



THE ESSENTIALS SERIES

BUILD YOUR HOPPER



Every chapter of the build video, written out in the same order, with a picture from the footage at each step. The same steps, in a different medium.

16 CHAPTERS • 86 STEPS

FTW ROBOTICS

CONTENTS

01	Install the motors	1	09	Face mask	15
02	Inner front faceplate	4	10	Top body panel, front screw	16
03	Printed circuit board	5	11	Bottom body panel	18
04	Antennas	7	12	Module port cover, the top hat	20
05	Motor wire channels	8	13	Top body panel, rear screws	21
06	Connect the motor ports	10	14	Propeller install	22
07	Top body panel	12	15	Propeller guards	24
08	Install the feet	13	16	Battery and calibration	25

THE ONE RULE

**No screw on Hopper gets tightened. Drive it until it stops, and leave it lightly snug.
That is true of every screw in this guide.**

WATCH IT

The same sixteen chapters run as video in the Build card on ftw-robotics.ai/resources. Every chapter here carries the timecode it starts at, so you can find your place in either one.

FOLLOW IT

This guide is the build written out in that same order, with a picture from the footage at each step. Work from these pages with the drone in front of you.

Chapter 01

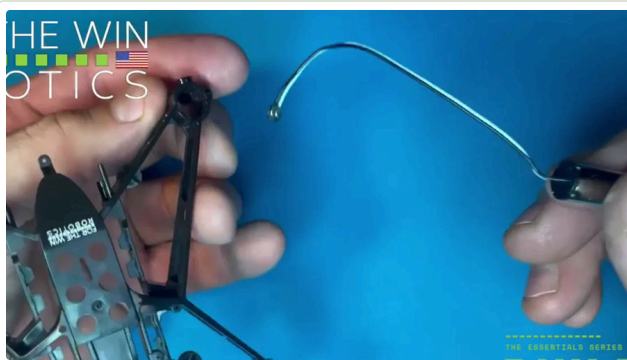
INSTALL THE MOTORS

VIDEO 0:00



STEP 01

Position the airframe logo forward. That is the front of Hopper, and every placement below is described from there.



STEP 02

Motor A has the white and black wire. It goes first, in the front right motor mount.



STEP 03

Seat it by hand until the motor sits snugly in the channel, then pick up the motor tool.



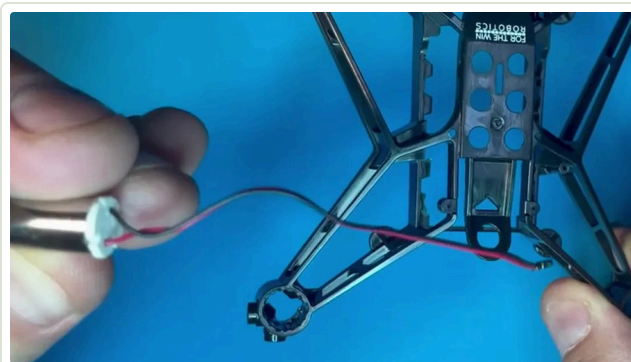
STEP 04

Insert the motor into the tool. Be careful not to bend the motor shaft. A bent shaft is a dead motor.



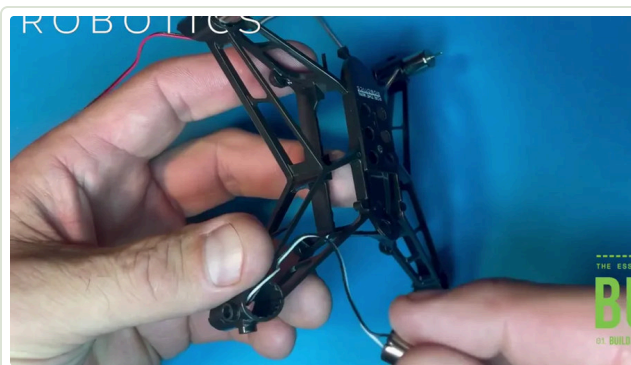
STEP 05

Squeeze the motor in the tool and press it into the channel. It stops on its own against the protrusion inside, leaving the motor sitting about an inch and a half out of the channel.



STEP 06

Motor C has the red and black wire. Looking at the front of the drone, it goes in the front left channel. Start it by hand, then press it home with the tool.



STEP 07

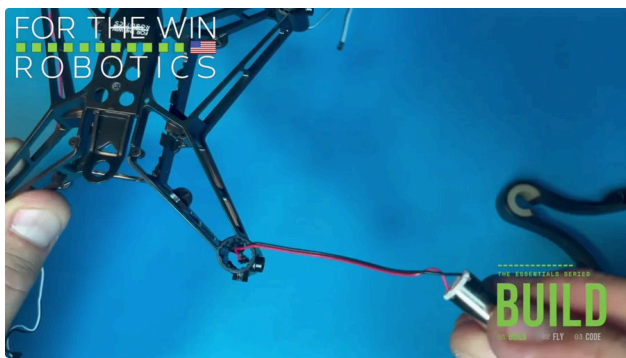
The second motor A goes diagonally across the airframe from the first. Thread the wire through the channel, start it by hand, finish with the tool.

**STEP 08**

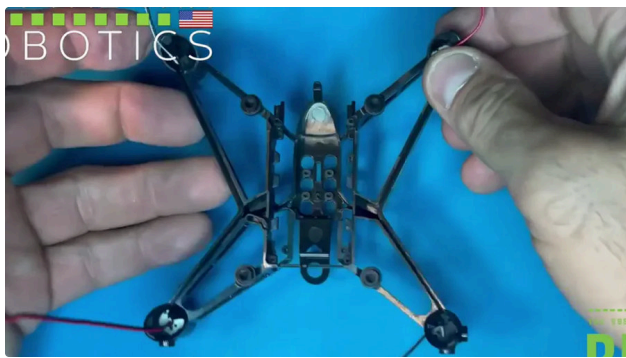
The motors are keyed, and so are the motor channels in the airframe. Each channel is built to accept only its corresponding motor.

STEP 09

The key is a guide, not a lock. The wrong motor can still be jammed into a channel, so if a motor feels unusually hard to seat, stop and check you have the right one for that position rather than forcing it.

**STEP 10**

The last one is the second motor C, diagonal from the other C. Red and black wire. Thread, start, press.

**STEP 11**

With all four in, press each one down once more to close any gap, then flip the airframe over.

