HDZero Halo

H743 flight controller (FC) with ExpressLRS Gemini 2.4 GHz receiver

User manual · MPU6000 and ICM42688 versions



Read the safety instructions in chapter 1 before assembly and first connection. Always remove the propellers when configuring and testing.

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1. Safety instructions

1.1 Before you start

HDZero Halo is a flight controller (FC) designed to be built into an FPV drone. Assembly, wiring and setup require experience with soldering, electronics and the Betaflight software. If you are unsure, ask an experienced modeller for help or contact us.

- This product is not a toy. It is not intended for children; keep it out of their reach – it contains small parts that can be swallowed.
- Disconnect the battery and the USB cable before making any change to the wiring.
- **Always remove the propellers** when configuring, testing motors or updating firmware. Motors may start spinning unexpectedly.
- Protect the board from moisture, dust, metal objects and short circuits. Do not use a damaged board, connectors or cables.

1.2 Power supply and batteries

- The flight controller is powered from a **3S to 8S** battery (via the ESC connector or the BAT pads). A higher voltage can destroy the board.
- Observe correct polarity when connecting the battery. Reversed polarity or a short circuit can damage the electronics, cause a Li-Po battery fire and burns.
- Do not overload the BEC outputs beyond the values given in chapter 2.2. The ESC cable supplied in the package is rated for a maximum current of 4 A.
- Charge Li-Po and LiHV batteries only under supervision, on a non-flammable surface and with a charger intended for them. Do not use a swollen or damaged battery.

1.3 Radio transmission and antennas

- The integrated ExpressLRS receiver transmits telemetry back to the radio in the 2.4 GHz band. Use only antennas supplied or specified by the manufacturer.
- Do not operate the receiver without an antenna connected and do not bend the antenna cables sharply.
- The user is responsible for the transmit power setting and for compliance with the regulations of the country of operation (see chapter 6).

2. Product description

2.1 Introduction

The HDZero Halo is a compact flight controller (FC) powered by the H743 MCU for high-performance computation. It integrates an ExpressLRS (ELRS) receiver with **Gemini** support and features a switchable 9 V / 3 A BEC output for video transmitters (VTX), along with a 5 V / 4 A 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 colours straightforward and simplifies the routing of addressable LED strip wires. Designed for digital video systems, it eliminates the analogue OSD chip. It is particularly optimised for use with the HDZero Race V3 VTX, ensuring a low-profile stack.

The Halo Flight Controller features dedicated sockets for connecting ESCs (with the included cable rated for a maximum of 4 A) and for connecting 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**. This manual applies to both versions.

2.2 Specifications

Parameter	Value
Model	HDZero Halo Flight Controller
MCU	STM32H743 (480 MHz)
Gyro	MPU6000 or ICM42688 (depending on version)
BEC output	5 V / 4 A 9 V / 3 A (switchable) 4.5 V / 0.5 A
Black box	16 MB 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

Parameter	Value
Analogue OSD	no
FC firmware	Betaflight, target HDZERO_HALO
ELRS receiver	**Value**
Chip set	ESP32 + 2× SX1280
FC UART	TX1/RX1
Gemini RX	yes
RF frequency	2.4 GHz
Max. TX RF power (telemetry)	10 mW
Antenna interface	2× U.FL
ELRS firmware	HDZero Halo FC 2.4G Gemini RX
Dimensions and power	**Value**
Power supply	3S–8S
Size	29 × 30.5 mm
Mounting holes	20 × 20 mm, Φ 4 mm holes for rubber grommets (M3 screws)
Weight	5.6 g
Dedicated sockets for	ESC; HDZero and other digital VTXes

