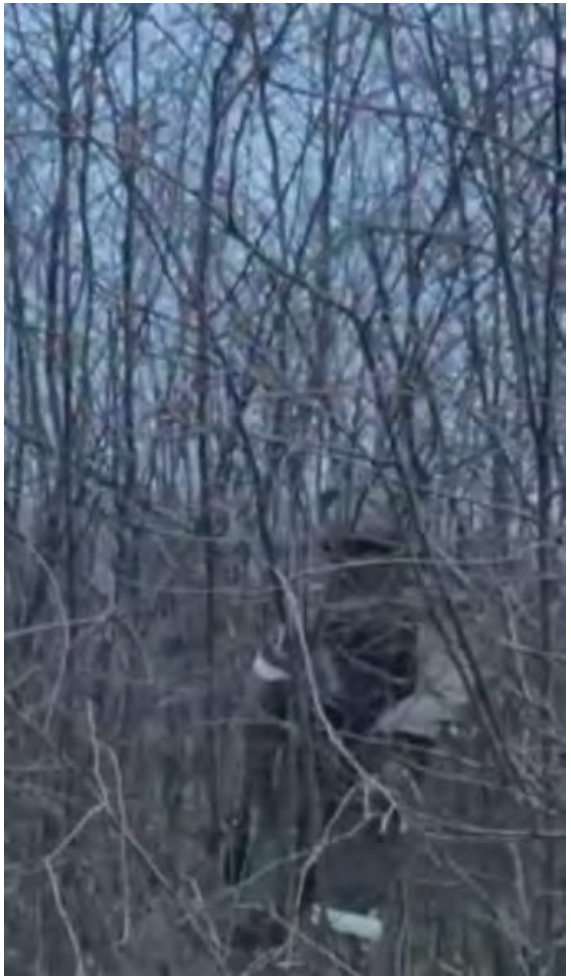
Protection

CREATING FALSE POSITIONS



Comment from the author: layouts should be realistic, false positions should be equipped with logic in mind, and quality should not be neglected.

Protection against UAVs:

CREATING FALSE POSITIONS

USE REALISTIC MODELS OF EQUIPMENT, SIMULATE PROCESSES

Protection against UAVs:

Set of heat emitters

Author's comment: The presence of heat simulators at a false position increases its realism and effectiveness significantly. In combination with mining, it is possible to hit drones without exposing oneself and without risk to UAV countermeasure teams.

CREATING FALSE POSITIONS

HEAT SIMULATORS:

Trench candle (5-8 hours of burning)

KFP-1 catalytic wick stove (unleaded gasoline, 4 liters for 60 hours)

Detection and countermeasures against UAVs:

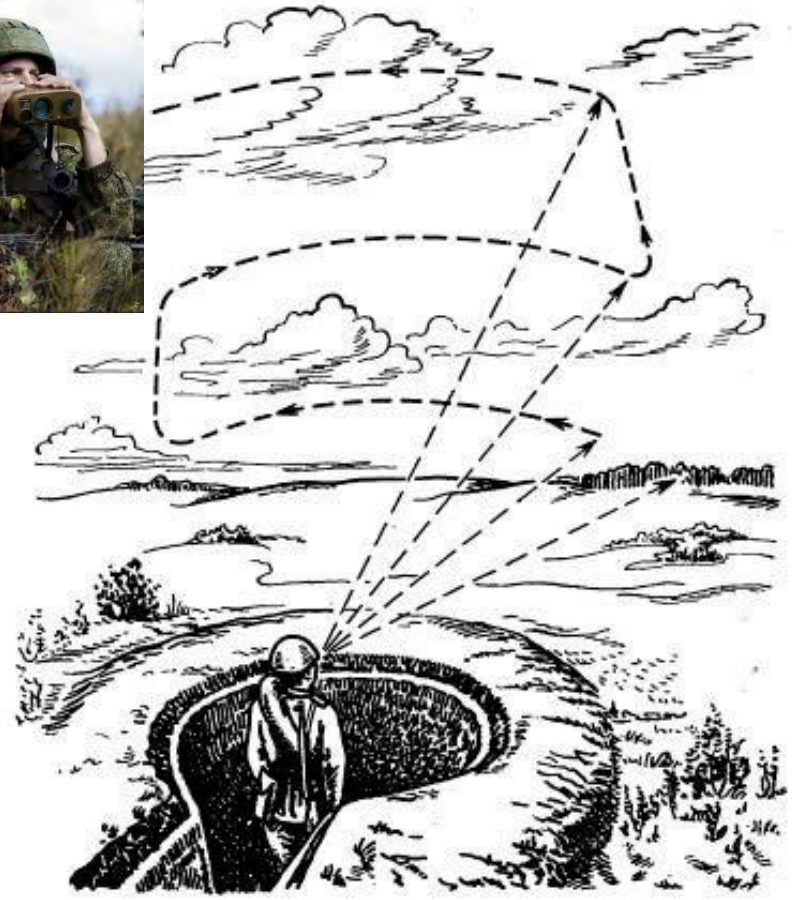
AIR SURVEILLANCE ORGANIZATION (ASO):

1. Placement. PVNs are placed in open areas that provide a view of the airspace of the protected territory in all directions, away from sources of extraneous noise. In urban conditions, it is advisable to place PVNs on the roofs of buildings (structures).

2. Equipment. The PVN must be camouflaged and provide protection for the observer-shooter.

3. Post composition. As a rule, two or three scouts are assigned, one of whom is the senior scout. The personnel of the observation post must have personal weapons, means of night and day observation (optical, optoelectronic devices, thermal imagers), means of communication and warning, supplies of food, water, and other means necessary for conducting long-term covert observation of the airspace.

AIR TERMIN
OBSERVATIONS



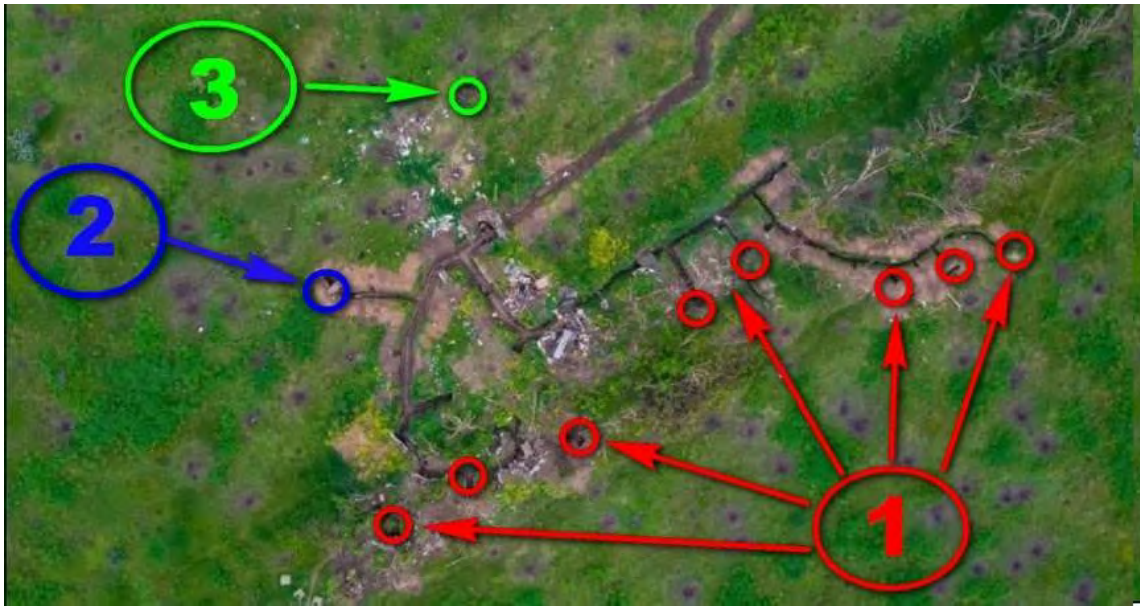
Schematic diagram of airspace observation by an observer

