TNC 310

The Compact
Contouring Control
for Milling Machines

TNC 310
The Compact Contouring Control for All Milling Applications

The **TNC 310** is a compact contouring control for milling, drilling and boring machines with three or four controlled axes.

The TNC 310 is workshop oriented. A simple keystroke initiates the **HEIDENHAIN plain language dialog** and the control starts supporting you immediately, asking for all necessary information with straightforward prompts and questions. You can program any conventional milling, boring, or drilling task right at the machine. You can choose, for example, among several possible ways to program a circular arc:
- Circular path defined by radius, end point, and rotational direction
- Circular path defined by its end point, with a smooth (tangential) departure from the previous contour element
- Circular path defined by center point, end point, and rotational direction
- Corner rounding: circular path, defined by radius and corner point, with a smooth (tangential) connection with its adjoining contour elements

You enter the positional data in Cartesian coordinates, that is with X, Y and Z, or in the polar coordinates of radius and angle. You can enter absolute and incremental dimensions even in the same NC block.

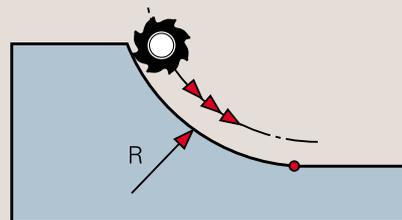Of course the TNC can also offset the tool dimensions.

For simple jobs such as face milling you can save yourself the effort of writing a part program:
It's also easy to traverse manually with the TNC.
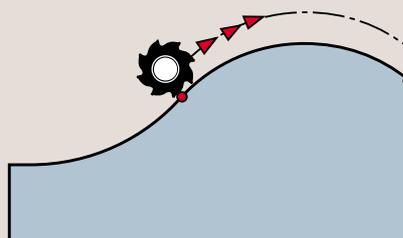

The machine tool operator does the programming

Two examples of programming circular paths

Circular path defined by radius, end point, and rotational direction.

Circular path defined by its end point, with a smooth (tangential) departure from the previous contour element.

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The Programming Graphics of the TNC 310
A two-dimensional programming graphic feature provides immediate program verification: the TNC draws each positioning movement on the display screen a soon as you've entered it, enabling you to avoid errors and increasing programming reliability.
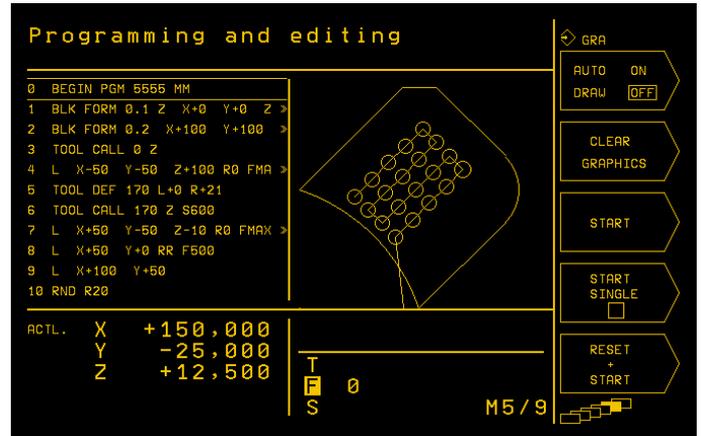

The Test Graphics of the TNC 310 help you verify a completed program. The TNC graphically simulates the results of machining with an end mill. You can already see how the TNC will mill the contour that you have programmed.

The programmed workpiece can be shown in one of three display modes:
• in a plan view
• in three planes (as in a workpiece drawing)
• in 3-D view.
Details can also be displayed in magnification.
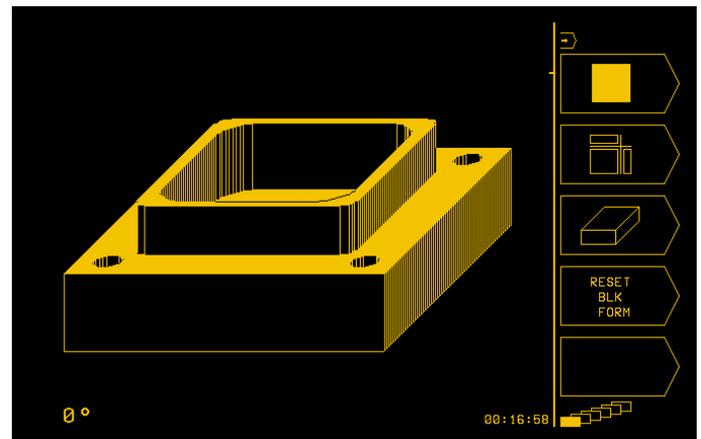
The practical fixed cycles of the TNC 310 speed programming significantly. You simply select the desired fixed cycle, and the TNC asks in plain language for all the necessary input. What's more, it graphically illustrates the type of information required for each input parameter.


