3-Axis Cable Chain Upgrade for Makergear M2

PARTS LIST AND ASSEMBLY GUIDE

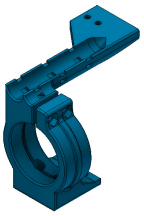
J. Haupt, 9/6/15 Rev A: 9/23/15

Parts

Replacement Extruder Motor Mount

Files:
ReplacmentExtruderMotorMount.stl
ReplacementExtruderMotorMount.stp

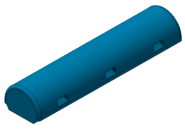
Material used: PETG



Replacement Extruder Harness Cover

Files:
ReplacementExtruderHarnessCover.stl
ReplacementExtruderHarnessCover.stp

Material used: PETG



HBP Bracket

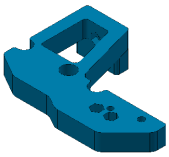
Files:
HPBBracket.stl
HBPBracket.stp

Material used: PETG

Y+Z Bracket

Files:
Y+ZBracket.stl
Y+ZBracket.stp

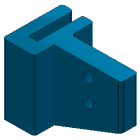
Material used: PETG



Z Bracket

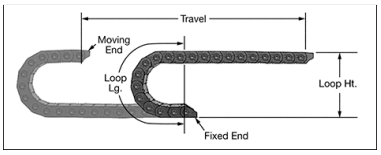
Files:
ZBracket.stl
ZBracket.stp

Material used: PETG



.9” Wide Cable and Hose Carrier

McMaster-Carr Part: 4516T46
Length: 3’



Mounting Ends for Cable and Hose Carrier

McMaster-Carr Part: 4556T33
Quantity: 3 pairs

Wire

Of appropriate gauge to extend wire harness for Y motor, Y limit switch, and HBP.

Suggested Hardware

14x	M3 Nuts, standard or lock
4x	M3x10 Flat Head Socket Cap Screws
6x	M3x8 Flat Head Socket Cap Screws
4x	M3x22 Socket Head Cap Screws
1x	M3x18 Socket Head Cap Screw
1x	M3 Washer
1x	M2.5x10 Socket Head Cap Screw

Other Materials

2-3mm Wide Zip Ties
Solder
Shrink tubing
Adhesive (for mounting Z Bracket)
Original Hardware for extruder motor mount assembly
Original wire harness sheathing (for exposed sections of wire, as desired)

Notes

-User jdacal from Thingiverse and the Makergear forum found that a smaller version of the cable chain works as well. He used part number 4516T44 for the .5” wide chain and 4556T31 for the mounting ends. If using these parts you may need to add more links than I have listed in the assembly instructions.

-Important: The HBP Bracket is large enough that the ~.85% shrinkage of PETG will prevent proper fitting to the machine. Set your scale factor to 1.0085 when printing.

-The assembly instructions are meant as a guide more than explicit directions and might be skipped altogether. Assembly is not difficult; the worst part is sorting, routing, and extending the wire harness.

-This kit was designed for an early-2013 model Makergear M2. If Makergear has made changes to the dimensions and bolt patterns on more recent models the solid models of the brackets may need modification to work on those models.

-All printed parts were made with either Taulman n-vent (AKA Eastman Amphora) or eSun black PETG. I’m told that Taulman n-vent *is* PETG and indeed I use the same slicer process settings for both, but I think it’s worth noting that Taulman n-vent seems to have superior bridging qualities.

-A printed bracket was originally designed to secure the fixed end of the x-axis cable chain but it didn’t allow the cable chain to lie flat against the M2’s machined top plate. I don’t like relying on zip ties but in rare cases they make more sense than a printed part, and I feel this is one of those cases.

-10-15mm of vertical range is lost at the bottom of the z stage by installing the z-axis cable chain.

-As of 8/23/2015 the cable chain and end pieces cost $61.77. It’s my preference to use commercial off-the shelf components when possible but I’m sure with a little design effort a printable cable chain would be viable.

