



# Reconnaissance UAVs

## copter Type





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## Classification of reconnaissance quadcopters

**Mini UAV** (quadcopter type)



**Medium-sized UAVs** (quadrocopter type)



**Large UAVs** (quadrocopter type)





# Reconnaissance quadcopters

## Key Features:

1. The **weight** - both of the drone itself with the remote and its component batteries and charging hubs, is necessary to understand the load calculation.
2. **Signal transmission range** is a characteristic necessary to understand the range of communication with the drone, but this indicator is relative. The manufacturer calculates it in ideal conditions of radio wave propagation and takes as a basis the transmitter power, receiver sensitivity and characteristics of the installed antennas, but the propagation of radio waves is affected by terrain, weather and climatic conditions, background noise, artificial magnetic and radio frequency interference. Consequently, in practice, the range of communication with the drone may differ from the characteristics stated by the manufacturer. For example: the manufacturer DJI Matrice 30T declares the maximum distance transmission on frequency 2.4 GHz to 15 km. In practice, this distance is reduced to 7-8 km, and in conditions of strong interference (urban areas, limited visibility, many extraneous signals) to 1.5-3 km.
3. **Transmission frequency** - required for selecting a signal amplifier or remote antenna.
4. **Maximum flight and hover time** - how long the drone can perform the required tasks in the air, but you need to consider the time to take off, before entering the area and the time to return and land.
5. **Remote operation time.**
6. **Allowable wind speeds** and ability to work in adverse weather conditions.
7. **Flight speed.**
8. **Availability of obstacle sensors.**
9. **Suspension characteristics** - what cameras are equipped with the quadcopter their zoom, hybrid zoom. Characteristics of thermal imaging camera (if available) - sensor size and zoom. Characteristics of rangefinder (if available) - measuring range and error.



# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)

DJI Mini 2



DJI Mini 2 SE



- Take-off weight - 249 g.
- Signal transmission - up to 10 km
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 31 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours. When charging the mobile device - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed max. - 10 m/s (36 km/h).
- The camera is 4K, 12MP.



- Take-off weight - 249 g.
- Signal transmission - up to 10 km
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 31 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours. When the mobile device is charged - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed  
max. - 10 m/s (36 km/h).
- The camera is 4K, 12MP.
- The digital zoom is 4x.





# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)

DJI Mini 3 Pro



- Take-off weight - 249 g.
- Signal transmission - up to 10 km.
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 34 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours.  
When charging a mobile device - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed max. - 10 m/s (36 km/h).
- The camera is 4K 12MP.
- Digital zoom - 4K: 2x, .7K: 3x, FHD: 4x.



DJI Air 2s



- Takeoff weight - 595 g.
- Signal transmission - up to 12 km.
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 34 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours. When the mobile device is charged - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed max. - 10 m/s (36 km/h).
- Camera - 4K 20MP.





# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)

DJI Mini 4 Pro



- Take-off weight - 249 g.
- Signal transmission - up to 18 km. (city approx. 1.5-4 km, suburbs approx. 4-10 km,: open land/sea approx. 10-20 km).
- Transmission frequencies are 2.400-2.4835 GHz, 5.170-5.250 , 5.725-5.850 GHz.
- Flight time max. - 34 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours.  
When charging a mobile device - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed max. - 10 m/s  
(36 km/h).
- The camera is 4K 12MP.
- Digital zoom - 12 MP 1-2x, 4K: 1-3x, FHD: 1-4x.



DJI Mini 4K



- Takeoff weight - 246 g.
- Signal transmission - up to 18 km. (city approx. 1.5-4 km, suburbs approx. 4-10 km,: open land/sea approx. 10-20 km).
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 34 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours.  
When charging a mobile device - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed max.  
- 10 m/s (36 km/h).
- The camera is 4K 12MP.
- Digital zoom -12 MP 1-2x, 4K: 1-3x, FHD: 1-4x.





# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)

Autel EVO Nano



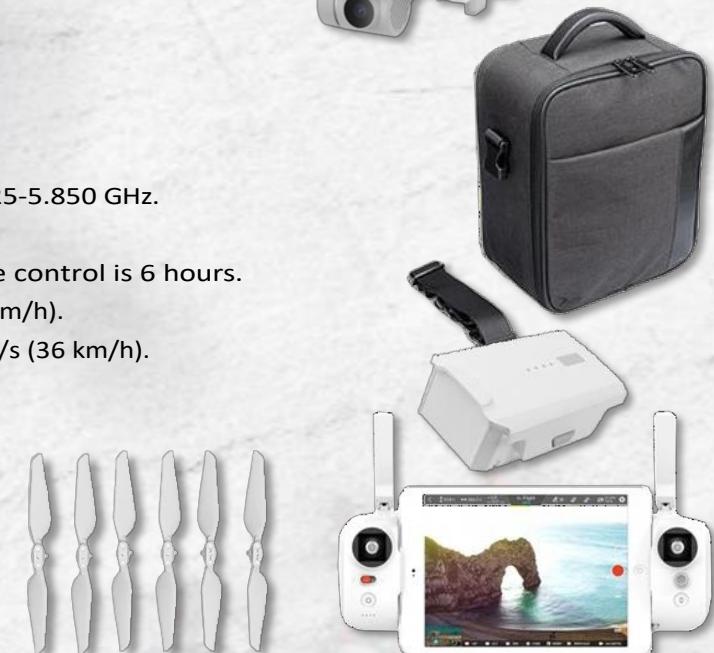
- Take-off weight - 249 g.
- Signal transmission - up to 16 km.
- Transmission frequencies are 2.400-2.4835 GHz, 5.150-5.250 , 5.725-5.850 GHz.
- Flight time max. - 28 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours.  
When charging a mobile device - 4 hours.
- Flight speed max. - 16 m/sec (57.6 km/h).
- Permissible wind speed max. - 10 m/s (36 km/h).
- Camera - 4K 48MP. 16x digital zoom.



FIMI X8 SE



- Take-off weight - 770 g.
- Signal transmission - up to 10 km.
- The transmission frequency is 5.725-5.850 GHz.
- Flight time max. - 35 min.
- The operating time of the remote control is 6 hours.
- Flight speed max. - 18 m/sec (64.8 km/h).
- Permissible wind speed max. - 10 m/s (36 km/h).
- Camera - 4K 48MP. 3x digital zoom.





# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)



Autel EVO Lite+



CHAPPIE II



- Take-off weight - 820 g.
- Signal transmission - up to 12 km.
- Transmission frequencies are 2.400-2.4835 GHz, 5.150-5.250 , 5.725-5.850 GHz.
- Flight time max. - 40 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours.  
When charging a mobile device - 4 hours.
- Flight speed max. - 19 m/sec (68.4 km/h).
- Permissible wind speed max. - 17 m/s (61.2 km/h).
- The camera is 6K, 16x zoom, night mode (ISO up to 48000).



- Take-off weight - 820 g.
- Signal transmission - up to 12 km.
- Transmission frequency:2.400-2.4835 GHz, 5.150-5.250 GHz, 5.725-5.850 GHz.
- Flight time max. - 40 min.
- Operating time of the remote control:  
Without charging the mobile device - 6 hours.  
When charging a mobile device - 4 hours.
- Flight speed max. - 19 m/sec (68.4 km/h).
- Permissible wind speed max. - 17 m/s (61.2 km/h).
- Camera - 6K, 16x zoom, night mode (ISO up to 48000).





# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)



This is an FPV drone from DJI that is great at providing pre-survey of rooms, trenches, and corridors

- Take-off weight - 377 g.
- Signal transmission - up to 13 km (without interference), 1.5-3 km (heavy interference).
- Transmission frequencies are 2.400-2.4835 GHz, 5.150-5.250 , 5.725-5.850 GHz.
- Flight time max. - 23 min.
- Operating time of the glasses: 3 hours.
- Joystick operating time: 10 hours.
- When charging a mobile device - 4 hours.
- Flight speed max. - 27 m/s (manual mode), 8 m/s (normal mode), 16 m/s (sport mode)
- Permissible wind speed max. - 10 m/s (36 km/h).
- The camera is 4K 12 MP.

DJI Avata 2

*DJI RC Motion 3*



DJI Goggles 3



*DJI Avata 2 Battery*

Capacity: 2150 mAh

Weight: 145 g

Standard voltage: 14.76 V





# Classification of reconnaissance quadcopters

## Mini UAV (quadcopter type)



This is an FPV drone from DJI that is great at providing pre-survey of rooms, trenches, and corridors

- Take-off weight - 135 gr.
- Signal transmission - up to 8 km (no interference), 1-1.5 km (strong interference).
- Transmission frequencies are 2.400-2.4835 GHz, 5.150-5.250 GHz, 5.725-5.850 GHz.
- Flight time max. - 17 min.
- Working time of the glasses: 3 hours.
- Joystick operating time: 10 hours.
- Remote control operating time: Without charging the mobile device - 6 hours. When charging a mobile device - 4 hours.
- When charging a mobile device - 4 hours.
- Flight speed max. - 16 m/s (manual mode), 6 m/s (normal mode), 8 m/s (sport mode)
- Permissible wind speed max. - 8 m/s (28.8 km/h).
- The camera is 4K 12 MP.
- Can be controlled with the DJI RC-N3 remote control and the DJI RC Motion 3 joystick.

DJI Neo



Equipment

Neo Motion Fly More Combo



DJI Goggles 3



DJI RC Motion 3



Equipment

Neo Fly More Combo



# Classification of reconnaissance quadcopters

## Medium UAVs (quadrocopter type)

DJI Mavic 3



- Takeoff weight - 895 g.
- Signal transmission - up to 15 km.
- Transmission frequency - 2.40.0-2.4835 GHz, 5.725-5.850 GHz
- Flight time max. - 46 min.
- Remote control operating time: Without charging of a mobile device - 6 hours.

When charging a mobile device - 4 hours.

- Flight speeds are 5 m/s (mode C), 16 m/s (mode N), 21 m/s (mode S).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Hasselblad wide-angle camera.
- The telephoto lens is a 28x hybrid zoom.



DJI Mavic 3 Classic



- Takeoff weight - 895 g.
- Signal transmission - up to 15 km.
- Transmission frequency: 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 46 min.
- Operating time of the remote control: Without charging the mobile device - 4 hours.
- Flight speeds are 5 m/s (mode C), 16 m/s (mode N), 21 m/s (mode S).
- Permissible speed wind max. - 12 m/s (43.2 km/h).
- The camera is 20MP.
- The digital zoom is 3x.





# Classification of reconnaissance quadcopters

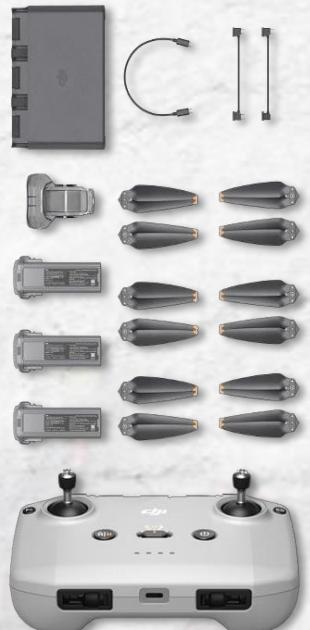
## Medium-sized UAVs (quadrocopter type)

DJI Mavic 3 Pro (DJI RC)



- Take-off weight - 958 g.
- Signal transmission - up to 15 km (without obstacles), up to 3 km (with obstacles, with low interference).
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 43 min.
- The operating time of the remote control is 4 hours.
- Flight speeds are 5 m/s (mode C), 16 m/s (mode N), 21 m/s (mode S).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- The camera is a Hasselblad CMOS 4/3 and two telephoto cameras.
- Digital zoom: 1-3x (Hasselblad camera), 3-7x (medium telephoto camera), 7-28x (telephoto camera).

DJI Air 3 (DJI RC-N2)



- Take-off weight - 720 g.
- Signal transmission - up to 18 km. (city approx. 1.5-4 km, suburbs approx. 4-10 km, open area 10-20 km)
- The transmission frequency is 2.400-2.4835 GHz, 5.170-5.250 GHz, 5.725-5.850 GHz.
- Flight time max. - 46 min.
- Operating time of the remote control: Without charging the mobile device - 6 hours. When charging the mobile device - 4 hours.
- Flight speed is 5 m/s (mode C), 16 m/s (mode N), 21 m/s (S mode).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - Wide-angle camera: 48 MP Medium telephoto camera: 48 MP.
- Digital zoom: Medium telephoto camera: 3-9x, Wide-angle camera: 1-3x.



# Classification of reconnaissance quadcopters

## Medium-sized UAVs (quadrocopter type)

DJI Mavic 3E



- Take-off weight - 1050 g.
- Signal transmission - up to 15 km (without obstacles), up to 3 km (with obstacles, with strong interference).
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 45 min.
- The operating time of the remote control is 3 hours.
- Flight speeds are 5 m/s (mode C), 16 m/s (mode N), 21 m/s (mode S).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - 20MP wide-angle camera.
- Digital zoom: 56x.



DJI Mavic 3T Thermal



- Take-off weight - 920 gr.
- Signal transmission - up to 15 km (without obstacles), up to 3 km (with obstacles, with strong interference).
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 45 min.
- The operating time of the remote control is 3 hours.
- Flight speeds are 5 m/s (mode C), 16 m/s (mode N), 21 m/s (mode S).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - 48MP wide angle camera, thermal imaging camera uncooled with 640x512 resolution.
- Digital zoom: 28x.





# Classification of reconnaissance quadcopters

## Medium-sized UAVs (quadrocopter type)

Autel EVO II Dual 640T V3



UCO special 1



- Take-off weight - 1150 g.
- Signal transmission - up to 15 km (without obstacles and interference).
- Transmission frequencies are 902-928 GHz, 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 38 min.
- Remote control operating time - 2.5 hours (max. brightness), 4.5 hours (50% brightness).
- Flight speed is 20 meters per second. (72 km/h).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - 50MP wide angle camera, thermal imaging camera uncooled with 640×512 resolution.
- Digital zoom: 16x (up to 4x) lossless increases).



- Take-off weight - 1150 g.
- Signal transmission - up to 15 km (without obstacles and interference).
- Transmission frequencies are 902-928 GHz, 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 38 min.
- The remote control has an operating time of 2.5 hours (max brightness), 4.5 hours (50% brightness).
- Flight speed is 20 meters per second. (72 km/h).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - 50MP wide angle camera, thermal imaging camera uncooled with 640×512 resolution.
- Digital zoom: 16x (up to 4x) lossless increases).





# Classification of reconnaissance quadcopters

## Large UAVs (quadrocopter type)

DJI Matrice 30T

- Take-off weight - 3095 g.
- Signal transmission - up to 15 km (without obstacles and interference), 1.5-3 km (strong interference).
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 41 min.
- Operating time of the remote control: built-in battery - 3.3 hours, built-in battery + external battery - 6 hours.
- The flight speed is 23 m/s. (82.8 km/h).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - Zoom camera, FPV camera with 1920×1080 resolution, thermal camera uncooled with 640×512 resolution.
- Digital zoom: 5x optical zoom, 16x hybrid zoom, Maximum hybrid zoom: 200x
- Laser rangefinder: measuring range 3-1,200 m.





# Classification of reconnaissance quadcopters

## Large UAVs (quadrocopter type)



Matrice 300 RTK with Zenmuse H20N harness

- Takeoff weight - 3600 g (without batteries), 6300 g (with 2 TB60 batteries).
- Signal transmission - up to 15 km (without obstacles and interference), 1.5-3 km (heavy interference).
- The transmission frequency is 2.400-2.4835 GHz, 5.725-5.850 GHz.
- Flight time max. - 55 min.
- Operating time of the remote control: built-in battery - 2.5 hours, built-in battery + external battery - 4.5 hours.
- The speed of flight is 23 m/s. (82.8 km/h).
- Permissible wind speed max. - 15 m/s (54 km/h).
- Camera - Zoom camera, FPV camera with 1920×1080 resolution, thermal imaging camera not cooled with 640×512 resolution.
- Digital zoom: 23x optical zoom, 200x digital) zoom and night vision sensor.
- Laser rangefinder: measuring range 3-1,200 m.





# Classification of reconnaissance quadcopters

## Large UAVs (quadrocopter type)



Autel EVO Max 4T

- Take-off weight - 1600 g.
- Signal transmission - up to 20 km (without obstacles and interference).
- Transmission frequencies are 902-928 GHz, 2.400-2.4835 GHz, 5.150-5.250 GHz, 5.725-5.850 GHz.
- Flight time max. - 42 min.
- Operating time of the remote control: built-in battery - 2.5 hours (maximum brightness), 4.5 hours (brightness 50%).
- The speed of flight is 23 m/s. (82.8 km/h).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - Wide angle camera, Zoom camera, thermal imaging camera uncooled with 640x512 resolution with x2, x8, x16x zoom.
- Digital zoom: 10x optical zoom and 160x hybrid zoom.
- Laser rangefinder: measuring range 5-1,200 m.





# Classification of reconnaissance quadcopters

## Large UAVs (quadrocopter type)

- Take-off weight - 8400 g.
- Signal transmission - up to 20 km (without obstacles and interference).
- Transmission frequency - 902-928 MHz 5.150-5.250 GHz (CE: 5.170-5.250 GHz) 2.400-2.4835 GHz 5.725-5.850 GHz.
- Flight time max. - 40 min.
- Operating time of the remote control: built-in battery - 2.5 hours (maximum brightness), 4.5 hours (brightness 50%).
- Flight speed is 25 m/s. (90 km/h).
- Permissible wind speed max. - 12 m/s (43.2 km/h).
- Camera - Wide angle camera, Zoom camera, thermal imaging camera uncooled with 640×512 resolution with x2, x8, x16x zoom.
- Digital zoom: digital zoom 1-35x optical zoom, 35-560x hybrid zoom.
- Laser rangefinder: measuring range 10-2000 m.

Autel Alpha





# Classification of reconnaissance quadcopters

## DJI quadcopter specifications summary table

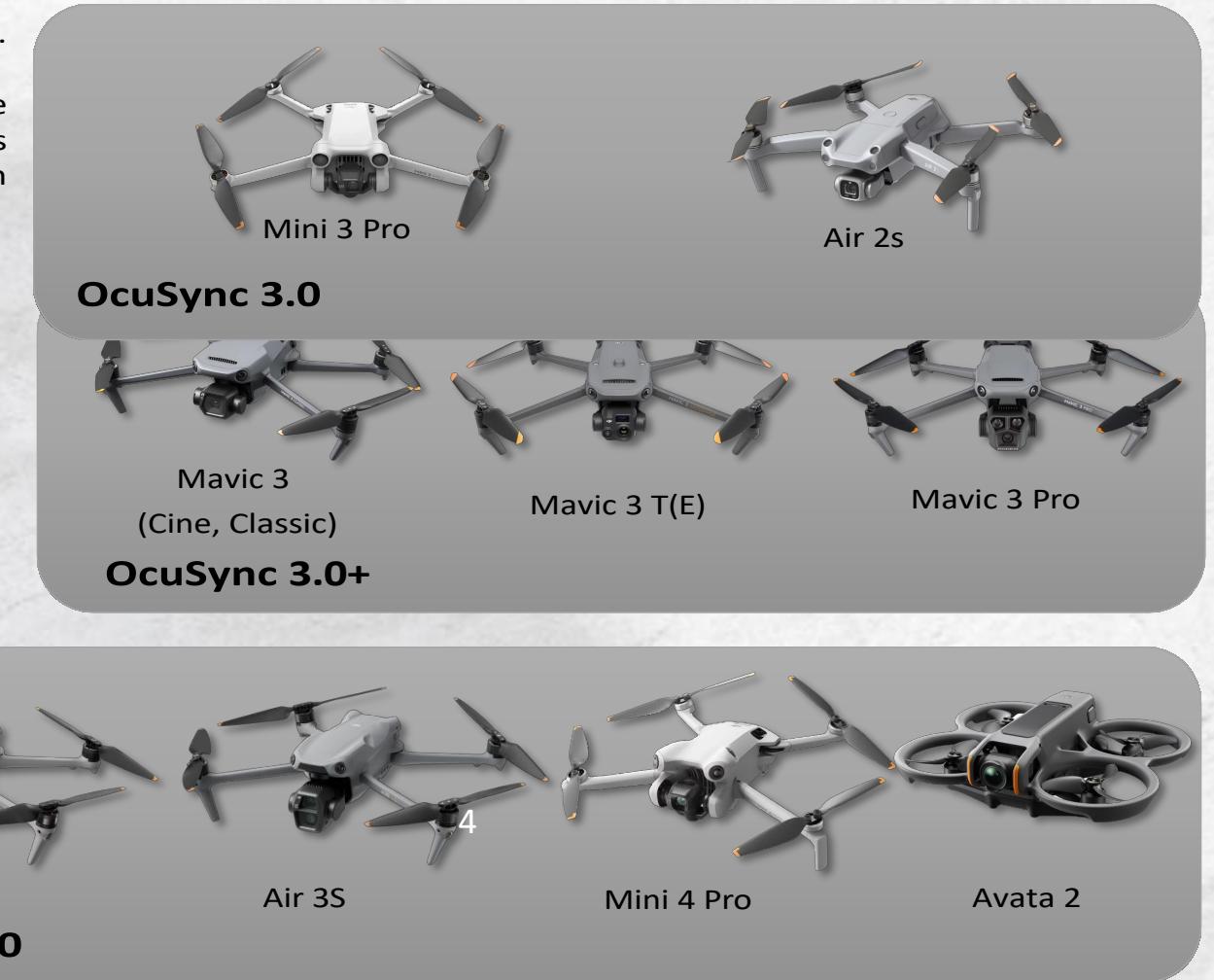
		Take-off weight	Signal transmission	Transmission frequency	Flight time max	Remote control operating time	Flight speed max	Assume wind speed max.	Camera
Mini 2		249 gr.	up to 10 km	2.4 GHz, 5.8 GHz	31 min.	6 hrs.	6 m/sec. (57.6 km/h)	10 m/sec. (36 km/h)	4K, 12 megapixels
Mini 2 SE		249 gr.	up to 10 km	2.4 GHz, 5.8 GHz	31 min.	6 hrs.	6 m/sec. (57.6 km/h)	10 m/sec. (36 km/h)	4K, 12MP, 4x
Mini 3 Pro		249 gr.	up to 10 km	2.4 GHz, 5.8 GHz	34 min	6 hrs.	6 m/sec. (57.6 km/h)	10 m/sec. (36 km/h)	4K, 12MP, 4x
Mini 4 Pro		249 gr.	up to 18 km	2.4 GHz, 5.2 GHz 5.8 GHz	34 min	6 hrs.	6 m/sec. (57.6 km/h)	10 m/sec. (36 km/h)	4K, 12MP, 4x
Air 2s		595 gr.	up to 12 km	2.4 GHz, 5.8 GHz	34 min	6 hrs.	6 m/sec. (57.6 km/h)	10 m/sec. (36 km/h)	4K, 20MP, 4x
Air 3		720 gr.	up to 18km	2.4 GHz, 5.2 GHz 5.8 GHz	34 min	6 hrs.	21 m/s. (75.6 km/h)	12 m/sec. (43.2 km/h).	4K, , 9x
Mavic 3		895 gr.	up to 15 km	2.4 GHz, 5.8 GHz	46 min.	4 hrs.	21 m/s. (75.6 km/h)	12 m/sec. (43.2 km/h).	4K, 20MP, 28x
Mavic 3 Classic		895 gr.	up to 15 km	2.4 GHz, 5.8 GHz	46 min.	4 hrs.	21 m/s. (75.6 km/h)	12 m/sec. (43.2 km/h).	4K, 20MP, 3x
Mavic 3 Pro		958 gr.	up to 15 km	2.4 GHz, 5.8 GHz	43 min.	4 hrs.	21 m/s. (75.6 km/h)	12 m/sec. (43.2 km/h).	28x
Mavic 3E (3T)		1050 gr.	up to 15 km	2.4 GHz, 5.8 GHz	45 min	3 hrs.	21 m/s. (75.6 km/h)	12 m/sec. (43.2 km/h).	56x (28x+tpv)
Matrice 30T		3095 gr.	up to 15 km	2.4 GHz, 5.8 GHz	41 min.	3 hrs.	23 m/s. (82.8 km/h).	12 m/sec. (43.2 km/h).	16x, 200x, tpv
Matrice 300		6300 gr.	up to 15 km	2.4 GHz, 5.8 GHz	55 min.	4.5 hours.	23 m/s. (82.8 km/h).	12 m/sec. (43.2 km/h).	23x, 200x, tpv



# Classification of reconnaissance quadcopters

## Video transmission system

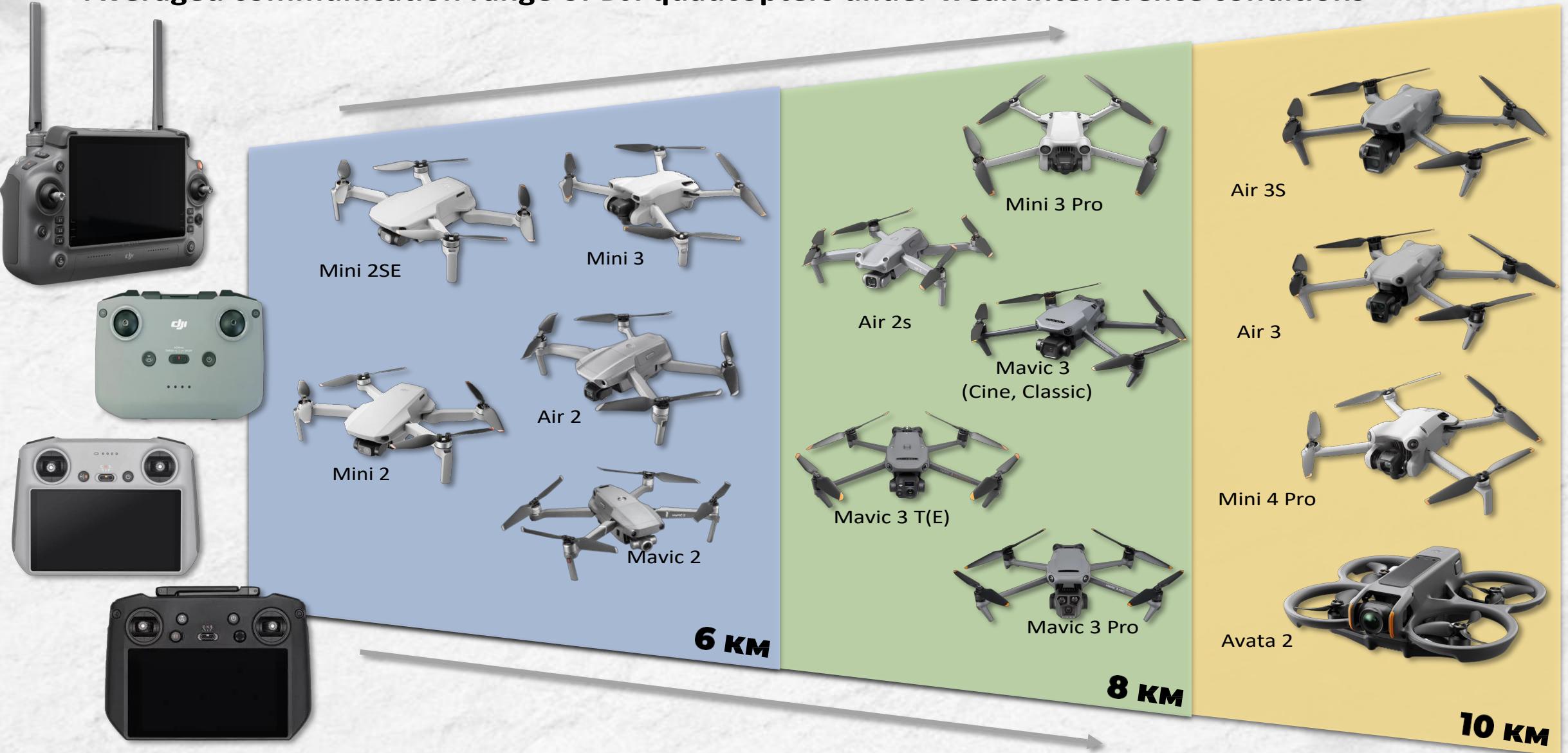
**OcuSync** is an integrated high-definition video transmission system. high-definition video transmission system, which provides a wireless connection between the remote control and the drone. With each new version, it increases range, improves real-time video quality, reduces signal interference and ensures smooth integration and operation.





