HEIDENHAIN

TNC 640 HSCI

Contouring Control for Machining Centers and Milling/Turning Machines

Information for the Machine Tool Builder

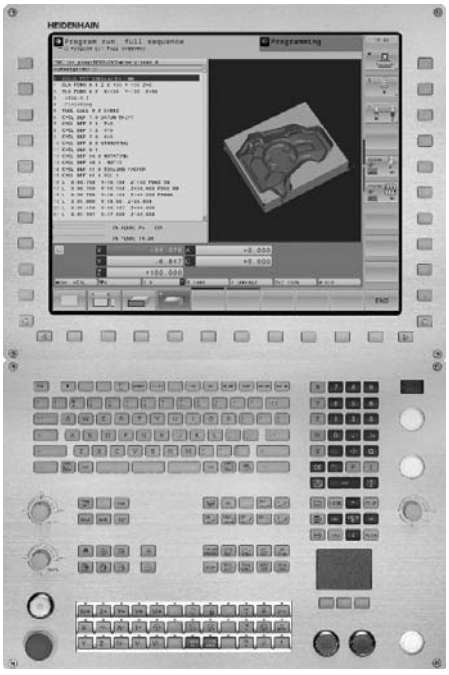
HSCI

September 2011

TNC Contouring Control with Drive System from HEIDENHAIN

TNC 640

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



BF 760 color flat-panel display
with **TE 745** keyboard

MC 6341, CC 6106

System tests

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

Expendable parts

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

- Buffer battery
- Fan
- Hard disk

Standards

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

Note

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

Contents

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

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

TNC 640 with NC software versions	
340590-01	(export license required)
340591-01	(no export license required)

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. If no explicit distinction is made between standard and FS components (FS = functional safety), then the data and other information apply to both versions (e.g. TE 745, TE 745 FS).

This catalog supersedes all previous editions, which thereby become invalid.

Subject to change without notice

Specifications

Specifications	TNC 640 HSCI	Page
Control systems	19″ design	**17**
Main computer	MC 6241 or MC 6341	18
Controller unit	CC 6106 or CC 6108 or CC 6110 or UEC 111 (inverter and system PL integrated) or UEC 112 (inverter and system PL integrated)	22
Visual display unit	BF 760 color flat-panel TFT display	25
Operating panel	TE 740 or TE 745 (integrated machine operating panel)	25
PLC inputs/outputs	PL 6xxx series; or on UEC 11x	26
Inverter systems		*
Compact inverters	✔	*
Modular inverters	✔	*
Axes[1]	**Max. 18**	**40**
Rotary axes	Max. 3	40
Synchronized axes	✔	42
PLC axes	✔	42
Spindle	*Milling:* max. 2; second spindle can be controlled alternately with the first *Turning:* 1 Milling spindle or lathe spindle activated via NC command	**45**
Shaft speed[2]	Max. 60000 min^{-1}	45
Operating-mode switchover	✔	45
Position-controlled spindle	✔	45
Oriented spindle stop	✔	45
Gear shifting	✔	45
NC program memory	Approx. 144 GB on HDR hard disk	–
Input resolution and display step		**40**
Linear axes	1 µm, 0.01 µm with option 23	40
Rotary axes	0.001°; 0.00001° with option 23	40

[1] As ordered
[2] On motors with two pole pairs
***** For further information, refer to the *Inverter Systems* brochure (ID 622420-xx)

Specifications	TNC 640 HSCI	Page
Functional safety	With FS components, SPLC and SKERN	**14**
For applications up to	• SIL 2 according to EN 61 508 • Category 3, PL d according to EN ISO 13849-1:2008	14
Interpolation	**MC 6xxx**	
Straight line	In 4 axes; in 5 axes with option 9	*
Circle	In 2 axes; in 3 axes with option 9	*
Helix	✔	*
Axis feedback control		**46**
With following error	✔	46
With feedforward	✔	46
Axis clamping	✔	40
Maximum feed rate	$\frac{60000\ \text{min}^{-1}}{\text{No. of pole pairs in motor}} \cdot \text{screw pitch [mm]}$	
Cycle times of main computer	**MC 6xxx**	**47**
Block processing	0.5 ms	48
Cycle times of controller unit	**CC 61xx/UEC 11x**	**47**
Path interpolation	3 ms	47
Fine interpolation	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)	47
Position controller	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)	47
Speed controller	*Single speed:* 0.2 ms *Double speed:* 0.1 ms (option 49)	47
Current controller	f_{PWM} / T_{INT} 3333 Hz / 150 µs 4000 Hz / 125 µs 5000 Hz / 100 µs 6666 Hz / 75 µs with option 49 8000 Hz / 60 µs with option 49 10000 Hz / 50 µs with option 49	22
Permissible temperature range	Operation: In electrical cabinet: 5 °C to 40 °C In operating panel: 0 °C to 50 °C Storage: –20 °C to +60 °C	–

***** For further information, refer to the *TNC 640* brochure (ID 892916-xx)

Machine Interfacing

Machine interfacing	TNC 640	Page
Error compensation	✔	**50**
Linear axis error	✔	50
Nonlinear axis error	✔	50
Backlash	✔	50
Reversal peaks with circular movement	✔	50
Hysteresis	✔	50
Thermal expansion	✔	50
Stick-slip friction	✔	50
Sliding friction	✔	50
Integral PLC		**55**
Program format	Statement list	55
Program input on the TNC	✔	55
Program input via PC	✔	55
Symbolic PLC-NC interface	✔	
PLC memory	At least 1 GB on hard disk	55
PLC cycle time	Typically 21 ms, adjustable	55
PLC inputs/outputs[1)]	1 x PLB 62xx or UEC 11x and max. 7 x PLB 61xx and 1 x TE 745 (with integrated MB) or PLB 6001 (max. total: 9 components)	**26**
PLC inputs, 24 V DC	Via PL or UEC 11x	26
PLC outputs, 24 V DC	Via PL or UEC 11x	26
Analog inputs, ±10 V DC	Via PL	26
Inputs for PT 100 thermistors	Via PL	26
Analog outputs, ±10 V DC	Via PL	26
PLC functions	✔	**56**
Small PLC window	✔	56
PLC soft keys	✔	56
PLC positioning	✔	56
PLC basic program	✔	58
Integration of applications		57
High-level language programming	Python programming language used in combination with the PLC (option 46)	57
User interface can be custom-designed	Inclusion of specific user interfaces from the machine tool builder (option 46)	57

[1)] Further PLC inputs/outputs via PL 550 for connection to MC 6xxx with PROFIBUS-DP interface

Machine interfacing	TNC 640					Page
Encoder inputs	CC 6106	CC 6108	CC 6110	UEC 111	UEC 112	**49**
Position	6	8	10	4	5	49
Incremental	1 V_{PP}					49
Absolute	EnDat 2.2					49
Speed	6	8	10	4	5	49
Incremental	1 V_{PP}					49
Absolute	EnDat 2.2					49
Nominal-value outputs	CC 6106	CC 6108	CC 6110	UEC 111	UEC 112	**23**
PWM	6	8	10	–	–	23
Motor connections	–	–	–	4	5	24
Commissioning and diagnostic aids						53
DriveDiag	Software for diagnosis of digital drive systems					53
TNCopt	Software for putting digital control loops into service					53
ConfigDesign	Software for creation of the machine configuration					53
Integrated oscilloscope	✔					54
Trace function	✔					54
Logic diagram	✔					54
API DATA function	✔					54
Table function	✔					54
OnLine Monitor (OLM)	✔					53
Log	✔					54
TNCscope	✔					54
Bus diagnosis	✔					54
Data interfaces						**60**
Ethernet (100BaseT)	✔					60
USB 2.0	✔					60
RS-232-C/V.24	✔					60
Protocols						**60**
Standard data transfer	✔					60
Blockwise data transfer	✔					60
LSV2	✔					60

Accessories

Accessories	TNC 640		Page
Electronic handwheels	One HR 410, HR 130, or up to three HR 150 via HRA 110		**30**
Touch probes	• One TS 220, TS 440, TS 444, TS 640 or TS 740 workpiece touch probe • One TT 140 or TL tool touch probe		**35**
PLC input/output systems	**With HSCI interface**		**26**
Basic module	**System PL**[1]	For 4 I/O modules: PLB 6204, PLB 6204 FS For 6 I/O modules: PLB 6206, PLB 6206 FS For 8 I/O modules: PLB 6208, PLB 6208 FS	26
	Expansion PL	For four I/O modules: PLB 6104, PLB 6104 FS For six I/O modules: PLB 6106, PLB 6106 FS For eight I/O modules: PLB 6108, PLB 6108 FS	26
I/O modules	PLD-H 16-08-00: 16 digital inputs and 8 digital outputs, 24 V PLD-H 08-16-00: 8 digital inputs and 16 digital outputs, 24 V PLD-H 08-04-00 FS: 8 digital inputs and 4 digital outputs, 24 V PLD-H 04-08-00 FS: 4 digital inputs and 8 digital outputs, 24 V PLA-H 08-04-04: 8 analog inputs ± 10 V, 4 analog outputs ± 10 V and 4 analog PT 100 inputs		27
HSCI adapter	PLB 6001: For connection of an OEM machine operating panel		32
PLC input/output systems	**With PROFIBUS-DP interface**		**28**
Basic module	**PLB 550** for four I/O modules		28
I/O modules	PLD 16-8: 16 digital inputs and 8 digital outputs, 24 V PLA 4-4: 4 analog inputs ± 10 V, and 4 analog inputs for PT 100		28
Machine operating panel	• Integrated in TE 745 or • PLB 6001 (HSCI adapter for OEM operating panel)		**25** **32**
Analog module	CMA-H 04-04-00: Additional module for analog axes/spindles in the HSCI system		**32**
USB hub	✔		**60**
PLC basic program	✔		**58**
TNC 640 programming station	Control software for PCs for programming, archiving, and training		
IPC 6341	Industrial PC with Windows 7		**21**

[1] Integrated in UEC 11x, otherwise necessary once in each HSCI control system

Accessories	TNC 640	Page
Software		
PLCdesign[1]	PLC development software	**57**
KinematicsDesign[1]	Software for kinematic configuration	**52**
TNCremo[2]	Data transfer software	**61**
TNCremoPlus[2]	Data transfer software with live-screen function	**61**
ConfigDesign[1]	Software for configuring the machine parameters	**53**
CycleDesign[1]	Software for creating cycle structures	**59**
TNCscope[1]	Software for data recording	**54**
DriveDiag[1]	Software for diagnosis of digital control loops	**53**
TNCopt[1]	Software for putting digital control loops into service	**53**
IOconfig[1]	Software for configuring PLC I/O and PROFIBUS-DP components	**27**
TeleService[1]	Software for remote diagnostics, monitoring, and operation	**54**
RemoTools SDK[1]	Function library for developing customized applications for communication with HEIDENHAIN controls	**61**

[1] Available to registered customers for downloading from the Internet
[2] Available to all customers (without registration) for downloading from the Internet

User Functions

User functions	Standard	Option	
Brief description	•		Basic version: 3 axes plus spindle
		○	4th NC axis plus auxiliary axis
			or
		0-7 77 78	} a total of 14 additional NC axes or 13 additional NC axes plus second spindle
	•		Digital current and spindle speed control
Program entry	•		HEIDENHAIN conversational
	•		DIN/ISO
Position data	•		Nominal positions for lines and arcs in Cartesian coordinates or polar coordinates
	•		Incremental or absolute dimensions
	•		Display and entry in mm or inches
Tool compensation	•		Tool radius in the working plane and tool length
	•		Radius-compensated contour look-ahead for up to 99 blocks (M120)
		9	Three-dimensional tool-radius compensation for changing tool data without having to recalculate an existing program
Tool tables	•		Multiple tool tables with any number of tools
Constant contour speed	•		Relative to the path of the tool center
	•		Relative to the tool's cutting edge
Parallel operation	•		Creating a program with graphic support while another program is being run
3-D machining		9	Motion control with minimum jerk
		9	3-D tool compensation through surface normal vectors
		9	Keeping the tool normal to the contour
		9	Tool radius compensation normal to the tool direction
Rotary table machining		8	Programming of cylindrical contours as if in two axes
		8	Feed rate in mm/min
Contour elements	•		Straight line
	•		Chamfer
	•		Circular path
	•		Circle center
	•		Circle radius
	•		Tangentially connecting circular arc
	•		Corner rounding
		50	Recess
		50	Undercut
Approaching and departing the contour	•		Via straight line: tangential or perpendicular
	•		Via circular arc
FK free contour programming	•		FK free contour programming in HEIDENHAIN conversational format with graphic support for workpiece drawings not dimensioned for NC
Program jumps	•		Subroutines
	•		Program-section repeat
	•		Calling any program as a subroutine

User functions	Standard	Option	
Fixed cycles	•		Drilling, conventional and rigid tapping, rectangular and circular pockets
	•		Peck drilling, reaming, boring, counterboring, (centering)
		50	Area clearance cycles, longitudinal and transverse, paraxial and contour parallel
		50	Recessing cycles, radial/axial
	•		Milling internal and external threads
		50	Turning inside and outside threads
	•		Clearing level and oblique surfaces
	•		Multioperation machining of straight and circular slots
	•		Multioperation machining of rectangular and circular pockets
	•		Linear and circular point patterns
	•		Contour train, contour pocket—also with contour-parallel machining
	•		OEM cycles (special cycles developed by the machine tool builder) can be integrated
Coordinate transformation	•		Datum shift, rotation, mirror image, scaling factor (axis-specific)
		8	Tilting the working plane, PLANE function
Q parameters Programming with variables	•		Mathematical functions =, +, –, *, /, sin α, cos α, tan α, arc sin, arc cos, arc tan, a^n, e^n, ln, log, $\sqrt{a}$, $\sqrt{a^2 + b^2}$
	•		Logical operations (=, = /, <, >)
	•		Calculating with parentheses
	•		Absolute value of a number, constant π, negation, truncation of digits before or after the decimal point
	•		Functions for calculation of circles
	•		Functions for text processing
Programming aids	•		Calculator
	•		Complete list of all current error messages
	•		Context-sensitive help function for error messages
	•		TNCguide: The integrated help system. User information available directly on the TNC 640
	•		Graphic support for programming cycles
	•		Comment and structure blocks in the NC program
Actual position capture	•		Actual positions can be transferred directly into the NC program
Test run graphics Display modes	•		Graphic simulation before milling operations, even while another program is running
	•		Plan view / projection in 3 planes / 3-D view, also in tilted working plane/3-D pencil-trace graphics
	•		Magnification of details
Interactive programming graphics	•		In the Programming and Editing mode, the contour of the NC blocks is drawn on screen while the blocks are being entered (2-D pencil-trace graphics), even while another program is running
Program-run graphics Display modes	•		Real-time graphic simulation during execution of the milling program
	•		Plan view / projection in 3 planes / 3-D view
Machining time	•		Calculation of machining time in the Test Run operating mode
	•		Display of the current machining time in the Program Run operating modes
Returning to the contour	•		Mid-program startup in any block in the program, returning the tool to the calculated nominal position to continue machining
	•		Program interruption, contour departure and return
Preset tables	•		One preset table for storing reference points
Datum tables	•		Several datum tables for storing workpiece-related datums
Pallet tables	•		Pallet tables (with as many entries as desired for the selection of pallets, NC programs and datums) can be machined workpiece by workpiece

User Functions

User functions	Standard	Option	
Touch probe cycles	•		Touch probe calibration
	•		Compensation of workpiece misalignment, manual or automatic
	•		Datum setting, manual or automatic
	•		Automatic tool and workpiece measurement
Parallel secondary axes	•		Compensating movement in the secondary axis U, V, W through the principal axis X, Y, Z
	•		Including movements of parallel axes in the position display of the associated principal axis (sum display)
	•		Defining the principal and secondary axes in the NC program makes it possible to run programs on different machine configurations
Conversational languages	•		English, German, Chinese (traditional, simplified), Czech, Danish, Dutch, Finnish, French, Hungarian, Italian, Polish, Portuguese, Russian (Cyrillic), Spanish, Swedish
		41	For more conversational languages, see *Options*

Options

Option number	Option	As of NC software 34059x-	ID	Comment
0 **1** **2** **3** **4** **5** **6** **7**	Additional axis	01	354540-01 353904-01 353905-01 367867-01 367868-01 370291-01 370292-01 370293-01	Additional control loops 1 to 8
8	Software option 1	01	617920-01	**Rotary table machining** • Programming of cylindrical contours as if in two axes • Feed rate in mm/min **Interpolation:** Circular in 3 axes with tilted working plane **Coordinate transformation:** Tilting the working plane, PLANE function
9	Software option 2	01	617921-01	**Interpolation:** Linear in 5 axes **3-D machining** • 3-D tool compensation through surface normal vectors • Keeping the tool normal to the contour • Tool radius compensation normal to the tool direction
18	HEIDENHAIN DNC	01	526451-01	Communication with external PC applications over COM component
23	Display step	01	632986-01	**Display step** to 0.01 µm or 0.00001°
41	Additional languages	01	530184-01 -02 -03 -04 -06 -07 -08 -09 -10	• Slovenian • Slovak • Latvian • Norwegian • Korean • Estonian • Turkish • Romanian • Lithuanian
46	Python OEM Process	01	579650-01	Python application on the TNC
48	KinematicsOpt	01	630916-01	Touch probe cycles for automatic measurement of rotary axes
49	Double Speed	01	632223-01	Short control-loop cycle times for direct drives
50	Turning	01	634608-01	Turning functions: • Tool management for turning • Tool-tip radius compensation • Switching between milling and turning modes of operation • Lathe-specific contour elements • Turning cycle package
77	4 Additional Axes	01	634613-01	4 additional control loops
78	8 Additional Axes	01	634614-01	8 additional control loops
93	Extended Tool Management	01	679938-01	Extended tool management
133	Remote Desktop Manager	01	894423-01	Display and operation of external computer units (e.g. a Windows PC)

Functional safety (FS)

Basic principle

Controls from HEIDENHAIN with functional safety meet safety integrity level 2 (SIL 2) as per the EN 61508 standard, as well as the performance level "d" as per EN ISO 13849-1 (which replaced EN 954-1). These standards describe the assessment of safety-related systems, for example based on the failure probabilities of integrated components and subsystems. This modular approach helps the manufacturers of safety-related systems to implement their complete systems, because they can begin with subsystems that have already been qualified. Safety-related position encoders, the TNC 640 control and functional safety accommodate this concept. Two redundant safety channels that work independently of each other are the foundation for controls with functional safety. All safety-relevant signals are captured, processed and output via two channels. Errors are detected by mutual comparison of the states and data in the two channels. This way, the occurrence of just one fault in the control does not lead to the safety functions being incapacitated.

Design

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

Components

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

Control components with functional safety are recognizable by the suffix FS after the model designation, e.g. TE 745 FS.

MB and TE

An MB machine operating panel with FS is absolutely necessary for systems with functional safety (integrated in TE 745 FS). Only on such a machine operating panel do all keys have a dual-channel design. Axes can be moved without additional permissive keys.

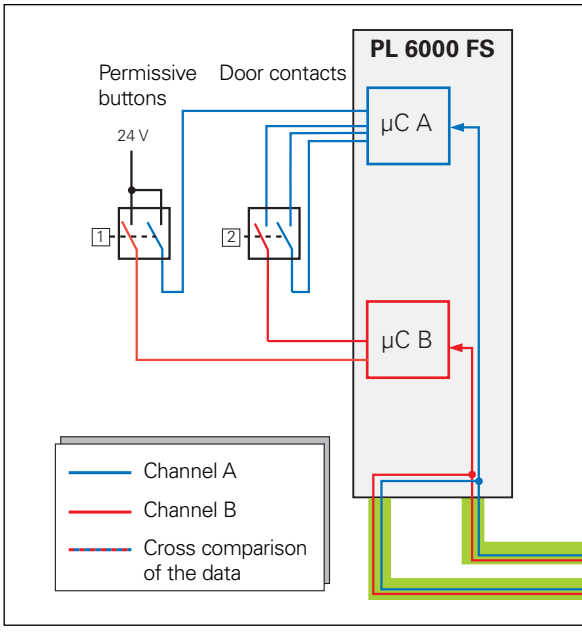
PLB

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

HR

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

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



Safety functions

The following safety functions are integrated in the hardware and software.

- Safe stop reactions (SS0, SS1, SS2)
- Safe torque off (STO)
- Safe operating stop (SOS)
- Safely limited speed (SLS)
- Safely limited position (SLP)
- Safe brake control (SBC)
- Safe operating modes in accordance with EN 12417:
  - 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:
At the time of introduction, the TNC 640 does not yet have the complete scope of functions for ensuring functional safety on all machine types. Before planning a machine with functional safety, please inform yourself of whether the current scope of features suffices for your machine design.

Activation of functional safety

If the control identifies a PLB 62xx FS in the system during booting, functional safety is activated. In this case, it is essential that the following prerequisites be fulfilled:

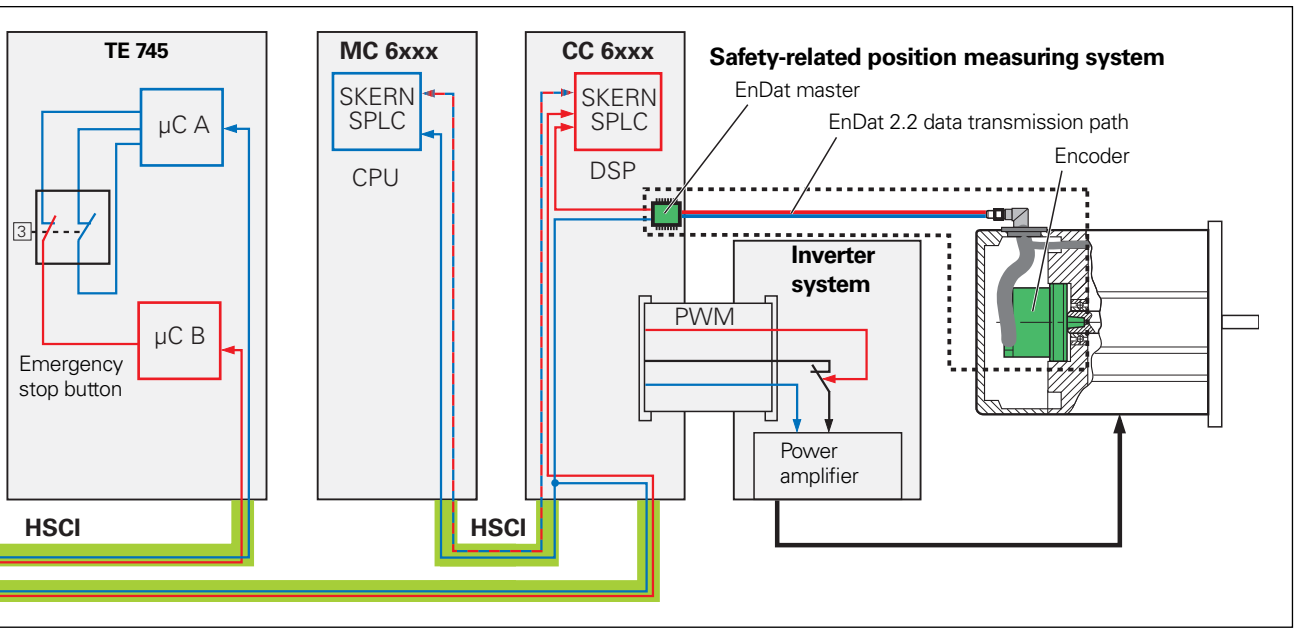
- Functional safety versions of safety-related control components (e.g. TE 745 FS, HR 410 FS)
- Safety-related SPLC program
- Configuration of safe machine parameters
- Wiring of the machine for systems with functional safety

Functional safety cannot be activated or deactivated by parameter.

