Installation and Configuration Manual for

the Massvie32 and the MassiveAcro Flight Controllers

Preliminary Release.

This Document will be updated.

Introduction:

What You Need:

1. 32Bit ST103-Based Flight Control (FC) board Such as the Massive32 or MassiveAcro
2. MicroUSB cable –or- USB to FTDI interface (Depending on your FC)
3. Host PC or laptop running Windows, Linux, or MacOS, (or a Chromebook)
4. Google Chrome Browser for your platform (To allow the use of Chrome Apps)
   https://www.google.com/chrome/
5. CleanFlight version of the Configurator:

   https://chrome.google.com/webstore/category/apps

   and search for CleanFlight. Other Configurators will not support the additional features of CleanFlight.
6. If you are running Windows, you will need USB FTDI Drivers (Even if your FC has built-in USB.)

Tip (Optional):

Developers and "Bleeding Edge" Users Only:

To Compile ClearFlight from Source, you also need:

1. GNU Tools for ARM Embedded Processors:

   https://launchpad.net/gcc-arm-embedded
2. If you are running Windows, you will also need:

   Cygwin

   GNU Make

Before you begin:

1. Safety First! Do not connect flight battery unless motor/ESC/receiver power is necessary. While the odds are remote, an error or firmware bug could cause the motors to arm.
2. When doing steps that require motor/ESC/receiver power, Remove Props, or ensure 'copter is securely held down, and all items (biological and otherwise) are clear of the props.
3. The MicroUSB port is delicate, and can easily be dislodged from the board. Be careful when connecting/disconnecting.

Installing CleanFlight:

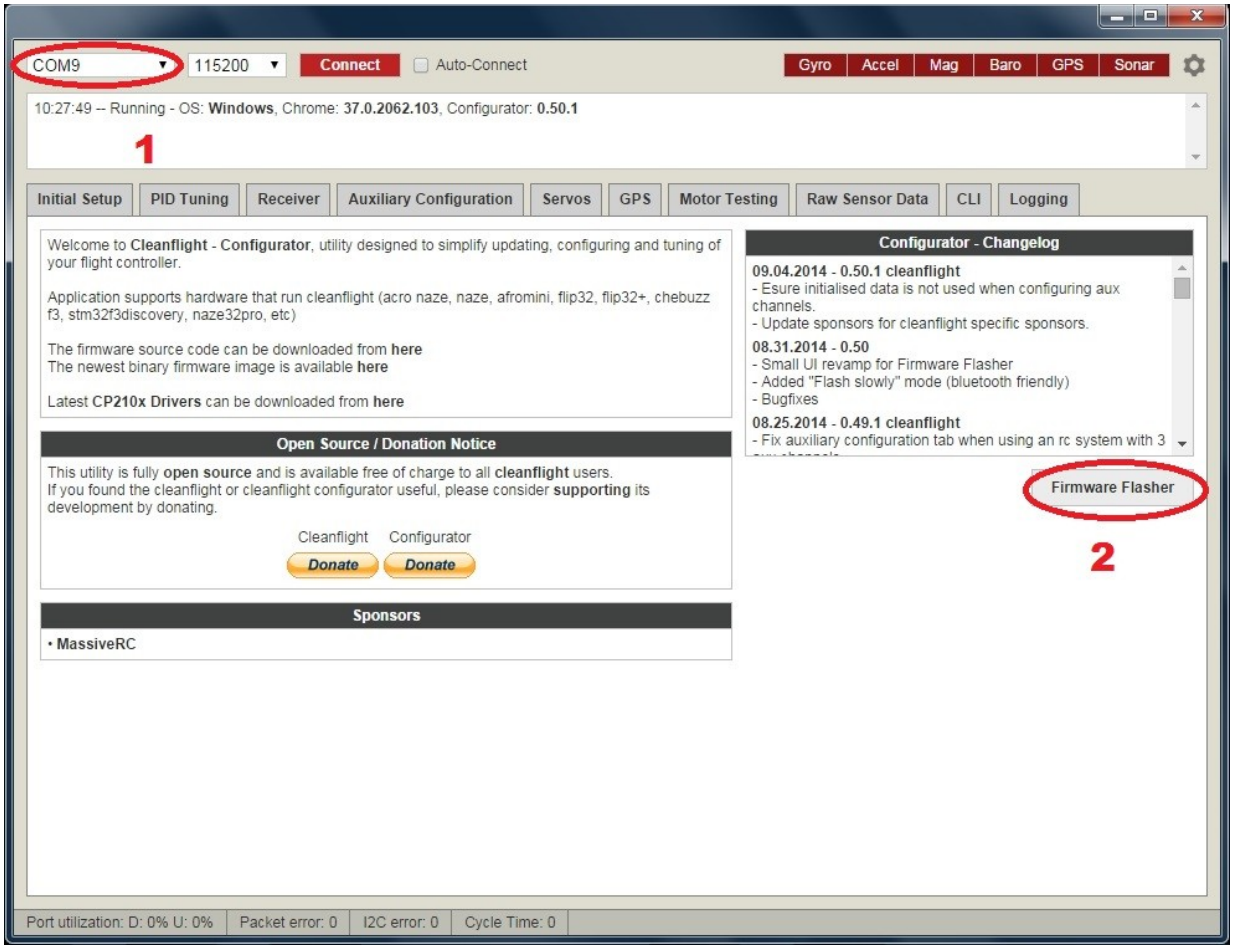
When the FC board ships, it may contain different flight software. Revisions and upgrades of flight software happen on a nearly daily basis. Before attempting to fly, it is important that you load a current, stable version of CleanFlight on your MassiveRC 32 bit board.

Connect the FC board to your PC with the USB cable or FTDI adapter (Depending on your board). This can be done with just the board by itself, or installed in the aircraft. The aircraft flight battery should not be connected during a software update.

