TILT

RACING DRONE

CLEANFLIGHT MANUAL

Cleanflight Manual

This document aims at explaining and guiding you in setting up your tilting arms multicopter. The actual Cleanflight (CF) version works with Abusemark Naze32 and all its clones and assumes a single servo is used to rotate both arms. CC3D and other CF-compatible flight controllers have not been tested yet.

We will appreciate your feedback: what you like, what you don't, what you think can work/be done better, what is missing, etc. Please contact us for comments at info@tiltdrone.com and join us at the official page on facebook TILT drone racer and the Dynamic Tilting Arms users&help group.

Servo and motors connection:

- **The servo signal cable goes to motor output M1**
- **M2 doesn’t have anything connected to it**
- **Motors 1 to 4 go to M3-M6 outputs respectively**

We also recommend NOT to connect the tilt servo power cables plus and GND to the Naze but on any external 5V supply.

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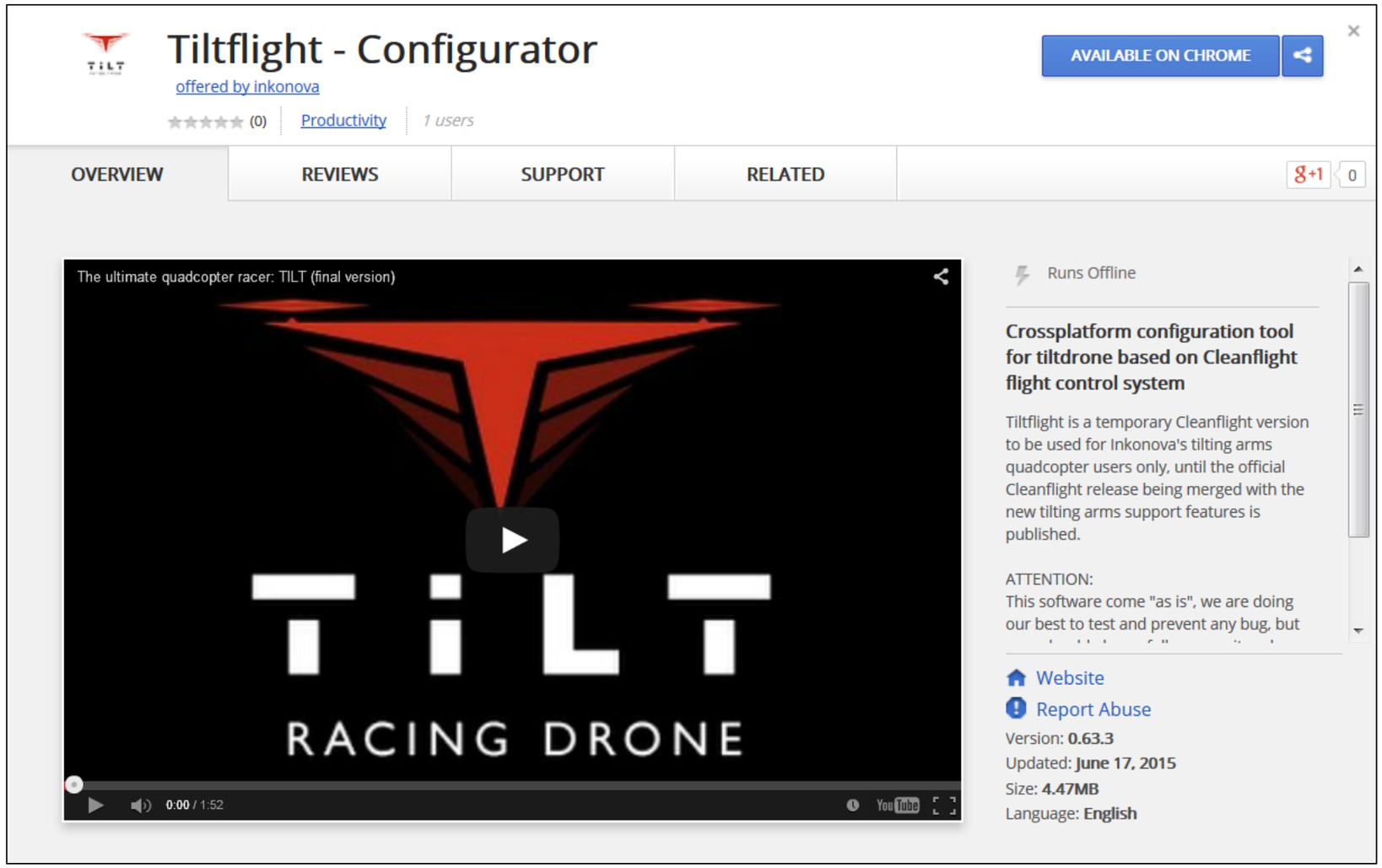
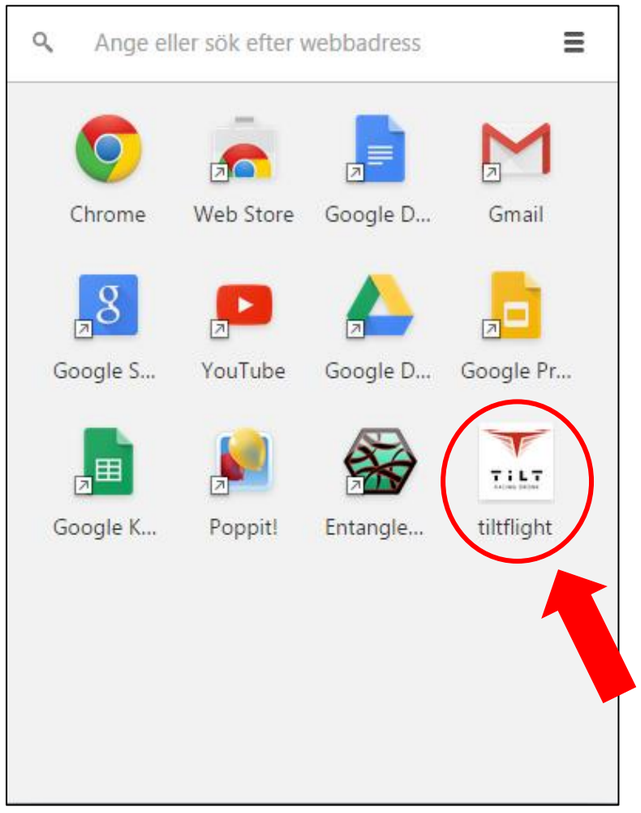
Cleanflight Configurator download

