CY8CKIT-028-SENSE IoT sense expansion kit guide

About this document

Scope and purpose

This guide will help you get acquainted with the CY8CKIT-028-SENSE IoT sense expansion kit. Hardware details of the board and its usage information is provided.

Table of contents

Safety and regulatory compliance information

This kit is intended as a development platform for hardware or software in a laboratory environment. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required authorizations are first obtained. Contact **support@cypress.com** for details.

This kit contains electrostatic discharge (ESD) sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, which can cause a discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused Boards in the protective shipping package.

End-of-Life/Product Recycling

The end-of-life cycle for this kit is five years from the date of manufacture mentioned on the back of the box. Contact your nearest recycler to discard the kit.

General safety instructions

ESD protection

ESD can damage boards and associated components. Infineon recommends that you perform procedures only at an ESD workstation. If such a workstation is not available, use appropriate ESD protection by wearing an antistatic wrist strap attached to the chassis ground (any unpainted metal surface) on your board when handling parts.

Handling boards

These boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide board over any surface.

1 Introduction

Thank you for your interest in the IoT sensor expansion kit (CY8CKIT-028-SENSE). This kit is intended as a companion to add common sensors, audio components, and a user interface to an Arduino™ UNO - based baseboard.

This kit targets two main applications:

- **Audio applications:** The kit includes two PDM microphones and one analog microphone. It also has an audio codec with an audio jack socket connector.
- **Machine Learning (ML) applications:** The kit includes multiple sensors to generate input data to feed ML algorithms, such as a 9-axis absolute orientation sensor, a pressure and temperature sensor, and the microphones.

This kit guide provides details on the kit contents, hardware, schematics, and BOM.

1.1 Kit contents

The kit has the following contents, as shown in **Figure 1**.

- IoT sense expansion board
- Quick start guide

Figure 1 CY8CKIT-028-SENSE IoT sense expansion kit contents

Inspect the contents of the kit; if you find any part missing, contact your nearest Infineon sales office for help. Go to **https://www.cypress.com/support** for more information on Cypress sales offices and support.

1.2 Getting started

This guide will help you get acquainted with the kit:

- The **Kit operation** chapter describes the theory of operation and major features of the kit.
- The **Hardware** chapter provides a detailed hardware description, kit schematics, and bill of materials (BOM).
- For programming and debugging details, see the **CY8CKIT-062S2-43012** and **CY8CKIT-064B0S2-4343W** kit guides.

The board plugs into any Arduino™ UNO - compatible development platforms from Infineon. This guide will demonstrate using the CY8CKIT-062S2-43012 or CY8CKIT-064B0S2-4343W as the baseboard. The CY8CKIT-028-SENSE IoT sense expansion kit does not have any programmable device on the board, but it contains a configurable audio codec that uses I2C as the configuration interface. The PSoC™ device present on the baseboard such as the CY8CKIT-062S2-43012 or CY8CKIT-064B0S2-4343W requires firmware, which you can develop with the ModusToolbox™ Software Environment (v2.3.1 or later).

1.3 Board details

The board that has the following features:

- High-precision, excellent pressure noise performance and high-stability XENSIV™ digital barometric air pressure sensor with built-in temperature sensor
  - Operation range 300 hPa–1200 hPa
  - Sensor precision 0.002 hPa
  - Relative accuracy ±0.06 hPa
  - Pressure temperature sensitivity of 0.5 Pa/K
  - Temperature accuracy ±0.5 °C
- Two high-performance XENSIV™ MEMS digital microphones making use of Infineon's dual-backplate MEMS technology to deliver a 105-dB dynamic range and high output linearity up to 130 dBSPL
  - 69 dB(A) signal-to-noise ratio
  - Less than 1 percent distortions up to 128 dBSPL (AOP - 130 dBSPL)
  - Digital (PDM) interface with 6-µs group delay at 1 kHz
  - Tight sensitivity (-36 ±1 dB) and phase (± 2 deg) tolerances
  - 28 Hz low-frequency roll-off
- Absolute orientation sensor combining 3-axis accelerometer, gyroscope, and geomagnetic sensor
- Wake-on-sound piezoelectric MEMS microphone
- Low-power stereo audio codec featuring Class-D speaker drivers to provide 1 W per channel into 8 Ω loads and an audio jack socket
- I2C-based 124 x 64 OLED display
- Arduino™ UNO compatible headers

Introduction

The IoT sense expansion shield pinout is shown in **Figure 2**. For pin assignment details, see the **3.2.7 Arduino™-compatible headers (J1, J2, J3, and** J4) section.

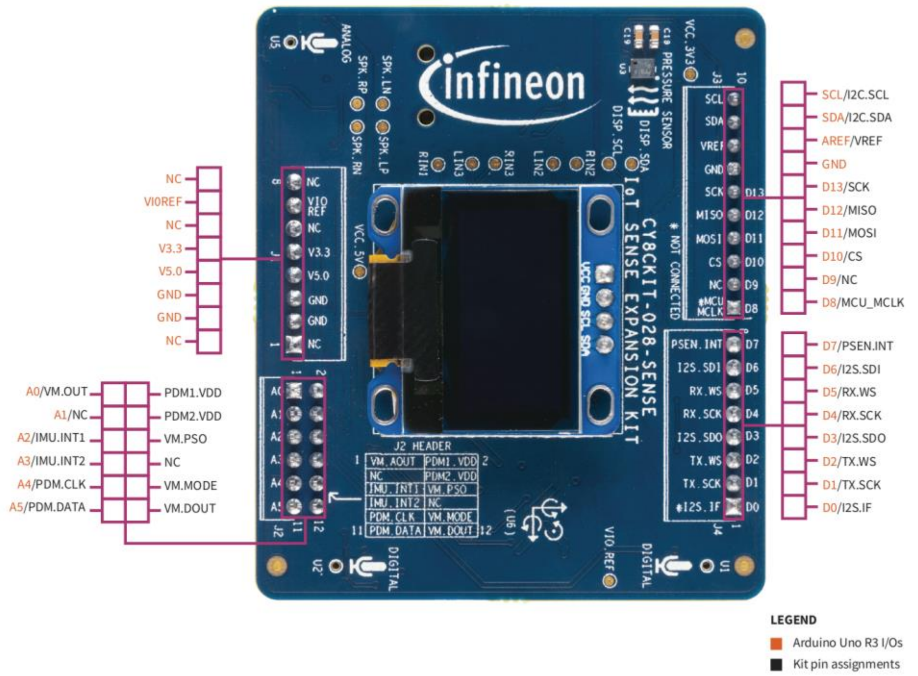

Figure 2 IoT sense expansion shield

1.4 Additional learning resources

An overview of PSoC™ devices is available at **https://www.cypress.com/psoc**. The web page includes a list of PSoC™ device families, integrated design environments (IDEs), and associated development kits. In addition, refer to the following documents to get started with PSoC™ 6 devices:

- **AN228571 – Getting started with PSoC™ 6 MCU on ModusToolbox™**
- **PSoC™ 6 technical reference manuals**

1.5 Technical support

For assistance, visit **Technical Support.** Visit **community.cypress.com** to ask your questions in Cypress developer community.

You can also use the following support resources if you need quick assistance:

- **Self-help**
- **Local sales office locations**

1.6 Document conventions

Table 1 Conventions

Convention	**Explanation**
File > **Open**	Represents menu paths: **File** > **Open** > **New Project**.
Bold	Emphasizes heading levels, column headings, table and figure captions, screen names, windows, dialog boxes, menus and sub-menus Displays commands, menu paths, and icon names in procedures: Click the **File** icon and then click **Open**.
Italics	Denotes variable(s) and reference(s) Displays file names and reference documentation: Read about the *sourcefile.hex* file in the *PSoC Creator User Guide*.
`Courier New`	Denotes APIs, functions, interrupt handlers, events, data types, error handlers, command line inputs, code snippets
Times New Roman	Displays an equation: $2 + 2 = 4$
>	Indicates that a cascading sub-menu opens when you select a menu item

1.7 Abbreviations and definitions

Table 2 Abbreviations

Abbreviation	**Definition**
ADC	Analog-to-Digital Converter
BOM	Bill of Materials
DAC	Digital-to-Analog Converter
IDE	Integrated Development Environment
I2C	Inter Integrated Circuit interface
I2S	Inter Integrated Circuit Sound Bus
IMU	Inertial Measurement Unit
IoT	Internet of Things
LED	Light Emitting Diode
MEMS	Micro Electro Mechanical System
MIC	Microphone
OLED	Organic Light Emitting Diode
PCM	Pulse Code Modulation
PDM	Pulse Density Modulation
PSoC™	Programmable System-on-Chip
SPI	Serial Peripheral Interface

2 Kit operation

2.1 Theory of operation

The IoT sense expansion kit is an Arduino™-compatible expansion shield to easily interface multiple sensors with PSoC™ 6 platform pioneer kits for audio and ML applications. This shield contains PDM microphones and barometric pressure sensor from Infineon's XENSIV™ family, I2S-based stereo audio codec from Cirrus Logic, analog MEMS microphone from Vesper, 9-axis absolute orientation sensor from Bosch and an 128x64 OLED display.

