

Model AR2 Assembly Manual

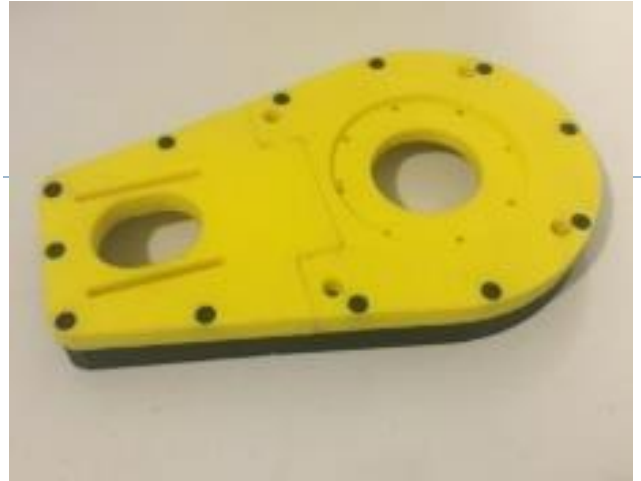
MECHANICAL UNIT ASSEMBLY

NOTE:

Currently the primary differences between the aluminum version and the printed version are as follows:

- The aluminum version uses precision series motors for J1, J2 and J3:
 - J1 = SKU: 17HS15-1684S-HG5
 - J2 = SKU: 23HS22-2804S-HG50
 - J3 = SKU: 17HS15-1684S-HG50(the printed version uses economy series motors as shown in the bill of materials)
- The aluminum version uses different motor mounts for J1 & J3.
- The aluminum version uses a different spindle and tension plate for J2.
 - The spindle and plate for the aluminum (precision motors) have a 14mm bore.
 - The spindle and plate for the printed (economy motors) have a 12mm bore.
- The aluminum version uses a slightly different motor support for J2.
 - The bore for the aluminum version is 1mm larger, has a split in the ring for clamping onto the motor body and it does not have the extension and hole for the spring dampener.
- The aluminum version does not use the spring dampener components.
- The aluminum version uses DM542T and DM320T digital stepper drivers.
 - The printed version uses analog ST6600 drivers.
- The aluminum version uses only the chain drive for J3.
- The aluminum version uses the wiring harness as outlined in the wiring harness manual on the project page.

The aluminum and printed version can be constructed either way – (using precision or economy motors). Both sets of models (.step files for the aluminum version and the .stl files for the printed version) are included in both sets of models to accommodate the differences listed above. The files for use with the precision series motors have the suffix “- precision GB”. In the next few months I will be creating a new manual showing the robots construction using aluminum components and the precision gearboxes. At that time I will archive the current manual replacing it with the new manual and obsolete the current instructions using the economy components. The design going forward will be using only the precision series motors and the digital drivers as these are far superior for a relatively minor increase in cost. The current manual can be used for constructing the aluminum version given the changes outlined above.



Epoxy J1 base plate sections 1 & 2 together. Place on wax paper on a flat surface while epoxy is curing.

Use (12) 4mm x 20 flat head screws to attach J1 base plate to both sections of the J1 support spacer.



Epoxy J1 alignment plug into J1 spindle as shown. Leave plug protruding 3mm to 4mm. This plug serves to keep the driven timing pulley on center.

Install (2) #32009 bearing races into the J1 turret housing as shown (one in the top and one in the bottom).



Install #32009 bearings on J1 spindle.



Place the J1 spindle and bearing into the bottom of the J1 housing.



Flip the housing assembly over and place the 2nd #32009 bearing over the other side of the spindle as shown.



Install (2) #30206 bearing races into the J2 turret housing as shown.



Attach the J2 turret housing to the J1 platform using (6) M6 x 18 flat head screws.



Install (2) M6 x 14 socket head screws in front of J2 turret housing going into the J1 platform.



Use an abrasive cut off disc and cut (1) M8 x 25 square head set screw down to 20mm total length.



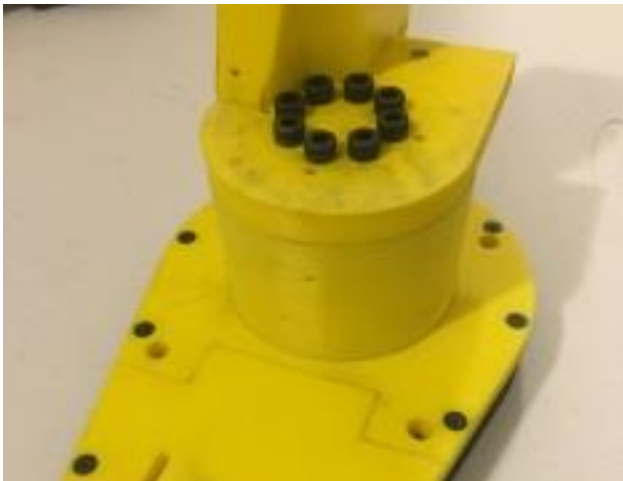
Install M8 square head screw in J1 baseplate as shown. Square head should be tangent to J1 rotation (the head is the contact for the J1 limit switch).



Install platform assembly onto J1 spindle assembly and secure with (8) M6 X 14 socket head cap screws.



Install (4) M4 x 10 set screws in the 4 perimeter holes in the platform. These place tension on the upper bearing. Snug the 4 set screws down evenly until there is no play in the bearings.



Install the J1 assembly onto the base assembly as shown. Make sure the flat surface with 2 holes is facing toward the back.



Secure J1 assembly from the bottom using (8) M4 X 10 socket head cap screws.



Install the J1 driven sprocket onto the J1 spindle and secure with (4) M6 x 14 socket head cap screws.



Install **17HS19-1684S-PG5** gear drive motor into J1 motor mount and secure with (4) M4 X 10 set screws.



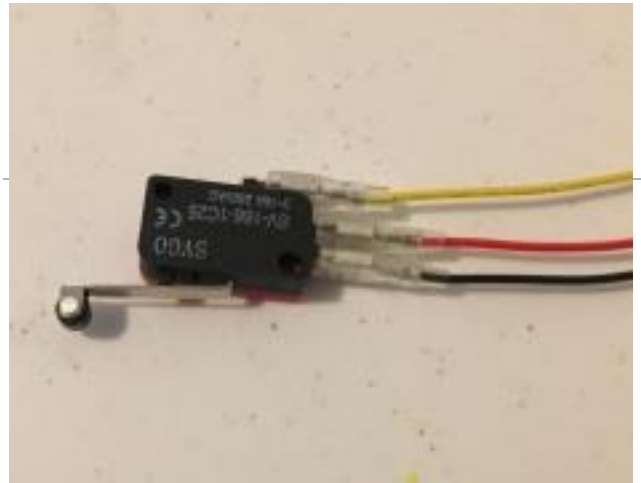
Install XL15 tooth – 8mm bore drive sprocket on J1 gear motor.



Install motor assembly onto base and secure with (4) 4mm X 20 socket head cap screws and (4) 4mm washers.



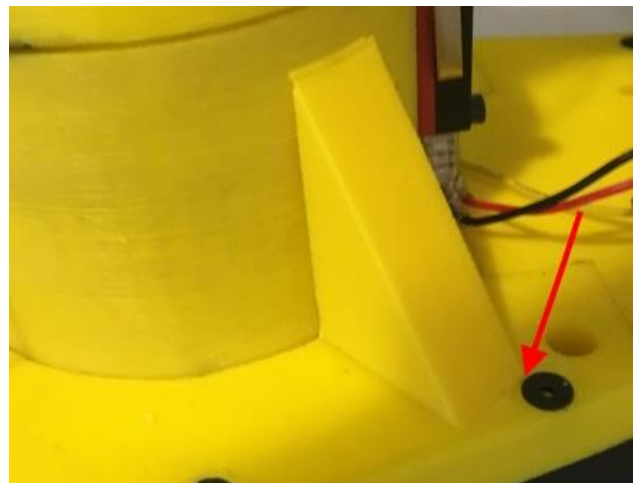
Install 180XL37 timing belt, set tension and tighten motor mount screws.



Connect a black, red, and yellow 22awg with .187" quick disconnect wire to limit switch as shown.

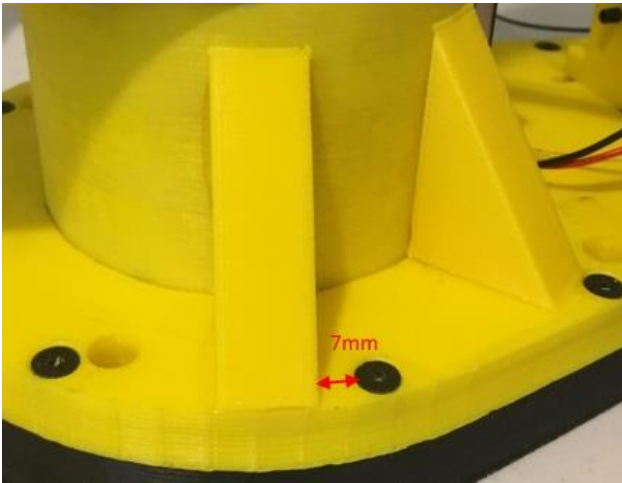


Mount limit switch to J1 housing using M3 X 14 socket head cap screw.

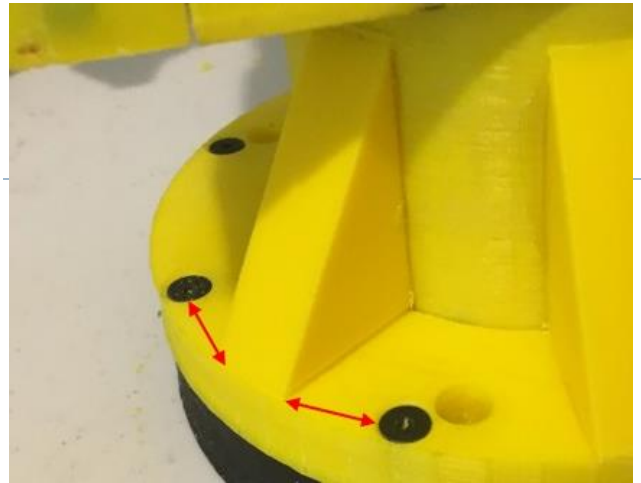


Use epoxy to glue the 1st of 6 support braces on left side of base with corner aligned with screw head as shown.

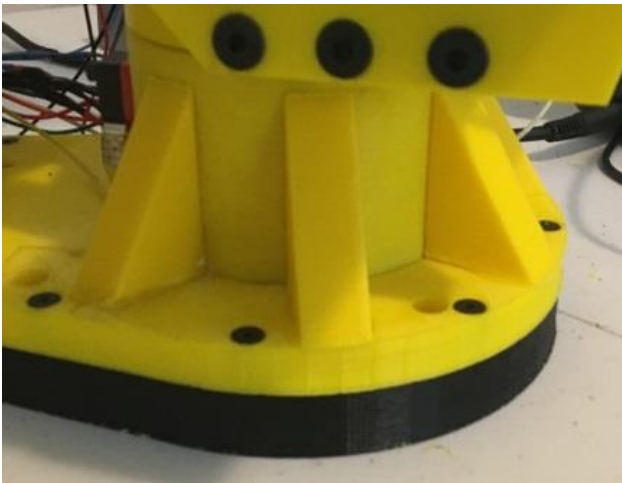
Note: support braces are not required for aluminum robot.



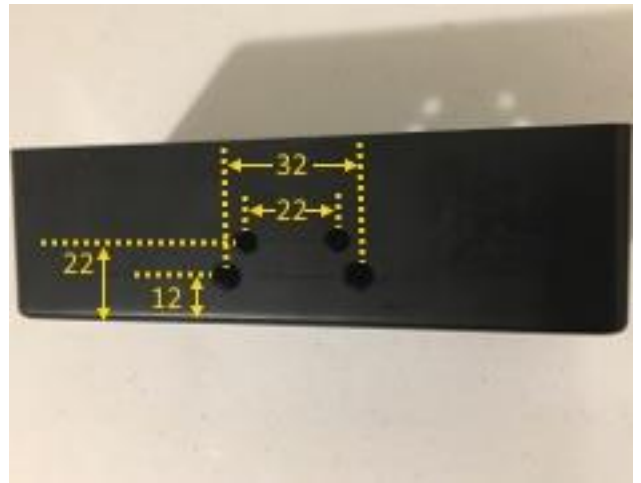
Epoxy 2nd support brace in place 7mm from the next screw head.



Epoxy 3rd support brace centered between next pair of screw heads.



Epoxy the 4th 5th and 6th support braces on opposite side mirror image to the first side.



Drill (2) 8mm holes 12mm from bottom 32mm apart.

Drill (2) 6mm holes 22mm from bottom 22mm apart

In 6" x 3" plastic enclosure as shown.



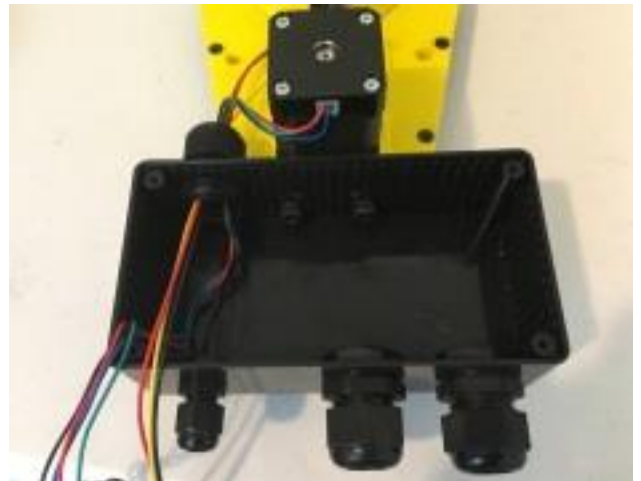
Using a stepped bit drill (1) 7/8" hole to the right of the 4 smaller holes as shown.



On opposite side of enclosure use a stepped bit to drill (2) 7/8" holes to the right side and (1) 1/2" hole on the left as shown.



Install (3) PG13 gland nuts into the 7/8" holes and install (1) PG7 gland nut into the 1/2" hole.



Secure enclosure to J1 motor mount using (2) 6mm X 14 socket head cap screws. The pull J1 motor and limit switch wires through front gland nut.



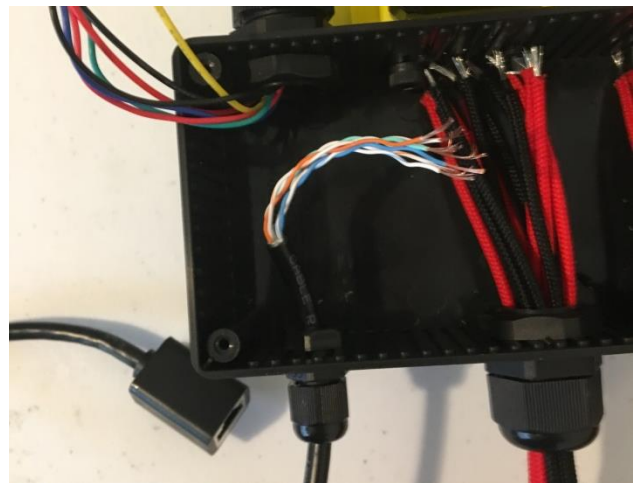
Cut the male connector off of one ATX 24 pin extension cable and then strip $\frac{1}{4}$ " of sheathing off the end of each wire.



