



Digital autonomous seismic
station NDAS-8224SBS

OPERATION MANUAL



© R-Sensors LLC, 2021

version 1.0

The following notation is used in the document:

- Ordinary text in black.
- Important notices in orange.
- Critical information in red.

Digital autonomous seismic station NDAS-8224SBS OPERATION MANUAL.

The information in this document has been carefully reviewed and is believed to be reliable for station NDAS-8224SBS firmware version 5.5.

R-sensors LLC reserves the right to make changes at any time without notice to improve the reliability and function of the product. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of R-sensors LLC.

© 2014–2021 R-sensors LLC. All Rights Reserved.

Table of Contents

1. Introduction	5
2. Delivery set and functions of connectors.....	7
3. Connection.....	7
4. Configuration and Operation.....	8
4.1. Software installation and initial settings.....	8
4.2. Initial settings of wireless connection	9
4.3. Wireless connection modes.....	10
4.4. Operation in Main Mode.....	10
4.5. Operation in Data Retrieving Mode.....	17
4.6. Firmware Upgrade.....	17
4.5. Battery operation	19
5. Degree of protection.....	20
6. Carrying and storage.....	21
7. Warranty and service	21
8. Information about Manufacturer.....	21
9. Technical specifications.....	22
9.1 Electrical parameters	22
9.2 Mechanical parameters	22
9.3 Sensors parameters.....	23
9.4 Digital system NDAS.....	23
APPENDIX 1. LOCATION OF CONNECTORS AND AXES	25
APPENDIX 2. CONNECTORS AND CABLES.....	28
APPENDIX 3. THE BATTERY	34

Additional documents to the Manual

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

APPENDIX 4. NDAS Program

APPENDIX 5. NDAS Basic Web UI Web interface

APPENDIX 6. NDAS data converter

1. Introduction

NDAS-8226SBS, a 4 channel 24-bit subsea digital autonomous seismic station (hereinafter referred to as – ‘station’ or ‘device’) is designed for underwater seismic and geophysical exploration. It contains a hydrophone, a 3-component seismic sensor MTSS-2003, a digital system NDAS and a battery. The fully charged station's battery lifetime is up to 30 days. The station is operational at any orientation and tilts. The built-in orientation sensors can help in further decoding of the obtained data.

The control of signal registration can be performed by operator in manual mode or according to a pre-programmed schedule. The built-in exact-time OCXO clock based on GPS or GLONASS system ensures the station's scheduled operation and precise time synchronisation.

Data is registered on the built-in non-volatile storage (SD-card). Along with the registration, the viewing of seismograms “on the fly” by means of a wired or wireless (while not submerged) connection is possible. The stored data contains exact time and coordinates labels for further synchronization during processing and can be converted into several common formats by means of a supplied converter.

The following protocols are used to work with the station:

- 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 station 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.



IN ORDER TO SIMPLIFY TRANSPORTATION BY AIR, THE STATION IS SUPPLIED WITHOUT A BATTERY. THE BATTERY'S DESIGN AND APPLICATION RECOMMENDATIONS CAN BE FOUND IN THE CORRESPONDING APPENDICES TO THIS MANUAL.

The station consists of the following parts:

- Two stainless steel tubes (1) connected by a interconnecting pipe(2)
- A battery (3)
- A combined Wi-Fi / GPS antenna (4)
- A multifunctional connector (5)
- A hydrophone (6)
- Three component seismic sensor MTSS-2003 (7)
- An ADC ad MCU boards (8)