Detection and countermeasures against UAVs:

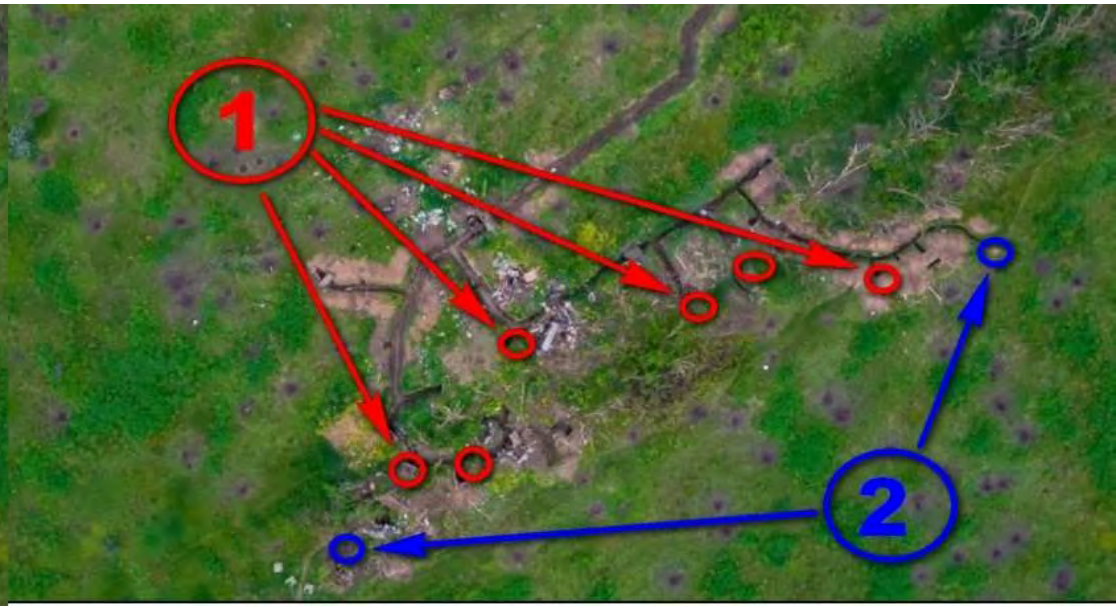
AIR TERMIN

OBSERVATION

OPTIONS FOR THE LOCATION OF THE OBSERVATION POST



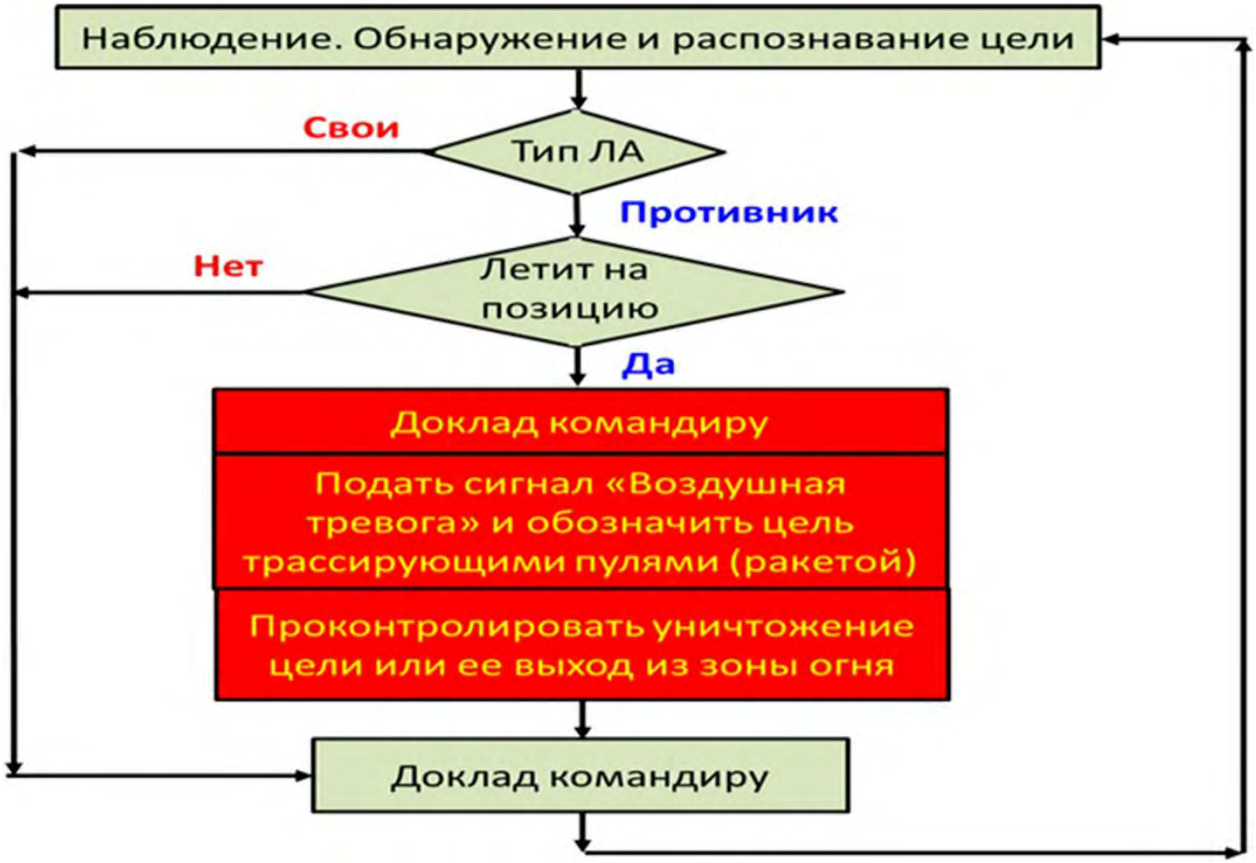
A. Observer in the rear



B. Observers on the flanks

The terrain features should be taken into account: it is advantageous to use heights, buildings, etc. for observation and detection.