# Classification of reconnaissance quadcopters

Averaged communication range of DJI quadcopters under weak interference conditions





## Remotes and flight applications

DJI



Autel





# Remotes and flight applications

## DJI remotes and flight apps

DJI RC-N1 (rm231) (without  
of the built-in screen) is different  
holder for

of a smartphone that displays  
drone image.

Compatible Drones:

- DJI Mini 2 / DJI Mavic Air 2: O2
- DJI Air 2S: O3
- DJI Mavic 3: O3+



+



+



## DJI Remote Controller (RC rm330)

Compatible Drones:

- DJI Mini 3 Pro
- DJI Air 2S
- Mavic 3 Classic
- Mavic 3 Cine



+



**DJI Fly**



## Remotes and flight applications

### DJI remotes and flight apps

#### DJI Smart Controller (rm500)

Compatible drones:

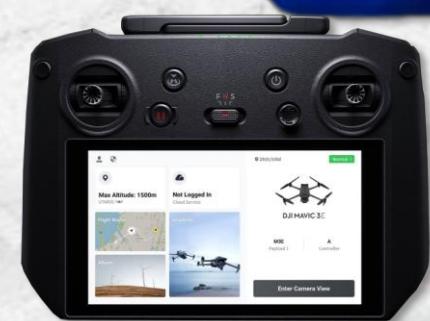
- Mini 2
- Mavic Air 2 (S),
- Mavic 2 Pro/Zoom
- Mavic 2 Enterprise (Dual/Advanced)
- Phantom 4 Pro V2.0



DJI GO4



DJI Pilot 2



#### DJI RC Pro Enterprise (rm510b)

Compatible Drones:

- DJI Mavic 3E
- DJI Mavic 3T





## Remote controls and flight applications

### DJI remotes and flight apps

#### DJI RC Plus (rm700b)

Compatible drones:

- Matrice 30 Series
- Matrice 300 RTK
- Matrice 350 RTK



DJI Pilot 2



#### DJI Smart Controller Enterprise

(rm500)

Compatible drones:

- Matrice 300 RTK



DJI Pilot 2





# Remote controls and flight applications

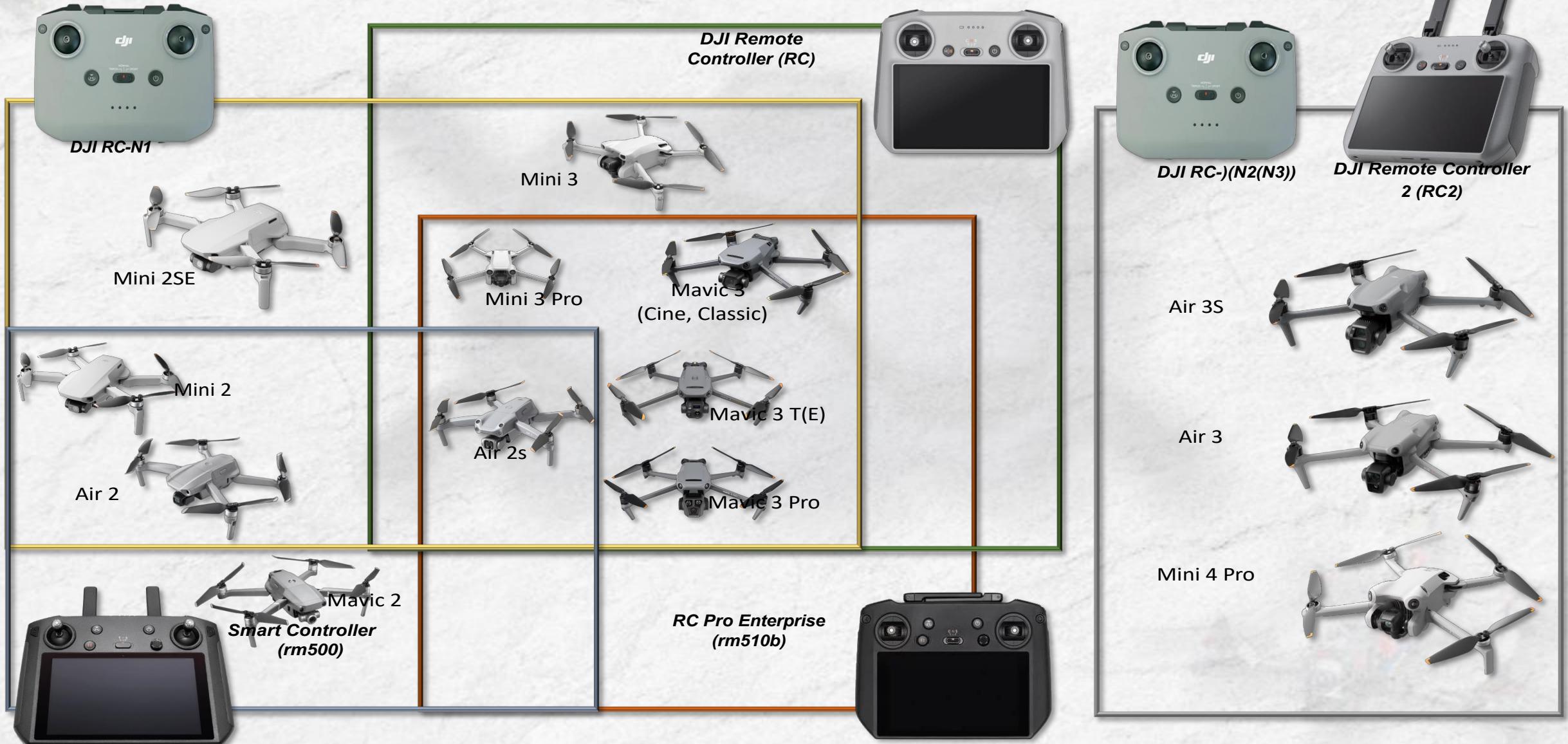
## Remote control compatibility with DJI quadcopters

		DJI RC-N1	DJI RC-N12	DJI Remote Controller (RC)	DJI Remote Controller 2 (RC2)	Smart Controller (rm500)	RC Pro Enterprise (rm510b)	Smart Controller Enterprise	DJI RC Plus (rm700)
Mini 2									
Mini 2 SE									
Mini 3 Pro									
Mini 4 Pro									
Air 2s									
Air 3									
Mavic 3									
Mavic 3 Classic									
Mavic 3 Pro									
Mavic 3E (3T)									
Matrice 30T									
Matrice 300									



# Remotes and flight applications

## Remote control compatibility with DJI quadcopters





**COSPROJECT**

## Multi-bind

**COS 3.0.**



**COS** is an alternative Android-based firmware and software suite for the Smart Controller, RC Pro, RC Pro Enterprise, RC Plus and RC, monitors CrystalSky, DJI Phantom 4 Pro Plus.

Model: DJI RC Pro / DJI RC Pro Enterprise (rm510 / rm510b)

Copters: Mavic 3, Mavic 3 Classic, Mavic 3 Pro, Mini 3 Pro, Mini 3, Air 2S, Mavic 3E, Mavic 3T, Mavic 3M, Matrice 30T, Agras T40, Inspire 3.

Capabilities : FCC, 5.8, 5.1-5.2, disable GPS, image broadcast to Companion, multi-bind Consumer and Enterprise drones



Model: DJI RC Plus (rm700)

Copters: Mavic 3, Mavic 3 Classic, Mavic 3 Pro, Mini 3 Pro, Mini 3, Air 2S, Mavic 3E, Mavic 3T, Mavic 3M, Matrice 30T, Matrice 300/350, Agras T40/T50, Inspire 3.

Capabilities: FCC, 5.8, 5.1-5.2, disable GPS, image broadcast to Companion, multi-bind Consumer and Enterprise drones



The COS **multi-bind** system allows you to control virtually the entire line of current DJI drones from a single remote (rm700, rm510, etc.), as well as save drones for future connection without the need to re-bind.

*Before using Mavic 3 (Classic, Pro) drones with rm700, rm510, etc. remote controls, it is necessary to unbind the drone from the standard remote control using the "Drone Unbind" application. The drone can be used with any suitable remote control with no limit of 5 flights.*

The screenshot displays the COS 2.0 mobile application interface. The main screen shows flight information: time (15:56), battery level (100%), memory usage (8598 M6 / 47820 M6), IP address (192.168.3.93), and update status (No new updates). It also shows the drone model (DJI RC Plus), serial number (4LFCK6W0027TZX), and license status (Activated). The bottom navigation bar includes tabs for ПУЛЬТ (Remote), ПОЛЁТ (Flight), ДРОНЫ (Drones), НАСТРОЙКИ (Settings), and О СИСТЕМЕ (System).

To the right, a dropdown menu for selecting a drone model is open, listing various DJI models:

- Потребительские (Consumer):
  - Mavic 3 / Cine
  - Mavic 3 Classic
  - Air 2S
  - Mavic 3 Pro
  - Mini 3 Pro
- Спец. применение (Special Application):
  - Mavic 3E / Mavic 3T / Mavic 3M
- Промышленные (Industrial):
  - Matrice 30
  - Matrice 300

At the bottom of the dropdown, there is a note: "Совет: для быстрого паринга нажмите и удерживайте кнопки C1+C2+Video до появления мигающего синего индикатора." (Tip: Press and hold the C1+C2+Video buttons until a blue indicator starts flashing for quick pairing.)

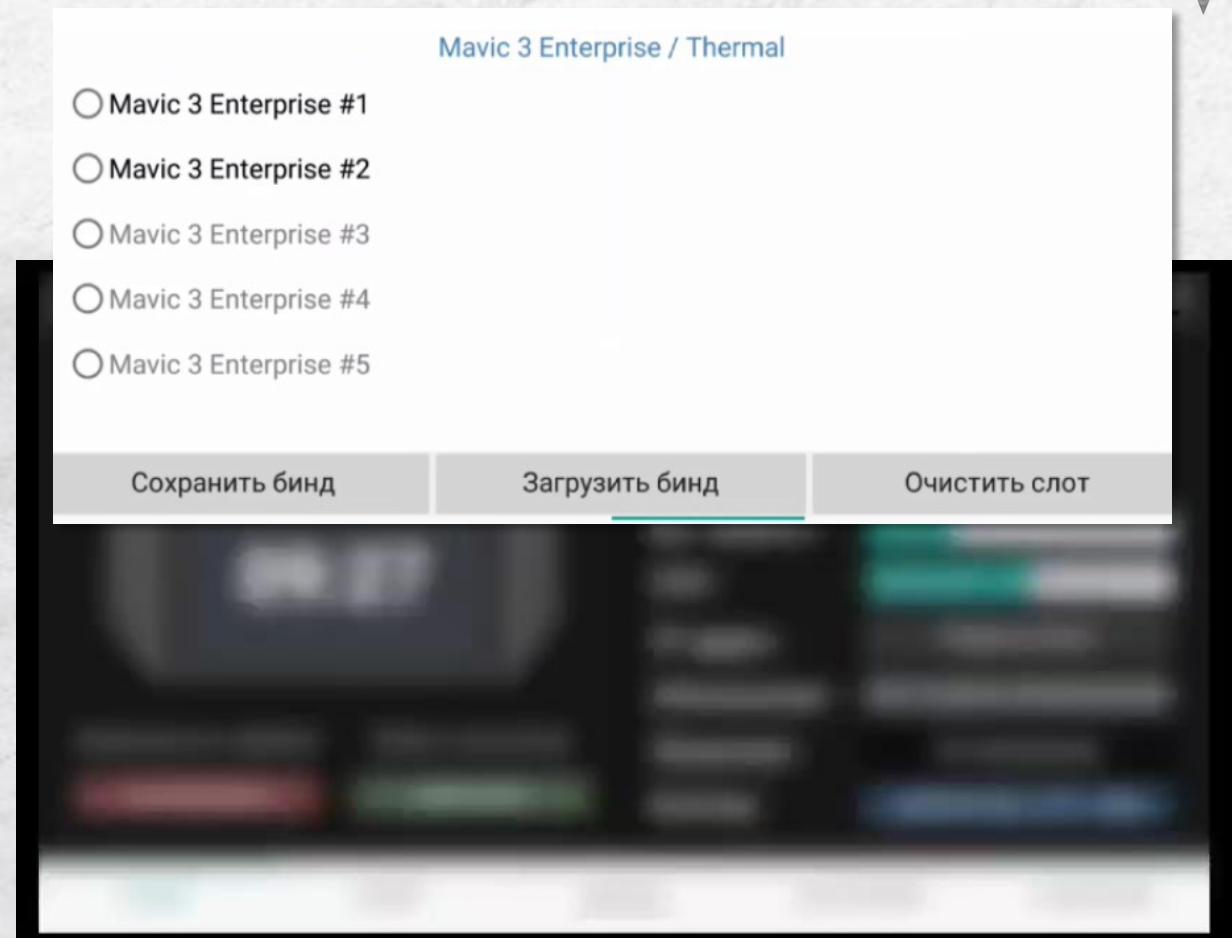


## Useful function COS COS 3.0

If the bind on the drone during flight fails and a black screen appears. In this case the following helps:

- Re-enter the Drones section on the remote with the COS software installed.
- Next, select Saved Drones and load the bind under the required number.

*It is very important to save the bind of the drone you are flying, so that in the case of the above described emergency situation it will be possible to reconnect and not lose it.*





## Remotes and flight applications

### Autel remotes and flight applications

Autel Robotics EVO Nano and Lite remote controls

Compatible drones:

- Autel EVO Nano
- Autel EVO Lite



Autel Robotics SE remote control

Compatible drones:

- EVO II Dual 640T
- EVO II Enterprise V3
- EVO II Pro V3
- EVO II RTK Series V3





## Remote controls and flight applications

### Autel remotes and flight applications

#### Autel Robotics V2 remote control

Compatible Drones:

- EVO II Enterprise
- EVO II RTK Series
- EVO II Series



#### Autel Robotics V3 remote control

Compatible drones:

- EVO II Dual 640T V3
- EVO II Enterprise V3
- EVO II Pro V3
- EVO II RTK Series V3
- EVO Max 4T
- Autel Alpha



#### Autel Explorer



#### - Autel Explorer



207  
(comma)



- UAV



- PATRIOT B3





# Remotes and flight applications

## Autel remotes and flight applications

**The remotes and smart controllers of different versions of drones are incompatible with each other at the hardware level.**

**Pairing between the two is impossible.**

- **The V1** remote control and smart controller is only compatible with the Autel Evo II **V1** drone
- Remote and Smart Controller **V2** is only compatible with Autel Evo II **V2** drone
- Remote control and smart controller **V3** compatible only with the Autel Evo II **V3** drone.

### Explanation of the appendices:

- **Autel Explorer** - for Autel Evo 1-2 drones.
  - for drone v1, the application version starts with v1.x.x.
  - for drone v2, the application version starts with v2.x.x.
  - for drone v3, the application version starts with v3.x.x.
- **AutelSky** - for Lite and Nano drones.
- **UAV** - for Autel EVO Max 4T drones.
- **UAV (comma)**- UCO's built-in drone app, the same Autel **Explorer**.





# Set of additional equipment and equipment for UAV calculation

1. Additional Batteries.
2. Chargers
3. Additional propellers.
4. Memory Cards.
5. A tablet or phone for flying with DJI RC-N1, DJI RC-N2.
6. Tablet or phone with AlpineQuest.
7. Monitor.
8. Signal amplifiers and remote antennas.
9. Dumps.
10. Gasoline generator.
11. Portable charging station, External batteries (PowerBank).
12. Drone detectors.





## Set of additional equipment and equipment for the UAV crew

### Optional DJI Battery Packs

#### DJI Mini 3 / Mini 3 Pro / Mini 4 Pro (Plus) Battery



Original Plus version battery for DJI Mini 3 series quadcopters, with a maximum flight time of 47 minutes for DJI Mini 3 Pro and 51 minutes for the DJI Mini 3 (measured at a constant speed of 21.6 km/h in windless conditions).  
Fits DJI Mini 4 Pro, with it the quadcopter flies up to 45 minutes.  
Capacity: 3850 mAh

For effective use, each copter should have a minimum of 5 batteries attached to it, more if possible. Fire correction requires a long stay in the air, moreover, a carousel, i.e. the group that performs this task should have 2 copters that change in the air. And there should be at least 5, and preferably 10-15 batteries for each of them. Also these batteries need to be charged, but the factory hub allows charging 3 batteries in series. Accordingly, for every 3 additional batteries there should be one more hub and power supply.

#### DJI Mavic 3 Battery

With a more capacious smart battery and a new efficient propulsion system, the DJI Mavic 3 has a maximum flight time of 46 minutes and a maximum hover time of 40 minutes.

Capacity: 5000 mAh  
Battery Type: LiPo 4S.

Original name: DJI Mavic 3 Intelligent Flight Battery





# Set of additional equipment and equipment for the UAV crew

## DJI Mavic 3 Reinforced Battery Packs



Fits Mavic 3 series  
7500 mAh, flight time 50 min.



With dual batteries the percentage of battery discharge on the screen has nothing to do with reality, you need to be guided by the voltage readings. A voltage of 3.7v is commensurate with 30%, 3.6 v is 10%.

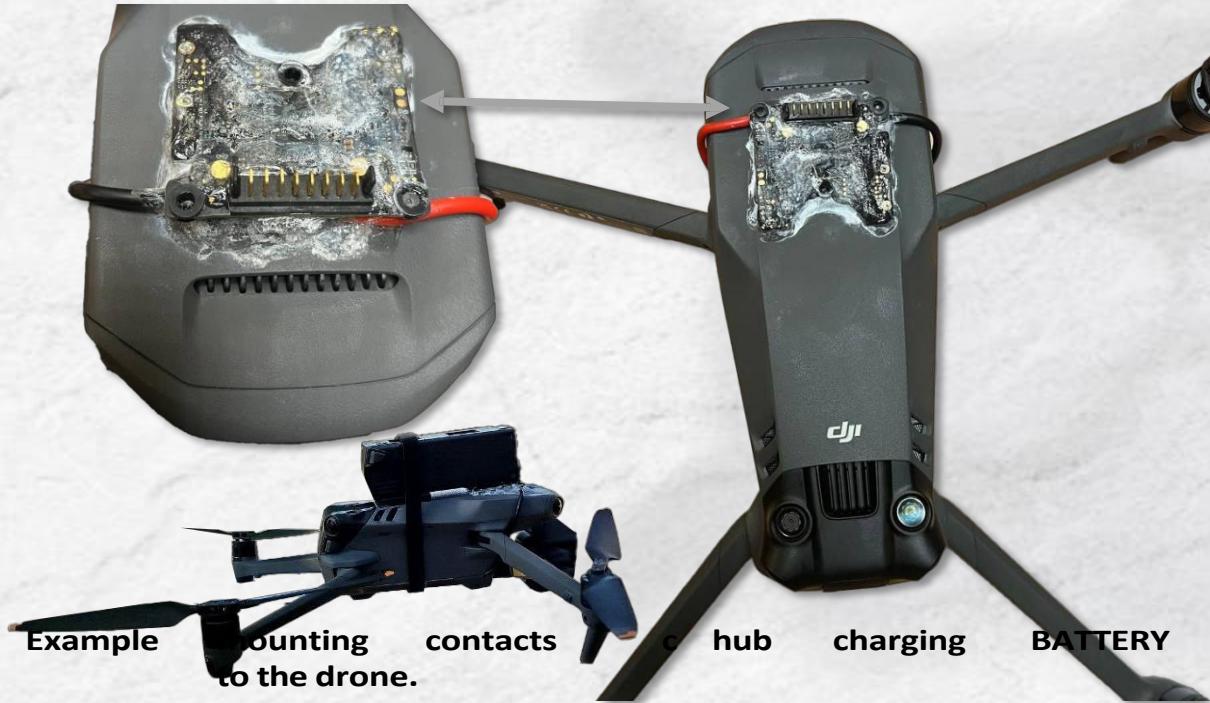
The original Mavic battery and its weight is selected for the most optimal efficiency of the drone. Additional batteries give a small increase in time and in turn increase the wear and tear on the drone's motors. *A balance of capacity and weight must be maintained.* When using dual batteries, place them on top of the drone to avoid covering the sensors and should be centered so that the load on the motors is even. Allow the motors to cool down after flight and do not gain altitude quickly after takeoff.





# Set of additional equipment and equipment for the UAV crew

## DJI Mavic 3 Reinforced Battery Packs



- Turn on the lower one, then the upper one.
- Turn it off after flight first then the bottom battery,

the top battery,

Example of attaching the second battery  
On the Mavic 3.





# Set of additional equipment and equipment for the UAV crew

## Optional DJI Battery Packs

### DJI TB30 Battery for DJI Matrice 30 Series

The TB30 smart battery can self-heat and has up to 400 charge cycles. Supports hot swapping of the battery, saving time when performing important tasks and ensuring uninterrupted flight operations.

Capacity: 5880 mAh

Compatible: DJI Matrice 30 Series Original Name: DJI Matrice 30 Series TB30 Intelligent Flight Battery



### WB37 Battery DJI CrystalSky, Cendence, FPV, DJI RC Plus (rm700), DJI Smart Controller Enterprise

Smart battery for CrystalSky monitor, remote control

Cendence controls, DJI RC Plus remote control (rm700).

Office hours:

- CrystalSky 7.85" display - 4-5 hours of operation
- CrystalSky 5.5" display - 5-6 hours of operation
- Cendence remote control - 4 hours of operation.
- DJI RC Plus (rm700) remote control - 4 hours of operation.

### TB60 Battery for DJI Matrice 300

The 5935 mAh TB60 battery provides the DJI Matrice 300 RTK with 55 minutes of unloaded flight time. It supports hot-swap function without shutting down the drone, which is extremely useful, especially for mission-critical tasks.

Compatibility: DJI Matrice 300 RTK

Original name: DJI Matrice 300 Series TB60 Intelligent Flight Battery





# Set of additional equipment and equipment for the UAV crew

## Autel optional battery packs

### Battery Autel EVO Lite / Lite+, CHAPPIE II

Original

smart  
battery  
for

Autel EVO Lite / Lite+ quadcopter. Consists of LiPo cells of high energy density. Provides up to 40 minutes of flight time.

Capacity: 6175 mAh.

Original name: Autel EVO Lite Series Battery



### Autel Evo II Battery



The 8070 mAh EVO Max 4T battery is a powerful 14.88V LiPo 4S battery that provides 42 minutes of flight time, has automatic self-heating at low temperatures, and supports hot swapping between flights to reduce downtime and take off as quickly as possible.

### Autel Evo II Battery

The original Autel EVO 2 smart battery consists of high energy density LiPo cells. The battery cells are made with Laminated Cell technology, so it can provide the quadcopter with 40 minutes of flight time.

Capacity: 7100 mAh.

Fits Autel EVO II Dual 640T V3, UCO special 1.





# Set of additional equipment and equipment for the UAV crew

## Tips for drone batteries

1. **Update the software.** The software versions of the batteries and the drone should match, and ideally the official software of the products should be updated to the latest version. If your drone has two batteries, all of the above applies to those two batteries. Conflicting software versions can result in your drone simply not taking off.
2. **Avoid extreme temperatures.** Extreme temperatures are the worst enemies of batteries. Do not use, charge or store drone batteries in temperatures outside the recommended range.
3. **Charge the batteries correctly.** DJI batteries are designed for use in DJI branded chargers. For this purpose, always choose a native charger - DJI charger for charging. Third-party chargers may have charging rates higher than 1C. While this will charge the battery faster - it will shorten battery and damage the battery cells. DJI chargers have a protection feature that ensures the charging process is at the correct temperature.
4. **Charging.** DJI specialists recommend waiting until the temperature inside the battery is suitable for charging, if the battery is overheated in hot weather, it will not charge. They won't charge in extreme cold either. If you don't need to recharge your drone's battery immediately, it's best to wait for it to cool down and then place it in the .
5. **Storage.** The ideal temperature for storing DJI batteries ranges from 22-30°C. It is highly recommended that you do not charge the batteries to 100% before putting them in storage. DJI smart batteries are automatically discharged to protect the integrity of the rechargeable cells. In most cases, you can set a time from 1 to 10 days in the app settings for the batteries to start self-discharging to 60%. If there is no such option in the app, the battery will do this by default in 10 days. If, however, the battery is below 40 to 60%, you will need to recharge it a bit to get the battery level at the required level for storage.



# Set of additional equipment and equipment for the UAV crew

## Tips for drone batteries

6. **Avoid complete discharge to 0%.** A battery that is too discharged is also vulnerable. It is always recommended to land the drone when the battery level is at least 15% to maximize battery life. If its charge level drops below 15%, try to put the battery on recharge as soon as possible.
7. **Use paired batteries together.** Some drones have dual batteries (e.g. Matrice 30T, Matrice 300 RTK), so put the same markings on each pair and only use both batteries from that pair together for both charging and operation. This will maximize battery life and positively affect the copter's flight quality.
8. **During cold weather, pre-warm the batteries.** Use a battery heater or turn on the battery power beforehand to warm up the battery to more than 15°C.
9. **Batteries should be replaced if:**
  - Visual inspection of the battery indicates that it is bloated, leaking, or damaged (cracks, dents, etc.).
  - The battery terminals are bent (this may cause a short circuit).
  - Presence of an in-app notification or pop-up that the battery cell is damaged or too low.
  - The battery has already gone through 200 charge cycles.  
The battery error is still present after repeating the standard charging and proper discharging procedure. Proper maintenance and storage will allow to expect 200 charge cycles per battery.
  - Accident or collision.