For more information

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

For details, see the *Functional Safety FS* Technical Manual.
Your contact person at HEIDENHAIN will be glad to answer any questions concerning the TNC 640 with functional safety.



Digital Control Design

Uniformly digital

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

HSCI

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

Main advantages of the control design with HSCI:

- Hardware platform for flexible and scalable control system (e.g. decentral axis systems)
- High noise immunity due to digital communication between components
- Hardware basis for the implementation of "functional safety"
- Simpler wiring (initial operation, configuration)
- Inverters remain connected via proven PWM interface
- Greater cable lengths in the entire system (HSCI up to 70 m)
- More control loops (18 axes, alternately 2 spindles)
- More PLC inputs and outputs
- Controller units can be installed elsewhere

CC or UEC controller units, up to eight PL 6xxx input/output modules, and an MB machine operating panel 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 housed in the operating panel is especially advantageous. All that is required is the power supply and an HSCI line to the controller in the electrical cabinet.

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

HSCI components		**Maximum number**	
MC	HSCI master	1 in the system	
CC, UEC	HSCI slave	4 drive-control motherboards (distributed to CC, UEC as desired)	
TE 745, PLB 6001	HSCI slave	1 in the system	Total of up to 9 components
PLB 62xx	HSCI slave	1 in the system (not with UEC 11x)	
PLB 61xx	HSCI slave	7 in the system	
HR handwheel	On MB 7xx or PLB 6001	1 in the system	
PLD-H-xx-xx FS	In PLB 6xxx FS	8 in the system	
PLD-H-xx-xx	In PLB 6xxx (FS)	64 in the system	

TNC 640 HSCI Control Systems

Overview

The TNC 640 contouring control includes various components, which can be selected and combined to fit the application.

		Type		Page
Main computer		**MC 6241**	**MC 6341**	**18**
	Processor	Pentium M	Pentium Dual Core	
Storage medium		HDR hard disk		**19**
NC software license		SIK		**19**
Controller unit	6 control loops	**CC 6106**		**23**
	8 control loops	**CC 6108**		**23**
	10 control loops	**CC 6110**		**23**
	12 control loops	**CC 6106 + CC 6106**		**23**
	14 control loops	**CC 6108 + CC 6106**		**23**
	16 control loops	**CC 6108 + CC 6108**		**23**
	18 control loops	**CC 6106 + CC 6106 + CC 6106** or **CC 6110 + CC 6108**		**23**
	20 control loops	**CC 6110 + CC 6110**		**23**
Controller unit with integral inverter	4 control loops	**UEC 111**[1)]		**24**
	5 control loops	**UEC 112**[1)]		**24**
Power supply		**PSL 130/PSL 135**		**29**
Visual display unit		**BF 760**		**25**
Operating panel		**TE 740** or **TE 745** (with integrated MB)		**25**
Machine operating panel		**TE 745** (MB integrated) or **PLB 6001** (HSCI adapter for OEM operating panel)		**25** **32**
PLC inputs/outputs[1)]		**PL 6xxx/PL 550** series		**26**
Connecting cables				**36**
Electronic handwheels		**HR 410/HR 130** or **HR 150**		**30**
Touch probes	Workpiece measurement	**TS 220/TS 440/TS 444/TS 640** or **TS 740**		**35**
	Tool measurement	**TT 140** or **TL**		**35**
Industrial PC		**IPC 6341**		**21**

[1)] **Please note:**
The MC 6xxx main computer does not have any PLC inputs/outputs. Therefore one PL 62xx or one UEC 11x is necessary for each control. They feature safety-relevant inputs/outputs as well as the connections for touch probes.

Main Computer

Main computer

The **MC 6xxx** main computers feature:
- Processor
- RAM memory
- HSCI interface to the CC 6xxx or UEC controller unit and to other control components
- HDL interface to the BF 7xx screen
- USB 2.0 interfaces, including to the TE 7xx operating panel
- Further interfaces, such as Ethernet and RS-232-C/V.24 for use by the end user

To be ordered separately, and to be installed in the main computer by the OEM:
- **HDR** storage medium with the NC software
- **SIK component** (System Identification Key) for enabling the control loops and software options

The following HSCI components are necessary for operation of the TNC 640:
- MC main computer
- Controller unit
- **PLB 62xx** PLC input/output unit (system PL; integrated in UEC 11x)
- Machine operating panel (integrated in TE 745) or **PLB 6001** HSCI adapter for connection of an OEM machine operating panel

MC 6241

Power supply

24 V DC of power are supplied to the main computer and other HSCI components by the PSL 13x supply unit. For the entire HSCI system, the 24 V DC NC supply voltage for the control components is required to be safely separated voltage (PELV). It must not be connected to the 24 V DC supply voltage for PLC components (e.g. holding brakes).

Export version

Because the entire NC software is saved on the HDR hard disk, no export version is required for the main computer itself. Export versions are available only for the easily replaceable HDR and the SIK component.

Versions

The MC 6xxx units feature the the HEROS 5 operating system from HEIDENHAIN. The standard versions are equipped with the HSCI, Ethernet, USB and RS-232-C interfaces.

	To be installed in	Processor	RAM memory	Other interfaces	Power loss	Weight	ID
MC 6241	Electrical cabinet	Pentium M 1.8 GHz	1 GB	HDL	40 W	4.0 kg	573398-03
				PROFIBUS DP			653220-03
MC 6341		Pentium Dual Core 2.2 GHz	2 GB	HDL	43 W		671226-01
				PROFIBUS DP			735873-01

Options

The capabilities of the TNC 640 can also be adapted retroactively with options to meet new requirements. These options are described on page 12. 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.

The MC 6xxx can be delivered with a selectable scope of software functions activated (see NC software license). Software options can also be enabled retroactively.

Main Computer—HDR, SIK Component

Storage medium

The storage medium is removable and must be ordered separately from the main computer. It contains the NC software 340 59x-xx. An HDR hard disk serves as storage medium.

	Free capacity	For main computer	Export license required	No export license required
HDR hard disk	144 GB	MC 6241 MC 6341	ID 617 779-01	ID 617 779-51

HDR hard disk

SIK component

The SIK component contains the **NC software license** for enabling control loops and software options. It gives the main computer an unambiguous ID code—the SIK number. The SIK component is ordered and shipped separately. It must be inserted in a special slot in the MC 6xxx main computer.

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

When ordering, please indicate the SIK number of your control.

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

SIK component

Master keyword (general key)

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

Software Key Generator (accessory)

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

NC software license and enabling of control loops
depending on CC (*italics:* export version)

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

Enabling further control loops

Further control loops can be enabled either as groups or individually. The combination of control-loop groups and individual control loops makes it possible to enable any number of control loops. Up to **20 control loops** are possible.

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

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

Industrial PC with Windows 7

IPC 6341

With the IPC 6341 Windows computer you can start and remotely operate Windows-based applications via the TNC's user interface. Option 133 is needed in order to display this information on the screen.

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

IPC 6341

The following components are necessary:

Computer with Windows

	To be installed in	Processor	RAM memory	Power loss	Weight	ID
IPC 6341	Electrical cabinet	Pentium Dual Core 2.2 GHz	2 GB	43 W	4.0 kg	749963-01

A hard disk—to be ordered separately—serves as storage medium.

	Operating system	Free capacity	ID
HDR hard disk	Windows 7 Embedded	Approx. 140 GB	599956-01

Controller Unit

Controller unit

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

Single-speed
Double-speed

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

CC 6106

Cycle times

With f_{PWM}	**Current controller**	**Speed controller**		**Position controller**
		Single-speed	**Double-speed**	
3333 Hz	150 µs	300 µs	150 µs	Same as **speed controller**
4000 Hz	125 µs	250 µs	125 µs	
5000 Hz	100 µs	200 µs	100 µs	
6666 Hz[1)]	75 µs	150 µs	150 µs	
8000 Hz[1)]	60 µs	125 µs	125 µs	
10000 Hz[1)]	50 µs	100 µs	100 µs	

[1)] Possible only with option 49

Number of control loops

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

Versions

- Modular CC 61xx controller units with PWM interface to the inverters
- Compact UEC 11x controller units with integrated inverter

Controller units and main computers operate in any desired combination.

CC 61xx

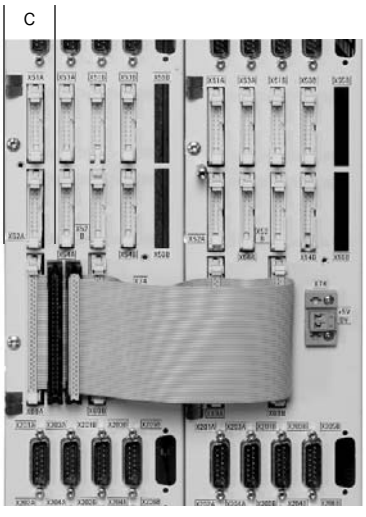
The **CC 61xx** controller units feature:
- Position controller
- Speed controller
- Current controller
- HSCI interfaces
- PWM interfaces to the UM, UR, UE power modules
- Interfaces to the speed and position encoders
- Interfaces for power supply (via inverter or PSL 135)
- SPI interfaces for expansion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

	CC 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_{PP} or EnDat 2.2	8 x 1 V_{PP} or EnDat 2.2	10 x 1 V_{PP} or EnDat 2.2
Position inputs	6 x 1 V_{PP} or EnDat 2.2	8 x 1 V_{PP} or EnDat 2.2	10 x 1 V_{PP} or EnDat 2.2
PWM outputs	6	8	10
Weight	4.1 kg	4.7 kg	4.8 kg
ID	662636-01	662637-01	662638-01

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

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

Constraints:
- Max. 20 control loops for max. 18 axes + 2 spindles (second spindle can be controlled alternately with the first spindle) can be activated
- A maximum of four drive-control main boards are allowed in the HSCI system (the CC 6106 contains one main board, the CC 6108/CC 6110 each contain two main boards).

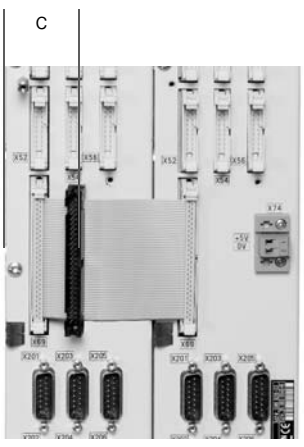


Ribbon cable for supply voltage

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

Combination	**Length**	**Dimension c**	**ID**
2 x CC 6108 or 2x CC 6110 or CC 6108 and CC 6110	300 mm[1)]	26.5 mm	325816-22
2 x CC 6106	80 mm	31.5 mm	325816-15

[1)] In order to reduce the voltage drop, the long ribbon cable is led doubled.



The short ribbon cables (ID 352816-15) included in delivery are not necessary for combinations with CC 6108 and/or CC 6110. They are only necessary for connecting sockets X69 A and X69 B if the CC units are used separately.

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

UEC 11x

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

Controller

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

Inverter

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

System PL

- Interfaces for one workpiece touch probe and one tool touch probe
- PLC with 38 freely available inputs and 23 outputs (7 of these outputs can be switched off), expandable via PL 61xx
- Configuration with IOconfig PC software

		UEC 111			**UEC 112**		
Controller		4 digital control loops			5 digital control loops		
Speed inputs		4 x 1 V_{PP} or EnDat 2.2			5 x 1 V_{PP} or EnDat 2.2		
Position inputs		4 x 1 V_{PP} or EnDat 2.2			5 x 1 V_{PP} or EnDat 2.2		
Inverter		*2 axes*	*1 axis*	*Spindle*	*3 axes*	*1 axis*	*Spindle*
Rated current I_N/ Max. current I_{max}[1] at PWM frequency	**3333 Hz**	**6.0/12.0 A**	**9.0/18.0 A**	**24.0/36.0 A**	**6.0/12.0 A**	**9.0/18.0 A**	**24.0/36.0 A**
	4000 Hz	5.5/11.0 A	8.3/16.5 A	22.0/33.0 A	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	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	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	3.6/7.3 A	5.5/11.0 A	14.6/21.9 A
	10000 Hz	3.0/6.0 A	3.0/6.0 A	12.2/18.3 A	3.0/6.0 A	3.0/6.0 A	12.2/18.3 A
Power supply		3AC 400 V to 480 V (± 10 %); 50 Hz to 60 Hz					
Rated power of DC link		**14 kW**			**14 kW**		
Peak power[2] of DC link		18 kW / 25 kW			18 kW / 25 kW		
Power loss at I_N (approx.)		450 W			450 W		
DC-link voltage		565 V DC			565 V DC		
Integral braking resistance		2.1 kW / 27 kW			2.1 kW / 27 kW		
Power pack for HSCI components		24 V DC / 3.5 A			24 V DC / 3.5 A		
Module width		175 mm			175 mm		
Weight (approx.)		20 kg			20 kg		
ID		625777-xx			625779-xx		

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

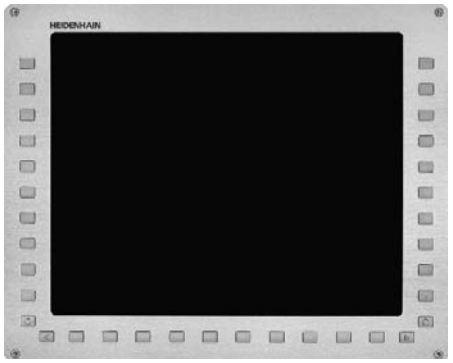
[2] 1st value: 40 % Cyclic duration factor for duty cycle time of 10 minutes (S6-40 %)
2nd value: 4 s Cyclic duration factor for duty cycle time of 20 s

19″ Screen and Keyboard

BF 760 color flat-panel display

ID 732589-01
Weight: approx. 7.8 kg

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



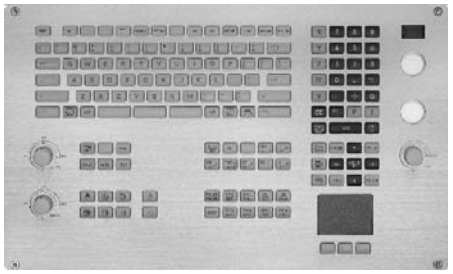
BF 760

TE 740 keyboard unit

ID 886546-01
Weight: approx. 3.2 kg

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

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



TE 740

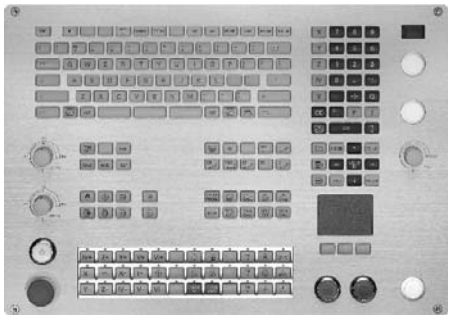
TE 745 keyboard unit with integrated machine operating panel

TE 745: ID 679817-01
TE 745 FS: ID 805482-01
Weight: approx. 4.2 kg

Same as TE 740, but with integrated machine operating panel

- Power supply 24 V DC / approx. 4 W
- 36 exchangeable snap-on keys with status LEDs, freely definable via PLC
- Operating elements: 12 axis keys, 24 function keys, NC start[1)], NC stop[1)], spindle start, spindle stop, emergency stop button, control voltage on[1)]; 2 holes for additional keys or keylock switches
- Connection for HR handwheel
- HSCI interface
- *TE 745*: 7 free PLC inputs and 5 free PLC outputs
  TE 745 FS: 5 free FS inputs and 5 free PLC outputs; and dual-channel FS inputs for emergency stop and permissive buttons of the handwheel

[1)] Keys illuminated, addressable via PLC



TE 745

PL 6xxx PLC Input/Output Systems with HSCI

The PLC inputs and outputs are available via external modular PL 6xxx PLC input/output systems. These consist of a basic module and one or more I/O modules, and are connected to the MC main computer via the HSCI interface. The PL 6xxx units are configured with the PC software IOconfig.

PLB 62xx

Basic modules

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

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

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

System PL

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

PLB 6204	For 4 I/O modules	ID 591832-03
PLB 6204FS	For 4 I/O modules	ID 586798-03
PLB 6206	For 6 I/O modules	ID 630054-03
PLB 6206FS	For 6 I/O modules	ID 622721-03
PLB 6208	For 8 I/O modules	ID 630055-03
PLB 6208FS	For 8 I/O modules	ID 620927-03

Expansion PL

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

PLB 6104	For 4 I/O modules	ID 591832-03
PLB 6104FS	For 4 I/O modules	ID 590479-03
PLB 6106	For 6 I/O modules	ID 630058-03
PLB 6106FS	For 6 I/O modules	ID 804755-01
PLB 6108	For 8 I/O modules	ID 630059-03
PLB 6108FS	For 8 I/O modules	ID 804756-01

Up to eight PL 6xxx units can be connected to the control (one PLB 62xx or UEC 11x and up to seven PLB 61xx). The maximum cable length results from the maximum permissible length of the HSCI chain of 70 m.

I/O modules

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

PLD-H 16-08-00	I/O module with 16 digital inputs and 8 digital outputs
PLD-H 08-16-00	I/O module with 8 digital inputs and 16 digital outputs
PLD-H 08-04-00 FS	I/O module with 8 digital FS inputs and 4 digital FS outputs
PLD-H 04-08-00 FS	I/O module with 4 digital FS inputs and 8 digital FS outputs

Total current	Outputs 0 to 7: ≤ 2 A per output (≤ 8 A simultaneously)
Power output	Max. 200 W
Weight	0.2 kg
PLD-H 16-08-00	ID 594243-02
PLD-H 08-16-00	ID 650891-02
PLD-H 08-04-00 FS	ID 598905-02
PLD-H 04-08-00 FS	ID 727219-02

PLA-H 08-04-04

Analog module for PL 6xxx with
- 8 analog inputs, ±10 V
- 4 analog outputs, ± 10 V
- 4 analog inputs for PT 100 thermistors

Weight	0.2 kg
ID	675572-01

Empty housing

For unused slots

ID	383022-11

IOconfig
(accessory)

PC software for configuring HSCI and PROFIBUS components

PL 550 PLC Input/Output Systems for PROFIBUS-DP

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

Basic module **With PROFIBUS-DP interface**

PLB 550

Basic module with PROFIBUS-DP interface
Slots for 4 I/O modules
The PLB 550 serves as a PROFIBUS slave. A total of 32 slaves can be connected to the MC with integrated PROFIBUS interface board (PROFIBUS single master). They are mounted on standard NS 35 rails (DIN 46227 or EN 50022).

Supply voltage	24 V DC
Power consumption	approx. 20 W
Weight	0.36 kg (bare)
ID	507872-01

PL 550

I/O modules **For PROFIBUS-DP**
The I/O modules for PL 550 consist of one module with digital inputs/outputs and one analog module. For partially occupied basic modules, the unused slots must be occupied by an empty housing.

PLD 16-8

I/O module for PL 550 with 16 digital inputs and 8 digital outputs. The max. power output per module is 200 W. A load of up to 2 A can be placed on each output. No more than four outputs may be loaded with 2 A at any given time.

Weight	0.2 kg
ID	360916-11

PLA 4-4

Analog module for PL 550 with
4 analog inputs for PT 100 thermistors
4 analog inputs, ±10 V

Weight	0.2 kg
ID	366423-01

Empty housing

For unused slots

ID	383022-01

IOconfig
(accessory)

PC software for configuring HSCI and PROFIBUS components

Power Supply for HSCI Components

HEIDENHAIN offers the PSL 13x power supply units for powering 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 24 V DC NC power supply required for the HSCI components by EN 61 800-5-1. The NC supply voltage and the PLC supply voltage are separated from each other by basic insulation.

PSL 130

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

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

HSCI component		**Current consumption 24 V DC NC**
Main computer	MC 6241 MC 6341 MC 7222	1.7 A 1.8 A 2.5 A
Machine operating panel	PLB 6001	0.2 A (without handwheel)
Keyboard unit	TE 745 integrated MB	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 760	2.5 A
Handwheels	HR 410 HR 130 HR 110 + 3x HR 150	0.05 A 0.05 A 0.2 A
Touch probes	See specifications of the touch probes	

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

	Module width	**Degree of protection**	**Weight**	**ID**
PSL 130	50 mm	IP 20	2.1 kg	575047-03
PSL 135	50 mm	IP 20	2.5 kg	627032-02

Accessories

Electronic Handwheels

Support of electronic handwheels is standard on the TNC 640. The following handwheels can be installed:

- One **HR 410** portable handwheel, or
- One **HR 130** panel-mounted handwheel, or
- Up to three **HR 150** panel-mounted handwheels via **HRA 110** handwheel adapter

Handwheels are connected to the MB machine operating panel or the PLB 6001 adapter for HSCI.

HR 410

Portable electronic handwheel with
- Keys for the selection of 5 axes
- Traverse direction keys
- Keys for three preset feed rates
- Actual-position-capture key
- Three keys with machine functions (see below)
- Two permissive buttons (24 V)
- Emergency stop button (24 V)
- Magnetic holding pads

All keys are designed as snap-on keys and can be replaced by keys with other symbols. (For key symbols see *Snap-On Keys*.)

Weight Approx. 1 kg

	Without detent	*With detent*	*Keys*
HR 410	ID 296469-53	–	FCT A, FCT B, FCT C
	ID 296469-54	–	Spindle right/ left/stop
	ID 296469-55	ID 535220-05	NC start/stop, spindle start (for PLC basic program)
HR 410 FS	ID 337159-11	ID 578114-03	FCT A, FCT B, FCT C

HR 130

Panel-mounted handwheel with ergonomic control knob. It is connected to the PLB 6001 or TE 745 directly or via extension cable.

Weight Approx. 0.7 kg

HR 130	*without detent*	ID 540940-03
HR 130	*with detent*	ID 540940-01

HRA 110

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

HRA 110

ID	261 097-04
Weight	Approx. 1.5 kg

Handwheel step switch with knob and cable

ID	270 908-xx

HR 150

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

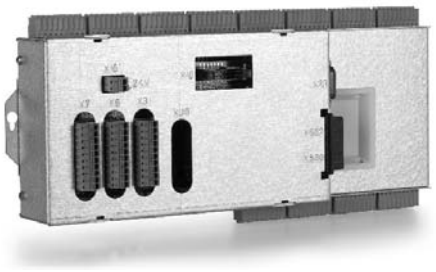
Weight		Approx. 0.7 kg
HR 150	*without detent*	ID 540 940-07
HR 150	*with detent*	ID 540 940-06

HSCI Adapter for OEM Machine Operating Panel

The PLB 6001 HSCI adapter is required in order to connect an OEM-specific machine operating panel to the TNC 640. The spindle-speed and feed-rate override potentiometers of the TE 7xx and the HR handwheel are also connected to this adapter.