NOTE

The motor wires are loose at this point. That is fine, and this is a good place to leave them.

Chapter 02

INNER FRONT FACEPLATE

VIDEO 3:27



STEP 01

The faceplate has two sets of holes, top and bottom. Only the bottom pair takes screws.



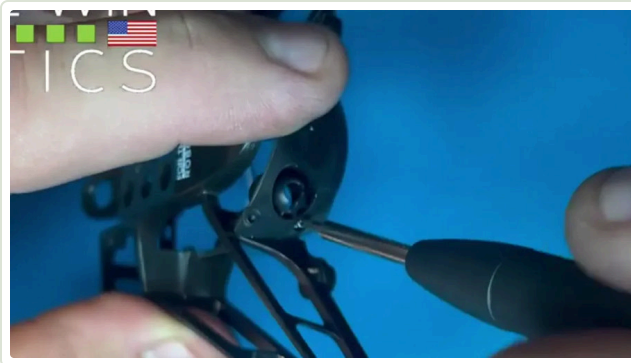
STEP 02

The top pair is a joint, not a fastening. The airframe's two long cylindrical protrusions slide inside the larger receiving cylinders on the faceplate.



STEP 03

Line the two up and thread them together gently, then press down until they seat.

**STEP 04**

Now the bottom pair. Put a screw through the faceplate hole and into the threaded airframe hole behind it. Turn until you feel tension, then stop.

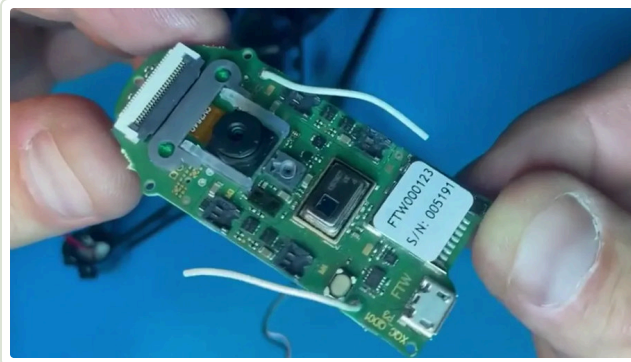
**STEP 05**

Repeat on the other side. The T3 screwdriver is magnetic, so the screw sits on the tip while you line up the hole.

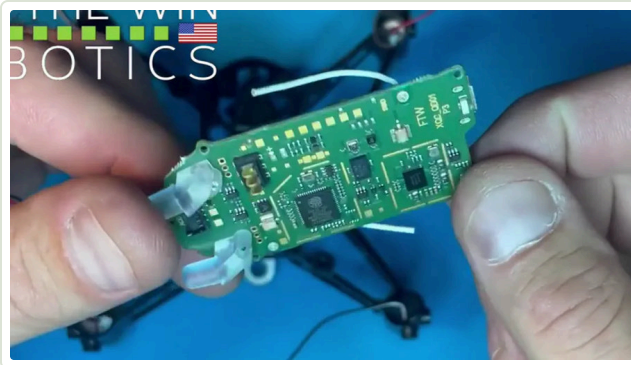
Chapter 03

PRINTED CIRCUIT BOARD

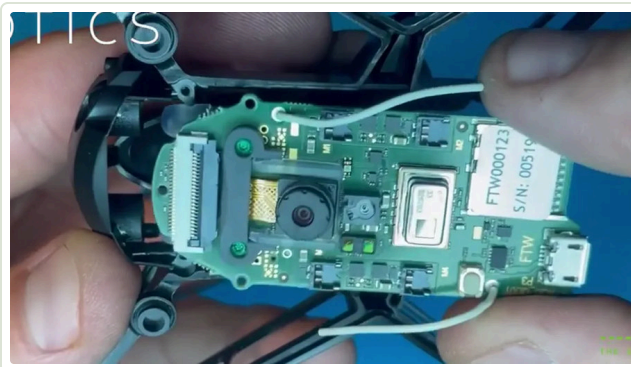
VIDEO 6:15

**STEP 01**

Know both faces before it goes in. Bottom side: the IR sensor, the lens, the motor ports, and the Bluetooth and WiFi antennas.

**STEP 02**

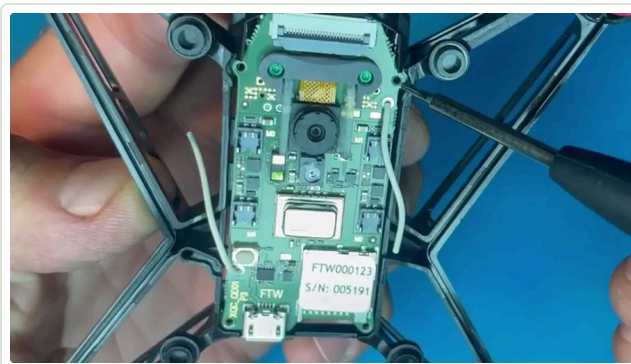
Top side: the light guides, which are Hopper's eyes, the power connector, and the four pin connector for whatever attaches in future.

**STEP 03**

Turn the airframe over and lay the PCB in with the bottom side facing up.

**STEP 04**

Go gently, so the light guides slide into the eye channels in the interface plate. It clicks into place and the airframe holds it.

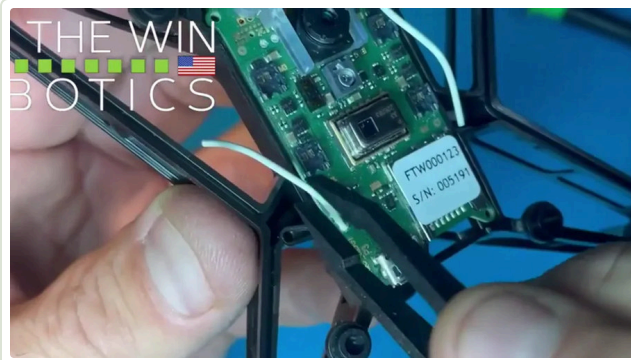
**STEP 05**

Check that the four screw holes on the top side and the two on the bottom line up. Nothing gets screwed down yet. You are only confirming it sits right.

