

# ***Kopis 2***



User Manual & Setup Guide  
v1.0

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# Overview

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KOPIS is a high-performance ready-to-fly FPV racing drone from Holybro, Low-deck design means centralized mass and excellent handling. Stretched-X motor layout is the choice of top racers because the rear props are further from the "dirty air" coming from the front props. The result is smoother cornering and higher top speed. The FPV antenna is in a unique location behind the quad, to protect against damage. Kakute F7 flight controller and Atlatl HV V2 video transmitter give perfectly integrated control of all quadcopter systems. TMOTOR F40 Pro-II 2400kv motors give awesome power and speed, just like top racers. RunCam Swift Micro camera is light and small, with great image quality. KOPIS gives all the performance, looks, and durability of a hand-built machine, without ever having to pick up a soldering iron!

## Features

- 5mm full 3k carbon fiber twill
- Counter-sunk screws on base for great appearance and protection of battery against damage.
- KakuteF7 flight controller with soft-mounted gyro for mechanical filtering of vibration. Means you can disable more software filters for best flight handling.
- Improved soft-mounting foam for KakuteF7 gives optimal balance of stiffness and damping for even better gyro performance than before!
- Betaflight OSD included. Monitor voltage and battery capacity in your FPV goggles. Change PIDs and Rates using your transmitter sticks.
- Atlatl HV V2 video transmitter:
  - 5.8 GHz
  - Standard 40-channel set. However 5645 MHz and 5925 MHz 5945 MHz are illegal in many areas, so they are not supported. **If you select one of these channels, it will simply fail to work.**
  - Output Power: 0.5 mW (pit mode), 25 mW, 200 mW, 500 mW, 800 mW
  - MMCX antenna connector for easy, secure connection. Won't break or come loose like the IPEX connector used on other vTX.
  - Control the vTX channel and transmit power from the OSD using your transmitter sticks or from your Transmitter. No more picking up the quad to change vTX settings!
- Buzzer included.
- RunCam Swift Micro FPV camera
- Adjustable camera uptilt from 0 degrees to 90 degrees.
- Serial receiver supported (SBUS, iBUS, Spektrum). **Legacy PPM and PWM receivers not supported.**

### *Specifications*

- MCU: STM32F745VGT6 32-bit processor
- IMU: ICM20689 (SPI) 32 kHz capable
- Barometer: BMP280
- TF card for Blackbox logging
- Tekko32 BLHeli\_32 4-in-1 ESC (Dshot1200 compatible)
- Supports 4S-6S battery (motors are optimized for 4S)
- Weight 299 grams without battery or props

### *Warranty and Return Policy*

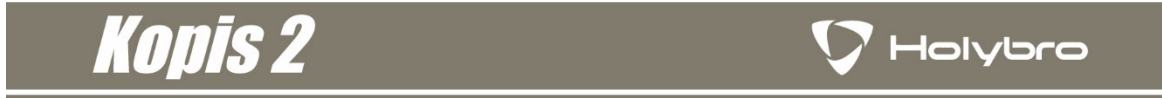
If you believe that your KOPIS is defective, please contact us. If we determine that the board is defective, it will be repaired or replaced at no charge to you. We may ask you to send your KOPIS to our service center for examination or repair. Shipping costs are your responsibility. Returned items should include the original packaging and all accessories.

If product is damaged or defective, we will repair or replace it. Refunds are only given when product is lost by the shipping company. The refund amount is limited to the price of the product. Shipping costs are never refundable.



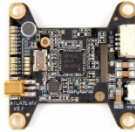











Contact us at:

- Email: [productservice@holybro.com](mailto:productservice@holybro.com)
- Facebook Page: Holybro
- Facebook Group: Holybro Shuriken Owner Group

# Spare Parts



**SPARE PART LIST**

ITEM No.	DESCRIPTIONS	PHOTO	ITEM No.	DESCRIPTIONS	PHOTO
11033	KAKUTE F7 board		510070	Carbon fiber 5mm ARM 4pcs	
13008	Atlatl HV V2 VTx Board		510071	Carbon fiber 4mm Bottom plate	
31013	ESC Tekko32 4-in-1 35A		530074	Antenna Foxeer Lollipop 5.8G RHCP	
31015	Kopis2 FPV Frame		540058 & 540059	Aluminium Parts (Aluminum standoff M3 21mm 4pcs)	
520037	T-MOTOR F40 PRO2 2400kv		530075	Battery Pad 3mm Silicon sheet	
530073	Propeller DALPROP CYCLONE T5046C(2pair)		530054	Strap(20*200mm) battery strap 2pcs	
520038	Camera Runcam Micro SWIFT		530056	Carrying case	

# Install Betaflight

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Although your KOPIS comes from the factory nearly completely ready to fly, you still need to install the Betaflight configurator on your computer so that you can make sure your transmitter is configured correctly. If you purchased the Plug-N-Fly version of the KOPIS, you also may need to use the configurator to bind your receiver.

## *Installing Drivers*

In order to connect to your KOPIS, you must get the Betaflight drivers installed on your computer. If you are on MacOS or Linux, Your O/S comes with the drivers you need pre-installed. You do not need to perform this step. You may skip directly to “Installing Betaflight Configurator”.

If you are on Windows, you must install the drivers manually. This is a place where beginners often struggle. We’re going to present the steps here, and if you can follow them, then great, but many people won’t be able to follow them. If you need a more personal approach, here is a link to a video that walks you through the process in more detail.



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*All About Betaflight Drivers, Including How to Install Them*

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<https://www.youtube.com/watch?v=m4ygG6Y5zXI>

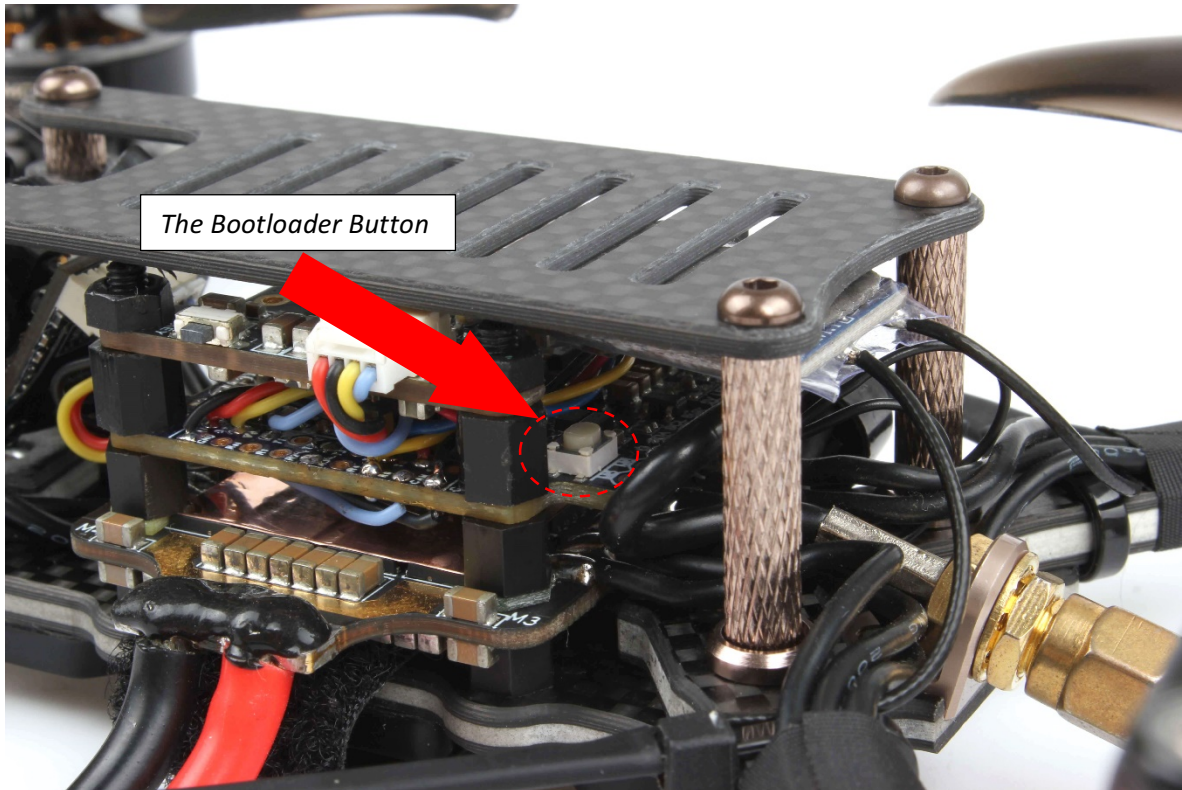
The video linked above shows a process of using Zadig to replace the VCP driver. The ImpluseRC Driver Fixer is an easier way of doing the same thing. The instructions below will show how to use the ImpulseRC Driver Fixer.

Here are the steps you will perform:

1. Download the Virtual COM Port (VCP) driver installer from [here](#). Unfortunately, you must either create a login or give them your email address, then wait for them to email you a link, to download the actual installer. We recommend that you create a user login because the “send you a link in an email” method sometimes takes a long time to go through.
  - a. To create a login at the STM site, first go to [this URL](#).
  - b. Click “Create an Account”
  - c. Enter your information in the next page and click “Register”
  - d. You will receive a confirmation email. Complete the confirmation process.
  - e. Log in to the STM site using the login you just created and download the VCP driver installer from the link in step 3.
2. Run the VCP installer and let it finish.
3. Download the ImpulseRC Driver Fixer from [here](#).
4. Run the ImpulseRC Driver Fixer. It will instruct you to plug in your flight controller.



