WorkBee CNC

CNC xPro V3 Assembly & Commissioning

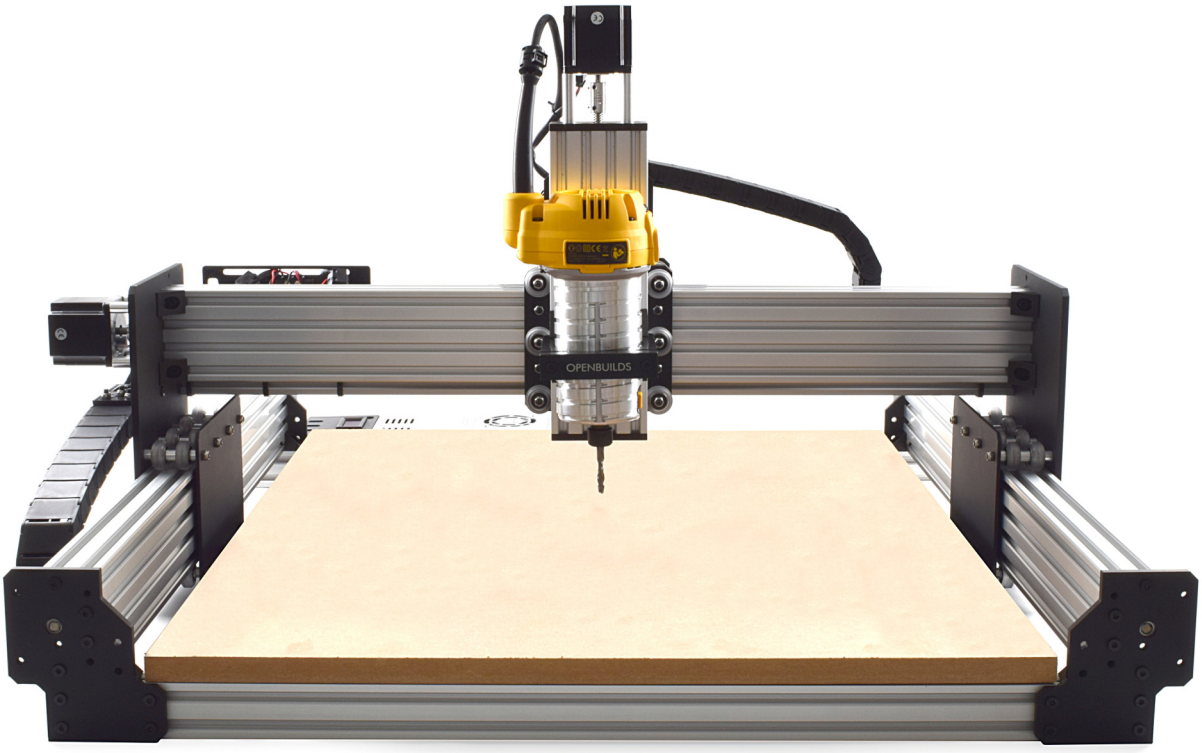


Table of Contents

1.0 Getting Started

1.1 Check Product Contents

When you receive your kit, the first thing you should do is check the contents against the list in Appendix A. The majority of the parts will be separated into boxes that correspond to the subsections in this manual. Additional spare small parts will be included. If anything is missing or damaged (or if you have any other problems) please contact us at sales@ooznest.co.uk and we will aim to resolve the issue as quickly as possible.

1.2 Notes on Assembly

This manual has been written for the construction of a 750 x 750mm screw driven version of the WorkBee. If you have a different version everything is exactly the same, with the exception of longer V-Slot extrusions and wire routing.

It is recommended that you read through the whole manual before beginning the build in order to get a full picture of the assembly process. Before beginning each step, make sure you have studied the diagram and have the required parts in front of you. A PDF version of the manual is available on our website and this will allow you to zoom in on the diagrams if needed.

Be very careful to not over tighten the nuts and bolts on the plastic parts, otherwise they may crack. Everything should easily fit together, and so if it isn't, take a step back and re-read the instructions.

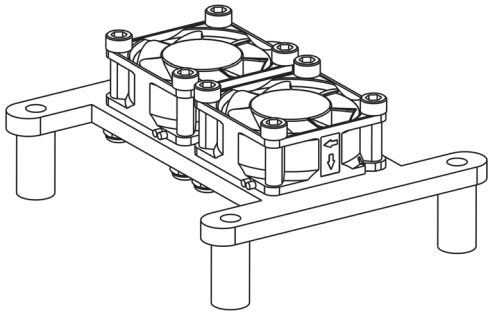
Assembly of this kit involves the use of electricity and therefore you should take appropriate precautions to ensure you are assembling the kit in a safe manner. When following wiring diagrams, double check that everything is connected correctly. Before carrying out any work on the electrics make sure that the machine is switched off.

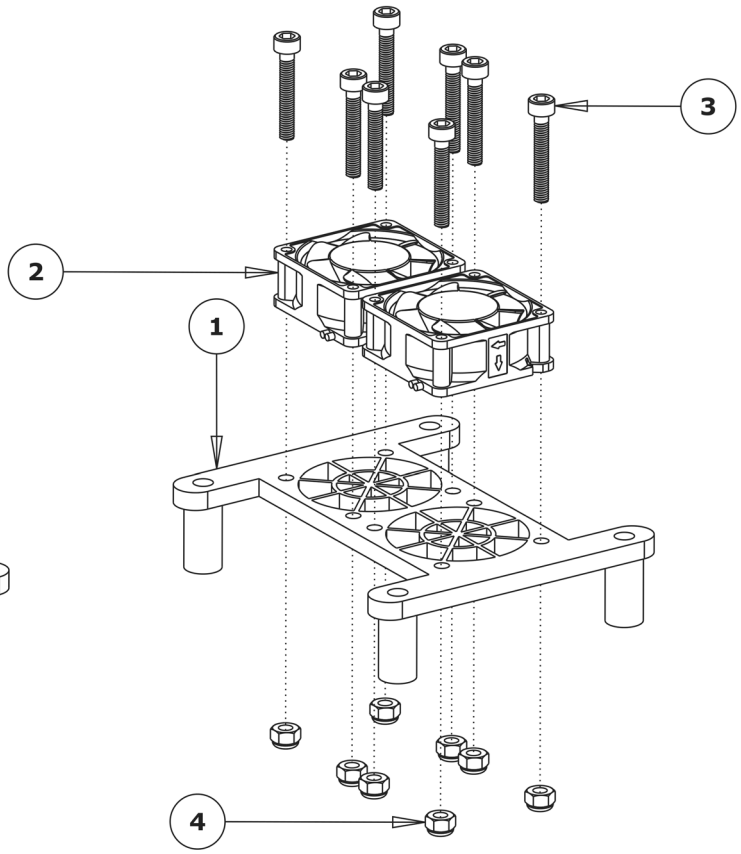
The polarity is indicated by the color of the wire, not by the color of the connectors at each end. For the AC IEC input, the live wire is brown, neutral blue, and earth is green and yellow. For the DC Wiring of the machine a positive wire is red, negative is black, and earth is green and yellow.