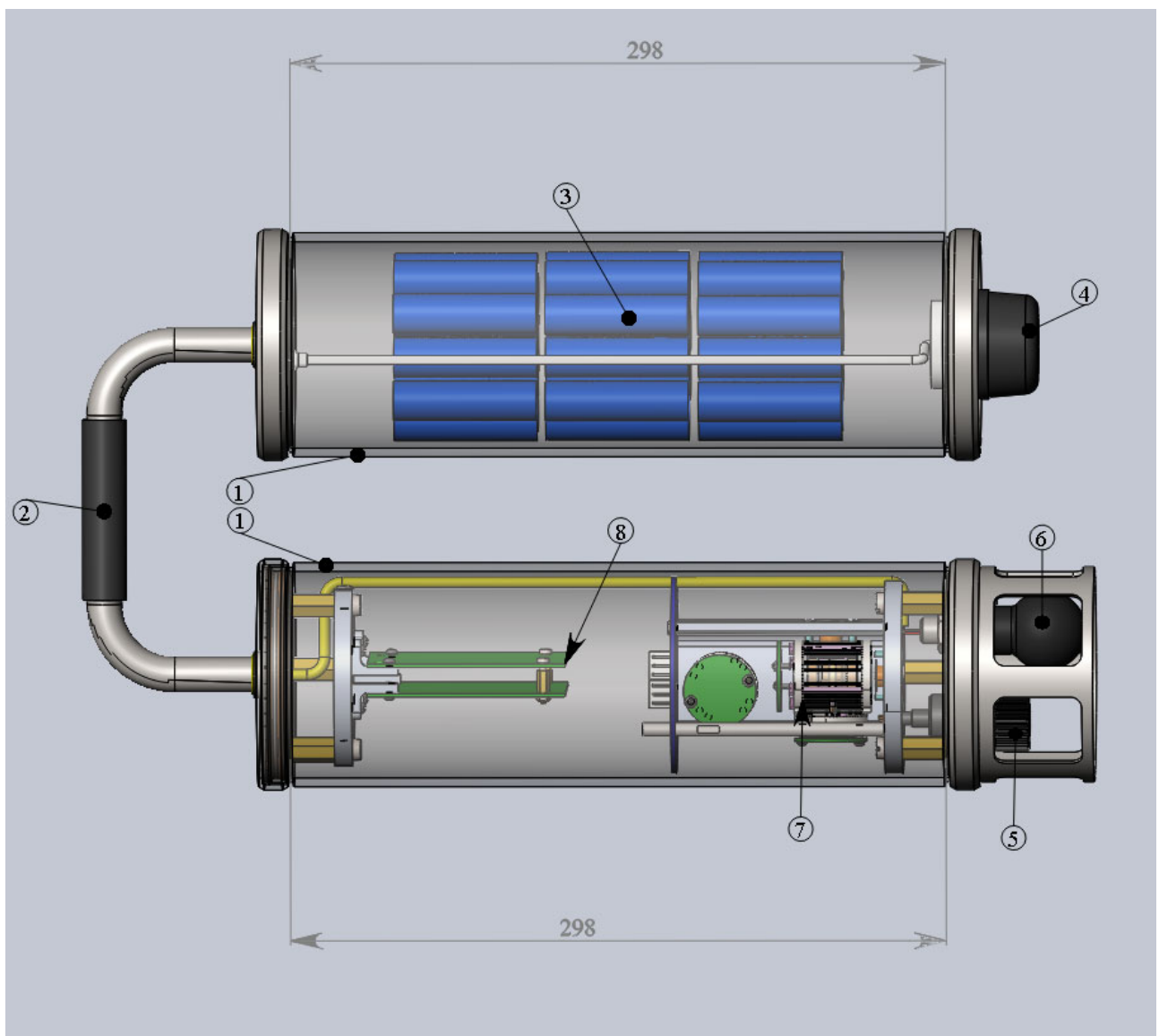


Fig. 1. The station components

2. Delivery set and functions of connectors.

The delivery set includes:

- NDAS-8224SBS Digital autonomous seismic station - 1 pc;
- Idle-state protective cap (green wire, installed on the station connector) - 1 pc;
- Connector screw-nut (installed on the station connector) - 1 pc;
- Active-state protective cap (red wire) - 1 pc;
- Indicator cap - 1 pc;
- 1.5-meter digital USB cable with 10-pin female connector (Russian type PC-10TB – RS-10TV) and USB-A connector - 1 pc.;
- 10-pin connector (Russian type PC-10TB – RS-10TV) - 1 pc.;
- 4-pin battery power connector DS1110-4 - 1 pc.;
- A CD-ROM with latest software - 1 pc.;
- Operation Manual - 1 pc.;
- Technical Passport - 1 pc.;

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

The following items are located on the station case:

- 10-pin waterproof male connector Russian type PC-10TB – RS-10TV;
- A hydrophone;
- A combined Wi-Fi / GPS antenna.

Location of items and a description of LED operation modes is supplied in Appendix 1 to this Guide.

3. Connection

A unipolar DC source with a nominal voltage of 10-16 V can be used to power the station. For underwater operation a Li-Ion battery with 12.6 V nominal voltage is used. When the device is powered from 12 V DC source, the average current consumed by the station is less than 100 mA.

The station is turning ON from the battery by installing either the Active-state protective cap (red wire) or the Indicator cap. If the Idle-state protective cap (green wire) or no cap installed, the station goes off in 1 – 1.5 minutes.

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 station is powered only from USB, voltage is not supplied to the sensors but for the hydrophone. If the station is powered from USB, it steadily keeps the ON state but turns off right after the disconnection of USB.

The charging of the Li-Ion battery can be done via the multifunctional connector in both ON or OFF states of the station. The charge power supply pins are located on the multifunctional connector.

For wireless operation, retrieving the precise coordinates and performing the exact time synchronization, a combined GPS/Wi-Fi antenna is used. The station displays the main status parameters through multifunctional connector by means of the indicator cap. The list of indicator operating modes is supplied in Appendix 1 to the Guide.

4. Configuration and Operation

Make sure is battery is fully charged before operation.

Turn the station on by installing the active-state protective cap (red wire) or the indicator cap into the multifunctional connector. After the boot, which takes several seconds, the station will try to synchronise the clock generator by means of GNSS receiver. The procedure requires a good view of the sky (ideally, an unobstructed view of the sky above 30° elevation angle) and takes from 30 minutes to 1 hour.

The currents synchronisation status can be viewed either by LEDs if the indicator cap is installed or over a wireless connection in NDAS program or the station's web-interface. After the synchronisation is achieved, the station is ready for operation.

The scheduled operations can be programmed via web interface (one event only) or the NDAS program (multiple events). Refer to the correspondent appendices to this Manual.

After the station is turned on, it remains running for at least one minute if no cap or idle-state cap is installed. During this time it is possible to change the Active cap to the Indicator cap and vice-versa.



Always install the Active-state protective cap before submerging the station. The indicator cap is not designed for underwater operations and will be damaged.

The station remains operational at any tilts with respect to vertical direction on surface or under water. During the recording the DATA are stored on the SD-card with the following assignment:

- Channel 0 for the Hydrophone;
- Channel 1 for the Z (vertical) axis;
- Channel 2 for the X axis;
- Channel 3 for the Y axis.

Location of the axes of sensitivity is supplied in Appendix 1 to this Guide.

4.1. Software installation and initial settings

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.

The software for the NDAS station and drivers are stored on the CD-ROM 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 station via a low-speed USB channel. Use a digital cable with a 10-pin female connector. Connect the station 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 station.



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 station 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 station via a low-speed USB link. Use the 10-pin female connector digital cable from the delivery set. Connect the station 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 station. 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 station via a low-speed USB link using a 10-pin female 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 station 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_RS003501, 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 station can operate in two modes:

- **Main mode**, including registration, schedule operation, changing and saving settings, and
- **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 station connected to a Wi-Fi network can be done through the NDAS software or through the station's web interface.

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



After the station is set to the Data retrieving mode, the low-speed wired connection is lost. To restore the possibility to operate the station via the wired connection, you will need to reset the station by powering it off.

4.4.1. The NDAS Program

The following operations are possible in the NDAS program:

- View the current status of the station (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).

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.



Since in the data retrieving mode the memory card is connected to the USB card reader IC directly, it becomes inaccessible for the processor. As a result, the FTP server does not operate when the device is this 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 1Hz 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 10-pin female connector and a USB-A connector. The cable is connected to the multifunction connector.



