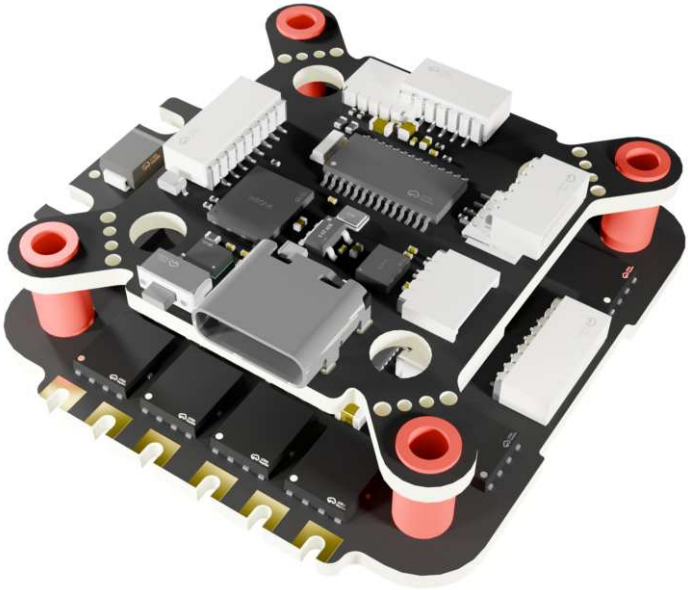
F4D MK1 + ESC 45 A

User manual
FlyingRC F4D MK1 (F405) flight controller and 4-in-1 electronic speed controller 45 A



ROTORAMA

Read the whole manual before assembly. The wrong signal cable wire order will destroy the flight controller.

Version 1.0 · Rotorama, s.r.o.

Contents

1. Safety instructions

1.1 Before you start

This product is a **set of electronic components for an unmanned aircraft** – a flight controller and an electronic speed controller – not a finished product ready for use. Both boards become usable only after being built into an aircraft, wired to the other parts and configured.

- Read this entire manual before you start building and keep it for future reference.
- The set works with battery voltage and with currents of tens of amperes. A wiring error can cause a **fire** or destroy the boards.
- Building requires experience with soldering and with model building. If you are not confident, ask an experienced modeller for help.
- This product is not a toy. It is not intended for children or for persons not familiar with this manual.
- Do not use damaged boards – after a crash, after overheating, with a cracked board or with a burnt component.

1.2 Handling the boards

Both boards are sensitive to static electricity and to mechanical damage.

- Hold the boards by their edges; do not touch the solder pads, connectors or components.
- Discharge static electricity by touching a grounded metal object before handling.
- Do not place the boards on metal or conductive surfaces, including the carbon parts of the frame.
- SH1.0 connectors are small. When plugging and unplugging, support the connector body with your fingers, otherwise you will tear it off the board.

1.3 Li-Po and LiHV batteries

The flight controller is designed for **3–6S Li-Po** batteries, that is 11.1–25.2 V. The ESC accepts **9–30 V**, that is 3–7S Li-Po or 3–6S LiHV. **The stricter of the two values always applies** – the whole set is therefore designed for **3–6S Li-Po** batteries. Connecting a 7S battery will destroy the flight controller instantly.

State	Li-Po	6S Li-Po	4S Li-Po
fully charged	4.20 V/cell	25.2 V	16.8 V
end the flight	3.50 V/cell	21.0 V	14.0 V
storage	3.80 V/cell	22.8 V	15.2 V

- Charge only with a charger intended for the given cell type and never leave it unattended.
- Do not use a battery with a swollen pouch, a damaged lead or after a hard crash.
- Never connect the battery with reversed polarity – reverse polarity destroys both the ESC and the flight controller, and such damage is not a product defect.
- Charge and store batteries in a non-flammable container, away from flammable materials.

1.4 Rotating propellers and bench testing

Most of the setup can be done without propellers. Do not fit the propellers until the aircraft is fully configured.

- **Always** remove the propellers before you connect the flight controller to a computer or before you test the motors.
- Secure the aircraft mechanically during motor tests and never reach into the plane of the propellers.
- When tuning parameters or flashing firmware, power the ESC **from a battery**, not from USB – but always without propellers.
- Never stand, and never let others stand, in line with the propellers.

1.5 Temperature and cooling

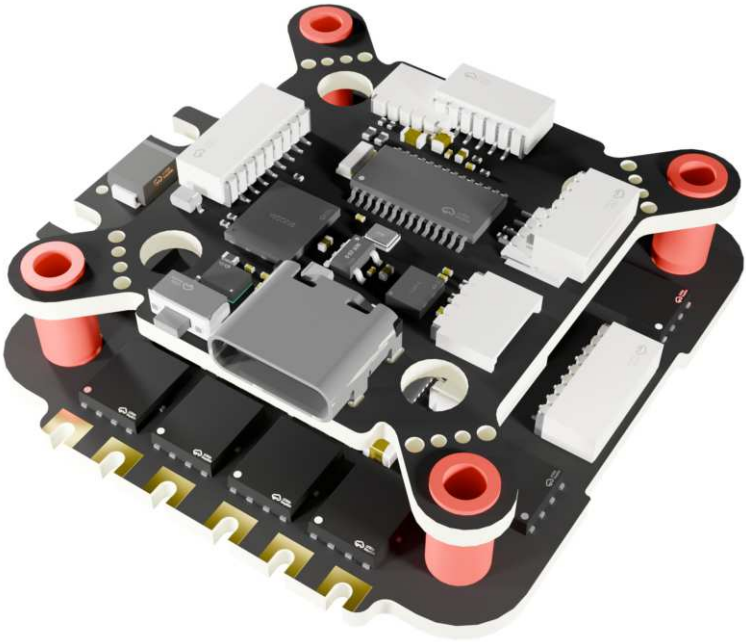
The ESC becomes very hot under load. The cases of the power MOSFETs are metal, conductive and hot.

- The ESC **must not** be wrapped in heat-shrink tubing, potted or waterproofed in any way. Such modifications block heat dissipation and any damage caused by them cannot be claimed under warranty.
- Motor wires must not touch the cases of the power MOSFETs.
- The boards must not touch the carbon parts of the frame, the battery connector or other boards – a short circuit may occur.
- Do not leave the aircraft standing with the battery connected and without airflow.
- Let the boards cool down after a flight before you touch them.

When the ESC operates outside its rated conditions – higher ambient temperature, high humidity, low pressure or no airflow – its current capability drops and the continuous current is lower than the rated value.

