



UKRINMASH



# RADAR STATIONS AND AIR DEFENCE EQUIPMENT



**UKROBORONPROM**  
Ukrainian Defence Industry



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## UKRINMASH - 25 YEARS AT THE INTERNATIONAL MARKET

The State Self-Supporting Foreign Trade and Investment Firm «Ukrinmash» which is the participant of the State Concern «UkrOboronProm», operates at the international market since 1991.

The aim of the Firm is to implement the interests of Ukraine in the field of military-technical cooperation with foreign partners. «Ukrinmash» has built reliable business connections with countries from every part of the world. The key mission is service excellence, reliability and customer satisfaction.

### «UKRINMASH» OFFERS:

- ▶ Export of weapons and military products in the field of armoured military vehicles, aircraft engineering, shipbuilding industry, radar ammunition and air defence, as well as rocket artillery weapons.
- ▶ Transfer of technologies and know-how, including the development of military factories and MRO centers.
- ▶ Maintenance, repair / overhaul and upgrade of military equipment.
- ▶ Training of foreign military personnel.
- ▶ Import of weapons and military products to Ukrainian Army and all other military and defence structures.
- ▶ R&D, investment and other partnership opportunities.
- ▶ Disposal, demilitarization of the old military equipment and territory demining.
- ▶ Marketing, advertising and intermediary services.

For the last few years Ukrainian Defence Industry has been in the stage of transformation into a highly effective structure. This process is taking place due to new technologies, products, innovations, efficient management and top-professionals who have come into this field. Today we are offering the new armament business culture, customer oriented, flexibility and personal approach.

We represent Ukrainian Enterprises of the State Concern «Ukroboronprom» which employ more than 80 thousand people, and the products of other Ukrainian enterprises. Ukraine is a reliable partner who exports the defence products to many countries of the world. The potential for development of the Ukrainian Military Industrial Sector is a tremendous one who is only at the beginning of its realization and prospects.

We suggest the widest product range in the field of aviation, armour, radio, artillery, as well as ship building and rocket industry, etc.

Ukraine makes part of prestigious club of the countries which has mastered the closed cycle in aircraft building, radio intelligence and radio-electronic warfare, whereas the Ukrainian export potential is among the best 10 in the world.

SE «Ukrinmash» is a unique special exporter and integrator which makes an important part of the Ukrainian Military Industrial Sector honored to be your reliable partner. We are proud that SE «Ukrinmash» is one of the most experienced and one of the biggest export-import companies of Ukraine which has been working in the armament and military hardware market for more than 25 years.

We present you our products range as well as services in repairing, upgrading, joint promotion of the products and cooperation in the military markets. SE «Ukrinmash» is not only reacting to the state of the market but initiates trends in the world market. For nowadays, SE «Ukrinmash» is making a new history of the military industry of Ukraine.





RADAR STATIONS AND AIR DEFENCE EQUIPMENT  
PRODUCTION



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PRODUCTION







### 3-D AIR SURVEILLANCE RADAR

## 80K6

The mobile 3-D Air Surveillance Radar for low, medium and high altitudes with analog, coordinate and track outputs, operating off-line or as a part of regional and national automatic control post (ACP) is designed to be used:

- ▶ As a part of anti-aircraft missile troops to issue targeting to anti-aircraft systems;
- ▶ as an information link in the air forces and air defence units for air traffics control.

MAIN PERFORMANCE DATA	
RADAR OPERATION LIMITS IN RANGE:	
- minimum, km	6
- maximum, km	400
- in azimuth, deg	360
- in elevation, deg	0...35
- in altitude, km	40
Scanning interval, s	5 or 10
TARGET DETECTION RANGE, RCS=3-5 M <sup>2</sup>	
At P=0.8 F=10-6	
At flight altitude 100 m	40
At flight altitude 1000 m	110
At flight altitude 10...30 km	300-350
Clutter suppression, dB	50
Simultaneously track capability	150-200
IFF equipment	built-in
Number of transport units	1+1 with a power station

  
Operating frequency range  
S

  
Deployment/closing time, hour  
<0.5



### MOBILE 3-D AIR SURVEILLANCE RADAR


## 80K6M

Mobile Radar 80K6M designed to be used as a part of radio and anti-aircraft missile troops, to issue targeting to the anti-aircraft missile troops and to ensure the following:

- ▶ detection, tracking and measurement of the airborne target coordinates and their ground speed calculation;
- ▶ recognition of the aircraft IFF equipment;
- ▶ calculation of elevation and azimuth bearing at active jamming stations;
- ▶ data issuing to the radar workstations and the integrated systems.

MAIN PERFORMANCE DATA	
Q-ty of elevation scanning modes	2
Time of mode switch-over, not more, sec	0.1
Elevation coverage area, deg	
- in mode 1.	0...35
- in mode 2	0...55
Clutter suppression, dB	>50
Beam shaping method	digital
Q-ty of antenna beams	12
Detection range of aircraft with RCS 3-5m <sup>2</sup> , km (Probability of true detection P=0.8 and probability of false detection F=10 <sup>-6</sup> )	
- at flight altitude 10 km	200
- at flight altitude 100 m	40
Mean square error of coordinate calculation under no man-made jamming:	
- in range, m	100
- in azimuth, min	20
In altitude, within range up to 100 km, m	
- in mode 1	300
- in mode 2	400
MTTR, min	30
Deployment time, min.	6
Band of operating temperature, C	-40...+50C
Number of transport units	1

  
Operation band  
S

  
Frequency q-ty  
6

  
Indicator range, km  
400

  
Scanning rate, sec  
5. 10





### 3-D AIR SURVEILLANCE RADAR

## 36D6M1

- ▶ High probability of detection of small air targets, hovered helicopters including targets slowly moving tangentially to the radar
- ▶ Extremely accurate positional information
- ▶ Exceptional interference immunity against any jammers
- ▶ Capability of jamming station direction finding
- ▶ Automatic association of echo-signals with return signals of the built- in IFF equipment
- ▶ Capability to represent radar information and targeting over narrowband communication channels
- ▶ High reliability
- ▶ High mobility
- ▶ Extreme stability of transmitter with true coherency

#### MAIN PERFORMANCE DATA

Detection range for low flying targets: RCS -1 m <sup>2</sup>	
- at flight altitude 50 m	31 km
- at flight altitude 100 m	42 km
- at flight altitude 1000 m	110-115 km
RCS - 0.1 m (cruise missile) at flight altitude 50 m	27 km
RPM	6 and 12 rev/min
Suppression factor	>48 dB
Accuracy:	
- range	50 m
- azimuth	0.2°
- altitude	400 m
Resolution:	
- range	300 m/at range of 90 km
- azimuth	3.5°
Track capability	>200 tracks
Environmental conditions:	
- temperature	-40°C...+50°C
- humidity	98%
- height	3000 m



