

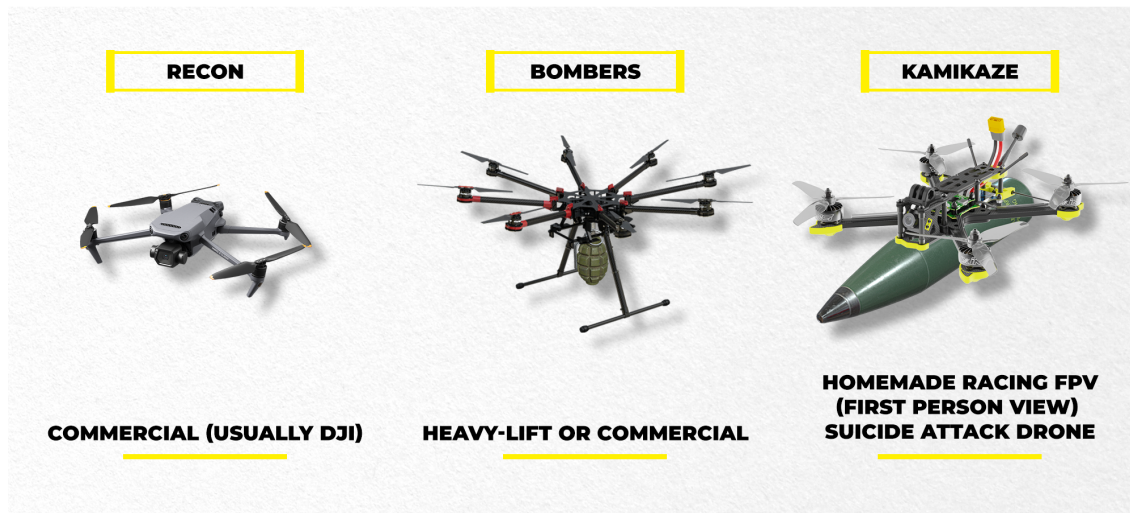
HOW TO BUY DRONES FOR UKRAINE



Purpose of this document

This guide has been created to assist the purchase, modification and delivery of drones to Ukraine's military. It's written from the perspective of a civilian, US-based purchaser but should be applicable to purchasing drones anywhere.

DRONE USES AND TYPES



There are 3 main uses of drones in Ukraine: recon, bombers and kamikaze. The first two are typically commercial drones, typically manufactured by industry-leader DJI.

Kamikaze/FPV drones are typically homemade by small factories in Ukraine.

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Types of drones used by the Ukrainian military

FIXED-WING DRONES



COMMERCIAL QUADCOPTER DRONES








Military drones can be separated into two types: Large, expensive drones typically provided by governments and militaries. This category includes all fixed-wing drones and those with built-in weapons-delivery systems. This guide does not discuss or concern itself with these types of drones, as they are typically inaccessible to most civilian purchasers.



Of the remaining, civilian types of quadcopter drones, they can be broken down into two main types: Commercial and First Person View (FPV). This document will focus on commercial drones manufactured by the DJI company, as they are cheapest and most useful for the majority of Ukrainian military units.

TYPICAL DJI DRONES AND USES

DJI MINI 2	DJI AIR 2S	DJI MAVIC 3	DJI MAVIC 3T	DJI MATRICE 30T
				
TYPE: RECON	TYPE: RECON/BOMBER	TYPE: RECON	TYPE: RECON	TYPE: RECON
COST: \$360 (USED. UNAVAILABLE NEW)	COST: \$1250 (NEW) \$600 (USED)	COST: \$3000 (NEW) \$1800 (USED)	COST: \$5500-\$7500 (NEW)	COST: \$10000 (NEW) ~\$8000 (USED)
USE: DAYTIME	USE: DAYTIME	USE: DAYTIME	USE: DAY & NIGHT	USE: DAY & NIGHT
RANGE: SHORT RANGE < 2 KM	RANGE: SHORT RANGE < 3 KM	RANGE: MEDIUM RANGE < 6 KM	RANGE: MEDIUM RANGE < 6 KM	RANGE: MEDIUM RANGE < 6 KM