5. While holding down the bootloader button on the Kakute F7, plug it into your PC via USB. The ImpulseRC Driver Fixer should complete successfully. The bootloader button is quite small. Use a plastic tool to press it. If you use a metal tool like a screwdriver tip, be careful not to damage it. Use the flat of the tool and not the tip.



### *Is It Over Yet?*

THAT WAS SUPER ANNOYING WASN'T IT. Yes... we know.

The good news is, you do not need to repeat this process again. Sort of. You never need to install the drivers again on this computer, unless you reinstall the operating system for some reason. If you use another computer for the first time, you will need to install those drivers on it. Also, you may need to re-run the ImpulseRC Driver Fixer sometimes when you go to flash the board. If you try to flash the board and it fails, repeat steps 4 and 5 above.

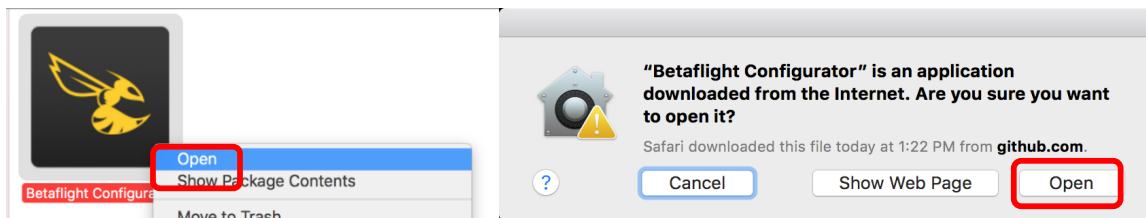
## *Installing Betaflight Configurator*

Betaflight is managed using the Betaflight Configurator application, also known for short as the Betaflight GUI, or just, “The GUI”. (GUI is pronounced “gooey” in case you wondered. Only weirdos say, “Gee You Eye”.) Download the Betaflight Configurator application here:

<https://github.com/betaflight/betaflight-configurator/releases>

This is a standard application package for Windows, MacOS, or Linux. After you download it, install and run it the same as any other application.

On MacOS you must give the application permission to run and access the network. The simplest way to do this is to right-click the installer and choose Open. A security prompt will appear asking, “Are you sure you want to open it?” Click Open on this prompt and the relevant configuration changes will be made automatically.



# Install the Receiver

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Your KOPIS comes fully built. But there are still some basic steps that you need to do, to make sure that your transmitter is going to work correctly with KOPIS. We're going to walk through those steps now.

KOPIS comes either as a *Plug-n-Fly* (PnF) model or a *Bind-n-Fly* (BnF) model. The BnF model has a FrSky XSR receiver already installed. If you purchased the BnF model, you can skip the installation instructions below. Go directly to the binding instructions.

If you purchased the PnF model of the KOPIS, you need to install your own receiver. We strongly recommend that you use a low-profile-receiver like the FrSky XM+ or R-XSR. The KOPIS is designed to be small and light, for best flight performance. But this also means it will be hard to fit a large receiver onto it.

First, use a 2mm hex driver to remove the four screws at the corner of the KOPIS top plate. Remove the top plate. This will expose the flight control stack. A wire has been pre-installed from the factory for your receiver to connect to.

**The pre-installed wire has a connector for a FrSky XSR receiver. If you have a FrSky radio, simply plug that receiver in to the pre-installed wire.** If you have any other receiver, cut the connector off the wire and solder it directly to your receiver, or install a new connector if you prefer. (DO NOT CUT THE WIRES WHEN THE BATTERY IS PLUGGED IN!) The XSR Receiver uses the same plug as the FrSky R-XSR receiver, however the pinout is not compatible between the two receivers. You cannot simply plug an R-XSR receiver into the Kopis and have it work.

The pre-installed wire has three colors: red, black, and yellow. The red wire is for power; the black wire is for ground; the yellow wire is for signal. Be sure to reference the pinout diagram for your receiver, to ensure that you are connecting the correct pads together.

You must use a receiver that supports a serial protocol such as SBUS, iBus, and Spektrum Satellite. **You cannot use a PPM or PWM receiver with the Kakute flight controller on the KOPIS.**

If your receiver requires 5v power (most receivers except for Spektrum Satellite), no additional action is required. If your receiver requires 3.3v power (most Spektrum Satellite receivers), **you must move the red wire from the 5v pad on the Kakute to the 3v3 pad right next to it.** This will require you to take the Atlatl video transmitter off the top of the flight control stack to get at the solder pads on the KOPIS. **Do not connect a receiver that takes 3.3v power to the 5v wire that is installed from the factory or you will destroy the receiver.**

We recommend securing the receiver to the quad using a piece of servo mounting tape or double-sided foam tape. If it will fit, stick the receiver to the top of the Tekko ESC, between the ESC and the flight controller. If it will not fit there... well, let's just say you'll need to get creative.

# Bind the Receiver

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Now that your receiver is installed in your KOPIS, the next thing you need to do is *bind* the receiver to your Taranis. Binding is the process of letting the Taranis and the XSR know that they should talk to each other. It's how your quadcopter knows to listen to your transmitter and not anybody else's.

The exact instructions for binding your receiver will be different depending on what receiver and transmitter you have. Here are instructions for some common receivers.

## *Binding A FlySky Receiver*

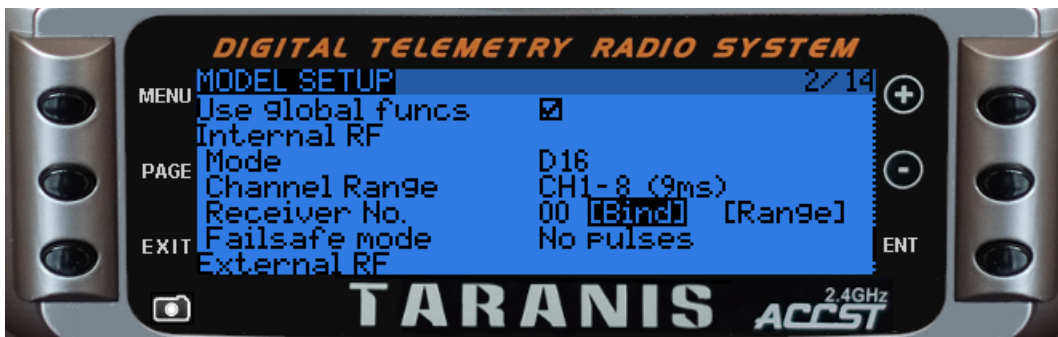
For the FlySky A8S receiver, the binding instructions are as follows.

1. Un-plug the A8S receiver from the wire header that came pre-installed on your KOPIS.
2. REMOVE THE PROPS from your KOPIS for safety. DO NOT SKIP THIS STEP.
3. Plug in your LiPo to the KOPIS main battery lead.
4. Hold down the BIND button on the back of the A8S receiver. While holding down the BIND button, plug the A8S receiver in to the wire header that came pre-installed on your KOPIS. The LED on the receiver will blink quickly.
5. With the FS-i6 transmitter powered off, hold down the Bind Key, then power on the radio while continuing to hold down the Bind Key. The Bind Key is on the front of the radio, to the lower-left of the screen. The radio will power on and the screen will say "RXBinding."
6. The LED on the receiver will switch from quickly blinking to slowly blinking. This indicates that binding has occurred.
7. Power down the FS-i6 transmitter.
8. Power the FS-i6 transmitter back up, this time without holding down the BIND KEY. The LED on the receiver will go solid red (no blinking). This indicates that the receiver is communicating with the transmitter.

## Binding A FrSky Receiver

For the FrSky XSR, X4R-SB, and XM+ receiver, the binding instructions are as follows.

1. REMOVE THE PROPS from your KOPIS for safety. DO NOT SKIP THIS STEP.
2. In the Taranis, navigate to the Model Setup screen by pressing MENU, PAGE.
3. At the bottom of the Model Setup screen, scroll down to find the “Internal RF” sub-section.
4. Confirm that Mode is set to D16
5. Highlight [BIND] and press the ENT button. BIND will begin flashing and the Taranis will make a high-pitched beeping (assuming its volume is turned up).



6. If the quadcopter battery is plugged in, un-plug it so that the receiver is powered down.
7. Hold down the BIND/FS button on the receiver. On the XM+ especially, the button is very small and it can be difficult to depress with your finger. If you use a tool to press the button, be very gentle so as not to damage the button.
8. While continuing to hold down the BIND/FS button on the receiver, plug in the LiPo to the quadcopter so that the receiver powers up. It can be helpful to have a friend do this while you hold down the bind button.
9. Binding will be indicated by the green LED lighting up solid and the red LED blinking.

If binding is not successful, most likely you didn't fully depress the bind button. In this case, un-plug the LiPo and repeat steps 6-8.

