

NCT[®]

CONTROL | DRIVES | MOTORS
KEEP MOVING

NCT 304

SMART CNC FAMILY

NCT 304

NCT 304

In the NCT 304 control, behind the monitor there is a 4-core computer performing CNC and user interface (HMI) tasks. On three cores, the NCT user interface (HMI) installed on well-known WINDOWS operating system and wide range of applications run, while the NCT CNC system (CNC kernel) runs on one core.

Application of the WINDOWS operating system enables the NCT programming software, namely the VECTOR, the myNCT and the solid body graphical representation, to be integrated into the NCT 304. The system has been built up and made open in such a manner that either the NCT company or the machine tool builder himself can replace or develop further the user interface in accordance with his own demands or the given application. This development opened a totally new market for the NCT. Through it, we became able to design for machine tool builders a custom-tailored, own and special user interfaces. Thus, we can reach those OEM partners demanding CNC user and programmer interfaces of their own design.

New capabilities facilitating operation and data input

Touchscreen

The biggest advantage of the capacitive touchscreen is that it enables a highly user-friendly interface (HMI) to be created. Data input can also be carried out by using a virtual keyboard 'painted' on the touchscreen. Since we are talking about a virtual keyboard, it is not a problem to adjust to different languages. The size of the buttons and their location at the periphery of the screen provides a convenient data input.

PC keyboard

In the case, when user prefers the PC keyboard, any type of it can be connected to a USB port available on every NCT 304 control as standard accessory, and the keyboard can be placed at a convenient and ergonomic position on the support that can be mounted under the machine keyboard at the lower part of the desk offered by the NCT. Plug & Play!

Manual data input

Features provided by the manual mode of the control play a significant role in user-friendly operation of the CNC machine tools. The NCT 304 performs prominently in this field too. The control stores the commands issued and lists them in the screen. Having selected any row of the list, the command series can be reissued any time, by the cycle start.



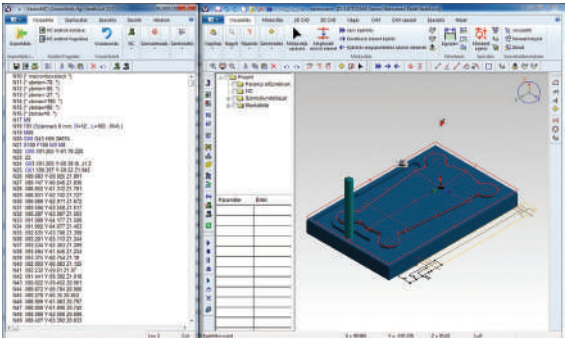
New services supporting programming and program testing

VECTORCAM

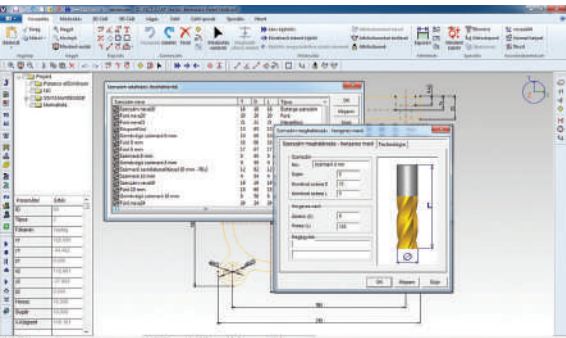
In case of unit or short-run production, not the time of program execution but the time of program writing has to be reduced. The highly user-friendly VECTORCAM application (APP) integrated into the NCT 304 control serves this purpose. It is not CAD/CAM, but it is a real INDUSTRIAL SOFTWARE created for machine tool operators and programmers! Knowledge of high-level computing techniques is not required to use this software! With a machine tool, it can be used effectively from the simplest outline drawing to the 3D simulation.



Simple and fast CNC programming without knowing G codes. Making some motions, the contour of machining can be drawn; the tooling, the technology offered to it automatically and the machining strategy can be selected, and then the 3D simulation of the machining can already be started. At the end of the process, the solid body model of the finished workpiece will be displayed, which can be reduced, enlarged and rotated. When the virtual workpiece is accepted, the machining can be started.



Simultaneously with representing the solid body, the finished technological program can already be seen on the left side of the screen.



Tooling can be selected from the tool directory. Loading tools and technological parameters is an automatic simultaneous process. The data base size can be increased by the user freely.

Turning

- Roughing strategies
- Finishing methods
- Threading
- Drilling, boring
- C-axis machining
- Tool directory
- Technology selection
- Deburring, chamfering
- Profiling

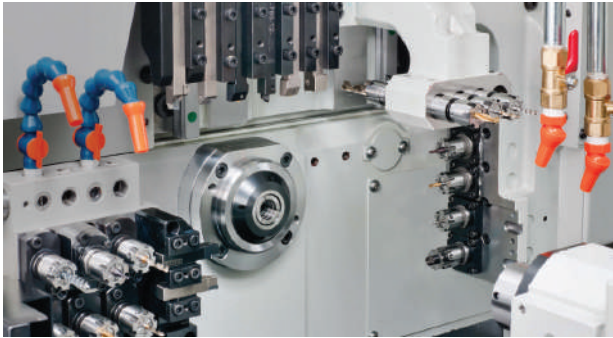
Milling

- Drilling on point pattern
- Contour milling
- Face milling
- Milling pocket with bosses
- Engraving onto surface of any kind
- Remnant removal
- Milling outer/inner tread
- Helical hole milling
- Wide variety of contour approach and depart
- Deburring, chamfering
- Profiling
- Tool directory

