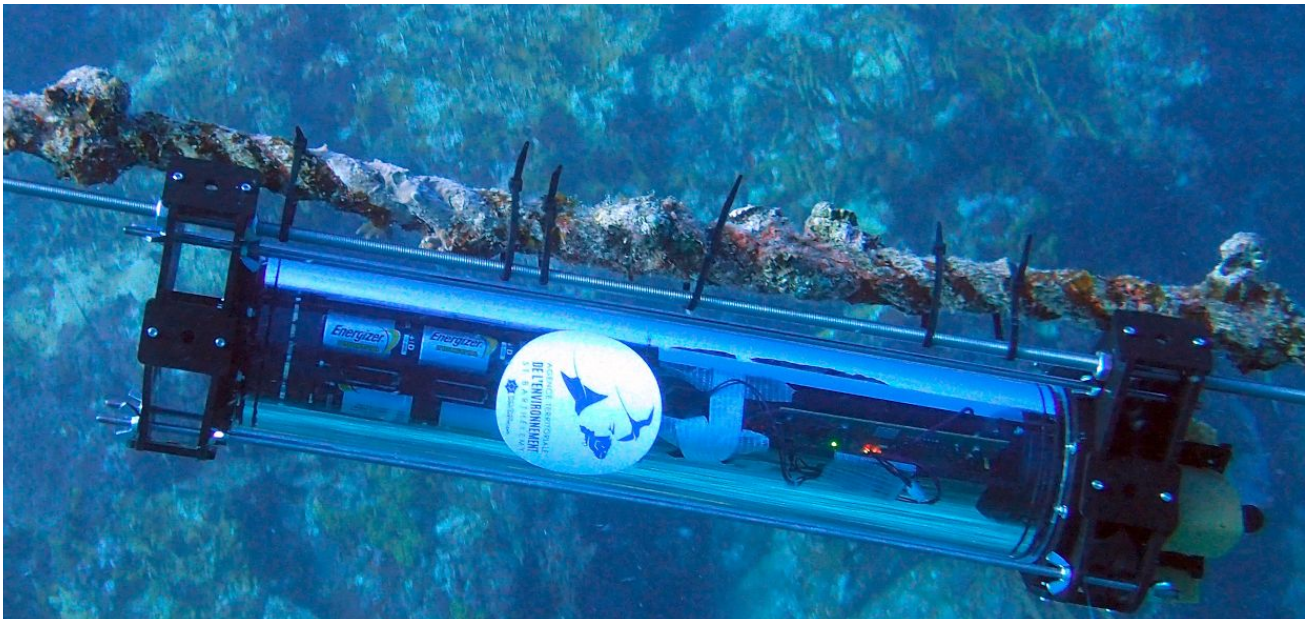


## ACOUSTIC ACQUISITION SYSTEM

## JASON HIGHBLUE



## SUMMARY

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## CONTENT

The HighBlue package comes with everything needed to use and includes the following:

- Watertight carrying case IP65, rolling
- Sealed tube until -100m, length 60cm with 3 plugs, one external switch, and a penetrator.
- Block batteries for the series connection of 21 type batteries D
- Grabber BlueEar 16bit Mono
- Map  $\mu$ SD 512GB +  $\mu$ SD- adapter > SD
- C75 hydrophone
- Rack hydrophone protection
- Flange for spare seals
- Joint replacement for tape
- Silicone grease
- Penetrator Wrench
- Allen wrench
- Screws and nuts in stainless steel additional A4.
- Cable micro USB for updating the embedded firmware.

The JASON HIGHBLUE system incorporates the latest technologies for signal acquisition, allowing a compromise between high sample rate and reduced energy consumption.

It can be used in "stand alone" mode, in which data acquisitions is connected directly to external USB media, or in "connected mode". In the latter case, the JASON HIGHBLUE system is connected to a PC via the USB link.

## TECHNICAL CHARACTERISTICS

### ACQUISITION:

- Acquisition Sample Rates: 512 Ksps / 256 Ksps / 128 Ksps / 64 Ksps / 32 Ksps / 8 Ksps
- Frequency range of the input signal: 5 Hz to 256 kHz.
- Acquisition in 8, 16 bits, adjustable via a configuration script.
- Differential acquisition with 3.3V maximum input level.
- Accurate timestamping
- Anti-aliasing filter configurable to input signal without change of input signal in the passband (see section characteristic filters).v

### AMPLIFIER :

- Amplifying the signal from the hydrophone: X2
- Single ended input and differential output

- Input impedance:  $10^{13}$  ohm.

#### HYDROPHONE C75:

- Sensitivity of the transducer: -200dB, re. 1V /  $\mu$ Pa
- Gain preamplifier: 20dB
- Effective sensitivity: -180 dB re. 1V /  $\mu$ Pa
- Linear frequency: 10Hz to 170kHz ( $\pm$  3dB)
- Usable bandwidth: 3 Hz to 250 kHz (+ 3 / -12dB)
- Power 5 to 32Vdc
- Acoustic Overload pressure: 184 to 201dB, re 1 $\mu$ Pa



#### STORAGE:

- Storage support on micro SD card (or SD via an adapter)

#### ENERGY CONSUMPTION :

- Max Power Consumption: 1.65W in lifelong learning (SD and hydrophone including C75)

#### CHARACTERISTICS OF INPUT FILTERS

**Lowpass 1 (Wideband1):** Cutoff frequency =  $0.4 * \text{Sampling Rate}$ , constant gain in the passband, high attenuation beyond so as to avoid aliasing phenomena with an attenuation of 110 dB in the stopband.