This shield is supported by ModusToolbox™ software examples with the CY8CKIT-062S2-43012 and CY8CKIT-064B0S2-4343W companion kits (referred to as the "baseboard").

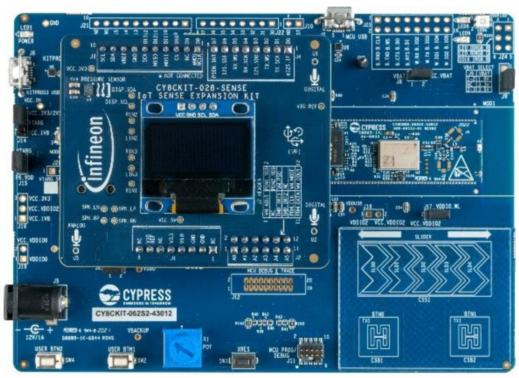

Figure 3 CY8CKIT-028-SENSE IoT sense expansion kit connected to a CY8CKIT-062S2-43012 baseboard

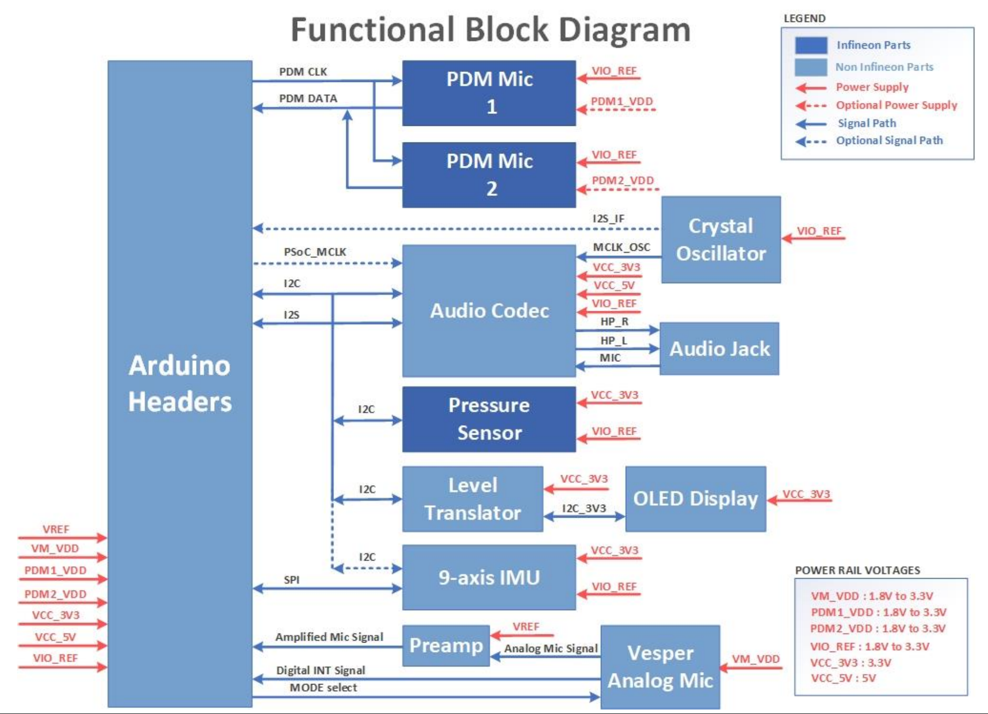

Figure 4 CY8CKIT-028-SENSE IoT sense expansion kit functional block diagram

Kit operation

The kit comes with the IoT sense expansion board. **Figure 5** shows the components on the IoT sense expansion board.

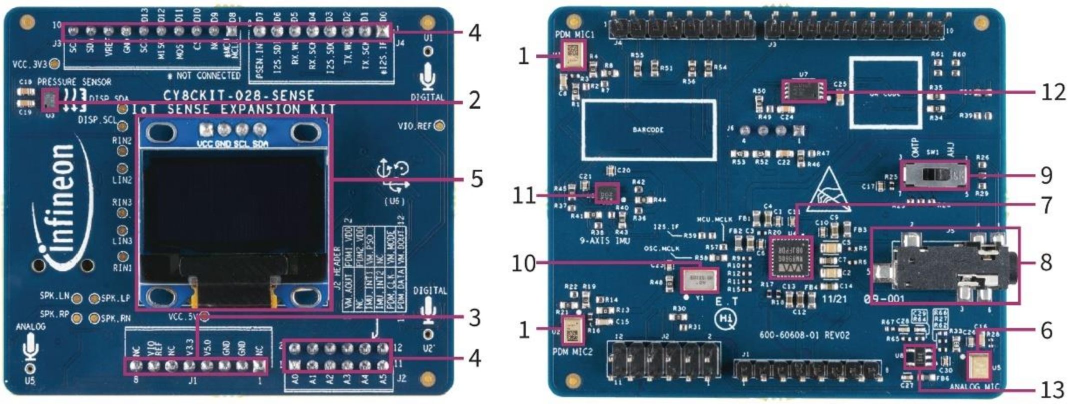

Figure 5 IoT sense expansion board details

The board has the following peripherals:

1. **XENSIV™ digital MEMS microphones (U1, U2)**: These are two Infineon digital MEMS microphones are used to capture sound and generate digital audio data, which is transferred through the PDM interface.
2. **XENSIV™ digital barometric air pressure sensor (U3):** This is an Infineon digital MEMS barometric pressure sensor with built-in temperature sensor. This sensor uses I2C to transfer the sensor data.
3. **Arduino™ UNO R3 compatible power header (J1):** This is an Arduino™-compatible header to interface with the PSoC™ 6 baseboard, which has Arduino™-compatible interface female connector to provide power to this shield.
4. **Arduino™ UNO R3 compatible I/O headers (J2, J3, J4):** These are the Arduino™-compatible headers to interface the PSoC™ 6 baseboard, which has an Arduino™-compatible interface female connector to provide the I/O interface between the baseboard and the shield.
5. **OLED module (ACC6):** This is a 0.96-inch, 128 x 64 OLED display, which can interface with PSoC™ 6 MCU via I2C.
6. **Vesper piezoelectric MEMS analog microphone (U5):** An analog piezoelectric MEMS microphone with a wake-on-sound mode that allows the detection of voice activity while consuming only 10 µA of supply current.
7. **Audio codec (U4):** A low-power stereo audio codec with built-in Class-D audio amplifier capable of driving 1-W speaker at 8 ohm.
8. **3.5-mm stereo audio jack socket (J5):** A 4-pin audio jack socket (TRRS) to connect a stereo headphone with a microphone.
9. **Audio jack socket type selection switch (SW1):** This switch is used to change the audio jack socket type (AHJ or OMPT).
10. **Crystal oscillator (Y1):** This is a 12.288 MHz crystal oscillator used for generating the I2S MCLK for the audio codec and I2S peripherals of PSoC™ 6 MCU.
11. **Bosch 9-axis absolute orientation sensor (U6):** This kit contains a 9-axis IMU sensor with 3-axis gyro, accelerometer, and geomagnetic sensor, which can be interfaced with PSoC™ 6 MCU via I2C or SPI.
12. **I2C level translator (U7):** This level shifter is used to generate a constant 3.3-V level I2C signal from various I2C target-level voltages.
13. **Preamplifier (U8):** This is an opamp-based non-inverting amplifier used to preamplify the analog MIC audio output.

See **3.2 Hardware functional description** for details on various hardware blocks.