Multi-channel and 5-axis machining, measurement within the working space

Multi-channel

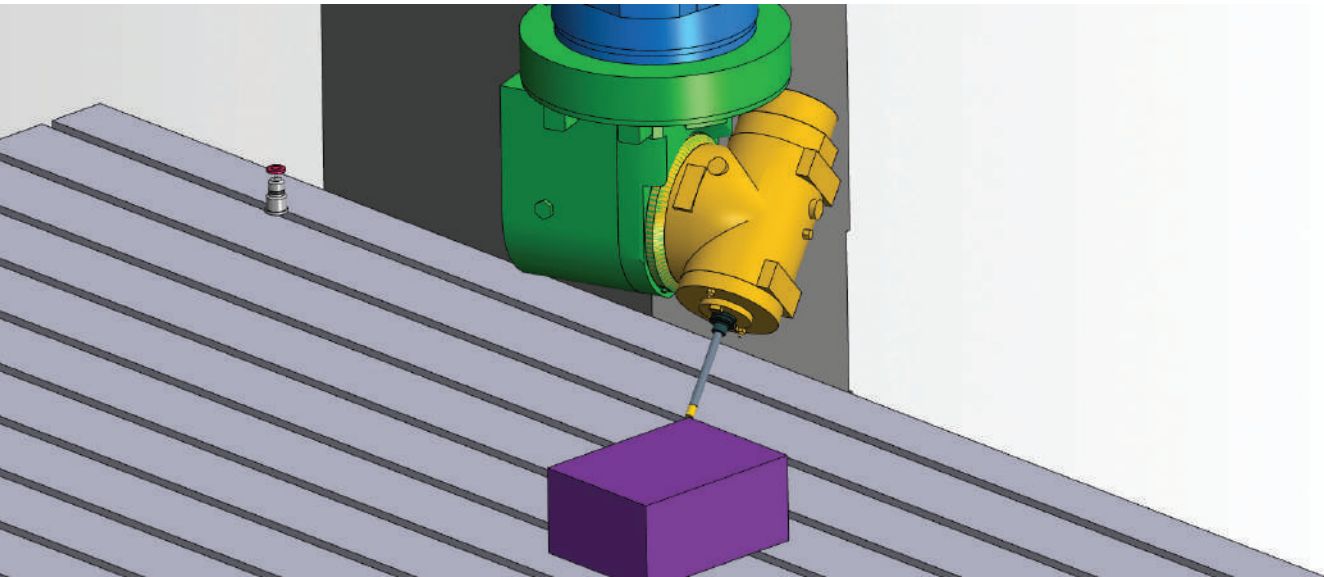
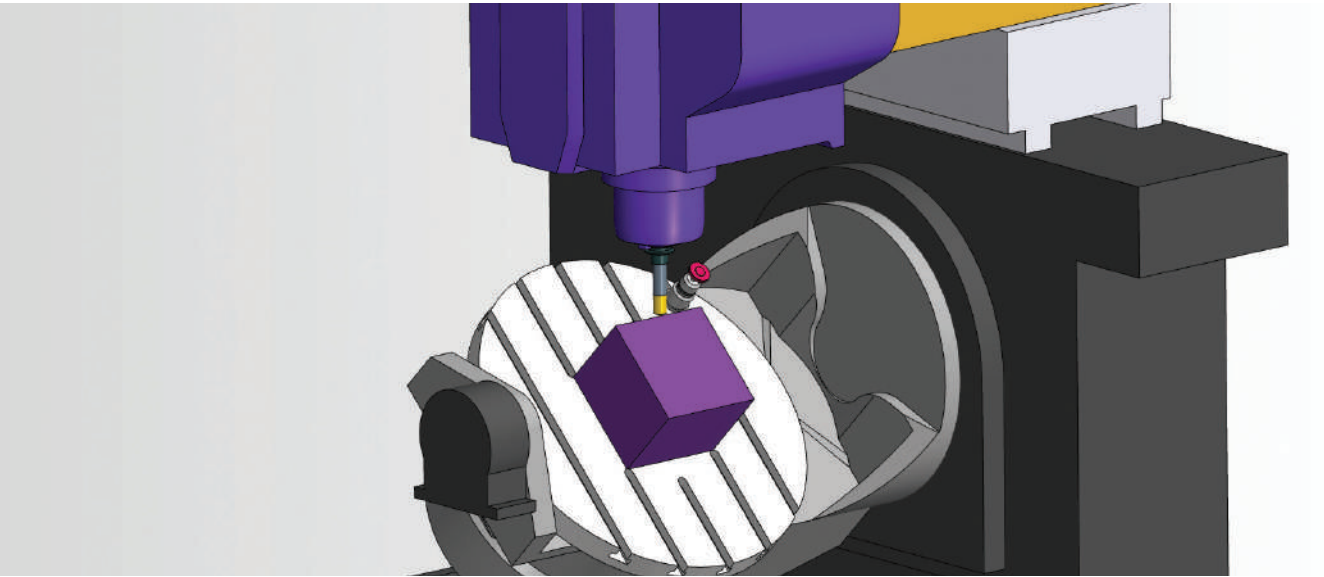
The NCT 304 is a multi-channel control. Actually, it means several logical CNC controls in one physical unit. Each channel is an independent CNC control executing its own technological program while synchronizing with the other channels continuously.



3+2D, 5D, TCP, TPC, CPC

With our 5D capabilities, we became able to control the most complex types of machining centres. The opportunity presented itself to provide our controls for machines used in wood industry, stone machining, medical technology, laser cutting and for the most expensive machines of metal industry. In the world market, only a few CNC manufacturers are able to offer this service!

TCP is the first step of the 5D machining. In such a case, the linear and the rotating axes move together so that the well-defined point of the tool travels along the programmed contour at a feed rate specified in the program. The next level of the 5D machining is TPC, when the shank of the tool is guided along the programmed path; and CPC, when not a well-defined point of the tool, but its cutting point varying continuously is guided along the programmed path.



15-19" CAPACITIVE TOUCHSCREEN

BROAD OPTIONS TO USE

 Windows 10

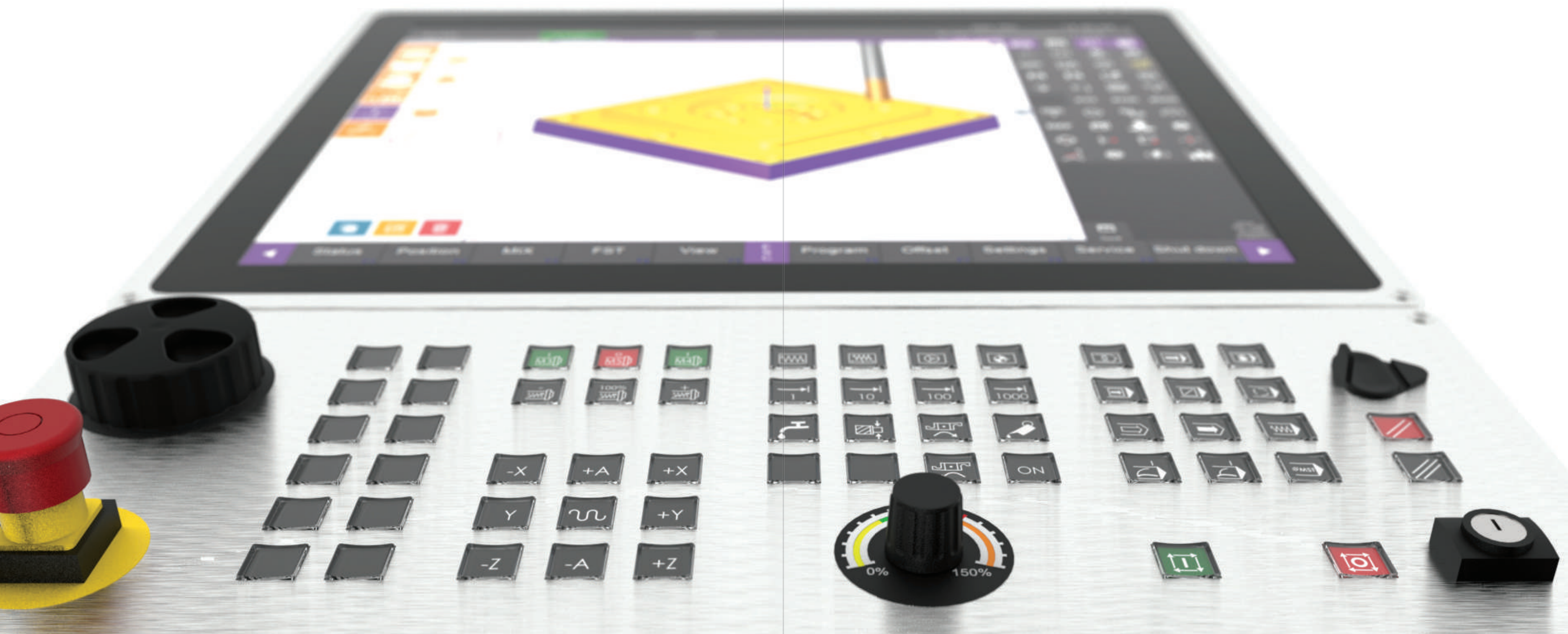
 HEIDENHAIN

vectorcam

Ether**CAT**

EnDat 2.2

INtime



Remote diagnostics, machine monitoring and energy management



Remote diagnostics

Our remote diagnostics service will provide simple, fast and economic error detection and troubleshooting if the user allows us to connect to the NCT control via Internet. Through remote diagnostics, the NCT expert being at home has almost as many capabilities for operating the control as many capabilities he had standing next to the machine.