2. Product description

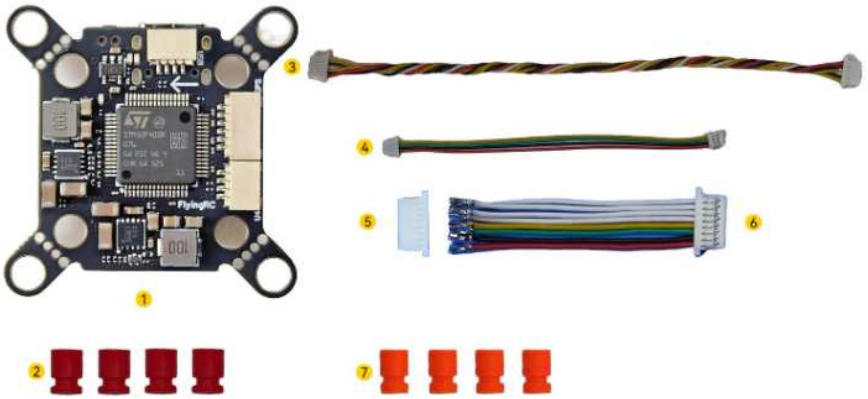
The **FlyingRC F4D MK1** is a flight controller for FPV drones built around the STM32F405 microcontroller with an ICM-42688-P gyroscope and a barometer. All peripherals connect through SH1.0 connectors, so no soldering is needed. It is supplied as a set with a **4-in-1 electronic speed controller 45 A** running AM32 firmware. Both boards have a 30.5 × 30.5 mm mounting hole pattern.



The F4D MK1 flight controller and 4-in-1 electronic speed controller 45 A set

2.1 Package contents

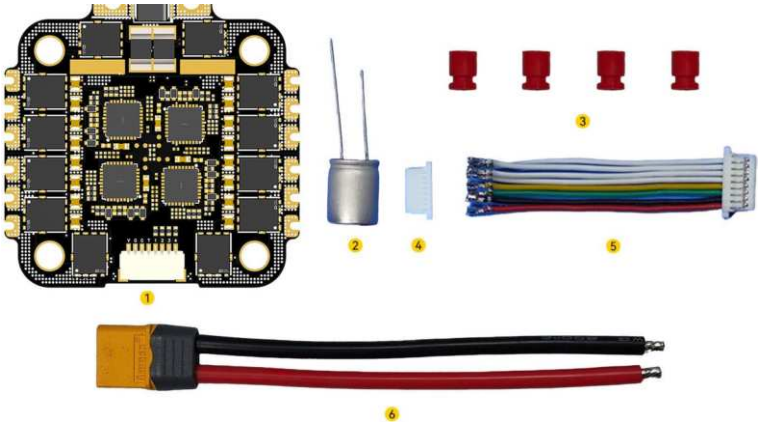
Flight controller



Flight controller package contents

① 1× FlyingRC F4D MK1 (F405) flight controller
② 4× silicone anti-vibration grommet M3
③ 1× cable for the DJI digital video transmitter, 6-pin, 15 cm
④ 1× SH1.0 cable, 4-pin, silicone, 10 cm
⑤ 1× SH1.0 connector, 8-pin, with crimp contacts
⑥ 1× SH1.0 cable, 8-pin, 30 AWG, silicone, 3.5 cm
⑦ 4× silicone anti-vibration grommet M2

Electronic speed controller



ESC package contents

① 1× FlyingRC 4-in-1 ESC 45 A

② 1× solid capacitor 35 V / 680 µF

③ 4× M3 anti-vibration standoff

④ 1× SH1.0 crimp connector

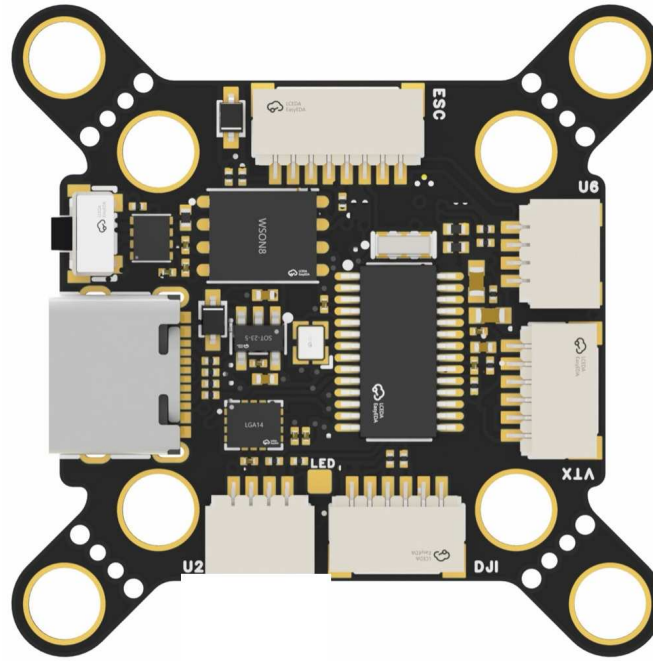
⑤ 1× SH1.0 8-pin signal cable

⑥ 1× XT60 power cable, 12 AWG, 12 cm

The battery, motors, frame, propellers, receiver and video transmitter are not included.

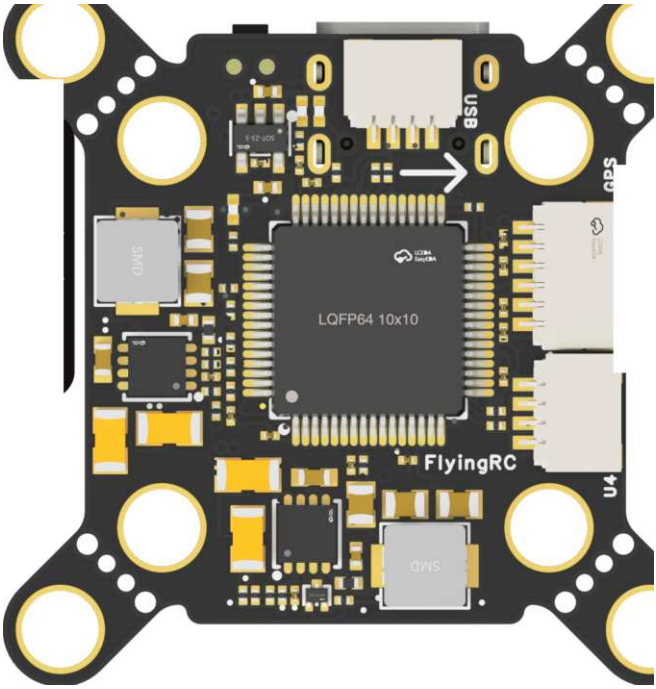
2.2 Flight controller – connectors and pads

All peripherals connect through **SH1.0** connectors; the name of each connector is printed on the board next to it. **T** marks the transmit wire of a serial port, **R** the receive wire. The **U2**, **U4** and **U6** connectors are general-purpose serial ports UART2, UART4 and UART6.