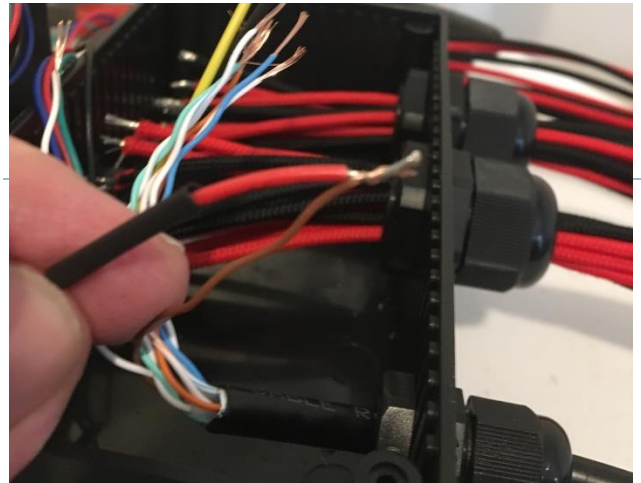
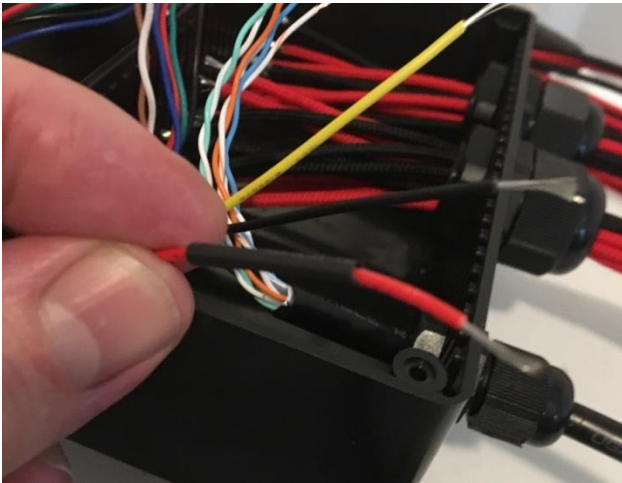
Insert 12 wires from the left side and 12 wires from the right side of the ATX 24 pin extension into the left and right PG13 gland nuts respectively.



Cut the male connector off of one RJ45 extension cable, strip back 2" of the outer black sheathing and then strip $\frac{1}{4}$ " of sheathing off the end of each wire.



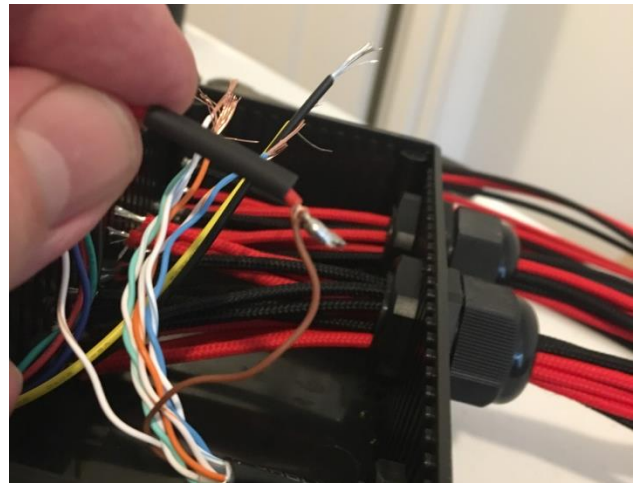
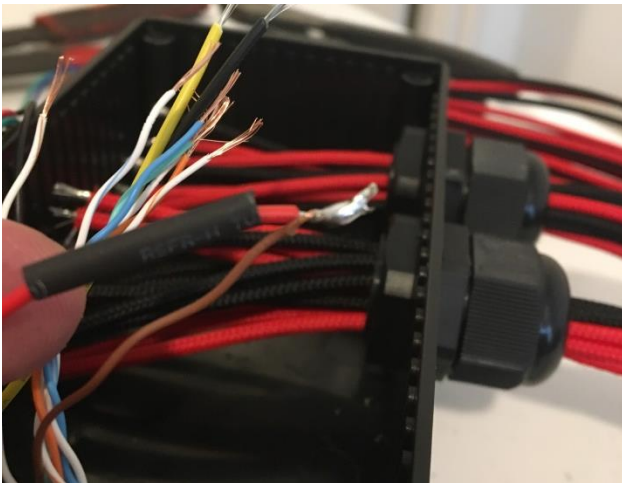
Insert the RJ45 extension cable into the PG7 gland nut as shown.



(The next 5 steps will outline connecting wires using solder and heat shrink tubing)

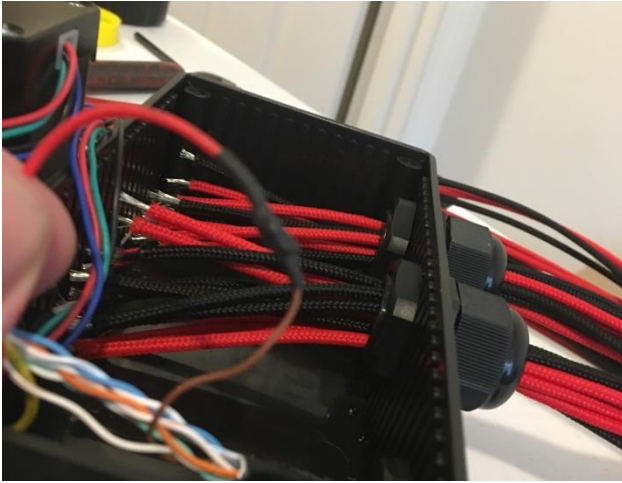
We will start with the red wire from the J1 limit switch going to the brown wire on the RJ45 cable - Slip a piece of heat shrink tubing over the red wire.

Twist the ends of the red wire from the J1 limit switch to the brown wire from the RJ45 cable.

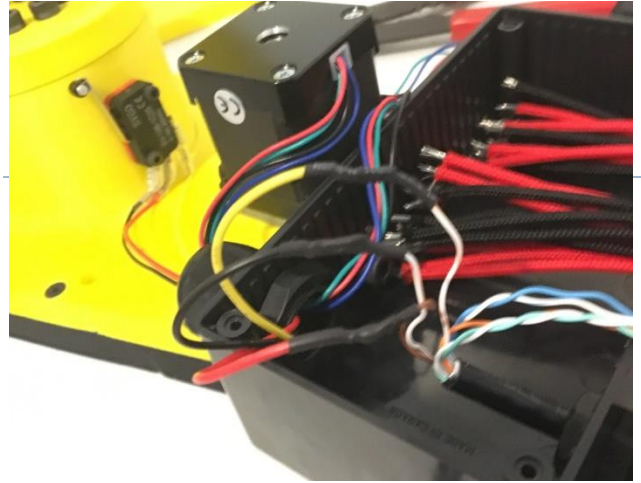


Use a soldering iron and rosin core silver bearing solder to solder the wires together.

Bend the brown wire away from the solder joint as shown.

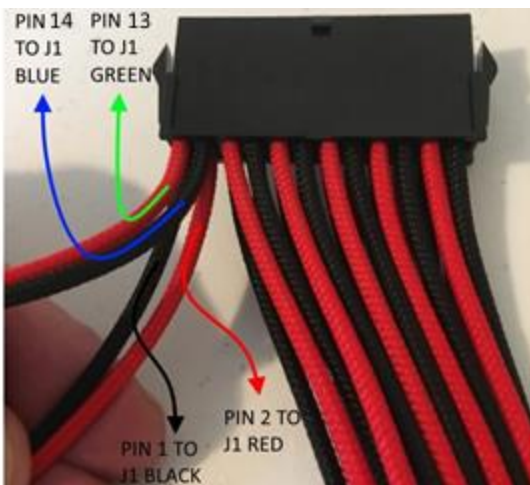


Pull the heat shrink tube down over the solder joint and then use a heat gun or soft flame to shrink the tube over the joint. *(future steps in this manual will not go into detail on soldering but will only state to solder and heat shrink over the connection).*



Use solder and shrink tubing to connect the J1 limit switch black to the white/brown stripe on RJ45. Connect the J1 limit switch yellow to the white/orange stripe on the RJ45.

(Also refer to the RJ45 pinout diagram and the limit switch schematic).



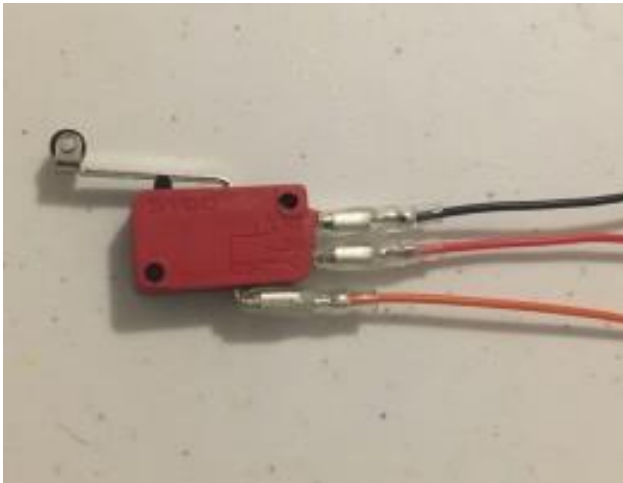
The next step is to connect the (4) J1 motor wires to the correct wires on the ATX cable. You will need to trace the wires from the back of the connector and find the end inside the enclosure.

(Also refer to the ATX pinout diagram and the stepper motor wiring schematic)



Solder and heat shrink the following connections:

- ATX pin 1 to J1 black
- ATX pin 2 to J1 red
- ATX pin 13 to J1 green
- ATX pin 14 to J1 blue



Connect a black, red, and orange 22awg with .187" quick disconnect wire to limit switch as shown.



Mount limit switch to J2 housing using M3 X 14 socket head cap screw.



Install J2 spindle into J2 arm and secure using (8) M4 x 10 flat head screws. Make sure keyway is aligned up toward arm.

Note: J2 arm is printed in 2 separate components and must be epoxied together.



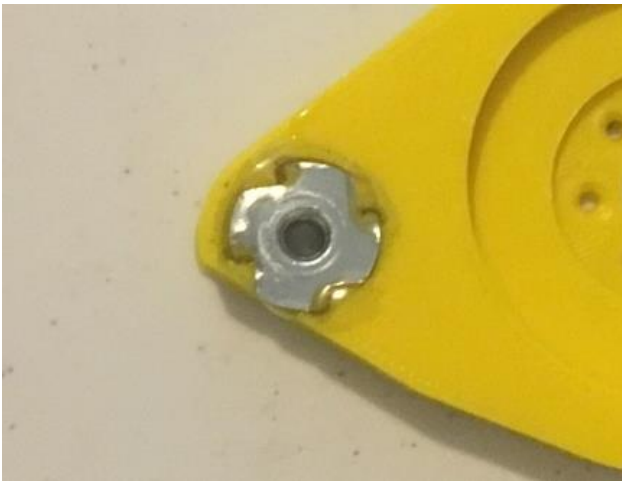
Install (1) #30206 bearing onto J2 spindle as shown.



Pre install (1) M3 x 6 set screw in J2 spindle but do not allow it to protrude into keyway yet.



Install J2 arm assembly as shown and then install the other #30206 bearing from the opposite side.



Apply a liberal amount of epoxy into end of J2 spindle retainer and Install M8 – T nut as shown.



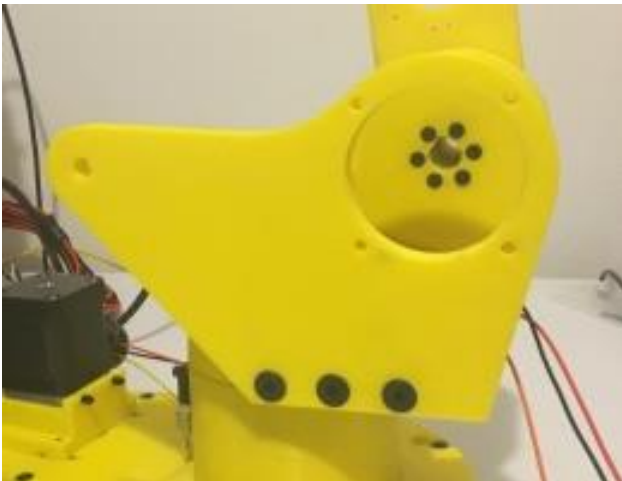
After epoxy is cured sand excess epoxy both front and back as well as the bottom to make sure all sides are flush.



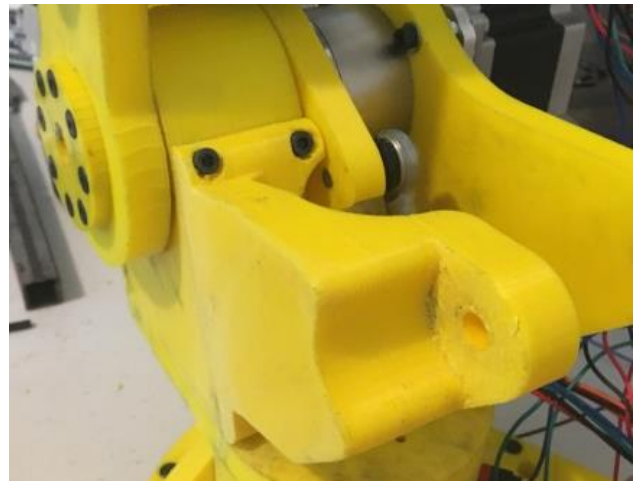
Install the J2 spindle retainer and secure with (6) M3 x 25 flat head screws. Snug screws until there is no play in J2 bearings.



Install M6 ball joint. Grind 1 to 2 threads off post - do not allow threads to extend out other side of retainer.



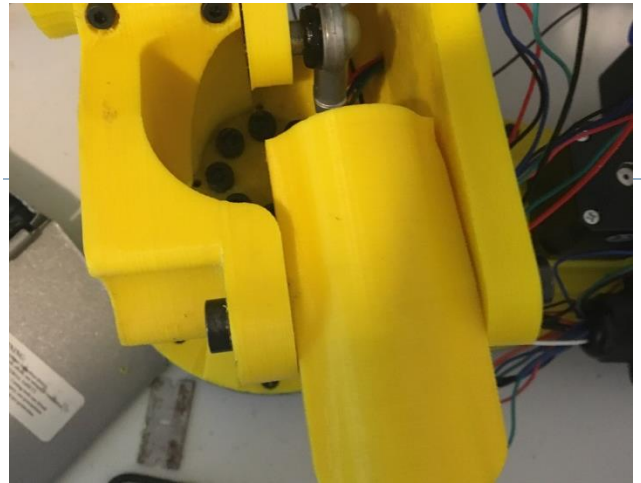
Install J2 motor support plate using (3) M6 x 18 flat head screws.



Install auxiliary spring housing support. Secure in place with (3) M4 x 10 socket head screws – in addition to screws apply epoxy between support and J2 turret housing.



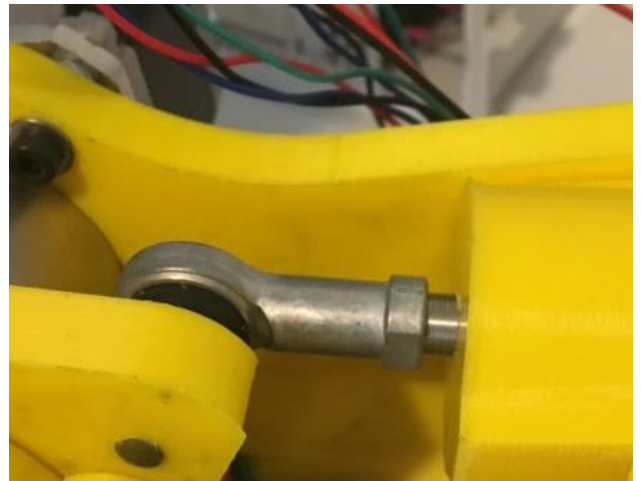
Grind 2 threads from end of M8 x 14 shoulder screws so that threads do not extend inside spring housing.