Actions to take when detecting a UAV in the air:



Algorithm of actions for the observer

- Upon detection of an unknown UAV over (or near) the facility, immediately report this to to your immediate supervisor.
- When detecting a UAV, you are required to give an air hazard signal - AIR! BIRD! DRONES! (It doesn't matter which word you shout, it is important that you are understood).

Methods for detecting UAVs:

OPTICAL CONTROL

Includes cameras, thermal imagers, and other optical sensors that can detect drones by their visible or thermal radiation.

A observers, they can be supplemented with external e,
even be ineffective.

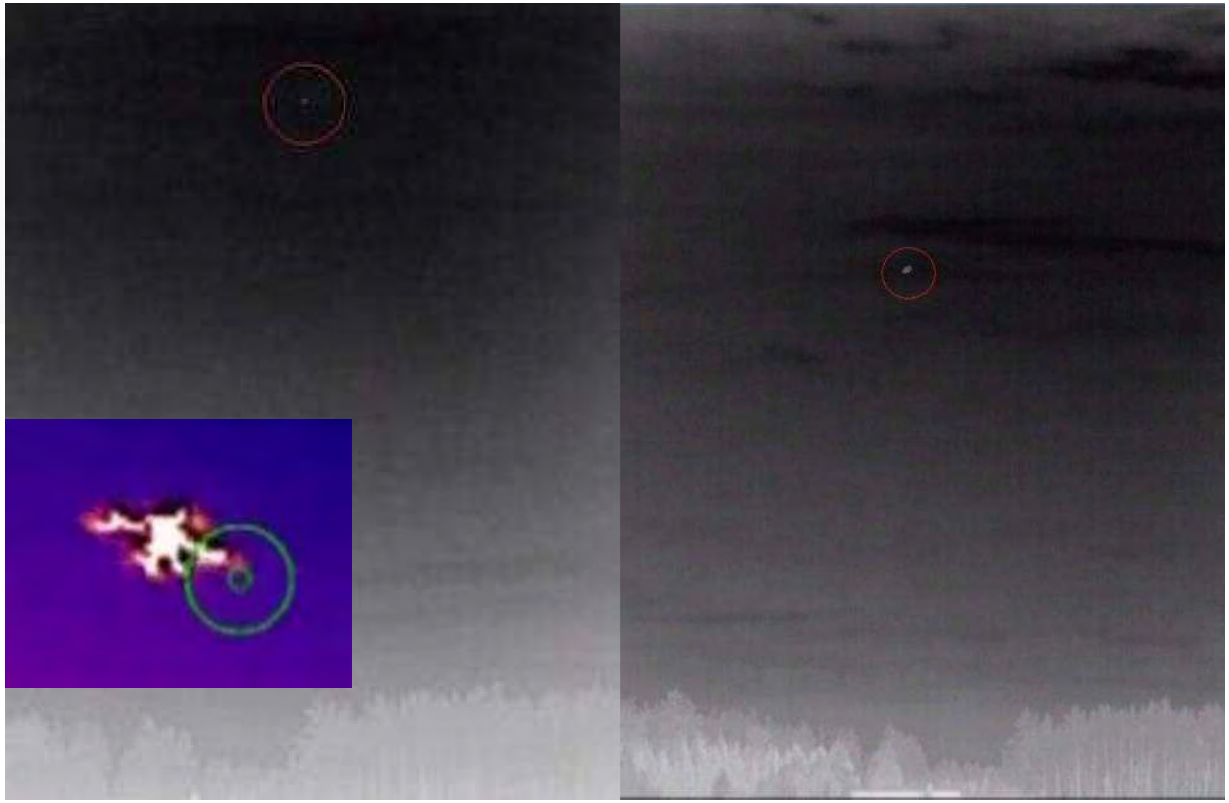
Methods for detecting UAVs:

Iray Ïinder 35R v2 thermal imaging monocular with laser rangefinder

Iray Bino BH 50 thermal imaging binoculars

Įegat 335R, Iray Saim SCĮ 35W, Ïortuna General 40 M3 thermal imaging sights

USE OF THERMAL IMAGERS FOR UAV DETECTION

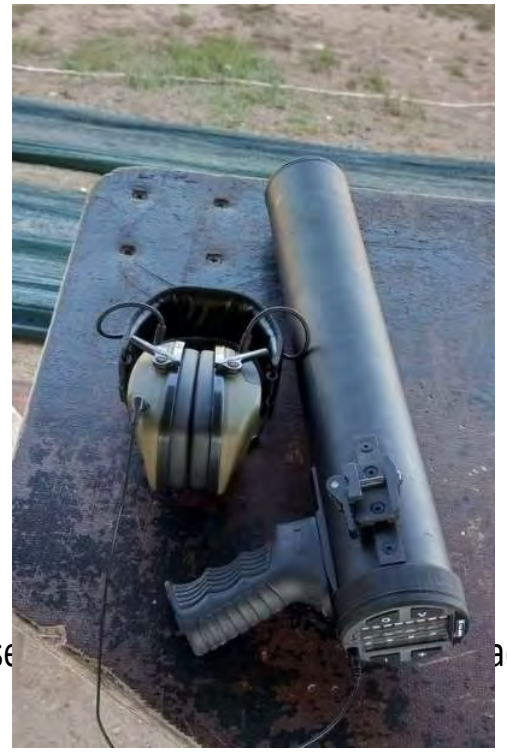


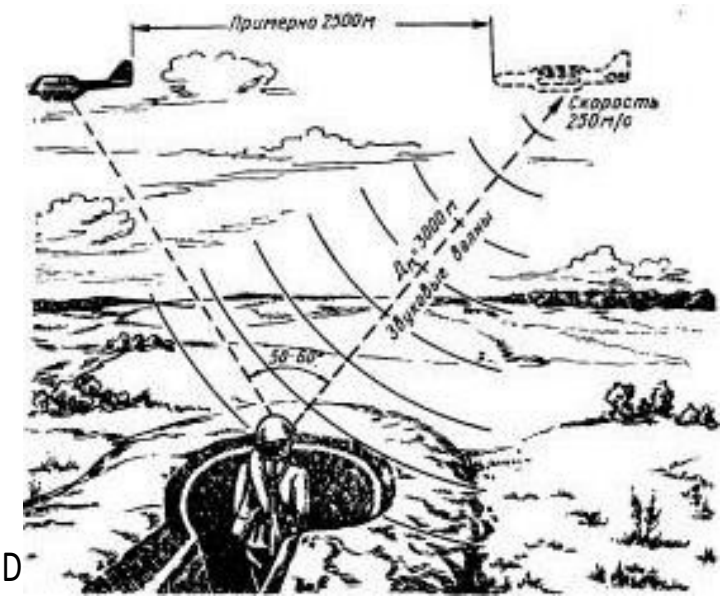
UAV viewed through a thermal imaging sight against the night sky

Methods of detecting UAVs:

ACOUSTIC MONITORING

Used to detect sound signals generated by a drone or its motors.



