

User manual for SKYLINE32 flight controller

Key Features:

1. Dimensions: 35mmx35mm x 5mm (L xW xH)
2. Weight: 4.5g (W/O wires)
3. 32-bit ARM micro processor running at 3.3V/72MHz.
4. With gyro, Magnetometer, and space reserved for Barometer and Accelerometer.
5. Manual mode, Angle mode, Horizon mode, heading hold mode, head-free mode, altitude hold flight mode.
6. Support Quad-, Tri-, Hex-, Octo-, various multirotors
7. Support RC input - Standard, CPPM (PPM Sum)
8. Battery voltage monitoring and low voltage alarm.
9. Onboard Micro-USB for setup and configuration.
10. Baseflight configuration GUI.
11. GPS position hold / return to home

Note: SKYLINE32 hardware is compatible with NAZE32 firmware, including baseflight, cleanflight. Below are the links to the source codes:

<https://github.com/multiwii/baseflight>

<https://github.com/cleanflight/cleanflight>

SKYLINE32 is loaded with baseflight and Baseflight-Configurator . This manual is a baseflight Setup Tuning Guide for SKYLINE32.

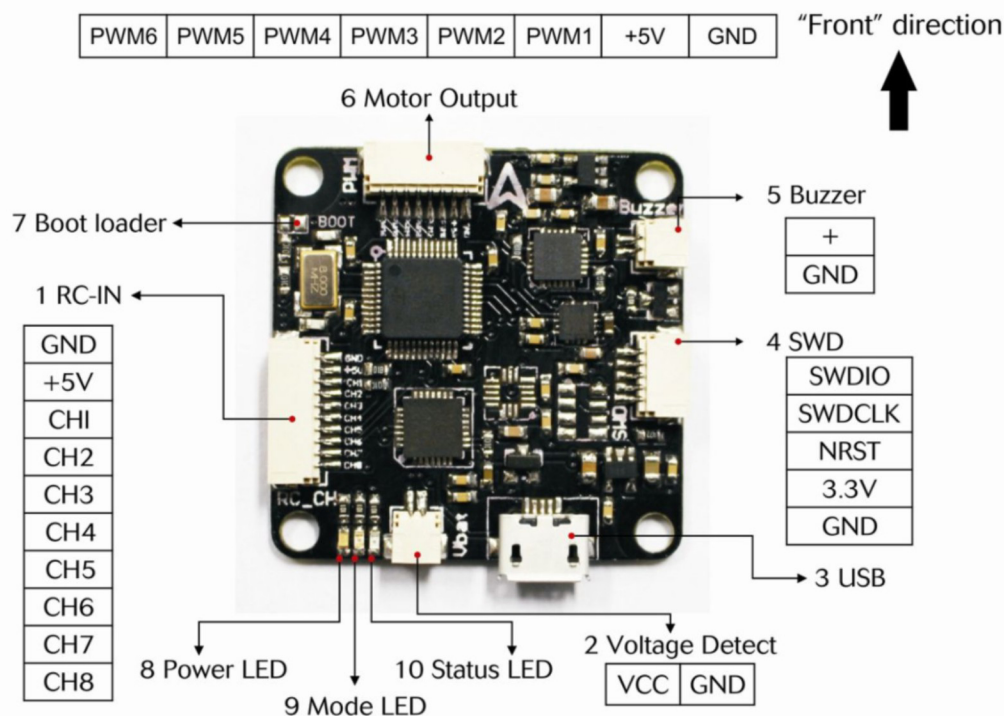
If you are using cleanflight firmware, please go to the below link to download and install cleanflight Configurator:

https://chrome.google.com/webstore/search/cleanflight?utm_source=chrome-ntp-icon

Note: with firmware and configuration based on "MultiWii" software, the processor used is not Atmel AVR, and can not be compiled via Arduino or other AVR tools. Below is some information about STM32 development:

<http://code.google.com/p/afrodevices/wiki/STM32Development>

Hardware and Connection:



[1] RC Input / Servo Output (CPPM / PWM) / GPS connector

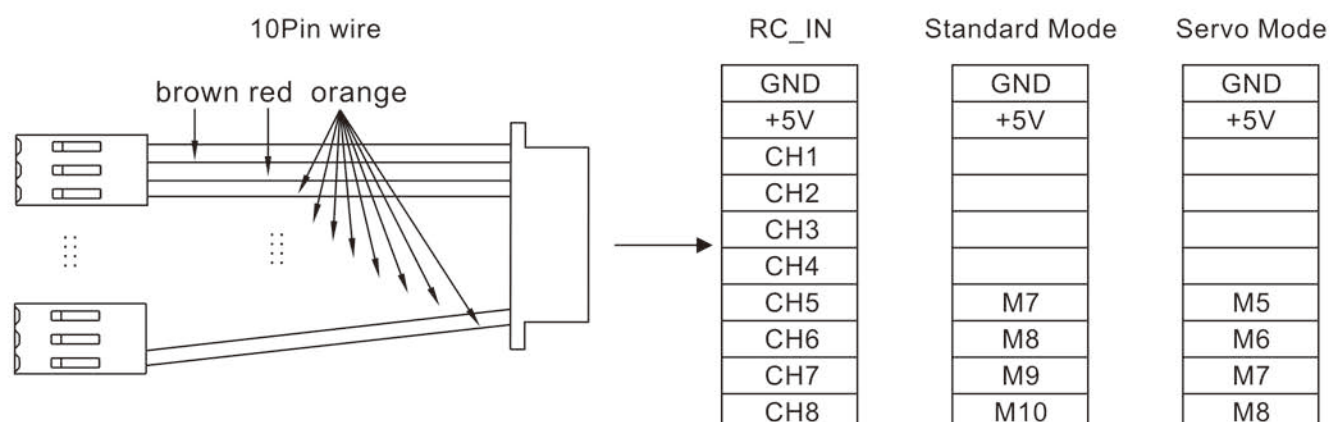
When using CPPM receiver, CH1 is for CPPM receiver signal pin

Default pin order is (from top to bottom): GND, +5V, CH1-CH8. CH1-CH8 for channels: AIL, ELE, THR, RUD, AUX1...AUX4

[1] RC Input / Servo Output (CPPM / PWM) / GPS connector

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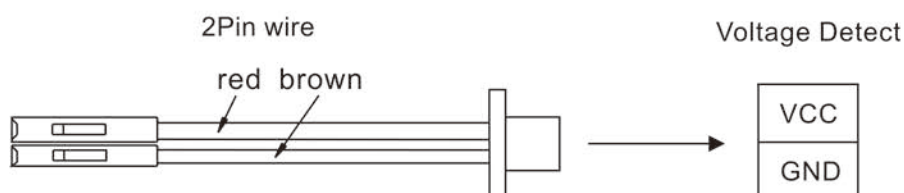


When GPS feature is enabled, CH3 and CH4 are used for GPS connection.(CH3:TX, CH4:RX). When using CPPM receiver, these are normally unused, with standard receiver, connect AIL to 1, ELE to CH2, THR to CH5, RUD to CH6, and AUX1/2 to CH7 and Ch8.

