Brushless Servo Upgrade Kit
— Installation Guide —

Models 2575, 2576, 2577, 2578

This upgrade kit, compatible with most AxiDraw V3 and AxiDraw SE family machines, replaces the standard pen-lift servo motor with a narrow-band brushless servo motor and upgrades the AxiDraw power supply.

This guide walks through the process of installing the new motor, including replacing the servo mount and mounting and connecting the new electronics.

We strongly recommend that you **read through all of the steps before starting the installation.** One key reason is to *make sure that you have the correct tools* needed for your specific upgrade configuration.

For ease of viewing the photos in this guide, consider reading this guide on a phone, tablet, or computer screen, rather than printing it.

If you should need any assistance installing this upgrade, please let us know right away; we're here to help!

There are variations between different AxiDraw machines. If something doesn't look right or doesn't seem to fit right, please don't hesitate to say so.

Please let us help you get up and running!

Email: support@bantamtools.com
Tech support chat: bantam.tools/chat

Preliminary step 1: Tool check

Certain tools are required to install this upgrade; they are not included with this upgrade kit:

- Wire cutters, sharp scissors, or a similar tool to cut cable ties.
- Hex L-wrenches: 2 mm and 2.5 mm
  (Both hex L-wrenches are included in the standard set of tools that ships with an AxiDraw.)
- One specialized screwdriver; *type to be determined*.

  That screwdriver will be type **PZ1**, **PZ2**, or **T20**, depending on your AxiDraw. To determine which, for your exact configuration, keep reading.

You may also find tweezers and a pin, needle, or ballpoint pen tip helpful.

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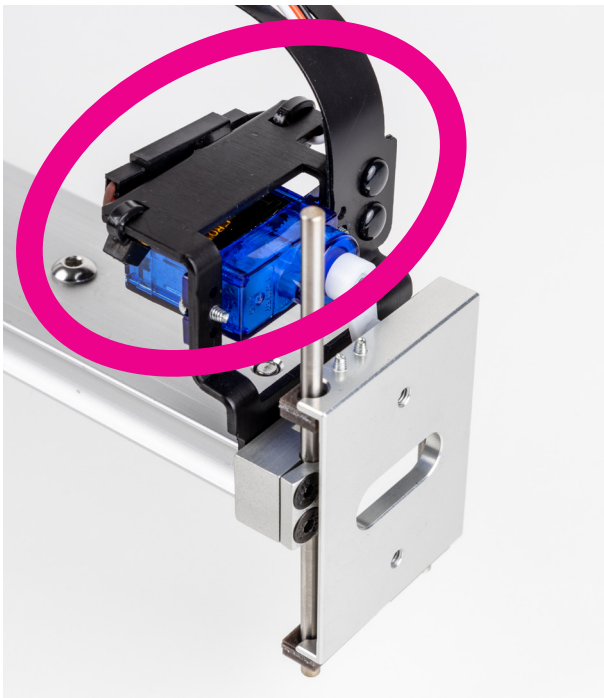
Preliminary step 2: Disconnect the AxiDraw

Before anything else, physically disconnect both the USB and power cords from the AxiDraw.

Preliminary step 3: Compatibility Checks & Starting Point

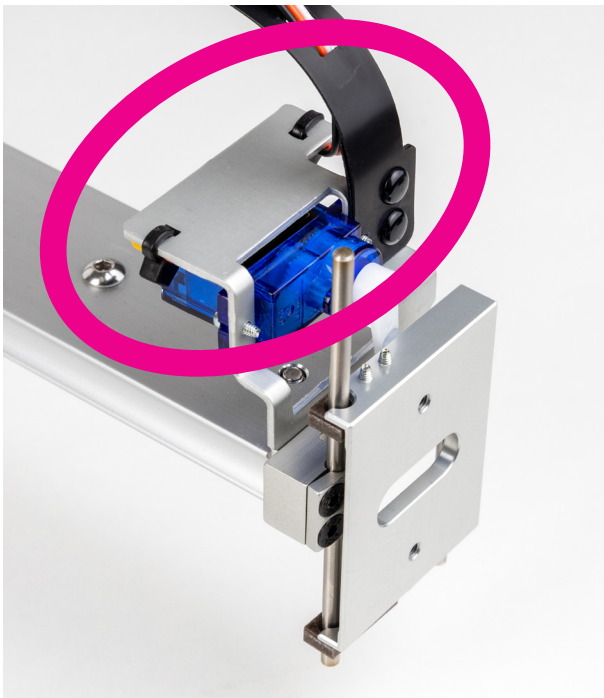
To verify that your AxiDraw is ready for this upgrade, look at the mounting bracket where your existing pen-lift servo motor is attached. Compare its appearance to the two photos below:



(A) If the mounting bracket looks like the photo above, with a **black-colored** aluminum flap that **covers the top** of the servo motor:

The installation process will involve removing the old servo motor (without removing or replacing the servo mount).

If your AxiDraw looks like this, proceed to **Part A**, starting with **Step A1** on the next page.



(B) If the mounting bracket looks like the photo above, with a **silver-colored** aluminum flap that **covers the top** of the servo motor:

The installation process will involve removing the old (silver-colored) servo mount and replacing it with the upgraded black one. Make sure that you have upgrade kit model **2575** or **2576**, which come with the black mount included. (If you don't, please contact support to get that part.)

If your AxiDraw looks like this, skip directly to **Part B**, starting with **Step B1**, starting on page 8.

If your servo mounting bracket is not of this shape — if it does not have the metal flap above the servo motor — your AxiDraw is *probably not* directly compatible with this upgrade. (Please contact support to discuss upgrade options for your AxiDraw.)

Part A - Swapping the servo motor

***Part A** is for AxiDraw units that already have the black servo mount to begin with. If your AxiDraw has the silver-colored servo mount, skip ahead directly to **Part B**.*

Step A1: Screwdriver needed

The screwdriver that you will need is a **Pozidriv PZ1**, or "Pozi #1". Make sure that you have one on hand before proceeding.

Step A2: Disconnect old servo

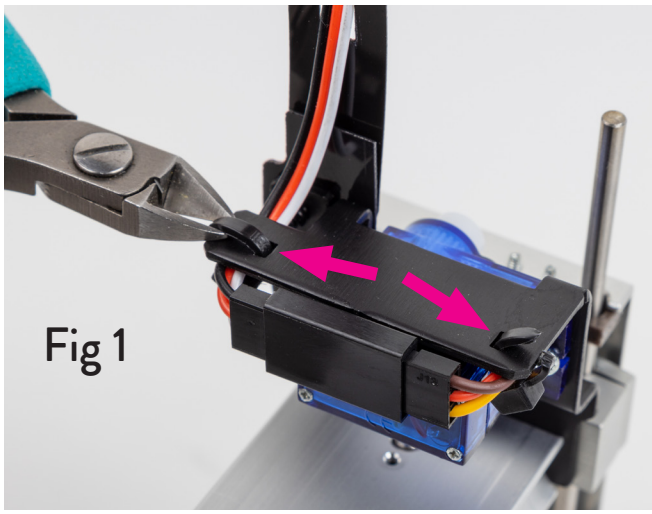
The existing servo wiring is typically held in place by two cable ties, as indicated (**Fig 1**).

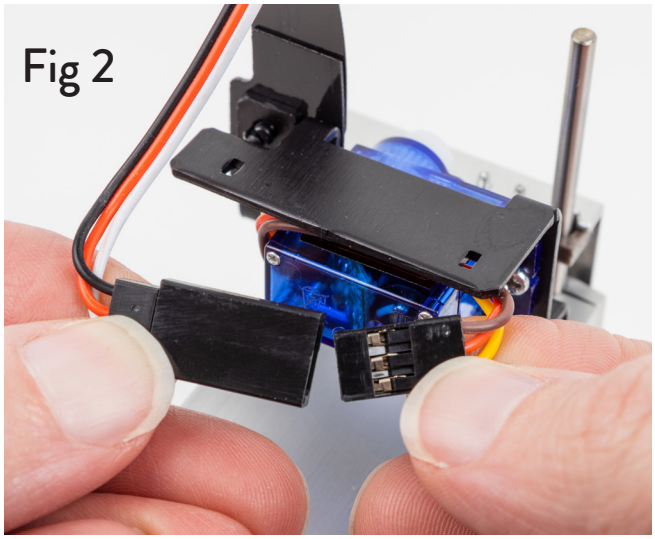
Use wire clippers or sharp scissors to cut and remove both cable ties. **Do not** cut or damage the wiring itself.

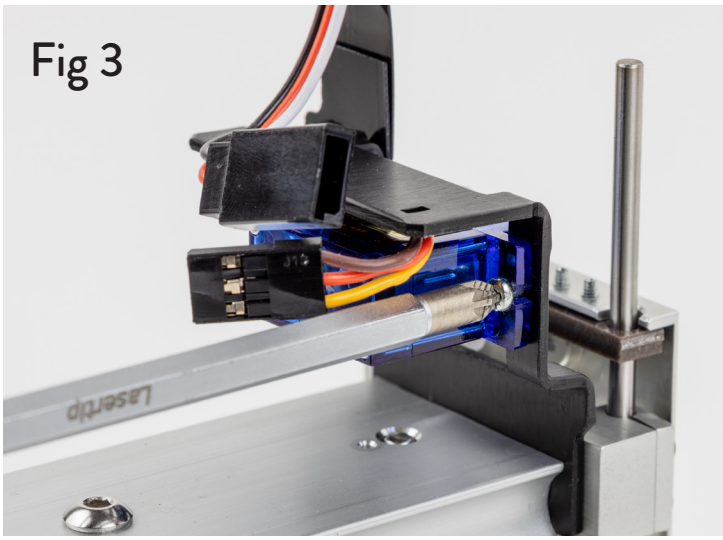
Once the cable ties are cut, disconnect the old servo motor by pulling its cable end (brown/red/yellow) out of the jack as shown (**Fig 2**).

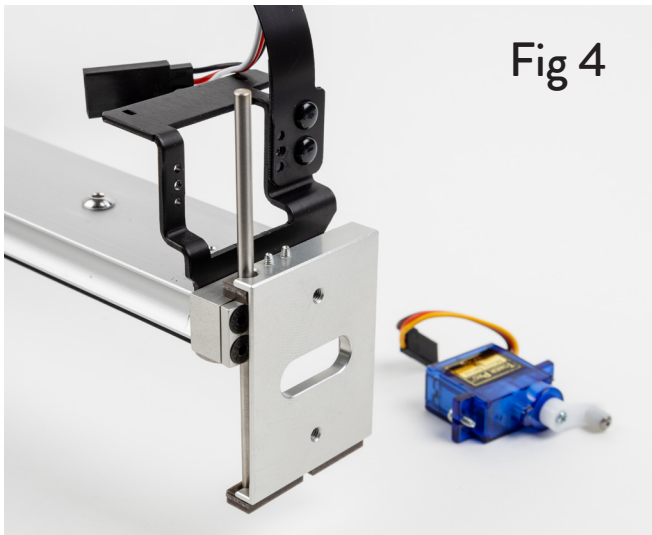
Step A3: Detach the old servo

Using your PZ1 screwdriver, unscrew the two screws that hold the old servo motor in place and thus remove it from the servo mount (**Figs 3-4**).



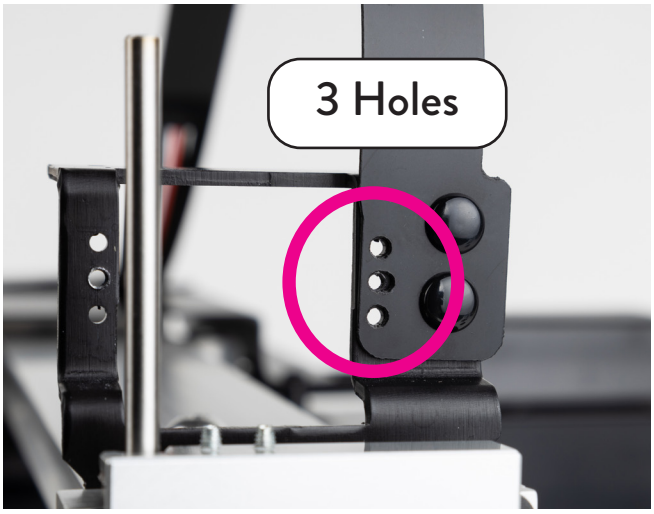






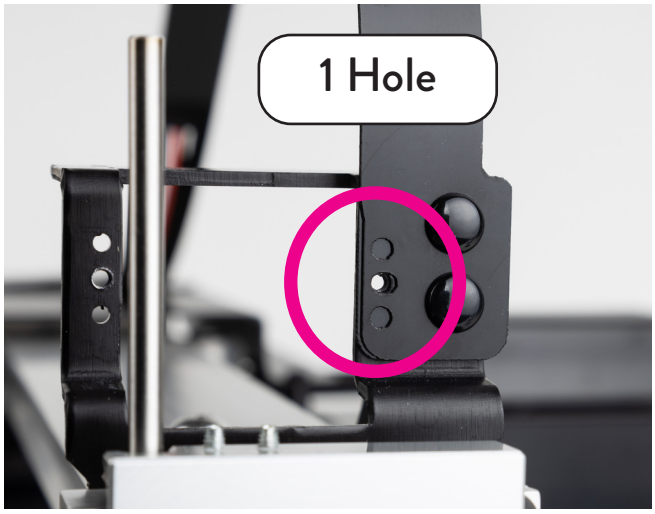
Step A4: Check the cable guide

Take a close look at where the cable guide is attached to the servo mount, and compare it to the pictures below:



If your servo mounting bracket looks like the photo above, with **3 holes** through the cable guide, you will **leave the cable guide attached.**

Thus, skip ahead to **Step A6** on page 6.



If your servo mounting bracket looks like the photo above, with only **1 hole** through the cable guide, you will disconnect the cable guide.

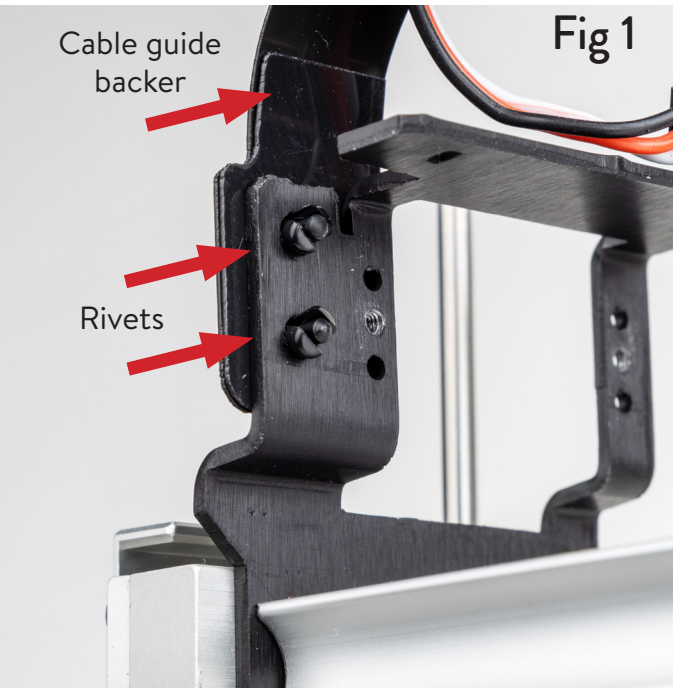
To do so, proceed on to **Step A5** on the next page.

