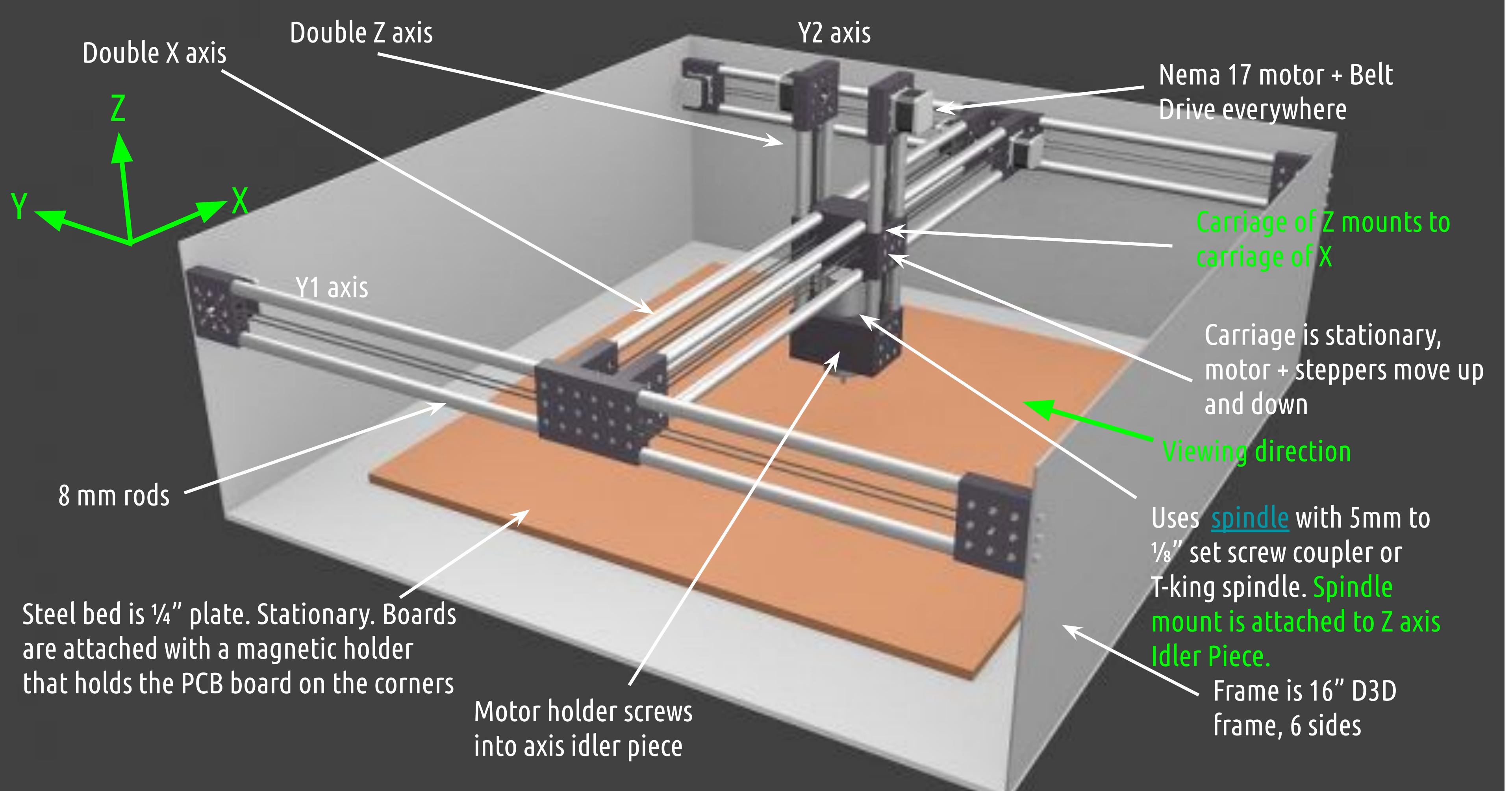
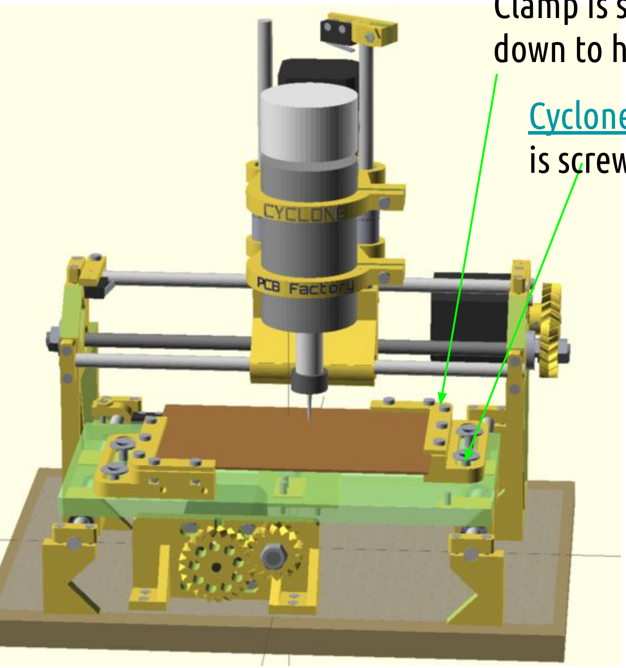