Operation band  
S



Instrumented range, km  
90, 180, 360



Azimuth coverage  
360°



Elevation coverage  
0.5°...30°



MTBF, hours  
>800



MTTR, min  
<30



### SOLID-STATE RADAR

## DELTA

#### MAIN PERFORMANCE DATA

Resolution:	50...60 m - in range 1,0°...1,5° - in azimuth
<b>MAXIMUM DETECTION RANGE:</b>	
- small air target	8...20 km
- small surface target	up to horizon
Accuracy:	20...40 m - in range 4...6 mrad - in azimuth
Tracking target number:	up to 50
Noise figure	3dB
Peak power	from 8 W up to 80 W
Pulse width	64; 32; 16; 4 sec
Signal bandwidth	about 5 MHz
PRF	about 1,4 2,5 3,8 6,7 kHz
Antenna gain	32 dB
Antenna beamwidth:	0,8...1,2° - in azimuth; about 10° - in elevation
Polarization	horizontal
Rotating rate	20; 10; 5 rpm
Signal processing	Digital with PLM
Extracting	automatic digital with CFAR
Data processing	digital with PLM
Serviceability monitoring	fully automatic in work process
Multifunction detection	semi-automatic up to plug-in units
Data registration	up to 50 trajectories
Interface	RS-422; Ethernet; CAN 2.0

«DELTA» is modern mobile two-dimensional pulse coherent solid-state radar for surface and air surveillance with low probability interception of its electromagnetic radiation. It delivers in a fully automatic way the current coordinates of any target located within its area of detection. This mobile radar could be installed on transport vehicles (automobiles, armored personnel carriers, infantry combat vehicles, etc.) which allows arrange its operation in uplands in order to ensure necessary viewing conditions. «DELTA» analyzes the space in azimuth by the continuous rotation of its aerial system, which is mechanically driven.



Bandwidth, Mhz  
150



Coverage, in range, km  
UP TO 96



Coverage, in azimuth  
360°



Readiness time  
2 MINUTES

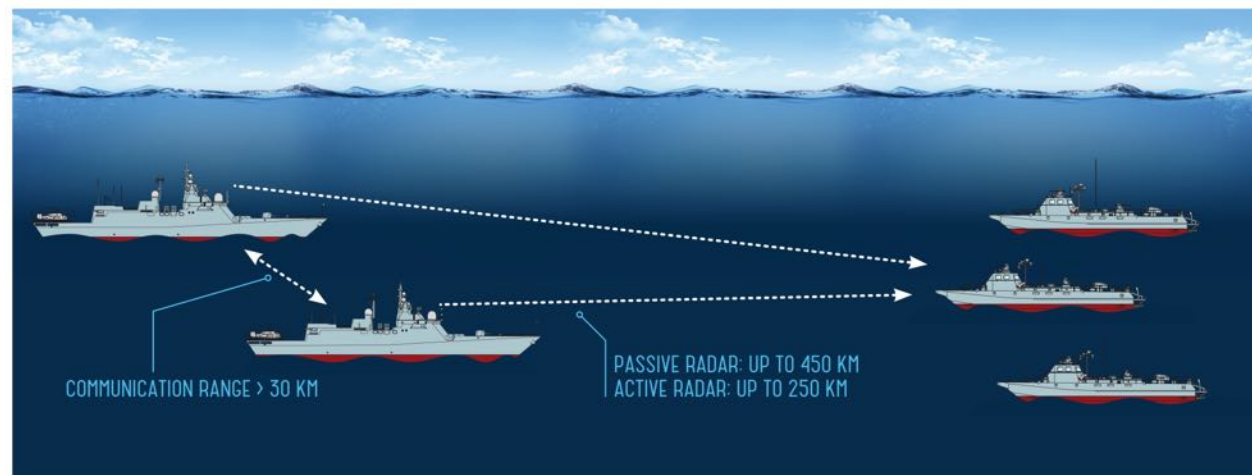


Power consumption  
500 W



Equipment mass  
300 KG





### MULTIFUNCTIONAL TARGET DESIGNATION RADAR SYSTEM

## MINERAL-ME

System provides long-range over-the-horizon detection of the surface targets, reception and processing surface situation data received from coastal systems, tactical group vessels, equipped with "Mineral" type systems, and also from aircraft and helicopters that transmit data using regular means of radio communication, develops and presents information coordinates to weapon system of a vessel and tactical group, vessel provides guidance for joint combat actions.

System composition:

- ▶ active radar for surface targets detection and target designation (ARS);
- ▶ passive radar for surface targets detection and target designation (PRS);
- ▶ station of mutual information exchange, mutual vectoring (orientation) and joint surface targets data processing (MEI-MOR station).

MAIN PERFORMANCE DATA				
Radar		Active	Passive	MEI-MOR
Frequency band		I	I, G, E/F, D	I
Scanning zone	Through azimuth	360°	360°	360°
	Through range	up to 250 km	up to 450 km	up to 30 km
Number of targets tracked	Detection mode	-	up to 50	-
	Target designation mode	-	up to 10	-
Number of targets processed		-	-	up to 200
Number of interacting ships		-	-	up to 9



### MOBILE OPTOELECTRONIC COUNTERMEASURE SYSTEM

## KASHTAN-3M

MAIN PERFORMANCE DATA	
Enemy laser designators radiation detection probability, not less than	0.9
Probability of the ammunition drift (re-aiming) on LDT	0.6 – 0.8
Time from the moment of the enemy laser designator radiation detection to the moment of the LDT setting, no more than, s	1
Continuous running time in duty mode, hrs	24
Apparatus transition time from off-mode to duty mode, no more than, min	3
Apparatus transition time from duty mode to combat mode, no more than, s	7

Mobile automated optoelectronic countermeasure system KASHTAN-3M is intended to protect all types of combat and auxiliary surface ships and especially important military and civil ground objects against precision guided munitions (PGMs) – missiles, shells and air bomb, equipped with semi active laser homing systems (SALHS). The system solves the task of the protection by setting of laser decoy targets (LDT), created at the safe distance from protected objects on the earth or sea surface. The system is available in a navy and an army versions.

