

---

Make a Quadcopter using KK 2.1.5  
Flight Controller

---

PLANTING  
THE  
SEED  
OF  
INNOVATION

---



## Typical Applications

A quadcopter, also called a quadrotor helicopter or quadrotor, is a multirotor helicopter that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors (vertically oriented propellers).

## Specifications

### 1000 KV Brushless Motor

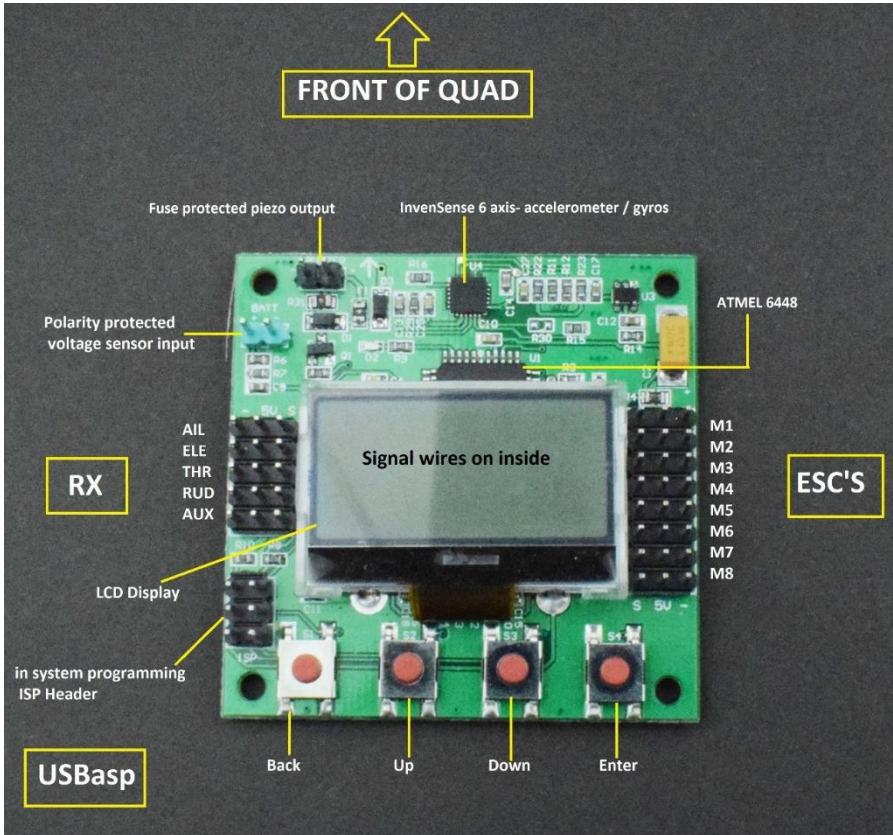
- A2212/13.RPM/V: 1000KV.Batteries: 2-3 Li-Poly
- Efficiency: 80%.
- Current: 4-10A (>75%).
- No load current: 10V/0.5A.Max.
- transient current: 12A/60S
- Shaft diameter: 3.17mm.
- Dimensions: 27.5\*30mm.
- Weight limit for compatible model plane: 300-900g.
- Compatible propeller model: APC 10\*5/ APC 11\*5.5/ APC 10\*4.7

### KK 2.1.5 Multi rotor Flight Control Board

- Size: 50.5mm x 50.5mm x 12mm
- Weight: 21 gram (Inc. Piezo buzzer)
- IC: Atmega644 PA
- Gyro/Acc: 6050MPU
- Auto-level: Yes
- Input Voltage: 4.8-6.0V
- AVR interface: standard 6 pin.
- Signal from Receiver: 1520us (5 channels)
- Signal to ESC: 1520us
- Firmware Version 1.6

# USER MANUAL

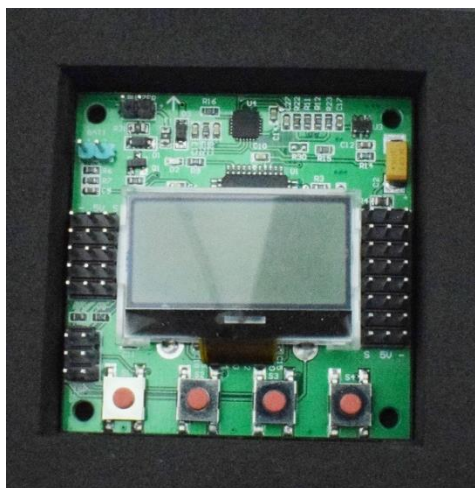
## KK 2.1.5 Multi rotor Flight Control Board



