R·sensors

6-CHANNEL SEISMIC DATA LOGGER NDAS-8226

OPERATION MANUAL

version 1.0

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Additional documents

(available at ftp://download.r-sensors.ru/NDAS/Manuals/)

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1. Introduction

NDAS-8226, a 6 channel seismic data logger (hereinafter referred to as – 'recorder' or 'device') is designed for recording of the Earth's surface natural seismic events during seismic surveys by means of seismic sensors with analogue outputs. Equipped with analogue acceleration sensors (accelerometers) or velocity sensors (geophones), the recorder can also be used to record seismic signals during seismic exploration, seismic microzoning as well as for seismic monitoring of engineering structures, dams, high-rise buildings, etc. The recorder contains circuits for powering the seismic sensors and emitting test signals to verify their operability.

Control of signal registration can be done by an operator either in a manual mode or according to a set-up schedule. The built-in exact-time clock based on GPS or GLONASS satellite systems ensure the recorder's scheduled operation.

Data is registered on the built-in non-volatile storage (SD-card). Along with registration, viewing of seismograms "on the fly" by means of a wired or wireless connection is possible. The stored data contains exact time labels and coordinates for further synchronization during processing.

The following protocols are used to work with the recorder:

- USB type Full Speed connection for configuration and setup;
- USB type High speed connection for reading the stored data;
- IEEE 802.11 b/g/n Wi-Fi wireless connection for configuration and setup.

The recorder is not explosive, toxic or environmental pollutant.

DUE TO THE CONSTANT TECHNICAL IMPROVEMENT AND MODERNIZATION OF PRODUCTS, DESIGN AND SOFTWARE MAY BE SUBMITTED TO CHANGES NOT EXPRESSED IN THIS OPERATION MANUAL. PLEASE CONTACT THE MANUFACTURER FOR REFERENCES.

2. Delivery set and functions of connectors.

The delivery set includes:

- NDAS-8226 seismic data logger - 1 pc;
- 1.5-meter digital cable with 7-pin connector (Russian type *2RM18KPN7G* - 2РМ18КПН7Г) and USB-A connector - 1 pc.;
- Standard digital USB A/B cable - 1 pc.;
- Wi-Fi antenna with an SMA-M connector - 1 pc.;
- GPS antenna with 5-meter cable and an SMA-M connector - 1 pc.;
- 7-pin power connector (Russian type *2RM18KPN7G* - 2РМ18КПН7Г) - 1 pc.;
- 10-pin sensors connector (Russian type *2RM22KPN10G* - 2РМ22КПН10Г) - 2 pc.;
- Operation Manual - 1 pc.;
- Technical Passport - 1 pc.;

The following items can be supplied optionally:

- *A CD-ROM with latest software*
- *SMA-M / RP SMA-M adapter (for connecting a Wi-Fi antenna with an SMA-F connector or extension cord)*;
- *SMA-M / SMA-M adapter;*
- *7-pin 2RM18KPN7G (2РМ18КПН7Г) connector power cable.*

The function of the wires and connectors' pinouts, pictures of cables and antennas are supplied in Appendix 2 to this Guide.

The following connectors and indicators are located on the recorder case:

- 2 of 10-pin connectors 2RMG22B10Sh (2РМГ22Б10Ш) type for seismic sensors;
- 7-pin multifunctional connector 2RMG18B7Sh (2РМГ18Б7Ш);
- USBBF7 type USB-B for data retrieving;
- SMA-F connector type for Wi-Fi antenna;
- SMA-F connector type for GPS antenna;
- Time synchronization status LED (Yellow);
- Operating mode LED (Green).

Location of the connectors, location of the indicators and a description of their operation modes are supplied in Appendix 1 to this Guide.

3. Connection

A unipolar DC source with a nominal voltage of 12 or 24 volts is used to power the recorder. The permissible range of main supply voltage is 9..36 V. When the device is powered from 12 V DC source, the average current consumed by the recorder is 50 mA. With the connection of seismic sensors, the consuming power increases accordingly up to 200 mA. The main power supply pins are located on the multifunctional connector.

A USB port connection can be used as an auxiliary power source. The load capacity of the USB port in this case must be at least 500 mA. The permissible supply voltage range on the auxiliary channel is 4.5..5.5 V. When the recorder is powered only from USB, voltage is not supplied to the seismic sensors.

To retrieve precise coordinates and achieve exact time synchronization, connect the GPS antenna to the appropriate connector. Active or passive GPS antennas with an SMA-M type connector can be used. An adapter is required to connect an antenna with an SMA-F connector.

For wireless operation, connect a Wi-Fi antenna to the appropriate connector. The supplied Wi-Fi antenna can be connected directly to the recorder. An adapter is required to connect an antenna with an SMA-F connector.

When power is applied, the recorder displays the main status parameters through two LED indicators. The list of indicators operating modes is supplied in Appendix 1 to the Guide.

4. Configuration and Operation

To install NDAS software, a PC-compatible computer with the Windows operating system is required. A user manual for installing and using the program is supplied in Appendix No. 4 to this Guide.