Chapter 04

ANTENNAS

VIDEO 7:37



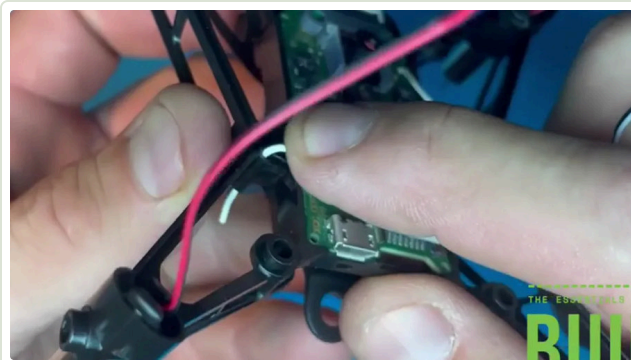
STEP 01

Still working on the underside. The Bluetooth antenna is the one furthest from the lens.



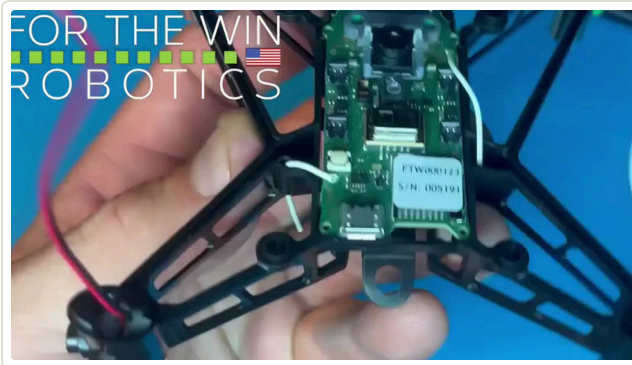
STEP 02

Feed it through the pre-drilled hole so it sits protected. Tweezers make this easier.

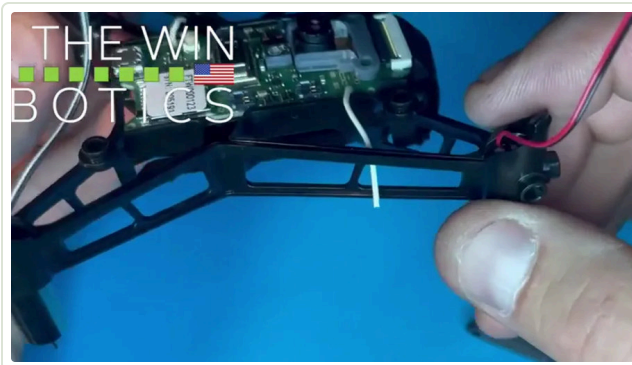


STEP 03

Work it in a little at a time, gently repositioning the PCB as you go so it nests properly into the airframe.

**STEP 04**

What you are protecting through all of this is the solder joint where the antenna meets the board.

**STEP 05**

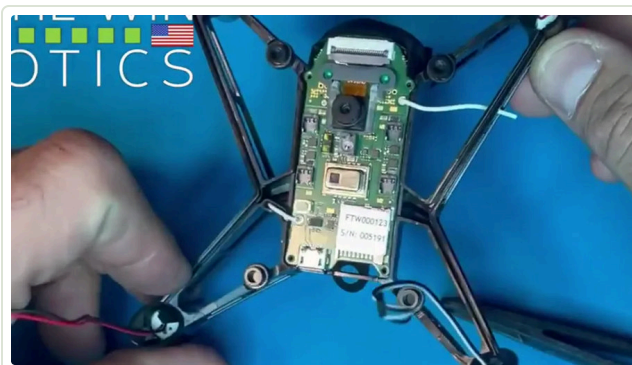
Bend the WiFi antenna gently so it points outward and through the airframe, protected the same way.

NOTE

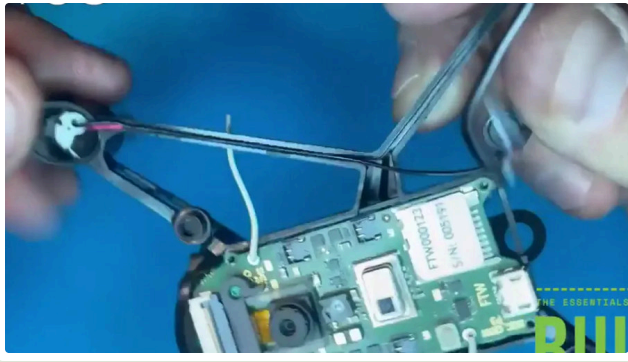
If the solder joint does break, it can be re-soldered, and it is not the end of the world. Contact us first.

Chapter 05**MOTOR WIRE CHANNELS**

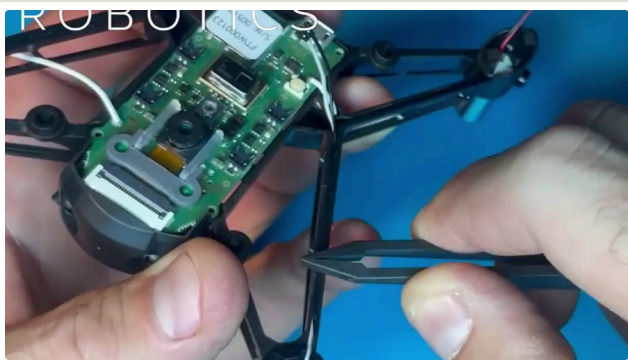
VIDEO 8:38

**STEP 01**

Channels are cut into the airframe to carry each motor wire from its motor channel to the PCB.

**STEP 02**

Lay every wire black side up. On a C motor that hides the red, on an A motor it hides the white, and the underside of Hopper comes out clean instead of striped.

**STEP 03**

Roll the flat of the tweezers, or the metal of the T3 screwdriver, along the channel to press the wire down smooth and flush.

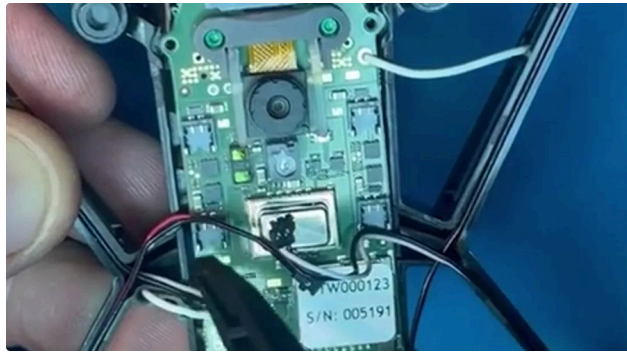
**STEP 04**

The wires stay put once the feet are on and the connectors are in. If one lifts before then, press it back.

