

## **DinoCam Assembly**

This document will run through the assembly process for the DinoCam as currently designed. Depending on your 3D printer & laser cutting tolerance, you might find you need to make adjustments. These instructions will overview how my DinoCam was assembled, using a Bambu, Prusa Core One, and Glowforge.

### **Getting Started – Fabricating the Parts**

Review the BOM & Supply List. Make sure to purchase all needed materials and tools. You will need access to a 3D printer and Laser cutter to fabricate these parts – if you do not have access to these tools you can outsource them to places like SendCutSend or Ponoko for laser cutting and Makelab for 3D Printing. I used a glowforge plus HD and a Prusa Core One to fabricate my Dino Cam. Of course, you can upgrade any of these materials or prints as you see fit (for instance, I decided to waterjet cut my fishing pole as it broke in acrylic and I used resin to print my dinosaur).

Review all STEP files and DXFs for the 3D Prints and Laser cuts. You'll likely want to use the "recommended" files, but there are alternate versions that are available to explore and may work well for your specific design. Feel free to modify any of the files as you wish! You'll see that I provided laser cut files with a "wave decal" that add a fun pattern onto the two plate layers. I recommend choosing a character from thingiverse for your "dinosaur". You'll want to scale your character to have a base of about 1" x 1", but you can adjust as needed. I used flush cutters to cut a hole in the rowboat for my dinosaur's tail, for instance.

### **Building the Subassemblies**

There are two main subassemblies for this build: the main crank shaft that gets assembled into the base, and then the base plate system that contains all of the "wave related" items. The master assembly adds final details like the top plate, rowboat, and dinosaur.

Subassemblies:

|        |                  |
|--------|------------------|
| DC-100 | Main Crank Shaft |
| DC-101 | Base Plate       |
| DC-102 | Master Assembly  |

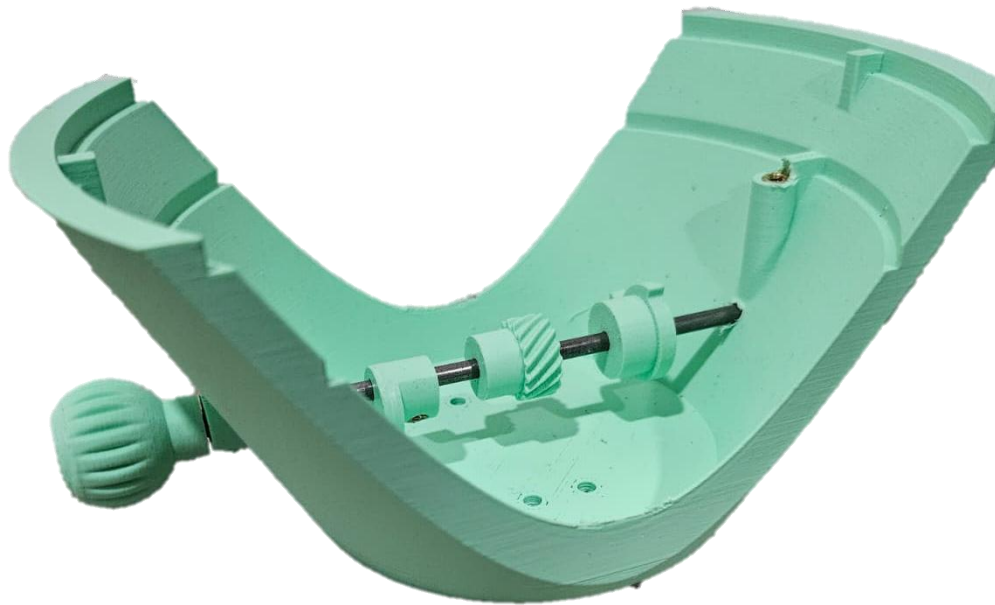
To get started, we'll work on DC-100 which will get the base & main crankshaft assembled.

### **Building DC-100**

Parts needed: DC-001 (Base), DC-004 (Crank Rod), DC-005 (x 2) (Knob Handle), DC-006 (Fishing Pole Cam), DC-007 (Rowboat Cam), DC-008 (x 1) (Helical Gear), DC-017 (x 5) (2-56 Heat Sets), DC-018 (x 5) (2-56 Set screws)

Tools Needed: Hand Drill, 2-56 Allen Key, 1/8" Drill bit, 9/64" Drill bit, hacksaw/bandsaw, quick grip clamps (2), soldering iron, sand paper or a belt sander.

