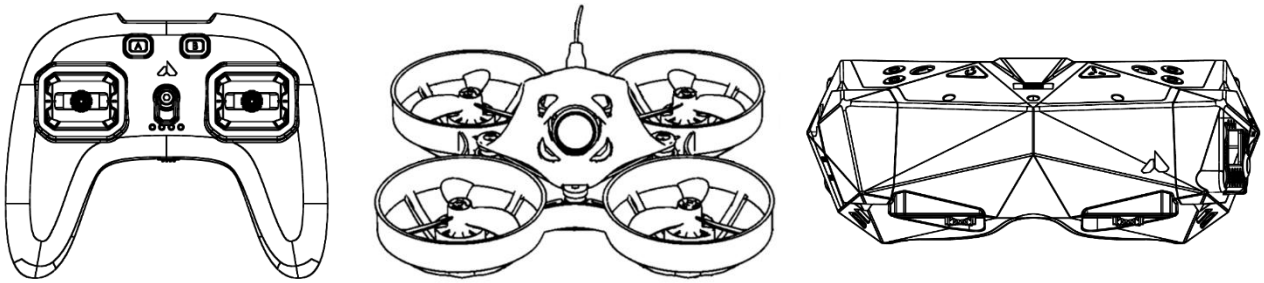
ORQA

EDUCATIONAL STEM DRONE SET

FPV.Ace



User manual

Rev. 1.1 | March 2025

EN

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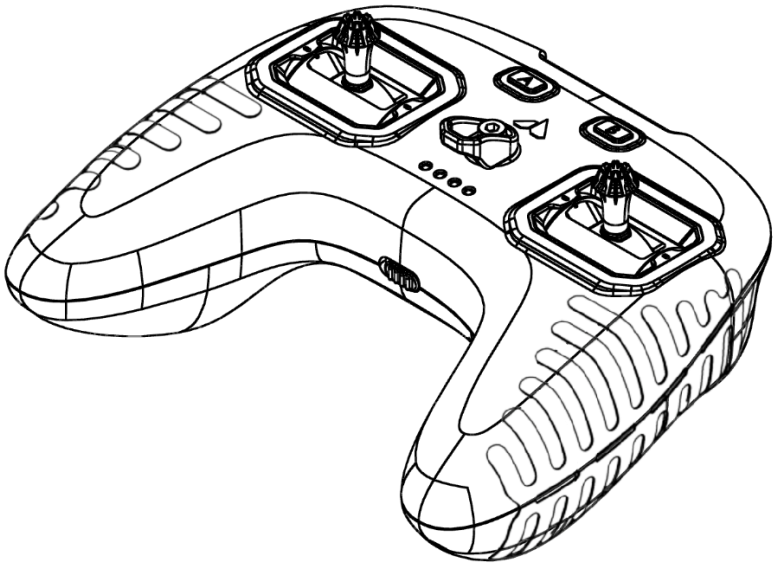
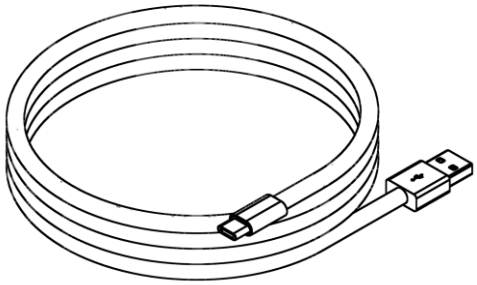
Intro: FPV.Ace contents

Chapter 1: Drone Sim Mastery



Orqa FPV.Ctrl

HEX Tool M3 x 3



USB-A to USC-C cable

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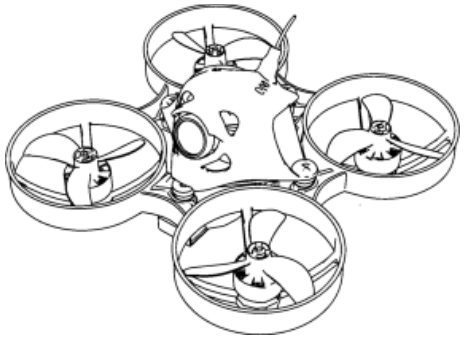
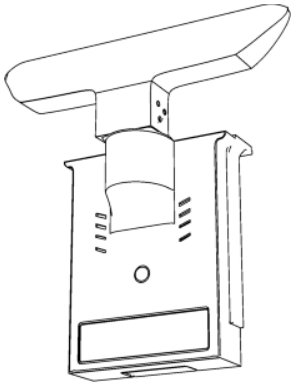
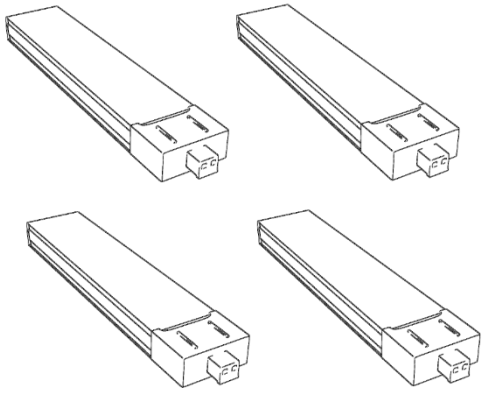
Chapter 2: LOS Take Off



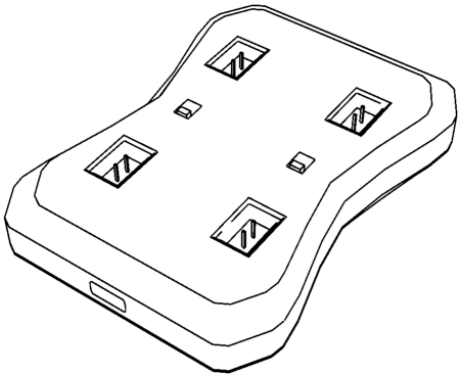
Microdrone AcroBee65 BLV4 BNF Ghost



ImmersionRC Ghost UberLite Tx Module



300 mAh 1S batteries



1S battery charger

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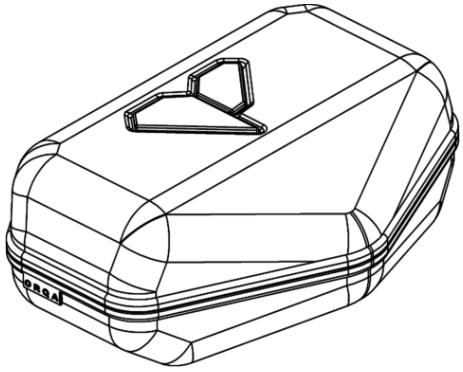
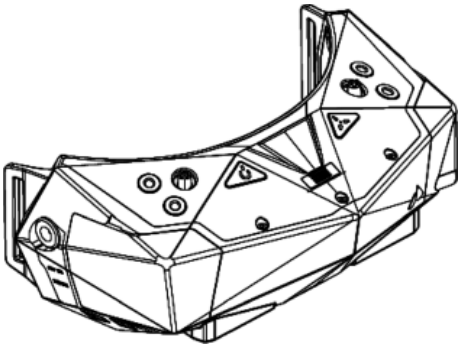
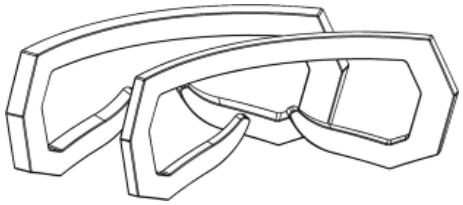
Chapter 3: FPV Dive In



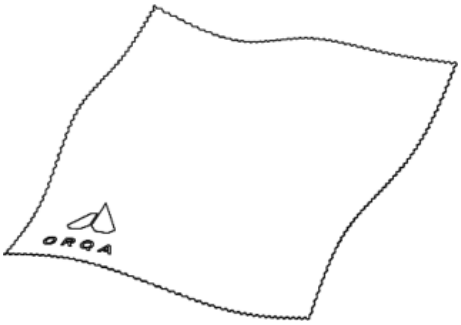
Case



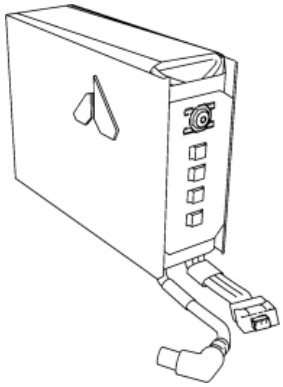
FPV Goggles – Orqa FPV.One Race



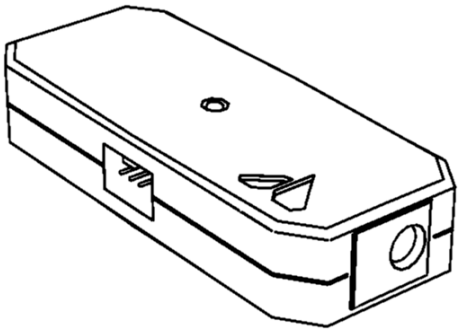
Foam



Cloth for Lens



Orqa FPV.Battery by Tattu
(7.4 V DC, 2500 mAh, 2S Li-Po)



