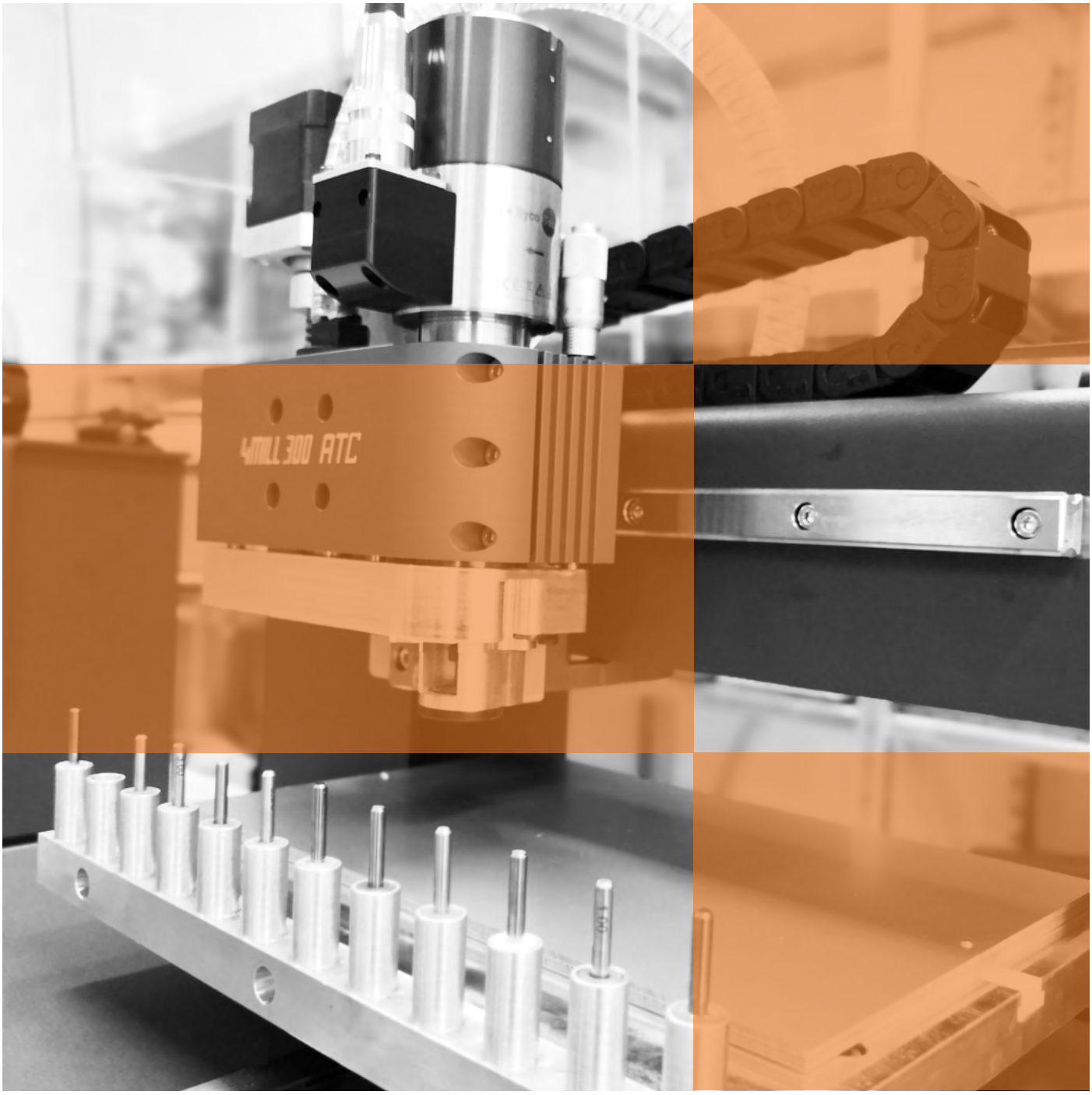


mipec

MIPEC 4MILL MACHINE
USER MANUAL

CONTENT

1 ABOUT THIS DOCUMENT

This manual contains required information for the operating the machine. It is assumed that the person reading this manual has the basic knowledge in using a personal computer and the basic knowledge using Microsoft Windows operating system. It is also assumed that the operator has the basic knowledge regarding safety precautions and behavior in the workplace.

Where should the document be available
When working at or with the 4MILL, this document must be available at hand for all the people that might be working with the machine. As the machine owner, you must make sure that the machine is operated only by the people who have read and understood this manual or have been informed about the contents of the manual.

Explanations of signs and notations in document
Throughout this document, different notations were used to simplify the navigation through the document and to emphasize the importance of certain parts.

Danger to health or danger to life
this symbol means that not conforming to the situation described may pose a risk to health and life.

Risk of machine and/or accessory damage
this symbol indicates that not conforming to the situation described may result in machine and/or accessories damage (tools, material etc...).

Tip: This symbol is used when we want to give you a hint on how to perform a certain task in a simpler way or bringing the user attention to a specific task.

Bold text
Used as a marker for words used as terminology words throughout the document, such as names of the part of the machines, or in software, the captions of the commands to use.

Italic
Used as a marker for brand names and software message dialogs.
Used as marker for specific file folders.

Brand names
MIPEC is a trademark of P2J Technology. Microsoft and Windows are brand names or registered trademarks of the Microsoft Corporation in USA and/or other countries.
All other brand names belong to their respective owners.

2 SOFTWARE AND MANUALS

Software and manuals can be downloaded from the link sent to you after purchasing the machine or stored on delivered USB stick.

3 INTRODUCTION

What can I do with the machine
Thank you for the purchase of your new 4MILL. This milling machine is especially suitable to make printed circuit boards (PCB's). Standard delivered software with the machine is TrackMaker; application that allows you to import Gerber and Excellon files and from this data manufacture a PCB. Using additional software modules (not included) and/or hardware components it is possible to perform a variety of tasks. Please contact us regarding your application so that we can help you find the suitable solution.

In general, the machine is able to do 2D and 2 ½ D work.

For PCB milling production, the following work can be done:

- Milling and drilling of the single-sided, double-sided circuit boards
- Milling of cutouts in any shape

Following materials may be processed using the machine:

- All types of the PCB material (i.e. FR3, FR4, Duroid, GFK/CFK, PTFE/ceramic)
- Nonferrous materials
  - Aluminum
  - Brass
- Various plastic materials
- Wood

If you have any specific material you wish to process please contact your local distributor for more information

Liability for damage
4MILL has been developed and manufactured in accordance with the state-of-the-art standards and rules. However, the usage of the machine may pose a risk to life or body parts of the end user, or cause damage to the machine, material, tools or other equipment used with the machine.

It is very important that you read this manual before putting the machine into operation. Failing to do so will invalidate any warranty claims.

Disclaimer

The manufacturer and/or seller will not be held liable for the damage caused by the following actions or conditions:

- Usage in unsuitable environment
- Not complying to the legal safety requirements
- Not complying to the technical information
- Installation by unauthorized or unqualified personnel
- Installation not carried out correctly
- Improper handling of any kind, or any usage that is not included in this manual or accompanying manual
- Missing or incomplete maintenance
- Unauthorized technical modifications
- Use of non-original spare parts and those that are not specifically designed for this machine
- Use of unsuitable materials

4 SECURITY AND PROTECTIVE REGULATIONS

Risk of death by electric shock!

Missing or insufficient electrical fuse protection can result in fatal electric shocks and/or fire. Fuse holders MUST NEVER be bridged.

Risk of injury!

The open cover of the acoustic cabinet can drop down due to impact shocks or vibrations. This can result in limbs being broken or crushed.
When opening the cover of the acoustic cabinet, make sure that it engages in the uppermost position and cannot drop down because of vibrations or the influence of other persons.

The machine is controlled by the PC software. It may start unintentionally.

General safety instructions

Read the instructions for installation/operating manual before operating the machine. In case of uncertainties, ask a person qualified in operating the machine or contact the qualified and authorized support.

The machine may be operated by only one person at a time.

Use the machine only in accordance with its designated use.

General safety instructions (continued)

Never operate the machine in environments subject to fire or explosion hazards.

Protect the machine against direct sunlight and humidity.

Operate the machine only with accessories approved by manufacturer and use only original MIPEC tools.

Use the machine only in perfect condition. Prior to each use, perform a visual inspection. Look out in particular for damaged cables and hoses. Make sure that the safety devices are in perfect working order. It is prohibited to bridge safety devices or to make them inoperable unless such provision is available in the software and you are aware of the risks involved.

Make sure that there is no risk of stumbling caused by cables and hoses.

Have the machine operated, serviced and repaired by sufficiently qualified and authorized personnel only.

Repairs must only be carried out by qualified and authorized personnel or after having consulted the qualified and authorized support center.

Keep children away from the working area.

Do not eat, drink or smoke when operating the machine.

Operators with long hair must wear a hair net.

Observe the general and legal regulations for accident prevention and environmental protection.

Operate service and repair the machine only when wearing the prescribed protective equipment.

Prior to any maintenance work, pull out the mains plug.

Maintenance work must be carried out regularly.

When damage or malfunctions are observed, put the device immediately at standstill. Have any malfunctions fixed immediately. If damage cannot be eliminated, put machine out of action and secure it against being switched on. Then contact your dealer for further support.

Extract the dust and material residues in the machine or remove with a brush. Do not blow compressed air through it!

5 REQUIRED ACCESSORIES

For the operation of the *MIPEC 4MILL*, you need the following accessories:

- Computer with installed *Microsoft Windows 7/8/10/11*; All different editions (i.e. *Home, Professional, Ultimate*...) are supported, as well as 32bit and 64bit processor architectures. We recommend *Windows 10*.
- Safety switch
- Dust extraction device
- Compressor or air pressure connection (6mm) of 0,6MPa, 30l/min (only for ATC machine)
- Tools and consumables

6 MACHINE PARTS DESCRIPTION

Machine backside:

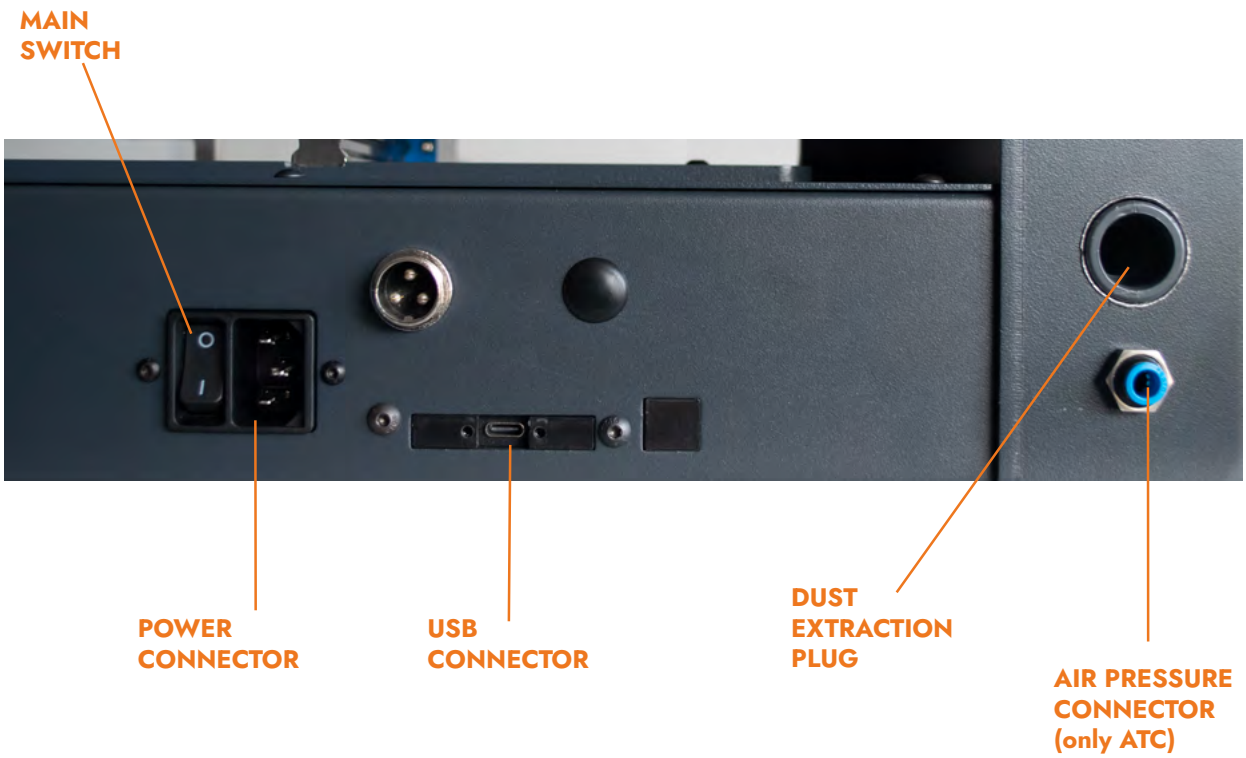


Figure 1 – machine backside

Electronics:
Machine controller is located on the bottom of the machine. Here all the connections are mounted. Each connector is described further in the document

When milling oversized material, make sure that there is enough clearance behind the machine. Failing to do so may result in damaged material and machine.