Chapter 06

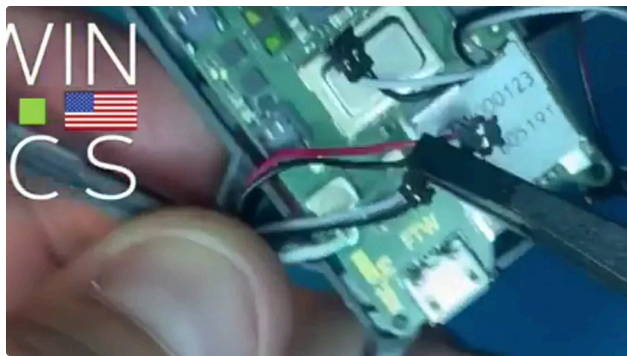
CONNECT THE MOTOR PORTS

VIDEO 10:39



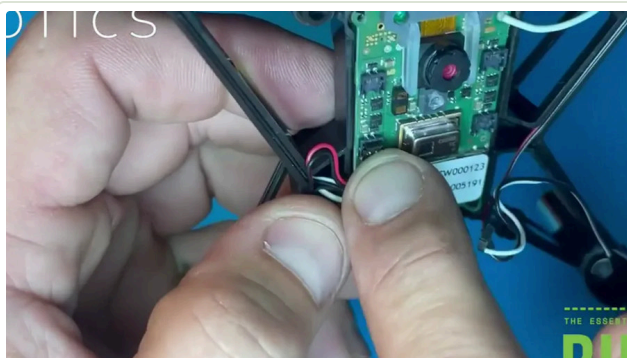
STEP 01

One rule covers all four: each connector goes to the motor port closest to its own motor. It does not matter whether it is an A or a C.



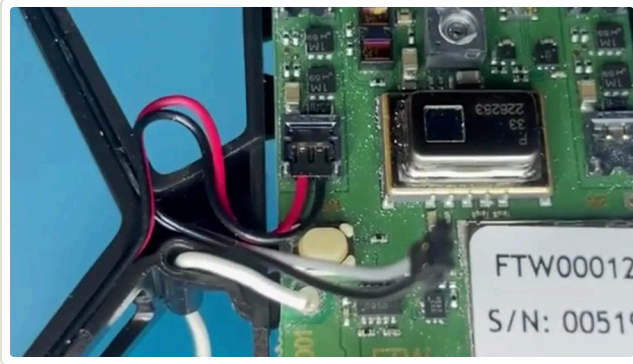
STEP 02

Orient the connector gold circles up.

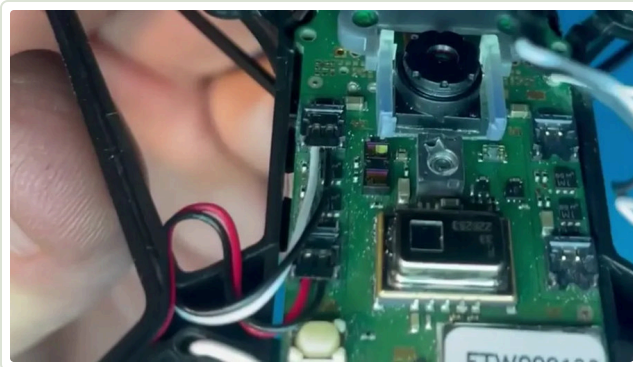


STEP 03

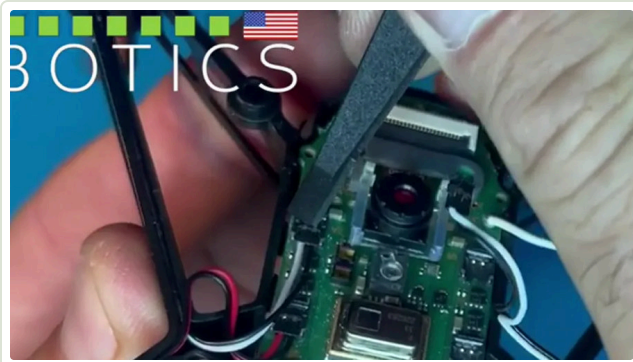
Line it up and press it in with a finger or the tweezers. The click is quiet. What tells you it seated is how it sits afterwards.

**STEP 04**

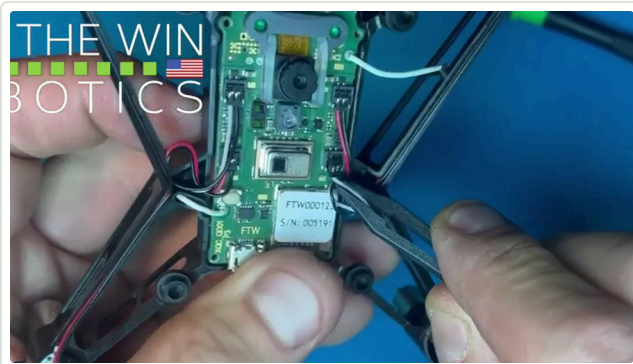
Check it is flat. A connector angled even slightly on either side gives an intermittent connection, and that is a drone that crashes on takeoff.

**STEP 05**

Make sure the wire leaving each connector is clear of its neighbour, and that two ports on the same side are not interfering with each other.

**STEP 06**

Press down gently and flat with the tweezers to finish the connection.

**STEP 07**

Work around all four the same way.

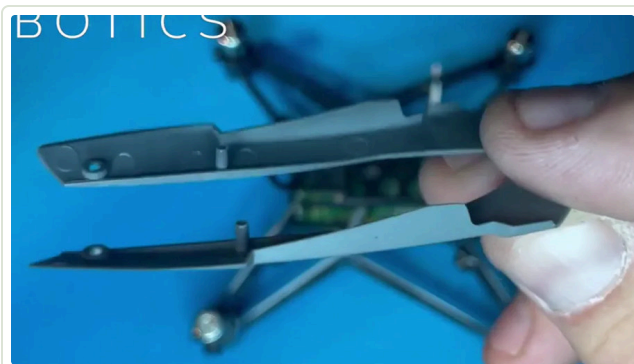
**STEP 08**

With all four connected, stow the slack. Pinch the excess wire and press it into the channel and the triangular cavity just before the PCB until the channel is full. Go gently, because pressing too hard can pull a wire back out of its connector.

