FR4 Machine Shield

Assembly Manual

Revision History

Rev B (12/7/16)
>Initial release

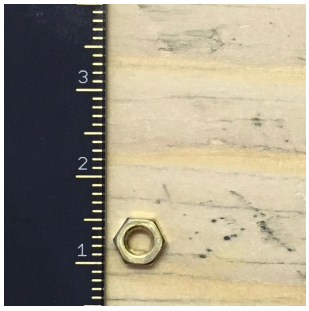
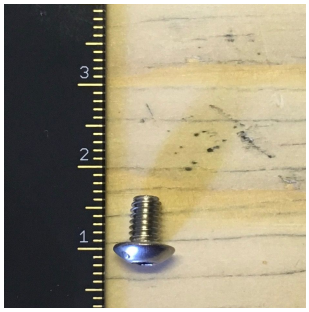
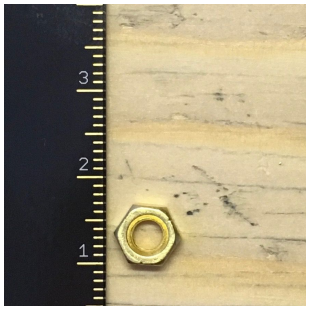
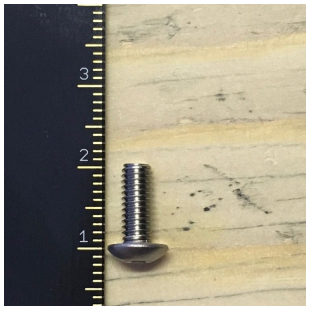
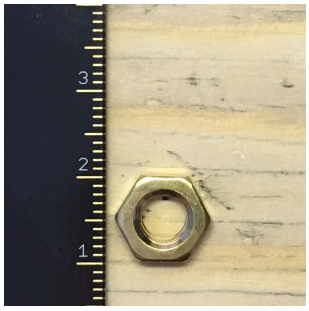
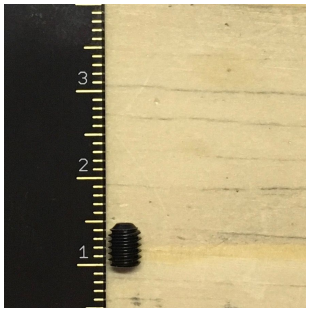
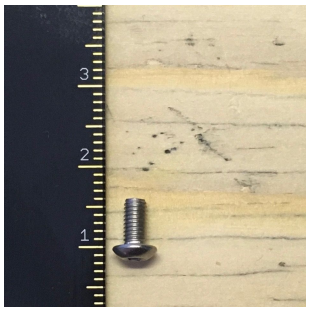
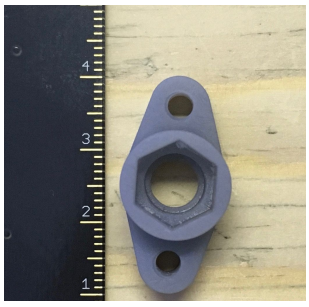
Rev C (1/24/17)
>More Clarity on final joint soldering process
>Added note about checking for bent pins on card edge connector (P. 36)
>Added note about conformal coating for cutting metal (P. 12)
>Added notes about installing new motor couplings (P. 11/12)

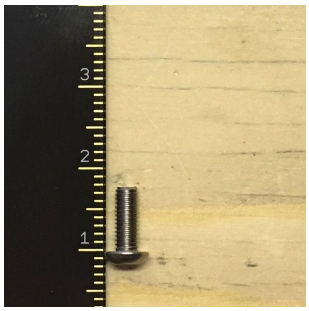
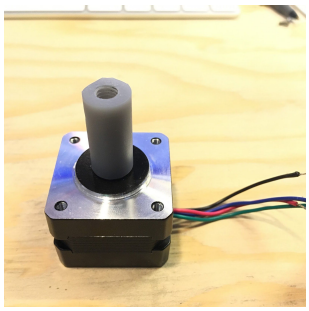
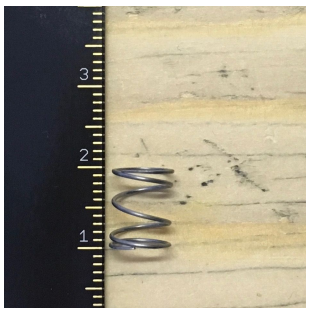
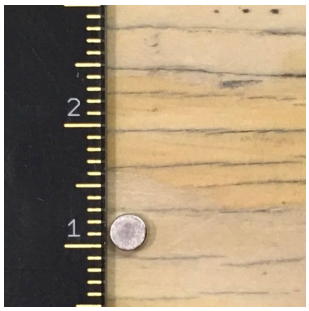
Rev D (2/10/17)
>New anti backlash nut
>Information on anti backlash nut assembly in important notes section.

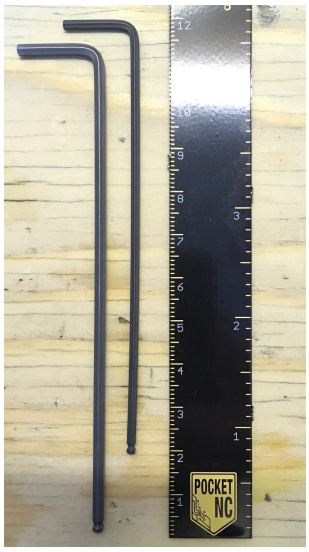
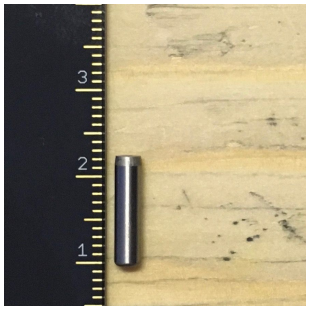
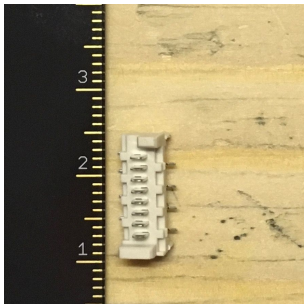
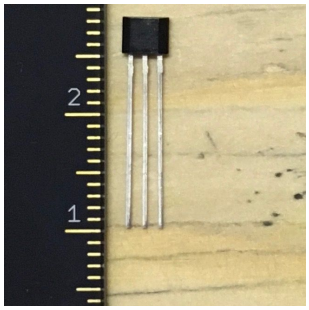
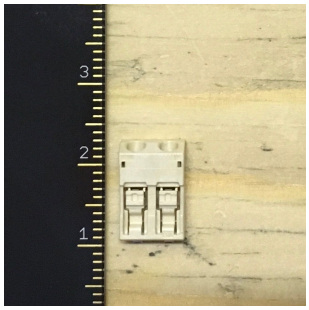
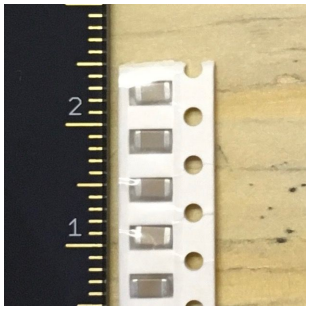
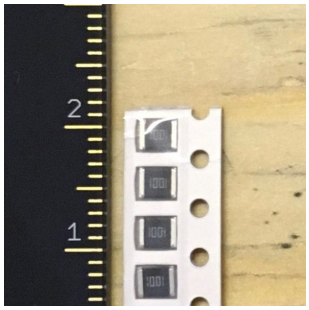
Table of Contents

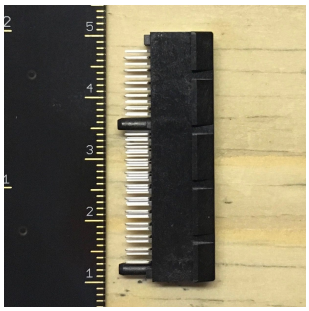
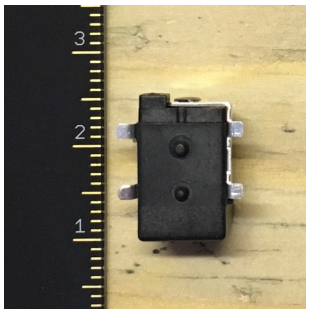
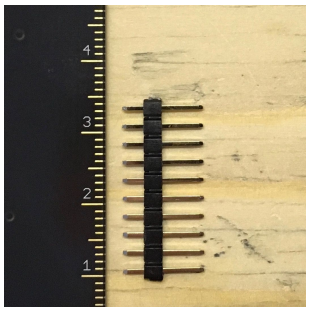
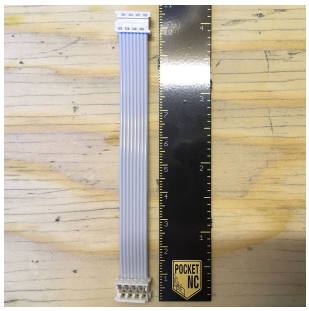
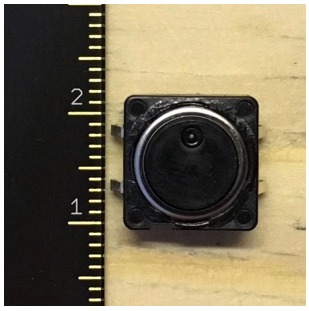
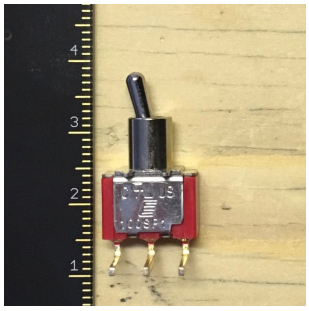
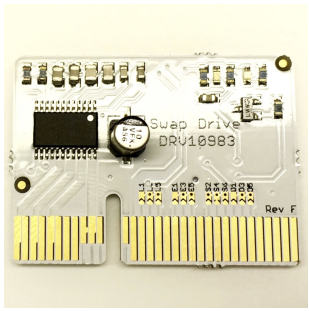
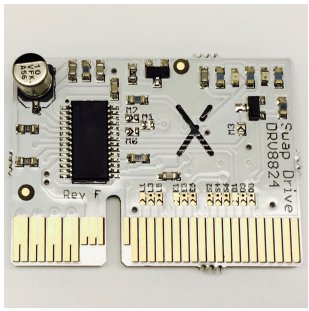
Bill Of Materials

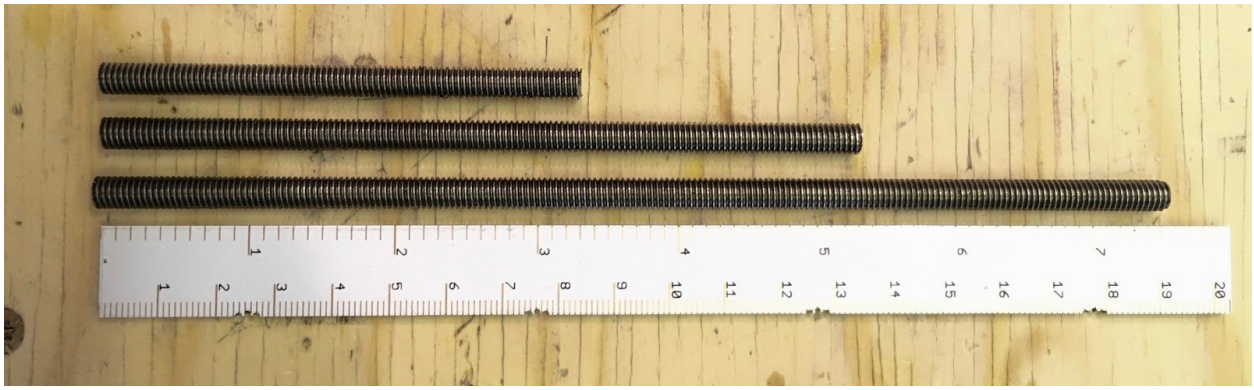
Note fasteners are labels M A x B, where A is the diameter of the fastener in mm and B is the length of the fastener in mm.

M3 Brass Hex Nut (qty. 12) **P/N FH001**		**M4 x 6 BH Screw (qty. 4)** **P/N FH005**	
M4 Brass Hex Nut (qty. 12) **P/N FH016**		**M4 x 10 BH Screw (qty. 4)** **P/N FH004**	
M6 Brass Hex Nut (qty. 6) **P/N FH017**		**M4 x 4 Set Screw (qty. 6)** **(mounted in motor couplings)** **P/N FH006**	
M3 x 6 BH Screw (qty. 12) **P/N FH003**		**Anti Backlash Nut (qty. 3)** **P/N FM003**	

M3 x 8 BH Screw (qty. 6) P/N FH002		Nema 14 & Shaft Coupling (qty. 3) (qty. 3) FM001/002	
Anti Backlash Spring (qty. 3) P/N FM005		Tweezers (qty. 1) P/N FH009	
Small Solder (44 Inches) P/N FH011		Large Solder (44 Inches) P/N FH018	
Flux (3 mL) P/N FH012		Magnets (qty. 4) P/N FH014	

2 & 2.5mm Wrench (qty. 1 each) **P/N FH007 / 8**		**XYZ Rails (qty. 6)** **X Rails 8.83” P/N FB003** **Y Rails 6.27” P/N FB002** **Z Rails 4.25” P/N FB001**	
⅛” Dowel Pin (qty. 2) **P/N FH015**		**8 Pin Connector** **(qty. 4)** **P/N FE006**	
Hall Sensor (qty. 4) **P/N FE002**		**Spindle Connector** **(qty. 2)** **P/N FE009**	
0.1uF Cap (qty. 4) **P/N FE013**		**1k Ohm Resistor (qty. 5)** **P/N FE012**	

64 Pin Card Edge Connector (qty. 4) **P/N FE003**		**2.1mm Barrel Jack (qty. 1)** **P/N FE008**	
Arduino Connector (32 pins) **P/N FE010**		**Ribbon cable Connector (qty. 2)** **P/N FE007**	
Pause / Start / Stop / Probe Buttons (qty. 4) **P/N FE014**		**On / Off Switch (qty. 1)** **P/N FE011**	
Spindle Motor (qty. 1) **P/N FS001**		**Spindle Driver (qty. 1)** **P/N FS002**	
Stepper Driver (qty. 3) **P/N FM009**		**Lead Screws (qty. 3)** **FM006** **FM007** **FM008**	**See Following Image**



Important Notes

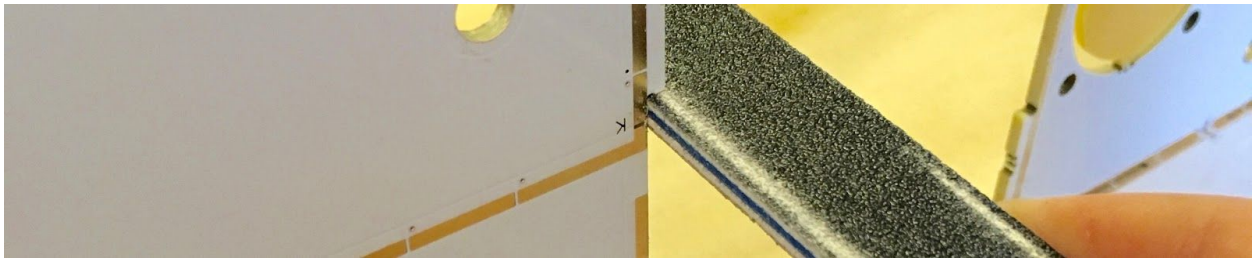
Follow instructions step by step! Diverting from the instructions may cause irreversible problems with an assembly and require an entire new panel of FR4 circuit board. We recommend reading the instructions through once before beginning assembly.

Note that the assembly manual is a work in progress. For the most up-to-date version, visit our website(http://www.pocketnc.com/fr4-resources) where you can also find the open source files for the FR4 Machine Shield.

If you have any questions as you move through the assembly process, we ask that you first check the forum (https://groups.google.com/forum/#!forum/fr4-machine-shield) to see if there is an answer to your issue there. If not, please post your question. We will monitor the forum and help as we are able but your fellow backers will also be a great resource. If you continue to have issues, feel free to contact us at info@pocketnc.com.

Due to the process used to route out and separate circuit boards from a larger panel during manufacturing, some components may require light sanding before mating

with other circuit board components. Use the provided file for this purpose.



Linear guide holes on the FR4 panel have been precision reamed after the manufacturing process to provide a more accurate machine. **This is only important to make note of if ordering FR4 panels from a source other than Pocket NC.**

This kit requires liquid solder for the connecting of joints. Solder melts above 450 degrees fahrenheit. Please note that parts can be very hot and cause burns, so be careful.

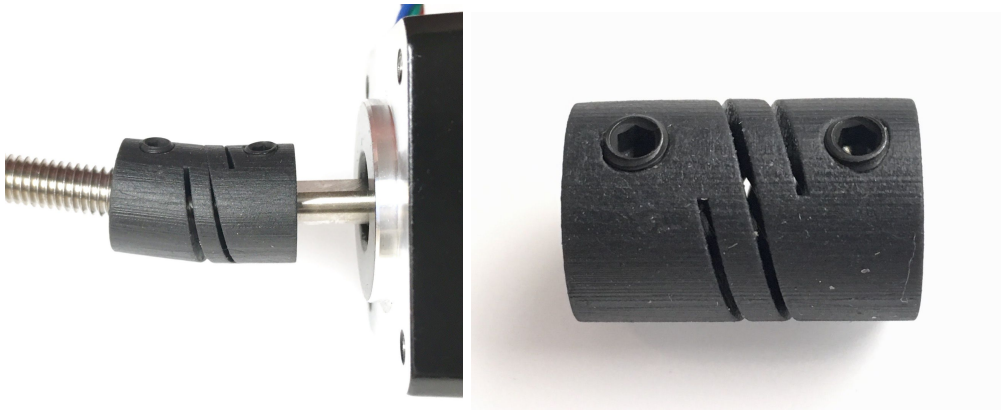
The FR4 Machine Shield is made from FR4 circuit board, a fiberglass material that may irritate the skin or be hazardous if swallowed. Keeping a clean work area and dispose of any small unused particles of FR4.

All solder provided is lead free.

The large solder provided with each FR4 kit is flux free and will not flow without the use of flux. Flux has been provided in a syringe pump and should be applied to a surface in which the large solder is used, before attempting to solder. Excess flux will not help solder flow. Wipe up excess flux using a cotton swab and reuse in other areas.

Clean flux off linear guides when not assembling. Flux is a corrosive that will cause linear guides to rust. A linear guide can be completely rusted in only a few hours so be sure to keep things clean. Re-apply oil if necessary.

All boards should be cleaned or washed with dish soap and a toothbrush then dried after sub assemblies are completed or if leaving an assembly for an extended period of time before completion. Flux on circuit boards for an extended period will cause corrosion. Boards should also be clean before electronics are soldered in place.



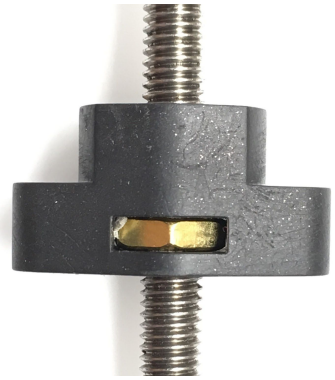
A revision of the motor / lead screw coupling has been created. This is the second version of the FR4 motor / lead screw coupler. It was designed to eliminate binding of the lead screw from misalignment, with minimal axial displacement. A second setscrew has been incorporated for connection to the motor shaft. Every machine shipped on or after Jan 16 2017 has a new set of couplers included.

To install the new coupling, the old coupling must be pulled off the motor shaft. In some cases the coupling must be broken off. The Best method for this is to crush the

old coupling using pliers or vise grip pliers. Applying force to only one side of the coupling may cause damage to the motor. Before breaking the coupling or installing the new coupling, the motor should be **removed and desoldered** from the machine shield.

When connecting the new coupling press the new coupling fully on until the shaft reaches the internal stop. Then back the coupling off the shaft 1-2 mm (.04" - .08"). This **clearance is required for proper function of the coupling**.

Rev. B of the FR4 anti backlash nut requires an additional step not required by Rev. A. Users with the Second version must install a M6x1 brass nut into the side of anti backlash nut. This nut should be centered in a way that allows the threaded rod to thread with no binding. Note that the fit of the nut is normally tight.



The small solder provided with each kit has a special type of flux included in the core of the strand. It does not require additional flux and it does not need to be cleaned as long as it is not used with additional flux.