Serial number:

Figure 2 - label

Serial number on the machine gives support personnel information about your machine. Keep this number at hand when contacting support or your local dealer.

Safety switch and power switch:

Safety switch is assembled on the machine and is used to switch OFF the machine in case of emergency. Safety switch MUST be released, otherwise all movements of the machine are blocked.

Power switch is external device used to switch ON or OFF the common vacuum cleaner simultaneously with the machine spindle. With MIPEC DEU-400 dust extraction unit, the Power switch is not required.

Figure 3 – safety and power switch and its connection

Dust extraction plug:
Dust extraction plug is used to connect a dust extraction device to the machine. When the machine is milling it must be at all times connected to the functional dust extraction device.

Operating the machine without the dust extraction system may pose a risk to your health. Among other, this is to take in consideration when milling FR4 PCB material or Teflon based PCB material; therefore, milling without the dust extraction is not allowed. If you are in doubt which material you should mill with the machine plea se contact your local dealer.

Your dust extraction device should be equipped with a fine-dust particle filter (HEPA filter) in order to prevent the fine dust particles getting in the air.

Besides the health hazard, the milling result of the machine will not be good if the dust extraction unit is not connected. Dust generated may in fluence the depth of milling.

Since there are many different dust extraction systems available on the market, it is impossible to provide a universal connector for the dust extraction you have. We can help you purchase the adequate adaptor piece for your dust extraction system. On the following picture (figure 3) is the sample of such a connector.

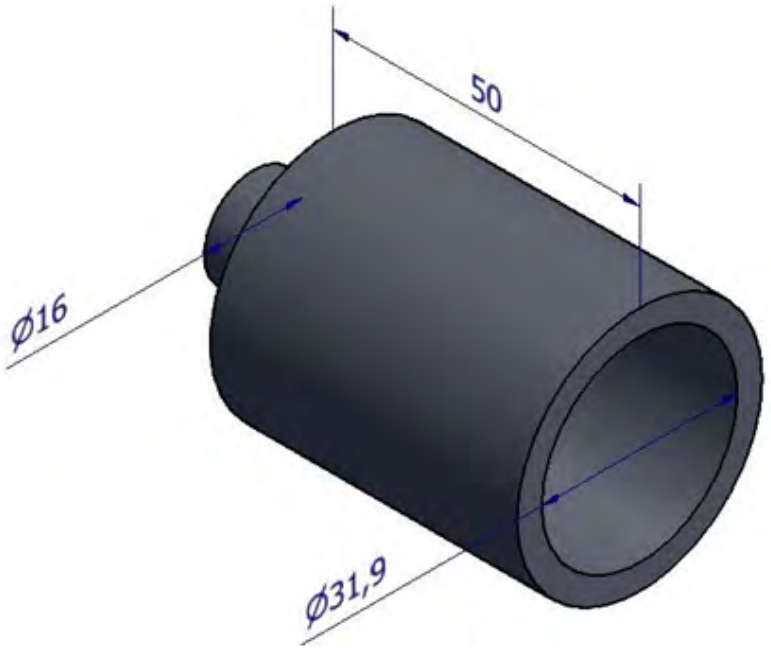


Figure 3 – example of dust extraction system connector

Air pressure connection – only for ATC machine

ATC machine requires air pressure for safe tool change and protective and cooling air going through the spindle.
This air pressure must be connected by 6mm hose to AIR PRESSURE CONNECTOR (see figure 1).

The pressure must be 5-6 bar (73 – 87 psi). Air must be dry and dust-free. It must not contain any foreign bodies or lubricants.

Purity class according to ISO 8513-1:2010
Particle class 1

The number of particles per cubic meter of compressed air must not exceed 20.000 particles in the range between 0,1-0,5microns, 400 particles in the range between 0,1-0,5microns, 10 particles in the range between 1-5 microns.

Water class 4
A pressure dew point of +3oC or higher is required. Water in liquid form is not permissible.

Oil class 2
A maximum of 1 mg of oil is permitted per cubic meter of compressed oil. This value corresponds to the total liquid oil, oil aerosol and oil mist content.

Using of compressed air which doesn't meet requirement mentioned above can lead to irreversible motor damage.

7 ELECTRONICS CONNECTIONS

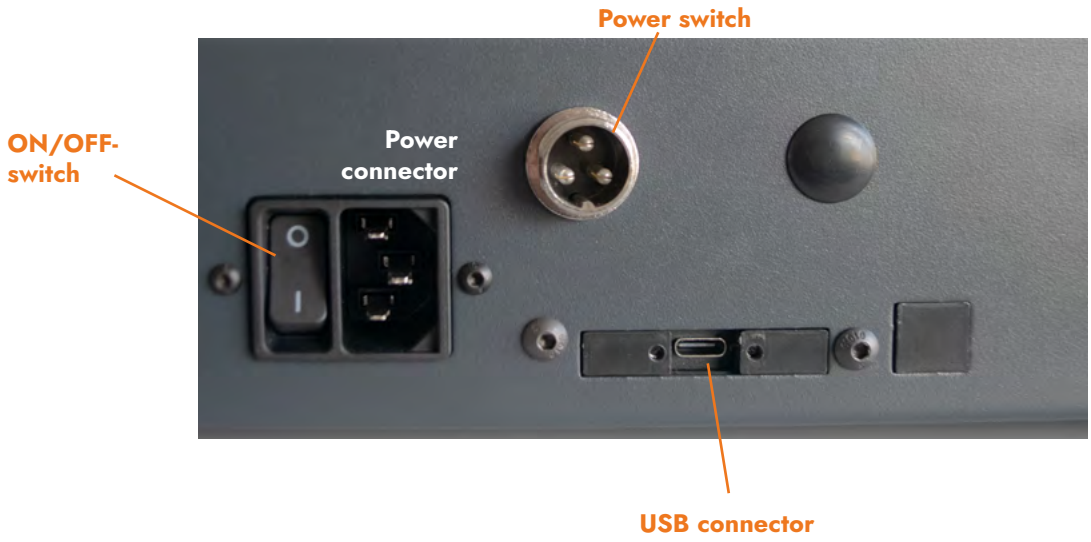


Figure 4 - Electronic connections

1. Machine ON/OFF switch
Used to switch the machine ON / OFF.

2. Power supply cable (110 VAC – 240 VAC)
Before plugging in the power supply cable, make sure that the machine on/off switch is in the OFF position (see picture above). Plug in the cable into the plug as seen on the right picture and connect either to 240 or 110 VAC outlet.

3. USB cable plug
USB connector is used for connection between the PC and machine. Insert the USB cable in the plug as seen on the picture on the right. Other end of the cable should be inserted in a USB port on the computer.

8 MACHINE MECHANICAL PARTS DESCRIPTION

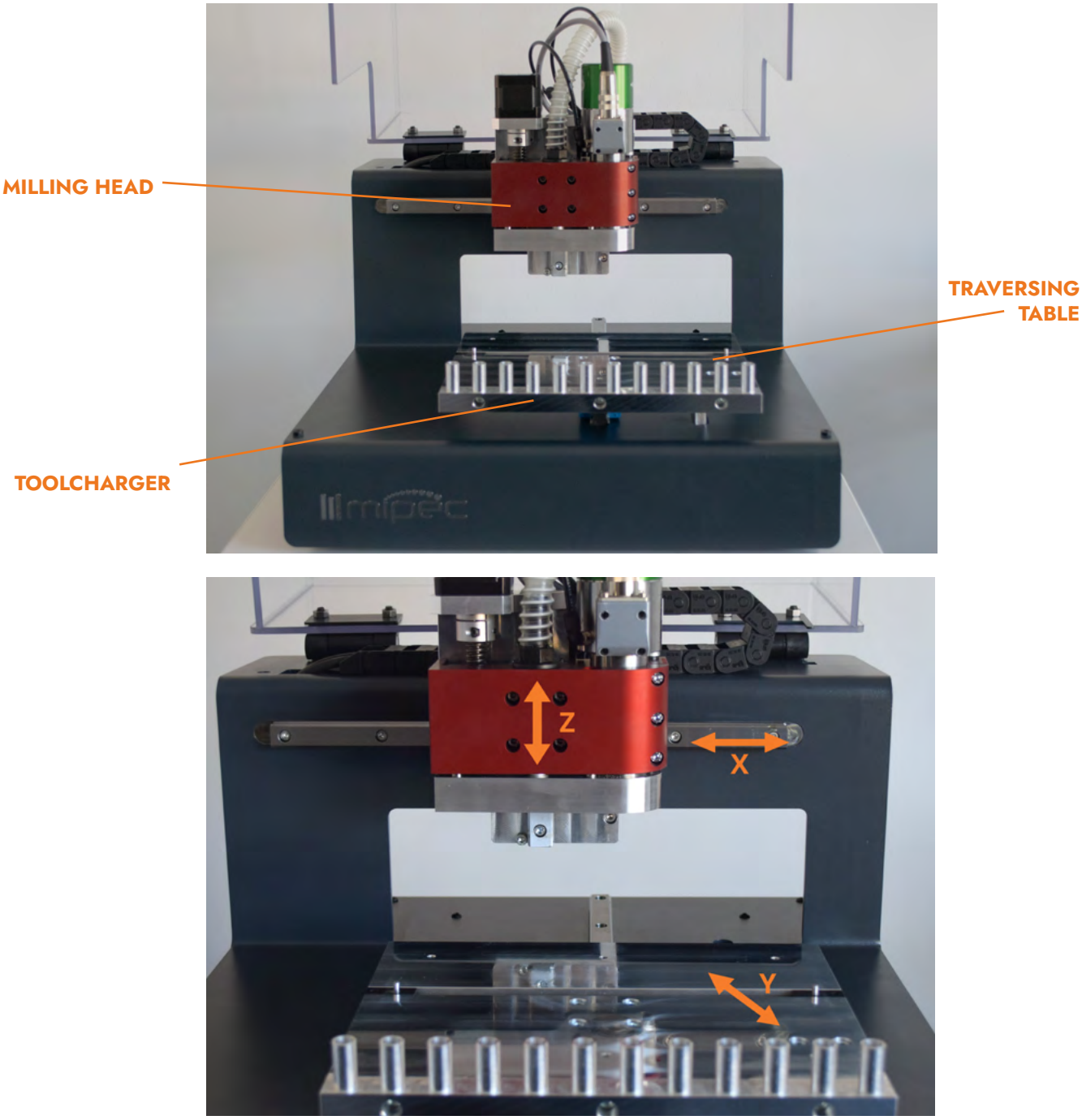


Figure 5 - Machine parts and axis

Milling head is the moving part. It moves from left to right (X) and up and down (Z). It carries the **milling motor**. Traversing table is the moving part it moves from back to front (Y). It is used as material mounting table.