PLB 6001

- HSCI interface
- Connection for HR handwheel
- Connection for spindle-speed, feed-rate and rapid-traverse override
- Screw fastening or top-hat-rail mounting
- Configuration of the PLC inputs/outputs with the IOconfig computer software
- Inputs and outputs for keys and key illumination
  Without FS: terminals for 64 inputs and 32 outputs
  With FS: terminals for 32 FS inputs and 32 outputs



Weight	Approx. 1.2 kg
PLB 6001:	ID 668792-01
PLB 6001 FS:	ID 722083-01

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. However, all of the interpolating axes must be either analog or digital. Mixed operation is not possible.

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

CMA-H 04-04-00

Additional module for analog axes/spindles

- Expansion board for CC 61xx or UEC 11x controller units
- 4 analog outputs ± 10 V for axes/spindle
- Spring-type plug-in terminals

ID 688721-01

Snap-On Keys For Control

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.

Axis keys

Orange

V	ID 679 843-31						
IV	ID 679 843-32						

Gray

X+	ID 679 843-03	V–	ID 679 843-12				
X–	ID 679 843-04	VI+	ID 679 843-13				
Y+	ID 679 843-05	VI–	ID 679 843-14				
Y–	ID 679 843-06	Y–	ID 679 843-43				
Z+	ID 679 843-07	Y+	ID 679 843-44				
Z–	ID 679 843-08						
IV+	ID 679 843-09						
IV–	ID 679 843-10						
V+	ID 679 843-11						

Machine functions

	ID 679 843-01	FN 3	ID 679 843-26				
	ID 679 843-02		ID 679 843-27				
	ID 679 843-16		ID 679 843-28				
	ID 679 843-22		ID 679 843-29				
	ID 679 843-23		ID 679 843-30				
FN 1	ID 679 843-24		ID 679 843-40				
FN 2	ID 679 843-25						

Spindle functions

	ID 679 843-18		ID 679 843-21		ID 679 843-48		ID 679 843-51
	ID 679 843-19		ID 679 843-46		ID 679 843-49		ID 679 843-52
	ID 679 843-20		ID 679 843-47	100%	ID 679 843-50		

Other keys

	ID 679 843-15		ID 679 843-39				
	ID 679 843-17		ID 679 843-41				
	ID 679 843-36		ID 679 843-42				
	ID 679 843-37		ID 679 843-45				
	ID 679 843-38						

Snap-on keys for HR 410

The snap-on keys make it easy to replace the key symbols. In this way, the HR 410 handwheel can be adapted to different requirements. The snap-on keys are available in packs of 5 keys.

Axis keys

Orange

A	ID 330 816-42	X	ID 330 816-24	U	ID 330 816-43	IV	ID 330 816-37
B	ID 330 816-26	Y	ID 330 816-36	V	ID 330 816-38		
C	ID 330 816-23	Z	ID 330 816-25	W	ID 330 816-45		

Gray

A–	ID 330 816-95	V+	ID 330 816-69		ID 330 816-0W		ID 330 816-0R
A+	ID 330 816-96	W–	ID 330 816-0G		ID 330 816-0V		ID 330 816-0D
B–	ID 330 816-97	W+	ID 330 816-0H		ID 330 816-0N		ID 330 816-0E
B+	ID 330 816-98	IV–	ID 330 816-71		ID 330 816-0M	Z–	ID 330 816-65
C–	ID 330 816-99	IV+	ID 330 816-72	Y–	ID 330 816-67	Z+	ID 330 816-66
C+	ID 330 816-0A	X–	ID 330 816-63	Y+	ID 330 816-68		ID 330 816-19
U–	ID 330 816-0B	X+	ID 330 816-64		ID 330 816-21		ID 330 816-16
U+	ID 330 816-0C		ID 330 816-18		ID 330 816-20		ID 330 816-0L
V–	ID 330 816-70		ID 330 816-17		ID 330 816-0P		ID 330 816-0K

Machine functions

SPEC FCT	ID 330 816-0X	FN 3	ID 330 816-75		ID 330 816-0T		ID 330 816-86
SPEC FCT	ID 330 816-1Y	FN 4	ID 330 816-76		ID 330 816-81		ID 330 816-87
FCT A	ID 330 816-30	FN 5	ID 330 816-77		ID 330 816-82		ID 330 816-88
FCT B	ID 330 816-31		ID 330 816-78		ID 330 816-83		ID 330 816-94
FCT C	ID 330 816-32		ID 330 816-79		ID 330 816-84		ID 330 816-0U
FN 1	ID 330 816-73		ID 330 816-80		ID 330 816-89		ID 330 816-91
FN 2	ID 330 816-74		ID 330 816-0S		ID 330 816-85		ID 330 816-3L

Spindle functions

	ID 330 816-08		ID 330 816-40	0	(red) ID 330 816-47		ID 330 816-48
	ID 330 816-09		ID 330 816-41	1	(green) ID 330 816-46		ID 385 530-5X

Other keys

	ID 330 816-01		ID 330 816-50		ID 330 816-90		ID 330 816-93
	ID 330 816-61		ID 330 816-33		ID 330 816-27	0	ID 330 816-0Y
NC I	(green) ID 330 816-11		ID 330 816-34		ID 330 816-28		ID 330 816-4M
NC 0	(red) ID 330 816-12		ID 330 816-35		ID 330 816-29		ID 330 816-3M
	ID 330 816-49		ID 330 816-22		ID 330 816-92		ID 330 816-3N

Touch Probes

Touch probes for workpiece measurement are connected via the system PL 62xx or the UEC 11x. These touch probes generate a trigger signal that saves the current position value to the NC. For more information on the touch probes, ask for our brochure or CD-ROM titled *Touch Probes*.

TS 220

Workpiece measurement

The TS touch trigger probe has a stylus with which it probes workpieces. The TNC provides standard routines for datum setting and workpiece measurement and alignment. The touch probes are available with various taper shanks. Assorted styli are available as accessories.

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

TS 220 — TTL version

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

TS 440 — Compact dimensions

TS 444 — Compact dimensions, battery-free power supply through integrated air turbine generator over central compressed air supply

TS 640 — Standard touch probe with wide-range infrared transmission and long operating time

TS 740 — High probing accuracy and repeatability, low probing force

The infrared transmission is established between the TS touch probe and the SE transceiver unit. The following SE units can be combined with the TS touch probes:
SE 640 for integration in the machine's workspace
SE 540 for integration in the spindle head

TS 640 with SE 640

Tool measurement

The touch probes for tool measurement from HEIDENHAIN are suited for probing stationary or rotating tools directly on the machine. The TNC has standard routines for measuring the length and diameter of the tool as well as the individual teeth. The TNC automatically saves the results of measurement in a tool table. It is also possible to measure tool wear between two machining steps. The TNC compensates the changed tool dimensions automatically for subsequent machining or replaces the tool after a certain limit—as for example after tool breakage.

TT 140 — With the triggering **TT 140 touch probe** the disk-shaped contact plate is deflected from its rest position upon contact with a stationary or rotating tool, sending a trigger signal to the NC control.

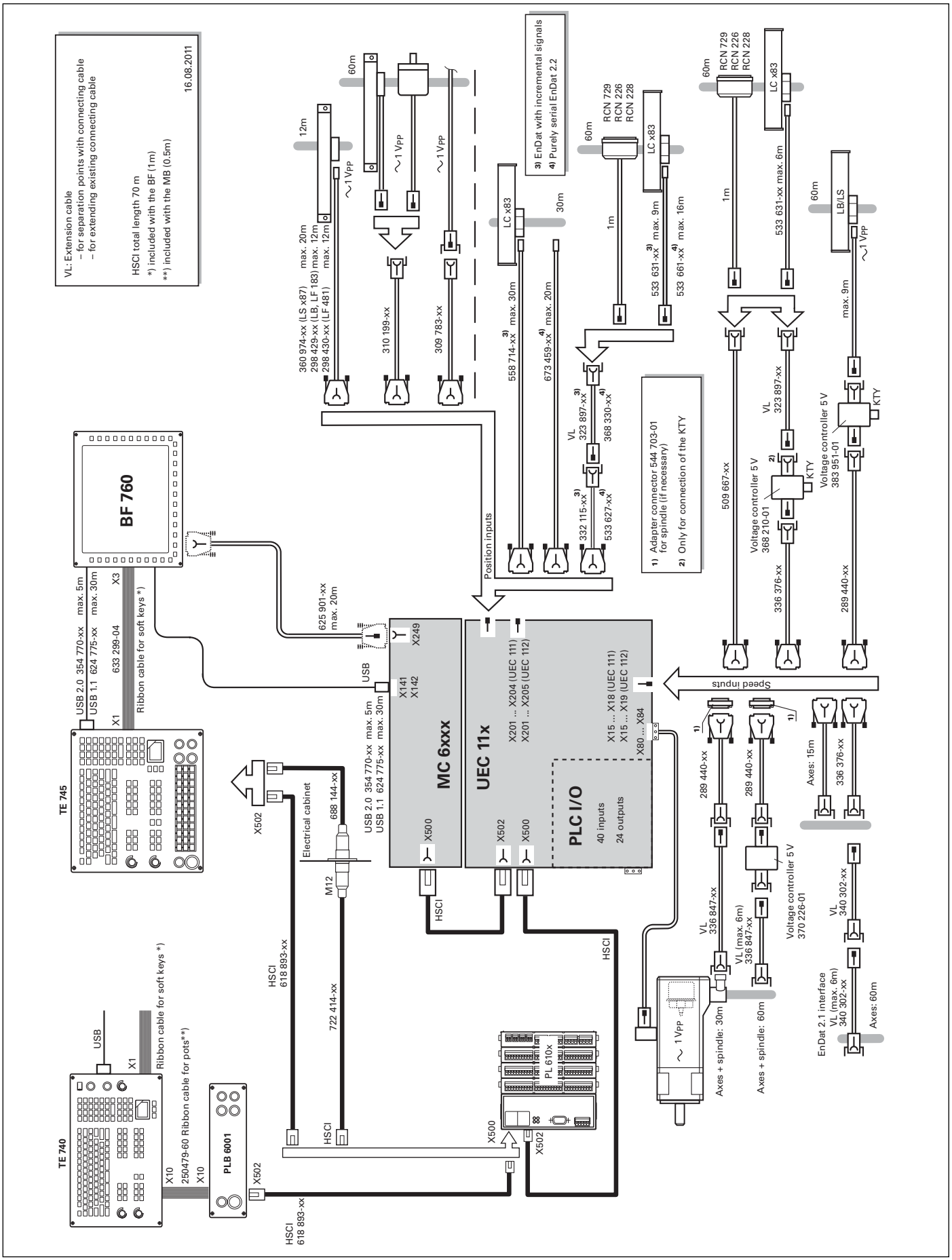
TT 140

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

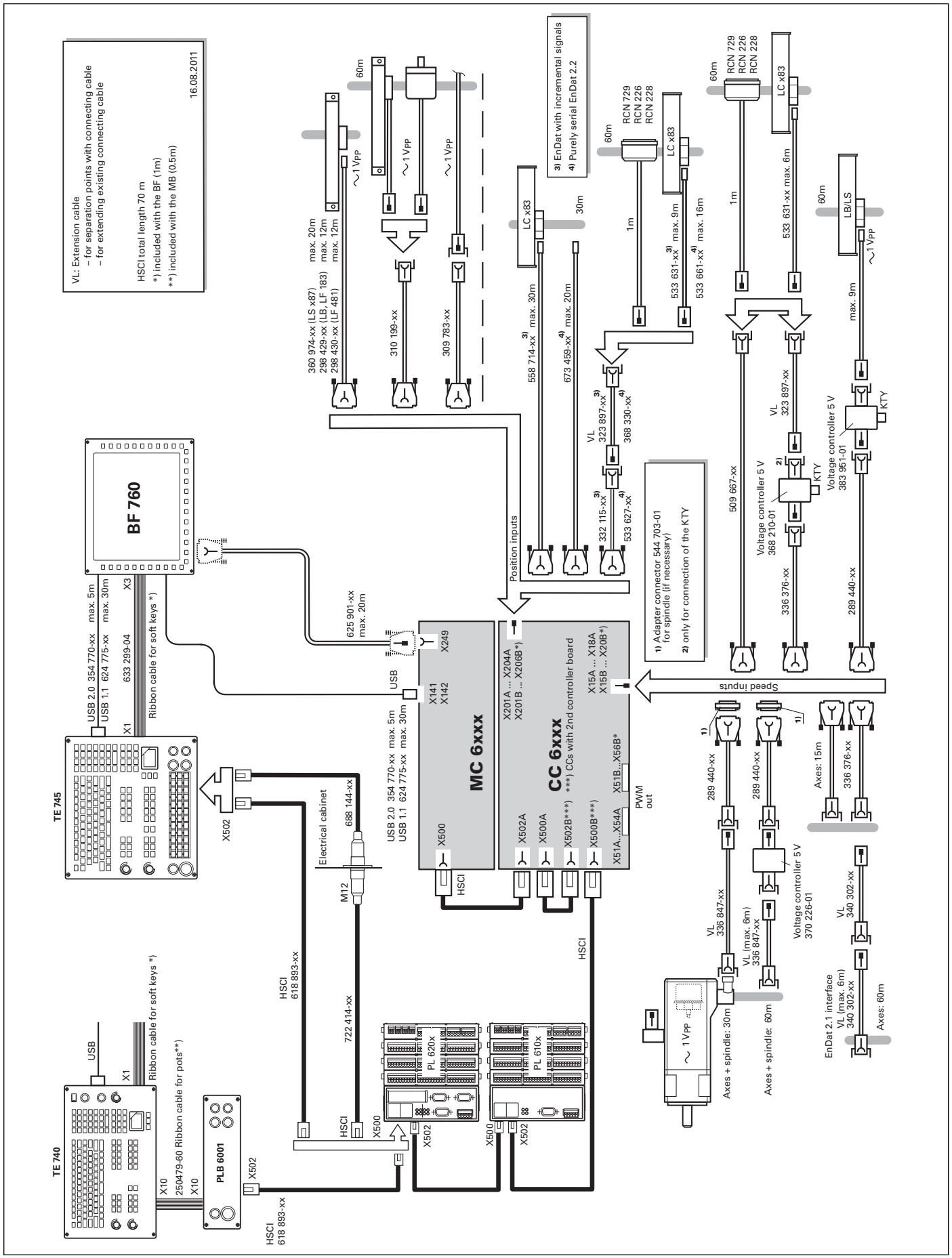
TL Micro 150,
TL Micro 300

Cable Overviews

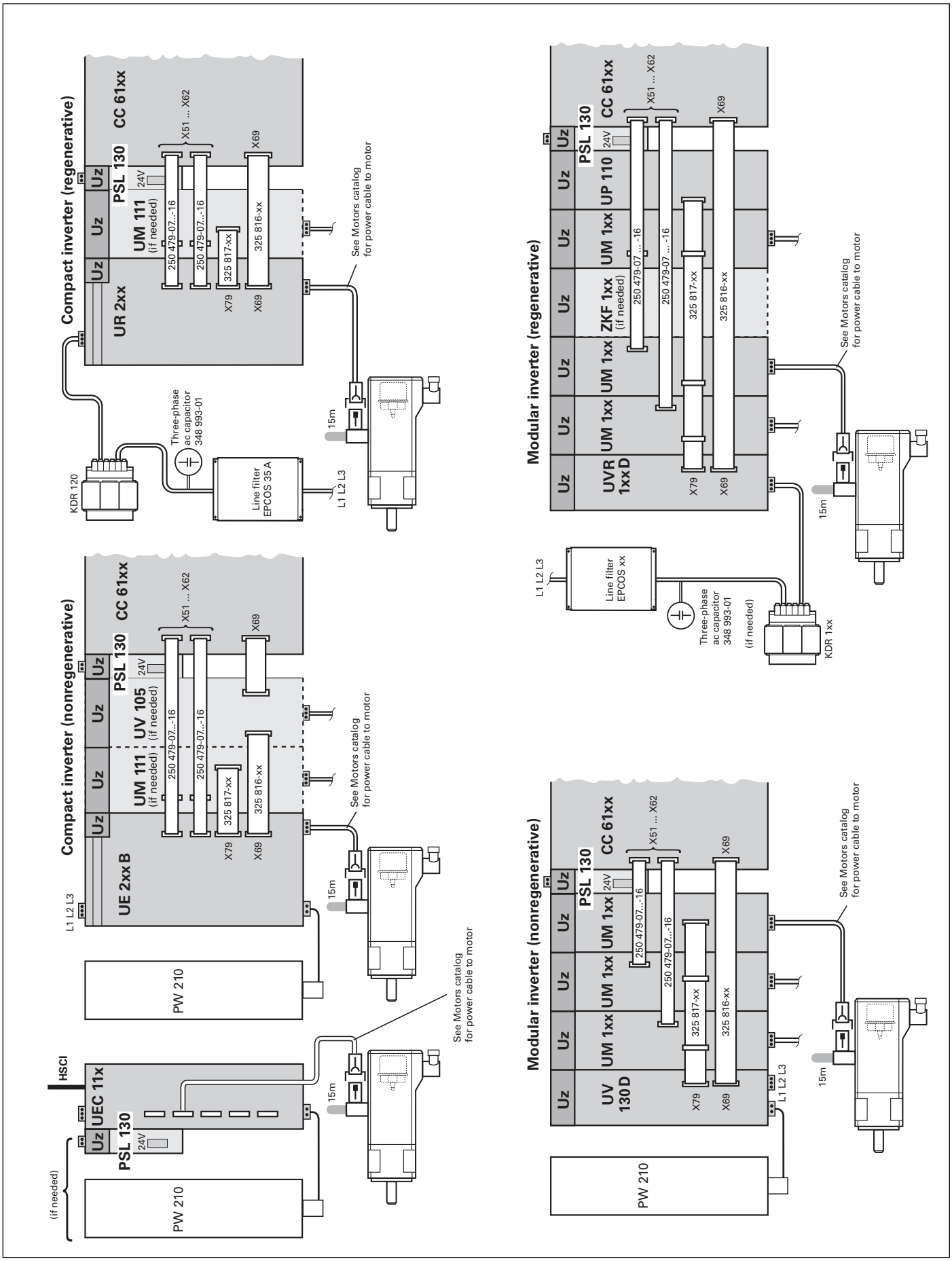
Control System with UEC 11x



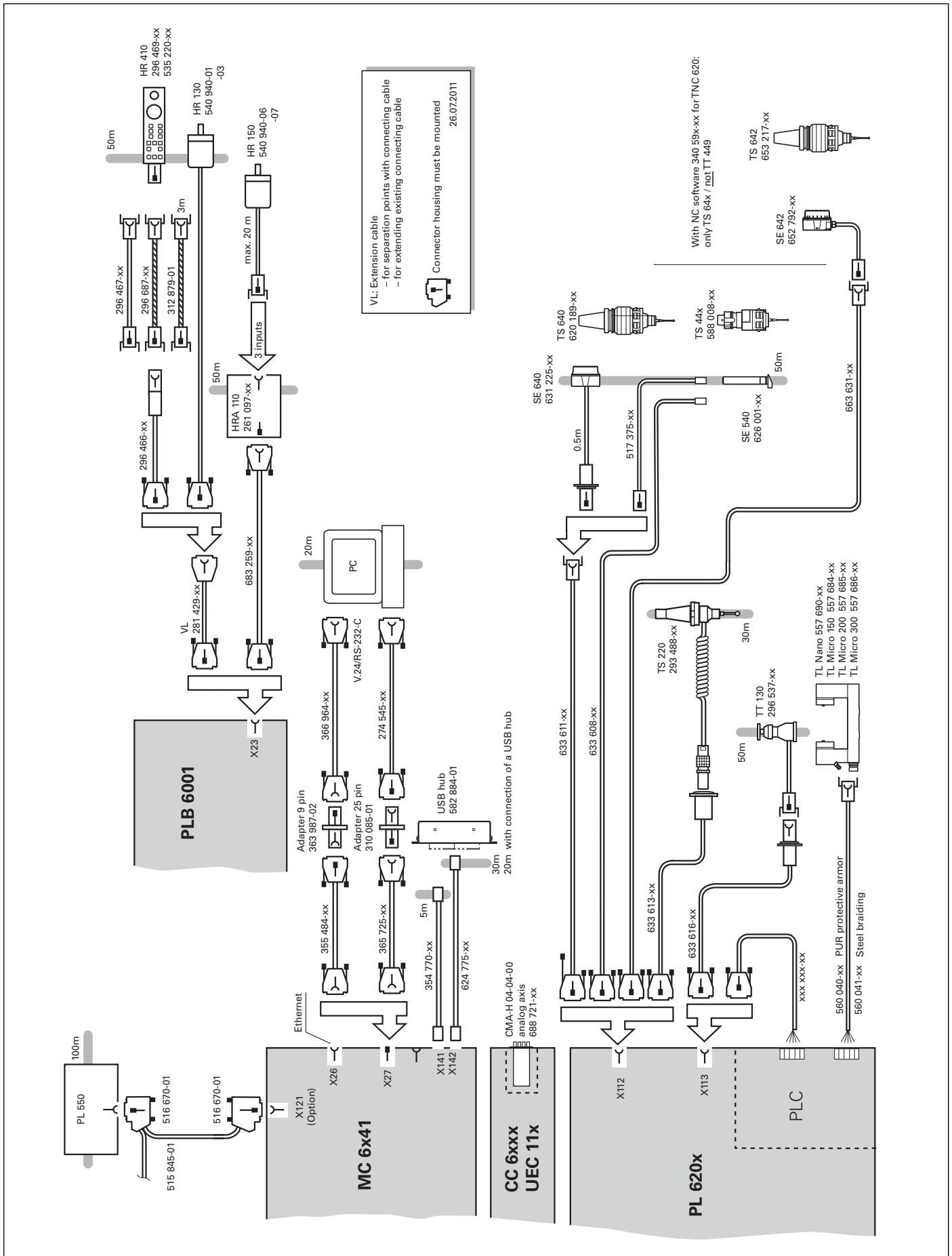
Control System with CC 6106



Inverter Systems



Accessories



Technical Description

Axes

Linear axes

Depending on the options enabled, the TNC 640 can control linear axes with any axis designation (X, Y, Z, U, V, W ...).

Display and programming

–99 999.999 to +99 999.999 [mm]
–99 999.999 99 to +99 999.999 99 [mm] with option 23

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

Feed rate override: 0 to 150 %

Traverse range

–99 999.999 to +99 999.999 [mm]
–99 999.999 99 to +99 999.999 99 [mm] with option 23

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

Rotary axes

The TNC 640 can control rotary axes with any axis designation (A, B, C, U ...).

Special parameters and PLC functions are available for rotary axes with Hirth coupling.

