HEIDENHAIN

TNC 620

The Compact Contouring Control for Milling, Drilling and Boring Machines

Information for the Machine Tool Builder

March 2008

TNC Contouring Control with Inverter System from HEIDENHAIN

TNC 620

- Contouring control for machines with up to 5 axes and controlled spindle
- HEIDENHAIN inverter systems recommended
- Uniformly digital with HSCI interface and EnDat interface
- Compact design: Screen, keyboard and main computer all in one package
- Dimensions: 400 mm x 470 mm x 100 mm
- Integrated 15-inch TFT flat-panel display
- Memory 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 times
- USB removable media can be connected

TNC 620

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

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

- Buffer battery
- Fan

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

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 620	340 560-01

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

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

Subject to change without notice

Specifications

Specifications	TNC 620	Page
Control systems	• MC 6110 • Integrated 15-inch TFT color flat-panel display • Integral TNC operating panel • MB 620 machine operating panel optional • HSCI interface	**13**
Controller unit	CC 6106 or UEC 111 (inverter and system-PL integrated) or UEC 112 (inverter and system-PL integrated)	16
PLC inputs/outputs	PL 6xxx series or on UEC 11x series	18
Inverter systems		*
Compact inverters	✔	*
Modular inverters	✔	*
Axes	Basic version: 4 control loops (3 axes + closed-loop spindle) Optional: 4th axis with option 0 5th axis with option 1	**15, 28**
Rotary axes	✔	28
PLC axes	✔	29, 41
Spindle	1	**37**
Speed[1)]	Maximum spindle speed: 60000 min^{-1}	37
Operating-mode switchover	✔	37
Position-controlled spindle	✔	37
Oriented spindle stop	✔	37
Gear shifting	✔	37
NC program memory	300 MB	
Input resolution and display step		
Linear axes	1 µm 0.01 µm with option 23	28
Rotary axes	0.001° 0.00001° with option 23	28
Interpolation		**
Straight line	In 4 axes In 5 axes with option 9	**
Circle	In 2 axes In 3 axes with option 8	**
Helix	✔	**

1) On motors with two pole pairs
* For further information, refer to the *Inverters* brochure (ID 622420-xx)
** For further information, refer to the *TNC 620* brochure

Specifications	TNC 620	Page
Axis feedback control		**30**
With feedforward	✔	30
With following error	✔	30
Maximum feed rate	$\frac{60000\ \text{min}^{-1}}{\textit{No. of pole pairs of the motor}} \cdot \textit{screw pitch}$ [mm] at f_{PWM} = 5000 Hz	
Cycle times of main computer	**MC 6110**	**31**
Block processing time	6 ms 1.5 ms with option 9	31
Cycle times of controller unit	**CC 6106/UEC 11x**	**31**
Path interpolation	3 ms	31
Fine interpolation	*Single-speed:* 0.2 ms *Double-speed:* 0.1 ms with option 49	31
Position controller	*Single-speed:* 0.2 ms *Double-speed:* 0.1 ms with option 49	31
Speed controller	*Single-speed:* 0.2 ms *Double-speed:* 0.1 ms with option 49	31
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	31
Permissible temperature range	Operation from +5 °C to +45 °C Storage from –35 °C to +65 °C	

Machine Interfacing

Machine Interfacing	TNC 620	Page
Error compensation	✔	**35**
Linear axis error	✔	35
Nonlinear axis error	✔	35
Backlash	✔	35
Reversal peaks with circular movement	✔	35
Hysteresis	✔	35
Thermal expansion	✔	35
Stick-slip friction	✔	35
Sliding friction	✔	35
Integrated PLC		**40**
Program format	Statement list	40
Program input on the TNC	Via external USB keyboard or via soft keys	40
Program input via PC	✔	40
Symbolic PLC-NC interface	✔	40
PLC memory	50 MB	40
PLC cycle time	21 ms, adjustable	40
PLC inputs/outputs	Max. eight PL 6xxx (one PL 62xx or UEC 11x and max. seven PL 61xx)	**18**
PLC inputs, 24 V–	Via PL or UEC 11x, max. 1024	18
PLC outputs, 24 V–	Via PL or UEC 11x, max. 512	18
Analog inputs, ±10 V	Via PL	18
Inputs for PT 100 thermistors	Via PL	18
Analog outputs, ±10 V	Via PL	18
PLC functions	✔	**41**
Small PLC window	✔	41
PLC soft keys	✔	41
PLC positioning	✔	41
PLC basic program	✔	42

Machine Interfacing	TNC 620			Page
Encoder inputs	UEC 111	UEC 112	CC 6106	**33**
Position	4	5	6	34
Incremental	1 V_{PP}			34
Absolute	EnDat			34
Shaft speed	4	5	6	34
Incremental	1 V_{PP}			34
Absolute	EnDat			34
Commissioning and diagnostic aids				38
DriveDiag	Software for diagnosis of digital drive systems			38
TNCopt	Software for putting digital control loops into service			38
Integrated oscilloscope	✔			39
Trace function	✔			39
Logic diagram	✔			39
API DATA function	✔			39
Table function	✔			39
Online monitor (OLM)	✔			38
Log	✔			39
TNCscopeNT	✔			39
Data interfaces				**44**
Ethernet (100BaseT)	✔			44
USB 1.1	3 (1 on the front, 2 on the rear)			44
RS-232-C/V.24	✔			44
Protocols				**44**
Standard data transfer	✔			44
Blockwise data transfer	✔			44
LSV2	✔			

Accessories

Accessories	TNC 620		Page
Electronic handwheels	One HR 410 or HR 130, or up to three HR 150 via HRA 110		**20**
Touch probes	• One TS 220, TS 440, TS 444, TS 640 or TS 740 workpiece touch probe • One TT 140 tool touch probe		**23**
PLC input/output systems	**With HSCI interface**		**18**
Basic module	**System PL**[1]	PLB 6204 for 4 I/O modules PLB 6206 for 6 I/O modules PLB 6208 for 8 I/O modules	18
	Extension PL	PLB 6104 for 4 I/O modules PLB 6106 for 6 I/O modules PLB 6108 for 8 I/O modules	18
I/O modules	PLD-H 16-08-00: 16 digital inputs and 8 digital outputs, 24 V PLA-H 04-00-04: 4 analog inputs, ± 10 V, and 4 analog inputs for PT 100 (in preparation)		18
USB hub	✔		**44**
PLC basic program[1]	✔		**42**
TNC 620 programming station	Control software for PCs for programming, archiving, and training		

Accessories	TNC 620	Page
Software		
PLCdesignNT[2]	PLC software developing environment	**42**
KinematicsDesign	Software for kinematic configuration	**36**
TNCremoNT	Data transfer software	**45**
TNCremoPlus	Data transfer software with live-screen function	**45**
CycleDesign[2]	Software for creating cycle structures	**43**
TNCscopeNT[2]	Software for data recording	**39**
DriveDiag[2]	Software for diagnosis of digital control loops	**38**
TNCopt[2]	Software for putting digital control loops into service	**38**
IOconfig[2]	Software for configuring PLC I/O and PROFIBUS-DP components	**18**
TeleService[2]	Software for remote diagnostics, monitoring, and operation	**42**
RemoTools SDK 1.2[2]	Function library for developing customized applications for communication with HEIDENHAIN controls	

[1] Integrated in UEC 11x, otherwise necessary once in each HSCI control system
[2] These software products are available to registered customers for downloading from the Internet.

User Functions

User Functions	Standard	Option	
Program entry	•		HEIDENHAIN conversational and ISO formats
Position data coordinates	• • •		Nominal positions for lines and arcs in Cartesian coordinates or polar coordinates Incremental or absolute dimensions Display and input in mm or inches
Tool compensation	•	 21 9	Tool radius in the working plane and tool length Radius-compensated contour look-ahead for up to 99 blocks (M120) Three-dimensional tool-radius compensation for changing tool data without having to recalculate an existing program
Tool tables	•		Multiple tool tables with any number of tools
Constant contouring speed	• •		Relative to the path of the tool center Relative to the tool's cutting edge
Parallel operation	•		Creating a program with graphical support while another program is being run
3-D machining		9 9 21 9 9	Motion control with minimum jerk, HSC filters 3-D tool compensation through surface normal vectors Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point Keeping the tool normal to the contour Tool radius compensation normal to the tool direction
Rotary table machining		8 8	Programming of cylindrical contours as if in two axes Feed rate in distance per minute
Contour elements	• • • • • • •		Straight line Chamfer Circular path Circle center point Circle radius Tangentially connecting circular arc Corner rounding
Approaching and departing the contour	• •		Via straight line: tangential or perpendicular Via circular arc
FK free contour programming		19	FK free contour programming in HEIDENHAIN conversational format with graphic support for workpiece drawings not dimensioned for NC
Program jumps	• • •		Subroutines Program section repeats Calling any program as subroutine
Fixed cycles	•	 19 19 19 19 19 19 19	Drilling, tapping with a floating tap holder, rigid tapping Peck drilling, reaming, boring, counterboring, (centering) Milling internal and external threads Clearing level and oblique surfaces Straight slots and circular slots 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

User Functions	Standard	Option	
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
	•		Graphical 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		20	Graphic simulation before a program run, even while another program is running
		20	Plan view / projection in 3 planes / 3-D view, also in tilted working plane
		20	Magnification of details
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		20	Graphic simulation during real-time machining
		20	Plan view / projection in 3 planes / 3-D view
Machining time	•		Calculation of machining time in the Test Run operating mode
	•		Display of the current machining time in the Program Run operating modes
Returning to the contour	•		Mid-program startup in any block in the program, returning the tool to the calculated nominal position to continue machining
	•		Program interruption, leaving and returning to the contour
Preset tables	•		One preset table for storing reference points
Datum tables	•		Several datum tables for storing workpiece-related datums
Pallet tables		22	Pallet tables (with as many entries as desired for the selection of pallets, NC programs and datums) can be machined workpiece by workpiece
Touch probe cycles		17	Touch probe calibration
		17	Compensation of workpiece misalignment, manual or automatic
		17	Datum setting, manual or automatic
		17	Automatic workpiece measurement
Conversational languages	•		English, German, French, Italian, Danish, Spanish, Portuguese, Finnish, Dutch, Czech, Polish, Hungarian, Russian, Swedish, Chinese (traditional, simplified)

Options

Option number	Option	ID	Comment
0 **1**	Additional axis	354540-01 353904-01	Additional control loops 1 and 2
8	Software option 1	617920-01	**Coordinate transformation** • Tilting the working plane **Machining with a rotary table** • Programming of cylindrical contours as if in two axes • Feed rate in distance per minute **Interpolation** • Circle in 3 axes with tilted working plane
9	Software option 2	617921-01	**Block processing time: 1.5 ms** **Interpolation** • Linear in 5 axes **3-D machining** • Motion control with minimum jerk, HSC filters • 3-D tool compensation through surface normal vectors • Using the electronic handwheel to change the angle of the swivel head during program run without affecting the position of the tool point • Keeping the tool normal to the contour • Tool radius compensation normal to the tool direction
17	Touch probe functions	634063-01	**Touch probe cycles** • Compensation of workpiece misalignment, manual or automatic • Datum setting, manual or automatic • Automatic tool and workpiece measurement
18	HEIDENHAIN DNC	562451-01	Communication with external PC applications over COM component
19	Advanced programming features	628252-01	**FK free contour programming** • Programming in HEIDENHAIN conversational format with graphic support for workpiece drawings not dimensioned for NC **Fixed cycles** • Peck drilling, reaming, boring, counterboring, centering • Milling internal and external threads • Clearing level and oblique surfaces • Straight slots and circular slots • 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
20	Advanced graphic features	628253-01	**Verification graphics, machining graphics** • Plan view • Projection in three planes • 3-D view
21	Software option 3	628254-01	**Tool compensation** • Radius-compensated contour look-ahead for up to 99 blocks **3-D machining** • Superimpose handwheel positioning during program run
22	Pallet management	628255-01	**Pallet management**
23	Display Step	632986-01	**Display step** to 0.01 µm or 0.00001°
49	Double Speed		Direct drives (high-frequency spindles, linear motors, torque motors) require very high quality controllers and very short cycle times for position, speed and current controllers. "Double-speed" control loops are preferably used to control such drives.

Digital Control Concept

Uniformly digital

In the uniformly digital control concept 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 just very high accuracy and surface quality, but rapid traverse speeds as well. Please refer to the *Uniformly Digital* Technical Information sheet for more detailed information.

HSCI

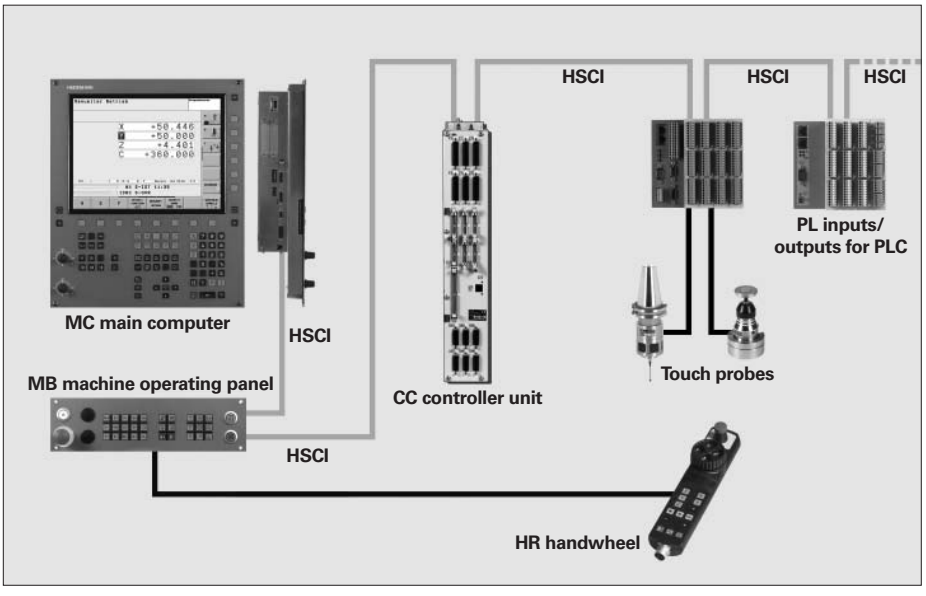
HSCI, the HEIDENHAIN Serial Controller Interface, connects the main computer, controller(s) and other control components. HSCI is based on 100BaseT Ethernet hardware. A special interface component developed by HEIDENHAIN makes short cycle times for data transfer possible.