## *Binding A Spektrum Satellite Receiver*

Binding a Spektrum Satellite receiver is little different than binding normal receivers. Spektrum Satellite receivers were originally designed to work only when plugged in to a full-sized receiver. Satellite receivers don't have the ability to bind without help from a full-sized receiver.

There are two ways to bind a Spektrum Satellite receiver. One way involves using some command-line instructions in Betaflight to cause your flight controller to pretend to be a full-sized receiver. The FC commands the Satellite to go into binding mode. Most F4 flight controllers, including the Kakute flight controller in your KOPIS, don't support this type of binding.

Here is how you can bind your Spektrum Satellite receiver to your Spektrum radio without using the flight controller in your KOPIS. You will need a full-sized Spektrum-compatible receiver. We recommend the Lemon LM0027 since it is cheap (less than \$12 U.S.) and widely available.

1. Plug the Bind Plug that comes with the LM0027 onto the Binding Pins.
2. Plug the Spektrum Satellite receiver into the Satellite Port on the LM0027 with a Spektrum Satellite Extension Cable.
3. Plug a 5v power source in to any of the servo pins on the LM0027. The red LEDs on the LM0027 and the Satellite receiver will flash quickly indicating they are in binding mode. A spare ESC with a BEC is one possible source of 5v power. You could also wire a servo plug to the 5v and GND pads on your FC or a spare PDB. **DO NOT APPLY 5V to the Satellite Receiver directly.** It will be destroyed.
4. The Bind Button is on the upper-left shoulder of most Spektrum radios. While holding down the Bind button on the Spektrum radio, switch the radio's power on.
5. The red LEDs on the LM0027 and the Satellite receiver should stop flashing. The screen on the Spektrum radio should indicate that binding has occurred.

At this point, the Satellite receiver is bound to the transmitter. You can now un-plug the Satellite receiver from the LM0027 and install the Satellite receiver in your KOPIS. We suggest keeping the LM0027 around for binding of future satellite receivers. You could even buy a cheap PDB and solder the LM0027 to its 5v output pads and use that as your "binding adapter".

# Verify Channel Mapping

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Next, you must verify that your transmitter is configured correctly for the default configuration that was shipped with your KOPIS.

1. REMOVE THE PROPS from your KOPIS for safety. DO NOT SKIP THIS STEP.
2. Connect your KOPIS to your computer's USB port.
3. Start the Betaflight Configurator. Click the "Connect" button in the upper-right to connect to your KOPIS.
4. Go to the Receiver Tab. Move your transmitter sticks. Verify that the correct channel moves when you move each stick.
  - a. Moving the left stick up should move Throttle up (higher number).
  - b. Moving the left stick left should move Yaw down (lower number).
  - c. Moving the right stick up should move Pitch up (higher number).
  - d. Moving the right stick left should move Roll down (lower number).
5. If any of your controls move the wrong channel, you must re-order the Channel Map parameter in the top-center of the Receiver Tab screen to correct them. The channel map parameters are:
  - a. (A)ileron = Roll Channel
  - b. (E)levator = Pitch Channel
  - c. (T)hrottle = Throttle Channel
  - d. (R)udder = Yaw Channel

For example, if your Yaw and Roll were swapped with each other, you would change the Channel Map from AETR1234 to RETA1234. The 1234 at the end of the map will always be the same. Rearrange the A, E, T, and R in the channel map until the controls are as described in step 4.

*The steps described above assume a Mode 2 transmitter. We assume that most pilots will be flying Mode 2. We want to acknowledge all you Mode 1 flyers too. Please understand that we're just trying not to confuse beginners with too much information. If you're a beginner and this paragraph didn't make sense, don't worry about it.*

# Verify Channel Directions

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If the channels are mapped correctly, but move the wrong direction, you must reverse the channel in your transmitter. This is commonly the case for the Roll and Yaw channels on Spektrum radios.

## *Reversing Channels on a FlySky Radio*

Here are instructions for reversing channels on a FlySky FS-i6 radio.

1. Power on the radio.
2. The Hold down the “OK” button to enter the System Setup screen.
3. Press the Down button to highlight the Functions Setup option.



4. Press Ok to enter the FUNCTIONS menu.
5. The selection arrow will be pointing at “Reverse”. Press Ok to enter the Reverse menu.



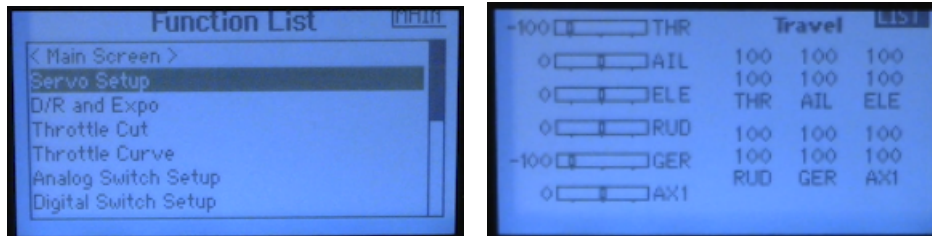
6. Press Ok to cycle through the channels. Press Up or Down to choose whether the channel direction is Normal or Reversed. Reverse the required channels so that the channels move as described above in the Betaflight Receiver Tab.
7. When you are finished making the required changes, HOLD DOWN the “Cancel” button to save and exit the menu. Simply pressing Cancel exits without saving.



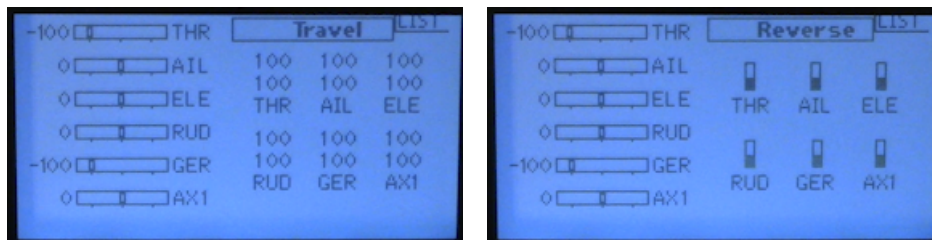
## Reversing Channels on a Spektrum Radio

Here are instructions for reversing channels on a Spektrum DX6e. Other Spektrum radios may be similar.

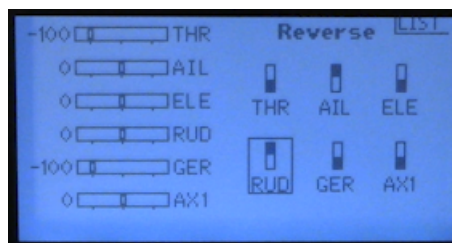
1. In the main menu, highlight Servo Setup and click the jog-wheel to open the Servo Setup screen.



2. In the Servo Setup screen, move the jog-wheel to highlight "Travel". With "Travel" highlighted, click the jog-wheel, then scroll the jog-wheel to find the "Reverse" screen.



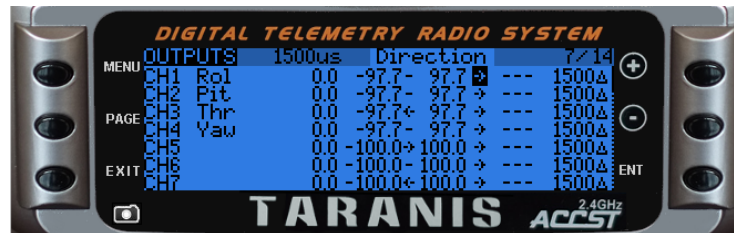
3. Click the jog-wheel to de-select "Reverse". Scroll the jog-wheel to highlight the channel that you want to reverse. Click the jog-wheel to reverse the channel. The final configuration for most Spektrum radios is shown below. You still need to verify for yourself that the channels move the correct direction by checking the behavior in the Betaflight Receiver Tab.



## Reversing Channels on a Taranis

Here are the instructions for reversing channels on a Taranis.

1. Press Menu to enter the menus. Then press Page until you come to the Outputs screen, as shown below.



2. Scroll to highlight the channel that you want to reverse. Press ENTER.
3. Scroll to move across the line until you highlight the Direction arrow as shown above on the Roll axis.
4. Press ENTER to invert the channel direction.
5. Press EXIT to back out of the menu.

# Adjust Channel Centers

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If your channels don't center properly, your KOPIS will drift when you center the sticks. To check whether your channels are adjusted correctly, first center your transmitter sticks.

REMOVE THE PROPS from your KOPIS. DO NOT SKIP THIS STEP. Plug in a LiPo to the KOPIS and plug the KOPIS into your computer's USB port.

In the Betaflight Configurator Receiver Tab, look at the Roll, Pitch, Yaw, and Throttle channels. These channels should be at exactly 1500. If they are within the range of about 1498 to 1502, then you can skip this step. If they are much different than 1500, you must adjust your channel center-points.

Before you adjust channel center-points, ensure that the Trim switches on your radio are centered. The radio will typically indicate on the screen and with an audio tone when the trim switches are centered. Press each of the four trim switches and listen for the tone that the radio makes. Usually the tone will be higher as the trim approaches center, and there will be a long single beep when the trim is centered. Taranis will speak, "Trim Centered".