4.1. Software installation and initial settings

The software for the NDAS recorder and drivers are stored on the CD-ROM, if it is supplied with the device. To install the NDAS software, unzip the archive with the program distribution package. Run the installation using the installer 'setup.exe'. Follow the instructions of the installer. Install and run the NDAS program.

A user manual for using the NDAS program is supplied in Appendix 4 to this Guide. The distributives of the latest version of NDAS are available on the FTP server at: ftp://download.r-sensors.ru/NDAS/NDAS%20App/ .

To set the initial parameters, you need to connect the recorder via a low-speed USB channel. Use a digital cable with a 7-pin connector. Connect the recorder to the USB port of the computer. For the first time you turn it on, you may need to install the FTDI driver. The driver will be installed by the Windows OS in an automatic mode. In addition, the driver is included in the software package supplied with the recorder.

Pay attention to the compatibility of the downloaded software version and the firmware of the device. Compatible firmware versions are indicated in the “Release notes” document in the program distribution folder.

4.2. Initial settings of wireless connection

At the default settings, the recorder operates in the “station” mode and uses the following wireless network parameters for connection:

- SSID of 'NDAS';
- Password 'NDAS12345678';
- WPA2 security type
- IP address, network mask and Gateway are set by DHCP.

To change the initial wireless settings, you need to connect the recorder via a low-speed USB link. Use the 7-pin connector digital cable from the delivery set. Connect the recorder to the USB port of the computer. For the first time you turn it on, you may need to install the FTDI driver. The driver is installed by the Windows OS in an automatic mode. In addition, the driver is included in the software package supplied with the recorder. Run the NDAS program selecting the COM port connection.

Drivers are available for download from the FTP server at
ftp://download.r-sensors.ru/NDAS/Miscellaneous/NDAS%20One%20FTDI%20Drivers/
as well as from the manufacturer’s website at
http://www.ftdichip.com/ Drivers / VCP.htm

If the required wireless network parameters do not match those indicated, you are required to connect the recorder via a low-speed USB link using a 7-pin connector digital cable and use the NDAS program to set the required wireless settings.

After the device is connected to a wireless network, the device can be configured and controlled both via a wireless (Wi-Fi) and a wired (USB-COM) connection. The type of connection is selected in the start window of the NDAS program.

4.3. Wireless connection modes

The recorder can be configured to operate in the following modes:

- ‘Station’ mode - connection to the device via a Wi-Fi router;
- ‘Access Point’ mode - connection to the device directly;

In the "access point" mode, the device creates its own Wi-Fi network, with a name consisting of the SSID of the network, the specified settings, and the serial number of the device. For example, if you specify “NDAS” in the SSID parameters, the devices will create networks with the names NDAS_RS003601, NDAS_ND003501, etc.

When operating in the "access point" mode, the network password must be at least 8 characters long.

In the "access point" mode, only one device is supported - a subscriber. Connecting the other device to the network disconnects the first one.

The static IP address settings are necessary for the device to operate in networks where there is no DHCP server. This option is available only in the "station" mode. In the "access point" mode, the device runs its own DHCP server which always assigns the IP address 192.168.37.1 to the device itself.

Do not use static IP settings in networks where a DHCP server is running as this will result in a conflict of IP addresses. If you want to assign the device a specified IP address, use the IP address reservation settings of DHCP server.

4.4. Operation in Main Mode

The recorder can operate in two modes:
in the **Main mode**, including registration, schedule operation, changing and saving settings, and
in the **Data Retrieving mode**, when high-speed data retrieving from a memory card is possible while signal recording is not possible.

Switch of modes and configuring a recorder connected to a Wi-Fi network can be done through the NDAS software or through the recorder's web interface.

To control and configure the recorder through a wired connection, you must use the NDAS program.

4.4.1. The NDAS Program

The following operations are possible in the NDAS program:

- View the current status of the recorder (power supply voltage, free space on the memory card, presence of a Wi-Fi and GPS signal, time synchronization status, other available parameters);
- Change of the SSID wireless network settings and the password, safe modes;
- Change of configuration parameters (sampling frequency, schedule recording setup, channel gain and range setting);
- Registration start and stop;
- Preview of retrieved data on the fly;
- Operations with the built-in SD card (deleting, recording switch on/off, switch to the data retrieving mode);
- The emitting of test signals.

4.4.2. Web interface

The web interface is optimized for convenient configuring NDAS devices on smartphones and tablets. The web interface can be accessible through the browser of any device connected to the same network to which the device itself is connected. The device's web interface allows performing

the same operations as the NDAS program, except for editing the recording schedule — only the first row of the table can be changed.

The settings web page can be accessible through entering the local domain name of the device titled as <serial number> .local (for example, *RS003601.local*) or directly by IP address.

A detailed user manual for working with the web interface is supplied in Appendix No. 5 to this Guide.

