

# Orqa **MRM-2S** Aircraft Manual

**Confidential**

Orqa d.o.o, Feb 6, 2024



**O R Q A**



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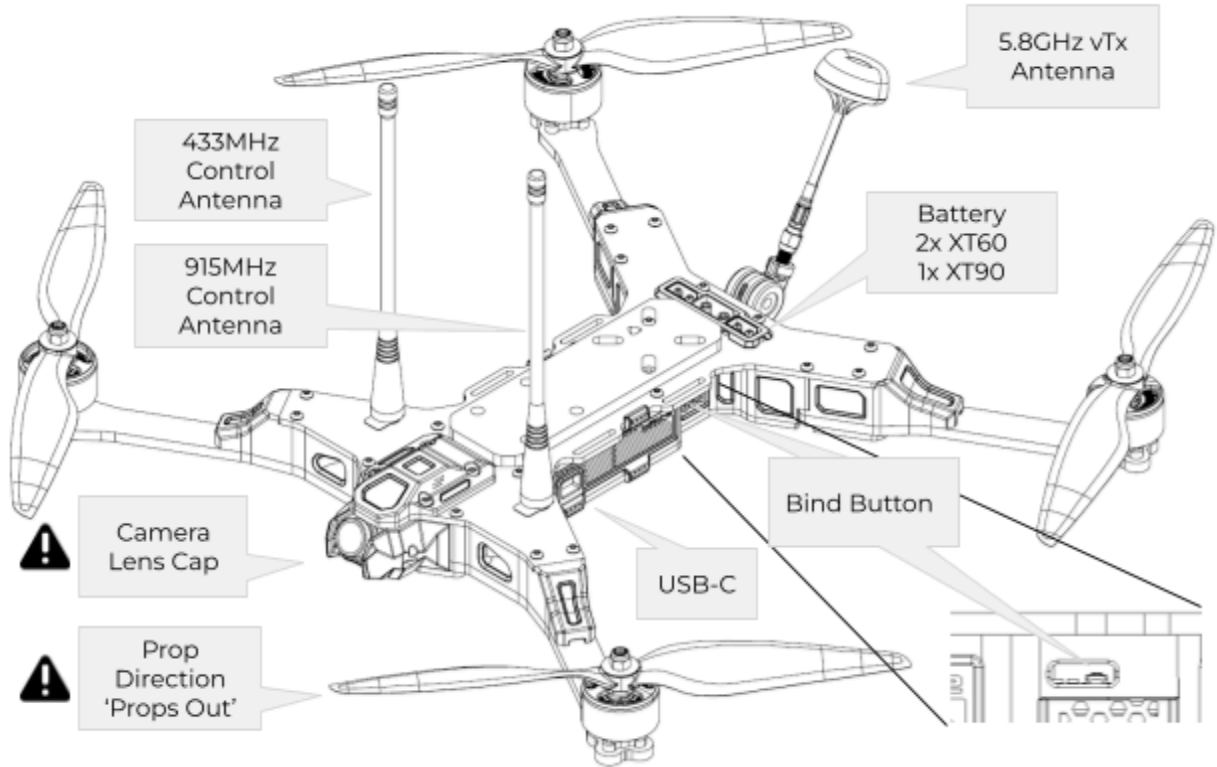
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**ORQA**



1. Props	2. Antennas	3. Battery	4. Binding
Observe Prop Direction, <b>Props Out</b>	Control antennas are <b>SMA</b> (not RP-SMA). Ensure fitted correctly.	2 x <b>XT60</b> , 1 x <b>XT90</b> are in parallel for 2p or 1p packs. 6s LiPo ~7000mAh recommended, or LiIon equivalent.	New drones are in <b>bind mode</b> , no need for bind button. Press bind button once after power-up to bind to new tx.

