

**COMPUTER
NUMERICAL CONTROL SYSTEM
FOS.202**

**GENERAL DESCRIPTION
OF
CNC SERIES
FOS.202**

FullOpSys Co.

FOS.202 series CNC systems are intended for mill and lathe machine tools control, equipping of serial or modernized machine tools. Synchronous control up to 8 axes is provided. Separate control of 2 servo spindles is supported.

FOS.202 series CNC systems are constructed by a modular principle on the basis of an industrial personal computer (PC). Operational system is Windows which is most dynamically developing environment today with an abundance of applied software packages.

The modular concept of FOS.202 series CNC construction means set of industrial PC, established in it PCI slots, the multiaxial motion controller, discrete information input/output devices with the input/output peripheral interface modules connected to them, and also Operator Panel with Engineer Board. It is necessary to add the Software which also is constructed by a block principle and includes:

- The CNC Kernel (DLL libraries, API functions)
- The Configurator describing the machine tool
- The PLC Program with the debugger
- The graphical user interface (GUI)
- The graphical Simulator of the NC-programs

Each of these components is independent software product and can be used in other applications. The PLC programming language (*PLC-script*) developed for FOS.202 series CNCs enables to make the full description of work of electroautomatics of the machine tool and to adapt CNC for any concrete machine tool by integrator of average qualification by means of usual text editor and easily accessible alphabet. For simplification of process of development and debugging of the PLC interface program the special program-debugger fixing presence of syntactic and logic mistakes is applied.

Structurally FOS.202 CNC device consists of the Base Control Block, the Operator Panel, peripheral discrete signals input/output modules and a Manual Pulse Generator.

4, 6 or 8-axial PCI-7344, PCI-7354, PCI-7356, PCI-7358 National Instruments (USA) Controllers as the Motion Controller for FOS series CNC are used. They provide synchronous control of servo- or stepper drives and also amplifiers with 62.5 μ s/axis or 62.5 μ s/pair axis time

of servocycle. Built in PID algorithm allows to refuse expensive servodrivers and to use economic amplifiers for control of stepper motors, DC motors, synchronous and asynchronous motors.

Basic functionalities of FOS series CNC:

- Full configuration of the machine tool by system integrator and a parametrical binding to the machine tool - a binding of axes to channels of control, input of position, dynamic and kinematics parameters of axes, characterization of encoders and stepper motors, characterization of spindles, handwheels, measuring probe, turrets.
- Simple and effective tool of development and debugging of PLC program by the engineer-integrator.
- Built in application tool allowing to carry out tuning of drives.
- 2D Graphic simulator, working both in real time (synchronously with movements of the machine tool) and separately without real movements for visualization of a trajectory, with an opportunity of a choice of simulation planes and scaling.
- The Monitor - 12.1" TFT/LCD 800x600, 15" TFT/LCD 1024x768, color, flat panel, with the full-function membrane keyboard.
- Support of two simultaneously and independently working spindles (two servo spindles or two spindles with a gear box).
- Two handwheels connection possibility.
- Movement from a handwheel on a set vector.
- Discrete inputs/outputs - per byte programmed 192 In/Out (optional up to 384 In/Out). Optoisolated Inputs with input level 3...32VDC (50mA) or 5V TTL levels. Electromechanical Relay Outputs (3A 30VDC, 3A 250VAC) or 5V TTL levels (Pull-Up resistor).
- Active high or active low levels of inputs/outputs programming possibility.
- Programmed on a level Flags on each axis - +Lim, -Lim, Home, Fault, Enable - with a digital filtration and optoisolation.
- Control of stepper drives in Step/Dir or CW/CCW modes with frequency up to 8MHz.
- The control of servo-drivers and amplifiers are analogous in a programmed range $\pm 10V$ with resolution of 16 bits.
- Inputs for feedback devices – quadrature incremental encoders - with rates of 20 MHz. Digital filters on all inputs of encoders.
- 62.5 μs PID loop update rate.
- Loading the operating program through USB port (USB Flash Card) or network Ethernet (10/100 Mb/s).
- Simultaneous 8 coordinates interpolation.