D3D CNC Circuit Mill Concept

PCB Holder

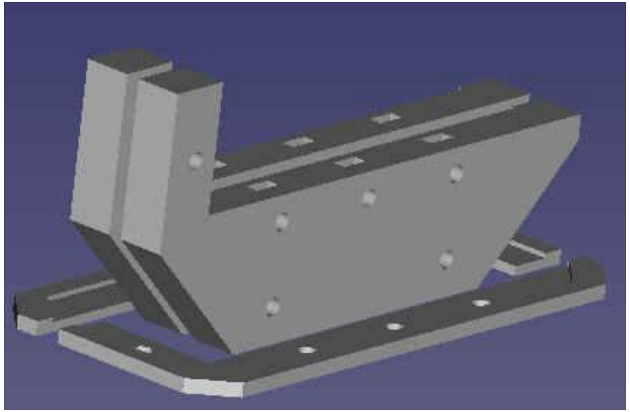
General Procedure -

Download the simplified x axis, and use it as is for x,y,z motion (it’s already simp



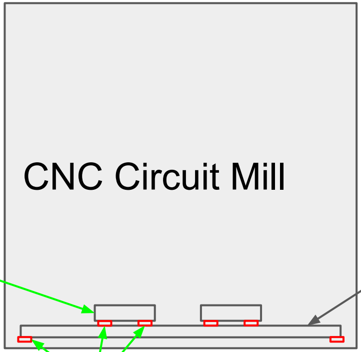
Clamp is screwed down to hold PCB

Cyclone PCB Mill Holder is screwed down



Holder STL for printing

D3D PCB Mill holder has magnets glued to it to attach magnetically to the steel plate. Thus, they are fully adjustable. Clamp is screwed down. 6 magnets per holder



Magnets

¼”x8”x16” **steel plate** attached with 4 magnets on each side to CNC Mill frame

Design Process Step By Step

General Procedure -

Download the simplified x axis, and use it as is for x,y,z motion (it's already simplified)

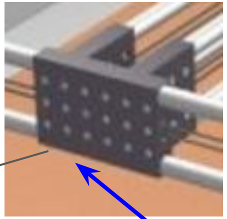
1. Use concept model of page 1 (recreate concept model page one using only X-axis)
2. Merge x axis and duplicate it 5 times
   a. Do not add new parts unless absolutely necessary (instead use carriage of Universal-cnc axis (XY))
3. Draw the square frame 13" with 10" inside 3mm thick
4. Draw a simple file of motor with exact diameter, height should be accurate
5. Design a mount for the motor which connects to idler piece of Z axis
6.