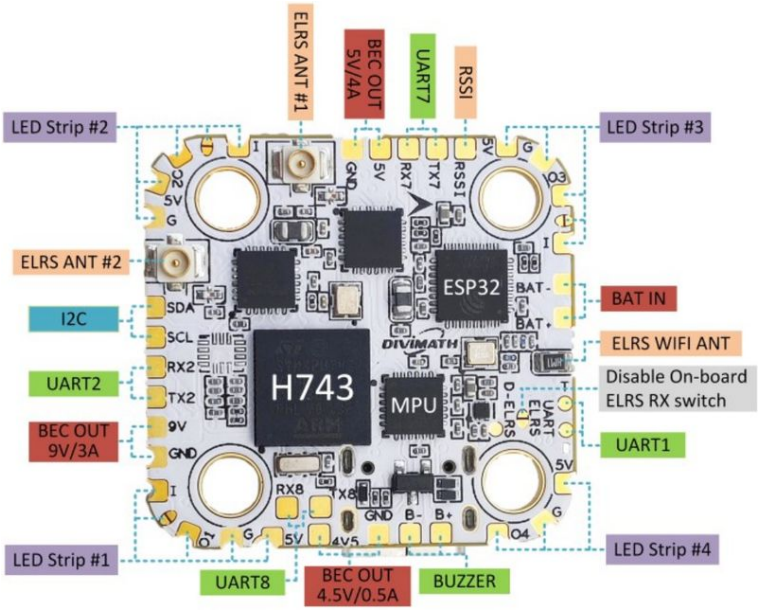
2.3 Package contents

- 1× HDZero Halo FC
- 5× rubber grommet (6.6 mm)
- 5× rubber grommet (8.0 mm)
- 1× ELRS T-shaped short antenna (40 mm)
- 1× ELRS T-shaped long antenna (90 mm)
- 2× ELRS antenna retainer
- 1× ESC cable (8-pin SH1.0, 30 mm)
- 1× 8-pin SH1.0 connector

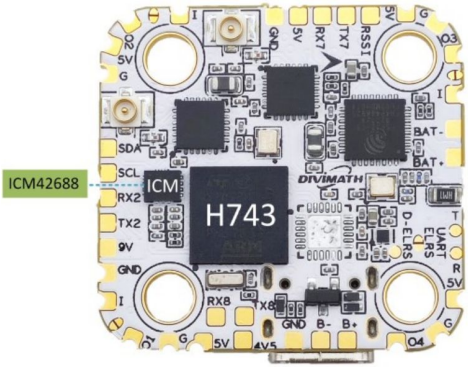
※ The package does **not** include an ESC, a video transmitter (VTX), a battery, screws or a radio.

2.4 Board diagram

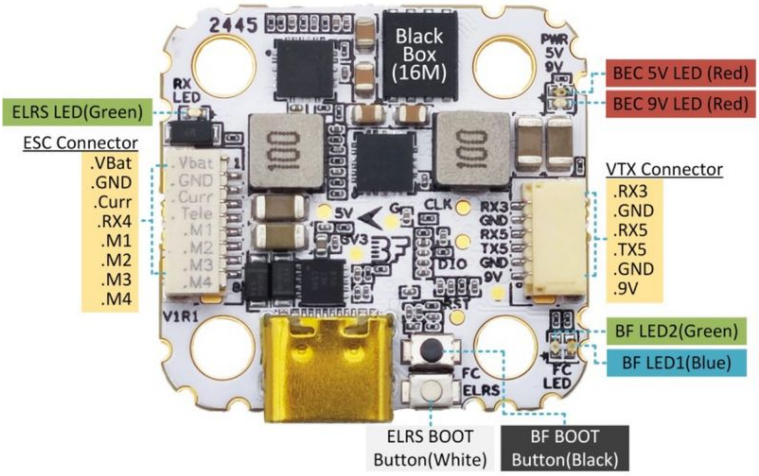
The manufacturer's diagrams keep the original labels – they match the pad and connector markings printed on the board.



