restricted

PSOC™ Edge E84 HMI Kit (KIT_PSE84_HMI) user guide

About this document

Scope and purpose

This document provides guidance on using the KIT_PSE84_HMI PSOC™ Edge E84 HMI kit. It explains the kit's operation, describes the out-of-the-box (OOB) example and its operation, and provides hardware details of the board.

Intended audience

This evaluation board is intended for all technical specialists who are familiar with connectivity, and this board is intended to be used under laboratory conditions.

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Table 1 Safety precautions

	**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.*

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1 Introduction

The PSOC™ Edge E84 HMI kit enables evaluation and development of a wide range of multimedia, graphics, ML, and wireless applications in a compact and easy-to-use form factor. The kit features an onboard programmer and debugger, a 3.95-inch MIPI-DSI capacitive touch display, onboard microphones and speaker, a camera, and a variety of sensors for application development. It can demonstrate use cases such as a smart thermostat, washer or dryer, desktop display or many other applications that require human-machine interaction and powerful edge processing connectivity.

The PSOC™ Edge E84 MCU offers several key features that enable efficient execution of machine learning algorithms. These include a dual-CPU subsystem for parallel processing, a large memory capacity for storing and processing datasets, low-power operation suitable for battery-powered applications, flexible clocking options for timing control, high-speed data access and communication, analog processing capabilities, and programmable GPIOs for hardware control.

For more details, refer to the PSOC™ Edge E84 MCU section or PSOC™ Edge E84 MCU datasheet.

1.1 Kit contents

PSOC™ Edge E84 HMI Kit includes:

1. PSOC™ Edge E84 HMI kit
2. USB Type-C to Type-C Cable

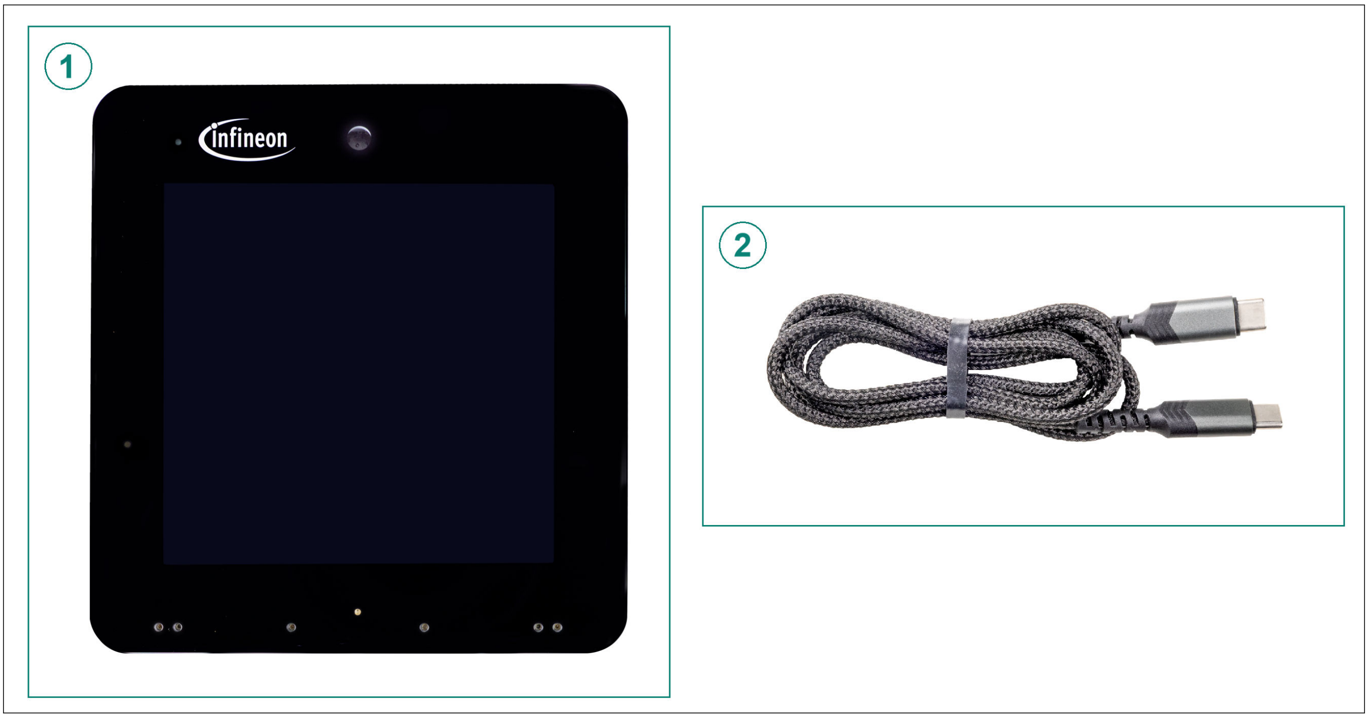


Figure 1 Kit contents

Inspect the contents of the kit; if you find any parts missing, go to the Infineon Support Page.

1.2 Getting started

The document includes the following information:

- Kit operation

  Describes the major features and functionalities of the PSOC™ Edge E84 HMI kit, including programming and debugging
- Hardware

Provides a detailed description of the kit hardware, including schematics, and the bill of materials (BOM)

- Application development using PSOC™ Edge E84 HMI Kit is supported in ModusToolbox™ software. For the latest software support for this development kit, including the different development ecosystems, see the AN235935 - Getting started with PSOC™ Edge E84 MCU on ModusToolbox™ software
  - ModusToolbox™ software is a free development ecosystem that includes the ModusToolbox™ IDE. Using the IDE, you can enable and configure device resources, middleware libraries, and program and debug the device. You can download the software from the ModusToolbox™ home page
- A set of code examples available to help you evaluate the PSOC™ Edge E84 HMI kit and become familiar with the PSOC™ Edge E84 MCU and helps you in creating your own design. These examples are accessible through the ModusToolbox™ Project Creator tool or from the Code examples for ModusToolbox™ software page

1.3 Board details

The PSOC™ Edge E84 HMI kit includes the following features:

- PSOC™ Edge E84 MCU - PSE846GPS2DBZC4A. See the device datasheet
- AIROC™ CYW55513IUBGT-based Wi-Fi & Bluetooth® combo Murata Type 2FY (LBEE5HY2FY) connectivity module
- 3.95-inch Raspberry Pi compatible MIPI-DSI capacitive touch TFT LCD (RK040HF22-CT120C from Rocktech Displays Ltd.)
- 1-Gbit external Octal SPI flash that provides fast, expandable memory for data and code
- 512-Mbit Octal SPI HYPERRAM™
- Device USB Type-C and a USB host camera
- System power monitoring in real time
- 6-axis accelerometer and gyroscope (BMI270), digital humidity and temperature sensor (SHT40) and XENSIV™ 60 GHz RADAR sensor (BGT60TR13C) shield for data collection
- KitProg3 onboard SWD programmer/debugger, USB-UART, and USB-I2C bridge functionality
- Two XENSIV™ MEMS analog microphones, four XENSIV™ MEMS PDM microphones, and an onboard speaker for audio applications
- MicroSD card interface
- M.2 (E-key) interface for radio connectivity module
- Two mikroBUS shuttle interface connectors by MikroElektronika
- Supports 1.8 V and 3.3 V operation of PSOC™ Edge E84 MCU
- RGB user LED, two user buttons, a system power reset switch, and a reset switch for PSOC™ Edge E84 MCU
- One mode selection switch and one status LED for KitProg3

Figure 2 shows the components of the PSOC™ Edge E84 HMI Kit.

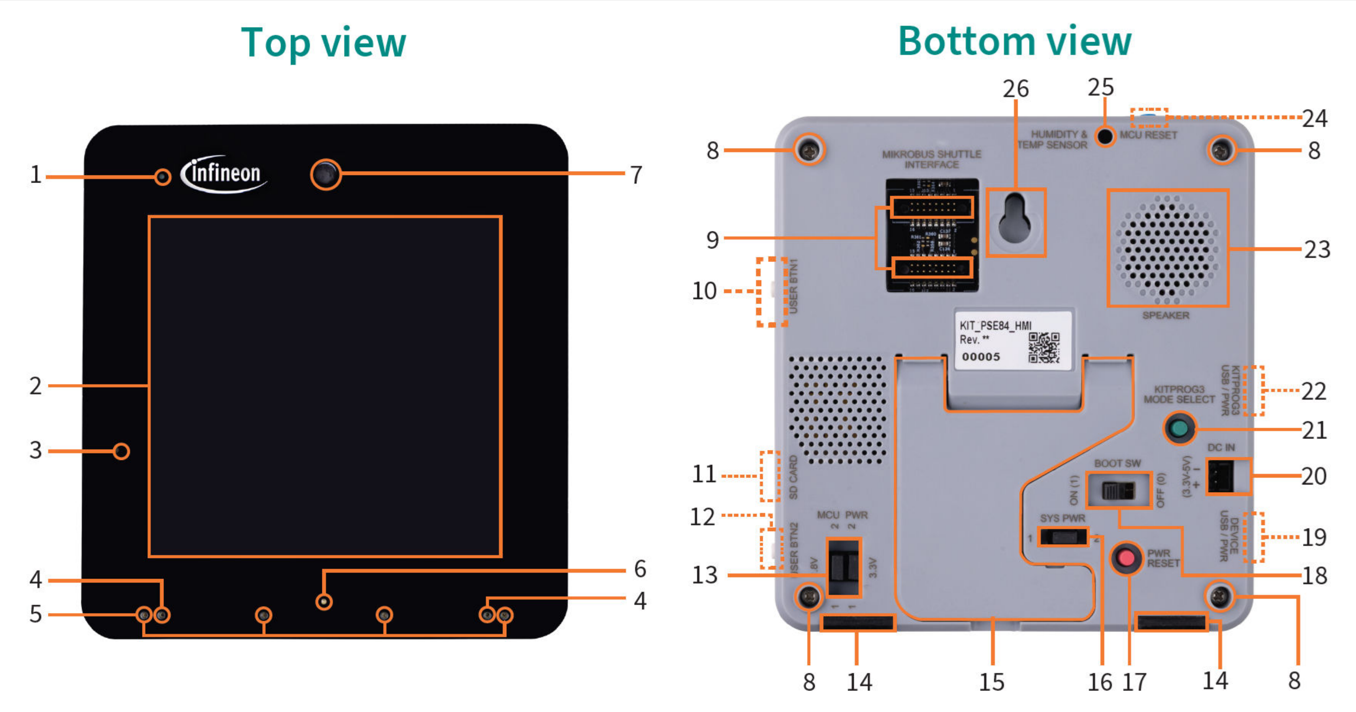


Figure 2 **Kit markup**

1. **Power LED (green LED):** Indicates the status of power supplied to the board
2. **3.95-inch Raspberry Pi compatible MIPI-DSI capacitive touch TFT LCD:** A high-resolution display (480×480 pixels, with 512×480 hardware stride alignment) RK040HF22-CT120C (from Rocktech Displays Ltd.)
3. **KitProg3 status LED:** Indicates the status of the KitProg3 programming and debugging tool, providing visual feedback during programming and debugging operations
4. **Analog microphones (IM73A135V01XTSA1):** High-quality XENSIV™ analog microphones designed for low-power wake word detection applications. These microphones provide an option for ultra-low power voice activation scenarios. Note: - Currently not utilized in this thermostat application
5. **PDM microphones (IM73D122V01):** High-quality XENSIV™ MEMS digital microphones that provide audio input
6. **RGB User LED:** Provides visual feedback to the user. It can be programmed to display different colors and patterns to indicate different states or events, such as power on, power off, or system errors
7. **USB Camera:** A 0.3-megapixel camera sensor that provides image capture capabilities for the development kit
8. **M2 Phillips pan head machine screws:** These hardware screws used to secure the kit's components and peripherals, providing stable mechanical assembly
9. **mikroBUS shuttle interface header by MikroElektronika:** Allows connection of mikroBUS-compatible modules for expanding kit functionality with additional peripherals
10. **PSOC™ Edge E84 MCU user button 1:** Provides an input to the PSOC™ Edge E84 MCU. In the thermostat application, this button serves as a Push-to-Talk function, allowing users to manually trigger the voice assistant and provide voice commands without using the wake word
11. **MicroSD card interface:** Provides convenient data storage and transfer capabilities compatible with standard microSD card formats
12. **PSOC™ Edge E84 MCU user button 2:** Provides an input to the PSOC™ Edge E84 MCU
13. **PSOC™ Edge E84 MCU power monitoring headers:** Provide access to monitor the power consumption specifically of the PSOC™ Edge E84 MCU core. They allow measurement of the microcontroller's voltage, current, and power consumption for MCU-specific power analysis and optimization

14. **Kit rubber pad:** Provides cushioning and protection for the kit's components and peripherals
15. **Kit stand:** Allows the users to position the kit at a convenient angle
16. **System power monitoring header:** Provides access to monitor the overall system power consumption including all peripherals, sensors, display, and connectivity modules. It enables comprehensive power analysis of the entire development kit for system-level power management and optimization
17. **System power reset switch:** Allows the users to reset the system's power. It provides a convenient way to restart the system and is useful for troubleshooting and debugging
18. **BOOT configuration switch:** Configures the system's boot source selection. When the switch is in the ON position, the system boots from Flash memory. When in the OFF position, the system boots from RRAM
19. **USB device Type-C connector:** Allows the users to connect the kit to a USB host device
20. **External power supply VIN connector:** Allows the users to connect an external power supply to the kit
21. **KitProg3 programming mode selection button:** Allows the users to select the KitProg3 programming mode. It provides a convenient way to switch between different programming modes (USER mode and Advance mode). For more information, follow the KitProg3 datasheet
22. **KitProg3 program/debug USB Type-C connector:** Allows the users to connect the KitProg3 programming and debugging tool to the kit
23. **Speaker:** Provides audio output to the user. It is used for applications such as audio playback, system notifications and is designed to provide high-quality signals with low distortion
24. **PSOC™ Edge E84 MCU Reset button:** Allows the users to reset the PSOC™ Edge E84 MCU. It provides a convenient way to restart the system and is useful for troubleshooting and debugging
25. **Humidity and temperature sensor:** Provides measurements of the ambient humidity and temperature
26. **Wall mount hook slot:** Allows the users to mount the kit on a wall. It provides a convenient way to secure the kit and is designed to be adjustable and customizable

Figure 3 shows the components of PSOC™ Edge E84 HMI baseboard.

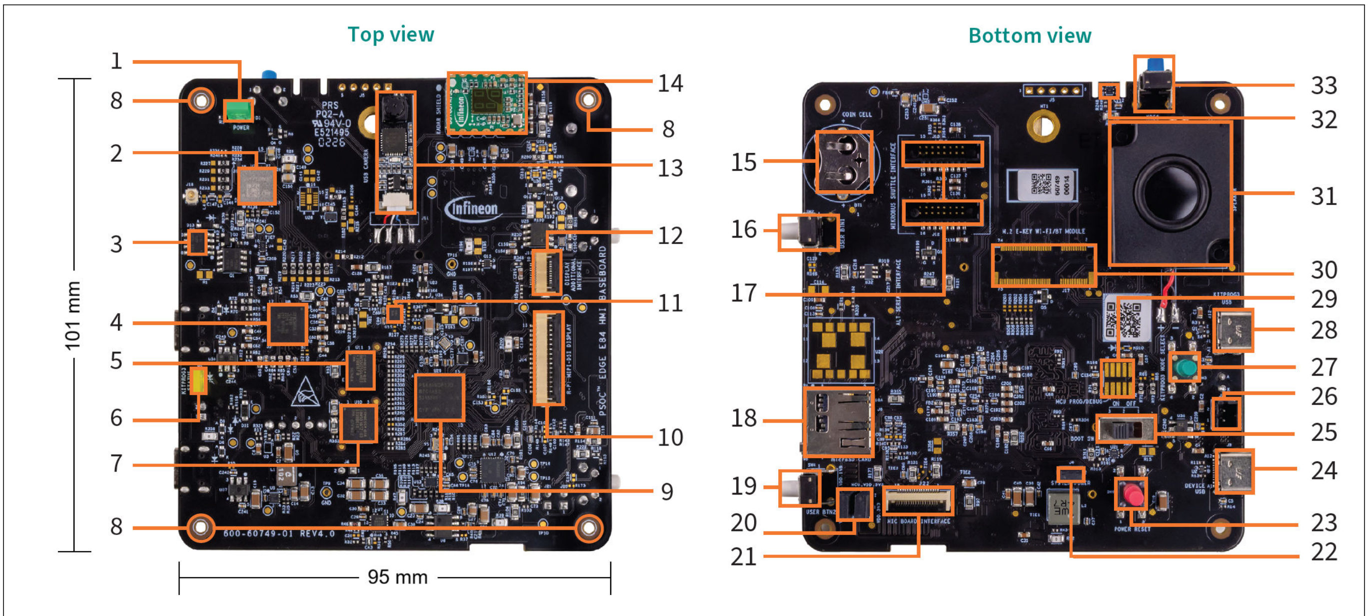


Figure 3 **Baseboard markup**

1. Power LED (**D1**)
2. CYW55513-based Murata Type 2FY radio module – LBEE5HY2FY (Murata) (**U27**)
3. Wi-Fi/Bluetooth® external antenna connector (**J18**)
4. KitProg3 (PSOC™ 5LP) programmer and debugger – CY8C5868LTI-LP039 (**U8**)
5. 512-Mbit Octal-SPI HYPERRAM™ – S80KS5123GABHI023 (**U11**)

6. KitProg3 status LED (**D2**)
7. 1-Gbit Octal-SPI NOR flash – S28HS01GTGZBHI030 (**U10**)
8. M2 Mounting hole
9. PSOC™ Edge E84 MCU – PSE846GPS2DBZC4A (**U29**)
10. Raspberry Pi-compatible 15-pin MIPI-DSI display connector (**J14**)
11. 6-axis IMU – BMI270 (Bosch Sensortech) (**U15**)
12. 10-pin Display I/O Connector (**J15**)
13. USB Camera (**ACC20**)
14. XENSIV™ 60 GHz RADAR shield – BGT60TR13C
15. Coin cell retainer (**BT1**)
16. PSOC™ Edge E84 MCU user button 1 (**SW2**)
17. MikroBUS shuttle interface headers by Mikroelektronika (**J12**, **J13**)
18. MicroSD card interface (**J8**)
19. PSOC™ Edge E84 MCU user button 2 (**SW4**)
20. PSOC™ Edge E84 MCU power monitoring headers (**J20**, **J21**)
21. 18-pin Microphone board interface connector (**J22**)
22. System power monitoring header (**J4**)
23. System power reset switch (**SW6**)
24. USB device Type-C connector (**J3**)
25. BOOT configuration switch (**SW5**)
26. External power supply VIN connector (**J2**)
27. KitProg3 programming mode selection button (**SW3**)
28. KitProg3 program/debug USB Type-C connector (**J1**)
29. PSOC™ Edge E84 MCU 10-pin SWD/JTAG program and debug header (**J6**) - (DNI)
30. M.2 E-Key radio interface (**J17**) - (DNI)
31. Speaker (**ACC6**)
32. Humidity and temperature sensor – SHT40-AD1B-R2 (Sensirion) (**U19**)
33. PSOC™ Edge E84 MCU reset button (**SW1**)

Figure 4 shows the components of microphone board.

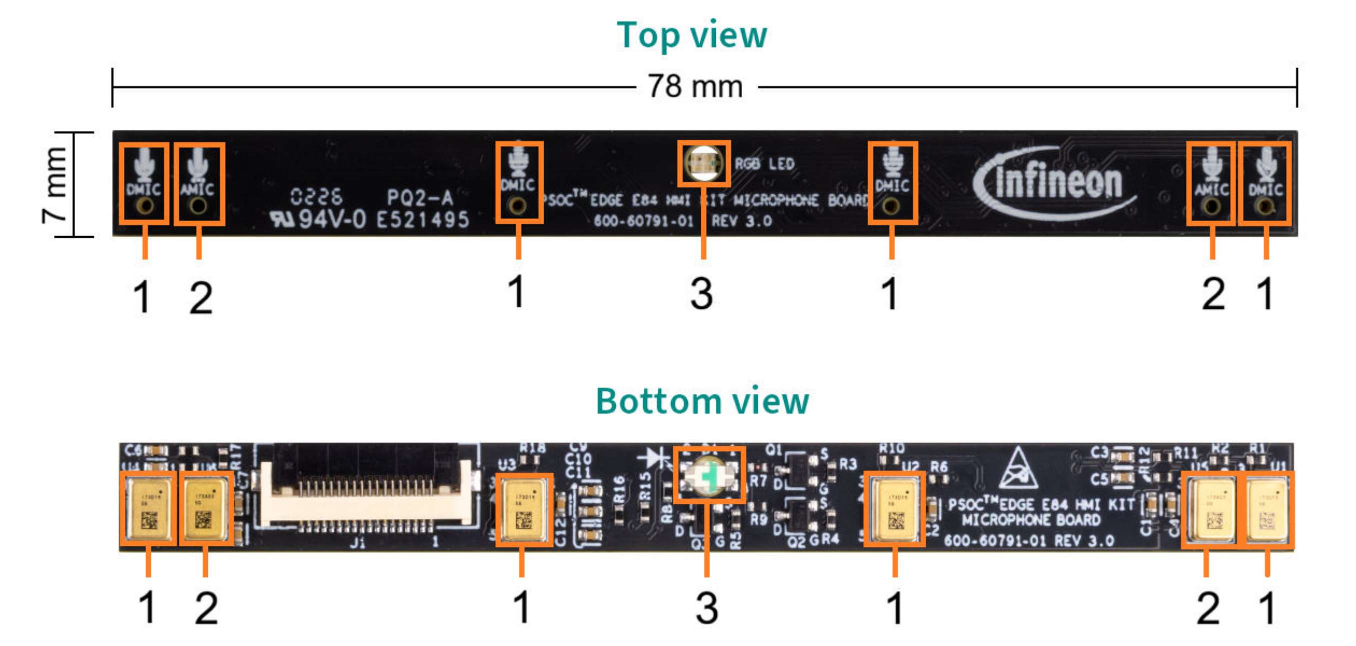


Figure 4 **Microphone board markup**

1. XENSIV™ MEMS PDM microphones – IM73D122V01 (**U1**, **U2**, **U3**, **U4**)
2. XENSIV™ MEMS Analog microphones – IM73A135V01XTSA1 (**U5**, **U6**)
3. RGB User LED (**D1**)

***Note**: The PSOC™ Edge E84 HMI Kit baseboard includes an unpopulated area for PAS CO2 sensor that is no longer sold by Infineon.*

1.4 Additional learning resources

Infineon provides a wealth of data in the PSOC™ Edge E84 webpage to:

- Select the right PSOC™ device for the design
- Quickly and effectively integrate the device into the design

1.5 Technical support

For assistance, go to Infineon support page. Visit Infineon Developer Community to ask any product-related questions.

You can also use the Self-help (Technical Documents) support resources for quick assistance

1.6 Documentation conventions

Table 2 **Document conventions for guide**

Convention	Usage
Courier New	Displays file locations, user entered text, and source code: C:\...cd\icc\

(table continues...)

Table 2 (continued) Document conventions for guide

Convention	Usage
Italics	Displays file names and reference documentation: Read about the sourcefile.hex file in the PSOC™ Creator user guide
File >Open	Represents menu paths: **File** > **Open** > **New Project**
Bold	Displays commands, menu paths, and icon names in procedures: Click the **File** icon and then click **Open**
Times New Roman	Displays an equation: 2 + 2 = 4
Text in gray boxes	Describes cautions or unique functionality of the product

2 Kit operation

This chapter provides an overview of the PSOC™ Edge HMI Kit and its key components that power the smart thermostat application. The thermostat application runs on the PSOC™ Edge E84 HMI Kit, equipped with a PSOC™ Edge E84 dual-core microcontroller featuring machine learning capabilities.

The kit includes a 4-inch MIPI-DSI capacitive touch display (Rocktech RK040HF001), delivering a responsive and intuitive user interface. The comprehensive sensor suite comprises XENSIV™ PDM microphones (IM73D122V01), analog microphones (IM73A135V01XTSA1), XENSIV™ 60-GHz radar (BGT60), a 6-axis motion sensor (BMI270), and environmental sensor temperature and humidity sensing (SHT40).

Additionally, the kit features the Wi-Fi & Bluetooth® combo module (CYW55513-based Murata type 2FY radio module) for wireless connectivity and Octal-SPI flash (S28HS01GTGZBHI030) and HYPERRAM™ memory (S80KS5123GABHI023) devices. These integrated components enable the thermostat application to demonstrate advanced smart home functionality while leveraging the full capabilities of the PSOC™ Edge platform.

2.1 Theory of operation

The PSOC™ Edge E84 HMI Kit is built around the PSOC™ Edge E84 MCU. Figure 5 illustrates the block diagram of the device. For more details on the features of the PSOC™ Edge MCU, refer to the device datasheet.

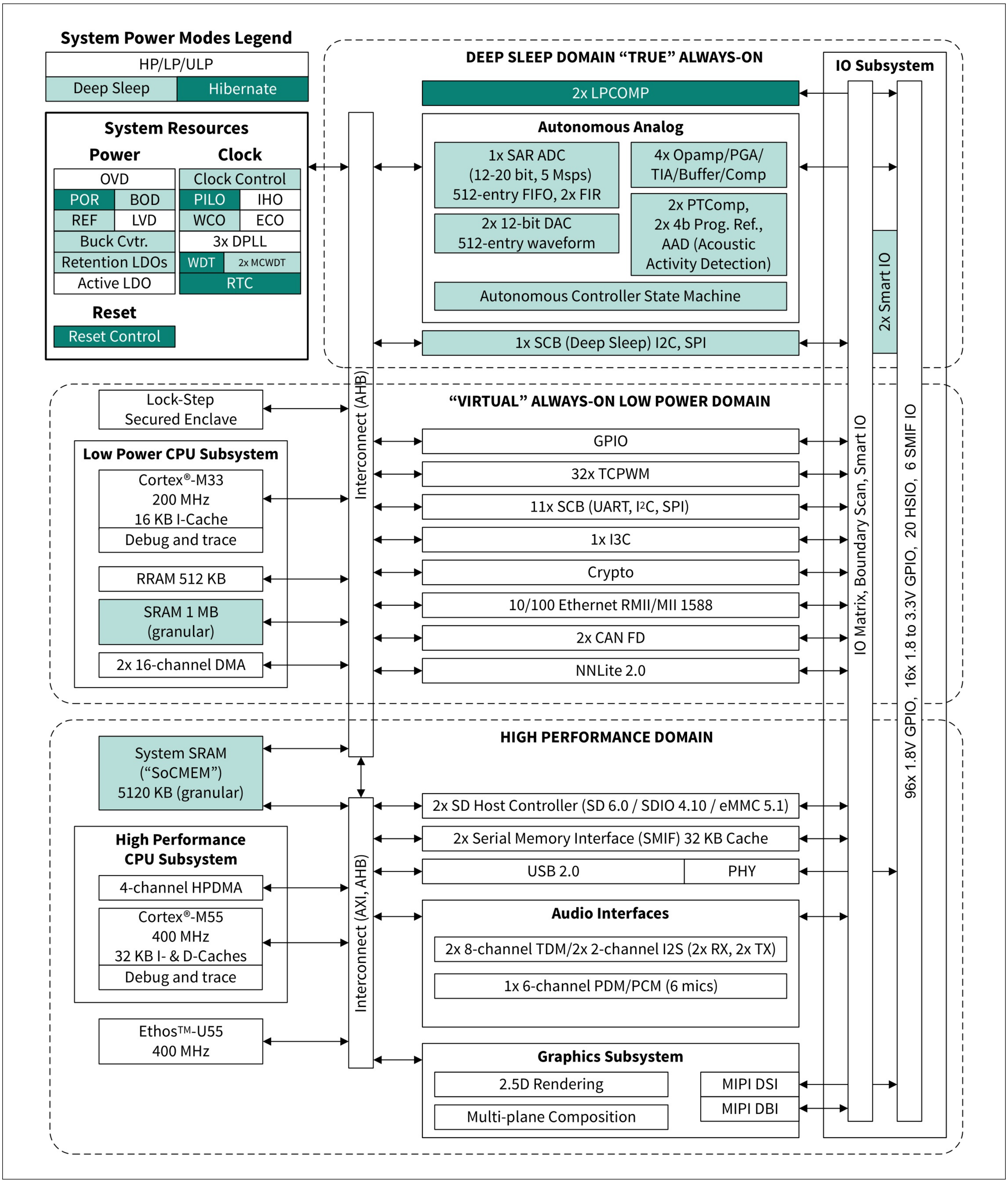


Figure 5 **Block diagram of PSOC™ Edge E84 MCU**

Figure 6 shows the power block diagram of the PSOC™ Edge E84 HMI kit.

2 Kit operation

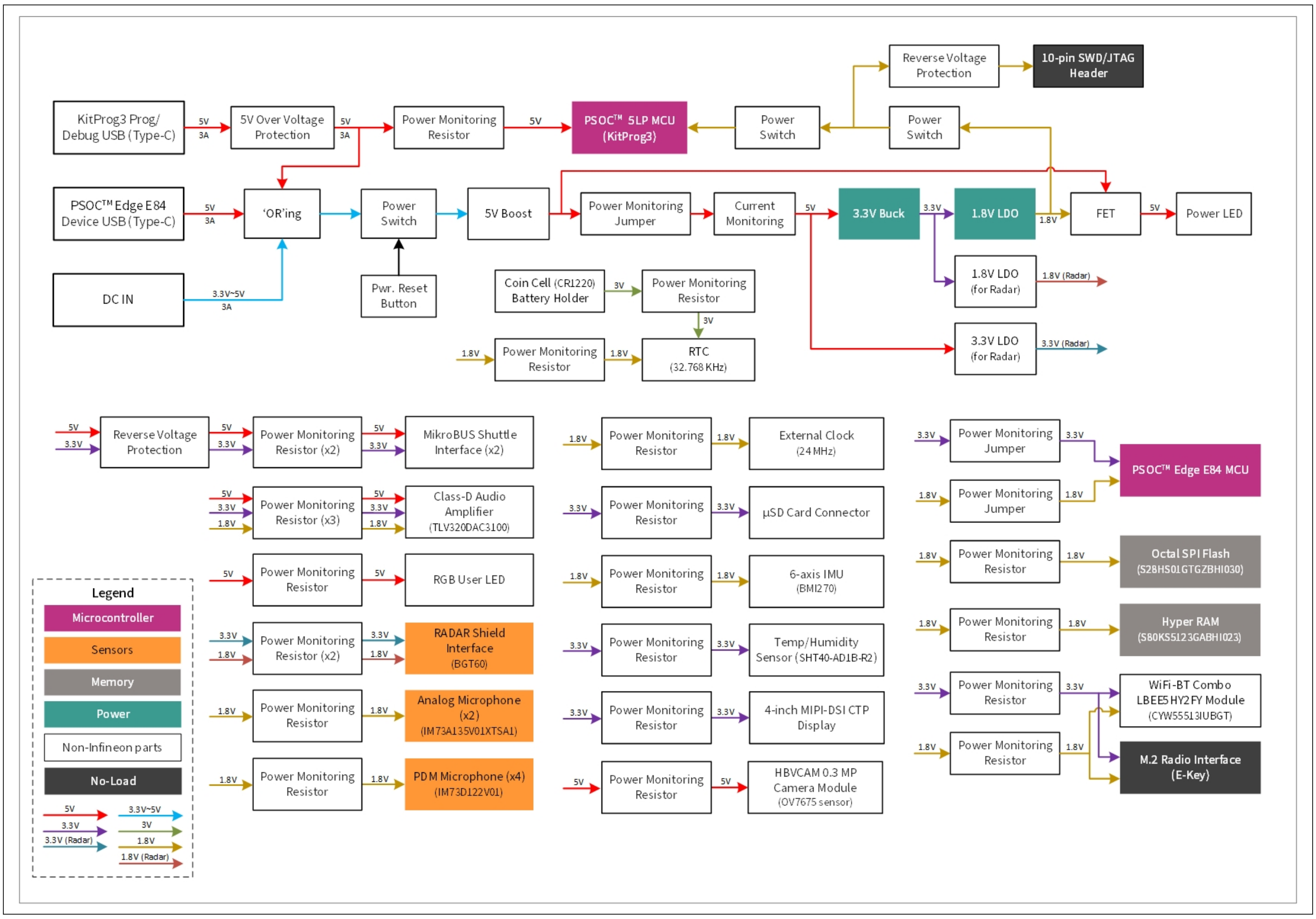


Figure 6 **Power block diagram of PSOC™ Edge E84 HMI Kit**

Figure 7 shows the functional block diagram of the PSOC™ Edge E84 HMI kit.

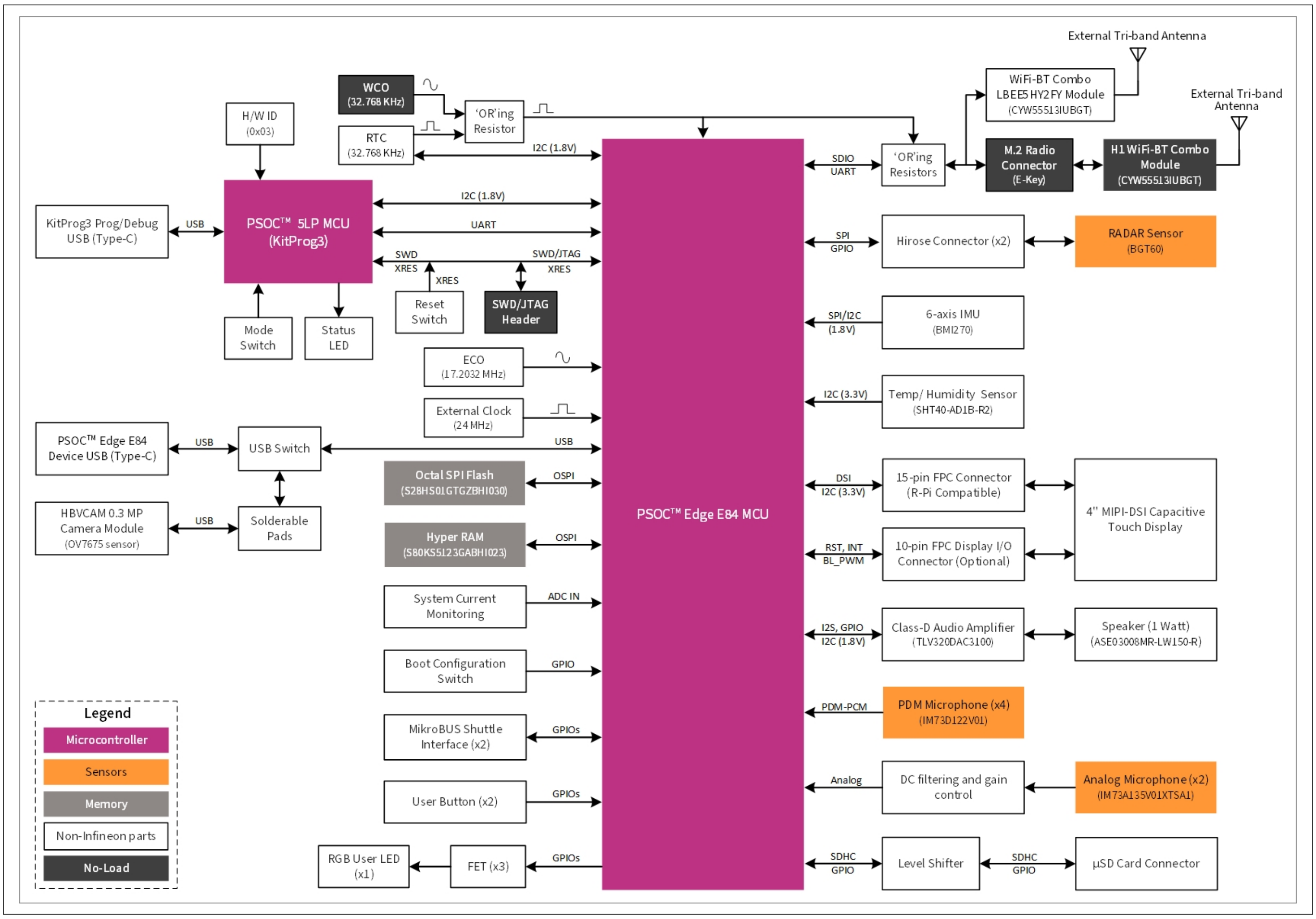


Figure 7 **Functional block diagram of PSOC™ Edge E84 HMI Kit**

2.2 Using the OOB example

By default, the PSOC™ Edge E84 HMI Kit comes pre-programmed with firmware that simulates a smart thermostat application, demonstrating key functionalities including modern graphics with touch screen interaction, voice command processing, and Bluetooth® and Wi-Fi connectivity.

The following sections provide step-by-step instructions for operating the thermostat through these various control methods. Additionally, the settings menu allows users to customize various system preferences including screen timeout duration, notification volume levels, display brightness, and temperature unit selection (°C/°F), ensuring a personalized user experience tailored to individual preferences.

For a detailed description of the project, refer to the example's `README.md` file available at [GitHub Repository Link]

2.2.1 Installing the mobile app

The PSOC™ Edge E84 HMI Kit mobile app is compatible with both **Android** and **iOS** devices. For complete functionality, the app requires Bluetooth® LE, Wi-Fi, and location permissions.

2.2.1.1 Android installation

Supported OS version: Android 12 and above

Download and install the **PSOC™ Edge E84 HMI kit** app from Google Play Store using the following QR code or visit the direct link.

Figure 8 **QR code**

Direct link: Google Play Store link - PSOC™ Edge E84 HMI kit

2.2.1.2 iOS installation

Supported OS version: iOS 15 and above

Download and install the app from Apple App Store using the following QR code or visit the direct link.

Figure 9 **QR Code**

Direct Link: Apple App Store link - PSOC™ Edge E84 HMI kit

2.2.2 Out-Of-Box (OOB) steps

The PSOC™ Edge HMI kit is by default programmed with the code example: PSOC™ Edge HMI Thermostat app. The following steps describe on how to use the example.

1. Connect a USB Type-C cable to the KitProg3 USB connector, and the other end to a USB port on a PC.

Figure 10 KitProg3 USB connected

2. The thermostat starts with a boot-up screen displaying Thermostat user interface
3. Visit the devkit.infineon.com website and update the kit to the latest firmware version.

Figure 11 QR code to update with latest firmware

4. An on-screen tutorial is available for quickly getting started with thermostat evaluation. Follow instructions displayed on the screen to evaluate the highlighted feature, and tap the instruction tab to proceed to the next step. The tutorial can be skipped and accessed later through the settings menu. The following points provide more information on the highlighted features.

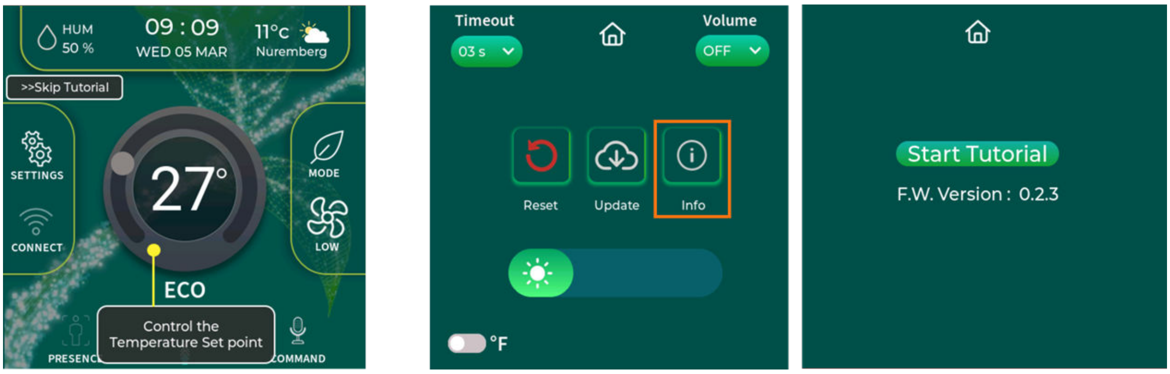


Figure 12 Onscreen Tutorial

5. Use the touch screen on the PSOC™ Edge E84 HMI kit to set your target temperature or adjust the fan speed or mode. The thermostat simulates operation by showing changes in temperature and fan speed. For detailed interactive UI operations, see User interface and touch control

Figure 13 GUI and touch control

6. Speak the phrase **Okay Thermostat** to trigger the voice assistant and provide voice commands such as **Go to Settings** or **Reduce temperature by {one/two/.../ten} degrees**. The thermostat adjusts its settings based on the given commands. To explore more commands, see Voice assistant

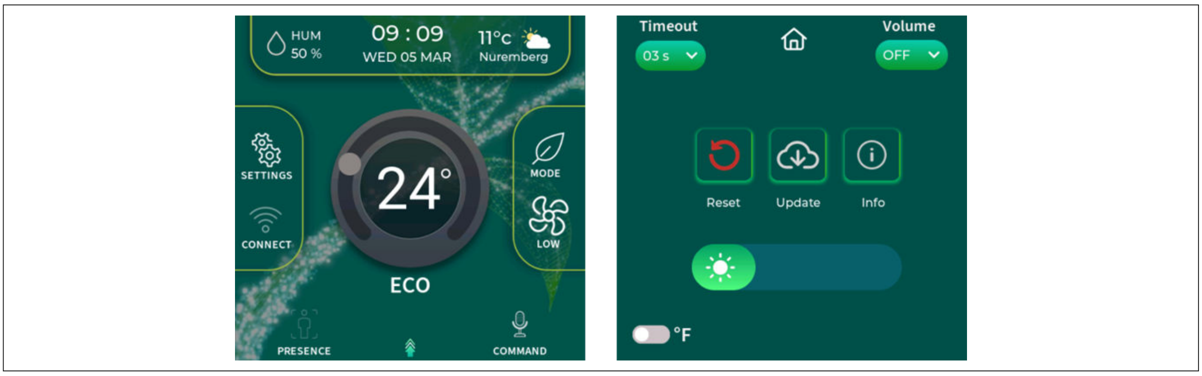


Figure 14 Voice assistant

7. The kit uses a radar sensor to detect human presence. Move away from the kit (beyond 1 meter) to observe the kit automatically enter IDLE mode by dimming the screen. Approach the kit again to observe the display transition back to the ACTIVE state. To understand technical detail about presence detection, see Presence detection

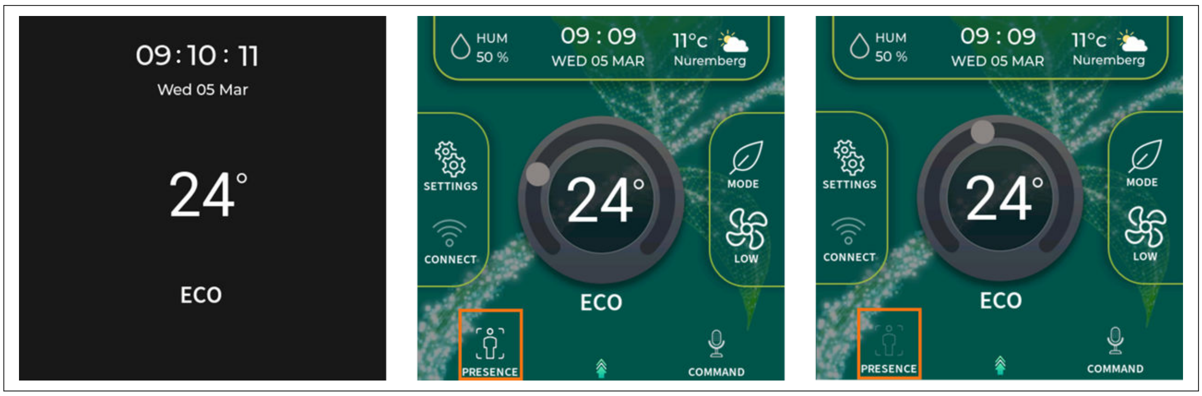


Figure 15 Presence Detection

8. Follow the step 8 through 12 to control the thermostat application remotely. Tap the **Connect** icon as shown in Figure 16. Tap the mobile icon to start Bluetooth® advertisements. Open the mobile app, tap on the plus icon and follow the instructions to pair your device with the thermostat via Bluetooth® (Bluetooth® LE). To explore mobile app operation flow, see Mobile app-based control

Figure 16 **Connect icon to start Bluetooth® pairing with mobile app**

9. Once paired, the mobile app indicates an active connection with the Thermostat over Bluetooth® (Bluetooth® LE). Tap the **Thermostat** icon on the home screen to navigate to the thermostat control screen. You can adjust temperature, fan speed, modes, and configure the date and time directly from the connected smartphone

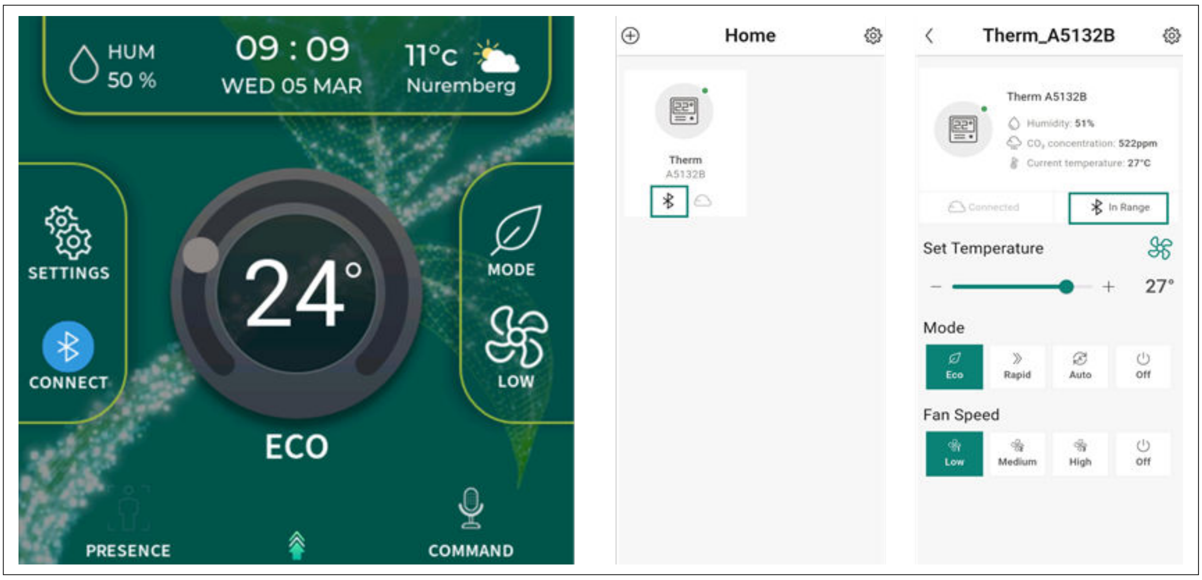


Figure 17 **Control thermostat application over Bluetooth® LE**

10. On the PSOC™ Edge E84 HMI kit, tap the Wi-Fi icon, and enter your Wi-Fi SSID and password using the provided keyboard. The thermostat will then connect to your Wi-Fi network

Figure 18 **Wi-Fi setup with on-screen keyboard**

11. Alternatively, you can configure Wi-Fi credentials through the mobile app. Connect to the thermostat using Bluetooth® LE, then navigate to **Settings** > **Configure Wi-Fi** and select your network

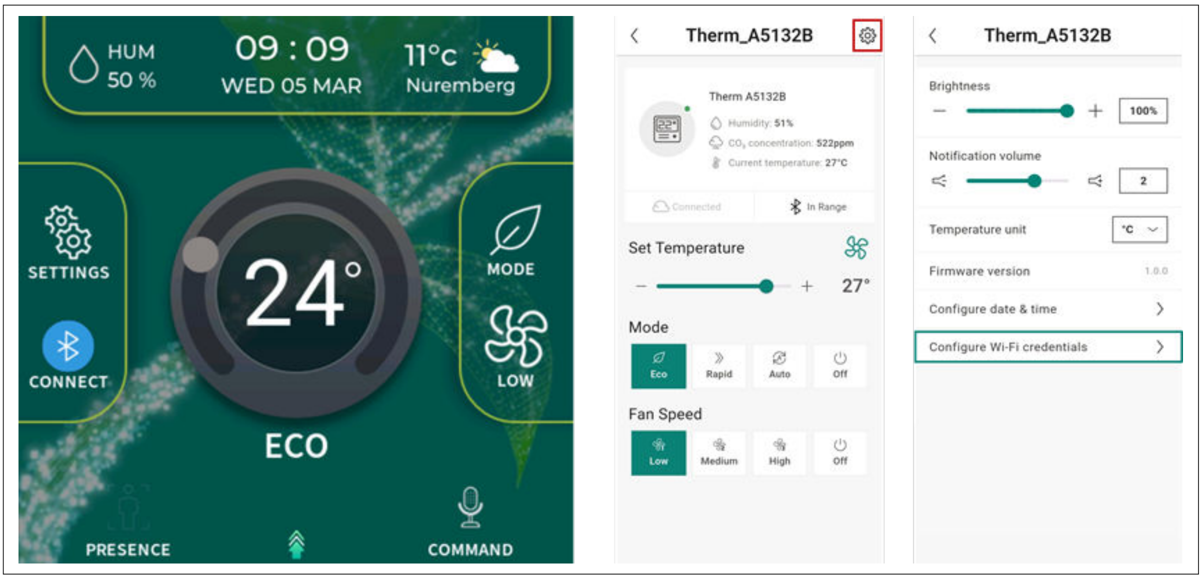


Figure 19 **Wi-Fi setup with mobile app**

12. After connecting to the Wi-Fi network (assumed to have an active internet connection), the thermostat connects to the AWS cloud platform using an MQTT client. This connection enables cloud-based remote control and monitoring of the thermostat via mobile app

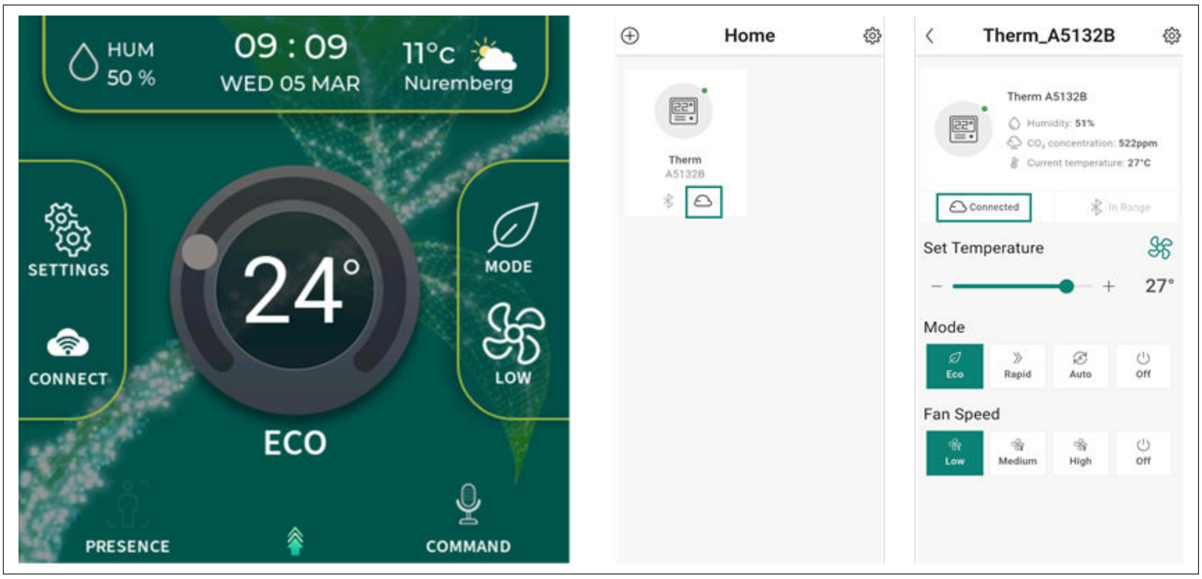


Figure 20 **Control thermostat application over Cloud**

13. The thermostat supports seamless switching between Bluetooth® LE and cloud connectivity modes. Tap the Connect icon to open the connectivity overlay. When connected to cloud, a Bluetooth® LE icon appears in the overlay allowing you to switch to direct Bluetooth® connection. Similarly, when using Bluetooth® LE connection, a cloud icon is available to switch to cloud-based control.

