FLIGHTORY

STALLION

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

Join our Discord server as well, where the discussions are organized by topics, and the interaction between users is lively.
https://discord.gg/GPMgDZ3Cxv

Follow us on Instagram for regular updates and fresh content
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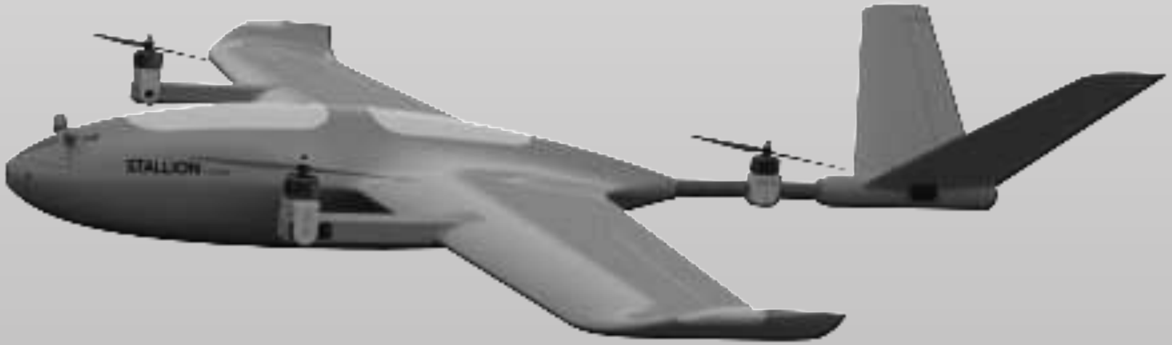
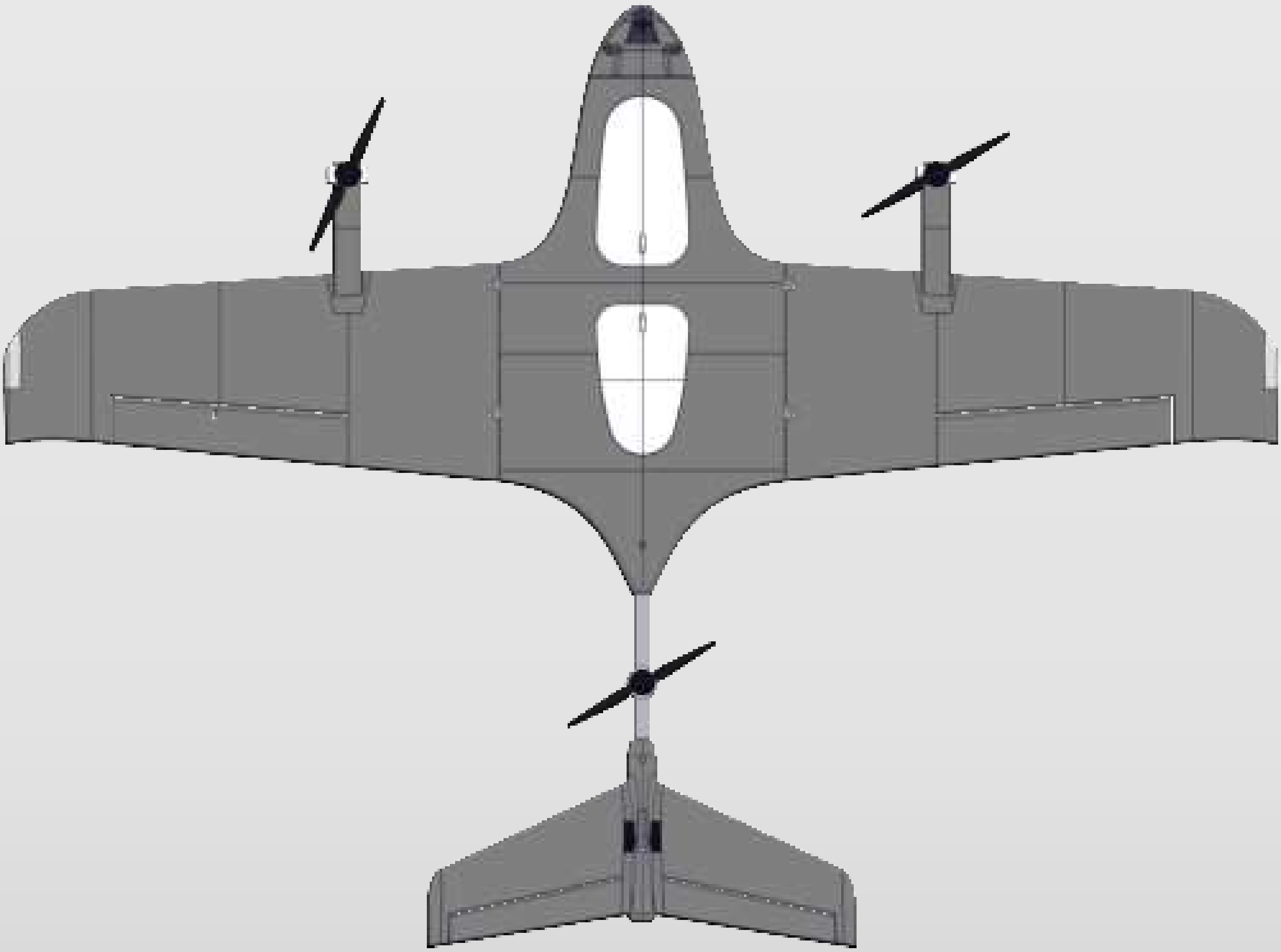


General Aircraft Data

The build of this aircraft requires owning the basic version of the Stallion. 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 Stallion, which details the construction of the entire aircraft.

General Aircraft Data



The aircraft is in the classic trimotor configuration with front tilt motors and one rear fixed motor. Yaw in hover mode is controlled by tilting the front motors. The rest of the aircraft's geometry remains unchanged from the regular Stallion version.

PARTS LIST - VTOL

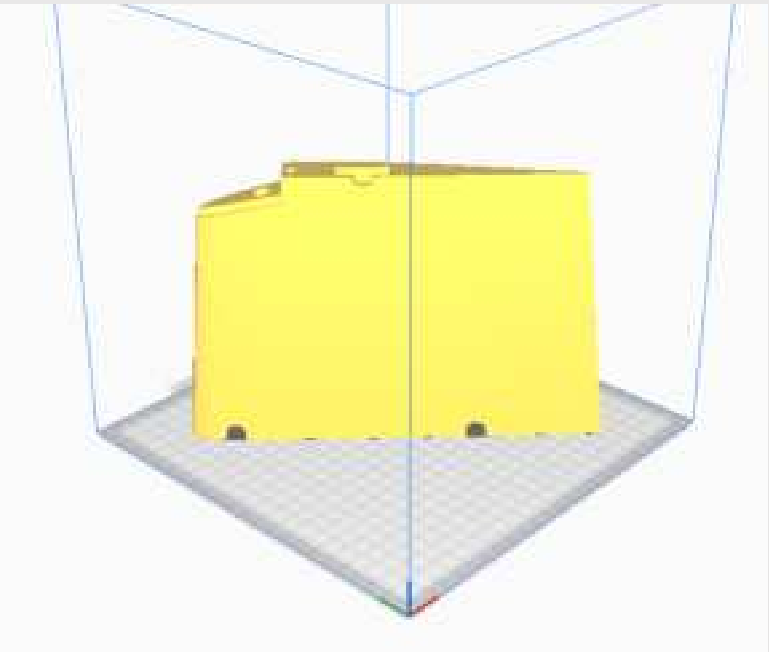
PART	MATERIAL
BOOM L /R	PETG
MOTOR MOUNT FRONT	PETG
MOTOR MOUNT TAIL	PETG
WING 1 L/R VTOL	LW-PLA
WING 2 L/R VTOL	LW-PLA
WING 3 L/R VTOL	LW-PLA

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.