When using CPPM receiver, CH5 to CH8 can also be used as motor or servo outputs, depending on airframe type and configuration.

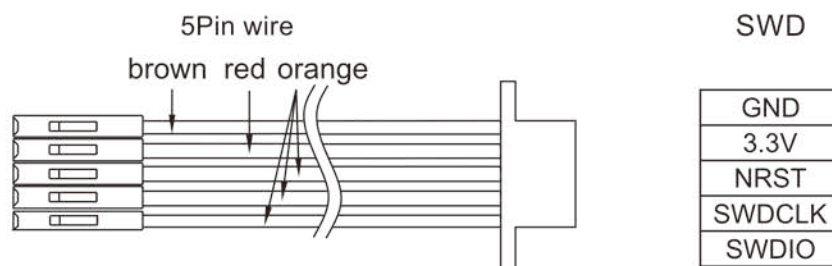
[2] Battery Voltage Monitor: connect this header to battery or power distribution board to enable battery voltage monitoring. Supports Up to 6S LiPo battery.

Warning: No reverse polarity protection - connecting battery in reverse will instantly destroy the hardware.

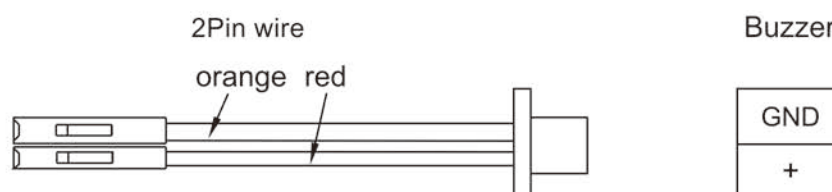


[3] Micro-USB port: For firmware upgrade and configuration.

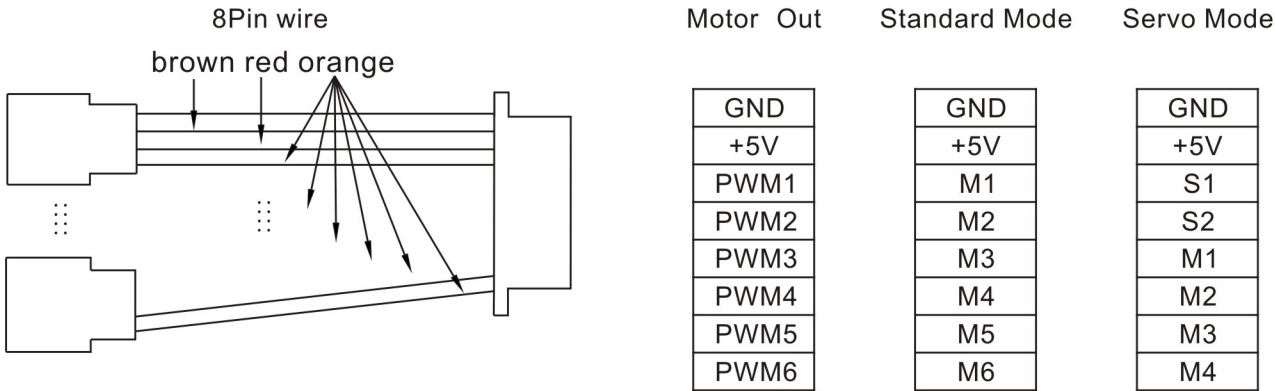
[4] SWD port: for software modification during software development period.



[5] Buzzer: connect a buzzer here while battery voltage monitor is enabled, buzzer used as a low voltage alarm.



[6] ESC / Servo Headers: From right to left: GND, +5V, PWM1- PWM6. Standard mode: PWM1-PWM6 for ESC input M1-M6; Servo mode: PWM1-PWM6 for servo input S1, S2 and ESC input M1-M4.



[7] Bootloader pads: for upgrading firmware. Use a paperclip or tweezers to short pads together and connect power to SKYLINE32, wait for 2 seconds, then remove the short. Firmware update tool can then be used to reload firmware.

[8] Power LED: LED on when the board is power on.

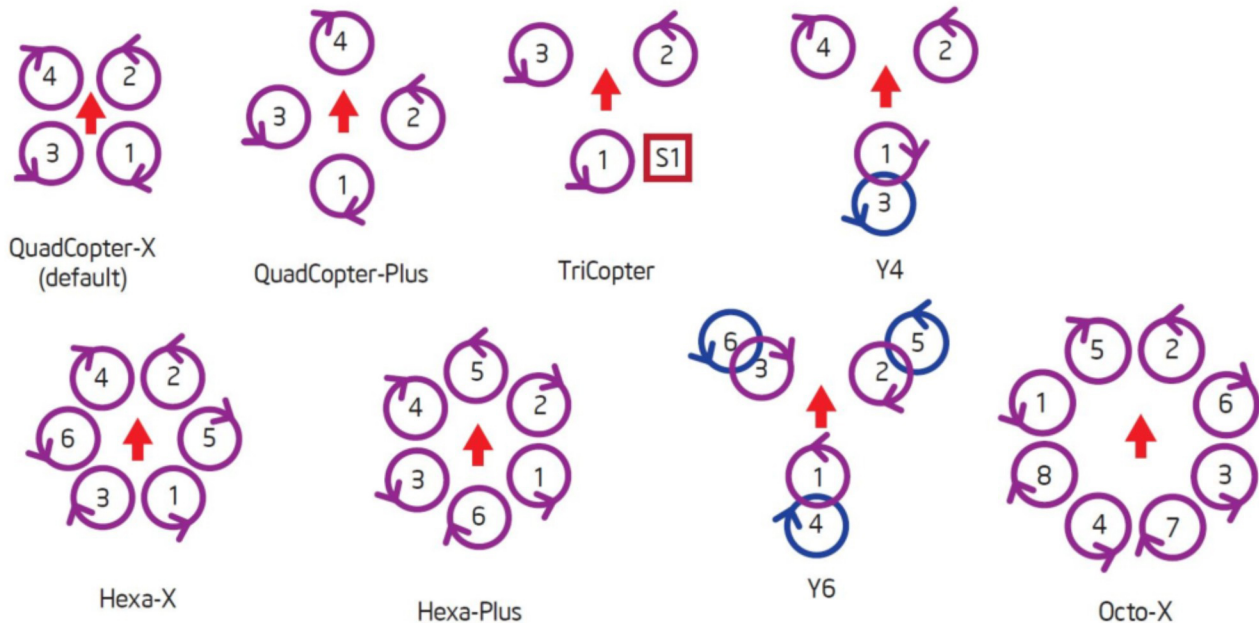
[9] Mode LED: The LED will be on for the corresponding mode chosen.

[10] Status LED

Warning: Please connect the polarity correctly, or else the flight controller board will be burned.