Legal

Anyone who wishes to use these parts, for personal use or for profit, may do so with the provision that I (Justine Haupt) be given credit somehow.

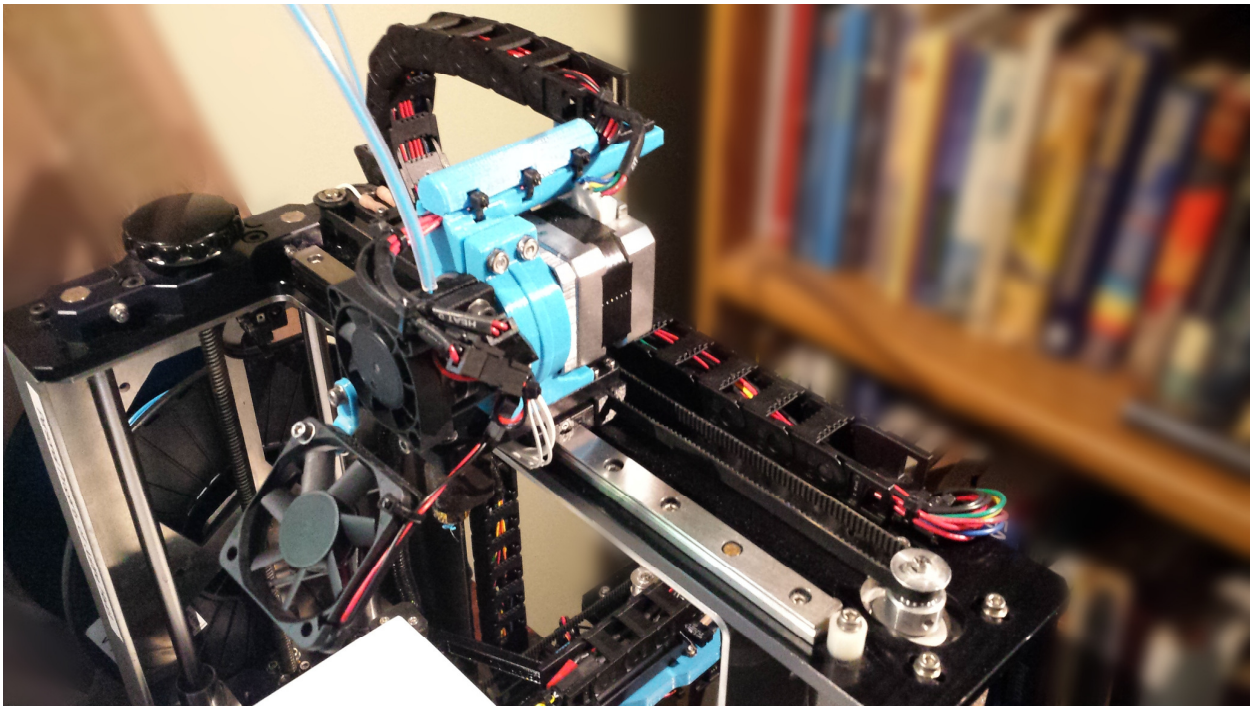
Assembly

Prepping the wire harness:

1. Remove the black woven wire harness sheathing by snipping all the zip ties. Remove any electrical tape from the wire bundle. Residue left from electrical tape can be cleaned from the wires with a solvent.
2. Re-group the wiring as follows:
   -The x-axis motor and all wires for the extruder assembly should be in one group leading directly from the controller board up to the x-axis motor, and then to the extruder assembly.
   -All other wires (z-axis motor, z-axis limit switch, x-axis limit switch, y-axis motor, y-axis limit switch, and HBP) should be in another group, with sections branching off as needed for the z-axis motor, the x- and z-axis limit switches, the y-axis motor and y-axis limit switch, and finally the HBP.
3. Extend the wires for the HBP, y-axis motor, and y-axis limit switch by soldering in sections of wire. On my early-2013 model M2 I found an extension of 200mm to be just right, leaving prudent slack in the right places. The wire I used was not as finely stranded (flexible) as that on the stock harness, so I added the new sections near the controller board where bending fatigue from the stages isn't a concern.