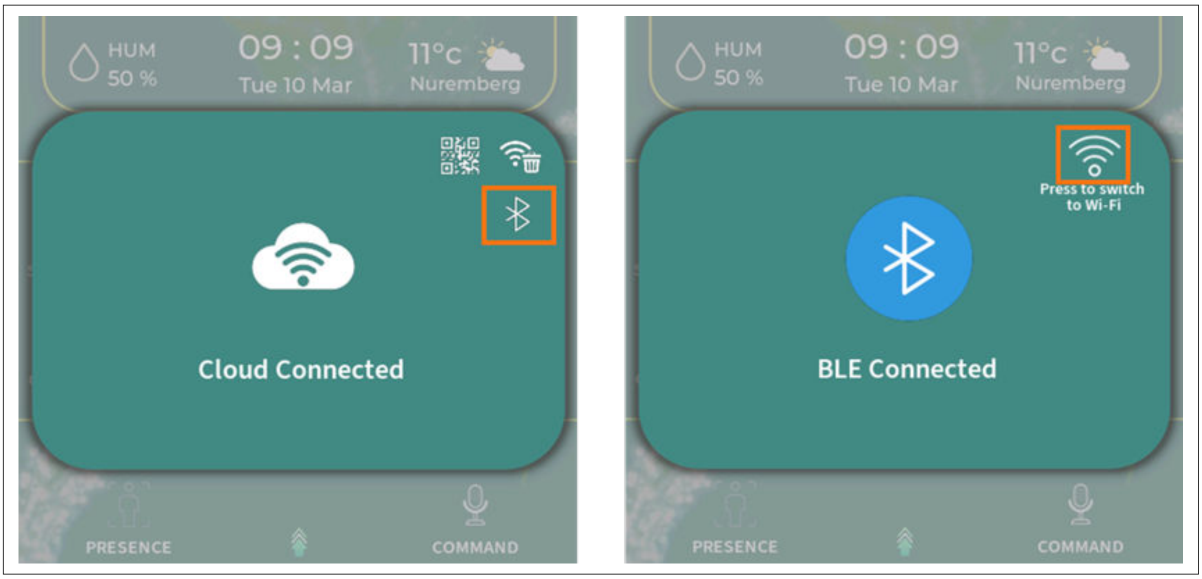


Figure 21 Seamless switching between Bluetooth® LE and Cloud connectivity

14. After connecting to Wi-Fi, the thermostat fetches **location-based weather** and **temperature** information from an HTTP server. The real-time weather data is updated and is displayed directly on the thermostat screen. The **current time** is also retrieved from the HTTP server and updated on the thermostat user interface. To understand process, see Location-based real-time weather and time zone

Figure 22 **Weather, temperature and time update through HTTP server**

15. The time information is stored in the **RTC**, ensuring the system maintains accurate time and date, even during power loss.

Note: *To ensure RTC functionality, a coin-cell battery must be installed in the HMI kit. For installation procedure, see* Coin cell installation

16. The thermostat application uses the onboard SHT40 humidity sensor to measure and display the current room humidity with real-time percentage updates. To simulate changes in humidity and test the sensor, gently blow air toward the sensor area (highlighted in the 2nd image with red box) and observe the humidity increase immediately on the display. When humidity exceeds 55%, the system displays a `High Humidity Alert!!!` notification. For more information, see Environmental sensors

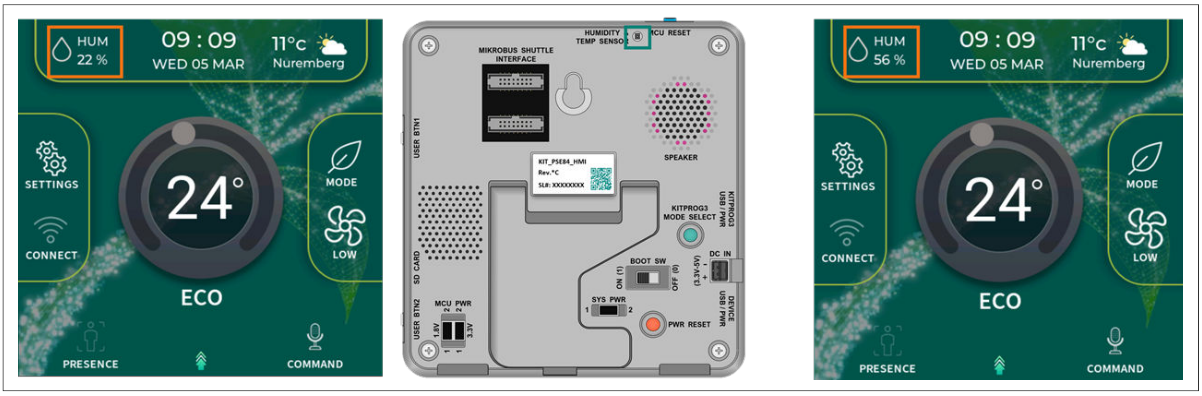


Figure 23 Real-time humidity sensor

17. Access the **Settings** menu on the thermostat to customize its features and behavior. You can adjust preferences such as display brightness, screen timeout values, temperature unit (°C/°F), notification alert volume, and advanced options such as factory reset

Figure 24 Settings screen

18. The factory reset option restores the thermostat to its original configuration by resetting firmware to default settings such as screen timeout, notification volume, screen brightness, deleting connectivity cache (removing connected devices), and removing stored Wi-Fi credentials

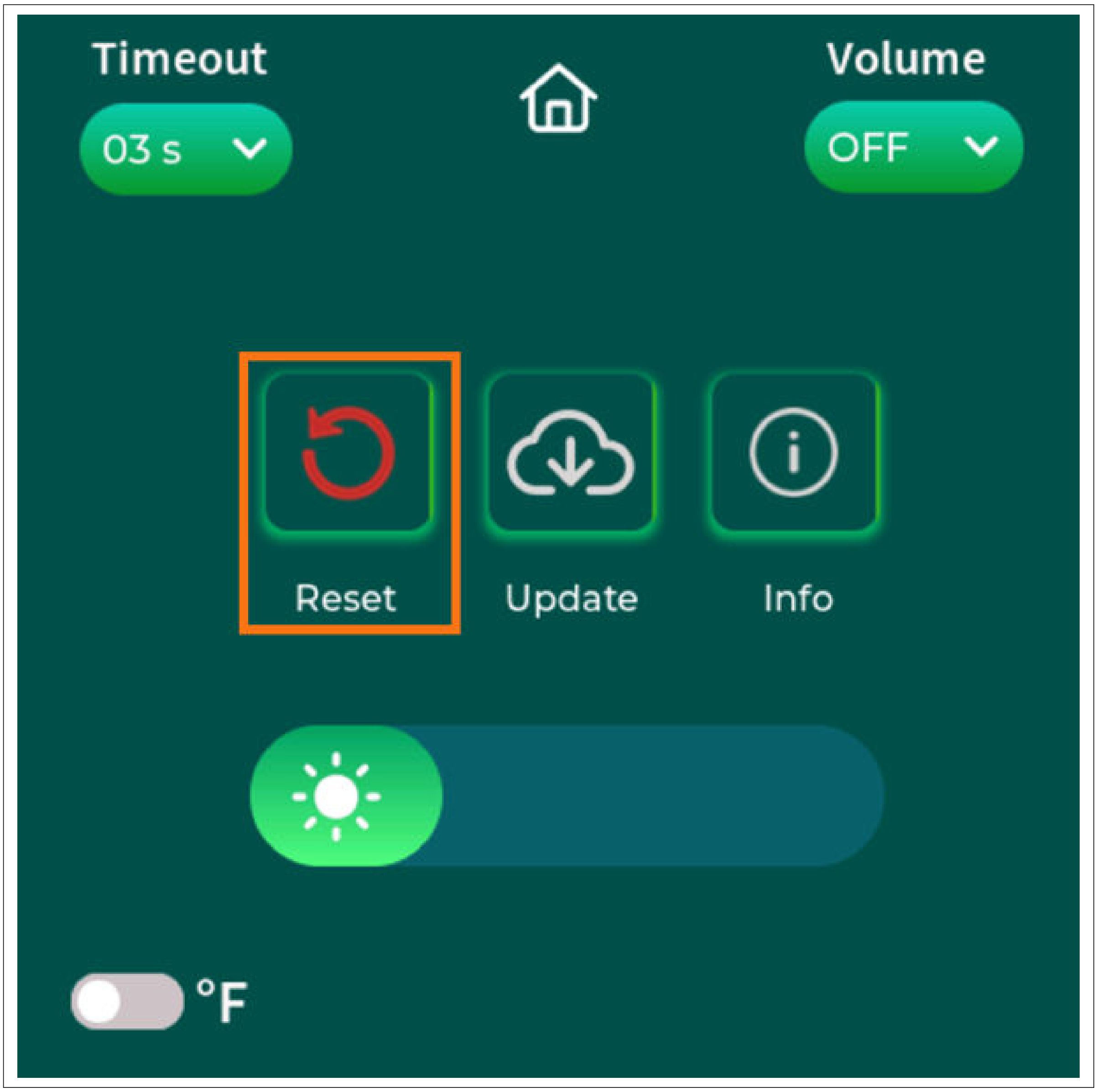


Figure 25 **Factory reset**

2.2.3 User interface and touch control

2.2.3.1 System overview

The **RK040HF22-CT120C** (from Rocktech Displays Ltd.) touch display subsystem leverages the Light and Versatile Graphics Library (**LVGL**) v9.1.0, running Thermostat application on the CM55 core, with GPU acceleration provided by VG-Lite for seamless DSI-based rendering.

The hardware includes a **MIPI DSI LCD controller**, configured at a resolution of 480×480, and a **capacitive touch controller** connected via an I2C interface operating at 400 kHz for reliable user touch input. The display communicates using a DPI-24 bit, 2 DSI Lane configuration with a bandwidth of 500 Mbps per Lane, targeting a smooth frame rate of **40 FPS**.

The thermostat's screen provides an intuitive interface to interact with various features and monitor environmental conditions. It serves as the primary way for users to control room parameters, adjust settings, and receive real-time updates.

2.2.3.2 User interface elements

The display subsystem provides intuitive interaction through two categories of interface elements:

- Interactive controls – These are interactive elements you tap or swipe to directly change settings
- Status displays – These display environmental and system information for your observation

2.2.3.2.1 Interactive controls

These interactive elements allow you to actively control various parameters and settings on your thermostat, including temperature adjustment, operating modes (heating/cooling/auto), fan speed control, connectivity configuration, and system settings.

Figure 26 Interactive controls

1. **Circular bar**
   - Use this feature to control the **room temperature** by interacting with an intuitive circular touch interface
   - Tap and drag your finger along the circular bar to adjust the target temperature; the display immediately reflects your selection
2. **Settings icon**
   - Use this icon to open **Settings** menu that allows you to customize thermostat features for enhanced user experience. The available settings are:
     - Timeout: Adjust the inactive time before the screen transitions to IDLE mode
     - Volume: Change the notification sound volume
     - Reset button: Perform a factory reset to restore the original settings
     - Update button: Check for firmware updates via the cloud for the latest features and improvements
     - Info button: Display the firmware version and access a brief tutorial about how to use the thermostat
     - Brightness slider: Adjust the screen brightness level to suit your preferences or environment

  - °F button: Switch the temperature display between Celsius and Fahrenheit
  - Home icon: Tap this icon to return to the active screen from the settings menu

3. **Wi-Fi icon**
   - Tap this icon to establish connectivity for the thermostat, either pair with your mobile app via Bluetooth® LE configuration or set Wi-Fi credentials to connect over cloud (refer section Mobile app-based control). Connectivity enables the features including cloud control, firmware updates, and remote monitoring
4. **Mode icon**
   - Tap this icon to change the current operating mode of the thermostat
   - Modes include options such as heating, cooling, and auto (automatic adjustments based on environmental conditions)
5. **Fan icon**
   - Tap this icon to control the fan speed
6. **Mic icon**
   - Tap this icon to trigger the voice assistant and open a list of available voice assistant commands
   - Speak the commands from this list as a reference for actions such as changing modes or adjusting temperature using your voice

2.2.3.2.2 Status displays

These display elements show environmental and system information for user's observation, including current room humidity, presence detection status, date and time, weather conditions, and connectivity indicators.

Figure 27 Status displays

1. **Presence icon**
   - Displays the status of the person presence (< 1 meter) based on XENSIV™ BGT60 radar-based presence detection
   - This feature automatically transitions the thermostat between ACTIVE and IDLE modes based on user proximity

2. **Room temperature**
    - Shows the current room temperature
3. **Room humidity**
    - Displays the current room humidity level in RH% (relative humidity)
4. **Date and time**
    - Displays the current time and date, automatically synchronized with your local time zone after connecting to Wi-Fi
    - The thermostat integrates a real-time clock (RTC) to retain this information even during a power loss
5. **Location and weather**
    - Provides the current weather conditions and local temperature for your location
    - This information is fetched dynamically over Wi-Fi using location-based HTTP services

2.2.4 Voice assistant

2.2.4.1 System overview

The voice assistant system integrates DEEPCRAFT™ AI technology to provide natural voice control for thermostat operations. The voice assistant system combines wake word detection with command recognition capabilities, enabling hands-free interaction through far-field voice capture and real-time audio enhancement processing.

The voice assistant operates through an event-driven architecture supporting the Wake Word + Single Command mode, where users say **Okay Thermostat** followed by a voice command. The system processes one command per wake word activation and returns to standby mode, requiring the wake word for each new command.

2.2.4.2 Audio processing

The voice processing pipeline implements a four-stage architecture for optimal voice recognition performance.

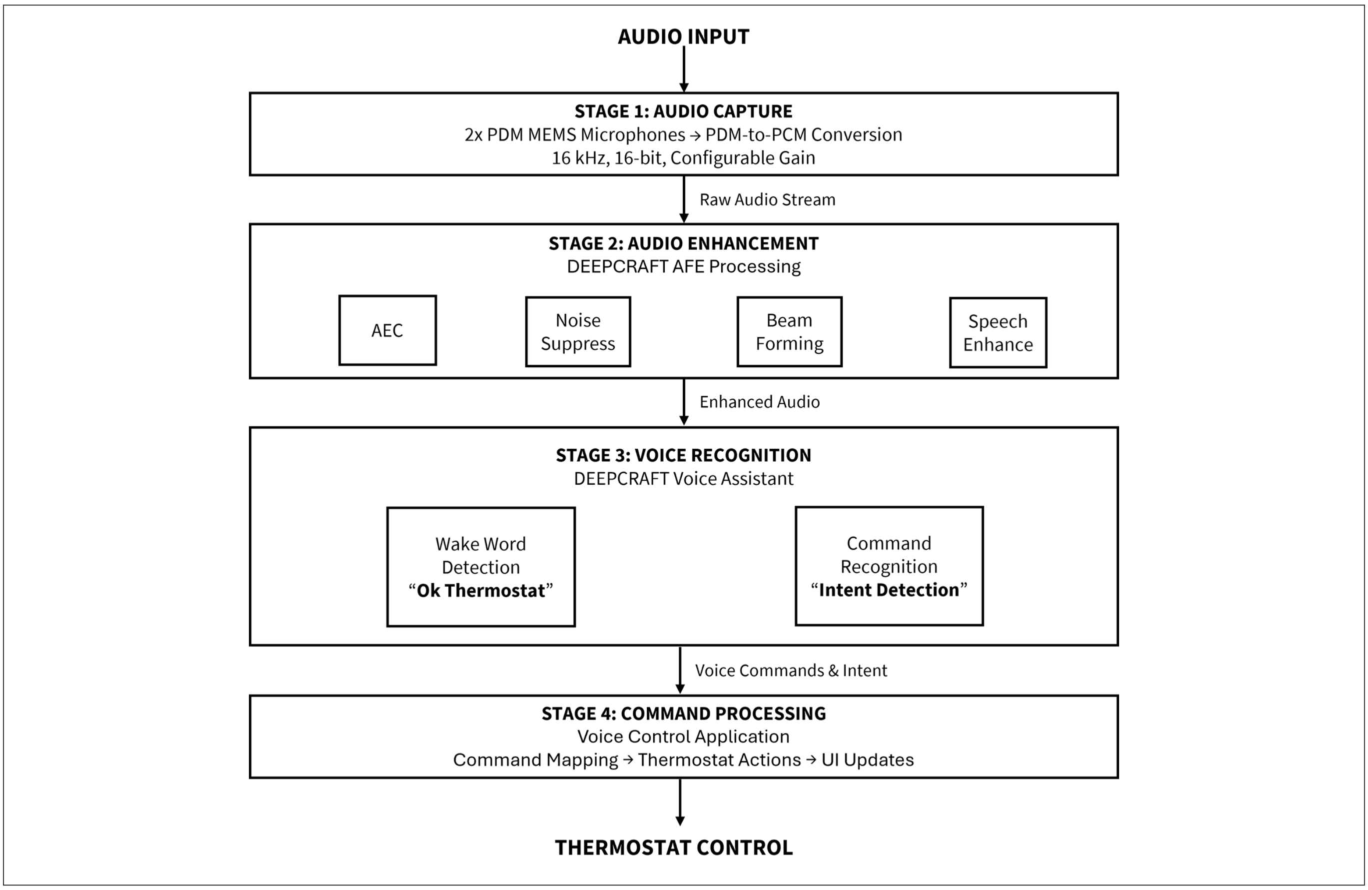


Figure 28 **Audio processing**

1. **Stage 1: Audio capture**

   Two PDM MEMS microphones capture voice input with PDM to PCM conversion at 16 kHz sampling rate and 16-bit resolution. The system supports stereo dual-microphone or mono input modes with configurable gain control ranging from -25dB to +83dB

2. **Stage 2: Audio enhancement**

   DEEPCRAFT™ Audio Front-End (AFE) processing provides real-time signal enhancement including Acoustic Echo Cancellation (AEC) for speaker feedback removal, noise suppression for far-field voice pickup, beam-forming algorithms for directional audio capture, and speech enhancement preprocessing for improved recognition accuracy

3. **Stage 3: Voice recognition**

   The DEEPCRAFT™ Voice Assistant Core processes enhanced audio through dedicated neural network models optimized for low-latency operation. Wake Word Detection identifies the designated trigger phrase while Command Recognition extracts intent and parameters from spoken commands

4. **Stage 4: Command processing**

   The voice control application coordinates between voice assistant output and thermostat interface, implementing command-to-intent mapping for temperature control, brightness adjustment, and system mode changes with real-time UI updates

2.2.4.3 Voice assistant operation

The Voice Assistant system employs the DEEPCRAFT™ Voice Assistant model for comprehensive audio analysis and command interpretation. The system performs dual-function recognition by identifying the designated wake word **Ok Thermostat** and determining the intent behind spoken commands through advanced natural language processing algorithms.

Upon successful wake word detection, the GUI transitions to the home screen and waits for further commands. A successful wake word detection is also indicated by a blue color light on the RGB user LED and the highlighted microphone icon in the user interface.

2.2.4.3.1 Control commands

The voice assistant recognizes various thermostat control commands and immediately updates the screen to reflect the changes. This provides instant visual feedback when you control the thermostat using voice commands. The voice assistant processes a single command per activation and automatically times out after command completion, requiring wake word activation for each new voice command.

Table 3 Control commands

Voice commands	Description
Set temperature to <numbers30> {degree,degrees} Change temperature to <numbers30> {degree,degrees}	Sets the thermostat to the specified temperature
Increase temperature by <numbers10> {degree,degrees} Raise temperature by <numbers10> {degree,degrees}	Increases the current temperature by the specified amount
Decrease temperature by <numbers10> {degree,degrees} Lower temperature by <numbers10> {degree,degrees} Reduce temperature by <numbers10> {degree,degrees}	Decreases the current temperature by the specified amount
Switch ON heating Turn ON heating	Sets the thermostat mode to "ECO MODE"
Switch OFF heating Turn OFF heating	Sets the thermostat mode to "OFF MODE"
Switch ON cooling Turn ON cooling	Sets the thermostat mode to "ECO MODE"
Switch OFF cooling Turn OFF cooling	Sets the thermostat mode to "OFF MODE"
Increase fan speed	Increases fan speed
Decrease fan speed Reduce fan speed	decreases fan speed
Set mode to eco Set mode to rapid Set mode to auto Change mode to eco Change mode to rapid Change mode to auto	Sets mode to respective command
What's the Wi-Fi status What is the Wi-Fi status	Checks the Wi-Fi status and display connection notification on screen

(table continues...)

Table 3 **(continued) Control commands**

Voice commands	Description
Mute volume Mute sound Disable volume Disable sound	Sets notification volume to OFF
Unmute volume Unmute sound Enable volume Enable sound	Sets notification volume to medium
Decrease brightness Decrease screen brightness Reduce brightness Reduce screen brightness	Decreases the display brightness
Increase brightness Increase Screen brightness	Increases the display brightness
Go to setting <end-silence> Go to setting screen Go to settings <end-silence> Go to settings screen	Opens **Setting** screen

Note: *Developers can add custom voice commands by importing the `.vaproj` file into the DEEPCRAFT™ Voice Assistant Portal, editing the model with new commands and intents, then downloading and integrating the updated files into the application.*

2.2.5 Presence detection

2.2.5.1 System overview

This module explains the implementation of human presence detection subsystem using the Infineon XENSIV™ BGT60TR13C 60 GHz FMCW radar sensor, integrated into a smart thermostat platform running on an Arm® Cortex®-M33 MCU with FreeRTOS. The radar sensor communicates with the host MCU over SPI and provides raw digitized IF (Intermediate Frequency) data, which is then processed by the Infineon XENSIV™ radar presence algorithm library to classify occupancy as either presence or absence. The system can detect both macro-motion (such as walking or gesturing) and micro-motion (such as breathing or slight body movement of a seated person), making it significantly more capable than traditional PIR-based occupancy sensors. The detection range is currently configured for approximately 1 meter but is software-configurable up to approximately 6 meters by adjusting algorithm parameters — no hardware changes are required.

2.2.5.2 Radar signal processing

The BGT60TR13C is an FMCW (Frequency Modulated Continuous Wave) radar — it transmits a frequency chirp and listens for reflections. Objects at different distances produce different beat frequencies in the received signal. The firmware converts these beat frequencies into a **range profile** so the algorithm can tell where a target is and whether it is moving.

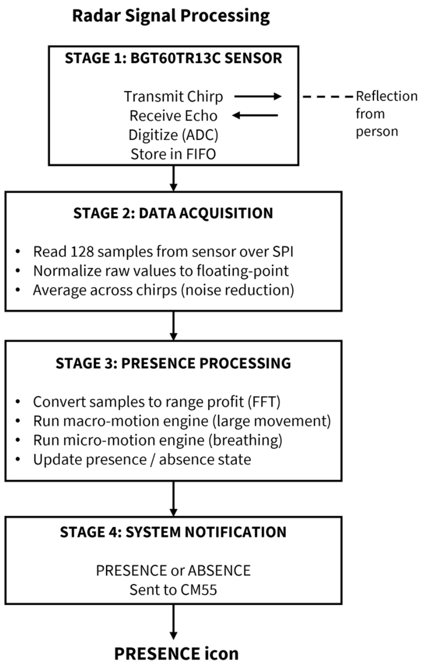


Figure 29 **Radar signal processing**

The processing happens in the following stages that run continuously:

1. **Stage 1: BGT60TR13C sensor**

   The radar sensor continuously transmits frequency chirps and captures reflected echoes from objects in its field of view. For each chirp, the on-chip 12-bit ADC digitizes the received IF (beat) signal into **128 samples** and stores them in an internal FIFO buffer

2. **Stage 2: Data acquisition**

   Once a complete frame is ready, the sensor asserts an interrupt to the host MCU. The acquisition stage then:

   a. Reads all 128 raw samples from the sensor over **SPI burst transfer**
   b. Normalizes each 12-bit value to a floating-point range of **0.0 – 1.0**
   c. Averages across chirps (when multiple chirps/frame are configured) to improve signal-to-noise ratio

   In the current single-chirp configuration, the averaging step is a pass-through — the normalized 128-sample frame is immediately forwarded to Stage 3

3. **Stage 3: Presence processing**

   The processing stage converts the time-domain samples into a **range profile** using an FFT (Fast Fourier Transform). The algorithm then runs **two detection engines** in parallel

Table 4 **Macro-motion engine (detects large movements)**

Aspect	Detail
What it detects	Walking, arm gestures, and body repositioning
How it works	Compares current range profile magnitudes against a periodically updated reference snapshot
Trigger condition	Difference exceeds `macro_threshold` in any monitored bin

(table continues...)

Table 4 (continued) Macro-motion engine (detects large movements)

Aspect	Detail
Confirmation time	Must persist for `macro_movement_validity_ms` (currently 100 ms)

Table 5 Micro-motion engine (detects subtle movements)

Aspect	Detail
What it detects	Breathing, slight hand motion
How it works	Analyzes small phase variations in the radar return over successive frames
Trigger condition	Phase variations exceed `micro_threshold`
Confirmation time	Must persist for `micro_movement_validity_ms` (currently 250 ms)

The two engines work together in a cascaded state machine.

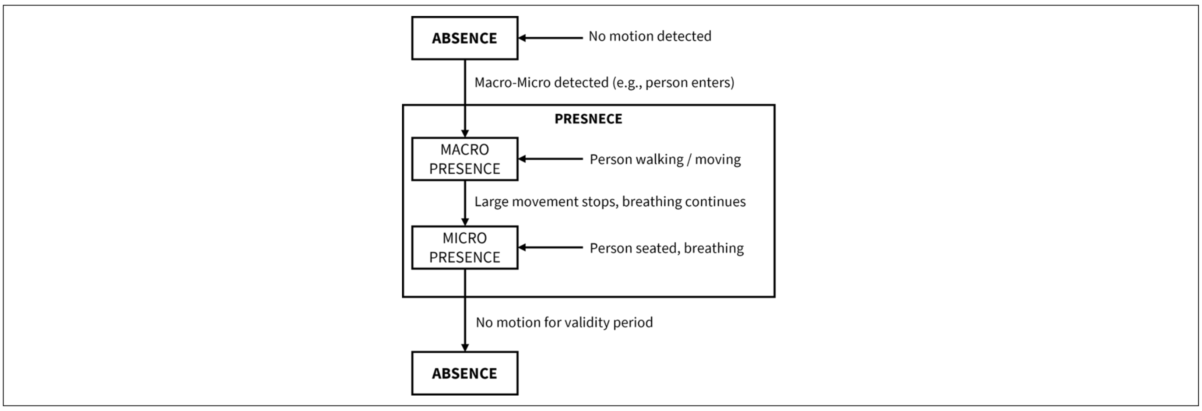


Figure 30 Combined mode (MICRO_IF_MACRO)

4. **Stage 4: System notification**

   The final result (`PRESENCE_DETECTED` / `ABSENCE_DETECTED`) is forwarded to the thermostat application via a callback

2.2.5.3 Presence detection operation

The presence detection result from the radar subsystem running on the **CM33 core** is communicated to the **CM55 core**, which drives the thermostat's display and user interface. The UI provides real-time visual feedback of the occupancy state through a **presence icon** and **screen transitions**, allowing users to immediately observe the radar detection behavior.

Table 6 UI behavior

Radar state	Presence icon	Description
Absence	Dimmed (greyed out)	No occupant detected within range
Presence	Highlighted (glowing)	Occupant detected within ~1 m

The **primary indicator** is the presence icon — it **Highlighted** (glowing) when a person is detected within range and **dims** (greyed out) when no one is present. If the thermostat screen is to be in the **idle screen** and the radar detects presence, the display will automatically transition to the active screen.

2.2.6 Mobile app-based control

2.2.6.1 System overview

The thermostat application supports a dedicated mobile application that allows control and monitoring of the device from a smartphone. The app provides two primary methods of connectivity for controlling the thermostat: Bluetooth® Low Energy (Bluetooth® LE) for direct, local control and Cloud-based remote control for accessing the device from anywhere. These communication methods enable control of key features such as temperature adjustment, fan speed settings, mode selection, and monitoring of environmental parameters.

2.2.6.2 Bluetooth® LE-based control

Bluetooth® LE provides a direct, local connection for controlling the thermostat. With Bluetooth® LE, users pair the thermostat to the mobile app and utilize features such as temperature adjustment, fan speed control, and mode switching. This method is ideal for close-range operation without requiring internet connectivity.

For Bluetooth® LE-based provisioning, follow these steps:

1. On the thermostat, tap the Bluetooth® (Bluetooth® LE) icon. The thermostat pops up with a window. To start Bluetooth® LE advertising, tap the Bluetooth® LE icon again. This makes the thermostat discoverable by the mobile app

Figure 31 Bluetooth® LE advertising

2. Open the mobile app on your smartphone. Navigate through **Plus Icon** > **Thermostat** > **Scan Nearby Device**. The app searches for nearby thermostat devices advertising via Bluetooth® LE. From the list of discovered devices on the app, tap on the thermostat. This initiates the Bluetooth® LE connection between the thermostat and the mobile app

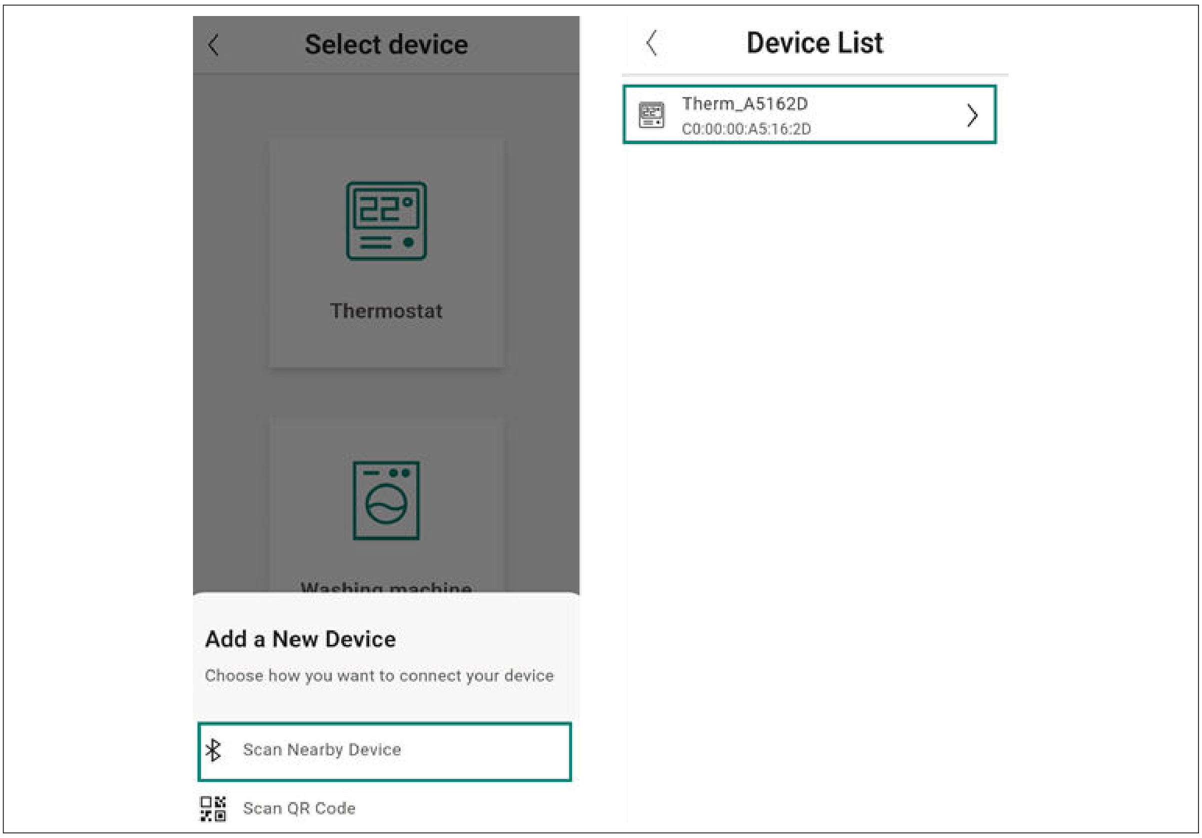


Figure 32 **Connection between thermostat and mobile app**

3. Once the Bluetooth® LE connection is successful, the mobile app will automatically navigate to the home screen. On the home screen, you will see the thermostat listed on the mobile app dashboard, confirming that the device has been added
4. Verify the Bluetooth® LE connection status: On the thermostat, the Bluetooth® LE icon changes to indicate the active connection. On the mobile app, a Bluetooth® LE indicator shows that the connectivity medium **In Range**

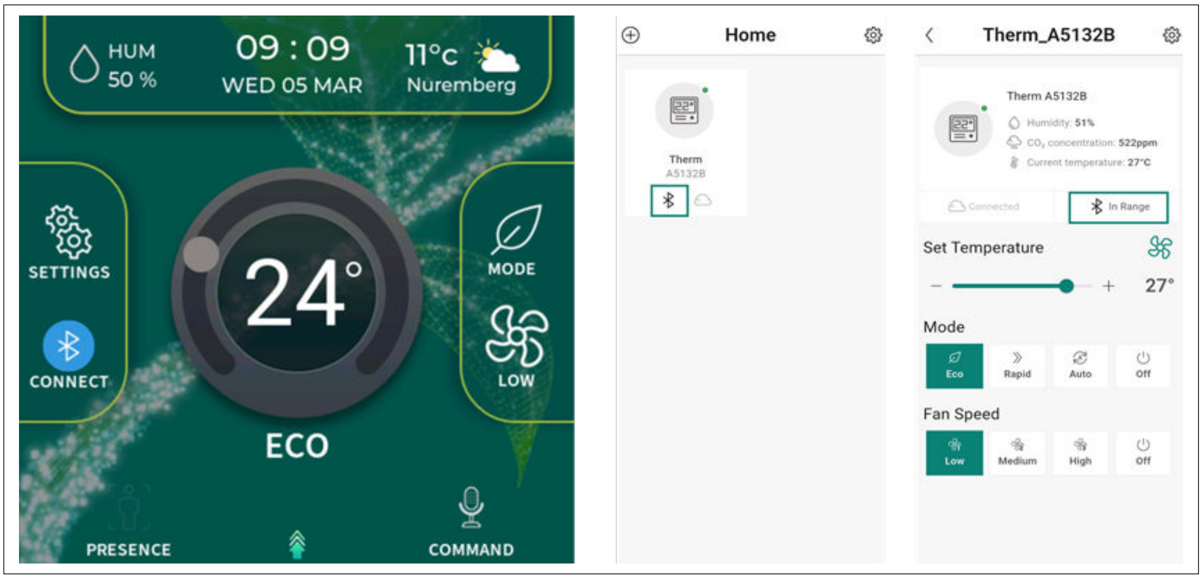


Figure 33 **Connectivity indication on thermostat and mobile app**

2.2.6.3 Cloud-based control

The Cloud-based Remote-Control feature allows you to manage the thermostat from anywhere with an internet connection. By connecting the thermostat to a Wi-Fi network and linking it to the mobile app via the cloud, you can access the thermostat features, receive real-time environmental updates, and control settings remotely.