Connecting the motors:

Figures below show motor position and rotation:



In above figures, the front of red arrow points to the head of the multirotor; and the arrows in the small circles points to the direction of motor rotation; motor numbers are marked inside the circles; S1 stands for servo; purple motors are top, and blue is bottom.

Note: Configurations with more than 6 motors require CPPM receiver.

Program driver installation:

Please install the CP2102 program driver before any firmware upgrade and configuration. Below is the link for the program driver, please download and install, then you can proceed firmware upgrade and baseflight configuration:

<http://www.silabs.com/products/mcu/pages/usbtouartbridgevcpdrivers.aspx>

Firmware upgrade:

Hardware is loaded with the most current firmware at the time of assembly. It is recommended to upgrade to the latest stable or development firmware for new features.

[1] The below tools are required for firmware update:

(1) Flash Loader Demonstrator

<http://code.google.com/p/afrodevices/downloads/list>

(2) Hercules SETUP utility

http://www.hw-group.com/products/hercules/index_en.html

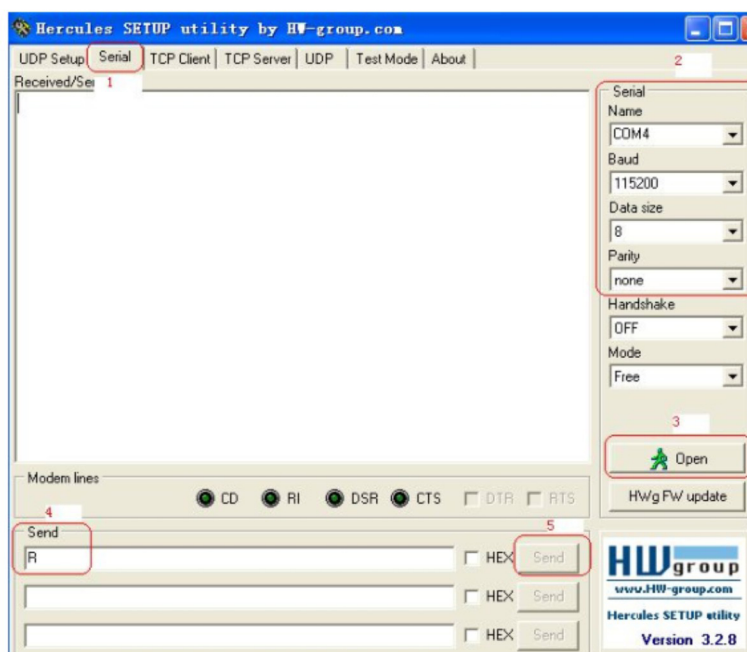
(3) Latest baseflight firmware

<https://github.com/multiwii/baseflight/tree/master/obj>

[2] Entering bootloader mode

Enter Bootloader mode before firmware upgrade. There are two ways of entering Bootloader mode:

Method 1:



1. Run Hercules SETUP and switch to “Serial” tab.

2. Choose COM port, baudrate of 115200, 8bit, no parity, please refer to above figure.

3. Click “Open”, the Received/Sent data window will show the Serial port COM4 opened, please refer to the figure:

Received/Sent data
Serial port COM4 opened

4. In any 3 of the Send boxes, type “R”.

5. Click “Send” on the right, all 3 LEDs will be ON, indicating the hardware is in bootloader mode. Exit Hercules SETUP.(The COM port will be occupied if Hercules SETUP is still running)

6. Proceed to Firmware Update step [3]

Method 2:

1. Temporarily short the bootloader pads (where is a marked “BOOT”) using tweezers or paper clips.

2. While bootloader pads are still shorted, apply power to the board via USB port. Only the POWER LED is ON at this point. Wait for 2 seconds, then unshorted the bootloader. If any of the status LEDs blinks, repeat from beginning.

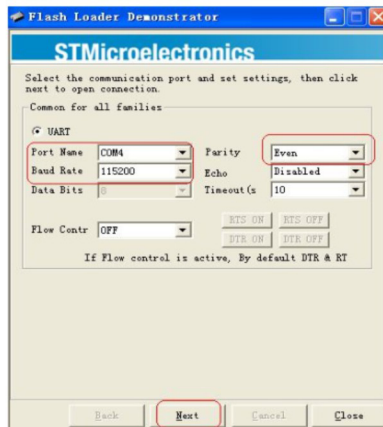
3. Proceed to 'Firmware Update' step [3]

[3] Firmware Update

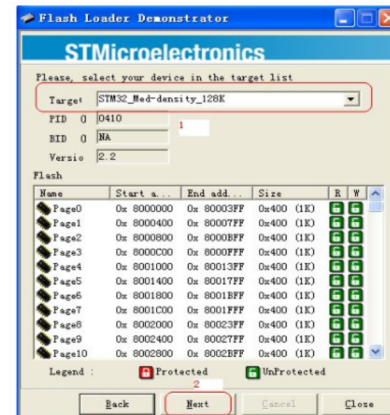
1. Using Flash Loader Demonstrator to flash the firmware.

2. Run Flash Loader Demonstrator

3. Choose COM port, baudrate of 115200, make sure parity is set to EVEN as shown in the following figure, then click “Next”



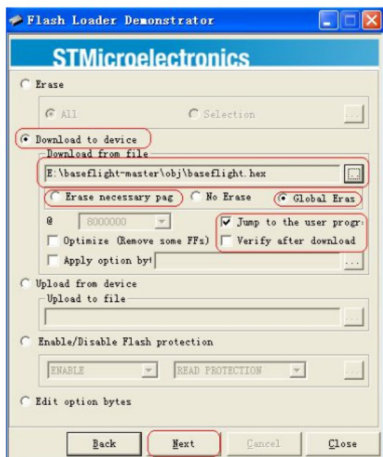
4. Choose device size as 128K, then click “Next”



5. On the last page of Flash Loader as shown in the figure choose:

- (1) Download to device.
- (2) Browse to the location of .hex file to update.
- (3) Choose “Erase necessary pages” or “Global Erase”
- (4) Check “Jump to user program” checkbox.
- (5) Click “Next” to download the update.

After successful update, the Status LED will flash in the usual pattern.



Configuration:

Baseflight-Configurator setup and use:

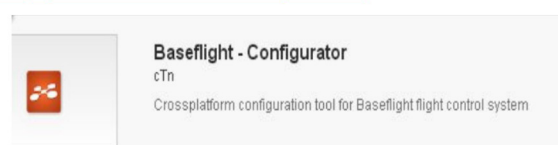
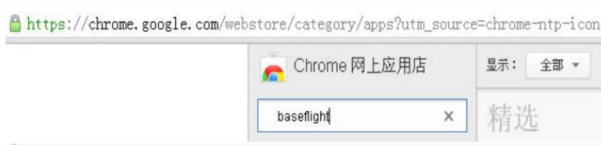
Please follow the steps below:

1. Connect the motor and ESC
2. Connect ESC to SKYLINE32
3. Connect the receiver to SKYLINE32
4. Connect to Lipo battery. Note: Please remove the propellers before power on.

