CY8CKIT-028-SENSE IoT Sense Expansion Kit User Guide

About this document

Scope and purpose

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

Intended audience

This expansion board is intended for all technical specialists who are familiar with IoT and sensing technologies and is intended to be used under laboratory conditions.

Expansion Board

This board is to be used during the design-in process for interfacing and evaluating sensor features, and for checking datasheet specifications.

Note: *PCB and auxiliary circuits are NOT optimized for final customer design.*

Reference Board/Kit

Product(s) embedded on a PCB with a focus on specific applications and defined use cases that may include software. PCB and auxiliary circuits are optimized for the requirements of the target application.

Note: *Boards do not necessarily meet safety, EMI, quality standards (for example UL, CE) requirements*

Important notice

"Evaluation Boards and Reference Boards" shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as "Reference Board").

Environmental conditions have been considered in the design of the Evaluation Boards and Reference Boards provided by Infineon Technologies. The design of the Evaluation Boards and Reference Boards has been tested by Infineon Technologies only as described in this document. The design is not qualified in terms of safety requirements, manufacturing and operation over the entire operating temperature range or lifetime.

The Evaluation Boards and Reference Boards provided by Infineon Technologies are subject to functional testing only under typical load conditions. Evaluation Boards and Reference Boards are not subject to the same procedures as regular products regarding returned material analysis (RMA), process change notification (PCN) and product discontinuation (PD).

Evaluation Boards and Reference Boards are not commercialized products, and are solely intended for evaluation and testing purposes. In particular, they shall not be used for reliability testing or production. The Evaluation Boards and Reference Boards may therefore not comply with CE or similar standards (including but not limited to the EMC Directive 2004/EC/108 and the EMC Act) and may not fulfill other requirements of the country in which they are operated by the customer. The customer shall ensure that all Evaluation Boards and Reference Boards will be handled in a way which is compliant with the relevant requirements and standards of the country in which they are operated.

The Evaluation Boards and Reference Boards as well as the information provided in this document are addressed only to qualified and skilled technical staff, for laboratory usage, and shall be used and managed according to the terms and conditions set forth in this document and in other related documentation supplied with the respective Evaluation Board or Reference Board.

It is the responsibility of the customer's technical departments to evaluate the suitability of the Evaluation Boards and Reference Boards for the intended application, and to evaluate the completeness and correctness of the information provided in this document with respect to such application.

The customer is obliged to ensure that the use of the Evaluation Boards and Reference Boards does not cause any harm to persons or third party property.
The Evaluation Boards and Reference Boards and any information in this document is provided "as is" and Infineon Technologies disclaims any warranties, express or implied, including but not limited to warranties of non-infringement of third party rights and implied warranties of fitness for any purpose, or for merchantability.

Infineon Technologies shall not be responsible for any damages resulting from the use of the Evaluation Boards and Reference Boards and/or from any information provided in this document. The customer is obliged to defend, indemnify and hold Infineon Technologies harmless from and against any claims or damages arising out of or resulting from any use thereof.

Infineon Technologies reserves the right to modify this document and/or any information provided herein at any time without further notice.

Safety precautions

Note: *Please note the following warnings regarding the hazards associated with development systems*

Table 1 **Safety precautions**

	Warning: *The DC link potential of this board is up to 1000 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.*
	Warning: *The evaluation or reference board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait five minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.*
	Warning: *The evaluation or reference board is connected to the grid input during testing. Hence, high-voltage differential probes must be used when measuring voltage waveforms by oscilloscope. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.*
	Warning: *Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.*
	Caution: *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.*
	Caution: *Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.*
	Caution: *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	Caution: *A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.*
	Caution: *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

Table of contents

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 6-axis motion 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 Technical Support for more information on Infineon sales offices and support.

1.2 Getting started

The following sections 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 has the following features:

- High-precision, excellent pressure noise performance and high-stability XENSIV™ digital barometric air pressure sensor with a 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
- A motion sensor with a 3-axis accelerometer and gyroscope (the Rev ** kit has a BMX160 motion sensor, which supports a 3-axis magnetometer too)
- 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 section 3.2.7 Arduino™-compatible headers (J1, J2, J3, and J4).
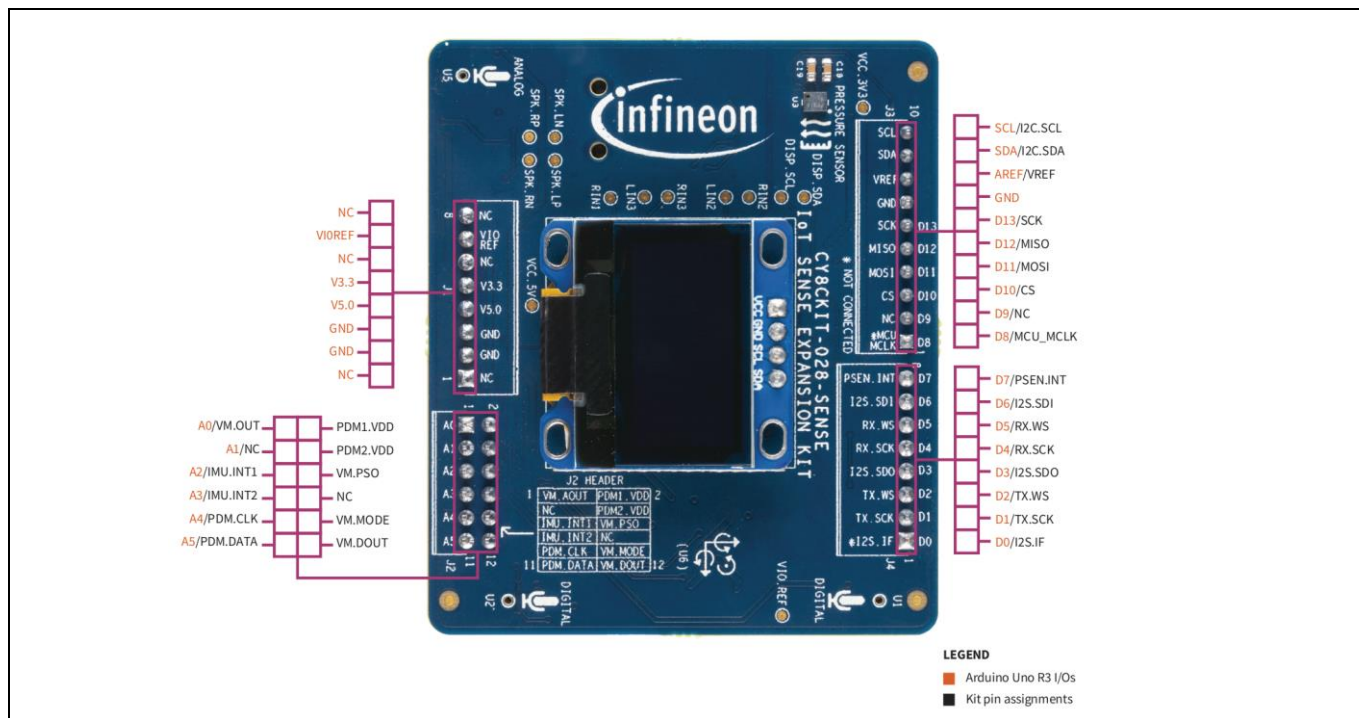

Figure 2   IoT sense expansion shield

1.4   Additional learning resources

An overview of PSoC™ devices is available in the PSoC™ 6 web page. This 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™ software
- PSoC™ 6 technical reference manuals

1.5   Technical support

For assistance, visit Technical Support. Visit community.infineon.com to ask your questions in Infineon developer community.

