

STPCRAFT SERIES 2 MODEL 600

BY DENNIS HOBBS



It's a Router, Milling Machine, 3D printer and Hot Wire Cutter all in One Machine!

How many of us have wanted to create fuselage formers, wing ribs and a host of other part for our models in a much more accurate way, rather than standing at a band saw for hours sawing out dozens of individual pieces or worse still, hand cutting all those pieces, and not always accurately! Would you also like to be able to recreate exact scale pieces in 3D on the same machine? How about a milling facility in the workshop? The same Stepcraft machine can do this as well. The future is here!

I had become increasingly frustrated with a very nice, very versatile, but small Proxxon MF70 CNC conversion. Unfortunately its 130x70mm working space is just not adequate for my current work. Because of this, my journey to find a replacement at reasonable cost started. My "must have" features in a new machine were zero backlash and high rigidity in a desktop size. Unfortunately most of the available milling machines that could have properly been called "precise" came with serious cost, weight and space implications. Alternatively, gantry routers can often mean compromises on rigidity and most locally-available solutions still required far too much floor space with sizes based on standard sheet sizes.

I explored some of the Chinese units, such as generic 6040's that you can find on the internet and eBay. They looked reasonable on paper and adequate when viewed on YouTube reviews, however the process of selecting, importing and paying for a suitable unit quickly became a convoluted exercise. For example, one \$2500 USD machine FOB China, was going to exceed AU \$5000 after Australian taxes, port fees, and customs charges. My biggest concern was that I could not see the machine in action anywhere, leaving me to wait until I received it to find out if it would work or not. This was a risk I was not willing to take. And then, of course, there was the subject of support. Who would I call to support the machine? The inexpensive costs on paper, were quickly deemed a non-viable solution.

After speaking to Proxxon World, who supplied my original MF70, a suggestion to consider the Stepcraft CNC system was offered. I did have some initial conceptual issues with the Stepcraft when looking at their information online; mainly the accuracy of lead screws versus ball screws, what appeared to be light construction and the small stepper motor size. However, the plus-side looked quite good; a very nice German-designed machine, small footprint with a good working area, integrated electronics, and many optional attachments that could be added. After some research, I discovered that many people were having very good success machining aluminium, which was important to me. The best part for me was that it was locally sold and supported here in Brisbane.

A visit to Stepcraft Australia - My Tool Store was arranged where I was able

to see a demo of Stepcraft and see for myself how the machine compared to my initial conceptual issues. After some time spent seeing and touching the machine as well as a demo of it in operation, I ordered one and received it a few days later. Excited to have this new CNC machine operating, I was quick to begin the assembly.

First Steps

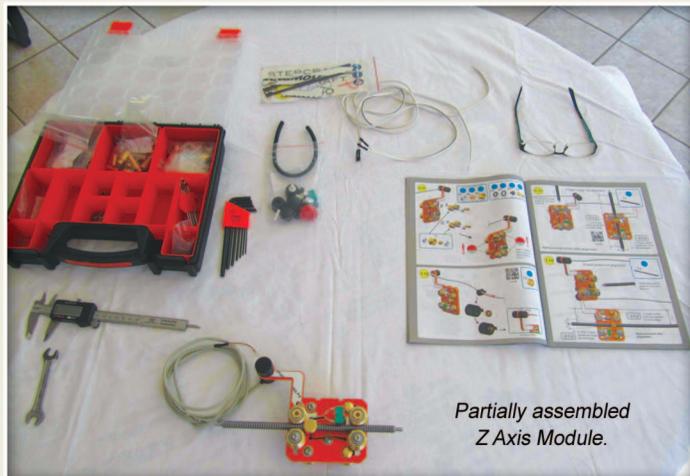
All parts are easily laid out in a large polystyrene box and after familiarizing with the manual, individual parts were identified, organized and selected for assembly. The assembly process was straightforward with only some minor issues that were quickly worked out with a call to my local dealer. The Stepcraft kit did not require any special tools. Most of the assembly is done with various sizes of Allen keys.



Components in Package.

Carefully following the assembly manual and accompanying online videos was necessary to get final adjustments correct. Any issues I had during the assembly were resolved at the final alignment and levelling stage. I did find that the assembly process became much easier after I took the small parts out of the bags and placed them into a compartmented box.

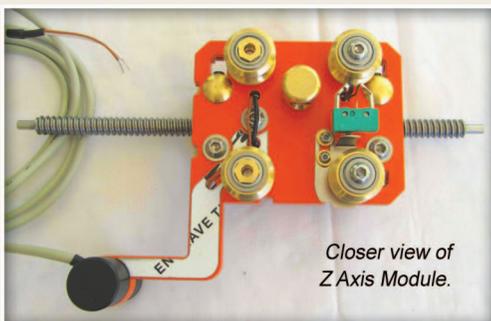
Z Axis Module



Partially assembled
Z Axis Module.