The following are two methods used to onboard and set up the remote control (over Cloud):

Method 1: Configure using mobile application

1. On thermostat, tap the Bluetooth® (Bluetooth® LE) icon. The thermostat pops up with a window. To start Bluetooth® LE advertising, tap the Bluetooth® LE icon again. This makes the thermostat discoverable by the mobile app

Figure 34 BLE advertising

2. Open the mobile app on your smartphone. Navigate through **Plus Icon** > **Thermostat** > **Scan Nearby Devices**. The app searches for nearby thermostat devices advertising via Bluetooth® LE. From the list of discovered devices on the app, tap on the thermostat. This initiates the Bluetooth® LE connection between the thermostat and the mobile app

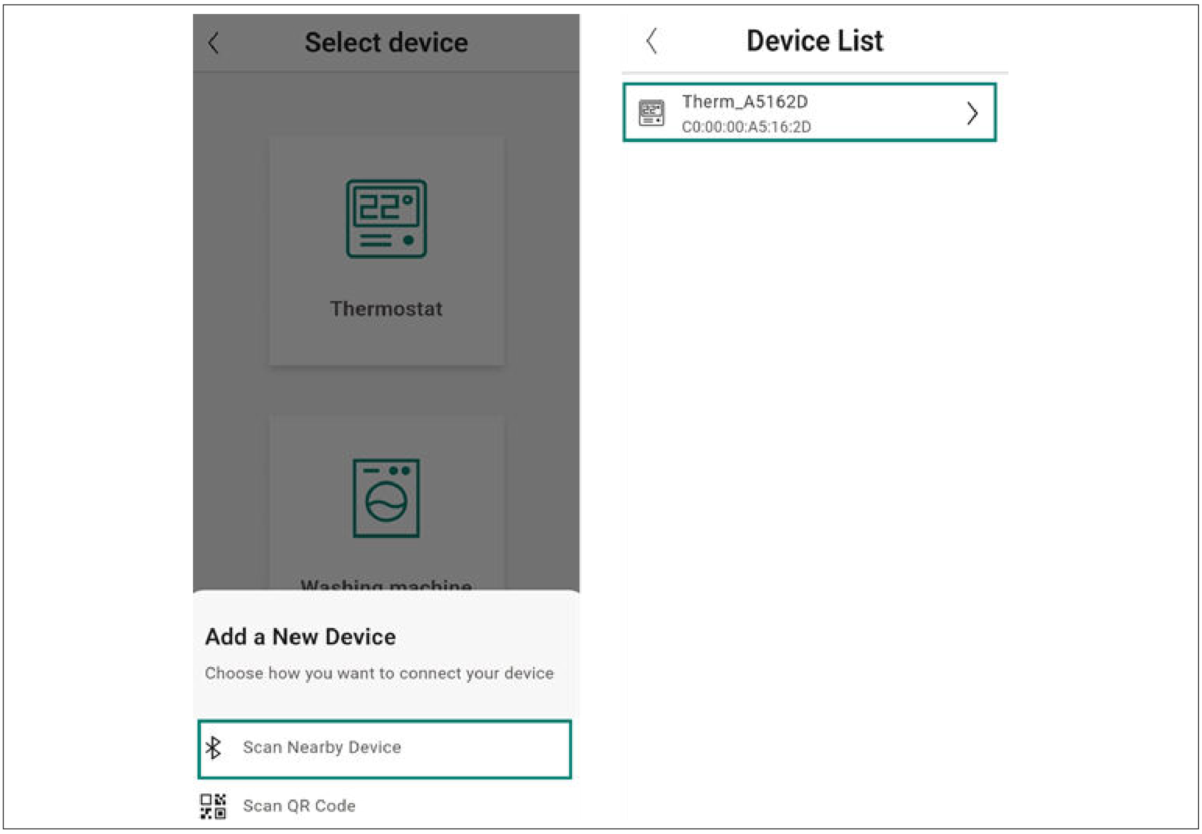


Figure 35 Connection between thermostat and mobile app

3. Once the Bluetooth® LE connection is successful, navigate to the **Settings** section in the mobile application. Select the option **Configure Wi-Fi Connection** in the **Settings** menu

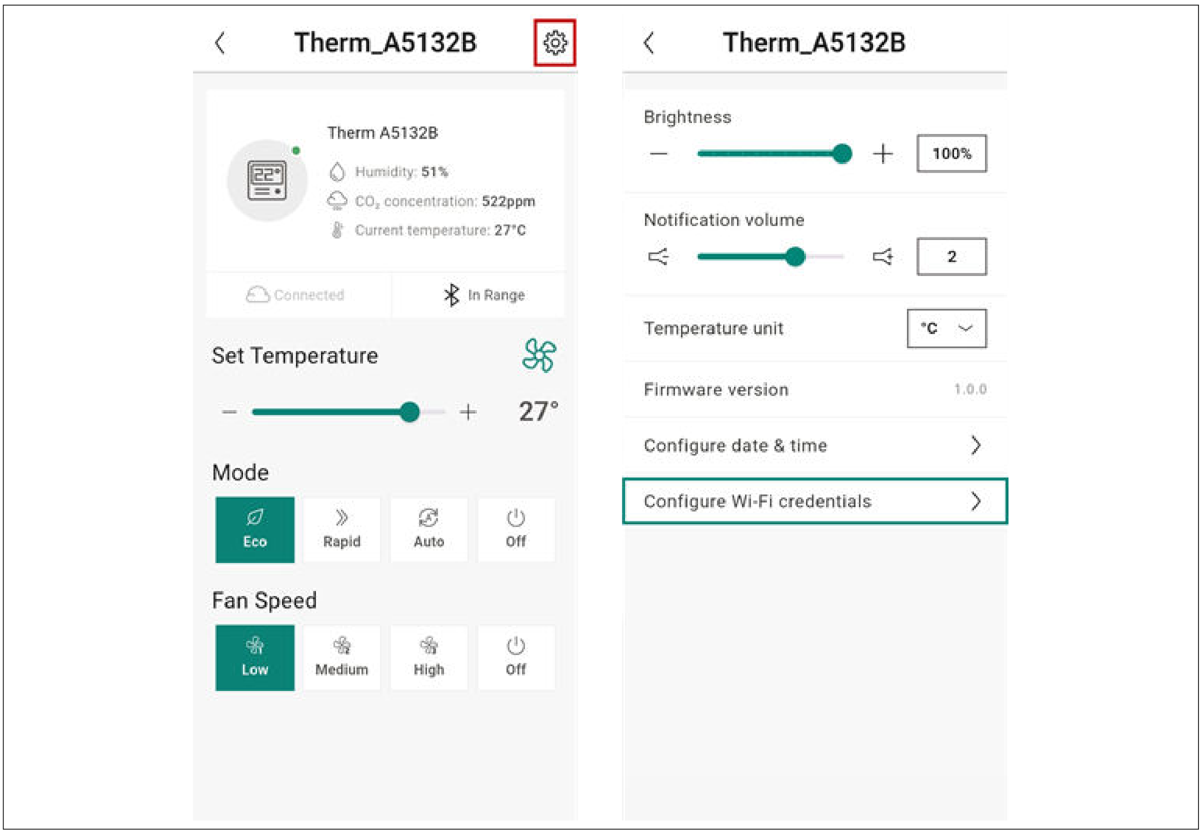


Figure 36 Configure Wi-Fi connection

4. From the Wi-Fi Configuration screen, select the **SSID** (Wi-Fi network name) and enter the network's password
5. Tap **Connect**, and the thermostat establishes a connection to the Wi-Fi network and automatically connects to the cloud. Check the connection status in both the thermostat and mobile app

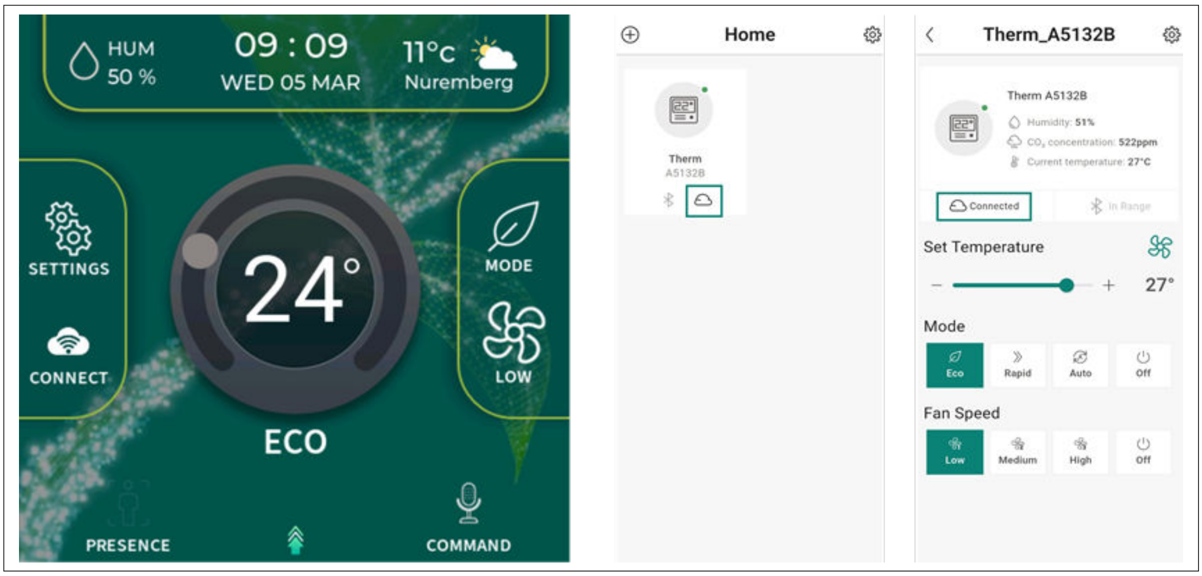


Figure 37 Connection to Wi-Fi network and cloud

Method 2: Direct thermostat configuration

1. On the thermostat, tap the **Bluetooth® (Bluetooth® LE) icon**. On the Bluetooth® LE panel, tap the **Keyboard** icon to open the Wi-Fi configuration interface

Figure 38 Wi-Fi configuration interface

2. Enter the **SSID** (Wi-Fi network name) and **password** using the on-screen keyboard. Confirm the input by pressing the **Connect** button. The thermostat tries to connect to the selected Wi-Fi network

Figure 39 Connect to Wi-Fi by entering the credentials

3. Once the thermostat successfully connects to the Wi-Fi network, it automatically establishes a connection to the **cloud**. Verify the connection status on both the thermostat and mobile app

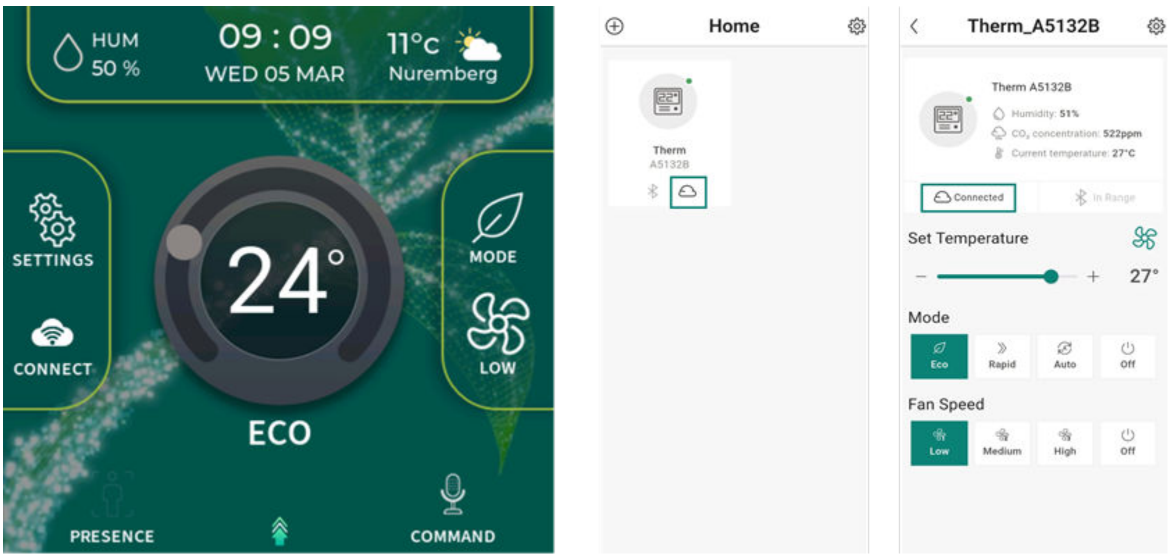


Figure 40 Cloud connectivity indication on thermostat and mobile app

2.2.7 Location-based real-time weather and time zone

2.2.7.1 System overview

The thermostat implements automatic location-based weather and time zone synchronization through Wi-Fi connectivity. The system operates as a background process that retrieves the geolocation data, weather information, and time zone details without user intervention beyond initial Wi-Fi network connection.

The synchronization process completes within 1 to 2 minutes following Wi-Fi connection establishment, providing real-time weather data and local-time information displayed on the thermostat user interface. The system automatically updates this information every 15 minutes to ensure current data availability.

Note: *For optimal location accuracy, connect to a router-based Wi-Fi network instead of mobile hotspot because mobile network providers may mask IP locations leading to inaccurate weather and time zone information.*

2.2.7.2 Operational workflow

The system executes a three-step data acquisition sequence every 15 minutes when Wi-Fi connectivity is available. The process begins with geolocation detection using the network's public IP address, followed by weather data retrieval and time zone synchronization.

1. Geolocation detection

   The thermostat queries the `ipinfo.io` HTTP server using the network's public IP address to obtain latitude and longitude coordinates corresponding to the device location. The system extracts geographical coordinates, time zone information, and city name data from the server response

2. Weather data acquisition

   Using the retrieved coordinates, the system requests current weather conditions from the open-meteo.com HTTP server. The response includes real-time temperature, humidity levels, wind speed, and weather condition codes specific to the detected location

3. Time zone synchronization

   The thermostat sends coordinate data to the timezonedb.com HTTP server to obtain formatted local time information. The system parses time components including year, month, day, hour, minute, and second values, then calculates the corresponding weekday using Sakamoto's algorithm

Figure 41 **Time zone synchronization**

This entire process occurs automatically in the background, requiring no input from the user apart from connecting the thermostat to Wi-Fi.

Once the synchronization is complete, the thermostat updates its user interface (UI) to display:

- Real-time weather data based on the current location, such as temperature and weather conditions
- Accurate local time and time zone info for the detected location

The time information is then stored in MCP7940N Real-Time Clock (RTC), which provides reliable time-keeping functionality. The MCP7940N RTC maintains time and date (HH:MM) information during power loss, though second precision may be lost and will re-synchronize upon network re-connection.

2.2.8 Environmental sensors

2.2.8.1 System overview

This module explains the implementation of humidity monitoring subsystem using the Sensirion SHT40 digital humidity sensor, integrated into a thermostat application running on an Arm® Cortex®-M55. The SHT40 communicates with the host MCU over a shared I2C bus (slave address `0x44`) and operates in single-shot measurement mode — the firmware issues a one-byte command, waits for an on-chip conversion, then reads back 6 bytes containing raw 16-bit tick values for temperature and humidity along with CRC-8 checksums. A layered driver stack handles the wire-level I2C transaction, CRC verification, and tick-to-physical conversion. The processed humidity value is exposed to the rest of the thermostat application as an integer percentage (0–100%RH).

Although the SHT40 reports both temperature and humidity, only the **humidity channel** is consumed by the thermostat's control logic — for indoor-air-quality monitoring, user notification, and automatic fan-speed adjustment during AUTO mode. The firmware uses the **low-precision** measurement mode (`0xE0`, 2 ms conversion time) to minimize I2C bus occupancy on the shared bus, which also serves the display touch controller.

2.2.8.2 Humidity sensor data processing

The SHT40 is a capacitive humidity sensor with on-chip signal conditioning. The firmware sends a single-byte I2C command, the sensor performs an internal ADC conversion, and returns a pair of 16-bit raw tick values (temperature + humidity) with per-word CRC protection. The firmware then converts the humidity ticks into a physical %RH value

Figure 42 shows the processing stages that run continuously.

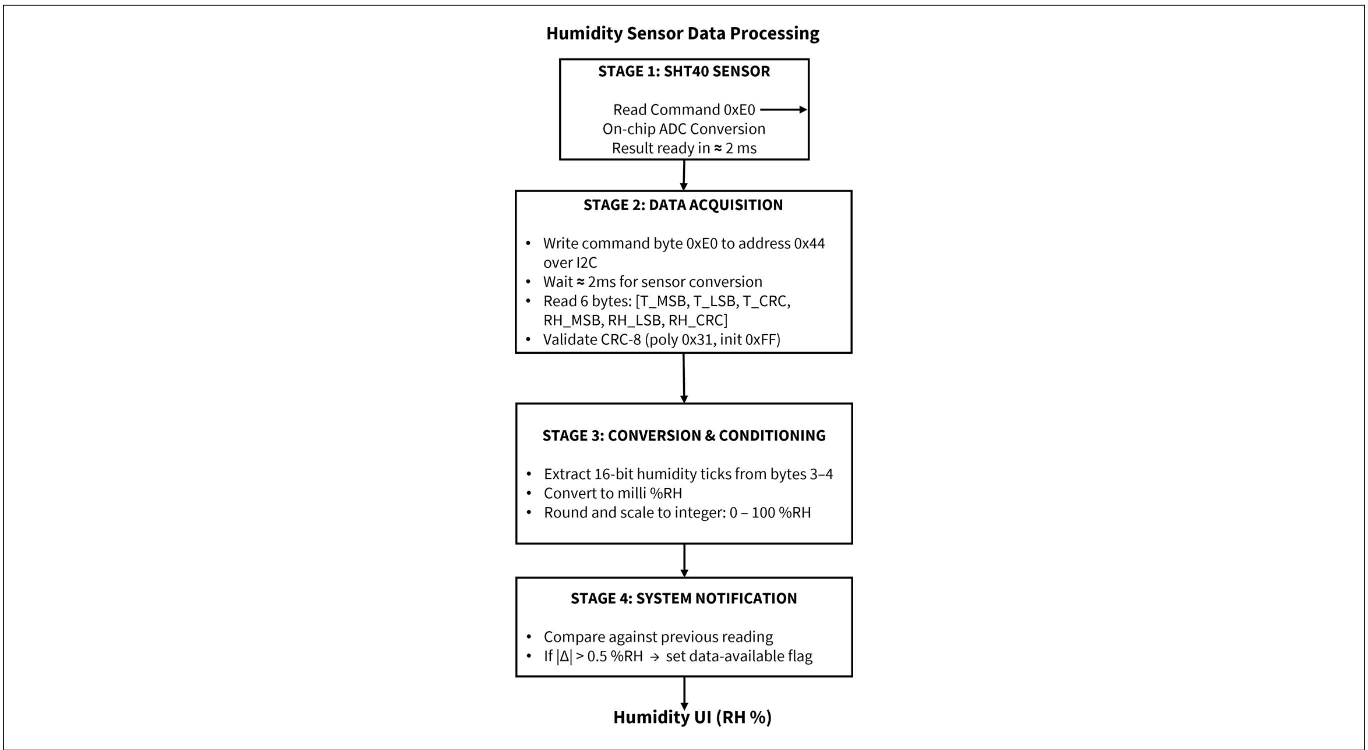


Figure 42 Humidity sensor data processing

1. **Stage 1: SHT40 Sensor**

   When the host MCU issues the low-precision measurement command `0xE0` over I2C, the SHT40's integrated controller triggers an analog-to-digital conversion on its capacitive relative-humidity sensing element. The capacitance of this polymer-based element varies with ambient moisture; the on-chip ADC digitizes that capacitance shift into a raw 16-bit tick value in approximately 2 ms, after which the result — together with a corresponding temperature reading and per-word CRC bytes — is latched into the sensor's output register and made available for the host to read back

2. **Stage 2: Data Acquisition**

   The sensor task runs in a periodic loop. At each sampling interval (2 s in active mode, 10 s in idle mode) the firmware acquires the shared I2C bus, writes the single-byte measurement command, and reads back the response frame

Table 7 SHT40 Specifications

Parameter	Value
I2C slave address	`0x44` (Default); `0x45` (Alternate)
Measurement command	`0xE0` low precision, single shot

(table continues...)

Table 7 (continued) SHT40 Specifications

Parameter	Value
Soft reset command	`0x94`
Response frame	6 bytes — `[T_MSB, T_LSB, T_CRC, RH_MSB,` `RH_LSB, RH_CRC]`
Available precision modes	High (`0xFD`, 10 ms), Medium (`0xF6`, 5 ms), Low (`0xE0`, 2 ms)

Each 2-byte data word is followed by an 8-bit CRC computed with polynomial `0x31` and initial value `0xFF`. The driver validates both CRCs before accepting the frame. If CRC verification fails, the measurement is discarded and a soft-reset command (`0x94`) is issued to return the sensor to a known state; the next scheduled sampling cycle will retry the measurement

3. **Stage 3: Conversion and conditioning**

   Once the raw 6-byte frame passes CRC validation, the driver extracts the 16-bit humidity tick value from bytes 3–4 and converts it to a physical unit using a fixed-point approximation of the Sensirion-specified transfer function

   - Raw input → 16-bit unsigned integer (`humidity_ticks`, range 0x0000–0xFFFF)
   - Output unit → Milli-percent relative humidity (milli %RH = %RH × 1000)

4. **Stage 4: System Notification**

   After conversion and clamping, the firmware compares the new integer %RH value against the previously reported reading; only when the absolute difference exceeds a 0.5%RH dead-band (`|Δ| > 500 milli %RH`) does it raise the `sensor_data_available` flag and latch the updated value — changes smaller than the threshold are silently discarded to suppress sensor noise and prevent needless processing. The thermostat's UI task polls this flag on each display refresh cycle and, when set, retrieves the latest humidity percentage and renders it on the thermostat screen, providing the user a continuously up-to-date indoor humidity reading

2.2.8.3 Humidity sensor operation

The humidity value produced by the SHT40 subsystem on the **CM55 core** is consumed by the thermostat's control logic and user interface. The system provides real-time visual feedback of the indoor humidity level and, when operating in **Auto** mode, takes automatic corrective action if humidity rises above a safe threshold.

In a smart thermostat deployment, maintaining indoor humidity within a comfortable band (typically **40–55% RH**) is critical for occupant comfort and for protecting the building from mold, condensation, or excessive dryness. The SHT40 continuously monitors ambient humidity and the control logic evaluates the latest `Humidity Percentage (rh_pct)` value against a configurable high-humidity threshold. When the thermostat is in **Auto** mode, the following table shows the system response:

Table 8 Thermostat responses on different humidity levels

Condition	System response
`rh_pct` **rises above** the threshold	• A notification is presented to the user (on-screen alert and/or cloud push) informing them that indoor humidity is elevated • The fan mode is automatically escalated to **High** to increase air circulation

(table continues...)

Table 8 (continued) Thermostat responses on different humidity levels

Condition	System response
`rh_pct` **drops below** the threshold	The fan mode reverts to its previous automatic setting
Thermostat mode is **Rapid/Eco/Off** (Not Auto)	A notification is presented to the user only; automatic fan-speed override is disabled

When the thermostat is in **Auto** mode and the humidity crosses above the configured threshold, the UI immediately reflects the escalated fan state and presents an on-screen notification. Once humidity returns below the hysteresis band, the alert clears and the fan icon returns to its normal-speed appearance. In non-Auto modes, the humidity value is displayed passively with no automatic control actions.

2.3 Creating a project and program/debug using ModusToolbox™ software

1. Connect the board to the PC using the provided USB cable through the KitProg3 USB connector, as shown in Figure 43. The kit enumerates as a composite device when you connect it to your PC
2. The KitProg3 on this kit is in CMSIS-DAP Bulk mode by default. The status LED (amber), LED2 and power LED (green), LED4 are turned ON at this time. If you do not see the desired LED status, see the KitProg3 user guide for details on the KitProg3 status and troubleshooting instructions

Figure 43 KitProg3 USB connected to the kit

3. In the Eclipse IDE for ModusToolbox™ software, import the desired code example (application) into a new workspace
   a. Click New Application from the Quick Panel

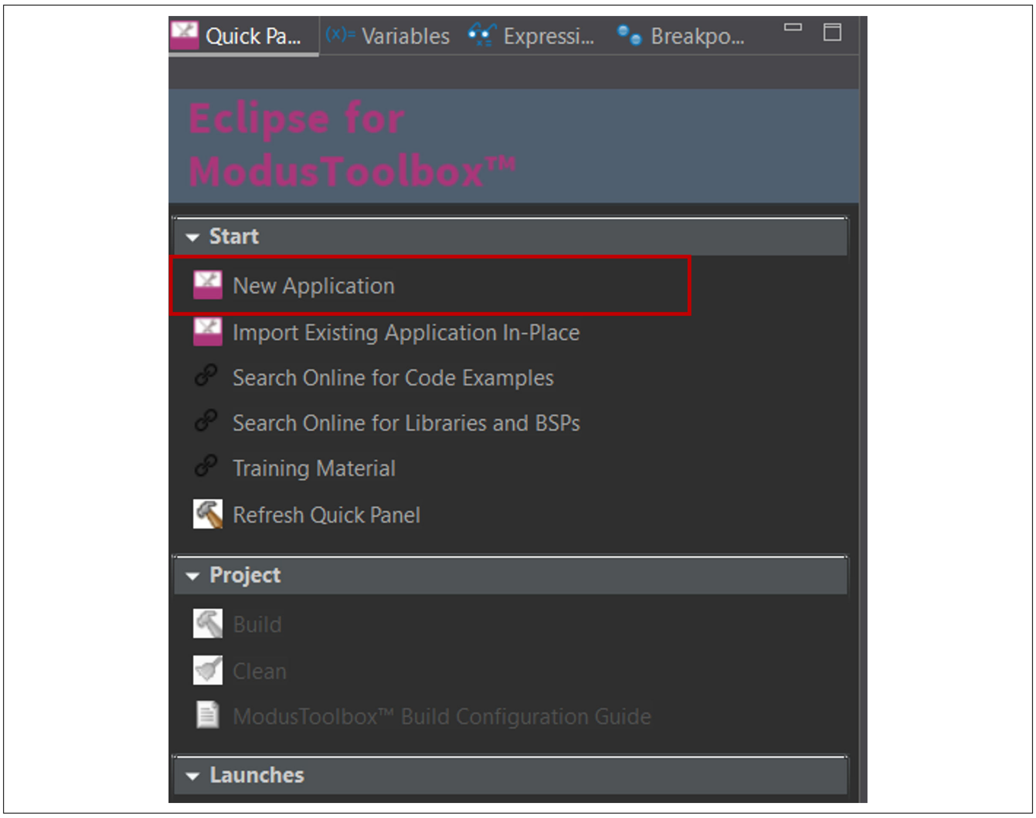


Figure 44 **Create new application**

b. Select the BSP in the Choose Board Support Package window and click Next. For example, use the **KIT_PSE84_HMI** BSP in the following steps to understand the procedure

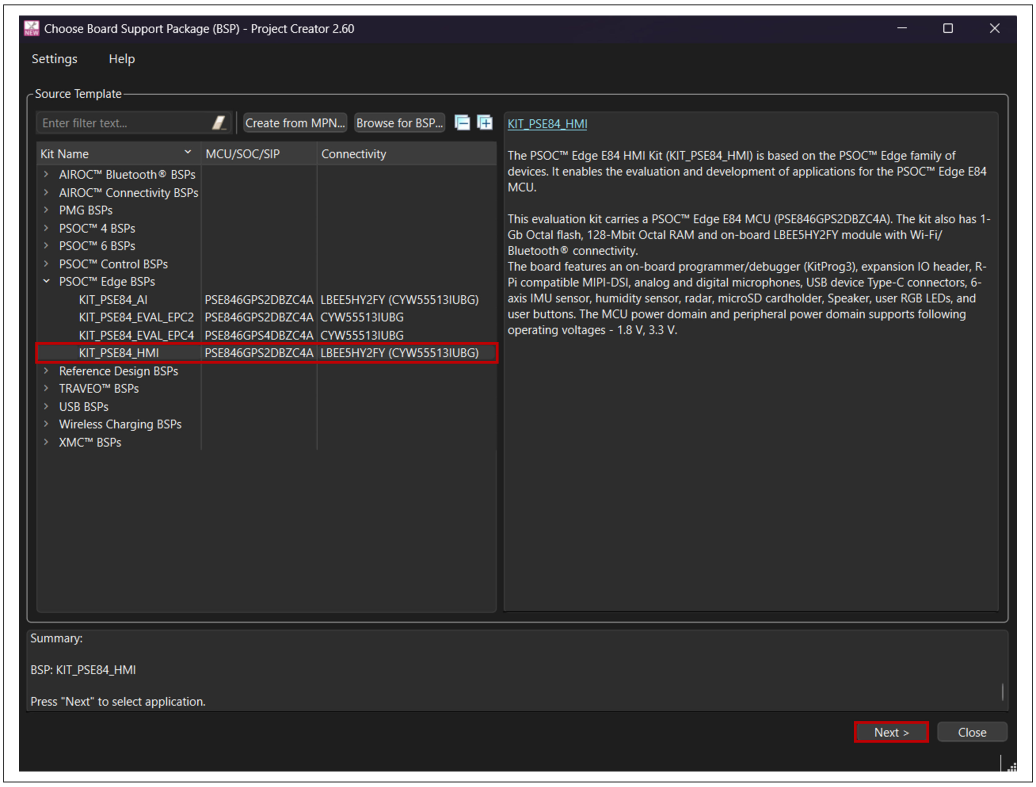


Figure 45 **New application creation: Choose target BSP**

c. Select the application in the Select Application window and click **Create**

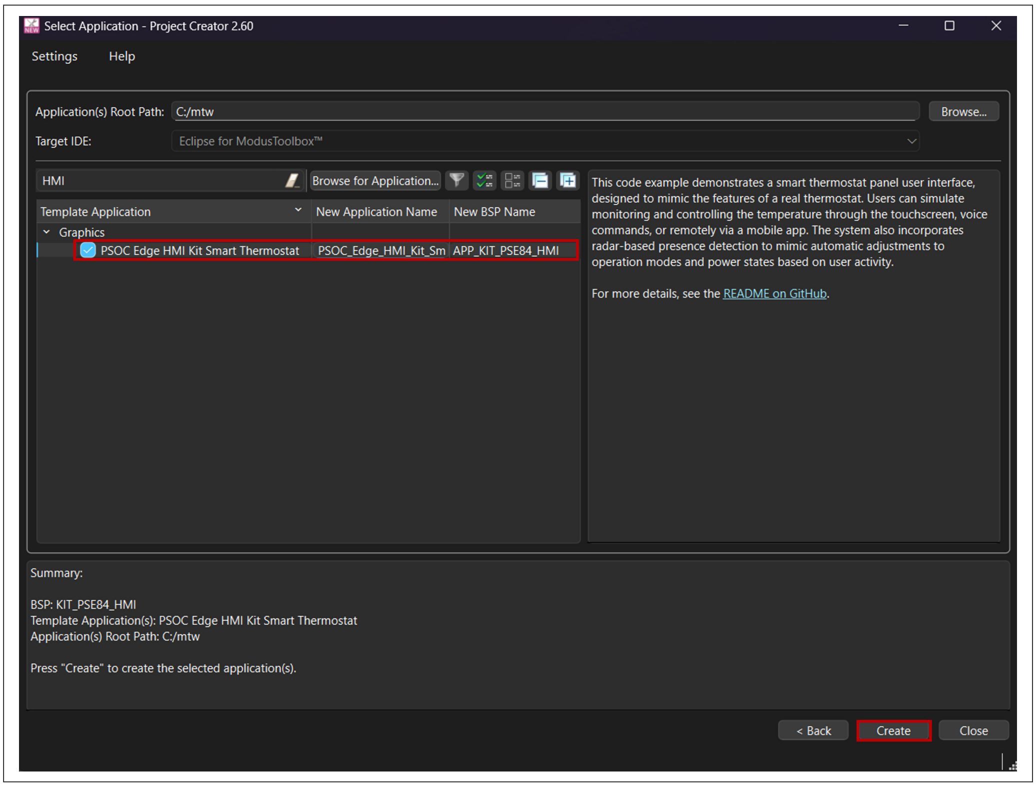


Figure 46 New application creation

4. To build and program a PSOC™ Edge E84 MCU application in the Project Explorer, select project. In the Quick Panel, scroll to the Launches section and click the Program Application , as shown in the following Figure 47

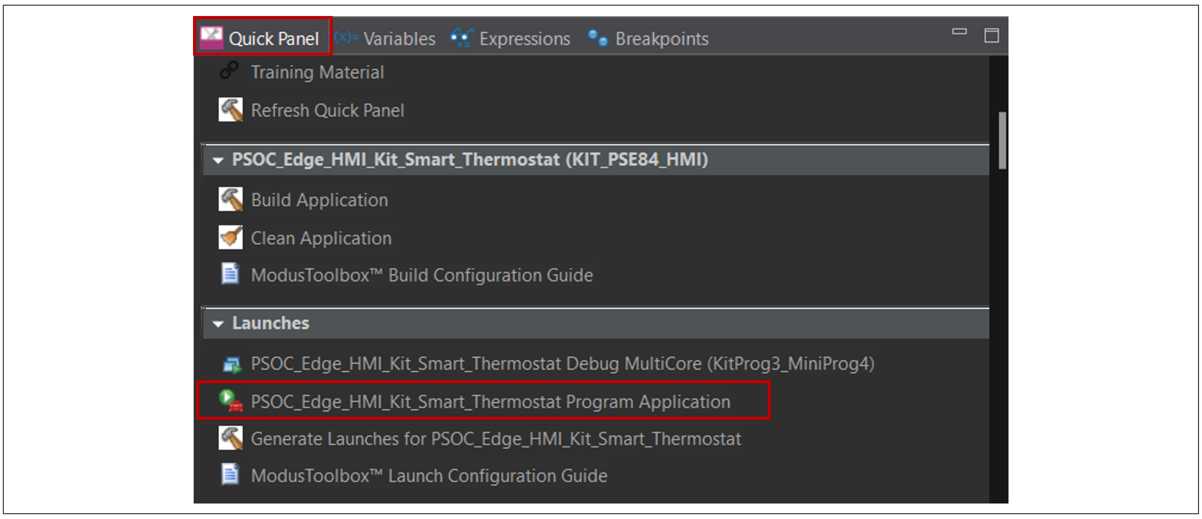


Figure 47 Programming in ModusToolbox™

5. ModusToolbox™ has an integrated debugger. To debug a PSOC™ Edge E84 MCU application in the Project Explorer, select the project. In the Quick Panel, scroll to the Launches section and click the **Debug MultiCore (KitProg3_MiniProg4)** configuration as shown in the following Figure 48. For detailed explanation on how to debug using ModusToolbox™, see **Help** > **Eclipse for ModusToolbox™ IDE Documentation** > **User Guide**.

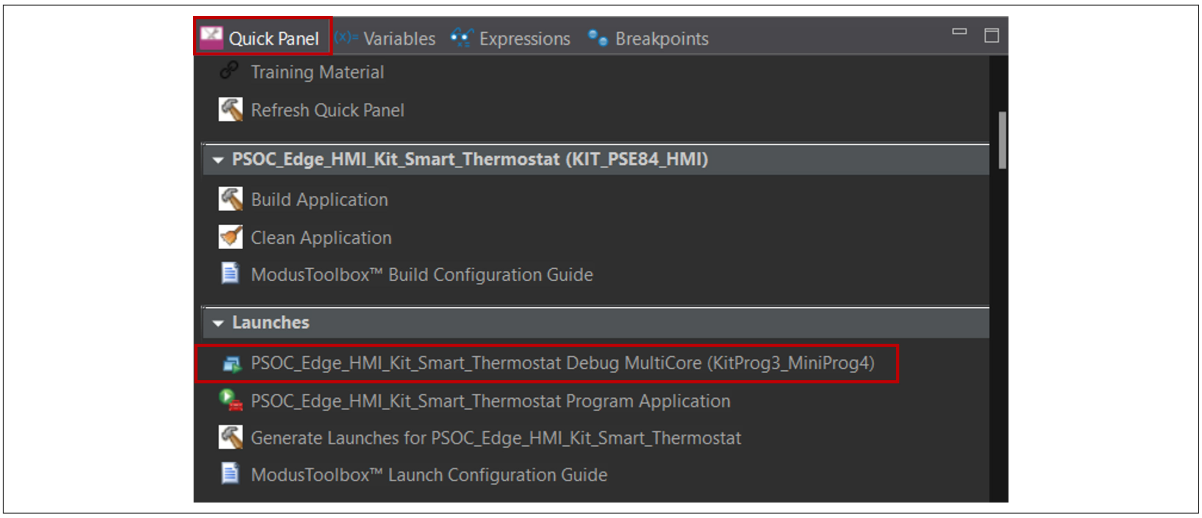


Figure 48 **Debugging in ModusToolbox™**

2.4 Steps to change the boot flow to octal SPI external flash memory

The PSOC™ Edge MCU is configured by default to use quad SPI external flash memory for extended boot. However, the PSOC™ Edge HMI kit comes with an octal SPI flash memory. Therefore, the policy file has been updated and provisioned to use octal SPI flash memory by default for the boot flow on this kit.

***Note**: If you re-provision the kit with a new policy file, make sure to configure the boot flow to use octal SPI external flash memory for extended boot. Follow the steps mentioned in the following section to update the policy file and provision the kit accordingly.*

2.4.1 Prerequisite

Infineon's Edge Protect Tools is a set of command line tools used to perform the functions needed for key signing, key generation, OEM certificate creation, device provisioning, and so on. These tools are executed through a shell tool. **Edge Protect Tools** executable is available in the **Edge Protect Security Suite v1.6**, located in the C:/Users/<username>/Infineon/Tools/ModusToolbox-Edge-Protect-Security-Suite-1.6/tools/edgeprotecttools/bin/ directory.

Add the executable path to the system environment path variable of the host PC.

To use Edge Protect Tools CLI, "modus-shell" is recommended to use, which is installed along with ModusToolbox™, located in the ModusToolbox/tools_x.y directory.

2.4.2 Transfer of ownership

Ownership of the device must be transferred to yourself before changing the policy file. Follow these steps to transfer ownership:

1. Open modus-shell and navigate to the top level of ModusToolbox™ application directory. This will be the same level as the application project directories

```
cd <app-directory>
```

2. Execute the following command to initialize the tools. This step is required one-time when using new application directory or new version of the tools

```
edgeprotecttools -t pse8xs2 init
```

3. Execute the following command to configure the openOCD tools path:

```
edgeprotecttools set-ocd --name openocd --path <openocd_path>
```

Note: *Replace `<openocd_path>` with the path to the openocd directory . Typically, this will be `C:/Infineon/Tools/ModusToolboxProgtools-1.5/openocd`*

4. Create a private and public key pair. The following command generates one pair of keys that is placed in the keys directory:

```
edgeprotecttools create-key --key-type ECDSA-P256 --output keys/oem_private_key_0.pem
keys/oem_public_key_0.pem
```

5. To generate a new CSR, execute the following command:

```
edgeprotecttools -t pse8xs2 oem-csr --certificate-name "oem-cert" --oem "Dummy OEM" --
project "Dummy Project" --project-number "1234" --public-key-0 keys/oem_public_key_0.pem
--cert-type development --output packets/apps/prov_oem/oem_csr.bin --sign-key-0 keys/
oem_private_key_0.pem
```

6. Submit the generated CSR to Edge Protect Signing Service to generate the Infineon-signed OEM certificate and download the generated certificate.

Note: *Log in to the OSTS platform to access the Infineon Edge Protect Signing Service.*

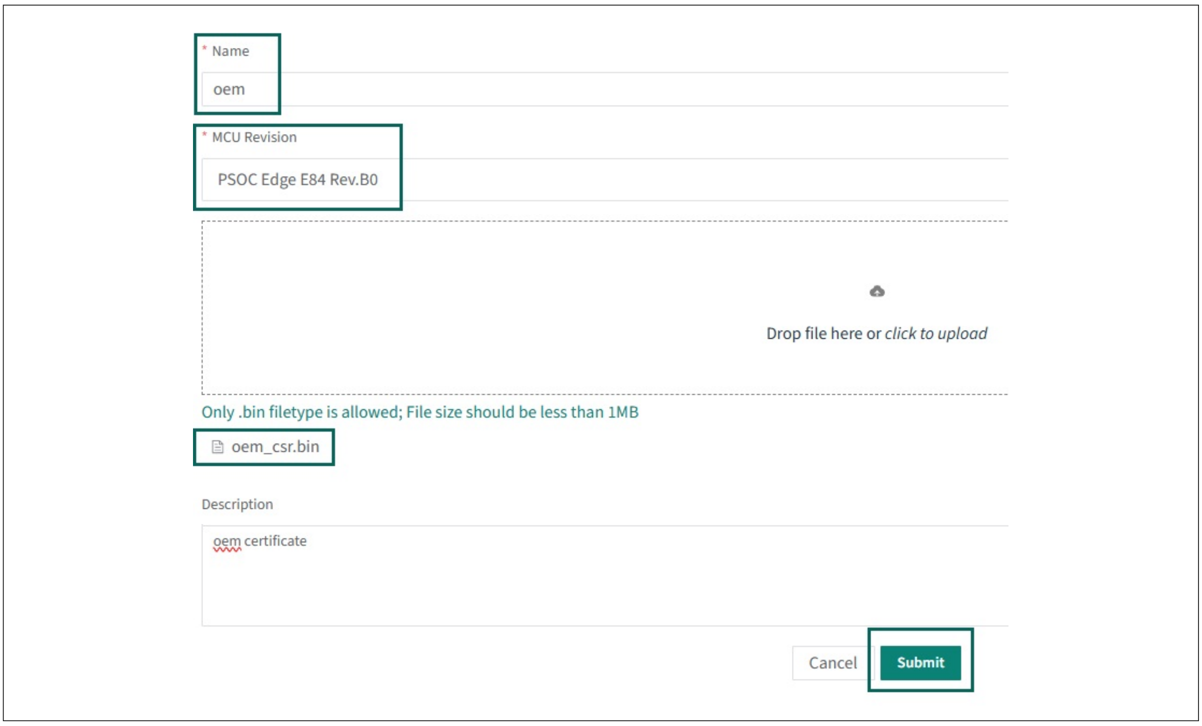


Figure 49 Submit CSR to generate signed certificate

7. Provision the device with the new key and certificate to transfer the ownership

```
edgeprotecttools -t pse8xs2 provision-device -p policy/policy_oem_provisioning.json --key
keys/oem_private_key_0.pem --ifx-oem-cert packets/apps/prov_oem/oem_cert.bin
```

***Note**: For more details on transfer of ownership, see AN237849.*

2.4.3 Switching to external octal SPI flash memory

Update the OEM policy to change the boot flow to external octal SPI flash memory. This allows the extended boot to launch your application from the external octal SPI flash.

Follow the steps below to change the boot flow.

***Note**: Most PSOC™ Edge HMI kit code examples are currently programmed to the external octal SPI flash.*

- The OEM policy file (`policy_oem_provisioning.json`) is located in the `[application directory]/policy/` directory, which is created when `edgeprotecttools` is initialized.

- In the OEM policy, set the `external_flash` > `smif_chip_select` > `value` to '0' and `external_flash` > `smif_data_width` > `value` to '8' in the OEM policy:

```
    "external_flash": {
        "smif_chip_select": {
            "description": "Chip select for primary external flash",
            "applicable_conf": "0, 1, 2, 3",
            "value": 0
        },
        "smif_data_width": {
            "description": "Select data width used to interface the external flash",
            "applicable_conf": "4, 8",
            "value": 8
        },
```

- Once the policy is updated, provision the device with the updated policy

```
edgeprotecttools -t pse8xs2 provision-device -p policy/policy_oem_provisioning.json --key
keys/oem_private_key_0.pem
```

***Note**:* *For changing the boot flow to external octal SPI flash, see the "Switching between octal and quad SPI external flash memory" section of* AN237849

3 Hardware

3.1 Schematics

Refer to the schematic files available on the kit webpage.

3.2 Hardware functional description

3.2.1 PSOC™ Edge E84 HMI base board

3.2.1.1 PSOC™ Edge E84 MCU

PSOC™ Edge E84 MCU is a dual-CPU microcontroller with a neural net companion processor, DSP capability, high-performance memory expansion capability, low-power analog subsystem with high-performance analog-to-digital conversion and low-power comparators, IoT connectivity, communication channels, and programmable analog and digital blocks. It also has audio and graphics blocks.

PSOC™ Edge E84 MCU includes the following features:

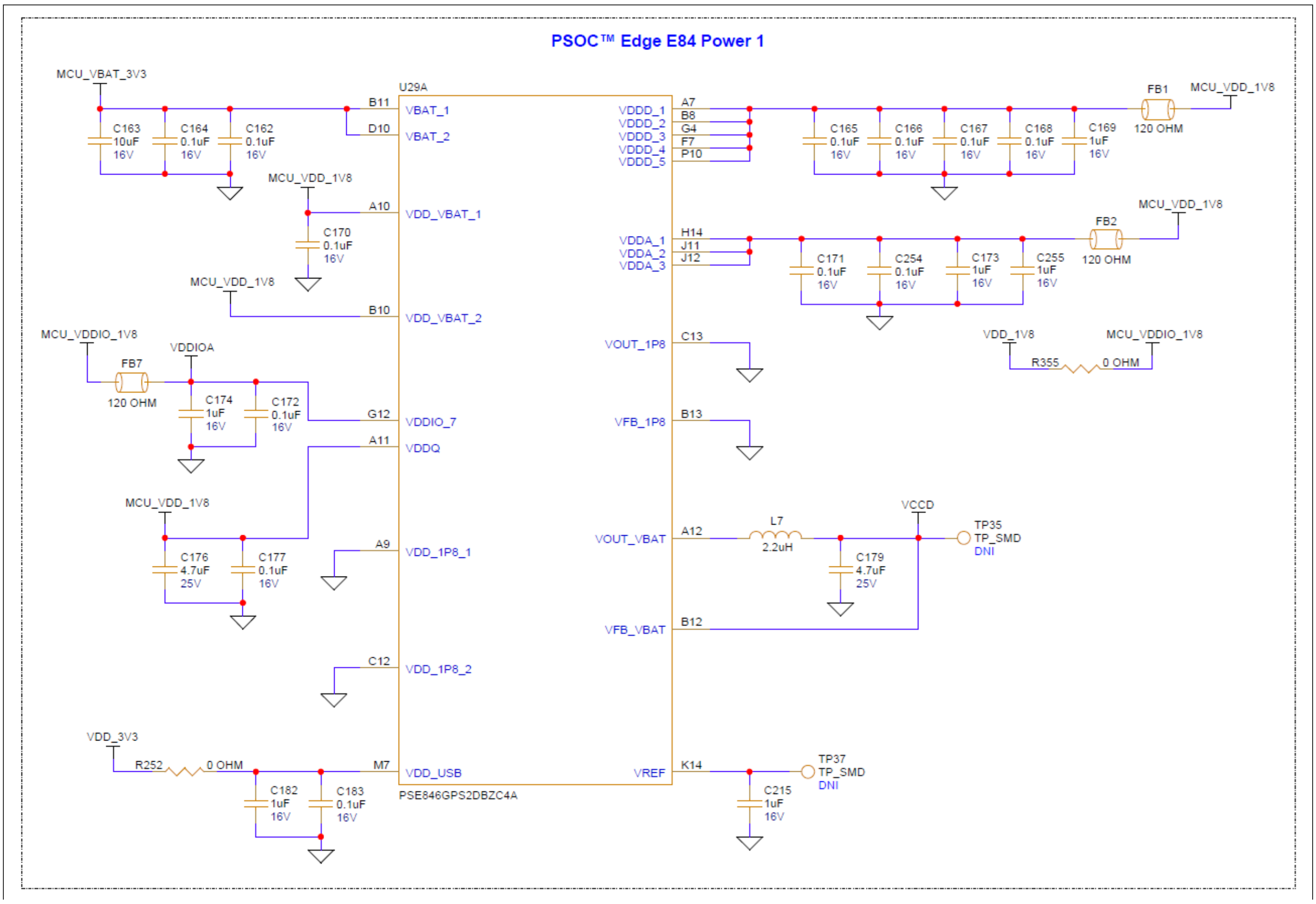
- High-performance compute, DSP, and machine learning (ML) blocks
- Low-power CPU block for security, control, and communication
- Security up to Infineon Edge Protect Category 4 (EPC 4); supported by Trusted Firmware-M (TF-M), and mbedTLS crypto acceleration package
- Lock-step secured enclave protected Root-of-Trust (RoT), secured boot, secured firmware updates
- Low-power operation: multiple power modes; DC-DC buck converter; dynamic voltage and frequency management
- Optimizable power: independent voltage domains; selectable SRAM retention
- Communications and connectivity: USB, SD host, Serial Memory Interface (SMIF), Ethernet, CAN FD, I3C, I2C, UART, SPI
- Graphics and audio blocks
- Always-on power domain: Autonomous Analog with ADC, DAC, opamps, comparators, Acoustic Activity Detection (AAD)
- Programmable GPIO pins: drive modes, strengths, and slew rates; over-voltage tolerant (OVT) pins for I2C compliance. Some ports have a smart I/O programmable logic array
- ModusToolbox™ development environment; installable SDKs and libraries; industry-standard Arm® tools; RTOS support

PSOC™ Edge E84 MCU offers several key features that enable it to run the machine learning algorithms efficiently. These include a dual CPU subsystem for parallel processing, a large memory capacity for storing and processing datasets, low-power operation for battery-powered applications, flexible clocking options for timing control, high-speed data access and communication, analog processing capabilities, and programmable GPIOs for hardware control. For more details, see the PSOC™ Edge E84 MCU datasheet.

In addition, Infineon's broad portfolio of hardware, software, and tool solutions, combined with DEEPCRAFT™'s expertise in developing robust machine learning solutions for edge devices, making it easier to leverage the advanced opportunities from AI/ML. DEEPCRAFT™ Studio, an end-to-end development platform, is planned for ML model creation, training, and deployment. This platform will enable you to bring AI into various embedded applications, enhancing functionalities, control, energy efficiency, and privacy. With DEEPCRAFT™ AI, you can benefit from a faster time to market, serving a wide range of applications for global customers.

3.2.1.1.1 PSOC™ Edge E84 MCU power supply system

PSOC™ Edge E84 MCU is designed to operate at low power, making it suitable for battery-powered applications. The powering section of the board includes the core and I/O domain power connections, decoupling capacitors, and ferrite beads to isolate the digital and analog domains. The core and I/O domain power connections are designed to provide a stable and efficient power supply to the PSOC™ Edge E84 MCU. The core power supply is connected to the 1.8 V rail, while the I/O power supply is connected to both the 3.3 V and 1.8 V power rails. These power rails are designed to provide the required voltage levels for the core and I/O operations.


