Getting started with the industrial analog microphone array expansion for STWIN

Introduction

The STEVAL-STWINMA2 microphone array expansion adds advanced audio sensing capabilities to the STEVAL-STWINKT1B (and STEVAL-STWINKT1) SensorTile Wireless Industrial Node (STWIN) kit for high frequency vibration monitoring applications.

The board includes four low-power, high signal-to-noise ratio (SNR) IMP23ABSU capacitive sensing microphones, supported by a very low drop voltage, low quiescent current, and low-noise voltage regulator, ideal for battery-powered applications such as STWIN.

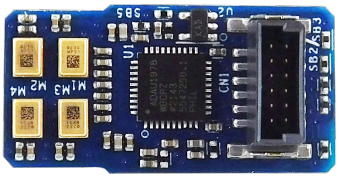
The expansion board is connected via a dedicated 12-pin connector to the core system board.

The combination of STWIN and STEVAL-STWINMA2 is supported thanks to the software examples provided within the X-CUBE-MEMSMIC1 expansion software package for STM32Cube.

The package includes one example of microphone data steaming via USB and one example of ultrasound condition monitoring (UltrasoundFFT) that calculates the FFT of the analog microphone signal and streams the result to a PC GUI via USB.

The microphone sampling rate is set by default to 192 kHz whereas the microphone bandwidth is up to 80 kHz.

Figure 1. STEVAL-STWINMA2 board



1 Features

- Analog microphone array expansion for STEVAL-STWINKT1B (and STEVAL-STWINKT1)
- Connects to the STWIN core system board through a dedicated 12-pin connector
- 3 V to 5.5 V power supply input
- 4 mm square-shaped differential microphone array
- Four IMP23ABSU high-performance, single-ended, analog, bottom-port MEMS microphones
- LDK130 300 mA low quiescent current very low noise LDO
- Ultrasound frequency response up to 80 kHz
- On-board audio-grade quad ADC
- Serial audio interface (SAI) digital output

2 Precautions for use

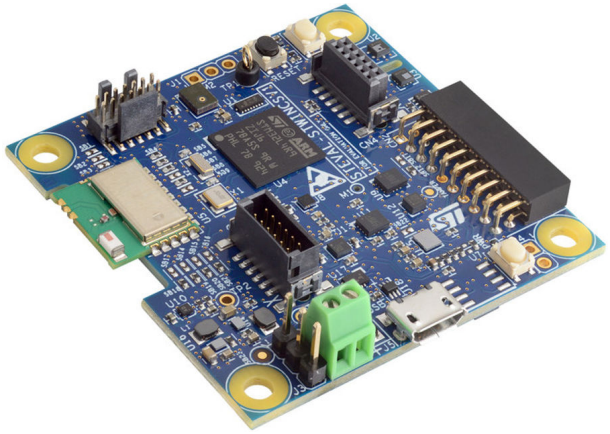
Important: *The STEVAL.STWINMA2 evaluation board has a level of radiated emissions in Class A. Regarding immunity, the board is not immune to indirect electrostatic discharges (electrostatic discharges applied to objects adjacent to the board). During the ESD test the board obtained level C, meaning that the board was not damaged during the test, but requires the intervention of the operator to reset it. When an electrostatic discharge is applied to an adjacent object, there is the risk that the board interrupts its functioning, and in this case the intervention of the operator is required to reset the board, meaning un-plug and re-plug the device.*

Important: *This kit is not immune to indirect electrostatic discharges. During the ESD test, the kit has obtained level C. This means that the expansion board has not been damaged during the test, but the intervention of the operator was necessary to reset it. When an electrostatic discharge is applied to an adjacent object, the board might interrupt its functioning. In this case, the intervention of an operator is required to reset the board (that is, to unplug and replug the power supply line).*

3 How to use the board

The STEVAL-STWINMA2 has to be used with the STEVAL-STWINKT1B (or STEVAL-STWINKT1). The board should be plugged on top of the STWIN core system board, using the CN4 connector, as shown below.

Figure 2. STWIN core system board



The shape of the connector makes it impossible to plug the board with the wrong orientation (see the figure below).