Major commercial DJI drone models

DJI Mini 2

Smallest and cheapest commercial drone. Suitable for short-range reconnaissance. A quiet drone with a real life flight time of 20-25 minutes, zoom is 4x. Radio signal is good, but not as good as the Air 2S and Mavic 3. This drone can't carry a grenade. Other characteristics:

- legal to fly without a drone pilot part 107 license
- extremely affordable
- small size / very light: 249g / .5 lb
- good for flying a couple kilometers away from where you are
- good for infantry: check your position and how it's camouflaged
- can help correct an mortar and grenade launchers fire

Links and pricing

- Mini 2 Fly More Combo: Used \$360, New \$600



- Make sure it is not Mini 2 SE, Mini SE or Mini
- <https://www.amazon.com/DJI-Mini-Fly-More-Combo/dp/B08JGX61H7>

DJI Air 2, DJI Air 2S

Medium sized and cost commercial drone. Suitable for 2 km (Air 2) and 3 km (Air 2S) - range reconnaissance and light bombing missions. Has a real life flight time of 20-25 minutes, zoom is 4X (Air 2) and 8x (Air 2S). Radio signal is same as Mini 2 (Air 2), better in Air 2S. The drone can carry 1 bomblet up to 300-400 gram

- Air 2S: <https://www.amazon.com/DJI-Air-Fly-More-Combo/dp/B08Z3DYBMC>
- Air 2S fly more combo \$1250:
<https://www.amazon.com/DJI-Air-Fly-More-Combo/dp/B08Z2VHRFC>
- Air 2 only Used ~ price starts from \$420-\$430 for Fly More Combo

DJI Mavic 3 & DJI Mavic 3 fly more combo

Larger drone with longer flight time, payload and recon capabilities. The DJI Mavic 3 is the most popular consumer drone in Ukraine. The real life flight time is 30-35 minutes, zoom is 28x for all Mavic 3s except Mavic 3 Classic (that has almost no zoom, 3X). The radio signal range is very reliable. The drone can carry up to 2 grenades, but please don't use it as a bomber. They are much more useful for recon missions

- Mavic 3 Fly More Combo \$3000:
<https://www.amazon.com/DJI-Mavic-More-Combo-Omnidirectional/dp/B09HH9BG5M?th=1>

DJI Mavic 3T (Thermal)

The DJI Mavic 3T is similar to the DJI Mavic 3 but it also has a thermal camera. This drone can see in the darkness. Unlike the standard Mavic 3, RemoteID can't be disabled. There are solutions available such as spoofer boards to deal with this.

- DJI Mavic 3T Worry-Free Basic Combo \$5500
https://www.bhphotovideo.com/c/product/1730099-REG/dji_cp_en_00000414_sb2_mavic_3_thermal_with.html
- DJI Mavic 3T Worry-Free Plus Combo \$7500
<https://store.dji.com/product/dji-mavic-3e-and-dji-care-enterprise-basic?vid=123141>

Because drones in Ukraine lose warranty



Details on Types of Drones to Buy

Name	Use	Details	Fly More Combo Cost	Variants
Reconnaissance				
DJI Mini 2	Short range recon	(daytime) Short range < 5 km - Recon 4X Zoom - Fire correction for light mortars, grenade launchers - Platoon situational awareness - Own Camouflage verification - 720p live stream	\$400 (used. Unavailable new)	BUY * Mini 2 DO NOT BUY * Mini * Mini SE * Mini 2 SE
DJI Mini 3 Pro	Daytime short range recon	(daytime) Short range < 5 km - Better Recon 4X Zoom - Fire correction for light mortars and grenade launchers - Platoon situational awareness - Own Camouflage verification - 1080p live stream With special batteries can fly 1.5 times longer than Mini 2 S: I would not recommend Mini 3 Pro. It is unclear of it can be anonymized. A Dutch sniper has Mini 3 Pro that he cant use for this reason.	\$8000 (new)	BUY * Mini 3 Pro DO NOT BUY * Mini 3
DJI Air 2	Daytime short range recon	(daytime) Short range < 5 km - bombing (1 bomblet) - Recon 4X Zoom - Fire correction for light mortars, grenade launchers - Platoon situational awareness - Own Camouflage verification - 1080p/720p live stream	\$450 (used) Unavailable new)	BUY * Air 2 DO NOT BUY * Air 3 (YET)