Document conventions

Table 2   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

1.6   Abbreviations and definitions

Table 3   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 a barometric pressure sensor from Infineon's XENSIV™ family, I2S-based stereo audio codec from Cirrus Logic, analog MEMS microphone from Vesper, a motion 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
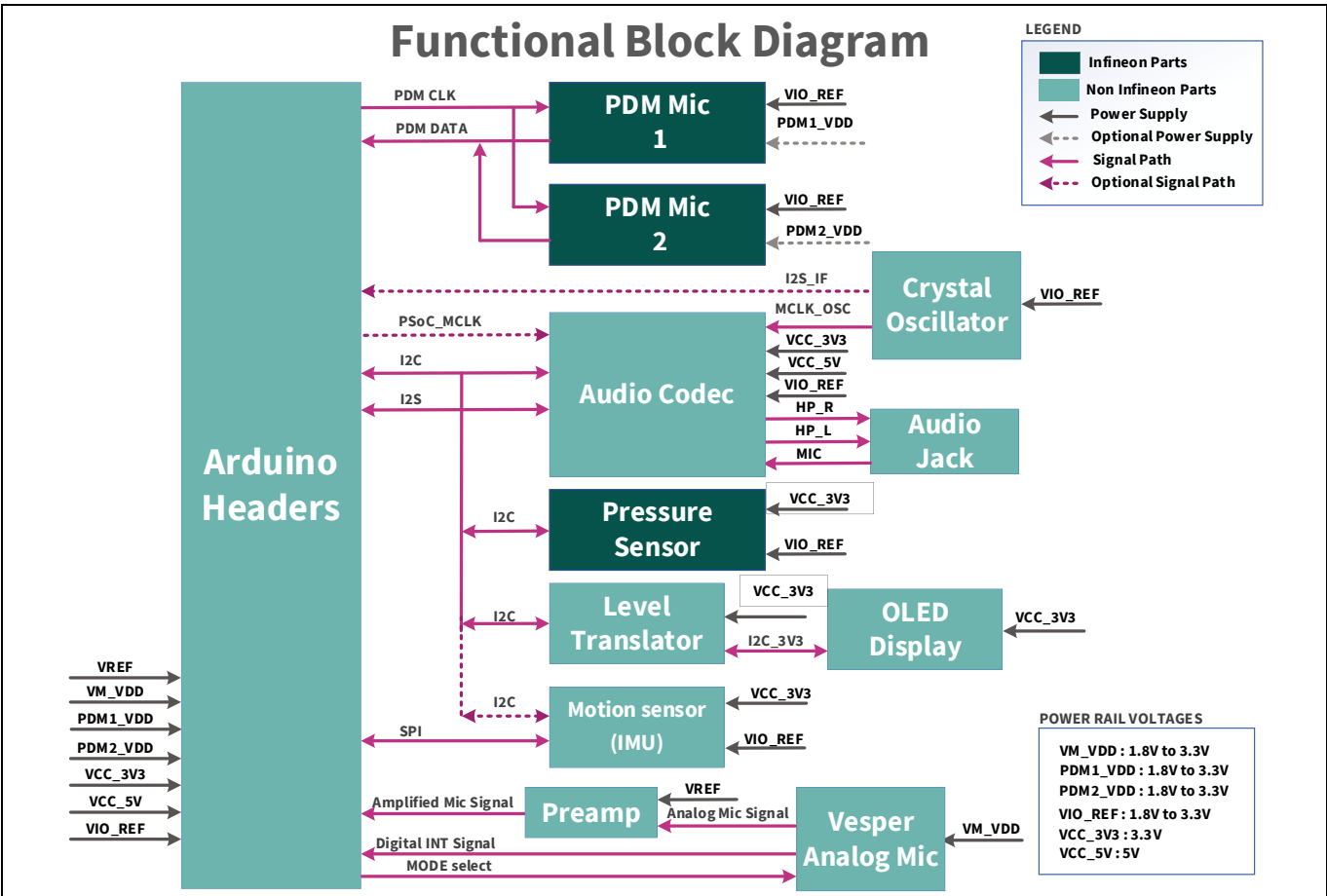

Figure 4   CY8CKIT-028-SENSE IoT sense expansion kit functional block diagram

Kit operation

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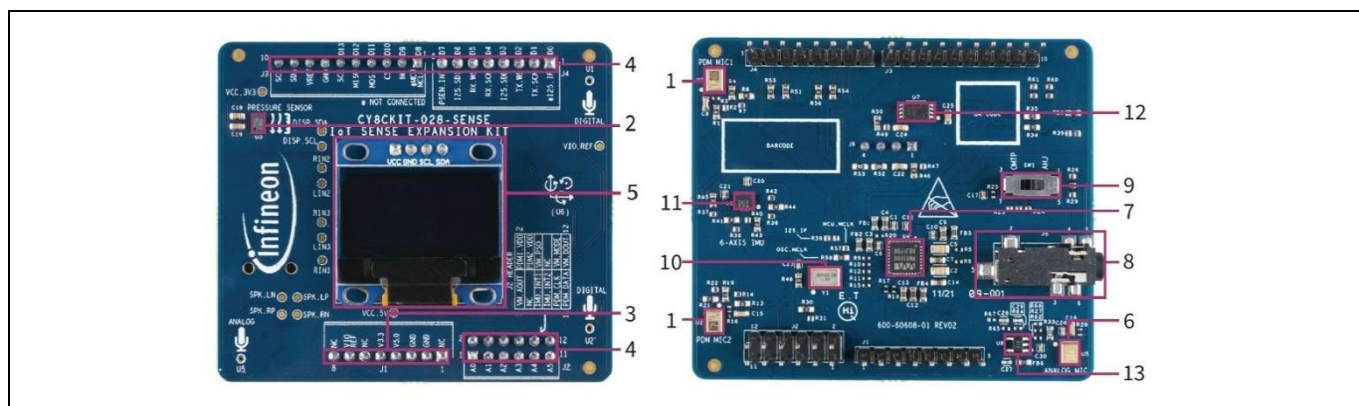

Figure 5   IoT sense expansion board details

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. **Motion sensor (U6):** This kit contains a motion sensor with a 3-axis accelerometer and gyroscope, which can be interfaced with a PSoC™ 6 MCU via SPI (default interface) or I2C.

Note: The Rev *B version of this kit has BMI160, which does not support the magnetometer feature.

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.
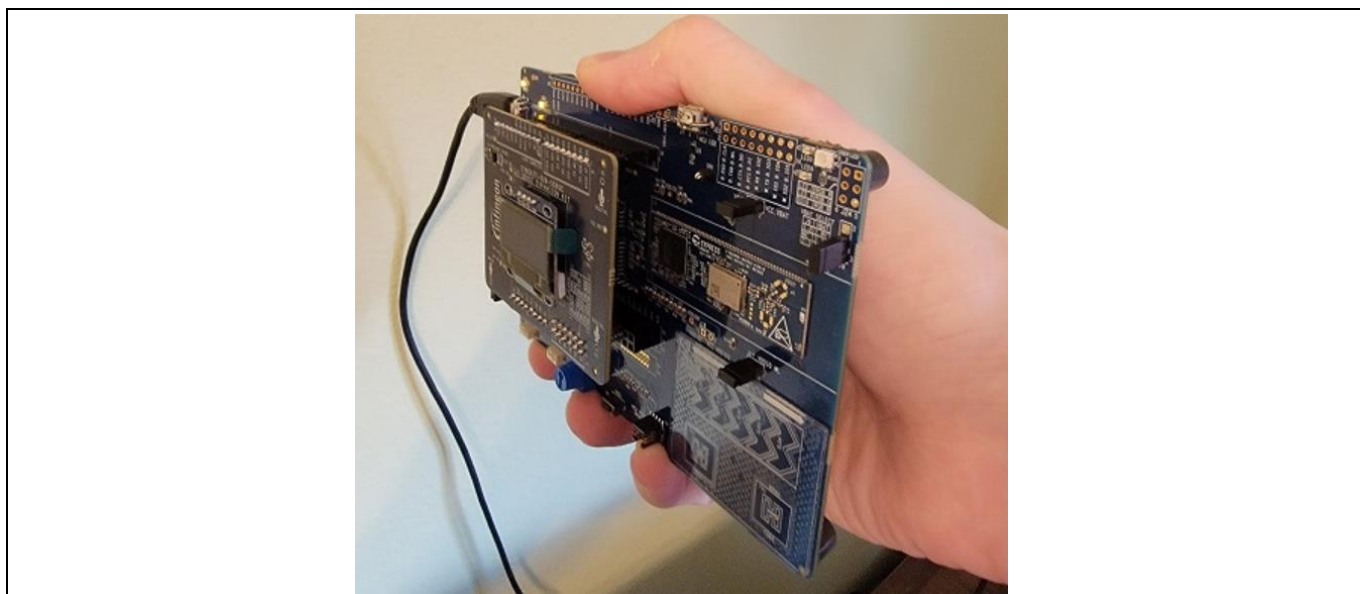6. Hold the board with the following orientation while moving your arm to complete a gesture.