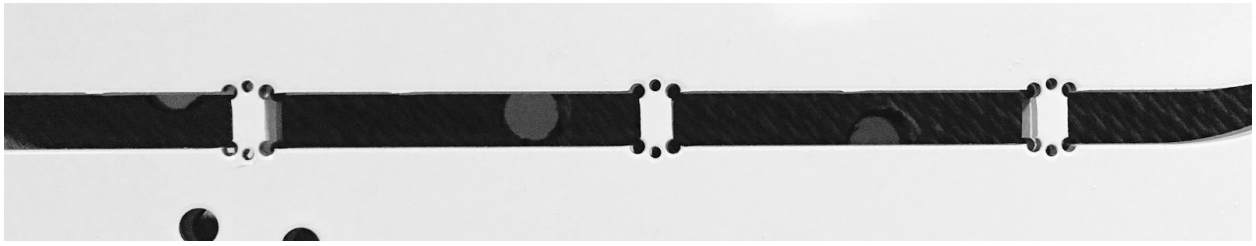
Machines used to cut metallic substances such as copper circuit boards or aluminum may have issues with electrical shorts unless conformally coated. Pocket NC recommends Loctite G02 glue for this purpose.

Three small additional squares have been provided in the large sheet of circuit board. Use these 3 pieces (located near the white wrench) to practice soldering using the tactics or instructions of the first assembly. These pieces do not need to be saved, they are only provided for your benefit!

The assembly process of the FR4 Machine shield happens in three stages:

1. Individual frame assemblies (soldering individual boards together to make a 3D structures)
2. Soldering of electrical components
3. Connection and assembly of individual frame assemblies

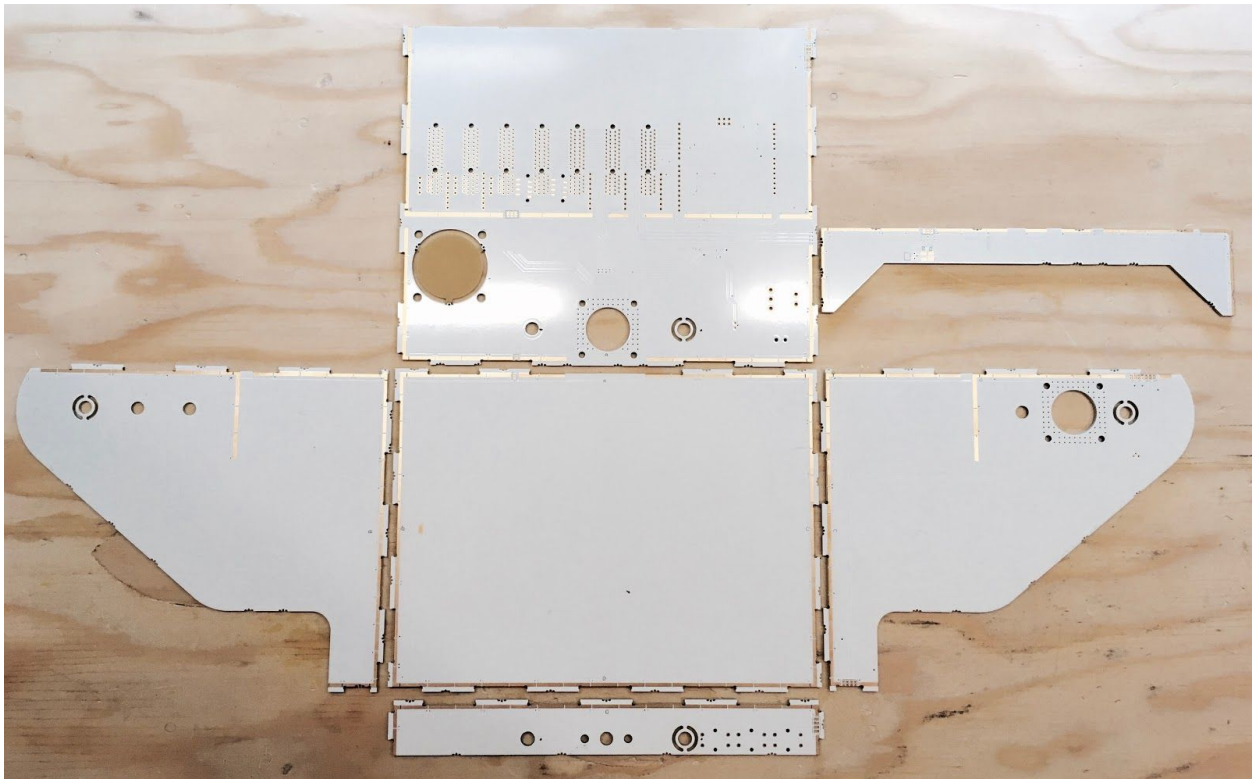
Before starting the assembly, users will need to remove all pieces from the two sheets of 12” x 18” circuit board. To do this, apply pressure to the top and bottom of circuit board in an alternating fashion. This will cause individual boards to separate at points in the structure referred to as mouse bites. Use a pair of pliers to remove individual mouse bites from from a part.



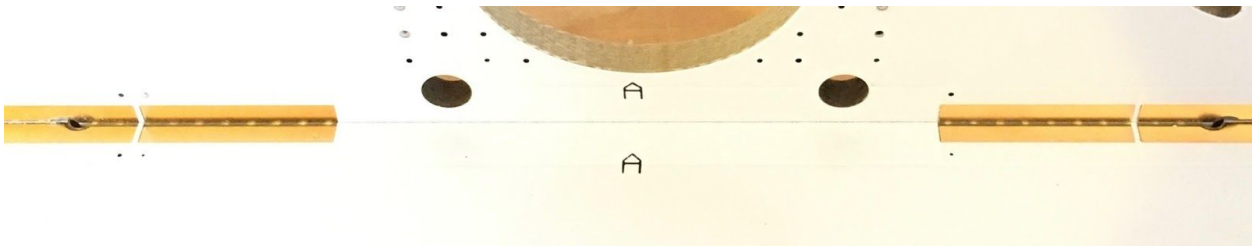
When all pieces are separated, arrange in groups corresponding to each assembly. The first group to be assembled will be the largest or external structure.

Assembly

Assembly 1: Main Assembly



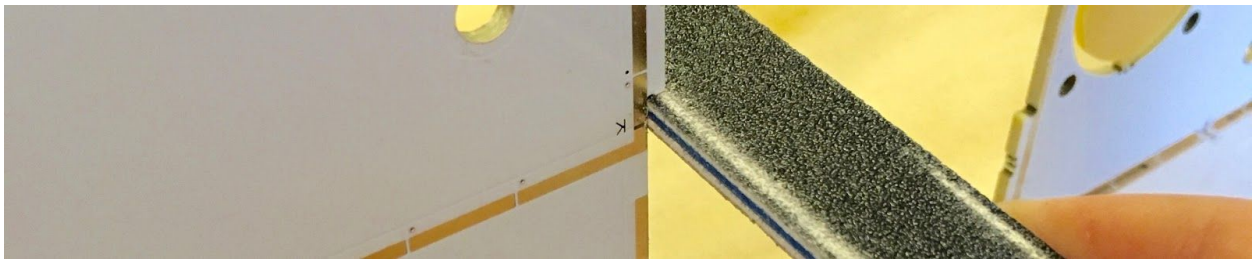
Before soldering any components together, lay out all boards to match the assembly above. Letters on individual boards should match that of a mating board. See the following photo.

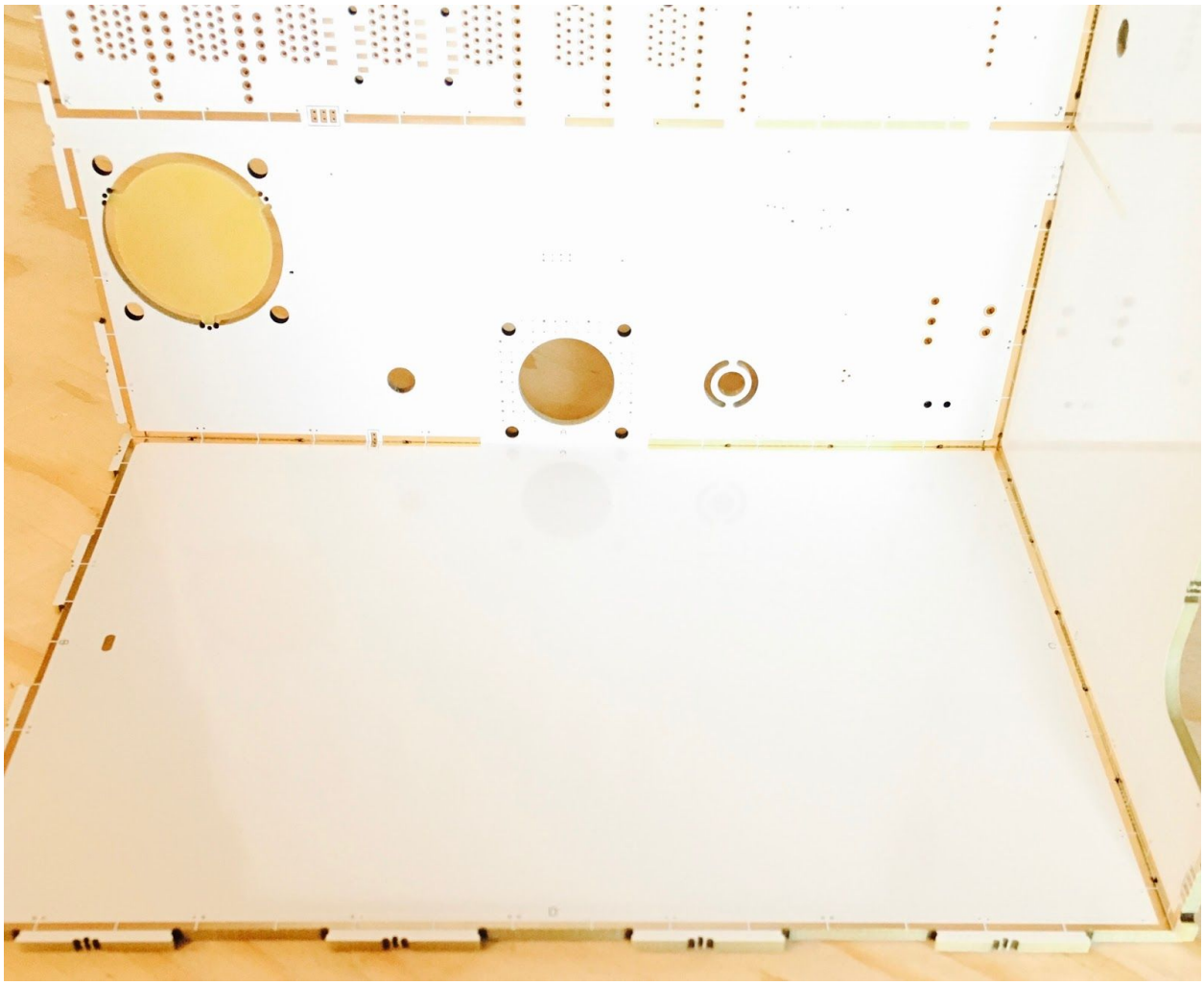


Make sure all components fit together smoothly and without air gaps before soldering. Only two components need to be checked at a time to verify fit. **Note that individual components are soldered together along a copper strip shown in the picture above.**

Next, partially assemble three sides of the main assembly (back, bottom and right hand side). If necessary use a small amount of tape to temporarily maintain fit and

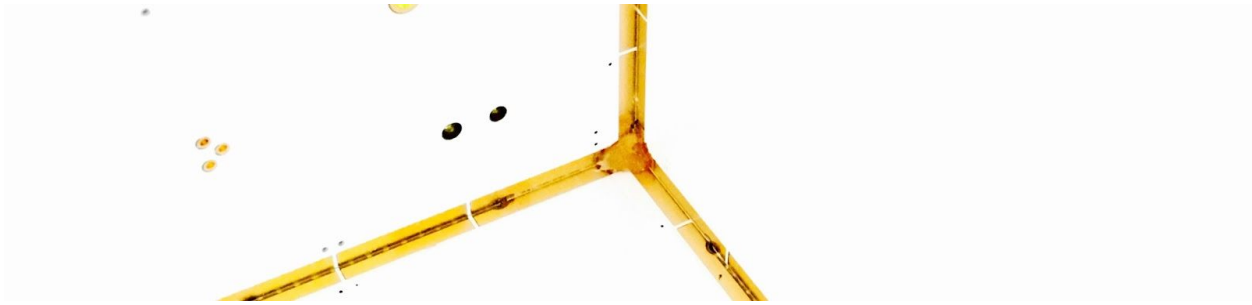
shape while soldering. If components have an overly tight fit, use the provided file to sand down mating edges.





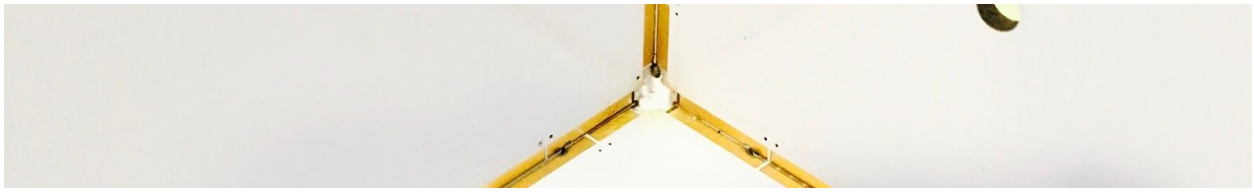
A solder bead should be added to every internal corner of the structure making 6 in total. See photos on page 15. This is to maintain shape while assembling other sub structures of the FR4 Machine shield. **Soldering more than the 6 points at this time, may lead to an unusable frame!**

Solder panels together using the large solder and flux that has been provided with each kit. First apply a small dot or drop of flux to the internal corner where the three panels meet.

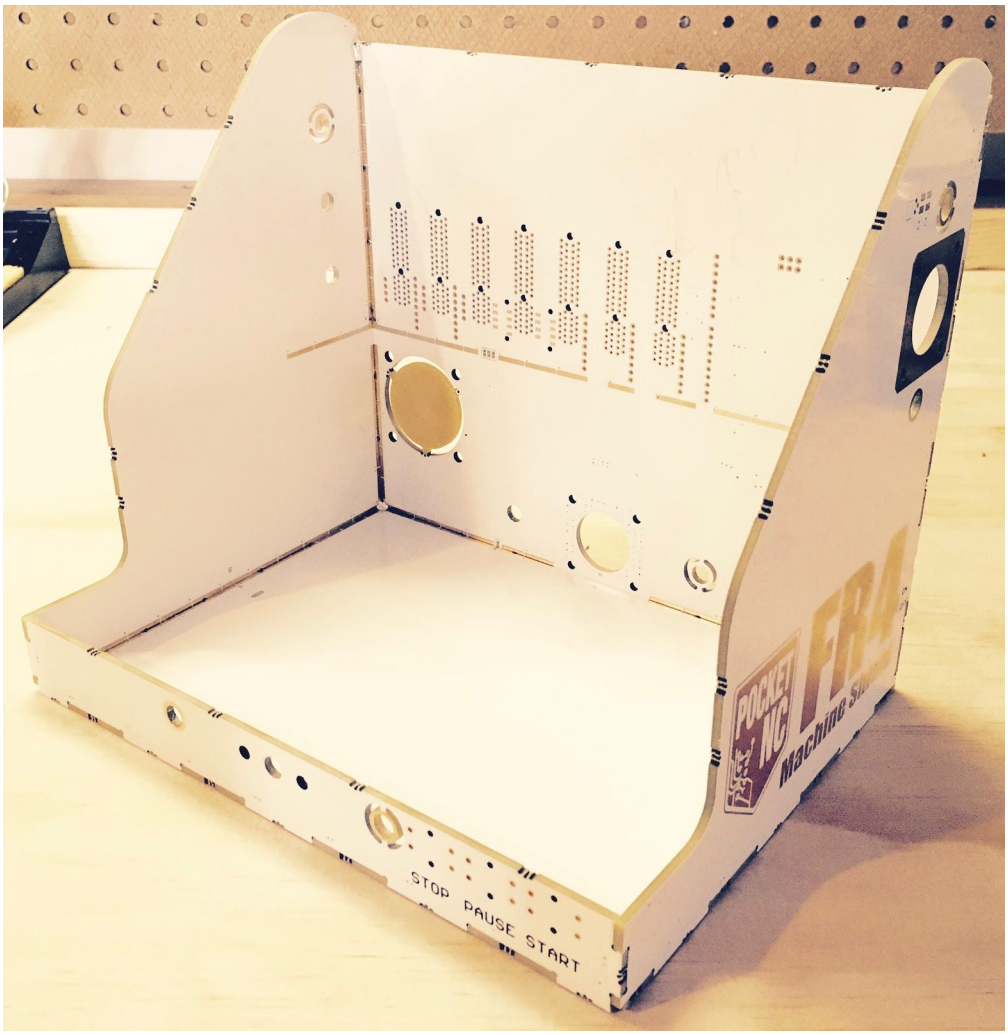


The most effective method for soldering assemblies together will be to apply solder to the iron rather than to the assembly. Once the iron has a sufficient amount of solder on the tip it can be applied to a flux coated copper strip.

Do not apply more solder than that of the picture below. This allows users to reheat solder and make adjustments if needed!

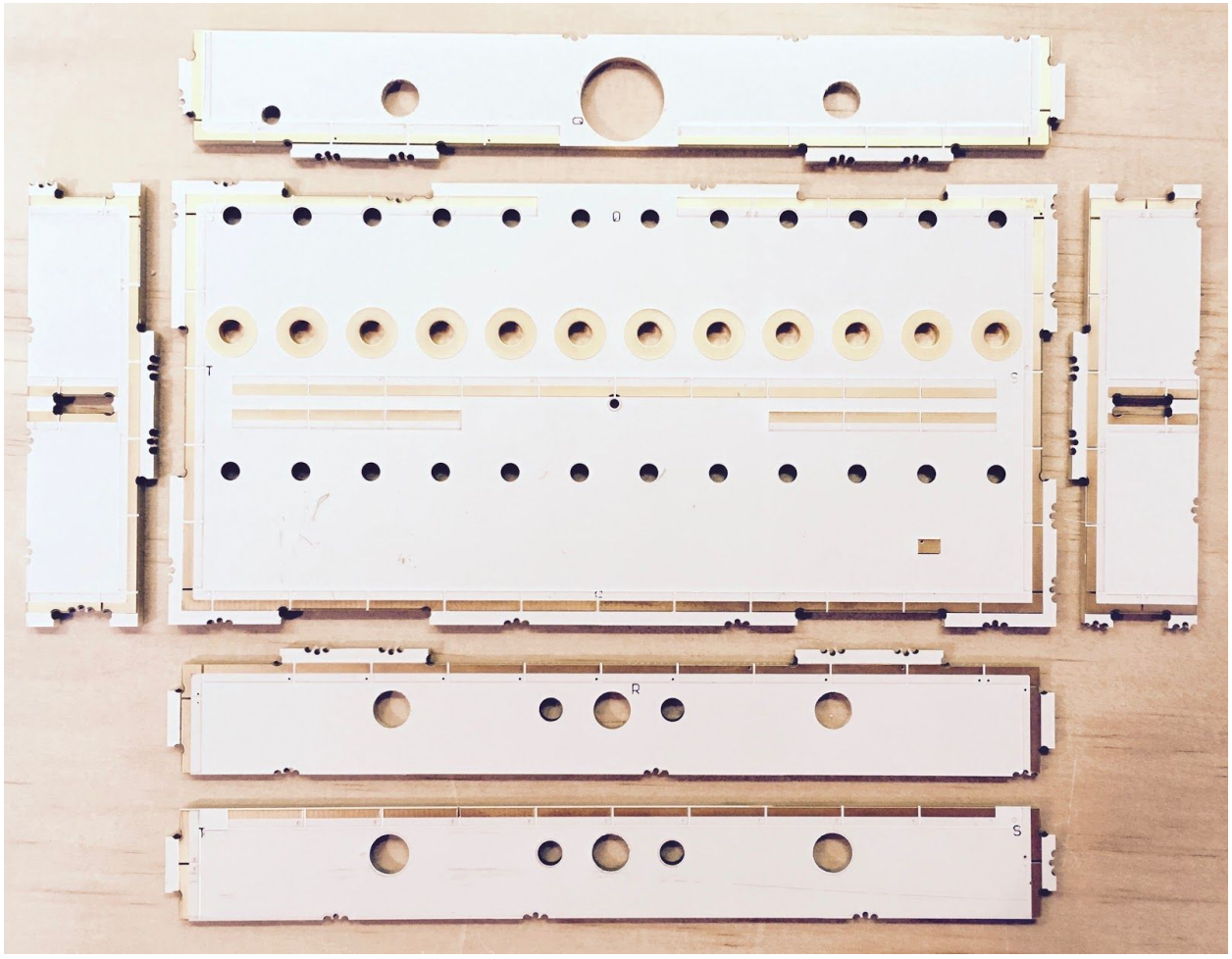


At this point, partially assemble the remaining two (2) sides of the structure and tack the remaining five (5) corners.



