REEF Quadrotor Build Documentation

The following document serves as a guide for assembling and configuring a quadrotor for running software developed at the REEF such as REEF Estimator and REEF Controller.

Step 1. Gather and purchase materials.

The following items must be purchased before assembly can begin:

Item	Link	Cost/Unit	Quantity	Total Cost
S500 Quadrotor frame	Amazon	$46.99	1	$46.99
Landing gear skid	Amazon	$7.69	1	$7.69
Flip32 Flight Controller Board	ReadyToFlyQuads	$15.00	1	$15.00
Intel NUK microcomputer + RAM + SSD or equivalent		$656.75	1	$656.75
Vibration Absorption Sheet	Amazon	$14.99	1	$14.99
30A Electronic speed controllers (ESCs)	Amazon	$15.99	4	$63.96
780KV Motors	BuddyRC	$43.30	4	$173.20
CW propeller adapters	DronesVision	$10.85	2	$21.70
CCW 11x4.7 Propellers	ACProp	$3.52	2	$7.04
CW 11x4.7 Propellers	ACProp	$3.52	2	$7.04
Motor bullet connectors	Amazon	$7.99	1	$7.99
Astra Pro RGBD camera (or equivalent)	ORBBEC	$149.99	1	$149.99
MaxBotix MB1242 Sonar	MaxBotix	$39.95	1	$39.95
4-pin sonar wire	Amazon	$7.25	1	$7.25
5V/5A UBEC for flight controller	HobbyKing	$6.40	1	$6.40
1’ Micro USB cable	Amazon	$7.99	1	$7.99
XT60 connector w/pigtail	Amazon	$5.99	1	$5.99
5-40V Boost converter for microcomputer	Amazon	$10.87	1	$10.87
DC Barrel jack with pigtail for microcomputer	Amazon	$15.00	1	$15.00
Lumenier 6600mAh 4S LiPo battery	GlobeRC	$85.99	1	$85.99
Battery straps	Amazon	$7.99	1	$7.99
Heat shrink kit	Amazon	$7.99	1	$7.99
Electrical tape	Amazon	$3.98	1	$3.98
18AWG Hook up wire	Amazon	$9.55	1	$9.55
VELCRO strips	Amazon	$2.98	1	$2.98
Foam mounting tape	Amazon	$11.88	1	$11.88
			Grand total:	$1396.15

Additional parts:

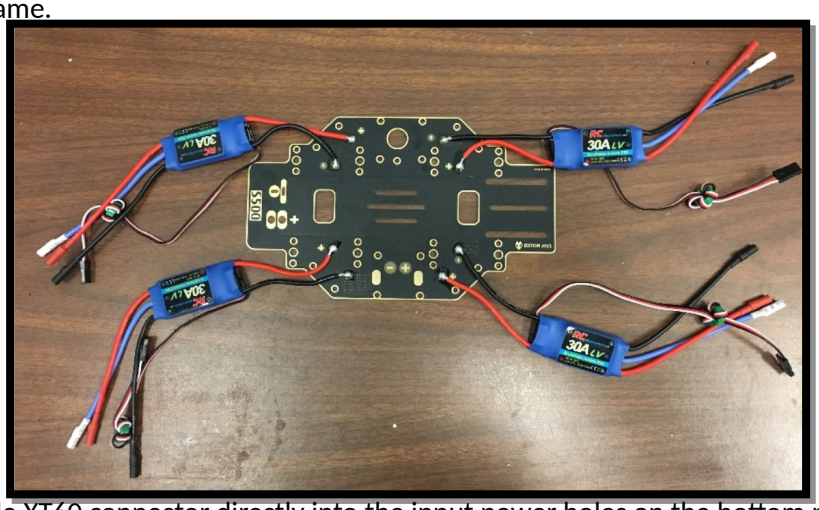
- 3D-printed mounts for RGBD camera, flight controller board, and sonar.
    - [Include photos and link to inventor file downloads.]
- 2.4GHz Transmitter and PPM receiver – we used Futaba T7C (Amazon) and FrSky TFR4 (HobbyKing). Another option is Turnigy Evolution w/TGY-iA6C (HobbyKing).
- Soldering and wiring tools as well as a multimeter will be required.

Construct an XT60 battery extension cable with an inline 5V/5A UBEC to power the flight controller and 18AWG hook up wire to power the boost converter for microcomputer power. To do this, slide heat shrink onto the

purchased female XT60 with pigtail and solder UBEC input wires, approx. 1’ of 18AWG hook up wire, and a male XT60 connector onto the other side of the pigtail. Pull the heat shrink over everything and apply heat.

