Arduino cnc shield v3 tutorial pdf

Let's convert a cheap Chinese CNC machine into parallel port to Arduino and GRBL. All right, guys, this is the culmination of seven readings, research and determination. This is my first instructable so I hope this will help you where you need to go. A little background before we get started:The 3020, 3040 and 6040 (and the more obscure 2015, 2016 and 2020) CNC router milling machines that come out of China are hugely popular in hobbyist and professional circles. If you are a DIY type, these machines offer a great way to repeat the processes and basically do a few things that no hand tool allows you to do. For professionals, these machines have relatively accurate leadscrew/ballscrew fittings that allow another machine to pump away so components when the machine machine is busy with the job. All in all, these cheap machines (ranging from $600-2500 delivered to DHL) are a great way to get to the CNC. You can find it all over eBay and Aliexpress, in my experience, you'll find barely cheaper options for Aliexpress and buyer protection is much better than eBay. Model numbers represent the size of the working area, that is. the 3040 is 30cm x 40cm, the 6040 is 60cm x 40cm etc. The range of these models makes choosing the right one in the store quite simple, the more expensive and larger ones (typically 3040 and 6040) will be the more accurate ball screw type linear movements rather than typically trapezoidal guide screws. the 2015, 2016 and 3020 machines (there will be ballscrews in about 3020) have a nylon or Delrin type nut for linear travel. You can tell which model is leadscrew or ballscrews the letter after the model. 3040T will be trapezoidal leadcrews and the 3040Z will ballscrews (ballscrewz?) :D You have experience with both ball screw and lead screw type movements, the money you pay, it is better to make a machine with ball screws, because they wear better and very little if there is no backlash (side to side game) present. These machines come with adjusting stepper motors and typically cable tracks already built in, also come with a control box. The control box for almost all of these machines comes with a very old Mach 3 style Parallel Port interface. Signal pulses will be sent from the Mach 3 software to the port and that will drive the engines and make the CNC machine come alive. This type of system is old, dated and windows only. I have been a Mac person since 2003, so I'm not going to switch back to PCs anytime soon, so when I heard that I could convert this to Arduino powered, I went to the CNC for a neat tool to make that CNC become mine. So, after the long out of breath introduction, here's how i changed a 3020 machine to the following bits and bobs:1) 3020 CNC machine ... 2) Arduino Uno (the clone will also work)3) Protoneer CNC Shield V3.XXX (new boards due anytime now, clones too 3 x A4899 Grading motor drivers (they attach to the CNC Shield, be sure to attach it in the right direction!) 5) 3 x 4 Pin Dupont female connectors (one axle each, the board will show you where to attach them) 6) Shielded USB cable (Arduino, it's long enough to go from the control box to laptop/PC) 7) GRBL firmware G-code generator of choice (inkscape plugin, makercam, JSCUT) 9) G-code sender of choice (Universal G-Code Sender, GRBL Controller, Chilipeppr, etc.) You will see the video that the conversion is complete, but if you crack an box, you can basically see three main components. 1. The power source, it's either a coil or, in my case, a perforated metal box. The main lines are coming from the inside. A DC wire will be connected to the driver's board... 2. On the driver's board, you are familiar with this, because the leads to the connecting cables on the XYZ ports will be attached to this. If you had a board like my 3020, it would be super easy to undo as they screw terminals. Just take them back and you can pull them out. Power lines from the power source must also be present and withdrawn)3. The spindle is a VFD (Variable Frequency Driver), it's probably a closed box or an open circuit board. This is recognized because you will have a control board and dial the speed of the spindle. --If you forget the label on the XYZ cables, don't worry, just follow them to the ports in the back and you can see which is which. The Arduino must have flashed the latest version of GRBL. What does GRBL mean? I don't know, the jury hasn't decided yet. GRBL is an open source G-Code interpreter, it is the CNC machines with Marlin firmware for 3D printers. You can find grbl in Arduino, you can mount it in the case. But before you do that, you need to remove the old parallel port guideboard. Don't throw it out, you probably have some awesome electronic components that can be saved from it. You've already got the wires out, so