9.3 MULTICOPTER

In this chapter, you will learn how to:

- Prepare items needed for assembling a modified MultiCopter Tarot 680 Pro
- Assemble SkyEye's modified MultiCopter

- Diameter: 650MM
- Rotor size: 12-13 inch carbon fiber propeller
- Brushless motor: 4S/620KV4006 brushless motor
- Battery specifications: 14.8Vnominal 4000-5000mAH
- Brushless ESC: 50A, 6s battery compatible
- Hovering flight time: 15-18 MIN
- Full weight: 2.76 KG

9.3.1 PARTS PREPARATION

Other Parts for upgrading and customization

GPS and Compass Module (3DR)
Power Module
6 pcs ESC, XRotor Pro 50A MultiRotor ESC Opto. compatible for 6s battery pack
Brushless DC Outrunner Motor, 800kV
Telemetry 915Mhz, and 5.8Ghz
Pixhawk 3Dr
Transmitter
R3008 SB Receiver

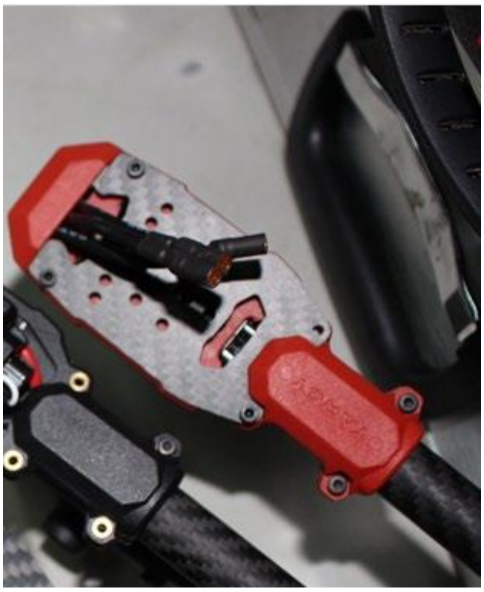
9.3.2 INSTALLATION OF PARTS

1. **Mount the clippers using screws (top center plate)**
   The plate having soldering terminals. Use a threadlock to avoid loosening of screws during flight.

For demonstration only. Mount the clippers using screws ON ONE PLATE ONLY

2. **Figuring out where to put the ESC, it is decided that it shall be placed underneath the motor.**

The screws hold the motor to the plate.



Motor is to be mounted above the plate with the ESC wires connected to the motor wires.

Disassemble the plate. Separating the side for ESC and another side for the motor

3. **You may use a 3D printed ESC Holder as or simply put a double sided tape, with enough thickness to offset the ESC from the plate.**

This eases the channeling of ESC Wires thru the hole up to the motor above it.
Mount the ESC on the tape. Make sure that it is properly centered and secure it further by a zip tie.

Bottom View with the ESC

4. To avoid friction between wires and plate due to lack of space, you may cut along the already available holes in the plate.

5. Insert the wires into the hollow tube and into the opposite side.

6. Mount the motor as illustrated.

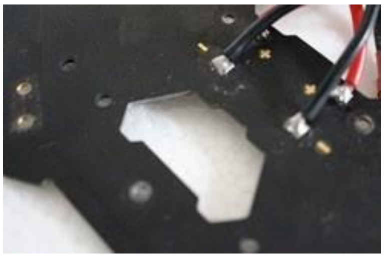
Upper. Shown is sample mounting of a motor atop the ESC. Connect the motor wires to the ESC Wires and arrange them in the cleanest way possible. Shortening the wires is not necessary

7. Assure that the wires reached the end of the tube with enough extra length to connect with other devices or terminals.

Another way to connect ESC is to put it directly on the center plate. Cons is it will be disruptive to the compass performance and other devices

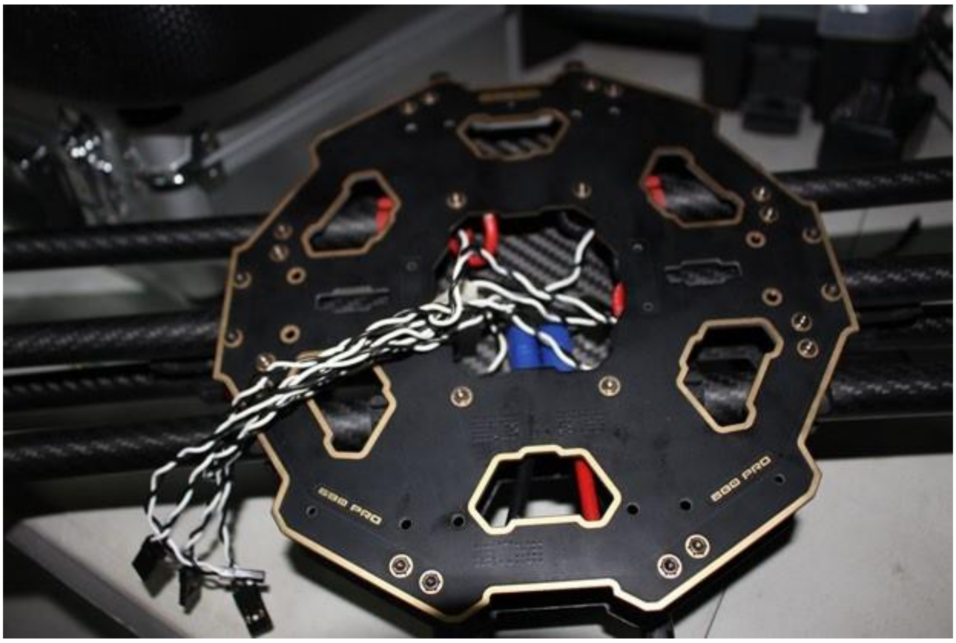
8. Solder the ESC connectors to the terminal points of the Carbon Plate.

The power supply terminal points in between the black arms. Solder them on the center plate. Mount the motor clamp at the center.



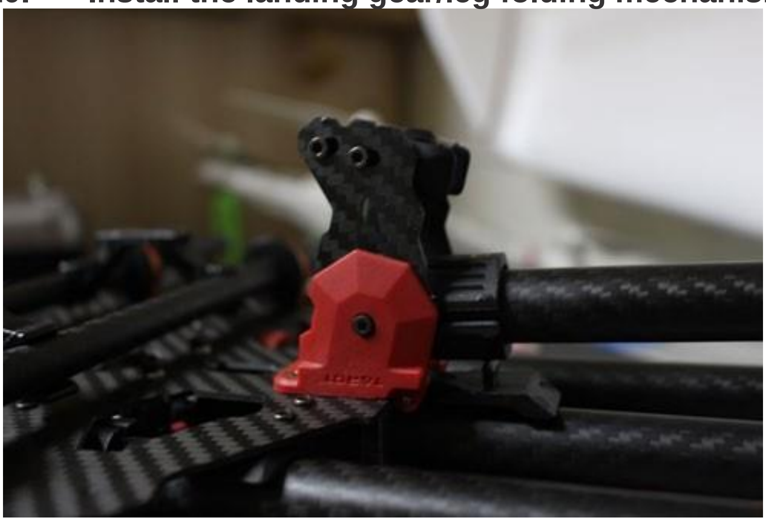
9. Make/Get an XT60 Connector and solder it to the power supply terminal of center plate.

Another XT60 connector is soldered in parallel. One XT60 with AWG12 is directly plugged into the Power Module while the other will be connected to a separate UBEC.



Screw clippers to the bottom plate. Use threadlock.
ESC wires to be soldered to the Center plate should always be properly arranged at the center.

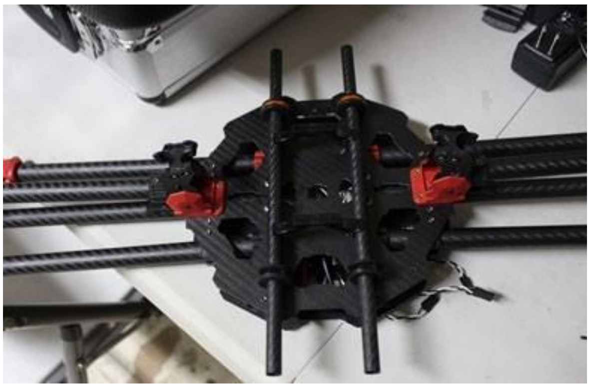
10. Install the landing gear/leg folding mechanism on the lower plate.



