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The Modular Sensing® Pressure Logger can be used to monitor water levels or absolute pressure changes in a wide range of applications, including rivers, lakes, dams, fishways, tidal areas, and groundwater. The logger is easily configurable without needing external applications by standard USB connection. This logger features a high precision ceramic pressure sensor in a stainless steel housing and factory-calibrated temperature sensor, both embedded in a durable IP68 polycarbonate housing. The programmable recording time provides an ideal solution for long time recording of water level, pressure and temperature in monitoring campaigns, research studies, etc.

Modular Sensing® products are based in open source hardware and software. This allows 1) to provide a high quality product at a lower price than other alternatives and, for advance users, 2) the possibility of loading custom software.

## Specifications

### Absolute pressure and water level measurements

<b>Sensor Type*</b>	JC-CZ02
<b>Range</b>	0 to 160 kPa (Max 6 m water depth) Operation Temperature: -40°C to 125 °C Compensated Temperature: -10°C to 70 °C
<b>Water level accuracy**</b>	Typical error: ±0.1% FS (1.6 cm for 160 kPa) Maximum error: ±0.2% FS (3.2 cm for 160 kPa)
<b>Pressure accuracy***</b>	Typical error: ±0.1% FS Maximum error: ±0.2% FS
<b>Resolution</b>	Minimum: 0.008% FS
<b>Pressure respond time</b>	< 0.5 seconds
<b>Over Pressure</b>	2X (Max range)

\*Default configuration, compatible with different sensors and ranges (e.g. 0-160 kPa, 0-400 kPa, 0-600 kPa, etc.).

\*\*Known water density, with barometric compensation and stable temperature.

\*\*\*Combined linearity, hysteresis and repeatability.

### Temperature measurements

<b>Sensor Type*</b>	Si7051
<b>Range</b>	Operation Temperature: -40°C to 125 °C
<b>Resolution/Temperature accuracy**</b>	0.1 °C
<b>Temperature respond time***</b>	0.7 seconds
<b>Long Term stability</b>	<0.01 °C/Yr

\*Default configuration, compatible with different sensors and ranges (e.g. SI7006).

\*\*±0.1 °C: 35.8 °C to 41 °C; ±0.13 °C: 20.0 °C to 70.0 °C; ±0.25 °C: -40 °C to +125 °C.

\*\*\* Disassembled device. The respond time will depend on the system thermal mass and airflow.

## Logger

<b>Real-time clock</b>	DS3231 Accuracy $\pm 2$ ppm from 0°C to +40°C Accuracy $\pm 3.5$ ppm from -40°C to +85°C
<b>Battery</b>	Battery type: 18650, rechargeable 3.7 Volt lithium, user-replaceable
<b>Battery Life*</b>	More than 1 years with 5 minute or greater logging interval under a temperature of 20°C
<b>Memory (SD-card)</b>	8 – 246 GB, standard SD card
<b>Weight</b>	Approximately 190 g in air (volume = 170.9 cm <sup>3</sup> ) 20 g in fresh water
<b>Dimensions</b>	4 cm diameter; 13.6 cm length;
<b>Housing materials</b>	Polycarbonate tubing; POM caps; Stainless steel bolts and sensor; Viton and Buna-N O-rings;
<b>Logging interval**</b>	Event/Continues mode with pressure and temperature: 20 Hz (Battery duration > 5 days) Sleep mode, logging interval: recommended > 30 s
<b>Battery indication</b>	Battery voltage is logged in the datafile
<b>Environment Rating</b>	IP68

\*Tested duration. Higher durations are expected.

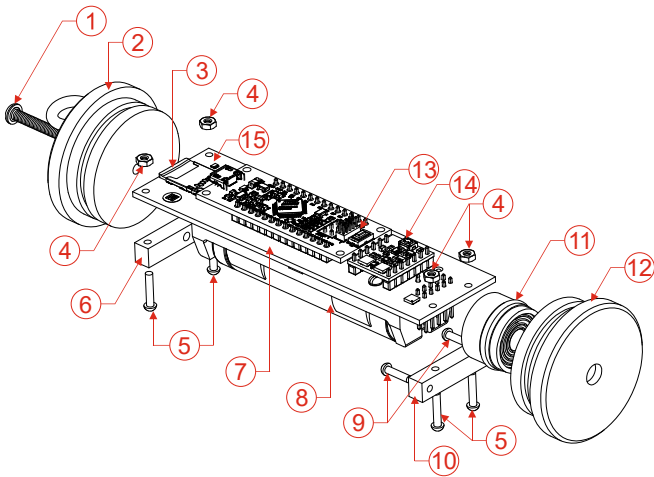
\*\*Default program, advance users can generate their own configurations by modifying the code. Arduino Zero compatible.