Recon/Bombing				
DJI Phantom 4	Daytime short range bomber	(daytime) Short range < 2 km - bombing (2 bomblets) - Recon 2X Zoom - Fire correction for light mortars, grenade launchers - Platoon situational awareness	\$400 (used)	
DJI Air 2S	Daytime short range recon & bombing	(daytime) Short range < 6 km - bombing (1 bomblet) - Better Recon 8X Zoom - Fire correction for mortars, artillery, grenade launchers - Platoon situational awareness - Own Camouflage verification - 1080p live streaming	\$1250 (new) \$700 (used)	BUY * Air 2S DO NOT BUY * Air 3 (YET)
DJI Mavic 3	Daytime medium range recon	(daytime) Short range < 8 km - Better bombing (2 bomblets) - Mavic 3 Great Recon 28X Zoom - Mavic 3 Classic BAD Recon 3X Zoom - Fire correction for heavy mortars, tube artillery - Company / Battalion situational awareness - 1080p live streaming - Can bomb with but wasteful to do so S: Mavic 3 classic and Mavic 3 Pro cant be anonymized yet. I recommend removing them from this guide.	\$3000 (new) \$1800 (used)	BUY * Mavic 3 * Mavic 3 Pro EXPENSIVE BOMBER * Mavic 3 Classic TOO EXPENSIVE * Mavic 3 CINE See below for details



<p>DJI Mavic 3T (Thermal)</p>	<p>Day & night medium range recon</p>	<p>(day and night) Short range < 8 km</p> <ul style="list-style-type: none"> - Mavic 3T Excellent Recon 56X Zoom - Thermal camera 640x512 - Fire correction for heavy mortars, tube artillery - Company / Battalion situational awareness - 1080p live streaming - Can bomb with but wasteful to do so 	<p>\$5500-7500 (new)</p>	<p>BUY * Mavic 3T</p> <p>TOO EXPENSIVE, NO Thermal * Mavic 3E</p> <p>See below for details</p>
<p>DJI Matrice 30T</p>	<p>Day & night medium range recon</p>	<p>(day and night) Short range < 8 km</p> <ul style="list-style-type: none"> - Matrice 30T Awesome Recon 200X Zoom - Thermal camera 640x512 - Fire correction for heavy mortars, tube artillery, MLRS - Company / Battalion situational awareness - 1080p live streaming - Can bomb with but wasteful to do so 	<p>\$10000 (new) ~\$8000 (used)</p>	<p>BUY * Matrice 30T</p> <p>TOO EXPENSIVE, NO Thermal * Matrice 30E</p> <p>See below for details</p>
<p>DJI Matrice 300 RTK + H20T Zenmuse camera</p>	<p>Day & night medium range recon</p>	<p>(day and night) Medium range < 10 km</p> <ul style="list-style-type: none"> - Matrice 300T Awesome Recon 200X Zoom - Thermal camera 640x512 - Fire correction for tube artillery, MLRS - - Company / Battalion situational awareness - 1080p live streaming - Bombing (2 bomblets), but wasteful to do so 	<p>\$19000 (new) ~\$10000 (used)</p>	<p>BUY * Matrice 300 RTK + Zenmuse H20T</p>

