO 13 849-1 (successor to EN 954-1). These standards describe the assessment of safety-related systems, for example based on the failure probabilities of integrated components and subsystems. The modular approach helps manufacturers of safety-related systems to implement their systems, because they can begin with prequalified subsystems. Safety-related position encoders, the CNC PILOT 640 control and functional safety accommodate this concept. The basis for the controls with functional safety (FS) are two redundant, mutually independent safety channels. All safety-relevant signals are captured, processed, and output via two channels. Errors are detected by mutual comparison of the states and data in the two channels. The occurrence of a single error in the control therefore does not result in a loss of the safety function.
<b>Structure</b>	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 TE 725T 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.
<b>Components</b>	<p>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!</p> <p>Control components with functional safety are recognizable by the suffix FS after the model designation, e.g. TE 725T FS.</p>
<b>MB and TE</b>	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.
<b>PLB</b>	In systems with functional safety (FS), a combination of hardware (FS and standard) is possible, but a PLB 62xx FS is mandatory.
<b>HR</b>	<p>FS handwheels are required in systems with functional safety because only they have the required cross-circuit-proof permissive buttons.</p> <p>For a current list of components approved for FS, see the <i>Functional Safety FS Technical Manual</i>.</p>

## Safety functions

The following safety functions are integrated in 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. TE 725T 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.

## External safety

On 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. The realization of these functions according to EN 13849-1 or DIN IEC 61800-5-2 requires 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 machine tool builder through appropriate wiring of the circuitry.

## 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).

# Operating system

## HEROS 5

The CNC PILOT 640 and the PNC 610 operate with the real-time operating system HEROS 5 from HEIDENHAIN. This future-focused operating system already features powerful functions as the standard setting:

### 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

### Tools

- Web browser: Firefox®\*
- Document Viewer: display of PDF, TXT, XLS, and JDEC 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
- Oage 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

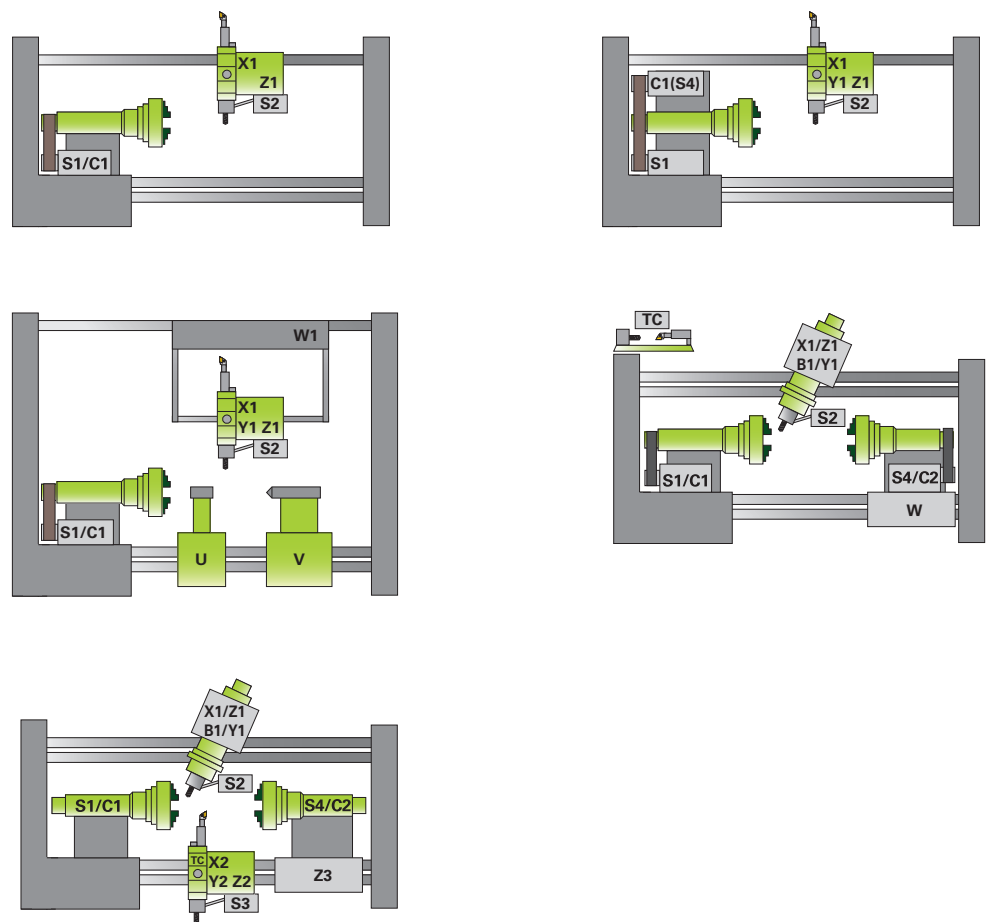


\* Firefox is a registered trademark of the Mozilla Foundation

# Axes

## Overview

The CNC PILOT 640 is a contouring control for CNC lathes and is ideal both for horizontal and vertical lathes as well as vertical boring and turning mills. The CNC PILOT 640 supports lathes with main and counter spindle, C axis or positionable spindle, and driven tools, as well as machines with Y and B axes. In multi-channel machining, different machining steps can be carried out simultaneously using several slides.



## Display and programming

Feed rate in

- mm/min
- mm/revolution
- Feed rate override: 0 % to 150 %
- Maximum feed rate at  $f_{PVM} = 5000 \text{ Hz}$ :

$$\frac{60000 \text{ rpm}}{\text{No. of motor pole pairs}} \cdot \text{Screw pitch [mm]}$$

## Traverse range

–99999.9999 to +99999.9999 [mm]

The machine tool builder defines the traverse range. The user can set additional limits to the traverse range if he wishes to reduce the working space (software limit switch). A protection zone for the spindle (Z–) can also be specified.

## Tool carriers

The CNC PILOT 640 supports quick change tool posts (multifix), tool turrets, and tool magazines. The tool carriers can be located in front of or behind the workpiece.

**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.

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

**B axis (option 54)**

With a B axis it is possible to drill, bore, and mill in oblique planes. Programming, as usual, can be done in the main plane.

Moreover, by tilting the B axis and rotating the tool you can bring it into positions that enable you, for example, to use a single tool to machine in the longitudinal and transverse directions on the main and counter spindles. The number of required tools and tool changes can thus be reduced.

**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).

**Real-time coupling function (option 135)**

The real-time coupling function (synchronizing functions) allows the cyclic calculation of a position offset for an axis from the actual and nominal values of any other axes in the system. This enables you to realize complex simultaneous movements of several NC or PLC axes. The mutual dependence of the axes is defined in mathematical formulas.

**PLC axes**

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

**Multi-channel capability (option 153)**

Multi-channel machining provides up to three channels for asynchronous multi-slide machining. This is regardless of whether several slides simultaneously machine one workpiece or multiple workpieces in the workspace. Furthermore, with multi-channel machining the controlling of loading systems through a free machining channel is possible.

# Spindle and counter spindle

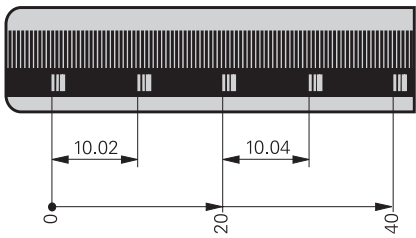
<b>Overview</b>	For machines featuring a higher level of automation, you can position the spindle or counter spindle, or switch to C-axis operation.
<b>Display and programming</b>	Spindle speed: <ul style="list-style-type: none"><li>• Constant shaft speed: 1 to 99999 rpm</li><li>• Constant surface speed: 1 to 9999 m/min</li></ul>
<b>Spindle positioning</b>	Input resolution and display step: 0.001°
<b>Speed limiting</b>	<ul style="list-style-type: none"><li>• The CNC PILOT 640 monitors the actual speed.</li><li>• Speed limiting can be adjusted via parameter and in the feed-rate/spindle/tool menu (TSF menu).</li></ul>
<b>Spindle override</b>	50 to 150 %
<b>Maximum spindle speed</b>	<p>The maximum spindle speed is calculated as follows:</p> $n_{\max} = \frac{f_{\text{PWM}} \cdot 60000 \text{ rpm}}{\text{NPP} \cdot 5000 \text{ Hz}}$ <p><math>f_{\text{PWM}}</math> = PWM frequency in Hz NPP = Number of pole pairs</p>
<b>Gear ranges</b>	A specific parameter set can be defined for each gear range. The gears are switched via the PLC. Up to 10 gear ranges are supported.
<b>Operating mode switchover</b>	For controlling the spindle, different parameter sets can be saved for closed-loop control (e.g. for vye or delta connections). You can switch between the parameter sets in the PLC.
<b>Position-controlled spindle</b>	The position of the spindle is monitored by the control.
<b>Encoder</b>	HEIDENHAIN rotary encoder with sinusoidal voltage signals (1 V <sub>pp</sub> ) or EnDat interface.
<b>C-Axis Machining (option 55)</b>	<p>For milling, drilling, and boring cycles, either the spindle or counter spindle is switched to C-axis operation, or a separate C-axis drive is activated.</p> <p>Input resolution and display step: 0.001°</p>
<b>Counter Spindle (option 132)</b>	The <b>Counter Spindle</b> option is necessary in order to work with a counter spindle. The Spindle Synchronism option is included in the Counter Spindle option.

# Driven tool

<b>Overview</b>	The driven tool is used for drilling and tapping holes as well as for milling in M19 or C-axis operation. Programs for the driven tool can be input in manual operation, via cycles with smart.Turn, or in the DIN editor.
<b>Display and programming</b>	Speed of the driven tool: <ul style="list-style-type: none"><li>• Constant shaft speed: 1 to 99999 rpm</li><li>• Constant surface speed: 1 to 9999 m/min</li></ul>
<b>Speed limiting</b>	<ul style="list-style-type: none"><li>• The CNC PILOT 640 monitors the actual speed.</li><li>• Speed limiting can be adjusted via parameter and in the feed-rate/spindle/tool menu (TSF menu).</li></ul>
<b>Spindle synchronism (option 131)</b>	The <b>Spindle Synchronism</b> option is necessary for special operations with a driven tool (e.g. polygonal turning.) This option is included in the Counter Spindle option.

# Encoders

Overview	For speed and position control of the axes and spindle, HEIDENHAIN offers both incremental and absolute encoders.
Incremental encoders	Incremental encoders have as measuring standard a grating consisting of alternate lines and spaces. Relative movement between the scanning head and the scale causes the output of sinusoidal scanning signals. The measured value is calculated by counting the signals.
Reference mark	When the machine is switched on, the machine axes need to traverse a reference mark for an accurate reference to be established between measured value and machine position. For encoders with distance-coded reference marks, the maximum travel until automatic reference mark evaluation for linear encoders is only 20 mm or 80 mm, depending on the model, or 10° or 20° for angle encoders.
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 <sub>PP</sub> levels are suitable for connection to HEIDENHAIN numerical controls.
Absolute encoders	With absolute encoders, the position information is contained in several coded tracks. Thus, an absolute reference is available immediately after switch-on. Reference-mark traverse is not necessary. Additional incremental signals are output for highly dynamic control loops.
EnDat interface	<p>The CNC PILOT 640 features the serial EnDat 2.2 interface (includes EnDat 2.1) for the connection of absolute encoders.</p> <p><b>Note:</b> The EnDat interface on HEIDENHAIN encoders differs in its pin assignment from the interface on Siemens motors with integrated absolute ECN/EQN rotary encoders. Special adapter cables are available.</p>
Encoder inputs	<p>Incremental and absolute linear, angle, or rotary encoders from HEIDENHAIN can be connected to all <b>position encoder</b> inputs of the controller unit.</p> <p>Incremental and absolute rotary encoders from HEIDENHAIN can be connected to all <b>speed encoder</b> inputs of the controller unit.</p>

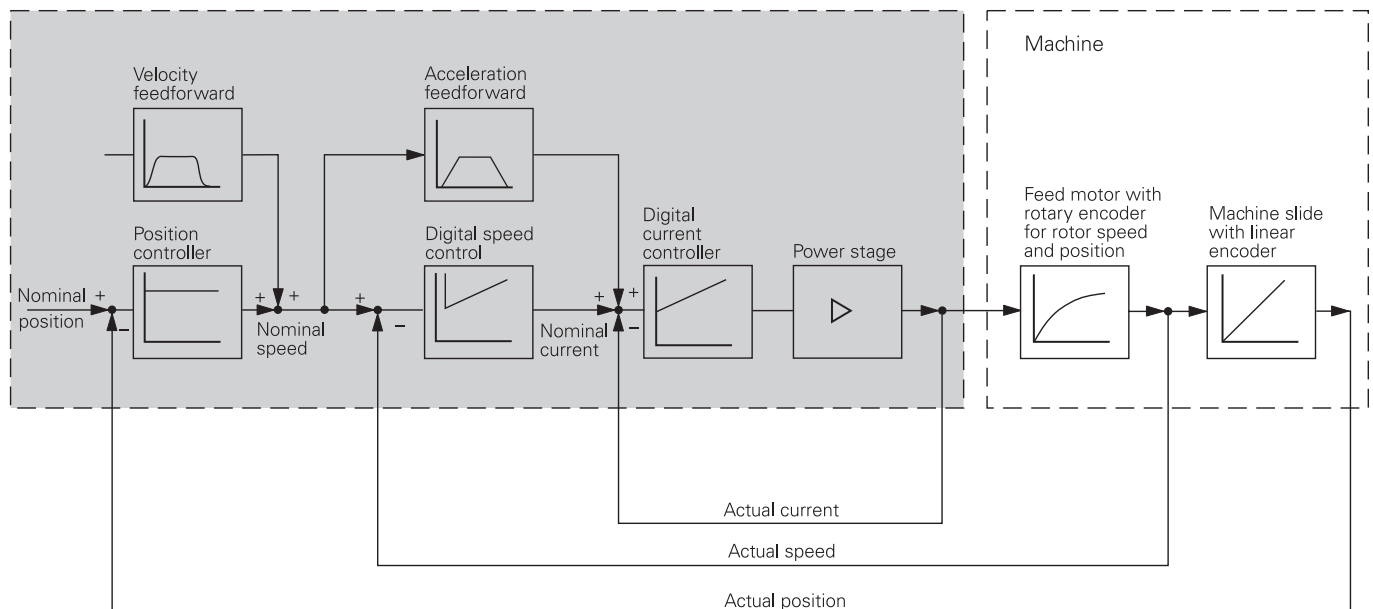


Inputs	Signal level/ Interface <sup>1)</sup>	Input frequency <sup>1)</sup>	
		Position	Speed
Incremental signals	~1 V <sub>PP</sub> EnDat 2.1	33 kHz/350 kHz	350 kHz
Absolute position values	EnDat 2.1 EnDat 2.2	—	—

<sup>1)</sup> Switchable

# Digital servo control

**Integrated inverter** Position controllers, speed controllers, current controllers, and inverters are integrated in the CNC PILOT 640. HEIDENHAIN synchronous or asynchronous motors are connected to the CNC PILOT 640.



**Axis feedback control** The CNC PILOT 640 can be operated with following error or feedforward control.

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

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

**Control loop cycle times**

The cycle time for **path interpolation** is defined as the time interval during which interpolation points on the path are calculated. The cycle time for **fine interpolation** is defined as the time interval during which interpolation points are calculated that lie 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 <sup>1)</sup> at $f_{PWM} = 5000\text{ Hz}$
Position controller	0.2 ms/0.1 ms at $f_{PWM} = 5000\text{ Hz}$
Speed controller	0.2 ms/0.1 ms <sup>1)</sup> at $f_{PWM} = 5000\text{ Hz}$
Current controller	0.1 ms at $f_{PWM} = 5000\text{ Hz}$

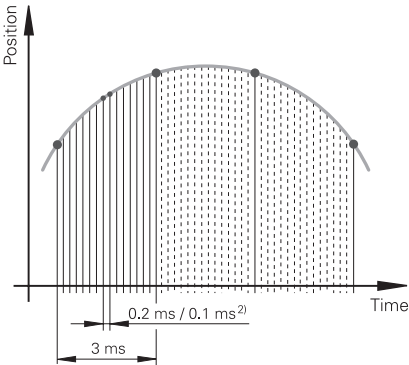
<sup>1)</sup> Double speed (with option 49)

**Double-speed control loops (option 49)**

Double-speed control loops permit higher PWM frequencies as well as shorter cycle times of the speed controller. This makes improved current control for spindles possible, and also higher control performance for linear and torque motors.