Display and programming

0° to 360° or
–99 999.999 to +99 999.999 [°]
–99 999.999 99 to +99 999.999 99 [°] with option 23

Feed rate in degrees per minute (°/min)

Traverse range

–99 999.999 to +99 999.999 [°]
–99 999.999 99 to +99 999.999 99 [°] with option 23

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

Free rotation

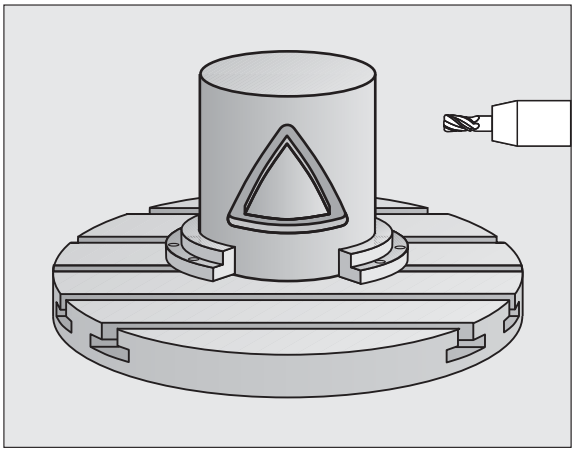
For milling-turning operations, the rotary axis can be started via the PLC with a defined feed rate. For functions specific to milling/turning machines, see *Turning Operations*.

Cylindrical surface interpolation (option 8)

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

Axis clamping

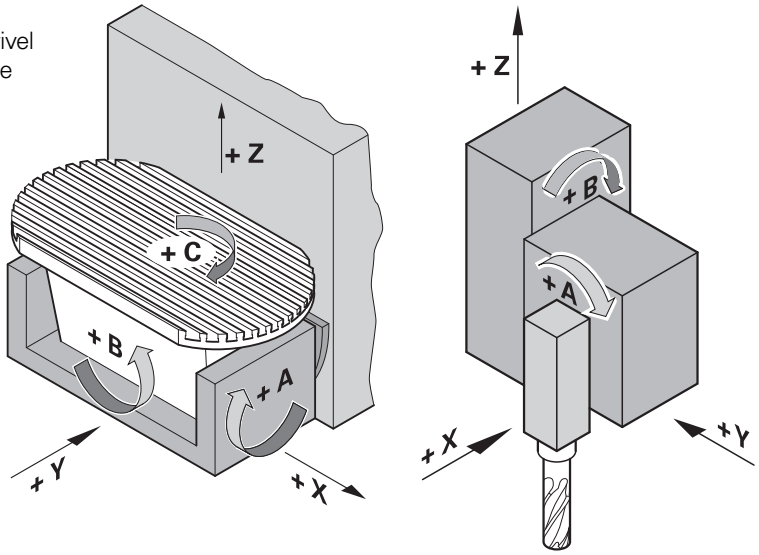
The control loop can be opened through the PLC in order to clamp specific axes.



Tilting the working plane
(option 8)

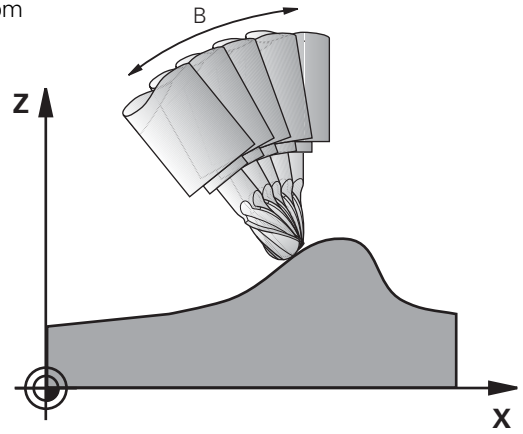
The TNC 640 has special coordinate transformation cycles for controlling swivel heads and tilting tables. The offset of the tilting axes and the tool lengths are compensated by the TNC.

The TNC 640 can manage more than one machine configuration (e.g. different swivel heads).



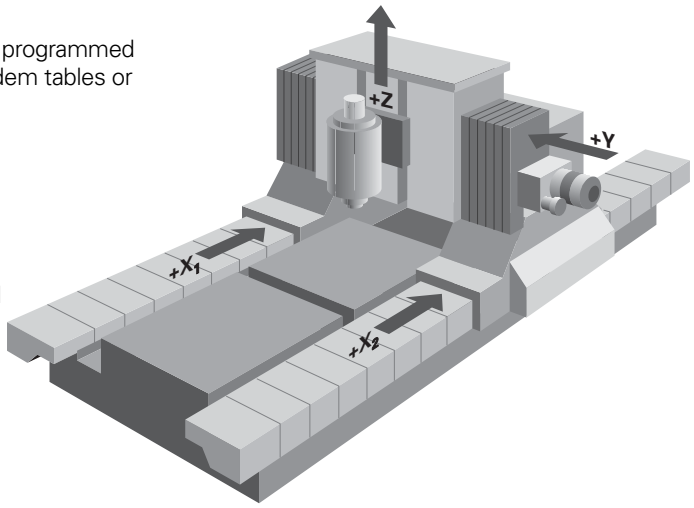
5-axis machining
(option 9)

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



Synchronized axes

Synchronous axes are moved simultaneously and are programmed with the same axis designation, e.g. gantry axes, tandem tables or torque control.



Gantry axes

Gantry axes can be distributed to several drive-control motherboards (DSP), and so to several controller units.

Torque control

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

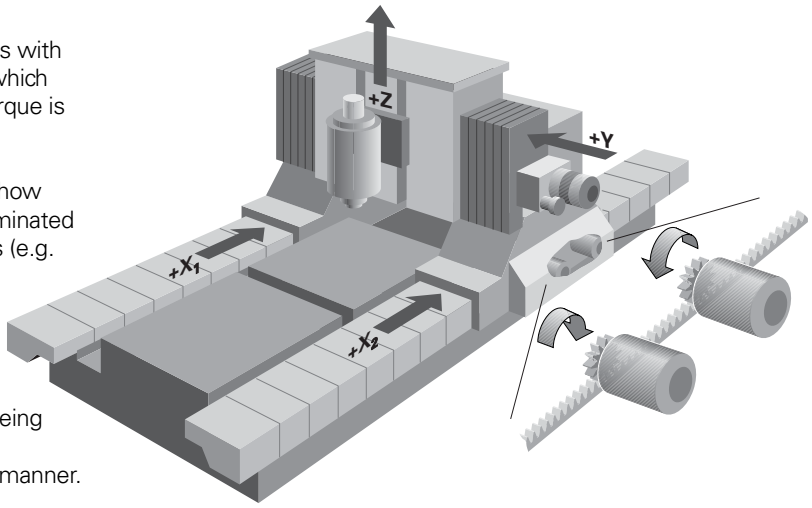
- a defined distribution of drive torque is desired,

or

- parts of the controlled system show a backlash effect that can be eliminated by "tensioning" the servo drives (e.g. racks).

For torque control, the master and slave must be on the same motherboard (DSP).

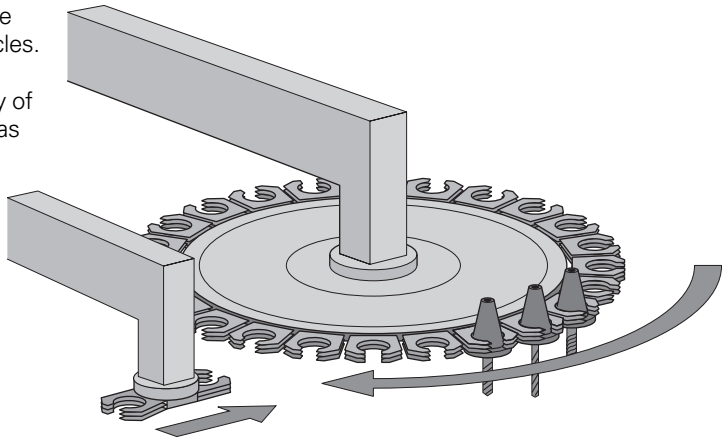
Depending on the controller unit being used, up to five slave axes can be configured for each master in this manner.



PLC axes

Axes can be controlled by the PLC. They are programmed over M functions or OEM cycles.

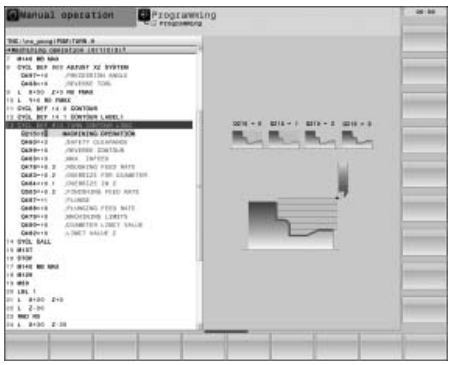
The PLC axes are positioned independently of the NC axes and are therefore designated as asynchronous axes.



Turning Operations

Performing turning operations
(option 50)

The TNC 640 supports machines that can perform a combination of milling and turning operations in a single setup. It offers the operator a comprehensive package of cycles for both types of operations, which are programmed in HEIDENHAIN's workshop-oriented conversational format.



In turning mode, the rotary table serves as the lathe spindle, while the milling spindle with the tool remains stationary.

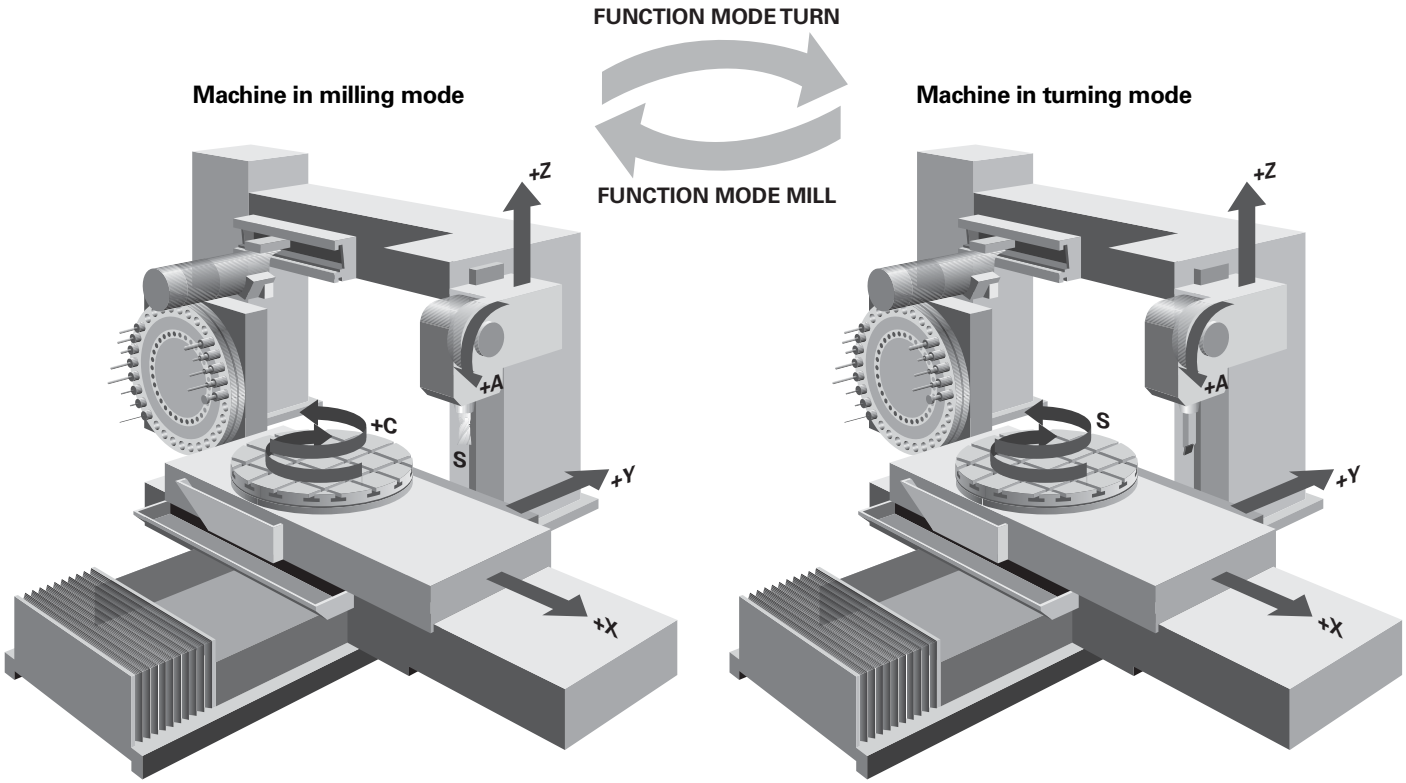
Rotationally symmetric contours are produced during turning operations. The preset must be in the center of the lathe spindle for this.

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

Toggling between milling and turning modes

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

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



Measuring the unbalance – Balancing

An important and basic prerequisite for turning operations is that the radial runout of the workpiece has been balanced. Both the machine (rotary table) and the workpiece must be balanced before machining. If the clamped workpiece has an unbalance, undesirable centrifugal forces can result, influencing the accuracy of the runout.

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

The TNC 640 can determine an unbalance of the rotary table by measuring the effects of the centrifugal forces on neighboring axes. A rotary table positioned via a linear axis would be ideal for this. For other machine designs, measurement of the unbalance via external sensors is appropriate.

The TNC 640 offers the following functions:

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

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

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

Spindle

The TNC 640 contouring control is used in connection with the HEIDENHAIN inverter systems with field-oriented control. As an alternative, an analog nominal value can be output.

Controller unit CC 61xx

With the CC 61xx and UEC controller units, the PWM basic frequency can be set for each controller assembly (e.g. 4 kHz). Possible basic frequencies are 3.33 kHz, 4 kHz or 5 kHz. The **Double Speed** option (option 49) can double this frequency for high-speed spindles (e.g. 8 kHz for HF spindles) (see the *TNC 640 Technical Manual*).

Controller groups

1: X51 + X52
2: X53 + X54
3: X55 + X56

Maximum spindle speed

The maximum spindle speed is calculated as follows:

$$n_{max} = \frac{f_{PWM} \cdot 60\,000\ min^{-1}}{NPP \cdot 5000\ Hz}$$

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

Operating-mode switchover

Various parameter sets can be stored for controlling the spindle (e.g. for wye/delta connection). You can switch between the parameter sets in the PLC.

Position-controlled spindle

The position of the spindle is monitored by the TNC 640.

Encoder

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

Tapping

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

Oriented spindle stop

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

Spindle override

0 to 150 %

Gear ranges

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

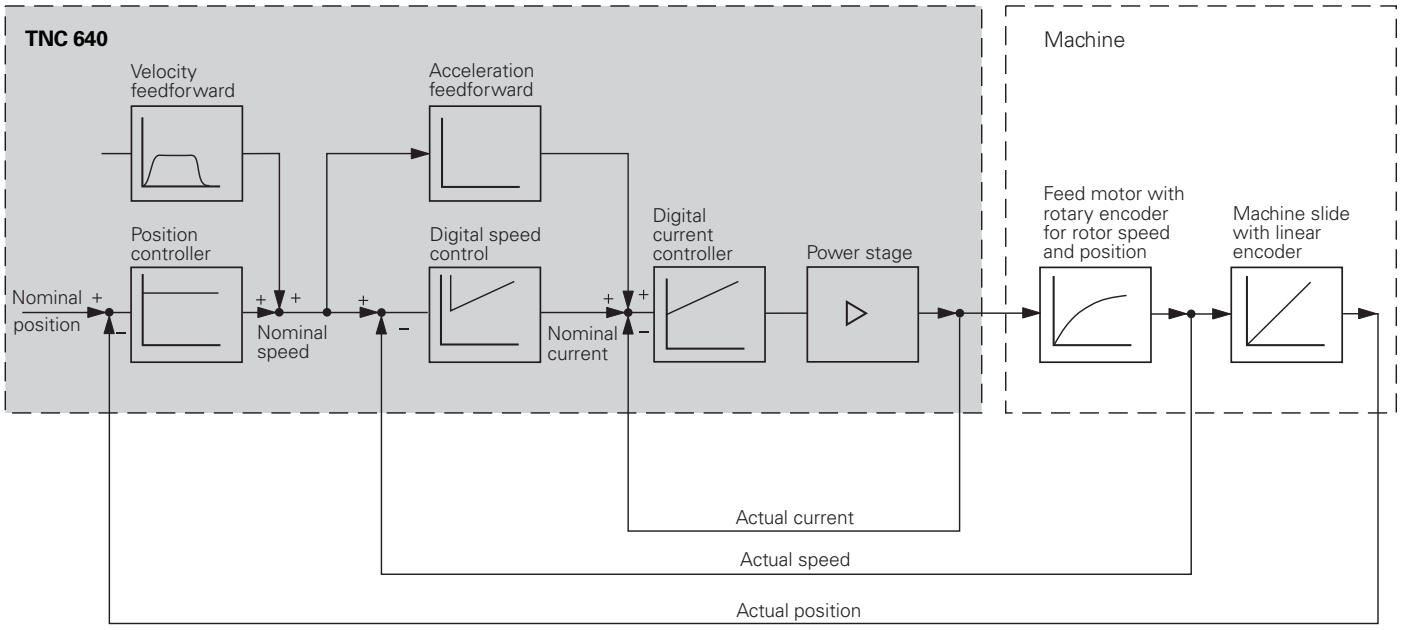
Second spindle

Up to two spindles can be alternately controlled.
You can switch from spindle 1 to spindle 2 through the PLC. Because the second spindle is controlled instead of an axis, the number of available axes is reduced by one.

Digital Closed-Loop Control

Integrated inverters

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



Axis feedback control

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

Servo control with following error

The term "following error" denotes the distance between the momentary nominal position and the actual position of the axis.

The velocity is calculated as follows:

$v = k_v \cdot s_a$

v = velocity
k_v = position loop gain
s_a = following error

Servo control with feedforward

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

Compensation of torque ripples

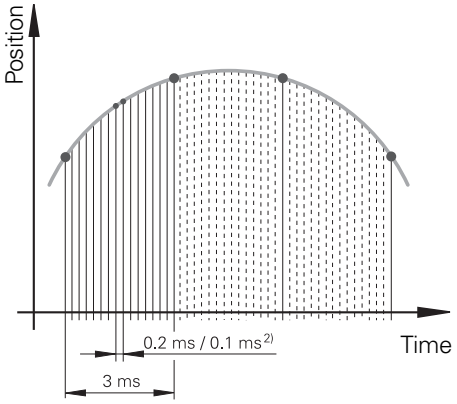
The torque of synchronous, torque and linear motors is subject to periodic oscillations, one cause of which can be permanent magnets. The amplitude of these oscillations depends on the motor design, and under certain circumstances can have an effect on the workpiece surface. After the axes have been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

Control-loop cycle times

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

	CC 6xxx/UEC 11x
Path interpolation	3 ms
Fine interpolation	0.2 ms/0.1 ms[1)]
Position controller	0.2 ms/0.1 ms[2)]
Speed controller	0.2 ms/0.1 ms[1)]
Current controller	0.1 ms at f_{PWM} = 5000 Hz

[1)] Double-speed (with option 49) without position encoder
[2)] Single-speed/double-speed (with option 49)



Double-speed control loops (option 49)

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

Jerk

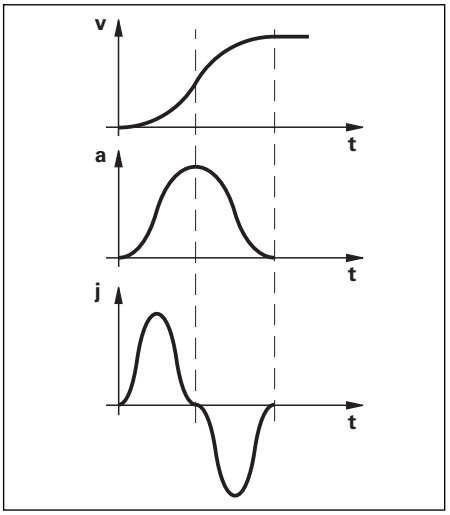
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

Jerk limiting

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

Smoothed jerk

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



Fast Contour Milling

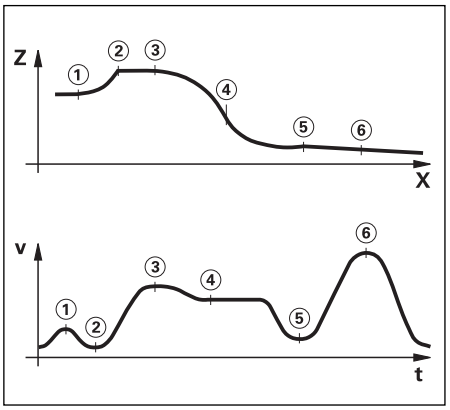
Short block processing times

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

The block processing time of the MC 6x41 is 0.5 ms. This means that the TNC 640 is able to run long programs from the hard disk, even with contours approximated with linear segments as small as 0.2 mm, at a feed rate of up to 24 m/min.

Look-ahead

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



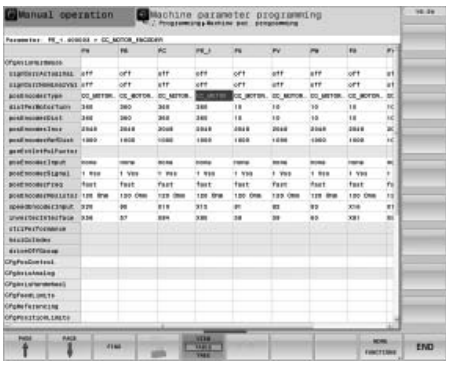
Machine Configuration

A control must have access to specific machine data (e.g. traverse distances, acceleration, speeds) before it can execute its programmed instructions. These data are defined in machine parameters. Every machine has its own set of parameters.

Structured organization of machine parameters

The TNC 640 features a simplified configuration editor. The machine parameters are displayed on the control's screen in a clear tree structure. You move through the structure with the TNC operating panel or a USB mouse. The parameters are entered in windows, much like on a PC.

As an alternative, the configuration editor can display a table view. The table view is especially beneficial when configuring the parameter sets, since you can see the parameters of all axes at a glance.



Quick access using MP numbers

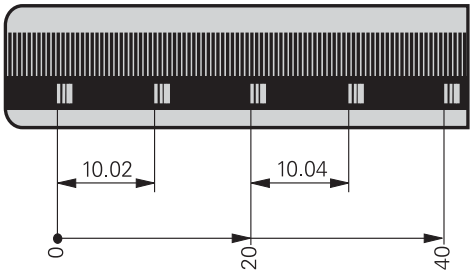
Each machine parameter has a unique 6-digit MP number. The GOTO function can be used for quick access to any machine parameter.

Encoders

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

Incremental encoders

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



Reference mark

When the machine is switched on, the machine axes need to traverse a reference mark 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.

Reference mark evaluation

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

Output signals

Incremental encoders with sinusoidal output signals with levels ~ 1 V_{PP} 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. Additionally, incremental signals can be output, depending on the interface.

EnDat interface

The TNC 640 features the serial EnDat 2.2 (includes EnDat 2.1) interface for the connection of absolute encoders.
Note: The EnDat interface on HEIDENHAIN encoders differs in its pin assignment from the interface on Siemens motors with integrated absolute ECN/EQN rotary encoders. Special adapter cables are available.