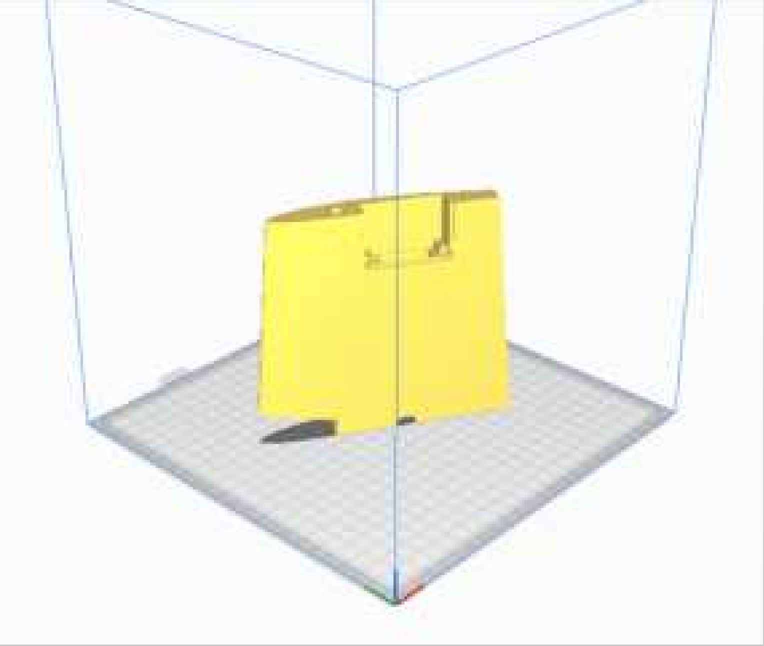
Reccomended Accessories and RC Equipment

Reccomended electronics	
Motors	Emax ECOII 2807 1300KV link / T- Motor F90 1300KV link
Propellers	7x4 / 7x5 / 7x6 (two CCW, one CW) link
Servos	2pcs PowerHD 1810MG link / GDW DS041MG link
ESC	3pcs Emax Formula Series 45A BLHeli32 link / Lumenier 51A link
Battery	4S (max 4S3P 10,5Ah Li-Ion) or similar LiPo
Bearings	2pcs 3x8x4mm Flange Bearing link
Screws / Nuts / Washers	3 pcs M3 Screws, Nuts and Washers

