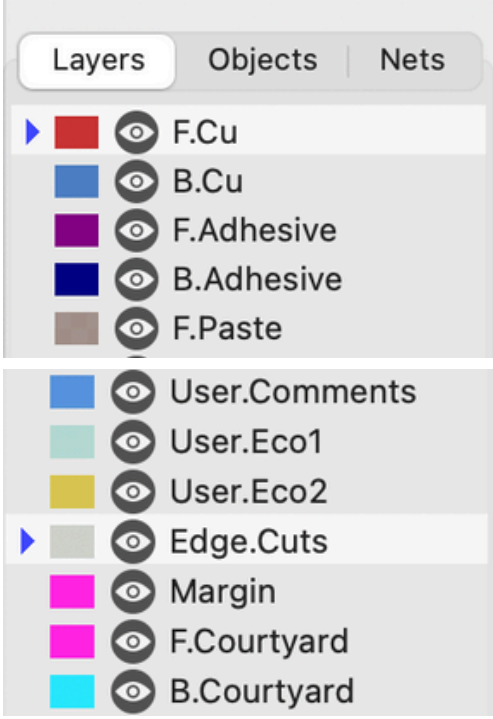
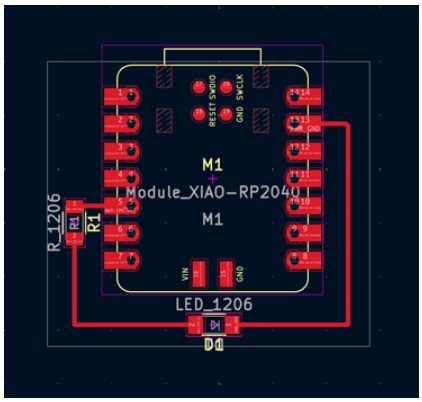
Generating Files for Mods

Exporting from KiCad

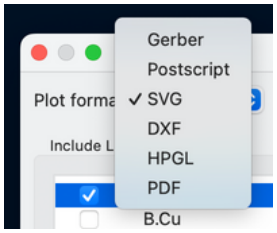


In the KiCad PCB Editor, draw all traces on the ***F.Cu*** Layer. This stands for “Front Copper.” Draw all shapes that define the edge of the board on the ***Edge.Cuts*** Layer.

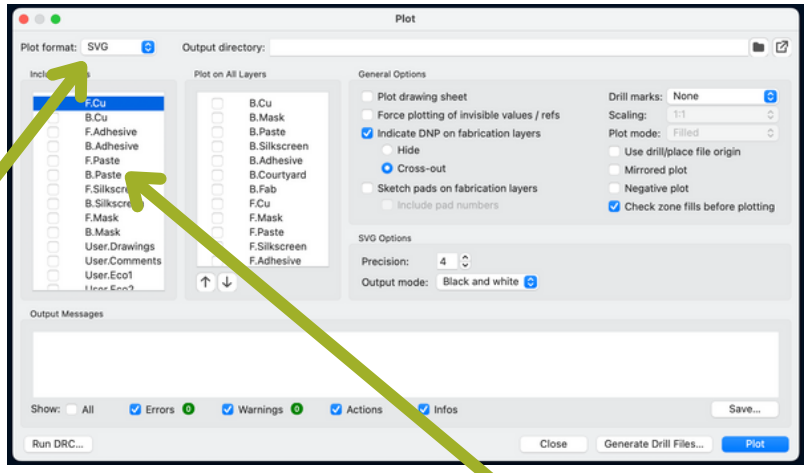


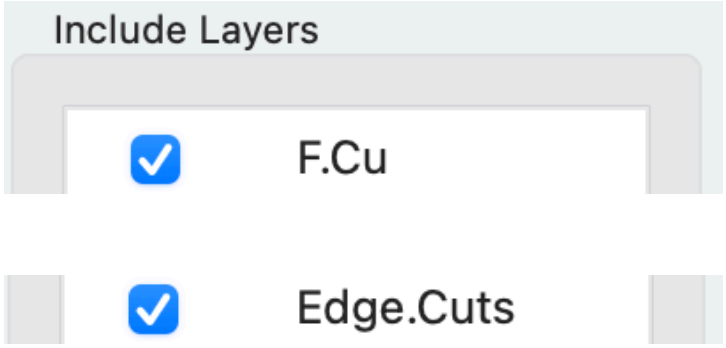
The Shapes on the ***Edge.Cuts*** should appear as faint outlines and traces on ***F.Cu*** should be bold and more visible.

Then select ***File → Plot...*** and a window consisting of output options should appear.



Change ***Plot format*** to ***SVG***.

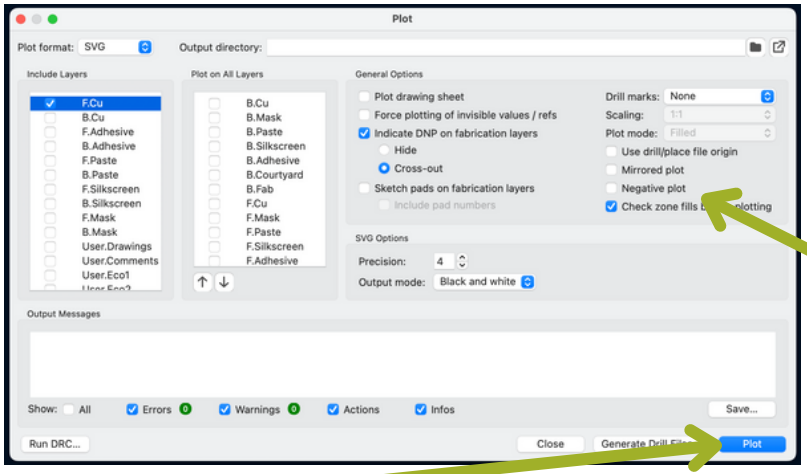




In the ***Include Layers*** section, select both ***F.Cu*** and ***Edge.Cuts*** and ensure that no other layers are selected. This ensures that only these two layers are exported.

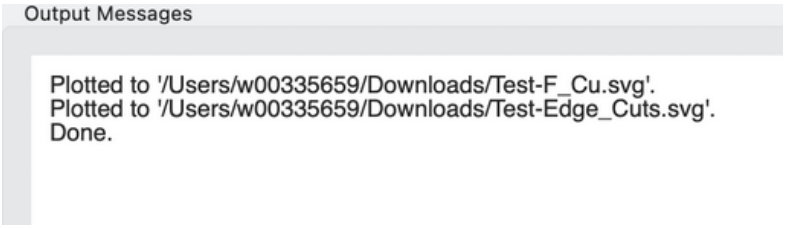
Generating Files for Mods

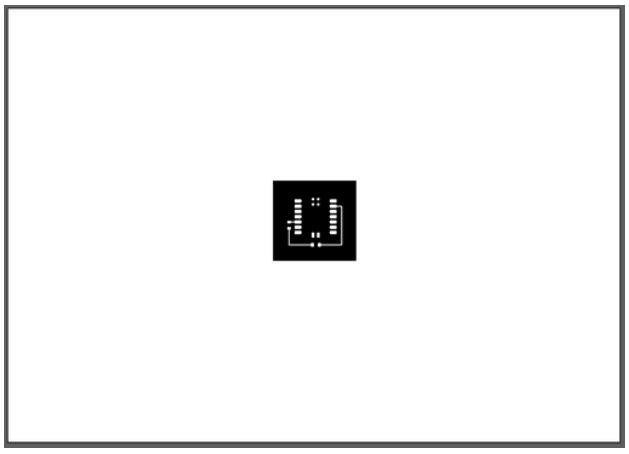
Exporting from KiCad



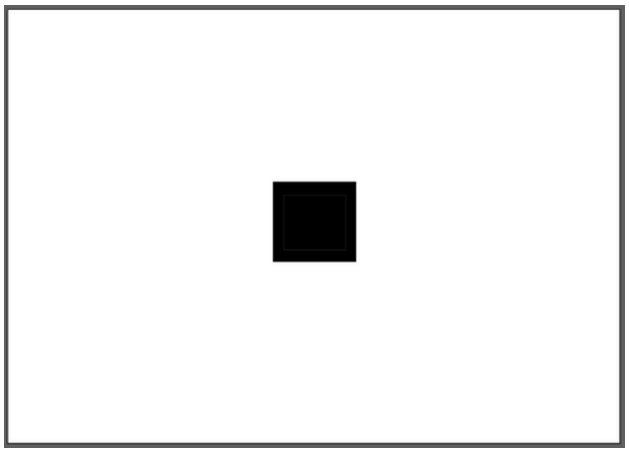
Enable the checkbox for ***Negative plot***. All other settings can remain at their default values.

