SHIELD_XENSIV_A XENSIV™ sensor shield user guide

About this document

Scope and purpose

This user guide provides detailed information about the XENSIV™ sensor shield, which is a hardware add-on board for baseboards compatible with Arduino. It covers the shield's features, functionality, and usage, including its Infineon XENSIV™ sensors, supporting hardware, and other sensors, such as IMU, magnetometer, and humidity sensor. Additionally, this user guide covers the integration of Infineon's security devices, offering a comprehensive solution for secure and reliable sensing applications.

Intended audience

The expansion board is intended for technical specialists familiar with IoT and sensing technologies, and is intended to be used under laboratory conditions.

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Safety precautions

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

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.*

Table of contents

Table of contents

1 Introduction

Thank you for your interest in the XENSIV™ sensor shield (SHIELD_XENSIV_A). This shield is designed to be a companion for adding common sensors to a baseboard based on Arduino UNO R3.

The kit package includes a XENSIV™ sensor shield that contains a 0.96-inch thin film field-effect transistor (TFT) display, a radar sensor, a humidity and temperature sensor, a motion sensor, a magnetometer sensor, a pressure sensor, a CO2 sensor, PDM microphones, OPTIGA™ Trust M security controller, and a QWIIC connector.

You can use ModusToolbox™ to develop and debug your projects with the shield connected to a baseboard (such as CY8CKIT-062S2-43012). ModusToolbox™ consists of a set of tools that enable you to integrate Infineon devices into your existing development methodology.

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

1.1 Kit contents

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

- XENSIV™ sensor shield
- Quick start guide

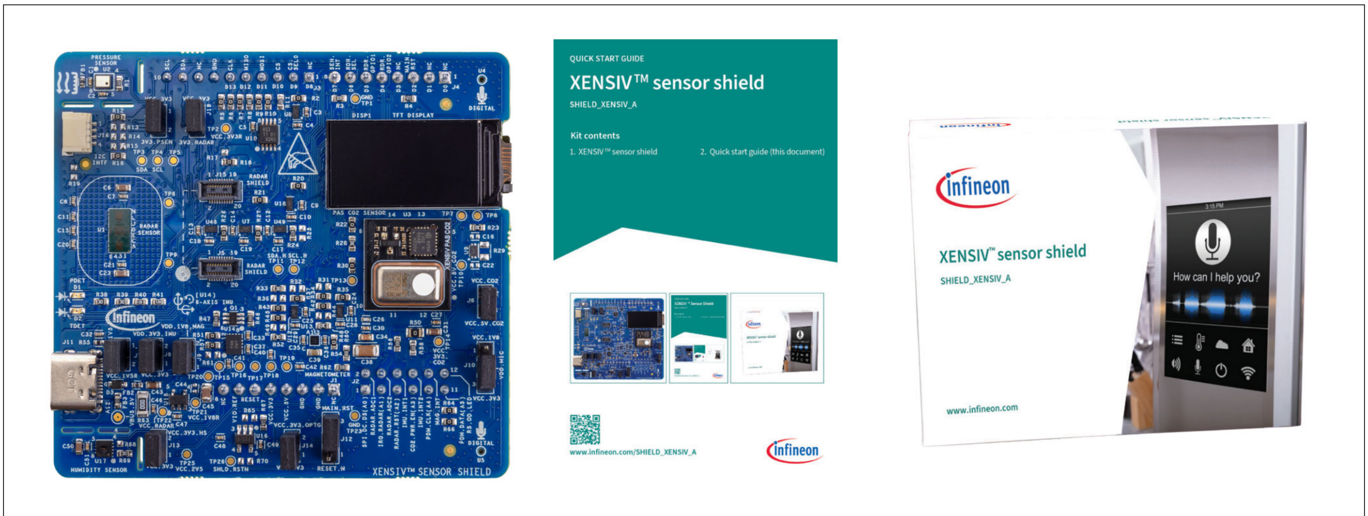


Figure 1 SHIELD_XENSIV_A XENSIV™ sensor shield kit contents

Inspect the contents of the kit; if you find any part missing, contact your nearest Infineon sales office for help. For more information, see Technical Support.

1.2 Getting started

The following sections help you get acquainted with the kit:

- The Kit operation section describes the theory of operation and major features of the kit
- The Hardware section provides a detailed hardware description, kit schematics, and bill of materials (BOM)

The board is compatible with Arduino UNO-based Infineon development platforms. The SHIELD_XENSIV_A XENSIV™ sensor shield requires a baseboard with a microcontroller, such as the CY8CKIT-062S2-43012 or CYW920829M2EVK-02. This baseboard device needs firmware, which can be created using ModusToolbox™ (version 3.1 or later).

1.2.1 Connecting XENSIV™ sensor shield to CY8CKIT-062S2-43012 (PSOC™ 6 MCU)

This section provides instructions on how to get started with the SHIELD_XENSIV_A XENSIV™ sensor shield using the CY8CKIT-062S2-43012 (baseboard) development kit and create the out-of-the-box (OOB) application. The OOB application demonstrates the shield's basic functionality and capabilities.

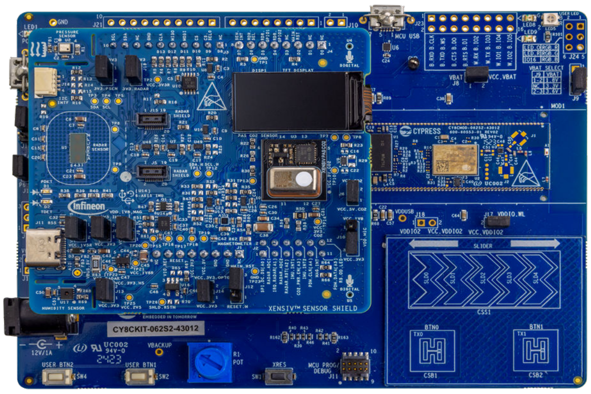


Figure 2 **SHIELD_XENSIV_A XENSIV™ sensor shield connected with CY8CKIT-062S2-43012**

1.2.1.1 Creating an out-of-the-box (OOB) application and program using ModusToolbox™

The OOB application initializes several sensors on the SHIELD_XENSIV_A XENSIV™ sensor shield and displays the sensor data on the TFT display and serial terminal. For more details on the implementation, see the `README` file.

1. Connect the SHIELD_XENSIV_A XENSIV™ sensor shield to the baseboard kit (CY8CKIT-062S2-43012) as shown in Figure 2
2. To connect the baseboard to your PC, use the provided USB cable and connect it through the KitProg3 USB connector. KitProg3 operates in either CMSIS-DAP Bulk mode (default) or CMSIS-DAP HID mode. Additionally, KitProg3 supports CMSIS-DAP Bulk mode with two UARTs. Programming is faster in Bulk mode. In Bulk mode, the status LED is always ON, while in HID mode, it ramps at a 1 Hz rate. To switch between these modes, simply press and release the mode select button (SW3). If you do not see the desired LED status, see the KitProg3 user guide for details on the KitProg3 status and troubleshooting instructions

   Note: *By default, only Bulk mode is enabled.*

3. In the ModusToolbox™ IDE, import the “XENSIV™ Sensor Shield: OOB demo” code example (application) into a new workspace In the ModusToolbox™ IDE, import the "XENSIV™ Sensor Shield: OOB demo" code example (application) into a new workspace. To do this:
   a. Click **New Application** from the Quick Panel

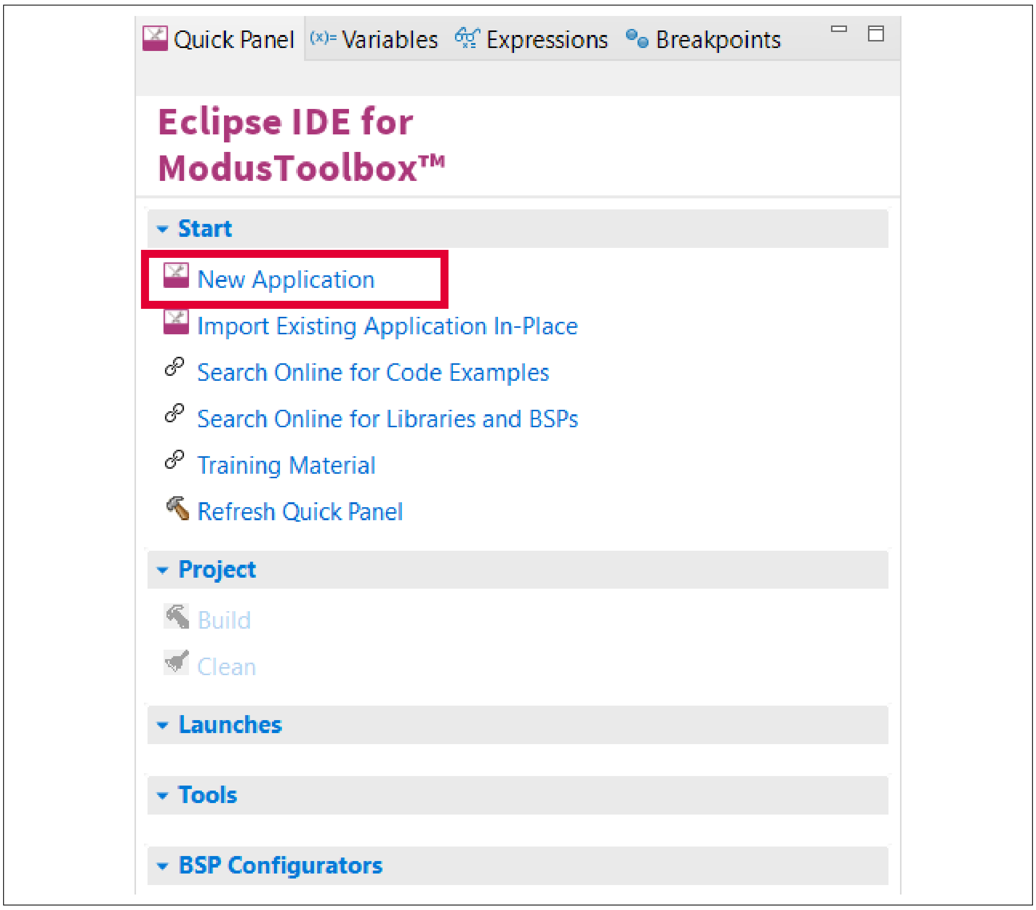


Figure 3 **Create a new application**

b. Select the CY8CKIT-062S2-43012 in the **Choose BSP Target** window and click **Next**