More

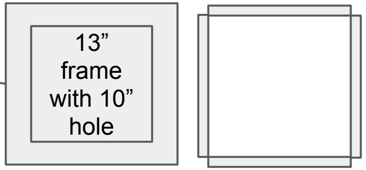
- Universal-cnc axis but assume magnetic connection

Basic Calculations -

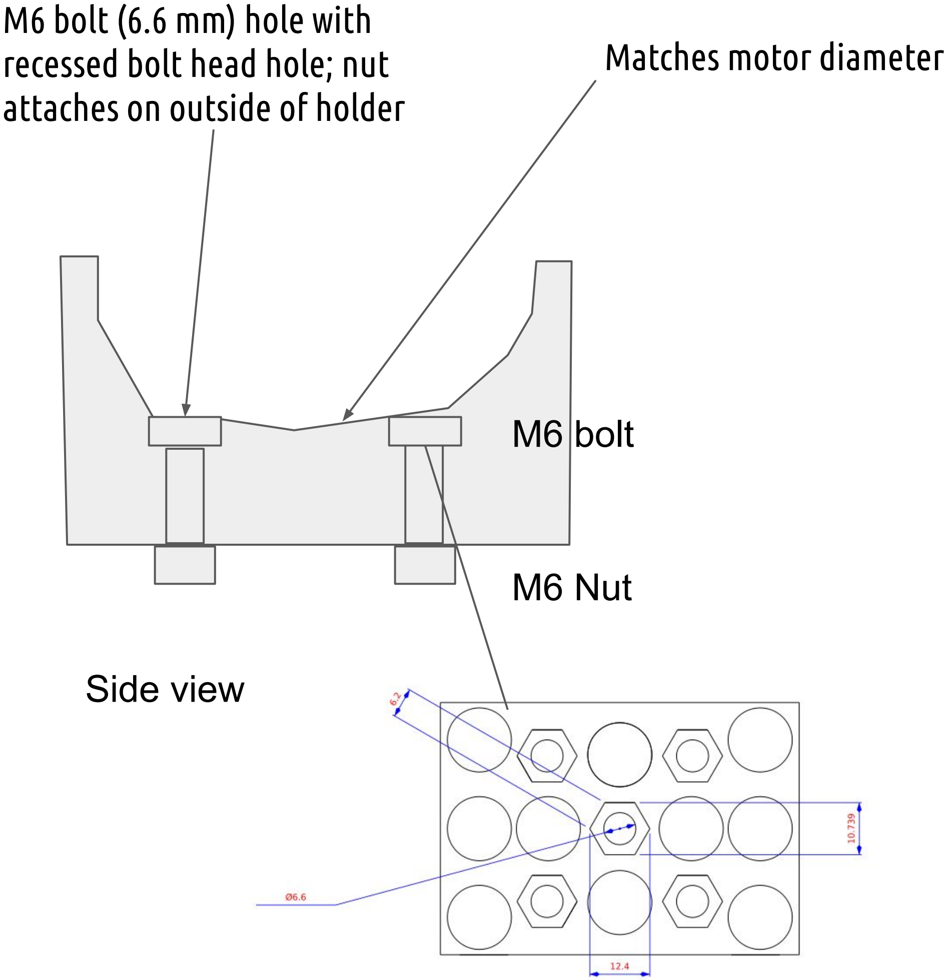
- Should get down to 0.01mm based on 16 microstepping - assuming there is no backlash
- We can accept up to 4 microstepping (0.04 mm)



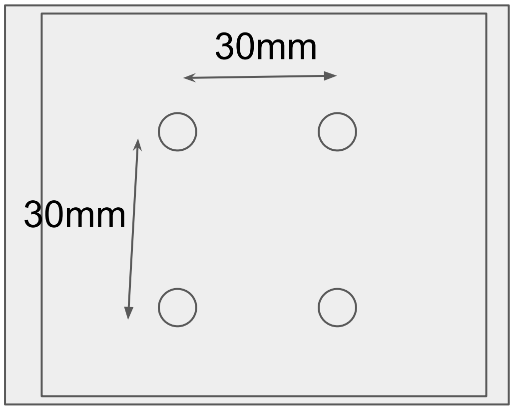
Instead of wide part, use 2 Carriage Pieces