Launch the Chrome CleanFlight Configurator.

Do not click 'Connect' at this time.

Your Screen should look something like this (Windows example shown – the serial port shown at the top left (1) will be different in other operating systems, but should show a valid serial port):



If a valid serial port is not shown, try the following:

- Windows/Macintosh: Install the correct USB drivers. Try here:

  http://www.ftdichip.com/Drivers/VCP.htm

  or search for the particular chip on your FTDI adapter.

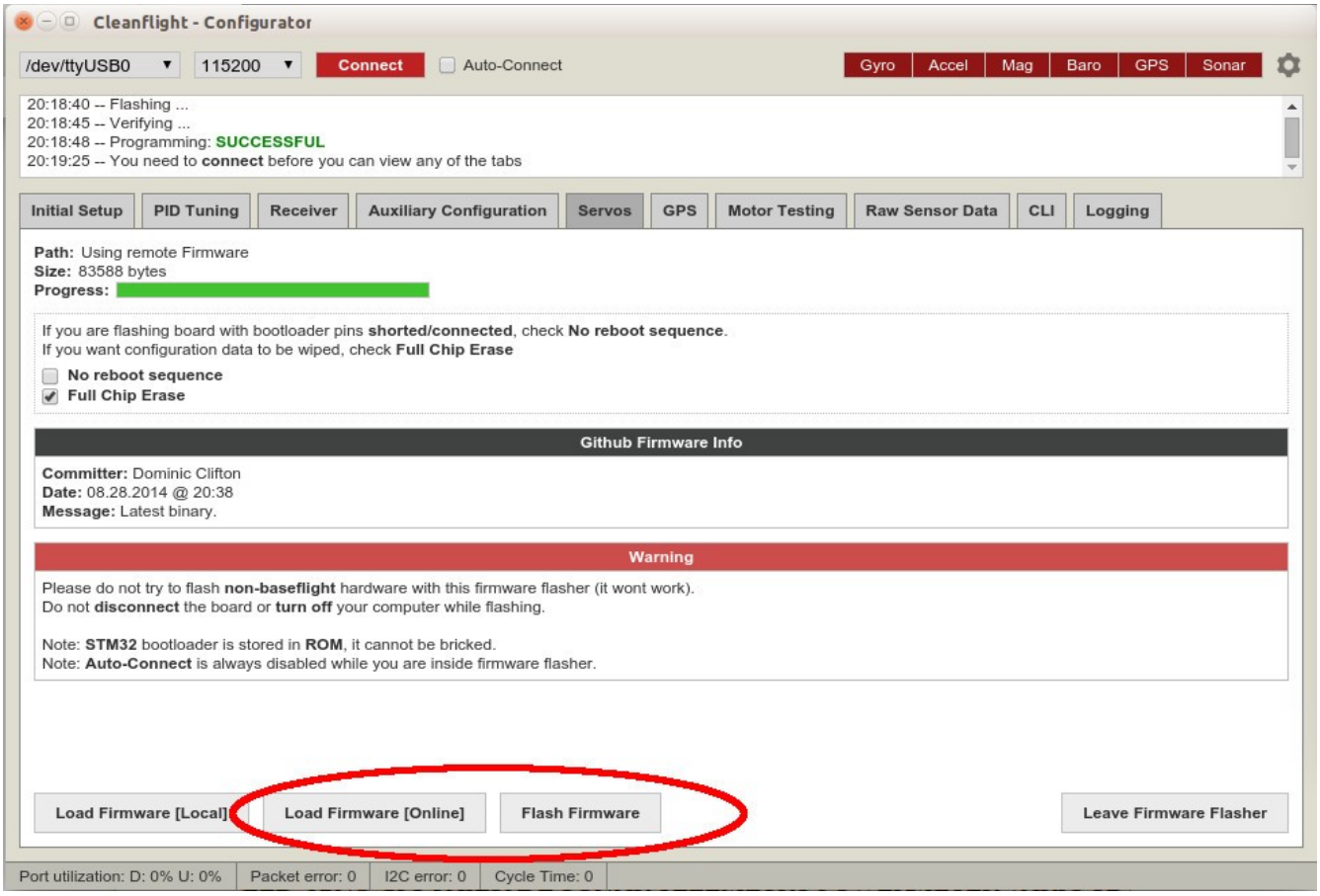
- Linux: Make sure your user account is a member of the dialout group:

  ```
  sudo adduser user dialout
  ```

  (Where 'user' is your username). Log out and then back in again.

Once you see the correct serial port, Click on Firmware Flasher (Lower Right - (2)).

This will take you to the firmware flasher screen.



Select **Full Chip Erase** as shown above.

Select **Load Firmware [Online]**. This will automatically download the latest stable version of the CleanFlight binary for your board.

Once the file is downloaded, click **Flash Firmware**.

When it is complete, you can click **Leave Firmware Flasher**.

Load Verification:

We are going to use the Command Line Interface (CLI) to verify the correct version of the firmware on your board. This is as much to rid you of fear of the Command Line as it is to accomplish anything else:

Connect to your board using the Connect button at the top of the Configurator.