- Moving from left to the right in X ax direction is considered a **positive** X direction
- Moving from right to the left in X ax direction is considered a **negative** X direction
- Moving from up, to down in Z ax direction is considered a **positive** Z direction
- Moving from down to up in the Z ax direction is considered a **negative** Z direction
- Moving from back to front in the Y ax direction is considered a **positive** Y direction
- Moving from front to back in the Y ax direction is considered a **negative** Y direction

Axes of the machine are defined as shown on the picture above. Maximum axis travel is as follows:
X max = 220.000 mm
Y max = 220.000 mm
Z max = 50.000 mm

The machine is in its zero position when the **milling head** is completely on the left side, **traverse table** completely on the back of the machine and **Z ax** fully retracted (up position).

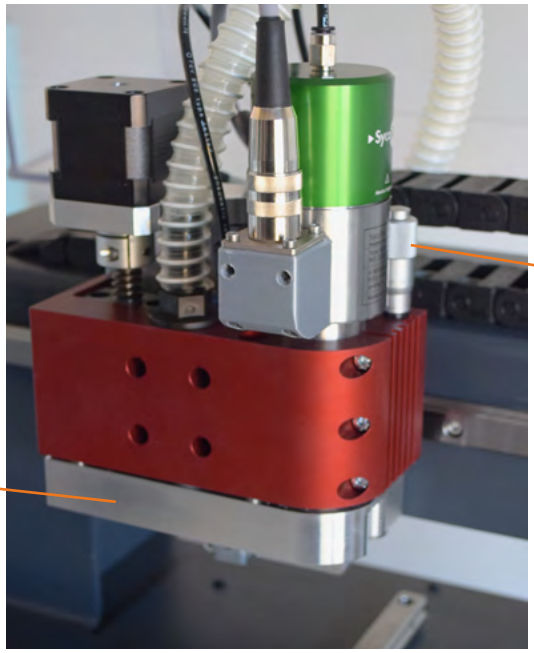


Figure 6 - Milling head

- **Micrometer** is used to define correct milling depth

- **Engraving head** is at the same time a **dust extraction head**. It allows the depth adjustment of the tool protrusion by the means of the micrometer. For easier manu al tool-change, the small cap with black ring can be removed so that it is not staying in the operator's way. After tool change it must be mounted back to its position on the magnets.

9 INSTALLATION

Where to put the machine
This machine must not be set up in moist rooms. The surface of the table where you place the machine on must be sturdy and even. It is necessary to ensure that the table has sufficient strength and torsion-sturdiness to support the machine. The room temperature should be between 15° and 30°C as this is the best range for the gliding quality of the employed lubricants. It is possible to use the machine in a widened temperature range, but in this case, the machine settings might need adjustment.

Contact your dealer as only authorized person can and should execute adj - ustments on machine settings

The relative air humidity may be max 80% non-condensing. To connect the machine, an AC power supply with 230 V/50 Hz or 110 V/50 Hz, is needed. When possible, the computer should be fused separately. Please also take care not to connect the machine to the same power net with other insufficiently shielded devices as these could electrically interfere with the high-end controller and cause a failure of the system. After power cable and USB cable are connected, software installation should take place.

10 SOFTWARE

Installing TrackMaker
Your machine is delivered included 1 license of software TrackMaker. Software for your machine can be downloaded from the link you received after purchasing your machine or from USB stick delivered with the machine.

To start installing the software, run the installer Setup (i.e. double click the file) and follow install shield wizards instructions.

In order to install the TrackMaker software you will need full administrator privileges.

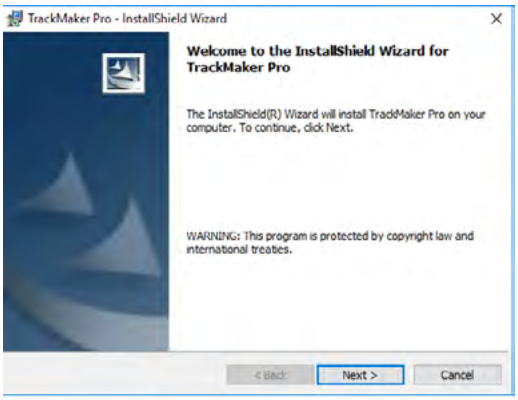


Figure 7 – TrackMaker installation

As the software does not have any custom installation steps, you must click on the **Next** button when prompted until the installation is complete. At the end of installation click on **Finish** button to complete the installation process.

Just before the installation starts and if you are using Microsoft Windows 7/8/10, the Microsoft **User Account Control** (UAC) will pop up the dialog requiring your confirmation to allow the installation. Click on **Yes** to start the installation.

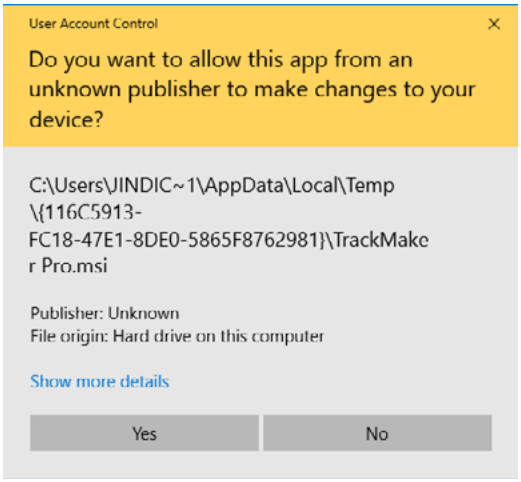


Figure 8 – UAC appear

Software - what has been installed
After the installation is complete, the following data is installed:

In the *C:\Program Files* folder, a folder is created *P2J\TrackMaker*; this folder holds the installation executable and dynamic link libraries (DLL's).

If your PC is running a 64 bit version of Windows the application will be installed in the C:\Program Files (x86) folder

All the configuration files are located in the following folder:

- For Windows 7/8/10/11
  C:\Users\[your user name]\AppData\Roaming\P2J

Information on the location of configuration files has been mentioned in order to help you locate the files in case the support personnel should ask you to send configuration files to them, or to update your local files.

Do not modify the contents of the configuration files. Manual editing of the files may lead to software not starting and making your machine unusable.

All the projects are located in your *Documents* folder under the subfolder *P2J\TrackMaker\JOB*. Sample file is located in the subfolder *Sample*.

Note that the above paths assume default settings in the English version of the Windows. If you have custom folders or localized version of Windows, then please browse to the corresponding folder or look at the Windows documentation on folder locations.

Shortcut is created on your desktop with name TrackMaker.

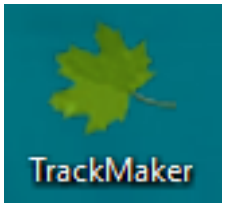


Figure 9 - Application shortcut

After installation the TrackMaker must be activated. The way how to do it is described in TrackMaker manual and in printed machine installation manual delivered with the machine.

11 STARTING THE MACHINE FOR THE FIRST TIME

Machine has a provision that all operations that machine is doing are stopping if the hood is open. However, this function must be enabled in the TrackMaker soft ware. If you are feeling more confident to have this feature on, please check the enabling of the hood switch section in TrackMaker manual.

First startup of the machine is executed without the safety switch on the hood activated.

1. Install the software.
2. Make sure the machine is not connected to the power supply and that the machine switch is in OFF position.
3. Connect the power cable to the machine and to the outlet. (See Figure 4 - Electronic connections).
4. Connect the USB cable to the USB connector on the machine, and other end to the PC USB slot. (See Electronics for the connections).
5. Make sure the engraving head is on proper place. (See picture: Figure 6 - Milling head).
6. Close the hood.
7. Switch the machine on by putting the machine on/off switch in the ON position.
8. Windows will start installing the device driver. Windows should inform you that your driver has been installed successfully. (This may take a minute).
9. Start the TrackMaker application by double clicking on the shortcut icon on the desk top (see Figure 9 - Application shortcut).
10. If the installation of drivers succeeded, you should get the message on the screen "Do you wish to make a Reference Run?" Click **Yes**. Machine will start homing.

Machine spindle must be warmed up accordingly to warm up diagram delivered together with machine. Running the machine without previous warmup may cause serious damage of the spindle. At this case the warranty can't be accepted.

12 SETTING UP THE MACHINE

This section describes the basics of understanding how to use the machine. Although this manual is focused to the milling of PCB's, most of the principles apply for other applications. If you have purchased the machine for processing other applications, please refer to the appropriate manual, delivered with the accompanying software.

Material mounting table
Your machine is standard equipped with a single groove table for mounting PCB's. This table has in its middle a groove where the two **mounting pins** are mounted. Pins have a double use.

1. **They are used to hold the material in the position**
2. **They are used as reference points to mill double-sided copper clad laminates (mirror line).**

Figure 10 – machine table with mounting pins and central T-groove

The distance between the mounting pins is 210mm. Pins have a diameter of 3 mm.

Setting up material and underlay material

In order to start milling with the machine the underlay material and the PCB material must be placed on the machine table. In delivered starter set you received the underlay material and the PCB material, they come pre-drilled with holes for fixing pins. You may need to clean the holes in delivered material with 3mm drill or 3mm contour router.

In case that you want to use your own materials, you must drill the holes yourself. Material has following dimensions: 220 x 150mm. Distance between holes is 210mm. We recommend drilling the holes with drill 2,95mm and then softly enlarge holes with 3mm drill or contour router manually.

Single-sided materials can be fixed with double sided sticky tape as precise positioning by mirror line pins is not required. You just need to secure the undelay material and PCB material against movements.

If your material is smaller than the one specified in default setting, you will have to move the stones with mounting pins in the T-groove.

Underlay material

Underlay material is used as a disposable sheet which serves as a protection plate for the machine table. When machine is milling PCB boards, drilling and routing (cutting the board from the rest of the material), is done in the underlay material rather than in the machine table.

Never use the machine without the underlay material. This will lead to irreversible damage to the machine table

Standard underlay material for PCB milling is a wooden sheet with dimensions W: 220 mm L: 150 mm H: 3 mm. If you prepare your own material, cut a sheet of wood 3 mm thick to the dimensions 220x150 mm. In the center of the sheet drill two holes with distance of 210 mm between them with diameter of 4 mm. (See: Figure 8 - Underlay material size with holes). Holes are drilled with the drill of 4 mm for ease of mounting the underlay material.

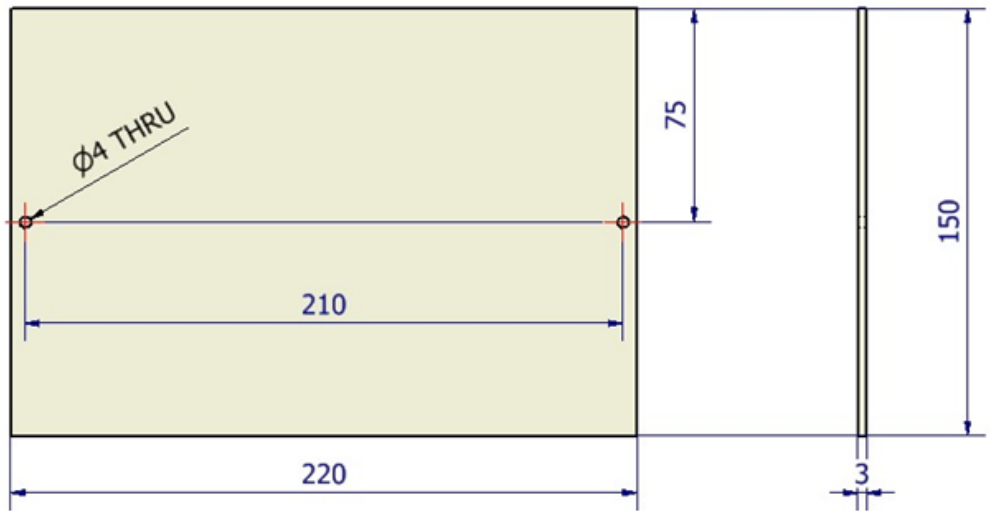


Figure 11 - Underlay material size with holes

If you are using the material that has a different thickness than 3 mm please see the section Setting up the default zero position. Not re-adjusting the zero position may lead to bad milling results or tool and machine damage.