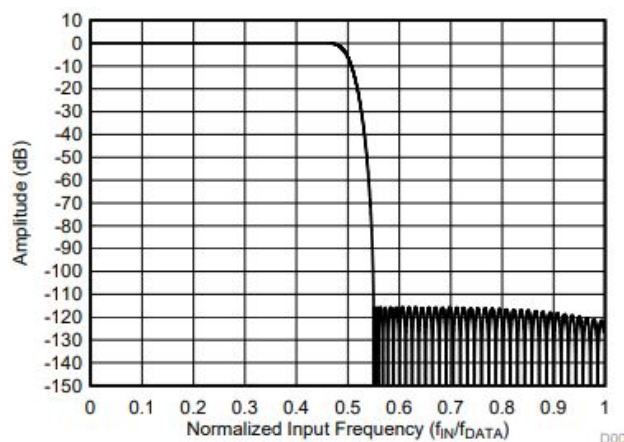


Figure 1: Transfer function of the filter WB1

**Lowpass 2 (Wideband2):** Cutoff frequency =  $0.5 * \text{SR}$ . constant gain in the passband, high attenuation beyond so as to avoid aliasing phenomena.

JASON HIGHBLUE

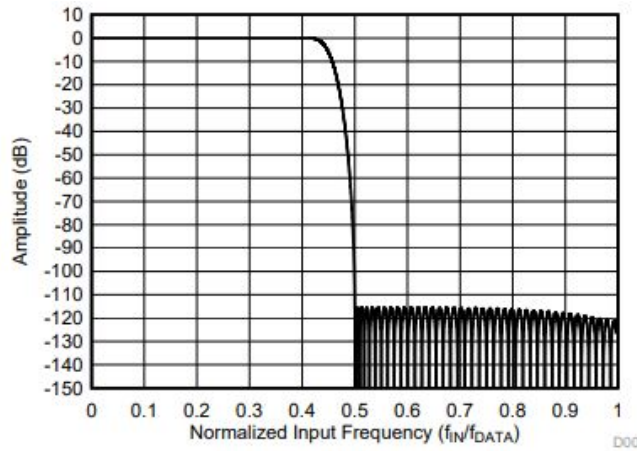


Figure 2: Transfer function of the filter WB2

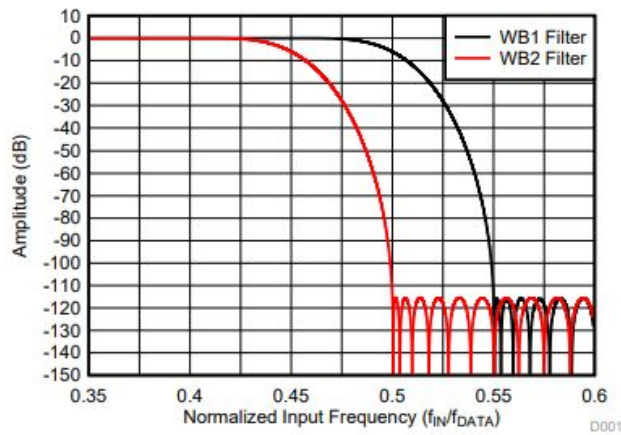


Figure 3: Comparison of transfer functions of filters WB1 and WB2

**Filter Low Latency (sinc / sin5c):** Constant phase shift between the output and input signals irrespective of the frequency of the input signal. In return, the gain is not perfectly consistent in bandwidth. The noise level is lower than with an anti-aliasing filter.

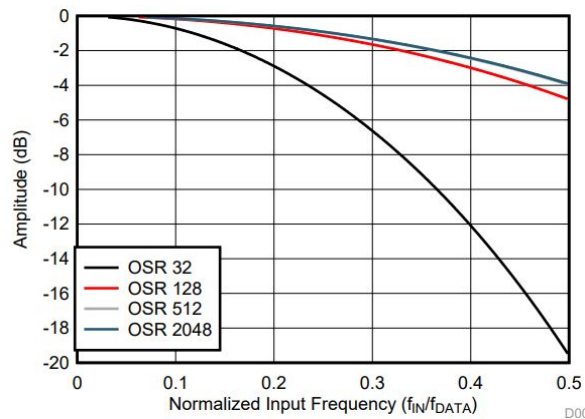


Figure 4: Filter Transfer Function Low Latency for frequencies below the Shannon limit



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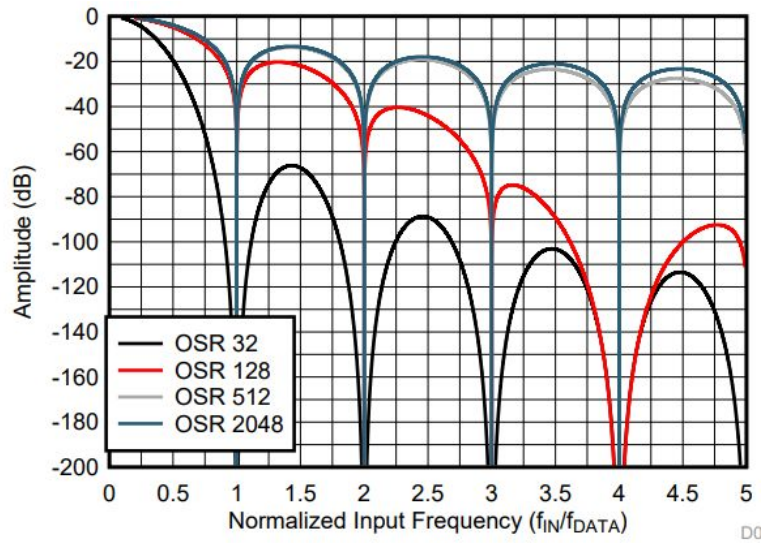