When the wired connection is used, the NDAS program also exchanges data with the host device through the serial port, so in this case, you need to 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 station is a folder titled "RS_XXXXXXXX", where "XXXXXXXX" is the serial number of the station. Inside of the main directory, the station 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 30 minutes to 1 hour, 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 μ s. 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 station'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:

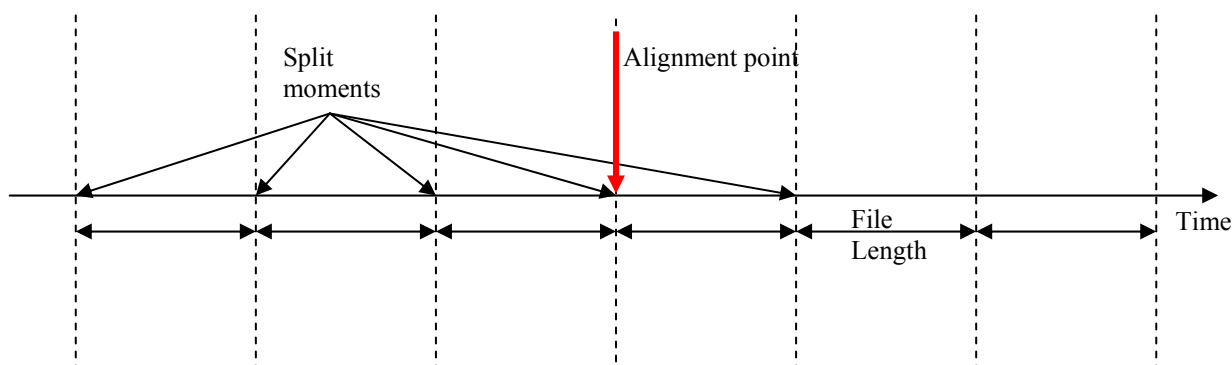
- If the SD card was removed during recording and then inserted back;
- If in the scheduled recording mode the memory card was inserted after synchronization was done and the start time was missed out;
- When the working directory has changed during the time synchronization process;

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 station in the data retrieving mode, connect it to a computer using a standard digital USB A/B cable.

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



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

In the data retrieving mode, the station’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.



Note that in the Data retrieving mode the low-speed connection is unavailable, so the backward switch command can be sent only over the wireless connection. The alternative way to exit the Data retrieving mode is to switch off the station which results in a reboot.

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

The NDAS series devices manufactured since 2018 have a built-in bootloader which allows a safe upgrade of 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.

4.5. Battery operation



PRECAUTIONS:

All the recommendations contained in this clause must be strictly applied in order to ensure a safe and optimal use of the battery.

(1) Misuse of the battery may lead it to overheat or ignite and cause serious injury. Make sure to follow the safety rules listed below:

- Never short circuit the battery terminals
- Do not open the battery
- Do not reverse the polarity
- Do not overcharge or over-discharge
- Always comply with the voltage range given on the battery label
- Do not disassemble the battery
- Do not use the battery without its electronic management system
- Do not subject the battery to excessive mechanical stresses
- Do not expose the battery to water or condensation

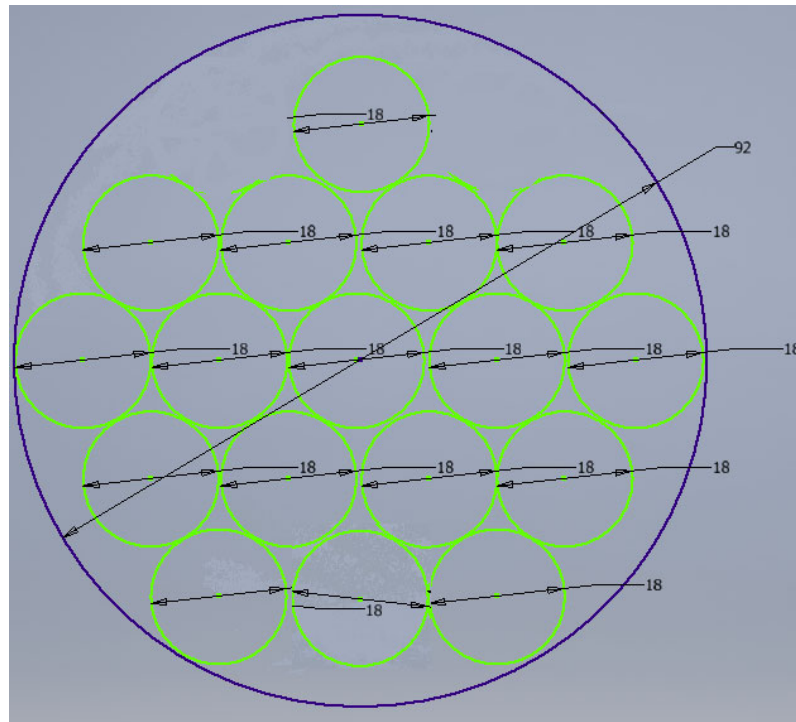
(2) Do not place the battery on or near fires, or other high temperature locations ($> 70^{\circ}\text{C}$). Doing so may cause the battery to overheat or ignite. Using the battery in this manner may also result in a loss of performance and a shortened life expectancy.

(3) Immediately disconnect the battery if, during operation, battery emits an unusual smell, feels hot, changes shape, or appears abnormal in any other way. Contact Saft if any of these problems are observed.

As the station's consumption does not exceed $50\ \mu\text{A}$ in the standby mode, it can be left with a fully charged battery for a prolonged period. However, disconnect the battery if there is a long period of idle time ahead.

To charge the battery, disconnect the charger from mains. Plug the charger's cable connector to the multifunctional connector. Do not apply excessive force. If the connection is fine, the led on the charger goes green. Plug the charger to the mains. The red led indicates that the charging process is in progress. When the led goes green again, disconnect the charger from the station.