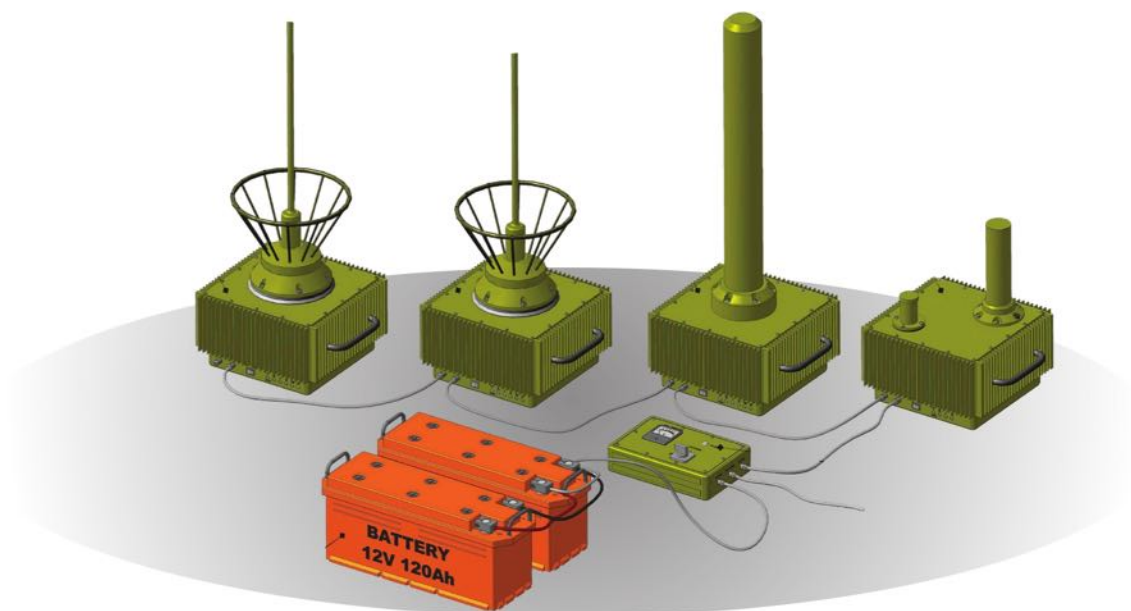
Operating wave length, mm  
1.06

Detection angle sector, horizon  
0° TO 360°

Detection angle sector, bearing  
-15° TO +90°

Light-sensitive cells sensibility up to  
5 - 1011 J/CM2





### ANTI-BOMB RADIO JAMMING SYSTEM

## GARANT

Anti-Bomb Radio Jamming System "GARANT" is intended for suppression of radio control links and countermeasure by means of stationary, mobile and man-pack radio set radio communication, channels, reception paths of cellular communications systems mobile phones, as well as for protection of mobile vehicles (moving truck trains and single vehicles) and stationary objects by prevention explosion of radio-controlled mines, high-explosive charges, etc. Described problem is solved by the radiation of jamming radio signal in all frequency range, where application and use of the specified control radio links are possible.

System "GARANT" can be installed on a vehicle practically of any type, for example, armoured

personnel carrier, roof of the automobile body-van or tank.

System "Garant" consists of 4 blocks - BPRL. Each block consists of the four jamming transmitters and one high effective four lead-in wide band antenna with the circular directional pattern in a horizontal plane. The block BPRL-4 consists of single transmitter and single wide band antenna. The whole system includes 13 transmitters (the frequency range of jamming radio signal radiation is divided into 13 bands) and 4 antennas.

Frequency range of noise radiation, MHz	Type of noise	Summary integral output power of noise, W	Radio suppression distance, m	Consumed power, W, maximum	Supply voltage, V	Ambient temperature, °C
20-2 700	WIDE-BAND BARRAGE	230	75-500	900	10-36	FROM -40 TO +60



### MAINTENANCE MODULE

## MM-36D6

Maintenance module (MM) is designed for control, serviceability, diagnostics and renewal of Line Replacement Units (LRU) being incorporated in the Radar: digital, digital-to-analog and analog cells; high frequency units and subunits; PCBs and secondary power supply units.

► **Workstation 1** is made applying the automated diagnostic system which consists of hardware, software and repair databases for the tested LRUs.

The hardware consists of 135-channel test-processor, 16-channel logic and signature analyzer and 6-channel analog generator and performs the following functions:

- testing of PCBs via connectors with simultaneous recording of the PCB reaction for test;
- in-circuit testing of the PCB and elements;
- providing LRUs under test with power supply.

► **Workstation 2** is the PC-based measuring-diagnostic system which is designed to diagnosticate and measure the high-frequency LRU parameters.

- The system incorporates:
- RF and UHF units of oscillators being controlled;
  - digital oscilloscope unit;

- built-in spectrum analyzer.

► **Workstation 3** is a multi-purpose workstation intended for diagnostics of failed cells, assemblies, subunits and units providing switching, check and control, obtaining secondary voltages, processing and conversion of analog signals as part of the radar units and cabinets. WS-3 possesses the built-in facilities of protection, control and check of its main parameters.

► **Workstation 4** is a multi-purpose repair station. It is equipped with a set of fixtures, tools and special-purpose equipment.

The dismantling of faulty radio elements, the radio elements performing, soldering of newly mounted elements and varnishing are accomplished at WS-4. MM-36D6 is provided with Spare Parts, Tools and Accessories to repair six radars, radar reference LRUs, complete test-programs for LRUs being repaired and signatures for cells being tested.

MM-36D6 is located in the transportable module on the basis of a sea container with overall dimensions 6100x2450x2600mm and equipped with the air-conditioning, ventilating and heating systems.





### RADAR

# TRASA

The mobile stand-alone automatic solid-state secondary surveillance radar with phased arrays antenna operates in radar surveillance systems of NATO MK XA (MK -XII) and international RBS ATC system and the «friend-or-foe» system. The radar is designed to provide automatic detection, coordinate determination, tracking and of airborne targets equipped with transponders of secondary radar.

#### MAIN PERFORMANCE DATA

Coordinate determination error:	
- range, m	100
- azimuth, min	<50
Qualitative indices of track information:	
- tracking quality ratio	0.95
- false track ratio	0.0001
Throughput capacity, minimum «TRASSA»	250
Output information	track
Data read-out and transfer	automatic
Road transport speed:	
- highway, km/hour	60
- country road, km/hour	30
Number of transport units	1
MTBF, hrs	1 000
MTTR, minutes	30
Continuous operation time, hrs	72
Turn-on time, minutes	3
Electric power supply system	automatic (with stand-by), industrial supply mains
Environmental conditions:	
- ambient temperature, °C	-40...+50
- relative air humidity	98% at 25°C
- altitude, m	3 000
- wind speed, m/s	30



### SURFACE SHORT RANGE RADAR

# 112L1 / 112L1A

#### MAIN PERFORMANCE DATA

	BARSUK	BARSUK-A
View area:		
- azimuth	360°	360°
- range	0-2 km	0 - 2 km
Detection range of targets with radial velocity 2-50 km/h:		
- single person	1 200 m	1 200 m
- vehicle	1 600 m	1 600 m
- armored vehicle	2 000 m	2 000 m
Resolution:		
- azimuth	1,5°	3°
- range	25 m	25-50 m
Operating temperature range	- 30 ... + 50°C	
Wind speed	up to 15 m/s	up to 25 m/s
Weight with battery	5.5 kg	10 kg

Portable Radars 112L1-Barsuk/ Barsuk-A are designed for detection of moving personnel and vehicles (patrol version) with the aim of reconnaissance or protection of territory. The radars provide detection of the targets round the clock under low visibility conditions (rain, fog, snow etc.). Detected targets are at built-in indicator in form of amplitude of the signal with mark of range. Recognition mode allows to specify range and azimuth of the target and classify it by acoustic spectrum (single person, animal, vehicle). Solid-state transmitter of the radar is implemented in microstrip version. The BARSUK-A is installed on tripod as opposed to the BARSUK Mobile Radar.



Range, km  
2-360



Azimuth, deg  
360



Height, km  
25



Band  
DM



Power consumption, kW  
8+10



Deployment time, min  
30



Frequency, GHz  
36



Transmitter power, mW  
60



Antenna aperture, mm  
90



Power consumption, W  
8





## MOBILE AUTOMATED COMMAND POST MODULE

Command Post is designed to provide automated collection, processing and displaying of data from radar positions (primary and secondary, analogue and digital) and radio height finders; transmitting of processed and integrated information about air situation to the high-level Command Posts. "MODULE" is modern processing system capable to input, handle and combine data from several

sources. It provides connection of virtually all types of radar stations, including old-fashioned analogue, without degradation of their technical parameters. The processed data can be used for target allocation/designation, and transmitting of control and direction commands to AD missile and fighter-interceptor units.