The board side with the ESC, U6, VTX, U2 and DJI connectors, the LED pad and the USB Type-C connector

The other side of the board carries the microcontroller, both BEC converters and the **USB**, **GPS** and **U4** connectors. The white arrow on the board points in the direction of flight.



The board side with the microcontroller and the USB, GPS and U4 connectors

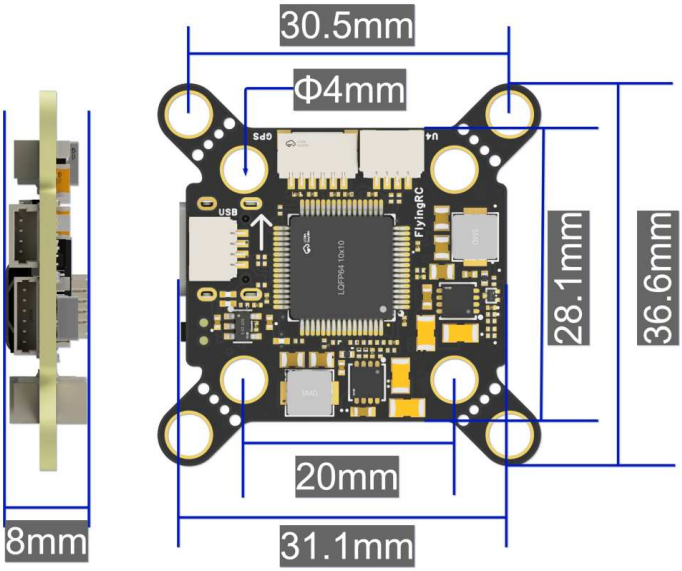
Overview of the connectors and their pins:

Connector	Pins	Pinout
ESC	8	M4 · M3 · M2 · M1 · RX · CURR · G · VBAT
DJI	6	8–26 V · G · TX · RX · G · SBUS
VTX	6	CAM · G · 9V · VTX · G · 9V
GPS	6	SCL · SDA · TX · RX · G · 5V
U2	4	5V · G · RX · TX
U4	4	5V · G · RX · TX
U6	4	5V · G · RX · TX
USB	5	for the USB extension cable
LED	pad	data wire of the WS2812 strip, soldering required

※ The manufacturer gives the pin order of the U2, U4 and U6 connectors in a single common UART connector drawing. Always compare it with the marking on the board itself before you wire anything up.

2.3 Flight controller specifications

Model	FlyingRC F4D MK1
Microcontroller	STM32F405RGT6, 168 MHz
Memory	1 MB Flash, 192 kB RAM
Gyroscope and accelerometer	ICM-42688-P
Barometer	DPS310
Analogue OSD	AT7465E
Serial ports	6× UART, UART3 as a receive wire only
PWM outputs	5 channels – 4 for motors and 1 for an LED strip
I2C bus	1
Current sensing (ADC)	yes
Buzzer	none
LED strip	WS2812, soldering required
USB connector	USB Type-C on the board
Flight data logging	16 MB NOR Flash on the board
SBUS	supported, SBUS pin on the DJI connector
SWD debug interface	none
Power input	3–6S Li-Po, 11.1–25.2 V DC
BEC output for peripherals	5 V / 3 A (MP9943)
BEC output for VTX and camera	9 V / 2 A (MP9943), switchable
Dimensions	36.6 × 36.6 × 8.0 mm; 28.1 × 31.1 × 8.0 mm with the mounting tabs cut off
Mounting holes	30.5 × 30.5 mm and 20 × 20 mm patterns, M4 holes (4 mm diameter)
Weight	6.3 g
Operating temperature	−10 °C to 100 °C
Storage temperature	0 °C to 40 °C
Supported firmware	Betaflight (factory default), INAV, Ardupilot; PX4 is not supported



Flight controller dimensions

2.4 Serial ports (UART)

The flight controller has six serial ports. In Ardupilot firmware the **SERIAL port numbers do not match** the UART numbers printed on the board; the mapping is given in the table below.

Board marking	Port	Ardupilot	Default function
USB	USB	SERIAL0	console
DJI	UART1	SERIAL1	telemetry 1
U2	UART2	SERIAL6	receiver input (CRSF)
ESC (R3)	UART3	SERIAL2	ESC telemetry
U4	UART4	SERIAL4	free
GPS	UART5	SERIAL3	GPS
U6	UART6	SERIAL5	free

- **UART3** is broken out as the **RX** receive wire on the ESC connector only – it carries ESC telemetry.
- Direct memory access (DMA) is available on **UART1** and on the transmit wire of **UART6**. UART3, UART4 and UART5 work without DMA.
- Once wired up, each port must be assigned its function. If you connect a GPS module to the GPS connector, for example, set *SERIAL3_PROTOCOL* to GPS in

Ardupilot and make sure no other port is set to GPS.

※ For receivers using a protocol other than SBUS or PPM – ExpressLRS, for example – the manufacturer gives the setting *BRD_ALT_CONFIG* = 1, while its text mentions SERIAL7 even though the mapping table puts the receiver input on SERIAL6. If the receiver does not communicate, try setting this parameter and restarting the flight controller.

2.5 PWM outputs and motors

The flight controller has five PWM outputs. Outputs **S1 to S4** are broken out on the ESC connector, the fifth output drives an addressable LED strip. The motor outputs are split into two groups according to the microcontroller timers:

Group	Outputs	Timer	Channels
1	S1, S2	TIM8	CH4, CH3
2	S3, S4	TIM1	CH3N, CH1

- All four outputs support the **DShot** 150, 300 and 600 protocols.
- Outputs in the same group **cannot** be used at the same time for DShot ESCs and for 50 Hz servos.

2.6 I2C bus and voltage and current sensing

The I2C bus is broken out on the GPS connector as **SCL** (clock wire) and **SDA** (data wire). It is used to connect an external magnetometer; in Ardupilot it is enabled with *COMPASS_AUTODEC* = 1.