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FVP/Kamikaze/Suicide				
Homemade 3D printed	Day FPV	(daytime)	\$400-500	
Homemade 3D printed	Nighttime FPV	(night time) With τη	\$600-800	

Details

- DJI is generally agreed to be the best manufacturer for commercial drones, if buying this type for infantry units to conduct recon use of the drone.
- Mavic 3s are most commonly requested but not necessarily best. Certainly not the cheapest
- We recommend buying DJI drones as Fly More Combo or buy extra batteries and make sure the drone has a charger hub.
- Max flying distance 30 km is unrealistic in practice. Mavic 3 range is 6-8 km. Longer range requires double batteries and significantly increases chances of losing the drone.

Future considerations

Availability of new Mavic 3, Air 2S and Mini 2 will be limited in the near future because they are replaced by newer drones. But still these are the drones to get because they are customizable with improved signal range, no fly zone removal and most importantly RemoteID can be disabled so they are not visible by the drone detection system DJI Aeroscope.

More and more units are requesting custom-made FPV drones rather than off-the shelf commercial (typically DJI) drones. Contact us if a unit you support needs FPV drones.



DJI drones to avoid

- DJI Mini 3 (RemotelD can't be disabled)
- DJI Mini 3 Pro (RemotelD can't be disabled)
- DJI Mini 2 SE (Poor signal range)
- DJI Mavic 3 SE - too expensive while has no night-time capabilities
- DJI Mavic 3 Classic (RemotelD can't be disabled and too expensive as a bomber)
- DJI Mavic 3 CINE - too expensive for recon / fire correction
- DJI Mavic 3 Pro (RemotelD can't be disabled)
- Matrice 30E is too expensive while has no night-time capabilities



FPV Kamikaze drones



“FPV” refers to “First Person View” meaning the operator of the drone uses FPV goggles to get a first person view from the drone. These drones are typically cheaper, custom-made and used for kamikaze suicide missions to deliver explosives to a tank or bunker.

- Extremely useful. Manufactured in Ukraine and everywhere in the world including Russia and China.
- Typical role: kamikaze drone destroying armor, weapons, personnel in range of 10-15 km.
- Carries 1-2 kg warhead up to 10-15 km.

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- Typical cost of a single FPV drone is \$300-600. Up to \$600 for the best long-haulers. Video signal is analogue, as opposed to the usual digital. FPV drones with digital video signal may cost a tiny bit more.
- Ukraine needs 100,000+ per month.



FPV drone manufacturing workshop in Ukraine

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Ukrainian soldiers attaching RPG warhead to a FPV drone

Most popular and well known Ukraine FPV drone manufacturers are [TORO](#) and [Escadrone](#)

Each unit uses particular FPV drones and unlike DJI drones they have more differences. It is not recommended to purchase FPV drones in a shop before making sure that particular unit uses exactly that type of drones.



How to know which kind of drone to buy

Key is to supply the right kind of drone to the right unit. A Mini drone is not right for bombing, there is no sense in supplying an expensive Mavic 3 for short-range recon missions, and none of these DJI drones are appropriate for suicide Kamikaze/FPV missions. Critical to ask the unit which type of drone they need.

Questionnaire

We've developed a questionnaire that we send units. It asks the following questions:
(Contact us for the Ukrainian-language version of this questionnaire)

In order to properly provide the correct drone type to the requesting Ukrainian military unit, we require some basic information about the unit and the intended use of the drone.

- *On which direction (military front) does the unit operate?*
- *Is the drone needed on the front line ("zero-line")? Or is it anticipated to go to the front line soon? Or is the drone needed behind the front line? Maybe for pilots training? Or for pilots training and then for the frontline?*
- *Which drone training did pilots go through? Did they receive a certificate?*
- *If they haven't, are there experienced pilots nearby who committed to train new pilots and make sure they will fly safely?*
- *Which drones have pilots worked with?*
- *What are typical planned missions for this drone?*
- *What are typical ranges of mentioned missions? In other words, how far the drone needs to fly from RC?*
- *What kind of antennas are you using if any?*
- *Which drones are needed and how many batteries per drone are needed?*
- *How urgent is the need?*

Additional purchase considerations

- How much Zoom is needed
- Motion-correction needed for fast flying?
- Flying in the wind? Rain? Snow?