Parts Orientation

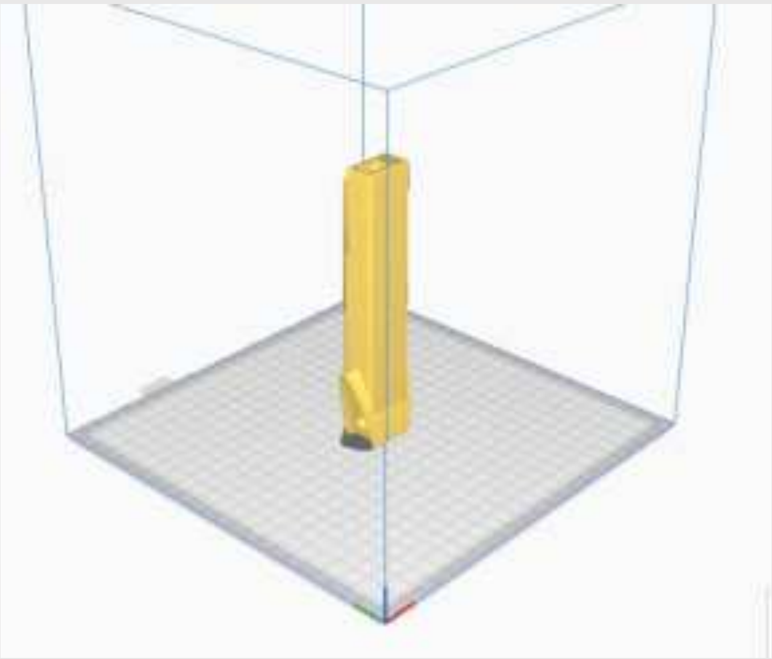


WING 1 L/R VTOL - 3% cubic subdivision infill

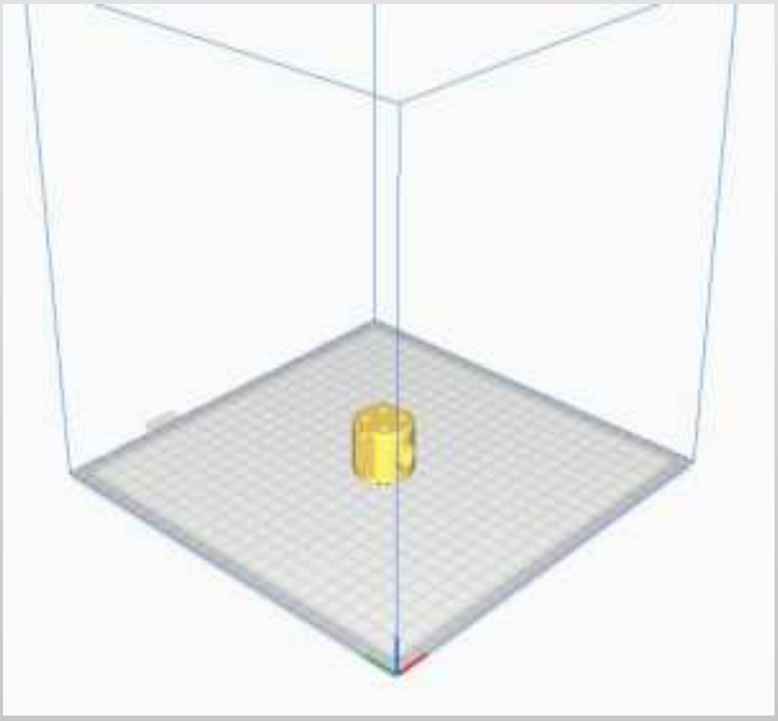


WING 2 L/R VTOL - 3% cubic subdivision infill

Parts Orientation

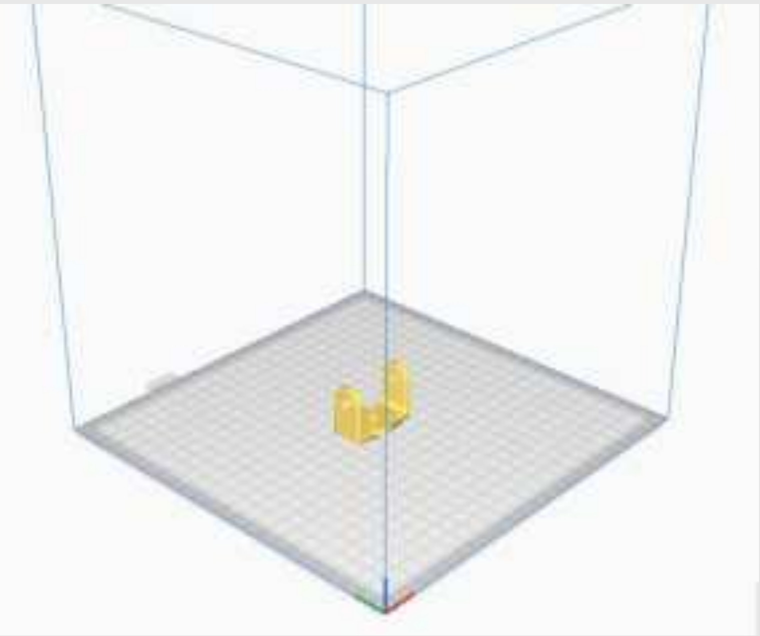


BOOM L/R – 3 walls, 20% cubic infill



MOTOR MOUNT TAIL 3 walls, 20% cubic infill

Parts Orientation

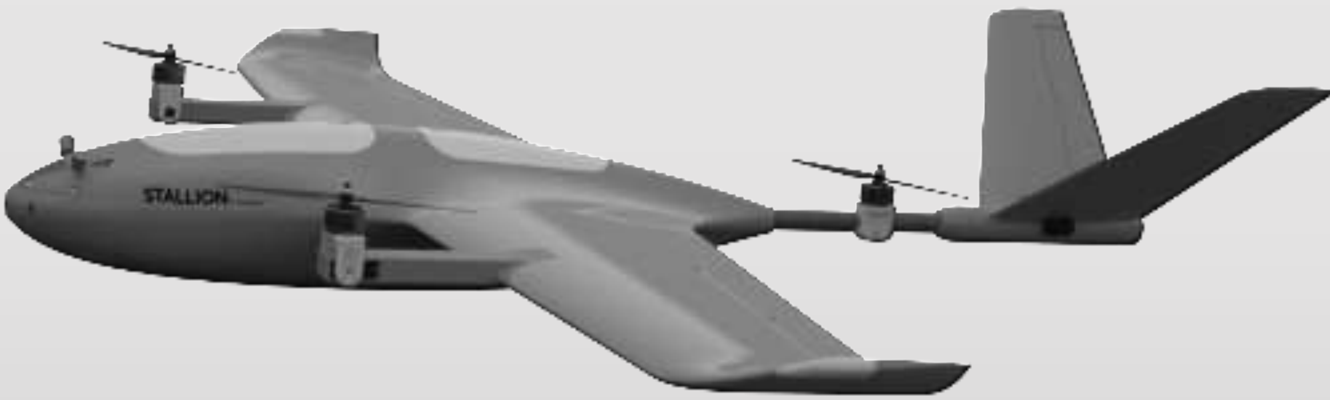


MOTOR MOUNT FRONT- 100% infill solid print

This component is particularly exposed to loads and vibrations.
It requires printing with full infill. Additionally, I recommend reinforcing this part further. A simple and quick way is to acquire a small sheet of thin fiberglass cloth and a small amount of epoxy resin. It's best to cut several small pieces and place them on the inner side of this element, paying particular attention to critical areas, and laminate them with resin. Mounts prepared in this way have passed tests successfully and can be used in flight without issues.

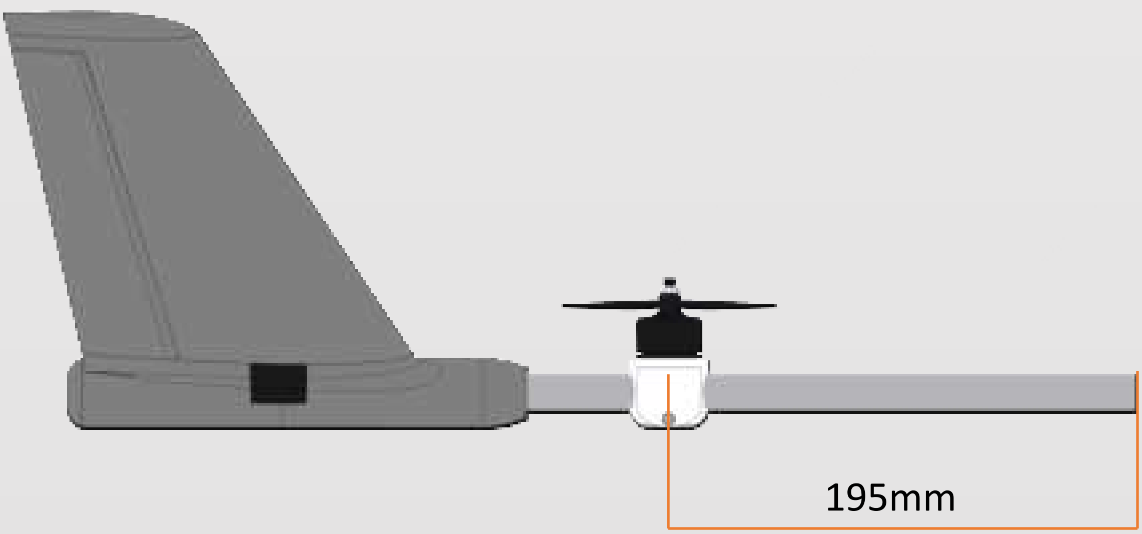
STL AND STEP FILES

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



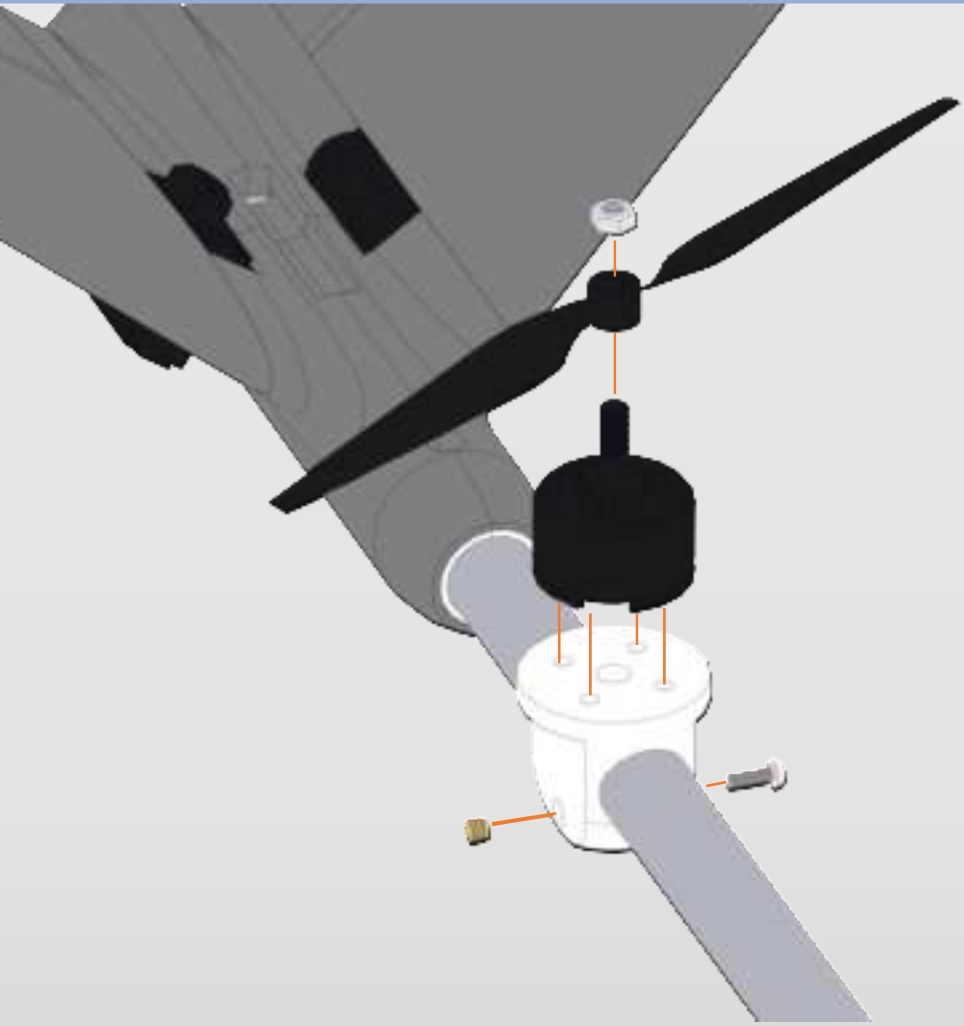
You can find these files in folders labeled STEP