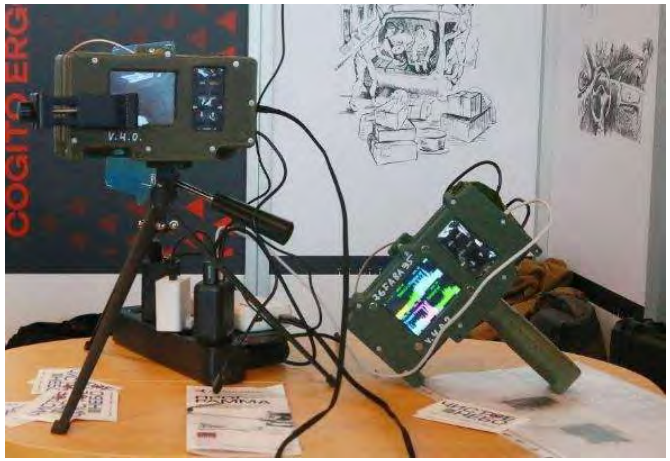


Use active

D

Methods for detecting UAVs: Radio-technical control

Radio technical control systems for combating quadcopters operate according to a specific algorithm, performing a series of specific sequential procedures for direction finding, suppression, and signal interception.



The Masterok 4 drone detector detects drones and determines their flight direction using control channels in the frequency range from 700 MHz to 6.2 GHz. (up to 2.5 km)

UAV detection methods

Radio technical control

Positions of UAV countermeasure groups: detection and suppression

UAV detection methods: Radio-technical control



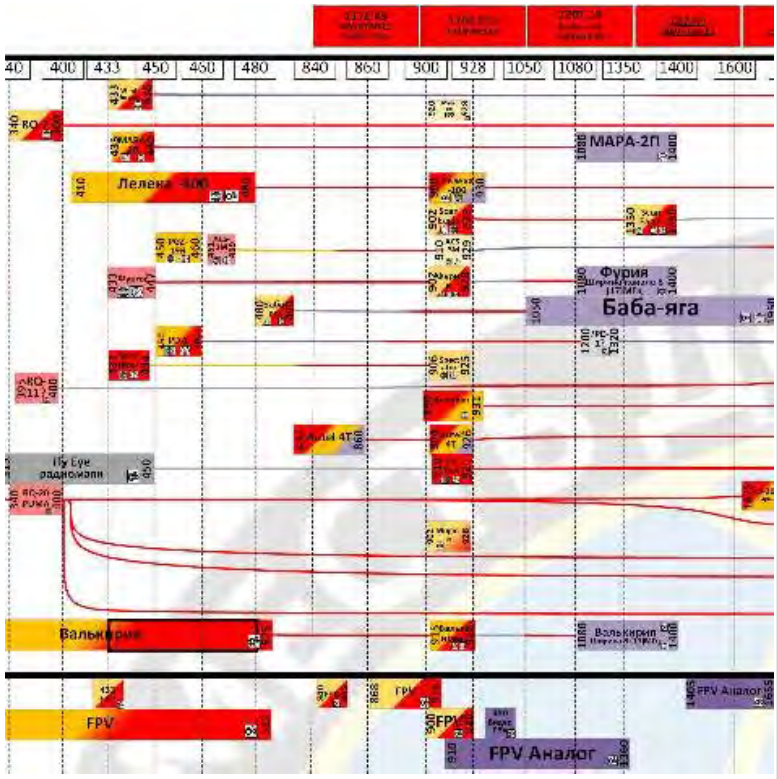

Portable homemade drone detectors, portable drone detectors

Tiny SA Ultra spectrum analyzer with special firmware "PEP UAV v2.5.2a"

TABLE OF RADIO FREQUENCIES OF TYPICAL UAVS

The most common frequency ranges for controlling ÏPV drones include 2.4 GHz and 5.8 GHz.

2.4 GHz provides reliable communication over medium distances, while 5.8 GHz offers higher bandwidth and less susceptibility to interference, but is limited in transmission range. The most common frequencies for video transmission are 5.8 GHz, 2.4 GHz, and 1.2 GHz.



Example table with common frequencies for UAVs of the Armed Forces of Ukraine

433 MHz - 447 MHz (433M)	Leleka-100 UAV - control Furia UAV (BPAK A1-S) - control SPECĽAĽOR UAV - control MARA-2P UAV - control
860-930 MHz (900M)	Valkyrie UAV - control ÏPV Express ĮRS drones - control ÏPV CrossÏire drones - control ÏPV drones "ÏrSky" - control UAV "Leleka-100" - video UAV "SPECĽAĽOR" - telemetry UAV "ACS-3M" - telemetry Furia UAV (BPAC A1-S) - telemetry
1100-1300 MHz (1.2G)	Valkyrie UAV - video Long-range ÏPV transmitters - video Commercial drones (DJI, Autel, etc.) - GPS 2/5 navigation
1300-1500 MHz (1.4G)	Baba Yaga UAV - control Fury UAV (BPAC A1-S) - video
1560-1610 MHz (1.5G)	All drones with GPS/Glonass - navigation
2400-2500 MHz (2.4G)	DJI/Autel - video ASC-3M UAV - video PD-1/PD-1M UAV - video ÏrSky ACCSĽ receiver - video DJI ÏPV Remote Control - control BetaÏPV Cetus ÏPV Kit - control UAV ÏIMI - video Windhover UAV - video
5150-5250 MHz (5.2G)	AUĽEĮ Ĵite UAV - control AUĽEĮ EVO III UAV - control AUĽEĮ EVO Max 4Ľ UAV - control
5725-5850 MHz (5.8G)	Valkyrie UAV - video DJI UAV (Mavic, Air, Mini, Matrice) - video Autel UAV - video

UAV detection methods: Radio engineering control

Non-directional single-band pin antennas (choose antennas with a swivel mount)

Non-directional omnidirectional single-band pin antennas

Directional all-band antennas (log-periodic "triangle" and horn "vivaldi")

Highly directional "wave channel" ("yagi") antennas, pictured for the 2.4/5.8 bands

Methods for detecting UAVs:

Omnidirectional UAV detector "Bulat" v.4 (manufactured by "3MX")

Specifications: Detection range up to 1.5 km
Battery life from 1 battery: 5 hours

When a UAV is detected, the device alerts the user with vibration and light indication

Methods for detecting UAVs:

PORTABLE INDUSTRIAL DRONE DETECTORS FOR INDUSTRIAL USE

UAV detection methods

Radar monitoring systems are used to detect flying objects based on reflected radio signals.