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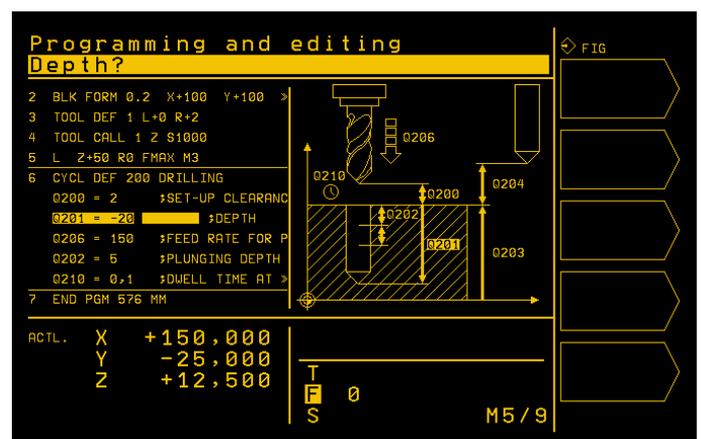
Operating Panel of the TNC 310

The TNC 310 is programmed with soft keys.

The Operating Panel of the TNC 310
The integrated monochrome flat-panel display clearly shows all relevant information for programming, operating, and checking the control and machine tool, such as program blocks, plain language prompts, and error messages. Graphic support during program entry and test run provides further information. During the course of machining, status displays continually offer helpful data, such as the tool position, the current program, and the active cycles and coordinate transformations.
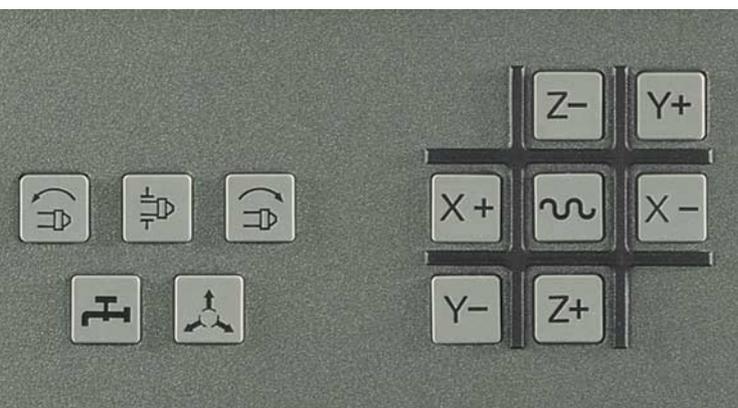
With the gray axis-direction keys you can position the machine axes in latched traverse or incremental jog.

The well-though-out configuration of keys simplifies programming and machining. Soft keys provide programming flexibility while you type in the target positions on the numeric keypad.

	Selecting the screen layout
MOD	Supplementary operating modes
HELP	Help function

Programming

	Programming and editing
CE	Clear entry or error message
ENT	Store entry
END	End of block
	Page through soft-key rows
DEL	Delete NC block
	Soft key
↑ ↓	Select programs and NC blocks
→	Select words in NC blocks

Machine Operating Modes

	Manual Operating Mode. Can be switched by soft key to Electronic Handwheel or Incremental Jog.
	Positioning with Manual Data Input
	Program Run Single Block. Can be switched by soft key to Program Run Full Sequence, or Test Run.
NC I NC 0	NC start and stop
	Spindle ON and OFF
* *	Spindle rotation left and right
*	Spindle brake
*	Coolant
*	Tool change
X- * ...	Direction keys for machine axes
*	Rapid traverse

* Standard layout: Exchangeable key symbols help the machine tool builder to best adapt the TNC 310 operating panel to the requirements of the machine series. Contact HEIDENHAIN for more information.

