
# User Manual
# AeroFC Autopilot

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## Document Control

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| Organization | PDRL |
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# 1 DOCUMENT INTRODUCTION

The user manual of Aero Flight controller (AeroFC) helps user with understanding the overall aspects of the product in various forms. The information has been divided into:

a) Product Information
b) Installation
c) Configuration
d) Warranty and Support

## 1.1 LIST OF IMAGES USED IN THIS DOCUMENT

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## 1.2 ABBREVIATIONS USED IN THIS DOCUMENT

Here are the abbreviations and their meaning used in this RFP.

| Abbreviations | Full Form of abbreviations |
|---|---|
| | |
| AeroFC | Aero Flight Controller |
| PDRL | Passenger Drone Research Private Limited. |
| I2C | Inter-Integrated Circuit |
| Lidar | Light Detection and Ranging |
| UART | Universal Asynchronous Receiver/Transmitter |
| ESC | Electronic Speed Controller |
| CAN | Controller Area Network |
| TELEM | Telemetry |
| AeroGCS | Aero Ground Control Software |
| GPS | Global Positioning System |
| | |

# 2 PRODUCT INTRODUCTION

## 2.1 PRODUCT SPECIFICATIONS

### 2.1.1 Product Overview Table

| Performance Parameter | PDRL Aero FC |
|---|---|
| | |
| Main FMU Processor | STM32F765 (32 Bit Arm® Cortex®-M7, 216MHz) |
| RAM | 2MB memory, 512KB RAM |
| IO Processor | 32 Bit Arm® Cortex®-M3, 24MHz, 8KB SRAM |
| On-Board Sensors | Accelero/Gyro: ICM-20689<br>Accelero/Gyro: BMI055<br>Magnetometer: IST8310<br>Barometer: MS5611 |
| Power Supply Connection | 2 Power Source with automatic failover |
| Power Consumption | Power: 4.3~5.4V<br>USB Input: 4.75~5.25V<br>Servo Rail Input: 0~36V |
| Interfaces | ○ 8-14 PWM outputs (6 from IO, 8 from Main controller)<br>○ Dedicated PWM/Capture inputs on Main Controller<br>○ Dedicated R/C input for CPPM<br>○ Dedicated R/C input for PPM and S.Bus<br>○ Analog / PWM RSSI input<br>○ S.Bus servo output<br>○ 5 general purpose serial ports<br>○ I2C ports<br>○ SPI buses<br>○ CAN Buses with serial ESC<br>○ Analog inputs for voltage / current of 2 batteries |

### 2.1.2 Dimensions

AeroFC product dimension are as below:

a) Height: Outer height of the AeroFC is 29mm.
b) Length: Outer length of the AeroFC enclosure is 103mm.
c) Width: Outer width of the AeroFC enclosure is 50.50 mm
d) Mounting Screw: Mounting screw 2x5 mm.