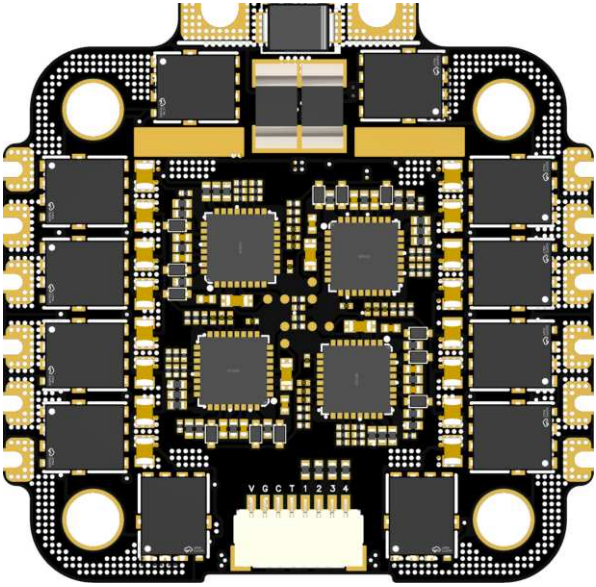
Battery voltage is sensed on the **VBAT** pin through a divider built into the board, current on the **CURR** pin from the current sensor of the ESC.

Firmware	Parameter	Value
Betaflight	current sensor scale	100 (1/10 mV/A)
Ardupilot	BATT_VOLT_PIN	10
Ardupilot	BATT_VOLT_MULT	11.0
Ardupilot	BATT_CURR_PIN	11
Ardupilot	current sensor scale	100 (A/V)
INAV	voltmeter divider ratio	1100

※ The manufacturer's documentation gives two different sets of values for the analogue inputs – *BATT_VOLT_PIN* 14, *BATT_VOLT_MULT* 21 and *BATT_CURR_PIN* 15 in the ADC input table, and the values listed in the table above in the recommended settings overview. After the first power-up, always compare the voltage shown in the configurator with the voltage measured directly on the battery and recalibrate the divider ratio if they differ.

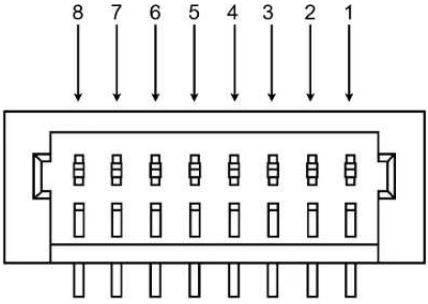
2.7 ESC – description and connector

The ESC is a 4-in-1 unit running **AM32** firmware. The HYG011N04 power MOSFETs use a DFN 5 × 6 package with a large bottom thermal pad that conducts heat into the printed circuit board. Current is also carried by two gold and nickel-plated surface-mount copper strips. The ESC supports sinusoidal startup.



Top side of the ESC with the connector and pin markings

The signal connector is an 8-pin SH1.0 type. Pins are counted from the left when looking at the connector from the front:

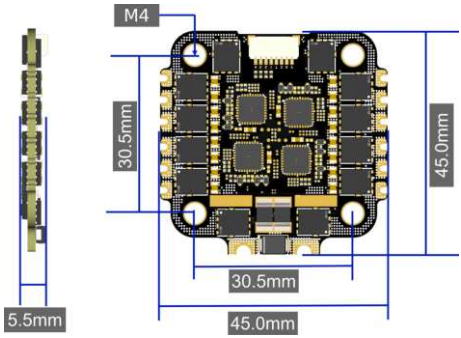


SH1.0 8P connector pin numbering

Pin	Name	Function
1	VBAT	battery voltage
2	G	ground
3	CURR	analog current sensor output
4	TX	ESC telemetry
5	M1	motor 1 signal
6	M2	motor 2 signal
7	M3	motor 3 signal
8	M4	motor 4 signal

The signal cable is factory-crimped in the order matching the ESC. Before connecting the battery for the first time, always compare the wire order with the flight controller connector using the table in section 4.5.

2.8 ESC specifications



ESC dimensions

Model	FlyingRC 4-in-1 ESC 45 A
Microcontroller	QF32F4AK8U7, 32-bit, 120 MHz
Memory	64 kB Flash, 16 kB RAM
Gate driver	ID6288
Power MOSFETs	HYG011N04, DFN 5 × 6 package, 40 V
On-resistance	1.0 mΩ at 10 V
Power input	9–30 V, 3–7S Li-Po or 3–6S LiHV
Continuous current per channel	45 A for 5 s (tested on 4S)
Burst current per channel	50 A (tested on 4S)
Current meter scale	100 (1/10 mV/A) in Betaflight, 100 (A/V) in Ardupilot
Firmware	AM32
Input signal	DSHOT150/300/600, OneShot, PWM and others
Printed circuit board	6 layers, 2 oz copper, resin-filled vias, immersion gold finish
Dimensions	45 × 45 × 5.5 mm
Mounting holes	30.5 × 30.5 mm pattern, M4 holes (4 mm diameter)
Weight	16.6 g
Operating temperature	−10 °C to 100 °C
Storage temperature	0 °C to 40 °C

3. Legal conditions of operation in the Czech Republic and the EU

3.1 The law of the country you fly in applies

Regulations (EU) 2019/947 and 2019/945 apply in all Member States of the European Union, but the national implementing rules differ from state to state – registration portals, pilot age, geographical zones, insurance, frequency bands and transmit powers. The information in this chapter describes the situation in the Czech Republic. If you fly in another country, you must follow the rules of that state.

3.2 The set is a component, not a finished drone

Neither board is an unmanned aircraft. Regulation (EU) 2019/945, which defines classes C0 to C6, applies to finished unmanned aircraft systems bearing a class identification label, not to individual parts. The boards therefore cannot bear a class marking, and they contain no radio equipment – the receiver and the video transmitter are bought separately and follow their own documentation.

Once the boards are built into an aircraft, Regulation (EU) 2019/947 and the related Czech rules apply to the **operation** of that aircraft. Responsibility for compliance rests with the operator.

3.3 Operator registration and operational categories

These obligations apply to the finished aircraft you build the boards into.

