

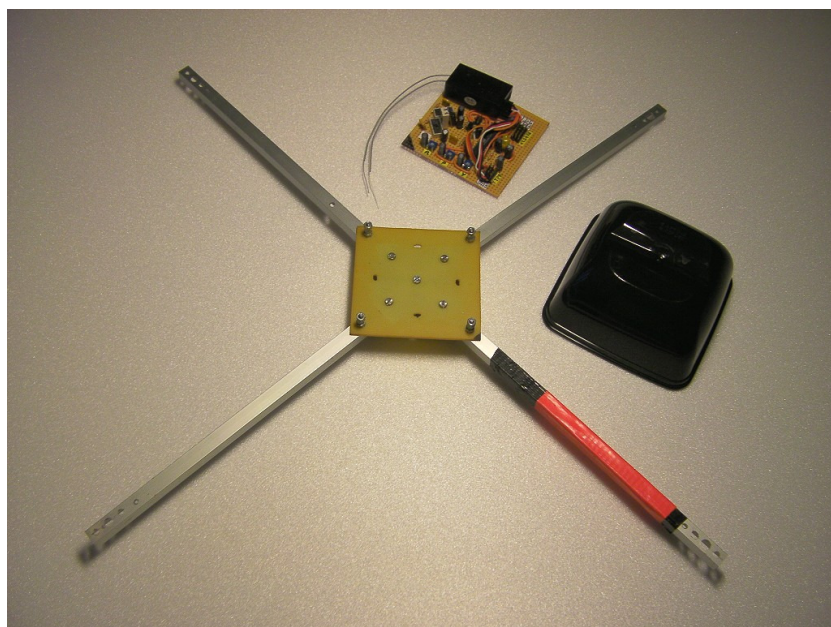
How to build the Quadricopter «QRO » (Quad Rotor Observer)



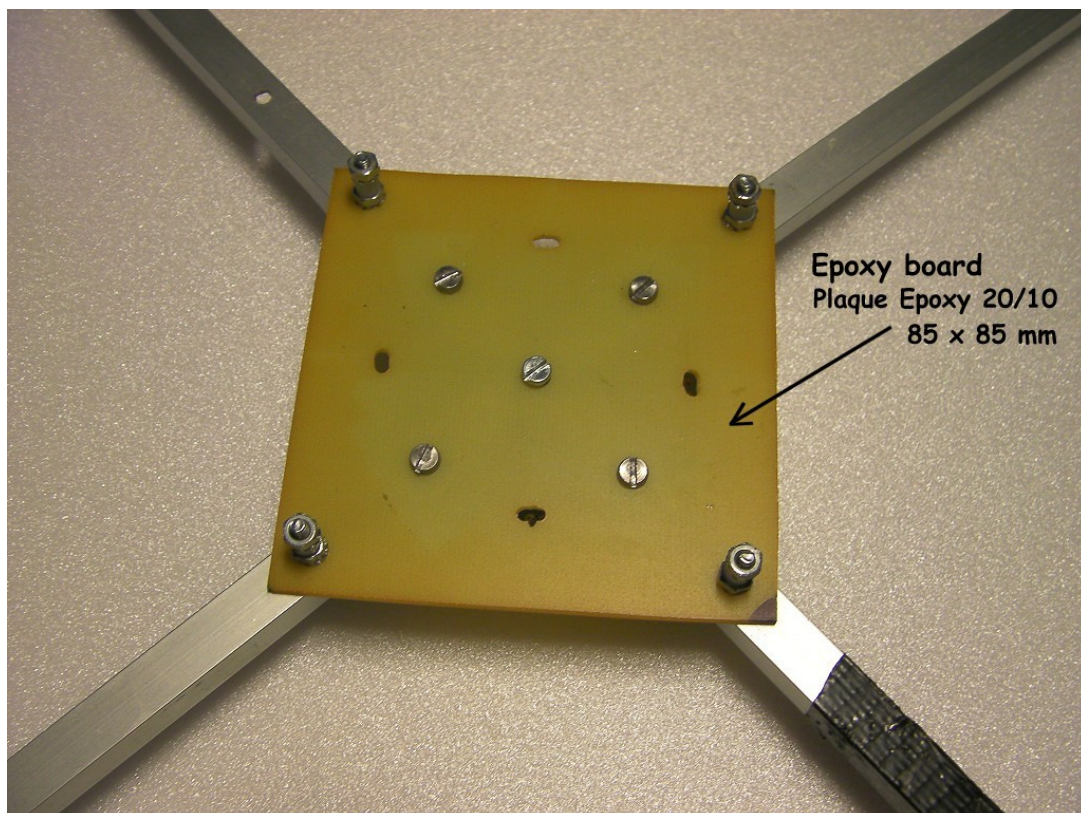
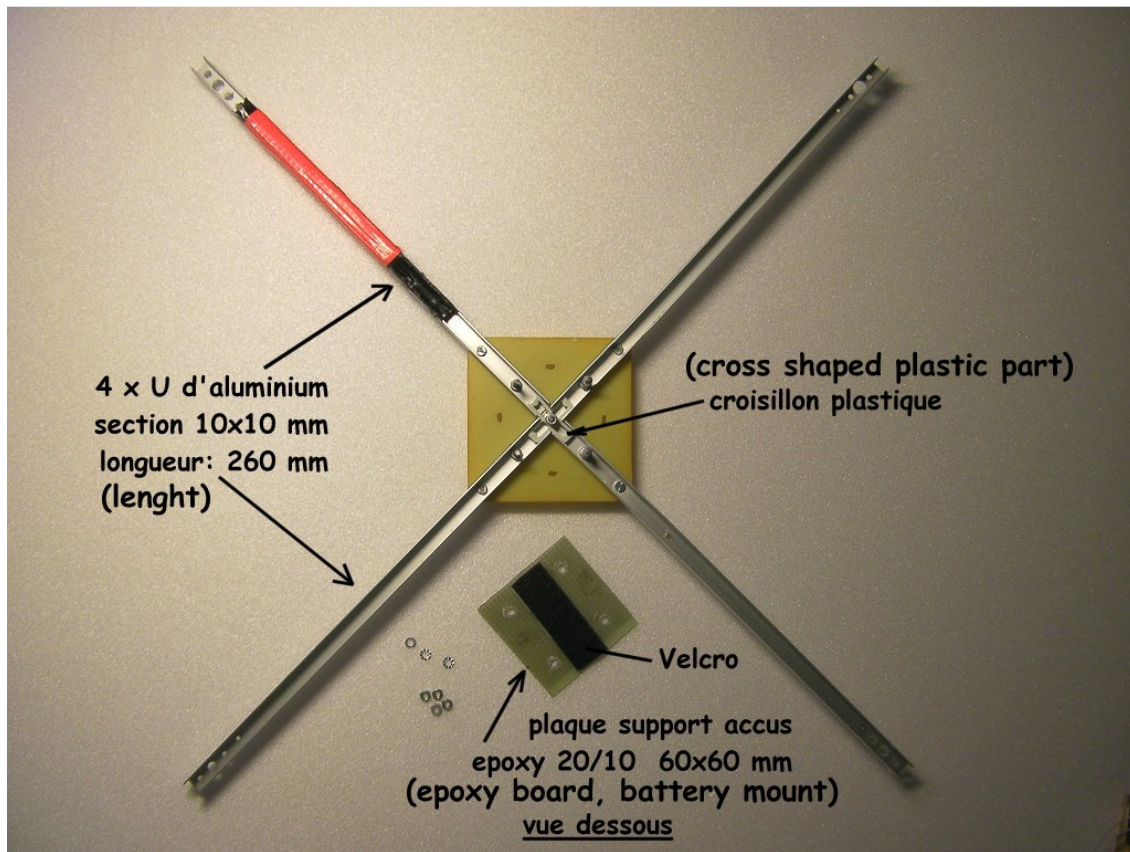
by Jean-Louis Naudin (v1.3 - February 2011)