If the size of the underlay material (width and length) is different than mentioned as above, or if the distance between the drilled holes for the mounting pins is not 210 mm, you might have to move the right mounting pin left or right to be able to mount the underlay material.

If you change the position of the mounting pins, the new positions must be adjusted in the software. Failing to do so will lead to unusable double-sided PCB's.

PCB material

Various PCB materials can be used with the machine. The default and most common are the FR3 and FR4 materials (single sided or double sided) with average thickness of 1.6 mm. If you have purchased the PCB material together with the machine, the mounting holes will fit the current machine configuration if mounting pins were not moved.
If you have your own PCB material that you want to use with the machine, the preparation for drilling holes is the same as for the underlay material except that the drilled hole size should be 3 mm rather than 4 mm as it is specified for the underlay material. Please follow the instructions mentioned there.

Unlike with the underlay material, the drilled holes for the PCB material MUST have the diameter of 3 mm. If the drilled hole is too big, the PCB material will be lost and the milling result may be unusable and/or tool may break.

If either pin's position is changed or you are using different sizes of underlay material or PCB material, you will have to adjust the positions of the holes on both underlay material and PCB material.

When using different PCB material thickness, please read information in setting up the default zero position

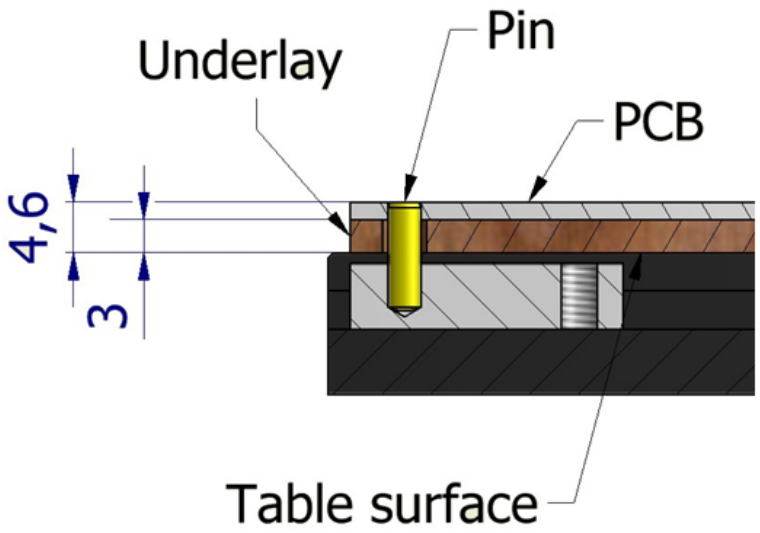


Figure 12 - Properly placed underlay and PCB material

Top of the pin should be aligned with the top of the material. If the pin is protruding out of the material you will not have problems with the fixture of the material, but you will have to be careful not to mill in the close vicinity of the pin. If the pin is be low the surface, this is no problem as long as the PCB is properly fixed (max value should be about 0.5 mm below the surface of PCB).

13 TOOLS

This section will explain the usage of the tools for PCB milling. For other milling applications, please refer to the delivered documentation.

Tool description

Tools used for PCB manufacturing can be divided in two groups.

- Tools that are milling on the surface of the material
- Tools that are milling through the material

All tools that are working on the surface of the material are 36 mm long; all the other tools (i.e. the ones going through the material – drills and contour routers) are 38 mm long.

Tools for working on the surface can be split in two sub-groups: Engraving tools and rubout tools. Engraving tools are V-shaped cutters allowing milling insulation widths of 0.1 – 0.2 mm and 0.2 – 0.5 mm. Rubout tools are in general used for removing larger copper free areas and they come in different diameters ranging from
0.25 – 3 mm. Again, all these tools are 36 mm long.

Tools for cutting through the material consist of all the drills ranging from 0.2 mm to 3 mm in steps of 0.1 mm and contouring routers ranging from 1 – 3 mm in steps of 0.5 mm.

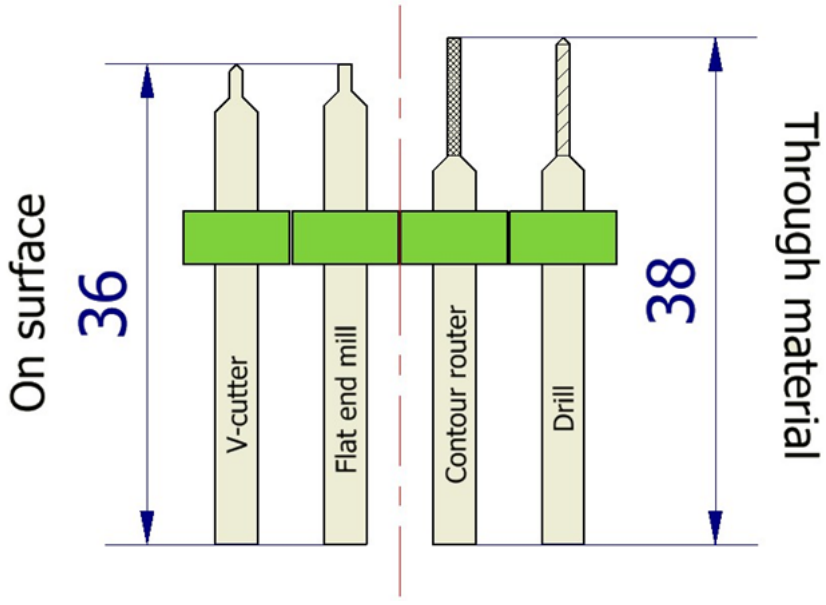
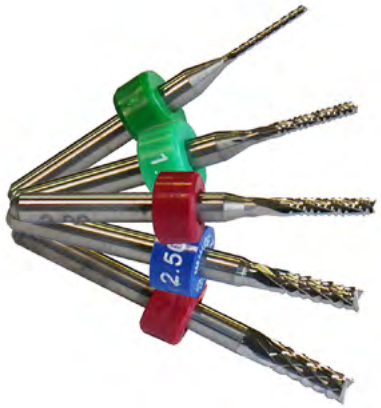
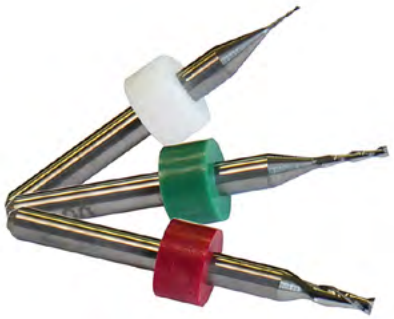


Figure 13 - Different tool types



Contour routers



Endmills

PCB drill bits

Universal cutters

Tools on pictures are as seen from left to right:

- Normal line milling tool (UNIVERSAL CUTTERS)
- Flat end mill
- Contour router
- Drill

The V-cutters used to engrave the insulation tracks come in two different shapes, cutter that is called **Normal line milling tool** and a cutter that is called **Fine line milling tool**. **Normal line milling tool** is used for insulation milling ranging from 0.2 – 0.5 mm while the **Fine line-milling tool** is used for insulation milling ranging from 0.1 to 0.25 mm. As a standard setting **Normal line, milling tool** is used for most of insulation milling if the clearances on the board are allowing it.

Changing of tools

To put the tool in the motor:

- Remove the engraving head out of the way to have clear access to the tool clamp, it holds on 4 magnets. See figure 27.
- Insert the tool in the clamp all the way to the tool stop ring. Hold the tool in with one hand and with other hand turn the tool lock knob clockwise to lock the tool. Keep turning on the knob until the tool is properly locked (only for manual tool change, manual tool change with ATC machine is described below).
- Now put the engraving head again back to place.

Be careful not to touch the tool with the engraving head when pivoting the engraving head. Tool may break.

To remove the tool from the motor:

- Remove the **engraving head** out of the way to have clear access to the **tool clamp**, it holds on 4 magnets.
- Hold the tool with the left hand. With your right hand, turn the tool lock knob counterclockwise to unlock the tool.
- Pull the tool out of the tool clamp.
- **Put the engraving head again back to place after tool change.**

This is only the recommended way of changing tools. Users may find easier ways of changing tools.

Do not touch the tip of the tool when changing tools. Tool tips are sharp. Danger of cutting injuries.

Take care when changing tools, especially small tools. If you touch the tool tip, the tool may break.

14 SETTING UP THE DEFAULT ZERO POSITION

About zero position
Default zero position is already configured and stored in your machine. The value is based on the standard tool lengths, standard underlay material thickness and standard PCB material thickness. To see the standard values please see the corresponding sections of this document. If you keep on using the standard values, it is very unlikely that you will have to change the default **zero position**.

Where is it used
Default zero position is used by the software to define where in the Z ax should the machine start milling. This value may differ from one machine to other.

Where is my default zero position?
Default zero position is already stored in machine controller and normally you don't need to set it. It is defined by underlay material thickness and PCB thickness, as well as the tool lengths used. To establish the position, follow the following steps:

- Make sure the underlay material is on the machine.
- Make sure there is PCB material on the underlay material.
- Load **drill** in the motor. This should be a thicker drill - about 2 mm in diameter.
- Using the machine control buttons, bring the machine somewhere over the material. Then using the down steps move the machine to the position in Z ax so that the tip of the tool is just touching the surface of the PCB material.
- When you are touching the material with the tip of the tool, go to **Settings - Machine | Settings tab** and click on the **Get** button. Software will automatically load the position into the edit box. Then click **Save** button.

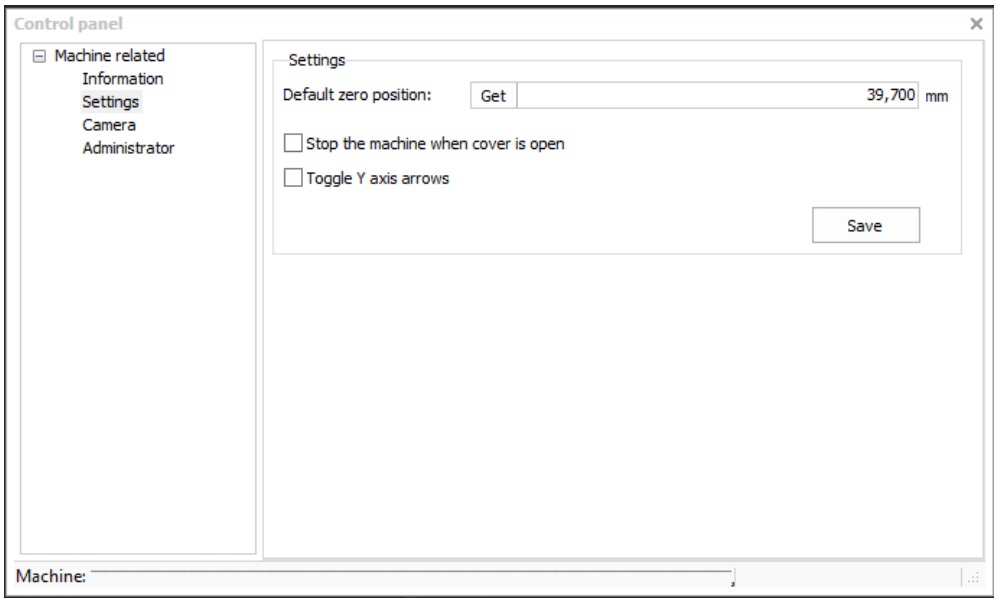


Figure 14 - Getting the default zero position

The stored position will be 1 mm above the current Z position, as this is the proper position.

Please note that your zero position may be different from the one displayed in this manual.

Be careful when moving the Z ax. If you are moving the machine to a position that is too low, the tool will enter the material. In this case, the material and/or the tool may be damaged.