- The operator must **register** if the aircraft carries a sensor capable of capturing personal data, i.e. a camera – regardless of weight. In the Czech Republic registration runs at dron.caa.gov.cz and the number issued must be displayed on the aircraft.
- An aircraft without a class marking built after 1 January 2024 may be operated as a **privately built unmanned aircraft system** – in subcategory A1 below 250 g and 19 m/s, otherwise in subcategory A3; subcategory A2 is not available. A drone based on this set usually weighs well over 250 g, so expect **subcategory A3**.
- The usual open-category limits apply: **up to 120 m** above ground, continuous visual contact and no flying over assemblies of people. Subcategory A3 also requires 150 m from residential, commercial, industrial and recreational areas.
- With FPV goggles, an **unmanned aircraft observer** must stand next to you and keep visual contact with the aircraft without optical aids.
- Before flying, check the geographical zones at dronemap.rlp.cz and weigh the actual take-off mass including the battery.
- Liability insurance is not compulsory for small aircraft in the open category, but we recommend it.

4. Installation and wiring

4.1 What else you need

In addition to the package contents you will need:

- a frame with a 30.5 × 30.5 mm mounting pattern and four motors matching the chosen size,
- a 3–6S Li-Po battery and a matching charger,
- a receiver and a radio transmitter,
- a video transmitter – digital or analog – together with a camera or goggles,
- a temperature-controlled soldering iron, solder, wires and heat-shrink,
- a computer with the Betaflight, INAV or Ardupilot configurator and a USB-C cable.

4.2 Mounting in the frame

Both boards mount on the **30.5 × 30.5 mm** pattern. The mounting holes of both boards are **M4** with a 4 mm diameter; together with the supplied anti-vibration grommets they take **M3 screws**. The ESC is usually mounted **at the bottom**, closer to the battery, with the flight controller above it.

① Fit the supplied M3 anti-vibration grommets into the holes of both boards.

② Place the ESC in the frame and fasten it with M3 screws.

③ Place the flight controller above the ESC so that the white arrow on the board points **forward** in the direction of flight.

④ Tighten the screws only lightly – overtightening compresses the grommets and stops them damping vibration.

⑤ Check that the boards touch neither each other nor the frame with any component or solder pad.

- The flight controller can also be mounted on the **20 × 20 mm** pattern using the supplied M2 grommets. The ESC only has the 30.5 mm pattern, however, so the complete set mounts on 30.5 mm.
- The mounting tabs of the flight controller can be cut off; the board then measures 28.1 × 31.1 mm and mounts on the 20 × 20 mm pattern only.

If the flight controller faces any other direction, set the orientation in the configurator. Mechanically correct installation is always more reliable.

4.3 Power supply and capacitor

The battery connects to the **ESC**. The flight controller is powered from the ESC through the VBAT wire of the signal cable; it has no separate power pads.

① Solder the supplied XT60 cable to the power pads of the ESC. Observe the polarity – **+** is positive, **−** negative.

② Solder the supplied **35 V / 680 µF capacitor** to the same pads. The red stripe on the can marks the **negative** terminal.

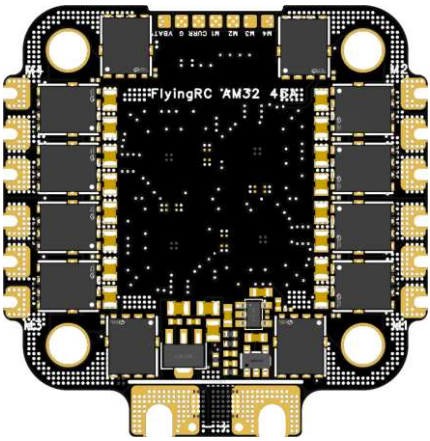
③ Once cool, check the joints and make sure the solder does not bridge adjacent pads.

The capacitor suppresses voltage spikes from the motors. Without it you risk gyro noise, video transmitter dropouts and destruction of the ESC.

- The solder pads of the ESC are large and gold-plated, so they conduct heat well. Use a soldering iron with enough power, ideally with a T12 or 936 series tip, and solder with about 63 % tin content.
- If you do not have suitable equipment, have the power cable and the capacitor soldered for you.

4.4 Motors

The motor wires are soldered to the **M1** to **M4** pads in the corners of the ESC. The pad markings are printed on the bottom side of the board.



Bottom side of the ESC with the M1 to M4 motor pads

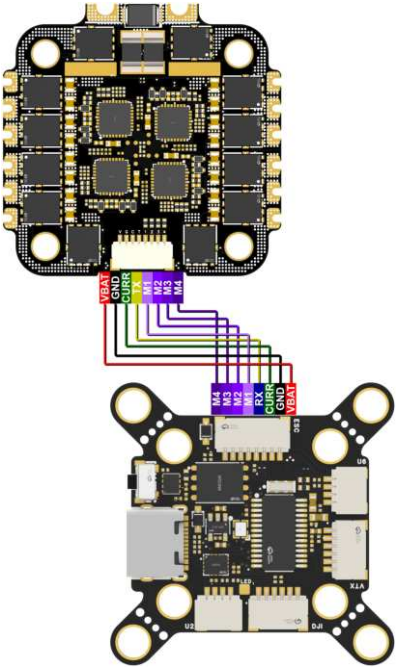
- The order of the three motor wires does not matter – the direction of rotation is set in the ESC firmware.
- The motor wires **must not touch the metal cases of the power MOSFETs**, which are conductive.
- Route the wires so that they cannot reach the propellers and secure them in the frame.
- Check the assignment of motors to the individual outputs in the configurator before fitting the propellers.

4.5 Connecting the flight controller and the ESC

‼ The signal cable must have the wire order matching the ESC you use. The wrong order will destroy the flight controller. Always check the order before you connect the battery for the first time.

The ESC package includes a double-ended SH1.0 8P cable. One end is factory-crimped in the order matching the ESC, the other end is loose. The supplied SH1.0 8P connector lets you rearrange the wires to match the flight controller connector. Both boards follow the Betaflight connector standard, so the wires face each other in the same order.

