FLIGHTORY

SUPER STINGRAY

VTOL

USER MANUAL

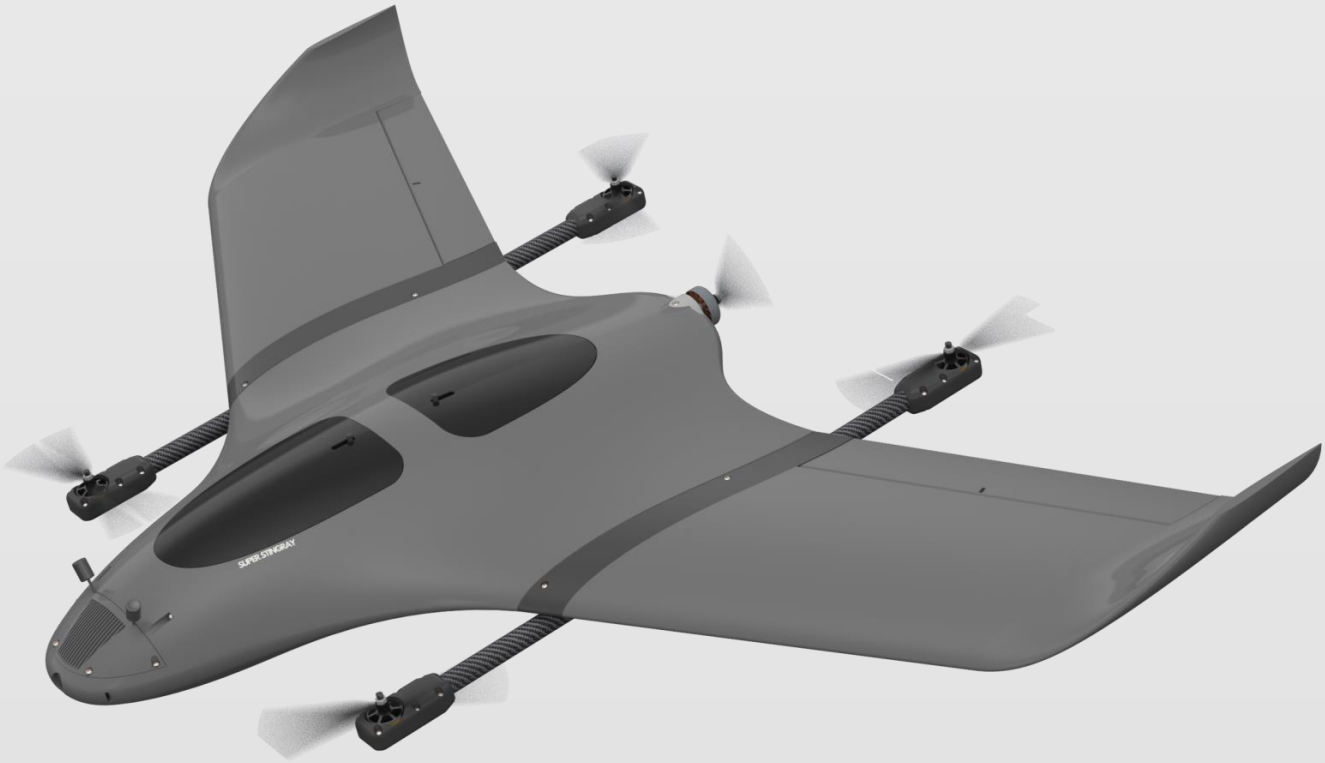
V.1

Socials

Join Flightory Tech group on Facebook and create community with us. Share progress of your builds. Any suggestions or questions welcome.
www.facebook.com/groups/flightory

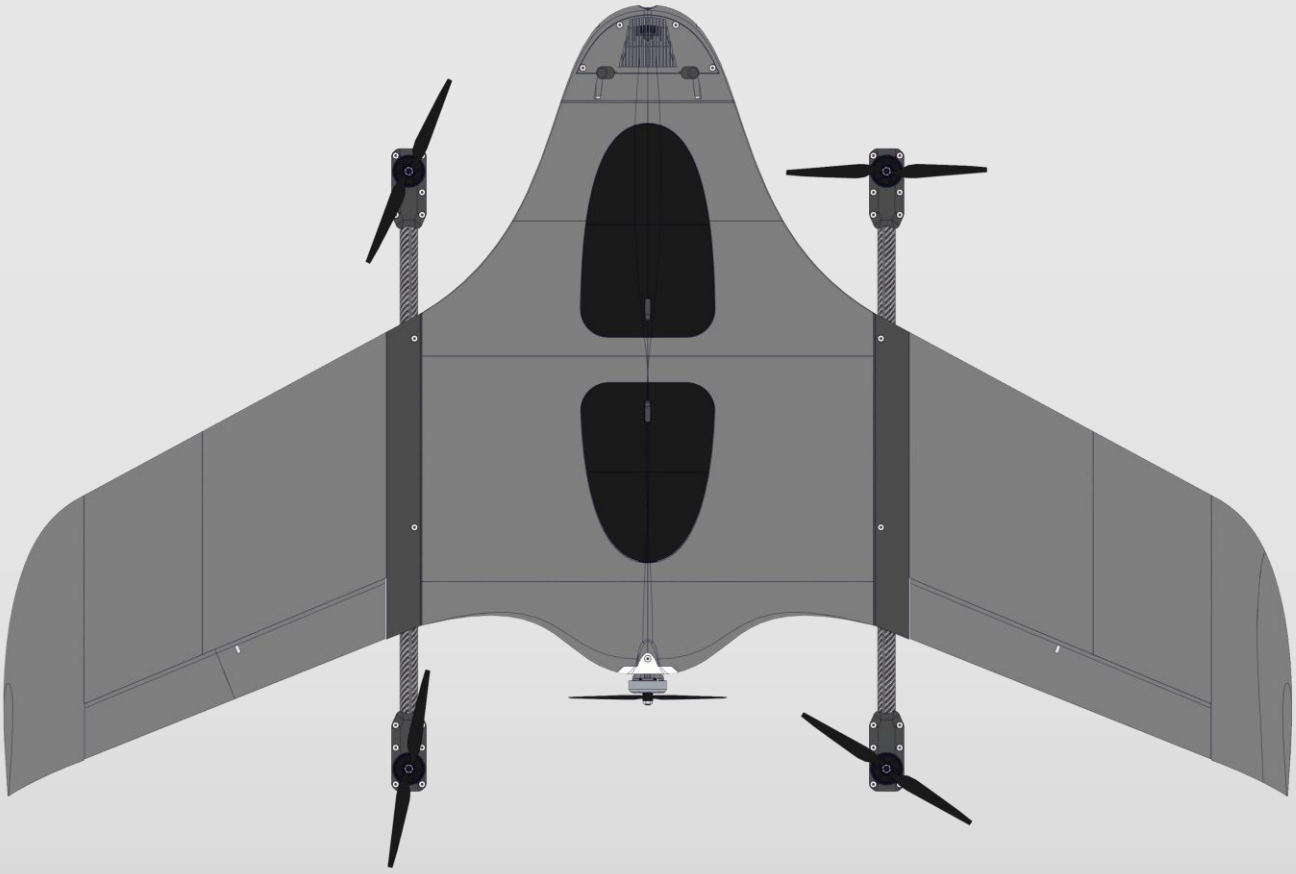
Follow Instagram where I share more footage on a regular basis
www.instagram.com/flightory_

General Aircraft Data



The build of this aircraft requires owning the basic version of the Super Stingray. Modification for VTOL requires reprinting the wings along with all motor mounting components. This instruction manual presents conversion to VTOL version. If you are starting to build the aircraft from scratch, refer to the manual for the regular Super Stingray, which details the construction of the entire aircraft.

General Aircraft Data



The aircraft is in a classic 4+1 configuration with a single pusher motor located at the rear and 4 VTOL motors arranged in an X pattern. The rest of the aircraft's geometry remains unchanged from the regular Super Stingray version.