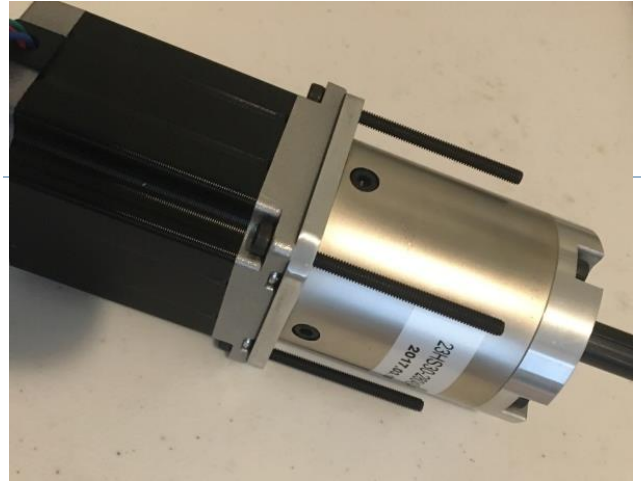
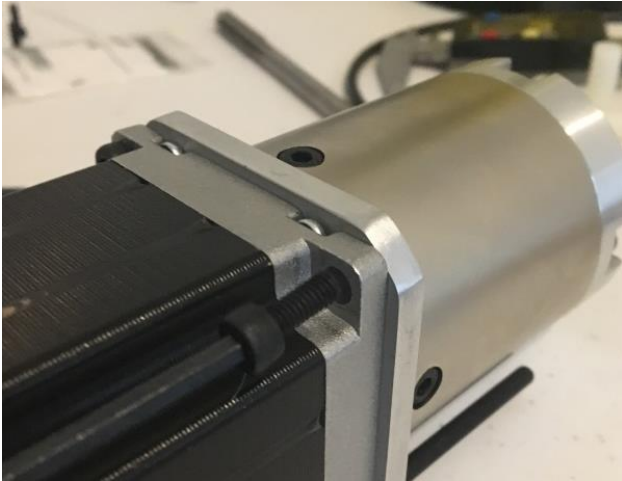
Install spring housing and secure with (2) M8 x 14 shoulder screws. Apply grease inside mounting holes – make sure spring housing rotates freely.



Install M8 x 80 shoulder screw through spring plunger then place (1) 2" x .845" x .080" spring and (1) 3" x .56" x .054" spring over shoulder screw.



Install spring assembly into spring housing and extend shoulder screw through end of spring housing and screw into the ball linkage.



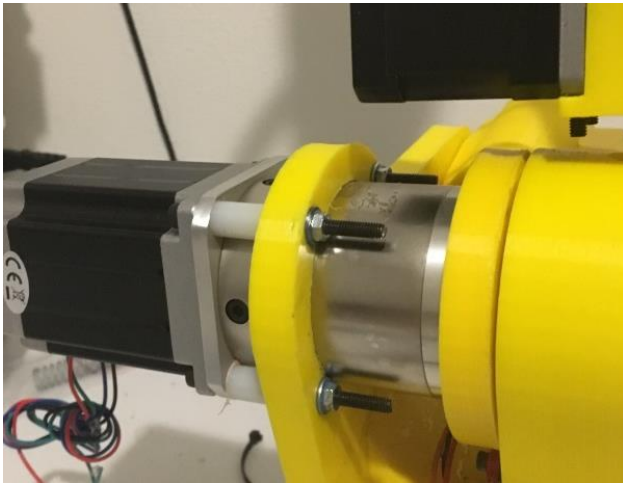
One at a time – remove factory 4mm screws from **23HS30-2804S-PG47** gear motor and replace with 55mm long fully threaded screws. *(do this for all 4 mounting holes one at a time- see next step)*

(4) 4mm x 55 socket head screws installed.



Cut (4) nylon spacers down to 15mm long.
(these are 3/8" x 3/16" x 1" spacers from the hardware store)

Install spacers as shown.



Install **23HS30-2804S-PG47** gear motor as shown and secure with (4) 4mm washers and nuts.



Make sure keyway in shaft and spindle are aligned.



Cut length of 4mm key stock down to 60mm length using abrasive saw.



Use belt sander to round the corners on one end.



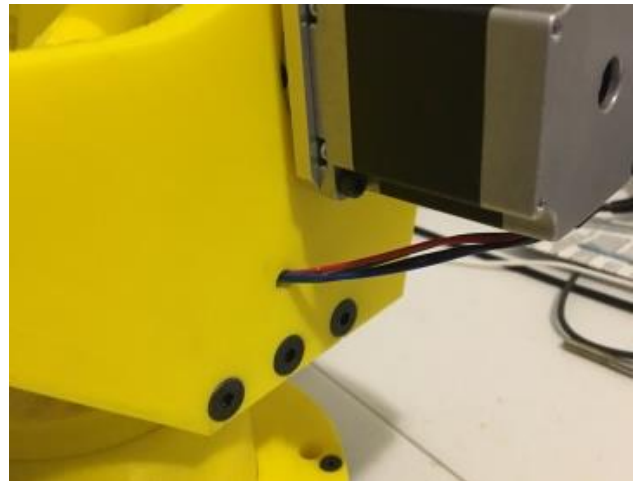
Insert 4mm key as shown with rounded end in.



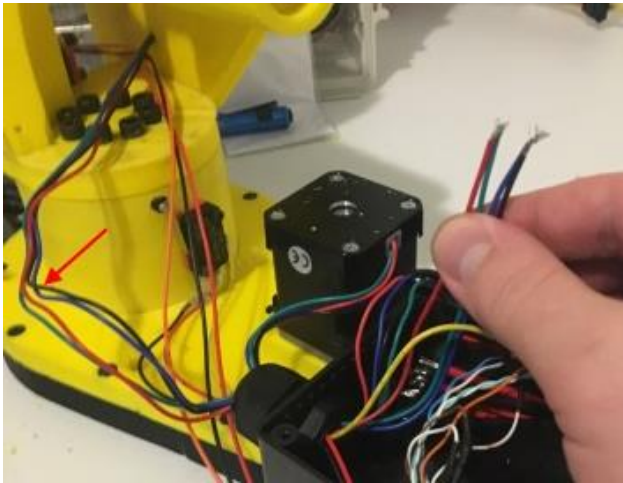
Use small hammer to lightly tap the key fully into position.



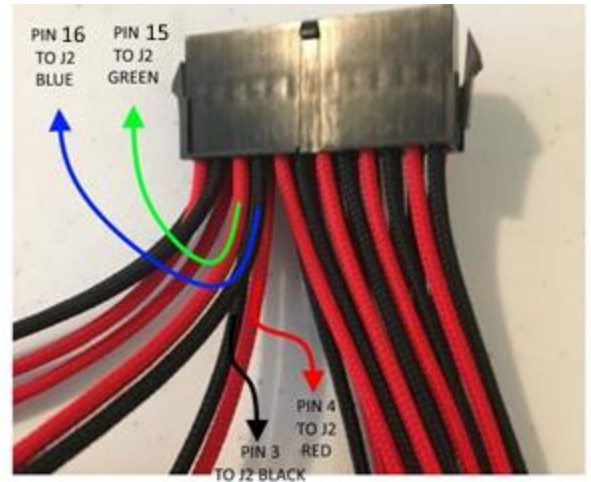
With J2 arm straight up tighten 3mm set screw onto key stock that was inserted.



Route J2 motor wires through hole in support plate as shown.

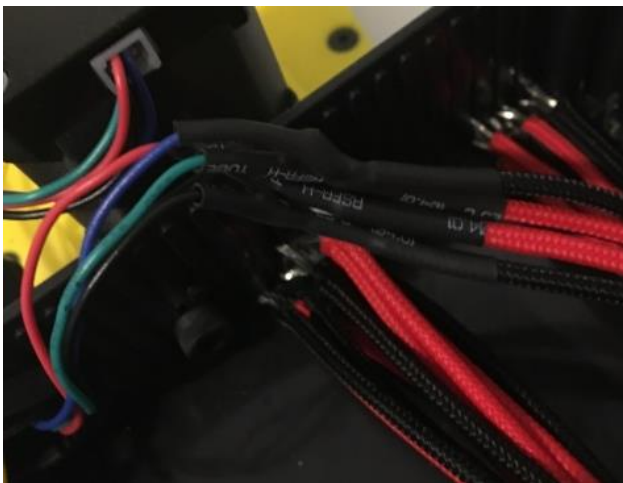


Pull the J2 wires into enclosure. Do not trim these wires they need to stay full length.



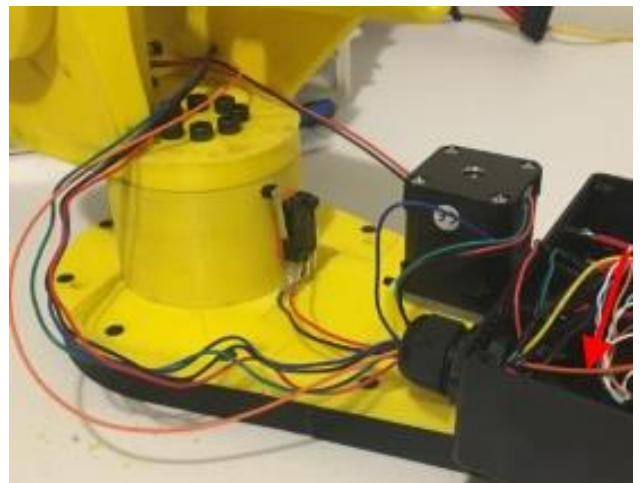
The next step is to connect the (4) J2 motor wires to the correct wires on the ATX cable. You will need to trace the wires from the back of the connector and find the end inside the enclosure.

(Also refer to the ATX pinout diagram and the stepper motor wiring schematic)

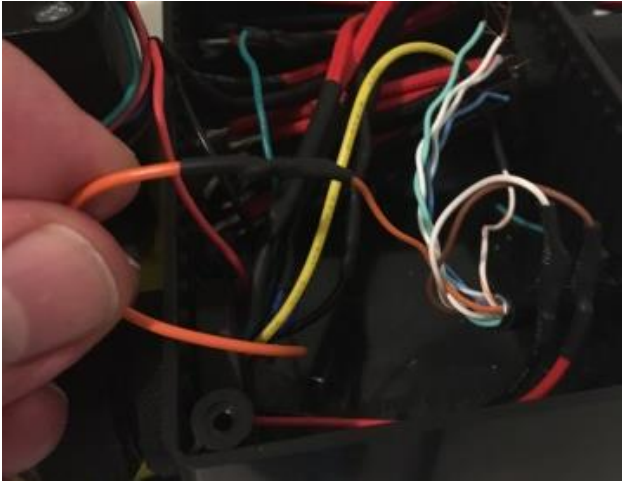


Solder and heat shrink the following connections:

- ATX pin 3 to J2 black
- ATX pin 4 to J2 red
- ATX pin 15 to J2 green
- ATX pin 16 to J2 blue



Pull the orange wire from the J2 limit switch into the enclosure. Make sure orange wire has the same amount of slack as the other J2 wires and is run along side of them. This wire loom must have enough slack for J1 to fully articulate in both directions.

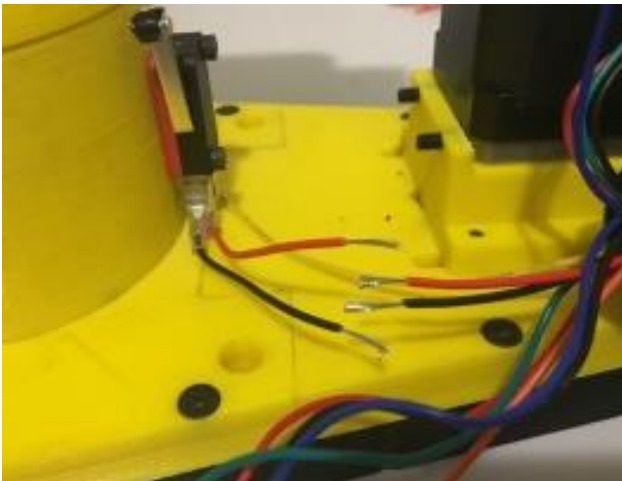


Use solder and shrink tubing to connect the J2 limit switch orange to the orange/white stripe on RJ45..

(Also refer to the RJ45 pinout diagram and the limit switch schematic).



Cut the red and black wires from the J1 limit switch as shown. *(we need to splice power from these wires to the next J2 limit switch)*



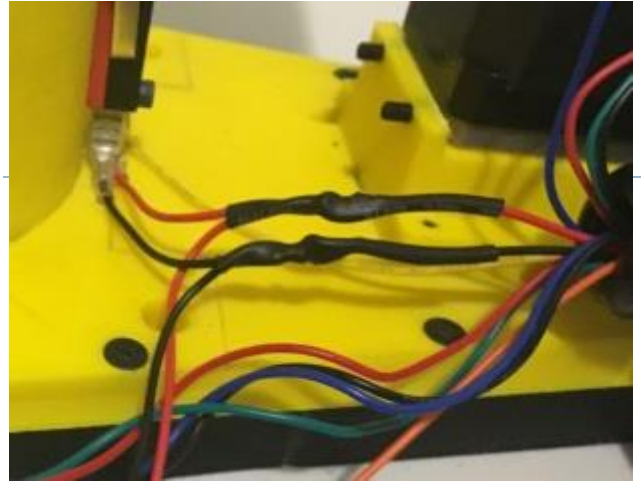
Strip ¼" of sheathing from each end of the wires you just cut.



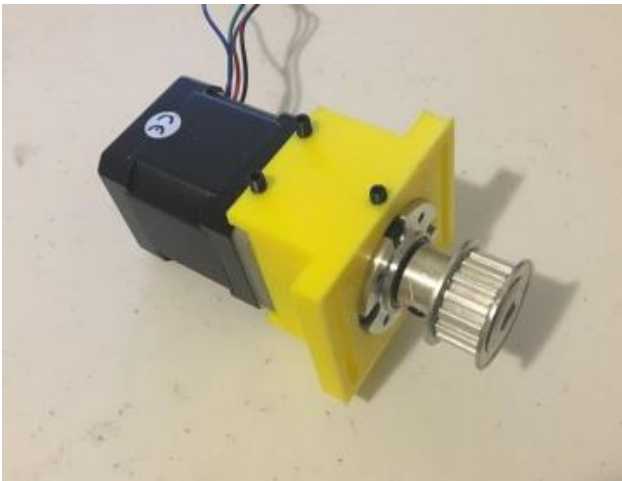
Cut and strip the red and back wires coming from the J2 limit switch. Make sure they have the same amount of slack as the other J2 wires and is run along side of them. This wire loom must have enough slack for J1 to fully articulate in both directions.



Place heat shrink tube over the red and black wires coming from the enclosure; then solder the black wires together and then the red wires together.



Pull the heat shrink tube over each of the 3 wire splices as shown and then apply heat to shrink the tube.

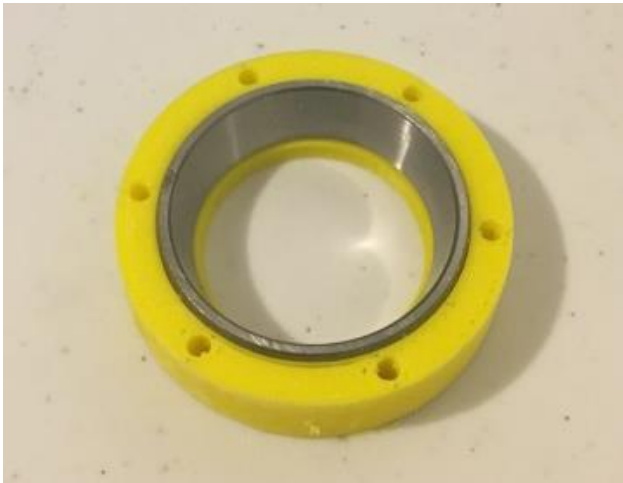


Install (1) **17HS19-1684S-PG19** geared stepper motor into J3 motor housing and secure with (6) M4 x 10 set screws. Then install (1) XL15 tooth – 8mm bore drive sprocket on motor shaft.

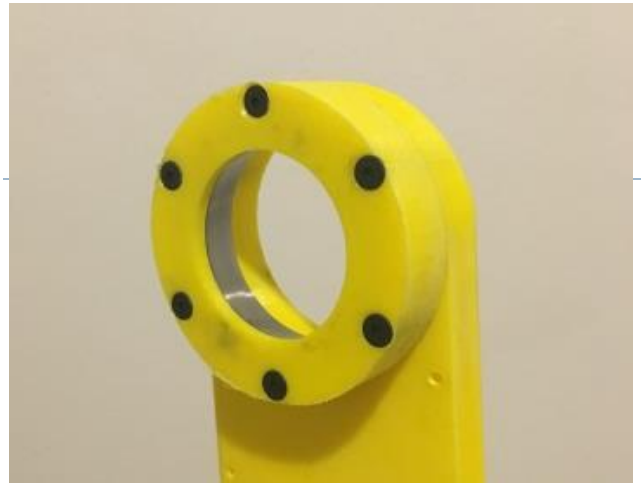
Note: there is also a chain option.



