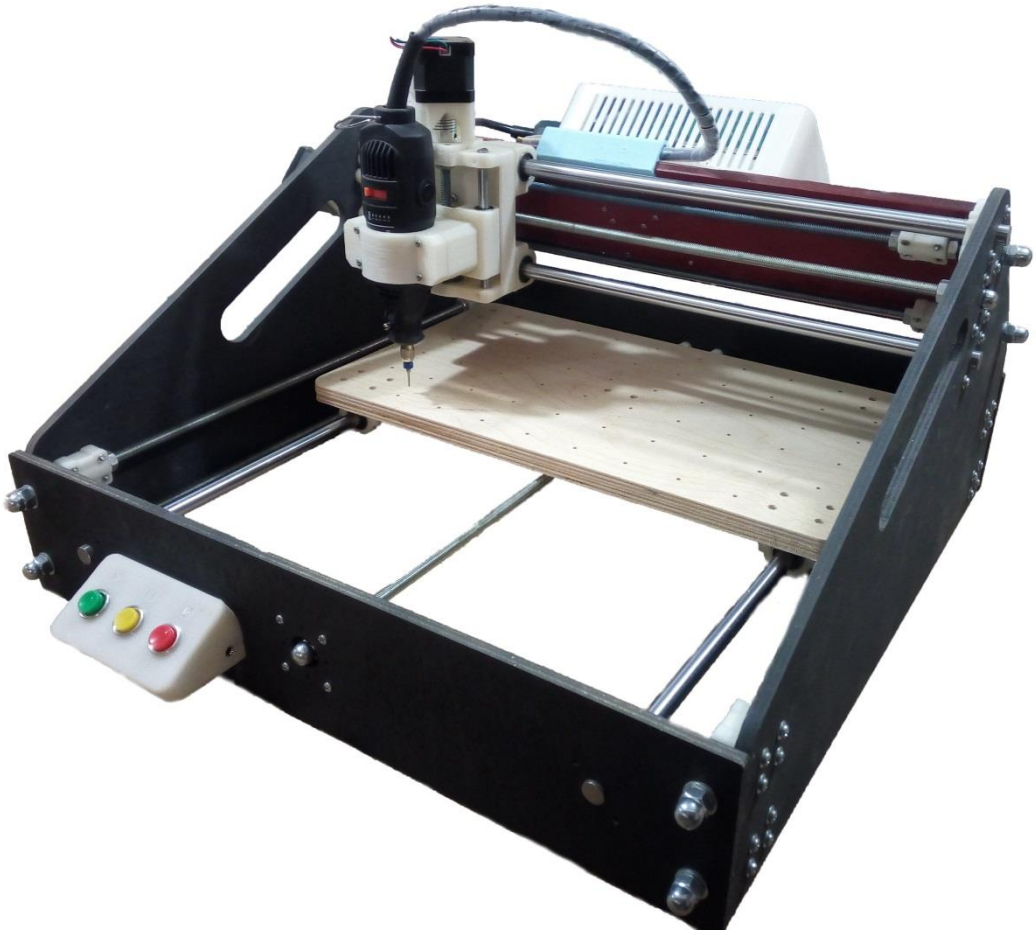
Table milling machine.



Instruction manual.

Table of Contents

General Information

Miling machine with numerical control – for hobbies. Its use is intended for processing of various materials - wood, plastic, textolite, non-ferrous metals.

The vertical milling machine, portal type with a movable working table. The machine can perform the following operations: milling, drilling, engraving and cutting.

The machine can be useful for advertising, jewelry, modelers, carpenters and polygraphy.

Package contents

• Table-top machine;
• Manual;
• Disk with necessary software;
• Power cord (length 1.5 meters);
• Connecting cable for connection of the controller to the computer (USB-type A-USB B 1.5 m long);
• Cable for adjusting the cutter outlet (jack 3.5 - 2 clips of the "Crocodile" type, 30 cm long)

• A set of clamps for fixing workpieces of small thickness (thickness 1-3 mm, 4 pcs.);
• Set of clamps for fixing blanks of medium thickness (thickness 1-10 mm, 4 pcs.)
• Set of clamps for fastening workpieces of large thickness (thickness 15-20 mm, 4 pcs.)
• Spindle Dremel395 125W
• Set of milling cutters for processing (6 pcs)
• Sacrificial fence (1 pc., Hardboard)

Technical characteristics

Parameters	Unit of measurement.	Values
Processing area		
Length (move in X)	mm	360
Width (Y move)	mm	230
Height (Z move)	mm	40
Working table dimensions		
Length	mm	430
Width	mm	240
Number of holes for fixing	pieces	56
Material of the working table	-	Plywood 16mm
Distance between the table and the bottom surface of the spindle plate		
Thickness of cylindrical guides		
By X	mm	12
By Y	mm	12
By Z	mm	8
Diameter and pitch of gear screws		
By X (diameter, step)	mm	8;1,25
By Y (diameter, step)	mm	8;1,25
By Z (diameter, step)	mm	16;5
Stepper motor designation		
By X	-	PL57H76-3.0-4
By Y	-	PL57H76-3.0-4
By Z	-	PL57H76-3.0-4

Speed and accuracy of movement		
Max. movement speed	mm/min	Up to 500
Working movement speed	mm/min	Up to350
Positioning discreteness	mm	0,01
Repeatability	mm	0,05
Dimensions and weight		
Length	mm	575
Width	mm	575
Height	mm	300
Machine weight	kg	20

Safety while working

The milling machine can be dangerous when inappropriately. The operator is responsible for the correct installation, use and technical maintenance of the machine.

When working with the machine, the operator must use personal protective equipment:

- tight fitting special clothes, eye protection glasses, headphones or ear plugs that protect from noise effects above 80 dB.

If the wiring of the machine is damaged, there is a risk of electric shock. When replacing damaged wiring, the machine must be completely disconnected from the electrical network.

Before cleaning, maintenance and repair, measures must be taken to prevent the machine from accidentally turning on.

To avoid injury of the operator and breakdown of the machine:

• Do not leave foreign objects on the machine and in the processing area;

• Do not leave the machine running unattended;

• Do not hold the workpiece by hand;

• Do not put your hands in the working area of the machine while the program is working or while the spindle is switched on;

• It is necessary to securely and properly fix the processed workpiece;

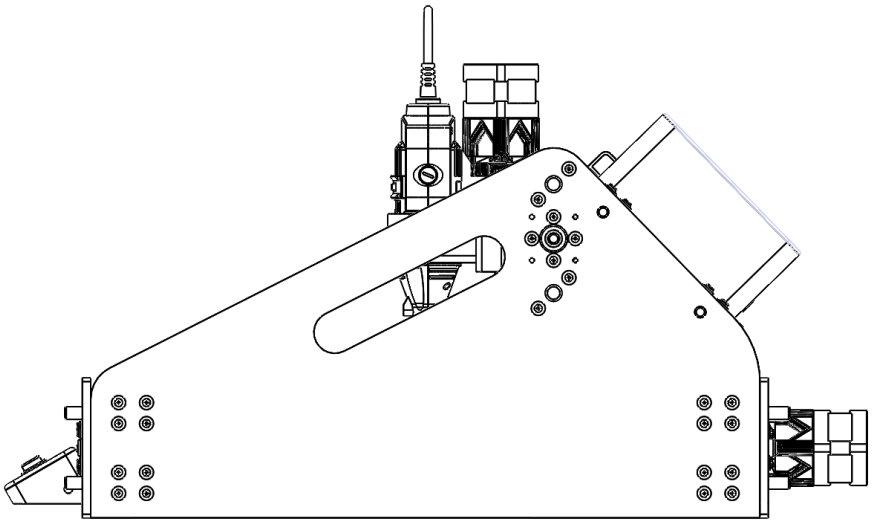
• The cutting tool must be installed securely and correctly;

• Do not exceed permissible movement speed.

