VHF-UHF MOBILE RADIOMONITORING STATION

"BARVINOK-M"

- **Panoramic look with signal detection and direction finding in the frequency band of 25 - 3000 MHz with 10 GHz/s rate**
- **Automatic detection and direction finding of emission sources of modern communication systems (Conventional & Frequency Hopping) using correlation vector method**
- **Coordinates' computation with displaying them on the digital map**

- **Network classification and signal parameters measurement**
- **Signal reception and digital registration**
- **Audio and visual control over signals detected**

- **Radio electronic environment (REE) data storing and processing**
- **Informational interaction inside direction finding network with time synchronization by GPS navigation system**
- **Range of coverage: up to 20…30 km in the 25 - 500 MHz frequency band**
  up to 5…10 km in the 500 - 3000 MHz frequency band

General information

The purpose of mobile radio monitoring station «Barvinok-M» is to provide detection and direction finding of signals in the frequency band of 25 – 3000 MHz.

«Barvinok-M» station provides scanning of preset VHF-UHF frequency band, spatial search and localization of RES position by surface wave of vertical polarization.

Equipment of «Barvinok-M» station is mounted inside Customer's vehicle (minibus) namely: high-rate detector-finder of VHF-UHF band, automated operator position equipped with industrial computer, tracking receiver and equipment for digital signal registration and classification.

VHF-UHF direction finding antenna feeder system is mounted on top of the vehicle under radiotransparent streamlined antenna cover.

Navigation equipment (GPS-receiver) with radio communication equipment provides a possibility of synchronous work of mobile stations «Barvinok-M» both as Salve and Master station, and also under control of «Barvinok-K» station.

Power supply of the station is provided through UPS from industrial network with given voltage 220 V, frequency 50 Hz from independent source that is mounted in the rear section of the vehicle.

«Barvinok-M» is serviced by a single operator. «Barvinok-M» software is developed using modern computer technologies and is operated by Windows-7 OS. Due to GUI station operation doesn't involve high qualification and special knowledge of operator, and built-in self-testing system allows defining of malfunction up to bench-replacement assembly.

«Barvinok-M» detector-finder refers to the class of the systems with spatial signal processing and it provides signal detection by signal spatial features together with assessment of direction towards RES using correlation vector method of bearing computation.

VHF-UHF antenna system consists of two ring antenna arrays each containing 7 monopoles covering frequency sub bands of 25-1000 MHz and 1-3 GHz respectively.

Reception system of VHF-UHF band is based on multichannel receiver with double frequency conversion. 1-3 GHz frequency band is converted to 300-800 MHz using microwave converter. Analogue-to-digital converter size in the sections of reception system of detector-finder is 16 bit.

Purpose

Mobile VHF-UHF station for radiomonitoring «Barvinok-M» provides the following:

- REE monitoring over the territory in view of 20-30 km in the band of 25-500 MHz and up to 5-10 km in the band of 500-3000 MHz;
- Search, detection and direction finding of new radio emission sources within given segment of VHF-UHF (25–3000 MHz) frequency bands;
- Network classification and measurement of signals parameters of the RES detected;
- Control over already known sources put under observation;
- Disclosure of radiation modes and composition of radio nets operating on conventional and hopping frequencies with selection of separate sources by frequency-bearing panorama;
- Signal registration at the audio and IF outputs of the tracking receiver;
- Coordinates computation of the source location with displaying them on the map;
- Parameters and operation modes control, data gathering from Slave stations of the direction finding network;
- Automated processing and documentation of REE data;
- Informational interaction with stations from the composition of the complex.

Station composition

1) VHF-UHF direction finding antenna feeder system composed of two ring antenna arrays with 7 elements (25-1000 MHz and 1-3 GHz),
2) Omni directional VHF band antenna (active monopole, 25-1000 MHz),
3) Omni directional UHF band antenna (discone antenna, 1-3 GHz),
4) Microwave converter 1-3 GHz;
5) Unit of wideband input devices and switch of VHF-UHF band,
6) Unit of panoramic detector-radio direction finder of VHF-UHF band on the basis of multichannel RRD and unit of digital signal processing with ADLINK server,
7) VHF-UHF tracking receiver «Galaktika-U»,
8) Operator's board on the basis of industrial computer,
9) GPS-receiver with antenna,
10) Digital compass,
11) Transmitting equipment of UHF band (modem, UHF-unit, antenna),
12) GSM-modem (GPRS, 900/1800 MHz)
13) Networking equipment (LAN-switch, cables),
14) Uninterruptible power supply (UPS) 2000 VA,
15) Power switchboard,
16) Portable diesel generator (220 V/50 Hz, 4 kW),
17) Complete set of connecting cables and HF-feeders,
18) Complete set of mounting parts and accessories, including units of field heterodynes DH-20 (30-1000 MHz), DH-50 (1-3 GHz) (DH - discrete heterodyne),
19) Operating and maintenance documentation (User Guides and Maintenance Manuals),
20) Vehicle of Ford Transit VAN 330L type.

