OMPHOBBY

FLIGHT SYSTEM 3

USER GUIDE

REVISION 0

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Introduction

Congratulations on your purchase of the all new OMPHOBBY Flight System 3, the most advanced offering in micro helicopter flight control technology today!

OFS3 has been developed, validated and perfected over a period of two years and through thousands of test flights to deliver unparalleled flight performance for novices and 3D champions alike. With completely open flight parameter adjustability and future proofing, OFS3 comprises an all-new 2-in-1 telemetry capable ESC with improved governing, as well as a groundbreaking, new flight controller, rewritten from the ground up, which together set a new standard in micro helicopter flight control.

Customer feedback has been taken very seriously during the development of OFS3. Those familiar with previous generations of OFS and its derivatives will find vastly improved control characteristics, more precise stick tracking and stopping behavior, enhanced stability and a generally more pleasant flight feel.

The OFS3 system has been carefully designed to provide an effortless setup and tuning experience, catering to the needs of both novice and experienced users. The previous OFS generation's button-and-LED-setup procedure has been retained to allow for simple, fast and tool-free adjustments of the helicopter's flight characteristics at the field without the necessity of external devices.

For those wanting to dive in deeper, OMPHOBBY's Bluetooth® module in combination with the OMPHOBBY smartphone app for iOS and Android opens up a full suite of adjustments, allowing users to access every single parameter that makes OFS3 tick and fly, such as full individual P, I, D, and F gain adjustments, control deadbands, servo travel limits and reverses, expo, vibration filtering, torque assisted left yaw gains and more.

Firmware updates to OFS3 are possible through the OMPHOBBY app, extending and improving OFS3's capabilities for years to come.

In addition to the S.BUS and DSM2/X protocol support, native ExpressLRS, CROSSFIRE, and Tracer support via the CRSF protocol with telemetry return opens up a new era in micro RC helicopters, where flying by timer is now a relic of the past as all crucial flight information relating to the model's power system and flight performance is now available on the display of your transmitter.

With all these exciting and new capabilities, OFS3 is not just constrained to the M2 EVO MK2 it is being released with. Being more open than ever, adjustments for flying with scale fuselages, which change the model's dynamics drastically, can be made more easily. OFS3 can even be adapted by the user to fly almost any micro helicopter that features an H-3 120° swashplate and motor-driven tail.

With all this said, we at OMPHOBBY now wish you amazing flights and always happy landings with your new OFS3 flight controller!

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Important Notes

Remote Control Helicopters, as the ones intended to be flown by OFS3, are not toys. They are sophisticated precision models and must be used with caution. Read this manual carefully before using OFS3 in any RC model. Failure to use OFS3 properly may result in property damage, serious injury, or even death. Make sure to be conscious of your own personal safety and the safety of others, as well as the environment around you when using OMPHOBBY products.

The manufacturer and seller assume no liability for the operation or use of this product. OFS3 is intended for use only by adults that have familiarized themselves with the operation of R/C helicopters. After the sale of this product, the manufacturer and seller cannot maintain any control over its operation or usage.

R/C helicopters require skill to operate. It is recommended that you obtain the assistance of an experienced R/C helicopter pilot before attempting to fly your OFS3 equipped helicopter for the first time.

Damage or dissatisfaction of the product as a result of crashes, incorrect setup, modifications, or lack of necessary user skill is not covered by any warranty.

Please contact our distributors for technical support and parts supply as necessary.

Safety Notes

This product must only be used in safe and open areas, away from obstacles and people and other living beings. Do not operate R/C helicopters within the vicinity of homes or crowds of people.

R/C helicopters may experience accidents, failures, and crashes due to a variety of reasons not limited to but including lack of maintenance, pilot error, or radio interference. Always ensure the model is flown in a way that such failures cannot result in harm to property or life.

The pilot is solely responsible for their own actions and damage or injury occurring during or as a result of the usage of OFS3 and helicopters with OFS3 installed. Models must always be inspected before every usage for potential defects, issues or malfunctions.

Information Recency Notes

This manual is subject to updates and revisions without prior notice. For the latest documentation on OMPHOBBY products, please visit the official support page at **omphobby.com**. You can also access it by scanning the adjacent QR code.

Additional Components Required For Use

Component	Recommended	Alternative	Alternative
Receiver	ELRS Receiver	DSM2/X Receiver	S.BUS Receiver
Transmitter	ELRS Compatible Transmitter	DSM2/X Compatible Transmitter	Compatible Transmitter
Features	Full Telemetry Safety Switch	-	-

Flying OFS3 Equipped Models

Below you will find a recommended checklist for safe operation of your model with OFS3.

Before your flight

- ☐ Inspect the helicopter for damage or loose components.
- ☐ Check your battery's power level. Only fly fully charged batteries.
- ☐ Power on the transmitter and ensure the switches are set to prevent the motor from spinning up accidentally.
- ☐ Power on OFS3 and wait for initialization, validate correct initialization based on the Flight Controller LEDs.
- ☐ Verify that the transmitter and receiver are connected and that the model reacts to control inputs correctly.
- ☐ Place the model in an open area with no obstacles or bystanders.
- ☐ Fly and have fun!

After your flight

- ☐ Safe the helicopter against accidental spool up.
- ☐ Disconnect the battery.
- ☐ Check your battery's physical state. Ensure it isn't excessively hot or showing signs of swelling.
- ☐ Review your telemetry values, if using a compatible transmitter.
- ☐ Power down your transmitter.
- ☐ Inspect the helicopter for loose components.
- ☐ Let the power system cool down.
- ☐ Prepare for your next flight with OFS3!

OFS3 Feature and Capabilities Overview

OFS3 is an advanced multi-axis flight control system with 3D and self leveling capabilities, developed from the ground up to deliver both exceptional stability and unparalleled 3D performance for micro helicopters. It comes with a full suite of features, which will be outlined in this chapter.

Flight Modes

3D Mode

3D mode is OFS3's primary flight mode, where the pilot can freely control the attitude and rotation of the model in space. The pilot commands rotation rates of the model around the axes, which the flight controller tracks by fundamentally reimplemented and improved PIDF control loops. In this flight mode, the model is entirely unconstrained and can perform complex maneuvers, such as inverted flight, flips, rolls, loops, tictocs, pirouetting flips, and more, only being limited by the pilot.

Superior yaw stability is guaranteed by a second-generation TALY (Torque Assisted Left Yaw) algorithm, which utilizes throttle changes of the main motor to assist with left yaw commands on motorized tails. Through an entirely new implementation, OFS3's tail rotor performance can easily be compared to that of a traditional collective-pitch tail, without any of the mechanical complexity and any of the drawbacks of previous TALY implementations.

The main rotor speed is controlled by a newly written governor algorithm in the 2-in-1 stack, giving better RPM consistency than ever before. Using the digital DSHOT600 protocol for both motors, RPM changes needed for flight control are faster and more accurate than ever.

Attitude Mode

Attitude Mode, also called self leveling mode, is a flight mode where the model always returns to level flight when the cyclic stick (elevator/aileron) is let go. The model cannot be fully flipped or rolled in this mode, and a bank angle limitation of 45° is active at all times. The cyclic stick commands a tilt angle in this mode, and needs to be held to build horizontal velocity, as opposed to the traditional 3D mode.

Attitude Mode can be calibrated for largely drift-free flight when the cyclic stick is centered. The reference for leveling the model is the local gravity vector of the Earth. Adjustments to how the model aligns with the gravity vector can be made by the pilot to ensure a drift-free flight when the cyclic stick is in its neutral position. This procedure is described in detail on page 22.