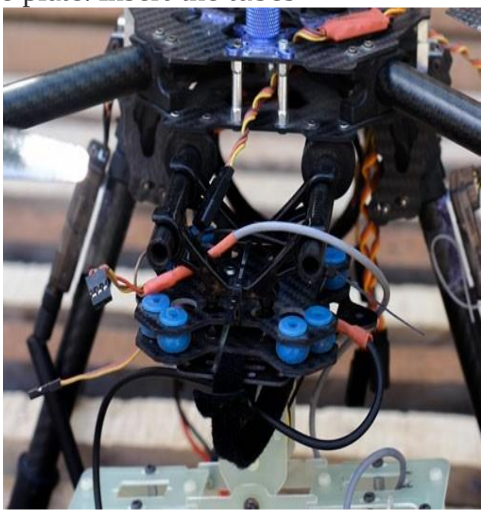
Knob facing outward

11. Install the camera rail battery mount.

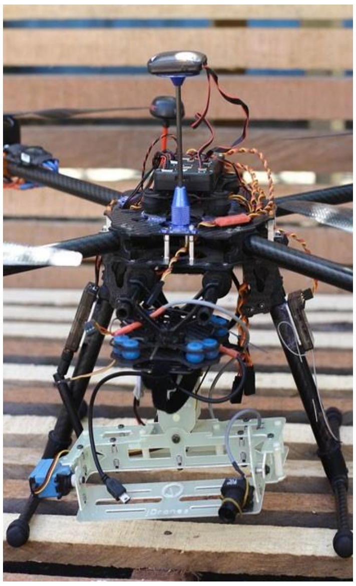
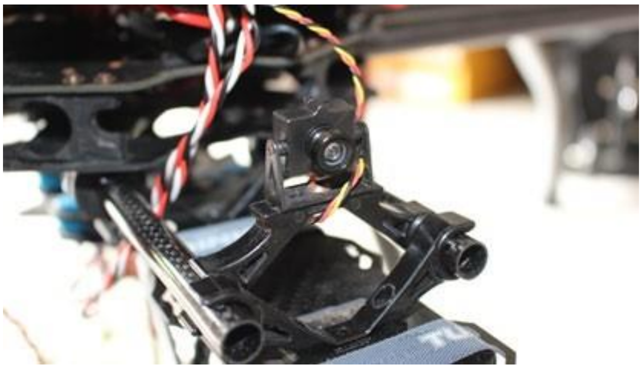
It is used to mount a camera gimbal or move battery to change Center of Gravity.

Screw the rubber assembly on the plate. Insert the tubes

Mount the gimbal assembly

FPV Camera assy mounted on a longer tube rail

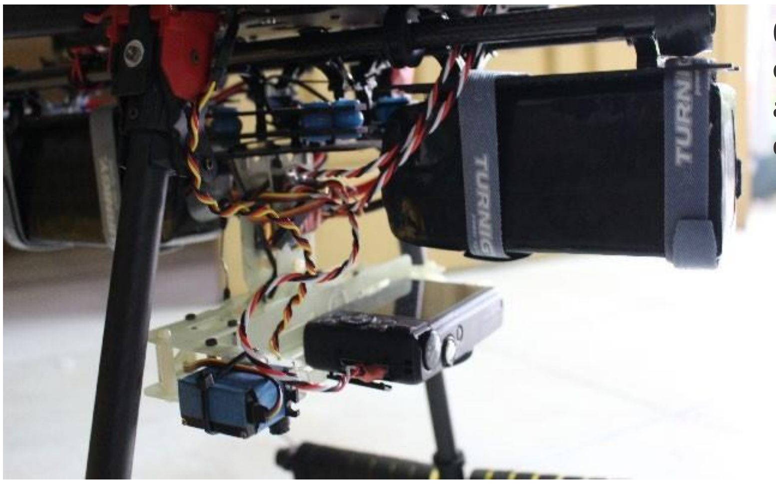
How the camera is attached to the gimbal assy.

Prior to operation, make sure that a CHDK ready memory card is installed.

Memory card checkpoints:

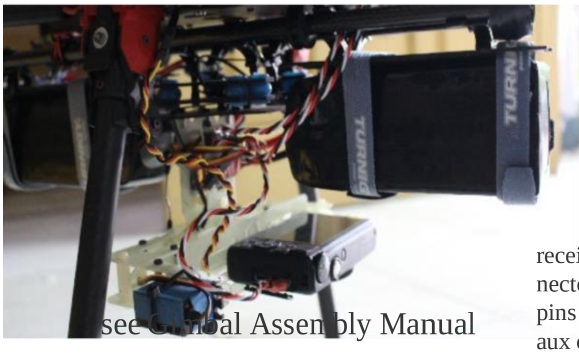
1. Must be CHDK ready
2. Must be unlocked.

To unlock, push the tiny button at the side downwards before installing.

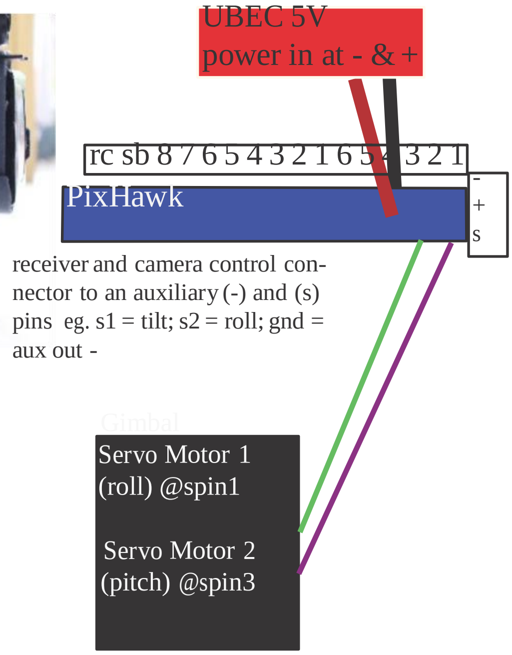


(below)2 Lipo batteries connected in parallel by a Y-cable with an XT60 connector