2.2 Using the machine learning gesture classification code example

CY8CKIT-028-SENSE can be used with the CY8CKIT-062S2-43012 and CY8CKIT-064B0S2-4343W baseboards. The following sections describe on how to create a project to run on the baseboard that uses the CY8CKIT-028-SENSE shield. For a detailed description of the project, see the example's readme file in the **GitHub repository**.

2.2.1 Operation

If using CY8CKIT-064B0S2-4343W, the PSoC™ 64 device must be provisioned with keys and policies before being programmed. Follow the instructions in the **"Secure Boot" SDK user guide** to provision the device. If kit is already provisioned, copy-paste the keys and policy folders to the application folder.

1. Connect the CY8CKIT-028-SENSE shield to the baseboard kit.
2. Connect the board to your PC using the provided USB cable through the KitProg3 USB connector.
3. Open a terminal program and select the KitProg3 COM port. Set the serial port parameters to 8N1 and 115200 baud.
4. In the ModusToolbox™ software (either Eclipse IDE for ModusToolbox™ or command-line interface), build and program the "Machine Learning Gesture Classification" code example on to the kit. See the example's readme for programming details.
5. After programming, the application starts automatically. Confirm that "Gesture Classification Example" and some log data are printed on the UART terminal, the gesture classifications and confidence are updated continuously.
6. Hold the board with the following orientation while moving your arm to complete a gesture.

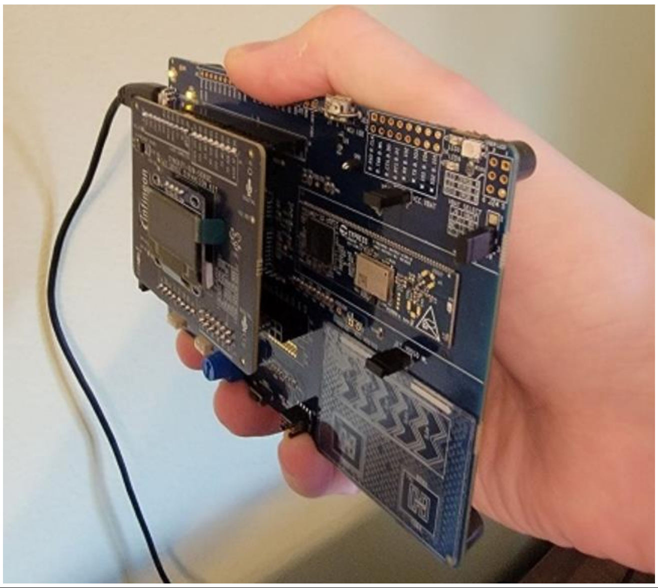

Figure 6 Holding posture of CY8CKIT-028-SENSE with baseboard for gesture classification application

7. Perform a counter-clockwise circle movement continuously. Confirm that the UART terminal prints the gesture as **Circle**, and the confidence of the circle increases past 70%. For best results, repeatedly perform a circle movement that has a diameter of one foot, and complete one circle per second.
8. Perform a counter-clockwise square movement continuously. Confirm that the UART terminal prints the gesture as **Square**, and the confidence of the square increases past 70%. For best results, repeatedly perform a square movement that has a side length of one foot, and complete one square in two seconds.

9. Perform a side-to-side movement (left <-> right) continuously, confirm that the UART terminal prints the gesture as **Side-to-side**, and the confidence increases past 70%. For best results, repeatedly perform a one-foot-wide left-to-right movement in half-a-second.
10. When not performing any of the gestures above, confirm that the UART terminal prints the gesture as **None**.

Note: See the example's readme file for up to date instructions.

3 Hardware

3.1 Schematics

See the schematic files available on the **kit webpage**.

3.2 Hardware functional description

3.2.1 Digital MEMS microphone (IM69D130)

The CY8CKIT-028-SENSE kit contains two digital PDM MEMS microphones from Infineon Technologies sharing the same PDM bus. Each PDM microphone has a SELECT pin; if this pin is connected to GND, the PDM data is available on the falling edge of the PDM clock. If this pin is connected to VDD, the PDM data is available on the rising edge of the PDM clock.

By default, these PDM microphones are powered by VIO_REF to match the I/O logic level, but for low-power operation, an optional resistor is provided to power the microphones from a GPIO of the PSoC™ 6 device.

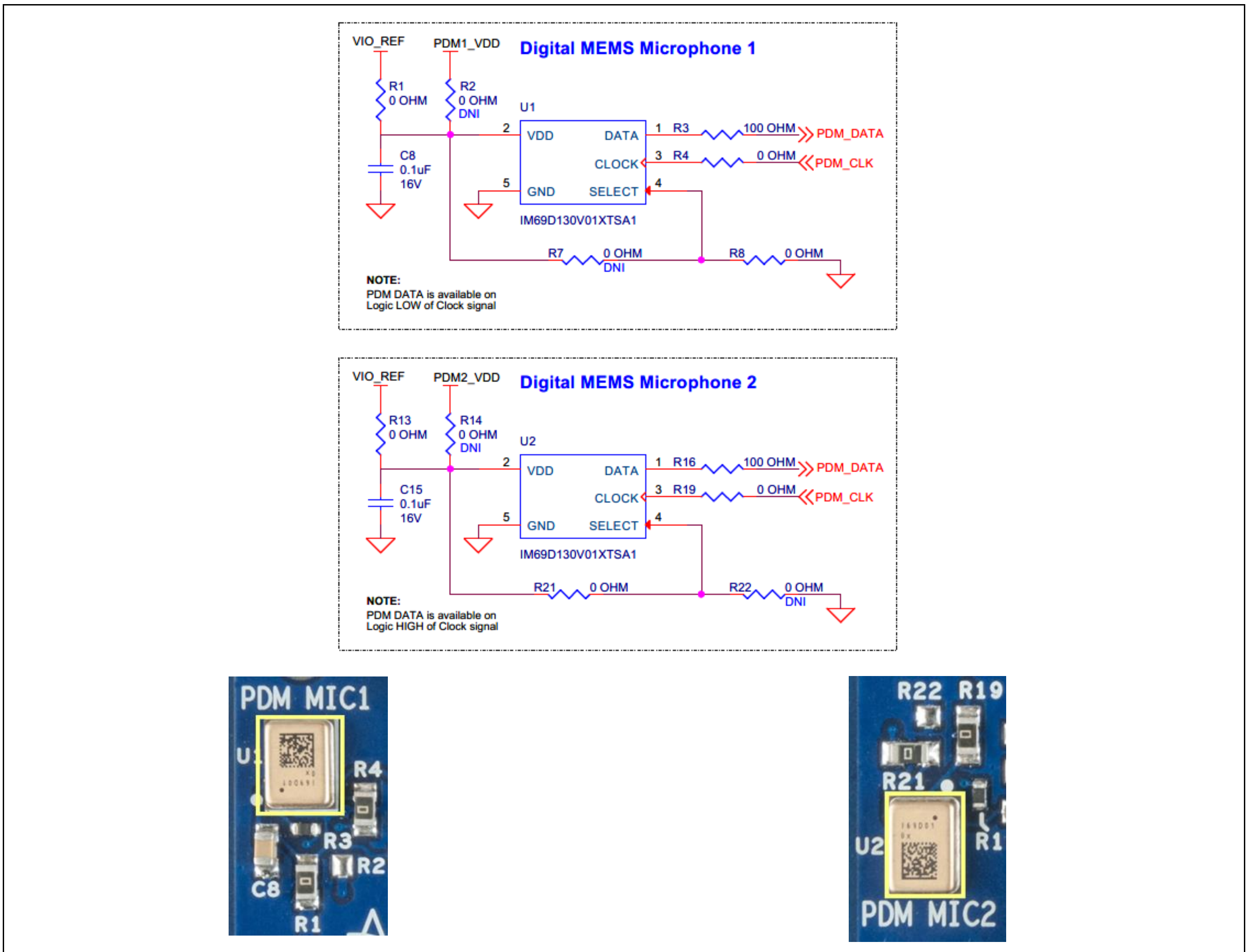

Figure 7 Schematic of digital MEMS microphones

3.2.2 Digital barometric pressure sensor (DPS310)

The kit contains Infineon's digital MEMS barometric pressure sensor with a built-in temperature sensor interfaced with PSoC™ 6 MCU via I2C. This pressure sensor supports the SPI interface also, but this shield is designed to use it with I2C only.