After the multirotor frame and flight controller are installed, some configuration is needed for the SKYLINE32. Below is the instruction for Baseflight-Configurator setup and use:

1. Go to Chrome Web Store, search baseflight and add to APP.

https://chrome.google.com/webstore/category/apps?utm_source=chrome-ntp-icon



2. Run the Baseflight-Configurator, connect the SKYLINE32 to the PC (via Micro-USB port) , see below figure:

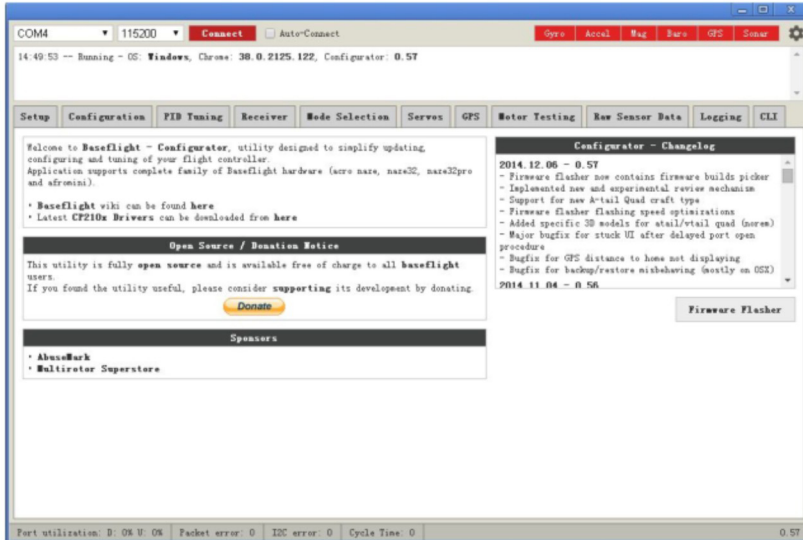


Fig. 1

3. Select COM, and set baudrate, then click “connect”



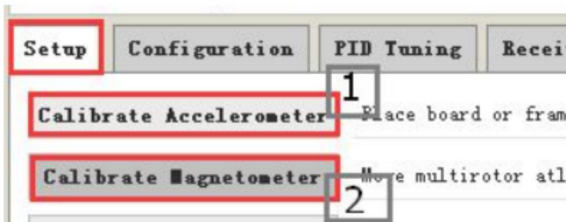
After the SKYLINE32 and Baseflight-Configurator is connected, in the upper right corner of Fig. 1, sensor connection status will be shown. From left to right: Gyro, Accelerometer, Magnetometer, Barometer, GPS, Sonar. As it is shown in below figure, green means sensors connected, and red means sensors which are not connected. Sensor connection depends on the hardware and firmware.



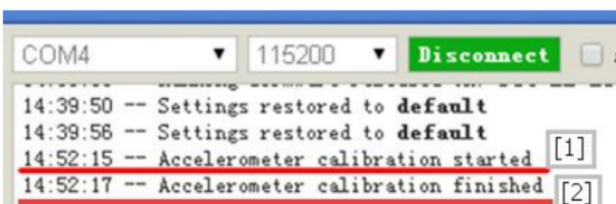
Now we will do some basic settings.

SKYLINE32 Basic settings:

First calibrate the Accelerometer and Magnetometer.

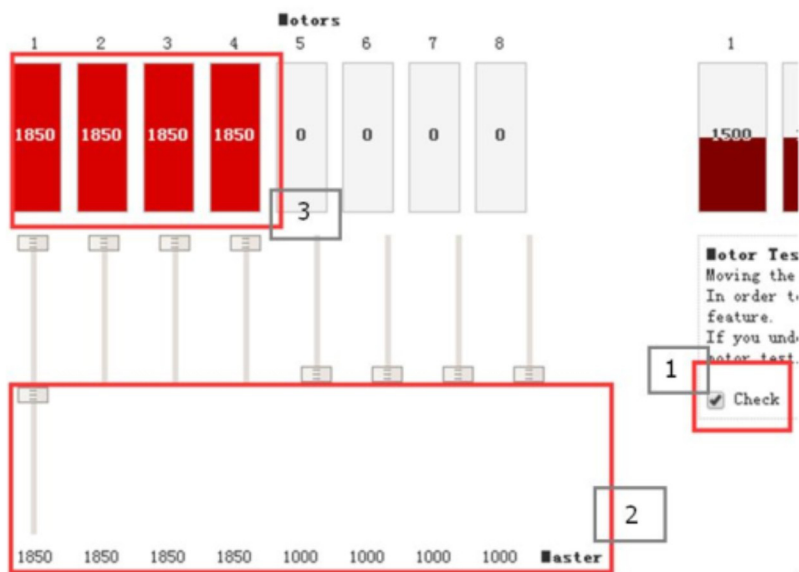


1. Calibrate Accelerometer: Place the multirotor in a horizontal position, click Calibrate Accelerometer tab, the Accelerometer will be calibrated automatically. And the result will be stored after the calibration is finished.



2. Calibrate Magnetometer: Click Calibrate Magnetometer to start calibration, pick up the multirotor and rotate 360 degree for more than 30 seconds (including ROLL, PITCH and YAW axis)Then, calibrate the ESC's: There are two methods of calibrating ESC's.

Method 1: Remove the propellers, Run Baseflight, connect SKYLINE32, then a Motor Testing GUI will appear:



1. Click "Check"
2. Slide the button Master to the top, then power up the ESC by plugging in the Lipo, slide to the bottom after the Full Throttle is confirmed. Wait till the OFF Throttle is confirmed (you will hear a musical tone from the motors), then the ESC's are calibrated.
3. Throttle value: If the Full Throttle, and OFF Throttle are not detected, they can be calibrated on the Configuration GUI.

Cut of the power after calibration is finished, disconnect USB cable.

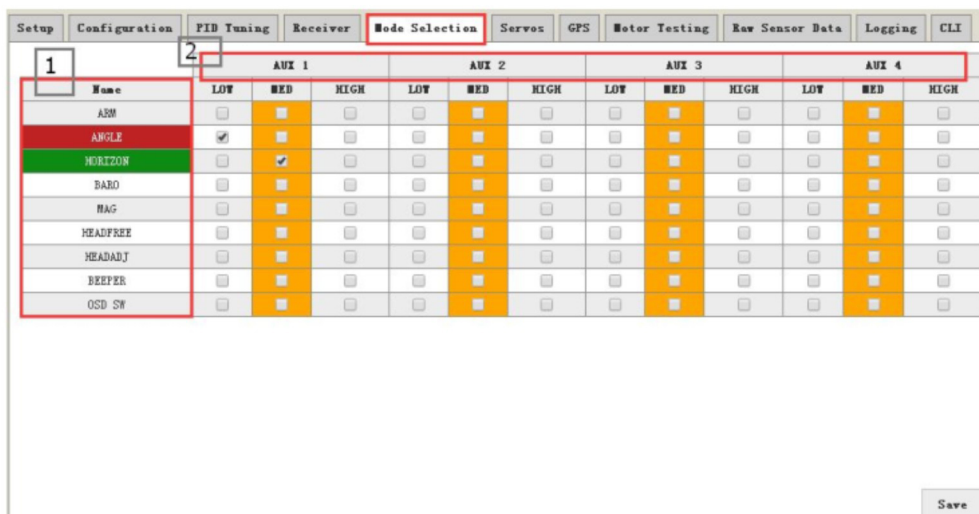
Method 2: Remove the propellers, Run Baseflight, connect SKYLINE32, then go to CLI GUI.

