

Application Note

SpectroMic PCB Ver.:1.0

(AIS240A-EVB01)

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Subject to change without notice.

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Table of Contents

1		Ger	neral Description	3
2		Fea	itures	3
3		Get	ting Started	4
4		Har	dware	4
	4.	1	Board with Dimensions	4
	4.	2	AIS240A "SpectroMic" Package	4
	4.	3	SpectroMic Pin List	5
	4.4	4	Block Diagram	6
	4.	5	Application Circuit	6
5		Sof	tware	7
	5.	1	Installation	7
	5.	2	Features	7
	5.	3	Main Control Panel at start-up	7
	5.4	4	Run Live-Spectrogram	8
	5.	5	Register Maps	9
	5.	6	Running an Al Model	9
6		List	t of Abbreviations	9
7		Rev	/ision History	9
8		List	t of Figures	10
9		List	t of Tables	10
1	0	Imp	oortant Notice and Disclaimer	11



1 General Description

AIS240A or "SpectroMic" is a multi-chip module (MCM) integrating the two following ICs: The AIS210A "Sparrow" MEMS microphone with programmable Gain and Voice Activity Detection and the AIS2001 "Monarch" Analog Microphone Interface with Feature Extraction. Further details about these two ICs can be found in the respective datasheet.

2 Features

- Acoustic activity detection with adjustable threshold level and frequency characteristic
- Wide gain adjustment range with internal programmable resistors, and/or external resistors
- SPI interface
- 2 Interrupts to wake microcontroller, one optional from VAD and one when spectral data ready
- Raspberry Pico 2 for configuration, running standalone applications or feature data transmission to host device
- USB powered
- Can run battery powered for standalone applications
- Two on-board multicolor LEDs for visualization



Figure 1: System concept with SpectroMic



3 Getting Started

In order to use SpectroMic Board, the following hardware and software is required:

- SpectroMic PCB Ver.: 1.0 (see Figure 2)
- USB 2.0 Micro-B cable to connect the Board to a host device
- PC running Windows 10/11
- AIStorm's SpectroMic GUI Software

4 Hardware

4.1 Board with Dimensions

The Board is shown in Figure 2. Its dimensions are 66 mm by 28 mm.





Figure 2: SpectroMic PCB Ver.:1.0 top and bottom view

4.2 AIS240A "SpectroMic" Package





Figure 3: AIS210A package top (left) and bottom (right) view





Figure 4: AIS210A package dimensions in mm

4.3 SpectroMic Pin 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



4.4 Block Diagram



Figure 5: Block diagram of SpectroMic PCB

4.5 Application Circuit



Figure 6: SpectroMic application circuit



5 Software

-Spectrogram	js Sparrow Regs																
0.4 2																	
-0.4 -0.4 Pause Resume	-0.3	-0.2	-0.1	6	0		0.1		0.2		0.3	}		0.4			255
-0.4 Pause Resume Patings	-0.3		-0.1	6	0		0.1		0.2		0.3	}		0.4			255
0.2 0.4 Pause Resume Settings □ Device: Al Enabled	-0.3 Al Device Model Detection	-0.2	-0.1 EQ Bin1	6 Bin2	Bin3	Bin4 Bir	0.1 5 Bin6	Bin7	0.2 Bin8	Bin9	0.3 Bin10	Bin11	Bin12	0.4 Bin13	Bin14	Bin15	255 Bin10
Occ O	-0.3 Al Device Model Detection Open	-0.2 n: Off	-0.1 EQ Bin1	6 Bin2	Bin3	Bin4 Bir	0.1	Bin7	0.2 Bin8	Bin9	0.3 Bin10	Bin11	Bin12	0.4 Bin13	Bin14	Bin15	255 Bin10
Settings Device: Al Enabled Device: VAD Enabled Device: Low Power Mode	-0.3 Al Device Model Detection Open Live Model Detection:	-0.2	-0.1 EQ Bin1	6 Bin2	Bin3	Bin4 Bir	0.1	Bin7	0.2 Bin8	Bin9	0.3 Bin10	Bin11	Bin12	Bin13 1,00	Bin14	Bin15	255 Bin 10
Settings Device: Al Enabled Device: Low Power Mode Device: XCLK Enable	-0.3 Al Device Model Detection Open Live Model Detection:	-0.2 n: Off No model Opened Off	-0.1 Bin1 1,00 Bin17	6 Bin2 1,00 Bin18	Bin3 1,00 Bin19	Bin4 Bir 1,00 1, Bin20 Bir	0.1 5 Bin6 10 1,00 21 Bin22	Bin7 1,00 Bin23	0.2 Bin8	Bin9 1,00 Bin25	0.3 Bin10	Bin11	Bin12	0.4 Bin13 1,00 Bin29	Bin14 1,00 Bin30	Bin15 1,00 Bin31	Bin10
Settings Device: Al Enabled Device: VAD Enabled Device: Low Power Mode Device: Low Power Mode Device: CKLK Enable	-0.3 Al Device Model Detection Open Live Model Detection:	n: Off No model Opened Off	-0.1 EQ Bin1 1,00 Bin17	6 Bin2 1,00 Bin18	Bin3 1,00 Bin19	Bin4 Bir 1,00 1,/ Bin20 Bir	0.1 5 Bin6 1,00 21 Bin22	Bin7 1,00 Bin23	0.2 Bin8 1,00 Bin24	Bin9 1,00 Bin25	0.3 Bin10 [1,00 Bin26	Bin11	Bin12 1,00 Bin28	0.4 Bin13 1,00 Bin29	Bin14 1,00 Bin30	Bin15 1,00 Bin31	Bin10

Figure 7: Main Control Panel at start-up

5.1 Installation

- The latest software and firmware can be downloaded on request as .exe file for easy access as well as python code.
- To flash new firmware (uf2-file) onto the on-board Raspberry Pico 2, please check the Raspberry homepage.