**Crossover Position Filter (CPF)**

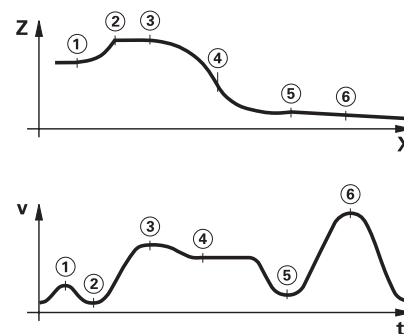
To increase the stability of the position control loop in systems with resonances, the position signal from the position encoder, which is filtered through a low-pass filter, is combined with the position signal from the motor speed encoder, which is filtered through a high-pass filter. This signal combination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



# Fast machining

## Look-ahead

The CNC PILOT 640 calculates the geometry ahead of time in order to adjust the feed rate. In this way, directional changes are detected in time to accelerate or decelerate the appropriate NC axes.



## Jerk

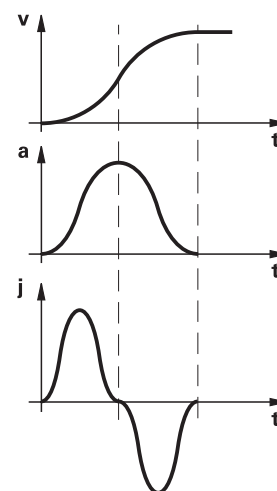
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

## Jerk limiting

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

## Smoothed jerk

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



## Advanced Dynamic Prediction (ADP)

The Advanced Dynamic Prediction feature (ADP) expands the conventional look-ahead of the permissible maximum feed rate profile and makes optimized motion control possible to produce clean surfaces and perfect contours. ADP shows its strengths for example during bidirectional finish milling through symmetrical feed behavior on the forward and reverse paths as well as through particularly smooth feed rate curves on parallel milling paths. NC programs that are generated on CAM systems negatively influence the machining process through various factors such as short step-like contours, coarse chord tolerances, and heavily rounded end-point coordinates. Through an improved reaction to such influence quantities and the exact fulfillment of dynamic machine parameters, ADP not only improves the surface quality of the workpiece, it also optimizes the machining time.

# 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 path traversed (movement monitoring)
- Position deviation at standstill
- Nominal speed value
- Checksum of safety-related functions
- Supply voltage
- Voltage of buffer battery
- Operating temperature of the MC and CPU
- Run time of the PLC program
- Motor current and 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 CNC PILOT 640 in the machine's EMERGENCY STOP loop is checked when the control system is switched on. In the event of an error, the control displays a message in plain language.

## 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.

## Load monitoring (option 151)

Load monitoring monitors the load that occurs during machining processes, in order to detect the wear or breakage of tools. By performing a reference operation for each machining step, the nominal load on the drives is determined. The actual drive load is then continuously compared to the nominal load. Up to four drives can be monitored per machining step. Two definable limit values lead to error reactions should a tool wear out or break.

### Tool wear

If the load and/or the load integral exceed the limit value for tool wear, the CNC PILOT 640 marks the current tool as worn out. With active tool life monitoring the tool will automatically be replaced by a defined replacement tool the next time it is called.

### Tool breakage

If the load exceeds the limit value for tool breakage, the CNC PILOT 640 immediately stops machining (cycle stop).

Meaningful error messages are issued if the limit values are exceeded. Furthermore, the CNC PILOT 640 can display the load values numerically and graphically in a separate window.

\* No safety functions

# Error compensation

<b>Overview</b>	The CNC PILOT 640 automatically compensates mechanical errors of the machine.
<b>Linear error</b>	Linear error can be compensated over the entire travel range for each axis.
<b>Nonlinear error</b>	The CNC PILOT 640 can compensate for ball-screw pitch errors and sag errors simultaneously. The compensation values are stored in a table. Nonlinear axis-error compensation also makes it possible to compensate for position-dependent backlash.
<b>Backlash</b>	The play between table movement and rotary encoder movement on direction changes can be compensated in length measurements by spindle and rotary encoder. This backlash is outside the controlled system.
<b>Hysteresis</b>	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.
<b>Reversal spikes</b>	In circular movements, reversal spikes can occur at quadrant transitions due to mechanical influences. The CNC PILOT 640 can compensate for these reversal spikes.
<b>Static friction</b>	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 CNC PILOT 640 can compensate for this problem condition.
<b>Sliding friction</b>	Sliding friction is compensated by the speed controller of the CNC PILOT 640.
<b>Thermal expansion</b>	<p>To compensate thermal expansion, the machine's expansion behavior must be known.</p> <p>The temperature can be recorded via thermistors connected to the analog inputs of the CNC PILOT 640. The PLC evaluates the temperature information and transfers the compensation value to the NC.</p>
<b>Load Adaptive Control (LAC) (option 143)</b>	<p>LAC (option 143) enables you to adapt controller parameters dynamically depending on the load or friction.</p> <p>In order to optimize changed control behavior at differing loads, adaptive feedforward controls can exploit data on acceleration, holding torque, static friction, and friction</p> <p>The CNC PILOT 640 currently has no cycle for determining the load. If you want to use software option 143, please consult your contact person at HEIDENHAIN.</p>

# Commissioning and diagnostic aids

## Overview

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

## ConfigDesign (accessory)

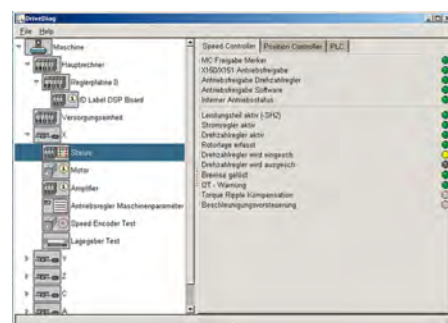
PC software for configuring the machine parameters

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

## DriveDiag

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

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

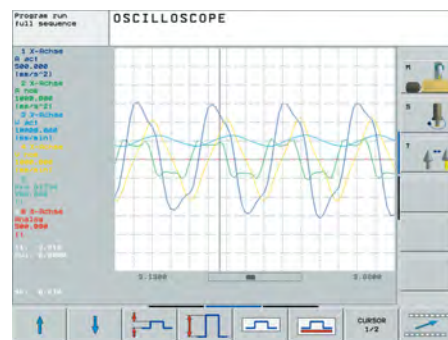


DriveDiag can be called immediately at the control through the diagnostics soft key. End users have read-access, whereas the code number for the machine tool builder gives access to comprehensive testing possibilities with DriveDiag.

## Oscilloscope

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

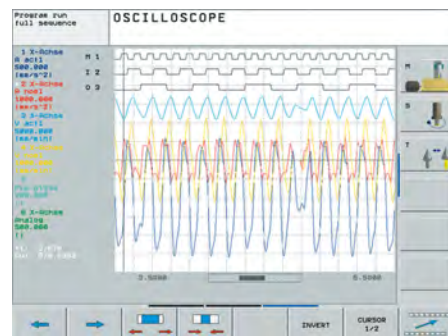
- Actual value and nominal value of the axis feed rate
- Contouring feed rate
- Nominal and actual position
- Following error of the position controller
- Content of PLC operands
- Encoder signal (0° – A) and (90° – B)
- Difference between position and speed encoder
- Nominal velocity value
- Integral-action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

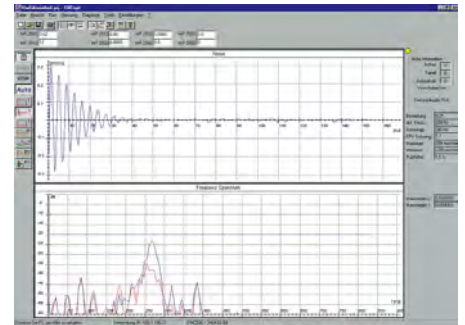
- Marker (M)
- Input (I)
- Output (O)
- Timers (T)
- Counter (C)
- IpoLogic (X)



**TNCopt  
(accessory)**

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

- Commissioning the current controller
- Commissioning the velocity controller (automatic)
- Optimization of sliding-friction compensation (automatic)
- Optimization of the reversal-spike compensation (automatic)
- Optimization of the  $k_v$  factor (automatic)
- Circular interpolation test, contour test



**Online Monitor  
(OLM)**

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

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

**TNCscope  
(accessory)**

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

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

**TeleService  
(accessory)**

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

<b>Single station license</b>	ID 340449-xx
<b>Network license</b>	For 14 workstations ID 340454-xx
	For 20 workstations ID 340455-xx

**Bus diagnosis**

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

**TNCtest**

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

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

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

**TNCanalyzer**

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

**Function**

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

# Integrated PLC

## Overview

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

## PLC inputs/outputs

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

## PLC programming

Format	Statement list
Memory	350 MB
Cycle time	9 ms to 30 ms (adjustable)
Command set	<ul style="list-style-type: none"> <li>• Bit, byte, and word commands</li> <li>• Logical operations</li> <li>• Arithmetic commands</li> <li>• Comparisons</li> <li>• Bracketed terms</li> <li>• Jump commands</li> <li>• Subprograms</li> <li>• Stack operations</li> <li>• Submit programs</li> <li>• Timers</li> <li>• Counters</li> <li>• Comments</li> <li>• PLC modules</li> <li>• Strings</li> </ul>

## 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 only be read 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 be backed up from the control to a separate data medium (USB drive, network, e.g. through TNCremo) and later restored. You need not enter the password, but the data cannot be read until the keyword is supplied.

## PLC window

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

## PLC soft keys

The machine manufacturer can display his own PLC soft keys in the vertical soft-key row on the screen.

## PLC positioning

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

## PLC axes

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

**PLCdesign  
(accessory)**

PC software for PLC program development.  
The PC program **PLCdesign** can be used for easy creation of PLC programs. 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). 10 MB of dedicated memory are reserved for this function. 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:

- Controlling all axes
- Clamped axes
- Homing the axes; reference end positions
- Compensating the axis temperature
- Feed rate control
- Control and orientation of the spindles (S1 to S5)
- Spindle brake
- Gear switching via M functions
- C axis via main drive
- C axis with separate drive
- Vertical PLC soft-key row
- Support for 19" screens
- Displaying and managing PLC error messages
- Hydraulic control
- Hydraulic chuck
- Control of the coolant system (internal, external, air)
- M functions
- Lubrication
- Chip conveyor
- PLC support for handwheels
- Control of doors
- Tool change with multifix
- Positioning of the tool turret with three-phase motor

# Interfacing to the machine

## **OEM cycles**

The machine manufacturer has the possibility of creating his own UNITS for programming in smart.Turn (menus, texts, dialogs, and evaluations). These UNITS can be called by a menu item in the UNIT menu.

With the CNC PILOT 640 you can create your own manufacturer cycles (OEM G functions). The range G500 to G590 is intended for these G functions. They can be called via the G-function menu and integrated directly into the NC program.

In addition to the OEM G functions, PLC G functions (G602 to G699) can also be defined. The PLC G functions are processed directly in the PLC.

## **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 CNC PILOT 640.

## **Tool calibration**

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

## **Touch probe configuration**

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

## **Magazine management**

The magazine management provides several functions for various magazine types:

- Loading and unloading of tools in chain-type magazines
- Loading and unloading between magazine and spindle
- Support for manual tools in manual magazines
- Support for block search in tool magazines

# Data transfer and communication

## Data interfaces

<b>Overview</b>	The CNC PILOT 640 is connected to PCs, networks, and other data storage devices via data interfaces.	
<b>Ethernet</b>	The CNC PILOT 640 can be interconnected via the Ethernet interface. For connection to the data network, the control features a 1000BASE-T (twisted pair Ethernet) connection.	
	Maximum transmission distance: Unshielded: 100 m Shielded: 400 m	
Protocol	The CNC PILOT 640 communicates using the TCP/IP protocol.	
Network connection	<ul style="list-style-type: none"><li>• NFS file server</li><li>• Windows networks (SMB)</li></ul>	
Data transfer speed	Approx. 400 to 800 Mbps (depending on file type and network utilization)	
<b>RS-232-C/V.24</b>	Data interface according to DIN 66 020 or EIA standard RS-232-C. Maximum transmission distance: 20 m	
Data transfer rate	115 200; 57 600; 38 400; 19 200; 9600; 4800; 2400; 1200; 600; 300; 150; 110 bps	
Protocols	The CNC PILOT 640 can transfer data using various protocols.	
Standard data transfer	The data is transferred character by character. The number of data bits, stop bits, the handshake, and character parity must be set by the user.	
Blockwise data transfer	The data is transferred blockwise. A block check character (BCC) is used 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.	
Adapter block	For connecting the interface to the electrical cabinet or operating panel.	
	<b>RS-232-C adapter</b>	9-pin ID 363987-xx 25-pin ID 310085-xx
<b>USB</b>	The CNC PILOT 640 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.	
<b>USB cables</b>	Cable length up to 5 m	ID 354770-xx
	Cable length 6 m to 30 m with integrated amplifier; limited to USB 1.1.	ID 624775-xx

**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 CNC PILOT 640 and a PC.

**TNCremo (accessory)**

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

Functions:

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

**TNCremoPlus (accessory)**

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

Additional functions:

- Interrogation of DNC data (NC up time, Machine up time, 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 Ethernet connection (e.g. Windows PC). The information is displayed on the control's screen. The 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 come to terms with the increasingly complex requirements of the machine's environment.

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

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

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

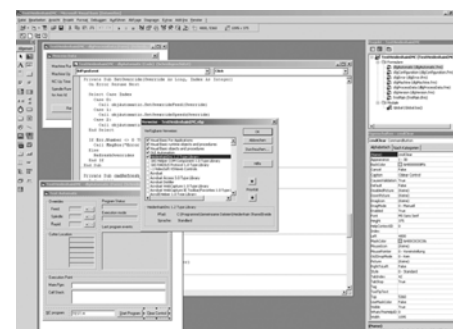
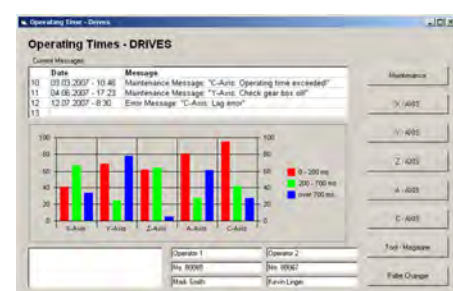
## RemoTools SDK (accessory)