4.4.3. FTP server

An FTP server can be used to access files over the network on the device's memory card. To view contents of the file system and download necessary files, you can use any modern browser (Chrome, Firefox, IE, Safari), Windows Explorer as well as specialized programs such as Total Commander or FileZilla.

To access the FTP root directory, type the IP address of the device or the local domain name (if the system supports the Bonjour service) with the "FTP" prefix, for example, "ftp://192.168.0.100" or "ftp: // rs003601 .local ". The server accepts any username and password.

A detailed user manual for working with the FTP server is supplied in Appendix No. 6 to this Guide.

The FTP server does not operate when the device is in the data retrieving mode.

If the data is being recorded, the FTP server allows downloading all the files except for the files that are currently open for recording, namely the current SIVY file and the file of the current one-Hz recording.

4.4.4. Safe modes of FTP and Web servers

Safe modes have been introduced to eliminate the risk of accidental data corruption for cases in which access to the devices' interface and file system is open to a wide audience. In the safe mode of the web interface, an option to change instrument parameters and send start and stop commands is blocked. Only preview mode of settings and logged data is available. The FTP server's safe mode restricts access to the file system with the read-only mode. Safe mode settings can only be changed using the NDAS program.

4.4.5. Serial port and log output

All main events of the device firmware are accompanied by corresponding log messages that are transmitted to the serial port of the low-speed USB connection and can be displayed by terminal programs. In the Windows environment, such programs include “Tera term”, “DockLight”, “Terminal by Bray”, etc. When configuring the serial port parameters, the following values must be specified:

- Baud Rate - 115200;
- Data bits - 8;
- Stop bits - 1;
- Parity bits - 0;

For using the serial port, use a digital cable with a 7-pin connector and a USB-A connector. The cable is connected to the multifunction connector.

When using a wired connection, the NDAS program also exchanges data with the device through the serial port, so in this case, you must disable all terminal programs that can block access to the port. The reverse is also true - the NDAS program will block access to the serial port for other programs.

The NDAS program communicates with the device over the serial port using an internal data exchange protocol. Upon receipt of the first package having a header of the corresponding format, the device switches to the data exchange mode via the protocol. At the same time, all messages of the log file are also packed in the format of the NDAS package, but if necessary, the message body can still be read by any terminal program.

4.4.6. File system

The main directory of the recorder is a folder titled “RS_xxxxxxxx”, where “xxxxxxxx” is the serial number of the recorder. Inside of the main directory, the recorder creates subdirectories with recordings of signals called working directories as well as the LOGS directory, in which the operational logs are stored.

The system sets up the operational directory at the time the first record file is created. If at the time of creating the directory there is information about the current time, the name of the operational directory will be formed on the principle of "YYYY-MM-DD", that is year-month-day. If there is no time information, the name will contain “NO_TIME_xxx”, where “xxx” is the next number in order.

The operational directory remains unchanged as long as the device is operating, except for the following two cases:

- If the operational directory was created in the absence of time data, then after the synchronization procedure the operational directory will be changed, and all subsequent data will be recorded to the directory with the correct name.
- After switching the device from the data retrieving mode back to the main mode, the file system is initialized leading to the updating of the operational directory.

Inside the operational directory, the device creates recording files with a name in the form "YYYY-MM-DD HH-MM-SS", that is "year-month-day hour-minute-second", corresponding to the actual start time rounded to the second. Record files have the extension of * .siv.

When the option to record an additional one-Hz signal is turned on, a subdirectory with the name of "1Hz" is created in the operational directory, where additional files are recorded.

The LOGS folder contains text files of the system log with the format name LOG_xxx, where xxx is the file serial number. The content of the files duplicates the text messages displayed by the device on the serial port. The maximum size of the log file is limited to 1MB; if this size is exceeded, a new file is created with the following serial number. The data are recorded sequentially and the record continues to the latest file after reboot.

4.4.7. Time synchronization

This device automatically links the recorded data to the exact time obtained via the GPS/GLONASS receiver. The process of synchronizing the system clock with the exact time can take from several seconds to 30 minutes, depending on the temperature conditions, the time passed from the last synchronization and the conditions for receiving the satellite signal at the installation site. The synchronization process goes through several stages:

- After connecting the GPS / GLONASS antenna, the receiver searches for satellite signals and, in the presence of a stable signal, performs a navigation task - that is determining the coordinates and time. At this moment, the "GPS" flag lights up in the NDAS program window, the "GPS" LED on the device's case begins to flash sparsely;
- The clock generator frequency is being tuned to set the clock of the system precisely;
- After the adjustment is completed, the system clock is corrected with an accuracy of better than 1 μs. At this moment, the SYNC flag is lit in the program window, and the SYNC LED on the device's case starts flashing regularly.
- After synchronization is complete, the GPS antenna can be installed that will not affect the regular operation of the device.
- However, if a GPS signal is present during recording, the device will continue to smoothly adjust the frequency of the clock generator as well as put time stamps every minute and measure the current drift of the clock. This will significantly increase the time accuracy of the recording and will improve the correlation of data taken from two independently operating devices.

