LightFin

LightFin Nano User Manual

ELRS receiver, six-channel mixing, and rate stabilization in one board

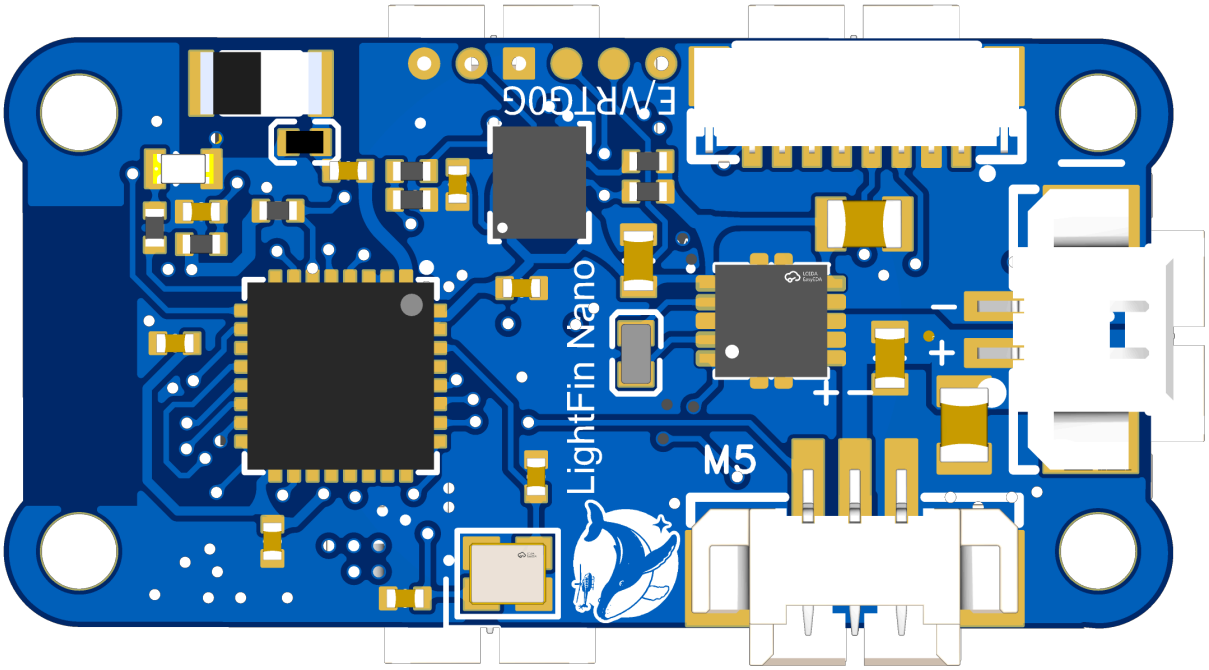

Figure 1: LightFin Nano product and connector overview

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Applicable hardware: LightFin Nano stabilized receiver; firmware: v0.9.3_e364

Contents

1 Product Overview

LightFin Nano, developed by **HumpbackLab**, is a lightweight integrated receiver and control module. It combines an ELRS receiver, six output channels, channel mixing, rate stabilization, voltage telemetry, and brushed-motor drivers on a compact PCB. It is intended for fixed-wing and other lightweight models where size, weight, and wiring must be kept to a minimum.

1.1 Key Capabilities

Feature	Description
Channel outputs	Six channels of micro-servo output with configurable channel mixing.
Brushed motor drivers	Four channels can drive brushed motors, with a rated maximum current of 5 A per channel.
Radio link	Binds to ELRS 3.x transmitter modules.
Stabilization	Manual, Rate, and Angle modes with adjustable PID and input-filter settings.
Output setup	Configurable servo minimum, center, and maximum travel, plus output testing in Wi-Fi mode.
Telemetry	Battery voltage, roll attitude, and pitch attitude telemetry.
Configuration	Settings can be adjusted from the transmitter or the configurator.
Firmware maintenance	Firmware can be updated over Wi-Fi.

Tip: LightFin Nano can also be used as a conventional ELRS receiver that supplies received data to an external flight controller. The hardware supports this use case, but you must solder the UART RX, UART TX, and other required signal wires yourself.