Step A5: Remove the cable guide

If you have 3 holes visible through the cable guide — from step A4 — skip this step; leave your cable guide attached.

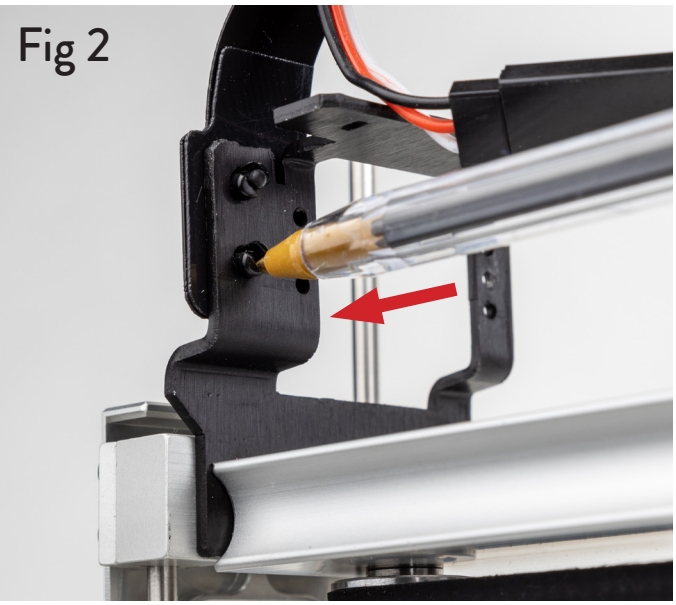
The **cable guide** — the flexible black plastic ribbon — is attached to the servo mount by two plastic rivets (**Fig 1**). (The exact shape of your cable guide may not match the one shown here; they vary slightly between AxiDraw models.)

Between the cable guide and the servo mount is a second piece of black plastic, the **cable guide backer**, also held in place by those rivets.

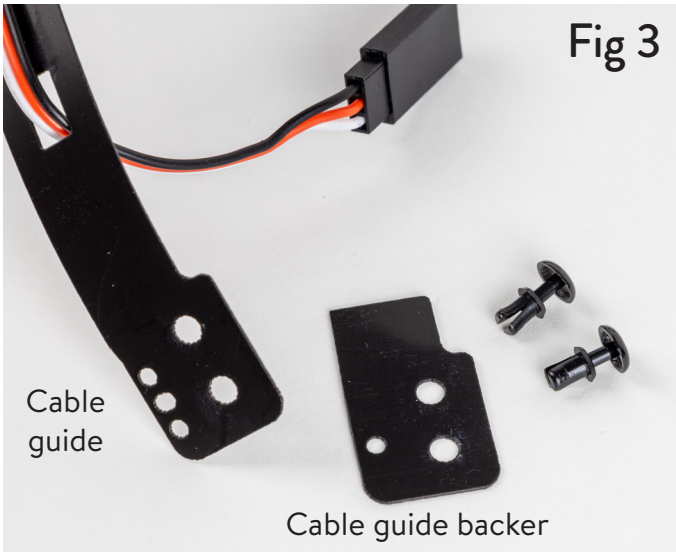


Remove the two plastic rivets, to release the cable guide parts from the servo mount.

The best way to remove this type of rivet is to press the center pin in from the back side (**Fig 2**), with a narrow implement like a pin, needle, screwdriver, or sturdy pen point. Once you push that center point in a bit, you can pull out the two parts of the rivet from the front side.



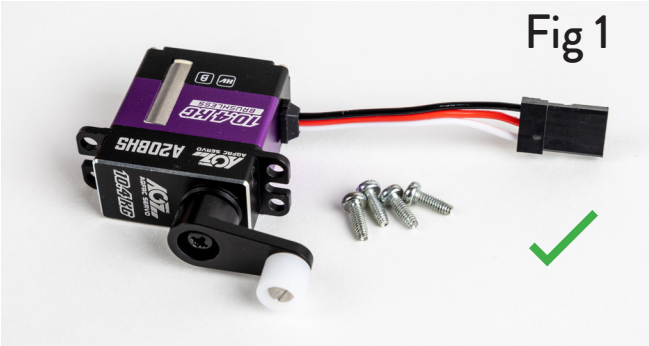
Once both rivets are removed, carefully separate the parts (**Fig 3**).



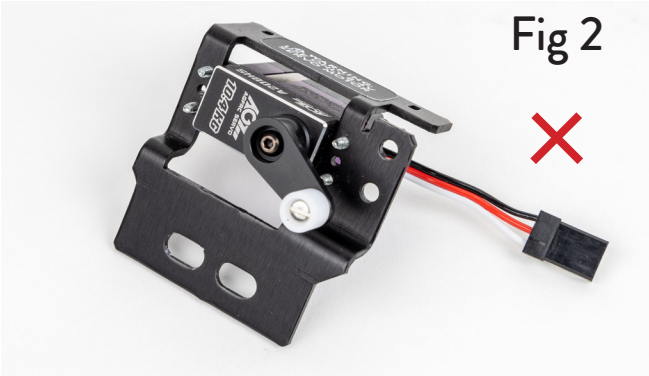
Step A6: Identify servo motor and screws

First, identify the brushless servo motor and the four small screws from the kit of upgrade parts (**Fig 1**).

Orient the black lift arm of the servo motor pointing towards the cable, as shown here.



> ***Aside:*** If the servo motor in your upgrade kit is already attached to a mount (**Fig 2**), use the **PZ1** driver to remove the four screws that hold it in place, getting you back to the state shown in (**Fig 1**).



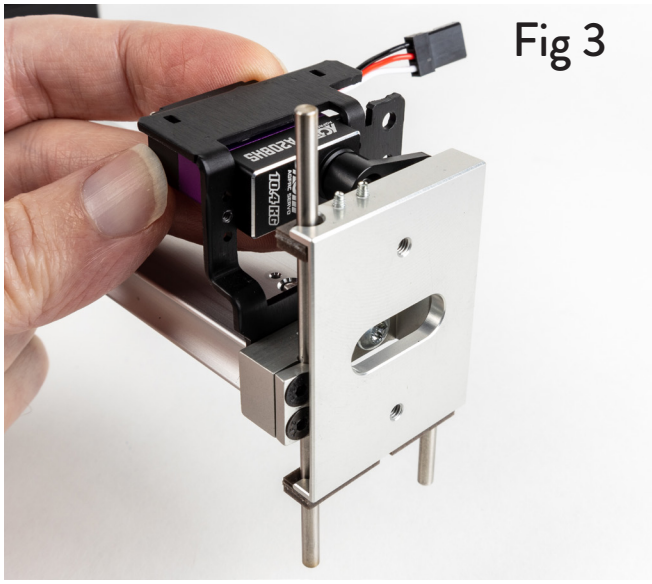
Step A7: Attach the brushless servo motor

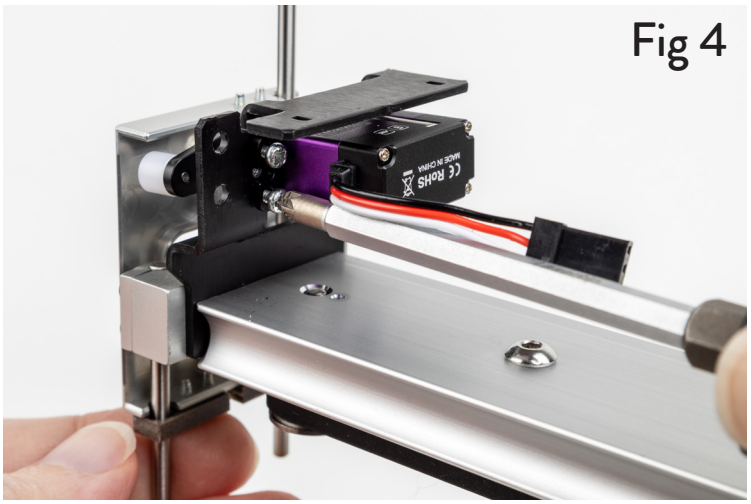
Test fit the new servo motor in place, behind the servo mount. Lift up the front face of the vertical slide so that it can rest on the wheel at the end of the black lift arm (**Fig 3**).

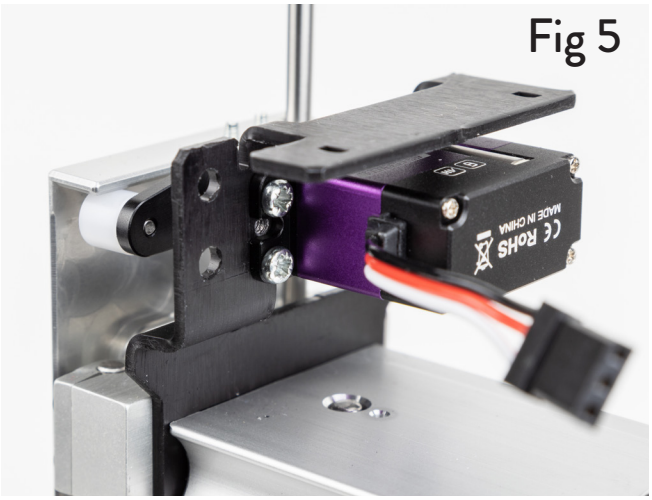
(If the vertical slide has come "unfolded", with the two parts "hinged" together, fold it back together so that the rails slide vertically.)

Then, use your **PZ1** driver to attach the new servo (**Fig 4**) in place with the four screws. The screws go through the four holes at the corners of the motor and into the matching (outer four) holes of the servo mount.

Get all four screws started before tightening any of them, and then tighten each with gentle pressure (**Fig 5**).







Step A8: Add the warning label

Locate the “Warning” label from the kit of upgrade parts (**Fig 1**).

Peel the label off of the backing. (The label *may* have a large black outer rectangle left over from the printing process; we only need the smaller inner label part.)

Place the label on the top of the metal flap at the top of the servo mount (**Fig 2**), taking care to fit it on the metal part, and not covering either of the holes in the top of the servo mount. You may find tweezers or a similar tool helpful.

Then, smooth the sticker into place (**Fig 3**).

Fig 1

Fig 2

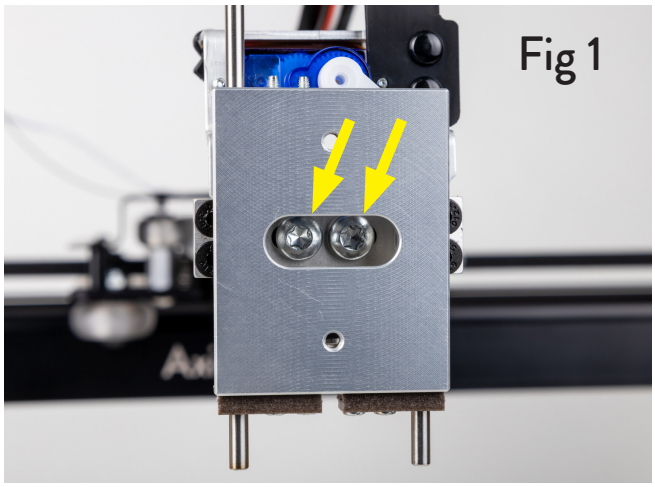
Fig 3

This concludes Part A.

Next, skip directly ahead to Part C, starting on page 13.

Part B - Upgrading the servo mount

***Part B** walks through the first steps for upgrading from an AxiDraw with a silver-colored servo mount. If you just finished Part A, skip past this section, directly to **Part C**.*



Step B1: Tool check

To determine the screwdriver type that you'll need, remove the pen clip and lower your pen position to its lowest point **(Fig 1)**. Look through the hole in the front face of the pen slide to see the two screw heads visible inside. You may need to manually lift the pen slide up a bit in order to see them.

If the two screw heads have a 6-pointed star shape, the necessary screwdriver is a **Torx T20**.

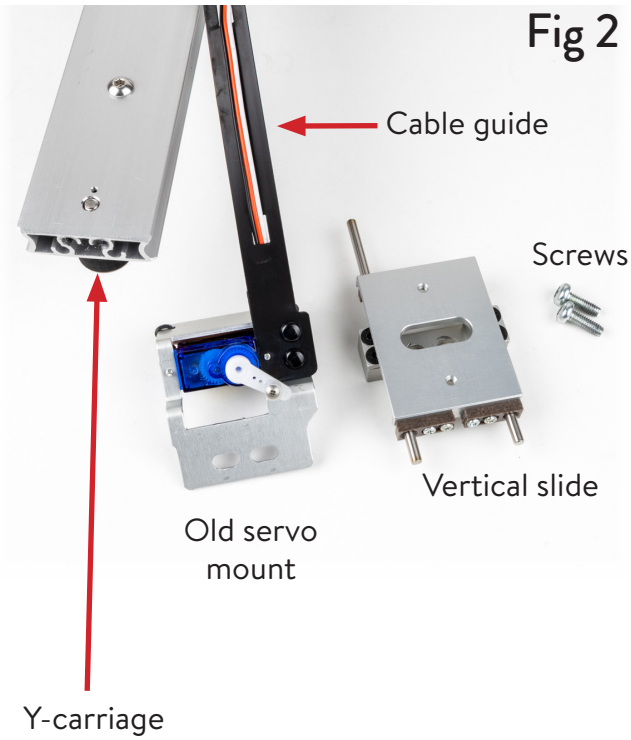
If the two screw heads have a cross shape, the necessary screwdriver is a **Pozidriv PZ2**, or "Pozi #2".

Step B2: Remove the vertical slide

Disconnect the AxiDraw from power and USB.

Then, using the appropriate screwdriver, loosen and remove those two screws (**Fig 2**). They *will* be tight.

Be extremely careful as you remove the screws: Alternate between them as you unscrew them, and make sure that the screw heads are free of and **do not** press against the vertical slide; they could damage the slide.



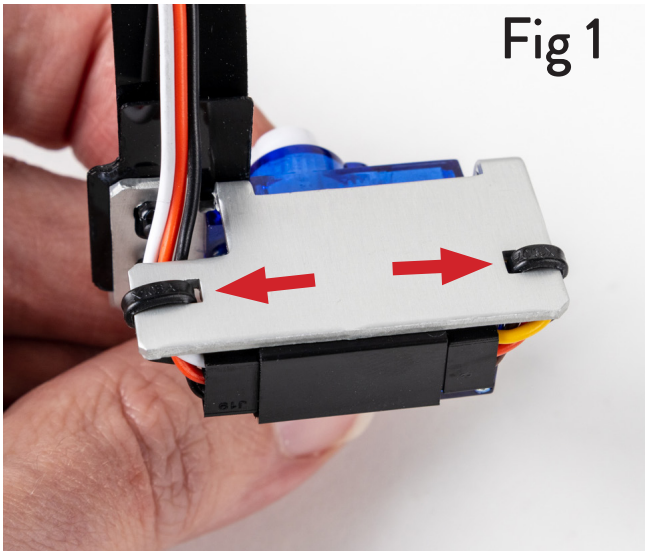
These two screws normally attach the **vertical slide** to the **Y-carriage** of the AxiDraw, clamping the **old servo mount** in place between them. The old servo mount is still attached to the **cable guide**.