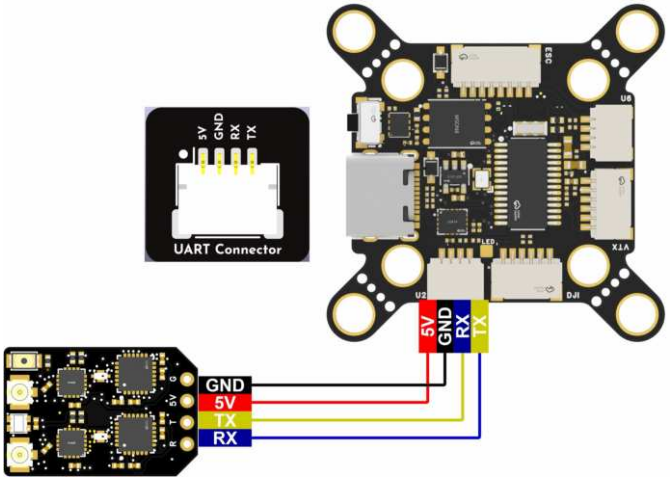
ESC	Flight controller	Function
VBAT	VBAT	battery voltage
G	G	ground
CURR	CURR	current sensor
TX	RX	ESC telemetry
M1	M1	motor 1 signal
M2	M2	motor 2 signal
M3	M3	motor 3 signal
M4	M4	motor 4 signal



Flight controller to ESC wiring based on the manufacturer's documentation

4.6 Receiver

The receiver connects to the **U2** connector, which is routed to UART2 – SERIAL6 in Ardupilot firmware.

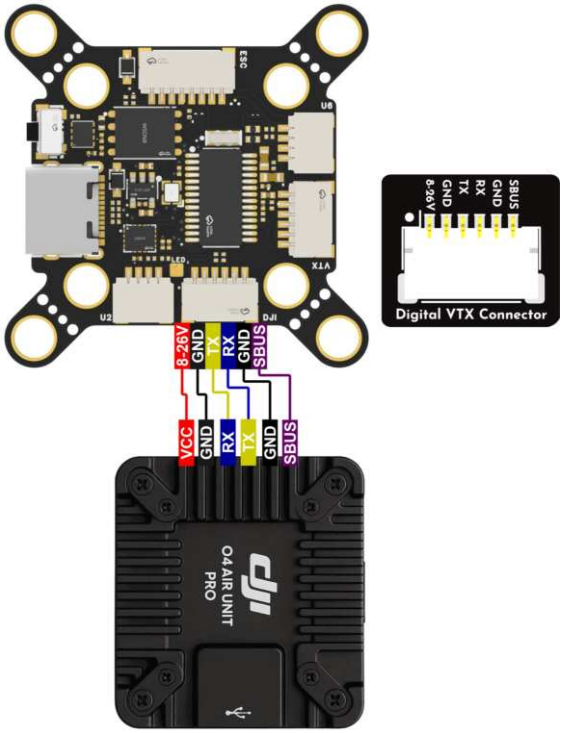


Receiver wiring based on the manufacturer's documentation

- The **TX** and **RX** wires cross over: connect the receiver TX pin to **RX** on the flight controller and the receiver RX pin to **TX**.
- Power the receiver from the **5V** and **G** pins of the same connector.
- A receiver using the **SBUS** protocol connects to the SBUS pin of the DJI connector.

4.7 Digital video transmitter

The six-pin **DJI** connector is intended for a digital video transmitter. A 15 cm cable is included in the package – no soldering is needed.

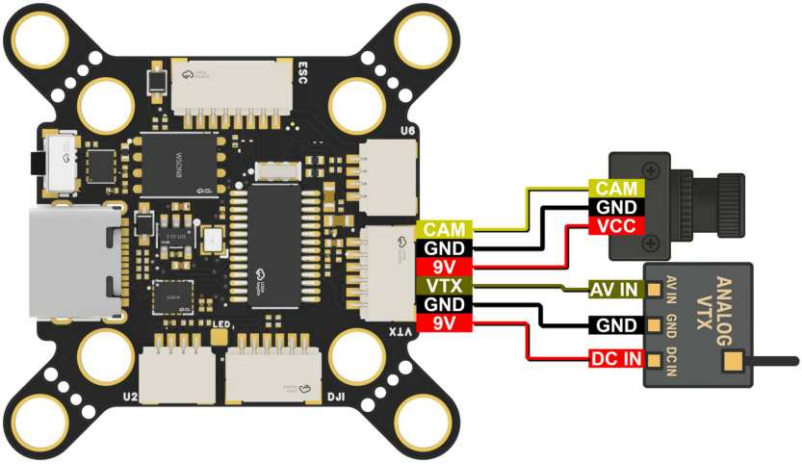


Digital video transmitter wiring based on the manufacturer's documentation

- The connector carries **8–26 V** power, the **UART1** serial port for data and the on-screen display (OSD), and the **SBUS** input.
- The **TX** and **RX** wires cross over here as well: flight controller TX to video transmitter RX and vice versa.
- Power on this connector follows the battery voltage and is therefore not switchable. Only the 9 V output on the VTX connector can be switched – see chapter 5.9.

4.8 Analogue camera and video transmitter

The six-pin **VTX** connector carries the **CAM**, **G**, **9V**, **VTX**, **G** and **9V** pins. It serves both the analogue camera and the analogue video transmitter.

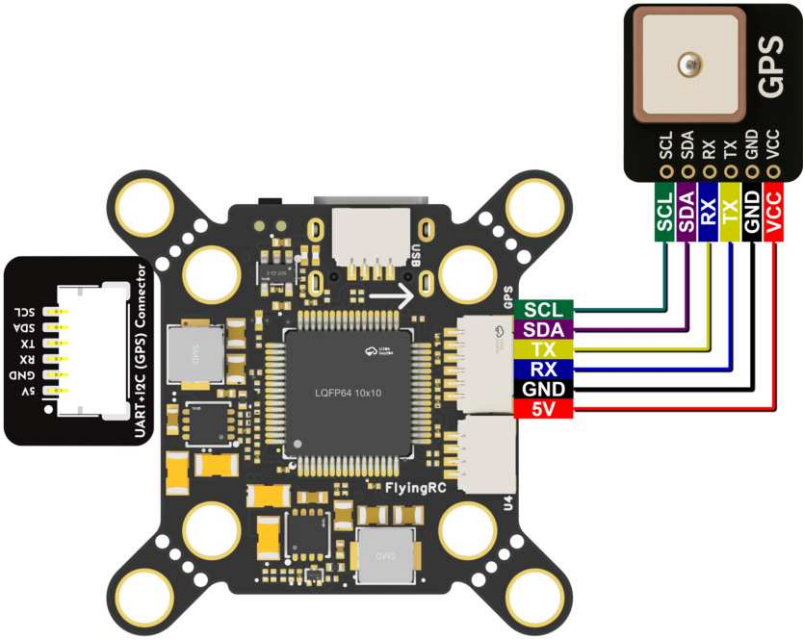


Analogue camera and video transmitter wiring based on the manufacturer's documentation

- Connect the camera video signal to the **CAM** pin and the camera power to **9V** and **G**.
- Connect the video input of the transmitter to the **VTX** pin and its power to the second **9V** and **G** pair.
- The 9 V supply comes from a converter on the board and can be switched off from the transmitter – see chapter 5.9.
- The analogue on-screen display (OSD) is drawn by the AT7465E chip; with digital video the display is drawn in the video transmitter.