## Set of additional equipment and equipment for the UAV crew

### Mini 3, Mini 3 Pro, Mini 4 Pro chargers

#### DJI Mini / Mini 3 Pro / Mini 4 Pro 3-Battery Charging Hub

It has a charge function up to 60%, which is the optimal level for long-term storage. The red color of the LED above the button indicates charge mode up to 60%, green - up to 100%.

Charging time (PD 40W or higher):

- 2453 mAh (3 pcs.): 150 minutes (50 minutes per battery)
- 2453 mAh (2 pcs.): 100 minutes
- 2453 mAh (1 pc.): 50 minutes

- Mini 4 Pro battery (3 pcs.): 180 minutes (60 per battery)
- Mini 4 Pro battery (2 pcs.): 120 minutes
- Mini 4 Pro battery (1 pc.): 60 minutes

- 3850 mAh (3 pcs.): 225 minutes (75 minutes per battery)
- 3850 mAh (2 pcs.): 150 minutes
- 3850 mAh (1 pc.): 75 minutes





# Set of additional equipment and equipment for the UAV crew

## Mini 3, Mini 3 Pro, Mini 4 Pro chargers

### DJI Mini 3, Mini 3 Pro, Mini 4 Pro 4 Battery Charging Hub (LCD Display) (YX)

It has 2 modes of operation: charging up to 100% and up to 60% (LiPo battery storage charge). It is powered via USB Type-C port.

The ports are categorized into 2 groups: CH1+CH3 and CH2+CH4. Within the groups, the batteries are charged in series, so if you need to charge 2 batteries in parallel, you need to insert them into the ports of different groups.

Charging time:

- 2 standard batteries (2453 mAh): 50 minutes
- 2 Plus version batteries (3850 mAh): 67 minutes
- 4 standard batteries (2453 mAh): 100 minutes
- 4 Plus version batteries (3850 mAh): 135 minutes



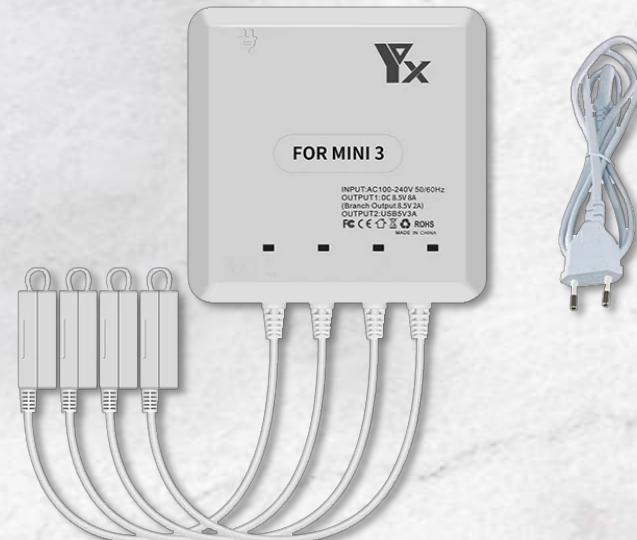
### DJI 4 Battery Charger

### Mini 3, Mini 3 Pro, Mini 4 Pro (YX)

Charger for 4 DJI Mini 3 / Mini 3 Pro / 4 Pro batteries, remote control and smartphone from YX. It has 2 USB ports and 4 battery charging outputs.

Time for full simultaneous charging of 4 batteries:

- 2453 mAh batteries: approximately 70 minutes
- 3850 mAh batteries: approximately 110 minutes





# Set of additional equipment and equipment for the UAV crew

## Mavic 3, Mavic 3 PRO, Mavic 3E, Mavic 3T Battery Chargers

### DJI Mavic 3 Battery Charging Hub

The battery charging concentrator improves efficiency by sequentially charging the batteries according to their remaining charge level, with the more fully charged batteries first. Charging time approx. 1 hour 36 minutes (per battery).

### Multifunctional charger

#### DJI Mavic 3 (YX)

Thanks to the included hub, you can use the batteries as a powerbank and charge your mobile devices or, for example, your remote control. Also included in the kit comes with a discharge device, the level to which the batteries will be discharged is customizable.

Charges three batteries in 150 min, two - for 100 minutes.



### DJI Mavic 3 3-Battery Charging Hub (CYNOVA)

The 200W power will provide fast and efficient charging of three quadcopter batteries at once. There is a mode of switching the batteries to storage mode (charging up to 60%). Provided protection against overcharging batteries, from overheating, short circuit, overcurrent and overvoltage. You can use the hub with the battery installed in it as a powerbank.

Charge time:

- 1 battery: approx. 60-70 min.
- 2 batteries: approx. 70-80 min.
- 3 batteries: approx. 80-90 min.





# Set of additional equipment and equipment for the UAV crew

## Mavic 3, Mavic 3 PRO, Mavic 3E, Mavic 3T Battery Chargers

### DJI Mavic 3 (YX) 3-Battery Charger

Charger for 3 batteries and DJI Mavic 3 remote and any mobile device via USB ports. Charges 3 of the battery in about 90 minutes.



### Car charger for 2 batteries and DJI Mavic 3 remote control (YX)

Allows you to charge 2 batteries, a remote control and a mobile device. The charger has 4 types of protection: overcharge, short circuit, overvoltage, overheating.

Charging time:

- one battery: about 90 minutes
- two batteries: about 100 minutes



DJI Mavic 3 Charger (With Display) (YX) Charger for 4 batteries and DJI remote Mavic 3 and any mobile device.

via USB ports. There is a separate mode, designed to prepare batteries for long-term storage (in this mode batteries are charged by 40-60%).

There is also protection against over-voltage, over-current, short-circuit and battery overcharge.

Charging time: it takes about 150 minutes to fully charge 4 batteries.





## Set of additional equipment and equipment for the UAV crew

### DJI MATRICE 30 SERIES, DJI MATRICE 300 Battery Chargers

#### DJI MATRICE 30 SERIES BS30 DJI MATRICE 30 Series Smart Charging Station

The BS30 battery station is designed for the serial pair recharging of 8 TV30 batteries for DJI Matrice series quadcopter 30 and 2 WB37 batteries for the quadcopter remote control. The charging station also supports standby and storage modes.

Charging time: 30 min (charging two TB30 batteries from 20% to 90%).  
Approx. 50 min (charging two TB30 batteries from 0% to 100%).



#### Battery charging station

#### Intelligent Battery BS60

The charging station has a total of 12 battery ports and can charge up to eight TB60 Intelligent Flight Battery and four WB37 Intelligent Battery batteries. It simultaneously charges four drone batteries and four controller batteries. It takes approximately 60 minutes to fully charge two TB60 Intelligent Flight Batteries and 30 minutes to charge them to 20 to 90 percent capacity.





## Set of additional equipment and equipment for the UAV crew

### Autel EVO Lite+, CHAPPIE II battery chargers

Autel Robotics EVO Lite Series Power Adapter  
for Lite/Lite+ drones

The Autel EVO Lite charger/power adapter can charge the EVO Lite battery and has a USB-A port to connect the remote control's charging cable so that both devices can be charged at the same time.



Autel Robotics EVO Lite Multi-Charger  
for EVO Lite/ Lite+

The Autel EVO Lite Multi-Charger Battery Hub is a compact strip that can charge up to 3 Lite batteries in series. It is compatible with Autel EVO Lite/ EVO Lite+ batteries.

Charging time (3 batteries): 4.5 hours.





# Set of additional equipment and equipment for the UAV crew

## Battery chargers Autel EVO II Dual 640T V3, UCO special 1

Charging hub for Autel Evo 2 batteries,

Autel EVO II Dual 640T V3, UCO special 1 Charging

concentrator for Autel Robotics EVO II

allows you to simultaneously charge up to 4 EVO batteries using a standard EVO II battery charger.

Two modes charging: simultaneous charging and alternate charging.

Reference charging time (4 batteries): 5.5 h.



Parallel charging mode. The charging process starts from the lowest battery charge, at the same power level the batteries are charged simultaneously.



Mode sequential charging. The batteries will be charged sequentially according to their power level, from high to low.

charging

Charger for 3 Autel Evo II batteries, remote control and mobile device (YX) Charger 3 capable of charge

rechargeable batteries and remote control at the same time, an additional USB port can be used to charge your cell phone. A full charge of three batteries takes approx.

80 minutes. The built-in cooling fan and automatic overheat protection system help control temperature and protect your charger from overloading.





# Set of additional equipment and equipment for the UAV crew

## Autel EVO Max 4T battery chargers

Charger and cable for  
Autel EVO Max 4T battery

Battery Charger All of these ensure that your Autel EVO Max 4T device's battery is charged safely and efficiently.

Reference charging time (1 battery): 80 minutes



Charging hub on Autel Max 4T

Charger                    charger,                    designed                    for  
Autel Evo Max 4T quadcopters. Capable of charging up to three batteries  
and remote control at the same time.  
Charging time for one battery: approximately 60-70 minutes Charging time  
for two or three batteries: 100-110 minutes





# Set of additional equipment and equipment for the UAV crew

## Additional propellers



Carbon for  
DJI mavic 3



Low noise propellers for DJI Mavic  
3

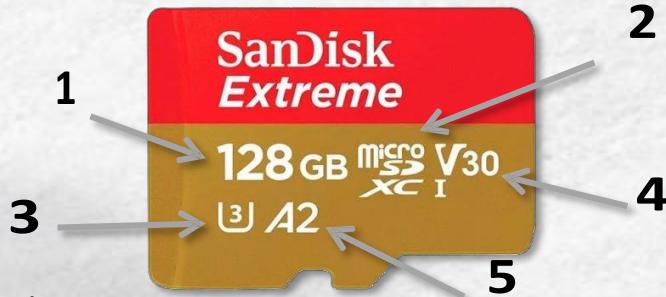
DJI Mavic 3 Enterprise Series Propellers



Matrice 30 Series Propellers

It is recommended to use only original propellers and always carry a stock of at least 4 pairs of propellers. If a propeller is damaged or missing the orange mark, it must be replaced, as this can lead to an emergency situation and rapid wear of the motors.

## Memory cards



1. Memory card capacity;
2. Card Format;
3. UHS class is the minimum guaranteed write rate for video (U1 -10 MB/s, U3-30 MB/s);
4. Class V card is the minimum guaranteed recording rate for video (V10- 10MB/s - FullHD, V30- 30MB/s - 4k, V60-60MB/s - 8k,);
5. Smartphone compatibility.
  - It is recommended to choose memory cards with UHS-I U3 speed class or higher, video recording speed V30 or higher.
  - Remember to format the SD card to the appropriate file system (FAT32 or exFAT).
  - Have 2-3 pcs with you and do not insert into untested devices as they may format the card.



# Set of additional equipment and equipment for the UAV crew

## Tablet or phone for flying with DJI RC-N1, DJI RC-N2 remote control

To work with DJI RC-N1, DJI RC-N2 remote control you need devices for the operator - phone or tablet. One priority is screen brightness, operators work in the light. The other is security, so everything Apple does should be left behind. The optimal solution for a **smartphone** - **Redmi 11** and analogs. **Tablet** - **Xiaomi Mi Pad 5** and analogs, which does not have a GPS module, which increases the security of the operator. The minimum required is at least a smartphone. Ideally - both phone and tablet, as the pilot has different tasks - sometimes mobility is a priority. For a tablet you need a **holder** and a good long **Type-C to Type-C cable**, on which you should not save money either, it is fraught with loss of signal. It is better to have 3-5 Type-C - Type-C cables of quality standard USB 2.0 or USB 3.0 (**not USB 3.1, 3.2**) with length 30-100cm. Be sure to equip smartphone-tablet with a matte anti-reflective hydrogel film.





# Set of additional equipment and equipment for the UAV crew

## Tablet or phone with AlpineQuest

In addition to device for work c  
The DJI RC-N1, DJI RC-N2 remote control requires a tablet or phone with orientation and exploration software.

For example: AlpineQuest, ZOV Maps.

## Monitor

On the small screen of a drone remote, tablet and even more so on a phone, it is difficult to see small, low-visibility and camouflaged objects.  
It is recommended to use portable monitors that can be powered by an external battery (PowerBank). It is also necessary to have several cords for image transmission from the remote control (Type-C - Type-C, HDMI - mini HDMI, HDMI - , mini HDMI - HDMI).  
For example: ARZOPA, PORPOISE, BlitzWolf, UPERFECT with a diagonal larger than 15.6-inch.





## Set of additional equipment and equipment for the UAV crew

### Dumps



system dumping system selected based on the basis of type of ammunition and of the drone that will be used. **Drops can be:** universal; for dropping VOG-17 and others; for RGD-5 and F-1 grenades; for dropping OFSP-0.5; KZSP-0.5; for dropping PFM-1S mines. The most suitable and widespread drone for dumping Mavic 3 и its modifications, recommended load capacity not more than 600 g. For dumping suitable UCO S1 recommended load capacity not more than 800 gr.

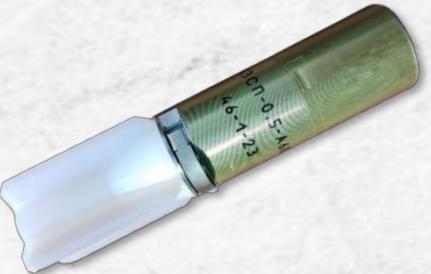
It is recommended that the ammo dump does not overlap the drone's sensors, then it will not go into ATTI mode.



# A set of additional equipment and supplies

## UAV calculations

### Ammunition used for dumping



**KZSP-0.5**

Weight in transport position, kg	0,515
Weight of the field installation for dumping, kg	0,490
Length, mm	213,5
Body diameter, mm	48
Minimum discharge height, m	25
Fuse detonation time, s	1-2



**OFSP-0.5**

Weight in transport position, kg	0,515
Weight of the field installation for dumping, kg	0,490
Length, mm	190
Body diameter, mm	48
Minimum discharge height, m	30
Fuse detonation time, s	1-2



Shot weight, kg	0,350
Grenade weight, kg	0,280
Length (without shank and of the lug), mm	132
Body diameter, mm	32



**VOG-25P**

Shot weight, kg	0,275
Weight of explosives, kg	0,042
Length (without shank and of the lug), mm	122
Body diameter, mm	40



**PFM-1C**

Weight, kg	0,08
Dimensions, mm	119x64x20
Actuation force, KGs	5 to 25
Self-destruction time, h	1 to 40

**Special gas grenade K-51**

Weight, kg	0,350
Length, mm	155
Body diameter, mm	58



**Φ-1**

Weight, kg	0,600
Length, mm	117
Body diameter, mm	55



**RGD-5**

Weight, kg	0,310
Length, mm	117
Body diameter, mm	58





# A set of additional equipment and supplies

## UAV calculations

### Gasoline generator

It is recommended to use an inverter with a power of about 3 KW. Lightweight, compact, economical mode of operation, and also generates electricity of high quality, which allows you to connect to it sensitive the quality of the incoming current electronic equipment.



### Portable charging station, external batteries (PowerBank)

It is necessary have portable charging stations with two 220 volt sockets, power from 2000 W.

If you need to move around, you can use smaller charging stations with 12 volt connectors.

Always have multiple PowerBanks to charge remotes and gadgets c with fast charging support and at least 30 watts of power.



Portable charger  
Romoss RS1000 station



Portable charger  
TopON TOP-X100



Romoss Sense 8PS  
Pro



# Set of additional equipment and equipment for the UAV crew

## Signal amplifiers and remote antennas. Basic concepts and provisions.

**An antenna radiation pattern** is a graphical representation of the dependence of antenna gain or antenna directivity on the direction of the antenna in a given plane.

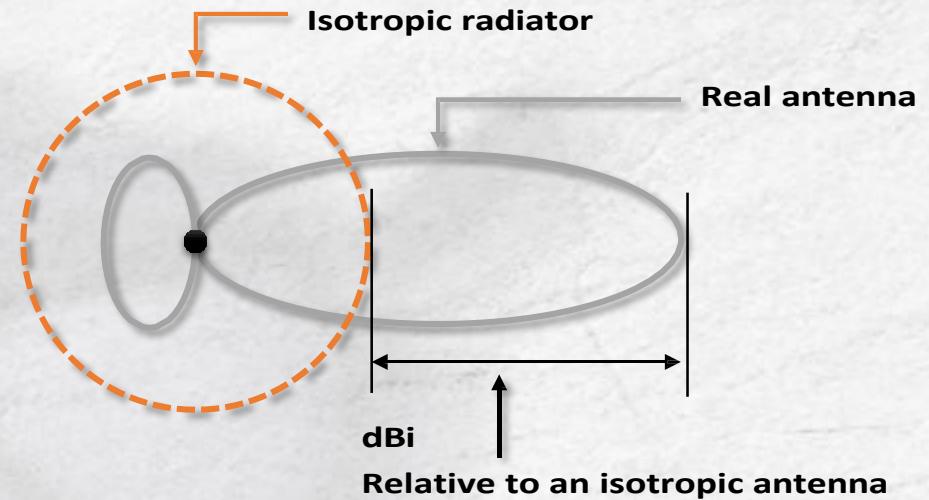
**dB<sub>i</sub> (Russian dBi)** - isotropic decibel (decibel relative to an isotropic radiator). It shows the signal power gain relative to an ideal isotropic antenna. An isotropic antenna radiates perfectly throughout the entire range of the signal. That is, it has a perfectly circular signal propagation sphere, where the signal goes in all directions with equal strength.

**Specific attenuation** is a value that characterizes the loss of signal level when it passes through one meter of cable. It allows you to compare cables of different brands.

The attenuation is greater the longer the cable length and the higher the signal frequency.

Specific attenuation is measured in decibels per meter (dB/m).

**It is recommended to use LMR-400 ultraflex coaxial cable as an extension cord, they last longer and are easier to coil/uncoil.**



**Alientech DUO 2/DUO 3  
Series Coaxial Extension Cable  
- 8 meters RG-8**

1 meter:	2.4G=1.23 dB	5.8G=1.8 dB
2 meters:	.4G=1.62 dB	5.8G=2.4 dB
3 meters:	2.4G=2.43dB	5.8G=3.6dB
4 meters:	2.4G=3.24 dB	5.8G=4.8 dB
5 meters:	2.4G=4.07 dB	5.8G=6.01 dB
6 meters:	2.4G=4.89 dB	5.8G=7.2 dB
7 meters:	2.4G=5.7 dB	5.8G=8.4 dB
8 meters:	2.4G=6.52 dB	5.8G=9.6 dB



## Set of additional equipment and equipment for the UAV crew

### 4hawks Raptor XR antenna.



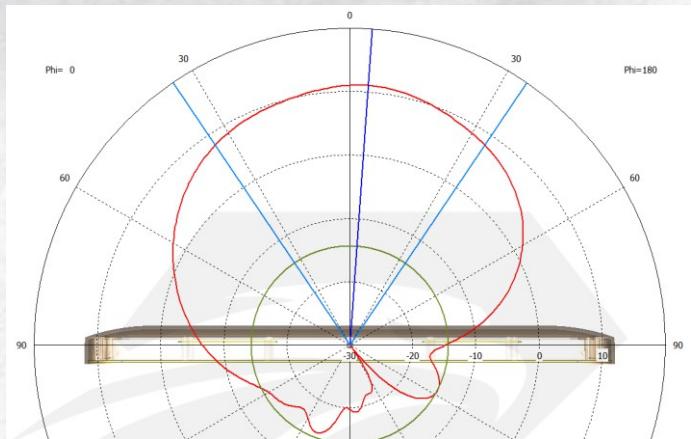
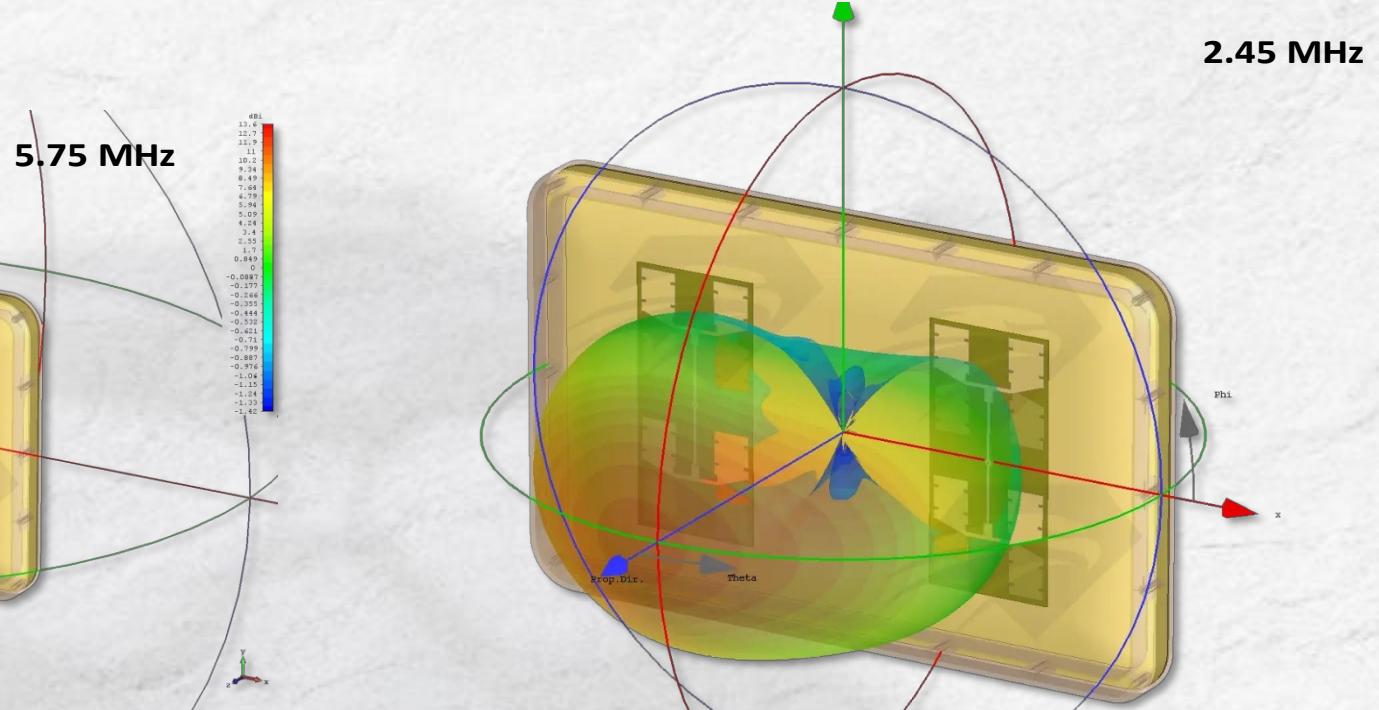
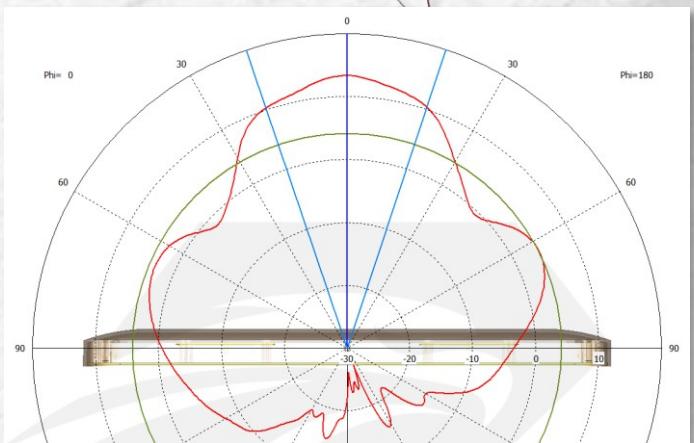
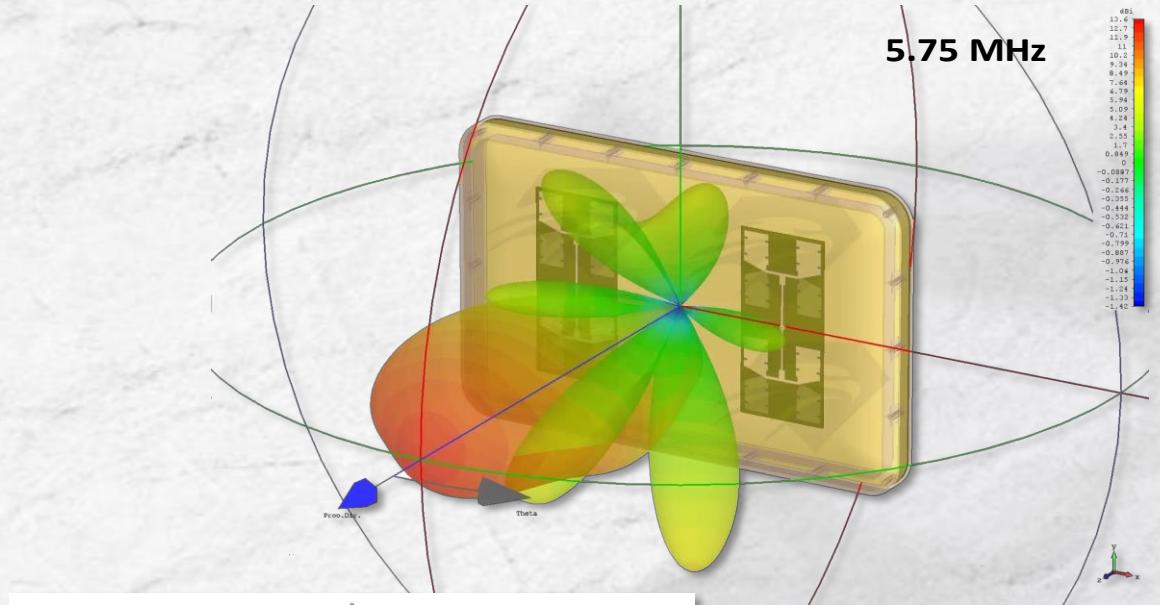
4Hawks antenna for DJI models, works on both 2.4 GHz and 5 GHz frequencies. It is not a signal amplifier, it works as an antenna. The entire construction is 100% UV protected, which ensures the durability of the equipment. In addition, part of the construction is made of aluminum to make the whole structure as lightweight as possible. The mount is made of stainless steel for reliable stability.

- Operating frequency - 2.40 - 2.50 GHz and 5.00 - 5.80 GHz
- Operating angles - 70°/40° and 40°/25°
- Polarization - Linear
- Antenna gain - 2.4G - 11dB±1; 5.8G - 14dB±1.
- Impedance - 50 Ω
- Weight - 520g (antenna 450g+ mount 70g)



# Set of additional equipment and equipment for the UAV crew

4hawks Raptor XR antenna.



dbI
11.3
10.6
9.88
9.17
8.47
7.76
7.06
6.35
5.65
4.95
4.23
3.53
2.82
2.12
1.41
0.706
0
-1.79
-3.59
-5.38
-7.18
-8.97
-10.8
-12.6
-14.4
-16.1
-17.9
-19.7
-21.5
-23.3
-25.1
-26.9
-28.7





# Set of additional equipment and equipment for the UAV crew

## Signal amplifiers and remote antennas

### Alientech DUO II signal amplifier



- Dual-band operation: 2.4G and 5.8G
- Operating frequency range: 2400-24835 GHz / 5.725-5.850 GHz
- Antenna Gain: 2.4G>13 dBi±1 / 5.8G>15 dBi±1
- Antenna horizontal half-radius angle: 65-84°
- Antenna vertical half angle: 63-75°
- Reception gain: 10 dB±1
- Transmission gain: 15 dB±1
- Input power range: 10-20 dBm
- Battery voltage and capacity: 3.7 V 2800 mAh



The Alientech Duo II and Duo 3 signal booster is an amplifier for DJI and Autel drone users that greatly improves the signal quality between the remote control and the drone.