Step 2. Remove the original connectors from the leads (cut to approx. 9”) of all 4 motors and solder the purchased male bullet connectors in their place. Then apply heat shrink all the way over the smooth, cylindrical portion of the connector.

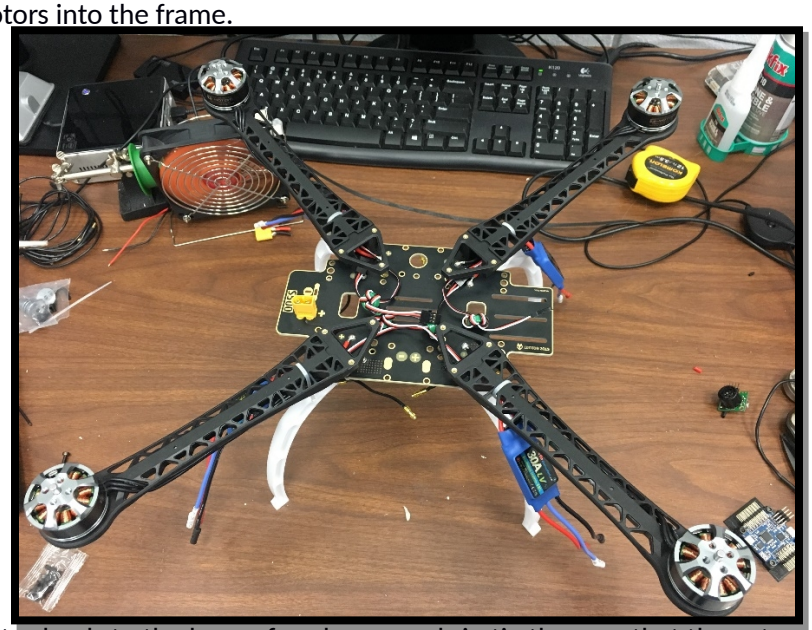
Step 3. Remove female XT60 connectors from all 4 ESCs and solder the power connections to the bottom plate of the S500 frame.



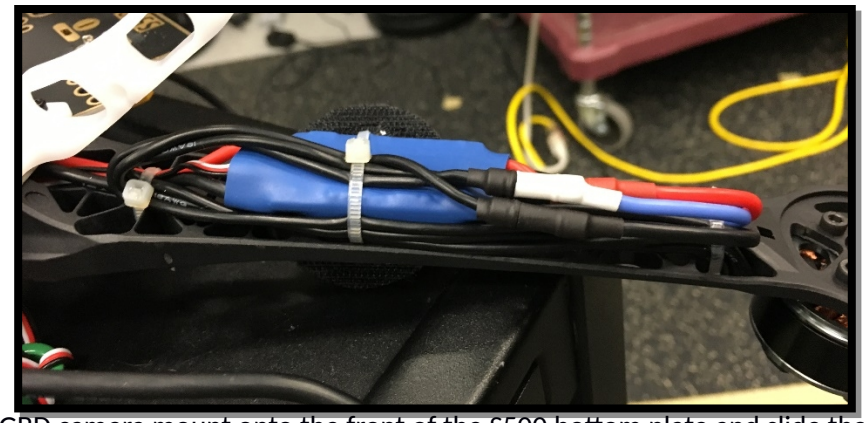
Step 4. Solder a female XT60 connector directly into the input power holes on the bottom plate.

Step 5. With the ESC PWM wires pulled through to the center of the bottom plate, attach all 4 legs (top of plate) and landing gear (bottom of plate) with screws through the bottom of the landing gear.

Step 6. Screw all 4 motors into the frame.