To prevent damage to health or damage to parts of the machine, an emergency stop button (E-STOP) is located on the front panel, after which the spindle and stepper motors stop immediately and stop the execution of the control program.(CP)

Construction description

The machine is a vertical milling machine of portal type with a movable table. The general view is given in Figure 1.



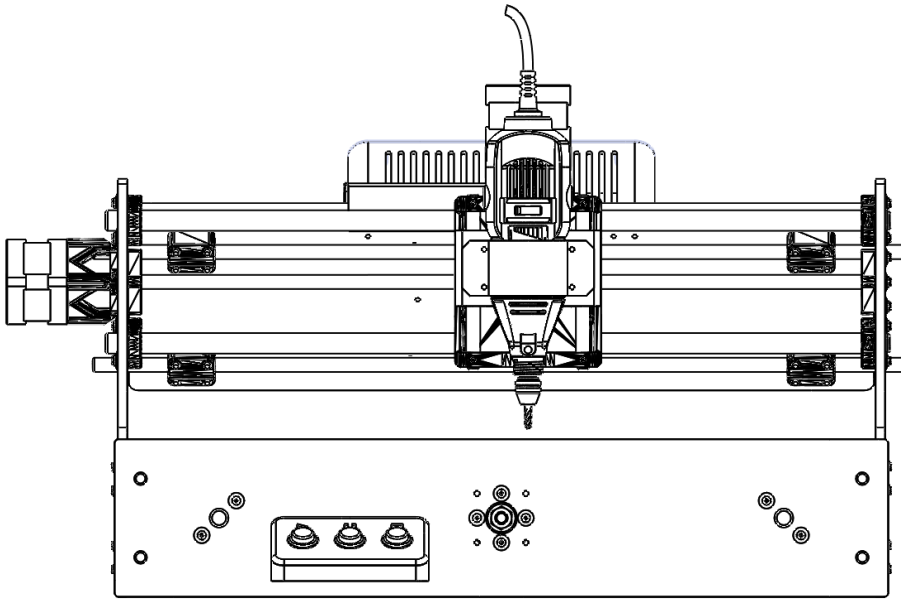


Figure 1 – General view of the machine.

Cutouts for easy installation and carrying of the machine are located on the sidewalls of the machine.

a control panel, on which there is a connector for connecting the probe for setting the cutter outlet (on the right panel) and the control buttons on the front panel (see Figure 2, from left to right) are located on the control panel:

- Start / continue button;
- Suspend button
- Emergency stop button.

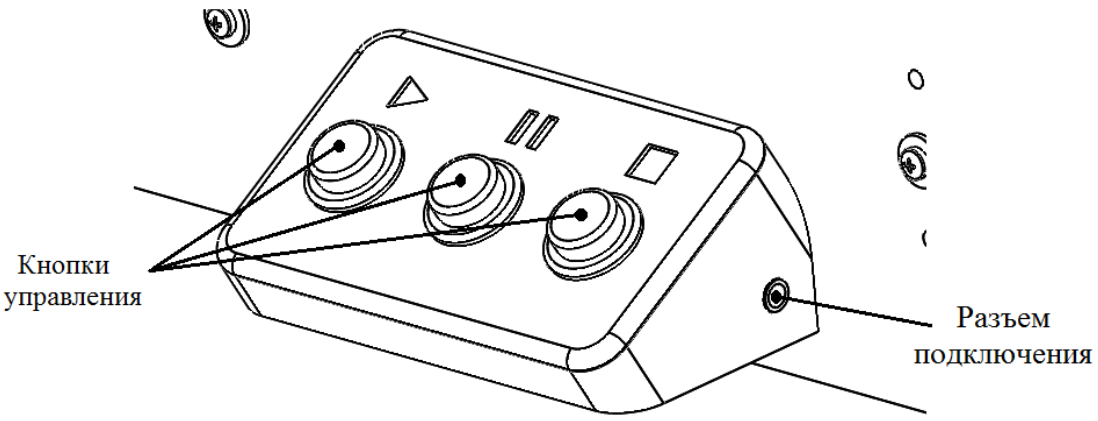


Figure 2 – Control panel. Appearance

On the back panel of the machine there is a block in which all the electronics of the machine are located. The general view of the control unit is shown in Figure 3.

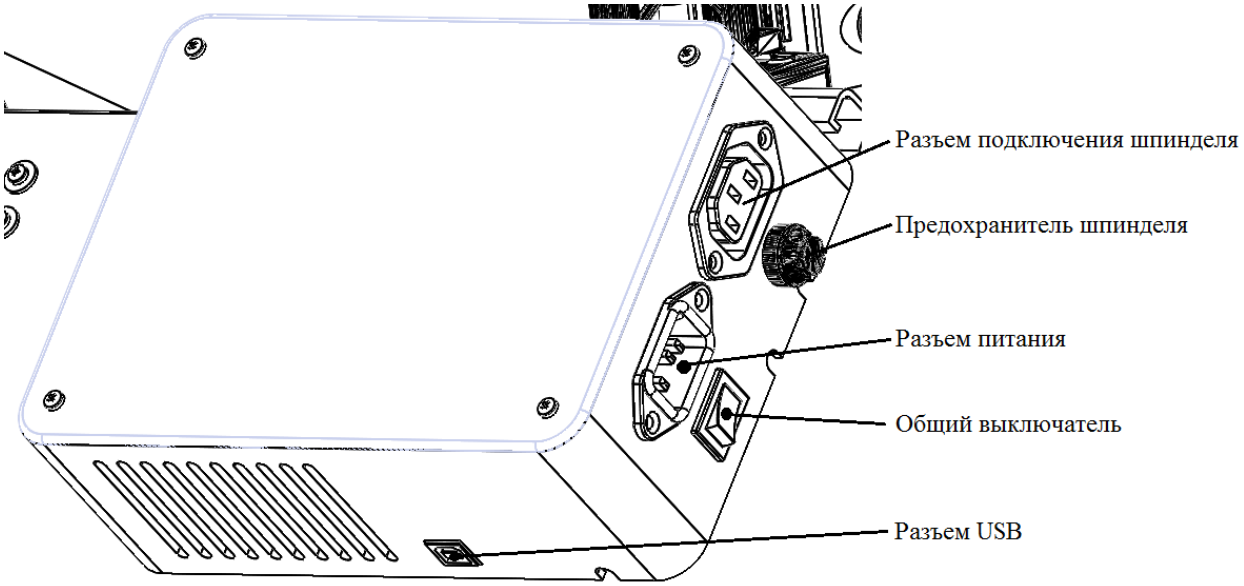


Figure 3 – Control panel. appereance.