2 Safety Information

Caution: Always remove the propeller and disconnect any powered load that could move unexpectedly before configuration, firmware updates, or output testing. The brushed outputs are rated for a maximum of 5 A per channel; this is not a recommended continuous operating current. Actual usable current also depends on the power supply, connectors, wire gauge, cooling, and ambient temperature.

3 Hardware Overview and Connectors

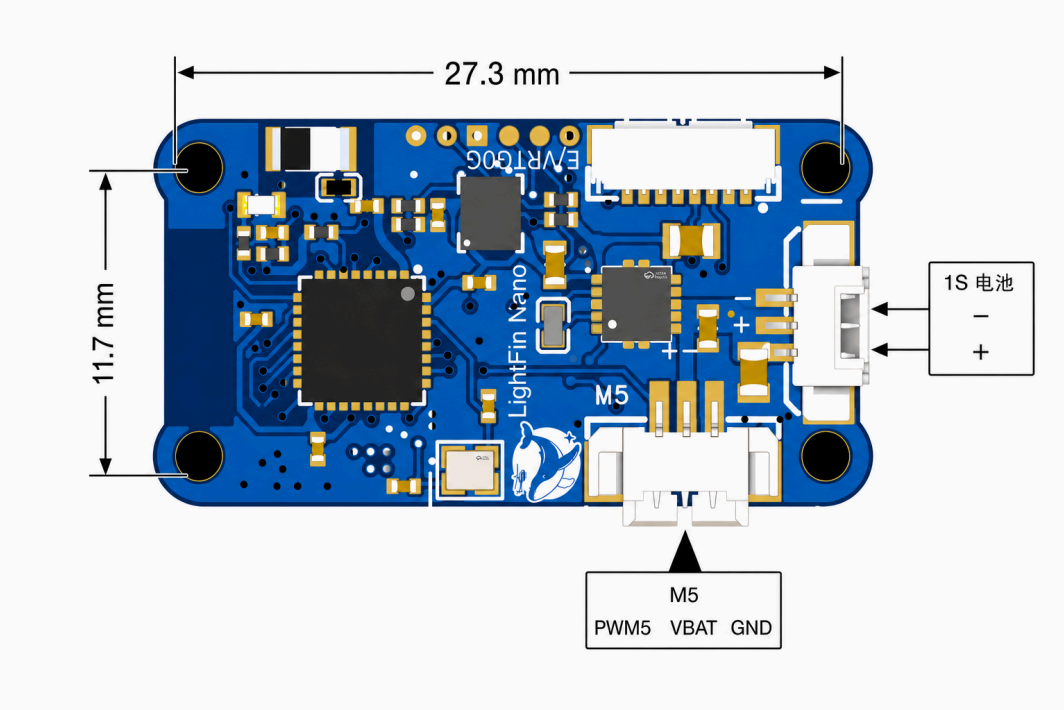


Figure 2: LightFin Nano top-side connector labels

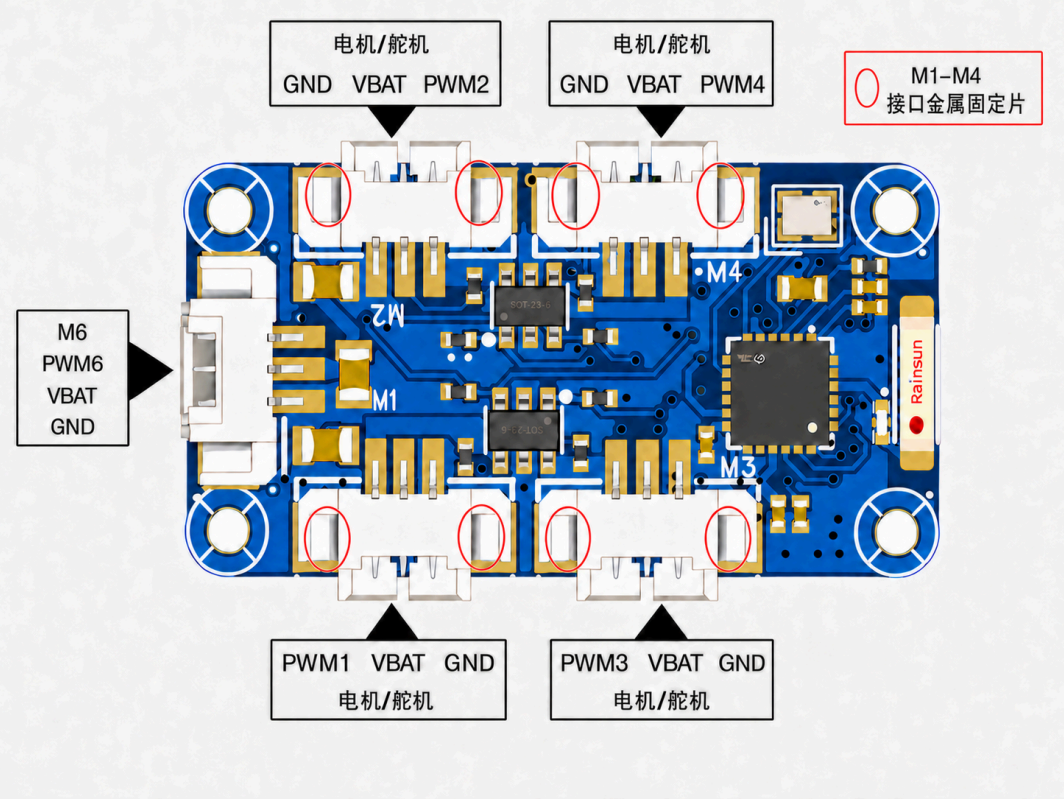


Figure 3: LightFin Nano bottom-side connector labels

Caution: Connect brushed motors to the `PWMx` and `VBAT` pins of the first four channels (`M1-M4`). If you need to solder motor wires directly, use the metal pad strips on both sides of the `M1-M4` connectors.

4 Quick Start

> **Shortest path for first use**: Power on -> connect the configurator -> check for firmware updates -> set the ELRS binding phrase -> configure PWM, mixing, and board orientation -> check outputs at low power -> remove the propeller and complete the ground test.