KK2.1 Multi-Rotor controller manages the flight of (mostly) multi-rotor Aircraft (Tri copters, Quadcopters, Hex copters etc.). Its purpose is to stabilize the aircraft during flight and to do this, it takes signals from on-board gyroscopes (roll, pitch and yaw) and passes these signals to the Atmega324PA processor, which

in-turn processes signals according to the user's selected firmware (e.g. Quadcopter) and passes the control signals to the installed Electronic Speed Controllers (ESCs) and the combination of these signals instructs the ESCs to make fine adjustments to the motors' rotational speeds which in-turn stabilizes the craft. The KK2.1 Multi-Rotor control board also uses signals from your radio system via a receiver (Rx) and passes these signals together with stabilization signals to the Atmega324PA IC via the aileron; elevator; throttle and rudder user demand inputs. Once processed, this information is sent to the ESCs which in turn adjust the rotational speed of each motor to control flight orientation (up, down, backwards, forwards, left, right, yaw)

## Initial Setup



### STEP- 1

Mount the FC on the frame with the LCD facing front and the buttons facing back. You can use the supplied antistatic foam container as a form of protective case for the Flight Controller on the craft.

### STEP-2

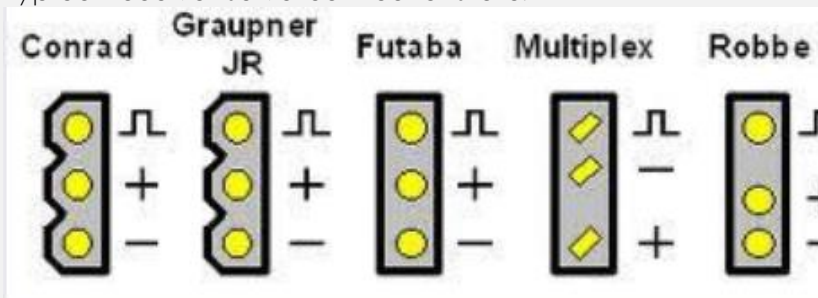
Connect the receiver outputs to the corresponding left-hand side of the controller board. The pins are defined as:



Ensure the negative (black or brown) is orientated so that it is on the pin that is nearest to the edge of the Flight Controller Board, so looking at the board the color sequence will be Black, Red and Orange. The channels are connected as follows from the front of the board towards the push buttons: -

RECIEVER CHANNEL	FLIGHT CONTROLLER
Aileron	Aileron
Elevator	Elevator
Throttle	Throttle
Rudder	Rudder
AUX 1	AUX

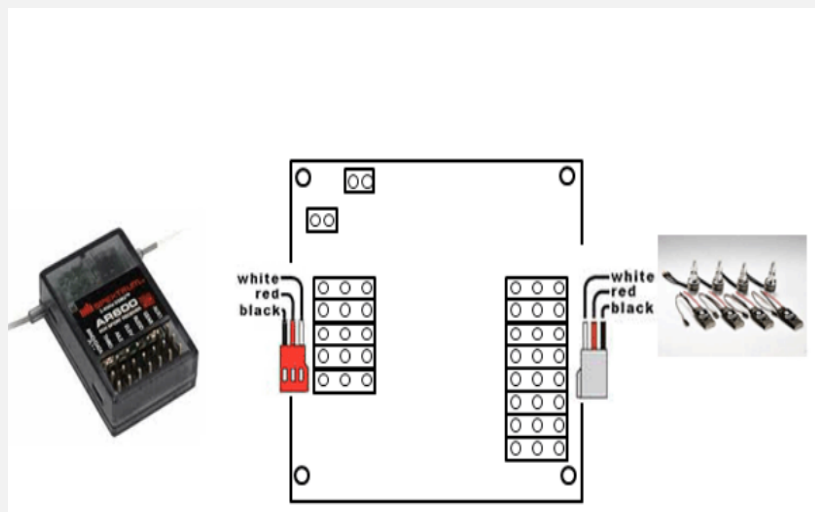
Typical receiver servo connections are:



**STEP-3** Connect the ESC's to the right side of the Flight Controller Board. M1 is towards the front of the board and M8 is nearest to the push buttons. The negative (black or brown) lead towards the edge of the FC. The negative (black or brown) lead is connected to the edge of the Flight Controller.