Select ***Plot*** and two SVG files should be generated: one for the traces and one for the edge cuts.





[Project]-F_Cu.svg

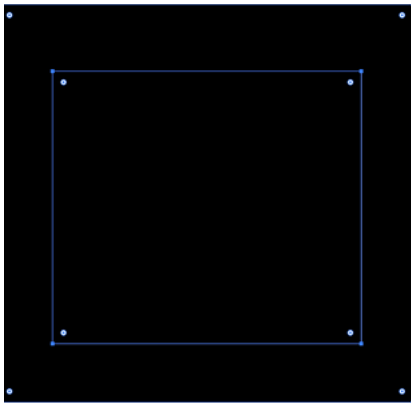


[Project]-Edge_Cuts.svg

Notice how both SVGs are created with much white space surrounding them. These files will not work for milling without a few modifications. It is easiest to make these modifications using Adobe Illustrator.

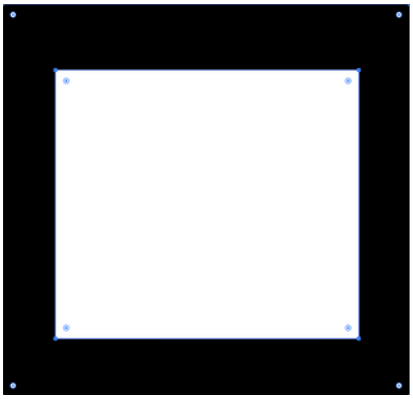
Generating Files for Mods

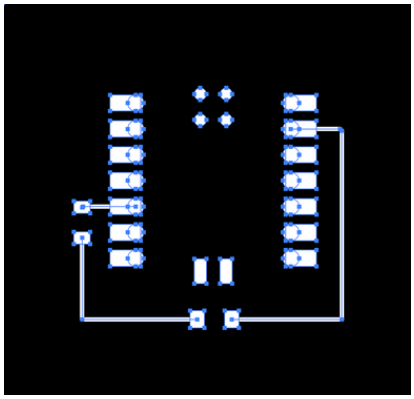
Creating PNGs with Adobe Illustrator



Start by opening the *Edge_Cuts.svg* file in Adobe Illustrator. It should consist of a black shape with a faint white outline of the edge designed in KiCad. The program to generate tool paths requires the edge cut to be defined as a solid white shape surrounded by a thick black border.

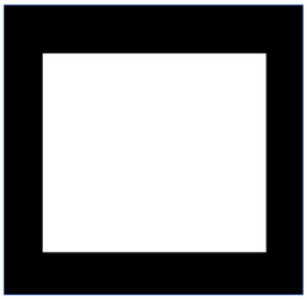
Select everything, ***ungroup*** [*cmd*/*ctrl-shift-g*] them, and change the fill of the inner shape defining the outer edge of the board to white. After this, ***group*** [*cmd*/*ctrl-g*] both shapes again.

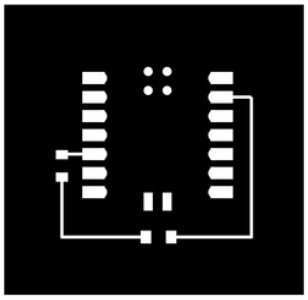




Next, open the *F_Cu.svg* file in Adobe Illustrator. Select everything and ***group*** [*cmd*/*ctrl-g*] it together. ***Copy*** [*cmd*/*ctrl-c*] the traces and black backgorund that were just grouped together.

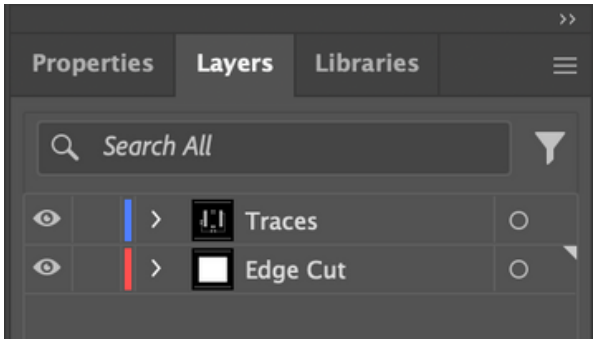
Paste [*cmd*/*ctrl-v*] the traces into the same Illustrator file as the edge cuts.





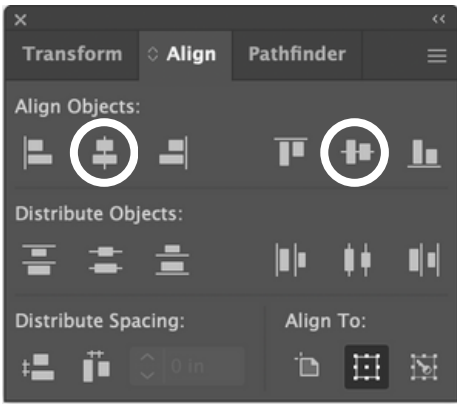
Generating Files for Mods

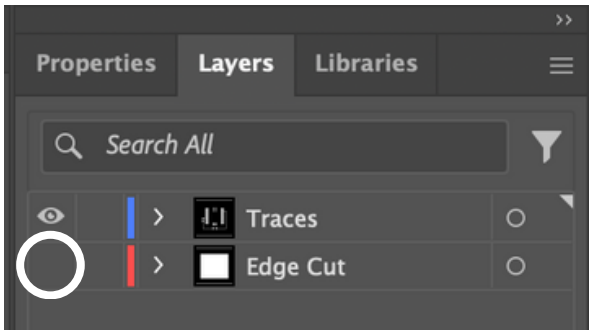
Creating PNGs with Adobe Illustrator



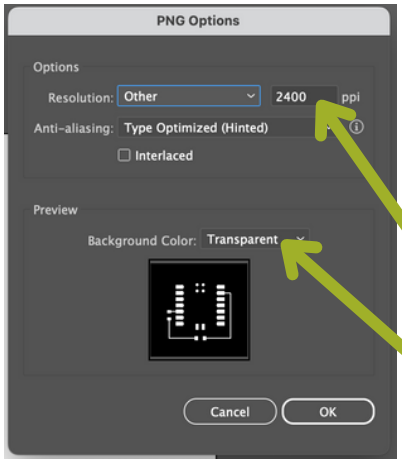
Place the *F_Cu.svg* and *Edge_Cuts.svg* onto their own respective layers. An easy way to do this is to select a layer, right click the object to move, then select ***Arrange → Send to Current Layer***.

Align both *F_Cu.svg* and *Edge_Cuts.svg* to each other's center points by selecting both and using the ***Horizontal Align Center*** and ***Vertical Align Center*** tools found under ***Window → Align***. Both shapes should now be perfectly aligned such that the topmost layer covers the bottom.