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

Kit operation

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.
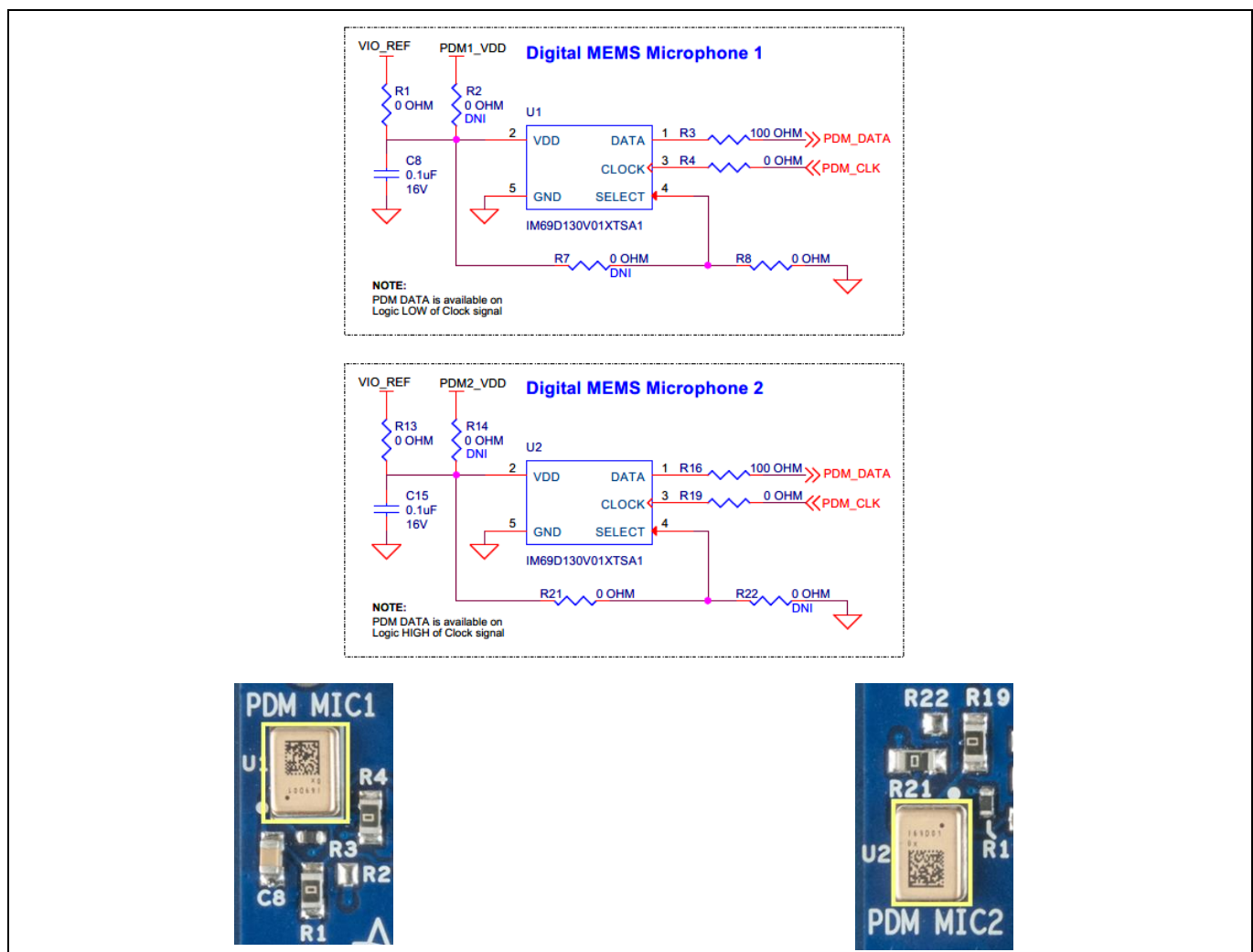

Figure 7   Schematic of digital MEMS microphones

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 100-K 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.
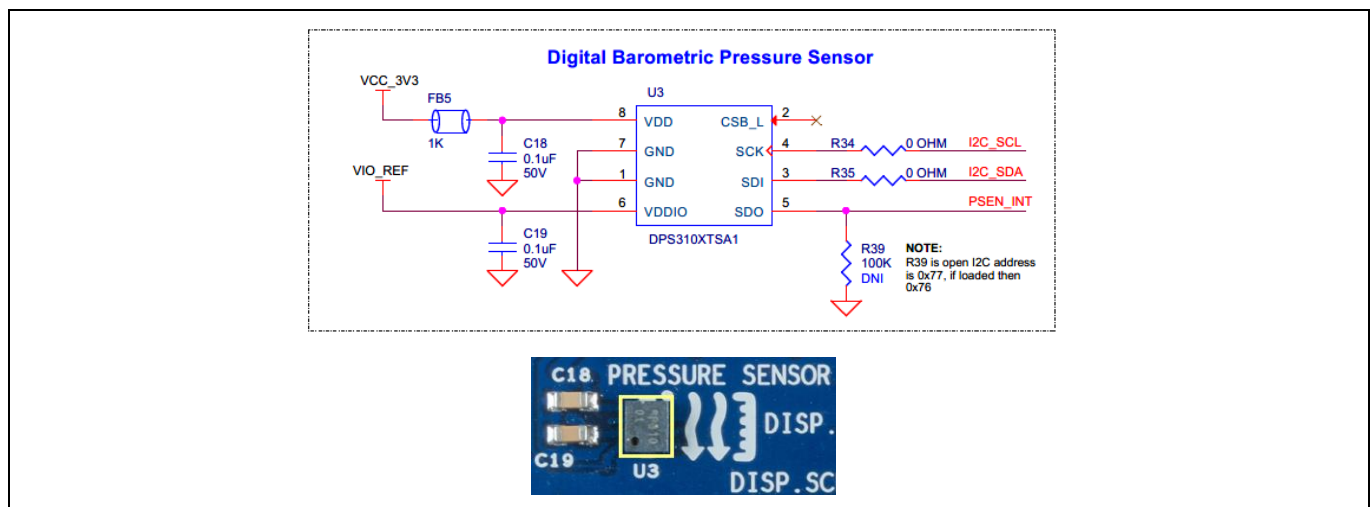

Figure 8   Schematic of the digital barometric pressure sensor

3.2.3 The motion sensor

This kit contains a motion sensor, also known as the Inertial Measurement Unit (IMU), that provides precise acceleration and gyroscopic angular rate in each spatial direction.

*Note: The Rev *B version of this kit has BMI160, which does not support the magnetometer feature.*