Install J3 motor assembly on J2 arm using (4) M4 x 20 socket head cap screws and (4) 4mm washers.



Install (1) #30204 bearing race into the J3 bearing cup.



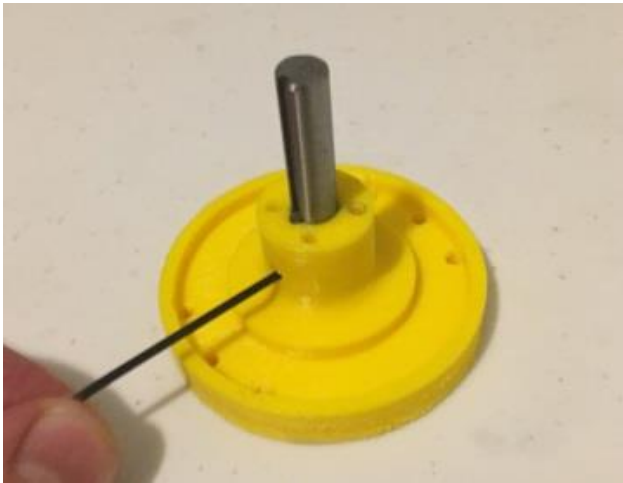
Secure J3 bearing cup and race to end of J2 arm using (6) M3 x 25 flat head screws.



Use abrasive saw to cut length of 8mm keyed shaft to 53mm long.



Use abrasive saw to cut length of 2mm keyed stock to 25mm long



Install 8mm shaft into J3 spindle. Install 2mm key stock into shaft and spindle slot and secure with 3mm x 4 set screw.



Install 35x52x4 Thrust Bearing and washers onto J3 spindle.



Install J3 spindle and shaft into J2 arm, from opposite side slide #30204 bearing onto spindle shaft and install J3 spindle retainer. Secure with (4) M3 x 10 flat head screws. Tension screws so there is no play in bearings.



Install (1) XL15 tooth – 8mm bore drive pulley on J3 spindle shaft.

NOTE: these steps utilize XL series pulleys and belt to drive J3. following this there will be an option to use a 4mm roller chain instead.



Install 210XL37 timing belt, set tension and tighten J3 motor mount screws.



The next few steps outline the option of using a chain and sprockets rather than a belt. The chain is a little more expensive options but it offers higher rigidity and is recommended.



The 13 tooth 8mm bore sprockets must be drilled and tapped to accept a 4mm set screw. Use a 3.3mm (#29) drill to drill 2 holes in each sprocket.

(holes should be 90° from each other)



Use 4mm tap to thread (2) holes in each sprocket (total 4 holes)



Install one sprocket on the J3 motor shaft.



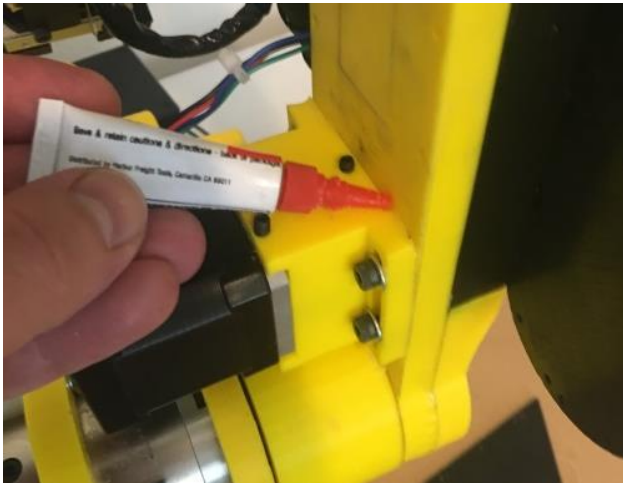
Install one sprocket on the J3 spindle shaft.



Cut length of 04B roller chain down to 20-3/4" long. It should have 43 links.



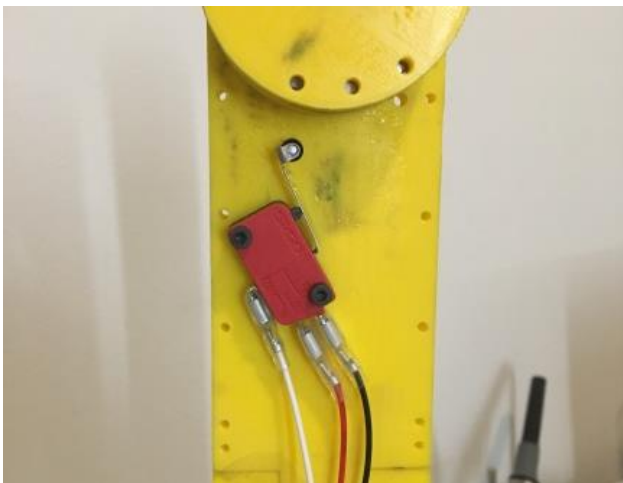
Install connecting link in length of chain and install around both sprockets. Apply grease to chain.



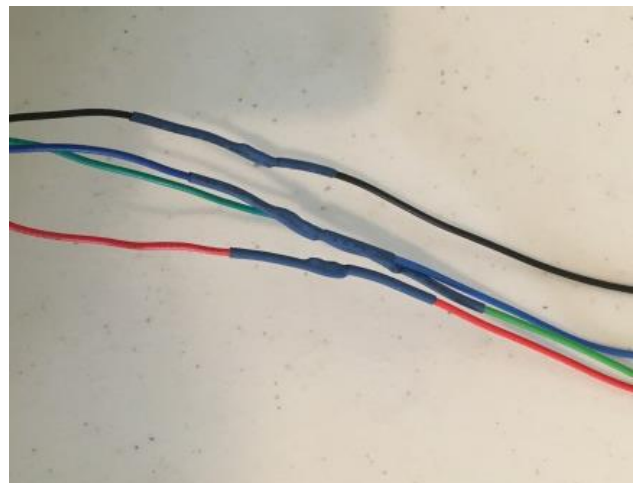
Set tension on chain as tight as possible and tighten motor mount screws. Apply small dab of super glue between mount and arm to lock in place. If mount needs removed glue can be broken with razor knife.



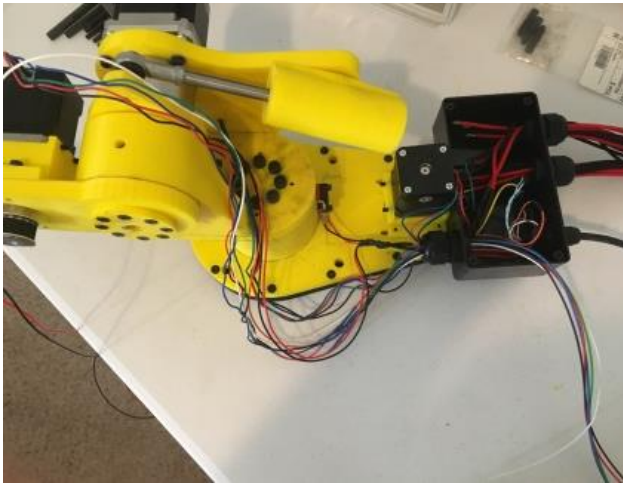
Connect a black, red, and white 22awg with .187" quick disconnect wire to limit switch as shown.



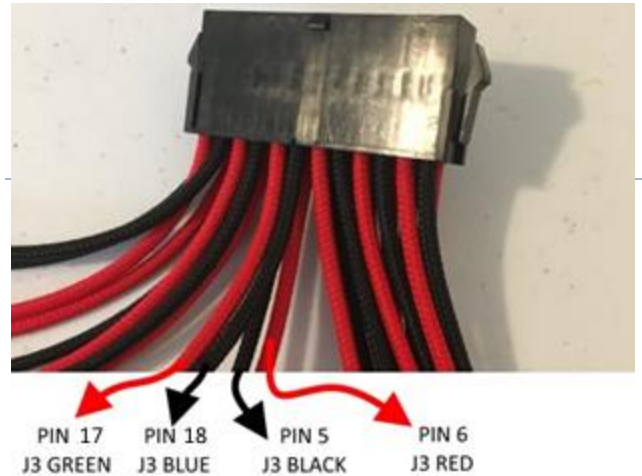
Mount limit switch to J2 arm using (2) M3 X 14 socket head cap screws.



The 4 wires from the J3 motor are not long enough, you will need to extend them. Use solder and heat shrink tube and connect each wire to a length of 22awg wire of matching color.

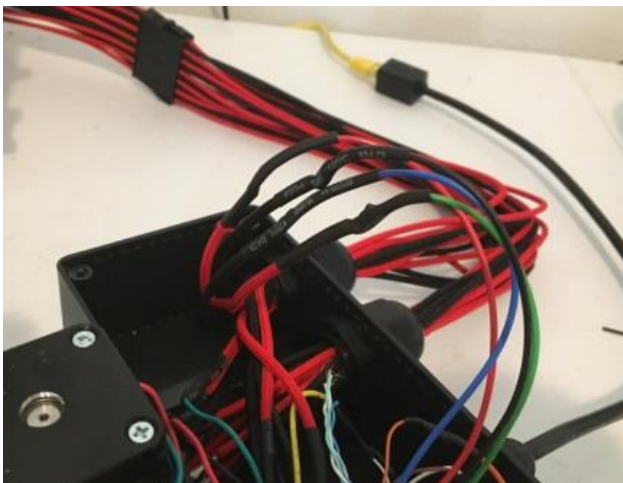


Pull the (4) extended J3 motor wires as well as the white wire from the J3 limit switch into the enclosure as shown. Make sure to leave appropriate slack shown - this wire loom must have enough slack for J1 & J2 to fully articulate in both directions.



The next step is to connect the (4) J3 motor wires to the correct wires on the ATX cable. You will need to trace the wires from the back of the connector and find the end inside the enclosure.

(Also refer to the ATX pinout diagram and the stepper motor wiring schematic at the end of this manual)



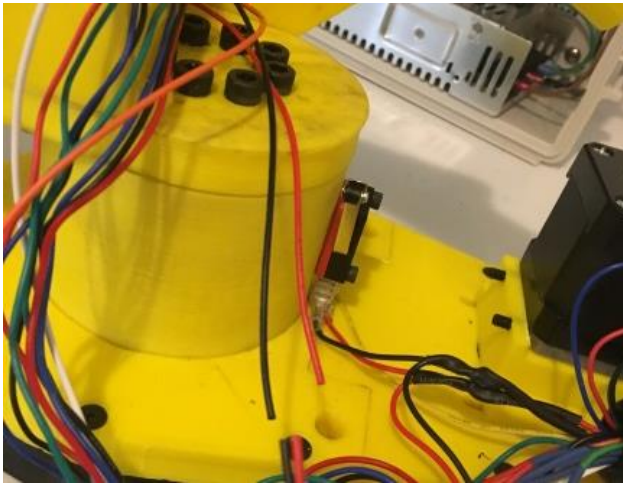
Solder and heat shrink the following connections:

- ATX pin 5 to J3 black
- ATX pin 6 to J3 red
- ATX pin 17 to J3 green
- ATX pin 18 to J3 blue

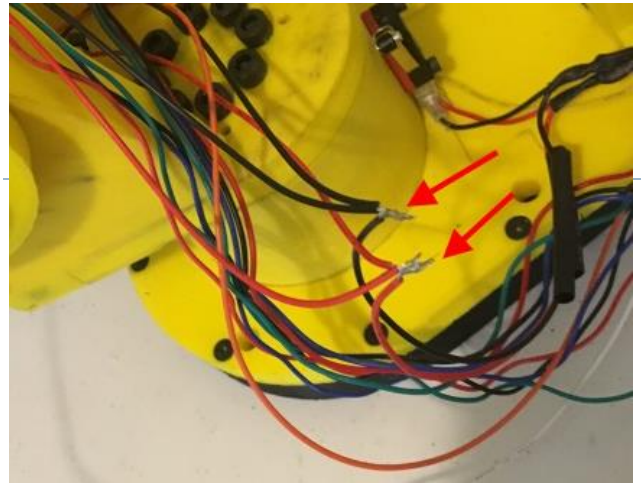


Use solder and heat shrink tube to connect the white wire from the J3 limit switch to the white/green strip wire from the RJ45 cable.

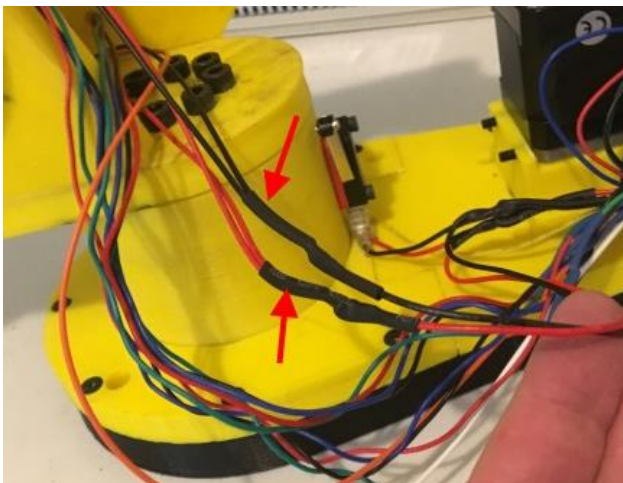
(Also refer to the wiring schematic at the end of this manual)



Cut the red and black wires coming from the J2 limit switch as shown.



Slide a length of heat shrink tube over the red and black wires you just cut coming from the enclosure, then splice these wires and the red/black wires from the J3 limit switch together so each is a 3 way splice.



Solder and heat shrink each of the new 3 way splices.

[\(Also refer to the wiring schematic\)](#)



Install (2) B-1616 (1" ID) needle roller bearings into the J3 turret housing (install one each side).



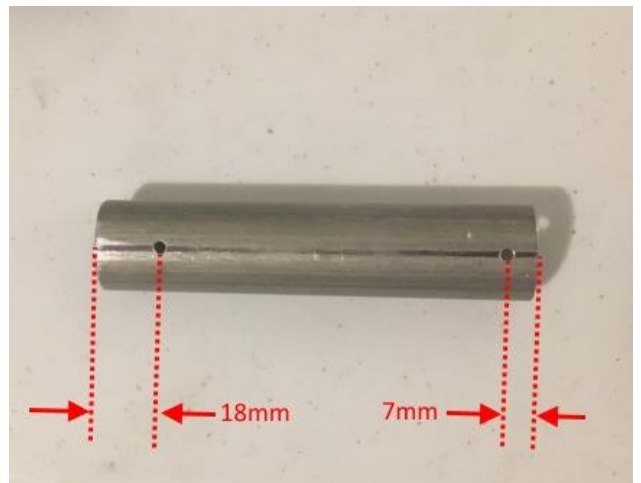
Secure turret housing to J3 spindle using
(2) M4 x 14 flat head screws (center)
And (4) M4 x 10 cap screws (outer).



Cut length of high strength aluminum
tubing down to 116mm long.



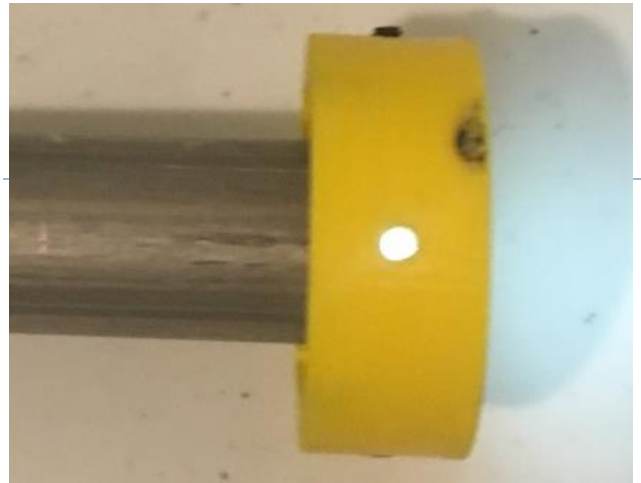
Place tubing next square tube or angle
surface to draw line down center.