To avoid overheating of the electronic components of the machine, it is necessary to monitor the free movement of air through the ventilation openings. Additionally, it is not recommended to install the machine near heating elements (for example, radiators).

The spindle is switched on automatically when the CP is started. The rotation is adjusted by moving the slider on the front of the spindle in the range 10,000-33,000 rpm (see Figure 4). The spindle switches off in the extreme left position.

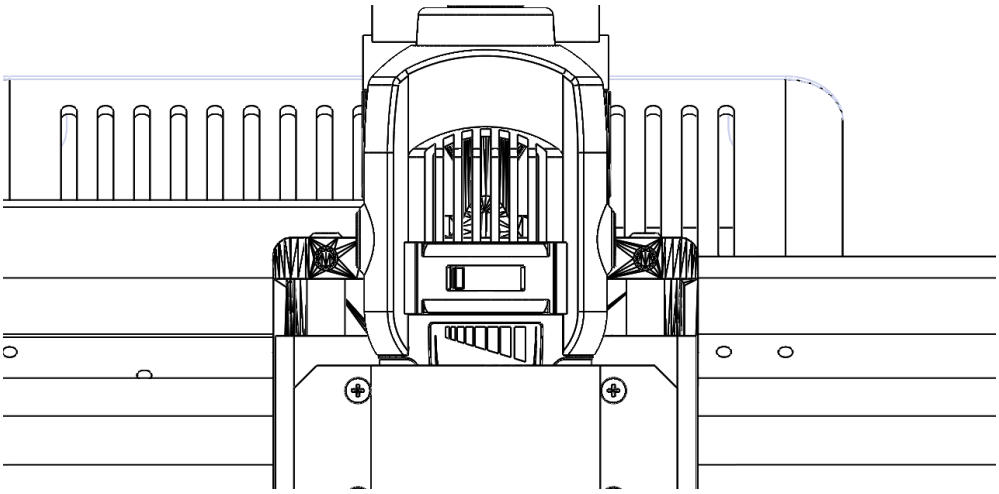


Figure 4 – Control block. Appearance.

The machine should be installed on a flat surface, preventing foreign objects from falling under the machine parts. Otherwise, it is possible that the machine mechanisms will cut them.

Installing the software

Before the first connection of the machine to the computer, you must install all the necessary software for proper operation.

Installing drivers

The driver installation files are on the enclosed disk in the "Drivers" folder. You need to run the dpinst-x86.exe file in it for installation on computers with a pre-installed 32-bit operating system or dpinst-amd64.exe for 64-bit. Then follow the instructions of the installation wizard

After successful installation, you can connect the machine to the computer using USB cable to configure the machine drivers (do not connect the power cable). After connection, the automatic setting of the machine driver will start immediately

After this, it is necessary to determine the number of the COM port through which the data will be exchanged. To do this, you must perform the following actions:

- open the "Control Panel / System / Device Manager".

Use the Windows help to open the "Device Manager".

- the "Ports (COM and LPT)" tab will display: ArduinoUno (COMN)
- where N –number, where there is a number of COM port of your router.

If the driver does not automatically install, you need to contact support for assistance.

Installing the control program

This model of milling machine is run by GRBL protocol. In accordance with that, one of the following programs or others, compatible with GRBL, can be used for controlling:

- UniveralGCodeSender
- GRBLController
- JCNC
- ChiliPeppr etc.

Let's take a look at the UniveralGCodeSender(UGS) installation. The program installation is based on copying the UniveralGCodeSender(UGS) file from the disk to any place on the computer.

For example: C:/CNC/ UniversalGcodeSender-v1.0.9

To properly run the program on your computer, you also need to install the Java platform. Installation files are also located on the disk with the software:

- jre-8u91-windows-x86 для32-битных версий ОС;
- jre-8u73-windows-x64для64-битных версий ОС.

The program is launched by running the file Start-windows.bat, located in the UniversalGcodeSender-v1.0.9 folder.

Test connection

Before the first start-up, you must connect the power and USB cables to the machine, and slide the speed slider on the spindle to the far left position.

UGS Interface

The program is launched by opening the file start-windows.bat. After that, the main window of the control program appears on the computer

screen (see Figure 5):