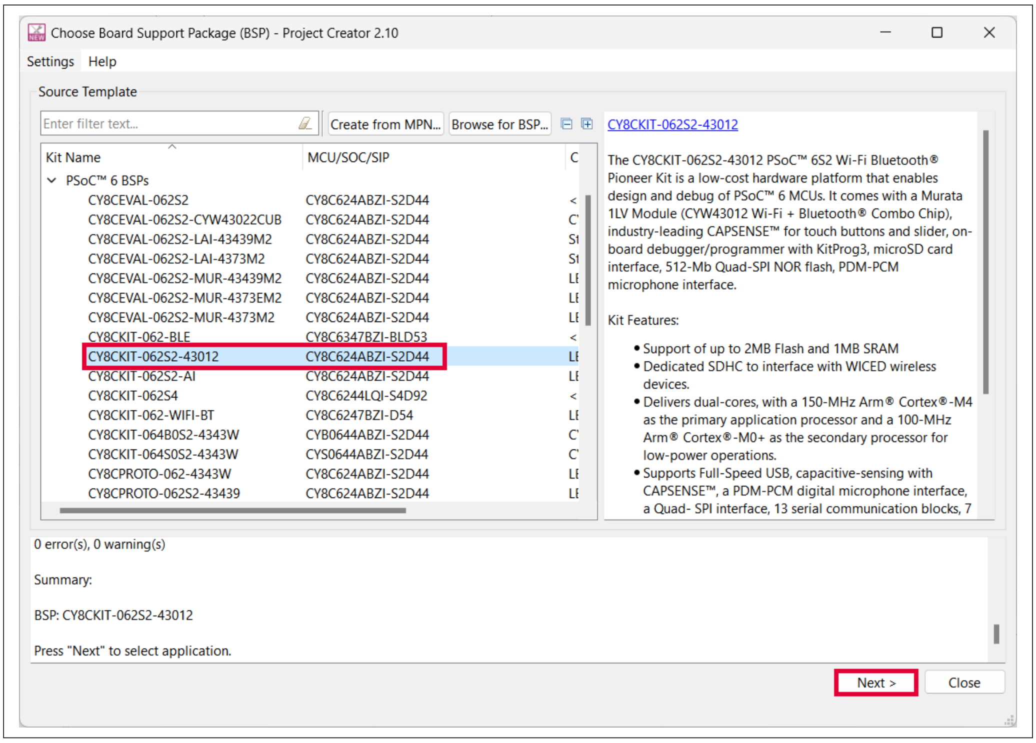


Figure 4 **New application creation: Choose target BSP**

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

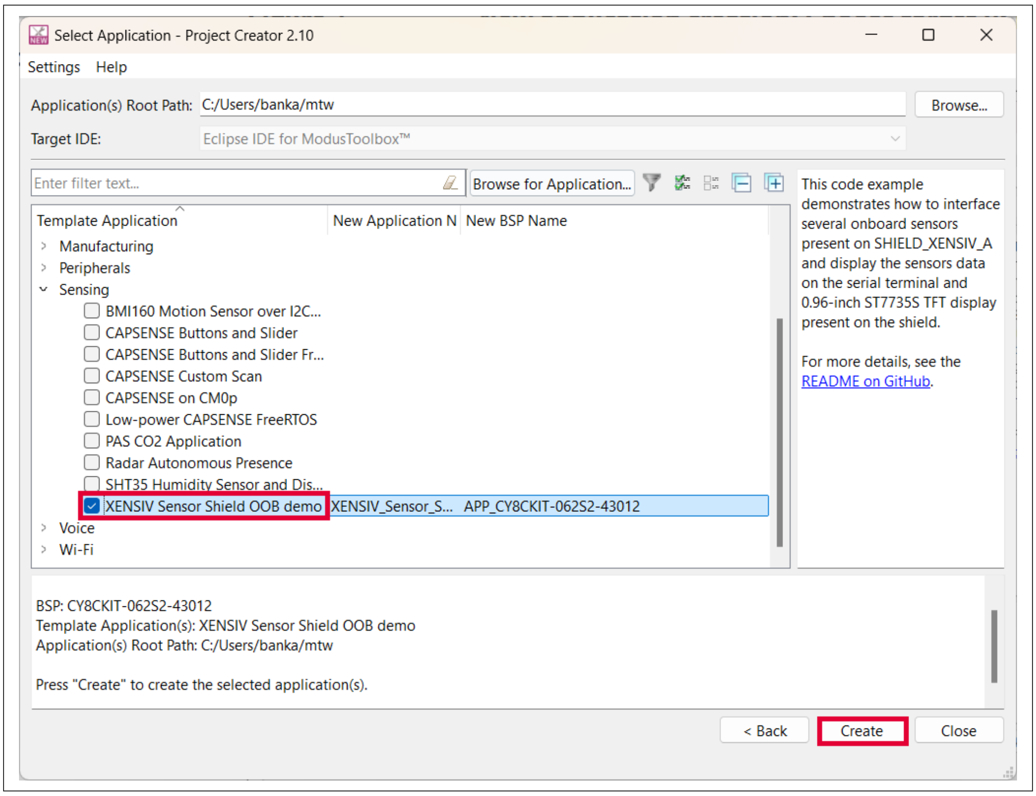


Figure 5 **New application creation**

4. To build and program a PSOC™ 6 MCU application in the Project Explorer:

a. Select the **<App_name>** project

b. In the Quick Panel, scroll to the **Launches** section and click the **<App_Name> Program (KitProg3_MiniProg4)** configuration, as shown in Figure 6

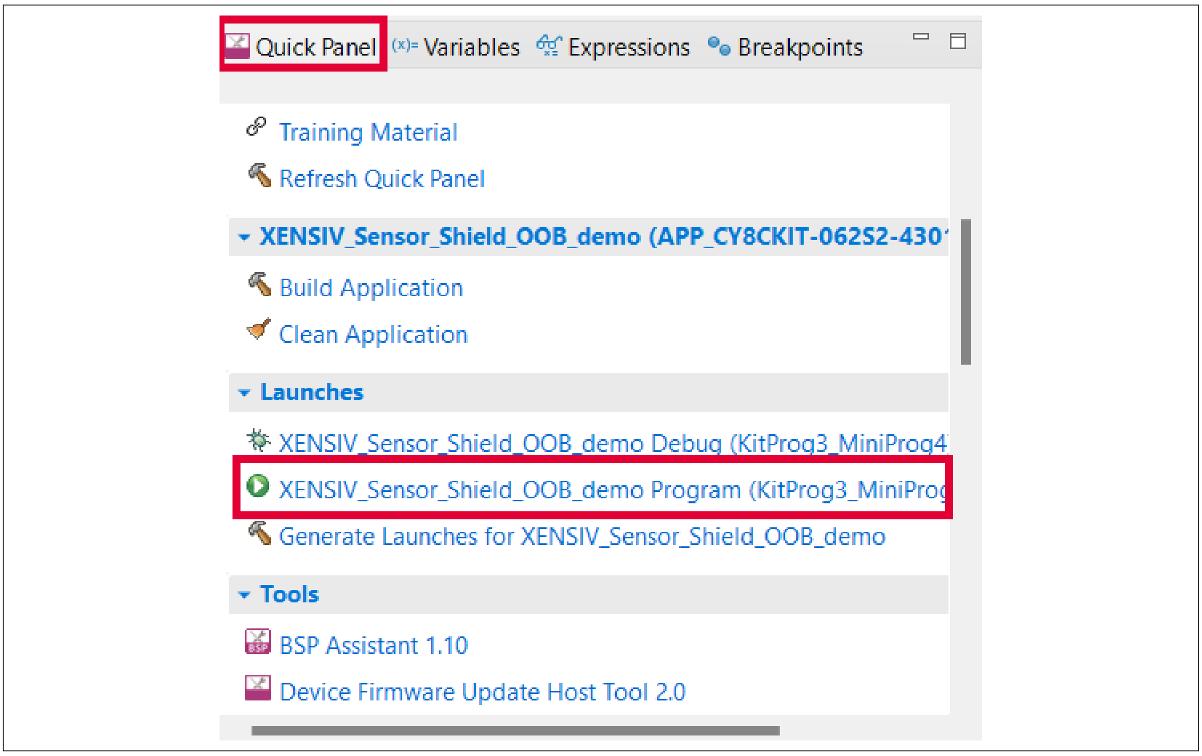


Figure 6 **Programming in ModusToolbox™**

5. Open a terminal program and select the KitProg3 COM port. Set the serial port parameters to 8N1 and 115200 baud rate
6. After programming, the application starts automatically in three seconds, initializing all the sensors and displays present on the SHIELD_XENSIV_A XENSIV™ sensor shield. Confirm that the "XENSIV™ Sensor Shield: OOB demo" is displayed on the serial terminal and observe the startup screen with the Infineon logo on the display
7. Wait for the instructions screen to appear on the display, then follow the instructions displayed on the screen. Press the user button (SW2) on the baseboard to switch between the sensors. The output from the currently active sensor will then be displayed on both the serial terminal and the TFT display

The order of sensor switching is as follows:

- Radar sensor
- Humidity and temperature sensor
- Motion sensor
- Magnetometer sensor
- Pressure sensor
- CO2 sensor

***Note**: Before switching to the next sensor, wait until the display shows the current sensor readings. Then, press the user button (SW2) to switch to the next sensor. If the TFT display does not switch to the next sensor upon button press, press the Reset button on the baseboard to restart the application.*

1.2.1.2 Code examples supported for XENSIV™ sensor shield on CY8CKIT-062S2-43012

Table 2 List of code examples supported for SHIELD_XENSIV_A XENSIV™ sensor shield on CY8CKIT-062S2-43012

Code example	GitHub
Out-of-the-box (OOB) example	mtb-example-ce239846-shield-xensiv-a-oob
SHT35 humidity sensor example	mtb-example-sht35-humidity-sensor-freertos
Radar autonomous presence detection	mtb-example-sensors-radar-autonomous-presence
CO2 sensor example	mtb-example-sensors-pasco2
Motion sensor example	mtb-example-psoc6-motion-sensor-freertos
Imagimob streaming protocol example	mtb-example-imagimob-streaming-protocol
Imagimob ready model deployment example	mtb-example-ml-imagimob-deploy-ready-model
OPTIGA™ MQTT client example	mtb-example-optiga-mqtt-client

1.2.1.3 Additional configurations

1. To receive data from the serial terminal over UART, disable UART flow control on the CY8CKIT-062S2-43012. Connect the kit to your PC via KitProg3 USB, then open the 'fw-loader' tool (part of ModusToolbox™) and execute the following command:

```
fw-loader --set-kp3-flow-control 0 none
```

```
banka@ISCN5CG2257ZHV ~/ModusToolbox/tools_3.1/fw-loader/bin
$ fw-loader --set-kp3-flow-control 0 none
Infineon Firmware Updater, Version: 3.7.0.2317
(C) Copyright 2018-2024 by Cypress Semiconductor Corporation (an Infineon company)
All Rights Reserved

Info: Start the API initialization
Info: Connected - KitProg3 CMSIS-DAP BULK-0B09114A02012400
Info: The hardware initialization has completed in 329 ms
Info: Disconnected - KitProg3 CMSIS-DAP BULK-0B09114A02012400
Info: Connected - KitProg3 CMSIS-DAP BULK-0B09114A02012400
The UART none flow control mode for the KitProg3 Primary UART was set successfully.
```

Figure 7 Flow control disable using fw-loader

***Note**: Use the latest KitProg3 firmware to disable flow control.*

2. When the CY8CKIT-062S2-43012 is powered only through the MCU USB connector (J7), connect the SHIELD_XENSIV_A XENSIV™ sensor shield's USB power supply (J11) using a USB Type-C cable. This provides an additional voltage source to the on-board radar sensor (1.5 V), radar shield interface (1.8 V), magnetometer sensor (1.8 V), and PDM microphones (1.8 V) through the USB Type-C connection, as the shield is not powered with 5 V Arduino-compatible power pins

3. For programming and debugging details, see the CY8CKIT-062S2-43012 Kit guide

1.2.2 Connecting XENSIV™ sensor shield to CYW920829M2EVK-02 (Bluetooth® LE MCU)

The section provides instructions on getting started with the SHIELD_XENSIV_A XENSIV™ sensor shield using the CYW920829M2EVK-02 (Bluetooth® LE MCU) development kit and creating the out-of-box (OOB) application. The OOB application demonstrates the shield's basic functionality and the CYW20829 Bluetooth® LE MCU's capabilities by connecting it with Infineon's Sensor Hub Android application.

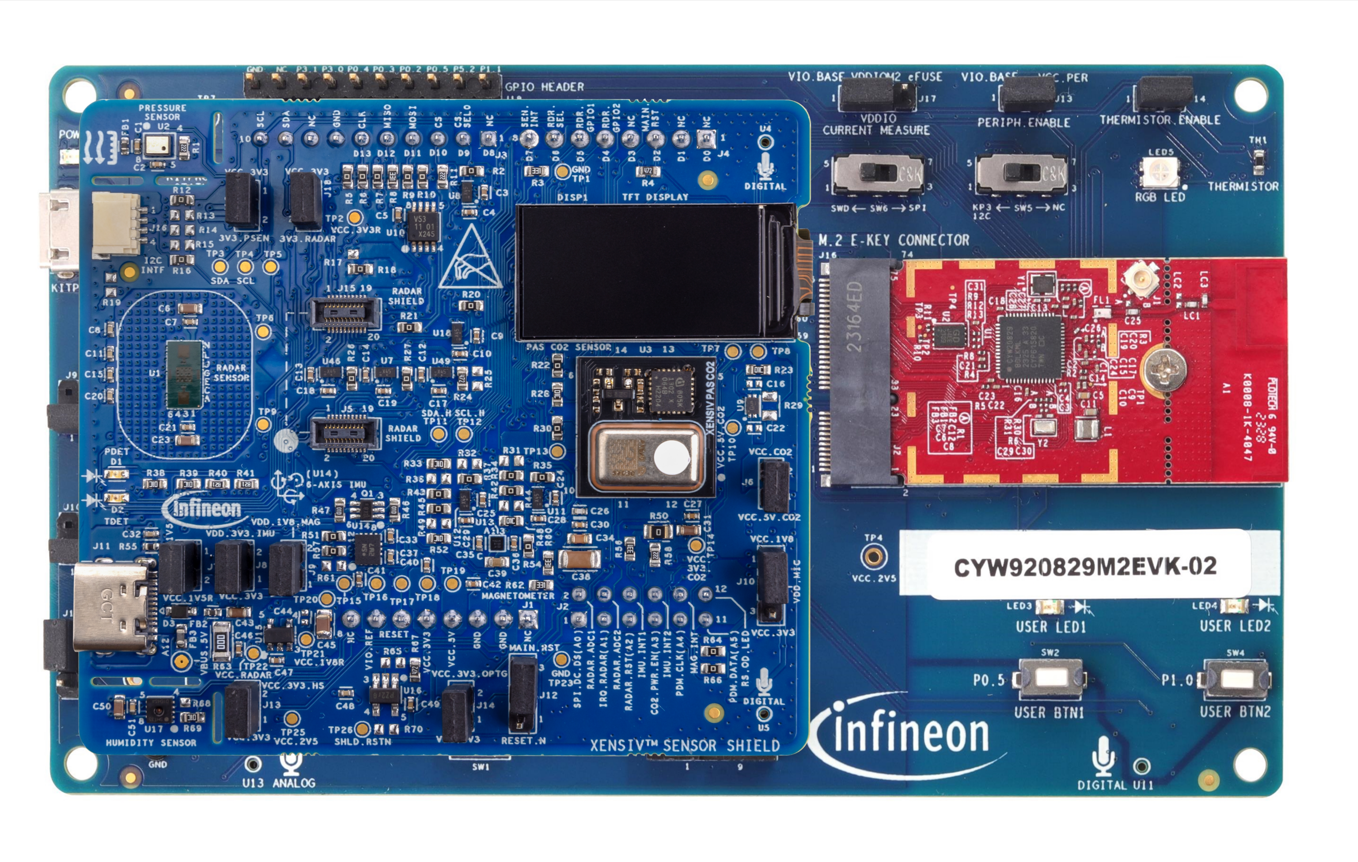


Figure 8 **SHIELD_XENSIV_A XENSIV™ sensor shield connected with CYW920829M2EVK-02**

1.2.2.1 Creating an out-of-box (OOB) application and programming using ModusToolbox™

The OOB application initializes several sensors on the SHIELD_XENSIV_A XENSIV™ sensor shield and displays the sensor data in the console output. Additionally, the Sensor Hub Android application can be used for visualizing data on an Android device. For more details on implementation, see the `README` file. For more details on the Infineon Sensor Hub Android application, see Sensor Hub Android application.