2.0 CNC xPro Assembly

2.0.1 Fan Mount Assembly

ITEM NO	DESCRIPTION	QTY
1	CNC-XPRO-FAN-MOUNT	1
2	DUAL-30MM-24V-DC-FAN	1
3	M3-CAP-HEAD-20MM	8
4	M3-NYLOC-NUT	8

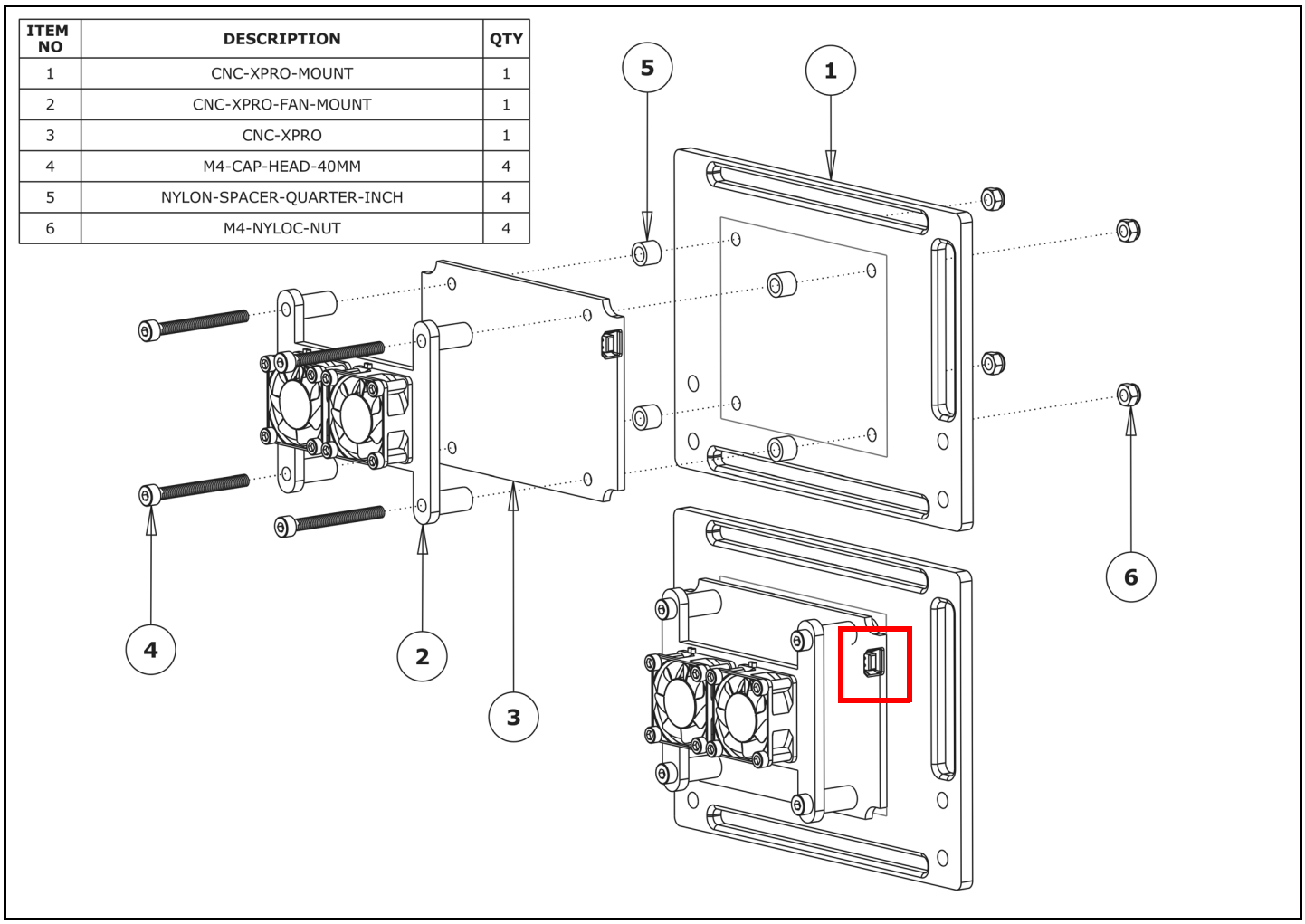




A. Attach the Dual-30mm-24V-DC-Fan to the CNC-xPro-Fan-Mount using 8 x M3-Cap-Head-20mm bolts and 8 x M3-Nyloc-Nuts. Ensure that the Dual-30mm-24V-DC-Fans are blowing downwards by ensuring that the side of the fan with the label on is against the CNC-xPro-Fan-Mount. Make sure that the power wires on the Dual-30mm-24V-DC-Fans are both on the same side of the CNC-xPro-Fan-Mount.

2.0.2 Attaching The CNC-xPro

ITEM NO	DESCRIPTION	QTY
1	CNC-XPRO-MOUNT	1
2	CNC-XPRO-FAN-MOUNT	1
3	CNC-XPRO	1
4	M4-CAP-HEAD-40MM	4
5	NYLON-SPACER-QUARTER-INCH	4
6	M4-NYLOC-NUT	4