it's not going to be too hard. I had to mount my Arduino board for the first time with a few screws (a screw bosses on the old board) before attaching to the CNC Shield. The CNC Shield spots 4 leading chips. It accepts the A4988 or DRV8825, and later ones are stronger and able to accept up to 36 volts and 1/32 microstreads. I only have the A4988 available, so I went for them. Before you install the driver chips, you must decide how many micro steps you want to run the machine. The rule of thumb is that the more micro-steps, the smoother the movements, but they reduce torque. Conversely, the fewer micro-stairs, the more torque the stepper motors have. I have to use jumper to set how many micro-steps, I wanted 1 / 8 microsteps, which I think is a good compromise between smooth movement and torque. To learn how to set this up: Shield Note: I have a clone of the CNC Shield V3, so my jumper settings were different from those advertised on the Protoneer blog. Maybe it's an anomaly or a widespread table error. NOTE: When installing the driver chips, make sure that they are positioned in the correct orientation. You can see on the board where the pins of the stepper motors and the drivers chips will see which pins must go towards the pins. Alternatively, you can just check out a lot of many images of CNC Shield online. Okay... so I've removed the XYZ cables from the old driver's board, the Arduino and the stuff is mounted ... now you need to interface from the old to the new. XYZ cables will need Dupont connectors to connect to the CNC shield. You can do it in a few ways, the easiest way was to make a female connector lead so that you can solder the old cables. The cables are already paired, so try to keep them in the same orientation. It will be red/red and black/black, not black/red, black/red. Conventional electronics wisdom says so, but not this time. Stepper motors work with 2 pairs of leads, it dictates the direction to push when a current is transferred, if you find that the direction is reversed when you fire up the machine and jog around, it's a simple question whether the shaft leads to the board and turn it into 180 degrees. In my conversion, I have a dedicated USB cable that I put on the Arduino, and it's just simple coming out of the control box, I don't bother positioning a board so I can unplug it. This USB connector not only connects your computer to Arduino, but also operates it. The CNC Shield also needs power, it has the power of stepper engines. The power doesn't feed the Arduino, so don't worry about baking. There must be a screw clip to connect the lead from the power supply to the CNC shield, do so. Once connected, you can ignite your favorite GRBL control software. That's it, that's it. this may seem like a long process, but honestly, if you read all this, it took longer to read this than it would be converted. This whole process took about 45 mins. So... if you haven't watched the video. He's here again. Let the good times roll! Here's a quick mini tutorial on finding out the value to put into your GRBL settings with the right amount of steps to translate designs into the real world exactly. A typical stepper engine is 200 steps per revolution. These are called FULL steps, or 1.8° per step. This setting has the highest torque and fastest, but not the smoothest. Most of these machines list the types and sizes of lead/ballscrew it. In my 3020, the guide screw 1404.14: 14mm diameter of the screw thread (OD)04: 4mm track (or distance between threads)We are most concerned with the 04 number, as it describes the amount of linear travel something connected to the driver's screw traveling through a revolution. So a 1205 thread with a diameter of 12 mm and thread size, so on, and so on. This also applies to ball screws, the thread size 1603 is 16 mm in diameter and 3 mm. - Now we can connect the two numbers. Stepper: 200/revLeadscrew: 4mm/revA GRBL settings call an MM number, so it's a simple math really. 200/4 = 50 steps to something to travel 1mm (if you have a 3mm thread, would be 200/3 etc) 50 of the number I put grbl --Heres where we get fancy, micro cascading. I have my CNC machine set up to 1/8 micro step, which means each step is divided into 8 microsteps. 200 steps x 8 micro steps = 1600 full steps/revThe same mathematical setting1600/4 = 400 steps to move something to 1 mm (again, if the thread is different than the separator number will be different)400 is the number I inserted into the GRBL - The more steps they take to make the movement smoother, but slower, and less power at torque. FORTUNATELY, chinese CNC machines are all metric, which makes this math very simple. If these were ACME threads, there would be some metric/anglo-Saxon conversions, resulting in some very odd numbers. --Ok now go cut yourself some fun! Fun!