### Alientech Duo 3 signal amplifier



- Tri-band compatibility: 2.4G, 5.2G and 5.8G
- Frequency ranges: 2400-24835 MHz, 5.150-5.850 MHz
- Operating voltage: 6-9 V
- Antenna gain: 2.4G>13 dBi±1 / 5G>15 dBi±1
- Antenna horizontal half-radius angle: 65-84°
- Antenna vertical half angle: 63-75°
- 2.4G reception gain: 12 dB±1
- 5.2G and 5.8G reception gain: 15 dB±1
- Transmitter coefficient: 15 dB±1
- Input power range: 10-25 dBm
- Battery: 3.7 V, 3000 mAh

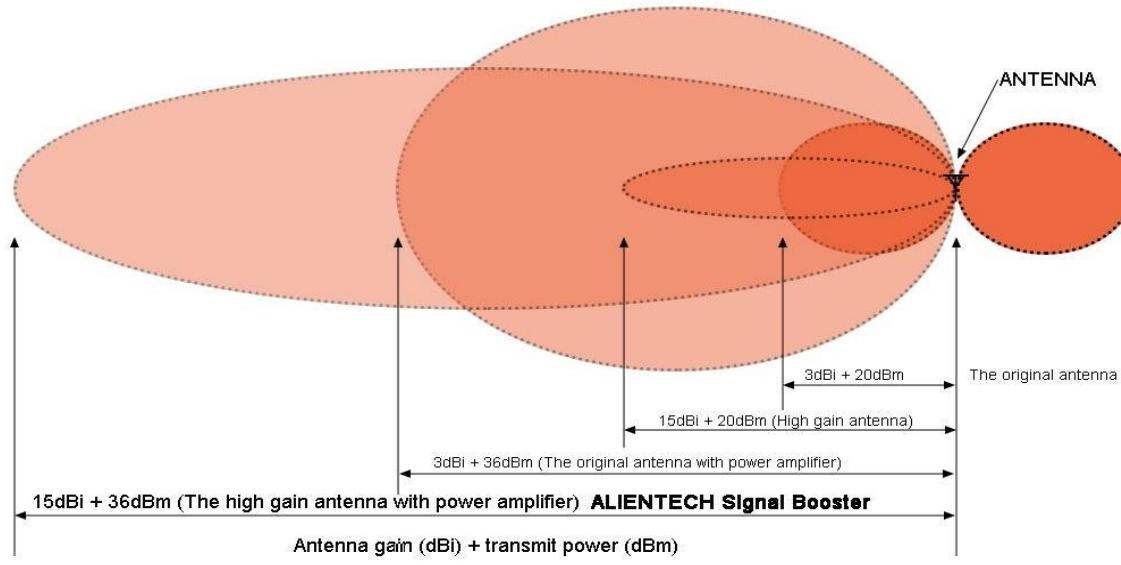


# Set of additional equipment and equipment for the UAV crew

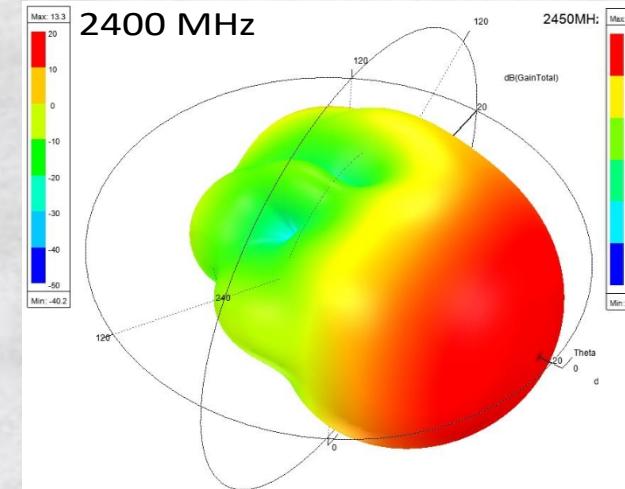
## Signal amplifiers and remote antennas

Alientech DUO II

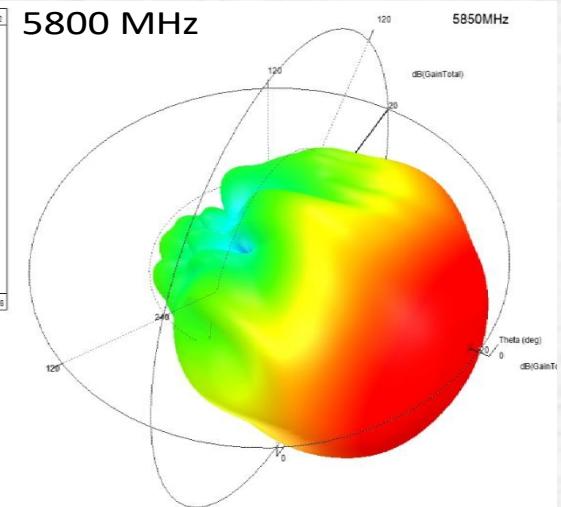
Radiation pattern  
излученности направленности



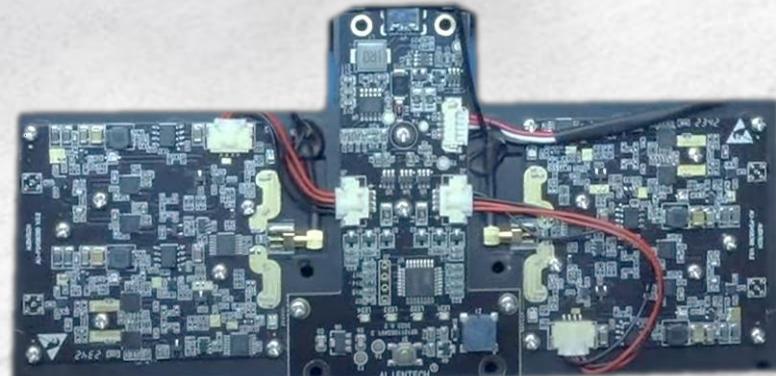
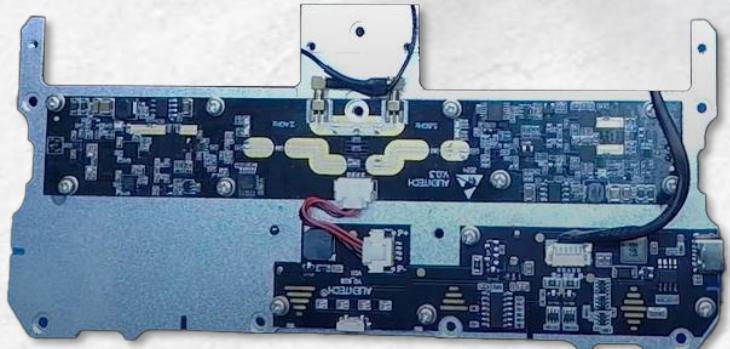
2400 MHz



5800 MHz



Alientech Duo 3





## Set of additional equipment and equipment for the UAV crew

### Alientech DUO II and 3 signal amplifiers



- The Alientech Duo II and Duo 3 signal amplifier can be used on the remote. However, it is not recommended to use thin coaxial wires such as RG-58, as well as the recommended wire length should not exceed 10 meters.
- Alientech Duo II and Duo 3 due to their small size and weight are more suitable for use directly on the remote than on the remote.





## **Set of additional equipment and equipment for the UAV crew**

## **Acasom ROC-2 signal amplifiers**



- Frequency range - 2400-2500 MHz, 5150-5850 MHz
  - Maximum output power - 37 dBm (5 W)
  - Antenna gain - 13 dB $\pm$ 1(2.4); 18 dB $\pm$ 15.8)
  - Battery capacity - 5000 mAh
  - Transmission gain -18 dB $\pm$ 1(2.4); 18 dB $\pm$ 1 5.8)
  - Net weight - 0.43 kg



## Set of additional equipment and equipment for the UAV crew

### AvengeAngel ANT-MAN signal amplifiers



AvengeAngel ANT-MAN 2.4G, 5.2G, 5.8G tri-band signal booster, improves antenna performance for DJI drones, powerful dual amplifier. Built-in lithium battery, portable drone range extender antenna, continuous operation for 5 hours. Similar in characteristics and dimensions to the Alientech DUO 3 signal antenna.

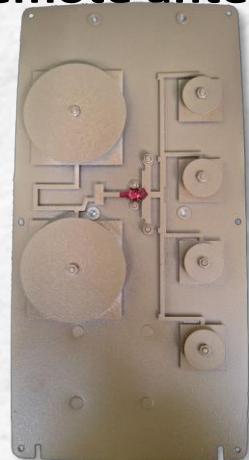
- The operating frequency is 2400-2500 MHz 5000-5875 MHz.
- The output power is a 5 watt tri-band amplifier.
- Operating angles - horizontally 65 degrees, vertically 20°
- Transmission gain is 18 to 20dB.
- Antenna gain - 2.4G - 13dBi±1; 5.8G - 15dBi±1.
- The battery voltage and capacity is 7.4V, 1500 mAh.
- LCD screen function - Displays the battery level.



# A set of additional equipment and supplies

## UAV calculations

### VIGOR UAV remote antenna



Dual band amplifier  
Wi-Fi 2.4 GHz and 5.8 GHz EDUB



The device is designed to amplify the signal of the **DJI Mavic** UAV remote control and drones of other manufacturers. Works with copters in the civilian frequency bands 2.4 and 5.2, 5.8 GHz. With the directional remote antenna and booster increases the range of communication and resistance to REB means.

**The main task** of the device is to protect the UAV operator from being hit by shrapnel. This is achieved by moving the console antenna out to 22 meters. The operator works from a shelter (basement, dugout, trench). Resistance to REB equipment is achieved by increasing the signal level at the copter's receiver input. Two bands allow you to retain control if one band is suppressed.

Range - 2.4 GHz, 5.2, 5.8

Operating frequency range and power:

2400 - 2500 MHz, 2 watts,

5150 to 5850 MHz, 2 watts.

Battery life not less than - 24 hours Battery - 3 Ah, 12 V (Li-Ion 3S1P)

Flight sector - horizontal 70°, vertical 20° Antenna gain - 2.4G-11 dBi,

5.8G-14 dBi Dimensions - 280x150x80 mm

Weight max - 2 kg



## Set of additional equipment and equipment for the UAV crew

### Acasom ROC-4 signal amplifiers



Dual band amplifier  
Wi-Fi 2.4 GHz and 5.8 GHz EDUB



ROC-4 2.4G/5.8G, 10W, 8000mAh, dual-band signal booster, antenna range extender, remote control for DJI Mavic 3, 3T, Matrix 30T and Autel quadcopters.

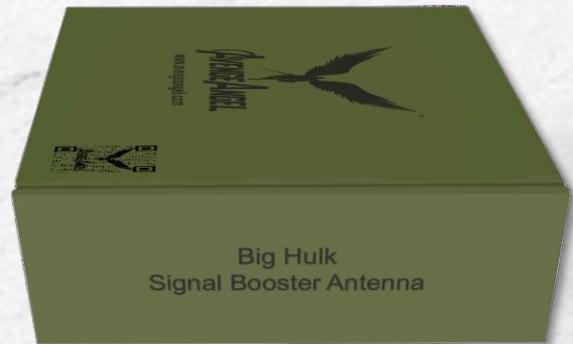
It can be used both directly with the remote control and on the remote control. Due to its large size and weight, it is recommended to use the remote control. It is not recommended to use thin coaxial wires such as RG-58. Minimum attenuation on coaxial wires 8D-FB, LMR-400 and their analogs. The length of the wire should not exceed 20 meters. If the length is longer, the signal transmission may deteriorate.

- Frequency range - 2400-2500MHz, 5150-5850MHz
- Maximum output power 40 dBm (10 W)
- Antenna gain - 15 dB±1(2.4); 18 dB±1 5.8)
- The battery capacity is 8000 mAh
- Transmission gain -18 dB±1(2.4); 18 dB±1 5.8)



## Set of additional equipment and equipment for the UAV crew

### AvengeAngel Big Hulk signal amplifier



AvengeAngel Big Hulk 2.4G/5.8G dual-band signal booster, is a remote antenna designed specifically for quadcopters, the most powerful dual-band booster. IPX68 waterproof, built-in lithium battery provides continuous operation for 8 hours. Complete with tripod and 20 meters cable assembly.

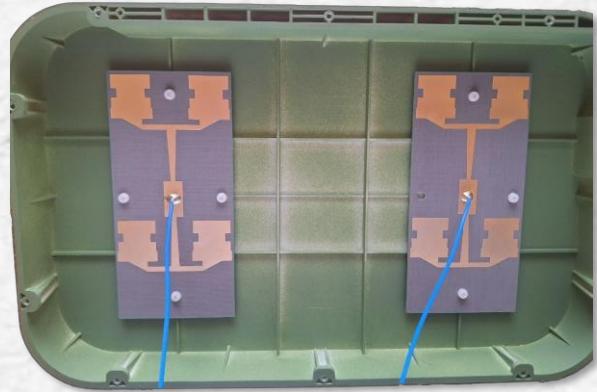
Newer model AvengeAngel Big Hulk plus 2.4G, 5.2G, 5.8G tri-band signal booster.

- The operating frequency is 2400-2500 MHz 5000-5875 MHz.
- Output power - two dual band power amplifiers (4W per channel)
- Operating angles - horizontally 65 degrees, vertically 20°
- The transmission gain is 20~22 dB.
- Antenna gain - 2.4G - 15dB±1; 5.8G - 18dB±1.
- The battery voltage and capacity is 7.4V, 5000 mAh.
- LCD screen function - Displays the battery level.
- Weight - 1680 g.

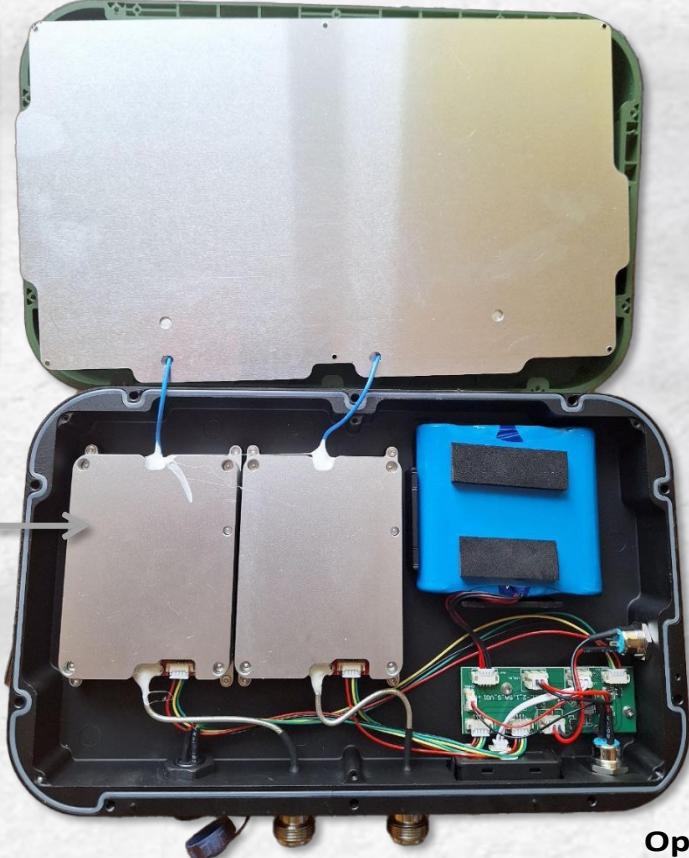


# Set of additional equipment and equipment for the UAV crew

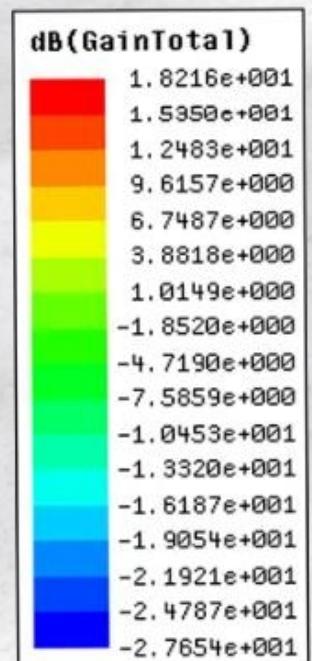
## AvengeAngel Big Hulk signal amplifier



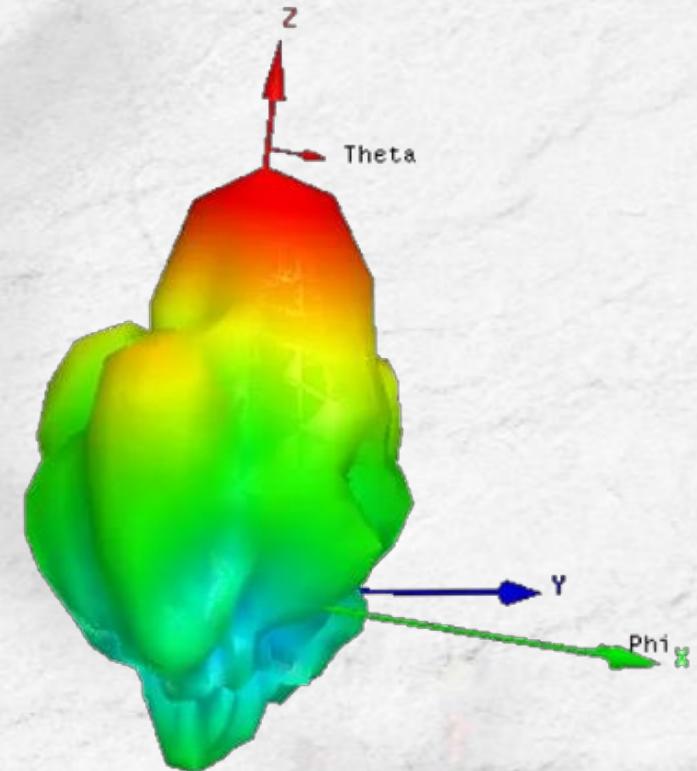
**Sunhans signal amplifier  
Duan-Band 2.4G&5.8g**



Radiation pattern



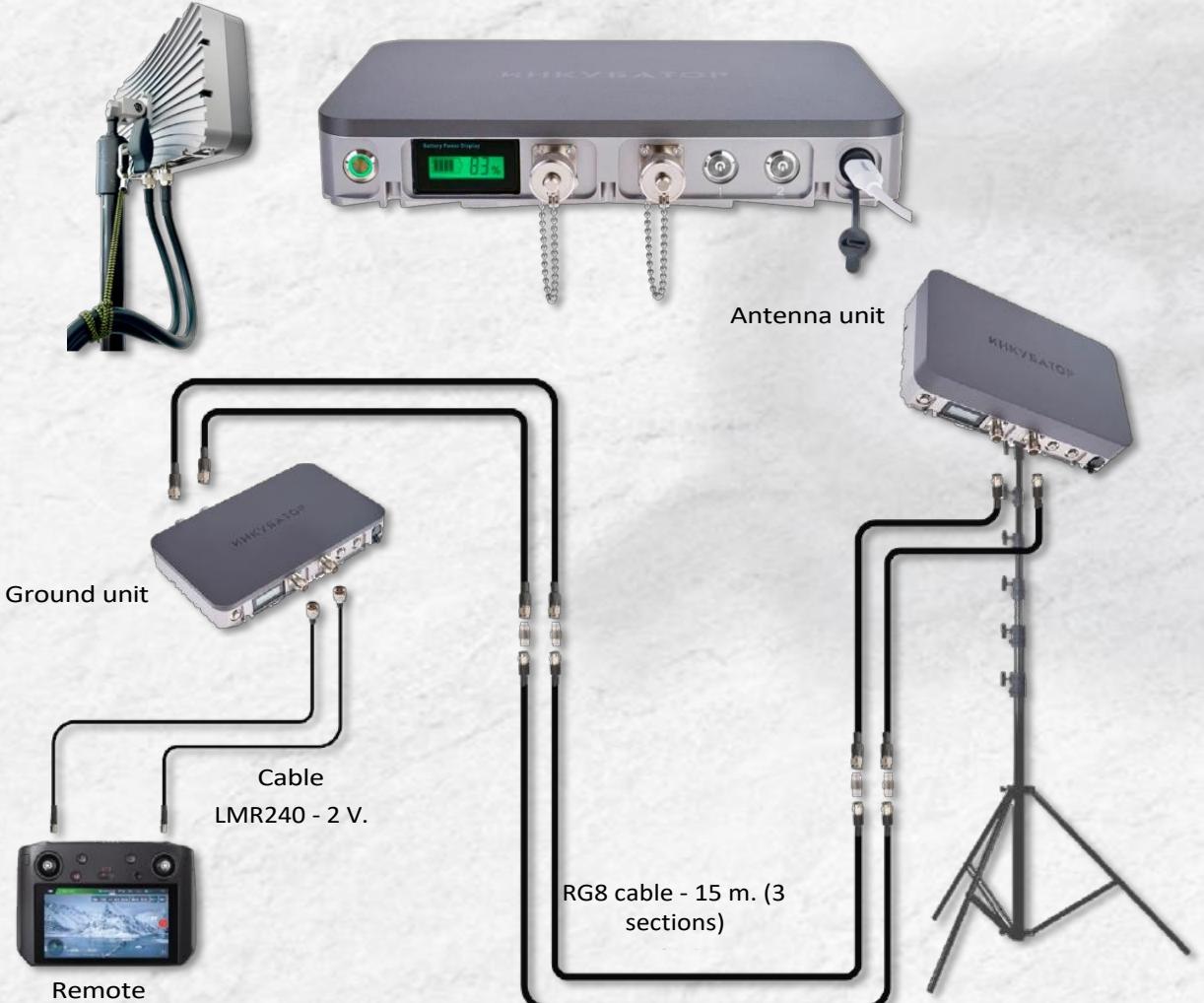
Operating angles - horizontally 65 degrees, vertically 20°





# Set of additional equipment and equipment for the UAV crew

## Signal Amplifier Incubator 2.0



Remote antenna for DJI, UCO, Autel drones. The kit includes a remote up to 45 meters with simultaneous signal amplification on 2.4~2.5GHz, 5.0~5.8GHz bands. This allows you to work from a shelter (dugout, basement, etc.), increase the stability of the communication at the expense of due to four dual-band amplifiers и make the drone's control more robust in an EMP environment. AvengeAngel Big Hulk analog.

Operating frequency - 2400-2500 MHz 5000-5875 MHz. Output power - two dual-band power amplifiers (4W per channel)

Angles of operation - 2.4GHz up 76 °, vert. 66 °, 5.8GHz mountain 26 °, vert. 28 °. Within a radius of up to 2 km confident reception in any direction

- The transmission gain is 20~22 dB.
- Antenna gain - 2.4G - 15dB±1; 5.8G - 18dB±1. Battery voltage and capacity - 7.4V, 6400 mAh. Continuous operation time - up to 15 hours
- LCD screen function - Displays the battery charge level. Cables - 6 interchangeable segments of 15 meter RG8/U 50 OHM coaxial cable with N (male) connectors.
- 
- 
- 
- 
-



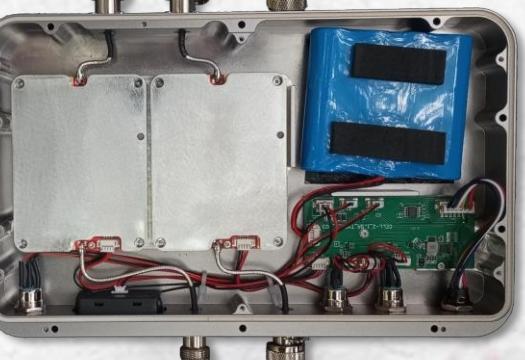
# Set of additional equipment and equipment for the UAV crew

## Signal Amplifier Incubator 2.0



Antenna unit

Диаграмма излучения  
radiation pattern  
similar to AvengeAngel Big Hulk.



Ground unit



# Set of additional equipment and equipment for the UAV crew

## Comparison of Avenge Angel Big Hulk, Acasom ROC-4 and Incubator 2.0 amplifiers

### *user measurements*

Parameter	Avenger Angel Big Hulk	Acasom ROC-4	Incubator 2.0 Antenna	Incubator 2.0 ground unit	Parameter	Avenger Angel Big Hulk	Acasom ROC-4	Incubator 2.0 Antenna	Incubator 2.0 ground unit
Receive gain in line mode, dB									
2.4 GHz	11,5	7,3	10,0	10,1	Transmission power, W				
5.2 GHz	11,0	13,6	13,0	13,0	2.4 GHz	2,3	4	2,5	2,5
5.8 GHz	14,4	11,0	13,8	13,8	5.2 GHz	1,1	-	0,8	0,8
Noise figure in receive mode, dB									
2.4 GHz	3,7	2,9	3,5	3,5	5.8 GHz	1,2	-	1,3	1,3
5.2 GHz	4,9	3,9	4,7	4,7	Losses in standard cable (outstation), dB				
5.8 GHz	5,1	5,3	4,5	4,5	2.4 GHz	5,1 (20 м)	-	11,1 (3*15M)	-
Transmission gain in linear mode, dB									
2.4 GHz	21,9	15,6	19,4	18,7	5.2 GHz	8,1 (20 м)	-	17,3 (3*15M)	-
5.2 GHz	13,0	18,6	13,6	10,6	5.8 GHz	8,4(20 м)	-	18,2 (3*15M)	-
5.8 GHz	15,7	17,2	19,2	18,6	Dust and moisture protection level				
						IP65	IP50	IP64	IP64

- All three devices share a similar concept and structural layout, and use the same antennas, and AvengeAngel BigHulk and Incubator 2. and the same amplifiers.
- The ROC-4 device exhibits potentially higher gain (Ksh) and higher output power (up to 4 W at 2.4 GHz in some cases), as well as more uniform gain (Kp).
- Incubator 2.0 does not meet the withering IP67 standard. If we take into account the lack of additional buttons and USB connector, we can say that Incubator 2.0 is a copy of AvengeAngel BigHulk.



# A set of additional equipment and supplies

## UAV calculations

### Alientech Deimox signal amplifier



ALIENTECH Deimox designed for universal drone compatibility. Features  $15 \text{ dB}\pm 1$  amplified receive and transmit with a combined gain range of  $22.9 \text{ dB}\pm 1$  to  $39 \text{ dB}\pm 1$ . Supports extension cables up to 40 meters.