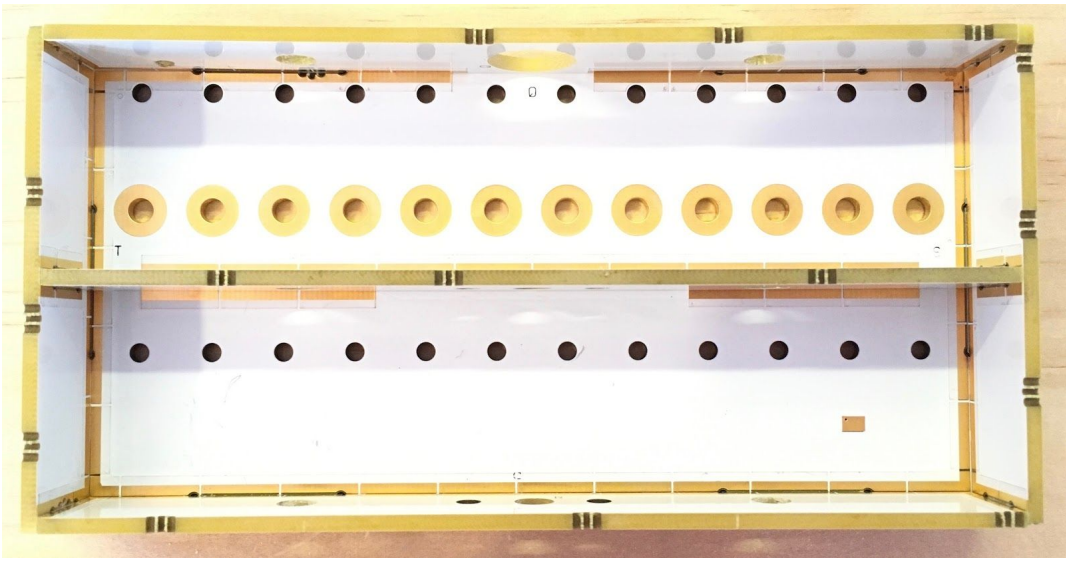
When complete, the main structure should look like the picture above, held together by 6 beads of solder, one in each corner.

Assembly 2: Y Axis

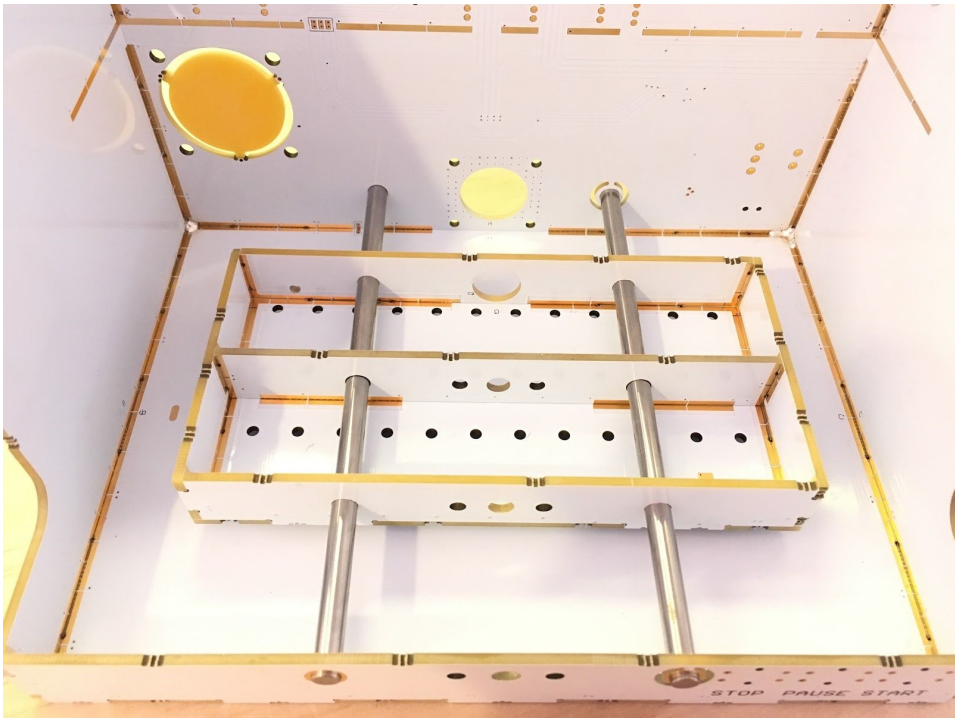


Before soldering any components together, lay out all boards to match the assembly in the previous photo. Letters on individual boards should match that of a mating board.

Next partially assemble sides of the table assembly **but do not solder**. If necessary use a small amount of tape to temporarily maintain fit and shape. If components have an overly tight fit, use the provided file to sand down mating edges.



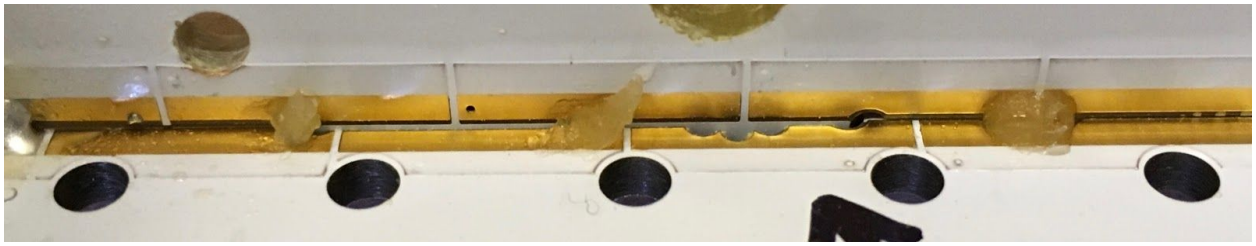
Once the table has been partially completed, it will be temporarily installed within the main assembly for the solder tacking process. This is done to ensure fit and alignment. **Note that the table assembly is upside down in the photo, this is only for access to the copper strips for soldering.**



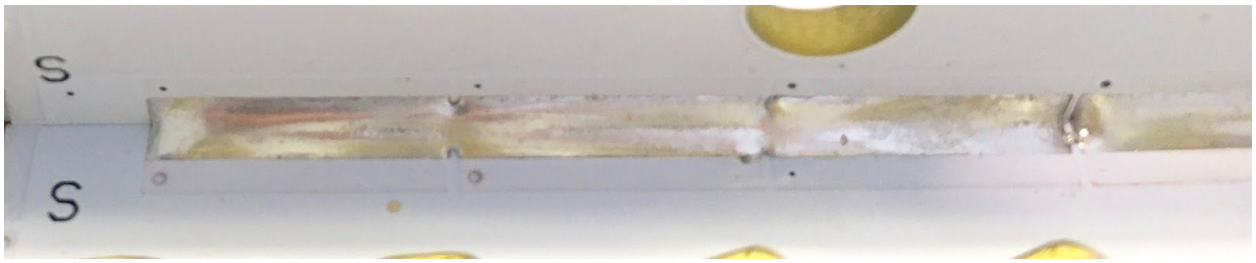
The table assembly should be tacked together in the four outer corners after it is checked for fit but while it remains inside the main assembly. A properly assembled table should slide freely from front to back, if necessary, adjust the fit of the table assembly until a proper fit is achieved.

After the table has been tacked together, check once more that the assembly slides smoothly from front to back. If any binding occurs, adjust the assembly before moving on to the next step. To adjust the assembly, reheat solders to remove pressure between guide rods and assembly pieces. It may be necessary to remove the top piece and sand mating edges to produce a slip fit. **The center support brace requires that it be square for proper function, use a pieces with a square edge from another assembly to check squareness of the center support.**

Next, remove the table from the main structure, then place small dots of flux around the perimeter of the table assembly. One dot every 0.5 inch to 0.75 inch should be enough. Apply more as needed and reuse extra using a cotton swab. Heat the flux with the soldering iron to achieve an even coat of flux.



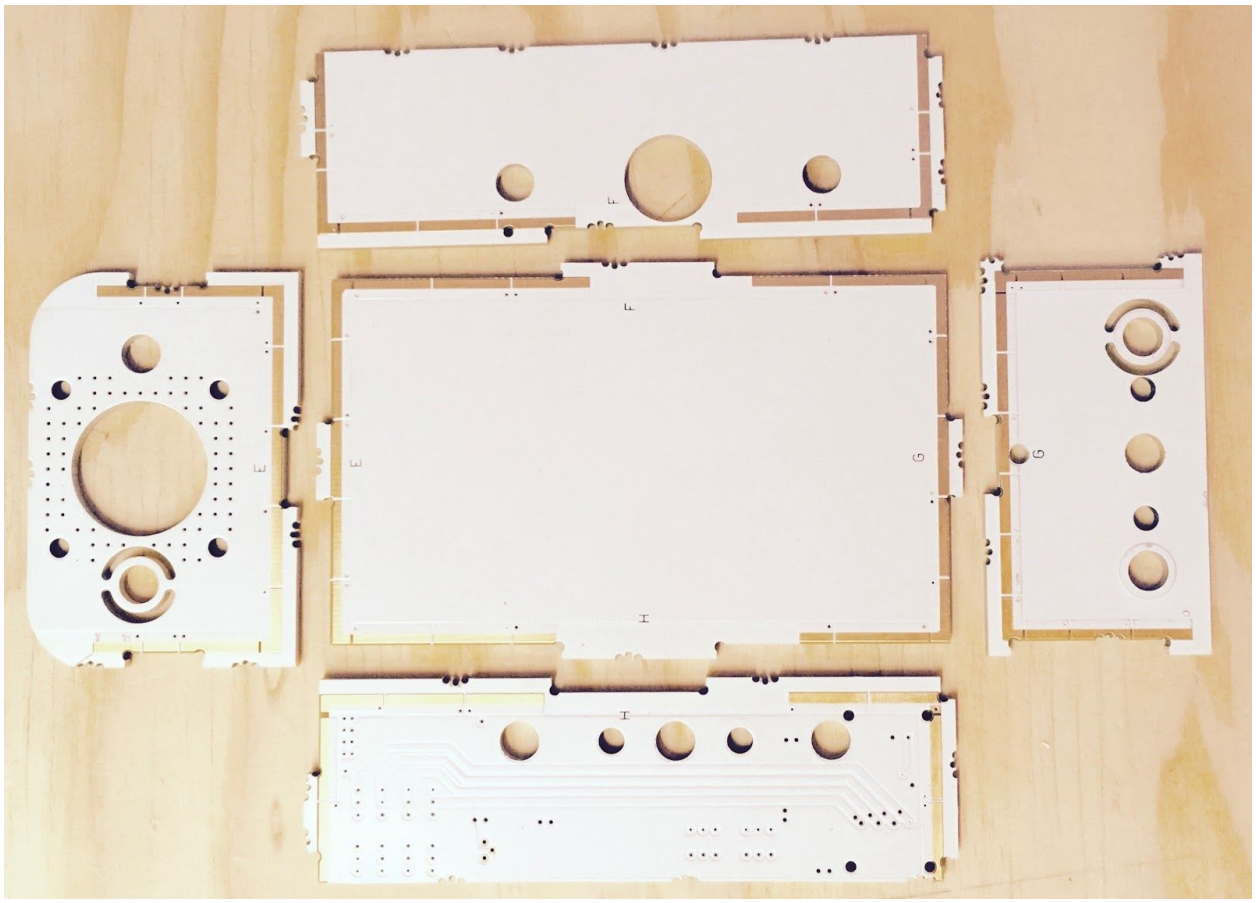
Next, finish soldering all joints of the Table assembly. **Note that extra solder will not improve strength.**



Next, Fasten M4 brass nuts (P/N FH016) to the mating copper pad on the bottom side of table assembly. Any M4 fasteners provided with the FR4 kit can be used to hold the nuts in place while soldering. Use the larger solder and flux for this step. **Note that the machine does not come with enough M4 fasteners to complete the soldering of all brass nuts at once, so solder nuts in sections of 4 or 6 at a time.**

When finished, a smooth solder bead should wrap completely around the brass nut.

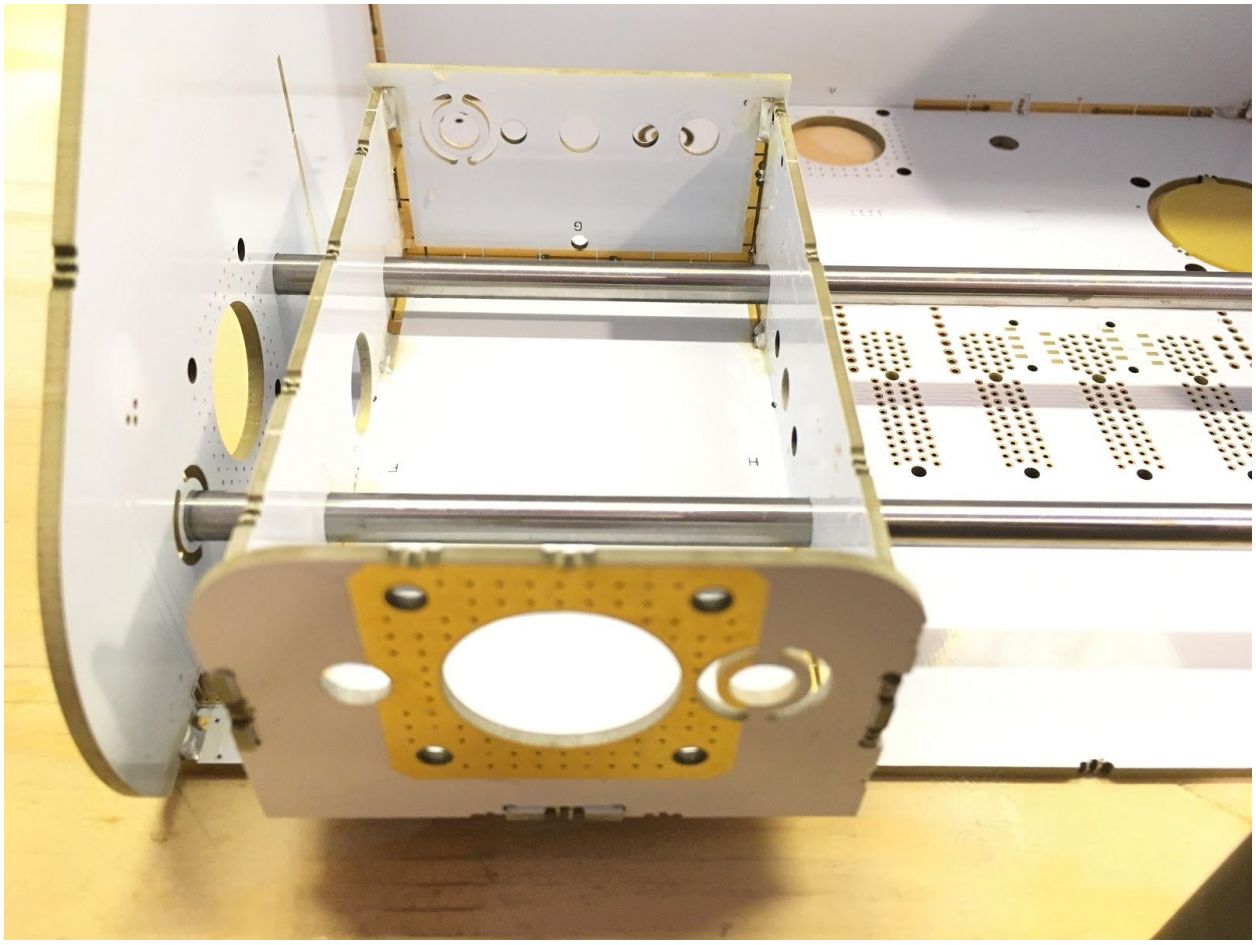
Assembly 3: X Axis



Before soldering any components together, lay out all boards to match the assembly in the previous photo. Letters on individual boards should match that of a mating board.

Next partially assemble sides of the X assembly **but do not solder**. If necessary use a small amount of tape to temporarily maintain fit and shape. If components have an overly tight fit, use the provided file to sand down mating edges.

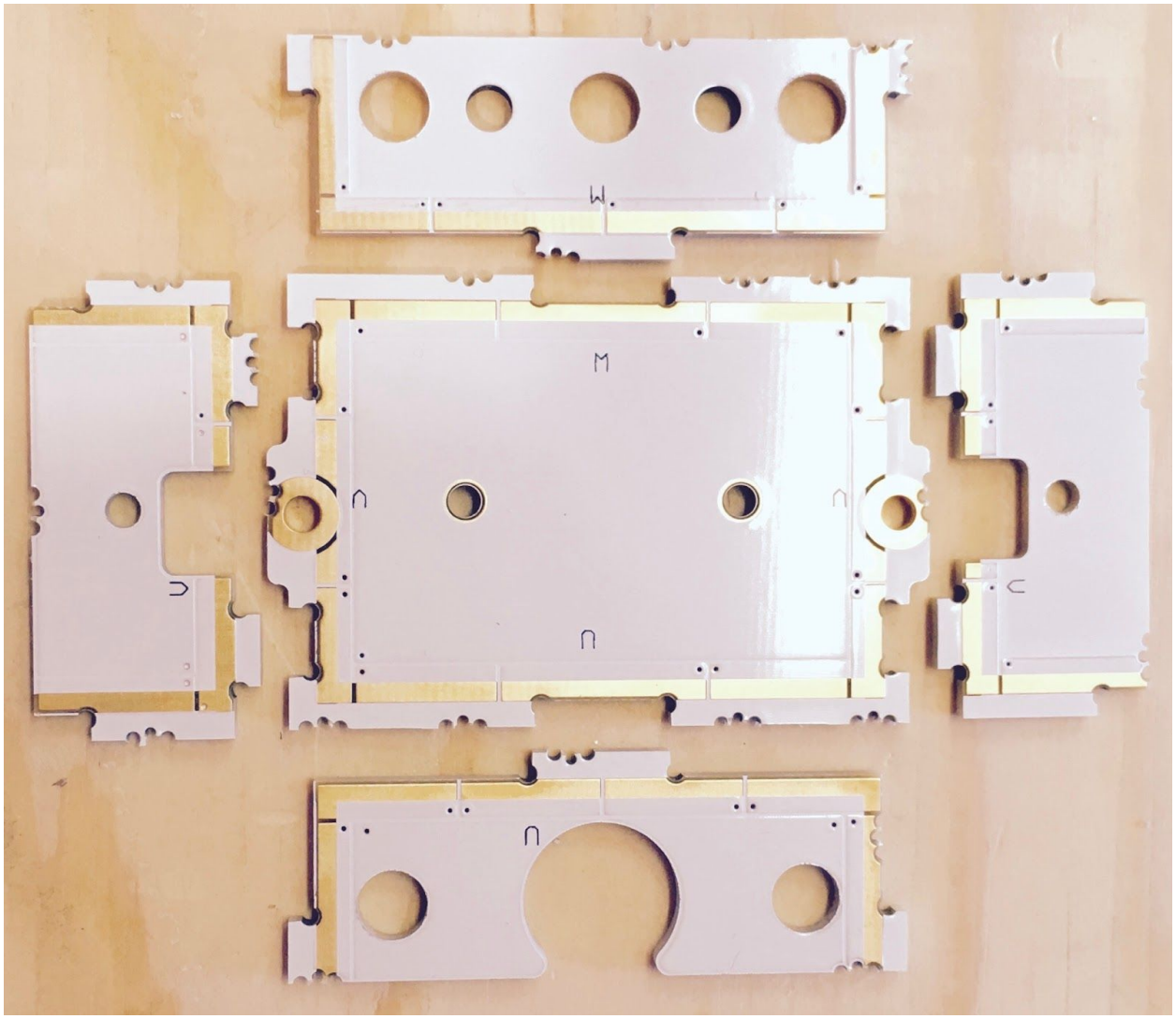
Once the X assembly has been partially completed, it will be temporarily installed within the main assembly for the solder tacking process. This is done to ensure fit and alignment. **Note that in the following photo, the main assembly has been rested on its back to allow better access for soldering of the X assembly.**



The X assembly should be tacked together in the corners after it is checked for fit. A properly assembled X axis should slide freely from side to side. If the X assembly does not slide freely, adjust the fit of the assembly until a proper fit is achieved.