Be aware that prolonged 3D flight may tilt the attitude reference temporarily. It will return to level once the model is flown more calmly for a short period of time.

Receiver Connectivity

While OFS3 continues to support both S.BUS and DSM2/X known from previous iterations of OFS, it now also supports the CRSF receiver protocol used by TBS CROSSFIRE, Tracer, and ExpressLRS. This protocol offers the significant advantage of telemetry return, which allows for return of valuable flight data to the transmitter, based on which warnings and vibrations can be played to indicate, for example, an empty battery. Telemetry items include:

- Battery Voltage (V)
- Battery Current (A)
- Used Capacity (mAh)
- Rotor Speed (RPM)
- ESC Temperature (°C)
- Vehicle Attitude in Roll, Pitch, and Yaw (Radians, Degrees)

More receiver protocols will be supported in the future via firmware update.

Setup Capabilities

LEDs and Button

Similar to the previous iteration of OFS, OFS3 allows the user to change the most important parameters right on the flight controller, which includes basic settings of the control loops like total gain, feedforward, and rotation rates, as well as servo centering and collective pitch endpoints.

Bluetooth® App with Full Parameter Access

With OFS3, OFS has graduated from being a simplified RTF flight controller to a fully fledged, highly advanced flight control system for micro helicopters. To unlock its full range of capabilities, OFS3 seamlessly connects to the OMPHOBBY app on iOS and Android through the included Bluetooth® module.

The OMPHOBBY app allows the user full customization of all core flight control parameters, providing access to every single value that makes OFS3 fly. This includes full PIDF gain access, rotation rates, control deadband values, vibration filters, stick exponentials, software throttle mode, TALY parameters, and more.

Firmware updates to the flight controller can be done through the app, and firmwares can be rapidly developed and deployed by OMPHOBBY.

To find the latest firmware for your OFS3 flight controller, please visit the support page at **omphobby.com**.

User Feedback

Special attention in OFS3's development was paid to the flight characteristics, incorporating user feedback on previous iterations of OFS. While OFS3's flight code has been rewritten from the ground up and contains not a single line of previous OFS flight code, certain comparisons with the previous generation of OFS, specifically on M2 V2 and M2 EVO, can be drawn. Notable improvements include:

- Control deadband on the pitch, roll, and yaw axes has been minimized by default and is now fully user adjustable from no deadband at all, to levels of deadband similar to previous OFS generations.
- The TALY (Torque Assisted Left Yaw) algorithm is more robust, does not saturate anymore, is available at much lower RPMs and does not cause yaw creep after a quick yaw stop.
- Cyclic control range is extended and user-customizable to allow for more cyclic pitch, in turn increasing achievable rotation rates.
- Servo endpoints are now relative to servo center values, eliminating the phenomenon of unequal cyclic throws after adjusting servo centers.
- Cyclic reversals in 3D maneuvers like tictocs can be performed faster and crisper with the model following the control inputs more closely.
- Headspeed governor and TALY remain active at all times.
- Pirouetting control is more stable and smoother, allowing for more precise and consistent pirouetting maneuvers.
- Attitude mode robustness and accuracy has been drastically improved, calibration mode is less sensitive to control inputs for easier handling and increased precision.
- Telemetry return is now possible with ExpressLRS, CROSSFIRE, and Tracer receivers. Additional protocols will be added in the future.
- RPM can now be accurately set by entering a specific throttle value. Refer to the "Setting RPM by Throttle Percentage" section on page 23 for a chart of throttle values vs. main rotor RPM.
- An optional, special Software Throttle mode allows the user to define three RPM presets in the flight controller which can be selected through an extra channel, allowing the user to not use transmitter throttle curves at all.

Battery Information at a glance

A row of LEDs will show you battery information at a glance when the flight controller is powered up and initialized, even if you are not using telemetry. This adds a layer of safety to the system, ensuring a user can easily gauge their battery level on the fly.

OFS3 Helicopter Component Connections

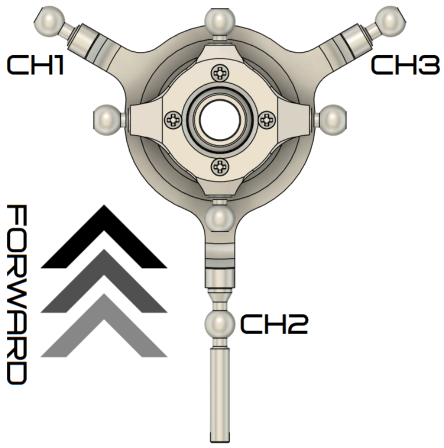
OMPHOBBY Flight System 3 requires the following connections to fly a helicopter:

- Receiver
- Servos
- Main Motor
- Tail Motor
- Battery

Servo Connections

If you purchased OFS3 installed in an OMPHOBBY helicopter, the servos are already connected. Refer to this section if you are retrofitting a helicopter with OFS3, or if you need to reconnect the servos during a repair.

OFS3 currently supports helicopters with an H-3 120° swashplate with two front servos, and one rear servo. The adjacent diagram correlates the servo positions to the channels on the flight controller.



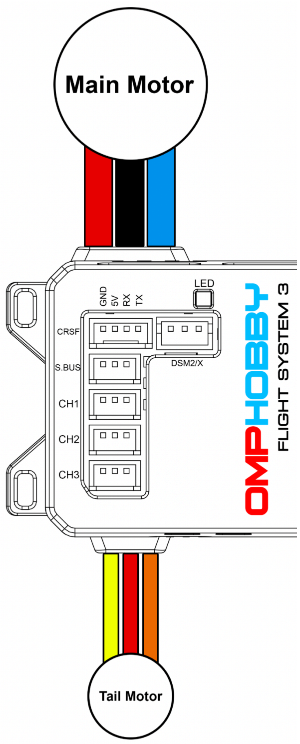
Servo is connected to…	Servo Port on OFS3
Left Swashplate Joint	CH1
Rear Swashplate Joint	CH2
Right Swashplate Joint	CH3

If you are using OFS3 in a helicopter with a servo layout different from the corresponding OMPHOBBY helicopter, you may need to reverse servos according to its specific layout. This is only possible through the OMPHOBBY Bluetooth® App.

⚠ **Always ensure proper servo leveling and mechanics setup after a repair, or when retrofitting an existing helicopter with OFS3. Failure to do so can, depending on the severity of the setup errors, lead to off-axis pirouetting, asymmetric flight characteristics, reduced control margins, axis cross coupling, servo saturation, loss of control, and total loss of the helicopter. Review the relevant sections of this manual for guidance.** ⚠

Motor Connections

If you purchased OFS3 installed in an OMPHOBBY helicopter, both motors are already connected from the factory. Refer to this section if you are retrofitting a helicopter with OFS3, or if you need to reconnect the motors while repairing a helicopter.

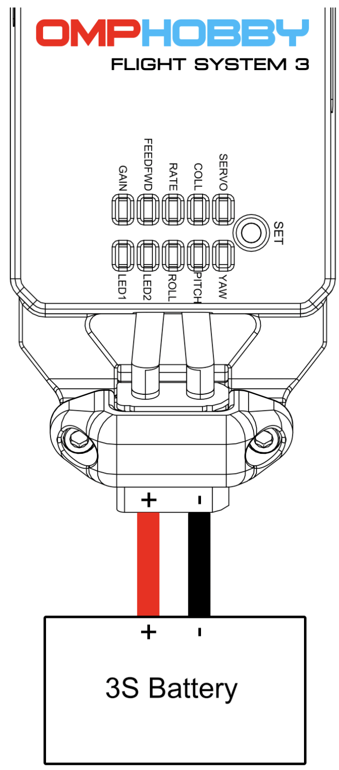


⚠ **The main motor and tail motor must be connected to the correct outputs of the flight controller. The color-coding of the motor wires must be obeyed to guarantee correct direction of rotation, as otherwise the helicopter will become uncontrollable upon motor start. Do not connect the motors to the wrong outputs, this may have catastrophic consequences for the model, as well as your health and safety.** ⚠

The adjacent diagram illustrates the correct motor connections by the example of the M2 EVO MK2.