Time synchronization is maintained until the device is rebooted. Changing of some parameters of the device may lead to its reboot resulting in the loss of synchronization.

For correct conversion of GPS time to UTC, the system maintains up-to-date information on the seconds of coordination, also called leap seconds. The update the number of seconds of coordination may occur once every six months, before the zero time of January 1st and July 1st. Changing the number of seconds of coordination may require updating the device firmware. Recalculation of seconds of coordination can take up to 15 minutes; the time synchronization in this case can be done only after the process is completed.

If the device is recording data at the zero time of January 1st or July 1st, even in case the number of seconds of coordination changes, the time will not be re-adjusted until the next recording stops in order to maintain the data integrity.

4.4.8. Modes of the registration

There are 4 possible modes of the registration:

- Manual mode – the registration is turned on and off manually using the NDAS program or via WEB interface;
- Immediate start - registration starts automatically whenever the device is turned on;
- Synchronous start - registration starts automatically after the time synchronization is completed;
- Schedule table - registration starts and ends automatically at the scheduled time.

When the device operates in the manual or immediate start mode, the presence of GPS synchronization is not necessary. If the signal recording began before synchronization occurs, the file header will not contain data on the exact time, and the files will be placed in a folder with the name of “NO_TIME_xxx”, where “xxx” is the serial number of the folder.

If during the registration that was started before synchronization, the GPS signal appears, the device will begin the synchronization procedure without interrupting the recording. In this case, as soon as the procedure is completed, a new operational folder with the correct name will be created, and the next pile of data will be recorded to a new file with the correct time information.

When operating in the synchronous start mode, the device starts recording after the synchronization procedure is completed from the beginning of the next whole minute.

When operating in the table mode, the signal recording starts automatically at the preset time with the accuracy of one sample. Registration always starts after synchronization, but after the device is synchronized, the presence of a GPS signal is not necessary until the moment the power is turned off or the device is rebooted.

The device finds the nearest time line in the table and waits for the start time. If the current time is inside of one of the intervals specified by the table, the recording starts immediately from the next whole minute.

When reaching the end of the table, the device goes into the manual mode. If the option “shutdown after finish” is set, the device goes into the hibernation mode characterized by reduced power consumption. The device can be removed out of this mode by turning off the power.

In the event of a power failure at the moment of scheduled recording, the recording resumes only after restoring synchronization with the GPS signal. The presence of a GPS signal in this case is required for resuming scheduled recording.

4.4.9. Cyclic recording option

If the cyclic data recording option is enabled and there is no free space on the SD-card, the device starts deleting the oldest files to free up space. When using this option, attention must be paid to the following:

- Files are scanned only inside of the recorder's main directory — that is in a directory with the name of “RS_xxxxxxxx”, where “xxxxxxxx” is the serial number of the device. All other directories are ignored;
- Scanning is done only for files with the extension of ".siv". All other files are ignored;
- If after the cleaning procedure no files remain in the directory, the directory is also deleted;
- As an evaluation criterion, the file modification time attribute is used.

Carefully use the cycle recording option in the absence of synchronization. When the device is on, the clock starts from the same moment - January 1, 2017 – thus the files will be deleted in arbitrary order rather than in the order they were actually recorded.

Avoid configurations in which a large number of small files will be created on the device - this can slow down the file scanning function and potentially lead to data loss.

4.4.10. Option to record an additional 1 Hz frequency signal

When the option to record an additional signal is turned on, the device, in addition to the main data, starts recording files with a sampling frequency of 1 Hz. Files go to a subdirectory with the name of “1Hz”, and are named according to the same principle as the main files, with the addition of “1Hz”.

In most cases, the main and additional files are created synchronously (with an accuracy of 1 sample) and have the same name, however, some situations are possible in which the files will not be synchronized:

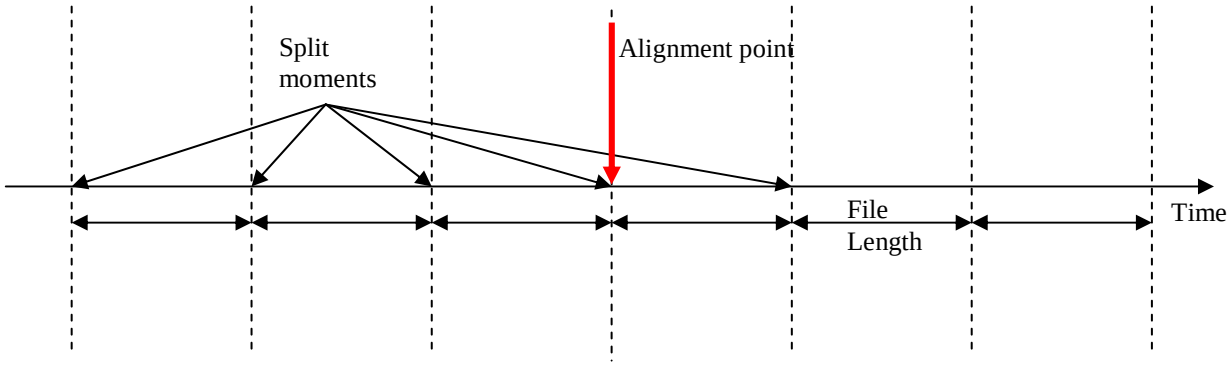
- If the SD card was removed during recording and then inserted back;
- If in the scheduled recording mode the memory card was inserted after synchronization was done and the start time was missed out;
- When the working directory has changed during the time synchronization process;