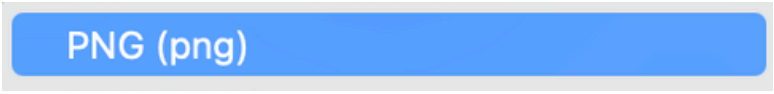




Hide the Edge Cut Layer by clicking the eyeball next to the layer name. Only *F_Cu.svg* should be visible on the Illustrator canvas



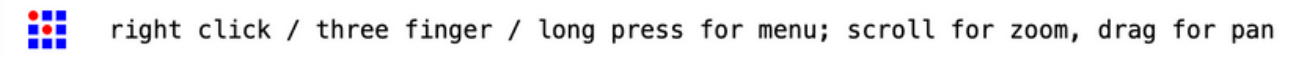
Export as a PNG by selecting ***File → Export As...***



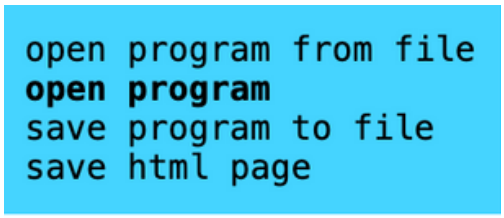
In the ***PNG Options*** box, change the ***Resolution*** to ***Other*** and set the ppi to ***2400***. Ensure that the ***Background Color*** is set to ***Transparent***. Do the same for the Edge Cut Layer to generate a separate PNG.

Using Mods Web Application

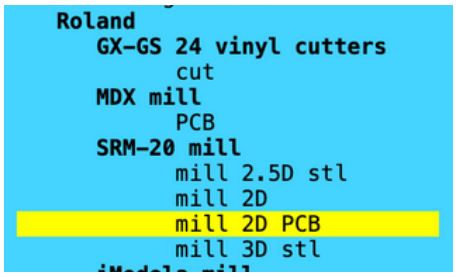
https://modsproject.org/



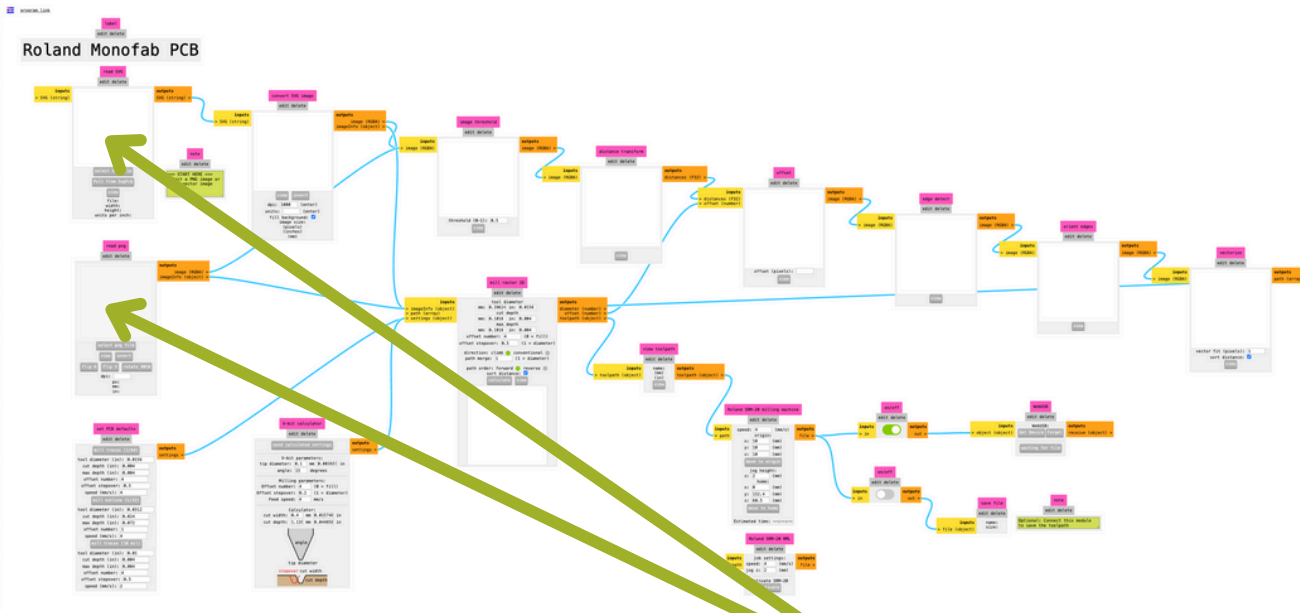
Two-Finger / Right Click to bring up the first menu, then select ***programs***



Select *open program* and scroll through the list of available programs until you find ***Roland***



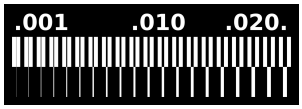
Under ***Roland***, there is a category for our machine, the ***SRM-20 mill***. Under this category, select ***mill 2D PCB***



This will cause the mods ‘program’ to appear. Start importing either a PNG or SVG file into the respective module

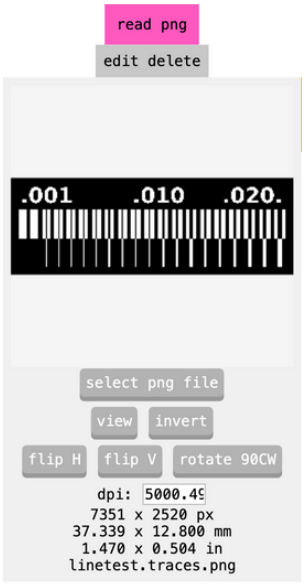
Using Mods Web Application

https://modsproject.org/

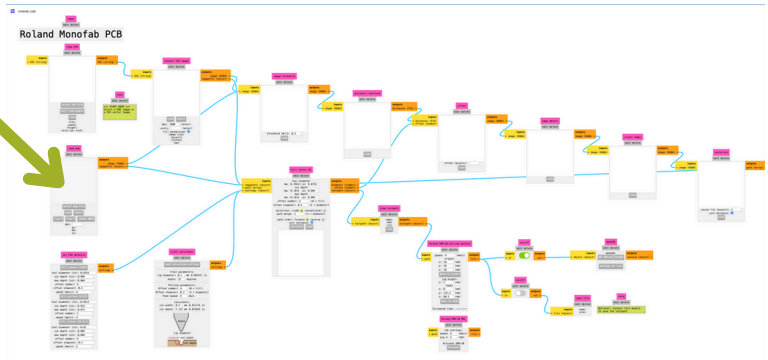


For this guide we will use two PNG images: one for the traces (top) and one for the outline (bottom)

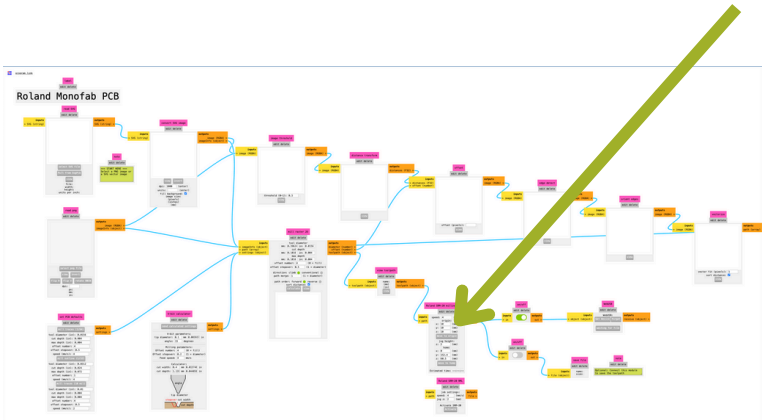
- **Traces:** the copper paths that connect our components
- **Outline:** the border around our traces that specifies where to cut the shape of our circuit board

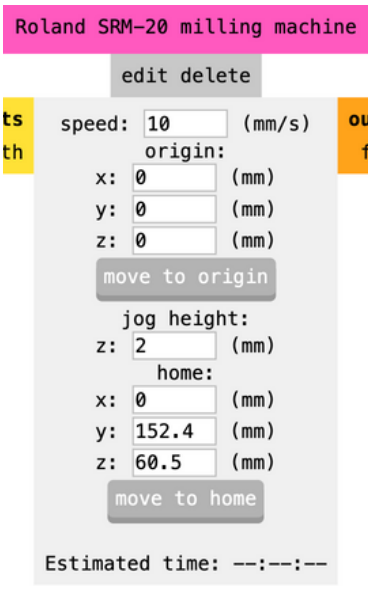


In the ***read png*** module, click the button that says ***select png file*** and choose the PNG file of your traces. The location of the ***read png*** module is shown below.