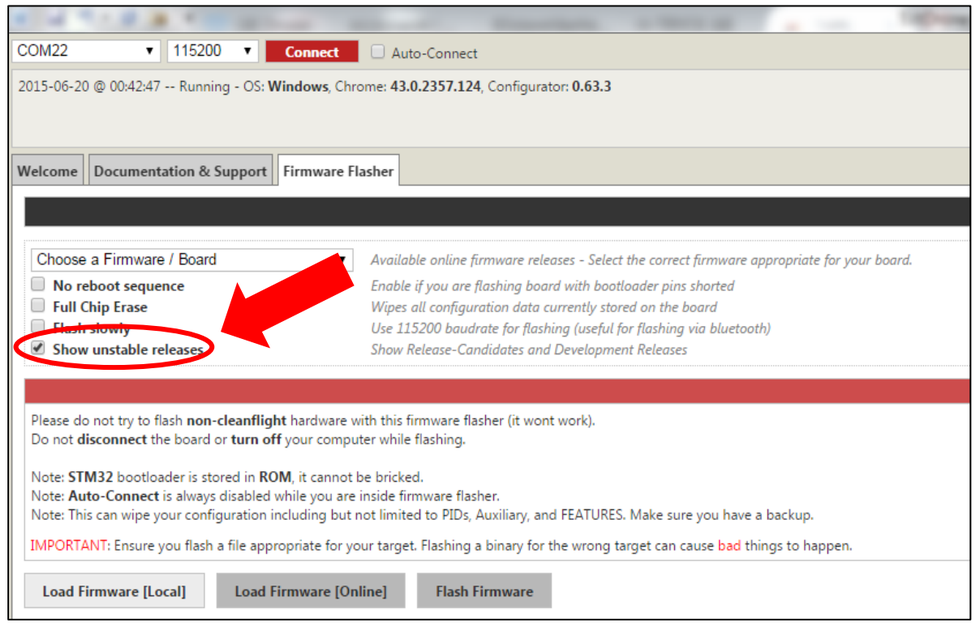
Our Cleanflight code with tilting arms support is now public on Google Chrome. When the next official CF version is released including our tilting arms features, you'll be notified and our 'Tiltflight' code will eventually be remove from the Chrome Store. To enjoy your TILT quadcopter, just dowload the Configurator from HERE.

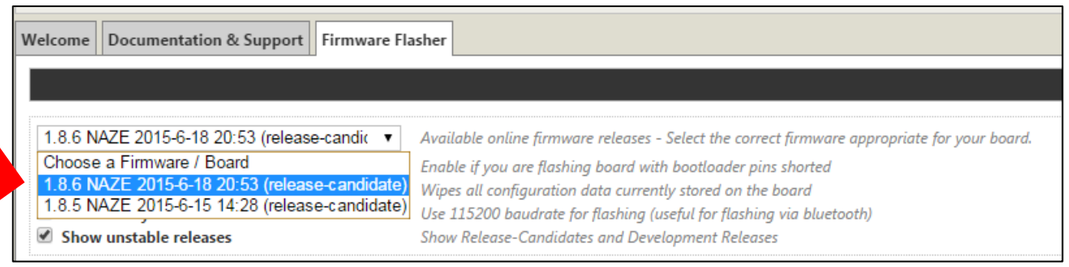


Flashing the Cleanflight firmware

After installing our Cleanflight Configurator (we call it TiltFlight in Google's webstore just to distinguish it from the oficial Cleanflight Configurator. We'll notify you when the tilt features will be available in the new official Cf), click it and go to the Firmware Flasher tab and tick on 'Show unstable releases'. Then select the latest firmware version you'll see in the unfolded menu. Finally, flash it as you flash any other Cf firmware. Select '**Full chip erase**' if you want to erase all previous settings (even if you don't tick this option, we recommend you to always revise your settings prior to fly with a new flashed firmware).