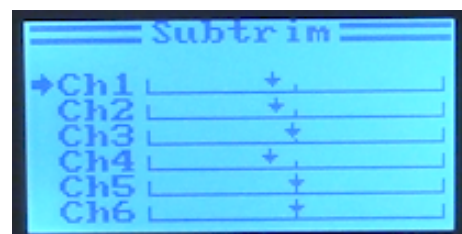
## *Adjusting Channel Center on a FlySky Radio*

Here are instructions for reversing channels on a FlySky FS-i6 radio.

1. Power on the radio.
2. Hold down the "OK" button to enter the System Setup screen.
3. Press the Down button to highlight the Functions Setup option.



4. Press Ok to enter the FUNCTIONS menu.
5. Press the Down key to move the selection arrow to "Subtrim". Press Ok.
6. Center the transmitter sticks. The spring-loaded sticks will auto-center. You will need to manually center the left stick (throttle).



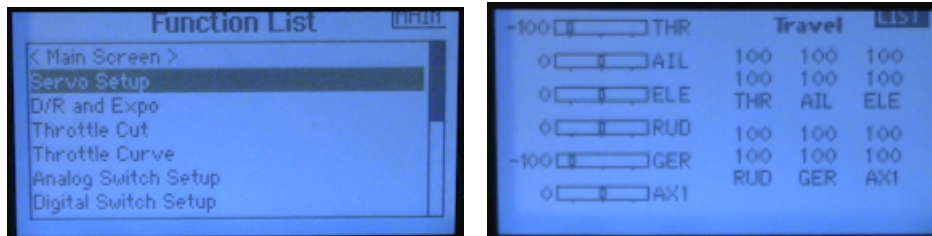
## ***Kopis 2***

7. In the Subtrim screen, Ok cycles through the channels. Up/Down raises or lowers the channel center. With the transmitter sticks centered, adjust the subtrim for channels 1, 2, 3, and 4 so that the channel reads as close to 1500 as you can get it in the Betaflight Receiver Tab.
8. When you are finished making the required changes, HOLD DOWN the "Cancel" button to save and exit the menu. Simply pressing Cancel exits without saving.

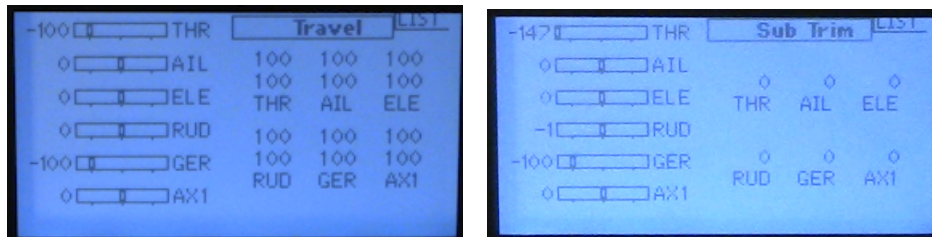
## Adjusting Channel Center on a Spektrum Radio

Here are instructions for adjusting channel center on a Spektrum DX6e. Other Spektrum radios may be similar.

1. In the main menu, highlight Servo Setup and click the jog-wheel to open the Servo Setup screen.



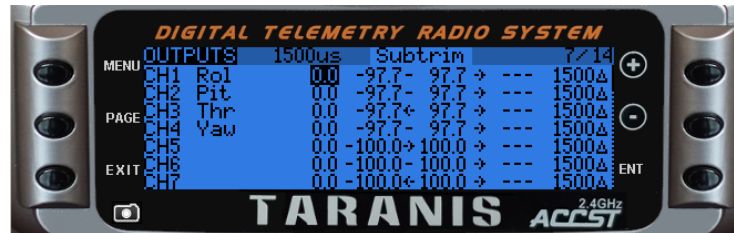
2. In the Servo Setup screen, move the jog-wheel to highlight "Travel". With "Travel" highlighted, click the jog-wheel, then scroll the jog-wheel to find the "Subtrim" screen.



3. Click the jog-wheel to de-select "Subtrim". Scroll the jog-wheel to highlight the channel that you want to adjust. Click the jog-wheel to select the value.
4. Leave the sticks centered. While watching the channel in the Receiver tab, scroll the jog-wheel until the Receiver Tab shows 1500 for the channel.

## Adjusting Channel Center on a Taranis Radio

1. Press Menu to enter the menus. Then press Page until you come to the Outputs screen, as shown below.



2. Scroll to highlight the channel that you want to adjust. Press ENTER.
3. Scroll to move across the line until you highlight the Subtrim value as shown above on the Roll axis.
5. Press ENTER to select the channel subtrim value. Leave the sticks centered. While watching the channel in the Receiver tab, scroll up or down until the Receiver Tab shows 1500 for the channel.
4. Press EXIT to back out of the menu.

# Adjust Channel Endpoints

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If your channel endpoints are not adjusted correctly, the quadcopter may rotate faster in one direction than the other. In extreme cases, you may not even be able to arm! To check whether your channel endpoints are adjusted correctly, first REMOVE THE PROPS from your KOPIS. DO NOT SKIP THIS STEP. Plug in a LiPo to the KOPIS and plug the KOPIS into your computer's USB port.

Go to the Betaflight Configurator Receiver Tab. Lower your throttle all the way down. The Throttle channel should have a value of 1000. Raise your throttle all the way up. The throttle channel should have a value of 2000. Push your yaw stick all the way to the left. The Yaw channel should have a value of 1000. Push your yaw stick all the way to the right. The Yaw channel should have a value of 2000. The same should be true for Pitch and Roll: down or left should be equal to 1000; up or right should be equal to 2000.

If your channels are not equal to 1000 and 2000 when you fully deflect the sticks, you need to adjust your channel endpoints.

## *Adjusting Channel Endpoints on a FlySky Radio*

Here are instructions for adjusting channel endpoints on a FlySky FS-i6 radio.

1. Power on the radio.
2. The Hold down the "OK" button to enter the System Setup screen.
3. Press the Down button to highlight the Functions Setup option.



4. Press Ok to enter the FUNCTIONS menu.
5. Press the Down key to move the selection arrow to "End Points". Press Ok.



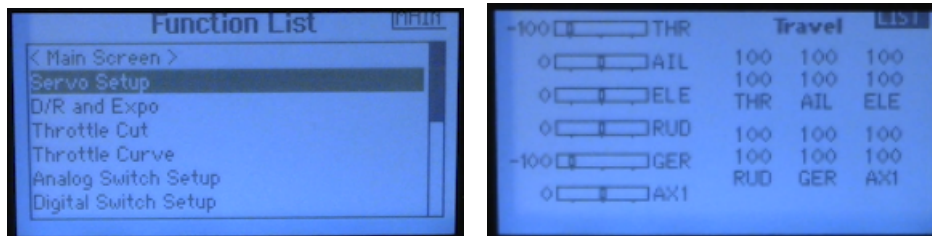
6. In the Endpoints screen, Ok scrolls between channels. Up/Down adjusts the endpoint. You control whether you are adjusting the top or bottom endpoint by raising or lowering the stick for the channel you are adjusting. This can be a little confusing because it's probably not obvious to most people which channel goes with which stick. The default channel order for the FlySky radio and for Betaflight is:
  - Channel 1 = Aileron = Roll = Right stick left/right axis
  - Channel 2 = Elevator = Pitch = Right stick up/down axis
  - Channel 3 = Throttle = Left stick up/down axis
  - Channel 4 = Rudder = Yaw = Left stick left/right axis
7. For each of channels 1, 2, 3, and 4, adjust the top and bottom endpoint. Do this by holding the correct stick full left or down to adjust the bottom endpoint and full right or up to adjust the top endpoint. Then use the up/down buttons on the FlySky FS-i6 to adjust the endpoint % until the Betaflight Configurator Receiver Tab shows 1000 (for the bottom endpoint) or 2000 (for the top endpoint).
8. When you are finished making the required changes, HOLD DOWN the "Cancel" button to save and exit the menu. Simply pressing Cancel exits without saving.



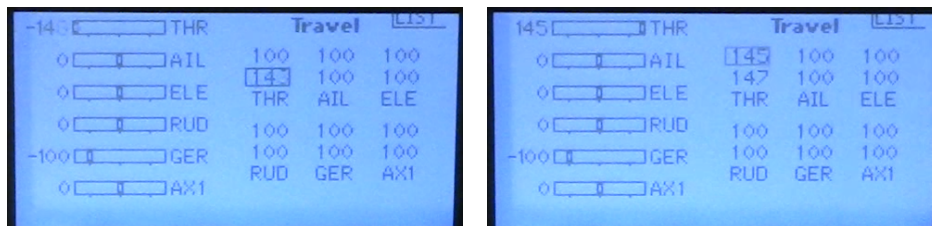
## Adjusting Channel Endpoints on a Spektrum Radio

Here are instructions for adjusting channel center on a Spektrum DX6e. Other Spektrum radios may be similar.

1. In the main menu, highlight Servo Setup and click the jog-wheel to open the Servo Setup screen. The Travel screen should appear.