The SDO pin of the pressure sensor is pulled down with a 100K resistor, which determines the I2C device address of the sensor. If the pull-down resistor is loaded, the 7-bit I2C device address will be 0x76; if not, the address will be 0x77. This pressure sensor has a separate I/O power supply pin (VDDIO), which is connected to VIO_REF to match the logic levels of both I/O lines of PSoC™ 6 MCU and sensors.

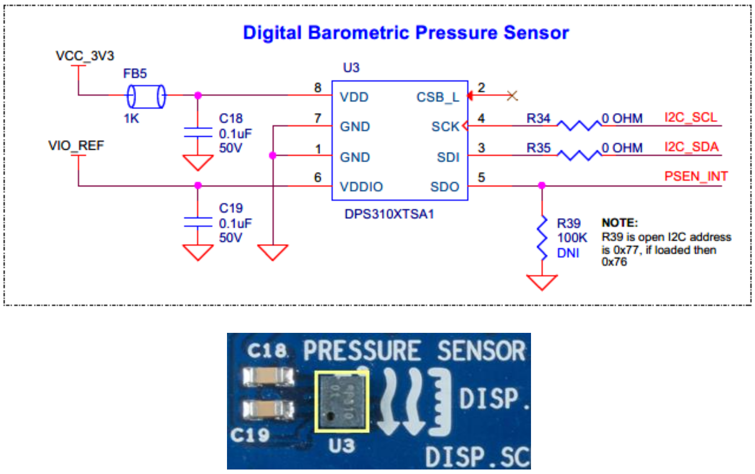

Figure 8 Schematic of the digital barometric pressure sensor

3.2.3 The 9-axis absolute orientation sensor (BMX160)

The kit contains a BMX160, a highly integrated low-power 9-axis absolute orientation sensor, also known as Inertial Measurement Unit (IMU) that provides precise acceleration, gyroscopic angular rate and geomagnetic measurement in each spatial direction.

The interface can be configured for both I2C and SPI. See section **3.3.3 Rework for 9-axis absolute orientation sensor to select interface SPI or I2C** for details.

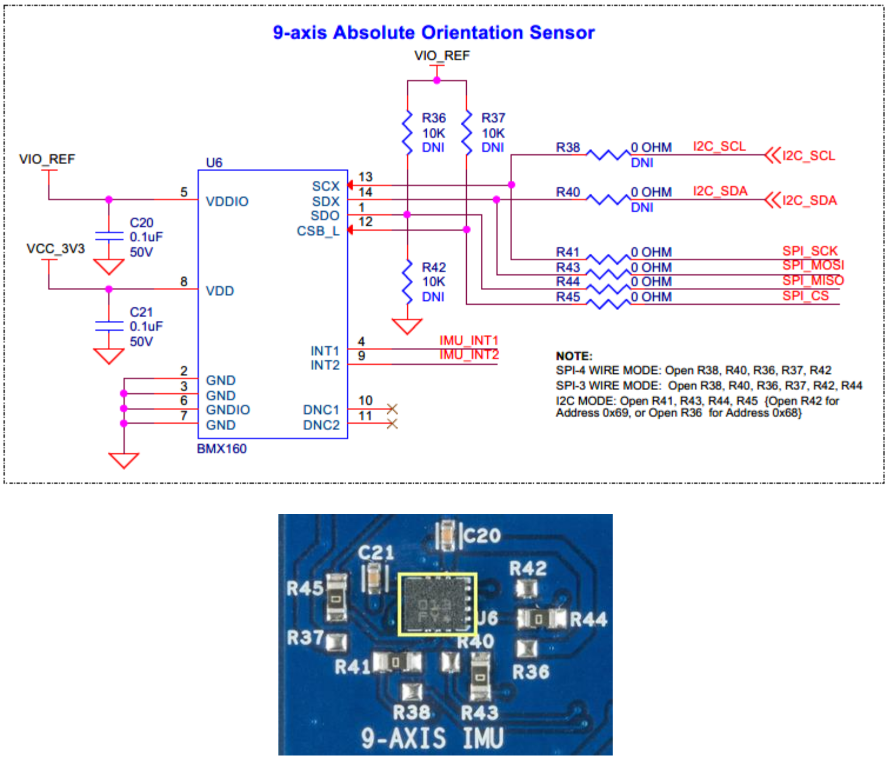

Figure 9 Schematic of the 9-axis absolute orientation sensor

3.2.4 Audio codec (WM8960)

The kit contains Cirrus Logic's audio codec, which is a low-power, high-quality stereo codec. It contains Class-D stereo speaker drivers which provide 1 W per channel into 8 Ω speaker loads with a 5 V supply. It is interfaced with PSoC™ 6 MCU on the baseboard via I2S.

This codec has an internal PLL, which generates various system clock frequencies. This kit has a crystal oscillator to feed the external clock to the audio codec; it also has a provision for resistor bypass to provide external clock from the PSoC™ 6 MCU on the baseboard. See sections **3.3.1 Rework on audio codec MCLK source** and **3.3.2 Rework for the baseboard MCU I2S external** clock for details.

To configure the registers of the audio codec, an I2C interface is provided to the PSoC™ 6 MCU on the baseboard. This I2C bus is shared between all components using the I2C interface and PSoC™ 6 MCU on the baseboard. The default 7-bit I2C device address is 0x34.

Note: *The KitProg3 UART's RTS and CTS pins of the baseboard are multiplexed with the I2S interface on the shield. This would cause the noise in the output of the audio codec. Remove the resistors R18 and R19 on the baseboard to disconnect the UART RTS and CTS signals. See the Board details section of the CY8CKIT-062S2-43012 and CY8CKIT-064B0S2-4343W kit guides for details.*

Note: *When using the audio codec in this shield, please do not configure the I2S peripheral in full-duplex mode (RX and TX enabled). Only enable one direction per time. This avoids noise on the I2S lines when running the RX and TX at the same time.*

