AIS240A MEMS Microphone with Feature Extraction

General description

The AIS240A “SpectroMic” is a smart analog MEMS microphone with included microphone interface and feature extraction. It is a multi-chip module that integrates the two ICs AIS210A “Sparrow” and AIS2001 “Monarch”.

The AIS210A “Sparrow” is a MEMS microphone with analog signal output, acoustic activity detection and adjustable signal gain. An interrupt line can notify or wake up a host controller whenever the acoustic activity exceeds a selectable threshold.

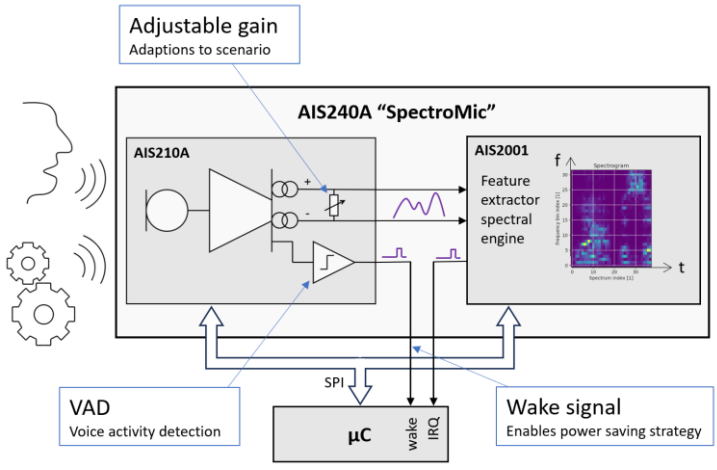
The AIS2001 “Monarch” is a smart analog MEMS microphone interface with included feature extraction.

The proprietary charge domain feature extraction engine eliminates the need for data conversion and complex power-hungry DSP while generating the appropriate form of spectrogram for neural network word and sound classification input. This results in superior ultra-low power performance with no compromise in accuracy.

The analog front-end amplifier interfaces directly to single-ended analog MEMS microphones with minimum additional components. This allows for a significant power benefit compared to digital microphones.

The AIS2001 development environment supports standard flows such as TensorFlow lite. The trained and quantized parameters can be stored directly in the on-chip SRAM. This provides ultimate flexibility for ultra-low power standalone applications.

Block Diagram



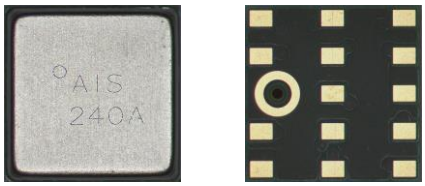
Features

- Acoustic activity detection with adjustable threshold level and frequency characteristic
- Single package with acoustic port on bottom
- Wide gain adjustment range with internal programmable resistors, and/or external resistors
- Ultra-low current consumption:
  - 19 µA always-on
  - <300 µA during spectral processing
- Single 1.8V supply supports common analog MEMS microphone ranges.
- Supports 32 configurable frequency bins in Feature Extraction image.
- 32 KB SRAM for coefficient storage
- SPI interface (load coefficients, transmit features to Microcontroller)
- 2 Interrupts to wake microcontroller: VAD and spectral data ready
- Small footprint in a 32 pin 5x5 QFN package (5.4 mm x 5.4 mm).

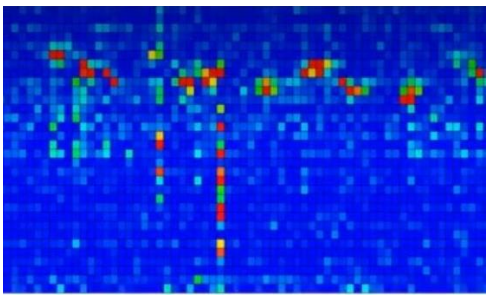
Applications

- Wake-word recognition
- Acoustic Anomaly / Event Detection
- Event Based classifier templates

Package Illustration



Example PSD Output



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1 Overview

1.1 Purpose

This document describes the multi-chip module AIS240A “SpectroMic”, which is a smart analog MEMS microphone with included microphone interface and feature extraction. It integrates the two ICs AIS210A “Sparrow” and AIS2001 “Monarch”.