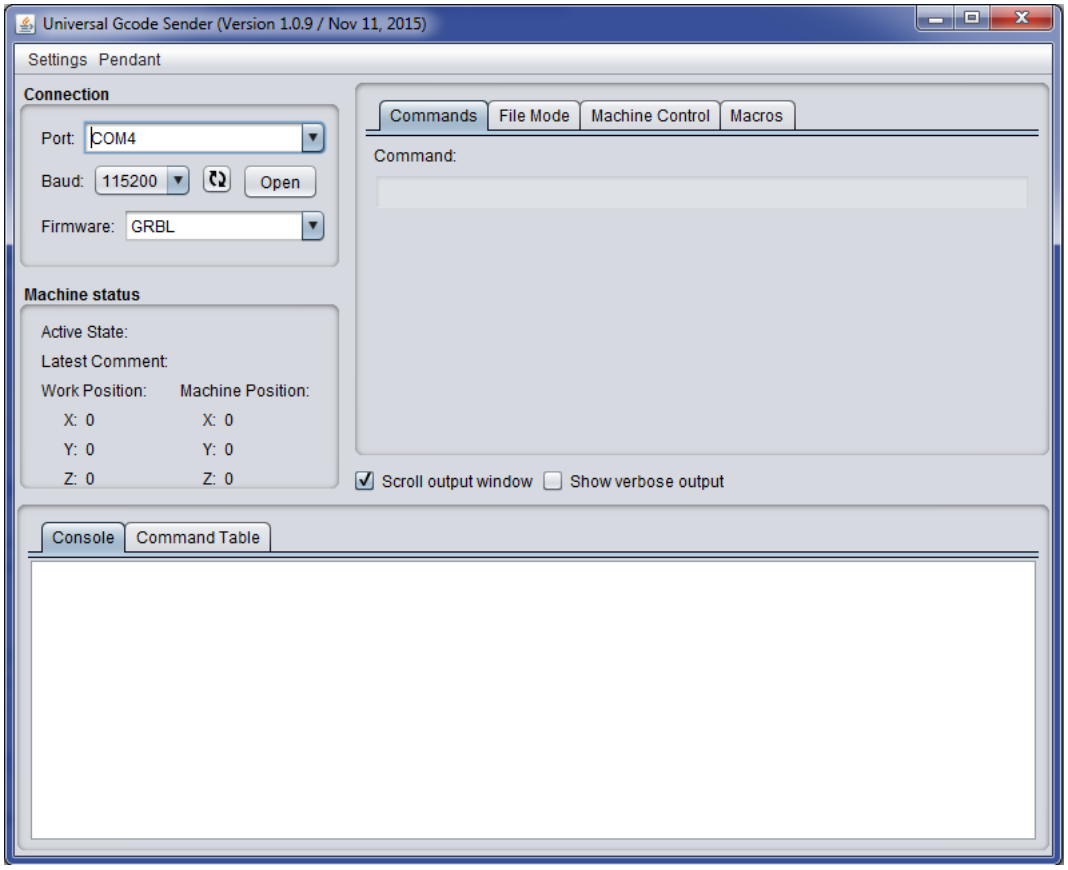


Figure5 – The UniversalGCodeSender window

To connect to the machine, you need to change the settings in the "Connection" area:

• Port - the port used by the machine. Selects the previously defined port from the drop-down menu;

• Baud - the rate of exchange. For this machine, pick the value "115200"

• Firmware - protocol. Choose GRBL.

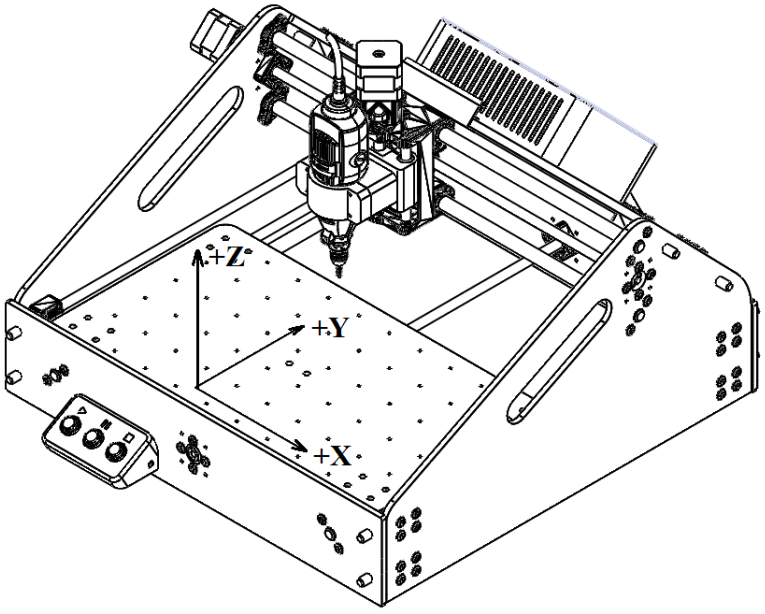
After setting all parameters, click the "Open" button in the same area. If all the previous steps are correct, then the "ActiveState" value of the "Machinestatus" area will be set to "Alarm" highlighted in red, and the "Firmware version" tab will appear in the "Console" tab. Otherwise, carefully check the COMport number and the exchange rate in the program, as well as the USB cable

Immediately after turning on, the machine is locked for movement. In order to unlock the machine, go to the "MachineControl" tab (see Figure 6):

Figure 6 – Tab MachineControl

We click on the button «$X». In the "Machinestatus" area, the value of "ActiveState" will be set to "Idle" and will be highlighted in white.

At this stage it is already possible to move the router along the working area of the machine. The machine is controlled by 3 axes, the location of which



is shown in Fig. 7.

Figure 7 – Coordinate system location

The move step is specified by the "Stepsize" parameter. It is recommended to select a value of 1mm.

Moving the router goes in a straight line with the buttons "X +", "X-", "Y +" "Y-" "Z +" "Z-". If you check the "EnableKeyboardMovement" option, you can control the machine using the following keyboard buttons:

- Right / Left arrows - X axis;
- Up / down arrows - Y axis;
- Page Up / Page Down - Z axis.

After this, the first connection of the machine can be considered successful. You can go work on a milling machine.

The Basic Methods of Work

Setting the Milling Machine

Attention: Installing and replacing the cutter must be done ONLY when the cutter is turned off.

Turning off the machine is done by moving the speed adjustment slider to its body in the extreme left position.

For convenient installation of the milling cutter, it is recommended to move to the uppermost position by pressing the "Z +" buttons in the UGS or the "PageUp" keys (if this function is enabled)

Turning off the router is done by moving the speed adjustment slider to its body in the extreme left position.

For convenient installation of the milling cutter, it is recommended to move to the uppermost position by pressing the "Z +" buttons in the UGS or the "PageUp" keys (if this function is enabled)

To install the cutter in the collet of the machine, first loosen the collet clamp. To do this, use one hand the lock button of the milling shaft fixing button of the machine, and the use the other hand to turn the collet nut counter-clockwise for a couple of turns.

Use the same hand to insert the milling cutter into the collet of themachine. Mills equipped with a thrust ring are installed until they stop. Mills that do not have a thrust ring are installed in the chuck for a length of about 15 millimeters, but not less than 10 mm, for a secure fixation of the cutter.

After that, the milling cutter is locked in the chuck by turning the collet nut clockwise first with the hand and then with the key coming with the

milling cutter (see Figure 8).

Figure 8 - Installing the cutter.

Fixing the workpiece

To easily place the workpiece on the desktop, you must first move the spindle to the upper left corner of the desktop using the spindle shift buttons.

Depending on the thickness of the workpiece, one of the included clamps is selected, which are fastened with screws on the surface of the work table.

We will take as an example the fastening of a pine board with dimensions of 250x200x18mm. Fastening is done using the clamps, which come together with the machine. The clamps are mounted on the workpiece so that the workpiece is firmly held on the table surface, but not interfered with by the execution of the UE. After installing the clamps, a screw is installed in one clamp hardness, which is screwed into one of the 56 holes on the surface of the working table. After tightening all the screws, the workpiece is checked for reliable fastening to the surface of the working table, with a little effort. After that, the installation of the workpiece can be considered successful

Since there is a large number of mounting holes, it is possible to install almost any workpiece that can be machined on this machine. An example of

fixing a workpiece is shown in figure 9:

Figure 9 - Workpiece fixing

If you intend to cut through the workpiece or cut sheet materials, it is strongly recommended to place a "sacrificial board" made of hardboard on the table to protect the desktop from damage.

Securing the workpiece of other thickness is made similarly with the help of clamps, which are included in the delivery set of the machine. After this, you can proceed to setting the milling cutter to zero and proceed to the direct machining.