Operating panel of the TNC 310

Fixed Cycles

Standard milling and drilling cycles
The TNC speeds programming by providing fixed machining cycles for standard milling and drilling jobs. You simply select the desired fixed cycle and the TNC asks in plain language for all the necessary input. What's more, it graphically depicts the type of information required for each input parameter.

You can drill with a defined decrement for pecking. For reaming you can retract at a defined feed rate, and when boring you can have the tool disengage in the working plane. All the drilling cycles include a second setup clearance to stay free of fixtures. For milling tasks, the TNC provides cycles for slot milling with reciprocating plunge, for rectangular and circular pockets and islands, and for multipass milling of plane, inclined, and twisted surfaces.

Other new cycles in the TNC permit programming of drilling and milling patterns defined by Cartesian or polar coordinates.

The TNC presents help graphics illustrating the information needed in input parameters

# Coordinate Transformations Program Section Repetitions and Subprograms

Coordinate transformations

To program detail patterns that repeat themselves on a workpiece you can **shift** the **coordinate system** in incremental or absolute terms, or **rotate** it around the datum. Milling and drilling patterns can be **mirrored** in both axes of the working plane. With the **scaling factor** cycle the TNC enlarges or reduces the programmed contour to compensate shrinkage or provide an oversize in all axes.

Program section repeats and subprograms

Often enough, machining patterns repeat themselves on the same, or on different workpieces. There's no reason to program a particular pattern more than once: the TNC saves you a great deal of programming time with its subprogramming capability.

With **program section repetition** you can label a section of the part program and repeat it any desired number of times in succession before the program continues. A work sequence that is required in various places in a program can be labeled as a **subprogram** to be called wherever and as often as desired.
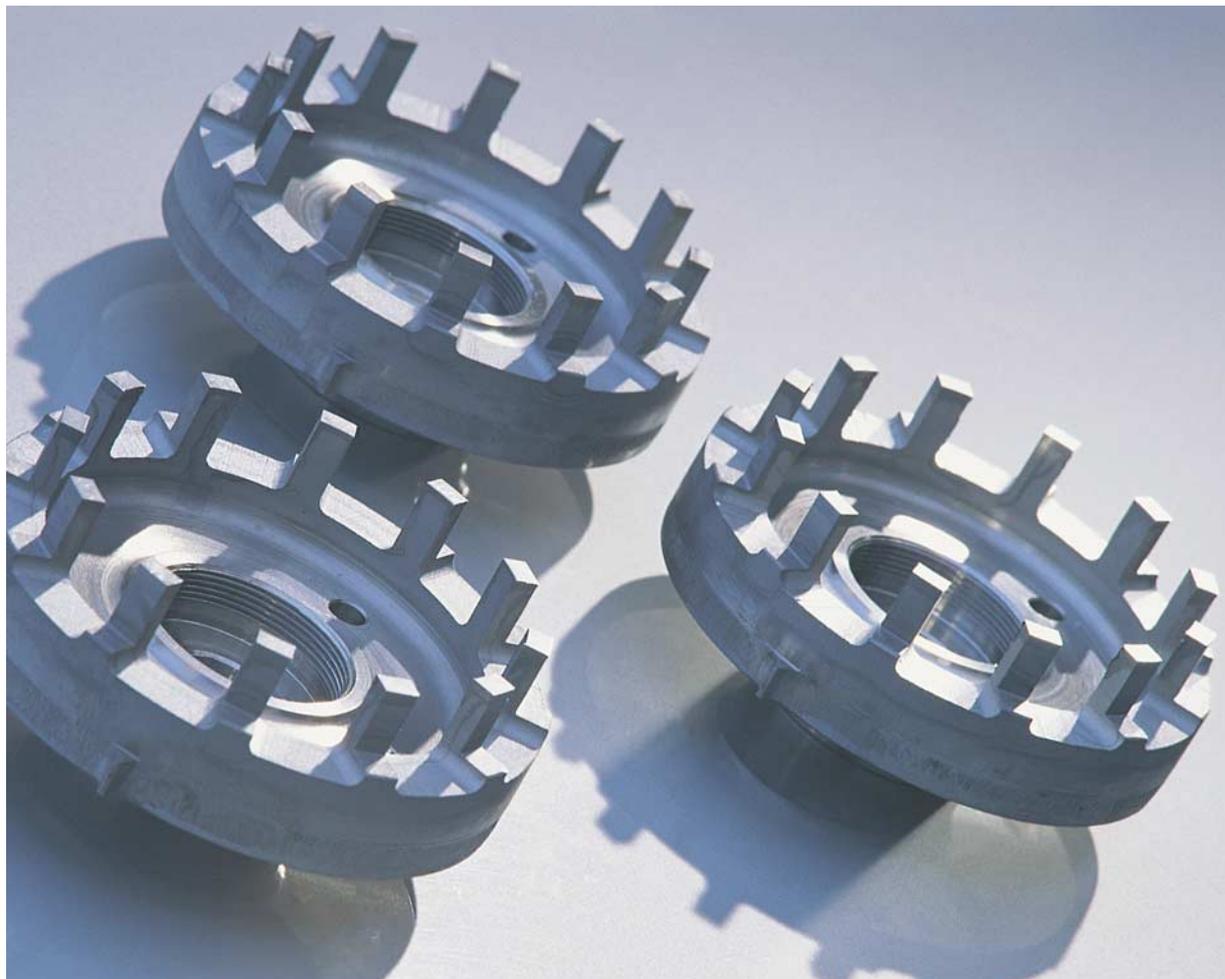
Manual Operation

