DOPPLER METEOROLOGICAL RADAR "DMRL-3"

The support realized by meteorological data from purpose-designed meteorological radars serves as one of constituents of data support for ATC automated systems that ensures more comprehensive air situation picture, determination of meteorological conditions within the radius of up to hundreds of kilometers, and short-term (1-3 hours) tendencies of development thereof.

One of the ways of ensuring meteorological observations at places of MRL-5 operation as well as at airdromes is installation of high resolution meteorological radars, which allow detecting atmospheric phenomena including non-stationary ones.

"DMRL-3" Meteorological Radar is small-size Doppler meteorological radar of 3cm band with capability to operate in the mode of dual polarization.

"DMRL-3" Meteo Radar provides the following:

-Generation of maps of upper boundary of cloudiness, horizontal and vertical cross-sections of radar parameters of meteo-objects (reflectivity, velocity, spectrum width, differential reflectivity, differential phase and cross-correlation factor);

-Obtaining spatial structure and types of cloudiness and precipitation;

-Getting data concerning dangerous weather phenomena (cloudiness, precipitation, storms, hail, squall) within the radius of up to 100-150km;

-Defining the danger of hail, storm and cloudiness development tendencies;

Appearance of "DMRL-3"

- Measurement of precipitation intensity for wide areas;

-Defining precipitation direction, calculating precipitation movement velocity and precipitation vertical and horizontal dimensions;

-Measurement of radial velocities of movement of meteorological formations ;

-Online evaluation of movement velocity and zones of wind field enhanced inhomogenuity of cloud systems;

-Output of radar data for the users in codograms required.

BASIC SPECIFICATIONS OF "DMRL-3" RADAR

Parameter Denomination	Parameter Value
1. Operating frequency band, MHz	9550-9650
2. Coverage Instrumented range of detection, km, not less than Maximal height of detection, km, not less than Elevation angle, deg. Minimal detection range, m, not more than	 150 20 from -2 up to +92 200
3. Antenna Type Pattern width in two planes on the level of 3dB for each polarization, deg (reflector diameter*, m)* Polarization Error of angular coordinates measurement, deg. Accuracy of setting the angle specified, deg. Maximal speed of scanning, rpm	 reflector-type parabolic 1.3 ± 0.1 (2.0) horizontal + vertical 0.05 0.1 24
4. Transmitter Type Peak power, kW, not less than Pulse width, μs Sounding frequency, Hz Modulation type	 transistor-type 0.3 0.15-100.0 300-5000 MONO/LFM
5. Receiver Noise factor, not more than Intermediate frequency, MHz Sounding signal stability, dB, not less than	 2.5 300 50
6. Availability of monitoring and control system	+
7. Power supply (external mains or self-contained source of power supply) Voltage, V Frequency, Hz Power consumed by the equipment taking into account the system for maintaining temperature modes, kW, not more than	 220, 1 phase 50 4

BRIEF DESCRIPTION OF BASIC COMPONENTS OF “DMRL-3”

In “DMRL-3” Meteorological Radar the antenna of 3cm band is used as the component of antenna device. Parameters of antenna movement are variable within wide limits and can be set by means of the software depending on the tasks to be accomplished and on external conditions.

The transmitting device is intended for generation of sounding signal. For the purpose to reduce the peak power, the succession is used comprising low-frequency modulated signals of big width (from 4 up to 100μs) and short signals (~ 0.15 μs) with monochromical fill-up. For obtaining the clutter suppression required, high stability of the transmitter is ensured by the way of digital shaping of calibration signal on the intermediate frequency with subsequent conversion into the carrier frequency. Output amplifier is based on transistor-type amplifiers of power with air cooling.

The receiving device is intended for amplification of echo-signal received, its conversion into intermediate frequency, analog-to-digital conversion with subsequent phase detecting and bandpass filtering in digital form. Signal conversion is performed as per superheterodyne scheme.

The equipment of data processing system is based on CUDA technique and it makes calculation of spectral characteristics of reflected signals with the resolution of 20-30m. Data processing algorithms are in general similar to the ones of “DMRL-C” and provide the following:

-Matched filtering of a signal;

-Doppler period-to-period processing of azimuthal package;

-Selection of interfering reflections from stationary objects;

-Generation of the map of local clutter remaining reflections;

-Generation of intensity maps for reflections, velocities, spectrum width and polarization characteristics (for the case of ordering dual-polarizational version) of meteorological formations.

For the purpose to enhance convenience of operation and to reduce the time for trouble shooting, “DMRL-3" is equipped with automated system of monitoring and control.

The antenna module includes the antenna system comprising radiator and reflector. The reflector is mounted onto the column of the drive. The radiator is fastened to the reflector by means of the system of rods and is powered by power inlet waveguides. Inside the column of the drive two current collectors are installed, i.e. current collectors for elevation angle and for azimuth for the purpose of transfer of power and data takeoff via Ethernet interface.