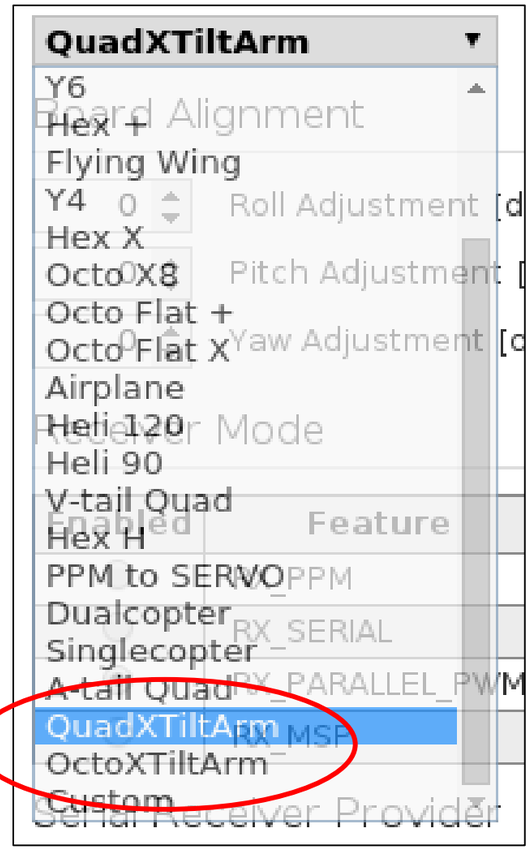




Configuration tab

After flashing the firmware (remember to select '**Full erase the chip**' if you are updating/downgrading from another firmware version!) in the Configuration tab:

1. Check you have PPM
2. Choose the *quadXTilt* or *octoXTilt* (for X8 multicopters)



Receiver Mode

Enabled	Feature	Description
◉	RX_PPM	PPM RX input
○	RX_SERIAL	Serial-based receiver (SPEKSAT, SBUS, SUMD)
○	RX_PARALLEL_PWM	PWM RX input
○	RX_MSP	MSP RX input

PID setup tab

We have only field tested the code with multiwii (0). Other PID controllers should also work and arebut right now their use is under your responsability. The comming tuning sessions will be done with PID_controller=1 but for now take the parameters shown below for PID_controller=0. Start by changing the two parametres below in the CLI:

- set looptime = 2000
- acc_lpf_factor = 100
- save

Choose looptime according to your ESC max frequency:

3500 - 286Hz

3000 - 333Hz

2500 - 400Hz

2000 - 500Hz (Rctimer 30A mini ESC)

1600 - 600Hz

In the **<u>Annex A</u>** at the end of this document you'll find screenshots of the latest settings where TILT starts getting in shape from the tuning perspective.

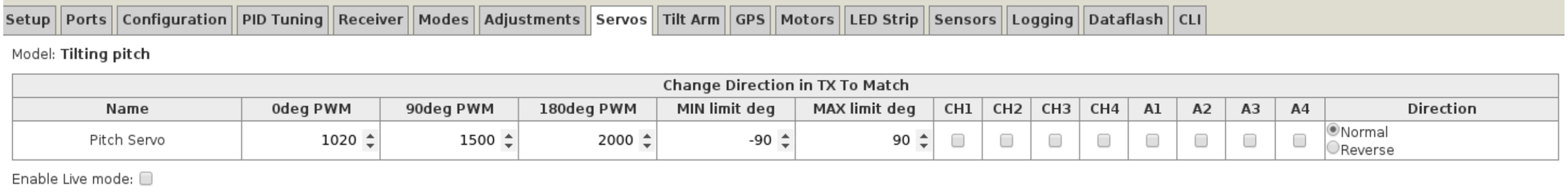
Servos tab

What we want to set up are the first 5 columns and the 'Direction' one (NOT columns 'CH1' to 'A4):

- 0° is when the servo is all on one direction: this is normally around 1000 µs. However, we've found that for non-180 degrees servos, the PWM for this servo angle is below 500 µs (see note below).
- 90° is when the servo arm is centered: this is normally around 1500 µs.
- 180° is when the servo arm is exactly in the opposite direction from 0 deg: this is normally around 2000 µs.
- MIN/MAX limit deg is a software limitation in degree on the spin of the servo: MIN for the maximum travel BACKWARDS and MAX for the maximum travel FORWARD. It's a good idea to start with ±45° from the neutral position (therefore, if 90° is the vertical motor position, ±45° means the travel of the arms will go from −45° to +135°). When you feel comfortable, you can increase the arms travel.

NOTE: During our tests of several servo brands and versions we found out that servos come calibrated in different ways, and some can't even do a real full 180° (even forcing the PWM out of the recommended specs, especially digital ones, which are limited by firmware). Therefore, it is very important to properly set up the 'MIN limit deg' and 'MAX limit deg', for instance to 45° or 60° and use a angle measuring tool to check the angulation (ideally a goniometer but a simple square sheet of paper folded in diagonal will give you the 45° reference).