The recommended battery layout is 3S17P of NCR18650GA cells which gives 11,1V nominal voltage with 56 Ah (622 Wh max). The supply circuits of the station protect the battery from overdischarge. The threshold voltage is $9.0 \pm 0.6\text{V}$ which gives $3.0 \pm 0.2\ \text{V}$ per element and corresponds to 85 – 90 % of full discharge.



The recommended battery charger should give 12.6V nominal voltage at 6.0 A maximum current. The temperature conditions for charge are +10 to +45°C, for discharge -20 to +60°C.



If other type of Li-Ion cell is used, the condition stated in manufacturer's specification should be strongly observed.

5. Degree of protection

In accordance with the international dust and moisture protection standard, the degree of protection of this device is IP 69 - no ingress of dust; complete protection against contact (dust-tight); protected against close-range high pressure, high-temperature spray downs.

In accordance with the NEMA enclosure ratings, the degree of protection of this device NEMA 6P - indoor or outdoor use to provide a degree of protection against falling dirt; hose-directed water and the entry of water during prolonged submersion at a limited depth; and will be undamaged by the external formation of ice on the enclosure



To ensure a proper degree of dust and water protection, the multifunction connector must no left open during the water exposure!

6. Carrying and storage

The station 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 -20 to $+50^{\circ}\text{C}$.

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:

R-sensors LLC; 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	12/24/36/48 V DC – main supply (10.5-60 V DC allowable range) or 5 V from USB - auxiliary supply* (4.5 .. 5.5 V allowable range)
Consumption during autonomous recording	< 1250 mW

9.2 Mechanical parameters

Types of connectors: <ul style="list-style-type: none"> • multi-function connector 	10-pin waterproof plug Russian type <i>PCF-10TB</i> (RSG-10TV). (functional analog: PY04-10Z)
Maximum inclination during installation	Any
Maximum diving depth	50 m
Temperature range	-20°C ..+55°C
Weight fully equipped without batteries	12.2 kg 10.0 kg
Dimensions** length x width x height, mm	Two tubes 100 x 380 each Overall dimensions 270 x 460 x 120
Housing material	Stainless steel

* - All sensors but hydrophone are not powered from auxiliary supply

** -See drawings in appendix 1

9.3 Sensors parameters

Hydrophone	
Type of sensing element	Molecular-electronic transducer
Configuration	Single sensitivity axis
Sensitivity	800 $\mu\text{V}/\text{Pa}$ (-182 dB)
Maximum output signal, type of signal	± 2 V, analog, differential
Bandwidth	1 Hz – 300 Hz
Integral noise in passband	0,01 Pa
Temperature stability	200 ppm/ $^{\circ}\text{C}$
Three-component seismic sensor	
Type of sensing element	Molecular-electronic transducer
Sensitivity axes	Three orthogonal axes
Sensitivity	250 V/(m/sec)
Maximum input signal	24 mm/sec
Maximum output signal, type of signal	± 6 V, analog, single-ended
Bandwidth	1 Hz – 300 Hz
Integral noise in passband	100 nm/sec

9.4 Digital system NDAS

ADC type	Sigma-delta
Number of channels	4
Input voltage range	
Hydrophone channel	± 4 V differential (± 2 V single-ended)
Seismic sensor channels	± 24 V differential (± 12 V single-ended)
Input impedance	180 kOhm 2700 pF
Dynamic range	132 dB
Gain coefficient (G)	1, 2, 4, 8, 12 Software selectable
ADC sampling rate	1, 5, 10, 50, 100, 125, 250, 500, 1000 sps (samples per second)
ADC resolution	24 bit
ADC noise performance	21.4 ENOB at Gain = 1 and 100 sps

Digital filter Cut-off frequencies	500 sps – 200 Hz 250 sps – 90 Hz 125 sps – 50 Hz 100 sps – 40 Hz 50 sps – 18 Hz 10 sps – 3.6 Hz 1 sps – 0.325 Hz
GNSS receiver	Inbuilt GPS and GLONASS receiver
GNSS timing accuracy	< 1μS
Reference generator type	MXO37/8P - 8.192 MHz
Internal clock accuracy	5 ppb
Data recording mode	Continuous; Schedule
Data recording format	Internal with the possibility for conversion into Binary, miniSeed, SEG-Y, ASCII, SAC
Data recording modes	Manual, scheduled, auto start on power up, auto start on synchronization with GPS
Data storage	32 Gb micro SD flash card
Data transfer	Full-speed USB 1.1 (configuration) High-speed USB 2.0 (read data) Wi-Fi IEEE 802.11b / g / n
Inbuilt sensors for orientation determination	3-axis MEMS accelerometer 3-axis magnetic sensor
The output of orientation	Azimuth, Tilt
The orientation accuracy	+/- 3 deg
Inbuilt sensors for device health monitoring	Supply voltage sensor Humidity sensor Pressure sensor Temperature sensor