PSOC™ Edge E84 Power 1
MCU_VBAT_3V3
U29A
VBAT_1
VBAT_2
VDD_VBAT_1
VDD_VBAT_2
VDDIO_7
VDDQ
VDD_1P8_1
VDD_1P8_2
VDD_USB
PSE846GPS2DBZC4A
VDDD_1
VDDD_2
VDDD_3
VDDD_4
VDDD_5
VDDA_1
VDDA_2
VDDA_3
VOUT_1P8
VFB_1P8
VOUT_VBAT
VFB_VBAT
VREF
MCU_VDD_1V8
MCU_VDDIO_1V8
VDDIOA
FB7 120 OHM
FB1 120 OHM
FB2 120 OHM
VDD_1V8
R355 0 OHM
L7 2.2uH
VCCD
TP35 TP_SMD DNI
TP37 TP_SMD DNI
VDD_3V3
R252 0 OHM

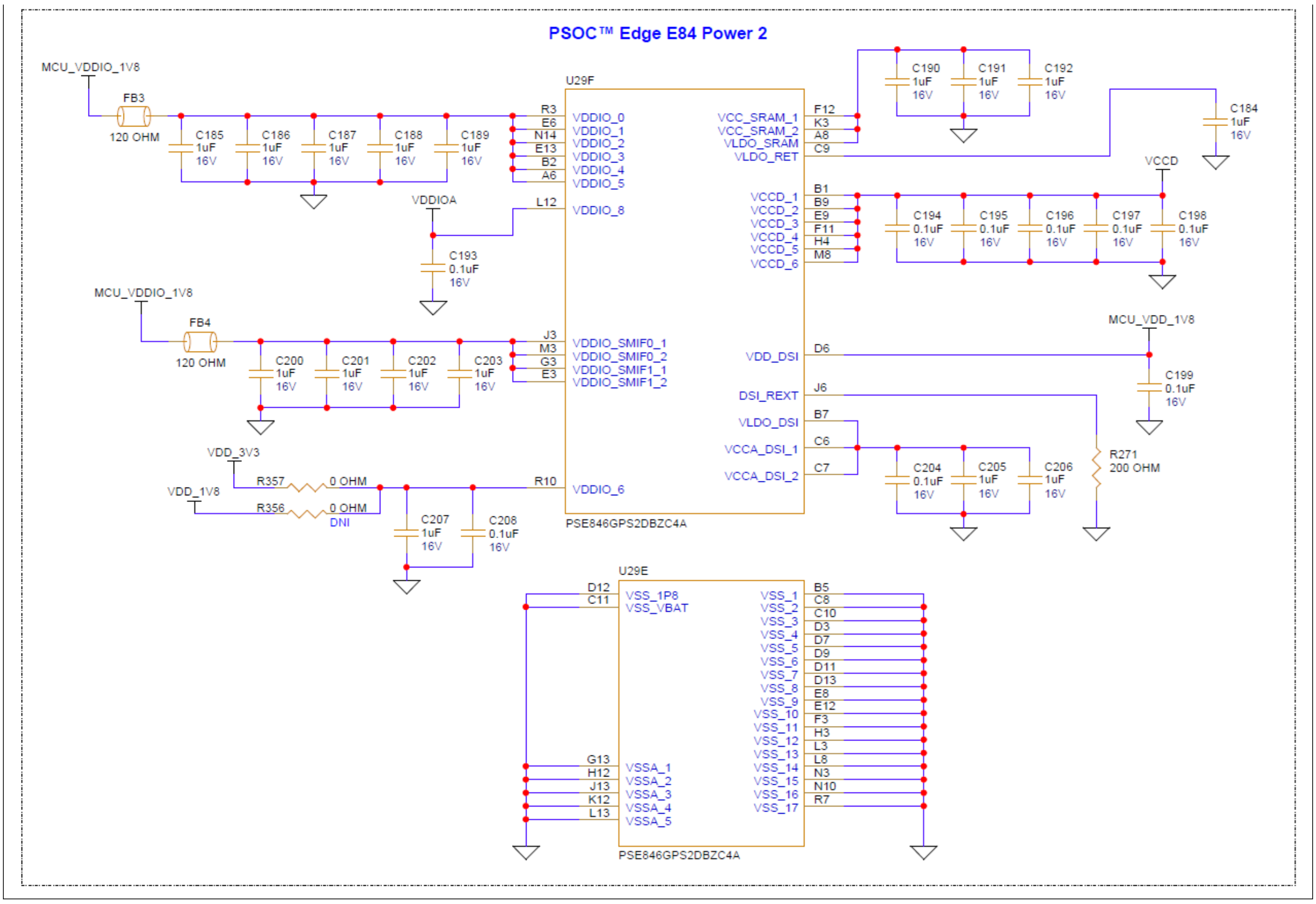


Figure 50 **Schematic for PSOC™ Edge E84 MCU power supply system**

Ferrite beads are used to isolate the digital and analog domains, preventing interference between these two domains. They are placed on the power lines connecting the digital and analog domains, ensuring that the power supply remains stable and free from interference.

Decoupling capacitors are placed close to the power pins of the MCU to filter out high-frequency noise and prevent it from affecting the operation of the MCU. These capacitors maintain a stable power supply and improve the system's performance.

3.2.1.1.2 PSOC™ Edge E84 MCU I/Os

The PSOC™ Edge E84 MCU features a comprehensive set of I/O ports designed to facilitate easy interfacing with various sensors and peripherals. PSOC™ Edge E84 MCU has 22 I/O ports, each of which can be configured with different functions based on the application requirements (refer to the datasheet for the list of alternate functions supported by the I/Os of each port). Each I/O port of the PSOC™ Edge E84 MCU is associated with a dedicated power supply, enabling users to configure different I/O ports at different logic levels.

Table 9 **PSOC™ Edge E84 MCU I/O ports and associated power rails**

PSOC™ Edge E84 MCU I/O ports	PSOC™ Edge E84 MCU power rail	Logic level
P0, P4	VDDIO_SMIF1	1.8 V
P1, P2, P3, P5	VDDIO_SMIF0	1.8 V
P6, P7	VDDIO0	1.8 V

(table continues...)

Table 9 (continued) PSOC™ Edge E84 MCU I/O ports and associated power rails

PSOC™ Edge E84 MCU I/O ports	PSOC™ Edge E84 MCU power rail	Logic level
P8	VDDIO1	1.8 V
P9, P20	VDDIO2	1.8 V
P10, P11	VDDIO3	1.8 V
P12, P21	VDDIO4	1.8 V
P13, P14	VDDIO7	1.8 V
P15	VDDIO8	1.8 V
P16, P17	VDDIO6	3.3 V
P18, P19	VDDIO5	1.8 V

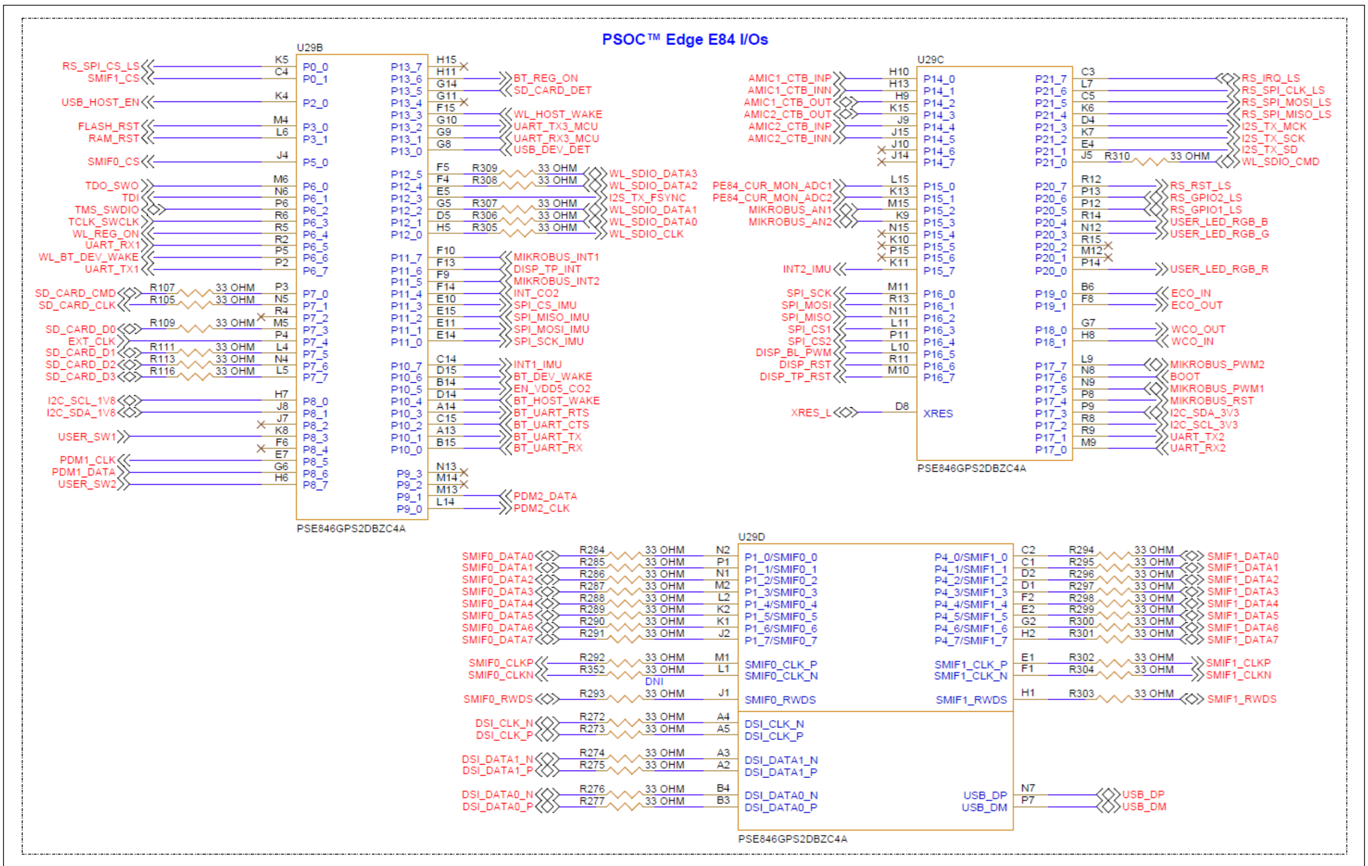


Figure 51 Schematic of PSOC™ Edge E84 MCU I/O signals

Table 10 PSOC™ Edge E84 MCU I/O pin assignment

PSOC™ Edge E84 MCU pin number	Signal name	Functionality
XRES	XRES_L	Resets the PSOC™ Edge E84 MCU
P0[0]	RS_SPI_CS_LS	Chip select signal for Radar sensor SPI interface
P0[1]	SMIF1_CS	Chip select signal for HYPERRAM™

(table continues...)

Table 10 (continued) PSOC™ Edge E84 MCU I/O pin assignment

PSOC™ Edge E84 MCU pin number	Signal name	Functionality
P1[0]/SMIF0_0	SMIF0_DATA0	Data line 0 for Octal SPI Flash
P1[1]/SMIF0_1	SMIF0_DATA1	Data line 1 for Octal SPI Flash
P1[2]/SMIF0_2	SMIF0_DATA2	Data line 2 for Octal SPI Flash
P1[3]/SMIF0_3	SMIF0_DATA3	Data line 3 for Octal SPI Flash
P1[4]/SMIF0_4	SMIF0_DATA4	Data line 4 for Octal SPI Flash
P1[5]/SMIF0_5	SMIF0_DATA5	Data line 5 for Octal SPI Flash
P1[6]/SMIF0_6	SMIF0_DATA6	Data line 6 for Octal SPI Flash
P1[7]/SMIF0_7	SMIF0_DATA7	Data line 7 for Octal SPI Flash
P2[0]	USB_HOST_EN	USB host camera enable pin
P3[0]	FLASH_RST	Resets the Octal SPI Flash
P3[1]	RAM_RST	Resets the HYPERRAM™
P4[0]/SMIF1_0	SMIF1_DATA0	Data line 0 for HYPERRAM™
P4[1]/SMIF1_1	SMIF1_DATA1	Data line 1 for HYPERRAM™
P4[2]/SMIF1_2	SMIF1_DATA2	Data line 2 for HYPERRAM™
P4[3]/SMIF1_3	SMIF1_DATA3	Data line 3 for HYPERRAM™
P4[4]/SMIF1_4	SMIF1_DATA4	Data line 4 for HYPERRAM™
P4[5]/SMIF1_5	SMIF1_DATA5	Data line 5 for HYPERRAM™
P4[6]/SMIF1_6	SMIF1_DATA6	Data line 6 for HYPERRAM™
P4[7]/SMIF1_7	SMIF1_DATA7	Data line 7 for HYPERRAM™
P5[0]	SMIF0_CS	Chip select signal for Octal SPI Flash
P6[0]	TDO_SWO	Test Data Out or Serial Wire Output for debugging
P6[1]	TDI	Test Data In for JTAG debugging
P6[2]	TMS_SWDIO	Test Mode Select or Serial Wire Debug I/O
P6[3]	TCLK_SWCLK	Test Clock for JTAG or Serial Wire Debug
P6[4]	WL_REG_ON	Power regulator control for Wi-Fi section of 2FY module/M.2 Radio
P6[5]	UART_RX1	Receive data pin for KitProg3 UART interface
P6[6]	WL_BT_DEV_WAKE	Wake-up signal for Wi-Fi and Bluetooth® device
P6[7]	UART_TX1	Transmit data pin for KitProg3 UART interface
P7[0]	SD_CARD_CMD	Command line for microSD card interface
P7[1]	SD_CARD_CLK	Clock line for microSD card interface
P7[3]	SD_CARD_D0	Data 0 line for microSD card interface

(table continues...)

Table 10 (continued) PSOC™ Edge E84 MCU I/O pin assignment

PSOC™ Edge E84 MCU pin number	Signal name	Functionality
P7[4]	EXT_CLK	External clock input for system timing
P7[5]	SD_CARD_D1	Data 1 line for microSD card interface
P7[6]	SD_CARD_D2	Data 2 line for microSD card interface
P7[7]	SD_CARD_D3	Data 3 line for microSD card interface
P8[0]	I2C_SCL_1V8	Clock signal for I2C (1.8 V logic) communication
P8[1]	I2C_SDA_1V8	Data signal for I2C (1.8 V logic) communication
P8[3]	USER_SW1	User button 1 with hibernate wakeup capability
P8[5]	PDM1_CLK	Clock signal for PDM1 interface of Digital Microphones
P8[6]	PDM1_DATA	Data signal for PDM1 interface of Digital Microphones
P8[7]	USER_SW2	User button 2 with hibernate wakeup capability
P9[0]	PDM2_CLK	Clock signal for PDM2 interface of Digital Microphones
P9[1]	PDM2_DATA	Data signal for PDM2 interface of Digital Microphones
P10[0]	BT_UART_RX	Receive data signal for Bluetooth® UART interface
P10[1]	BT_UART_TX	Transmit data signal for Bluetooth® UART interface
P10[2]	BT_UART_CTS	Clear-to-send signal for Bluetooth® UART interface
P10[3]	BT_UART_RTS	Ready-to-send signal for Bluetooth® UART interface
P10[4]	BT_HOST_WAKE	Wake-up signal for the Bluetooth® host
P10[6]	BT_DEV_WAKE	Wake-up signal for the Bluetooth® device
P10[7]	INT1_IMU	Interrupt 1 signal from the IMU sensor
P11[0]	SPI_SCK_IMU	Clock signal for IMU sensor SPI interface
P11[1]	SPI_MOSI_IMU	Master Out Slave In signal for IMU sensor SPI interface
P11[2]	SPI_MISO_IMU	Master In Slave Out signal for IMU sensor SPI interface
P11[3]	SPI_CS_IMU	Chip select signal for IMU sensor SPI interface
P11[5]	MIKROBUS_INT2	Interrupt signal from the mikroBUS Shuttle interface 2

(table continues...)

Table 10 (continued) PSOC™ Edge E84 MCU I/O pin assignment

PSOC™ Edge E84 MCU pin number	Signal name	Functionality
P11[6]	DISP_TP_INT	Interrupt signal from display capacitive touch panel
P11[7]	MIKROBUS_INT1	Interrupt signal from the mikroBUS Shuttle interface 1
P12[0]	WL_SDIO_CLK	Clock signal for Wi-Fi SDIO interface
P12[1]	WL_SDIO_DATA0	Data 0 signal for Wi-Fi SDIO interface
P12[2]	WL_SDIO_DATA1	Data 1 signal for Wi-Fi SDIO interface
P12[3]	I2S_TX_FSYNC	Frame sync signal for I2S transmit (Word select signal)
P12[4]	WL_SDIO_DATA2	Data 2 signal for Wi-Fi SDIO interface
P12[5]	WL_SDIO_DATA3	Data 3 signal for Wi-Fi SDIO interface
P13[0]	USB_DEV_DET	USB device VBUS detect signal
P13[1]	UART_RX3_MCU	UART Receive data pin for mikroBUS Shuttle interface 2
P13[2]	UART_TX3_MCU	UART Transmit data pin for mikroBUS Shuttle interface 2
P13[3]	WL_HOST_WAKE	Wake-up signal for Wi-Fi host
P13[5]	SD_CARD_DET	Card detect signal for microSD card interface
P13[6]	BT_REG_ON	Power regulator control for Bluetooth® section of 2FY module/M.2 Radio
P14[0]	AMIC1_CTB_INP	Positive input for analog microphone 1
P14[1]	AMIC1_CTB_INN	Negative input for analog microphone 1
P14[2]	AMIC1_CTB_OUT	Analog output from the MCU for analog microphone 1
P14[3]	AMIC2_CTB_OUT	Analog output from the MCU for analog microphone 2
P14[4]	AMIC2_CTB_INP	Positive input for analog microphone 2
P14[5]	AMIC2_CTB_INN	Negative input for analog microphone 2
P15[0]	PE84_CUR_MON_ADC1	Positive ADC input from current monitoring section to MCU
P15[1]	PE84_CUR_MON_ADC2	Negative ADC input from current monitoring section to MCU
P15[2]	MIKROBUS_AN1	Analog signal for mikroBUS Shuttle interface 1
P15[3]	MIKROBUS_AN2	Analog signal for mikroBUS Shuttle interface 2
P15[7]	INT2_IMU	Interrupt 2 signal from the IMU sensor
P16[0]	SPI_SCK	SPI Clock signal for mikroBUS Shuttle interfaces

(table continues...)

Table 10 (continued) PSOC™ Edge E84 MCU I/O pin assignment

PSOC™ Edge E84 MCU pin number	Signal name	Functionality
P16[1]	SPI_MOSI	SPI Master Out Slave In signal for mikroBUS Shuttle interfaces
P16[2]	SPI_MISO	SPI Master In Slave Out signal for mikroBUS Shuttle interfaces
P16[3]	SPI_CS1	SPI Chip Select signal for mikroBUS Shuttle interface 1
P16[4]	SPI_CS2	SPI Chip Select signal for mikroBUS Shuttle interface 2
P16[5]	DISP_BL_PWM	PWM control signal for display backlight
P16[6]	DISP_RST	Reset signal for display
P16[7]	DISP_TP_RST	Reset signal for display capacitive touch panel
P17[0]	UART_RX2	UART Receive data pin for mikroBUS Shuttle interface 1
P17[1]	UART_TX2	UART Transmit data pin for mikroBUS Shuttle interface 1
P17[2]	I2C_SCL_3V3	Clock signal for I2C (3.3 V logic) communication
P17[3]	I2C_SDA_3V3	Data signal for I2C (3.3 V logic) communication
P17[4]	MIKROBUS_RST	Reset signal for mikroBUS Shuttle interfaces
P17[5]	MIKROBUS_PWM1	PWM signal for mikroBUS Shuttle interface 1
P17[6]	BOOT	Used to control boot mode of the PSOC™ Edge E84 MCU
P17[7]	MIKROBUS_PWM2	PWM signal for mikroBUS Shuttle interface 2
P18[0]	WCO_OUT	Output for the Watch Crystal Oscillator
P18[1]	WCO_IN	Input for the Watch Crystal Oscillator
P19[0]	ECO_IN	Input for the External Crystal Oscillator
P19[1]	ECO_OUT	Output for the External Crystal Oscillator
P20[0]	USER_LED_RGB_R	Red channel of the RGB User LED
P20[3]	USER_LED_RGB_G	Green channel of the RGB User LED
P20[4]	USER_LED_RGB_B	Blue channel of the RGB User LED
P20[5]	RS_GPIO1_LS	GPIO1 signal for Radar sensor SPI interface
P20[6]	RS_GPIO2_LS	GPIO2 signal for Radar sensor SPI interface
P20[7]	RS_RST_LS	Reset signal for Radar sensor SPI interface
P21[0]	WL_SDIO_CMD	Command signal for Wi-Fi SDIO interface
P21[1]	I2S_TX_SD	Data signal for I2S transmit interface
P21[2]	I2S_TX_SCK	Clock signal for I2S transmit interface

(table continues...)

Table 10 (continued) PSOC™ Edge E84 MCU I/O pin assignment

PSOC™ Edge E84 MCU pin number	Signal name	Functionality
P21[3]	I2S_TX_MCK	Master clock for I2S transmit interface
P21[4]	RS_SPI_MISO_LS	Master In Slave Out for Radar sensor SPI interface
P21[5]	RS_SPI_MOSI_LS	Master Out Slave In for Radar sensor SPI interface
P21[6]	RS_SPI_CLK_LS	Clock signal for Radar sensor SPI interface
P21[7]	RS_IRQ_LS	Interrupt signal for Radar sensor SPI interface
SMIF0_CLK_P	SMIF0_CLKP	Positive Clock line for Octal SPI Flash
SMIF0_CLK_N	SMIF0_CLKN	Negative Clock line for Octal SPI Flash
SMIF0_RWDS	SMIF0_RWDS	Read-Write Data Strobe signal for Octal SPI Flash
SMIF1_CLK_P	SMIF1_CLKP	Positive Clock line for HYPERRAM™
SMIF1_CLK_N	SMIF1_CLKN	Negative Clock line for HYPERRAM™
SMIF1_RWDS	SMIF1_RWDS	Read-Write Data Strobe signal for HYPERRAM™
DSI_CLK_P	DSI_CLK_P	Positive Clock line of MIPI-DSI interface
DSI_CLK_N	DSI_CLK_N	Negative Clock line of MIPI-DSI interface
DSI_DATA0_P	DSI_DATA0_P	Positive Data 0 line of MIPI-DSI interface
DSI_DATA0_N	DSI_DATA0_N	Negative Data 0 line of MIPI-DSI interface
DSI_DATA1_P	DSI_DATA1_P	Positive Data 1 line of MIPI-DSI interface
DSI_DATA1_N	DSI_DATA1_N	Negative Data 1 line of MIPI-DSI interface
USB_DP	USB_DP	Positive Data line of USB interface
USB_DM	USB_DM	Negative Data line of USB interface

3.2.1.1.3 Clock architecture for PSOC™ Edge E84 MCU

The PSOC™ Edge E84 HMI Kit is designed to support advanced applications with its hardware features. It includes a 24-MHz external clock source from a crystal oscillator (**Y5**) connected to **P7[4]** as primary clock source. A 17.2032 MHz clock source from a crystal (**Y3**) is connected to **P19[0]** and **P19[1]** to enable the external crystal oscillator (ECO). Additionally, a 32.768-kHz RTC (**U28**) square wave clock source is connected to the **P18[1]** pin of the PSOC™ Edge E84 MCU by default. Additionally, a crystal (**Y4**) is connected to **P18[0]**, **P18[1]** as the WCO (Watch Crystal Oscillator) which is multiplexed with the RTC (**U28**) clock source. Note that **Y4** is not populated and not connected to the MCU by default.

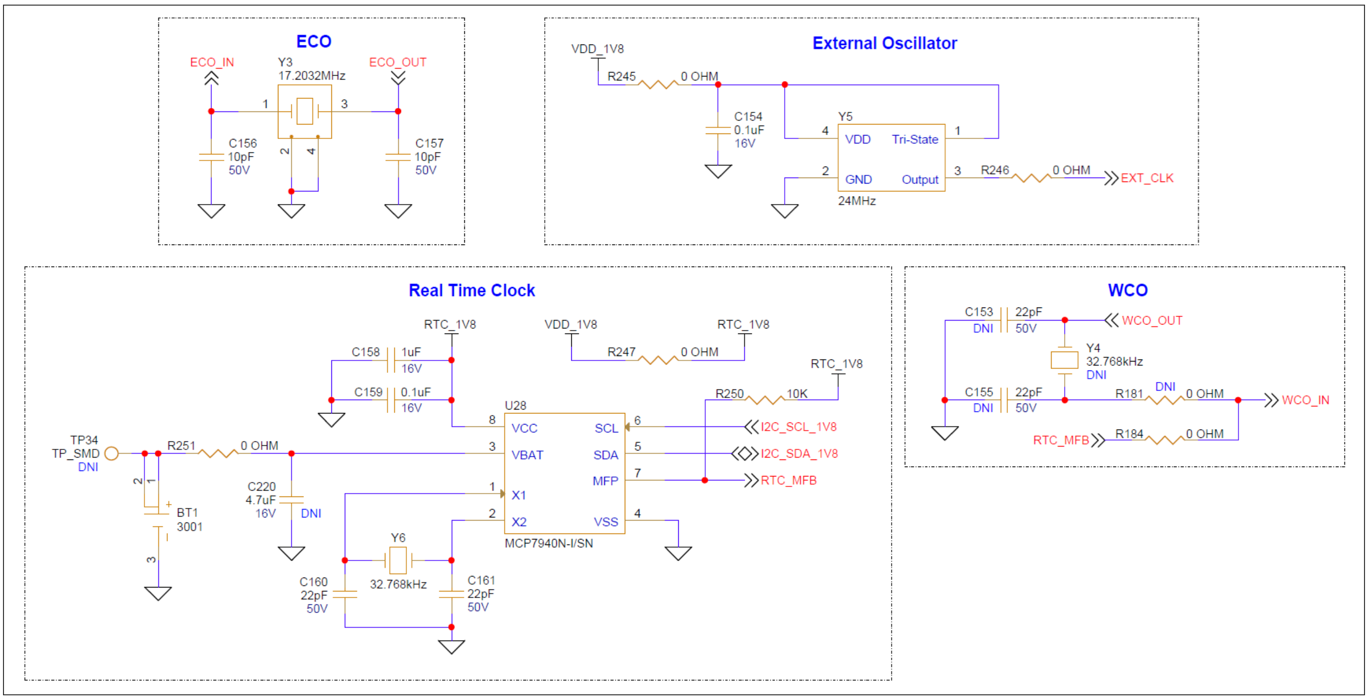


Figure 52 Schematic of Clock architecture for PSOC™ Edge E84

Note that under certain environmental conditions (high humidity), the ECO (**Y3**) and RTC (**U28**) may not produce the desired clock signal, which can result in boot failures. Under normal environmental conditions (humidity less than 80%), the device should operate as expected.

3.2.1.1.4 PSOC™ Edge E84 programming/debugging interface

In the PSOC™ Edge E84 HMI Kit, a default programming/debugging interface is through the on board KitProg3 programmer/debugger. In addition, you can use an external programmer like MiniProg4 to program/debug PSOC™ Edge E84 device through this 10-pin header (**J6**) which is not populated by default.

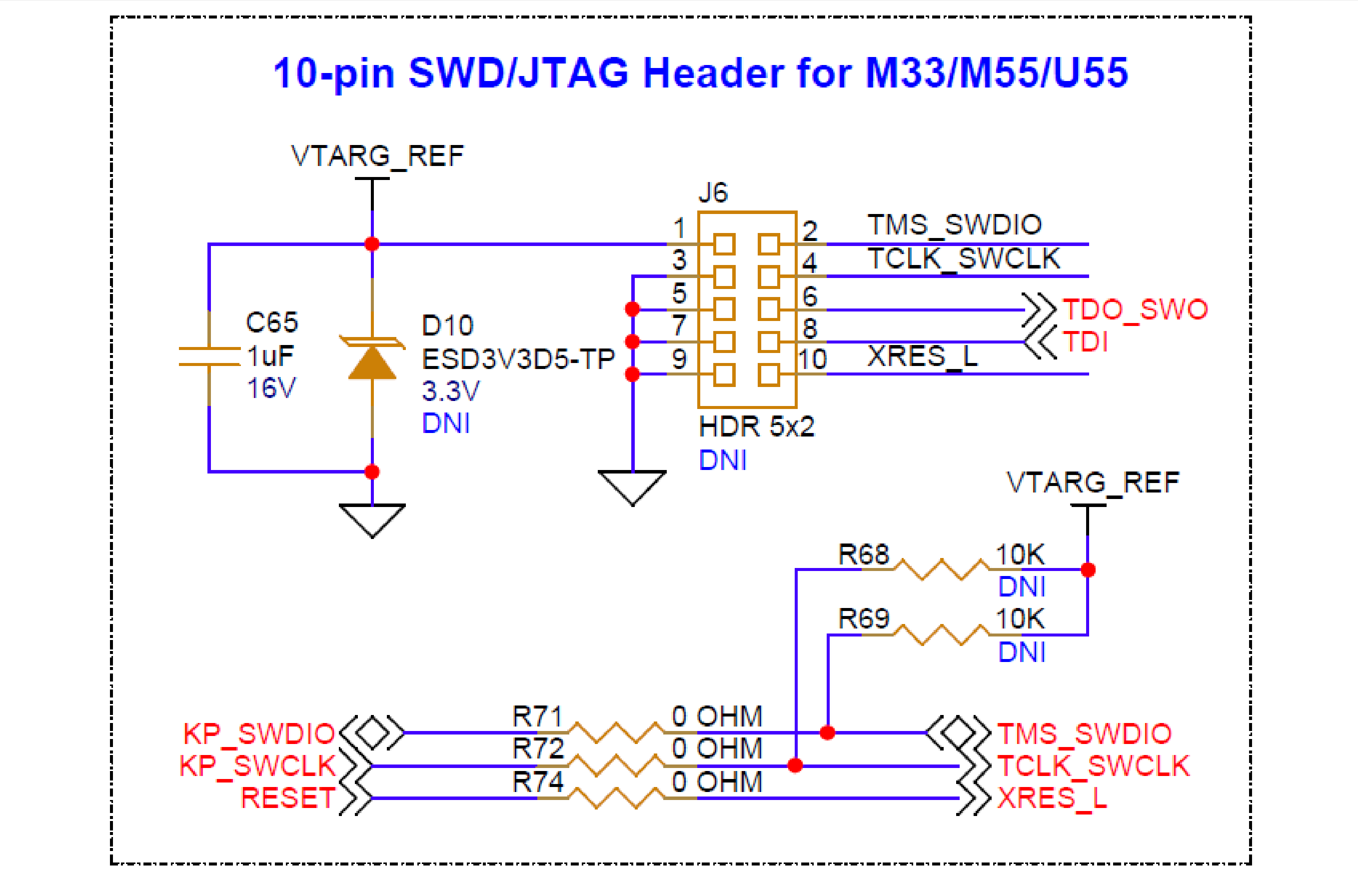


Figure 53 **Schematic of PSOC™ Edge E84 programming/debugging interface**

The interface circuit **D10** provides ESD protection, and **C65** provides filtered reference voltage for external programmer to detect the target voltage of the PSOC™ Edge E84 device.

Note: *Do not feed power to the board through this header. The **J6.1** must be used only for sensing the target voltage reference.*

3.2.1.2 Memory subsystem

3.2.1.2.1 Octal flash

PSOC™ Edge E84 HMI Kit has an Infineon SEMPER™ Octal flash memory (S28HS01GTGZBHI030) (**U10**) of 1 Gb capacity.

The NOR flash is connected to the Octal xSPI interface of the PSOC™ Edge E84 MCU device. The NOR flash device supports 8-bit (Octal I/O) serial commands. The device can operate up to 200 MBps in SDR mode and 400 MBps in DDR mode.

Table 11 **Pin assignments of Octal flash interface**

Signal name	PSOC™ Edge E84 I/O	Logic level
SMIF0_DATA0	P1[0]	1.8 V
SMIF0_DATA1	P1[1]	1.8 V
SMIF0_DATA2	P1[2]	1.8 V

(table continues...)

Table 11 (continued) Pin assignments of Octal flash interface

Signal name	PSOC™ Edge E84 I/O	Logic level
SMIF0_DATA3	P1[3]	1.8 V
SMIF0_DATA4	P1[4]	1.8 V
SMIF0_DATA5	P1[5]	1.8 V
SMIF0_DATA6	P1[6]	1.8 V
SMIF0_DATA7	P1[7]	1.8 V
SMIF0_RWDS	SMIF0_RWDS	1.8 V
SMIF0_CS	P5[0]	1.8 V
SMIF0_CLKP	SMIF0_CLK_P	1.8 V
SMIF0_CLKN	SMIF0_CLK_N	1.8 V
FLASH_RST	P3[0]	1.8 V

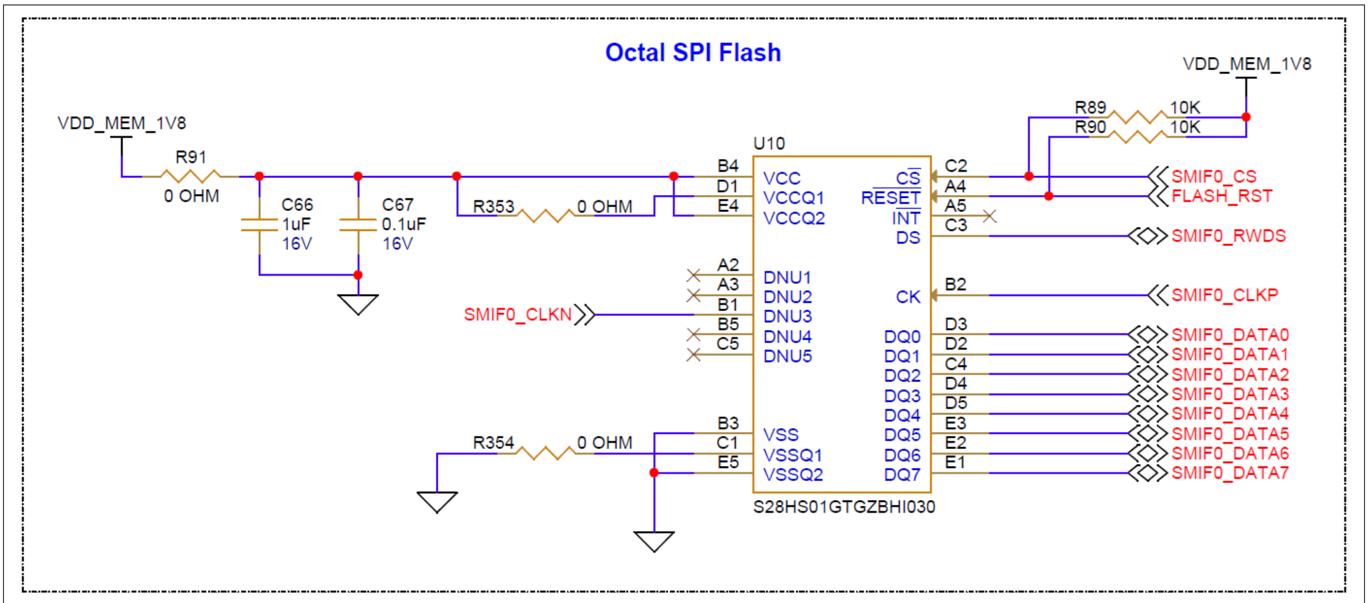


Figure 54 Schematic of Octal flash

3.2.1.2.2 HYPERRAM™

PSOC™ Edge E84 HMI Kit has an Infineon HYPERRAM™ memory (S80KS5123GABHI023) (**U11**) of 512 Mb capacity. The PSRAM is connected to the Octal xSPI interface of the PSOC™ Edge E84 MCU device. The PSRAM device supports 8-bit (Octal I/O) serial commands. The device can operate only in DDR mode with 400 MBps data rate.

Table 12 Pin assignments of HYPERRAM™ interface

Signal name	PSOC™ Edge E84 I/O	Logic level
SMIF1_DATA0	P4[0]	1.8 V
SMIF1_DATA1	P4[1]	1.8 V
SMIF1_DATA2	P4[2]	1.8 V

(table continues...)

Table 12 (continued) Pin assignments of HYPERRAM™ interface

Signal name	PSOC™ Edge E84 I/O	Logic level
SMIF1_DATA3	P4[3]	1.8 V
SMIF1_DATA4	P4[4]	1.8 V
SMIF1_DATA5	P4[5]	1.8 V
SMIF1_DATA6	P4[6]	1.8 V
SMIF1_DATA7	P4[7]	1.8 V
SMIF1_RWDS	SMIF1_RWDS	1.8 V
SMIF1_CS	P0[1]	1.8 V
SMIF1_CLKP	SMIF1_CLK_P	1.8 V
SMIF1_CLKN	SMIF1_CLK_N	1.8 V
RAM_RST	P3[1]	1.8 V

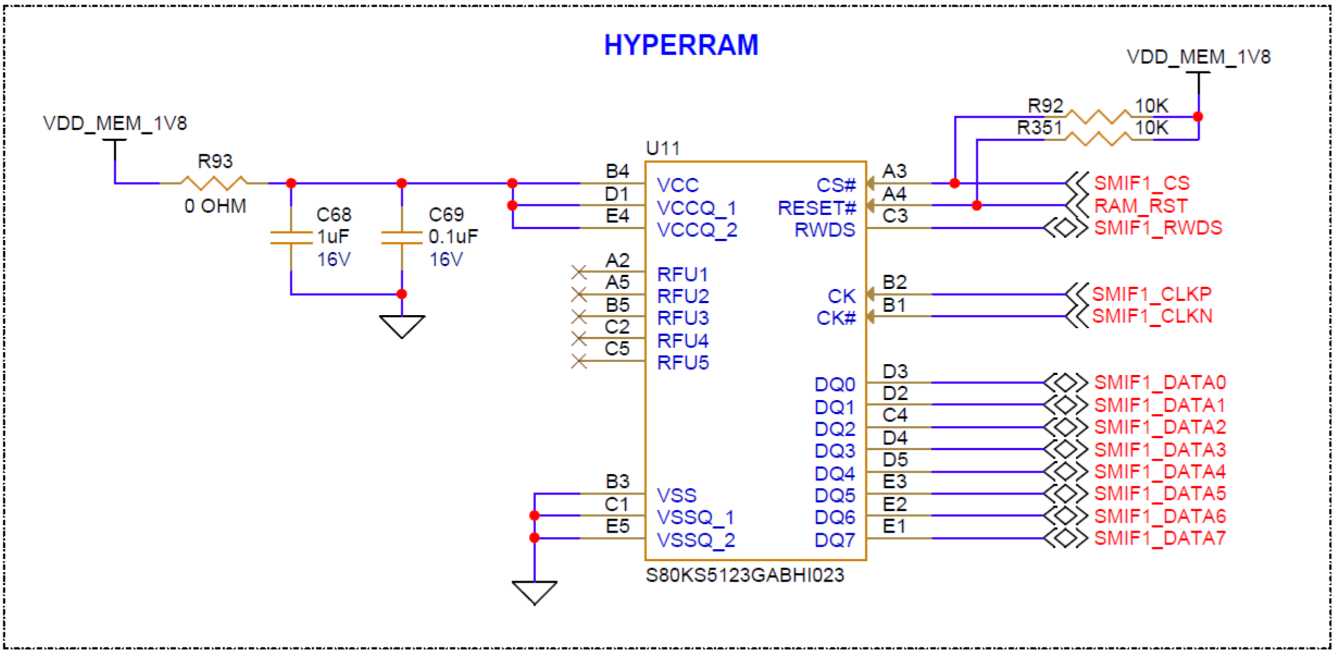


Figure 55 Schematic of HYPERRAM™

3.2.1.3 Wi-Fi 6 & Bluetooth® LE 5.4 Dual-Radio module interface

The LBEE5HY2FY Murata SiP (system-in-package) module (2FY module), powered by the Infineon CYW55513 chipset, is a dual-mode wireless solution that offers Wi-Fi 802.11a/b/g/n/ac/ax + Bluetooth® 5.4 BR/EDR/LE up to 143 Mbps PHY data rate on Wi-Fi, 3Mbps PHY data rate on Bluetooth® and 2 Mbps PHY data rate on Bluetooth® LE. The WLAN section supports SDIO 3.0 interface and the Bluetooth® section supports high-speed 4-wire UART interface. This module is designed for easy integration into various applications, providing reliable and high speed wireless connectivity.

The 2FY module is powered with an external VBAT supply voltage of 3.3 V and an I/O's supply voltage of 1.8 V for interface I/Os.

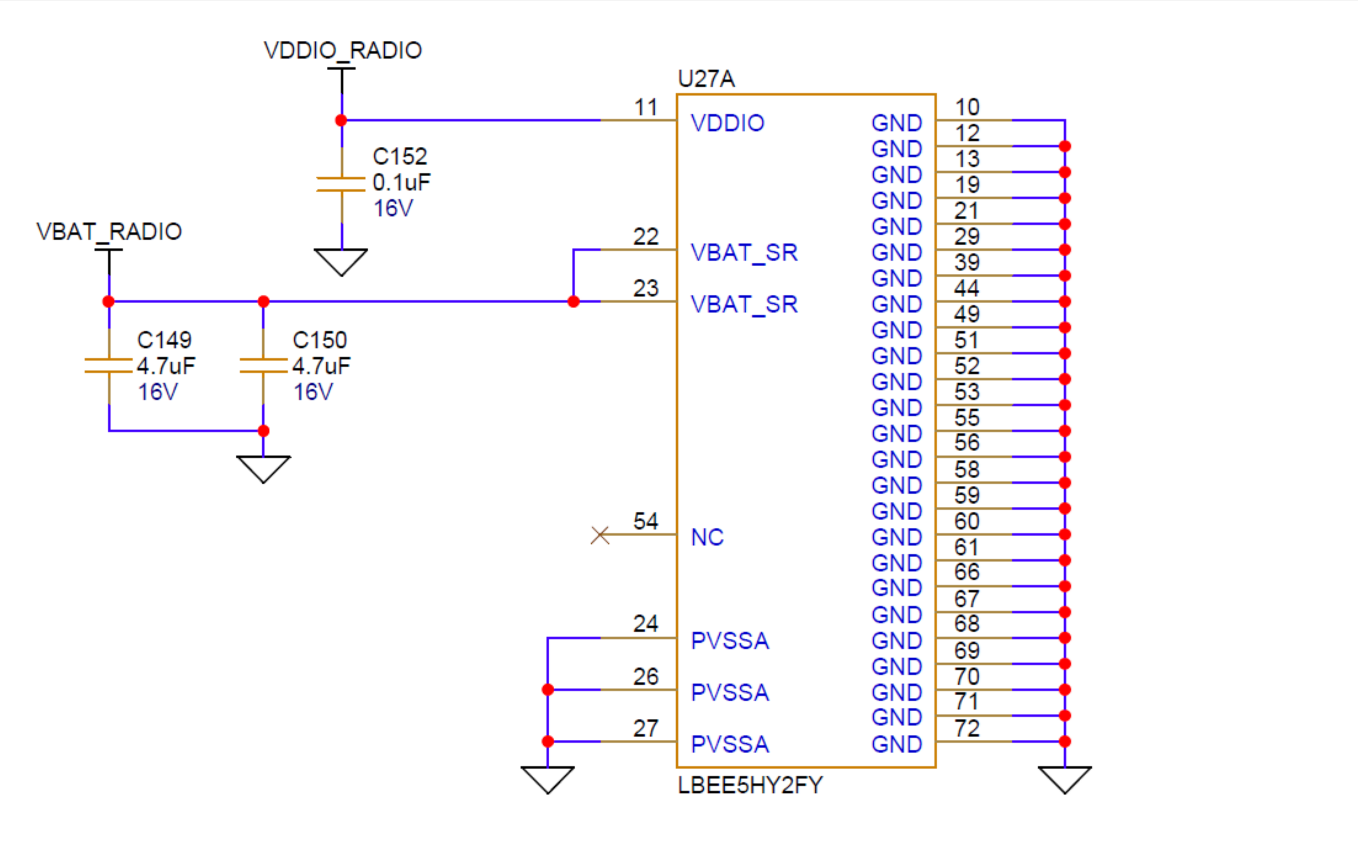


Figure 56 Schematic of 2FY module power section

Table 13 PSOC™ Edge E84 and 2FY module interface details

2FY module signal	PSOC™ Edge E84 MCU I/O	Description
BT_REG_ON	P13[6]	BT_REG_ON signal controlled by PSOC™ Edge E84 device I/O used to power up or power down the internal regulators used by the Bluetooth® section. Also, when deasserted, this pin holds the Bluetooth® section in reset.
WL_REG_ON	P6[4]	WL_REG_ON signal controlled by PSOC™ Edge E84 device I/O used to power up or power down the internal regulators used by the WLAN section. Also, when deasserted, this pin holds the WLAN section in reset.
WL_HOST_WAKE	P13[3]	Wi-Fi HOST_WAKE or general-purpose I/O signal
BT_HOST_WAKE	P10[4]	Bluetooth® HOST_WAKE or general-purpose I/O signal
BT_DEV_WAKE	P10[6]	DEV_WAKE or general-purpose I/O signal
SDIO_CLK	P12[0]	SDIO clock input
SDIO_CMD	P21[0]	SDIO command line
SDIO_DATA[0]	P12[1]	SDIO Data 0 line
SDIO_DATA[1]	P12[2]	SDIO Data 1 line

(table continues...)