- Direction: here you can reverse the servo rotation if you need to.



To set up the values in this tab:

1. Set ‘MIN limit deg’ and ‘MAX limit deg’ to –90° and +90° respectively, ‘0 deg PWM’ to 1000 µs, ‘90 deg PWM’ to 1500 µs, and ‘180 deg PWM’ to 2000 µs.

2. Do full pitch forward and backward: the arm should move. Adjust the ‘0 deg PWM’ and ‘180 deg PWM’ values until you get a full 180° degree or you reach the physical limitation of servo.

3. Now set ‘MIN limit deg’ to –45° and ‘MAX limit deg’ to +45° and fine tune the 0° and 180° values

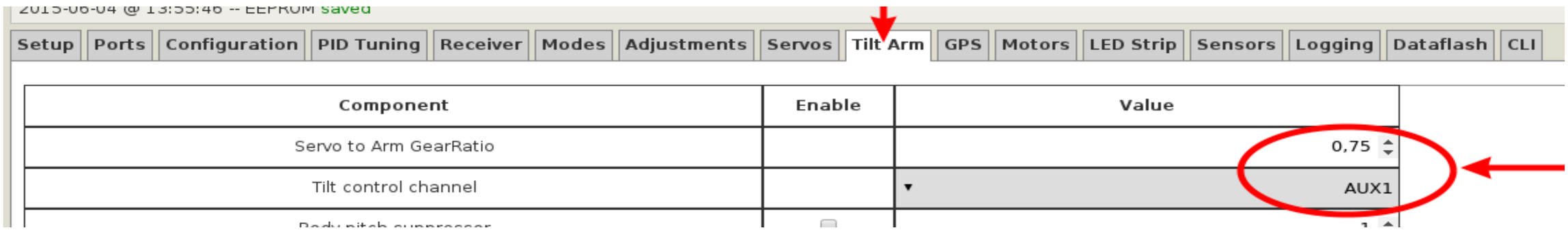
4. Finally, set MIN and MAX limit to your preferred value. We like to fly with a ±60° therefore.

Tilt arm tab

This setup is very important to make the firmware math work correctly, please check your servo before every flight.

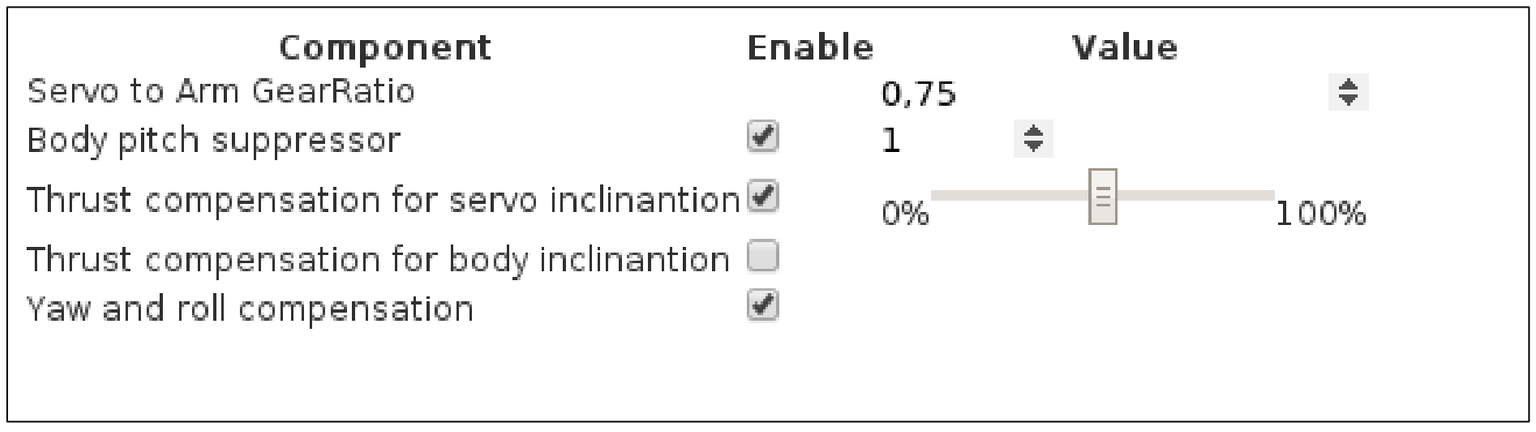
	If at any time you hear the Servo forcing its position and getting hot to the touch, turn the sistem off and let him cool down. Possible causes of overheating are physical limitation reached (decrease min/max limit) or something is preventing the servo to move, like too much tension on the belt or high friction on the polymer bearings.

1. Connect the TILT flight controler (without propellers!) to the pc, then connect the battery.
2. If the motors are not vertical, unscrew a bit the set screw in the arms pulleys, rotate the arms and tighten the set screws again.
3. Set the Arm Gear Ratio to the correct value: you have to divide the servo pulley teeth by the arms pulley teeth.