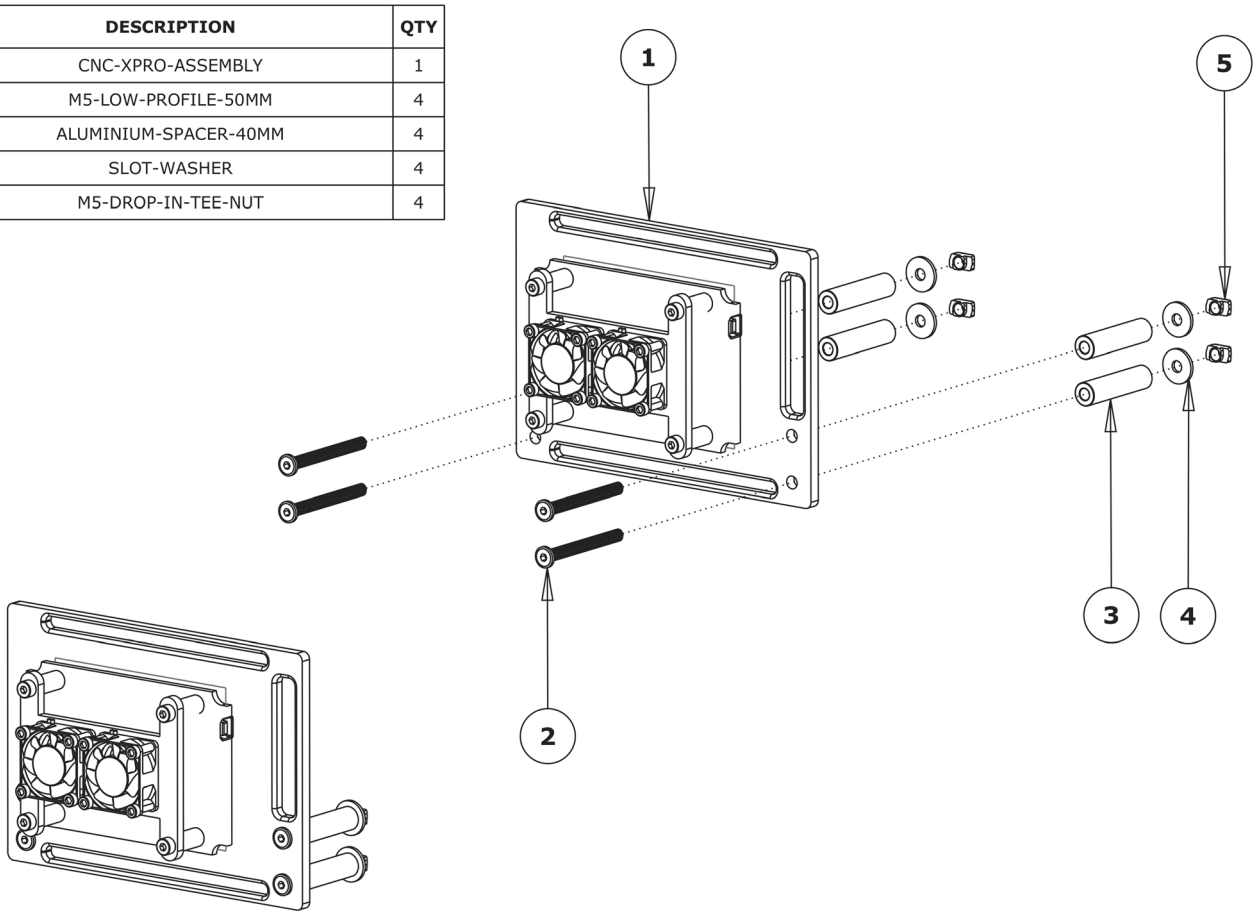


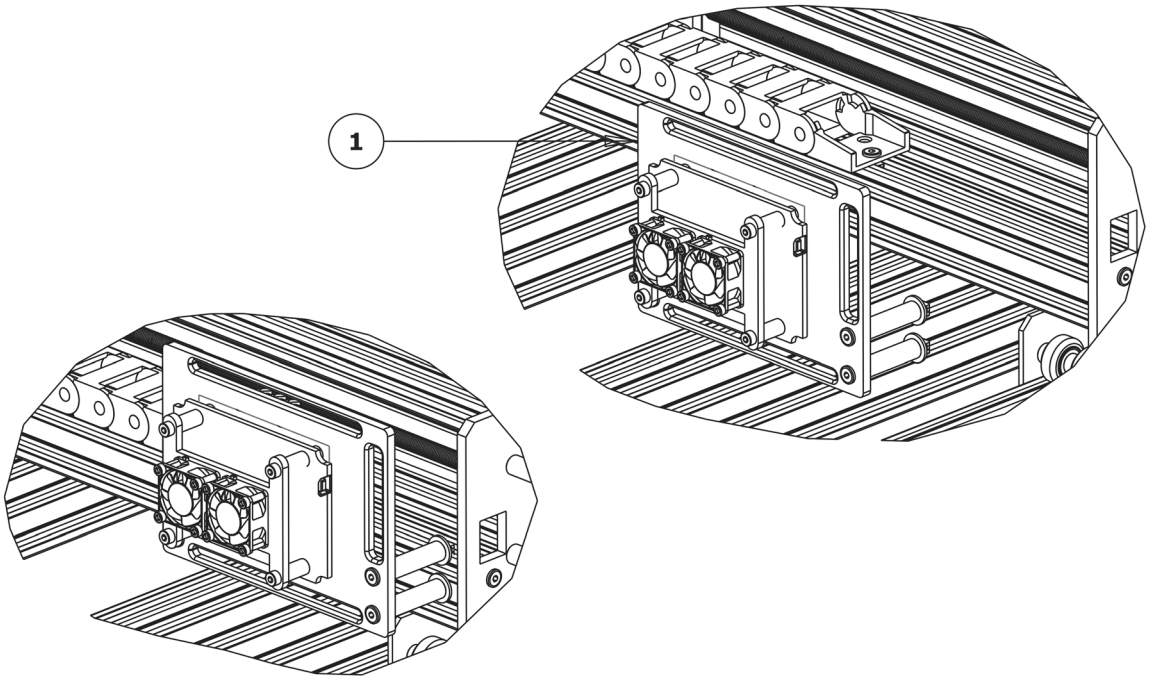
A. If you have purchased the bluetooth adaptor, now would be a good time to attach it to the CNC-xPro following the instructions on the pamphlet inside the bluetooth packet.

B. Insert 4 x M4-Cap-Head-40mm bolts through the previously assembled CNC-xPro-Fan-Mount, and then through the CNC-xPro and each through a Nylon-Spacer-Quarter-Inch. Finally, go through the CNC-xPro-Mount. While doing so plug the fans into the white 3 pin fan output header on the CNC-xPro. The CNC-xPro should be orientated so the USB terminal is in the same position as shown by the red square above. Secure the whole assembly using 4 x M4-Nyloc-Nuts.

2.0.3 Mounting the CNC-xPro Assembly

ITEM NO	DESCRIPTION	QTY
1	CNC-XPRO-ASSEMBLY	1
2	M5-LOW-PROFILE-50MM	4
3	ALUMINIUM-SPACER-40MM	4
4	SLOT-WASHER	4
5	M5-DROP-IN-TEE-NUT	4





A. Insert 4 x M5-Low-Profile-50mm bolts through each mounting hole on the CNC-xPro-Mount.

B. On to each M5-Low-Profile-50mm bolt slide an Aluminium-Onehalf-Inch and a Slot-Washer. The rounded face of the Slot-Washer should be flush against the Aluminium-Onehalf-Inch.

C. On to the end of each M5-Low-Profile-50mm bolt, slightly thread a M5-Drop-In-Tee-Nut.

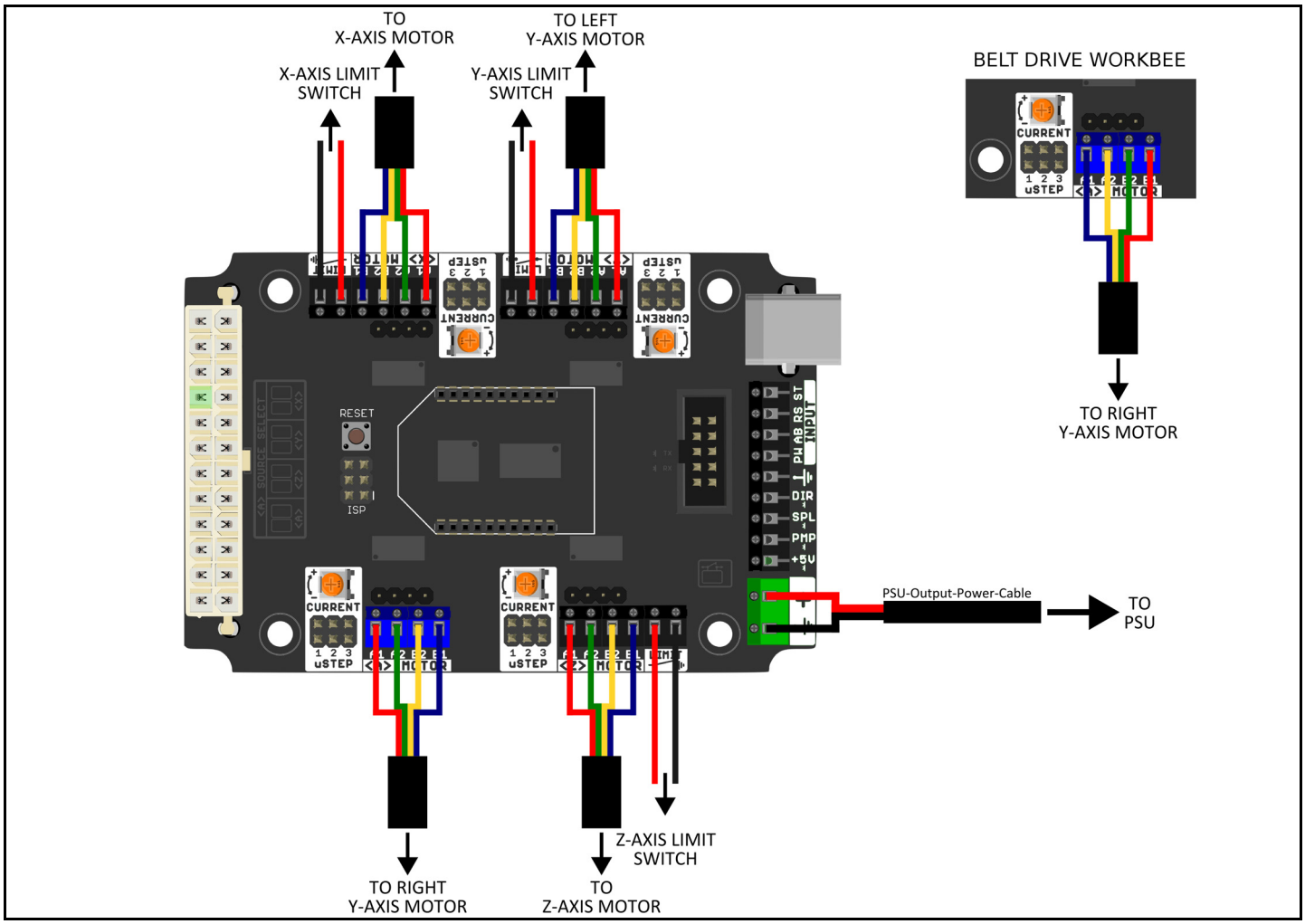
D. Bring the CNC-xPro-Assembly to the back of the WorkBee X-Gantry, and align the M5-Low-Profile-50mm bolt assemblies from Step A/B/C with the backward facing top and bottom slots on the V-Slot-2040-750mm.

E. With the M5-Low-Profile-50mm bolt assemblies aligned, mate the CNC-xPro-Assembly with the V-Slot-2040-750mm slots. It should be roughly 10mm from the end of V-Slot-2040-750mm.