Setting the zero position of the cutter

The zero position of the cutter is the point from which the machine starts executing the CP. To set the milling cutter to zero, proceed as follows:

1. In the UGS program, use the navigation buttons to move the cutter to the point at which you plan to start the execution of the CP (zero point);
2. put a small piece of paper over the workpiece so that when the cutter is lowered its tip rests against it;
3. Gradually lower the cutter using the "Z-" button or the "PageDown" key to lower the cutter. The displacement step should be equal to 0.1mm. After each movement, check that the paper is moving freely. Repeat the operation until the cutter pinches the sheet of paper against the workpiece (see Fig. 10):

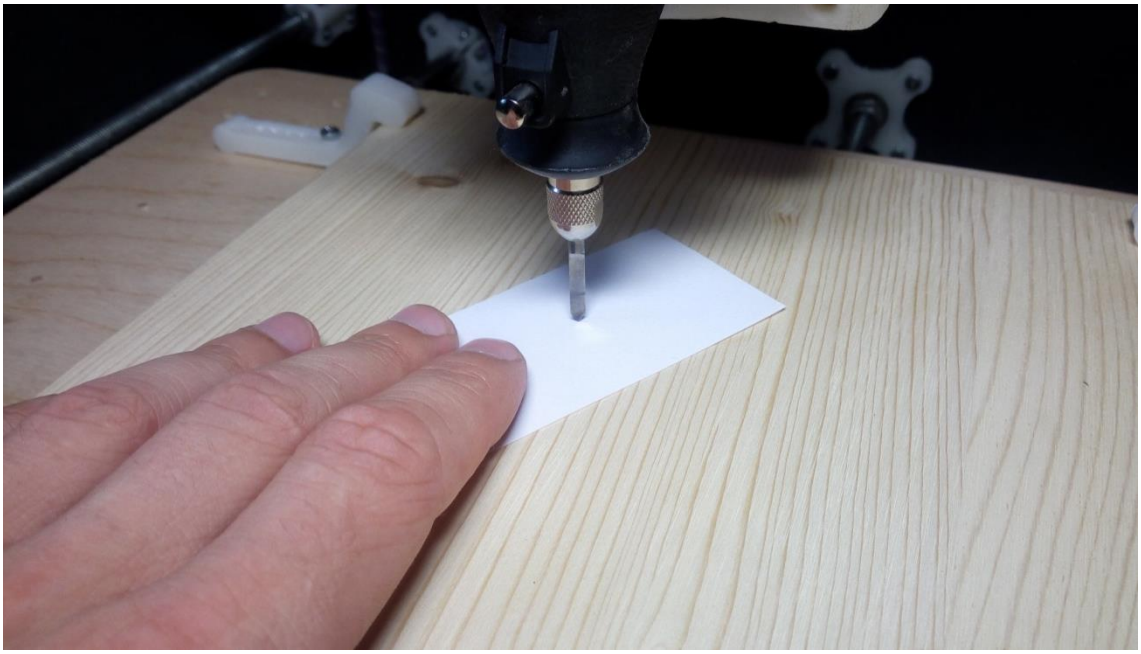


Figure 10 – Setting the zero position of the cutter

1. After that it is necessary to reset the coordinates of the current position. To do this, all the axes are reset individually in the UGS by the "ResetXAxis", "ResetYAxis", "ResetZAxis" buttons or all the axes simultaneously with the "ResetZero" button. After that, the zero position of the cutter will be memorized.

2. After that, you can raise the cutter and remove the paper. The initial position setting has been completed.

Executing the CP from a file

CP is a file containing algorithm by which the machine performs a certain task, for example cutting material or 3d milling.

The algorithm itself consists of a sequence of lines (frames). In each frame, one command is given to perform an action with certain parameters (for example, moving to a point with a coordinate of 10.10 at a speed of 100mm / min). After executing this frame, the machine proceeds to the next. After completing all the CP frames, the machine completes its work.

In UGS work with files is carried out in the tab "FileMode", which is shown in Figure 11:

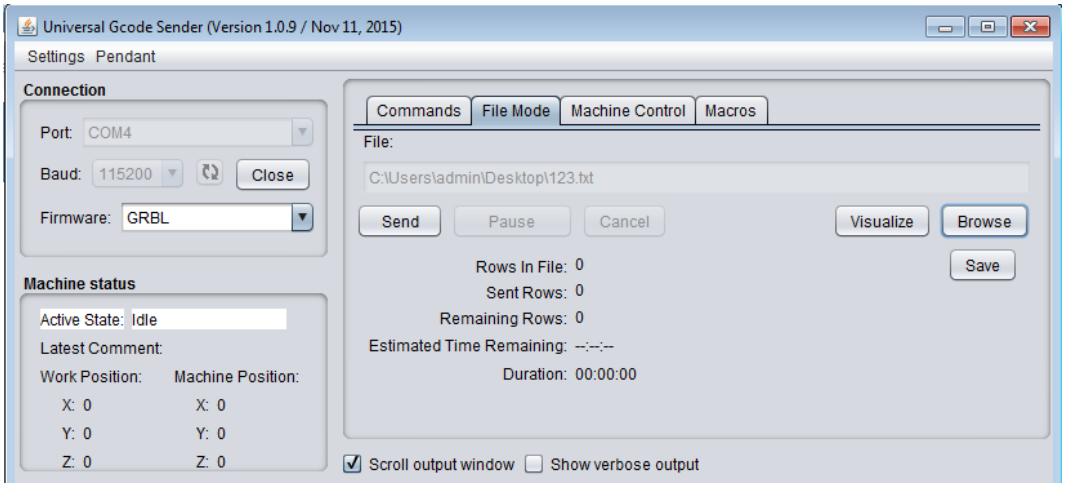


Figure 11 – Tab «FileMode».

Below is a description of the functions of the buttons located on this tab:

• "Browse" - select the file;

• "Visualize" - 3D representation of the CP;

• "Send" - start execution of the selected file;

• "Pause" - suspension of the execution of the CP with the possibility of continuing work;

• "Stop" - interrupting the execution of the CP without the possibility of continuing work;

• "Save" - save the selected CP in a new file.

Running the CP. Engraved Monogram

The first program to be performed on the machine will be engraving the monogram with a 90 degree angle engraver. The size of the monogram is 100x52mm. The file of the control program is located in the folder "CP" on the electronic medium that comes with the machine, which is called "monogram 100x52 gr90.cnc".

After installing the workpiece and cutter, as well as setting the zero position of the cutter, we can proceed to the very process of executing the CP.

In the UGS program, open the CP using the "Browse" button. The slider for adjusting the speed of the router is adjusted to the right position. We check that there are no foreign objects on the desktop. After that, start the execution of the CP with the "Send" button.

After starting the execution, the milling cutter will automatically start and execute the program for engraving a monogram.