Main advantages of the control concept with HSCI:

- Hardware platform for flexible and scalable control system (e. g. local axis systems)
- High noise immunity due to digital communication between components
- Possible cable lengths of the complete system increased
- Number of PLC inputs and outputs increased
- Simpler wiring (initial operation, configuration)
- Inverters connected as previously via well-proven PWM interface

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.



TNC 620 HSCI Control System

Overview

The TNC 620 contouring control comprises the following components:

		Model			Page
TNC 620	**Main computer** with TNC operating panel and 15" screen	**MC 6110**			**14**
	Memory card	**CFR**			**15**
	NC-software license	**SIK component**			**15**
	Power supply unit	**PSL 130** (as required)		**PSL 130**	**19**
	Controller unit Control loops	**UEC 111**[1] Max. 4	**UEC 112**[1] Max. 5	**CC 6106** Max. 6	**16**
	PLC inputs/outputs System PL Extension PL	**PL 6xxx** series Integrated Max. 7 PLB 610x	**PL 6xxx** series Integrated Max. 7 PLB 610x	**PL 6xxx** series One PLB 620x Max. 7 PLB 610x	**18**
	Machine operating panel	**MB 620**			**19**
Acces-sories	**Electronic handwheels**	**HR 410** or **HR 130** or **HR 150**			**20**
	Touch probes	**TS 220** or **TS 440** or **TS 444** or **TS 640** or **TS 740**			**23**
		TT 140			

[1] Inverter and system PL integrated

Main Computer

Main computer

The **MC 6110** main computer includes:
- Processor: Celeron with 400 MHz
- 512 MB RAM memory
- TNC operating panel with soft keys
- 15-inch TFT color flat-panel display; resolution: 1024 x 768 pixels
- HSCI interface to the controller unit and to other control components
- Further interfaces, such as Ethernet, USB, RS-232-C/V.24

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

The following HSCI components are necessary for operation of the TNC 620:
- **PL 62xx** PLC input/output unit (system PL; integrated in UEC 11x)
- **MB 620** machine operating panel

MC 6110

Position inputs	6 x 1 V_{PP} or EnDat
Weight	7.8 kg
ID	594038-01

Power supply

24 V of power are supplied to the main computer and other HSCI components by the UEC controller unit. If the current consumption is greater than 3.5 A or a CC 6106 is used, then a PSL 130 power supply unit is also necessary.

Export version

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

Options

The capabilities of the TNC 620 can also be adapted retroactively with options to meet new requirements. These options are described on page 11. 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.

Main Computer—CFR Memory Card, SIK Component

CFR CompactFlash

The NC software for the TNC 620 is contained on the CFR CompactFlash memory card (= CompactFlashRemovable). It is also the memory medium for NC programs (up to 300 MB) and the PLC program (up to 50 MB).

TNC 620	ID 617770-01
TNC 620 export version	ID 617770-51

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 6110 main computer.

The SIK component with the NC software license is available in various versions, depending on the enabled control loops. Additional control loops—**up to the total of 6 control loops**—can be enabled later by entering a keyword. HEIDENHAIN provides the keyword, which is based on the SIK number. When ordering, please indicate the SIK number of your control. When the keywords are entered in the control, they are saved in the SIK component. This enables and activates the options. Should service become necessary, the SIK component must be inserted in the replacement control to enable all required options.

SIK component

Master keyword (General Key)

There is a master keyword (General Key) for putting the TNC 620 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 using a soft key.

NC software license and enabling of control loops

There are always 4 control loops enabled in the basic version. The controller unit must be capable of handling the number of activated control loops. The maximum number of control loops depends on the constellation:

- CC 6106: 6 control loops
- UEC 112: 5 control loops
- UEC 111: 4 control loops

NC software license for	**SIK ID** Standard version	Export version
4 control loops	526924-01	526924-51
4 control loops incl. options 19 and 20	526924-04	526924-54
5 control loops	526924-02	526924-52
6 control loops	526924-03	526924-53

Subsequent enabling of control loops

If additional control loops are required for retrofitted options, the controller unit must be capable of handling further control loops.

Control loop	**ID number**
1st additional control loop	354540-01
2nd additional control loop	353904-01

Controller Unit

Controller unit

Due to the very short cycle times of the position, velocity 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
(option 49)

Double-speed control loops (option 49) are preferred for controlling direct drives and HSC spindles. **Single-speed control loops** suffice for conventional drives. When switching from single speed to double speed, the number of available control loops is reduced by one each.

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

Controller units and main computers operate in any desired combination. HEIDENHAIN offers the following versions:
- Modular CC 6106 controller unit with PWM interface to the inverters
- Compact UEC 11x controller units with integrated inverter

CC 6106

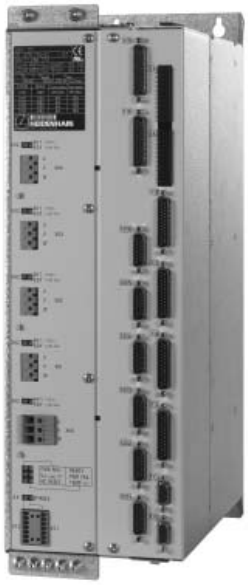
CC 6106

The **CC 6106** controller unit features:
- Position controller
- Speed controller
- Current controller
- HSCI interfaces
- PWM interfaces to the UM 1xx, UR 2xx, and UE 2xx power modules
- Interfaces to the speed encoders
- Interfaces to the position encoders
- Interfaces for the power supply (supply via UVR 1xxD, UE 2xxD or UR 2xx)

	CC 6106
Digital control loops	Max. 6
Speed inputs	6 x 1 V_{PP} or EnDat 2.2
Position inputs	6 x 1 V_{PP} or EnDat 2.2
PWM outputs	6
Weight	4.1 kg
ID number	598928-xx

UEC 11x

Along with the controller with PLC inputs and outputs, the UEC 11x compact controller units also include an inverter with integrated braking resistor. They form 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

System PL
- Interfaces for one workpiece touch probe and one tool touch probe
- PLC with 38 inputs and 23 outputs (of which 7 outputs can be switched off) freely available (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/ Maximum current I_{max}[1] for 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		3 x 400 V (± 10%); 50 Hz to 60 Hz or 3 x 480 V (± 10%); 50 Hz to 60 Hz					
Rated power dc link		**14 kW**			**14 kW**		
Peak power[2] 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			565 V		
Integral braking resistance		2.1 kW / 27 kW			2.1 kW / 27 kW		
Power pack for HSCI components		24 V/3.5 A			24 V/3.5 A		
Module width		175 mm			175 mm		
Weight (approx.)		20 kg			20 kg		
ID number		625777-01			625779-01		

[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

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.

PL 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–
Power consumption	Approx. 20 W
Weight	0.36 kg (bare)

System PL

- Necessary once per control system
- Includes connections for TS touch probes (except with UEC)
- Safety-relevant inputs/outputs

PLB 6204	for 4 I/O modules	ID 591832-01
PLB 6206	for 6 I/O modules	ID 630054-01
PLB 6208	for 8 I/O modules	ID 630055-01

Expansion PL

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

PLB 6104	for 4 I/O modules	ID 591828-01
PLB 6106	for 6 I/O modules	ID 630058-01
PLB 6108	for 8 I/O modules	ID 630059-01

PL 61xx

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 cable of 100 m.

I/O modules

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

PLD-H 16-08-00

I/O module for PL 6xxx with 16 digital inputs and 8 digital outputs

Total current	Outputs 0 to 7: ≤ 8 A per output (≤ 8 A simultaneously)
Power output	Max. 200 W
Weight	0.2 kg
ID	594243-01

PLA-H 04-00-04[1)]

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

Weight	0.2 kg
ID	559070-01

Empty housing

For unused slots

ID	383022-01

IOconfig (accessory)

PC software for configuring the PL 6xxx and PL 550 (PROFIBUS-DP) components

[1)] Availability: planned for middle of 2008

Power Supply for HSCI Components

PSL 130

24-V power pack for supplying the HSCI components

Supply voltage	Line voltage: 400 V ± 10 % 50 Hz and DC-link voltage: 400 V to 750 V Power consumption: Max. 1 000 W	
Outputs	NC: PLC: Per output: Total:	24 V– (double isolation) 24 V– (basic isolation) Max. 21 A / 500 W Max. 32 A / 750 W
Weight	2.1 kg	
ID	575 047-01	

PSL 130

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
MC 6110	1.8 A
MB 620	1.0 A
PL 62xx (incl. TS and TT)	0.5 A
PL 61xx	0.2 A

Machine Operating Panel

MB 620 machine operating panel

- 21 exchangeable snap-on keys, freely definable via PLC
- Operating elements: 12 axis keys, 16 function keys, NC start[1)], NC stop[1)], spindle start, spindle stop (all snap-on keys; see *Snap-On Keys*); emergency stop button, control voltage on[1)]; 2 holes for additional keys or detachable-key switch
- HSCI interface
- 8 PLC inputs and 8 PLC outputs

Weight	0.9 kg
ID	617 693-01

- Power supply: 24 V, current consumption: 1 A
- Configuration of the PLC inputs/outputs with the IOconfig PC software

[1)] Keys illuminated

MB 620

Accessories

Electronic Handwheels

The standard TNC 620 supports the use of electronic handwheels. 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 the handwheel adapter **HRA 110**

Handwheels are connected to the MB machine operating panel.

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)
- Holding magnets

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

HR 410 model	**Mechanical detent**	
	with	**without**
Standard assignment with the FCT A, FCT B, FCT C function keys	–	296469-53
For PLC basic program with NC start/stop, spindle start	535220-05	296469-55
With spindle right/left/stop	–	296469-54

HR 130

Panel-mounted handwheel with ergonomic control knob.
It is connected to the logic unit directly or via extension cable.

Weight Approx. 0.7 kg

HR 130 without detent ID 540940-03
HR 130 with mechanical 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 selection switch (accessory) or by machine parameters. The position of the second selection switch (accessory) is evaluated by the PLC, for example to set the proper interpolation.

HRA 110

ID	261 097-03
Weight	Approx. 1.5 kg

Handwheel selection 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 540 940-06
HR 150 with detent	ID 540 940-07

Snap-On Keys

The snap-on keys make it easy to replace the symbol keys. In this way, the MB machine operating panel and 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	X´–	ID 330 816-0W	Y+	ID 330 816-0R
A+	ID 330 816-96	W–	ID 330 816-0G	X´+	ID 330 816-0V	Y–	ID 330 816-0D
B–	ID 330 816-97	W+	ID 330 816-0H	X–	ID 330 816-0N	Y+	ID 330 816-0E
B+	ID 330 816-98	IV–	ID 330 816-71	X+	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	Z–↓	ID 330 816-19
U–	ID 330 816-0B	X+	ID 330 816-64	Y´–	ID 330 816-21	Z+↑	ID 330 816-16
U+	ID 330 816-0C	X´–	ID 330 816-18	Y´+	ID 330 816-20	Z´–↑	ID 330 816-0L
V–	ID 330 816-70	X´+	ID 330 816-17	Y´–	ID 330 816-0P	Z´+↓	ID 330 816-0K

Machine functions

SPEC FCT	ID 330 816-0X	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		
FN 3	ID 330 816-75		ID 330 816-0T		ID 330 816-86		

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		

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		
NC 0	(red) ID 330 816-12		ID 330 816-35		ID 330 816-29		
	ID 330 816-49		ID 330 816-22		ID 330 816-92		

Touch Probes

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

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

TS 640 with SE 640

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 mounting in the machine workspace
SE 540 for integration in the spindle head

Tool measurement

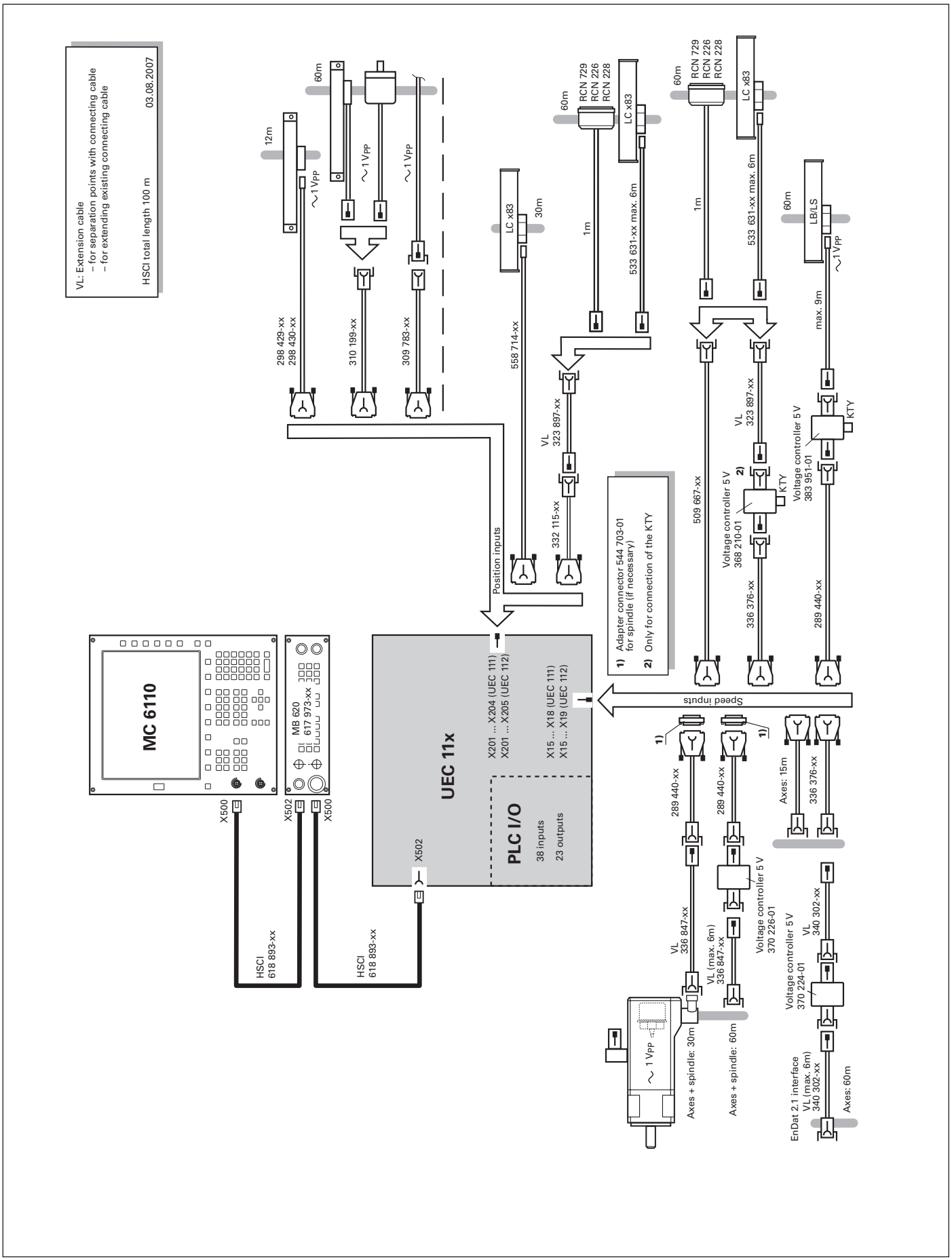
The touch probes for tool measurement from HEIDENHAIN are suited for probing stationary or rotating tools directly on the machine. The TNC has standard routines for measuring length and diameter of the tool as well as the individual teeth. The TNC automatically saves the results of measurement in a tool 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 has been reached—as for example after tool breakage.

