

# XXcontroller V1.6

## Essentials

Available configurations: TRI/QUAD+/QUAD-X/V-TAIL/HEX6/Y6/H6  
Specifically written for KK+ board with Mems Board V1.1 (has gyros + accelerometer)  
You will need for configuration a Serial LCD display - this must be Sparkfun compatible  
eg: [www.multircshop.com/site/index.php?route=product/product&path=35&product\\_id=593](http://www.multircshop.com/site/index.php?route=product/product&path=35&product_id=593)  
or [www.sparkfun.com/products/9393](http://www.sparkfun.com/products/9393)  
You will need to modify the KK+ board (see separate document on how to do this)  
You will need a Receiver (5+ channels) with either PPM out or a separate PPM encoder.

## Software Features

PID control loop  
Stable-mode switch-able in-flight  
2 camera servos available configurable for Roll/Pitch axis  
Hierarchical (structured) menu

- Configuration changes made using Tx & LCD Display (no PC needed)
- Diagnostic Menu info to help identify problems

Low Voltage Alarm  
Start-up check on gyros will dis-able copter if a problem found

*note: PPM sequence needs to be: Roll, Pitch, Coll, Yaw, Aux (Ch5)  
if it is not, then you need to flash a different eeProm hex file to correct this.*

## Installation

Flash the relevant hex file. Hex file names are in the form:

XX16x\_XXXX\_M999\_EN.hex

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|     |     |     |

|     |     |     + Language (if present): EN=English

|     |     + Chip type M168 or M328

|     + Type: QUAD+, QUADX or TRI etc

+ Version: V1.6j

Motor Configurations						
	M1	M2	M3	M4	M5	M6
TRI	Front-Left (CW)	Front-Right (CCW)	Tail (CW/CCW)	Tail-Servo (Normal)	Tail-Servo (Reversed)	
QUAD+	Front (CW)	Left (CCW)	Right (CCW)	Back (CW)		
QUAD-X	Front-Left (CW)	Front-Right (CCW)	Back-Right (CW)	Back-Left (CCW)		
V-TAIL	Front-Left (CW/CCW)	Front-Right (CCW/CW)	Back-Right (CW/CCW)	Back-Left (CCW/CW)		
HEXA6	Front (CW)	Front right (CCW)	Back right (CW)	Back (CCW)	Back left (CW)	Front Left (CCW)
Y6	Top-Left (CW)	Top-Right (CW)	Top-Back right (CW)	Bottom-Left (CCW)	Bottom-Right (CCW)	Bottom-Back right (CCW)
H6	Front-Left (CW)	Front-Right (CCW)	Centre-Right (CW)	Back-Right (CCW)	Back-Left (CW)	Centre-Left (CCW)

*nb: Prop rotation directions are as viewed looking down (rather than from behind).*  
The Serial LCD Display connection on the board is as follows:  
On KK+ 5.5d, this is the 10pin connector:  
LCD RX = Pin 9 LCD 5V = Pin 2 LCD Ground = Pin 10  
For KK5.5e, there is a dedicated LCD 3-pin connector  
Other KK boards, the LCD RX pin is ICSP pin 1 (PB4)

## **First-time Setup**

Plug the Rx PPM wire connection into the ELE (RxPitch) pin header on the board

If using Camera Servos, plug them into AIL (RxRoll) and RUDD (RxYaw) connectors for Servo1 & 2 respectively.

Plug in LCD, power on TX and connect battery.

wait for LCD to show main menu (eg: Copter QUAD+)

If the menu is constantly scrolling, make sure that your Rx connected light is on, if it is, then adjust the Tx Pitch Trim until it stops scrolling.

If your display is garbled then you will need to perform the 'Adjust the LCD Timing' procedure.

*note: the 'Adjust the LCD Timing' is not in all versions, so you may need to use a version which has this feature.*

### *Navigating through the menus*

See XX16\_Menu pdf for menu structure.

use the TxPitch to cycle through the current menu level (also allows changing of actual values)

use TxRoll → to enter a sub-level menu and TxRoll ← to return back

There are 3 important procedures you must perform before flying:

1. Tx Stick Calibration (aka 'Stick Centering')
2. Calibrating the ESC throttle range
3. Sensor Calibration

### **Tx Stick Calibration**

In the menu, go Setup/TxStick/Calibrate and perform this function.

Put Throttle stick to minimum and select the menu option.

The LED will flash for a second or two and the LCD will display message 'Done!'

*note: you can re-do this function at any time.*

### **Calibrating the ESC throttle range**

Please read the 'manual' that comes with your ESC for the correct sequence.

Generally, the procedure will be as follows:

Everything powered off

If you are new/unsure about this procedure, please Remove Propellers

Turn on Tx, and put Collective to Max

Connect battery and wait for ESC bleep sequence\* (\*see below for HobbyWing/Turnigy sequence).

Put throttle to minimum.

Disconnect battery.

Now re-connect battery and check that ESC's will arm and that they all start at the same time.

With the exception of TRIcopters, if you have setup your copter in the manner stated above, then you are ready to fly!

The default Stick-Arm side is Yaw-Right, but you can change this to your own preference.

### **TRIcopters**

For TRIcopters, because the mechanical setup can vary, the Tail Servo signal is output on both M4 (normal direction) and M5 (reversed direction).