When should I change my default zero position – VERY IMPORTANT, READ CAREFULY!

Default zero position should be changed **only** in the following cases:

- You have used an underlay material that does not have the thickness same as the previous underlay material.
- You are using a material THICKER than the previously used material, or when the thickness of the new PCB material is more than 2 mm different from the previous material.

15 SETTING UP THE ENGRAVING DEPTH

Engraving depth is crucial for correct milling of the insulation tracks. Setting up the engraving depth is done by milling a **test line** with the **Normal line milling tool** and adjusting the depth of the milling with the **micrometer**.

Make sure that the PCB material is properly secured on the table before milling.

Proper depth of milling is obtained when the tool is milling a groove in the material that has at least the dimensions as shown on the following figure (Figure 15 - Milling depths for V-cutters):

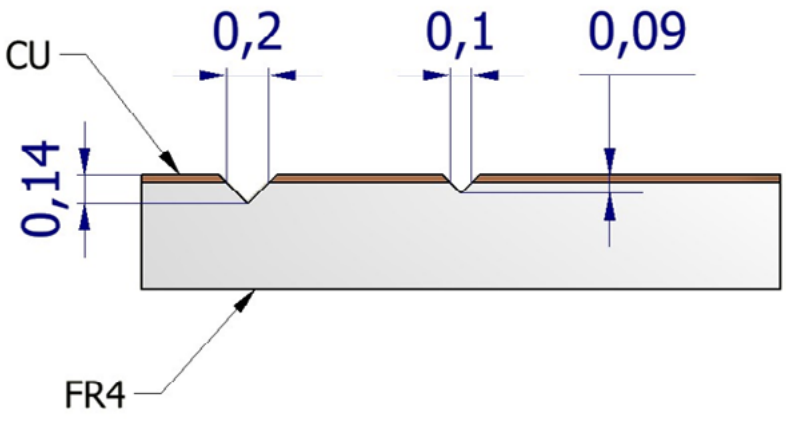


Figure 15 - Milling depths for V-cutters

Insulation width of 0.2 is correct for **Normal line milling tool** while insulation width of 0.1 mm is correct for **Fine line milling tools.**
Milling less deep with these tools is possible, however the tool life will degrade for about 20 – 25%. Same rule applies if milling too deep (if the width of milling is > 0.5 mm for **Normal line milling tool** or > 0.25 for **Fine line milling tool).**

To start setting up the milling depth, please insert the **Normal line milling tool** in the motor. Turn the knob of the micrometer clockwise until you can visually determine that the tool is not protruding out of the engraving head. Start TrackMaker, if already not started, and go to **Machining** page.
Use the arrows of the move control to position the machine on some place on the material where there you can mill a line (i.e. free area on the material). You should be able to mill a line 20 mm in the positive Y direction. Now in the same page go to **Control panel** group. Click on **Mill test line**  command .
Motor will start; Z axis will go to the default zero position, go into the material and move the machine 20 mm in the Y positive direction. Then the Z axis will go back to zero position and the motor will stop.
Inspect the line. If there is no line, move the machine 20 mm in the negative Y direction. Turn the micrometer now counterclockwise for 0.1 mm (one scale value is 0.01 mm), and click on the **Mill test line** command again.
Repeat the steps until you get the proper line width.
All these steps are equal for any 36 mm long tool (i.e. tools that operate on the material surface).

Even though your machine had a pre-set engraving depth, it is wise to check your milling depth before you start milling with the machine for the first time.

In order to perform the milling depth test, you might have to keep the hood open. Once the machine starts milling the line, stay clear of the machine. It will automatically move. Risk of injuries.

16 MIRROR LINE

Mirror line is a virtual line that is running through the centers of the mounting pins. This line is used when double-sided boards are milled.

Position of the mirror line is crucial for milling double-sided boards. Any change to the position of mounting pins requires re-configuration of the mirror line.

In the case you need to reposition the mirror line, the mirror line will be positioned on the place where the machine is currently staying. This allows you to either as precise as possible position the tip of the tool over the pin, or you can drill a new hole for the mounting pin, and that way re-set the mirror line.

For drilling new hole for mirror line pin, go with the head over the required pin1 position, insert drill 2.95mm and go with Z axis as low as the tool will touch the T-stone in the T-groove of the table.

You can run the motor by clicking on Motor control command in **Machine controls** menu. Enter required RPM's (for 2,95mm drill 20.000RPM) and click **OK**. When motor is running, move the **Z axis** down about 4mm. This is the value, where mirror line pin will be in accurate position according the 3mm underlay material and 1,6mm PCB material. Length of the pin is 8mm.

When you drilled hole 4mm deep, click the **Z axis homing button** and stop the motor by entering 0 RPM and click **OK**. Motor will stop.
Store current X and Y coordinates into **obstacle database** for Mirror line pin 1.
Settings – Mirror line pins

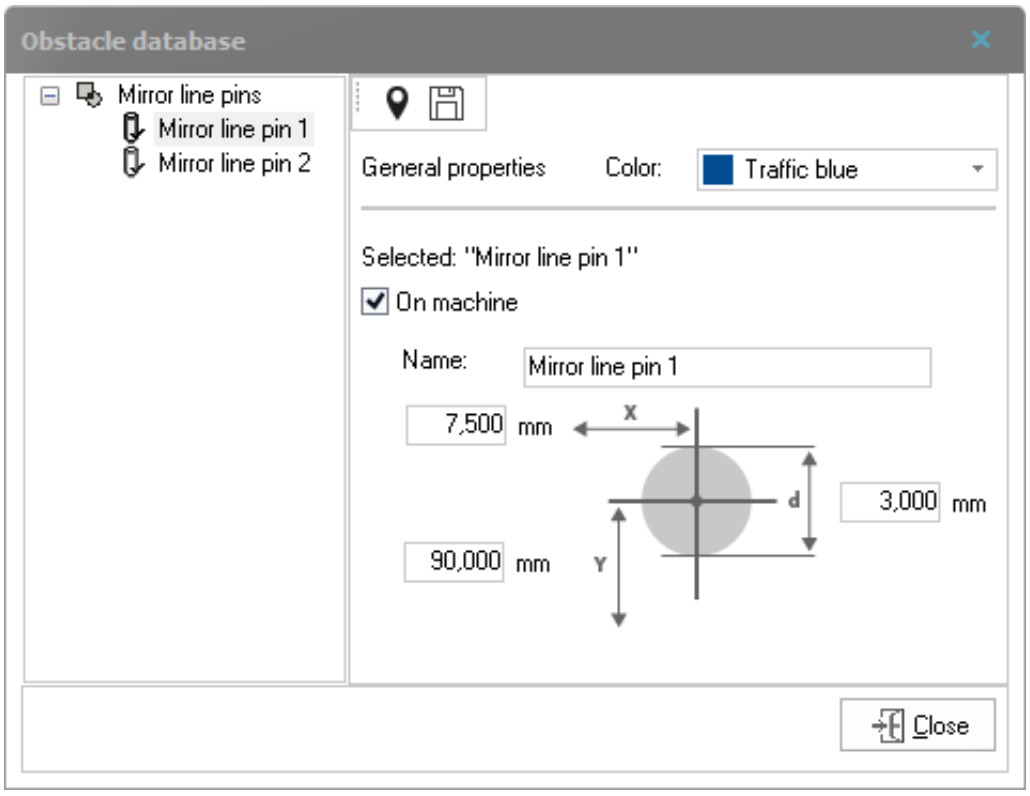


Figure 16 – obstacle database

To set the position of Mirror line pin 2 move in X ax about 210mm in positive (right) direction and repeat whole procedure as mentioned above but X and Y coordinates will be stored for mirror line pin 2.

Setting up the mirror line

It can happen that from some reason the position of holes on the bottom layer is not correct (i.e. when the stone with pins are moved). In this case, the mirror line needs to be set up by changing coordinates of the mounting pins.
The way to set the pin positions is to load a thin tool in the motor and visually position the machine above the pin and then read in the pin position into the TrackMaker.

To have the mirror line set in the more correct way, create a new project in the TrackMaker.

In a Top layer create circle pad with 2mm diameter, the same also in Bottom layer. Both pads should be over each other. Then create drill of 1mm diameter and move it to the center of pads in bottom and top layer.

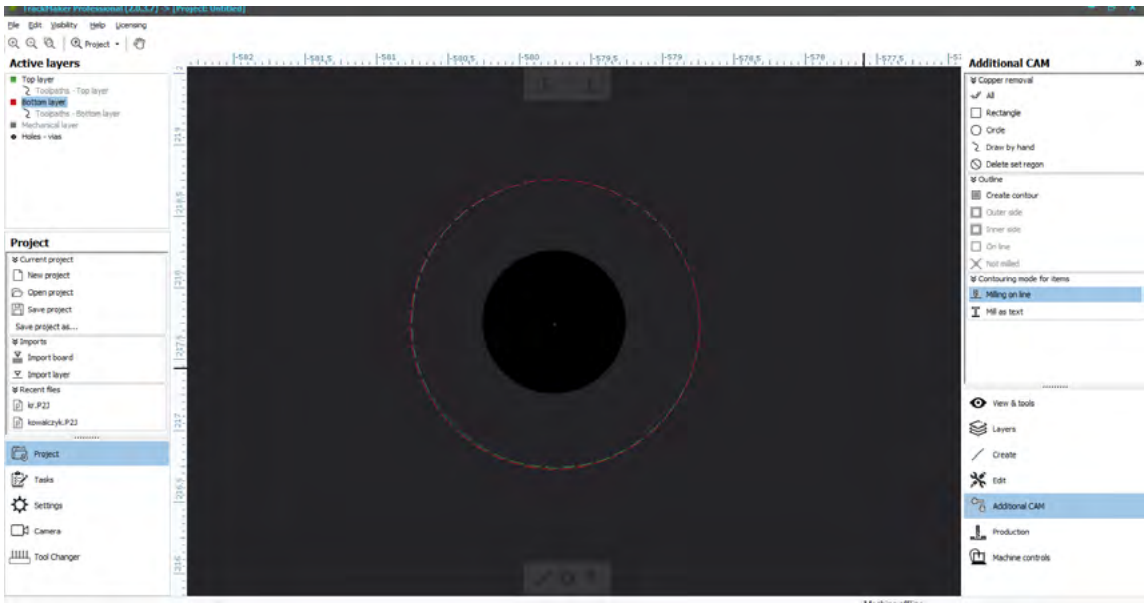


Figure 17 – Project for mirror line setting up

Place the board somewhere on the machine so that the file is in Y direction some 50 mm from the pin 1 (left pin) and that the X position is approximately same as the pin 1 position. Mill the PCB. A hole will be drilled, a circle will be milled on the top side, you will have to flip the board and then a circle on the bottom side will be milled. Inspect the milling results. To find out the correct position of the pin, use the following graphics.

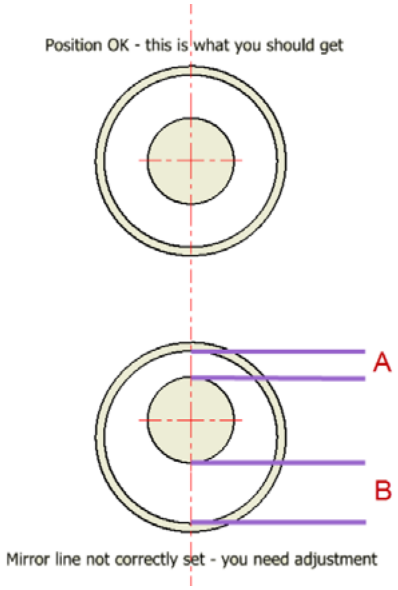


Figure 18 – mirror line pins position correction

Correction value for the mirror line pin can be calculated as follows: Correction = (B-A)/4
Now you read out the pin 1 Y position in the Mirror line pins dialog in TrackMaker. Add the correction value to the Y pin position. Enter the new value and press save.
Now move the board above the Pin 2 (right pin) and repeat the same operation but just using the data from pin 2.