Deimox designed for outdoor operation in the temperature range of  $-40^\circ\text{C}$  to  $80^\circ\text{C}$  and is resistant to rain and extreme cold. The device is powered by a battery (DC11.1 V/15000 mA). Its operating voltage is 12W, with an impressive transmit power of up to 10V, aided by a high gain antenna. Horizontal radiation angles range from  $65^\circ$  to  $83^\circ$  for wide coverage.

- The operating frequency range is 915 MHz (870 MHz to 960 MHz), 1.2 GHz (1170 MHz to 1280 MHz), 2.4 GHz (2400 MHz to 2483.5 MHz) and 5.8 GHz (5100 MHz to 5850 MHz).
- Maximum transmission power - 10 W
- Antenna gain -  $2.4G>15 \text{ dB}\pm 1 / 5G>21 \text{ dB}\pm 1$
- Horizontal radiation angle -  $65^\circ\sim 83^\circ$
- Reception gain -  $15 \text{ dB}\pm 1$
- Transmission gain -  $15 \text{ dB}\pm 1$
- Integrated radiation gain -  $22.9 \text{ dB}\pm 1\sim 39 \text{ dB}\pm 1$
- Input power range - 5-20 dBm
- Noise figure - $\leq 2.5 \text{ dB}$
- Battery voltage/capacity: DC11.1V/15000mA
- Continuous operation time, not less than - 8 hours



# Set of additional equipment and equipment for the UAV crew

## Alientech Deimox signal amplifier



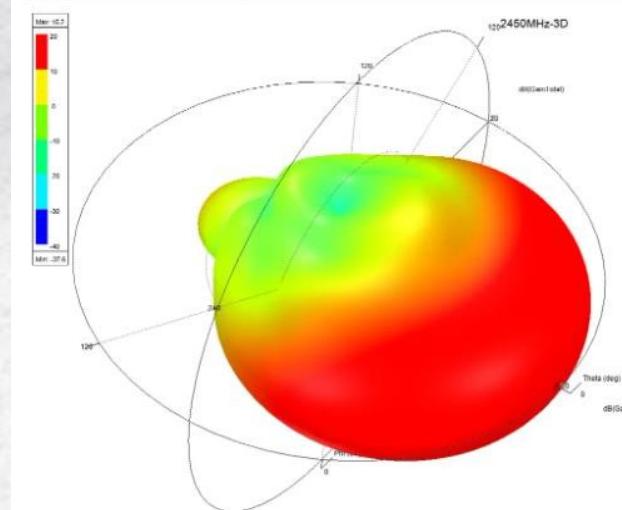
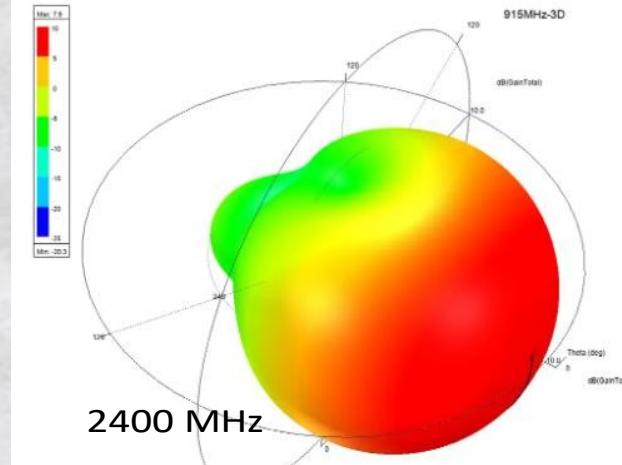
The DEIMOX power amplifier antenna is equipped with multiple high-gain antennas, which includes one set of 915 MHz antennas, one set of 1.2G antennas, two sets of 4-element 2.4G antennas, and two sets of 12-element 5G broadband antennas (5.1-5.9 GHz band).

Radiation pattern

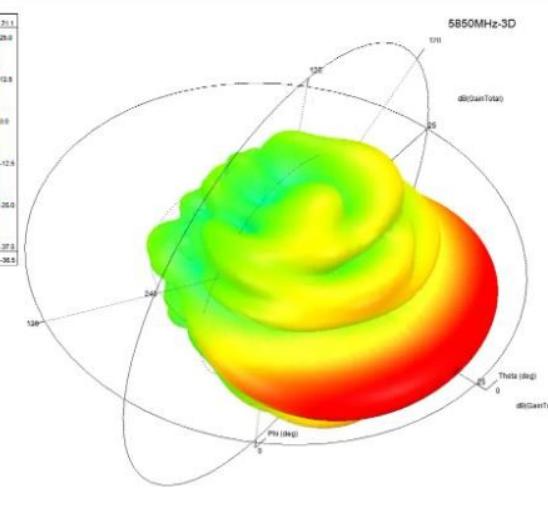
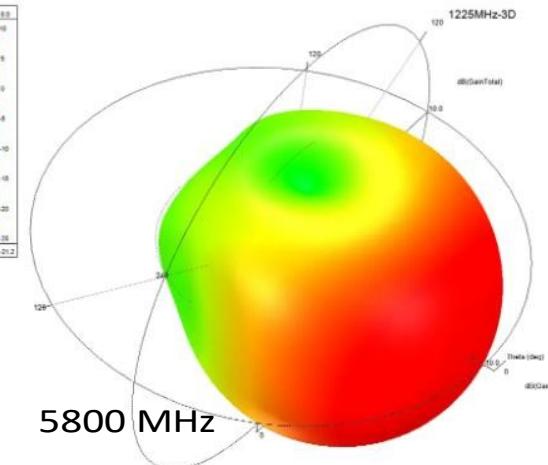
915 MHz

1200 MHz

диаграмма направленности излучения



5800 MHz





# Set of additional equipment and equipment for the UAV crew

## Preparing remotes for operation with signal amplifiers and remote antennas

To connect the quadrocopter remote control to the signal amplifier, it is necessary to install the connectors provided by the manufacturer into the remote control. QMA RF connectors are RF quick connect connectors. They are compact and convenient quick connect and remove, but have limited

It is recommended to use an N connector (also, N-type connector) to connect the quadrocopter remote control to the signal amplifier, which is a medium-sized threaded weatherproof RF connector used for connecting coaxial cables. This connector is the most reliable connection.

number of connections (Guaranteed connections and uncouplings - 100 times).

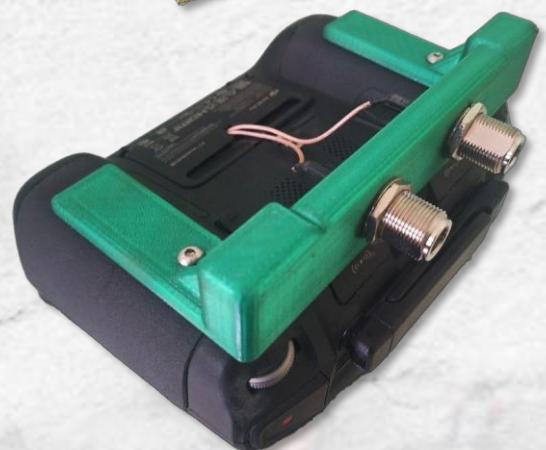


**U.FI (IPEX)-QMA (female)**

number of



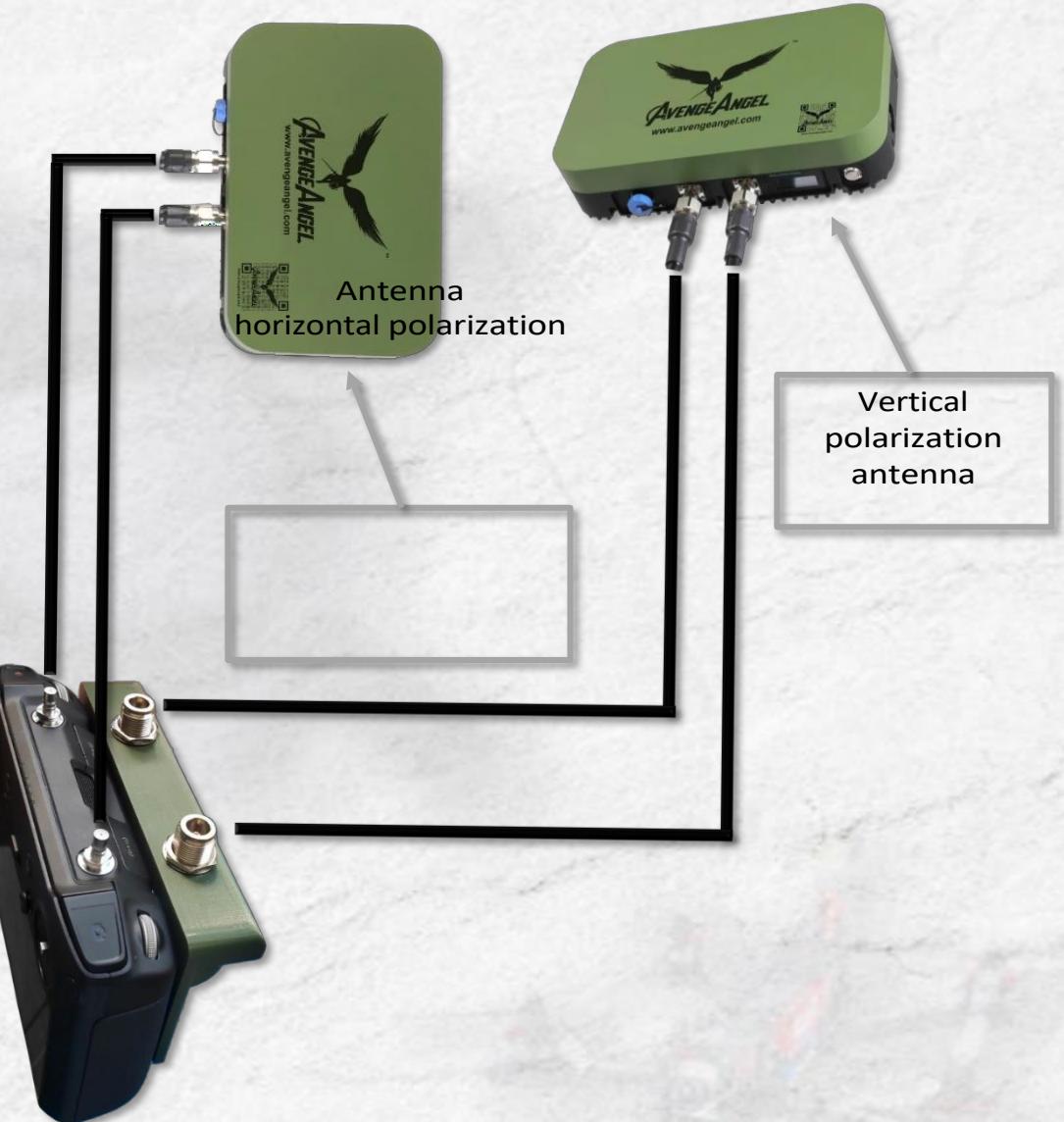
**U.FI(IPEX)-N(female)**





## Set of additional equipment and equipment for the UAV crew

The Mavic 3 and its series have two antenna groups, vertical and horizontal polarization. When operating directly from the remote control, both antenna groups are used, but when the antenna is placed on the remote control, only one vertical polarization group is used. If you use two antenna groups, you can improve the communication quality, but you need to connect two communication amplifiers to the two antenna groups.

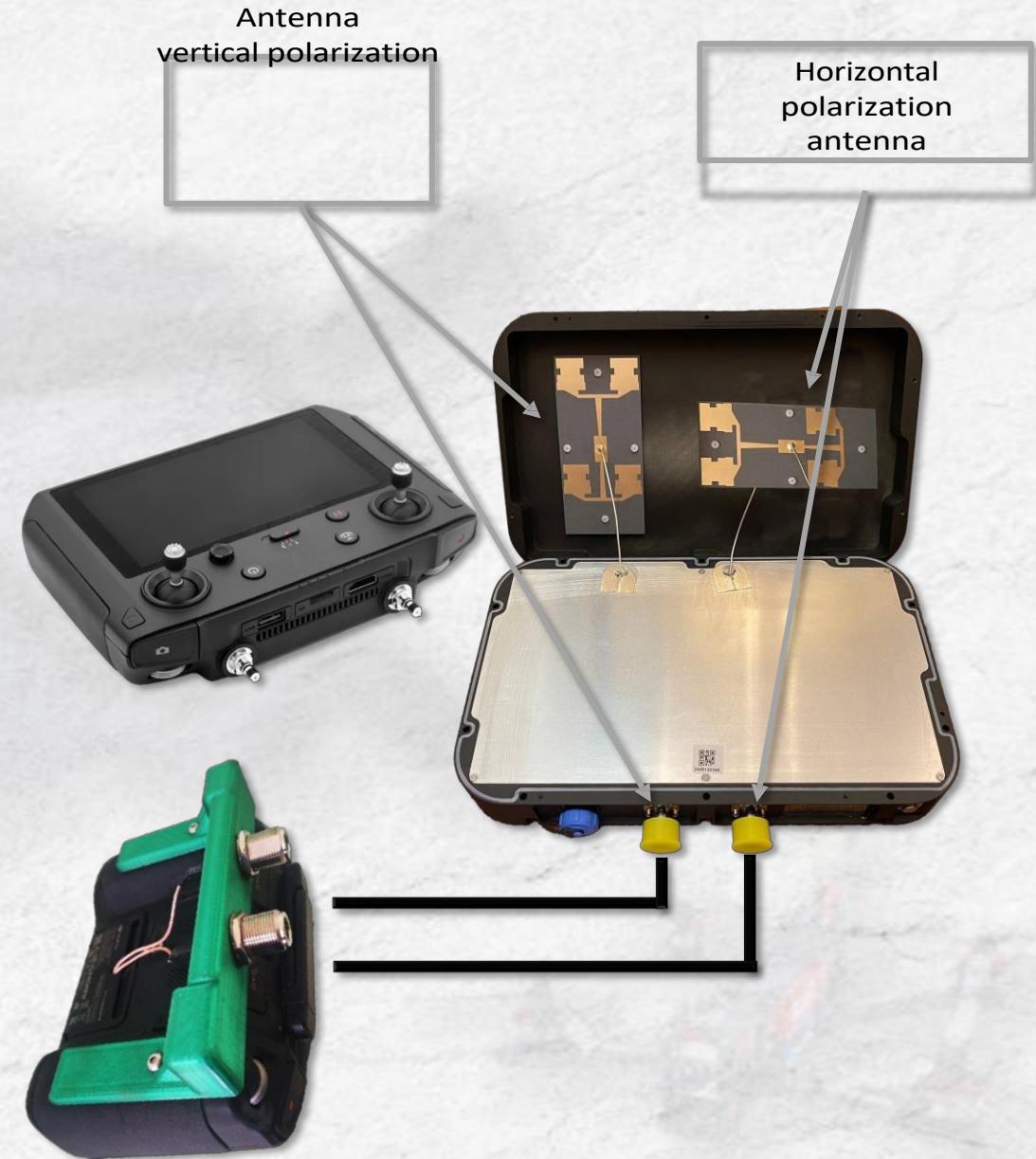




## Set of additional equipment and equipment for the UAV crew

The second way to connect vertical and horizontal polarization antennas. There are four antennas in the remote control - 2 vertical polarization and 2 horizontal. In each group of antennas, one is transmitting and the other is receiving only. On the board, the outermost two outputs go to receive the signal, and the center 2 pigtails to receive-transmit. Only the transmitting and receiving antennas should be connected and the antenna should be placed horizontally inside the incubator or AvengeAngel Big Hulk.

1. **ANT2** - RX Horiz 1 (Horizontal Polarization Receiver Only)
2. **ANT0** - TX/RX Vert 1 (Vertical Polarization Transceiver)
3. **ANT1** - TX/RX Horiz 1 (Horizontal Polarization Transceiver)
4. **ANT3** - RX Vert 2 (Vertical Polarization Receiver Only)





# Set of additional equipment and equipment for the UAV crew

## Operating frequencies, frequency analyzer and drone detectors

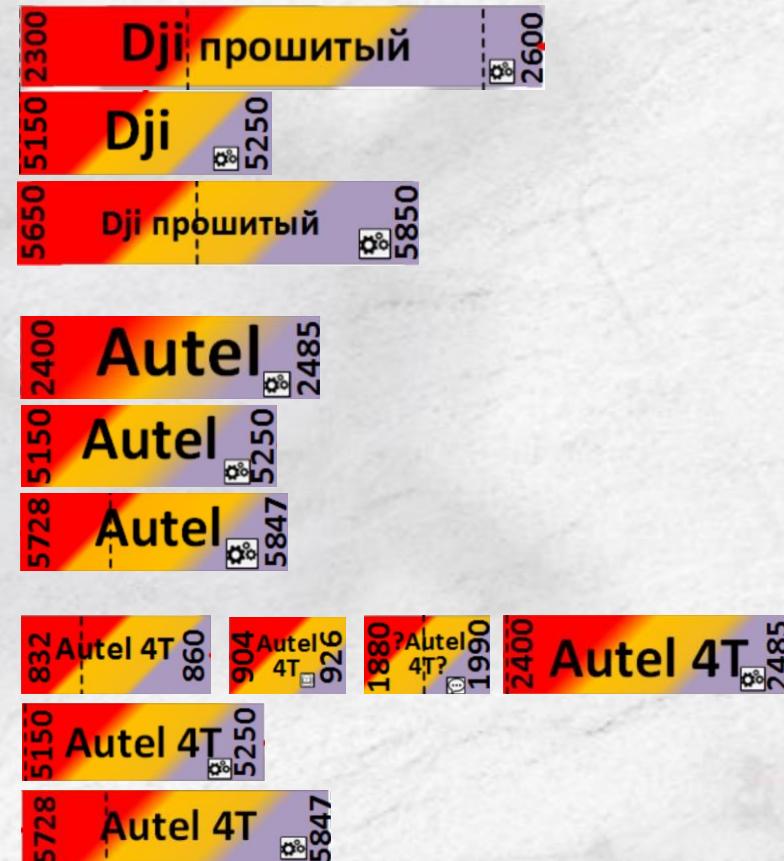
The control frequency determines the communication between the control panel and the drone, allowing the pilot to send commands and control the flight. In addition, video transmission frequencies determine the quality and stability of the video stream that is transmitted from the drone's camera to the pilot's console. Most foreign UAVs use the 2.4 GHz band frequency.

**Private ranges of the main quadcopter models according to the manufacturer's data**

DJI	Autel	Autel EVO MAX 4T
<ul style="list-style-type: none"><li>• 2400-2585 (20)</li><li>• 5150-5300 (20)</li><li>• 5725-5850 (20)</li></ul>	<ul style="list-style-type: none"><li>• 2400-2585 (20, 40)</li><li>• 5150-5300 (20, 40)</li><li>• 5725-5850 (20, 40)</li></ul>	<ul style="list-style-type: none"><li>• 850-940 (20, 40)</li><li>• 2400-2483 (20, 40)</li><li>• 5150-5250 (20, 40)</li><li>• 5725-5850 (20, 40)</li></ul>
<i>Navigation</i> <ul style="list-style-type: none"><li>• 1500 (1550-1620)</li></ul>	<i>Navigation</i> <ul style="list-style-type: none"><li>• 1500 (1550-1620)</li></ul>	<i>Navigation</i> <ul style="list-style-type: none"><li>• 1200 (1170-1260)</li><li>• 1500 (1550-1620)</li></ul>

The width of the operating channel in this range is given in parentheses.

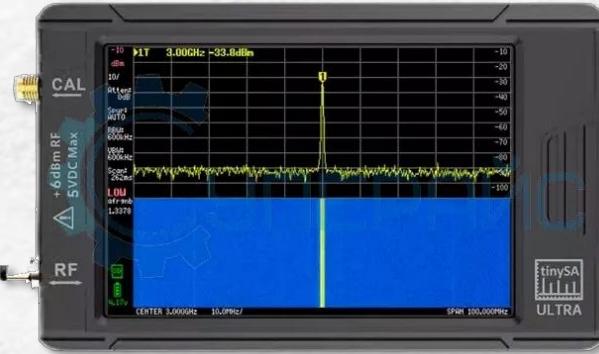
**Private ranges of major quadcopter models according to measurements from the Goodwill Revenge channel**





# Set of additional equipment and equipment for the UAV crew

## Frequency analyzers



**Portable analyzer  
of the TinySA ULTRA spectrum**

Frequency range	100 kHz - 800 MHz (standard mode) 100 kHz - 6 GHz (Ultra mode)
Scanning resolution	max. 450 points
Scanning time from 0 to 350 MHz	165 ms.
Built-in attenuator	20 dB - 4 GHz
Phase noise	-92 dBn/Hz, at 100 kHz offset -110 dBn/Hz, at 1 mHz offset
Average noise level	-153 dBm/Hz, with attenuator off (at 100 MHz) -169 dBm/Hz, when off attenuator (at 100 MHz)



**Portable spectrum analyzer SA6**

Measuring frequency range	35 to 6200 MHz
Measured frequency range	24 MHz to 9 GHz
Minimum noise level	<90 dBm, at frequencies up to 3000 MHz <85 dBm, at 3000 - 4000 MHz <80 dBm, at 4000 - 6200 MHz
Scanning speed at >100 MHz	700 MHz / sec
Bandwidth	200 kHz, fixed
Internal attenuator	0 - 30 dB



**Arinst SSA R3 handheld spectrum analyzer**

Displayed frequency range	24 MHz to 12 GHz
Measured frequency range	24 MHz to 9 GHz
Noise floor in 24 MHz band - 6.2 GHz	110 dBm
Maximum scanning speed	20 GHz/s
full dynamic range including VSWR and attenuator 125 dB	



## Set of additional equipment and equipment for the UAV crew

### Spectrum analyzer with integrated antenna (field indicator) Arinst SFM3



The Arinst SFM3 is a portable panoramic electromagnetic field detector with a built-in antenna. It is a modified omnidirectional rectangular monopole with trident feed. The device is designed for search and localization of radio emission sources, measurement of radiation levels of devices and household appliances in the frequency range from 23 MHz to 6.2 GHz. Built-in omnidirectional antenna, coordinated in a wide range of frequencies, allows you to localize sources of radio emissions from a distance of 10-20 meters. Delicate design and no moisture protection.

1. Built-in omnidirectional antenna
2. Availability of color resistive IPS display with diagonal of 4 in.
3. Wide frequency range: 23 MHz to 6.2 GHz
4. High scanning speed: up to 20 GHz/second
5. Program demodulator HFM/FM/AM
6. Dynamic range over 80 dB
7. Various signal search modes
8. Charging from USB tourC
9. Light weight and dimensions: weight 400 g, dimensions 222x81x27 mm
10. Autonomous operation up to 4 hours



## Set of additional equipment and equipment for the UAV crew

### ARINST VNA-PR1 portable two-port vector circuit analyzer



Portable two-port vector circuit analyzer ARINST VNA-PR1 is designed to measure the matching characteristics of passive and active radio devices (antennas, cables, filters, attenuators, amplifiers), check the integrity of high-frequency cables, measuring their parameters and other amateur radio measurements.

The instrument measures S11 and S21 parameters, voltage standing wave ratio (VSWR), impedance, admittance, phase, group delay time (GDT), loss and distance to fault in the cable.

1. wide operating frequency range: from 1 to 6200 MHz
2. high scanning speed of 1000 dots/second
3. setting the VSWR threshold line for Smith, Polar plots, SWR and Log. Amp (in measurement mode S11)
4. the ability to measure the distance to damage and cable losses
5. ability to compensate for the electrical length of the cable
6. Amplitude scale shift when measuring the AFC of active devices and attenuators
7. low weight and dimensions: 400 grams with "pocket" dimensions of 150×81×27 mm
8. built-in 5000 mAh battery provides up to 2.5 hours of battery life



# Set of additional equipment and equipment for the UAV crew

## Drone detectors

The distance at which the device is able to detect the drone depends on the distance of the drone from the detector user, the UAV's flight altitude, the UAV's radio transmission power, terrain features, artificial magnetic and radio frequency interference, weather, etc. The distance at which the device is able to detect the drone depends on the drone's distance from the detector user. The signal coming from the drone must reach the antenna of the detector unobstructed - this must be ensured by the user. Otherwise, the detector will not detect the drone's presence.



### ASEL LABS or ZOV UAV detector

- Removable LiPo battery: 2000 mAh
- Charging cord: 220 V
- USB charging cord: 3-24 V
- Operating time of one battery: 5 hours
- Permissible operating temperature:-20...+50°C
- Size: 55\*120\*36mm (antennas are not included)
- Weight: 250g (antennas not included)
- Antennas:
  - Long spring antenna is the main antenna, up to 2,000 meters.
  - Folding plastic antenna - for the car, that would always be raised up, up to 1000 meters.
  - Short - redundant, up to 600 m.
- Drone detector detection frequencies: 900 Mhz, 1.4 G, FPV 1.2 G, FPV 3.3-3.5 G, FPV 4.9 G, FPV 5.8 G, 2400-2500 Mhz, 5150-5350 Mhz, 5530-5900 Mhz, WiFi.

### Portable omni-directional UAV detector "Bulat" v.4

- UAV detection distance: up to 1.5 km;
- Battery life: up to 6.5 hours;
- Battery type and capacity: Lithium, 2100 mA\*h (15,540 mW\*h);
- Antenna connectors: SMA, 2 pcs;
- Charging port: DC 3., USB Type-C;
- Earphone jack: Jack 3.5mm;
- Operating temperature range: -20°C to +45°C;
- Dimensions: 120 x 60 x 34 mm;
- Weight: 300 g.
- Drone detection frequency range: 300 to 6200 MHz





# Set of additional equipment and equipment for the UAV crew

## Drone detectors



**NABAT drone detector**

- Drone model: DJI, Autel, FPV, other UAVs
- Operating frequency range: 700 to 5975 MHz
- Range: up to 1500 meters
- Audible alarm (direction finder): Yes
- Light signaling (direction finder): Yes
- Battery life: up to 8 hours

**UAV AMULET detector**

- Operating frequency range: 400 - 6200 MHz (software defined)
- Video signal detection sub-bands, MHz: 950 to 1700, 2400-2500, 3300-3400, 4900-6200 MHz
- Target detection range: 1000 - 3000 m
- With external directional sector antennas: more than 2000 m
- Moisture and dust protection category: IP64
- Battery capacity: 3800 mAh
- Continuous operation time: 9-11 h in active detection mode
- Battery: removable, replaceable
- Weight: 0.3 kg





# Set of additional equipment and equipment for the UAV crew

## Drone detectors



### Drone Detector Yurka 1.2

- Dimensions (without antennas): 110 x 75 x 27 mm
- Operating frequency range:  
2.4 GHz / 5.2, 5.8 GHz
- Powered by built-in 3.7 V, 4400 mAh lithium battery pack
- Threat indication with 128 x 160 dot color LCD display, 85dB ringing volume and vibration.
- Battery life when fully charged from 4 hours
- UAV detection thresholds and algorithms: Adjusting thresholds separately by range
- Filtering impulse interference and narrowband signals
- Interference masking mode separately by bands
- Tuning Receivers sensitivity in the range of 10-100%

### SIRO RDS-H1B-D drone detector

- A wide range of drone models: DJI, Autul, WiFi,
  - Operating frequency range
    - Omnidirectional antenna: 900 mHz, 1.1 GHz, 1.2 GHz, 1.4 GHz, 2.4 GHz, 5.2 GHz, 5.8 GHz, etc.
    - Common frequency bands for Drones
    - Directional antenna: 2.4 GHz, 5.8 GHz
  - Detection distance
    - Omnidirectional antenna: 0.7 km-1.2 km
    - Antenna for detecting directions: 2Km-3km
  - Directional accuracy: azimuth error <15°(1 km)
- Weight of the equipment: 800., Antenna 310g.