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

## RemoTools SDK

ID 340442-xx

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



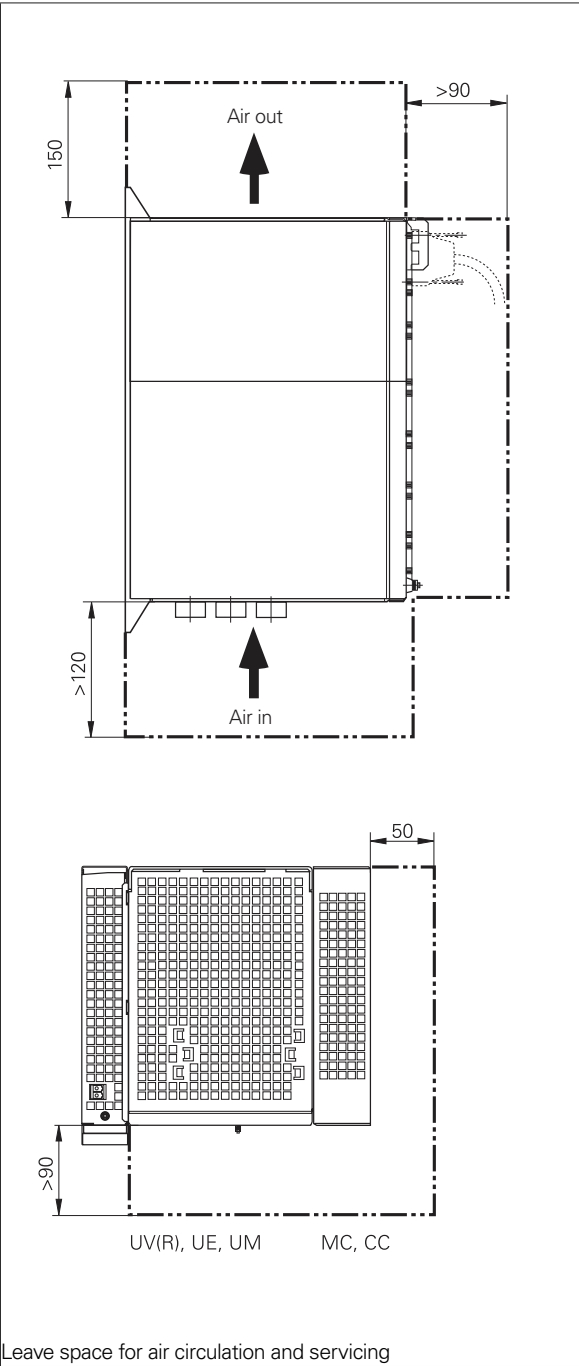
# Mounting information

## Clearances and mounting

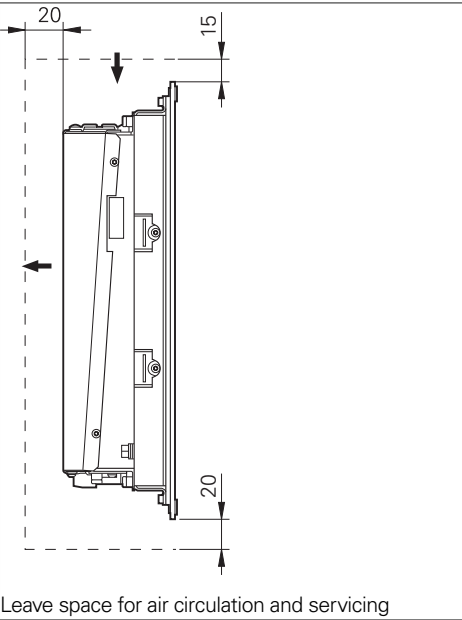
**Proper minimum clearance**

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

Installation in an electrical cabinet



Installation in an operating panel



**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

- Keep a minimum distance of 20 cm from the MC, CC, and its leads to devices that carry interference signals
- Keep a minimum distance of 10 cm from the MC, CC, and its leads to cables that carry interference signals. For cables in metallic ducting, adequate decoupling can be achieved by using a grounded separation shield.
- Shielding according to EN 50 178
- Use equipotential bonding 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.

Main computer

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



# MC 6441, IPC 6641

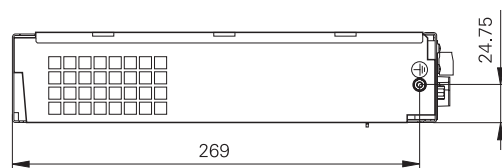
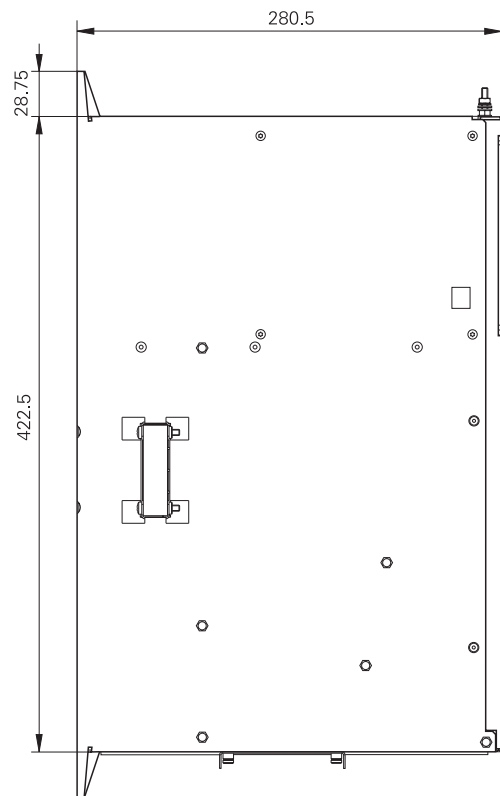
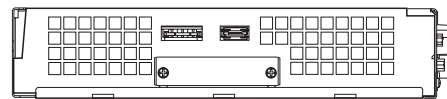
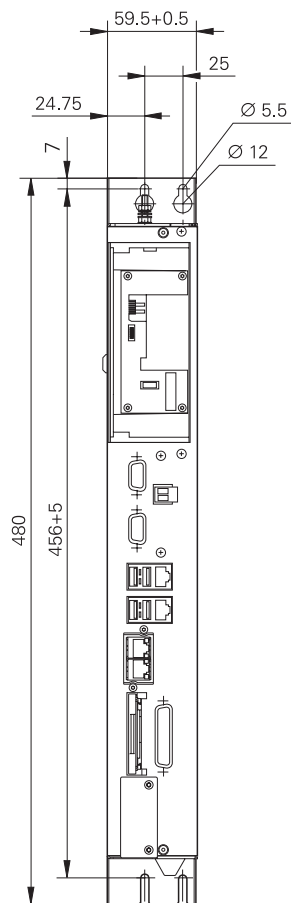
mm



Tolerancing ISO 8015

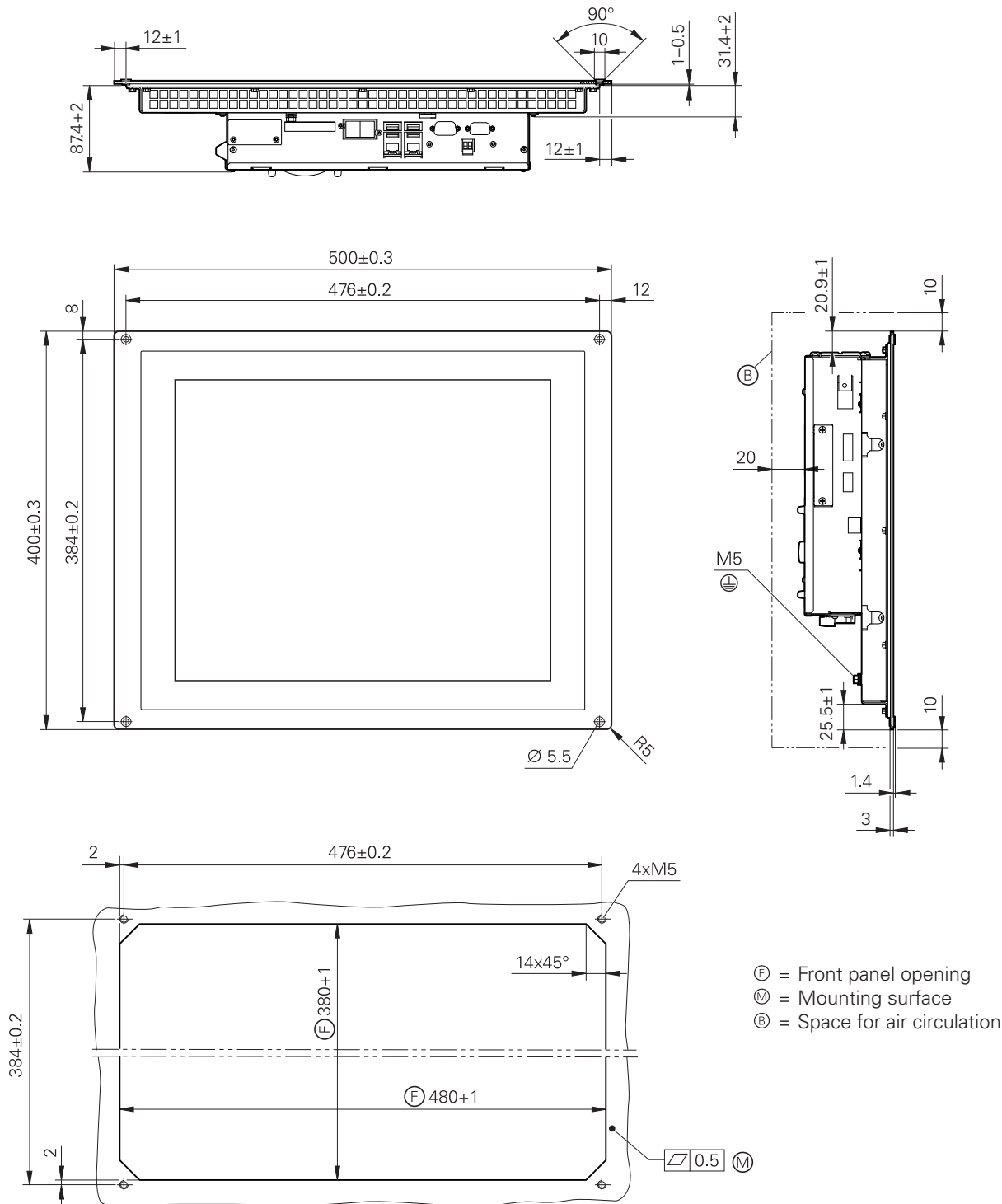
ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



MC 8532

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



# MC 8420T

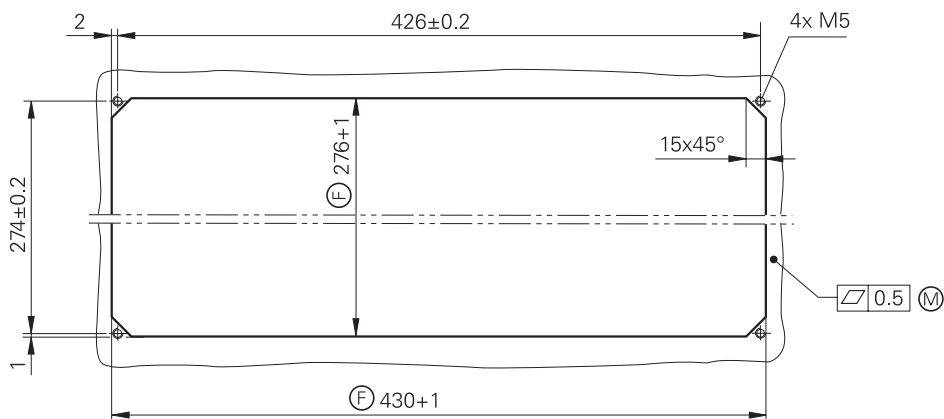
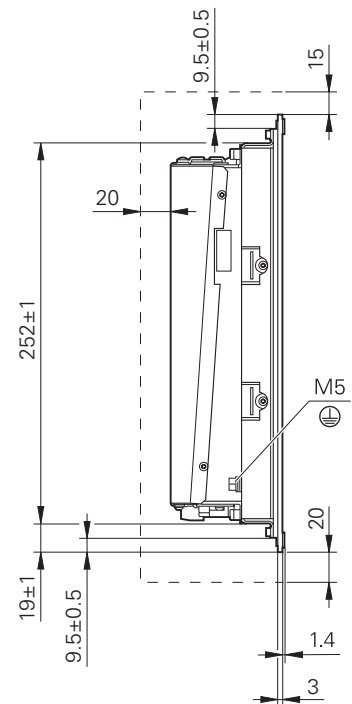
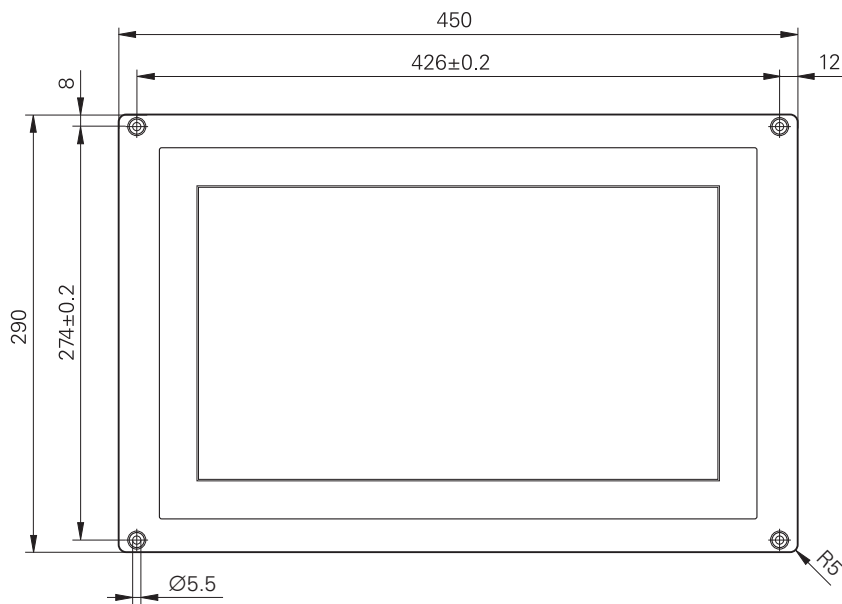
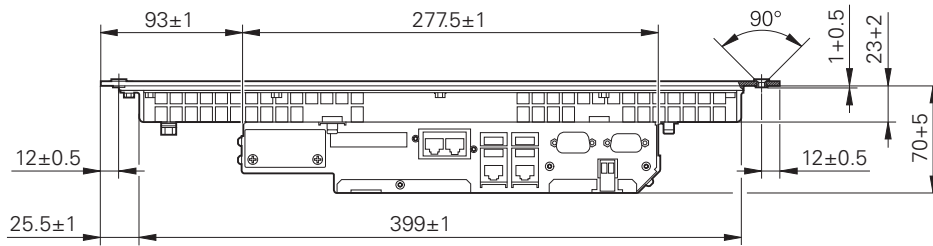
mm



Tolerancing ISO 8015

ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm

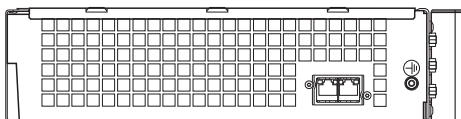
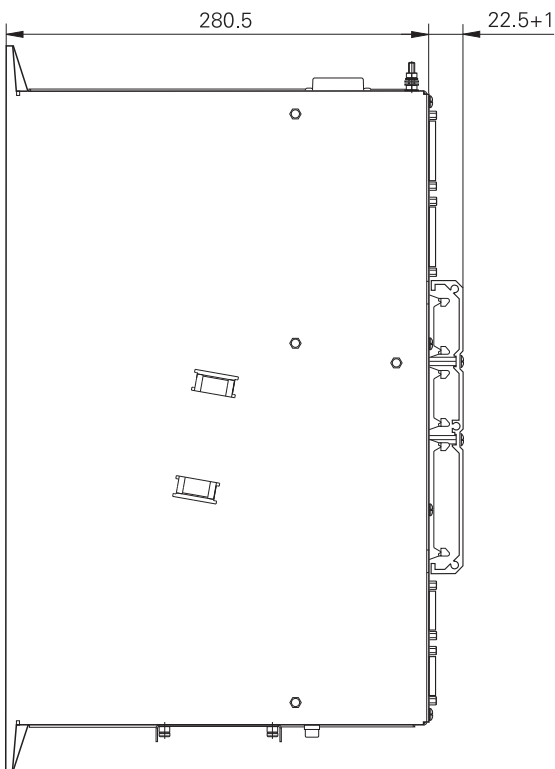
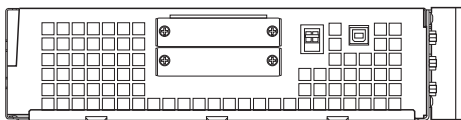
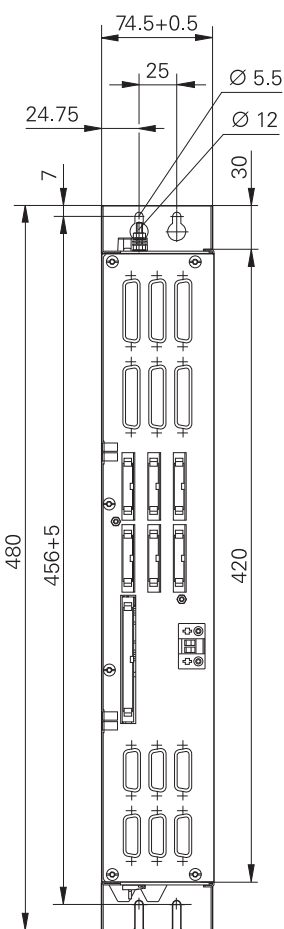


