

STATIONARY RADIO DIRECTION FINDING STATION OF HF BAND “Vostok-RP1”



PURPOSE

Stationary radio direction finding station “Vostok-RP1” is used for automated direction finding of radio emission sources (RES) within the frequency band 0.5 MHz – 30 MHz at the distance of up to 2000 km and more and is designed for:

- Observation of signal waveform (amplitude spectrum, ASL pattern) in real time mode;
- Informational interaction with RDF Centers form the composition of RDF network via communication channels;
- Position estimation of radio emission source from single point (SSL method).

Stationary RDF station “Vostok-RP1” that is currently produced comparing to similar station of previous generation additionally provides the following:

- Receiving and efficient direction finding of steeply falling radiowaves ($\beta > 60^\circ$) with left and right polarization due to implementation of multimode loop antenna elements;
- Continuous registration of signal I/Q-components by all direction finding channels for specifying bearings by operator of station or RDF center in postponed mode;
- Possibility of remote control via LAN-channel;
- Possibility of taking bearings by operator of RDF Center of remote RDF station without involvement of operator of the product.

MAIN FUNCTIONING PECULIARITIES

1) Widebase antenna system of radio direction finder provides its high performance under conditions of interference signal fading.

2) Receiving and bearing taking of signals of vertical and elliptic polarization with left and right field vector rotation (for two ring antenna array); for three ring antenna – vertical polarization only.

3) Simultaneous measuring of azimuth and elevation angle of radiowave arrival provides a possibility to make an assessment of source position from a single point (SSL method) with position indication on the map.

4) Distance determination to the source by SSL method implementing ionosphere forecast (error of distance definition is $\Delta D \leq 25\%$).

Implementation of different methods of direction finding (amplitude and correlation interferometer) and also combining of data pickup methods (automatic, visual, audio) validates direction finding information about signal under the most difficult conditions of HF band receiving.

5) Continuous signal registration to computer HDD provides a possibility of playback and direction finding in unreal time mode for short-term signals and signals with low quality of reception.

COMPOSITION

- Antenna feeder system can be supplied in two variants:
 - 1) Two concentric Circular Antennas Array (CAA) with radius 60 m and 25 m, CAA with major radius containing 9 loop antenna elements, CAA with minor radius containing 9 nonsymmetrical vertical vibrators.
 - 2) Three concentric CAA with radius 60 m, 30 m and 15 m containing by 9 nonsymmetrical vertical vibrators each.
- Unit of wideband input equipment and antenna switchers.
- Multicircuit digital HF band receiver (9 channels are used and 1 reserve) with unit of digital signal processing and control on the basis of Intel Core i7 computer of ADLINK production – rack of receiving and measuring device.
- Board of control and indication on the basis of computer with LCD-monitors.
- Board of operating control.
- Equipment of data transceiving (is supplied by Customer).
- System of time synchronization based on navigation receiver GPS-18.
- Unit of field heterodyne for generating discrete frequency grid (0.5 MHz and 1 MHz) of supervisory signal is used for measuring instrumental accuracy of radio direction finder.
- Power supply system (power distribution board, UPS, line regulator 220 V),
- Complete set of HF feeders, connecting cables and accessories;
- Complete set of operational and maintenance documentation.

Note. 1. Product “Vostok-RP1” can be supplied without AFS. Operation of the product will be provided in this case from AFS of “Vostok-OPK1” product.

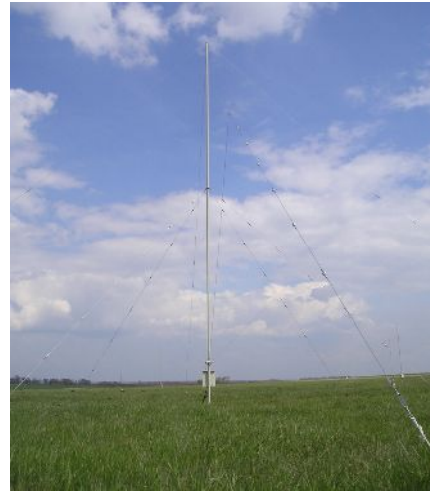
2. Type of antenna feeder system is selected by Customer.

3. Radio direction finder is connected to communication channels of the Customer.

External view of monopole antenna elements of direction finding AFS of "Vostok-RP1" product



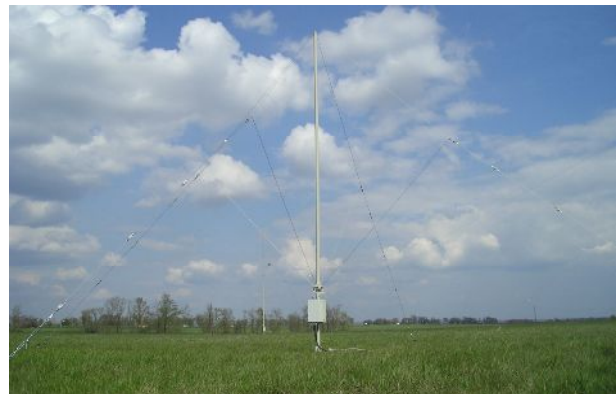
External view of loop antenna elements of direction finding AFS of "Vostok-RP1" product (I frequency subband)



Unit of wideband input devices and switching



External view of loop antenna elements of direction finding AFS of "Vostok-RP1" product (II frequency subband)



Board of control and indication



Rack of receiving and measuring device



MODES OF OPERATION

Initialization: equipment serviceability check after switching on, setting of initial parameters.

Autonomous control: direction finding of radio emission sources signals; signal processing (audio control, observing, direction finding and recording).