Table 13 (continued) PSOC™ Edge E84 and 2FY module interface details

2FY module signal	PSOC™ Edge E84 MCU I/O	Description
SDIO_DATA[2]	P12[4]	SDIO Data 2 line
SDIO_DATA[3]	P12[5]	SDIO Data 3 line
BT_UART_TXD	P10[0]	UART serial output. Serial data output for the HCI UART interface.
BT_UART_RXD	P10[1]	UART serial input. Serial data input for the HCI UART interface.
BT_UART_RTS	P10[2]	UART request-to-send. Active-low request to send signal for the HCI UART interface.
BT_UART_CTS	P10[3]	UART clear-to-send. Active-low clear-to-send signal for the HCI UART interface.

PSOC™ Edge E84 device communicates to 2FY module using a standard SDIO interface for WLAN and UART interface for Bluetooth® operation.

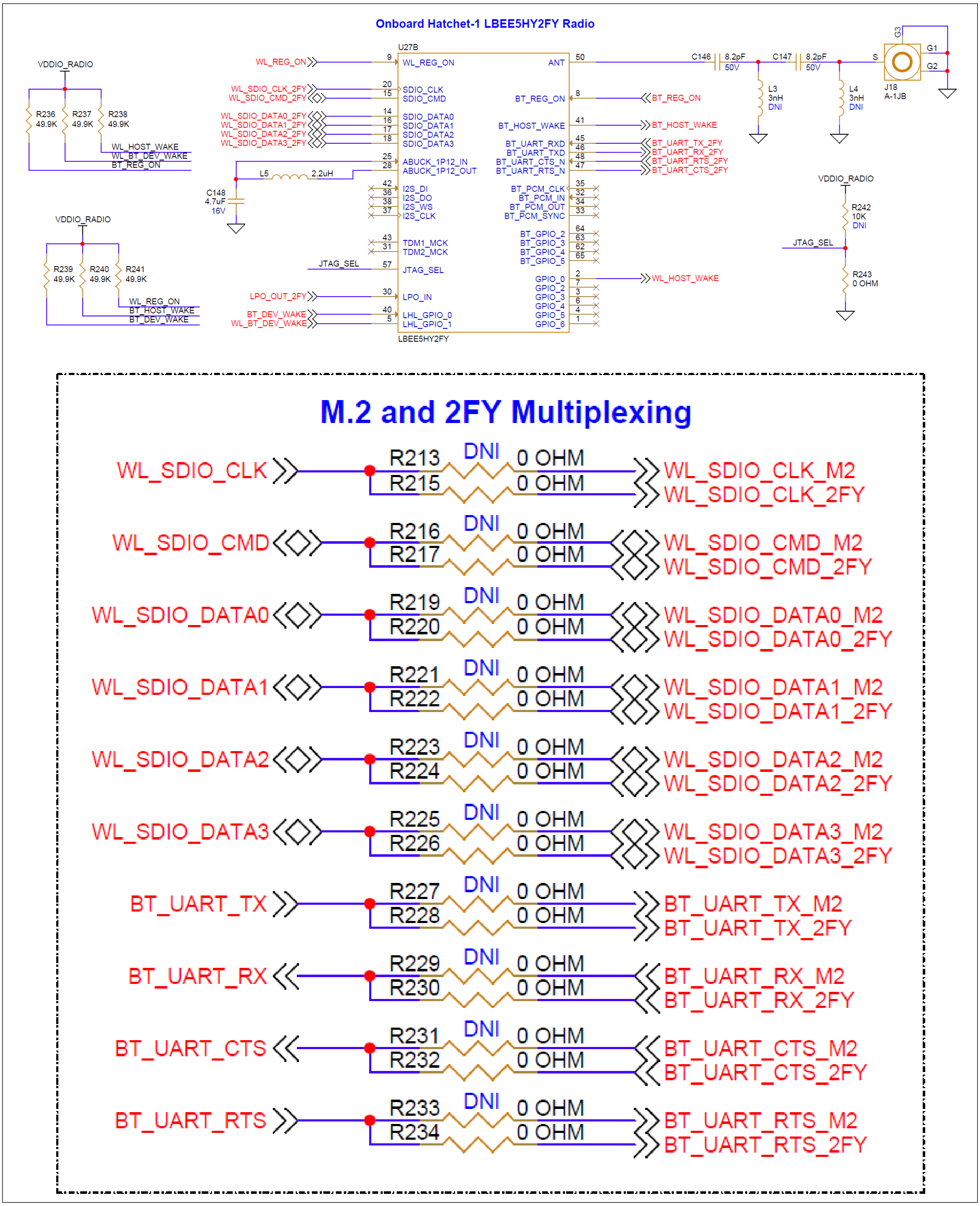


Figure 57 **2FY module interface schematic**

An onboard oscillator (**Y1**) of 32.768 kHz is used to provide external clock input (LPO_OUT_2FY) to the 2FY module or M.2 radio module. It is connected to 2FY module by default.

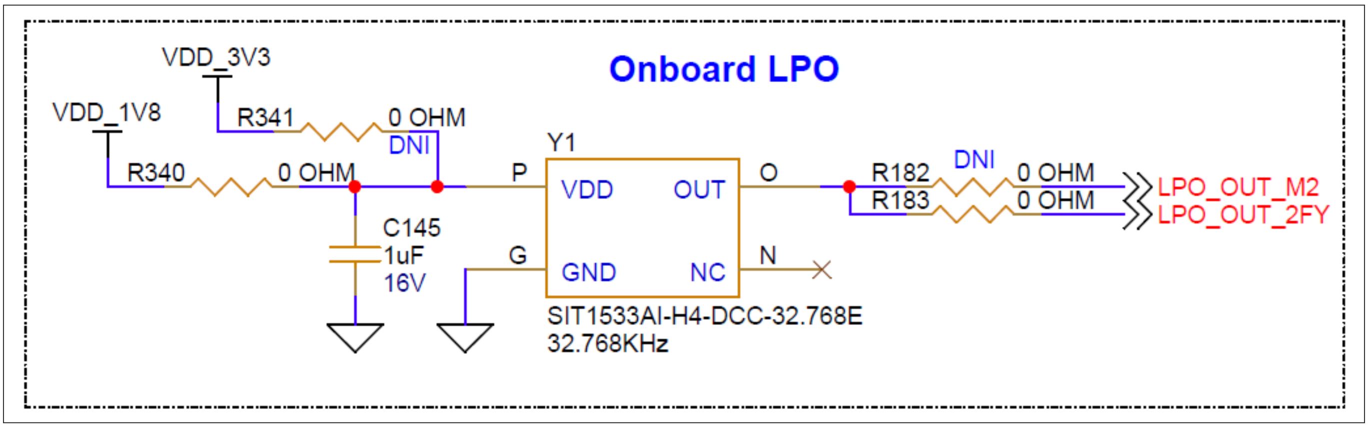


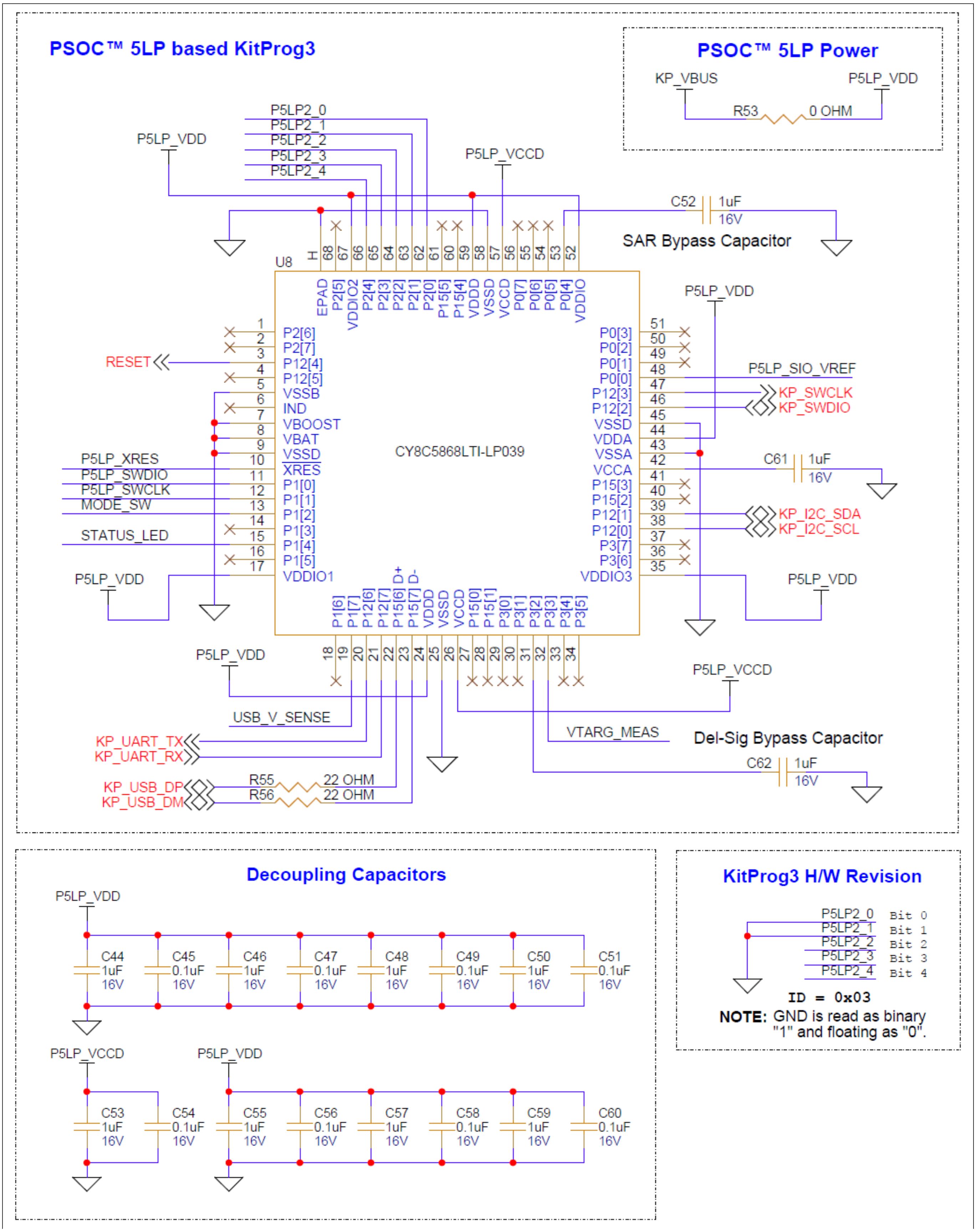
Figure 58 **Schematic of LPO for 2FY (or M.2 radio) module**

3.2.1.4 PSOC™ 5LP as onboard programmer/debugger

3.2.1.4.1 PSOC™ 5LP-based KitProg3

The onboard PSOC™ 5LP (CY8C5868LTI-LP039, **U8**) device is used as the KitProg3 programmer/debugger to program and debug the PSOC™ Edge E84 MCU. PSOC™ 5LP device is connected to the USB port of a PC through a Type-C USB connector, and to the SWD and other communication interfaces of the PSOC™ Edge E84 MCU.

For more information, see the PSOC™ 5LP webpage. Additionally, see the CY8C58LPxx family datasheet.


PSOC™ 5LP based KitProg3
PSOC™ 5LP Power
KP_VBUS
P5LP_VDD
R53
0 OHM
P5LP2_0
P5LP2_1
P5LP2_2
P5LP2_3
P5LP2_4
P5LP_VCCD
C52
1uF
16V
SAR Bypass Capacitor
U8
CY8C5868LTI-LP039
EPAD
P2[5]
VDDIO2
P2[4]
P2[3]
P2[2]
P2[1]
P2[0]
P15[5]
P15[4]
VDDD
VSSD
VCCD
P0[7]
P0[6]
P0[5]
P0[4]
VDDIO
P2[6]
P2[7]
P12[4]
P12[5]
VSSB
IND
VBOOST
VBAT
VSSD
XRES
P1[0]
P1[1]
P1[2]
P1[3]
P1[4]
P1[5]
VDDIO1
P0[3]
P0[2]
P0[1]
P0[0]
P12[3]
P12[2]
VSSD
VDDA
VSSA
VCCA
P15[3]
P15[2]
P12[1]
P12[0]
P3[7]
P3[6]
VDDIO3
P1[6]
P1[7]
P12[6]
P12[7]
P15[6] D+
P15[7] D-
VDDD
VSSD
VCCD
P15[0]
P15[1]
P3[0]
P3[1]
P3[2]
P3[3]
P3[4]
P3[5]
RESET
P5LP_XRES
P5LP_SWDIO
P5LP_SWCLK
MODE_SW
STATUS_LED
P5LP_SIO_VREF
KP_SWCLK
KP_SWDIO
C61
1uF
16V
KP_I2C_SDA
KP_I2C_SCL
USB_V_SENSE
KP_UART_TX
KP_UART_RX
KP_USB_DP
KP_USB_DM
R55
22 OHM
R56
22 OHM
VTARG_MEAS
Del-Sig Bypass Capacitor
C62
1uF
16V
Decoupling Capacitors
P5LP_VDD
C44 1uF 16V
C45 0.1uF 16V
C46 1uF 16V
C47 0.1uF 16V
C48 1uF 16V
C49 0.1uF 16V
C50 1uF 16V
C51 0.1uF 16V
P5LP_VCCD
C53 1uF 16V
C54 0.1uF 16V
P5LP_VDD
C55 1uF 16V
C56 0.1uF 16V
C57 1uF 16V
C58 0.1uF 16V
C59 1uF 16V
C60 0.1uF 16V
KitProg3 H/W Revision
P5LP2_0 Bit 0
P5LP2_1 Bit 1
P5LP2_2 Bit 2
P5LP2_3 Bit 3
P5LP2_4 Bit 4
ID = 0x03
NOTE: GND is read as binary "1" and floating as "0".

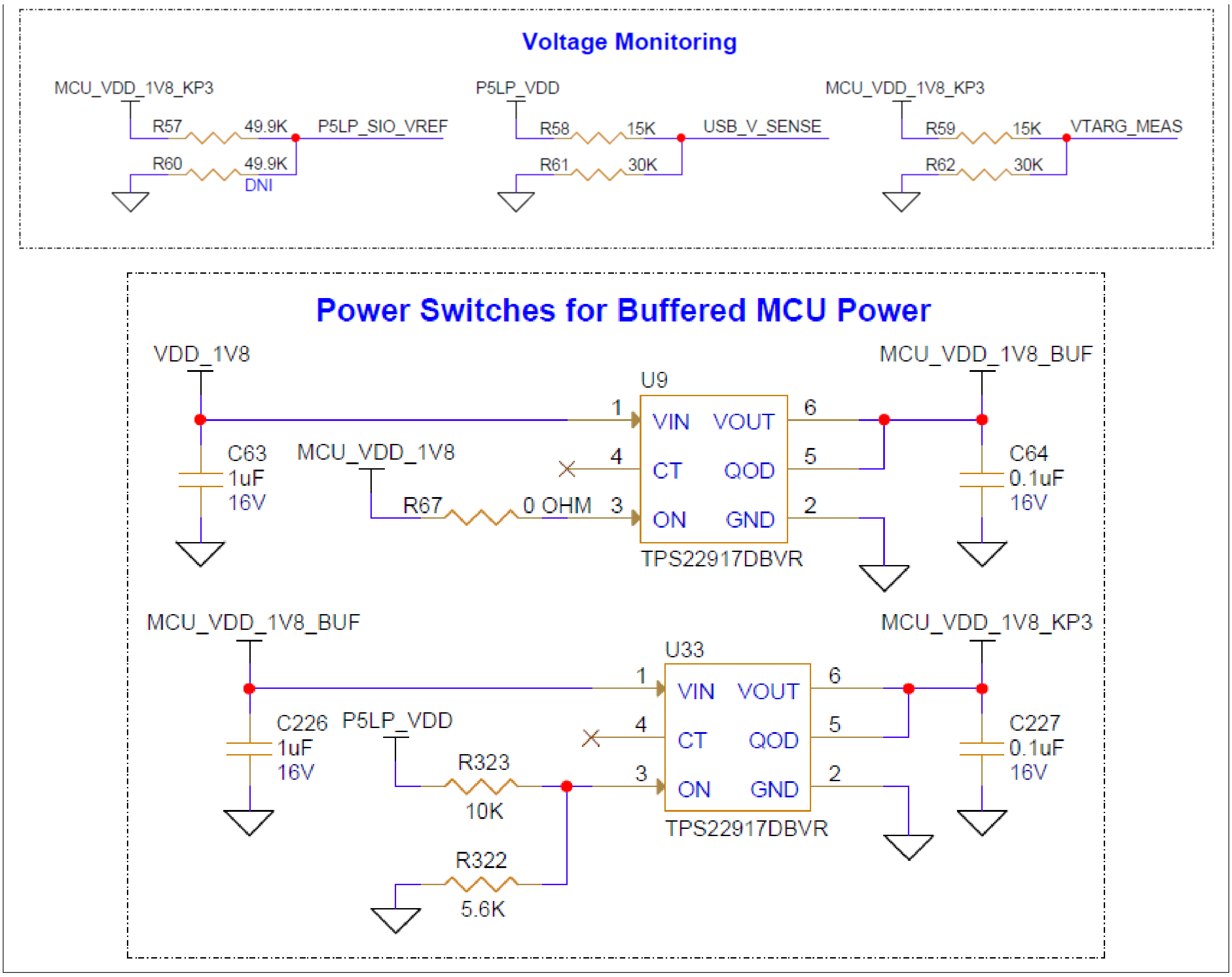


Figure 59 Schematic of PSOC™ 5LP-based KitProg3

3.2.1.4.2 KitProg3 programming mode selection button and status LED

There is a mode selection button (**SW3**) connected to the **P1[2]** pin of the PSOC™ 5LP device for programming mode selection. This button can be used to switch between Bulk and HID modes (see the KitProg3 user guide for details). The button works in an active LOW configuration and is shorted to GND when pressed.

PSOC™ 5LP has a status LED (**D2**, Yellow) connected to its **P1[4]** pin of the PSOC™ 5LP device, which indicates the programming status. See the following table for a summary of the LED status:

Table 14 KitProg3 mode switching

KitProg3 programming modes	Status LED (D2)
CMSIS-DAP/Bulk mode (default)	ON
CMSIS-DAP/HID mode	RAMPING at 1 Hz

***Note**: Switching between the programming modes can be done through the Firmware-loader tool. For details, see Section Mode Switching in the KitProg3 user guide.*

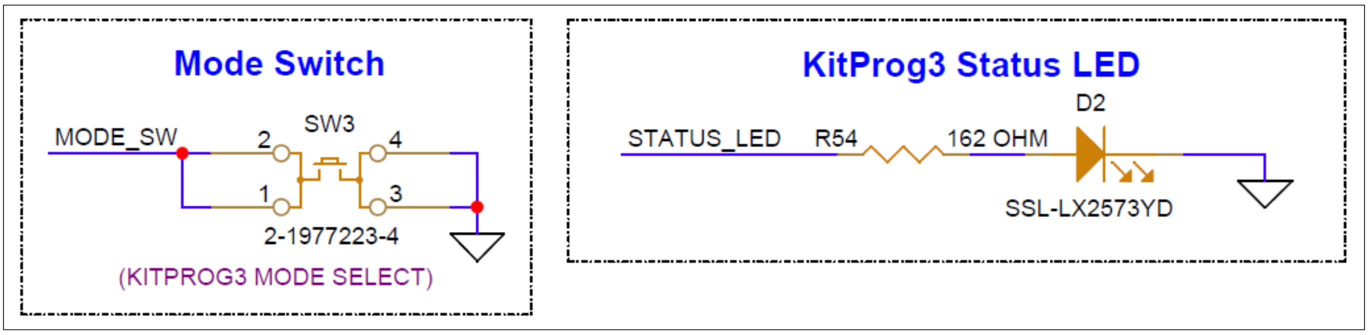


Figure 60 Schematic of KitProg3 mode selection button (SW3) and status LED (D2)

3.2.1.4.3 Serial interconnection between PSOC™ 5LP and PSOC™ Edge E84

In addition to being used as an onboard programmer/debugger using the SWD interface, the PSOC™ 5LP device also functions as an interface for the USB-UART and USB-I2C bridges. The USB-Serial pins of the PSOC™ 5LP devices are hard-wired to the I2C/UART pins of the PSOC™ Edge E84 MCU. The I2C pins are connected to all 1.8 V logic level I2C interface-based on board sensors. Therefore, the PSOC™ 5LP device can be used to control a sensor with the I2C interface and PSOC™ Edge E84 MCU.

Table 15 Pin assignments of serial interface between PSOC™ 5LP and PSOC™ Edge E84

PSOC™ 5LP signal	PSOC™ Edge E84 I/O	Logic level
KP_SWCLK	P6[3]	1.8 V
KP_SDWIO	P6[2]	1.8 V
RESET	XRES	1.8 V
KP_I2C_SCL	P8[0]	1.8 V
KP_I2C_SDA	P8[1]	1.8 V
KP_UART_TX	P6[5]	1.8 V
KP_UART_RX	P6[7]	1.8 V

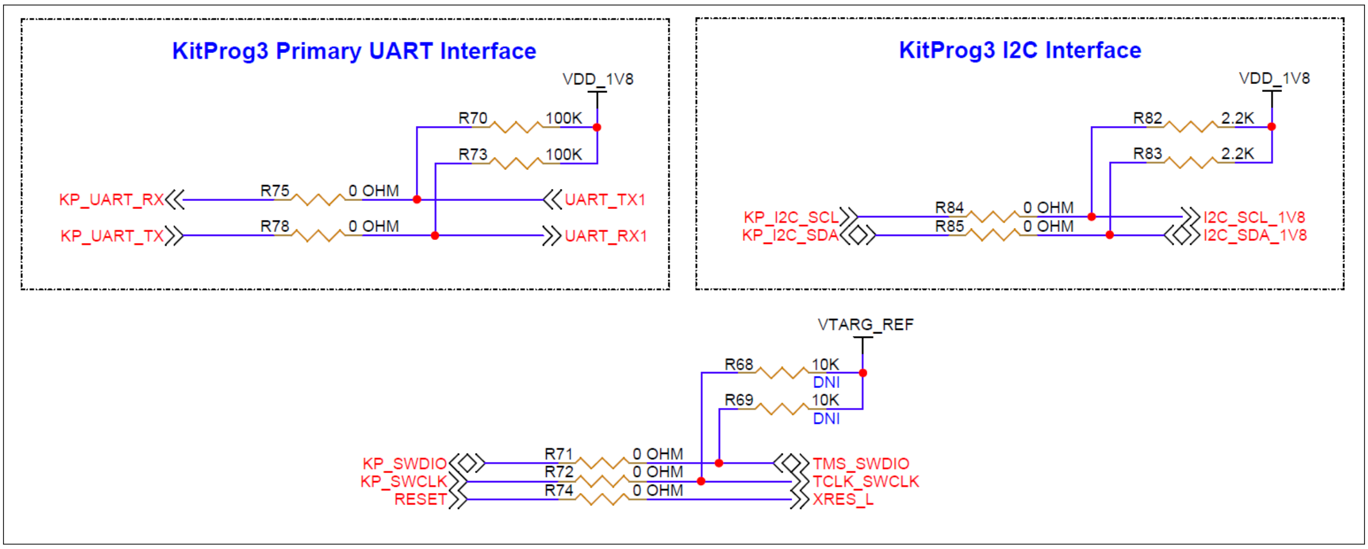


Figure 61 Schematic of serial interconnection between PSOC™ 5LP and PSOC™ Edge E84

3.2.1.5 Power supply system

3.2.1.5.1 Power inputs and over voltage protection

The power supply system on this kit is versatile, allowing the kit to be supplied from any of the following sources:

- 5 V, 3 A input from on board KitProg3 Type-C USB connector (**J1**)
- 5 V, 3 A input from the PSOC™ Edge E84 MCU Type-C USB connector (**J3**)
- 3.3 V - 5 V, 3 A from the external Battery/DC input power connector (**J2**)

The power supply system is designed to provide 1.8 V (core and I/O), and 3.3 V (I/O) operating voltages to the PSOC™ Edge E84 MCU and 5 V for the PSOC™ 5LP based KitProg3 operation. In addition, the voltages of 1.8 V, 3.3 V, and 5 V rails are also used for the operation of PSOC™ Edge E84 MCU, memory, radio and various sensors available on the kit.

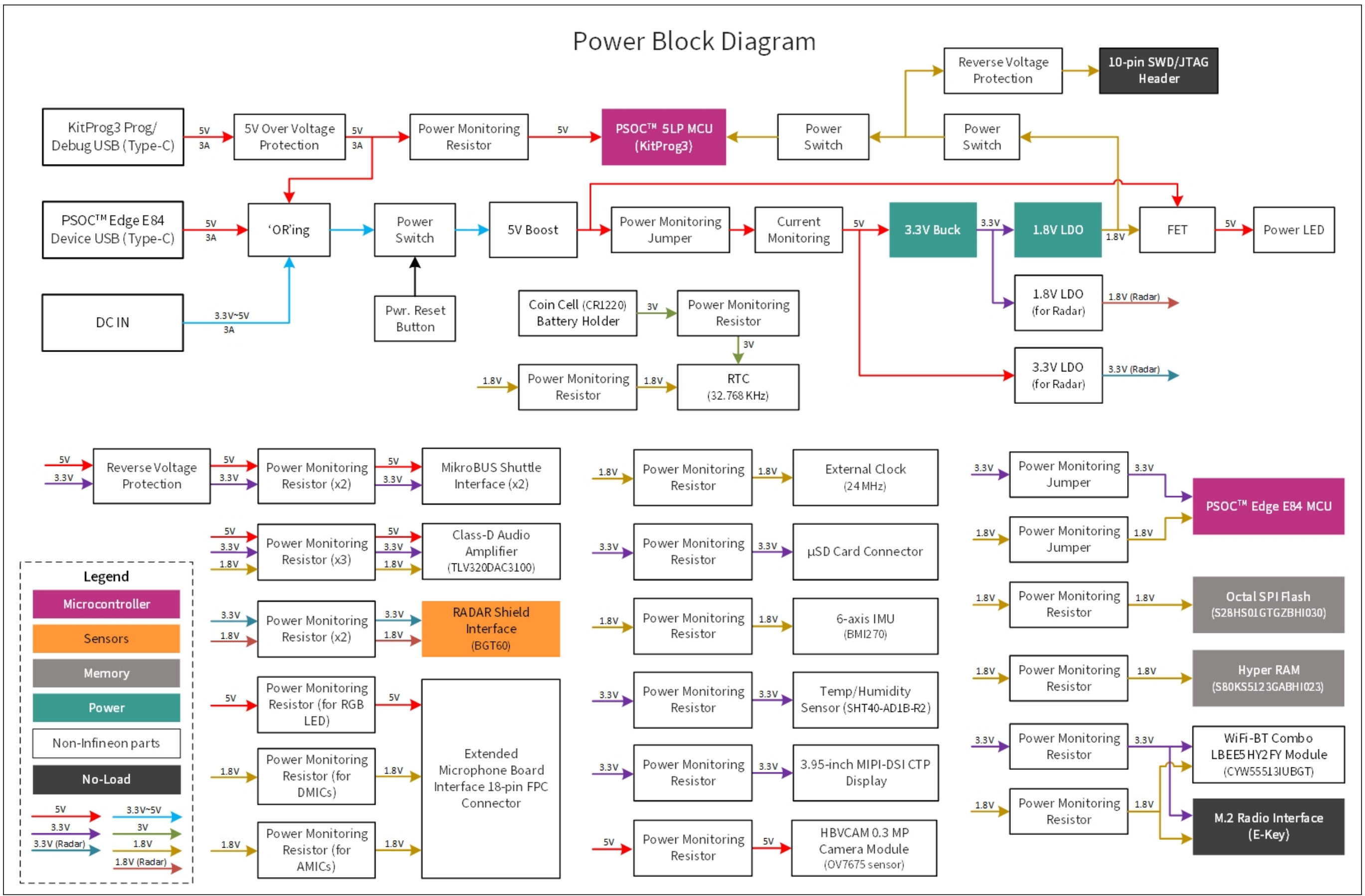
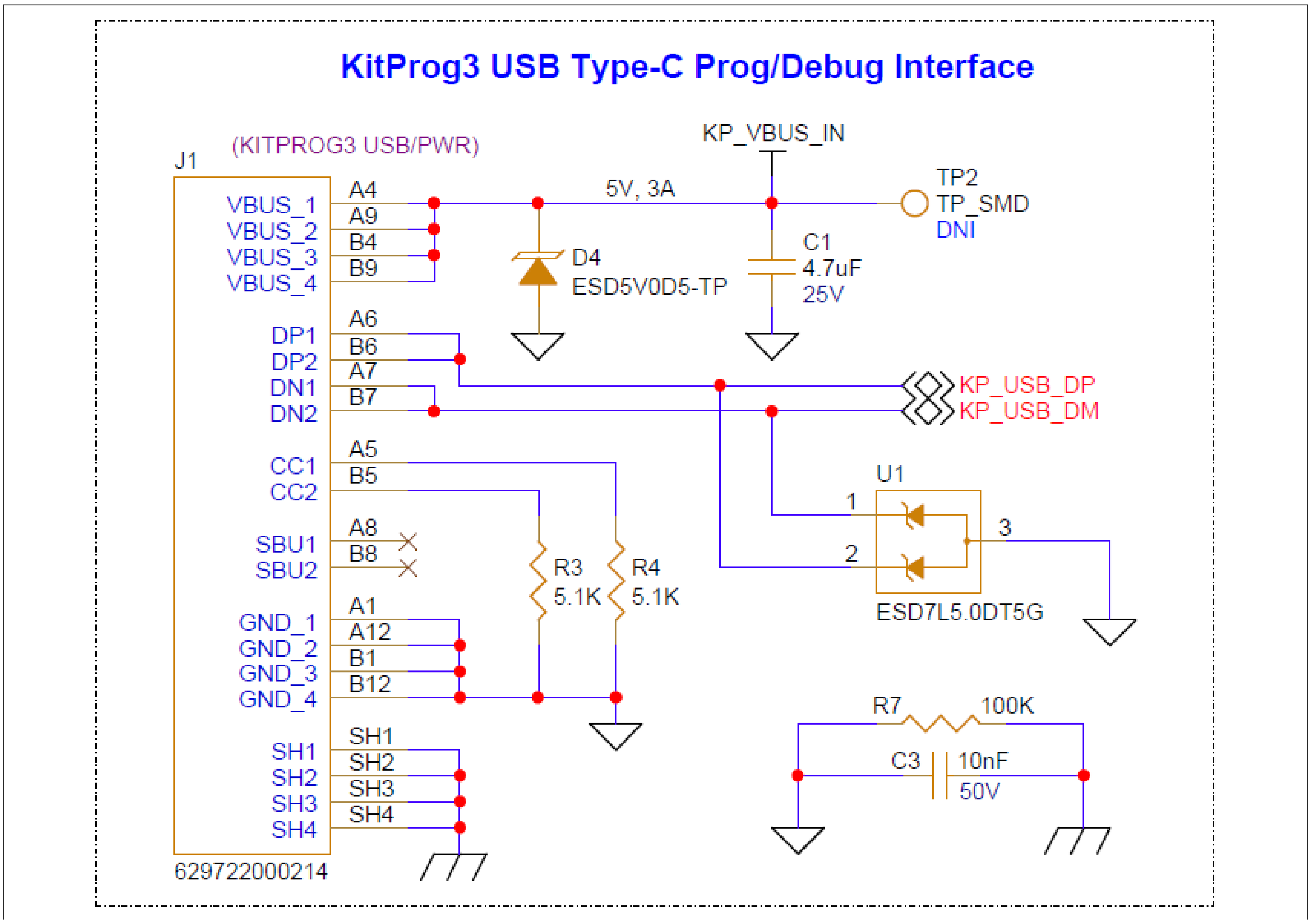


Figure 62 Block diagram of power architecture

The KitProg3 Type-C USB connector (**J1**) and PSOC™ Edge E84 device USB connector (**J3**) can only provide 5 V/3 A, as it is hard configured by pulling the CC1 and CC2 lines to GND by the 5.1 KΩ pull-down resistor (**R3**, **R4**, **R11** and **R13**).

The DC input connector can support 3.3 V - 5 V, 3A supply.


KitProg3 USB Type-C Prog/Debug Interface
J1
(KITPROG3 USB/PWR)
KP_VBUS_IN
5V, 3A
TP2
TP_SMD
DNI
VBUS_1
VBUS_2
VBUS_3
VBUS_4
A4
A9
B4
B9
D4
ESD5V0D5-TP
C1
4.7uF
25V
DP1
DP2
DN1
DN2
A6
B6
A7
B7
KP_USB_DP
KP_USB_DM
CC1
CC2
A5
B5
U1
SBU1
SBU2
A8
B8
R3
5.1K
R4
5.1K
ESD7L5.0DT5G
GND_1
GND_2
GND_3
GND_4
A1
A12
B1
B12
R7
100K
C3
10nF
50V
SH1
SH2
SH3
SH4
629722000214

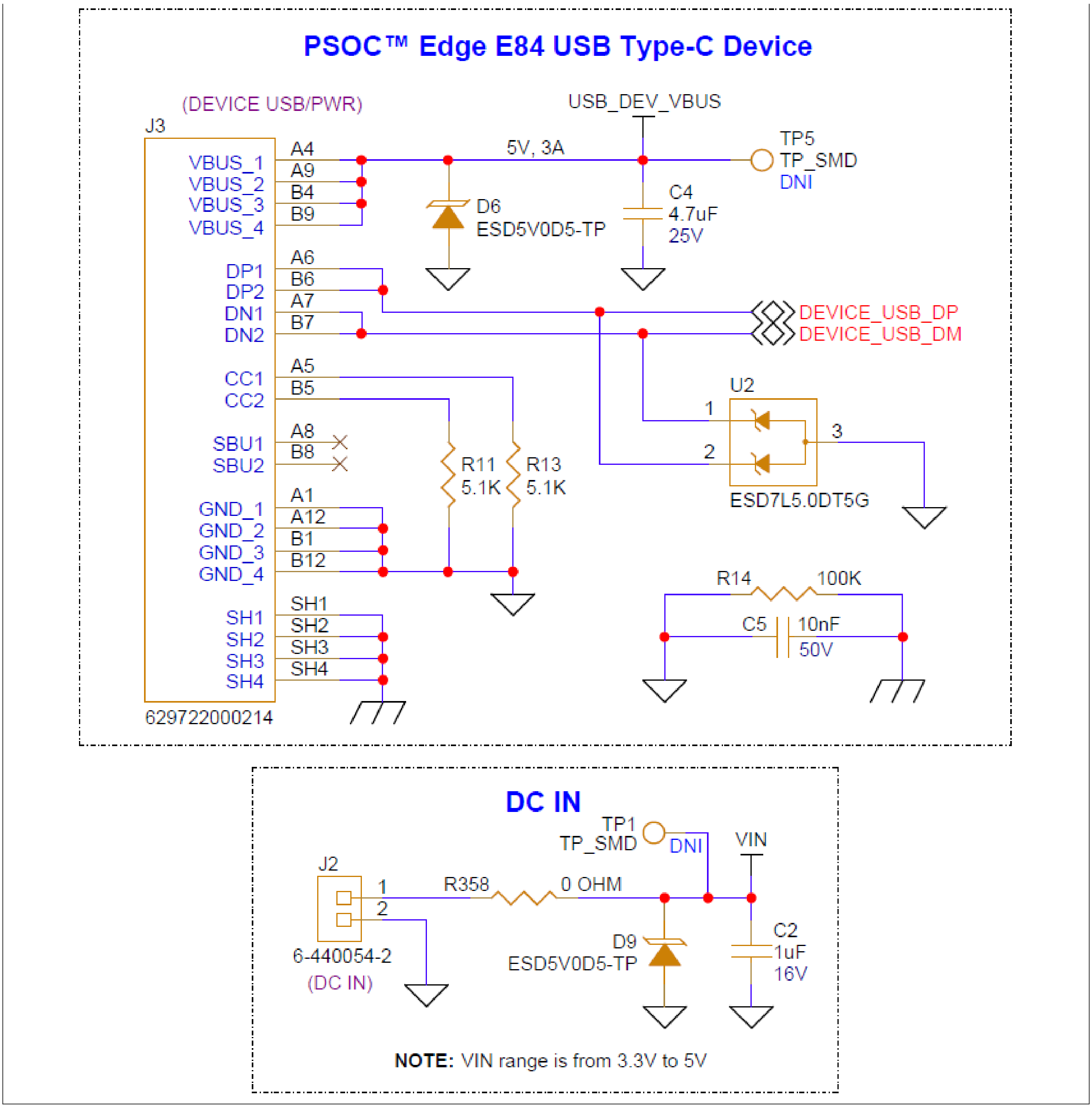


Figure 63 **Schematic of power supply inputs**

There is an over voltage protection circuit to prevent the on board KitProg3 from over voltage spikes.

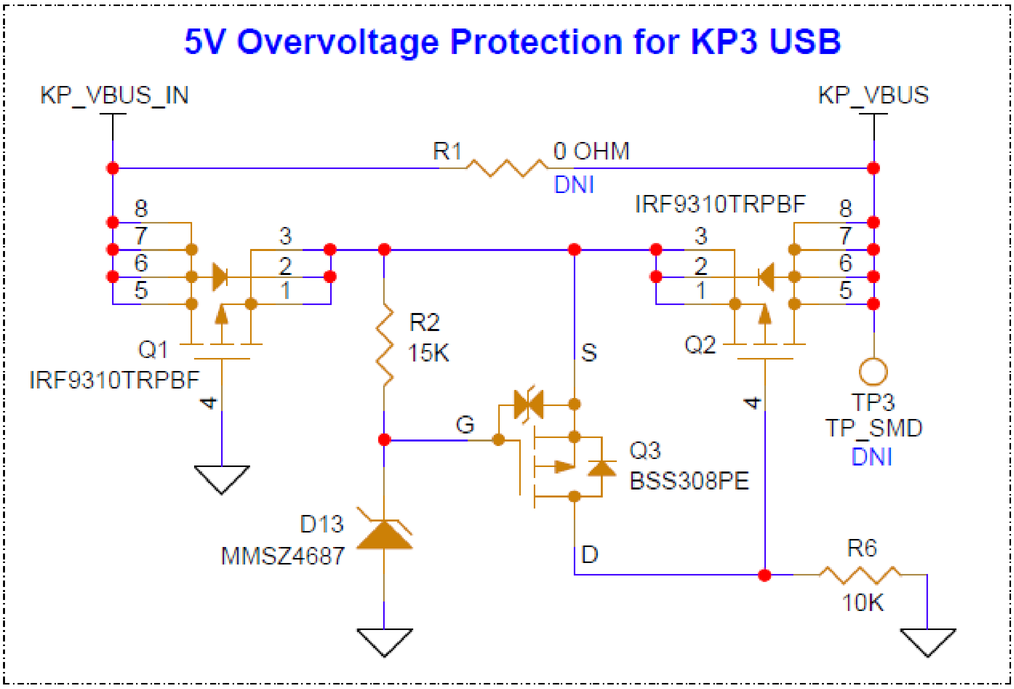


Figure 64 **Schematic of 5 V over voltage protection circuit for KP3 USB**

The supply rails KP_VBUS (5 V from **J1**), USB_DEV_VBUS (5 V from **J3**), and VIN from DC input connector (**J2**) are combined into VCC_ORED through ideal diode 'OR'ing circuits (**U36**, **U37** and **U38**) as shown in Figure 65.

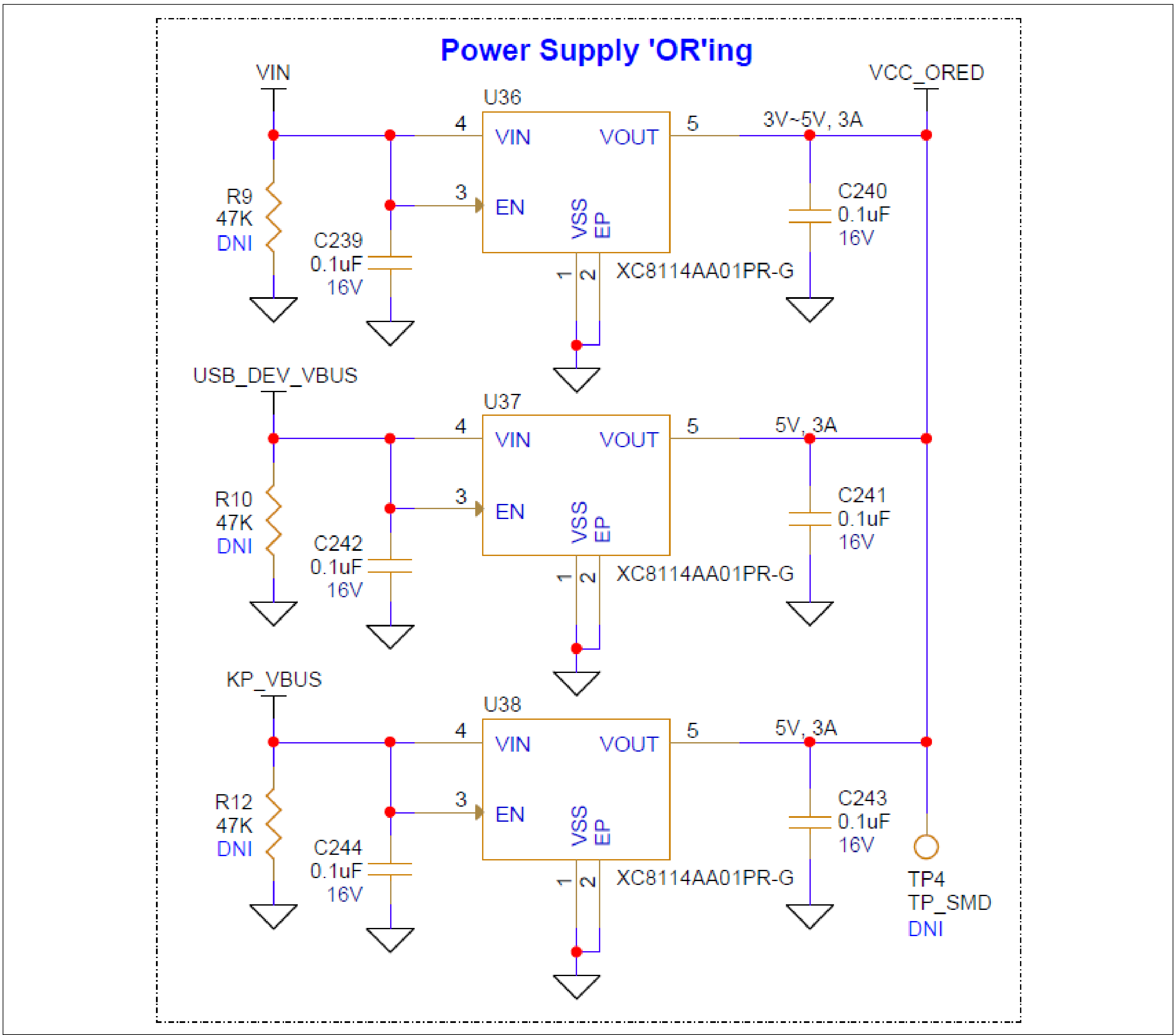


Figure 65 **Schematic of power supply OR'ing**

3.2.1.5.2 Voltage regulators

There are five voltage regulators present on the kit:

- 5 V Boost regulator (**U5**): Powers the Power LED and next stage of voltage regulators
- 3.3 V Buck regulator (**U7**): Powers the Wi-Fi & Bluetooth® module VBAT power supply, PSOC™ Edge E84 device VBAT and IO's supply, Audio amplifier, Humidity and Temperature sensor and MIPI DSI compatible display
- 1.8 V LDO regulator (**U6**): Powers the PSOC™ Edge E84 device core and IO's power supply and other on board peripherals and sensors
- 3.3 V LDO regulator for radar (**U39**): Powers the onboard RADAR sensor
- 1.8 V LDO regulator for radar (**U40**): Powers the onboard RADAR sensor

VCC_IN rail powers the 5 V Boost regulator (**U5**). The VDD_5V_MON rail powers the current monitoring IC (**U4**) and Power LED (**D1**). The output of the current monitoring IC VDD_5V, powers the 3.3 V Buck regulator (**U7**) and 3.3 V LDO linear voltage regulator for radar (**U39**).

3.3 V Buck regulator (**U7**) powers the 1.8 V Buck regulator (**U6**) and 1.8 V LDO linear voltage regulator for radar (**U40**).