2S battery charger

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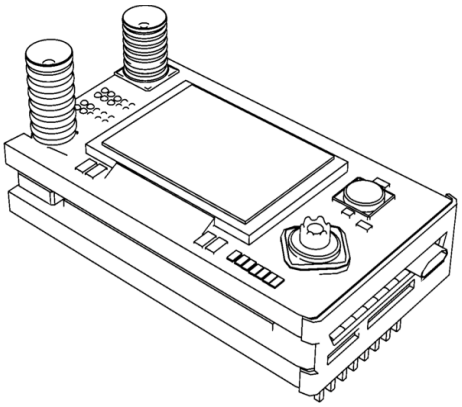
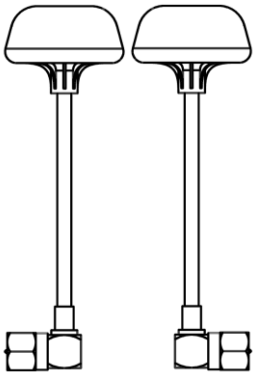
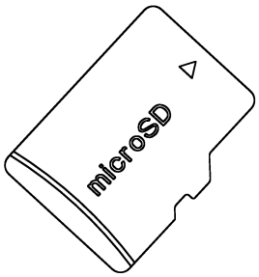


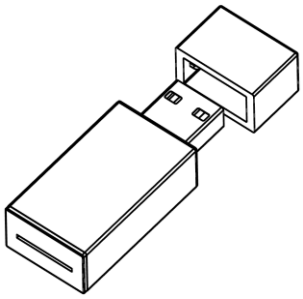
ImmersionRC rapidFIRE 5.8Ghz Video Receiver



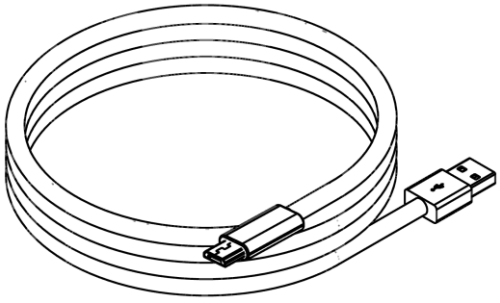
SpiroNET 5.8GHz antenna set



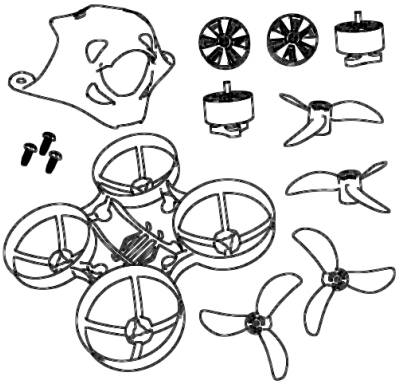
32 GB microSD card



microSD USB card reader



USB-A to Micro USB cable



Spare parts and tools (propellers, motors, frame, canopy, screws)

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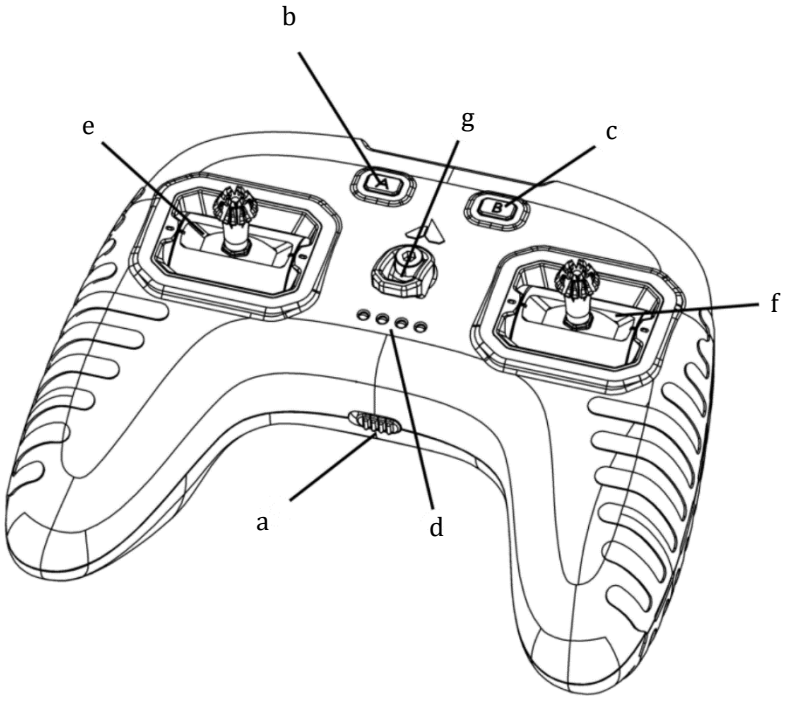
1. Drone Sim Mastery

Before you start flying with a real drone, the first chapter will make sure that you are prepared for such an endeavor. *Orqa FPV.SkyDive* simulator is the best free-to-play drone simulator on the market with the unique Flight School module that gives you an opportunity to master your flying skills in a crash-free environment.

You will master your drone flying skills with the *Orqa FPV.Ctrl* radio controller which you can later use to fly the real drones and gradually improve your skills to a level of an Ace drone pilot.

1.1. Use of FPV.Ctrl

Due to default settings, your controller will be in the state of rest, and you won't be able to turn it on. To turn it on, you will need to connect the controller to a charger by using the USB cable. Then, you will turn on the controller by turning on the power switch (picture 1.1.a) after turning it on, the green LEDs will show you the battery life (picture 1.1.d)



Picture 1.1.: a – power switch, b – button A, c – button B, d – LED indicator, e – left stick, f – right stick, g – lanyard hook.

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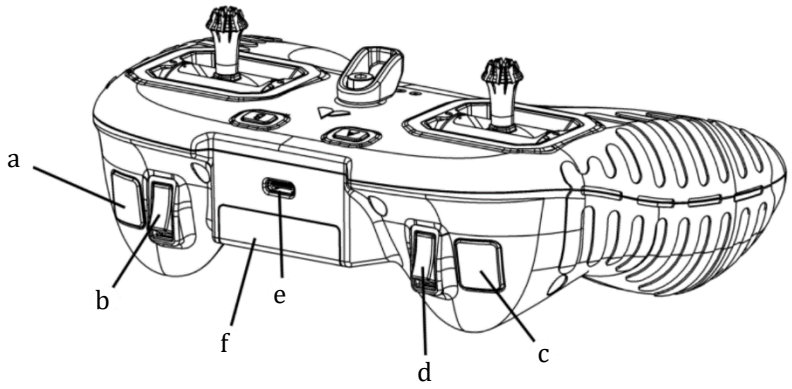
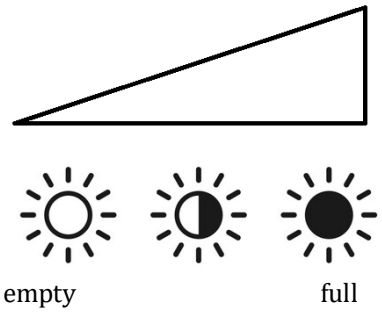
Settings of the controller and transmitter can be changed within an app that is available for both iOS and Android. When you are inside an app, you will be able to connect to your controller via Bluetooth. Once you have connected the controller to an app, it will remember the device and it will always be paired with it. In case you want to connect your controller to a different device, you will have to hold the B button until you see running red LED lights. Afterwards, the controller will delete its past connection, change its MAC address, and then it will be ready to connect with a different device. The name of the controller that can be seen during the Bluetooth phase is unique, and it can be found underneath the radio transmitter panel (picture 1.2.f).



Picture 1.2.: a – button R1, b – switch R2, c – button L1,
d – switch L2, e – connector USB-C, f – dock for the radio transmitter

1.1.1. Battery charging

Insert one end of the USB-C cable into the controller (picture 1.2.e.), and the other end into the computer or the charger with the maximum charging current set to 1.5 A. While the controller is charging, four LED lights will pulse with a green light. In case the controller is turned off during the charging phase, only the first LED lamp will be green.



picture 1.3.: green LED lights indicating battery level.

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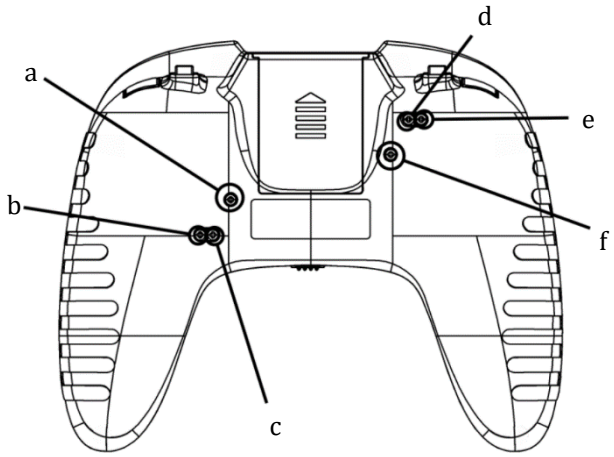
The time it takes to charge will depend on the maximal output voltage of the USB charger. In most situations, batteries should be full within two hours. When the controller is disconnected from the USB charger, four LEDs will display the status of the battery (picture 1.3.).