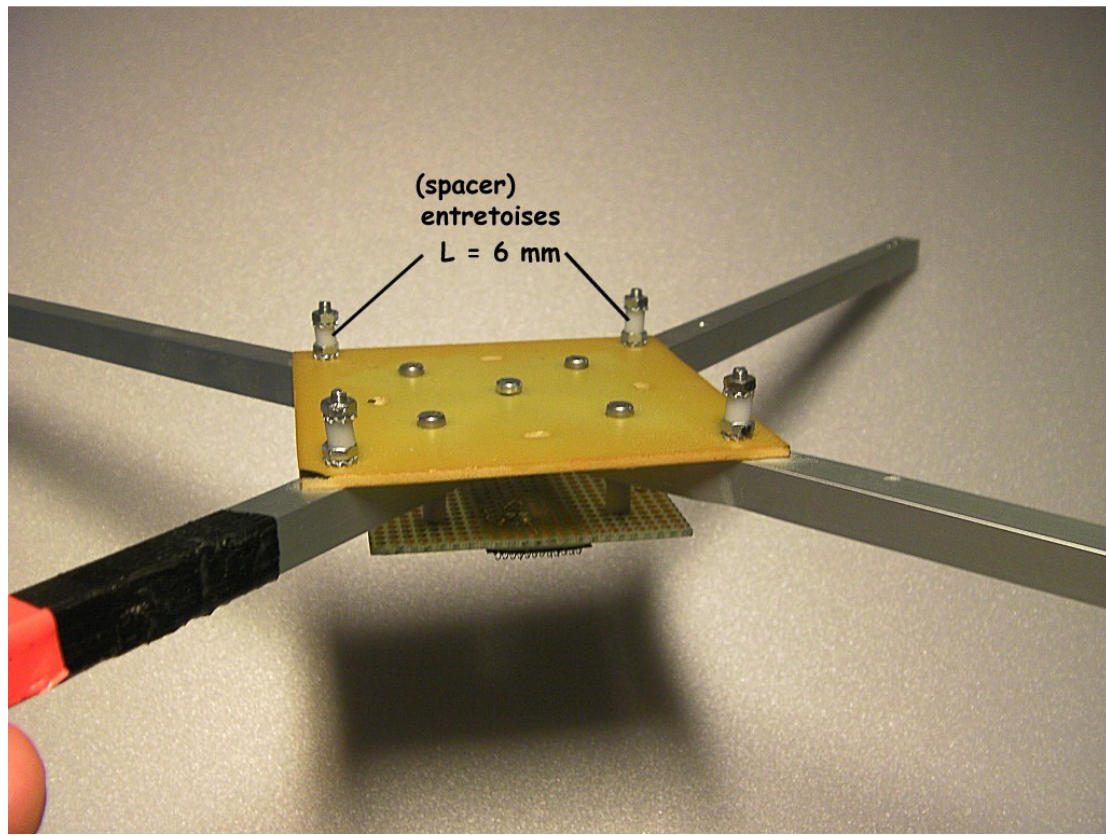
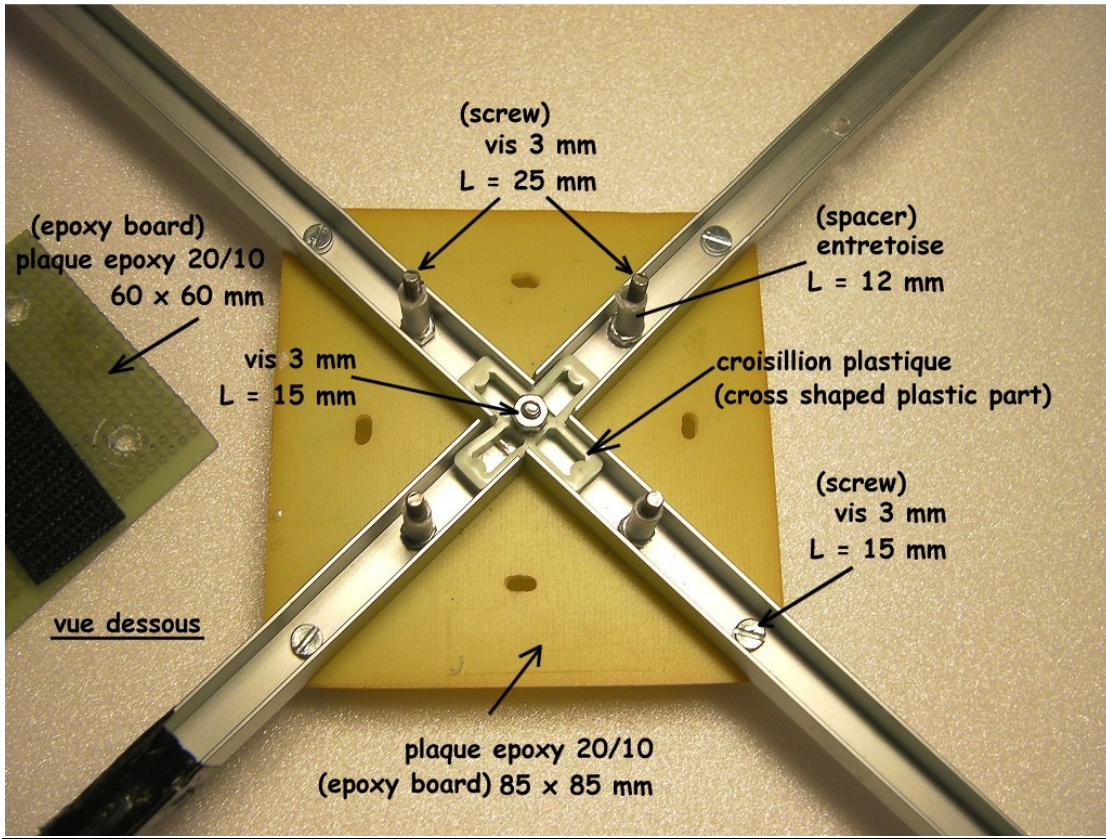
Here you will find a tutorial by pictures for building yourself a quadcopter which will allow you to fly anywhere (outdoor and indoor) and also to do aerial photos. Its piloting is relatively simple (simpler than a variable pitch helicopter) with the help of the electronic flight controller (a KKmulticopter type).