APPENDIX 1. STATION'S OVERVIEW

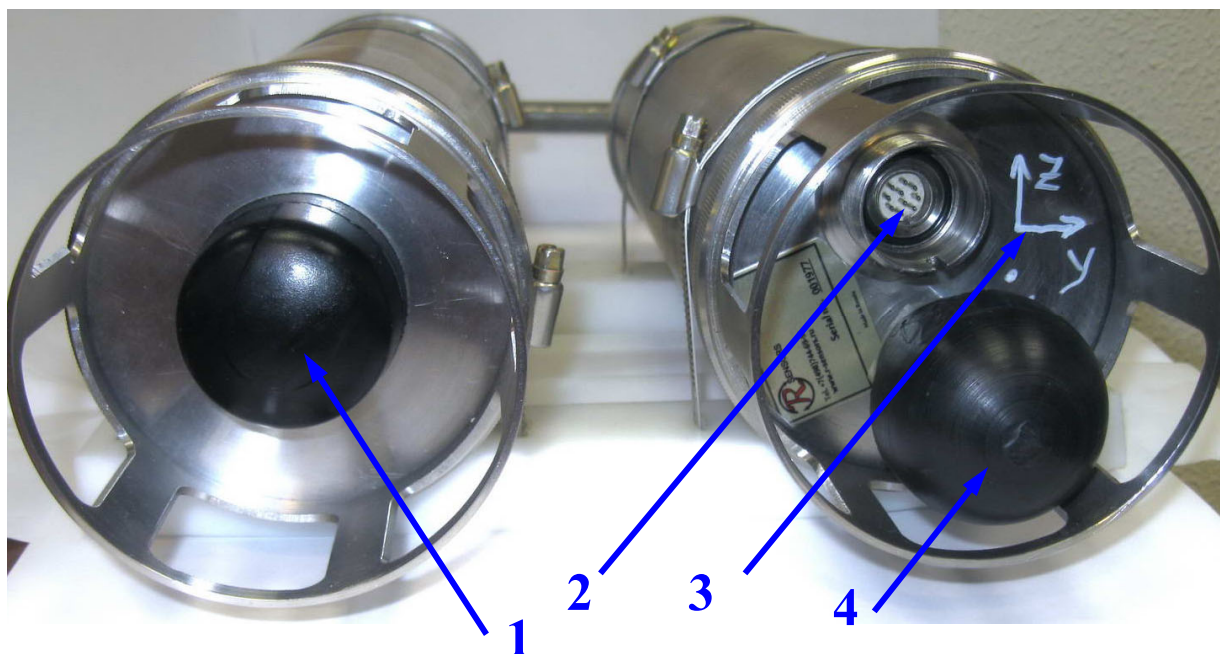


Fig. 1. The station connectors and items

Table 1. Marking in fig. 1

No	Purpose
1	GPS/WiFi combined antenna
2	Multifunctional connector
3	Sensitivity Axes' orientation
4	Hydrophone



Fig. 2. Station with indicator cap installed

Table 2. LED operation modes*

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

* - When power is turned ON both LEDs light up for 1 second 3 times and then go out.



Fig. 3. The axes of sensitivity's orientation

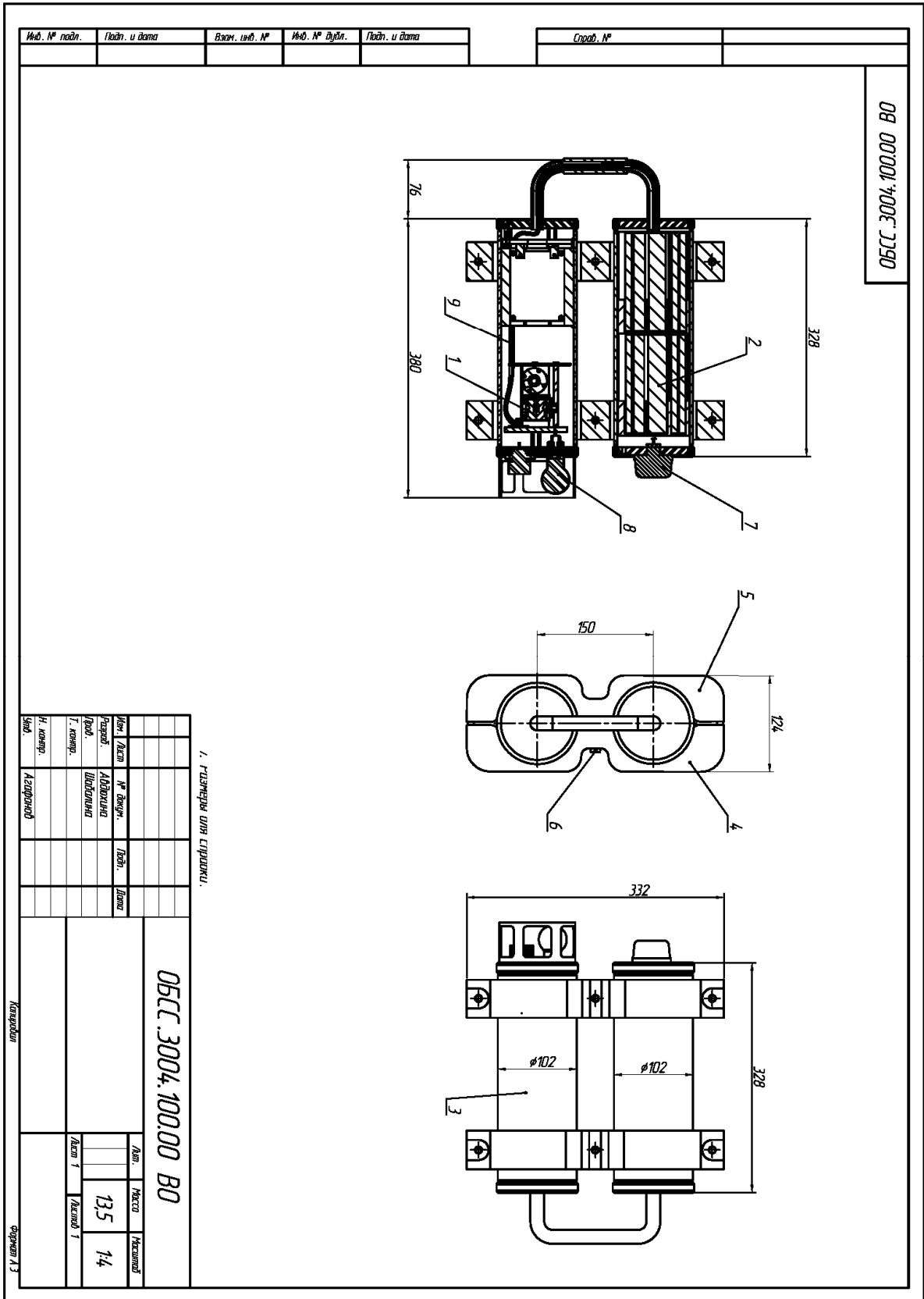
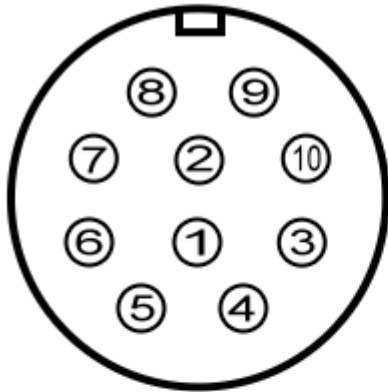