4. Select the receiver channel that you will use to change between dynamic tilting and fixed tilt: any value there below 1500 µs will activate dynamic tilting. However, above 1500 µs, this channel will fix the motors inclination to the corresponding PWM value (only forward). Therefore, if this channel is a potentiometer, the upper half pot travle allows you to set any fixed motor angle up to the value 'MAX limit deg' from the Servos tab. Or, you can just use a two-position switch here and set one position to a value under 1500 µs and the other to a pre-determined motor inclination from 0° and forward.

5. *Body pitch suppressor*: if enabled, the value set there is a divider witch is applied to the RC input on the pitch (elevator) channel. The body will pitch X times less, were X is the division coefficient: for instance, with 1 the body will picth normally, with 10 it will pitch 10 times less and, if negative, it will pitch in the opposite direction. We found out **10 is a good starting value** to have a bit of visual feedback in LOS or from the FPV camera to know what the quad is doing but still having the camera facing forward (not down) in fast forward velocity.



6. *Thrust compensation for servo inclination*: as the motors tilt you will loose altitude. This feature tries to help you keep an horizontal fly path adding thrust when needed so that you have to work less on the throttle stick to keep a leveled flight. The slider rapresents the throttle stick position in hovering. This is very important to set correctly since, a too high value will make your quad compensate too much and fly away without control: **start with a low value ALWAYS. Please be careful while setting this parameter, and be prepared to disarm your engine using a switch (DON'T USE ARM/DISARM USING TROTTLE/YAW STICK).**

7. *Thrust compensation for body inclination*: similar to above but works only on the body pitch inclination to compensate the small allowed body inclination that may occurr due low 'body pitch suppressor', wind, fast acceleration/deceleration, etc.

8. *Yaw and roll compensation*: the more the motors tilt forward or backward from the vertical orientation, the more mixed are the yaw and roll axis, i.e. that a yaw input has a roll component on the craft and viceversa. In the limit, when the motors are 90° forward or backwards (i.e. horizontal) yaw will became roll viceversa. This setting tries to mix the yaw and roll results from the PIDs to minimize unwanted effects, especially in banked/coordinated turns.