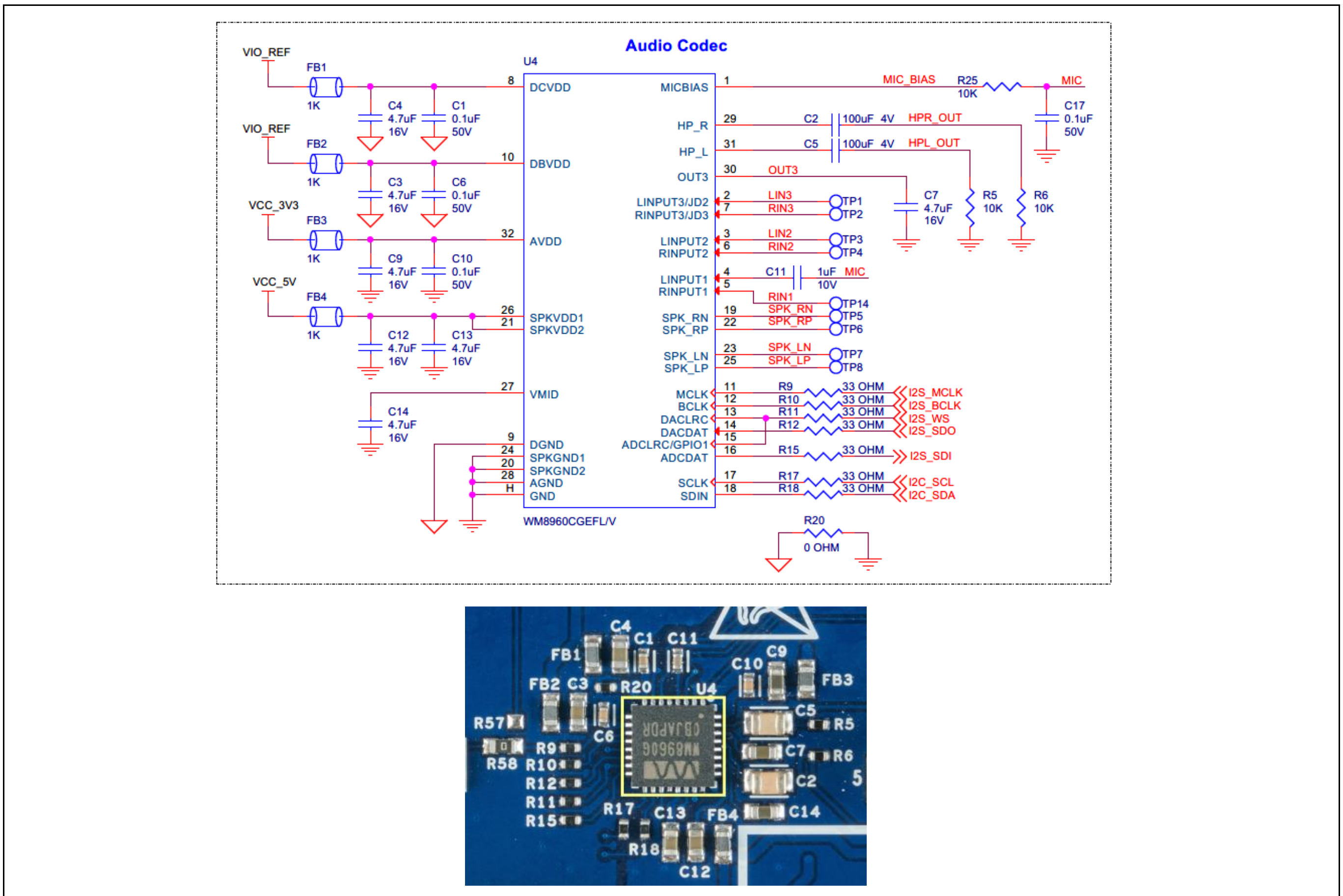

Figure 10 Schematic of the audio codec

3.2.4.1 Audio jack socket and type selection switch

An audio jack socket is provided to connect headphones to the audio codec. A switch and resistor are provided to select the microphone for different headphones with OMTP and AHJ connector interface types.

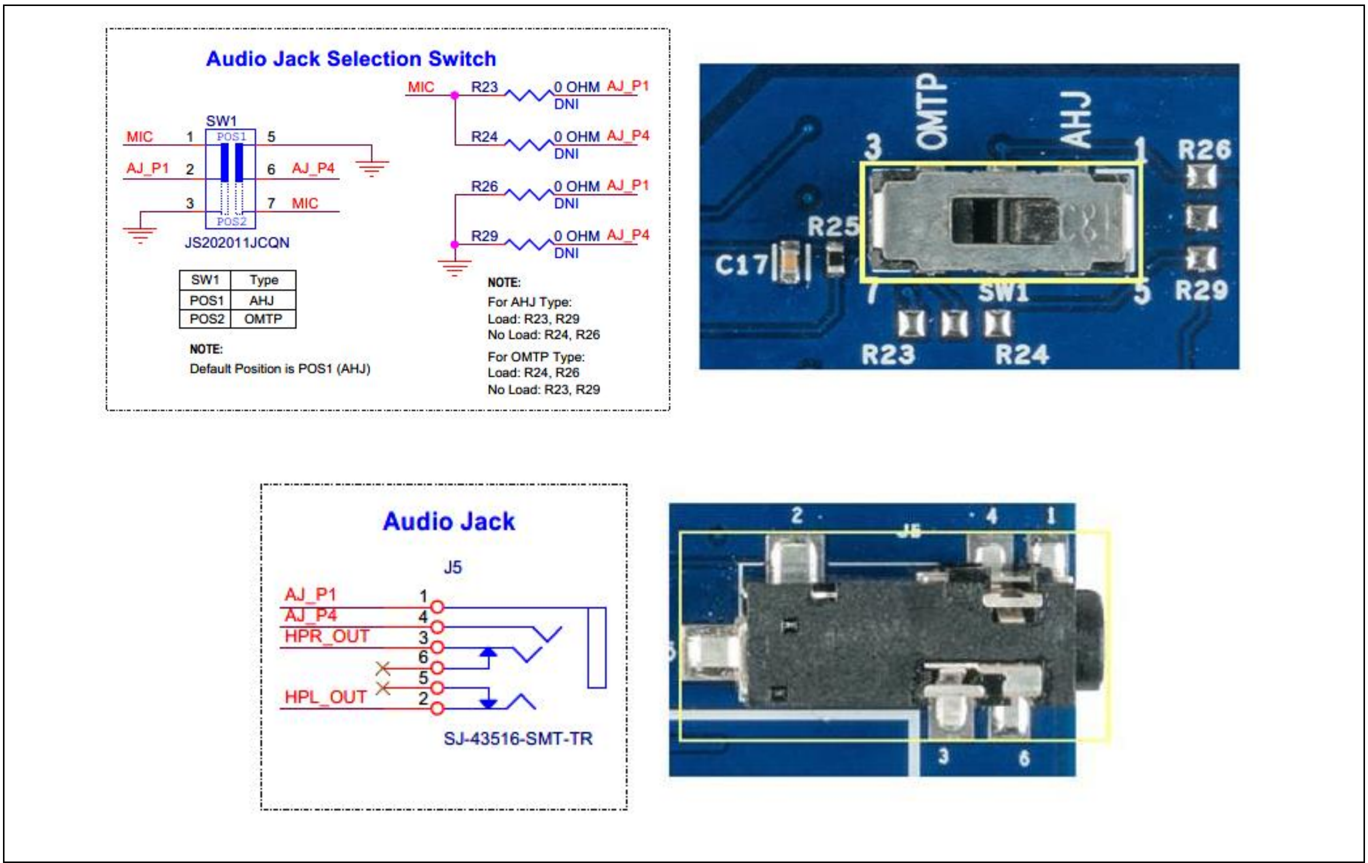

Figure 11 Schematic of the audio jack socket and type selection switch

3.2.4.2 I2S master clock (MCLK) source

The audio codec I2S MCLK can be sourced by either by the **MCU_MCLK** signal from the baseboard connected through the **J3** Header (**J3.1**), or the **OSC_MCLK** signal from the crystal oscillator (**Y1**). By default, the crystal oscillator is used.

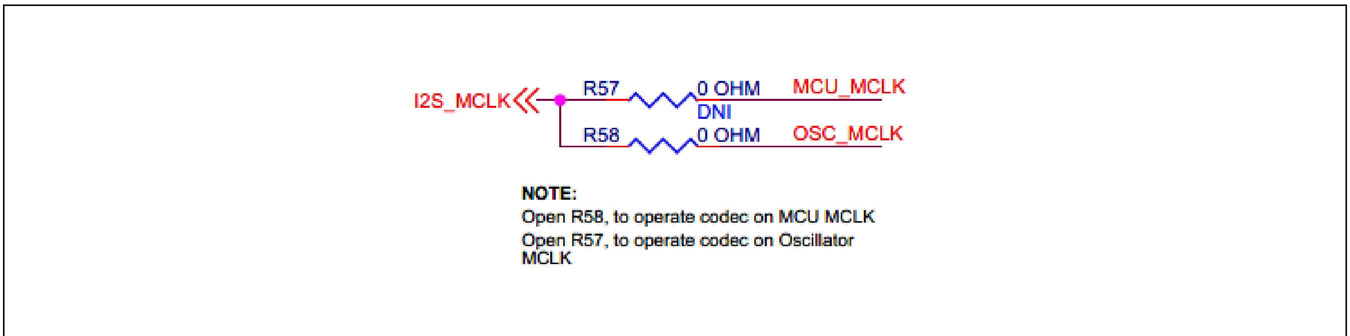

Figure 12 Schematic of I2S MCLK sourcing with resistor provision

3.2.4.2.1 Crystal oscillator

The kit contains a 12.288 MHz crystal oscillator to provide an external MCLK for the audio codec. The same clock can source the I2S_IF (external CLK for the I2S block of PSoC™ 6 MCU) with a resistor provision. See section **3.3.1 Rework on audio codec MCLK source** for details.

