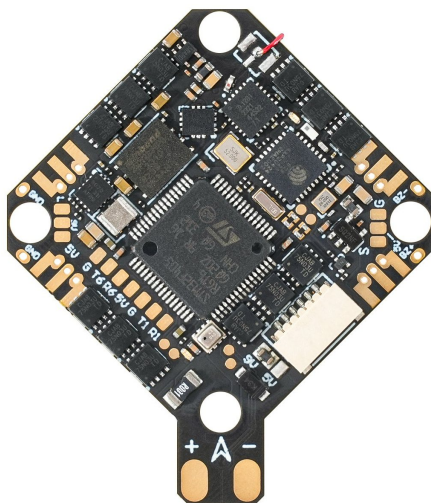




F4 2-3S 20A AIO FC V1

Flight controller with ESCs and a 2.4 GHz ELRS receiver
User Manual — ICM42605 gyroscope variant



Read this manual carefully before installation and first use, in particular Chapter 1 — Safety Instructions. This product is not a toy and is not intended for children.

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1. Safety Instructions

1.1 Before you begin

The BETA FPV F4 2-3S 20A AIO FC V1 is an electronic component for building a small FPV drone (whoop). It combines a **flight controller (FC)**, four **electronic speed controllers (ESC)** and an integrated **ExpressLRS 2.4 GHz receiver**. Installation and setup require basic knowledge of FPV drone building, soldering and working with the Betaflight Configurator software.

- This product is **not a toy** and is not intended for persons under 14 years of age.
- Read this entire manual before installation and keep it for future reference.
- A drone built with this board is subject to the rules for operating unmanned aircraft under Regulation (EU) 2019/947; familiarise yourself with the regulations of the country in which you fly.
- The builder and pilot are responsible for the safe construction, configuration and operation of the finished drone.

1.2 Electrical and mechanical hazards

- **Disconnect the battery** before any soldering or wiring changes.
- Observe the correct **supply polarity**. Reversed polarity will destroy the board beyond repair. The polarity is marked directly on the power pads (+ and -).
- Make sure no joint creates a **short circuit** — especially after soldering the motor and power leads. We recommend making the first battery connection through a short-circuit protector (smoke stopper).
- The board and the ESCs **get hot** during operation. After a flight, do not touch the power components until they have cooled down.
- Spinning propellers cause serious injuries. **Disarm** (switch off the motors) before handling the drone in any way. **Remove the propellers** when configuring on a computer.
- The electronics are sensitive to electrostatic discharge. Hold the board by its edges and do not place it on conductive surfaces.

1.3 LiPo batteries

The board is powered by a **2S or 3S LiPo** battery, which is not included in the package. Lithium batteries can catch fire if handled improperly. Charge them only with a charger designed for LiPo batteries, in balance charging mode, and never leave them unattended while charging. Do not use a damaged or swollen battery.

State	Per cell	2S	3S
Fully charged	4.2 V	8.4 V	12.6 V
End the flight	3.5 V	7.0 V	10.5 V
Storage	3.8 V	7.6 V	11.4 V

Detailed rules can be found in the article [Rules for the safe use of LiPo batteries](#) at www.rotorama.cz.

1.4 Operating environment

- The board has no protection against water or dust. Do not fly in rain and do not land in wet grass or snow.
- Do not operate the board near flammable materials and never leave a connected battery unattended.
- After flying in a humid environment, let the electronics dry out completely before connecting a battery again.