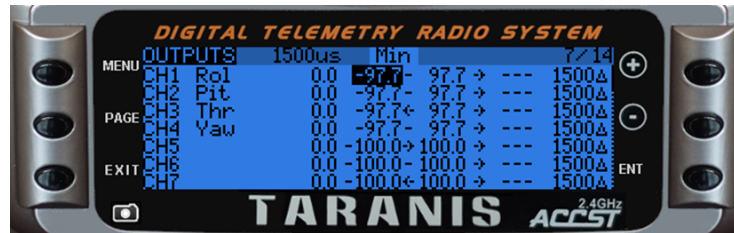
2. In the Travel screen, move the jog-wheel to highlight the THR channel. Lower the throttle stick all the way down. Click the jog-wheel to select the THR channel.



3. Scroll the jog-wheel to adjust the Throttle channel lower endpoint until the Betaflight Receiver Tab shows 1000 as the value for the Throttle channel.
4. Raise the throttle to the top. Repeat the previous step to adjust the top endpoint until the Betaflight Receiver Tab shows 2000 as the value for the Throttle channel.
5. Repeat the steps above for each of the remaining channels: Yaw, Pitch, and Roll. Hold the stick to the lower extreme of its movement (left or down) and adjust the channel endpoint to cause the Receiver Tab to show 1000 as its value. Hold the stick to the upper extreme of its movement (up or right) and adjust the channel endpoint to cause the Receiver Tab to show 2000 as its value.

## Adjusting Channel Endpoints on a Taranis Radio

1. Press Menu to enter the menus. Then press Page until you come to the Outputs screen, as shown below.



2. Scroll up or down to highlight the channel that you want to adjust. Press ENTER.
3. Scroll down to move across the line until you highlight the Min value as shown above on the Roll axis.
6. Press ENTER to select the channel Min value. Hold the stick at its minimum position (full left or full down). While watching the channel in the Receiver tab, scroll up or down until the Receiver Tab shows 1000 for the channel.
7. Press EXIT to back out one time. Scroll to select the channel Max value. Hold the stick at its maximum position (full right or full up). While watching the channel in the Receiver tab, scroll up or down until the Receiver Tab shows 2000 for the channel.
8. Repeat the above steps to adjust the endpoints for all four channels: Throttle, Pitch, Roll, and Yaw.
9. Press EXIT to back out of the menu.

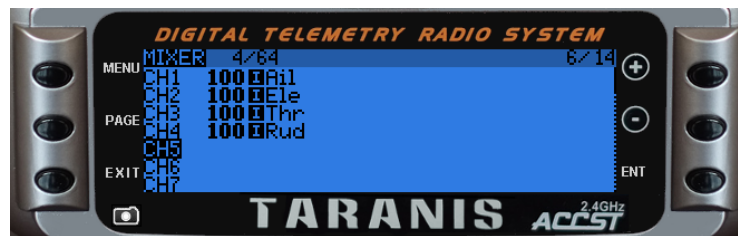
# Set Up Arming Switch

For safety, your KOPIS will not allow the motors to spin unless the quadcopter is *armed*. The preferred way to arm a quadcopter is using a switch on your transmitter. To do this, you will need at least five channels on your transmitter. Fortunately, most transmitters today have six or more channels.

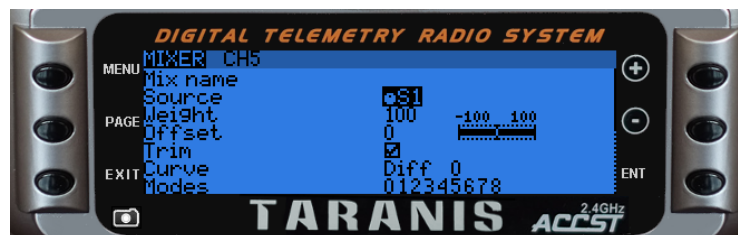
There are two steps to setting up your arming switch. First, you must set up your transmitter. Second, you must set up Betaflight.

## Set up Aux Switch on Taranis

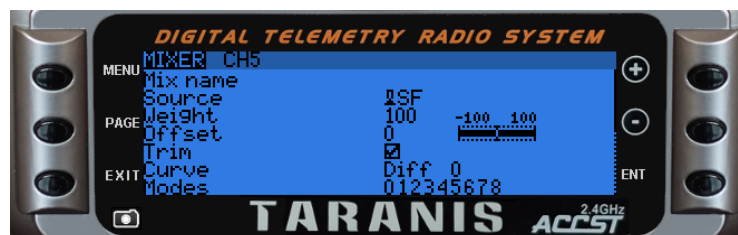
1. Press MENU, then press PAGE four times until you see the MIXER screen.
2. Scroll down to CH5.



3. Press ENTER to create a new mix.
4. In the new mix screen, scroll down to highlight the Source line.



5. Press ENTER one time. The Source parameter will flash.
6. Flick the switch that you want to use for arming one time. The Source parameter will change to read that switch label. We suggest using switch SF, the large two-position switch on the upper-left shoulder of the Taranis.



7. Press EXIT to back out to the main menu. Switch SF is now mapped to channel 5, Aux1.

## *Set up Aux Switch on Spektrum*

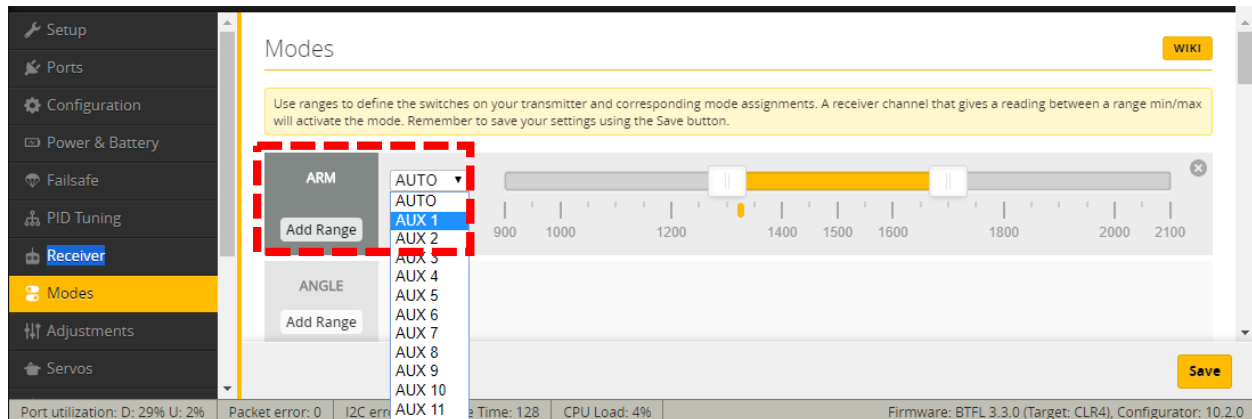
Good news! Our DX6e came pre-configured with the channel 5, Aux-1, pre-assigned to the upper-left shoulder switch. This is exactly how we want things configured for switch arming, so the Spektrum is ready to go!

## *Set up Aux Switch on FlySky*

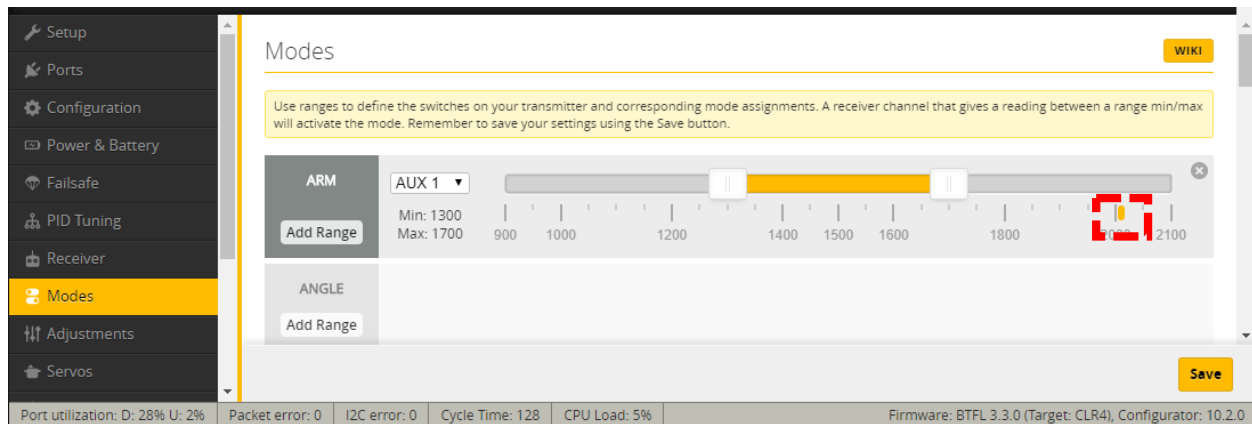
Good news! Our FS-i6 radio came pre-configured with the channel 5, Aux-1, pre-assigned to the upper-left switch, switch SWA. This is exactly how we want things configured for switch arming, so the FlySky is ready to go!