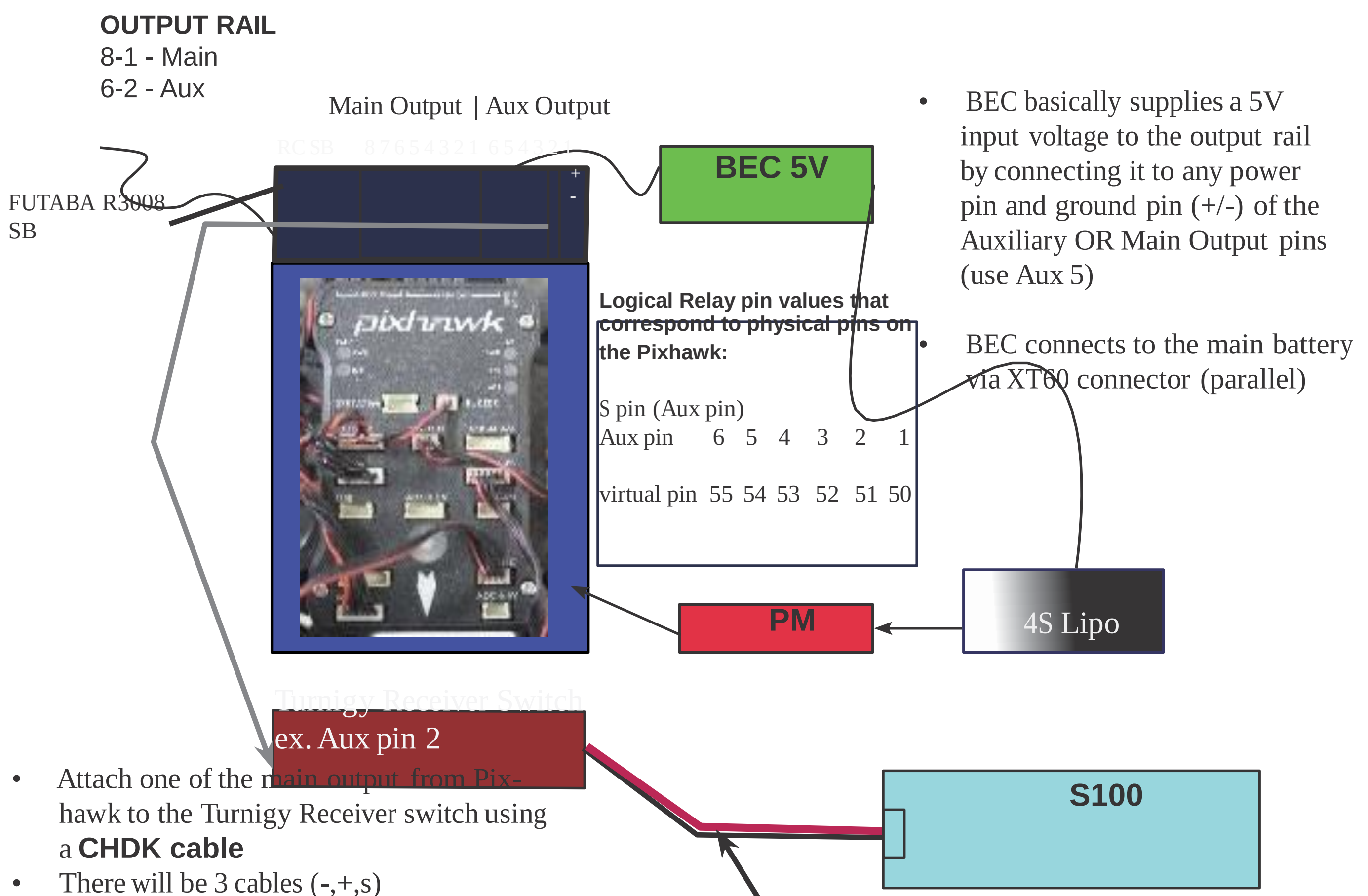
Battery and camera placement. Install these items only during testing and preflight operations



see Gimbal Assembly Manual

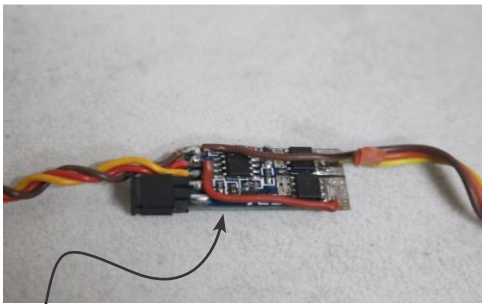


Shown below are the wiring connections between the camera and pixhawk



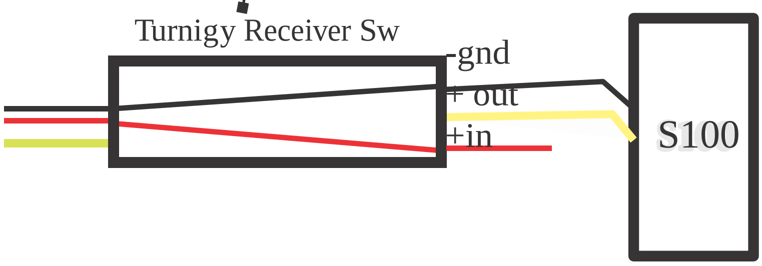
- BEC basically supplies a 5V input voltage to the output rail by connecting it to any power pin and ground pin (+/-) of the Auxiliary OR Main Output pins (use Aux 5)
- BEC connects to the main battery via XT60 connector (parallel)

- Attach one of the main output from Pixhawk to the Turnigy Receiver switch using a **CHDK cable**
- There will be 3 cables (-,+,s)
- Pixhawk sends a **PWM** signal towards Turnigy Receiver Switch thru Aux Output pin 2 (RC 10). Turnigy Shutter switch simply acts as momentary shutter switch for a CHDK enabled S100 camera
- Two Aux pins are set as PWM (relays)



Turnigy Receiver Switch Circuit Board is modified in order to attain its function

Shown is the circuit layout



+in is a negligible cable

+out is a power input connected by a jumper tapped from the Turnigy Receiver Power Input
-gnd is the ground tapped from Turnigy Receiver ground

yellow line = signal wire
red line = power wire
black line = ground wire

Shutter configuration with Pixhawk

Pixhawk has 6 AUX Ports (AUX1-AUX6, referred to as RC9-RC14 in Mission Planner) that can be configured as servos, relays, or digital inputs or outputs. The configuration below is for the Pixhawk with RC10/ AUX2 connected to camera control hardware and configured as either a servo or relay.

Aux Port 1 = RC 9
Aux Port 2 = RC 10
Aux Port 3 = RC 11
Aux Port 4 = RC 12
Aux Port 5 = RC 13
Aux Port 6 = RC 14

CAM_DURATION	20		0 50
CAM_SERVO_OFF	1000		1000 2000
CAM_SERVO_ON	2000		1000 2000
CAM_TRIGG_DIST	1		0 1000
CAM_TRIGG_TYPE	0		0:Servo 1:Relay

By default, the pins are digital outputs as outlined above. A digital pin will instead be a digital input if it is assigned to a parameter that represents a digital input. For example, setting CAM_FEEDBACK_PIN to 50 will make pin 50 the digital input that receives a signal from the camera when a picture has been taken.

- First set the camera trigger output type using the **CAM_TRIGG_TYPE** setting:
- Open Mission Planner and then click on **CONFIG/TUNING | Full Parameters List.**
- Set CAM_TRIGG_TYPE: Camera shutter (trigger) type to 0 for a servo (output PWM signal) or 1 for a relay (Note: although ardupilot supports multiple relay channels only the first relay can be used as a camera trigger) see figure above
- The actual port used for the shutter is set and configured in the **Camera Gimbal Configuration Screen:**
- Open **Initial setup | Optional Hardware | Camera Gimbal**. The shutter settings are shown in the section at the bottom.

Mission Planner: Camera Gimbal Configuration Screen

The Shutter drop-down list is used to set the connected camera trigger port.

Here we have selected **RC10**, which corresponds to **AUX2** on the Pixhawk.

The **Shutter Duration** setting specifies how long the servo/relay will be held in the Pushed state when the shutter is activated, in tenths of a second. Above the value is 10, so the pushed state is held for one second. For Servos only (settings ignored for relay outputs):

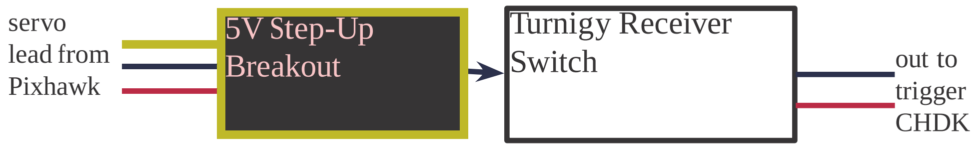
The **Shutter Pushed and Not Pushed** settings hold PWM signal values that will be sent when the servo is in those states.
The **Servo Limits** setting specifies the range of PWM signal values within which the servo will not bind.

TROUBLESHOOTING:

If in case Pixhawk is having problems in camera shutter due to insufficient voltage supplied at the relays (Aux Output pins, ie <3.3V), you may use a 5V Step-Up Breakout - a 5V DC-DC converter. This breakout board will accept voltage inputs between 1 and 4 Volts and output a constant, low ripple 5V output capable of sourcing up to 200 mA. This board is great for supplying power to 5V sensors on a 3.3V board, or providing 5V from a AA battery.

