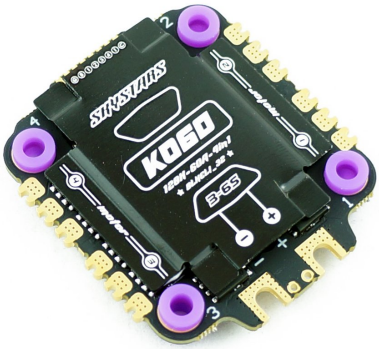
Skystars KO60A AM32

4-in-1 electronic speed controller (ESC) 60 A, 3–6S
User manual



Read this entire manual before installation and keep it for future reference.

Rotorama, s.r.o. · www.rotorama.com

Contents

1. Safety instructions

2. Product description

2.1 Intended use

2.2 Package contents

2.3 Specifications

2.4 Board layout and FC connector

3. Installation

3.1 What else you need

3.2 Mounting in the frame

3.3 Soldering the motors

3.4 Power leads and capacitor

3.5 Electromagnetic compatibility guidelines

4. Connecting to the flight controller (FC)

5. Betaflight setup

5.1 Protocol and bidirectional DShot

5.2 Voltage and current

5.3 ESC telemetry

5.4 Motor order and direction

6. AM32 configuration and firmware

7. Use, maintenance, troubleshooting

8. Information for the EU and Czech market

9. Warranty and rights in case of defects

1. Safety instructions

1.1 Before you start

The speed controller is designed to be built into a radio-controlled multicopter (FPV drone). Installation requires soldering and basic knowledge of electronics. If you are unsure, have the installation done by an experienced modeller.

- This product is not a toy. It is not intended for children or for persons who are not familiar with operating RC models.
- Never work on the speed controller (soldering, rewiring, measuring) while a battery is connected.
- Before connecting a battery for the first time, check the polarity of the power leads and make sure there are no short circuits or solder residues between the pads.
- For the first power-up after installation we recommend using short-circuit protection (a so-called smoke stopper).

1.2 Spinning propellers

Motors driven by the speed controller may start unexpectedly – for example due to incorrect settings, during a motor test in the configurator or during a firmware update.

- Whenever you work on the bench (setup, motor test, AM32 configuration, firmware update), **always remove the propellers**.
- Keep a model with propellers fitted away from your body, other people and animals; Arm (motor start) only in a safe place.

1.3 Li-Po batteries

The speed controller is designed for Li-Po batteries with 3 to 6 cells (3–6S). The following values apply to the batteries:

State (Li-Po)	3S	4S	5S	6S
fully charged 4.20 V/cell	12.6 V	16.8 V	21.0 V	25.2 V
end flight 3.5 V/cell	10.5 V	14.0 V	17.5 V	21.0 V
storage 3.8 V/cell	11.4 V	15.2 V	19.0 V	22.8 V

- The manufacturer specifies a supply voltage range of 12–26 V. A fully charged **6S LiHV** battery reaches 26.1 V (4.35 V/cell) and thus exceeds the upper limit – do not use it. Never connect batteries with more than 6 cells.
- Charge batteries only with a suitable charger, under supervision and on a non-flammable surface.

- Do not use a damaged, swollen or overheated battery.

1.4 Electrical installation and heat

- Observe the supply polarity. Swapping + and − on the power pads may destroy the speed controller.
- Always fit the supplied low-ESR capacitor to the power input (see Chapter 3.4). Without it, voltage spikes may damage the speed controller.
- The speed controller heats up during operation. Ensure airflow and do not exceed the continuous current of 60 A. Do not remove the cover (EMI shield).
- Protect the speed controller from moisture, dust, metal chips and carbon dust from the frame – they can cause short circuits.

1.5 Regulations of the country of operation

The speed controller is part of an unmanned aircraft. Regulations (EU) 2019/947 and 2019/945 apply in all member states of the European Union, but national implementing rules differ from country to country – operator registration, pilot competency, geographical zones, insurance and permitted radio bands. **The law of the country in which the drone is operated always prevails.** If you operate the drone in a country other than the Czech Republic, follow the regulations of the country in which you fly.