- ⊕ = Front panel opening
- Ⓜ = Mounting surface
- ⊕ = Space for air circulation

# Controller unit

CC 6106

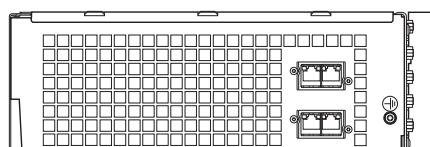
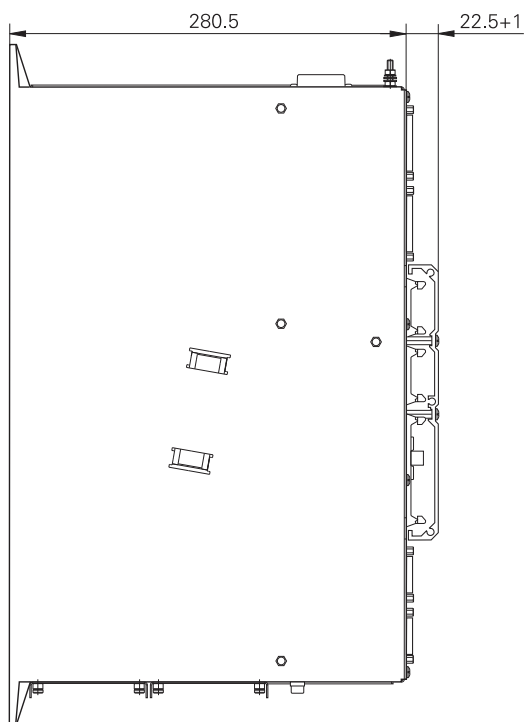
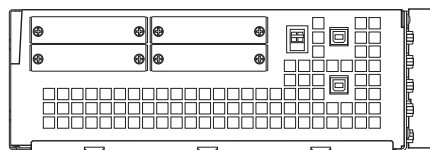
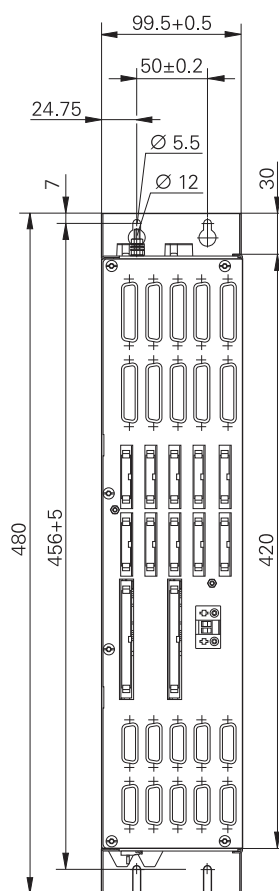
mm  
  
Tolerancing ISO 8015  
ISO 2768 - m H  
< 6 mm: ±0.2 mm



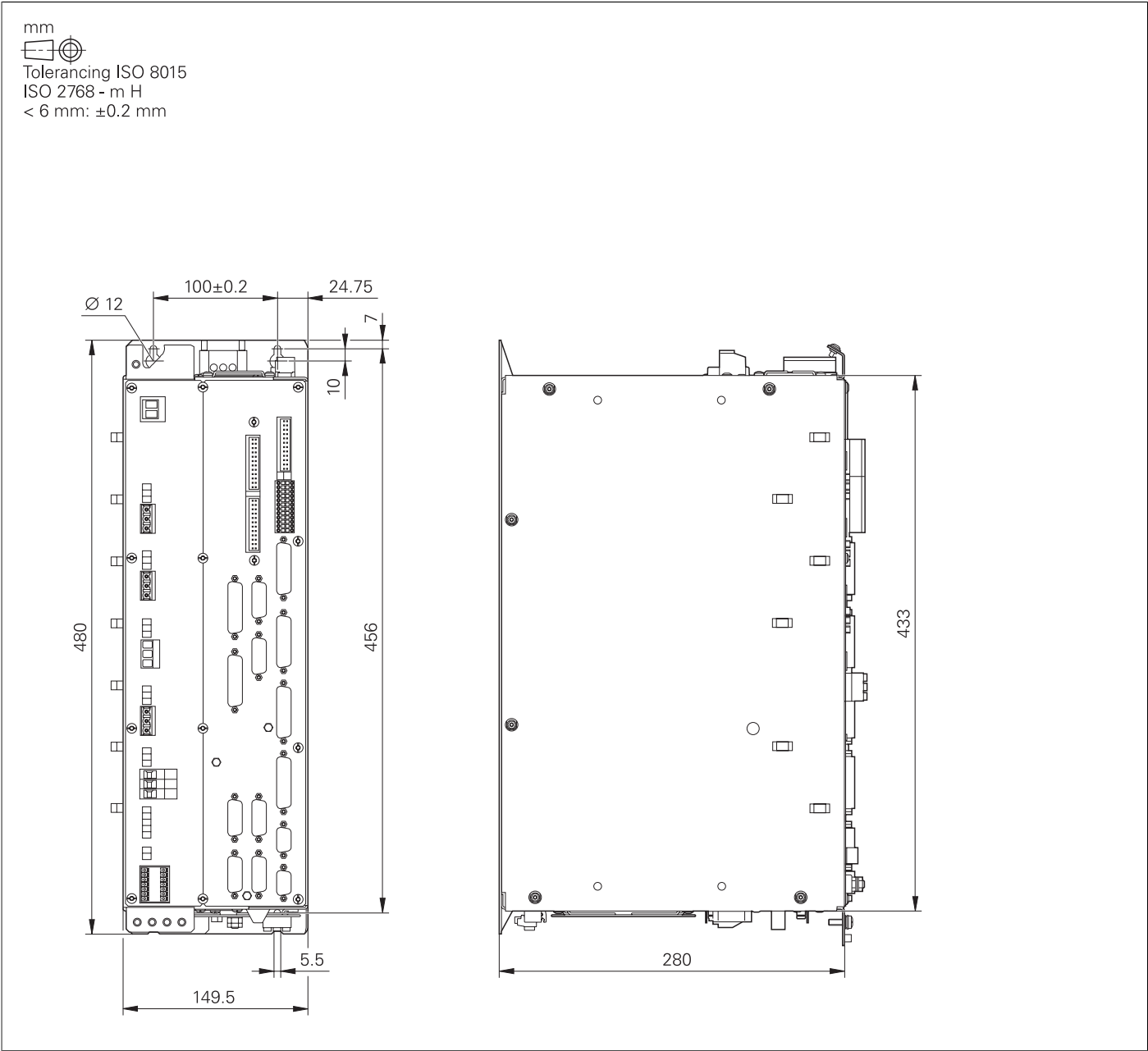
**CC 6108, CC 6110**

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

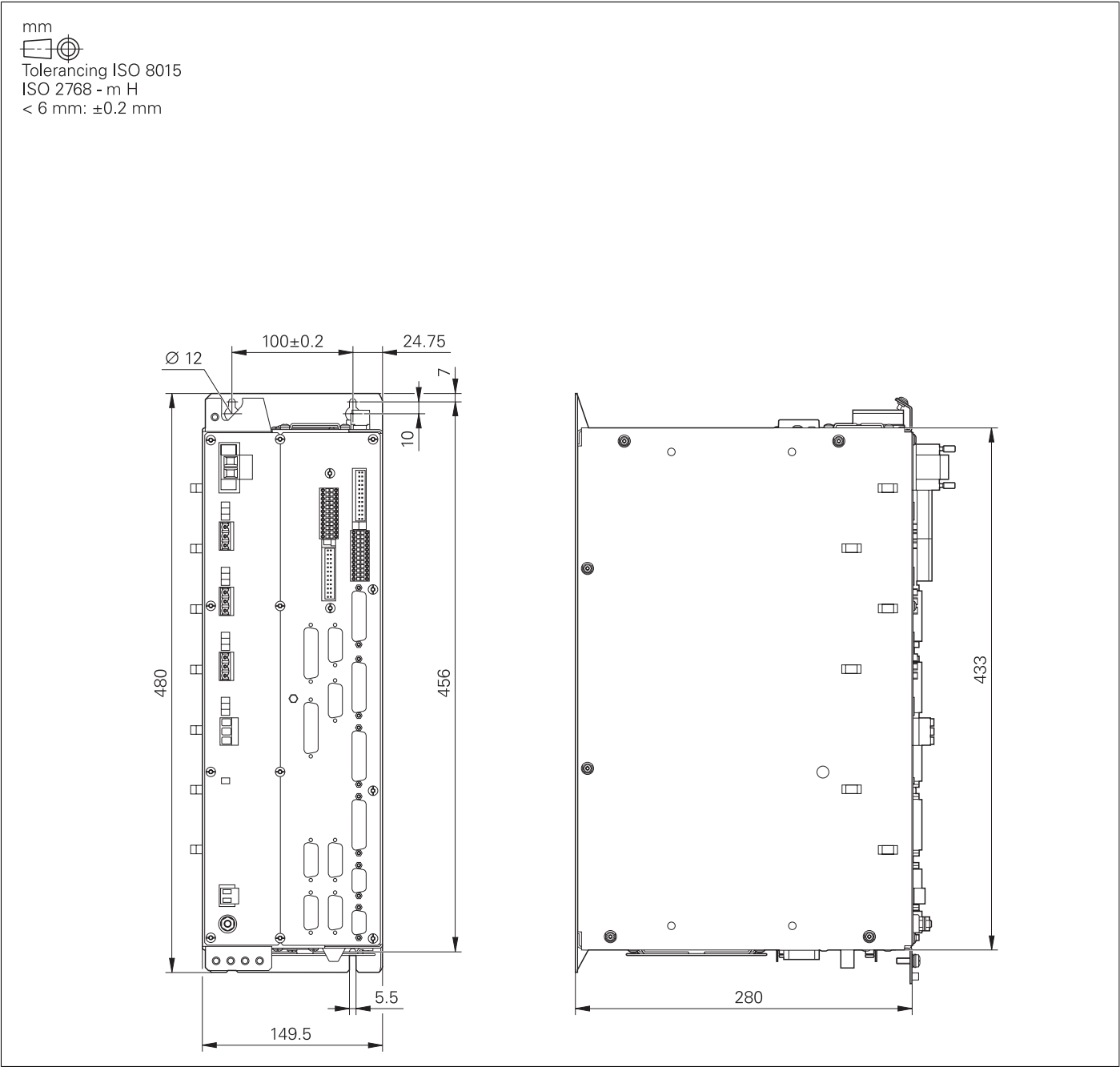
CC 6108: 8 control loops  
CC 6110: 10 control loops



UEC 111, UEC 112, UEC 113



**UMC 111 FS**



## Screen and keyboard

**BF 860**

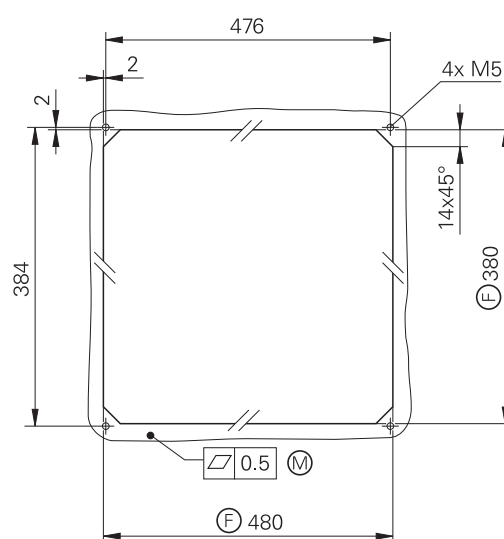
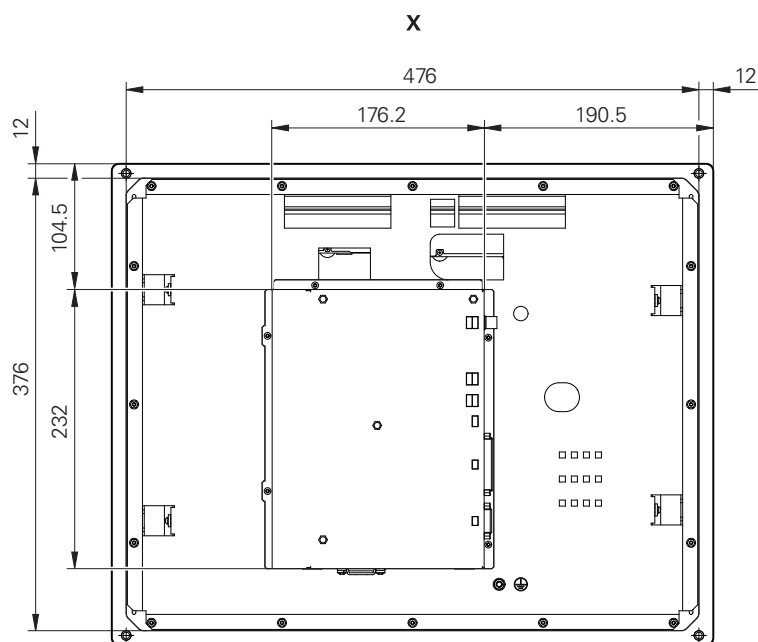
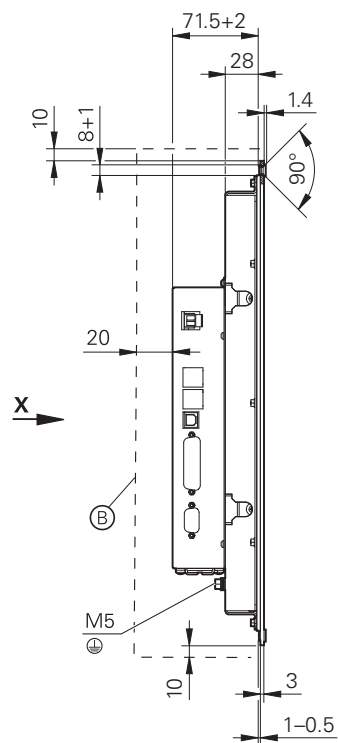
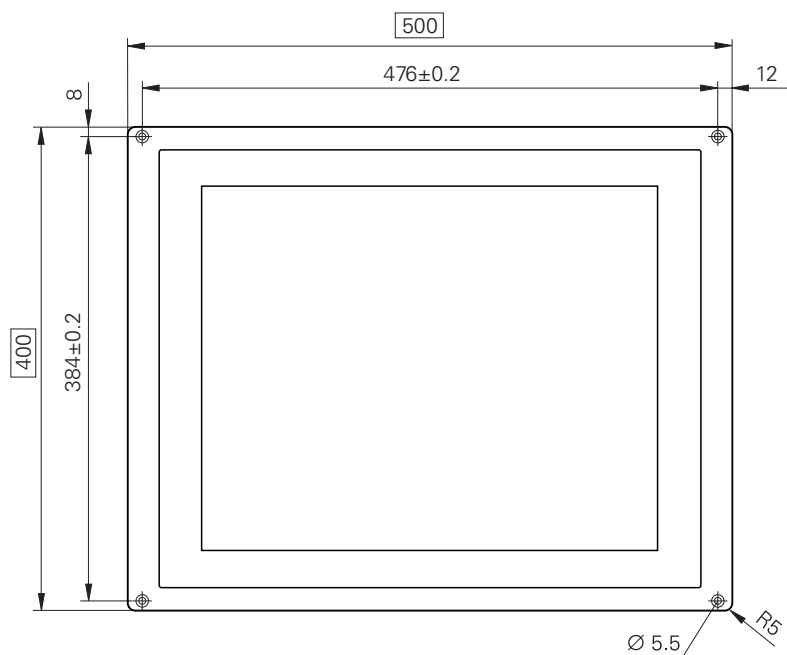
mm



Tolerancing ISO 8015

ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



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

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

Technical drawing of a 12-channel signal generator front panel, showing dimensions and tolerances.