Tail Motor Assembly



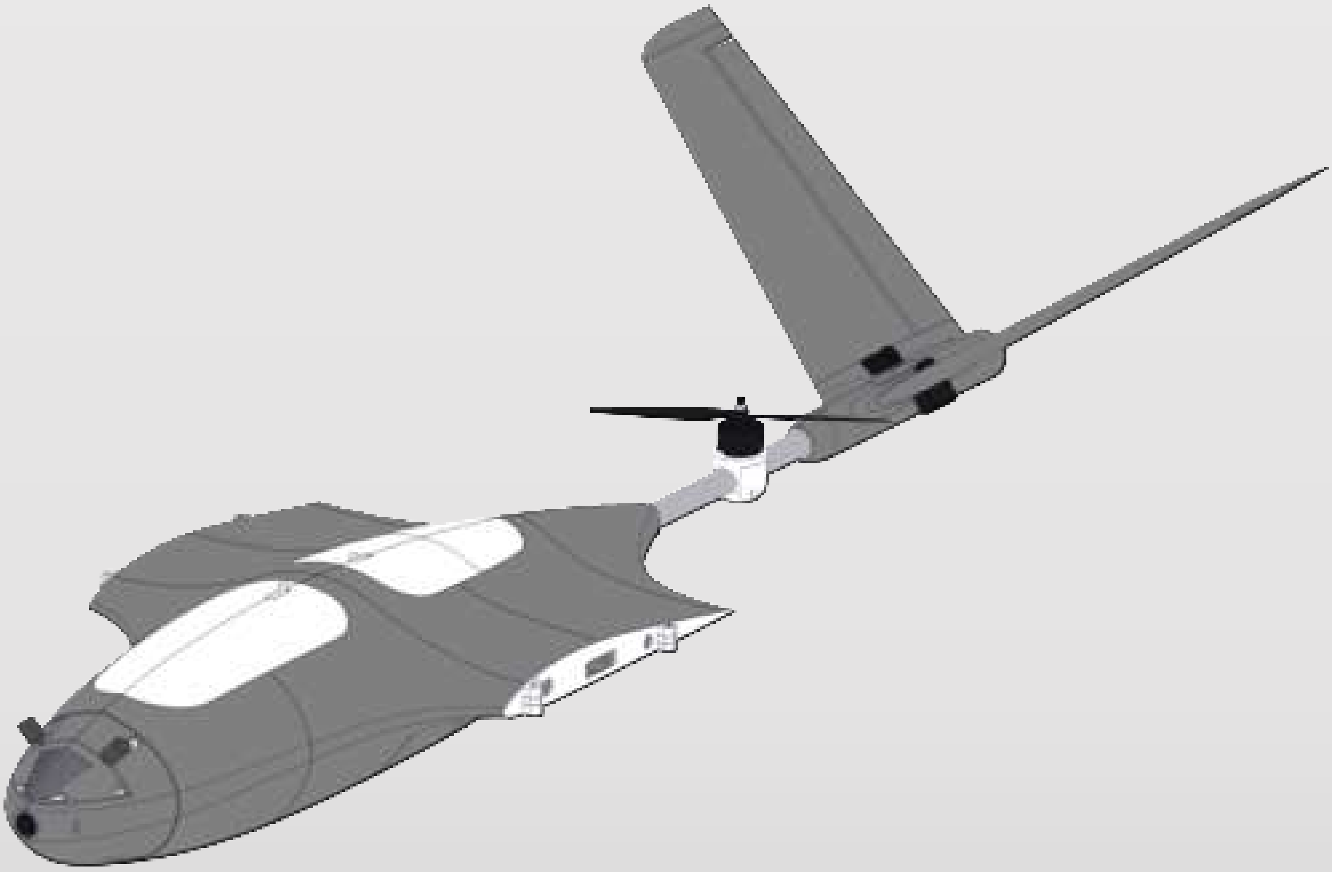
To mount the tail motor, you'll need to remove the tail boom.
The correct positioning of the motor is as shown in the diagram.
The motor shaft should be located 195mm from the front end of the tube.

Tail Motor Assembly



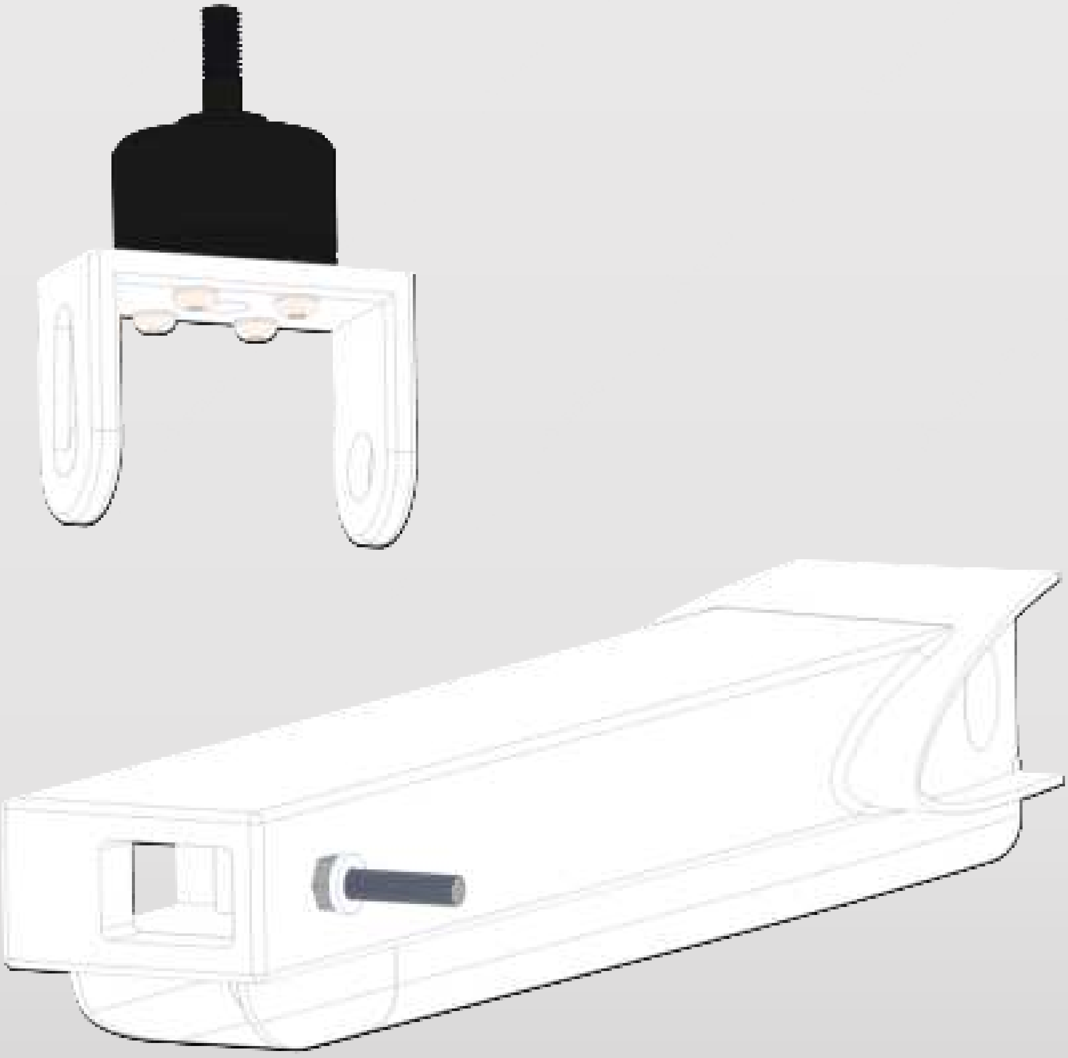
Take the MOTOR MOUNT TAIL and screw the motor onto it. To mount it, you slide it onto the tailboom. Press the M3 threaded insert from one side and insert the M3 screw from the other side. Align the motor properly and tighten the mount on the tail boom to make it stiff and immobile. You'll need to cut a small hole through which you'll route the motor cables inside the boom to the fuselage. You can do this with a drill or, for example, a Dremel cutting tool or similar.