Drill 3.3 mm hole 18mm from one end
and 7mm from other end. Tap both holes
to M4.



Insert aluminum tube into J5 motor mount.



Use flashlight to verify alignment of M4 hole in tubing with M4 hole in motor mount.



Install (1) M4 x 5 set screw into J5 motor housing – set screw should just start to thread into tubing. Make sure the M3 timing lug is opposite M4 set screw.



Secure J5 linear screw motor #17LS19-1684E-200G to J5 motor mount using (4) M3 x 14 socket head cap screws. Install (1) M3 x 6 socket head cap screw into motor housing. Note: this screw serves as a timing lug – it is located opposite the holes in the aluminum tube and is referenced in the previous step.



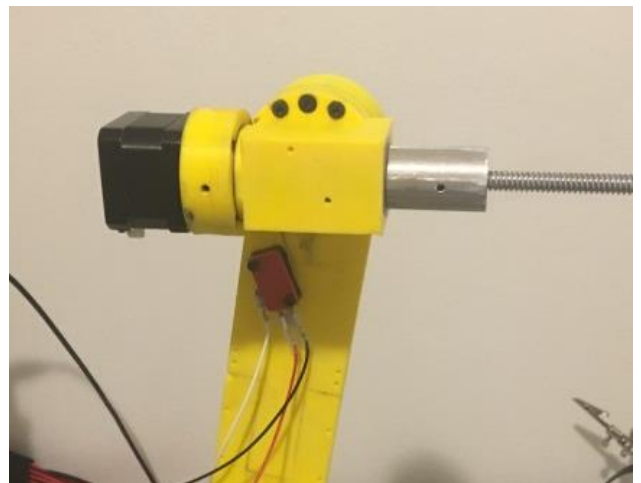
Install (1) .032" bearing washer over tube and into motor mount as shown.



Install (1) 1" ID needle bearing over tube and into motor mount as shown.



Install (1) .032" bearing washer over tube and on top of needle bearing as shown.



Insert J5 Motor shaft assembly into J3 turret housing as shown.



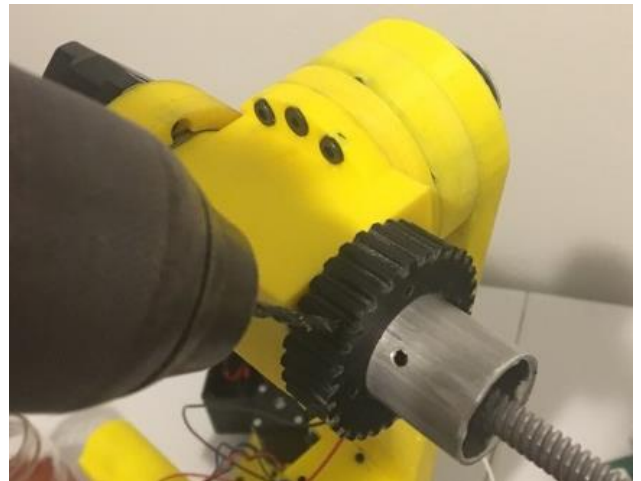
Install (1) .032" bearing washer over tube as shown.



Install (1) 1" ID needle bearing over tube and onto .032" bearing washer as shown.



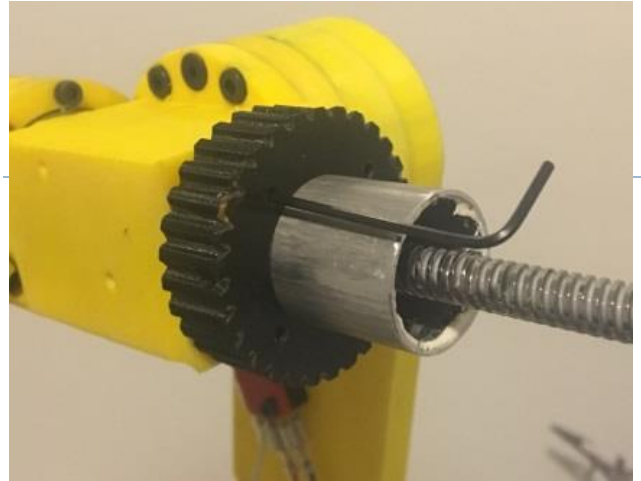
Install (1) .126" thick bearing washer over thrust bearing as shown.



Install J4 driven pulley with recessed side over thrust bearing/washers. Make sure it is seated firmly and then use 3mm drill to mark tubing. Remove pulley then drill and tap marked position on tube for M4. Do this on both sides of pulley then reinstall pulley.



Install (2) M4 x 6 set screws (opposite sides where holes were drilled/tapped – make sure set screws partially start to thread into tube locking the pulley in place.



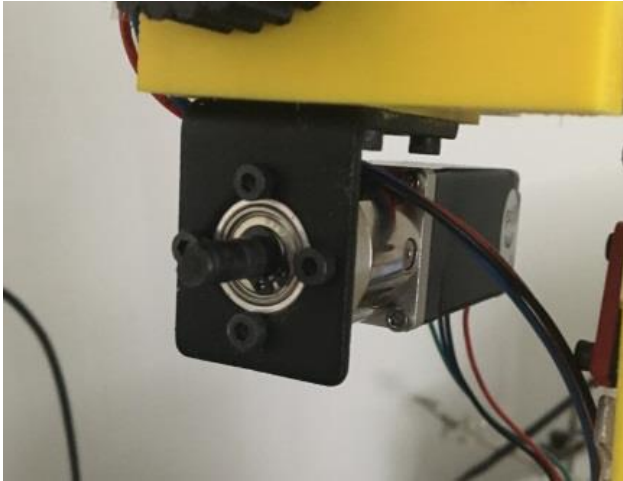
Install (4) M3 x 10 set screws into face of pulley and then snug until there is no play in J4 thrust bearings.



Install J4 motor mount / limit switch contact block as shown and secure with (3) M4 x 10 socket head cap screws.

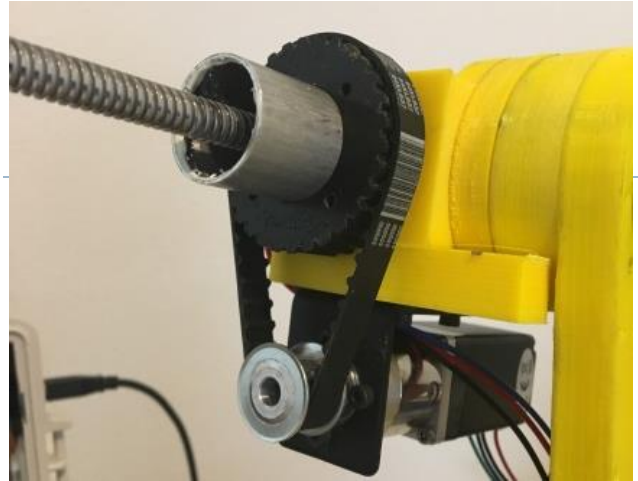


Install Nema 11 motor mount bracket and secure with (4) M3 x 14 socket head cap screws.

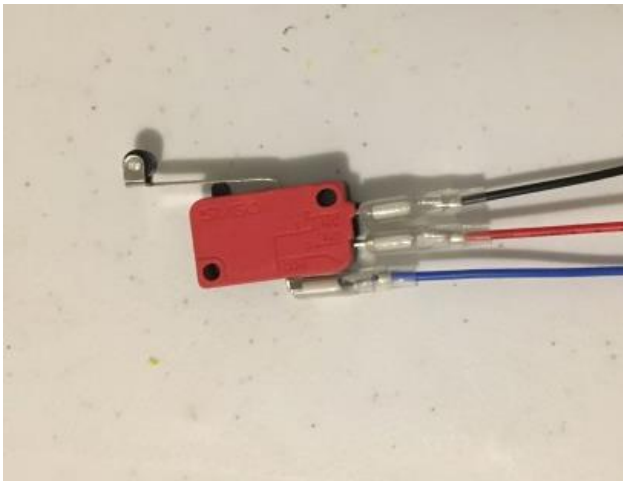


Install **11HS20-0674S-PG5**

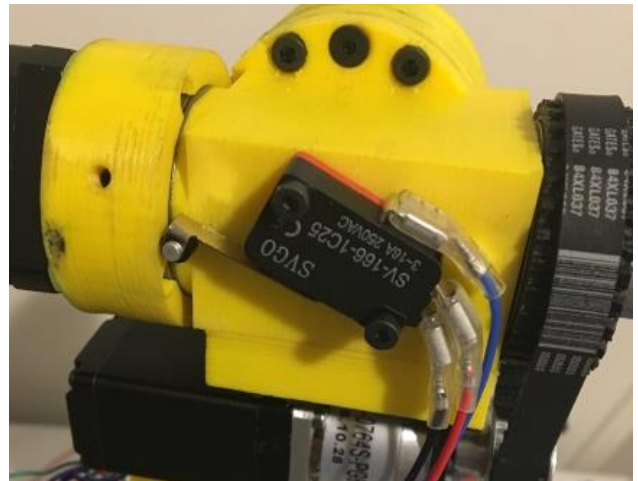
Geared stepper motor into bracket and secure with (4) M3 x 8 socket head cap screws.



Slide XL 10 tooth 6mm bore drive pulley onto motor shaft along with 84XL037 Gates timing belt simultaneously over J4 driven sprocket. Tighten drive pulley set screw.

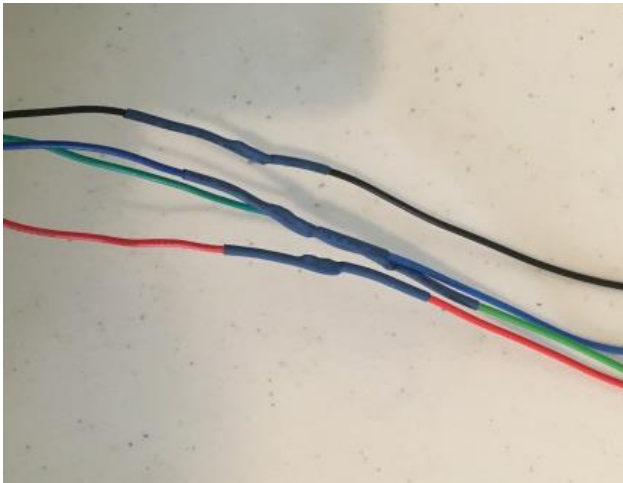


Connect a black, red, and blue 22awg with .187" quick disconnect wire to limit switch as shown.

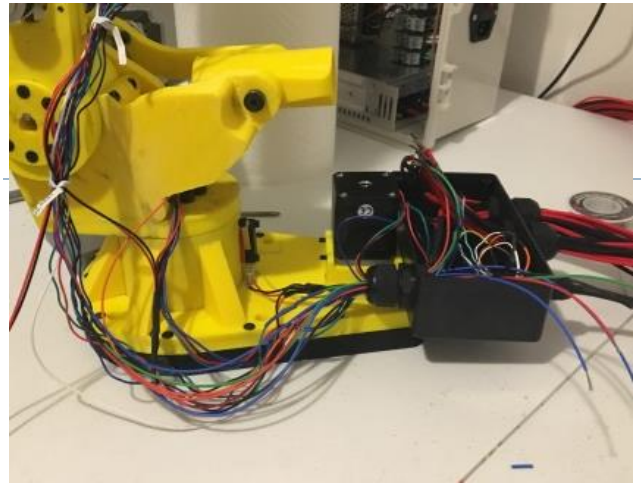


Secure limit switch to J3 turret housing using (2) M3 x 14 socket head cap screws.

(note the lower screw will need to be ground slightly shorter as this is a very shallow hole – be careful not to strip out hole when assembling ABS robot, use small amount of epoxy on end of screw and allow to cure in place if you have issues)



The 4 wires from the J4 motor are not long enough, you will need to extend them. Use solder and heat shrink tube and connect each wire to a length of 22awg wire of matching color.



Pull the (4) extended J4 motor wires as well as the blue wire from the J4 limit switch into the enclosure as shown. Make sure to leave appropriate slack - this wire loom must have enough slack for J1, J2 and J3 to fully articulate in all directions.



PIN 19
TO
J4 GREEN

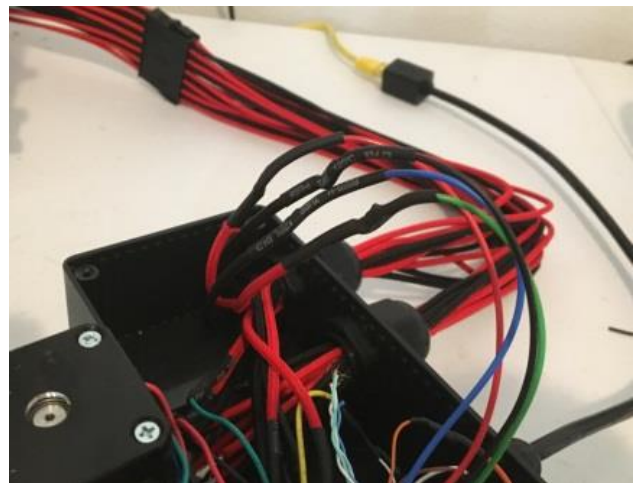
PIN 20
TO
J4 BLUE

PIN 7
TO
J4 BLACK

PIN 8
TO
J4 RED

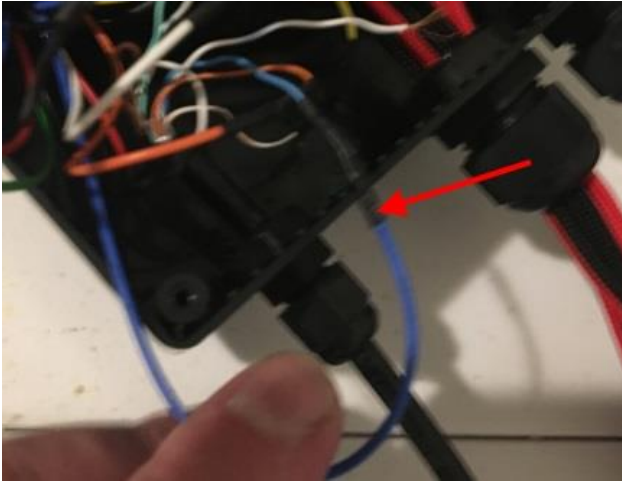
The next step is to connect the (4) J4 motor wires to the correct wires on the ATX cable. You will need to trace the wires from the back of the connector and find the end inside the enclosure.

[\(Also refer to the ATX pinout diagram and the stepper motor wiring schematic\)](#)



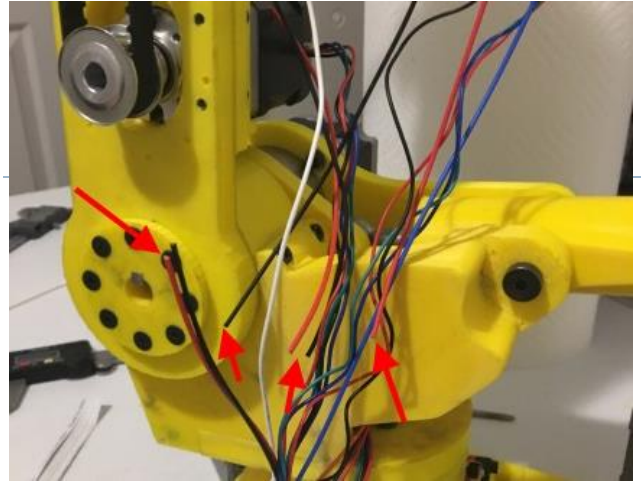
Solder and heat shrink the following connections:

- ATX pin 7 to J4 black
- ATX pin 8 to J4 red
- ATX pin 19 to J4 green
- ATX pin 20 to J4 blue

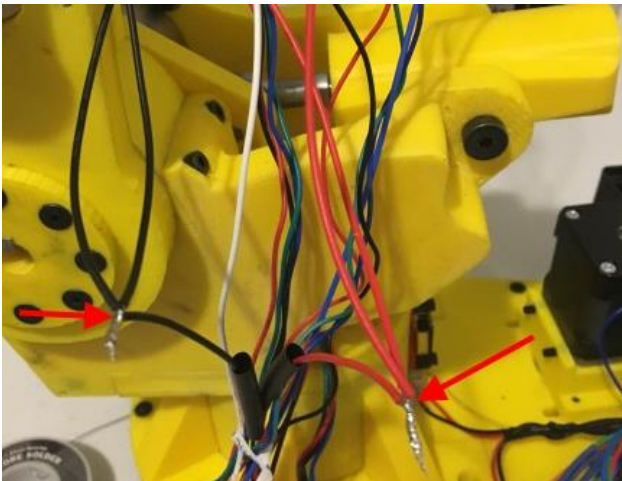


Use solder and heat shrink tube to connect the blue wire from the J4 limit switch to the blue/white strip wire from the RJ45 cable.