**Top View Dimensions:**

- Overall Width:  $500 \pm 0.3$  mm
- Overall Height:  $320$  mm
- Internal Width:  $476 \pm 0.2$  mm
- Internal Height:  $289$  mm
- Bottom Width:  $457$  mm
- Bottom Right Corner:  $R5$
- Mounting Hole Diameter:  $\varnothing 5.5$
- Mounting Hole Position:  $X$

**Side View Dimensions:**

- Overall Depth:  $37.4$  mm
- Mounting Flange Width:  $44.8 \pm 1$  mm
- Mounting Flange Thickness:  $2$  mm
- Mounting Flange Angle:  $90^\circ$
- Mounting Flange Diameter:  $\varnothing 10$
- Mounting Flange Position:  $X$
- Mounting Flange Thickness:  $1.4$  mm
- Mounting Flange Width:  $5.4$  mm
- Mounting Flange Diameter:  $\varnothing 8 \pm 1$

**Front Panel Opening Dimensions:**

- Overall Width:  $476 \pm 0.2$  mm
- Overall Height:  $304 \pm 0.2$  mm
- Internal Width:  $484 \pm 1$  mm
- Internal Height:  $305 \pm 1$  mm
- Mounting Surface:  $4 \times M5$
- Mounting Surface Position:  $X$  (3x)  $2:1$
- Mounting Surface Thickness:  $2.3 \pm 0.1$  mm
- Mounting Surface Diameter:  $\varnothing 22.5$
- Mounting Surface Width:  $3.3 \pm 0.1$  mm
- Mounting Surface Height:  $24.3 \pm 0.2$  mm
- Mounting Surface Angle:  $11 \times 45^\circ$
- Mounting Surface Tolerance:  $0.5$  mm

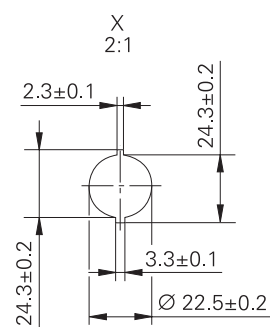
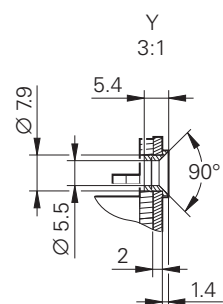
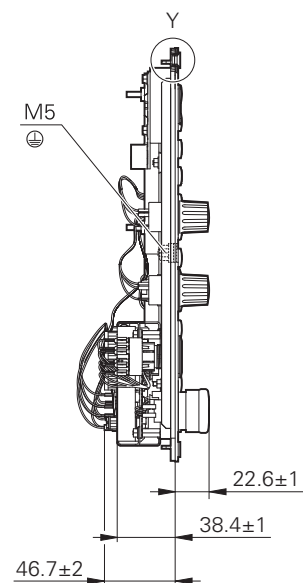
**Legend:**

- $\textcircled{F}$  = Front panel opening
- $\textcircled{M}$  = Mounting surface

## 94

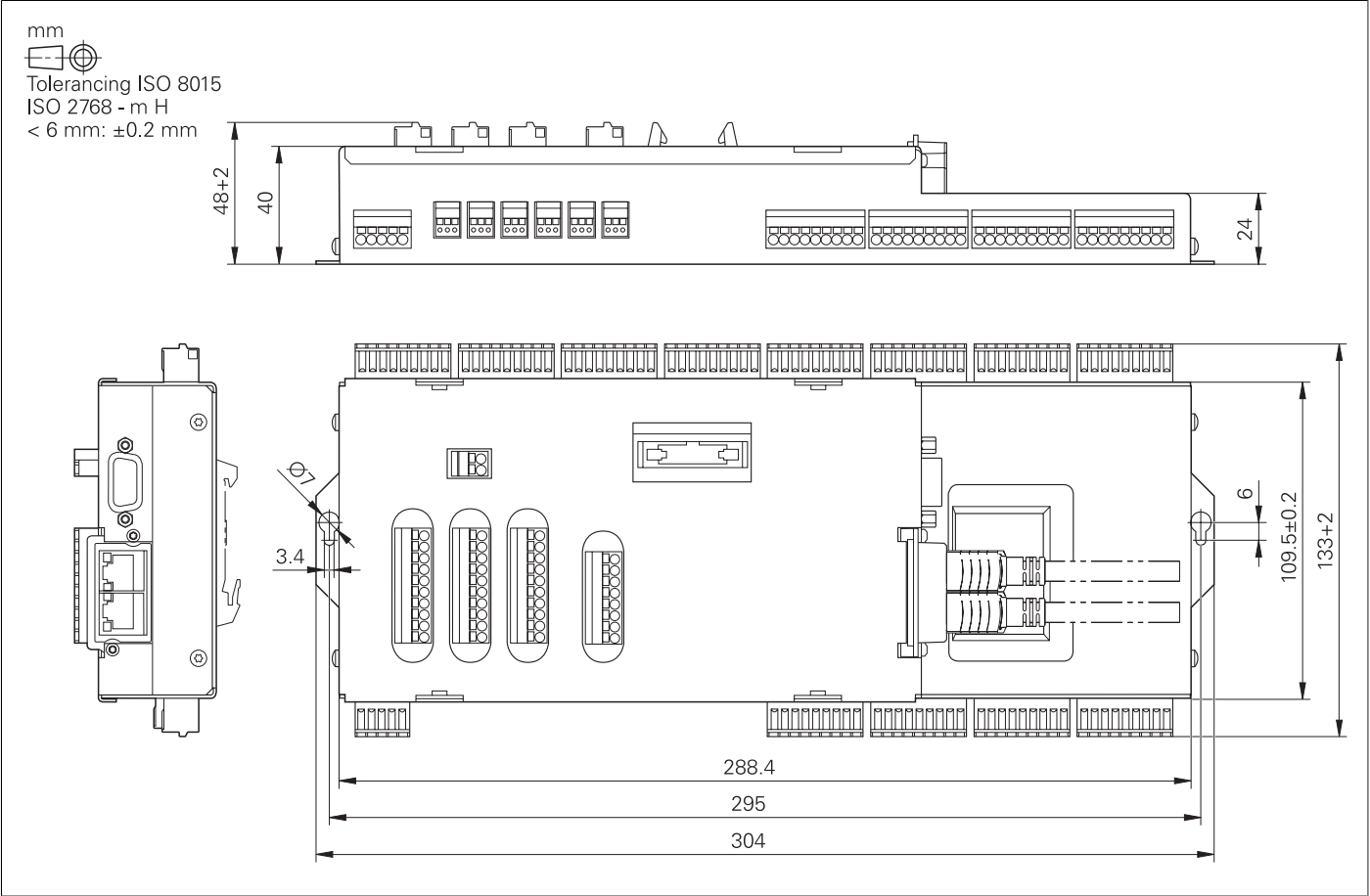
ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