Tail Motor Assembly



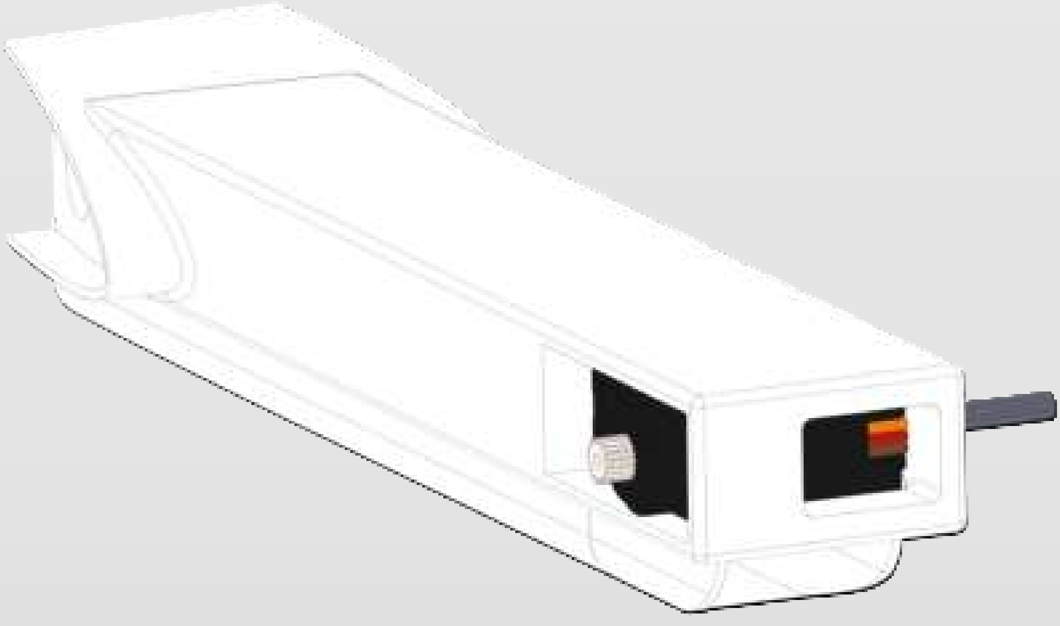
You can now slide the tail boom into the fuselage and secure it with the M3 screw as usual.

Front Boom Assembly



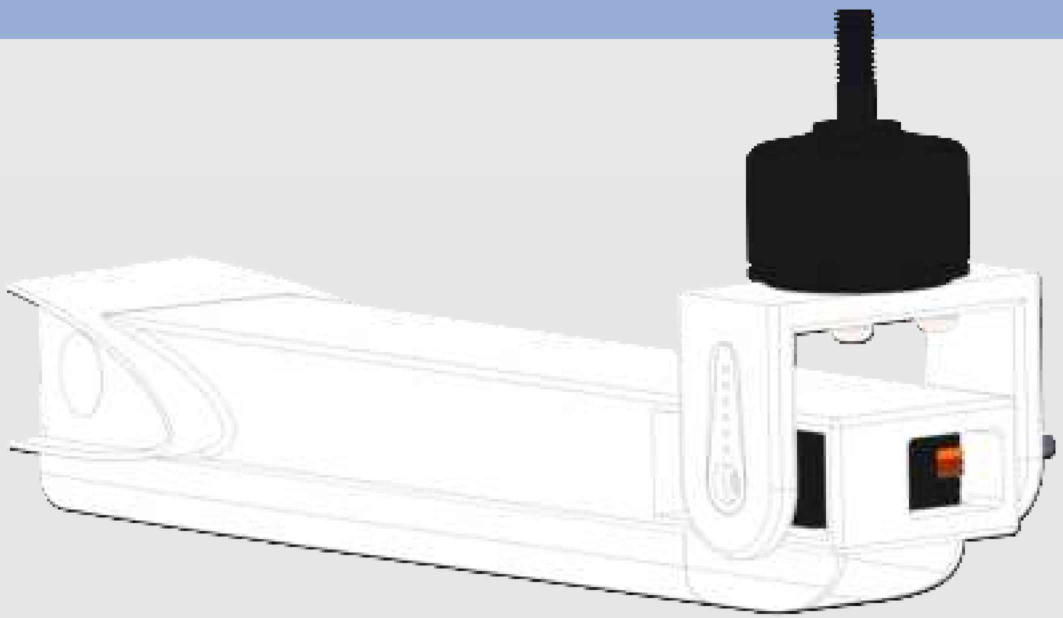
To start, screw the motor onto the MOTOR MOUNT FRONT. At this stage, also screw in the M3 screw from the inside of the BOOM as shown in the drawing. Secure it tightly with a nut from the outside. Finally, place a washer.
The screw should be about 15mm long.

