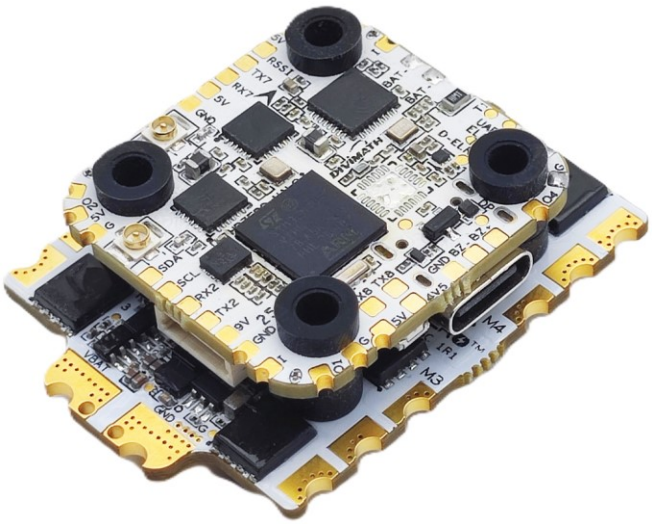
User Manual of

HDZero Halo Flight Controller and 4in1 70A ESC



Revision	Date	Description
1.0	Jan 14, 2025	Initial draft
1.3	Feb 6, 2025	Added Halo Flight Controller
1.4	June 24, 2025	Added Halo 4in1 70A ESC
1.5	July 24, 2025	Added support for DSHOT2400

For more product information, please visit:
www.hd-zero.com

Contents

HDZero Halo Mini Flight Controller with Gemini ELRS RX

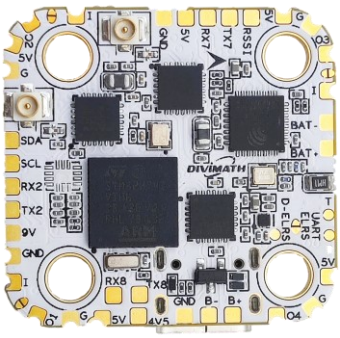
Introduction

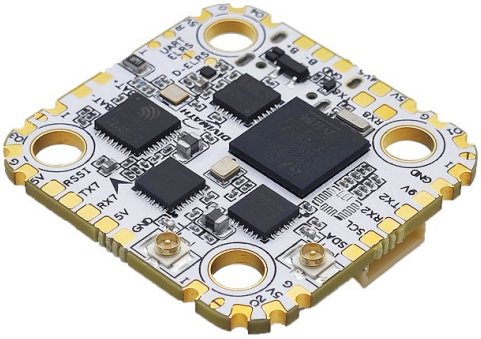
The HDZero Halo is a compact flight controller powered by the H743 MCU for high-performance computation. It integrates a Gemini ELRS receiver and features a switchable 9V/3A BEC output for video transmitters, along with a 5V/4A output for LED strips and other peripherals. The integrated ELRS RX simplifies quad assembly and ensures high-performance link quality with its Gemini.

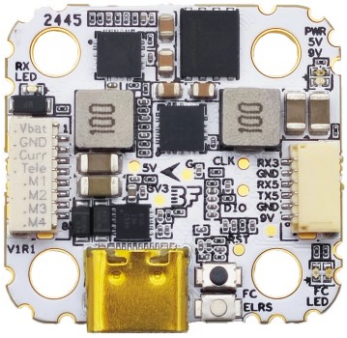
The Halo Flight Controller makes connecting parallel LED strips for single colors straightforward and simplifies the routing of addressable LED strip wires. Designed for digital video systems, it eliminates the analog OSD chip to save space and reduce costs. It's particularly optimized for use with the HDZero Race v3 VTX, ensuring a low-profile stack.

The Halo Flight Controller features dedicated sockets for connecting ESCs with a maximum 4A included cable, as well as for connecting any digital VTXes. This design makes it a solderless flight controller, ensuring easy assembly and quick swaps in the field.

The Halo Flight Controller is available in two versions, MPU6000 and ICM42688, to meet different pilot preferences.







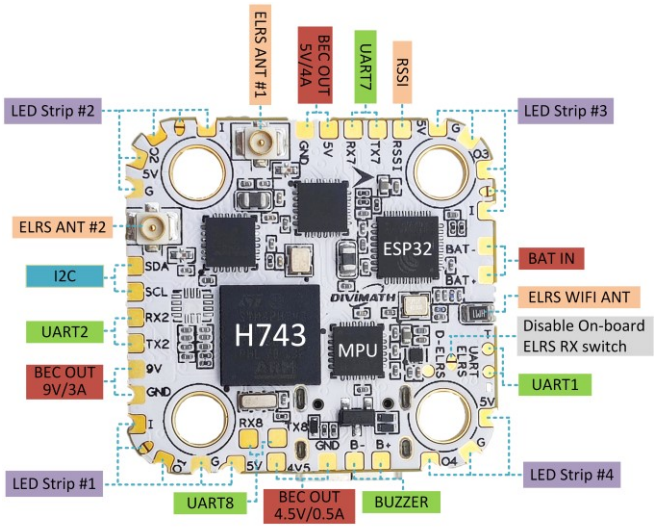
Specification

Model	HDZero Halo Flight Controller
Flight Controller	
MCU	STM32H743 (480MHz)
Gyro	MPU6000 or ICM42688
BEC output	DC 5V/4A DC 9V/3A DC 4.5V/0.5A
Black Box	16MB Flash memory
I2C Pads	Yes
UART Pads	TX2/RX2, TX7/RX7, TX8/RX8
ESC Telemetry	RX4
VTX MSP UART	TX5/RX5
DJI HDL	RX3
Buzzer Pads	Yes
LED Strip	Parallel or Serial
USB	Type-C
Analog OSD	No
FC Firmware	Betaflight: HDZERO_HALO
ELRS Receiver	
Chip Set	ESP32 + 2x SX1280
FC UART	TX1/RX1
Gemini RX	Yes
RF Frequency	2.4GHz
Max TX RF Power	10mW
Antenna Interface	2xU.FL
ELRS Firmware	HDZero Halo FC 2.4G Gemini RX
Dimensions	
Power Supply	3S ~ 8S
Size	29x30.5mm with 20x20 M4 mounting holes
Weight	5.6g
Dedicated sockets for	ESC, and HDZero and other Digital VTX's