Battery Connection

In the case of the M2 EVO MK2, OFS3 comes equipped with an XT30 connector and is compatible with 3S (11.1 V) LiPo batteries. The maximum input voltage is 13.05V, use of 3S LiHV batteries is permitted. Higher voltage can cause permanent and irreparable damage to your OFS3 flight stack and is not covered under product warranty.



⚠ **Pay close attention to the battery connector's polarity. While the XT30 is keyed, contact can potentially be made by forcing the connector, even when reversed. Connecting the battery with reversed polarity is strictly prohibited and will lead to permanent and irreparable damage to your OFS3 flight stack, which is not covered under warranty.** ⚠

OFS3's low voltage cutoff (LVC) is set to 3.3 V per cell, and therefore specifically on the M2 EVO MK2, 9.9 V total battery voltage. Once LVC is triggered, the ESC will gradually reduce the rotor speed, indicating that the pilot should land immediately in order to prevent damage to the flight battery.

It is not recommended to fly the model to LVC. To prolong battery life, it is recommended to never let the battery drop below 3.5 V per cell in flight, and to land the model once the battery reaches a level of about 3.7 V per cell of resting voltage.

Receiver Connection

OFS3 supports the following receiver protocols:

- CRSF (ExpressLRS / CROSSFIRE / Tracer)
- DSM2/DSMX
- S.BUS

The receivers' respective connection details will be outlined in the following chapters. Pure PWM receivers are not supported.

CRSF (ExpressLRS, CROSSFIRE, and Tracer)

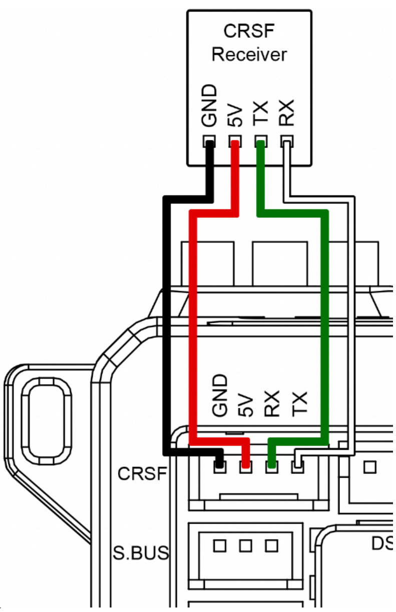
OFS3 supports the CRSF receiver protocol with full telemetry return. The CRSF protocol is used by ExpressLRS (ELRS), TBS CROSSFIRE (XF), and TBS Tracer receivers. If not specified otherwise, any instructions regarding CRSF are valid for ELRS, XF, and Tracer transmitter systems.

When purchasing an ELRS, XF, or Tracer receiver, ensure that it supports the CRSF protocol and operates at 5V. Telemetry return is only supported when a full duplex connection between receiver and OFS3 is established, which requires both UART RX and TX to be connected.

CRSF Physical Connections

CRSF requires a connection between the CRSF port of the OFS3 flight controller and a corresponding receiver. The serial connection follows UART conventions. The connector used is a Picoblade 4-pin type, but is also compatible with JST MX 1.25mm connectors. A pre-made cable can be purchased under part number OSHM2133.

Receiver	OFS3	OSHM2133	Purpose
GND	GND	Black	Power Delivery
5V	5V	Red	Power Delivery
TX	RX	Green	Control Signal
RX	TX	White	Telemetry Return



The adjacent diagram illustrates the required connection between the CRSF receiver and flight controller. Note that it is possible to fly with the receiver's TX pin connected only, but no telemetry will be returned.

ELRS Module Settings

When using ELRS, the transmitter module should be configured to match the receiver being used. The following settings are recommended as a baseline and have been tested with OFS3. As Channel 6 is used for throttle, the ELRS Switch Mode should be set to 8ch to allow for the maximum possible resolution and range.

Setting	Value	Note
Baud Rate	921k Baud	Data rate module ↔ transmitter
Packet Rate	333 Hz Full	Data rate of the control uplink
Telemetry Ratio	1:4	Data rate of the telemetry downlink
Switch Mode	8ch	Enables extended throttle range

ELRS/XF Transmitter Channel Mapping

The ELRS channel convention and PWM ranges outlined in the table below are expected by the flight controller when a CRSF receiver is connected.

⚠ **Channel 5 must be set to at least 1501 µs or higher for flight**. **ELRS treats Channel 5 as an arming channel and will only output full power when it is set above 1500 µs. The motor will remain OFF if Channel 5 is left at 1500 µs or below. OFS3 will however initialize when Channel 5 is above 1500 µs. Channel 5 can double as a safety switch, or can be permanently set high.** ⚠

Ch	Control Function	PWM (Min / Center / Max)	Output HIGH when..
1	Aileron	988 µs / 1500 µs / 2012 µs	Rolling Right ↷
2	Elevator	988 µs / 1500 µs / 2012 µs	Pitching Forward ↑
3	Collective	988 µs / 1500 µs / 2012 µs	Collective Up ⇧
4	Rudder	988 µs / 1500 µs / 2012 µs	Yawing Clockwise ↷
5	Optional Motor Safety Switch (ELRS Arm)	988 µs – 1500 µs Safe 1501 µs – 2012 µs Armed	Vehicle is Armed
6	Throttle / Motor Switch	988 µs – 2012 µs, ⇧2140 µs	RPM is High
7	Attitude / 3D Mode	988 µs – 1212 µs Attitude 1213 µs – 2012 µs 3D	Flight Mode is 3D
8	Software RPM Selection (If enabled through the app, unused by default)	988 µs – 1329 µs RPM1 1330 µs – 1688 µs RPM2 1689 µs – 2012 µs RPM3	RPM 3 is Selected

CRSF Telemetry Sensors

OFS3 supports a variety of CRSF telemetry sensors. However, due to the CRSF protocol, not all items can be returned in the correct sensor, as they were not considered by the creators of the CRSF protocol. Therefore, OFS3 returns main rotor RPM in the Altitude sensor and ESC temperature in the Heading sensor. Due to the nature of how the CRSF protocol transmits sensors, other sensors such as Battery Percentage, GPS Coordinates, GPS Satellites, Vertical Speed, and Ground Speed may be populated during sensor discovery. These sensors should be disregarded.

To discover these sensors in EdgeTX, the following steps are necessary:

1. Ensure the model is powered off.
2. Open the “Telemetry” tab in Model Settings.
3. Under “Sensors”, click the “Discover new” button.
4. Power up the model, wait for connection.
5. Observe the sensor list populating.
6. Once no new sensors are being discovered anymore, click the “Stop” button.
7. Edit the “Alt” and “Hdg” sensors and change their name, unit, and precision as listed in the table below.