4.1 Connect the Configurator

1. Power on LightFin Nano. If it does not connect to a transmitter, wait approximately 60 seconds for it to enter Wi-Fi mode.
2. Before connecting to the receiver hotspot, it is strongly recommended that you **check for updates** while you still have internet access.
3. Connect to the receiver hotspot. Its default name is usually `ExpressLRS RX`, and its default password is `expresslrs`.
4. Open `http://10.0.0.1` in the configurator.

4.2 Set the ELRS Binding Phrase

Set the same unique **Binding Phrase** on the transmitter and LightFin Nano.

Enter a suitable binding phrase on the model page and save it.

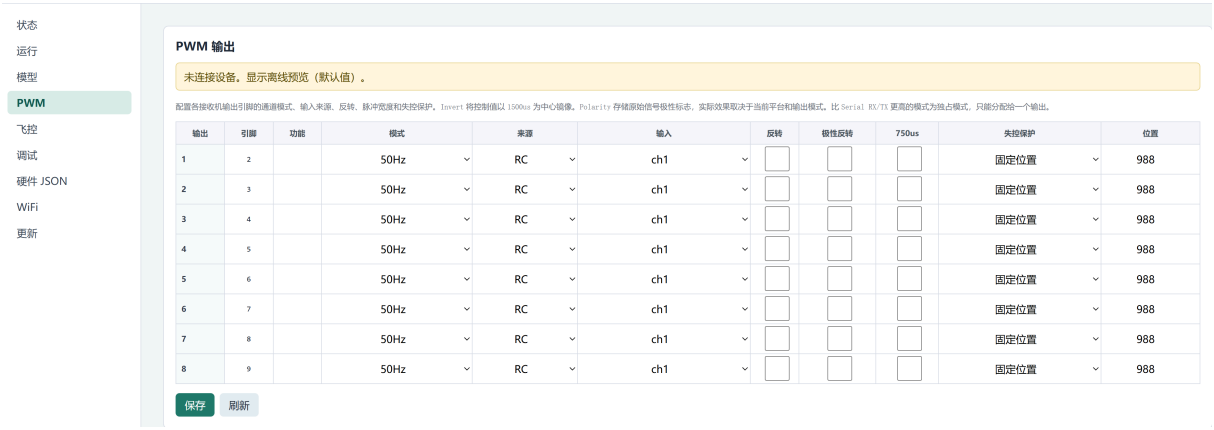
Tip: The UI does not display the binding phrase in plain text. When you enter a new phrase, the UI converts it to a UID and saves it. An empty input field on a later visit does not mean that the setting has been lost.