1.1.2. Controller sticks

1. The left stick will snap back to the center position when moving it to either the left or right angle, while moving the stick up or down, will make it stay in the position you left it at.
2. The right stick will snap back to the center position regardless of which angle you decide to move it to.

Since the controller comes calibrated out of the factory, it is not necessary to do the initial calibration. If the sticks are not centered or if suspensions were disassembled, after adjusting the sticks, you will need to do a calibration through the mobile app, following the guide within it. Suspensions of the sticks can be adjusted from the backside of the controller (picture 1.4.) with a hexagonal screwdriver with a section of 1,5 mm.



Picture 1.4.: a – right gimbal tension adjustment, b – right gimbal resistance adjustment, c – right gimbal ratchet adjustment, d- left gimbal ratchet adjustment, e - left gimbal resistance adjustment, f – left gimbal tension adjustment

1.1.3. Bluetooth connecting

Connecting via Bluetooth is done within the smartphone application (section 1.1.). If the controller isn´t shown during the Bluetooth search, that means that the controller is already paired to another device. To delete the connection with the previous device, hold the B button (picture 1.1.c.) until the LEDs indicate the running red light, afterward, your controller should be visible and able to connect via Bluetooth.

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1.1.4. Updating the firmware

Updating the firmware is done wirelessly by using the Orqa mobile app. To start an update process, hold the A button (picture 1.1.b.) while you turn on the controller. The controller is in the state of updating once the LEDs are lit up in white-blue-blue-white pattern.

1.1.5. Calibration

Turn on the controller and within the app, as mentioned at the beginning of section 1.1., connect it to your smartphone. Then, within the menu, choose *About and Settings*, then *Calibration,* and in the new tab make sure to tap on *Start Calibration*. Follow the instructions on the screen by moving the sticks of the controller as indicated on the diagram displayed within the app. After finishing the calibration, the position of the circles on the diagram should match the position of your controller sticks. If that is not the case, redo the calibration process.

1.1.6. Technical specifications

Tab 1.1.: technical specs for the FPV.Ctrl radio controller

stick suspenders	High-precision Hall sensors
operating voltage	6,4 V – 8,4 V (2S Li-ion Battery)
consumption (usual)	150 mW, typical
built-in battery type	2 x Li-Ion 18650
connectivity	Bluetooth 5, USB-C
maximum charging current	1,5 A
charging duration	2 h (approx.)
mass (without radio module)	309 g
size	170 mm x 140 mm x 58 mm

1.2. Orqa FPV.SkyDive simulator

Orqa FPV.SkyDive simulator is available in 2 versions; *Public* and *Institutional*. For *Orqa FPV.Ace* users, both versions are provided with unlimited features access, meaning that a full version with all DLCs are included (flight school, challenges, game modes, maps, various drone selection, etc.).

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1.2.1. Public version of FPV.SkyDive simulator

Available to all users with an active private *Steam* account. Upon installation, users who own the Orqa FPV.Ctrl radio controller and connect it via USB-C to their computer will have unlimited access to all features, including all DLCs.

Public version of the simulator is not limited only on the *Orqa FPV.Ctrl* radio controller, and it can be used with other types of drone RC controllers or standard gamepad-style controllers, but for them, the DLCs are available for purchase at determined prices visible in the *Orqa FPV.SkyDive* simulator. Public users can download the *Steam* version of *Orqa FPV.SkyDive* simulator here.

1.2.2. Institutional version of FPV.SkyDive simulator

The institutional version is intended for educational institutions, organizations, or business-related users and professionals. This stand-alone version must be installed on a computer using the license key provided with the purchased *Orqa FPV.Ctrl* radio controller (one controller, one license). It can only be used with a single computer. After purchasing the hardware, a download link for the simulator, along with the license key(s) and detailed installation instructions for installation, will be delivered via email.

For additional information about the institutional version, please reach out to us at skydive@orqafpv.com or sales@orqafpv.com.

1.2.3. Technical requirements

Tab 1.2.: recommended technical specifications for the simulator FPV.SkyDive Academy.

Operating system	**Windows 7, 8, 10 or 11 64-bit**	**OSX 10.12 or latest**	**Linux**
Processor	Intel Core i5 7400	3,8 GHz	Intel Core i5 7400
Memory (RAM)	4 GB	4 GB	4 GB
Graphic card	Intel HDG 630		Intel HDG 630
Free storage	1 GB	1 GB	1 GB
DirectX	version 11		

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2. LOS Take Off

After mastering the art of flying with *FPV.Ctrl* radio controller within the *FPV.SkyDive* simulator, it is time to progress to the LOS take off (**L**ine **O**f **S**ight).

Take off with an ultra-light and durable microdrone *NBD AcroBee65 BLV4 BNF Ghost*. This drone is safe for indoor usage but can be flown outside as well (in line with relevant country-specific law regulations).

Connection between microdrone and radio controller is ensured with the *Immersion RC Ghost UberLite* radio module which is inserted in *FPV.Ctrl* radio controller.

2.1. Binding the radio module with the drone

Binding steps:

1. Remove the lid of the dock for the radio transmitter module (picture 1.2.f.) and insert the IRC Ghost UberLite radio module into the dedicated slot (picture 2.1.).
2. Turn on the power switch on the radio controller (picture 1.1.a.).
3. When the radio controller is not bound to the drone, the LED light on the radio module will be lit up in red. LED light on the radio module is also a button, and by pushing it, the LED light on the module turns blue, indicating that the radio controller is ready for binding.
4. Connect the microdrone to the battery (picture 2.2.). If the battery is not empty, the drone will turn on, which will be followed by the specific sound, and the LED lights on the drone´s PCBA board will light up.
5. The drone will automatically connect to the first available radio module set in the binding mode within the range.[1]
6. After successful connection with the radio module the LED light on the module will change color from blue to green, indicating that drone is now connected to the radio module and accompanied radio controller.
7. To activate the drone motors, the left gimbal stick needs to be in the down-end position. Only then can the drone motors be activated by pressing the left latching button (shown in picture 1.2.c.). If the left gimbal stick is not positioned as described, the drone motors cannot be activated.

[1] The default factory settings of the drone ensure that upon connecting to the battery for the first time, the drone will immediately be available to connect with the radio module that is previously set to the binding mode. If the drone disconnects from the radio module for any reason or if you want to connect it to a different radio module, you can rebind it by connecting the battery to the drone and pressing the bind button on the drone (as shown in picture 2.3). The drone will then bind to a different radio controller, which must be correctly set for binding (as described in step 3.).

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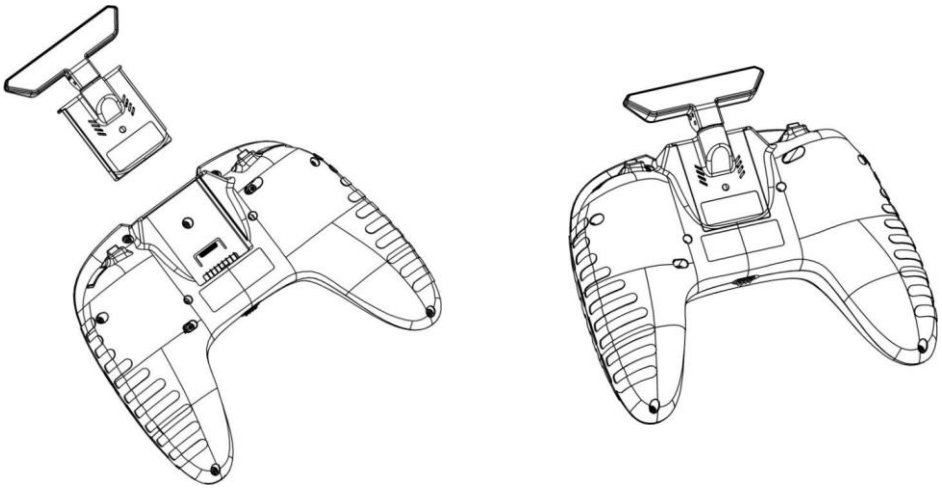
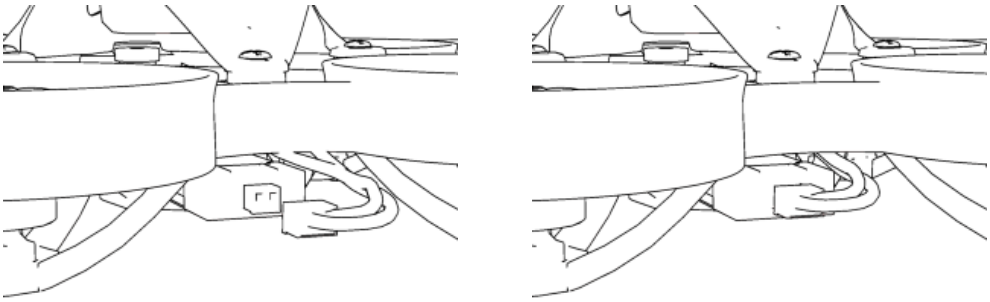
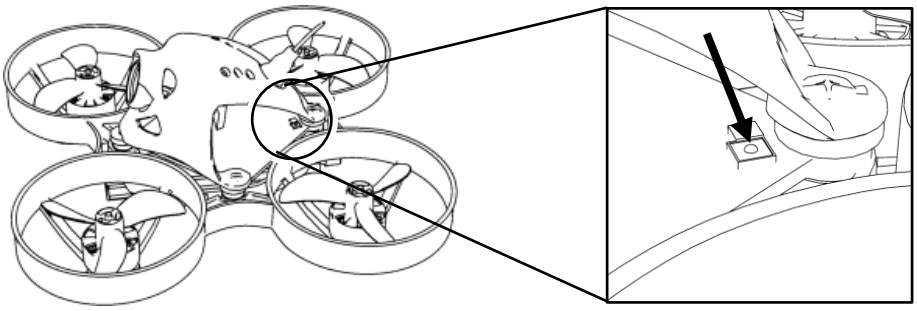