1. Ensure the SHIELD_XENSIV_A XENSIV™ sensor shield is disconnected from the CYW920829M2EVK-02 baseboard. The configuration of the CYW920829M2EVK-02 does not support programming when the SHIELD_XENSIV_A XENSIV™ sensor shield is connected
2. To connect the baseboard to your PC, use the provided USB micro cable and connect it through the KitProg USB connector
3. Ensure that switch SW6 on the baseboard is set to SWD

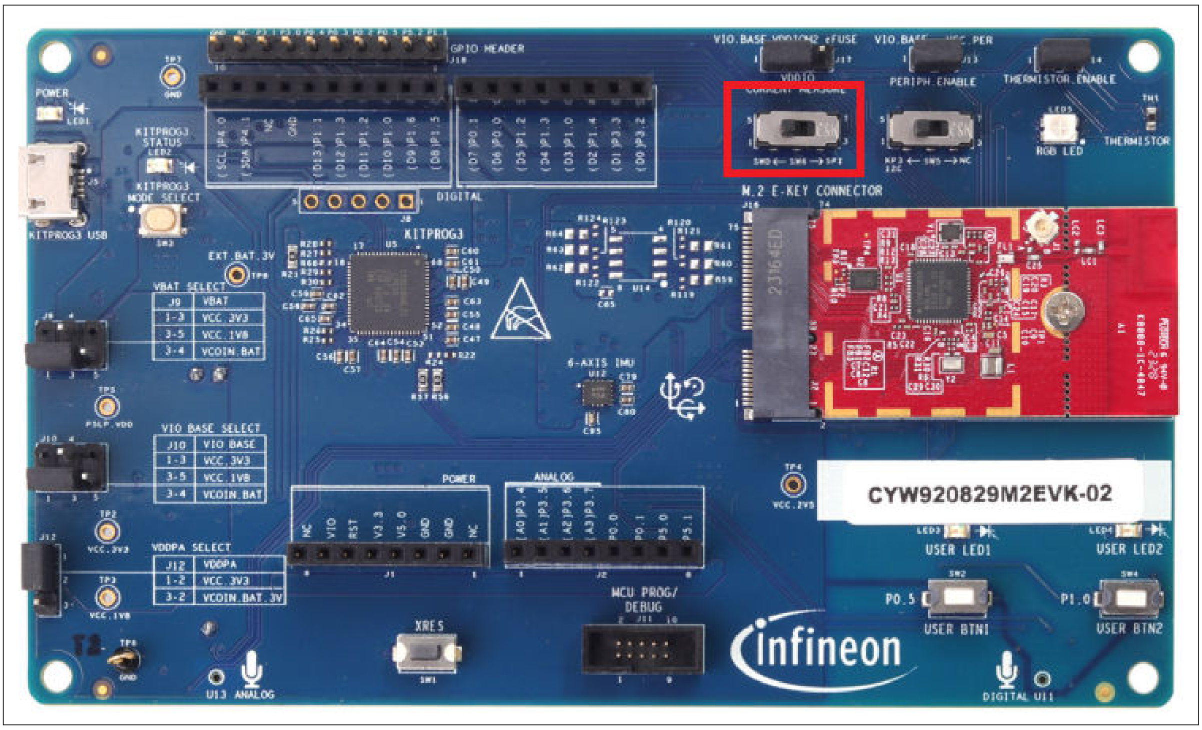


Figure 9 **CYW920829M2EVK-02 SW6 configuration**

4. In the ModusToolbox™ IDE, import the 'XENSIV™ Sensor Hub' code example into a new workspace. To do this:

   a. Click **New Application** from the Quick Panel

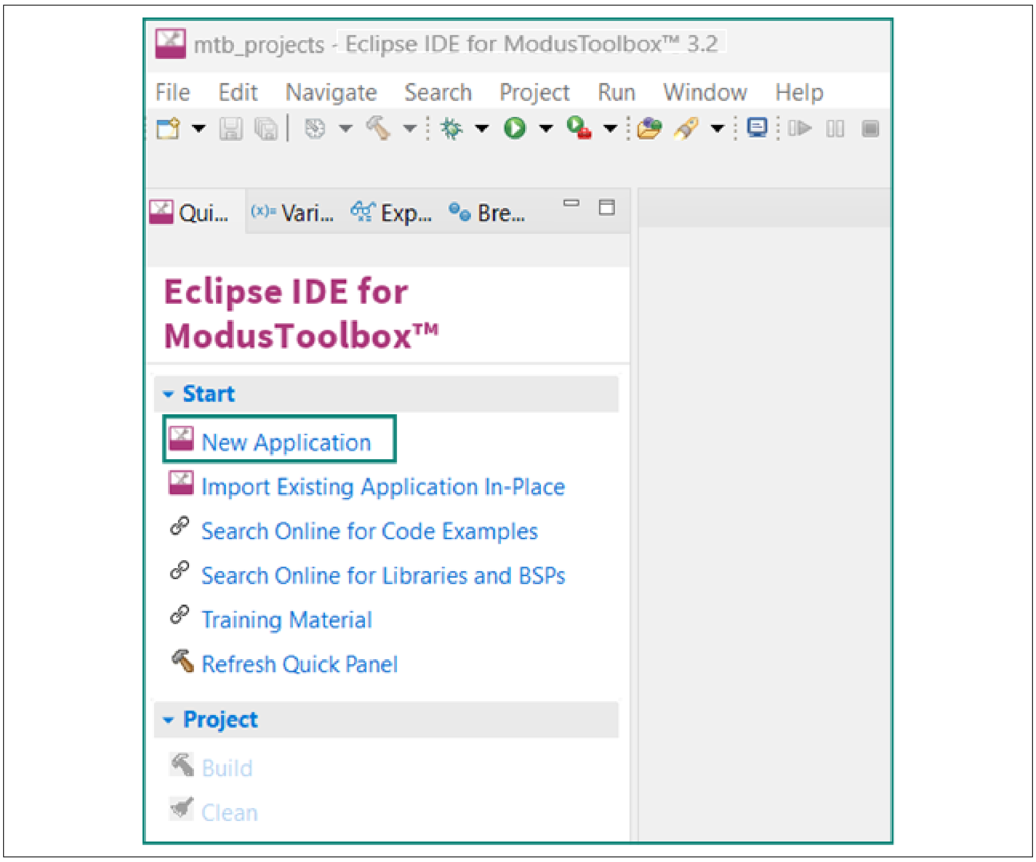


Figure 10 **Create a new application**

   b. Select the CYW920829M2EVK-02 in the **Choose BSP Target** window and click **Next**

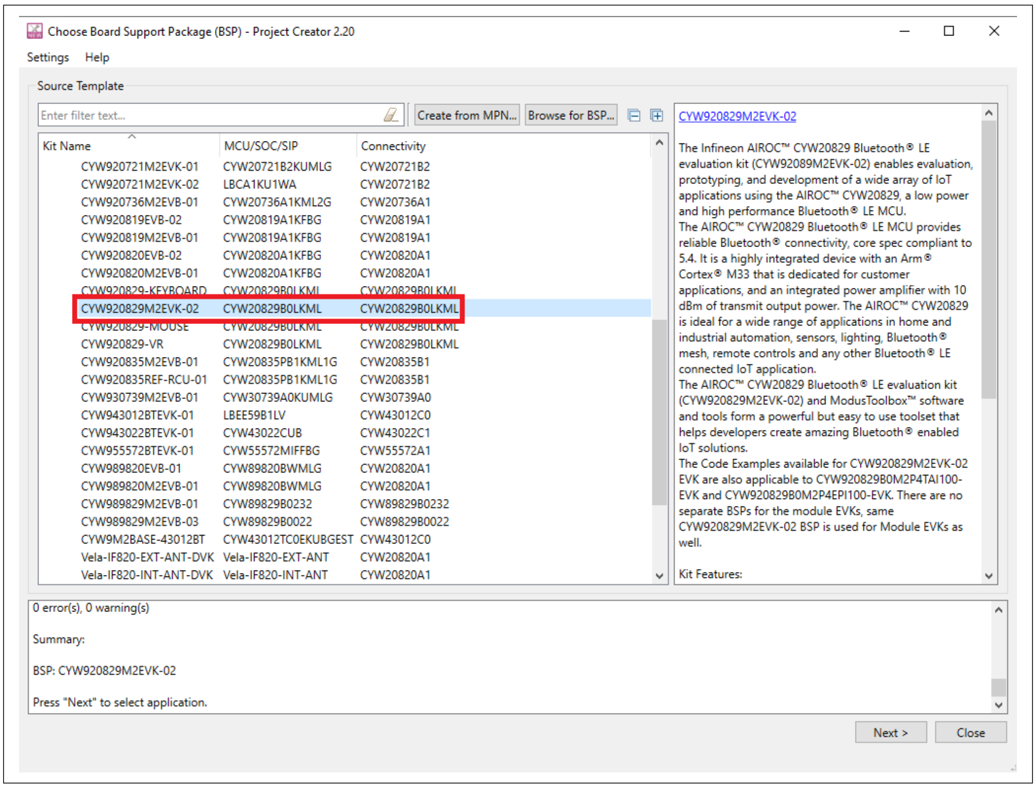


Figure 11 **New application creation: Choose target BSP**

c. Select the Bluetooth® LE XENSIV™ Sensor Hub Sensing Service application in the **Select Application** window and click **Create**

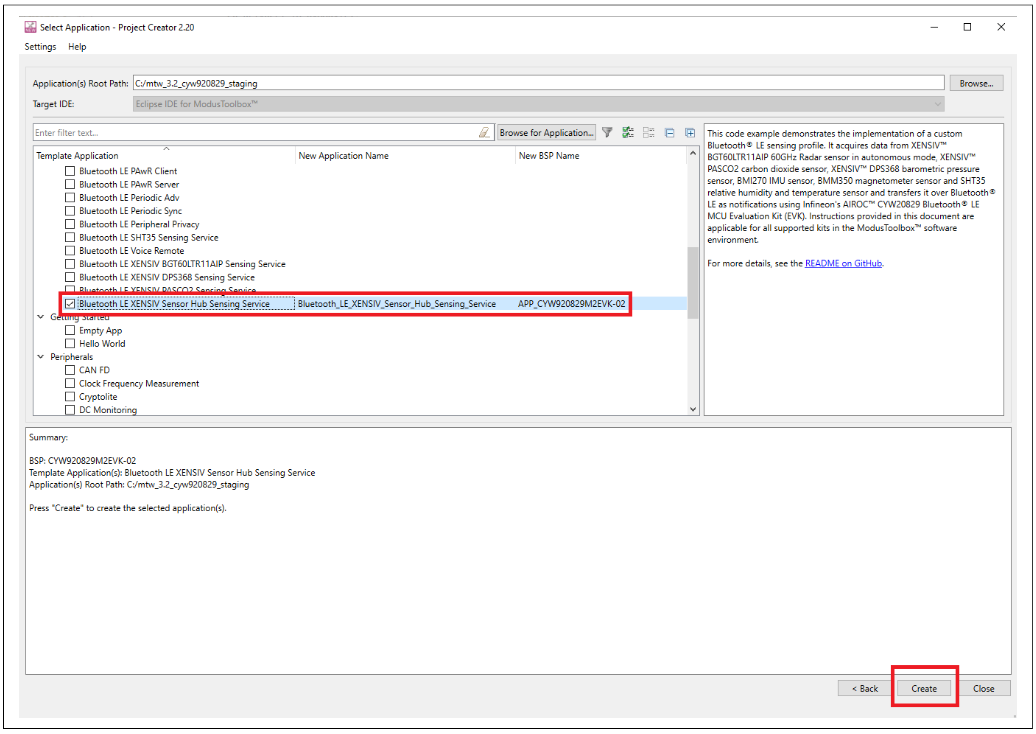


Figure 12 **Select Application: Choose Bluetooth® LE XENSIV™ Sensor Hub Sensing Service project**

5. To build and program the CYW20829 MCU application in the Project Explorer:
    a. Select the **XENSIV™ Sensor Hub** project
    b. In the **Quick Panel**, scroll to the **Launches** section and click the **XENSIV™ Sensor Hub Program (KitProg3_MiniProg4)** configuration