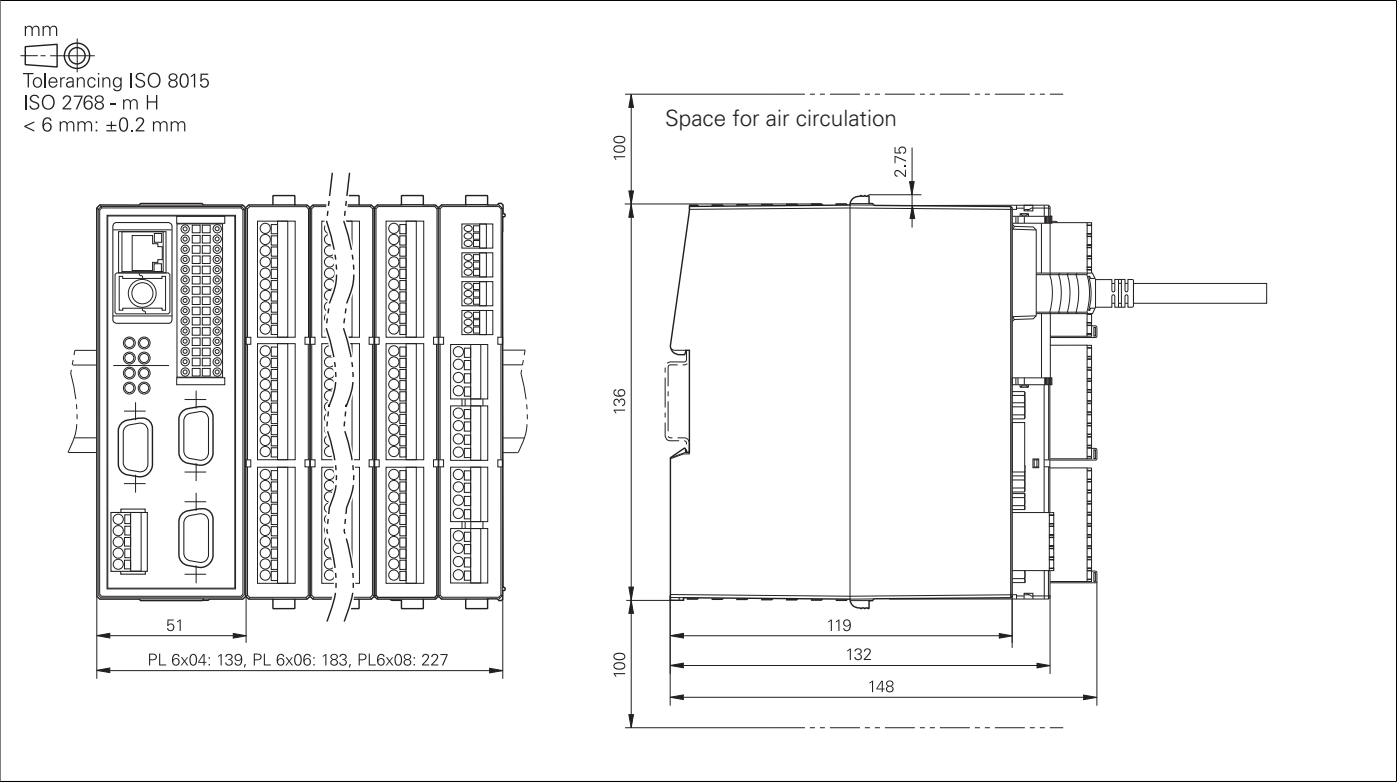
Ⓜ = Mounting surface

**PLB 600x**



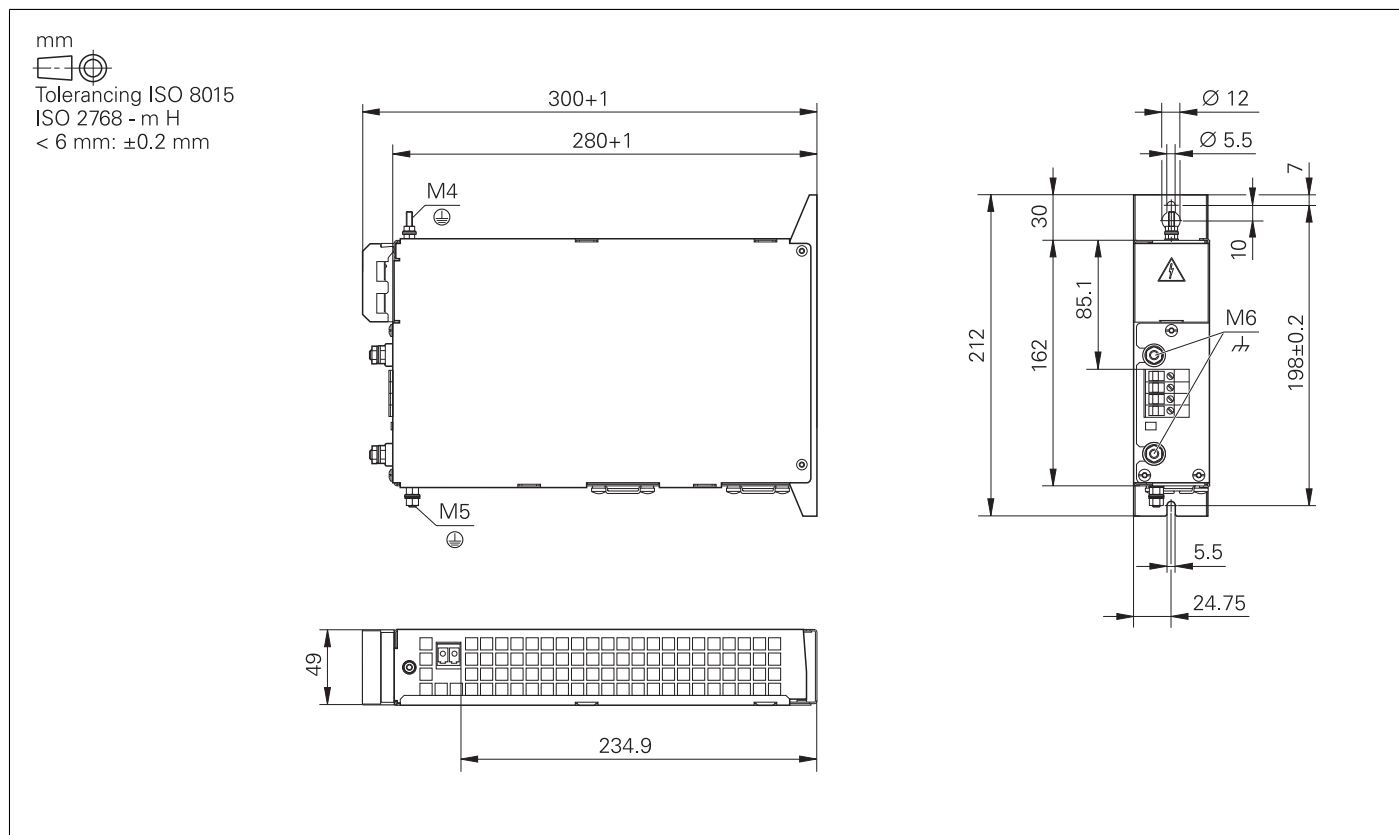
# PLC inputs and outputs

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

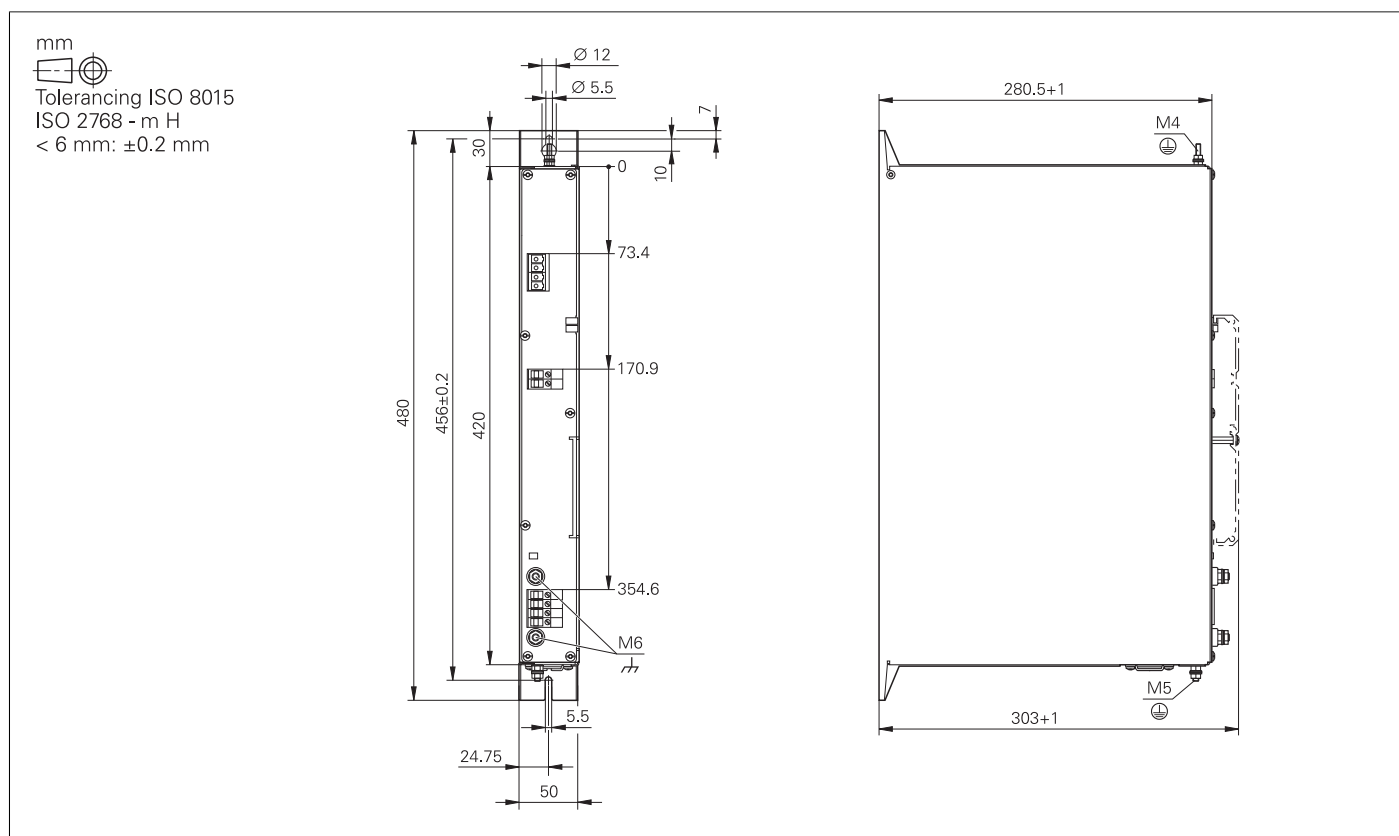


# Power supply units

## PSL 130

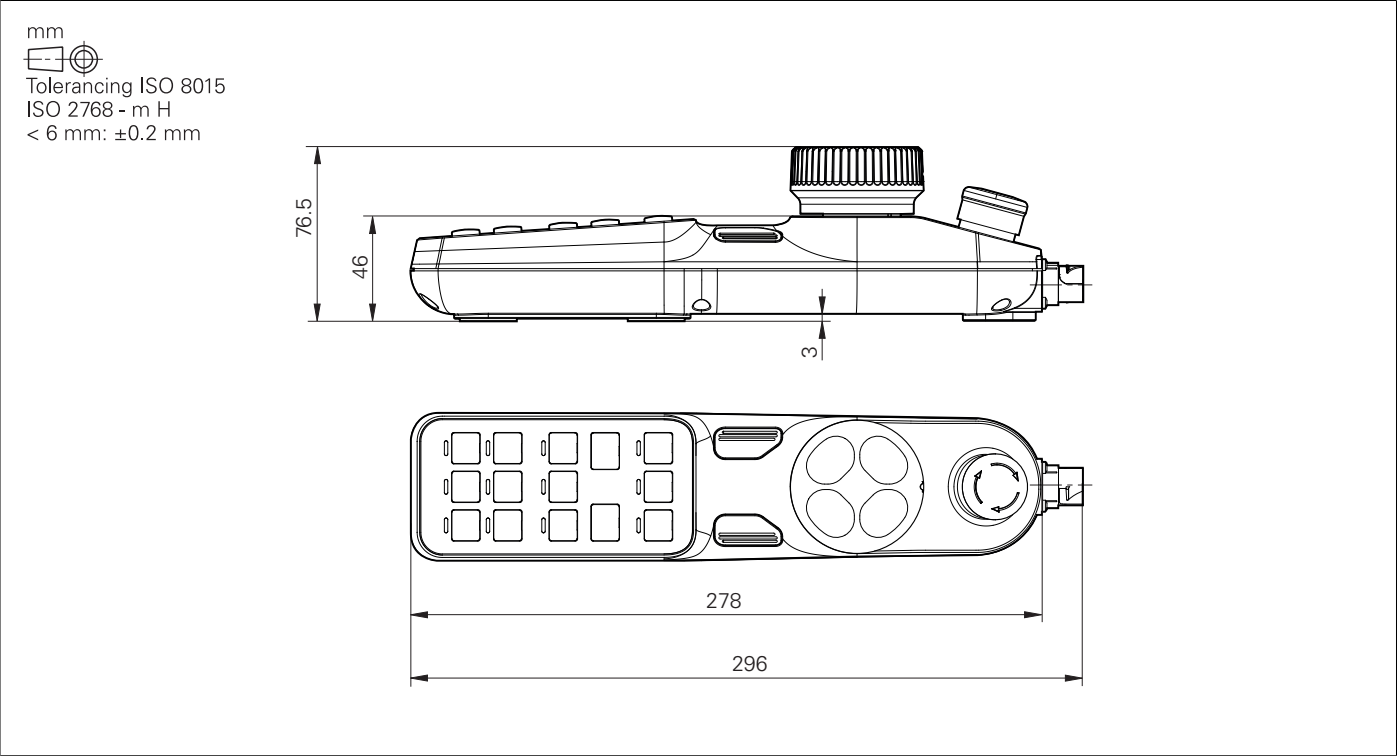


## PSL 135

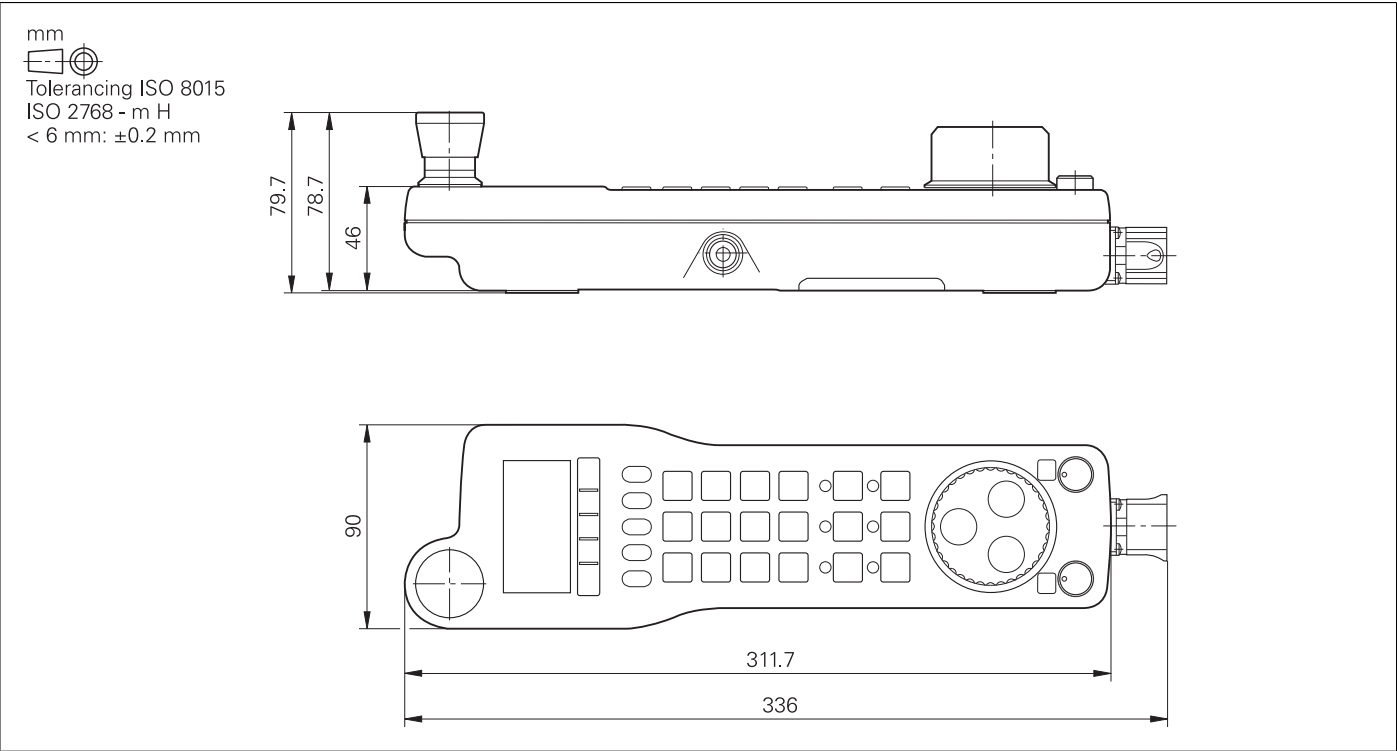


# Electronic handwheels

## HR 510, HR 510 FS



## HR 520, HR 520 FS



## Holder for HR 520, HR 520 FS

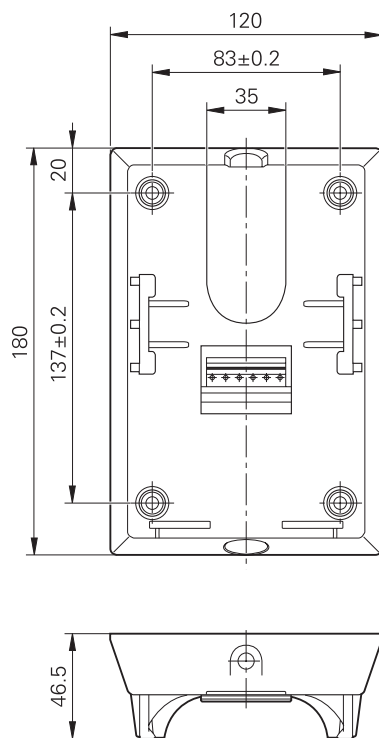
mm



Tolerancing ISO 8015

ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



## HR 550 FS

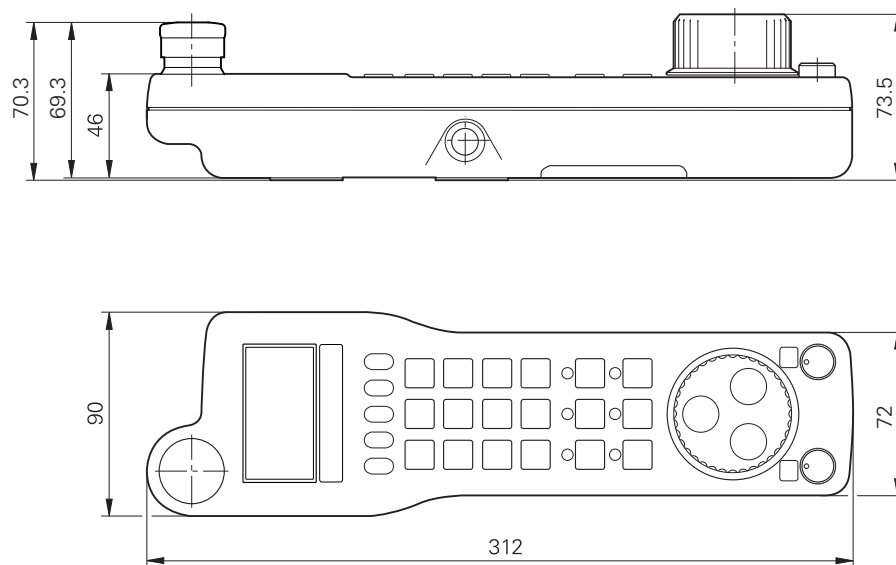
mm



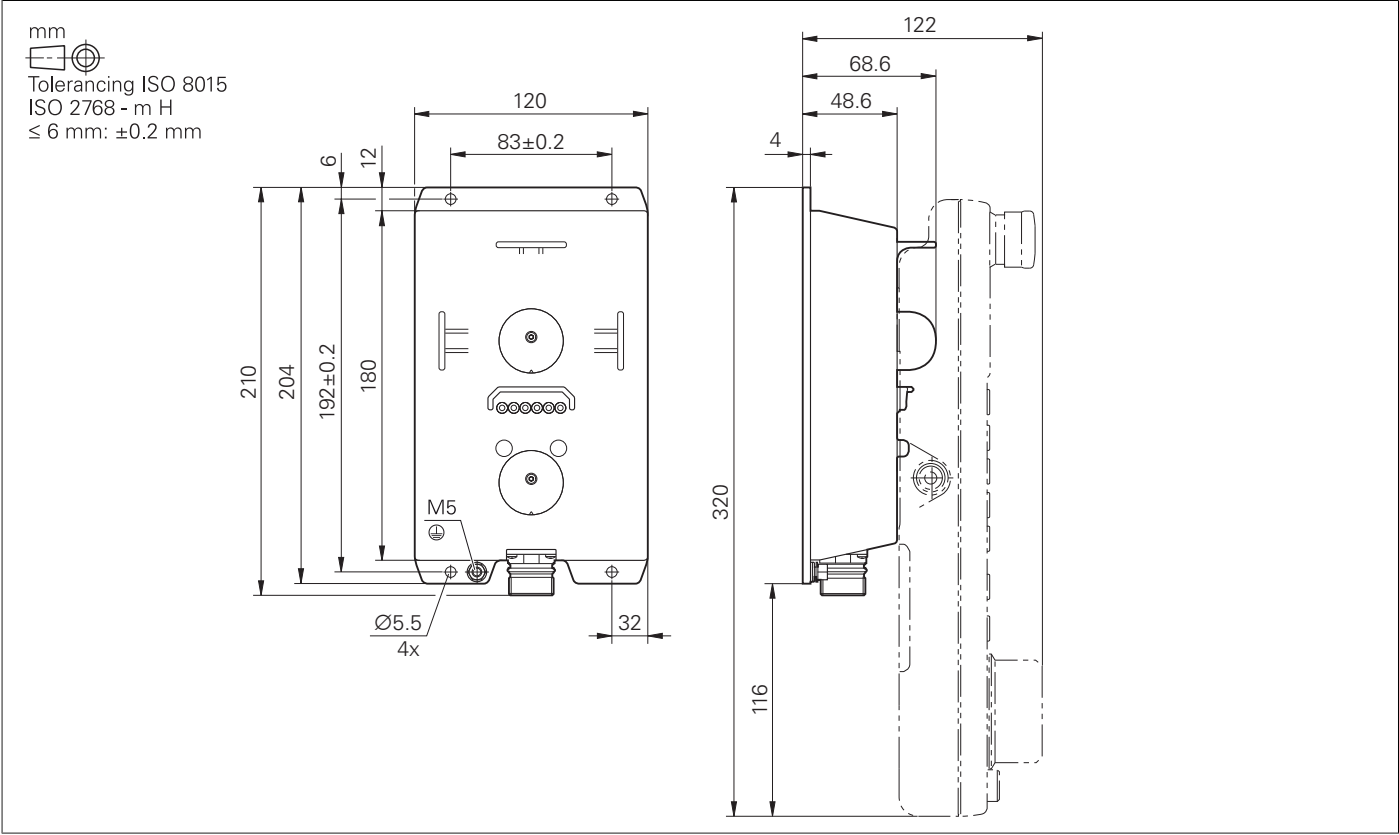
Tolerancing ISO 8015

ISO 2768 - m H

$\leq 6$  mm:  $\pm 0.2$  mm



HRA 551 FS



**HR 130, HR 150 with control knob**

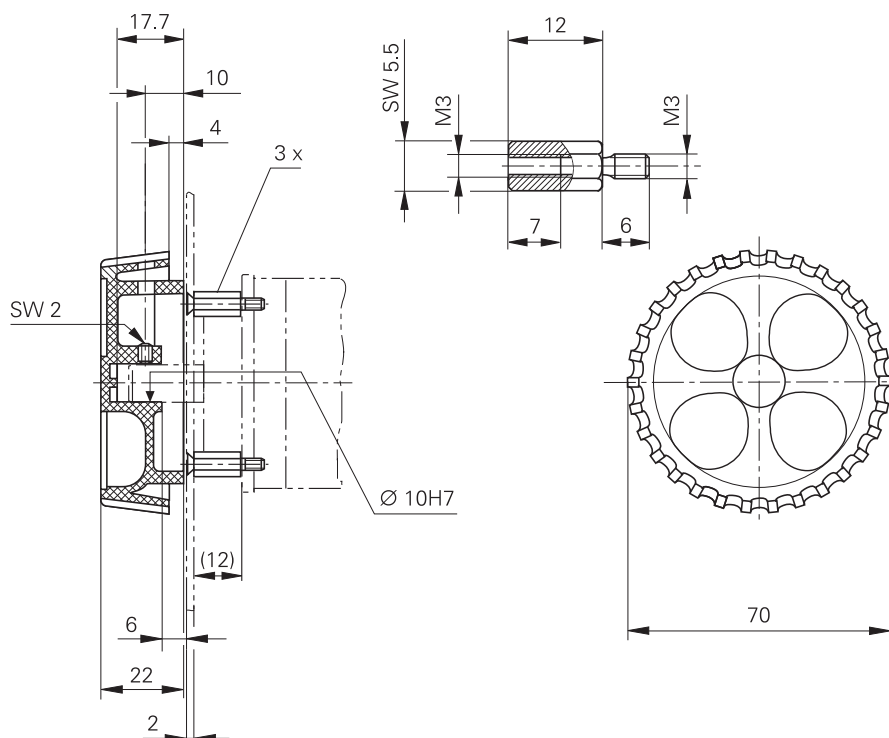
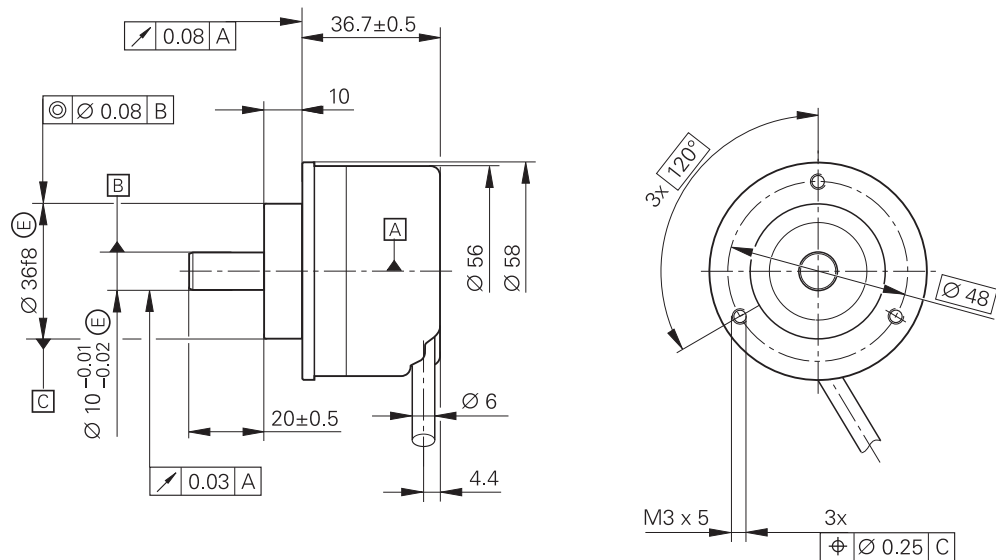
mm



