Open Acoustic Devices

HydroMoth 1.0.1 Datasheet

theteam@openacousticdevices.info

30th October 2023

This datasheet describes the HydroMoth hardware, the base unit for the underwater version of the acoustic monitoring device AudioMoth®.

PLEASE NOTE: HydroMoth requires the AudioMoth Underwater Case for use underwater.

Contents

1 HydroMoth overview

HydroMoth is a low-cost, full-spectrum acoustic monitoring device, based on the Gecko processor range from Silicon Labs. It becomes an underwater recorder when enclosed inside the AudioMoth Underwater Case.

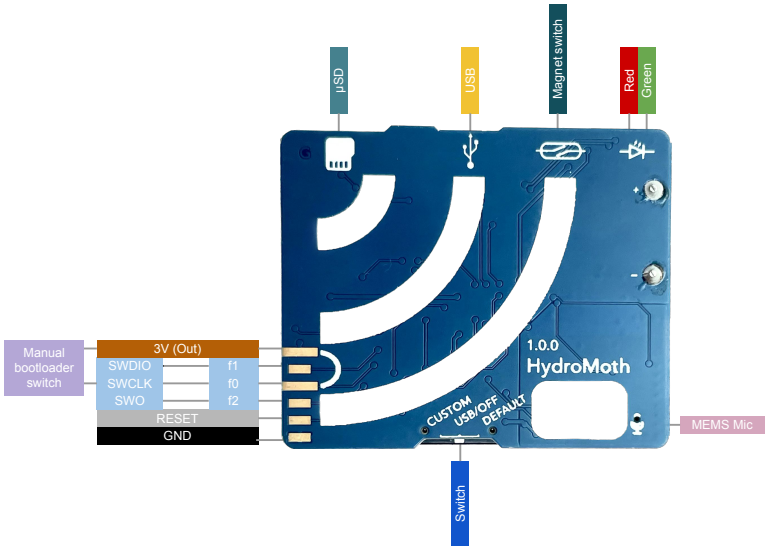

Figure 1: *Front of the HydroMoth 1.0.1§*

HydroMoth has following features:

- Silicon Labs Wonder Gecko microcontroller
  - 48MHz 32-bit processor
  - DSP instruction support and floating-point unit
  - 256kB Flash
  - 32kB RAM plus an extra 256kB of external SRAM
  - For full details of the Wonder Gecko microcontroller please see the Wonder Gecko reference manual.
- On-board analog MEMS microphone, Sensitivity -38 dBV/Pa, 63 dBA SNR, 10Hz to 192kHz
- Sample rates up to 384kHz
- Micro-USB B port for power, configuration and for reprogramming the Flash
- 6-pin serial wire debug port
- MicroSD card connector compatible with up to 1TB capacity
- Daily clock drfit of ±0.26 seconds
- Magnetic reed switch to allow recordings to be started and stopped from outside enclosures

HydroMoth is powered by an ultra low power (ULP) Silicon Labs EFM32WG380F256 ARM Cortex-M4F 32-bit micro-controller, chosen for its large number of in-built features and ULP consumption (211 µA/MHz in run mode and 20 nA/MHz in shutoff mode). The overall hardware utilises features such as cascaded operational amplifiers for microphone pre-amplification, 12-bit ADC with 16-bit oversampling, DMA for data routing in low energy modes, SPI for high-speed MicroSD card communications and USB for device configuration. DMA routing uses the additional feature of the external bus interface (EBI) to synchronise with an external IS61LV25616AL4 4-Mbit static random access memory (SRAM) IC to improve on the internal 32-kB RAM for audio buffering.

It can be configured to record at many sample rates, making it suitable for monitoring sounds from different source types. These include: anthropogenic noise, such as boat engine noise (8 kHz sample rate); audible wildlife, such as fish or crustacean vocalisations (48 kHz sample rate); and ultrasonic wildlife, such as cetaceans (384 kHz sample rate). The device can be used in multiple deployment scenarios, such as scheduled or triggered acoustic monitoring, large-scale acoustic monitoring projects, long-term acoustic monitoring projects, environmental monitoring for education, and large scale citizen science projects.

For debug and trace, six pads are exposed and configured to standard J-Link serial wire output (SWO). Serial debug and trace use the standard Silicon Labs tool, Simplicity Studio.

Configuring and reprogramming HydroMoth can be done using USB and the AudioMoth Configuration App and AudioMoth Flash App desktop apps, respectively. Once configured settings are persistent. However, time is lost whenever the device loses power. To redeploy the device after power loss, the time can be set using the smartphone AudioMoth Chime App and the desktop AudioMoth Time App.

HydroMoth requires the AudioMoth Underwater Case to be deployed underwater. Recordings can be stopped and started from outside of the case using a magnet.

2 Maximum Ratings

Maximum operating conditions for the HydroMoth are:

- Operating Temp Max 85°C
- Operating Temp Min -40°C
- 3.6V minimum input voltage
- 6V maximum input voltage
- 3V maximum output voltage
- Maximum 100mA output current

3 Electrical Specification

TEST CONDITIONS: temperature 23±2°C, running AudioMoth Firmware Basic version 1.8.2.

Parameter	Notes	Min	Typ	Max	Units
Supply voltage		3.3	4.1	6	V
Supply current	Energy Mode 0, no SD card operation	19	21	23	mA
	Energy Mode 1, no SD card operation	8	10	12	mA
	Average current during SD card write	20	33	60	mA
	Sleep current, no external mic	-	65	-	μA
Internal microphone	Knowles SPU0410LR5H-QB				
Sensitivity	94 dB SPL @ 1 kHz	-41	-38	-35	dBV/Pa
Signal to Noise Ratio	94 dB SPL @ 1 kHz, A-weighted	-	63	-	dB(A)
Pre-amplification					
Standard gain range	AudioMoth Configuration App low, mid and high gain	4.33	15.00	30.00	A_V
Low gain range	AudioMoth Configuration App low, mid and high gain with low gain range selected	0.33	1.00	2.00	A_V
Storage					
MicroSD card	Formatted to exFAT	-	32	1000	GB
Clock					
Daily time drift	±3ppm	-	±0.26	-	s

4 Applications Information

HydroMoth can only be used underwater when deployed inside the AudioMoth Underwater Case. For a detailed guide see the 'Using HydroMoth to Make Underwater Recordings' application note.

5 Hardware version changes

Version 1.0.1 (Current)

- Improved reed switch circuitry

Version 1.0.0

- Initial version