After completing the program, the milling cutter will go back to its original position and turn off. A message will appear on the UGS screen,

indicating that the program was successful and the elapsed time. As a result, the monogram on the surface of the workpiece will be engraved, as shown in Figure 12:

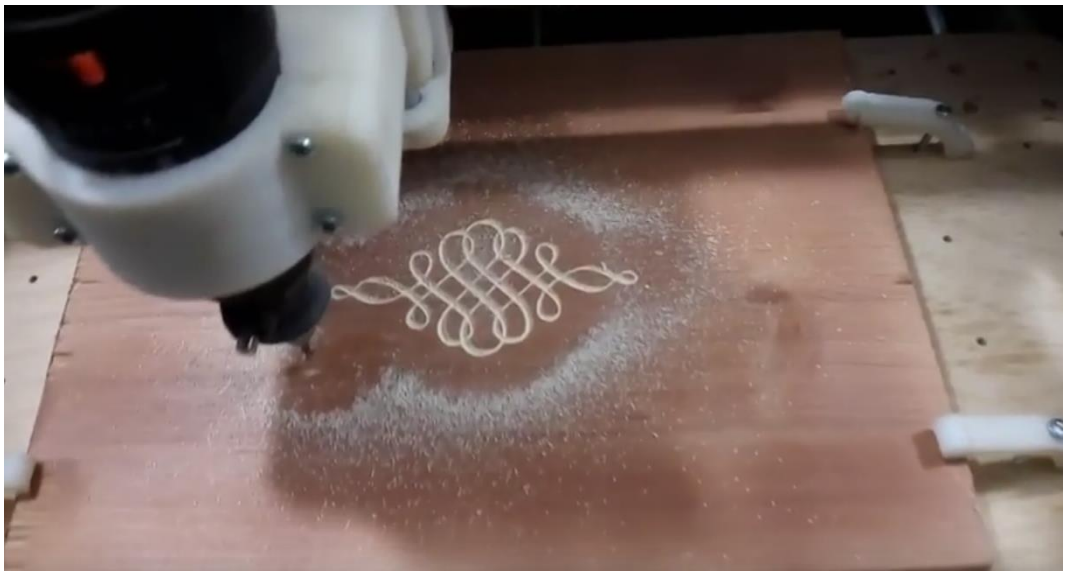


Figure 12 – Monogram

Writing a control program

Writing a control program is one of the most important tasks when working with a CNC machine, since errors in the CP can lead not only to damage to the workpiece or tool, but also to breakdown of the machine itself or to damage to health. Therefore, you should be cautious with the preparation of the CP.

Writing of a CP is done in CAM-systems. CAM systems include tools for technological preparation of products, provide automation of programming and control of equipment with CNC or GAPS (Flexible automated production systems). For learning purposes, we will show the examples of writing the CP in the most visual and easy-to-learn ArtCAM system.

Processing by Profile. The ”Eiffel Tower” Designer

According to the procedure described below, it is possible to cut such sheet materials as plastic, plywood, cardboard, MDF, wood, etc. With cutting, it is possible to make design photo frames, bases for decoupage, designs from

plywood, as well as figured pruning of engravings and other various works. We will apply the CP writing to the example of manufacturing the design "Eiffel Tower", made of plywood 3 mm.

After opening the ArtCAM program, select the "New Model" menu item on the left side of the screen, then you will be prompted to enter the size of the workpiece. The maximum allowable size of the workpiece is 360x230 mm. We leave the allowance at 5mm on each side and enter the size of 350x230mm (see Figure 13) and click "OK".

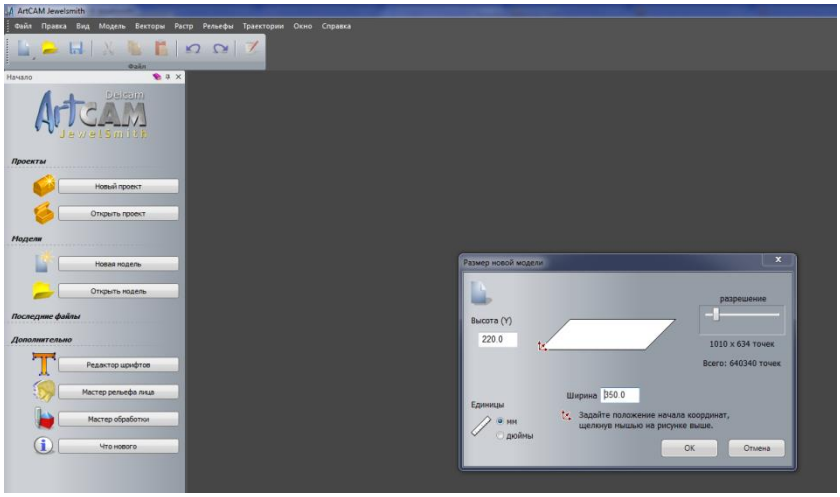


Figure 13 – The size of the new model.

Next, you need to import the vector model of parts that you need to cut. ArtCAM supports the import of vectors of the following formats: dxf, dwg, ai, eps. Import is made through the menu item "Vectors" - "Import ...". In the opened window, you need to find the vector we need on the computer. The proposed design is in the folder "CP" - "Tower" and consists of 5 parts. Let's open the first one. In the next window we are offered the parameters with which the import will be performed (see Figure 14). Leave the parameters unchanged and click OK.

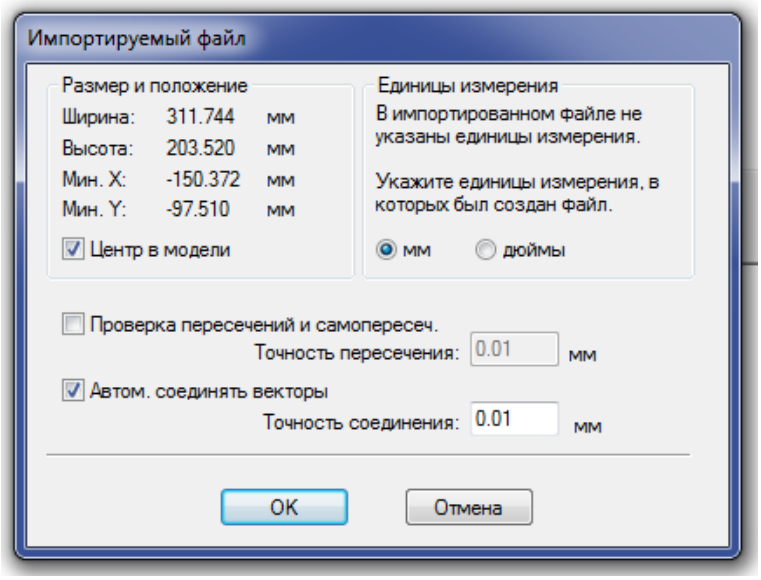


Figure 14 – Vector import settings.

After closing the dialog box, the imported vectors will be displayed on the screen. If the imported vectors are not removed or need to be moved around the work field, you can group them. To do this, hold down the "Shift" key and select the required vectors with the left button and then select the "Group vectors" item (see Figure 15) in the context menu (by right-clicking on the vector). After this, you can move each part along the working field without deformation of the parts. After all the vectors have been located on the working area, without going beyond and intersection, then you can proceed to write the control program.