After the X assembly has been tacked together, check once more that the assembly slides smoothly from side to side. If any binding occurs, adjust the assembly before moving on to the next step. To adjust the assembly, reheat solders to remove pressure between guide rods and assembly pieces. It may be necessary to remove the top piece and sand mating edges to produce a slip fit. **Note, the X assembly is not completely soldered together at this point. The Z assembly must be completed and checked for fit within the X assembly before the X assembly is fully soldered.**

Assembly 4: Z Axis



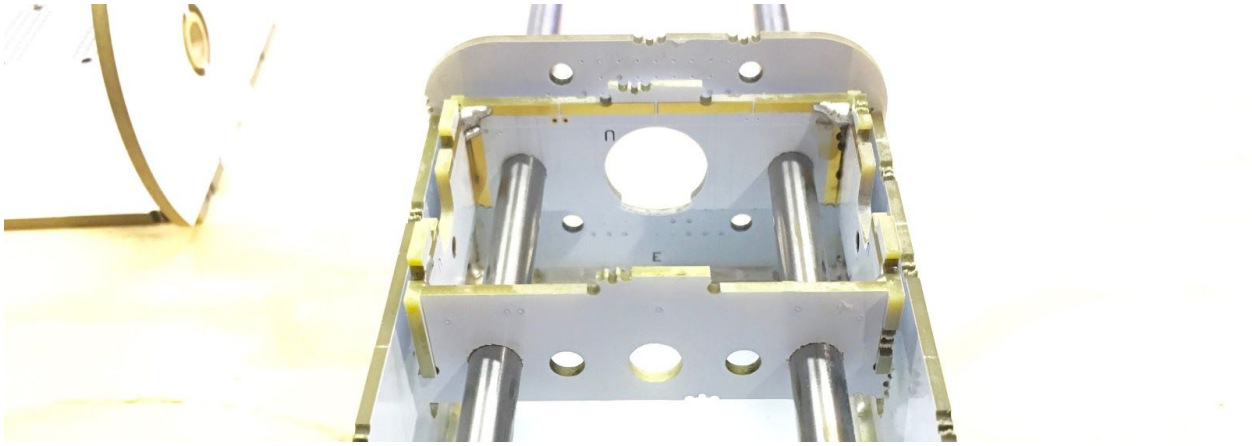
Before soldering any components together, lay out all boards to match the assembly in the previous photo. Letters on individual boards should match that of a mating board.

Next partially assemble sides of the Z assembly **but do not solder**. If necessary use a small amount of tape to temporarily maintain fit and shape. If components have an overly tight fit, use the provided file to sand down mating edges.

Once the Z assembly has been partially completed, it will be temporarily installed within the X assembly for the solder tacking process. This is done to ensure fit and alignment. See following photo.

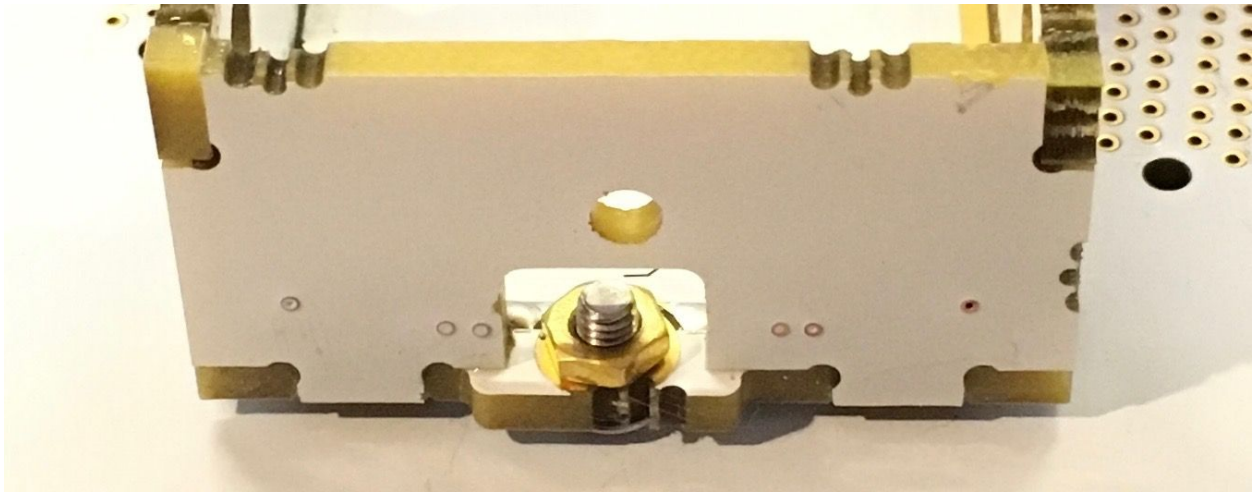
The Z assembly should be tacked together at the corners after it is checked for fit. A properly assembled Z axis should slide freely from end to end maintaining a smooth motion, if needed, adjust the fit of the assembly until a proper fit is achieved.

Note, checking fit may be slightly harder with the Z assembly as the sides do not fully snap together. If necessary, a small bead of solder can be used in the corners of the assembly to keep parts together.



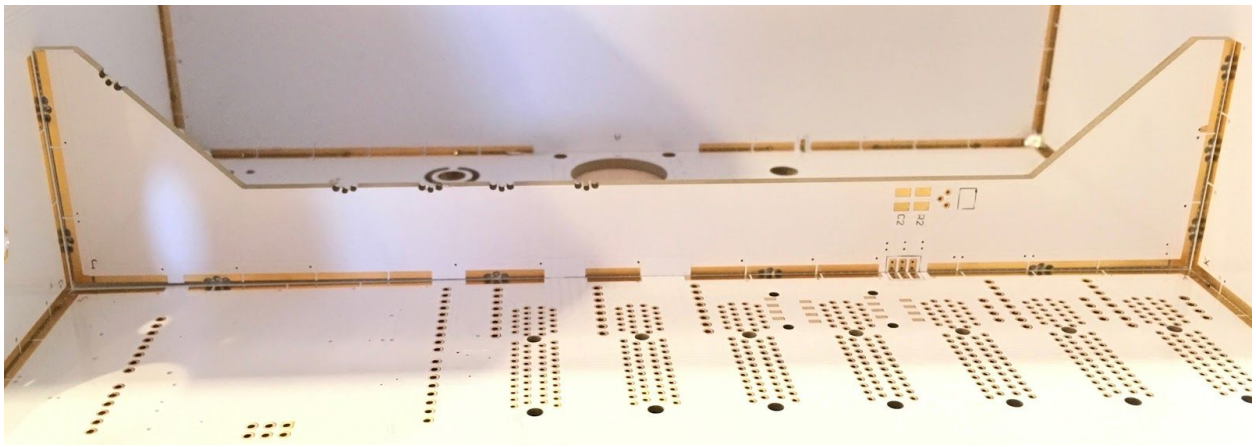
After the Z assembly has been tacked together, check once more that the assembly slides smoothly from end to end. If any binding occurs, adjust the assembly before moving onto the next step.

Note that in the following photo, the slot in the side of the Z assembly needs to match the hole provided for the M3 brass nut. Check that this is correct before tacking anything in place.



Once the Z assembly has been tacked together install and solder 2 M3 brass nuts (P/N FH001) on the pad shown in the previous photo. Once the brass nuts are soldered in place, finish soldering all joints of the Z assembly and the X assembly.

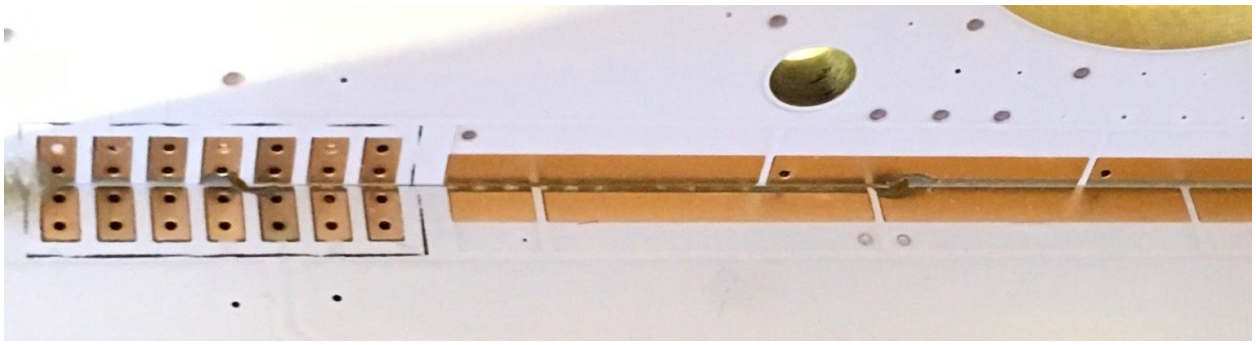
Next, install the support brace into the main assembly. The process is most easily accomplished by laying the main assembly on its back and installing the support from the top side of the structure (see the following picture).



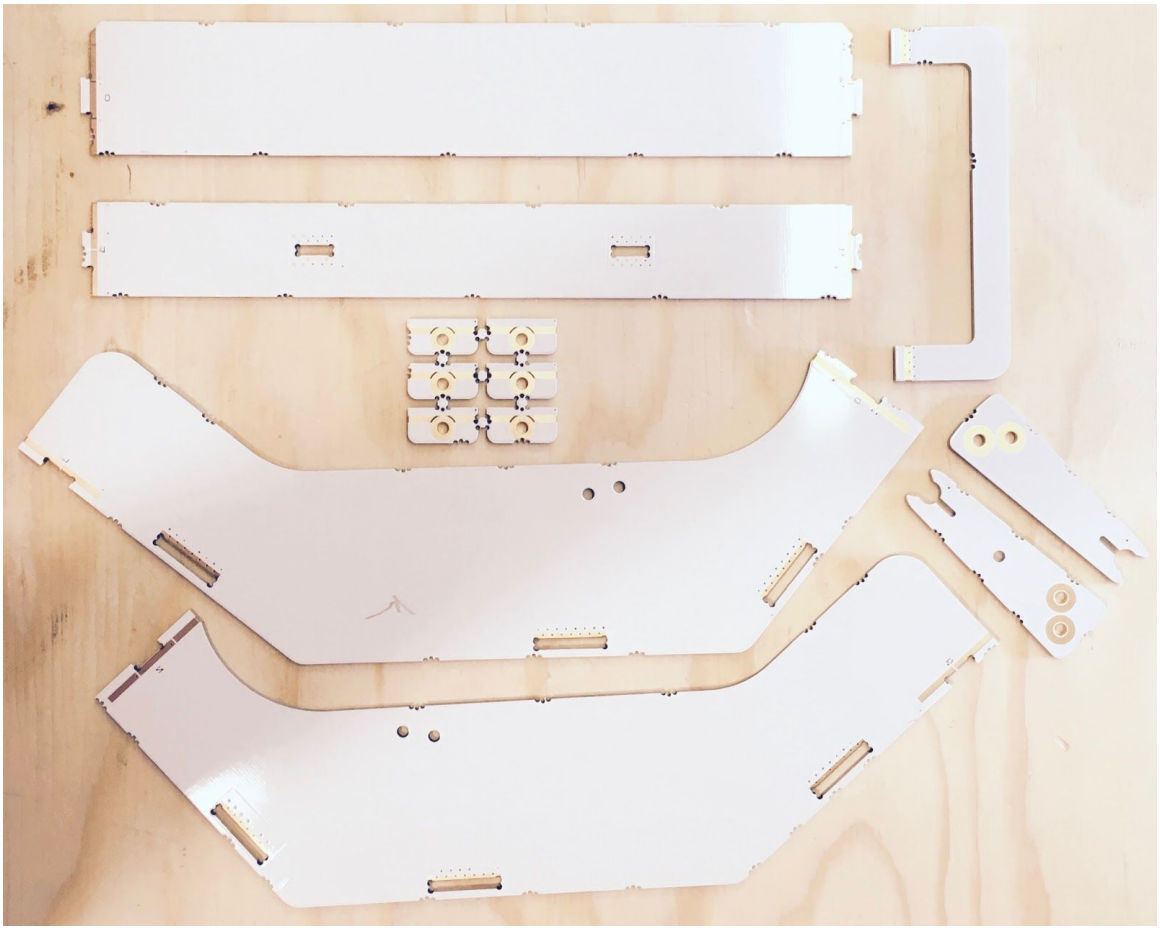
Apply flux and solder to the left and right corners of the support brace allowing for adjustment until the brace is fully soldered. Once the brace is perfectly aligned (copper edges next to copper edges) **finish soldering of all joints on the main assembly except those used for electrical connections. (see following image and note).**

Note, that some joints are also used as electrical connections to rout things such as power ground and signals. These joints should

be soldered with small flux core solder to provide a more accurate joint. See the following picture for two different types of joints. The joint on the left should use the small flux core and the joint on the right should use the large solder and flux.

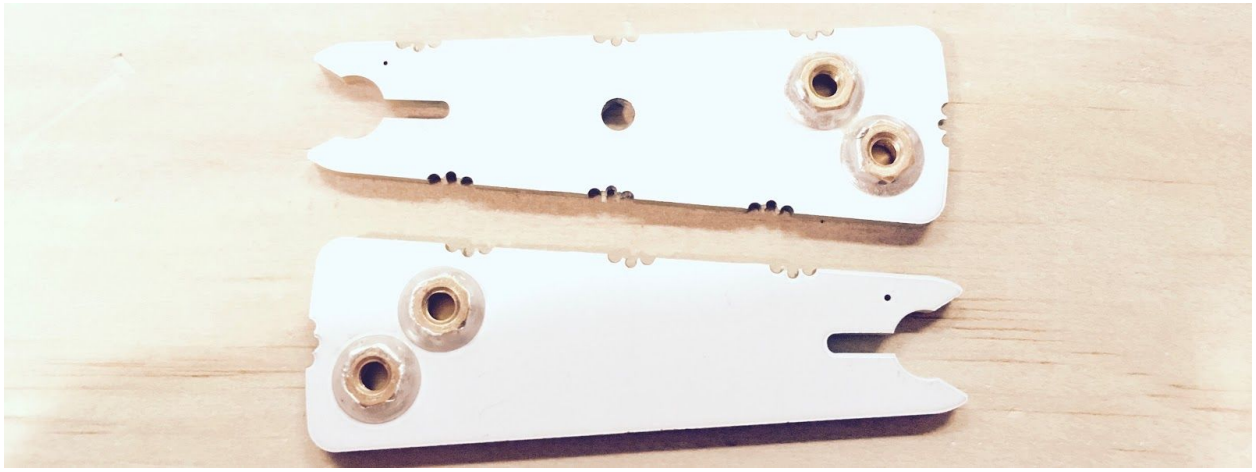


Assembly 5: Lid



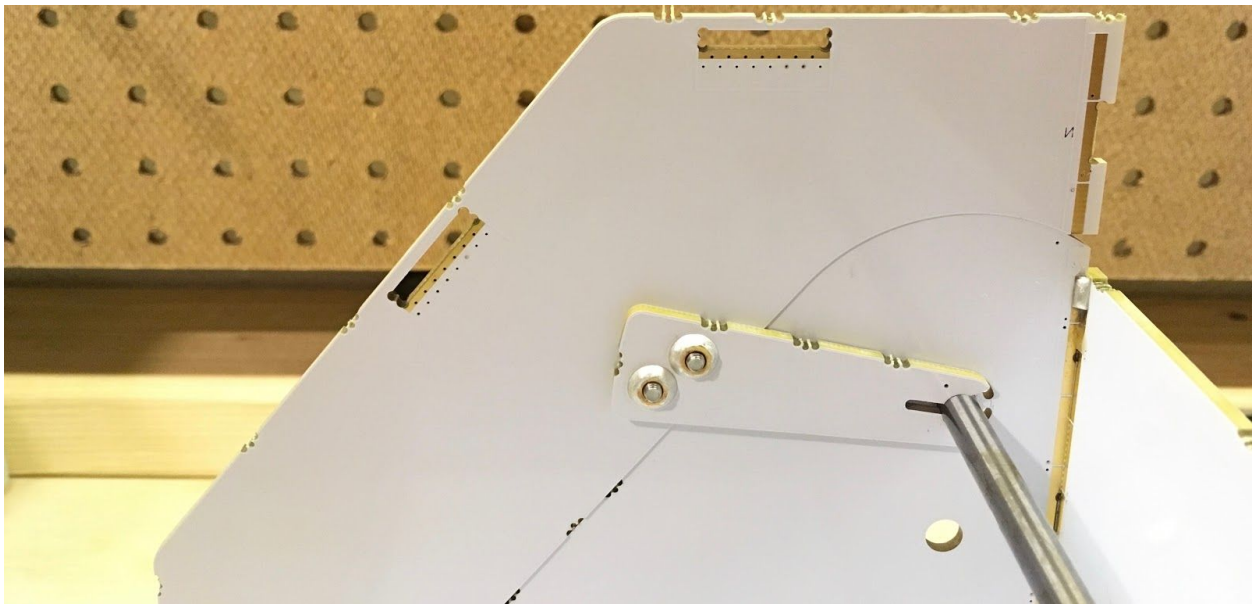
Before soldering any components together, lay out all boards to match the assembly above. Letters on individual boards should match that of a mating board.

Next check all sides of the lid assembly for fit **but do not solder**. If components have an overly tight fit, use the provided file to sand down mating edges.

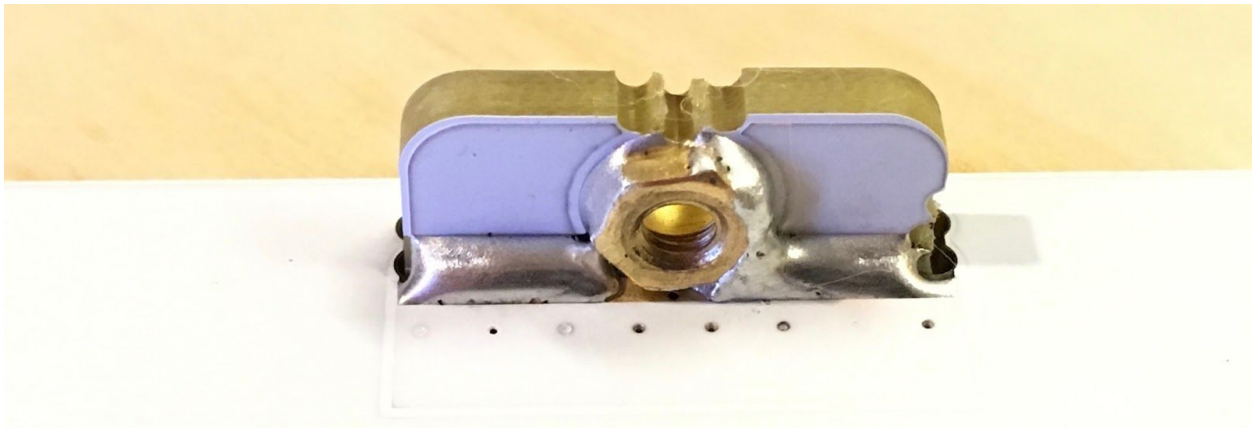


Next, solder 4 M3 brass hex nuts (P/N FH001) onto the lid hinges as seen in the previous photo.

Install both hinges onto a long linear guide rod through the main assembly as seen in the following photo. Use two M3x8 screws (P/N FH002) to hold each lid side in place.



Once the lid assembly sides have been partially fixed to the main assembly, they will be soldered to the remaining components. This is done to ensure fit and alignment.