Drone Jamming (C-UAS)

C-UAW (Counter-Unmanned Aerial Vehicle) weapons, also known as ECM (Electronics Countermeasures) weapons are beyond the scope of this document. Be aware that they exist and are a constant concern for drone operators. The Russians have plentiful and powerful ECM assets. To help foil this, it is important to anonymize, reprogram and signal-boost drones before delivery to the unit. Contact us for more information or a list of drone jamming manufacturers.

Drone Components

OPTICS

Gimbal-ed cameras

All recon drones have cameras mounted on motion-stabilized gimbals. This allows them to take clear video while on flight. Whereas FPV racing drones (typically used for kamikaze or suicide missions) use cameras fixed to the drone, to be inexpensive.

Optical vs digital zoom

Zoom is critical for drones as it allows them to safely stay far back and still see the action

Night vision

We don't know of any drones using regular night vision like a PVS-14 monocular. Instead, all night vision-enabled drones seem to be equipped with thermal vision, which is better.

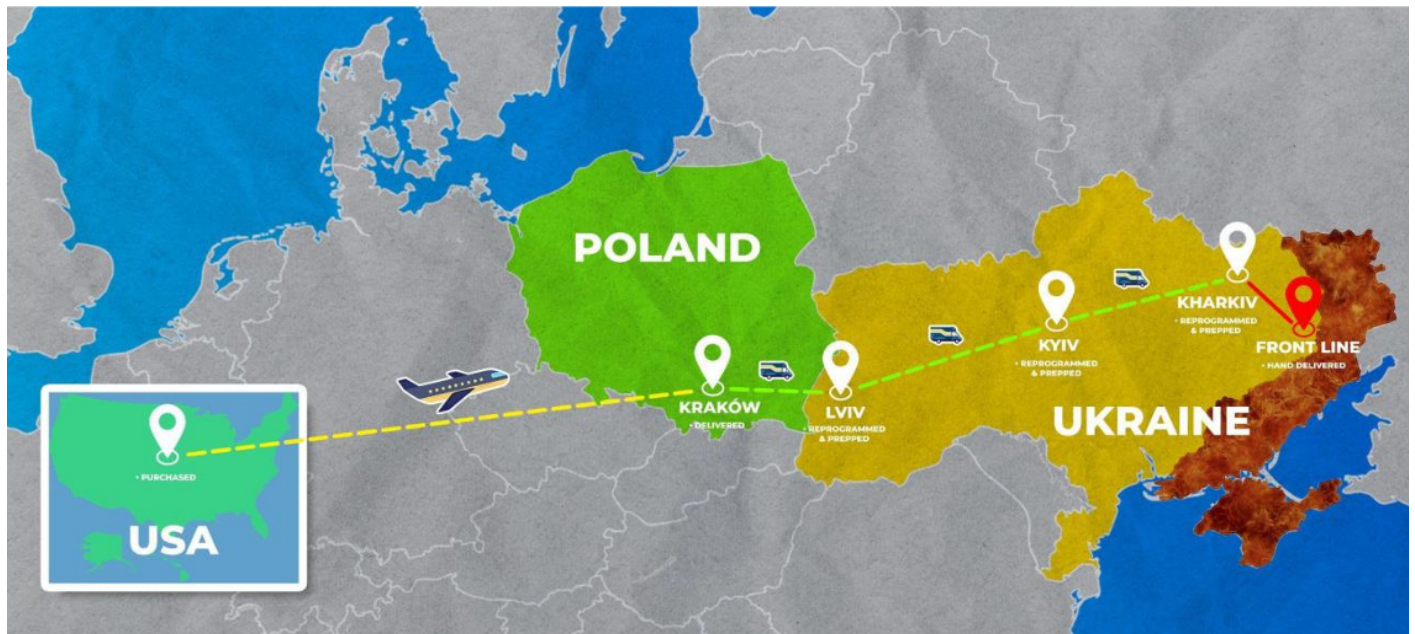
Thermal optics

Thermal cameras detect IR radiation (heat) from the ground. This allows them to sense humans or running vehicles very effectively, especially during night time or winter. This is a very efficient way to detect soldiers storming your position or to correct artillery fire. Most importantly this optic allows using the drone at night or to spot soldiers using camouflage.

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HOW TO BUY DRONES



- Drones are typically cheaper in the US so bought here then flown to Poland, then transported to a Ukrainian city where the drones are improved (anonymized and signal boosted), then sent via Nova Posta or driven by a volunteer to the actual unit.
 - Best to contact us first, so that you can buy the right drone and have it sent directly to the reprogramming center
 - Best to buy new on Amazon or eBay. If buying on eBay, best to coordinate with us to not compete bidding.
 - With all DJI drones, try to buy the “Fly More Combo” for cheaper deals on essential accessories and extra batteries. It typically consists of 2 extra batteries, 6 extra propellers, a charging hub and a bag
 - Once bought, have the drone sent to be reprogrammed here in US, Ukraine or Poland. • Once reprogrammed, the drone should be delivered to the recipient military unit in Ukraine by a trustworthy courier who will ensure it’s properly delivered and that any needed receipt paperwork or photos are collected.