The interface can be configured for both I2C and SPI. See section 3.3.3 Rework for motion sensor to select interface SPI or I2C for more details.
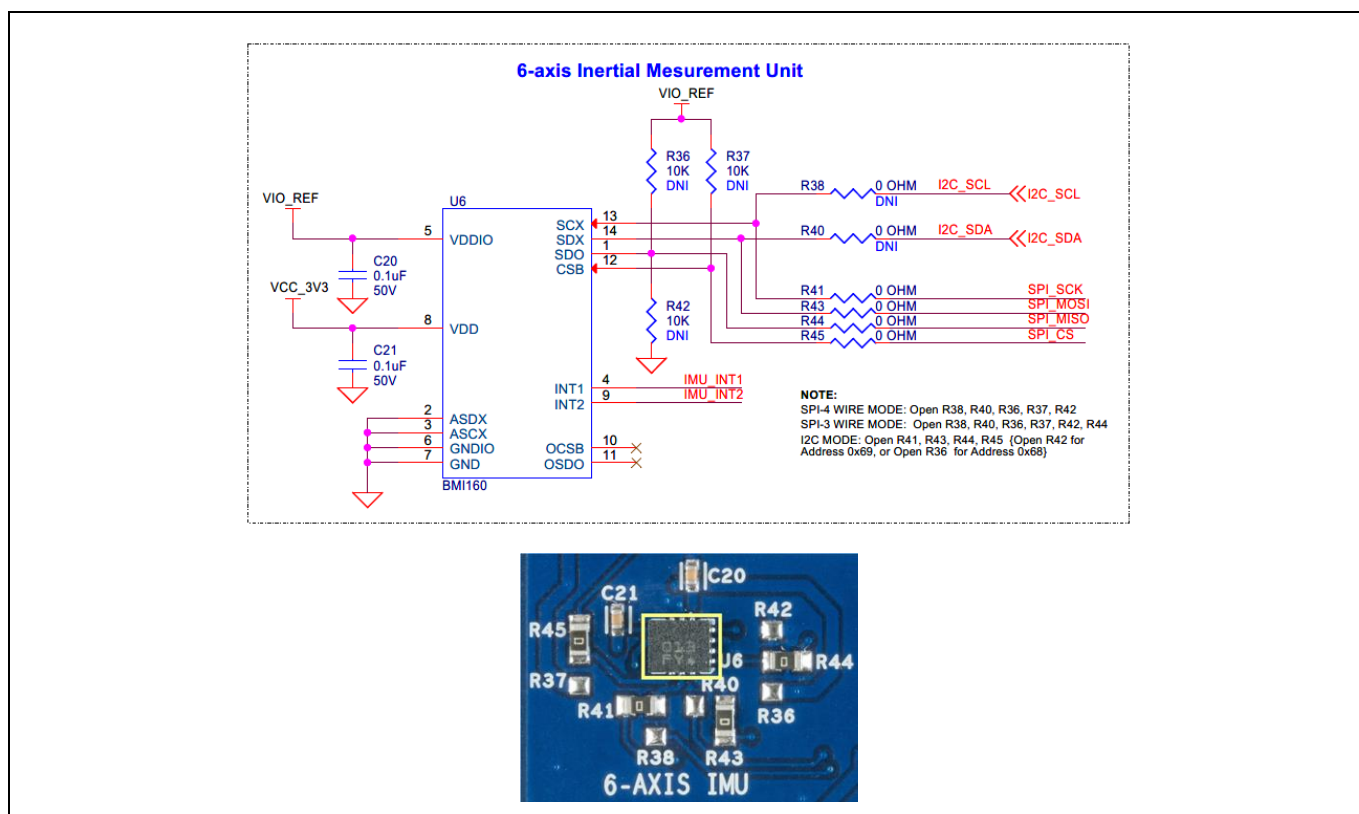
Figure 9   **Schematic of the 6-axis motion sensor**

3.2.4   Audio codec (WM8960)

This 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, 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.*
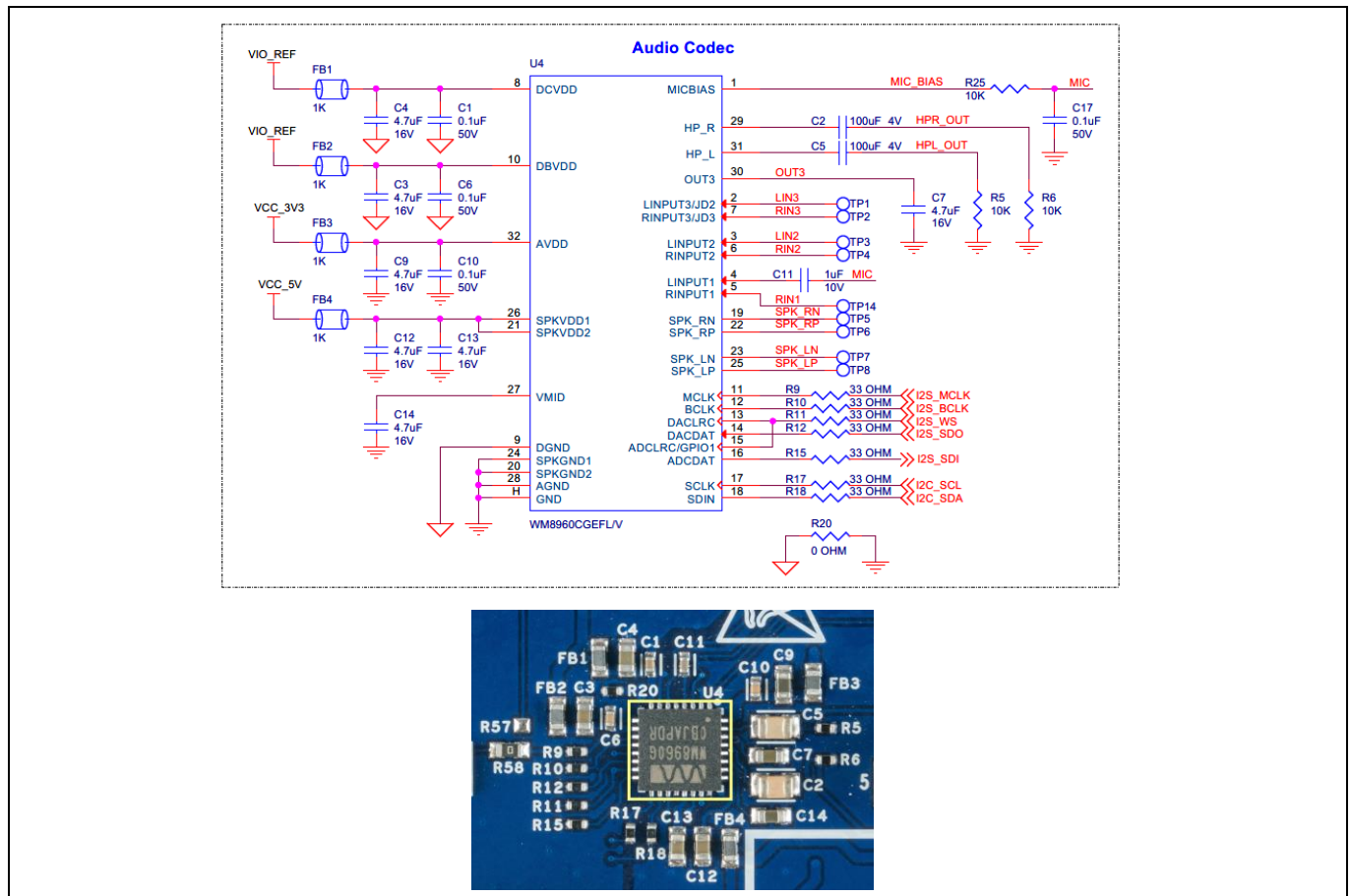
Figure 10   Schematic of the audio codec

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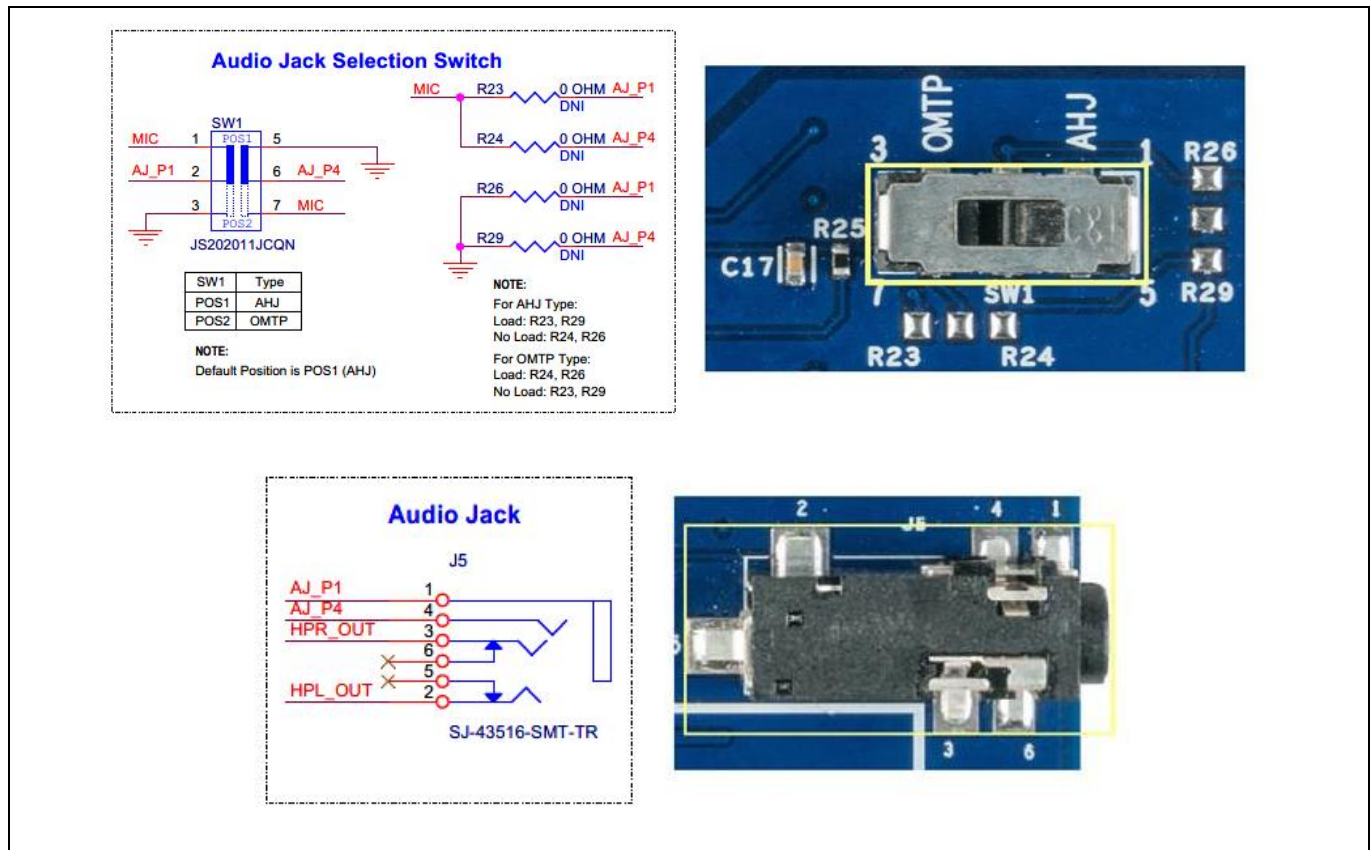
Figure 11   Schematic of the audio jack socket and type selection switch