Picture 2.1.: Depiction of inserting the IRC Ghost UberLite radio module into the Orqa FPV.Ctrl radio controller.



Picture 2.2.: Depiction of connecting of the drone to the battery.



Picture 2.3.: Depiction of the button binding procedure that binds the microdrone to a different radio controller set for binding. For the first battery insertion, pressing the button is not necessary as it will automatically connect with the available radio module set to binding mode.

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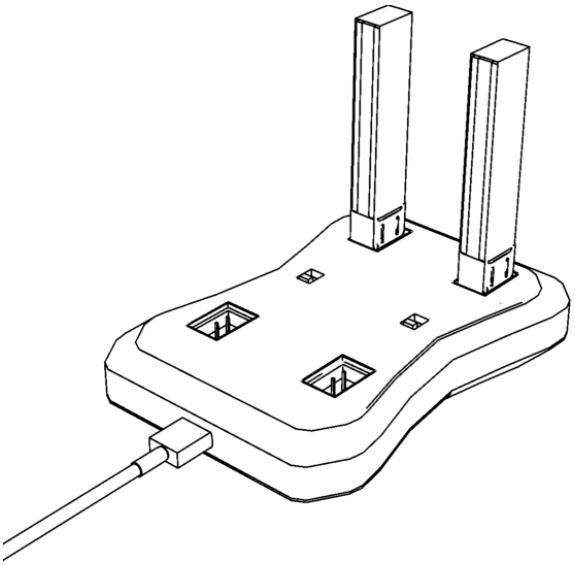
2.2. The drone battery and charging

The bundle contains four 1S type, 300 mAh drone batteries with PH 2.0 connectors. The batteries are charged with the charger (shown in picture 2.4.), which is connected via a USB-A to Micro-USB cable to the adapter. There are two HV (**H**igh **V**oltage) switches on the charger, used for charging to 4.2 V or 4.35 V. When charging a battery, a red LED light next to the slot will indicate that the battery is being charged. The battery is fully charged once the red light turns green. The charger can be used to charge 4 batteries simultaneously.



Picture 2.4.: PH 2.0 1S battery charger with USB-A to Micro USB cable.

Flight time with a fully charged battery typically lasts between two to four minutes, depending on the flying regime. Experienced pilots often fly with more intensity, while beginners tend to be more cautious, at lower speeds and less aggressive maneuvers, though they may encounter more obstacles. It's advisable to stop flying when the battery voltage drops below the recommended 3.3V to prolong the lifespan of the battery. Continuing to fly at lower voltages can shorten the battery's lifecycle.

If you don't have OSD (On-Screen Display) on your goggles (section 3.4.4.), or if you are flying in line of sight, you won't be able to monitor the battery voltage during flight. In these cases, maintain flight times under two minutes to ensure battery longevity.

To optimize battery lifespan, store batteries at around 3.8V. Note that the original charger cannot charge or discharge batteries to this storage voltage. You can discharge a full battery close to 3.8V using the drone itself as indicated on the OSD. However, it's recommended to use a charger capable of charging and discharging batteries to the storage voltage level.

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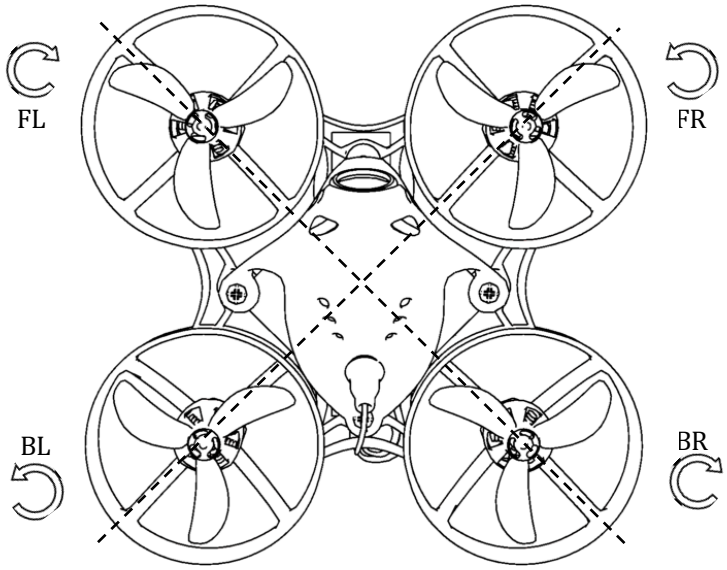
WARNING **FIRE HAZARD!**	Ensure that the batteries are kept away from flammable objects. Avoid disassembling or piercing, or puncturing the batteries, as this can cause explosions if the battery is damaged or exposed to heat sources like fire. Minimize unnecessary discharge and recharge cycles. Never leave a battery unattended while charging,

2.3. Drone propellers

There are four propellers attached to the drone motors, and the bundle also contains an extra set of four propellers, serving as substitutes. Although they might appear identical at first glance, it's crucial to notice the differences between them. Propellers come in pairs with blades that differ in direction. One pair has blades directed clockwise, while the other pair has blades directed counterclockwise. The direction of the rotor blades on the propellers must be diagonally aligned with the corresponding pair on the drone (see picture 2.5). Any other alignment of the propellers will cause the gyroscope effect, rendering the drone unflyable.



Picture 2.5.: The propellers of same type are paired diagonally

If a propeller is damaged, replace it with a substitute, ensuring that the direction of rotation of the blades matches that of the motors. If you have lost one or more propellers and are unsure about the direction of blade rotation, refer to picture 2.5 for correct placement. When removing a propeller from the motor, do so gently, holding the motor securely to prevent it from being dislodged from its mount.

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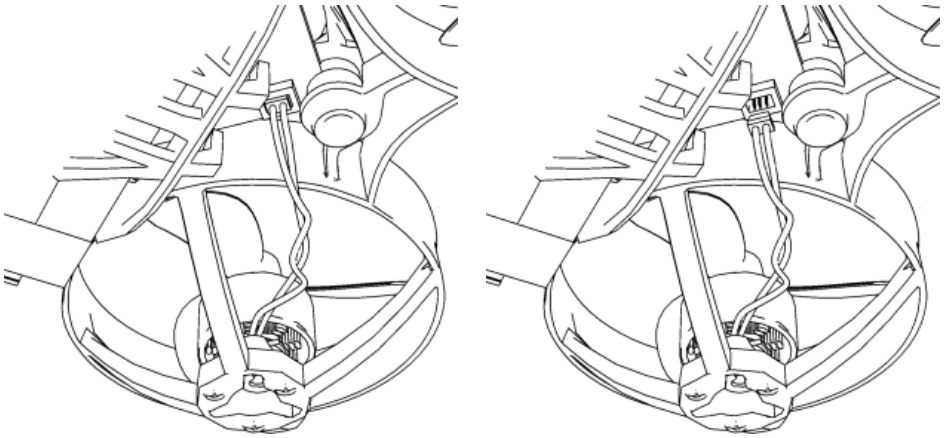
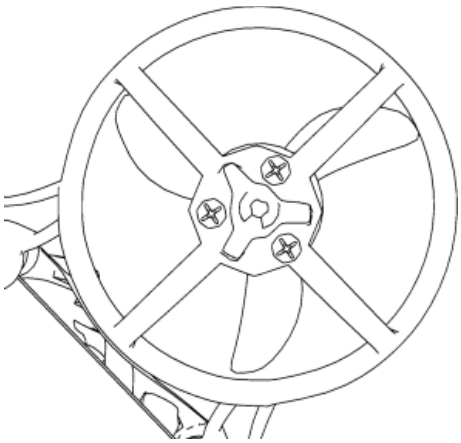
2.4. Drone motors

The FPV.Ace Microdrone is equipped with four BLDC motors, specifically type 0802 with a constant velocity of 19,000 KV. BLDC stands for Brushless DC motors. The four digits indicate the motor dimensions: the first two digits (08) represent the stator diameter (8 mm), and the second two digits (02) represent the stator height (2 mm). These motors have a shaft diameter of 1 mm, weigh 2.16 grams, and use JST-1.0 power connectors, which are compatible with the drone output.