1.2 System Concept

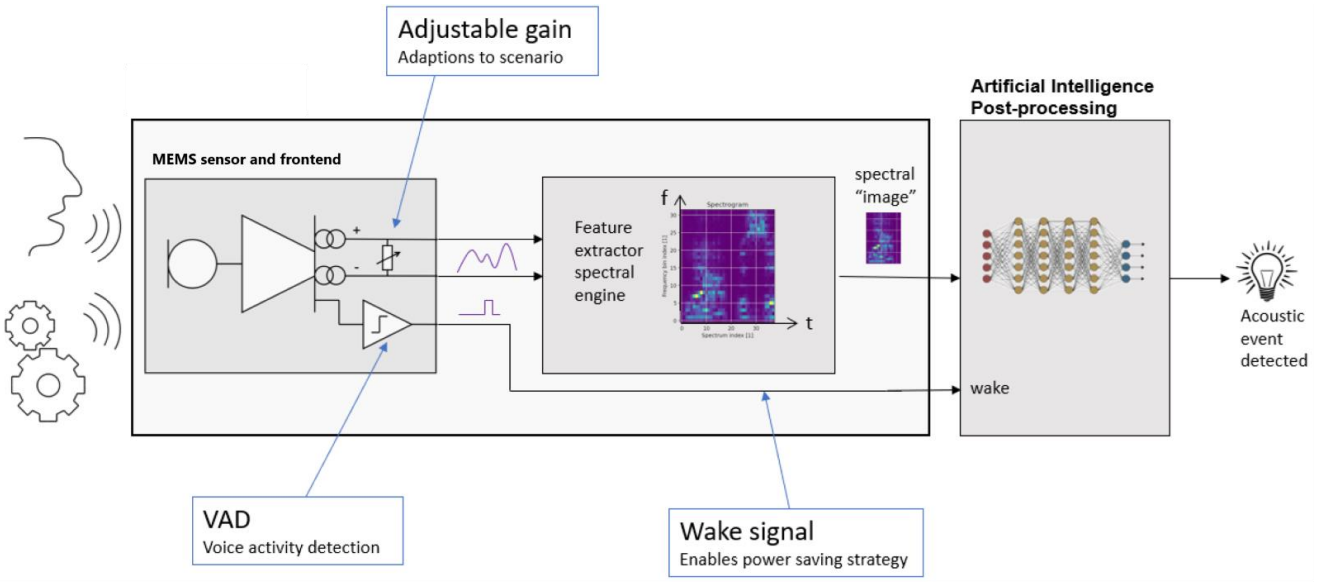

Figure 1: System concept with Spectromic

2 Absolute Maximum Ratings

Please check the individual data sheet for more details.

3 Characteristics

Please check the individual data sheet for more details.

4 Digital Functions

For more information on the SPI Interface and Register Map of AIS210A and AIS2001, please check the individual data sheet for more details.