4.3 Verify the Link

Single-color LED state	Typical meaning
Slow blink (about 500 ms on/off)	Waiting for a transmitter connection.
Double blink	Traditional binding mode is active.
Fast blink (about 25 ms on/off)	Wi-Fi mode is active.
Solid	Connected to the transmitter.

5 Configuration

5.1 PWM Channel Configuration



Output mode:

- For brushed-motor output, select `10KhzDuty`.
- For servo output, select a frequency from 50 Hz to 400 Hz according to the servo specification.

Source:

- `RC`: Control the output directly from a transmitter channel.
- `Mixer`: Use the mixing logic configured in the configurator.

Failsafe behavior when the receiver is locked or the link is lost:

- For motors, `No pulses` is recommended.
- For servos, select a fixed position and set it to a neutral value such as 1500 us.

> **Caution:** The first four channels support both motors and servos. When using them for servos, enable **Polarity inversion**.

5.1.1 Set Servo Travel

舵机行程

分别设置每路 50–500Hz PWM 输出的最小、中位和最大脉宽；RC 与混控器来源都会在中位两侧独立线性映射，非 PWM 模式和失控保护脉宽不受影响。

输出	最小值 (us)	中位值 (us)	最大值 (us)
1	1000	1500	2000
2	1050	1520	1950
3	1000	1500	2000
4	1000	1500	2000
5	1100	1500	1900
6	1100	1500	1900

For servo outputs from 50 Hz to 400 Hz, you can set the minimum, center, and maximum pulse widths individually. The defaults are 1000 us, 1500 us, and 2000 us. The allowed range is 500 us-2500 us, and the values must satisfy minimum < center < maximum.

1. Confirm that the output uses a PWM frequency supported by the servo.

2. Make sure the servo arm and linkage can move freely, then adjust the center from its default.
3. Slowly adjust the minimum and maximum. Do not let the servo stall or drive the linkage beyond its mechanical limits.
4. Save the settings, then recheck the center and both endpoints.

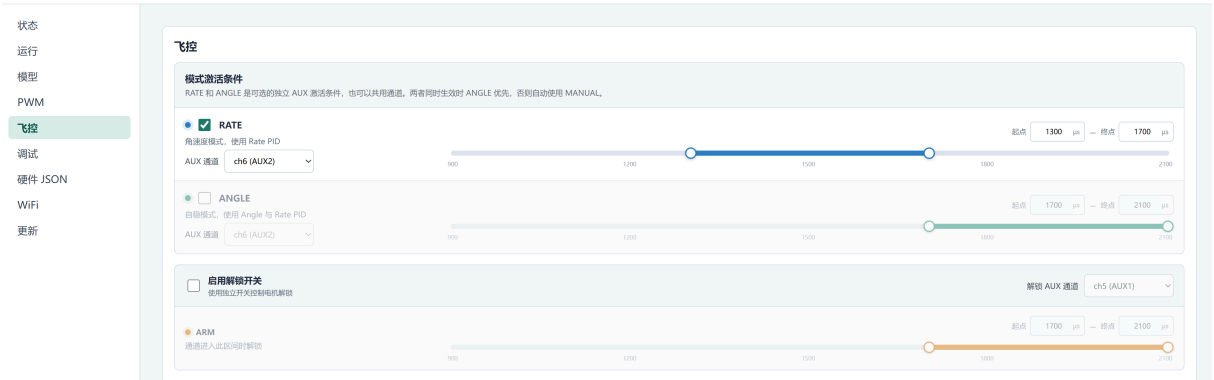
> **Tip:** Servo travel settings do not apply to `10KhzDuty` brushed-motor outputs.

5.1.2 Wi-Fi Output Test

In Wi-Fi mode, you can enable output testing and directly specify the pulse width for each servo. The test value is constrained by the minimum and maximum already configured for that output. Use this feature to check servo center, direction, and mechanical travel.