TT 140 — With the triggering **TT 140 touch probe,** the contact plate is deflected from its rest position, sending a trigger signal to the NC control, during probing of the stationary or rotating tool.

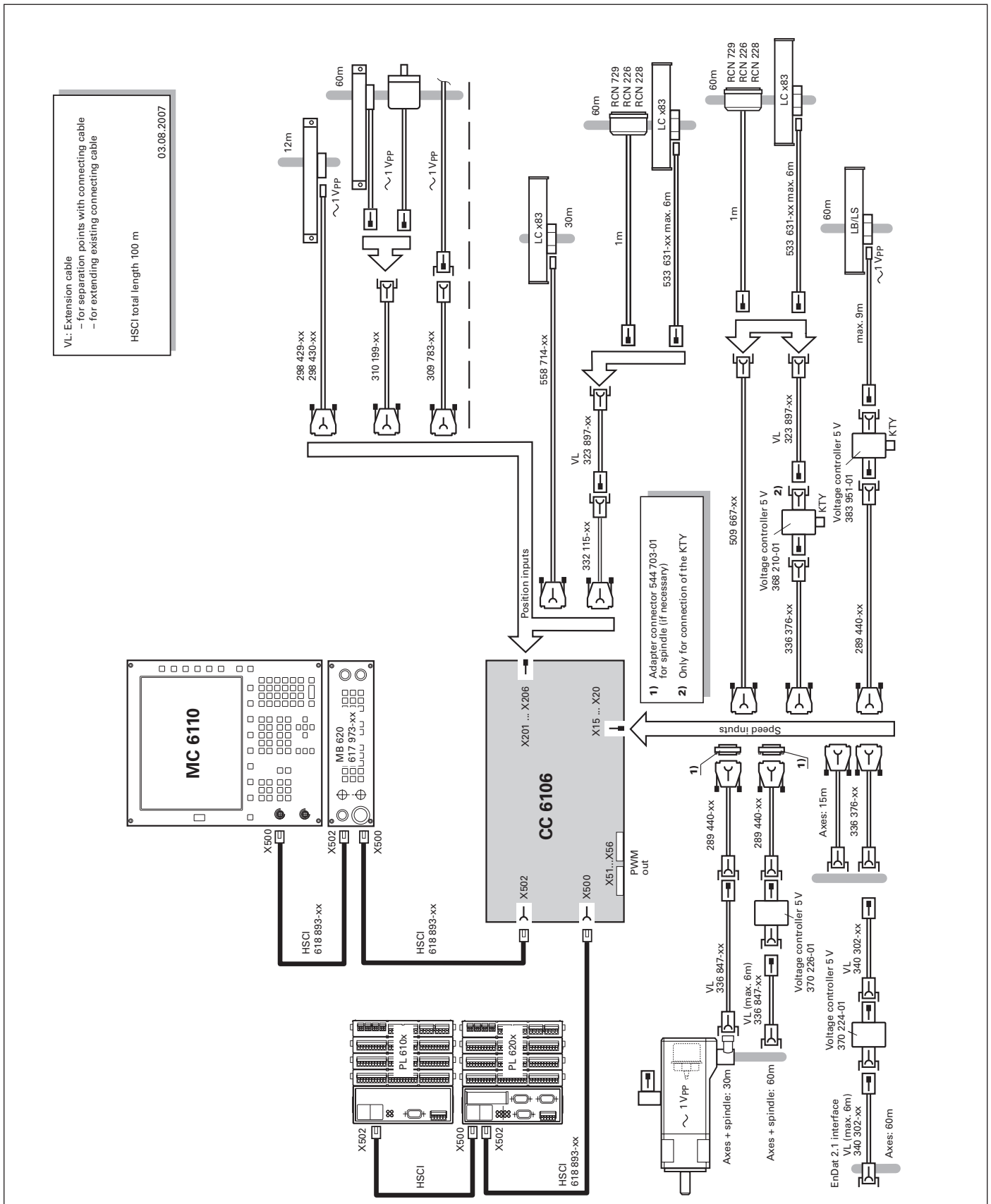
TT 140

Cable Overviews

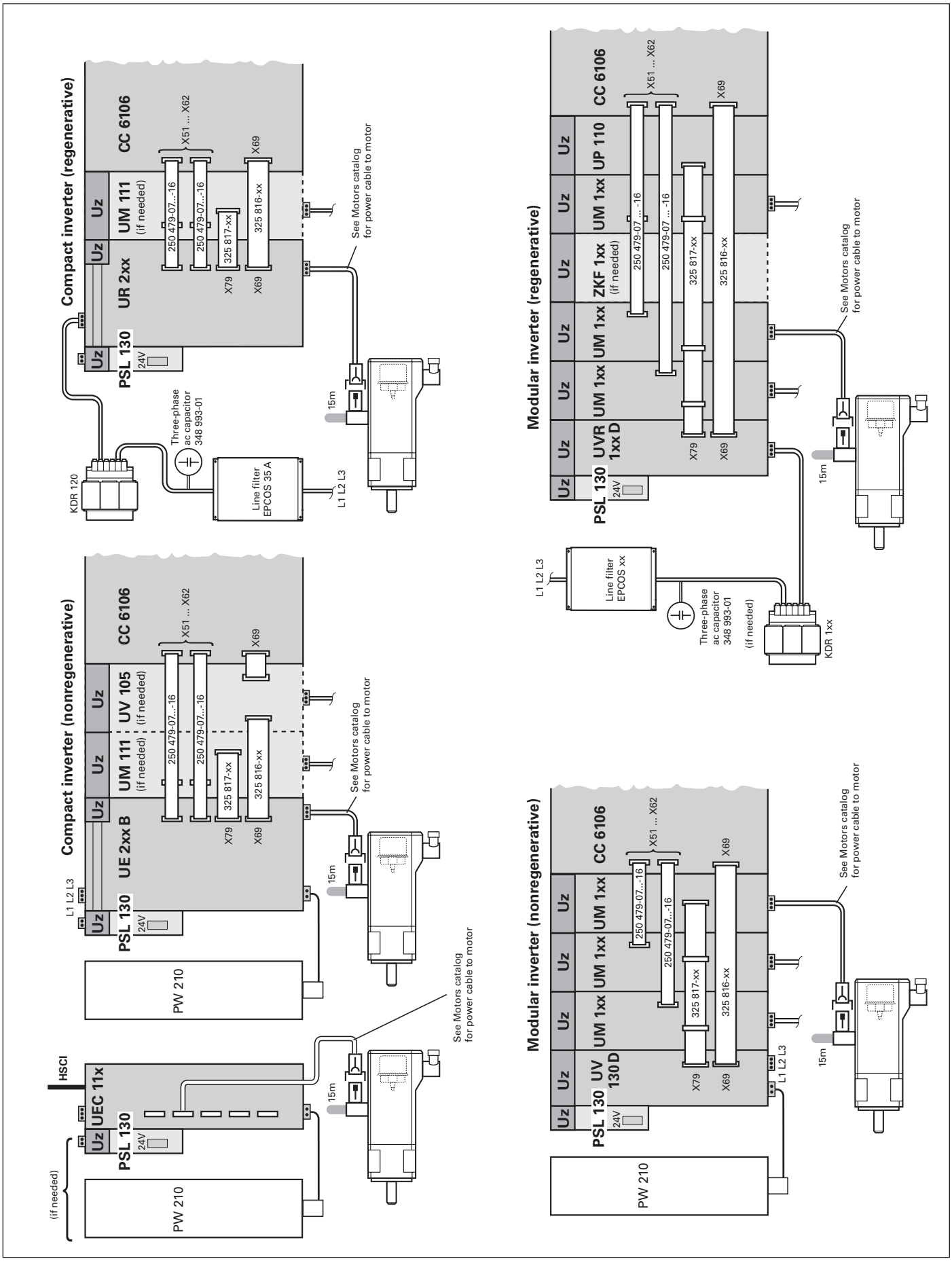
Control System with UEC 11x



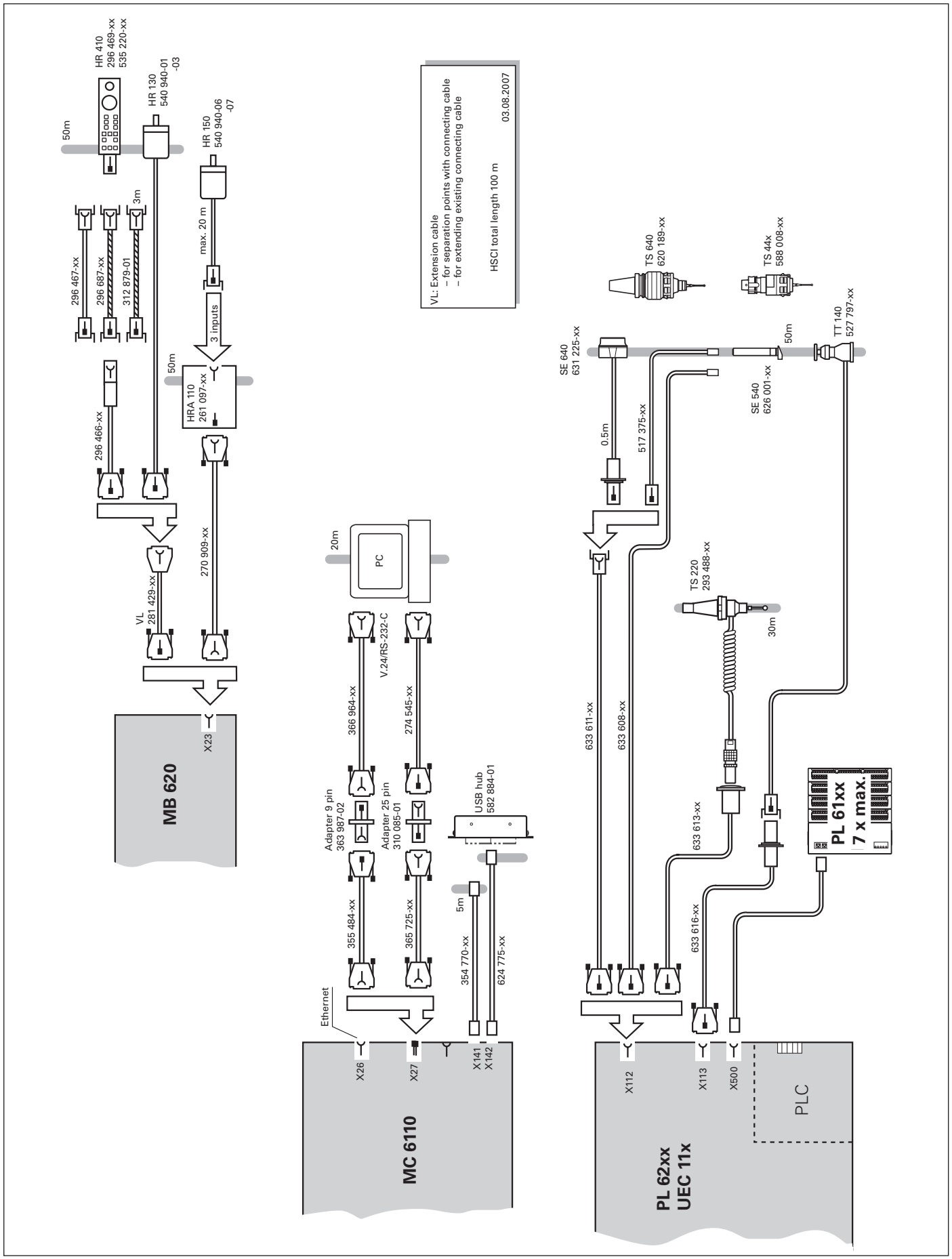
Control System with CC 6106



Inverter Systems



Accessories



Technical Description

Axes

Linear axes

Depending on the options enabled, the TNC 620 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 depending on the workpiece contour, or mm per spindle revolutionFeed-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.
Different traverse ranges can be defined for each axis via parameter sets (selection by PLC).

Rotary axes

The TNC 620 can control rotary axes with any axis designation (A, B, C, U...).

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

Display and programming

0° to 360° or
–99 999.999 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.
Different traverse ranges can be defined for each axis via parameter sets (selection by PLC).

Free rotation

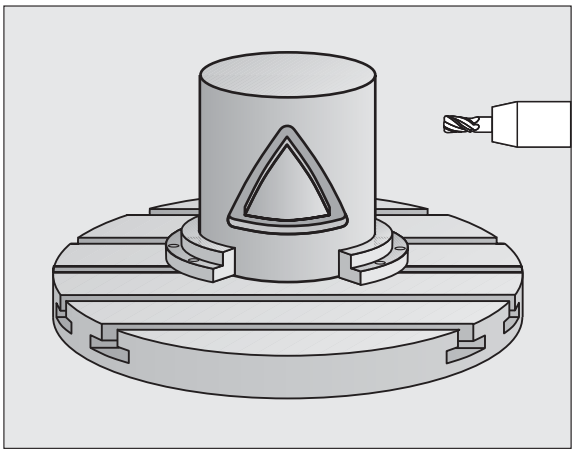
For milling-turning operations, the rotary axis can be started via the PLC with a defined feed rate.

Cylindrical surface interpolation (option 8)

A contour defined in the machining plane is executed on the cylinder surface.

