LS1/LS2 MANUAL

Long-Term Underwater Acoustic Recorder

Manual v2.0

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Overview

Hardware

LS1/LS2 are dataloggers designed for collecting large amounts of underwater acoustic recordings. Setup is designed to run through a simple button interface with a display. No PC is needed to setup and deploy the LS1/LS2.

- HTI-96-min hydrophone
- Adjustable sample rate
- 1 TB microSD formatted as exFat

Software
LS1/LS2 store data directly as audio wav files.

Any audio analysis software (Adobe Audition, Cornell Raven, MATLAB, R, Python) will work with these files.

Setting up LS1/LS2 for Deployment

See the online video for a tutorial on setting up the LS1/LS2

Step 1. Prepare microSD card. The microSD card should be formatted as exFAT (for version 2 of the LS1/LS2).

Step 2. **O-rings**. Clean and grease o-rings with silicone grease and insert into the groove on the ring. The fatter radial o-ring is 5 mm wide x 90 mm inner diameter (McMaster Part number 9262K395). The o-ring that seals with the top of the tube is -155 (McMaster Part number 9452K176).

Step 3. Turn on power switch.

The microSD card will be scanned for free memory. Only the card in slot 1 is used in version 2 of the LS1/LS2.

Use buttons to change settings

> **UP/DN**: Used to move through menu settings and make changes.
> **En**ter: Used to change values.

Display Setting	Description
Start	Press Enter to Start
Record	Record duration in seconds
Sleep	Sleep duration in seconds. This is the time from the END of one recording to the START of the next recording. Continuous Recording: Sleep = 0 seconds. For continuous recording the minimum Record duration (i.e. file size) is 600 s.
Rate	Sample rate Note for 250 kHz and 300 kHz you may need to increase the gain to achieve lower noise recordings.
Gain	Gain of the audio codec. The gain setting ranges from 0 to 15 and the corresponding dB of gain will be shown in the display.
Time	It is highly recommended to use UTC time.
Year:	Year
Month:	Month
Day:	Day of month
Hour:	Hour (24 hour time)
Minute:	Minute

Second:	Second
Battery	Number of battery *packs* you will fill. There are 3 D-cells per battery pack.
Mode	Switch between Norm(al) and Diel recording. In Diel recording mode the Start HH:MM and End HH:MM are specified to limit recording to certain parts of the day (e.g. record only in the morning). In Normal recording mode, recordings are made throughout the day.

Step 5. Start Recording. Press Enter when the display shows START to start recording. If this is not done, the recorder will automatically start after 10 minutes.

Step 6. Close lid. The radial o-ring is the main sealing o-ring, so there is no need to make the lid more than hand tight.

Stopping Recording

If a recording is in process after recovery, you can press the UP + DN buttons at the same time to close the file.

File Names

Example: 20210319T163400_2614231252441225_2.0dB_3.8V_ver2.00.wav

File names contain the following separated by underscores:
>   Date and time of the start of the file
>   Serial number of board (not the hydrophone serial number)
>   Gain of the board
>   Voltage of the batteries
>   Version of the firmware

setup.txt Commands

All commands are optional. Default column lists values if no setting in setup.txt file. Record duration and record interval can be set through the button interface.

Command	Function	Default	Example	Setup.txt example
RD	Record duration (s)	Last used	Record 600 second files	`RD 600`
RI	Record interval (s)	Last used	Sleep 240 seconds between files	`RI 240`
SG	Hydrophone system gain. See table for dB gains associated with different settings.	4	Set gain to setting '10', which corresponds to 11.1 dB gain	`SG 10`
ND	Remove DC from audio. Turning on increases electrical noise	Off	Turn on feature to remove DC from audio	`ND`

Power

The LS1/LS2 has battery holders for 4 sets of D-cell batteries (12 batteries total).

The LS1X/LS2X has battery holders for 8 sets of D-cell batteries (24 batteries total).

Always use new batteries of the same brand and tape them into place.

The display will provide estimated run time based on the number of battery packs that are filled (LS1: 1-4 battery packs: LS1X: 1-8 battery packs) and the memory available in the microSD card.

HTI Hydrophone and Recording Gain

The LS1/LS2 uses a hydrophone manufactured by High-Tech Inc. The sensitivity of the hydrophone will be on a specification sheet included with the shipment (typically -170 dBV/uPa or -180 dBV/uPa).

The hydrophone has a red LED in the end to indicate when it is getting power. This will only be turned on during startup and recording. The hydrophone red LED will be off when sleeping.

The A/D converter gain can be changed through the setup.txt file. The default is setting 4. The setting can be changed with SG command in setup.txt. The actual setting that was used is stored to the log.txt file.

Setting	Clip Level (peak-peak)	Clip Level (peak)	Gain (dB)
0	3.12	1.56	-3.9
1	2.63	1.315	-2.4
2	2.22	1.11	-0.9
3	1.87	0.935	0.6
4	**1.58**	**0.79**	**2.0**
5	1.33	0.665	3.5
6	1.11	0.555	5.1
7	0.94	0.47	6.6
8	0.79	0.395	8.1
9	0.67	0.335	9.5
10	0.56	0.28	11.1
11	0.48	0.24	12.4
12	0.4	0.2	14.0
13	0.34	0.17	15.4
14	0.29	0.145	16.8
15	0.24	0.12	18.4

Vent Plug

This plug is only to be used if there is a leak in the housing.

A leak in the housing can be dangerous because the housing will pressurize internally to the same pressure as the depth of deployment.

If there is a leak, it is critical to relieve the pressure before removing the lid, otherwise the lid could fly off.

The vent plug can be used to relieve the pressure, by turning it slowly until you start hearing air come out. Once air starts coming out, stop unscrewing and wait until air stops coming out. The vent plug is designed to stay in the endcap and safely vent air through holes machined in the plug.

Once the internal pressure has equalized, you may remove the top lid with the hydrophone. There is no need to fully remove the vent plug. Then gently retighten the vent plug. On PVC housings be very careful not to overtighten the plug, otherwise the threads in the bottom endcap may strip.