In case of motor malfunction, disconnect the drone battery from the battery connector and unplug the motor from the connector on the PCBA board (see picture 2.6). Next, unscrew the screws holding the motor in place (see picture 2.7) and gently remove the motor from its stand. Install the spare motor in the same location, tighten the screws, and connect the motor to the PCBA board connector. Attach the propeller to the motor shaft, ensuring the correct propeller type and rotation direction as indicated in section 2.3.



Picture 2.6.: Before removing the motor, disconnect it from the PCBA connector.



Picture 2.7.: Motor is held by the screws from the bottom side.

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When replacing the motors, you need to pay attention to the rotation direction. The rotation direction of the motors is factory set, and they are paired diagonally. The default positions for the motors rotating clockwise are front left (FL) and back right (BR), while the motors rotating counterclockwise are front right (FR) and back left (BL). The rotation direction can also be identified by the color of the connector wires: red wires indicate clockwise rotating motors, and black wires indicate counterclockwise rotating motors.

2.5. Technical specifications

Tab 2.1.: technical specs of the drone, NBD AcroBee65 BLV4 BNF Ghost.

Size	65 mm
Motors	Flow 0802 19.000 KV, brushless
Propellers	Azi (three-pointed) 31 mm, Ø 1,0 mm
Camera	BeeEye, 600 TVL, 120° viewing angle
Mass	24,5 g (without battery)
Microcontroller (MCU)	STM32F411
Electronic Speed Controller (ESC)	12A BLHeliS Pre-Flash, Bluejay 0.18: S-H-40 48 kHz
ESC connector	JST-1.0 three-pole
On Screen Display (OSD)	NBD7456
Receiver	Ghost 2.4G s ImmersionRC qT antenna
Uart2	Tx for receiver Ghost 2.4G
Uart1	Tx i free Rx
Power connector	NBD-PH 2.0
Recommended battery	Nitro Nectar Gold 300 mAh 1S PH 2.0, Nitro Nectar Gold 250 mAh 1S PH 2.0
Firmware	BeeBrain BLV4 Ghost Betaflight 4.4

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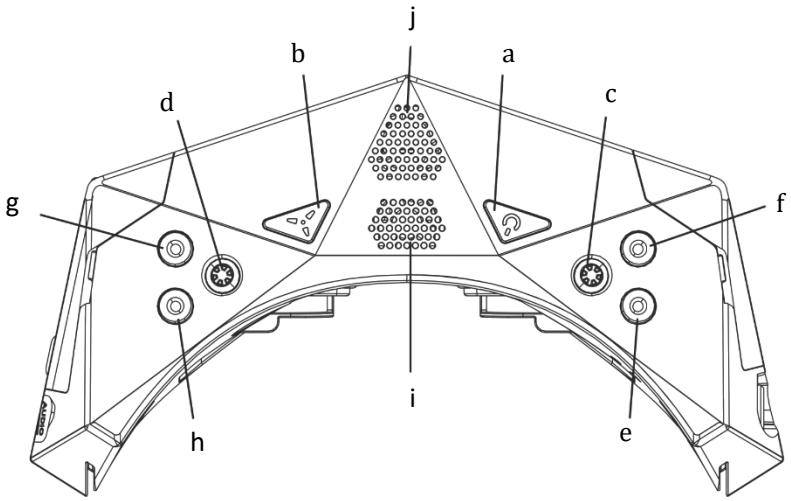
3. FPV Dive In

Finally, you are ready to dive deep into the immersive world of FPV flying (**F**irst **P**erson **V**iew). You will expand your horizons and experience the thrill of flying with both your feet safely on the ground. In this chapter, you will get familiar with the goggles, Orqa FPV.One. They will serve as the cockpit of your drone. Uniquely designed to meet the needs of most pilots, they are ideal for upgrading your flight abilities. For them, we will need the analog receiver, the *ImmersionRC RapidFIRE 5.8Ghz*.

3.1. First use of Orqa FPV.One goggles

3.1.1. Overview of the goggles



Picture 3.1.: Depiction of the FPV.One goggles from the top view. a – power switch, b – defogging fan, c – right navigation stick, d – left navigation stick, e – battery level check, f – DVR quick record, g – channel up, h – channel down, i – defogging air intake, j – cooling air exhaust.

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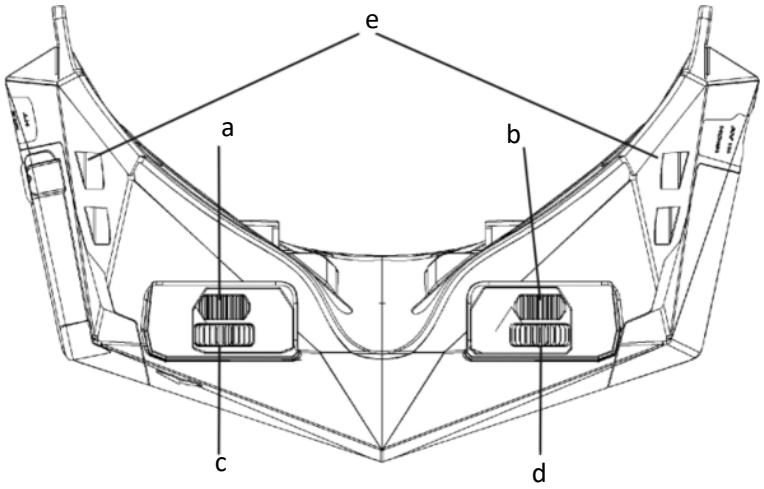
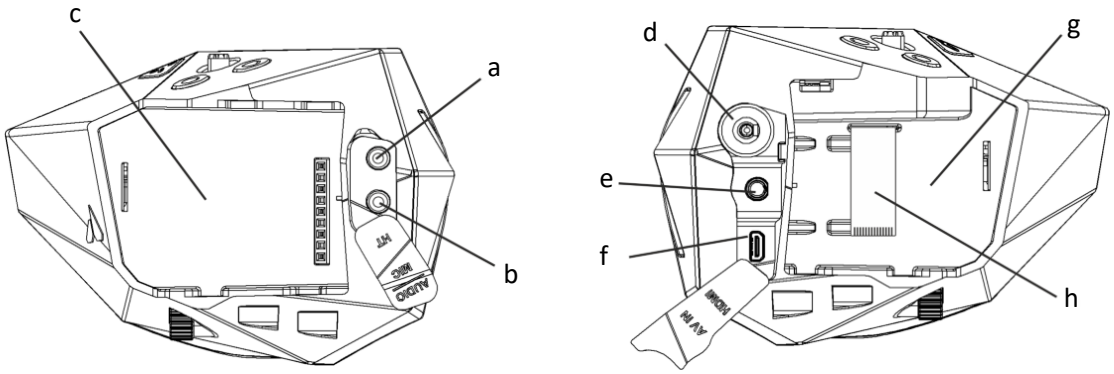
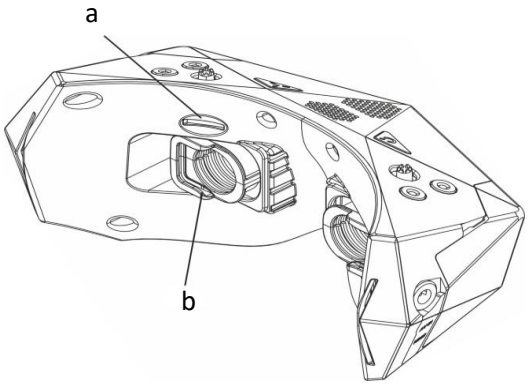


Picture 3.2.: Depiction of the goggles FPV.One from the bottom view. a – left IPD adjust wheel, b – right IPD adjust wheel, c – left focus adjust wheel, d – right focus adjust wheel, e – cooling air intake.



Picture 3.3.: Depiction of the goggles FPV.One from the side view. a – audio out / microphone in, b – head tracker output, c – receiver bay, d – power connector, e – AV input, f – micro-HDMI input, g – secondary bay, h – module interface FFC.



Picture 3.4.: Depiction of the goggles FPV.One from the back view. a – micro-SD card slot, b – diopter slot.

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3.1.2. Navigating the goggles

A power switch (picture 3.1.a.) is used to turn the goggles on and off. There are more ways to turn them on (section 3.1.6.3.).

To prevent the lenses from fogging due to moisture in the air or sweating, switch on the defogger (picture 3.1.b.). When there is no more need for it, turn off the ventilator so as not to drain the battery faster.