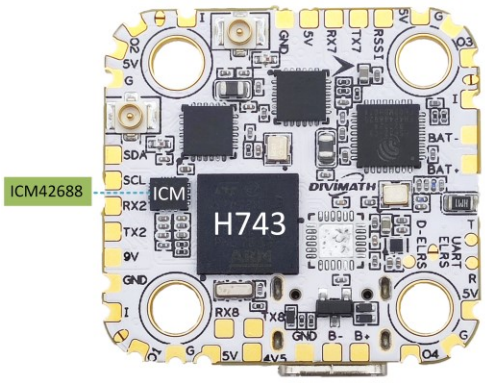
Includes

- 1x HDZero Halo FC
- 5x Rubber Grommet(6.6mm)
- 5x Rubber Grommet(8.0mm)
- 1x ELRS T-sharp short antenna (40mm)
- 1x ELRS T-sharp long antenna (90mm)
- 2x ELRS antenna retainers
- 1x ESC Cable (8-pin SH1.0, 30mm)
- 1x 8-pin SH1.0 connector

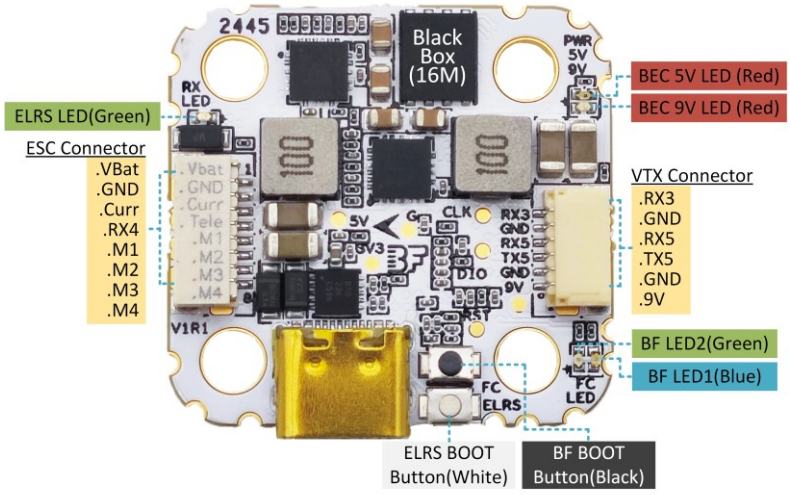
Diagram



HDZero Halo FC – Top View (MPU6000)



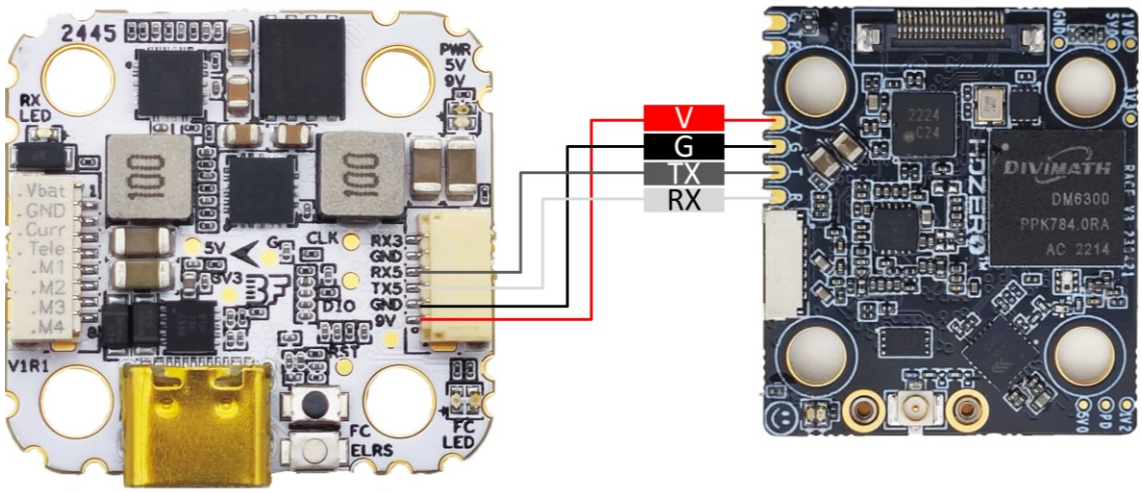
HDZero Halo FC – Top View (ICM42688)



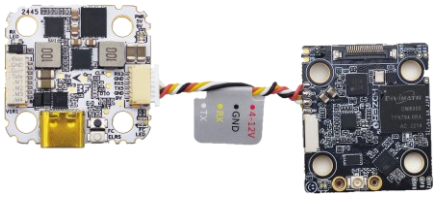
HDZero Halo FC – Bottom View

Wiring

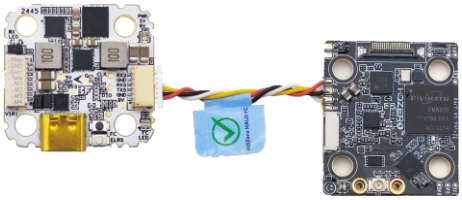
HDZero RACE V3 VTX Wiring



Unfortunately, the previous batches of HDZero VTX-R3 have different signal definitions for its connector, requiring users to re-pin it (see picture below) to match the correct connections. However, the latest HDZero Race v3 VTX features an updated connector that perfectly matches the Halo FC, enabling seamless plug-and-play installation.