Top view – MPU6000 version



Top view – ICM42688 version (gyro location)

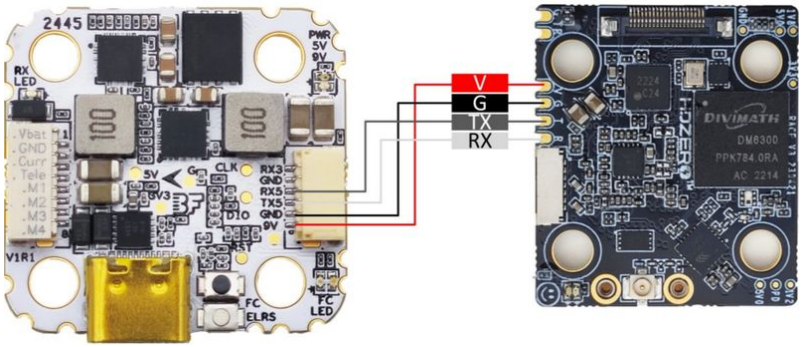


Bottom view

Label	Meaning
ELRS ANT #1, #2	U.FL antenna connectors of the ELRS receiver
ELRS WIFI ANT	Wi-Fi antenna of the ELRS receiver
Disable On-board ELRS RX switch	pads for disabling the integrated ELRS receiver
BAT IN	battery power input
BEC OUT 5V/4A, 9V/3A, 4.5V/0.5A	power outputs for peripherals
LED Strip #1–#4	LED strip pads
ESC Connector	Vbat, GND, Curr, RX4 (telemetry), M1–M4
VTX Connector	RX3, GND, RX5, TX5, GND, 9V
ELRS LED (Green)	green status LED of the ELRS receiver
BEC 5V LED, BEC 9V LED (Red)	red LEDs indicating BEC voltage
BF LED1 (Blue), BF LED2 (Green)	Betaflight status LEDs
ELRS BOOT (White)	white BOOT button of the ELRS receiver
BF BOOT (Black)	black BOOT button of the flight controller

3. Wiring

3.1 HDZero Race V3 VTX



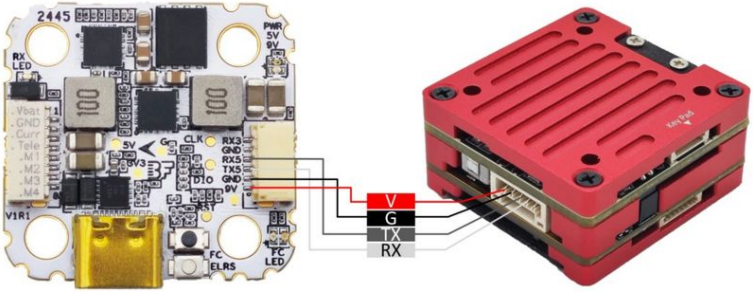
HDZero Race V3 VTX wiring

Unfortunately, the previous batches of HDZero VTX-R3 have different signal definitions for their connector, requiring users to re-pin it (see picture on the left) 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.



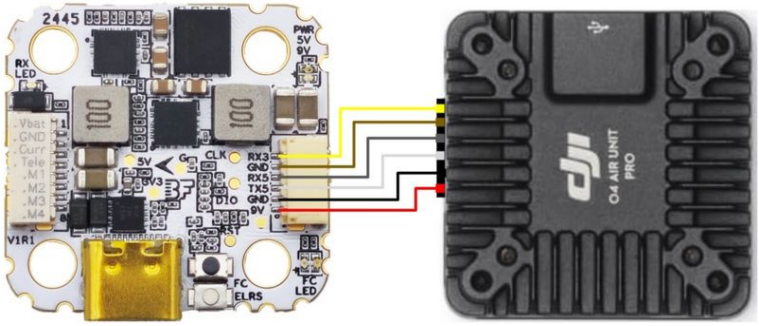
Left: previous batches of VTX-R3 (after re-pinning) · right: newest batch of HDZero VTX-R3