Motor Mount



Side view

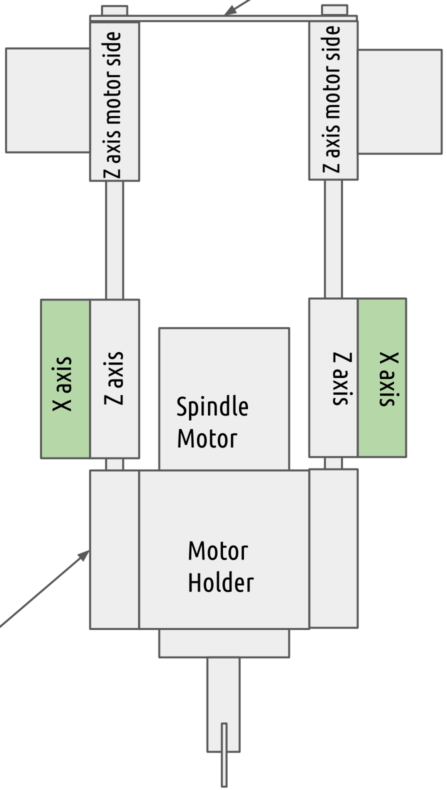


Top view

Motor Mount Initial Concept

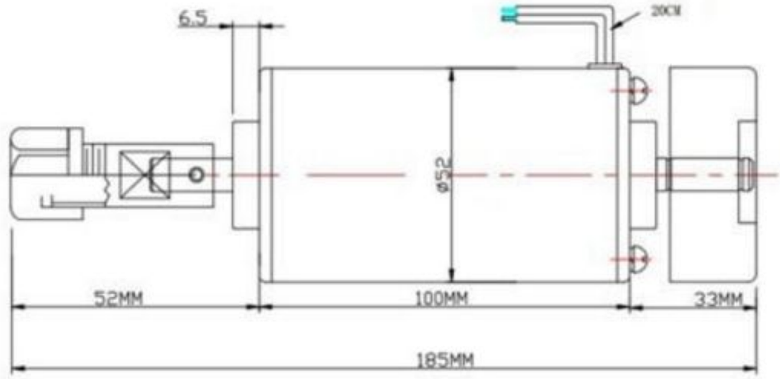
Stabilizing bar bolted to nut catchers

Mount Concept:



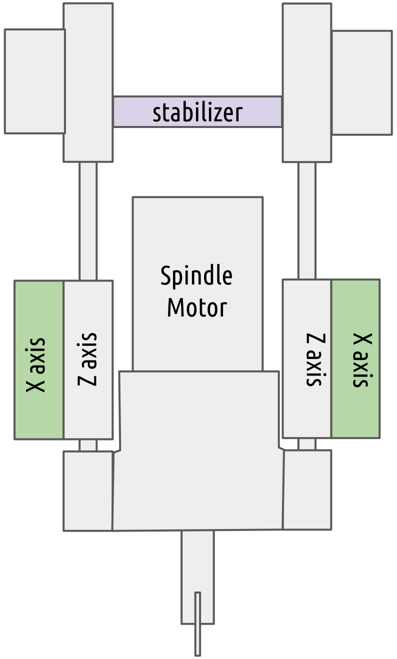
Idler Dimensions: 55x66 mm

Issue: Don't want the spindle to be too far below the X axis.



Motor Dimensions:

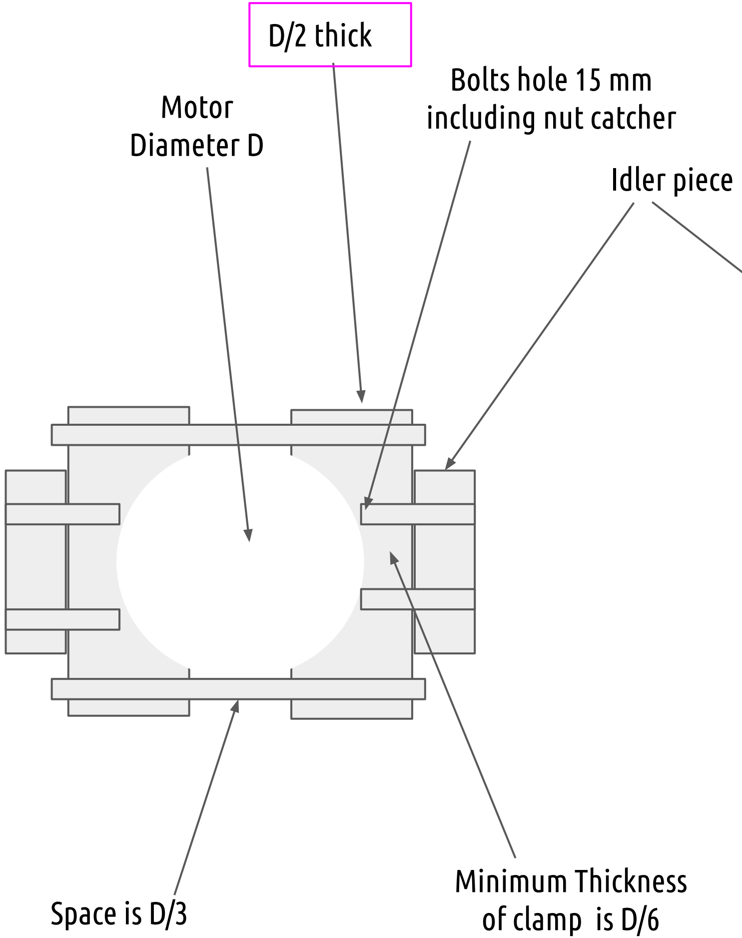
Mount Concept 2

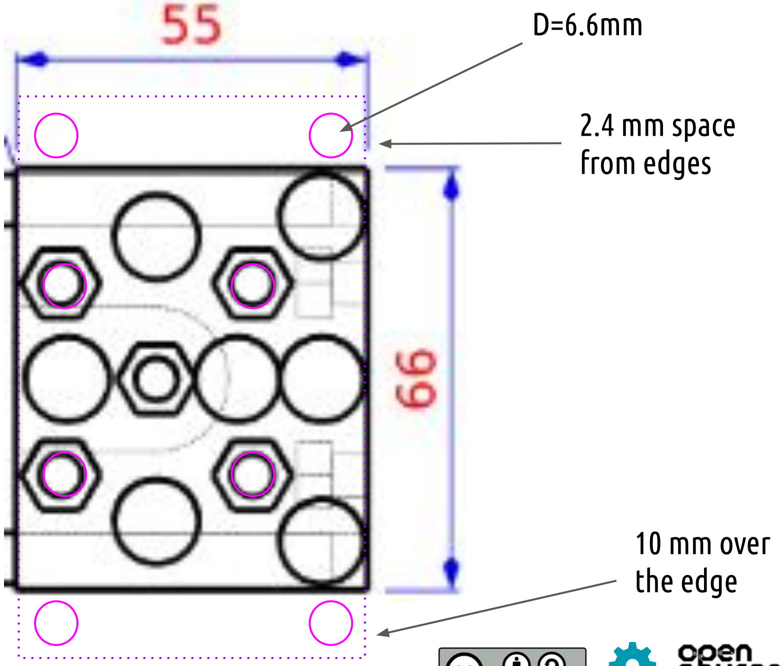


- Mount spindle motor as high as possible to minimize cantilever of the tool tip
- If mounting stability is poor, add a stabilizer bolt between the stepper motors
  - Stabilizer could use existing bolt holes, and be fixed with nuts

Mount Detail Top View

- [2] half clamps hold motor in place
- Clamps are attached to idler piece using [4] bolts
- [4] 6 mm or ¼” bolts or threaded rods clamp motor between the clam shells
- To draw the motor clamp - modify the idler piece to build around bolt pattern