In all the above cases, the registration unit will create new files on the memory card, and the beginning of these files will correspond to the earliest data stored in the device buffers. Since the buffer size and the amount of data in the buffer for different signals and sampling rates are different, the time at which the files start will also differ.

4.4.11. Specified time file start aligning

The option to align the beginning of a file to a specific time affects the moment at which a split will be performed and a new file will be opened. This option is useful when it is necessary to acquire records of the same time intervals from several devices that are not started synchronously

(not in the table mode). The moments of "splitting" are sample from the alignment time at intervals that are multiples of a given file length. The algorithm is illustrated in the figure below.



Example 1.
The file length is 3 hours, the alignment point is July 17, 2018, 16:00:00
Recording starts July 17 at 11:45.
A new file will be created at 13:00, then at 16:00, at 19:00 and then every 3 hours.

Example 2.
The file length is 1 hour, the alignment point is January 01, 2017, 00:30:00.
Recording begins on July 17, 2018, 12:43.
A new file will be created at 13:30, then at 14:30, and then in the middle of each new hour.

Example 3.
The file length is 24 hours, the alignment point is January 1, 2017, 18:00:00
Recording starts July 17, 2018 at 13:30.
A new file will be created at 18:00 and then every next day at the same time.

4.4.12. Data filtering

An analogue-to-digital (ADC) converter of the device generates a signal with a sampling frequency of 1000 Hz. Output signals with frequencies below 1000 Hz are formed by decimation, accompanied by anti-aliasing filtering of high frequencies.

Cascades of FIR filters with linear phase response are used as filters. For detailed information about the filtering algorithms used, contact the device manufacturer.

The general filter characteristics are presented in the table below:

Final sampling frequency, Hz	Delay *, ms	Edge of Passband, Hz	Edge of Stopband, Hz	Frequency response unevenness, mdB	Suppression coefficient, dB
500	63.5	200	250	0.7	-177
250	95.5	90	120	0.7	-175
125	349.5	50	62.5	1.4	-177
100	413	40	50	1.5	-177
50	573	18	24	1.5	-175
25	2483	10	12.5	2.2	-177
10	2960.5	3.6	4.8	2.3	-175
5	4679.5	1.625	2.425	2.6	-174
1	23779.5	0.325	0.485	3.4	-174

* The delay of the cascade of anti-aliasing filters is presented, without taking into account the signal delay in the ADC circuits which is 4.5 ms.

4.5. Operation in Data Retrieving Mode

The data retrieving mode allows for a quick transfer of the recorded information from the device's SD card to a computer for further processing. To use the recorder in the data retrieving mode, connect it to a computer using a standard digital USB A/B cable.

Set the recorder into the data retrieving mode with the "Card reader" command in the NDAS program or the web interface. The recorder can be powered either via a high-speed USB port of a computer or via the main power supply.

To give the command to switch to the data retrieving mode, the NDAS program must have either a wireless connection or a low-speed USB connection with the recorder.

In the data retrieving mode, the recorder's SD card is presented in the list as an external drive similar to a regular USB drive which allows reading/recording/formatting by means of the computer's operating system.

The device automatically exits the data retrieving mode when the USB-B cable has been disconnected or after a reboot has been done. In addition, this mode can be disabled through the NDAS program or the web interface.

The stored data can be retrieved over the network in the normal mode by means of the FTP server (see section 4.4.3). If the device is set to the data retrieving mode, the FTP server becomes unavailable.

4.6. Firmware Upgrade

NDAS series devices manufactured since 2018 have a built-in bootloader that allows safely upgrading the firmware, the license file and the built-in web interface.

Each time the device is turned on or rebooted, the bootloader checks the root directory of the memory card for the following files and, if present, apply updates to:

- “ndas_firmware.bin” – a firmware file;
- “Ndas_bootloader.bin” – a bootloader file (unsafe, see note below):
- “ndas_license.dat” – a license file;
- "Ndas_webserver" - a folder with html-pages of the web interface;

To update, place the new file or folder in the root of the device’s memory card in any possible way, making sure that the name is correct, then reboot the device and wait for the update process to complete. The process is accompanied by alternating frequent flashing of the LEDs, after the successful completion of which the LEDs go into the normal mode.

If necessary, during the update it is possible to observe messages displayed in the log file using one of the terminal programs (see section 4.2.5). All messages also go to the file BOOT_LOG.txt, which is created in the main directory on the memory card.