## Logger Operation

No additional software is required to operate the logger. The measured data and the configuration parameters are both accessible via SD card.

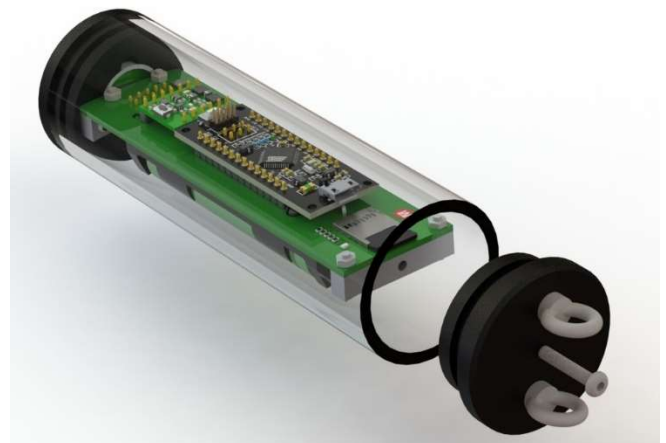
In addition, it is possible to connect via serial with the logger for real time data streaming or as an alternative configuration method.

## Assembly and disassembly

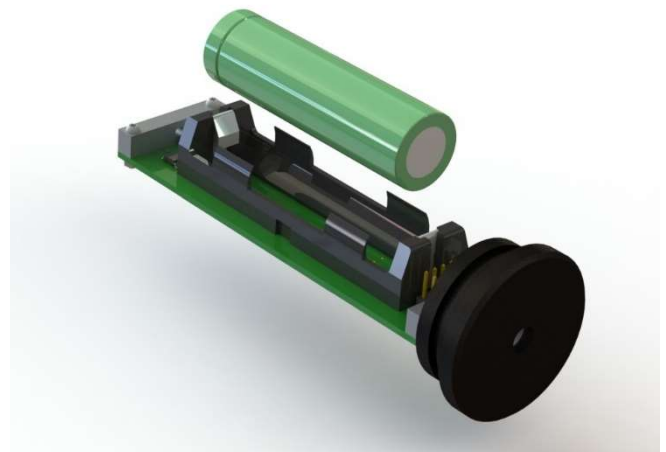


1) Sealed bolt; 2) Back cover; 3) SD card; 4) M2 nut; 5) M2\*10 mm bolts; 6) Back holder; 7) PCB; 8) Battery; 9) M2\*8 mm bolts; 10) Front holder; 11) Pressure sensor; 12) Front cover; 13) Reset button in the microcontroller; 14) Restart button in the power controller. 15) Status Led.

**SD card access:** Remove the sealed bolt (1) and the back cover (2). This will provide direct access to the SD card. SD card will give access to the data and logger configuration files.



**Access to USB and battery removal:** Remove the sealed bolt (1), the back cover (2) and finally the tube. This will provide direct access to the battery and the USB port.



## Configuration

The pressure logger can be configured by modifying the configuration files in the SD card, by entering to the sensor menu using a Serial Terminal program (during the examples [CoolTerm](#) free software will be used) or by MS pressure logger software (recommended).

Download link of MS Pressure Logger software (W10):

[www.gea-ecohidraulica.org/MS/MSPL\\_en.zip](http://www.gea-ecohidraulica.org/MS/MSPL_en.zip)

### Configuration and data recovery using SD card:

Extract the SD card and access to it. SD card contains all the data logged by the sensor as well as configuration files:

1. *dataFiles*: [SENSORNAME]F[FILENUMBER].txt. Collection of files with the different data recorded.
2. *eventFiles*: [SENSORNAME]EV[FILENUMBER].txt. Collection of files with the data recorded during an event. Only if event mode is activated.
3. *Config.txt*: File containing the configuration parameters.
4. *Time.txt*: File used to update time in the sensor.
5. *fileMemo*: Sensor file that tracks the latest file generated.

For data extraction, copy and paste the desired data file in to your computer. To start a new file next time, open *fileMemo* and increase the number by one or delete it. If *fileMemo* is not modified, data will continue recording in the last *dataFile* generated, without deleting previous data. Extract the SD card safely. Insert the SD card into the sensor, after push reset and restart buttons.