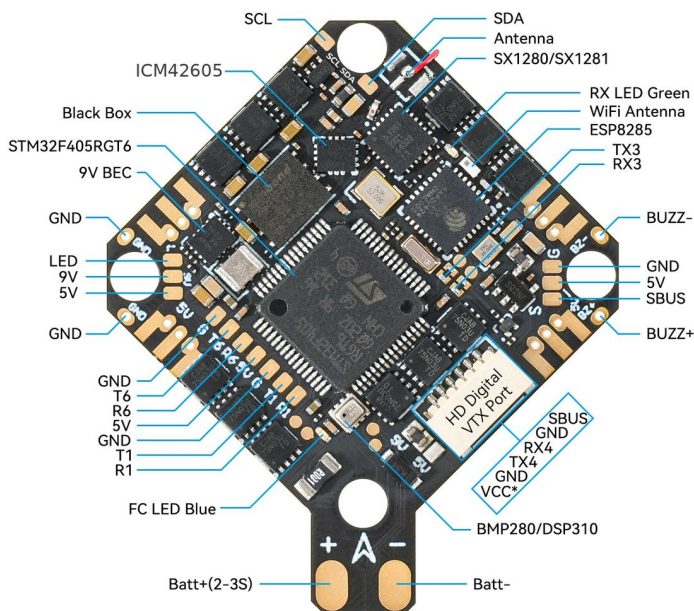
2. Product Description

2.1 Package contents

- 1x F4 2-3S 20A AIO FC V1 flight controller (ICM42605 gyroscope variant)
- 4x M2×10 machine screw
- 4x M2×10 nylon screw
- 4x M2 nut
- 4x anti-vibration rubber damper
- 4x JST 1.25 mm angled socket (motor connectors)
- 4x JST 1.25 mm straight socket (motor connectors)
- 1x SH1.0 4-pin adapter cable
- 1x USB-C to SH1.0 adapter
- 1x power cable with XT30 connector
- 1x filter capacitor
- 1x video transmitter cable, 30 mm (connector on both ends)
- 1x video transmitter cable, 60 mm (connector on one end)

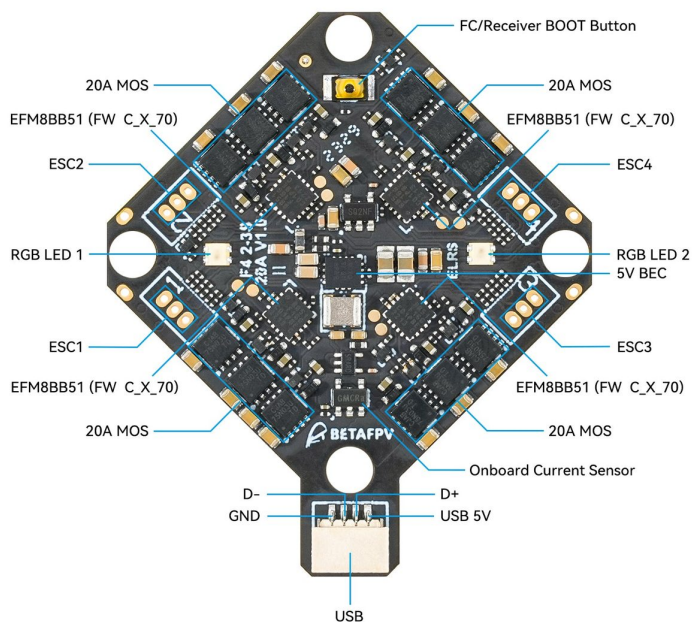
2.2 Board overview

The top side of the board carries the processor, the gyroscope, the barometer, the blackbox memory and the integrated ExpressLRS receiver with a wire antenna and a Wi-Fi chip for firmware updates. Around the edge of the board are the solder pads of the serial ports (UART1 and UART6), the SBUS port, the LED, 9V and 5V outputs, the buzzer pads (BUZZ+ and BUZZ-) and the I2C bus (SCL and SDA). The connector labelled HD Digital VTX Port is used to connect a digital video transmitter without soldering.



Top side of the board — component and solder pad layout (VTX connector VCC: 9 V by default, switching to 5 V see Chapter 3.5)

The bottom side of the board carries the four ESCs with their power transistors, the ESC1 to ESC4 motor pads, the current sensor, the 5V BEC, two RGB LEDs, the BOOT button (shared by the flight controller and the receiver) and the USB connector (SH1.0 4-pin). The battery power pads are on the board's tab next to the USB connector.



Bottom side of the board — ESCs, motor pads, BOOT button and USB connector

2.3 Specifications

Processor	STM32F405RGT6 (168 MHz)
Gyroscope / accelerometer	ICM42605 (SPI connection)
Barometer	BMP280 / DSP310
Blackbox memory	16 MB
Sensors	voltage and current
Receiver	integrated ExpressLRS 2.4 GHz (CRSF protocol)
Receiver antenna	wire (enamelled wire)
Serial ports	4x UART + SBUS port
BEC	5 V/3 A and 9 V/2 A (at 8 V supply voltage)
ESC current	20 A continuous, 25 A peak
ESC firmware	Bluejay
Motor protocols	DSHOT300, DSHOT600 (bidirectional DSHOT)
Flight controller firmware	Betaflight, target BETAFLPVF405
Power supply	2-3S LiPo (7.4-12.6 V)
USB connector	SH1.0 4-pin (USB-C adapter included)
Mounting pattern	26x26 mm, holes for M2 screws
Weight	5.58 g (without motor connectors and power cable)

※ The output current of both BEC circuits decreases as the board temperature rises.