5.2 Features

- Monitor Live-Spectrogram (extracted features from Monarch)
- Load AI models to test on Live-Spectrogram data
- Access and control Monarch and Sparrow registers (The register maps of Monarch and Sparrow can be found in the respective Datasheet)
- Switch operating modes, e.g. Voice Activity Detection (VAD)
- Equalize the gains for all 32 frequency bins

5.3 Main Control Panel at start-up



Here is an explanation of the marked control elements from Figure 7:

- 1. Choose between accessing Main tab, the Direct- and Indirect Register Map controls of Monarch, and the Sparrow Register Map controls
- 2. Live-Spectrogram visualization (time on horizontal axis, 32 frequency bins on vertical axis)
- 3. Pause/Resume the Live-Spectrogram visualization
- 4. Check box for settings and operating modes
- 5. Al section for monitoring results and loading models
- 6. Equalize gains for all 32 frequency bins individually
- 7. Slider to adjust scaling of the Live-Spectrogram colormap

5.4 Run Live-Spectrogram

To run the Live-Spectrogram, under Settings in the main control panel enable the following settings:

- 1. Device: XCLK Enable
- 2. Device: Enable PSD IRQ

These two enabled check boxes and a Live-Spectrogram example are both shown in Figure 8:



Figure 8: Live-Spectrogram of the spoken word "down"



The Live-Spectrogram in Figure 8 displays 32 frequency bins on the vertical axis for each of the 100 intervals on the horizontal axis. Each time interval is 16ms long which results in an overall displayed time of 1.6 seconds. The maximum dynamic range for each Live-Spectrogram data point is from 0 to 65535.

5.5 Register Maps

Detailed information about the Register Maps of Monarch and the Register Map of Sparrow can be found in the respective Datasheet. Please see the most recent Raspberry firmware about the correct register settings. Whenever register values are to be changed, make sure to open the according Registers-tab in the GUI and before using the "Write"-command always first press "Read All" in Monarch Register tabs or "Read" in in the Sparrow Register tab to update the GUI from the device.

5.6 Running an Al Model

At start-up, the Chimera Light PCB GUI loads a default AI model to spot 10 Keywords from a dataset. It runs fully on the host device and its current live results are displayed in the "AI" section under "Live Model Detection: ". This is also shown in Figure 8, where the spoken word "down" is detected.

With the Open button in the same section a suitable external model (.onnx-file) can be opened, to load an external AI model. This will also fully run on the host device.

With enabling the "Device: AI Enabled" checkbox in the "Settings" section, an AI model can be run on the firmware of the Raspberry Pico 2 microcontroller independently of the above-mentioned AI models.

6 List of Abbreviations

Name	Description
AI	Artificial Intelligence
EQ	Equalizer
IC	Integrated Circuit
LED	Light-Emitting Diode
MCM	Multi-Chip Module
PSD	Power Spectral Density
VAD	Voice Activity Detection

Table 1: List of Abbreviations

7 Revision History

Table 2: Revision History

Revision	Date	Description	Author
0.1	2025-04-24	Initial revision	Maximilian Heindel
1.0	2025-04-29	Document release	Maximilian Heindel



8 List of Figures

Figure 2: SpectroMic PCB Ver.:1.0 top and bottom view4Figure 3: AIS210A package top (left) and bottom (right) view4Figure 4: AIS210A package dimensions in mm5Figure 5: Block diagram of SpectroMic PCB6Figure 6: SpectroMic application circuit6Figure 7: Main Control Panel at start-up7	Figure 1: SpectroMic concept	3
Figure 3: AIS210A package top (left) and bottom (right) view4Figure 4: AIS210A package dimensions in mm5Figure 5: Block diagram of SpectroMic PCB6Figure 6: SpectroMic application circuit6Figure 7: Main Control Panel at start-up7	Figure 2: SpectroMic PCB Ver.:1.0 top and bottom view	4
Figure 4: AIS210A package dimensions in mm5Figure 5: Block diagram of SpectroMic PCB6Figure 6: SpectroMic application circuit6Figure 7: Main Control Panel at start-up7	Figure 3: AIS210A package top (left) and bottom (right) view	4
Figure 5: Block diagram of SpectroMic PCB6Figure 6: SpectroMic application circuit6Figure 7: Main Control Panel at start-up7	Figure 4: AIS210A package dimensions in mm	5
Figure 6: SpectroMic application circuit6Figure 7: Main Control Panel at start-up7	Figure 5: Block diagram of SpectroMic PCB	6
Figure 7: Main Control Panel at start-up	Figure 6: SpectroMic application circuit	6
	Figure 7: Main Control Panel at start-up	7
Figure 8: Live-Spectrogram of the spoken word "down" 8	Figure 8: Live-Spectrogram of the spoken word "down"	8

9 List of Tables

Table 1: List of Abbreviations	9
Table 2: Revision History	9



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