3.2 HDZero Freestyle V2 VTX



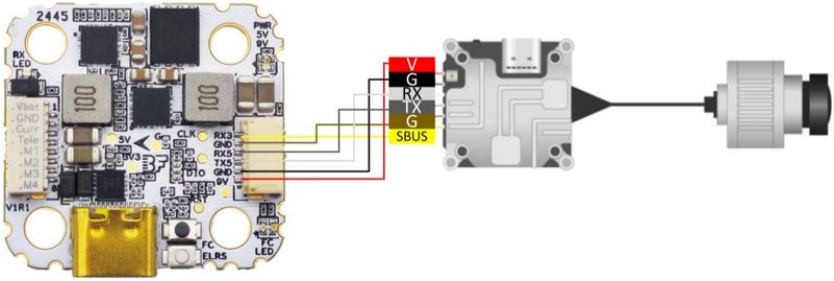
HDZero Freestyle V2 VTX wiring

3.3 DJI O3 / O4



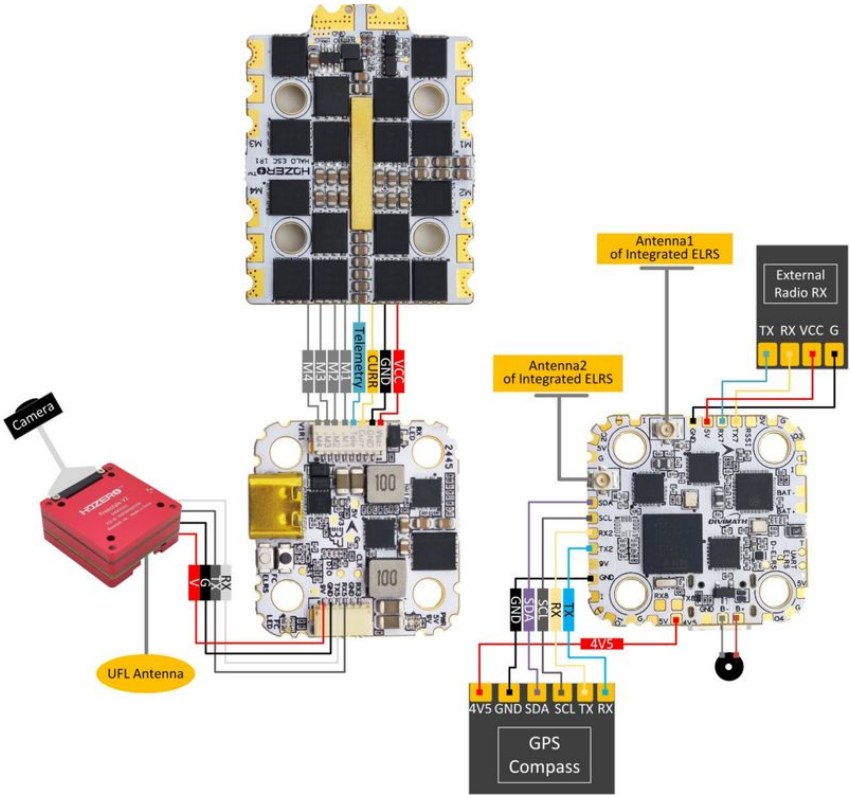
DJI O3 / O4 wiring

3.4 DJI Vista



DJI Vista wiring

3.5 Peripherals (external radio RX, GPS)

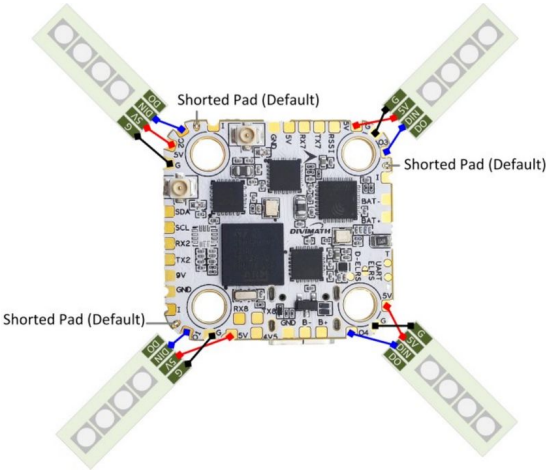


Wiring of peripherals – external radio RX, GPS with compass, buzzer and ESC

The diagram also shows the antennas of the integrated ELRS receiver (Antenna1, Antenna2), the video transmitter with camera and the ESC. The GPS module with compass is powered from the 4V5 output and connected to the SDA, SCL, RX2 and TX2 pads.