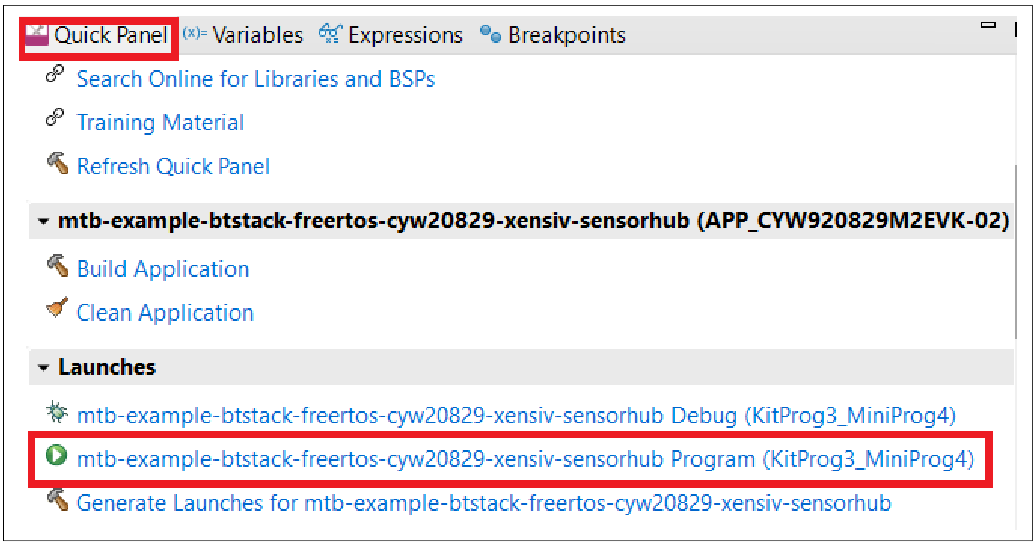


Figure 13 Programming in ModusToolbox™

6. Once programmed:
    a. Remove the USB cable from the PC
    b. Reconnect the SHIELD_XENSIV_A XENSIV™ sensor shield to the CYW920829M2EVK-02 baseboard
    c. Reconnect the USB cable to the PC
7. Open a terminal program and select the KitProg3 COM port. Set the serial port parameters to 8N1 and a baud rate of 115200
8. After programming, the application starts automatically by initializing all the sensors present on the SHIELD_XENSIV_A XENSIV™ sensor shield. Confirm that 'XENSIV™ Sensor Hub Service' is displayed on the serial terminal, along with a prompt to enter a number between 1 and 6 to enable a specific sensor

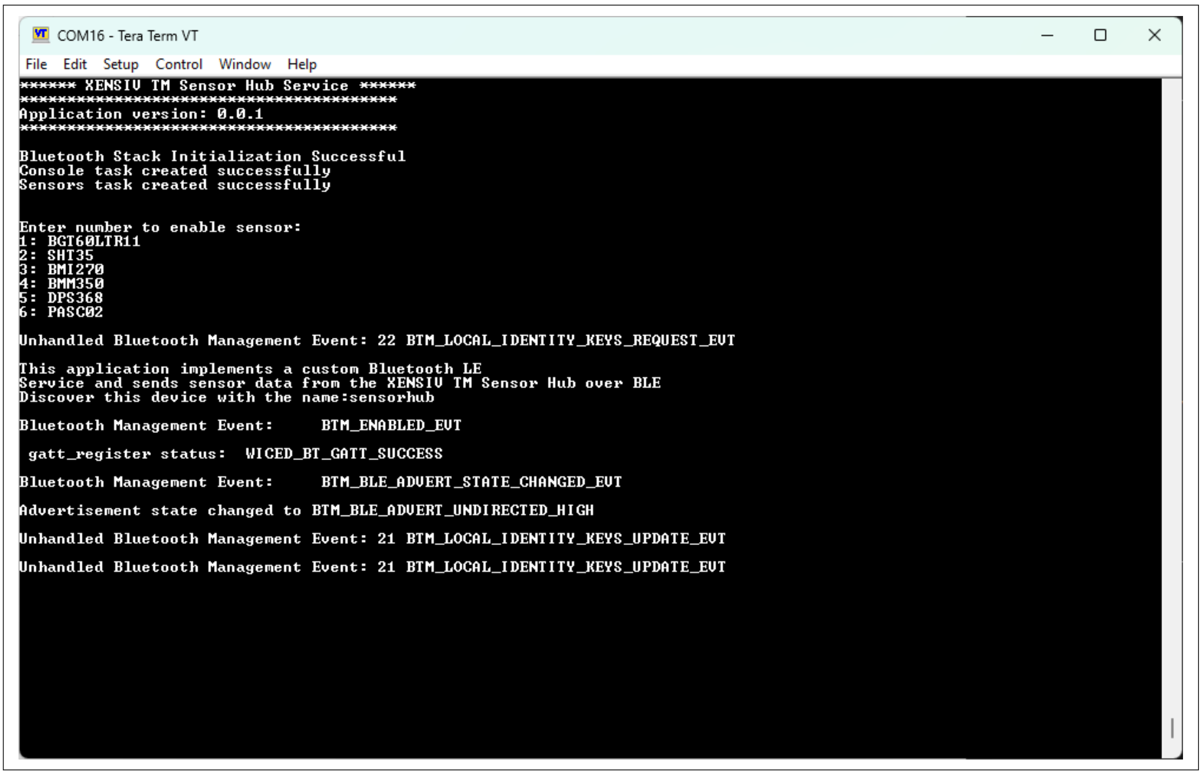


Figure 14 **XENSIV™ Sensor Hub Service terminal output**

9. Enter a number displayed in the prompt to enable the corresponding sensor. The acquired sensor data will be displayed in the terminal
10. To control the CYW920829M2EVK-02 and the SHIELD_XENSIV_A XENSIV™ sensor shield with Infineon's Sensor Hub Android mobile application, see section Sensor Hub Android application

1.2.2.2 Code examples supported for XENSIV™ sensor shield on CYW920829M2EVK-02

Table 3 **List of code examples supported for SHIELD_XENSIV_A XENSIV™ sensor shield on CYW920829M2EVK-02**

Code example	GitHub
XENSIV™ Sensor Hub	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-xensiv-sensorhub
SHT35 Temperature humidity sensor	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-relative-humidity-sht35
BMI270 IMU sensor	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-imu-bmi270
BMM350 Magnetometer sensor	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-magnetometer-bmm350
XENSIV™ BGT60LTR11AIP Radar sensor	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-xensiv-bgt60ltr11aip-autonomous
XENSIV™ PASCO2 Carbon dioxide sensor	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-xensiv-pasco2v15

(table continues...)

Table 3 **(continued) List of code examples supported for SHIELD_XENSIV_A XENSIV™ sensor shield on CYW920829M2EVK-02**

Code example	GitHub
XENSIV™ DPS368 Pressure sensor	https://github.com/Infineon/mtb-example-btstack-freertos-cyw20829-xensiv-dps368

1.2.3 Sensor Hub Android application

The Sensor Hub Android application is used to connect to and acquire data from the Code examples supported for XENSIV™ sensor shield on CYW920829M2EVK-02 with Bluetooth®. Note that this app is not available on the Google Play Store and is released as an .APKfile. For assistance or application-related queries, contact Infineon Support . The following services and characteristics are supported:

Table 4 **Bluetooth® services and characteristics supported**

Service name	Characteristic name	Buffer length (bytes)	Data	Visualization in app
XENSIV™ sensor shield	SHT35	8	Relative humidity (%) and temperature (°C)	Graph plots
XENSIV™ sensor shield	BMM350	4	X, Y, Z, and temperature (°C)	Graph plots
XENSIV™ sensor shield	BMI270	1	Board orientation	Text only
XENSIV™ sensor shield	BGT60LTR11	2	Motion, direction of motion (target approaching/ departing)	Virtual LED
XENSIV™ sensor shield	PASCO2	2	CO2 parts per million (ppm)	Graph plot
XENSIV™ sensor shield	DPS368	8	Pressure (hPa) and temperature (°C)	Graph plots
XENSIV™ sensor shield	Sensor enable	1	Sensor to enable for data acquisition	N/A

1.2.3.1 Software requirements

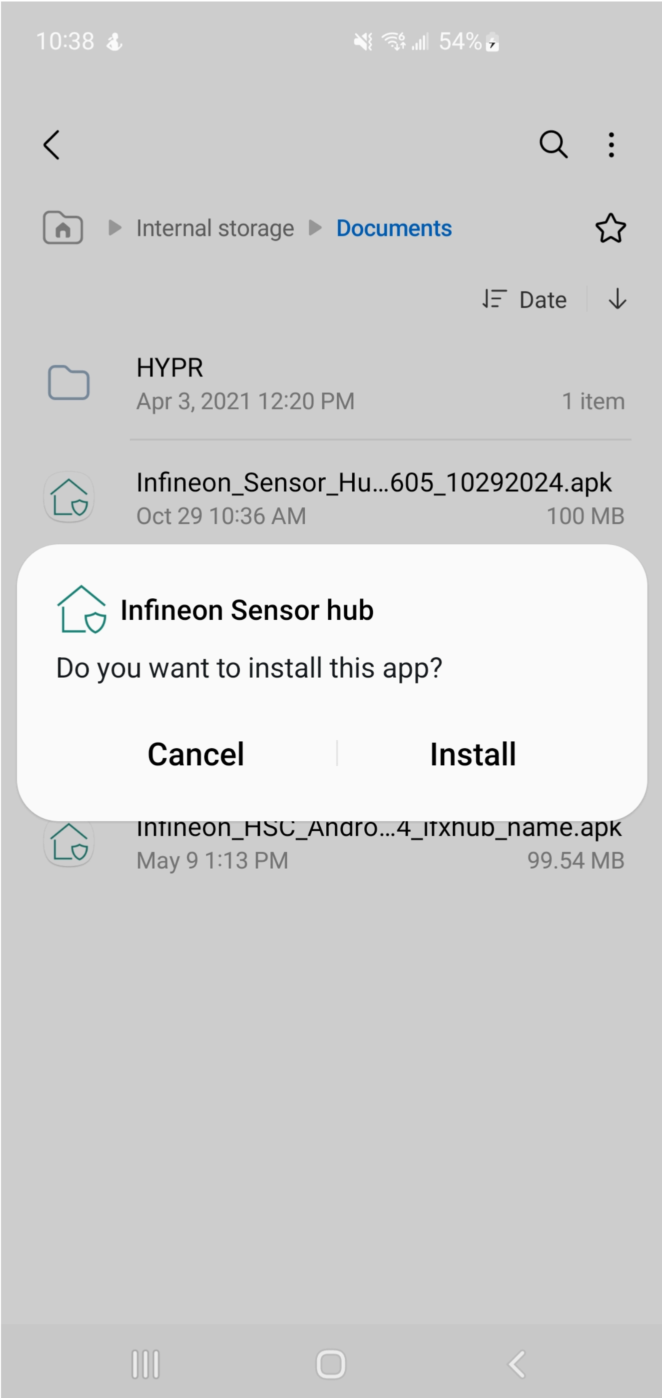
Android OS: Version 12 or later (API level 32), with the latest version recommended.

1.2.3.2 Hardware requirements

Android device: Equipped with Bluetooth® 4.0 or later.

1.2.3.3 Installation

1. Download or copy the released `.APK` file to your Android device
2. Click on the `.APK` file to install it


10:38
54%
Internal storage
Documents
Date
HYPR
Apr 3, 2021 12:20 PM
1 item
Infineon_Sensor_Hu...605_10292024.apk
Oct 29 10:36 AM
100 MB
Infineon Sensor hub
Do you want to install this app?
Cancel
Install
Infineon_HSC_Andro...4_ifxhub_name.apk
May 9 1:13 PM
99.54 MB

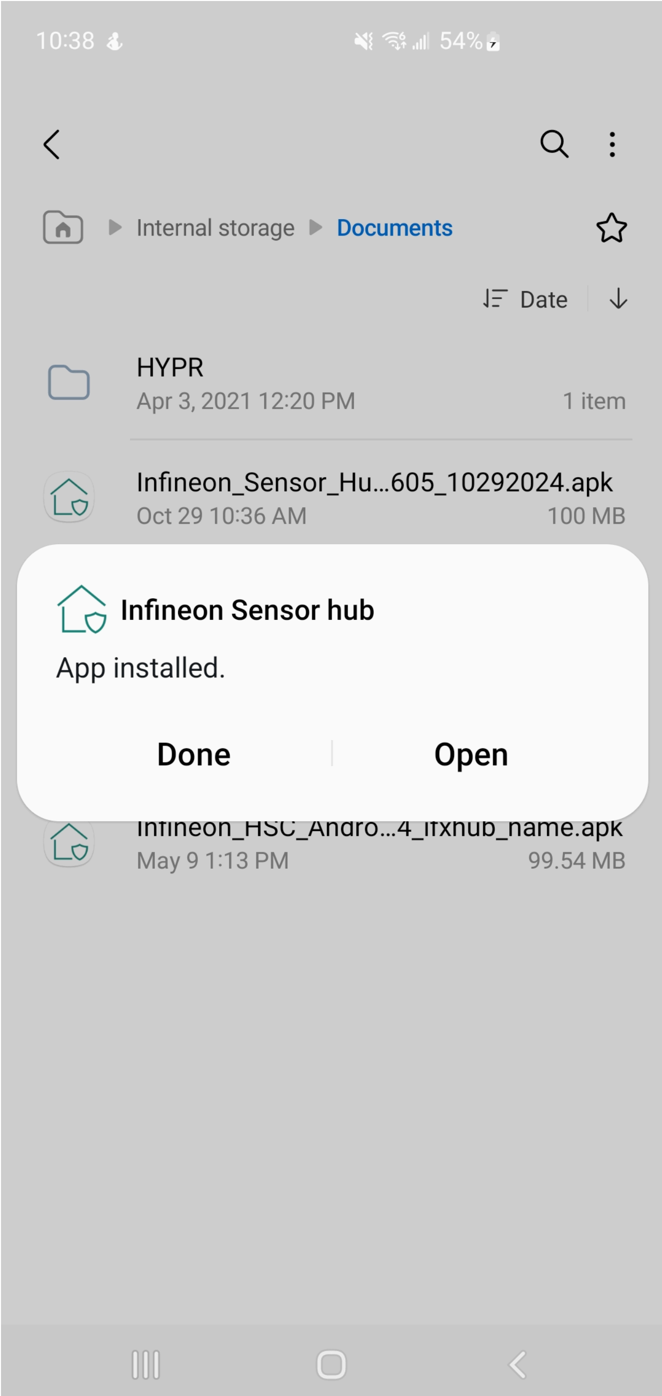


Figure 15 **App installation**

1.2.3.4 Application UI description

This section describes the app layout along with the various components and their functionality.