What we're making:



- 1) Drill out the holes in the side of DC-001 with the 9/64" drill bit.
- 2) Cut DC-004 to 4 15/16" length with the hacksaw or a metal cutting band saw. Sand down any burrs on the edges. Ensure that it slides freely through the holes drilled out in DC-001.
  - a. If it does not slide freely through the holes re-do step 1. You should not have to sand down DC-004.
- 3) Depending on print tolerances, DC-005, DC-006, DC-007, and DC-008 may need to be drilled open. Test fit each piece on DC-004; a tight fit is recommended, but you will need to be able to slide these to the correct position on DC-004. If they are too tight, follow the steps below:

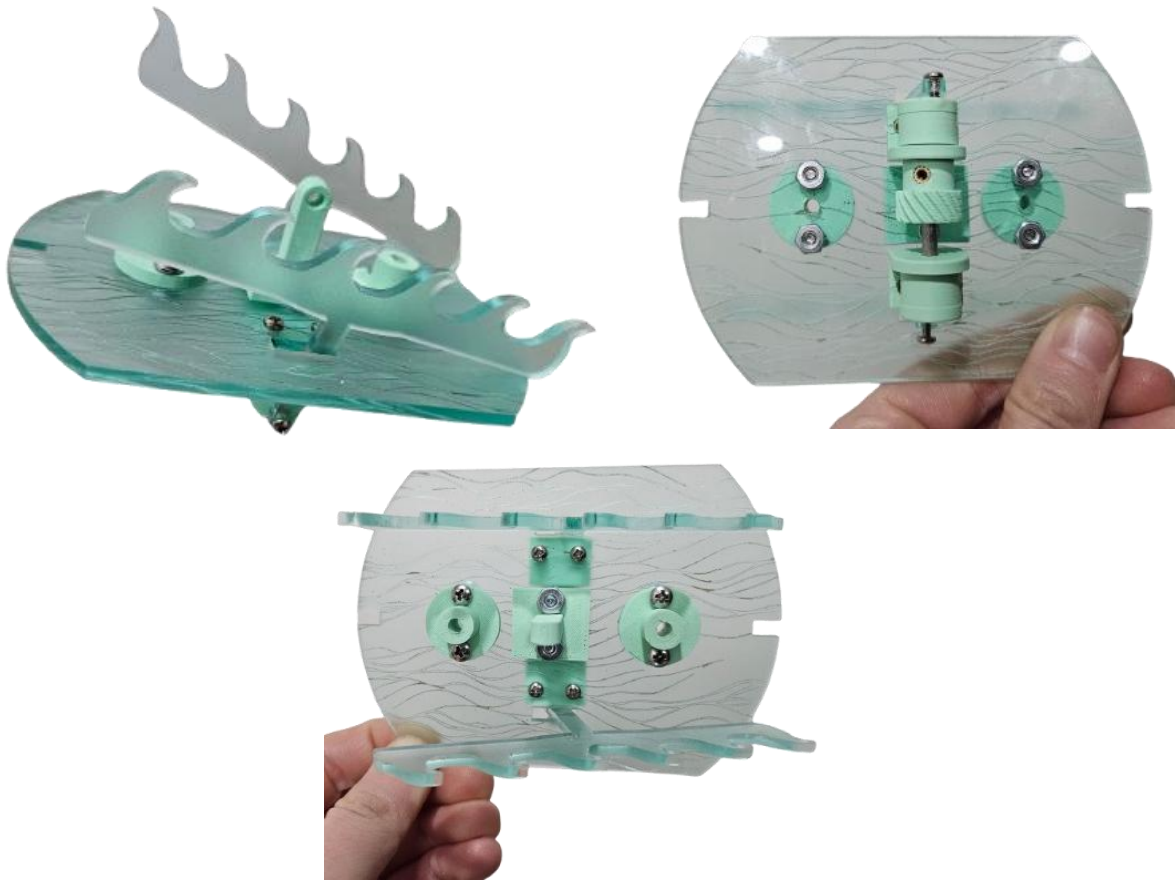
- a. Using the clamps, secure the cams/gears/knobs (they're small – if doing this by hand *be careful!*). Using the hand drill (or a drill press, if desired) with the 1/8" drill bit, drill through the center hole.
  - b. Test fit onto DC-004. If still too tight, redo with the 9/64" drill bit.
  - c. Repeat for any DC-006, DC-007, or DC-008 that are too tight.
- 4) Place the heat set inserts into DC-005, DC-006, DC-007, and DC-008. (*Not required for this sub-assembly, but DC-010 (2) and the other DC-008 will also need a heat set insert, which can be installed now*).
  - a. Tip: Install the heat set inserts with the rod running through the parts – this makes sure you don't sink the inserts in too far and can't assemble later! You should not need to press these inserts all the way into the parts.
- 5) Now we can assemble the main crank shaft! Fit DC-005 onto one end of DC-004. Using a set screw and the allen key, tighten this down so it stays in place on the rod. Insert this through *one side only* of DC-001.
- 6) In order, place DC-007, DC-008, and DC-006 onto the shaft of DC-004. Make sure to add them on in the orientation shown in the photo above. Make sure the helical gear teeth *face the snail cam*. DO NOT TIGHTEN DOWN YET!
- 7) Slide DC-004 through the hole on the other side of DC-001. You may need to shift any of the cams/gears to allow you to do this. Push DC-004 all the way through, so that DC-005 butts up against DC-001.
- 8) Use the other copy of DC-005 to secure the crank shaft into the base. Use the set screw and allen key to tighten this down.
- 9) Now it's time to align and position the cams & gear. Using the slot in the bottom of DC-001, insert DC-026 part way up through the bottom, so the uneven edge is facing up. Begin to adjust the parts – once you have everything in the right position, you should be able to push DC-026 all the way up so that it touches the crankshaft.
- 10) Leaving DC-026 pressed up against the crankshaft, tighten the components down into place using the set screws and the allen key. Note that the orientation of the cams to each other is up to personal preference; no specific orientation is required as long as they are in the right position. *Do not overtighten against the shaft – you may rip your heat sets out of your prints!*
- 11) Remove DC-026 (I recommend pushing it out with the allen key). Using either crank, test spin the crank in the base. The assembly should spin freely with minimal side to side motion. If you are seeing more than 1/16" of horizontal movement, you may need to disassemble and sand down DC-004.
- 12) NOTE: depending on your printing & laser cutting tolerances, we may need to adjust the exact placement of these parts later!