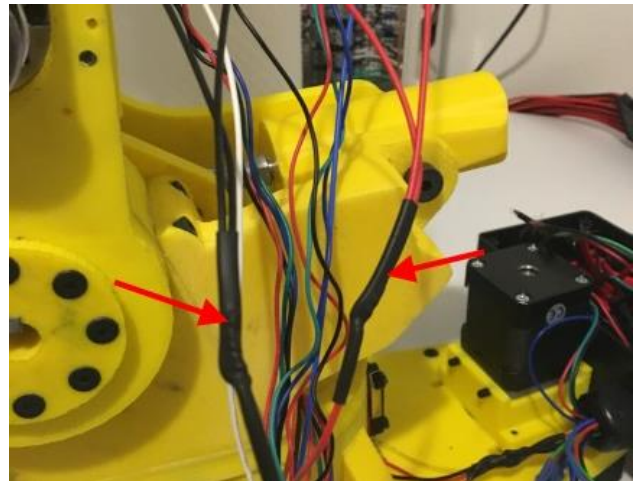
(Also refer to the wiring schematic)



Cut the red and black wires coming from the J3 limit switch as shown.



Slide a length of heat shrink tube over the red and black wires you just cut coming from the enclosure, then splice these wires with the red/black wires from the J4 limit switch together so each is a 3 way splice.



Solder and heat shrink each of the new 3 way splices.

(Also refer to the wiring schematic)



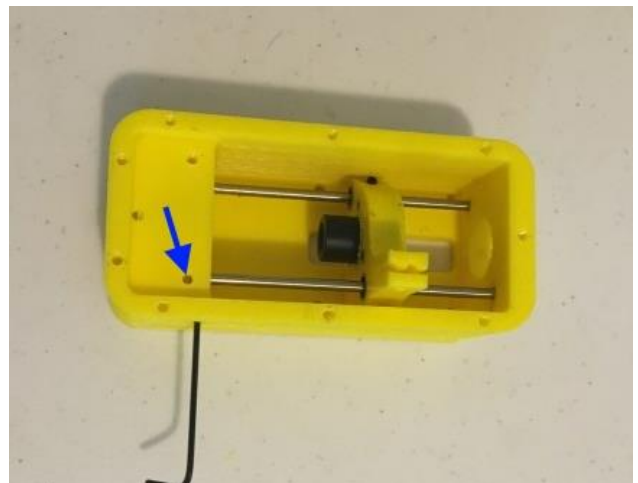
Install POM nut (supplied with 17LS13-0404E-200H linear motor) into the J5 carrier. Countersink the 3 holes in POM nut and then secure with (3) M3 x 10 flat head screws.



Install (2) LM3UU 3mm linear bearings into J5 carrier then secure with (1) M3 x 6 set screw in bottom hole and (1) M3 x 3 set screw in top hole.



Use abrasive saw to cut (2) 3mm linear rods down to 85mm length.

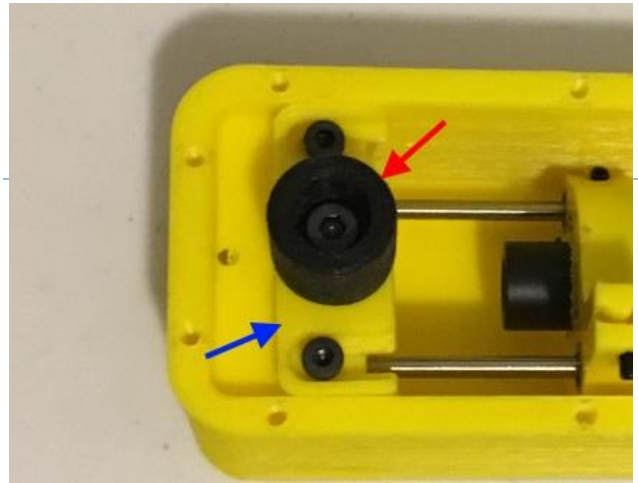


Install (2) 3mm liner rods into J5 housing and through the J5 carrier bearings as shown. Secure both rods with (2) M3 x 6 set screws – one from the top and one from the bottom . Note: make sure the lower linear rod is not inserted too far, it should not extend into the passage for the screw hole indicated with blur arrow.

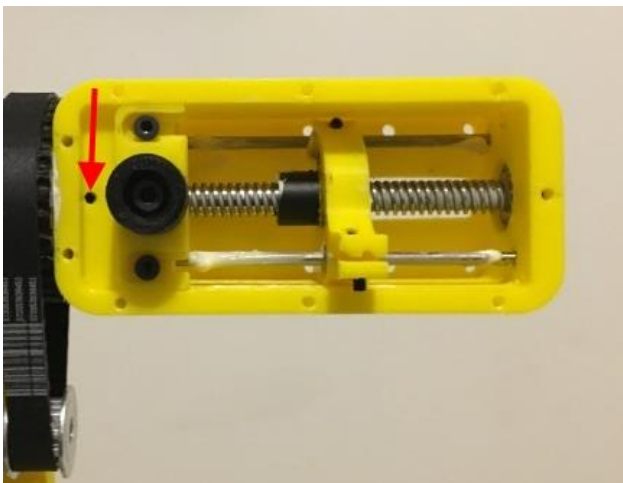


Install 688Z 8x16x5mm bearing in end of J5 housing and secure with (2) M3 x 6 set screws from front (shown) and back.

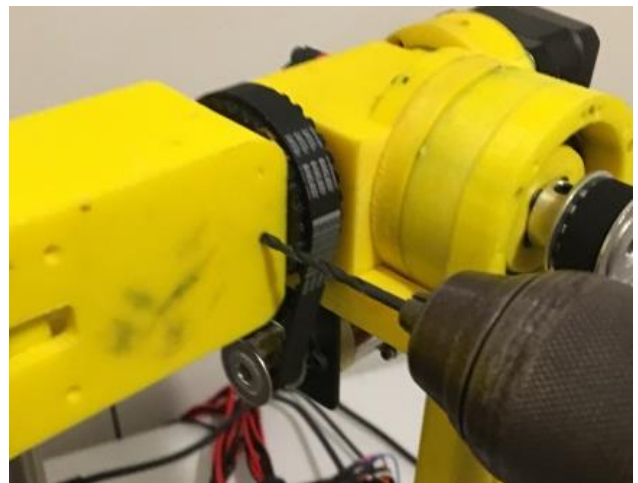
Note: this bearing is press fit – on ABS version also use loctite or adhesive around perimeter of bearing.



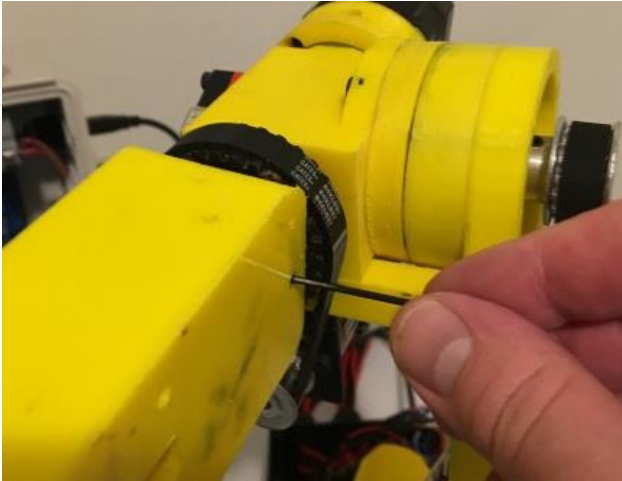
Install J5 idler tension block (blue arrow) and secure with (2) M3 x 8 socket head cap screws. Then install J5 idler post (red arrow) into tension block and secure with (1) M4 x 10 socket head cap screw.



Install J5 housing onto J4 aluminum tubing (thread motor shaft into POM nut as you go). Make sure the hole indicated with red arrow aligns perfectly with hole in aluminum tube. Note: this hole in housing is too shallow for a set screw and is used for visual alignment only.



On opposite side use 2.5mm drill through center hold shown to mark tubing. Remove housing, finish drilling hole and tap to M3 then reinstall carrier.



Install (1) M3 x 6 set screw into the hole you just tapped.

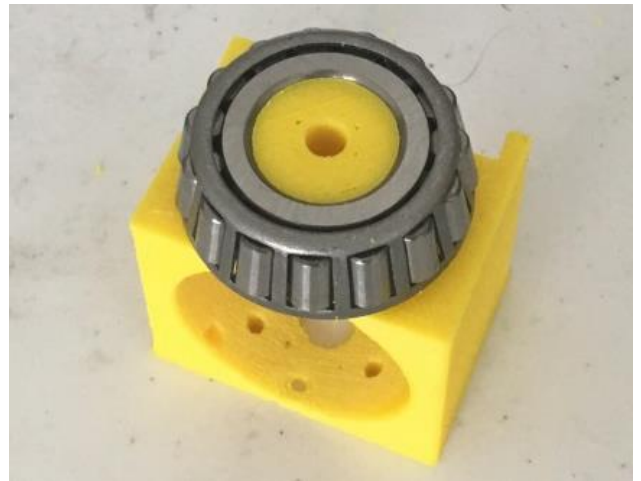


Make sure set screw just starts to thread into aluminum tube.

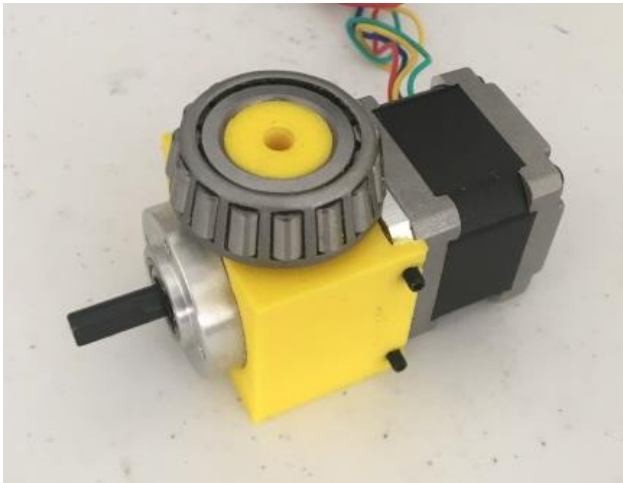
Then install 2 more M3 x 6 set screws on top and bottom of carrier to secure housing to tube.



Install #30203 taper roller bearing race into J5 main bearing support arm.



Install #30203 taper bearing onto J6 housing side post.

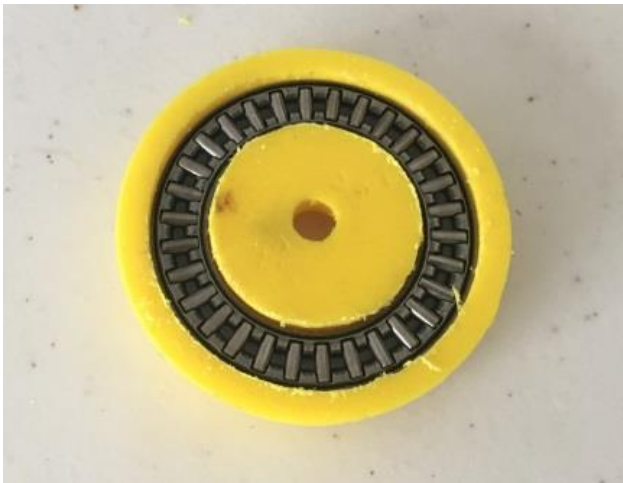


Install 14HS13-0804S-PG19 geared stepper motor into J6 housing and secure with (4) M3 x 3 set screws.

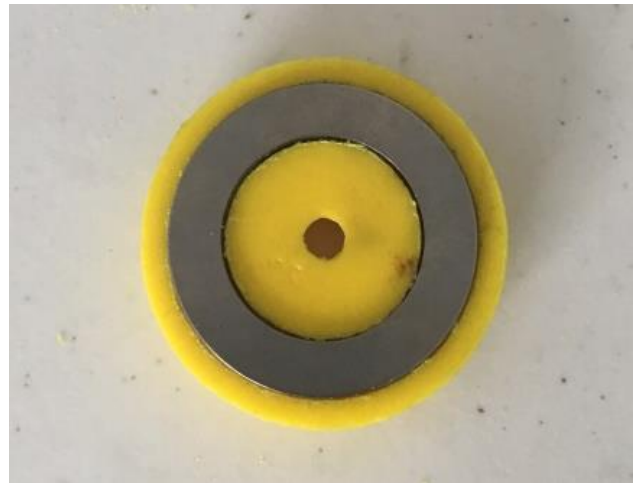
Note: wire harness is 90° to bearing post as shown.



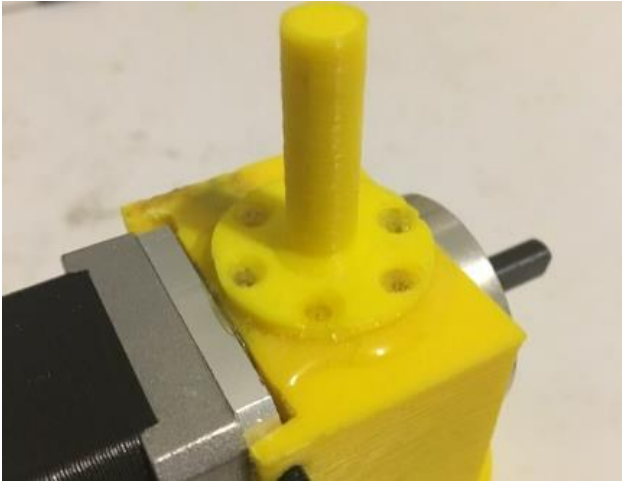
Install (1) .126" thick bearing washer into J6 bearing cap.



Install (1) 1" ID needle bearing into J6 bearing cap.



Install (1) .032" bearing washer into J6 bearing cap on top of bearings.

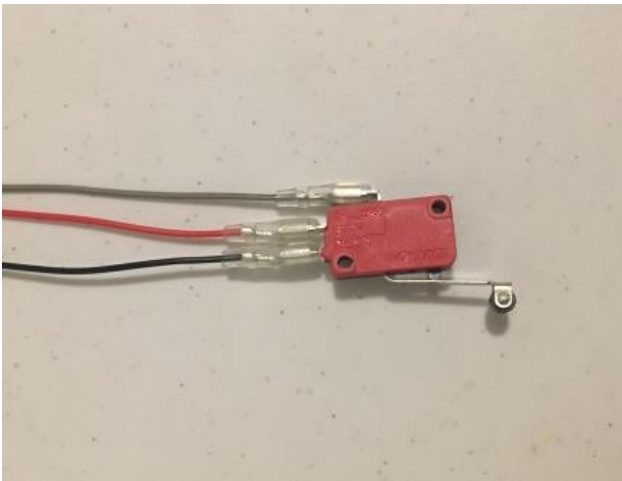


Use epoxy to secure J6 drive post to J6 housing as shown. (given ABS material the 6 shallow holes do not offer enough support to use screws – holes are used for visual alignment only)



Install J6 motor bearing assembly into bearing support arm with J6 cap assembly on opposite side and secure with (1) M6 x 14 socket head cap screw.