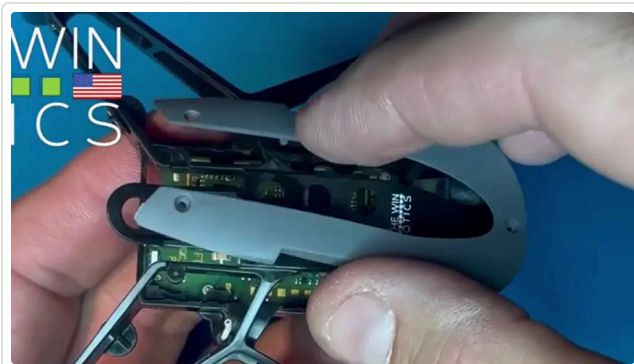
Chapter 07

TOP BODY PANEL

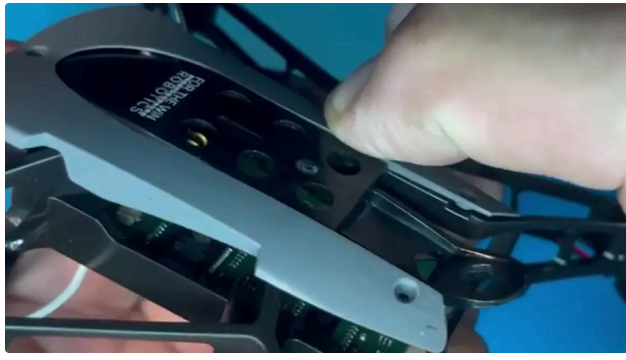
VIDEO 15:13

**STEP 01**

The panel has one protrusion on each side that drops into a hole in the middle of the airframe. The fit is tight by design.

**STEP 02**

Three screw holes go in later, to mount it more securely. For now it just sits.



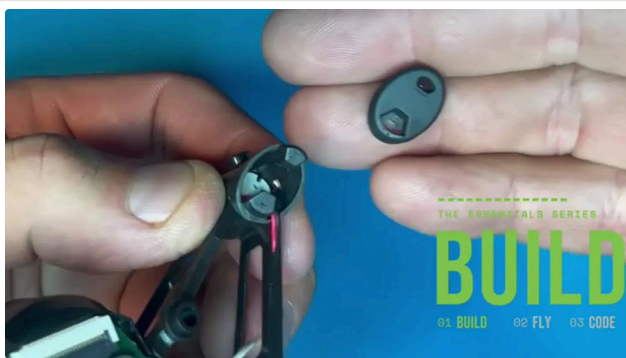
STEP 03

Front and back are visibly different. Line it up the right way round and press down.

Chapter 08

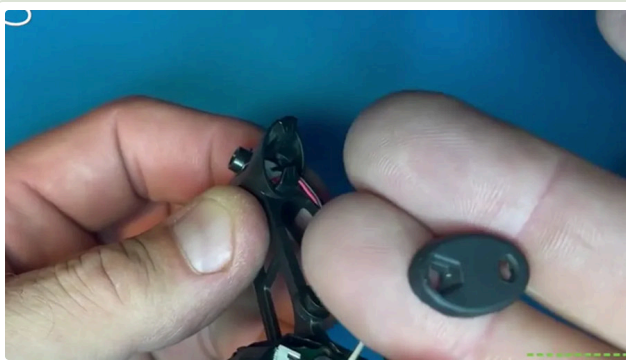
INSTALL THE FEET

VIDEO 16:17



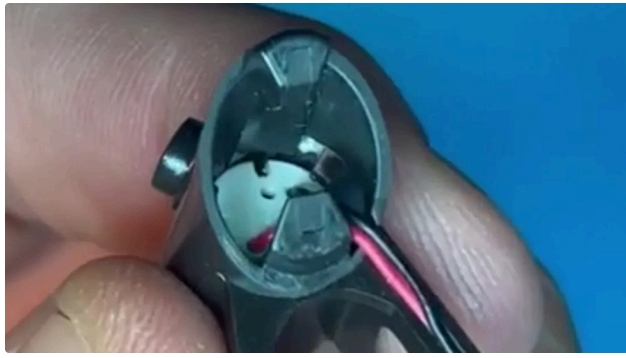
STEP 01

All four feet are identical. Any foot fits any position.



STEP 02

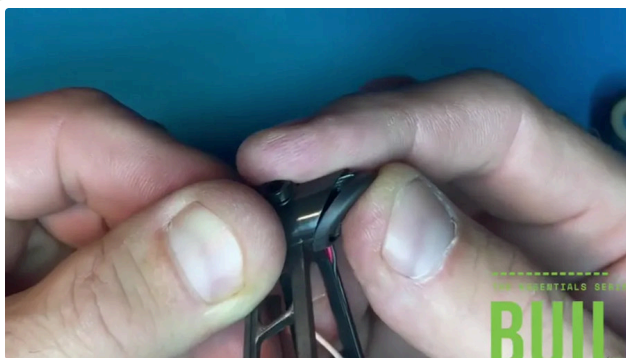
Each foot has a larger hole and a smaller one, and an inside face and an outside face that are clearly different from each other.

**STEP 03**

The airframe has two protrusions at each position: the lower one larger, the upper one small.

**STEP 04**

Slide the larger lower protrusion into the foot first, right into the rubber.

**STEP 05**

Then pull the foot up and over so the upper protrusion hooks into the smaller hole. The T3 screwdriver gives you the leverage.

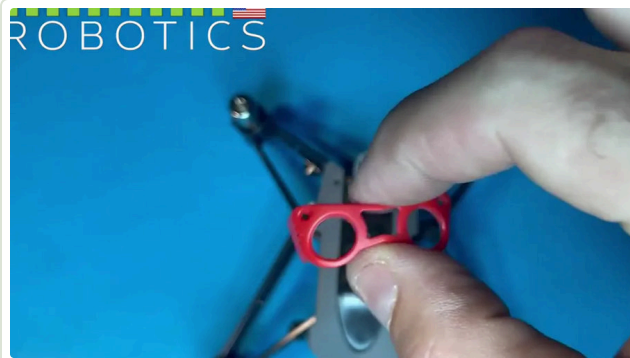
**STEP 06**

Repeat for the other three, keeping motor wire out of the way as you go.