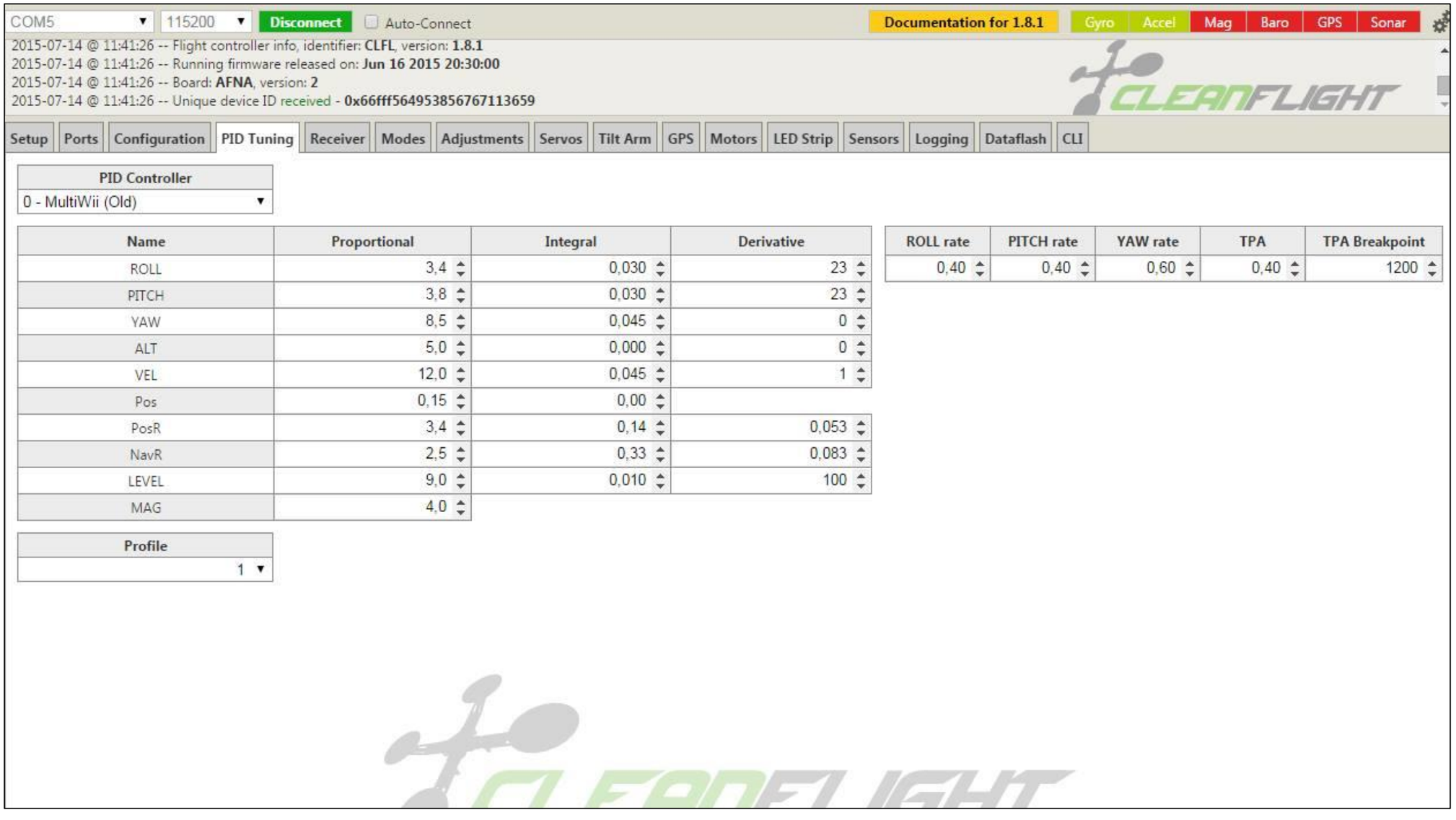
Annex A: Cleanflight settings

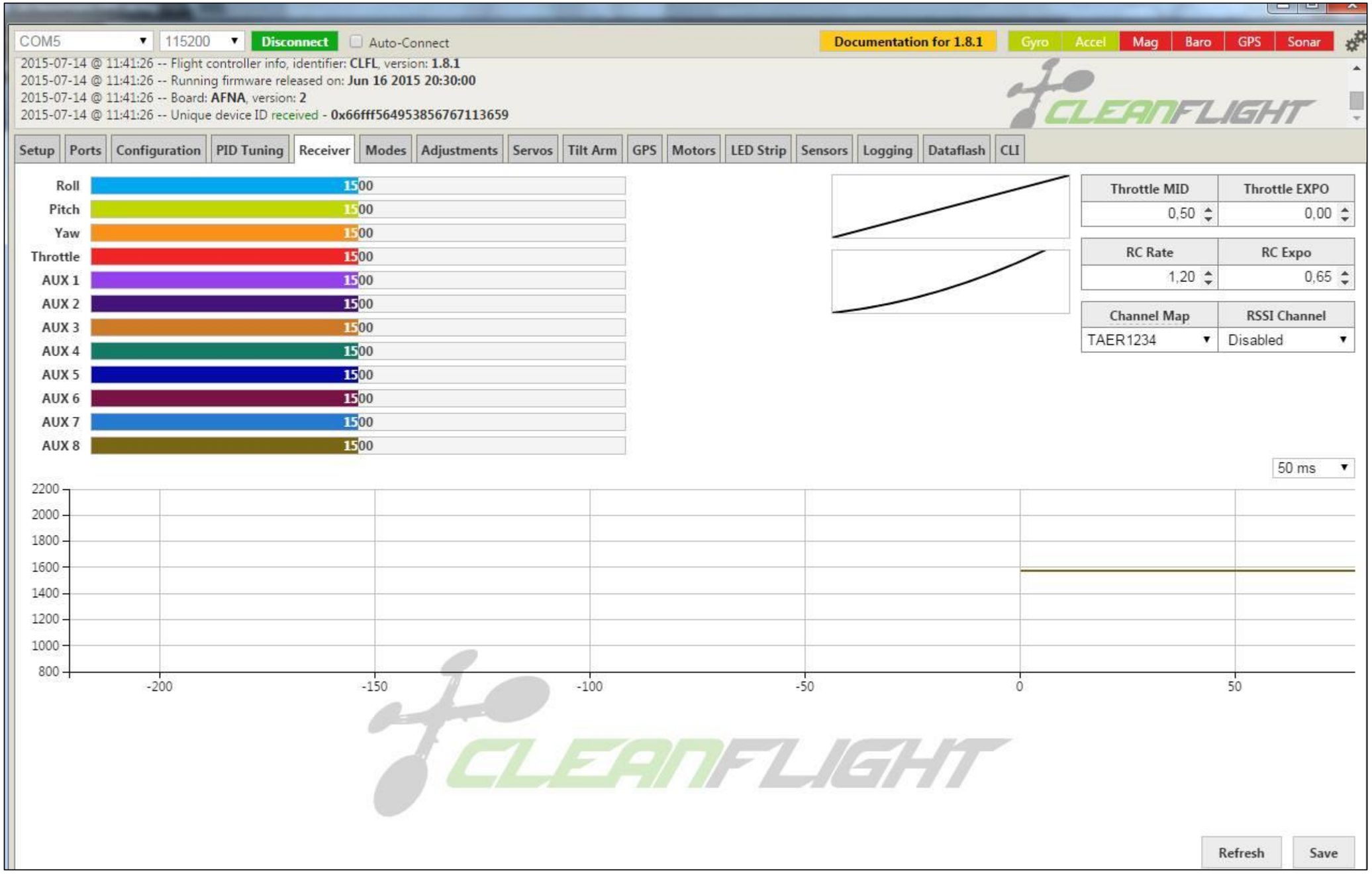
Here you'll find the latest settings and, when possible, videos flying with such values.