#### 2.1.2.1 Top Cover Details

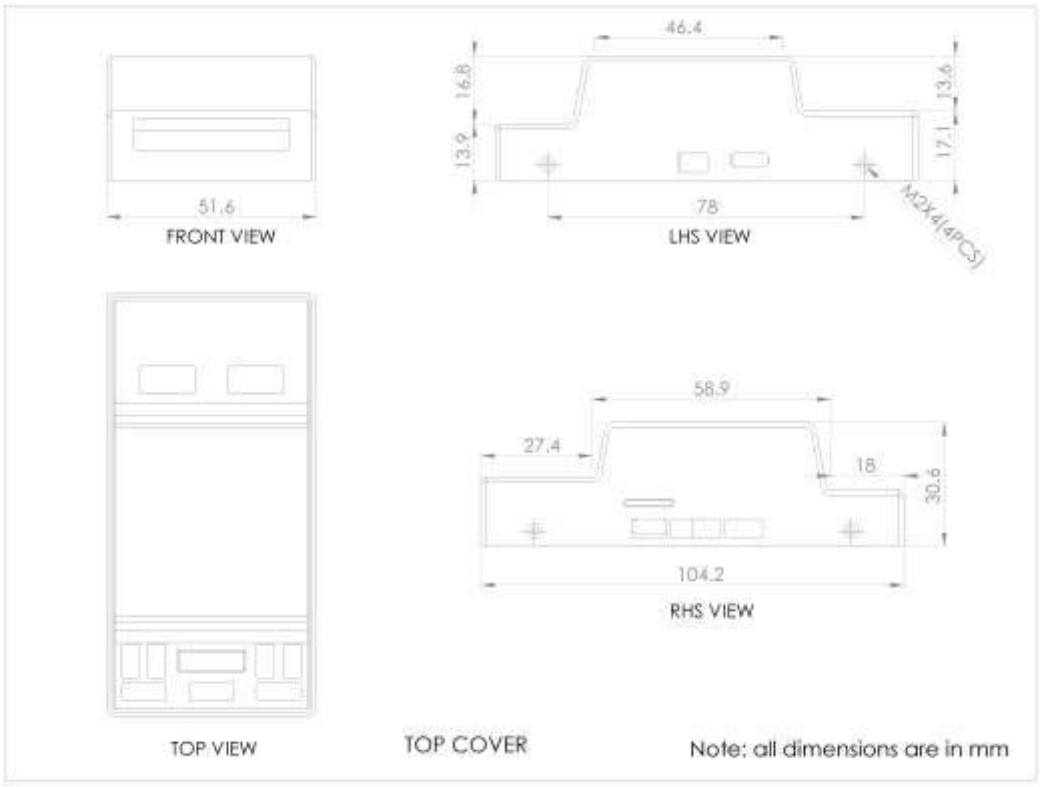


Image #1: AeroFC Enclosure Dimension

### 2.1.2.2 Bottom Cover Details

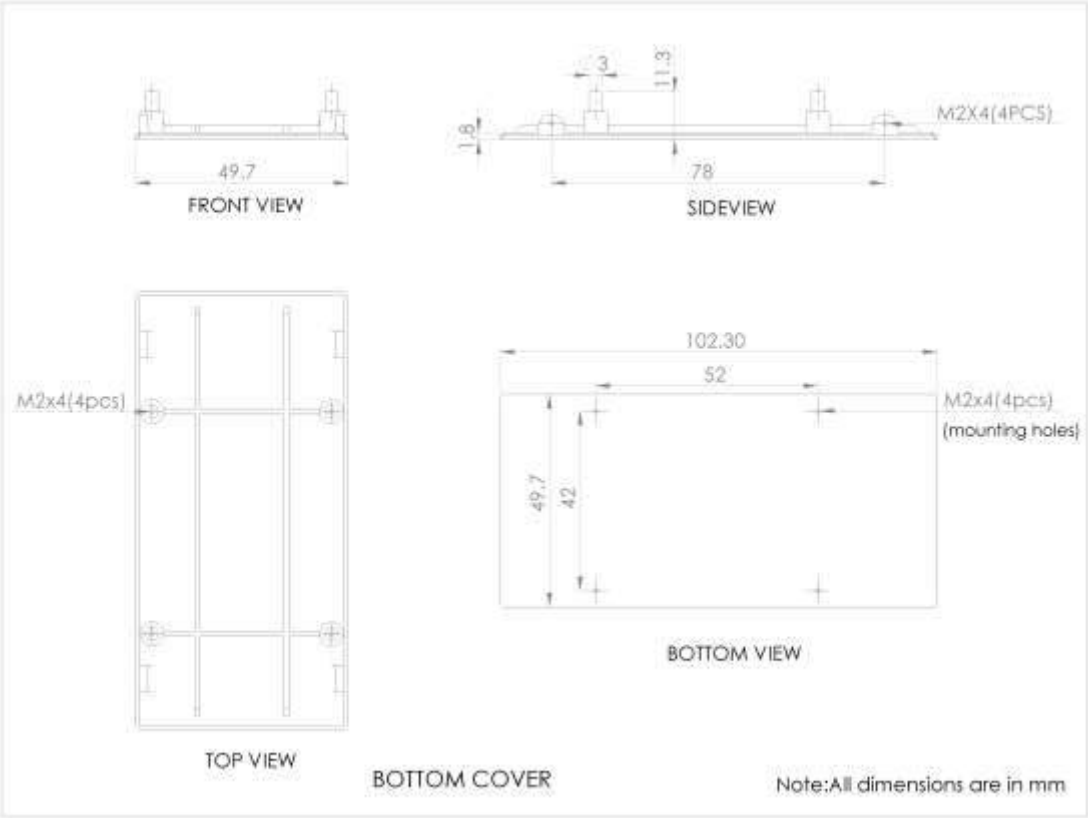


Image #2: AeroFC Enclosure Bottom Dimension

### 2.1.3 Screws Used

| Screw Image | Screw Details |
|---|---|
| | Make and Model:- CSK Philips machine screws<br>Dimension:- M2x5mm<br>Material:- Stainless steel<br>Quantity:- 4pcs |
| | Make and Model → PAN head Philips machine screws<br>Dimension → M2x8mm<br>Material → Stainless steel<br>Quantity → 4pcs |

### 2.1.4 Power Specifications

- Operating power: 4.3~5.4 V
- USB Input: 4.75~5.25 V
- High-power servo rail, up to 36 V (servo rail does not power the autopilot)
- Dual voltage and current monitor inputs
- It supports triple redundant power input if power input is provided to both battery inputs and the USB port simultaneously. If any two power fails, it will still operate.