2.4 Integrated ExpressLRS receiver

ExpressLRS (ELRS) is an advanced open source RC system with long range, low latency and a high refresh rate. The integrated receiver operates in the **2.4 GHz** band, communicates with the flight controller over the serial **CRSF** protocol on UART3 and sends telemetry back to the radio transmitter. The receiver firmware can be updated over Wi-Fi or via Betaflight passthrough (see Chapter 4.7).

※ UART3 is routed to the TX3 and RX3 solder pads, but in the factory state it is **occupied** by the onboard receiver — the pads are connected by two resistors. UART3 is **not freely available**; it is only freed by desoldering the resistors, which breaks the connection to the onboard receiver (see Chapter 4.3).

3. Installation and Wiring

3.1 What else you will need

- a whoop frame with a **26x26 mm** mounting pattern (the board is used, for example, in the BETAFLPV Pavo Pico, Pavo20 Pro and HX115 SE drones),

- four brushless motors with JST 1.25 mm connectors or soldered leads; do not use motors with extremely high KV — motors above 20,000 KV burn out easily,
- propellers matching the chosen motors and frame,
- a digital video transmitter with a camera (DJI O3, Caddx Vista / Runcam Link, Walksnail Avatar or HDZero),
- a radio transmitter using the ExpressLRS 2.4 GHz system,
- a 2S or 3S LiPo battery with an XT30 connector and a matching charger,
- a computer with the Betaflight Configurator software.

3.2 Mounting in the frame

Attach the board to the frame using the four mounting holes with a **26x26 mm** pattern. The package contains metal and nylon M2 screws, nuts and anti-vibration rubber dampers — mount the board on the dampers so that motor vibrations are not transferred to the gyroscope. The board must be oriented with the **arrow pointing forward** (the arrow is marked on the tab with the power pads). The USB connector faces backwards so that it remains accessible after installation.

3.3 Connecting the motors

The motors connect to the **ESC1 to ESC4** pads on the bottom side of the board — either by soldering or via the JST 1.25 mm sockets, which are included in both angled and straight versions. Check the motor assignment and direction of rotation in the Betaflight Configurator after setup (see Chapter 4.5).

3.4 Power supply and battery choice

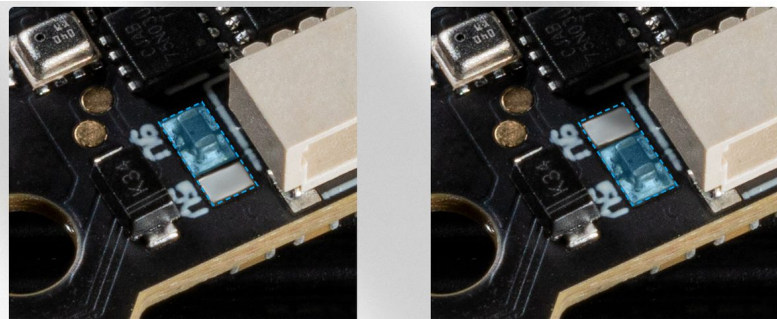
Solder the supplied cable with the **XT30** connector to the power pads on the board's tab. Observe the correct polarity marked on the board (+ and –). We also recommend soldering the supplied **filter capacitor** to the power pads — it smooths out voltage spikes from the ESCs and protects the electronics. The board is designed exclusively for **2S to 3S** batteries (7.4–12.6 V). Always insert a **fully charged** battery before a flight.

3.5 Connecting a digital video transmitter

A digital video transmitter connects to the 6-pin **HD Digital VTX Port** connector without soldering — two adapter cables are included. The connector carries the SBUS, GND, RX4, TX4, GND and VCC signals; communication with the video transmitter runs on **UART4** (the *Configuration/MSP* option must be enabled on it in Betaflight).

The connector's **VCC** output is set to **9 V** from the factory (9V BEC, intended for the DJI O3). The **Walksnail Avatar HD mini 1s and Lite** video transmitters require a **5 V** supply — in that case the bridge (chip bead) must be moved from the 9V position to the 5V position as shown in the picture below. Powering the video transmitter from a separate BEC prevents video dropouts when the battery

voltage sags.