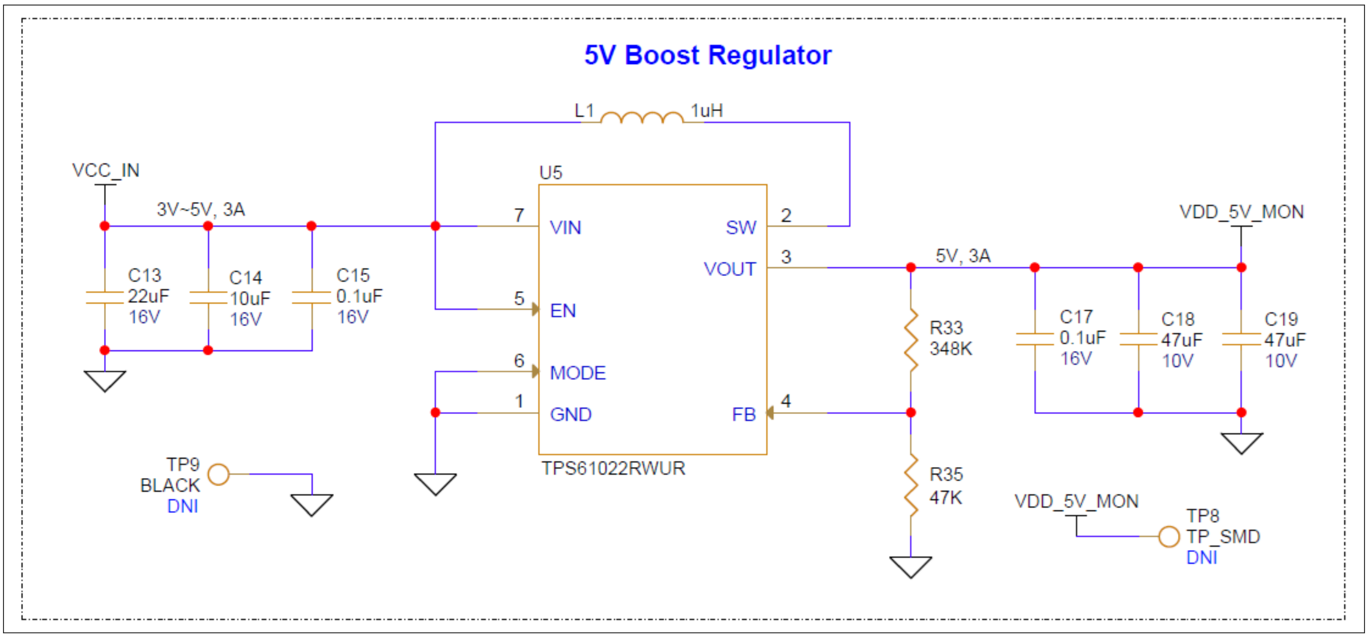


Figure 66 **Schematic of 5 V Boost regulator**

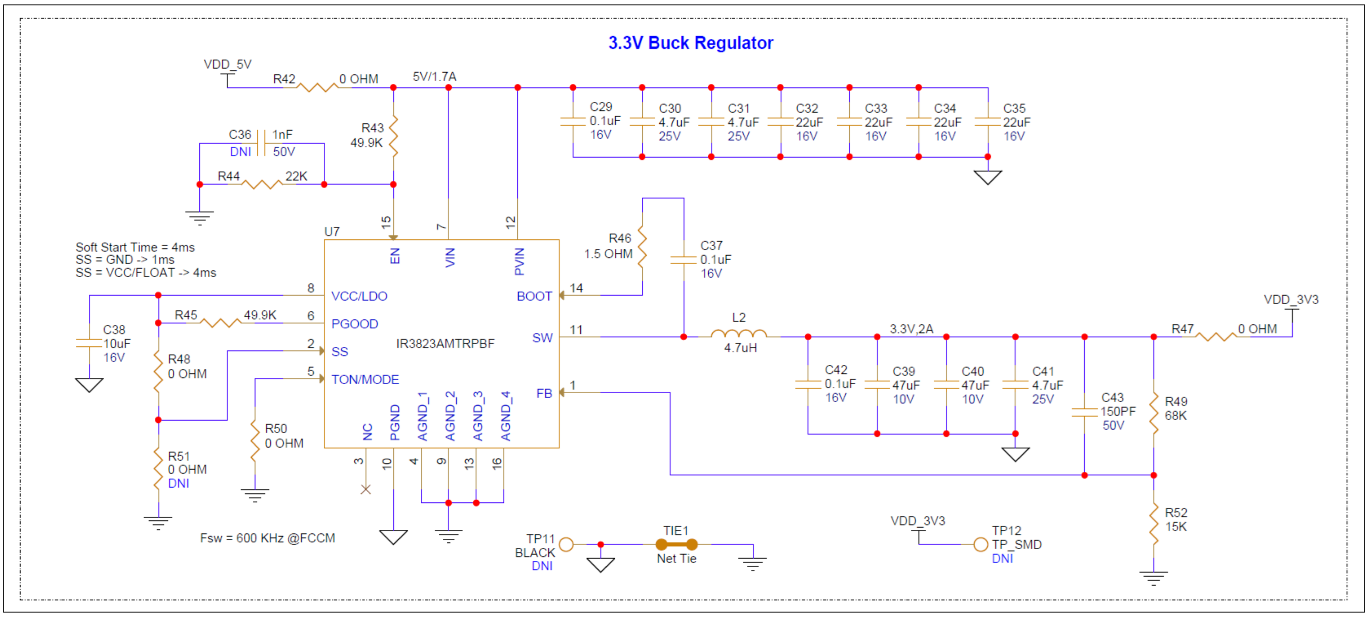


Figure 67 **Schematic of 3.3 V Buck regulator**

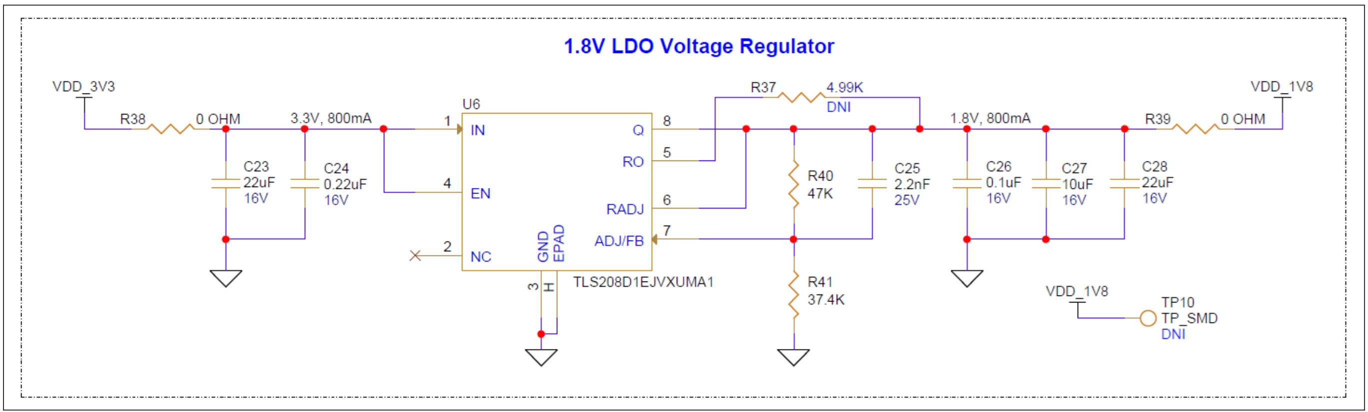


Figure 68 Schematic of 1.8 V LDO regulator

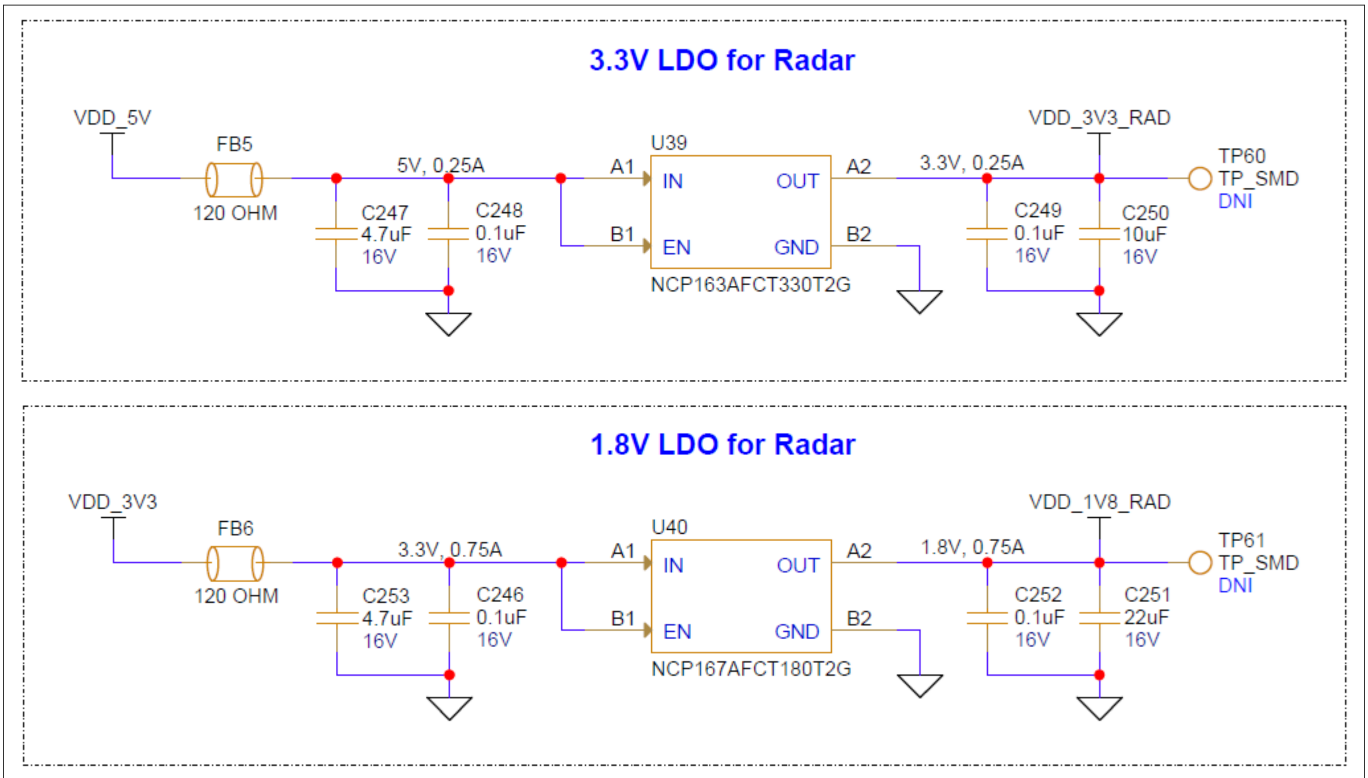


Figure 69 Schematic of 3.3 V LDO and 1.8 V LDO for radar

3.2.1.5.3 Power monitoring headers

There are two types of power monitoring headers on the kit.

1. System power monitoring header

   J4: To measure the overall system current in real time

2. MCU power monitoring headers

   J20: To measure the 1.8 V domain current of the PSOC™ Edge E84 MCU in real time

   J21: To measure the 3.3 V domain current of the PSOC™ Edge E84 MCU in real time

Additionally, the radio module currents (VBAT_RADIO and VDDIO_RADIO) and the memory sub-system current (VDD_MEM_1V8) can be measured through the resistors **R26**, **R29** and **R30** respectively.

For more details on schematic of system power monitoring header, see Figure 72

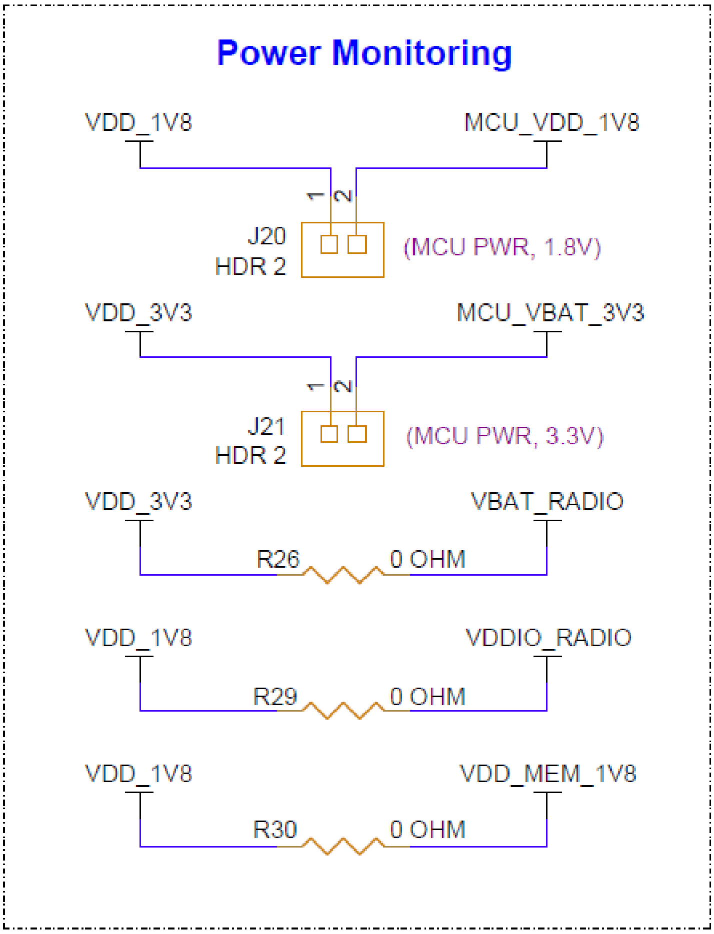


Figure 70 **Schematic of MCU power monitoring headers**

3.2.1.5.4 Power switch and current monitoring section

The output of the 'OR'ing circuit VCC_ORED is connected to a power switch (**U3**). The output of the power switch VCC_IN powers the next stage onboard regulators. The power switch can be momentarily disabled by pressing the tactile Power Reset switch (**SW6**). This can be used to toggle the power of the kit (except KitProg3 section).

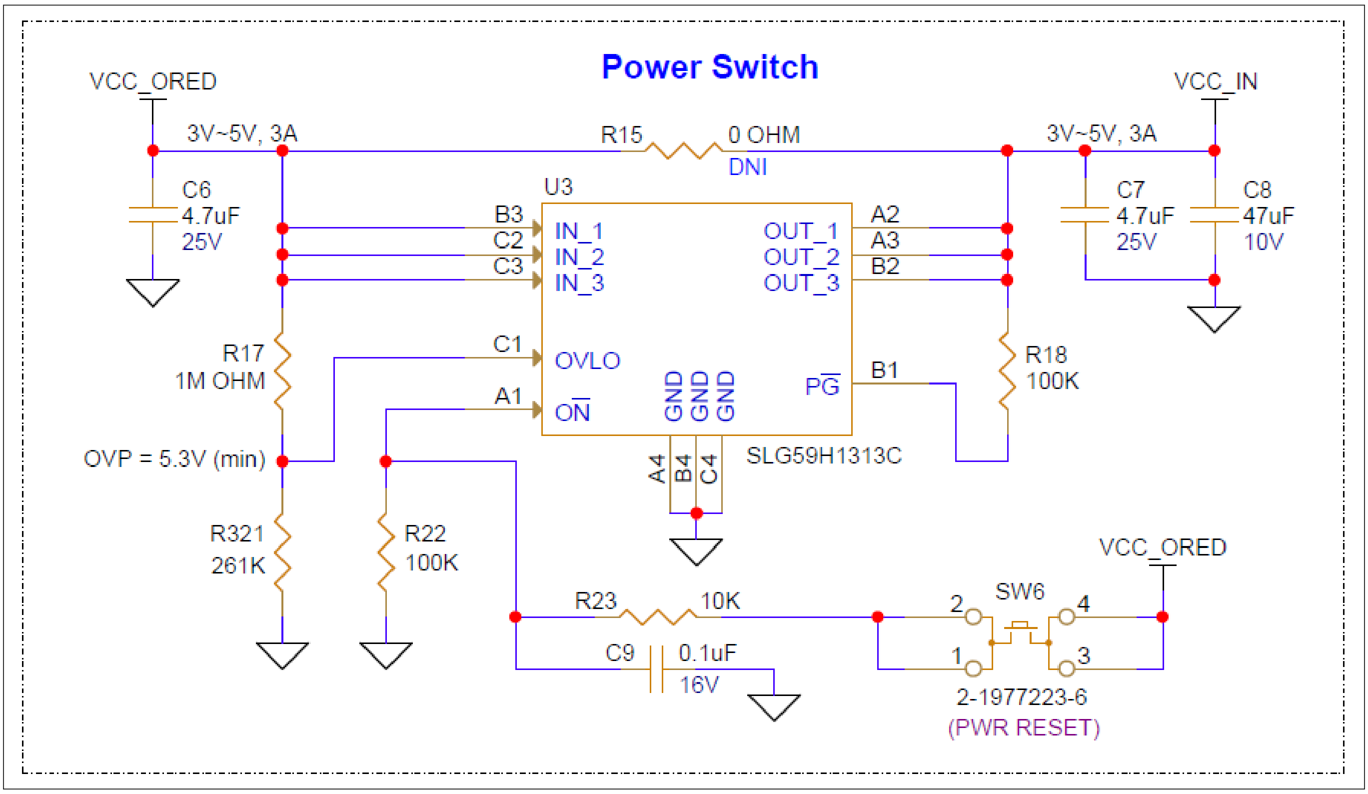


Figure 71 Schematic of power switch

On the other hand, there is an on board Current monitoring IC (**U4**) to measure the overall system power in real time. This IC measures the voltage drop across the shunt resistor (**R28**) and feeds the proportional analog voltage to the PSOC™ Edge E84 MCU which hence calculates the current consumed by the overall system.

The overall system current can also be measured at **J4** header using an ammeter.

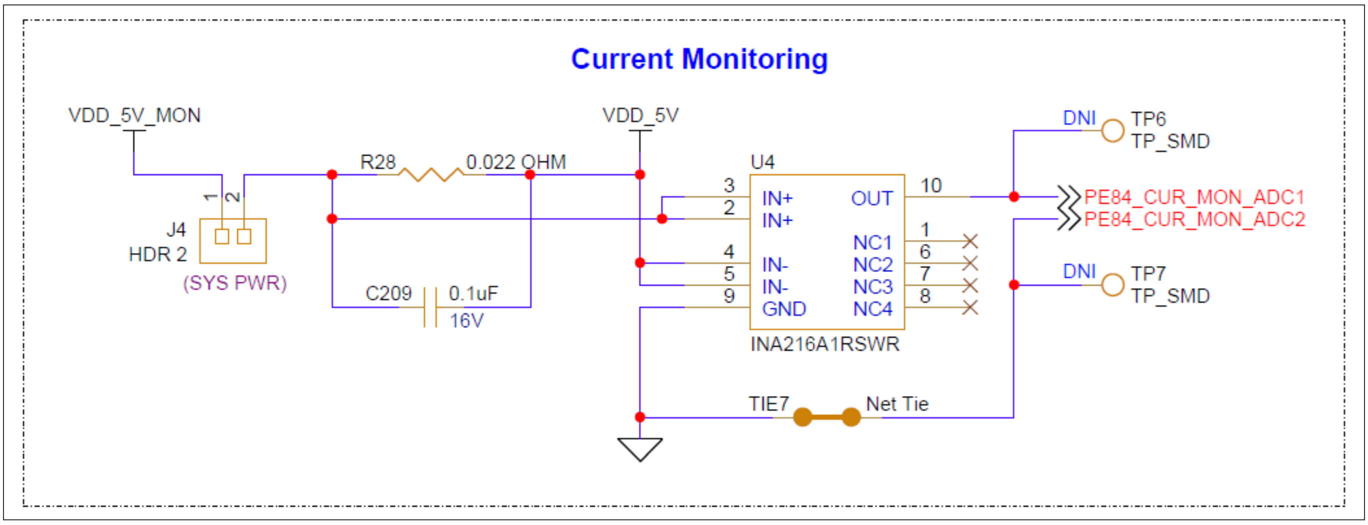


Figure 72 Schematic of current monitoring section

3.2.1.6 M.2 (E-Key) external radio interface

The M.2 E-key external radio interface (**J17**) adds radio connectivity to PSOC™ Edge E84 MCU as required. Any M.2 E-key radio module, compatible with Infineon M.2 connector pin mapping, can be interfaced to the kit. The WLAN interface to the PSOC™ Edge E84 MCU is SDIO and the Bluetooth® interface is UART. The VBAT supply

(VBAT_RADIO) for the module is provided from the 3.3 V and the I/O supply (VDDIO_RADIO) is provided from the 1.8 V rail.

Note that this M.2 E-key external radio interface is not populated on the kit and not connected to the PSOC™ Edge E84 MCU by default. For connection details, see Rework for M.2 (E-key) external radio interface .

Table 16 **Infineon M.2 (E-Key) radio interface pin mapping**

Group	Signal name	PSOC™ Edge E84 MCU I/O	M.2 (E-Key) connector pin
WLAN interface	SDIO_CLK	P12[0]	9
	SDIO_CMD	P21[0]	11
	SDIO_DATA[0]	P12[1]	13
	SDIO_DATA[1]	P12[2]	15
	SDIO_DATA[2]	P12[4]	17
	SDIO_DATA[3]	P12[5]	19
	WL_REG_ON	P6[4]	56
	WL_HOST_WAKE	P13[3]	21
	WL_DEV_WAKE	P6[6]	66
Bluetooth® interface	BT_UART_TXD	P10[0]	22
	BT_UART_RXD	P10[1]	32
	BT_UART_RTS	P10[2]	34
	BT_UART_CTS	P10[3]	36
	BT_REG_ON	P13[6]	54
	BT_HOST_WAKE	P10[4]	20
	BT_DEV_WAKE	P10[6]	42
Clock	LPO_IN	-	50
Power	VBAT	-	2, 4, 72, 74
	WL_VDDIO	-	64

Note: *Some modules from Laird Connectivity such as Sterling-LWB5+ does not follow the Infineon M.2 interface standard. For such modules, use the resistor setting mentioned in the* Rework for M.2 (E-key) external radio interface *section.*

Table 17 **Pin mapping for Sterling LWB5+ M.2 module from Laird Connectivity**

Signal name	Infineon M.2 connector pin	Laird M.2 connector pin
WL_DEV_WAKE	66	42
BT_DEV_WAKE	42	40

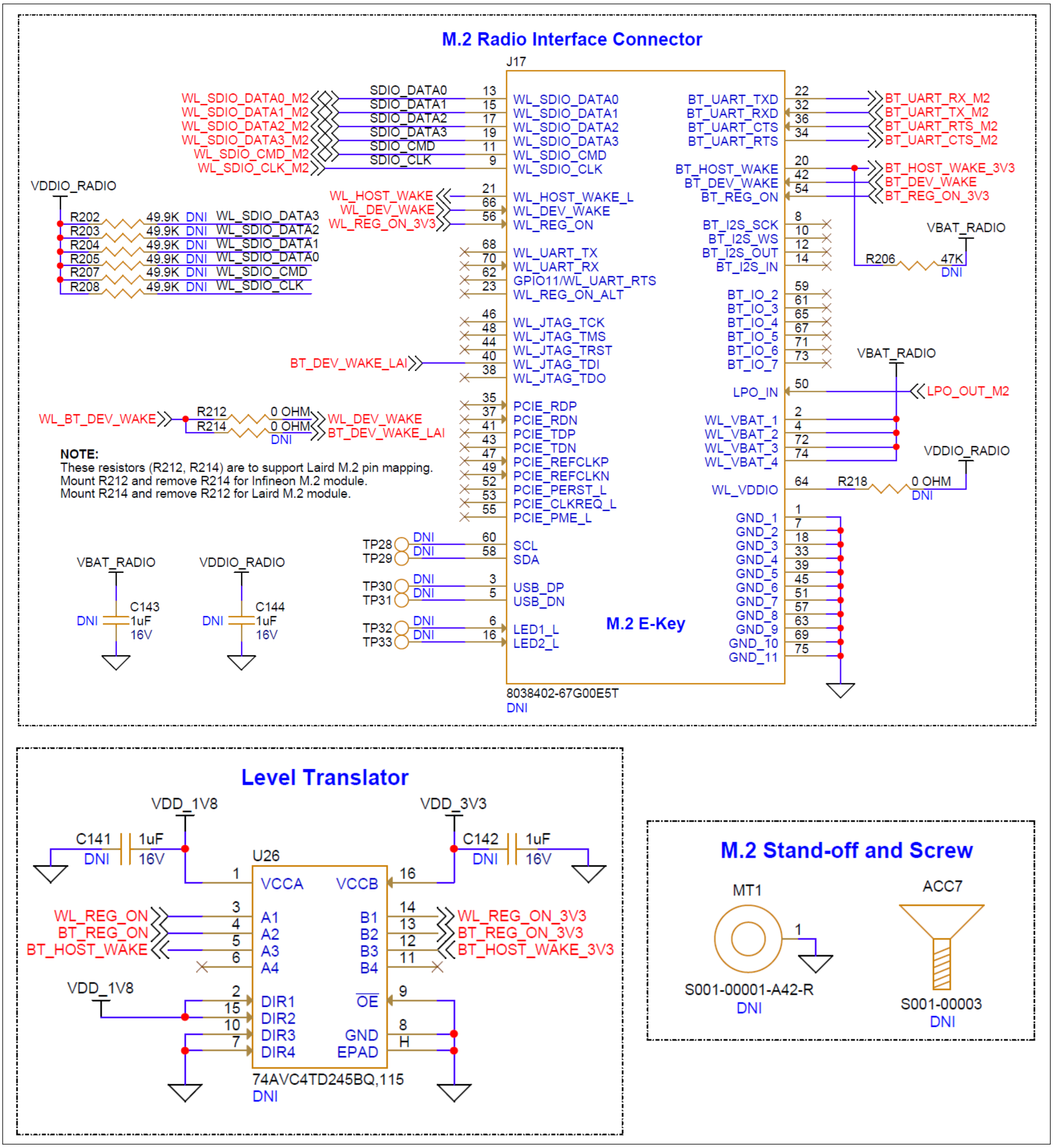
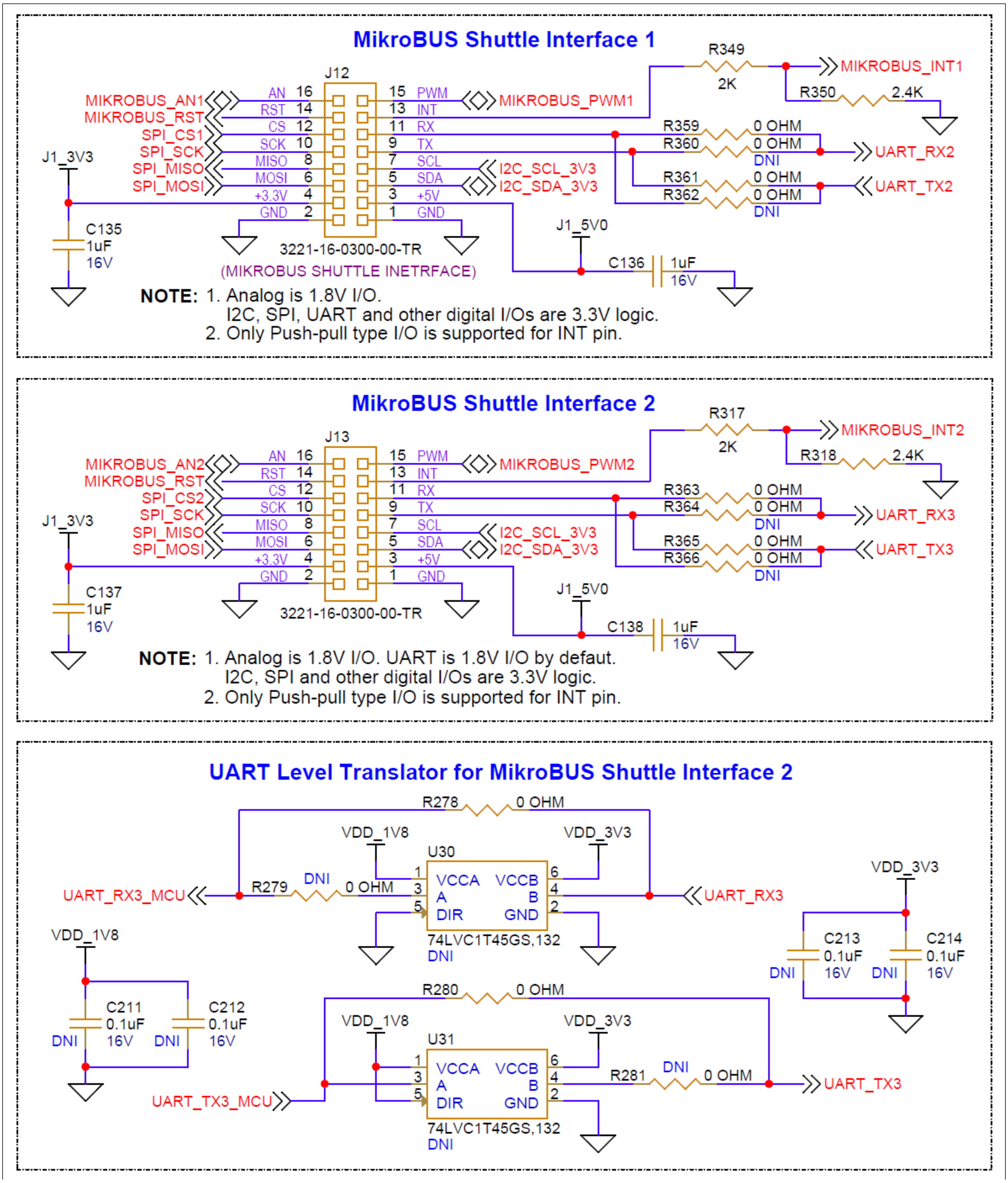


Figure 73 **Schematic of M.2 (E-Key) external radio interface**

3.2.1.7 mikroBUS Shuttle interface by MikroElektronika

The board has two headers compatible with mikroBUS Shuttle interface (**J12** and **J13**) to support different add-on shields compatible with mikroBUS by MikroElektronika. You can connect 3.3 V mikroBUS shields to develop applications. But it does not support 5 V shields, so connecting a 5 V add-on board may permanently damage the board.

Note:
- *Analog I/Os (MIKROBUS_AN1, MIKROBUS_AN2) will only support 1.8 V for both* ***J12*** *and* ***J13***
- *UART interface of the* ***J13*** *header will support 1.8 V by default*
- *Only push-pull type I/O is supported for INT pin for both* ***J12*** *and* ***J13***


MikroBUS Shuttle Interface 1
J12
MIKROBUS_AN1
MIKROBUS_RST
SPI_CS1
SPI_SCK
SPI_MISO
SPI_MOSI
J1_3V3
AN 16
RST 14
CS 12
SCK 10
MISO 8
MOSI 6
+3.3V 4
GND 2
15 PWM
13 INT
11 RX
9 TX
7 SCL
5 SDA
3 +5V
1 GND
MIKROBUS_PWM1
I2C_SCL_3V3
I2C_SDA_3V3
R349 2K
MIKROBUS_INT1
R350 2.4K
R359 0 OHM
R360 0 OHM DNI
UART_RX2
R361 0 OHM
R362 0 OHM DNI
UART_TX2
C135 1uF 16V
3221-16-0300-00-TR
(MIKROBUS SHUTTLE INETRFACE)
J1_5V0
C136 1uF 16V
NOTE: 1. Analog is 1.8V I/O.
I2C, SPI, UART and other digital I/Os are 3.3V logic.
2. Only Push-pull type I/O is supported for INT pin.
MikroBUS Shuttle Interface 2
J13
MIKROBUS_AN2
MIKROBUS_RST
SPI_CS2
SPI_SCK
SPI_MISO
SPI_MOSI
J1_3V3
MIKROBUS_PWM2
I2C_SCL_3V3
I2C_SDA_3V3
R317 2K
MIKROBUS_INT2
R318 2.4K
R363 0 OHM
R364 0 OHM DNI
UART_RX3
R365 0 OHM
R366 0 OHM DNI
UART_TX3
C137 1uF 16V
3221-16-0300-00-TR
J1_5V0
C138 1uF 16V
NOTE: 1. Analog is 1.8V I/O. UART is 1.8V I/O by defaut.
I2C, SPI and other digital I/Os are 3.3V logic.
2. Only Push-pull type I/O is supported for INT pin.
UART Level Translator for MikroBUS Shuttle Interface 2
R278 0 OHM
VDD_1V8
VDD_3V3
U30
VCCA VCCB
A B
DIR GND
74LVC1T45GS,132
DNI
UART_RX3_MCU
R279 DNI 0 OHM
UART_RX3
VDD_3V3
C213 0.1uF 16V DNI
C214 0.1uF 16V DNI
VDD_1V8
C211 0.1uF 16V DNI
C212 0.1uF 16V DNI
R280 0 OHM
U31
74LVC1T45GS,132
DNI
UART_TX3_MCU
R281 DNI 0 OHM
UART_TX3

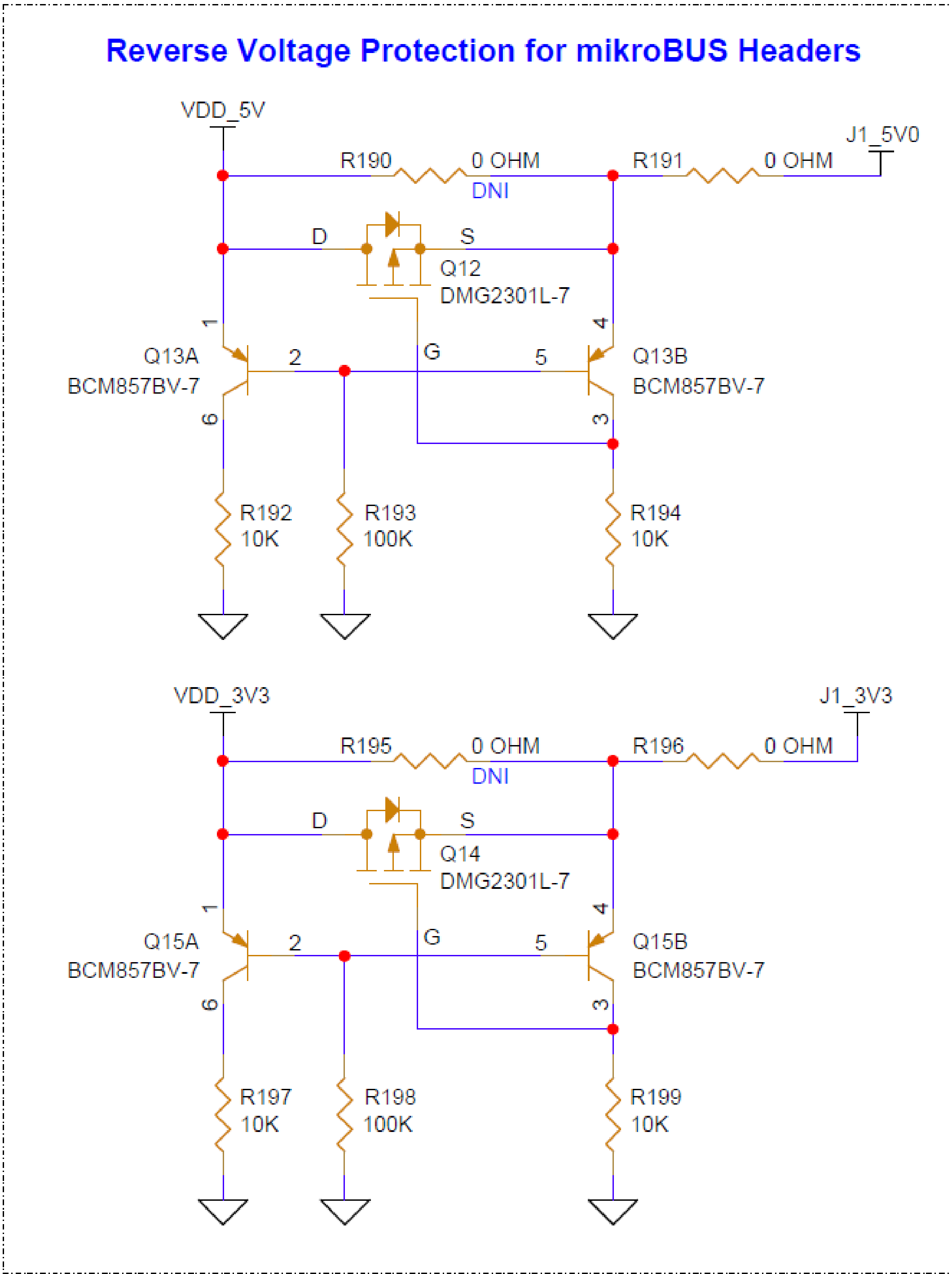


Figure 74 **Schematic of mikroBUS shuttle interface by MikroElektronika**

3.2.1.8 Audio amplifier and speaker

The kit contains an audio amplifier (**U12**), which is a low-power, highly integrated, high-performance stereo audio DAC with 24-bit stereo playback and digital audio processing blocks which supports of 8 KHz to 192 KHz sampling rates. It contains a Class-D BTL mono speaker driver and a Class A/B stereo headphone driver. The amplifier is connected to a 8 Ω speaker (**ACC6**) which can drive up to 1 W.

The amplifier is interfaced with PSOC™ Edge E84 MCU on the EVK via an I2S interface for audio data communication and an I2C interface which provides control and full access to the registers and the state machines. The amplifier's DVDD, IOVDD domains are supplied from 1.8 V (AMP_1V8); AVDD, HPVDD domains are supplied from 3.3 V (AMP_3V3) and SPKVDD domain from 5 V (AMP_5V). The I2C device slave address of the amplifier is **0x18**.

Table 18 Audio amplifier signal pin assignment

Signal name	PSOC™ Edge E84 I/O	Logic level
I2S_TX_MCK	P21[3]	1.8 V
I2S_TX_SCK	P21[2]	1.8 V
I2S_TX_SD	P21[1]	1.8 V
I2S_TX_FSYNC	P12[3]	1.8 V

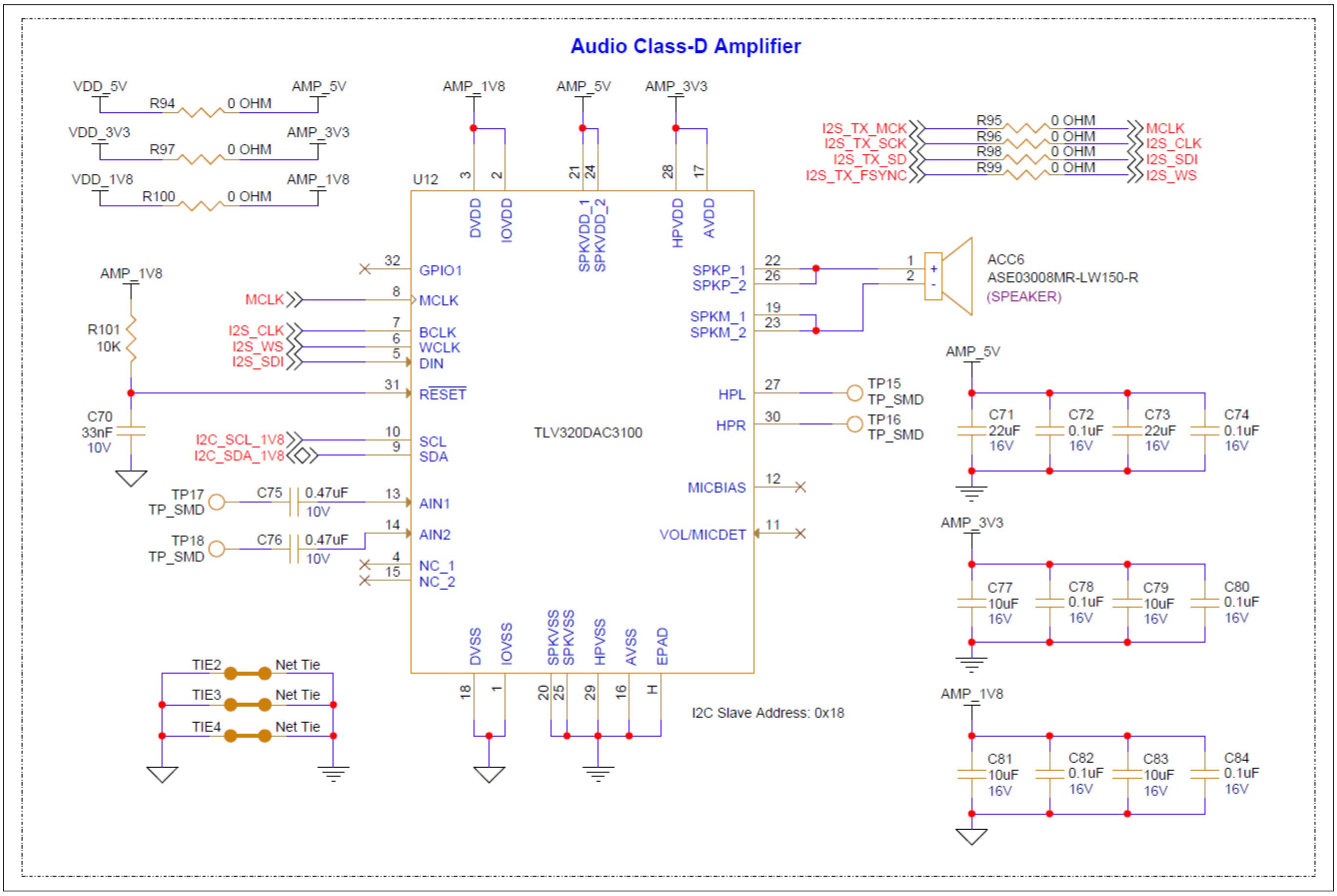


Figure 75 Schematic of audio amplifier and speaker

3.2.1.9 AMIC signal processing circuit

This is a signal processing circuit on the baseboard which is used to tune the frequency response and the signal amplitude of the XENSIV™ MEMS analog microphones , which is present on the PSOC™ Edge E84 HMI MIC Board.

Table 19 Analog microphone signal pin assignment

Signal name	PSOC™ Edge E84 I/O	Logic level
AMIC1_CTB_INP	P14[0]	1.8 V
AMIC1_CTB_INN	P14[1]	1.8 V
AMIC1_CTB_OUT	P14[2]	1.8 V

(table continues...)

Table 19 (continued) Analog microphone signal pin assignment

Signal name	PSOC™ Edge E84 I/O	Logic level
AMIC2_CTB_INP	P14[4]	1.8 V
AMIC2_CTB_INN	P14[5]	1.8 V
AMIC2_CTB_OUT	P14[3]	1.8 V

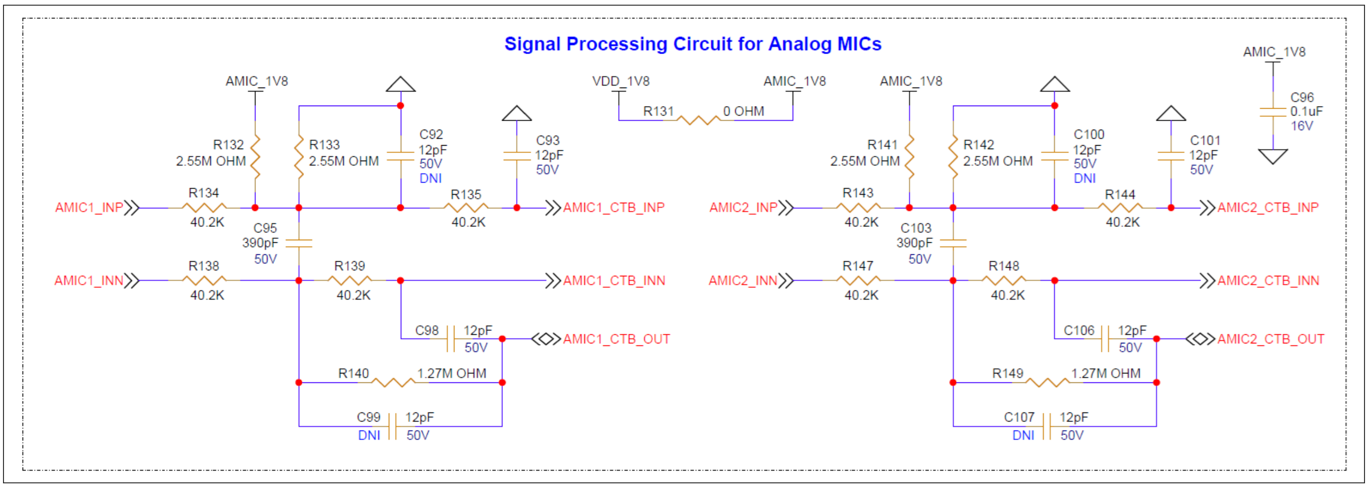


Figure 76 Schematic of AMIC signal processing circuit

3.2.1.10 MIPI-DSI display interface

The kit has an on board 15-pin MIPI-DSI Raspberry-Pi compatible display interface (**J14**) that supports a two-lane protocol that can go up to 1.5 Mbps speed per data lane. Refer to Waveshare official website for details on Raspberry-Pi compatible displays.

There is an optional 10-pin control signal interface (**J15**) which is additionally used for the 3.95-inch 480 x 480 capacitive touch TFT LCD integrated with the kit.

Table 20 Display signal pin assignment

Signal name	PSOC™ Edge E84 I/O	Logic level
I2C_SCL_3V3	P17[2]	3.3 V
I2C_SDA_3V3	P17[3]	3.3 V
DISP_RST	P16[6]	3.3 V
DISP_TP_RST	P16[7]	3.3 V
DISP_TP_INT	P11[6]	3.3 V Note
DISP_BL_PWM	P16[5]	3.3 V

***Note**: The display side logic level is 3.3 V but the MCU pin logic level is 1.8 V. There is a voltage divider (**R315** and **R316**) which down scale the logic level from 3.3 V to 1.8 V.*

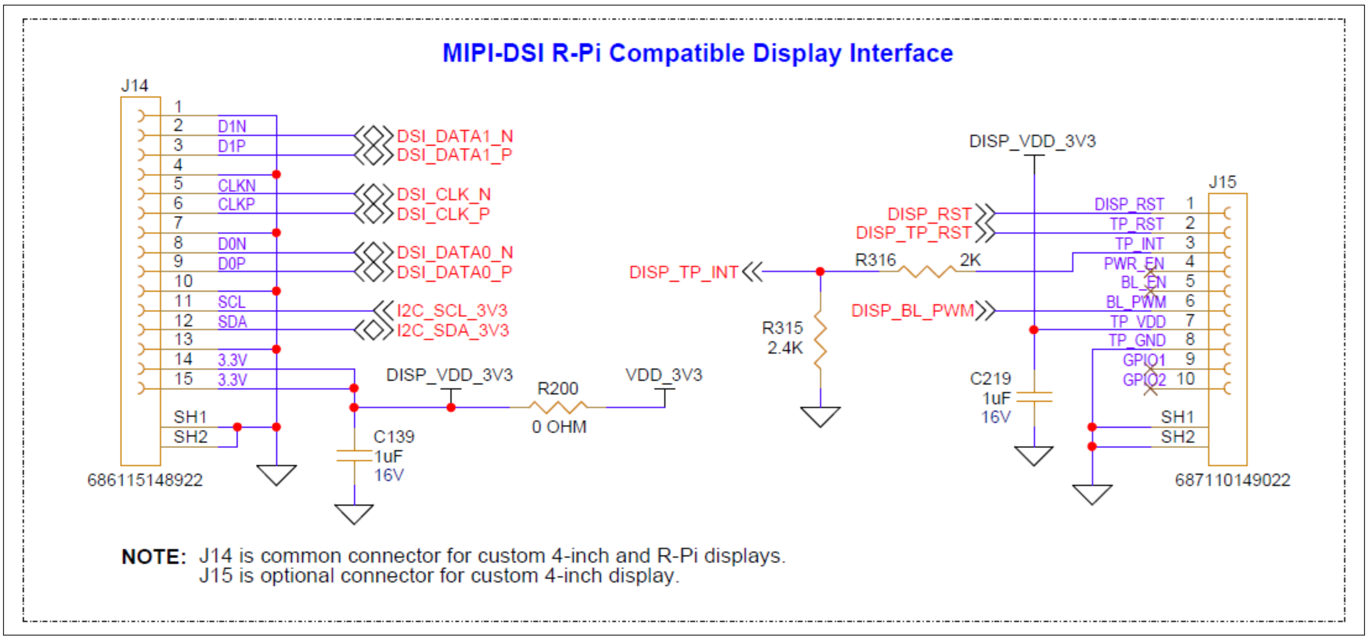


Figure 77 Schematic of MIPI-DSI display interface

3.2.1.11 USB device

The kit consists of a Device Type-C USB (**J3**) for the PSOC™ Edge E84 MCU, which can also be used as a power source for the board, as mentioned in section Power inputs and over voltage protection . The device USB lines are connected to the PSOC™ Edge E84 MCU by default through a USB multiplexer (**U21**).