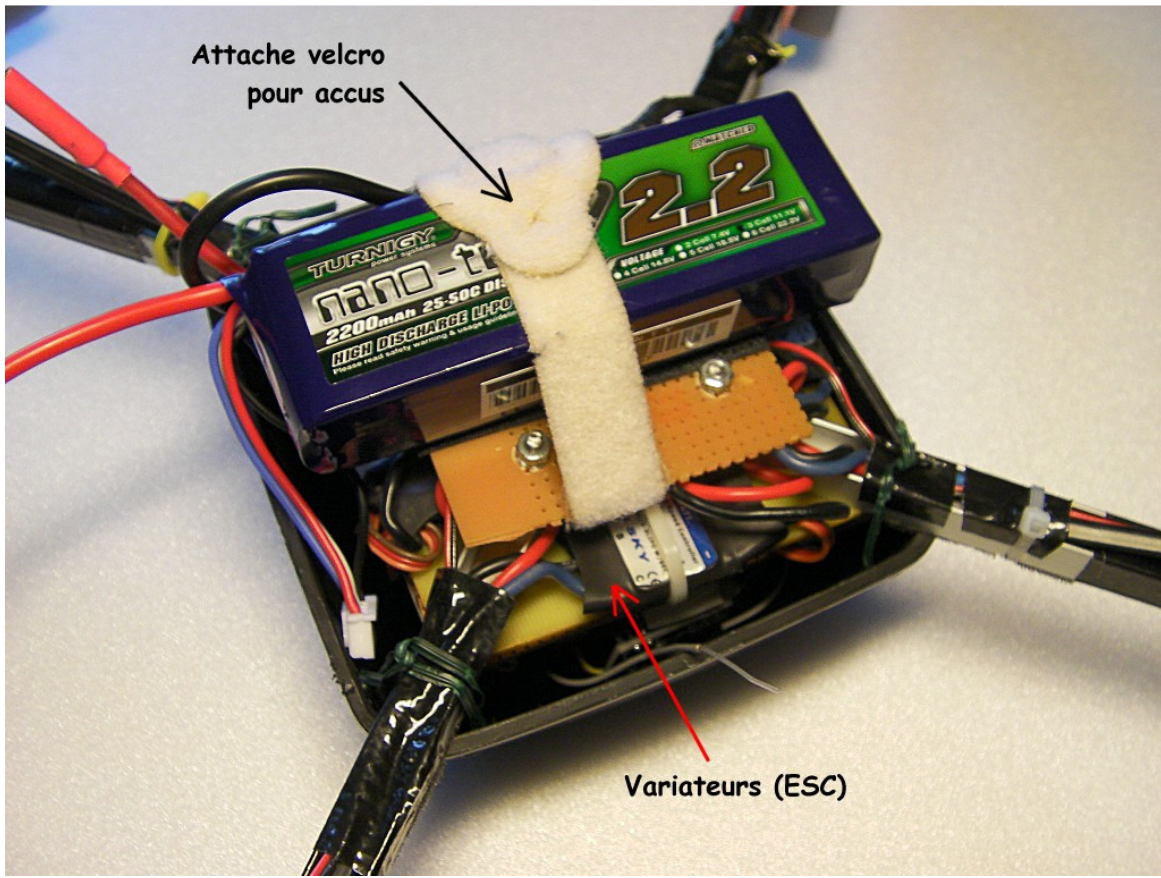
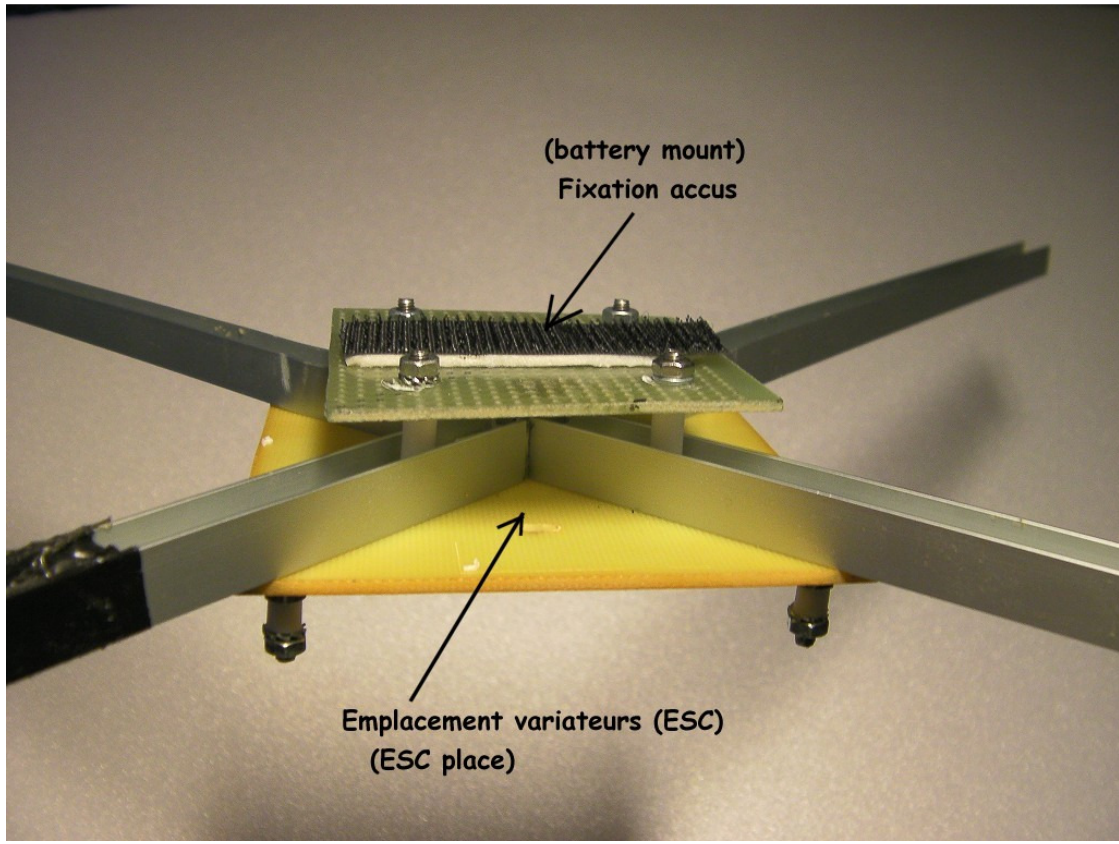
The construction is relatively simple and cheap. The main frame of the QRO uses common components that you will find in any hobby stores. You need only a U shaped aluminum spear (10x10 mm), some 3mm screws and bolts, two epoxy sheets (20/10 mm thick), a cross shaped plastic part and some plastic rods (5 mm wide). The black cover comes from a ready to eat food for microwave oven.