Figure 5: Filter Transfer Function Low Latency for a range of fréquences beyond the Shannon limit frequency

FEATURES ANALOG DIGITAL CONVERSION STAGE:

**Table 1. Wideband Filters Performance Summary at AVDD = 3.0 V, DVDD = 1.8 V, and 2.5-V Reference**

MODE	DATA RATE (SPS)	OSR	TRANSITION BAND	PASS BAND (kHz)	SNR (dB)	V <sub>RMS_noise</sub> (μV <sub>RMS</sub> )	ENOB	I <sub>DVDD</sub> (mA)
High-resolution (HR)	512,000	32	Wideband 1 filter	230.4	103.7	11.61	18.72	7.50
			Wideband 2 filter	204.8	104.1	10.64	18.84	
	256,000	64	Wideband 1 filter	115.2	107.3	7.61	19.33	4.35
			Wideband 2 filter	102.4	107.7	7.25	19.40	
	128,000	128	Wideband 1 filter	57.6	110.4	5.35	19.83	2.80
			Wideband 2 filter	51.2	110.9	5.06	19.91	
	64,000	256	Wideband 1 filter	28.8	113.4	3.79	20.33	2.00
			Wideband 2 filter	25.6	113.9	3.58	20.41	

Figure 6: acquisition noise level depending on the configuration of wideband filters

**Table 2. Low-Latency Filter Performance Summary at AVDD = 3.0 V, DVDD = 1.8 V, and 2.5-V Reference**

MODE	DATA RATE (SPS)	OSR	-3-dB BANDWIDTH (kHz)	SNR (dB)	V <sub>RMS_noise</sub> (μV <sub>RMS</sub> )	ENOB	V <sub>pp_noise</sub> (μV <sub>pp</sub> )	I <sub>DVDD</sub> (mA)
High-resolution (HR)	512,000	32	101.8	107.6	7.40	19.37	64.67	1.60
	128,000	128	50.6	110.8	5.12	19.90	44.11	1.39
	32,000	512	13.7	116.2	2.74	20.80	24.14	1.33
	8,000	2048	3.5	122.0	1.41	21.76	11.32	1.32

Figure 7: Noise level of acquisition depending on the configuration of Low Latency filters

## MANUAL

### RECOMMENDATIONS OF USE

#### SAFETY PRECAUTIONS

In this manual, the warning signs and caution should be read by users to avoid dangerous accidents and problems. The meaning of these symbols is as follows:



Attention

If users ignore this symbol and mishandle the device, it can result in personal injury and damage to equipment.

Please read the safety tips and the following precautions to ensure a safe use of the JASON system.

**FOOD:** The power consumption of this device is low. It should only be operated by being powered by a type of continuous supply of 12 to 35V (or Li Ion / Batteries / battery according to the application, contact us).

- Lead acid batteries must be recharged using a 12V battery charger.
- When you disconnect the battery to perform charging, grasp the connector on the electronic board and never pull on the cable.
- Use a conventional 12V lead acid battery without changing the power cables.
- The JASON system can not be used to recharge the batteries.
- In case of no use, remove the batteries from the system.
- If leakage battery leakage occurs, wipe the battery compartment, battery terminals and batteries to remove any remaining fluid. Common Baking Soda ( $\text{NaHCO}_3$ ) can be applied to neutralize battery acid contamination.

#### ENVIRONMENT

To avoid problems and malfunctions, avoid using the system in an environment where it will be exposed to:

- Extreme temperatures ( $<-15^\circ\text{C}; >60^\circ\text{C}$ )
- Heat sources such as radiators or stoves
- Excessive vibration or shock

#### HANDLING

- Do not place any objects filled with liquids, such as vases, on the open, as this may cause electric shock.
- Never place naked flame sources, such as lighted candles on the system as this may cause a fire.
- The JASON BLUE MONO system is a precision instrument. Be careful not to drop or subject it to shock or excessive pressure, as this could cause serious problems.

## JASON HIGHBLUE

- Make sure that no foreign objects (coins or pins etc.) or liquid (water, soft drinks and fruit juices) to penetrate the unit.

### CONNECTING CABLES AND INPUT / OUTPUT

You should always turn off the system and all other equipment before connecting or disconnecting cables. Be sure to disconnect all connection cables and turn off the power before moving the system.

### MODIFICATIONS

Never attempt to modify in any way. It may cause damage and be dangerous for the user.

## PRECAUTIONS

### ELECTRICAL INTERFERENCE

For security reasons, the system JASON HIGHBLUE was designed to provide maximum protection against the electromagnetic radiation from the device and to protect against external interference. However, any equipment that is very sensitive to electronic interference or that emits strong electromagnetic waves must not be placed near the system because the possibility of interference can not be completely eliminated. With any type of digital control device, including the JASON-HIGHBLUE, electromagnetic interference can cause malfunctioning and corrupt or destroy data. Care must be taken to minimize the risk of damage.

### CLEANING

Use a dry, soft cloth to clean the system. If necessary, dampen the cloth slightly. Do not use abrasive cleaners, waxes or solvents (such as paint thinner or cleaning alcohol), since these materials may dull the finish, damage the surface or cause damage to the PCB.

Please keep this manual in a safe place for future reference.

## INSTALLATION

### UNPACKING:

As with any electronic device, you should take care to handle this equipment carefully. Before removing the device from its packaging, discharge yourself of any static charge using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge. Contact us immediately if any components are missing or damaged.