- Unlimited quantity of the frames of the operating program.
- Full Look Ahead function, that allows to process details with a complex surface on the greatest possible speed without pushes and shock influences.
- Movement by cubic splines - interpolation on curves allows to change direction gradually and the control system supports higher average working feedrate, than at moving on a polygonal trajectory.
- Program compensation of the backlashes on the all axes.
- Return on a profile in inverse sequence with unlimited quantity of courses on all axes.
- Support of functions of the measuring probe.
- Support of parametrical programming. Use of local, common and system variables, performance of arithmetic and logic operations, formation of expressions with application of trigonometrical functions.
- The Formatted output of the information in a text file during realization of the operating program.
- Unlimited numbers of subprograms levels.
- Support of programming of a repeating pieces of the operating program.
- Indicating of currently active G- and M-codes.
- Indicating of values of local, common and system variables.
- The assignment of positions and feedrates in a format of a floating comma.
- The possibility of orientation and positioning of the servospindle on the set angle.
- The possibility of blocking of the axes which are not participating during processing.

Operator Functions

- Manual/Automatic modes of the work
- Manual moving mode – work mode, jog mode
- Absolute and relative moving modes by separate axes
- Feeding from Handwheel, moving from Handwheel in the vector mode
- Rotating of the spindle in the work mode, rotating of the servo-spindle in the jog mode too
- Percentage control of the feeding and servo-spindle rotating
- Tools change function
- Choice of metric or imperial unites system
- Configuration of up to 6 Coordinate Systems
- Emergency Stop

- Setting of the time and period of guiding rails lubrication
- Setting of the parameters of the oil dosing unit of the air coolant system
- Loading, editing and saving of the control nc-programs
- Start/stop of the control program
- Manual Data Input (MDI)
- Per-frame processing mode
- Block of frames execution mode with automatic detection and setting of initial conditions (M- and G-functions)
- Rest by Operator sanction with passing in the manual mode and back
- Observe of current M- and G-functions
- Browse of the local, common and system variables

Interface Functions

- Indicator Board
 - Positions in the Machine Coordinate System, Working Coordinate System, Distance to point
 - Program or Real feed rate vector of the tool relative processing part
 - Program or Real spindle rotating speed
 - Percent of the feed rate corrector
 - Percent of the spindle rotating speed corrector
 - Current tools numbers and their correctors
 - CNC general readiness
 - Readiness of the separate systems of the machine tool (pneumosystem, hydrosystem)
 - CNC errors
 - Axes limits reaching
- Screen of settings the Coordinate Systems shifting, tool correctors, lubrication and coolant oil dosage parameters
- Screen of choice, loading and saving of control programs
- Operative text editor for control programs
- Indication of executing frames of the control program with progress bar of execution
- Screen of active M- and G-codes
- Real time indication of discrete and analogous inputs/outputs conditions
- Indication of warning messages
- Screen of errors with CNC or PLC errors classification
- Screen of 2D (3D in the future) simulator

Preparatory Functions

- Fast positioning (G0)
- Linear (G1), circular and helical (G2, G3) interpolations
- Dwell (G4)
- Exact stop after positioning (G9)
- Moving in the polar coordinates (G15, G16)
- Plains for circular interpolations and tool radius compensations (G17, G18, G19)
- Imperial and metric unites (G20, G21)
- Scaling, rotating and mirroring (G22, G23, G24, G68, G69, G150, G151)
- Spindle rotating speed control (G25, G26)
- Moving to reference points (G28, G29, G30)
- Measuring function (G31)
- Threading (G33, G34)
- Tool radius compensation (G40, G41, G42)
- Tool length compensation (G43, G44, G49)
- Choice of Local, Machine and Working Coordinate Systems (G52, G152, G53, G54-G59)
- Exact stop mode (G61)
- Cutting mode (G64)
- Multipassing lathe cycles (G70-G73, G76, G170)
- Multipassing front end and cylinder grooves boring cycles (G74, G75)
- Singlepassing turning and threading cycles (G77-G79)
- Chip breaking modes (G160-G162)
- Deep hole drilling and turning (G171, G172)
- Programmed cycles: drilling, threading and boring (G80-G86, G180, G183, G700-G702)
- Programmed cycles for pockets, bosses and grooves processing (G300-G308)

- Absolute and relative move settings (G90, G91)
- Constant cutting speed mode and maximal spindle rotation speed set (G96, G92)
- Set of feed rate by the moving time, by the speed and by one rotate of spindle (G93, G94, G95)
- Set of the return level by Z axis at exiting from the mill cycles (G99)