1. Enter CLI GUI and type the below command :

```
set mincommand = 1900 [Enter]
```

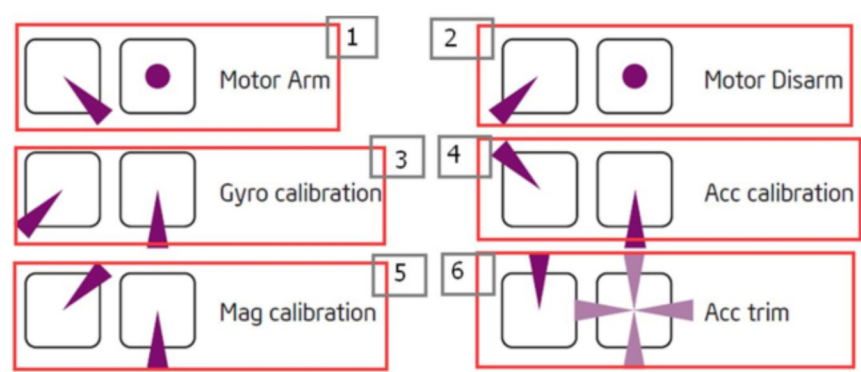
 Save [Enter]
2. Disconnect the motor and the USB
3. Reconnect the USB and enter CLI GUI
4. Type command `set mincommand = 1908` , **but DO NOT press Enter key**
5. Connect the battery, wait for the Full Throttle signal, calibration starts during this period of time, press Enter key after the Full Throttle is confirmed.
6. Before the ESC enters programming mode, type command `save` and press Enter key, or change to other settings (e. g. Logging) to save.
7. When you hear the ESC give a music tone to start, the ESC calibration is finished.
8. Cut of the power, and disconnect USB.

Select Mode:



1. Modes: Disarm mode, Angle mode, Horizon mode, heading hold mode, head-free mode, altitude hold flight mode. These modes appear depending on the hardware sensors which are connected. For example, if there is no Barometer module, Baro will be disabled.
2. Mode channels: Choose the channels for the corresponding modes. Click “Save” in the lower right corner. After the mode channels are saved, if the corresponding modes are enabled, the mode tabs will be green, if the modes are disabled, the tabs will be red. Some modes should be chosen together to take effect, for example, when altitude hold flight mode (BARO) is chosen, HORIZON mode should be chosen as well.

Below is a figure about control stick action:



1. Motor Arm
2. Motor Disarm
3. Gyro calibration
4. Accelerameter calibration
5. Magnetometer calibration
6. Acc trim

Baseflight settings and tunings: Settings



In Setup GUI, you can calibrate Accelerometer, Magnetometer, restore default settings, backup settings, and restore the backup.

- (1) Accelerometer calibration: Please refer to Accelerometer calibration in SKYLINE32 basic setting section
- (2) Magnetometer calibration: Please refer to Magnetometer calibration in SKYLINE32 basic setting section
- (3) Restore default settings
- (4) Backup settings
- (5) Restore the backup settings:

Configuration:

15:51:41 -- Unique device ID received - 0x668f50485726767172018
 15:51:41 -- Running firmware released on: Dec 6 2014

Setup **Configuration** PID Tuning Receiver Mode Selection Servos GPS Motor Testing Raw Sensor Data Logging CLI

Mixer (1)

4 2
3 1
Quad X

Throttle (2)

1150 Minimum Throttle
 1500 Middle Throttle [RC inputs center value]
 1850 Maximum Throttle
 1200 Failsafe Throttle
 1000 Minimum Command

Serial Receiver (3)

SPEKTRUM1024
 SPEKTRUM2048
 SBUS
 SUMD

Battery Voltage (4)

3.3 Minimum Cell Voltage
 4.3 Maximum Cell Voltage
 110 Voltage Scale

Board Alignment (5)

0 Roll Adjustment [deg]
 0 Pitch Adjustment [deg]
 0 Yaw Adjustment [deg]

Features (6)

☐ Enable PWM input (and disable PWM input)
☒ Enable Battery voltage monitoring
☐ Enable in-flight level calibration
☐ Enable Serial-based receiver (SPESAT, SBUS, SUMD)
☐ Don't spin the motors when armed
☐ Enable servo gimbal
☐ Enable 3rd serial port
☐ Enable LED ring support
☐ Enable GPS (PWM or 3rd serial port required)
☐ Enable failsafe settings on PWM/PWM signal loss
☐ Enable sonar
☐ Enable FrSky compatible telemetry output
☐ Enable battery current monitoring
☐ Enable VARIO
☐ Enable 3D mode (for use with reversible ESCs)

Accelerometer & Magnetometer (7)

0 Accelerometer Roll Trim
 0 Accelerometer Pitch Trim
 0 Magnetometer Declination [deg]

GPS (8)

NMEA Type
 115200 Baudrate
 Auto-detect Ground Assistance Type

Current Sensor (9)

400 Scale the output voltage to milliamps [1/10th mV/A]
 0 Offset in millivolt steps
☐ Enable support for legacy Multiwii MSP current output

Save

In Configuration GUI, you can do the following settings: Motor wire connection sequence, Throttle settings, Serial Receivers, Battery Voltages, Frame Board Alignment, Feature settings, Accelerometer & Magnetometer trim, GPS settings, Sanor (Current Sensor)

- (1) Motor wire connection sequence and direction of rotation. Includes settings for 20 types of aeroplane models.
 - (2) Throttle settings. Minimum throttle, middle throttle, Maximum throttle, failsafe throttle protection and minimum Command settings.
 - (3) Options of transmitter (Radio).
 - (4) Battery setting: Includes minimum voltage for battery cell, maximum voltage for battery cell and battery capacity.
 - (5) Flight controller aligning and change head direction without moving the position of the flight controller to correct the install deviation (Unit: Angle). Rolling direction, pitching direction and yaw direction can be adjusted.
 - (6) On the right there is features tab for flight controller feature options. Click “√” at corresponding option box to choose the feature. There is another way to choose flight controller features, on “CLI” GUI. Please refer to “CLI” GUI in basic setting section.
 - (7) On the right side Accelerometer & Magnetometer part, after calibration accelerometer and magnetometer in Setup part, you can adjust the accelerometer and magnetometer here again to achieve better performance.
 - (8) GPS part. Setting GPS while using it.
 - (9) Current Sensor part. Sonar sensor can be setting.
- Click “Save” after all the above configuration.