### INSTALLING THE HARDWARE:



The hardware of the system is delivered already assembled. No additional installation is required. Only the connection of the IO and power supply is required. However, a system disassembly guide is available below. (For data extraction, as well as for replacing or charging the battery).

## SYSTEM STARTUP

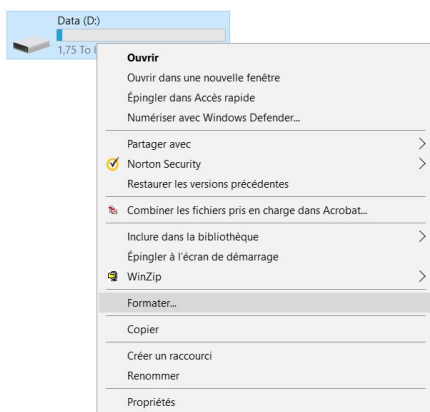
Commissioning is very simple. Please accomplish the following steps in order:

### FORMATTING THE STORAGE MEDIUM

The JASON HIGHBLUE system takes into account that the FAT / FAT32 file systems. **(The exFAT system is not compatible with the system)**. It is therefore necessary to format the storage media to use FAT32.

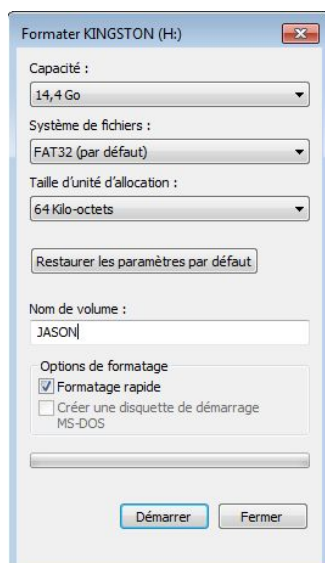
**Please preferably use fast storage media to benefit from a high transfer rate, and avoid packet loss (eg Western Digital Element 1TB).**

Formatting can be done via the Windows format utility (right click on the media to format):



Go to the desktop of your system, right-click the storage media format -> "Format".

Select a unit of allocation of 65536 (64K).



Click "Start".

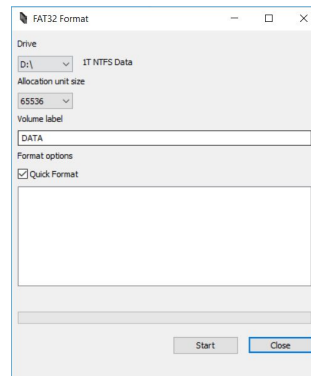
Wait for the the media to be formatted.

---

**The formatting can also be done via the formatting tool "guiformat.exe"** This Windows formatting tool does not allow any time to format large capacity

## JASON HIGHBLUE

system FAT32. Windows often proposes that exFAT is incompatible with the system. Specific formatting tools will solve this problem. Available for download from the web for free.



Click "Start" and wait a few minutes. The support is ready.

### CONFIGURE / UPDATE THE SYSTEM TO A DESIRED OPERATION.

The system parameter (and / or updates) via the text configuration file "JASONCONFIG.CFG" giben below :

```
//System Configuration File

Sampling_Resolution=16; // 16 = Resolution in bits (8 or 16)
Sampling_Freq=256000; // 256000 = Sampling frequency(in sample
//per sec). Possibles values are
//512000,256000, 128000,64000 With WidBand
//Filters, or 512000,
//128000,32000,8000 With Low Latency
//filter
Filter_Selection=1; // = 1 ; filter selection. Possibles
//values are:
//0->Wideband1 (0.45 to0.55)*fDATA
//1->Wideband2 (0.40 to0.50)*fDATA
//2->LowLatency
AutoStart=true; // = true = Auto record at boot
FILE_Size_Limit=150000000;//File Size limitation (in bytes) =
//150000000 for 5 minutes
Record_Use_TimeInterval=true; //Set or unset the discrete
//recording
Record_Time=60; //Time period of record (in
//seconds)
Record_Interval=60; //Time period of wait time
//between each record(in
//seconds)|
```

**WARNING: This file is placed in the root of the storage medium. Its content is "Case sensitive"**

If this file is not present, the recordings will not start.

UPDATING THE DATE AND TIME OF THE SYSTEM.

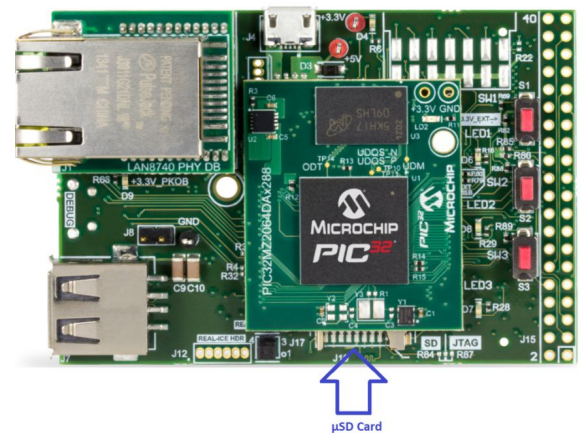
The system parameter (and / or updates) via a text configuration file "CLOCK.CFG" in the following form:

```
CLOCKTIME= 11/02/2018 10:02:00;
```

To insert the  $\mu$ SD support (and / or power on) the system CLOCK.CFG read the file, and updates the date and time of the system with the read settings and it removes the CLOCK.CFG file storage media. The date and time are kept current as the battery backup (CR2032) is present on the system.