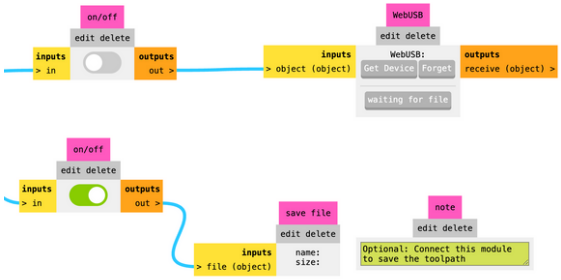
In the ***Roland SRM-20 milling machine*** module, change ***speed*** to 10, and ***x***, ***y***, and ***z*** to 0. The location of the module is shown below.



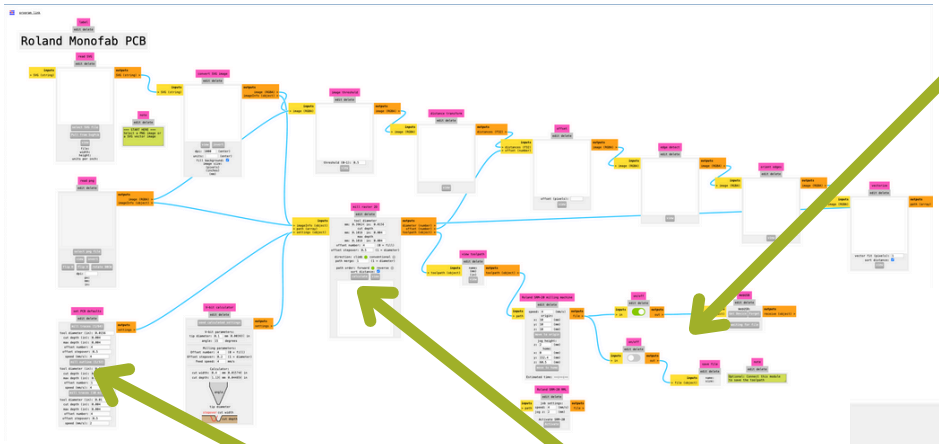


Using Mods Web Application

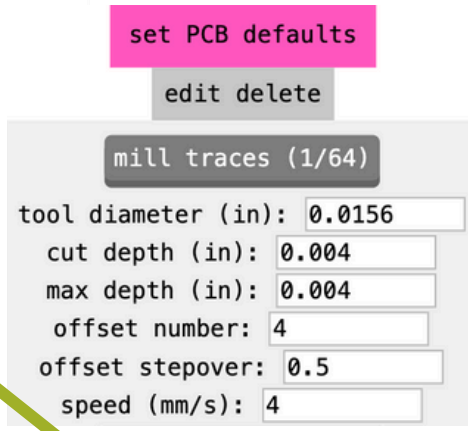
https://modsproject.org/



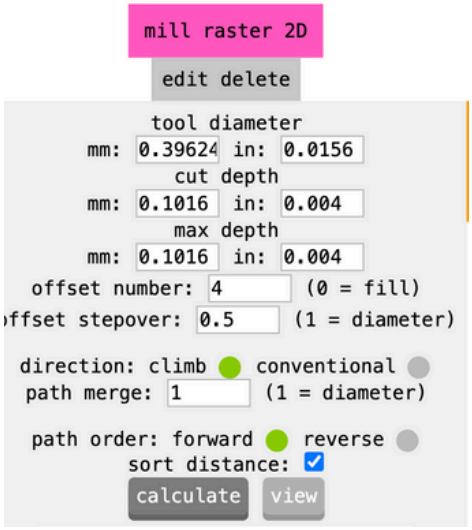
Disable the ***on/off*** module that connects to the ***WebUSB*** module and enable the **on/off** module that connects to the ***save file*** module. The location of these modules is shown below

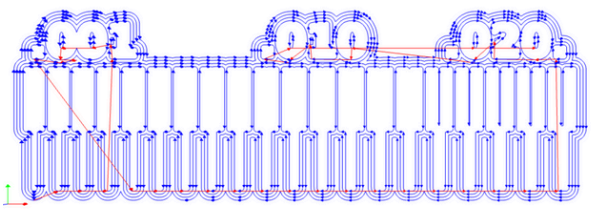


In the ***set PCB defaults*** module, select the button that says ***mill traces (1/64)***. The location of that module is shown above.



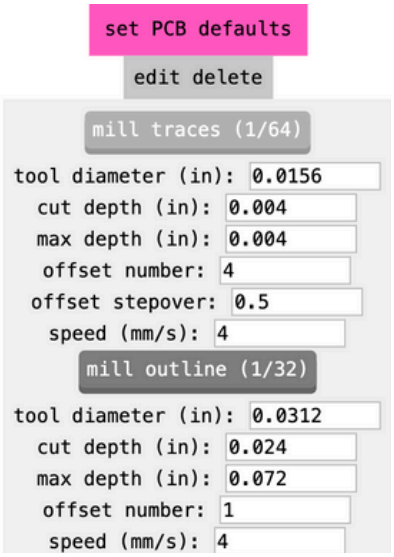
Finally, in the ***mill raster 2D*** module, click the button that says ***calculate***. The location of this module is shown above. This will download a RML file and open a window with a preview of the tool path.





Using Mods Web Application

https://modsproject.org/

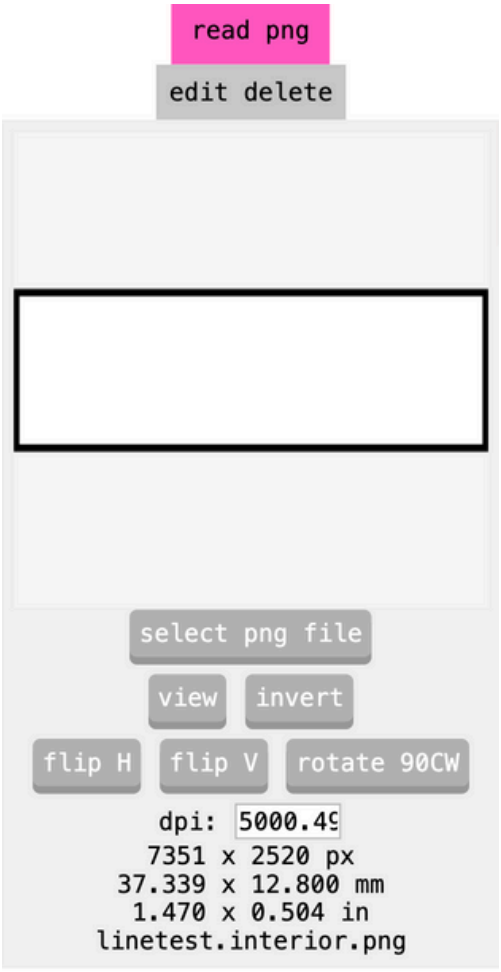


The process for creating the toolpath of the outline is exactly the same, except that in the ***set PCB defaults*** module, you must select the button that says ***mill outline (1/32)***!