4.9 GPS module and compass

The GPS module connects to the **GPS** connector, that is to UART5 – SERIAL3 in Ardupilot firmware.



GPS module with compass wiring based on the manufacturer's documentation

- Connect the **TX** pin of the module to **RX** and the **RX** pin of the module to **TX**.
- A module with a compass also uses the I2C bus – the **SCL** and **SDA** pins of the same connector.
- Place the module as far as possible from the power wires and from the motors, otherwise the compass will be disturbed.
- In Ardupilot set *SERIAL3_PROTOCOL* to GPS and make sure no other port is set to GPS.

4.10 LED strip

The data wire of an addressable **WS2812** strip is soldered to the pad marked **LED** next to the U2 connector. Take the 5 V power and ground for the strip from the 5V and G pins of any free UART connector.

- The LED pad is the only place on the board where soldering is required; all other peripherals connect through connectors.
- The LED output is the fifth PWM channel.

5. Setting up

5.1 Connecting to a computer

The flight controller is connected to a computer with a **USB Type-C** cable.

① Remove the propellers.

② Connect the flight controller to the computer with a USB-C cable. Do **not** connect the battery.

③ Start the configurator and press *Connect*.

④ If the board does not appear, try a different cable – many USB-C cables are charge-only and have no data lines.

USB does not power the motors or the video transmitter. The motors and the ESC are tested only with the battery connected and always without propellers.

5.2 Flight controller firmware

The flight controller ships with **Betaflight** firmware loaded at the factory. Betaflight, INAV and Ardupilot are all supported.

Betaflight	MATEKF405TE
INAV	MATEKF405TE
Ardupilot	MatekF405-TE

- The manufacturer does not release a dedicated target for this board; for all three firmwares it refers to the **Matek F405-TE** target.
- Flashing a different target will not damage the board, but it will not work correctly – in particular the port and output assignment.
- Save your configuration with the *diff all* command on the *CLI* tab before you reflash the firmware.

The manufacturer provides limited technical support for Betaflight and Ardupilot firmware. No technical support is provided for INAV firmware.

5.3 Basic flight controller settings

Firmware	Parameter	Value
Betaflight	gyroscope orientation	CW 90° Flip
Ardupilot	COMPASS_AUTODEC	1 – external magnetometer
Ardupilot	SERIAL3_PROTOCOL	GPS – module on the GPS connector

The values for voltage and current sensing are given in chapter 2.6.

5.4 ESC firmware

The ESCs ship with AM32 firmware pre-flashed and are tested at several voltages before dispatch.

‼ Do not use the ESC configurator running in a web browser. Flashing firmware this way may destroy the ESC microcontroller.

To flash the firmware and set the parameters, use the AM32 ESC Tools application, which you download from the manufacturer's website and run locally.

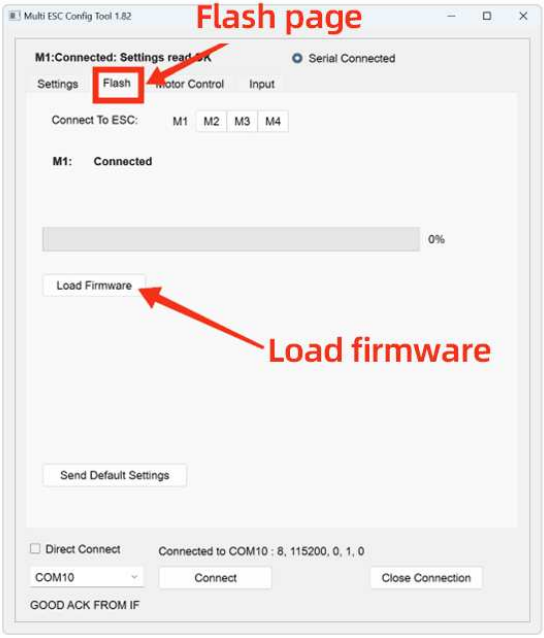
① Remove the propellers.

② Close the Betaflight configurator so that the serial port of the flight controller is released.

③ Connect the flight controller to the computer and **connect a battery to the ESC**.

④ Start AM32 ESC Tools, select the COM port of the flight controller in the bottom right corner and press *Connect*.

⑤ If no error message appears, the application is connected.



The Flash tab in AM32 ESC Tools

⑥ Go to the *Flash* tab, select **M1** and press *Load Firmware*.

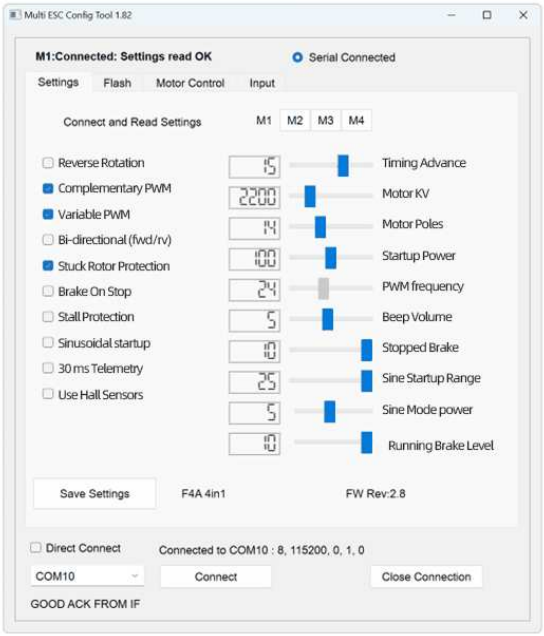
⑦ Select the downloaded firmware file in the dialog and press *Flash Firmware*. Wait until the progress bar completes.

⑧ Press *Send Default Settings* to restore the default parameters. This step is required when several firmware versions have been skipped.

⑨ Repeat the whole procedure for M2, M3 and M4.

5.5 ESC parameters

The parameters are set in the same application on the *Settings* tab; the connection procedure is the same as in chapter 5.4.