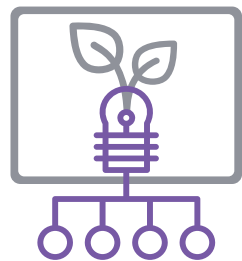
There is no call-out fee, and what is the most important, the expensive waiting time can be avoided! The use of the remote diagnostics service extends warranty time and this service is absolutely free during warranty.



Machine monitoring

The NCT control records every operator's action, PLC and CNC event in a so-called log file. From the log data of a selected interval, the most important operation modes of the machine tool (MACHINING, SETTING, STANDSTILL, ERROR STATE) are filtered and plotted graphically against time. From the diagrams, degree of the utilization of the machine can be read out, and retroactively (even for many months) the times and reasons for standstill of the machine will be displayed. The log file data are very helpful to find the reason of machine tool failure.

For precise and fast service or for preparation for repair, please forward log file data to the NCT centre!



Energy management

The increasing price of energy and environmental consciousness demand a very strict energy management from all of us.

The NCT control constantly monitors the electric network of the machine tool, the sequence of phases; it monitors and logs the consumption and the network errors, to which the machine tool builder can react through PLC (for example, in the case of power failure he can stop the machine in time or he can limit number of electric equipment in case of energy consumption peak). Consumption during a selected period within the logged interval (even in case of one work-piece) can be displayed in a table or graphically and even in the currency unit set.

In serial production, the price of electric energy can be managed in an economical way. More dynamic machining or lower energy price – the opportunities that can be chosen.

High-speed and high-precision path tracking

High-Speed and High-Precision (HSHP) path tracking

The five basic elements of this capability are as follows: read ahead, third-degree (bell-shaped curve) acceleration and deceleration, speed and acceleration feedforward, NANometre-resolution computing and smooth interpolation. These capabilities provide the user with high speed, high precision and high surface quality during machining.

Read ahead

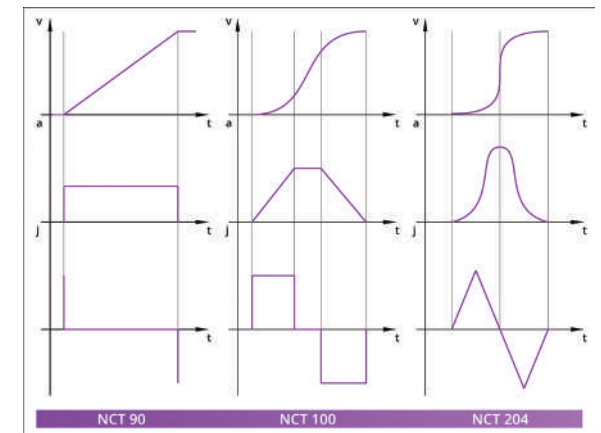
Along a zigzag and unknown road, we travel more slowly; whereas, along the same way we will travel more rapidly if somebody informs us about the speed the next corner can be turned with safety. In order to reach the highest speed along the path, the contour elements will be read ahead and the speed valid at each subsequent contour element will be calculated again and again taking into account that the calculated value can be reached without exceeding the safe acceleration and deceleration parameters specified for the machine.

Third-degree acceleration/deceleration

With development of a new mathematical model for speed calculation, it became possible to build the third-degree acceleration/deceleration in the NCT controls by using which the highest dynamics of all drive systems and mechanisms can be produced.

Speed and acceleration feedforward

It is a system consisting of one servo axis and several elements connected in series. In respect of control engineering, the time elapsed while a command runs from the starting point to the last element of the system, is very long. The path generator of the NCT control calculates speed and acceleration for each displacement and feeds them forward to the speed and current regulator of the servo drive. Since the regulating units receive these data before dataflow would run through the control loop, the control time decreases and thus dynamics, speed and accuracy of the system can be increased.



From left to right, the drawings illustrate the development, as they show the dynamic behaviour of the NCT 90, NCT 100 and NCT 204. In the bottom row it is clearly seen, that in the case of the NCT 204 control the jerk (the acceleration change) does not jump and it takes the axis the least amount of time and distance to reach its target speed.

NANometre-resolution

The internal data handling system of the NCT control makes possible a nanometre-resolution path generation and speed calculation. The EnDat 2.2 measuring system and the EtherCAT communication channel perfectly provide resolution and speed required by the nanointerpolation.

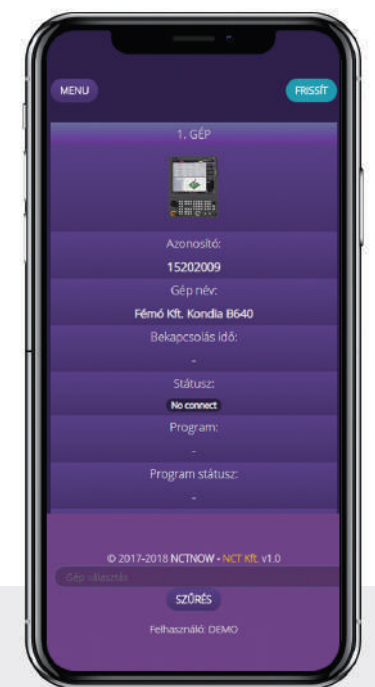
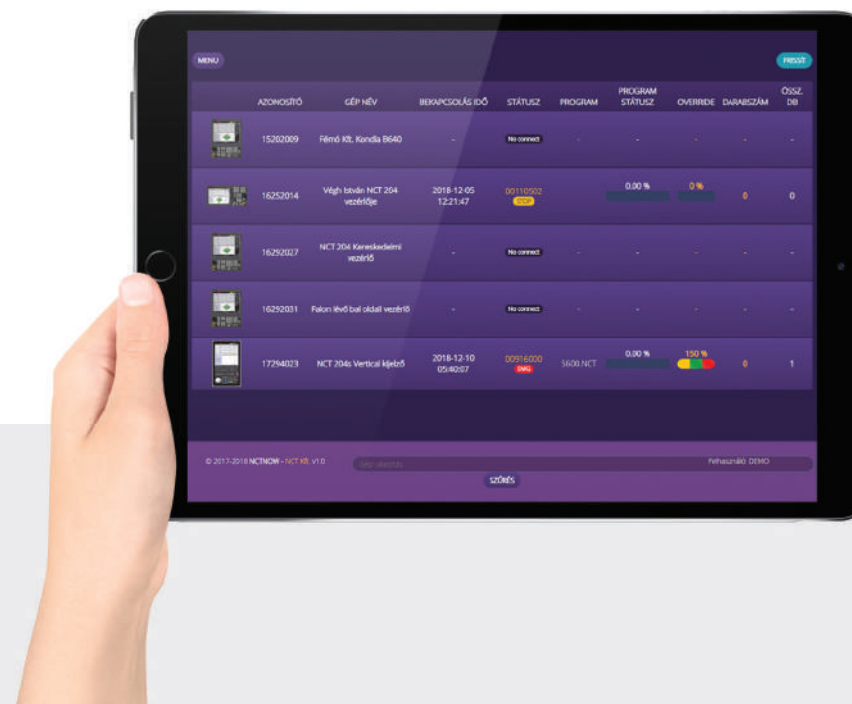
SMOOTH path calculation

Usually, the CAM systems generate series of points interconnected by straight lines. After turning the SMOOTH on, in order to reach a better surface quality and a higher feed rate, the path generator of the control uses not straight lines to interconnect these points but it generates a so-called SPLINE curve; this curve advances not through the points specified by the CAM system but in a 3D tube the diameter of which is specified by the maximum permissible path tracking error.