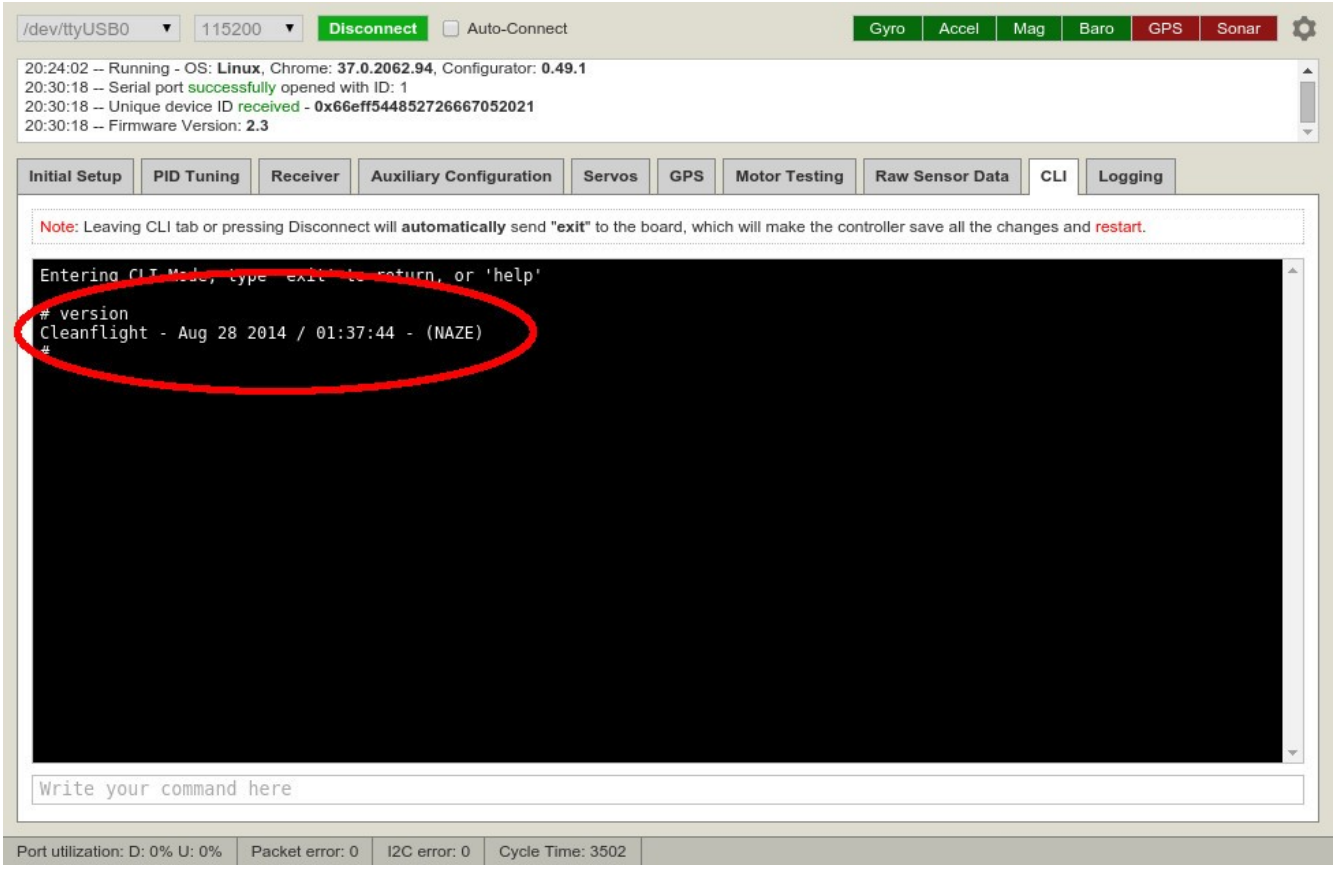
Click the CLI tab.

On the Command Line at the Bottom, type:

```
version
```

(and press Enter)

You should see something like:



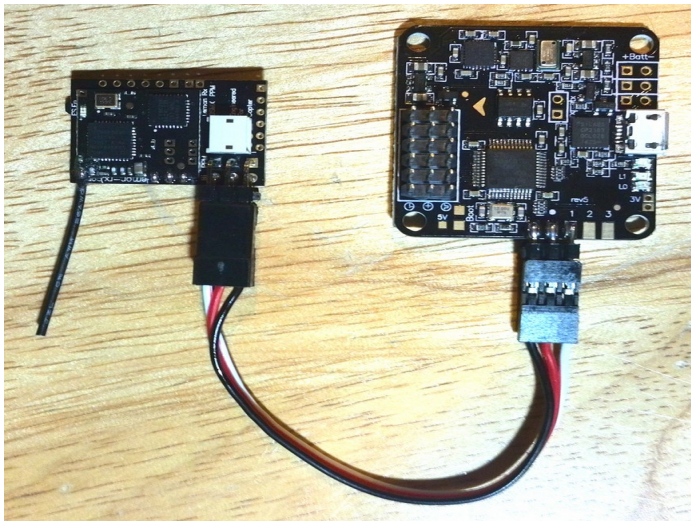
Your version may be later.

Configuration for LemonRX Spektrum Compatible PPM Receiver:

Skip this section for other receivers.

1. Connect the PPM Receiver to the FC board as shown:

LemonRX PPM Receiver	MassiveRC32 FC board
GND	Blank
+5V	Dot
PPM	1



Notes:

1. Satellite receiver not shown for simplicity.
2. Reference Appendix A for wiring diagram.
3. Use top 3 connections on the LemonRX PPM Receiver. Bottom connections are for the Bind Plug. (Remove Bind Plug once binding is complete.)
4. The USB connection does not supply power to the Receiver. Power must be supplied from 1 of the motor ESC's for receiver operation or for Binding (see Appendix A).

2. In the Configurator, click on the CLI tab.
3. Enter the following commands, one at a time [Enter] after each one. These commands are CaSe SeNsItIvE:

```
feature RX_PPM

map TAER1234

save
```

4. Wait for the controller to reboot, then click the 'Receiver' tab.
5. Power up your R/C controller, and move the controls. Verify each channel responds as expected.

   If the mapping is not correct, find the monitor of channel setup of your R/C Controller, and determine the correct mapping.

   ```
   A=Aileron (Roll), E=Elevator (Pitch), R=Rudder (Yaw), T=Throttle
   ```

   Issue the correct map command, save, and then test using the Receiver tab again.