PID Tuning.

15:51:41 -- Running firmware released on: Dec 6 2014

Setup Configuration **PID Tuning** Receiver Mode Selection Servos GPS Motor Testing Raw Sensor Data Logging CLI

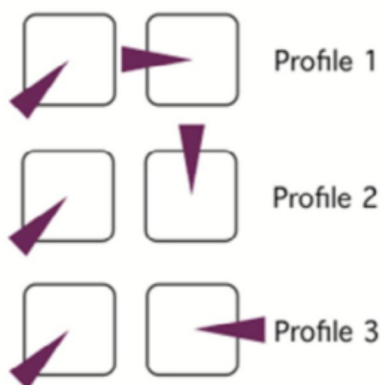
Name	Proportional	Integral	Derivative	ROLL & PITCH rate	YAW rate	TPA
ROLL	4.0	0.030	23	0.00	0.00	0.00
PITCH	4.0	0.030	23	(2)	(3)	(4)
YAW	8.5	0.045	0			
ALT	(1)	5.0	0.000			
VEL		12.0	0.045			
Pos		0.11	0.00			
PosK		2.0	0.08			
NavK		1.4	0.20			
LEVEL		9.0	0.010			
MAG		4.0				

Profile: 1

(5)

Refresh Save

- 1-PID
- (1) ROLL, PITCH, YAW axis rate settings.
 - (2) ROLL, PITCH axis sensitivity rate setting. The closer the setting is to 1.00, the faster the Rolling and Pitching can be.
 - (3) YAW axis sensitivity rate setting. The bigger the value is, the more sensitive the Yawing direction is.
 - (4) After PID is tuned, if there is any vibration during flight, adjust TPA to make linear of P value lower.
 - (5) Profile: 3 options. We suggest saving 3 PID setting profiles which makes it much easier to choose the suitable settings during flight. Below is a figure shown how to choose the profile by the control sticks.



lick " Save" after all the above settings.

Receiver

15:51:41 -- Unique device ID received: 00000000000000000000000000000000

15:51:41 -- Running firmware released on: Dec 6 2014

Setup Configuration PID Tuning **Receiver** Mode Selection Servos GPS Motor Testing Raw Sensor Data Logging CLI

Roll	1500	(1)	Throttle MID	0.50	Throttle EXP0	0.00
Pitch	1500	(2)	RC Rate	0.90	RC Expo	0.65
Yaw	1500	(3)	Channel Map	AETR1234	ESSI on AUX	(6)
Throttle	1500	(4)				
AUX 1	1500					
AUX 2	1500					
AUX 3	1500					
AUX 4	1500					

2200
2000
1800
1600
1400
1200
1000
800

9950 10000 10050 10100 10150 10200

Refresh Save

1-Receiver

- (1) Throttle MID value setting. For example, if you want your multicopter hovering at 50% throttle but you don't want control stick at the position of 50% throttle but prefer in the position of 30% throttle, you need to set this value to 0.8 or 0.9.
 - (2) Throttle Expo: Increase throttle Expo value. If you want throttle to follow your hand more sensitively you can increase this value to 0.35.
 - (3) RC rate: Increase RC rate will make multicopter get faster feedback. Set the value as 1.35 will be a good choice.
 - (4) RC expo is similar to radio expo. Set the value to 0.00. It is the same to set RC expo in baseflight or in radio.
 - (5) Channel MAP: TAER1234 for JR. Please choose the correct radio, so that the corresponding settings will be selected. Don't forget to save the settings.
 - (6) RSSI on AUX: AUX channel signal strength control. After AUX channel is selected, it will show the corresponding settings.
- Click "Save" after all the settings.

Mode Selection

Please refer to SKYLINE32 basic settings choose different modes.

Motor Testing



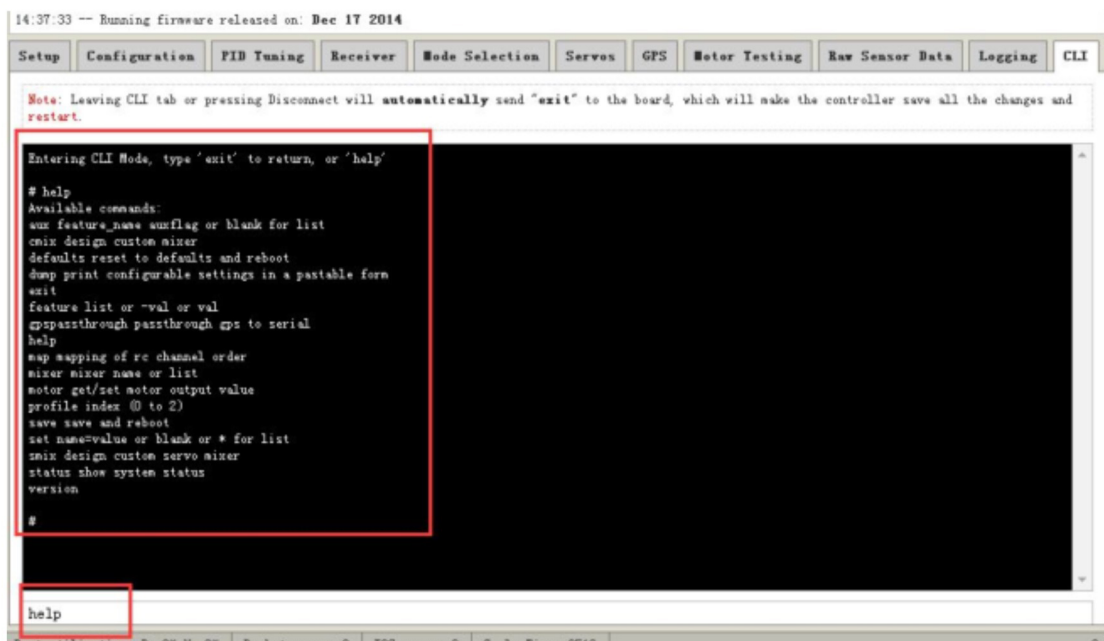
1-ESC testing

- (1) Separate ESC throttle control stick. Calibrate and test each ESC.
- (2) All ESC's calibration choice.
- (3) All ESC's throttle sliding block, to calibrate and test all ESC's.