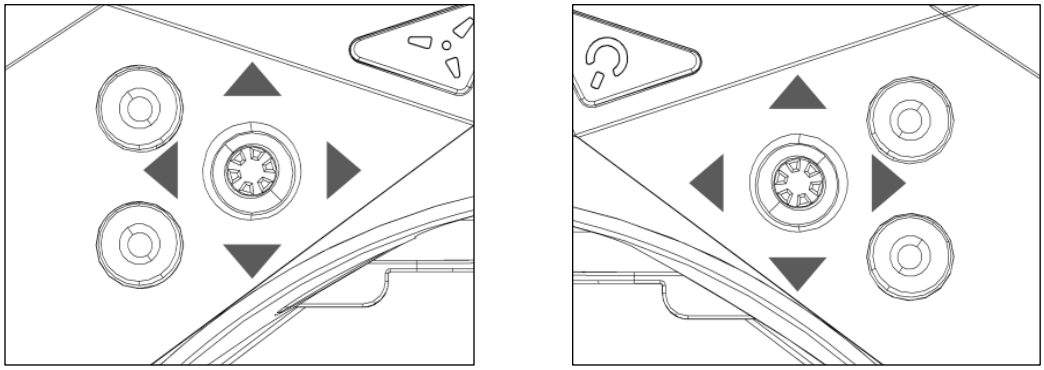
In DVR playback mode, the right navigation stick (picture 3.1.c.) controls the playback of stored videos (more on this in section 3.1.8.3.), and in the goggle menu the left stick (picture 3.1.d.) is used to navigate the main menu. The roles of these sticks can be swapped. Battery status can be checked by pressing the button (picture 3.1.e.) or if the sticks have been reversed, the button will now be used to exit the menu.

To record via DVR (***D**igital **V**ideo **R**ecorder*) pressing the button (picture 3.1.f.) you will either start or stop recording.

Pressing the button for the channel down (picture 3.1.g.) will change the receiver's channel to the channel down. If you hold down the same button for a long time, you will also change the radio spectrum area. If the sticks are reversed, this button will exit the menu. Pressing the button for the channel up (picture 3.1.h.) will change the receiver's channel to the channel up. If you hold down the same button for a long time, you will also change the radio spectrum.

3.1.3. Navigating the menus

There are two main menus that are navigated using the sticks on the top of the goggles (picture 3.1.c. and 3.1.d.). An enlarged view of these sticks is shown in the image below (picture 3.5.).



Picture 3.5.: left and right sticks on the top of goggles.

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The left stick is used to navigate the main menu, which includes all the primary controls and settings of the goggles. The default main stick is the left one, but this can be changed in the menu *Button options*. The right stick is primarily used for playback control or within the menu when adjusting DVR and video playback settings.

To access the main menu or the additional menu, simply press the corresponding stick. Within the menu, move the corresponding stick up, down, left, or right to make your selection. To save any changes made within the menu, press the corresponding stick. To exit the menu, press the back button. (See picture 3.1.g when the left stick is the main one, and picture 3.1.e when the right stick is the main one). To leave a submenu, you can either move the main menu to the left or press the back button. Note that all changes within the menu will be saved only if the menu has been closed before the goggles are turned off.

3.1.4. Video receiver

In the *Receiver settings menu*, you can select the receiver module that you have installed in the receiver slot (picture 3.3.c.). In order to control different receiver modules directly from the goggles, it is important to select the module that you are using, as this ensures that the OSD (***o****n-****s****creen* ***d****isplay*) of the goggles and the OSD of the module work in harmony.

For example, if you select *RapidFire*, you will be able to change the channel by pressing the button for channel up or down (picture 3.1.g. and 3.1.h.), but if you hold the same button, you will get the frequency range in which the receiver module operates. This option is only available if the *RapidFire* module is being used. (The mentioned possibilities are only available outside the main menu.)

Additionally, by accessing the channel tab (in the menu *Channel Table*) (tab 3.1.) you can select the desired frequency of the receiver module *RapidFIRE*.

Tab 3.1.: Table of the channels which can be chosen in the menu *receiver settings*. Numbers represent the frequency of each channel in *MHz*

	CH 1	**CH 2**	**CH 3**	**CH 4**	**CH 5**	**CH 6**	**CH 7**	**CH 8**
I	5740	5760	5780	5800	5820	5840	5860	5880
R	5658	5695	5732	5769	5806	5843	5880	5917
E	5705	5685	5665	5645	5885	5905	5925	5945
B	5733	5752	5771	5790	5809	5828	5847	5866
A	5865	5845	5825	5805	5785	5765	5745	5725
L	5362	5399	5436	5473	5510	5547	5584	5621

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3.1.5. Settings

3.1.5.1. Goggle settings

Input source is used for choosing the input source of video and you can choose between *Automatic*, *VRX, HDMI*, or *AV*. Selecting *automatic,* a picture of the input signal that the goggles receive will appear. In automatic mode, the default setting is *VRX* (*video receiver*), but as soon as you connect another source, the goggles input will automatically switch to it. If the signal for the HDMI source is not supported, a notification *Unsupported HDMI Input* will appear. The *Automatic* option is set to select the source in order by priority: *HDMI, AV*, or *VRX*.

HDMI resolution can be selected between 600 and 768 pixels, but the changes will only take effect after you turn the goggles off and on again. *FAN auto ON* or *OFF* enables or disables the automatic use of the fan for defogging the lenses. The fan speed can be set between 0 to 13.

3.1.5.2. Image settings

Brightness, *color, contrast, and luminescence* can be set between 0 and 50, or they can be *Reset to default.*

3.1.5.3. User profiles

In the submenu *user profiles* you can load, save, import, or export user profiles to the SD card, which contains all the goggle settings.

3.1.5.4. Screen sharpness

Submenu *Deep Focus* and *Quick Focus* can be used as a help or reference to configure your IPD (Inter-Pupillary Distance) and screen sharpness.

3.1.6. Features

3.1.6.1. Battery

The most important information during the flight is the battery status. The goggles display the battery status and show a notification when the battery level is low. There are several ways to adjust the battery status display.

Level shows the battery voltage. It can be changed to a percentage system by changing the setting *Display on the screen* from *mV* to *%*. While using the goggles, the battery status can be shown by pressing the button for the battery (picture 3.1.e.).

Size of the batteries can also be adjusted to match the one that the goggles are connected to. In this package, the 2S type battery is included.

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The low cell alarm level can be adjusted in increments of 0.02 V, within the range of 3.22 V to 3.50 V per cell. For a 2S battery with two cells, this translates to a range of 6.44 V to 7.00 V. When the battery voltage falls to or below the set value, the goggles will emit a short warning sound, and the voltage status (or percentage) will be displayed in red. An alarm will sound every 60 seconds. If the battery voltage drops below 6.1 V, the goggles will turn off safely.

Additionally, if you want to move the position of the battery status indicator, choose *OSD position (**O**n-**s**creen **d**isplay position)*. Use the left control stick (see picture 3.5) to move the battery status indicator to the desired location. When you are satisfied with the location, press the left control stick to save the new position and exit the settings.

3.1.6.2. Stand-by

Setting the goggles to standby mode turns off the receiver and displays, saving battery life. To activate standby mode, hold the button for displaying battery status and the button for DVR recording simultaneously (see pictures 3.1.e. and 3.1.f.) until the popup window counts down to zero. The goggles will then enter standby mode. Pressing any button on the goggles will turn them back on.

In the *Standby settings*, you can enable or disable the sound indicator for entering or exiting standby mode under the *Manual standby sound* option. You can also adjust the interval for repeated sound reminders of standby mode, ranging from 20 to 240 seconds, in 10-second increments.

3.1.6.3. Button settings

Power mode - can be configured in three different ways: *One-Press mode*, where a single press activates the device; *Short-Long mode*, which requires a short press followed by a long press; and *Always-ON mode*, where the device remains powered unless the battery is connected or disconnected.

Sound button – can be turned *ON* or *OFF*.

Joystick – can be configured to select the main control stick for navigating menus, choosing between left or right. Activating Reverse joystick swaps the joystick's up-down axis functionality.

Quick image settings – enabling Quick image settings allows users to swiftly modify settings without accessing the main menu during regular use. When enabled, using the left stick adjusts brightness (up-down) and contrast (left-right), while the right stick controls luminescence (up-down) and color (left-right).

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3.1.7. About goggles

In the *Info* menu you can see important information about goggles: goggle serial number, firmware version, hardware version and uptime of the goggles (total amount of time the goggles were running). Technical specifications, notifications and warnings and release notes are visible in the menu *Device Information*. Date and time can be changed in the menu *Date and Time*, and the goggles can be reset to factory settings in the menu *Factory Reset*.