Setting up Fail Safe:

Setting up Failsafe is an important step to not only prevent the loss of your aircraft, but to prevent injury

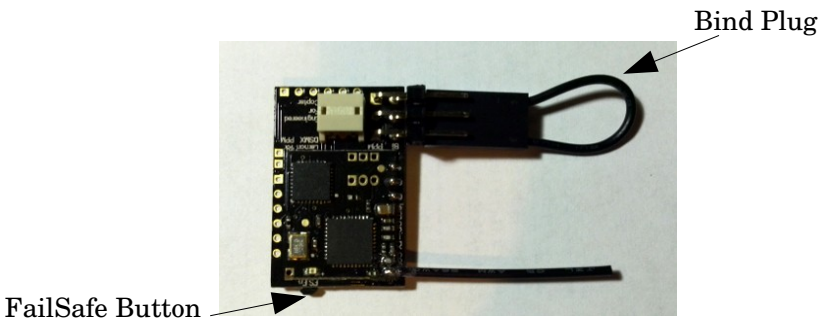
during the second part of the proverbial “What goes up, must....”.

At this time, it is suggested that you use the receiver's failsafe, especially with PPM receivers.

In the event of a control signal loss, the receiver will command the FC to a preset stick and throttle setting.

If your 'copter is built, you can determine the correct failsafe throttle setting by actually flying it, or (safely) hand-holding it. Make note of the throttle stick position when the vehicle is light, but has definite positive weight. Don't set it for a nice landing, set it for a rapid, but upright descent. Leave the controllers throttle stick in that position during the following steps.

1. Plug bind plug into the receiver.
2. Provide power to the unit and the R/C controller.
3. Press the FailSafe button to memorize the controllers' current throttle and stick positions.
4. Green light will turn on at the bottom of the receiver to indicate Failsafe is successfully enabled.
5. Remove bind plug.



The procedure is similar for other R/C receivers that support FailSafe. Consult the R/C system's documentation. Do not fly without a working failsafe. Do not test your failsafe by switching off the transmitter while the 'copter is in flight. Always do a range check before flying a new system, or after changing any aspect of the R/C system.

Motor/ESC Connection:

Refer to Appendix B for Motor/ESC connection.

Connect ESC signal inputs as indicated in Appendix B. Extract the socket or cut the center lead (+5V) from *all but one* of the ESC signal connectors. Due to slight variations in each ESC's +5V output (BEC), using more than one of them will cause some to be “back-fed”, resulting in unnecessary battery consumption, ESC heating, and possible ESC failure. Tape the extracted socket so that it does not short out.

For Tricopter, connect as follows:

Motor Output Connection (FC)	ESC or Servo
1	Tail Servo
2	(No connection)
3	Motor 1
4	Motor 2
5	Motor 3

Use Servo Mode.

For more than 6 motors (e.g. Octocopter), use the Receiver terminal connections as follows:

Receiver Pin 5 → Motor 7

Receiver Pin 6 → Motor 8

Must use PPM Receiver.

If Camera Stabilization is used, connect camera servos to 1 and 2, and all Motors connect 2 pins higher than their normal positions.

Example: Standard Hexacopter with Camera Stabilization:

Motor Output Connection (FC)	ESC or Servo
1	Camera X Servo
2	Camera Y Servo
3	Motor 1
4	Motor 2
5	Motor 3
6	Motor 4
Receiver Connection (FC)	ESC or Servo
5	Motor 5
6	Motor 6

Must use PPM Receiver. Use Servo Mode.

Tip (Optional):

When selecting which ESC to use to supply the +5V (BEC) select the one that continues to provide a steady +5V output when the battery (input) voltage is the lowest. There can be significant variation even among identical ESC's purchased at the same time. This is most easily done with a variable power supply. Do not use a battery. Do not exceed manufactures ratings for the ESC. Doing this can prevent FC crashes/resets due to brownouts or low battery voltage.

Select the Model Type:

Selecting the Model Type is done via the CLI:

1. Click on the CLI Tab.
2. Type the command to select your model type, such as:

   ```
   mixer QUADX
   ```

3. Type `'save'` to save the selected setting and reboot.

See Appendix C, under 'mixer' for Preset Mixer Types.

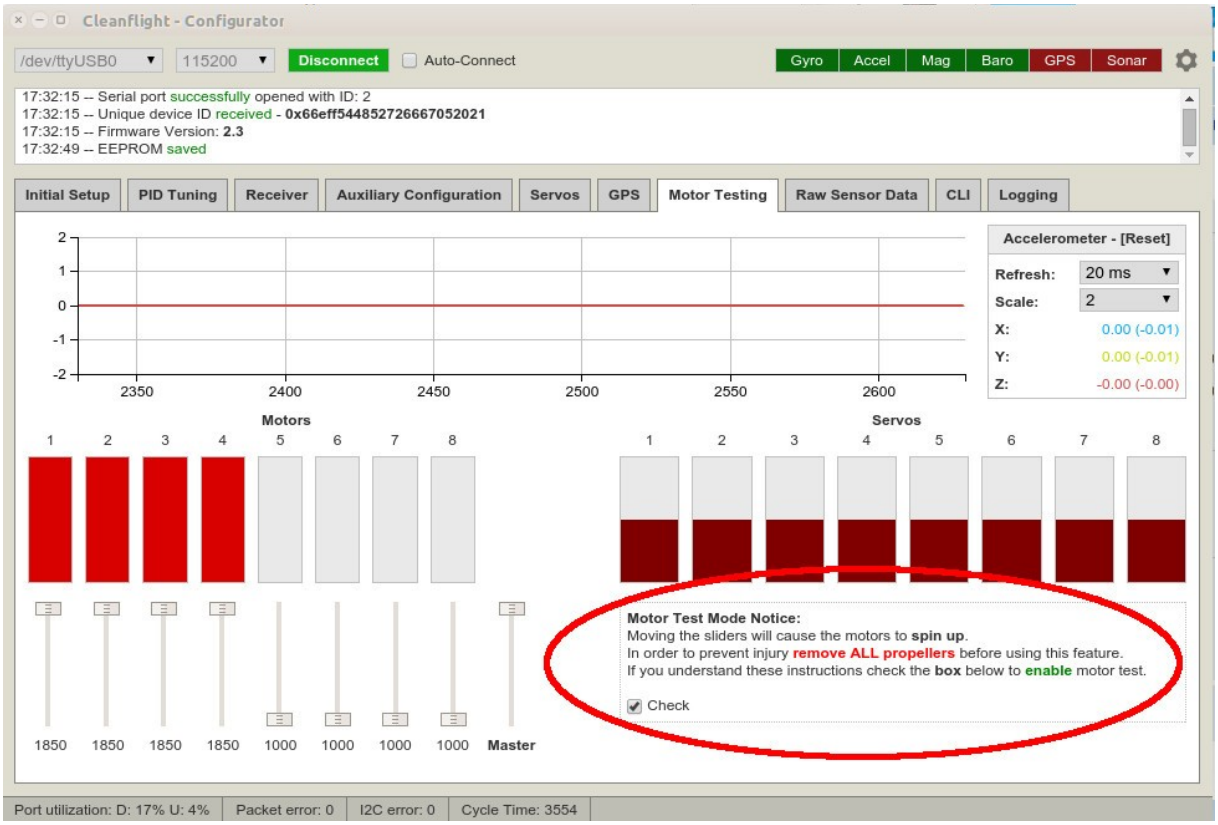
Calibrate Your ESC's:

Note: The steps in this section Calibrate the Throttle Range of the ESC's. These steps **Do Not** program the ESC's or set them correctly for your model. **Before** performing this section, you should have set the ESC's features using either the transmitter, or the correct programming card for your ESC's. Consult the ESC manufactures' instructions.

Before you fly, you must calibrate the ESC's. Do this as follows:

All ESC's must be connected to the FC. You do not need the R/C System.

1. Remove all Props. – No, I really mean it. Remove the props. We will be sending full throttle commands to all motors, with the Flight Battery connected. Don't trust your ESC's arming feature with your eyesight. Remove the Props – Get it? Good.
2. Ensure the Flight Battery is disconnected, but have it handy.
3. Connect the FC via USB.
4. Connect to the Chrome CleanFlight Configurator, and Connect.
5. Select the Motor Testing Tab.
6. After you Read and Heed the warning, Check the Checkbox in the Motor Testing Mode Notice box.



7. Move the Master slider all of the way to the top. Check that the value for each connected motor goes to the Maximum Throttle Setting (1850 Default). If the correct bars do not increase, it probably means that you have not selected the proper Model Type. See “Select the Model Type”, in a previous section of this document.
8. Connect the Flight Battery. The motors should beep, but not arm (spin).
9. With the Battery still connected, move the Master slider all of the way to the bottom (1000). The motors should beep again, indicating a valid calibration.
10. Disconnect the Flight Battery. Do Not advance the Master slider, or any others with the battery connected, as a motor or motors could arm.

Tip (Optional):
I recommend doing the above procedure as many as 3 times to make sure all ESC's “Get it” (Calibrate successfully). Do this especially if some ESC's do not emit the same beeps as the others. Make sure you disconnect the Flight Battery before attempting a second calibration.

Connecting a GPS:

A GPS receiver is required for Position Hold (PS), Return to Home (RTH), or to have your Speed, Distance to Home, etc. visible on an On Screen Display (OSD), or via a Telemetry System.

With the Massive 32 or Massive Acro boards, GPS is typically connected to Pins 3 (TX) and 4 (RX) of the

R/C connection pads on the left side of the board. This assumes a PPM R/C receiver is used. If a parallel (classic individual connections) R/C receiver is used other arrangements must be made for connecting a GPS receiver.

When connecting the GPS board, please note the following:

- Pins 3 and 4 are not adjacent to one another.
- TX and RX cross between the GPS board and the FC board.

GPS	FC
TX	Pin 4 (RX)
RX	Pin 3 (TX)

- The FC board considers this to be Serial Port 2 (also referred to as UART 2). Serial 1 (UART 1) is connected to both the USB connector, and the RX and TX pins near the center of the board. These pins should not normally be used for the GPS, for reasons we will see in another section.
- +5V and Ground for the GPS receiver can be obtained from either an unused motor connector, or from a separate 5V breakout board. It is also acceptable to obtain +5V from a separate ESC.

Configuring GPS:

GPS boards purchased from MassiveRC are pre-configured for 115200 baud, UBLOX protocol, and 5 Hz update. These are the optimal settings for the 32 bit Flight Controllers.

If you are using a GPS receiver purchased elsewhere, it must be configured per the manufactures instructions. You must know or set the protocol and baud rate.

For a GPS connected as indicated above, connect to the CleanFlight Configuator, and issue the following commands, pressing [ENTER] after each one:

```
feature GPS
set serial_port_2_scenario = 2
set gps_baudgps_baudrate = 115200
gps_provider = 1
gps_sbas_mode = 2
exit
```

Notes:

- Some of the above settings are the defaults. They are included here to verify, or to be sure they are set correctly.
- The SBAS_Mode indicated above is for users in the United States. If you are elsewhere, please use the correct setting from Appendix C.

- A GPS fix may not be available inside a building
- Initial GPS fix (if the GPS has not been used in several days) may take as much as 15 minutes.

The exit command will save the settings, and reboot the Flight Controller. Once the FC has rebooted, click on the GPS tab of the CleanFlight Configurator.