## Set of additional equipment and equipment for the UAV crew

### Drone detectors



#### DRONESHIELD RfPatrol Mk2

Australian company DroneShield manufactures a wearable UAV detector RfPatrol under the Mk II index. The RfPatrol Mk II is actually a passive station in the form factor of a wearable radio (800g weight).

The RfPatrol Mk II is actually a passive radio reconnaissance station in a wearable radio form factor (800g weight) that can detect and intercept communications between commercial UAVs and their operators, including control signals, telemetry, location data and video images transmitted from the UAV. The detection range is claimed to be up to 1 km in urban areas and up to 4 km in the field. Lithium-ion rechargeable battery, quick-release according to a common NATO standard. Military grade battery. Battery weight 380 g. provides 10 hours of continuous operation. Protection class IP67.





# Set of additional equipment and equipment for the UAV crew

## Drone detectors

### MASTEROK 4 UAV UAV Detector-Pelegraphizer

MASTEROK 4 reconnaissance device is designed to detect drones and determine the direction of its approach, using control channels in the frequency range from 700 MHz to 6.2 GHz. The MASTEROK 4 device allows the user to detect a drone within a radius of up to 2.5 km and determine the direction of its approach.

#### TECHNICAL CHARACTERISTICS



Operating frequency range	700 MHz to 6.2 GHz
Scanned frequency ranges	4
Scanned frequency ranges in new versions	8
PO	
UAV detection range	2.5 kilometers.
Continuous operation time on the main battery	4 ч.
Continuous operation time with the optional battery	8 ч.





# GPS/GNSS Spoofing

Spoofing is a technique for falsifying electronic data. GPS/GNSS Spoofing for quadcopter - This is the spoofing of the drone's navigation coordinates, causing it to determine its location at a false point.

Static

Dynamic

## Problem solving

### Static spoofing

It affects mainly the location of the home point. There is a risk that in case of telemetry loss, the drone will fly in the wrong direction on auto-return. You can also suffer from static spoofing if you get into an area with height restrictions or in a region where a different communication standard is used. In this case, the drone programmatically imposes restrictions on the remote control's radiation power and flight altitude

### Dynamic spoofing

This is when the drone is shifted its coordinates at a certain speed or simultaneously simulates several points at different ends of the planet. If this speed is low - it will start to fly away. If it is high - the drone believes that it is upside down and automatically turns off the engines. This is actually the reason why drones crash so massively.

#### 1. Hardware modification

Power off the GNSS module or remove it. Used on Autel EVO II Dual 640T V3 (UCO S1) and Autel EVO Max 4T. Since the drone software allows you to fly with the GNSS module power off.

#### 2. Portable drone jammers

The drone itself is fitted with a portable jammer for the navigation system, after which the drone will of course be completely blind to satellites, but at the same time it will also be impossible to spoof.



#### 3. Program modification

Implemented in 1001 firmware. Added the ability to fly "without GPS" with complete ignoring of data from the GPS module, which allows you to ignore GPS spoofing by REB means and take off without satellites. If the quadrocopter begins to behave inappropriately, accumulates errors and succumbs to spoofing, it is necessary to switch the flight mode and return back to the mode in which the 1001 firmware works.



# Improving the performance of UAVs

## "1001" firmware for DJI software enhancement

For the use of DJI Mavic 3 quadcopters in the SWO area, a firmware version "1001," was created in which:

- DRONE ID disabled (invisibility on Aeroscope and similar means).
- Added the ability to fly "no GPS" with complete ignoring of data from the GPS module, allowing you to ignore GPS spoofing by REB assets and takeoff without satellites.
- NFZ (No Fly Zone) restrictions have been disabled.
- The maximum flight altitude has been increased to 10 km.
- FCC mode is activated on the quadrocopter itself (additionally uses 5.8 GHz frequency and higher data transmission power - increases the range of communication with the quadrocopter).
- Removed all restrictions (range, altitude, etc.) if logging into an account in the DJI FLY app is not done (but the drone must, of course, be initially activated).
- Forcing the lower sonar to shut down, in case the drone won't descend because the sensor itself is obscured by the suspension.
- The onboard lights are off.

You can determine that the drone is flashed to "1001" firmware visually: the drone is flashing "1001" at power up in the icon with the number of satellites counts down: 99,88,77,66,55,44,33,22,11. After it lights up white color 0.

- Added command "lost\_compass," - return the drone by compass when losing communication with the remote control: the drone turns by compass to the direction from which it came (the direction in which the drone flew after gaining an altitude of 50 meters for 30 seconds), and independently starts flying back (this mode does not work in ATT).
- The drone always turns on in "gps\_off mode," and it does not depend on the position of the switch on the remote.
- You can switch between "without GPS" and "with GPS" modes either with the center switch "CINE/"NORMAL" or "gps\_off,"/"gps\_on," commands.
- Added the ability to use non-standard batteries with a capacity greater than 6300 mAh - removed the associated check and restriction.
- Any version of DJI FLY can be used with the drone flashed "1001".
- If the drone is equipped with a 2.4GHz amplifier (booster), it is necessary to forcibly select the 2.4GHz frequency every time the drone is turned on. Otherwise, the drone will work in two frequencies, and when switching to 5.8Gi, the radio path will work without an amplifier.



# Improving the performance of UAVs

## Booster installation

### *hardware enhancement*

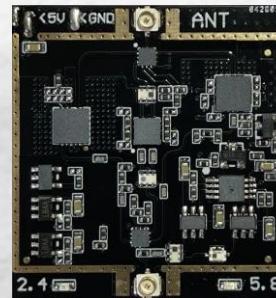
REB affecting the drone jams the receiver of the signal, to counteract this is amplified transmission from the remote control by installing signal amplifiers on the remote control. Thus, the signal from the console "breaking through" REB reaches the drone, but this in turn does not increase the range of flight (communication). To increase the range, in addition to amplifying the remote control it is necessary to amplify the drone itself.



### Drone signal amplification

#### DJI - SkyBooster 2.4

The signal amplification board SkyBooster 2.4 Boosters is an excellent solution for increasing the stability of communication in REB conditions and increasing the signal range. The average radiated power is 2.5w in contrast to the maximum of the standard signal is only 600mVT, which is many times less. Compatible with drones and DJI remotes: Mavis 3T, Mavis 2 Pro, Mavis 2 Zoom, Mavis 2 Enterprise Advanced/Dual, Mavis 3 Pro, Mavis 3 Pro Cine, Mavis Air 2, Mavis Air 2S, Mavis Air 3, Mavis Mini, Mini SE, Mini 2, DJI RC-N1, DJI RC, DJI RC Pro, DJI RC 2, DJI RC Plus, DJI , DJI RS 2, DJI RS Plus, DJI Smart Contractor.



### Dual band amplifier

#### 2.4 GHz/5.8 GHz

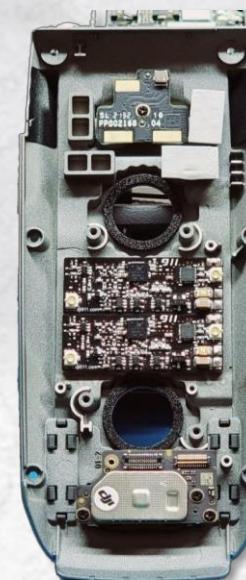
##### Dual band amplifier

2.4 GHz/5.8 GHz bidirectional signal with automatic switching is a highly efficient and compact PCB. Maximum power dissipation  $\approx$  6 W Transmission gain 2.4 GHz 13 dB

Transmission gain 5.8 GHz 13 dB

2.4 GHz reception gain 13 dB

5.8 GHz reception gain 13 dB



### NeoBooster Dual

Operating frequency range, GHz: 2.39..2.51 Power supply voltage (Min/Max), V: 3.3...5 Amplifier weight, g: 2

Transmit gain, dB: 18 Receiving gain, dB: 5





# Recommendations for the work of the UAV calculation

## Pre-flight training:

1. Charge the quadcopter batteries to 100% before each flight. Monitor the charge of the batteries. Charge the batteries only with original chargers.
2. Charge the remote control battery (if built-in) to 100%. Always monitor the remote control's charge.
3. Check that the blades are installed correctly, otherwise the drone may flip over during takeoff. There are no scratches, chips or cracks on the blades, if there is damage, replace the required number of blades.
4. Unfold the quadcopter's beams if you have a folding design.
5. Wipe down the suspension and sensors.
6. If you see that the horizon is off - calibrate the suspension.
7. Calibrate the compass of the quadcopter.
8. Calibrate the IMU.

**IMPORTANT:** make sure that no magnetic field sources or cell phones are near the drone during calibration and IMU.

9. Select a takeoff and landing site away from the operator, preferably in the rear of the formation.
10. Choose an alternate landing spot in case the enemy detects your drone.
11. Study the area where you will be working from maps or photographs. Always fly only by memorizing terrain features and landmarks.
12. Prepare your phone or tablet with maps of the terrain and keep them open. Follow the drone's flight and compare the terrain with the maps for the fastest and most efficient navigation and targeting.
13. Take off carefully, your first flights, position the drone at a safe distance and altitude to check that it is not being pulled sideways and everything is working properly.
14. If you have a drone without obstacle sensors or machine vision, always assess the number of obstacles around you and set the correct altitude to return home.
15. If the drone displays errors or notifications during self-diagnostics or during flight, read them carefully and comply with the drone's requirements.
16. Always monitor in operating mode flight and telemetry from the drone.



# Recommendations for the work of the UAV calculation

## Pre-flight training:

In the process of using quadrocopters in both combat missions and training activities, weather conditions (altitude wind, rain, temperature, fog, cloud cover, etc.) are a key factor.

The VentuSky Pro app is great for online weather monitoring.

A functional application for weather tracking with visualization of airflow movement. It combines a classic location-specific weather forecast with an interactive map that allows you to see weather changes over a wider area. Wind animation visualizes the movement of air currents. The application will allow you to get a forecast for the next days with an accuracy of up to an hour, as well as to find out the time of sunrise and sunset anywhere in the world.

### Accessible weather indicators:

- Temperature (by altitude);
- Precipitation;
- Wind (16 levels with direction by altitude);
- Wind gusts (with direction by altitude);
- Cloudiness (high, medium, low, total);
- Zero isotherm (altitude with a temperature of 0°C).





# Recommendations for the work of the UAV calculation

## Flight:

1. The drone should be launched at a distance from the calculation (from 100 to 200 meters).
2. The drone should be landed at the rear of the group (also at a distance of 100 to 200 meters). The takeoff and landing site should be hidden by trees.
3. Don't forget to turn on stealth mode.
4. Make a test flight before starting a flight task.
5. While the drone is "going" to the point, you should never gain altitude the copter should fly at a low altitude.
6. You should record video of the drone's operation through the "screen recording" function.
7. One should always keep an eye on the altitude and communication indicators they may be missing when the enemy starts to "jamming."
8. At the first interference or other signs that the enemy has started "jamming", you should move the drone away.
9. When using remote antennas, make sure that they are charged and not completely discharged.
10. Keep an eye on the battery charge level and leave a reserve charge for return and landing, if the battery charge level is less than 30%, return the drone immediately.
11. Keep an eye on changing weather conditions: wind, rain and temperature. Return the drone in advance if necessary. It is necessary to take into account wind flows, which will differ at different altitudes in speed and direction. At an altitude of 150 meters the wind speed may be 8 m/s, and at 180 meters it may be 4 m/s.
12. When returning the drone, make sure there is no tail. Do not return the drone in a straight line to its position, try to make a loop.
13. If you find a tail behind you hover and wait for the enemy drone to leave, if this is not possible land the drone on a spare site away from the calculation and pick up the drone after a long period of time.
14. It is necessary to constantly monitor which side of the drone is turned to you to understand where to pull it if the video falls off.



# Recommendations for the work of the UAV calculation

## ATTI mode (ACA)

**ATTI mode (ATTITUDE)** is a flight mode that does not use the drone's GPS-based navigation system. Visual positioning sensors are also ignored. Only altitude hold is working on the drone. In ATTI mode, the drone does not hold its position. It may look like the drone has been hijacked and is being pulled away from you, but it is not, the drone is simply being carried away by the wind.

1. On average, an altitude gain of about 350 meters at multiple sites provides an acceptable range of vision. At this altitude it is possible to stay in the air without going into ATTI mode. The hover location needs to be selected.
2. There should be a contrasting object below the drone that stands out from the general background, so that it is visually easier for the drone to lock on to the object. However, it is necessary to exclude highly glaring metallic objects, such as the roof of a hangar.
3. It is desirable that the surface is flat and without obvious distortions of relief, also this applies to large objects of different heights, such as high-rise buildings.
4. I recommend starting to gain altitude at less than 100 meters. Once the drone has locked on to a contrasting object, start gaining altitude smoothly. Watch the horizontal speed of the drone. When it rises 0.7 m/s or more, slow down the altitude gain, then gain altitude again, controlling which direction the drone is drifting.
5. Eliminate jerking and abrupt movement joysticks  
Governance.
6. Horizontal speed at the moment of drone hovering from 0.0 to 0.4 m/s is considered normal, if it is higher, there is a risk of going into ATTI. After horizontal velocity of 1 m/s it will increase, the drone loses its visual position, and goes into the "ACA" mode.
7. If the horizontal speed is higher than 0.8 m/s, you can try to smoothly steer the drone in the opposite direction, returning it to the starting point. It happens that the drone hangs perfectly at 300 meters, at 320 it goes into ATTI mode, and at 340 it hangs without deviating from its position. Try different altitudes.
8. The M3E/T has unstable altitude gain/drop when moving in ATTI mode. Often, it happens when strong wind currents elementary do not give and blow the drone with a large roll. It is enough to slow down the horizontal speed, in extreme case stop completely and level it on the horizon, then climb/drop higher or lower and get out of the flow, continuing the movement.
9. When using Matrice 30T there is unstable behavior and loss of altitude during the transition from Normal to ATTI mode, but this problem is solved instantly, if you forcibly switch it to ATTI mode. To do this, assign the command **"Lower View System On/Off"**.



# Recommendations for the work of the UAV calculation

## Features of using Autel EVO II Dual 640T V3 (UCO S1)

### Pre-flight training

1. Enable FCC mode if disabled.
2. Turn off the landing sensors.
3. Disable the visual positioning sensor.
4. Set the speed mode to maximum.
5. Activate the climb and descent switch.
6. Do a compass and IMU calibration (every time you change position) every 10-15 flights, the compass is sensitive to change of launch location.
7. Warm up the compass (40-60 seconds is sufficient).
8. Raise the copter to a height of 1-2 meters, make a smooth rotation around its axis 360 degrees then 30, 100, 200 meters (to do after calibrating the compass, these actions ensure its stable and correct operation).
9. For application 207 (comma), activate disable GPS and visual position and check for satellites before takeoff.
10. Activating disable GPS does not provide full protection against GPS/GNSS Spoofing. It is recommended to hardware remove the GNSS module.

More demanding than the 3t. With proper skill there are no problems. Unpredictable behavior of the drone near the ground is likely due to problems with hard software and positioning sensors.

### Landing a drone on your arm

Unlike DJI, Autel drones are extremely reluctant to land in your hands. Landing requires the safe landing sensors to be activated. The area of the hand and two folded arms is not enough for the drone to catch and disengage the motors, if the area transmitted from the sensors is insufficient, it starts to build up speed and pull out of the hand - very unsafe. The solution - take a five-point and land on it, sits without any problems. Without the intuitive landing mode, it is oriented by the barometer, which at low altitude, works extremely unstable, it was not possible to land.

### Flying at night

1. The thermal imaging camera, when properly set up, shows an excellent picture, with excellent stabilization.
2. At high altitudes, when the drone drifts downwind, if you don't steer with the stick, this drift is almost invisible in the thermal imaging camera. You can almost see a still image and the drone has already gone a decent distance, you need to be able to control this moment.



# Recommendations for the work of the UAV calculation

## Recommendations for work in winter time

**icing** is the deposition of ice on the external surfaces of the UAV. Icing occurs mainly when flying in supercooled water clouds or mixed clouds, or in a supercooled rain zone, mainly at temperatures between 0 and 10°. Upon contact with the drone, supercooled droplets freeze, covering the drone with an icy crust.

1. If the battery is too cold or too hot, it should not be charged, but should be allowed to warm up to an acceptable temperature or cool down. The temperature range at which LiPo (lithium polymer) batteries can be charged is 5°C to 45°C, and the optimum temperature is 10°C to 20°C.
2. Before flying, make sure the battery is fully charged and warmed up to 20°C. Even though DJI batteries have built-in heating. Since heating the battery is energy consuming for the battery itself (it will partially discharge the battery).
3. It is recommended that you let the copter hang in place for 30 to 60 seconds before active flights.
4. The temperature of the copter should be equal to the temperature, in sub-zero weather this is due to the fact that when you take the UAV from a warm room to the "street", condensation will form on it, which will later lead to icing of the copter.
5. When selecting a takeoff location, choose an open area with a hard surface, as snow picked up by the propellers can get on the motors and into the copter body, which can lead to subsequent icing or short circuits.
6. Do not fly close to buildings - the upward flow of warm air rising to the roof of the building can tip the drone over, in most cases this causes the quadcopter to crash.
7. Two shockproof cases are recommended. One for storing the copters at ambient temperature and one for storing the batteries using disposable battery packs. disposable warming pads (insoles) for hands/feet. If it is not possible to use a case, use pouches.
8. Watch the altitude of the zero isotherm (altitude with a temperature of 0°C). Try not to cross this altitude to avoid icing.



# Tasks solved by quadrocopter-type UAVs

## Key Objectives:

1. **Reconnaissance of terrain.** The result of such reconnaissance is the detection of the enemy, traces of his presence and other facts about which the relevant units should be warned. The UAV crew can provide a convoy of vehicles and the most important thing here is a timely warning that something suspicious is happening at some distance to the left or right of the route.
2. **Artillery reconnaissance and fire correction.** The result of artillery reconnaissance is the coordinates of the target in the desired coordinate system. Artillery correction involves observing projectile bursts near the target and transmitting the appropriate corrections by one means or another.
4. **Minimizing terrain.** Delivery light anti-personnel mines (PFM-1S) and dropping them in places of probable enemy movement.
5. **Demining.** Delivery of detonation means to initiate emplaced mines.
6. **Repeater.** Use as a repeater for FPV drones.
7. **UAV-assisted combat management.** UAV calculations can help the unit commander see the situation from above in real time and control forces and assets in real time. To command from above it is important to accurately identify each fighter, to train personnel to act according to clear landmarks, there is no point in shouting "Run to the right," for there is no point in shouting "Run to the right" from above. Each man's "right" is different. To have communication equipment for each soldier.
8. **Patrolling terrain, neighborhoods and columns.**
9. **Fire damage.** UAVs are often used to drop modernized projectiles from various heights. Since the drop requires flying as close to the target as possible, this increases the risk to the operator of losing the drone many times over. The most vulnerable target for a drop is one that is standing still. Wind and movement of the drone decrease the accuracy of the drop. How and what to drop depends on the payload of the particular UAV model.
10. **Photo and video recording of the application of fire damage.**



# Tasks solved by quadrocopter-type UAVs

## Main tasks: Reconnaissance of the area

*General demasking features of objects (targets) in reconnaissance include:*

1. characteristic location of objects;
2. signs of activity (motion, dust, smoke, fire, etc.);
3. traces of activity (freshly dumped soil, flares, etc.);
4. color objects (if it different from color of the surrounding area);
5. reflections from glass and unpainted metal parts.

*Demasking signs starting positions, c from which*

*missiles and rockets are launched are:*

1. rockets mounted on launchers in the out in the open or under covers;
2. availability of car radios with antennas at the position;
3. the appearance of a large cloud of smoke and dust over the position after the launch;
4. illuminated missile tracks on the active section of the trajectory;
5. inversion trace of the missile on the trajectory;
6. the flash and glow of a nighttime launch.

*Artillery batteries in firing positions not firing are detected by the following demasking features:*

1. Depending on the nature of the terrain, the task to be performed, the type and caliber of the guns, and the range of fire, artillery is echeloned to a depth of 1 to 10 km from the front line.
2. The size of the battery's OP, taking into account the location of vehicles and close protection, is up to 300-800 meters in front and up to 800 meters in depth.
3. In forested and swampy terrain, OPs are located on forest edges facing the front line, in clearings, near roads, and on elevated terrain overgrown with shrubs. In rugged terrain, OPs are located in groves, gullies, ravines, and behind the back slopes of heights.
4. In populated areas, OPs are selected in squares, parks, squares, stadiums, near buildings, in the shade of buildings and trees.
5. On the OP of a medium caliber battery the guns are placed at intervals of 30-50 m. The guns may be arranged in a line or in figures (circle, wave, ledge to the right, ledge to the left).
6. Self-propelled guns can be equipped with trapezoidal or corner-shaped gun trenches. For towed guns, gun trenches with a circular or limited sector of fire are equipped. The diameter of the trench, including the bunker, is 18-22 meters.
7. At the OP of a large-caliber battery the guns are arranged in battery line or platoonwise at intervals of 200-300 m.



# Tasks solved by quadrocopter-type UAVs

## Main tasks: Reconnaissance of the area

*Firing batteries may be detected by the following demasking features:*

1. by the brilliance of the shots;
2. by dust and smoke over the OP during firing.
3. At night and at dusk, batteries demask themselves by the brilliance of shots (in the form of a short flame tongue of pale pink or reddish color) and the glow of shots against the background of clouds and forest edges.
4. During the daytime in sunlight, the brilliance of shots is very rarely observed. In some cases, rings of smoke are formed when shots are fired. If the enemy battery is firing at short notice, the individual smoke of the shots does not have time to dissipate and, layered one on top of another, forms a cloud of smoke.
5. Smoke from shots fired in dry weather lasts for 1-2 seconds. In humid air or after rain it is more noticeable, lasts longer and takes a regular oval shape.
6. If the firing battery is in a forest, it is sometimes impossible to observe the brilliance of the shot, in which case the battery's location should be judged by the smoke. Remembering the characteristic outlines of the treetops between which the smoke has appeared, the firing position should be tied to the nearest landmarks.

*Simulated firing false batteries are distinguished from firing batteries by the following characteristics:*

1. simulated flashes have a longer lasting effect than gun flashes;
2. The smoke of false flashes is thicker, more cloying, and not in the form of a jet;
3. no shell bursts in the location of their troops.

*Mortar platoon ODs are located in battalion defense areas, in the areas of the battalion's second echelon companies:*

1. Mortar entrenchments occupy up to 100-150 meters along the front. Mortar trenches may be connected by communication routes;
2. Mortar emplacements are usually selected in forests, ravines and hollows, in quarries, in ruins of buildings, in large craters from shell and bomb bursts, in pits, at steep river banks, on the back slopes of heights, in bushes and other places that facilitate camouflage and complicate detection;
3. Mortar positions include mortar trenches, communication routes between trenches, and shelters for troops and vehicles. The trenches are spaced at varying distances from each other;
4. There is no such pattern of trench placement as in the firing position of an artillery battery. Sometimes positions may also be located in trenches;
5. Mortar trenches appear as round dots of a dark gray tone. Slots and communication passages in the form of dark stripes are sometimes observed next to these dots;
6. In wooded and swampy terrain, trenches for mortars are built on the surface of the ground; trench walls are made of wooden logs or wattles covered with earth. The height of the walls reaches one meter or more;
7. When reconnaissance of mortar units it should be borne in mind that the range of firing of mortars does not exceed 3-6 km, so, having determined the area of fire from mortars, it is necessary to conduct reconnaissance of the mortar position within the specified range.



# Tasks solved by quadrocopter-type UAVs

## Main tasks: Reconnaissance of the area

*Demasking features of firing mortars:*

1. During the daytime, in the absence of wind, a characteristic jet of smoke is observed in the direction of firing up to a height of 10-15 meters. Sometimes together with the jet a smoke ring is formed, rising to a height of 15-20 meters. In the presence of wind the smoke is observed worse and for shorter periods of time;
2. At night, a small glow or glow may be observed against the background of local objects located behind the OP (forest edge, front slope of an elevation, etc.);
3. at night, and in cloudy weather and during the day, the shot is observed oval-shaped red flashes.

*Jets demask themselves by their appearance and firing:*

1. In the daytime, in the absence of wind, dark clouds of smoke are observed at the end of the active section of the trajectory and a large cloud of smoke and dust over the firing position, which dissipates only after 20-30 seconds;
2. In the presence of wind, the dark smoke clouds at the end of the active portion of the trajectory quickly dissipate and become inconspicuous, the cloud of smoke and dust above the OD also dissipates and lengthens in the wind direction;
3. During the daytime in cloudy weather and at night, one can see expanding dawns and fire trails on the active part of the trajectory 1-1.5 km long, by which one can establish the direction to the firing battery.

*The enemy may use the following methods of camouflage from aerial reconnaissance:*

1. positioning of positions on a variegated terrain background, in small continuous bushes, where no special clearing for firing is required;
2. placing guns in buildings or man-made structures, which are given the appearance of civilian-type buildings;
3. observing traffic discipline to avoid the formation of paths, roads, and also masking paths, roads and of "blowing" cones;
4. use of special tab masks to cover trenches, sodding of the surface of dugouts;
5. masking the entire area occupied by the battery with cut vegetation, i.e. creating artificial shrubbery;
6. Creation of false positions having, as far as possible, all the de-masking features of valid positions, including elements of camouflage to an acceptable degree.



# Tasks solved by quadrocopter-type UAVs

## Main tasks: Reconnaissance of the area

The task of reconnaissance of the enemy's defensive positions is to determine the nature and degree of engineering equipment of defensive structures, their occupancy by troops, the location of firepower, control points and radio-technical facilities in the defense system.