**DO NOT MOUNT THE PROPELLERS AT THIS STAGE - FOR SAFETY REASONS**

The completed Receiver and Motor wiring (for a QUAD Copter) looks like this:



The Flight Controller Board must always have a source of +5v from an ESC, either one of the motors ESC or from a separate unit feeding the Receiver. If each ESC has a BEC (normal unless OPTO types) then it may be necessary to remove the power feed from the other ESC, usually by cutting the power line (RED) Cable on the other ESC.

**STEP-4** Set up a new model on your transmitter and use a normal airplane profile and bind the Receiver to the Transmitter.



PI Editor

Receiver Test

Mode Settings

Stick Scaling

Misc. Settings

Self-Level

Settings

Camera Stab

Settings Sensor

Test ACC

Calibration

CPPM Settings

Mixer Editor

Show Motor

Layout Load

Motor Layout

Factory Reset

## STEP-5

Turn on the power and press the 'Menu' button, then using the 'Up' and 'Down' buttons highlight 'Receiver Test' sub-menu and press Enter. Now move each channel on your transmitter and check that the displayed direction corresponds with the stick movements on the Flight Controller, if any are reversed, then go to your Transmitter and reverse that channel. Check that the AUX channel is showing "ON" when you activate the AUX Switch on your transmitter, if not, reverse the AUX channel on your transmitter. Use the trim or sub-trim controls on your transmitter to adjust the channel values shown on the LCD to zero.

## STEP-6

Scroll down to and enter the "Load Motor Layout" sub-menu and choose the configuration you want. If the configuration you want is not listed, use the "Mixer Editor" sub-menu to make one. See later for more on that.

PI Editor

Receiver Test

Mode Settings

Stick Scaling

Misc. Settings

Self-Level

Settings

Camera Stab

Settings Sensor

Test ACC

Calibration

CPPM Settings

Mixer Editor

Show Motor

Layout Load

Motor Layout

Factory Reset

## STEP-7

Enter the "Show Motor Layout" sub-menu and confirm the following. Is the configuration correct? Are the motors and servos connected the correct output? Correct rotation direction? Does the motor speed up when dropping the arm it is mounted on?

## PI Editor

Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

## PI Editor

Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

## STEP-8

Enter the "Receiver test" and check for nominal values on each channel, move your Transmitter sticks around to ensure they are all working, including AUX1.

Enter the "PI Editor" sub-menu and check for correct PI gain values and use this menu option to adjust the PI gain settings. Use the PREV and NEXT buttons to highlight the parameter you want to change, then press the CHANGE button. To adjust both Roll and Pitch at the same time, see the "Mode Settings" sub-menu.

At this stage the propellers can be fitted to test the Flight Control board. Hold the craft (!) and then Arm it by give right rudder and zero throttle for a few seconds. It will beep and the RED LED will turn on. However, do-not arm it until you have put the multicopter on the ground and stepped away 5 meters. After landing, place it in SAFE Mode by holding the rudder to left with zero throttle. It will beep and the RED LED will turn off, always do this before you approach the multicopter. If the craft wants to tip over right away, check your connections and your custom made mixer table if you have one. If it shakes and maybe climbs after it's airborne, adjust the Roll and Pitch Pgain down or if it easily tips over after its airborne, adjust up. If it drifts away, use the trims to keep the drift down. It will normally drift away with the wind.

PI Editor  
Receiver Test  
**Mode Settings**  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

PI Editor  
Receiver Test  
Mode Settings  
**Stick Scaling**  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

Turn on the Self-levelling by holding right aileron while arming or disarming it. Turn it off by holding left aileron. Alternatively you can assign this to the AUX channel. See below. Sub-menu descriptions.