Borisoglebsk-2

"Leer-3"

R-330Zh "Zhitiel"

MEANS OF RADIO-ELECTRONIC PROTECTION AGAINST UAVs

The Argus-5000 anti-drone system is designed to suppress UAVs such as the Fury, Leleka, Valkyrie, etc.

The Groza drone suppressor is designed to combat small-class UAVs.

The Sky Hunter-4P system is designed to detect and jam UAV control and data transmission channels.

The SkyDetector-2 system is designed to detect UAVs by radio signals and alert about the appearance of unauthorized UAVs in its area of operation.

The Rants-1 system is designed to detect UAVs by radio signals and alert about the appearance of unauthorized UAVs in its area of operation

The Silok-02 kit is designed to detect and jam the control and data transmission channels of radio-controlled model aircraft, as well as to jam the signal reception equipment of satellite radio navigation systems

The Pereod jammer is designed to combat UAVs.

The Barrier RI Dome kit is designed to prevent the illegal use of UAVs by introducing targeted interference in the control and aviation channel frequency ranges.

The "Pautina" product is designed to jam UAV data transmission channels for emergency landing.

UAV suppression measures:

Omnidirectional jammers (dome suppressors)

dome jammer TRITON

- "DOME" PROTECTION AGAINST UAVs
- TWO Jamming Ranges - 800+ and 900+ MHz
- POWERED BY ON-BOARD NETWORK OR AUTONOMOUSLY BY 24V BATTERY
- REMOTE CONTROL WITH REMOTE CONTROL

ic war

Strazh-360 electronic warfare system

/arfare system

UAV suppression equipment: Jamming devices (REB)

Examples of portable dome electronic warfare systems with circular and sector (panel) antennas

Examples of narrow-beam anti-drone guns

UAV suppression devices:

OMNIDIRECTIONAL JAMMING DEVICES (REB)

Placement of the Lesochek jamming station on the hood of a car

Tetrad electronic warfare system on UAZ protective scre

Author's comment: here, the lecturer/instructor can explain in more detail the principle of operation and application of such stations. The key point is that their use will most likely be detected by the enemy, since we generate a significant signal that is noticeable in the radio range to create interference

UAV suppression measures:

ALL-DIRECTIONAL MOBILE JAMMING DEVICES

Author's comment: these systems are used by both sides of the conflict. Their disadvantages are their weight and cost, but their operating principle is clear and simple, and they are easy to use—you just need to select the frequency and turn on the jammer. It should be noted that such devices are ineffective in enclosed and radio-absorbing spaces.

UAV suppression devices:

ANTI-DRONE GUNS

Portable Drone Blocker "Garpia"

Stupor anti-drone gun

Author's comment: The principle of using anti-drone guns is simple, but to increase their effectiveness, you need to know the frequency of the approaching drone. Buttons on the body allow you to select the range. The effective distance is no more than 500 m, and a large number of batteries are required. If the UAV does not change course at a distance of less than 200 m, it is worth stopping suppression, as there is a risk of hitting the operator of the anti-drone gun.

UAV suppression measures: ANTI-DRONE GUNS

LPD-801 anti-drone rifle

LPD-802 anti-drone rifle

Pars anti-drone gun

UAV suppression devices:

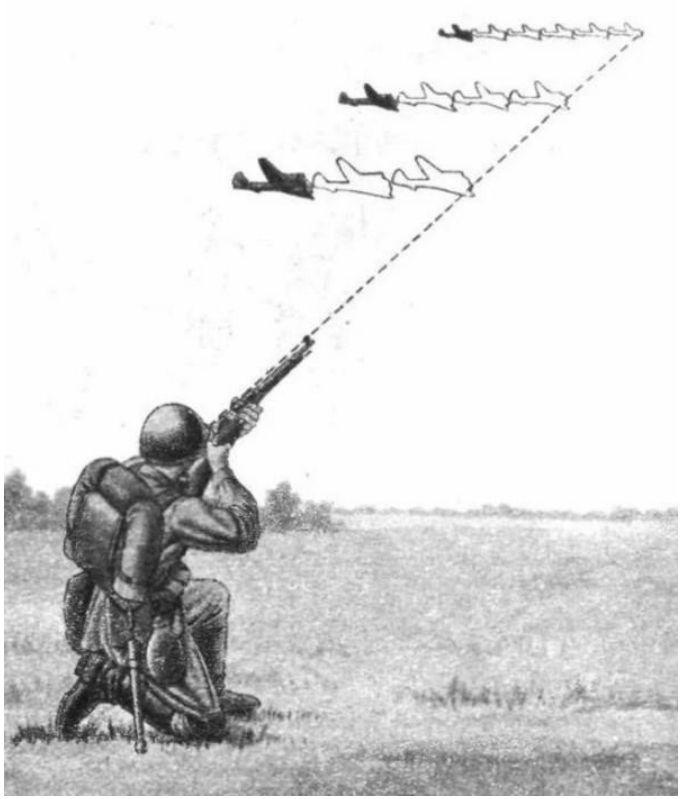
UAV countermeasure group

UAV COUNTERMEASURE GROUP

Soldier with a downed UAV

Comment from the author: Countermeasure groups hunt drones by constantly changing positions; in addition to small arms, they may have special transport and various suppression equipment (for example, a group with PKT (with bipods), smoothbore guns, drone detectors, and PD guns).

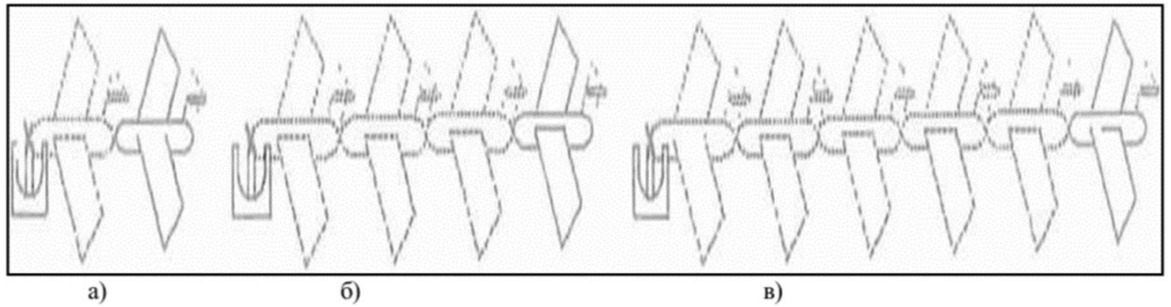
UAV suppression measures: FIREARMS



Basic rules for firing at UAVs:

For UAVs flying at speeds of up to 45 m/s to the side or above the firing position (above your unit), fire is conducted in an accompanying manner.