PARTS LIST - VTOL

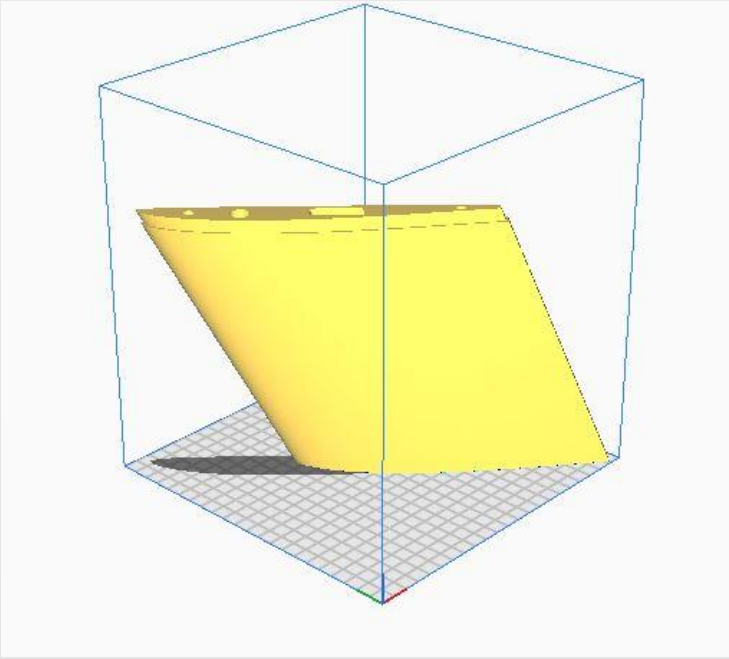
PART	MATERIAL
AILERON VTOL L /R	LW-PLA
WING 1 VTOL L/R	LW-PLA
WING 2 VTOL L/R	LW-PLA
WING ROOT VTOL L/R	PETG
BOOM MOUNT L/R	PETG
MOTOR MOUNT TOP VTOL	PETG
MOTOR MOUNT BOTTOM VTOL	PETG

If you have access to a printer capable of printing at high temperatures around 300°C you may also consider printing with materials containing carbon fiber additives instead of regular PETG, which will further reinforce the components.

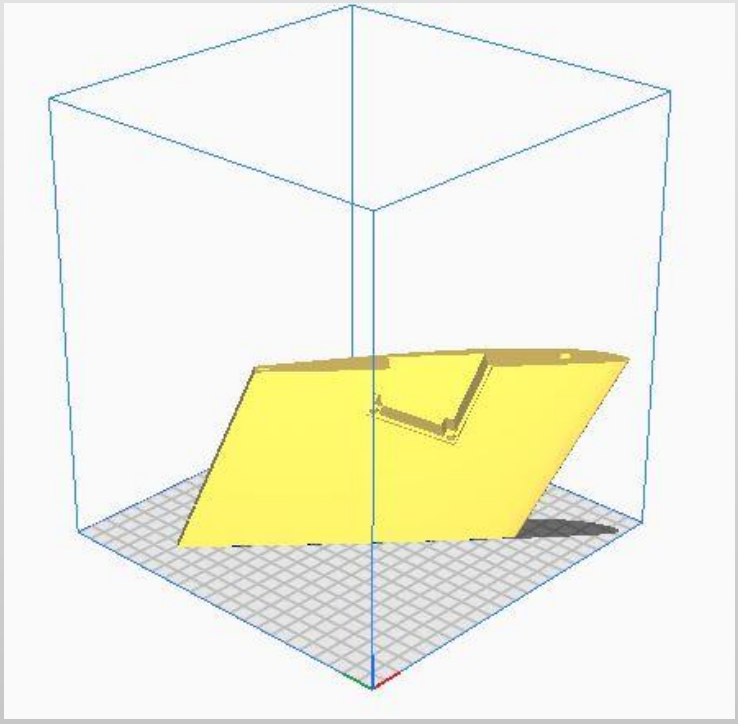
Reccomended Accessories and RC Equipment

Reccomended electronics	
Motors VTOL	Emax ECOII 2306 1700KV link/ T- Motor F60 1700KV link
Motor Pusher	23XX 1000-1400 KV e.g. link / link
Propellers VTOL	7x4 / 7x5 / 7x6 (two CCW, two CW) link
Propeller Pusher	10x5 / 10x6 e.g. link
ESC	5pcs BlHeli30-40A / 4in1 T-Motor V45A or similar link
PDB	Matek PDB or similar link
Battery	4S (max 4S3P 10,5Ah Li-Ion) or similar LiPo link