CONNECTING THE EXTERNAL STORAGE MEDIUM

To connect your storage media to the system, simply insert it into the connector  $\mu$ SD:



Insert card into the slot until "click" is heard

SYSTEM STARTUP

If "Autostart" = true, then the system will start the recordings with the parameters of the configuration file from its power. For powering the tube under water, it is sufficient to rotate the cap on the top of tube tape clockwise (red arrow).



Orange LED located on the capture card should light indicating that the system is recording.

**STOP SYSTEM AND RECOVERY MEASURES**

For powering down the tube under water, it is sufficient to rotate the cap on the top of tube tape counterclockwise (white arrow).

All LEDs on the card must go out. The measured data is saved continuously on the  $\mu$ SD storage system. These are directly saved as a .WAV file.

**Note:** During the shutdown, it is possible that the last record is lost. This is why it is necessary to ensure enough wait time after the start of a record (greater than or equal to the parameter "Record\_time"), or else to have a "FILE\_SIZE\_LIMIT" reduced (which the effect of cutting the recording file size).

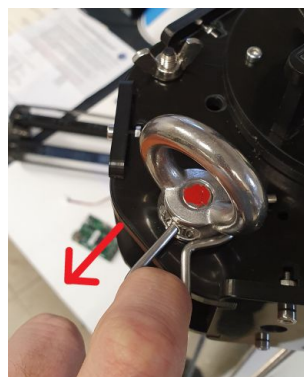
To recover the data on the card  $\mu$ SD, refer to the next chapter "of the tube opening procedure".

## REMOVAL AND SYSTEM MAINTENANCE

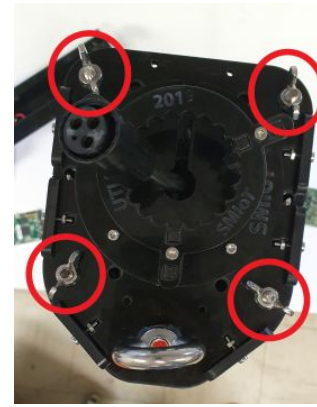
### THE TUBE OPENING PROCEDURE

To open the tube to recover the data on the card or  $\mu$ SD to perform maintenance, it is necessary to observe the following procedure:

1. Make sure the tube is off (switch off mode).
2. To prevent water being introduced into the tube and the electric or electronic parts, ensure that the right parts close to the top step are kept dry or if necessary dry with a cloth.
3. Remove the switch cap to allow air into the tube. (Unscrew and pull it upwards)



4. Remove the quick release pin of the ring located on the top step of the tube, this ring then will unscrew (*Note the rings of the various tubes are not interchangeable*).
5. Remove by unscrewing the four wing nuts of the upper portion of the tape.
6. Chock tape the bottom of the tube between feet and keep the transparent tube between knees:



7. Extracting the inner part of the tube by pulling the upper tape upward
8. Place both parts of the tube on a flat surface



Once the tube is removed the SD card can be removed and / or the batteries changed.

#### CLOSING PROCEDURE THE TUBE

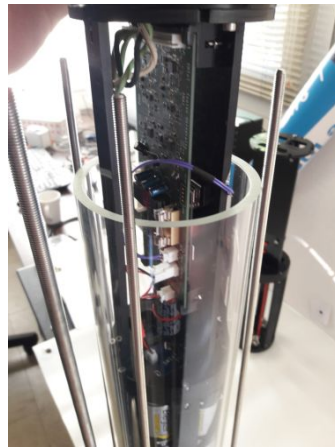
To close the tube it is necessary to observe the following procedure (**WARNING, any mishandling or non-compliance with this procedure can cause irreparable damage to the system**):

1. To start, make sure that the tube is turned off, and the switch cap is removed:
2. Check that all the cables are plugged correctly (see: next part: "Electrical Installation").
3. If the tube is about to be used, ensure that the  $\mu$ SD card is present, and is consistent with the system conditions (formatting FAT32 configuration script and storage).
4. Ensure the good condition of the tube seal (2 present on the lower flange and 2 present on the upper flange of the tube). They must not have any cuts or unevenness of wear. If a seal is worn or damaged, it is necessary to proceed to replace it before using the system. The joints must be clean and free of dust.

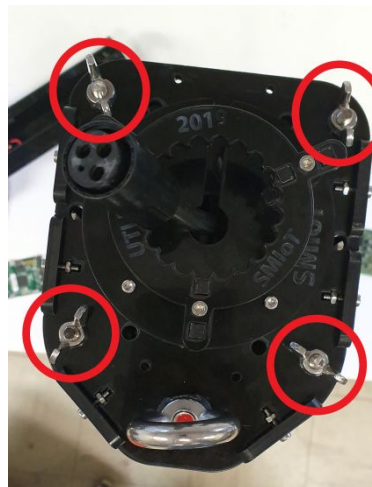


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5. Check the condition of lubrication of the joints. See section "lubrication of joints." Warning: greasing the gasket ensures the tightness of the tube and facilitates sliding when closing. A poor state of lubrication of joints may lead to deterioration of these and leakage can then occur. Place the tube vertically between legs, lower tape on the floor, and proceed with the insertion of the inner portion of the tube.
6. Ensure no wires get jammed between the pipe and flange.