5 Package Information

5.1 Package Illustration

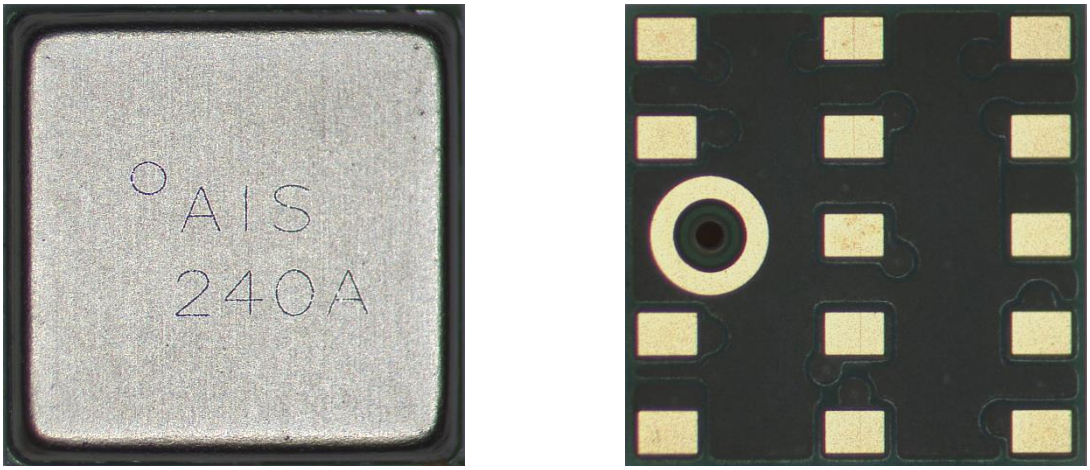

Figure 2: AIS240A package top (left) and bottom (right) view

5.2 Package Outline

Each of the 14 rectangular pads is 0.70 mm long and 0.50 mm wide. The microphone opening hole has a diameter 0f 0.35 mm the surrounding GND pad has an inner diameter of 0.85 mm and an outer diameter of 1.4 mm.

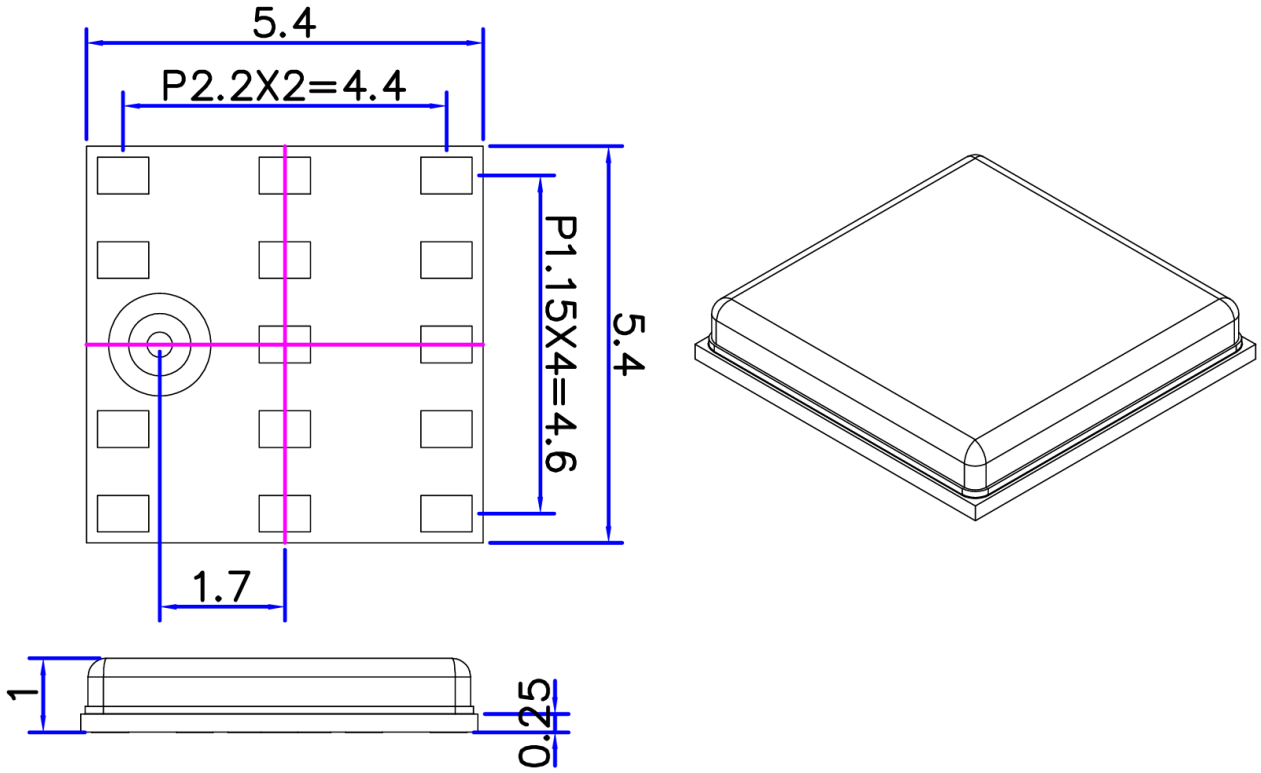

Figure 3: AIS240A package dimensions in mm

5.3 Pad List

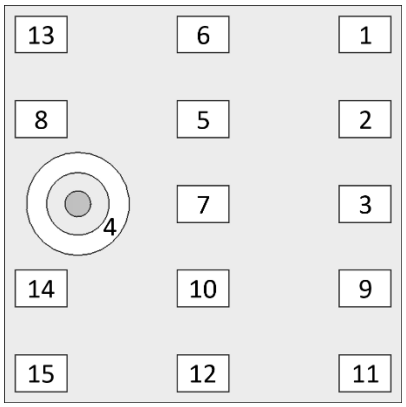

Figure 4: Package (top view)