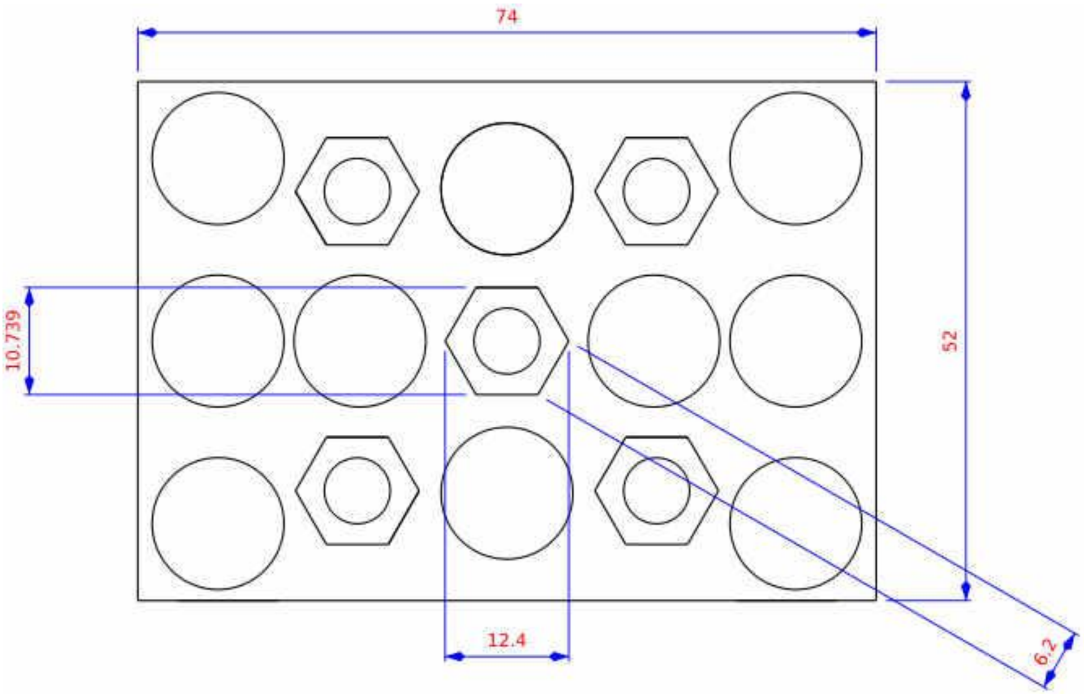


Additional design information

Need:

- spacing for motor
- Nut catcher size

Carriage Piece



open source hardware

open source ecology

D3D CNC Circuit Mill

General

- 5x5 milling area
- Enough z to simply lift spindle
  - Shank is 1” for most tools. Tool sticks out ½”
  - Need 1.5” z travel
- 5/16” rods - just like in 3D printer
- Use the 13” D3D frame for the CNC circuit mill

Feature Size Requirement - for current OS Power Meter

- Current - minimum cut is 0.2mm wide
  - That’s the size of cut with endmill
  - Designed for 0.1mm
- Trace design width min = 0.5mm
- Plunge is 0.125 mm deep

Basic Calculations -

- ½” drive sprocket with GT2 belt
- 180 steps per revolution stepper, with 16 microstepping
- One revolution is pi*D = 3.14 * 12mm = ~38
- One microstep = 38/180/16 = 0.013 mm
  - That is a factor of 10 higher positioning accuracy than required

Supplies

10 degree

30 degree

Bits

- 10 degree, ⅛” shank
- 30 degree, ⅛” shank
- 0.3-1.2mm Drills
- Endmills - 1mm
- ⅛” Cutout Endmill