Chapter 09

FACE MASK

VIDEO 18:43



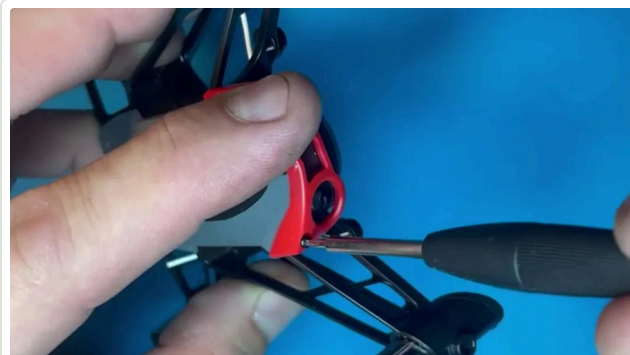
STEP 01

The face mask comes in four colours and every one installs the same way, with two screws.



STEP 02

It goes on the top holes of the interface plate, the pair you deliberately left open back at the faceplate step.



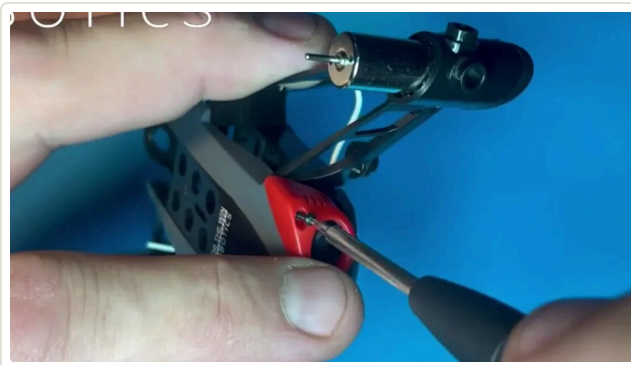
STEP 03

Hold the mask and the drone together, get a good look at the first hole, and confirm it is lined up before the screw goes anywhere.



STEP 04

Drive the screw until it reaches its first stop. That is all it needs.



STEP 05

Second screw the same. Do not press down. It should find thread without force, and pressing is how small screws go flying.

Chapter 10

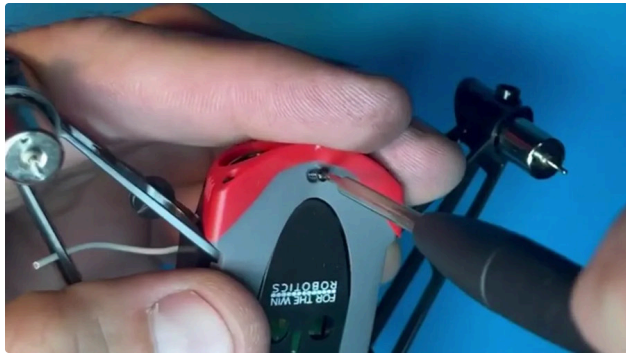
TOP BODY PANEL, FRONT SCREW

VIDEO 20:12



STEP 01

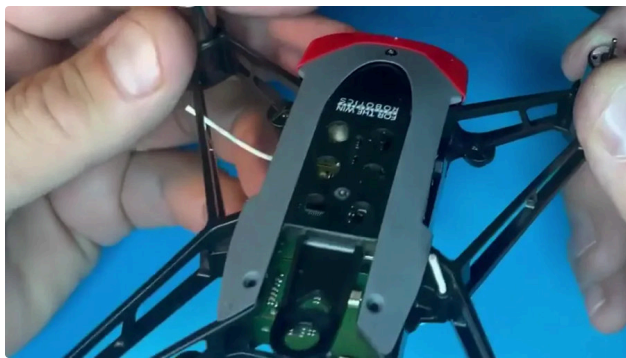
One screw goes in beside the face mask, holding down the front of the top body panel.

**STEP 02**

Drive it through the panel's plastic first, then go looking for the airframe hole underneath.

**STEP 03**

The top body panel's holes are tighter than the rest of the holes on Hopper, which is exactly why you clear the plastic before you start hunting for thread.

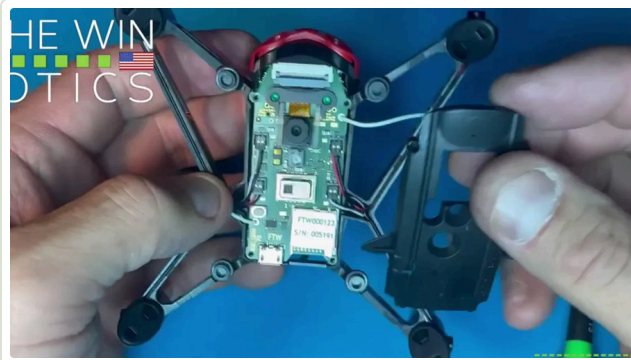
**STEP 04**

Leave the two rear top panel screws open for now.

Chapter 11

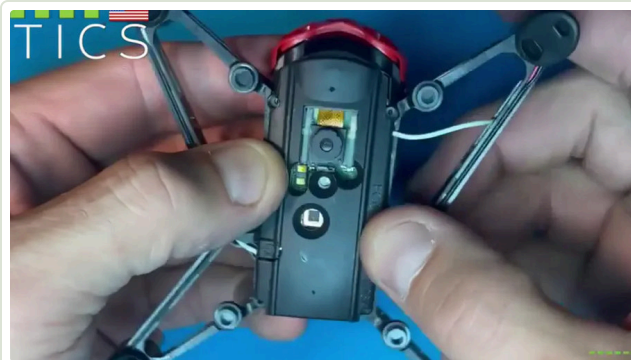
BOTTOM BODY PANEL

VIDEO 21:01



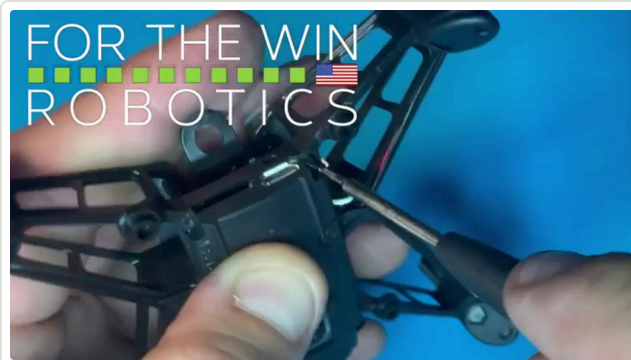
STEP 01

Flip Hopper over. This is a critical piece, and it only goes on well if everything underneath it is already right.