## Set up Aux Mode in Betaflight

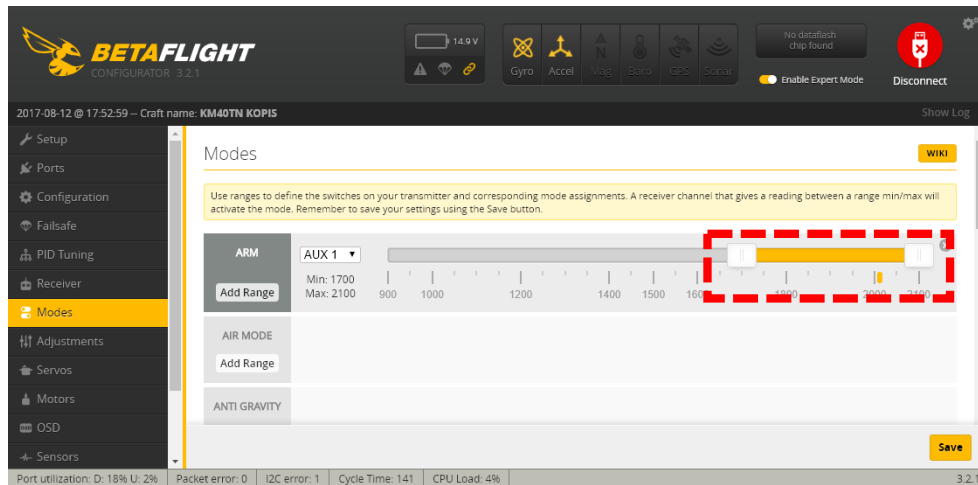
1. REMOVE THE PROPS FROM YOUR KOPIS. Seriously. DO NOT SKIP THIS STEP.
2. In Betaflight Configurator, go to the Modes Tab. Click “Add Range” next to the Arm tab. The screen will change to look as shown below. Change the pull-down menu from “AUTO” to “AUX 1” as shown below.



3. Turn on your transmitter. Plug in a LiPo. The small yellow indicator will move to indicate the current position of the Aux1 channel.



- Put your arm switch in the position you intend to use as “armed”. You should see the yellow indicator move as you move the switch. (This won’t work if you haven’t bound your transmitter, of course.) The common standard is to use “switch pushed away from you” as the neutral position on a transmitter. By this logic, “switch pulled towards you” should be armed. My personal preference is to use “switch pulled towards you” as disarmed, because it’s easier to slap the switch that direction if you are trying to disarm in a hurry.
- With the switch in the “armed” position, drag the yellow range marker to the end of the channel where the yellow indicator is.



- Click “Save” in the lower-right of the window. **YOUR MOTORS MAY NOW START SPINNING I SURE HOPE YOU REMOVED YOUR PROPS!**

# Mount the Antenna(s)

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The method pictured below is what we believe to be the best way to mount the receiver antenna(s) on a mini-quad. To do this, install a small zip-tie on the arm of your KOPIS, pointing towards the front of the quad. Pass the zip-tie underneath the ESC wires. Place a length of heat shrink tubing over the zip-tie, then thread the end of the antenna into the heat-shrink so that it lays flat against the zip-tie.



Before shrinking the heat-shrink, tuck or twist any excess length of antenna wire into the body of your KOPIS so that it doesn't get cut by the props or snagged by a branch while flying. Do not kink the antenna wire. Do not cut the antenna wire to shorten it.

Once everything is routed how you like, shrink the heat shrink to secure the antenna in place. Finally, cut off the excess end of the zip-tie, but be careful not to cut the actual antenna wire.

# Customize The OSD

In the OSD tab, you can choose which values you want to see on screen while you are flying. Enable and disable individual elements using the Elements toggles on the left.

The Video Format section lets you choose whether your camera is NTSC or PAL. Betaflight defaults this value to Auto, but Auto sometimes picks wrong. If this happens, you might not see any OSD text, or the bottom of the OSD text might be off the bottom of the screen. In some cases, you won't see any video at all—just the OSD. Because of this, we recommend manually setting the Video Format to NTSC or PAL depending on which type of FPV camera you have.

You can rearrange the individual OSD elements on screen by dragging them with your mouse in the “Preview” section of the window.

OSD

WIKI

Note: OSD preview may not show the actual font that is installed on the flight controller.

Some individual OSD Elements of note are:

**Main Batt Voltage:** This is probably the single most important element to use. Your battery must never go below 3.3 volts per cell under any circumstances, or it will suffer damage. For a 3S battery, this would be 3 times 3.3 = 9.9 volts. For a 4S battery, it would be 13.2 volts. Any time the battery goes below this level, it is likely being damaged, at least a little. More importantly, you will have very little power and may crash if you are doing aggressive maneuvers.

Although 3.3 volts is the recommended absolute minimum, you will get the best life out of your batteries if you keep the voltage above about 3.5 volts per cell—10.5 volts for 3S and 14.0 volts for 4S. If you are flying and you notice the battery going below this level, it might be time to land, or at least go easier on the throttle. If your batteries consistently drop to this level when you try to fly, it might be time to get new batteries.

When you are using the battery, its voltage will drop. This is referred to as “sag”. After you land, the battery will recover a small amount and its voltage will rise. Our recommendation is that, the battery



should be at no less than 3.75 volts per cell—11.25 volts for a 3S and 15.0 volts for a 4S—after it has been allowed to rest at the end of a flight. If your batteries are consistently resting at below this level at the end of a day of flying, then you might be shortening their lifespan at least a little.

**mAh Drawn:** Although voltage is what ultimately determines whether a battery is being damaged, mAh may be a better way of deciding when to land. Because voltage sags when you raise the throttle and recovers when you lower the throttle, it can be hard to tell exactly how used-up the battery is. mAh is like a “gas gauge” for your battery. It shows how much capacity you have consumed, independent of other factors.

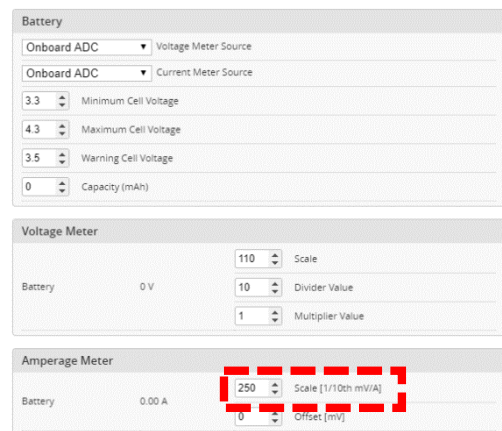
A good practice is to draw from a battery no more than about 80% of its rated mAh. So, a 1300 mAh battery would be able to deliver about 1000 to 1100 mAh. With a healthy battery and an honest battery rating, this will result in the battery resting at about 15.0 volts after flying. If you draw 80% of a battery’s rated capacity and it is resting at higher than 15.0 volts, the manufacturer might have under-rated its capacity. If the battery is resting at lower than 15.0 volts, the manufacturer might have over-rated its capacity. Also, remember that batteries lose capacity as they age. A battery that consistently fails to deliver 80% of its rated capacity without sagging below 14.0 volts might need retirement.

## Current Sensor Calibration

The current sensor in your KOPIS has been set with a nominal calibration value. However, you may be able to improve the accuracy by performing a more precise calibration. We recommend that you record the mAh used at the end of your first few flights, then compare it to the mAh that your battery charger puts back into the batteries. Then adjust the Current Scale in the Power And Battery tab to compensate for any difference.

Here is an example:

- OSD shows 1100 mAh Drawn at the end of the flight.
- Charger shows 1000 mAh put back in to the battery.
- $1100 / 1000 = 1.10$ . The OSD is reading 10% high.
- Current Scale works backwards from how you might think. To make the OSD read lower, you make Current Scale larger. Since the OSD is reading 10% high, we need to INCREASE Current Scale by 10%. This will cause the OSD to read 10% lower.
- If the Current Scale was at 400, we will multiply it by 1.10 to add 10%, meaning the new value should be 440.



The mAh put back in by the battery will seldom perfectly match the mAh reported by the OSD, but by taking several measurements and averaging the results, you can usually get it reasonably close.

# Install the Props

If the props are not installed correctly on a quadcopter, it will FLIP OUT when you try to fly. This can damage the quadcopter. It can also damage property and injure people. Here is how to install the props correctly.

Props for a quadcopter come in clockwise (CW) and counter-clockwise (CCW) direction. The prop must be installed on the motor that is spinning the correct direction. Props have a top side and a bottom side. The top side must face up.

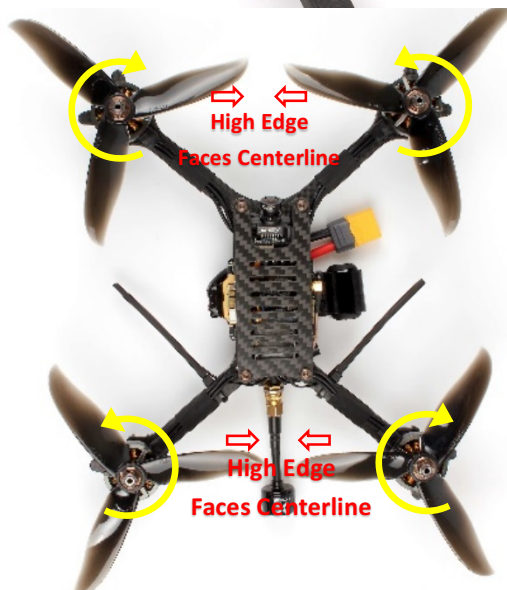
Finding the top side of a prop is easy. The prop will have lettering embossed on it, such as “5x4x3”. The lettering is always on the top side. With practice, you can come to recognize the shape of the airfoil and identify the top of the prop without looking for the lettering.