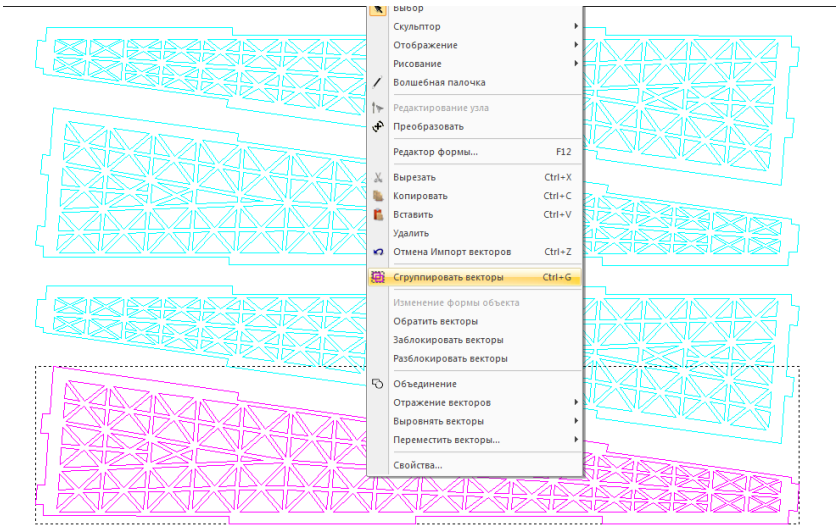


Figure 14 – Combining vectors into groups.

Generation of all CPs is produced from the "Trajectories" item of the top menu of the main program window. Processing by the profile is selected by the item "Trajectories" - "New 2D trajectory" - "Profile ..."

In the window that appears, enter the following processing parameters:
"Profile type and vector relationship"
- Allowance: 0mm

"Depth of cut"
- Initial depth: 0mm
- Final depth: 4mm
- Accuracy: 0.05 mm
The other parameters remain unchanged.

Next, you must select the profile tool and workpiece. To select the tools in the "Profile tool" area, select the item "press to select ...", and the "Tool base" window will open

In this window, the most common types of milling cutters for working on this type of milling machine are presented. For the cutting of plywood, a straight cutter of the "Corn" type with a diameter of 1.5 mm will be used. Next, an example is shown of how to set the cutter parameters in the ArtCAM program. Following this principle, you can configure other types of cutters.

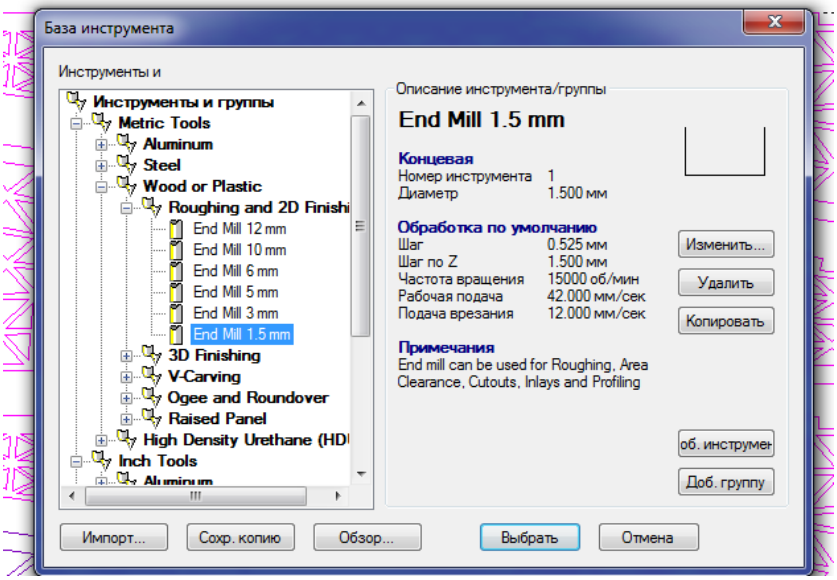


Figure 15 – Tool base.

In the left part of the window, select the type of the tool you need, going down the hierarchical tree: "Tools and Groups" - "MetricTools" - "WoodorPlastic" - "Roughingand 2DFinishing". In this group, end mills of different diameters are presented. The closest tool to the tool used is an end mill with a diameter of 1.5 mm "EndMill 1.5mm", but in order to use it, you need to copy this profile and change the mode of its operation.

To do this, select "EndMill 1.5mm" in the left part of the window. In the right part of the window you can see the operating mode of this cutter. You must select "Copy", then another "EndMill 1.5mm" cutter will appear in the list. Select it and click the "Change ..." button. Adjust the cutter according to figure 16:

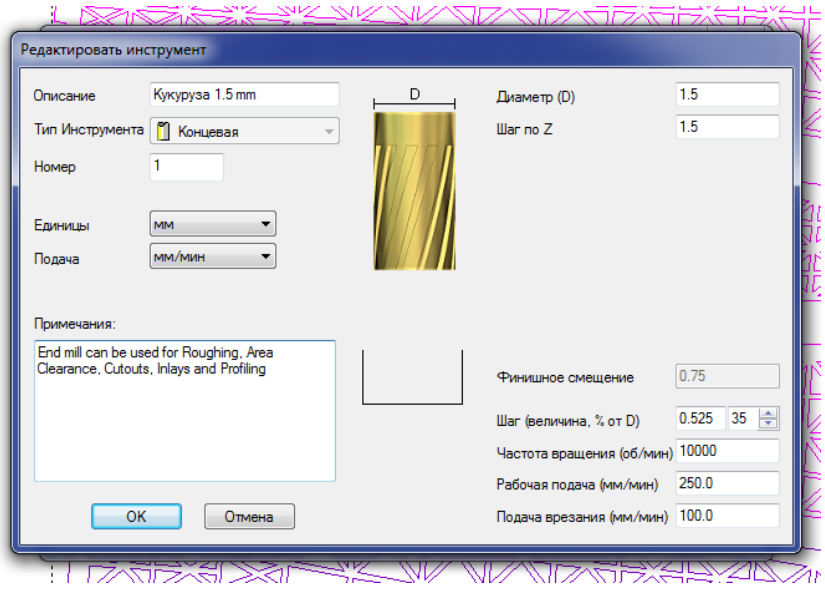


Figure 16 – Cutter parameters «Corn».

After the setting it up, confirm the parameters with the "OK" button and select the cutter from the list with the "Select" button. The milling cutter appears as the selected tool.

In the "Options" area, open the "SafeZ" drop-down menu and enter the following parameters:

- Secure Z: 5mm.
- Initial. X: 0 mm.
- Initial. Y: 0 mm.
- Initial. Z: 5 mm.