## Building DC-101

Parts Needed: DC-002, DC-008 (1), DC-009, DC-010 (2), DC-011 (2), DC-012 (2), DC-013, DC-014 (2), DC-015 (10), DC-016 (10), DC-017 (5), DC-018 (3), DC-029 (2)

Tools Needed: small Phillips head screwdriver, 2-56 Allen Key, Hand Drill, 1/8" drill bit, 9/64" drill bit, quick grip clamps, hacksaw/bandsaw, soldering iron, sand paper or a belt sander.

What we're making:



- 1) Cut DC-009 to 1.75" length with the hacksaw or a metal cutting band saw. Sand down any burrs on the edges.
- 2) We'll need to check that all parts fit with our 1/8" rod again – this will mean drilling everything out with either the 1/8" drill bit or 9/64" (as with the previous assembly, I recommend starting with 1/8" and if things are still too snug, switch to the 9/64"). You'll need to drill out: DC-008, DC-010, and DC-012.

- 3) Using the soldering iron, install the heat set inserts into DC-008 and DC-010. Note that DC-010 will need a heat set insert along the shaft and also on the top face. Make sure to install the heat set inserts on the top face so that they are flush to the edge – sitting proud may make your waves wobble.
- 4) Before we can assemble the crank, we will install all of the brackets and mounts. Starting with DC-013, install this through the two center holes in DC-002 with the 4-40 hardware (DC-015 & DC-016). NOTE: if you are using a patterned acrylic plate, make sure you place the mount on the *patterned* side as it will be facing up. Make sure the hardware is installed in the orientation shown in the photos for DC-101.
- 5) Mount DC-012 to either side of DC-013, with the mount on the same side. Make sure the 4-40 hardware is in the correct orientation, as shown below.
- 6) Before we mount all of our hardware on the BOTTOM of the acrylic plate, we want to check that the “follower” 1/8” rod slides freely through the collar mounts. You want this to be a smooth slide – not a tight fit. If you cannot slide the remaining rod through both collars, use the 1/8” drill bit in a drill press (recommended over a hand drill) and drill straight through the collar and acrylic. Test again. If it still does not slide freely, repeat with the 9/64” drill bit.
- 7) Mount DC-011 on the *opposite side* of DC-012 and DC-013, using the only holes remaining in the plate. Make sure to tighten down the 4-40 hardware so that everything is snug. This is the last of the mounting pieces, so ensure everything is tightened down and matches the photo below – the screws will be difficult to access after this point.
- 8) Now we’ll assemble the crankshaft rod to the plate. To start, confirm that DC-010 and DC-008 all can be fit onto DC-009. Snug is good, but if any parts are too tight to move we’ll need to drill them open -
  - a. Using clamps and the 1/8” drill, drill the center hole open. If the part is still too tight to slide onto DC-009, then repeat this process with the 9/64” drill bit.
- 9) Assemble one of the cranks (DC-010) onto the end of DC-009. Make sure the end is flush and the rod does not protrude from the crank. Tighten down with the set screw. Slide this through the first bracket on the mount plate.
- 10) Install DC-008 inside the two brackets in the orientation shown below. Press DC-009 all the way through until the crank is flush with the bracket, and then adjust DC-008 so that the non-worm end is flush against the bracket and tighten down with the set screw and allen key.
- 11) Install the final crank (DC-010) on the other end of the shaft (DC-009). If you want your waves to “alternate” timing, orient the heat set to be 180deg off from the other end. Tighten down with the set screw and allen key.