If the correction value is negative, this means that you have to subtract the correction value from the original pin Y position.

17 AUTOMATIC TOOL CHANGER

Setting and functions - only for 4MILL300ATC machine

Machine 4MILL300ATC is equipped with 12 positions tool changer and spindle with pneumatic clamp. This allows automatic tool change function. For tool changer settings and functions see the manual below.

ATC machine MUST be connected to air pressure of 0,6MPa. Missing or low air pressure may result in damaged tool changer, tool clamp, tools or material.

Connected air pressure MUST be clean, oil and dust free. Oil in air may cause wrong function of tool changer.

How to set the tool changer?

ATC and manual machines used the same version of TrackMaker software. If you are user of ATC machine, you must activate tool changer option first. To activate or deactivate tool changer option, go to following tabs: **Setup — Settings — Tool changer** and choose **Use the tool changer.**

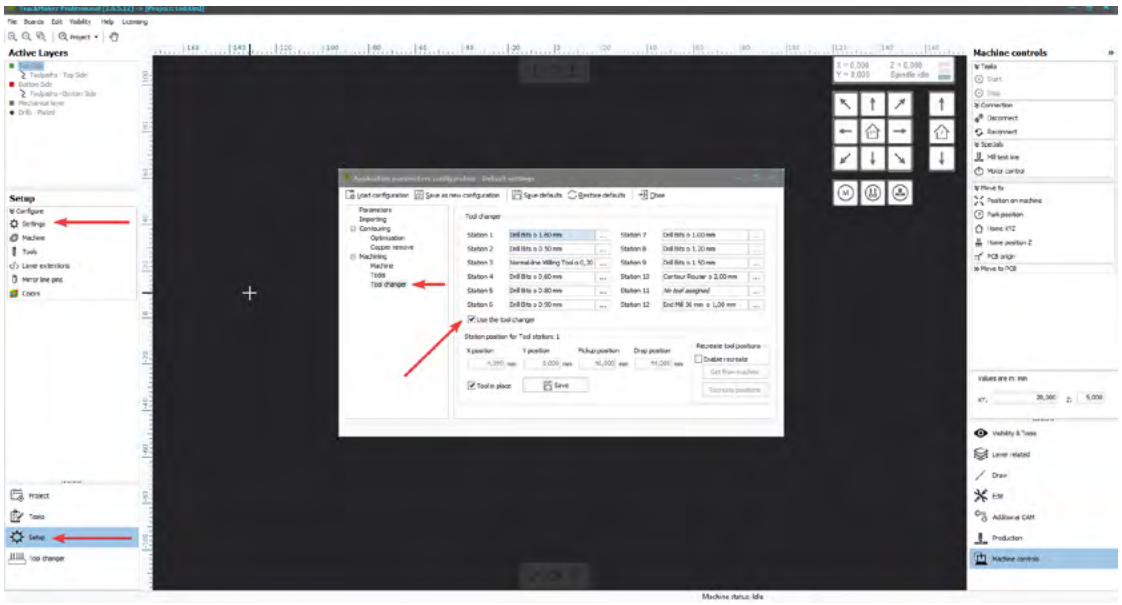


Figure 19 – Use the tool changer

Once the tool changer is enabled, the **Tool Changer** tab is displayed in the left down corner of TrackMaker screen and also virtual Tool changer bar is displayed on virtual machine table as shown on the picture below.

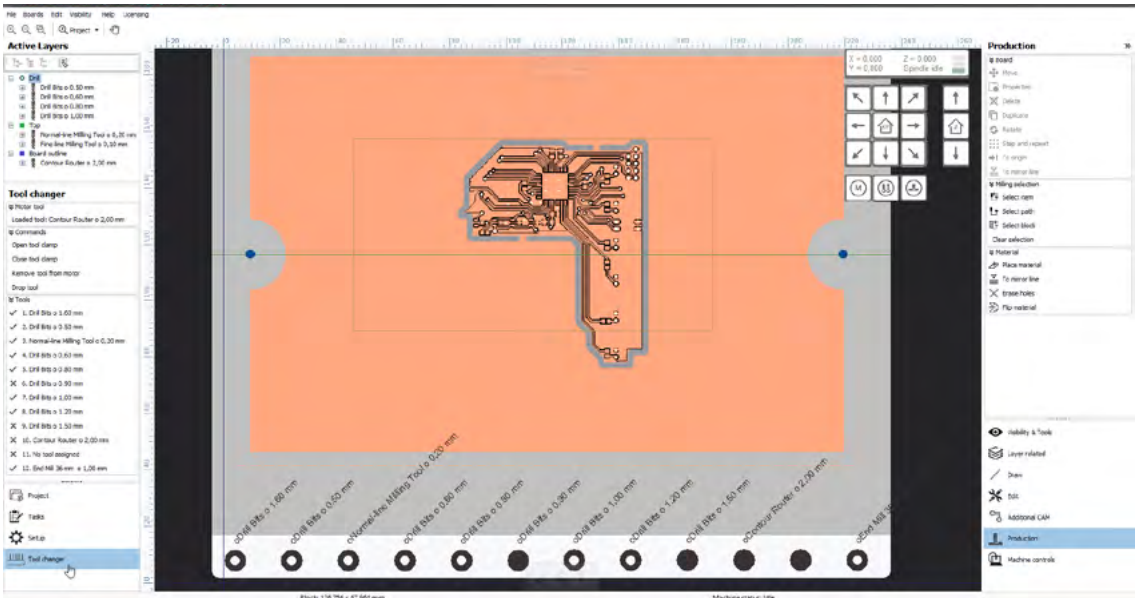


Figure 20 – Tool changer tab and tool changer virtual bar

Black dots are positions of tool changer (Position 1 is on the left side, position 12 is on the right side of tool changer bar). When there is white dot inside the black dot, it means, the tool is in the position.

Figure 21 – stations numbers on virtual tool changer bar

Tools are simply inserted into positions. Ring fits the tool in the bed in ideal position for pick-kup. Tool has to be loaded with shaft upside.

Figure 22 – real tool changer bar with correctly inserted tools

How to assign tools to tool changer positions

The same windows where we enabled the tool changer is used to assign tools to tool changer position. So, go through **Setup – Settings – Tool changer**.

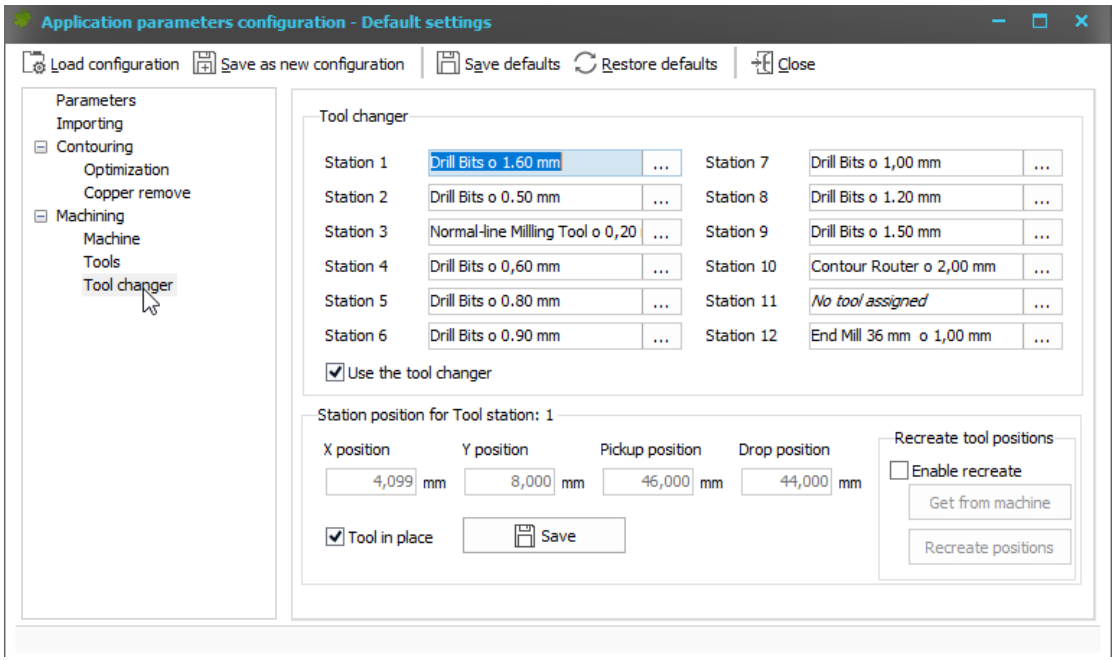


Figure 23 – tool changer configuration window

Tool changer configuration window gives general information about tools assigned to tool changer stations, coordinates of stations positions, and also positions for pickup and drop.

Before first use of tool changer, the positions of tool changer stations MUST be checked. Using of predefined coordinates after TrackMaker installation may cause tools or tool changer damages.

The milling and drilling tools must be assigned to the toolchanger position after TrackMaker installation accordingly to project requerments!

To assign the tool in Station 1, click with left mouse button to the symbol of three dots

The list of available tools will be displayed on the right side of the window

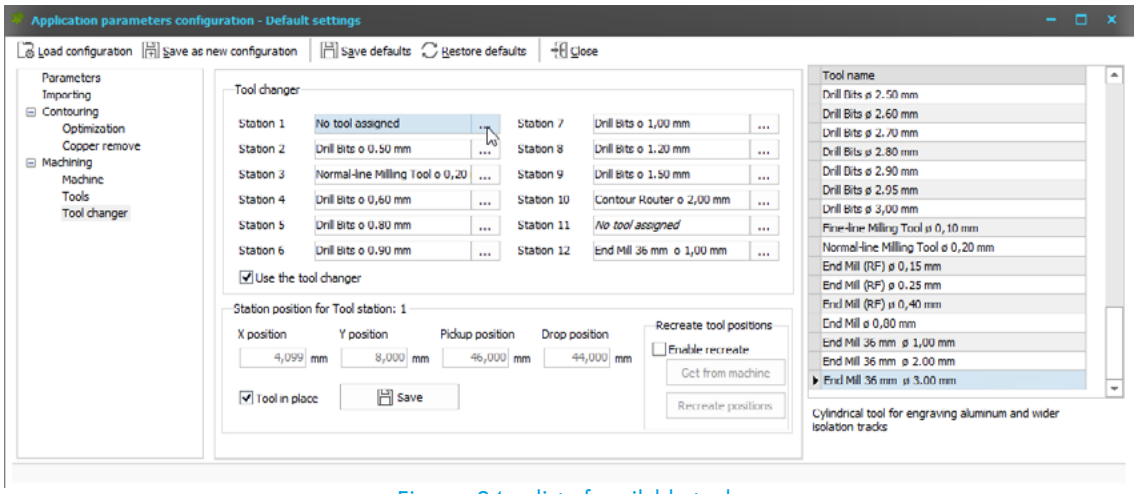


Figure 24 – list of available tools

Choose the required tool from the list and with left mouse button double click the tool will be assigned to the station. For example Normal line milling tool (accordingly to tool list generated by TrackMaker when calculating project).