5. Channels	6. Video	7. Band Switch	8. Camera	
Roll Pitch Throttle Yaw Arm Band * Video * * suggested	<b>CH1</b> <b>CH2</b> <b>CH3</b> <b>CH4</b> <b>CH5</b> <b>CH6</b> <b>CH8</b>	Setup vTx, assign switch, in ghost Tx <b>Video Tx</b> menu. <pre> VIDEO TX ▶Channel 1 5740MHz Band IRC Power 25mW Send On/Off None ←           </pre>	Configure the band switch in the ghost Tx <b>Radio</b> menu. <pre> RADIO ▶Radio 1... Radio 2... Select Band 1 Switch None ←           </pre>	Ensure camera <b>lens cap is removed</b> before flight

9. Firmware
Betaflight <b>v4.1</b> Installed by default. Use Betaflight Configurator <b>v10.9.0</b>

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## Radio Controller

The Dual Sub-GHz JR module should be inserted into a standard R/C radio. Protocol selection on the radio (any recent OpenTx/EdgeTx build) should be set to **GHST** (ghost).

Recommended radios include:

FrSky Taranis 2019 edition

FrSky X7

*Other radios work, but may struggle when uplink power is increased to 3W, at 1W typically radios are happy.*

The low-cost TX12 really struggles with higher power, and doesn't like the 4xxMHz modes at all. This radio cannot really be recommended at this point.

The RadioMaster TX16s works 'ok', 3W is fine on 915MHz, but for 4xxMHz, avoid anything more than 1W (for 4xxMHz, 1W will go a loooooong way).

## Channel Mappings

When configuring the R/C radio, the following channel mappings should be set.

Note that these may be reconfigured in Betaflight, but these mappings are the standard mappings used by all interceptor drones as shipped.

Function	Channel	
<b>Roll</b>	CH1	
<b>Pitch</b>	CH2	
<b>Throttle</b>	CH3	
<b>Yaw</b>	CH4	
<b>Arm</b>	CH5	
<b>Band Select</b>	CH6	Use to switch between primary and shadow band
<b>vTx On/Off</b>	CH8	Used to turn off the vTx until required

To assign the band-select switch, enter the **Radio** menu, and select it in the **Switch** menu item.

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## Controller Battery

When selecting a battery for the radio controller try to use a high capacity pack, either 18650, or 21700 cells, with the highest current rating possible. 21700 Molicels are recommended.

## Antenna Connections

When looking at the OLED side of the JR module, the low frequency (shadow band) antenna is installed on the left SMA, and the primary antenna (915MHz) is on the right SMA. Do not swap these, or at high power levels damage may occur.

<b>WARNING</b>	<b>DO NOT OPERATE</b> this high-power control link without suitable antennas connected. <b>DAMAGE WILL OCCUR</b> if 3W of RF is reflected back into the power amplifiers. <i>The OLED on the JR module will show the required antenna locations at startup.</i>
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## Drone Setup

### Antenna Connections

The rear SMA connector is for the video transmitter antenna.

The two front connectors will be marked by the factory, one for the primary control band (915MHz for example), and one for the shadow band.

Ensure that both antennas are attached before flight.

*For early shipment drones that are not marked by the factory, when you look directly at the camera, from the front of the drone, the 9xx MHz antenna is on the right, the 4xx MHz antenna is on the left.*

<b>NOTE</b>	Note that for early production units <b>RP-SMA</b> connectors are used on the radio controller, and standard <b>SMA</b> connectors are used on the drone.
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## Battery Selection

Battery selection really depends upon application, and payload.

A good start for 20km flight with a reasonable payload is a Tattu 7000mAh 6s LiPo pack.

There are three yellow battery connectors on the drone, an XT90 for larger single packs, and two XT60s to connect smaller packs in parallel with a level of redundancy.

## Payload Mounting

When attaching a payload to the drone, try to keep the center of gravity near the center point of the drone. This keeps motor loads similar in flight.

## Prop Installation

The props are installed in a 'props-out' configuration, this means the front props spin out and away from the camera, and the rear props spin out and away from the tail of the drone. Refer to the image below when installing props. Ensure that the text on the props is on the top side.

## Binding Rx and Tx

Binding not only connects the controller to the drone, but also informs the drone of the frequency choices made on the controller.

On each of the bands (primary and shadow) there are at least 2 options, which are defaulted to 915MHz, and 490MHz from the factory. These are sent to the drone during this bind operation.

To bind, turn off the drone, enter the bind menu on the controller OLED, and select 'start bind', then power up the quad and wait < 30 seconds for bind to complete.

You can bind multiple drones to a single controller.

Be sure not to change the **RxID** unless you know what you are doing, this is the drone selection for multi-drone operations (known as 'Team Race' mode). See the 'Multi Drone Operation' later in this document.