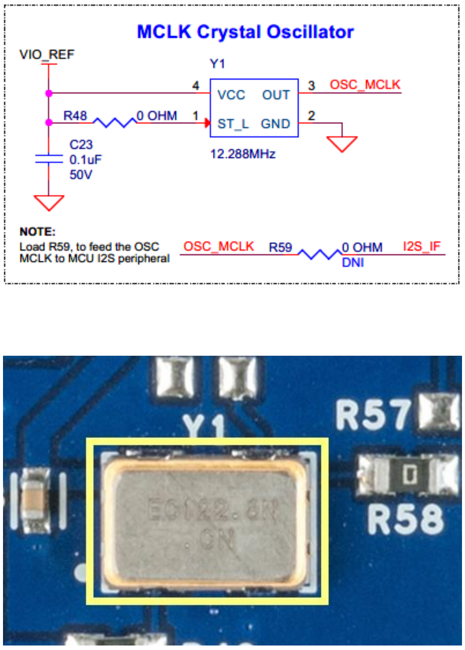

Figure 13 Schematic of the crystal oscillator

3.2.5 Piezoelectric MEMS analog microphone (VM1010) with preamplifier

The kit contains Vesper's analog piezoelectric MEMS microphone. This is a low-noise, single-ended analog MEMS microphone with a wake-on-sound mode that allows the detection of voice activity while consuming only 10 µA of supply current (or 18 µW of power).

In the wake-on-sound mode, the microphone detects sounds in the voice band above a configurable acoustic threshold level. When the microphone detects sound above the threshold, it instantly alerts the system of the acoustic event. The system can then switch the VM1010 to normal mode with full audio output within 200 µs. This is fast enough for VM1010 to capture the sound that exceeds the threshold and send it to the system for processing.

The analog microphone signal is preamplified using a non-inverting amplifier whose output is given to the SAR ADC of the PSoC™ 6 MCU on the baseboard.

The acoustic threshold level can be adjusted by varying the resistor value between GA1 and GA2 as specified:

- Open – Max acoustic threshold
- 90.9K – Mid acoustic threshold
- 18K – Min acoustic threshold (default setting)

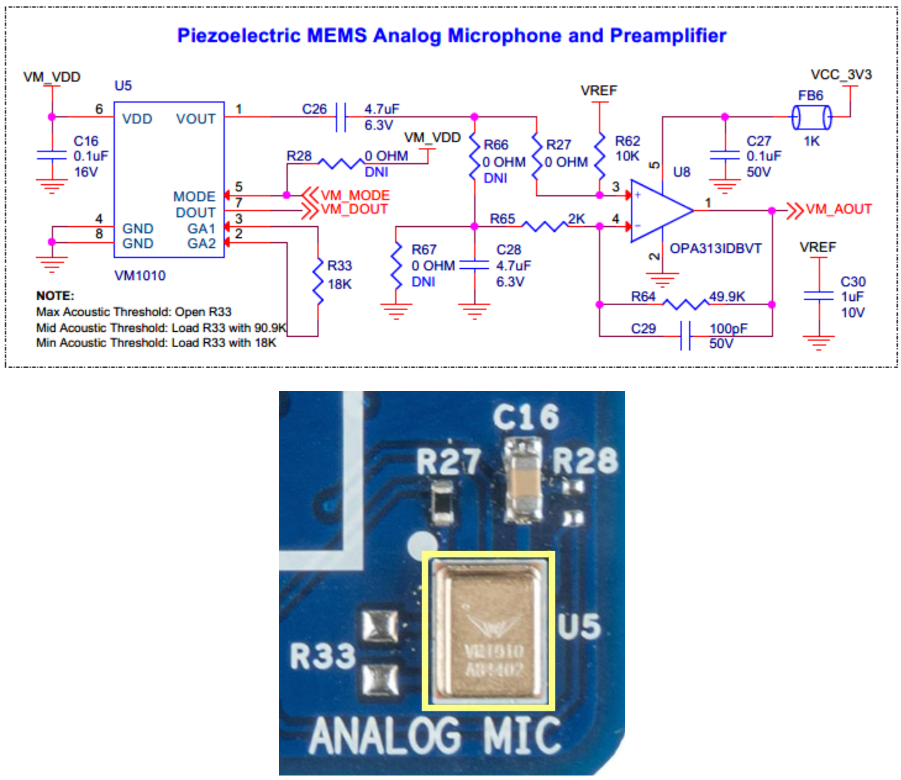

Figure 14 Analog microphone with its preamplifier

3.2.6 OLED display module

The kit contains a monochrome 0.96” 128 x 64 OLED display module. This display module has high contrast and works without backlight. This display is interfaced to the PSoC™ 6 device via I2C. The interface circuitry is provided on this kit as shown in **Figure 15**. The 7-bit I2C device address of OLED display module is 0x3C.

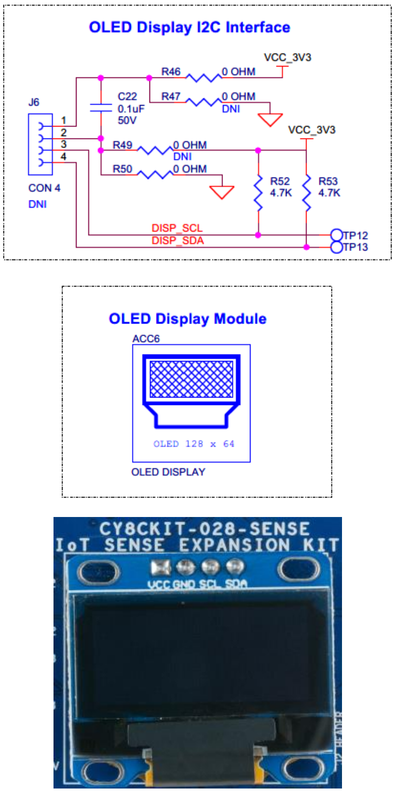

Figure 15 Schematic of the OLED display module interface

3.2.6.1 I2C level translator for OLED display module

The kit contains OLED display that operates at a voltage range of 2.5 VDC to 5.5 VDC, but the baseboard MCU can run at a voltage level of 1.8 VDC to 3.3 VDC. To make sure that the display works at 1.8 VDC, a level translator is used to generate I2C signals at a voltage level that display works with.

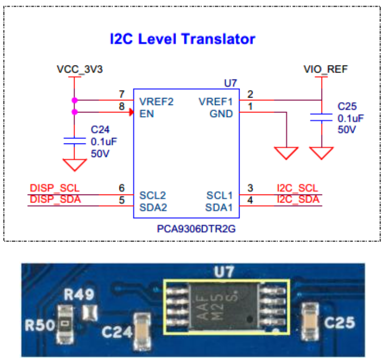

Figure 16 Schematic of the I2C level translator

3.2.7 Arduino™-compatible headers (J1, J2, J3, and J4)

The kit has four Arduino™-compatible headers: **J1**, **J2**, **J3**, and **J4** to provide power supply, I2C interface, SPI interface, I2S interface, PDM interface, and control I/O for sensors to the CY8CKIT-028-SENSE kit from the baseboard, and provide I2S MCLK to the baseboard.

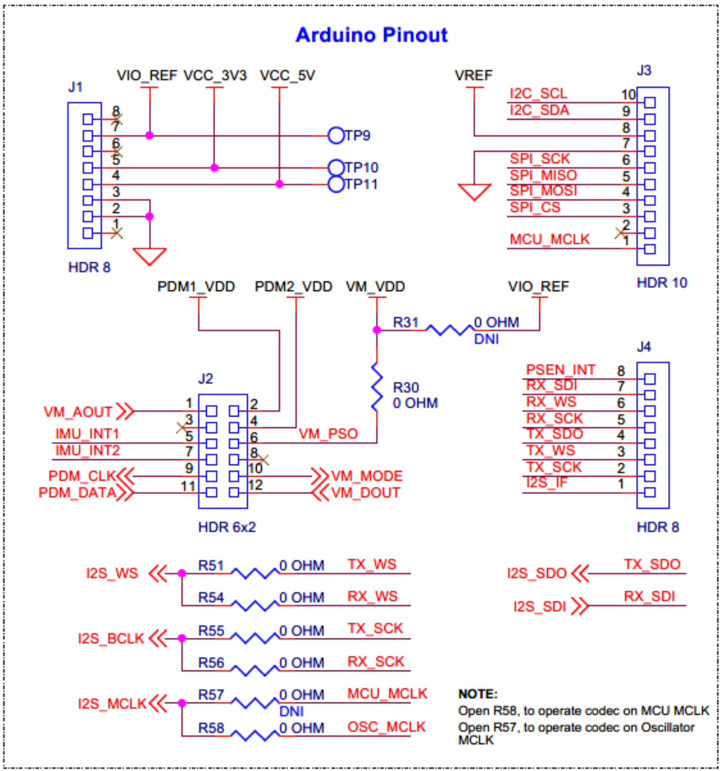

Figure 17 Arduino™-compatible headers

The pin assignment of the Arduino™ header and signal mapping to the baseboard are shown in **Table 3**.