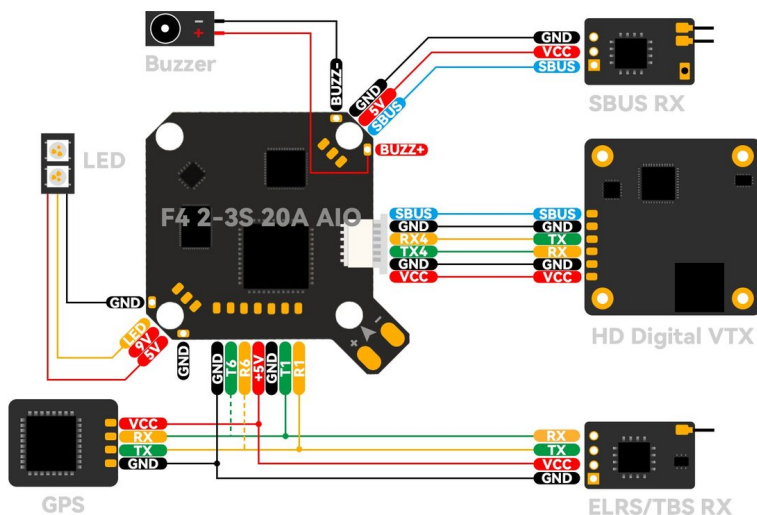


Switching the VTX connector voltage: left — factory state 9 V, right — bridge moved to the 5 V position

Before connecting a video transmitter, check its permitted supply voltage. Connecting 9 V to a video transmitter designed for 5 V will destroy it beyond repair.

3.6 Connecting other devices

The free serial ports **UART1** and **UART6** and the **SBUS** port are routed to solder pads around the edge of the board. They can be used to connect a GPS module (VCC, R1/R6, T1/T6, GND pads; in Betaflight, set *Sensor input* → *GPS* on the chosen UART and enable the GPS feature and set the module's protocol in the *GPS* tab), an external CRSF receiver, or an SBUS receiver on the SBUS pad (UART5 port). A buzzer can be connected to the BUZZ– and BUZZ+ pads and addressable LED strips to the LED, 5V/9V and GND pads. The motor beeper function is enabled in the firmware from the factory, even without an external buzzer.



Connecting external devices: buzzer, LED, GPS, SBUS receiver, digital video transmitter and an external ELRS/TBS receiver

4. Setup

4.1 Connecting to a computer

Connect the board to a computer with the supplied **USB-C to SH1.0** adapter plugged into the USB connector at the rear of the board. Configuration is done in the **Betaflight Configurator** software; the board uses the **BETAFPVF405** target. If Windows does not recognise the board, install the STM32 Virtual COM Port driver and try a different USB cable.

The propellers must be removed during any configuration with the battery connected.

4.2 Binding the receiver

- ① Connect and disconnect the board's power supply (battery or USB) three times in a row.
- ② The receiver's green LED starts **double-flashing** — the receiver is in binding mode. Binding must be completed within 60 seconds, after which the receiver switches to Wi-Fi mode.
- ③ Start binding on the radio transmitter (the *Bind* option in the ExpressLRS LUA script).
- ④ A solid LED means the receiver is bound.

The radio transmitter and the receiver must use the **same major version** of the ExpressLRS firmware, otherwise binding will fail. If the LED always flashes three times after binding, the *Model Match* setting conflicts — toggle it in the radio's LUA script and repeat the binding.

4.3 Using an external receiver

A receiver of another system can be connected to the free UART1/UART6 ports (CRSF protocol) or to the SBUS pad (UART5 port) as described in Chapter 3.6; in Betaflight, enable *Serial RX* on the chosen port and set the corresponding protocol in the *Configuration* tab. The onboard receiver's power supply can be permanently disconnected by desoldering the ferrite bridge (chip bead) next to the TX3/RX3 pads; desoldering it also saves energy. Desoldering the two resistors at the TX3 and RX3 pads frees the UART3 port for other devices.

※ Desoldering the bridge and the resistors is an irreversible modification of the board; to return to the onboard receiver, the pads must be soldered together again. Such a modification is not a defect of the product and cannot be claimed under warranty.

4.4 Accelerometer calibration

Place the drone on a level surface and run *Calibrate Accelerometer* in the *Setup* tab of the Betaflight Configurator. Perform the calibration after the first assembly and then whenever the artificial horizon in the OSD does not match the drone's actual attitude.

4.5 Motor check

With the propellers removed, connect the battery and verify in the *Motors* tab that each slider spins the correct motor and that the motors spin in the correct direction according to the chosen scheme (*Props In / Props Out*). A motor's direction of rotation can be reversed in the ESC configuration; the motor assignment can be changed with the *Motor reordering* function.