Parts Orientation

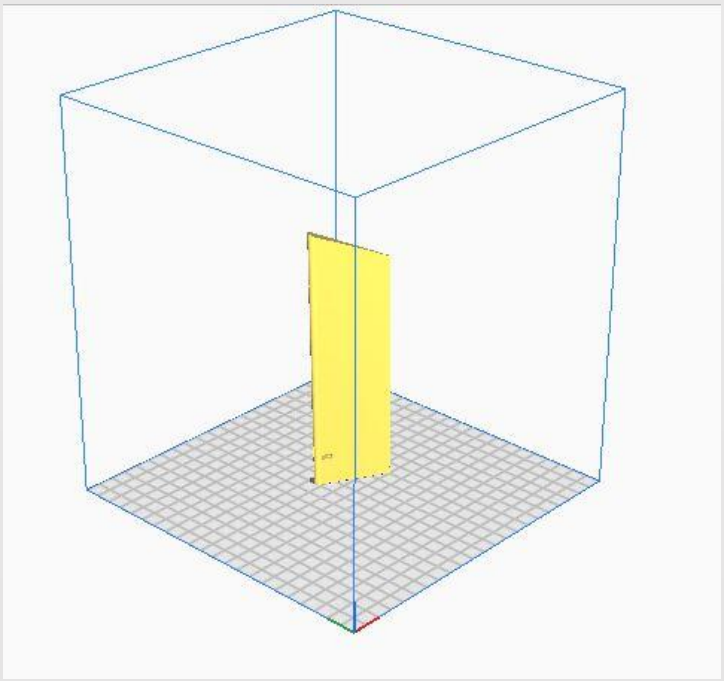


WING 1 L/R VTOL - 3% cubic subdivision infill

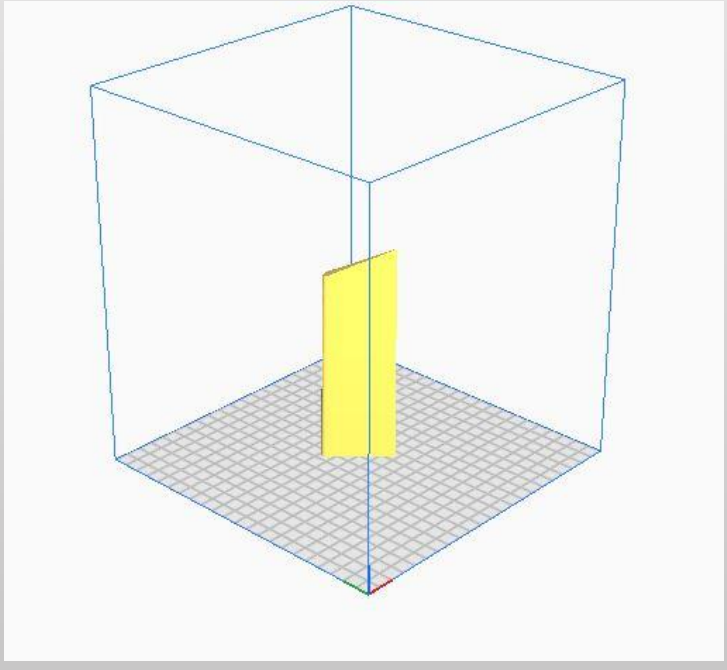


WING 2 L/R VTOL - 3% cubic subdivision infill

Parts Orientation

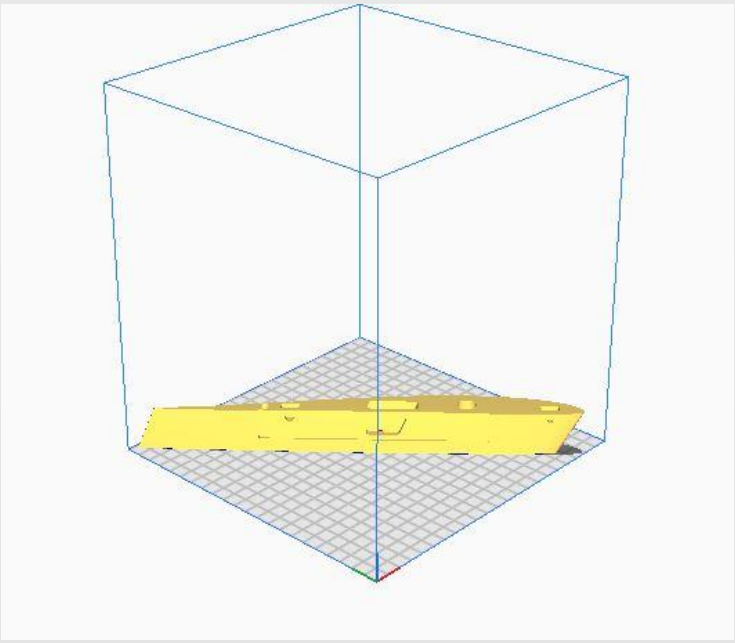


AILERON 1 VTOL L/R - 3% gyroid infill

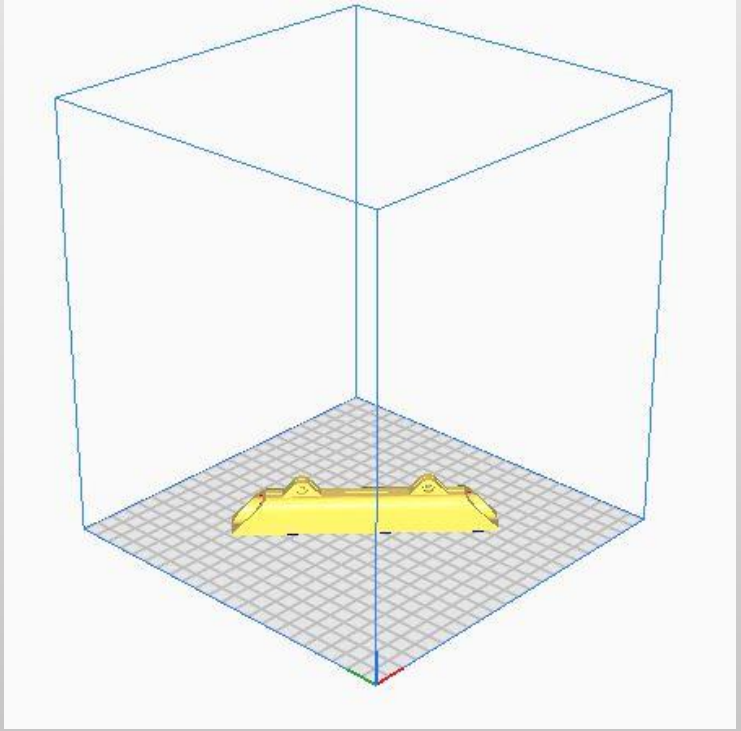


AILERON 2 L/R VTOL - 3% gyroid infill

Parts Orientation

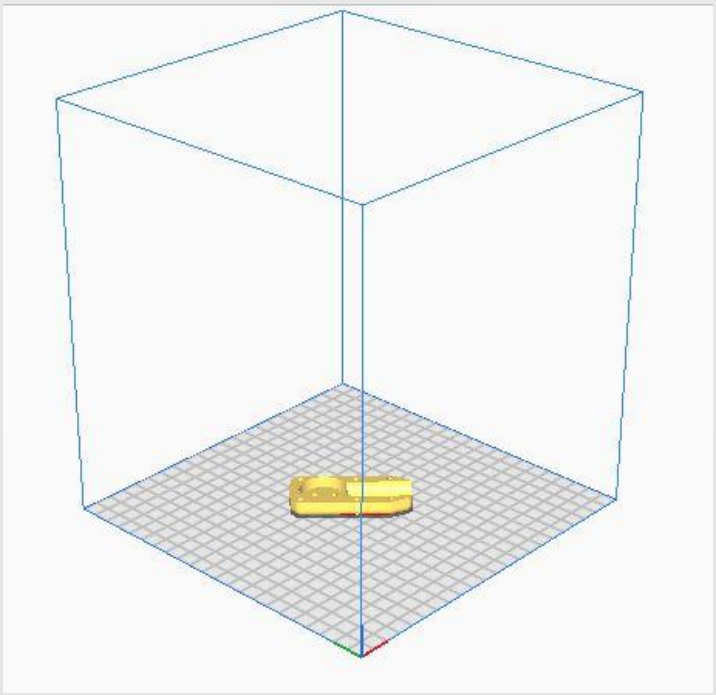


WING ROOT VTOL L/R – 3 walls, 20% cubic infill