Spindle, 12000 RPM

- T-King 48V, $55
- 12V Motor
  - ⅛” to 5 mm coupler

Power Supply

- 12V
- 48V, adjustable
-

Copper Boards

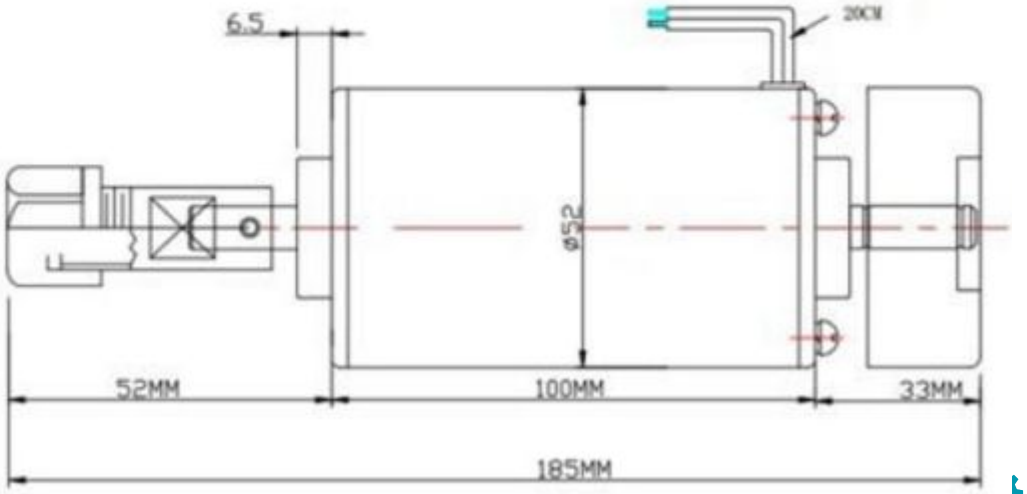
- Set of 20

Spindle Motors

- $19 - 12,000 RPM - 5mm shaft, 12V
  - Specs - TRS-775W
- Mabuchi RS-775WC - $18

⅛” to 5mm coupler

- T-King 48V, $55

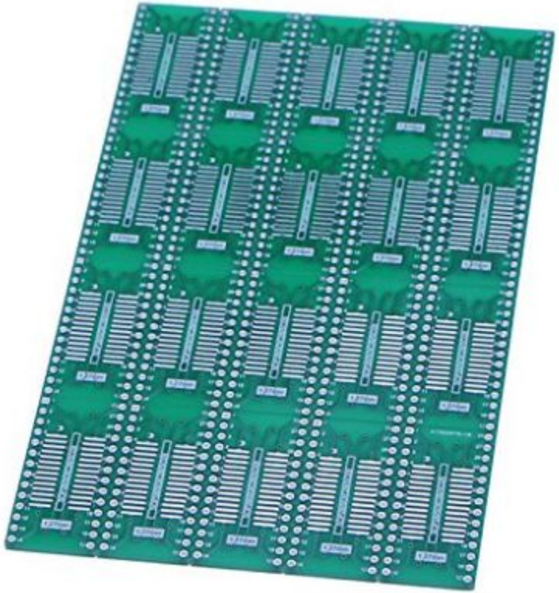


Spindle

- Dremel
- T-King, 48V, 12000 RPM
- Spindle, 200W
- Spindle, 500W -
- John Stager Log from 2013 shows the open source spindle.

Feature Size

- Worst case - using an interface circuit
- Objective: working circuit board mill



Existing Resolution - Lead Screw - on Shane's Mill

- 0.0076 mm step size (averaged over 1 mm)
- 0.127 mm backlash - correction is implemented on top of this
  - Anti-backlash nut is most of that

Calendar

Install OSPM	Shake down OSPM	Mill - Frame Build	Attach Axes-	Spindle mount	Bed install	Electronics
Software	Sample Runs - debugging backlash	Refining copper fixing	Plunge depth refinement	Automate calibration process		

Lead Screw/Ball Screw Sourcing (Shane)

- Ball Screw + Rail $135
-

Open Source Toolchain - Shane

- RAMPS/Marlin
- Kicad to Gerber file
- Gerber to Gcode for our mill
- Settings for our mill
- Fixing workpieces
- Calibrating height + level of workpiece
  - Touch-off calibration circuit -
  - Correct G-Code file
- Doing a cut

Literature Search -Shane

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BOM

- Sreadsheet - Spindle + lead screw
- Design Lead screw drive system
- RAMPS + Marlin
  - 2D in Marlin for milling
  - Need backlash corrector code
- FlatCAM - open source. Takes Gerber File to Gcode

Calculations

Force Requirements

- ~5 lb plunge for milling
- ~5 lb for through-holes
- ~5 lb lateral for milling
- ~10 lb lateral x and y for cutting
- Spindle - about 2 lb, built in fan