> **Caution:** The servo moves immediately when output testing is enabled. Remove the propeller and disconnect motors or other powered loads before testing. Disable output testing when finished; disabling it stops the servo PWM output.

5.2 Flight Mode Configuration



Configure the arming channel and the activation channels and ranges for Rate and Angle modes. Mode channels can be selected from CH5 through CH16. A mode becomes active when its channel value falls within the configured range.

Mode	Behavior
Manual	No attitude correction. Stick inputs are sent directly to the mixer.
Rate	Controls roll, pitch, and yaw angular rates. Returning the sticks to center suppresses continued rotation.

Angle	Controls roll and pitch angles and returns the aircraft to level when the sticks are centered. Yaw remains rate-controlled.

If neither the Rate nor Angle activation range is active, the system returns to Manual mode. Do not overlap the two ranges. If they overlap, Angle mode has priority. During ground testing, move the switch through each position and verify that each position activates only one mode.

5.3 PID Settings

Configure the PID parameters for the selected mode. Typical parameter magnitudes for Rate mode are:

- `P`: 0-2
- `I`: 0-10
- `D`: 0-0.5
- `I_lim`: 0-10

For basic stabilization, PD control is usually sufficient.

5.3.1 Input Filters

Firmware v0.9.3_e364 adds two low-pass filter settings:

Setting	Default	Purpose
Gyro LPF	30 Hz	Filters gyroscope angular-rate input to reduce vibration and noise entering the control loop.
D-term LPF	20 Hz	Filters the PID D-term input to reduce servo jitter and high-frequency output.

Both settings accept values from 5 Hz to 100 Hz; 0 disables the filter. A lower cutoff frequency provides stronger filtering but adds control latency. Keep the defaults for initial use. Reduce the cutoff frequency gradually only after confirming significant sensor noise or servo jitter.

5.4 Mixer Configuration

Add or remove motor or servo outputs as needed. Each output has four values representing the contribution of each control axis:

Output = Throttle × throttle coefficient + Roll × roll coefficient

1. Pitch × pitch coefficient + Yaw × yaw coefficient

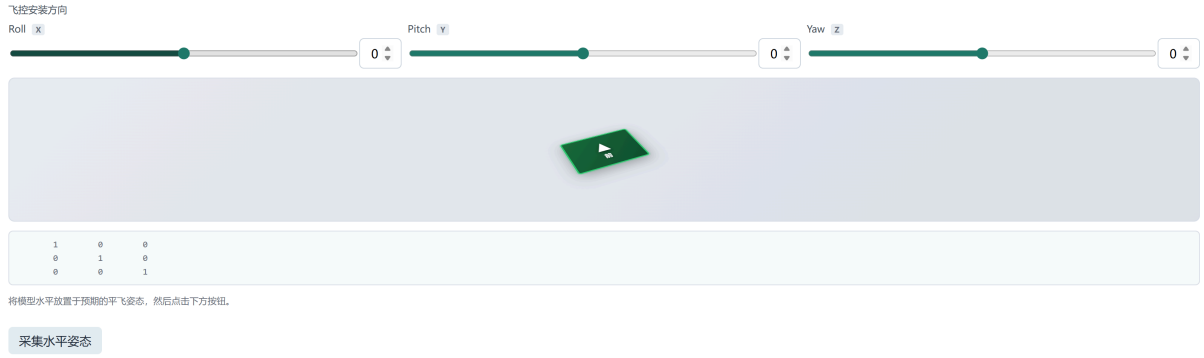
The roll, pitch, and yaw values are the PID controller outputs.

Starting with v0.9.3_e364, each mixer output can be independently set to **Motor** or **Servo**:

- A motor output is based on minimum throttle and is controlled by the arming state.
- A servo output is centered at 1500 us and is not disabled by the motor arming state. It can still respond to mixer input while disarmed.

> **Caution:** Mixer outputs marked as servos may move while the system is disarmed. Before adjusting mixer coefficients or servo travel, keep people clear of the mechanism and make sure no control surface is obstructed.

5.5 Set Flight Controller Orientation



After installing LightFin Nano in the aircraft, hold the aircraft level and select the command to capture the level attitude.

When capture is complete, point the aircraft vertically upward and select the command to capture the vertical attitude. This completes the orientation setup.