***Note**: Although the Device USB connector is Type-C but only USB 2.0 high speed/full speed is supported by the MCU.*

Table 21 USB device control signal pin assignment

Signal name	PSOC™ Edge E84 I/O	Logic level
USB_DEV_DET	P13[0]	1.8 V
USB_HOST_EN	P2[0]	1.8 V

For more details on schematic of PSOC™ Edge E84 USB Type-C device, see Figure 63

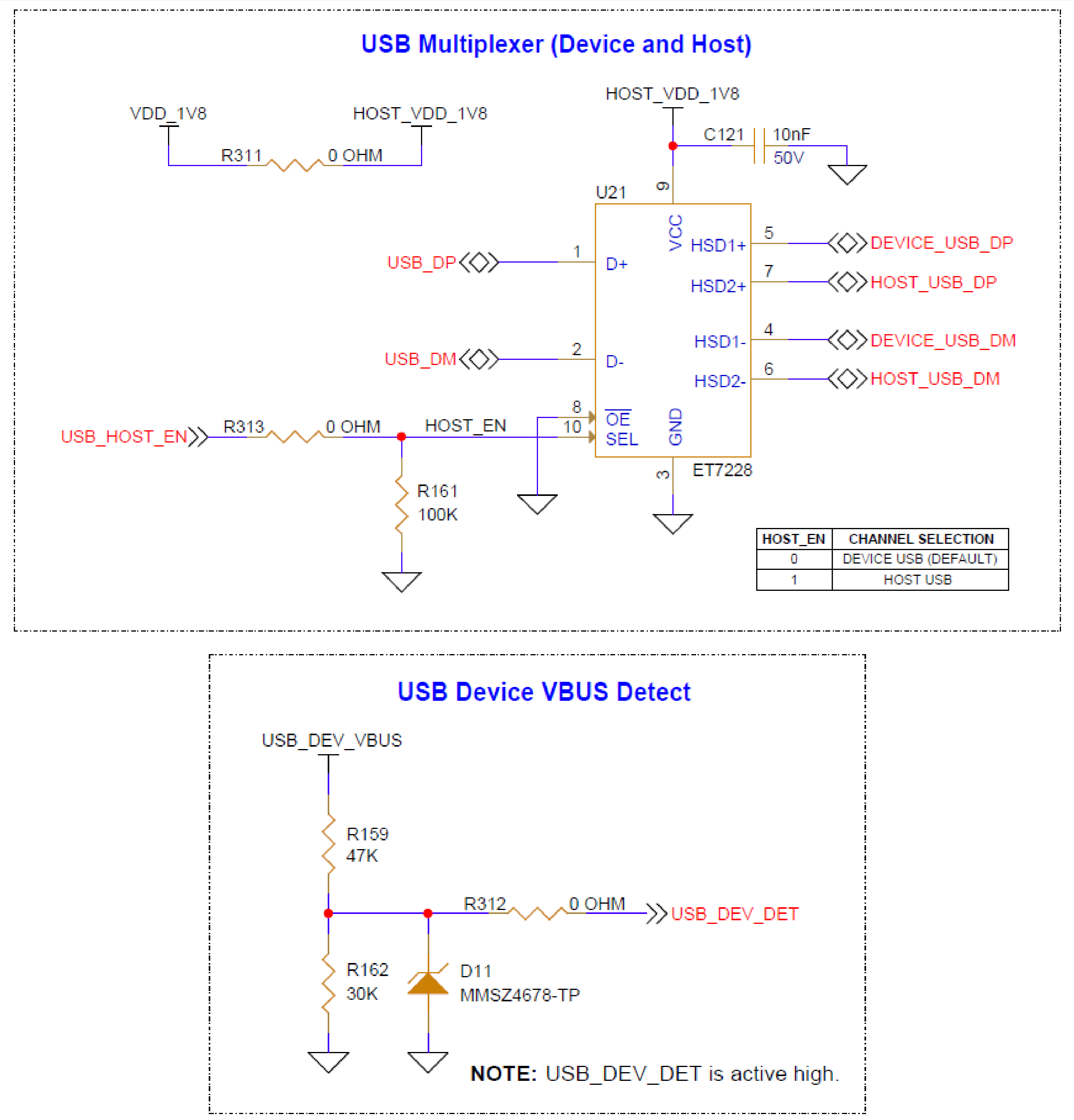


Figure 78 **Schematic of USB device**

3.2.1.12 USB host camera

The kit consists of a USB host camera module (OV7675 based, 0.3 MP, 640 x 480, 30 FPS) through the interface **J11**, for the PSOC™ Edge E84 MCU. Note that the host camera functionality needs to be enabled through firmware only (by pulling the USB_HOST_EN pin high) and is not enabled by default. The host USB signals are multiplexed with the device USB signals using a USB multiplexer (**U21**). By default, the host USB signals are not connected (the device USB is connected by default), as the default state of the USB_HOST_EN pin is low. Hence, the USB_HOST_EN pin is pulled high through the firmware to enable the USB host camera.

The board uses a USB host VBUS enable (**U23**, **U24**) circuit to enable the 5V (VBUS_HOST) output power for the host USB camera, which is controlled by the same USB_HOST_EN pin. This circuit also provides an over current protection (600 mA minimum, 800 mA typical) on the host USB camera to protect the on board regulator.

Refer to Table 21 for USB_HOST_EN pin assignment.

For more information on schematic of USB device, see Figure 78

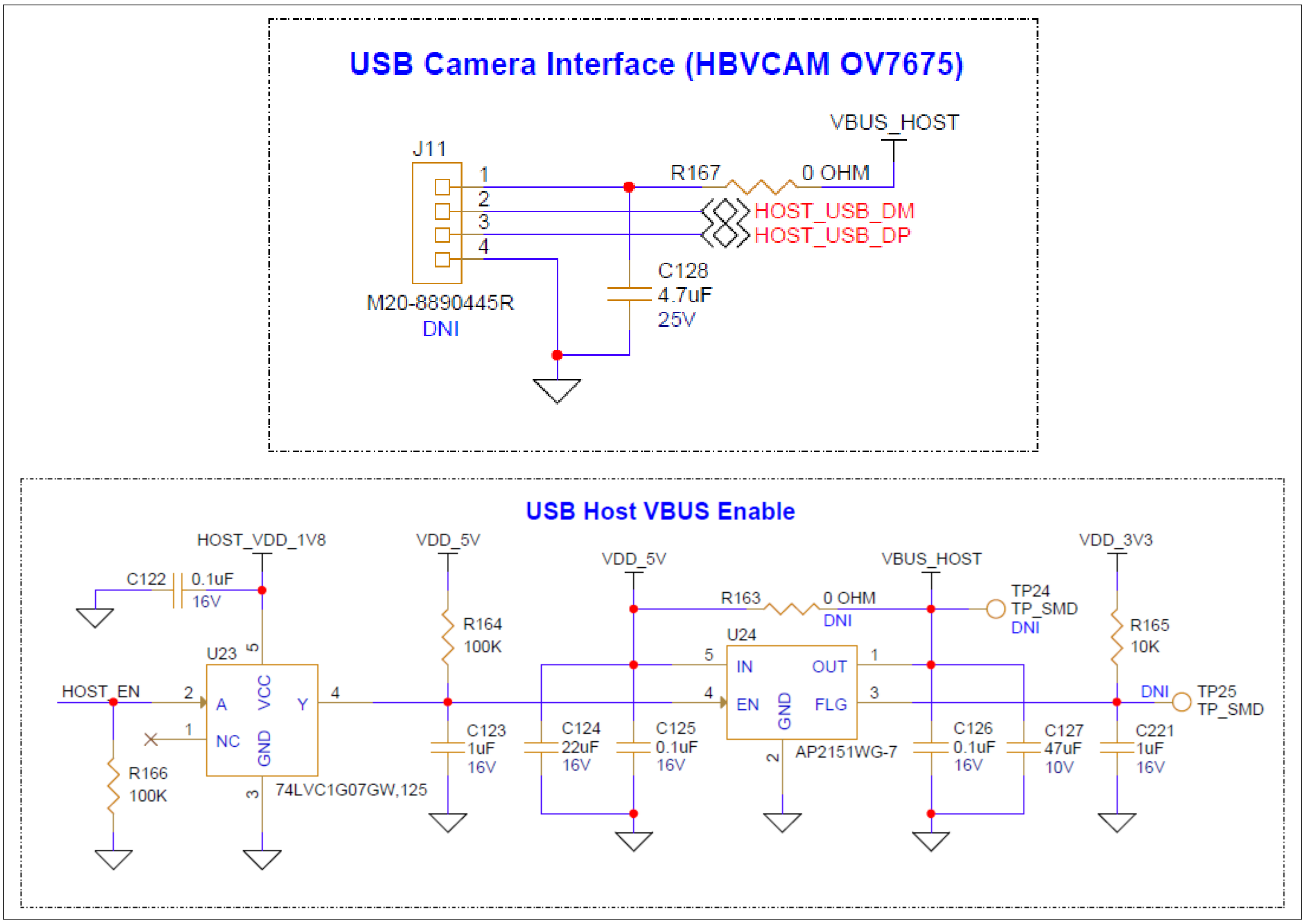


Figure 79 **Schematic of USB Host camera**

3.2.1.13 MicroSD card interface

This kit contains a microSD card holder (**J8**), which is connected to the SDHC[1] interface of PSOC™ Edge E84 MCU through a level translator (**U13**). The SD card works at 3.3 V logic level, which supports SDHC and eMMC cards. SDHC will support up to 50 MHz and eMMC will support up to 52 MHz of clock frequency for this kit. The card detect pin SD_CARD_DET is at high state by default when no SD card is inserted. Whenever the SD card is inserted, the pin changes its state to low, which is read by the PSOC™ Edge E84 MCU.

Table 22 **MicroSD card signal pin assignment**

Signal name	PSOC™ Edge E84 I/O	Logic level
SD_CARD_CLK	P7[1]	1.8 V
SD_CARD_D0	P7[3]	1.8 V
SD_CARD_D1	P7[5]	1.8 V

(table continues...)

Table 22 (continued) MicroSD card signal pin assignment

Signal name	PSOC™ Edge E84 I/O	Logic level
SD_CARD_D2	P7[6]	1.8 V
SD_CARD_D3	P7[7]	1.8 V
SD_CARD_CMD	P7[0]	1.8 V
SD_CARD_DET	P13[5]	1.8 V

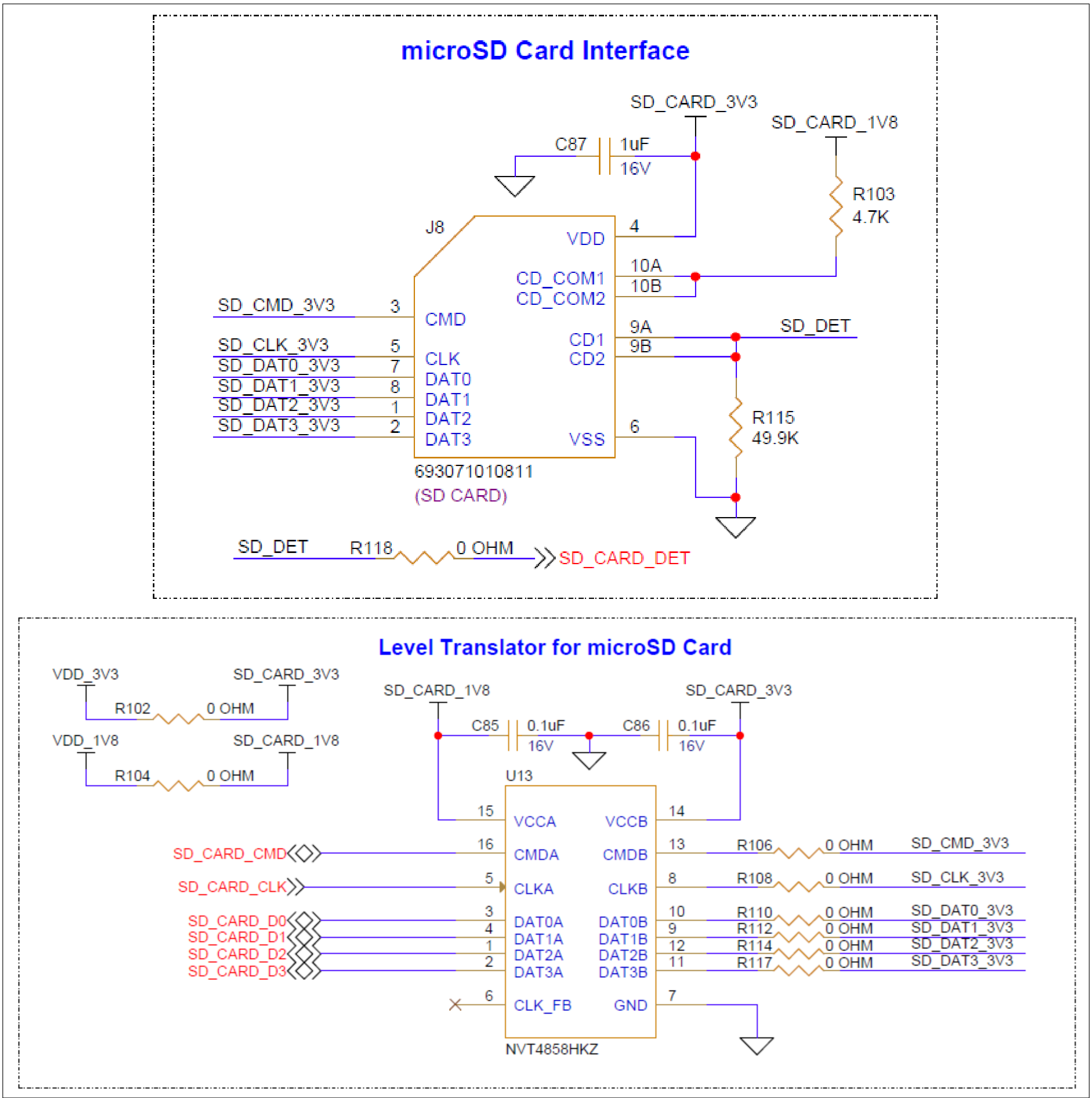


Figure 80 Schematic of MicroSD card

3.2.1.14 6-axis IMU (accelerometer + gyroscope)

This kit contains a 6-axis motion sensor (**U15**), also known as the inertial measurement unit (IMU), that provides precise 3-axis acceleration and 3-axis gyroscopic angular rate data in each spatial direction. The sensor uses an I2C interface to communicate along with two interrupt signals which are connected to the **INT1_IMU** and **INT2_IMU** pins of the sensor to the PSOC™ Edge E84 MCU by default. There is also provision to change the communication protocol to the SPI interface by removing **R345**, **R347**, **R342**, **R129** and populating **R344**, **R346**, **R343**, **R128**.

The default I2C address is **0x68** (also configurable to **0x69** by removing **R123** and populating **R124**).

Table 23 Pin assignment for 6-axis IMU interface signals

Signal name	PSOC™ Edge E84 I/O	Logic level
I2C_SCL_1V8	P8[0]	1.8 V
I2C_SDA_1V8	P8[1]	1.8 V
INT1_IMU	P10[7]	1.8 V
INT2_IMU	P15[7]	1.8 V
SPI_SCK_IMU[1)]	P11[0]	1.8 V
SPI_MOSI_IMU[1)]	P11[1]	1.8 V
SPI_MISO_IMU[1)]	P11[2]	1.8 V
SPI_CS_IMU[1)]	P11[3]	1.8 V

1 Not connected by default.

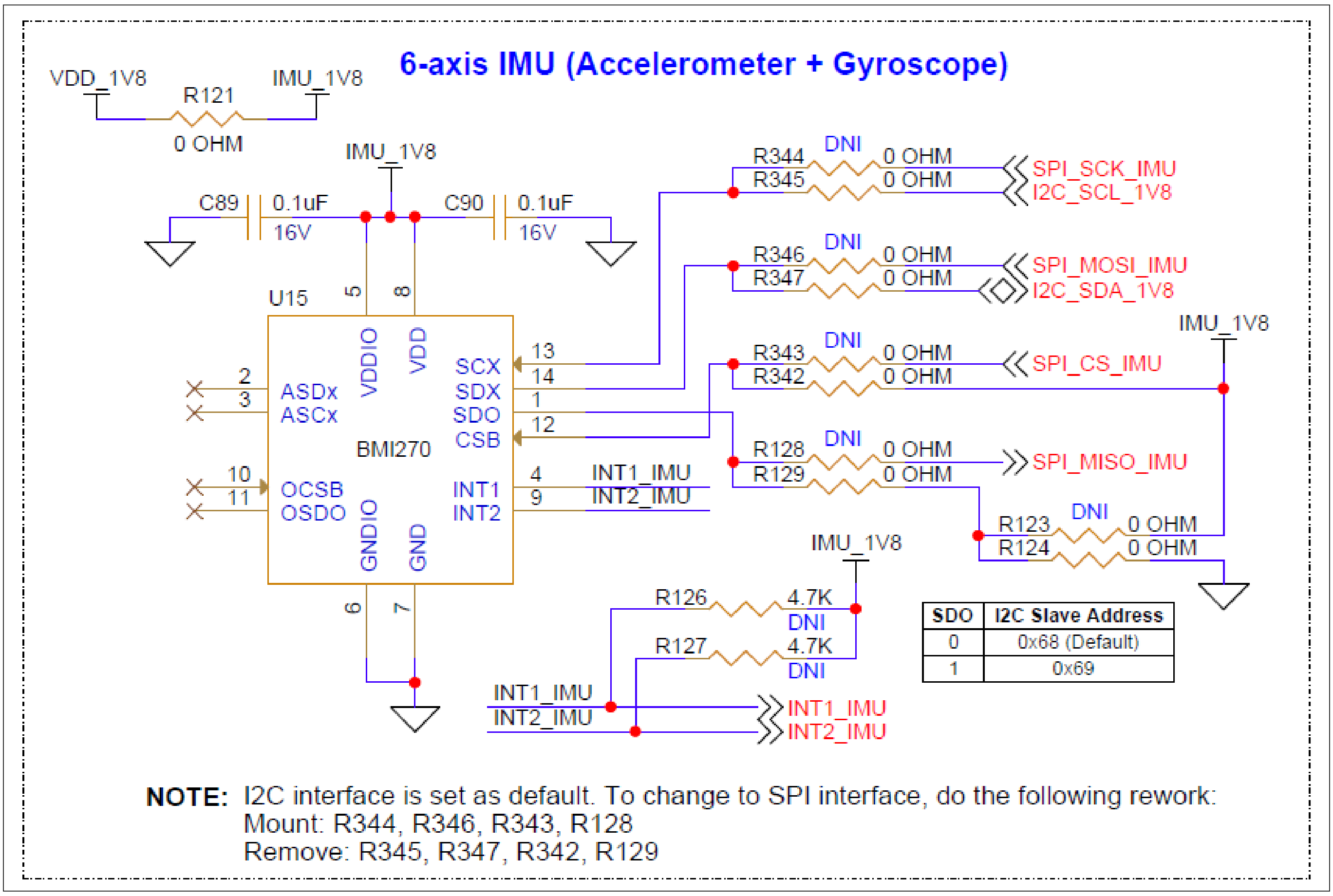


Figure 81 Schematic of 6-axis IMU (accelerometer + gyroscope)

3.2.1.15 XENSIV™ 60 GHz RADAR shield interface

The kit contains Infineon's XENSIV™ 60 GHz RADAR shield (BGT60TR13) connected through the connectors **J9** and **J10**. This a 60 GHz radar sensor with integrated antennas; one transmitting and three receiving antennas. The sensor incorporates an L-shaped antenna array, ensuring both horizontal and vertical angular measurements. This sensor comes with an Antennas in Package (AIP) concept, which eliminates the antenna design complexity at the user end. The RADAR sensor uses an SPI interface to communicate, along with an interrupt signal (**RS_IRQ_LS**) and a reset signal (**RS_RST_LS**)

Table 24 Pin assignment for XENSIV™ 60 GHz RADAR shield interface

Signal name	PSOC™ Edge E84 I/O	Logic level
RS_SPI_CLK_LS	P21[6]	1.8 V
RS_SPI_MOSI_LS	P21[5]	1.8 V
RS_SPI_MISO_LS	P21[4]	1.8 V
RS_SPI_CS_LS	P0[0]	1.8 V
RS_IRQ_LS	P21[7]	1.8 V
RS_RST_LS	P20[7]	1.8 V
RS_GPIO1_LS	P20[5]	1.8 V
RS_GPIO2_LS	P20[6]	1.8 V

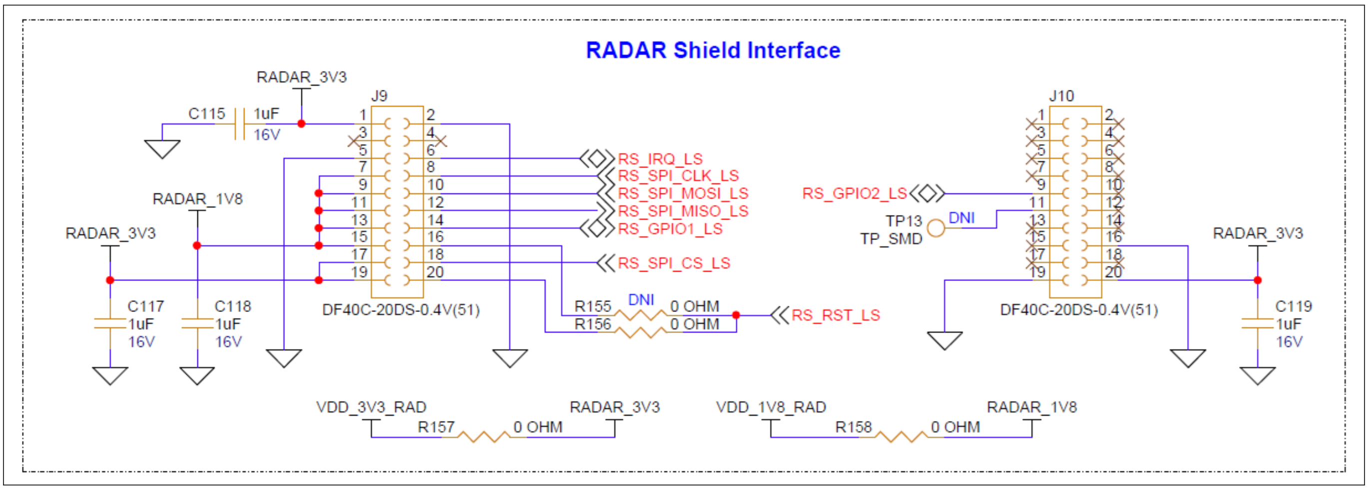


Figure 82 Schematic of XENSIV™ 60 GHz RADAR shield interface

3.2.1.16 Digital humidity and temperature sensor

This kit features a digital humidity sensor SHT40 (**U19**), which comes equipped with a built-in temperature sensor. This sensor communicates with the PSOC™ Edge E84 MCU via the I2C interface. The default I2C address for this sensor is **0x44**. This sensor is powered with 3.3 V supply from the rail VDD_3V3.

Table 25 Pin assignment for digital humidity and temperature sensor interface signals

Signal name	PSOC™ Edge E84 I/O	Logic level
I2C_SCL_3V3	P17[2]	3.3 V
I2C_SDA_3V3	P17[3]	3.3 V

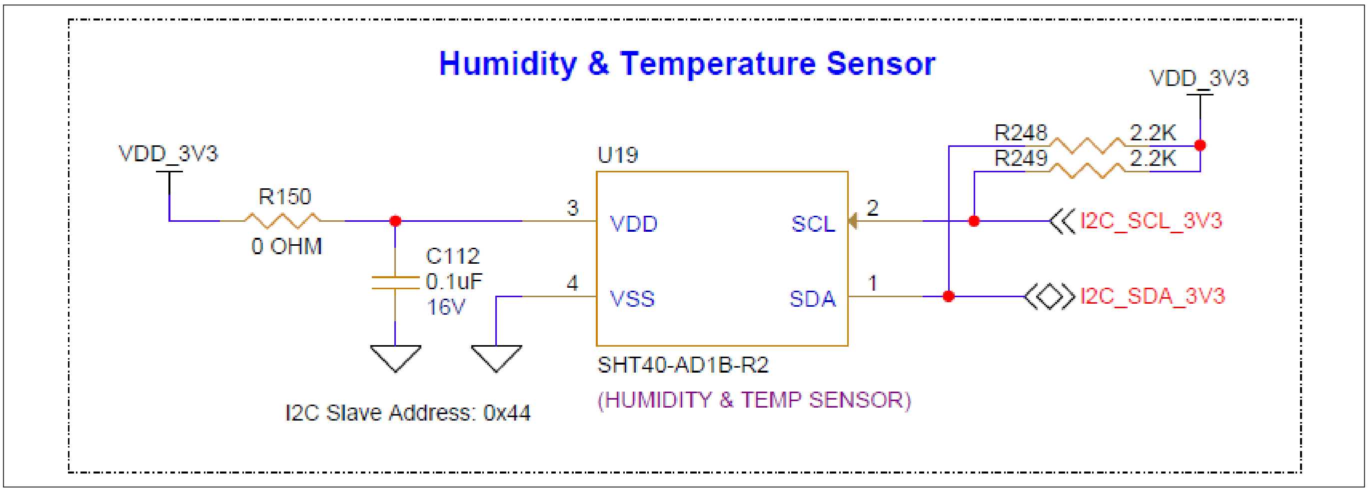


Figure 83 Schematic of digital humidity and temperature sensor

3.2.1.17 Power LED

The kit has a green power LED (**D1**) for power indication. The LED is supplied from 5 V rail with a current limiting resistor of 120 Ω.

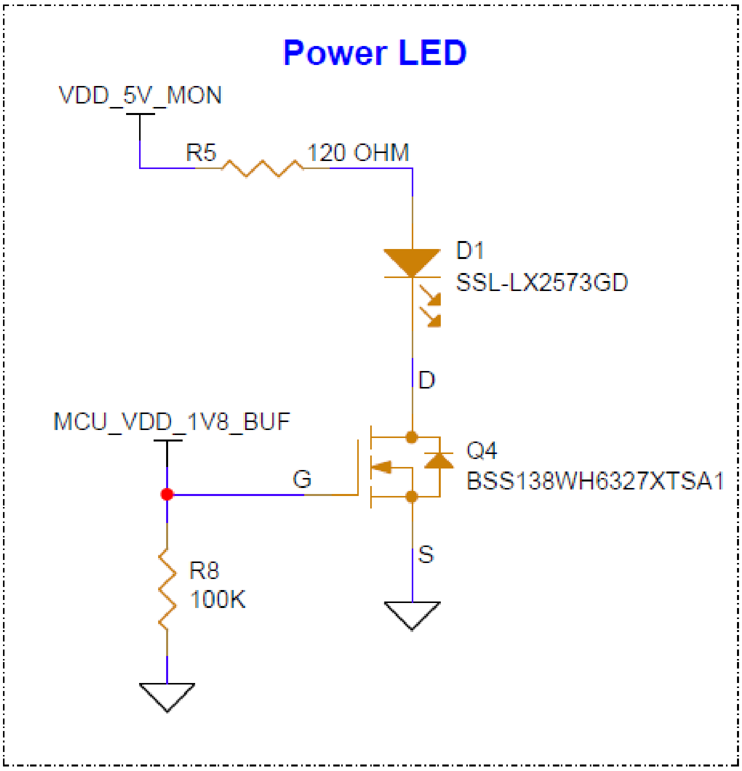


Figure 84 **Schematic of Power LED**

3.2.1.18 Reset and user buttons

This kit contains one MCU reset switch (**SW1**) for resetting the PSOC™ Edge E84. When this **SW1** is pressed, the **XRES_L** line of the PSOC™ Edge E84 MCU is pulled to the ground, which in turn resets the target device. The **XRES_L** has a 4.7 KΩ pull-up resistor.

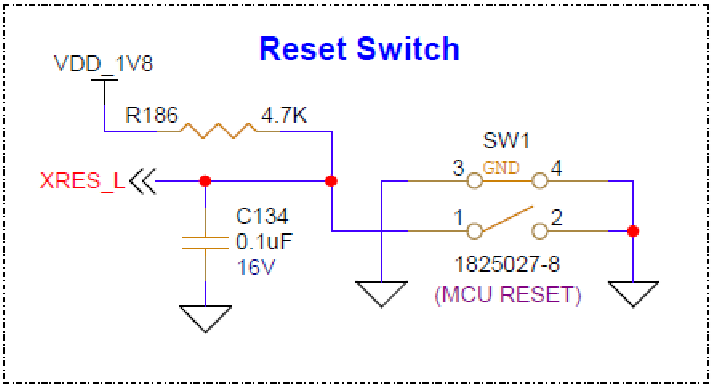


Figure 85 **Schematic of MCU reset switch**

The board features two user buttons **SW2** and **SW4**, which serve as a general user input or for controlling different application states. Both user buttons are active low.

Table 26 **Pin assignment for user buttons**

Signal name	PSOC™™ Edge E84 I/O	Logic level
USER_SW1	P8[3]	1.8 V
USER_SW2	P8[7]	1.8 V

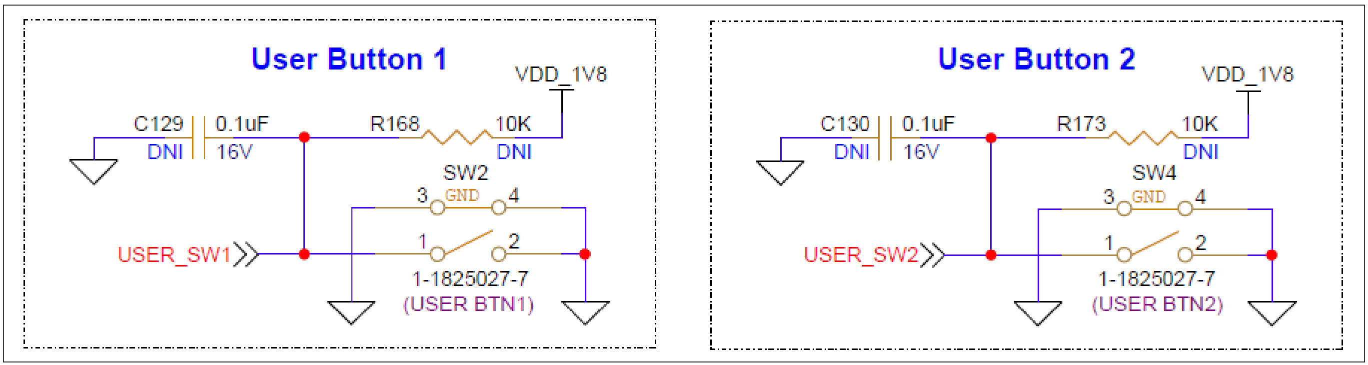


Figure 86 Schematic of user buttons

3.2.1.19 Boot configuration switch

There is a 1-bit boot configuration slide switch (**SW5**) that sets the boot location for the PSOC™ Edge E84 MCU. The switch output pin **BOOT** is connected to the **P17[6]** pin of the PSOC™ Edge E84, whose state is read by the MCU, and based on that, the boot location is set. See Table 27 for the boot source options. By default, the switch position is set to 1 (ON).

Table 27 Boot configuration switch boot location

SW5 Position	Boot location
0 (OFF)	Internal RRAM (OEM_APP)
1 (ON, Default)	External Octal flash (OEM_ALT_APP)

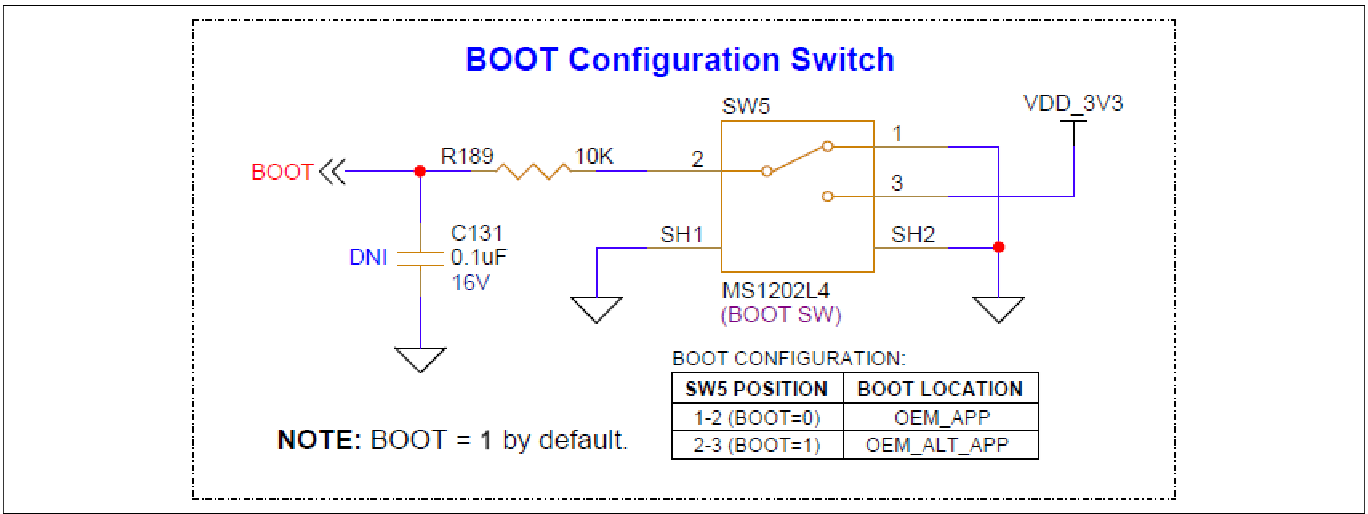


Figure 87 Schematic of boot configuration switch

3.2.1.20 PSOC™ Edge E84 HMI MIC board interface

The kit has an 18-pin bottom mount FPC connector (**J22**) to interface with the extended PSOC™ Edge E84 HMI MIC Board. The microphone board is connected to the **J22** on the baseboard using an 18-pin FPC cable. The interface carries the XENSIV™ MEMS digital microphones, XENSIV™ MEMS analog microphones , and RGB user LED signals.

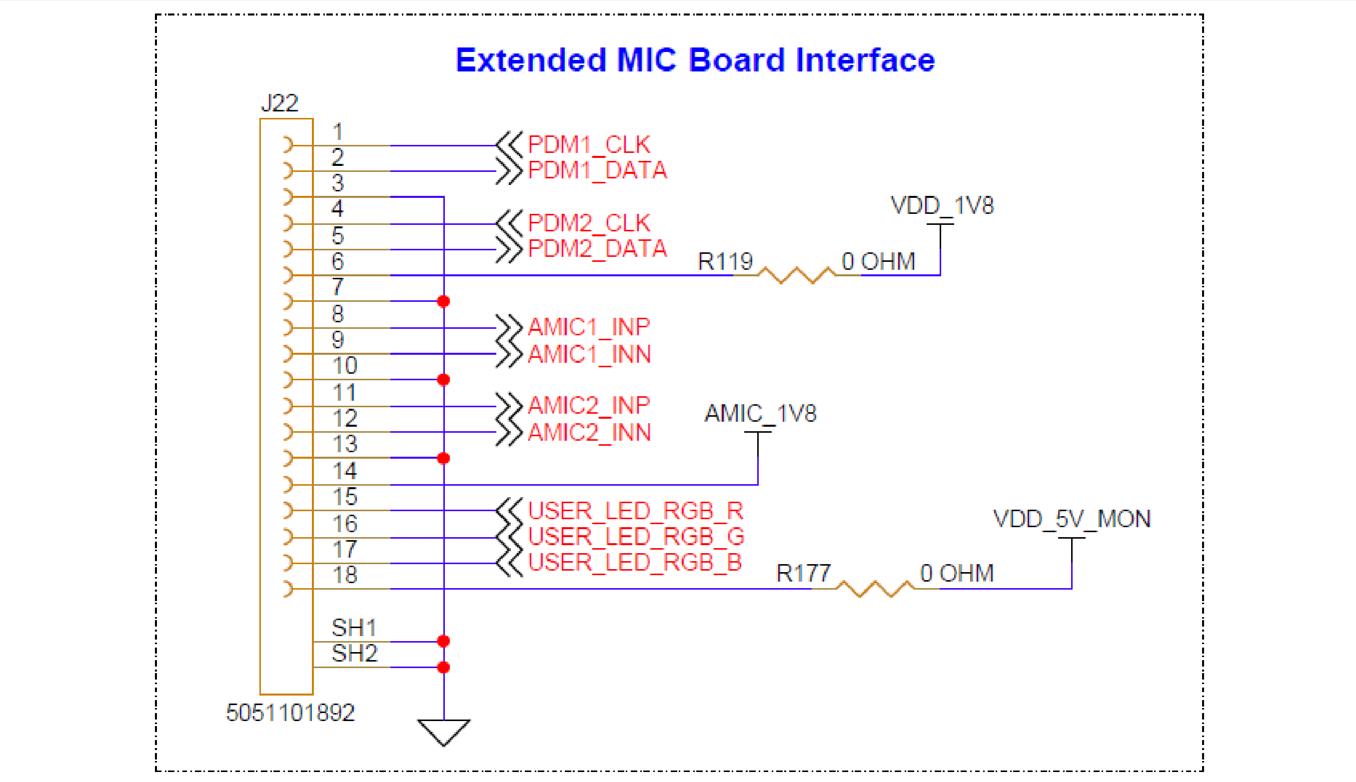


Figure 88 Schematic of PSOC™ Edge E84 HMI MIC board interface

3.2.1.21 I2C device addresses

Table 28 List of I2C addresses of the devices on the kit

Device	Reference designator (on baseboard)	I2C address (7-bit hex)
Audio amplifier (TLV320DAC3100)	U12	0x18
6-axis IMU (BMI270)	U15	0x68 (default)/0x69
Humidity and temperature Sensor (SHT40-AD1B-R2)	U19	0x44
Real-time clock (MCP7940N-I/SN)	U28	0x6F

3.2.2 PSOC™ Edge E84 HMI MIC Board

3.2.2.1 XENSIV™ MEMS digital microphones

The PSOC™ Edge E84 HMI Kit contains Infineon's four digital PDM MEMS microphones (**U1**, **U2**, **U3**, **U4**) IM73D122V01. The microphones (**U1**, **U2**, **U3**, **U4**) are placed in a linear pattern from left to right with a distance of 24.5 mm apart from each other where **U1** being the left most and **U4** being the right most microphone. **U1**, **U2** share the PDM1 bus and **U3**, **U4** share the PDM2 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.

The microphones are supplied from a 1.8 V (**DMIC_1V8**) rail.

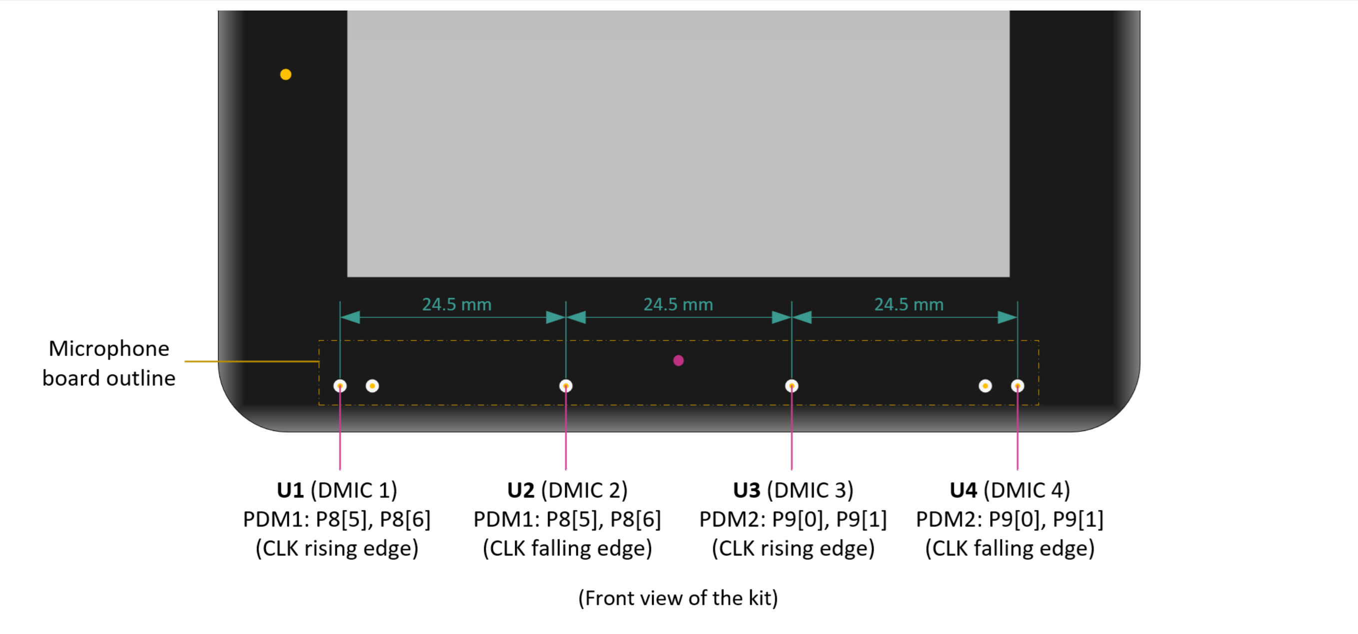


Figure 89 **PDM microphones placement on kit**

Table 29 **Pin assignment of microphones PDM interface**

Signal name	PSOC™ Edge E84 I/O	Logic level
PDM1_CLK	P8[5]	1.8 V
PDM1_DATA	P8[6]	1.8 V
PDM2_CLK	P9[0]	1.8 V
PDM2_DATA	P9[1]	1.8 V

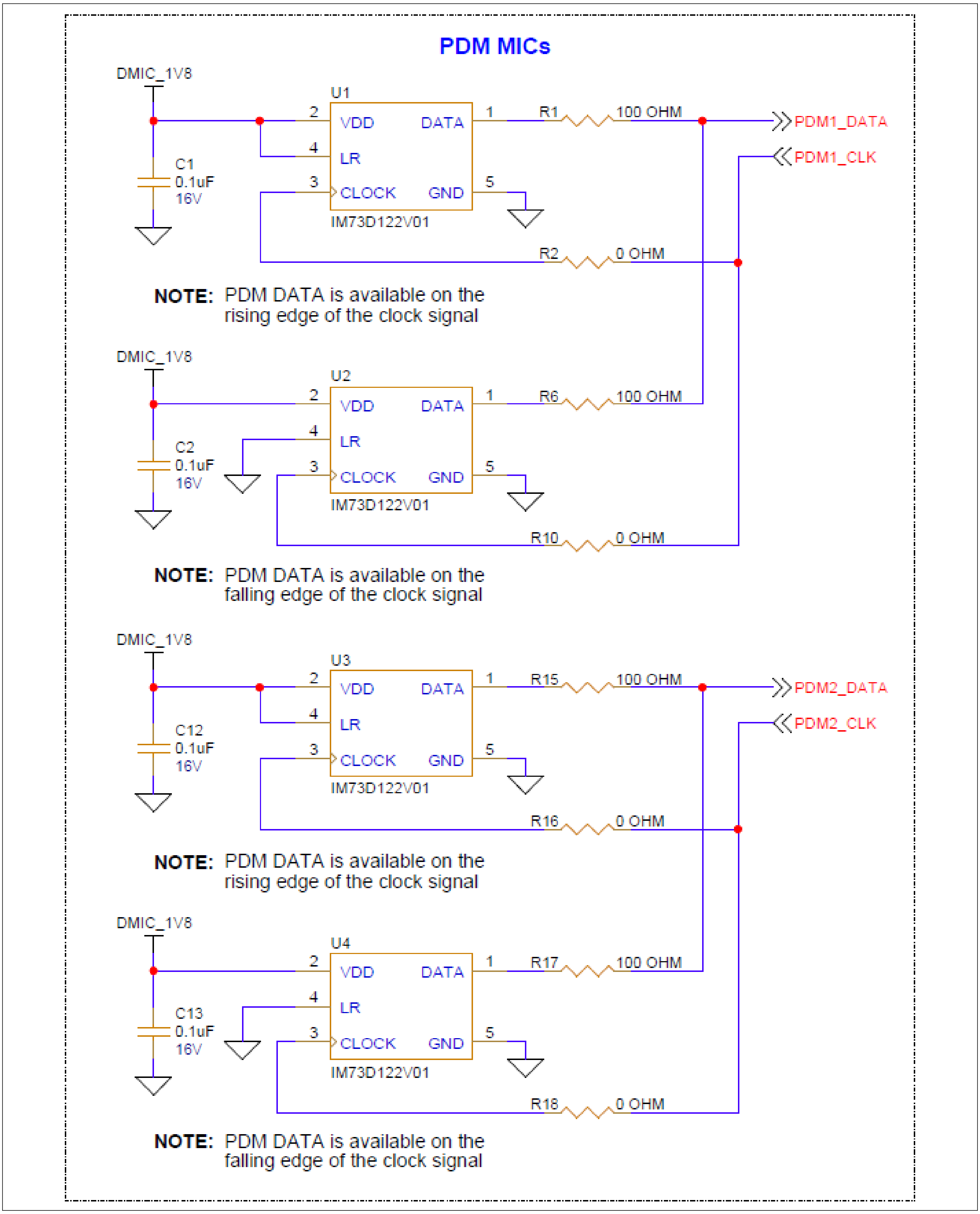


Figure 90 **Schematic of XENSIV™ MEMS digital microphones**

3.2.2.2 XENSIV™ MEMS analog microphones

The PSOC™ Edge E84 HMI kit contains two analog XENSIV™ MEMS microphones (**U5**, **U6**) IM73A135V01XTSA1 from Infineon Technologies which are designed for high SNR (low self-noise) and low distortion (high AOP) applications. **U5** is the left channel microphone and **U6** being the right channel, placed 66.5 mm apart from each other. Both microphones are supplied from 1.8 V (**AMIC_1V8**) rail.