Encoder inputs

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

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

Inputs	**Signal level/ Interface**[1]	**Input frequency**[1]	
		Position	Shaft speed
Incremental signals	~ 1 V_{PP}	33 kHz/ 350 kHz	350 kHz
Absolute position values Incremental signals	EnDat 2.2[2]/02 ~ 1 V_{PP}	– 33 kHz/ 350 kHz	– 350 kHz
Absolute position values	EnDat 2.2[2]/22	–	–

[1] Switchable
[2] EnDat 2.2 includes EnDat 2.1

Types of Error Compensation

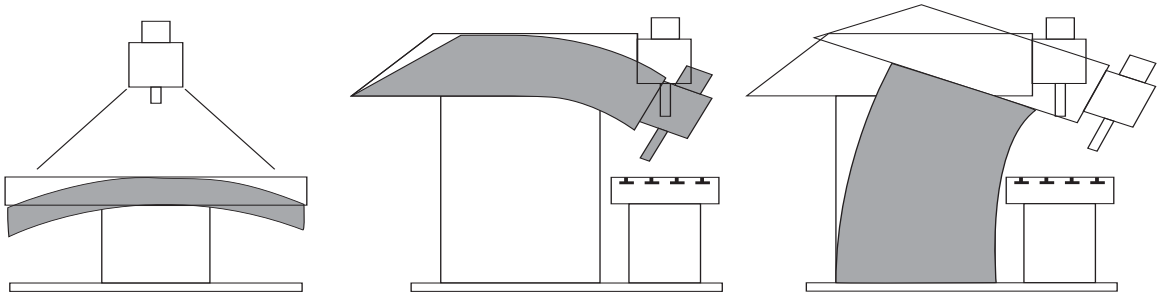
The TNC 640 automatically compensates mechanical errors on the machine.

Linear error

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

Nonlinear error

The TNC 640 can compensate for ball-screw pitch errors and sag errors simultaneously. The compensation values are stored in a table.



Backlash

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

Hysteresis

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

Reversal peaks

In circular movements, reversal peaks can occur at quadrant transitions due to mechanical influences. The TNC 640 can compensate for these reversal peaks.

Stick-slip friction

At very low feed rates, high static friction can cause the slide to stop and start repeatedly for short periods. This is commonly known as stick-slip. The TNC 640 can compensate for this problem condition.

Sliding friction

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

Thermal expansion

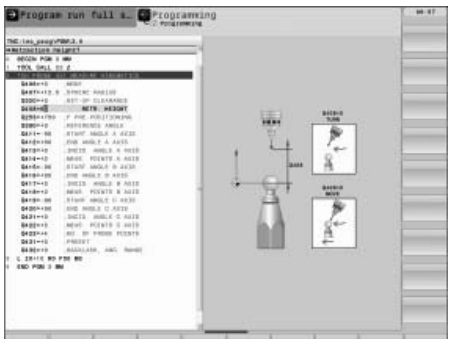
To compensate thermal expansion, the machine's expansion behavior must be known.

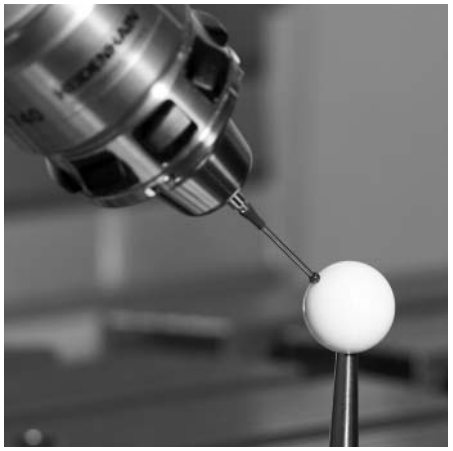
The temperature can be recorded via thermistors connected to the analog inputs of the TNC 640. The PLC evaluates the temperature information and transfers the compensation value to the NC.

KinematicsOpt
(option 48)

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

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





Calibration sphere
(accessory)

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

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

Monitoring Functions

During operation, the TNC 640 monitors:

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

With EnDat 2.2 encoders:

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

In the case of hazardous errors, an EMERGENCY STOP message is sent to the external electronics via the control-is-ready output, and the axes are brought to a stop. The correct connection of the TNC 640 in the machine's EMERGENCY STOP loop is checked when the control system is switched on.
In the event of an error, the TNC 640 displays a message in plain language.

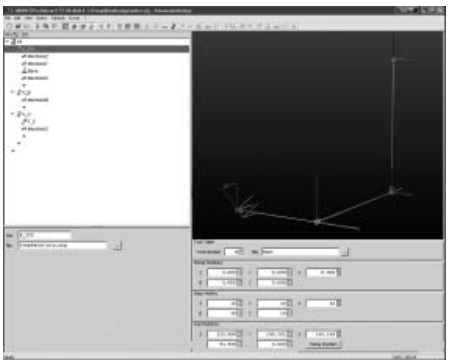
Context-sensitive help

The HELP and ERR keys provide the user with context-sensitive help. This means that in the event of an error message, the TNC 640 displays information on the cause of the error and proposes solutions. The machine tool builder can also use this function for PLC error messages.

KinematicsDesign (accessory)

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

- Complete kinematic configurations
- Transfer of configuration files between control and PC



When used with the iTNC 530, KinematicsDesign provides further conveniences:

- Assignment table
- Kinematics description table
- Kinematics subfile description table
- Tool-carrier kinematics description table
- Definition table for collision-monitored objects (CMO)
- Initial and subsequent configuration of Dynamic Collision Monitoring (DCM; option 40)

If KinematicsDesign is connected with a control online (operation is also possible with the programming station software), then machine movements can be simulated graphically along with axis traverse. With the iTNC 530, when DCM is active the workpiece space is also simulated and any collisions or collision-endangered objects are displayed in a definable color.

Depending on the control involved, the visualization capabilities range from the pure depiction of the transformation sequence to wire models or, on the iTNC 530, to a complete representation of the working envelope.

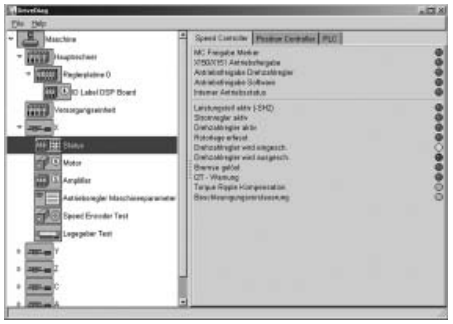
Commissioning and Diagnostic Aids

The TNC 640 provides comprehensive internal commissioning and diagnostic aids. In addition, highly effective PC software for diagnosis, optimization and remote control is available.

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)

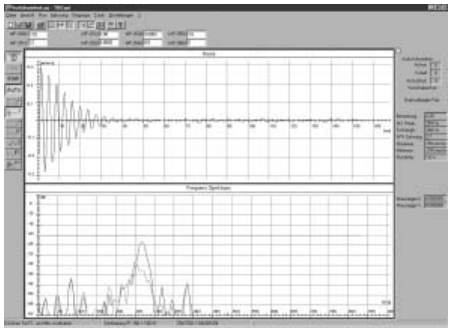
DriveDiag



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 1xx D and UM 1xx D
- Displaying and evaluating the internal control conditions and the status signals of the inverter components
- Displaying the analog values available to the drive controller
- Automatic test for proper function of motors and inverters, of position encoders and speed encoders

DriveDiag can be called directly from the TNC 640 via the Diagnosis soft key. It is also available for downloading as PC software (accessory) from the HEIDENHAIN FileBase on the Internet. End users have read-access, whereas the code number for the machine tool builder gives access to comprehensive testing possibilities with DriveDiag.

TNCopt (accessory)



PC software for commissioning digital control loops

Functions:
- Commissioning of the current controller
- (Automatic) commissioning of the speed controller
- (Automatic) optimization of sliding-friction compensation
- (Automatic) optimization of the reversal-peak compensation
- (Automatic) optimization of kV factor
- Circular interpolation test, contour test

Requirements

DriveDiag and TNCopt place the following demands on the PC:
- Windows 2000/XP/Vista operating system
- At least 15 MB of free hard-disk space
- Serial or Ethernet interface

OLM
Online monitor

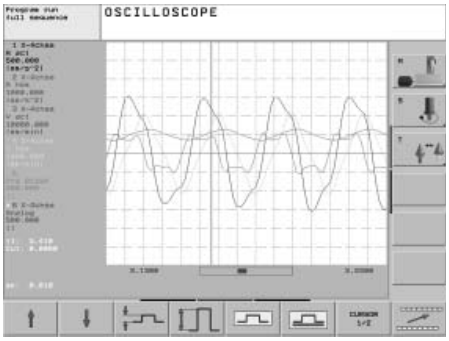
The online monitor (OLM) supports the commissioning and diagnosis of control components through:
- Display of control-internal variables for axes and channels
- Display of controller-internal variables (if a CC is present)
- Display of hardware signal states
- Various trace functions
- Activation of spindle commands
- Enabling control-internal debug outputs

The online monitor is a component part of the TNC 640 and is called by a code number.

Oscilloscope

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

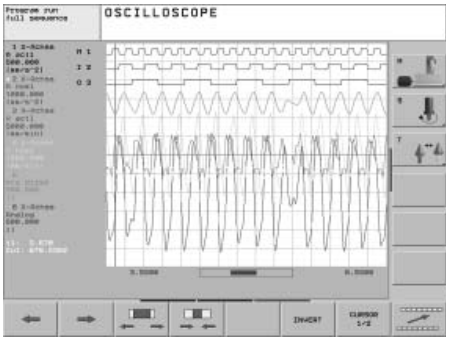
- Actual value of axis feed rate
- Nominal value of axis feed rate
- Contouring feed rate
- Actual position
- Nominal position
- Following error of the position controller
- Nominal values for speed, acceleration and jerk
- Actual values for speed, acceleration and jerk
- Content of PLC operands
- Encoder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



Logic signals

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

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



TNCscope (accessory)

PC software for transferring the oscilloscope files to the PC. Note: The trace files are saved in the TNCscope data format.

API DATA

The API DATA function enables the control to display the states or contents of the symbolic API markers and API double words. This function requires that your PLC program use the new 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 instruction list in each line in HEX or decimal code. The active lines of the instruction list are marked.

Log

For the purposes of error diagnosis, there is one log for all error messages and one for all keystrokes.

TeleService (accessory)

PC software for remote diagnosis, remote monitoring, and remote control of the TNC 640. For further information, ask for the *Remote Diagnosis with TeleService* Technical Information sheet.

Bus diagnostics

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

Integral PLC

The PLC program is created by the machine tool builder either at the control or using 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 6xxx PLC input/output systems or the UEC 11x.
The PLC inputs/outputs and the PROFIBUS-DP-capable input/output system must be configured with the PC software IOconfig.

PLC programming

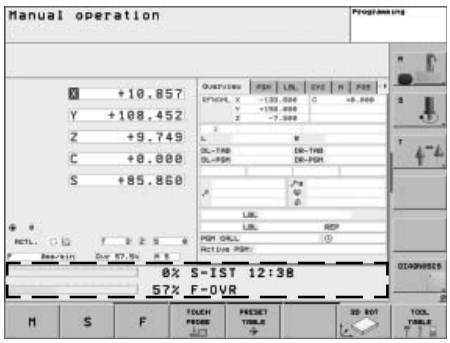
Format	Statement list
Memory	At least 1 GB RAM
Cycle time	Typically 21 ms, adjustable
Instruction set	• Bit, byte and word commands • Logical operations • Arithmetic commands • Comparisons • Nested calculations (parentheses) • Jump commands • Subroutines • Stack operations • Submit programs • 952 timers • 48 counters • Comments • PLC modules • 100 strings

PLC window

PLC error messages can be displayed by the TNC 640 in the dialog line during operation.

Small PLC window

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



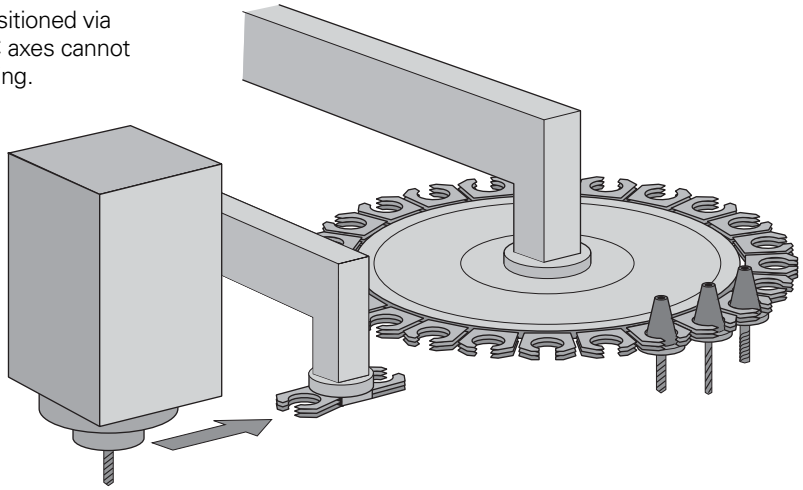
Small PLC window .....

PLC soft keys

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

PLC positioning

All closed-loop axes can be also positioned via the PLC. PLC positioning of the NC axes cannot be superimposed over 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.
PLCdesign can be used to easily create PLC programs.
Comprehensive examples of PLC programs are included.

Functions:
- Easy-to-use text editor
- Menu-guided operation
- Programming of symbolic operands
- Modular programming method
- "Compiling" and "linking" of PLC source files
- Operand commenting, creation of a documentation file
- Comprehensive help system
- Data transfer between the TNC 640 and the PC
- Creation of PLC soft keys

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

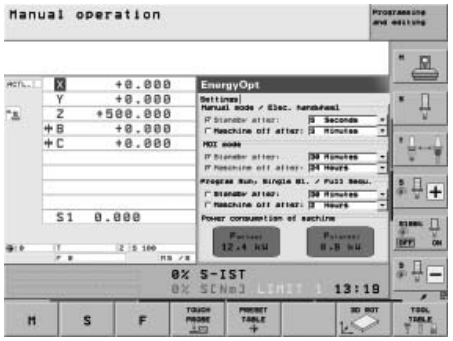
Python OEM process
(option 46)

The Python OEM Process option is an effective tool for the machine tool builder to use an object-oriented high-level programming language in the control (PLC).

Python is an easy-to-learn script language that supports the use of all necessary high-level language elements.

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

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



PLC basic program

The PLC basic program serves as a basis for adapting the TNC 640 to the requirements of the respective machine. It can be downloaded from the Internet.

These essential functions are covered by the PLC basic program:

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

OEM Cycles (Option 19)

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

CycleDesign (accessory)

The soft-key structure for the OEM cycles is managed using the **CycleDesign** PC program. In addition, CycleDesign can be used to store help graphics and soft keys in BMP format on the hard disk of the TNC 640.
Graphic files can be compressed to ZIP format to reduce the amount of memory used.

Tool Management

With integral PLC, the tool changer is moved either via proximity switch or as a controlled axis. The TNC 640 is responsible for all tool management, including tool-life monitoring and replacement tool monitoring.

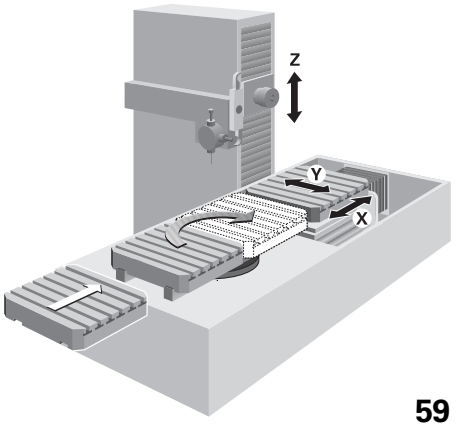
Tool measurement (option 17)

Tools can be measured and checked using the TT 140 tool touch probe (accessory). The TNC 640 provides standard cycles for automatic tool measurement. It calculates the probing feed rate and the optimal spindle speed. The measured data is stored in a tool table.

Touch-Probe Configuration (Option 17)

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

Pallet Management



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

Data Interfaces

The TNC 640 is connected to PCs, networks and other data storage devices via data interfaces.

Ethernet

The TNC 640 can be interconnected via the Ethernet interface. The TNC 640 features a 100BaseT Ethernet (Twisted Pair Ethernet) connection to the data network.

Maximum transmission distance:
Unshielded 100 m
Shielded 400 m

Protocol

The TNC 640 communicates using the TCP/IP protocol.

Network connection

- NFS file server
- Windows networks (SMB)

Data transfer rate

Approx. 40 to 80 Mbps (depending on file type and network utilization)

RS-232-C/V.24

Data interface according to DIN 66020 or EIA standard RS-232-C. Maximum transmission distance: 20 m

Data transfer rate

115200; 57600; 38400; 19200;
9600; 4800; 2400; 1200; 600; 300; 150; 110 bps

Protocols

The TNC 640 can transfer data using various protocols.

Standard data transfer

The data is transferred character by character. The number of data bits, stop bits, the handshake and character parity must be set by the user.

Blockwise data transfer

The data is transferred blockwise. A block check character (BCC) is used for testing data integrity. This method improves data security.

LSV2

Bidirectional transfer of commands and data according to DIN 66019. The data is divided into blocks and transferred.

Adapter block

For connecting the interface to the electrical cabinet or operating panel
RS-232-C/V.24 adapter 9-pin ID 363987-02
25-pin ID 310085-01

USB

The MC 6xxx features two USB 2.0 ports for the connection of standard USB devices, such as the mouse, drives, etc. The USB ports are rated for a maximum of 0.5 A. One of them is led to the BF or TE, where there is an easily accessible USB port. The integrated USB hub on the rear of the screen has further USB ports.

USB cable

Cable length up to 5 m ID 354770-xx
Cable length 6 m to 30 m
with integrated amplifier; USB 1.1. ID 624775-xx

USB hub

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

Power supply: 24 V DC / max. 300 mA
ID 582884-02

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.

ID 508921-01

Software for Data Transfer

TNCremo
(accessory)

This PC software package helps the user to transfer data from the PC to the TNC 640. The software on the PC carries out block-wise data transfer with block check character (BCC).

Functions:
- Data transfer (also blockwise)
- Remote control (only serial)
- File management and data backup of the TNC 640
- Reading out the log
- Print-out of screen contents
- Text editor
- Managing more than one machine

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

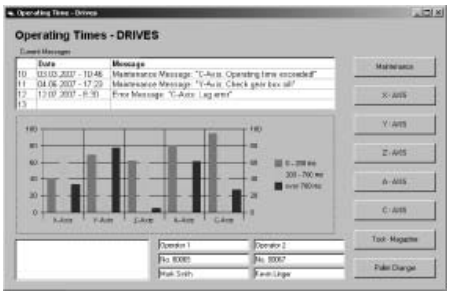
TNCremoPlus
(accessory)

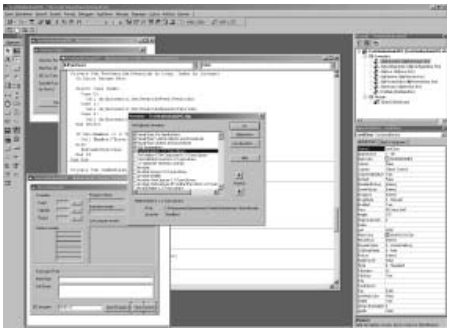
In addition to the features you are already familiar with from TNCremo, TNCremoPlus can also transfer the current content of the control's screen to the PC (live screen). This makes it very simple to monitor the machine.
ID 340447-xx

Remote Desktop Manager
(option 133)

Remote operation and display of external computer units via Ethernet connection (e.g. to a Windows PC)
The information is displayed on the control's screen.
ID 894423-01

DNC Applications





The development environments on Windows operating systems are particularly well suited as flexible platforms for application development in order to come to terms with the increasingly complex requirements of the machine's environment. The flexibility of the PC software and the large selection of ready-to-use software components and standard tools in the development environment enable you to develop PC applications of great use to your customers in a very short time, for example:
- Error reporting systems that, for example, send the customer a text message to his cell phone reporting problems on the currently running machining process
- Standard or customer-specific PC software that decidedly increases process security and equipment availability
- Software solutions controlling the processes of manufacturing systems
- Information exchange with job management software

HEIDENHAIN DNC
(option 18)

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

RemoTools SDK
(accessory)

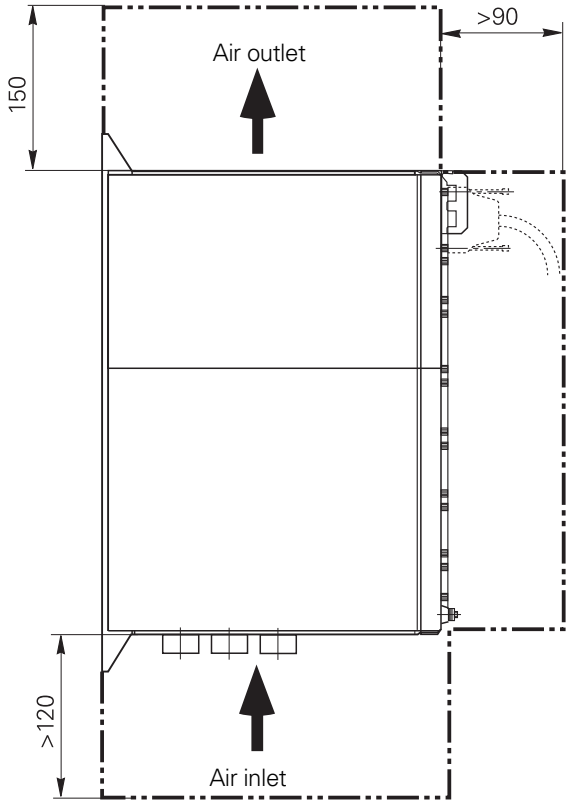
To enable you to use HEIDENHAIN DNC effectively, HEIDENHAIN offers the **RemoTools SDK** development package. It contains the COM components and the ActiveX control for integration of the DNC functions in development environments.

ID 340442-xx

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

Mounting Instructions

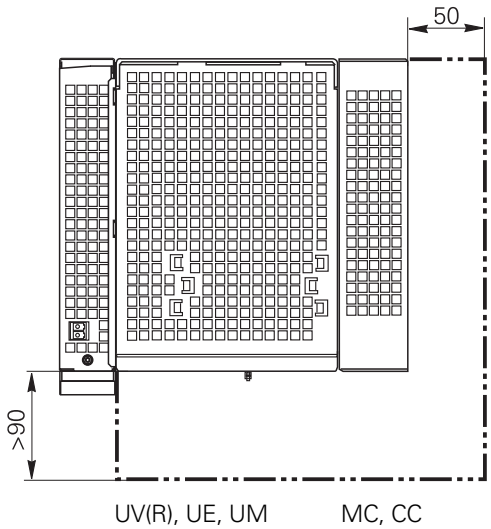
Mounting attitude When installing the **MC, CC, UV(R), UM, and UE,** take note of the minimum spacing, space needed for servicing, and the appropriate length and location of the connecting cables.



Leave space for air circulation! Temperatures of > 150 °C may occur with the UE 21xB with integrated braking resistor; do not attach any temperature-sensitive parts!

Leave space for servicing!

Leave space for air circulation and servicing!



Leave space for servicing and connecting cables!

UV(R), UE, UM MC, CC

Mounting and electrical installation

Keep the following in mind during mounting and electrical installation:
- National regulations for power installations
- Interference and noise immunity
- Conditions of operation
- Mounting attitude

Degrees of protection

The following components fulfill the requirements for IP 54 (dust protection and splash-proof protection):
- Visual display unit (when properly installed)
- Keyboard unit (when properly installed)
- Machine operating panel (when properly installed)
- Handwheel

All electric and electronic control components must be installed in an environment (e.g. electrical cabinet, housing) that fulfills the requirements of protection class IP 54 (dust and splash-proof protection) in order to fulfill the requirements of contamination level 2.