Fig. 4. The station dimensions

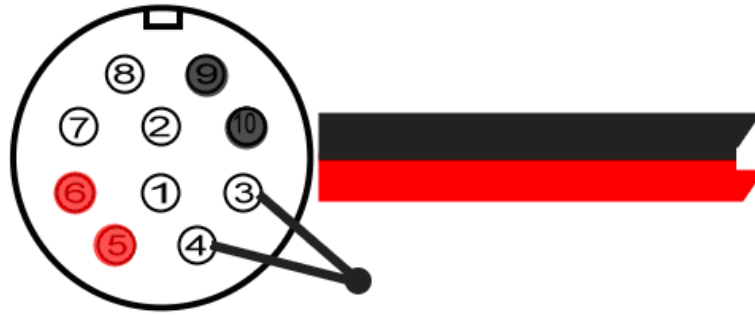
APPENDIX 2. CONNECTORS AND CABLES



PC10-TB male connector (front view)

1	Vbus USB	Vbus USB
2	GND USB	Common for USB
3	Control IN	Connect to Control OUT for Turn on
4	Control OUT	Connect to Control In for Turn On
5	+VBAT Charge	Battery + charge input
6	+VBAT Charge	Battery + charge input
7	+D USB	+D USB
8	-D USB	-D USB
9	-VBAT Charge	Battery charge common
10	-VBAT Charge	Battery charge common

Fig. 1. The station's connectors pinout.



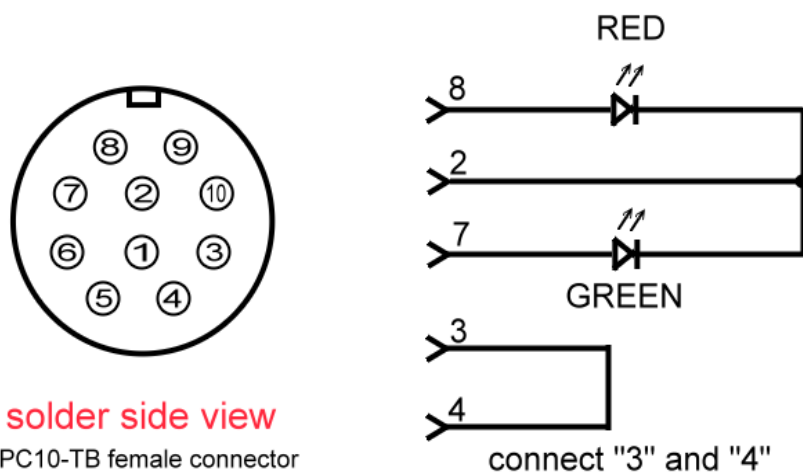
solder side view

PC10-TB female connector

1	N/C	No connect
2	N/C	No connect
3	Control IN	Connect to Control OUT
4	Control OUT	Connect to Control IN
5	+VBAT Charge	Red
6	+VBAT Charge	Red
7	N/C	No connect
8	N/C	No connect
9	-VBAT Charge	Black
10	-VBAT Charge	Black

Fig. 2. Charge cable

Connect "3" and "4" for turning on the station if needed

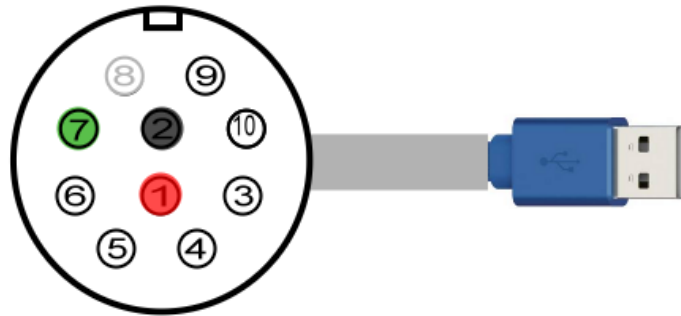


solder side view

PC10-TB female connector

connect "3" and "4"

Fig.3. Indicator cap

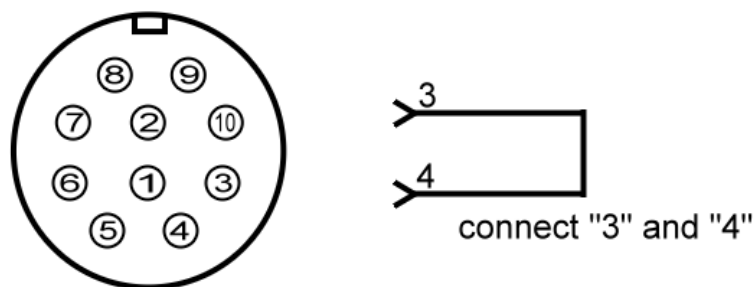


solder side view

PC10-TB female connector

1	Vbus USB	Red
2	GND USB	Black
3	N/C	No connect
4	N/C	No connect
5	N/C	No connect
6	N/C	No connect
7	+D USB	Green
8	-D USB	White
9	N/C	No connect
10	N/C	No connect

Fig.4. Digital USB cable.



solder side view

PC10-TB female connector

Fig.5. Active cap (red wire)



Fig. 6. Active cap (red wire, to the right);
Idle-state cap (green wire, to the left)