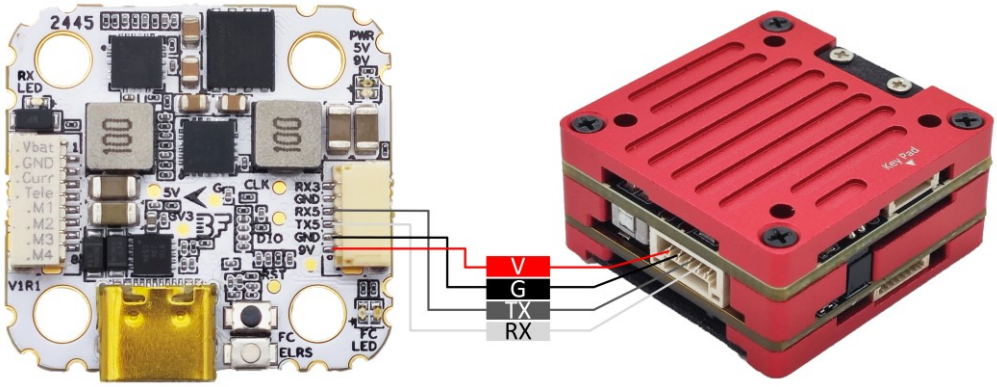


The previous batches of VTX-R3 (after re-pinning)