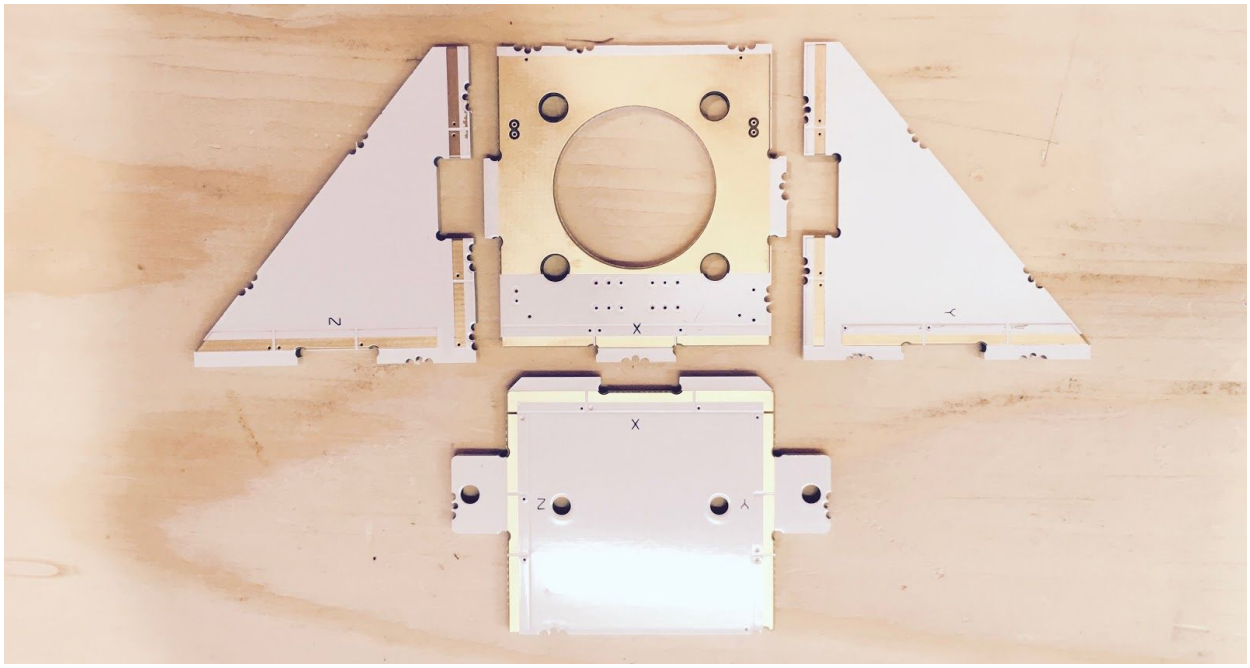


Note, If you ordered clear plastic covers for your lid assembly or you plan on making your own, solder the lid mounts on now! If you don't plan on using a cover at this time, you can skip this step!

The lid assembly should be tacked together after it is checked for fit. A properly assembled lid should open and close freely maintaining parallelism with the side panels of the main assembly. If the sides of the lid assembly are not parallel with the main assembly, adjust the fit of the assembly until a proper fit is achieved. Then complete soldering around the edges.

Assembly 6: Spindle Mount

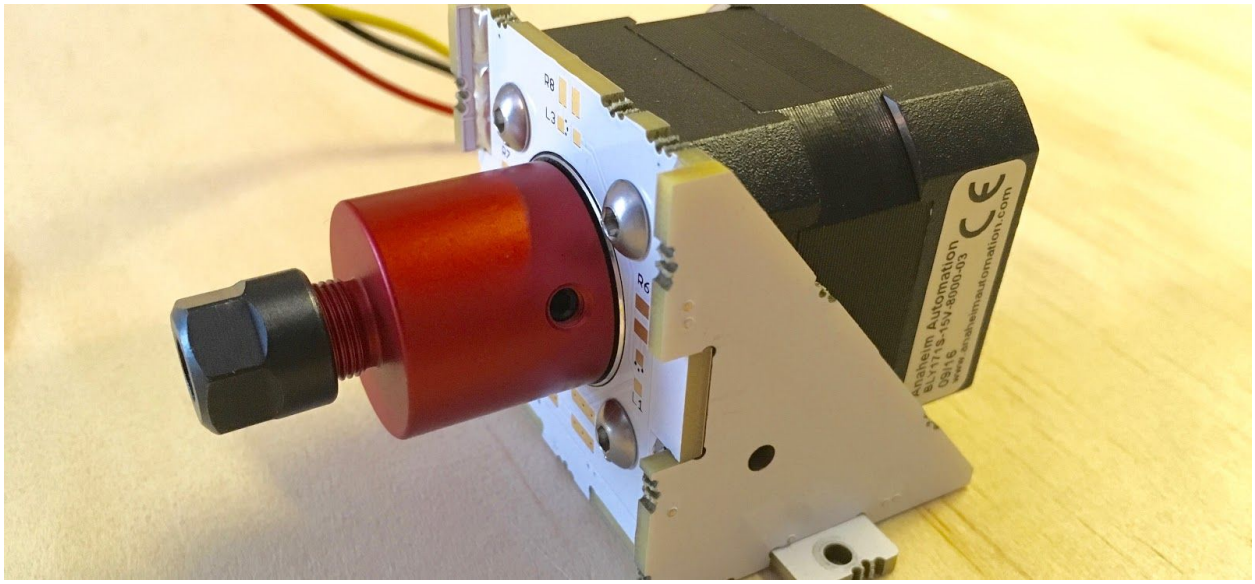
Note, if you don't plan on using the spindle motor assembly, or you did not purchase this option with your Kickstarter kit, you can skip this step.



Before soldering any components together, lay out all boards to match the assembly above. Letters on individual boards should match that of a mating board.

Next partially assemble sides of the spindle assembly **but do not solder**. If necessary use a small amount of tape to temporarily maintain fit and shape. If components have an overly tight fit, use the provided file to sand down mating edges.

The spindle assembly should be tacked together at the corners after it is checked for fit. Once complete, complete solder on all joints including the bottom joints. When finished **AND CLEANED**, install the spindle motor and four M4x6 screws (P/N FH005).



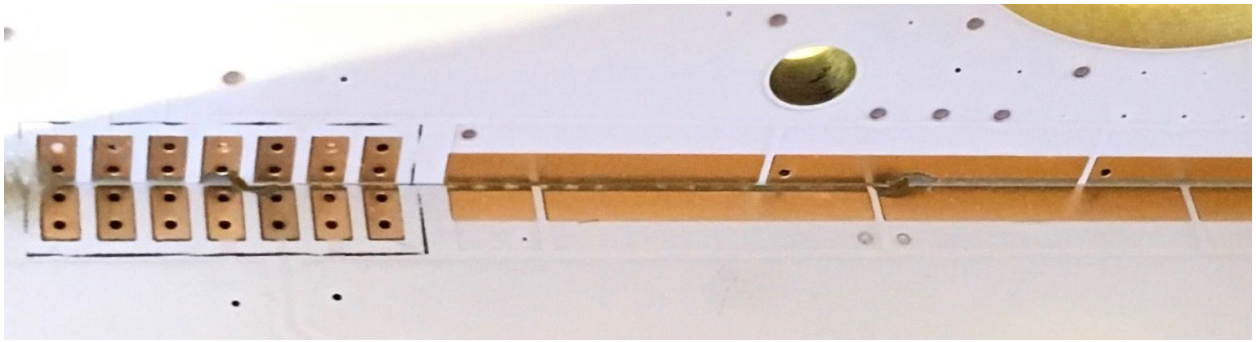
Note that all boards should be cleaned or washed and then dried after all assemblies are completed or if leaving an assembly for an extended period of time before completion. Flux on circuit boards for an extended period will cause corrosion. Boards should also be clean before electronics are soldered in place.

Electronics

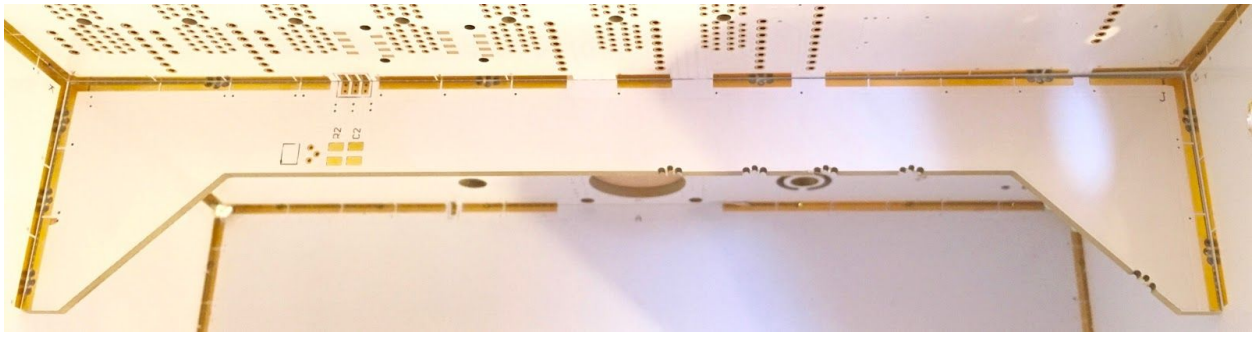
Electronics 1: Hall Sensors

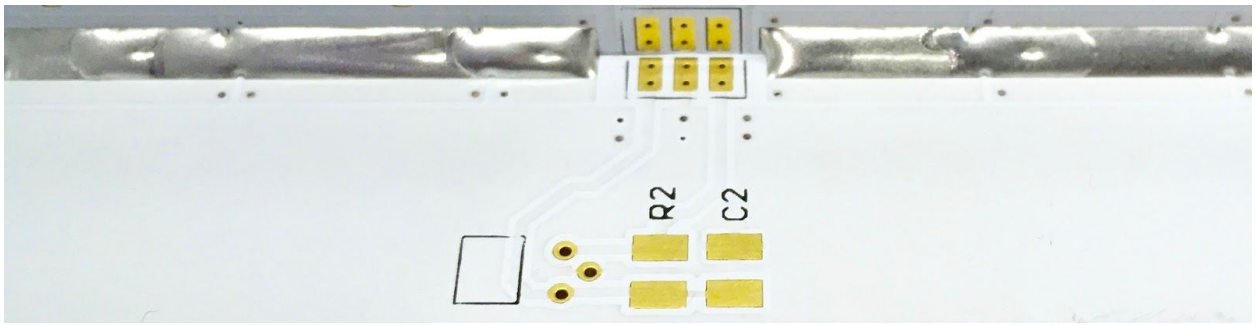
Note, all assemblies should be cleaned from the soldering flux before starting soldering of electrical components. Assemblies can be washed using a dishwasher and dish soap or by hand. If assemblies have not yet been cleaned, go back and do that now.

All electronic components should be soldered in place using the small flux core solder (P/N FH011). This includes joints used as electrical connections for ground, power and signals. These pads exist in four locations on the main assembly each consisting of a different pin count. One set is hidden behind the STOP START and PAUSE buttons See the following image. The small solder has special properties that let it flow without the use of extra flux and don't require it to be cleaned after use.



The first components to be soldered will be hall sensors (P/N FE002), resistors (P/N FE012) and capacitors (P/N FE013). In total, three of each component will be mounted to the main assembly. The first sensor set (3 components) is located on the top side of the main assembly support brace.

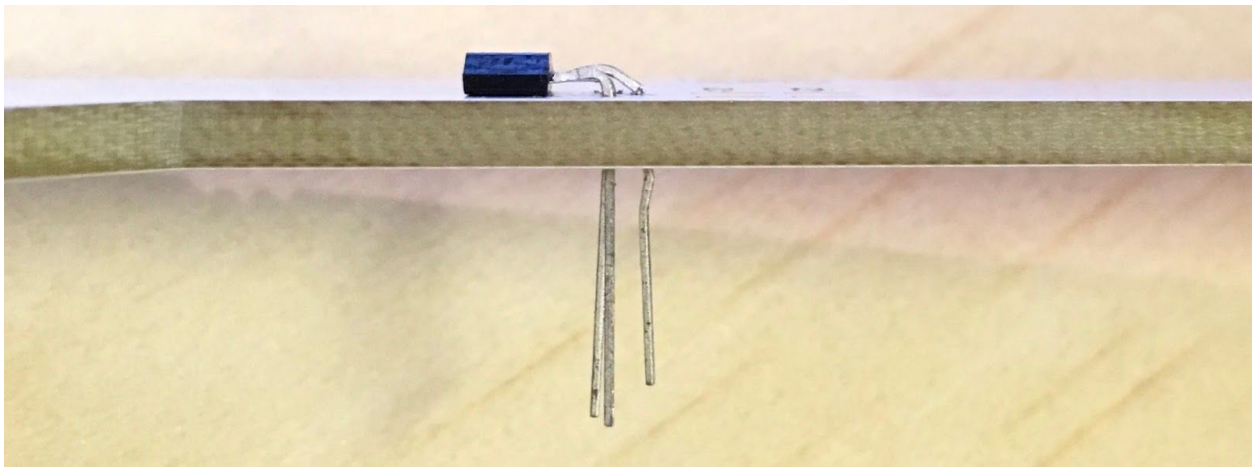




Resistors should be soldered to gold plated pads labeled R# and capacitors should be soldered to gold plated pads labeled C#. This is most easily done by applying a small bead of solder to one of the gold pads, then holding a component in place using tweezers and reheating / cooling the solder covered pad while the component is in place. Complete the soldering of the component by applying a small amount of solder to the remaining solder pad. The following are several videos on soldering for beginners. https://www.youtube.com/watch?v=f95i88OSWB4 https://www.youtube.com/watch?v=QzoPxvIM2qE

Hall sensors should be soldered in place with **chamfered edges facing up**. A small black box shows the location and circuit board side which the hall sensor should be mounted. When completed, each hall should be flat against the circuit board it is mounted to, with no metal legs protruding from opposing side. To achieve the best fit,

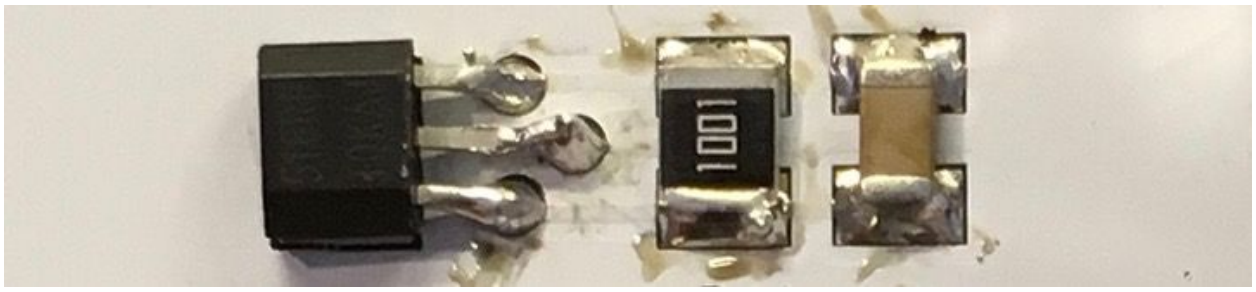
adjust the fit of a hall **before soldering in place**.



Note that **not** all hall sensors are soldered in place on the same side as the resistor and capacitor. A black box shows which side a hall sensor should be soldered to.

One last black resistor should be soldered on the pads labeled R5. These pads are on the back of the main assembly.

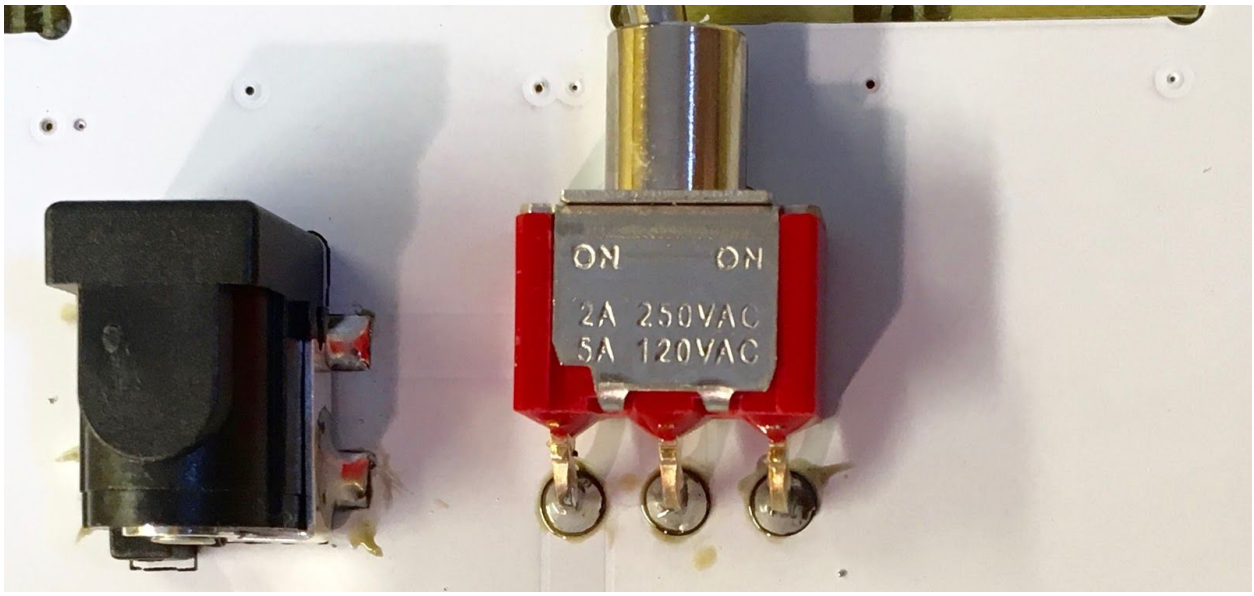
When complete, the hall sensors and resistors should look similar to the following photo. Be sure no solder connection is made between pins of a hall sensor. **Remove the ends of the hall sensor that protrude from the opposite side. On the X motor side of the main assembly, you will want to sand or file any bits that stick out past the board as protruding prongs could cause a short over time!**



A fourth hall sensor is located along the side of the X assembly. Use the same strategy to install those components now.