Once it is loose, take care because the front edges of the Y-carriage may be sharp.

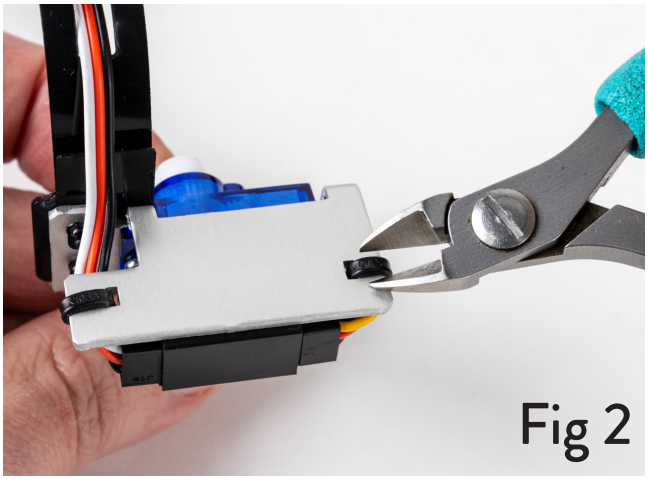
In the steps that follow in Part A, we will detach the cable guide, and then attach the vertical slide with the new servo mount.

Step B3: Disconnect the old servo

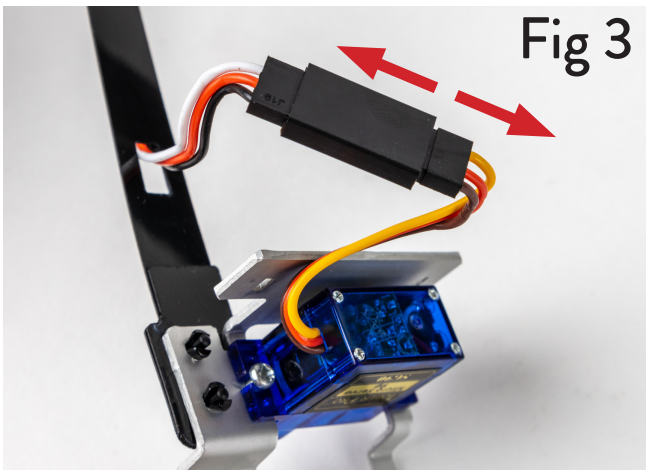
The existing servo wiring is typically held in place by two cable ties, as indicated (**Fig 1**).

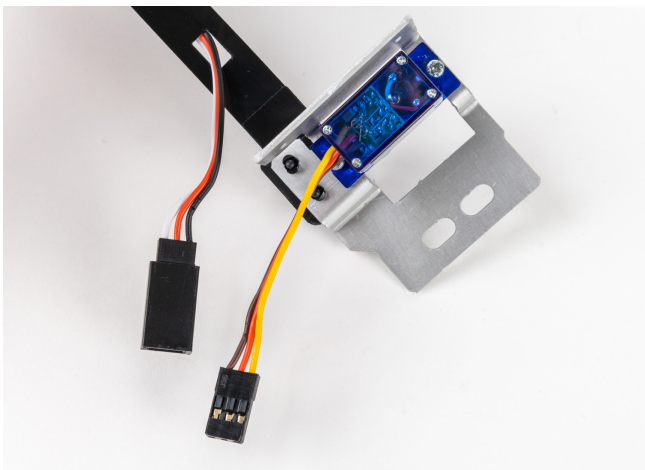


Use wire clippers or sharp scissors to cut and remove both cable ties (**Fig 2**). **Do not** cut or damage the wiring itself.



Once the cable ties are cut, disconnect the old servo motor by pulling its cable end (brown/red/yellow) out of the jack as shown (**Fig 3**).





Step B4: Disconnect the cable guide

The **cable guide** — the flexible black plastic ribbon — is attached to the old servo mount by two plastic rivets (**A**). (The exact shape of your cable guide may not match the one shown here; they vary slightly between AxiDraw models.)

Between the cable guide and the servo mount is a second piece of black plastic, the **cable guide backer**, also held in place by those rivets.

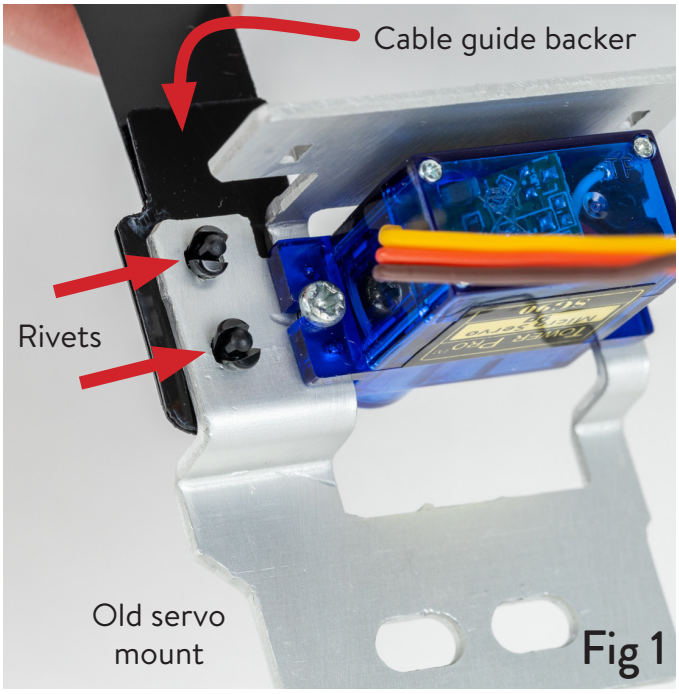


Fig 1

Remove the two plastic rivets, to release the cable guide parts from the old servo mount.

The best way to remove this type of rivet is to press the center pin in from the back side (**Fig 2**), with a narrow implement like a pin, needle, screwdriver, or sturdy pen point. Once you push that center point in a bit, you can pull out the two parts of the rivet from the front side.

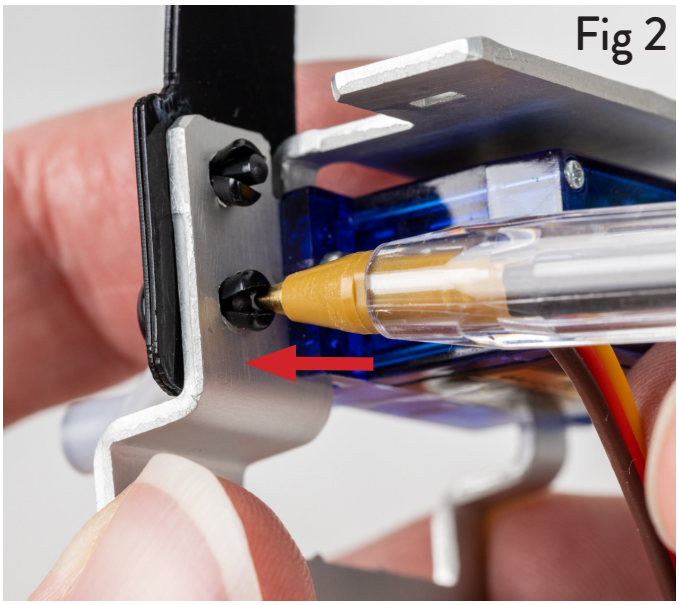


Fig 2

Once both rivets are removed, carefully separate the parts (**Fig 3**). This concludes removing the old servo mount. In the next step, we begin installing the new servo mount.

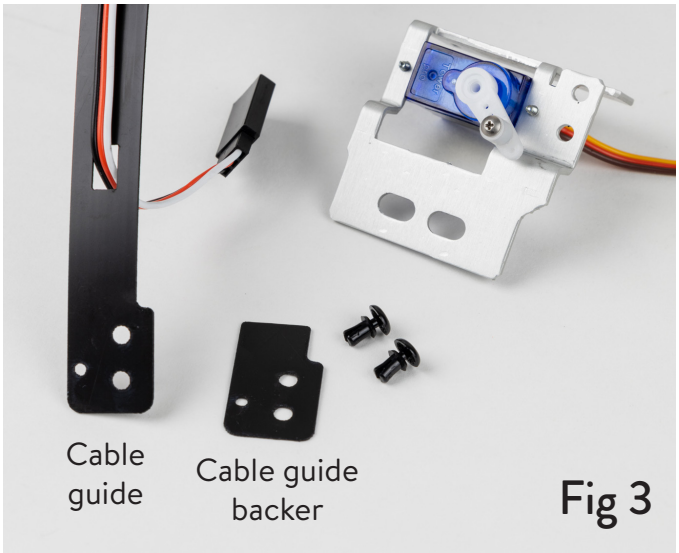


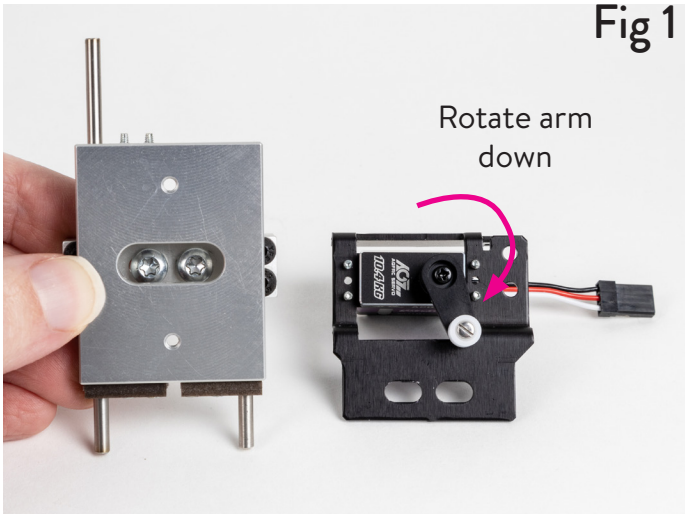
Fig 3

Step B5: Attach the new servo mount

Now, let's attach the vertical slide with the new servo mount.

First, get things oriented correctly:

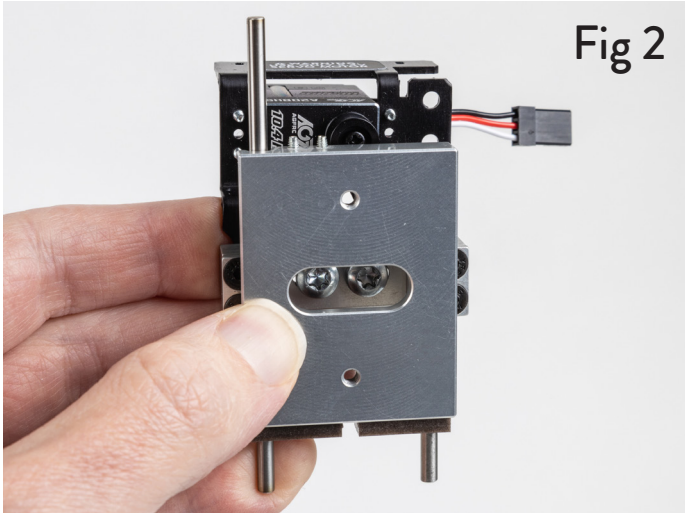
1. Rotate the black lift arm on the servo to point down to the right, as shown here (**Fig 1**).
2. If the vertical slide has come "unfolded", with the two parts "hinged" together, fold it back together so that the rails slide vertically.
3. Orient the vertical slide as shown here, with only a single shaft coming out the top.



Then, drop the two screws from the vertical slide through the big hole in the front of the vertical slide, into their slots (**Fig 1**).

Next, place the servo mount behind the vertical slide (**Fig 2**), such that:

1. The black lift arm is still pointing down, now hidden by the vertical slide,
2. The vertical slide is still oriented with the one shaft coming out the top.
3. The two screws go through the two big slots in the black servo mount.

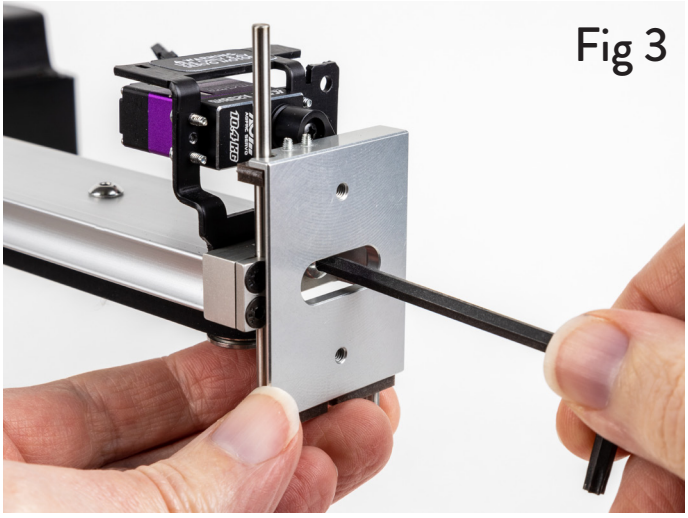


Finally, use those two screws to re-attach the slide assembly to the end of the Y carriage (**Fig 3**).

The front face of the Y carriage may have two or four holes in it.

- If there are only two holes, use those.
- Otherwise, *for all AxiDraw models except the AxiDraw V3/A3*, use the top two holes.
- On the AxiDraw V3/A3 *only*, use the bottom two holes (which are further apart).

Be extremely careful as you screw this back into place. Alternate between two screws and make sure that both screw heads are kept free of and **do not** press against the vertical slide; they could damage the slide.



Step B6: Checks

Your new servo mount and coreless servo should now be installed in place behind the vertical slide (**Fig 1**).

Basic checks to make sure that everything looks OK:

- The vertical slide should move up and down freely when you lift it.
- The vertical slide should be supported by the rolling wheel at the end of the lift arm.
- The vertical slide and servo mount should be reasonably perpendicular to the table top, not at an odd angle.

If anything is amiss, this is a good time to identify and correct it.

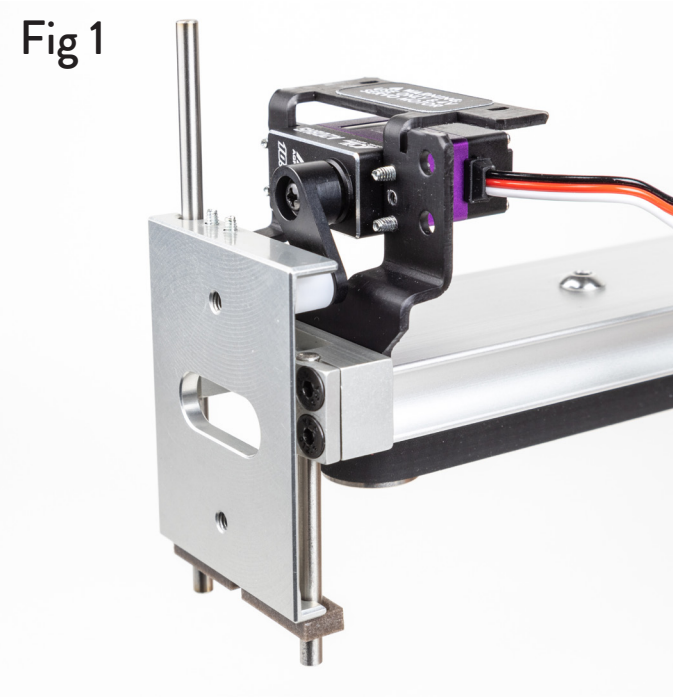


Fig 1

Step B7: Special check on AxiDraw V3/A3

For AxiDraw V3/A3 only: there is one more check.