Range, km  
1 600



Height, km  
0-99



Speed, km/h  
UP TO 3 600



Number of tracked and controlled targets (including active jammers)  
200 (40)



Operating personnel  
3

### MAIN PERFORMANCE DATA

Accuracy parameters:	
- coordinates, m	200
- height, m	10-300
Height information renewal period radar	corresponds to the revolution period of main
Target initiation and tracking mode	automatic
Track initiation period	3 revolution periods of the main radar
Interfaced radar types:	
- analogue	P-18, P-14, 5N84, 5N84A, 44G6, 5N87, P-37
- digital	19G6, 35Д6, 36Д6, 22G6, 55G6 and similar
Interfaced radio height-finders	PRV-9, 11, 13, 16, 17
Number of simultaneously connected radar data sources:	
- remote	8
- local	8 (including up to 4)
Number of simultaneously interfaced users	no limitations
Data transmitting rate in the data line, bps	9600
Types of interfaced automation complexes:	
Electronic Reconnaissance	68K6, 5N60, 5N93M, 5D91, 86G6, 5U69
- Air Defense Missiles	5N75, 5S99, 5N37, 73N6, 9S52, 9S52M
- Fighter Aviation	5K34
Data exchange protocols with interfaced facilities and command posts	ASTERIX; other protocols - as required by interfaced unit
Speakerphone and telephone	provides operative and command speakerphone
Communication equipment	telephone connection, and transceivers control
MTBF, hrs	10 000
Power consumption, kW:	
- main equipment and facilities	up to 2
- supplementary equipment	up to 4
Time of deployment, h	less than 1
Time of closing down, h	less than 1
Number of transportation units	1





## AUTOMATED RADIOCOMMUNICATIONS JAMMING SYSTEM

# MANDAT-B1E

Radio-Communications Jamming System Mandat-B1E is an automated data acquisition and data procession system. It gathers data on emission sources and radiates aimed barrage jamming signals within an area of monitoring. The complex allows to reveal enemy grouping in operational and tactical depth, to define a disposition of military units, divisions, their terrain co-ordinates and

relocation based on enemy radio command lines and radio networks. Within the whole controlled/covered area (60 km depth and 90 km front) and within the whole operating frequency range (1.5-1 000 the system effectively jams up to 80 frequency radio links or up to 6 radio links with technique – that allows to ruin the management of enemy forces.

  
Coverage area (front), km  
**UP TO 90**

  
Coverage area (depth), km  
**UP TO 60**

  
Communication range between units  
of the complex, km  
**200 (40)**

The System “Mandat-B1E” is intended for jamming ground-based communication facilities using any kind of modulation and operating either on fixed frequencies or with frequency hopping technique within and frequency bands. Selective jamming (both on time and frequency) as well as barrage jamming is used to jam all previously detected frequencies.

**In the process of operation one post consisting of automated F, F jamming stations enables to solve the following main tasks:**

- ▶ scanning within a frequency range;
- ▶ automatic detection of up-to-date radio communication systems and sources of emission, including those with F technique;
- ▶ automatic classification and measurement of signals parameters;
- ▶ acoustical and visual monitoring of all signals;
- ▶ received signals data accumulation and procession;

- ▶ received data documentation;
- ▶ effective jamming within a range of 1,5...1000 of up to 40 fixed frequency communication channels and data transfer;
- ▶ links or up to 3 networks with technique
- ▶ monitoring all high priority communication channels and data transfer links;
- ▶ received and accumulated data transfer to a command post.

**The system consisting of 2 posts and a reconnaissance station additionally performs the following functions:**

- ▶ determination of coordinates within a coverage area (up to 60km depth, up to 90km front);
- ▶ effective jamming of up to 80 frequency communication channels and data transfer links or up to 6 networks with F technique;
- ▶ situational awareness data accumulation and procession;
- ▶ receiving data documentation.

### MAIN PERFORMANCE DATA

	R-330RD	R-330KV1	R-330UV1	R-330UV2
Application	Reconnaissance station HF, UHF	Jamming station HF	Jamming station UHF2	Jamming station UHF1
Operating frequency range, MHz	1.5 ± 1 000	1.5 ± 30	30 ± 230	225 ± 1 000
Response time from signal appearance till jamming signal radiation, ms (within swath)	—	2 (28.5MHz)	0.3 (80MHz)	0.3 (80MHz)
Coordinates definition accuracy, % of the range	5 ± 10			
Jamming signal strength, kW	—	1.0	2.0	2.0
Situational awareness display	available			
Navigation system	NAVSTAR GPS, GLONASS			
Power supply system	Autonomous electric power station, industrial power supply system 380V, 50Hz,			



## SURFACE AND LOW-FLYING TARGETS DETECTION RADAR 111L1-LIS

111L1-LIS Radar is designed for detection of moving people and vehicles, low-flying slow targets and surface marine targets for security and reconnaissance support. Target recognition mode allows to specify target range and its direction and after listening to the specific sound spectrum of a signal to classify the target. The basic version is designed to allow the radar installation on the vehicle and includes facilities for automatic antenna system leveling using data from built-in accelerometric horizon sensors. The radar can be installed on APC or ACV. The radar's operation is harmless to the human's body. The millimeter's bandwidth doesn't create interferences with other radio-technical systems and is not influenced by interferences of other systems. Millimeter bandwidth beam is less influenced by water surface than the beam of centimeter bandwidth. This enables more precise small-target detection of water targets.



### MAIN PERFORMANCE DATA

Target detection range (radial speed 2-50 km/h):	
- single person	5 km
- vehicle	10 km
- armored vehicle	10 km
- ship	10 km
Radar resolution range:	
- bearing	1°
- range	15
Power consumption	not more than 65 W
Operating temperature range:	30°C...+60°C (-20°C...+50°C for remote display)
Setting-up procedure	does not exceed 5 min



### MAIN PERFORMANCE DATA

Reconnaissance / check range of fire positions, km:	
- artillery	30
- mortars	30
- MBRL	30/50
- tactical missiles	55/80
Electronic surveillance sector, deg	90
Deployment/Closing time, min	10-15
Crew per shift, persons	5
MTBF, hrs	>400
Length, mm	11 500
Width, mm	3 160
Height, mm	3 800
Weight, t	23.5
Chassis type	KrAZ 63221

## RADAR SYSTEM 1L220U-KC

Radar System 1L220U-KC is designed to provide:

- reconnaissance of coordinates of fire positions (FR) of enemy artillery, multi barrel system launch (MBRL), launching positions (LP) of enemy tactical missiles by the first shot and supply of target designation signals to friendly fire means to defeat;
- check of impacts and adjustment of the friendly fire means.

The system is also able to accomplish:

- identification of the firing system class: mortars, MBRL, artillery, tactical missiles;
- predicting of enemy impact points;
- collection of reconnaissance data concerning the battlefield, evaluation of width and depth of enemy batteries location (orientation) and transmission of reconnaissance data to the command posts of the Higher Command and to the command posts of the interacting fire units.



Full scan time, sec  
25-30



Scan zones, in azimuth  
-60...+60°



Scan zones, in range, m  
0-15



Power consumption, W  
65



Radar weight, kg  
40





## RADAR MALACHITE

Radar «MALACHITE» - digital, interference-proof radar reconnaissance aircraft and surface targets provides detection, identification of the origin and transmission of radar information consumers automatically.