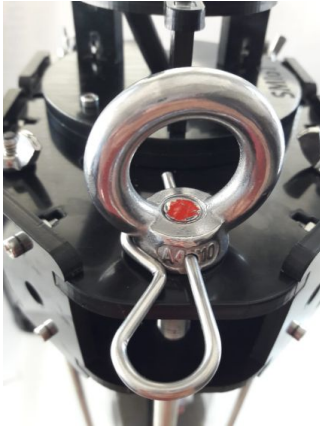
7. Guiding the threaded rods in their corresponding holes on the top of tube tape:



8. Add the 4 wing nuts and the anchoring ring on their respective threaded rod and tighten.
9. Then add the locking pin on the anchoring ring:



**JASON HIGHBLUE**



10. Grease if necessary the connector of the hydrophone (see section "Lubrication connectors").
11. Lubricate the switch cap (see section "Lubrication plug and penetrators").
12. Then replace the cap of the switch in its location and rotate the screw one and a half turns.



13. Check tightening the nut: To prevent any rotation of the tube, a nut has been placed inside the lower tape to minimize any resonances transmitted by the tube structure to the hydrophone . Check the tightness and tighten this nut if necessary :



14. The tube is ready for use.

BATTERY BLOCK ASSEMBLY

This block allows the assembly of 21 batteries connected in series delivering a voltage of 31.5V and a capacity of 530Wh. This procedure must be done carefully (extension to 28 batteries or more is possible in future version, contact us).

**STEP 1 OF 3:**

a: Place the batteries on the floor. To do this, place the inside of the tube vertically as shown with tape at the upper top:



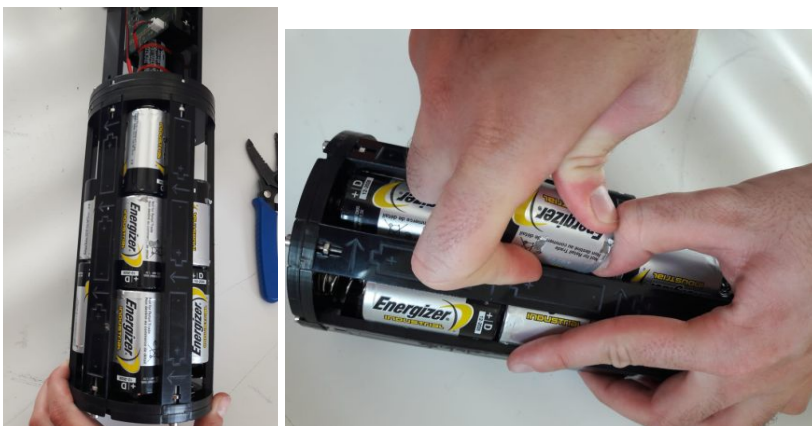
b: Insert the batteries according to the silkscreen printed on the battery pack per the image above. It is appropriate to place the stack to the left of the cross - bottom and top +. To facilitate inserting the batteries in the block, it is recommended to insert them at the middle of the stack on screen printing ties, to play on the elasticity of the material. Doing so for every stage 1. Do not forget to place the battery in the central column, facing down + and - up:



Then do the same for the second stage:



**STEP 2 OF 3:** This step is mounting the 3rd layer, making sure not to forget the central column, and by not filling the last (inability to bring a stack in the middle if all the others are placed). This step is not difficult with a little practice by following these steps. For easily mounting the 3rd layer, one uses an already placed cells in the block, and it is made to change column by inserting it between the two stacks of another column:



**STEP 3 OF 3:** This last step is to place the last block of batteries before adding a small border fabric, which will allow the extraction of it at the next change of batteries:

JASON HIGHBLUE

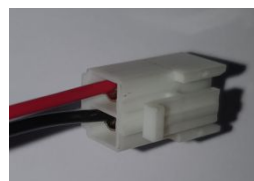
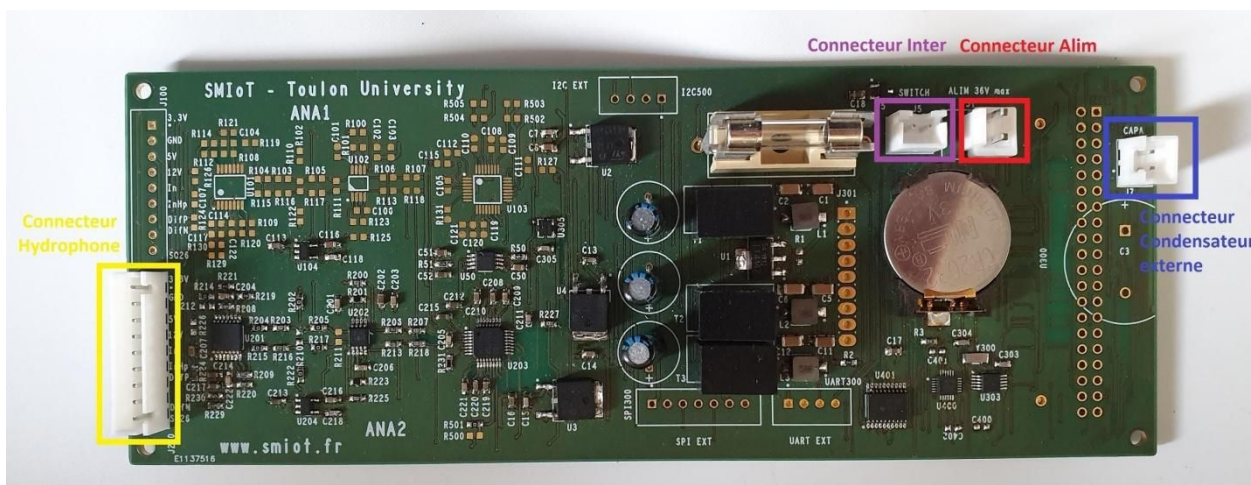
Once the stack is positioned with the rim, insert it into the box by sliding the battery side spring to the bottom spring, and by forcing the cell to be inserted. Do not hesitate to go with the palm of the hand.