### 2.1.5 PIN Descriptions

#### 2.1.5.1 Telem_1

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | Tx | Transmitter line |
| 3 | Rx | Receiver line |
| 4 | CTS | Clear to send line |
| 5 | RTS | Request to send line |
| 6 | GND | Ground |

#### 2.1.5.2 UART_4

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | Tx | Transmitter pin |
| 3 | Rx | Receiver pin |
| 4 | SCL2 | Clock line |
| 5 | SDA2 | Data line |
| 6 | GND | Ground |

#### 2.1.5.3 Telem_2

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | Tx | Transmitter line |
| 3 | Rx | Receiver line |
| 4 | CTS | Clear to send line |
| 5 | RTS | Request to send line |
| 6 | GND | Ground |

#### 2.1.5.4 CAN_2

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | CAN_H | CAN HIGH line |

| | | |
|---|---|---|
| 3 | CAN_L | CAN LOW line |
| 4 | GND | Ground |

#### 2.1.5.5 CAN_1

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | CAN_H | CAN HIGH line |
| 3 | CAN_L | CAN LOW line |
| 4 | GND | Ground |

#### 2.1.5.6 GPS and Safety

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | Tx | Transmitter line |
| 3 | Rx | Receiver line |
| 4 | SCL1 | Clock line |
| 5 | SDA1 | Data line |
| 6 | Safety_SW | Safety switch pin |
| 7 | Safety_SW_LED | Safety switch LED |
| 8 | Safe_VCC | VCC |
| 9 | Buzzer | Buzzer pin |
| 10 | GND | Ground |

#### 2.1.5.7 I2C_2

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | SCL2 | Clock line |
| 3 | SDA2 | Data line |
| 4 | GND | Ground |

#### 2.1.5.8 I2C_1

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |

| | | |
|---|---|---|
| 2 | SCL1 | Clock line |
| 3 | SDA1 | Data line |
| 4 | GND | Ground |

#### 2.1.5.9 Power_2

| Pin | Name | Description |
|---|---|---|
| 1 | Power_IN | Input power |
| 2 | Power_IN | Input power |
| 3 | SCL1/Current | Clock line/Current pin |
| 4 | SDA1/Voltage | Data line/Voltage pin |
| 5 | GND | Ground |
| 6 | GND | Ground |

#### 2.1.5.10 Power_1

| Pin | Name | Description |
|---|---|---|
| 1 | Power_IN | Input power |
| 2 | Power_IN | Input power |
| 3 | Current | Clock line |
| 4 | Voltage | Data line |
| 5 | GND | Ground |
| 6 | GND | Ground |

#### 2.1.5.11 ADC

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | 3V3 ADC | ADC pin |
| 3 | 6V6 ADC | ADC pin |
| 4 | GND | Ground |

#### 2.1.5.12 SPI_5

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | SCK | Clock line |

| | | |
|---|---|---|
| 3 | MISO | Master In Serial Out line |
| 4 | MOSI | Master Out Serial In line |
| 5 | CS1 | Chip select 1 |
| 6 | CS2 | Chip select 2 |
| 7 | GND | Ground |

#### 2.1.5.13 DSM/SBUS/RSSI

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | DSM/SBUS RC | |
| 3 | RSSI | |
| 4 | DSM 3V3 | |
| 5 | GND | Ground |

#### 2.1.5.14 SBUS_OUT

| Pin | Name | Description |
|---|---|---|
| 1 | NC | Not connected |
| 2 | SBUS_OUT | |
| 3 | GND | Ground |

#### 2.1.5.15 I2C_3

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | SCL3 | Clock line |
| 3 | SDA3 | Data line |
| 4 | GND | Ground |

#### 2.1.5.16 Debug and UART_7

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | Vcc |
| 2 | Debug_Tx | Transmitter line |
| 3 | Debug_Rx | Receiver line |
| 4 | FMU_SWDIO | Data line |

| | | |
|---|---|---|
| 5 | FMU_SWCLK | Clock line |
| 6 | GND | Ground |

#### 2.1.5.17 I2C_4

| Pin | Name | Description |
|---|---|---|
| 1 | 5V | VCC |
| 2 | SCL_4 | Clock line |
| 3 | SDA_4 | Data line |
| 4 | GND | Ground |

DSU7 is an interface for AeroFC naming, which includes FMU SWD and UART7 interfaces. UART7 is used as the DEBUG interface for AeroFC with PX4 firmware. Whereas when running ArduPilot firmware; UART7 is used as the communication serial port and USB is used to debug the output.