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.
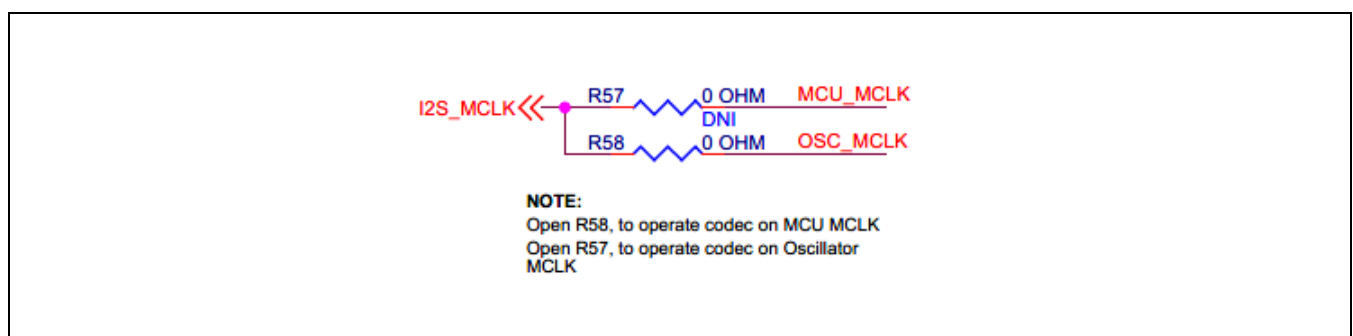

Figure 12   Schematic of I2S MCLK sourcing with resistor provision

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.
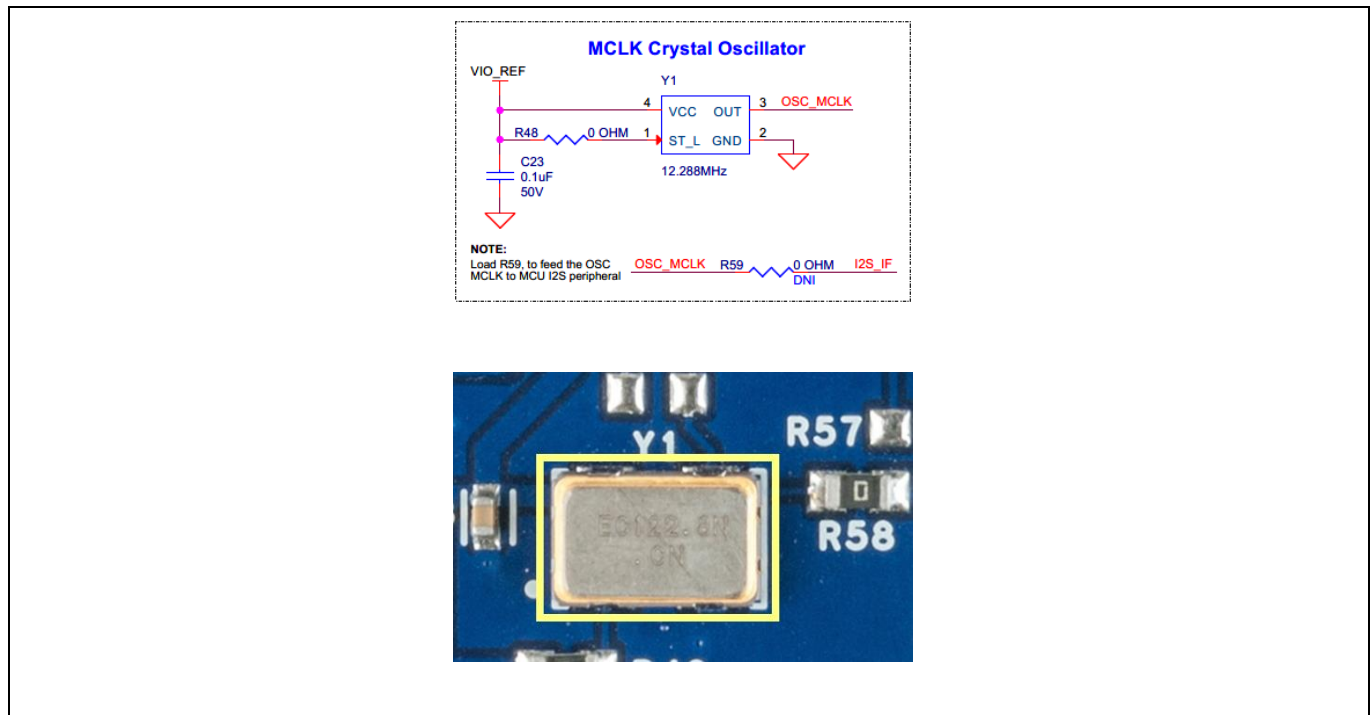
Figure 13   Schematic of the crystal oscillator

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
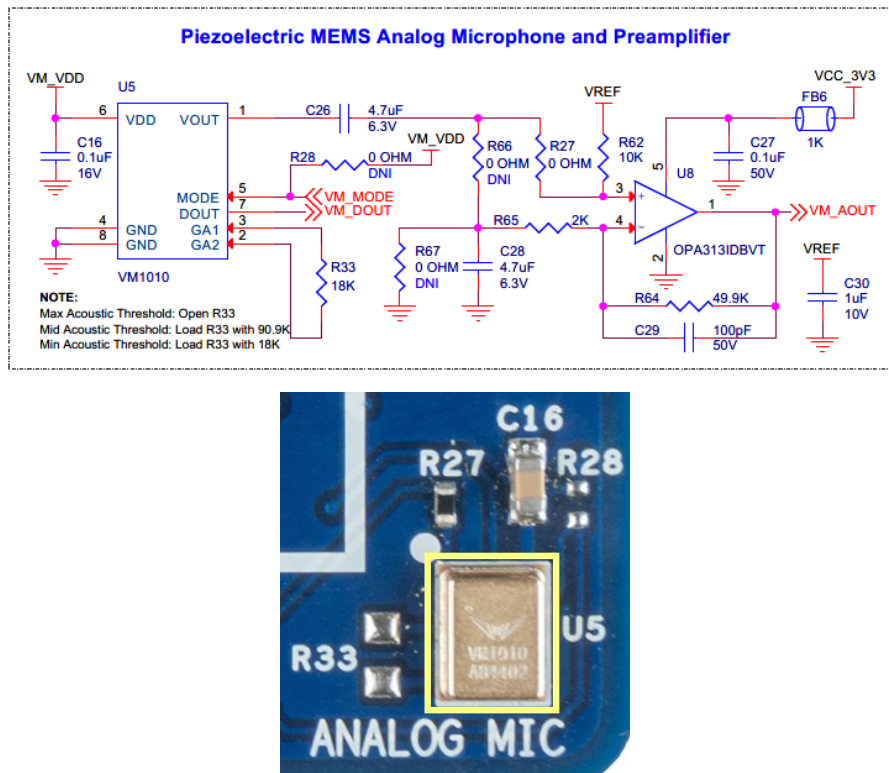- 18K – Min acoustic threshold (default setting)