The structure of «MALACHITE» radar includes:

- ▶ antenna-mast device and two diesel power units with a capacity of 13 kW located on the chassis;

- ▶ equipment room cab on the chassis of the trailer.

Radar «MALACHITE» provides:

- ▶ detection of high-speed and low-flying air targets;
- ▶ control of the water area and the detection of sea targets up to the radio horizon;
- ▶ an effective tool in the fight with the targets using «stealth» technology;
- ▶ the ability to detect targets with a small effective reflecting surface and UAVs;

Modification «Malachite-M» is designed to provide detection and tracking of marine targets.

### MAIN PERFORMANCE DATA

The amount of detectable and tracked targets, pcs	256
Range UAV detection, km	30-70
Resolution:	
- range, km	0.42
- azimuth	< 6°
Interfacing with command posts	provided



Range target detection, km  
2.5 - 400



Power consumption of the radar, kW  
6.5



Time between failures, hrs  
2 000



## VHF AND UHF TACTICAL SIGINT - LLVI AND DF SYSTEM SHADOW

### THE COMPLEX PROVIDES

- Investigation of RF sources for reconnaissance
- Pinpointing and ranging of military units HQs, stationary and mobile communications repeaters, EW or ECM installations, artillery spectators, UAV ground stations, etc
- Transmitting coordinates of targets revealed to artillery or other fire support means
- Detecting of enemy's reconnaissance groups inside friendly territory
- Control of radio communications usage of friendly forces

The Shadow System is intended for detection and monitoring of stationary, mobile and hand-held RF appliances, both digital and conventional. Direction finding unit is a rack-mount, which makes it independent from chassis and allows mounting in wide range of vehicles or at stationary point. Remote control capabilities allow to reduce needs in high-qualified personnel and allows to control all system from a single place.



Frequency, MHz  
30 - 3 000



Detection range, km  
25 - 30



Direction finding, MHz  
130 - 800



Channel quantity of simultaneous monitoring, pcs.  
8



Detection accuracy, deg  
3-5





### MOBILE SYSTEM OF SURFACE RECOGNITION AND ECM

## JAB

Mobile System of surface recognition and ECM «JAB» is intended for detection, classification and identification of surface moving targets as well as low-speed low-flying air targets, target pointing with the aim to provide performance of tasks on security of wide areas and reconnaissance.

System provides:

- ▶ automatic detection (with radar) and receiving detail information (with visual channel) about surface moving targets geographically referenced and with output of the information to command center;
- ▶ automatic affixment of the system on the terrain with the help of satellite navigation systems; calculation and record route traffic at PC.



### MAIN PERFORMANCE DATA

Radar detection range, km:	
- person	2.5
- vehicle	6.4
IR channel detection range, km:	
- person	2.4
- vehicle	6.4
TV channel	36x
Operating temperature, °C	-20...+50
The distance to the remote panel:	
- through a wired channel, m	up to 100
- over a wireless channel, m	up to 300



### PORTABLE JAMMER GPS/GLONASS

## ANKLAV

Portable jammer «ANKLAV» is intended to provide jamming navigation receivers GPS/GLONASS.

It is an effective tool in combating drones and precision-guided weapons.

Portable jammer «ANKLAV» is manufactured in portable and stationary version with directional antennas and omnidirectional ones.

### MAIN PERFORMANCE DATA

Jamming range, km:	
- with directional antennas	40
- with omnidirectional antennas	20
Operation modes:	
GPS jamming	
GLONASS jamming	
GPS/GLONASS jamming	
Accommodation options portable jammer «ANKLAV»:	
- portable mobile option	
- on buildings and fixed towers	
- in armoured vehicles and automobiles	





## MULTIFUNCTIONAL DISPLAY

# MFI-27

Designed for installation to the cockpits of aircrafts and helicopters, for example to the Su-27 and MiG-29 fighters. LCD 5"x4" provides a comfortable work of operator at any ambient light conditions. Active TFT matrix has high resolution characteristics and this wide viewing angles and allow to display high quality graphics even under the sunny light. Control panel is equipped with automatic brightness adjustment system. There are 20 multifunctional knobs and 2 potentiometers on the control panel. It is possible to load a software to MFI-27 through the external connector.



### MAIN PERFORMANCE DATA

Screen size	5"x4" (132.5 x 99.4)
Block dimensions, mm	197x164x188
Resolution, color pixels	640x480
Weight, kg, not more	4
Power consumption, A:	
- electronics by 27 V	1.5
- heating system by 115 V	1
Brightness up to, cd/m2	1 200
High contrast	≥200:1
Two analog video input Composite (PAL, SECAM, NTSC) connectors two video input Fiber Channel color/monochrome (option) connectors	
Video output to recorder: 1 Fiber Channel	
Two channels interface standard MIL STD 1553B	
Six input / two output lines ARINC – 429	
3 USD control interfaces channels, Ethernet-1 pcs, RS232-2 pcs	

## MULTIFUNCTIONAL PROCESSING SYSTEM

Designed to provide a new operational modes of the upgraded weapon control system of the fighter.

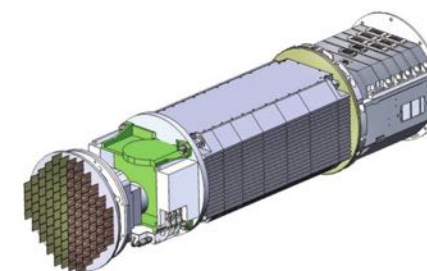
It provides:

- ▶ receiving an information and sending it to a multifunctional display (MFI-27);
- ▶ processing an aperture synthesis algorithms and Doppler beam sharpening algorithms while a radar operates in surface search modes;
- ▶ moving target detection and tracking algorithms processing;
- ▶ processing an algorithms of targets destination and a launch zones computation for the new types of weapons suspended.



### MAIN PERFORMANCE DATA

Processor frequency, MHz	1 000
System bus type	VPX
System memory, Mb	1 000
Flash memory (optional), Gb, up to	16
Number of the ARINC 429 interface lines	50
Number of parallel bus lines	16
Number of output logical commands	16
Number of the ADC channels	28
Number of the DAC channels	10
Power consumed, W, up to	45



### MAIN PERFORMANCE DATA

Direction finding method	monopulse
Direction finding area, area:	
- On azimuth	±60°
- On an elevation	±60°
RMS error of direction finding, degree:	2°-5°
Sensitivity of receiving channels passive radar homing head, dB/W	-120
Frequency range	X
Band width of operating frequencies, GHz	1
The maximum corners of deviation of search area, degree:	40°
Maximum range target lock, km, no less	70/110
minimum range target lock, km, no less	2,5
Output	digital
Time between failures, no less	500
Weight of equipment of a PRHH, kg, no more	16

## BROADBAND RADAR SEEKER

# TOPAZ

Is designed for medium range «air-to-air» and «air-to-surface» missiles. It is used as a part of passive radar system and provides the search and acquisition of air or ground hostile radars emissions in a day- or night-time operation, in different meteorological conditions and against different background surfaces.