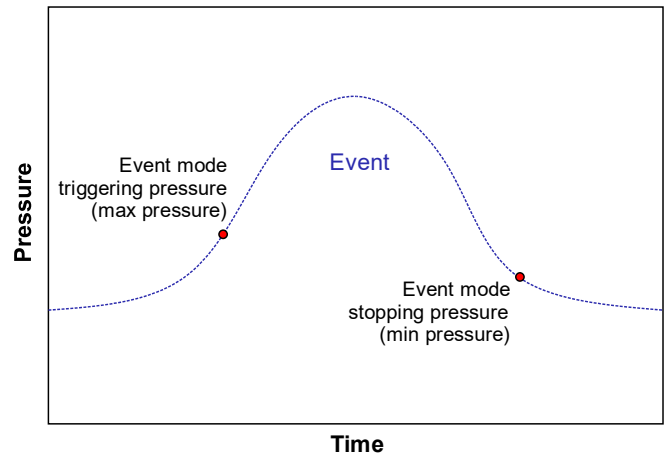
For configuration, open *Config.txt*, explore the configuration options and change the options, with the precautions of maintaining the file structure and format. After modifying, push reset and restart buttons.

- *Sampling rate*: number of seconds between measurements. > 30 s recommended. Battery duration is proportional to sampling interval.
- *Logger activated*: No ("N") or Yes ("Y"). It determines if the sensor is activated for logging. Option that allows to safe battery when the device is stored. DEFAULT: "Y".
- *Event activated*: No ("N") or Yes ("Y"). It determines if event mode detection is activated. This mode allows to record in a higher sampling rate (*Sampling rate event*) a target event, defined by even activation rate (*Event activate>Event deactivate*). DEFAULT: "N".
- *Temperature sensor*: No ("N") or Yes ("Y"). It determines if temperature sensor is activated during event mode. It allows to reach higher sampling rates. DEFAULT: "Y".

Extra configuration parameters after software v1.3:

- *Delay start*: No ("N") or Yes ("Y"). It allows to establish a logging starting date/time in the future. The device will remain sleep until this point in time is reached. After it will log in the specified normal sampling rate. *Delay alarm*, defines the starting point in the future. DEFAULT: "N".
- *Offset*: A value in pascals that is subtracted from the pressure reading. DEFAULT: "0".

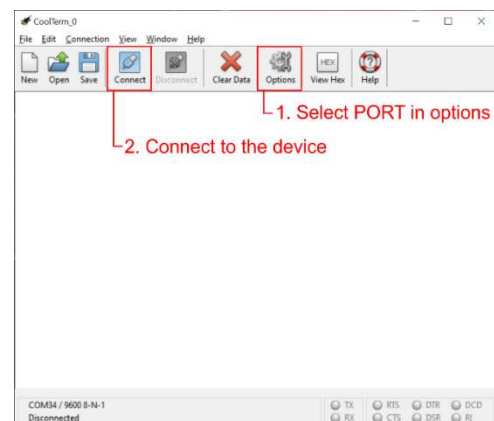
- *Battery*: A value that indicates the latest recorded battery status.



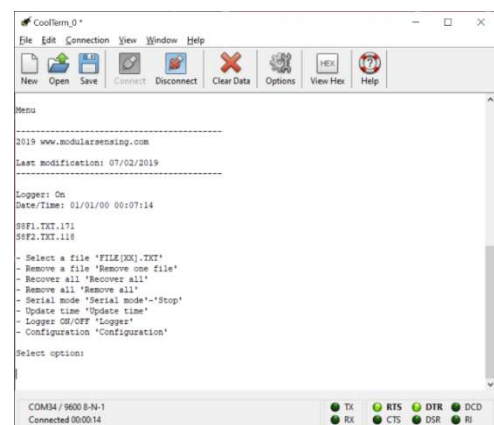
Usage of Event mode option. When this option is activated (Event activated: "Y") the sensor is able to detect special pressure events and record them in a higher sampling rate.

### Configuration and data recovery using a terminal program:

Connect the device to the PC and wait until it recognizes (in W10 no additional drivers are required). Open Coolterm, find the Com Port of the sensor and connect. With a successful connection, a menu with different options will appear.



Main screen in CoolTerm. First select port in "Options" (no additional configuration is required) after connect to the device in "Connect".



Menu of the device with different configuration options.

Enter to different options sending commands via serial port.



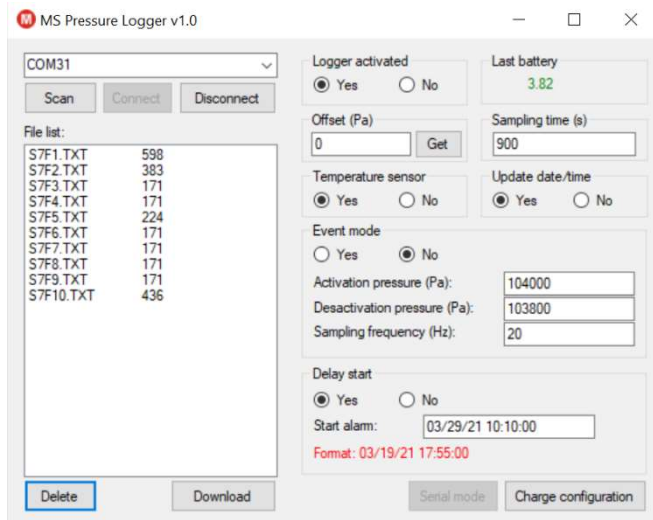
Enter to “Send string” option to send commands to the device. Connection → Send string. Type the command with new line or space after it and push send.