The lettering on the prop will also indicate its direction. Props labeled with an “R”, such as, “5x4x3R” are clockwise-rotation (CW). Props labeled without an “R”, such as “5x4x3” are counter-clockwise rotation (CCW). Instead of memorizing (and then forgetting) this fact, we strongly advise you to learn to recognize a prop’s direction from its structure.



If you look at a prop blade, you will see that there is a *high* edge and a *low* edge. The blade is designed to spin in the direction that the *high* edge is facing.

Think about a fan-blade pushing air. The prop is going to push air down so that thrust is generated to push the quadcopter up. Think about which way the prop is going to push air if it spins one way vs. the other. Seriously. Go get a prop right now and spend some time looking at it and thinking about which way it will push air depending on which way it spins.



The default motor directions for a Cleanflight or Betaflight quadcopter are shown to the left. Based on this, the correct way to install the props is as shown.

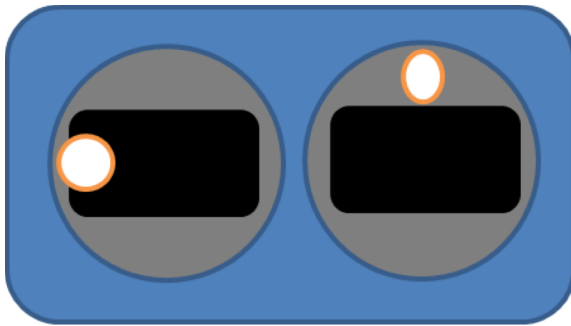
Notice that the *high* edge of the prop blade faces the direction that the prop is spinning.

Notice that the *high* edge of the prop blade faces the center-line of the quad on the front and back of the quad. This is the simplest way to remember how to install the props correctly.

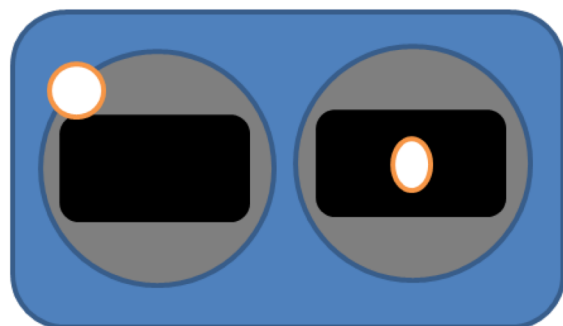
# Using The OSD

If you are using a Betaflight Flight Controller with Betaflight OSD, you can manage the Atlatl's transmit power and channel from within the OSD.

Mode 2

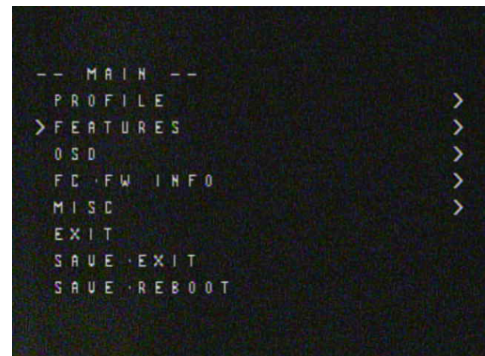


Mode 1

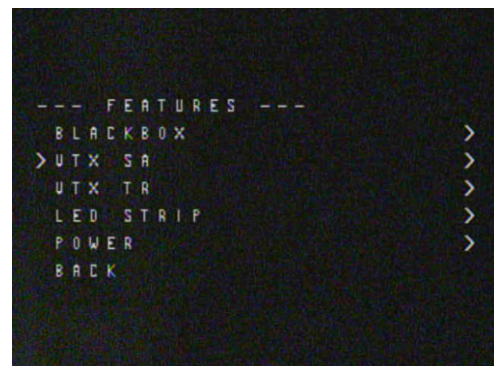


The graphics above show the stick command to bring up the OSD menu. The stick command is: throttle centered, yaw left, pitch forward. The exact stick command therefore depends on which mode your transmitter sticks are in.

In the OSD menu, use pitch up/down to move the cursor between menu items. When a menu option has a > symbol to the right of it, this indicates that it contains a sub-menu. Roll-right will enter the sub-menu. For example, in the screen to the right, moving the cursor to “Features” and then moving the roll stick to the right will enter the “Features” sub-menu.



To manage the Atlatl, enter the “Features” menu. From there, enter “VTX SA”



## ***Kopis 2***

The screen to the right shows the current vTX settings. From here, you can change the frequency band, channel, and power level of the video transmitter. After making the changes, move the cursor to "Set" and press roll-right to confirm the settings.



# Atlatl Functions

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## *Channel-Change Button*

The Atlatl can be configured via either SmartAudio or the channel change button. If you have SmartAudio enabled in Betaflight, then the button cannot be used. If you prefer to use the button, you must disable SmartAudio in Betaflight.

Here is how to use the button:

- To change channel, hold down the button for 2 seconds until the Channel LED blinks. You are now in channel select mode. Press the button one time to advance the channel.
- To change band, first go into channel select mode. From channel select mode, hold down the button for 2 seconds until the Band LED blinks. You are now in band select mode. Press the button one time to advance through the bands.
- To change power, first go into band select mode. From band select mode, hold down the button for 2 seconds until the Power LED blinks. You are now in power select mode. Press the button one time to advance through the power options.
- From power select mode, hold down the button for 2 seconds to exit configuration and return to normal operation.

## *Pit Mode*

Have you ever powered up your copter, only to have one of your friends start shouting and crash? Your video transmitter was on the same channel he was on, or even a nearby channel, and your signal was so loud that it overpowered his own. This is commonly referred to as being “stomped on”, and it’s a big problem any time more than one person is flying together. Even if you are not on the same channel as somebody else, you can stomp on them if you are too close to them

Pit Mode helps to prevent you from stomping on other pilots. When the transmitter is in Pit Mode, it will only transmit at a very low power. Within a short distance, you will be able to see your own copter’s transmission, but other pilots who are further away, won’t be affected.

To put the Atlatl into Pit Mode, hold down the button while you plug in your battery. This will cause the Atlatl to power up in Pit Mode. If you’re flying with friends, it’s a good idea to make a habit of this, to ensure that you don’t stomp on any of them when you power up.

When the Atlatl is in Pit Mode, you can change the channel, band, and power settings. These will take effect when you power cycle the board. This allows you to configure the Atlatl without stomping on other pilots who are already in the air.

Always follow best practices for frequency assignment when flying with other pilots. Never power up near other pilots, even if you think the channel is clear. Never land your copter near to other pilots either. Always power up, take off, and land, at least 20-30 feet away from pilots who are flying.

# Saving Your Configuration

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Once you have finished building, configuring, and tuning your multirotor, it's a good idea to back up your configuration so that you can restore it later. This is useful if you lose your quad, or if you damage your flight controller, or if you accidentally lock yourself out of your flight controller and must reset it to get back in.

Before we show you the right way to save and restore your configuration, let us warn you about the wrong way. Betaflight and Cleanflight have a "save configuration" and "restore configuration" button. Without going into too much detail, they have some significant drawbacks that mean we don't recommend that you use them.

The correct way to save your configuration is as follows.

1. Connect your Kakute to your PC by plugging in USB.
2. Start the Betaflight GUI app.
3. Go to the CLI tab.
4. In the text box at the bottom of the CLI, type "diff all" and hit enter. This will cause the flight controller to display all configuration options that you have changed from the default values.
5. In the lower-right corner of the configurator, click the "Save to File" button.
6. Save the file somewhere you won't lose it.

To restore your configuration, do this:

1. Open the text file in your text editor.
2. Highlight the entire contents of the file.
3. Right-click in the text editor window and choose "Copy".
4. Connect your Kakute to your PC by plugging in USB.
5. Start the Betaflight GUI app.
6. Go to the CLI tab.
7. Click the mouse once in the text box at the bottom of the CLI tab to place the cursor there.
8. Instead of typing any commands, right-click in the text box and choose "Paste".
9. Press the Enter key on your keyboard. The pasted-in text will rapidly scroll past.
10. Type "save" in the text box at the bottom of the screen.
11. Press Enter. The flight controller will reboot and the configuration will be restored.

# Pre-Flight Check

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For safety, here are steps that you should perform before EVERY pack you fly. Yes, there are a lot of them. There are a lot of steps before a fighter pilot takes off in his jet, or an F1 driver starts up his car. This is no different.