## FREQUENCY SYNTHESIZER WITH LOW PHASE NOISE AND AMPLITUDE FLUCTUATIONS

# OZON

### MAIN PERFORMANCE DATA

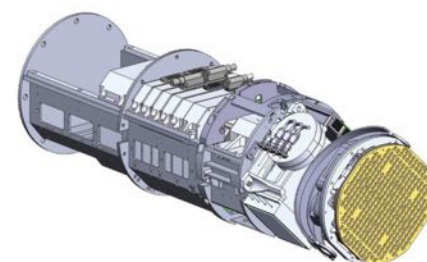
Frequency channel number	18
Output signal power, mW	400-700
Output signal amplitude fluctuations spectral density, dB	-125
Output signal phase noise level, dB/Hz, at the carrier offset:	
- 2 kHz, dB/Hz	- 104
- 10 kHz, dB/Hz	-120
- 25 kHz, dB/Hz	-130
- 170 kHz, dB/Hz	-135
Channel switch time, ms	40
Spectrum signal level, dB at the carrier offset:	
±(0,2-10,0) MHz	-90
±(10-100) MHz	-85
±(100-600) MHz	-80
±(600-1350) MHz	-60

Is designed for operation within airborne radars generating high frequency synchronization signals, set of signals, and heterodyne frequencies in the X band according to chosen channel number.



## ACTIVE RADAR HOMING HEAD MISSILES "GROUND-AIR" AND "AIR-AIR" MEDIUM-RANGE ONIX

Active radar seeker (ARS) of Ka band «Onix» provides search and acquisition of air targets of different types (maneuvering and non-maneuvering) in course of guidance, day- or night-time operation, in different meteorological conditions, at all angles, in a free space and against background surface, under ECM conditions. ARS allows to increase the accuracy of guidance at the final part of the trajectory and to provide the «fire and forget» principle.



### MAIN PERFORMANCE DATA

Quantity of simultaneously attacked targets	1...4
Search area, degree:	
- on azimuth	$\pm 20^\circ$
- on an elevation	$\pm 20^\circ$
The maximum corners of deviation of search area, degree	
- on azimuth	$\pm 40^\circ$
- on a place corner	$\pm 40^\circ$
The maximum corners of deviation of search area, degree/s:	40
Speed range of approach with the target, m/s	300...2400
Search area on range, km	0.1...20
Range of acquisition of an air target of type MiG-29 in a forward hemisphere, km:	20
Operating range of radio correction, km	60
Weight of equipment of a RHH, kg, no more	15

## LOW NOISE WIDEBAND FREQUENCY SYNTHESIZER UM511011

Is designed for CW and pulse microwave signals as well as a synchronization signals generating. According to the control information from central computer, digital control unit applies different types of modulation to generated CW or pulse signals, as well as receives service information from internal modules in order to send it to central computer

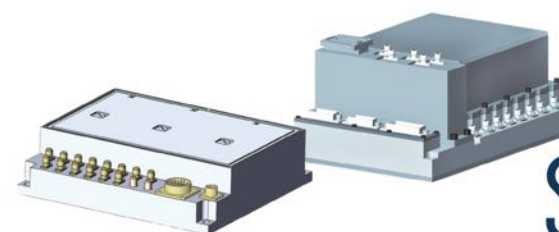


### MAIN PERFORMANCE DATA

	AAЭД.467871.004	AAЭД.467871.004-01
	45	44
Output power, mW	400-720	
Phase noise at the carrier offset:		
- 2 kHz, dB/Hz	104	
- 10 kHz, dB/Hz	115	
- 50 kHz, dB/Hz	130	
- 170 kHz, dB/Hz	130	
Switching time, ms, less than	10	
Spectrum spurious components level, dB	-80	

## RECEIVER- SYNTHESIZER UNIT

Receiver-synthesizer unit is a multifunctional device intended for application in perspective airborne radars. It provides wideband frequency output signals, heterodyne signals and synchronization signals for synchro detector.



### MAIN PERFORMANCE DATA

Frequency band	X
Frequency step, MHz	2
Signal instability	$\pm 1 \times 10^{-7}$
Frequency switching time, up to, usec	2
Phase noise level, at the carrier offset 1kHz, dB/Hz	100
Spurious spectral components, up to, dB	80



### BROADBAND SOLID STATE POWER AMPLIFIERS

## SSPA 2X10. SSPA 2X2.5

Broadband solid state power amplifiers SSPA-2x10, SSPA-2,5 are designed for power amplification in jamming systems, wideband communication systems and radars.

### MAIN PERFORMANCE DATA

	SSPA-2X10	SSPA-2,5
frequency range	X	X
output power $P_{-1}$ , dBm(W)	38.5-41 (7-12)	34 (2.5)
gain, dB, min	30	40
VSWR input/output, max	2.0	2.0
supply voltage, V $\pm 10\%$	27	27
power consumption, W, max	3	3
operating temperature range, deg C	-55 .... +80	-60 .... +80
weight, kg, up to	6	0,5

## HIGH FREQUENCY RADAR RECEIVER MODULE



### MAIN PERFORMANCE DATA

Frequency range	X
Gain (adjustable), dB	46
Noise factor, dB	3.5
Maximum input signal level, dB	-35
Image rejection, dB	40
Output bandwidth in narrowband mode, MHz	5
Output bandwidth in wideband mode, MHz	30
Gain control range, dB	25

High frequency radar receiver modules are AAЭД.434854.001, AAЭД.434854.002, AAЭД.434854.003 is intended for modern interceptor airborne radars (enhanced H001, H019 versions). It is equipped with an input attenuator for adjustment of input signal level, as well as protection of low-noise amplifier using for transmitted pulse, fast recovery is ensured.





UPGRADE



REPAIR







## SURFACE-TO-AIR MISSILE (SAM) SYSTEM 2K12M1-2L

# KVADRAT-2L

Engagement Radar Vehicle (SURN) 1S91-2L

Upgraded 2K12M1-2L Surface-To-Air (SAM) System (Kvadrat-2L) features improved performance and extended functional capabilities due to new algorithms of data processing and displaying, digital signal processing with software based MTI and automatic data read out and processing. 2K12M1-2L is offered as the upgraded follow-on to 2K12M1.

### Principles of Upgrade

- ▶ Capability to detect and destroy low-flying targets including VLO ("Stealth"). Improved operation in jamming conditions, in presence of reflections from underlying surface
- ▶ Automation of control from Command Post, automation of detection and tracking, prelaunch preparation and launch of missiles, crew training.
- ▶ Increase of kill area and kill probability due to optimization of signal processing, increased detection and tracking range of low-flying targets.
- ▶ Reduced response time and firing cycle.
- ▶ Extended service life – up to 15 years.
- ▶ Improved reliability and MTBF (1500 hours) due to replacement of 90% of analogue components with digital
- ▶ Improved survivability and control capabilities due to introduction of a specialized remote command and control post controlling Air Defense Missile System from up to 1000 meters (option)
- ▶ Crew training capability by simulation of air situation and action scenarios
- ▶ Standardized and modular configuration

- ▶ Simplified maintenance of system
- ▶ Reduced power consumption
- ▶ Improved ergonomics
- ▶ Improved survivability due to introduction of a remote command and control post (RCCP) capable of controlling SAM System from up to 500m (option).

### System Operational Characteristics

System is equipped with the simulator enabling training of combat crews in realistic conditions including simulation of ECM applied by the enemy. System is capable of operation in the following ambient conditions:

- ▶ humidity: 98% at +25° C;
- ▶ wind speed: up to 25 m/s.
- ▶ System is equipped with GPS.