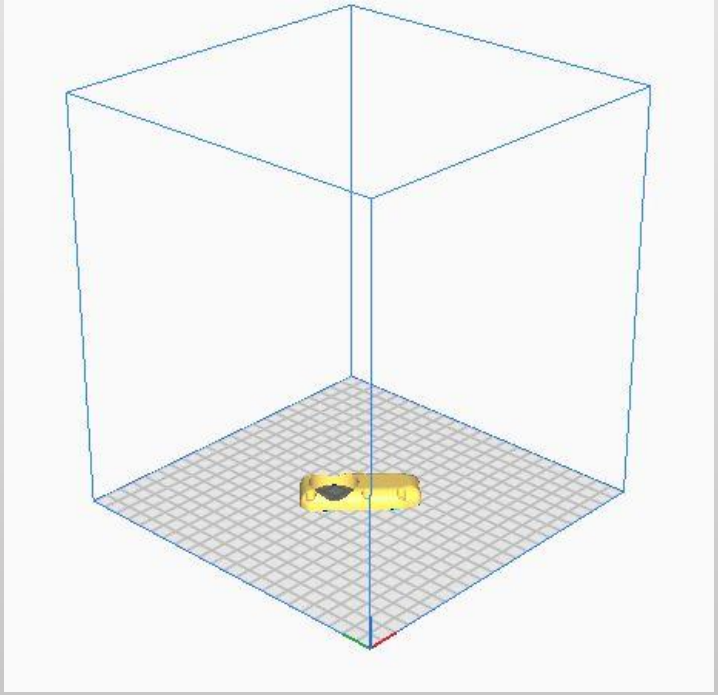


BOOM MOUNT 3 walls, 20% cubic infill

Parts Orientation



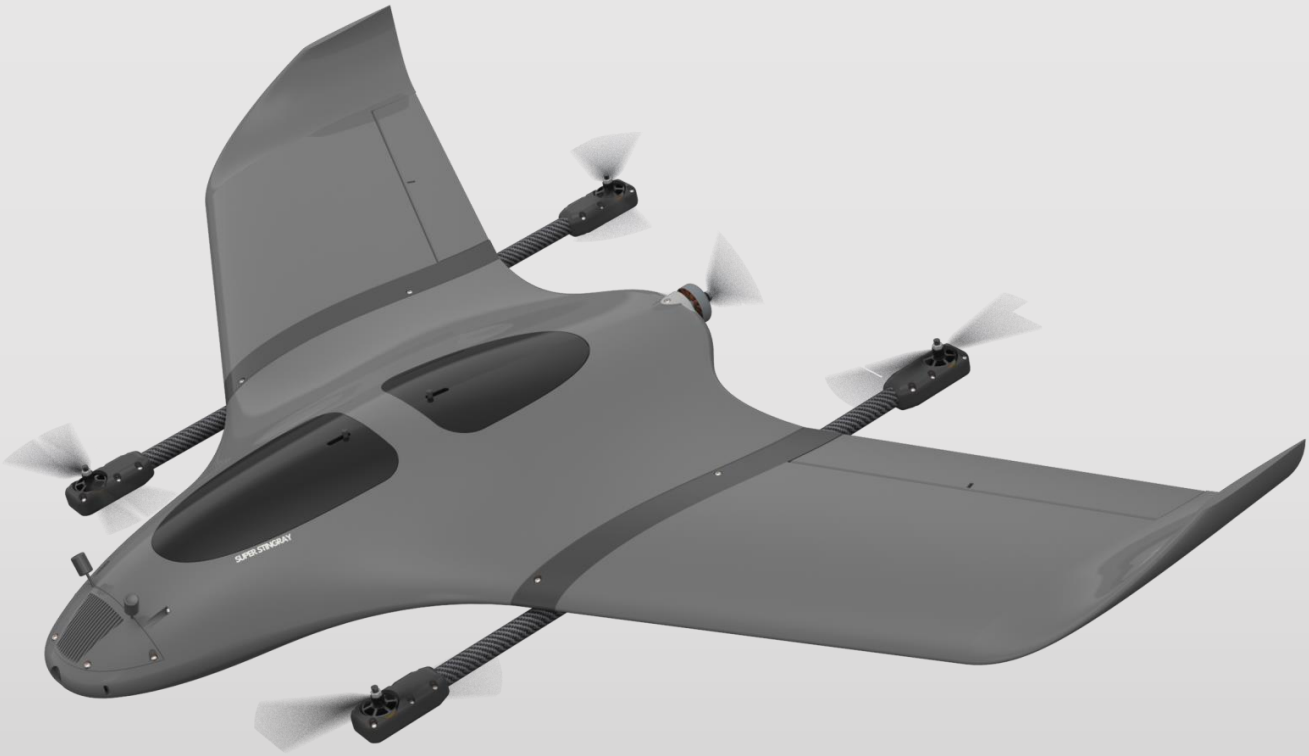
MOTOR MOUNT BOTTOM VTOL – 3 walls, 20% cubic infill



MOTOR MOUNT TOP VTOL - 3 walls, 20% cubic infill

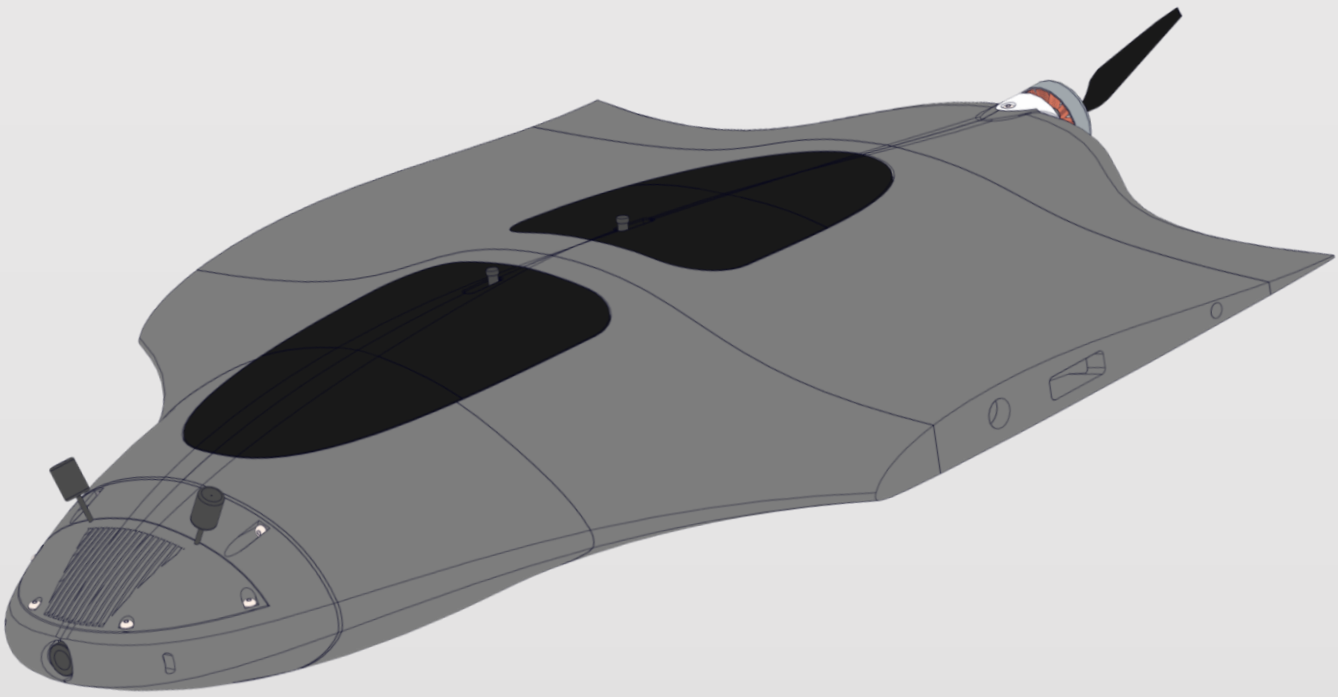
STL AND STEP FILES

All files in VTOL PACK are available in STL and STEP format.



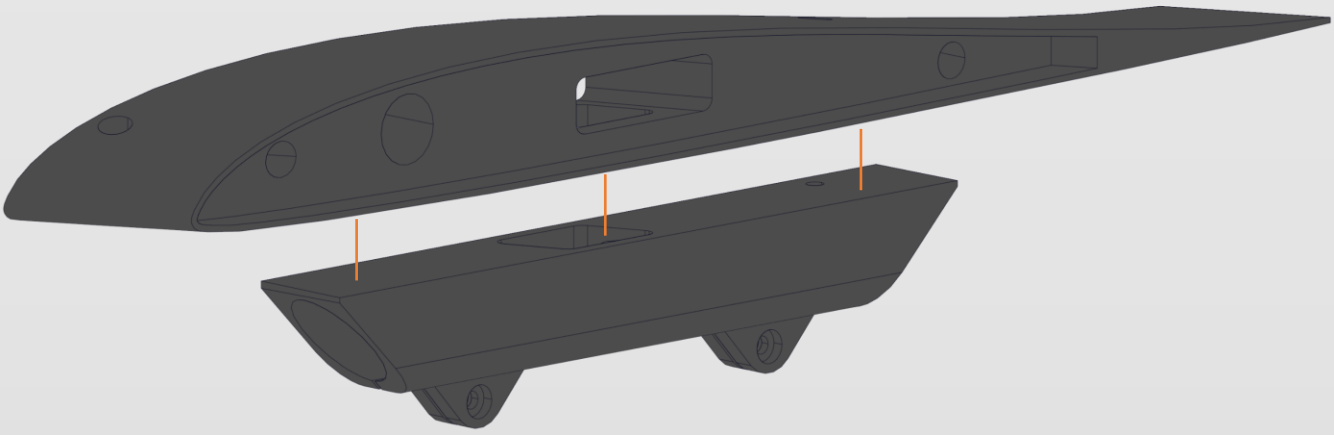
You can find these files in folders labeled STEP