3.6 LED strips – parallel wiring

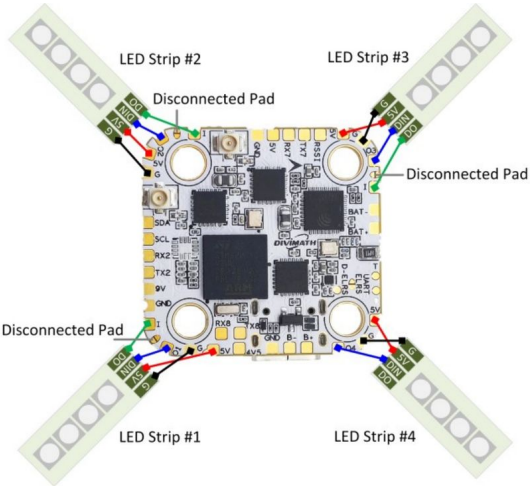
All strips share the same configuration. The pads marked *Shorted Pad (Default)* are bridged in the factory state.



LED strip wiring – parallel

3.7 LED strips – individually addressable

For individually addressable strips, the strips are wired in series. The pads marked *Disconnected Pad* are open.



LED strip wiring – individually addressable

3.8 Racing stack

Here are two examples of how to mount the HDZero Race V3 VTX and the HDZero Halo stack (with the HDZero Halo ESC, which is not included in the package) 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**.

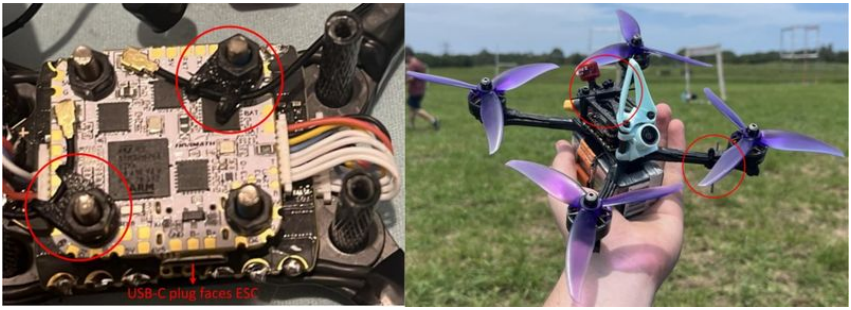
To reduce the space between FC and ESC, install the FC and ESC with the plugs facing downward. Note that this requires changing the order of the motors in the Betaflight *Motors* tab.



Stack mounting examples

3.9 ELRS antenna mount

Use the included antenna retainers (indicated by red circles) 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.



ELRS antenna routing – the USB-C plug faces the ESC

4. ExpressLRS receiver

4.1 Binding with an ELRS TX radio

There are two ways to put the Halo FC into binding mode:

① Connect the HDZero Halo FC to a PC via USB-C. Open Betaflight Configurator and connect to the FC. Navigate to the *Receiver* tab and click *Bind*.

② Or power-cycle the Halo FC three times: supply power, the ELRS LED lights up, turn the power off within 2 seconds and repeat two more times.

Once the RX is in binding mode, insert the ELRS TX module into your OpenTX/EdgeTX radio, select *External RF* mode and set it to the *CRSF* protocol. You will find the ELRS menu in the radio's system menu (make sure the ELRS.LUA file has been copied to the tools folder on the SD card first). Enter the ELRS menu and press *[Bind]*. The RX LED on the flight controller becomes solid if binding is successful.

Make sure you use the ELRS preset matching your link rate; failure to do so can lead to uncommanded movement in turns.

4.2 Receiver status LED

The green ELRS LED on the Halo FC:

- **solid** – bound, connection established,
- **double flash** – binding mode,
- **slow flash** – no connection with the TX module.