F. Screw each M5-Low-Profile-50mm bolt to engage the M5-Drop-In-Tee-Nut with the slot. Fully tighten each M5-Low-Profile-50mm bolt.

3.0 Wiring & Commissioning

3.1 CNC-xPro Wiring



A. Following the wiring diagram above, strip and connect the second PSU-Output-Power-Cable to the power input terminal on the CNC-xPro. If you have the bluetooth adaptor also attach the provided capacitor, with the correct orientation with regards to the positive and negative side.

B. Connect the 4 x NEMA23-Stepper-Motors to the CNC-xPro as shown above. Take note of the order of the wire colours. For the belt drive version of the WorkBee notice that the colour order is reversed on the A driver (this is also true for a 1000x1500mm Belt & Screw drive WorkBee).

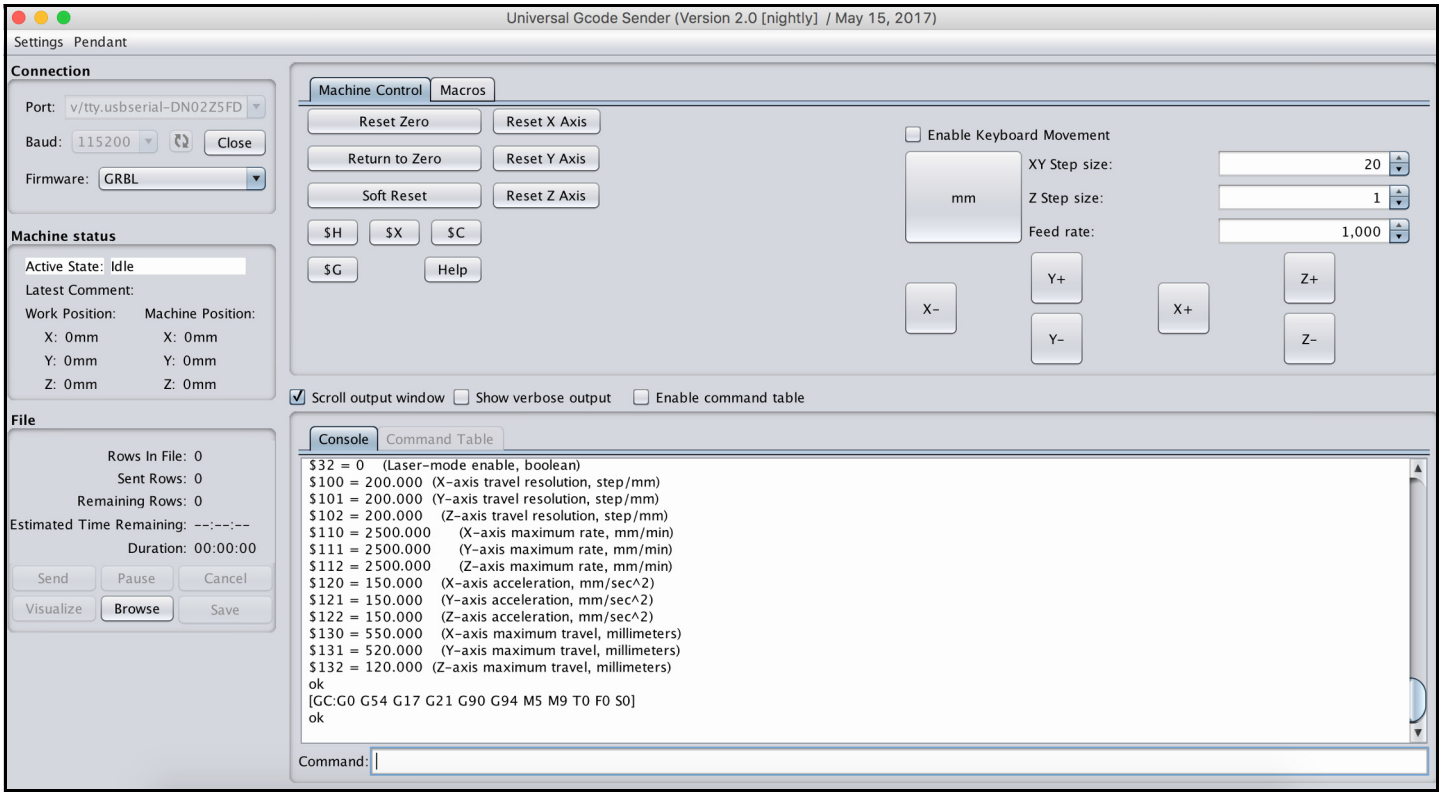
C. Wire in the 3 Limit-Switches, note the polarity of the wires in the image above.

D. Plug the PSU-Output-Power-Cable into the XT60-Male Output on the assembled 24V-360W-Power-Supply. Do not tidy up the wiring just yet, as this is best left until the machine has been fully checked to ensure that it is operating correctly.

E. If interested, it is a good idea to read the CNC-xPro Wiki for more in-depth information: https://github.com/Spark-Concepts/xPRO/wiki

3.2 Software & Machine Settings

3.2.1 Installing Universal G-Code Sender (UGS)



A. Universal G-Code Sender (UGS) is a simple Java-based cross platform G-Code sender. It requires the latest version of Java to be installed on your computer from https://java.com/en/download/ . Download UGS from the first Classic GUI link under the 'Nightly Builds' header from: https://winder.github.io/ugs_website/download/

B. Unzip the folder to a location of your choosing.

C. Run the file named 'UniversalGcodeSender.jar' and UGS should open and look similar to the above image.

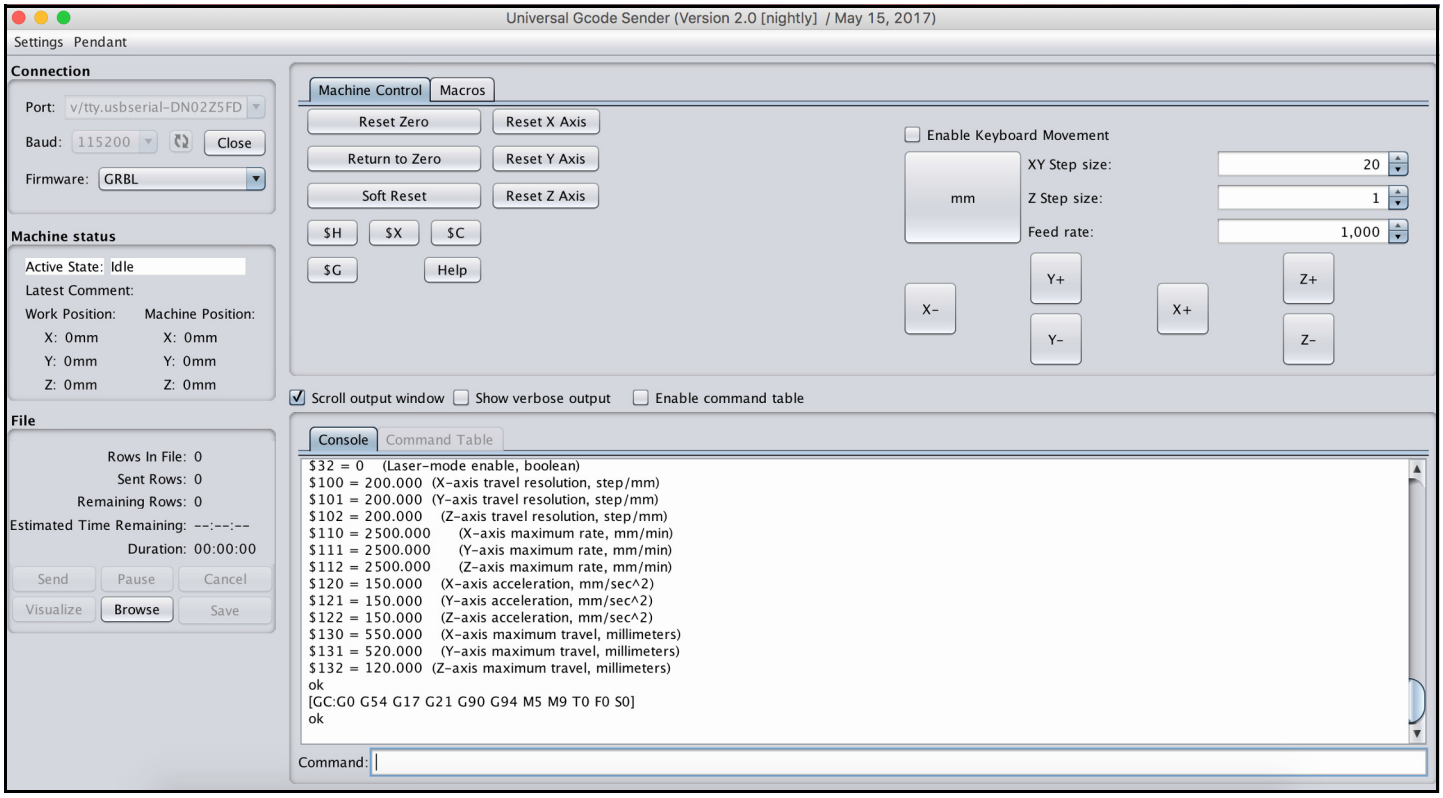
D. Download and install the appropriate drivers for the chip used on the CNC-xPro from: http://www.ftdichip.com/Drivers/VCP.htm. For Windows, under the comments section there is a link to an executable setup file.