It's important to remember that the wiring harness originates from inside this module. Once the machine is assembled, repairs or readjustments to the wiring and limit switches may necessitate major disassembly, so I suggest paying careful attention during these assembly steps to avoid having to disassemble the machine to correct this at a later time.

Be careful when fitting any of the lead screws, as the temptation to use this screw to apply pressure and adjust the lead screw nuts can be quite strong. It is very easy to bend a lead screw, which can cause undesired results later on. Be sure to follow the manual during these adjustment steps and watch the associated videos before continuing.



Closer view of
Z Axis Module.

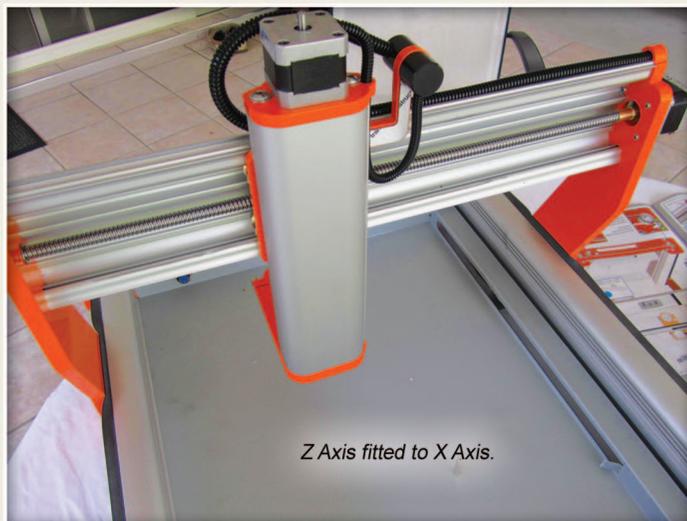


Assembled
Z Axis Module.

X Axis Module

When assembling the X-axis section of the machine, be sure to follow the instructions in the manual carefully and again, treat the lead screw and nut

very carefully. It was tempting to spend time trying to remove any endplay between the motor and lead screw, but it's not critical at this time. This adjustment is easily done and it's best to be performed after final assembly. Simply unbolting the X-axis stepper motor and withdrawing the lead screw a little bit will give good access to the brass thrust bearing.

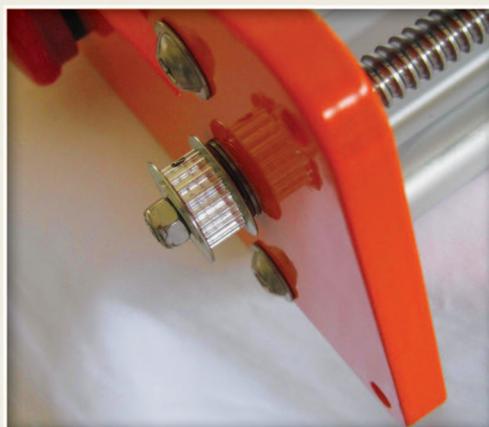


Z Axis fitted to X Axis.

Y Axis

The Y-axis contains two lead screws coupled by a timing belt and driven by one (larger) stepper motor.

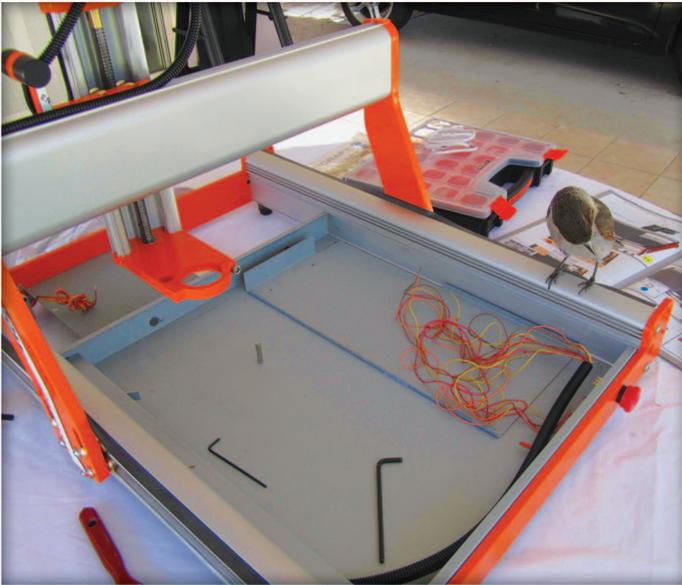
The thrust bearings on both sides are formed by two ball races fitted to either side of the Y stepper support plate and firmly locked in place by a NyLoc nut. The nut is screwed onto the lead screw against the timing pulley with a washer between the pulley and ball race. Again critical adjustments are best left to final alignment stage. It is important to take special care in fitting these bearings