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.
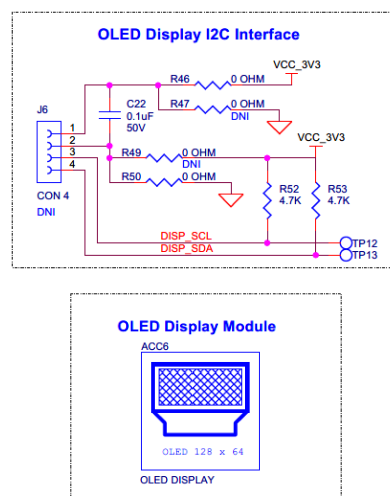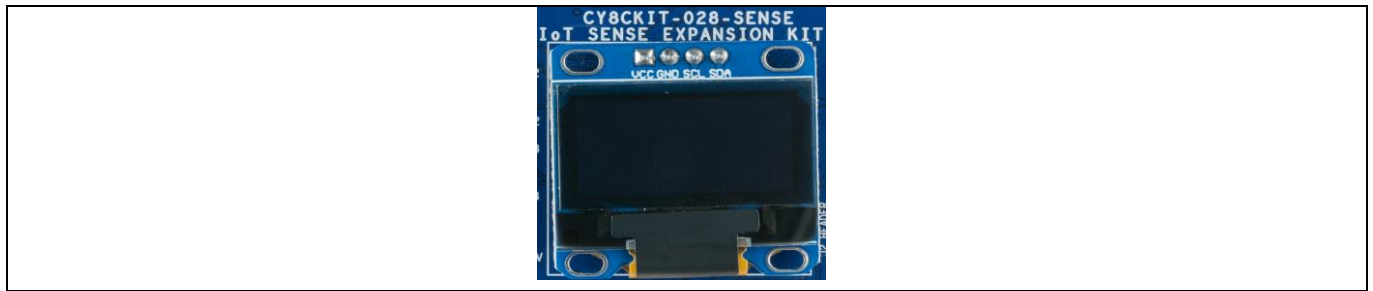
Figure 15   Schematic of the OLED display module interface

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.

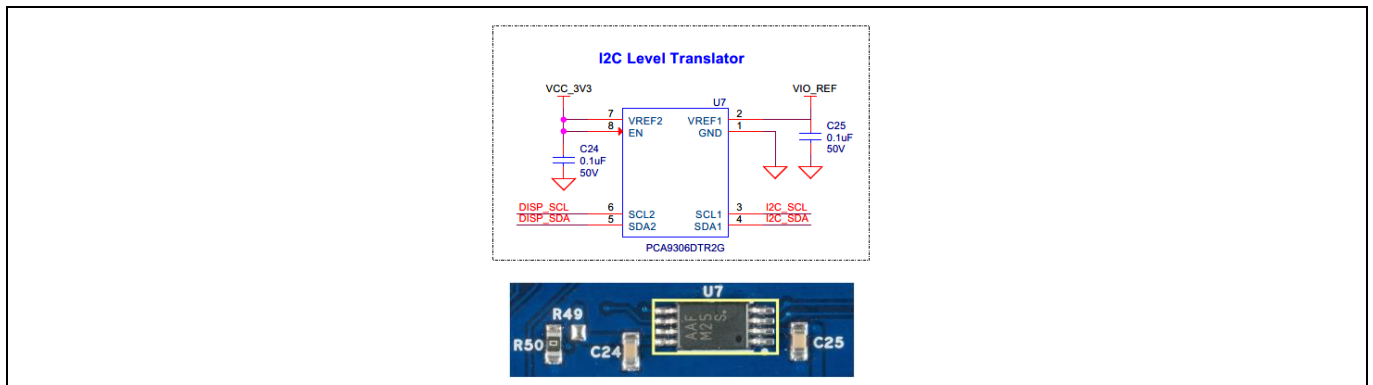**Figure 16   Schematic of the I2C level translator**

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**
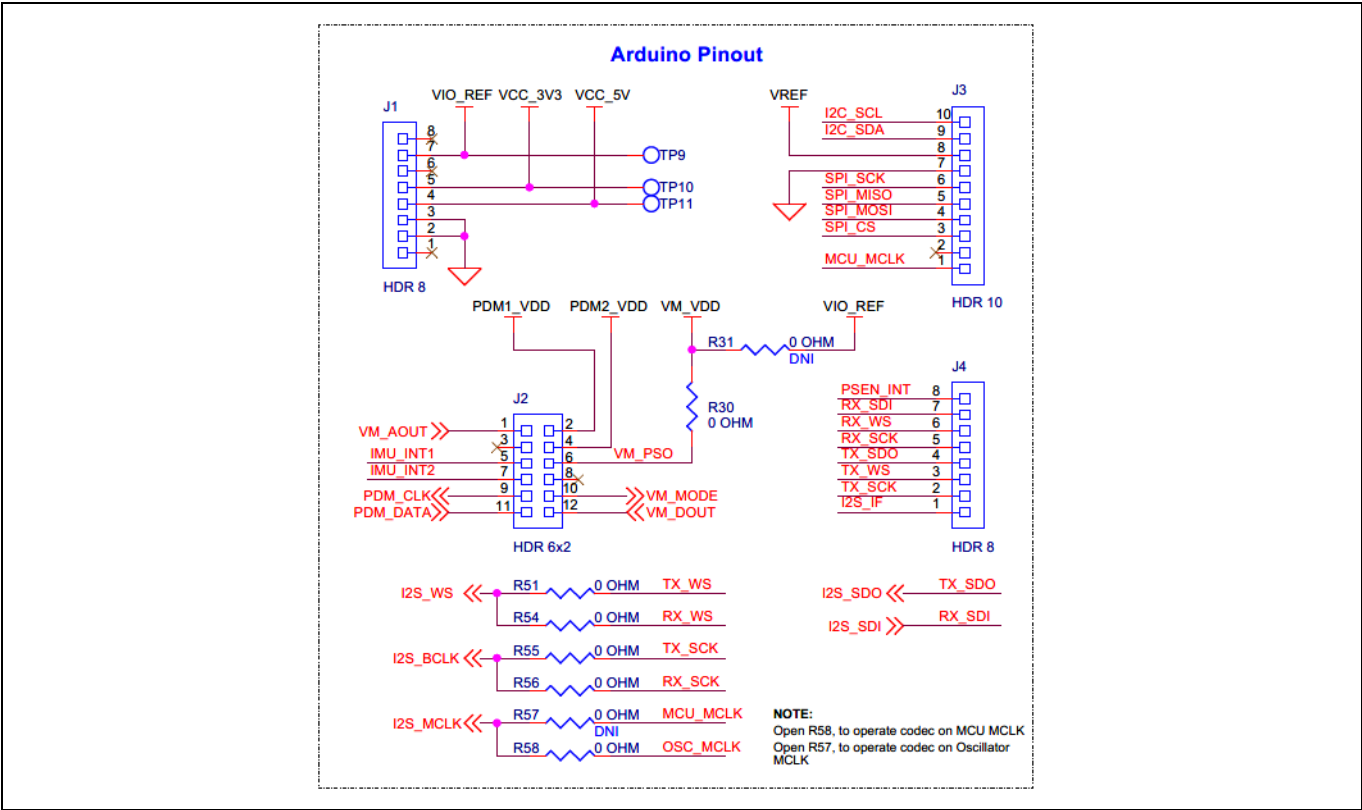
The pin assignment of the Arduino™ header and signal mapping to the baseboard are shown in Table 4.