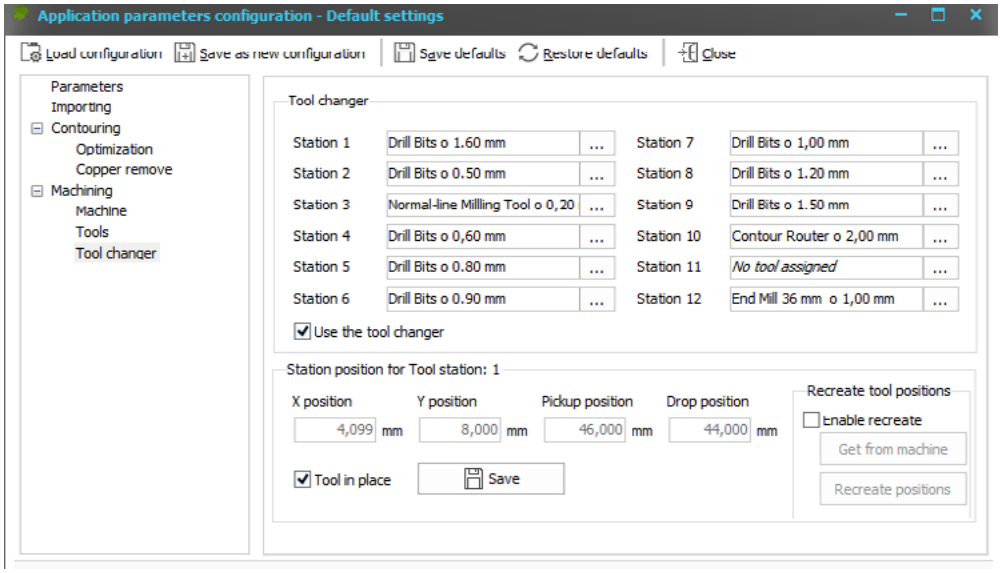


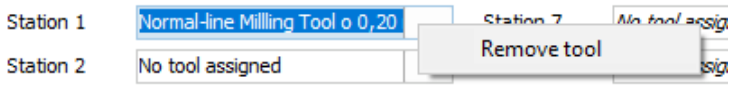
Figure 25 – required tool is assigned to position

Required tool is assigned to tool changer station now.

If you want to change the tool in tool changer station, the procedure is exactly the same as above.

Remove tool from station

To remove tool from station, click with right mouse button to symbol of three dots



Then click left mouse button on Remove tool command, the tool will be removed from position

Setting of Station position

Machine is delivered with all tool station positions already set. However, in some cases it can be necessary to adjust the tool station position. To set the positions, follow instructions below.

In TrackMaker version 2.0.3.29 and higher, only 1st and 12th position can be set after enabling function ENABLE RECREATE (figure 26). All other positions will be calculated automatically with function RECREATE POSSITIONS. It is not possible to change automatically calculated positions. Since the tool changer is made from one piece of metal, the error on the distance between stations is very small. For this reason, only two station positions can be edited, the first and the last. Positions from 2 through 11 are recalculated based on the position of the first and last station.

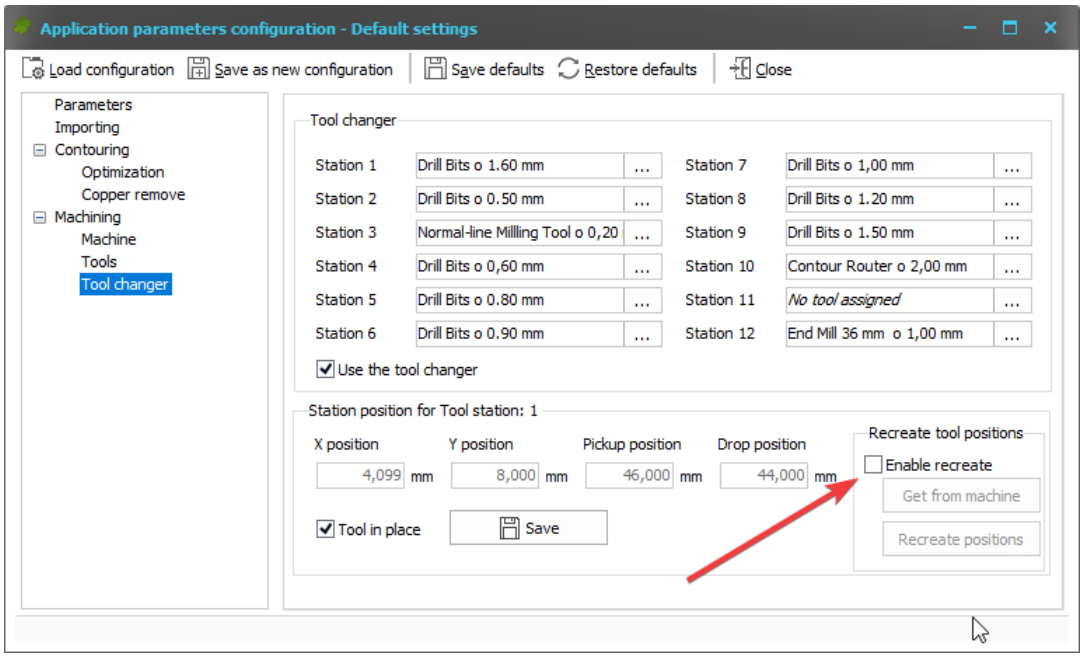


Figure 26 – enable recreate position

Do not try and change the pick and drop positions unless you are instructed to do so. The Pick and Drop positions are not there to compensate for the shape of the tools used. They are only there to accommodate correct dropping of tools.

To set the Station position, remove the aluminium engraving cap from the engraving head. It holds just on 4 magnets, so no tool is needed.

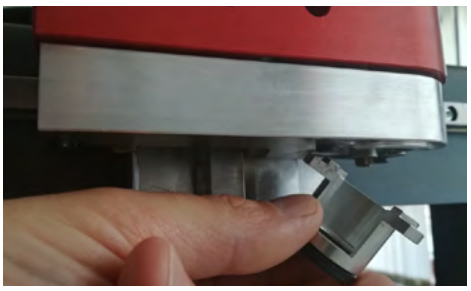


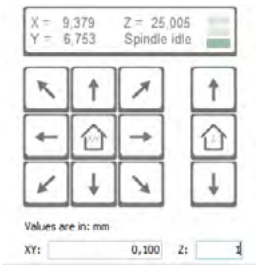
Figure 27 – removing of engraving cap

Now, load any tool manually (manual tool change is described in the manual below).

Switch to **Machining** tab in TrackMaker and use arrows or **Position on machine** function to move the head with tool to approximate position of station 1.

For fine position adjustment use small steps like 0,1mm. This will prevent tool changer or tools damages.

When the tool is approximately on coordinates of the tool changer position, use the Z axis arrows to go down with the head. Use small steps to avoid crashes of tool with tool changer as this may cause the tool damage. Just 1mm step in Z axis is sufficient to control the position settings.



Tool has to go to the center of the station. With small steps in X and Y you can correct the position all the time. Continue with moves down until the tool ring sits completely in the station bed. If the ring stops on the edge of the station, use small steps to find a correction in X or Y axes until the ring drop down freely. Usually this is visible by eyes where is necessary to move.

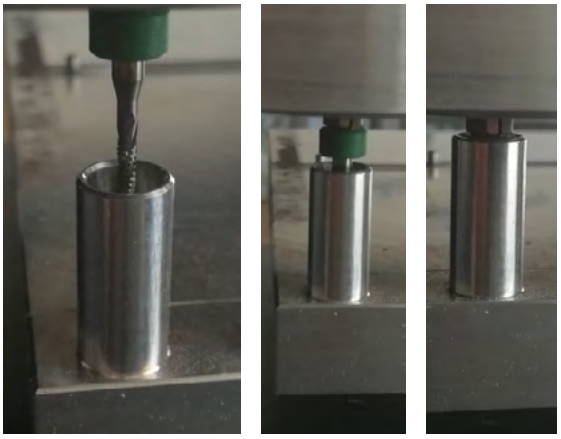
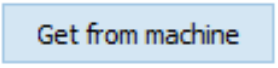


Figure 28 – slow positioning of tool into the station

Once the tool ring is in the bed, **open clamp** and go with head upwards (set bigger step like 20mm). If the tool stays in the bed without lifting together with opened clamp, the station position is correct and can be stored. If the tool is moving a little with the opened clamp, position has to be adjusted using the same procedure as described above.

Once the head is in correct position, it means that tool is not lifting with opened clamp, move the head back to the tool ring (if you went 20mm upwards with opened clamp, go 20mm down now) and **Close clamp**.

Now in the Tool changer configuration window just click to button



Station coordinates and also Pickup and Drop positions will be displayed in the window accordingly to current machine head possition.

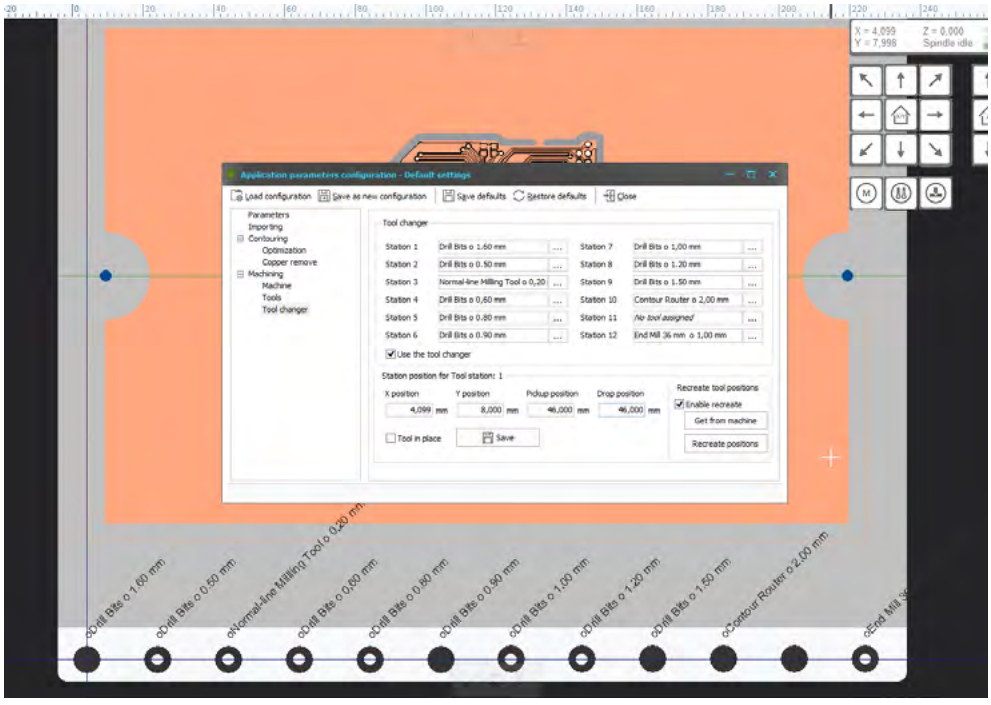


Figure 29 – get coordinates from the machine

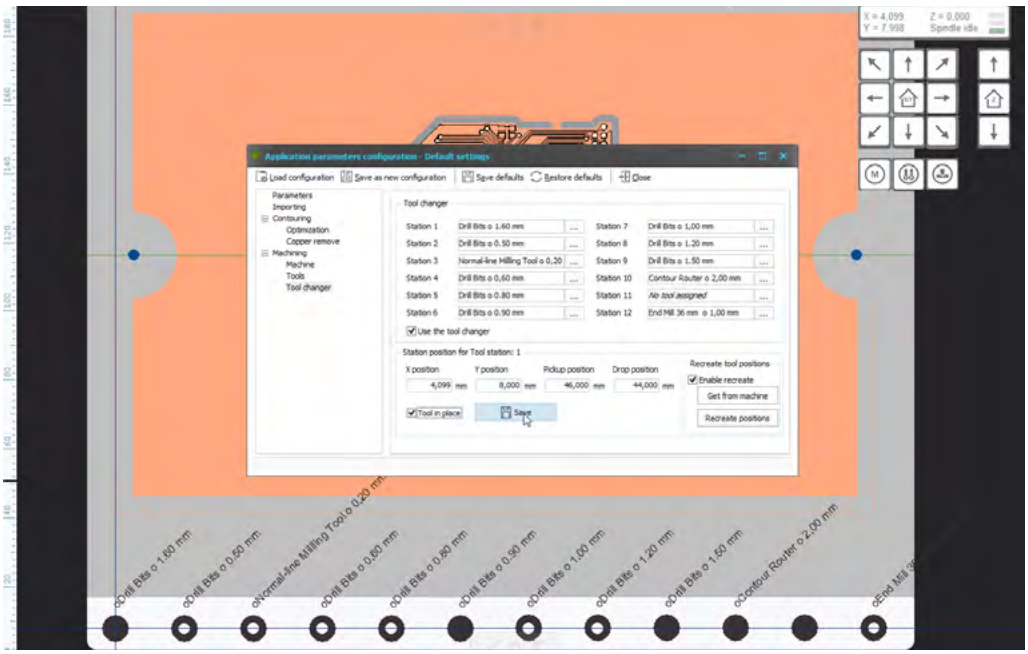
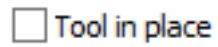


Figure 30 – tool is active in station

To display the tool in toolchanger position you must enable the Tool in place



We recomand to move the drop position 2mm above the pickup position as shown in the picture above. To apply changes you must click the Save button. Tool will be activated in the Station and will be shown in virtual tool changer with actual coordinates.