Fuselage Preparation



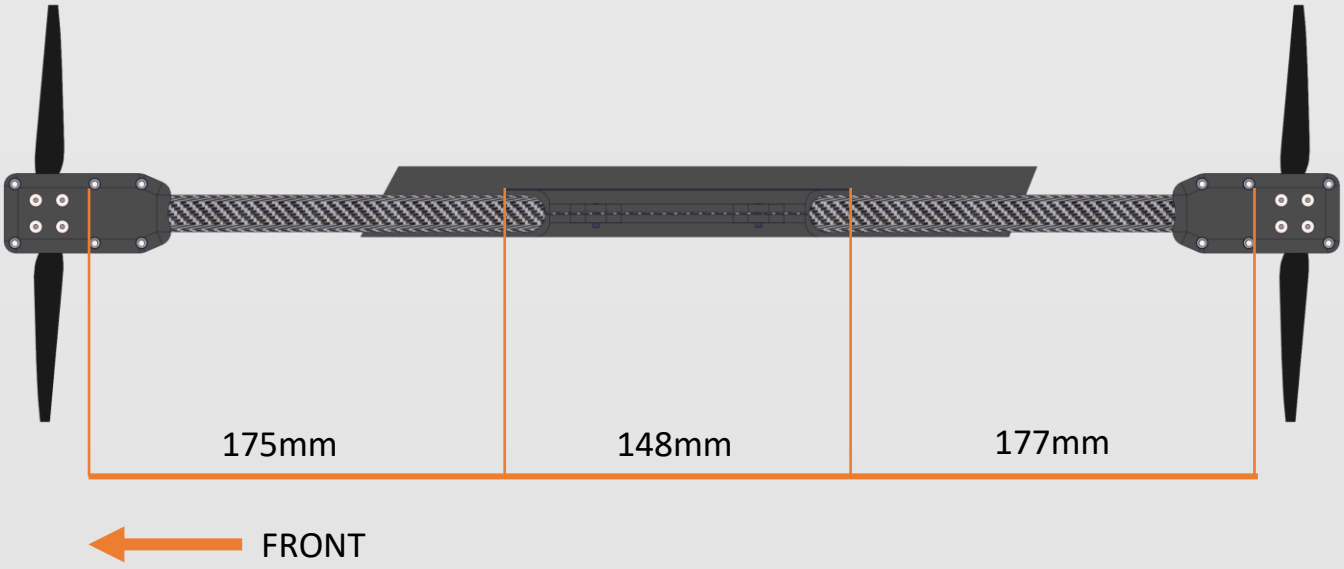
We start by preparing the fuselage. If you already have a built Fixed Wing version of the Super Stingray, simply remove the wings. If you are starting from scratch, refer to the instructions for the regular version of this aircraft, where the assembly of the fuselage is described.

Boom Assembly



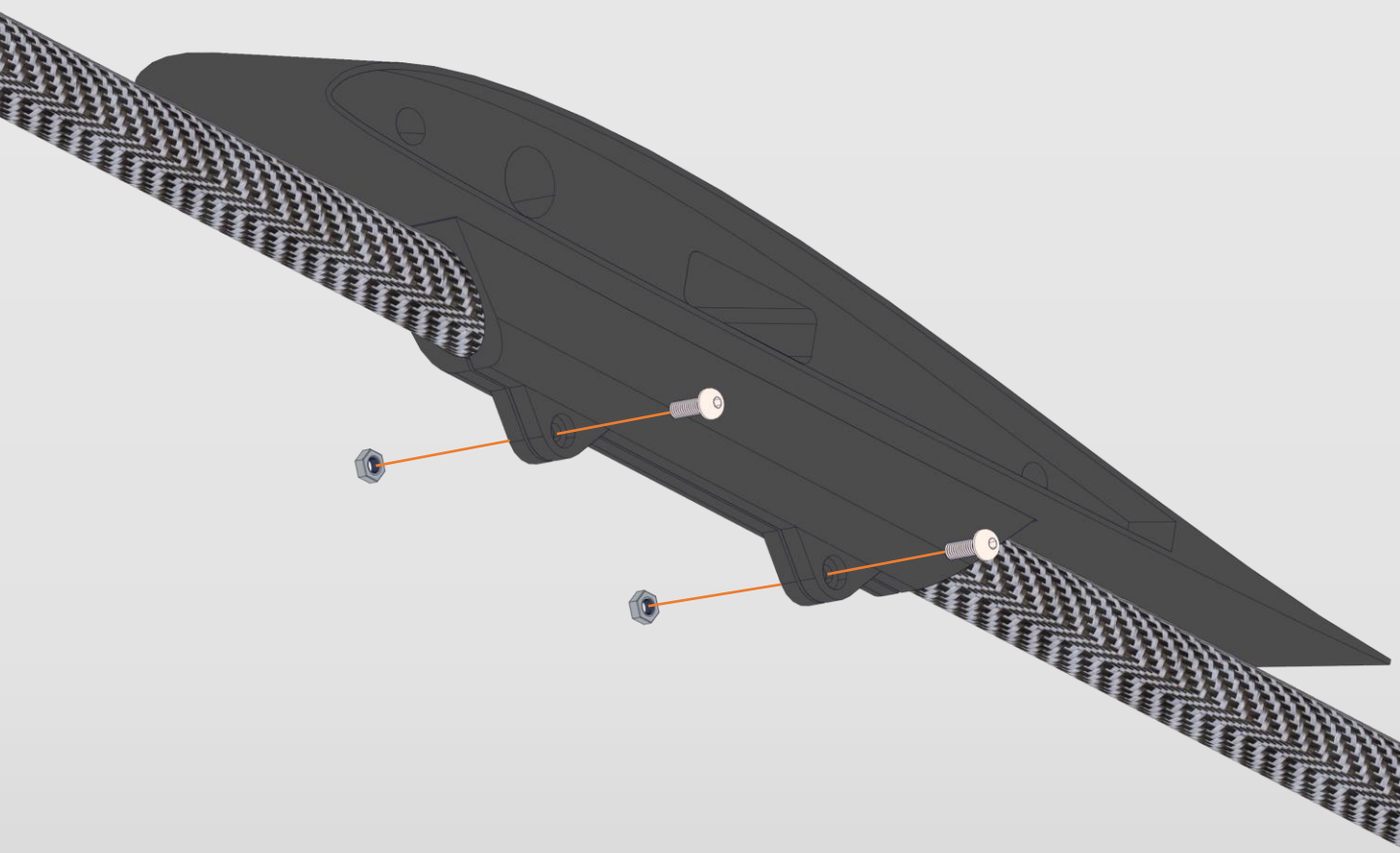
First, take the Wing Root VTOL and Boom Mount components and glue them together as shown using CA glue. Ensure achieving a strong bond between the two parts. Prepare this for both the left and right sides.