You will find below some detailed photos about the quadcopter frame :







Concerning the engines, I recommend for a training model such as the QRO v4 and v5 to use four 100 Watts brushless motors commonly used with 3S Lipo batteries. Such a setup is able to carry a payload of about 150g (i.e. my GoPro HD wide video camera). For GWS propellers 10x4.5, I recommend to use a Kv between 900 and 1200. The selected ESC depends of the type of the brushless motors used, a 30A ESC is commonly used.

Here an exemple of the motor which works well with the 10x4.5 GWS propellers.

**2212-15
930KV**

**FREE
shipping**



We can find such a motor for 9.99\$ at RCTimer, ref : [2212-15 930KV Outrunner Brushless Motor](http://www.rctimer.com/index.php?gOo=goods_details.dwt&goodsid=119&productname)

Link: http://www.rctimer.com/index.php?gOo=goods_details.dwt&goodsid=119&productname

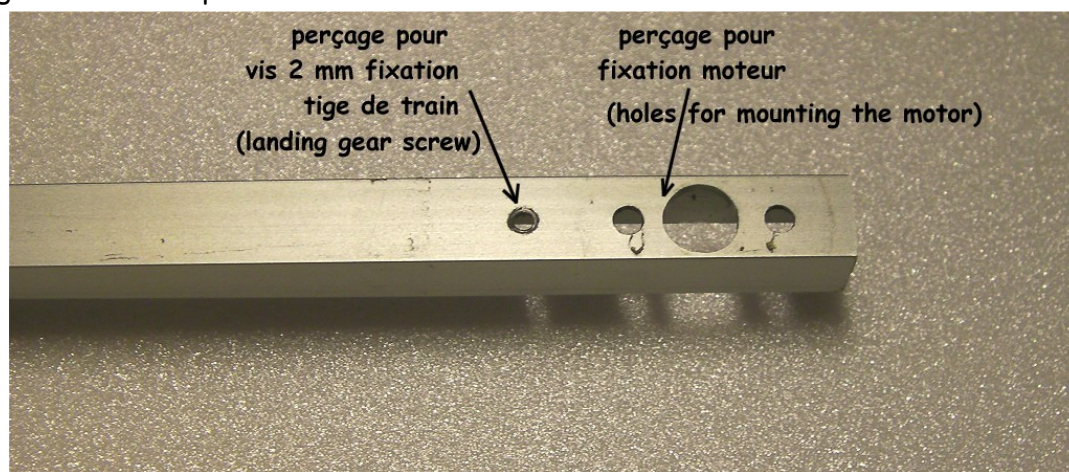
There is also another motor at the same price: [BC2826-13 1000KV Outrunner Brushless Motor](http://www.rctimer.com/index.php?gOo=goods_details.dwt&goodsid=125&productname)