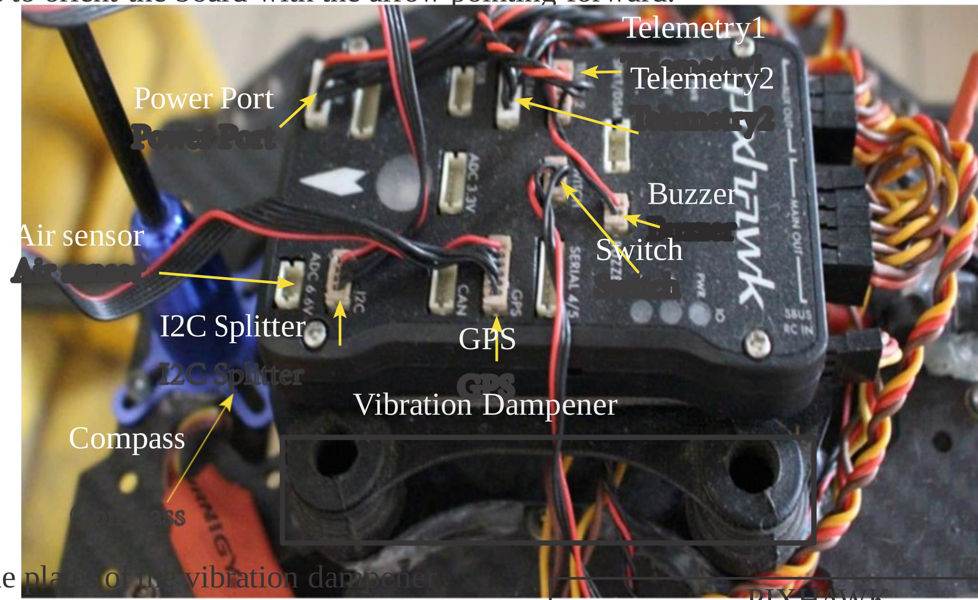
The breakout board includes all of the necessary peripheral components. The input, output and ground pins are broken out on a 0.1" grid to allow easy access on a breadboard.

Sample product is: SparkFun 5V Step-Up Breakout - NCP1402



12. Mount Pixhawk along with other aviation devices.

Use the provided vibration dampener and foam to mount Pixhawk as close as possible to your vehicle's center of gravity. Make sure to orient the board with the arrow pointing forward.



Remove one of the plates of the vibration dampener back plates and screw the footing directly to the board to lessen the overall weight

Mount the pixhawk on the Vibration Dampener with Foam in between

PIXHAWK

↓

FOAM

↓

VIBRATION DAMPENER

See figure above for Pixhawk Port wiring assignments.

13. Connect the ESC wires to the Pixhawk pin assignments

ESC WIRES

Connect each signal wire from the ESC to the main output signal (S) pins by motor number. Connect one wire for each motor to the corresponding pin.

Pin 1 = Motor 1	Pin 5 = Motor 5
Pin 2 = Motor 2	Pin 6 = Motor 6
Pin 3 = Motor 3	Pin 7 = Motor 7
Pin 4 = Motor 4	Pin 8 = Motor 8

Note that the PDB is already the center plate, thus ESC will be directly connected to the Pixhawk output terminals grid.

Each motor on the other hand is connected to an ESC.

Gimbal configuration through the mission planner

Under the configuration Menu, Hardware Options you will find a Camera Gimbal set-up screen.

For each servo/axis of your camera gimbal select the appropriate servo channel and ensure the “Stabilise” checkbox is checked.

Note

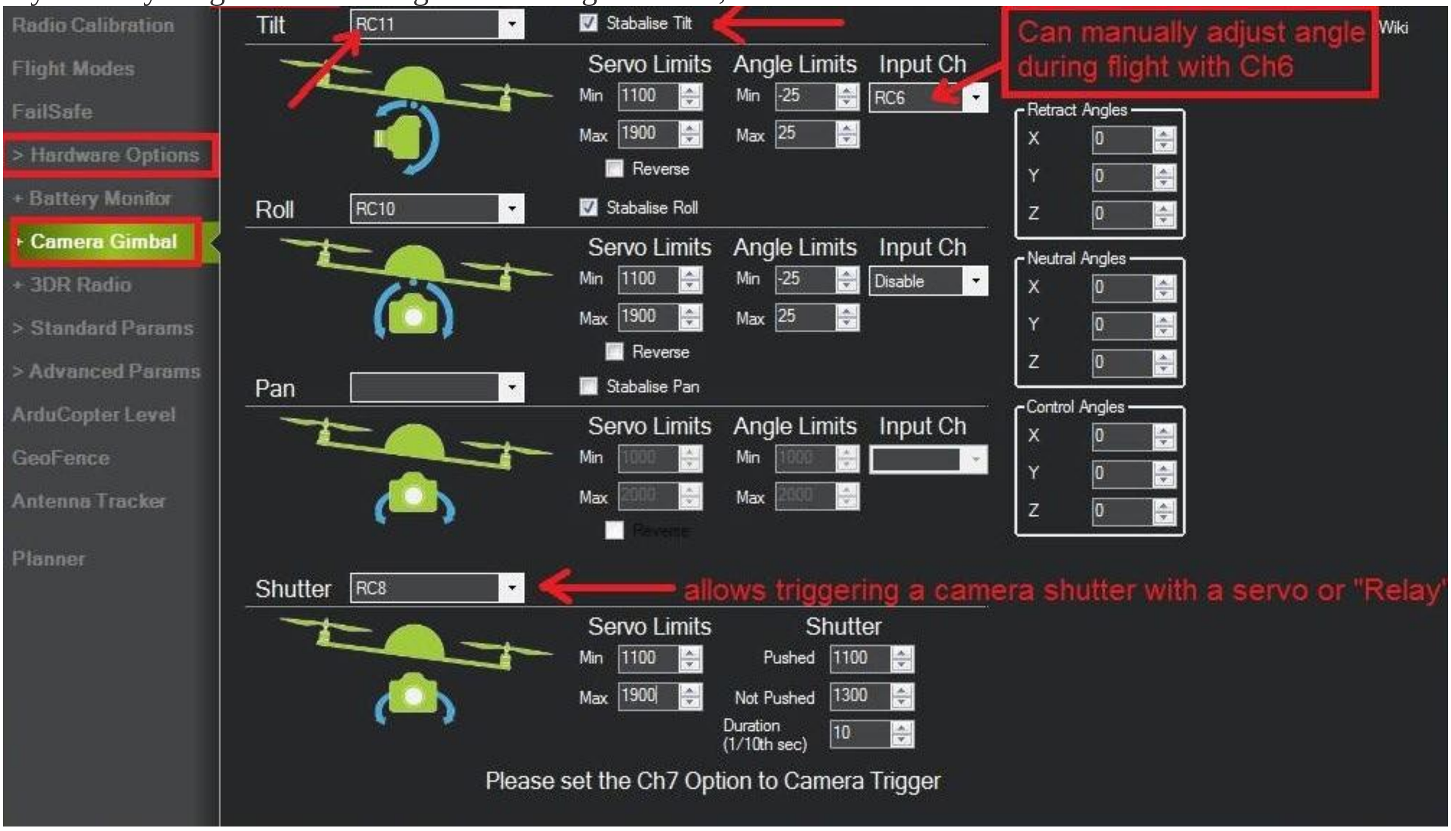
Modern brushless gimbals (like the Tarot and SToRM32) usually come with their own controllers that handle gimbal stabilisation. For those controllers the “Stabilise” checkbox must not be checked.

- The **Servo Limits** should be adjusted to ensure the gimbal servos don’t bind.
- The **Angle Limits** should correspond to the tilt angle of the gimbal itself at the servo limits. If you find during testing that your gimbal is not properly remaining stabilised (for example it’s over or undercor-recting as you tilt the copter), adjust the angle limits up or down slightly.
- (These are not really ‘angle’ limits but how much the servo is commanded to move within the limits of the 60° most servos can move.

  eg If set to -60/+60 the servo will reach -30°/+30° (its limit) when the ‘copter reaches -60°/+60°
- If set to -15/+15 the servo will reach -30°/+30° (its limit) when the ‘copter reaches -15°/+15°)

- **“Retract Angles”** refer to the position of the gimbal when the mount’s mode is “retracted” (i.e. MNT_MODE=0). “Retracted” normally means when the gimbal is pulled into the body of the aircraft which is generally not relevant for multicopters.
- **“Neutral Angles”** refer to the position of the gimbal when the mount is first initialised. This is normally facing straight forward.
- **“Control Angles”** are parameters to allow control of the gimbal from a ground station perhaps using a joystick. These values are overwritten by the ground station so there’s no point in updating them on the MP screen.