The PPMIN interface is limited to powering the RC receiver and cannot be connected to any power/load.

**Voltage Ratings**

AeroFC AutoPilot can be triple-redundant on the power supply if three power sources are supplied. The two power rails are: **POWER1**, **POWER2** and **USB**.

The output power rails **FMU PWM OUT** and **I/O PWM OUT** (0V to 36V) do not power the flight controller board (and are not powered by it). You must supply power to one of **POWER1**, **POWER2** or **USB** or the board will be unpowered.

**Normal Operation Maximum Ratings**

Under these conditions all power sources will be used in this order to power the system:

1. **POWER1** and **POWER2** inputs (4.3V to 5.4V)
2. **USB** input (4.75V to 5.25V)

**Debug Port**

The system's serial console and SWD interface operate on the **FMU Debug** port. Simply connect the FTDI cable to the Debug & F7 SWD connector (the product list contains the FTDI cable). It does not have an i/o debug interface.

## 2.2 PRODUCT BLOCK DIAGRAM

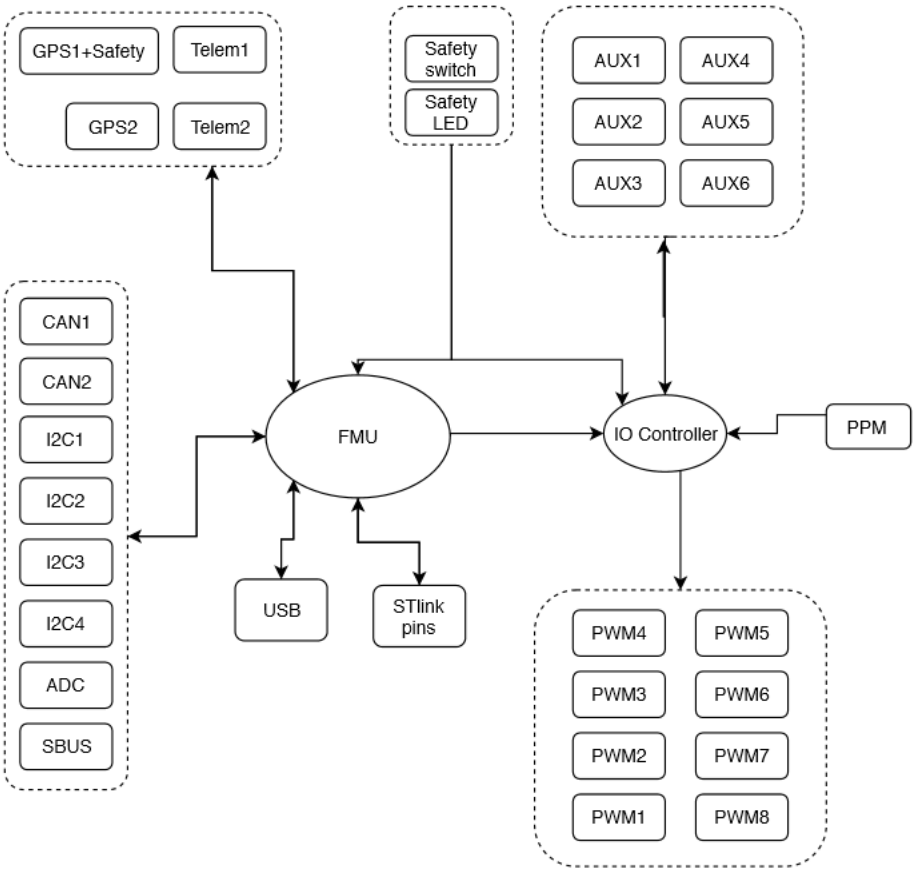


Image #3: AeroFC Autopilot Block Diagram

# 3 INSTALLATION

## 3.1 UNPACKING THE BOX

### 3.1.1 AeroFC Box First view

Image #4: AeroFC Packaging Box cover with Quick Start Guide