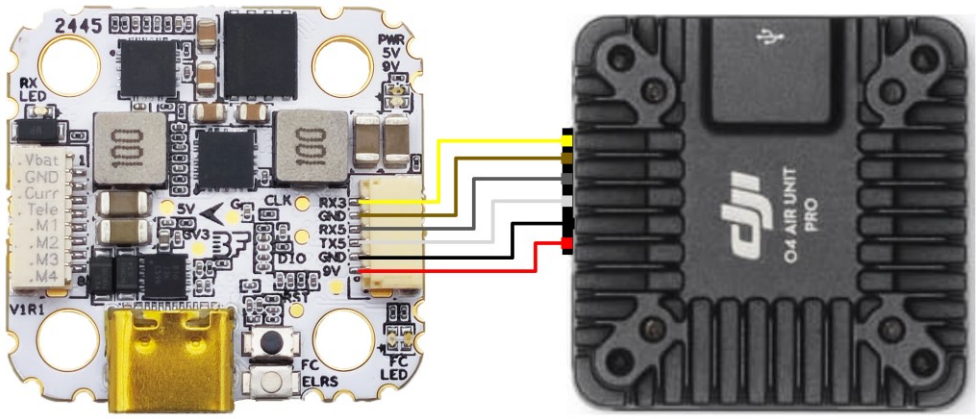


The newest batch of HDZero VTX-R3

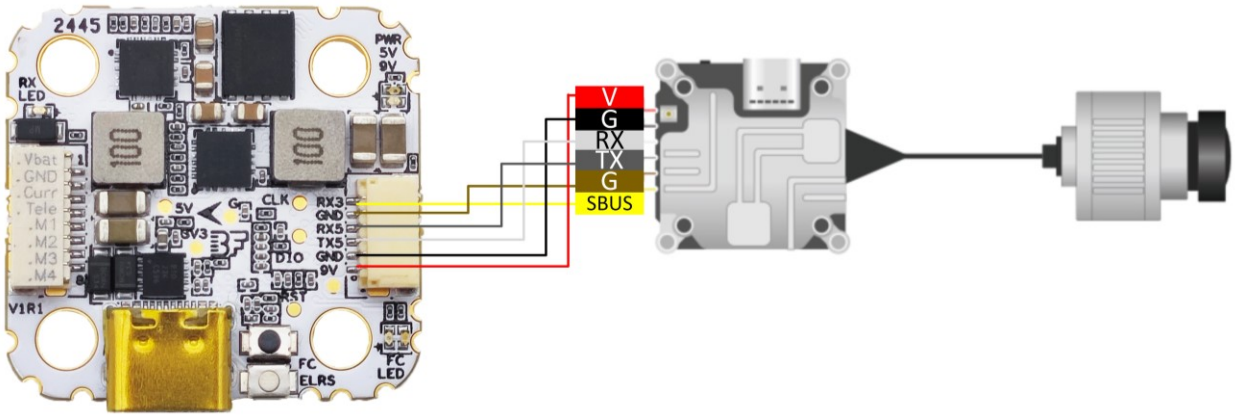
HDZero Freestyle V2 VTX Wiring



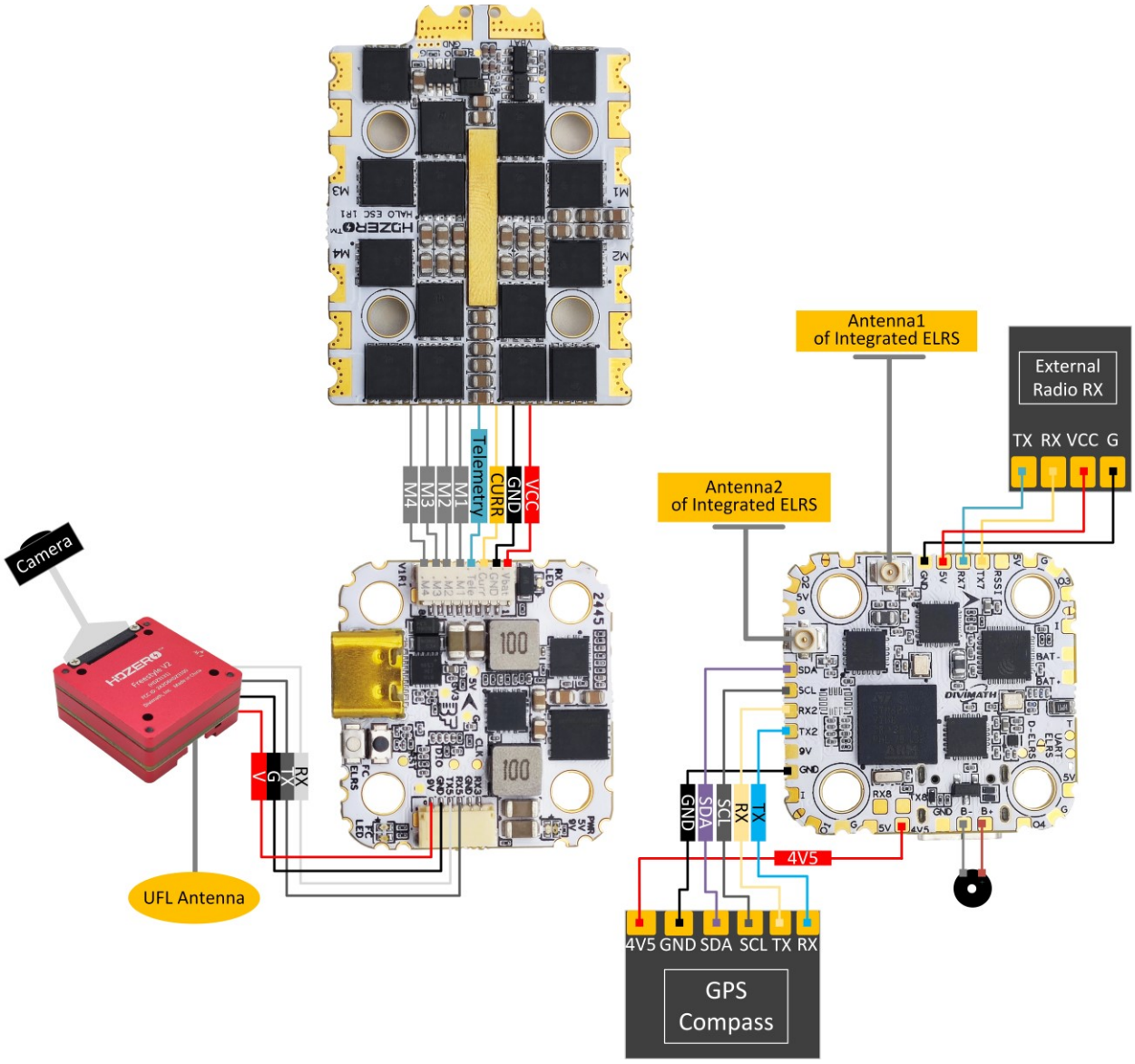
DJI O3/O4 Wiring



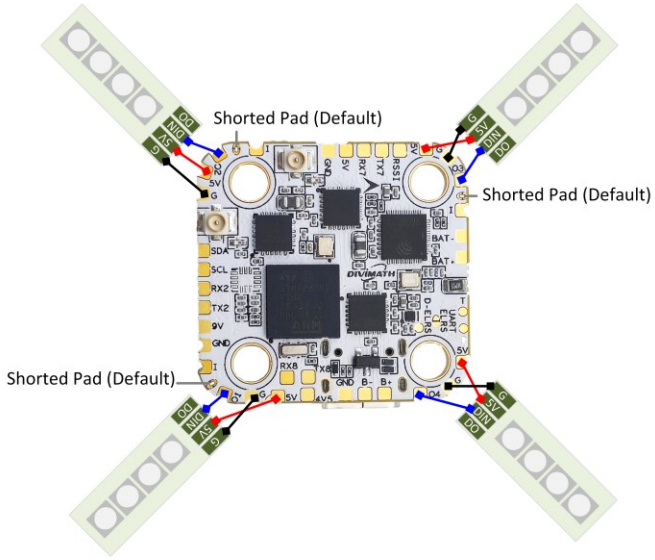
DJI VISTA Wiring



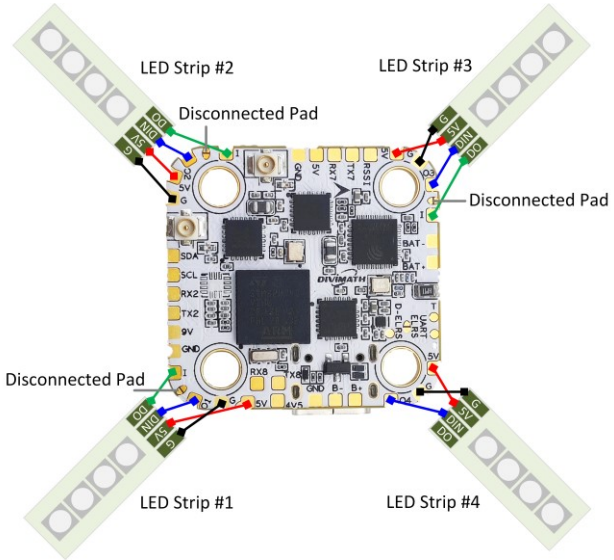
Wiring of Peripherals (External Radio RX, GPS)



LED Strip Wiring (Parallel, all strips share the same config)

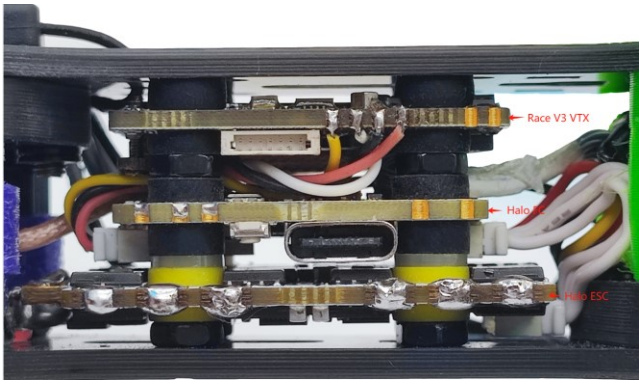


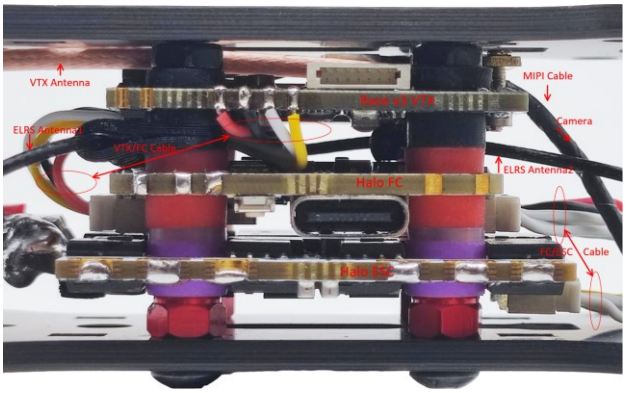
LED Strip Wiring (Individually, addressable LED strips)