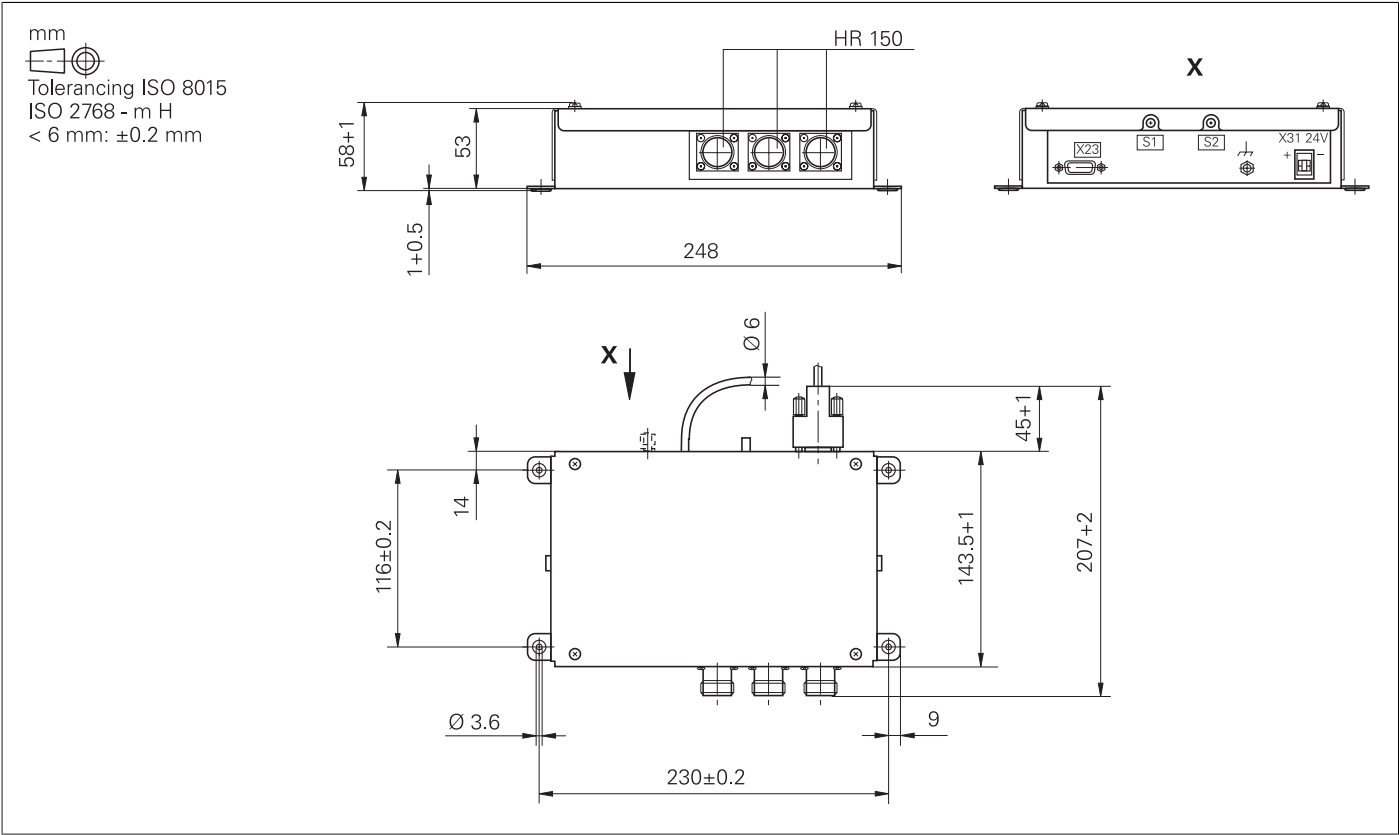
Tolerancing ISO 8015

ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



HRA 110



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

73.5+2

4

$\varnothing 25$

X1

X2

30+2

56

M5(4x)

$\varnothing 55 \pm 0.2$

$\varnothing 44 \pm 0.2$

①

S

$\varnothing 34$

44

$\varnothing 5.5$

②

S

32

M4

44

19

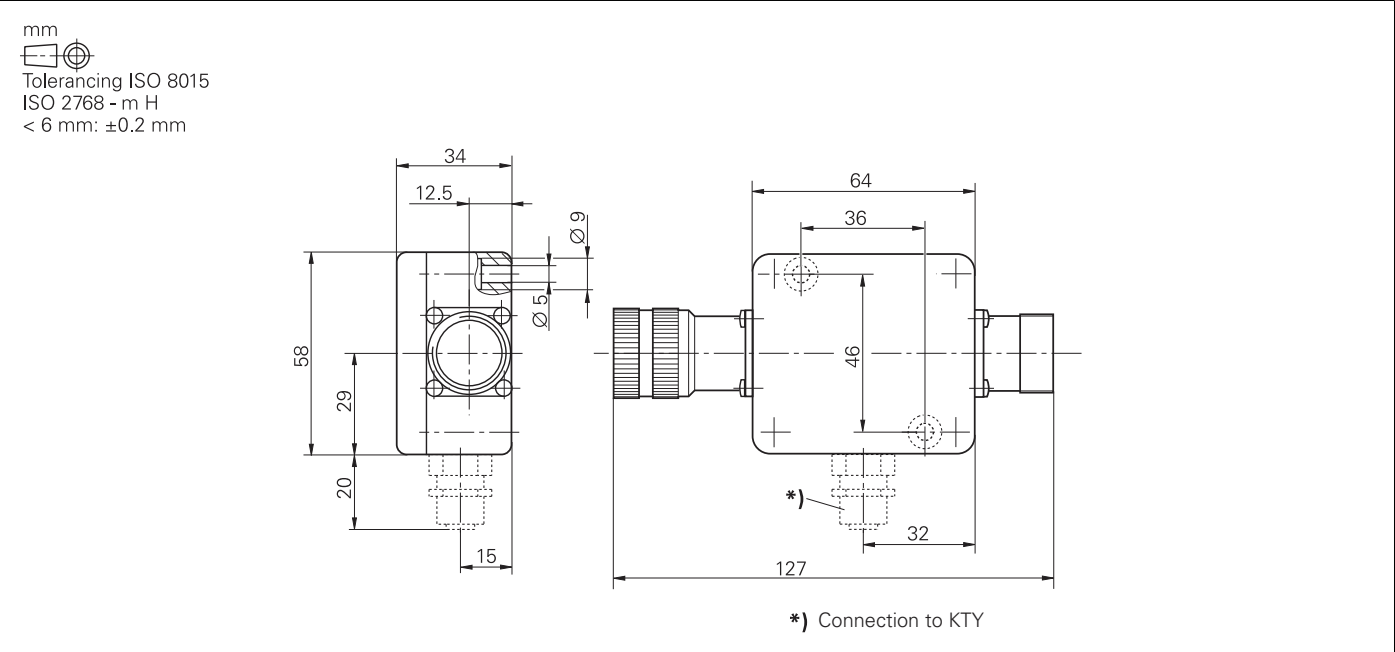
$\varnothing 37$

① Mounting opening up to wall thickness  $S = 4$

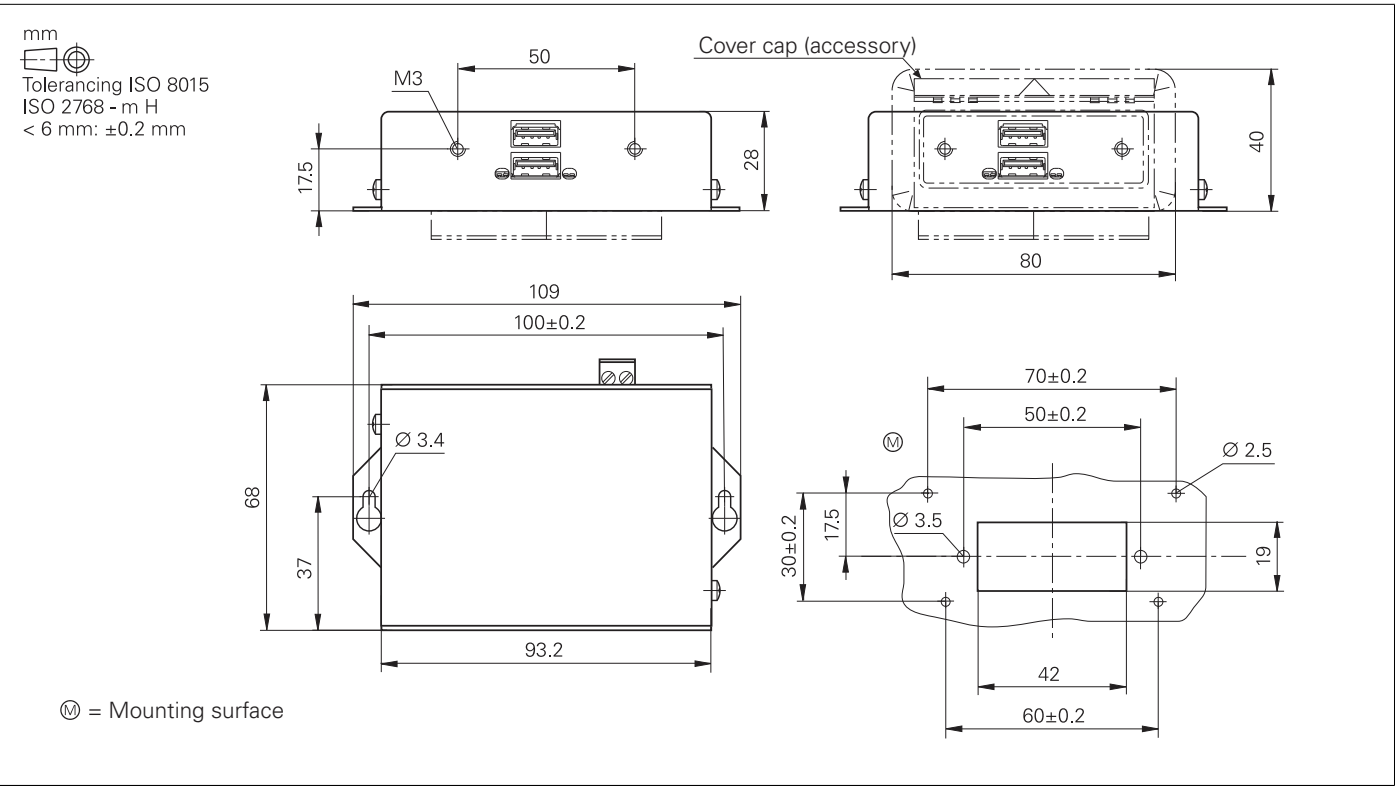
② Mounting opening for wall thickness  $S = 4$  or more

# Interface accessories

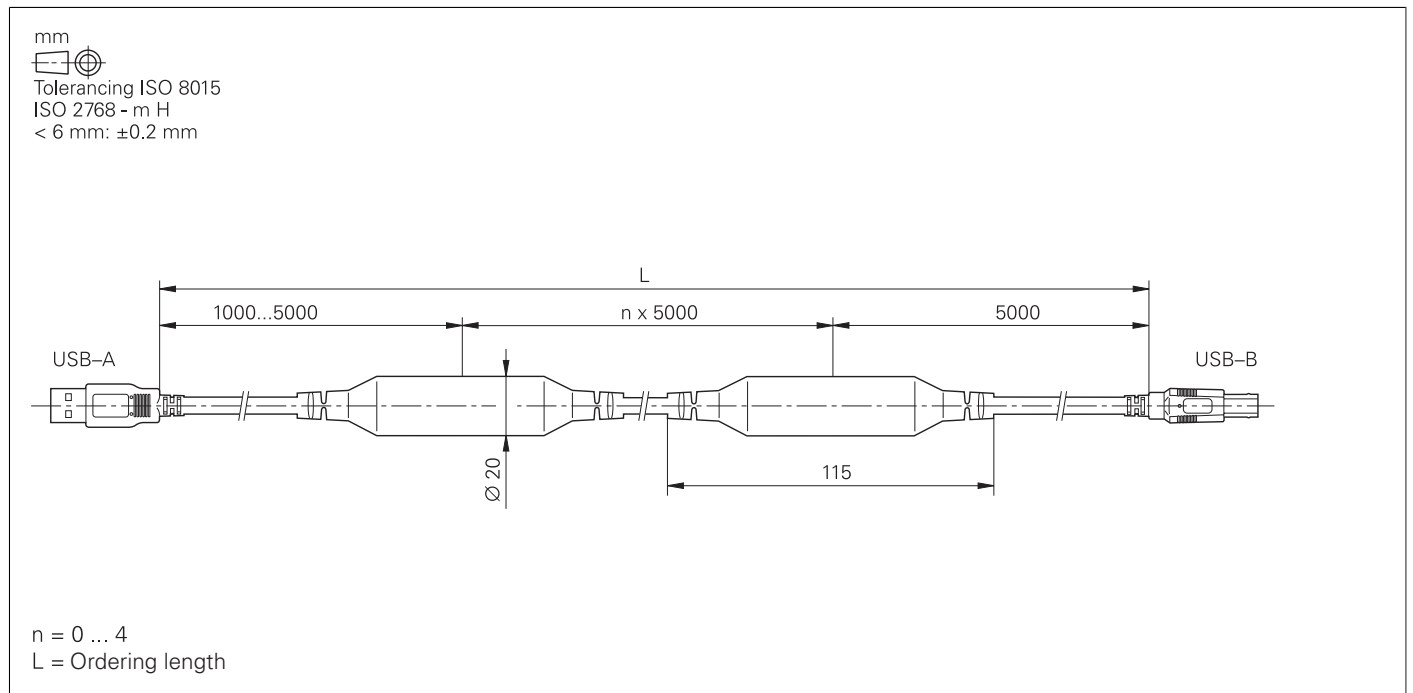
## Line-drop compensator for encoders with EnDat interface