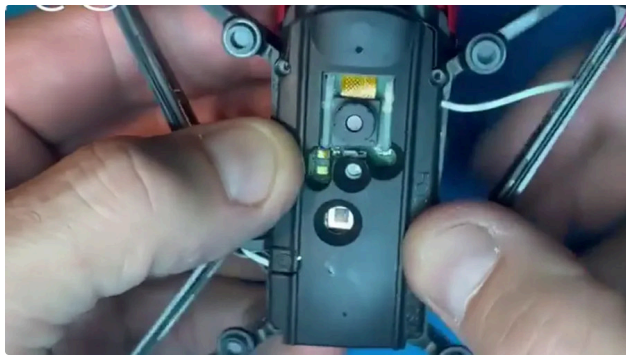
STEP 02

Check three things first: motor wires tucked properly into their channels, both antennas in the channels cut for them, and the tray the lens sits on clear of the panel.



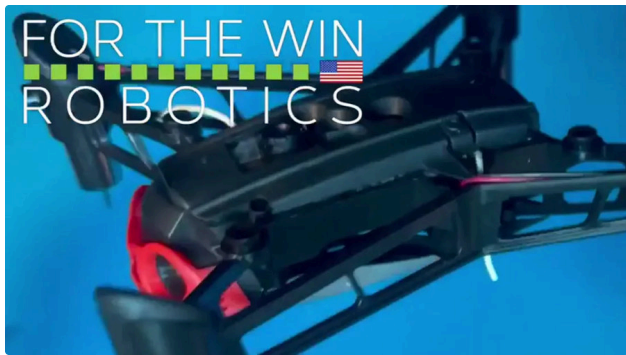
STEP 03

Line up the four holes and start with the rear two. One side at a time is the easier path.



STEP 04

If a screw turns without drawing the panel down, stop. Check the alignment between the panel and the board rather than forcing it.



STEP 05

Close the gap until the screw stops. Tight enough to close it, not tighter.



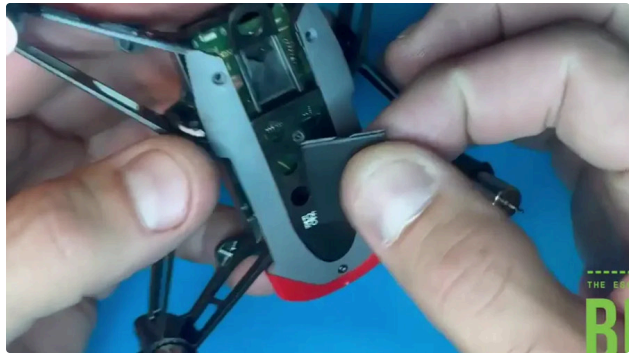
STEP 06

Done right it sits flush and flat, the antenna comes out through the hole meant for it, and there is essentially no seam.

Chapter 12

MODULE PORT COVER, THE TOP HAT

VIDEO 23:08



STEP 01

The top hat covers the module ports, the Lego style holes on the top of the airframe.



STEP 02

Put all six holes onto the airframe holes and press it down flat.



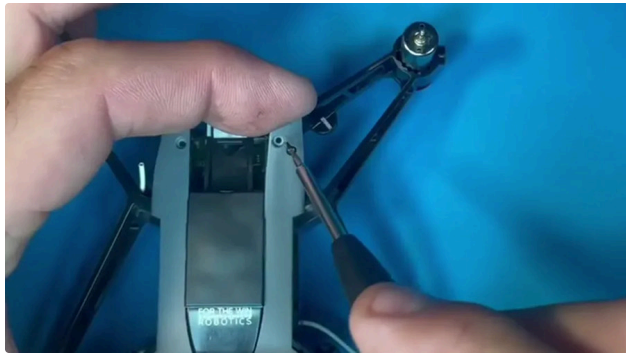
STEP 03

Covered, they keep the PCB protected for as long as nothing is attached to them.

Chapter 13

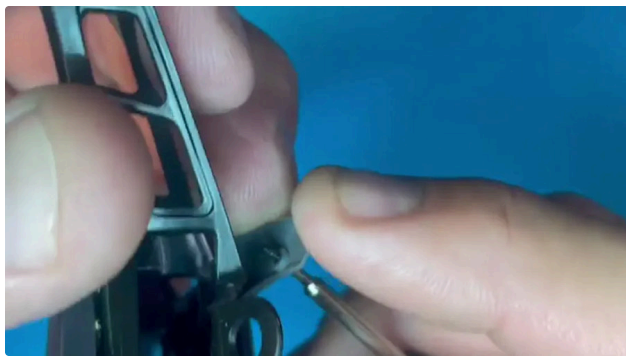
TOP BODY PANEL, REAR SCREWS

VIDEO 24:04



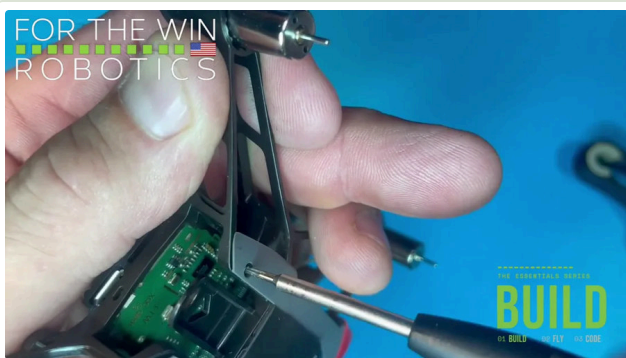
STEP 01

Two screws left, the rear pair on the top body panel.



STEP 02

Same technique as the front one: through the plastic first, then into the airframe hole.



STEP 03

Down until it stops. It does not need to be tight. Same on the other side.



STEP 04

The top of Hopper is now fully closed and protected.

Chapter 14

PROPELLER INSTALL

VIDEO 25:29



STEP 01

Propeller A is grey on current sets, and every A carries an A on the underside of a blade.



STEP 02

Propellers follow their motors, so the positions are already decided. Propeller A goes front right and back left. Propeller C goes front left and back right. Each pair sits diagonally across the airframe, exactly like the motors do.



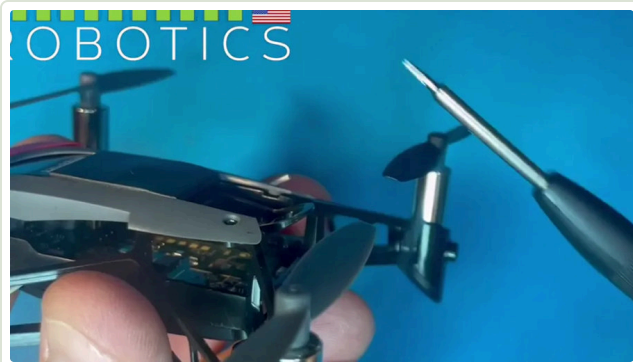
STEP 03

Press all four down firmly onto their motor stems. The shaft should go all the way in, so the propeller sits on the motor, or just about.