If you find your gimbal is moving in the wrong direction, check the **Reverse** checkbox.



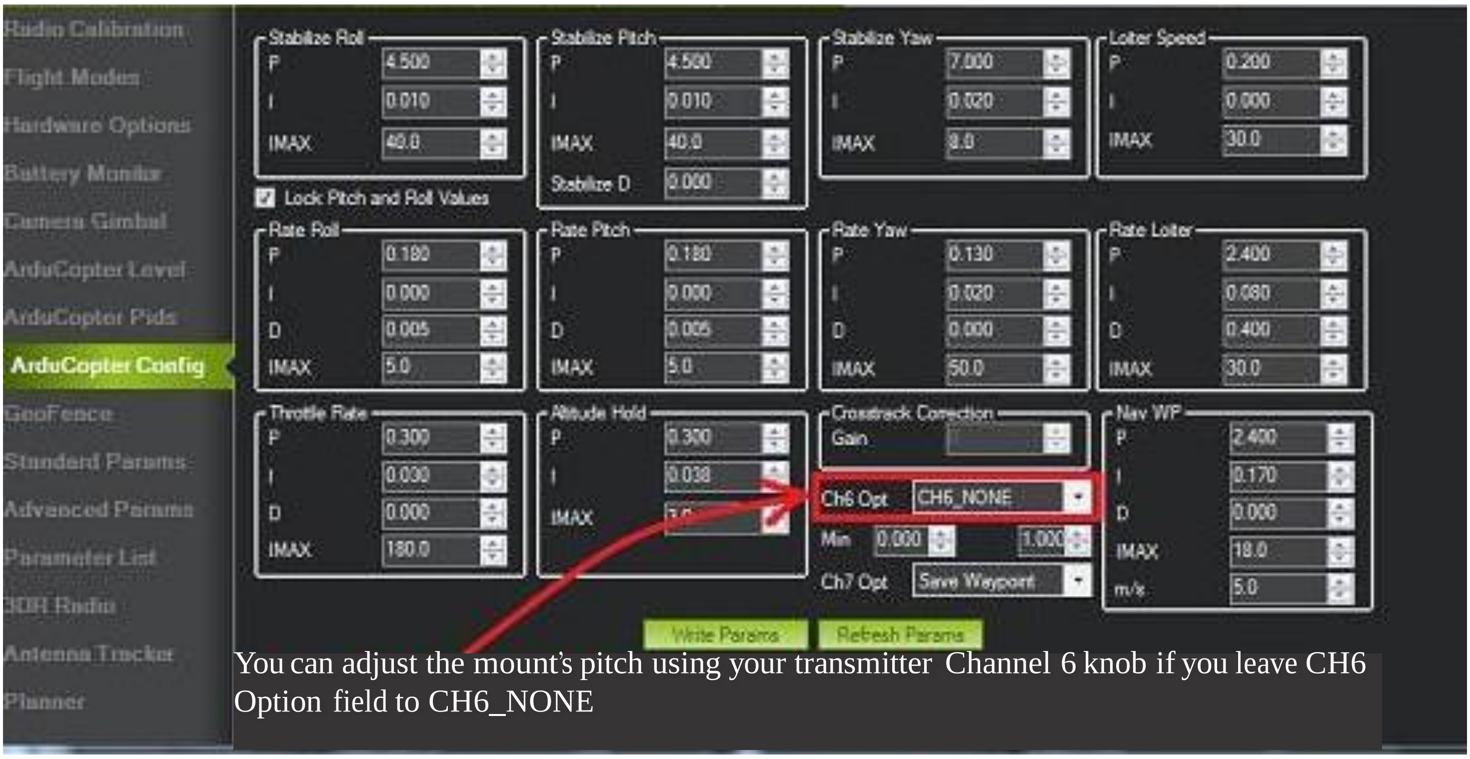
Connecting the servos to a PX4

- The Camera Gimbal Servo connections are located on (FMU USART2) on the PX4IO board.
- The 5 pin connector on the end of the PX4IO board opposite the servo connector and at the edge of the board.
- The roll camera gimbal servo out signal wire should connect to pin 2 (RC9).
- The pitch camera gimbal servo out signal wire should connect to pin 3 (RC11).
- If you have a yaw camera gimbal it's servo out signal wire should should connect to pin 4 (RC12).
- Provide power and ground separately to the servos.

If you wish to adjust the gimbal tilt, roll or pan while flying, you can set the input channel to “RC6” which normally corresponds to your transmitters tuning knob.

Note

If you do this you need to set your CH6 Opt to CH6_NONE in the Mission Planner Standard Parameters | Configuration screen.



You can adjust the mount's pitch using your transmitter Channel 6 knob if you leave CH6 Option field to CH6_NONE

Aligning Min and Max PWM values with full throw of gimbal

This section shows how to align the maximum and minimum PWM servo settings:

- Tilt airframe over hard left (just past where the servo stops moving, or ~45 deg), and raise the "Roll" "Servo" "Min" value until the servo starts to physically move a tiny bit, stop there.
- Tilt airframe over hard right (just past where the servo stops moving, or ~45 deg), and lower the "Roll" "Servo" "Max" value until the servo starts to physically move a tiny bit, stop there.
- Repeat for Pitch (forward and backward motion)

Leveling/centering the gimbal

To level and centre the gimbal:

- Keep the airframe perfectly straight-and-level
- If the gimbal is not quite perfectly level, tweak the hardware first, eg, get servo horn/s so that gimbal is as close to level as possible before doing next step/s .. do this by unscrewing horn from servo and repositioning it, and/or if using push-rods to the gimbal, by adjusting the length of them).
- If "tilt" is still not quite level, you can "trim" it by adjusting the Tilt->Angle->Min and Tilt->Angle->Max ... BOTH by one click in the same direction (eg, click both down arrows once each) This will ensure that the difference between them remains constant (important), but will adjust the "centre" position of the gimbal by small amounts (do not do this too much as it affects the maximum throw/s at the extremeties by the same amount).

Common fixes for poor video

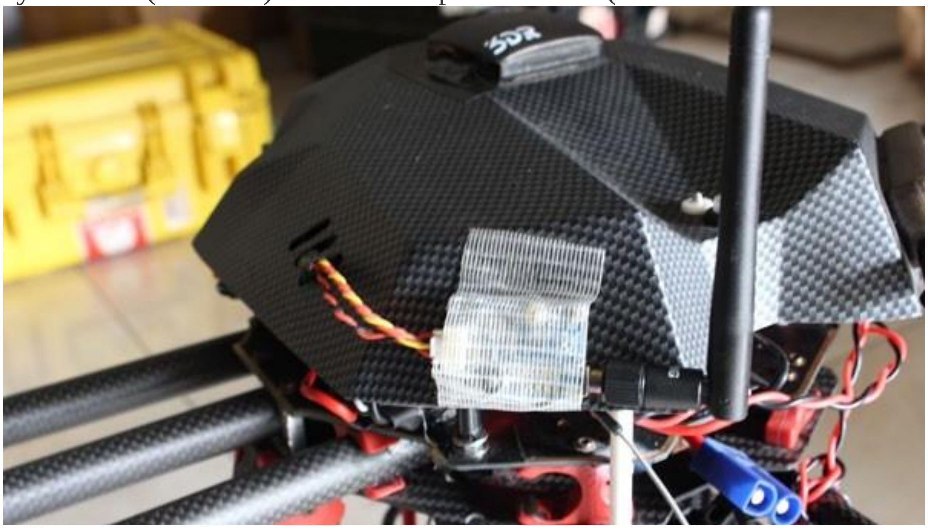
Some of the more common causes and solutions for poor video are listed below:

- "Jello" effect (or rolling shutter) is a by-product of using a camera with a CMOS sensor (GoPro, et al) caused by vibration from unbalanced props/motors and can be mitigated by mounting the camera on soft rubber, silcone, foam ear plugs or sometimes just on velcro.
- digital and optical stabilization systems found in many cameras often do not perform well because of the vibrations found on many multicopters.
- Exceptions: the Sony video camera balanced steady shot system is very effective even at maximum 30 power zoom.
- If you have jerky camera movement adjust the RC_Feel parameter to a lower number such as 50 or 25.
- For better and smoother Yaw, use Expo control on your RC and lower the Acro_Yaw_P gain in APM.
- It is important to remember that even with a perfect setup, photography is an art as well as a science. Using the camera pointing straight to ground is a good place to start, but more dramatic viewpoints can be achieved with angles other than vertical. Mount about 40 degrees deviation from vertical to obtain mainly ground photos but with oblique view. About 70 degrees off vertical will give you a lot more sky giving scenic photos (from Draganfly). ArduPilot will stabilise the gimbal to whatever position you set.