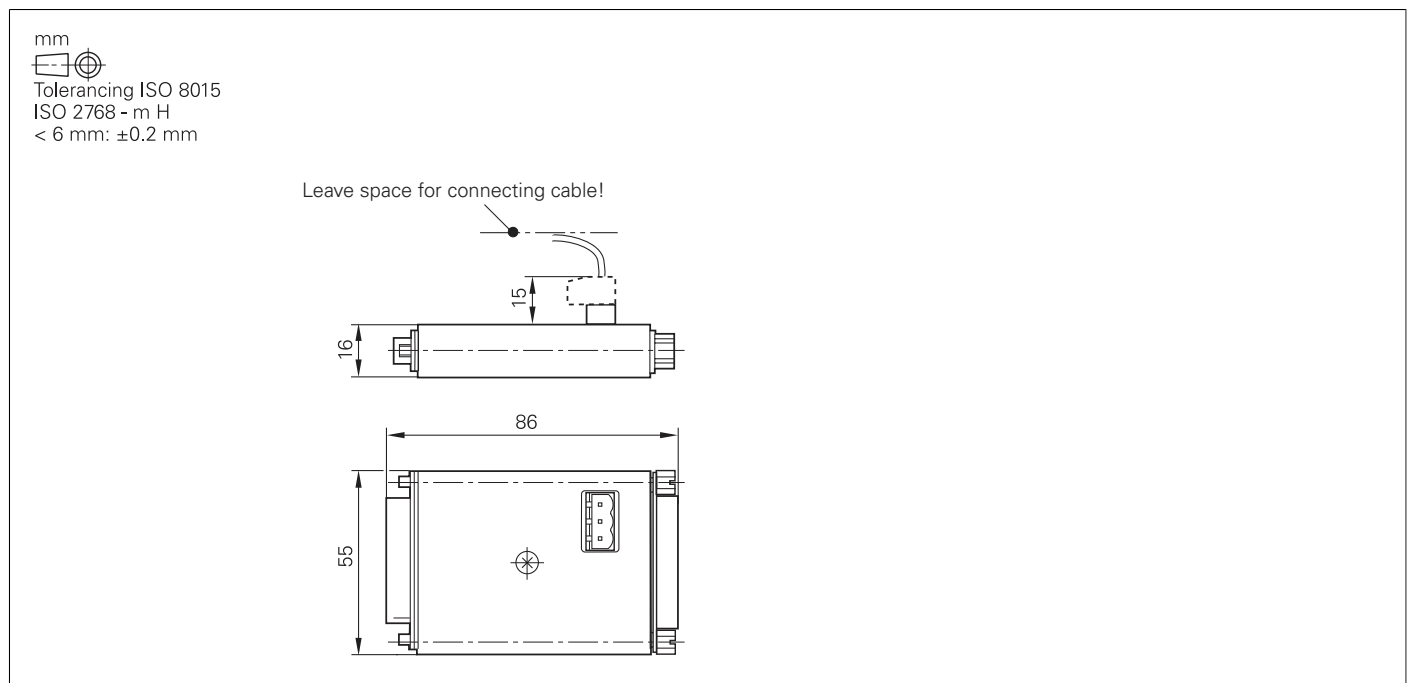
## USB hub



## USB extension cable with hubs

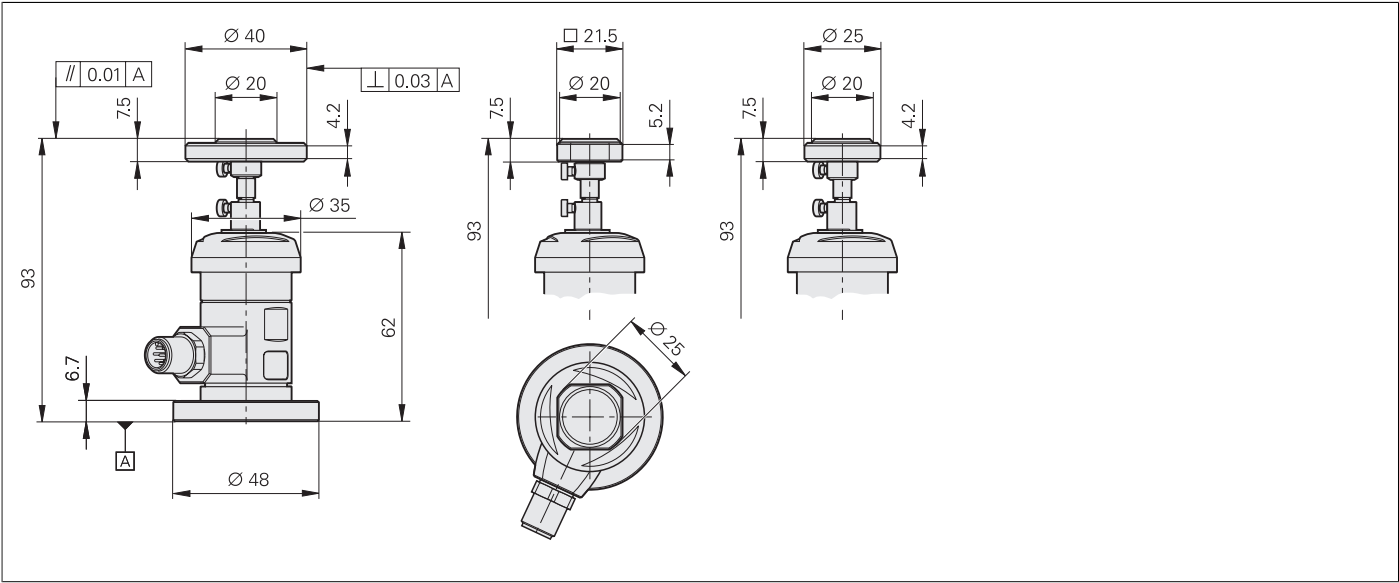


## KTY adapter connector

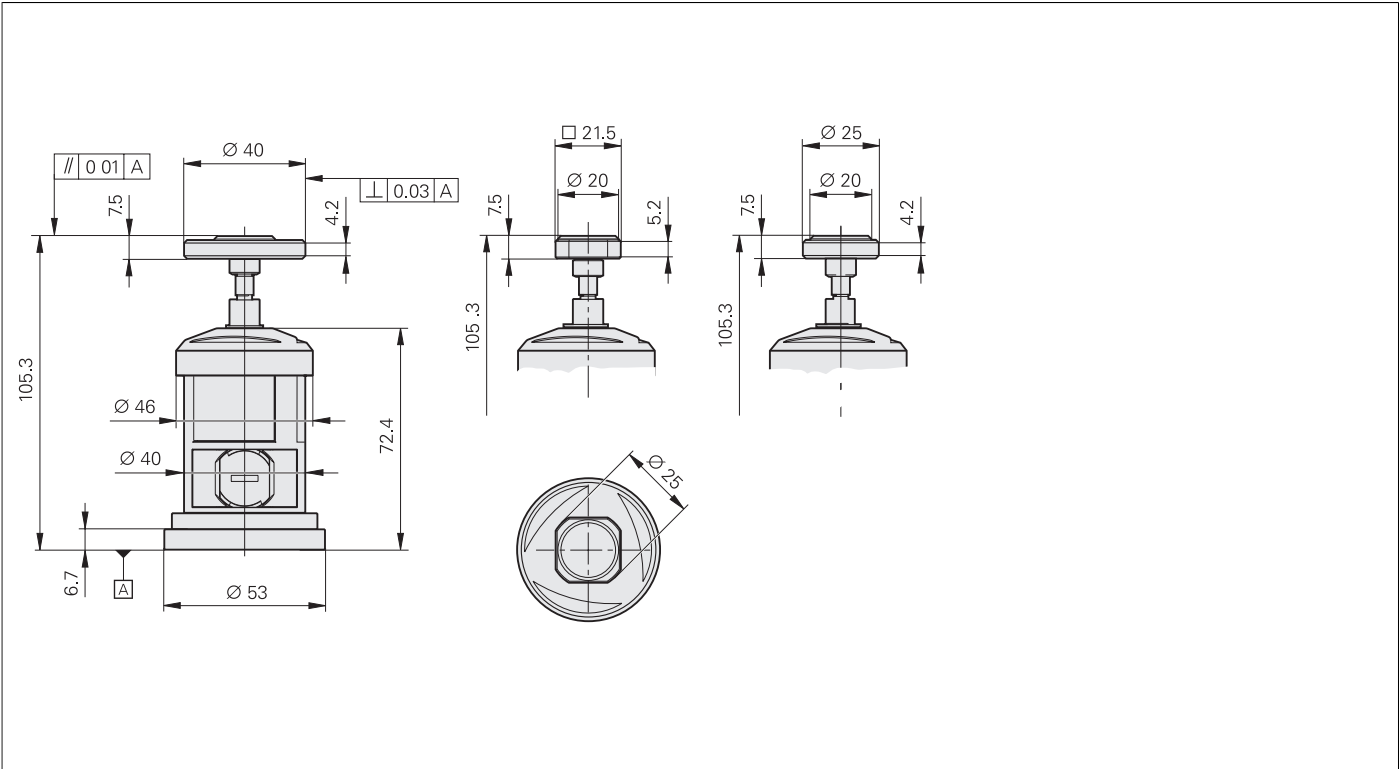


# Touch probe

TT 160 with cuboid probe contact



TT 460 with a cuboid probe contact



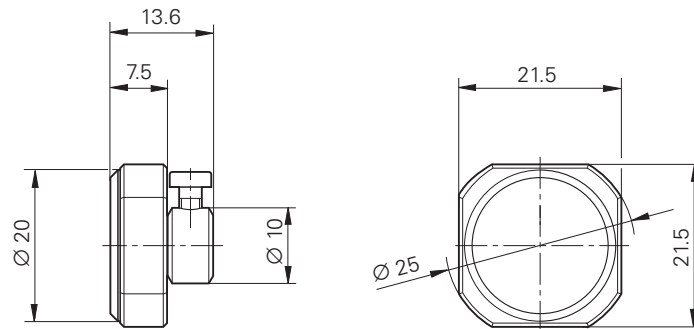
mm



Tolerancing ISO 8015

ISO 2768 - m H

< 6 mm:  $\pm 0.2$  mm



Cuboid probe contact for TT

# General information

## Documentation

Technical documentation	<ul style="list-style-type: none"><li>• <b>CNC PILOT 640</b> Technical Manual</li></ul>	ID 1090006-xx; in PDF format on HESIS-Web including Filebase
	<ul style="list-style-type: none"><li>• <b>PNC 610</b> Technical Manual</li></ul>	ID 1191125-xx; in PDF format on HESIS-Web including Filebase
User documentation	<ul style="list-style-type: none"><li>• <b>Inverter Systems and Motors</b> Technical Manual</li></ul>	ID 208962-xx; in PDF format on HESIS-Web including Filebase
	<ul style="list-style-type: none"><li>• <b>TS 260</b> Mounting Instructions</li></ul>	ID 808652-9x
	<ul style="list-style-type: none"><li>• <b>TS 460</b> Mounting Instructions</li></ul>	ID 808653-9x
	<ul style="list-style-type: none"><li>• <b>TS 740</b> Mounting Instructions</li></ul>	ID 632761-9x
	<ul style="list-style-type: none"><li>• <b>TT 160</b> Mounting Instructions</li></ul>	ID 808654-xx
	<ul style="list-style-type: none"><li>• <b>TT 460</b> Mounting Instructions</li></ul>	ID 808655-xx
	<b>CNC PILOT 640</b>	
	<ul style="list-style-type: none"><li>• <b>CNC PILOT 640</b> User's Manual</li></ul>	ID 1079662-xx
	<ul style="list-style-type: none"><li>• <b>smart.Turn and DIN Programming</b> User's Manual</li></ul>	ID 1118606-xx
	<b>Miscellaneous</b>	
Other documentation	<ul style="list-style-type: none"><li>• <b>TNCremo</b> User's Manual</li></ul>	As integrated help
	<ul style="list-style-type: none"><li>• <b>TNCremoPlus</b> User's Manual</li></ul>	As integrated help
	<ul style="list-style-type: none"><li>• <b>IOconfig</b> User's Manual</li></ul>	As integrated help
	<ul style="list-style-type: none"><li>• <b>PLCdesign</b> User's Manual</li></ul>	As integrated help
	<ul style="list-style-type: none"><li>• <b>CNC PILOT 640</b> brochure</li></ul>	ID 895949-xx
	<ul style="list-style-type: none"><li>• <b>Touch Probes</b> brochure</li></ul>	ID 1113984-xx
	<ul style="list-style-type: none"><li>• <b>Functions of the CNC PILOT 640</b> brochure</li></ul>	ID 1224137-xx
	<ul style="list-style-type: none"><li>• <b>Inverter Systems</b> brochure</li></ul>	ID 622420-xx
	<ul style="list-style-type: none"><li>• <b>Motors</b> brochure</li></ul>	ID 208893-xx
	<ul style="list-style-type: none"><li>• <b>RemoTools SDK virtualTNC</b> brochure</li></ul>	ID 628968-xx
Safety parameters	<ul style="list-style-type: none"><li>• <b>Programming Station for Lathe Controls</b> brochure</li></ul>	ID 826688-xx
	<ul style="list-style-type: none"><li>• <b>Remote Diagnosis with TeleService</b> Product Overview</li></ul>	ID 348236-xx
	<ul style="list-style-type: none"><li>• <b>Touch Probes</b> DVD</li></ul>	ID 344353-xx
	<ul style="list-style-type: none"><li>• <b>DataPilot CP 640, MP 620 Programming Station</b> demo version DVD</li></ul>	ID 1230525-xx
	<ul style="list-style-type: none"><li>• <b>DataPilot CP 640, MP 620 Programming Station</b> single-station license DVD</li></ul>	ID 1230536-xx
	<ul style="list-style-type: none"><li>• <b>DataPilot CP 640, MP 620 Programming Station</b> network license for 14 stations DVD</li></ul>	ID 1230537-xx
	<ul style="list-style-type: none"><li>• <b>DataPilot CP 640, MP 620 Programming Station</b> network license for 20 stations DVD</li></ul>	ID 1230538-xx
	<ul style="list-style-type: none"><li>• <b>HR 550FS</b> Product Information document</li></ul>	PDF
	<ul style="list-style-type: none"><li>• <b>Safety-Related Control Technology</b> Technical Information document</li></ul>	PDF
	<ul style="list-style-type: none"><li>• <b>Safety-Related Position Measuring Systems</b> Technical Information document</li></ul>	PDF
	<ul style="list-style-type: none"><li>• <b>Uniformly Digital</b> Technical Information document</li></ul>	PDF
Basic circuit diagram		

# Service and training

<b>Technical support</b>	HEIDENHAIN offers the machine manufacturer technical support to optimize the adaptation of the control to the machine, including on-site support.	
<b>Exchange control system</b>	In the event of a fault, HEIDENHAIN guarantees the rapid supply of a replacement control system (usually within 24 hours in Europe).	
<b>Helpline</b>	Our service engineers are naturally at your disposal by telephone if you have any questions on the interfacing of the control or in the event of faults:	
	<b>NC support</b>	+49 8669 31-3101 E-mail: service.nc-support@heidenhain.de
	<b>PLC programming</b>	+49 8669 31-3102 E-mail: service.plc@heidenhain.de
	<b>NC programming</b>	+49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de
	<b>Encoders / machine calibration</b>	+49 8669 31-3104 E-mail: service.ms-support@heidenhain.de
	<b>APP programming</b>	+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:	
	<b>Customer service, Germany</b>	+49 8669 31-3121 E-mail: service.order@heidenhain.de
	<b>Customer service, international</b>	+49 8669 31-3123 E-mail: service.order@heidenhain.de
<b>Machine calibration</b>	On request, HEIDENHAIN engineers will calibrate your machine's geometry, e.g. with a KGM grid encoder.	
<b>Technical courses</b>	HEIDENHAIN provides technical customer training in the following subjects: <ul style="list-style-type: none"><li>• NC programming</li><li>• PLC programming</li><li>• TNC optimization</li><li>• TNC service</li><li>• Encoder service</li><li>• Special training for specific customers</li></ul>	

## 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

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