Note that when binding a receiver to a transmitter, a firmware update may be suggested. If confirmed, then the update will be performed in < 60 seconds over-the-air, with no cabling required to the receiver other than power.



## Video Transmitter

The video transmitter in the MRM-2 is part of the hybrid, which also contains the dual sub-GHz uplinks.

The video transmitter channel is set in the **Video Tx** menu of the JR module OLED. Set the channel and band, plus the output power, and select **Send** to send to the drone.

Match the channel on the rapidFIRE in the goggles.

## EW Resilience

A complex topic, but to keep things simple:

1. Even the primary band of the Dual SubGHz radio can ignore the more common jammers, even when on the same band. This performance is not expected against more complex jamming technology.
2. It is a good practice to switch to the shadow band only when absolutely necessary (in the presence of jamming), the radio never sends packets on this shadow band until the pilot requests it.
3. The radios used in the Dual SubGHz system are extremely flexible and may be continuously updated in firmware to provide better EW resilience.
4. Firmware versions v1.0.1.1 and later include a 'Hi Band' vTx option to push the video transmitter above 6.0GHz. Maximum usable frequency for now is about 6.02GHz, but this is outside of the range of most common jammers.  
To select this on the rapidFIRE receiver, use the **favorites** mode, and increase frequency past 6GHz.
5. Monitor LQ and RSSI during flights that may involve EW. RSSI will generally stay similar, but LQ will drop during jamming attempts.

## How to Maximize Range

For the control link, 20km+ is possible with standard omnidirectional antennas.

Range (and penetration through buildings, etc.) may be increased with the use of directional antennas. For larger antennas, mount the JR module on a tripod, power it (up to 6s power is fine), and run just the S.Port, and Gnd wires to a dummy module mounted in the R/C radio.

For the video downlink, use a high-gain receiver antenna. These have narrow beams, so need to be carefully aimed. The TrueRC Sniper 5.8GHz antennas are highly recommended.

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For optimal range from a battery point of view, we ship with a value 'mAh/km' enabled in the betaflight OSD. If maximum speed is not a requirement, optimize this mAh/km value (lower values are better) by varying flight speed.

<b>WARNING</b>	When using omnidirectional antennas on the controller, be sure not to point them directly in the direction of the drone. The radiation pattern of these antennas is like a doughnut on top of the antenna. Where there are holes in the doughnut, there is no transmission/reception.
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When testing range, you can set each of the radios to 100mW, and then scale the range achieved mathematically.

100mW is 20dBm, 3W (max power of the JR module) is ~35dBm, a difference of 15dB.

15dB corresponds to a range increase of 5.62 times, so if you achieve 4km on 100mW, you will achieve ~22km on 3W mode.

Note that it is also possible to independently set the power of each of the radios, primary and shadow. Using 1W on 915MHz, and 3W on the shadow band will give extra security during jamming attempts.

## Video Goggles

A micro-SD card may be inserted to record video. The small button with the red dot on the top of the goggles is used to start and stop recording.

<b>WARNING</b>	Be sure to stop recording before powering down the goggles, or removing the battery. Failing to do this will result in a corrupted video file.
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It is a good idea to start the de-fogging fan before flight, especially when goggles are cold, and placed on a hot face.

Be sure to correctly set the IPD and Focus adjustments on the goggles before flight. This can be done looking at the 'snow' noise from the video receiver, and doesn't require the drone to be powered up.

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## Multi-Drone Operations

To operate multiple drones from a single pilot, when they are powered on at the same time (for swarming for example), the 'Team Race' functionality in the controller may be used.

During binding, give each drone a different receiver ID (**Rx ID**), and use the 'Multi-Drone' menu to configure one or more switches on your R/C controller to select the active drone.

Up to 12 drones may be used in multi-drone operations, and the pilot doesn't need to lift his goggles to switch to another drone, and launch.

Note that firmware version v1.0.1.2 or later is required for multi-drone operations.

## Connecting to a Distant Drone

Unlike similar control links in this same market, the ghost link can connect to a drone at the limit of control range the same as it connects to one a few meters from the pilot.

For long range testing, a safe way to do these tests is to launch from range (20km for example) and fly towards the pilot.

This way both primary and shadow bands, plus the video connection, may be fully tested before launch.