Axis clamping

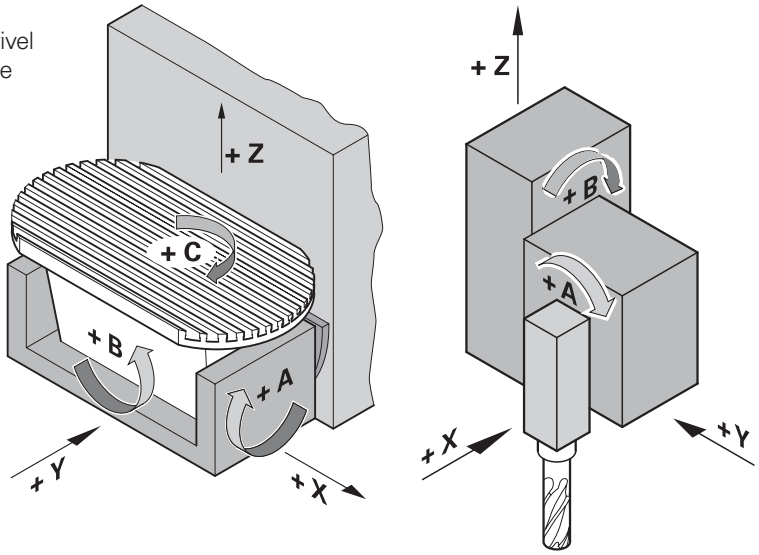
The control loop can be opened through the PLC in order to clamp specific axes.



Tilting the working plane (option 8)

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

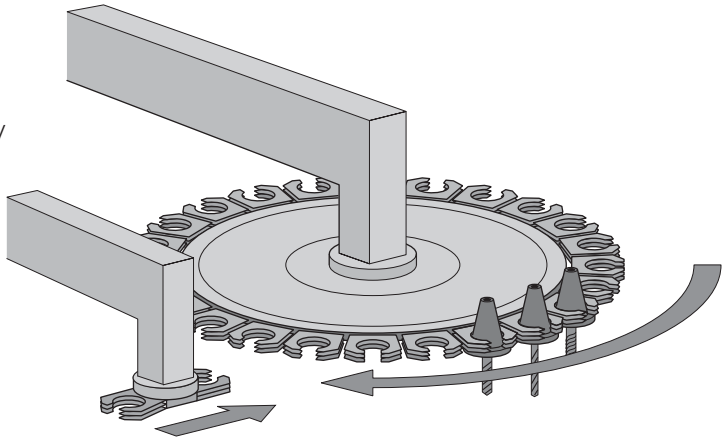
The TNC 620 can manage more than one machine configuration (e. g. different swivel heads).



PLC axes

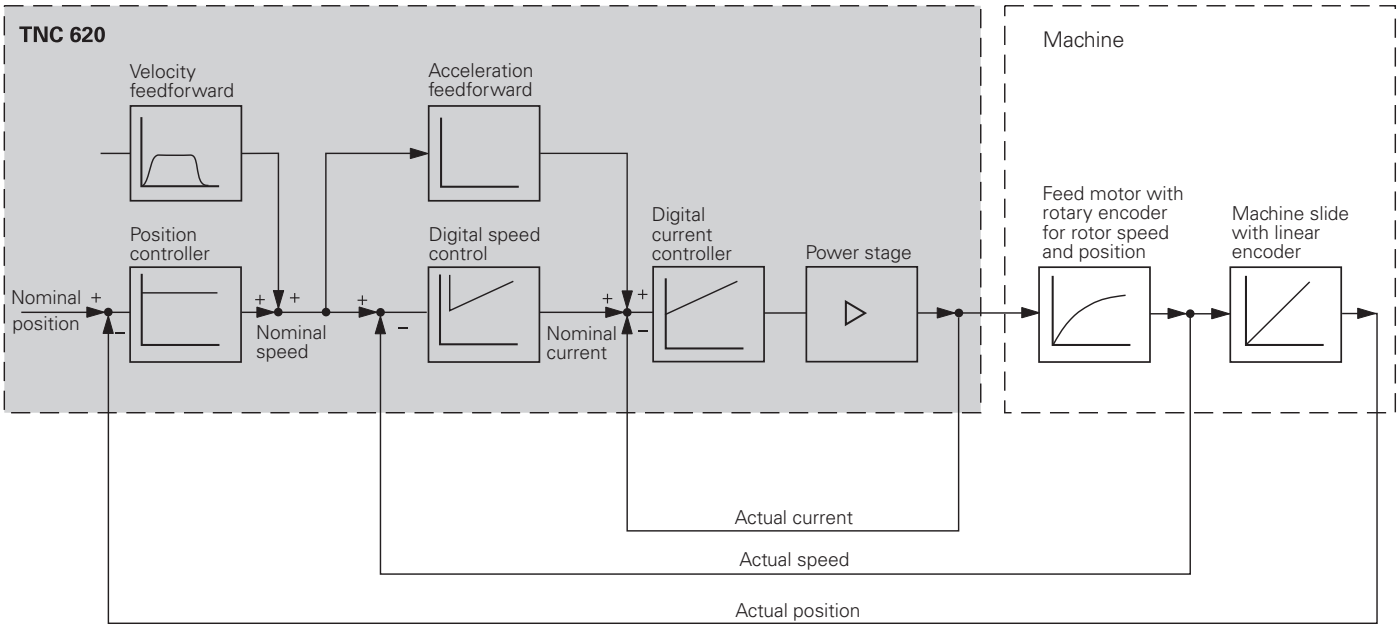
Axes can be controlled by the PLC. They are programmed over M functions or OEM cycles.

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



Digital Control

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



Axis feedback control The TNC 620 can be operated with lag or feedforward control. During roughing operations at high speeds, for example, you can switch to velocity semifeedforward control via an OEM cycle in order to avoid machining with reduced accuracy.

Operation with following error (servo lag) 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 = loop gain
s_a = following error

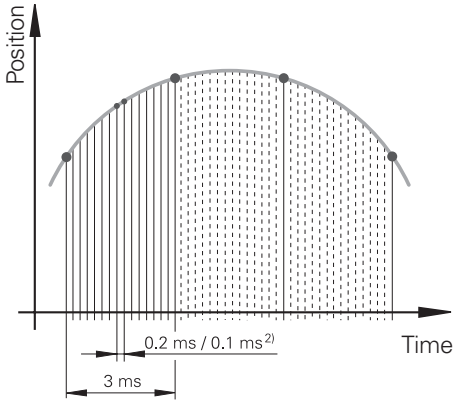
Operation with feedforward control Velocity feedforward means that the speed and the acceleration are adjusted to fit the machine. Together with the values calculated from the following error, it forms the nominal value. In this way, the following error becomes very small (in the range of a few µm).

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

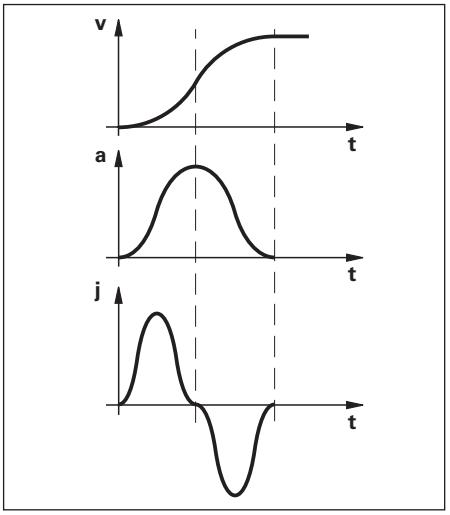
The derivative of acceleration is referred to as jerk. A linear change in acceleration causes a jerk step. Such motion sequences may cause the machine to oscillate.

Jerk limiting

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

Smoother jerk

The jerk is smoothed by a nominal position value filter. The TNC 620 therefore mills smooth surfaces at the highest possible feed rate and yet keeps the contour accurate. The operator programs the permissible tolerance in a cycle. Special filters for HSC machining (HSC filters, option 9) can specifically suppress the natural frequencies of an individual machine and achieve the desired accuracy with the best surface quality.



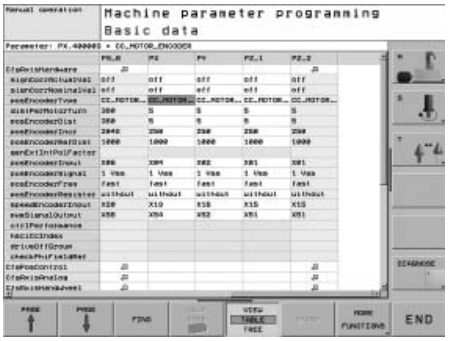
Machine Configuration

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. Each machine has its own set of parameters.

Structured organization of machine parameters

The TNC 620 features a simplified configuration editor. The machine parameters are displayed on the control's screen in a clear tree structure. Move through the structure with the TNC operating panel or a USB mouse. The parameters are entered in windows, similar to a PC.

As an alternative, the configuration editor can display a table view. This is especially useful when configuring the parameter blocks, since the parameters of all axes are then visible at a glance.



Quick access using MP numbers

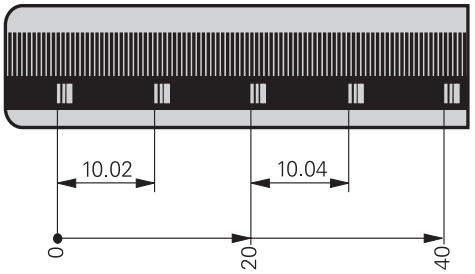
Each machine parameter has a unique 6-digit MP number. The GOTO function can be used for quick access to any machine parameter.

Encoders

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

Incremental encoders

Incremental encoders have as measuring standard a grating consisting of alternating 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 $\sim$ 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. Depending on the interface, additional incremental signals can be output.

EnDat interface

The TNC 620 is fitted with the serial EnDat 2.2 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 for position control

Incremental and absolute linear, angle or rotary encoders from HEIDENHAIN can be connected to all position encoder inputs of the CC 6xxx.

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

Encoder inputs for speed control

Incremental and absolute rotary encoders from HEIDENHAIN can be connected to all speed encoder inputs of the CC 6xxx.

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

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

Error Compensation

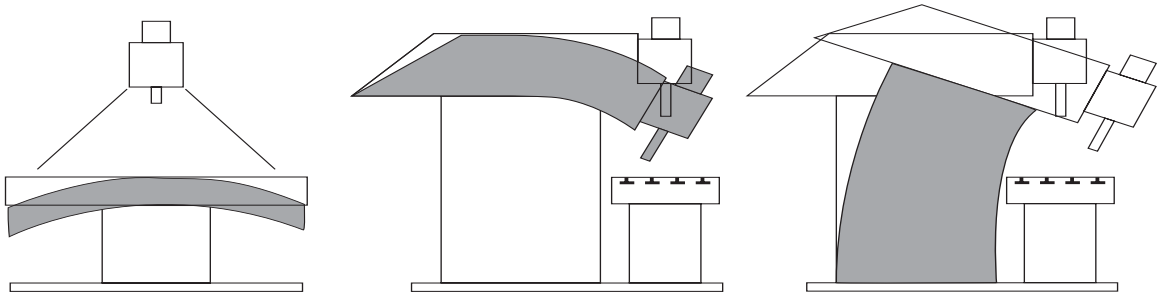
The TNC 620 automatically compensates mechanical errors on the machine.

Linear errors

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

Nonlinear errors

The TNC 620 can compensate for ballscrew pitch errors and following error simultaneously. The compensation values are stored in a table.



Backlash

For length measurements via spindle and rotary encoders, the play between the table movement and the rotary encoder movement on direction changes can be compensated. This backlash is outside the controlled system.

Hysteresis

The hysteresis between the table movement and the 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 620 can compensate for these reversal peaks.

Stick-slip friction

High static friction can lead to stick-slip: the slide stops and starts repeatedly for short periods at low feed rates. This is commonly known as stick-slip. The TNC 620 can compensate this problem condition.

Sliding friction

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

Thermal expansion

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

The temperature can be recorded via temperature measurement thermistors connected to the analog inputs of the TNC 620. The PLC evaluates the temperature information and transfers the compensation value to the NC.

Monitoring Functions

During operation, the TNC 620 monitors:

- Amplitude of the encoder signals
- Edge separation of the encoder signals
- Absolute position for encoders with distance-coded reference marks
- Current position (servo lag monitoring)
- Actual path traversed (movement monitoring)
- Position deviation at standstill
- Nominal speed value
- Checksum of safety-related functions
- Supply voltage
- 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 (monotime)
- 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 620 into the machine's EMERGENCY STOP loop is checked when the control system is switched on.
In the event of an error, the TNC 620 displays a message in plain language.

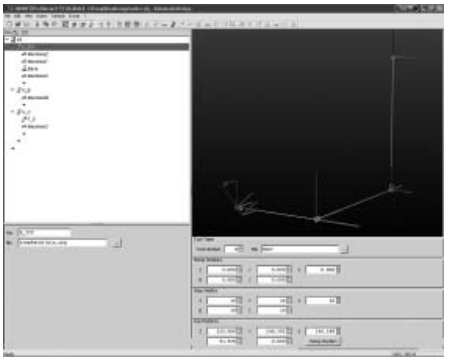
Context sensitive help

The HELP and ERR keys provide the user with context-sensitive help. This means that in the event of an error message, the TNC 620 displays information on the cause of the error and proposes solutions. The machine manufacturer can also use this function for PLC error messages.

KinematicsDesign

KinematicsDesign is a PC software program for creating adaptable flexible 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)
- Configuration and initial operation 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 include the pure depiction of the transformation sequence and even wire models or a complete representation of the working envelope on the iTNC 530.

Spindle

The TNC 620 contouring control is used in connection with the HEIDENHAIN inverter systems with field-oriented control.

CC 6106 controller unit

With the CC 6106 controller unit, 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 620 Technical Manual*.)

Controller groups

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

Maximum spindle speed

The maximum spindle speed is calculated as follows:

$$n_{max} = \frac{f_{PWM} \cdot 60\,000\ min^{-1}}{NPP \cdot 5\,000\ Hz}$$

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

Operating mode switchover

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

Position-controlled spindle

The position of the spindle is monitored by the TNC 620.

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 stages

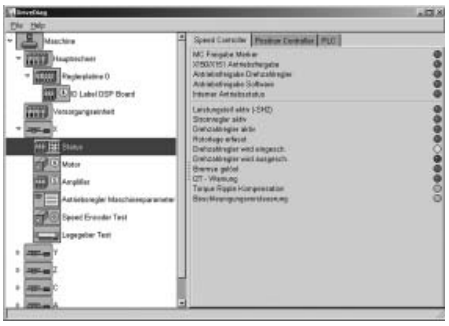
A specific nominal speed can be defined for each gear stage. The gear code is output via the PLC.