Boom Assembly



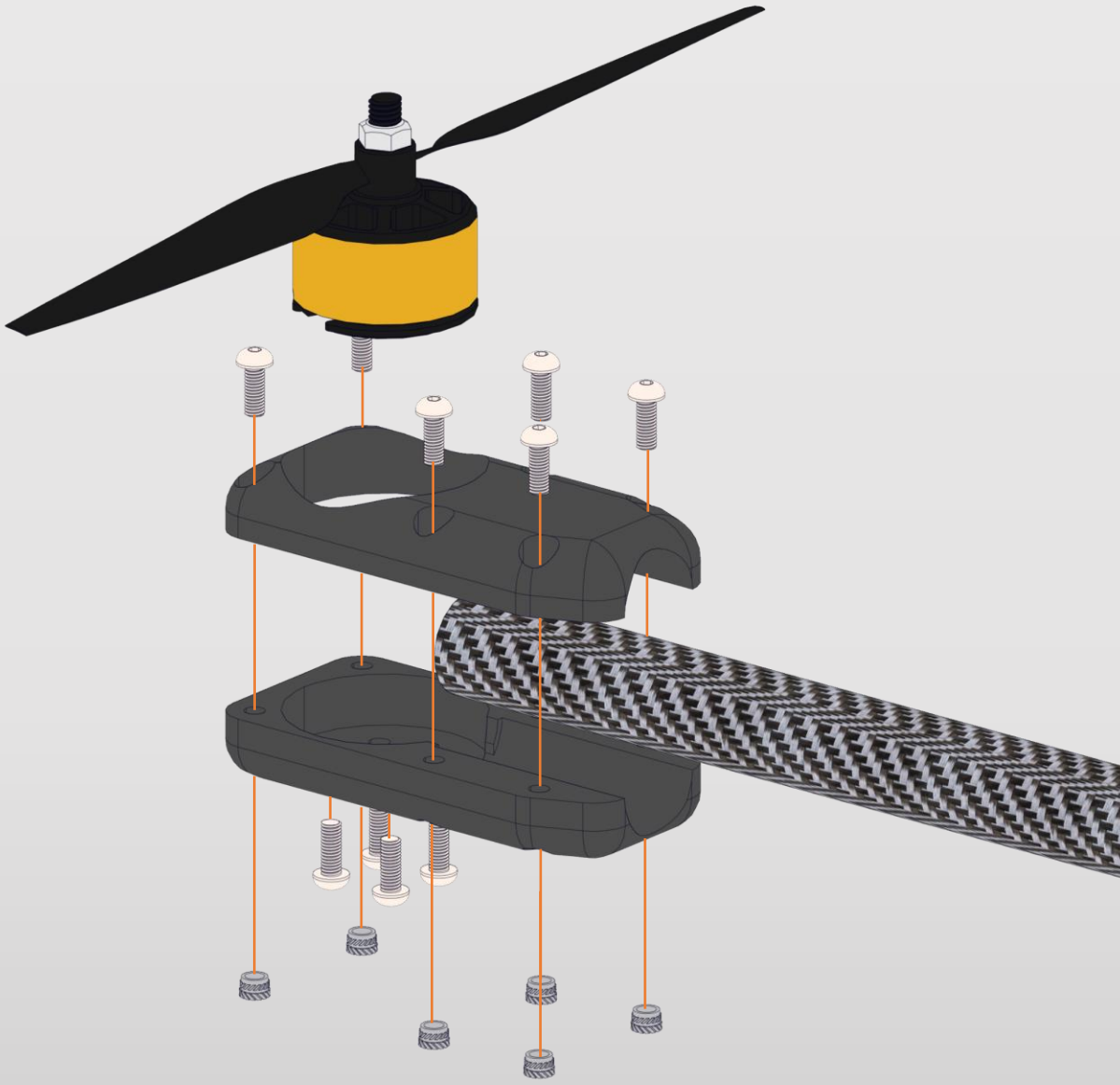
Above is an illustration showing the dimensions helpful for correctly placing the boom. It is a carbon tube with a diameter of 16mm and a length of 500mm. Insert it and measure the distances according to the drawing. You can mark the boundary points, for example, with a light-colored marker. Inside the Boom Mount, there is a hole that leads to a channel designed for wires. Cut a corresponding hole in the carbon tube at this location. It doesn't need to be perfectly shaped, but it is important that it is large enough to accommodate all the motor cables that will be routed through it in the next steps.

Boom Assembly



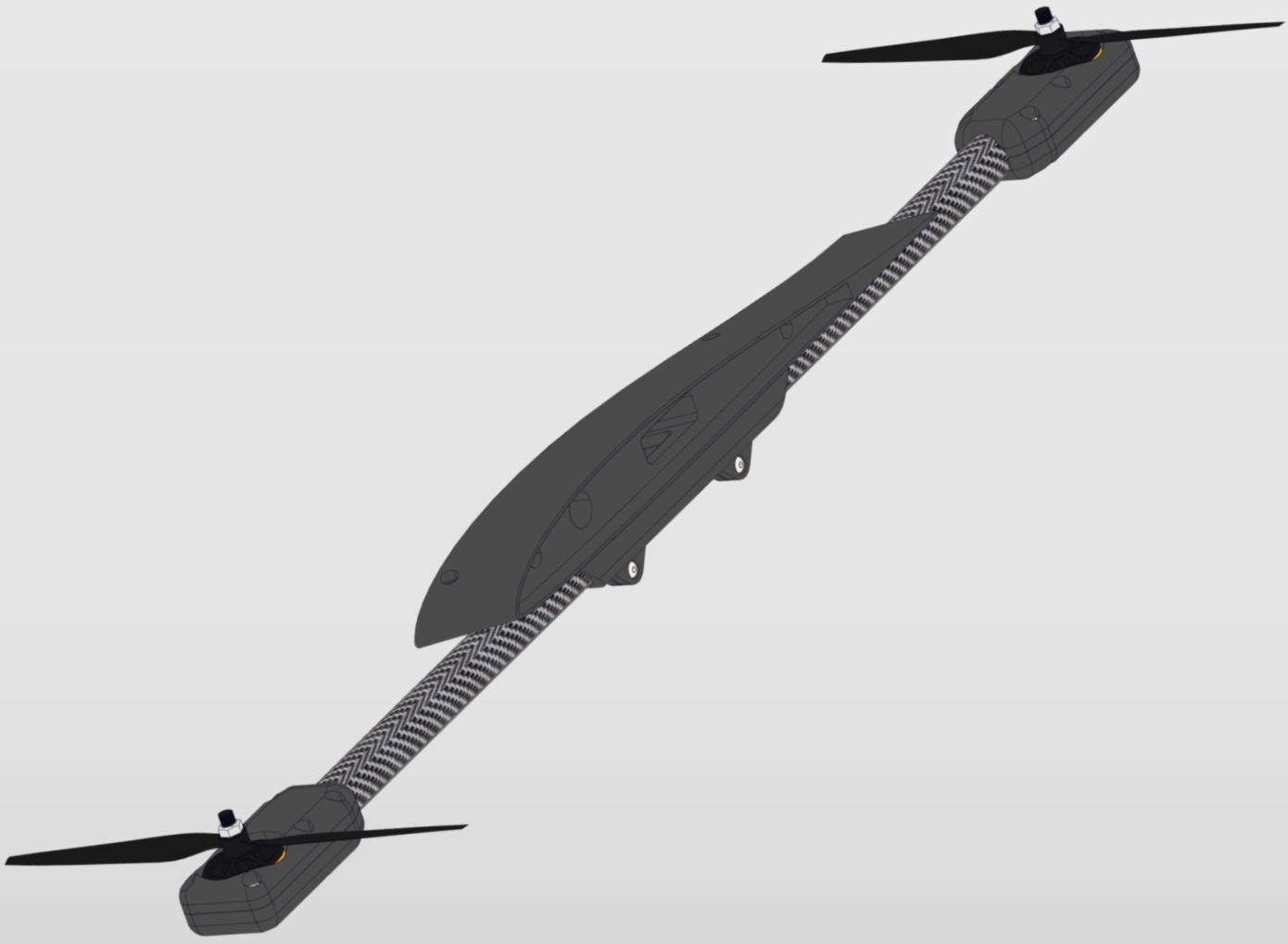
If the boom is already properly positioned, secure it. To do this, use M3 screws and nuts in the designated spots. As shown in the drawing, the mounting is done by clamping the tube and securing it against movement. Optionally, you can wrap the tube with a layer of duct tape at the mounting zone, which will further reduce play and increase friction, and strengthen the boom's attachment even more.