## STEP-9

Enter the "Mode Settings" and check and adjust: "Self-Level": Determines how the self-levelling function will be controlled, either by STICK or an AUX Channel. "STICK MODE": Self-levelling is turned on by holding the aileron to the right when arming or disarming. Turn it off with left aileron. "AUX": Self-levelling is turned on/off by the AUX Channel. "Auto Disarm": If set to YES then Flight Control board will automatically disarm itself after 10-mins of inactivity. "CPPM Enabled": Determine if the Flight Control Board is to use CPPM data input.

## STEP-10

Enter the "Stick Scaling" option, where you can adjust the response from the stick to your liking. Higher number gives higher response and lower numbers the converse. This is similar to the endpoint or volume adjustment on your transmitter, where you can adjust your transmitter to adjust the stick response and use the stick scaling if you want more or less response from stick inputs

PI Editor  
Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

### "Misc. Settings":

"Minimum Throttle": Adjust the setting so that the motors just keep running when the Transmitter throttle stick is at a minimum. "Height Dampening": Adjust so that variations in height are minimised.

"Height D. Limit": Adjust to limit control over Height Dampening to prevent over control.

"Alarm 1/10 volts": Adjusts the battery alarm voltage set-point. When set to 0 (zero) the alarm is disabled. Adjust this value to suit the battery in use and monitored by the Flight Control Board sensor input. For a standard 3-cell LiPo battery of 11.1volts use a value of 3.60 volts per cell to denote an empty battery and then set this value (in 1/10's) to  $(3.6 \times 3 \times 10) = 108$  and when the supply voltage drops to 10.8volts the alarm will sound. Note, if you set this value above zero and no battery is attached / monitored then the alarm will sound. As the voltage being monitored nears the set point the time between beeps will shorten, so a long time between pulses when the alarm voltage is getting close to very short time intervals when the voltage is at the alarm set point. "Servo Filter": This setting is a Low-Pass Filter, that enables channel jitter to be ignored, a good setting to start off with is 50 (mS). If you experience channel jitter then increase this value, if none then set to 0 (zero).

PI Editor  
Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings  
Sensor Test  
ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

PI Editor  
Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

**"Sensor Test":** Displays the output from the sensors. See if all shows "OK". Move the FC around and see that the numbers change.

**"ACC Calibration":** Follow the instructions on the LCD to calibrate the Acceleration Sensors, which is only necessary to do once at initial setup.

### **"CPPM Settings":**

This menu allows different Transmitter manufacturers standards for CCPM channels to be re-assigned, thus:

Roll (Ail):	1	to	2
Pitch (Ele):	2	to	1
Throttle:	3		
Yaw(Rud):	4		
AUX:	5		

This enables the Flight Control board to match any supplier's standard

PI Editor  
Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings  
Camera Stab  
Settings Sensor  
Test ACC  
Calibration  
CPPM Settings  
**Mixer Editor**  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

## "Mixer Editor":

**"Channel":** Select the channel to be adjusted.

**"Throttle":** Amount of throttle command. Usually 100% if the output channel is connected to an ESC

### "Aileron":

Amount of aileron/roll command. Use positive value for motors on the right side of the roll axis and negative for the left side of the roll axis. The value is given by the motor's distance from the roll axis. Increased values denote a further distance.

**"Elevator":** Amount of elevator/pitch command. Use a positive value for motors on the front side of the pitch axis and negative value for the back side of the pitch axis. The value is given by the motor's

Distance from the pitch axis. More is further away. **"Rudder":** The amount of rudder/yaw command. Usually 100%. Use a positive value for a CW spinning propeller and negative for a CCW spinning propeller.

**"Offset" Item:** Applies a constant offset to the channel. Keep this zero when it is an ESC channel and around 50% when connected to a servo or on the AUX channel. You can fine tune the channels position by adjusting this value. **"Type:" Item:** Set it to the type (servo or ESC) connected to the channel. For ESC: Output PWM rate is always high. Outputs zero when disarmed or throttle is at idle. Applies the "Minimum Throttle" item from the "Misc. Settings" sub-menu when armed and throttle is above zero.

For the Servo setting: Output PWM rate can be high or low. Outputs the offset value when disarmed or throttle is at idle.