Hardware

Table 4   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 6-axis motion sensor)
A3	P10[3]	IMU.INT2 (Interrupt pin 2 from the 6-axis motion 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
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 6-axis motion sensor)
D11	P12[0]	MOSI (SPI MOSI signal, connected to the 6-axis motion sensor)
D12	P12[1]	MISO (SPI MISO signal, connected to the 6-axis motion sensor)
D13	P12[2]	SCK (SPI clock signal, connected to the 6-axis motion 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)

---

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

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

3.2.8 I2C device addresses

The kit consists of four I2C devices (pressure sensor, OLED display module, 6-axis motion sensor, and audio codec), whose device addresses are specified in Table 5.

Table 5   I2C device addresses

Device	I2C device address (7-bit)
Barometric air pressure sensor (**U3**)	0x77 (0x76 optional configuration)
Audio codec (**U4**)	0x1A
Motion 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.
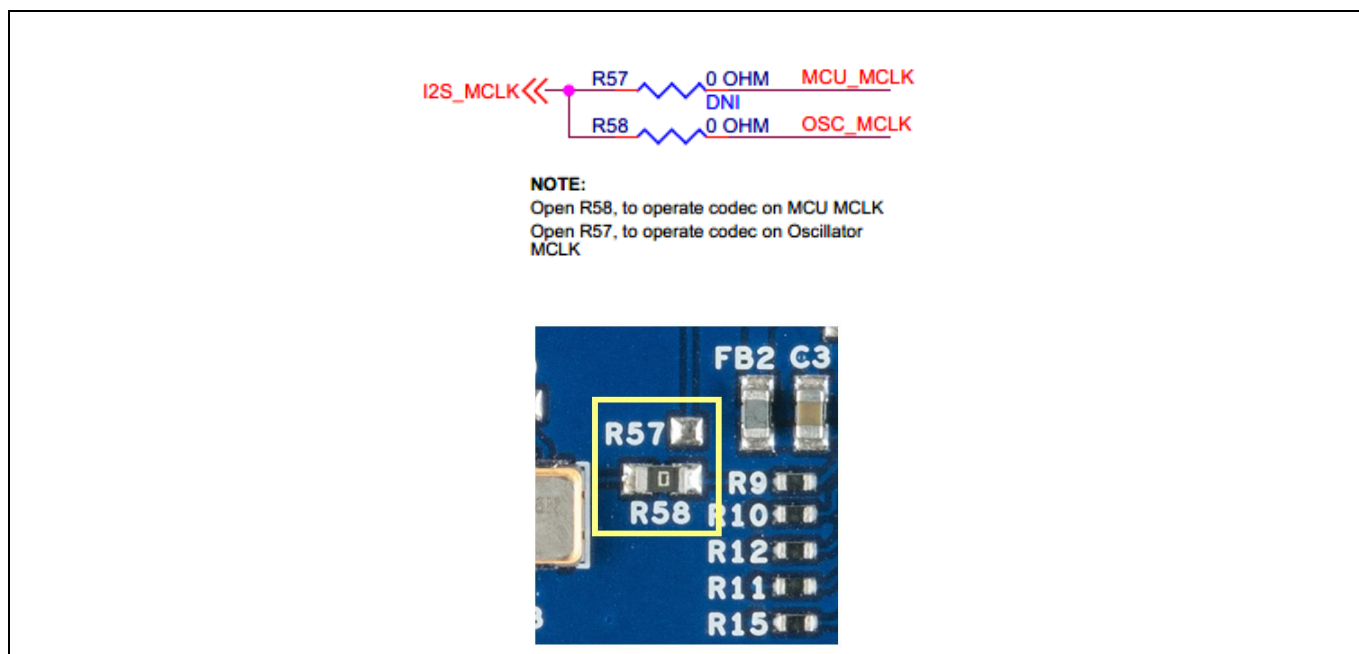

Figure 18   MCLK source selection for the audio codec

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 motion sensor to select interface SPI or I2C

The motion 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 6 gives the details of the resistors to be loaded or not loaded.

*Note: Rev *B version kit has BMI160 which does not support magnetometer feature.*

Table 6   Resistor configuration for the SPI and I2C mode of interface for the 6-axis motion 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 7   Resistor configuration for the I2C device address for the 6-axis motion sensor

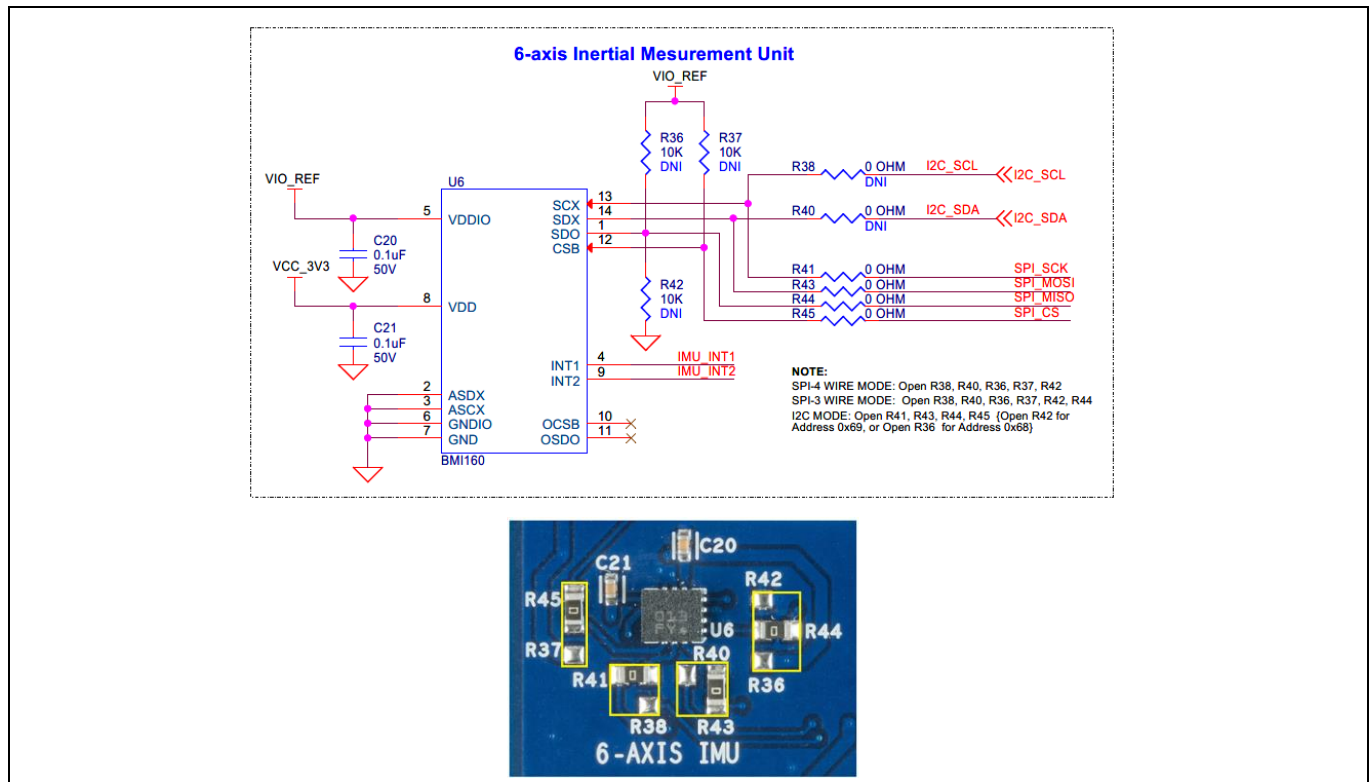| Device address (7-bit)	R36	R42
0x69	Loaded	Not Loaded
0x68	Not Loaded	Loaded

Figure 20   Schematic of the resistor configuration for the SPI and I2C mode of interface for the 6-axis motion 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 8.