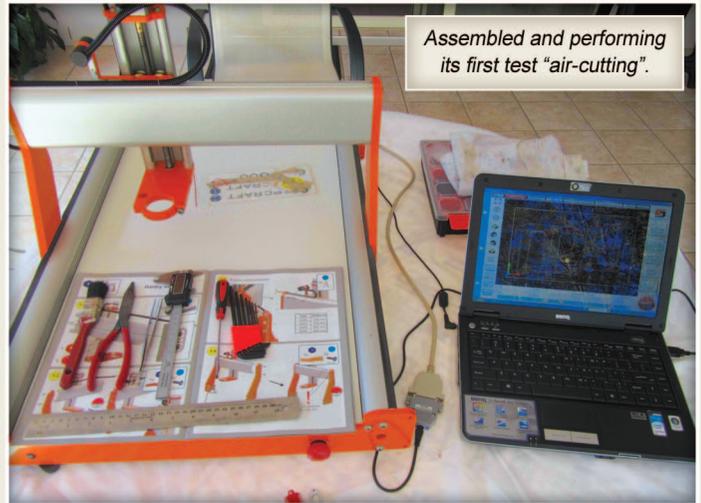
to ensure they are sitting properly in the frame, parallel to each other and with minimal play. There are some videos on Stepcraft's YouTube channel that help illustrate how to set up the proper track roller tension. It is worth seeking these videos out before you finalize the Y-axis assembly steps.



Wiring & Base



Pay careful attention to the wiring guide bracket at the bottom of the gantry support arm. There is not much clearance below it or from the stick-on feet! In fact the feet as pictured below are incorrectly located and did collide with the



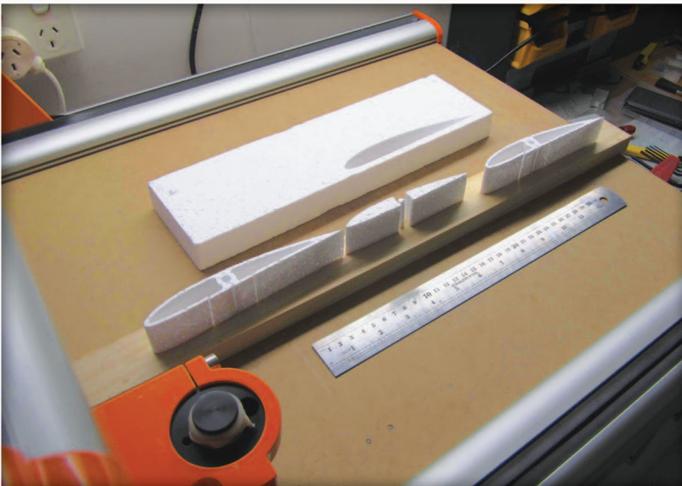
guide bracket. The feet were later placed at the extremities of the aluminium extrusion to resolve that issue... just as the manual specifies.

The wiring was finally terminated. Bootlace crimp pins were used (not required) to neaten and insure connection reliability.

The Stepcraft-2/600 is now installed in my small workshop. The laptop has been replaced with a standalone desktop computer running Windows XP. It's sitting underneath the router and next to the spindle's control box. Interactions with the router in this workshop are via the wireless keyboard and mouse.

Foam Cutting Attachment

My first attempts with foam cutter were not good as it required some trial and error to determine the correct speed and heating current required for various types of foam. I quickly found that cutting at around 800mm/min and approximately 1A heater current seemed to work quite well with this packing foam.



The careful part was getting my CAM program to generate a cutting file that comprised of one continuous line with the entry into centre areas accurately overlapping the exit line so I did not have two lines cut into the centre areas.

Testing the foam cutter by making some involute gears cut out of foam and generated via CAM plug-in.

Foam cutting was a little tricky to get used to, but once the cutting path was correct, it all became just another machining process.



The Foam Cutting Attachment.

Spindle

A HF-500 computer-controlled spindle was ordered with this machine. This spindle has a lot of advantages compared to a Dremel or Proxxon rotary tool or even a palm trim router. It uses a brushless DC motor, which provides plenty of torque, and since it's computer-controlled, turns on and off with the job and the G Code created with the CAM program automatically adjusts the RPM settings. The HF-500 is a little on the pricy side but has proven worthwhile. It is supplied with an ER11 collet chuck, external controller and an air pump for cooling.