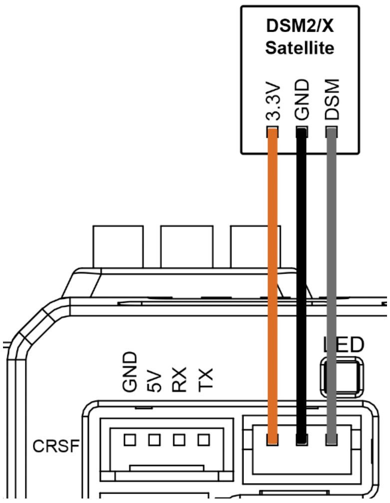
Sensor	Function	Note
RxBt	Battery Voltage (V)	Displays total pack voltage.
Curr	Battery Current (A)	Displays battery current.
Capa	Used Capacity (mAh)	Displays total used mAh.
Alt	Rotor Speed (RPM)	Rotor Speed in [1/min]. Rename the sensor to “NR” or “RPM”. Change units from m to RPM.
Hdg	ESC MOSFET Temperature (°C)	ESC MOSFET temperature in [°C]. Rename the sensor to “Tmp”. Change units from ° to °C. Change precision from 0.00 to 0.--
Ptch	Pitch Attitude (rad)	Default unit is radians, can be changed to ° if desired.
Roll	Roll Attitude (rad)	Default unit is radians, can be changed to ° if desired.
Yaw	Yaw Attitude (rad)	Default unit is radians, can be changed to ° if desired.

S.BUS and DSM2/DSMX

OFS3 supports the DSM and S.BUS receiver communication protocols. Neither protocol supports telemetry return. The channel mapping and directions of S.BUS and DSM2/X have been unified. Therefore, both protocols require identical transmitter settings, and will be discussed in the same section.

DSM2/DSMX Physical Connection

DSM2/DSMX satellites should be connected as shown in the adjacent diagram. OMPHOBBY part number OSHM2074 can be used for receiver connection.



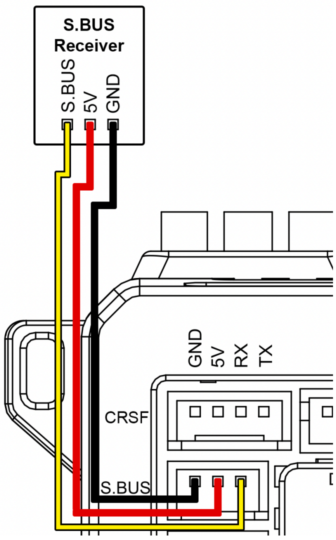
Receiver	OSHM2074	Purpose
3.3 V	Orange	Power Delivery
GND	Black	Power Delivery
DSM	Gray	Control Signal

The DSM port provides output from a stabilized 3.3 V rail, which is a common working voltage for DSM receivers. Verify that your receiver supports 3.3 V before powering it up through OFS3 for the first time. The connector type is JST-ZH 3-pin.

If using a DSM2 or DSMX satellite that does not have an integrated bind button, the satellite must be bound using a separate receiver to the transmitter before it can be used with the flight controller.

S.BUS Connection

The adjacent diagram illustrates the connection of a receiver outputting S.BUS. OMPHOBBY part number OSHM2055 can be used for receiver connection.



Receiver	OSHM2076	Purpose
GND	Black	Power Delivery
5 V	Red	Power Delivery
S.BUS	Yellow	Control Signals

The S.BUS port provides output from a stabilized 5 V rail, which is a common working voltage for S.BUS type receivers. Verify that your receiver supports 5 V before powering it up through OFS3 for the first time. The connector type used is Picoblade 3-pin, but is also compatible with JST MX 1.25mm connectors.

DSM and S.BUS Channel Mapping and Ranging

This table applies to most common transmitter systems using either DSM or S.BUS receivers, either natively or through a MULTI-Module. Futaba transmitters must extend all channel ranges to 119%, or toggle S.BUS Range from “Wide” to “Futaba” in the OMPHOBBY app. Values are either listed as Min / Center / Max, or as ranges.

Ch.	Function	Transmitter % Range	Transmitter PWM (µs)
1	Aileron	−100% / 0% / +100%	988 / 1500 / 2012
2	Elevator	−100% / 0% / +100%	988 / 1500 / 2012
3	Throttle	−100% – +100%, ⇪+125%	988 / 1500 / 2268
4	Rudder	−100% / 0% / +100%	988 / 1500 / 2012
5	Attitude Mode / 3D	−100% – −56.5% Attitude −56.0% – +100% 3D	988 – 1212 Attitude 1213 – 2012 3D
6	Collective	−100% / 0% / +100%	988 / 1500 / 2012
7	Software RPM Selection (If enabled through the app, unused by default)	−100% – −33.5% RPM 1 −33% – +36.5% RPM 2 +37% – +100% RPM 3	988 – 1329 RPM1 1330 – 1688 RPM2 1689 – 2012 RPM3

[Advanced] S.BUS and DSM2/X PWM Output Ranges

This table lists OFS3’s expected receiver PWM values of the above protocols vs. EdgeTX’s PWM output. If you are using a MULTI-module, the ranges are automatically converted if using SFHSS or DSM2/X, but not for FrSky protocols.

Ch.	EdgeTX PWM (µs)	S.BUS PWM (µs)	DSM PWM (µs)
1	988 / 1500 / 2012	2020 / 1520 / 1020	1160 / 1500 / 1840
2	988 / 1500 / 2012	2020 / 1520 / 1020	1160 / 1500 / 1840
3	988 / 1500 / 2012	2020 / 1520 / 1020	1160 / 1500 / 1840
4	988 / 1500 / 2012	2020 / 1520 / 1020	1160 / 1500 / 1840
5	988 – 1212 Attitude 1213 – 2012 3D	2020 – 1801 Attitude 1800 – 1020 3D	1160 – 1308 Attitude 1309 – 1840 3D
6	988 / 1500 / 2012	2020 / 1520 / 1020	1160 / 1500 / 1840
7	988 – 1329 RPM1 1330 – 1688 RPM2 1689 – 2012 RPM3	2020 – 1687 RPM1 1686 – 1336 RPM2 1335 – 1020 RPM3	1160 – 1386 RPM1 1388 – 1624 RPM2 1626 – 1840 RPM3

Bluetooth® Module

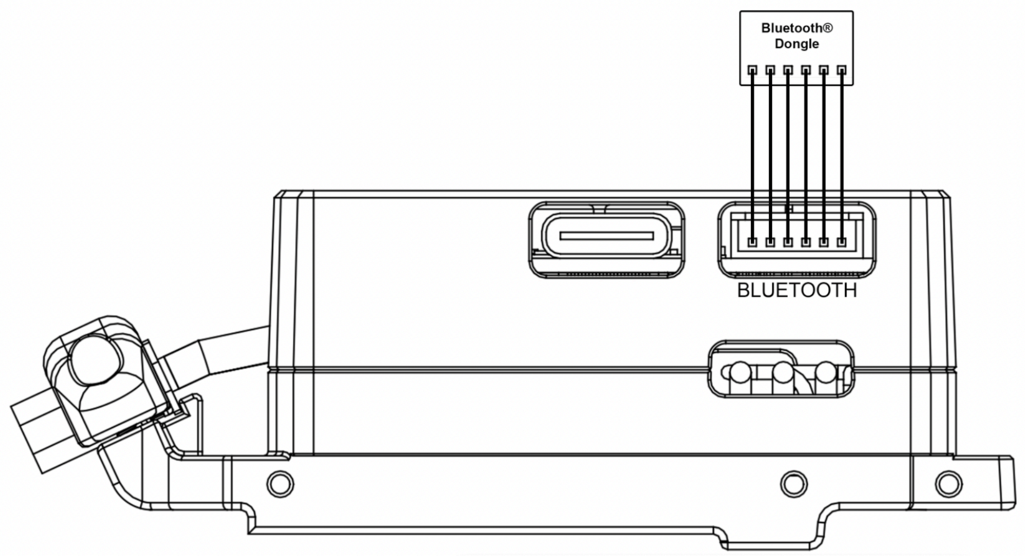
OFS3 supports configuration and firmware updates via the included Bluetooth® module, which can be connected to the flight controller's BLUETOOTH port, as shown by the example of the M2 EVO MK2's flight controller below. iOS and Android devices can connect to OFS3 and adjust model parameters by installing the OMPHOBBY app from the Apple App Store or Google Play Store, respectively.