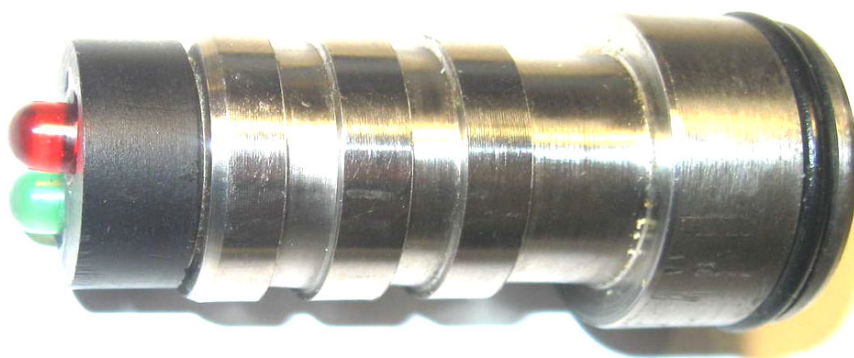


Fig. 7. Indicator cap



Fig. 8. Digital USB cable



Fig. 9. 10-pin connector (Russian type PC-10TB – RS-10TV) – to the left,
4-pin battery power connector DS1110-4 – to the right.

APPENDIX 3. THE BATTERY

The battery for the module is limited in diameter by 92 mm and in length by 260 mm.

The recommended battery layout is 3S17P of NCR18650GA cells which gives 11,1V nominal voltage with 56 Ah (622 Wh max). Two cells in the top row is intentionally missing. This lets the cables to pass the battery by inside the tube.

The supply circuits of the station protect the battery from overdischarge. The threshold voltage is $9.0 \pm 0.6V$ which gives $3.0 \pm 0.2 V$ per element and corresponds to 85 – 90 % of full discharge.

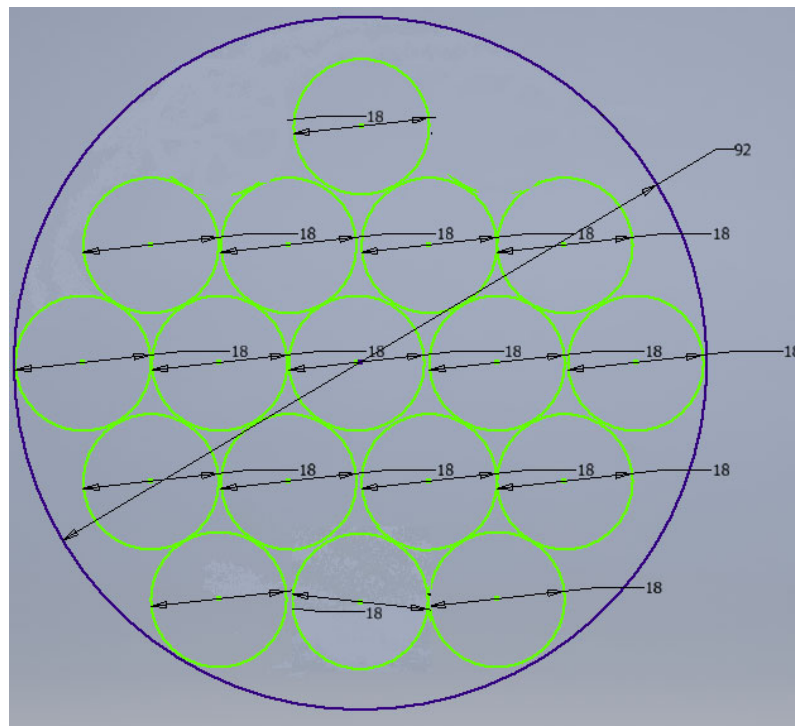


Fig. 1. The battery. Recommended layout

The battery is placed in a thin protective cover and after connection is placed into the station tube. The output cable length is about 15-20 cm.

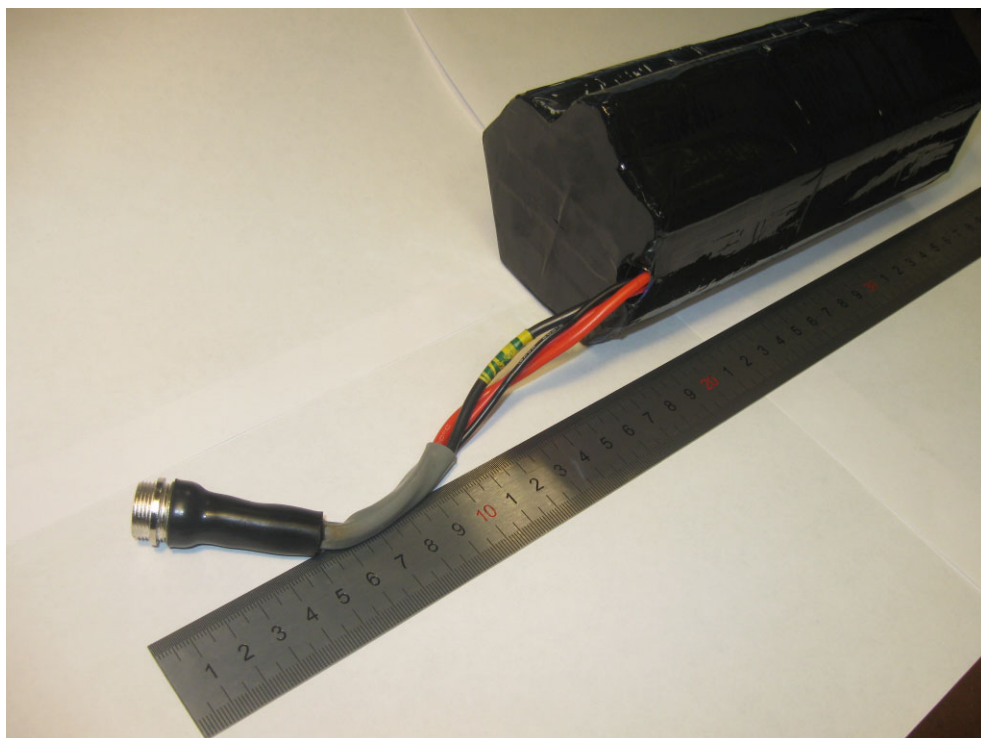


Fig. 2,3. The battery and its cable



1,4 : +Power
2,3: -Power(GND)

Fig. 4. The battery connector pinout
(Male connector, front (pins) side view)



Fig. 5. The battery connector

The output connector type is DS1110-4 round connector (<https://static.chipdip.ru/lib/407/DOC004407203.pdf>). The male part goes to the accumulator and the female part goes to the connecting cable



Fig. 6. The battery charger

The battery charger parameters must correspond to the battery's cells parameters. The recommended current is 6.0 A at 12.6V output.