## CONNECTIONS

### POWER CONNECTION

To function properly, the system must be powered with a 12V minimum voltage of up to 35V. To do so, is necessary to connect the JST connector from the battery pack to map (J1):



### CONNECTING THE REMOTE SWITCH



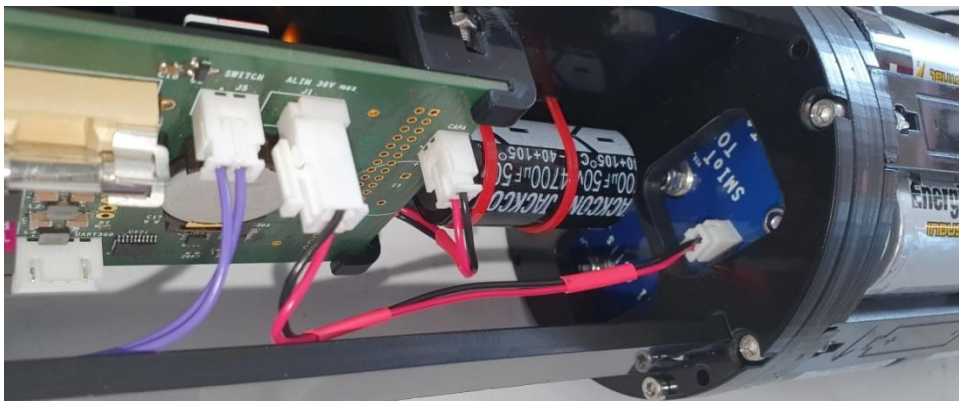
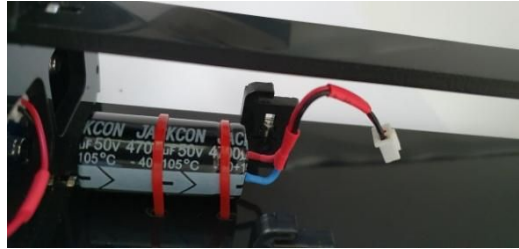


**JASON HIGHBLUE**

In order to start the system without having to re-open the sealed tube, a switch has been moved outside of the tube (upper Tape, connected by means of two purple plugs and a JST) and must be connected to the board via connector J5.

CONNECTING THE DECOUPLING CAPACITOR:

To avoid power loss at light impacts or movements, a decoupling capacitor has been added to the system. This must be connected to the capture card to ensure proper operation thereof.



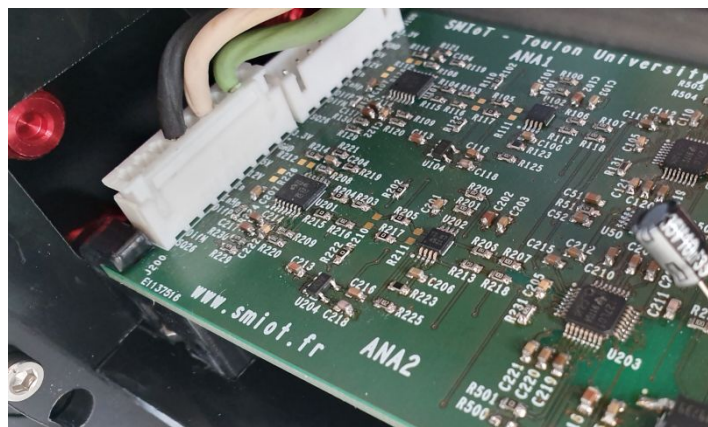
FINAL WIRING: IS AS SHOWN IN THE PHOTO

INSTALLING THE CR2032:

HIGHBLUE the system has a holder for a CR2032 for saving and maintenance of the internal clock for a period of 10 to 15 years in the case of cutoff of the power supply. This battery will be necessary to maintain the time of day system (Main Switch Off), or in the case of too low power (low battery, ...).



CONNECTING / HYDROPHONES:



The hydrophone connects to the circuit board via a 9-pin connector. In the case of a system in MONO configuration, the hydrophone is connected to the path "ANA2". In the case of a system configuration Stereo, the hydrophones are connected on both channels.

When wiring hydrophones ensure work is accomplished in an anti-static environment, and be discharged of static load. (Avoid wool clothing and touch a point of grounding ie: PC casing, ...).

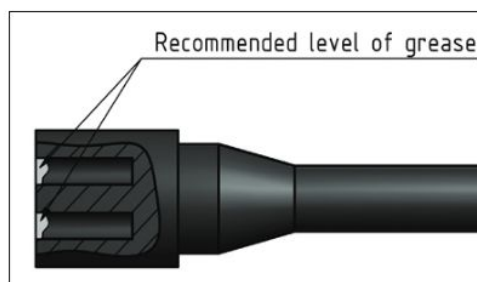
#### LUBRICATION CONNECTOR:

Follow these instructions carefully to properly use your connectors SubConn®

- The hydrophones connectors must be greased before each mating.
- Disconnect the hydrophone pulling the plug without any twisting using the solid surfaces not the cable.
- Do not pull on the cable and avoid the pronounced corners near the connector / penetrator.
- The SubConn® connectors should not be exposed to long periods of heat or direct sunlight. If a connector becomes very dry, it should be soaked in fresh water before use



#### RECOMMENDED LUBRICATION PRODUCTS:

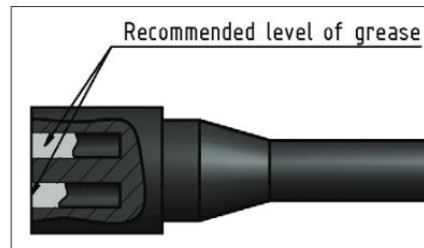


#### DRY COUPLING:

- The connectors must be greased with Molykote 44 Medium, or supplied lubricant (silicone grease) before each assembly
- A grease layer corresponding to at least 1/10 of the depth of the socket to be applied to the female connector.
- The inner edge of all holes must be completely covered and a thin transparent layer of grease must be visible on the face of the connector. After greasing completely, fit the male and female connectors to ensure optimum distribution of the grease on all pins and sockets.