NCT NOW

By using either your computer in the office or any of your mobile devices, you can have access to your machine tools any time from any places in the world. For this nothing else but Internet connection and the NCT NOW capability is needed.

You can see the momentary operational condition and utilization level of your machines. In case of failure, it is not necessary to take trouble with sending the log file. Through the NCT NOW, our service centre can download the log file.



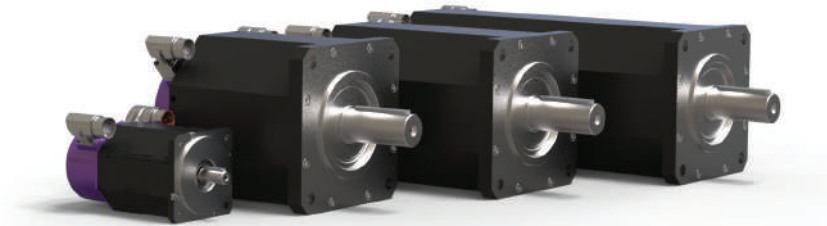
Structure and peripherals of the NCT 304 and the new compact drive technology

NCT servomotors

The A-, Ai-, AiS-, AMS- and TORQUE-type NCT motors meet even the highest user's requirements. As far as the mechanical design, the size, the speed and the electrical parameters are concerned, our motors have been developed specifically for machine tool application.

EnDat 2.2

In standard design, HEIDENHAIN EnDat 2.2 absolute measuring systems are built into the NCT servomotors; these systems assure resolution of 10-50 nm, high accuracy and such degree of reliability, which was unthinkable in the case of former incremental technology.



NCT compact servo drive family

It is a space-saving, easy-to-assemble and economic construction because drive boxes can be placed next to each other, and keeping a distance between the units is not required.

The cooling elements of the transistors can be place in a ventilated space isolated from the electric cabinet.

Automatic control for cooling ventilator– Energy saving

Covered buses – Smart appearance

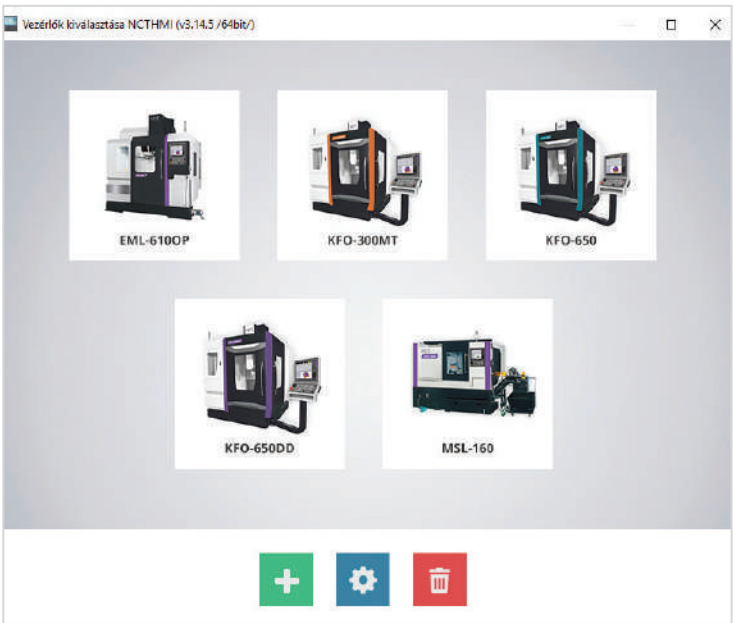
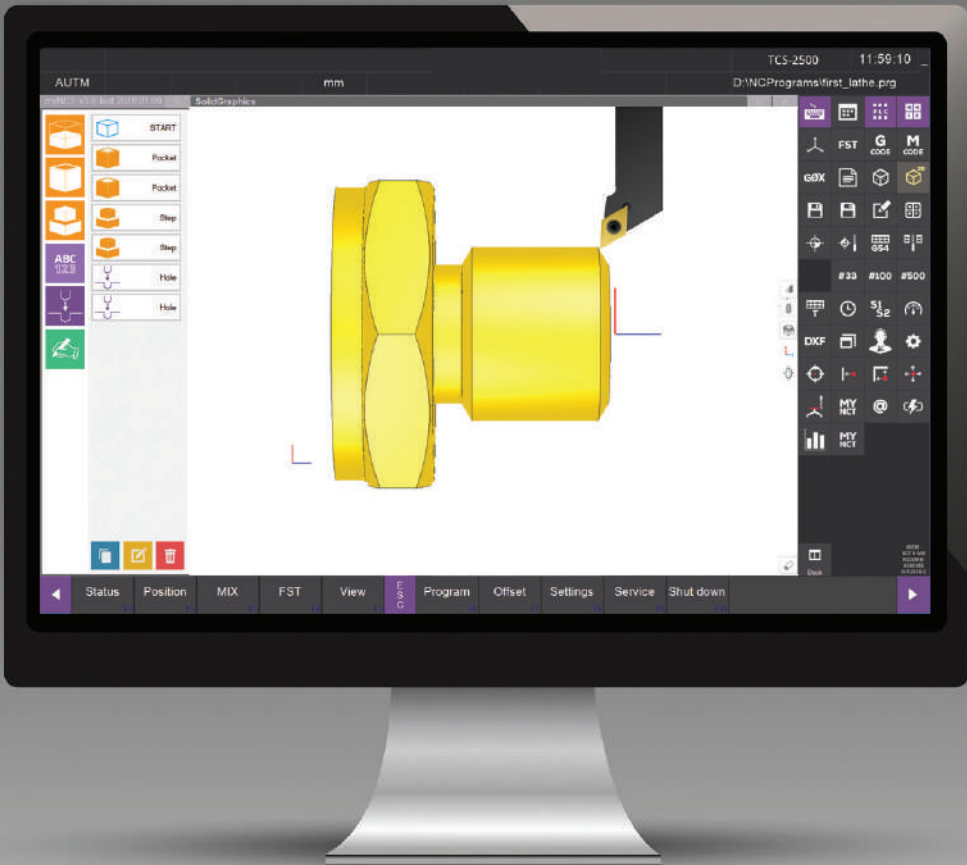
EtherCAT – Standard (SoE) communication

The NCT servo drives play a key role in the NCT remote diagnostics service, too. The SoE communication enables the remote monitoring up to the level of the EnDat 2.2 encoder mounted on the NCT motor.