E. Using the supplied USB-Cable, connect the CNC-xPro to your computer. It is recommended to get the WorkBee fully operating and multiple cuts completed under USB initially. Once everything is running correctly then use the bluetooth adaptor.

F. In UGS set the 'Baud' to '115200' and 'Firmware' to 'GRBL'. Press the refresh symbol.

G. On the 'Port' drop down list find the CNC-xPro, if on a Mac it should look similar to what is selected in the image above. If on a windows computer, it will show up as a COM port. Once found click 'Open' and UGS should successfully connect to the CNC-xPro. The Console output will show information similar to the above.

3.2.2 Configuring The Firmware



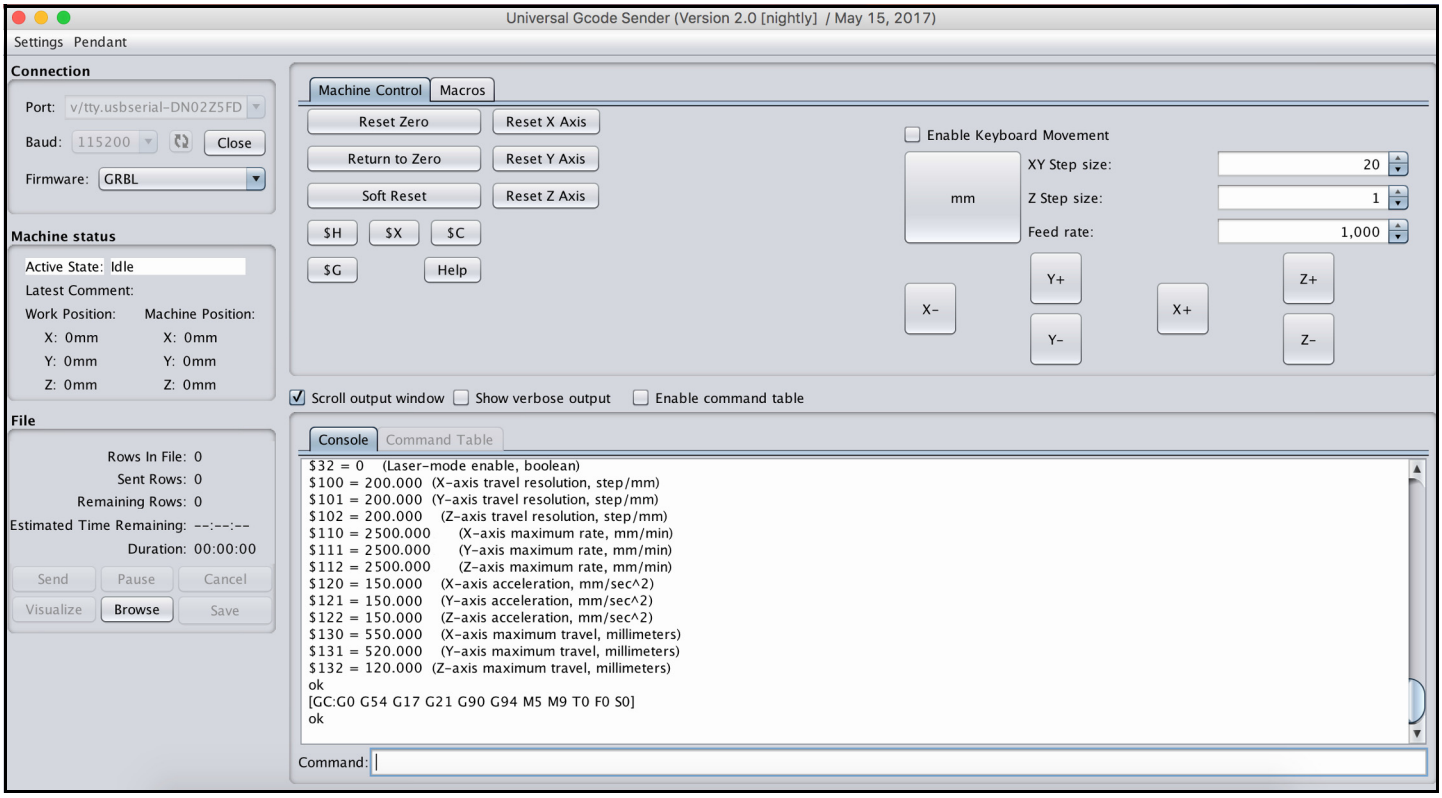
A. Under the large white console output, there is a text input area labeled 'Command:' where G-Code commands can be sent to the CNC-xPro. To bring up the current firmware settings type '$$' and press enter.

B. In Appendix B we have provided a set of recommended settings for each drive version of the WorkBee. Each setting has an id number and a value, and in order to change a setting to a new value, enter $id = new value. For instance, if setting number 100 is incorrect when compared to Appendix B, correct it by entering $100 = 200. Do this for all the settings in Appendix B, choosing the list that is appropriate for the drive of machine you have.

C. Setting number 130 and 131 will depend on the size of the machine you have. The values to enter here should be 200mm less than your X-Axis size and 230mm less than your Y-Axis size. For instance, on a 750x750mm machine the values for 130 and 131 should be 550 and 520 respectively.

D. If interested, it is a good idea to read the GRBL Firmware Wiki for more in-depth information: https://github.com/grbl/grbl/wiki

3.3 Testing



A. Next to each driver on the CNC-xPro, there is a current control pot, and these can be adjusted using the Ceramic-Screwdriver. Rotate clockwise to increase the current, and anti-clockwise to decrease. Turn each one clockwise until it stops, and then back 1/4 of a full turn. This is the ideal setting for the drivers.

B. Switch on the 24V-360W-Power-Supply, and the Dual-30mm-24V-DC-Fan should activate.

C. Looking from the front of the machine, the correct axes machine motion is: X-Axis negative to the left, Y-Axis negative towards the front, Z-Axis negative going down. To test this in UGS, click on the 'Machine Control' tab on the top bar. On the right hand side there are jog controls. Set the 'XY Step size' to 20, 'Z Step size' to 1, 'Feed Rate' to 1000 and select 'millimeters'. Press the 'X-' button to jog the machine in the negative X direction, and the carriage should move to the left. Press 'Y-' and the gantry should move towards the front. Press 'Z-' the Z-Axis should go down.