NOTE: Do not attempt to send drones via Meest to Ukraine! US Customs has recently been stopping the shipment of drones, presumably because of the batteries which are a fire hazard. This has been experienced on the West coast of the USA. East coast Customs may be more understanding.



- Buying used
 - There are great deals on drones, especially ones slightly damaged. But please coordinate with us before bidding so we do not compete!
 - Sometimes used models are actually better than new as the newer ones can be harder to reprogram.
- Buying in US vs EU
- Drone range is throttled down in Europe. Drones can have 4x the range in the US than in Europe, due to stricter regulations in the EU. There are ways to deactivate this and activate “Signal Boost Mode” in Ukraine.

SOURCES TO PURCHASE

- In USA

- New**

- Amazon
 - Costco (Link) - Good prices but limited selection.

- Used**

- eBay
 - Craigslist
 - OfferUp/Facebook marketplace
 - Forums
 - Pawn Shops

- In Europe

- Amazon
 - Marktplaats (NL)
 - eBay

- In Ukraine

- All the above. Contact us for couriers/shipping options
 - Dedicated drone shops (but prices will be higher)



Accessories

Cases

Many of the cases provided with the drones are not ideal. Important to find a hard-sided and waterproof case, with good shoulder strap. Many drone operators keep the drones in the original packaging. Add foam to lightweight bags for additional impact padding.

Batteries

Some special forces drone units have 30 batteries per drone because they fly nonstop. For normal units we suggest supplying 4-6 batteries.

External antennas

External antennas are very important for several reasons. Most importantly, it allows the operator to safely stay under cover while piloting. Since the enemy can easily radio-triangulate the signal coming from the drone controller, this is critical to keep the operator alive. The antenna also allows for a stronger signal, allowing the drone to travel farther and reduces (but doesn't remove) the risk of jamming.



External antennas boost signal and allow drone pilots to fly from shelter

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HOW TO FLY DRONES, IN UKRAINE

Learning how to fly drones in a combat environment is very different from drone piloting for fun or a civilian job. Teaching this critical skill is beyond the scope of this document. Contact us for a list of resources and flight schools.

FURTHER RESOURCES

- How to buy drones on eBay <https://www.youtube.com/watch?v=xTMOP7fID1s>
(Ukrainian language. Turn on auto generated English captions)
- <https://www.nytimes.com/2023/05/08/world/europe/ukraine-russia-attack-drones.html>