For high-voltage supply for the drive modules, there is a pair of buses lowered into the front panel. After easy removing the plastic front panel protecting against shock hazard, by turning the bus elements without removing them, any unit can be taken out from the line of drive.



PC Simulator



Excellent device for editing and testing a program on a PC. It is advised for education, off-line programming and testing CAM programs.

When in the simulator, the virtual equivalents of the machine tools in the factory has been created by loading the parameters of the machine tools, even very large CAM files can be tested very quickly by representing real run-time of the program. With knowledge of the exact execution time, utilization of the machines can be increased and planned.

Since the same code runs both on the PC and on the machine tool, it is guaranteed that the result achieved on the PC and the result of the real machining will be the same.



Solid body representation

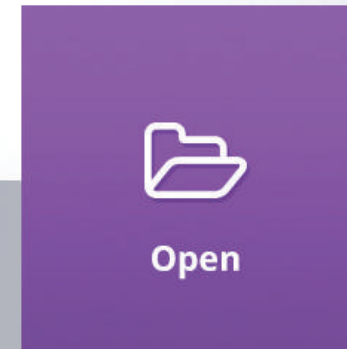
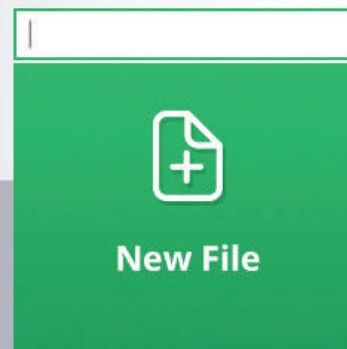
Since the input for this graphical presentation is a command data issued to the servo drives, therefore the image of the workpiece is displayed on the high-resolution screen of the NCT controls perfectly as it will look like in reality, after processing.

myNCT data input

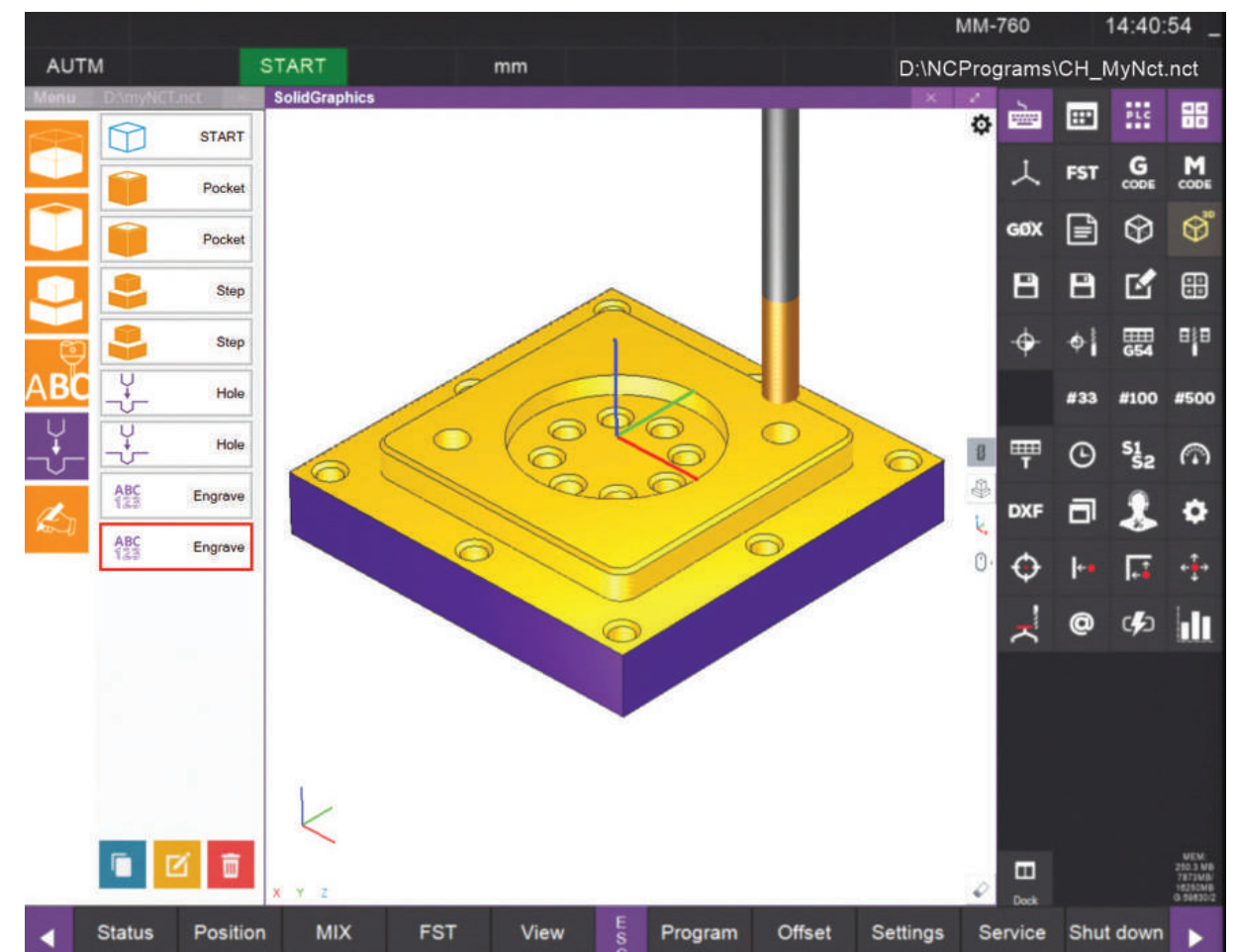
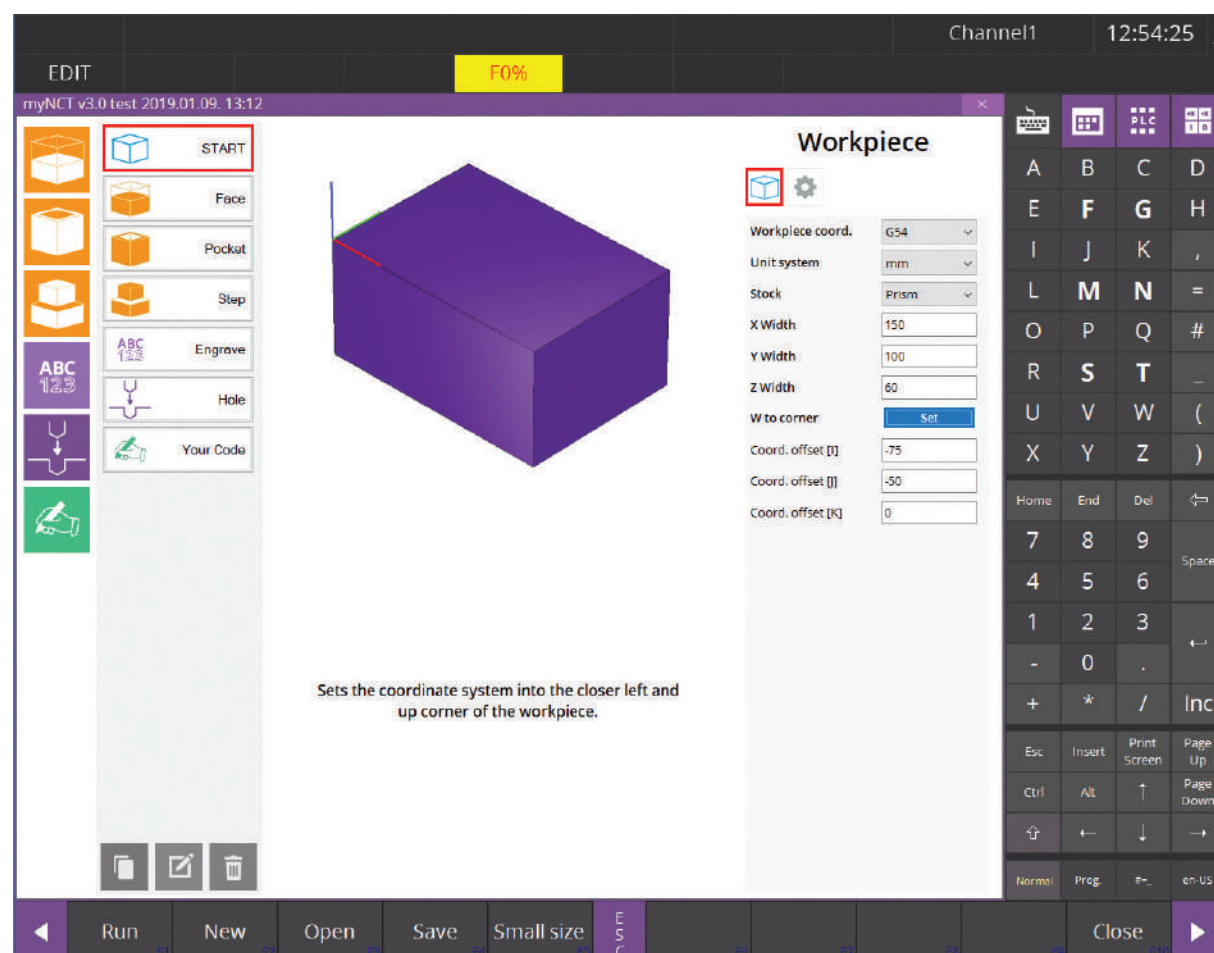
The most effective CNC program can be written in G code which is the alphabet of the CNC programming. The myNCT data input integrated into the NCT 304 supports efficient G programming. It is not necessary to keep complicated address linkages in mind!