When firing in an accompanying manner at a UAV flying at a speed of 15-30 m/s at a distance of 100, 200, 300, 500, 700, and 900 m, lead the target.
is taken to be equal to 1, 3, 5, 8, and 12 target bodies, respectively

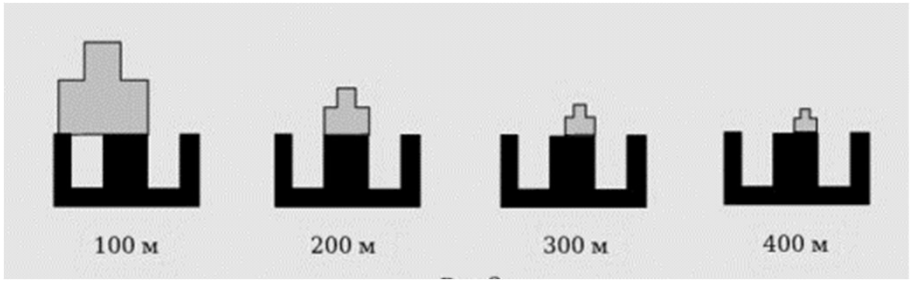


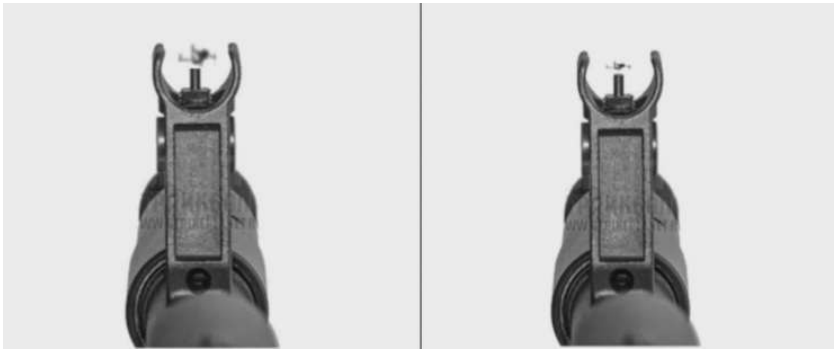
Aiming chart for an air target flying at a speed of 15-30 m/s at ranges of a) 100 m, b) 300 m, c) 500 m.

UAV suppression measures: FIREARMS

DETERMINING THE DISTANCE TO THE TARGET USING THE AK-74M SIGHTING DEVICES

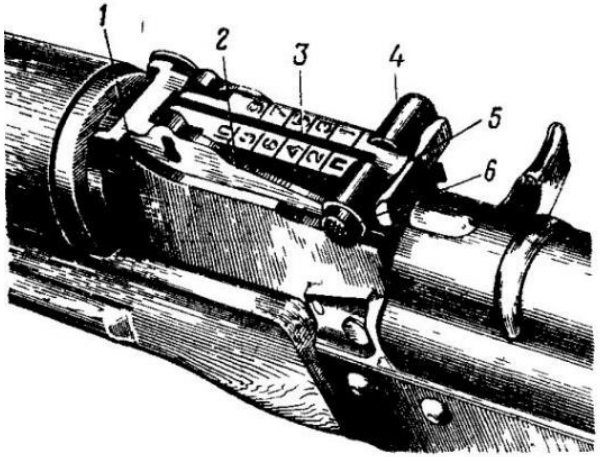
DETERMINING THE DISTANCE USING THE AIMING DEVICES OF THE AUTOMATIC RIFLE, I.E. BY COMPARING THE WIDTH OF THE TARGET WITH THE CROSSHAIR (AK-74M):

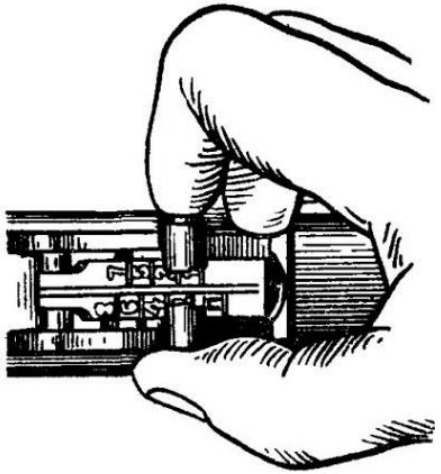




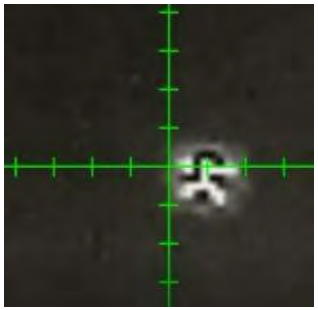
Distance to the target is about 100 m m

Distance to the target is about 200





Set the sight in accordance with the distance to the target and taking into account the ballistics of your weapon

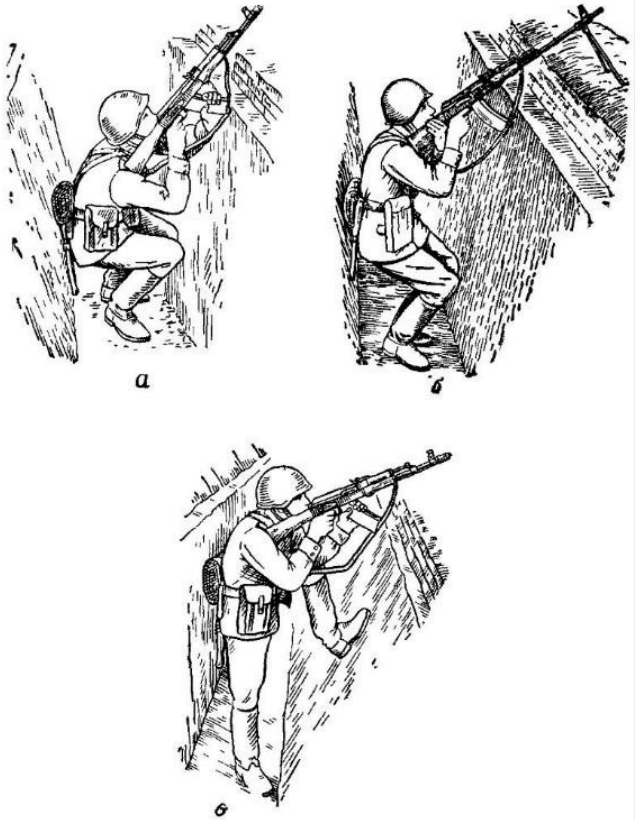


Optics/NIR: The target occupies two divisions, respectively, the distance is 100 m

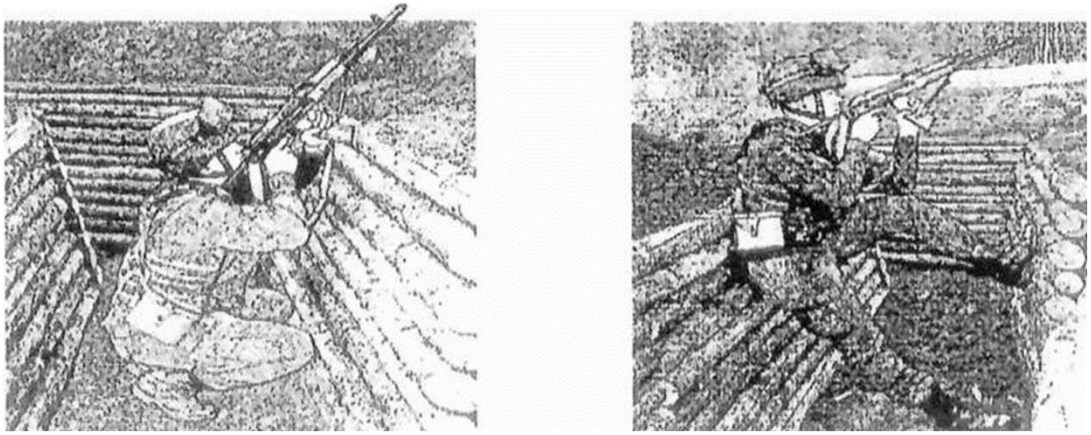
The target occupies one division, so the distance is 200 m.