WET CONNECTION (UNDERWATER)



- The connectors must be lubricated with Molykote 44 Medium, or supplied lubricant (silicone grease) before each assembly.
- A layer of grease corresponding to about 1/3 of the depth of the socket to be applied to the female connector.
- All holes must be filled out completely and a transparent layer of grease must be visible on the face of the connector.
- After greasing, completely fit the male and female connectors and remove any excess grease from the connector seal.

PRODUCTS RECOMMENDED CLEANING:

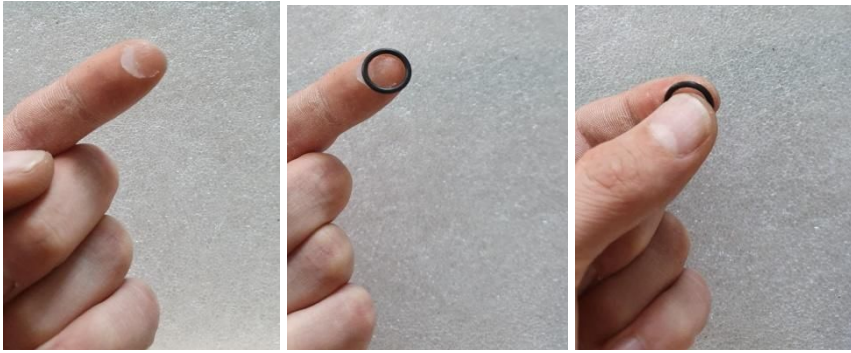


**Grease cap and penetrators**

When using the HIGHBLUE system, it is necessary to regularly check the condition of lubricating seals the tube and those penetrators if they were dismantled.

FOR A PENETRATOR:

Before greasing a joint, make sure you have clean fingers, free from dust, fiber, ... If the seal already contains a little grease, clean it using Isopropyl alcohol and a woven cloth. Do the same for the parts in contact with the seal. Then apply a grease silicone dollop on your index finger and spread grease on the joint by rotating your thumb.



Then place the seal on the indenter and reinsert the has its location on the tape of the tube. Then tighten the nut with the key provided.



FOR A SWITCH PLUG:

Remove any excess grease with a woven cloth, and some Isopropyl alcohol. Let dry a few seconds. Then apply a silicone grease dab on your finger, then spread it around the cap (at both small joints).



**CHECK-LIST**

- Check the uSD is correctly set.
- Check the batteries are fully charged and properly placed.
- Check the foam guard around the hydrophone is correctly installed.
- Check the screws are tight.
- Check that both ends of the tubes are closed, without wire, hair etc caught in the joints.

- Check that the switch cap is in place, tighten it to the test run of the system, enabling operation, the batteries and the uSD card has been verified. Unscrew interrupteur a bit just to get off the system.

## UPDATING THE SYSTEM

The firmware can evolve, and can be downloaded via the back of the card. Aa connector is provided for this purpose with a simple USB cable.



## Downloading and installing the software

To update the embedded firmware, simply download the specific tool: MPLAB X IDE. It is available at the following address: <https://www.microchip.com/mplab/mplab-x-ide>

It contains two components: the IDE, and PEI. In our case, only the IPE is required. It is therefore not necessary to install the IDE (large).

An installation tutorial is available at: <https://microchipdeveloper.com/ipe:installation>

## DOWNLOAD THE EMBEDDED FIRMWARE

To download the firmware embedded in the BlueEar map, simply connect via the micro-USB cable supplied the card to the PC. Once done, open MPLAB PEI, and select the next target:

PIC32MZ2064DAA288 (or PIC32MZ2064DAB288 following version of this component on the board), and follow the step described at the following address: <https://microchipdeveloper.com/ipe:importing-hex-file>

When importing, next select the hex file provided by SMIoT corresponding to the correction. Then follow the following procedure: <https://microchipdeveloper.com/ipe:programming-device>

## FAQ

## GUARANTEE

SMIoT is not responsible for leakage or immersion inside the tube. If damaged, spare O-rings are provided, or available on request to SMIoT within 15 days if necessary. It is impossible that leakage can occur unless above instructions are not followed.

## REMARKS / MISCELLANEOUS

### INFORMATION ON THE STATUS OF LEDs:

***We advise you to check the status of the LEDs to detect any false manipulation***

the LED **GREEN** indicates that the system has recognized the SD card, and is ready at start acquisitions.

the LED **ORANGE** indicates that the system is being recorded.

Finally, the LED **RED** indicates a potential problem: permanently lit: critical error (fatal error).

### NOTES:

The storage medium is **mandatory** in the case of stand-alone operation. If a system error in this case, restart the system.

## CONTACT US

- Website of the technology platform at: <http://smiot.univ-tln.fr/> with updates of the documentation and french version.

Website of the University of Toulon <http://www.univ-tln.fr/>

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