Boom Assembly



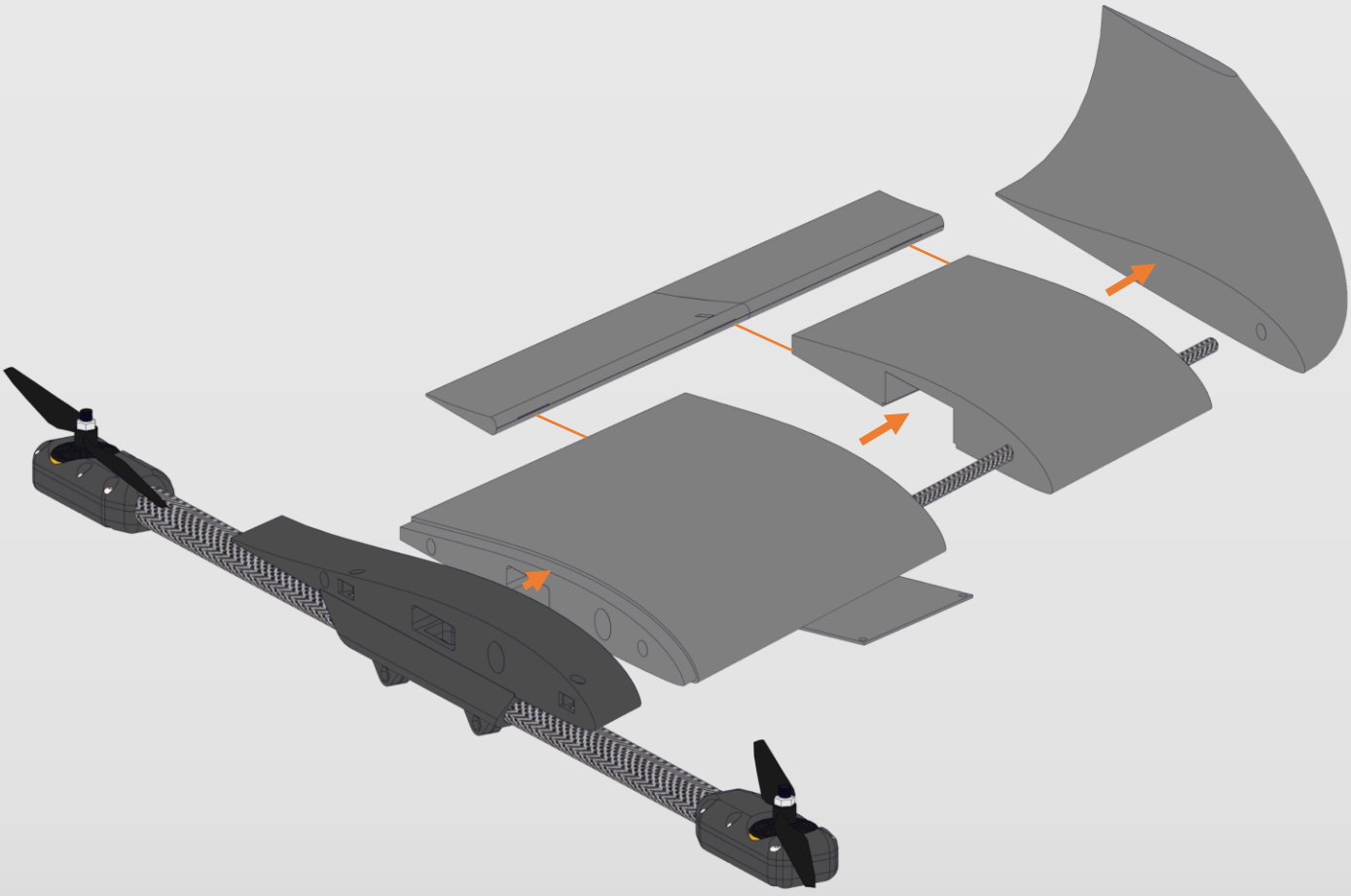
Now it's time to install the motors. Mounting is done by clamping the carbon tube between the upper and lower parts of the mount. As shown in the drawing, insert the M3 threaded inserts from below, and secure them with screws from above. In this case, you can also wrap the end of the tube with a layer of duct tape to increase friction and strengthen the mount.
It’s easier to install the propeller first and then attach the motor to the mount. At this stage, also extend the motor wires to the required length, route them inside the tube and lead into the fuselage.

Boom Assembly



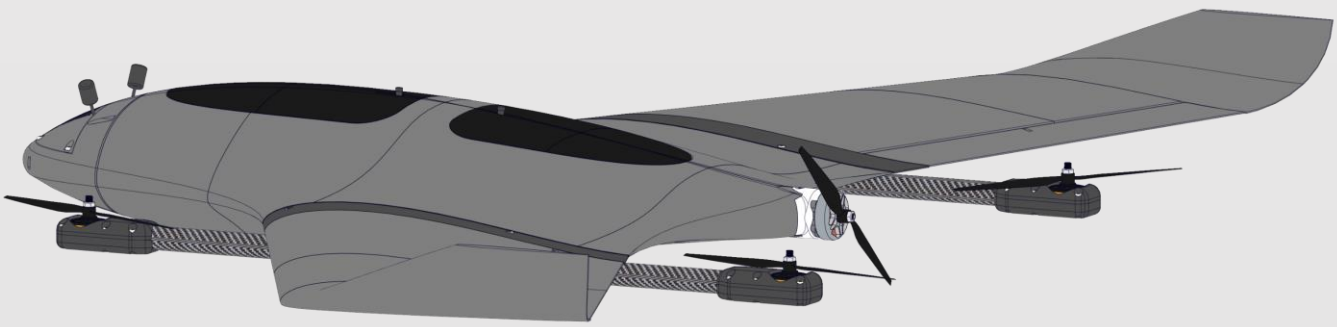
Proceed the same way with the remaining motor. Prepare this for both the right and left wings.

Boom Assembly



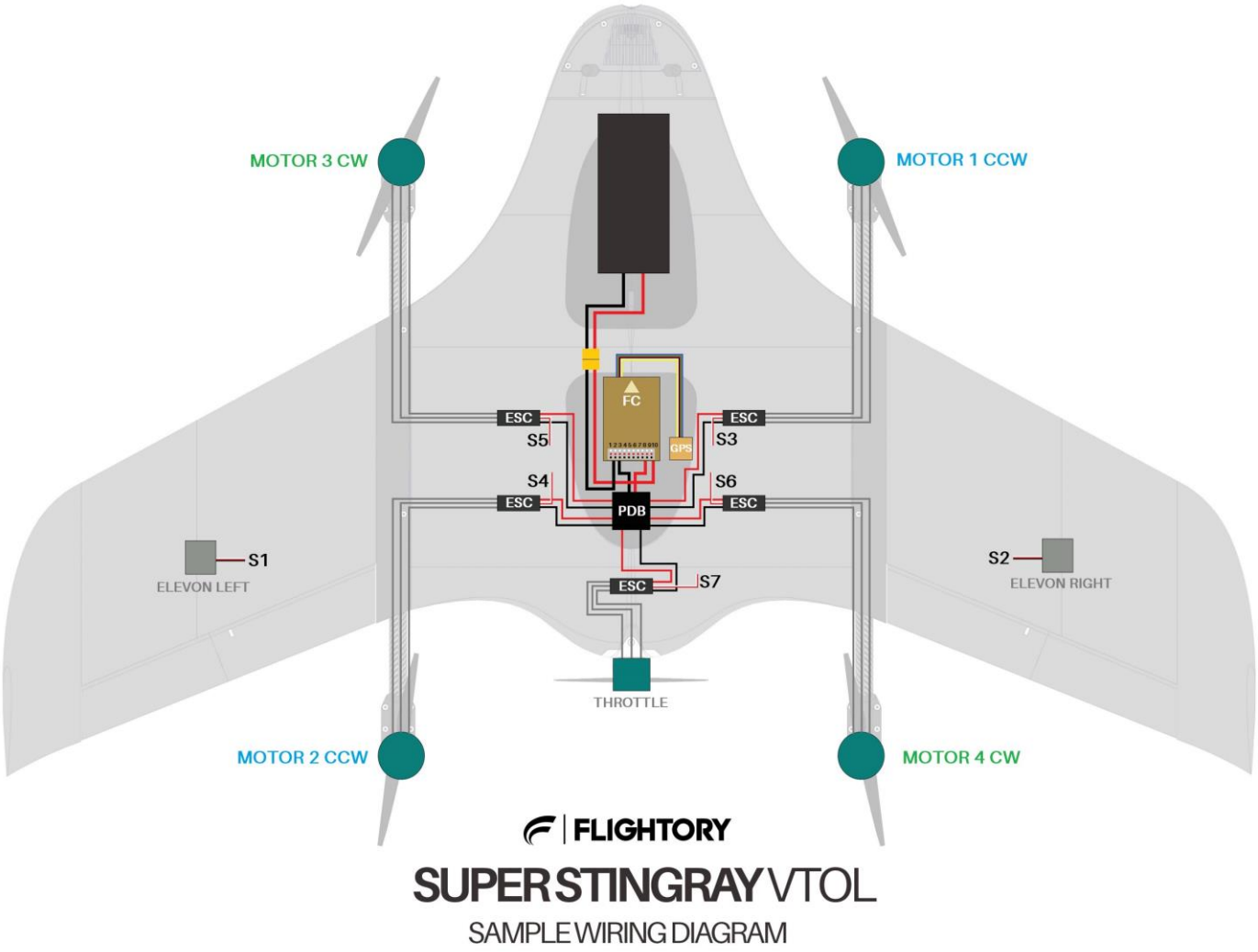
Now it's time to assemble the rest of the wing. Glue all the segments together using CA glue. Insert the 6mm carbon tube, cut to a length of 350mm, into the designed slot. The installation of the aileron, hinges, and servos is identical to the fixed wing version. However, make sure to print the aileron labeled as VTOL, as it is slightly shorter than the fixed wing one.