All components of the OEM operating panel must also comply with protection class IP 54, just like the HEIDENHAIN operating panel components.

Electromagnetic compatibility

Intended place of operation

The unit fulfills the requirements for a Class A device in accordance with the specifications in EN 55022, and is intended for use in industrially zoned areas.

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

Likely sources of interference

Noise is mainly produced by capacitive and inductive coupling from electrical conductors or from device inputs/outputs, such as:
- 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

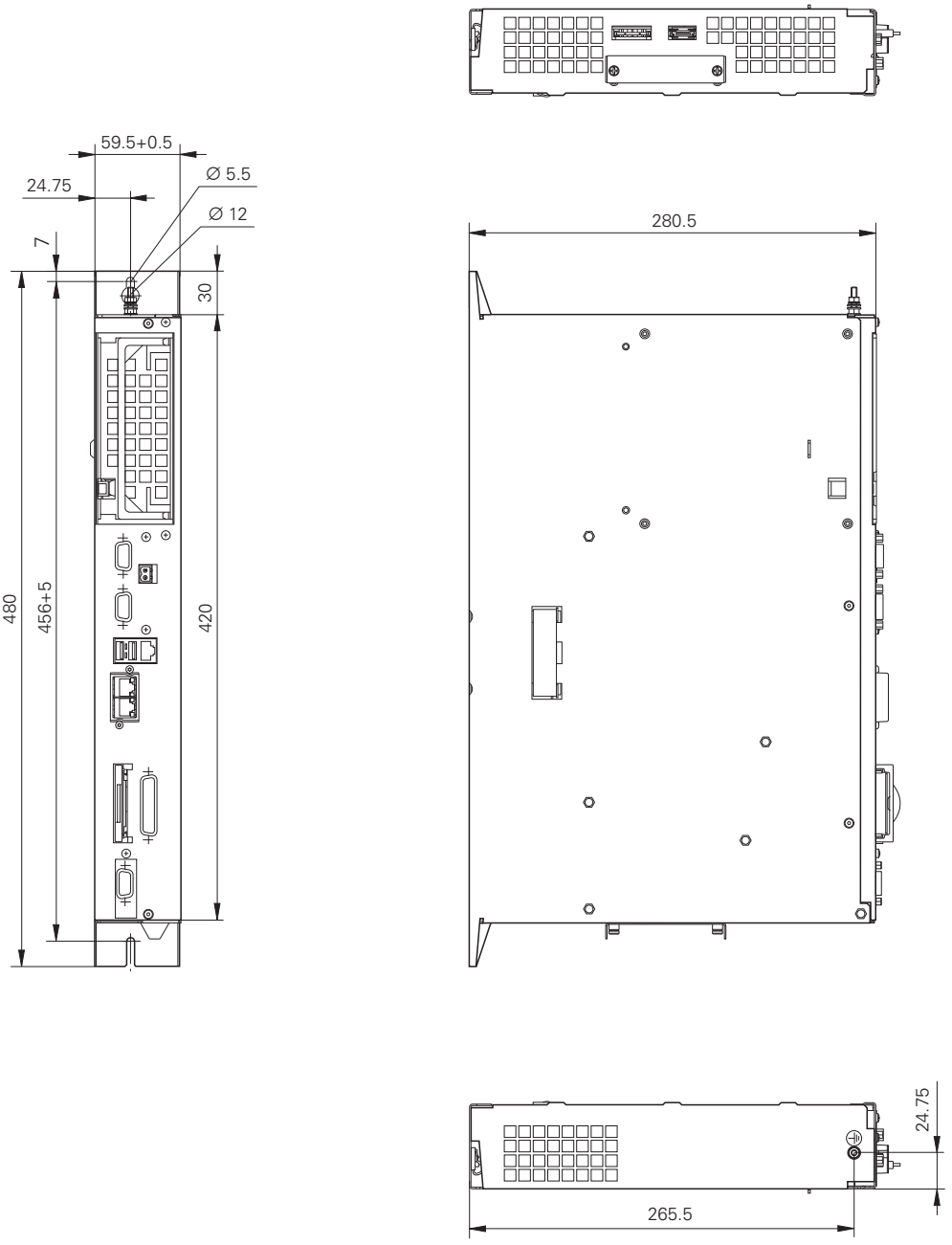
- Keep a minimum distance of 20 cm from the MC, CC and its leads to devices that carry interference signals.
- Keep a minimum distance of 10 cm from the MC, CC and its leads to cables that carry interference signals. For cables in metallic ducting, adequate decoupling can be achieved by using a grounded separation shield.
- Shielding according to EN 50178
- Use equipotential bonding conductors with a cross section of 6 mm^2
- Use only genuine HEIDENHAIN cables, connectors and couplings

Overall Dimensions

MC 6241, MC 6341

mm

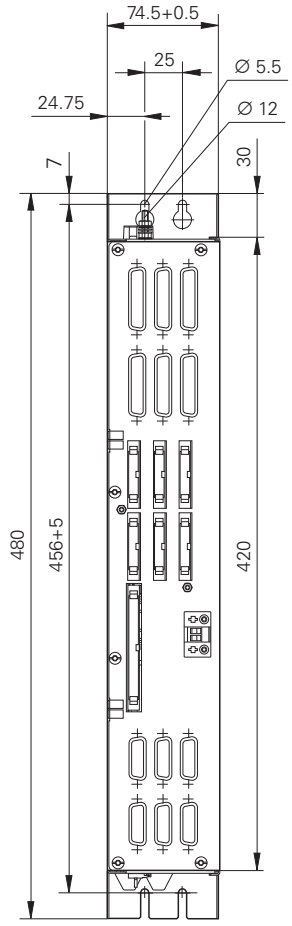
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

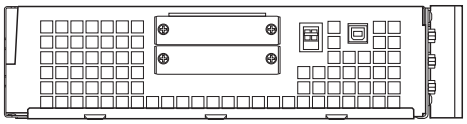


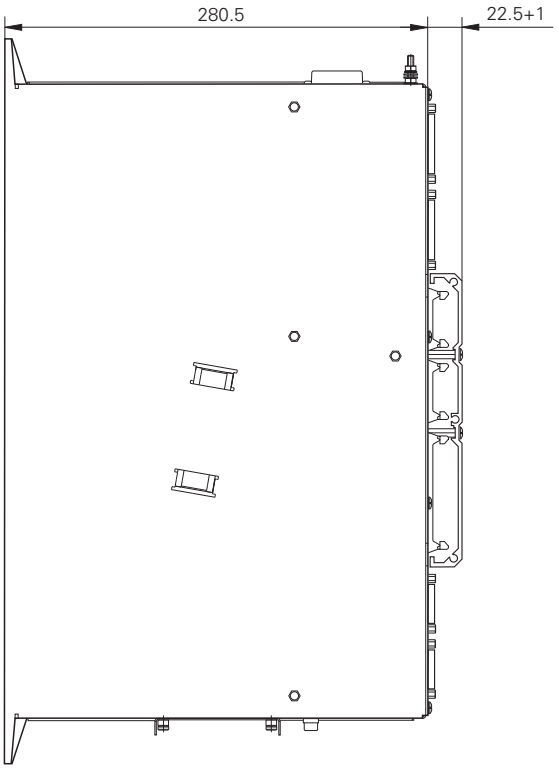
CC 6106

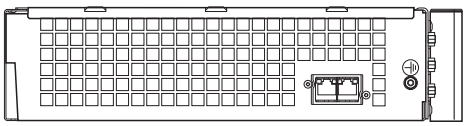
mm

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







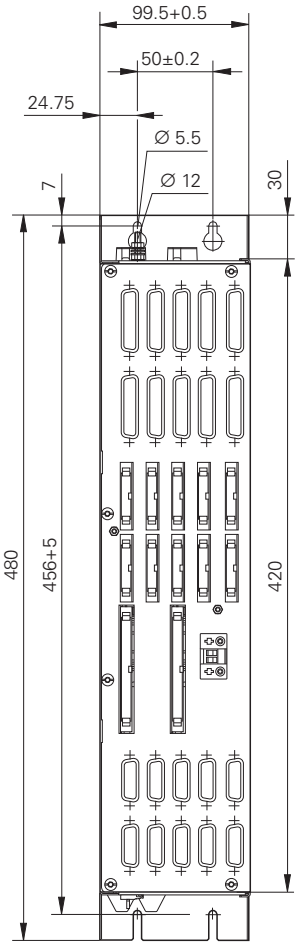


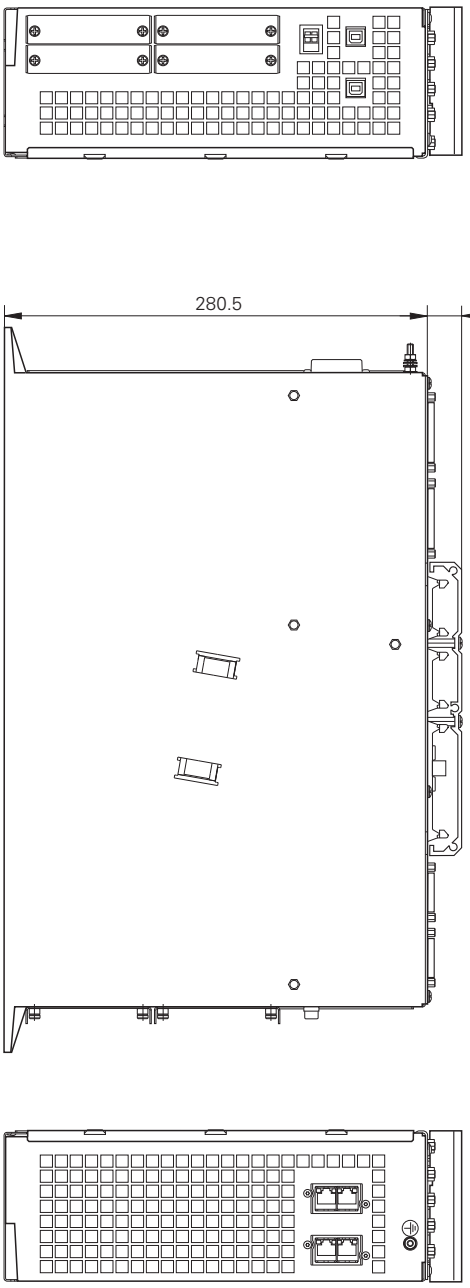
CC 6108,
CC 6110

mm

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

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

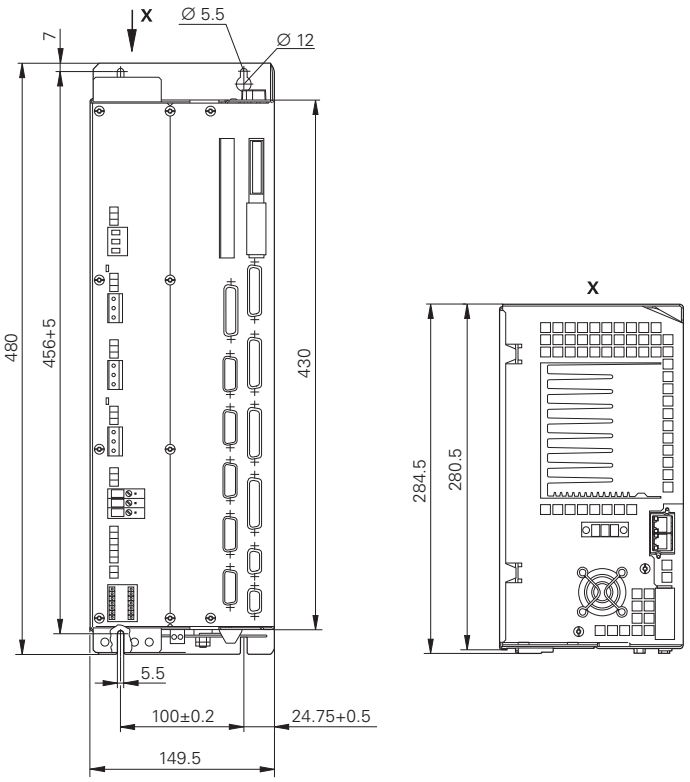




UEC 111,
UEC 112

mm

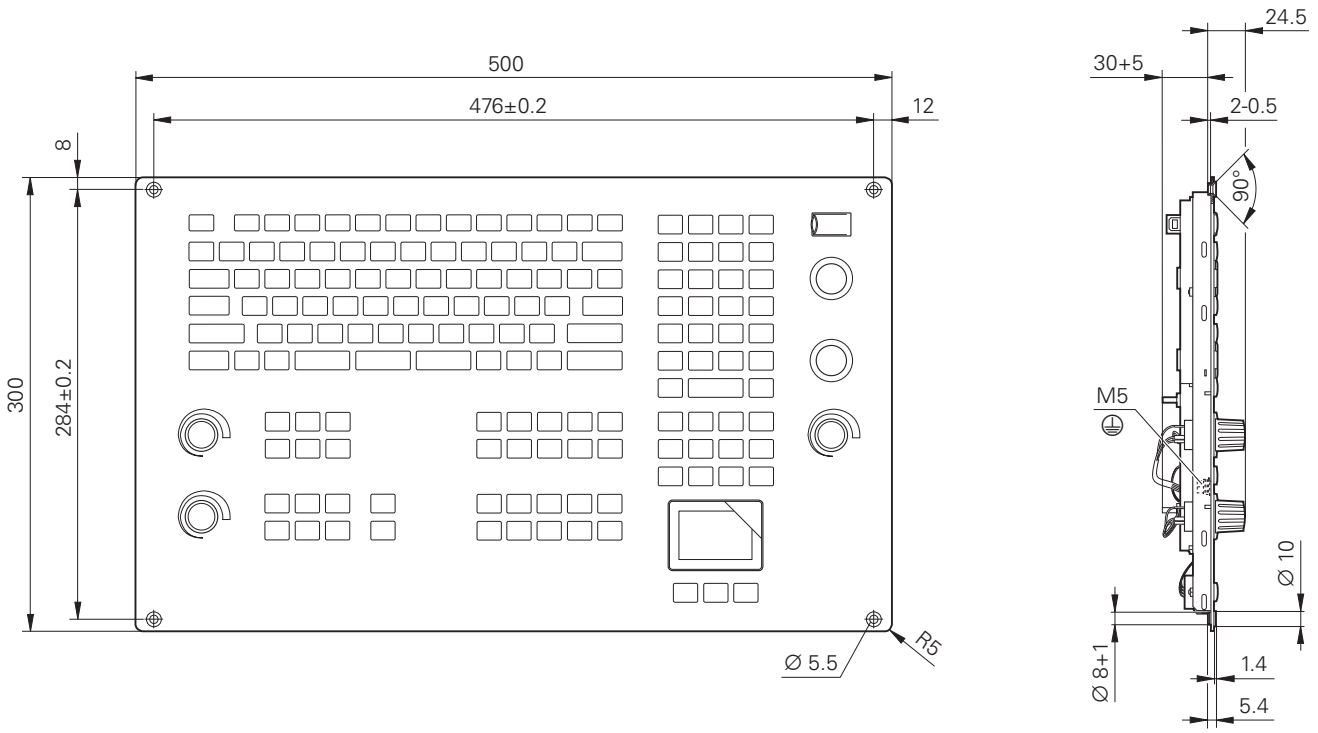
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

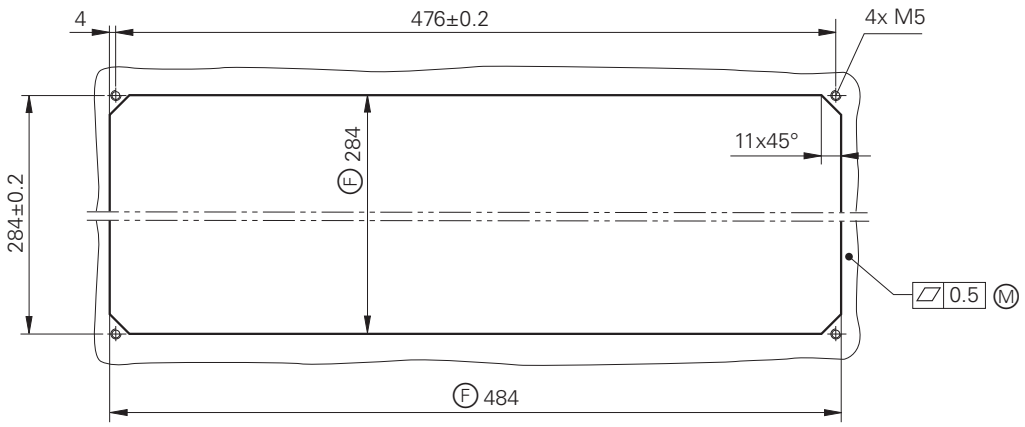


TE 740

mm

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

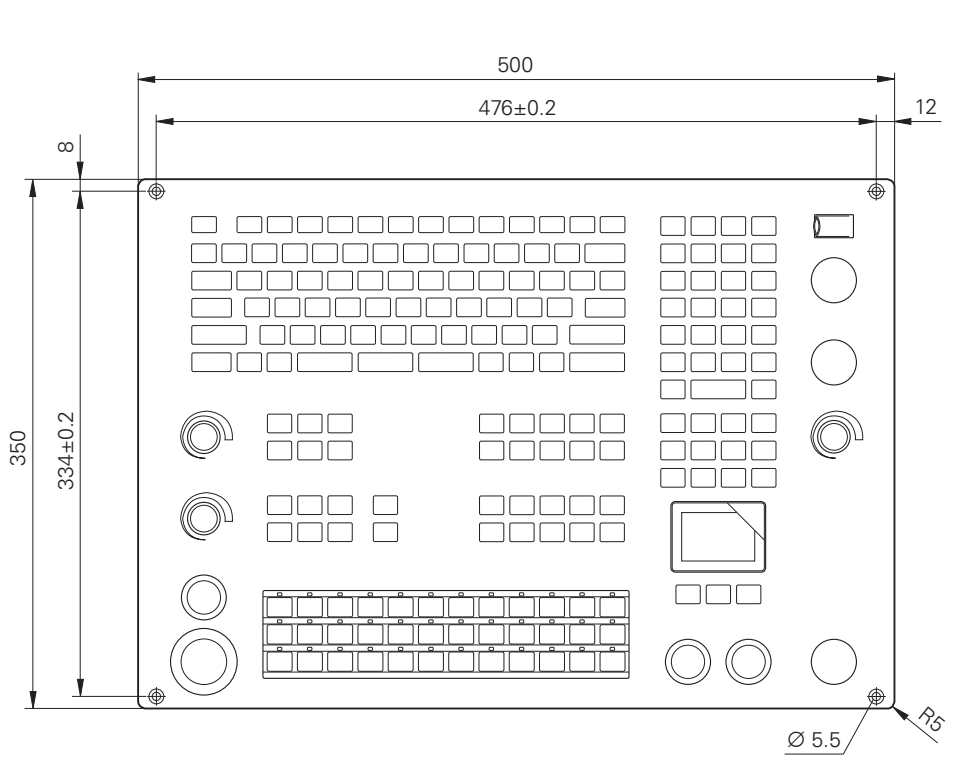


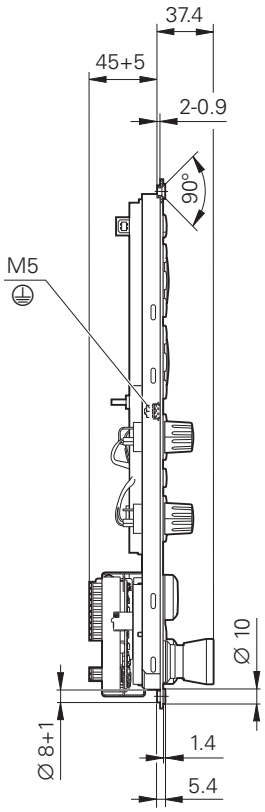


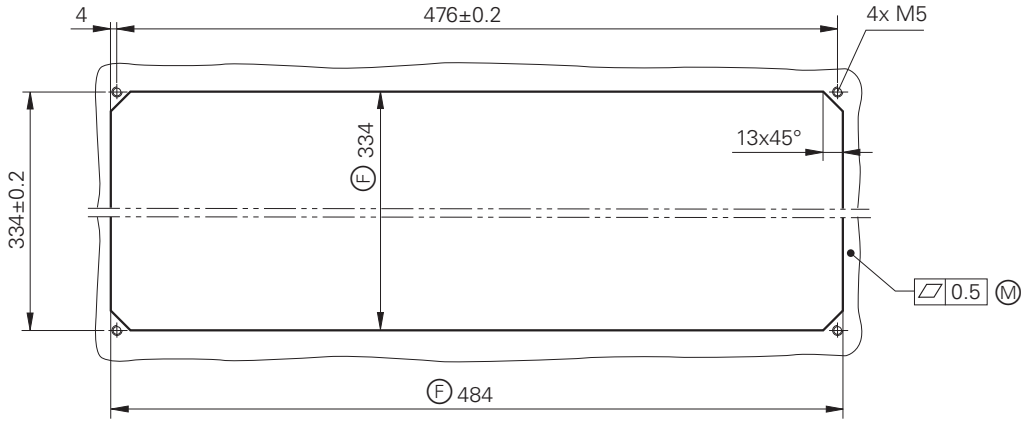
TE 745

mm

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





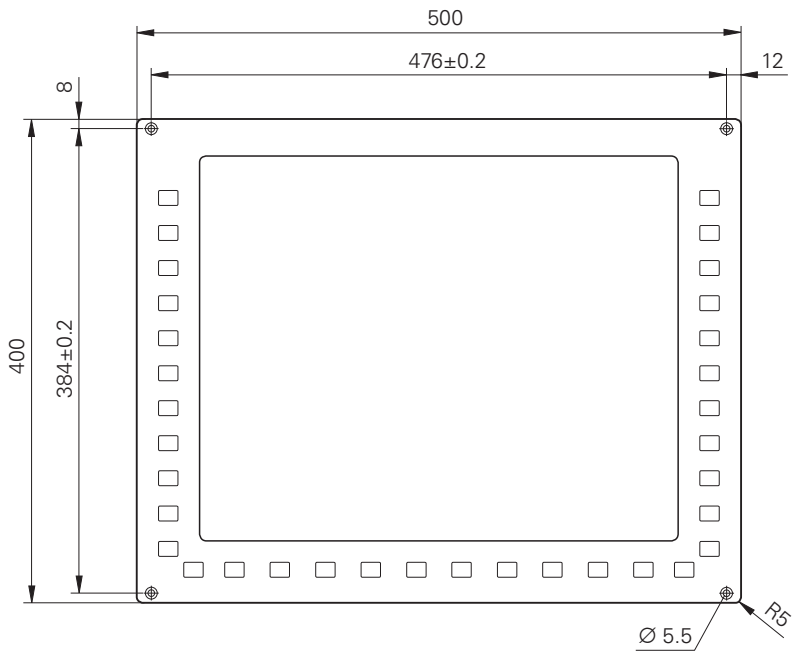


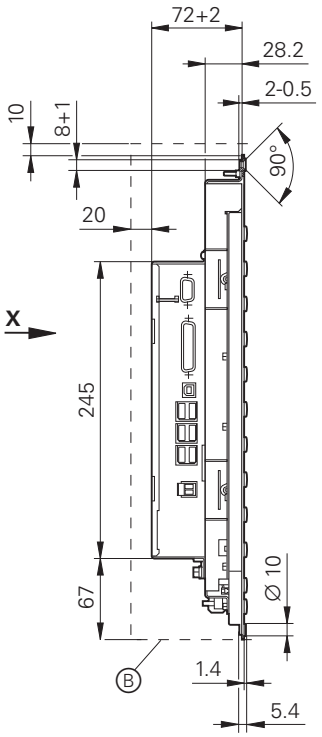
Ⓕ = Cutout in machine panel
Ⓜ = Mounting surface