The control offers dialogue tables. Table filling can be mixed freely with program writing by the use of text editor.

Necessarily, all this can be done simultaneously even with execution of another technological program.



The model of the pre-product can also be represented. Since, in this case, the machining is drawn on the pre-product, the user can directly see the result of machining. Where the two figures encounter, the colour of the lines changes, thus unwanted machining can be observed. Solid body representation can also be combined freely with line drawing of the tool path.



Specifications of NCT 304

GROUP	ITEM	S/O	DESCRIPTION
HARDWARE	1,93 GHz 4 core (304)	S	High speed by minimal heat production Control panel does not require external cooling
	120 GB SSD (304)	S	Running CAD/CAM files do not require external computer Semiconductor HDD Without moving parts, only a single SSD
	4 pcs of USB	S	100% PC compatibility Any PC keyboard can be used Any PC screen can be used
	Ethernet	S	Connect to office computer network Standard TCP/IP protocol
	Graphic touchscreen	S	Capacitive 19" or 15" size Touchscreen - default screen Default programming keyboard in screen Lifetime of touchscreen is 10 million presses (anywhere) Long lifetime, interchangeable protecting foil
	Machine control panel	S	ALPS pushbuttons Lifetime is 10 million clicks IP 54 protection Each button have LED light Modes, conditions, moving (JOG), start/stop buttons, speed and spindle range shifting switches 1 pc key switch Place for built-in handwheel 20 buttons for general purpose in 19" model 8 buttons for general purpose in 15" model
	Feedrate override	S	Magnetic arrestment Without mechanical arresting unit - long lifetime Absolute position measurement by magnetic indexing 31 ranges
	Handwheel mounted in control panel	O	Magnetic arrestment Without mechanical arresting unit - long lifetime Rotation measurement by magnetic indexing
	External, portable handwheel	O	Separated handwheel possible per axes Modes, moving and starting buttons, feedrate override Magnetic arrestment Without mechanical arresting unit - long lifetime Rotation measurement by magnetic indexing
	EtherCAT communication with peripherals	S	IO peripherals and servo drives can be connected to one Ethernet network Easy, inexpensive wiring Compatibility - using products of another manufacturer
	EtherCAT peripherals	O	Wide rage of variety Manufacture specific solutions by respected user demands
BASIC CNC	Windows Embedded operation system (NCT 304)	S	Windows file management Using standard WINDOWS peripherals
	Open Windows professional platform	O	NCT 304 Any application can be run beside of NCT HMI (user interface) CAD/CAM application (VECTOR, EdgeCAM)
	Intelligent software protection	S	EPU-SIS - electronic protection card Protecting options Dynamic memory management without data loss PAYBIT EtherCAT junction (external handwheel)
	Softwares downloaded from Internet	S	CNC system program Servo drive system program Servo parameters Ready, tested PLC programs for different machine tools Application shop (NCT 304)
	Workpiece time calculation	S	Workpiece time calculation (real time) Take into account tool change time and other secondary times Also works in test run Graphic display

Specifications of NCT 304

GROUP	ITEM	S/O	DESCRIPTION
AXES	Cycle intervals	S	125 us speed control 1 ms path compute 1 ms record processing 1 ms position control 10 ms PLC base 1 ms PLC quick module
	Axis max. number	O	Max. 8 channel Max. 32 axes Max. 16 axes per channels Max. 16 spindles Selectable main spindle for cutting, thread cutting, tapping per channels
	Standard axis number	S	Lathe: 2 axes + 1 spindle Milling machine: 3 axes + 1 spindle or 4 axes
	PLC axes	O	Moving axes from PLC program
	PLC axes number	O	Not limited, any axis can be defined as PLC axis
	Reference signal output	S	EtherCAT
	Reference signal output IO train	O	Analogue CAN BUS Pulse forward/backward Pulse + direction
	Generate TACHO signal	O	Issue proportional analogue tacho signal to measuring system signal frequency in motor shaft Issue command signal in one analogue line (reference signal - speed)
	Position feedback by servo drive	O	EtherCAT TTL I Vpp (voltage sinusoidal) II uApp (current sinusoidal)
	Position feedback by IO train	O	EnDat 2.2 (HEIDENHAIN linear scale) TTL (retrofit) I Vpp (voltage sinusoidal) II uApp (current sinusoidal)
	Taking reference point by NCT servo drive	S	Absolute EnDat 2.2
	Taking reference point by IO train	O	Absolute EnDat 2.2 C type (HEIDENHAIN linear scale, angle gauge) Reference pulse Switch
	Compensations	S	Backlash error Thread pitch error Backlash acceleration Stick slip Straightness
	Spindle max. number	O	Max. 16 spindles Max. 16 spindles per channel
SPINDLES	Simultaneous running	O	Several spindles running simultaneously
	Electronic interlock between spindles	O	Electronic interlock between spindles Ratio set by parameter Gear cutting functions Polygon turning
	Rigid tapping	O	Different acceleration for drilling and retracting set by parameter
	Orienting	S	To zero pulse of encoder To switch
MORE CHANNELS	Number of channels	O	Max. 8
	Represent channels	O	User can create its own screen
	Relation between channels	O	Wait from technological program PLC
	Special axis management	O	Synchronous control Superimposed control Mixed control