Slide the Y carriage all the way back to the main carriage. The new servo mount should not contact the cover over the main carriage. There is normally very little clearance here (**Fig 2**), but it should not actually catch there, limiting travel or causing excess friction.

If it does contact, then very slightly loosen the two screws that hold the vertical slide in place, and pull the servo mount up as far as it will go while you tighten the two screws again.

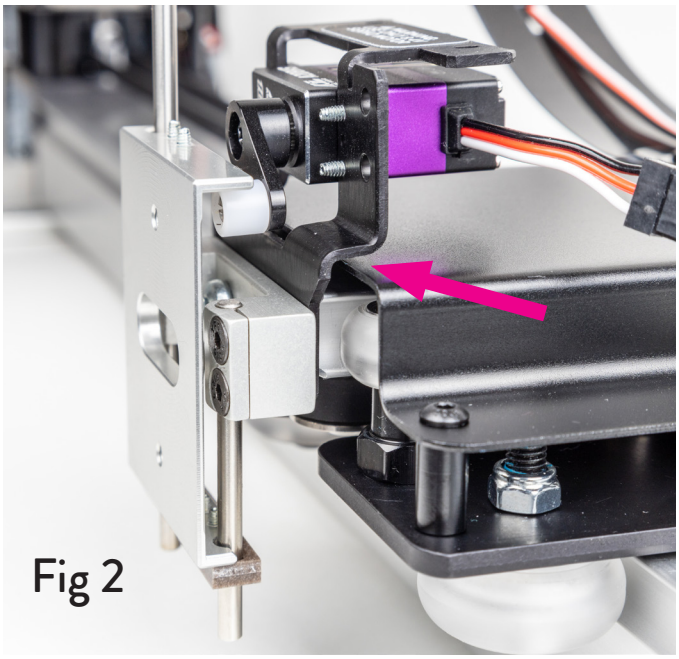


Fig 2

This concludes Part B.

Next, proceed to Part C, starting on the next page.

Part C - Cable Guide & Tiedown

Step C1: Attach the cable guide

*If your cable guide is already attached — if you left it on as directed by an earlier section — skip this step and proceed to **Step C2** on the next page.*

First, locate the parts for attaching the cable guide.

In addition to the existing cable guide (still attached to the AxiDraw) you'll need the cable guide backer that you removed earlier, plus two long plastic rivets and a black plastic spacer (**Fig 1**) from the upgrade kit.

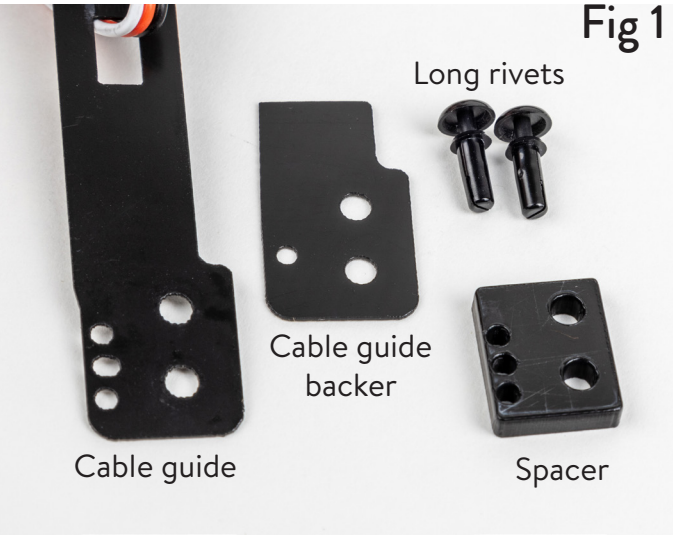


Fig 1

Place the spacer in position first, aligning its two large holes over those in the servo mount (**Fig 2**), and the small holes over the protruding screws that mounted the servo motor.

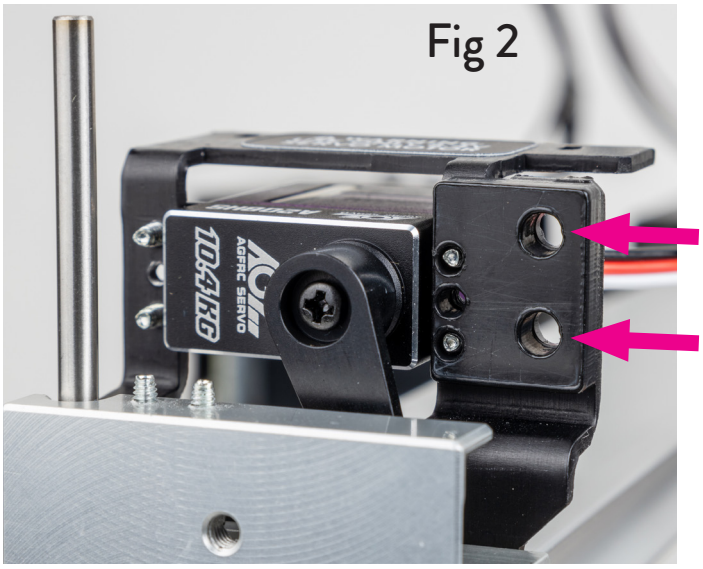


Fig 2

Next, align the cable guide backer behind the end of the cable guide. Slip one of the plastic rivets through one of the two large aligned holes in the pair (first through the cable guide and then through the backer). Then, guide the point of the rivet through the matching hole of the spacer and servo mount. If everything looks aligned, press firmly to snap the rivet into place (**Fig 3**).

Then, press the other rivet through the remaining hole and snap it into place as well (**Fig 4**).

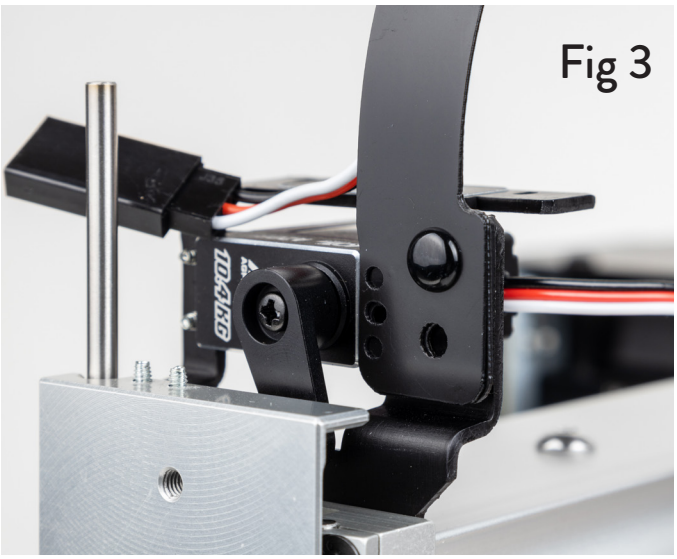


Fig 3

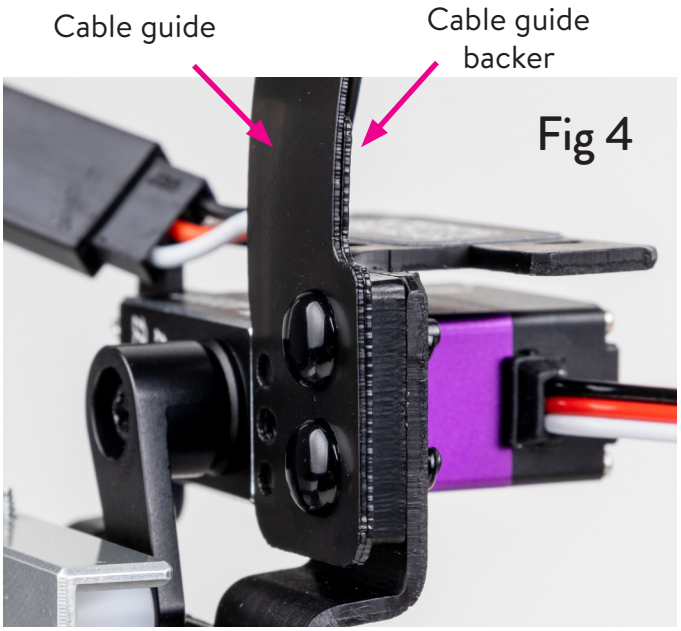


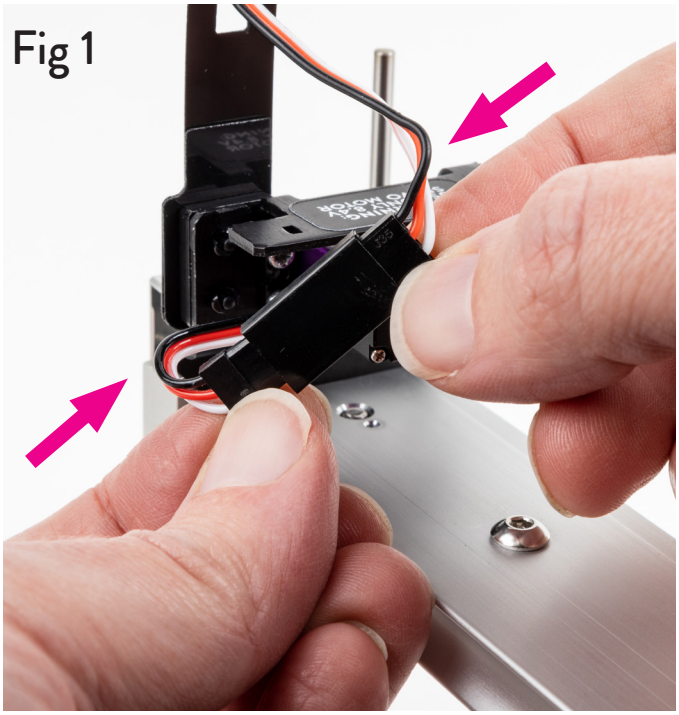
Fig 4

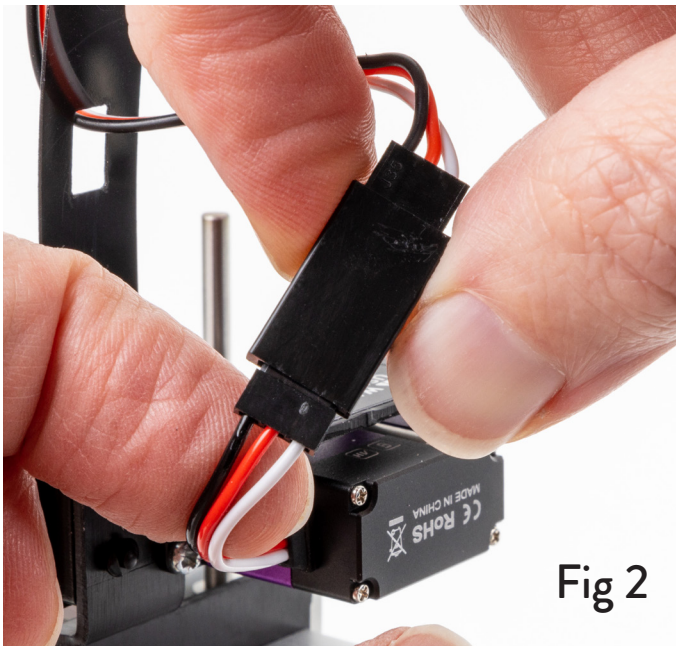
Step C2: Connect the servo cable

Plug the new servo motor into the connector jack until it is fully seated (**Fig 1**). As you do so, take care to avoid any extra twisting of the cable; It's best if it lays flat to the extent possible.

The orientation matters; connect the cables with the expected orientation (**Fig 2**):

- Black to Black
- Red to Red
- White to White





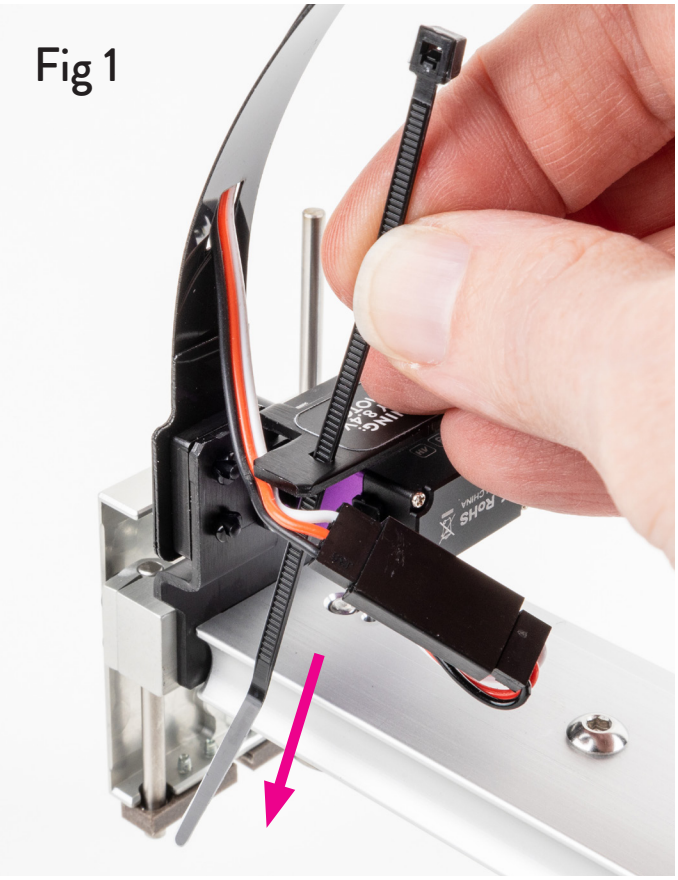
Step C3: Begin tying down the cable

We now begin the process of tying down the excess cable slack.

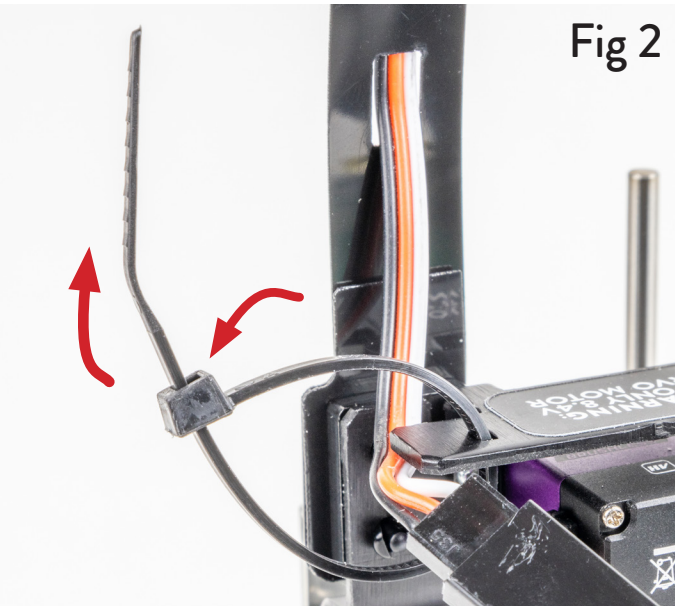
Ideally, we would like to end up with something as neat as the first pictures of this upgrade guide, before removing the old servo motor. We should end up with the red-white-black cable strain relieved in the same place — under the metal tab — and tied down neatly on the other side.