**HR 410
Portable Handwheel**

Ultra-Sensitive Manual Positioning with the Electronic Handwheel

TNC-controlled machine tools can be operated manually through the axis keys. A simpler and more precise way, however, is to use a HEIDENHAIN electronic handwheel.

Your machine drive moves the slide in direct relation to the rotation of the handwheel. You can reduce the transmission ratio for delicate setup operations stepwise in a range of 20 mm to 0.02 mm (0.8 to 0.0008 in.) per handwheel revolution.

HR 410 Portable Handwheel
On the HR 410 electronic handwheel the axis keys are integrated in the hand-wheel housing: you can change and move the axes at any time — regardless of where you happen to be standing. The HR 410 also has keys for traverse direction, for three preset feed rates for latched traverse, an actual-position-capture key, three keys for machine functions to be defined by the machine tool builder, enable buttons, and an emergency-stop button. If you don't constantly need the handwheel, or if you are finished with it, you can conveniently set it aside anywhere on the machine thanks to its magnetic holding pads.

HR 130 and HR 150 Panel-Mounted Handwheels
HEIDENHAIN also offers electronic handwheels for integration in the machine operating panel or in another location on the machine. The HR 130 can be connected to the TNC directly. An adapter permits connection of up to three HR 150 electronic handwheels, enabling the simultaneous control of all connected axes.

Workpiece Setup and Datum Setting with the 3-D Touch Probe

With the 3-D touch probe* from HEIDENHAIN and the probing cycles of the TNC, workpiece setup and datum setting are fast, easy, and accurate.

No more manual workpiece alignment
3-D touch probes eliminate tedious manual workpiece alignment during setup. During electronic alignment the TNC measures the angular attitude of the workpiece and compensates it through a basic rotation of the part program. No additional manual alignment is needed. With the probe functions you can also define corners, circle centers and workpiece surfaces as datums or datum surfaces.

Manual measurement
3-D touch probes and the TNC help you to perform manual measuring and inspecting functions. Such functions include:
• checking the dimensional accuracy of holes
• determining infeeds for finishing
• checking the depth of pockets or slots.

* The touch probe must be interfaced to the TNC by the machine tool builder.

TS 220

Positioning with Manual Data Input

For simple jobs such as face milling and drilling tasks, you can enter the positioning steps step-by-step in the TNC and run them immediately — without changing operating modes.

Actual Position Capture

Use the axis direction keys or the handwheel to move the tool to prominent workpiece positions, boreholes for example, saving each position by simply pressing a key. The coordinates of such positions are entered for use as required in the part program.