UAV suppression measures: FIREARMS

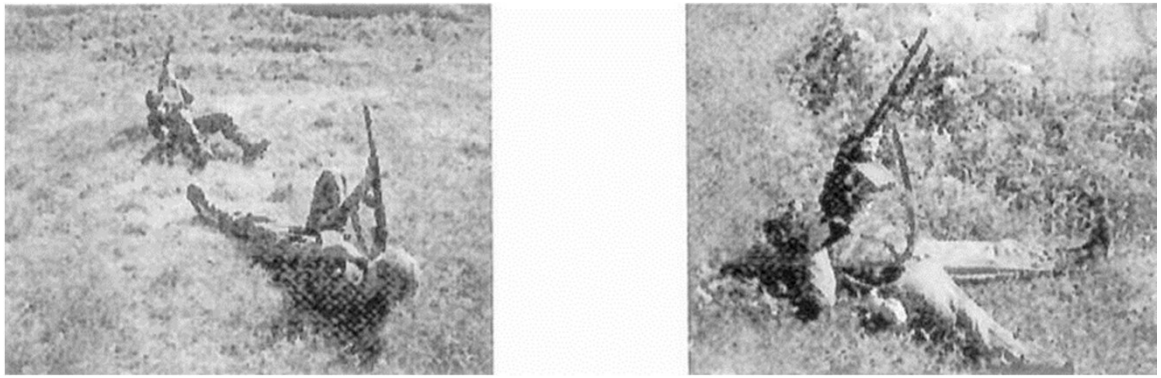
POSITIONS WHEN SHOOTING AT AIR TARGETS:



Position when shooting at an air target from a trench a) – with the magazine of the assault rifle resting on the front slope, b) – from a machine gun with a bipod, c) – from an assault rifle held in the hand



Shooting from a trench (communication trench) at air targets (with the forearm of the left hand and the magazine resting on the front slope of the trench, with the back and left foot resting on the slope of the trench



Fire team shooting at air targets from a prone position

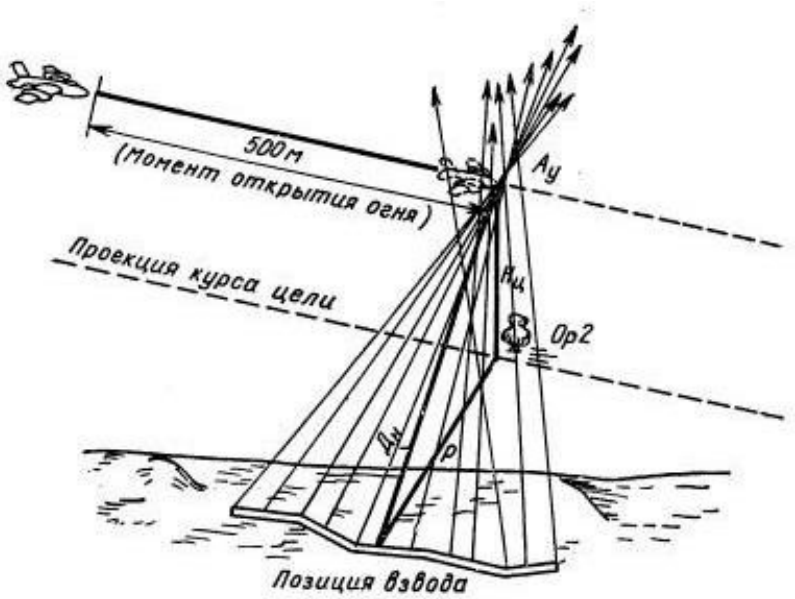
UAV suppression measures:

FIREARMS

Shooting at air targets using local objects

To increase the probability of hitting enemy UAVs with fire, it is advisable to use tripods for s arms.

Mount for small arms



Firing at an air target using a barrage method

For example: the command "Fire" is given when the UAV is 500 m away from the weapon and is carried out for 20-25 seconds in short bursts with fire correction.

UAV suppression measures: FIREARMS

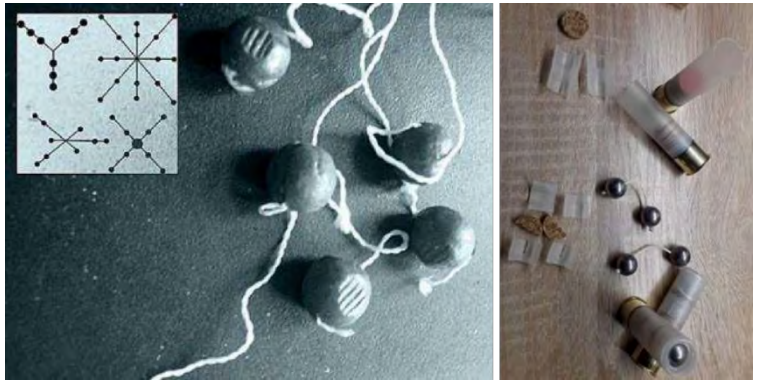
Most effective against multi-rotor drones at low altitudes (up to 100 meters) – 2.3.5 shot

The RPK light machine gun and optical sight are no less effective.

A device for firing 12-gauge cartridges from an AK-74M underbarrel launcher (and similar devices).

UAV suppression measures: FIREARMS

SPECIALIZED AMMUNITION MAY BE USED



OR THEIR INDEPENDENT MANUFACTURE

Means of suppressing UAVs:

COMMON AIR DEFENSE MEANS

Author's comment: These tools are typically used by specialists, but if there is an opportunity to train and transfer experience to a wider group, it should not be overlooked. Such tools are effective in suppressing UAVs. For example, the Igla MANPADS system can engage super-heavy and heavy UAVs such as Bayraktar, Sokol, etc.