This generates a tool path for the larger-diameter bit to cut straight through the FR1 sheet instead of just milling traces along the top surface.

Also ensure that you have the correct file selected for the process using the ***read png*** module.

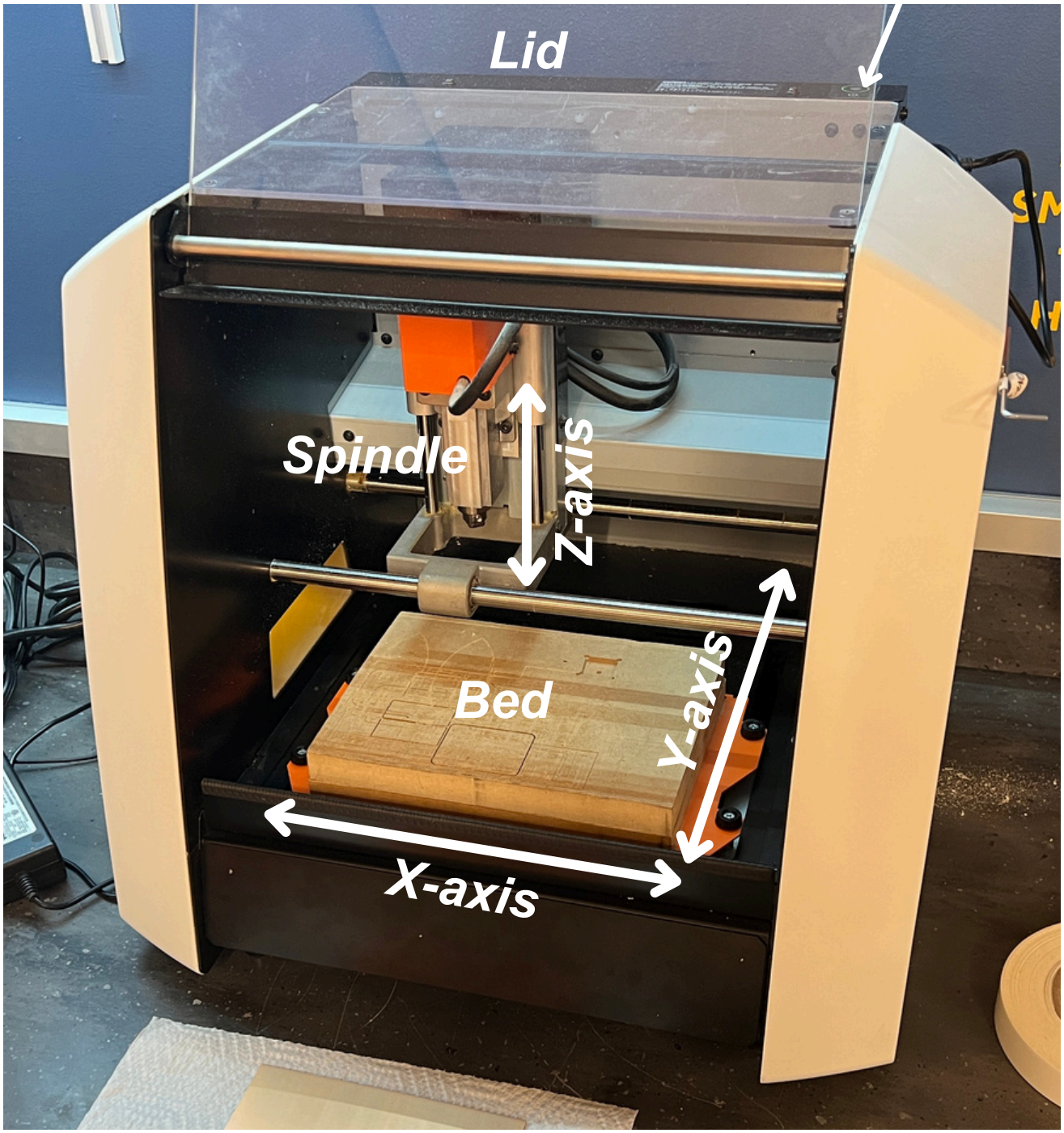
Each process should always have its own RML file. That is, one for traces, one for the outline, and one for all through-hole cuts (if applicable).



Using the Roland SRM-20

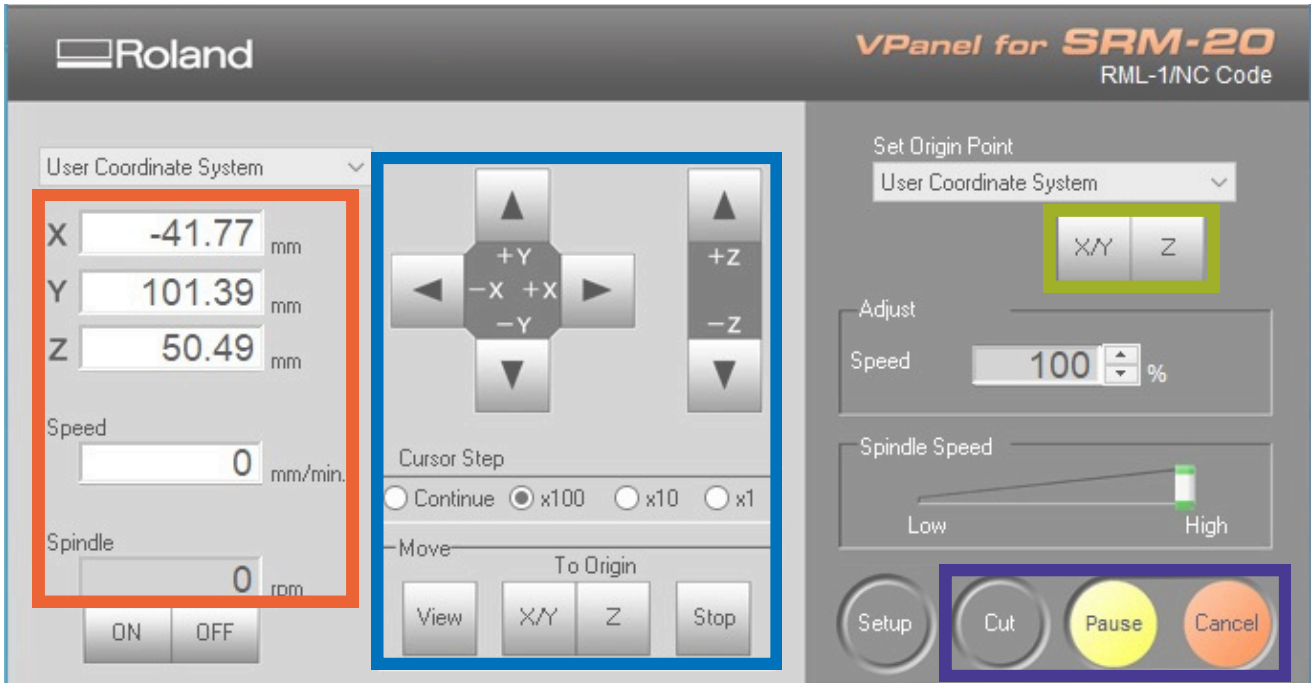
Axes & Parts of the SRM-20

The ***Power Button*** is located on the top right of the machine. The machine must be powered on to properly communicate with the software!



Using the Roland SRM-20

Functions of VPanel



The areas outlined in colorful boxes are the important features that you will use to control the Roland SRM-20.

Positional Information: Tells the ***X***, ***Y***, and ***Z*** Position of the end mill above the bed. ***Speed*** tells how fast the end mill / bed is moving in any of these directions while in motion (millimeters per second). ***Spindle*** tells how fast the end mill is rotating while in motion (rotations per minute).