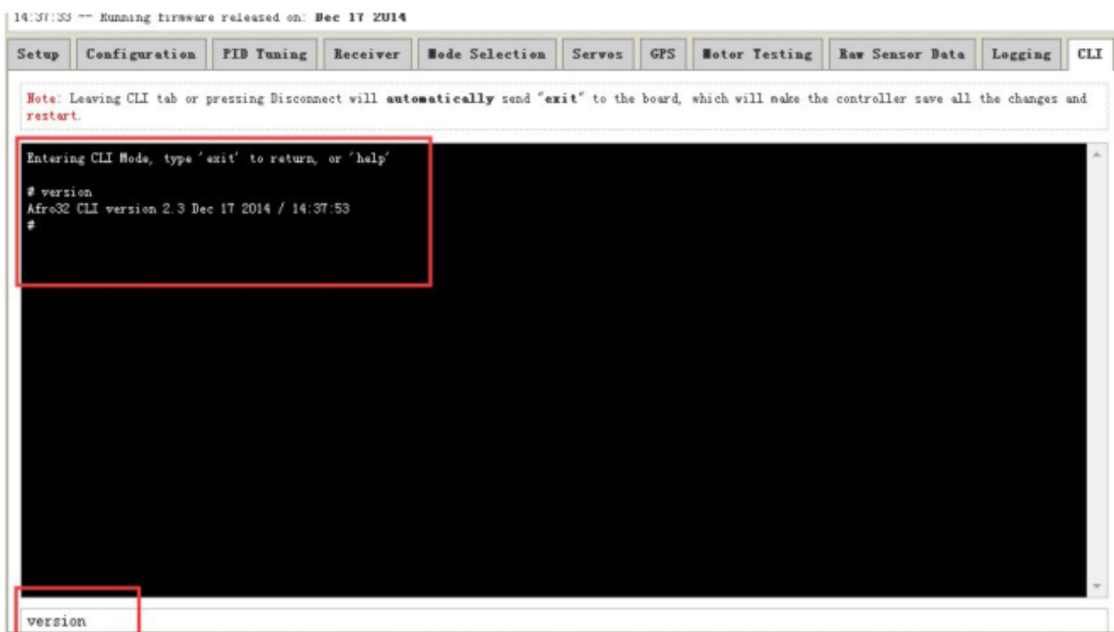
For ESC calibration, please refer to SKYLINE32 basic setting.

CLI

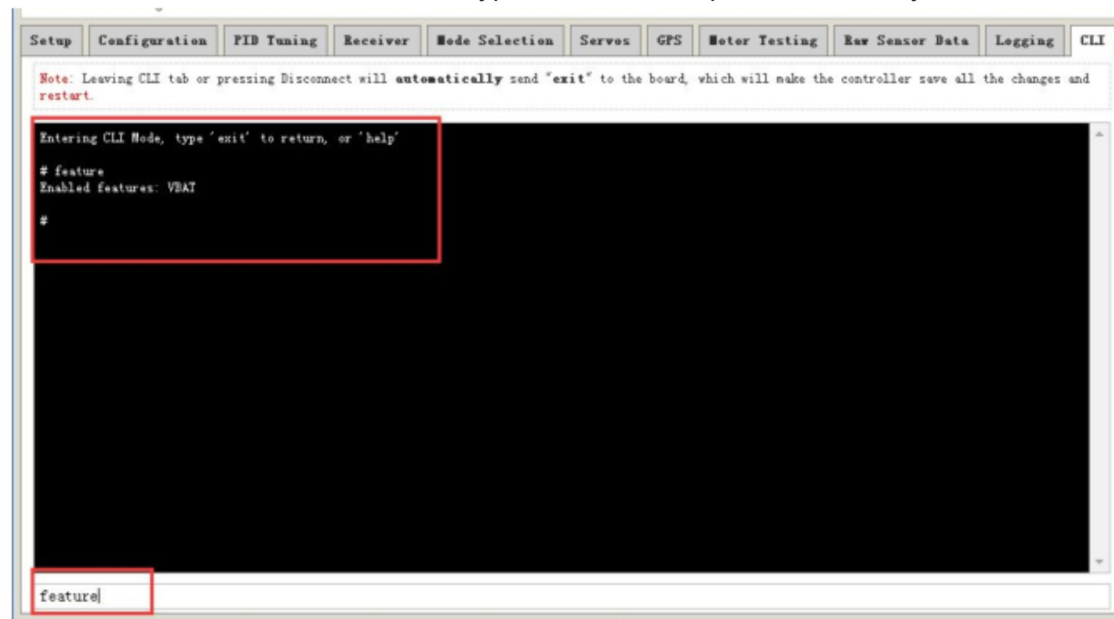
In CLI, you can check firmware version, functions enabled and disabled information. Type "help" and press "Enter" key to see some related command.



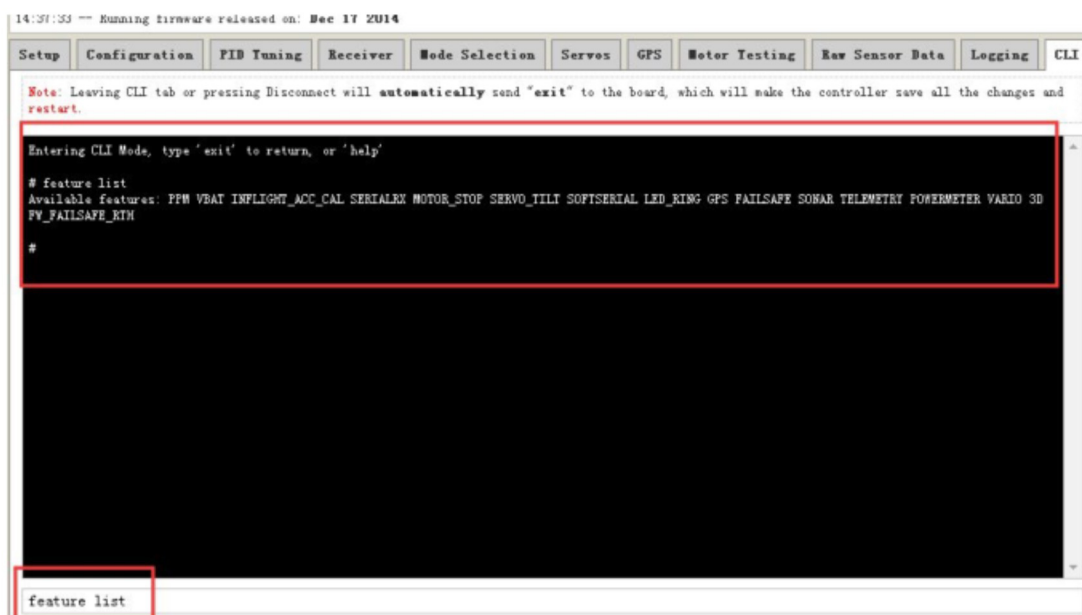
1. Check version---Type “version” and press “Enter”key