1. **Navigation bar**: The app uses a tab navigation layout with a navigation bar at the bottom of the screen. Below is a description of the available screens:
   - **Hub screen**: Provides options to scan, connect to, and disconnect from the CYW920829M2EVK-02
   - **Sensors screen**: Provides options to select a sensor and read its characteristics
   - **Activity screen**: Displays logs of Bluetooth® events and activity

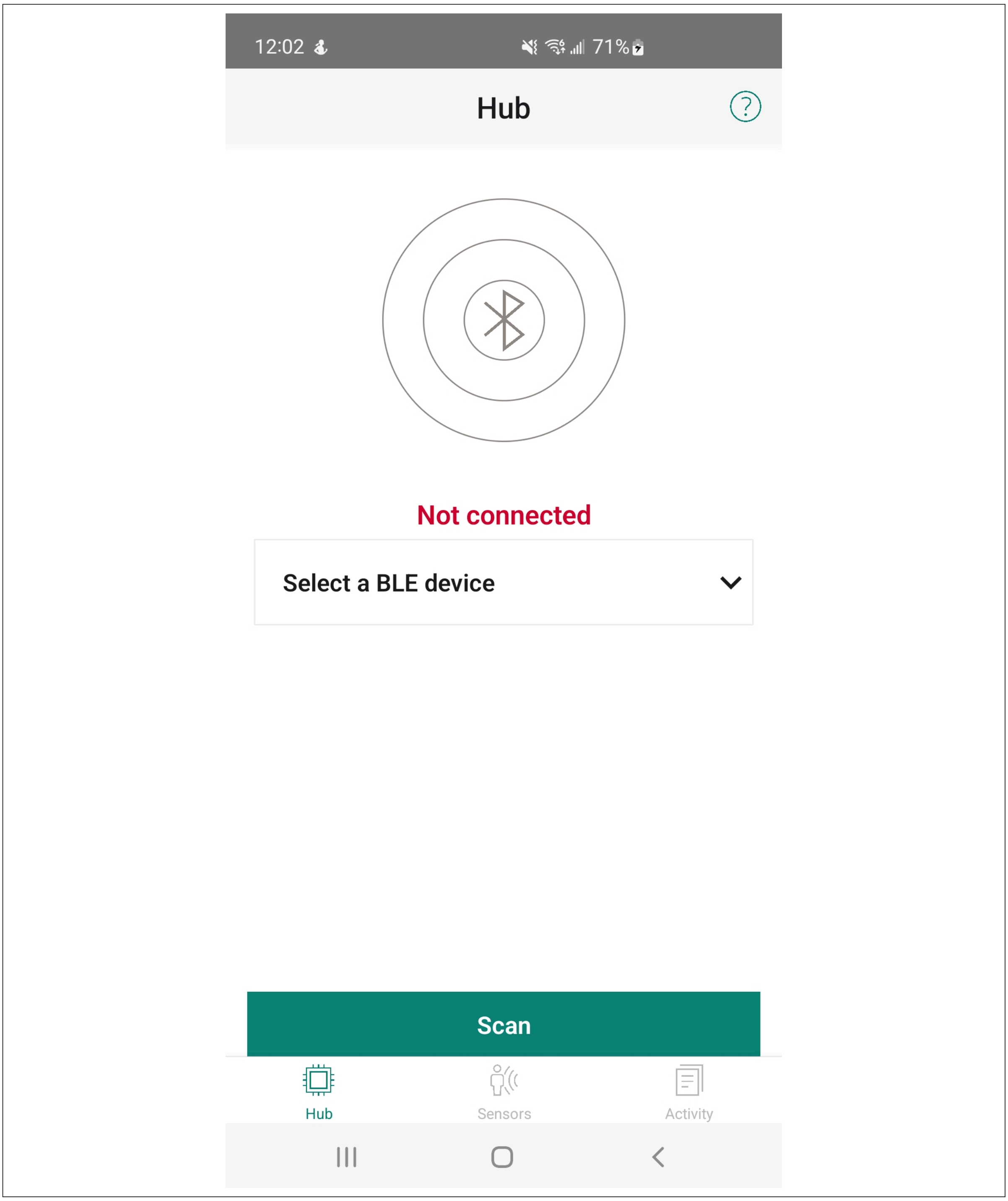


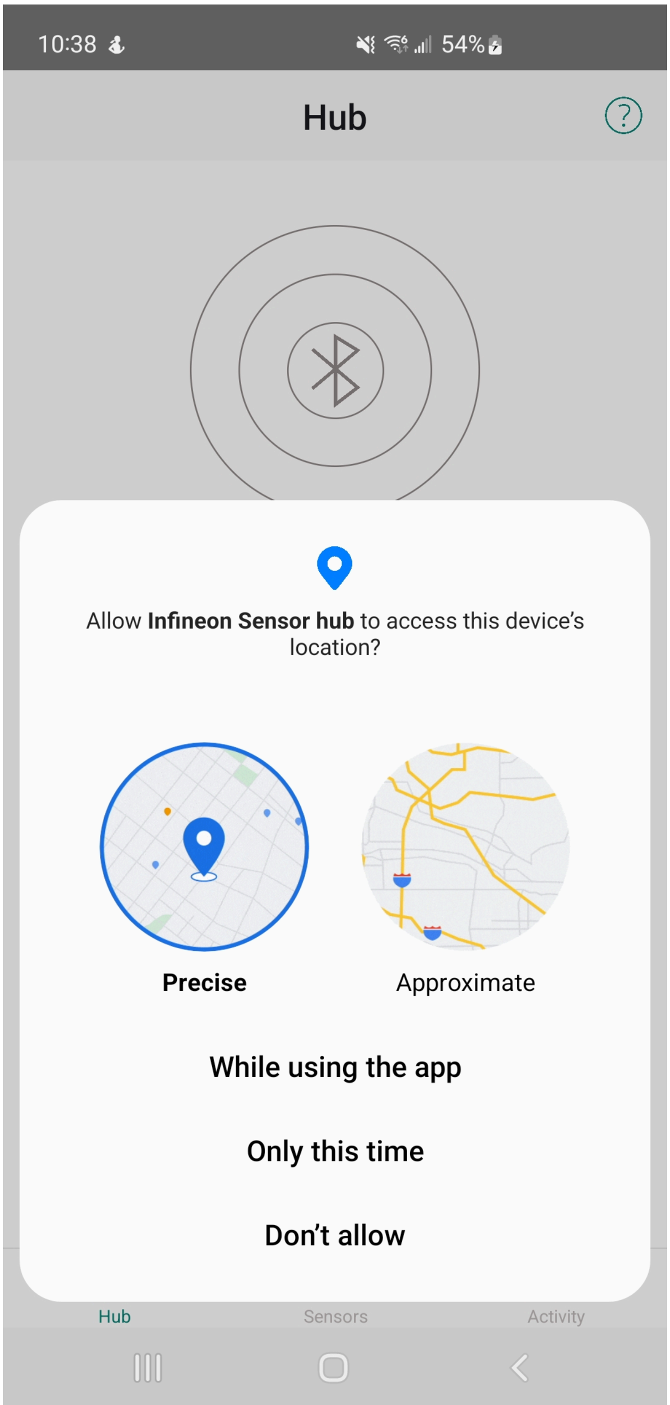
Figure 16 Navigation tab

2. **Hub screen**:

   a. Press the **XRES** button on the EVK to start the firmware

   b. Press **Scan** to discover the EVK. Allow user permissions when prompted. Discovered devices will be populated in the **Select a BLE** device drop-down menu

   Note: *The EVK will stop its Bluetooth® advertisement after 360 seconds. Ensure that scanning starts as soon as the **XRES** button is pressed so the Bluetooth® connection can be established within that period*


10:38
54%
Hub
Allow **Infineon Sensor hub** to access this device's location?
Precise
Approximate
While using the app
Only this time
Don't allow
Hub
Sensors
Activity

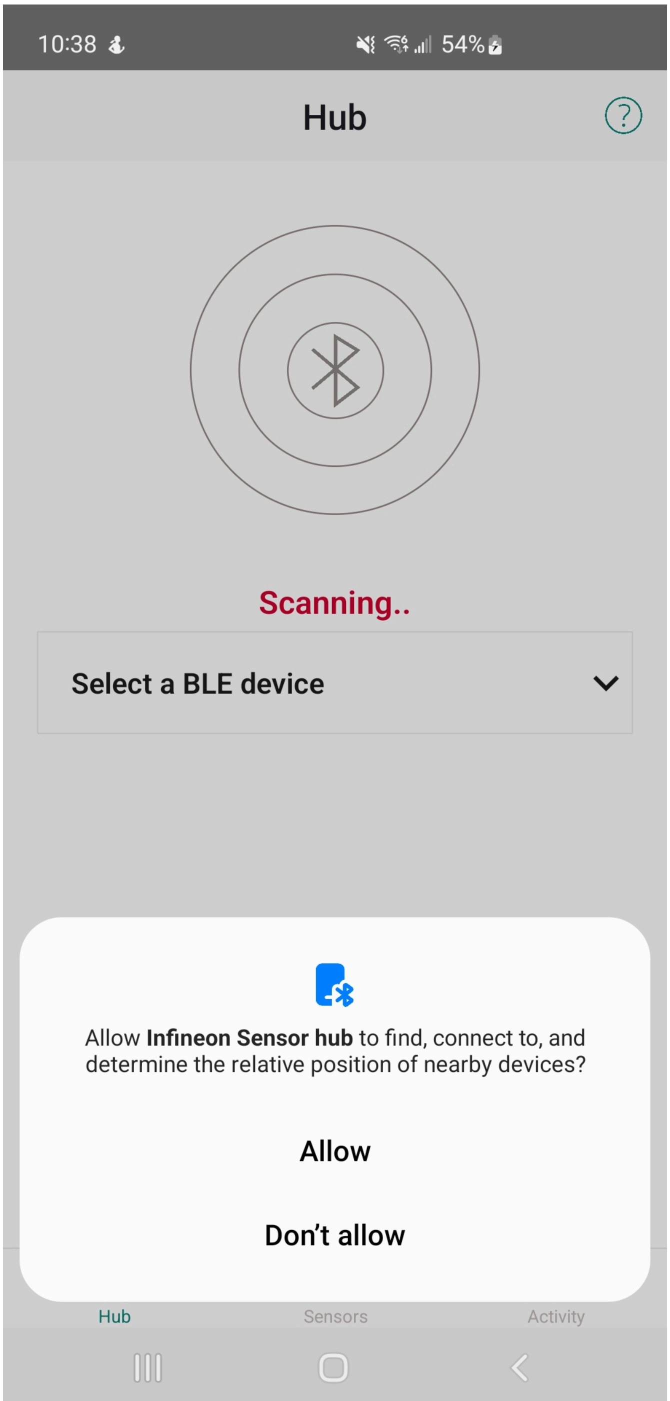
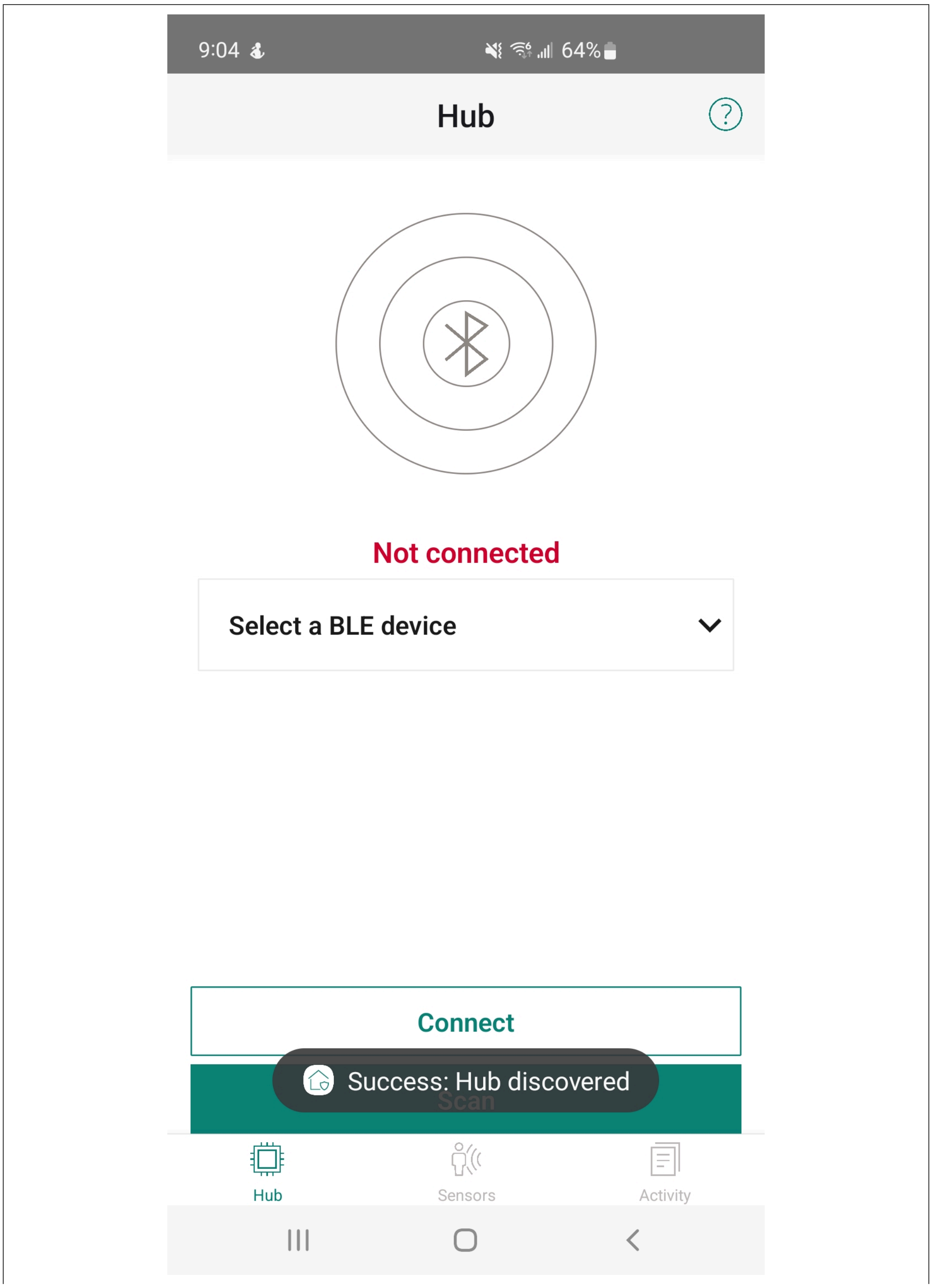