Specifications of NCT 304

GROUP	ITEM	S/O	DESCRIPTION
INTERPOLA-TION	Linear	S	Positioning Feed
	Circular	S	Along several quadrants
	Variable radius circle	S	Spiral of Archimedes
	Complex	S	Circular along 2 axes + linear along max. 14 axes
	Special	S	Polar coordinate Cylinder
	Tapping	S	Uniform pitch Through several records Different pitch
	Finishing (SMOOTH)	S	Laying third degree Bezier spindle curve
FEED RAPID TRAVERSE	Feed	S	Per minute Per revolution
	Feedrate override	S	Operated from PLC
	Acceleration/deceleration	S	Linear Quadratic
	Feed control functions	S	Continuous cutting mode Exact stop mode Corner override mode Tapping mode
	Feed automatic decrease	S	Internal machining of circle in G41, G42 state in the ratio of program-med and corrected radius Machining of circle in function of circle radius and permitted accele-ration/ deceleration Machining corners, in function of speed deviation set by parameter
HSHP HIGH-SPEED AND HIGH-PRECISION TRACKING	Nanointerpolation	S	Path computing, compensations in nanometer resolution Increased surface quality
	Acceleration/deceleration	S	Quadratic speed change Acceleration/deceleration without knocking
	Multibuffer mode	S	Read forward 1 000 blocks Switch on Switch off
	Feed forward	S	Tracking by decreased lag
	Point eliminator	S	Smoothing path generated by external device
	SMOOTH	S	Smoothing interpolation Bezier spline
	Number of workpiece coordinate systems	S	6 + 99
COORDINATE SYSTEMS AND TRANSFORMA-TIONS	Transformations	S	Rotating Mirroring Scaling
	Select plane	S	X-Y X-Z Y-Z
	PLC integrated in CNC	S	Quick, economic
	Max. number of IO lines	O	512 INPUT 512 OUTPUT

Specifications of NCT 304

GROUP	ITEM	S/O	DESCRIPTION
PLC	IO modules	O	16, 32 line inputs 16 line semiconductor outputs 8 line relay output Analogue input/output units (+/-10V, 4-20 mA) Linear scale connection Touch probe connection Pulse issue forward/backward Pulse issue (A, AN, B, BN) Pulse issue pulse/direction
	Ladder programming	S	Well-known programming language appropriate for international requirements Easy error detection
	Ladder display	S	Real time display of PLC processes in CNC Green flow
	Testing PLC	S	Logic analyzer Current flow display
MACHINE INSPECTION	Remote diagnostics	S	Connect to remote computer
	Logbook	S	The inspection module of software inspects and saves everything Graphic display
	Temperature diagnostics	O	Increased accuracy by compensating head deformations Measuring temperature in 8 points
	Vibration diagnostics	O	Increased safety Machine inspection
SOFTWARES TO HELP TECHNOLOGI-CAL PROGRAM-MING	myNCT	O	Easy, effective programming Most effective solution for programming in machine tool
	ASSIST	S	Interactive screen for help programming Interactive screen for help operating
	Running CAD/CAM program in CNC	O	NCT 304 Windows 7 platform VECTOR, EdgeCAM
FUNCTIONS TO HELP TECHNOLOGI-CAL PROGRAM-MING	Cycles	S	Drilling cycles Simple turning cycles Complex cycles (turning roughing, facing roughing, grooving, thread cutting, etc.)
	User-specified cycles	O	Cycles written in MACRO programming language
	Define chamfer	S	,C
	Define fillet	S	,R
	Intersection point computing	S	Line - line Line - circle Circle - line Circle - circle
MANAGE PROGRAM	Subroutine technique	S	4 calling levels
	Conditional block skip	S	Max. 9 switches
	Macro programming	S	Effective solution for programming user cycles
EXECUTE PROGRAM	AUTOMATIC	S	Assign selected program file to run
	MDI	S	Execute new program when interrupt AUTOMATIC execution
	Handwheel	S	Program execution controlled by handwheel
SERVO DRIVE TECHNICS	EnDat 2.2 rotary encoder	S	Standard measuring system of Ai series NCT servomotors 33 million position/revolution Absolute measuring system through 4096 revolutions
	EnDat 2.2 linear scale	O	Absolute measurement 50 nanometer resolution

Specifications of NCT 304

GROUP	ITEM	S/O	DESCRIPTION
SERVO DRIVE TECHNICS	SoE protocol	S	Sercos over EtherCAT
	CoE protocol	S	Can Open over EtherCAT
	Servo drive parameter setting	S	From CNC without using external unit Loading ready, tested parameters from directory Generate servo drive parameters of asynchronous servomotors using original parameters of motor (data table)
	Refreshing system program	S	From CNC without using external unit
	Servo drive setting	S	Autotuning Oscilloscope Circular test
	Tandem mode	O	Tandem mode of synchronous servo drives Tandem mode of asynchronous servo drives
	Power supply	O	Recuperation careful with mains
	Connection to other servo drives	O	By standard protocol (SoE, CoE) Analogue +/-10 V Pulse issue forward/backward Pulse issue (A, AN, B, BN) Pulse issue pulse/direction
SERVOMOTORS	A series	O	Ferrite magnet
	Ai series	O	Neodymium magnet
	AiS asynchronous motors	O	Liquid cooling Bearing cooling Temperature measurement in several points 10000, 12000, 15000 speed
	AMS power spindles	O	Liquid cooling A2-5, A2-6, A2-8 spindle nose Temperature measurement in several points
	TORQUE motors	O	High intensity liquid cooling Tilting milling head Rotary table, indexing table
DIAGNOSTICS	Oscilloscope	S	Display characteristics of servo drive features
	Logic analyzer	S	Display PLC outputs/inputs in time diagram
	Circular test	S	Graphic display of synchronous running servo drive axes Check dynamics of servo drives Does not require external unit Display mechanical errors in machine equipped with linear scale
	Symbolic IO	S	Dispay PLC variables in optional order
	IO test	S	Display PLC outputs/inputs in chart
	Measuring system test	S	Display servo drive features in chart
ENVIRONMEN- TAL AWARE- NESS	Recuperation braking	S	In case of recuperation, if capacitor has filled than energy flows into mains from motor in generator running. Since machine tools have connected in common mains with another consumers, they receive the generated energy so electricity meter ro-tates slower.
	High capacity capacitor	S	Motor will be in generator running in braking, so energy flows to the servo drive, at first, it fills the capacitor
	Electronic gearbox	O	The electronic gearbox is cheaper than the mechanical construction and it has lower current drain than a high power motor without gearbox. The users are always short of power and improving mains is very expensive. Furthermore it requires smaller transistors, less capacitors, so the electronics is also cheaper.
	Transferring heat out from electric cabinet produced by servo drives	S	Servo drives produce the most heat inside the electric cabinet. If this heat is transferred out from electric cabinet so it does not stoke the electric cabinet than it does not require energy for cooling electro-nics.