#### 3.1.1.1 View after removal of Quick start guide

Image #5: AeroFC packaging box cover after quick start guide

### 3.1.1.2 View of other components in package

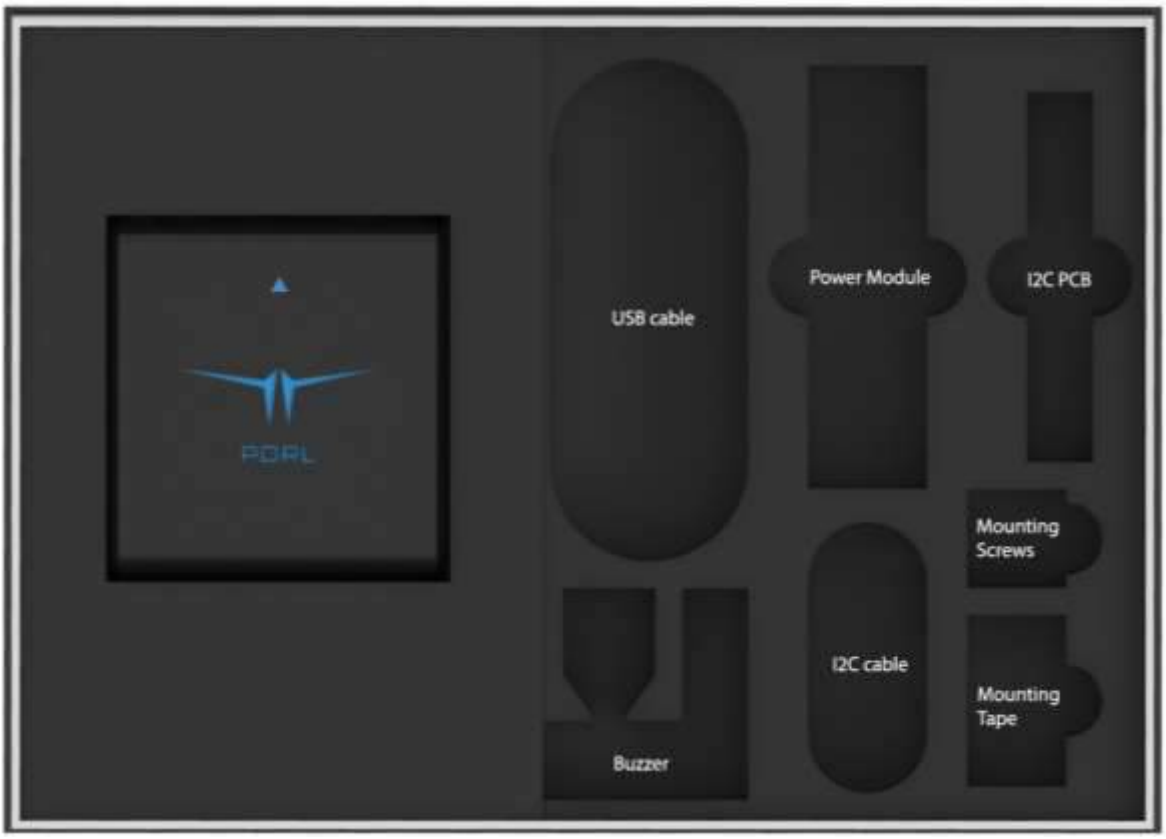


Image #6: AeroFC packaging box component layout

## 3.2 SAFETY INSTRUCTION WHILE HANDLING

- Only trained and qualified personnel should be allowed to install, replace, or service this equipment.
- To prevent the system from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature of 50°C.
- Non static environment

## 3.3 PRODUCT COMPONENTS IN BOX

| Serial Number | Component Name | Component Icon |
|---|---|---|
| | | |
| **1)** | Quick Start Guide |  |
| **2)** | AeroFC Autopilot |  |
| **3)** | C Type USB Cable: for Communication between AeroFC and Ground |  |
| **4)** | Buzzer: alarming buzzer |  |
| **5)** | Safety Switch: for arming device safely |  |
| **6)** | Mounting Tape: to stick flight controller on airframe |  |
| **7)** | Mounting Screws: to mount flight controller on airframe |  |
| **8)** | I2C Cables: for connection of I2C devices |  |
| **9)** | I2C PCB: for expansion of I2C PCB |  |
| **10)** | Power Module & Cable: to power up flight controller board |  |
| | | |