Table 3 Arduino™ header pin assignment

Arduino™ pin	PSoC™ pin [1]	Kit function
A0	P10[0]	VM.AOUT (Vesper microphone output)
A1	P10[1]	Not connected
A2	P10[2]	IMU.INT1 (Interrupt pin 1 from the 9-axis absolute orientation sensor)
A3	P10[3]	IMU.INT2 (Interrupt pin 2 from the 9-axis absolute orientation sensor)
A4	P10[4]	PDM.CLK (PDM microphone clock signal)
A5	P10[5]	PDM.DATA (PDM microphone data signal)
A8	P9[0] [2]	PDM1.VDD (Power supply to PDM microphone 1)
A9	P9[1] [2]	PDM2.VDD (Power supply to PDM microphone 2)
A10	P9[2]	VM.PSO (Power supply to the Vesper microphone)
A11	P9[3]	Not connected

[1] Based on CY8CKIT-062S2-43012 and CY8CKIT-064B0S2-4343W.

[2] Requires a zero-ohm resistor to use this function.

Arduino™ pin	PSoC™ pin [1]	Kit function
A12	P9[4]	VM.MODE (Controls the Vesper microphone mode)
A13	P9[5]	VM.DOUT (Interrupt signal from the Vesper microphone)
D0	P5[0] [2]	I2S.IF (External MCLK to drive the I2S block. Signal comes from the shield crystal oscillator)
D1	P5[1]	TX.SCK (I2S Tx clock signal, connected to the audio codec and shorted with I2S RX.SCK)
D2	P5[2]	TX.WS (I2S Tx word select signal, connected to the audio codec and shorted with I2S RX.WS)
D3	P5[3]	I2S.SDO (I2S Tx data signal, driven by the PSoC™ device and connected to the audio codec)
D4	P5[4]	RX.SCK (I2S Rx clock signal, connected to the audio codec and shorted with I2S TX.SCK)
D5	P5[5]	RX.WS (I2S Rx word select signal, connected to the audio codec and shorted with I2S TX.WS)
D6	P5[6]	I2S.SDI (I2S Rx data signal, driven by the audio codec)
D7	P5[7]	PSEN.INT (Pressure sensor interrupt)
D8	P7[5] [2]	MCU_MCLK (Master clock for the audio codec)
D9	P7[6]	Not connected
D10	P12[3]	CS (SPI slave select, connected to the 9-axis absolute orientation sensor)
D11	P12[0]	MOSI (SPI MOSI signal, connected to the 9-axis absolute orientation sensor)
D12	P12[1]	MISO (SPI MISO signal, connected to the 9-axis absolute orientation sensor)
D13	P12[2]	SCK (SPI clock signal, connected to the 9-axis absolute orientation sensor)
SCL	P6[0]	I2C SCL (connected to PSoC™ and the I2C devices in the shield)
SDA	P6[1]	I2C SDA (connected to PSoC™ and the I2C devices in the shield)

3.2.8 I2C device addresses

The kit consists of four I2C devices (pressure sensor, OLED display module, 9-axis absolute orientation sensor, and audio codec), whose device addresses are specified in **Table 4**.

Table 4 I2C device addresses

Device	I2C device address (7-bit)
Barometric air pressure sensor (**U3**)	0x77 (0x76 optional configuration)
Audio codec (**U4**)	0x1A
9-axis absolute orientation sensor (**U6**)	0x69 (0x68 optional configuration)
OLED display (**ACC6**)	0x3C

3.3 IoT sense expansion board rework

3.3.1 Rework on audio codec MCLK source

The audio codec MCLK can be sourced from either the baseboard MCU (**MCU_MCLK**) or the on-board crystal oscillator (**OSC_MCLK**). If **R57** is loaded and **R58** is not loaded, it configures **MCU_MCLK** as the source. If **R58** is loaded and **R57** is not loaded, it configures **OSC_MCLK** as the source. By default, **OSC_MCLK** is selected as the clock source.

Figure 18 **MCLK source selection for the audio codec**

3.3.2 Rework for the baseboard MCU I2S external clock

The crystal oscillator output (**OSC_MCLK**) can be given as the external clock for the I2S peripheral of the baseboard MCU. The R59 resistor must be loaded to source **OSC_MCLK** as the clock for the I2S peripheral.

Figure 19 **Baseboard MCU I2S external clock source selection**

3.3.3 Rework for 9-axis absolute orientation sensor to select interface SPI or I2C

The 9-axis absolute orientation sensor is capable of interfacing with both SPI and I2C to the host MCU. The board supports both options but SPI is used by default. **Table 5** gives the details of the resistors to be loaded or not loaded.

Table 5 Resistor configuration for the SPI and I2C mode of interface for the 9-axis absolute orientation sensor

Interface mode	Loaded resistors	Not loaded resistors
Serial Peripheral Interface (**SPI**)*	R41, R43, R44, and R45	R38, R40, R36, R37, and R42
Inter-Integrated Circuit (**I2C**)	R38, R40, R36, and R37	R41, R43, R44, and R45

***Default mode of interface on board.**

If **U6** is operated in the I2C mode, the device address is configured using R36 and R42.

Table 6 Resistor configuration for the I2C device address for the 9-axis absolute orientation sensor

Device address (7-bit)	R36	R42
0x69	Loaded	Not Loaded
0x68	Not Loaded	Loaded

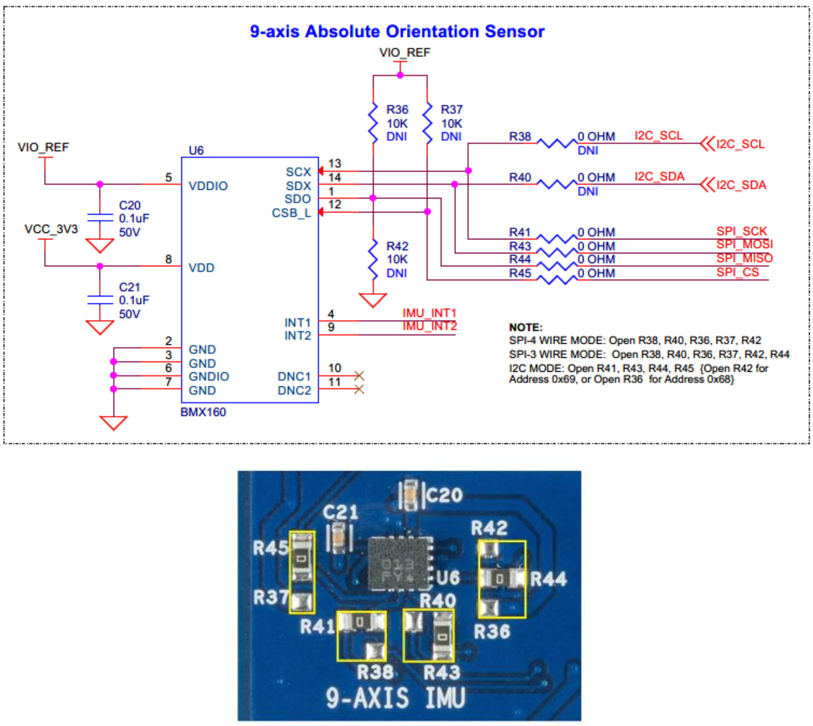

Figure 20 Schematic of the resistor configuration for the SPI and I2C mode of interface for the 9-axis absolute orientation sensor

3.3.4 Rework for barometric pressure sensor to configure the I2C device address

The barometric pressure sensor (**U3**) can be configured to have two I2C device addresses; a resistor provision is available as shown in **Table 7**.