Movement Controls: Allows user to move the end mill and machine bed in the selected direction. Cursor Step determines distance of movements when button is pressed.

- ***Continue*** = moves as long as button is being held
- ***x100*** = moves 1 millimeter per button press
- ***x10*** = moves 0.1 millimeter per button press
- ***x1*** = moves 0.01 millimeter per button press

To Origin allows end mill to move straight to the currently defined origin position of the machine

Set Origin Point: Sets the current X, Y, and Z position of the machine as either the ***X/Y*** or ***Z*** origin position

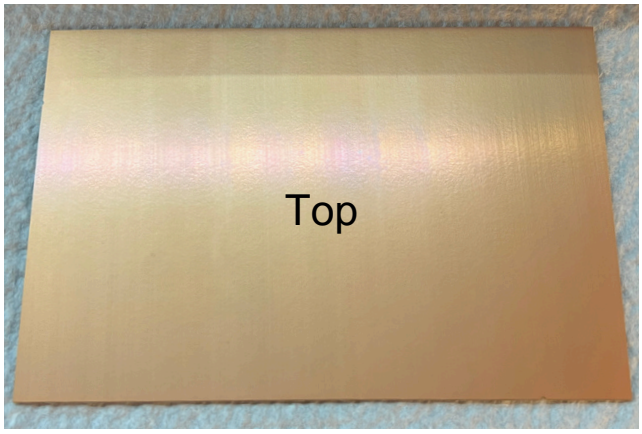
Milling / Cutting Controls: Controls the machine while performing a job

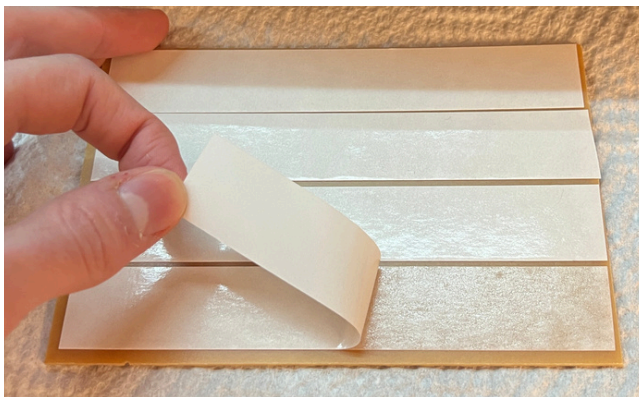
- ***Cut***: Selects the RML tool path file and starts the job
- ***Pause***: Pauses the currently active job
- ***Cancel***: Cancels the currently active job

Using the Roland SRM-20

Preparing the FR1 Copper Clad

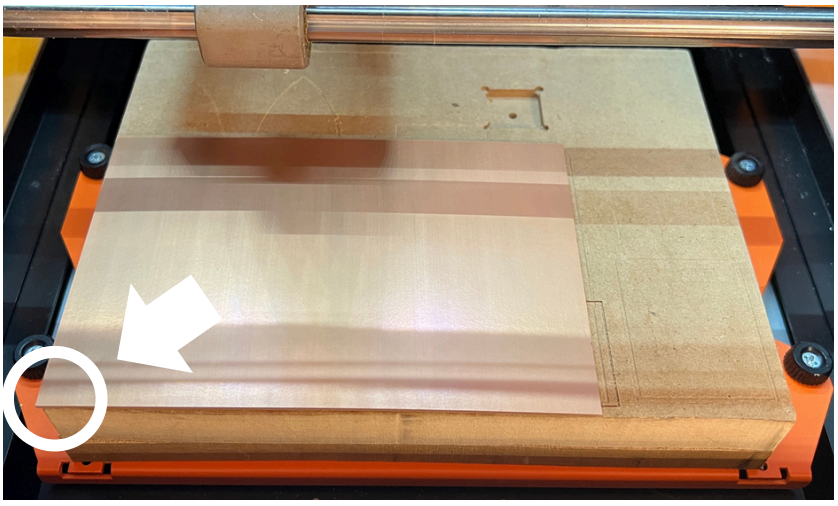
The FR1 Copper Clad sheets are single sided. The shiner, metallic copper side is the top and the dull fiberglass side is the bottom. Try to avoid touching the top surface as fingerprints can degrade the finish of the copper over time.





Place double-sided tape to cover the bottom surface of the FR1. Try to avoid air bubbles, overlapping the tape, or any other imperfections that could cause the sheet to lay unevenly when placed in the machine.

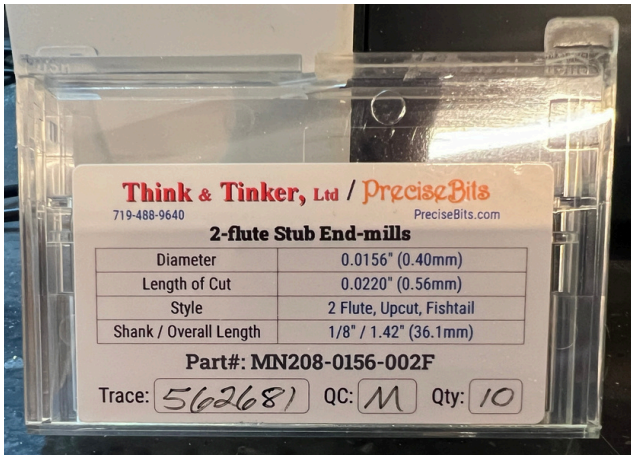
Position the FR1 on the bed by aligning the bottom left corners and push down firmly over the entire surface. Use a paper towel while pushing down to avoid touching the top surface directly



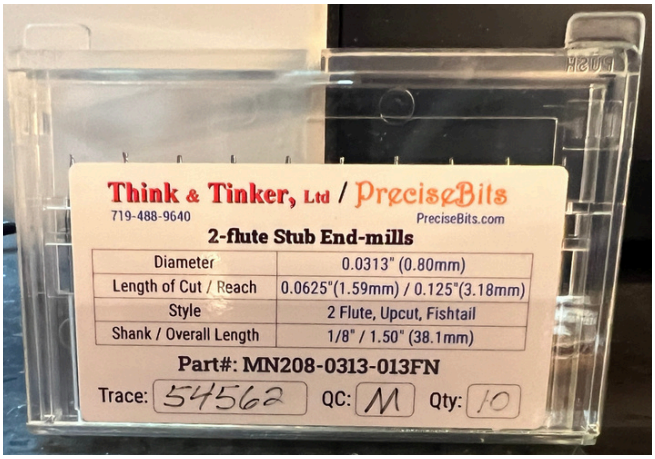
Using the Roland SRM-20

Loading the End Mill

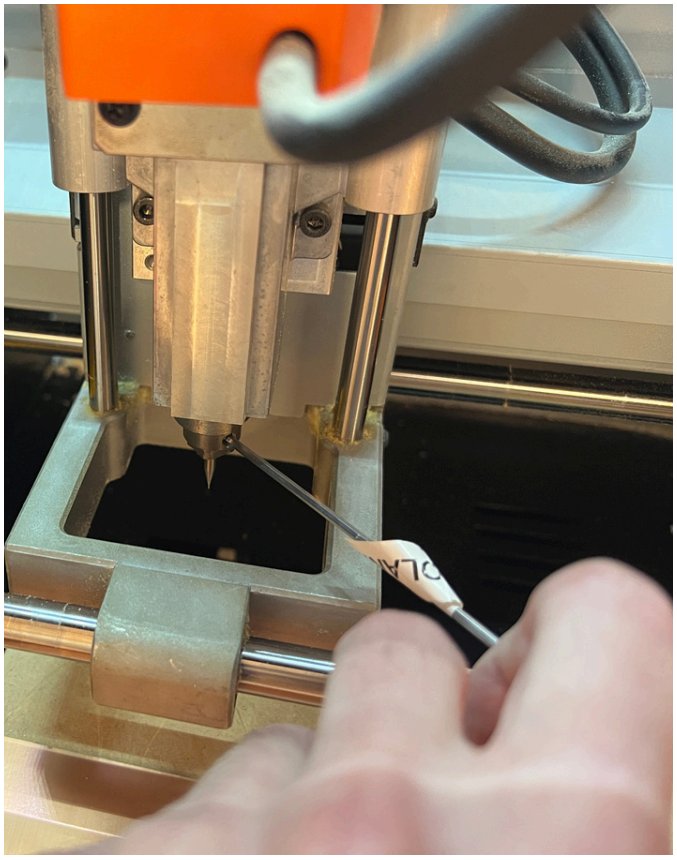
We have two types of end mills: one for milling the traces that make up the circuit and one for cutting through the outline and any holes of the board