## 3.4 INSIDE THE ENCLOSURE

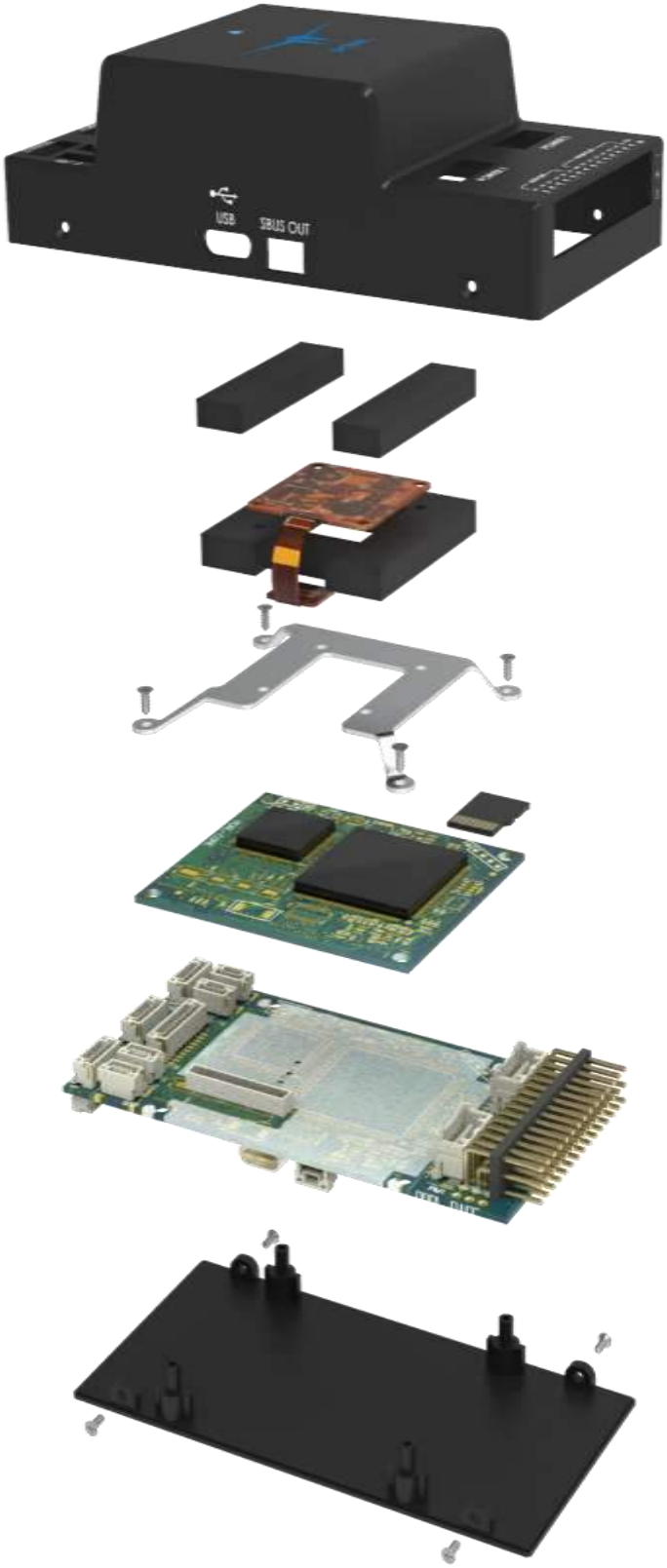


Image #7: AeroFC internal component structure

## 3.5 MOUNTING PROCEDURE

- Mount the AeroFC on your drone using the 3M double layer tape or screws provided with the package.
- Stick the 3M double layer tape at the bottom of AeroFC (refer diagram A) OR screw the AeroFC to the mounting plate of the drone (refer diagram B).

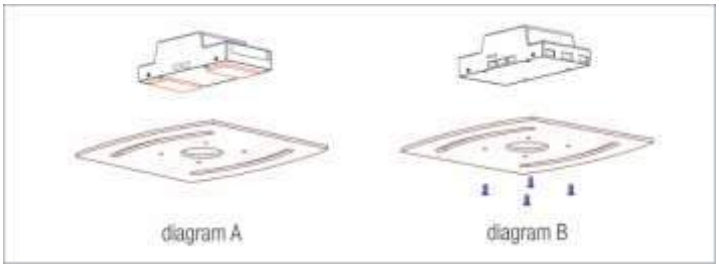


Image #8: AeroFC enclosure mounting process #1

- Make sure that the logo on the flight controller is pointing to the front of your drone as shown in the following image:

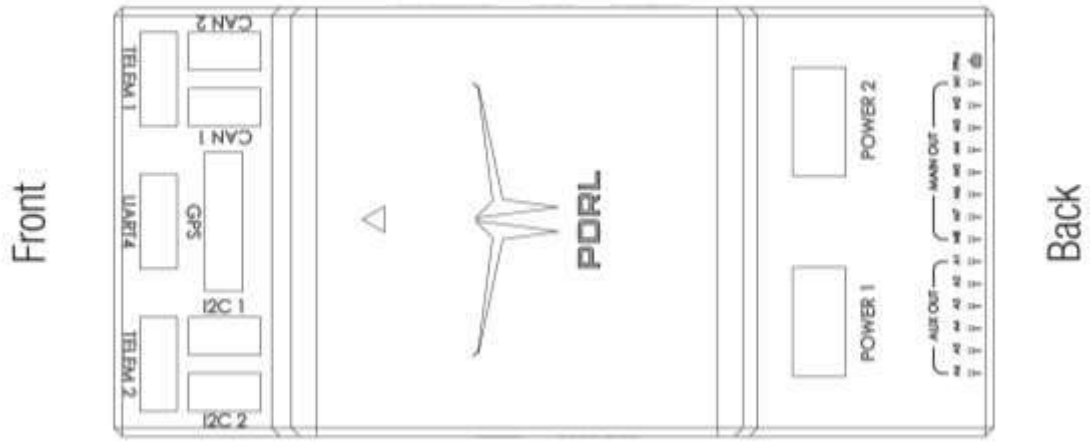


Image #9: AeroFC enclosure mounting process #2

## 3.6 CONNECTION SEQUENCE

The diagram describes the overall connections of various components onto AeroFC.

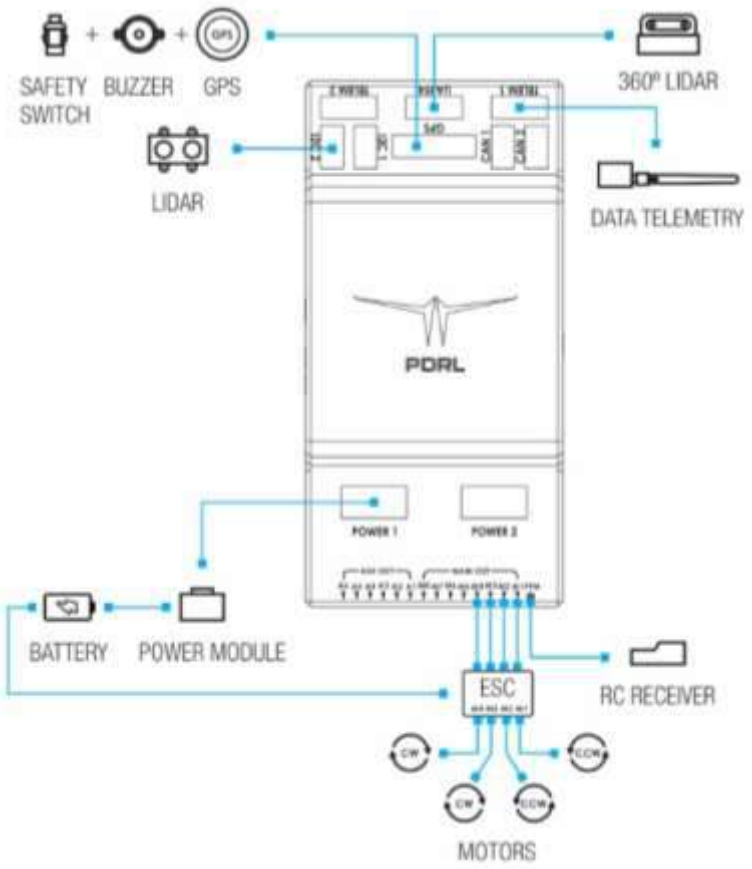


Image #10: AeroFC components connection diagram

The following sequence should be followed for connecting the devices/peripherals/sensors:

1) Connect power module to the power port of board.
2) Connect the AeroFC board to the computer/tab using USB cable.
3) Connect the safety switch,
4) Connect the buzzer
5) Connect the GPS AeroFC board
6) Connect the RC receiver to PPM pins of the board.
7) Connect the lidar to any I2C ping of the board.
8) Connect 360-degree Lidar to any UART port of the device.
9) Connect the telemetry to telemetry port 1.

# 4 CONFIGURATION

## 4.1 IN-BUILT FIRMWARE

By default, each AeroFC comes with AeroFC firmware.

## 4.2 GROUND CONTROL STATION SOFTWARE DOWNLOAD

### 4.2.1 Mission Planner

You can download the Ardupilot mission planner from its official website as mention below.

https://firmware.ardupilot.org/Tools/MissionPlanner/MissionPlanner-latest.msi

### 4.2.2 AeroGCS

You can download the PDRL AeroGCS from its official website as mention below.

http://pdrl.in/aerogcs-ground-control-software/

### 4.2.3 Qgroundcontrol

You can download the PX4 Qgroundcontrol from its official website as mention below.

http://qgroundcontrol.com/downloads/

## 4.3 CONNECTING WITH GROUND CONTROL STATION

Connect the AeroFC board to laptop using C type USB cable available in the box. Upon successful connection, a light on AeroFC board will power ON.