Table 8   Resistor configuration for the I2C device address for the barometric pressure sensor

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

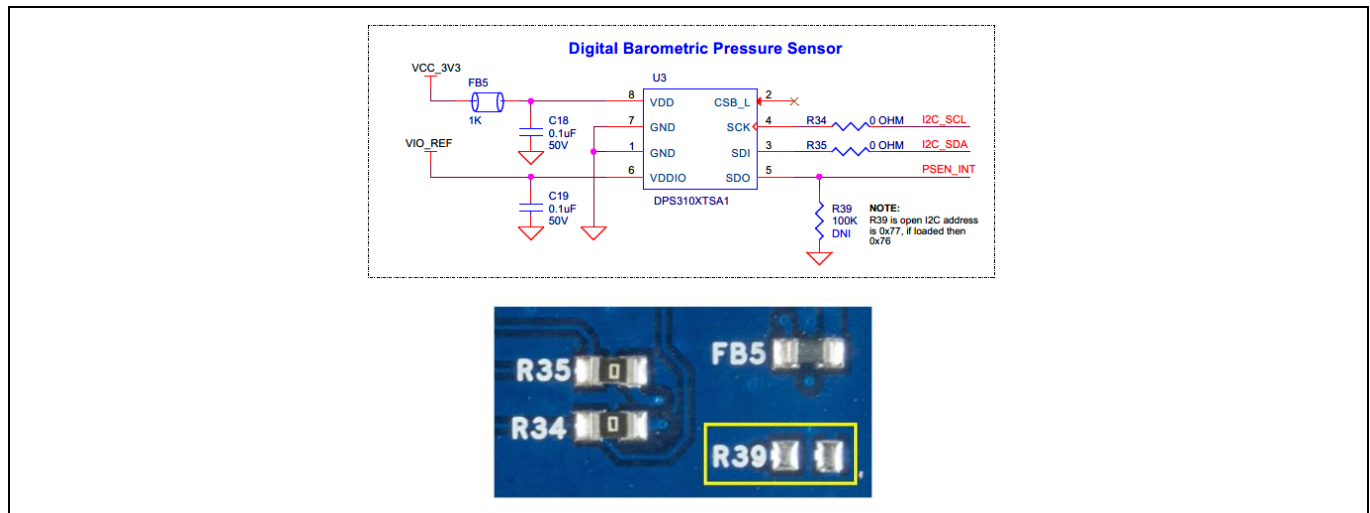*** Default I2C device address**

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 9 and Table 10.

Table 9   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 10   Resistor configuration for PDM MIC 2 power selection

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

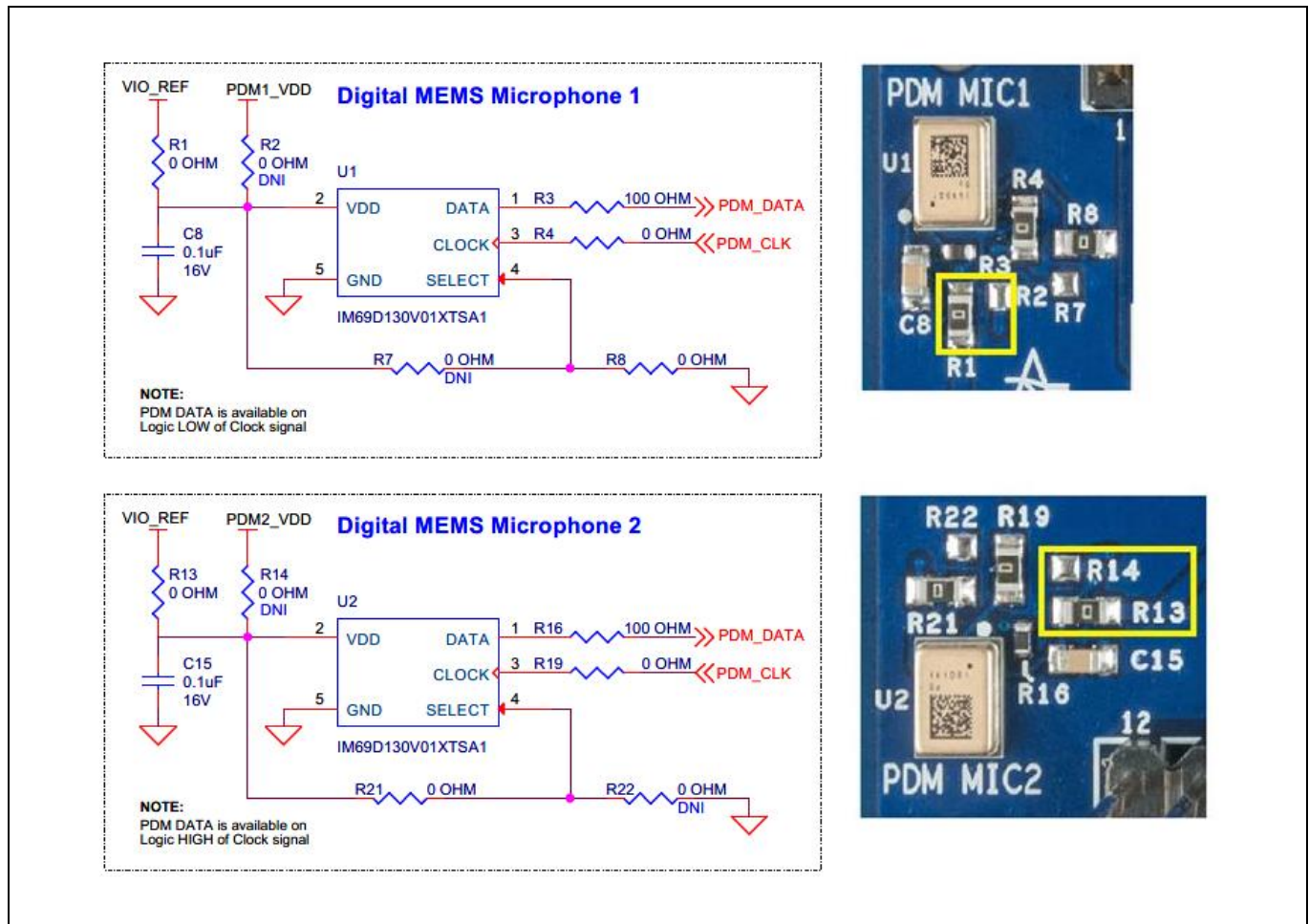*** Default power selection for PDM2 microphone**

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 be powered either through **VIO_REF** or **GPIO.** A resistor is provided to select the power source as shown in Table 11**.**

Table 11   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
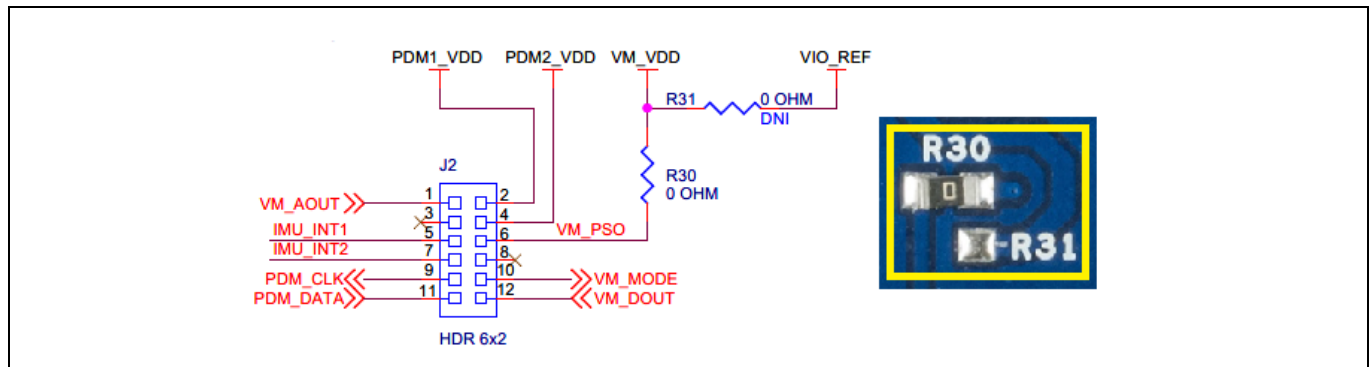
Figure 23   Schematic of resistor configuration for the PDM microphone's power source selection

3.4   Bill of materials

See the BOM file available on the kit webpage

Revision history

Document revision	Date	Description of changes
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.
2023-05-10	*B	Updated Board details. Updated all the links to Infineon links. Updated Operation. Updated The motion sensor. Updated I2C device addresses. Updated Rework for motion sensor to select interface SPI or I2C.
2023-05-31	*C	Changed the access mode for the document.

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

Warnings
Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.