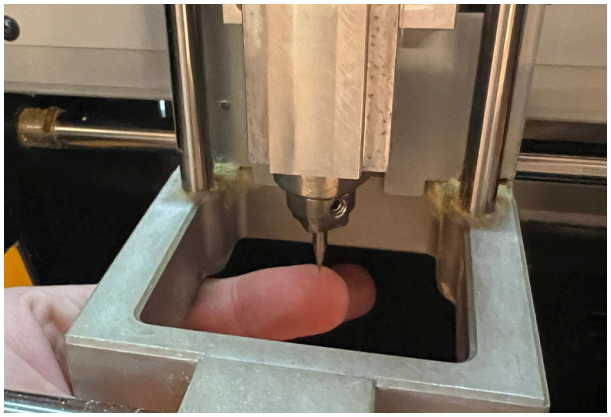


The ***0.0156" (0.4mm)*** diameter end mills are for milling traces



The ***0.0313" (0.8mm)*** diameter end mills are for cutting outlines



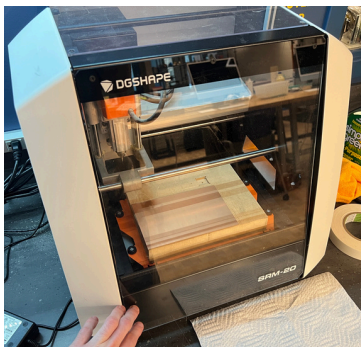


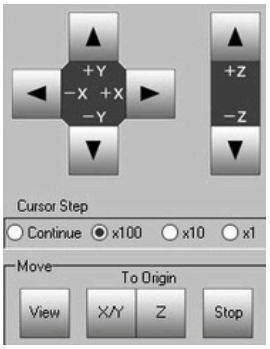
Remove an end mill by loosening the collet using the hex key on the right side of the machine. Careful, it will drop if not held! Load an end mill by pushing it up into the collet and tightening using the hex key.

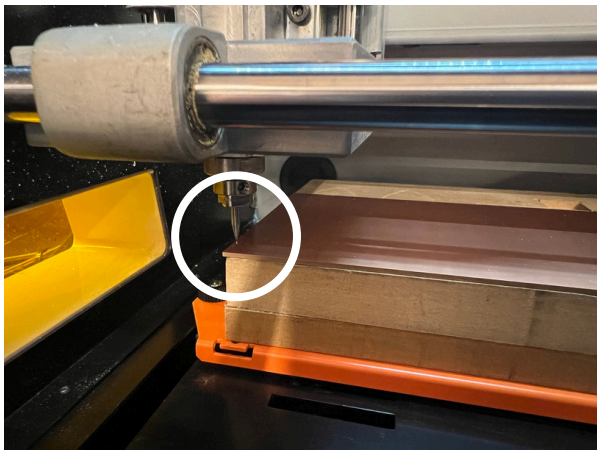
Using the Roland SRM-20

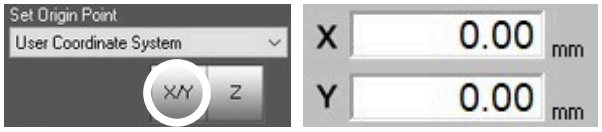
Setting the X, Y, & Z Origin

These next steps involve moving the machine using the movement controls within VPanel. **The machine will not reliably move unless the lid is closed!**



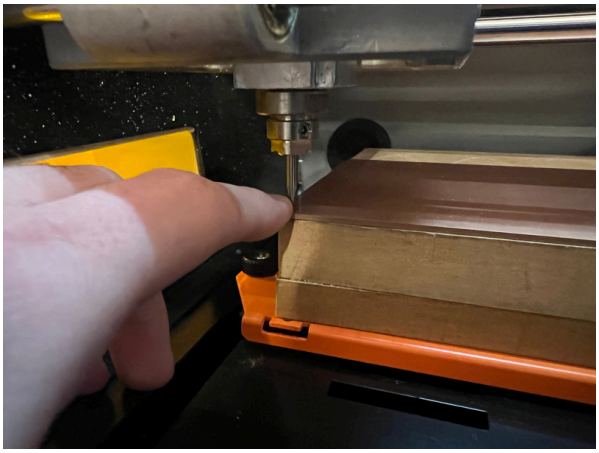


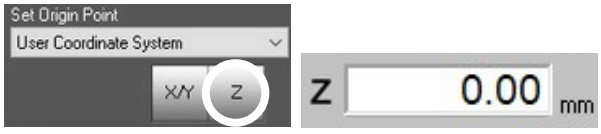




Bring the tip of the end mill close to **but not touching** the bottom left corner of the FR1. Then, hit the ***X/Y*** button in the Setting Origin section of VPanel. Confirm the change by selecting ‘yes’ when asked to continue. The X and Y position in the Positional Information section of VPanel should both change to 0.00 mm

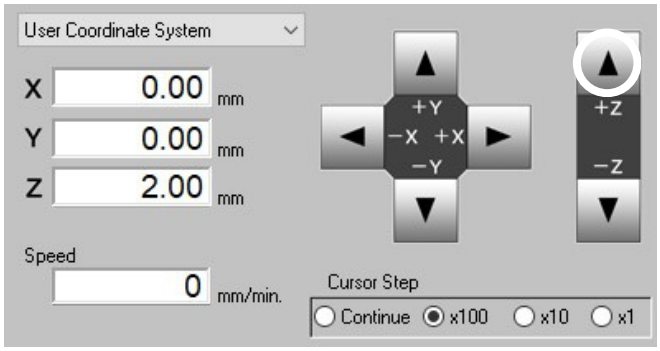
Loosen the collet until the end mill drops and **makes contact** with the FR1. Firmly press down on the FR1 near the end mill, then tighten the collet. Hit the ***Z*** button in the Setting Origin section of VPanel. Confirm the change by selecting ‘yes’ when asked to continue. The Z position in the Positional Information section of VPanel should change to 0.00 mm





Using the Roland SRM-20

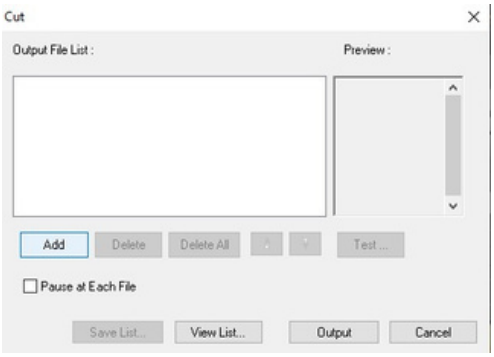
Starting a Job from VPanel

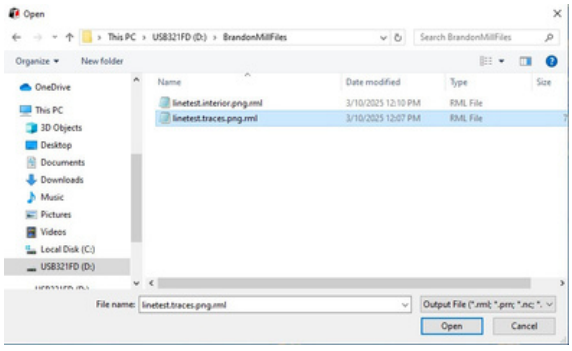


Assuming the Z origin was just set and the end mill is touching the FR1, increase the +Z position by about 2.00 mm. This ensures that the end mill can freely spin when the job begins.

