

# AudioMoth<sup>®</sup> 1.2.0 Datasheet

theteam@openacousticdevices.info

30th October 2023

---

This datasheet describes the standard AudioMoth<sup>®</sup> hardware and Open Acoustic Devices' original product. This document is intended for skilled users with suitable levels of design knowledge to integrate AudioMoth into other boards or products.

## Contents

1	AudioMoth overview	2
2	Maximum Ratings	3
3	Electrical Specification	4
4	Applications Information	5
4.1	External microphone Compatibility . . . . .	5
4.2	Connecting an external board . . . . .	5
5	Hardware version changes	5

# 1 AudioMoth overview

AudioMoth is a low-cost, full-spectrum acoustic logger, based on the Gecko processor range from Silicon Labs.

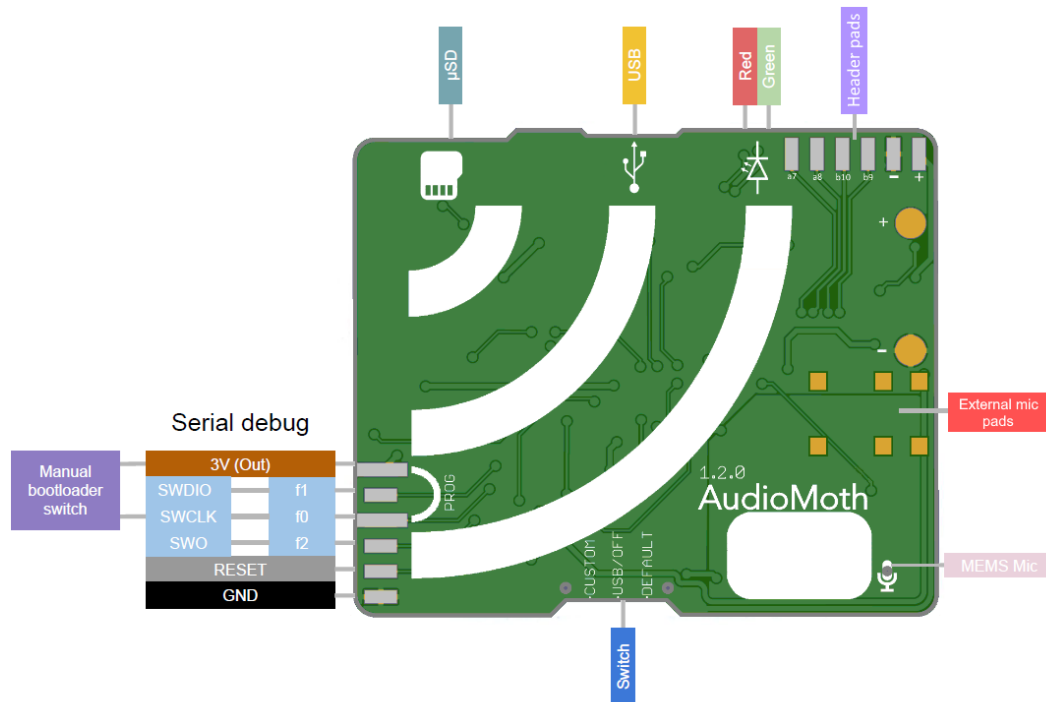


Figure 1: Front of the AudioMoth

AudioMoth has the 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 ([SPU0410LR5H-QB](#)), Sensitivity -38 dBV/Pa, 63 dBA SNR, 10Hz to 192kHz
- Sample rates up to 384kHz
- Footprint for 3.5 mm jack socket for external electret condenser microphones
- Micro-USB B port for power, configuration and for reprogramming
- 6-pin serial wire debug port
- MicroSD card connector compatible with up to 1TB capacity
- Daily clock drift of  $\pm 0.89$  seconds

AudioMoth 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  $\mu$ A/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.

AudioMoth 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 gunshots, chainsaws or engine noise (8 kHz sample rate); audible wildlife, such as bird, insect or frog vocalisation (48 kHz sample rate); and ultrasonic wildlife, such as bat or amphibian calls (384 kHz sample rate). The device can be used in multiple deployment scenarios, such as scheduled or triggered acoustic monitoring in remote areas, handheld acoustic monitoring, live streaming as a USB microphone, 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 AudioMoth 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](#).

## 2 Maximum Ratings

Maximum operating conditions for the AudioMoth 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  $23 \pm 2^\circ\text{C}$ , 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	-	$\mu\text{A}$
<b>Internal microphone</b>	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)
<b>External mic socket</b>	Electret condenser mics only				
Supply voltage	2.7k $\Omega$ bias resistance	-	3	-	V
<b>Pre-amplification</b>					
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	$A_V$
<b>Storage</b>					
MicroSD card	Formatted to exFAT	-	32	1000	GB
<b>Power to external boards</b>					
Supply voltage		-	3	-	V
Supply Current	Current available to external boards when AudioMoth is writing to SD card, in Energy Mode 0 and when asleep	-	50	-	mA
<b>Clock</b>					
Daily time drift	$\pm 20\text{ppm}$	-	$\pm 0.89$	-	s

## 4 Applications Information

### 4.1 External microphone Compatibility

AudioMoth is compatible with plug-in power electret condenser mics. For a detailed guide see the [‘Using AudioMoth with External Electret Condenser Microphones’](#) application note.

### 4.2 Connecting an external board

External boards can be powered by the 6-pin header pads on the top right edge of the AudioMoth board. AudioMoth supplies a regulated 3V supply with a maximum of 100mA current. Approximately 40mA of this current should be reserved for use by AudioMoth, leaving 60mA available to the external board.

As well as power, the header pads can be used to communicate with other boards. The pads expose four GPIO pins that directly connect to the microcontroller. These pins can be controlled in any number of ways using custom AudioMoth firmware. The pins available are labeled b9 (GPIO and UART TX), b10 (GPIO and UART RX), a8 (GPIO and Timer compare capture pin) and a7 (GPIO).

## 5 Hardware version changes

### Version 1.2.0 (Current)

- Updated audio front-end with the following changes:
  - Replaced internal microphone SPM0408LE5H-T with SPU0410LR5H-QB
  - Added 3.5mm jack socket footprint
  - Reduced digital noise

### Version 1.1.0

- Improved user-interface layout with the following changes:
  - Rounded corners
  - Indented switch, SD and USB position
  - Covered vias

### Version 1.0.0

- Initial version