Next install (6) M3 x 5 set screws in perimeter of bearing cap and set tension against needle bearings so there is no play in J6 motor assembly.



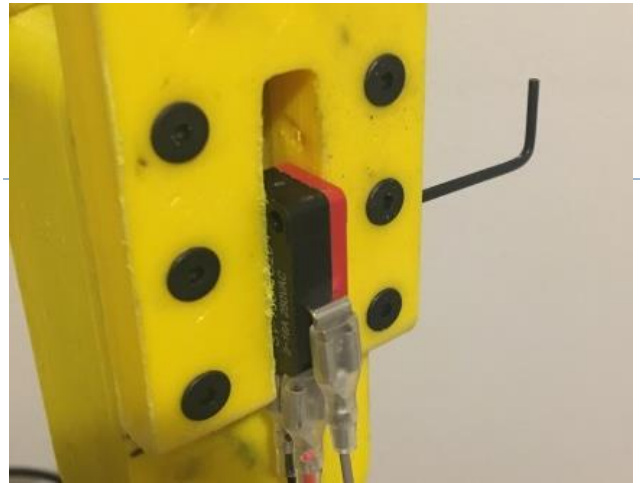
Connect a black, red, and grey 22awg with .187" quick disconnect wire to limit switch as shown.



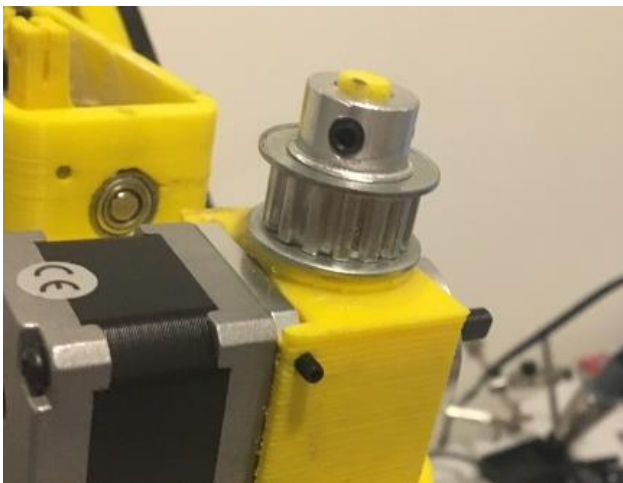
Manually rotate the screw shaft on the J5 motor until the J5 belt carrier is all the way to the end of its stroke as shown.



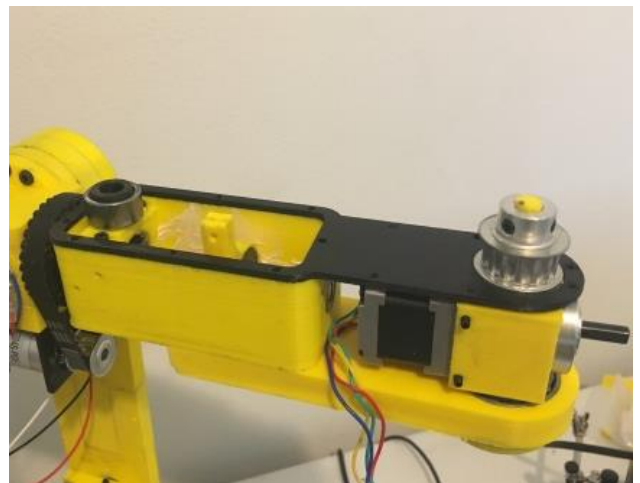
Install J5 limit switch into slot on J6 bearing support arm as shown. Roller on switch should be contacting the J5 belt carrier on inside of housing.



Adjust the switch position until you can hear/feel the switch make contact when you rotate or drive the J5 screw to the top of its stroke. The switch should click right when the belt carrier is reaching the top of its stroke. Secure the switch in place using (2) M4 x 10 set screw on top side of J6 bearing support arm.



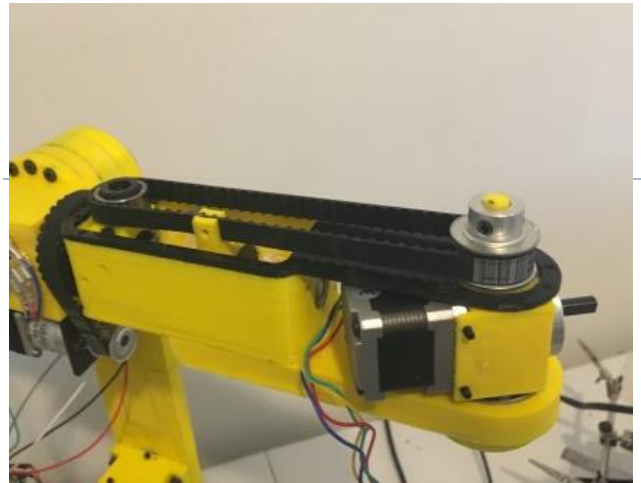
Install (1) XL15 tooth – 8mm bore drive sprocket on J6 spindle shaft as shown but do not tighten set screws yet.



Position the J5 side cover as shown.



Install HK1612 bearing over the J5 idler post as shown.

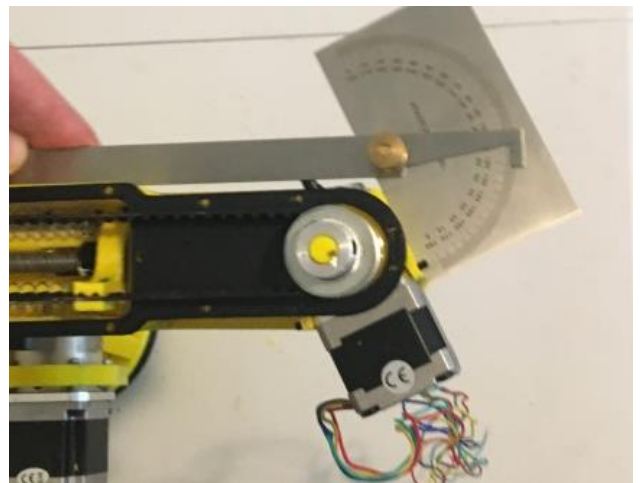


Install 150XL037 gates belt over J5 pulley and idler bearing as shown with belt inserted into the J5 belt carrier.

Set belt tension so belt is tight and there is no play then tighten the M4 screws on the J5 idler tension block.

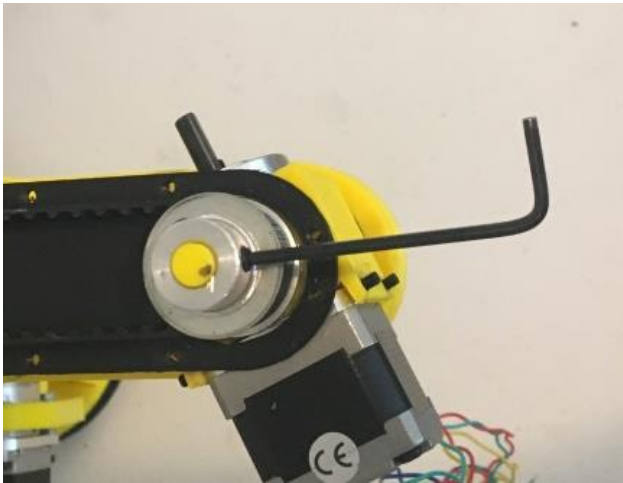


When using ABS components the M4 screws do not have the holding force to keep tension on the belt under load. Place a small drop of super glue around the heads of the M4 screws securing the head of the screw to the tension block. *(if disassembled or tension needs to be reset bond will need to be broken and a new tension block installed)*

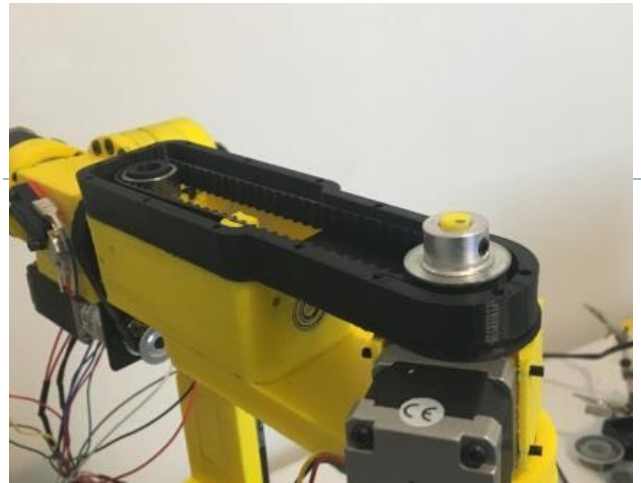


Rotate J5 shaft until belt carrier is to the top of its stroke and you can feel the J5 limit switch click or make contact.

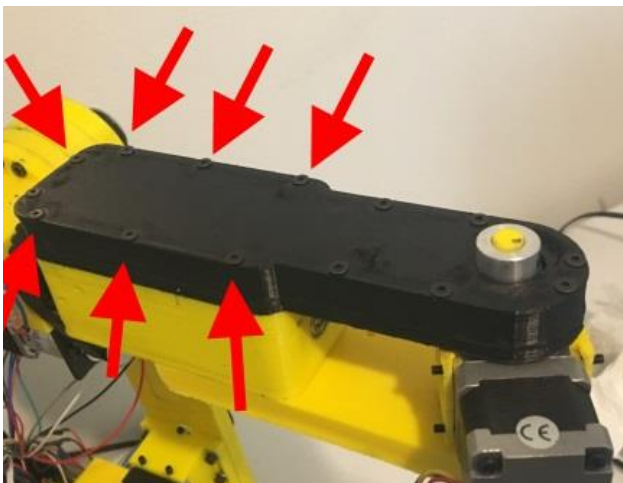
Use angle gauge and rotate J6 housing until its at 105°



Once angle is at 115° tighten both set screws on sprocket to lock J6 carrier at the correct angle.

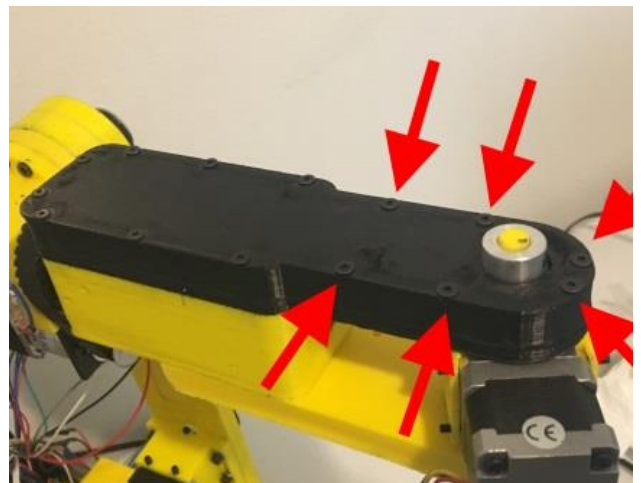


Position the J5 spacers as shown.



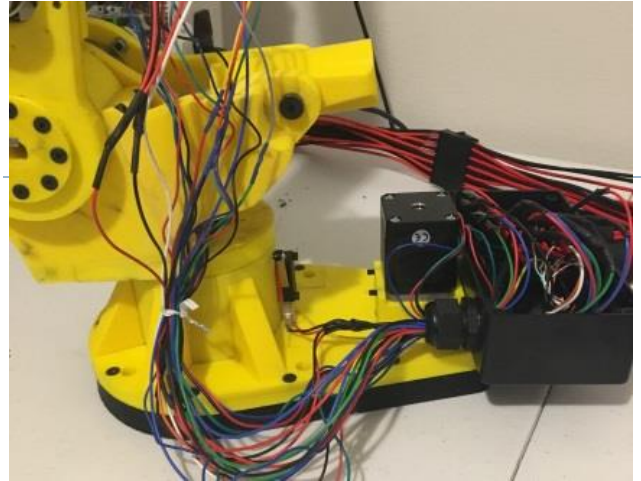
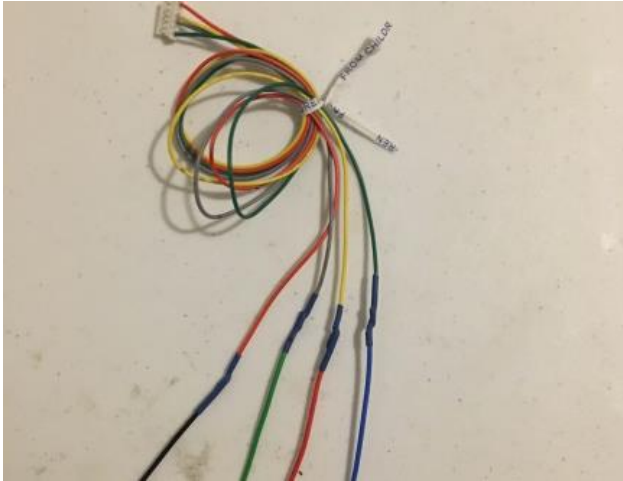
Install J5 side cover cap as shown. Secure to J5 housing with (8) M3 x 25 flat head screws.

(these go through the cap, spacer and side plate and then thread into the J5 housing)



Secure the the cover & spacer to the side plate on the front using (6) M3 x 20 flat head screws.

(these thread into shallow threads on the side plate)



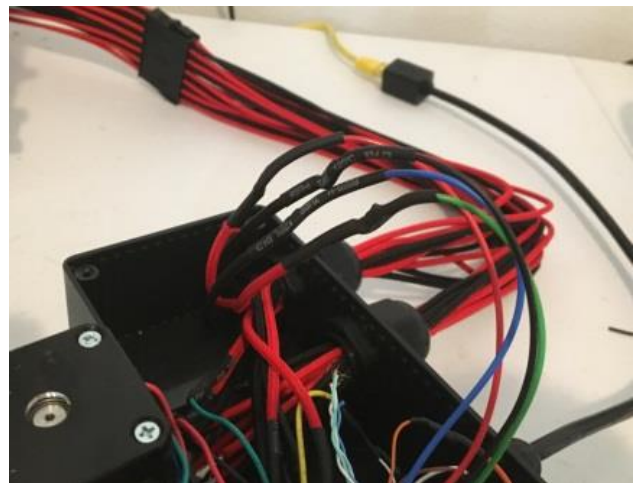
Extend the 4 wires from the J5 motor connector. They are also not the same colors as the other motors. Use solder and heat shrink tube and connect each wire to a length of 22awg wire. From the plug:

- Red to black extension wire
- Grey to green extension wire
- Yellow to red extension wire
- Green to blue extension wire

Plug the connector into the J5 motor. Leaving plenty of slack for full robot articulation run the 4 wires from J5 and the grey wire from the J5 limit switch into the enclosure.



PIN 21 TO J5 GREEN
 PIN 22 TO J5 BLUE
 PIN 9 TO J5 BLACK
 PIN 10 TO J5 RED

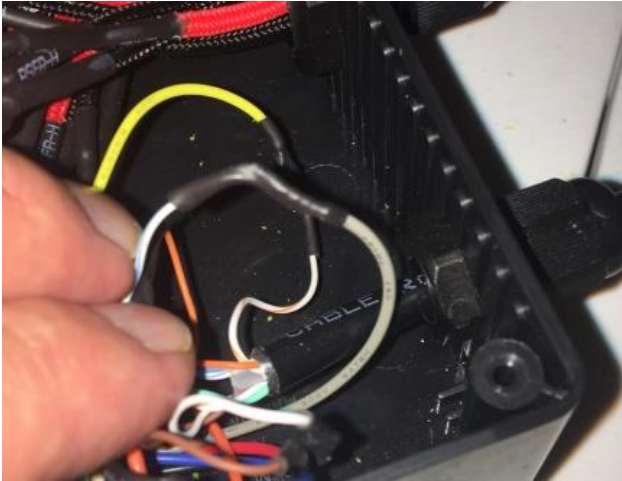


The next step is to connect the (4) J5 motor wires to the correct wires on the ATX cable. You will need to trace the wires from the back of the connector and find the end inside the enclosure.