Installing the X-axis cable chain:

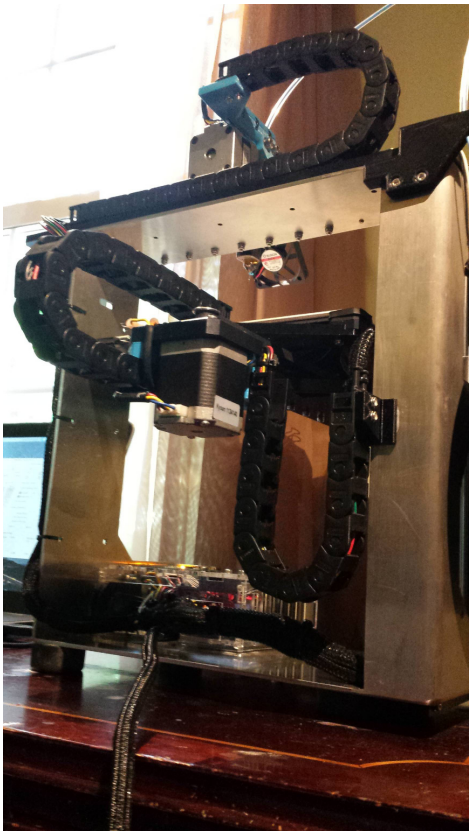
1. Disassemble the extruder motor mount and replace it with the "replacement extruder motor mount" and "replacement extruder harness cover" using the same hardware. The new extruder motor mount is based on Makergear's rev. 3 part.
2. Remove 19 links from the cable chain (McMaster part 4516T46) using a small flat head screwdriver to pry the links apart, and snap the end pieces (McMaster part 4556T31) to both ends. The end pieces must be oriented so that the mounting surfaces are on the outside of the chain's bend direction.
3. Route all the wires for the extruder assembly (motor, heater, thermistor, fans) through the cable chain.
4. Mount the cable chain to the mounting tab feature on the new extruder motor mount using M3x10 flat socket head screws (or similar) and M3 nuts.
5. Secure the opposite end of the cable chain with a single zip tie through the free slotted hole near the y-axis motor. See comment in the "Notes" section above.
6. Secure the wire bundle to the ends of the cable chains using zip ties, as needed.
7. Reconnect the extruder motor, fans, etc.
8. Install the replacement extruder harness cover. This part isn't necessary but serves to clamp the wires more tightly than the old cover now that the black woven sheathing is removed.



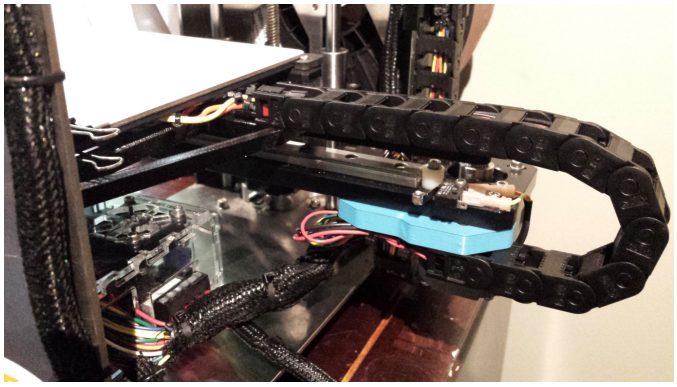
X-axis detail

Installing the Z-axis cable chain:

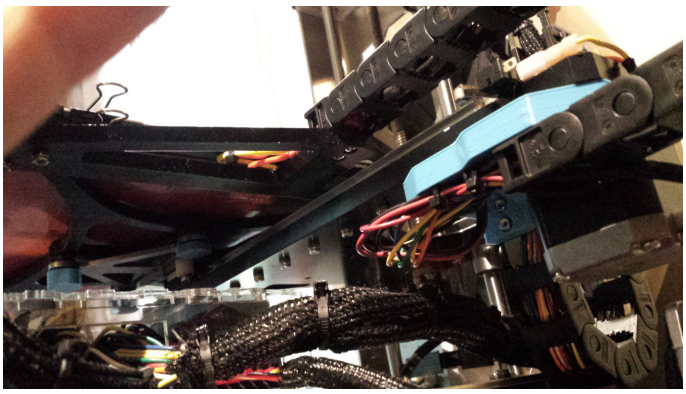
1. Press three M3 nuts into the hex holes in the Y+Z bracket.
2. Install the Y+Z bracket on the underside of the y-axis platform. An M3x18 (or similar) socket head cap screw with washer, inserted from the top through an unused slotted hole near the y-axis limit switch, engages with one of the pressed M3 nuts on the Y+Z bracket.
3. An M2.5x10 socket head cap screw is inserted from into a counter-bored hole on the Y+Z bracket from the bottom up, engaging an M2.5 threaded hole on the y-axis platform. On my machine this hole is also used to mount the y-axis limit switch from the top side. Short enough screws must be used that they don't collide inside the hole.
4. Remove 11 links from the cable chain (McMaster part 4516T46) and snap the end pieces (McMaster part 4556T31) to both ends. The end pieces must be oriented so that the mounting surfaces are on the outside of the chain's bend direction.
5. Route the wires for the y-axis motor, y-axis limit switch, and HBP through the cable chain.
6. Mount the cable chain to the Y+Z bracket and the Z bracket using four M3x8 flat head socket cap screws and M3 nuts.
7. Slide the Z bracket onto the edge of the printer without gluing.
8. By hand, move the Z stage all the way to the bottom of its travel range and adjust the height of the Z bracket on the printer so that the chain is at the end of its range of motion. The Z stage will not be able to go to the *very* bottom with the cable chain installed without the chain contacting the table the printer sits on. See comment in the "Notes" section above. From this position the z stage will travel up to the home position without running out of slack in the chain (with 11 links of chain).
9. Use a suitable adhesive (e.g. epoxy) to permanently mount the z bracket once the vertical height is found.
10. Route the cables exiting the z-axis cable chain beneath the y-stage and re-connect the cables for the y-axis motor and the y-axis limit switch.
11. Secure wire bundles to the ends of the z-axis cable chain with zip ties.



Note Z bracket on right



Y-axis detail showing Y+Z bracket



Y-axis detail (under side)

Installing the Y-axis cable chain:

1. Replace the 4 socket head cap screws that mount the two rear rubber pads on the build platform with longer M3x22 screws, so that they extend through the bottom side of the build platform support spider.
2. Mount the HBP bracket to the build platform spider by inserting onto the exposed M3 screw shafts and securing with 4 M3 nuts.
3. Remove 12 links from the cable chain (McMaster part 4516T46) and snap the end pieces (McMaster part 4556T31) to both ends. The end pieces must be oriented so that the mounting surfaces are on the inside of the chain's bend direction.
4. Route the cabling for the HBP through the cable chain and mount the ends of the cable chain to the HBP bracket using two M3x8 flat socket head cap screws and M3 nuts. Mount the other end of the cable chain to the bottom of the Y+Z bracket using two M3x10 flat head socket cap screws and M3 washers.
5. Reconnect the HBP wires and secure wire bundles to both ends of the y-axis cable chain with zip ties.

Wrapping up:

1. Re-attach the woven black wire sheathing to exposed sections of wire as desired.
2. Secure and strain relieve any remaining wires with zip ties.