Remote control: automated control of operator's actions, monitoring of signal-interference environment changes, reading of signal fragments for conducting detailed technical analysis via Ethernet local net.

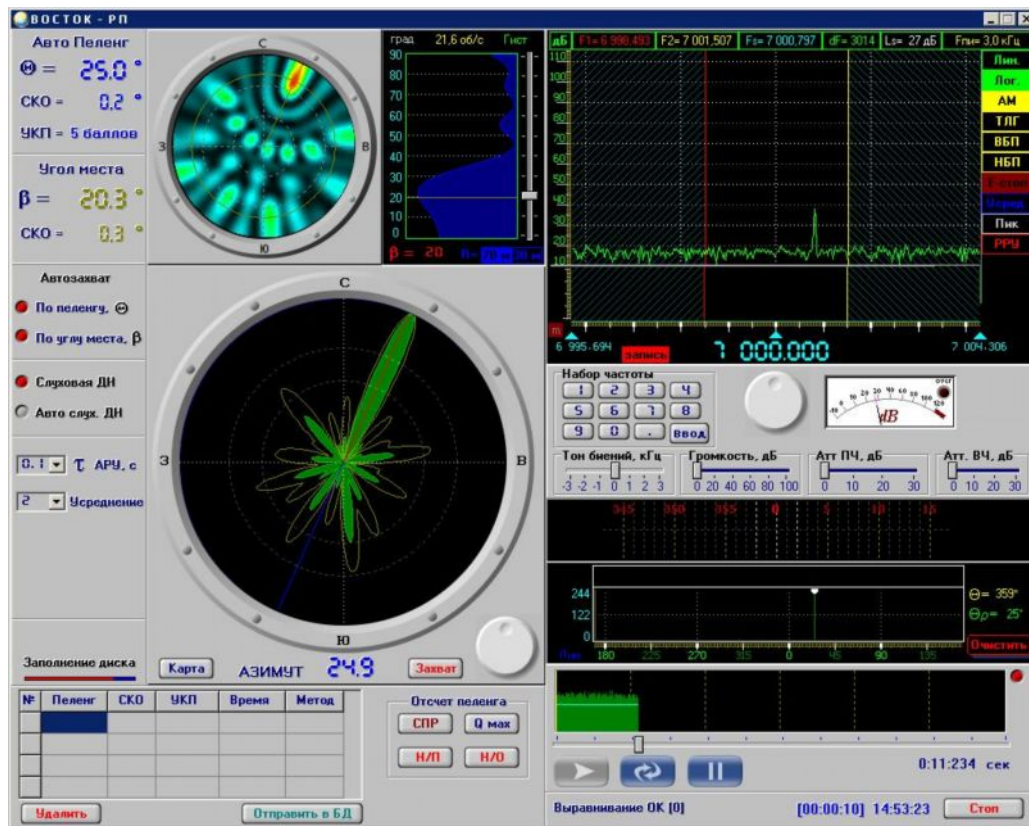
Testing: complex operability check and automated search of faulty element by the system of built in control.

MAIN INDICATION MODES

The following information can be displayed:

- Amplitude signal spectrum;
- ASL pattern (two dimensional);
- 3D ASL pattern (three dimensional);
- H-histogram (antenna pattern in elevation plane);
- Polyphase raster of correlation interferometer (divides signals with overlapped spectra);
- Bearing samples histogram ("coarse": $-180^{\circ} \dots +180^{\circ}$ "accurate": $-15^{\circ} \dots \Theta_{RES} \dots +15^{\circ}$);
- Oscillogram of signal record of RES which bearing is being taken by time;
- Maps of the area with bearing lines to RES and results of its position fixing computed by implementation of SSL method with ionosphere forecast.

Operating board of "Vostok-RP1" product



MAIN TECHNICAL PARAMETRES

Operating frequency band	0.5 MHz–30 MHz
Polarization	Vertical, circular (“left” and “right”)
Method of automated direction finding	Correlation interferometer
Method of diagrammatic (visual) direction finding:	Amplitude sector look
Error of bearing measurement Θ from 0° to 360°:	
in the frequency band 0.5 MHz – 3 MHz	< 2° (RMS)
in the frequency band 3 MHz – 30 MHz	< 1° (RMS)
Error of elevation angle measurement β within 20°...85° boundaries:	
in the frequency band 0.5 MHz – 3 MHz	< 5° (RMS)
in the frequency band 3 MHz – 30 MHz	< 3° (RMS)
Error of position fixing implementing SSL method (when $K_v = \sigma$)	20% of distance to RES
Sensitivity (depending on frequency):	
monopole antenna array	0.2 - 3 μV/m
loop antenna array	0.3 - 5 μV/m
Spatial selectivity of interference stations signals	
	10...15 dB
Sensitivity radio circuits (SNR=10 dB)	0.3 μV
Dynamic range by third order intermodulation	> 90 dB
Resolution of digital ADC circuits	16 bit
Relative frequency instability	$0.5 \cdot 10^{-7}$
Digital resolution of signals	10 and 20 Hz
Minimal duration of signals those bearings are being taken	5 ms
Dynamic range	≥ 120 dB
Frequency bandwidth (20 Hz adjustment)	0.03...8.0 kHz
Accuracy of bearing sample timing	± 10 ms
Continuous signals recording, HDD space consumption	4 Mb/hour
Data throughput rate (depending on transmission type)	2...5 RES/min
Visual bearing indication by numbers of radionet correspondents	present
Remote control	LAN (FOCL channel)
	main HF channel
	not more 800 VA
Consumed power	
Operating temperature range:	
equipment and operator board	+5 °C ...+ 4
antenna system	- 40 °C...+ 65 °C

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