- 12) Add the waves using the smaller 2-56 screws. Insert the waves in through the slot and screw into place. Do not overtighten – you want the waves to spin freely (and don't want to crack the acrylic!).
- 13) Double check that the assembly matches as below and everything is properly tightened down. From here we can test our mechanism!

### **Assembling DC-100 & DC-101**

Before we do final assembly, we need to check that our mechanisms are aligned properly and we don't need to make any adjustments.

Parts Needed: DC-100, DC-101, DC-023, DC-024 (1/8" Rod)

Tools Needed: Hacksaw/bandsaw, sandpaper or belt sander

What we're making:



- 1) To start, place DC-101 on to DC-100. You want the notches to be snug – a little bit of a press fit. Give the knob a spin and check that your helical gears mesh nicely. If they are skipping or jamming, check that your set screws are snug and that your gears are aligned properly.
  - a. Note: If the two tabs are NOT snug, you may want to use 4-40 heat set inserts and the base (DC-001) that is labelled with screwbosses (this is the recommended print). You can carefully drill into your middle plate and then screw this down to keep it from popping loose – which it will do if the fit isn't right!

- 2) Once you have your helical gears meshing (and your waves rolling!) we will work on the followers for the cams. Get your 1/8" rod and cut two follower lengths: 1.25" and 1 9/16". The longer follower is DC-023 (Fishing Pole) and the shorter is DC-024 (Rowboat).
- 3) Using a belt sander, round one side of each follower to help it slide freely. If you do not have a belt sander, deburring with sandpaper will suffice.
- 4) Drop DC-023 into the cam collar on the right and DC-024 into the cam collar on the left. They should align over the two cams. Spin the knobs (slowly) to test alignment.
  - a. If anything slips free or does not align, remove DC-101 and adjust the crank positioning with the allen key. This may take several tries to get right!
  - b. Recall: Snail cams only turn in one direction! Make sure you pay attention to your fishing pole cam.

### **Final Assembly Steps: DC-102**

Parts Needed: DC-100, DC-101, DC-003, DC-014 (2), DC-020, DC-021, DC-022, DC-025, DC-027

Tools Needed: Phillips head screwdriver (small), drill, 1/8" drill bit

What we're making:



- 1) Once DC-100 and DC-101 are working together, we can add on our rowboat, dinosaur, and fishing pole. To start, assemble the fishing pole using DC-020, DC-

021, and DC-022. Tie the string to the fish and to the fishing pole end. You can cut the length longer or shorter; 1-2" of string is recommended.

- 2) Using DC-025 and DC-016, place the fishing pole between the bracket on the front of the boat (DC-030) and secure in place. The fishing pole should rotate freely inside the boat.
- 3) Place DC-003 on top of the base assembly. If using a patterned surface, place the pattern side up. Make sure the hole in DC-003 for the fish is over the snail cam (DC-006).
- 4) Place the boat (DC-030) on top of the center mount (DC-013). Use the longer 4-40 screw and the square nut to secure in place. The boat should be able to rotate and should be in contact with the rear follower (DC-024).
- 5) Check that everything is still working! Rotate the crank handles – you should see the fishing pole bob on the snail cam and the boat should rock in a rhythmic up and down motion.
- 6) Drill a shallow 1/8" hole in the bottom of your dinosaur (or other character). Make sure to drill at least 1/4" deep. Place your dino on the post in your rowboat – he's ready to go fishing!