4.6 Arm, Disarm and failsafe

In the *Modes* tab, assign the **Arm** function (switching the motors on) to a switch on the radio transmitter. Get into the habit of **Disarming** the drone (switching the motors off) immediately after landing and checking that the motors are off before handling it in any way. In the *Failsafe* tab, verify that the drone switches the motors off (Drop) when the signal is lost. Test the failsafe function before the first flight: Arm the drone without propellers and switch off the radio — the motors must stop within two seconds.

4.7 Firmware updates

► Flight controller

The Betaflight firmware (target **BETAFPVF405**) is updated in the Betaflight Configurator. Before updating, save your configuration with the *diff all* command in the CLI tab. The factory configuration file (CLI dump) is available for download from the manufacturer's support pages at support.betafpv.com.

► ESCs

The ESCs use the **Bluejay** firmware (BB51 hardware) and are configured via ESC Configurator or BLHeliSuite. The factory PWM frequency is **48 kHz**; the manufacturer advises against switching to 96 kHz — the motors may fail to spin up after Arming.

Do not flash the ESC firmware repeatedly at short intervals — according to the manufacturer, this can cause stalling and destroy the board.

► ExpressLRS receiver

The receiver firmware can be flashed in two ways. **Via Betaflight passthrough:** close the Betaflight Configurator, connect the board via USB and, in the ExpressLRS Configurator, select the **BETAFPV 2.4GHz AIO RX** target and the *BetaflightPassthrough* method. **Via Wi-Fi:** power the board and wait 60 seconds until the receiver enters Wi-Fi mode; connect the computer to the *ExpressLRS RX* network (password *expresslrs*), open the address 10.0.0.1 in a browser and upload the firmware file. After the update, the receiver's version must match the version in the radio transmitter.

5. Operation

5.1 Pre-flight check

- The battery is **fully charged** (4.2 V per cell) and firmly attached.
- The propellers are undamaged, tightened and in the correct positions.
- The screws and dampers are secure, the receiver antenna is undamaged and does not reach into the propellers.
- The radio transmitter is on, the correct model is selected and the RC link and video range are fine.
- After connecting the battery, place the drone on a still, level surface for a few seconds — the gyroscope calibrates at startup.
- Check the camera image and the OSD data (voltage, RSSI/LQ).

5.2 Voltage monitoring and ending the flight

During the flight, monitor the battery voltage in the OSD or in the radio's telemetry. End the flight at the latest when the voltage drops to **3.5 V per cell** (7.0 V for 2S, 10.5 V for 3S). Deeper discharge permanently damages the battery. We recommend landing with a small reserve — the voltage sags under load and partially recovers after landing.

6. Maintenance and Troubleshooting

6.1 After every flight

- Disconnect the battery and check that the board, motors and wiring are not damaged or overheated.
- Remove grass, dust and dirt from the board and motors — ideally with a soft brush or compressed air.
- After a hard crash, check the solder joints, connectors and the receiver antenna.

6.2 Storage

Store the board and the finished drone in a dry place out of the reach of children. Store batteries removed from the drone, charged to the storage voltage of **3.8 V per cell**, in a fireproof container.

6.3 Troubleshooting

Problem	Possible cause and solution
The receiver will not bind	Different major ExpressLRS versions in the radio and the receiver — update the firmware (Chap. 4.7). The 60 s binding window expired — repeat the procedure from Chapter 4.2.
LED flashes 3x after binding	Model Match setting conflict — toggle the option in the radio's LUA script and bind again.
The board is not detected by the computer	Missing STM32 Virtual COM Port driver, a faulty cable, or another program is blocking the port.
Motors do not spin after Arming	Check the Arm conditions (drone attitude, throttle down), the motor wiring and the ESC PWM frequency (factory 48 kHz, Chap. 4.7).
No image from the video transmitter	Check the VTX connector supply voltage (9 V vs. 5 V, Chap. 3.5) and that Configuration/MSP is enabled on UART4.
Short RC range	A damaged or badly routed receiver antenna — route it away from carbon parts and power cables.

7. Information for the EU and Czech Market

7.1 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@rotorاما.cz
Phone	+420 252 252 098
Website	www.rotorاما.cz

7.2 Product conformity



- 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@rotorاما.cz.
- **Product identification:** the type designation (F4 2-3S 20A V1.0) is printed directly on the board; the flight controller firmware version can be displayed in the Betaflight Configurator software.

7.3 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>.

8. 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 7.1.
- 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.