Image #11: AeroFC laptop/tab connection

### 4.4 First Boot

Once AeroFC is connected to the laptop, with right configuration settings like port, baud rate and so on, the data will be fetched from the device. The ground station software will read all the necessary information and display it on the dashboard. If it is connected successfully and all information of the device is fetched properly, then it means all configurations are done properly. Here is the screen to understand it. In this screenshot, Mission planner is used to showcase the connection with Autopilot device.


Image #12: AeroFC first boot image using Mission Planner

# 5 Warranty and Support

### 5.1 Limited Warranty

The warranty obligations of PDRL for this product are limited to the terms set forth below:

#### 5.1.1 What is covered?

This limited warranty covers defects in materials and workmanship in this product.

#### 5.1.2 What is Not covered?

This limited warranty does not cover any damage, deterioration or malfunction resulting from any alteration, modification, improper or unreasonable use or maintenance, misuse, abuse, accident, neglect, exposure to excess moisture, fire, improper packing and shipping (such claims must be presented to the carrier), lightning, power surges, or other acts of nature. This limited warranty does not cover any damage, deterioration or malfunction resulting from the installation or removal of this product from any installation, any unauthorized tampering with this product, any repairs attempted by customer to make such repairs, or any other cause which does not relate directly to a defect in materials and/or workmanship of this product. This limited warranty does not cover cartons, equipment enclosures, cables or accessories used in conjunction with this product.

Any spare parts given with AeroFC board doesn't cover any warranty.

### 5.1.3 What is warranty period?

The standard limited warranty for AeroFC autopilot is of one year from the date of original purchase. Under this warranty, only the AeroFC board is covered. Post one year, if the additional warranty is purchased by the customer, then s/he can claim for additional warranty.

### 5.1.4 Who is covered?

Only the original purchaser of this product is covered under this limited warranty. This limited warranty is not transferable to subsequent purchasers or owners of this product.

### 5.1.5 What PDRL will do?

PDRL will, at its sole option, provide one of the following three remedies to whatever extent it shall deem necessary to satisfy a proper claim under this limited warranty:

a) Elect to repair or facilitate the repair of any defective parts within a reasonable period, free of any charge for the necessary parts and labor to complete the repair and restore AeroFC product to its proper operating condition. PDRL will also pay the shipping costs necessary to return this product once the repair is complete.
b) Replace AeroFC product with a direct replacement or with a similar product deemed by PDRL to perform substantially the same function as the original product.
c) Issue a refund of the original purchase price less depreciation to be determined based on the age of the product at the time remedy is sought under this limited warranty.

### 5.1.6 What PDRL will not do?

In order to get the warranty of the AeroFC, it is necessary to ship the product to PDRL or its authorized partner(s). The cost of shipping of part and its insurance will not be taken care by PDRL. As well, the responsibility to deliver the product to PDRL will not lie with PDRL.

### 5.1.7 How to obtain warranty?

To obtain a remedy under this limited warranty, customer should contact either the authorized PDRL partner from whom you purchased this product or the PDRL office nearest you. For a list of authorized PDRL partners and/or PDRL authorized service providers, visit our web site at www.pdrl.in .

In order to pursue any remedy under this limited warranty, customer must possess an original, dated receipt as proof of purchase from an authorized PDRL/its partner. If this product is returned under this limited warranty, this product should be properly packed, preferably in the original carton, for shipping.

## 5.2 TECHNICAL SUPPORT

PDRL offers one-month free email and phone technical support for the AeroFC device from the date of purchase of the device. During the one-month free technical support, customer can seek technical support through following methods.

a) Customer can send an email to techsupport@pdrl.in during the business days and business hours. Customer can call on 86006 24579 for any technical queries to address.
b) Response time SLA is two hours after receiving any email from registered users only for any kind of technical support.
c) Time SLA for Resolution of problem will be based type of problem.
d) Any email sent from any unrecognized email address would not be supported.

e) PDRL support team may request for further authentication for validation purpose during the technical support therefore it is necessary for customers to share required information.
f) Technical support related to PDRL products and services will be only covered under the scope of support services.
g) Only devices under AMC would be entitled to have technical support post one month of delivery.
h) Customer can seek help related to configuration issues, or any errors related to the AeroFC device.

## 5.3 PRODUCT LICENSE AND COMPLIANCES

AeroFC is an open hardware design, following the OSHW 1.1 definition licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) license. The schematic diagram of AeroFC is available at https://github.com/pixhawk/Hardware/tree/master/FMUv5 . The board has gone through CE certification tests successfully.