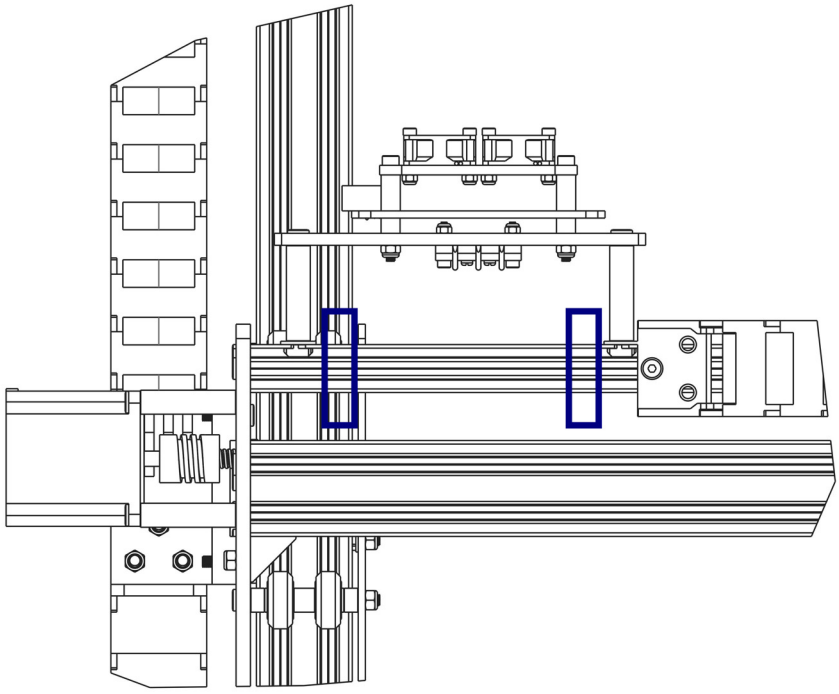
D. If in Step C any of the axes have moved in the opposite directions than should be expected, then the appropriate driver direction needs inverting. The $3 Direction Port Invert setting can be used to correct this issue, this is set by using the table in Appendix B section 2. For instance for a screw drive machine $3 currently is set at 2, setting $3 = 3, would invert the X Axis direction, but leave all the others as they are. Change $3 to the appropriate setting to get all the axes moving in the correct direction.

E. Next the homing cycle needs to be checked, the correct home position is the back right hand corner of the machine. Press the button labeled '$H', this is the Home button. The machine should first move positive upwards, and seek the Z limit switch. Once it has located the Z limit switch, the X-Axis should begin homing to the right, and the Y-Axis should begin homing to the back. Once the machine has located all 3 limit switches, it should pull off them by 3mm. If the machine homes in the incorrect direction on any of the axes, change setting $23 using Appendix B section 2 in the same fashion as Step D. If the machine fails to stop at any of the limit switches check that they are wired correctly according to Section 6.1

F. Testing of the machine is now complete.

3.4 Wire Tidying

ITEM NO	DESCRIPTION	QTY
1	CABLE-TIE-SMALL	2
2	CABLE-TIE-LARGE	2



A. Once the machine is operating correctly, using a Cable-Tie-Large secure the wires in Section 4.2.2 or 4.2.3 to the V-Slot-2040-750mm at the position shown by the right hand rectangle above. One at a time, the wires can be disconnected from the CNC-xPro and trimmed to the correct length.

B. Any excess wire in the PSU-Output-Power-Cable should be pulled out at the 24V-360W-Power-Supply end and bundled using a Cable-Tie-Large. Use 2 x Cable-Tie-Smalls secure the PSU-Output-Power-Cable to the slotted holes on the Y-Drag-Chain-Fixed-End-Mount.

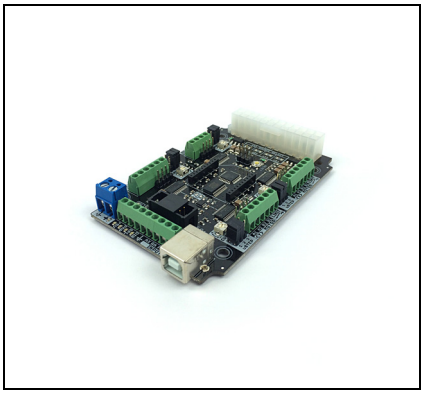
C. Using a Cable-Tie-Large secure the wires in Section 4.2.5 or 4.2.6, and the PSU-Output-Power-Cable to the V-Slot-2040-750mm at the position shown by the left hand rectangle above. One at a time, the wires can be disconnected from the CNC-xPro and trimmed to the correct length.