### Software

Software consists of application part and testing software. All software is stored in memory modules.



## RADAR P-14MA

As a result of upgrade the radar's detection performance is efficiently improved. Upgraded radar features automatic tracking capability, as well as data receiving from other radar sensors. Data can be exchanged over a variety of communication channels in approved format.

### Depth of upgrade:

The radar's equipment cabin is fully upgraded. Metric band is preserved. However, the number of working frequencies is increased from 4 to 200, the capability of instantaneous electronic frequency agility is added. Radar transmitter and receiver feature solid-state components only. The transmitter has a modular

design and provides 'soft-failure' redundancy: failure of individual module leads to partial performance declination.

Antenna-mast assembly is equipped with new asynchronous motor drives controlled by frequency inverters.

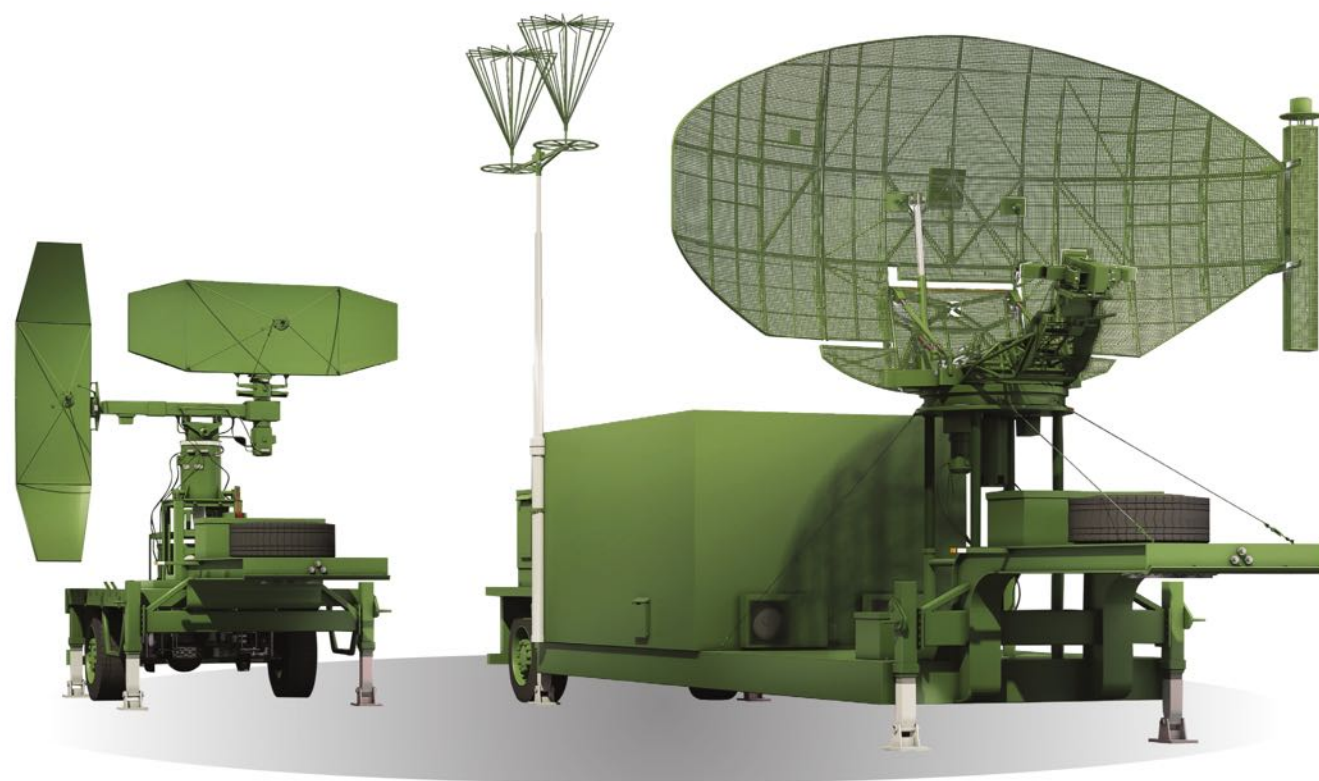
Upgraded P-14MA radar features efficient protection against pulse interference and active jamming. Level of interference is continuously monitored and graphically represented to the operator. Passive interference is rejected through digital adaptive MTI and generation of clutter map.



### MAIN PERFORMANCE DATA

	before upgrade	after upgrade
Range of working frequencies, MHz	170-190	160-200
Frequency agility:		
- method for frequency agility;	electromechanical	electronic
- discreet steps;	4 fixed frequencies	200 kHz
- frequency setting accuracy.	n/a	±10 kHz
Types of transmitted probing pulses:		
- short pulse;	10 μs	10 μs
- phase shift keyed signals:		
- 13-bit;		13 × 10 μs
- 28-88 bit.		(28 – 88) × 10 μs
Transmitter pulse power	700 kW	30 kW
Capability of instant probing signal power and structure changes	Not implemented	Implemented
Detection range for a target with RCS of 2.5m <sup>2</sup> , P=0.5:		
min range	-	2,7 km
at altitude of H=100 m	30 km	37 km
at altitude of H=500 m	85 km	105 km
at altitude of H=1000 m	110 km	130 km
at altitude of H=3000 m	185 km	220 km
at altitude of H=10000 m	290 km	340 km
Detection accuracy:		
- range	1 000 m	270 m
- azimuth	0.80	0.40
Resolution:		
- range	3 500 m	1 600 m
- azimuth	80	80
Range of adaptive MTI	-	0-500 km
Clutter suppression ratio	-	> 40 dB
Dynamic range of receiver and digital signal processor	-	> 100 dB
Automatic control of modernized height-finders	-	Implemented
Number of controlled height-finders	-	up to 4
Start-up time	8 min	3 min
Power consumption	60 kW	up to 40 kW





## GROUND-CONTROLLED APPROACH SYSTEM RSP-10MA

Upgraded Ground-Controlled Approach (GCA) System RSP-10MA is intended to ensure flight safety of aircraft and helicopters within terminal airspace, obtain positional information and guide aircraft to a safe landing in normal and adverse weather conditions. RSP-10MA combines primary and secondary radars, and Precision Approach Radar (PAR).