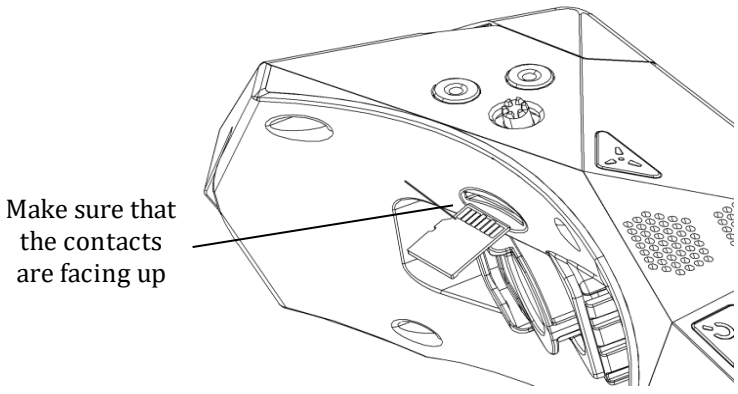
3.1.7.1. Updating the firmware

If the firmware needs to be updated, download the firmware file ([file].orqa) from Orqa's official website and save it to the *root* of the microSD card. In other words, the firmware file cannot be placed in any subfolder on the SD card. Turn off the goggles, insert the microSD card into the designated slot (see picture 3.4.b.), and wait for the installation of the new firmware to complete. The goggles will automatically boot once the installation is finished. This process may take a few minutes, depending on the size of the update. Once the update is completed, the system will automatically delete the installation file from the microSD card.

Keep in mind that the goggles won't allow an update if the battery is below 7.2 V. In addition to updating the *firmware* to the latest version, it is also possible to revert to an older version. To do this, simply place the installation folder of the desired version in the *root* directory of the microSD card.

3.1.8. Digital Video Recorder (DVR)

The Digital Video Recorder (DVR) records high-definition video and audio from any of the inputs. To use the DVR, first insert the microSD card into the corresponding slot with its contacts facing up (see picture 3.6). Inserting the microSD card incorrectly can cause undesired consequences, such as the card getting stuck in the slot and potentially damaging the contacts.



Picture 3.6.: Correct insertion of the microSD card in its slot.

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To begin recording, press the DVR button (see picture 3.1.f). The button is marked with a red dot on the top of the goggles. As soon as you press it, the DVR starts recording the input shown on the screen. During the recording session, a blinking red "REC" sign appears in the top right corner of the screen.

Keep in mind that the DVR won't record any on-screen display (OSD) elements that appear on your screen during the recording session. However, OSD elements created by the receiver (e.g., RapidFIRE RSS lines) will be recorded. Recorded contents of the DVR are saved to the microSD card. If the recording is not stopped, it will continue until there is no more space on the microSD card.

To avoid unwanted stoppage, you can turn on *Auto delete*. This feature allows the DVR to continue recording by chronologically replacing footage, starting with the oldest files. *Auto Delete* will only affect files created by Orqa's DVR system; all other files on the microSD card will remain unchanged. When the remaining free space on the microSD card falls below 30 minutes, the remaining recording time will be displayed next to the "*REC*" sign, for example, *30min REC*.

If there is no memory left on the microSD card, pressing the DVR record button will display the message "*SD card full*" on the screen. Please note that the DVR saves files in a maximum length of 5 minutes. Any recording longer than 5 minutes will be split into multiple files to prevent data loss or power loss during the recording session.

Since we are now on battery power, if the battery falls below 6.55 V, a "*REC BAT!"* sign will blink in the upper right corner of the screen. New recording sessions won't be possible if the battery is below 6.55 V, and a "*Battery critical*" sign will appear on the screen instead.

If you try to record with the DVR or format the SD card without an SD card inserted, a "*NO SD CARD*" message will appear. The formatting option is available in the DVR submenu under "*Format SDcard*," which quickly formats the inserted microSD card according to the appropriate FAT (***F****ile* ***A****llocation* ***T****able*) system. The system supports SD cards up to 2 TB.

3.1.8.1. Audio

In addition to recording video, the DVR can also capture audio from the drone if VTx is equipped with a microphone, or from the goggles using an external microphone when connected to the AV input on the goggles. If you wish to use a microphone, insert it into the 3.5 mm input on the left side of the goggles (refer to picture 3.3.a), ensuring that the port's output matches the one shown in picture 3.7.

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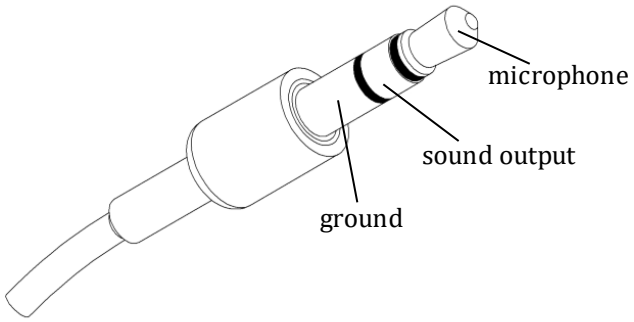

Picture 3.7.: Depiction of the sound-microphone 3,5 mm port output

You can adjust the volume of the sound within the DVR under the sub-menu *Volume Settings*. This allows you to change the volume levels of the microphone, receiver, and AV/VRX from 0 to 10, while the output volume can be changed from 0 to 4. Like any other slider in the menu, you select it by pressing the main stick in the middle. To increase the volume, move the stick to the left, and to save the settings, press the main stick again in the middle. The receiver's loudness also depends on the recording input from the AV.

3.1.8.2. Auto DVR

To enable automatic DVR recording, navigate to the DVR *Record Settings* submenu and activate *Auto DVR*. The goggles will then initiate auto recording upon detecting any video input signal, whether it's from HDMI, AV, or the receiver. To stop DVR recording and save the video to the microSD card, press the DVR recording button. However, if the goggles continue to receive video signals, auto DVR recording will start two seconds after the current recording ends. In such cases, it's not recommended to use the *Always-O*N feature (see section 3.1.6.3.), as turning off the battery while DVR recording is in progress can degrade file quality and lead to its deletion upon powering on the goggles next time.

When entering the menu, the DVR recording stops; however, two seconds after exiting the menu, recording resumes. Additionally, inserting a microSD card into the goggles while there's an existing video signal will also initiate DVR recording. Other recording options in this submenu include enabling/disabling the sound of the recording button (*DVR button sound*), the auto-deletion feature mentioned earlier (*Auto delete*) and setting the maximum length of recording sessions (*DVR record time*) from 3 to 30 minutes, adjustable in one-minute increments.

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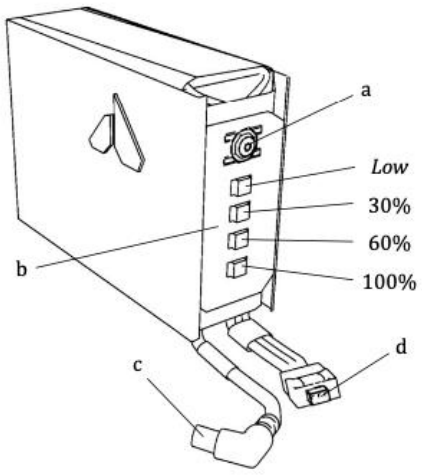
3.1.8.3. DVR reproduction

For viewing the recorded videos on your goggles, go to *Settings* > *Playback*. In there, you will find a list of recorded videos, automatically named, and sorted by time and date. Video is reproduced by selecting the footage on the list and then pressing the main stick in the center. Once the footage has been viewed, the system will automatically bring you back to the list of footage. To delete the footage, you shift the main stick to the right where the trash bin is, and then you press the stick back to the center. Footage can be paused/resumed by shortly pressing the stick to the center. Shifting the main stick up/down, you will regulate the speed of the footage. This means that by pressing down, you will slow the video; while pressing up, you will speed it up. Pausing for a short time and then resuming, the speed of footage will go back to default. Shifting the main stick to the left/right you will be able to rewind the video.

Please keep in mind that the system can recognize and therefore show only the footage made with the goggles DVR.

3.2. Battery and charging of the goggles

The goggles need to be powered using a DC voltage source between 6 and 25 V. It is recommended to use Orqa's original battery. The battery consists of two Li-Po cells connected in series (2S battery), with a nominal voltage of 7.4 volts and a capacity of 18.5 watt-hours, or 2,500 milliamp-hours. The battery has a button that, when pressed, displays the status of the battery power using four LED lights (see picture 3.8).



Picture 3.8.: Orqa's original battery for goggles. a – battery level check button, b – LED lights that show battery level, c – barrel power connector, d – three-pole JST balance connector.