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TNC 310
Specifications

	TNC 310

Standard features	• Compact contouring control with integrated flat-panel display and machine operating keys
	• All position inputs for 15-pin D-sub connector; primarily for connection of encoders with sinusoidal voltage signals ($\sim$ 1 V_{PP})
	• 4 controlled axes and spindle S
	  or
	  3 controlled axes and controlled spindle S
	• In addition 2 non-controlled axes can be connected via HRA 110 handwheel adapter

Interface to drives	5 analog outputs ±10 V
Spindle control	Absolute via PLC outputs or via one ±10 V analog output
Display	Integrated monochrome flat-panel display 192 mm x 120 mm (640 x 400 pixels)
Program memory	128 KB (64 programs with a total of approx. 6,000 HEIDENHAIN NC blocks)
Input resolution and display step	Up to 1 µm for linear axes Up to 0.001° for angular axes

Interpolation
  Straight lines
  Circular arcs
  Helical
	
	In 3 axes
	In 2 axes
	Combination of circular and linear motion

Block processing time[1]	From the program memory: 40 ms[2] With blockwise transfer mode: 100 ms[2]
Data interface	RS-232-C/V.24 max. 57,6 KB Data protocols: RTS/CTS, X-On/X-Off, blockwise transfer for running longer programs

Axis control
  Position loop resolution
  Cycle time
	
	1 µm or 0.001°
	Path interpolation: 6 ms

Error compensation	Linear and nonlinear axis error, backlash, reversal spikes during circular movements

Integrated PLC
  PLC memory
  PLC cycle time
  PLC inputs 24 Vdc
  PLC outputs 24 Vdc
	
	Approx. 1700 PLC commands
	24 ms
	23 freely assignable inputs and 1 control-is-ready input
	23 freely assignable outputs and 1 control-is-ready output

Commissioning aids	PLC trace function and oscilloscope via PC
Power supply	24 Vdc
Power consumption	22 W approx.
Operating temperature **Storage temperature**	0° C to 45° C (32° F to 113° F) –30° C to 70° C (–22° F to 158° F)
Weight	6.5 kg approx.

1) 3-D straight line without radius compensation
2) At 100% PLC utilization (approx. 1700 logic commands)

User Functions	TNC 310
Program input	HEIDENHAIN plain language
Position data	Nominal positions for straight lines and circular arcs in Cartesian or polar coordinates, absolute or incremental dimensions, display and input in millimeters or inches
Contour approach and departure	• Via straight line: tangential or perpendicular • Via circular arc
Tool compensation	Tool radius in the working plane and tool length
Tool table	One tool table for 254 tools
Subprogramming	Program section repeats, subprograms
Parallel operation	Creating programs while another program is being run
Fixed cycles	Peck drilling, tapping with/without floating tap holder, reaming, boring, hole patterns; slot milling, rectangular and circular pocket milling, stud finishing, multipass milling of plane surfaces
Coordinate transformation	Datum shift, rotation, mirror image, scaling factor
Datum table	Multiple datum tables
Programming aids	• HELP functions during programming • Graphic support during programming of cycles
Actual position capture	Actual positions can be transferred directly into the NC program
Test graphics Display modes	Graphic simulation before a program run • Plan view • View in three planes • Solid-model 3-D view • Magnification of details
Programming graphics	In the Programming and Editing mode of operation, the contour of the NC blocks is drawn on-screen while they are being entered (2-D pencil-trace graphics)
Processing time	• Calculating the machining time in the "Test Run" mode • Display of the current machining time in the program run modes
Returning to the contour	• Mid-program startup at any block in the program and approaching the calculated nominal position to continue machining • Interrupt program, depart contour and reapproach
Positip operation	Positioning non-controlled axes manually with distance-to-go display

Accessories	TNC 310
Electronic handwheels	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
3-D Touch Probe	**TS 220** 3-D touch trigger probe with cable connection
PC Software	**TNCremo:** Storage of part programs externally on a personal computer **PLCdesign:** PLC programming software for the machine tool builder **CycleDesign:** Software for creating cycles on the TNC

Dimensions

DIN ISO 8015
ISO 2768 - m H

370
14.57"

354±0.2
13.937±.008"

8
.315"

∅ 5.5
DIA .216"

310
12.21"

294±0.2
11.575"±.008"

8
.315"

354±0.2
13.937±.008"

6−0.5
.236−.02"

Ⓕ 342+1
13.46+.04"

6−0.5
.236−.02"

294±0.2
11.575"±.008"

Ⓕ 282+1
11.1+.04"

Ⓕ = Front panel
cutout

M 5

⊿	0.5
⊿	.02"

(170)
(6.69")

130
5.12"

32
1.26"

R60
R2.36"
R40
R1.58"

Ø 8
DIA .32"

Ø 10
DIA .4"

Ø 9+1
DIA .35" +.04"

2
.08"

3
.12"

Ø 10
DIA .4"