14. Mount the GPS and Telemetry modules.

Positioning can be modified to whichever contributes best to signal interception and transmission.

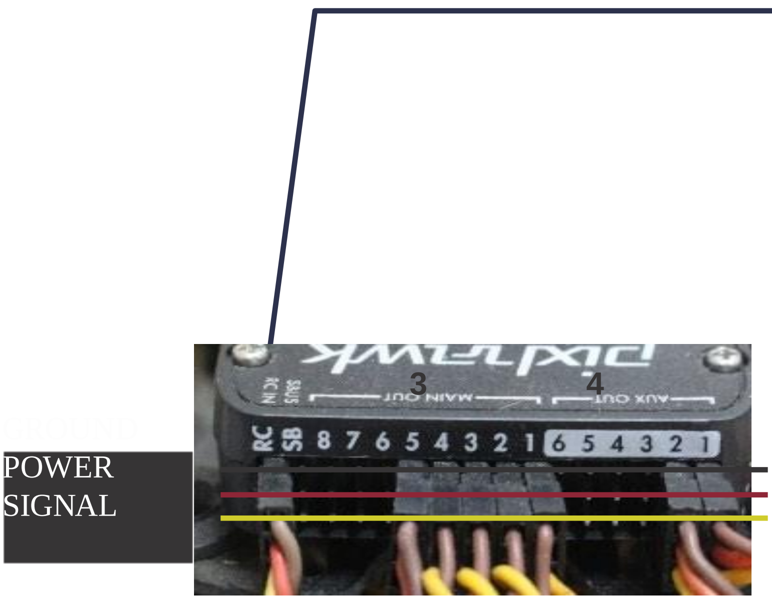
Telemetry Module (915Mhz) GPS/Compass Module (Connect wires to Pixhawk)



Mount the Telemetry module for FPV on the backside of canopy (5.8Ghz) Connect module to Telem 2 UART of Pixhawk.

17. Install the receiver module.

The copters utilize Futaba R3008 SB Receiver having 8 channel configuration.
Connect it to Pixhawk. See signal **RC pin** assignment in the figure below. Only 1 wire is used to con nect with Pixhawk as SBUS protocol is used for communication instead of PWM.



1. RC - Radio control receiver input
2. SB - S. Bus output
3. MAIN OUT - Outputs
4. AUX OUT- Auxiliary Outputs

18. Bind Transmitter to Receiver. Transmitter used is Futaba T10J.

Bind the transmitter to the receiver module of the copter. Refer to the transmitter manual or see example on the Surfer Assembly.

19. Lastly, install the propellers.

Secure and tighten the propellers with washer and bolt ‘n nuts.

CIRCUIT WIRING GUIDE using PixHawk

Includes connections from:

1. **AutoPilot to Receiver**
2. **Power Module to ESC to AutoPilot**
3. **Motor to ESC**
4. **FPV**
5. **CHDK**

9.3.3 QUALITY CONTROL

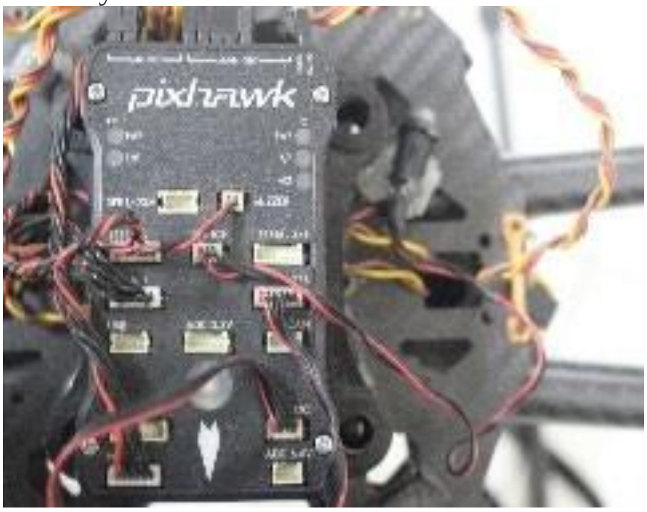
Following is the checklist to ensure that the drone remains in good condition:

1. Make sure that all wires are connected at the proper port
2. Keep the wire arrangement as neat as possible
3. Orderly place the drone parts inside the storage box during transporation or whenever there is no operation
4. Always visually check drone parts every after flight for abnormalities
5. Remove batteries and camera when not in use

9.3.4 AUTOPILOT SYSTEM CONFIGURATION

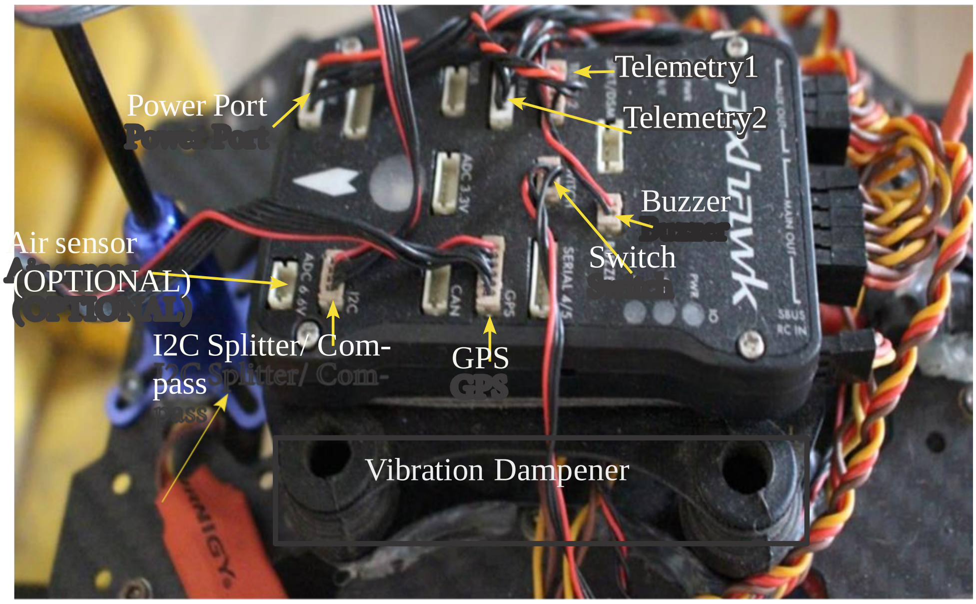
PX4 Pixhawk

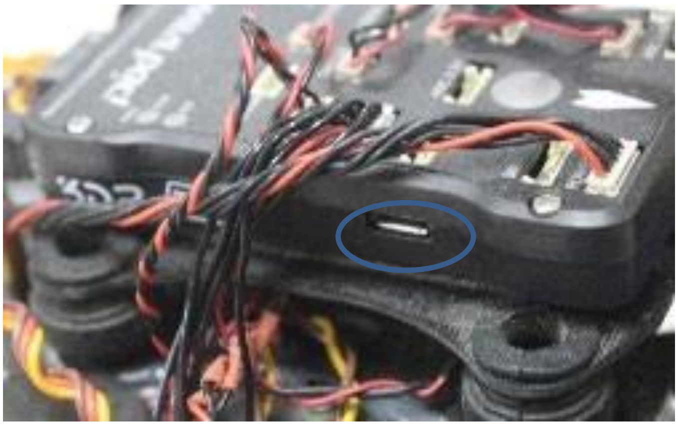
PIXHAWK is a high-performance autopilot-on-module suitable for fixed wing, multi rotors, helicopters, cars, boats and any other robotic platform that can move. It is targeted towards high-end research, amateur and industry needs and combines the functionality of the PX4FMU + PX4IO.