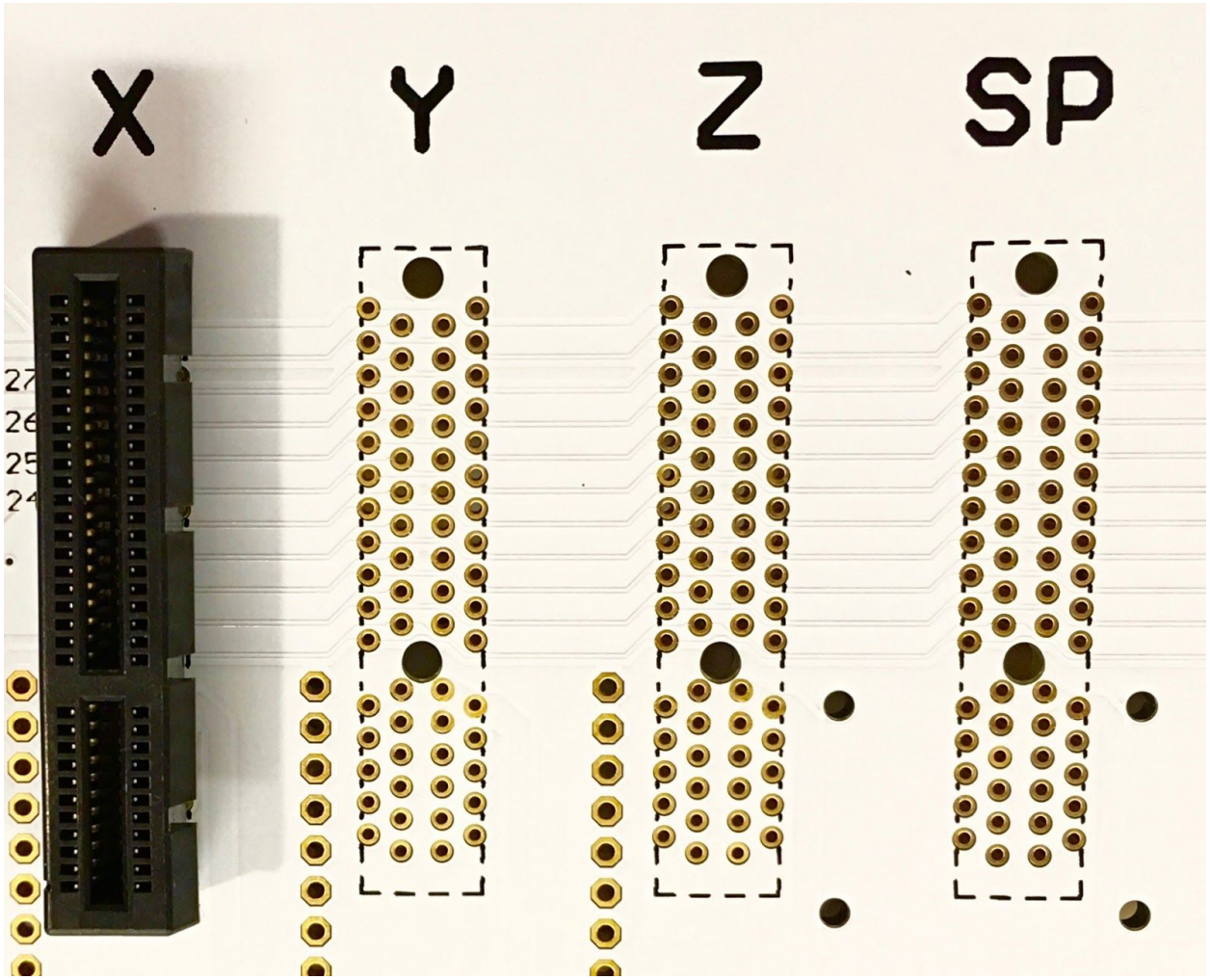
Electronics 2: Power Switch and Power Jack

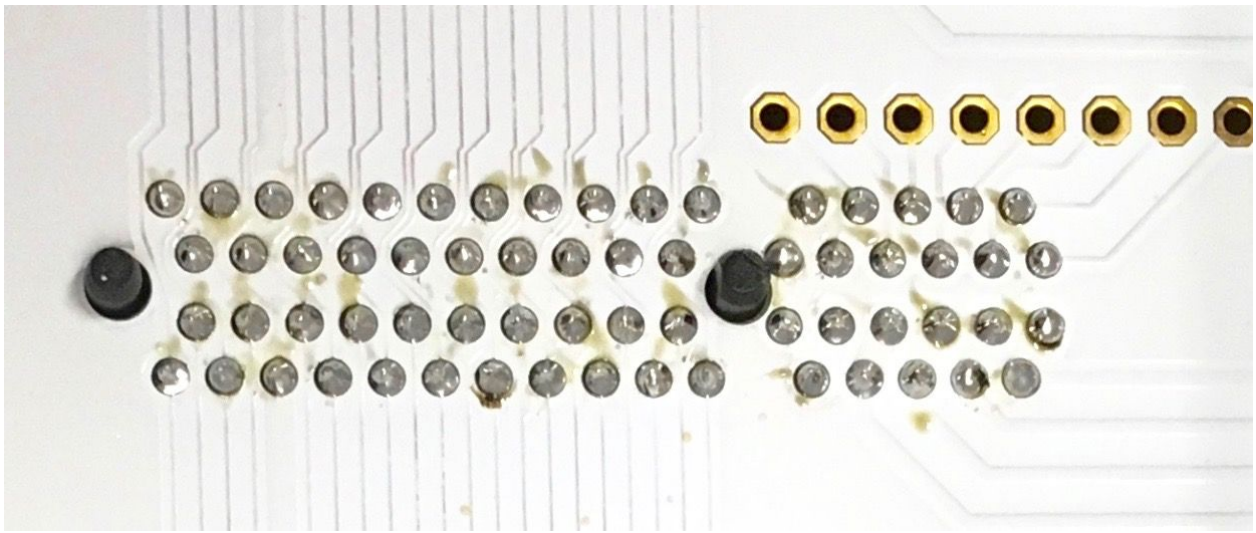
The FR4 Machine Shield receives power by means of a 2.1mm barrel jack connector (P/N FE008). This power can be switched on/off using the provided dip switch (P/N FE011). Both components are located on the back side of the main assembly. And should be soldered in place using similar methods as that of the hall sensors in the previous section. Use the small solder for these components. **Note that the dip switch has two additional mounting pins opposite the side it is mounted. These are for strength and should be soldered as well.**



Electronics 3: 64 Pin Card Edge Connectors

Four (4) card edge connectors (P/N FE003) are soldered in place from the inside of the machine but protrude from the back of the machine. Each should be soldered in place of the X, Y, Z and SP (spindle) locations seen in the following picture. Three additional connector slots have been provided for prototyping / using other devices and drivers. A good technique for soldering connectors in place, is to solder one pin in place while applying pressure to the back of the connector. This assures the connector is tight to a board while the remaining pins are soldered. Some pins may have a slight bend from shipping and should be straightened before soldering. Be sure all pins are through the card edge holes before soldering as pins stuck behind the panel after soldering will cause troubles!





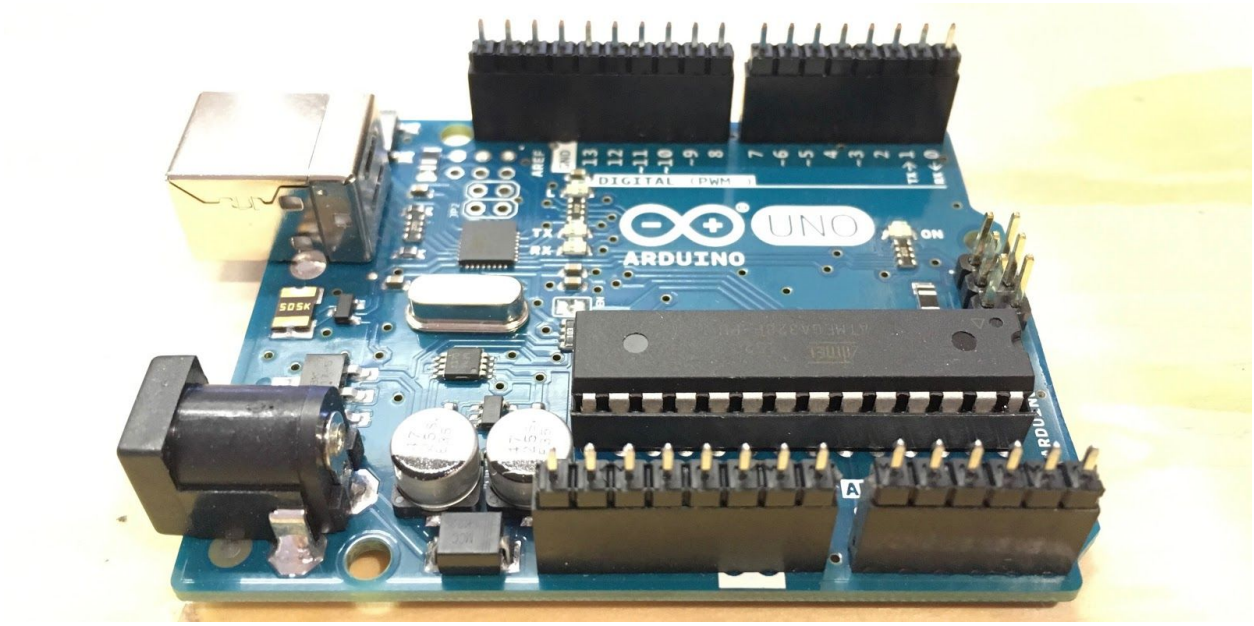
The previous photo shows the soldering of one card edge connector from inside the main assembly. Each solder joint and pin should be separated from all others.

Excess solder bridging the gap between two pins will cause improper function of a machine. Be sure to check each connection for solder bridged pins after soldering.

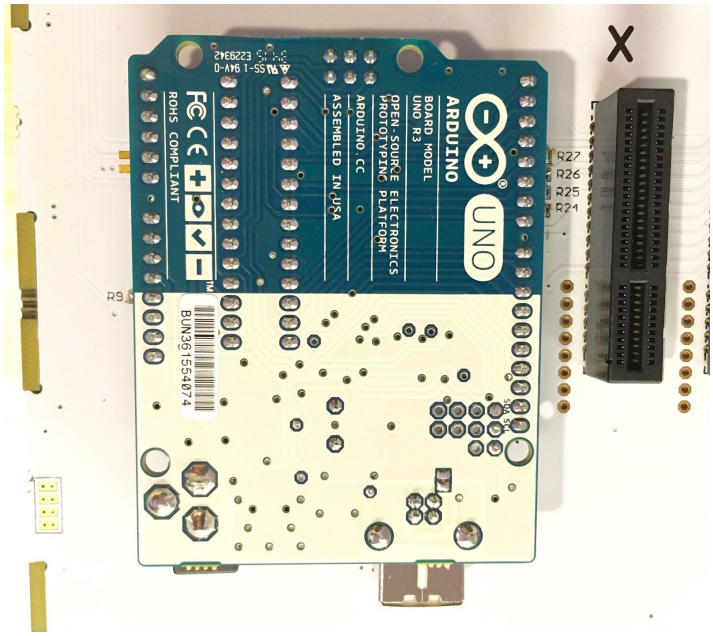
Electronics 4: Arduino Connector Pins

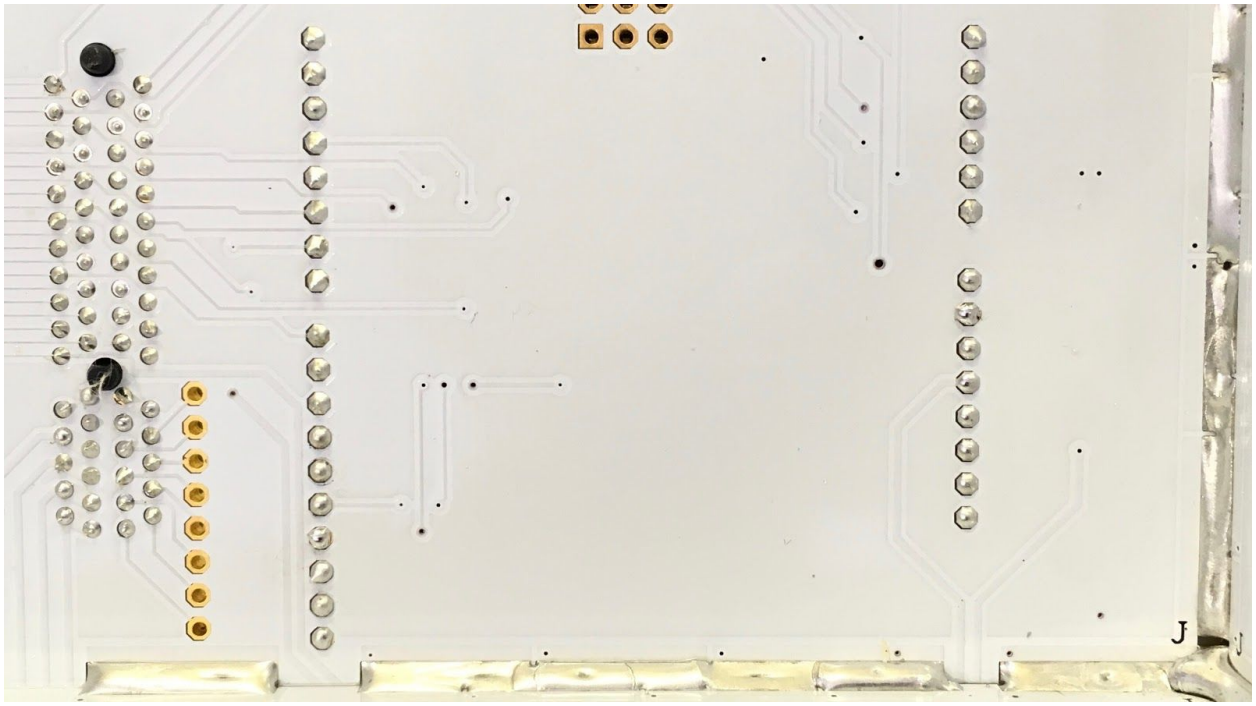
Each Arduino connector is held in place by (32) 0.1” / 2.54mm pitch header pins (P/N FE010). Header pins will need to be broken away from a single row of 32 pins, into shorter lengths matching that of the Arduino IO connectors. The easy way to accomplish this, is to install the header pins similar to that of the following picture and break away remaining pins using pliers or edge cutters.

When all pins have been trimmed, the pins should match that of the following picture.



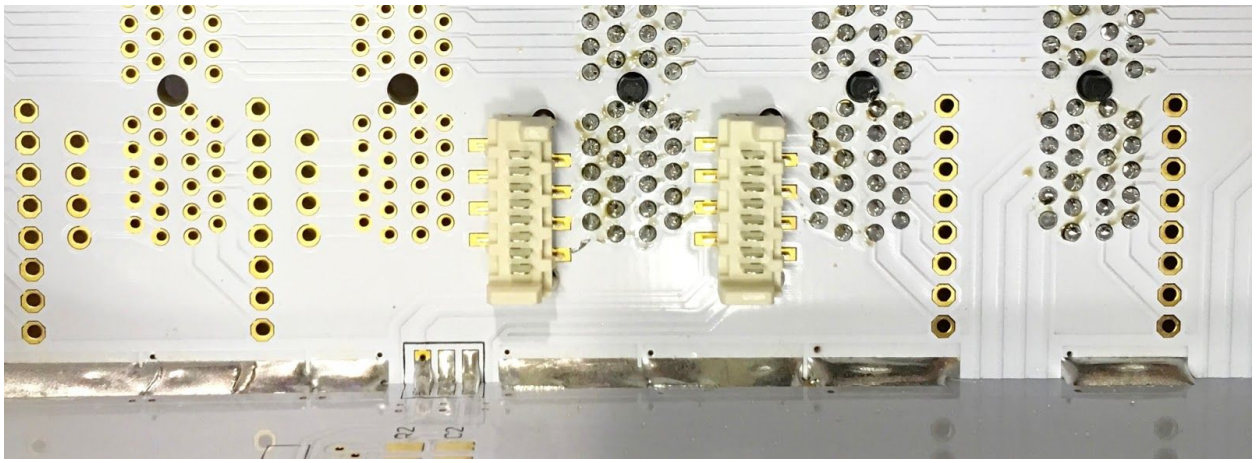
Use the Arduino to hold pins in place while soldering. Note that the Arduino mounts to the outside of the Machine Shield when complete. See following photo.

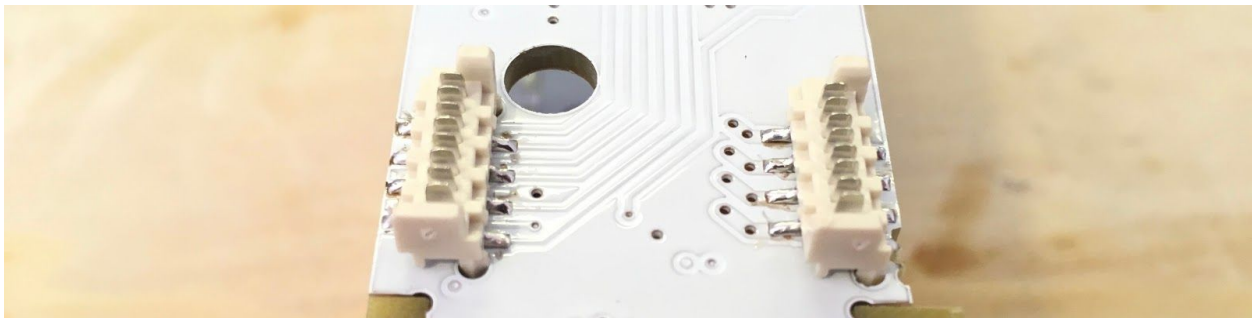




Electronics 5: X Connectors

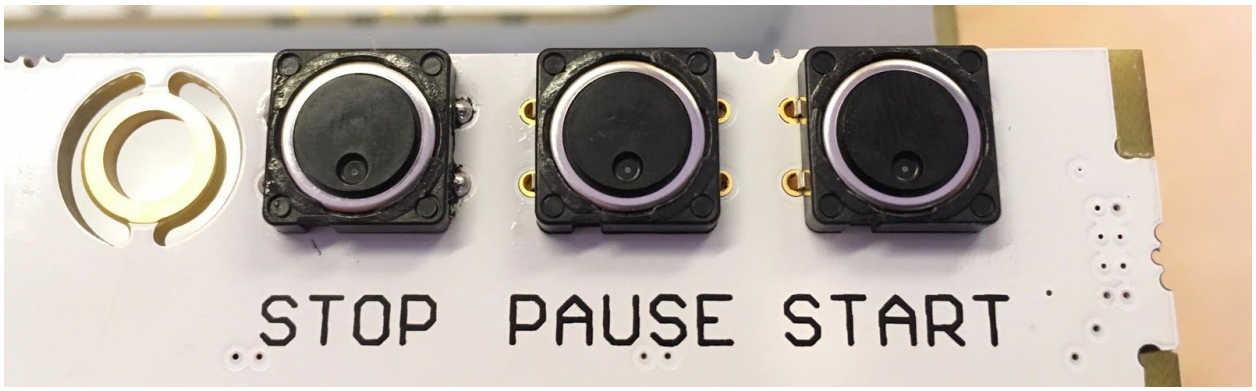
Four 8 pin connectors (P/N FE006) are used to transfer electrical signals from the main assembly to the X assembly. Two of these connectors are mounted to the main assembly and two are mounted to the x assembly. **NOTE: Each connector has two plastic clocking pegs that help with alignment.** Be sure when soldering, not to bridge any gap between two pins.

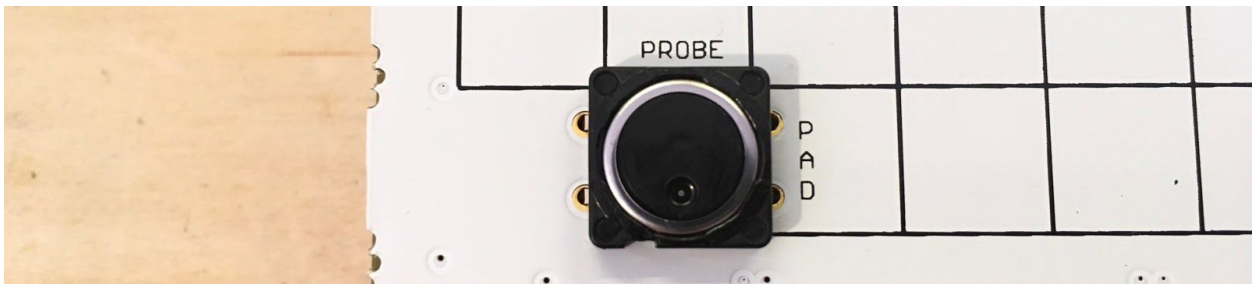




Electronics 6: Signal Buttons

Signal buttons should only be soldered from the back of a circuit board. Three of the buttons are located on the main assembly and one on the table assembly. **NOTE that the table assembly button (probe button) does not need to be soldered if the milling head will not be used.**