Figure 17 User permissions

c. A toast notification is displayed once the EVK is discovered. The names and Bluetooth® IDs of the EVK are populated in the drop-down menu for user selection

Note: *The app can only be connected to a single EVK at any given time. To connect with another EVK, the existing EVK must be disconnected first*


9:04
64%
Hub
Not connected
Select a BLE device
Connect
Success: Hub discovered
Scan
Hub
Sensors
Activity

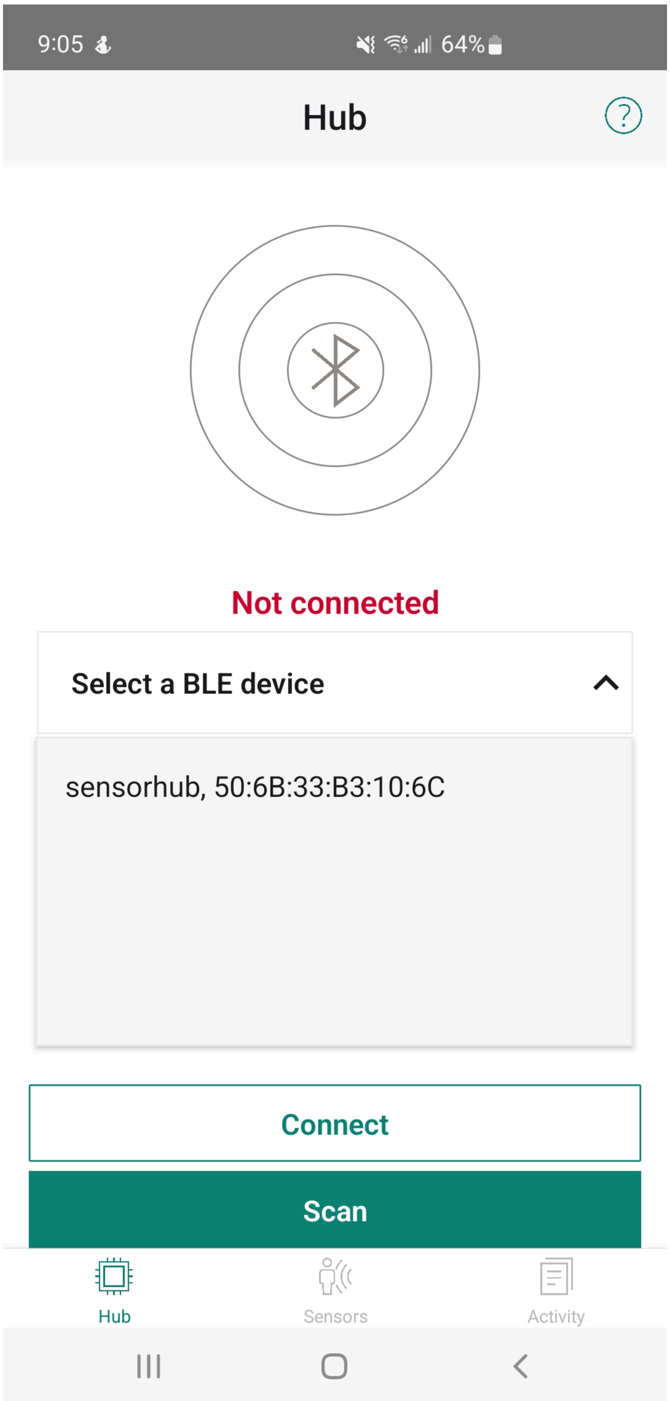


Figure 18 Discovery: successful

d.

1. Select the EVK from the drop-down menu and press **Connect**
2. If the connection is successful, a toast notification will be displayed
3. In case of an error, repeat this step. If the connection is still not successful, reset the EVK and start the process again

***Note**: Once connected, the **Connect** button title will be updated to **Disconnect**. Note that if the app is closed, Bluetooth® connectivity is not retained. The connection process must be repeated, starting with resetting the EVK*

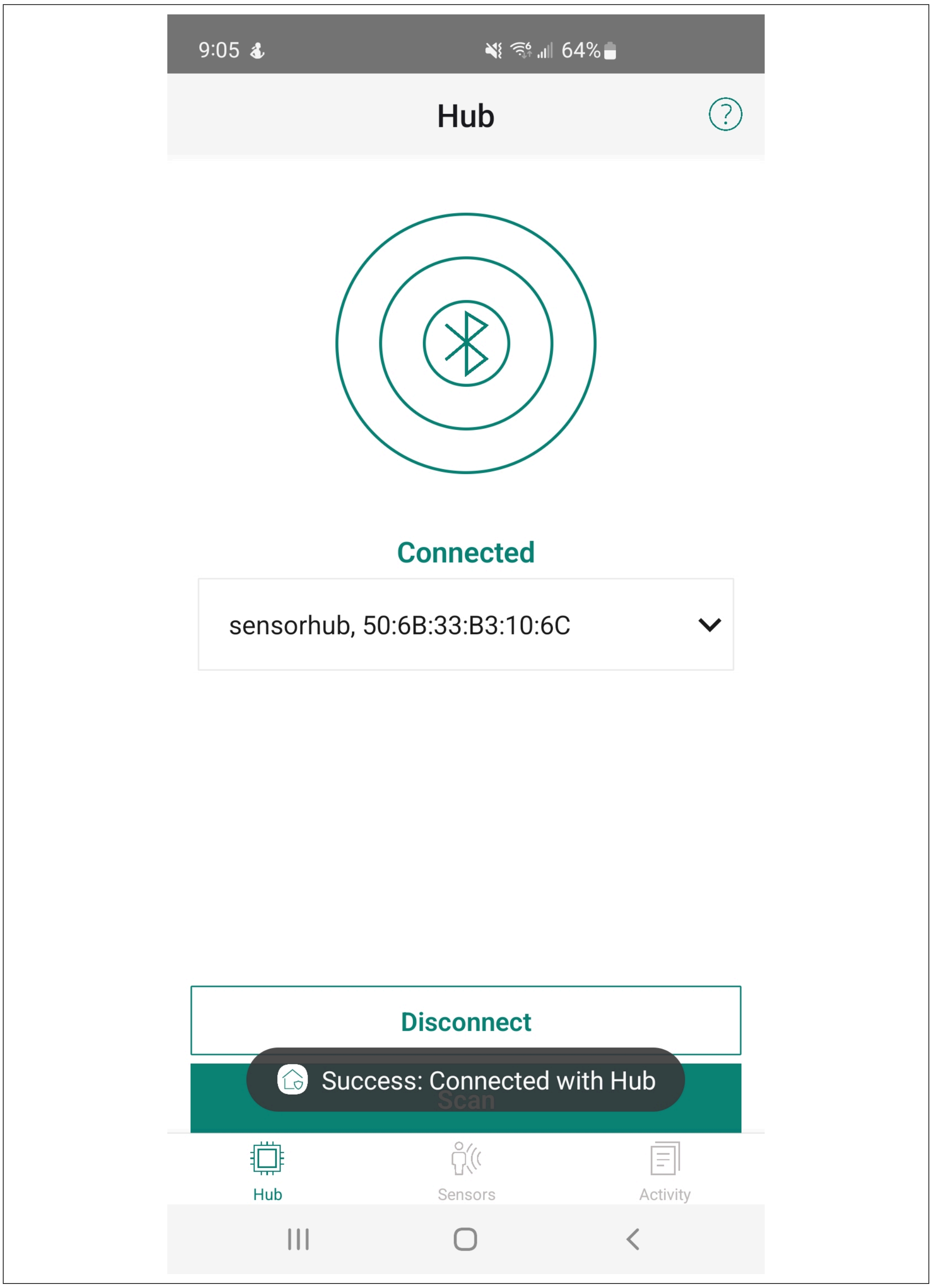


Figure 19 Connection: successful

3. **Sensor screen**:
   a. Once the EVK is connected, the **SELECT A SENSOR** drop-down menu will be populated with a list of available sensor devices

      ***Note**: In case of code examples for an individual sensor, only that specific sensor will be shown in the drop-down menu*

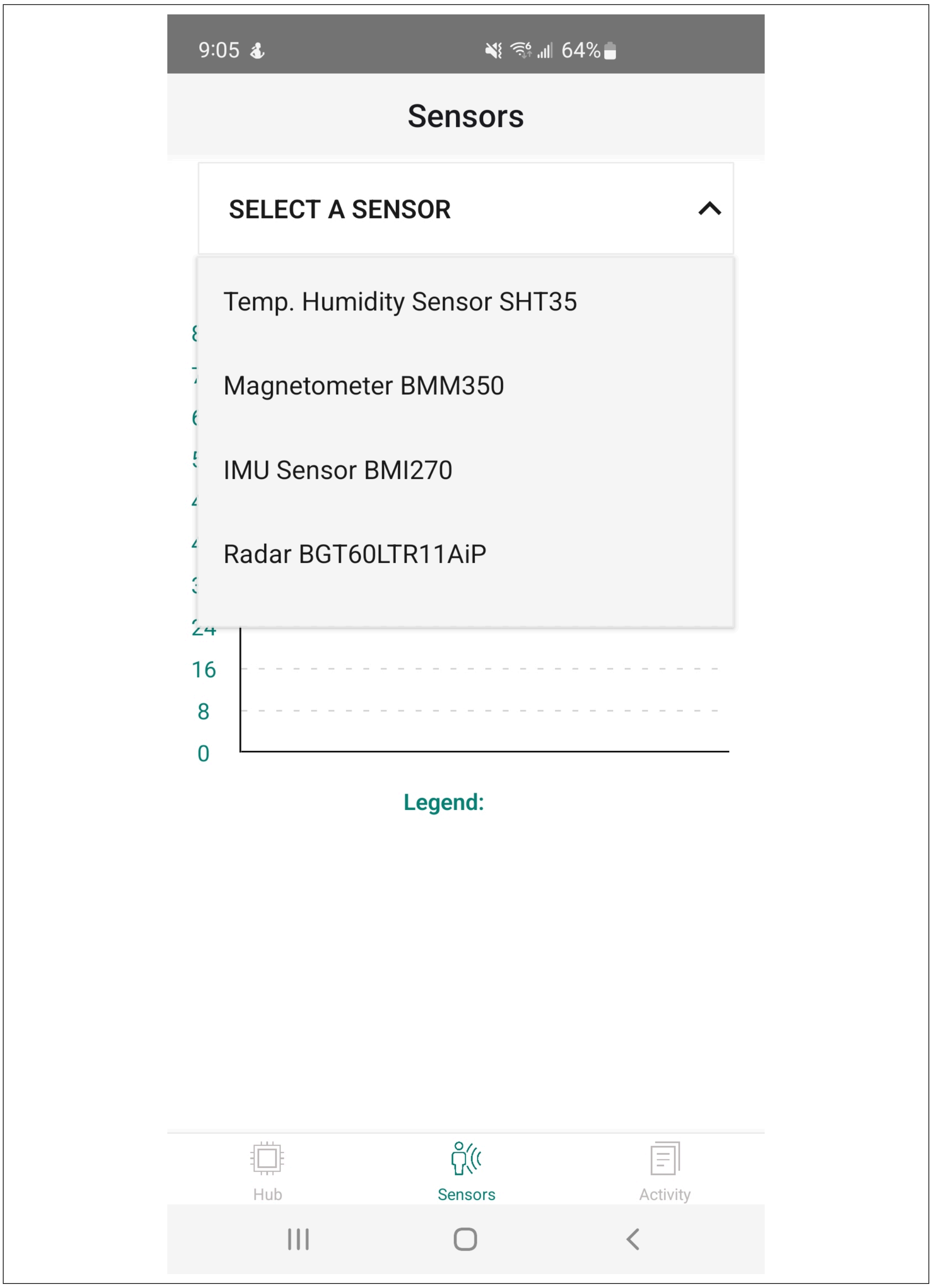


Figure 20 Drop down: populated

b. Select a sensor to set it in the firmware. Additionally, the visualization is initialized for data acquisition, and a toast notification is displayed if the sensor is successfully set. See Table 4 for details on data illustration