Click the ‘Cut’ button in the Milling / Cutting Control Section to set up the job

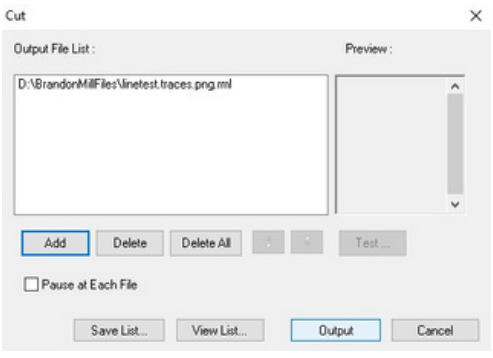
This will open a window to upload the RML generated by mods. If there is already a file in the Output File List, select it, then click ‘Delete’ to remove it from the queue. Once the Output File List is empty, click on the ‘Add’ button





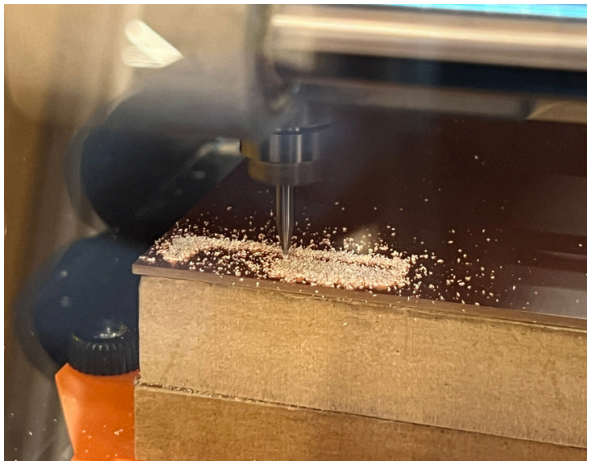
This should open the File Explorer. Navigate to the location of the RML file and select it, then click the ‘Open’ Button. Ensure that you select the correct file for the end mill that is loaded in the machine!

Confirm that the correct file was added to the Output File List, then click the ‘Output’ button. Once the spindle reaches the necessary RPM, the milling job will start! Click ‘Cancel’ in VPanel if anything seems wrong or unreasonably loud.



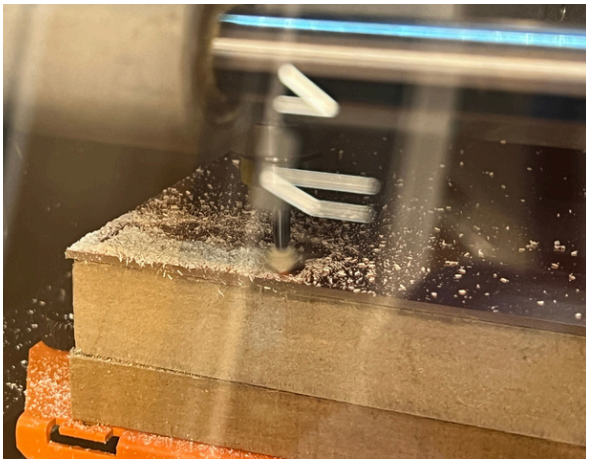
Using the Roland SRM-20

During the Job



It is normal for there to be dust while milling. Too much dust indicates the end mill may be too deep (too much pressure while setting Z origin) and too little dust indicates the end mill may be too shallow (too little pressure while setting the Z origin)

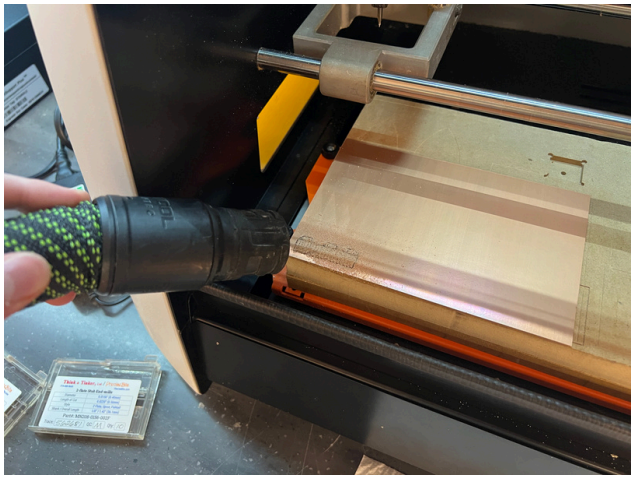
It is also normal for the debris to wrap around the tip of the end mill, especially when performing a cut. This can easily be removed once the job is completed and the debris cool.



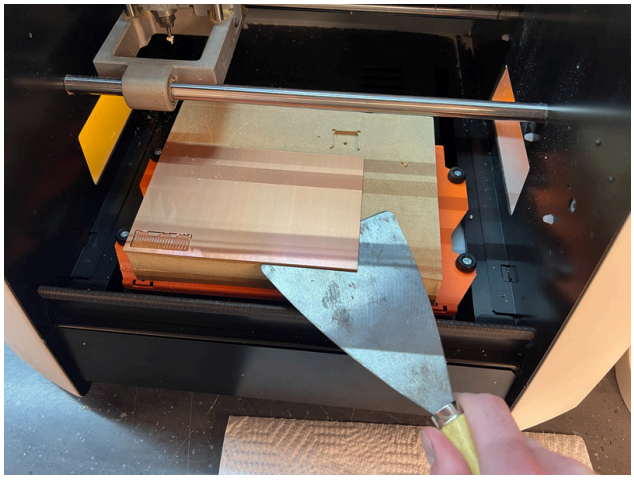
Use the FESTOOL vacuum to remove the dust after each process. Activate the vacuum by powering it on with the power button (left), then enable the suction by lightly pressing the MAN button (right).

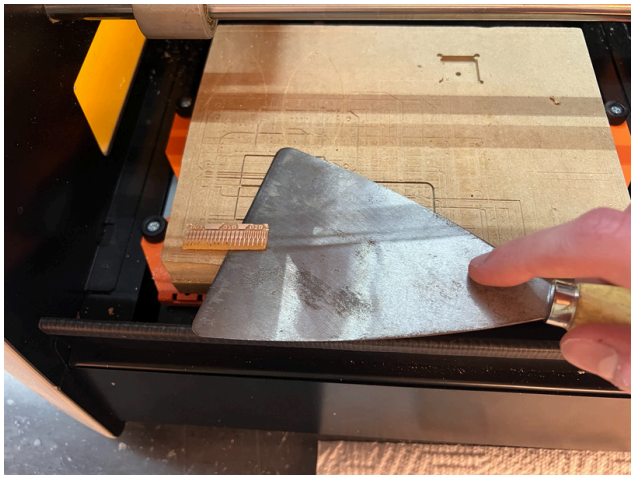
Using the Roland SRM-20

Removing the Board



Remove all of the dust from the top of the board with with the vacuum. **Try not to make contact with the board as this can damage the delicate traces.** Also vacuum all of the remaining dust from the walls and around the bed of the machine





Use a metal scraper to gently lift the FR1 and the milled board from the bed. Try not to bend either as the material can easily crack.

Remove the double sided tape from the back of the FR1 and board.