*Site engineering includes:*

1. Equipment of strongholds (platoon, company) and battalion defense areas for circular defense, positions for firepower (artillery, NUR, UR), antipersonnel and antitank obstacles, trenches, trenches and shelters for personnel and combat vehicles;
2. The basic equipment of strongholds consists of rifle trenches, communication passages, trenches, shelters, and firing trenches;
3. Rifle trenches and trenches demarcate themselves in summer by the light tone of the berm and the dark tone of the ditch (shadows from the walls), and in winter by the dark tone of the ditch;
4. Riflemen's loopholes (cells) in the trench system appear as a dark spot against the lighter background of the bunker toward the front. Handgun and antitank gun emplacements appear as a larger dot in contrast to the loopholes;
5. The areas for large-caliber machine guns appear as a light-colored semicircle adjacent to the trench. The trenches for recoilless guns have a rectangular shape;
6. Shelters for vehicles and combat vehicles are excavations with ramps;
7. Tank and self-propelled gun shelters differ from transport vehicle shelters in that a notch is made in the front steepness for the gun barrel. This notch appears as a thin dark band;
8. Unoccupied shelters appear to be a rectangle of lighter color of a darker tone than the surrounding area, and the busy ones are darker in tone;
9. When the shelters are dug out by means of mechanization, a large area of disturbed soil is formed in the form of a large light spot;
10. When dug by hand, the shelter is bordered with a light-colored semicircle or circle;
11. Anti-tank ditches are identified by their characteristic wide zigzag stripes of light and dark colors. They are built on relatively flat terrain and on gentle slopes;
12. Nadolobes are viewed as zigzag stripes composed of black spots.



# Tasks solved by quadrocopter-type UAVs

## Main tasks: Reconnaissance of the area

*In reconnaissance defenses  
be established:*

1. drawing of trenches, trenches, anti-tank obstacles;
2. the location of firing positions;
3. a system of barriers in the depth of the defense and between strongholds;
4. moves communications between structures и possible maneuvering routes.

*The main de-masking features areas*

*of concentrating reserves are:*

1. presence of troops, vehicles, tanks, self-propelled guns and other combat equipment in forests, ravines and settlements;
2. The presence and construction of various shelters and defenses;
3. "ruggedness" of roads at the edges of the forest, the presence of freshly cut clearings, the emergence of new access roads from the main roads to settlements and forests.
4. Areas where tanks are concentrated are usually forests, groves, bushes, gardens, settlements, shallow hollows;

*the enemy must*

5. Probable locations of concentration areas and reserve movement routes are indicated by the artillery commander when setting reconnaissance objectives;
6. The movement of troops on the roads in summer can be detected by the dust.
7. If the column is not visible, the length of the column is determined by the length of the dust cloud. The wind direction is taken into account when determining the direction of column movement along the dust;
8. The movement of a mechanized column produces a dense high dust cloud, dense in its lower part, while the movement of a foot and horse column produces a low dust cloud.

*In reconnaissance areas concentrations reserves  
the enemy must be established:*

1. the boundaries of the areas of concentration and the composition of the troops therein;
2. availability и nature defensive installations и other special installations;
3. the beginning and direction of the advancement of reserves, and boundaries them deployments;
4. Data on the accumulation of enemy troops in the areas of bridges, crossings, defiles, as well as data on the threat of bypassing or enveloping our troops from the flanks must be transmitted immediately.

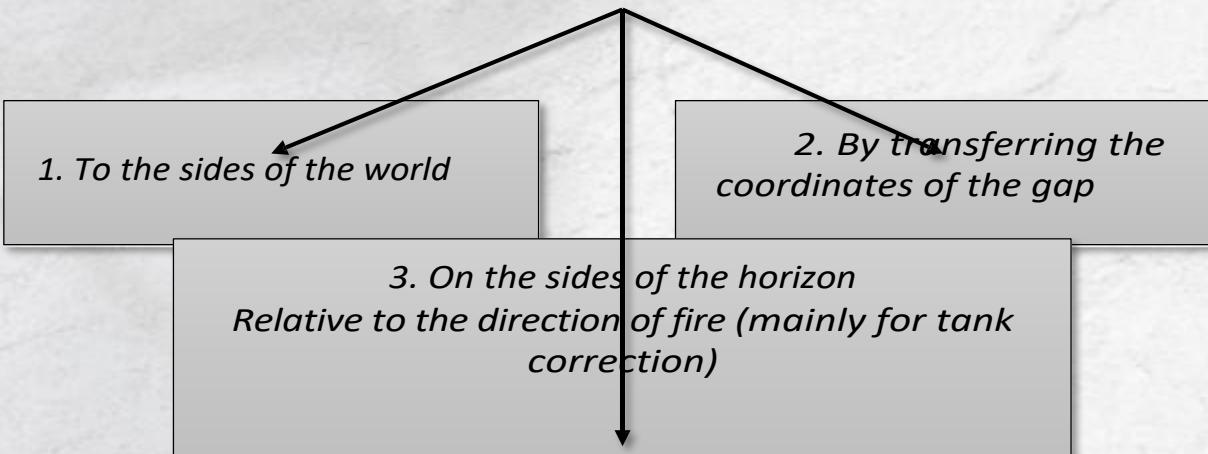


# Tasks solved by quadrocopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

1. When using a drone for correction, it is imperative to clarify how the artillery accepts the correction before transmitting the data.
2. When going to the correction point, do not fly close to the target, work from far away, keep the drone as far away as possible from the target being fired and corrected. The recommended distance to the target is 2-3 km, at an altitude of 250-500 meters.
3. Use a stopwatch during adjustment. It is necessary to time the time until the projectile arrives.
4. :
  - You can't see the arrival or the arrival is very far away and you're not sure it's your burst - we say: "Do it again";
  - A shell misfire, we say, "not a rupture."
  - The battery dies and needs time to change: use the carousel if there is a possibility to lift the second drone, if there is no such possibility, warn about the need for replacement.

### ***Main methods of artillery fire correction using quadrocopter-type UAVs***

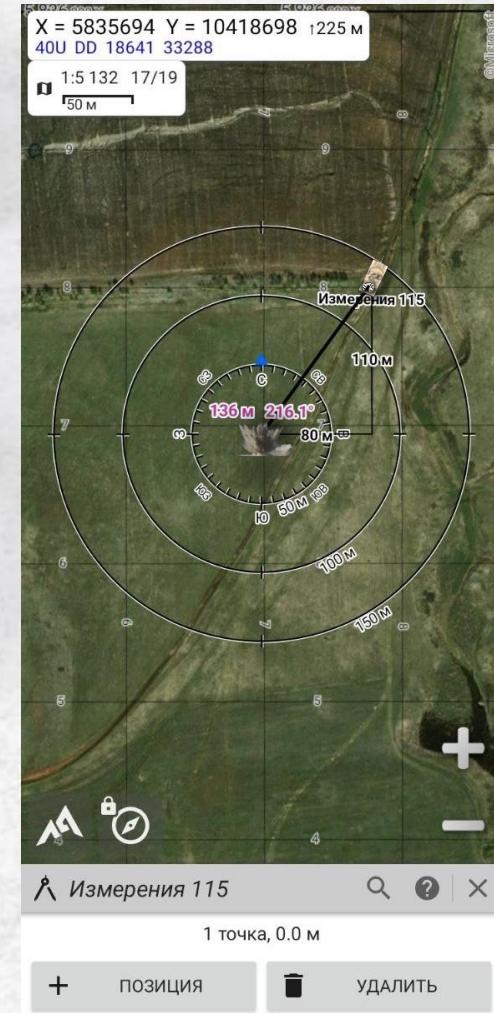
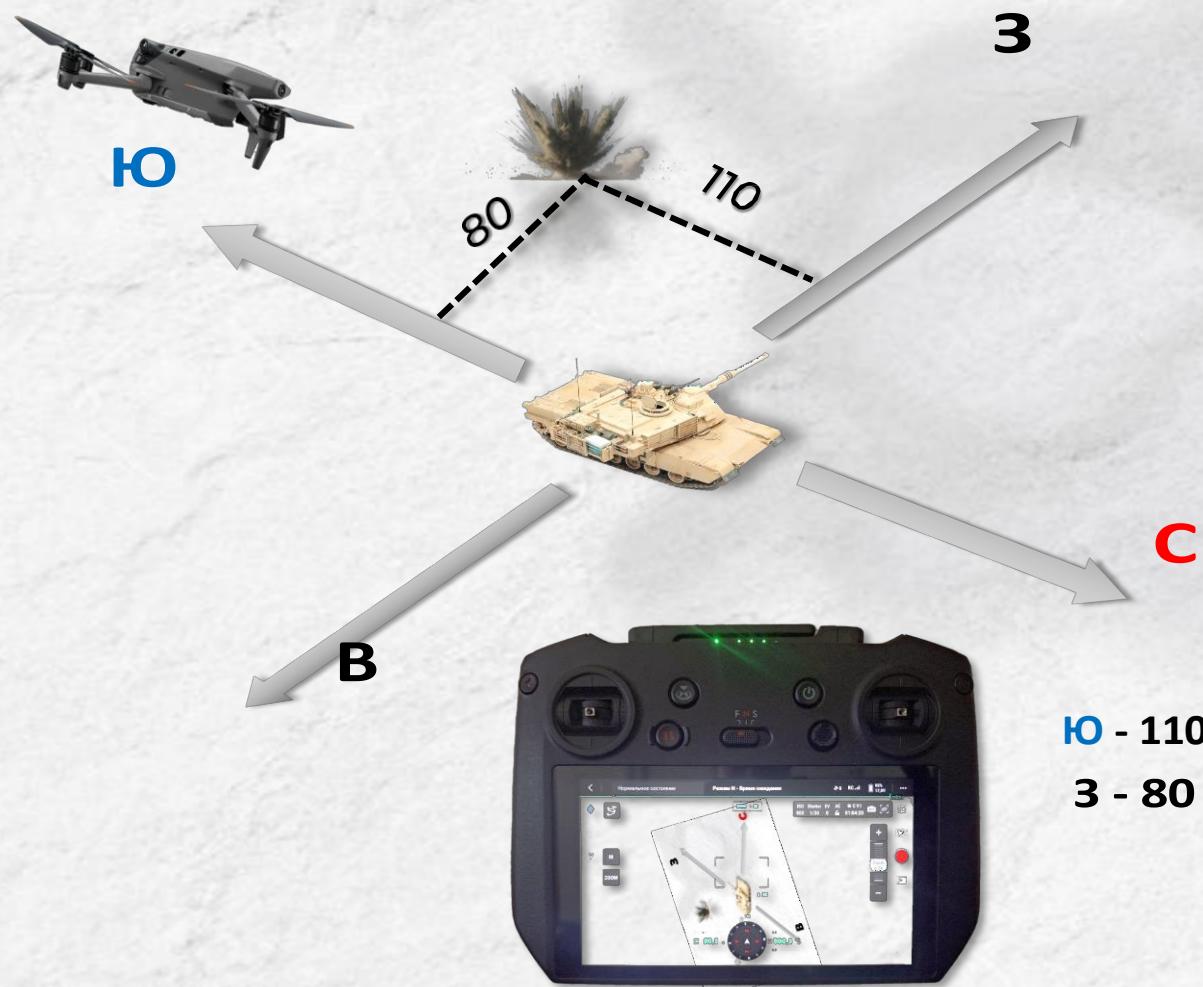




# Tasks solved by quadrocopter-type UAVs

Main tasks: Artillery reconnaissance and fire correction.

Correcting artillery fire to the sides of the world (using AlpineQuest application as an example)



**AlpineQuest**

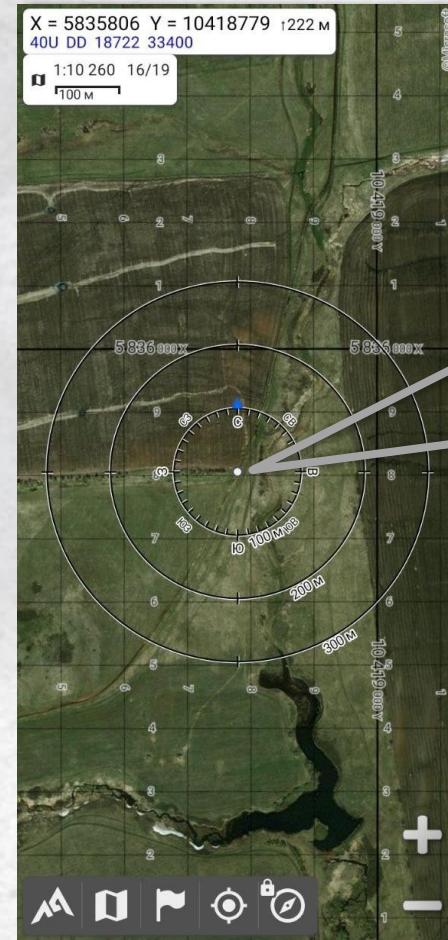


# Tasks solved by quadrocopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

**Correcting artillery fire to the sides of the world (using AlpineQuest application as an example)**

1. Once the target and the nature of its actions have been detected, the coordinates of its location must be transmitted.
2. Organize interaction with means of destruction. Specify the start of opening fire, type of ammunition, flight time, method of adjustment, and ammunition limitations.
3. Prepare for the adjustment. Replace the battery on the drone, if the adjustment is to be made in the following way "carousel" to prepare the second drone.
4. Check the configuration of the AlpineQuest application.



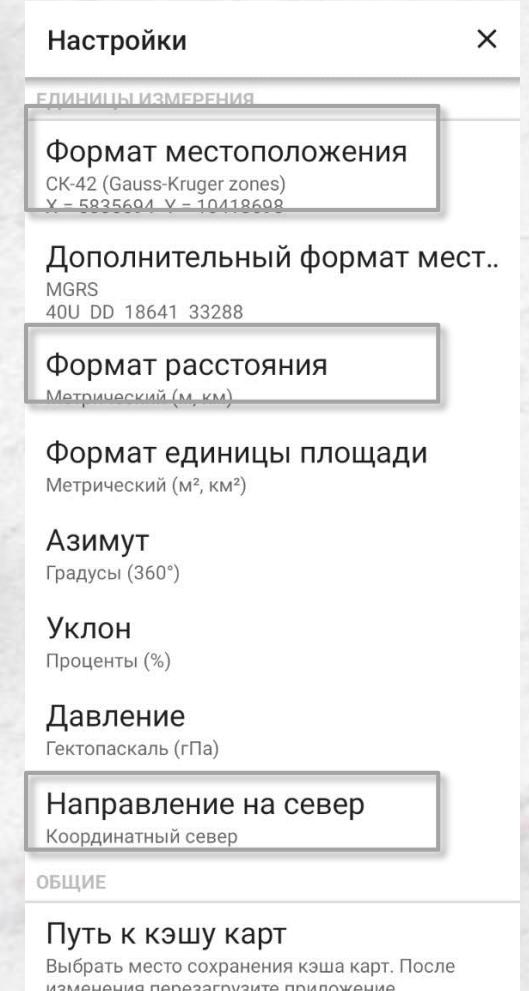
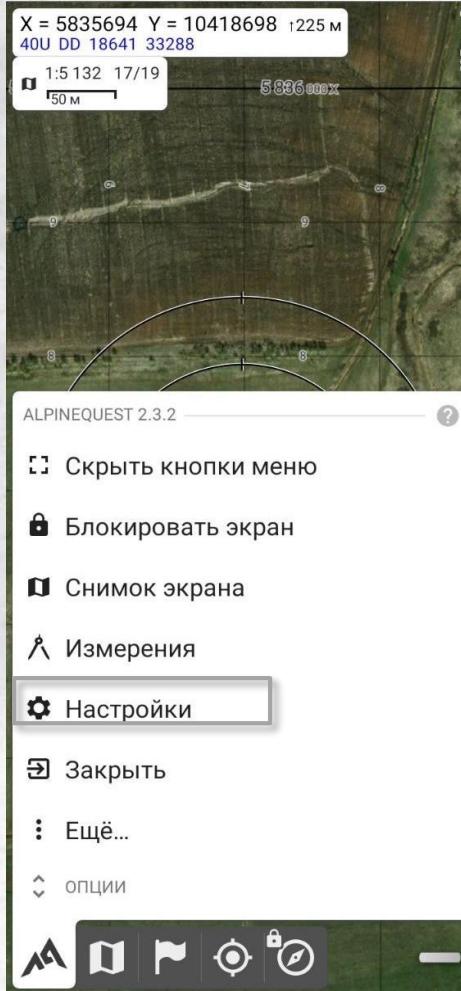


# Tasks solved by quadrocopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

Correcting artillery fire to the sides of the world (using AlpineQuest application as an example)

5. Go to the Settings menu.
6. Check items:
  - The location format is *SC-42*;
  - The distance format is *Metric*;
  - The direction to the north is *Coordinate North*.





# Tasks solved by quadcopter-type UAVs

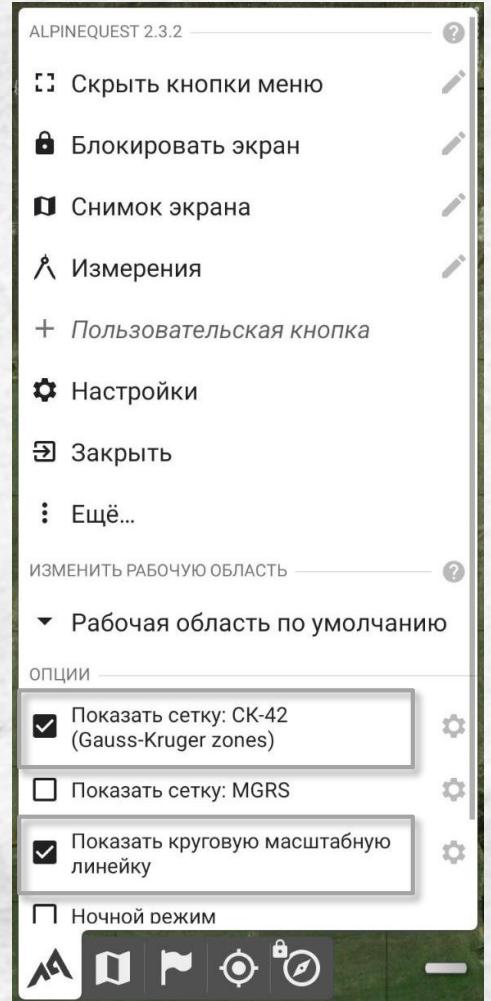
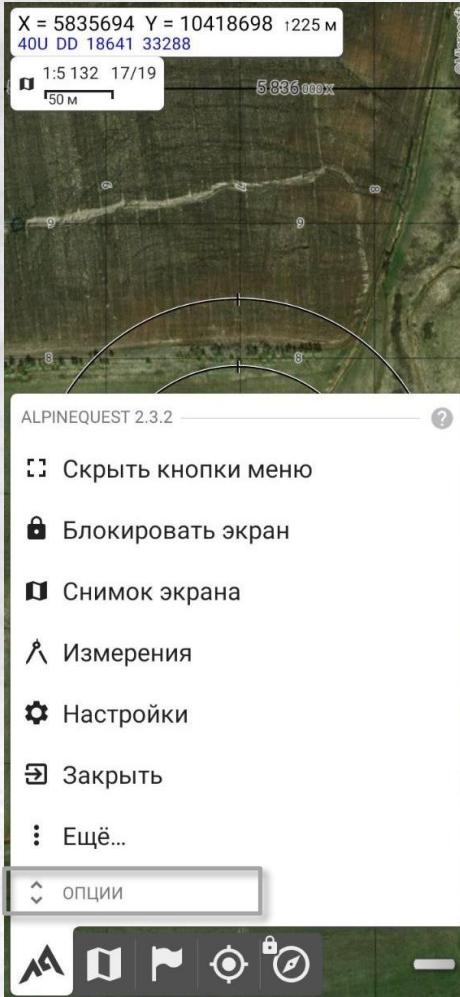
## Main tasks: Artillery reconnaissance and fire correction.

Correcting artillery fire to the sides of the world (using AlpineQuest application as an example)

7. Go to the Options menu.

8. Put a highlight on the items:

- Show grid: SC-42;
- Show circular scale .





# Tasks solved by quadcopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

Correcting artillery fire to the sides of the world (using AlpineQuest application as an example)

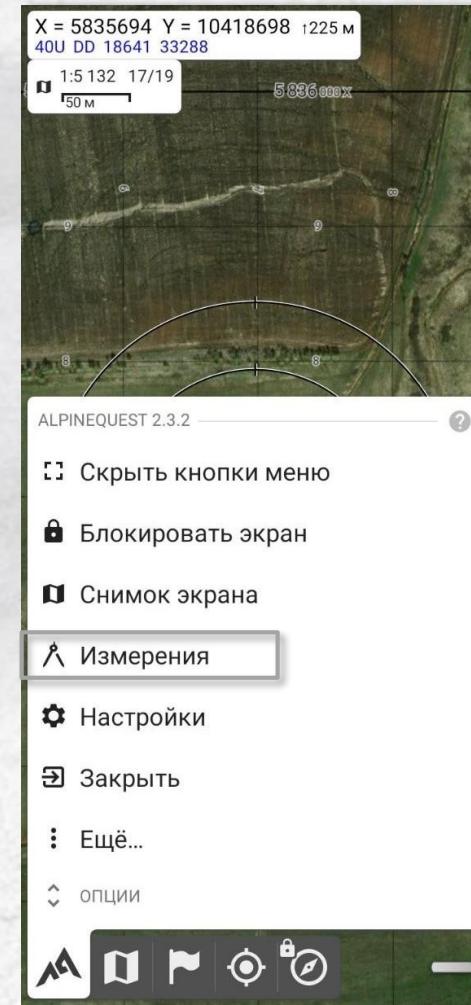
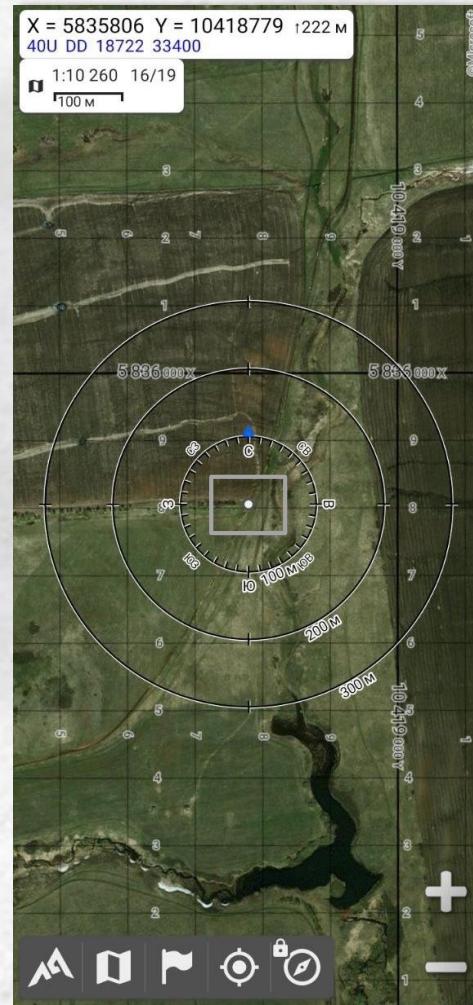
9. Aim the center of the screen (white dot) at the target.

10. Go to the "Measurements" menu.

11. Locate the gap. Aim the center of the screen at the gap. Transmit correction according to the sides of the light from the target (target-zero, reference point).

Ю -110

3-80





# Tasks solved by quadrocopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

**Correcting artillery fire by transmitting rupture coordinates (using AlpineQuest application as an example)**

1. After detection the target and the nature of its destruction, you need to transmit the coordinates of its location.

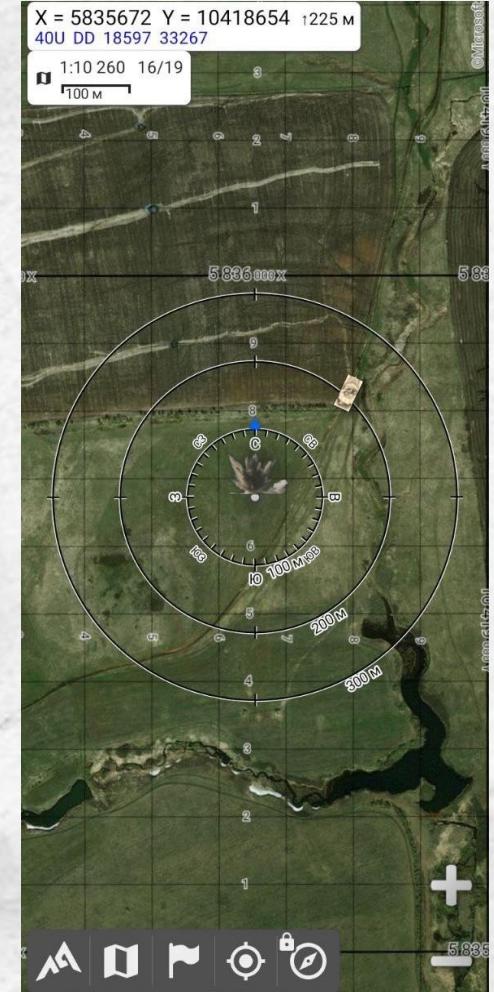
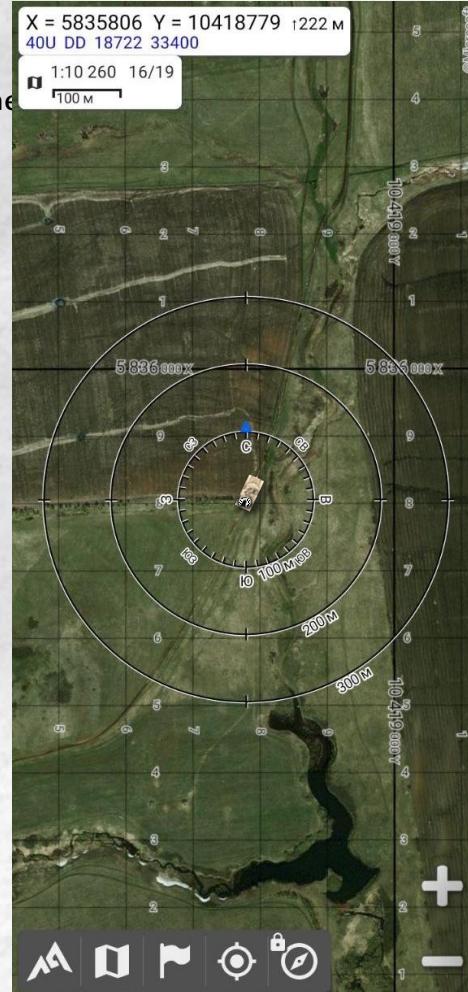
2. Organize interaction with means of destruction. Specify the start of opening fire, type of ammunition, flight time, method of adjustment, and ammunition limitations.

3. Prepare for the adjustment. Replace the battery on the drone, if the adjustment will be made in a way that "carousel" to prepare the second drone.

4. Check the configuration of the AlpineQuest application.

5. Once a rupture is detected, transmit its coordinates.

**X=5835672 Y=10418654**





# Tasks solved by quadcopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

### Correction of artillery fire by sides of the horizon relative to the direction of fire

(mainly for tank adjustment. Using AlpineQuest application as an example)

1. Once the target and the nature of its actions have been detected, the coordinates of its location must be transmitted.
2. Organize interaction with the target. Specify the start of opening fire, location of opening fire, type of ammunition, flight time, method of adjustment, and ammunition quantity limitation.
3. Prepare correction. Replace the battery on the drone, if the correction will be by the "carousel" method, prepare the second drone.
4. Check customization application AlpineQuest. Check items:
  - The location format is *SC-42*;
  - The distance format is *Metric*.
5. Remove the highlighting on items:
  - Show grid: *SC-42*;
  - Show circular scale .