Commissioning and Diagnostic Aids

The TNC 620 provides comprehensive internal commissioning and diagnostic aids. In addition, highly effective PC software for diagnosis, optimization and remote control is available.

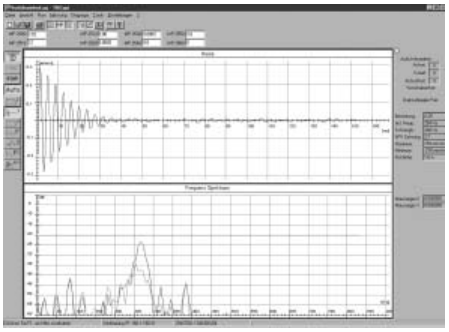
DriveDiag

DriveDiag permits quick and easy troubleshooting of the drives. It also makes it possible to display and evaluate the electronic ID labels.



The following diagnostic functions are available:
- Reading and displaying the electronic ID labels of QSY motors with EQN 13xx or ECN 13xx
- Reading and displaying the electronic ID labels of the UVR 1xxD and UM 1xxD inverter modules
- 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
- Automatic test of position and speed encoders

DriveDiag can be called directly from the TNC 620 via the Diagnosis soft key. It is also available for downloading as PC software 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-spike compensation
- (Automatic) optimization of kV factor
- Circular interpolation test, contour test

Requirements

DriveDiag and TNCopt place the following demands on the PC:
- Windows NT 4.0, 2000 or Vista operating system
- At least VGA—XGA recommended
- At least 16 MB RAM
- At least 15 MB of free hard-disk space
- Serial or Ethernet interface

OLM
Online monitor

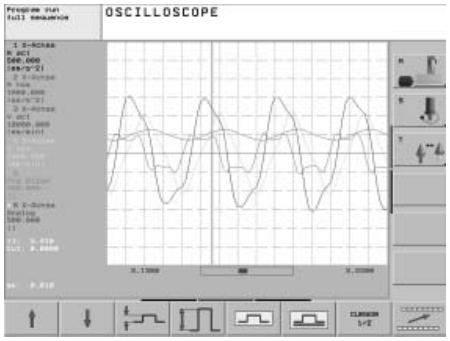
The online monitor (OLM) supports the commissioning and diagnosis of control components through:
- Display of control-internal variables for axes and channels
- Display of controller-internal variables (if a CC is present)
- Display of hardware signal states
- Different trace functions
- Activation of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

The online monitor is a component part of the TNC 620 and is called over a code number.

Oscilloscope

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

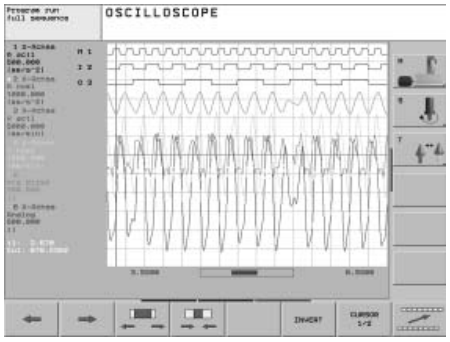
- Actual value of axis feed rate
- Nominal value of axis feed rate
- Machining feed rate
- Actual position
- Nominal position
- Servo lag of the position controller
- Nominal values for speed, acceleration and jerk
- Actual values for speed, acceleration and jerk
- Content of PLC operands
- Encoder signal (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)



TNCscopeNT (accessory)

PC software for transferring the oscilloscope files to the PC. Note: The trace files are saved in the TNCscopeNT 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 via the keyboard.

Trace function

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

Log

For the purposes of error 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 620. For further information, please request the *Remote Diagnosis with TeleService* Technical Information sheet.

Integrated PLC

The PLC program is created by the machine tool builder either with the PLC development software **PLCdesignNT (accessory)** or at the control with an external PC keyboard with a USB connection.

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 input/output systems for PLC.

PLC programming

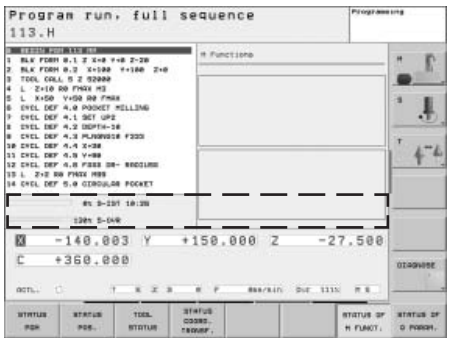
Format	Statement list
Memory	50 MB
Cycle time	21 ms, adjustable
Instruction set	• Bit, byte and word commands • Logical operations • Arithmetic instructions • Comparisons • Parenthetic calculations • Jump commands • Subprograms • Stack operations • Submit programs • 952 timers • 48 counters • Comments • PLC modules • 100 strings

PLC window

PLC error messages can be displayed by the TNC 620 in the dialog line during operation.

Small PLC window

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

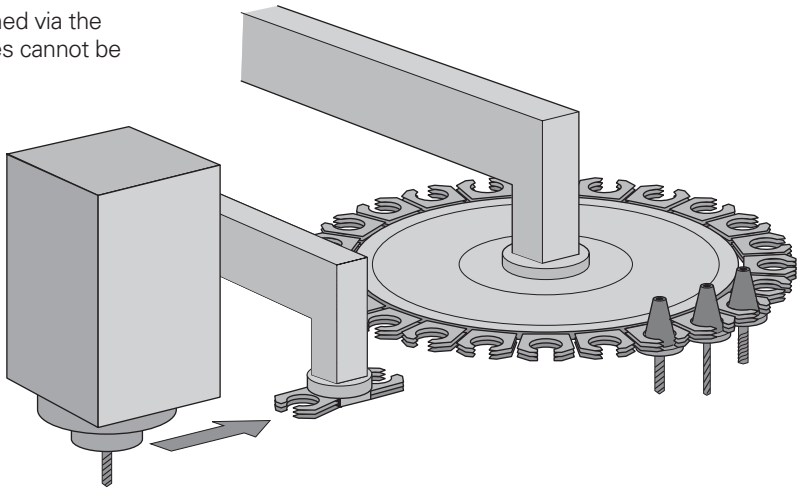


PLC soft keys

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



PLC axes

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

PLCdesignNT
(accessory)

PC software for PLC program development.
The PC program **PLCdesignNT** can be used for easy creation of 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 620 and the PC
- Creation of PLC soft keys

PC requirements:
- Operating system: Windows 98/NT/2000/ME/XP/Vista
- Compatible computer, Pentium 133 or higher
- At least 32 MB RAM
- At least 20 MB free memory on the hard disk
- At least VGA
- Serial interface; Ethernet interface recommended
- Internet Explorer 4.01 or higher

PLC basic program

The PLC basic program serves as a basis for adapting the TNC 620 to the requirements of the respective machine. Registered customers can download it from the Internet.

The following functions are covered by the PLC basic program:
- Controlling all axes
- Positioning the axes after the reference run
- Clamped axes
- Homing the axes, reference end positions
- Compensating the axis temperature
- Feed rate control
- Indexing fixture
- Controlling and orienting the spindle
- Activating tool-specific torque monitoring
- Manual or automatic tool change (pick-up device; single gripper or dual gripper). There is, of course, a larger range of definitions to choose from; the respective type of tool changer must be adapted to the exact requirements of the specific machine by the PLC programmer.
- **Functions** for configuring the tool changer
- Type of tool magazine (controlled by pulses or as an asynchronous axis)
- PLC soft keys
- Displaying and managing PLC error messages
- Displaying functions in the small PLC window
- Hydraulic control
- Electronic handwheel
- Controlling the coolant system
- Handling M functions
- Lubrication
- Chip conveyor
- Touch probes
- Controlling the doors
- Hirth axes
- Central drive

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 keys and the soft-key structure for the OEM cycles are managed using the PC program **CycleDesign.** In addition, CycleDesign can be used to store help graphics and soft keys in BMP format on the memory card of the TNC 620.
In order to reduce the amount of memory used, graphics files can be compressed as ZIP files.

Tool Management

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

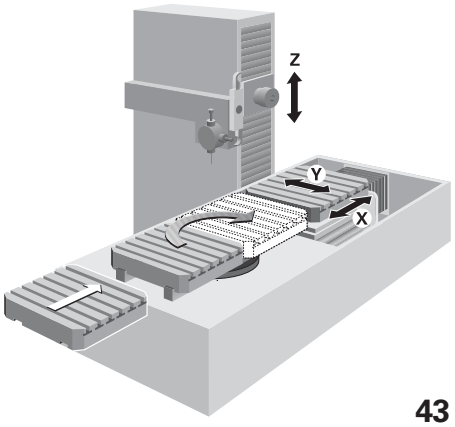
Tool measurement (option 17)

Tools can be measured and checked using the TT 140 tool touch probe (accessory). The TNC 620 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 (Option 22)



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 various pieces of information can be stored in the tables and called up later via the PLC.
The execution of pallet tables can be oriented to the workpiece or the tool.

Data Interfaces

The TNC 620 is connected to PCs, networks and other data storage devices via data interfaces.

Ethernet

The TNC 620 can be interconnected via the Ethernet interface. The TNC 620 features a 100BaseT Ethernet (Twisted Pair Ethernet) connection to the data network.

Maximum transmission distance:
Unshielded 100 m
Shielded 400 m

Protocol

The TNC 620 communicates using the TCP/IP protocol.

Network connection

- NFS file server
- Windows networks (SMB)

Data transfer rate

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

RS-232-C/V.24

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

Data transfer rate

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

Protocols

The TNC 620 can transfer data using various protocols.

Standard data transfer

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

Blockwise data transfer

The data is transferred blockwise. A block check character (BCC) is used for data security, which is improved as a result.

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 6110 features three USB 1.1 interfaces for the connection of standard USB devices, such as the mouse, drives, etc. Two are on the back of the control. One USB interface is on the front and stays accessible when the control is installed. A cover cap protects it from contamination. The USB interfaces are rated for a maximum supply current of 0.5 A. The maximum cable length for external USB units is 5 m without an amplifier. For lengths of 6 m and greater, USB connecting cables with integrated amplifiers are required.

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– / max. 300 mA
ID 582884-01

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 can be used to protect the ports from contamination.

ID 508921-01

Software for Data Transfer

TNCremoNT
(accessory)

This PC software package helps the user to transfer data from the PC to the TNC 620. The software on the PC carries out blockwise data transfer with block check character (BCC).

Functions:
- Data transfer (also blockwise)
- Remote control (only serial)
- Management of the TNC 620 files
- Backup of the TNC 620 files
- Read out the log
- Print-out of screen contents
- Edit ASCII texts
- Management of more than one machine (TNCremoNT)

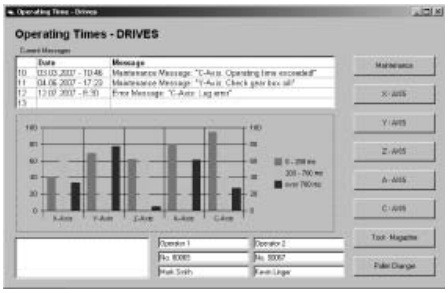
Requirements:
- Operating system Windows 98/NT/2000/ME/XP/Vista
- At least VGA
- At least 16 MB RAM
- At least 10 MB free memory on the hard disk
- Serial or Ethernet interface

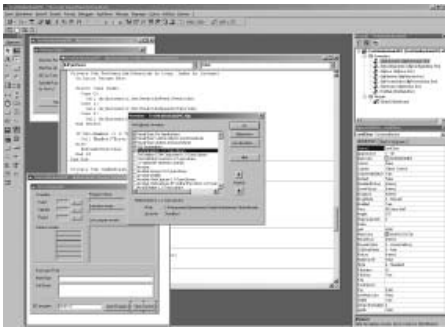
TNCremoPlus
(accessory)

In addition to the features you are already familiar with from TNCremoNT, 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

DNC Applications





The development environments on Windows operating systems are particularly well suited as a flexible platform for application development in order to come to grips with the increasingly complex requirements of the machine's environment. The flexibility of 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 in a very short time that can be of great use to your customers, for example:
- Error reporting systems that, for example, send the customer a text message 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 brochure *HEIDENHAIN DNC*.

Mounting Instructions

Installation

When installing the TNC 620, take note of the minimum spacing, space needed for servicing, and the appropriate length and location of the connecting cables.

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):
- TNC 620 (when properly installed)
- Machine operating panel (when properly installed)
- Handwheel

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 primarily in industrially-zoned areas.

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

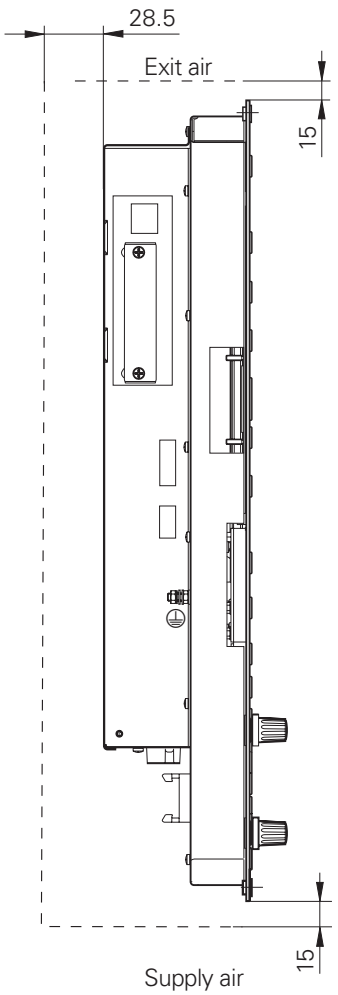
Likely sources of interference

Interference 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 TNC 620 and its leads to devices that carry interference signals.
- Keep a minimum distance of 10 cm from the TNC 620 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 potential compensating lines with a cross section of 6 mm^2
- Use only genuine HEIDENHAIN cables, connectors and couplings.

Leave space for air circulation and servicing!