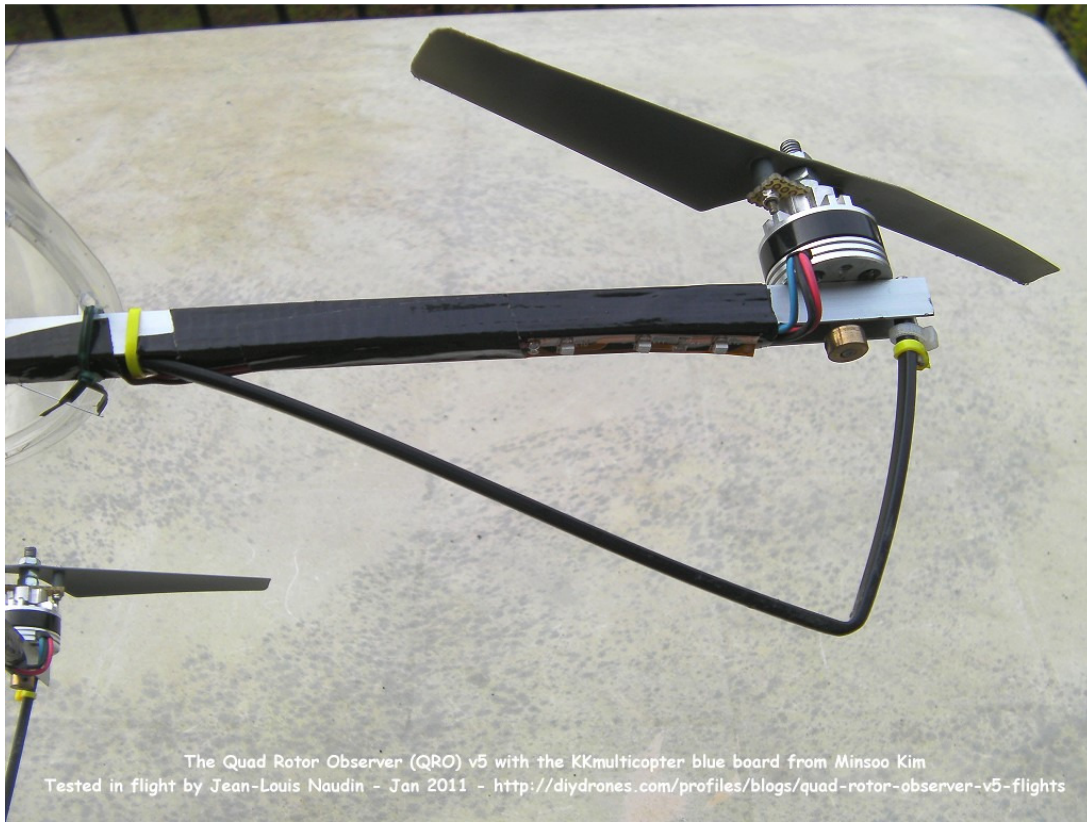
Link : http://www.rctimer.com/index.php?gOo=goods_details.dwt&goodsid=125&productname

The suggested ESC is: [Programmable ESC 30A Brushless Motor Speed Controller](http://www.rctimer.com/index.php?gOo=goods_details.dwt&goodsid=146&productname)

Link: http://www.rctimer.com/index.php?gOo=goods_details.dwt&goodsid=146&productname

For a model used for aerial photos and/or for more payload, you may use motors with similar Kv but which are able to deliver a power from 150 to 180 Watts. The holes in the U shaped aluminum spars for fixing the motors depend of the size of the motor used.





Here, I have used 100 W DualSky 2822CA brushless engines with propellers taken from my old X-UFO, I have just made some minor modifications for the 4mm motors axis.

About the propellers commonly used on quadcopters, you need to use two pairs of them: two CW 10x4.5 and two CCW 10x4.5.



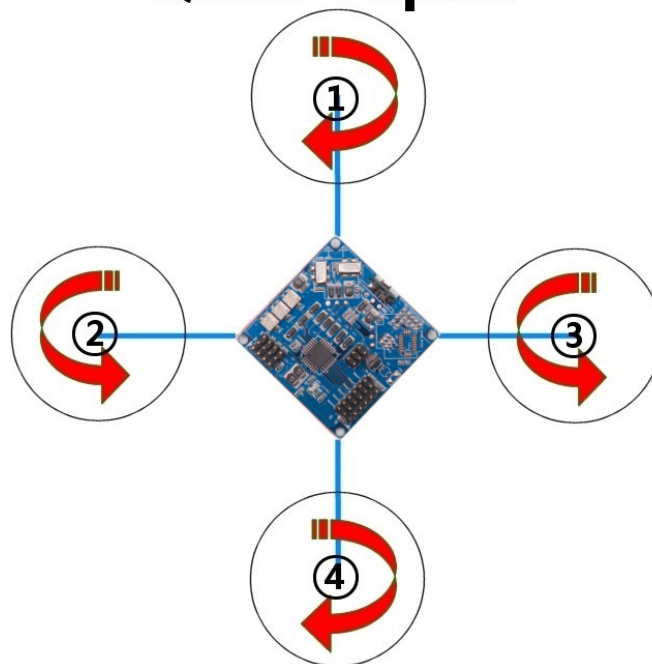
You will find such propellers at:

<http://www.fpv4ever.com/helices/197-1045-cw-propeller.html>

<http://www.fpv4ever.com/helices/198-1045-ccw-propeller.html>

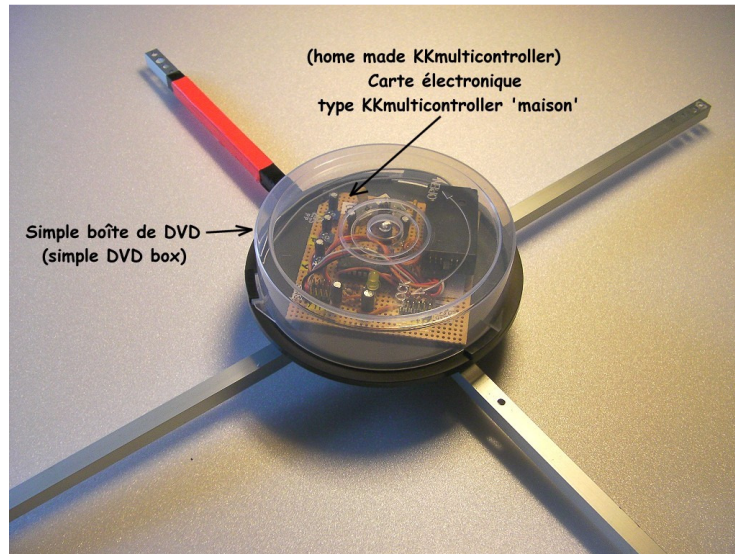
Here the diagram of the motions of the propellers:

QuadCopter



If the rotation of a motor isn't in the right way, you must cross 2 of the 3 wires output from the ESC.

Here is a possible setup of the cover of the frame (a simple DVD box):



Or another possible setup which is my preferred:



Above, a photo of my home made KK board fixed on the quadcopter frame.

Concerning the electronic of the flight controller, I have chosen without hesitation the diagram of the KKmulticontroller from 'Kaptain Kuk'. Until this day, with the Mike Barton firmware, this the best one on internet. The hardware/firmware setup is reliable and the stability of the quadcopter is very efficient in any weather condition, simple and cheap...

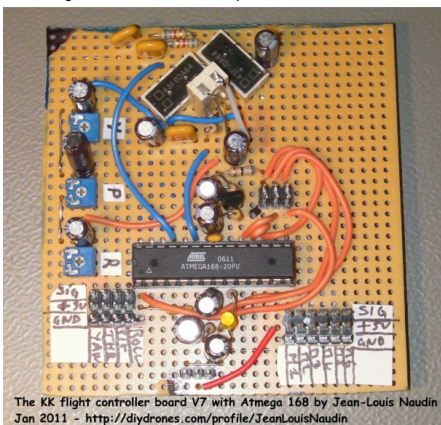
There are a lot of variants of the diagram, all the setup use an Atmel ATMEGA 168 microcontroller at 8MHz (internal clock) and very often they use 3 piezo gyroscopes taken from helicopter gyroscopes such as [HK401B \(Hobby King\)](#) at 11.99 \$ the unit or common GWS PG-03...

Link: http://www.hobbyking.com/hobbyking/store/uh_viewitem.asp?idproduct=10113

For those who do not want to build a KKmulticontroller board, there is the excellent board from Minsoo Kim, the [KKmulticopter « Blue board »](#) available ready to use for 100\$ at:

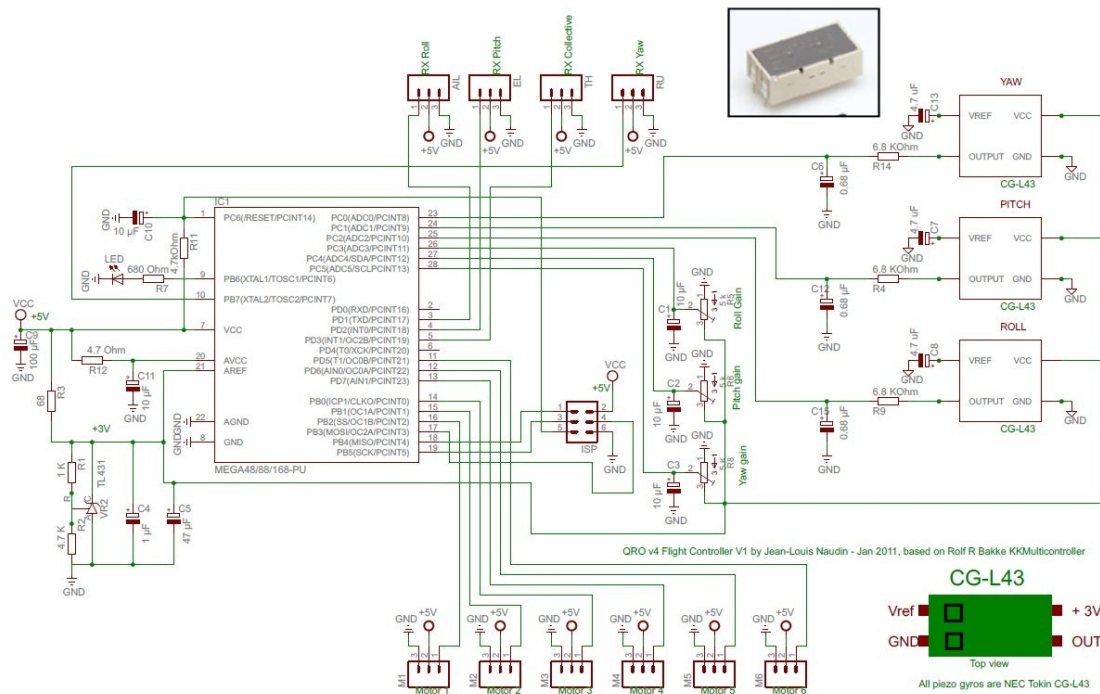
http://www.kkmulticopter.kr/index.html?modea=vieweng&mc_selected=MultiCopter&sc_selected=KKMulticopter&sn=multicopter_v02_q&id_no=15