Electric drives of “DMRL-3" antenna are the drives of azimuth and elevation angle. Output axises of actuating motor are kinematically connected to the antenna that results to the antenna movement in two planes of the space, namely: horizontal plane (in azimuth) and vertical plane (in elevation angle). Control over the drives is performed from the controlling computing complex responsible for processing of the entire radar data from digital inputs of the unit for drives control.

On balancing weights of the antenna module two compartments with the radar basic equipment are installed: transmitting-receiving compartment and the compartment for the central controlling computing complex.

Inside the transmitting-receiving compartment the transistor-type amplifiers of power are used as the transmitter. The summed-up output peak power of the said amplifiers is not less than 300W. The transmitting device ensures generation of single-frequency sounding signal with the passband of 1.0 MHz or 10.0MHz. Amplitude-phase stability of the transmitting device does ensure the local clutter suppression factor of not less than 50dB.

The receiving device is of two-channel type, and comprises the channels of horizontal and vertical polarization. The each receiving channel is designed as per the scheme with single conversion of frequency, and ensures the noise factor of not more than 20dB at a dynamic range of not less than 90dB. For minimizing the losses of signal, low-noise amplifiers with waveguide inputs are installed directly onto the waveguide section. The receiving equipment placed inside the transmitting-receiving compartment has modular design. The each receiving channel is designed as a separate integrated unit with the output of signal on intermediate frequency.

Signal processing equipment is of two-channel type (two processing channels provide polarizational receiving channels) and is designed using digital signal processors and programmable logical devices similar to the ones used within "DMRL-C". Analog-to-digital conversion of a signal received is carried out at intermediate frequency with generation of final amplitude-frequency response of the channel by means of digital filters, which ensure high identity of channel characteristics and phase stability thereof. After analog-to-digital conversion, a digital filter carries out filtration up to 12.5 or 1MHz depending on the operation mode. After passing the compression filter, the data is sent to the special calculator of the central controlling-computing complex for further processing.

Intra-period processing of signals of one channel (compression, association with angular data) is realized by programmable logical devices. Period-to-period processing (rejective filtration of local clutter, spectral analysis of period-to-period fluctuations) is carried out by special computer. The processing result is sent for data primary processing. The software for data primary processing allows generating volumetrical files of conic sections for meteo-processing within the spacial cells of required dimensions for meteo-objects detected (reflectivity, average Doppler shift of frequency, spectrum width and polarization characteristics). From the output of the processor for data primary processing, the radar data via LAN is sent for the secondary processing where the further processing and transfer of this data to the users is performed.

The automated system of monitoring and control provided within "DMRL-3" ensures remote switching-on of the equipment of the complex, control over the complex reconfiguration and monitoring of the equipment technical status.

Data primary processing and automated system for monitoring and control are included into the central controlling-computing complex.

Power supply for "DMRL-3" with the power consumption of not more than 3.0kW taking into account the auxiliary equipment is effected from the industrial mains of 220V 50Hz, or from Diesel Electric Power Plant.

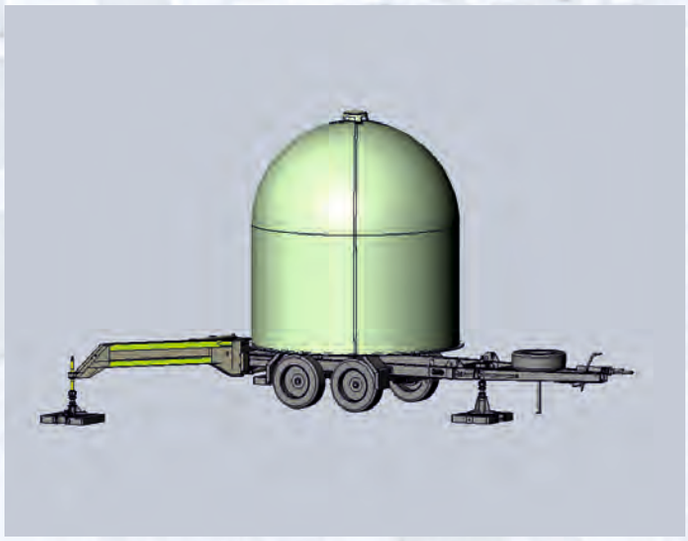
Composition of "DMRL-3" Meteorological Radar

"DMRL-3" includes the following as components:

- Antenna device;
- Transmitter-receiver and processing equipment (mounted into the rotating part of the antenna device under the radome):
- Rotation control device;
- Central controlling-computing complex;
- System of ensuring temperature modes;
- Primary power supply system;
- Radome;
- Remote terminal;
- Set of emergency SPTA.

The equipment of "DMRL-3" can be manufactured in stationary version, can be installed onto wheeled trailer or onto auto chassis of the type of KAMAZ-5350.