Make sure the firmware version of the device has been changed by means of NDAS program, the web interface or the log file content.

To download files as well as get up-to-date information about changes and compatibility, visit the FTP server at ftp://download.r-sensors.ru/NDAS/

If the firmware update is interrupted or failed, the device will boot in the safe mode using the default firmware. In this case, you can try to update again.
The mode at which the device has been booted can be found through the NDAS program, the web interface or the log file on the memory card.

The bootloader update procedure (file “ndas_bootloader.bin”) is unsafe. In the event of an error or power failure during the update process, the device will become inoperative. To restore the operability of the device, it will be necessary to repair it at the manufacturer, therefore it is not recommended to update the bootloader unless absolutely necessary.

5. Operating conditions

In accordance with the international dust and moisture protection standard, the degree of protection of this device is IP 65 - dust cannot get into the device (full protection against contact), protection against water jets from any direction.

The recorder must not be immersed in water or installed in flooded areas without additional protection!
To ensure the proper degree of dust and water protection, make sure that all unused connectors are covered with protective caps!

6. Carrying and storage

The recorder is strong enough and practically is not subject to damage during transportation. Use the packaging provided with it or any packaging materials to prevent damage to the connector on the housing cover and scratches on the housing. Storage temperature is from –45 to + 65°C.

7. Warranty and service

The warranty period of the product is 18 months. During this period, the replacement or repair of the defective product will be made at the expense of the manufacturer. After the warranty period, regular repair and maintenance charges will be applied.

8. Information about Manufacturer

Manufacturer:
LLC "R-sensors"; 141701, Russia, Moscow Region, Dolgoprudny, Zhukovskogo Street, 8A;
Tel.: +7 (498) 744-69-95, e-mail: r-sensors@mail.ru.

9. Technical specifications

9.1 Electrical parameters

Supply voltage	12/24 V DC – main supply (9-36 V allowable range) or 5 V from USB - auxiliary supply (4.5 .. 5.5 V allowable range)
Consumption during autonomous recording (no seismic sensors attached)	< 600 mW

9.2 Mechanical parameters

Types of connectors	7-pin 2RMG18B7Sh (2РМГ18Б7Ш) - multi-function connector 10-pin 2PMG22B10Sh(2РМГ22Б10Ш) (2 pc) - connectors for seismic receivers SMA-M - active / passive GPS antenna SMA-M - Wi-Fi antenna USB-B - high-speed USB
Weight	1.3 kg
Dimensions length x width x height, mm (inch)	160 x 100 x 81 (6.3" x 3.94"x 3.19")
Housing material	Aluminium

9.3 Recording parameters

ADC type	sigma-delta, differential input
Number of channels	6 independent
Sampling rates, sps	1, 5, 10, 25, 50, 100, 125, 250, 500, 1000
ADC resolution	24 bit
ADC noise performance	22 ENOB, at G = 1 and 100 sps
Input divider	Software switchable 1: 1, 1: 6
Gain Coefficients	Software switchable 1, 2, 4, 8, 12
Maximum input signal with a 1: 1 divider and a gain of 1 with a 1: 6 divider and a gain of 1	 ± 4 V peak-to-peak differential voltage ± 24 V peak-to-peak differential voltage
Input Impedance	180 kΩ || 2700 pF
Data format	Internal;, Binary, miniSeed, SEG, ASCII, SAC converters provided
GNSS receiver	GPS / GLONASS
GNSS timing accuracy	<1μS
Stability of the reference generator	0.5 ppm
Data recording modes	Manual, scheduled, auto start on power up, auto start on synchronization with GPS
Memory device	32 Gb micro SD flash card

Data transfer protocols	Full-speed USB 1.1 (configuration) High-speed USB 2.0 (read data) Wi-Fi IEEE 802.11b / g / n
Temperature range	-40 ... +60 ° C
Integrated monitoring sensors	Main power channel input voltage; temperature
Power supply output for seismic sensors Main channel voltage *auxiliary channel (if available) ** maximum current consumption	 +12 V ± 5% *-12 V ± 10%* 200 mA *(In case of an additional channel, the current consumption of both channels in common)*
Test sequence signals parameters Calib enable *Calib out (if available) **	 Logical "1" with a voltage of 3.3 V for the duration of the calibration signal Sinus 1V peak-to-peak, 1 Hz, 10 Hz; single pulse 1V; 1V square wave

- depending on the configuration, either a Calib_out signal (default) or -12 V voltage for bipolar power supply of the seismic sensors is present on Pin10 of the seismic sensors connector.