Figure 21 Drop down: SHT35 sensor set

c. Press **Read** to start data acquisition. A toast notification will be displayed, and the visualizations will be continuously updated. The most recent data values are also displayed below the plot

Figure 22 **Drop down: SHT35 read started**

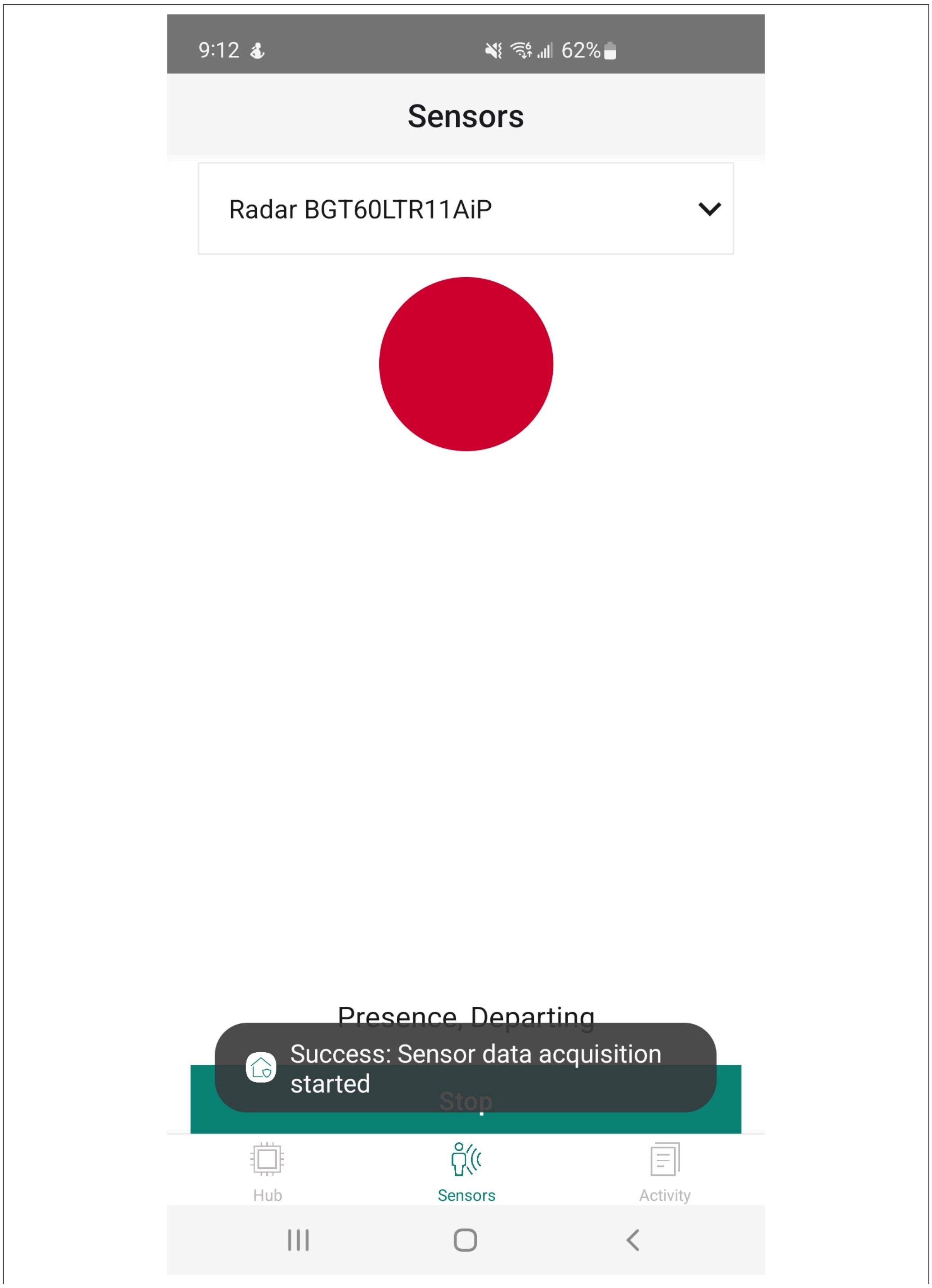
d. Press **Stop** to halt data acquisition and reset the visualization. A toast notification will also be displayed

Figure 23 **Drop down: SHT35 read stopped**

e. Repeat the same steps above to see data acquisition from another sensor.

In case of the:

- **XENSIV™ BGT60LTR11AIP 60GHz Doppler Radar sensor**: Motion and direction of motion are displayed, not time-domain data
- **BMI270 IMU sensor**: Orientation is displayed as text


9:12
62%
Sensors
Radar BGT60LTR11AiP
Presence, Departing
Success: Sensor data acquisition started
Stop
Hub
Sensors
Activity

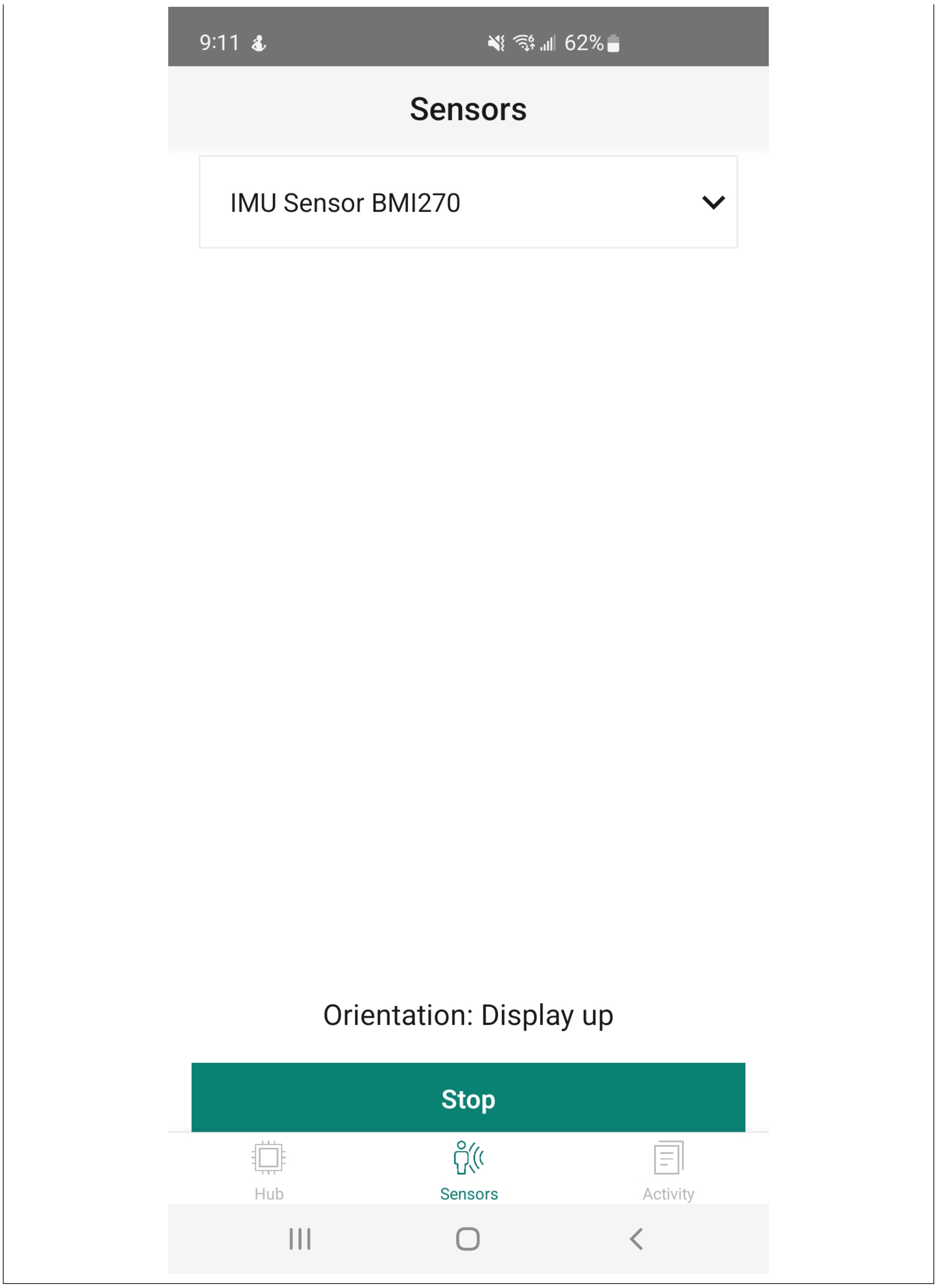


Figure 24 Drop down: XENSIV™ BGT60LTR11AIP read started

f. Once data acquisition on the Sensors screen is complete, make sure the EVK is properly disconnected by pressing **Disconnect** on the Hub screen. On successful disconnection, a toast notification is displayed, and the connection status on the Hub screen is changed to **Not connected**

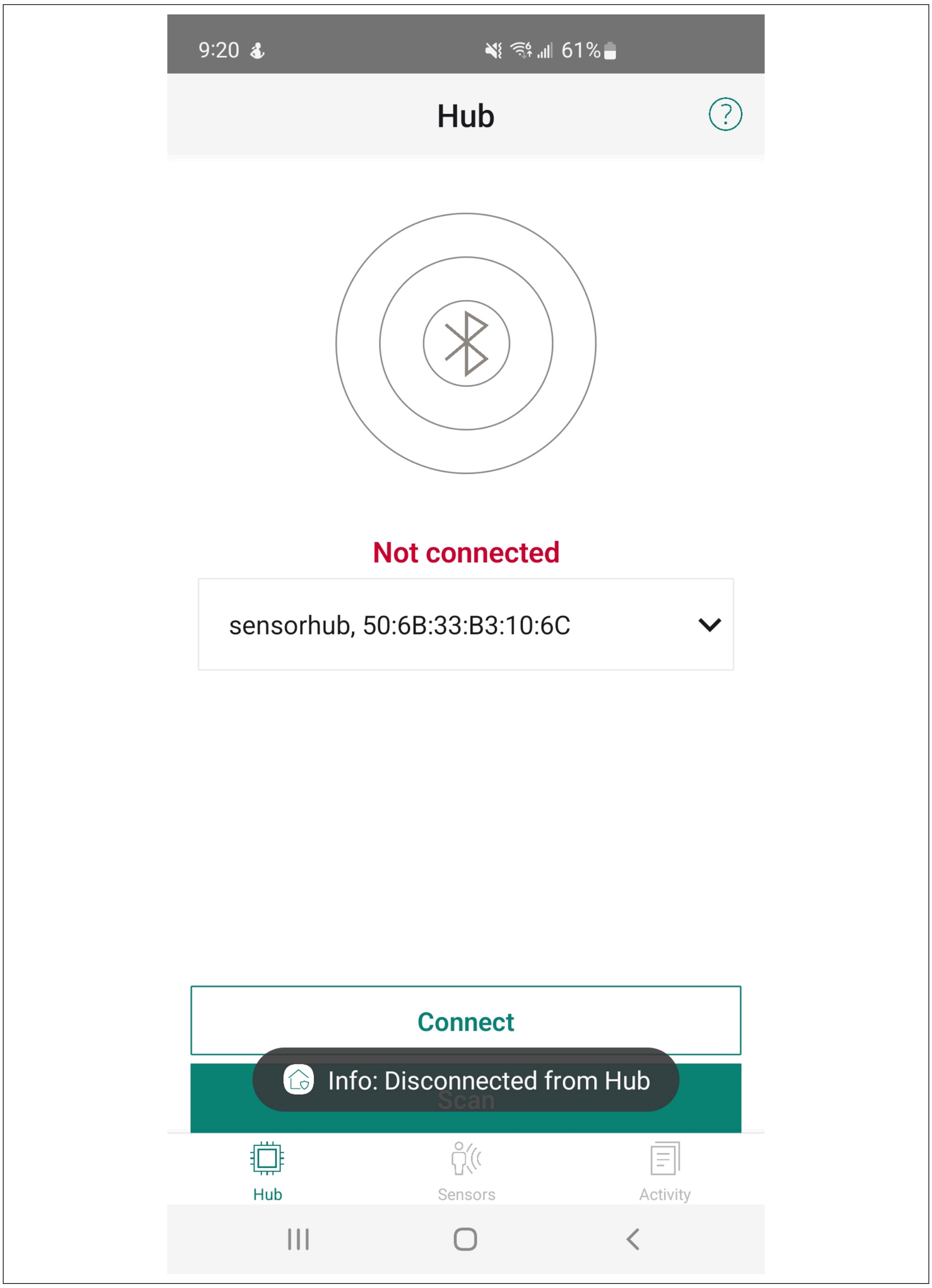


Figure 25 Disconnection: successful

4. **Activity screen**: The Activity screen generates logs for each activity performed in the app, such as button presses, drop-down selections, etc., along with a timestamp indicating when each activity was performed. The logs are displayed in order from most recent to least recent. The following is the format for the logs:
   - Name of the screen
   - Success/Error message
   - Timestamp of the Activity (local region format)