The Bluetooth® module is not required for flight operation, but can be optionally left connected to OFS3 for quick configuration via smartphone in the field. For this purpose, it is strongly recommended to attach the Bluetooth® module to the helicopter with double-sided tape, or similar.

While parameter adjustments through the OMPHOBBY app can be made to OFS3 while the motor is running, it is generally not recommended to change the configuration in flight, as it is possible to render the model unflyable by setting some expert parameters to their extremes. Due diligence and caution is advised. Expert parameters should only be adjusted by experienced pilots, and doing so happens at their own risk. Adjustments to the configuration made while the motor is running are only held in RAM and can not be permanently saved to flash until the motor is fully shut off. Saving parameters is only supported when the motor is stopped.

Firmware updates to OFS3 can be performed through the Bluetooth® module and the OMPHOBBY app for iOS and Android. To find the latest firmware for your helicopter, please visit the support page at **omphobby.com**.

As OFS3 is STM32-based, its bootloader generally cannot be bricked by failed firmware updates. In case of a failed firmware update, the user should simply try again. If the flight control firmware cannot be recovered for any reason, the SERVICE USB type-C port can be used to reflash the flight controller's firmware entirely. There is no additional functionality to the SERVICE port at this time.



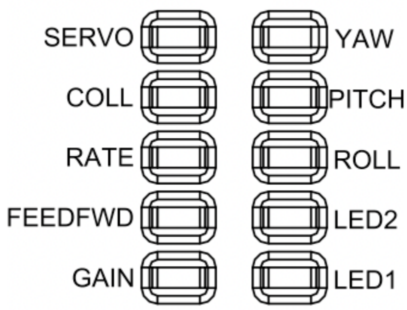
Flight Controller Setup

OFS3 requires a valid receiver signal to successfully initialize. Refer to the receiver connection chapter for more information. Flying or entering setup mode before the flight controller is fully initialized is not possible. The flight controller requires battery power in order to power up, change settings and fly. Please ensure that the connected battery is charged to an appropriate level at all times to supply sufficient voltage to the flight controller.

Configuration of the flight controller can be performed in button mode or with the OMPHOBBY mobile application with Bluetooth® module.

Flight Controller LEDs

OFS3 provides an array of ten LEDs for simplified setup purposes, allowing the user to adjust the most important functions of the flight controller without the use of the BT dongle and smartphone app. The LED array is shown on the right, and is divided into a parameter row (left) and a status row (right) the parameter or status behind each LED is listed in the following table. The name of some of the setup items has been adjusted from previous generations of OFS, their legacy designations are also listed in the table.



Setup Mode LED Descriptions

Item	Description	Legacy Designation
SERVO	Servo Centering Mode	SERVO
COLL	Collective Endpoints Adjustment	PITCH
RATE	Rotation Rate Adjustment	SPEED
FEEDFWD	Feedforward Adjustment	AGILE
GAIN	Control Loop Sensitivity Adjustment	GYRO
YAW	Yaw Axis Adjustment Group	RUDD
PITCH	Pitch Axis Adjustment Group	ELEV
ROLL	Roll Axis Adjustment Group	AILE
LED1	Status Indicator LED 1	LED
LED2	Status Indicator LED 2	LED

Status Indicator LED Codes

LED 1 is **RED**. LED 2 is **BLUE**. These LEDs are used to display information about OFS3's state to the user. Their location in the array is shown on page 16.

State	LED 1 and LED 2	Message
Before Init	LED 1 ON LED 2 Flashing Rapidly	No valid receiver signal detected Rate controls not centered
Before Init	LED 1 & LED 2 Flashing synchronously	Throttle channel high
After Init	LED 1 Flashing Slowly LED 2 ON	Flight Mode, 3D
After Init	LED 1 ON LED 2 ON	Flight Mode, Attitude
After Init	LED 1 ON LED 2 Flashing Slowly	Attitude Calibration Mode IMU Static Calibration in Progress
After Init	LED 1 OFF LED 2 OFF	Setup Mode
Anytime	All LEDs ON	Bootloader Mode (Reboot required to exit)

Battery Voltage Indication

After initialization, the flight controller will use the parameter row of LEDs to show a **voltage based estimate** of the battery level for the pilot to validate whether it is safe to take off with the current battery level. Note that this indication is only intended as a helpful reference and cannot replace a proper battery voltage checker or telemetry! Battery voltage can change under load and with ambient conditions. Proceed with proper caution. The table below outlines the voltage levels on the M2 EVO MK2.

LEDs lit	Battery Voltage	Individual Cell Voltage
5	12.6 V – 12.3 V	4.20 V – 4.10 V
4	12.2 V – 11.8 V	4.06 V – 3.93 V
3	11.7 V – 11.5 V	3.90 V – 3.83 V
2	11.4 V – 11.2 V	3.80 V – 3.73 V
1	11.1 V – 10.0 V	3.70 V – 3.33 V
1 Flashing	<10.0 V at any point in flight	<3.33 V at any point in flight

Entering Setup Mode (Button Configuration)

1. Power on the transmitter.
2. Power on the model and wait for the flight controller to initialize.
3. Press and hold the **SET** button for 3 seconds to enter setup mode. The tail motor will emit a sequence of beeps to confirm successful setup mode entry.

The LEDs will change state and begin blinking according to the onboard LED menu once setup mode has been successfully entered. Changed settings will not be saved unless setup mode is explicitly exited through a long press of the **SET** button.

Changing a Setting Value

Short press the **SET** button until the desired setting LEDs are illuminated. The number of continuous flashes of the specific LED indicates the value, with the highest value being 9 and the lowest value being 1. The factory default value for all settings is 5 flashes. White LEDs specify the axis (if applicable), blue LEDs indicate the respective setting for the selected axis, as well as its current value.

To change the value, use your transmitter's elevator control.

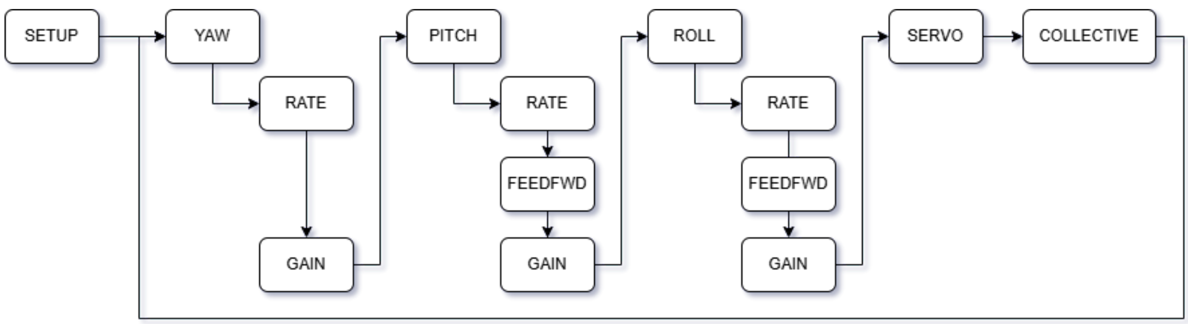
- Increase the value by pushing the stick forward briefly and returning to center.
- Decrease the value by pulling the stick back briefly and returning to center.