4.0 Appendix

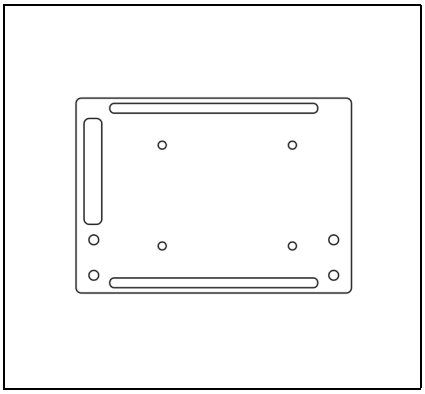
4.1 Appendix A - Kit Contents

CNC-xPro Assembly

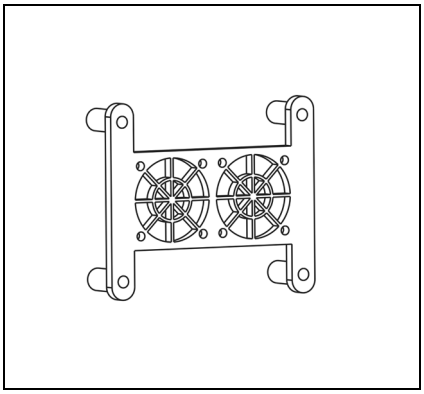
1 x CNC-xPro



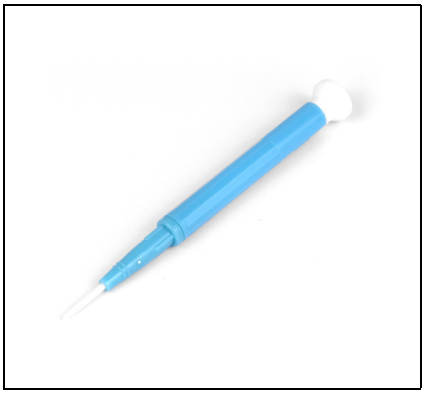
1 x CNC-xPro-Mount



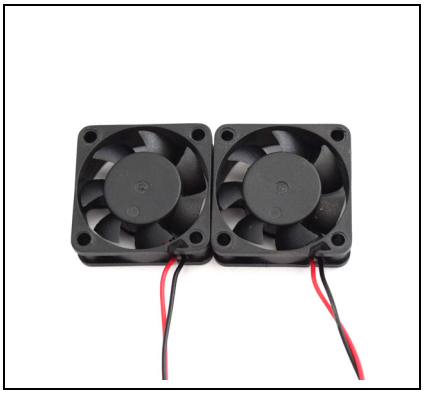
1 x CNC-xPro-Fan-Mount



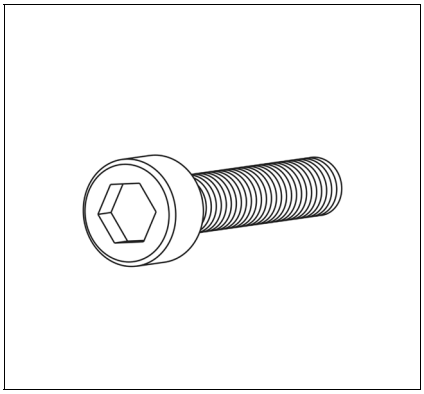
1 x Ceramic-Screw-Driver



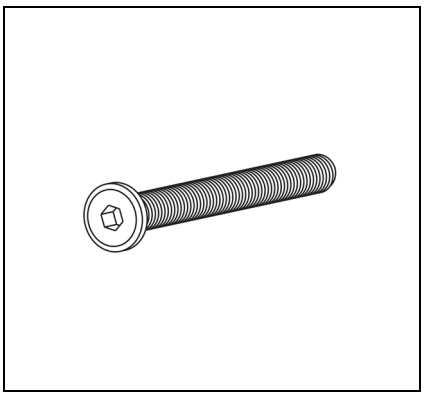
1 x Dual-30mm-24V-DC-Fan



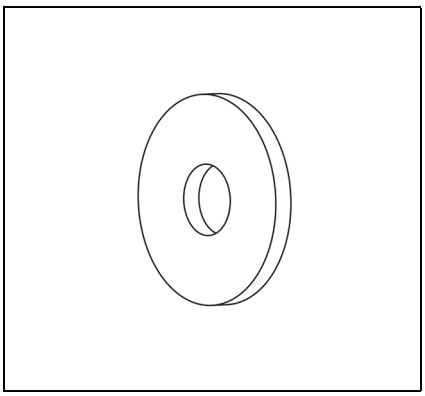
Cap-Head:
8 x M3-20mm
4 x M4-40mm



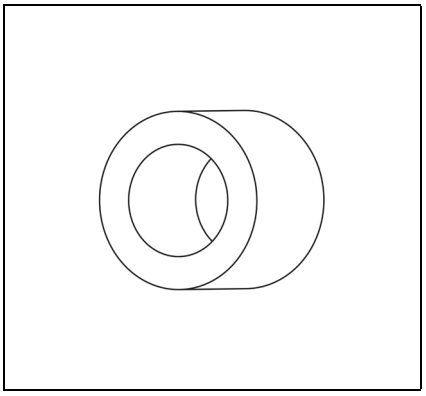
4 x M5-Low-Profile-50mm



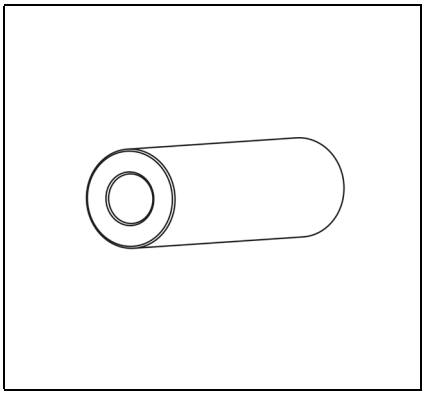
4 x Slot-Washer



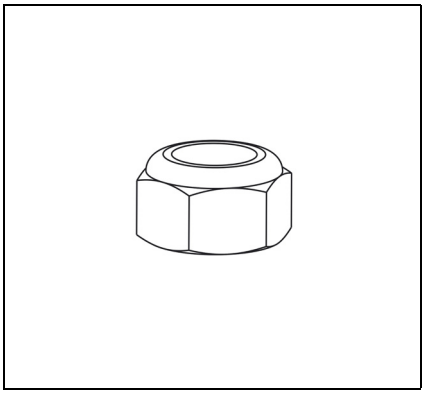
4 x Nylon-Spacer-Quarter-Inch



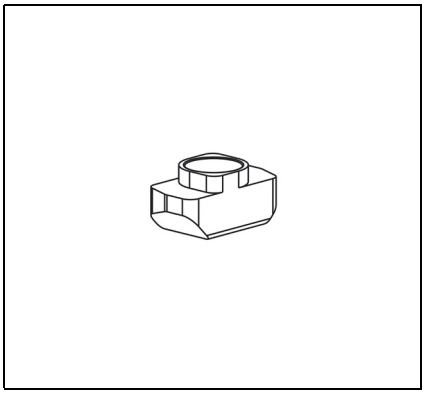
4 x Aluminium-Spacer-OneHalf-Ince



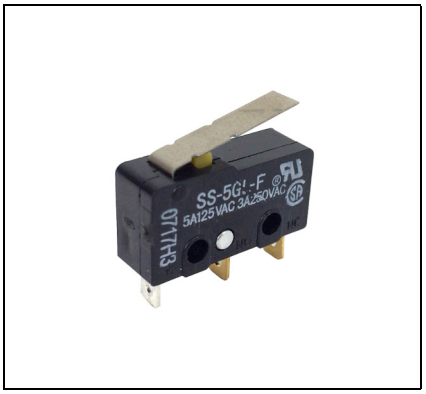
Nyloc-Nuts:
8 x M3
4 x M4



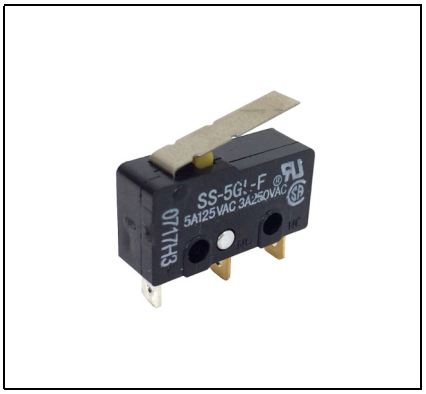
6 x M5-Drop-In-Tee-Nut



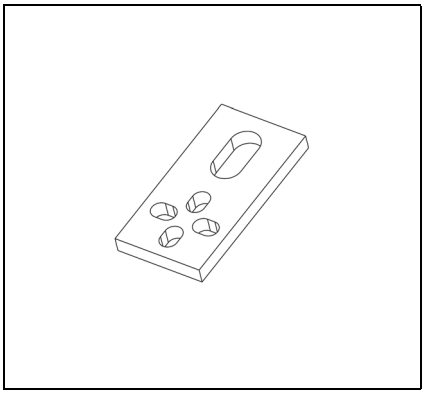
2 x Limit-Switch



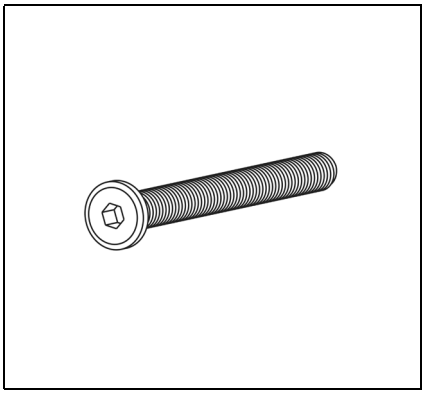
1 x Z-Axis-Limit-Switch (They are the same as the Limit-Switch except the holes are larger)



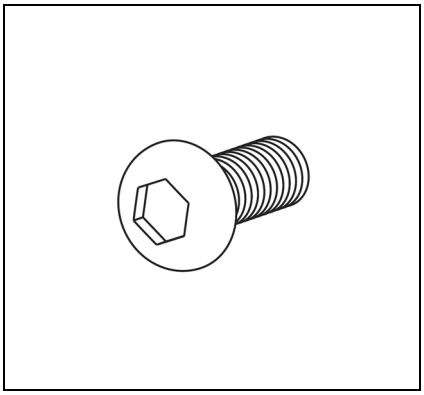
2 x Limit-Switch-Plate



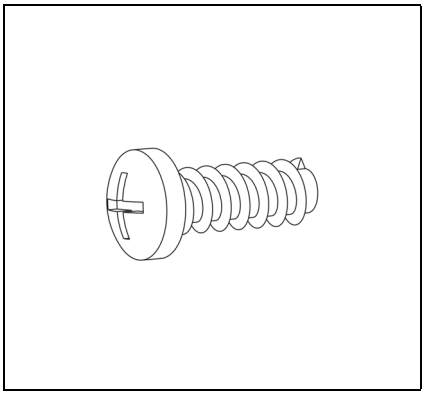
2 x M5-Low-Profile-8mm



2 x M3-Socket-Head-10mm



4 x Plastite-Screw-M3-8mm



1 x USB-Cable

5.0 Appendix B

5.1 Recommended GRBL Settings

The settings below are for a belt driven WorkBee.

```
$0 = 10 (step pulse, usec)
$1 = 255 (step idle delay, msec)
$2 = 0 (step port invert mask:00000000)
$3 = 3 (dir port invert mask:00000011)
$4 = 1 (step enable invert, bool)
$5 = 0 (limit pins invert, bool)
$6 = 0 (probe pin invert, bool)
$10 = 1 (status report mask:00000001)
$11 = 0.020 (junction deviation, mm)
$12 = 0.002 (arc tolerance, mm)
$13 = 0 (report inches, bool)
$20 = 1 (soft limits, bool)
$21 = 0 (hard limits, bool)
$22 = 1 (homing cycle, bool)
$23 = 0 (homing dir invert mask:00000000)
$24 = 100.000 (homing feed, mm/min)
$25 = 1000.000 (homing seek, mm/min)
$26 = 250 (homing debounce, msec)
$27 = 3.000 (homing pull-off, mm)
$30 = 1000 (Maximum spindle speed, RPM)
$31 = 0 (Minimum spindle speed, RPM)
$32 = 0 (Laser-mode enable, boolean)
$100 = 26.667 (x, step/mm)
$101 = 26.667 (y, step/mm)
$102 = 200.000 (z, step/mm)
$110 = 10000 (x max rate, mm/min)
$111 = 10000 (y max rate, mm/min)
$112 = 2500  (z max rate, mm/min)
$120 = 150.000 (x accel, mm/sec^2)
$121 = 150.000 (y accel, mm/sec^2)
$122 = 150.000 (z accel, mm/sec^2)
$130 = 550.000 (x max travel, mm)
$131 = 520.000 (y max travel, mm)
$132 = 120.000 (z max travel, mm)
```