4.3 ExpressLRS firmware

If you need to update the receiver firmware, follow the ExpressLRS update tutorials (typical updating steps) with these settings:

Device Category	HDZero
Device Target	HDZero Halo FC 2.4G Gemini RX

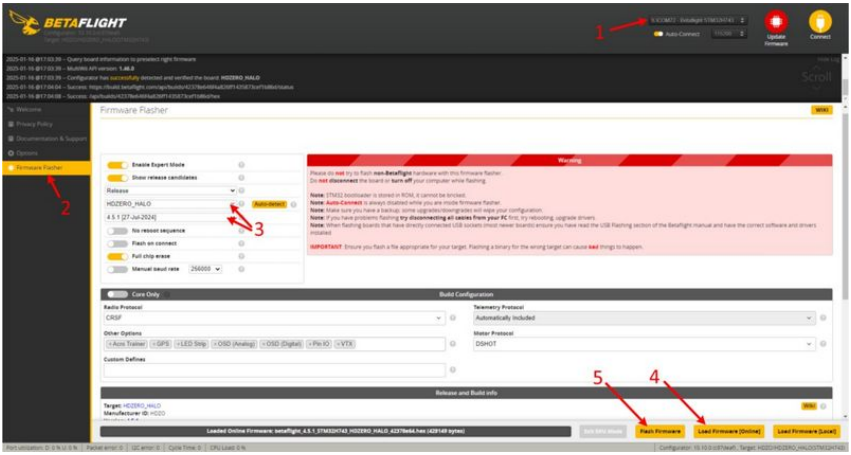
※ Firmware versions differ between production batches. Before updating, make sure the TX module and the receiver use compatible versions.

Official ExpressLRS documentation: www.expresslrs.org

5. Betaflight firmware and setup

5.1 Flashing Betaflight firmware

- Download and install Betaflight Configurator and launch it.



Firmware Flasher tab in Betaflight Configurator

① Select the target port.

② Click *Update Firmware* to enter the *Firmware Flasher* tab.

③ Select target **HDZERO_HALO** and the firmware version.

④ Click *Load Firmware [Online]* to download the firmware.

⑤ Click *Flash Firmware* to flash the flight controller.

5.2 DFU recovery

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

① Power off the Halo FC.

② Enable *No reboot sequence* and *Full chip erase*.

③ Hold the FC BOOT button (black, BF BOOT), connect the FC to the PC via USB-C, then release the button.

④ Install all STM32 drivers and Zadig if required (see the *USB Flashing* section of the Betaflight documentation).

⑤ Close Betaflight Configurator and restart it.

⑥ Click *Update Firmware* to enter the *Firmware Flasher* tab.

⑦ Select target **HDZERO_HALO** and the firmware version.

⑧ Click *Load Firmware [Online]*.

⑨ Click *Flash Firmware*.

5.3 Predefined CLI

The HDZero Halo online firmware already contains the required CLI settings. Predefined CLI commands are available if needed:

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

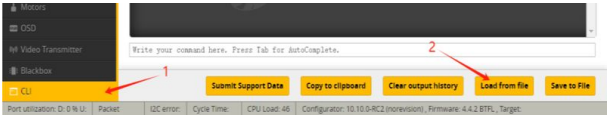


Download file in the Flight Configurator section

① In Betaflight Configurator switch to the *CLI* tab.

② Click *Load from file* and select c:\123\HDZERO_HALO.txt.

③ Click *Execute*.



CLI tab – Load from file button

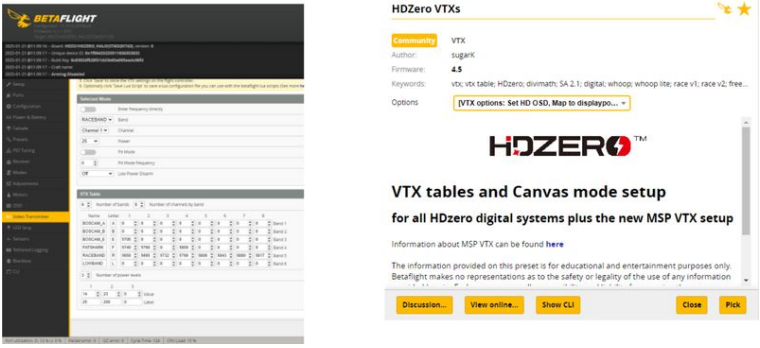
5.4 VTX table

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

① When you use an HDZero VTX, the VTX provides the table over MSP – the VTX needs sufficiently recent firmware (see the HDZero VTX documentation).