Note. Vehicle can be selected by the Customer when agreed upon with manufacturer. Size of the roof should be 1.5 x 3 m.

Equipment arrangement inside «Barvinok-M» station vehicle

Operator's position of «Barvinok-M» station

VHF-UHF unit of detector-finder

Aggregate station section

Apparatus station section

Technical parameters

VHF-UHF detector-radio direction finder:

- Operating frequency band **25-3000 MHz**
- Frequency scanning rate with detected signals processing:

Frequency resolution, kHz	**6.25**	**12.5**	**25**
Instrumental frequency scanning rate, GHZ/s	**2**	**5**	**10**

- Instrumental bearing error:
  within 25-100 MHz frequency band **3.0° (RMS)**
  within 100-1000 MHz frequency band **1.0° (RMS)**
  within 1000-3000 MHz frequency band **2.0° (RMS)**
- Sensitivity by EM-field (SNR=10 dB, BW=12.5 kHz):
  in the 25-50 MHz frequency band **15 - 40 µV/m**
  in the 50-1000 MHz frequency band **3 - 15 µV/m**
  in the 1-3 GHz frequency band **10 - 30 µV/m**
- Realtime BW **2.5 / 10 MHz**
- Probability of detection and direction finding of the signal with 100 ms duration when scanning in the 200 MHz frequency band **> 0.9**
- Probability of detection and direction finding of FH signals **> 0.9**
- Minimal duration of the signal to be detected and for its bearing to be taken **1 ms**
- Sensitivity of receiving sections (SNR=10 dB, BW=12.5 kHz) **0.7-1.0 µV**
- Dynamic range with respect to third order intermodulation: **> 80 dB**
- Dynamic range of received signal levels **120 dB**
- Suppression of spurious channels **> 80 dB**
- Relative frequency instability **$2 \cdot 10^{-7}$**
- Tuning time of receiver's frequency synthesizer **200 µs**
- Spectral density of heterodyne noise (given detuning 25 kHz) **– 100 dBc/Hz**
- Quality assessment of signal detection and direction finding **RMS Θ/U dBµV**

VHF-UHF equipment of tracking and signal registration:

- Number of receiving channels: **1** tracking and registration channel
- Operating frequency band **25-3000 MHz**
- Sensitivity (SNR=10 dB, BW=12 kHz) **0.7 - 1 µV**
- Dynamic range with respect to third order intermodulation: **> 80 dB**
- Dynamic range of received signal levels **> 120 dB**
- Automatic frequency tuning by detector-finder command ("Auto enquiry" mode) **available**
- Tuning time of receiver's frequency synthesizer **1 ms**
- Frequency tuning step **10 Hz**
- Frequency analysis and digital registration band **2,5 kHz - 3 MHz**
- Time of signal registration (is set automatically depending on the frequency band and detector-finder request queue **10…100 s**
- Total duration of continuous signal record of a signal given frequency band 300 kHz to HDD **4 hours**

Modes of operation

- **Initialization**: equipment operability check after switching it on, setting of initial parameters (scanning rate, detection thresholds, prohibited and conventional frequencies list, priority frequencies list), search tasks (operating frequency sub bands, amplitude and angular domain), position location system configuration.
- **Automatic control:** automatic search, detection and direction finding of RES signals, networks classification, servicing of detector-finder requests by operator, technical analysis, signal classification and registration, gathering and processing direction finding data from Slave stations, (when operating in the synchronized DF network), access to detection and DF results from remote operator's position.
- **Remote control:** automatic search, detection, and direction finding in real time with Master station, information delivery of RES detected on the request of Master station.
- **Testing:** equipment operation test and search for malfunctioning unit by built-in testing system.

Station control system

- Formation and efficient correction of the task by operator.
- Control over detector-finder and I/Q-registration in accordance with the task for monitoring conduction.
- Reception and registration of results of panoramic analysis and signal direction finding.
- Automatic processing of the queue of detector-finder accounting for frequency priority and azimuth sector look.
- Automatic control over executive receiver of the station in accordance with queue of frequency service, selection of analysis frequency and signal registration duration.
- Displaying of detection and direction finding results against electronic map of the area.
- Displaying of registered signal spectrum in the coordinates: Amplitude-Frequency and Time-Frequency (waterfall) in real time
- Time binding of detection and signal registration to the time of GPS navigation system.
- Synchronization of detector-finder deflection with analogous equipment of conjugated stations operating in the same network.
- Databases formation by revealed and registered signals of RES.
- Interface of interaction with detector-finder – **LAN (1 Gbps)**
- Interface of interaction with tracking receiver – **USB 2.0**
- Interface of interaction with «Barvinok-M» mobile stations – **GSM (9,6 kbps)** and **FM (3600 kbps)**

Main control functions

1) Setting of operating frequency sub bands and priority frequency list,
2) Input and editing of prohibited frequencies and conventional frequencies,
3) Selection of frequency resolution and averaging parameters (duration of look frame),
4) Parameters' input by which decimation of request queue is implemented,
5) Servicing of request queue (RESET/CALL, RETURN, PLACE, REGISTARTION),
6) Selection of preset frequency signal (interference) fragments with F-markers,
7) Control of component elements of the station through interfaces of control panel.