**"Rate":** High rate (400Hz) for ESC or digital servos, or low rate (80Hz) for analogue servos.



## Tuning Guide

PI Editor  
Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings Camera  
Stab Settings  
Sensor Test  
ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

Enable the Camera Control by turning it on by going to "Cam Stab Settings" screen and set the gains to a non-zero value. Start with 500. A negative value reverses servo direction. Adjust value until camera is steady.

1. The Gimbal Roll servo is connected to Motor-7 output.
2. The Gimbal Pitch servo is connected to Motor-8 output.

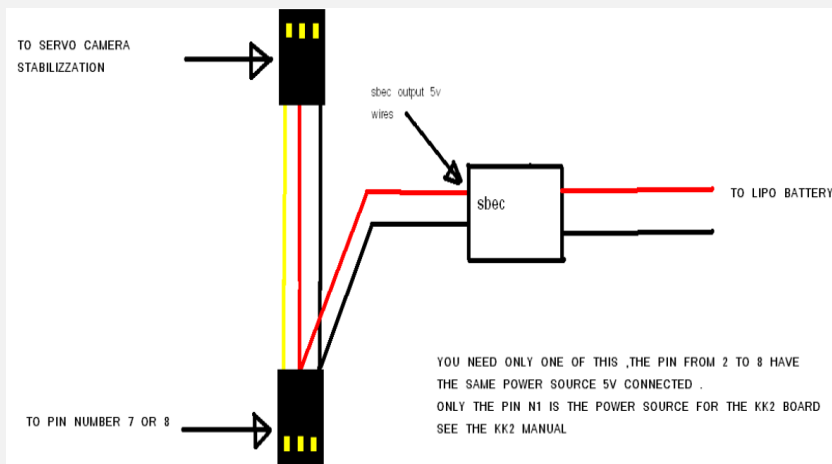
## Gimbal Connection Guide

PI Editor  
Receiver Test  
Mode Settings  
Stick Scaling  
Misc. Settings  
Self-Level  
Settings Camera  
Stab Settings  
Sensor Test  
ACC  
Calibration  
CPPM Settings  
Mixer Editor  
Show Motor  
Layout Load  
Motor Layout  
Factory Reset

Enable the Camera Control by turning it on by going to "Cam Stab Settings" screen and set the gains to a non-zero value. Start with 500. A negative value reverses servo direction. Adjust value until camera is steady.

1. The Gimbal Roll servo is connected to Motor-7 output.
2. The Gimbal Pitch servo is connected to Motor-8 output.

## Connection Diagram:



3. Use the offset values to trim servo position, but keep the values close to 50% by adjusting servo linkage first.

4. The camera stabilization starts as soon as you move the Throttle any stick

5. If you put the Throttle at Idle/Minimum the camera stabilization will be switched-OFF. NOTE: If you are using an "OPTO" ESC you may need an external 5v power source from an SBEC.

## Accessing the Self- Levelling Mode

1. You can access the self-levelling mode either from the settings of STICK or AUX channel.

2. When set to AUX Mode you must connect a spare channel usually CH5 or Ch6 and changing the Transmitter switch position will enable/disable Self-Levelling mode.

3. When set to STICK Mode to go into Self-Levelling Mode, you must set the Throttle to Minimum and set maximum Left Rudder

Whilst at the same time, setting maximum Left Aileron to disable SL or maximum Right Aileron to enable SL.

## Flight Controller Sounds

1. One Beep (short beep, 2 sec delay) is emitted when the board is armed and the throttle is closed, this is for safety reasons so you know it's armed.

2. One Long Beep is emitted when the board is either Armed or Disarmed.

## Status Screen

Displays the message "SAFE" and the KK2 will not arm unless it says "OK".

## General Points

Error messages can only be reset by cycling the power, except for the "sensors not calibrated" message, which is reset after a successful sensor calibration.

Error messages include lost RX connection.

The KK2.1 has an auto-disarm function and will disarm itself after 20 sec if throttle is at idle. For extra safety. Can be turned on/off in "Mode Settings" menu.