Specifications of NCT 304

GROUP	ITEM	S/O	DESCRIPTION
ENVIRONMEN- TAL AWARE- NESS	Switching fans	O	Measure temperature of electric cabinet and cooling ribs and stop fans if possible No undercooling
	Decreased motor inertia	S	Less inertia = lower power requirement= lower loss
	Modern power switches	S	Minimal loss Minimal heat production
	Thin grease lubrication	O	Does not pollute coolant water Does not pollute environment
INTERPRETED G CODES	Data determination	S	G20/G21, G90
	Incremental programming	S	G91 Also with operator I
	Workspace limitation on/off	S	G22/G23
	Interpolations	S	G0, G1, G2, G3 G12.1/G13.1 G7.1 [axis address] G7.1 [axis address]0 G33, G34 G5.1 Q2 G28, G30, G31 Qn, G37, G36 G84.2, G84.3 G50.2/G51.2 G4
	Spindle oscillation inspection off/on	S	G25/G26
	Feeds and its control functions	S	G94, G95, G96, G97 G9, G61, G62, G63, G64
	Control functions of high-speed ma- chining	S	G5.1 (P0, P1, Q1, Q0, R1, R2, R3)
	Workpiece coordinate systems	S	G54, G55, G56, G58, G59, G54.1 P1-99
	Coordinate systems, transformations	S	G52, G53, G92 G17, G18, G19, G50, G50.1, G51, G51.1, G68, G69
	Tool corrections	S	G36, G37, G40, G41, G42, G43, G44, G49
	Drilling cycles	S	G73, G74, G76, G80, G81, G82, G83, G84, G84.2, G84.3, G85, G86, G87, G88, G89, G98, G99
	Turning cycles	S	G70, G71, G72, G73, G74, G75, G76, G77, G78, G79
	Macro calling	S	G65, G66, G66.1, G67
	Variables	S	Symbolic Local until 4 levels: # 1 -#33 Common: #100-#499, #500-#999
MACRO PROGRAM- MING	Definition	S	#i=<formula>
	Arithmetical	S	+, -, *, /, MOD
	Logical	S	NOT, OR, XOR, AND
	Other	S	ABS, BCD, FIX, FUP
	Functions	S	SQRT, SIN, COS, TAN, ASIN, ACOS, ATAN, EXP, LN
	Conditional expressions	S	EQ, NE, GT, LT, GE, LE
	Junction	S	GOTO(block number) IF[<conditional expression>] GOTO(block number)
	Cycle management		WHILE[<conditional expression>] DOM...ENDm
	Data issue	S	POPEN, PCLOS, DPRNT, BPRNT, FOPON, FCLOS

NCT services and the NCT Academy

The NCT Academy Non-profit Ltd. is the No.1 CNC school in Hungary. The state-of-art machine tool fleet, the well-learned and experienced teaching staff and the NCT company behind the Academy – all of these guarantee the high quality.

Trainings under the National Qualifications Register (OKJ):

- CNC operator (OKJ: 35 521 01)
- Machine tool operator (OKJ: 34 521 03)
- PLC programmer (OKJ: 51 523 01)

Continuing vocational education and training:

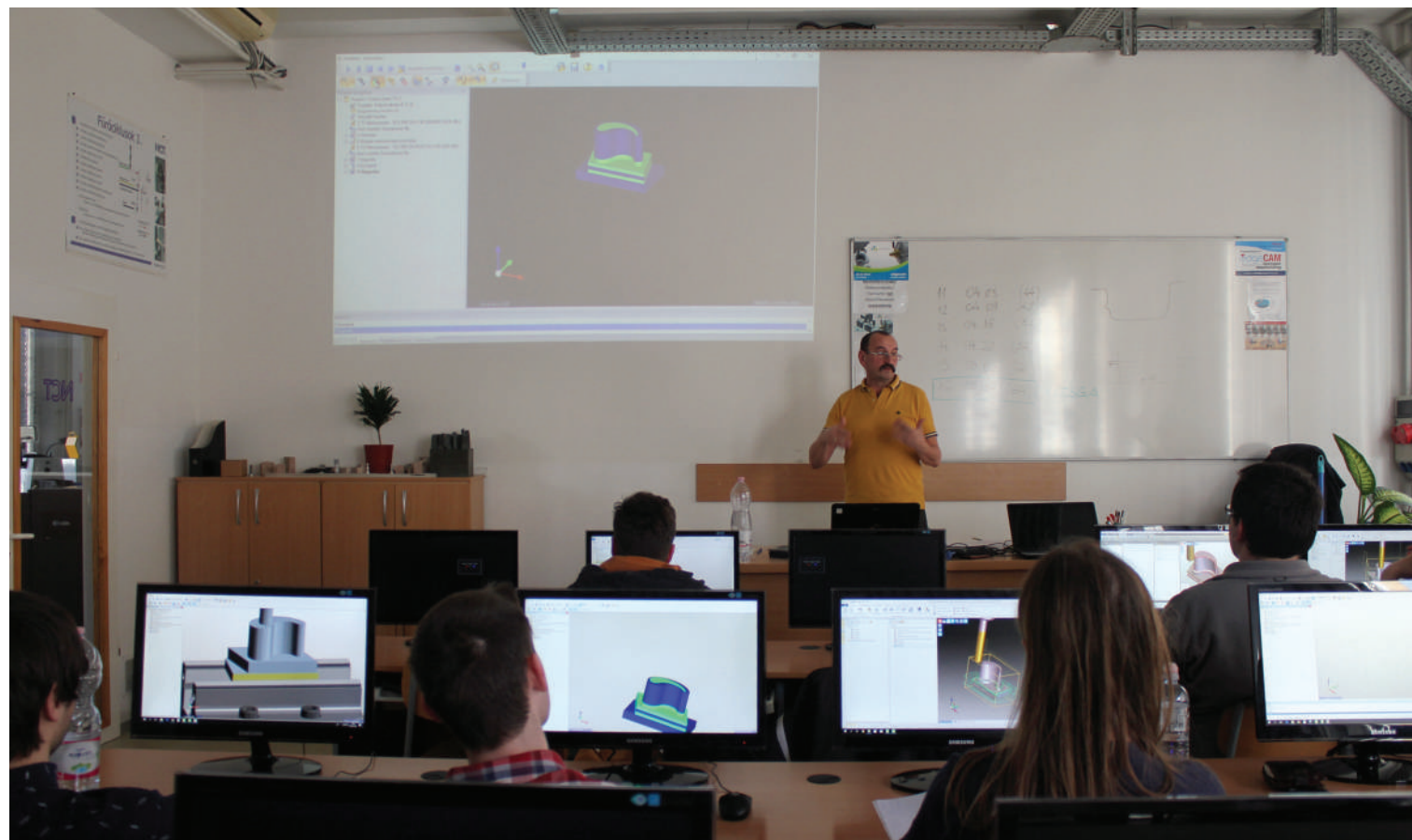
- CNC programmer
 - Sub spindle lathe
 - 5-axis CNC
 - Solid Edge Advanced 3D modeller
 - Vector CAD
- Special custom-tailored trainings are available at the NCT Academy or even at your premises.



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