Next, choose the thickness of the workpiece and the position of the zero coordinate. To do this, there is a drop-down menu "Click to specify the material ...". After opening it, a new dialog box "Set Presets" opens. Enter the parameters of the workpiece in accordance with Figure 17

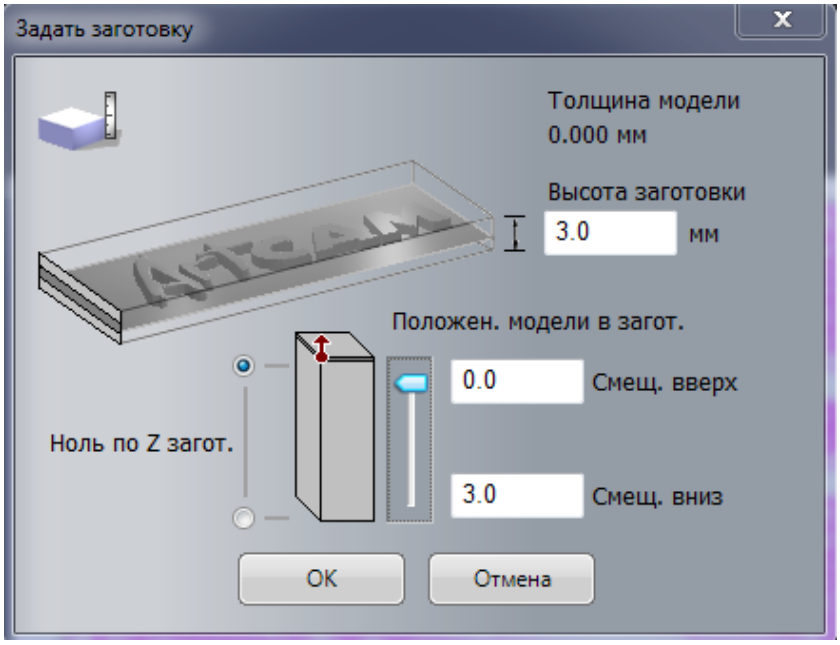


Figure 17 – Workpiece parameters.

The thickness of the workpiece is equal to the thickness of the plywood, that is, 3 mm.

The zero coordinate in height in our case is located on the upper side of the workpiece, which is indicated in the parameter "Position of the model in the workpiece".

After entering all the parameters, confirm the data with the "OK" button.

It remains only to enter the name of the trajectory (For example, "Part 1") and start the calculation of the trajectory with the "Calculate now" button.

After calculating the trajectory in the work area where the processed vectors are located, another burgundy color will appear - this is the processing trajectory (see Figure 18).

On the right side of the screen, in the Project panel, there is a project tree that contains all the elements of the current model. In the "Trajectories" branch there is the newly created trajectory "Part 1". After selecting Below the project tree, the work with trajectory tab appears. To save, select "Save Trajectories".

In the left part of the opened window, the entire list of trajectories calculated in this model will be displayed. On the right side, the CPs are displayed in order of execution, which will be saved. Choose the place and name of the file, and the file format. The format of the file is "Mach2 mm (*. Cnc) and click the" Save "button.

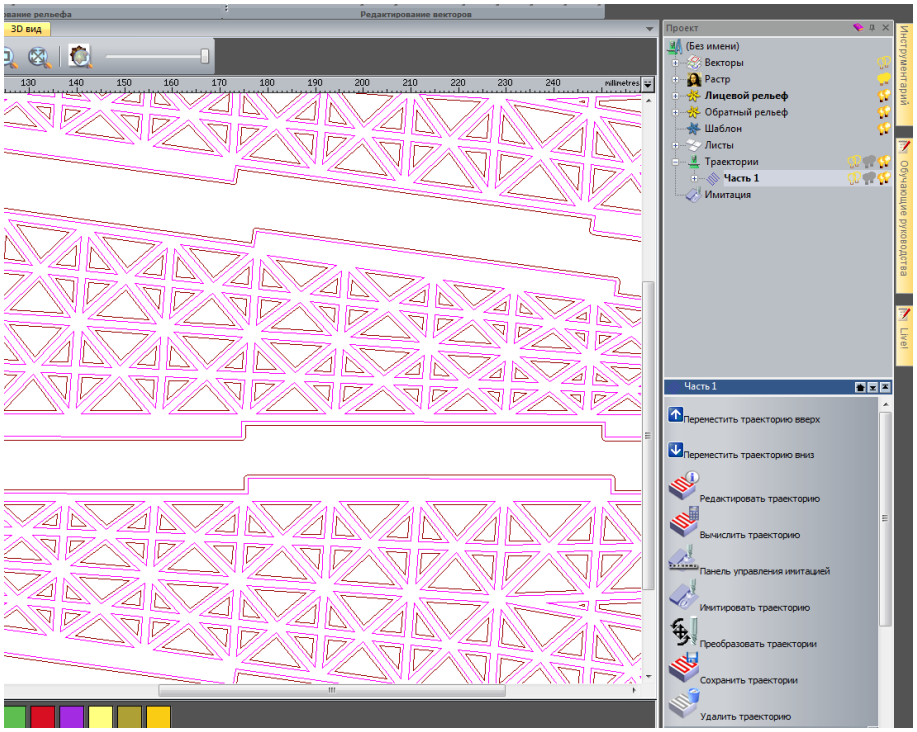


Figure 18 – CP parameters.

After saving, the CP file can be launched in the UGS program for execution.

By the same principle, the calculation is done for the remaining 4 parts of the design "Eiffel Tower".

After milling all the parts, assemble and glue of all the details of the design.

Maintenance

It is required to keep the machine clean. After the end of work, the machine must be cleaned from the processing products with a cloth and a brush, and blow out the components with compressed air.

The service life, productivity and accuracy of the machine depend on cleanliness of the equipment and timely maintenance of the machine, namely:

• Every 24 hours after the operation, wipe off dirt and lubricate the drive screws with engine oil;

• Every 24 hours after the operation, wipe off dirt and lubricate the guides with engine oil;

• Every 48 hours after the operation, lubricate the bearings in the bearing blocks with engine oil;

During operation, some parts and parts of the machine naturally get worn, and its performance gets disrupted. If the components and parts are heavily worn, they must be replaced.

Troubleshooting

Many malfunctions occur due to non-compliance with safety regulations and operating conditions.

Malfunction	Reason	Troubleshoot

Uneven feed	1.Transfer of the stepper motor; 2. Feed rate is too high for the mode; 3. the axle is cutting the drive nut or bearing blocks; 4. The machine is unevenly installed on the surface 5. Bearings are worn.	1. Set the parameters in the software that do not exceed the allowed values; 2. Reduce the feed speed; 3. Clean the drive screws and guides from dust and dirt and lubricate with engine oil; 4. Visually inspect the machine for the presence of foreign objects under it. 5. Replace the bearings.
The feed screw does not rotate	1. The clutch is being turned; 2. The clutch is broken	1. Tighten the screws on the clutch; 2. Replace the clutch.
The spindle does not turn on	1.The spindle is switched off; 2. The fuse has blown; 3.The brushes are worn;	1. Move the speed adjustment slider to the right position; 2.Check the safety of the fuse; 3. Replace brushes;