② The CLI file HDZERO_HALO.txt provides it (chapter 5.3).

③ Use a Betaflight Configurator preset – search for *HDZero VTXs*.



VTX table and the HDZero VTXs preset

5.5 Switchable 9 V BEC

The 9 V BEC output for the video transmitter can be switched on and off from the radio:

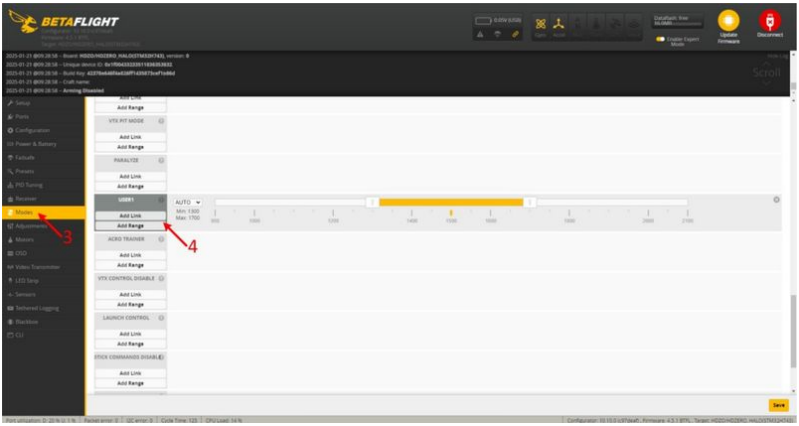
① Launch Betaflight Configurator and switch to the *CLI* tab.

② Enter the commands:
resource PINIO 1 E03
set pinio_config = 1
set pinio_box = 40
save

③ Switch to the *Modes* tab.

④ Add a range (*Add Range*) for the *USER1* mode.

⑤ You can then use the radio to switch the 9 V BEC.



Modes tab – range for USER1 mode

Some commands in the CLI tab can send arbitrary signals to the motor outputs. Make settings with the battery disconnected and without propellers.

6. Operation and legal requirements

6.1 The law of the country of operation applies

Regulations (EU) 2019/947 and 2019/945 apply in all EU member states, but national implementing rules differ from country to country – registration portals, minimum pilot age, geographical zones, mandatory insurance, permitted frequency bands and maximum transmit power. The information in this chapter describes the situation in the Czech Republic. If you operate a drone in another country, you must follow the regulations of the country in which you fly.

6.2 Frequencies and transmit power

The integrated ExpressLRS receiver operates in the 2.4 GHz band; according to the manufacturer, its maximum transmit power (telemetry) is **10 mW**.

Band	Limit in CZ	Regulation
2400–2483.5 MHz	25 mW e.i.r.p.	ČTÚ general authorisation VO-R/10, Art. 3(j)

- Use only antennas supplied or specified by the manufacturer.
- The user is responsible for the power setting. Outside the Czech Republic, the limits of the respective country apply.
- The bands and limits of the video transmitter (VTX) you connect to the flight controller are given in its own manual.

6.3 A drone built with this flight controller

The flight controller on its own is not an unmanned aircraft. A drone built with it is usually a privately built unmanned aircraft system without a class label; its operation is governed by Regulation (EU) 2019/947 and by the rules of the national aviation authority (in the Czech Republic www.caa.gov.cz). In particular:

- the operator of a drone with a camera must register and display the registration number on the drone,
- the pilot must have the competency required for the selected subcategory of operation,
- FPV flight with goggles in the open category is only possible with an observer who keeps the drone in direct visual line of sight,
- observe the maximum height of 120 m, do not fly over assemblies of people and respect geographical zones.
- We recommend taking out liability insurance.

7. Maintenance and troubleshooting

7.1 Maintenance

- After a crash, check the board, connectors, antenna cables and U.FL connectors. Replace damaged antennas.
- Keep the board dry and clean. Remove dirt with a dry brush; do not use water or solvents.
- Disconnect SH1.0 connectors by pulling the connector, not the wires.
- Check the failsafe function before every flight – the motors must stop when the radio is switched off.