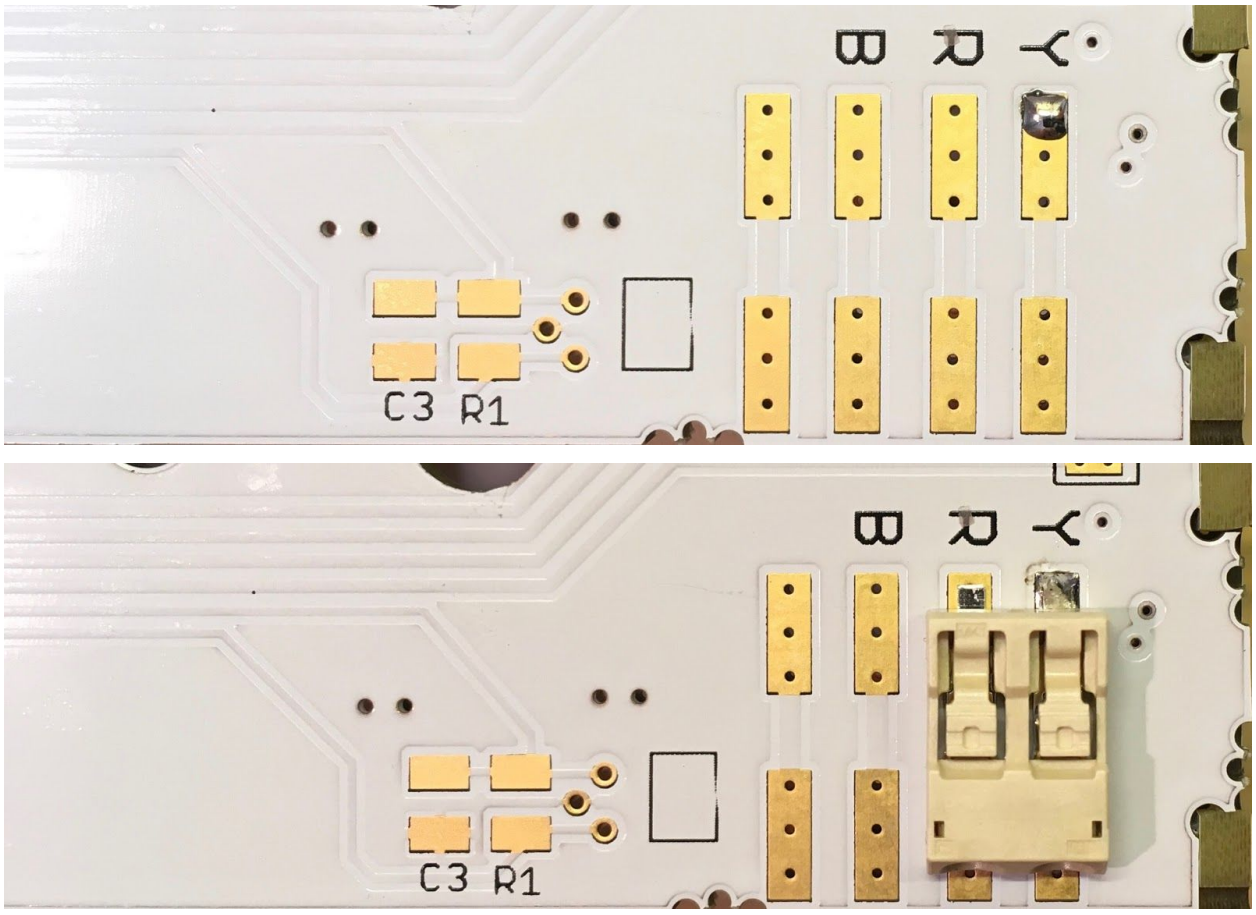




Electronics 7: Spindle Connectors

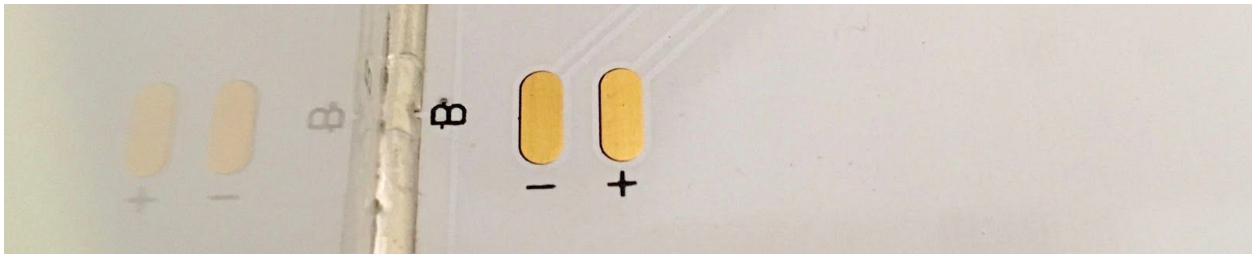
Spindle connectors (P/N FE009) are located on the X assembly. These connectors solder from both the front and back of the connector. By applying a small bead of solder to one copper pad before placing the component, you can avoid needing

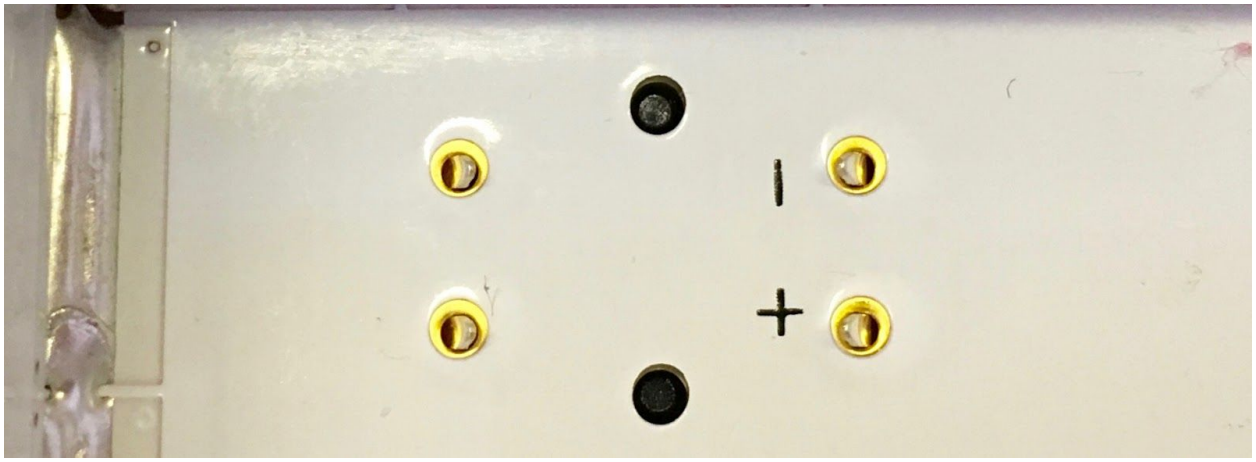
a third hand to place solder. **Note that only one pin of the connector in the photo below has been soldered.**



Electronics 8: Probe Wires

The probe button located on top of the table assembly requires signal wires connected to the main assembly. These wires can be made from spare motor wire from the x, y, or z motors. Trim a section of wire from one of the motors for this step, 3-4 inches will be plenty. Solder two wires to the table pads marked + & -, Use 3-4” of wire for each signal. The wire will need each end stripped before soldering. After the table has been installed in the main assembly **IN THE FINAL ASSEMBLY SECTION**, connect the remaining ends to the corresponding pads on the main assembly. + to + and - to -


B
B
−
+

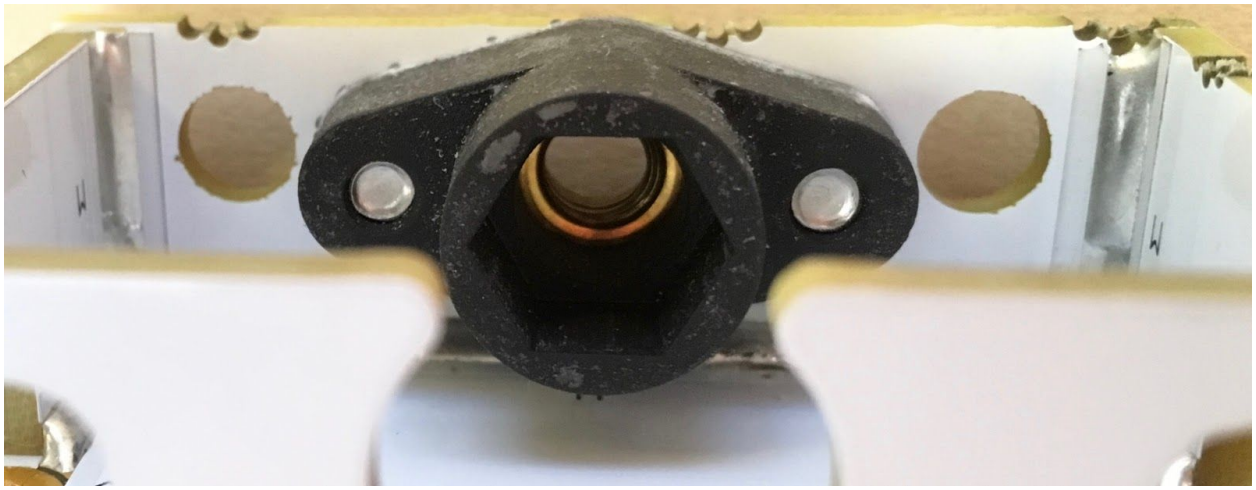


Final Assembly

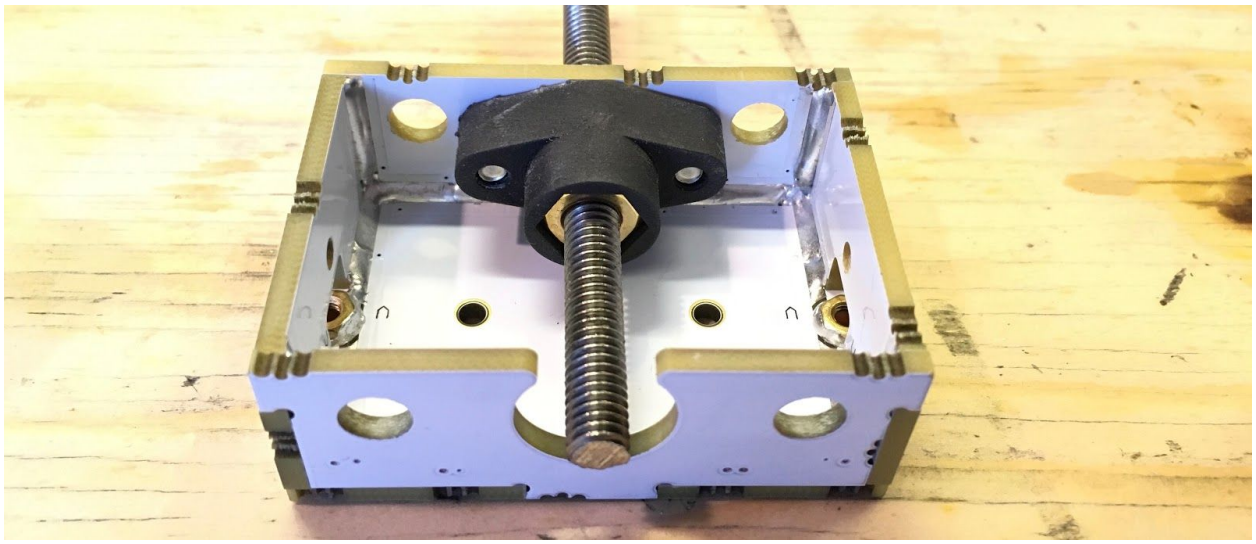
Final Assembly 1: Z and X Assembly

Anti backlash nut assemblies are created using threaded brass nuts with compression springs. This assembly is created in 4 steps.

1. Mount nut housing with integrated brass nut (P/N FM003) to the z assembly using 2 M4x10 screws (P/N FH004). See following image.



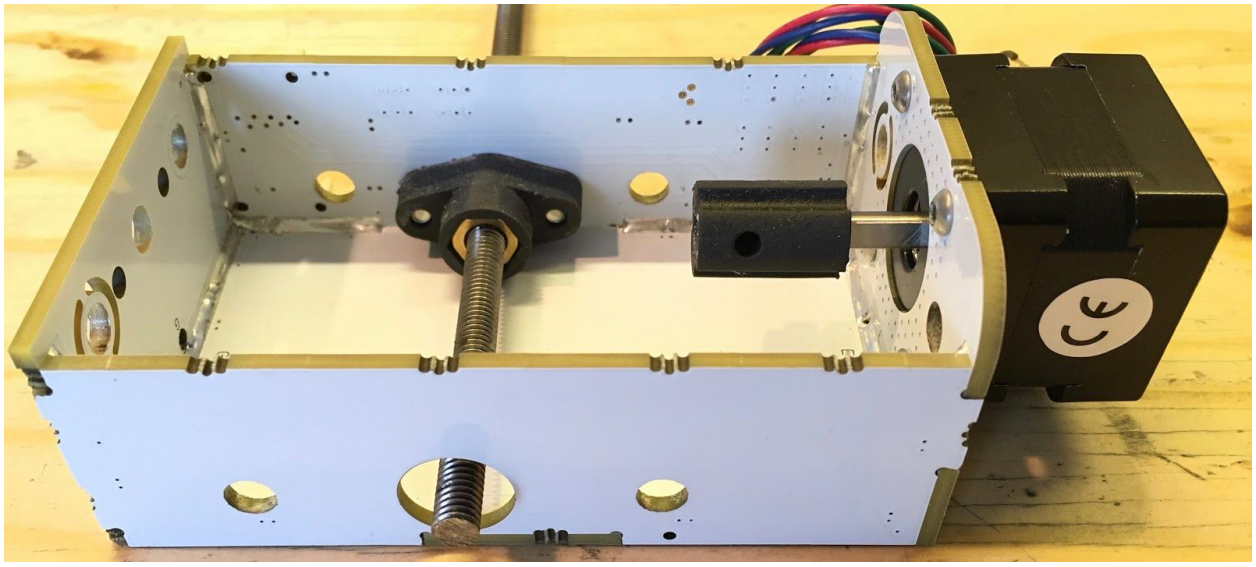
2. Install spring (P/N FM005) and second brass nut (P/N FH017) within the anti backlash housing.
3. Compress the spring between the two brass nuts so both components are inside the anti backlash housing and thread the shortest M6 threaded rod through the components. See image below. **Note, only one side of every threaded rod will be ground in a way that allows the rod to be threaded. Find this side before making the assembly.**



Next, install a single magnet (P/N FH014) into the small hole **located on the left hand side of the previous photo**. **Make sure the magnet is flush to the outside wall.**

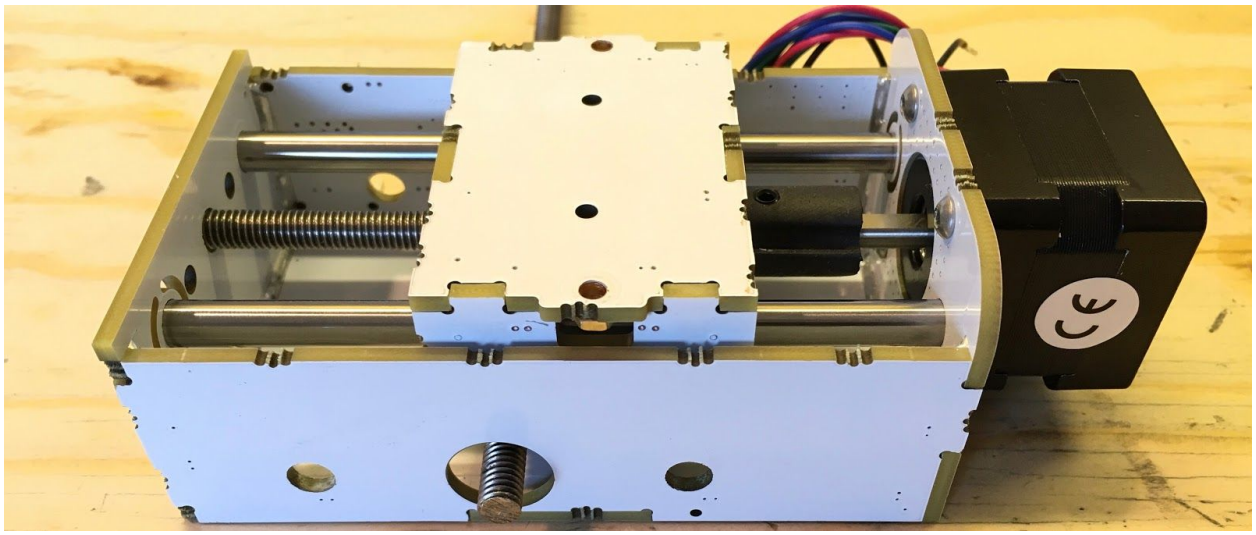
Then install a second magnet into the hole nearest the letter “G” located on the bottom of the x assembly. Again, **Make sure the magnet is flush to the outside wall.**

Next, install a second anti backlash assembly and a linear motor assembly within the X assembly. Mount the motor assembly using 4 M3x6 screws (P/N FH003). Make sure motor wires exit the motor on the electrical connector side of the X assembly. See following image.



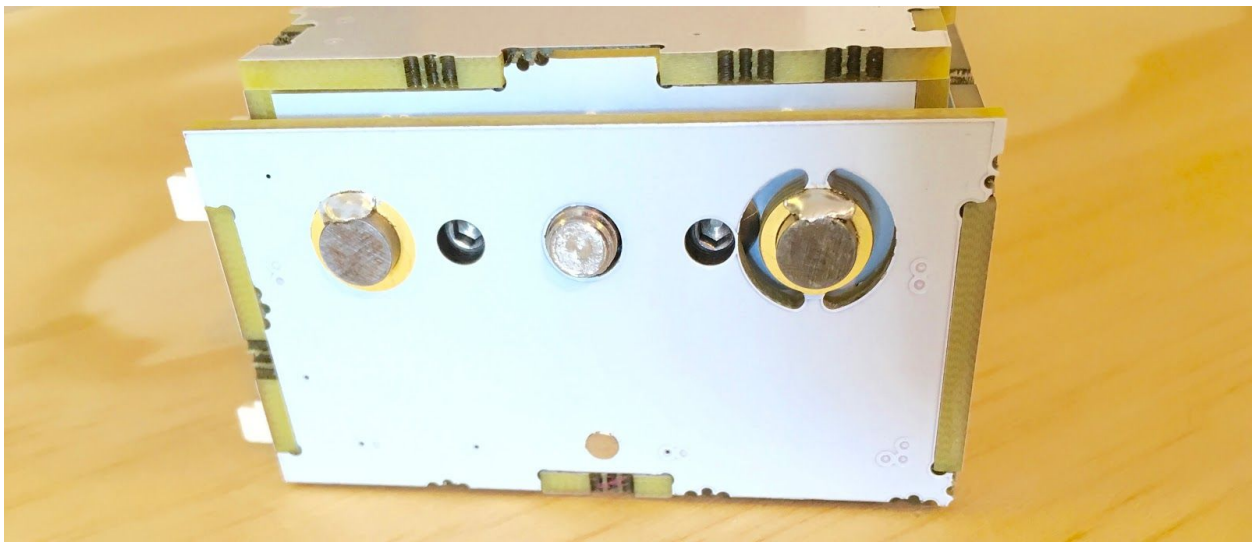
Next, install the Z assembly using the two shortest linear guides (P/N FB001). Then connect the Z axis linear motor to the Z axis lead screw by screwing the lead screw into Z motor

connector. Tighten the single M4x6 set screw down onto the lead screw to secure the connection. Be cautious not to over tighten. If needed, a flat spot can be made on the lead screw for a better setscrew grip. If the setscrew should strip the threads from the motor/lead screw coupling, thin quick dry glue can be added to the assembly for a permanent lock. See following image.

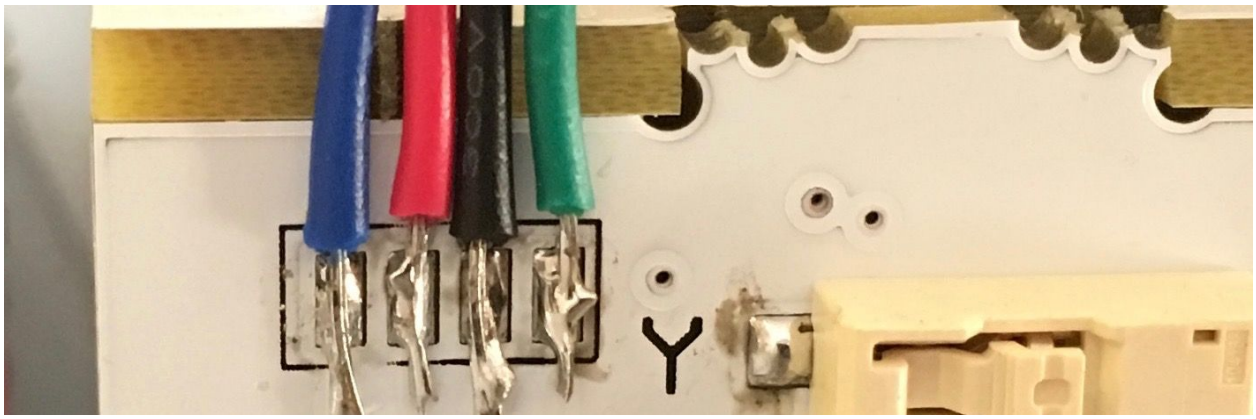


Hand rotate the screw assembly to check for binding of the assembly over the length of the travel. If any binding occurs, adjust the assembly until the problem is fixed.

To secure the rods in place, use a small bead of solder to create a solder joint between linear guide rods and the X assembly. Be sure the internal assembly is at the limit of its travel or closest to the location of the solder. This will ensure smooth motion of the internal assembly. See following image.