Save the settings when finished.

5.6 Voltage and Attitude Telemetry

Discover new sensors from the transmitter telemetry page. Confirm that the voltage reading changes reasonably with battery state before configuring the low-voltage alarm.

The firmware reports roll and pitch through CRSF attitude telemetry at approximately 10 Hz. Rediscover the sensors, then view the values on the transmitter telemetry page or in a widget that supports attitude display. The current yaw value is fixed at 0 and must not be used for heading.

6 Firmware Update

The computer or phone normally has no internet access while connected to LightFin Nano, unless AP mode is used. While disconnected from the receiver and connected to the internet, first download the latest firmware locally. After reconnecting to the receiver, check whether an update is needed.

7 Schematic

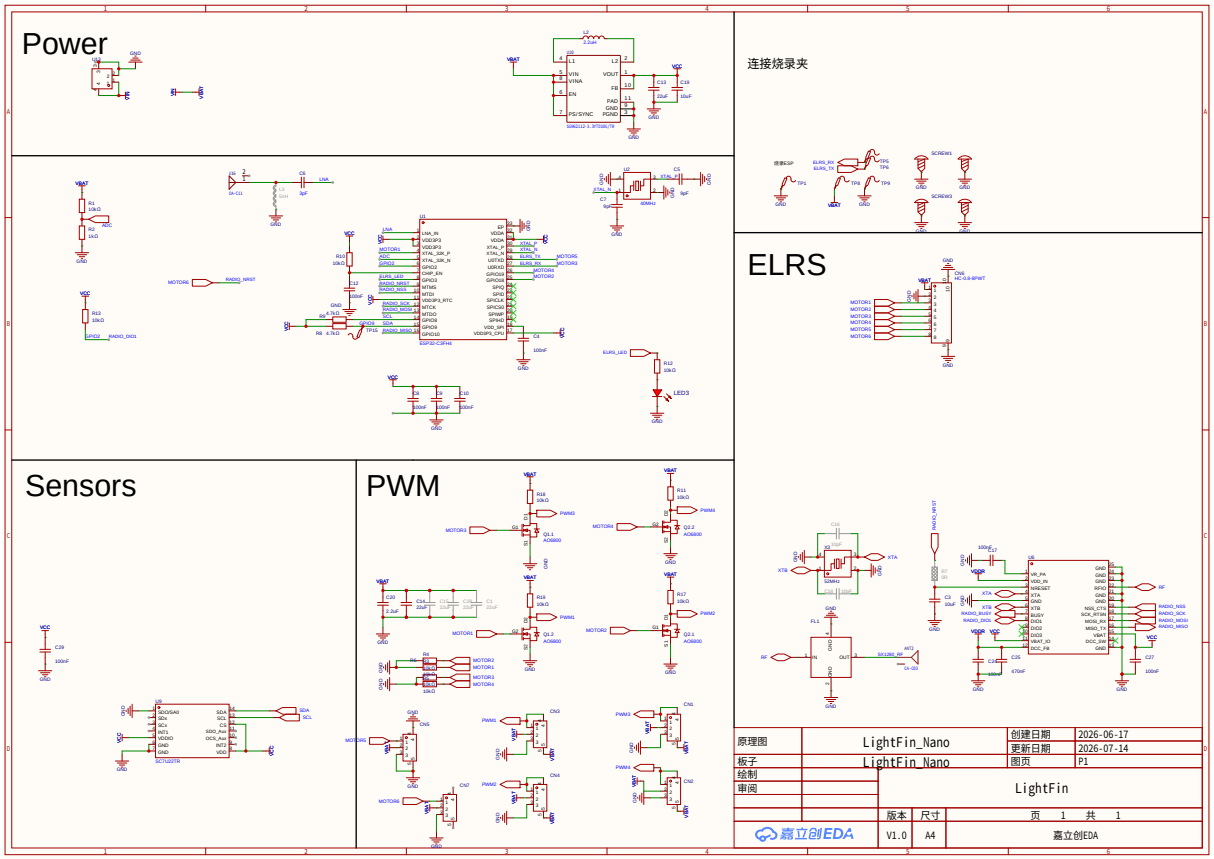


Figure 4: LightFin Nano schematic