General requirements

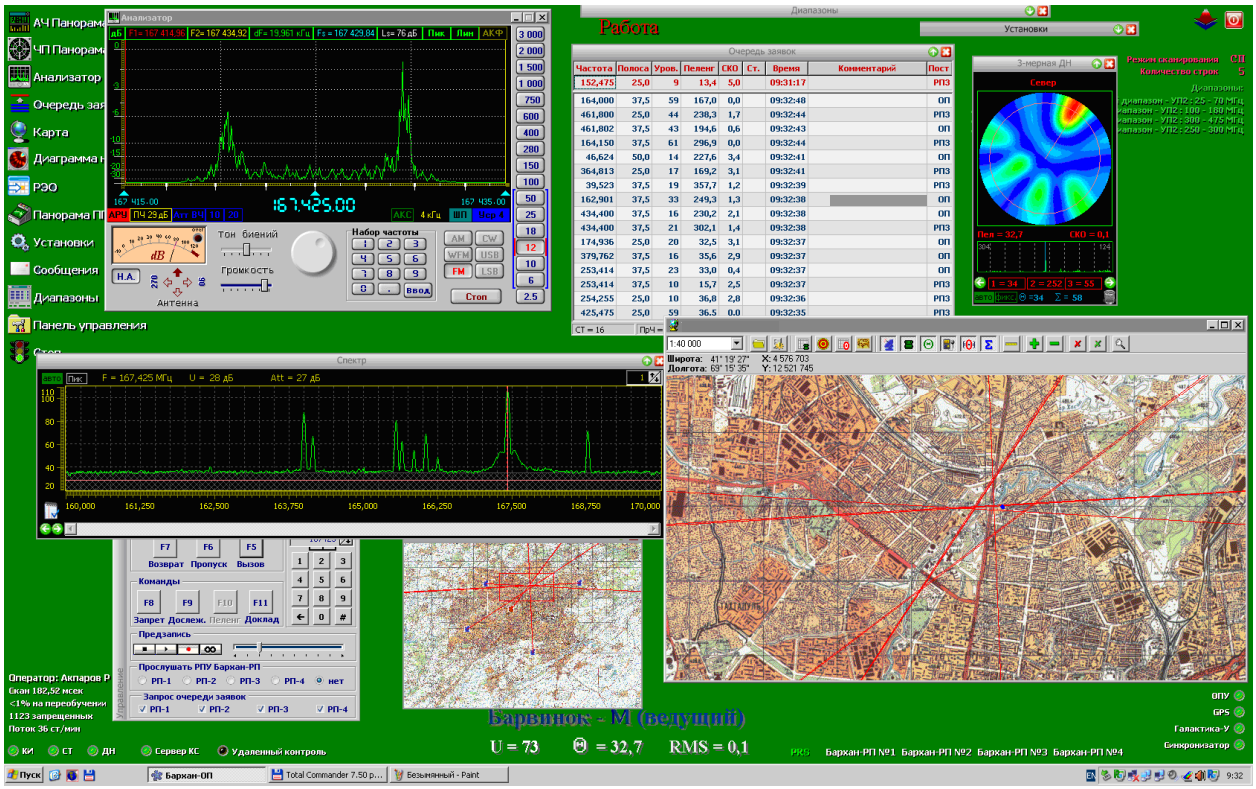
- Total power consumption — not more 600 W
- Time of continuous operation in case of power failure — not more 30 min
- Operating temperature range: operator's board — + 5° C ... + 45° C
  Equipment of direction finding station — + 0° C ... + 50° C
  Antenna-feeder systems — – 40° C ... + 60° C

Note. Given temperature conditions of equipment placed inside the vehicle must be provided with the help of air-conditioner and heating system.

Main indication modes:

1. Indication of controlled frequency band occupation panorama in coordinates: Azimuth-Frequency (in polar or Cartesian coordinates) and Amplitude-Frequency,
2. Indication of spectrum form and autocorrelation function of analyzed signal,
3. Digital indication of request queue and parameters of detected RES and radionetworks,
4. Displaying of results of automatic signal classification and results of their parameters measurement,
5. Displaying of the map of the area under monitoring with the coordinates of detected RES and azimuth marks of direction finding stations.

Desktop of Operator's board of «Barvinok-M» station



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