Finishing Build



Insert the completed wings using the 12x460mm and 6x680mm tubes as spars, just as with the fixed wing version. Finally, secure them in place with M3 screws. At this stage, the entire airframe is ready, and it's time to move on to connecting wires and configuration.

Wiring



Above is a diagram showing a sample wiring and equipment layout. This configuration uses 5 separate ESCs and a PDB for power distribution. Power is provided by a single battery. The diagram also includes suggested channel assignments for the servos and all motors. Only the essential equipment is shown on the schematic. FPV Camera, VTX, Receiver, and other optional sensors and equipment are not included, as they can be implemented in various ways depending on the chosen hardware.
The presented schematic is not the only solution but is intended to help beginners understand the setup. For example, instead of individual ESCs, you can use a 4-in-1 ESC board. Another option to consider is using separate batteries for hover and horizontal flight. The diagram is also available in a larger size in PDF format in the file package.

Configuration

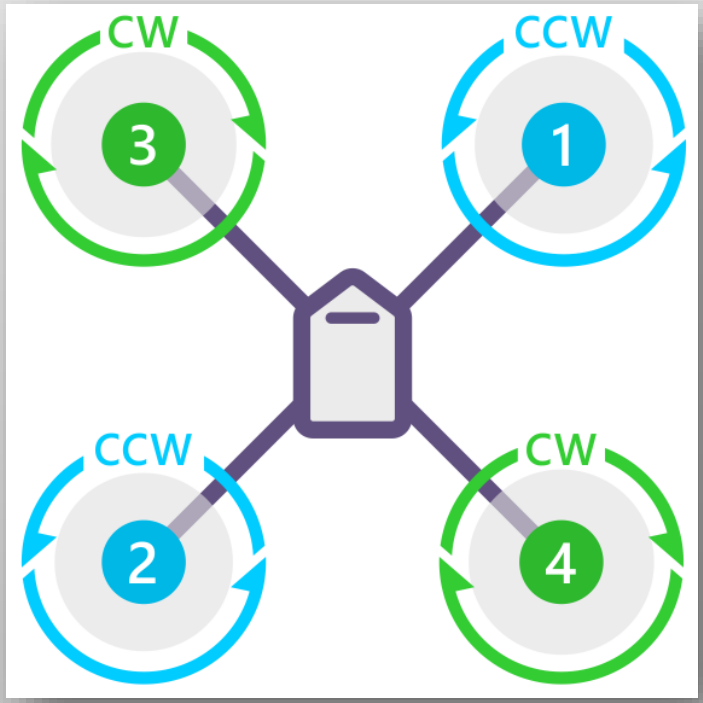
The software I recommend is Ardupilot. It's necessary to familiarize yourself with the information on the website where the full configuration of Quadplanes in Ardupilot is described.

https://ardupilot.org/plane/docs/quadplane-setup.html

I will present here the most important information and parameters that need to be set and paid attention to.

X Frame Configuration

The configuration used is a classic X Frame layout. Two pairs of propellers are needed: one pair of CW and one pair of CCW, as indicated in the drawing.



Configuration

Servo Output

This is the assignment of all channels that you can set at the beginning.

MAIN QUADPLANE PARAMETERS

Q_ENABLE = 1

Next, you need to set the parameter Q_ENABLE to 1. This enables all options related to quadplane support. You need to click ‚write' and then ‚refresh' to obtain the full list of parameters.

Q_FRAME_CLASS = 1

Next, set Q_FRAME_CLASS to 1, indicating the selection of the quadplane layout

Q_FRAME_TYPE = 1

This parameter specifies the choice of frame. 1 corresponds to our X frame layout.

TKOFF_THR_SLEW= 40

Defines the slew rate for the throttle during automatic takeoffs and when transitioning from hover mode to fixed wing. Expressed in percentage per second, so a value of 20 means the throttle will gradually increase over 5 seconds until it reaches the maximum value. A value of 40 corresponds to just over 2 seconds and is tested for our aircraft, allowing for a quick transition to horizontal flight without immediately loading the ESC with full power.

Q_ASSIST_SPEED = -1

Determines the speed below which the tilt motors will assist in generating lift. This can be seen as an additional safeguard against stalling, where the motors will automatically tilt upwards. However, we do not want this function in this aircraft, so we set it to -1 to disable it.

Q_M_PWM_TYPE = 2

Specifies the PWM type for the motors. If you are using the recommended ESCs, they support ONESHOT125, and the value of the parameter should be set to 2. If you are using other ESCs, adjust this parameter accordingly. Without specifying it, manual ESC calibration will be required.

MAIN QUADPLANE PARAMETERS

Q_OPTIONS = 163841

This parameter allows you to set additional options. You can manually select the functions you are interested in, and the parameter value will adjust automatically. By selecting the recommended options, the value comes out to be 163841. Select the functions: Level Transition (Maintains wings level within the LEVEL_ROLL_LIMIT range during transition), ThrLandControl (Allows manual throttle control during landing), EnableLandReposition (Allows manual position adjustment during automatic landing).

AIRSPEED_MIN = 17
AIRSPEED_MAX = 35

These parameters specify the minimum and maximum speed in m/s in automatic throttle modes. The values align well with the characteristics of the Super Stingray. The minimum speed is crucial during transitions. Full transition will be executed upon reaching the minimum flight speed.

Q_TRANSITION_MS = 3000

Q_TRANSITION is related to the previous one and determines the time in milliseconds for a full transition after reaching the minimum speed. During this time, the VTOL motors gradually slow down while the pusher motor speeds up. 3 seconds is the tested time for this aircraft, providing an efficient and smooth transition.

Q_LAND_SPEED = 20

The descent rate in Q_LAND mode. The value is expressed in cm/s. 20 ensures a gentle descent. After touching the ground, for a few seconds, the lack of altitude change is detected, and shortly after, the motors switch to disarmed mode.

Q_M_BAT_VOLT_MAX = 16.8
Q_M_BAT_VOLT_MAX = 13.2

These parameters determines the maximum and minimum battery voltage values. When using 4S packs, you should enter the above values. This allows compensation of throttle in hover mode depending on the current battery state. This way, the throttle position should always provide the same thrust regardless of the voltage.

Configuration

After setting all the mentioned parameters, the aircraft is ready for its first flight tests. However, I strongly encourage you to familiarize yourself with the entire chapter on quadplanes on the Ardupilot website. You will find a lot of information there regarding configuration and tuning, flight mode operations, and much more.

QUADPLANE GENERAL CHAPTER
https://ardupilot.org/plane/docs/quadplane-setup.html

IMPORTANT SUBSECTIONS

FLIGHT MODES
https://ardupilot.org/plane/docs/quadplane-flight-modes.html

FLYING A QUADPLANE
https://ardupilot.org/plane/docs/quadplane-flying.html

VTOL TUNING
https://ardupilot.org/plane/docs/quadplane-first-flight.html

QUADPLANE SETUP TIPS
https://ardupilot.org/plane/docs/quadplane-tips.html

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