Available command to communicate with the sensor are:

- 'FILE[XX].TXT'. To receive data from a file via serial connection
- 'Remove one file'. To delete a file from the SD card.
- 'Recover all'. To receive data from all files via serial connection.
- 'Remove all'. It allows to delete all files from the SD card.
- 'Serial mode'. It allows real time visualization of the data gathered by the sensor. 'Stop' command must be sent after to stop the data streaming.
- 'Update time'. To update the time of the sensor.
- 'Logger': To switch off/on the sensor.
- 'Configuration'. To change the configuration parameters of the sensor.

Configuration and data recovery using a MSPL software:

Since last software update v2.2, the MS pressure logger is able to use our custom data recovery and configuration software. The software is a simple user interface that allows an easier serial communication with the logger, allowing the data download, remove and configuration.



MS Pressure logger software.

To use the MSPL software, connect the device to the PC and wait until the PC recognizes it. Push Scan button, this will list all the COM ports available in the PC. Select the COM port of the device and push Connect button. After a successful connection, the device RGB led will change to blue color and it will be ready for downloading, elimination of files or charge new configuration parameters. Finally, push disconnect button to unplug the device.

Receiving data from serial can be slow. Data recovery by means of SD card is the fastest alternative. For data file elimination, updating date/time and general configuration, MSPL software is recommended.

## Data structure

Data in files are ordered in columns separated by tabulations:

Column	Variable	Units
1	Date	-
2	Time	-
3	Pressure	Pascal
4	Temperature (pressure sensor)	°C
5	Status pressure sensor	-
6	Temperature (specific sensor)	°C
7	Humidity (only if available)	%
8	Battery level	V

## Water level conversion

1 pascal = 0.10197 mmH<sub>2</sub>O (4 °C).

## Status Led

RED. Error accessing the SD card or reading a sensor. If the SD card is removed while sensor is in logger mode, the led will start blinking with a red color during next log. This led will stop blinking after the SD card is inserted.

BLUE. Successful Com Port connection.

For more details in logger operation, watch the operation video. (under construction)

## Calibration

All sensors used in the *MS Pressure Logger* are digital and thus, they are factory calibrated. Nevertheless, each of the developed sensor is subjected to an individual test. For this different pressure and temperature data are collected over the calibrated range of the logger.

## Barometric Compensation

Ideally, all pressure loggers and submerged water level loggers in the market require an atmospheric pressure compensation. This is achieved by adding a compensation value according to another pressure logger in the air or a compensation obtained from a near weather station.

Formula:

$$([Measured\ Absolute\ pressure\ in\ pascals] - [Measured\ Absolute\ Atmospheric\ Pressure\ in\ pascals]) * 0.10197 = [Water\ level\ in\ mm]$$

## Maintenance

MS Pressure Loggers have tested O-Rings (in the sealed bolt and covers) that have been properly installed. To maintain a functional



O-Ring seal it is necessary to have in mind some considerations when opening and closing the device.

- Be sure that, when closing the device, the O-Rings are clean and lubricated (silicon grease). Avoiding abrasion.
- Before closing the device, inspect O-Ring for signs of failure.
- Don't poke, jab, pry at the O-Ring with sharp or pointed objects.
- Don't expose the O-Rings to harsh chemicals.
- Don't expose the seals to higher pressure or temperature than rate.

Silicone grease used in factory: Xavax Hama OKS 1110 (available in amazon)

### Battery

The device is equipped with rechargeable Li-ion protected battery type KP-18650-3200A. The typical voltage values range from 4.2 V when fully charged until 3.2 V.

In principle, any 18650 Li-ion battery can be used in the device, however consult team members for assessment.

Specific chargers for 18650 batteries are sold in multiple online stores (e.g. amazon). For practical purpose charger with multiple charging slots (>2) are recommended. KP-18650-3200A protected batteries can be bought in TME ([www.tme.eu](http://www.tme.eu)).

#### Contact Details

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Versión manual 1.2

Versión MSPL Hardware 1.2

Versión MSPL Software 2.2

Versión MSPL App 1.0