2. Product description

2.1 Intended use

The Skystars KO60A AM32 is a quadruple speed controller (4-in-1 ESC) on a single board for a 30.5 × 30.5 mm mounting pattern. It drives the four brushless motors of a quadcopter according to the signal from the flight controller (FC). It is intended for 5" freestyle and racing quadcopters as well as for 7" long-range builds.

The speed controller comes with the open-source **AM32** firmware and has a built-in current sensor and a telemetry output. It has no voltage regulator of its own (BEC) – the flight controller generates its supply from the battery voltage itself.

※ The cover of the speed controller may be printed “BLHeli_32” (same board design). The speed controller is supplied with AM32 firmware; you can verify the installed firmware in the configurator (Chapter 6).

2.2 Package contents

1×	KO60 4-in-1 speed controller
1×	8-pin connection cable, 1.0 mm pitch (to the flight controller)
1×	filter capacitor (560 µF / 35 V, low ESR)
1×	XT60 connector
2×	silicone power lead
4×	silicone damper (soft mount) for M3 screws

Not included: flight controller (FC), motors, propellers, battery and mounting screws.

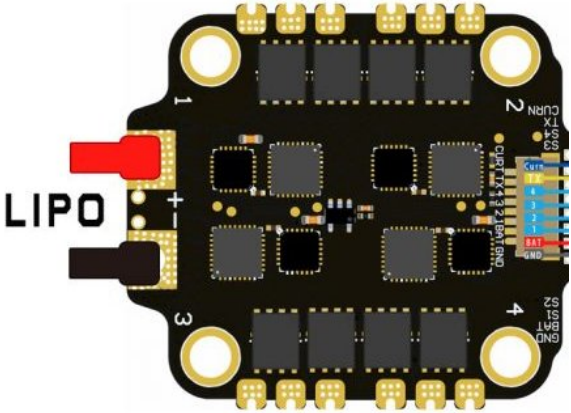
2.3 Specifications

Parameter	Value
Designation	Skystars KO60A AM32 (cover print: KO60)
Type	4-in-1 speed controller (ESC) for 4 motors
Supply	3–6S Li-Po (12–26 V)
Continuous current	60 A
BEC (5 V output)	none
Firmware	AM32 (factory installed)
Processor	32-bit ARM Cortex STM32F051, 48 MHz
Control signal	DShot300, DShot600, bidirectional DShot, servo PWM (according to AM32 documentation)

Parameter	Value
Telemetry	TX output (ESC telemetry), bidirectional DShot
Current sensor	yes, CUR output
Power transistors	24× MOSFET in 5 × 6 mm package
Printed circuit board	6 layers, 3 oz copper
Mounting pattern	30.5 × 30.5 mm, 4 mm holes, silicone dampers for M3
FC connector	8-pin, 1.0 mm pitch
Weight	14.1 g (manufacturer's figure)

Sources: manufacturer Skystars (skystars-rc.com), AM32 firmware documentation, Rotorama.

2.4 Board layout and FC connector



Board view: power pads (LIPO + / −), motor numbers 1–4 in the corners and the 8-pin connector (source: Skystars).

Pin	Function
CUR	analogue current sensor output to the flight controller
TX	ESC telemetry (to the RX input of a free UART on the flight controller)
4	motor 4 control signal
3	motor 3 control signal
2	motor 2 control signal
1	motor 1 control signal
BAT	battery voltage for supply and measurement in the flight controller
GND	ground

Pin order according to the manufacturer's diagram: CUR – TX – 4 – 3 – 2 – 1 – BAT – GND.

3. Installation

3.1 What else you need

- a flight controller (FC) with a 30.5 × 30.5 mm mounting pattern and a connector for a 4-in-1 ESC (or solder pads),
- four brushless motors suitable for the voltage of the battery used,
- a 3–6S Li-Po battery with an XT60 connector,
- M3 screws of suitable length and a soldering iron with solder and flux,
- a computer with Betaflight Configurator and a browser with Web Serial support (e.g. Chrome) for the AM32 configurator.