In order to install the battery, the following steps are required:

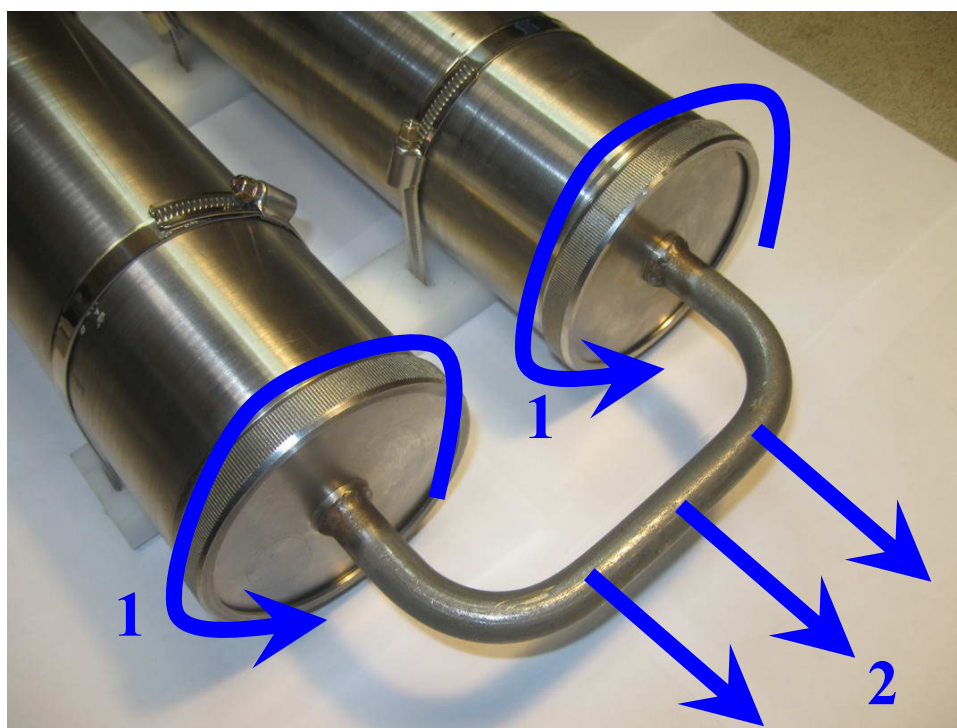


Fig. 7. The bottom lid

1. Unscrew two bottom lid ring nuts (Fig. 7).
2. Gently pull out the bottom assembly half way by the connection pipe (Fig. 8).



Fig. 8. The bottom assembly drawn half way

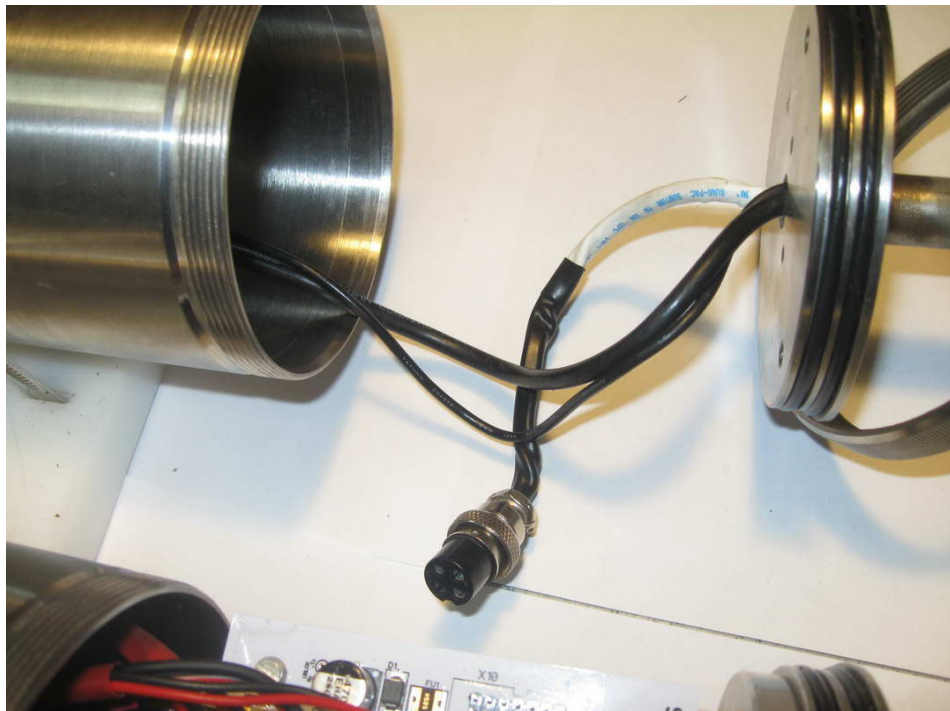


Fig. 9. The battery socket

3. Pull out the battery socket (Fig. 9).
4. Insert the battery (Fig. 10). Take care of the passing cables.



Fig. 10. The battery's installation



Fig. 11. The battery connection

5. Connect the battery (Fig. 11). Fix the connector's nut.
6. Add some porous material to fix the battery (Fig. 12).
7. Fit in the bottom assembly back into the station's case (Fig. 7).
8. Firmly screw two bottom lid ring nuts (Fig. 7).



Fig. 12. Extra porous material