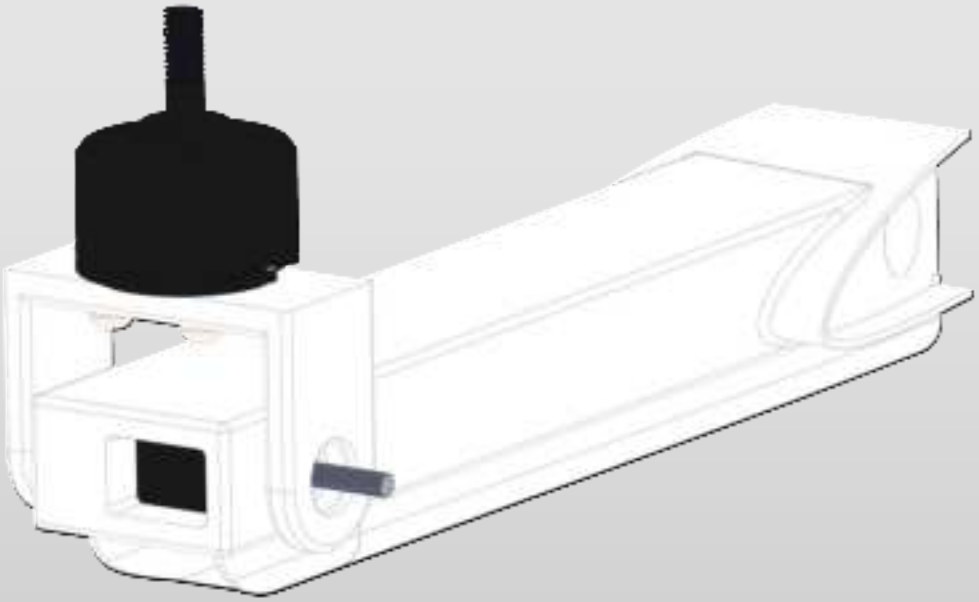
Front Boom Assembly



Next, insert the servo into the designated slot and secure it with the small screws that should be included in the servo package. Route the cables through the channel running underneath.

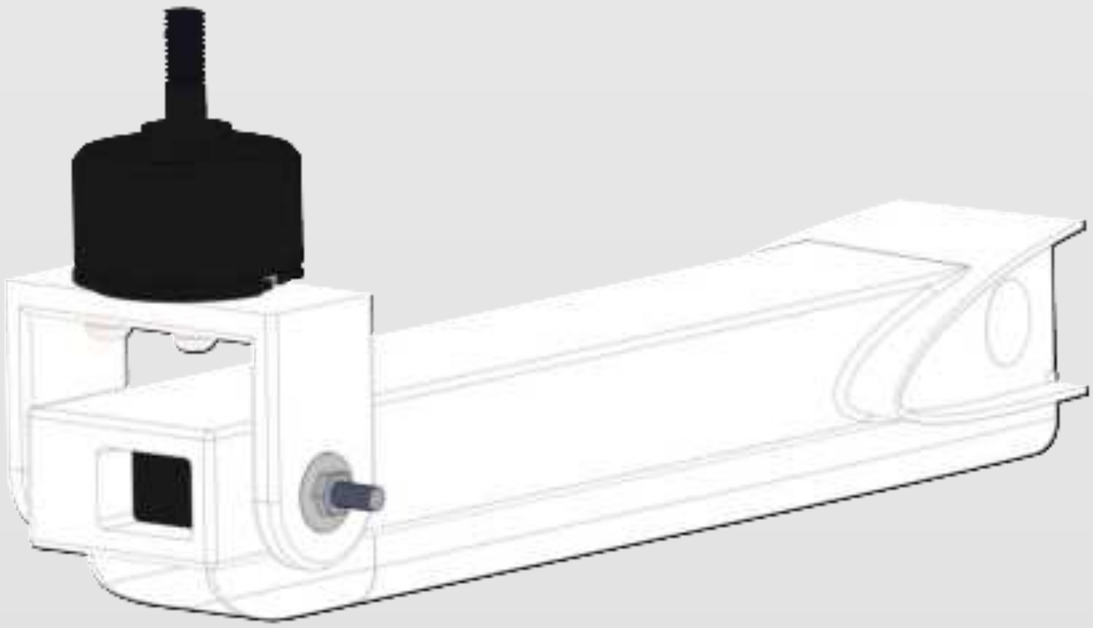
Front Boom Assembly





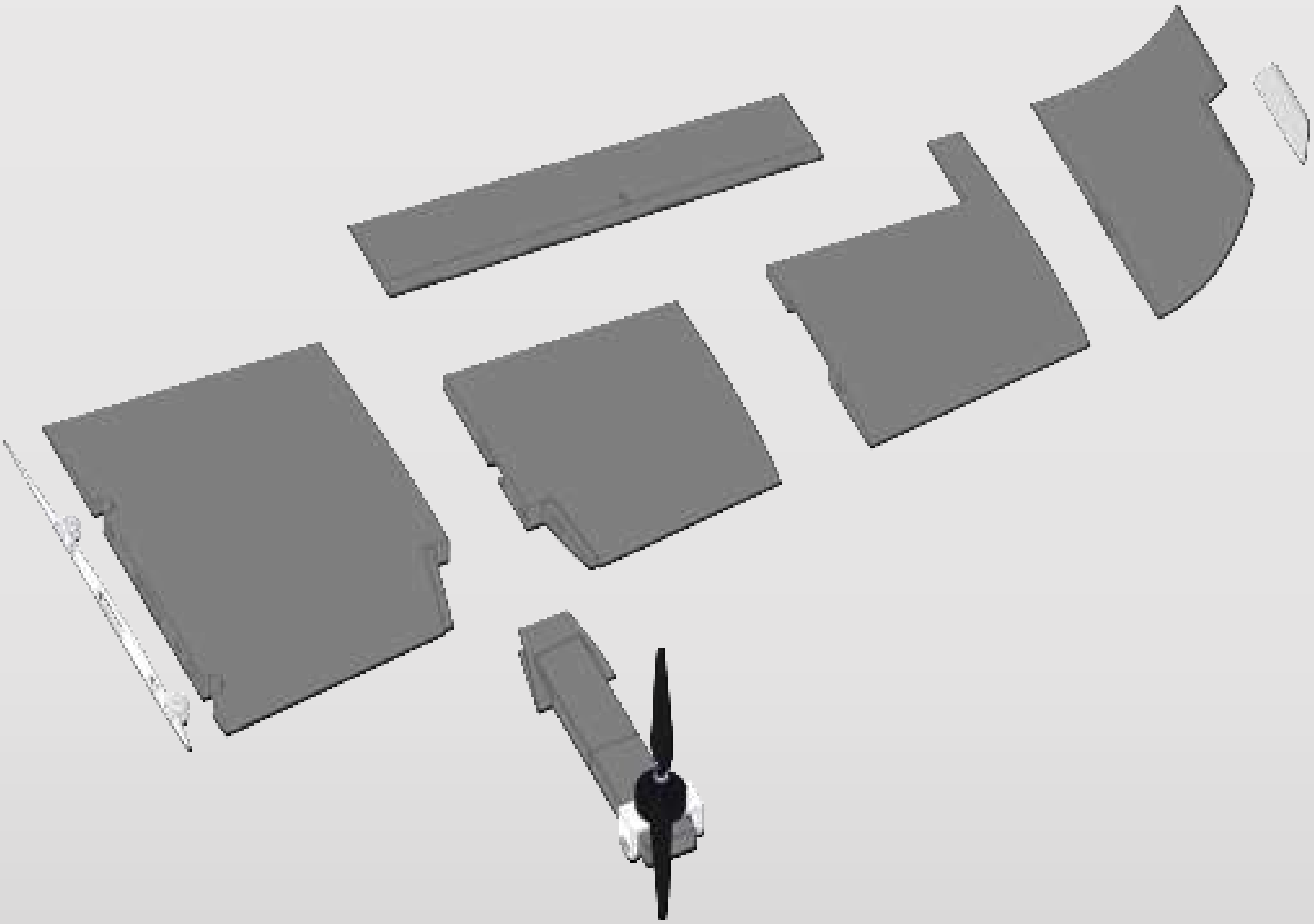
Now, place the motor in the manner shown in the drawing. Insert the servo horn, which secures the assembly from one side. Route the motor cables directly into the lower channel.