APPENDIX 1. LOCATION OF CONNECTORS AND INDICATION MODES

Fig. 1. The seismic sensors connectors

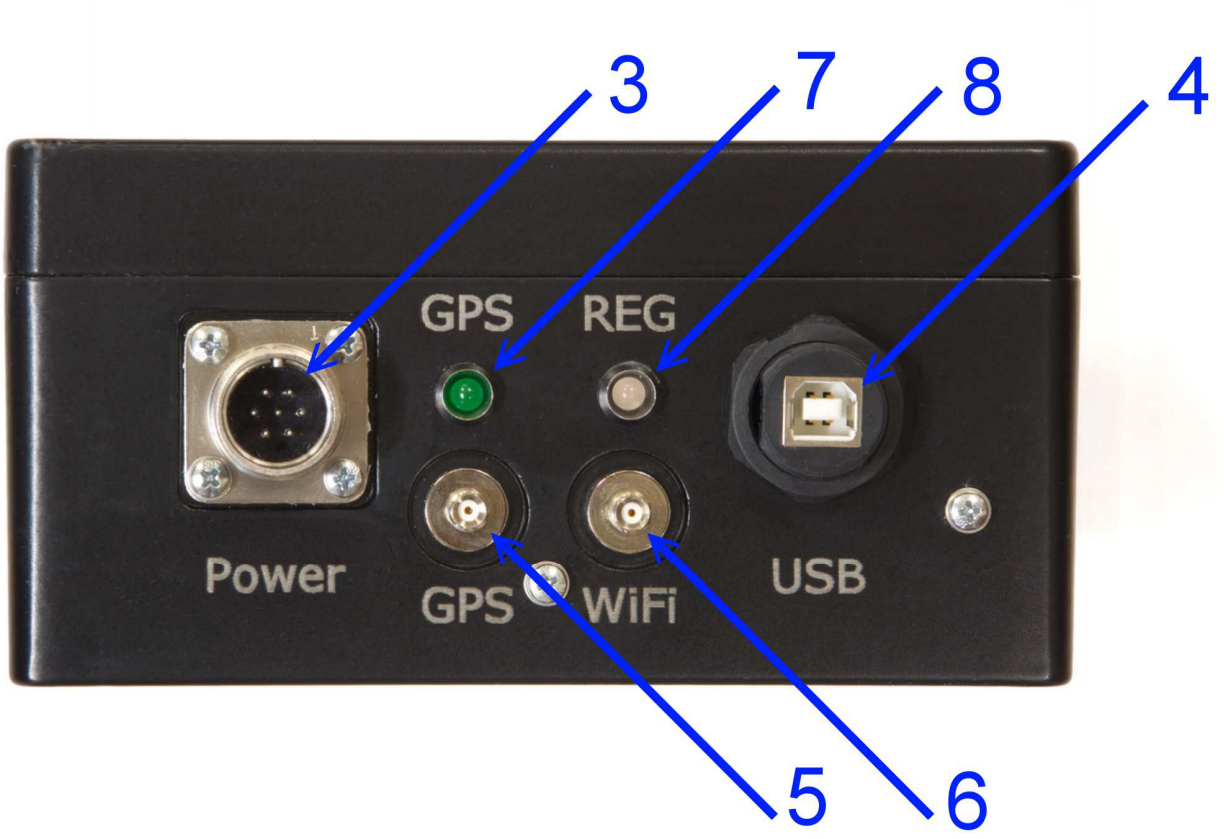


Fig. 2. Connectors and LEDs

Table 1. Marking in fig. 1 and 2

No	Purpose
1	Seismic sensors connectors for channels 1-3
2	Seismic sensors connectors for channels 4-6
3	Multifunctional connector
4	Data retrieving USB-B connector
5	GPS antenna connector
6	WiFi antenna connector
7	GPS green LED (sync status)
8	REG yellow LED (operation mode)

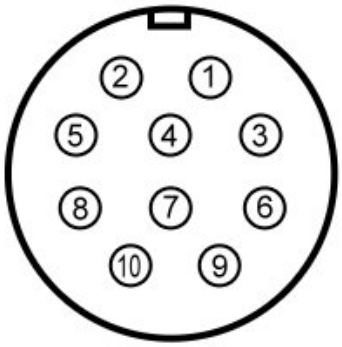
Table 2. LED operation modes*

* -When power is applied, both LEDs light up for 1 second 3 times, then go out.

Color	Operating mode
Yellow – operating mode	100% off - no recording, schedule is not set 10% on / 90% off - waiting for a start on the schedule 50% on / 50% off - Signal recording in progress Blinking rapidly - incorrect parameters or error
Green - synchronization status	100% off - no satellite signal, no synchronization 10% on / 90% off - there is a satellite signal, no synchronization 90% on / 10% off - no satellite signal, there is a synchronization 50% on / 50% off - there is a satellite signal and synchronization

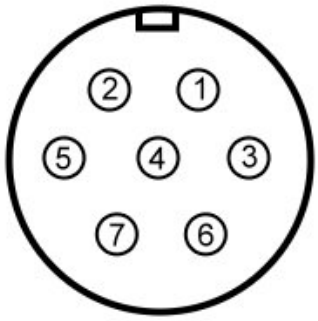
APPENDIX 2. CONNECTORS, CABLES, ANTENNAS