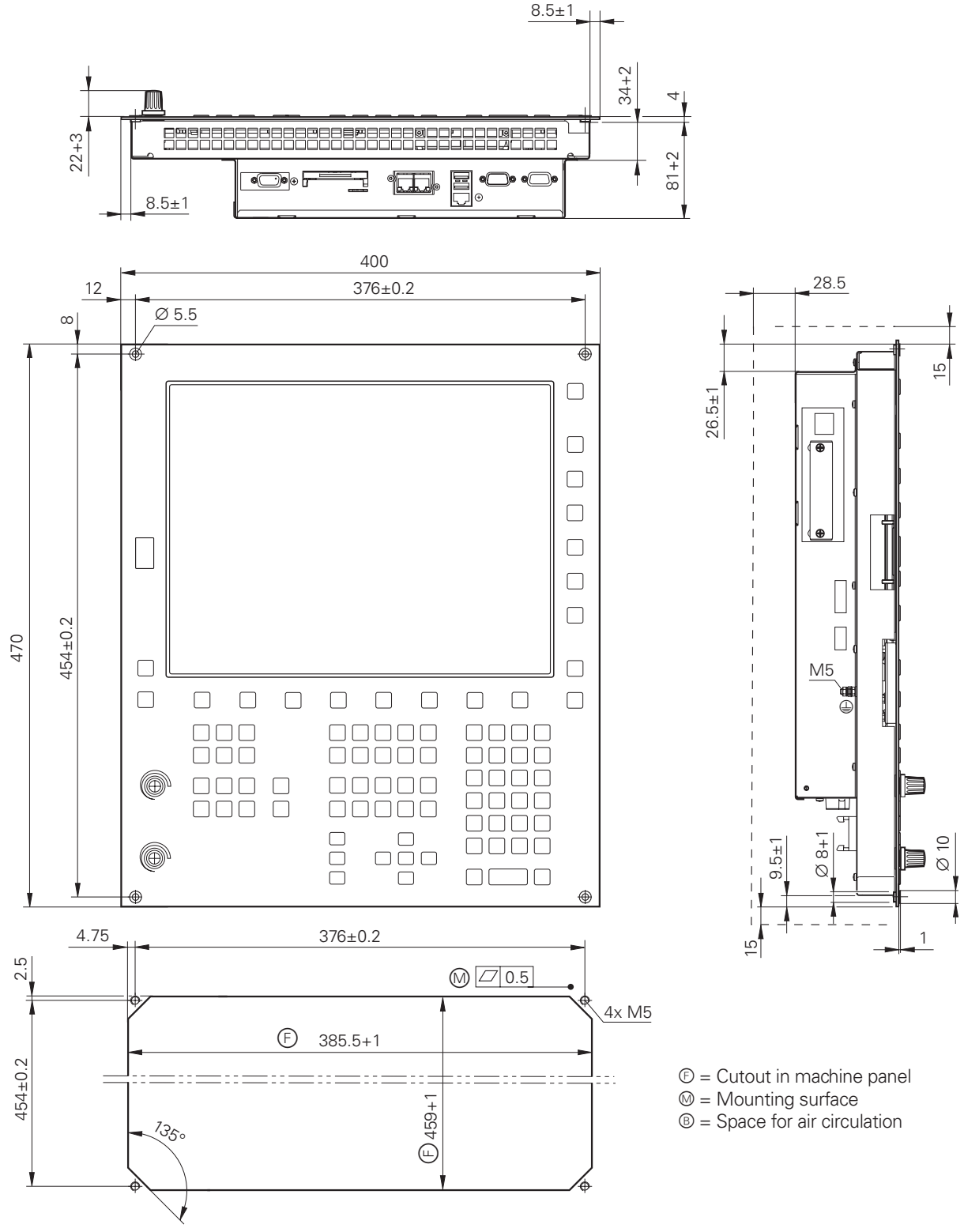


Overall Dimensions

TNC 620

Dimensions in mm

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

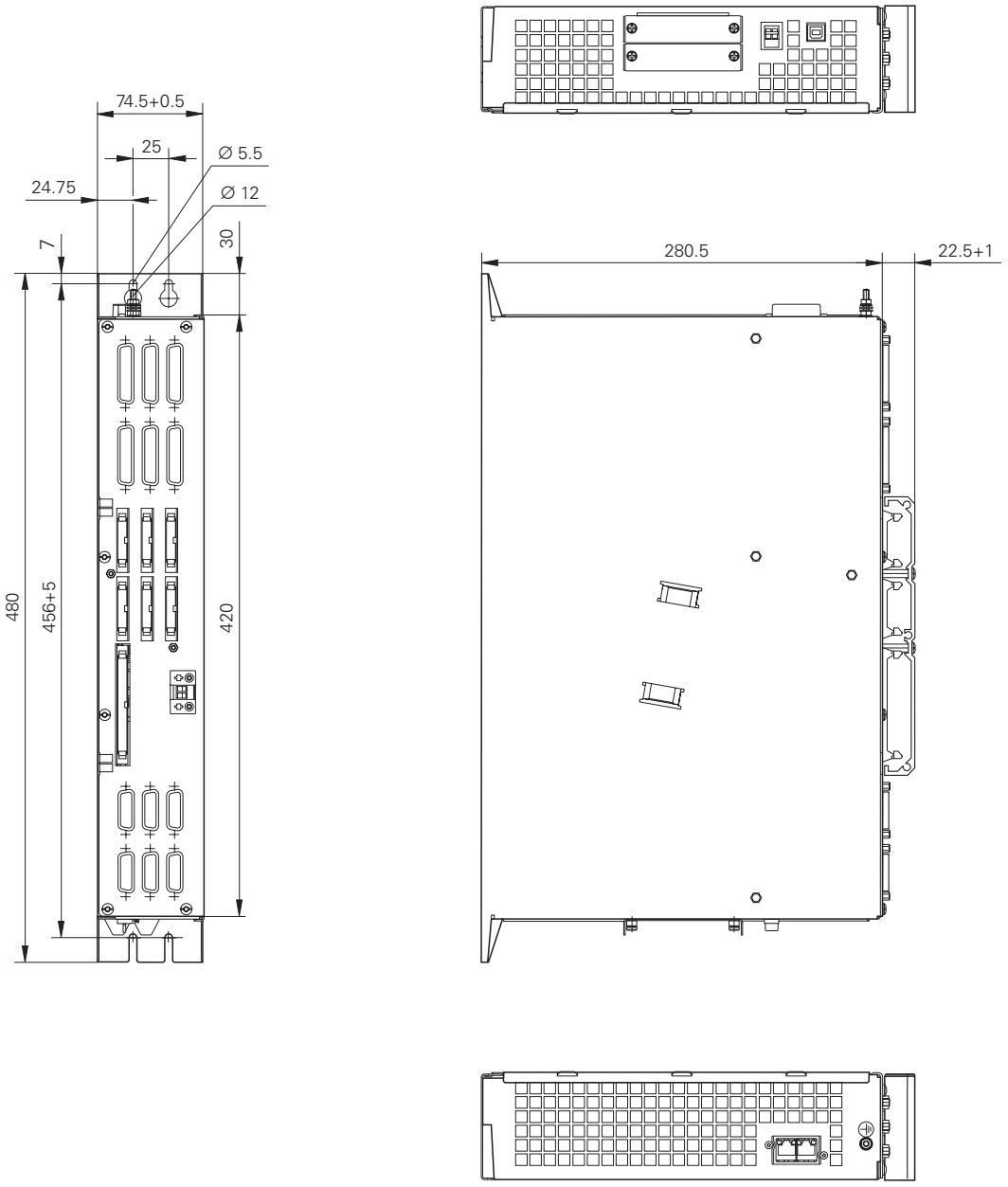


Ⓕ = Cutout in machine panel
Ⓜ = Mounting surface
Ⓑ = Space for air circulation

CC 6106

Dimensions in mm

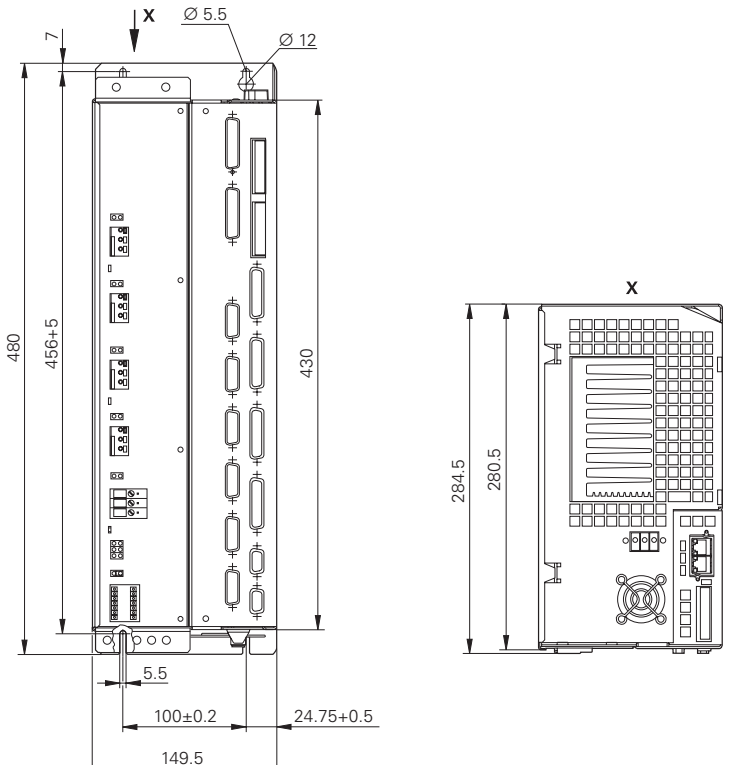
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



UEC 111, UEC 112

Dimensions in mm

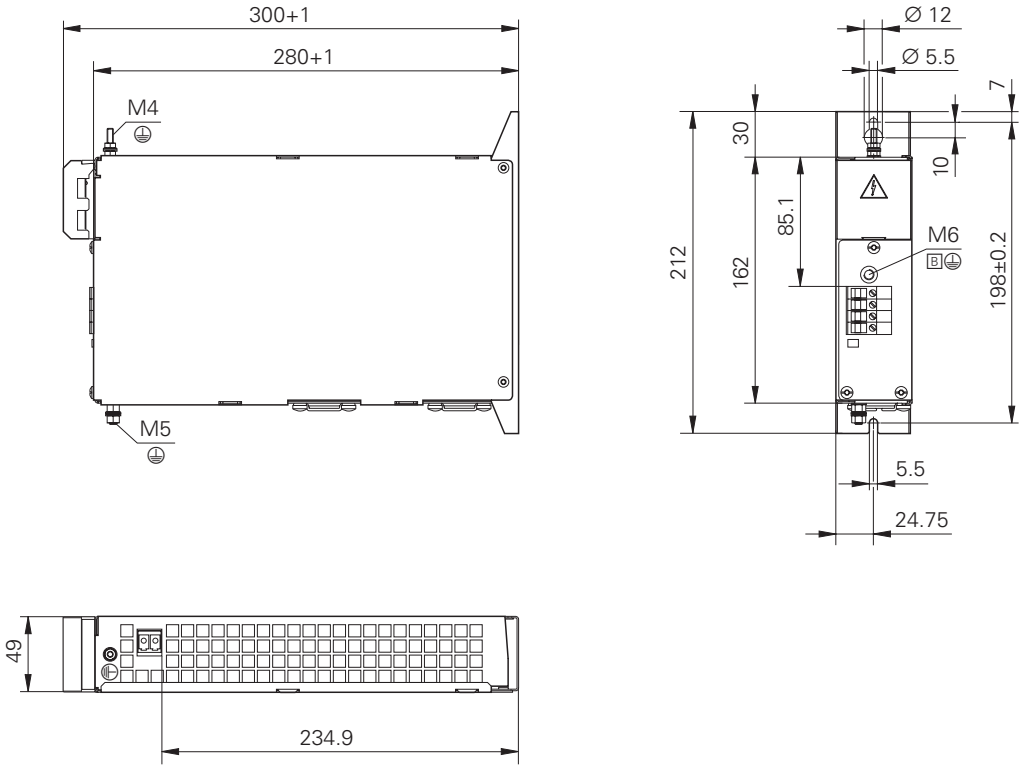
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



PSL 130

Dimensions in mm

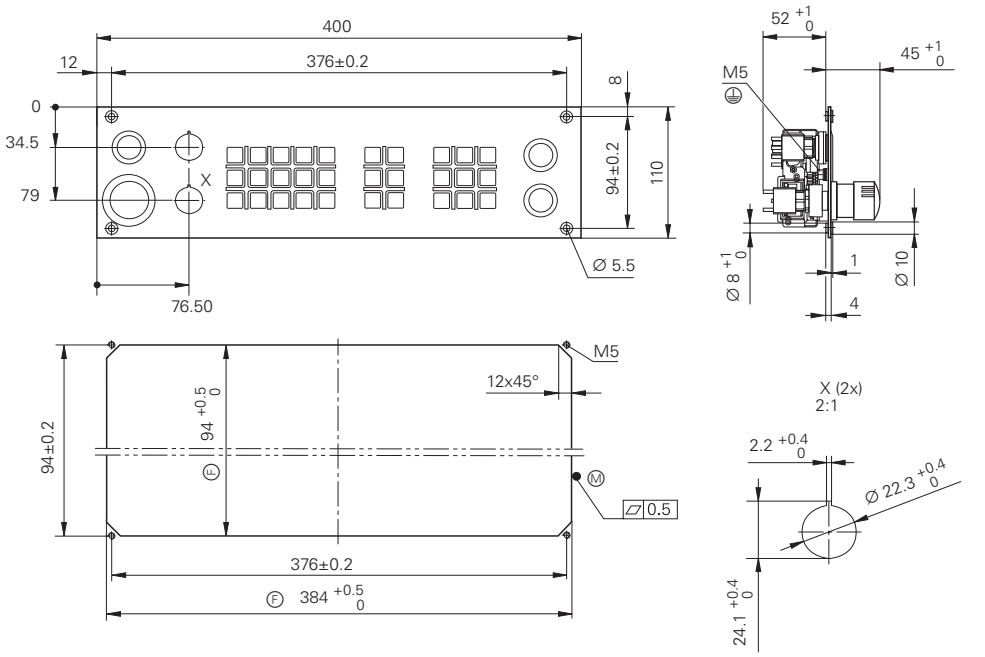
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