Table 7 Resistor configuration for the I2C device address for the barometric pressure sensor

Device address (7-bit)	R39
0x77*	Not Loaded
0x76	Loaded

*** Default I2C device address**

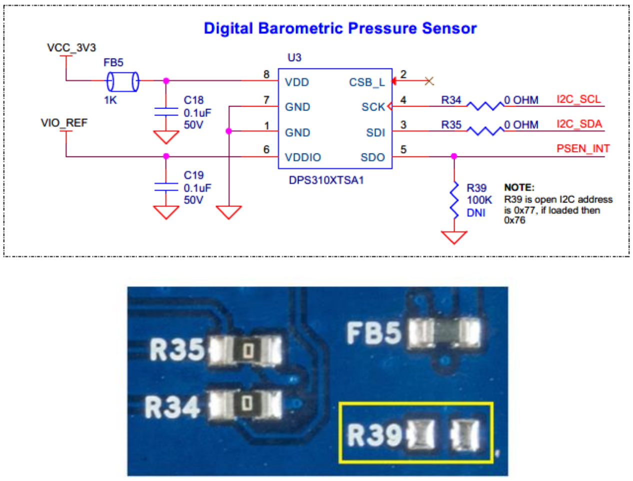

Figure 21 Schematic of the resistor configuration for the I2C device address of the pressure sensor

3.3.5 Rework for PDM microphone power source selection

The PDM microphones (**U1**, **U2**) can powered either through **VIO_REF** or **GPIO**. A resistor is provided to select the power source as shown in **Table 8** and **Table 9**.

Table 8 Resistor configuration for PDM MIC 1 power selection

Power source	R1	R2
VIO_REF*	Loaded	Not loaded
PDM1_VDD (GPIO)	Not loaded	Loaded

*** Default power selection for PDM1 microphone**

Table 9 Resistor configuration for PDM MIC 2 power selection

Power source	R13	R14
VIO_REF*	Loaded	Not loaded
PDM2_VDD (GPIO)	Not loaded	Loaded

*** Default power selection for PDM2 microphone**

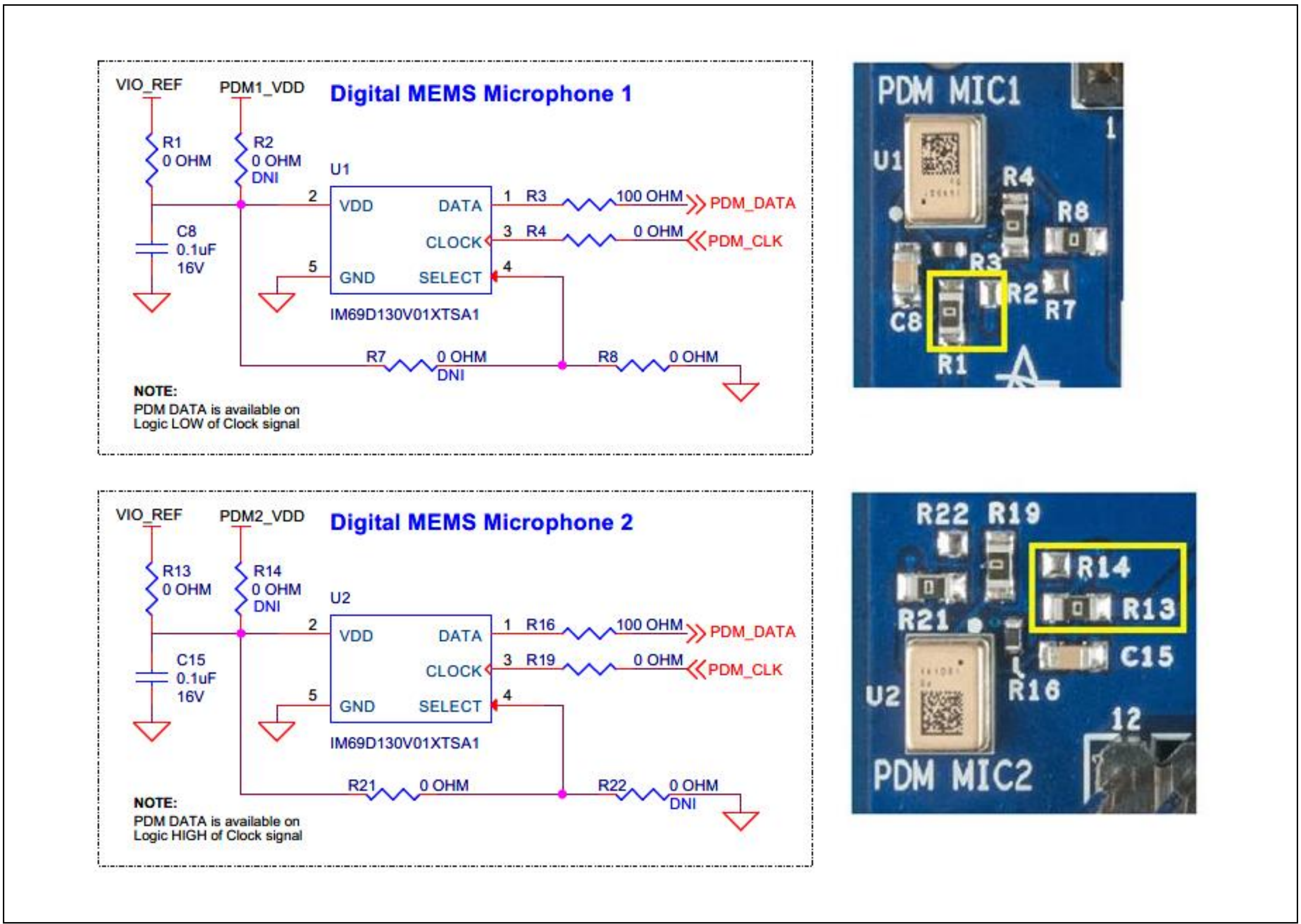

Figure 22 **Schematic of the resistor configuration for the PDM microphone's power source selection**

3.3.6 Rework for analog microphone power source selection

The analog microphone (**U5**) can powered either through **VIO_REF** or **GPIO.** A resistor is provided to select the power source as shown in **Table 10.**

Table 10 **Resistor configuration for analog microphone 1 power selection**

Power source	R30	R31
VIO_REF	Loaded	Not loaded
VM_PSO (GPIO)*	Not loaded	Loaded

*** Default power selection for analog microphone**

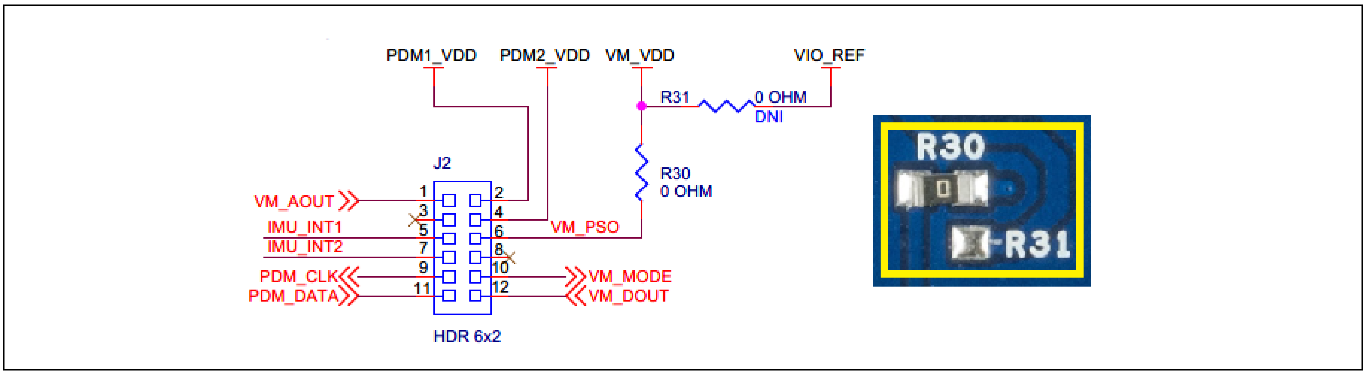

Figure 23 Schematic of resistor configuration for the PDM microphone's power source selection

3.4 Bill of materials

See the BOM file available on the **kit webpage**.

Revision history

Major changes since the last revision

Date	Version	Description
2021-05-28	**	Initial release.
2021-06-30	*A	Updated **Introduction**: Updated **Board details**: Updated **Figure 2**. Updated **Kit operation**: Updated **Using the machine learning gesture classification code example**: Updated **Operation**: Updated description. Updated **Hardware**: Updated **Hardware functional description**: Updated **OLED display module**: Updated description. Updated to new template.

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Edition 2021-06-30
Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
002-32652 Rev. *A