Primary channel of RSP-10MA operates in L-band (ICAO), secondary channel uses standard frequencies for RBS (interrogation – 1030 MHz, response – 1090 MHz) and Eastern UVD (interrogation – 1030 MHz, response – 740 MHz). Primary and secondary channels work on a common antenna. Precision

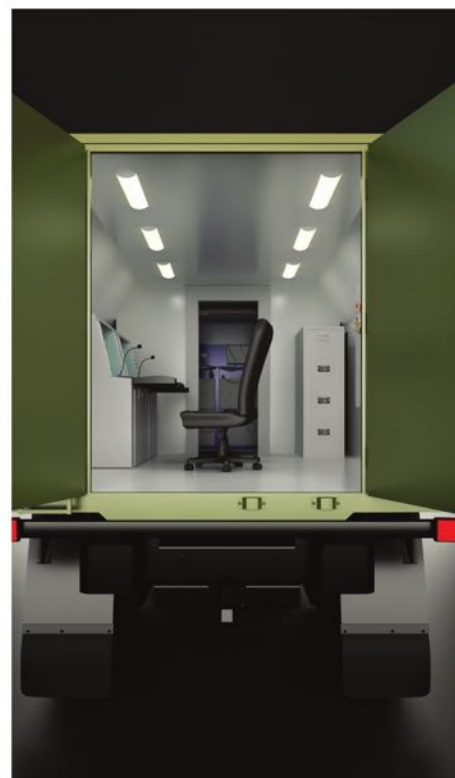
Approach Radar performs vertical and glide path guidance and operates in X-band. Radar includes PSR/SSR operator workstation and PAR operator workstation equipped with air situation displays and radio control panels. All air situation is automatically recorded with playback capability in passive and interactive modes. RSP-10MA is powered from two independent power supplies: from three-phase industrial mains (380V, 50 Hz) and from diesel power generators. RSP-10MA features efficient protection against pulse interference and active jamming. Level of interference is continuously monitored and graphically represented to the operator.

### MAIN PERFORMANCE DATA

	PSR	SSR
Range of working frequencies, MHz	1250 – 1350, 125 frequencies with step 0.8 MHz	
Frequency agility:		
- method for frequency agility;	electronic	-
- discreet steps;	800 kHz	
Supported modes	-	RBS, UVD and Mk XA
Types of transmitted probing pulses:		Interrogation code in modes A and C tP= 0.8 µs
- AM, µs;	1.5	
- phase shift keyed signals:		
- 13-bit;	19.5 µs	
- 28-88 bit.	(28 – 88) × 1.5 µs	
Transmitter pulse power	4 kW	1 kW
Detection range for a target with RCS of 2.5m <sup>2</sup> , P=0.5		
- minimum range	1 000 m	2.7 km
- maximum range	100 km	150 km
Detection accuracy:		
- range	100 m	100 m
- azimuth	0.4°	0.4°
Resolution:		
- range	250 m	150 m
- azimuth	5°	5°
Scanning period, s	5	5
Range of adaptive MTI	-	0-160 km
Clutter suppression ratio	-	> 35 dB
Dynamic range of receiver and digital signal processor	-	> 100 dB
Start-up time	3-5 min	
Power consumption	less than 16 kW	

	Azimuth	Elevation
Range of working frequencies	X-band	
Coverage area:		
- Azimuth	from -15° to +15°	from -15° to +15°
- Range, at least	25 km	25 km
- Elevation	from -3° to 15°	from -1° to 8°
Mean square error:		
- Range, less than	20 m	
- Azimuth, less than	0.030	
Range resolution	80 m	





## 2D SURVEILLANCE RADAR P-190U

The 2D Surveillance Radar for low-altitude target detection P-190U has the following features:

- ▶ full coherence is implemented, due to the significant improvements in radar performance;
- ▶ a wide range of narrow and broadband probing signals enabling radar adaptation to various combat conditions;
- ▶ digital signal processing, including matched clutter and active jamming suppression, target detection and coordinate measuring, target tracking and data distribution to consumers;

- ▶ practically approved reliable software with a user-friendly interface;
- ▶ only COTS components are used from renowned suppliers - this coupled with quality system approval guarantees the high level of reliability.

The radar equipment can be placed on ZIL, KrAZ, KAMAZ vehicle chassis (and similar) or in a Fixed-position shelter. As an option, this equipment can be installed in a modified hardware compartment of the P-19 radar.



Frequency band, MHz  
820-890. 04



Radar coverage zone, km  
MAX 300



Combat crew  
3



Start-up time, s  
40



Power consumption, kVA  
5



### MAIN PERFORMANCE DATA

Location accuracy:	
- range, m	90
- azimuth	0.3°
- bearing of active jammers	1.5°
Resolution:	
- range, m	550
- azimuth	5°
Jamming immunity:	
Against active jamming:	
- automatic monitoring of clutter conditions and automatic adaptive working frequency hopping 0.4 MHz discreet	+
- high dynamic range of signal processing system (of the receiver and digital signal processing unit) - 105dB	+
- extra expansion of dynamic range (by 30 dB) through automatic gain control	+
- 4-channel dejammer of active jamming is offered as an option, providing jamming suppression of 32 dB (at SNR of 40 dB)	option
Against passive jamming:	
- clutter suppression ratio (factor), not less than, dB	50
- working zone of the MTI system	0-300 km
- adaptive MTI	clutter map
Against non-synchronous pulse jamming	full suppression
Target detection mode, tracking:	
- plots per scan	up to 1000
- number of tracks	up to 150
- active jammer tracking	up to 36
Height-finder control mode (option) - fully automatic, on condition of installation of extractors number of controlled height-finders	up to 4
FA guidance modes and ADMS targeting (options):	+
Operating conditions:	
- temperature	-40°... +50°
- relative humidity	95%
Set-up/tear down time, min	up to 20
Power consumption, kVA	5 (without air conditioning system)





# RADAR STATIONS AND AIR DEFENCE EQUIPMENT UPGRADE AND REPAIR



## 2D VHF SURVEILLANCE RADAR P-180U

Ground-based long-range VHF surveillance radar P-180U is offered as the upgraded follow-on to its prototype, the analogue P-18. P-180U radar features protection against pulse interference and active jamming. Level of interference is continuously monitored and graphically represented to the operator. Jamming protection is achieved through expansion of the dynamic range of the signal processor and capability of electronic frequency agility. Passive interference is rejected through digital adaptive MTI and generation of clutter map.

The number of vehicles in standard configuration is decreased from 4 to 2. Two power generators are accommodated in an individual compartment of the antenna-mast assembly vehicle.

### MAIN PERFORMANCE DATA

	before upgrade	after upgrade
Range of working frequencies, MHz	150-170	140-180
Frequency agility:		
- method for frequency agility;	electromechanical	electronic
- discreet steps;	4 fixed frequencies	200 kHz
- frequency setting accuracy.	n/a	±10 kHz
Types of transmitted probing pulses:		
- short pulse;	6 μs	6 μs
- phase shift keyed signals:		
- 13-bit;		13 × 10 μs
- 28-88 bit.		(28 – 88) × 10 μs
Transmitter pulse power	300 kW	8 kW
Capability of instant probing signal power and structure changes	Not implemented	Implemented
Detection range for a target with RCS of 2.5m <sup>2</sup> , P=0.5:		
- min range	-	2,7 km
- at altitude of H=100 m	28/30 km	30/32 km
- at altitude of H=500 m	50/60 km	60/70 km
- at altitude of H=1000 m	65/75 km	70/80 km
- at altitude of H=3000 m	90/110 km	110/120 km
- at altitude of H=10000 m	175/250 km	300/360 km
Detection accuracy:		
- range	1 400 m	180 m
- azimuth	1.5	0.40
Resolution:		
- range	2 000 m	1 100 m
- azimuth	80	80
Range of adaptive MTI	-	0-400 km
Clutter suppression ratio	-	> 40 dB
Dynamic range of receiver and digital signal processor	-	> 100 dB
Automatic control of modernized height-finders	-	Implemented
Number of controlled height-finders	-	up to 4
Start-up time	8 min	3 min
Power consumption	10 kW	up to 6 kW





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