Front Boom Assembly



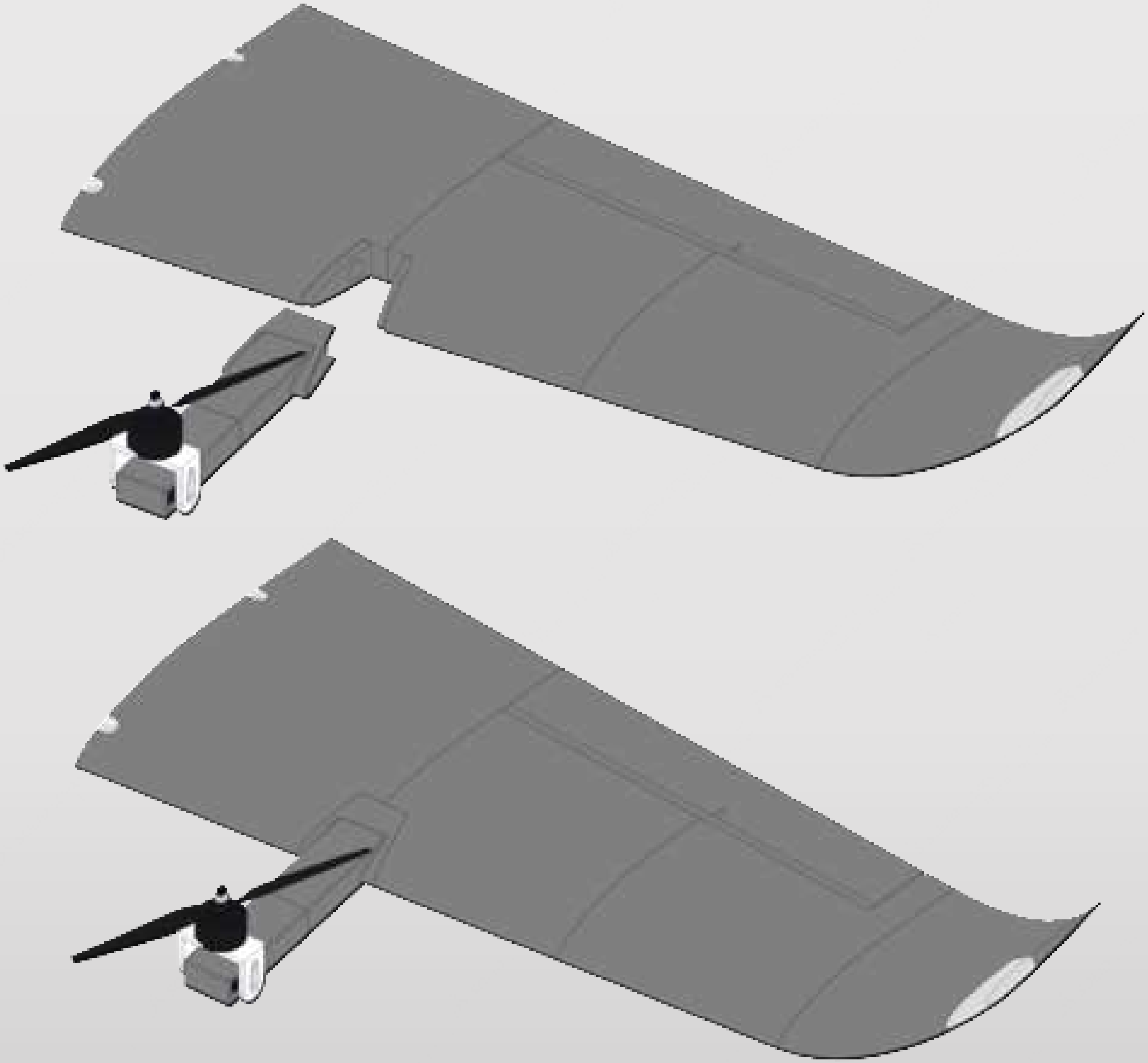
Now, on the other side, insert the 3x8x4mm bearing and finally secure it with an M3 nut. This ultimately stabilizes the mounting and ensures smooth movement.

Wing Assembly



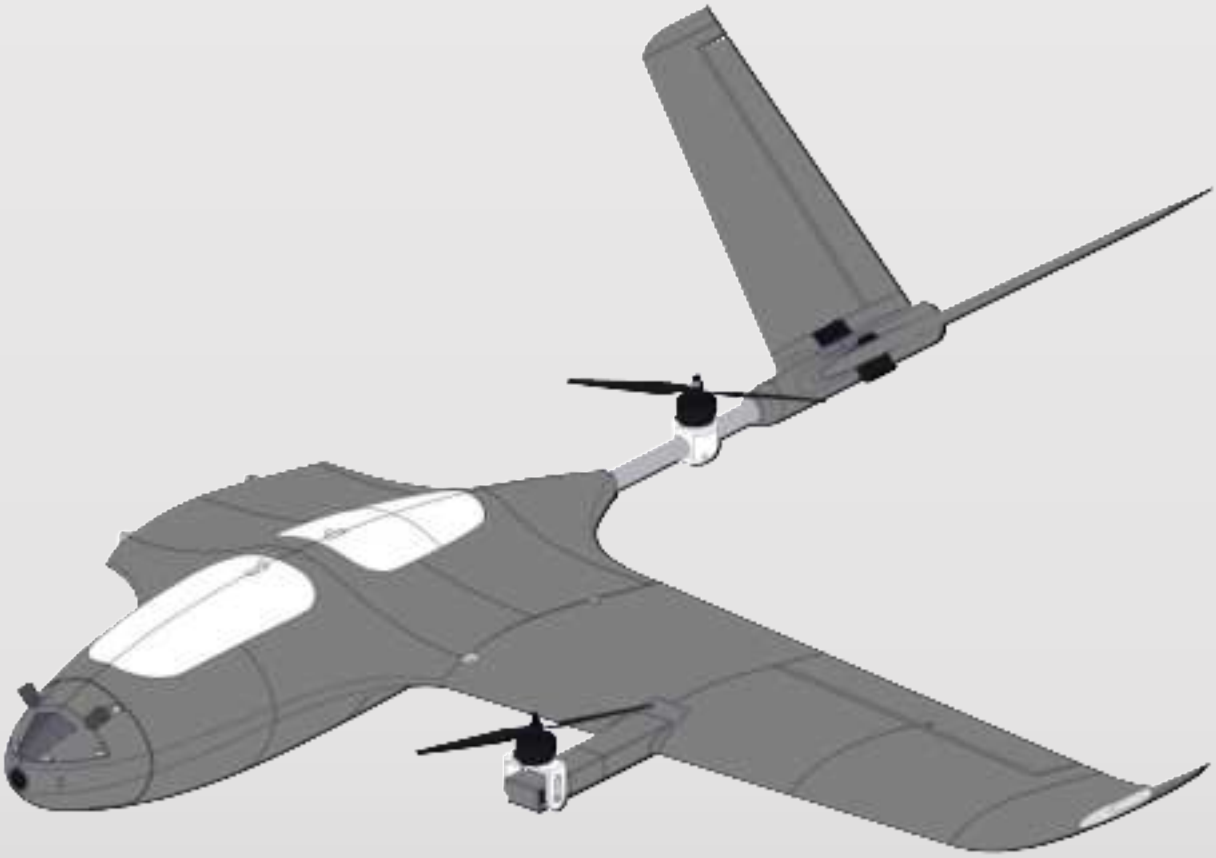
Now, assemble the entire wing. The assembly process is almost identical to the basic version of the Stallion. Only segments 1 and 2 of the wing have designated place for mounting the motor boom. Segment 3 is the same, and you can also choose whether to mount the LED or not.