If you have to reverse the Txyaw direction, the Stick-Arming side will also be reversed.

It is recommended that you set the Txyaw Trim to zero (centred) before running the Setup/TxCalibration option.

To set the servo arm position, you will need to arm the copter and then adjust the servo angle to be slightly against the propeller rotation direction.

### **Low Voltage Alarm (LVA)**

If your KK board has LVA built in, then you can enable this option in the menu (default is disabled).

First, you need to check calibration of the unit.

Apply a known voltage to the LVA battery input, and in the Other/LVA/Calibrate menu-option, adjust the voltage until it shows your known voltage.

Now go into the Setup/LVA/LowBatt option, and set the voltage you want the alarm to sound at.

Now enable the LVA in the Other/LVA/Setup option:

Off : disabled  
Buzzer : sound (bleep) buzzer if Low Battery  
LED lights : flash lights if Low battery

The LVA now looks for several consecutive low battery voltage readings before triggering the Low-Voltage alarm.

*note: after setting to LED lights, you must re-connect the power to the board.*

*note: If you change the Vref (also known as Aref) voltage, you will need to re-calibrate.*

### **Auto-Disarm**

The Auto-Disarm function works in conjunction with the on-board buzzer used for LVA

When enabled, the copter will dis-arm after approx 2 minutes if Collective is zero.

If a buzzer is wired up, it will also sound (bleeps).

## **General Flying**

Sensor Calibration for Gyros is the same as other KK/XX firmwares in that it takes place during arming. Calibration for Accelerometers is slightly different since the take-off point may not be perfectly level and this would affect the stick-free attitude.

Accelerometer calibration will occur either at the 1st arming or the last 'Forced' Sensor re-calibration and will be 'locked-in' until the power is removed.

So what you can do is, after power-on, place the copter level and do a 'Forced' Sensor re-calibration, and this will then be 'locked-in'

The amount of assistance given by the Accelerometers in stable-mode is determined by the Setup/Sensors/Accel-Gain value. There is a wide range available.

Note that if you could set a 0% assistance, it would be no different to running in Acro-mode.

As a general guide to setting Gyro GainP, increase the gain until the copter starts to oscillate, and then reduce the gain by a small amount.

If you notice that your copter starts to drift from being level, this may be due to gyro drift/acclimatisation.

Just land, dis-arm and re-arm (re-calibrates gyros) and see if the hover is now stable.

The mems gyros are a lot more stable than the piezo types, but do still drift by a small amount.

## Other Points

The Configuration Menu is active whenever the copter is dis-armed.

The software doesn't know if the LCD is plugged in or not, so, whenever the copter is dis-armed, don't play around too much with the TxRoll/Pitch sticks as you could accidentally change some settings !

If you un-plug the LCD display, and then subsequently plug it back in, the display will be blank.

Just move the Roll/Pitch sticks to get it to display something.

If when you power up the display says: 'controller error: gyro', then this is the start-up function checking that the gyro output is not too high.

The maximum allowed gyro /accelerometer output is 800 (see Diagnostics/Gyro/Roll etc menu options)

Occasionally, this is a false alarm and re-powering the board will clear the error.

If in the gyro menu option it says that the output(s) are 1023, then your board has a problem.

Please measure the Vref voltage, and the individual gyro output voltages.

If you have not used firmwares which feature PID control before, it is worth noting that they appear to work slightly differently.

The GainP is equivalent to the normal Gyro gain.

When in operation, the flight controller will attempt to adjust for any errors (← differences between what the pilot wants and the sensors report).

When a difference is found, an initial correction will be made (the amount is set by GainP) to the error, but, if the error remains, the sum of the errors will mount up and the controller will increase its attempts to correct the error (this is set by GainI).

Put in layman's terms, if the controller cannot correct the initial error (GainP), it will try harder over time (GainI).

If the copter is constrained in any way (ie on the ground), errors can build up which can cause motors to speed up or servos on TRICOPTER to not return back.

Motor Outputs: when looking at the Motor outputs in the Diagnostic menu, you will see that the numbers do not stay constant despite the copter being stationary. This is because the PID loop is constantly correcting for errors which there will always be.

Gyro calibration takes place @ arming, but can also be done when dis-armed by putting Collective to maximum.

Accelerometer calibration occurs at the 1<sup>st</sup> arming or the last 'Forced' Sensor re-calibration.

LED status:

when dis-armed, led should flash every 4/5 seconds, if not, the Controller has either got stuck in an endless loop, or, it detected an error (gyro problem) during start-up.

LED will be permanently on when armed.

Will flash rapidly when performing sensor calibration or stick-centering procedure.

Roll Stick not working or 'cannot select Menu option' (but Pitch works fine): try switching the BootLoader switch.

Diagnostics for Rx

1.54mS [ +3]

1.54ms is the incoming Signal length

+3 is the normalised level (+4) after hysteresis has been applied

HobbyWing/Turnigy Plush ESC Throttle calibration:

The sequence of beeps for these ESC's on 3S LiPo is as follows:

after power on:

3 bleep song: 'doh' 'ray' 'me' (rising tone)

pause

double bleep (← this is the key sound you need to listen for!)

at this point, put your TxCollective stick to minimum

there will be a single longer confirmation bleep, and thats it!