In practice, the amount of available cable slack varies from unit to unit, and it is not always easy or straightforward to achieve such a clean result. **The important thing** is that you don't leave extra cable loops hanging down that can get caught on something as the AxiDraw moves.

In case of ambiguity or variation, prioritize tying the cables up in a way that prevents hanging cable loops. (And, ask for help if you need it).



To get started: Tuck the black/red/white cable under the metal tab of the servo mount, and insert a cable tie down through the hole in the tab (**Fig 1**). Loop the cable tie back up and through the end clasp (ferrule) of the cable tie (**Fig 2**). Don't cinch it tight just yet.



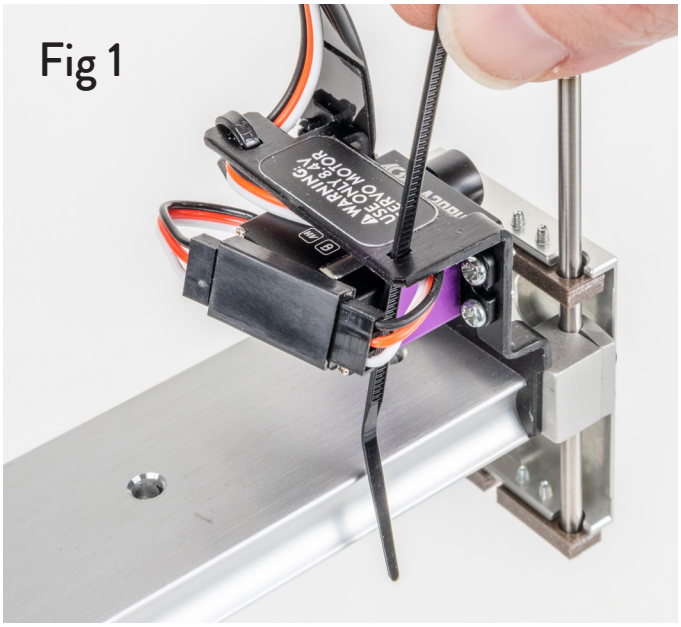
Step C4: Finish tying down the cable

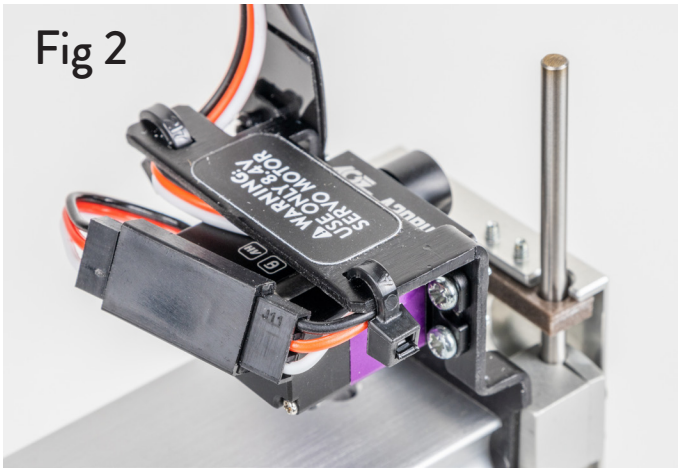
Tuck the excess cable over the top of the servo motor and below or behind the metal flap above it.

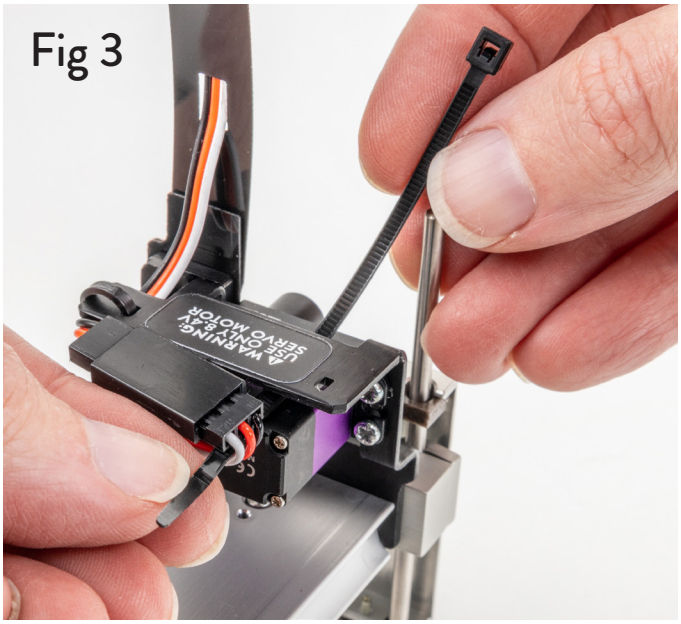
If you have enough slack to do so, add a second cable tie on the opposite side, down through the hole capturing this part of the cable in place (**Fig 1**).

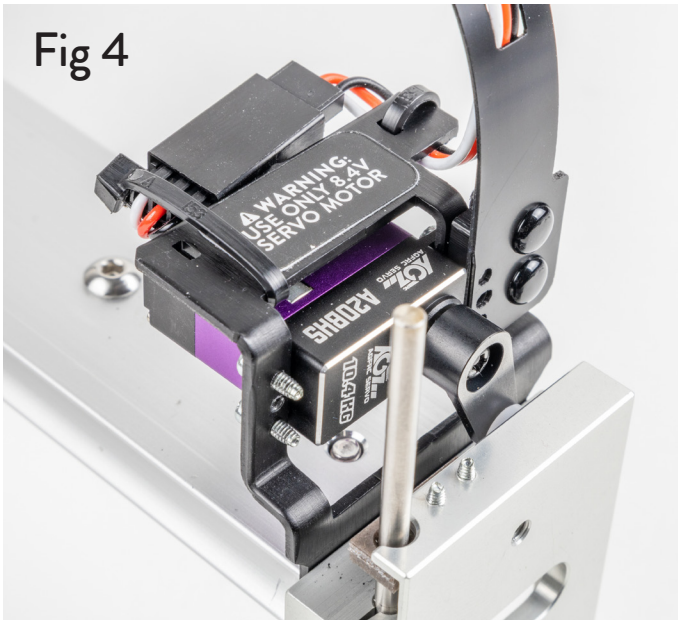
If everything looks neat — or neat enough; without loops of cable hanging down — go ahead and cinch up the two cable ties and trim off any excess ends of the cable ties (**Fig 2**).

As an alternative, if there isn't as much cable slack available, you can put the second cable tie beneath the metal flap that covers the top of the servo motor (**Fig 3**). If you do so, try to arrange things such that the cable ties don't cover the warning label (**Fig 4**). Cinch the two cable ties tight and cut the excess ends.





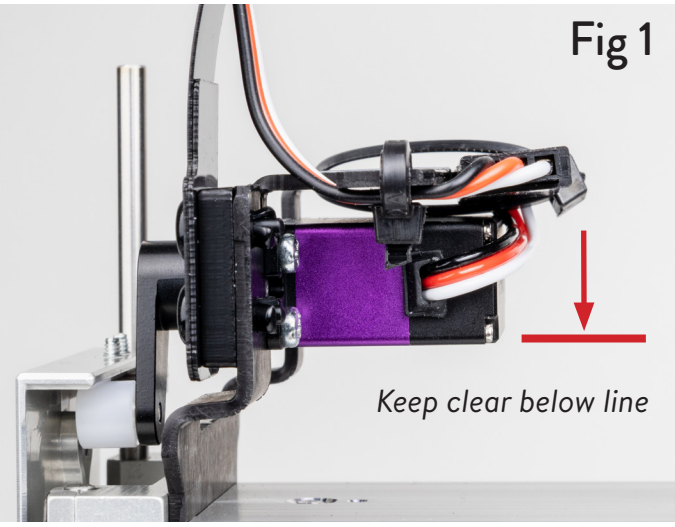


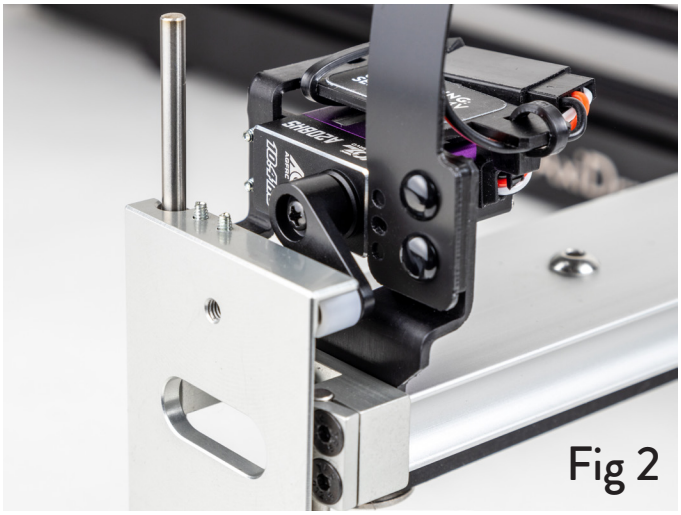


Step C5: Checks

The final appearance may vary a bit, but the important thing is that there should not be any excess cable below the servo motor itself (**Fig 1**). The cable should be tied down well enough that it can't fall down below that point either.

Finally, before we move along, make sure that the front face of the vertical slide is supported by the little white rolling wheel at the end of the pen lift arm (**Fig 2**).





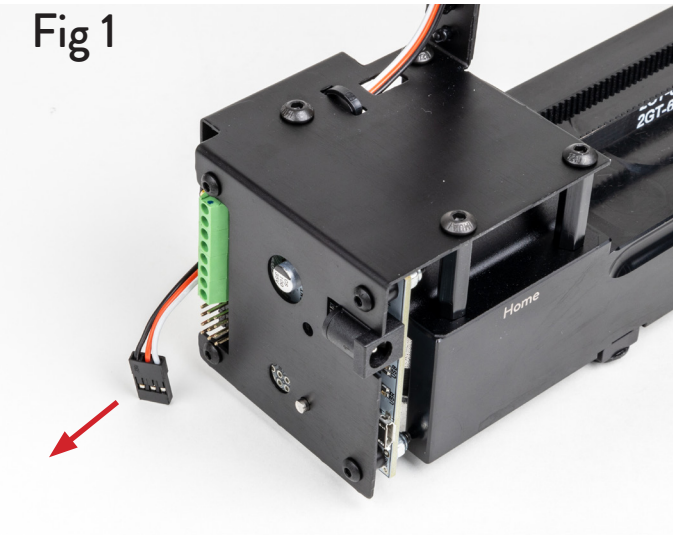
This concludes Part C (Cable Guide & Tiedown)

Next, proceed to Part D, starting on the next page.

Part D - Upgrading the electronics

Step D1: Disconnect servo cable

On the left-hand side of the AxiDraw, disconnect the servo extension cable, the black-red-white cable. Pull it straight out to release it (**Fig 1**).



Step D2: Remove three cover screws

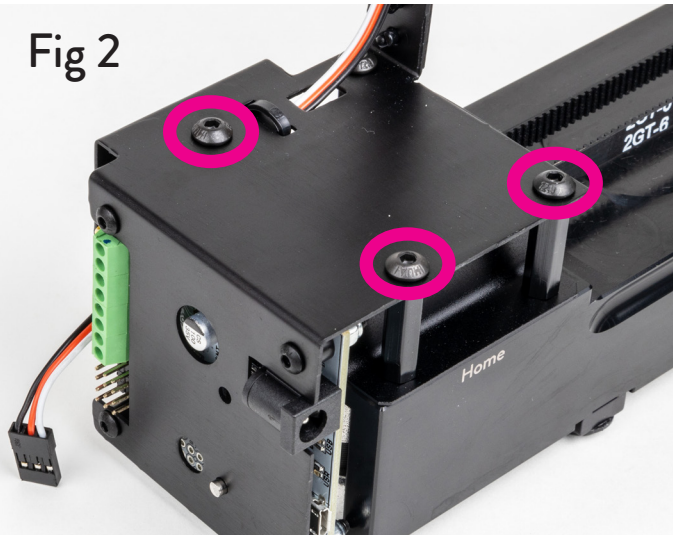
Identify the three highlighted screws on the top of the black metal cover over the AxiDraw electronics (**Fig 2**).

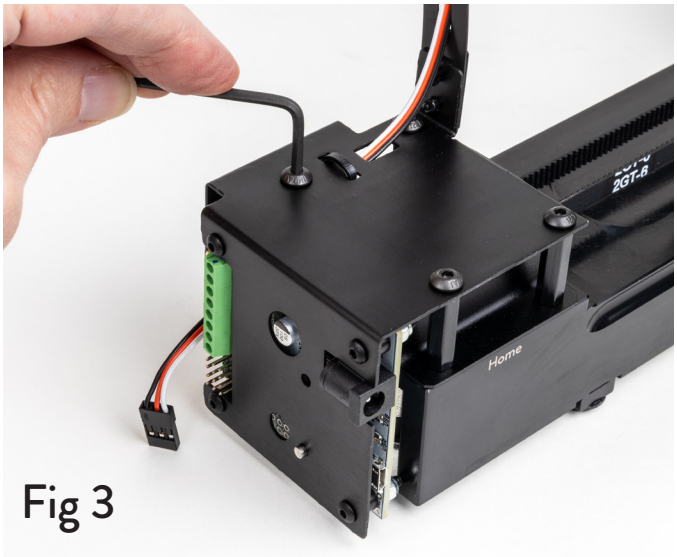
There are four screws on the top of the cover. The three to remove are the two “front” screws, closest to the **Home** label, plus the one in the back left, closest to where you disconnected the servo cable.

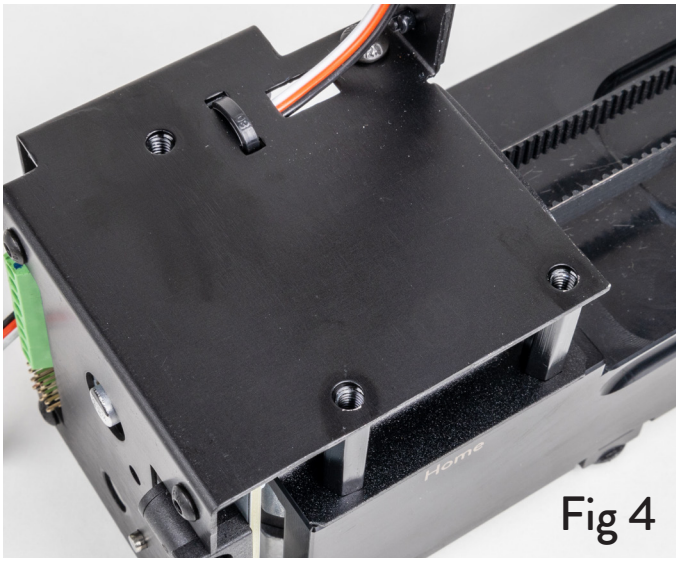
Using one of the hex L-wrenches, unscrew and remove those three screws (**Fig 3**, **Fig 4**).