You should see GPS data as shown:

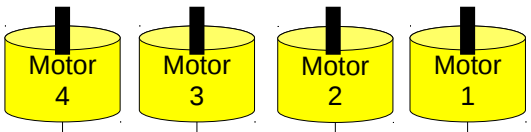
Appendix A:

Wiring Diagram:

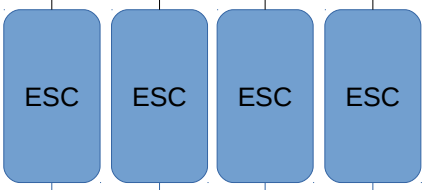
Motor 5 (Hexacopter)
Motor 6 (Hexacopter)

Octocopter/Decacopter:
Use Receiver Connections:
5 for Motor 7
6 for Motor 8
7 for Motor 9
8 for Motor 10
(Use PPM Receiver, or you lose AUX connections)

Normal QUADX Configuration:

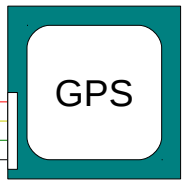


See next page for Motor Locations



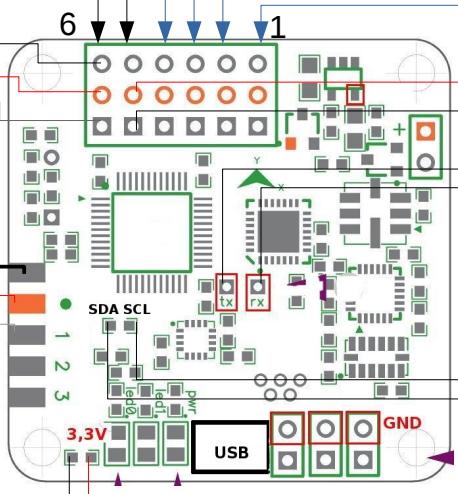
Tricopter:

1 → Tail Servo
2 → No Connection
3 → Motor 1
4 → Motor 2
5 → Motor 3



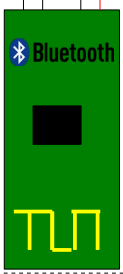
+5V UBEC (Red) Wire Removed from <u>all but one</u> ESC Connector

Ground
5V
Signal



GPS Connection:
GPS RX ---> Pin 3
GPS TX ---> Pin 4 (Bottom)
Get Power from unused pins as shown for BT Module.

BT Module:
RX → TX
TX → RX
+5 → +5
GND → GND

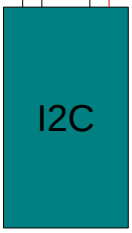


Note: USB Connector will not work when Bluetooth (or other item) is connected to TX/RX pins

PPM Receiver:
On the Lemon RX PPM Receiver use Top (Inboard) Connections:
Ground → Blank
+5 (Red) → Dot
PPM(White) → 1

LEMONRX PPM RECEIVER

Default Receiver Connections:
Use included spider cable
– Top of Board –
Pick any 1 Receiver Channel (e.g. Aileron)
And connect:
Ground → Blank
+5 (Red) → Dot
Aileron → 1
Connect remainder signal leads only:
Elevator → 2
Throttle → 3
– Bottom of Board –
Rudder → 4
Aux 1 → 5
Aux 2 → 6
Aux 3 → 7
Aux 4 → 8

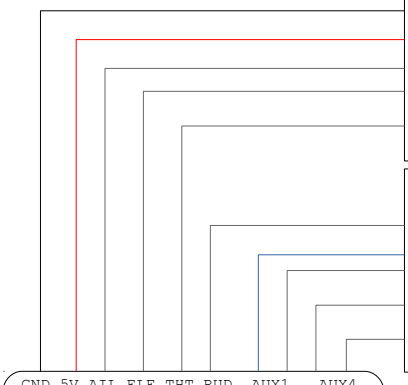


I2C Device
3.3V ONLY
SDA and SCL Pads on Bottom of FC

GND → GND
SDA → SDA
SCL → SCL
3.3V → VCC

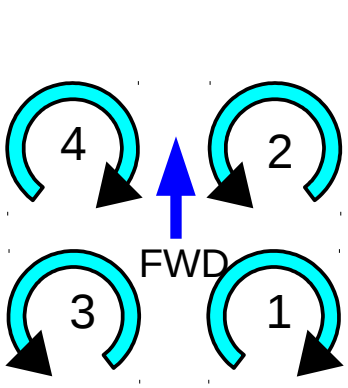
Top:
Blank
Dot
1
2
3

Bottom:
4
5
6
7
8

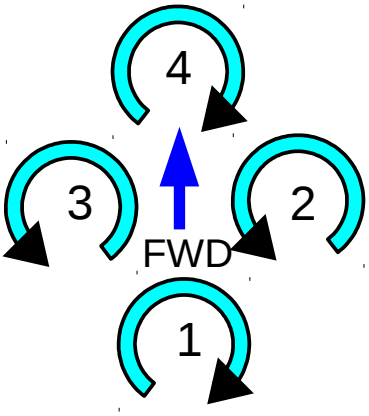


Appendix B:

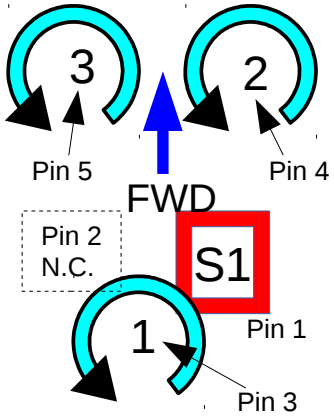
Motor Connection Diagrams



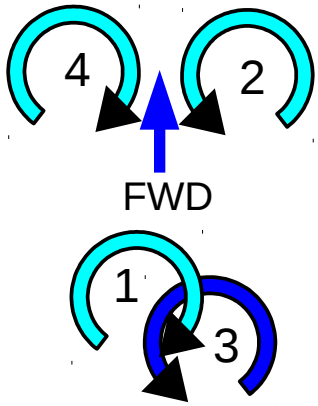
Quad X



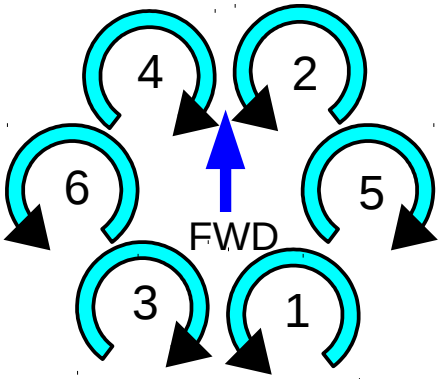
Quad +



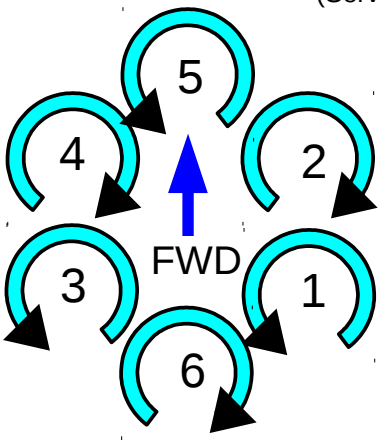
Tricopter
(Servo Mode)



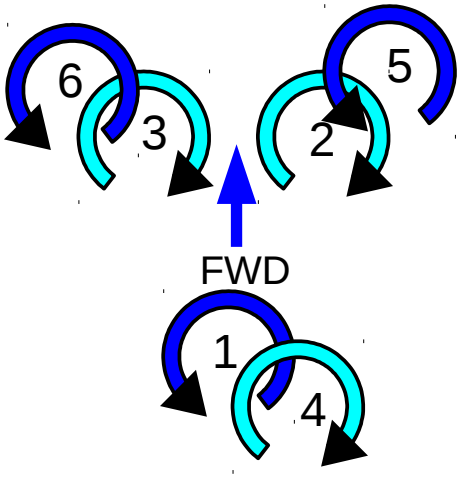
Y4



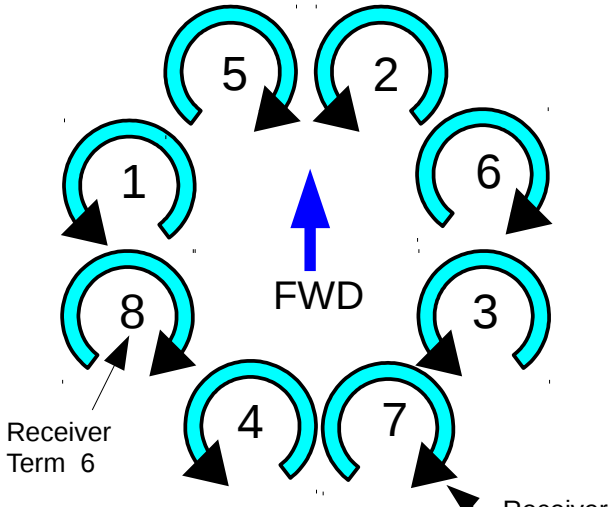
Hex X



Hex +



Y6



Octo
Must use PPM Receiver

Notes:
If Camera Stabilization is used, connect camera servos to 1 and 2, and all Motors connect 2 pins higher than their normal positions.
Example: Standard Hexacopter with Camera Stabilization:
Camera X servo → 1
Camera Y servo → 2
Motor 1 → 3 Motor 2 → 4
Motor 3 → 5 Motor 4 → 6
Motor 5 → Receiver 5
Motor 6 → Receiver 6
Must use PPM Receiver

Appendix C:

All command line commands/features/settings:

Basic Commands:

Command	**Parameters**	**Description**
aux	feature_name auxflag or blank for list	
cmix		design custom mixer
defaults		reset to defaults and reboot
dump		Dump all configurable settings
exit		self explanatory
feature	list or -val or val or blank for all	Show feature val Turn feature <val> on -val Turn feature <val> off list Show all available features blank Show enabled features
get	<variable>	get value of <variable> or omit ,v to get values for all variables
gpspassthrough		passthrough gps to serial
help		self explanatory
map	Map list, or blank to show current mapping. e.g. EATR1234	mapping of R/C channel order A=Aileron (Roll), E=Elevator (Pitch), R=Rudder (Yaw), T=Throttle, followed by 4 aux channels.
mixer	TRI	mixer name or list

	QUADP QUADX BI GIMBAL Y6 HEX6 FLYING_WING Y4 HEX6X OCTOX8 OCTOFLATP OCTOFLATX AIRPLANE HELI_120_CCPM HELI_90_DEG VTAIL4 HEX6H PPM_TO_SERVO DUALCOPTER SINGLECOPTER MULTITYPE_CUSTOM or Custom mixer settings.	
motor	<motor index> 'show' or 'set' <motor value>	get/set motor output value
profile	index (0 to 2)	Select one of the 3 stored Profiles
save		Save settings and Reboot
set	name=value or blank or * for list	Show settings
status		show system status
version		Display Flight Software Version

Features

Name	Description	
RX_PPM	PPM Receiver	
VBAT	Battery Voltage Monitor	
INFLIGHT_ACC_CAL		
RX_SERIAL	Serial (other than PPM) Receiver	
MOTOR_STOP	Motors stop when throttle is reduced all the way.	
SERVO_TILT		
SOFTSERIAL	Enables code for software (virtual) serial ports. Do not use unless you need additional serial ports emulated on the RX or motor out pins	
LED_STRIP		
GPS		
FAILSAFE		
SONAR		
TELEMETRY		
CURRENT_METER		
VARIO		
3D		
RX_PARALLEL_PWM	Classic R/C Receiver with a separate PWM output for each Channel.	
RX_MSP		
RSSI_ADC		