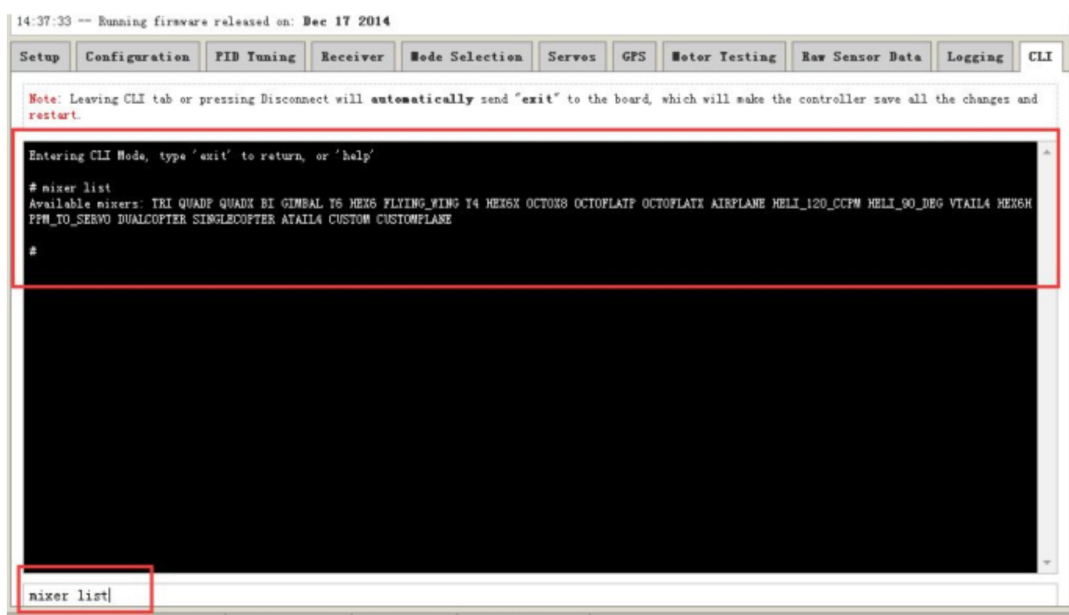
2. Check those enabled function--- Type “feature” and press “Enter”key



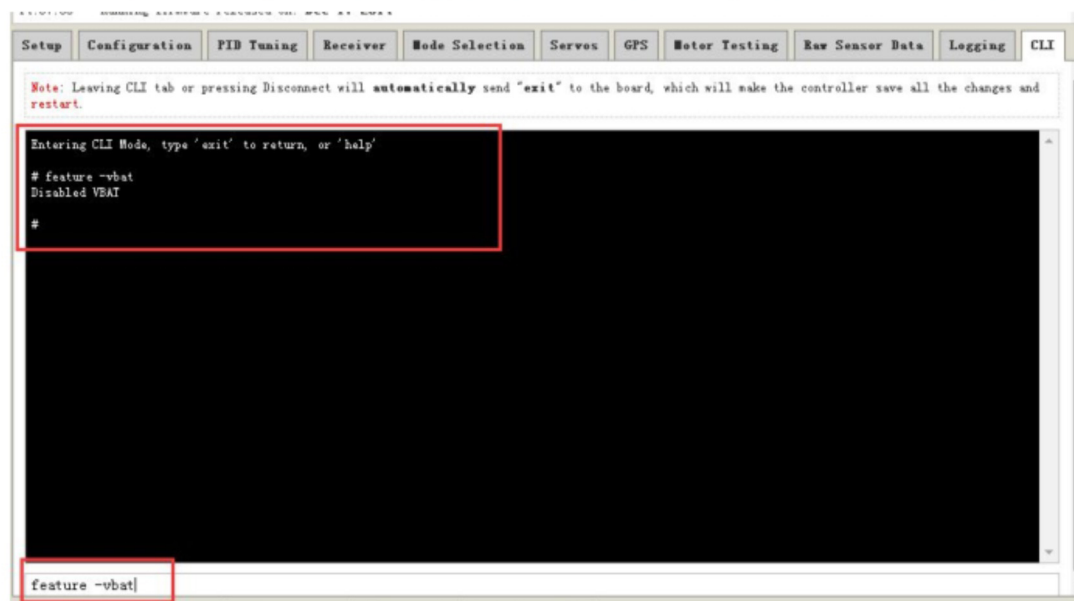
3. Check all enabled function---Type “feature list” and press “Enter”key



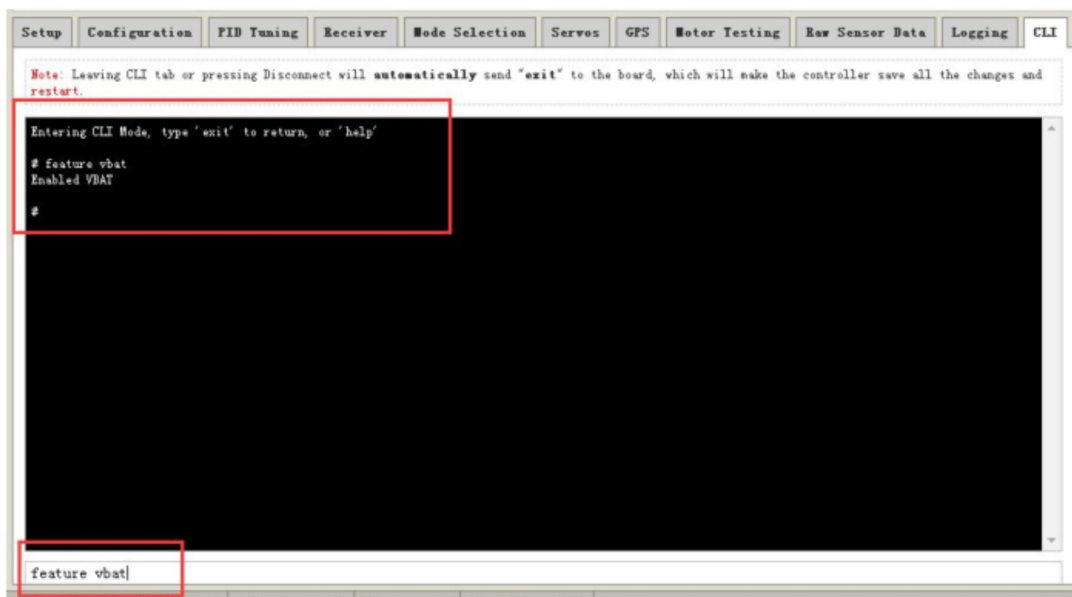
4. Check all multicopter enabled function---Type "mixer list" and press "Enter"



5. Disable some functions---Type "feature-item" and press "Enter". For example: Disable battery voltage monitor function just need to type "feature-vbat" and press "Enter" then save.



6. Disable some functions---Type "feature-item" and press "Enter" For example: Open battery voltage monitor function just need to type "feature-vbat" and press "Enter" then save it.



7. Check all settings--- Type “set” or “dump” then press “Enter”

Baseflight settings and tunings:

1. Roll and pitch drifting
 - Recalibrate acc
 - Using Acc Trim stick order to trim Acc
2. Course shift
 - Recalibrate ESC