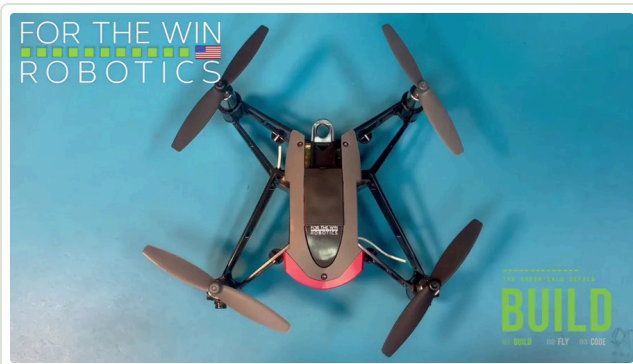
STEP 04

Now run the orientation test, which is what proves the orientation is correct. Look at the two front propellers, at the inner blades that point toward each other. They pitch from down to up as they come toward you.



STEP 05

Then do the same test at the rear. Those inner blades also rise from down to up, the opposite of the front, so the two pairs together follow one line up and over Hopper.



STEP 06

If a pair does not read that way, take that propeller off and swap it to the other diagonal.

NOTE

Colour is a convenience for telling your drone from someone else's. The blades are what identify the part.

Chapter 15

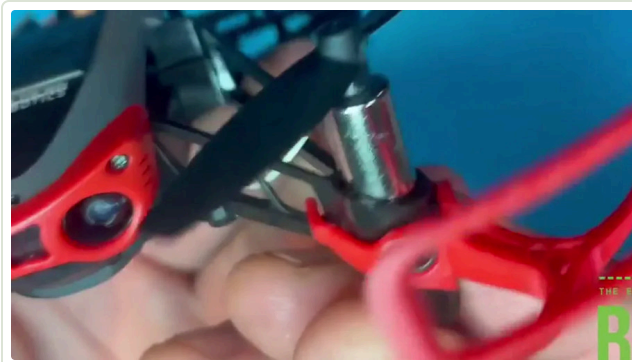
PROPELLER GUARDS

VIDEO 27:30



STEP 01

All four guards are the same, and any one fits any motor mount.



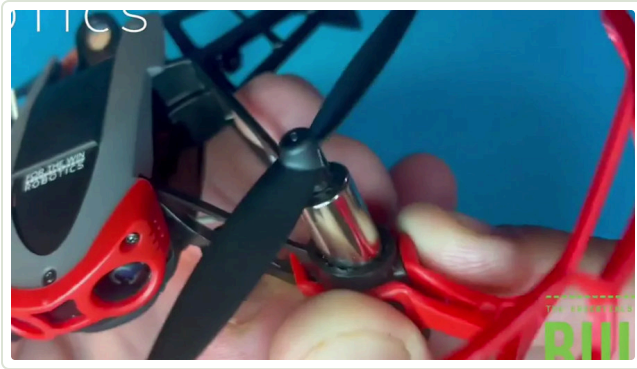
STEP 02

The arms go around the motor mount, inside the airframe.



STEP 03

Each of the two airframe protrusions on the outside of the mount takes one of the guard's two holes.



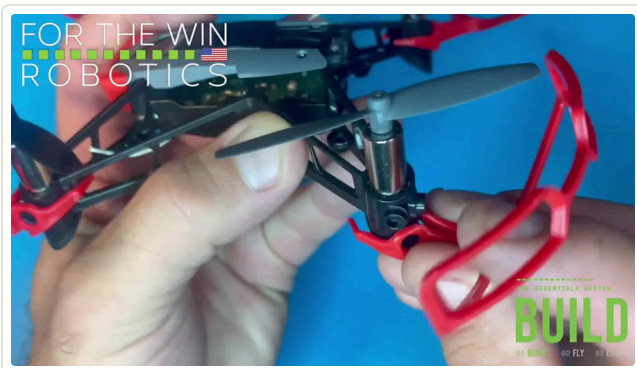
STEP 04

Squeeze until both sides lock in. It takes a little finesse.



STEP 05

The guard curves up and over the propeller it protects. If it is facing downward, it is on upside down.



STEP 06

Repeat for the remaining three the exact same way.

Chapter 16

BATTERY AND CALIBRATION

VIDEO 28:50

STEP 01

All three of Hopper's batteries should already be charged. You started them charging before the build so they would be ready when you got to this point.



STEP 02

The battery's contacts point down, to meet the three bars at the back of the PCB. Flip the battery over so the sides match.



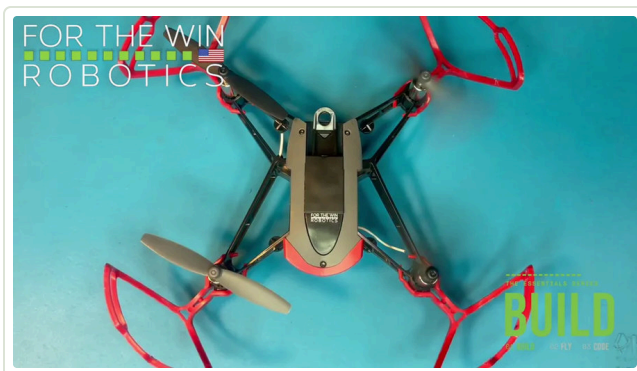
STEP 03

Set Hopper down on the floor before you insert the battery. Calibration begins the moment the battery clicks in.



STEP 04

Locate the battery port at the rear of the drone. Line the battery up without bending the propellers, and click it in.



STEP 05

Watch the propellers, not the lights. Calibration lives in the props, and they run an opening sequence the moment the battery clicks in. If they do not execute that sequence correctly, something is wrong. On firmware 2.0.6 this is what a normal power up looks like.

NOTE

The propeller tool is the easy way to get a battery back out once it is seated.

THAT IS THE WHOLE BUILD

FLY IS NEXT



Hopper is assembled, the propellers are on the right diagonals, and calibration has run.

WATCH IT

ftw-robotics.ai/resources

FOLLOW IT

ftw-robotics.ai/hopper-build.html

PRINT IT

ftw-robotics.ai/build-guide.pdf