MB 620

Dimensions in mm

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

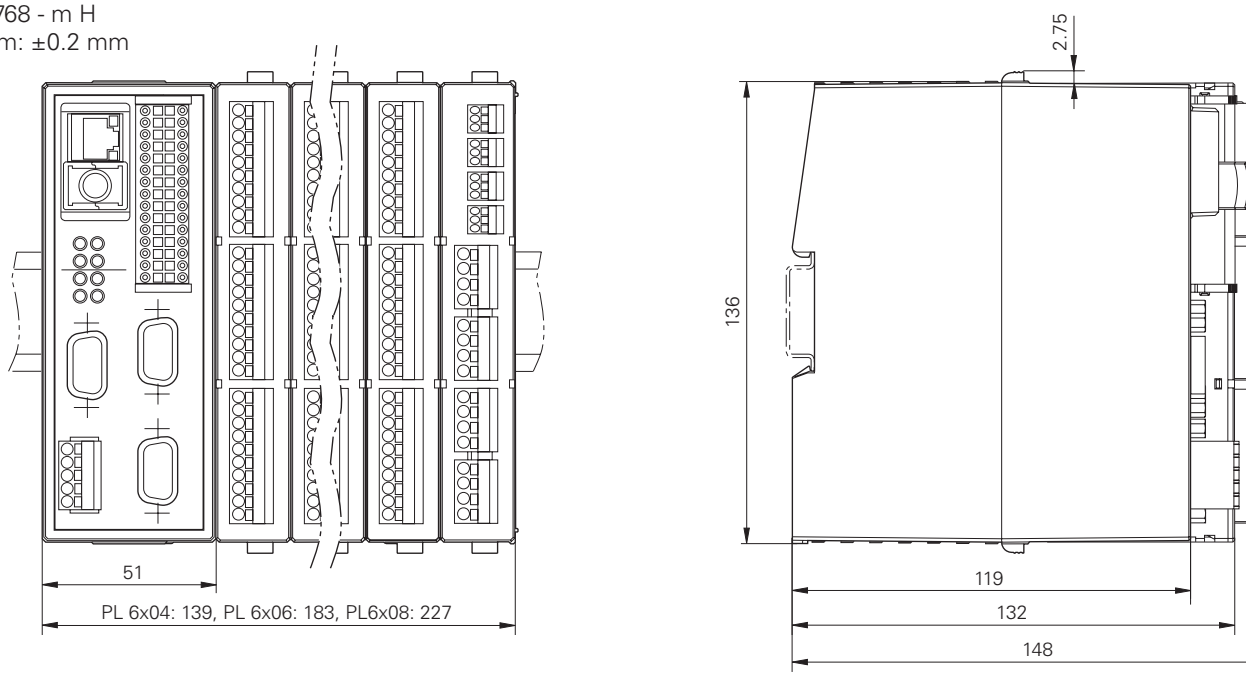


Ⓕ = Cutout in machine panel
Ⓜ = Mounting surface

PL 6xxx

Dimensions in mm

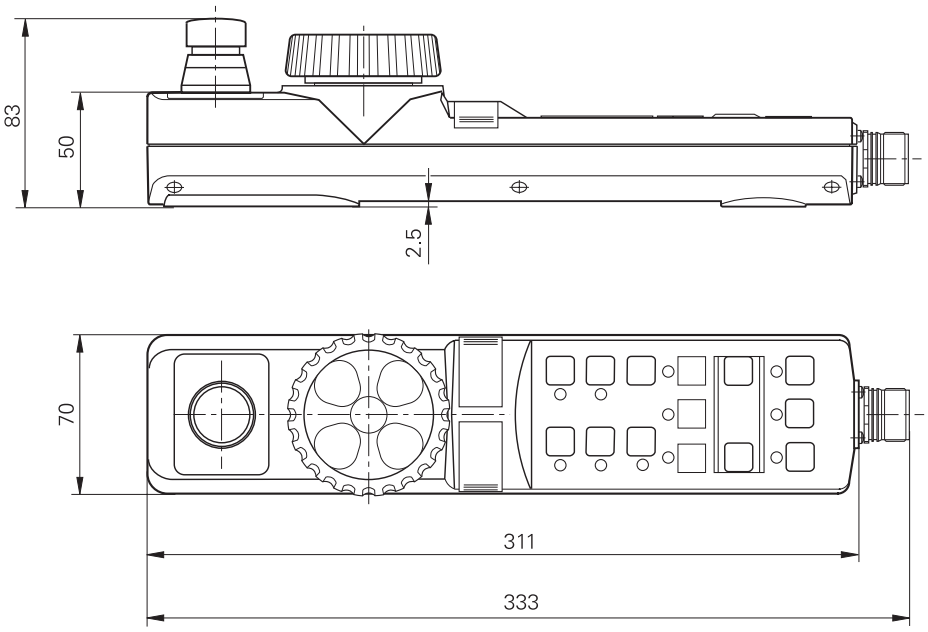
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



HR 410

Dimensions in mm

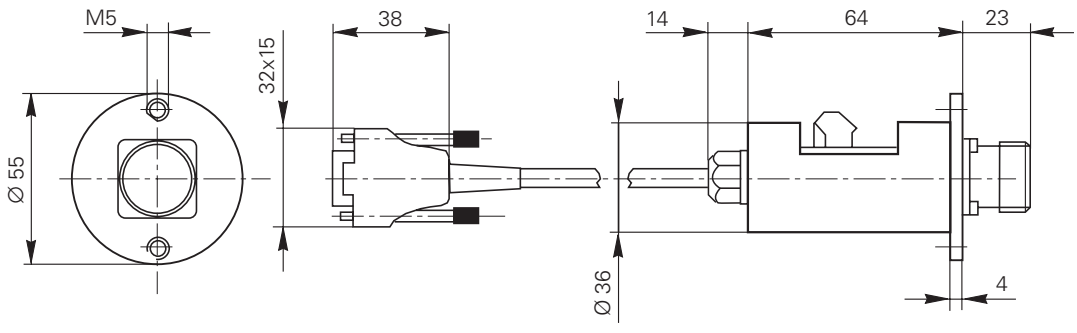
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



Adapter Cable for HR 410

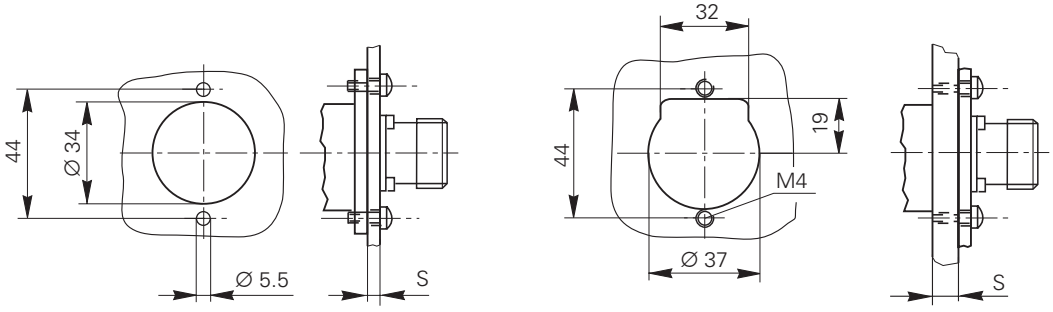
Dimensions in mm

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



Mounting opening for wall thickness S≤4

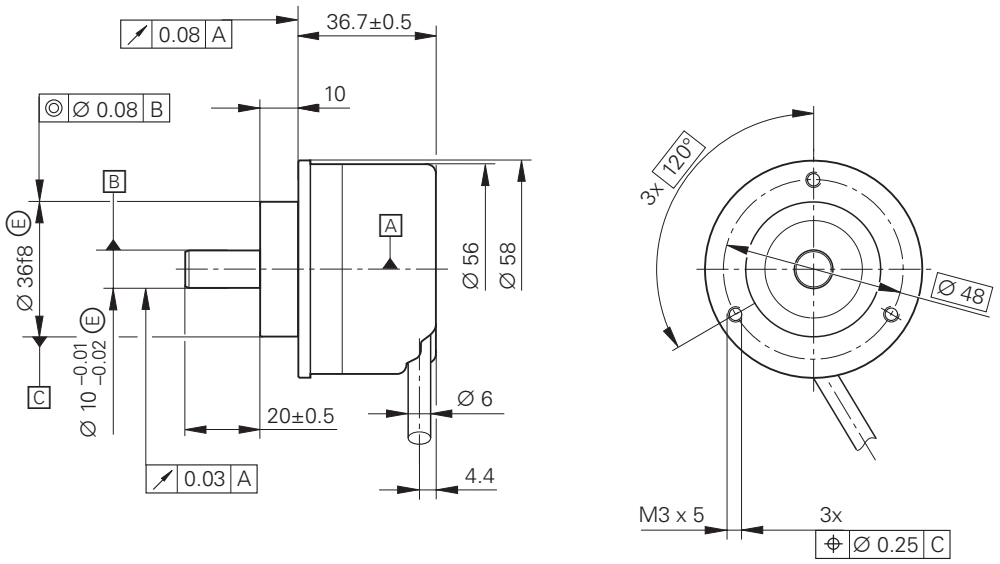
Mounting opening for wall thickness S>4

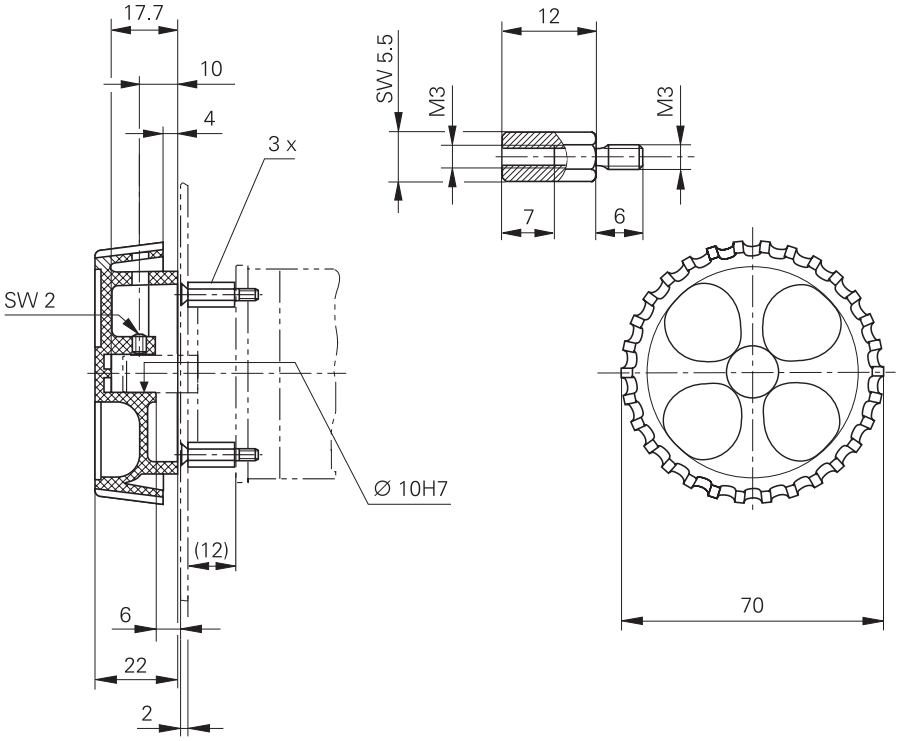


HR 130, HR 150 with Control Knob

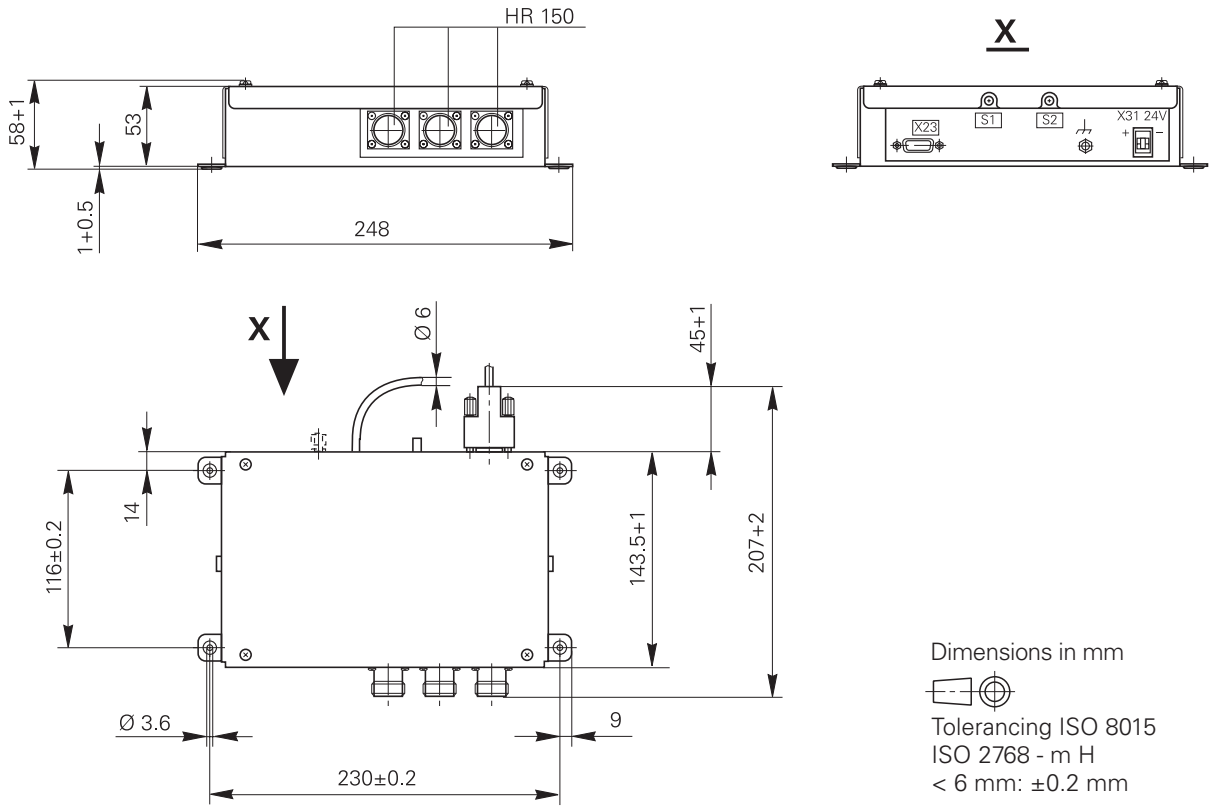
Dimensions in mm

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





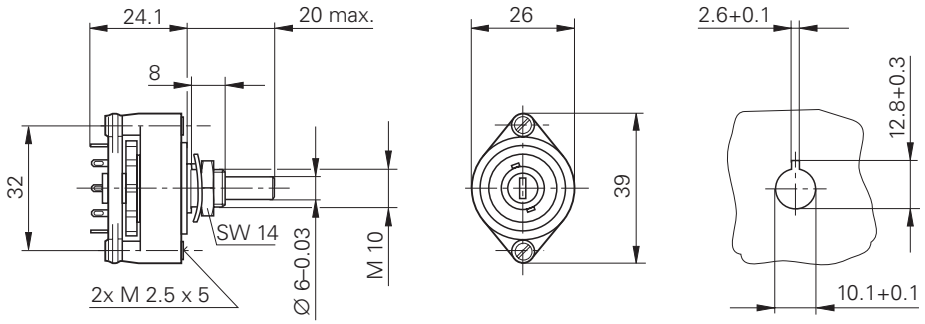
HRA 110



Selection Switch

Dimensions in mm

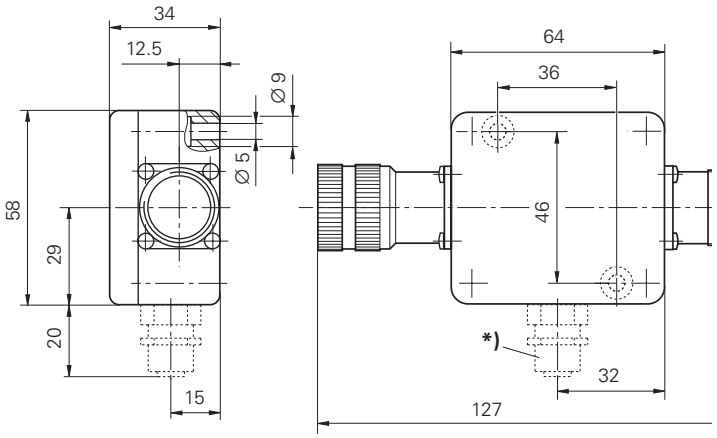
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