Wing Assembly



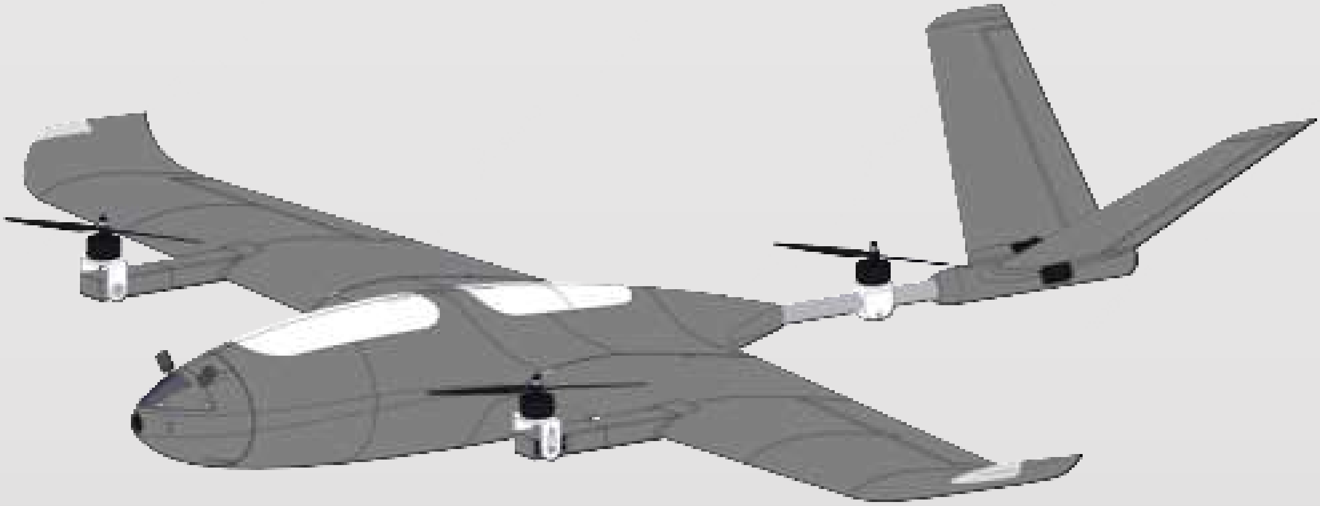
After assembling the wing, firmly glue the Boom in place using CA glue, making sure to do it evenly. Note that when mounting the wing to the fuselage, the main spar will also pass through the Boom, further reinforcing the structure.

Wing Assembly



Now insert the wings and route all the cables from the motor and servo to the channel in the wing that leads to the fuselage. Repeat the same process with the second wing.

Finishing Build



At this stage, the entire structure is now ready, and it's time to move on to connecting cables and configuration

Configuration

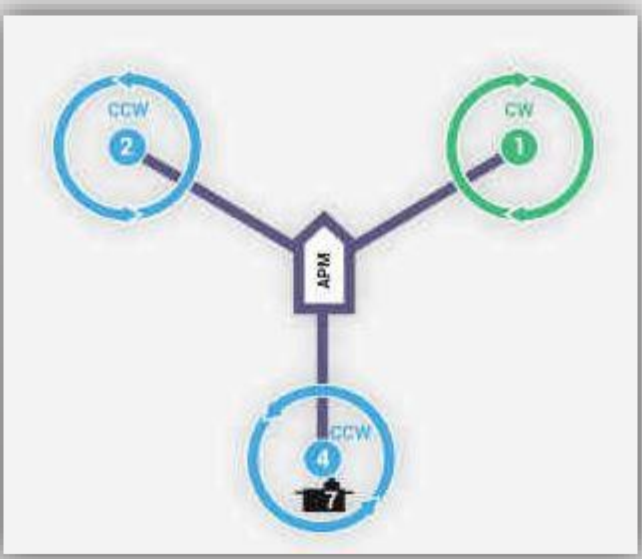
The software I recommend is Ardupilot. It's necessary to familiarize yourself with the information on the website where the full configuration of Tiltrotor Planes in Ardupilot is described.

https://ardupilot.org/plane/docs/guide-tilt-rotor.html

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

Tricopter Configuration

Stallion is a tricopter aircraft with two front tilt motors and one fixed rear motor. Yaw control is achieved by tilting the front motors. We select the option with front propellers CW and CCW. In the diagram, you can see the numbering of the motors, and this is how they should be numbered in Mission Planner.



Servo Output

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

MAIN TILT ROTOR 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_TILT_ENABLE = 1

Also set Q_TILT_ENABLE to 1, indicating the use of tilt motors.

Q_FRAME_CLASS = 7

Next, set Q_FRAME_CLASS to 7, indicating the selection of the tricopter layout

Q_TILT_MASK = 3

The next step is to set the parameter Q_TILT_MASK to 3. It specifies which motors are to tilt. The number is determined by adding the numbers of the motors together. In our case, the front motors are labeled 1 and 2, so 1+2=3.

Q_TILT_TYPE = 2

By setting Q_TILT_TYPE to 2, this parameter specifies the tilt type as vectored. This means that yaw in Hover mode will be controlled by tilting the front motors.

Q_TILT_YAW_ANGLE = 15

You need to specify the maximum tilt angle of the motors during yaw operations. Setting it to 15 degrees is suitable for the Stallion, meaning that the motor can tilt up to 15 degrees beyond its neutral vertical position when controlling the yaw channel. You can adjust this value to be higher or lower depending on how responsive you want the aircraft to be on the yaw.

Q_TILT_MAX = 45

This parameter specifies the tilt angle of the motors during transition. In this position, the motors will be during waiting for the required horizontal flight speed. 45 degrees is the default value and is good, no change required.

MAIN TILT ROTOR PARAMETERS

Q_TILT_RATE_UP = 15

This parameter determines how quickly the motors will tilt during transition and is expressed in degrees per second. 15 degrees means that a full transition will take 6 seconds and is a good value for the Stallion, ensuring smooth transition. You can separately set Q_TILT_RATE_DN, which is the speed of tilting the motors downwards. It is by default set to 0, and I recommend leaving it as such, as then the value of 15 degrees is applied for both directions.

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 = 7

Specifies the PWM type for the motors. If you are using the recommended ESCs, they support DSHOT1200, and the value of the parameter should be set to 7. This is a useful feature that allows you to bypass manual ESC calibration.

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).

MAIN TILT ROTOR PARAMETERS

ARSPD_FBW_MIN = 12
ARSPD_FBW_MAX = 25

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

Q_TRANSITION_MS = 7000

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 front motors gradually transition fully to horizontal flight, while the rear motor shuts off. Seven seconds ensure a smooth transition without the risk of losing lift and altitude.

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_MIN = 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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