3.2 Mounting in the frame

① Insert the silicone dampers (soft mounts) into the mounting holes of the speed controller.

② Place the speed controller in the frame so that the power pads face the exit point of the power lead and motor numbers 1–4 correspond to the motor positions.

③ Mount the flight controller above the speed controller (stack). Tighten the screws only lightly so that the dampers can do their job.

④ Check that neither the board nor any components touch the carbon frame.

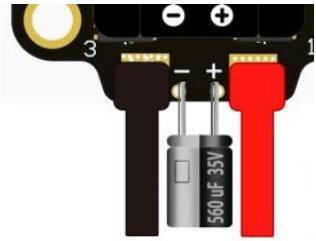
3.3 Soldering the motors

Each motor has a set of three pads on the board marked with the number 1–4. Solder the three motor wires to the corresponding set; the order of the wires within the set does not matter – the direction of rotation is set later (Chapter 5.4).

- Shorten the wires to the necessary length so that they are not under tension and cannot touch the propellers.
- Solder quickly with plenty of flux; do not overheat the pads or nearby components.
- After soldering, check that no solder bridge has formed between adjacent pads.

3.4 Power leads and capacitor

Solder the silicone power leads with the XT60 connector to the pads marked **+** and **−** (red to +, black to −). Solder the supplied 560 µF / 35 V capacitor to the power pads as close to the board as possible. The manufacturer explicitly requires the use of the supplied low-ESR capacitor.



Connecting the power leads and the capacitor (source: Skystars).

- Observe the polarity of the capacitor: the lead marked with a stripe (−) goes to the negative pad. A capacitor connected with reversed polarity may be damaged.
- Shorten the capacitor leads and insulate them with heat-shrink tubing. Secure the capacitor so that vibration cannot break it off.

3.5 Electromagnetic compatibility guidelines

A switching speed controller is a source of electromagnetic interference. To ensure that the equipment works reliably once installed and does not interfere with its surroundings, follow these guidelines:

- solder the capacitor as close to the power pads as possible,
- keep the power leads and motor wires as short as possible and twist the power leads together,
- route the signal cable to the FC, the receiver antenna and the video transmitter as far away from the power leads and motor wires as possible,
- do not remove the cover (EMI shield) of the speed controller.

4. Connecting to the flight controller (FC)

4.1 8-pin cable

The speed controller is connected to the flight controller with the supplied cable with 8-pin connectors (1.0 mm pitch). The pin order on the speed controller side is given in Chapter 2.4.

- Before connecting, compare the pin order on the speed controller with the pin order of the connector on your flight controller (see its manual).
- If the order matches, use the cable directly. **If it differs, do not use the cable as it is** – rearrange the wires in the connector or solder them individually to the corresponding FC pads.
- Incorrect wiring (e.g. BAT to a signal input) may destroy the flight controller.

4.2 No built-in BEC

The speed controller has no 5 V output. The BAT pin feeds the full battery voltage to the flight controller; the flight controller must have its own voltage regulator for the range of the battery used. Power the receiver, video transmitter and other peripherals from the outputs of the flight controller.

5. Betaflight setup

Keep the propellers removed during all steps in this chapter.

5.1 Protocol and bidirectional DShot

In Betaflight Configurator, on the *Configuration* (or *Motors*) tab, select **DShot300** or **DShot600** as the ESC protocol. AM32 firmware supports **bidirectional DShot** – when enabled, the speed controller sends the motor RPM to the flight controller, which Betaflight uses for RPM-based filtering (RPM filter). Set *Motor poles* according to the number of magnets in the motor.

5.2 Voltage and current

On the *Power & Battery* tab, select *Onboard ADC* as the source for both voltage and current measurement (voltage from the BAT pin, current from the CUR pin).

- In the wiring diagram of the KO60 speed controller, the manufacturer gives **Scale 290** and **Offset 0** for the *Amperage Meter*.
- Verify the measurement accuracy – compare the amount of energy recharged into the battery with the consumption figure (mAh) in the OSD and adjust the scale if necessary.

