This document describes the modifications made to the BLHeli FW.

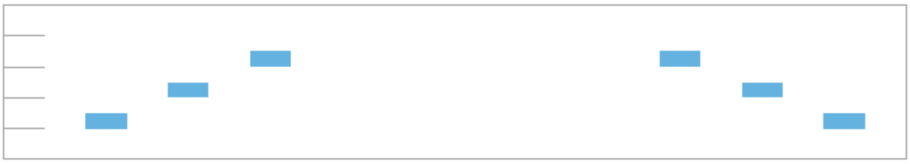
The BLHeli FW manual is still valid with the following exceptions noted. BLHeli FW - Delta Ray Edition:

1. Operates only in the “Multi” mode. Main and Tail modes are not supported and probably will not work correctly,
2. Supports only the 15 kHz Delta Ray brick driver signal (either positive or negative signal polarity). Other input signal types supported by BLHeli FW are not supported and probably will not work correctly,
3. Does not support TX programming,
4. Has low-voltage limiter hard-coded at 3.4 Volts/cell, and
5. The arming sequence startup behaviour has been modified as described below.

Arming sequence:

BLHeli FW - Delta Ray Edition does not require a specific arming sequence, since motor limits are coded in firmware for the Delta Ray.

When power is applied to the ESC, a rising series of three tones sound. The software then waits seven seconds to allow the Delta Ray brick to initialise. After that a series of three descending tones sound.

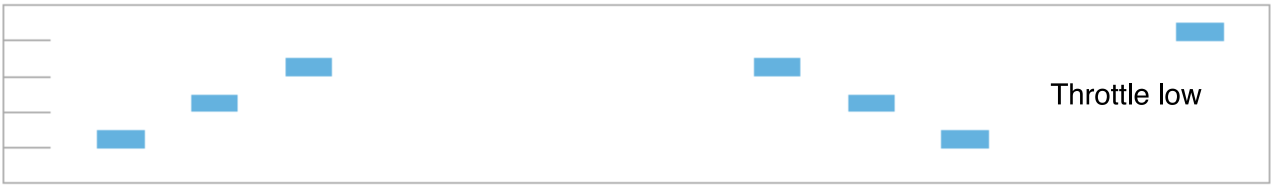


After the three descending tones sound, there is a two second window at which the throttle position can be set to enable the functions described below. Please note that the throttle must not be moved until the Delta Ray brick is initialised (i.e., until the three falling tones are heard), otherwise no throttle signal will be received by the ESC until the Delta Ray throttle is returned to idle.

The firmware recognises three different throttle positions at start-up:

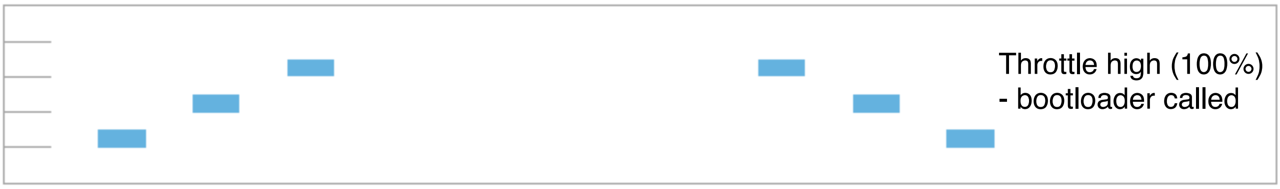
1. Throttle low (0%) - Normal operation.

If the throttle remains low following the three falling beeps, the ESC will be armed and a final high tone will be emitted. The throttle is now active.



2. Throttle high (100%) - boot loader

If the throttle is high (100%) following the three falling beeps, the firmware will enter the BLHeli bootloader. This allows the programming of the ESC through the throttle input as described in the BLHeli FW document “BLHeli programming adapters.”

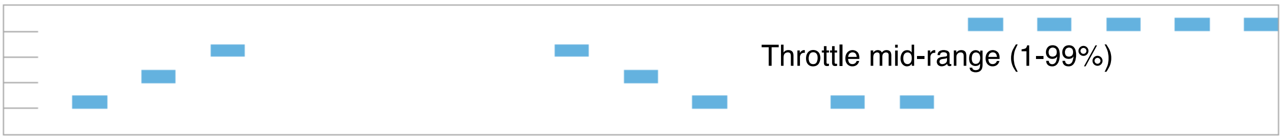


3. Throttle mid-range (1-99%) - throttle calibration

If the throttle is mid-range (1-99%) following the three falling beeps, the firmware will enter throttle calibration mode. In this mode, the firmware “beeps out” or enunciates the throttle position in percentage.

The “tens” are sounded out as a low tone, and the “ones” are sounded out as a high tone.

For example, if the throttle is at 25%, the following tones will be emitted

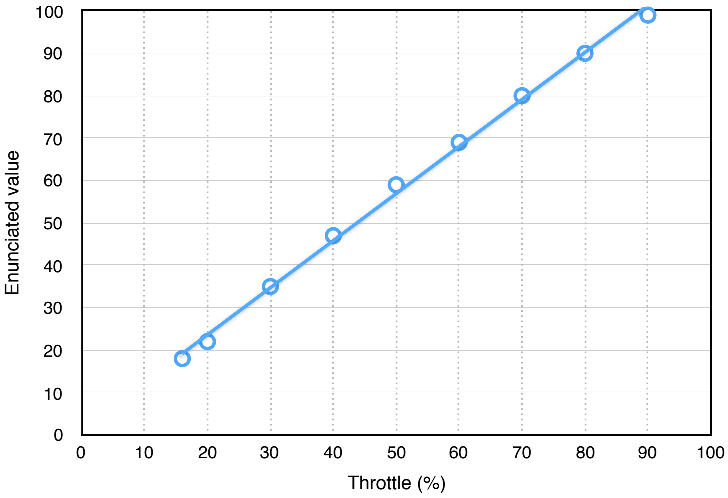


After each throttle position enunciation, the firmware will pause for two seconds before measuring the throttle again, and enunciate the new value. This process will continue until power is removed.

This function should only be used with a single ESC attached, otherwise the sounds from the two ESCs will interfere with one another.

Please note the following:

1. The maximum enunciated value is 99, even when the throttle is at 100%.
2. Depending upon the ESC, there may be some jitter in the enunciated value of a couple of percent due to timing/measurement uncertainty. This is normal.
3. The minimum throttle position on the Delta Ray is around 15-20%. This is because the Delta Ray brick firmware does not enable the throttle PWM pulse until that level is reached. This is (presumably) by design.
4. Likewise, the Delta Ray brick firmware sets the PWM pulse to 100% when the throttle is over about 90%. This is (also presumably) by design.
5. The above two features mean that the actual throttle value is offset somewhat from the throttle position. A measured example is shown in the chart below. Despite this, throttle linearity is good.
6. Changing the throttle trim of course will shift the curve up and down. It is important that throttle trim is not set so that there is a throttle signal at 0% throttle position or else it will not be possible to arm the ESC.
7. Depending upon the method chosen to tap the Delta Ray throttle signals, the throttle curve may look quite different. This example was taken from directly tapping the PCB traces and cutting the traces to remove the MOSFET load (see the hardware documentation for details).


Enunciated value
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Throttle (%)