Settings

Setting	**Description**	**Valid Values**	**Default**
looptime	Force a certain loop time. Normally omitted.		3500
emf_avoidance	Shift system clock to avoid harmonics associated with with 72 MHz R/C system. Set to 1 only if you run a 72 MHz R/C system, and you think you are having interference.	0 - 1	0
mid_rc		1000-2000	1500
min_check		1000-2000	1100
max_check		1000-2000	1900
rssi_channel			0
input_filtering_mode			0
min_throttle	Effectively the motor idle RPM. Increase if motors do not start or hesitate on arm. Increase if motors stop or stutter when throttle is reduced. (see MOTOR_STOP). Reduce if 'copter lifts or feels light, or is unnecessarily noisy on arm.	1000-2000	1150
max_throttle		1000-2000	1850
min_command		1000-2000	1000
3d_deadband_low		1000-2000	1406

3d_deadband_high		1000-2000	1514
3d_neutral		1000-2000	1460
3d_deadband_throttle			50
motor_pwm_rate			400
servo_pwm_rate			50
retarded_arm			0
small_angle			25
flaps_speed			0
fixedwing_althold_dir			1
serial_port_1_scenario	Configures Serial Port 1 for a certain scenario (use). See list to right. Usage: set serial_port_<port_number>_scenario = <scenario_ID> See also: feature SOFTSERIAL If the configuration is invalid the serial port configuration will reset to it's defaults and features may be disabled.	scenario_ID's: 0 UNUSED 1 MSP, CLI, TELEMETRY, GPS-PASTHROUGH 2 GPS ONLY 3 RX SERIAL ONLY 4 TELEMETRY ONLY 5 MSP, CLI, GPS-PASTHROUGH 6 CLI ONLY 7 GPS-PASSTHROUGH ONLY 8 MSP ONLY	1
serial_port_2_scenario	Configures Serial Port 2 for a certain scenario (use).	See above	2
serial_port_3_scenario	Configures Serial Port 3 for a certain scenario (use).	See above	0
serial_port_4_scenario	Configures Serial Port 4 for a certain scenario (use).	See above	0
reboot_character			82
msp_baudrate	MultiWii Serial Protocol baudrate setting. Must	e.g. 9600, 19200,	115200

	agree with connected devices that use MSP (Such as MinimOSD)	etc.	
cli_baudrate	Command Line Interface baudrate.	e.g. 9600, 19200, etc.	115200
gps_baudrate	GPS baudrate must agree with serial GPS setting.	e.g. 9600, 19200, etc.	115200
gps_passthrough_baudrate		e.g. 9600, 19200, etc.	115200
gps_provider	GPS provider protocol	0 NMEA 1 UBLOX	0
gps_sbas_mode	GPS Region	0 AUTO Global 1 EGNOS Europe 2 WAAS North America 3 MSAS Asia 4 GAGAN India	0
serialrx_provider			0
telemetry_provider			0
telemetry_switch			0
frsky_inversion			0
vbat_scale			110
vbat_max_cell_voltage			43
vbat_min_cell_voltage			33
current_meter_scale			400
current_meter_off			0
multiwii_current_meter_output			0
align_gyro			0
align_acc			0
align_mag			0
align_board_roll			0

align_board_pitch			0
align_board_yaw			0
max_angle_inclination			500
gyro_lpf			42
moron_threshold			32
gyro_cmpf_factor			600
gyro_cmpfm_factor			250
yaw_control_direction			1
acc_hardware			0
gps_pos_p			11
gps_pos_i			0
gps_pos_d			0
gps_posr_p			20
gps_posr_i			8
gps_posr_d			45
gps_nav_p			14
gps_nav_i			20
gps_nav_d			80
gps_wp_radius			200
nav_controls_heading			1
nav_speed_min			100
nav_speed_max			300
nav_slew_rate			30
alt_hold_deadband			40
alt_hold_fast_change			1
throttle_correction_value			0

throttle_correction_angle			800
deadband			0
yaw_deadband			0
yaw_direction			1
tri_unarmed_servo			1
rc_rate			90
rc_expo			65
thr_mid			50
thr_expo			0
roll_pitch_rate			0
yaw_rate			0
tpa_rate			0
tpa_breakpoint			1500
failsafe_delay			10
failsafe_off_delay			200
failsafe_throttle			1200
failsafe_min_usec			985
failsafe_max_usec			2115
gimbal_flags			1
acc_lpf_factor			4
accxy_deadband			40
accz_deadband			40
accz_lpf_cutoff			5.000
acc_unarmedcal			1
acc_trim_pitch			0
acc_trim_roll			0
baro_tab_size			21
baro_noise_lpf			0.600

baro_cf_vel			0.985
baro_cf_alt			0.965
mag_declination	Magnetic declination for your area. Get from NOAA website. Must be in decimal.		0
pid_controller			0
p_pitch	Pitch PIDs (Set in Configurator)		40
i_pitch	Pitch PIDs (Set in Configurator)		30
d_pitch	Pitch PIDs (Set in Configurator)		23
p_roll	Roll PIDs (Set in Configurator)		40
i_roll	Roll PIDs (Set in Configurator)		30
d_roll	Roll PIDs (Set in Configurator)		23
p_yaw	Yaw PIDs (Set in Configurator)		85
i_yaw	Yaw PIDs (Set in Configurator)		45
d_yaw	Yaw PIDs (Set in Configurator)		0
p_pitchf			2.500
i_pitchf			0.600
d_pitchf			0.060
p_rollf			2.500
i_rollf			0.600
d_rollf			0.060
p_yawf			8.000
i_yawf			0.500

d_yawf			0.050
level_horizon			3.000
level_angle			5.000
p_alt			50
i_alt			0
d_alt			0
p_level			90
i_level			10
d_level			100
p_vel			120
i_vel			45
d_vel			1