5.3 ESC telemetry

Route the TX pin of the speed controller to the RX input of a free UART on the flight controller. On the *Ports* tab, set *ESC* in the *Sensor Input* column for this UART and enable the *ESC_SENSOR* feature on the *Configuration* tab. If you use bidirectional DShot, telemetry via the TX pin is not required for the RPM filter.

5.4 Motor order and direction

① Connect the battery, open the *Motors* tab and confirm that the propellers are removed.

② Spin up the motors one by one and check that the motor spinning corresponds to the diagram on the screen. If not, adjust the output order (the motor reordering function in Betaflight Configurator or the *resource* command in the CLI).

③ Check the direction of rotation of each motor. Change a wrong direction in the AM32 configurator (Chapter 6) or by swapping two motor wires.

④ Check the *Motor direction is reversed* setting (Props In / Props Out) according to how your propellers will be fitted.

6. AM32 configuration and firmware

AM32 is open-source firmware for 32-bit speed controllers. Speed controller settings (direction of rotation, startup, braking, protections, etc.) and firmware updates are done in the AM32 web configurator (am32.ca) or in ESC Configurator (esc-configurator.com).

6.1 Connecting to the configurator

① Remove the propellers.

② Connect the flight controller to the computer with a USB cable. Close Betaflight Configurator so that it does not block the serial port.

③ Connect the battery – the speed controller must be powered.

④ In a browser with Web Serial support, open the configurator, connect to the flight controller's port and read the speed controller settings (connection through the flight controller, so-called passthrough).

⑤ Change the required parameters, write them to the speed controllers, disconnect and unplug the battery.

6.2 Firmware update

The firmware is updated in the same configurator through the flight controller. The speed controller is fully functional from the factory and an update is not necessary for normal operation.

- Flash only AM32 firmware intended for this speed controller (the target that the configurator reads from the speed controller). Do not select a different target.
- Do not disconnect the battery or the USB cable during the update.
- Incorrectly flashed firmware or a damaged bootloader can only be restored with a programmer connected directly to the board. Such damage is not a product defect.

7. Use, maintenance, troubleshooting

7.1 Before every flight

- Use a **fully charged** 3–6S Li-Po battery in good condition.
- Check the power leads, the XT60 connector, the capacitor and the motor solder joints.
- Check that the propellers are undamaged, correctly fitted and firmly tightened.
- After connecting the battery, wait for the motor startup tones. Arm only in a safe place.

7.2 After the flight and storage

- End the flight at 3.5 V/cell at the latest and disconnect the battery immediately.
- After the flight, check the temperature of the speed controller and motors. Excessive heating indicates overload (propellers too large, faulty motor) – eliminate the cause.
- After a crash, check the board, the solder joints and the capacitor. Remove dust and dirt with a dry brush.
- Store the speed controller in a dry place, out of direct sunlight and with the battery disconnected.

7.3 Troubleshooting

Problem	Cause and solution
Motors do not respond, cannot Arm	Check the cable to the FC and the pin order (Chapter 4.1), the selected DShot protocol (5.1) and the Arm conditions in Betaflight (*Setup* tab, Arming disable flags).
A different motor spins than expected	Adjust the motor output order (Chapter 5.4).
Motor spins in the wrong direction	Change the direction in the AM32 configurator or swap two motor wires (5.4).
Motor stutters or loses sync	Check the solder joints and the motor windings; check the capacitor. Startup parameters can be adjusted in the AM32 configurator.
Configurator does not find the speed controllers	Check that the battery is connected, Betaflight Configurator is closed and the browser supports Web Serial.
Current or consumption reading is wrong	Adjust the *Amperage Meter* scale (5.2).
No RPM data / RPM filter not working	Enable bidirectional DShot and set the correct number of motor poles (5.1).
Speed controller overheats	Reduce the load (smaller propellers, lower cell count), improve airflow, check the motors.

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:** the type designation (KO60) is printed on the cover of the speed controller; the installed firmware is shown in the AM32 configurator (Chapter 6).

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.