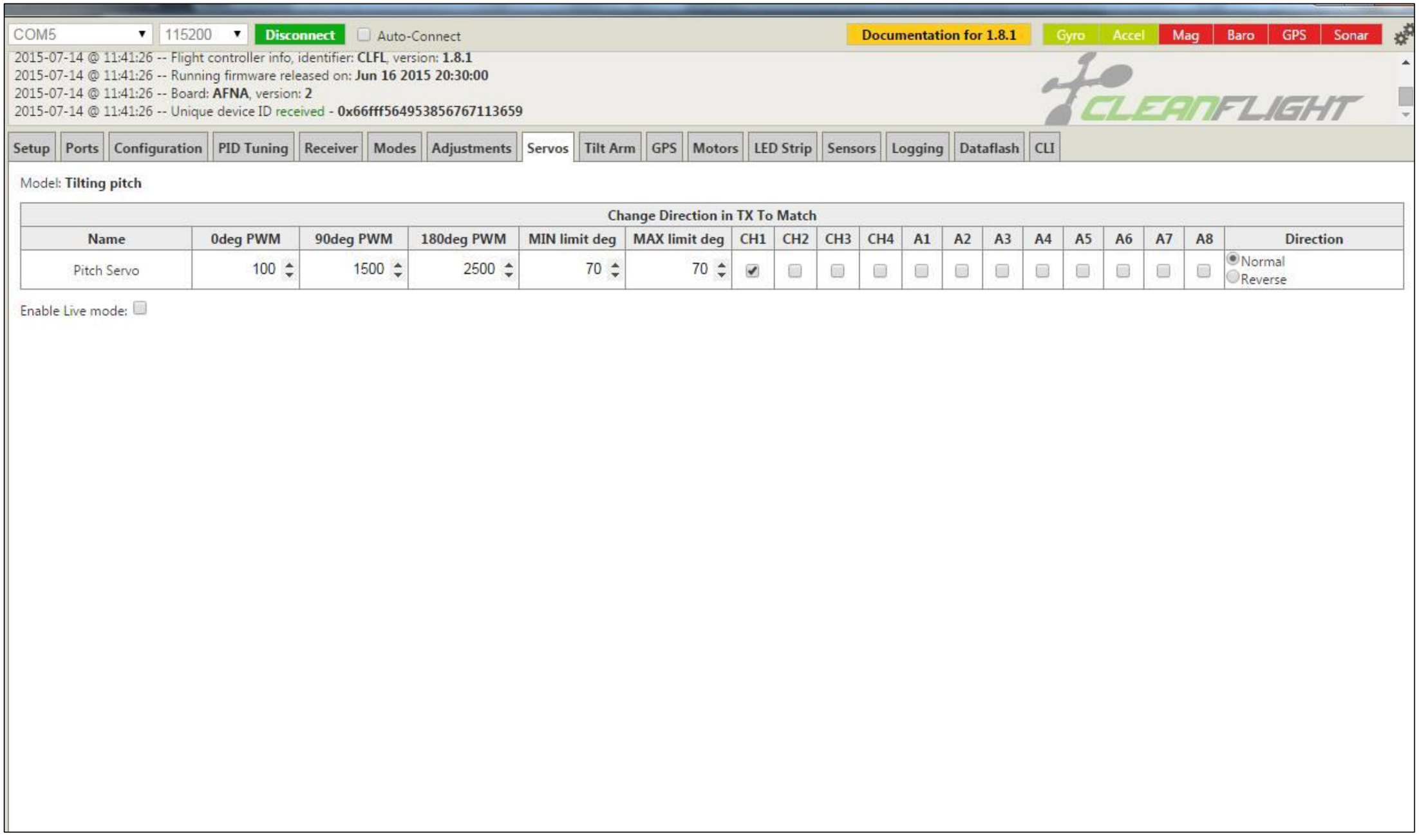
Tuning session #2 (15-07-2015)

If attempting to roll please increase the rates from those shown in the following screenshots!