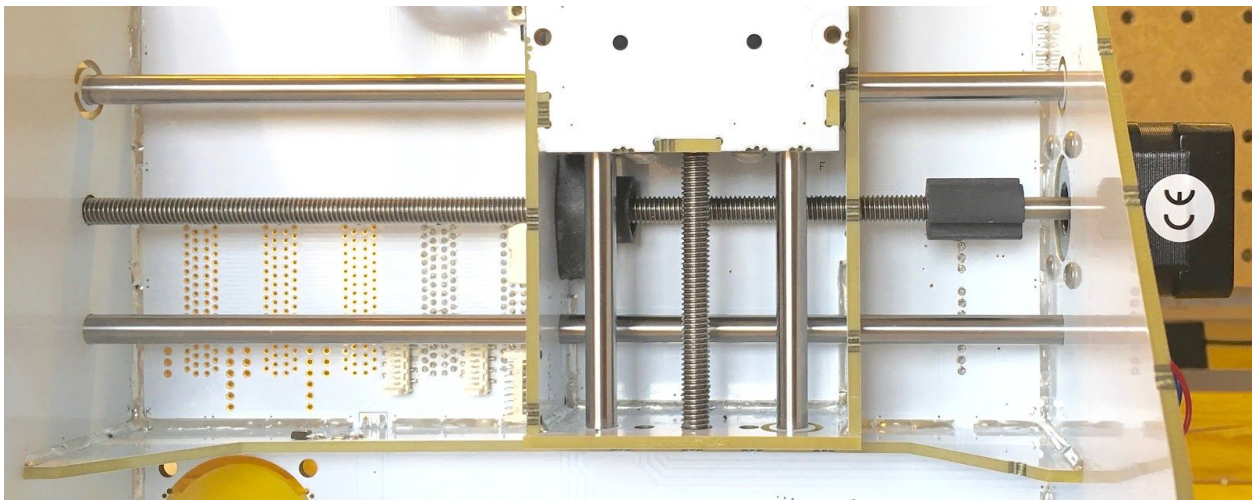
Last, shorten the leads of the z motor to an appropriate length. When finished solder wires to the corresponding pads on the side of the X assembly. See the following image.



Final Assembly 2: X and Main Assembly

Install the X assembly into the main assembly using the two longest linear guides (P/N FB003).

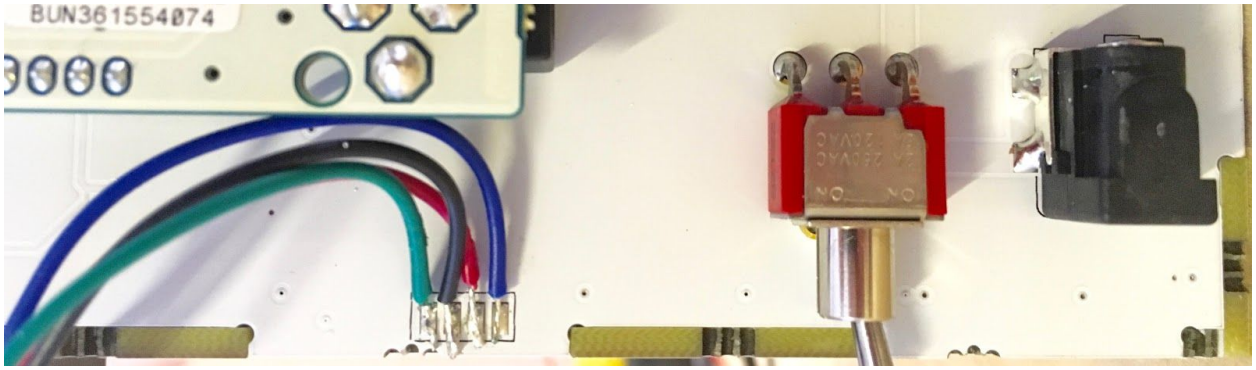
Next, install the X linear motor into the main assembly using 4 M3x6 screws(P/N FH003). Be sure motor leads exit the motor towards the back of the machine. Then connect the X axis linear motor to the X axis lead screw. Tighten the single M4x6 setscrew down onto the lead screw to secure the connection. Be cautious not to over tighten. If needed, a flat spot can be made on the lead screw for a better setscrew grip. If the setscrew should strip the threads from the motor / lead screw coupling, thin quick dry glue can be added to the assembly for a permanent lock. See following image.



Hand rotate the screw assembly to check for binding of the assembly over the length of the travel. If any binding occurs, adjust the assembly until the problem is fixed.

To secure the rods in place, use a small bead of solder to create a solder joint between linear guide rods and the main assembly. Be sure the internal assembly is at the limit of its travel or closest to the location of the solder. This will ensure smooth motion of the internal assembly. Both the left and right sides of the linear guides should receive a solder bead on the outside of the main assembly.

Last, shorten the leads of the X motor to an appropriate length. When finished solder wires to the corresponding pads on the side of the main assembly. See the following image.



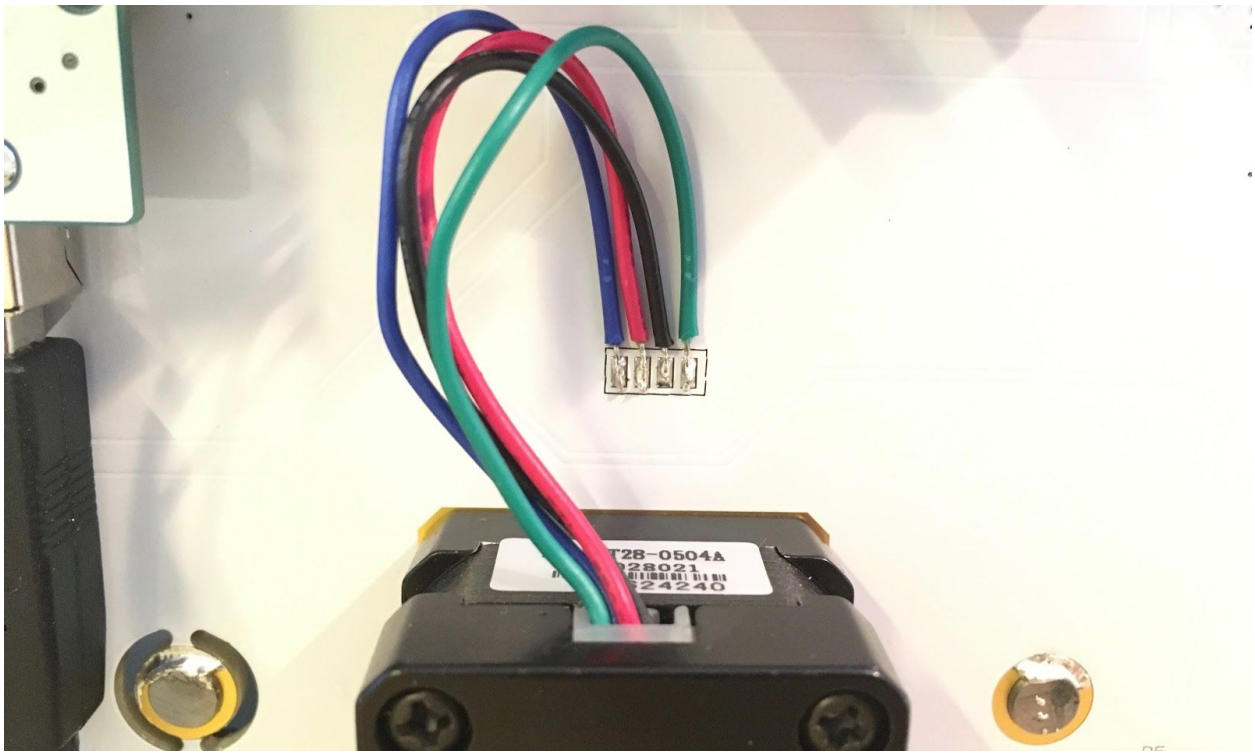
Final Assembly 3: Table and Main Assembly

First, install a magnet into the small hole located on the side of the Y or table assembly. This magnet can be towards the inside or outside of the assembly.

Next, install the table assembly into the main assembly using the two remaining linear guides (P/N FB002).

Next, install the Y linear motor into the main assembly using 4 M3x6 screws(P/N FH003). Be sure motor leads exit the motor towards the card edge connectors directly above the motor. Then connect the Y axis linear motor to the Y axis lead screw. Note that the anti backlash nut mounts to the center support of the table assembly. The components should be mounted to the side opposite that of the M4 brass nuts. Tighten the single M4x6 setscrew down onto the lead screw to secure the connection. Be cautious not to over tighten. If needed, a flat spot can be made on the lead screw for a

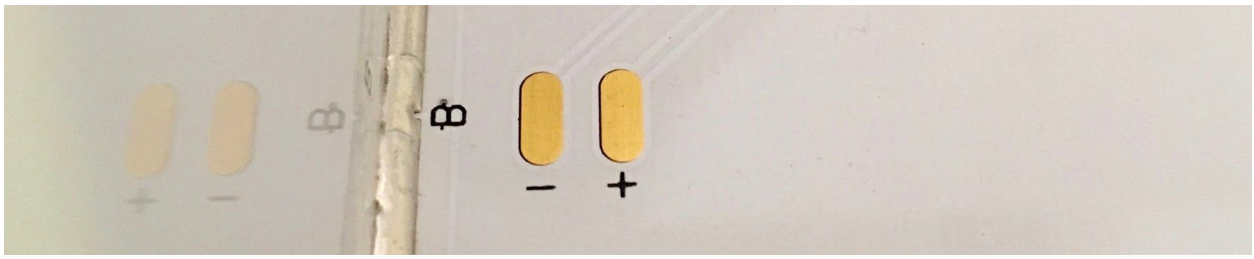
better setscrew grip. If the setscrew should strip the threads from the motor / lead screw coupling, thin quick dry glue can be added to the assembly for a permanent lock.



Hand rotate the screw assembly to check for binding of the assembly over the length of the travel. If any binding occurs, adjust the assembly until the problem is fixed.

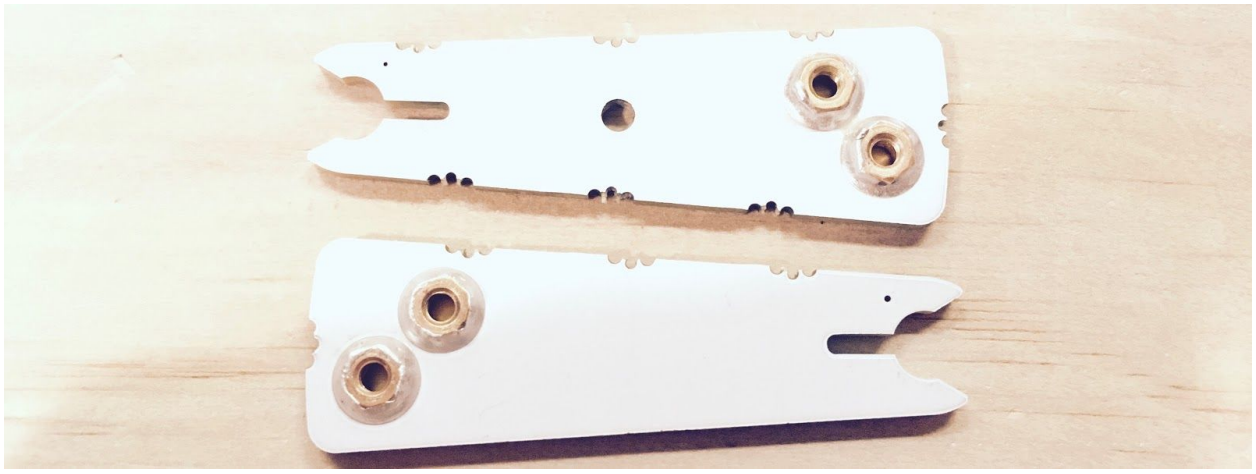
To secure the rods in place, use a small bead of solder to create a solder joint between linear guide rods and the main assembly. Be sure the internal assembly is at the limit of its travel or closest to the location of the solder. This will ensure smooth motion of the internal assembly. Both the front and back sides of the linear guides should receive a solder bead on the outside of the main assembly. Then solder the Y motor leads as seen in the previous photo

When finished, attach the red and black leads of the table assembly to the solder pads provided for the probe pad. See following photo.

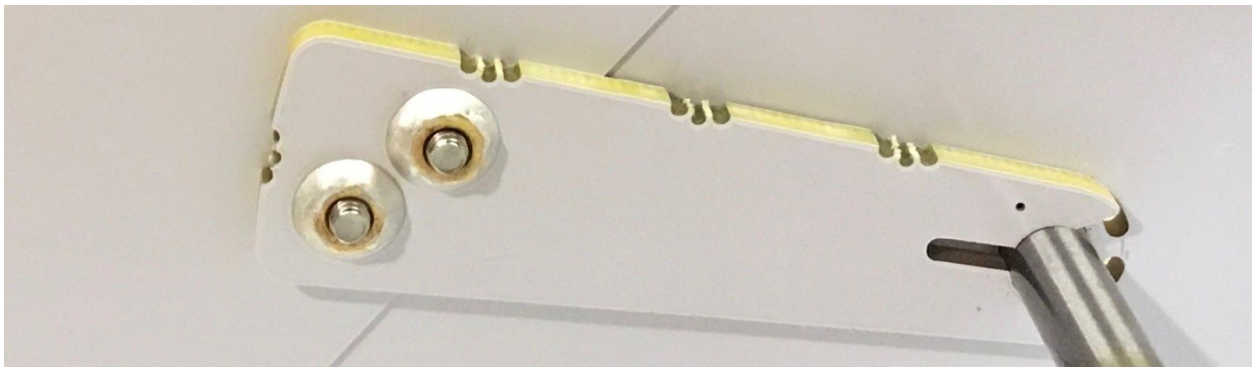


Final Assembly 4: Lid and Main Assembly

The FR4 lid assembly mounts to the upper linear guide rail of the X assembly using two hinge pieces. See following photo for hinges. Each hinge has a specific side and orientation. The top hinge should be mounted on the right side of the machine or X motor side. Each hinge should have the brass nuts facing each other. Before installing the first hinge, install a single magnet (P/N FH014) into the small hole between the linear guide rod seat and hex nuts. Install the magnet so it is flush with the side opposite that of the brass nuts.



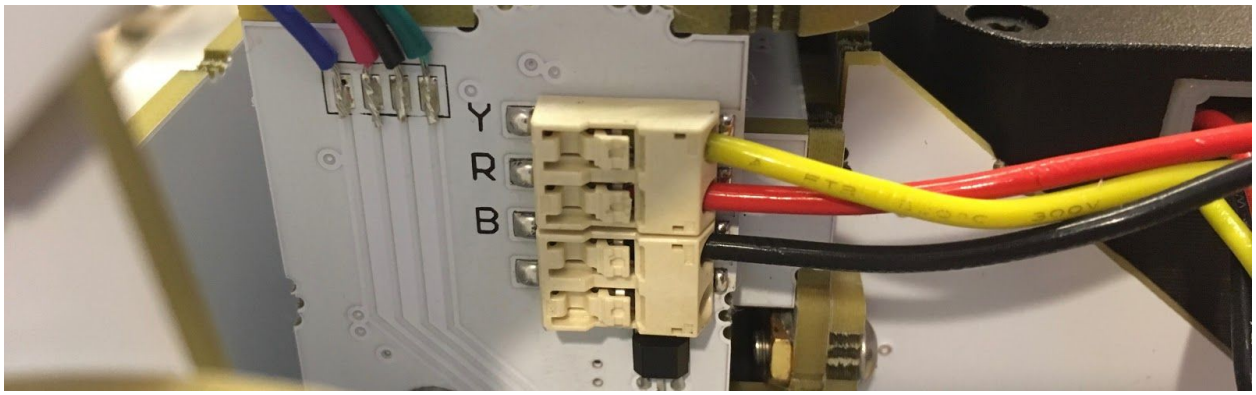
Snap hinges onto the linear guide rods, magnet hinge to the right and remaining hinge to the left. Then fasten the lid assembly to the hinges using 4 M3x8 screws (P/N FH002).



Final Assembly 5: Electronics Installation

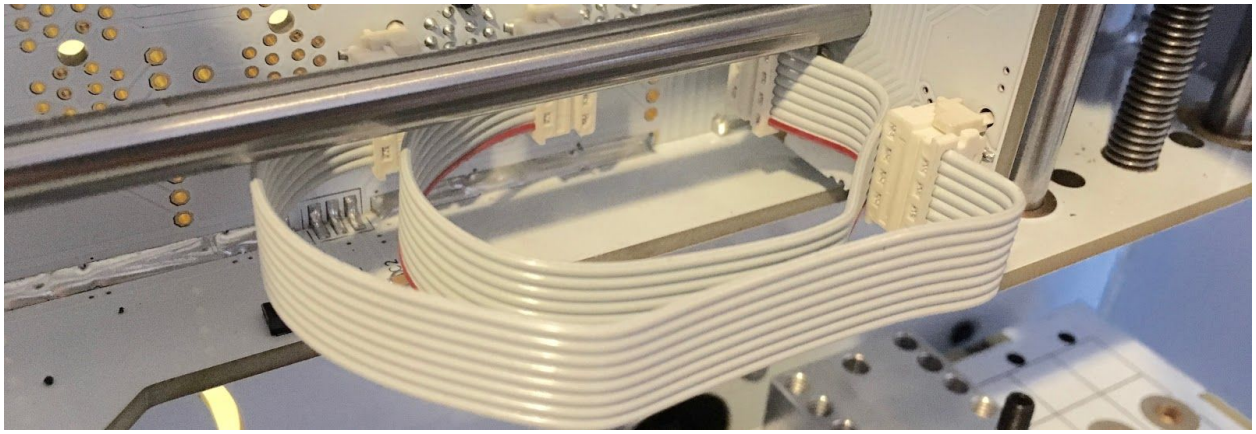
First, mount the spindle assembly onto the Z assembly using 2 M3x8 screws (P/N FH002). Each screw is located to the right and left of the spindle motor.

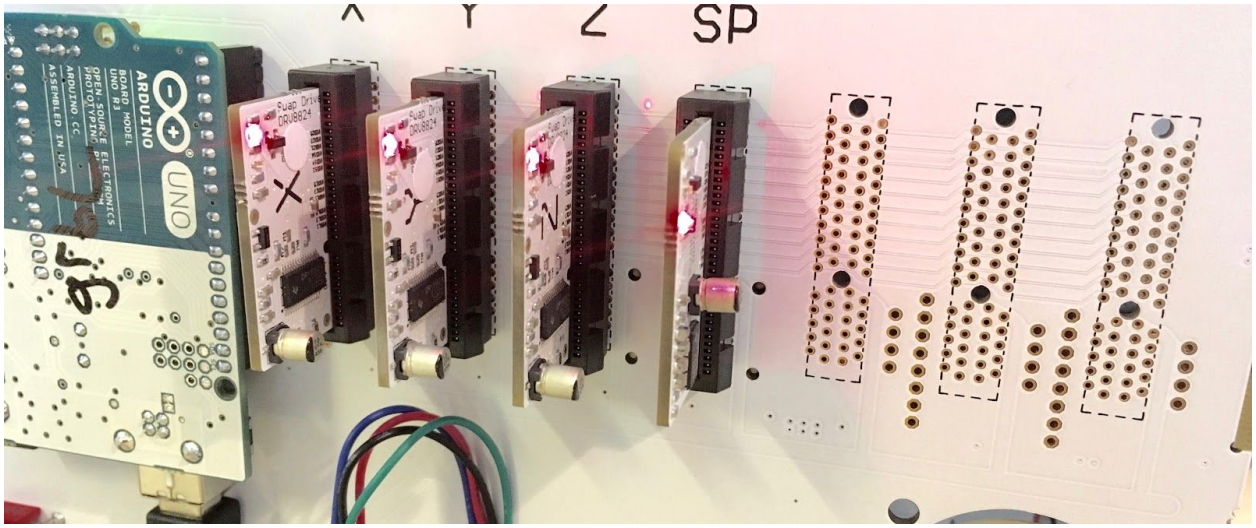
Next, install 3 spindle motor leads into the spindle motor connectors located on the X assembly. Note that a small bit of wire shielding has been partially separated and must be fully removed to expose wire before plugging into the connector. See following photo.



Next, install the 4 motor drivers into the corresponding connectors. These are marked X, Y, Z, and SP. The spindle motor swap drive is not marked with the letters SP. Last, install the Arduino Uno provided with your kit. If an arduino was not purchased with the FR4 kit, one will need to be programmed with the correct grbl settings before using on the machine. See http://www.pocketnc.com/fr4-resources for details.

The X assembly is connected to the main assembly via two ribbon cables. Each cable has two polarized ends and connects near the bottom left side of the X assembly and center of the main assembly. The ribbon cables are most easily installed with the X assembly to the right or nearest the X motor. **Note that each ribbon cable may differ in color and may or may not have a red wire. This wire does not designate top and bottom of the cable.** See the following photo.





Finished!

At this point your FR4 Machine Shield should be complete and ready for tinkering. It may be a good idea to check the machine for shorts before connecting to a computer. This can be done by plugging the Arduino into a usb wall plug.

Visit http://www.pocketnc.com/fr4-resources for further instructions to guide you in getting started with your FR4 Machine Shield.

For troubleshooting help, tips and tricks, see the FR4 Google Group (link at bottom) or contact info@pocketnc.com