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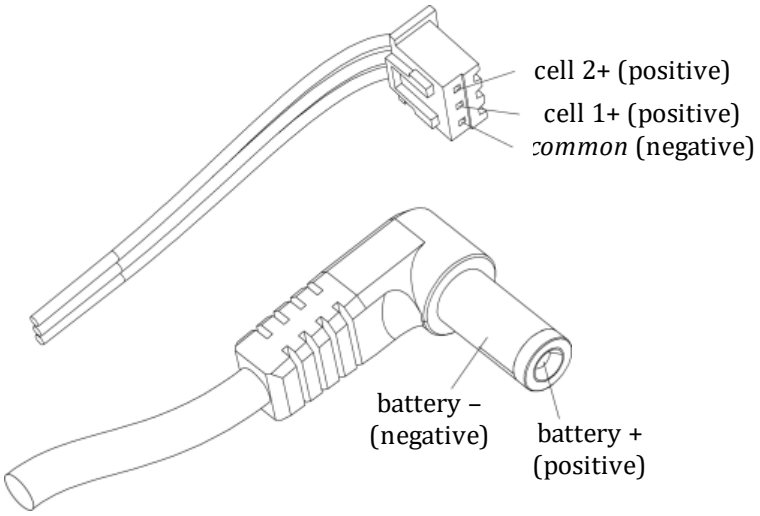
When the battery voltage becomes too low, it needs to be charged. You can check the battery level while using the Orqa goggles or by pressing the battery status button on the battery. To charge the battery, you will need a charger with a Li-ion or Li-Po profile. The best way to charge the battery is by using an 2S battery charger. This ensures that both cells in the battery are always at the same voltage after charging, which ensures a long battery life. To charge the battery, connect its connectors (Section 3.9) to the 2S battery charger. The charging current should be a maximum of 1.0 A, and the battery should be charged to 8.4 V (4.2 V per cell). A fully charged battery will have all four LEDs lit when you press the battery status button.



Picture 3.9.: Correct polarity of battery charger and standard JST balance connector.

WARNING! **FIRE HAZARD!**	Make sure to keep the batteries away from easily flammable objects. The recommended charging speed is 1C. Never charge it beyond 2C. Do not try to disassemble the batteries, and do not try to pierce them or manipulate their wires. Never go beyond the maximum capacity of the battery. The battery can explode if it is damaged or exposed to heat. Store the battery on the 3,8 V by cell. Avoid the unnecessary cycle of emptying and charging the battery. While charging the battery, never leave it unattended.

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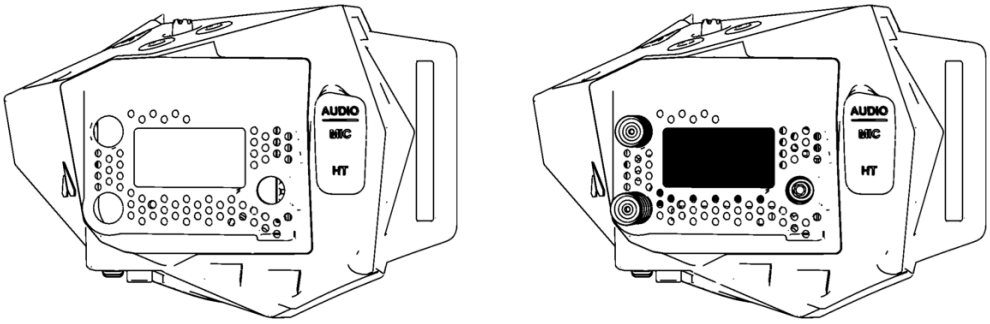
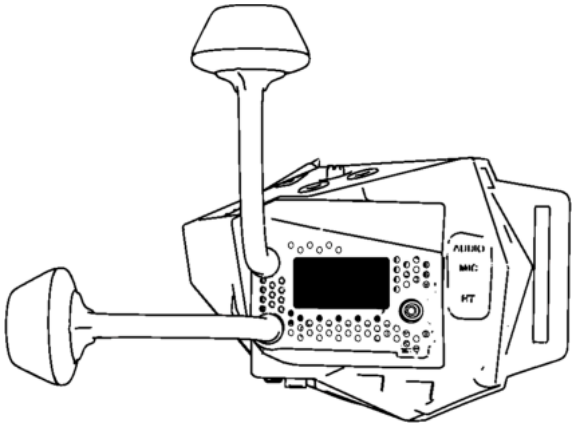
3.3. FPV goggles

The video signal from the drone to the goggles is displayed via the *ImmersionRC RapidFIR*E receiver, which is attached to the nine-pin slot of the goggles behind the panel shown in picture 3.3.c. After inserting the *RapidFIRE* module, it is important to mount the plastic panel back over the module (see picture 3.10). On the two coaxial connections of the video module, screw in both omnidirectional antennas. Point the antennas so that the upper one points upwards and the lower one points forward (see picture 3.11). This configuration is necessary due to the nature of the electromagnetic waves, which have mutually perpendicular longitudinal and transverse components.



Picture 3.10.: The left picture is goggles without a video module, and the right one is with the inserted *RapidFIRE* video module.



Picture 3.11.: The omnidirectional antennas on the goggles are positioned so that they are perpendicular to each other - the upper one facing up and the lower one facing forward.

3.3.1. Choosing the channels

In the section 3.1.4. It is explained how to select the input video signal channel within the goggles menu. It is also possible, and more convenient, to do this on the *RapidFIRE* module itself. When you turn on the video goggles, you will see a four-digit number in the upper left corner of the *RapidFIRE* screen, which represents the frequency in MHz

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(Tab 3.2). Below it, there will be two rows, the top row shows the available radio bands, where the selected one is shaded on the screen, and the bottom row shows the available channels for each radio band, where the selected one is also shaded. Use the stick on the right side of the *RapidFIRE* screen to change the radio band by moving the stick left-right and change the channel by moving the stick up-down.

Tab 3.2.: Example of the screen of *RapidFIRE* when the chosen field is *R* and the channel is *1*.

5658							
I	**R**	E	B	A	L		X
1	2	3	4	5	6	7	8

In addition to the *RapidFIRE* module screen, any change in radio band or channel is also displayed on the main screen of the goggles. The signal strength of the input signal for each channel is displayed with a bar to the right of the channel name, which is useful for searching for available video signals. For example, if there is only one drone in range of the goggles and you do not know its transmitting radio band or channel, the bar for its channel in one of the radio bands will easily stand out from the rest. This way, you can quickly find your drone's channel without searching blindly through each channel. If there are two or more drones on different channels and radio bands in range, the one closest to you will usually have the strongest input signal, assuming the drones are identical. Additionally, you can always go through each channel one by one and wait for your drone's camera image to appear.

3.3.2. Changing the drone’s transmitter channel

To connect your goggles to the drone’s video feed, ensure the drone is powered on and transmitting. Assuming you have already paired the drone with the radio controller (as described in section 2.1), push the right stick forward and the left stick to the left on the radio controller. This action should display the OSD menu on your goggle screens. Navigate the menu by moving the right stick forward or backward. To enter a submenu, move the right stick to the right; to exit a submenu, move the left stick to the left.

Select the submenu labelled *FEATURES* from the main menu. Within *FEATURES*, navigate to *VTX* where you will find *BAND* and *CHANNEL*. To adjust these settings, select one (either *BAND* or *CHANNEL*) and move the right stick left or right to change the channel on which the drone transmits the video signal. Once you've chosen the desired channel, return to the main menu by moving the left stick to the left.

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After changing the channel, the image on your goggles will disappear temporarily. Switch to the new channel as described in the previous section to restore the image. If you are still in the menu and satisfied with your settings, exit by navigating to and selecting *SAVE/EXIT*.

3.3.3. Calibration of drone gyroscope and accelerator

If the drone is connected to the radio controller (visible signal strength indicator in the lower left corner of the OSD menu), but the drone can't be armed, or maybe the drone is acting strange during the flight, the calibration of the gyroscope and accelerator is required. A frequent cause of decalibration is a crash or rough landing of the drone.

Calibration is done within the OSD menu. To access the OSD menu, push the right stick forward and the left stick to the left on the radio controller. When in the OSD menu, go to the submenu *FC&FIRMWARE*, and then *CALIBRATE*, then go to *GYRO* or *ACC* and then move the right stick to the right, on the right side there will be a sign *WAIT*, then *OK*, which means that the gyroscope, that is, the accelerator is done calibrating. Leave the menu to save the changes. Make sure to click on *SAVE&EXIT once you are ready to leave*. Maybe your drone will require rebooting, in which case you will select *SAVE&REBOOT*.

3.3.4. Flight information

During flight, the OSD will be divided into two rows, each displaying specific information about the drone.

First row, starting from the left side:

1. Flight time displayed in minutes and seconds (mm:ss),
2. Band, channel, and VTX signal power (example. *raceband* 3 output signal of 5 mW will be displayed like R : 3 : 5),
3. Battery level (%),
4. Battery voltage/cell (V).

Second row, starting also from the left:

1. Signal strength (scale and %),
2. Flight mode (*ANGL*, *HOR,* or *AIR*),
3. drone type (*BLV4 GHOST 65*),
4. the current strength of output from the battery (A).

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3.4. Technical specifications

Field of view (FOV)	33°
Screen resolution	1024 x 768 pixels
Aspect ratio	4:3 native
Power supply	6 – 25 V DC (2-6S lithium-ion battery)
Power consumption	2.6 W, typical
HDMI video input	Micro HDMI
Battery connector	2.1 x 5.5 mm, barrel connector
IPD range	56 – 74 mm
Focus adjust	- 4D to +4D
Integrated DVR	1280 x 960, 50/60 fps
Standard receiver bay	5V, high-power secondary bay for additions
Secondary slot for an additional module	$5\,V$, SDIO, UART
Weight	259g (without battery)
Dimensions	177 x 107 x 72 mm

Tab 3.3.: technical specs of video goggles FPV.One Race.

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