Depending on the age and model of the AxiDraw, you’ll either use the 2 mm or the 2.5 mm hex L-wrench, to remove the screws (which are either M3 or M4 size).

Keep track of which size hex L-wrench you used; that will be helpful shortly.







Step D3: Stage the power module

Identify the **power module** (**Fig 1**) from the upgrade kit.

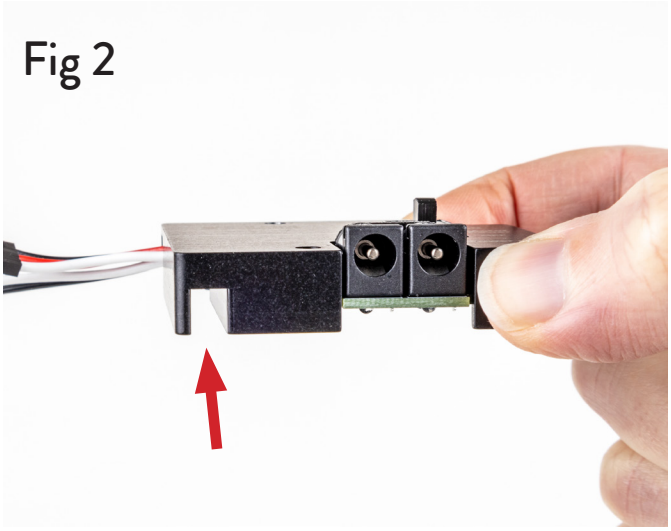
The power module has a channel through its lower side, designed for routing cables.

Optional but highly recommended:

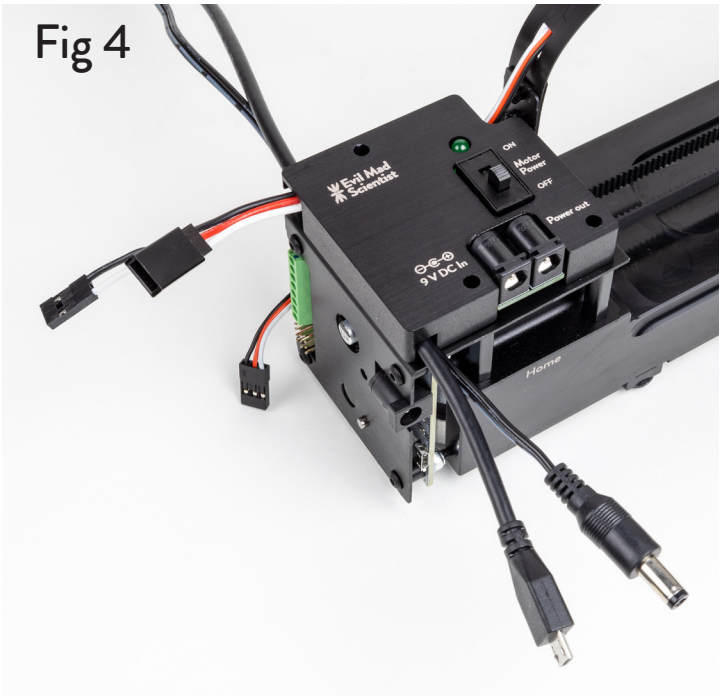
Place the power module over your USB and power cables, with the two cables fitted into its lower channel as shown (**Fig 3**).

The two cable ends should come out the front of the channel: The small ("micro-B") end of your USB cable and the barrel plug from the new 2.5 A power supply included with the upgrade kit.

(Do not plug in either end of either cable yet.)



Place the power module over the old electronics cover, roughly lining up the three holes in it with the holes from the three screw holes that you removed (**Fig 4**).



Step D4: Lightly attach power module

The upgrade kit includes 6 long black screws: 3 each, in two different thread sizes (M3, M4). You'll need 3 of one size or the other.

Find the 3 screws that are the same type as the short ones that you removed. If you kept track of which hex L-wrench you used to remove them, use the screws that fit that same wrench. Otherwise, compare the screw diameters.

Place the screws through the three holes in the top of the power module. Thread them very lightly into place: One turn only, to hold them in place (**Fig 1**).

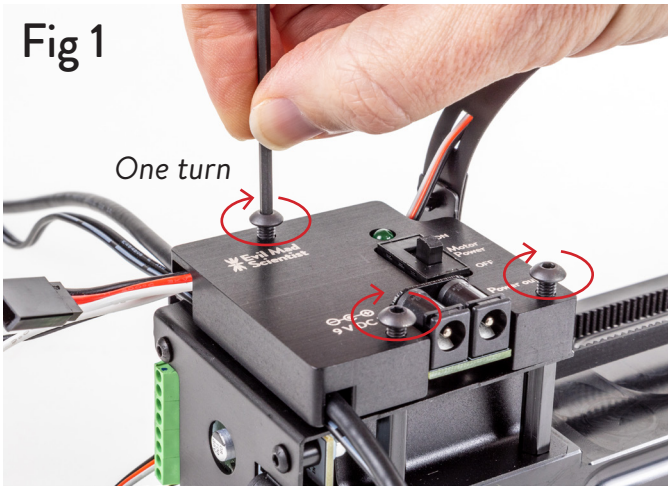


Fig 1

Step D5: Connect the new servo wiring

One of the two cables coming out of the power module has only two wires on it, black and white. Connect that cable to the EBB control board, in the third position up (two positions above where the old servo cable was connected), with the black wire towards the back of the AxiDraw and white towards the front (**Fig 2**, **Fig 3**).

Then, connect the two remaining cable ends together: the old servo plug goes into the new three-wire cable from the power module (**Fig 4**). Red to red, black to black, white to white (or white to blue, on the AxiDraw SE/A1 and SE/A2).

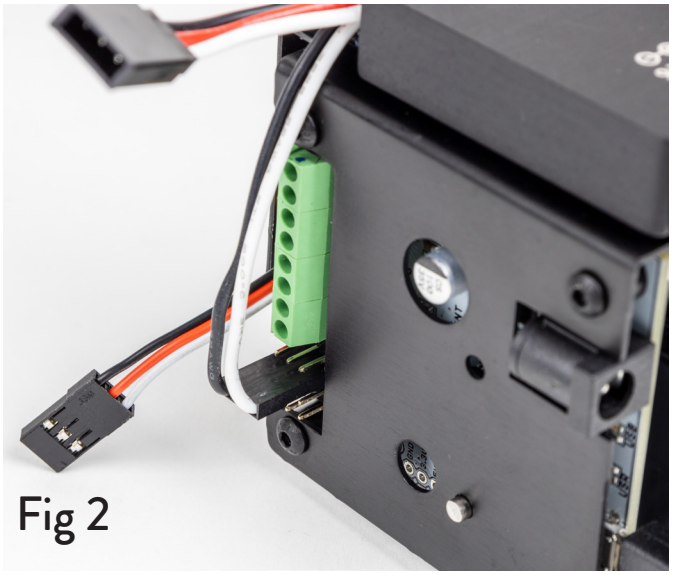


Fig 2

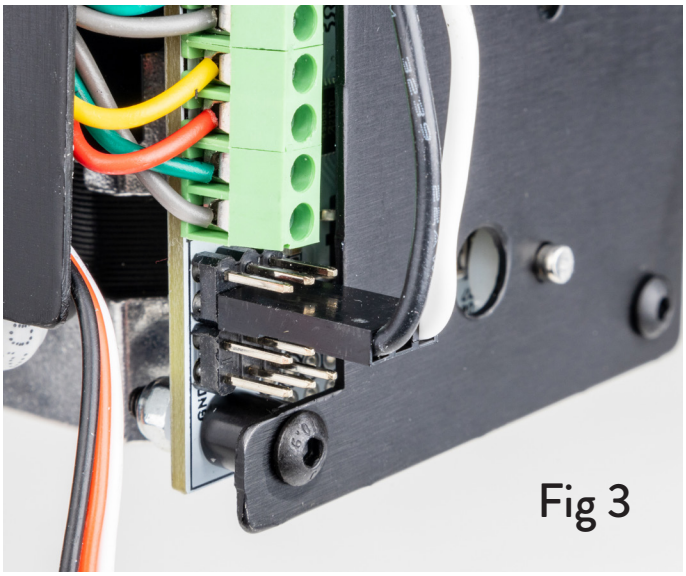


Fig 3

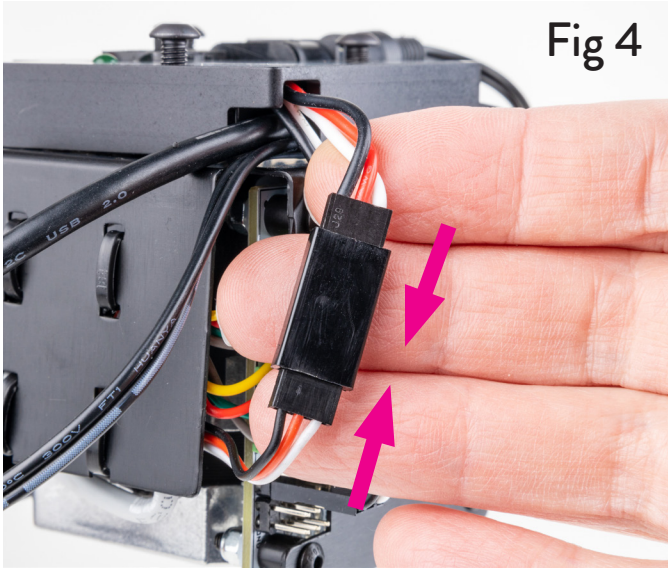


Fig 4

Step D6: Secure the power module

IMPORTANT SAFETY CAUTION:

Verify, and be certain, that the power supply is unplugged (unpowered) before starting this step. Continue to leave it unpowered until after the power module is secured by tightening the three screws at the end of this step.

If you have fed the USB and power cords under the power module:

Connect the two cables at this time, after verifying that the power cable is not plugged into power (**Fig 1**).

Plug the USB cable into the USB jack on the EBB control board, in the usual location towards the bottom of the AxiDraw.

Connect the barrel plug of the 9 V, 2.5 A power supply to the nearest power jack, which is labeled "9 V DC In".

Then, *very gently*, pull any excess cable slack back through the power module (**Fig 2**).

Secure the power module in place by tightening the three screws on the top (**Fig 3**).

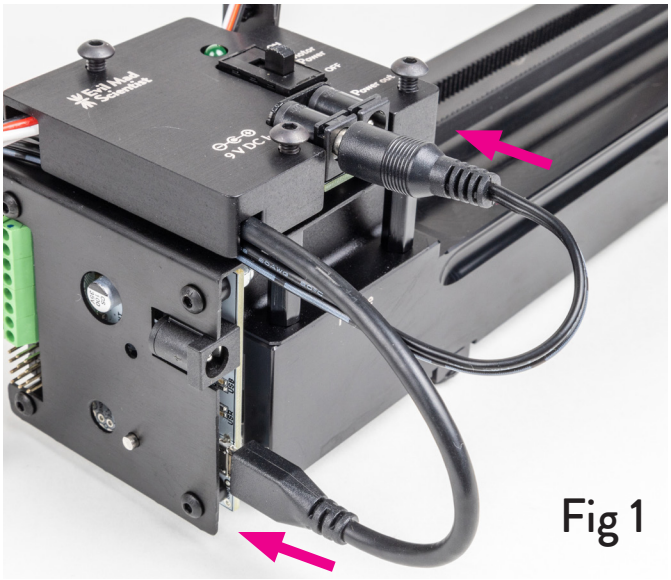


Fig 1

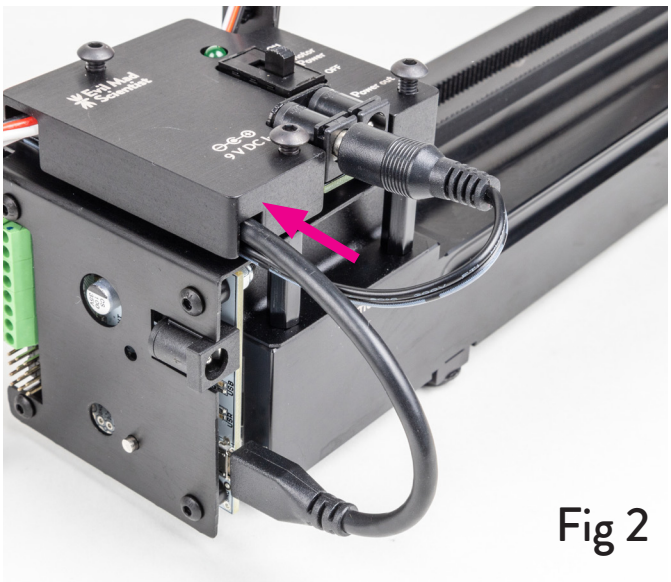


Fig 2

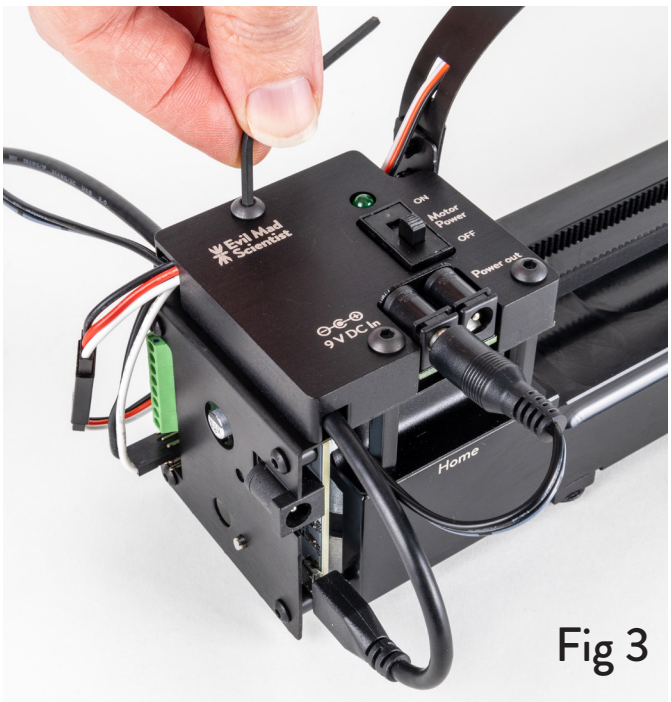


Fig 3

Step D7: Power jumper cable

The power jumper cable (**Fig 1**) is a short double-ended power plug cable.

Plug one end of the cable into the jack of the power module that is labeled "**Power out**".

Plug the other end into the existing power jack on the AxiDraw's control board (**Fig 2**, **Fig 3**).