VERSIONS OF “DMRL-3” METEOROLOGICAL RADAR PLACEMENT

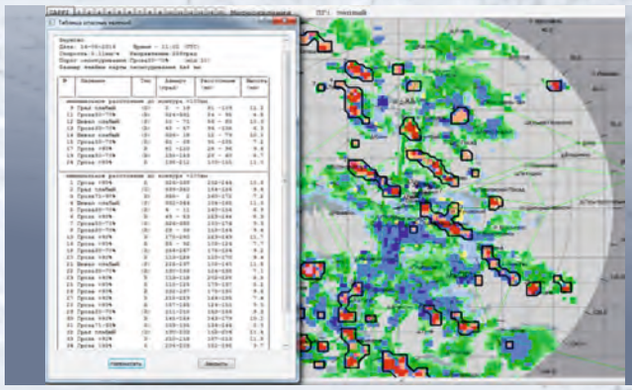


Transportable Version on Wheeled Trailer

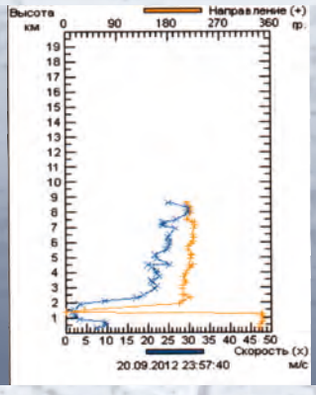
Mobile Version on Auto-Chassis

Stationary Version

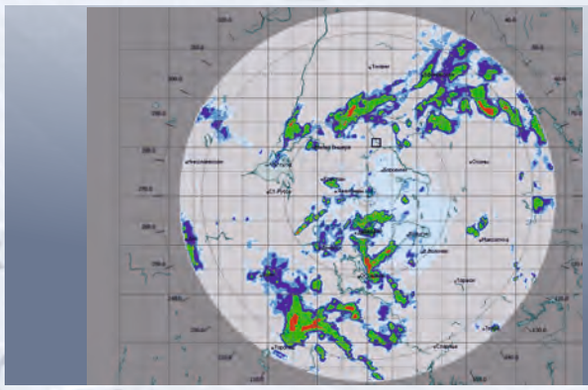
EXAMPLES OF MAPS GENERATED BY DATA SECONDARY PROCESSING SOFTWARE



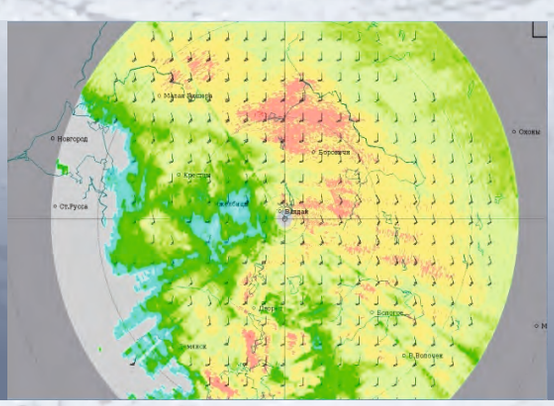
Map and Table of Dangerous Phenomena



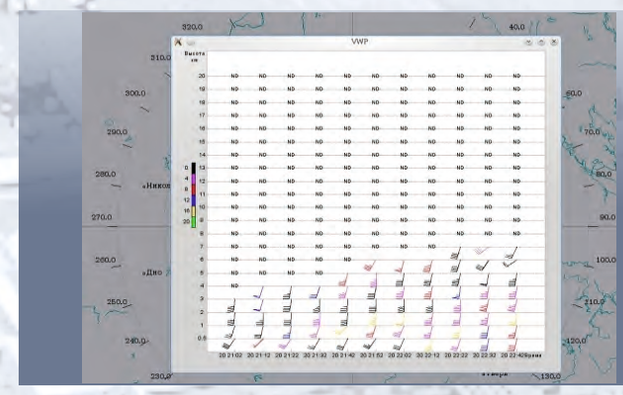
Wind Profile



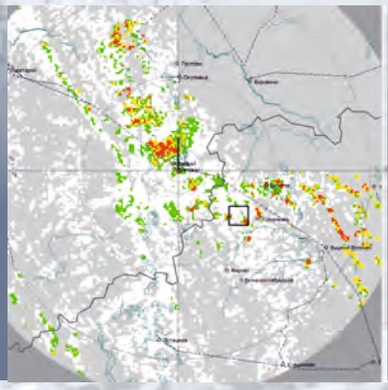
Visibility



Horizontal Wind



Horizontal Profile of Wind



Windshear

110, Dmitrovskoe shosse, Moscow, 127411, Russian Federation
Tel.: (+7 495) 485-15-88; 485-15-22 Fax: (+7 495) 485-03-88; 485-15-63
E-mail: lemz@tsr.ru http://www.lemz.ru