Table 1: Pad List

Pin No.	Pins	Function
1	VDD	1.8V Supply
2	AVDD	1.2V Regulator for Analog
3	DVDD	1.2V Regulator for Digital
4	GND	Ground
5	AP	Audio positive channel
6	AN	Audio negative channel
7	APF	Audio positive filtered channel
8	NCS_SP	SPI: Low active Chip select for Sparrow
9	NCS_MO	SPI: Low active Chip select not for Monarch
10	SI	SPI: Slave In
11	SO	SPI: Slave Out
12	SCLK	SPI: Clock
13	IRQ	Sparrow IRQ output
14	GPIO0	Monarch IRQ output
15	GPIO5	Monarch External Clock input

6 Typical Application Circuit

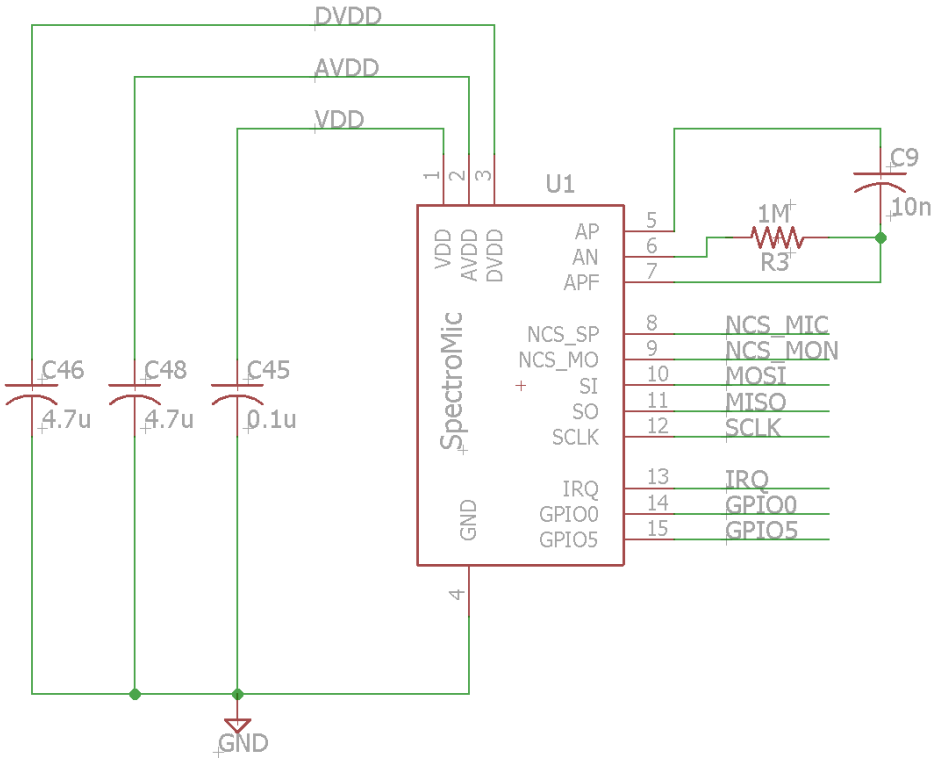

Figure 5: SpectroMic application circuit

Also see the block diagram on title page and for more details check the individual data sheet.

7 List of Abbreviations

Table 2: List of Abbreviations

Name	Description
GND	Ground
GPIO	General Purpose Input-Output
MEMS	Micro-Electromechanical Systems
PSD	Power Spectral Density
SPI	Serial Peripheral Interface
VAD	Voice Activity Detection

8 Revision History

Table 3: Revision History

Revision	Date	Description	Author
1.0	2025-05-27	Document release	Maximilian Heindel, Erik Sibrai

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