BF 760

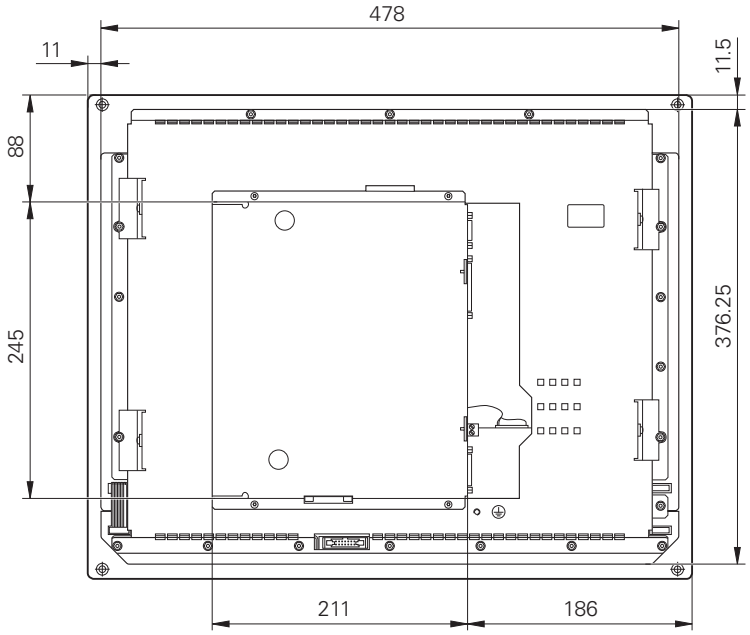
mm

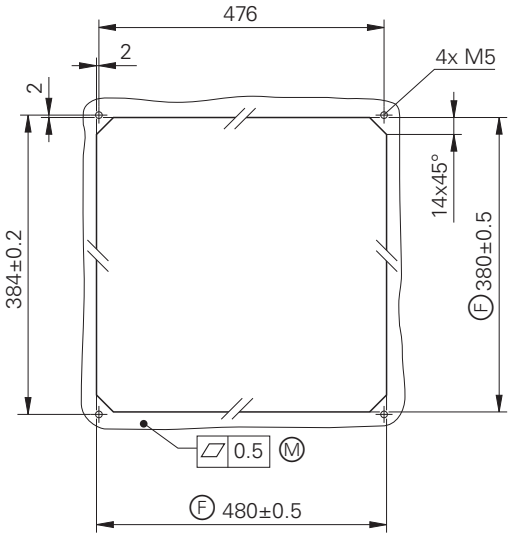
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm





X

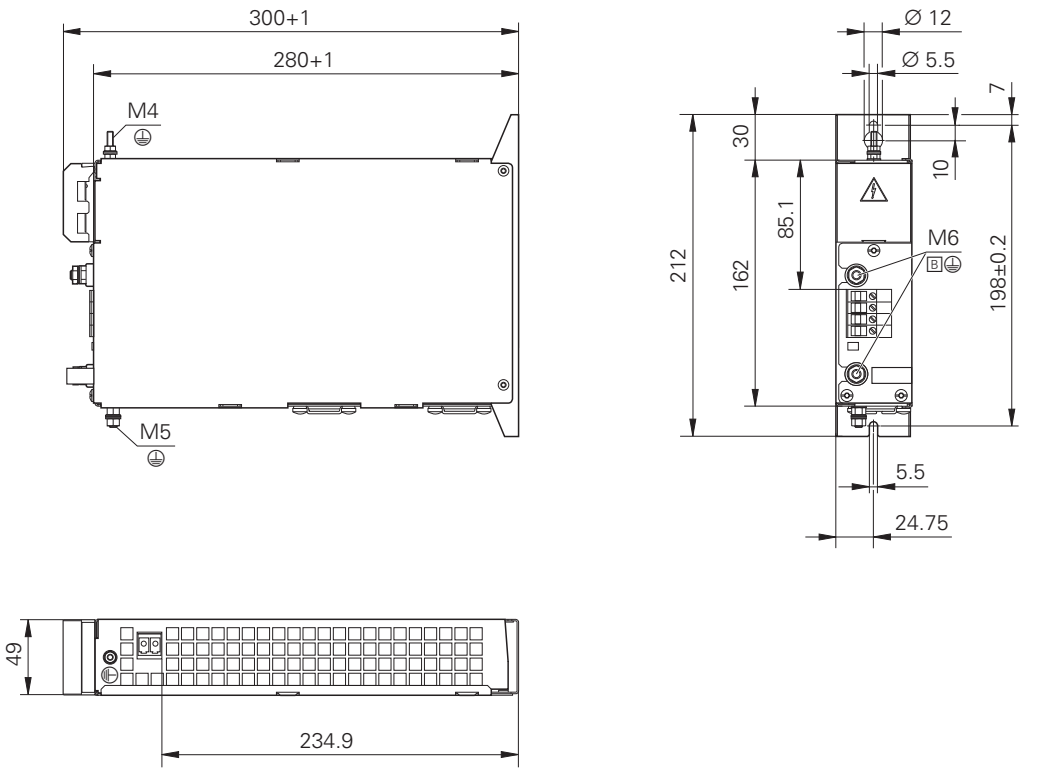




Ⓕ = Cutout in machine panel
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

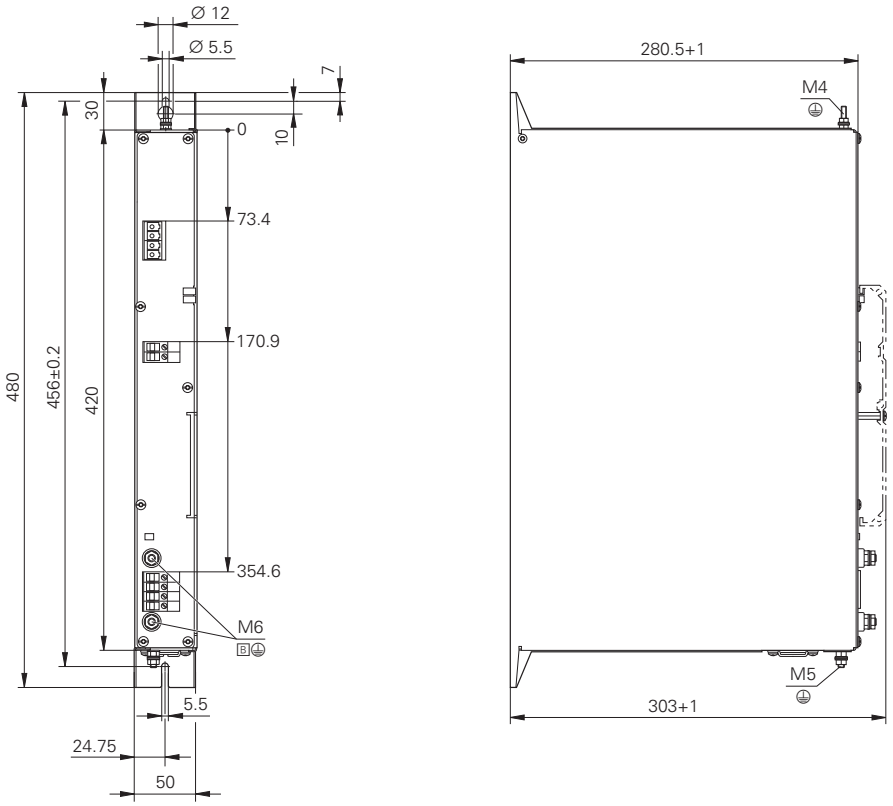
PSL 130

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



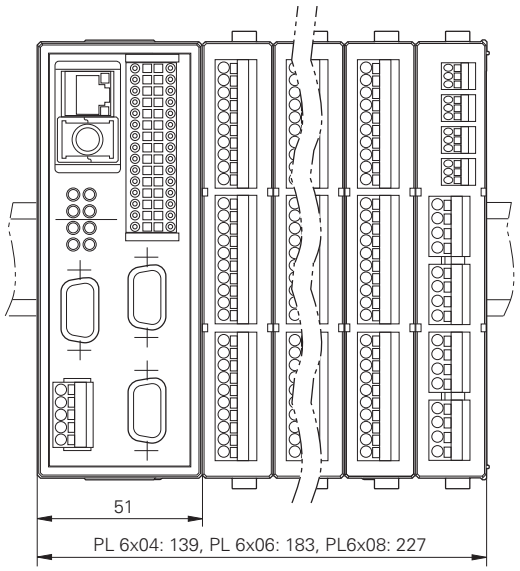
PSL 135

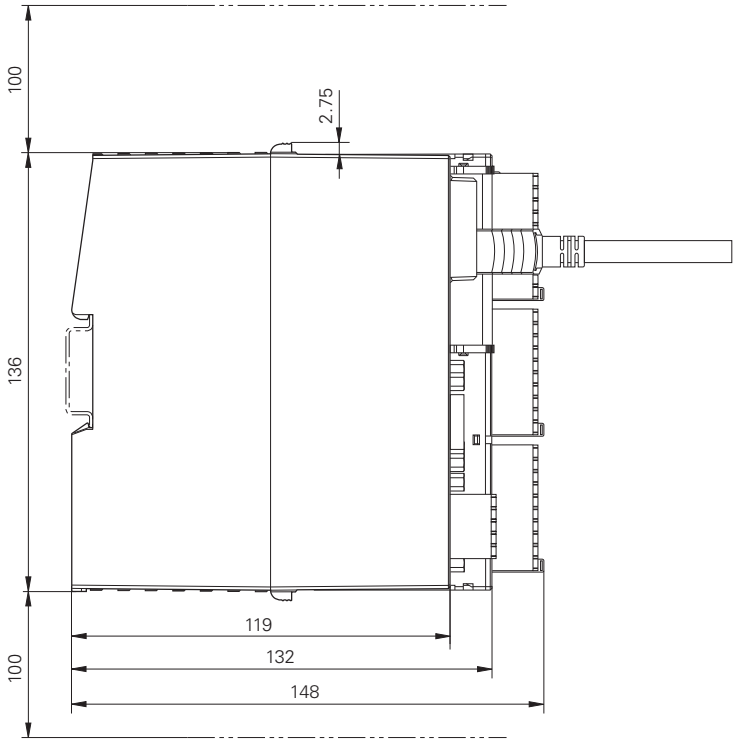
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



PL 6xxx

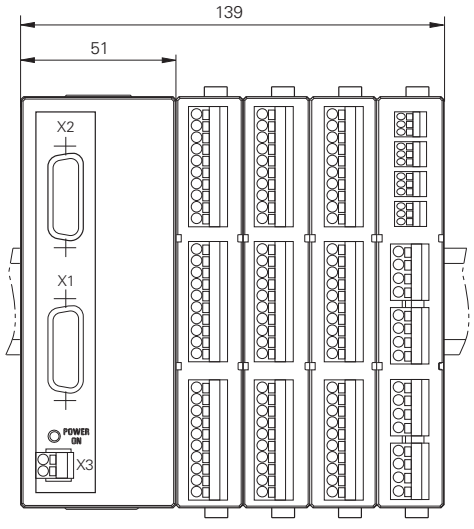
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

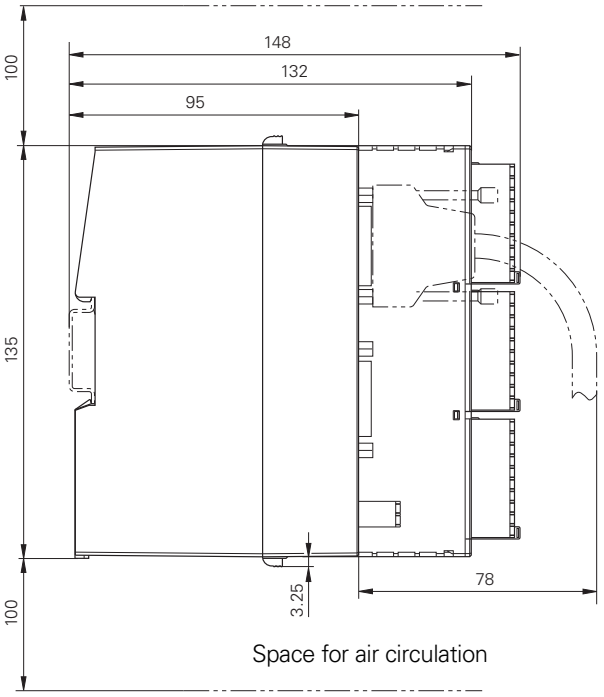




PL 550

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

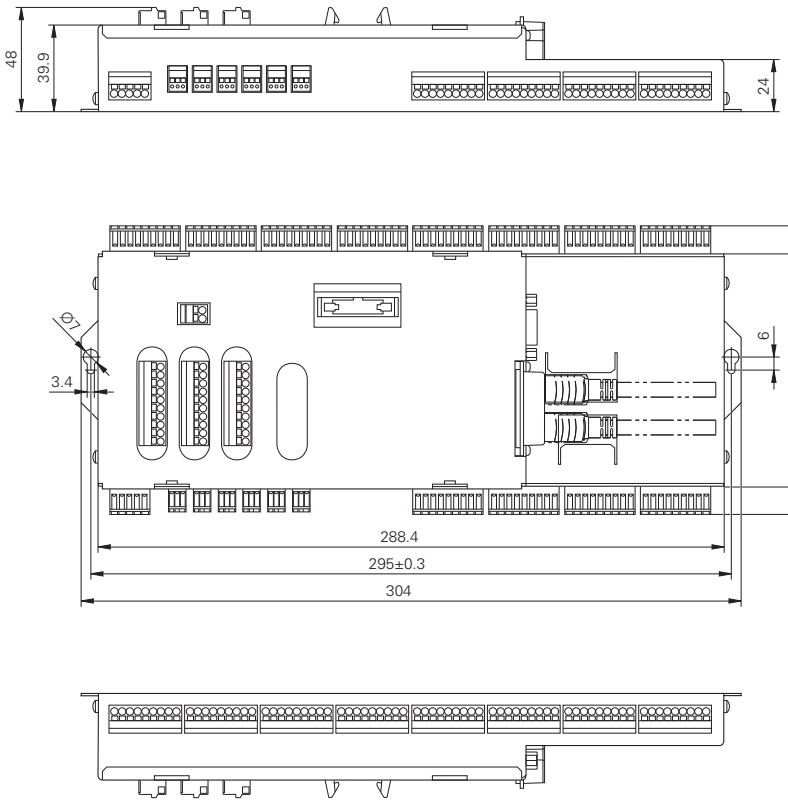




PLB 6001

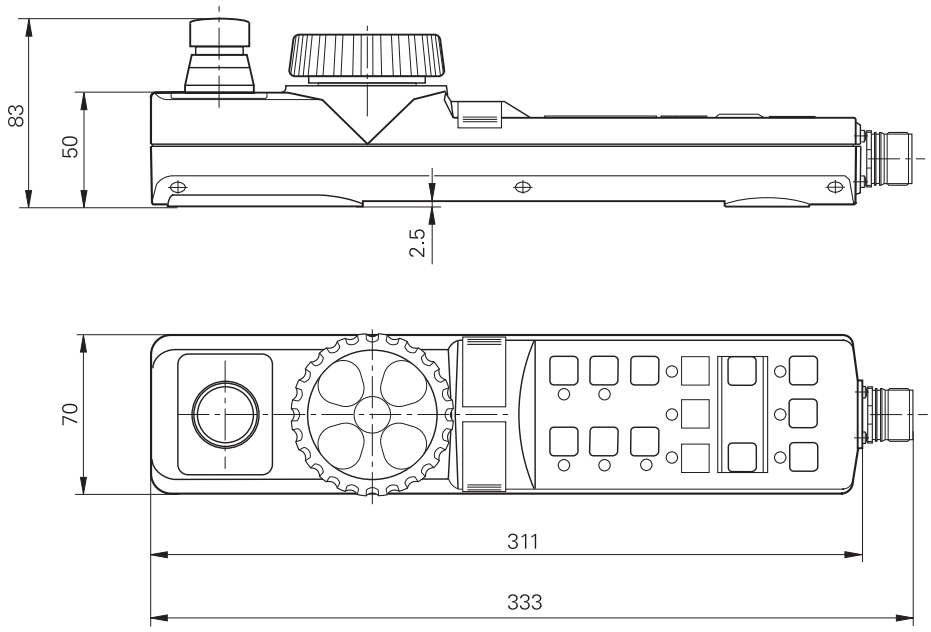
mm

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



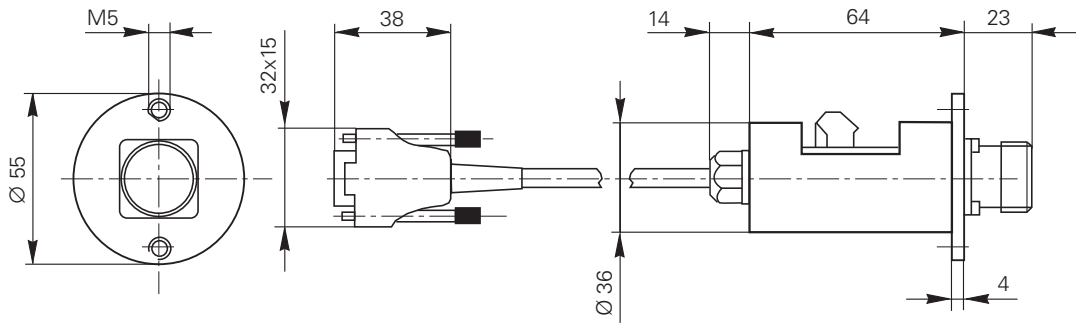
HR 410

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



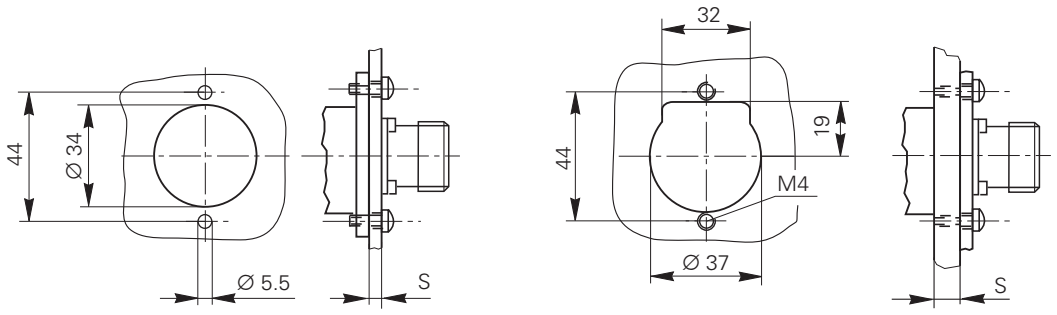
Adapter Cable for HR 410

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



Mounting opening for wall thickness S ≤ 4

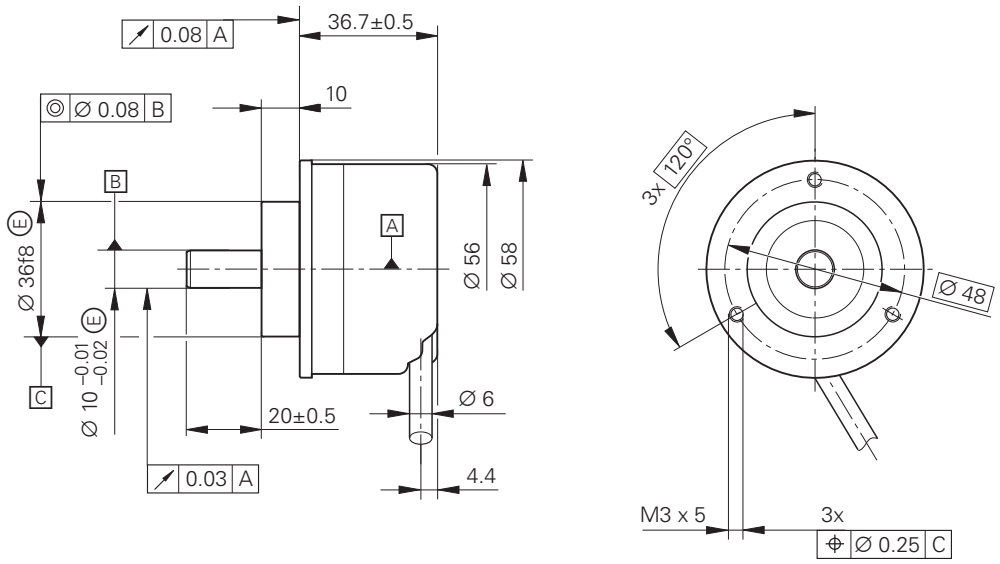
Mounting opening for wall thickness S > 4