Line Drop Compensator for Encoders with EnDat Interface

Dimensions in mm

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

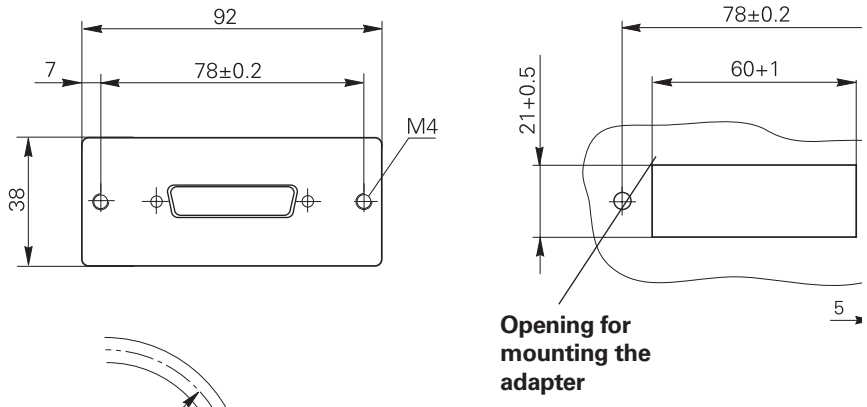


*) Connection to KTY

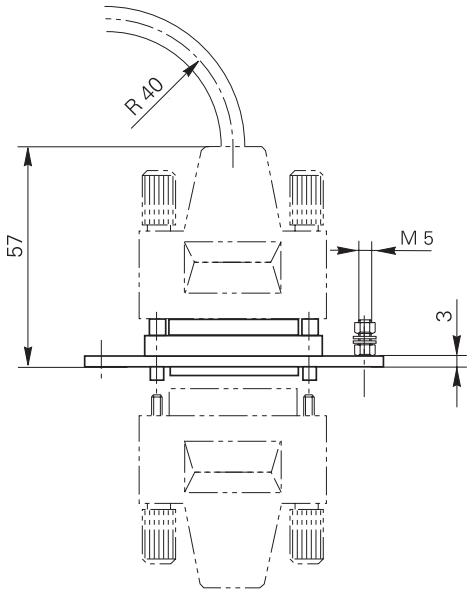
RS-232-C Adapter

Dimensions in mm

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



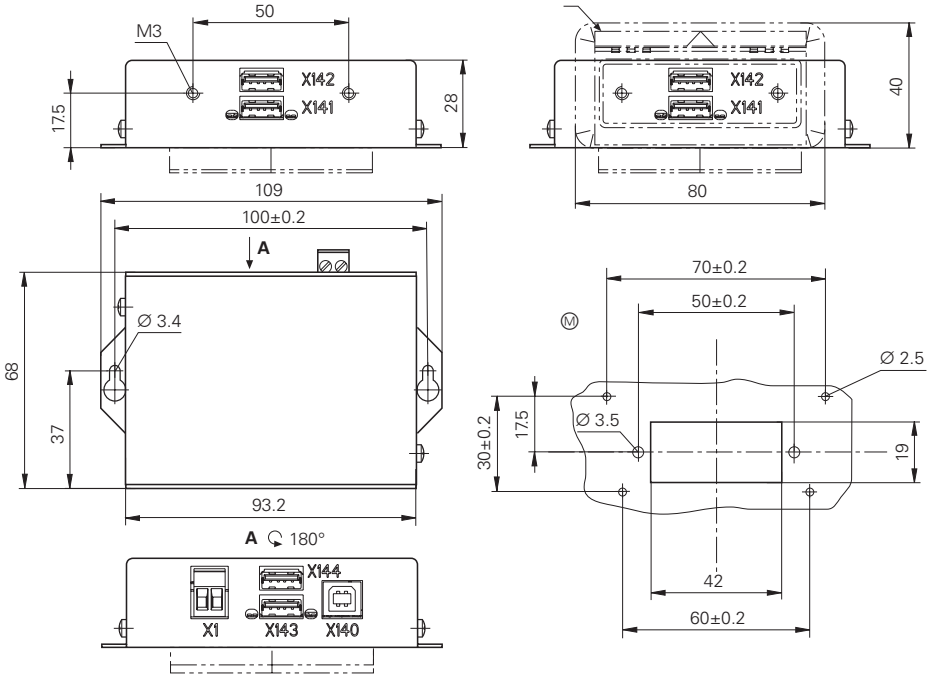
Opening for mounting the adapter



USB Hub

Dimensions in mm

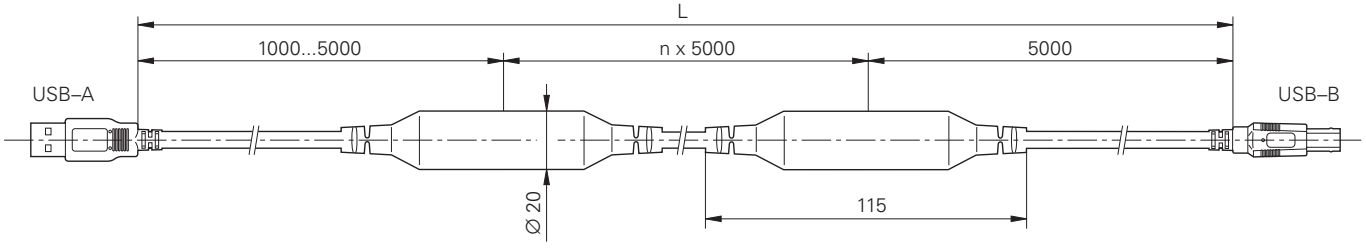
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



USB Extension Cable with Hubs

Dimensions in mm

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



n = 0 ... 4
L = Length selected when ordering

Documentation

Items supplied with the control include:
- 1 User's Manual for HEIDENHAIN conversational programming

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

Technical documentation	• Technical Manual for **TNC 620**	in preparation (pdf only)
	• Technical Manual for **Inverters and Motors**	ID 208962-xx
	• CD-ROM: **TNCguide OEM**	ID 208935-xx
User documentation	**TNC 620**	
	• **Conversational** User's Manual	ID 636026-xx
	• **Touch Probe Cycles** User's Manual	ID 636027-xx
	Miscellaneous	
	• User's Manual for **TNCremo**	as integrated help function and in PDF format
	• User's Manual for **TNCremoNT**	as integrated help function and in PDF format
	• User's Manual for **TNCremoPlus**	as integrated help function and in PDF format
	• User's Manual for **PLCdesign**	as integrated help function and in PDF format
	• User's Manual for **CycleDesign**	as integrated help function and in PDF format
	• User's Manual for **IOconfig**	as integrated help function and in PDF format
	• User's Manual for **KinematicsDesign**	as integrated help function and in PDF format
	• CD-ROM: **TNCguide**	ID 208934-xx
Other documentation	• Brochure for **TNC 620**	ID 636034-xx
	• Brochure for **Inverter Systems**	ID 622420-xx
	• Brochure for **Motors**	ID 208893-xx
	• Product Overview **Remote Diagnosis with TeleService**	ID 348236-xx
	• Brochure for **Touch Probes**	ID 208951-xx
	• CD-ROM: **Touch Probes**	ID 344353-xx

HEIDENHAIN Service

Technical support HEIDENHAIN offers the machine tool builder technical support to optimize the adaptation of the TNC to the machine, including at the machine's location.

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, e. g. 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:
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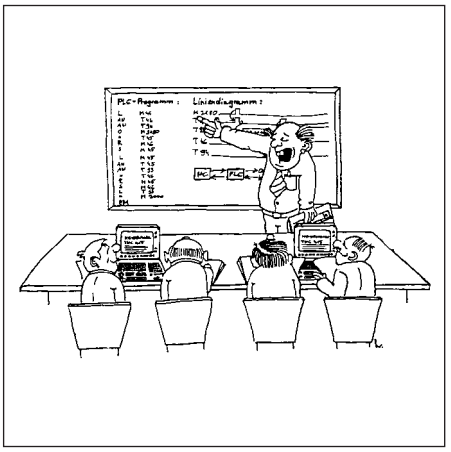
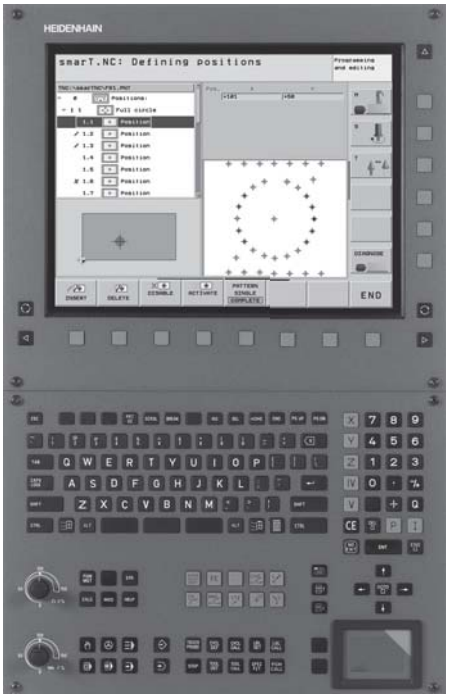


Other HEIDENHAIN Controls

iTNC 530 contouring control

Information:
brochure
iTNC 530

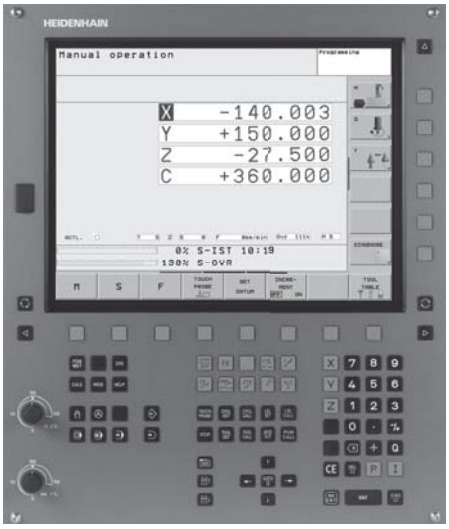
- Contouring control **for milling, drilling and boring machines, and machining centers**
- Max. 11 closed-loop **axes** and closed-loop spindle
- For **digital drive control** with HEIDENHAIN inverter systems
- Flat-panel color display (15-inch)
- Keyboard unit with alphanumeric keys
- Program memory on integrated hard disk
- Program input with smarT.NC in HEIDENHAIN conversational format or according to DIN/ISO
- DXF file import
- External programming on CAD/CAM systems or programming stations
- FK free contour programming
- **User aids:** Programming graphics, verification graphics, program-run graphics
- **Programming aids:** Milling, drilling and boring cycles, parametric programming, coordinate transformation, subprogramming
- Five-axis machining with TCPM and 3-D tool compensation
- Tilted working plane with PLANE function and machining with a rotary table
- HSC machining
- Collision monitoring (optional)
- Tool, datum, preset and pallet tables
- Connection of HR electronic handwheels, TS workpiece touch probes and TT tool touch probes
- Data interfaces: Ethernet (100BaseT), RS-232-C/V.24, RS-422/V.11, USB 1.1



TNC 320 contouring control

Information:
TNC 320
brochure

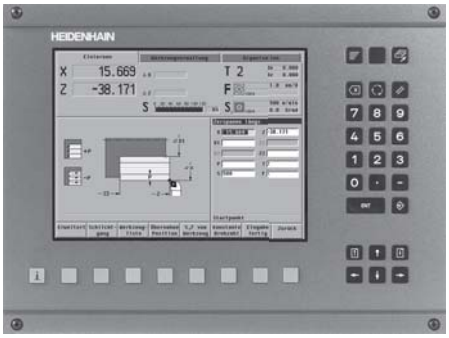
- Compact contouring control for **milling, drilling and boring machines**
- Three or optionally four closed-loop **axes** plus one closed-loop spindle
- **Analog speed command interface**
- Integrated keyboard and flat-panel color display (15-inch)
- Program memory: 10 MB on Compact Flash memory card (CFR)
- Program input in HEIDENHAIN conversational language, DIN/ISO programs entered via USB keyboard
- FK free contour programming
- Subprogramming and fixed cycles
- **User aids:** Programming graphics, verification graphics, program-run graphics
- **Programming aids:** Milling, drilling and boring cycles, parametric programming, coordinate transformation, subprogramming
- Machining with rotary or tilting tables (option)
- Tool and reference-point tables
- Connection for one HR electronic handwheel, one TS workpiece touch probe and one TT tool touch probe
- Interfaces: Ethernet (100BaseT), RS-232-C/V.24, USB 1.1



MANUALplus 4110 contouring control for lathes

Information:
MANUALplus 4110
brochure

- Simple CNC control for manually operated **lathes**
- 2 closed-loop axes plus closed-loop spindle
- Digital drive control
- 10.4-inch color screen
- Machining via handwheels or MANUALplus 4110 cycles
- Programming through sequential cycle input, program run in single-block or full-sequence mode
- Graphic simulation of machining, interactive graphically supported contour programming
- Insertion and execution of DIN programs
- NC program memory: Hard disk
- Interfaces: Ethernet (100BaseT), RS-232-C/V.24, RS-422/V.11



Subject Index

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