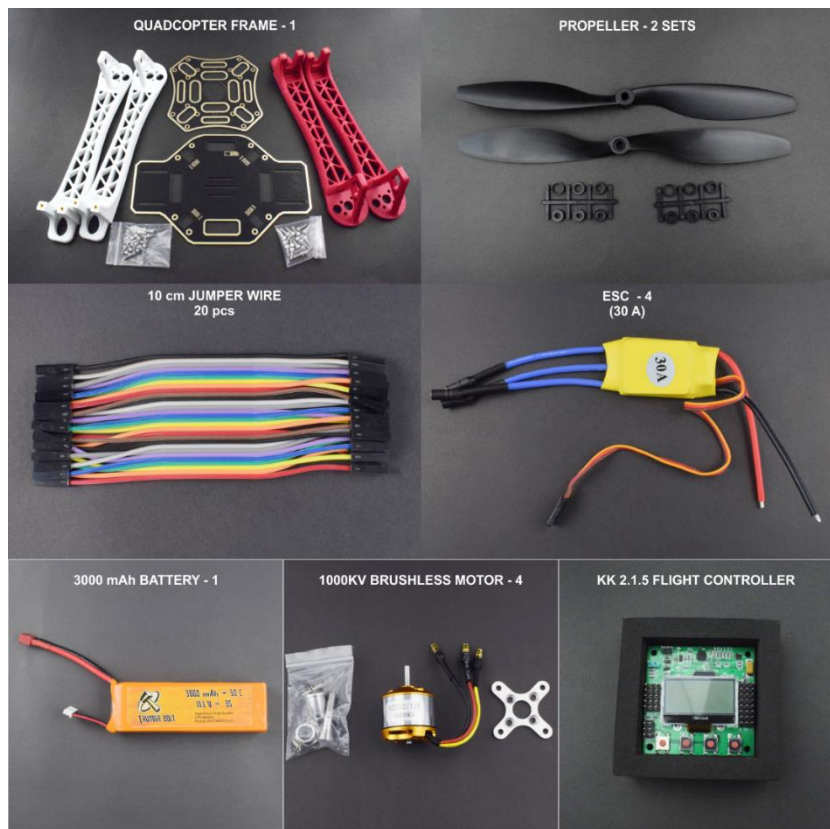
## Lost Model Alarm

The KK2.1 has a lost aircraft alarm and starts to beep (1 sec on and 4 sec off) after 30min of no activity (arm/disarm).

## Model Types Supported

Dualcopter  
Tricopter  
Y6 Quadcopter +  
Quadcopter X  
Hexcopter +  
Hexcopter X  
Octocopter +  
Octocopter X  
X8 +  
X8 X  
H8  
H6  
V8  
V6  
Aero 1S Aileron  
Aero 2S Aileron  
Flying Wing  
Singlecopter 2M 2S  
Singlecopter 1M 4S

## Hardware required



- 1) Quadcopter Frame (Preferably one which has a built in Power Distribution board) - 1
- 2) Microcontroller (KK 2.1.5 Flight Controller) - 1
- 3) Electronic Speed Control (30 Amps) (4 pieces)
- 4) Brushless Motor (1000KV) (4 pieces)
- 5) Propellers (2 sets)

- 6) Power Distribution Board (Not needed if frame has a built in one)
- 7) Lithium-Polymer 3000 mAH Battery - 1
- 8) Fly Sky FS-T6 Controller includes the Receiver - 1