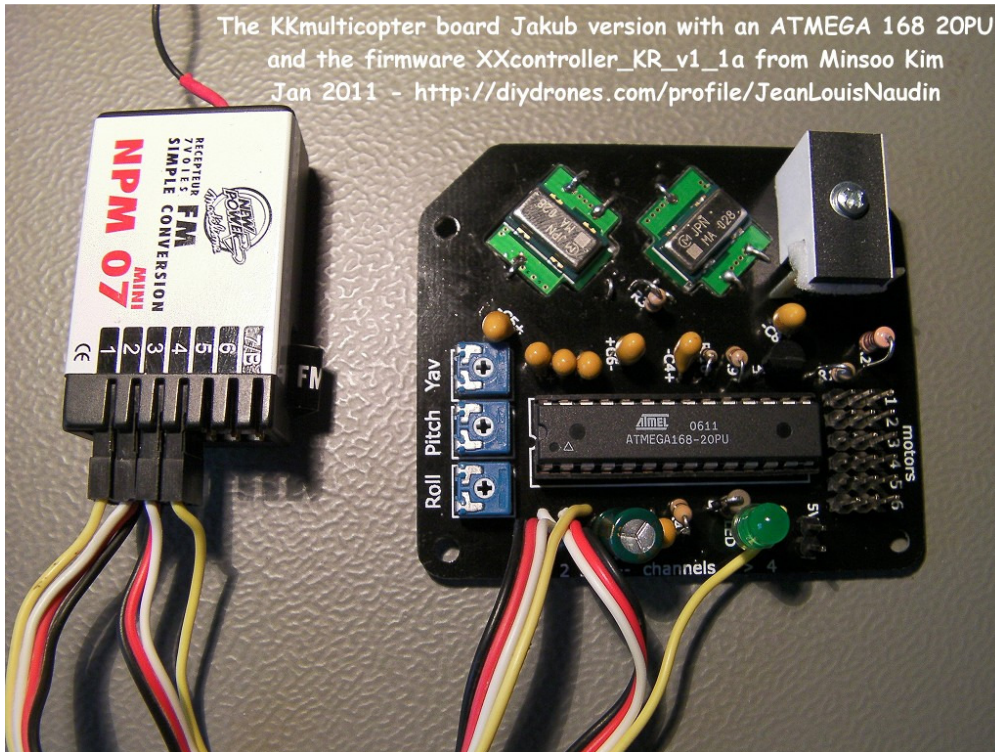
In this case, you need only to connect the four ESC, the receiver and to check the good direction of the commands... Below some various KKboard setup that I have successfully tested with similar results (just below, my home made KKmulticontroller board):



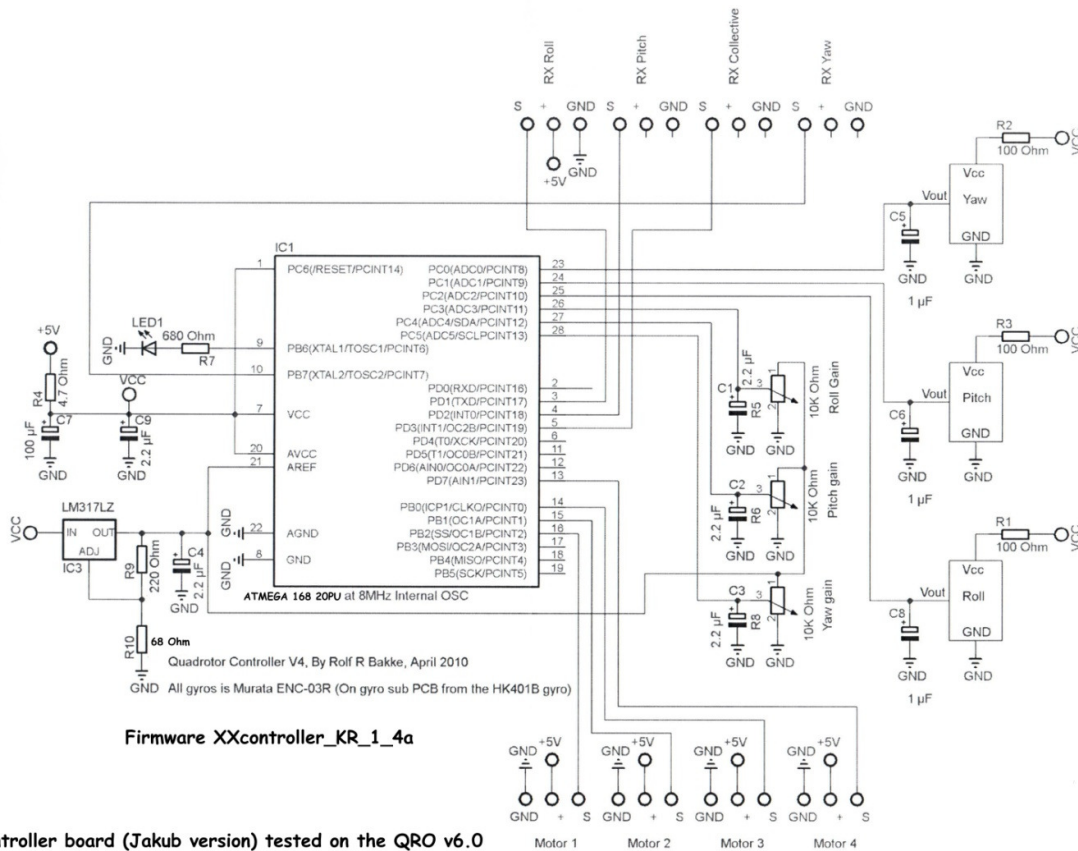
The KK flight controller board V7 with Atmega 168 by Jean-Louis Naudin Jan 2011 - <http://diydrones.com/profile/JeanLouisNaudin>