Key Features

- 168 MHz / 252 MIPS Cortex-M4F
- 14 PWM / Servo outputs (8 with failsafe and manual override, 6 auxiliary, high-power compatible)
- Abundant connectivity options for additional peripherals (UART, I2C, CAN)
- Integrated backup system for in-flight recovery and manual override with dedicated processor and stand-alone power supply (fixed-wing use)
- Backup system integrates mixing, providing consistent autopilot and manual override mixing modes (fixed wing use)
- Redundant power supply inputs and automatic failover
- External safety switch
- Multicolor LED main visual indicator
- High-power, multi-tone piezo audio indicator
- microSD card for high-rate logging over extended periods of time





Micro USB port | SD Card

Processor

- 32bit STM32F427 Cortex M4 core with FPU
- 168 MHz
- 256 KB RAM
- 2 MB Flash
- 32 bit STM32F103 failsafe co-processor

Sensors

- ST Micro L3GD20H 16 bit gyroscope
- ST Micro LSM303D 14 bit accelerometer / magnetometer
- Invensense MPU 6000 3-axis accelerometer/gyroscope
- MEAS MS5611 barometer

Interfaces

- 5x UART (serial ports), one high-power capable, 2x with HW flow control
- 2x CAN (one with internal 3.3V transceiver, one on expansion connector)
- Spektrum DSM / DSM2 / DSM-X® Satellite compatible input
- Futaba S.BUS® compatible input and output
- PPM sum signal input
- RSSI (PWM or voltage) input
- I2C
- SPI
- 3.3 and 6.6V ADC inputs
- Internal microUSB port and external microUSB port extension

Voltage Ratings

Pixhawk can be triple-redundant on the power supply if three power sources are supplied. The three rails are: Power module input, servo rail input, USB input.

Normal Operation Maximum Ratings

Under these conditions all power sources will be used in this order to power the system

Power module input (4.8V to 5.4V)

Servo rail input (4.8V to 5.4V) UP TO 10V FOR MANUAL OVERRIDE, BUT AUTOPILOT PART WILL BE UNPOWERED ABOVE 5.7V IF POWER MODULE INPUT IS NOT PRESENT
USB power input (4.8V to 5.4V)

Pixhawk connector pin assignments

TELEM1, TELEM2 ports

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (OUT)	+3.3V
3 (blk)	RX (IN)	+3.3V
4 (blk)	CTS	+3.3V
5 (blk)	RTS	+3.3V
6 (blk)	GND	GND

GPS port

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (OUT)	+3.3V
3 (blk)	RX (IN)	+3.3V
4 (blk)	CAN2 TX	+3.3V
5 (blk)	CAN2 RX	+3.3V
6 (blk)	GND	GND

SERIAL 4/5 port - due to space constraints two ports are on one connector.

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (#4)	+3.3V
3 (blk)	RX (#4)	+3.3V
4 (blk)	TX (#5)	+3.3V
5 (blk)	RX (#5)	+3.3V
6 (blk)	GND	GND

ADC 6.6V

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	ADC IN	up to +6.6V
3 (blk)	GND	GND

ADC 3.3V

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	ADC IN	up to +3.3V
3 (blk)	GND	GND
4 (blk)	ADC IN	up to +3.3V
5 (blk)	GND	GND

I2C

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	SCL	+3.3 (pullups)
3 (blk)	SDA	+3.3 (pullups)
4 (blk)	GND	GND

CAN

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	CAN_H	+12V
3 (blk)	CAN_L	+12V
4 (blk)	GND	GND

Console Port

The system's serial console runs on the port labeled SERIAL4/5. The pinout is standard serial pinout, to connect to a standard FTDI cable (3.3V, but its 5V tolerant).

Pixhawk			FTDI
1	+5V (red)		N/C
2	Tx		N/C
3	Rx		N/C
4	Tx	5	Rx (yellow)
5	Rx	4	Tx (orange)
6	GND	1	GND (black)

Absolute Maximum Ratings

- Power module input (0V to 20V) [refers to the voltage coming into Pixhawk from the power module]
- Servo rail input (0V to 20V)
- USB power input (0V to 6V)

Pixhawk Kit inclusions:
1. Pixhawk
2. Buzzer
3. Safety Switch
4. MicroSD card adapter
5. MicroUSB Cable
6. Six Wire Cable x2
7. Power Module
8. I2C Splitter Module
9. Four Position I2C Splitter Cable
10. Three-Wire Servo Cable
11. Mounting Foam

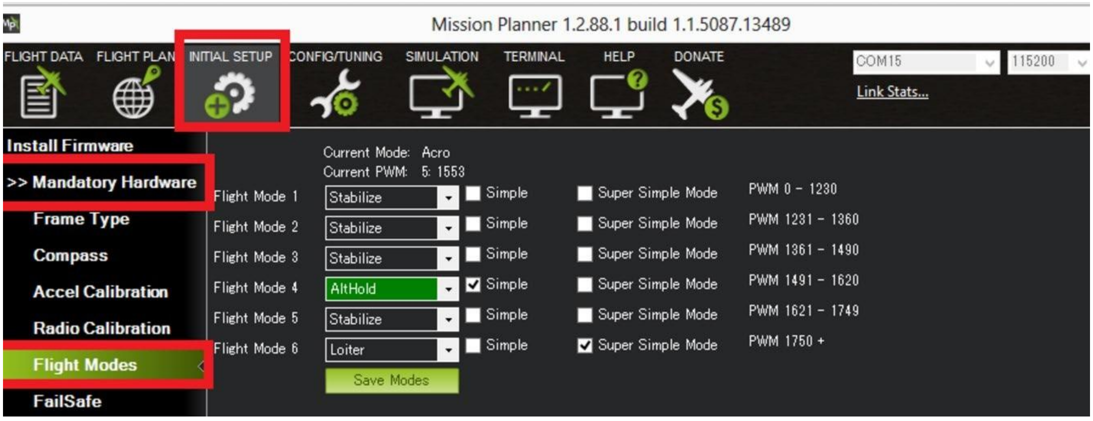
9.3.5 TRANSMITTER CONFIGURATION

RC Transmitter Flight Mode Configuration

This article shows how you can enable up to 6 autopilot control/flight modes to be set from your RC transmitter.

Flight modes configuration

The mapping between switch position and flight mode is set in the Mission Planner Flight Mode screen.



Mission Planner:Flight Mode Screen (Copter).

You can set up the flight modes available on the transmitter by doing the following:

- Turn on your RC transmitter
- Connect the Pixhawk (or other flight controller) to the Mission Planner
- Go to the Initial Setup | Mandatory Hardware | Flight Modes screen

Note

As you move your transmitter's flight mode switch the green highlight bar will move to a different position.

Use the drop-down on each line to select the flight mode for that switch position.
(Copter) Ensure that at least one switch position is left assigned to **STABILIZE**.
(Copter) Optionally check the Simple Mode check-box for that switch position. If using AC3.1 or higher you can optionally set Super Simple mode. If both Simple mode and Super Simple mode checkboxes are checked

Super Simple will be used.
When finished press the **Save Modes** button.
(Copter) Some modes can also be invoked from the auxiliary switches (a.k.a. ch7, ch8 option switches). For example, to set a dedicated switch for RTL.

Setting the flight mode channel

The flight mode channel is the input radio channel that ArduPilot monitors for mode changes.

On Copter this is always channel 5.

Transmitter configuration

The transmitter must emit PWM signals in the correct range to allow us to map a mode to a switch position.

Note

- The correct PWM ranges for selectable modes are shown alongside each mode selection dropdown in the Mission Planner Flight Mode screen (see screenshot above).
- If you want to just support three modes (using a three position switch) then you would configure the transmitter to produce PWM pulse widths of 1165, 1425, and 1815 microseconds for the respective switch positions.