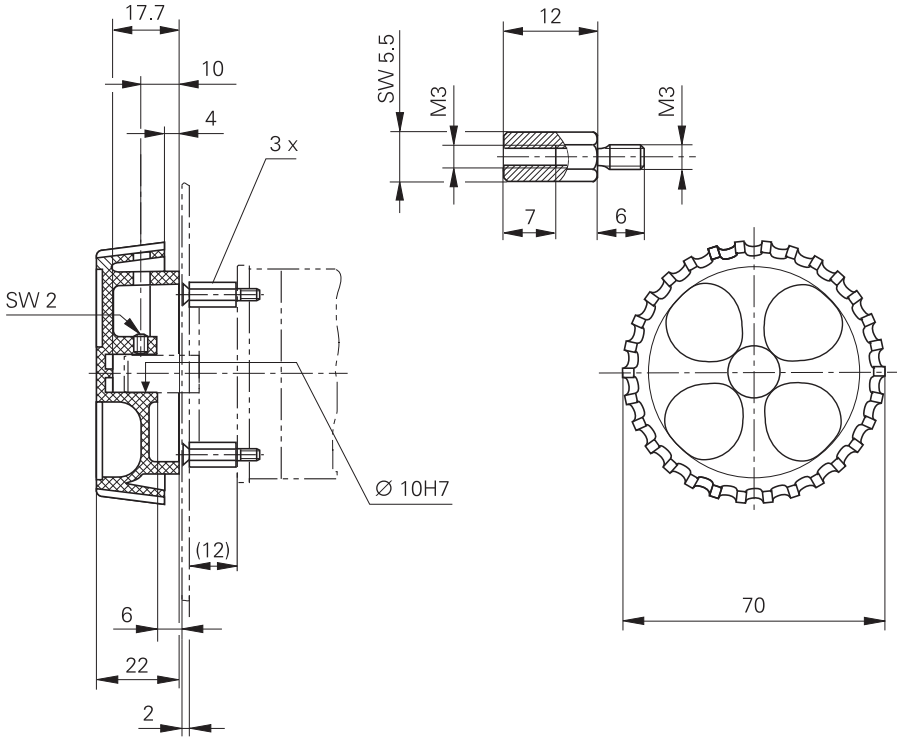


HR 130, HR 150 with Control Knob

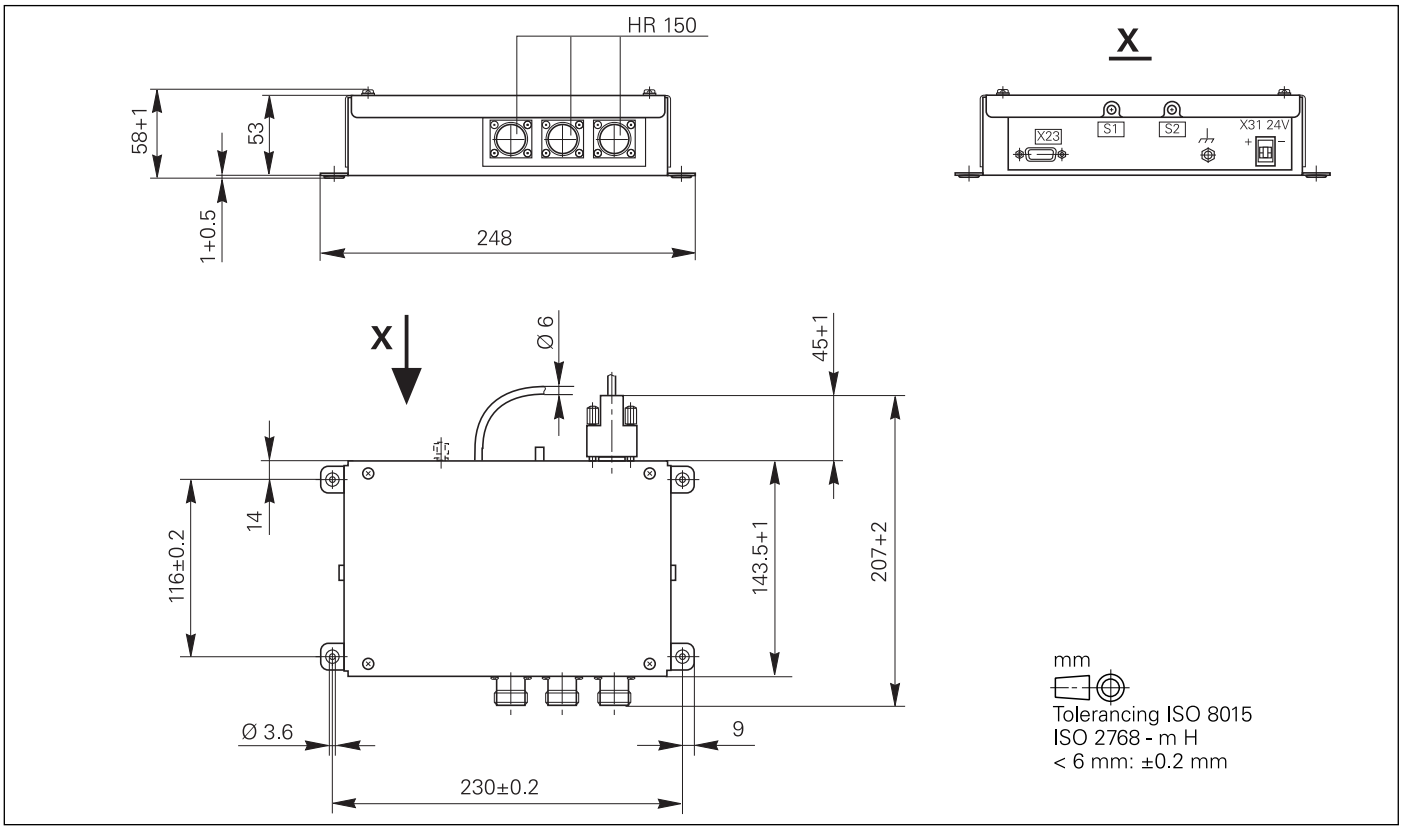
mm

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

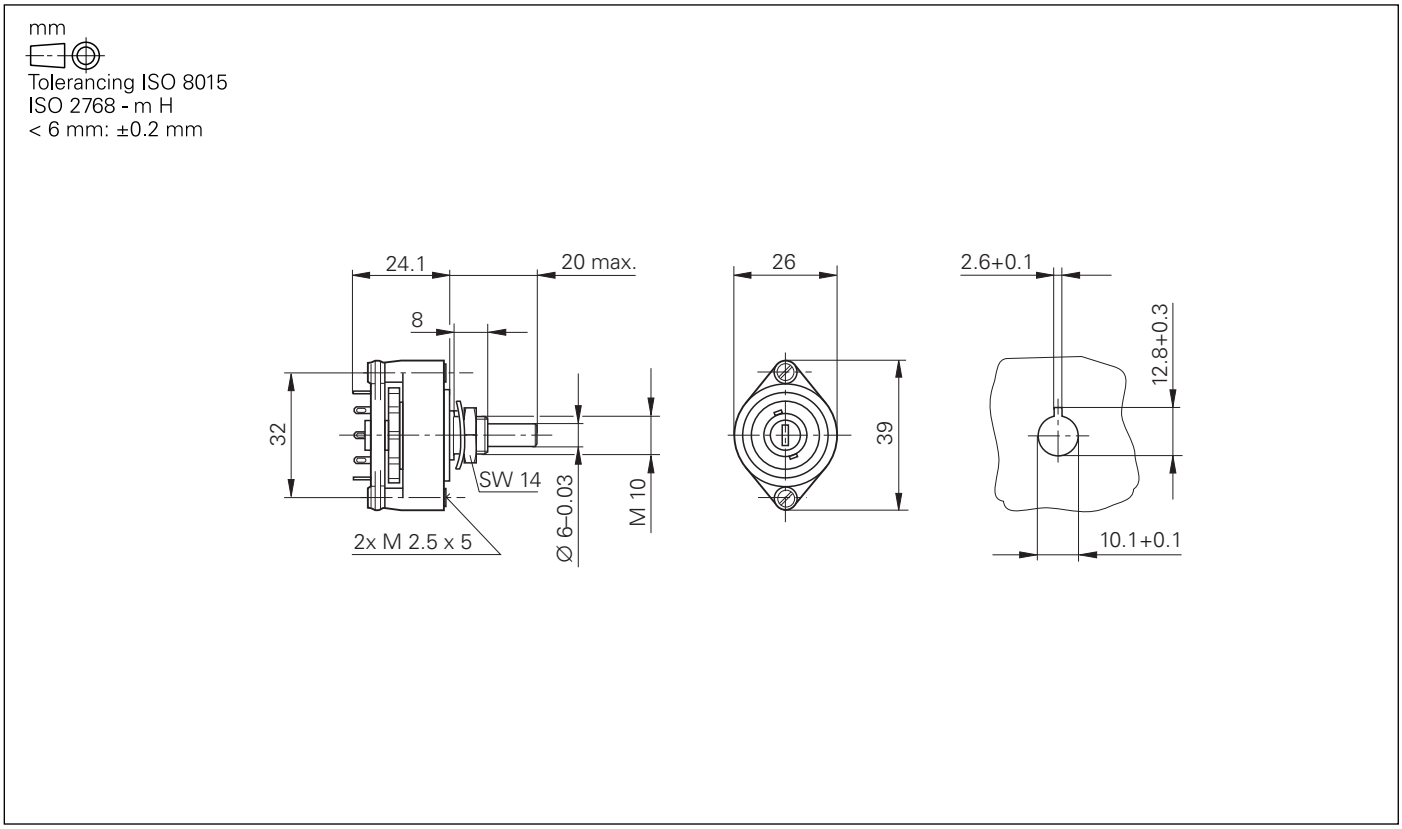




HRA 110



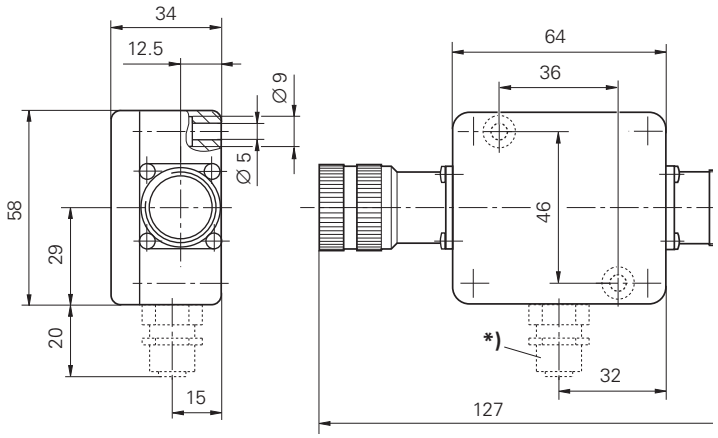
Step Switch



Line Drop Compensator for Encoders with EnDat Interface

mm

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

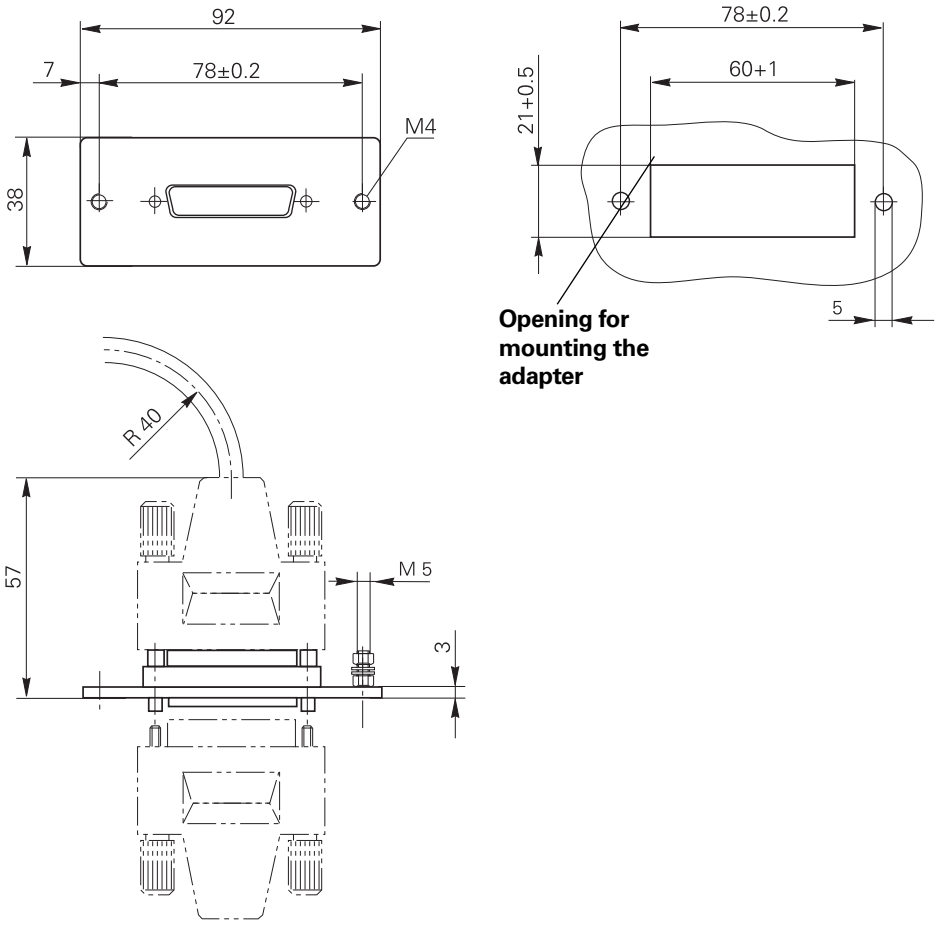


*) Connection to KTY

RS-232-C/V.24 Adapter

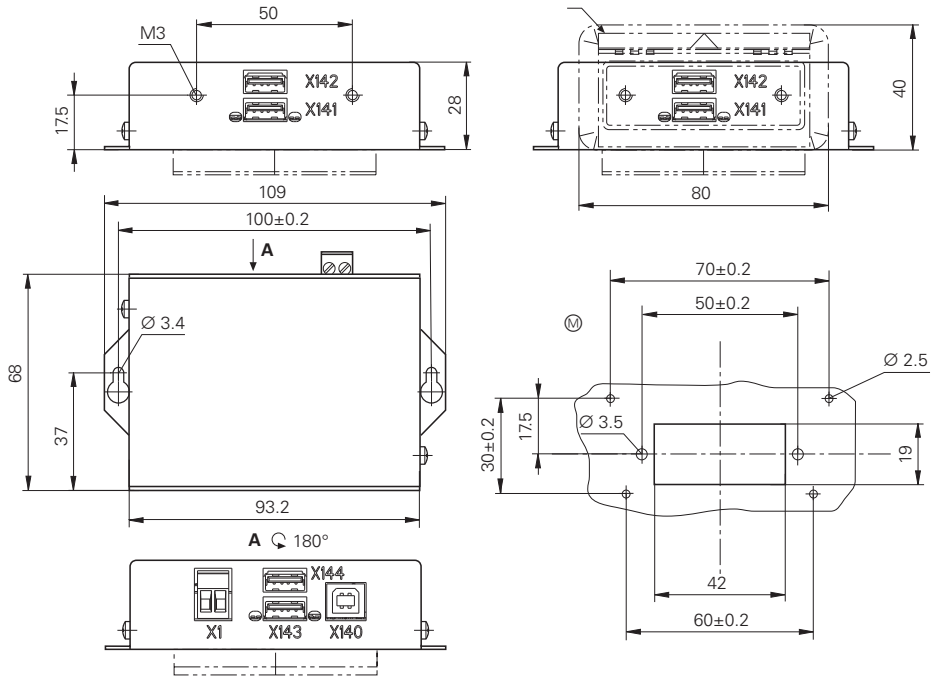
mm

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



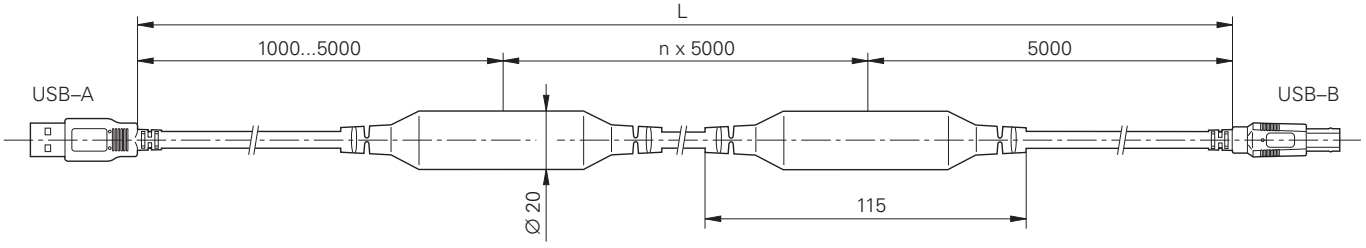
USB Hub

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



USB Extension Cable with Hubs

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



n = 0 ... 4
L = Length ordered

Documentation

Items supplied with the control include:
- 1 User's Manual for HEIDENHAIN conversational programming
- 1 User's Manual for DIN/ISO programming
- 1 User's Manual for Cycle Programming

This documentation must be ordered separately in the language required.
Further documentation is available from HEIDENHAIN.

Technical documentation	• **TNC 640** Technical Manual	ID 892899-xx; in PDF format on the HESIS web including FileBase
	• **Inverters and Motors** Technical Manual	ID 208962-xx
	• **TS 220** Mounting Instructions	ID 312821-91
	• **TS 440** Mounting Instructions	ID 632756-9x
	• **TS 444** Mounting Instructions	ID 632757-9x
	• **TS 640** Mounting Instructions	ID 632760-9x
	• **TS 740** Mounting Instructions	ID 632761-9x
	• **TT 140** Mounting Instructions	ID 297510-xx
	• **TT 449** Mounting Instructions	ID 664914-xx
User documentation	**TNC 640**	
	• **Conversational** User's Manual	ID 892903-xx
	• **Touch-Probe Cycles** User's Manual	ID 892905-xx
	• **DIN/ISO** User's Manual	ID 892909-xx
	Miscellaneous	
	• **TNCremo** User's Manual	As integrated help and in PDF format
	• **TNCremoPlus** User's Manual	As integrated help and in PDF format
	• **PLCdesign** User's Manual	As integrated help and in PDF format
	• **CycleDesign** User's Manual	As integrated help and in PDF format
	• **IOconfig** User's Manual	As integrated help and in PDF format
	• **KinematicsDesign** User's Manual	As integrated help and in PDF format
Other documentation	• **TNC 640** brochure	ID 892916-xx
	• **Touch Probes** brochure	ID 208951-xx
	• **Inverter Systems** brochure	ID 622420-xx
	• **Motors** brochure	ID 208893-xx
	• **HEIDENHAIN DNC** brochure	PDF
	• **Remote Diagnosis with TeleService** Product Overview	ID 348236-xx
	• **Touch Probes** CD-ROM	ID 344353-xx
	• **TNC 640 Programming Station** CD-ROM demo version	in preparation
	• **Uniformly Digital** Technical Information sheet	PDF

HEIDENHAIN Service

Technical support

HEIDENHAIN offers the machine tool builder technical support to optimize the adaptation of the TNC to the machine—including on-site support.

Replacement control system

In the event of a fault, HEIDENHAIN guarantees the rapid supply of a replacement control system (usually within 24 hours in Europe).

Hotline

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.

TNC support	☏ +49 8669 31-3101 E-mail: service.nc-support@heidenhain.de
PLC programming	☏ +49 8669 31-3102 E-mail: service.plc@heidenhain.de
NC programming	☏ +49 8669 31-3103 E-mail: service.nc-pgm@heidenhain.de
Measuring systems	☏ +49 8669 31-3104 E-mail: service.ms-support@heidenhain.de
Lathe controls	☏ +49 8669 31-3105 E-mail: service.lathe-support@heidenhain.de

Machine calibration

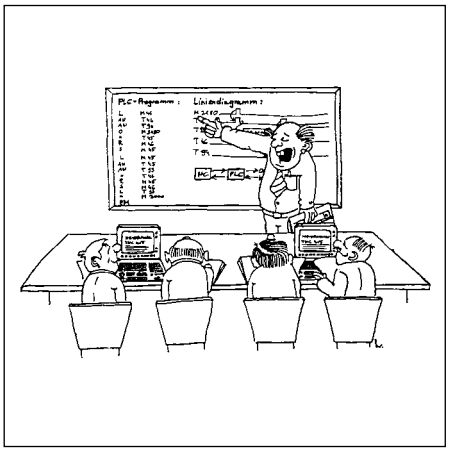
On request, HEIDENHAIN engineers will calibrate your machine's geometry, for example with a KGM grid encoder.

Seminars

HEIDENHAIN provides technical customer training in the following subjects:

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

For more information on dates, registration, etc. call in Germany:
☏ +49 8669 31-2293 or 31-1695
FAX +49 8669 31-1999
E-mail: mtt@heidenhain.de
www.heidenhain.de

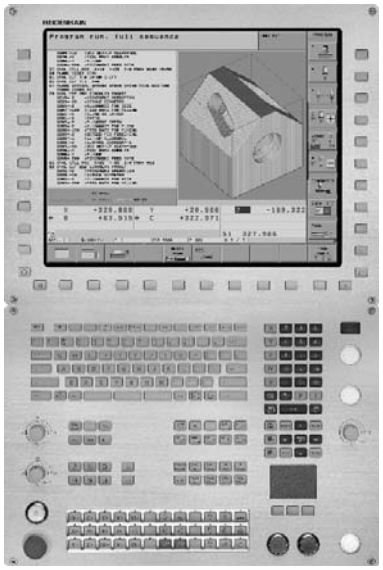


Other HEIDENHAIN Controls

iTNC 530

Information:
Brochure
iTNC 530

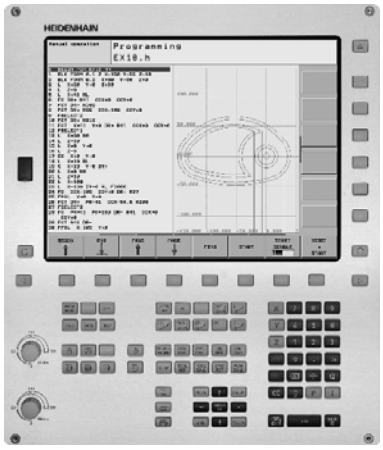
- Contouring control for **milling, drilling and boring machines, and machining centers**
- Up to 18 axes and controlled main spindle
- HEIDENHAIN inverter systems and motors recommended
- Uniformly digital with HSCI interface and EnDat interface
- TFT color flat-panel display, 15-inch or 19-inch
- Storage medium: HDR hard disk with 160 GB / SSDR solid state disk with 32 GB
- Programming in HEIDENHAIN conversational format, with smarT.NC or according to DIN/ISO
- Standard milling, drilling and boring cycles
- Touch probe cycles
- FK free contour programming
- Special functions for fast 3-D machining
- Short block processing time (0.5 ms)
- Automatic calculation of cutting data
- Pallet management



TNC 620

Information:
Brochure
TNC 620

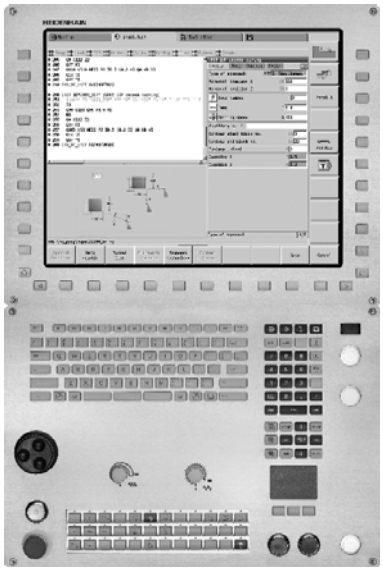
- Contouring control for **milling machines**
- Up to 5 axes and controlled main spindle
- HEIDENHAIN inverter systems and motors recommended
- Uniformly digital with HSCI interface and EnDat interface
- Compact design:
  – Screen, keyboard and main computer in one unit (MC 7110)
  – Screen and main computer in one unit (MC 7120) and separate keyboard with integrated ASCII keys
- Dimensions: 400 mm x 470 mm x 100 mm
- Integrated 15-inch TFT flat-panel display
- Storage medium for NC programs: CompactFlash memory card
- Programming in HEIDENHAIN conversational format or according to DIN/ISO
- Standard milling, drilling and boring cycles
- Touch probe cycles
- Short block processing time (1.5 ms)



CNC PILOT 620

Information:
Brochure
CNC PILOT 620

- Contouring control for **horizontal and vertical lathes**
- Up to 3 axes (X, Z and Y), controlled spindle and counterspindle, C1/C2 axis and driven tools
- Up to 3 programmable auxiliary axes (U, V, W) for control of steady rest, tailstock and counterspindle
- The position of a parallel secondary axis can be shown combined with its principal axis.
- HEIDENHAIN inverter systems and motors recommended
- Uniformly digital with HSCI interface and EnDat interface
- 19-inch TFT flat-panel display
- Storage medium: CompactFlash memory card
- Programming of turning, drilling and milling operations with smart.Turn, according to DIN/ISO or via cycles
- Free ICP contour programming for turning and milling contours



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