The Settings tab in AM32 ESC Tools

- **Motor KV** – set the value as close as possible to the actual KV of the motor. The deviation must not exceed 30 %. With a deviation above 100 % the motor may not run at all and the ESC may be damaged.
- **Timing Advance** – **do not change**. An incorrect setting will destroy the ESC and such damage is usually beyond repair.
- **Stall Protection** – enable it for low-KV motors (below 500) and always when sinusoidal startup is used.
- **Sinusoidal Startup** – not required for ordinary FPV drones.
- Save the changes with *Save Settings* and set the same values for all four motors.

5.6 Accelerometer calibration

Calibrate after installation in the frame, when the aircraft is complete.

① Place the aircraft on a level horizontal surface.

② Choose *Setup → Calibrate Accelerometer* in the configurator.

③ Do not move the aircraft during calibration.

5.7 Checking the motor order and direction

Always carry out this test without propellers and with the aircraft mechanically secured.

① Remove the propellers and connect the battery.

② Open the *Motors* tab in the configurator and enable motor testing.

③ Spin up motors 1 to 4 one by one and check that the intended motor runs.

④ Check the direction of rotation; if it is wrong, change it in AM32 ESC Tools with *Reverse Rotation*.

⑤ Fit the propellers according to the firmware diagram only after a successful test.

5.8 Arm, Disarm and failsafe

Assign **Arm** (motors on) and **Disarm** (motors off) to a switch on the radio. Do not use a lever or a button for Arm that can return by itself.

- The Arm switch must be in the off position before you connect the battery.
- Set the behaviour on signal loss on the *Failsafe* tab; the recommended setting is to cut the motors immediately.
- Test the failsafe function without propellers – switch off the radio and verify that the motors stop.

5.9 Switched 9 V supply

The 9 V supply for the video transmitter can be switched from the radio through the **PINIO1** output, controlled in Betaflight by the *USER1* mode.

- On the *Modes* tab of the configurator, assign the *USER1* mode to the chosen switch on your radio.
- Switching it off protects the video transmitter from overheating during bench tests and between flights.
- Remember to switch the supply back on before the flight.

5.10 Flight data logging

The flight controller logs flight data to the **16 MB NOR Flash memory** on the board. The memory holds several flight logs.

- Logging is enabled and the recorded data downloaded in the configurator on the *Blackbox* tab.
- Erase the memory after downloading, otherwise no further log will be written.
- The flight controller **has no memory card slot**.

※ In the general Ardupilot settings the manufacturer gives the parameter *LOG_BACKEND_TYPE* = 4 for logging to a TF card. The F4D MK1 flight controller has no memory card slot, however, and stores the data in the memory on the board.

6. Operation

6.1 Pre-flight check

Go through this checklist before every flight:

- The propellers are undamaged, correctly oriented and tightened.
- Both boards are firmly secured and no wire is loose or chafed.
- The motor wires do not touch the cases of the ESC power MOSFETs.
- The receiver antenna is connected and not kinked.
- The radio is switched on, its battery is charged and the Arm switch is in the off position.
- A **fully charged** battery is fitted in the aircraft – 4.20 V per cell for Li-Po.
- The battery connector is secured and the battery is strapped down.
- You have verified the range and the failsafe function.

6.2 Monitoring the battery voltage

The set measures voltage and current and passes the data to the on-screen display and telemetry.

- End the flight at **3.50 V per cell** at the latest – 21.0 V for a 6S pack and 14.0 V for a 4S pack.
- Deep discharge damages the battery permanently and reduces its capacity.
- The voltage reading fluctuates under load; what matters is the voltage at rest after landing.
- Let the battery cool down after the flight before charging it.

6.3 Temperature

Under high load the ESC becomes hotter than any other part of the aircraft.

- Disconnect the battery between flights, or at least switch off the 9 V supply.
- Do not leave the aircraft standing in the sun with the battery connected.
- If the ESC temperature rises excessively, check that the motors are not seized, that the propellers are undamaged and that the KV setting is correct.

7. Maintenance and troubleshooting

7.1 After every flight

- Disconnect the battery and let the boards cool down.
- Check the solder joints, the motor wires and the antenna mounting.
- Remove dirt with a soft brush; do not use solvents.
- After a crash, always inspect the boards against the light – look for cracked joints and loose components.

7.2 Soldering and repairs

- Use a temperature-controlled soldering iron; the ESC pads need enough power, the flight controller pads a fine tip.
- Do not overheat the pads – a lifted pad cannot be repaired.
- Always disconnect the battery and USB before soldering.
- Desoldering a component or modifying the board is not a product defect and cannot be claimed under warranty.

7.3 Storage

- Store the boards in an antistatic bag, in a dry place and out of the reach of children.
- Store batteries charged to **3.80 V per cell**, i.e. 22.8 V for a 6S pack.
- Check the batteries regularly during longer storage.

7.4 Troubleshooting

Problem	Possible cause	Solution
The board does not appear in the configurator	USB cable without data wires, missing driver	try a different cable; if problems persist, flash the firmware in DFU mode
Nothing lights up after the battery is connected	wrong signal cable wire order, reversed polarity	disconnect the battery immediately and check the cable against the table in chapter 4.5
A motor does not spin or spins the wrong way	swapped wires, reversed direction in the ESC firmware	check the order on the *Motors* tab, change the direction with *Reverse Rotation*
A motor starts jerkily or beeps and stops	wrong motor KV setting	set *Motor KV* to the real KV of the motor
The ESC overheats	no airflow, overload, seized motor	check the motors and propellers, provide airflow, never wrap the ESC in heat-shrink

Problem	Possible cause	Solution
The analogue video transmitter does not start	9 V power switched off, connector not seated	check the USER1 mode and that the connector is fully seated
The receiver does not communicate	swapped TX and RX, wrong port assignment	cross the TX and RX wires; in Ardupilot try BRD_ALT_CONFIG = 1
GPS does not get a fix	wrong port assignment, interference from the power wiring	set SERIAL3_PROTOCOL to GPS and move the module away from the wires
The voltage fluctuates, the gyroscope is noisy	missing or badly soldered capacitor	solder the supplied capacitor to the power pads of the ESC
The displayed voltage does not match reality	uncalibrated voltage divider	compare it with the voltage on the battery and adjust the divider ratio as described in chapter 2.6

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.cz

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:** the type designation is printed directly on both boards.

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 manufacturer does not issue its own warranty terms for this product.

- 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.