Saving Setting Changes

Press and hold the SET button while in any menu point until the flight controller exits back to flight mode, which will be confirmed by the tail motor emitting a sequence of beeps. This will save all changes made since entering the menu.

Navigating OFS3

When moving through OFS3's onboard LED menu, menu items will activate in the order of the following flow chart. Once the end of the chart is reached, OFS3 will loop around to the first item. The menu can be exited at any point through a long press of the **SET** button with all previously adjusted parameters saved.



Rate, Feedforward, and Gain Settings

The Rate, Feedforward, and Gain can be adjusted for the Yaw, Pitch, and Roll axes via the LEDs on the flight controller. These are the same basic adjustments also found on earlier OFS versions, allowing the pilot to easily tune the model's behavior.

Adjustments can be made directly on the flight controller without any additional tools or interfaces required, through an array of ten LEDs. For a given parameter, the number of continuous LED flashes indicates the value, with the highest being 9 and the lowest being 1. The factory default value for all settings is 5 continuous flashes.

RATE adjusts the absolute maximum rotation rate of the model for a given stick input, as long as the model is able to achieve the requested rate.

- Higher numbers of flashes increase the rotation rate for a given input.
- Lower numbers of flashes decrease the rotation rate for a given input.

FEEDFWD adjusts how much cyclic stick command is passed directly to the swashplate without any control loop interaction, which is used to tune the acceleration and stopping behavior of the model on any cyclic stick command.

- Higher numbers of flashes increase the feedforward, making the model more aggressive, but may also lead to strike-back after a stop.
- Lower numbers of flashes decrease the feedforward, making the model gentler in its reaction, but may also lead to creep after a stop.

GAIN adjusts the overall sensitivity of the control loop's P, I, and D terms in equal proportions. This is used to tune the overall stability of the model.

- Higher numbers of flashes increase the gain, making the model more stable, allowing it to follow control inputs more precisely and reject disturbances like wind better, but may lead to wobbling and oscillation if set too high.
- Lower numbers of flashes decrease gain, making the model less stable, shifting the control feel towards more fluid and smooth, but may lead to the model not following the stick command as precisely if set too low.

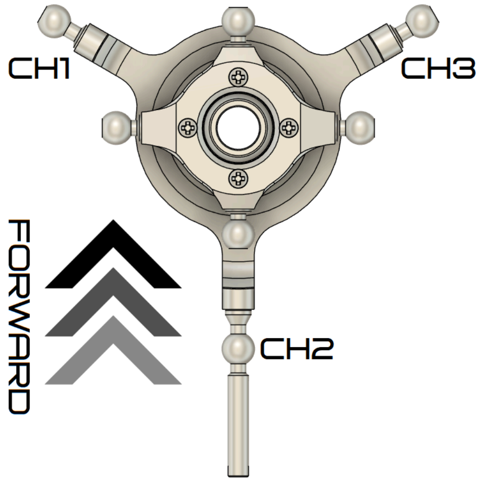
For deeper adjustments, such as free tuning of expert parameters like individual P, I, D, and F gains, control deadbands, servo travel limits and reverses, vibration filtering, TALY gains and more, the Bluetooth® module in combination with the OMPHOBBY smartphone app for iOS and Android is required. The default expert parameters are equivalent to all LEDs being set to 5 flashes.

When modifying expert parameters, any modifications through the LED menu are ignored. When using the LED menu, any modifications to the expert parameters in the app are ignored. The parameter set can also be switched in the app.

SERVO Settings

The SERVO menu allows the user to fine-tune their servo centering, as might be necessary after replacing a servo arm or servo after sustaining damage from a collision with terrain.

Once the SERVO menu is entered, the transmitter control axes will each be assigned to a servo for fine-tuning its center. The servo centers can then be modified by moving the respective control axis as specified in the table below.



If using the app to center servos, the motor is disabled when in servo centering mode. The model cannot be flown until servo centering mode is exited through the app again, or the model is rebooted entirely.

Servo	Stick Axis	Servo Up	Servo Down
CH1	AILE	Left	Right
CH2	ELEV	Forward	Backwards
CH3	RUDD	Right	Left

COLLECTIVE Settings

The COLL menu allows the user to individually adjust the magnitude of the positive and negative collective pitch of the model's rotor blades. This adjusts the total amount of rotor thrust that can be generated at a given RPM, in turn adjusting the total lift of the model, and how aggressively it responds to collective inputs.

In the COLL menu, the collective transmitter control works as usual, with the elevator control modifying the respective positive or negative endpoint the collective stick is set to. Adjusting one endpoint does not affect the other. Adjusting either endpoint does not affect the servo centers or zero collective.

Endpoint	Collective Stick	Elevator Forward	Elevator Backwards
Positive	High	Increase Positive Coll.	Decrease Positive Coll.
Negative	Low	Increase Negative Coll.	Decrease Negative Coll.

Additional Functionality

Flight Controller Tuning Parameter Reset

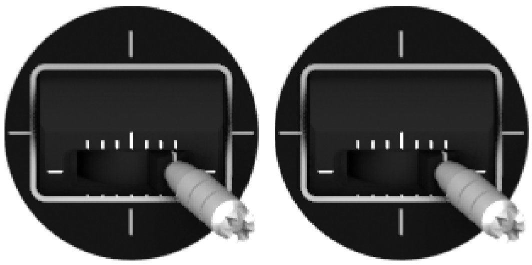
OFS3 supports tuning parameter reset. This reset does neither reset servo settings or collective adjustments, nor the selection of Software Throttle mode and output adjustments – it only affects parameters directly related to the flight control loops and will return them to factory defaults, both for the LED menu and app-adjusted expert parameters.

To reset the flight controller, wait for it to initialize into flight mode, then press the **SET** button five times (5x) in rapid succession. A bar of 5 LEDs will flash three times (3x) and the tail motor will emit a sound to confirm the reset.

IMU Static Calibration

OFS3 uses a next generation Inertial Measurement Unit (IMU), which, unlike traditional flight controllers, does not require gyroscope calibration upon power up. This is achieved by factory-calibration and advanced drift compensation methods, which account for varying environmental conditions.

In the rare case of rotational drift occurring in flight, the user can easily and quickly redo the static calibration of the IMU. For this procedure, the motor must be fully switched off, and the model must be placed on a solid, stable surface. This surface isn't required to be level, as the calibration does not affect the accelerometers.

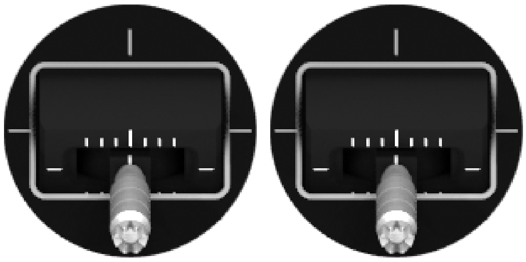


To initiate the calibration, hold **both sticks in their bottom right-hand corners on your transmitter**, until the LED pattern changes as described on page 17. This corresponds to negative collective, clockwise yaw, backwards elevator, and right roll. **All channel outputs must be beyond ±90%**. The main motor will continuously beep during the procedure. Once calibration is successfully finished, the tail motor will confirm exiting the procedure by playing a beep sequence once, and the LED pattern will return back to flight mode. The model has now stored the new calibration data and can be flown immediately.

Should the procedure not find successful calibration values within 15 seconds, e.g. if the model is unsteady, OFS3 will consider the procedure failed and exit static calibration mode without making any changes to the configuration. Failure of the procedure is indicated by the tail motor playing the beep sequence twice. It is recommended to then steady the model, and reattempt the procedure.