The screenshot shows the AlpineQuest 2.3.2 application interface. At the top right is a vertical toolbar with icons for menu, lock screen, screenshot, measurements, user button, settings, close, and more. Below it is a main menu bar with 'ALPINEQUEST 2.3.2' and a help icon.

The central part of the screen displays a map with a target location marked. A callout box shows coordinates: X = 5835694 Y = 10418698 1225 м, 40U DD 18641 33288, 1:5 132 17/19, 5836000x, and a 50m scale bar.

A floating 'Настройки' (Settings) window is open, containing the following sections:

- ЕДИНИЦЫ ИЗМЕРЕНИЯ**:
  - Формат местоположения: CK-42 (Gauss-Kruger zones), X = 5835694 Y = 10418698
  - Дополнительный формат мест.: MGRS, 40U DD 18641 33288
- Формат расстояния**: Метрический (м, км)
- Формат единицы площади**: Метрический (м<sup>2</sup>, км<sup>2</sup>)
- Азимут**: Градусы (360°)
- Уклон**: Проценты (%)
- Давление**: Гектопаскаль (гПа)
- Направление на север**: Координатный север
- ОБЩИЕ**: Путь к кэшу карт

At the bottom of the settings window, there is a note: 'Выбрать место сохранения кэша карт. После изменения перезагрузите приложение.'

The bottom of the screen shows a toolbar with icons for map, compass, flag, location, and settings, along with a zoom slider.



# Tasks solved by quadcopter-type UAVs

## Main tasks: Artillery reconnaissance and fire correction.

### Adjustment of artillery fire to the sides of the horizon relative to the direction of fire

(mainly for tank adjustment. Using AlpineQuest application as an example)

6. Draw a line from the firing point across the target and orient this line vertically.
7. Put the measurement on target.
8. Find the discontinuity, put a second measurement point on the discontinuity.
9. Draw a perpendicular to the correction line, suppress the third measurement point.
10. Along the correction line, draw a line to the target and place the fourth measurement point. The result should be a triangle.
11. Pass the proofreading.

**Next, 164.**

**Law - 79**

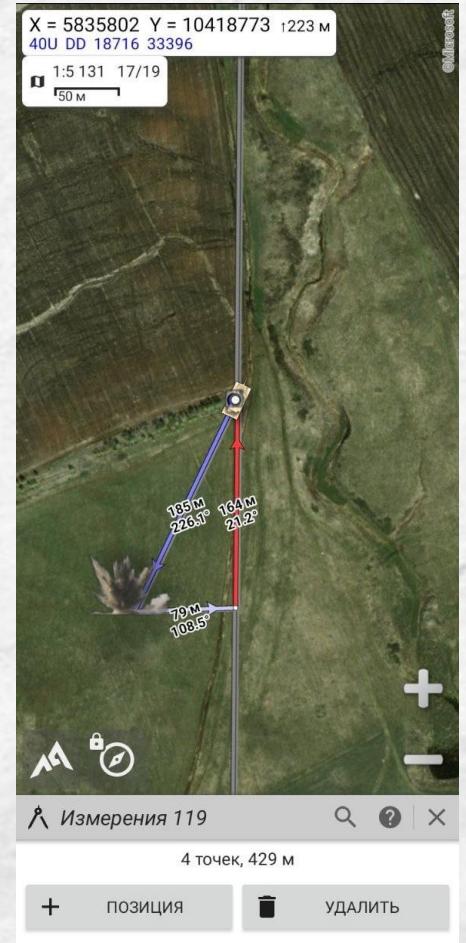
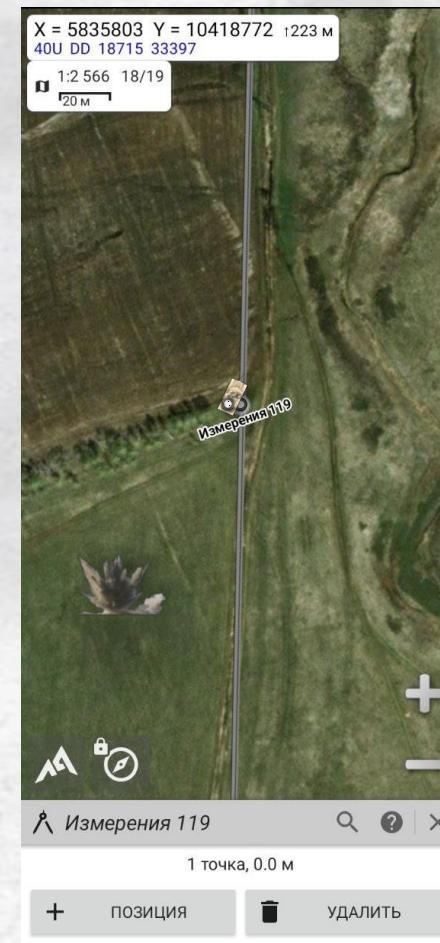
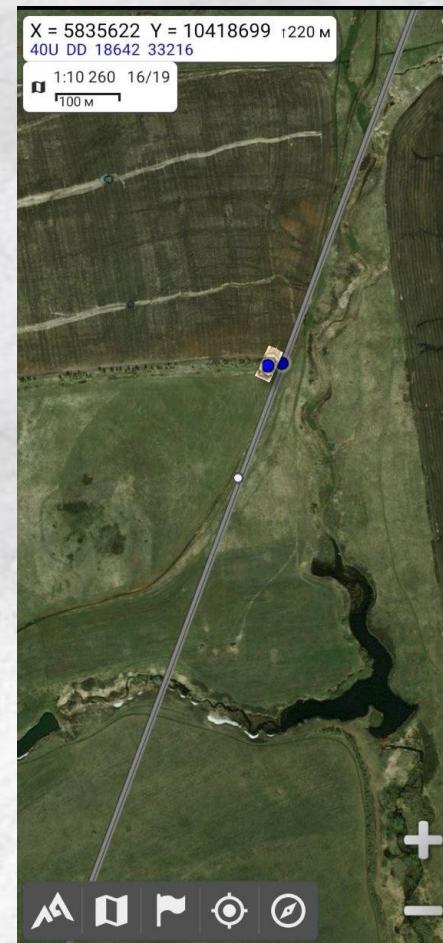
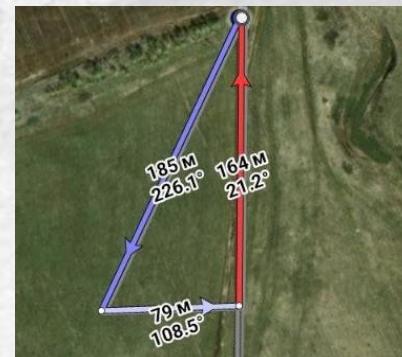
Correction:

further away - closer

right-left

Can be given either relative to the target or relative to the gap.

To be coordinated with the crew





# Broadcasting the quadcopter image (screen)

The main applications for screen broadcasting:

## 1. Telegram



## 2. PRISM Live



## 3. COS 2.0



## 4. PO Eye/Thunderbolt



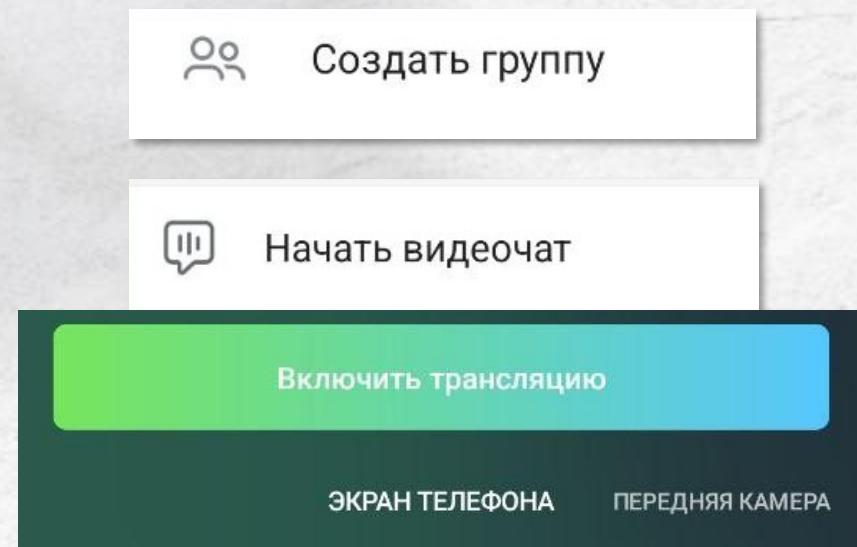
## 5. RTMP

Broadcast via

Telegram

1. Install Telegram, register a user.
2. Create a group.
3. Add required participants.
4. Start a video chat.
5. Enable screen broadcasting.
6. Collapse Telegram.
7. Open the flight app, start the flight.

*Do not record the screen from the remote control function, the broadcast is interrupted*





# Broadcasting the quadcopter image (screen)

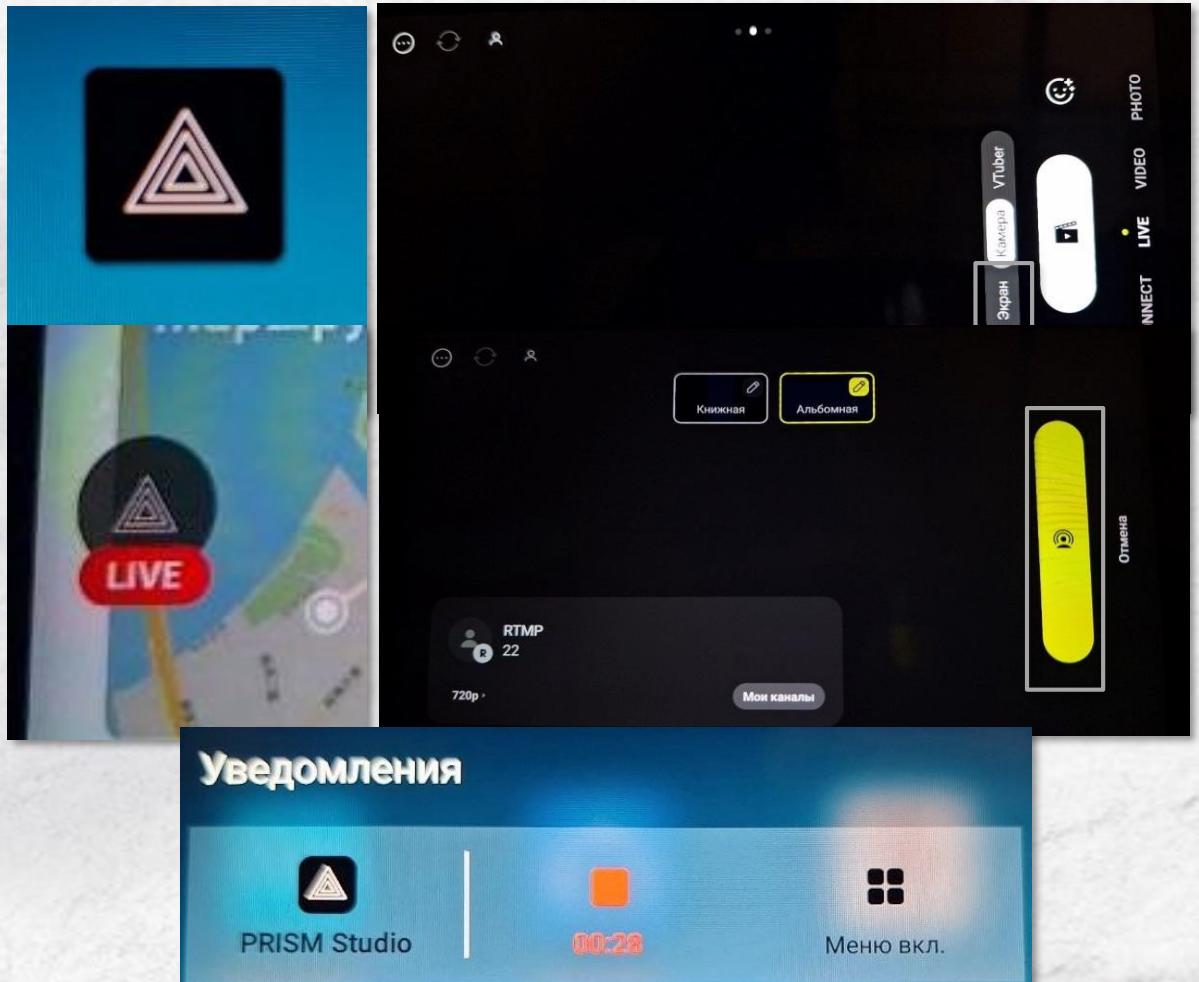
## Broadcast via Prism Live



PRISM Live is an application for filming and editing live broadcasts, videos and photos using various effects. Broadcasting is carried out via the Internet. It is possible to create your own servers.

1. Start the remote.
2. Connecting WI-FI.
3. Open the PRISM Live program.
4. Select "Screen."
5. Click on the button to start the broadcast.
6. Select a channel. If broadcasting is carried out from several consoles, but from one account, they will get their own channels. Select the desired channel.
7. Click on the button to start the broadcast.
8. Exit the PRISM Live program. On the DJI RC Plus remote control (rm700) press the "back" button twice.
9. A floating button appears.
10. A countdown from the beginning of the broadcast will appear in the notification window.
11. Launch the DJI Pilot 2 app, start working.
12. If you need to pause the broadcast, click on the floating button.
13. In the window that appears, click the "Screen Saver" button. The broadcast will not end, but will be replaced by a static screen saver. If you want to continue the broadcast, click "Screen saver" button again.

*Do not record the screen from the remote control function, the broadcast is interrupted.*





# Broadcasting the quadcopter image (screen)

## Broadcasting the screen of the remote control with the COS software

COS 2.0

Installed on RC, RC PRO, RC PLUS, supports all 3 series DJI (Mavic3 including), M30/300/350, Air2S.

To broadcast to android devices, you need to:

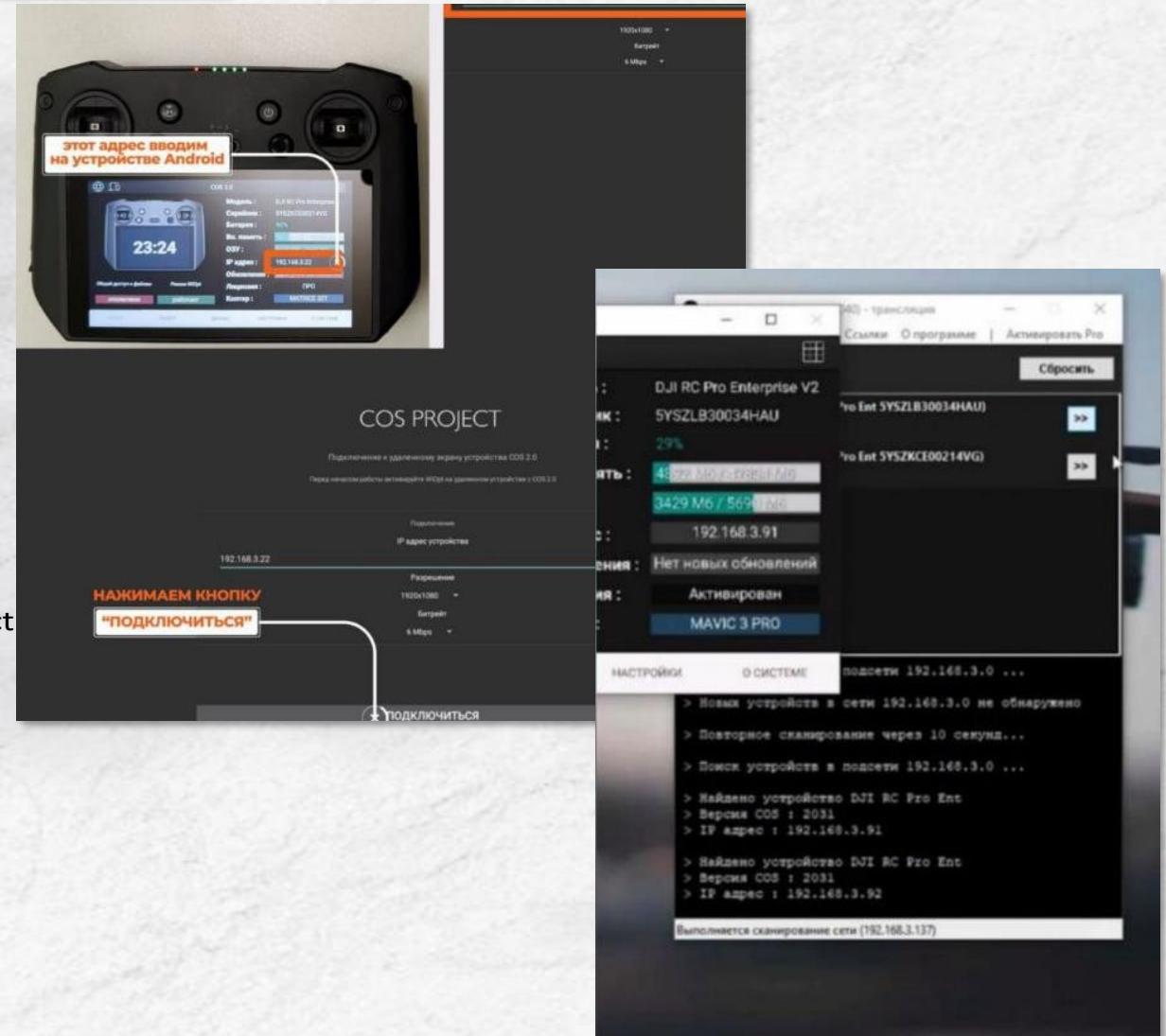
1. Install the RemoteDesk program;
2. Start the remote with COS;
3. On the android device, start RemoteDesk;
4. In RemoteDesk enter IP address remote (specified on the main screen in COS);
5. Click CONNECT.

Broadcasting from the COS console to a PC is required:

1. Install the Companion program on the PC;
2. Start the remote with COS;
3. Start Companion on the PC device;
4. Press button "Mode operation mode" и select "Broadcasting."

In auto mode, the program itself will scan the network for devices with COS, in manual mode you will need to manually enter the IP-address of the remote control (found on the main screen of the remote control). The list of devices in the network will appear, if automatic broadcasting does not start, press the button.

{ "broadcast".





# Broadcasting the quadcopter image (screen)

## RTMP

### Setting up broadcasting from commercial drones

There are three components involved in the video broadcasting process:

1. Video source - drone or stationary camera
2. Server - is, that receives, processes, records the video stream
3. The client - tho, c from which you can processed video stream from the server to view

### STEP 1: Server Setup

1. Download the MediaMTX video server software. This is a simple and free software. It can be installed on a regular desktop or laptop. The main thing is that this device should be in working condition 24/7 and connected to the network.
2. Find out the ip address of the server, i.e. the computer on which MediaMTX is running. To do this, from the computer go to the command line (cmd) and there run the command ipconfig. The address will be in the IPv4 line as XXX.XXX.XXX.XXX. For further example, let's assume that the ip address of your server is 192.168.50.10

**STEP RESULT:** You now have software running on your PC / laptop that will be able to receive video feeds from drones

### STEP 2: Setting up the source - broadcasting video from the drone (example for Mavic 3).

The same way you configure the broadcast for Autel.

1. Opening the DJI Fly app
2. Go to the menu (three dots in the upper right corner)>> Transmission >> Live streaming platforms>> RTMP
3. In the "RTMP address" field enter rtmp://ip address/video stream name. Let the stream from this drone be called VID1, then for our example with the server the broadcast address will be rtmp://192.168.50.10/VID1
4. Select the video stream settings and click "Start"
5. For other drones, all settings are similar, but you need to select different stream names.

**RESULT OF STAGE:** A video is streamed from your drone to your PC/laptop. You can check the work for the first example by going to <http://ip address/name of the video stream> in any browser.

### STEP 3: Organize and configure video stream output (client)

1. The easiest and fastest way is to display the stream from each drone on a separate browser window. Several windows with video from different sources can be displayed as a video wall on the screen.
2. There can be several clients to one server, including on different clients it will be possible to select those broadcast windows that the operator needs.

**STEP RESULT:** You have one or more drone video streams on your browser screen



# Cloaking

**Disguise** is a set of measures aimed at concealing troops and objects from the enemy, at misleading him about the presence, location, composition, actions and intentions of his troops, the plan of upcoming actions.

*Camouflage is aimed at achieving surprise action, increasing survivability and preserving the combat effectiveness of troops.*

## The main objectives of tactical camouflage:

1. Ensuring the secrecy of unit operations.
2. Ensuring plausibility intentions and troop activities.

false command

## Ways of accomplishing tactical camouflage tasks:

1. Concealment.
2. Imitation.
3. Demonstrative Actions.

Good camouflage, can significantly extend the service life of the equipment

### Disguising your actions:

1. Do not take off towards the enemy;
2. Change and camouflage takeoff and landing points;
3. Disguise trails and paths of travel;
4. Light camouflage (do not use white lights at night and do not allow dugouts to be seen through);
5. Sound masking (place generators as far away as possible to improve audibility).

### Imitating your actions:

1. Equipment of false positions and takeoff (landing) points;
2. Periodic simulation of activity in these positions. Moving masks, pulling tents, setting up trench candles to simulate heat signatures.

### Disguising one's positions:

1. Equipment and camouflage of operator's workplaces and places of residence;
2. Masking antennas;
3. Wire Masking;
4. Masking the locations of power generators;
5. Masking points unloading и reloading and locate them as far away as possible from workplaces.



## Disguise

It is important to realize that it is quite difficult to hide the silhouette of a mast/tracker with equipment, so the complex can be camouflaged only in conjunction with the use of natural plantings/development/relief, etc.

An antenna in the center of the field is doomed to defeat, so the use of camouflage covers and camouflage nets, combined with stealth, will add to the survivability of the equipment, but it must be remembered, in nature there is almost nothing geometrically correct, the rectangle of the net is very distinguishable from the drone.

Naturally, of course to use only radio-transparent paints to mask the antennas so as not to degrade the signal quality. In winter, white plaster and gauze are excellent. You can wrap the antenna in food film (protects it from moisture and does not affect its operation) and paint the antenna on top of it.

In an urban area, you can use burlap, pieces of Styrofoam, homemade and factory-made covers, pipes and the antenna turns into a pile of garbage.

It is also worth considering feeding the antennas from the dugout, so that they are not removed for charging and thus not demasked.

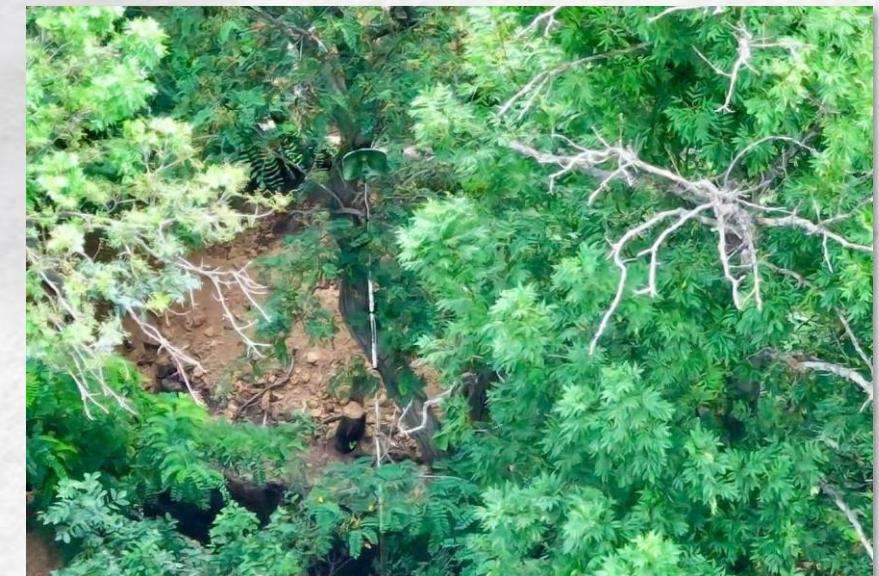
**The means of camouflage only work effectively in conjunction with properly made decisions.**





# Disguise

## Examples of equipment camouflage





# Search for lost drones

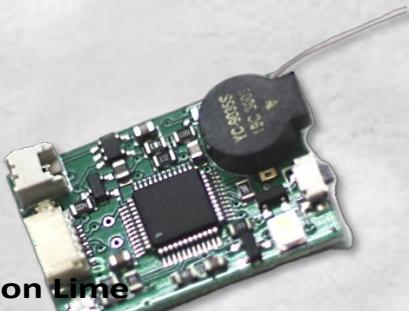
## The tBeacon search engine

In the process of training activities, it is not uncommon to lose drones. To find a lost drone, the tBeacon search system, which consists of:

- tBeacon Onyx or tBeacon Lime.
- The tBeacon Findy S device.



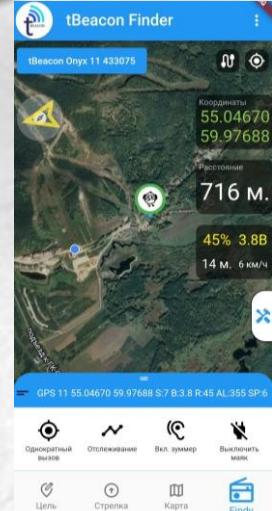
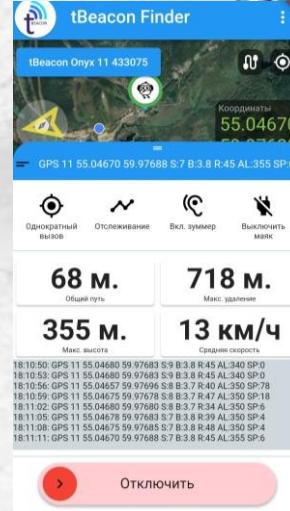
tBeacon Onyx beacon



tBeacon Lime



Findy S tBeacon device



## FEATURES:

1. Built-in GPS. No unnecessary connections - everything is already on board;
2. Activates on call. Does not interfere with the electronics on board, so sleeps until it hears the call;
3. Talks by voice. Dictates coordinates by voice into the radio, you only need to enter them into the navigator and find the lost person;
4. Long Range. The repeater in LoRa mode is capable of detecting a lost beacon from a distance of more than 20 kilometers (if line of sight is available);
5. Smartphone transmission. Can "whistle" like a phone modem, and the smartphone app tBeacon Finder (Android, iOS) can recognize this and bring you to the target;
6. Supports traditional modes: timer beacon, classic three-tone bearing signal;
7. Built-in high-power LED and siren;
8. Long runtime. 14 days in standby mode with the standard 130mAh battery.

The tBeacon Findy S is the "user" part of the tBeacon Finder. The device can be used standalone or connected to an Android or iOS smartphone and allows you to establish radio communication with a tBeacon (Lime, Onyx or Favis models), determine its location, speed, altitude, distance to it, etc.