Fig 1

Fig 2

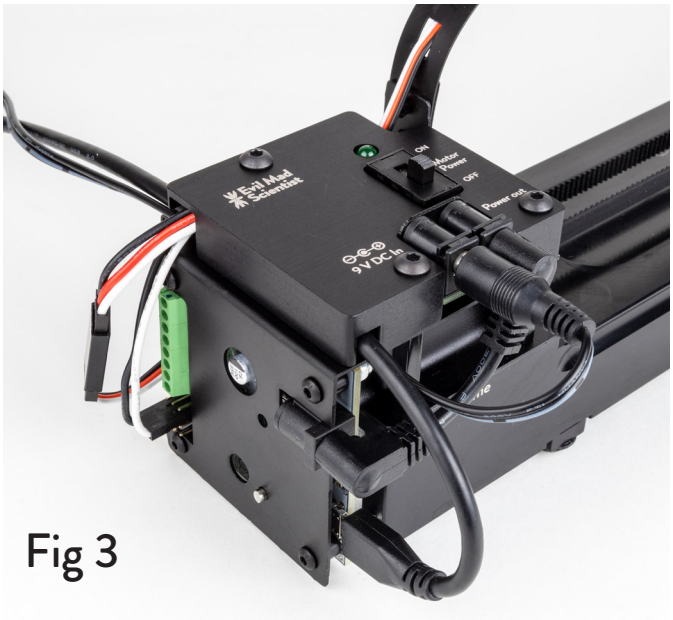


Fig 3

Part E - Using the upgraded AxiDraw

Step E1: Connecting power and USB

The upgraded AxiDraw with brushless servo motor should only be used with a regulated 9 V, 2.5 A, center-positive DC power supply such as the one provided in the upgrade kit.

If you have not already done so, go ahead connect the AxiDraw power and USB. If you did not route the power and USB cables under the power module, you may find it convenient to route the cables towards the back as shown (**Fig 1**).

If the USB and power cable are routed through the power module and you wish to switch to a different USB or power cables, loosen the three screws atop the power module in order to do so, and tighten them again once you have finished.

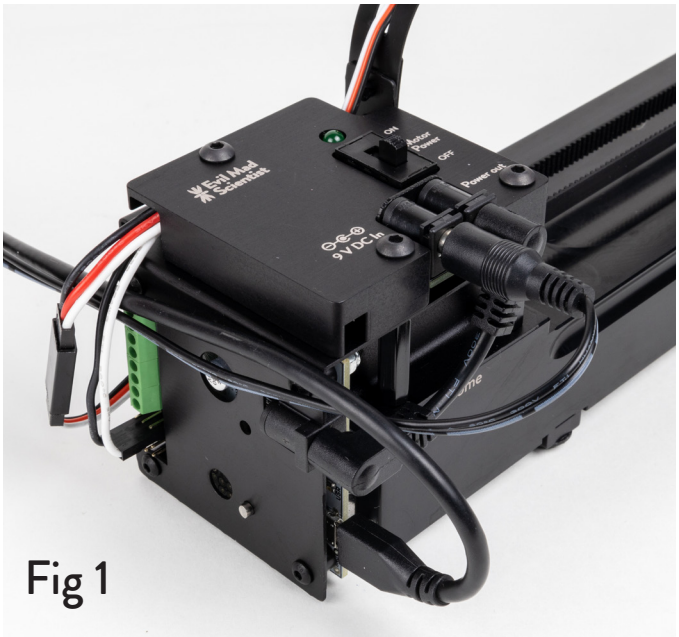


Fig 1

Step E2: The power switch

The power module has a slide switch labeled "**Motor Power**" (**Fig 2**). This switch controls power to both the horizontal stepper motors and the pen-lift servo motor. An LED light is lit when power is connected and the switch is turned on.

Power off the AxiDraw motors when not in use.

Fig 2

Step E3: Compatible servo motors

After upgrading the power supply, use only micro servo motors that are compatible with 8.4 V power and accept a Futaba-style (720 µs center) narrow-band control signal. The warning label on the servo mount (**Fig 3**) serves as a reminder.

(If you need to downgrade the AxiDraw to use standard servo motors, you can do so by fully removing the power module from the AxiDraw.)

Fig 3

IMPORTANT SAFETY WARNING:
Servo motors, except those specifically indicated, are **not compatible** with 8.4 V power. A hazard will exist if you connect a normal "low-voltage" servo motor to the 8.4 V provided by the brushless upgrade power module.

Step E4: Software and settings

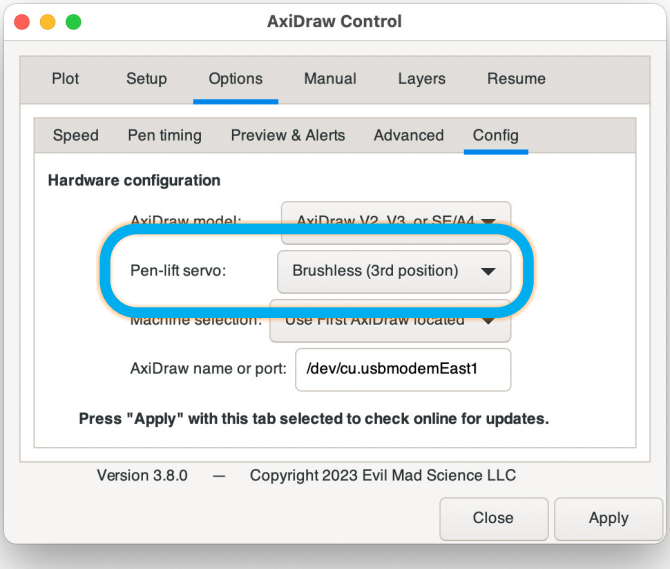
The brushless servo requires AxiDraw software version 3.8 or newer.

If you are using Inkscape with AxiDraw Control or AxiDraw Merge, select “Brushless” as the “Pen-lift servo” type on the **Options > Config** tab (**Fig 1**).

For the AxiDraw command line or Python API, configure the **penlift** option to select the brushless servo configuration:

https://axidraw.com/doc/cli_api/#penlift
https://axidraw.com/doc/py_api/#penlift

Fig 1



Step E5: Springs and weights

The brushless servo motor is much stronger and more robust than regular servo motors. It can be used with heavy pens, added weights, or the included spring kit (**Fig 2**) to add writing pressure when desired. (Do not add pressure with delicate pens like fountain pens, markers, or technical pens.)

Heavy weights may cause the AxiDraw base to tip forward. Heavy springs may cause the AxiDraw base to tip backwards; keep an eye on the base when changing configurations. The AxiDraw base may be clamped, screwed, or weighted down if necessary.

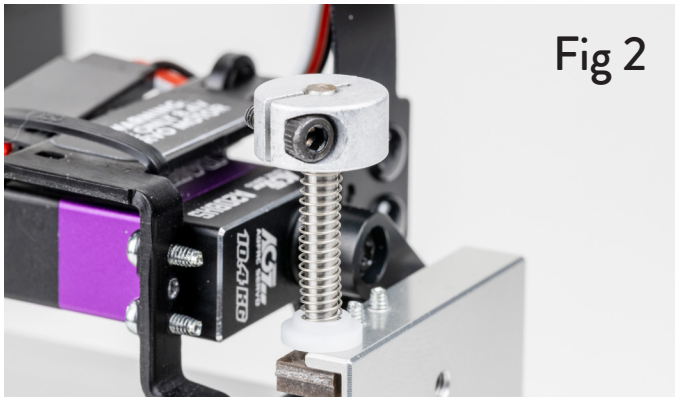


Fig 2

See Appendix for more about the spring kit

Step E6: Speed considerations

The brushless servo can, at high speeds, lower faster than gravity alone allows the pen to drop. If this happens, lower the pen-lowering speed, or consider adding a spring to help the pen lower faster.

The force of the pen hitting paper can also cause the pen to shift in the pen clip. Wrapping a piece of tape around the pen barrel can stop it from shifting.

Step E7: Maintenance

Periodically inspect the rolling wheel on the lift arm (**Fig 3**) for wear. This wheel will wear down over time with heavy use but can be replaced (See Appendix).

Heavy use, particularly with added weight or springs, can cause gradual wear on the other parts of the vertical slide. Vertical slides can be swapped or refurbished as needed; contact support.

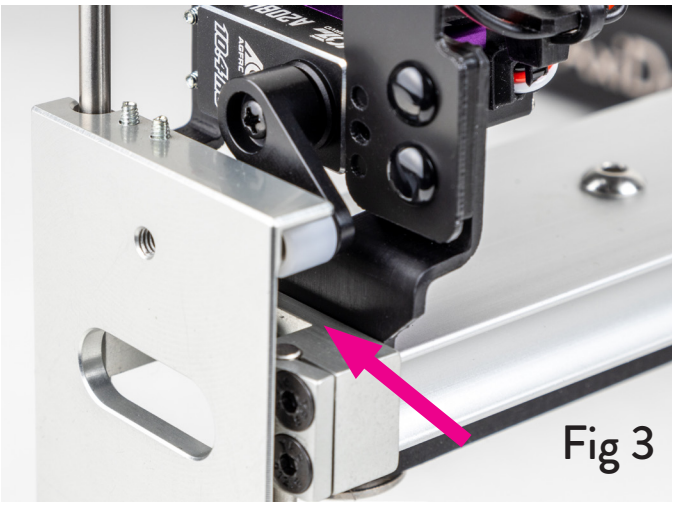


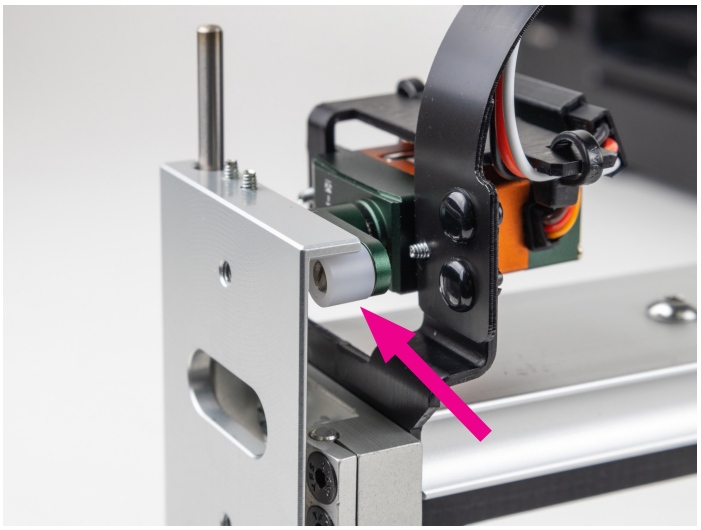
Fig 3

This concludes the installation and use instructions for the Brushless Servo Upgrade Kit.

Appendix: Wheel replacement & Servo Calibration

The rolling wheel on the end of the lift arm is designed to be replaceable. (It can wear down over time, but protects the lift arm and vertical slide so that they can last much longer.)

Periodically check this wheel's condition. It can work just fine after quite a bit of wear, but it should never get so low that the screw head inside is exposed.

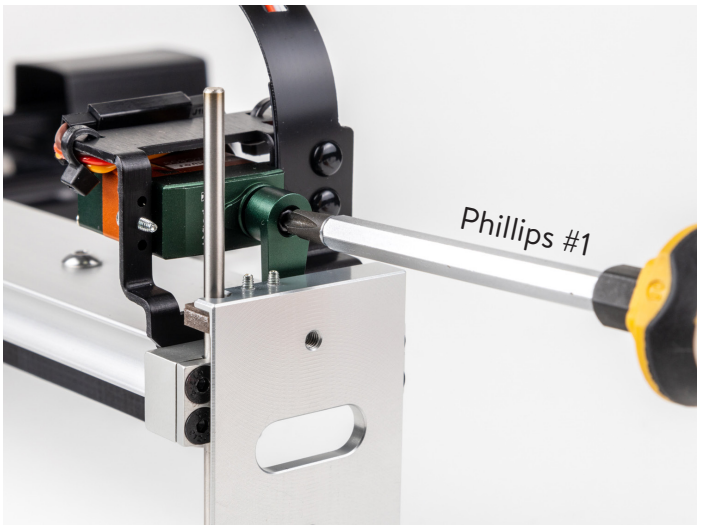


Replacing the wheel alone:

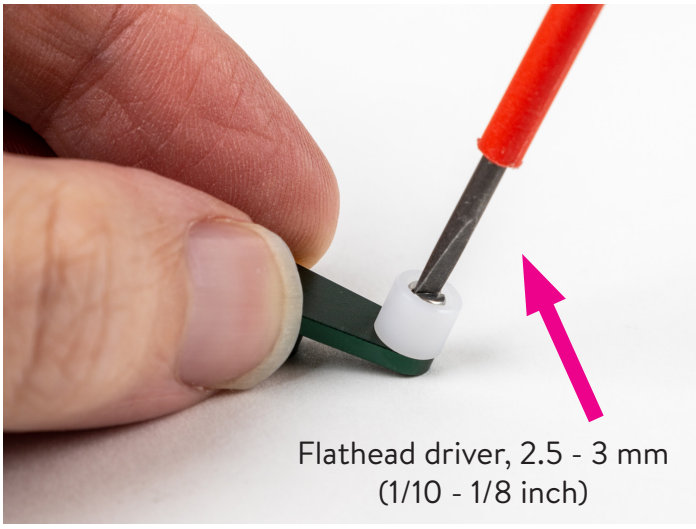
To replace the wheel without removing the whole servo motor, disconnect the AxiDraw from power and USB.

Point the lift arm straight down, and use a Phillips #1 driver to loosen and remove the screw that holds the lift arm in place. Hold the lift arm in place as you do so, keeping it pointing down.

Once you've removed the screw, you should be able to pull the lift arm off of the servo motor.



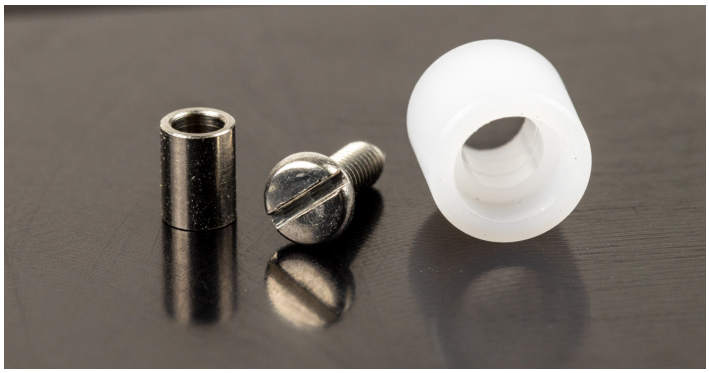
Once the lift arm is removed, use a 2.5 - 3 mm (1/10 - 1/8 inch) wide flathead screwdriver to unscrew the wheel.



– *Continues on next page* –

Replacing the wheel alone *(continued)*

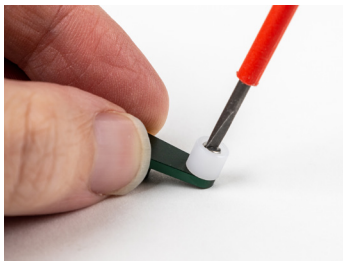
Inside the wheel is a screw that goes through a stainless steel sleeve. You'll re-use these with the new wheel. Put the screw through the sleeve, and then through the recessed end of the new wheel.

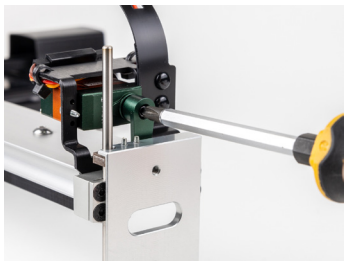


Then, reverse the prior steps: Screw the new wheel into place on the lift arm and tighten it into place. Then the lift arm back onto the servo motor — still pointing straight down — and screw it into place.