7.2 Troubleshooting

Problem	Possible cause and solution
PC does not detect the FC	Use a USB-C data cable. Install the drivers (chapter 5.2) and, if necessary, perform DFU recovery.
Receiver does not bind	Check binding mode (double flash of the LED), the CRSF protocol and compatible ELRS firmware versions in the TX module and receiver.
ELRS LED flashes slowly	The receiver has no connection with the TX module – switch on the radio and check binding.
Uncommanded movement in turns	Set the ELRS preset matching the selected link rate (chapter 4.1).
Motors spin in the wrong order	When mounting with plugs facing downward, change the motor order in the *Motors* tab (chapter 3.8).
VTX has no power	Check the switchable 9 V BEC and USER1 mode (chapter 5.5) and the VTX connector wiring.
VTX channels missing	Add the VTX table (chapter 5.4).
HDZero Race V3 does not work	Previous batches of VTX-R3 must be re-pinned (chapter 3.1).

8. Information for the EU and Czech Market

8.1 Importer and responsible person in the EU

The product is placed on the European Union market by the importer stated below, who is at the same time the responsible person within the meaning of Article 16 of Regulation (EU) 2023/988 of the European Parliament and of the Council on general product safety (GPSR).

Importer / responsible person in the EU	Rotorama, s.r.o.
Company ID (IČO)	051 57 692
VAT ID (DIČ)	CZ05157692
Registered office	Okrajová 1351, 674 01 Třebíč, Czech Republic
E-mail	info@rotorama.cz
Phone	+420 252 252 098
Website	www.rotorama.com

8.2 Product conformity

CE

- The product bears the **CE** marking and complies with the requirements of the applicable European Union harmonisation legislation.
- A copy of the **EU Declaration of Conformity** is available from the importer at the address stated above or at the e-mail address info@rotorama.cz.
- **Product identification:** type designation HDZero Halo Flight Controller and gyro variant (MPU6000 or ICM42688).

8.3 Disposal of electrical equipment



- The crossed-out wheeled bin symbol on the product, its packaging or in the documentation means that at the end of its service life the product **must not be disposed of together with mixed municipal waste**.
- Hand it over at a take-back point for electrical equipment – at a collection yard, at a take-back point of a collective system, or at the retailer when purchasing a new equivalent product. Take-back is free of charge for the end user.
- The obligations under Act No. 542/2020 Coll., on end-of-life products, are fulfilled by the importer through a collective take-back system.
- Proper disposal helps prevent negative impacts on the environment and human health and contributes to the reuse of secondary raw materials.

Through its contractual partner **ASEKOL a.s.**, the company ensures the take-back of waste electrical equipment from households and the separate collection of waste electrical equipment, batteries and accumulators in accordance with the applicable legislation. The customer is entitled to hand over old electrical equipment or a battery or accumulator at any collection point of the above contractual partner. The addresses of these take-back points are listed at www.asekol.cz, www.ecobat.cz and also https://visoh2.mzp.cz/RegistrMistZO/RegistrMistZOPublic/MapaMistZpetOdberu.

9. Warranty and rights arising from defective performance

The rights and obligations of the contracting parties are governed by Czech law, in particular by Act No. 89/2012 Coll., the Civil Code, and Act No. 634/1992 Coll., on consumer protection.

- The seller is liable to the buyer for the product being free of defects on receipt. If the buyer is a consumer, a defect may be notified **within two years of receipt** of the product (Section 2165 of the Civil Code).
- If a defect appears within **one year** of receipt, the product is deemed to have been defective already at the time of receipt (Section 2161(5) of the Civil Code).
- When purchasing online, a consumer has the right to **withdraw from the contract within 14 days** of receiving the goods without giving a reason (Section 1829 of the Civil Code).
- Claims should be made with the retailer from whom you purchased the product. The importer's contact details are given in Chapter 8.1.
- The competent body for out-of-court settlement of consumer disputes is the **Czech Trade Inspection Authority**, Štěpánská 796/44, 110 00 Prague 1, www.coi.cz.