Racing Stack

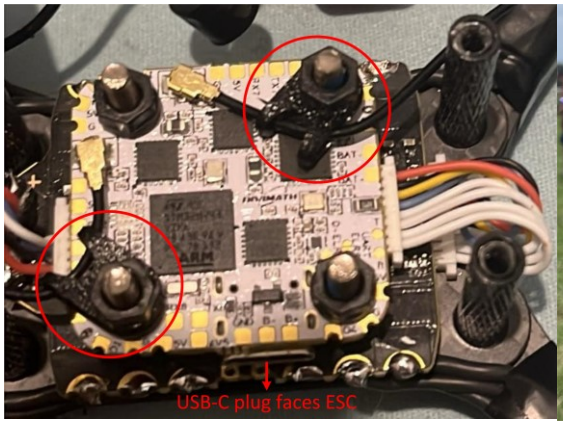
Here are two examples of how to mount the HDZero Race v3 VTX and the HDZero Halo stack in a racing drone. The configuration on the left fits a frame with 21.5 mm of clearance between the carbon plates, while the one on the right is suited for taller frames with a minimum clearance of 23 mm. To reduce space between FC and ESC, install the FC and ESC with plugs facing downward (note, this requires changing the order of the motors in Betaflight Motors tab).





ELRS Antennas Mount

Use the included antenna retainers—indicated by red circles below—to guide the antenna wires to the top plate and one of the arms. If space is limited, such as on compact racing drones, mounting only one antenna is acceptable.



Bind with ELRS TX radio

There are two ways to configure Halo FC for binding:

1. Connect HDZero Halo FC to PC via USB-C. Open Betaflight and connect to the FC. Navigate to the “Receiver” tab and click “Bind” to initiate binding mode; or

2. Power off the Halo FC.

   Power-cycle the Halo FC 3 times.

   - Supply power to the Halo FC
   - The ELRS LED lights up.
   - Turn it off within 2 seconds.
   - Repeat 2 more times.

   Once RX is in binding mode, insert the ELRS TX module into your OpenTX Radio transmitter, select External RF mode and set it to the CRSF protocol. You will find the ELRS menu in the Radio system (ensure the ELRS.LUA file is copied to the SD-Card tools first). Enter the ELRS menu and press [Bind]. The RX LED on the flight controller will become solid if the binding is successful.

   NOTE: Make sure you use the matching ELRS preset for your link rate, failure to do so can lead to un-commanded movement in turns.

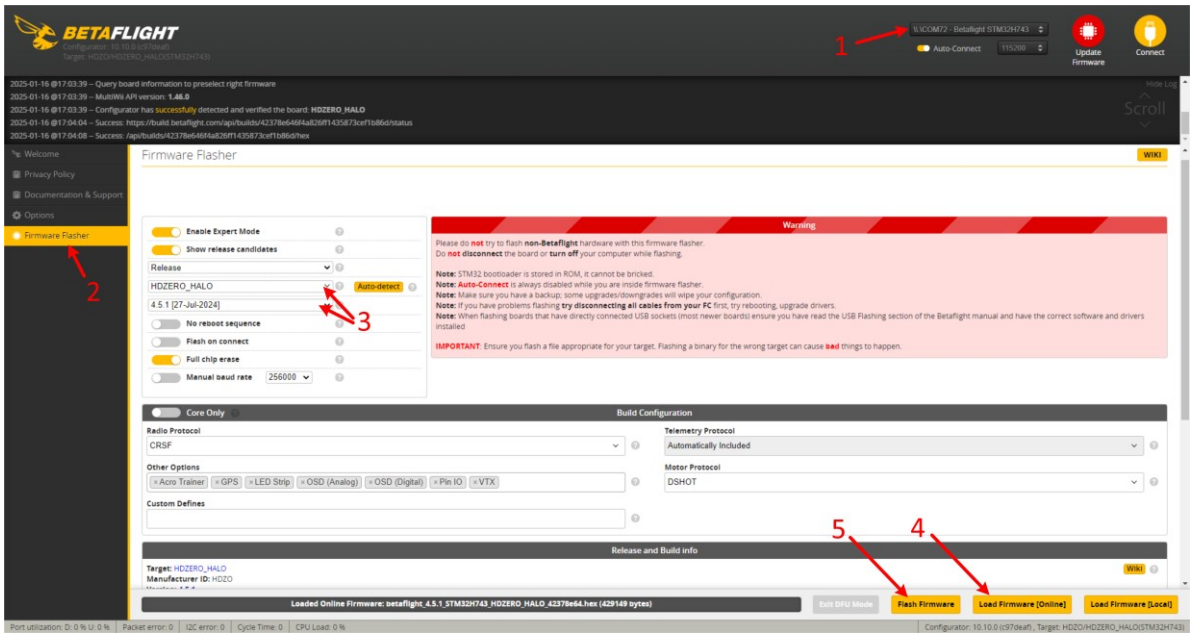
The green ELRS LED on Halo FC status:

- **Solid** means bind successful or Connection established;
- **Double-flash** means in bind mode;
- **Flash slowly** means no signal established with the TX module

Firmware

1. Flash Betaflight firmware

- Download and install the Betaflight Configurator.
- Launch the Betaflight Configurator
- To flash firmware:



1) Select the target port
2) Click "Update Firmware" to enter Firmware Flasher tab
3) Select target "HAZERO_HALO" and version, The factory version is 4.5.1[27-Jun-2024]
4) Click "Load Firmware [Online] " to download the firmware
5) Click "Flash Firmware" to Flash the Flight controller

- DFU flash:

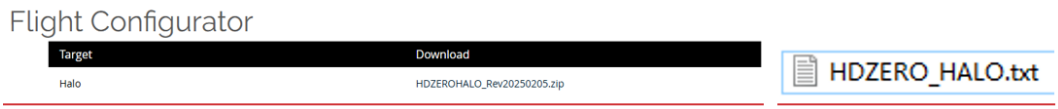
If you have lost communication with your board follow these steps to restore communication:

1) Power off HALO FC
2) Enable ‘No reboot sequence’, enable ‘Full chip erase’
3) Hold FC BOOT button and Power on via USB-C into PC, then release BOOT button
4) Install all STM32 drivers and Zadig if required (see USB Flashing section of Betaflight manual)
5) Close Betaflight configurator, Restart Betaflight configurator
6) Click "Update Firmware" to enter Firmware Flasher tab
7) Select target " HAZERO_HALO " and version, The factory version is 4.5.1[27-Jun-2024]
8) Click "Load Firmware [Online] " to download the firmware
9) Click "Flash Firmware" to Flash the Flight controller

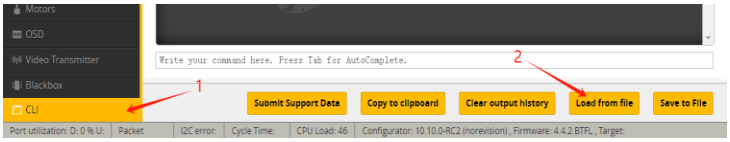
2. Execute CLI

- HDZero HALO online firmware already contains the required CLI, predefined cli are available if needed by following these steps:

  Download the file from Flight Configurator tab at https://www.hd-zero.com/document, and unzip HDZEROHALO_RevXYZ.zip into a temporary directory, i.e. c:\123

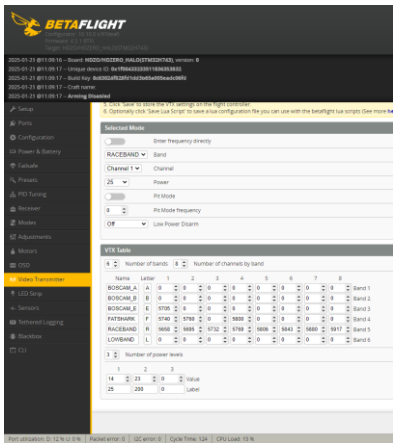


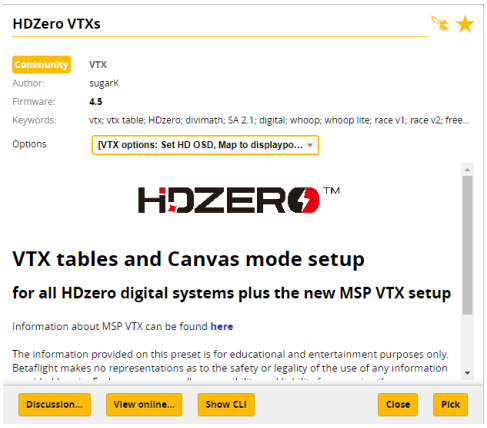
1) Switch to Betaflight Configurator CLI tab
2) Click “Load from file”, and select file c:\123\ HDZERO_HALO.txt for HDZero HALO
3) Click “Execute”



- VTX table is not included in the HDZero HALO online firmware, but it can be added in several ways:

  1) When you use HDZero VTX with HDZero HALO,
  the VTX will provide this over MSP, and VTX firmware needs to be version 1.7.0 or newer, or
  2) The CLI file HDZERO_HALO.txt provides, or
  3) Use Betaflight Configurator preset, search for
  HDZero VTXs to find this preset



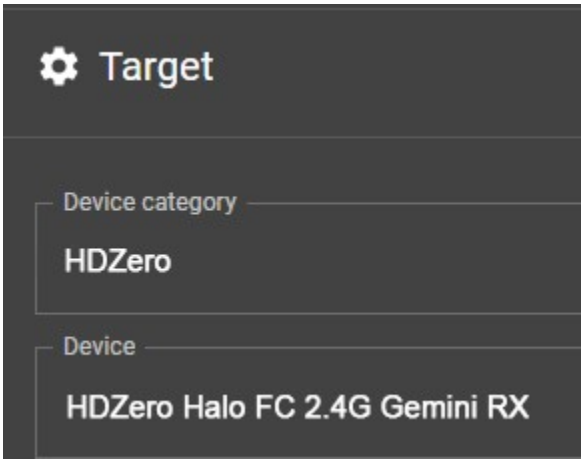


3. Flash ELRS firmware

The HDZero Halo factory ELRS firmware version is Released 3.5.1, If you need to update the firmware, please refer to the ELRS update tutorials (Typical Updating Steps), and the Device Category and Device target are as follow:

Device Category: HDZero

Device target: HDZero Halo FC 2.4G Gemini RX



Switchable 9v BEC

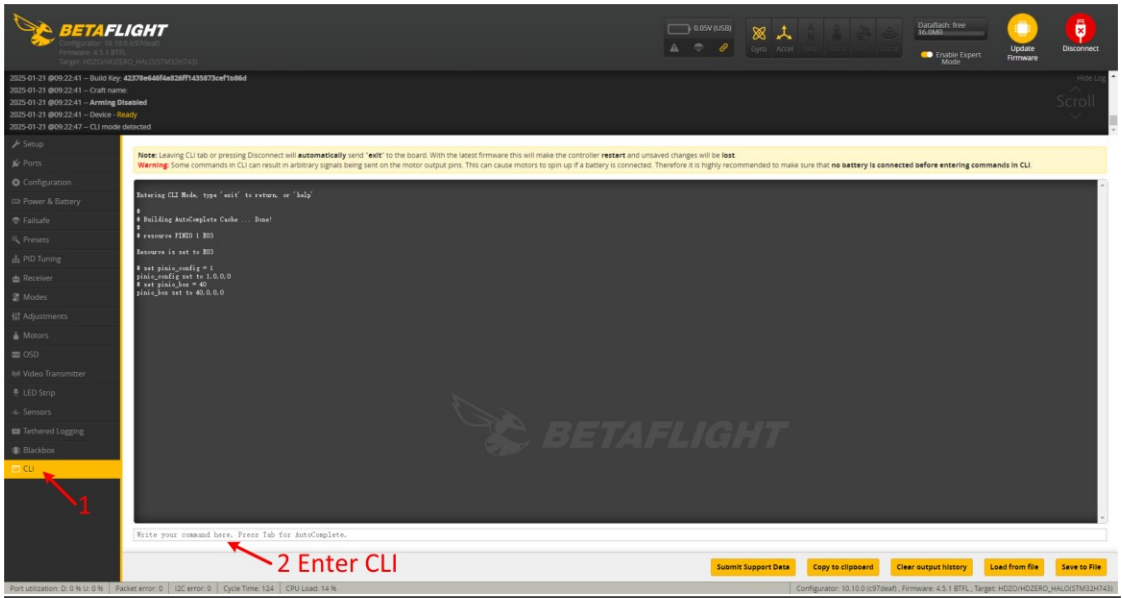
- Launch the Betaflight Configurator
- Switch to CLI tab
- Enter CLI:

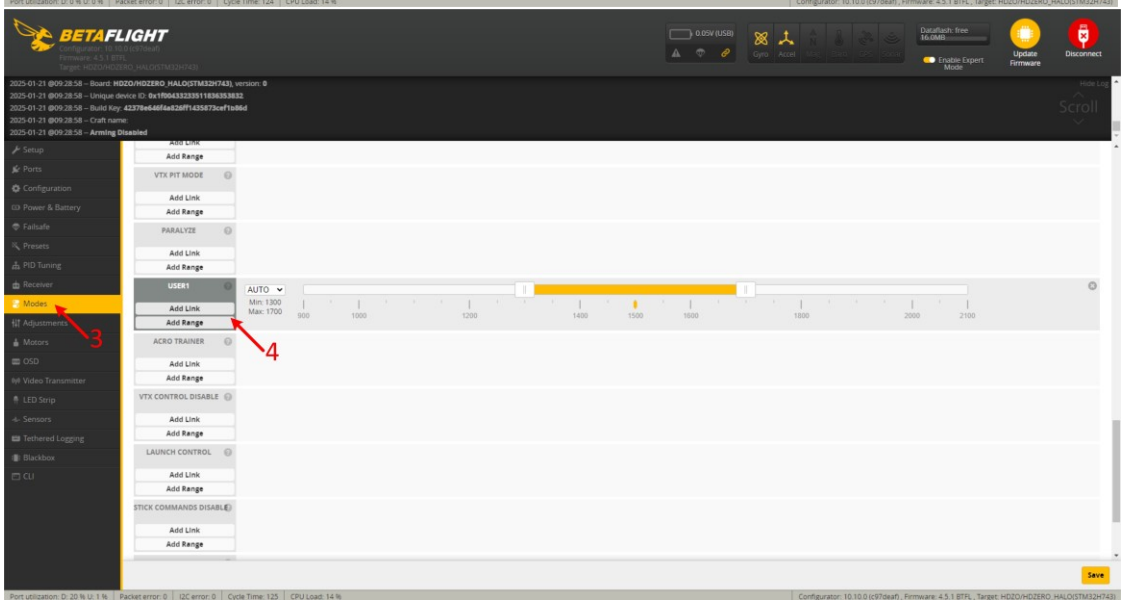
  resource PINIO 1 E03

  set pinio_config = 1

  set pinio_box = 40

  save
- Switch to Modes tab
- Add Range for USER1 mode
- Then you can use the remote control to switch 9v BEC





HDZero Halo 4in1 70A ESC

Introduction

The HDZero Halo ESC is a 4in1 ESC built for both racing and freestyle drone applications. It is engineered for exceptional reliability, crash resilience, and high current output—perfectly suited for the demands of drone racing.

The Halo ESC utilizes a split-board design with a dedicated MCU/driver board and a high-voltage power board, integrating 24 MOSFETs and an 8-layer PCB with over 3 oz copper thickness per layer to optimize current flow and thermal efficiency. A rear-mounted copper bar further enhances current delivery and heat dissipation. Each motor can sustain outputs over 70A for 30 seconds and peak at 100A for up to 3 seconds.

The Halo ESC supplies exceptionally clean power to the MCUs, safeguarding them against voltage spikes triggered by sudden motor acceleration or deceleration. This vital protection helps prevent MCU brownouts or lockups—common culprits behind burnt motors, failed MOSFETs, and critical flight failures.

The Halo ESC is protected with a conformal coating for enhanced resistance to moisture, dust, and corrosion.

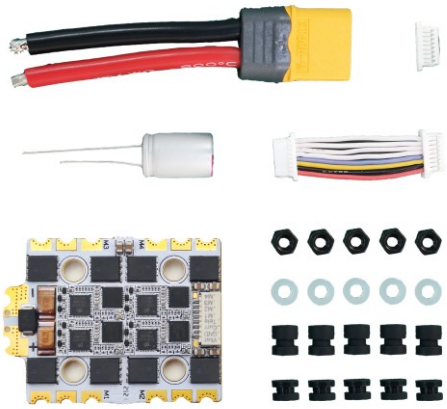
The Halo ESC is available in two versions, BLHeli32 and AM32, to meet different pilot preferences.