Figure 3. STWIN core system board and STEVAL-STWINMA2 (or STEVAL-STWINMAV1)

The three firmware examples that allow you to test the development board can be found in the X-CUBE-MEMSMIC1 package:

- AMicArray_Microphones_Streaming: microphone acquisition and streaming via USB
- AMicArray_Acoustic_SL: real-time sound source localization application using four signals acquired via digital MEMS microphones and the AcousticSL middleware to estimate the arrival direction of an audio source
- AMicArray_UltrasoundFFT: ultrasound condition monitoring application that calculates the FFT of the analog microphone signal and streams the result to a PC GUI via USB

Refer to X-CUBE-MEMSMIC1 documentation for more details on the firmware package.

4 Schematic diagrams

Figure 4. **STEVAL-STWINMA2 schematic - Mics, VDD and connector**

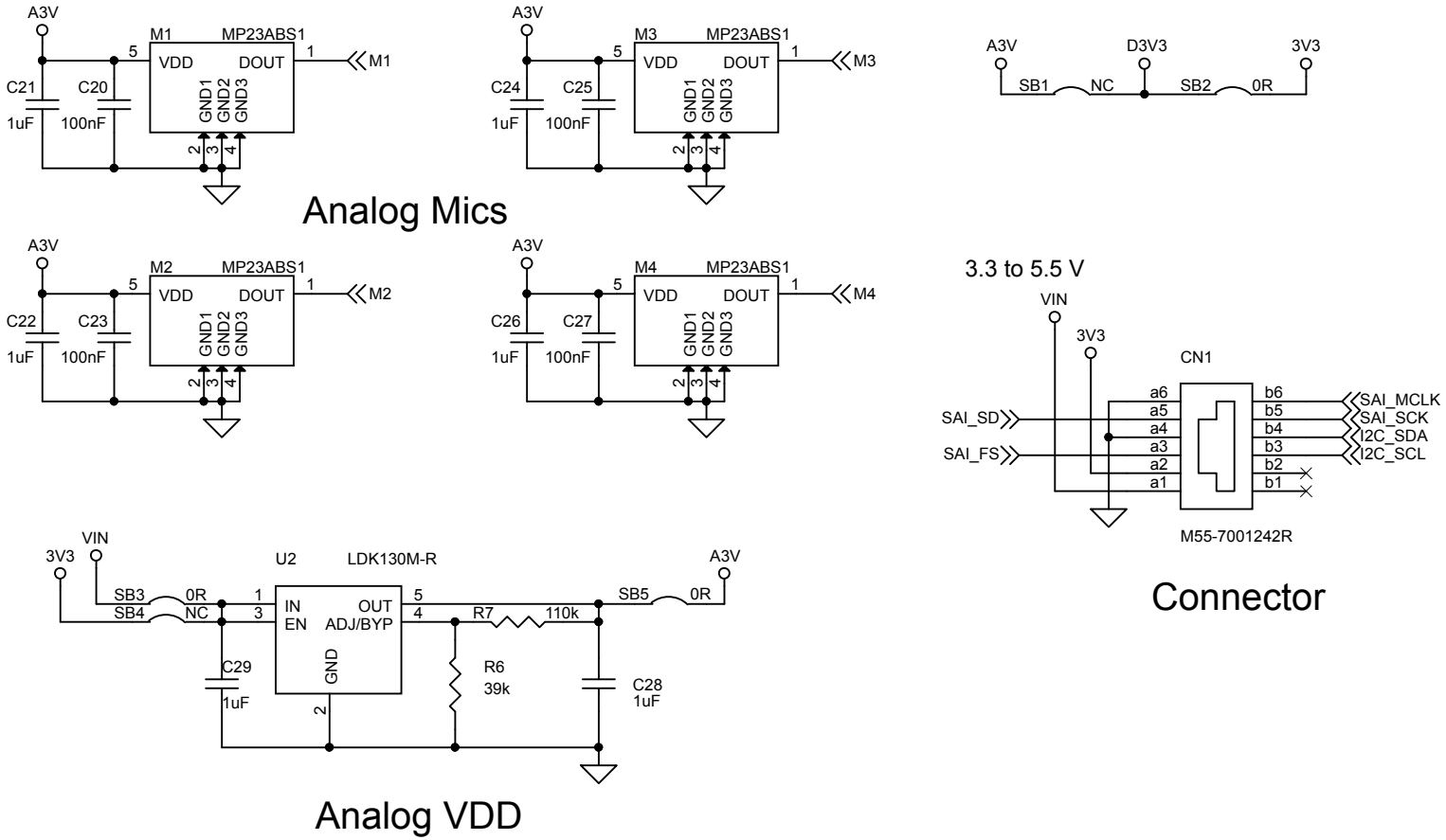
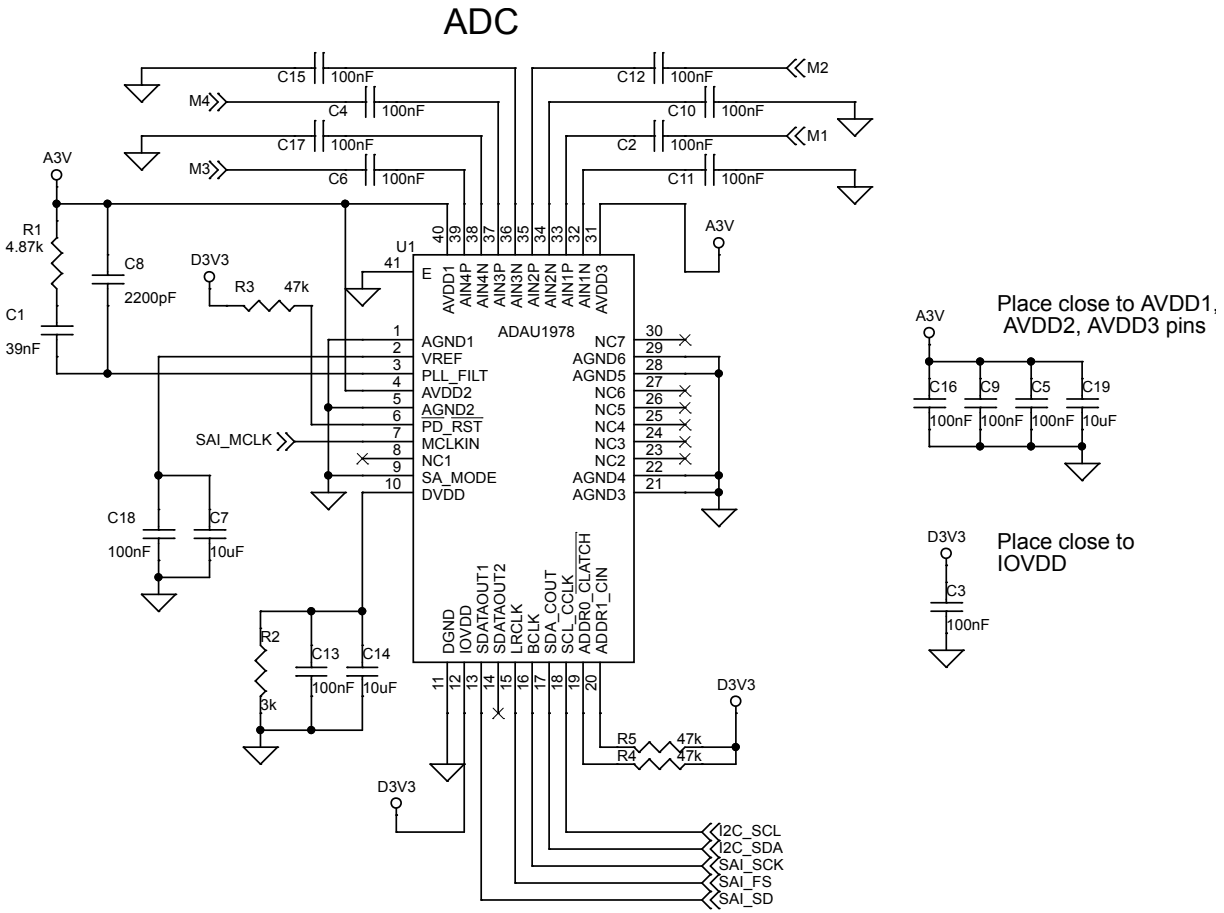