After removing and replacing the lift arm, plug the machine back in and use the AxiDraw software to raise and lower the pen between 0 - 100% heights.

Verify that the lift arm is still correctly positioned: It should only point **to the right** (or up or down); never past center to the left, or otherwise run into the limits of travel. If necessary, cut power and re-position the lift arm.

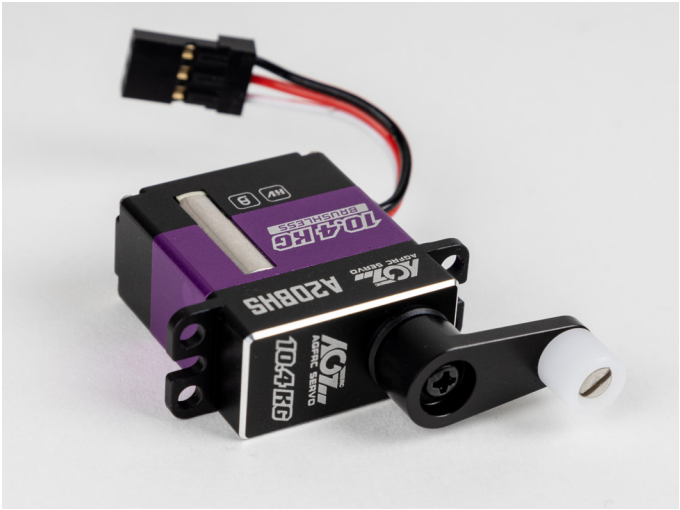




Calibrating the lift arm when replacing the servo motor

If you are moving the lift arm from one brushless servo motor to another, you can position the lift arm before screwing the servo motor into place.

A relatively easy way to do so is to set your pen up and pen down positions both to 50%, move the pen to that position, and then attach the lift arm, pointing to the right, while it is held there.



Appendix: Spring Kit

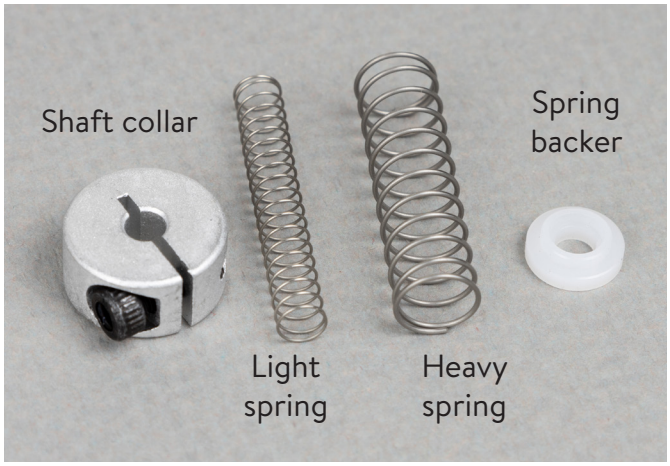
1. About the spring kit

The spring kit is an optional accessory. It allows a Bantam Tools NextDraw, or an AxiDraw with the brushless pen-lift motor, to apply some amount of pressure while writing. That's helpful for working with certain types of writing implements. It also helps the pen lower faster, when speed is a concern.

Downward pressure can increase the noise when using the machine — when a pen hits the paper hard.

Downward pressure can damage or destroy, and is thus not recommended for, delicate pens such as fountain pens or technical pens, and it can cause rapid wear on fiber-tip pens.

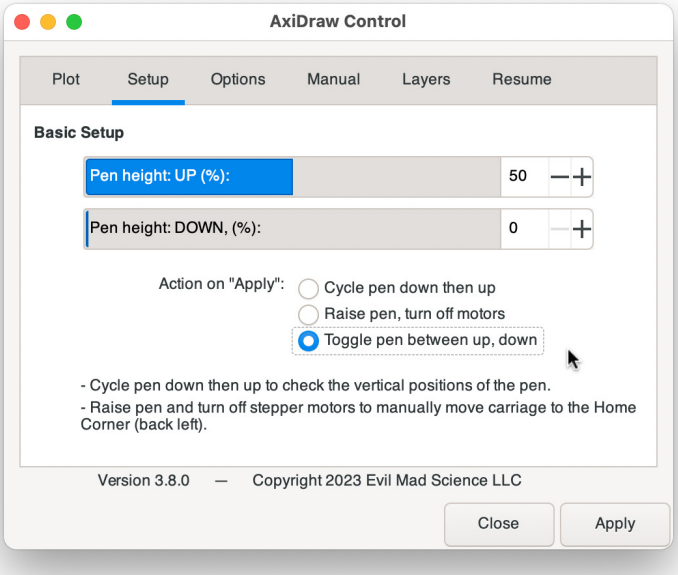
Carefully read and follow these instructions about the spring kit to avoid potential damage to your brushless servo and/or vertical pen-lift stage.



There are four parts to the kit: A **shaft collar**, a **light spring**, a **heavy spring**, and a machined plastic piece called the **spring backer**.

Using the spring kit reduces the available vertical travel range, as the spring does take up some part of that range. The critical part of what follows will be setting the pen-up height correctly with a spring in place.

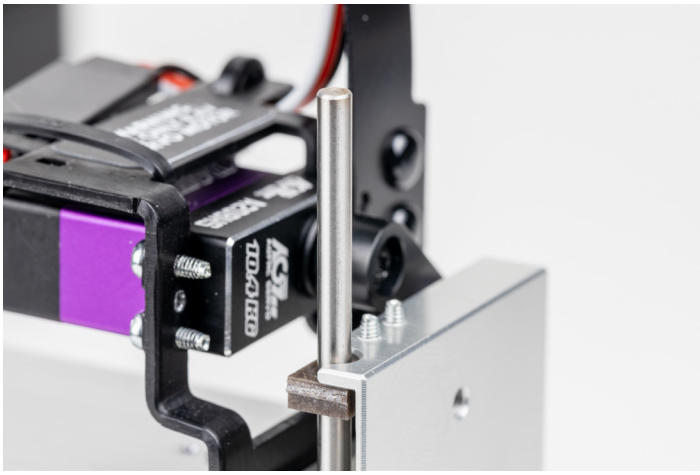
Springs wear out over time; replacements are available from Bantam Tools.



2. Initial setup

In the **Setup** tab of the software that you use (AxiDraw Control, AxiDraw Merge, NextDraw or NextDraw Merge), set the **pen-up height** to **50%**, and the **pen-down height** to **0%**.

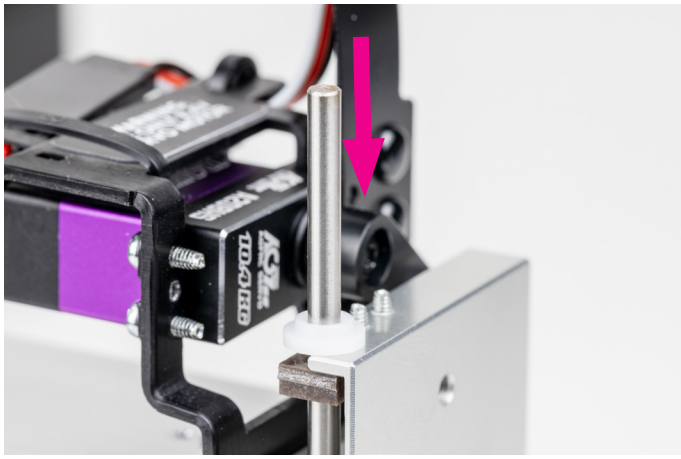
Then, if you are using Bantam Tools NextDraw, select the **Utility** tab and the "**Toggle the pen up/down**" option. If you use NextDraw Merge, AxiDraw Control or AxiDraw Merge, select the "**Toggle**" option on the **Setup** tab. Click Apply to toggle the vertical slide up and down until you are sure that it is in the "**down**" position, which should look like the image shown to the right:

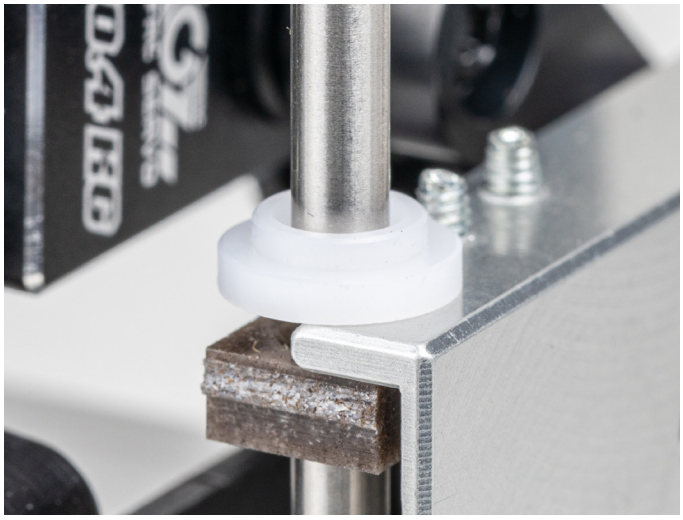


3. Add the spring backer

The spring backer has one smooth side and one side with a ridge on it.

With the vertical slide in the “pen down” state and the pen-up/pen-down positions still set to **50%** and **0%**, place the spring backer over the stainless steel shaft that extends above the vertical slide. Orient the backer smooth side down, with the ridge on the top.





4. Add the spring

Place a spring, either the light spring or heavy spring, over the shaft and spring backer. The light spring sits inside the raised ridge on the spring backer and the heavy spring sits around it.

If you’re just getting started, either is a reasonable choice. If, later, you decide that you want more or less downforce you can always switch.

The heavy spring gives about twice the force of the light spring, and works well for pens that require substantial force, such as traditional ballpoint pens.

The light spring does not add as much pressure; just a little bit. But that can make a substantial difference when working with gel pens and other types that benefit from a small amount of pressure.

All else being equal, the heavy spring will typically last longer, since it is made of thicker metal and does not wear against the vertical shaft.

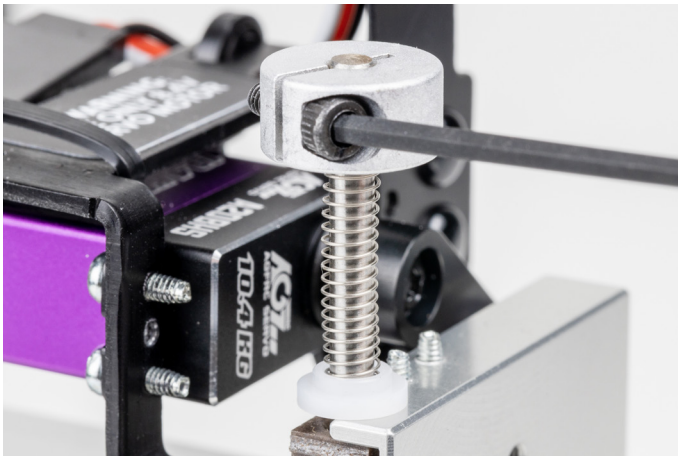
Light spring

Heavy spring

5. Add the shaft collar

Slip the shaft collar over the end of the shaft until its top is flush with the top of the shaft.

Tighten it firmly in place with your 2 mm hex L-wrench (the same one used to adjust the pen clip).



6. Test the range of motion

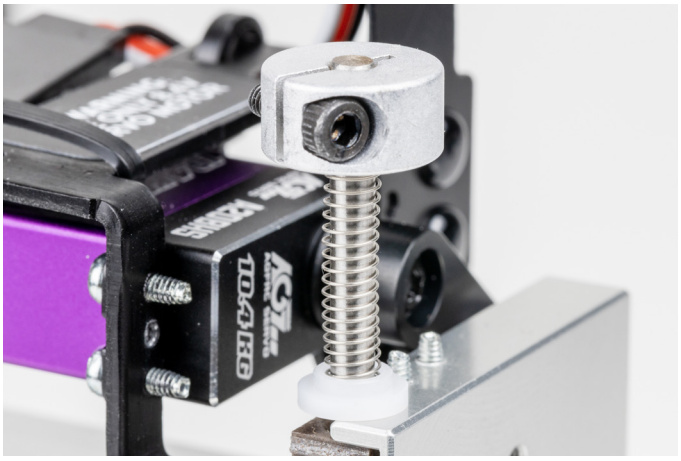
The safe range of motion for the vertical slide is from the bottom of travel until the spring is *almost* compressed to a solid. The spring should not become fully compressed to a solid or it can potentially damage the servo and slide. See the pictures below for reference.

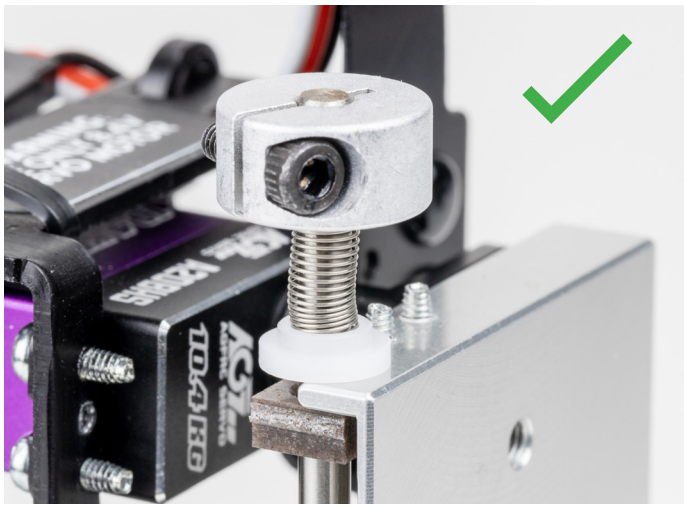
Go back to the software where you toggled the pen position. Toggle the pen up– and be ready to toggle it right back down again if necessary.

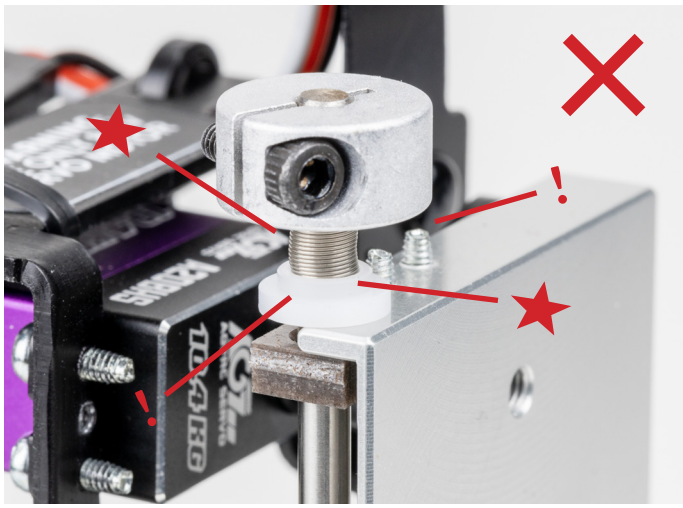
With the pen raised, **make sure that the spring is not compressed all the way to a solid.**

If the spring *is* compressed to a solid, toggle the pen back down immediately. Then, select a lower pen-up position and try again.

If the spring is not compressed to a solid, then you can adjust the pen-up position higher, so long as it does not become solid. Once your pen-up position is set, then choose the pen-down position to give an appropriate range of vertical motion for your application.







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