The procedure is the same for station 12. For easier setting please note, that the **Pickup** and **Drop position** will be the same for all stations. And distance between positions 1 and 12 is **220mm in X axis**. Once coordinates of station 12 are set and saved, click the button Recreate positions and than Save. Coordinates of all other positions are calculated automatically.

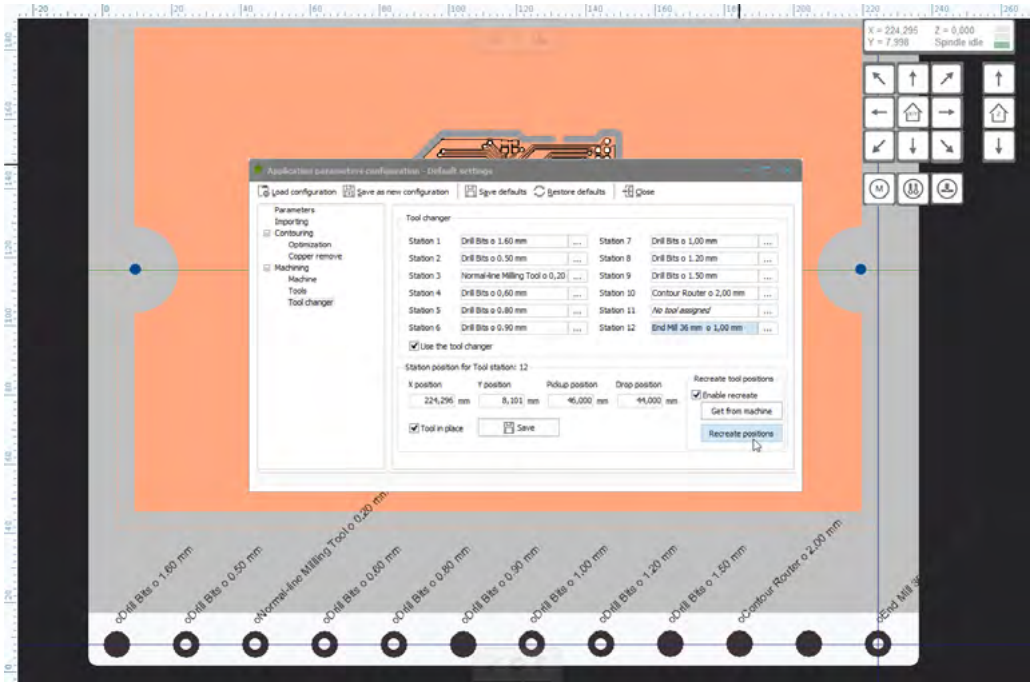


Figure 31 – recreate positions

Tools assigned to Stations could be changed anytime accordingly to project needs.

When ready with tool changer settings, remember to put the Engraving cap back at place. Again, no tool are needed, just soft „click" back on the magnets.

When ready with toolstation coordinates adjustments, remember to disable the Enable recreate function to avoid chenges by coineidence.

Tool Changer tab:

If the automatic tool changer is enabled, the **Tool Changer** tab is displayed in left down corner of the screen.

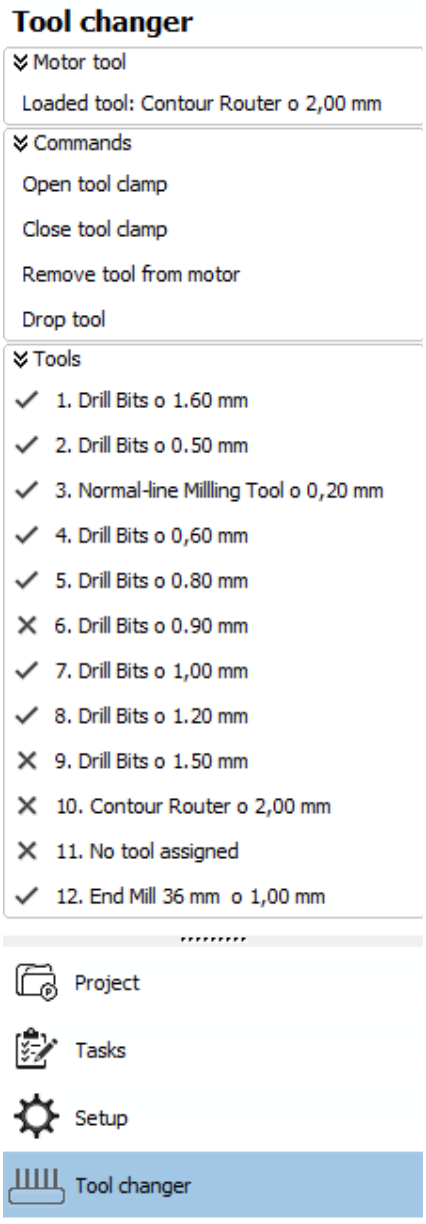


Figure 32 – tool changer tab

Motor tool:
Gives information about actual or last loaded tool in the motor. This is available only in case, that tool was picked up automatically from tool changer or TrackMaker gave a command to insert tool manually. If some tool is inserted manually but without previous TrackMaker command, machine is unable to recognize the tool. *No tool in motor* or last used tool (for example *Normal-line Milling tool*) will be shown in the **Motor tool** window, as shown on pictures above.

Commands:
Open tool clamp and *Close tool clamp*:
allows manual tool change. This can be applied in following cases:

- If there are no tools assigned to the tool changer positions, but tool changer is enabled, you can open clamp by click on „**Open tool clamp**", insert tool into the clamp, hold it in and click on „**Close tool clamp**". *(For example for Mill test line function, drilling of holes for mirror line pins, tool changer settings etc.)*

- If some tools needed to make a PCB are not assigned to tool changer, TrackMaker gives you a message to change the tool manually as follows:

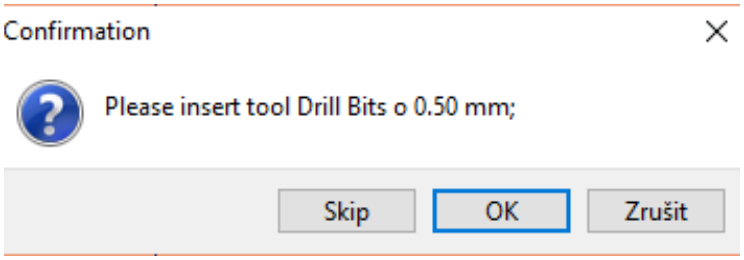


Figure 33 – command to change the tool manually

Click **OK**. Than you have to insert the tool into clamp – click on „**Open tool clamp**" – when tool clamp is opened, insert tool and hold the tool in clamp until click on „**Close tool clamp**". Clamp will close, and tool will be safely fixed in clamp.

By pressing **Continue** button, the machining will start.

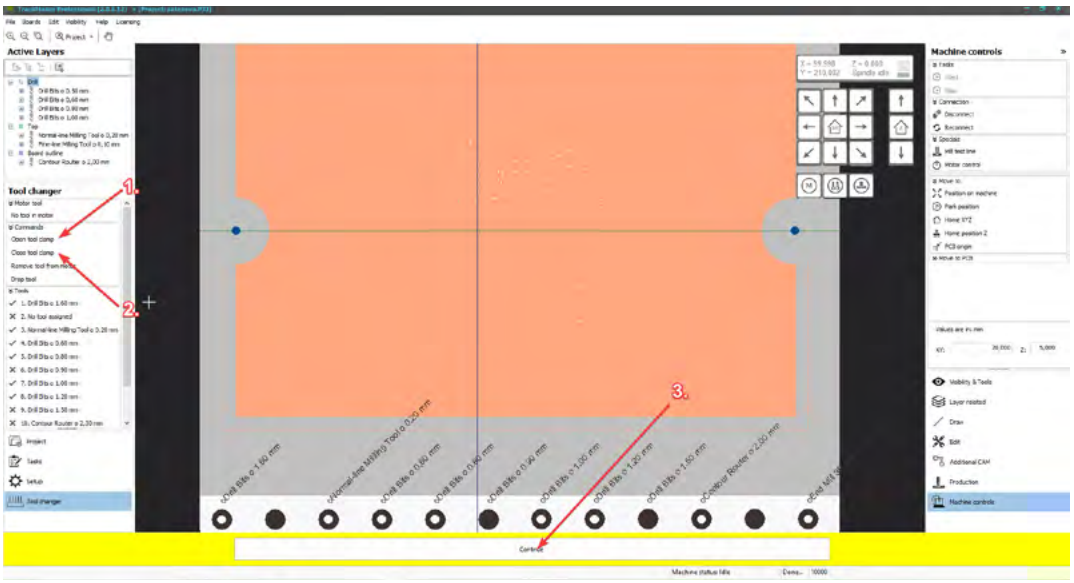


Figure 34 – manual tool change

To remove the tool manually, the whole operation will be done just in opposite way.

Remove tool from motor
This command deletes the tool from *Motor tool dialog*.

Drop tool
Machine will drop the tool into position assigned in tool changer setting.

Tools
Shows tools assigned to tool changer position. This tab allows also to pick the tool from tool changer or drop the tool back to the tool changer.
To **pick-up the tool** from tool changer, click by left mouse button on the tool from the list. TrackMaker will ask if you want to pick-up the tool from tool changer. By click **YES**, machine will pick-up the tool from tool changer automatically.
To **drop** the tool back to the tool changer, click by left mouse button on the tool from list, which is currently in the clamp. TrackMaker will ask you if you want to drop the tool to the tool changer. By click **YES**, machine will drop the tool back to tool changer automatically.

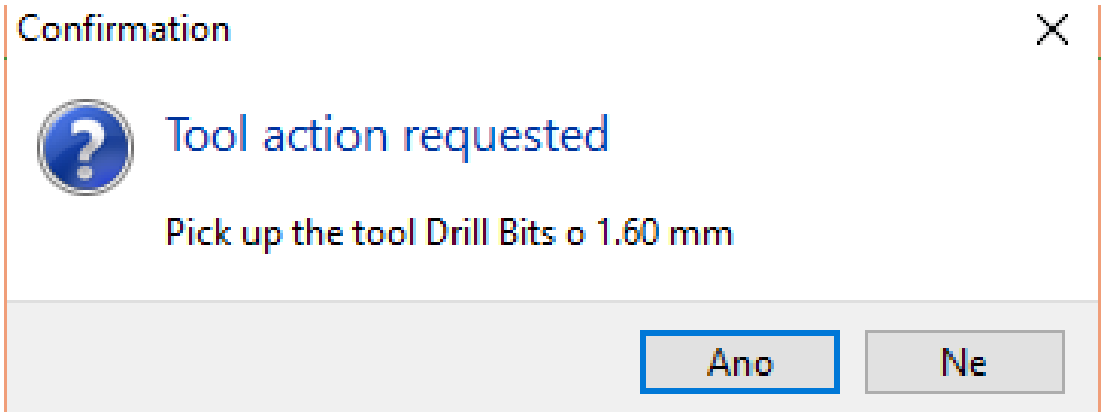


Figure 35 – Pick up tool and Drop tool function

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