

# SEISMIC SIGNAL RECORDER

A series of autonomous "Baikal" recorders of high-resolution seismic signals has been developed. It can be supplied in various modifications.



## Application areas:

- investigations and applied works in geophysics and seismology;
- seismic monitoring of the Earth's crust state;
- nondestructive testing of engineering structures;
- investigations of explosions, sources of industrial, domestic vibrations and natural seismic activity.

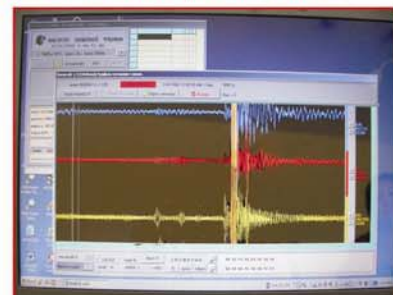
## Specific features:

- Strong hermetic housing allows field work in any weather conditions in a wide range of operating temperatures;
- Functional capabilities of the recorder are enhanced by using manual buttons;
- Recorder is located near seismic sensor arrays, seismic data are recorded on the built-in storage device (capacity: up to 128 Gb) with subsequent transmission to the computer via a USB channel;
- Internal generator is synchronized with UTC time by the built-in GPS module with an accuracy of 1  $\mu$ s;
- High stability of the generator allows long operation of the recorder at disconnected GPS antenna.

## Technical characteristics

the number of channels	3
data size	24 bits
input type	differential
input resistance	60 kohm
sampling rate, max	2000 Hz
operating frequency band (3 dB)	0-400 Hz
noise (0.15-40 Hz)	< 0.5 mW (eff.)
supply voltage (=ext.)	9-24 V
supply voltage (=int.)	2*1.5 V
power consumption	< 0.55 W
Range of operating temperatures	-200 +700C

Software allows specifying the following parameters and operation modes:



direct translation mode of seismic signals

- sampling rate;
- the number of recording channels;
- criteria for detection of seismic events;
- write turn-on with specified time intervals.

## Seismic signal recorder BAYKAL-ACN

### 1. INTRODUCTION

The technical manual contains information about the recorder, its structure, the principle of operation, technical characteristics, and instructions on work with the device and software.

### 2. PURPOSE

Mobile seismic signal recorder “Baykal-ACN” is an autonomous seismic station to record signals from external active seismic or other sensors in a wide frequency range with reference to absolute time scale.

The device can be used for short- and long-term seismic and geophysical measurements in real field conditions in a wide range of temperatures. Small consumed power from an external accumulator or inner battery, large nonvolatile (NVRAM) memory volume, a built-in high-stability generator and a GPS module with a high-quality analog-digital tract provide excellent working characteristics for solving a various class of problems.

### 3. Technical characteristics (typical)

<b>parameters</b>	<b>unit</b>	<b>Value</b>
Channels		3
Data width	bit	24
Inputs		differential
Input impedance		44 kOhm    4700 pF
Sample frequency, FD	samples / sec	50, 100, 200, 500, 1000, 2000, 4000
Frequency range, (-3dB)	Hz	0 - 370
Amplification factor, G		1; 10
Max input voltage (diff.) при G=1	V	± 1.56
<b>Conversion factor, on G=1</b>	nV/bit	200.0
<b>Noise: G=1; FD=100</b>	μV	< 1.0
<b>Signal to Noise ratio</b> G=1; FD = 100	dB	120.0
Changeable Card type, card size	GB	SD, up to 32
Inner oscillator stability		± 2·10 <sup>-7</sup>
Time accuracy, by internal GPS	μsec	± 2
Power supply (ext.)	V	10 – 15
Power supply (inn.)	V	2 × 1,5 (D type)
<b>Consumption,</b> «Wait» mode	Wt	< 0.2
«Write» mode		< 0.55
External active sensor supply		±5V(40 mA)
PC interface		USB 2.0, FULL SPEED
Temperature range	°C	- 30 ÷ + 60
Unit dimensions	mm	D 90 × h 210
Weight	kg	2

Typical characteristics are given in the table. Parameters shown by bold type are measured at the calibration and testing of each recorder. These parameters are available in individual data cards of devices.

#### 4. Operation of the recorder

Before starting work, use the user's application to set the following parameters:

- sampling frequency
- amplification
- if work on "calendar" is needed, set start time and record duration
- one can also name the station and each channel and specify the transformation coefficients obtained at calibration of the through tract for each channel with allowance for the transfer characteristic of the sensors.

Settings are stored in the EEPROM of the recorder.

After the device is placed at an observation point, external sensors, the GPS antenna, an accumulator or a power source are connected to it. After the power supply, Press control button 1 to switch the recorder on. the recorder performs loading and self-testing. The device changes to "STOP" mode. Now the recorder is ready for operation. Recording can be switched on or off at any time by pressing button 2.

The recorded information can be read-out as follows:

- through USB of a PC (the main method)
- from a memory card in a typical card reader with the help of a special program.

#### 4.2 Synchronization of the recorder

After power supply to the recorder, the internal program switches on the GPS and searches for visible satellites. After this, the "internal clock" is synchronized by UTS time from the GPS, and the GPS module is switched off. Then the GPS module is periodically switched on, the internal oscillator drift is measured, and, when necessary, the frequency is corrected.

A description of operating modes and control buttons is given in Section 6

### 5. GENERAL OPERATION INSTRUCTIONS

Before starting work, check

- the casing for visible mechanical damages
- whether the indication and control units are available
- To connect a power source (accumulator) and seismic sensors, connection cables must be made with the use of sockets supplied with the device. For description of sockets, see APPENDIX.
- Never supply voltage exceeding 30 V. Do not supply voltage to signal inputs exceeding 2.6 V relative to the common cable of power supply to sensors without external dividers.
- Replace the memory card only in switched-off device or in the "card change" mode. The card socket has a mechanism of the "push-pull" type. To extract the card, push the card end up to a click and pull it out. To place the card, insert and press it up to a fixing click.

## 6. WORK WITH THE RECORDER.

### a. MANUAL CONTROL



The front panel has two buttons (№1-red and №2-blue) to control the recorder and one state indication LED. The buttons allow switching on the recorder and write a new file without schedule. First of all, press button №1 to switch recorder on. Long pressing (more than 4 seconds) of button №1 in “Stop” mode switches recorder off.

Pressing of any button is indicated by red light of the LED. Releasing the button starts processing of the pressing. The response of the device depends on its current state.

The “Stop” mode is indicated by permanent or flashing yellow light of the LED. Press button №2 in the “Stop” mode to replace the card and/or initialize the current file allocation table and file counter. The “Card change” mode is indicated by alternating red-green light of the LED; it allows initialization of the current SD-card or its replacement by a new one. Press button №2 to initialize the SD-card; press button №1 to start the cleaning operation of the current card; in this case. ***All previous records will be lost!!!***

The “Wait” mode is indicated by slow green flashing light (once per second). Short pressing of button № 2 starts/stops the “Write” mode.

The “Write” mode is indicated by continuous green light. In this mode, press button №2 to complete the current record, update the file allocation table in the card, and switch to the “Wait” mode of the next calendar event. If errors (card filling) occur during the recording, the device automatically switches to the “Stop” mode; this error state is indicated by flashing red light.

LED Signal	Mode
yellow fast flashing	inner testing mode
yellow or yellow flashing	«Stop»
alternating red-green	«Card change»
green	«Write»
green flashing	«Wait»
alternating yellow-green	ADC «warm-up»
yellow flashing	No synchronization
yellow	synchronization
red flashing	error
red	button is pushed / start error