1. Turn on your controller.
2. If the controller has multiple model memories, confirm that the correct model is selected.
3. If you use switch arming, confirm that the arming switch on the transmitter is in the “disarmed” position and throttle is all the way down.
4. If you crashed last time you flew, perform a physical inspection of the quad for damage.
5. If you just installed any props, confirm that props are installed correctly. Yes, I know you’re sure you put them on correctly. CHECK IT AGAIN. Trust me.
6. Confirm that prop nuts are tight enough that a prop cannot spin without some effort. They don’t need to be gorilla-tight. Just tight enough that the prop doesn’t slip in flight.
7. Check LiPo battery voltage. A fully-charged LiPo should be about 4.2 volts per cell, or about 12.6 volts for a 3S, or 16.8 volts for a 4S.
8. Install the LiPo on the bottom of your KOPIS using the battery strap.
9. Secure the balance lead so that it can’t be struck by the props. For example, twist the balance lead around the discharge lead and tuck the balance plug between the red and black wires of the discharge lead.
10. Route the main LiPo discharge lead so that it cannot be struck by the props. This might involve twisting it to take up slack or wrapping it in the battery strap. The exact way of doing this will vary depending on the length of your battery lead.
11. Look in your FPV goggles or screen to see if anybody is transmitting on your channel. If they are, stop. Do not power up.
12. Scan the flight area for any safety issues that might be present, such as people or dogs. A spotter should always be watching the flight area while you fly.
13. Plug in the LiPo. Imagine that, the instant you plugged in the battery, the motors went to full power. How would you want to be holding the quad when that happened? One approach is to turn the quad upside down while plugging in the battery. This works especially well for bottom-mounted batteries like the KOPIS.
14. After plugging in the LiPo, set your KOPIS down and do not move it for a few seconds until you hear the three beeps that indicate the gyro has calibrated.
15. Verify that you have clean, strong video in your FPV goggles or screen. If you see interference or you see another pilot’s feed, resolve this issue before flying.
16. Arm the quad. Listen for the props hitting anything like an antenna or the battery wire. Check your video for any signs of issue like increased noise or degraded video quality.
17. Take off and fly. If you have just performed a repair on the quad, or if this is a new build, fly conservatively until you have verified that everything is working as intended. Fly low to the ground and close-in. Be prepared to disarm immediately if you lose video or lose control of the quad for any reason.

# Best Practices For FPV

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The analog video transmitters that we use can interfere with each other if not used properly. There is nothing more annoying than crashing or losing your quad because another pilot interfered with your signal! If you are going to fly with other people, here are best practices for you to follow.

## **DO NOT EVER POWER UP NEAR ANOTHER PILOT WHO IS FLYING.**

No matter what channel you are on. No matter what your power output is. No matter if you are in pit mode or not. No matter if you did it five times today and everything was fine. No matter what. If you power up near another pilot, you can interfere with them and knock them out of the air.

## **DO NOT EVER LAND OR FLY NEAR ANOTHER PILOT WHO IS FLYING.**

Whenever your video transmitter is powered up and it is nearby to another pilot who is flying, you can cause interference. So, coming in for a landing right at your own feet when your buddy is flying next to you is just as bad as plugging in your battery next to him.

Best practice is to designate a takeoff and landing area that is at least 50 feet away from the pilot station. Nobody can power up except in the takeoff and landing area, and after verifying that they are on a safe channel that is not going to interfere with anybody else who is in the air. Everybody lands in the landing area and then walks over and powers down their quad before returning to the pilot area.

## **ALWAYS ENSURE AT LEAST 40 MHZ SPACING BETWEEN PILOTS. 60 MHZ IS BETTER.**

When multiple pilots are flying together, frequency coordination is a must, to ensure that nobody interferes with anybody else. The shortest rule of thumb is that 40-60 MHz of spacing is the minimum. So, if one pilot is on 5740 MHz, the closest another pilot could be would be 5780 Mhz, and 5800 MHz would be better.

If you need to get more than three pilots in the air at the same time, we suggest you look up the IMD5 and IMD6 channel sets, or the "MultiGP best six channels" set. These are proven to work well.

## **USE THE LEAST TRANSMIT POWER POSSIBLE. 25 MW IS BEST. 200 MW AT MOST.**

Transmitting at higher output powers increases the likelihood of interference. 25 mW is more than enough power for good range most of the time. Above 200 mW, the likelihood of interference significantly increases. Of course, if you're flying alone, use as much power as you like!



# Quadcopter Safety

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Quadcopters are incredibly powerful machines. Their props can seriously injure you. Operating your quadcopter safely is up to you! This isn't intended as a complete safety manual, but here are a few guidelines we think are worth mentioning.

## *Arming Switch*

We firmly believe that a switch is the safest way to arm and disarm your quadcopter, because it allows you to quickly and confidently disarm the quad when you need to. However, arming switches have a risk: you can very easily bump the switch and arm the quad when you didn't intend to. The most common way this happens is if you have your transmitter dangling around your neck as you pick up your quad after a flight.



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*Taranis Safer Switch Arming*

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<https://www.youtube.com/watch?v=bv3VJ1jznw8>

The best way to avoid this is to set up a two-stage arming switch. A video showing how to do this on Taranis is linked above. There are various other ways to accomplish the same thing on other transmitters.

If you don't want to set up a two-stage arming switch, the next-best thing is to *raise your throttle* immediately after you disarm. Betaflight will not let the quad arm if the throttle is raised. So raising the throttle is like your safety switch. Make a habit of, "Flip the switch, then raise the throttle," every time you disarm.

There is one catch with this technique. If you raise the throttle, then flip the arm switch, the quad won't arm. However, if you then lower the throttle, the quad *will arm immediately*, as soon as the throttle touches bottom. The workaround for you should be that your "arming procedure" is always: verify switch disarmed, lower throttle, flip switch to arm. If you watch old-timers who have been doing this forever, you may even see them carry their transmitters with their finger resting on the arm switch, holding it in the disarmed position. This is a great habit to develop.

## *Safe Handling*

It's easy to become complacent when handling quads. They usually don't do anything unexpected. But they are incredibly powerful and dangerous, and can cause serious injuries. **EVERY SECOND THAT YOUR BATTERY IS PLUGGED IN**, you should treat your quad like the dangerous machine that it is. Keep your fingers out of the props. Think about what way the quad would fly if the props suddenly spun up. Carry the quad by the bottom plate or battery, facing away from yourself. Always un-plug the battery before picking up the quad, or immediately afterwards. Always plug the battery in just before setting the quad down. And for goodness sake, if your quad is doing something weird, don't "test-fly" it in your living room. Your ceiling will thank you.

## Failsafe

Failsafe is what happens when you fly too far away or your receiver gets disconnected from your flight controller. If you don't configure failsafe, the quad could fly away, or it could crash into something... or someone.



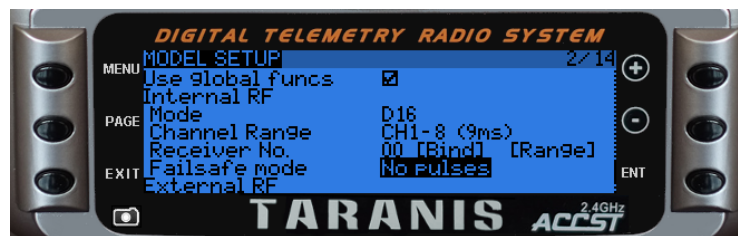
Failsafe

<https://www.youtube.com/watch?v=dikr9oDzQgc>

# DON'T EVER FLY WITHOUT VERIFYING THAT FAILSAFE WORKS CORRECTLY.

To verify failsafe, remove your props, then plug in your battery and arm your copter. Then turn off your transmitter. Your motors should stop within 1 to 3 seconds at most.

If your motors don't stop when you turn off your transmitter, DO NOT FLY YOUR MULTIROTOR UNDER ANY CIRCUMSTANCES.

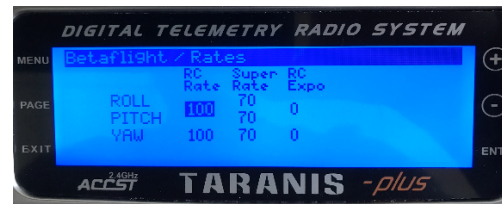
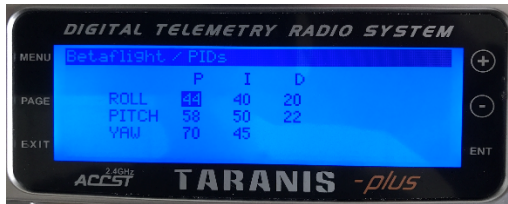


If you have a Taranis with an X-series receiver (bound in D16 mode), you can ensure failsafe is set correctly by choosing "No Pulses" as your failsafe mode in the Model Setup screen. If you have a Taranis with a D-series receiver (D8 mode) this setting has no effect!

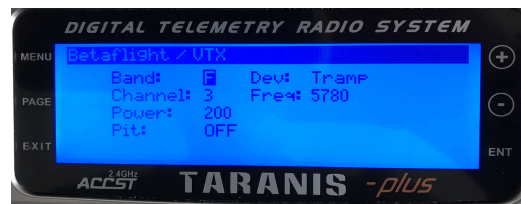
# Adjust PIDs / Rates / vTX from Taranis

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If you have a FrSky Taranis radio and if you are using SmartPort telemetry, you can use your Taranis to change your PIDs and rates.



This is done by installing a piece of programming code called a Lua script on your Taranis. If you are also using SmartAudio, you can use a Lua script to change your vTX settings. This is the same as if you were using the Betaflight OSD, but it works without you having to put your goggles on.



Detailed instructions for how to do this are beyond the scope of this document. Here's a video showing how to do it.



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*[How to Adjust PIDs, Rates, and vTX Settings via Lua Script](http://bit.ly/2GUmY96)*

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<http://bit.ly/2GUmY96>