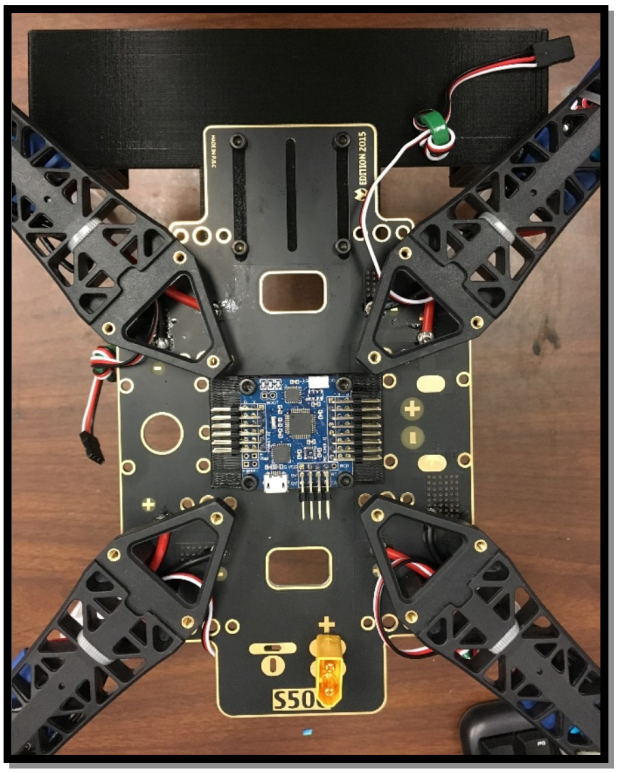


Step 7. Pull the 9” motor leads to the base of each arm and zip tie them so that the extra slack can be looped back and do the same with the ESC leads at the other end of the arm. Then connect them together in any order.

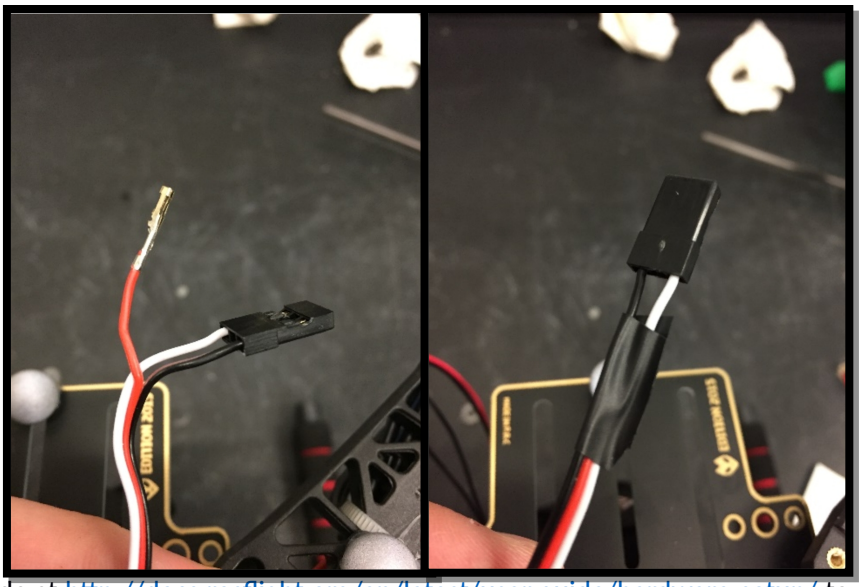


Step 8. Screw the RGBD camera mount onto the front of the S500 bottom plate and slide the camera into the mount. Attach the sonar sensor to its mount and attach it, facing downwards, to the bottom of the RGBD camera. Plug in a 4-pin sonar wire and hot glue it in place.

Step 9. Thread a battery strap (not pictured) through the holes in the bottom plate, then screw the Flip32 flight controller board into the 3D-printed mount. Then cut and apply vibration absorption strips (approx. ½" wide) to the edges of the longer sides of the bottom of the mount. Use the strips to stick the flight controller down to the center of the S500 bottom plate, so that the USB connector points towards the XT60 connector.



Step 10. Cut the end off of the red wire from the ESC PWM cables and apply electrical tape to cover the exposed end of the red wire.



Step 11. Use the guide at http://docs.rosflight.org/en/latest/user-guide/hardware-setup/ to connect ESCs, receiver, 4-pin sonar wire, and 5V UBEC power to the flight controller and configure it with the ROSFlight firmware. Leave a 1' micro USB cable plugged into the flight controller. Also calibrate the ESCs at this point.

Step 12. Attach the boost converter to the front of the frame above the camera using VELCRO and foam mounting tape. Screw in the input power leads from the XT60 pigtail and the output power microcomputer barrel jack. Plug a battery into the pigtail at this time and use a multimeter to measure the voltage output of the converter while using a small flathead screwdriver to adjust the potentiometer until it reads 19V.

Step 13. Screw the S500 top plate into the top of the arms.

Step 14. Using Velcro and foam strips, attach the microcomputer to the top of the plate. Then plug in its power connector, flight controller USB cable, and RGBD camera USB cable.

Step 15. Attach standard (silver) propeller adapters to motors 1 and 3 (top right and bottom left), and reverse-threaded (black) CW propeller adapters to motors 2 and 4 (top left and bottom right). Then attach corresponding propellers and perform a manual flight test in attitude control mode (see ROSFlight docs) with just the flight controller.

Final build with motion capture markers attached