1	+ CH 1 (4)	+ Канал 1 (4)
2	- CH 1 (4)	- Канал 1 (4)
3	+ CH 2 (5)	+ Канал 2 (5)
4	- CH 2 (5)	- Канал 2 (5)
5	+ CH 3 (6)	+ Канал 3 (6)
6	- CH 3 (6)	- Канал 3 (6)
7	Calibr. enable	Вкл. калибровки
8	Signal GND	Сигн. общий
9	+12V output	Выход +12В
10	-12V output or Calibr. output	Выход -12В или Выход калибровки



2РМ(Г)22Б10Ш1Е2 male connector
2РМ(Г)22Б10Ш1Е2 вилка

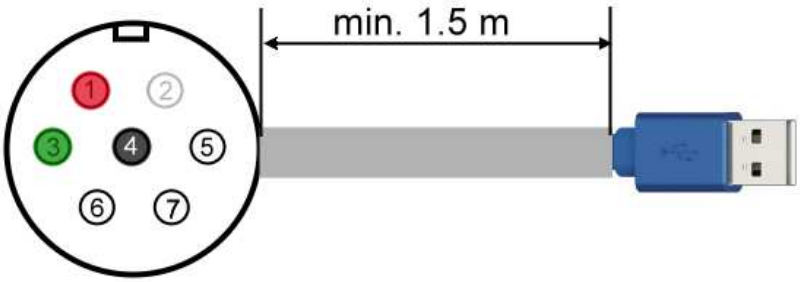
1	VBUS	VBUS
2	D-	D-
3	D+	D+
4	GND	GND
5	N/C	Не исп.
6	+PWR	+Питания
7	-PWR	-Питания



2РМГ18Б7Ш1Е2 male connector
2РМГ18Б7Ш1Е2 вилка

Fig. 1. The recorder’s connectors pinout.

1	VBUS	VBUS
2	D-	D-
3	D+	D+
4	GND	GND
5	N/C	Не исп.
6	N/C	Не исп.
7	N/C	Не исп.

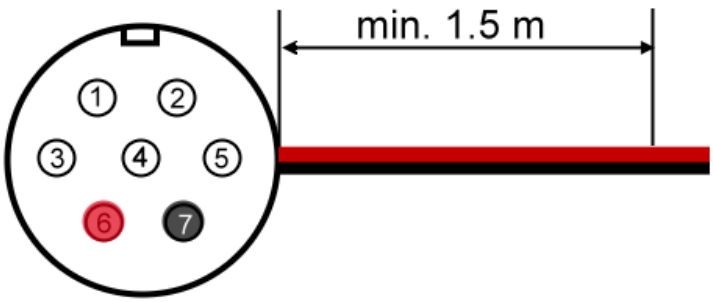


2РМ18КПН7Г1В1 female connector
2РМ18КПН7Г1В1 розетка

Fig. 2. Multifunctional connector, digital USB cable.

Fig. 3. Digital USB cable.

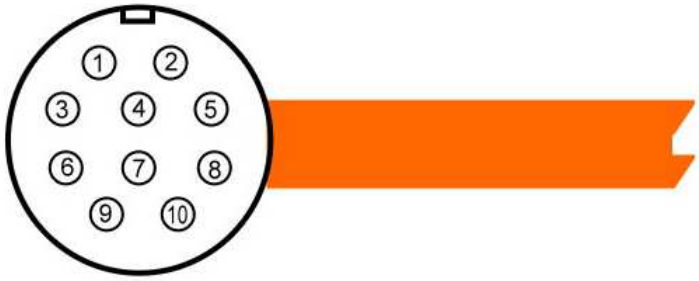
1	N/C	Не исп.
2	N/C	Не исп.
3	N/C	Не исп.
4	N/C	Не исп.
5	N/C	Не исп.
6	+PWR	+Питания
7	-PWR	-Питания



2РМ18КПН7Г1В1 female connector
2РМ18КПН7Г1В1 розетка

Fig. 4. Multifunctional connector, main power cable
(Supplied optionally)

1	+ CH 1 (4)	+ Канал 1 (4)
2	- CH 1 (4)	- Канал 1 (4)
3	+ CH 2 (5)	+ Канал 2 (5)
4	- CH 2 (5)	- Канал 2 (5)
5	+ CH 3 (6)	+ Канал 3 (6)
6	- CH 3 (6)	- Канал 3 (6)
7	Calibr. enable	Вкл. калибровки
8	Signal GND	Сигн. общий
9	+12V output	Выход +12В
10	-12V output or Calibr. output	Выход -12В или Выход калибровки



2РМ22КПН10Г1В1 female connector
2РМ22КПН10Г1В1 розетка

Fig. 5. Field cable for seismic sensors
(Supplied optionally)

Fig. 6. Standard A/B digital cable

Fig. 7. WiFi antenna – connector, exterior view
(The exterior view of the antenna in the delivery set may vary)

Fig. 8 GPS Antenna, connector and appearance

Fig. 9. *SMA-M / RP SMA-M adapter*

Fig. 10. SMA-M / SMA-M adapter