Specification

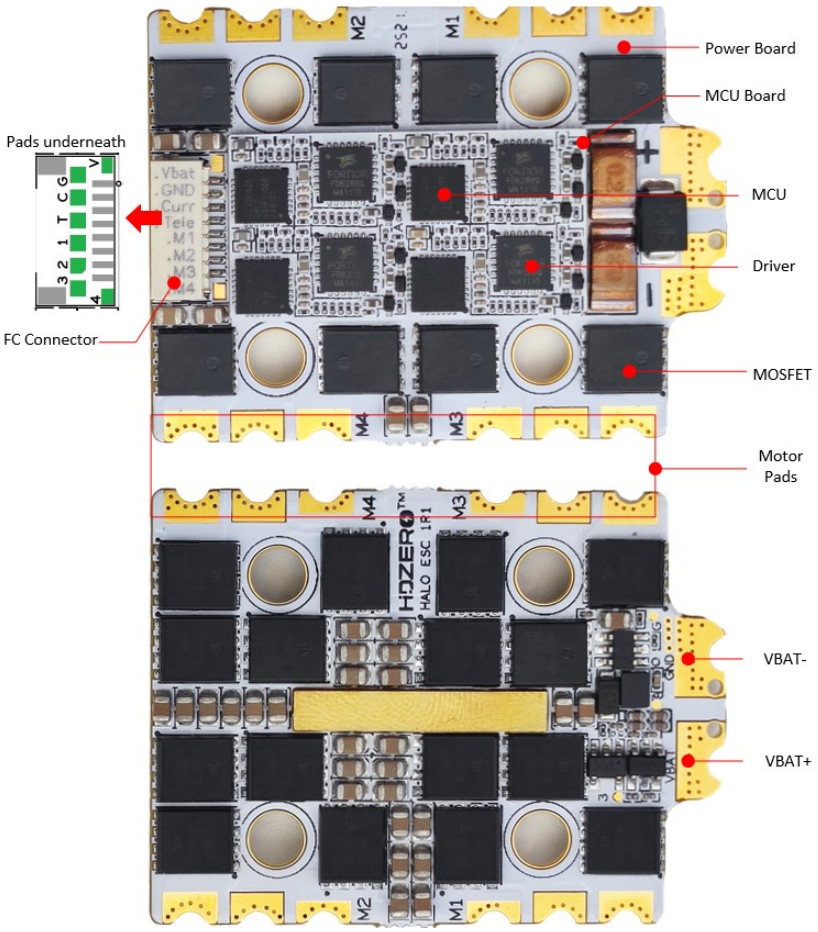
Model	HDZero Halo 4in1 70A ESC	
MCU	AT32F421 (120MHz)	
Firmware	BLHeli 32.10	AM32 2.18 Target: HDZ_ESC_1R0_F421
Input Voltage	DC 9V – 40V (3S – 8S)	
Telemetry	Supported	
Input signal	DSHOT 150/300/600/1200/2400, MultiShot, OneShot	
Output Voltage	VBAT (to power the FC)	
Max Current	Over 70Ax4 (Continuous) / 100Ax4 (Burst)	
Current Sensor	Scale = 170, offset = 0	
Dual-sided solder pads	YES	
Dimension	33x43mm	
Mounting	20x20mm, Φ4mm, M3 Rubber Grommets	
Weight	13.4g	

Includes

- 1x HDZero ESC
- 5x Rubber Grommet (4.5mm height)
- 5x Rubber Grommet (6.6mm height)
- 5x Nylon washer (M3 1.0mm thick)
- 5x 304 steel nuts (M3 2.3mm thick)
- 1x ESC Cable (-pin SH1.0, 30mm)
- 1x 8-pin SH1.0 connector
- 1x XT60 Cable(70mm,12AWG)
- 1x 35V/1000uf capacitor



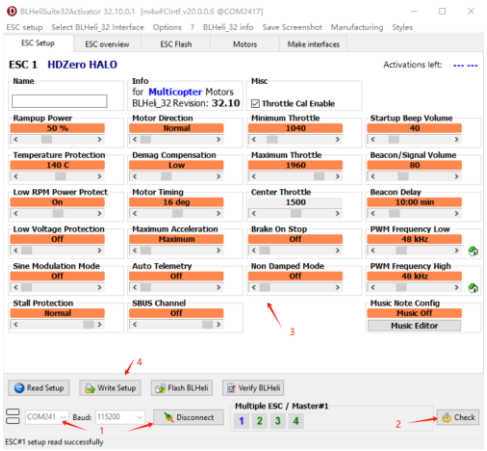
Diagram



Configuration/Firmware

BLHeli32

a) Download BLHeliSuite32 https://github.com/bitdump/BLHeli/releases/tag/Rev32.10
b) Remove all propellers from the drone that flight controller and Halo ESC are correctly installed
c) Power on the drone, and connect the FC to PC via USB
d) Execute BLHeliSuite32.exe
e) Select ESC Setup tab, Port | Connect | Check
f) Adjust parameters as needed, Write Setup to save the setting to ESCs



AM32

a) Remove all propellers from the drone that flight controller and Halo ESC are correctly installed
b) Power on the drone, and connect the FC to PC via USB
c) Open the AM32 Configurator: http://am32.ca
d) Click Port Select and Connect, then Read.
e) Adjust parameters as needed, then Save.

If needed, click [Flash firmware] to update the ESC firmware

HDZero Halo Stack

The HDZero Halo Stack features the Halo Flight Controller paired with the Halo ESC. It has 4 variations:

- Halo Flight Controller (MPU6000) + Halo ESC (AM32)
- Halo Flight Controller (ICM42688) + Halo ESC (AM32)
- Halo Flight Controller (MPU6000) + Halo ESC (BLHeLi32)
- Halo Flight Controller (ICM42688) + Halo ESC (BLHeLi32)

Includes

- 1x HDZero Halo FC
- 1x HDZero Halo ESC
- 1x ESC cable (8-pin SH1.0, 30mm)
- 1x XT60 cable (70mm,12AWG)
- 1x 35V/1000uf capacitor
- 9x Rubber grommet (4.5mm height)
- 6x Rubber grommet (6.6mm height)
- 5x Nylon washer (M3 1.0mm thick)
- 5x 304 Steel nuts (M3 2.3mm thick)
- 4x 12.9 Carbon steel screws (M3 25mm length)
- 1x ELRS T-sharp short antenna (40mm)
- 1x ELRS T-sharp long antenna (90mm)
- 2x ELRS Antenna retainers