Attitude Mode Calibration

In attitude mode, the model will always return to level once the cyclic controls are released. To achieve this, OFS3 aligns the model's pitch and roll orientations with the local gravity vector of the Earth, intending to provide a reproducible level attitude. While this is not a position hold mode, minimizing lateral drift of the model in this mode can be desirable for the user. As each and every helicopter is unique and local conditions can vary, OFS3 provides a procedure to fine-tune the attitude mode's reference orientation.



To enter attitude mode calibration, the flight controller must be in attitude mode and the motor must be OFF. **Move the collective to full negative and elevator fully backwards, both channel outputs must be beyond -90%,** and hold them for about 3 seconds until the LED pattern changes as described on page 17. The tail motor confirms entering calibration mode through a single beep sequence, and the swashplate may change its position slightly.

The model is now in attitude calibration mode, its flight characteristics are different to regular attitude mode, and the model needs to be flown accordingly:

- The model will still self-level, the cyclic stick's effect on model attitude is severely reduced.
- The cyclic stick now permanently trims the model's attitude in 3D space instead of only changing the model's attitude temporarily.
- If a control input is given into any particular direction, the level attitude of the model will permanently shift in this direction, and the model will remain in this new attitude, even if the cyclic stick is released. The length and magnitude of the control input determines the magnitude of the attitude change.

Flying in this mode is roughly similar to flying a model in 3D mode at drastically reduced rates. The pilot's objective is now to hold the model in a stable hover and adjust its attitude with small control inputs, until no more apparent drift in any direction is occurring. At this point, the model's dynamic equilibrium is found.

The pilot should now land vertically using only collective, without touching the cyclic controls any further, and shut off the motor so as to not change the model's attitude reference. Once the model has landed and the rotor has stopped, repeat the stick command used for entering calibration mode to save the calibration data and exit back to normal flight mode. The tail motor will confirm this with a beep sequence.

Setting RPM by Throttle Percentage

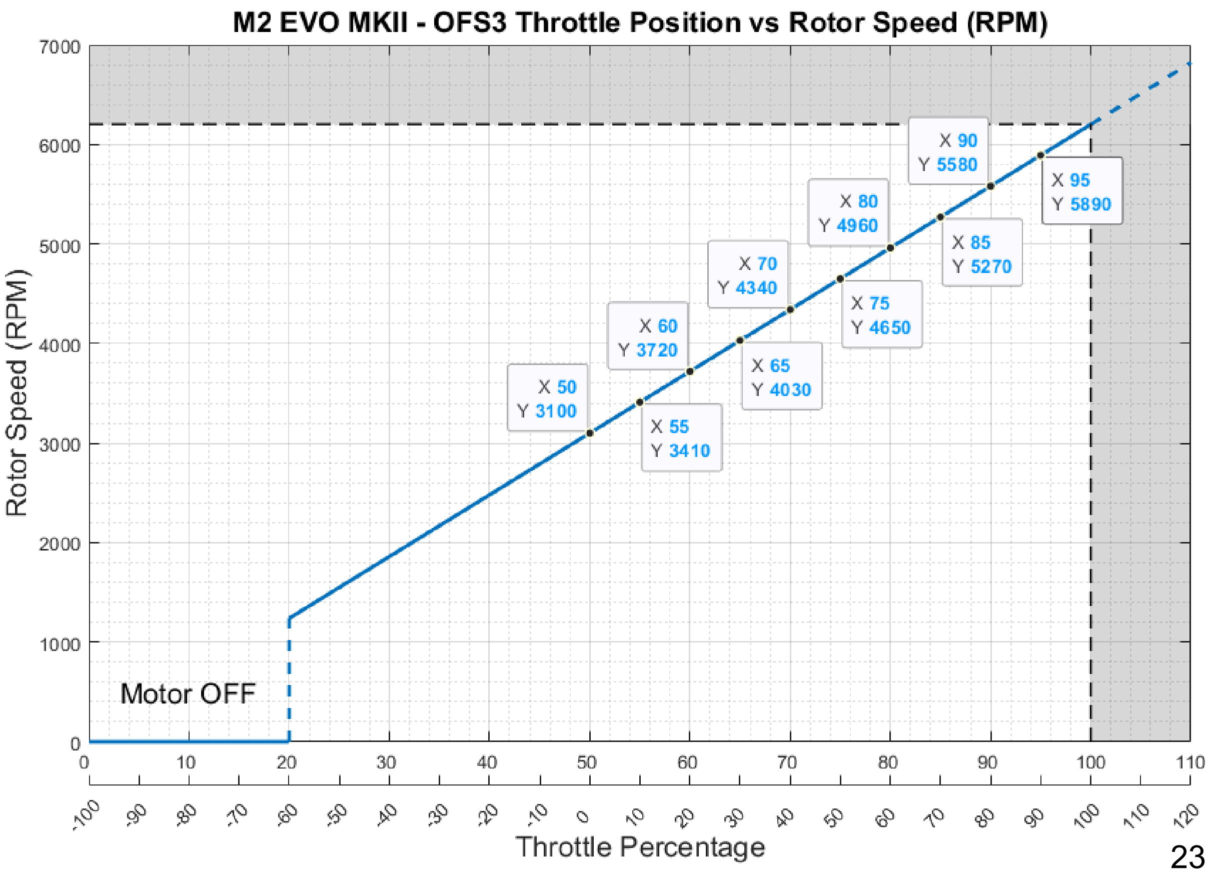
OFS3's fully integrated nature allows the user to precisely select RPM by setting a specific throttle percentage in the transmitter. Specific throttle mapping varies by helicopter. A 20% safe zone at the bottom of the range prevents accidental startup.

Shown below is the throttle mapping for the M2 EVO MK2 flight stack. In this example, the throttle is mapped to the range of the throttle channel in the range of 20% (-60%) to +100%, at a maximum of 6200 RPM. Recommended rotor speeds specifically for the M2 EVO MK2 are marked in the graph. Due to the linear nature of RPM vs. throttle, you can also use the rule of three for calculating the throttle percentage for your desired main rotor speed, 5400 RPM in the following example:

$$\frac{5400\ RPM}{6200\ RPM} * 100\% = 87\%$$

By setting the calculated percentage, the ESC will then govern the corresponding RPM. It is important to note that this approach only works if the channel's 100% value corresponds to the receiver protocol's 100% PWM output, as otherwise, the transmitter's channel display may become mismatched with the chart below.

⚠ The 100% speed is set to the maximum allowed continuous RPM of the model sold with OFS3. While the model can technically be set to run higher rotor speeds by increasing throttle beyond 100%, this is not permitted or endorsed by OMPHOBBY, might lead to the destruction of the model, will void the product warranty and happens solely at the user's responsibility. ⚠



Software Throttle Special Mode

Specifically for those users who wish to use more than one OFS3 equipped model with a single model memory, OFS3 offers a special mode called Software Throttle. This is disabled by default, and can be enabled through the OMPHOBBY app's Expert Settings.

If enabled, **Channel 7 on DSM and S.BUS** or **Channel 8 on CRSF** will act as an RPM preset channel, while the usual throttle channel acts solely as a motor ON/OFF switch. The startup point is the same as in regular mode, therefore, a single model memory can be set up to use both throttle modes. By setting the RPM Preset channel to values -100, 0, and +100, each of the RPM presets can be selected, which can be customized in the OMPHOBBY app. The throttle values correspond to the graph on page 23 in a total range of 0% to 125%.

An example of this mode's usefulness: A pilot may own an M2 EVO MK2 installed into a scale fuselage, and a stock M2 EVO MK2. The scale model requires much lower rotor speeds than the 3D model, which previously required different throttle outputs from the transmitter, meaning a switch of model memories before each flight.