Parts list for the Flight Controller v7		
Part	Value	Device
C1	10 µF	Electrolytic cap 16V
C2	10 µF	Electrolytic cap 16V
C3	10 µF	Electrolytic cap 16V
C4	1 µF	Electrolytic cap 16V
C5	47 µF	Electrolytic cap 16V
C6	0.68 µF	Capacitor
C7	4.7 µF	Electrolytic cap 16V
C8	4.7 µF	Electrolytic cap 16V
C9	100 µF	Electrolytic cap 16V
C10	10 µF	Electrolytic cap 16V
C11	10 µF	Electrolytic cap 16V
C12	0.68 µF	Capacitor
C13	4.7 µF	Electrolytic cap 16V
C15	0.68 µF	Capacitor
IC1	ATMEGA 168-PU	Atmel microcontroller
LED1	LED 3MM	LED
Part	Value	Device
Roll gyro	CG-LR43	NEC Piezo gyro
Pitch gyro	CG-LR43	NEC Piezo gyro
Yaw gyro	CG-LR43	NEC Piezo gyro
R1	1 Kohm	1/2 watt resistor
R2	4.7 Kohm	1/2 watt resistor
R3	68 Ohm	1/2 watt resistor
R4	6.8 Kohm	1/2 watt resistor
R5	5 Kohm	adjustable potentiometer
R6	5 Kohm	adjustable potentiometer
R7	680 Ohm	1/2 watt resistor
R8	5 Kohm	adjustable potentiometer
R9	6.8 Kohm	1/2 watt resistor
R11	4.7 Kohm	1/2 watt resistor
R12	4.7 Ohm	1/2 watt resistor
R14	6.8 Kohm	1/2 watt resistor
VR2	TL431CLP	Programmable Shunt Regulator

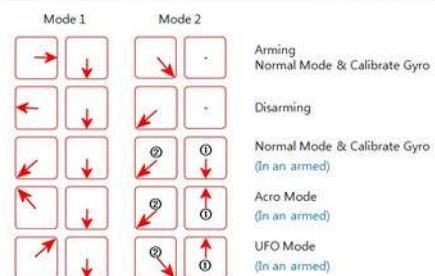
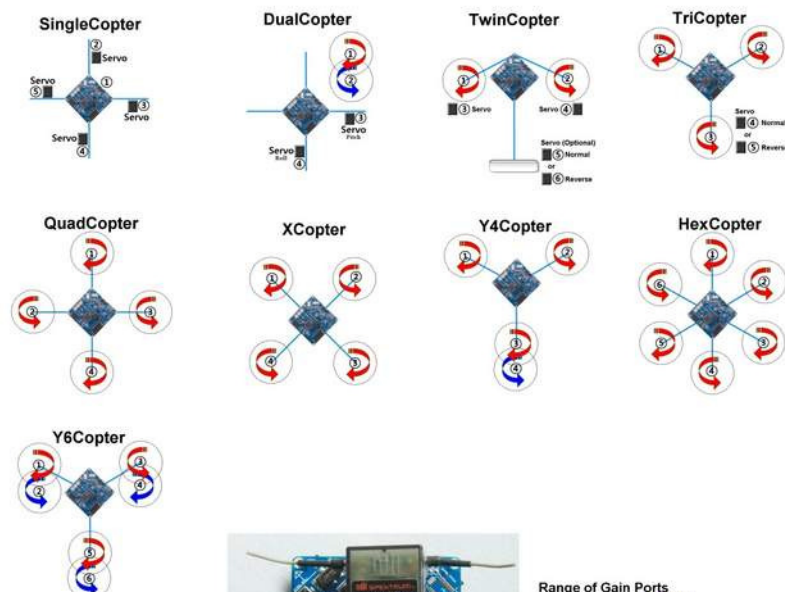
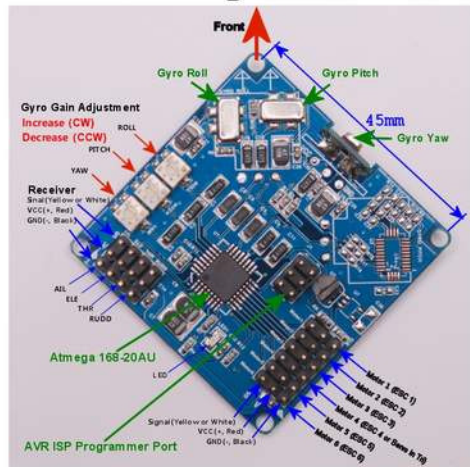




On the Jakub's board, the original Atmega 48 has been replaced by an Atmega 168-20PU
 There is a good tuto to build the Jakub's board at: <http://www.youtube.com/watch?v=5tS-MdL4rwI>



kkMultiCopter Controller



Please refer to setting manual
<http://www.kkmulticopter.kr/index.html?modea=manual>



<http://www.kkmulticopter.kr>

The firmware that I have successfully tested on all my QRO quadcopter models can be downloaded at : http://ardupilotdev.googlecode.com/files/XXcontroller_KR_v1_5b.zip

Here are some interesting links with the latest updates and lot of hints :

- <http://www.kkmulticopter.com/>
- <http://www.kkmulticopter.kr/index.html?modea=kk&modeb=KKMulticopter>

Here, a list of some specialized electronics shops:

- <http://fpv4ever.com/>
- <http://www.hobbyking.com>
- <http://www.rctimer.com/>

Some videos which show my QRO quadcopter in action :

<http://vimeo.com/18418632> <http://vimeo.com/18623259> <http://vimeo.com/18867459>

You will find additional infos in my blog at: <http://diydrones.com/profile/JeanLouisNaudin>

Good construction and enjoy your flights with the QRO...
 Jean-Louis Naudin