UAV suppression measures:

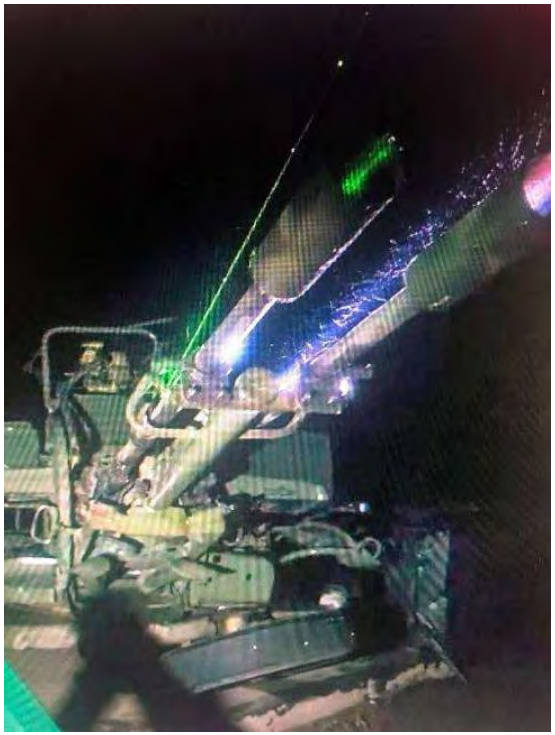
Left: a typical stationary PVN position, fortified, with memos on UAV types and fire control, a stationary installation of three AK-74M assault rifles
Right: Use of paired assault rifles as stationary air defense

STATIONARY PVN

If there is no risk of exposing positions, it is permissible to use portable flashlights, searchlights, etc.

UAV suppression measures:

STATIONARY PVN



USE OF SPOTLIGHTS AND LASER POINTERS AT MOBILE AIR DEFENSE POINTS OF THE ARMED FORCES OF UKRAINE

UAV suppression measures:

ALTERNATIVE METHODS

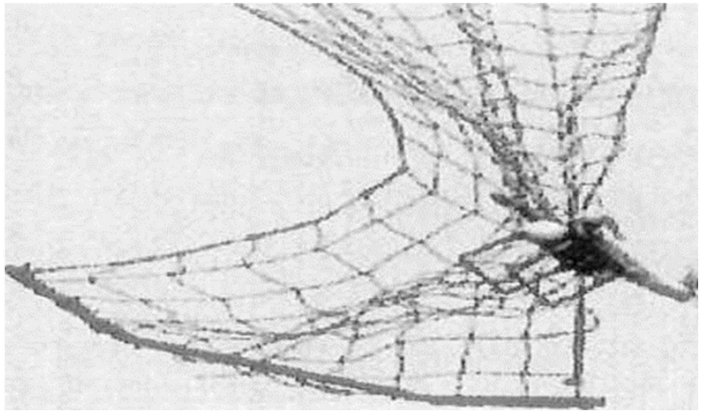
ANTI-DRONE UNMANNED AERIAL VEHICLES

A) DRONEBUJJEĽ KAMIKAZE DRONE BY CANADIAN AERIAJX

B) INTERCEPTOR DRONE WITH NET

NETWORK APPLICATION OPTION

NETWORK APPLICATION OPTION



NETWORK APPLICATION OPTION

UAV suppression measures:

ALTERNATIVE METHODS

MINING FALSE POSITIONS AGAINST UAVs

KINETIC INTERCEPTION OF ENEMY UAVs USING OWN UAVS (RAM, SHOT FROM A CARRIER, NET, HOOK, ETC.)

Author's comment: All alternative methods of suppression are presented as examples of the successful application of engineering skills and military ingenuity. All of these are rather exceptions to the rule, but such methods can complement UAV defense in a number of situations.

Actions when detecting a UAV on the ground:

- Do not touch anything, regardless of what you have found.
- Cordon off the area.
- Do not allow unauthorized persons to approach the UAV;
- Turn off all communication devices and prevent third parties from using them.
- Notify the commander / Call in bomb disposal experts to inspect the UAV.

IMPORTANT!

The call should be made from a distance of at least 200 m from t suspicious object.

Independent demining is extremely dangerous!

LIST OF SOURCES:

- Instructions for calculating anti-UAV (small special tactical group). Kyiv: Headquarters of the Special Operations Forces of the Armed Forces of Ukraine, 2024. 48 p.
- Karpovich A.V., Chernyshev Yu.M. Performing fire missions with a quadcopter-type unmanned aerial vehicle. Moscow: Military Publishing House, 2022. 112 p.
- Classification of UAVs of the Armed Forces of Ukraine // Telegram channel "UAV Inform." 2024. URL: https://t.me/bpla_info (accessed: 01.08.2025).
- Korolyov, A.Y., Korolyova, A.A., Yakovlev, A.D. Camouflage of Weapons, Equipment, and Facilities. St. Petersburg: ITMO University, 2015. 155 p.
- Levoshko, A.B. Tactical and Firearms Training for Militia. Moscow: Center for Strategic Conjuncture, 2022. 272 pp.
- Camouflage / Compiled by K.V. Bobrov, I.A. Ikonnikov, F.F. Kizelov, et al. 2nd ed., rev. and expanded. Moscow: Voenizdat, 1941. 423 p.: ill.
- Camouflage of Troops: Training Manual / Compiled by V.A. Ponomarev, M.B. Anisimov, R.Yu. Levinsky, A.G. Yarensky. Perm: Publishing House of the National Guard Troops, 2017. 224 p.
- Ministry of Defense of the Russian Federation. Main Directorate of Combat Training. Memo on the protection and counteraction of enemy UAVs. Moscow, 2023. 36 p.
- Ministry of Defense of the USSR. Guide to Engineering Means and Methods of Camouflage for Land Forces. Moscow: Voenizdat, 1986. 198 p.
- People's Translation Project. Optical and Optoelectronic Reconnaissance of the Missile Forces and Artillery of the Armed Forces of Ukraine. 2023. URĮ: https://народныйперевод.рф (accessed: 01.08.2025).
- Sadchikov, I.A. Kamikaze Drones of the Armed Forces of Ukraine: Reference Guide. Moscow: Tactik Press Publishing House, 2024. 88 p.
- Reference Book. Tactics of the enemy's use of UAVs (in diagrams) and methods of counteraction. Moscow: Center for Analysis of Strategies and Technologies, 2024. 64 p.
- Command of the Missile Forces and Artillery of the Armed Forces of the Russian Federation. Manual for the commander of a special forces group on calling in and correcting artillery fire. Moscow, 2023. 72 p.
- Frolov, I.V. Ukrainian UAV: Reference Guide on UAVs Used by Ukraine in the Joint Forces Operation Zone. Moscow: Online publication Vsem!ru, 2023. 120 p.

INFORMATION PREPARED BASED ON OPEN SOURCES. ALL MATERIALS ARE TAKEN FROM PUBLICLY AVAILABLE INTERNET AND MEDIA RESOURCES

Moscow, August 2025

Channel of the KB PHANTOM modern military camouflage design bureau: theory, multispectral camouflage, countering UAVs - t.me/KBPhantom