VIDEO: https://youtu.be/rpzbqyvrSlI




COM5
115200
Disconnect
Auto-Connect
Documentation for 1.8.1
Gyro
Accel
Mag
Baro
GPS
Sonar
2015-07-14 @ 11:41:26 -- Flight controller info, identifier: CLFL, version: 1.8.1
2015-07-14 @ 11:41:26 -- Running firmware released on: Jun 16 2015 20:30:00
2015-07-14 @ 11:41:26 -- Board: AFNA, version: 2
2015-07-14 @ 11:41:26 -- Unique device ID received - 0x66fff564953856767113659
CLEANFLIGHT
Setup
Ports
Configuration
PID Tuning
Receiver
Modes
Adjustments
Servos
Tilt Arm
GPS
Motors
LED Strip
Sensors
Logging
Dataflash
CLI
Roll
Pitch
Yaw
Throttle
AUX 1
AUX 2
AUX 3
AUX 4
AUX 5
AUX 6
AUX 7
AUX 8
1500
Throttle MID
0,50
Throttle EXPO
0,00
RC Rate
1,20
RC Expo
0,65
Channel Map
TAER1234
RSSI Channel
Disabled
50 ms
2200
2000
1800
1600
1400
1200
1000
800
-200
-150
-100
-50
0
50
CLEANFLIGHT
Refresh
Save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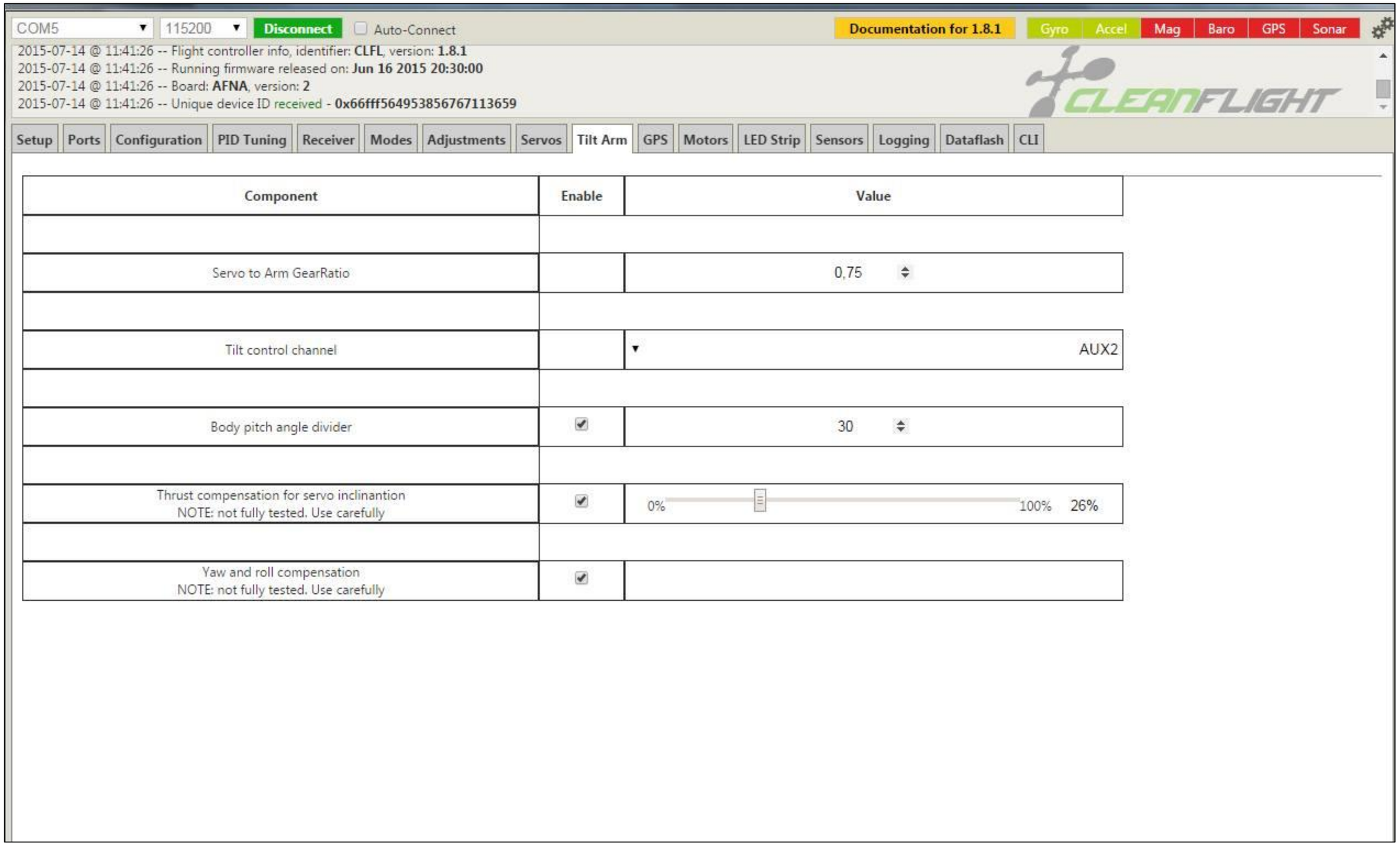
LED Strip
Sensors
Logging
Dataflash
CLI
Model: Tilting pitch
Change Direction in TX To Match
Name
0deg PWM
90deg PWM
180deg PWM
MIN limit deg
MAX limit deg
CH1
CH2
CH3
CH4
A1
A2
A3
A4
A5
A6
A7
A8
Direction
Pitch Servo
100
1500
2500
70
70
Normal
Reverse
Enable Live mode: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Logging
Dataflash
CLI
Component
Enable
Value
Servo to Arm GearRatio
0,75
Tilt control channel
AUX2
Body pitch angle divider
30
Thrust compensation for servo inclinantion
NOTE: not fully tested. Use carefully
0%
100%
26%
Yaw and roll compensation
NOTE: not fully tested. Use carefully

Code Number: MD04001-00-0108 Rev.6

Revision Date: 01/08/2015

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