The spindle runs smoothly with no noticeable bearing slop. As of this writing, the only cutting inaccuracies appear related to the tool flexing and not the spindle itself. I tend to notice it more when using smaller, longer cutters like the 2x12mm as used in the photo.

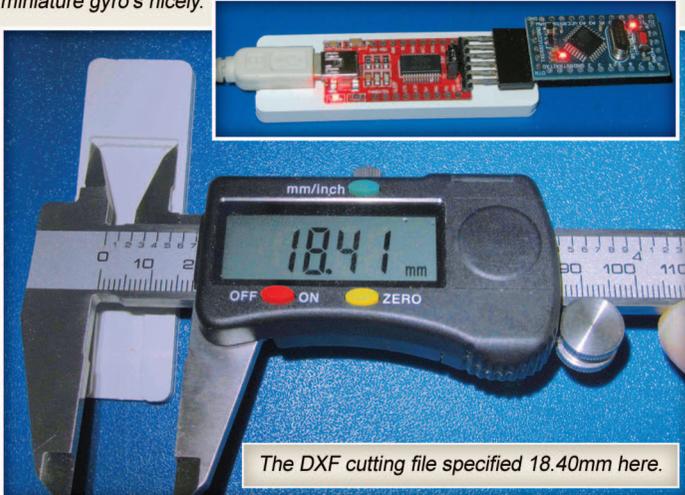
For now, cutting quality in PVC and aluminium appear to be largely operator and tool path dependent and with the proper settings, the Stepcraft provides excellent cutting performance with a high amount of accuracy.



A 2 x 12mm single flute cutter installed here to route out a PCB holder from 6mm plastic sheet.



An Arduino Pro Mini Clone, with its serial programming PCB, clipped into the newly cut holder. Easy to program, very cheap, and should connect to miniature gyro's nicely.



The DXF cutting file specified 18.40mm here.

Conclusion

Now that I have the machine assembled and running perfectly, I have been spending time to obtain more of a "feel" for the proper settings with various materials and cutting tools. I have to say that; overall, I was very impressed with the assembly process as it was straightforward and uncomplicated as long as you follow assembly manual and videos closely, and in the right order. Fortunately, there are quite a number of useful videos on the Stepcraft website along with several articles offering good practical advice. As a final note, I want to mention that the Stepcraft is a precision machine, and does require the end user to pay close attention to their workmanship and do not rush the process to ensure a satisfactory outcome. There are a few "traps" that a first time builder can fall into, such as bending a lead screw or setting adjustments too tight if you were to rush the process and not follow the manual and assembly advice. I am happy to know that I can now take a design file to the new machine, secure the work piece, and reliably cut, time after time. No fuss needed!

Why CNC & A Gantry Router?

These days the use of 3D printers is almost ubiquitous, and for the purposes of creating "sculptured objects", they are extremely useful and quite easy to use. They are also very good at producing low weight items because of their ability to print with fractional fills. One stumbling point is that one should have reasonable skills at preparing the initial 3D models, especially if you do not want to be dependent on generic downloadable files. Unfortunately when engineering or model parts are required, the use of 3D printers becomes much more complicated, restrictive in material choice, and be expensive if you want to work with a useful range of materials, whereas CNC machining is compatible with most materials; such as wood, engineering plastics, foams, metals and can quite often, achieve "impossible" results.

As usual, it takes good skills, an understanding of how to work the material of choice and a good concept of the desired result. These are of course, the same skills that many if not most modellers have developed over time and usually with significant effort. Thus the embracing of a (possibly) new skill of 3D Design is just one more thing to learn and master. Once this new skill is available, even at a rudimentary level, the possibilities of CNC machining applying to model construction and design can be seriously significant.

Essentially this Gantry router "draws" in a 3 dimensional space, on a wide range of materials and using a wide range of tooling. These tools can include:

- High speed carbide cutters for drilling, cutting, carving, and routing
- Engraving cutters for engraving PCB's and signs
- Laser sources for engraving and cutting
- Hot pens
- Hot nichrome wire for foam cutting
- Pen and ink
- Automatic tool changers
- 3D printer heads
- Water baths for the safe cutting of carbon fibre
- Drag knives for vinyl signs, labels, decals, fabric and sheet

Why This CNC Gantry Router?

My requirements were for a machine that could be treated just as another tool and affordable enough to simply leave idle as my daily work flow dictated. In this light, the requirement of having a larger, more useful CNC work area also seriously clashed with workshop space already hosting a lathe and 3D printer.

I soon discovered that there are not many "nice" choices available in the market place to suit this kind of need, but the Stepcraft 600 V2 ideally suited my requirements.

Available from www.stepcraft.com.au