Figure 5. STEVAL-STWINMA2 schematic - ADC



5 Bill of materials

Table 1. STEVAL-STWINMA2 bill of materials

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	1	CN1	M55-7001242R, CN1	M55 series 12 pin connector	Harwin	M55-7001242R
2	1	C1	39nF, C_0402, 10%	CAP CER 39nF 10V X5R 0402	Vishay	VJ0402Y393KXQCW1BC
3	18	C2, C3, C4, C5, C6, C9, C10, C11, C12, C13, C15, C16, C17, C18, C20, C23, C25, C27	100nF, C_0402, 10%	CAP CER 0.1UF 16V X7R 0402	Wurth Elektronik	WE 885012205037
4	3	C7, C14, C19	10uF, C_0402, 20%	CAP CER 10UF 10V X5R 0402	Samsung Electro-Mechanics America, Inc.	CL05A106MP8NUB8
5	1	C8	2200pF, C_0402, 20%	CAP CER 2200PF 10V X5R 0402	Yageo	AC0402KRX7R7BB222
6	6	C21, C22, C24, C26, C28, C29	1uF, C_0402, 10%	CAP CER 1UF 10V X5R 0402	Wurth Elektronik	WE 885012105012
7	4	M1, M2, M3, M4	IMP23ABSUTR, RHLGA 2.65X3.5X1.08(MAX)MM 4L	Analog bottom port microphone with frequency response up to 80 kHz for ultrasound analysis and predictive maintenance applications	ST	IMP23ABSUTR
8	1	R1	4.87k, R_0402,1%	RES SMD 4.87K OHM 1% 1/16W 0402	Yageo	RC0402FR-074K87L
9	1	R2	3k, R_0402, 1%	RES SMD 3K OHM 1% 1/16W 0402	Yageo	RC0402FR-073KL
11	1	R6	39k, R_0402, 1%	RES SMD 39K OHM 1% 1/16W 0402	TE Connectivity	CRGCQ0402F39K
12	1	R7	110k, R_0402, 1%	RES SMD 110K OHM 1% 1/16W 0402	TE Connectivity	CRG0402F110K
13	2	SB1,SB4	NC, R_0402	RES SMD 0 OHM 0402 (not mounted)	Vishay Dale	CRCW04020000Z0ED
14	3	SB2, SB3, SB5	0R, R_0402	RES SMD 0 OHM 0402	Vishay Dale	CRCW04020000Z0ED
15	1	U1	ADAU1978, LFCSP-40	PCM1864 ADC	AD	ADAU1978
16	1	U2	LDK130M-R, SOT323-5L	300 mA low quiescent current very low noise LDO	ST	LDK130M-R

6 Board versions

Table 2. STEVAL-STWINMA2 versions

PCB version	Schematic diagrams	Bill of materials
STEVAL$STWINMA2A (1)	STEVAL$STWINMA2A schematic diagrams	STEVAL$STWINMA2A bill of materials

1. *This code identifies the SSTEVAL-STWINMA2 evaluation board first version. It is printed on the board PCB.*

7 Regulatory compliance information

Notice for US Federal Communication Commission (FCC)

For evaluation only; not FCC approved for resale

FCC NOTICE - This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine

whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2

Notice for Innovation, Science and Economic Development Canada (ISED)

For evaluation purposes only. This kit generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to Industry Canada (IC) rules.

À des fins d'évaluation uniquement. Ce kit génère, utilise et peut émettre de l'énergie radiofréquence et n'a pas été testé pour sa conformité aux limites des appareils informatiques conformément aux règles d'Industrie Canada (IC).

Notice for European Union

This device is in conformity with the essential requirements of the Directive 2014/30/EU (EMC) and of the Directive 2015/863/EU (RoHS).

Notice for United Kingdom

This device is in compliance with the UK Electromagnetic Compatibility Regulations 2016 (UK S.I. 2016 No. 1091) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK S.I. 2012 No. 3032).

Revision history

Table 3. **Document revision history**

Date	Revision	Changes
11-May-2023	1	Initial release.

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