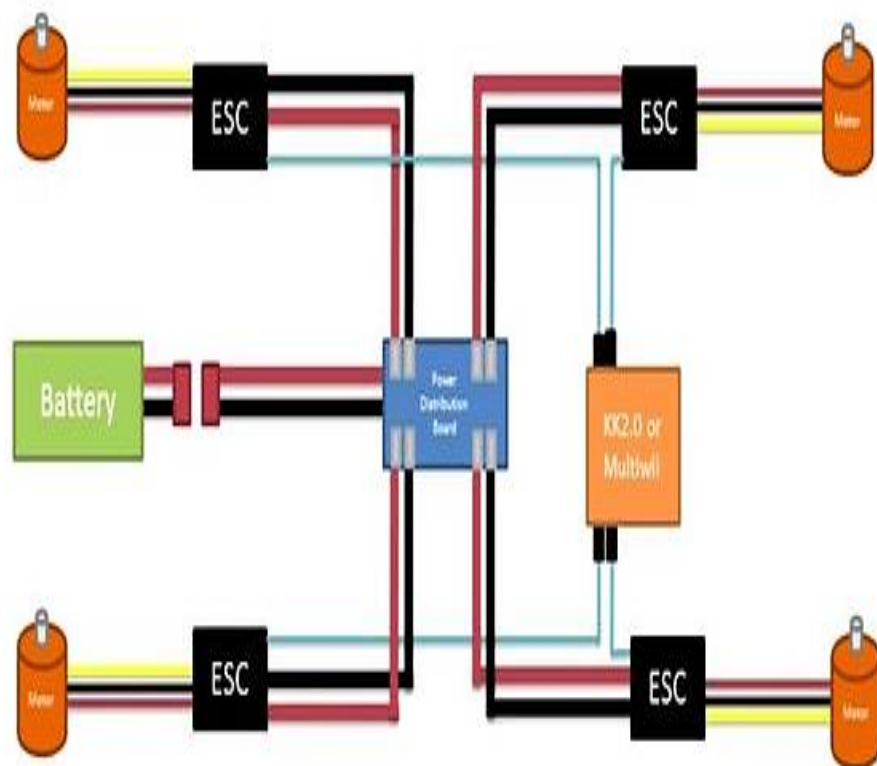
## Tools and Knowledge

- 1) Basic soldering skills
- 2) Alan keys
- 3) Shrink tubes
- 4) Zip ties (To hold the ESC's onto the frame)
- 5) Glue gun (To put all over the connections to avoid any contact between them)

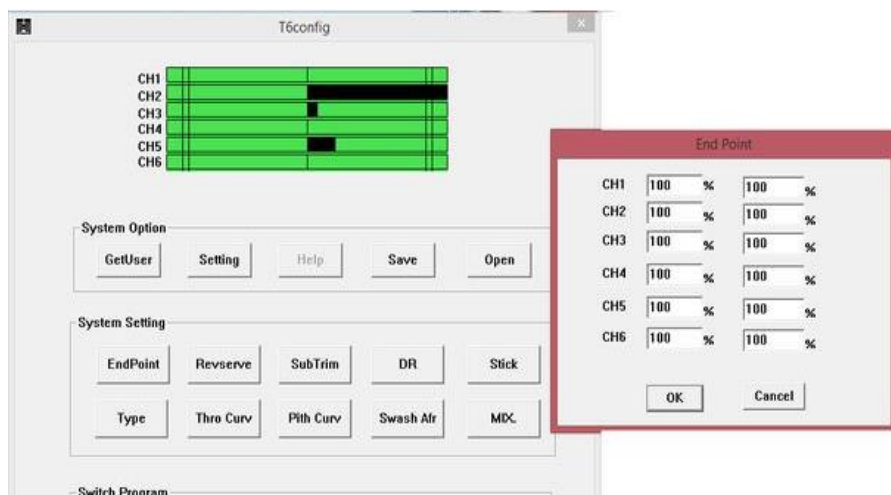
## Assemble and Connect

- 1) The motors and ESC's can be connected to each other via direct soldering or using Bullet Connectors of 4mm dimension.
- 2) The ESC's are then connected to the power distribution board, or in this case directly to the frame which has an inbuilt power distribution board, by soldering.  
(Make sure to know if the ESC's are supposed to be flashed or not, mine did not required to do so.)
- 3) Once this is done, solder the battery wire to the frame.
- 4) Once all the soldering work is done, and the hardware is setup, connect the KK Board (again flashed with the latest firmware) with the ESC servo wires, and Receiver.





## Plug in the battery and Test Your Quadcopter



If your code is all correct and your connections are all good you should see the LCD screen on the board lit up, from where you can easily calibrate both the Accelerometer and Magnetometer.



LIKE OUR PRODUCT GIVE US VALUABLE FEEDBACK  
ON -



<https://twitter.com/REES52Official>



<https://goo.gl/GaF2nw>



<https://www.facebook.com/Roboticsembeddededucationsservicespvtltd/>

Think  
Global  
ACT  
Local



# ROBOTICS EMBEDDED EDUCATION SERVICES PVT. LTD.

**For any queries, Contact On :-**

**+91-9599594524**

**011-65355152**

**Website - [www.rees52.com](http://www.rees52.com)**

**Email - [support@rees52.com](mailto:support@rees52.com)**