Solder and heat shrink the following connections:

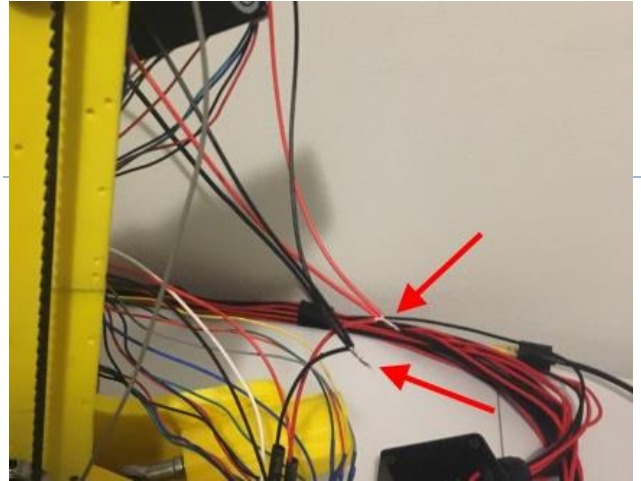
- ATX pin 9 to J5 black
- ATX pin 10 to J5 red
- ATX pin 21 to J5 green
- ATX pin 22 to J5 blue

[\(Also refer to the ATX pinout diagram and the stepper motor wiring schematic\)](#)

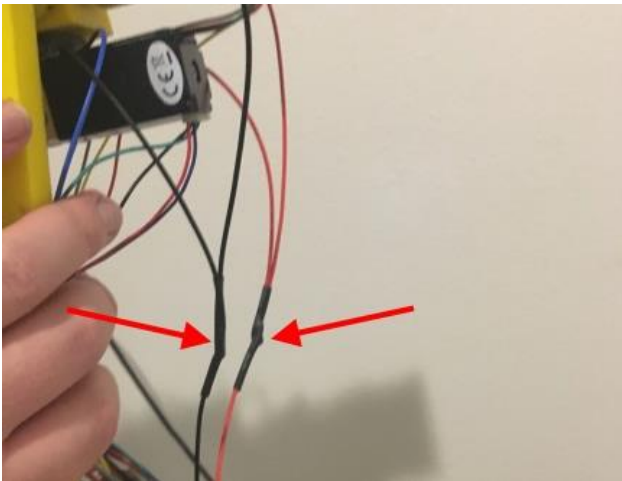


Use solder and heat shrink tube to connect the grey wire from the J5 limit switch to the white/blue strip wire from the RJ45 cable.

(Also refer to the wiring schematic at the end of this manual)



As done in previous steps splice the red and black wires from the J5 limit switch to the wires going to the J4 limit switch creating a 3 way splice for each.



Solder and heat shrink each of the new 3 way splices.

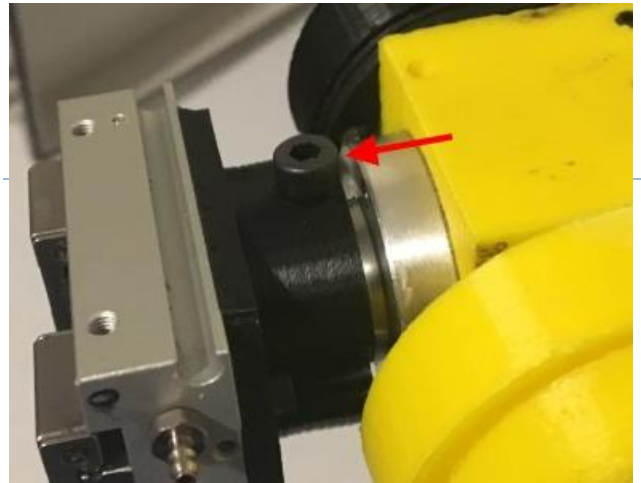
(Also refer to the wiring schematic at the end of this manual)



Secure J6 gripper mount to SMC MFH2-8D1 gripper using (2) M4 x 10 socket head cap screws.



Insert gripper mount over J6 motor shaft and secure with (2) M4 x 10 set screws.



Insert (1) M4 x 10 socket head cap screw into shoulder of gripper mount. *(this will be the contact for the J6 limit switch)*



Cut the arm on (1) long straight arm limit switch down to 30mm long as shown.



Cut the remaining piece of the arm down to 14mm long.



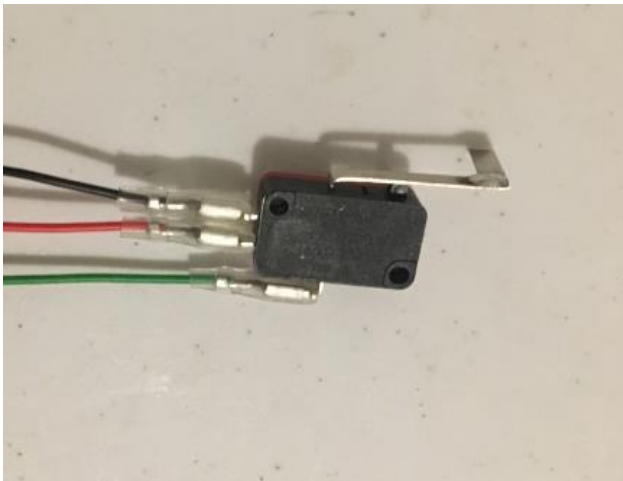
Use 6\36\2 rosin core silver bearing electrical solder and soldering iron to melt a blob of solder to end of 14mm piece of arm.

NOTE: THERE IS NOW A 3D PRINTED ARM YOU CAN EPOXY ONTO THE SWITCH- PLEASE SEE UPDATED IN WIRING HARNESS MANUAL

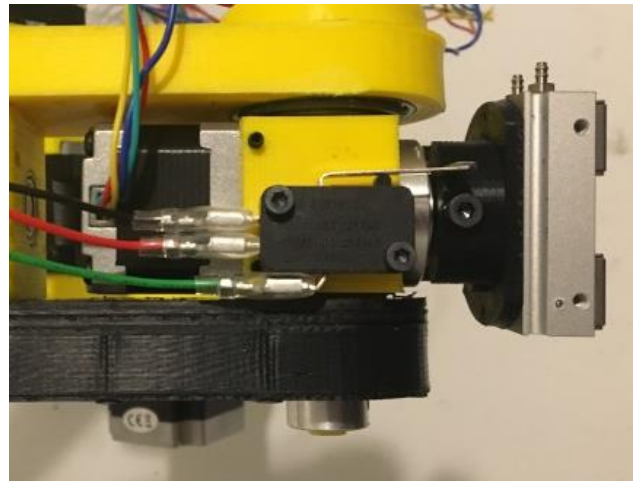


Use soldering stand holder (alligator clips) to hold switch and 14mm extension at 90° - place the blob at joint and use soldering iron to melt blob and secure both pieces together.

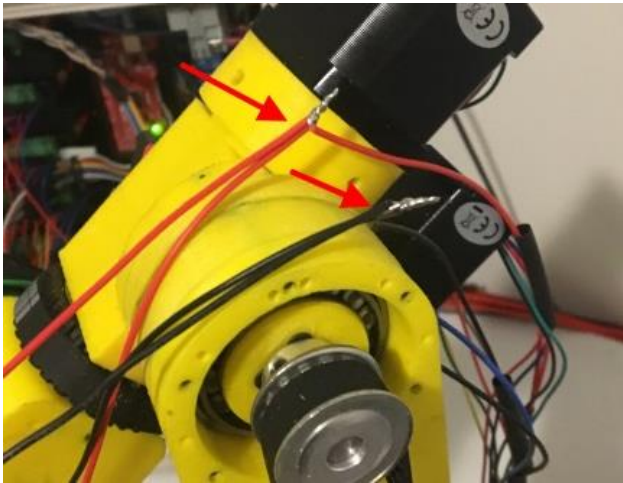
NOTE: THERE IS NOW A 3D PRINTED ARM YOU CAN EPOXY ONTO THE SWITCH- PLEASE SEE UPDATED IN WIRING HARNESS MANUAL



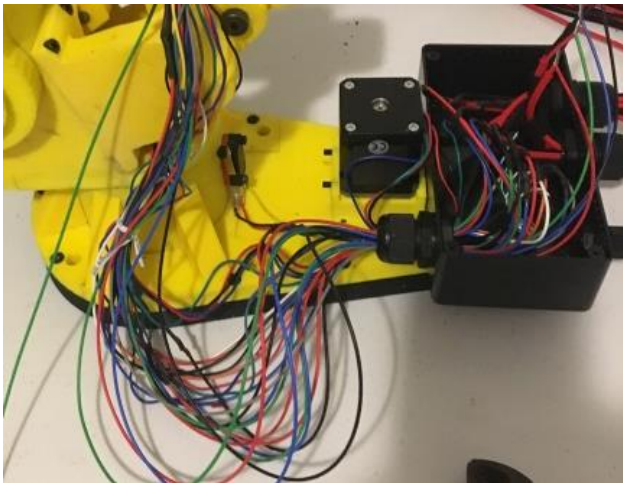
Connect a black, red, and green 22awg with .187" quick disconnect wire to limit switch as shown.



Secure limit switch to J6 housing as shown using (2) M3 x 14 socket head cap screws.



As done in previous steps splice the red and black wires from the J6 limit switch to the wires going to the J5 limit switch creating a 3 way splice for each. Use heat shrink tubing and make sure to leave enough slack in the J6 limit switch wire for full articulation of J4 and J5.

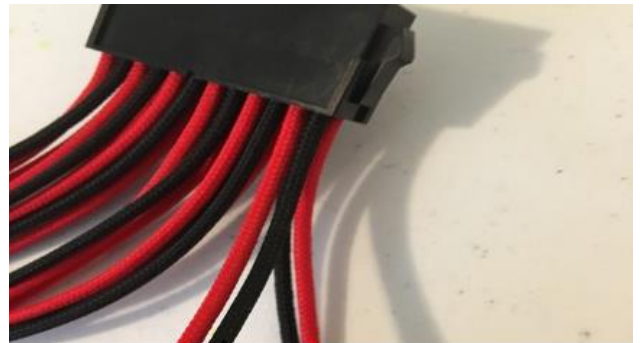


Leaving plenty of slack for full robot articulation run the 4 wires from J6 and the green wire from the J6 limit switch into the enclosure.



Extend the 4 wires from the J6 motor connector. They are also not the same colors as the other motors. Use solder and heat shrink tube and connect each wire to a length of 22awg wire. From the plug:

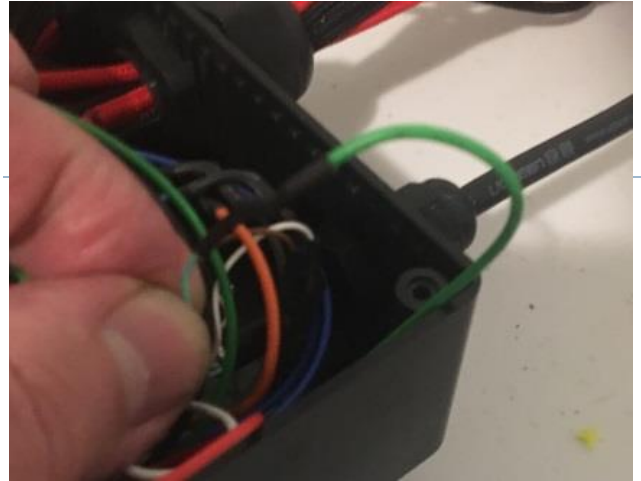
- Red to black extension wire
- Green to green extension wire
- Yellow to red extension wire
- Blue to blue extension wire



PIN 23 TO J6 GREEN
PIN 24 TO J6 BLUE
PIN 11 TO J6 BLACK
PIN 12 TO J6 RED

The next step is to connect the (4) J4 motor wires to the correct wires on the ATX cable. You will need to trace the wires from the back of the connector and find the end inside the enclosure.

(Also refer to the [ATX pinout diagram](#) and the [stepper motor wiring schematic](#))

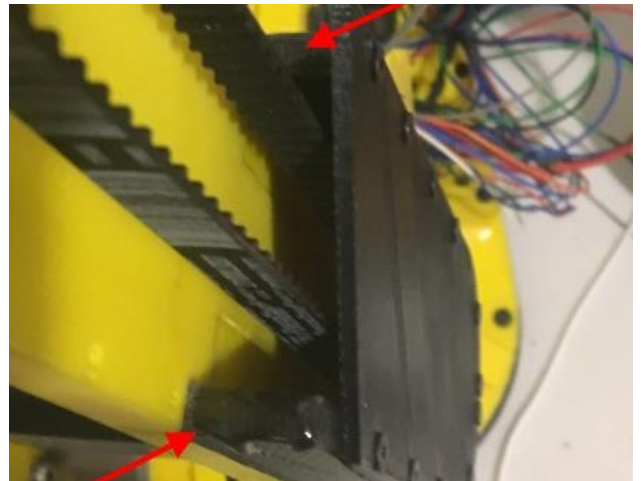
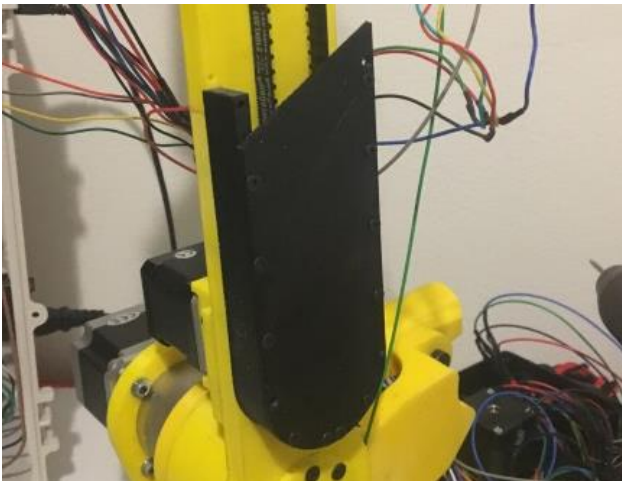


Solder and heat shrink the following connections:

- ATX pin 11 to J6 black
- ATX pin 12 to J6 red
- ATX pin 23 to J6 green
- ATX pin 24 to J6 blue

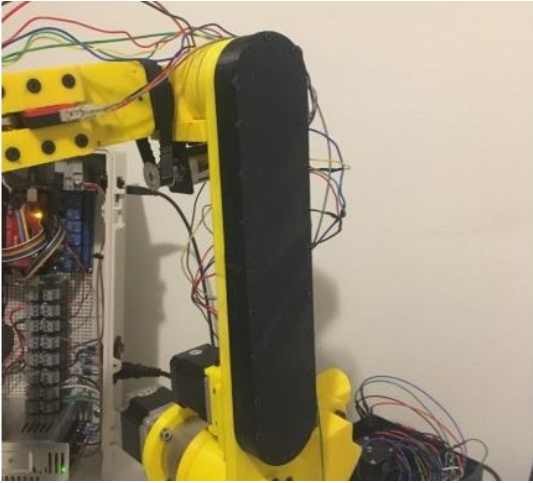
Use solder and heat shrink tube to connect the green wire from the J6 limit switch to the green/white strip wire from the RJ45 cable.

(Also refer to the [wiring schematic at the end of this manual](#))



Install (2) J2 side cover spacers and (1) J2 side cover cap as shown.

Apply epoxy to the tops of the 2 side cover spacers.



Install the other 2 side cover spacers and remaining cover cap. In total (28) M3 x 35 flat head screws are used to secure the cover caps and spacers.



Use epoxy to secure auxiliary J2 arm support as shown. Auxiliary support should be epoxied to J2 arm and cover spacers.

The final step in the mechanical assembly procedure is to bundle all the motor and switch wires and encase them in convoluted tubing. (note there are 2 P clips securing the tubing). It is recommended you go through the startup procedure first so that you can fully articulate each joint of the robot and make absolutely sure there is plenty of slack for each axis. This is extremely important and if you don't make sure the wires have enough slack and stay clear of the switches you will have a great deal of problems with movement and calibration.