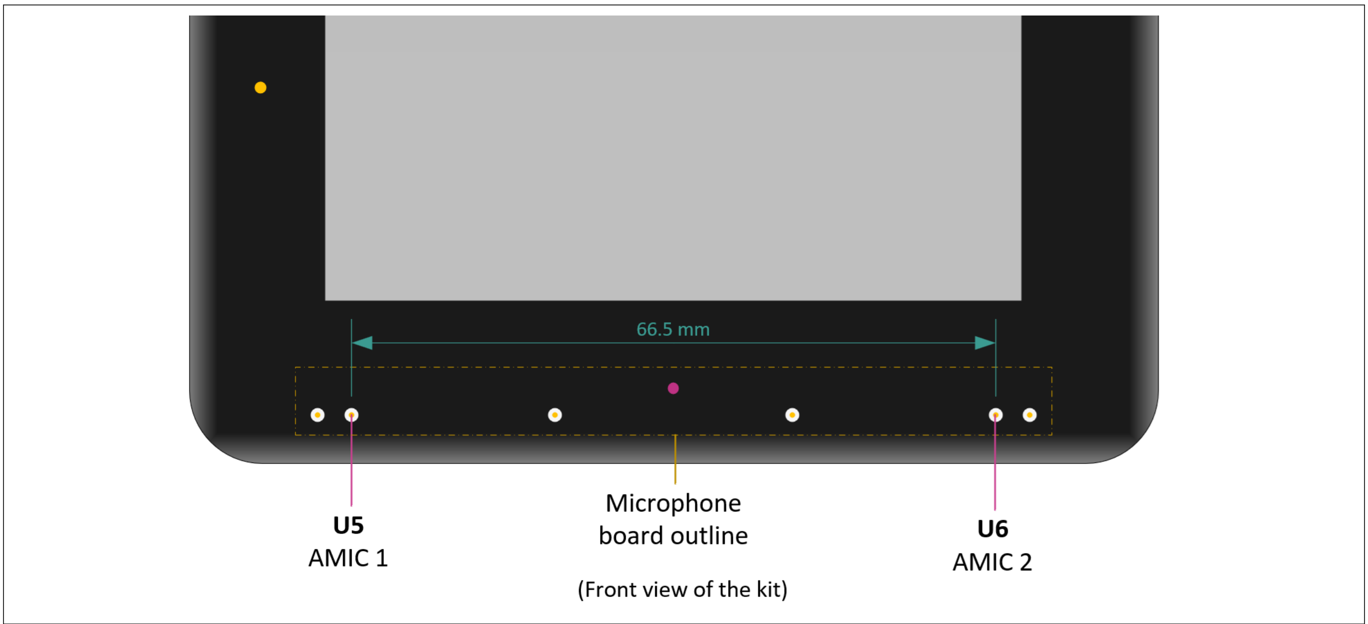


Figure 91 Analog microphones placement on kit

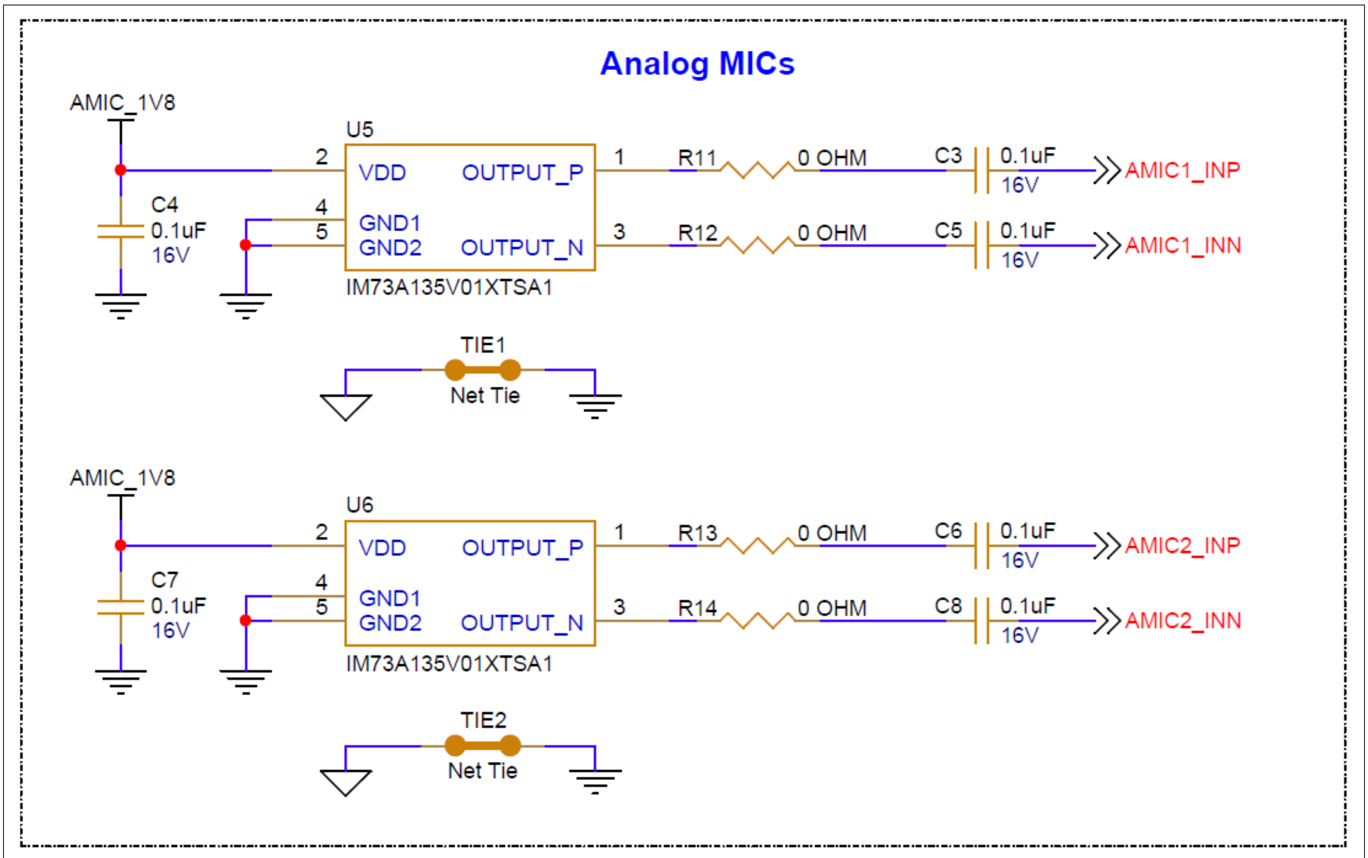


Figure 92 Schematic of XENSIV™ MEMS analog microphones

3.2.2.3 RGB user LED

The kit contains a RGB LED (**D1**) for general purpose indication.
The LEDs are active high and supplied from 5 V rail (USER_LED_5V).

Table 30 Pin assignment of RGB user LED

Signal name	PSOC™ Edge E84 I/O	Logic level
USER_LED_RGB_R	P20[0]	1.8 V
USER_LED_RGB_G	P20[3]	1.8 V
USER_LED_RGB_B	P20[4]	1.8 V

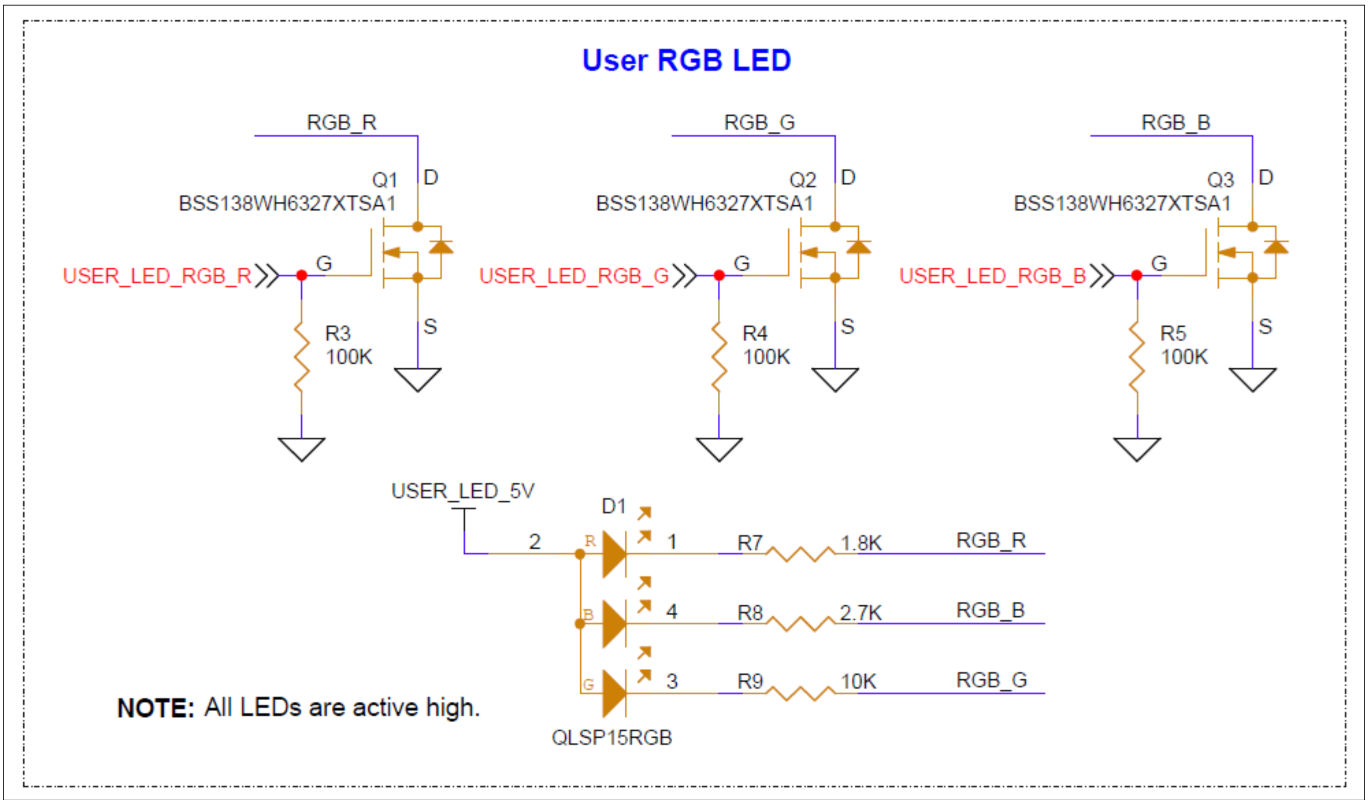


Figure 93 Schematic of RGB user LED

3.2.3 Enclosure of PSOC™ Edge E84 HMI Kit

The PSOC™ Edge E84 HMI Kit is enclosed in a 2-part enclosure (enclosure front and back parts). Dimensions of the assembled enclosure unit is 100 mm X 106 mm X 22 mm.


Top view
100mm
106mm

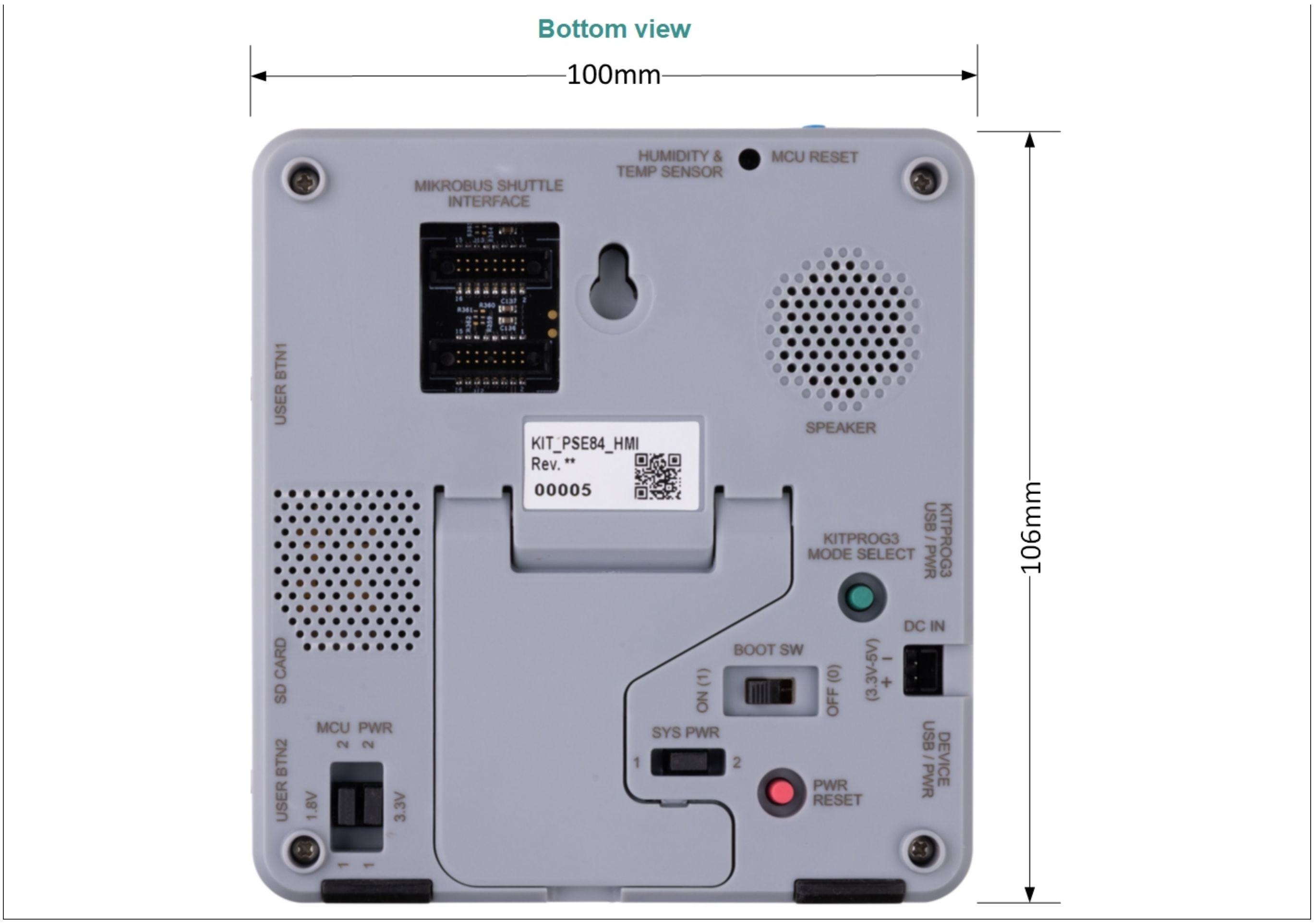


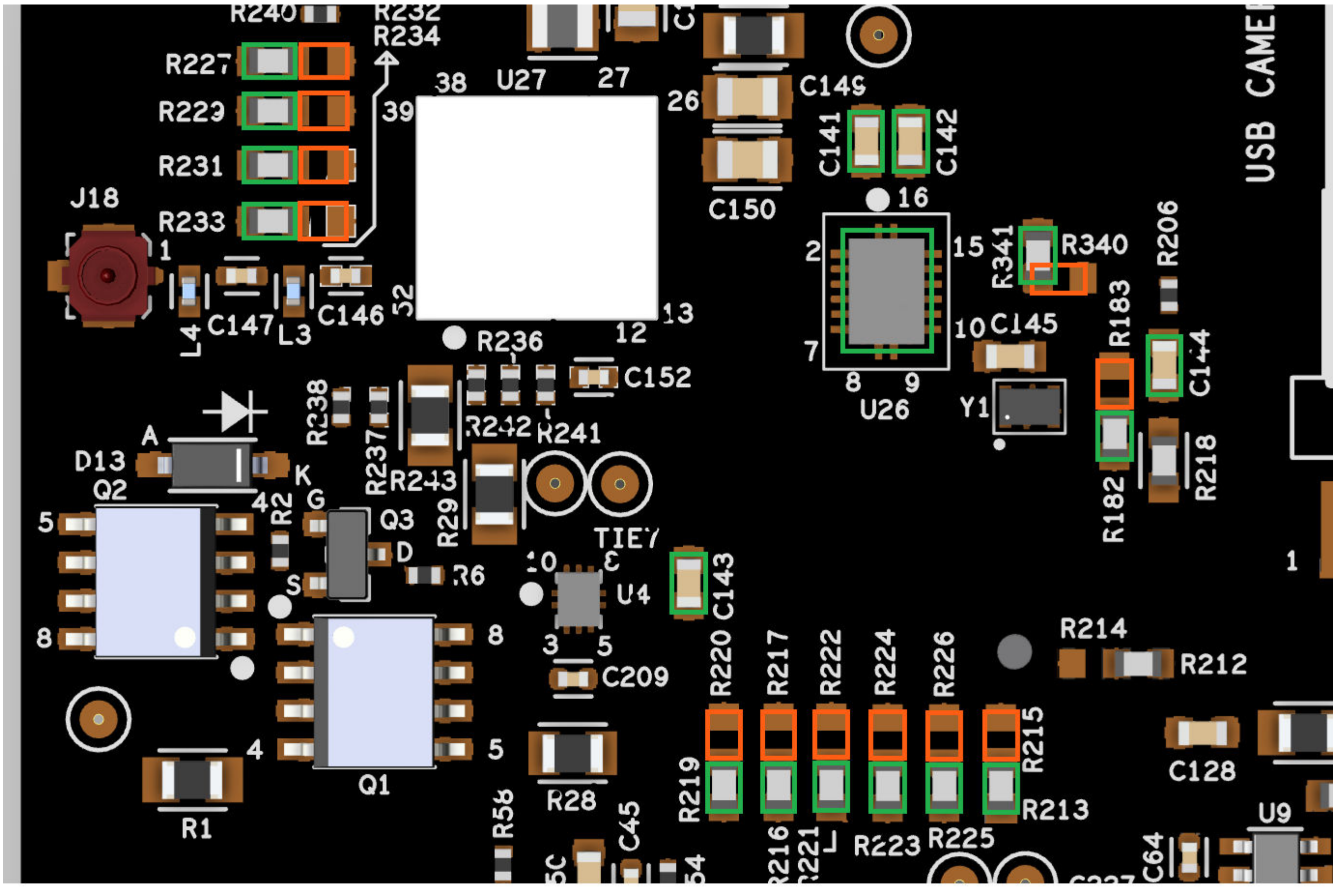
Figure 94 Enclosure of PSOC™ Edge E84 HMI Kit

3.3 PSOC™ Edge E84 HMI Kit rework

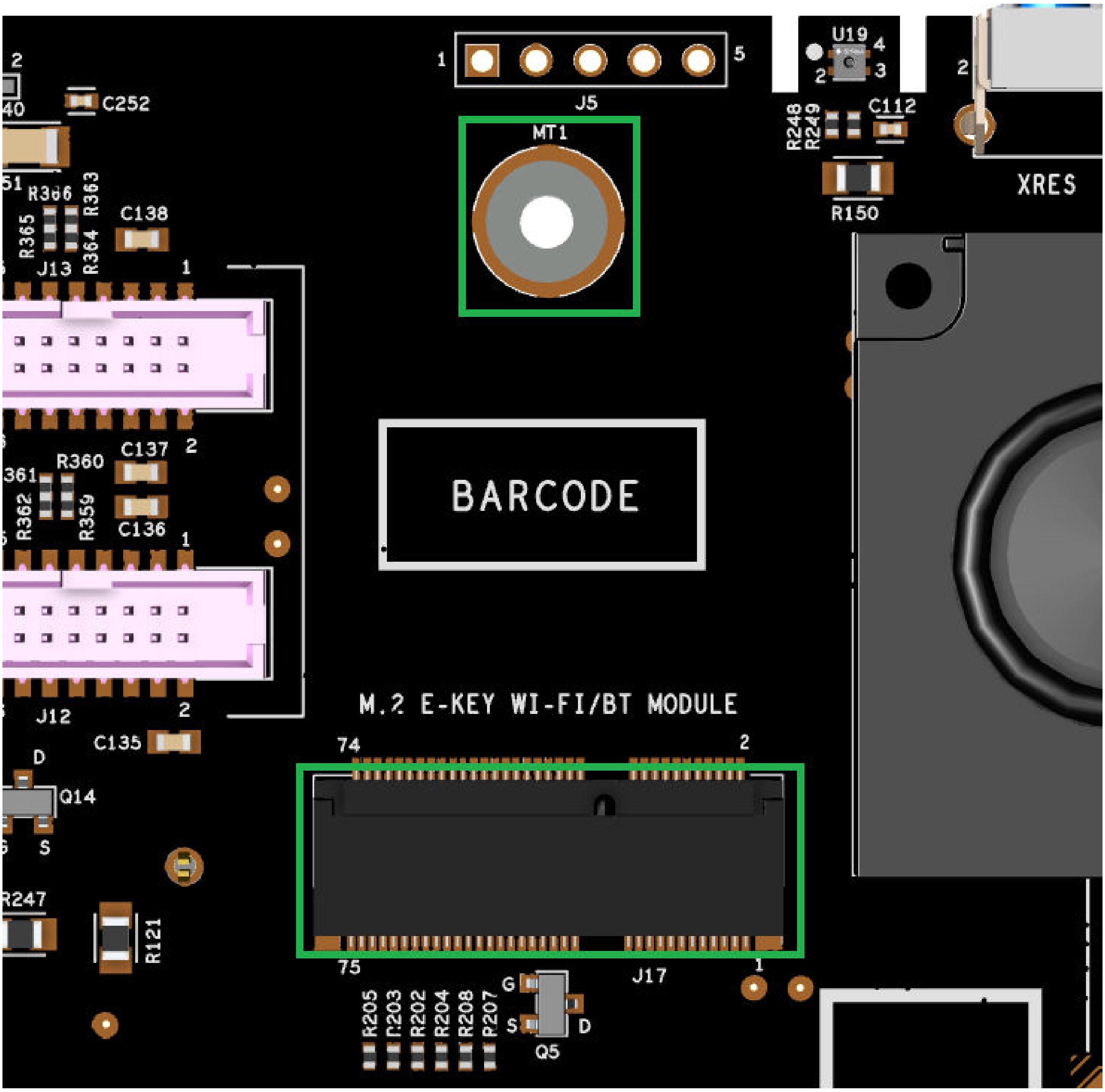
3.3.1 Rework for M.2 (E-key) external radio interface

To support the M.2 (E-key) external radio interface (with the Infineon's M.2 E-key radio module), do the following rework on the baseboard:

- Remove: R215, R217, R220, R222, R224, R226, R228, R230, R232, R234, R183, R340
- Populate: R213, R216, R219, R221, R223, R225, R227, R229, R231, R233, R182, R341, J17, C143, C144, MT1, U26, C141, C142


R240
R232
R234
R227
R229
R231
R233
J18
U27
38
27
26
39
C149
C141
C142
C150
16
USB CAME
15
R341
R340
R206
2
13
12
R236
C147
L4
L3
C146
10
C145
7
8
9
U26
Y1
R183
C144
C152
R238
R237
R242
R241
D13
A
K
Q2
G
Q3
D
S
R2
R29
R243
R6
U4
C143
R182
R218
1
R214
R212
R220
R217
R222
R224
R226
R215
C209
Q1
R1
R28
R58
C45
R219
R216
R221
R223
R225
R213
C128
U9
C64

(Top view)



(Bottom view)

Figure 95 **Rework for M.2 (E-key) radio interface**

Note:

- *Recommended part MPNs:*
  J17 *→ 8038402-67G00E5T*
  MT1 *→ S001-00001-A42-R*
- *Screw down the M.2 radio module using screw* ***ACC7.***
  Recommended part MPN: ***ACC7*** *→ S001-00003*

To support M.2 Laird module, do the following additional rework on the baseboard:

- Remove: R212
- Populate: R214

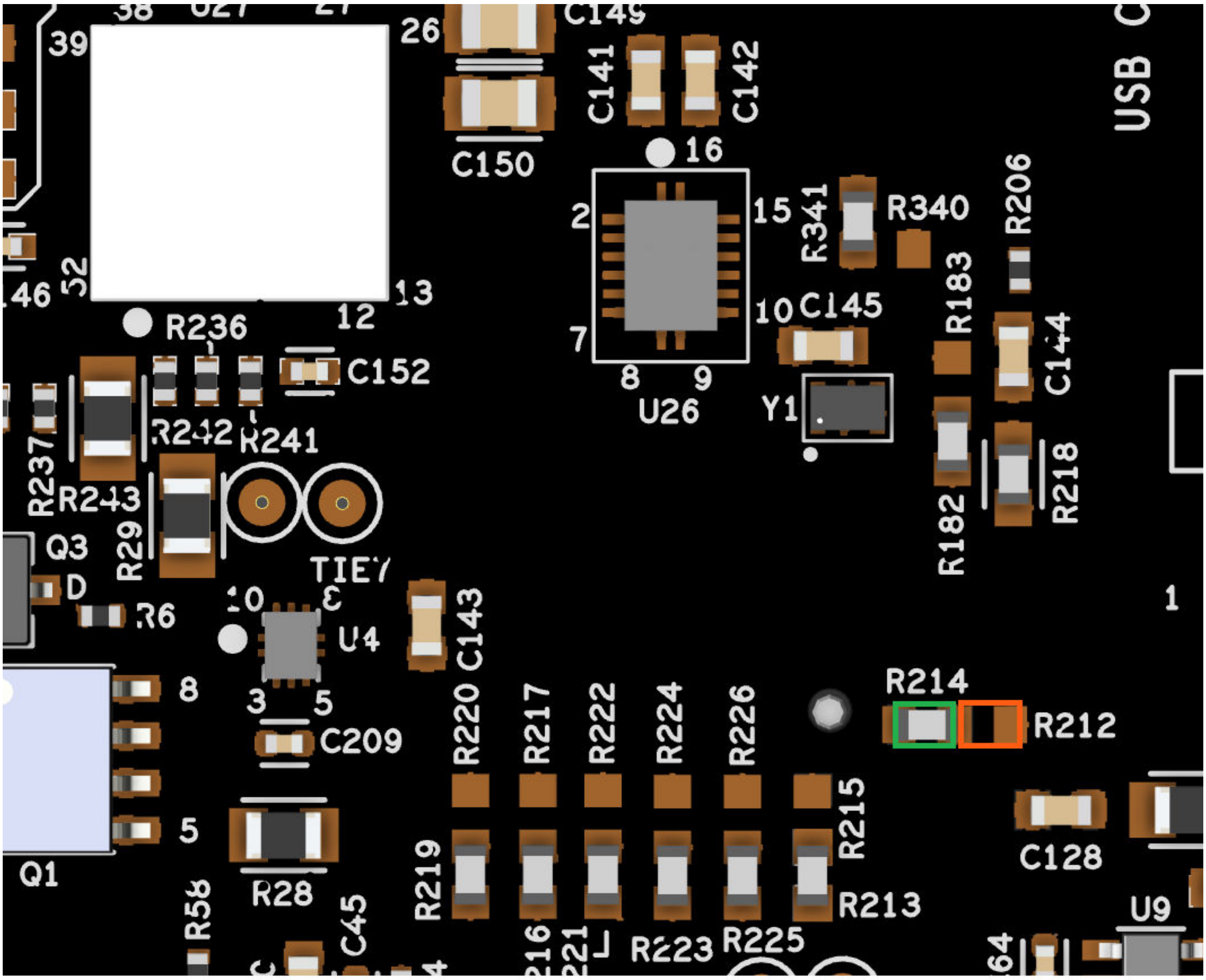
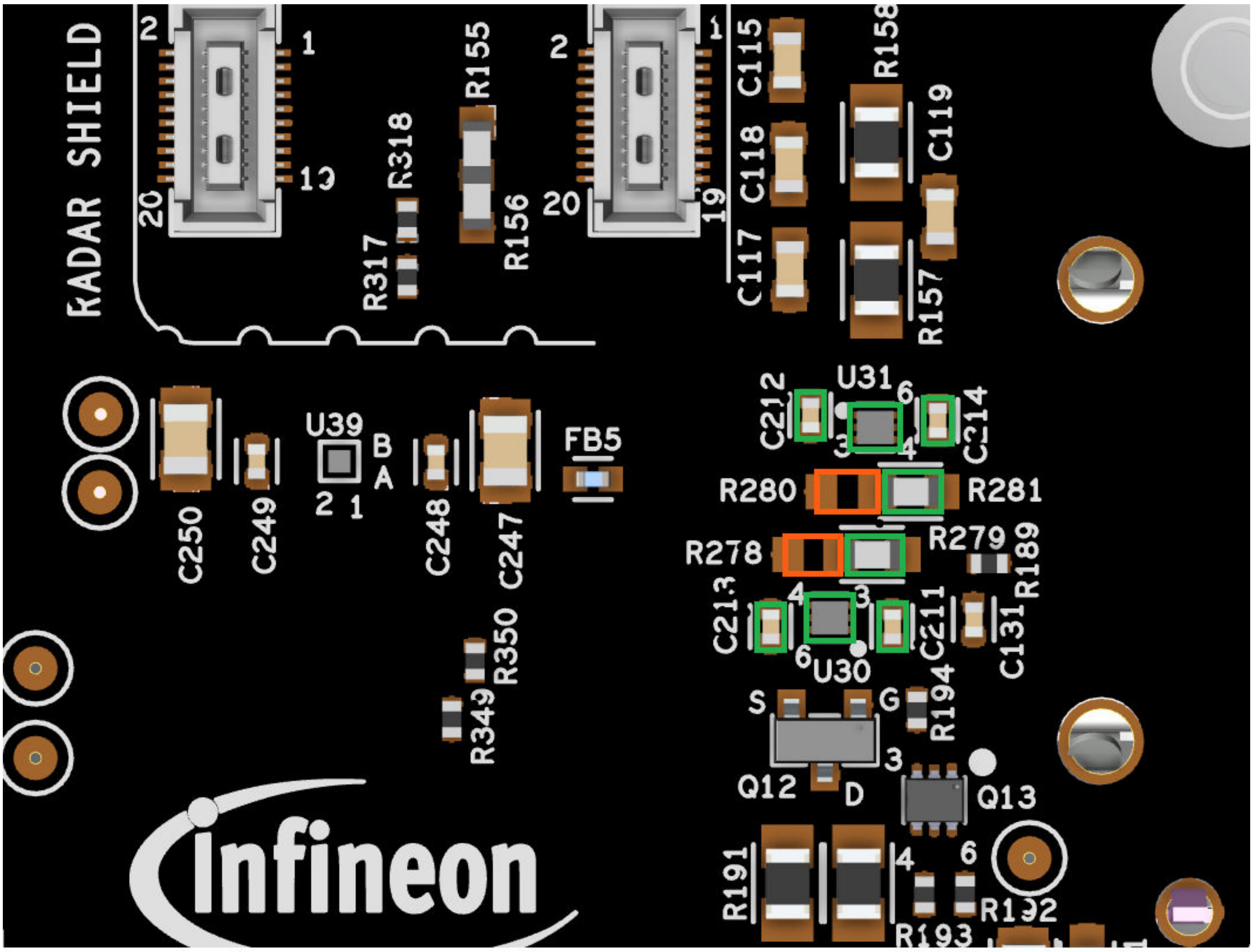


Figure 96 Rework for M.2 Laird module

3.3.2 Rework for UART level translator for mikroBUS shuttle interface 2

To support the 3.3 V logic level UART communication on mikroBUS shuttle interface 2, do the following rework on the baseboard:

- Remove: R278, R280
- Populate: U30, U31, R279, R281, C211, C212, C213, C214



(Top view)

Figure 97 **Rework for UART level translator for mikroBUS shuttle interface 2**

3.3.3 Coin cell installation

To install the coin cell to the kit, follow these steps:

1. Remove the back cover of the kit by unscrewing the 4 screws

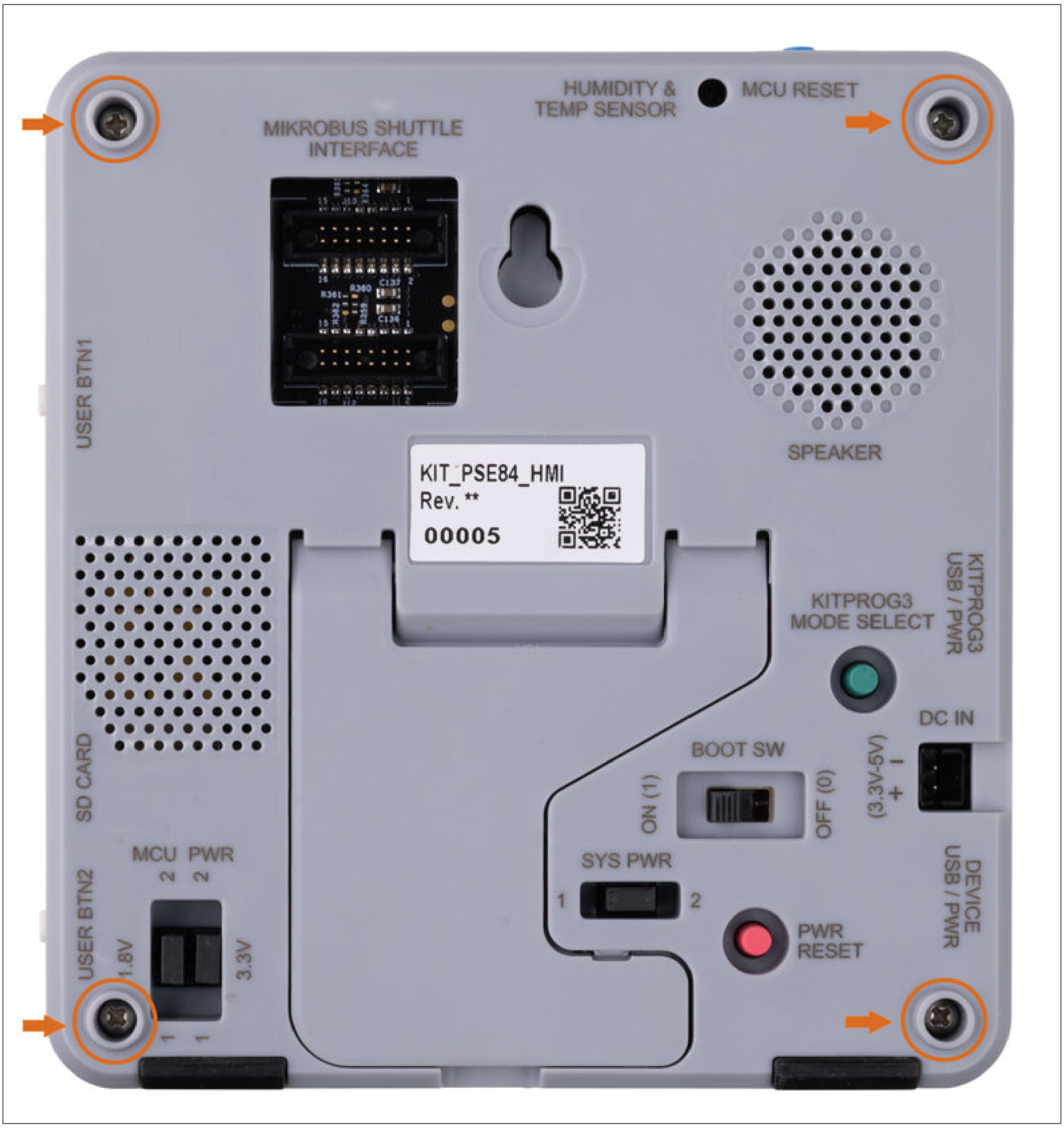


Figure 98 **Remove the back cover of the kit**

2. Insert the coin cell into the connector **BT1** as shown in Figure 99.
Recommended coin cell MPN: **CR1220** (Panasonic).
Then, attach the back cover again by using the 4 screws

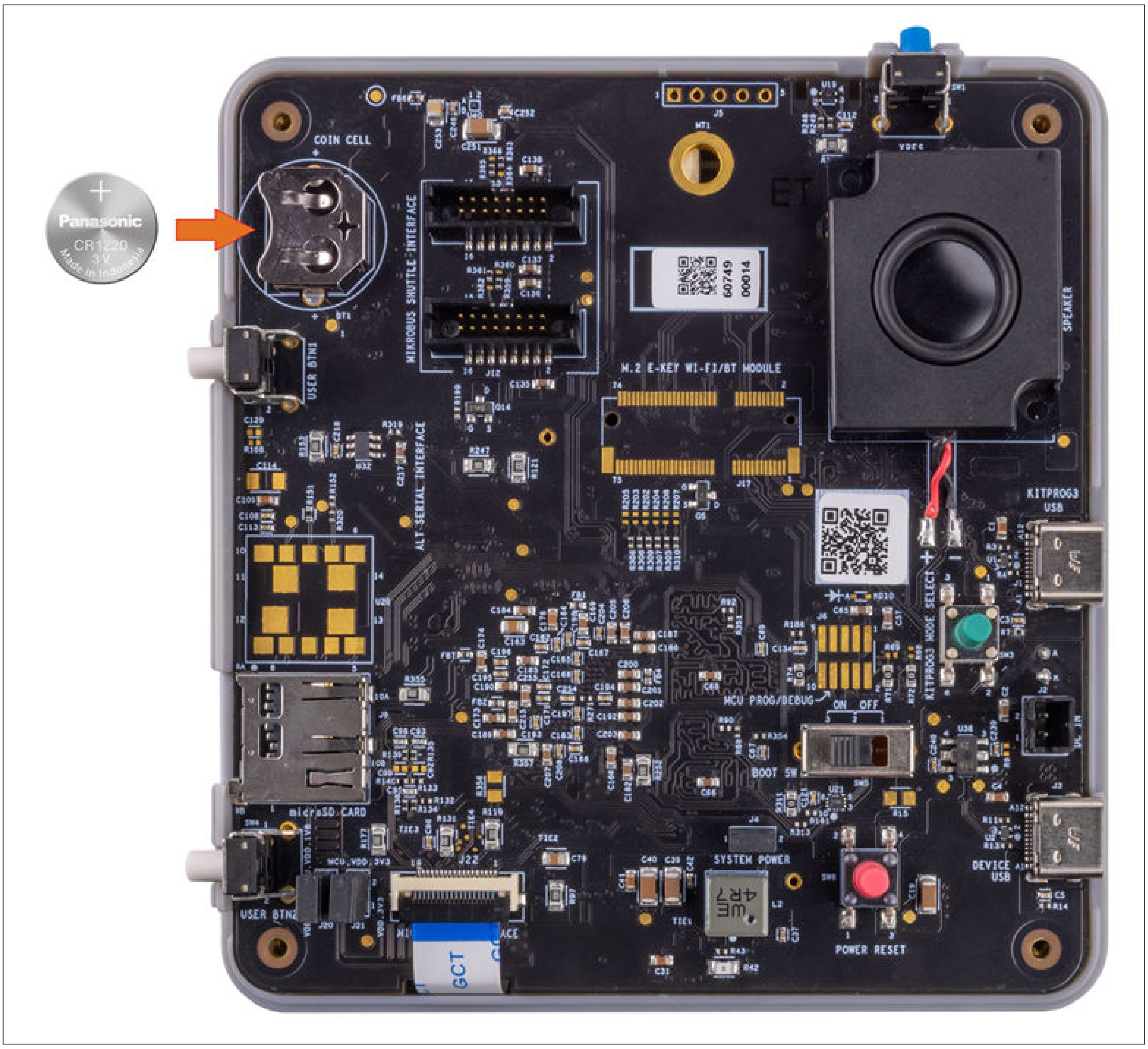


Figure 99 **Insert the coin cell**

4 Bill of materials

See the bill of materials available on the kit webpage.

5 Frequently asked questions

1. I do not have a USB Type-C connector on my PC. Can I still connect and use this kit?

To evaluate the full functionality of the kit, USB Type-C to Type-C cable is recommended. Alternatively, the kit can be powered through the DC IN connector (**J2**) using an external 5 V, 3 A power supply, along with the KitProg3 Program/Debug Type-C USB (**J1**) connecting with a USB Type-A to Type-C cable. If adequate power is not supplied, the user may not be able to use all the concurrent functionalities (or partially use) of the kit. For more information, see Power inputs and over voltage protection

2. What are the jumpers on the kit used for?

The kit includes a total of three jumpers:

- One jumper for overall system power monitoring: **J4**
- Two jumpers for MCU power monitoring: **J21** (MCU_VBAT_3V3) and **J20** (MCU_VDD_1V8).

For more information, see Power monitoring headers .

Ammeters can be connected across these jumpers to measure the current consumed by the PSOC™ Edge E84 MCU device and over all system. Remove the jumpers, connect the ammeters as shown in Figure 100 and power the kit.

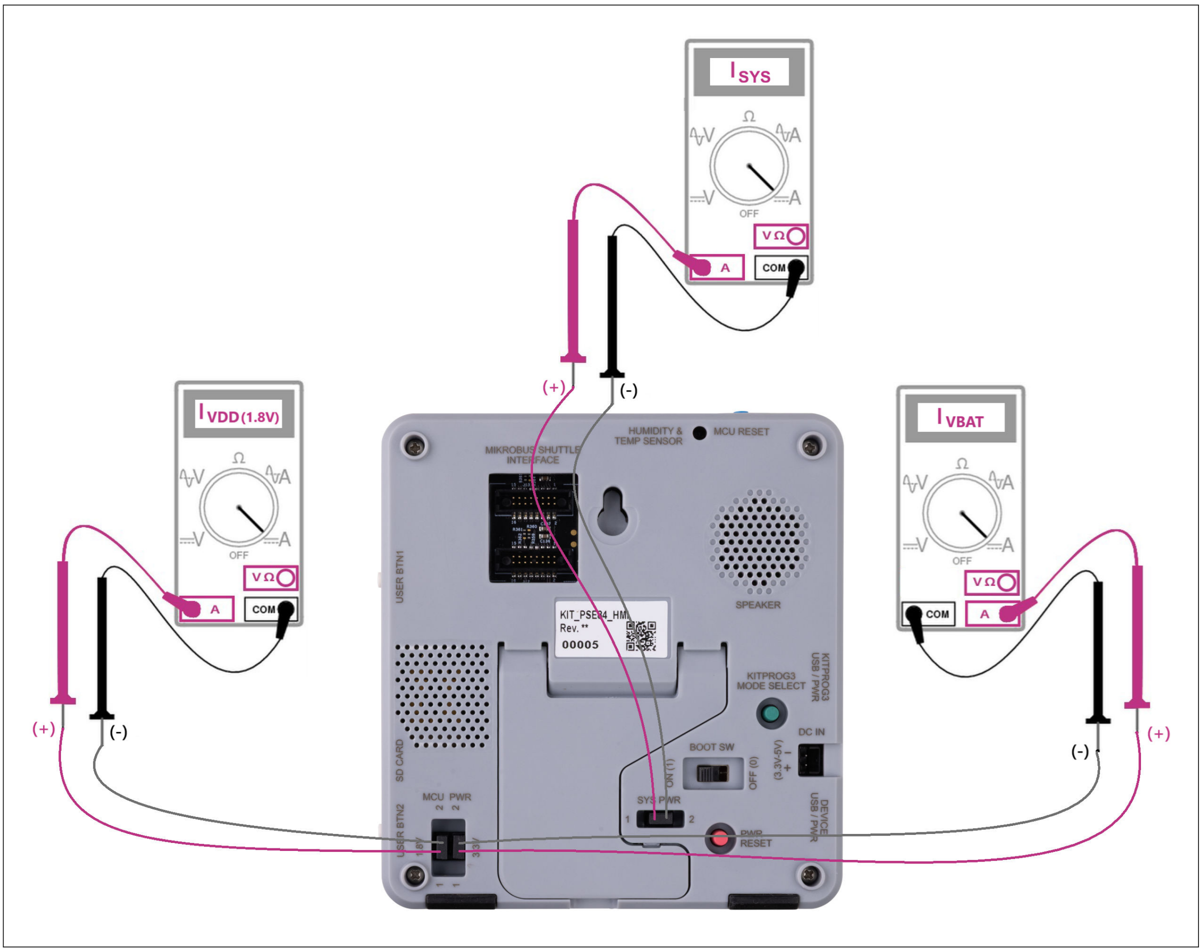


Figure 100 Ammeter connected to jumpers

3. What are the input voltage levels on the board?

Table 31 Input voltage levels

Supply	Typical input voltage	Absolute maximum
KitProg3 Type-C USB (**J1**)	5 V	5.5 V

(table continues...)

Table 31 (continued) Input voltage levels

Supply	Typical input voltage	Absolute maximum
Device USB Type-C (**J3**)	5 V	5.5 V
DC IN connector (**J2**)	3.3 V to 5 V	5.5 V

Revision history

Document revision	Date	Description of changes
**	2026-05-08	Initial release

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