Software Throttle removes the requirement to use throttle curves in the transmitter, as rotor speeds are directly set in the app. This allows the scale model to turn at a docile 3000, 3250, and 3500 RPM, while the 3D model can run high rotor speeds of e.g. 4800, 5100, and 5800 RPM, on the same model memory, without having to adjust throttle values to match. Additionally, control attributes like expo, rotation rates, collective pitch, and other flight parameters can also be adjusted in OFS3, individually for each model and independent of the transmitter's settings.

(Default) Proportional Throttle Mode

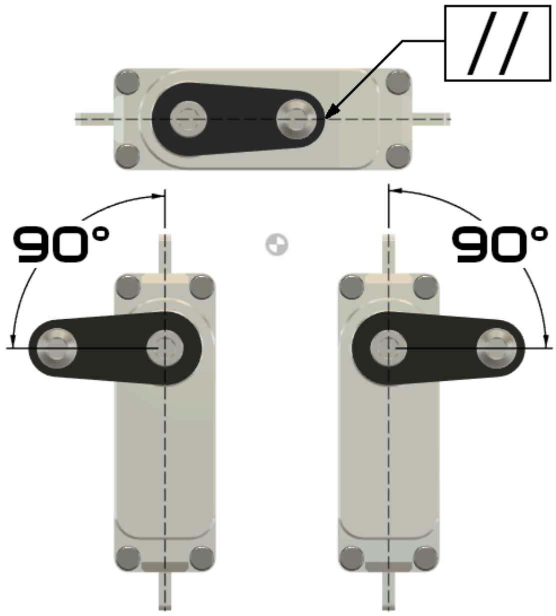
S.BUS/DSM	CRSF	Function	Range
Channel 3	Channel 6	Proportional Throttle	0% – 19% Motor OFF 20% – 100% Motor RPM
Channel 7	Channel 8	NONE	NONE

Software Throttle Mode

S.BUS/DSM	CRSF	Function	Range
Channel 3	Channel 6	Motor ON/OFF	0% – 19% Motor OFF 20% – 100% Motor RUN
Channel 7	Channel 8	RPM Presets	−100% – −34% RPM 1 −33% – +33% RPM 2 +34% – +100% RPM 3

Helicopter Mechanical Setup

Example: M2 EVO MK2



While the M2 EVO MK2 comes ready to fly and pre-set from the factory, it might be necessary to redo the mechanical setup after performing repairs, or when retrofitting an existing model with OFS3. The following steps will provide an example to guide you to a clean mechanical setup. Please note that these steps may differ for different helicopters.

1. Enter the servo centering mode (SERVO) by long-pressing **SET** and repeatedly pressing **SET** until SERVO LED lights up.
2. Adjust the servo centers as required and verify that all servo arms rest at a **90° angle relative to the main rotor shaft**. This is perpendicular to their housings of servos CH1 and CH3, and parallel to the housing of CH2.
3. Adjust the metal turnbuckles of the swashplate linkages individually in such a way that the **swashplate rests perpendicular to the main rotor shaft** in both lateral and longitudinal direction. Clockwise turns on the linkages' metal turnbuckles shorten them, counter-clockwise turns lengthen them.
4. Adjust the turnbuckles of the swashplate equally, so that the swashplate rests at a vertical position that sets the **blade pitch of both blades to 0°**. After these adjustments, it should still fulfill the requirements of step 3.
5. Enter the collective endpoints adjustment mode (COLL) by short-pressing **SET** once.

6. Adjust your positive and negative collective endpoints by setting the collective stick to either endpoint, and moving the elevator stick accordingly. It is recommended to set symmetric collective endpoints of about ±12° to ±14°.
7. Save your adjustments by holding the **SET** button until the flight controller returns to flight mode.

Bluetooth® Configuration

OMPHOBBY Flight System 3 supports configuration and firmware update via the included Bluetooth® dongle.

To connect to the iOS / Android application:

1. Download the OMPHOBBY application from the Apple App Store or Google Play Store.
2. Connect the Bluetooth® adapter with the corresponding port on your OFS3 Flight Controller, as shown on page 15.
3. Open the OMPHOBBY application and grant the Bluetooth® permissions once prompted. This step is crucial, as otherwise, the app will not be able to connect to the flight controller.
4. Power on your transmitter, OFS3, and wait for initialization.
5. Open the OMPHOBBY application and press “Connect Device”.
6. Select the ID of your Bluetooth® module in the following dialog window.
7. Upon successful connection, the main page of the app will open automatically.
8. Bluetooth® will stay connected if you back out of the flight controller settings. You can re-enter the settings main page by tapping “Go to Settings”. OFS3’s firmware can be updated through the About tab.

The main page holds basic adjustments for tuning the flight feel of OFS3. Some of the options presented there correspond to the LEDs on the flight controller.

[Mechanical Settings] holds all options pertaining to the mechanics of the helicopter, such as servo centers and collective endpoints, cyclic ring adjustments for center and high/low collective.

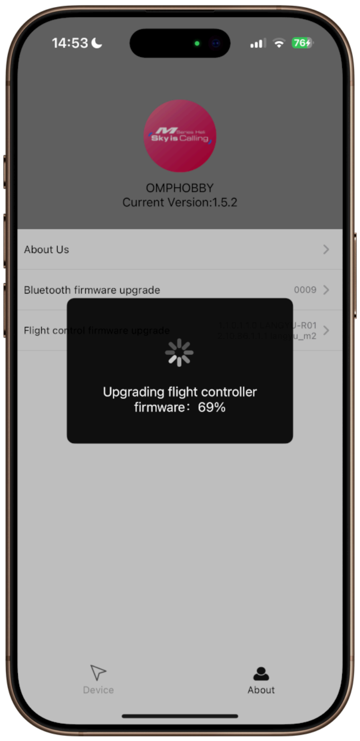
[Expert Settings] holds the core parameters that make OFS3 fly, giving the user unlimited access to all control loop parameters. Things found here include all PIDF gains, TALY PI gains, filter cutoff frequencies, control deadbands, expo settings, the control loop limits of the helicopter, and the settings for Software Throttle mode.

Updating OFS3's Firmware

Firmware updates to OFS3 can bring new functionality, improvements, and bug fixes to your flight controller. New firmwares can conveniently be installed via the OMPHOBBY smartphone app for iOS and Android.

⚠ **Only download and flash official OFS3 firmwares from omphobby.com. Do not download or install firmwares from anywhere else on or off the internet. Installing firmwares not directly downloaded from omphobby.com will void your OFS3 and model warranty.** ⚠

To update the flight controller's firmware:



1. Find the latest firmware for your OFS3 flight controller on the support page at **omphobby.com**, download it, and save it to your phone's Files app (iOS) or your downloads folder (Android).
2. Connect to OFS3 via Bluetooth®, as described on page 26.
3. Exit the model settings entirely through the back arrow in the top left-hand corner.
4. Head to the "About" tab in the bottom right-hand corner.
5. Tap the "Flight Control Firmware Upgrade" option. Should your Bluetooth® module require an update, this will automatically be done first. The Bluetooth® module firmware is integrated into the app.
6. When prompted, select the latest firmware you downloaded earlier, and the app will conduct the update for you.
7. Once the update is complete, OFS3 will automatically reboot into flight mode.
8. If the firmware update should fail for any reason, for example an unstable Bluetooth® connection, the flight controller will reboot into bootloader mode and cannot be flown. In this case, simply repeat the firmware update procedure and ensure a stable connection between your phone and OFS3.

To download the latest firmware for your OFS3 flight controller, please visit the **Firmware Download** page in the **Support** section on

www.omphobby.com

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