The settings below are for a screw driven WorkBee.

```
$0 = 10 (step pulse, usec)
$1 = 255 (step idle delay, msec)
$2 = 0 (step port invert mask:00000000)
$3 = 2 (dir port invert mask:00000010)
$4 = 1 (step enable invert, bool)
$5 = 0 (limit pins invert, bool)
$6 = 0 (probe pin invert, bool)
$10 = 1 (status report mask:00000001)
$11 = 0.020 (junction deviation, mm)
$12 = 0.002 (arc tolerance, mm)
$13 = 0 (report inches, bool)
$20 = 1 (soft limits, bool)
$21 = 0 (hard limits, bool)
$22 = 1 (homing cycle, bool)
$23 = 0 (homing dir invert mask:00000000)
$24 = 100.000 (homing feed, mm/min)
$25 = 1000.000 (homing seek, mm/min)
$26 = 250 (homing debounce, msec)
$27 = 3.000 (homing pull-off, mm)
$30 = 1000 (Maximum spindle speed, RPM)
$31 = 0 (Minimum spindle speed, RPM)
$32 = 0 (Laser-mode enable, boolean)
$100 = 200.000 (x, step/mm)
$101 = 200.000 (y, step/mm)
$102 = 200.000 (z, step/mm)
$110 = 2500 (x max rate, mm/min)
$111 = 2500 (y max rate, mm/min)
$112 = 2500 (z max rate, mm/min)
$120 = 150.000 (x accel, mm/sec^2)
$121 = 150.000 (y accel, mm/sec^2)
$122 = 150.000 (z accel, mm/sec^2)
$130 = 550.000 (x max travel, mm)
$131 = 520.000 (y max travel, mm)
$132 = 120.000 (z max travel, mm)
```

The settings below are for a belt & screw driven WorkBee.

```
$0 = 10 (step pulse, usec)
$1 = 255 (step idle delay, msec)
$2 = 0 (step port invert mask:00000000)
$3 = 2 (dir port invert mask:00000010)
$4 = 1 (step enable invert, bool)
$5 = 0 (limit pins invert, bool)
$6 = 0 (probe pin invert, bool)
$10 = 1 (status report mask:00000001)
$11 = 0.020 (junction deviation, mm)
$12 = 0.002 (arc tolerance, mm)
$13 = 0 (report inches, bool)
$20 = 1 (soft limits, bool)
$21 = 0 (hard limits, bool)
$22 = 1 (homing cycle, bool)
$23 = 0 (homing dir invert mask:00000000)
$24 = 100.000 (homing feed, mm/min)
$25 = 1000.000 (homing seek, mm/min)
$26 = 250 (homing debounce, msec)
$27 = 3.000 (homing pull-off, mm)
$30 = 1000 (Maximum spindle speed, RPM)
$31 = 0 (Minimum spindle speed, RPM)
$32 = 0 (Laser-mode enable, boolean)
$100 = 200.000 (x, step/mm)
$101 = 26.667 (y, step/mm)
$102 = 200.000 (z, step/mm)
$110 = 2500 (x max rate, mm/min) (Go upto 7500)
$111 = 10000 (y max rate, mm/min) (Go upto 7500)
$112 = 2500  (z max rate, mm/min) (Go upto 1500)
$120 = 150.000 (x accel, mm/sec^2)
$121 = 150.000 (y accel, mm/sec^2)
$122 = 150.000 (z accel, mm/sec^2)
$130 = 800.000 (x max travel, mm)
$131 = 1270.000 (y max travel, mm)
$132 = 120.000 (z max travel, mm)
```

5.2 Invert Mask Table

Setting Value	Mask	Invert X	Invert Y	Invert Z
0	00000000	N	N	N
1	00000001	Y	N	N
2	00000010	N	Y	N
3	00000011	Y	Y	N
4	00000100	N	N	Y
5	00000101	Y	N	Y
6	00000110	N	Y	Y
7	00000111	Y	Y	Y

6.0 Appendix C

6.1 Common Trouble Shooting Questions

The problems and answers below are the most common issues that we have received in our experience. If you are having an issue, before contacting us, we recommend reading through this beforehand.

Problem - LED Volt Meter is not displaying anything.

Check it is wired correctly - if it is wired correctly please email us asking for a replacement and one will be sent out right away.

Problem - The voltage drops on the LED Volt Meter when turning on the machine.

There is a switch on the side the power supply to change the input voltage. Make sure this is set to match your countries voltage supply.

Problem - Motors are not moving when issuing a jog command.

Check $4 = 1.

Problem - A motor is juddering, but not turning.

This is mostly due to either the motor being wired in an incorrect color order, or there is a loose wire connection.

Problem - When issuing a Y-Axis jog command, it just vibrates but doesn't move.

This is a common error on a belt drive machine, as the motors have to be turning in opposite directions. Go back through section 6.1, and specifically look at the top right of the image regarding belt drive wiring.

Problem - Soft limit errors every time when running a file.

Check $130, $131, & $132 are set to the correct value for your size machine. Make sure the CAM program is setup in millimeters. Make sure that work zero is set in a position which allows for enough travel on each axis to complete the job. Most CAM programs have a safe Z Height setting, so make sure there is also enough positive Z travel from work zero to accommodate this. Wherever the zero position is set in the CAM program, you need to home the machine and then move the tip of the cutter to this position, and press the 'Reset Zero' button

Problem - When cutting, circles are not circle.

This is most likely because either a coupler or pulley is slipping on the motor shaft. Check screws are tight, and one of them is on the flat portion of the motor shaft.

Problem - Machine goes randomly off course mid job or machine stops.

Electrical interference is a common cause of this problem. Make sure the USB & router cable are outside the drag chains, and sleep/low power mode is turned off on the computer. Carry out a long dummy run with a pen (i.e no router and no dust extraction) and see if the problem persists. If it still persists, try another computer.

Problem - Machine was working correctly, now suddenly behaving strangely.

Sometimes the $$ settings can change value, this usually happens if the machine is moved around by hand. Re-check all $$ values to make sure they are set correctly.

Problem - Can’t connect to CNC xPro/GRBL is not loading.

First try another USB Cable. Then try another computer. The last thing to try is resetting the firmware on the controller. To do this download the Arduino IDE: https://www.arduino.cc/en/Main/Software

Connect the CNC xPro via USB and make sure Universal G-Code sender is closed. Open the Arduino IDE. In the Arduino IDE set Tools > Board to ‘Arduino/Genuino Uno’. Set Tools > Port to the port the CNC xPro is connected to. Set Tools > Programmer to ‘AVRISP mkII’

Open Files > Examples > EEPROM > eeprom_clear and then click the upload button (Second button in from the left, is a arrow pointing to the right) if this gives an error please contact us. If you get the ‘Done uploading message’ follow these steps to upload GRBL: https://github.com/grbl/grbl/wiki/Compiling-Grbl