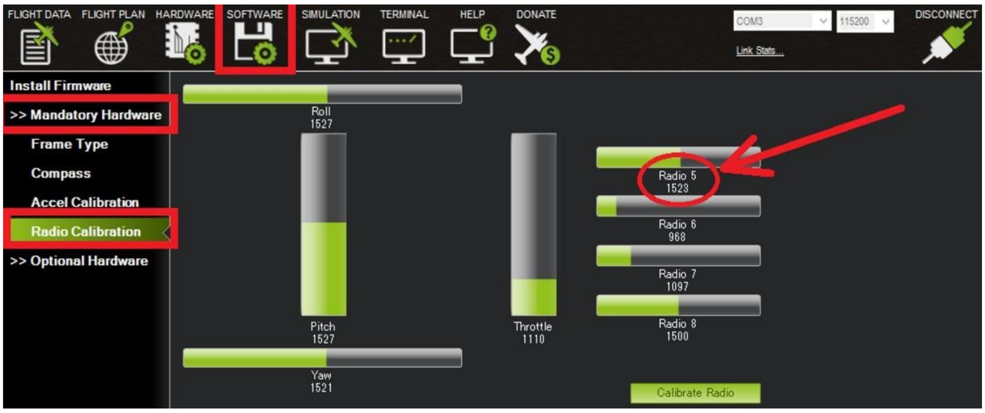
If you want to support 6 modes then the transmitter will need to emit **PWM widths** of around **1165, 1295, 1425, 1555, 1685, and 1815 milliseconds**. Typically this is achieved by configuring the transmitter to mix a two position switch and a three position switch (giving 6 modes in total). You can also do this with an analog dial if one is available, but it's hard to reliably turn a dial to just the right position for six distinct settings.

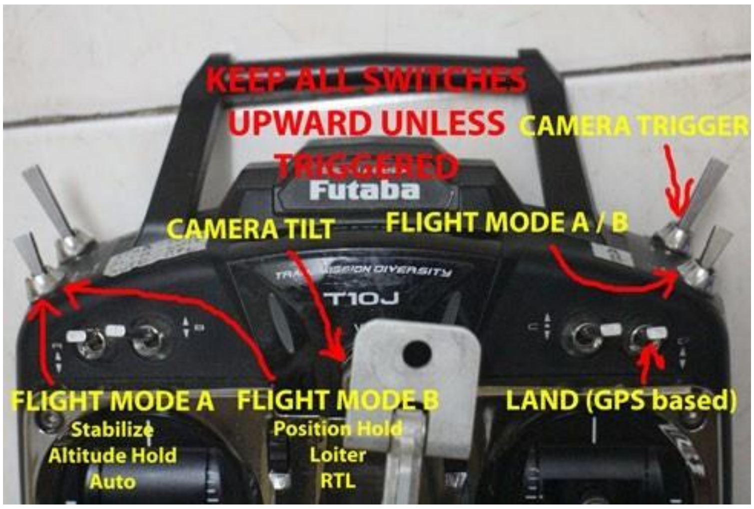
The sections below provide links showing how to configure transmitters from different manufactures, and how to test (in Mission Planner) that each switch setting is emitting the appropriate PWM signal.

Test transmitter switch settings

You can use the Mission Planner Radio Calibration screen to test the PWM pulse widths for each mode setting.

Simply toggle through the modes on your transmitter and confirm that the PWM for the selected channel matches the required PWM values. The screenshot below assumes that the flight mode channel is set to Radio 5.





T10J Switch Assignments

Flight Mode

1. Stabilize - Non-GPS, non-barometer, manual throttle control, use for take-off / landing. Enables the plane to level itself with respect to the ground.

- See Video. Watch how the control surfaces respond with each change in orientation.

2. Alt Hold - Non-GPS, barometer-dependent altitude control, easier to control, if THR is less than 50% then will descend slowly, if THR is more than 50% will ascend slowly, if THR is at 50% will hover

- See Video1, Video2 (maintains the last known altitude. it can be mixed up with loiter mode as shown in the video)

3. Auto - Auto mode. Plane switches to autopilot mode wherein it follows the waypoint prepro-grammed using Mission Planner.

4. Position Hold - GPS-based, barometer-dependent, feels like Loiter and Alt Hold hybrid, very responsive and sensitive to movement, throttle is same as Alt Hold, GPS compensated

5. Loiter - GPS-dependent, barometer-dependent, holds position well based on GPS. The plane with remain in one specific location (for mutirotor), or in circle radius (for plane) once toggled, yet may also be controlled manually by the transmitter joysticks.

- See video on number 2.

6. RTL - return to launch. This will enable the copter to return to the location where it is armed.

Switches

1. Land - Will land on spot, can still control during descend but you need to untrigger the switch or change flight mode if you want to abort landing
2. Camera Tilt - Used to level the camera for mapping
3. Camera Trigger - For test shot

Things to Remember

1. Add electrical tape to arms before locking to reduce vibration (because system is now too heavy for the frame)
2. Always check CG before flight
3. Arming switch is the red blinking LED push button on top rear side of the canopy, press this for 2 seconds before arming via transmitter
4. Transmitter arms by holding THROTTLE down and then pushing RUDDER to right (DOWN RIGHT) for about 3 to 5 seconds
5. Transmitter disarms by holding THROTTLE down and then pushing RUDDER to left (DOWN LEFT) for about 3 to 5 seconds
6. Disarm the copter via the red LED push button for 3-5 seconds before unplugging
7. Copter will automatically RTL if low batt, make sure to land it ASAP.
8. Flight plan should be going towards the home location or going towards landing spot to avoid completely draining the batt.
9. Flight time is about 20mins, including take-off and landing.

9.3.6 SYSTEM CHECK

PREFLIGHT
Groundstation

- Laptop - Power On
- Laptop Battery- Confirm Battery Lifespan
- Mission Planner - Start
- Telemetry Module - Connect USB
- Telemetry Module Antenna - Orient Vertically
- Com Settings - Com Port Select, Baud 57600

Aircraft

- Airframe/Landing Gear - No Damage
- Props - Secure, Undamaged, Correct Direction
- Motors - Secure, Undamaged
- ESCs - Secure, Undamaged
- GPS Receiver & Cable - Secured
- RC Rx Connections - Secured
- RC Satellite Rx and cable - Secured
- Telemetry Module & Cable - Secured
- APM - Secured
- APM Connections - Verify All Secured
- Battery - Install in AV
- Velcro Battery Straps - Secured

FLIGHT

- RC Tx - Verify Throttle at Minimum
- RC Tx - Power On
- RC Tx - Verify Battery Voltage
- RC Tx - Verify Correct Model Selected
- RC Tx Mode Switch - Stabilize
- Aircraft - Place at RTL Location
- Battery - Connect (Don't move AV)
- Telemetry Comms - Connect with MP
- Battery Cables - Secure
- RC Rx Antennas - Straight
- Telemetry Antenna - Straight and Vertical
- Telemetry Signal Strength > 75%
- Pitch & Roll AV - Ensure Correct response on AH
- Airspeed - Verify 0 (+/-3)
- Battery Voltage - Fully Charged
- GPS - 3D Fix
- Flight Plan - Verify

Configuration

- Spin up the propellers on the ground and check they are all moving in the correct orientation.
- Check that your copter knows what level is. With the copter on a flat surface connect to Mission Planner and ensure the artificial horizon display shows level.
- Check all failsafe settings are enabled.

Flying

- Make sure you have a GPS lock before flying if you intend to use any auto modes. Even if you're only flying in Stabilized mode this is a good idea so you can invoke Return To Launch if you get into trouble.
- **Test RTL** before sending your copter off on an auto waypoint flight. This is to check that the compass and GPS are working, and that it knows where home is before heading off on a more complex flight.
- Ensure that flight in Stabilize works well before you attempt any more complex flight modes. Ensure loiter works before trying RTL. Ensure RTL works before trying auto.
- Once armed stand 3m-6m away from the arming point as when in RTL the copter will be returning to this point.

When testing more complex flight modes, be ready to switch back to Stabilize mode at any moment if it does anything strange. Stabilize or Acro are the only modes which can save you from a problem with the software or sensors. RTL is a good mode to save you from human error, but relies on the copter being able to locate and fly itself, so this should not be used as an emergency mode if other auto flight modes go wrong.

Be sure you have a way of knowing when your battery is getting low, and land before you have used more than 80% of your battery capacity.