   All logs can be erased by pressing the **Clear all** button

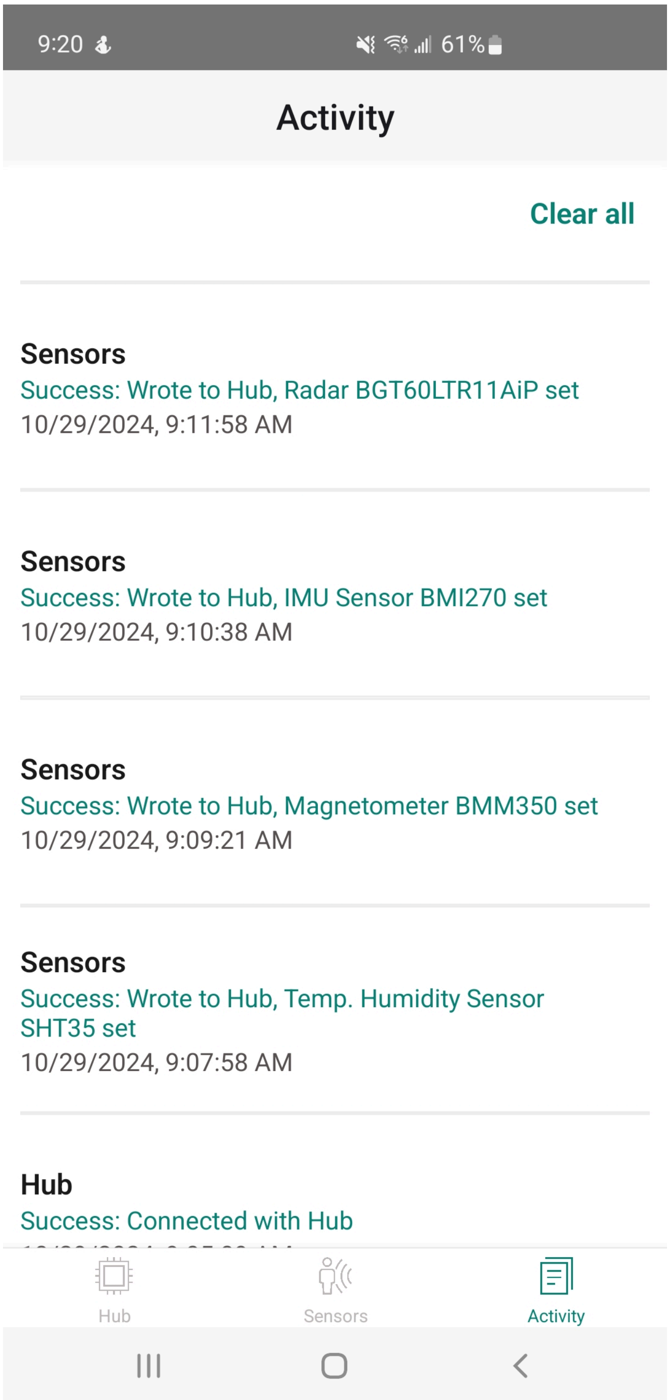


Figure 26 Logs

1.2.3.5 Known limitations

If a switch is made and another sensor is selected via the UART console during data acquisition on the Sensors screen, the user is not notified, and acquisition is paused. Acquisition can be resumed if the UART console is used to switch back to the previous sensor.

1.3 Board details

The board features the following components:

1. **XENSIV™ radar sensor (BGT60LTR11AIP)**: A built-in motion and direction detector that allows for autonomous operation, detecting human motion and direction (approaching or departing), and equipped with two on-board LEDs to illustrate sensor output
2. **XENSIV™ barometric pressure sensor (DPS368)**: Offers high accuracy and low power consumption, measuring both pressure and temperature
3. **XENSIV™ PAS CO2 sensor**: Leverages photoacoustic spectroscopy for accurate carbon dioxide (CO2) detection in a compact form factor
4. **XENSIV™ digital MEMS microphones (IM72D128)**: Provides ultra-high performance with low noise and distortion, making it ideal for applications requiring superior audio quality
5. **OPTIGA™ Trust M security controller**: A security solution that provides robust protection for embedded systems
6. **Digital humidity and temperature sensor (SHT35)**: A highly reliable sensor that uses an I^{2}C interface to transfer data
7. **Motion sensor (BMI270)**: An ultra-low power inertial measurement unit (IMU) providing a 6-axis sensor that combines a 16-bit tri-axial gyroscope and a 16-bit tri-axial accelerometer
8. **Digital geomagnetic sensor (BMM350)**: Capable of measuring the earth's magnetic field in three perpendicular axes
9. **SPI-based 0.96 inch TFT LCD**: Offers 80 x 160 pixel resolution
10. **External radar module interface**: Allows connection of different sensor shields, such as XENSIV™ BGT60TR13C, XENSIV™ BGT60UTR11AIP and so on
11. **I^{2}C connector**: Enables connection of any I^{2}C components using the QWIIC interface
12. **I/O headers**: Compatible with Arduino UNO R3

The SHIELD_XENSIV_A XENSIV™ shield pinout is shown in Figure 27. For pin assignment details, see the Headers compatible with Arduino (J1, J2, J3, and J4) section.

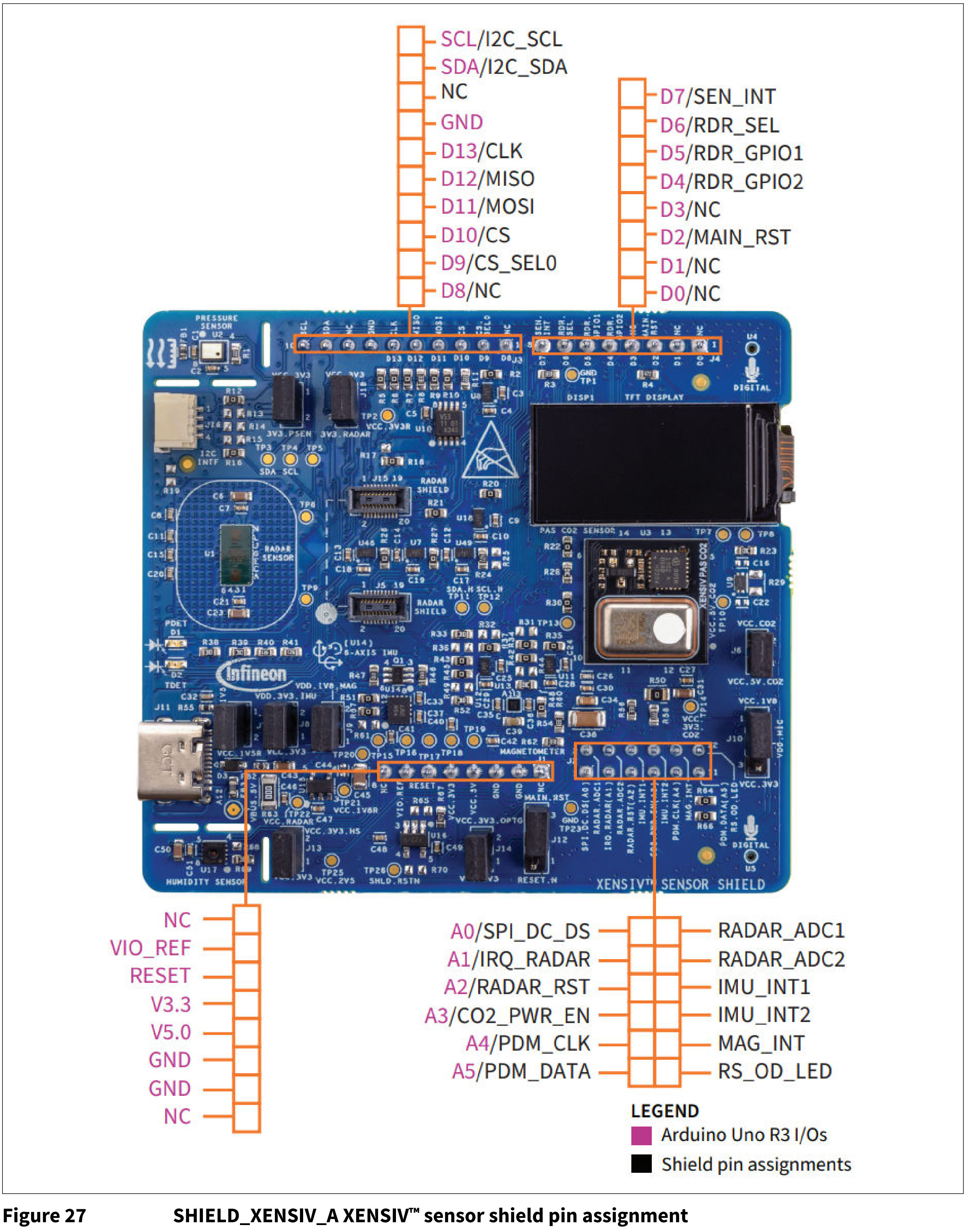


Figure 27 SHIELD_XENSIV_A XENSIV™ sensor shield pin assignment

Arduino pin	Shield pin	PSOC™ pin (CY8CKIT-062S2-43012)	Shield function
A0	J2.1	P10[0]	SPI_DC_DS (TFT display command pin)
A1	J2.3	P10[1]	IRQ_RADAR (radar interrupt)
A2	J2.5	P10[2]	RADAR_RST (radar reset signal)
A3	J2.7	P10[3]	CO2_PWR_EN (CO2 5 V power enable signal)
A4	J2.9	P10[4]	PDM_CLK (PDM microphone clock signal)
A5	J2.11	P10[5]	PDM_DATA (PDM microphone data signal)
A8	J2.2	P9[0]	RADAR_ADC1 (ADC out from the radar sensors)
A9	J2.4	P9[1]	RADAR_ADC2 (ADC out from the radar sensors)
A10	J2.6	P9[2]	IMU_INT1 (interrupt signal from the IMU sensor)
A11	J2.8	P9[3]	IMU_INT2 (interrupt signal from the IMU sensor)
A12	J2.10	P9[4]	MAG_INT (interrupt signal from the magnetometer sensor)
A13	J2.12	P9[5]	RS_OD_LED (radar shield open drain LED)
D0	J4.1	P5[0]	Not connected
D1	J4.2	P5[1]	Not connected
D2	J4.3	P5[2]	MAIN_RST (main reset signal for the sensors with the buffer)
D3	J4.4	P5[3]	Not connected
D4	J4.5	P5[4]	RDR_GPIO2 (radar sensor GPIO signal)
D5	J4.6	P5[5]	RDR_GPIO1 (radar sensor GPIO signal)
D6	J4.7	P5[6]	RDR_SEL (selection signal to select the on-board BGT60LTR11AIP radar sensor or the other radar shields)
D7	J4.8	P5[7]	SEN_INT (interrupt signal ORing from various sensors)
D8	J3.1	P7[5]	Not connected
D9	J3.2	P7[6]	CS_SEL0 (selection signal to select the SPI slave select)
D10	J3.3	P12[3]	CS (SPI slave select, connected to PSOC™ and the SPI devices in the shield)
D11	J3.4	P12[0]	MOSI (SPI MOSI signal, connected to PSOC™ and the SPI devices in the shield)
D12	J3.5	P12[1]	MISO (SPI MISO signal, connected to PSOC™ and the SPI devices in the shield)
D13	J3.6	P12[2]	CLK (SPI clock signal, connected to PSOC™ and the SPI devices in the shield)
SDA	J3.9	P6[1]	I2C_SDA (connected to PSOC™ and the I^2C devices in the shield)

Arduino pin	Shield pin	PSOC™ pin (CY8CKIT-062S2-43012)	Shield function
SCL	J3.10	P6[0]	I2C_SCL (connected to PSOC™ and the I^2C devices in the shield)

1.4 Additional learning resources

- For more information about ModusToolbox™ software functionality and releases, see ModusToolbox™ software
- For a list of trainings on ModusToolbox™, see ModusToolbox™ software training
- An overview of PSOC™ devices is available on the PSOC™ 6 webpage. This webpage includes a list of PSOC™ device families, integrated design environments (IDEs), and associated development kits. Additionally, refer to the following documents to get started with PSOC™ 6 devices:
  - AN228571 – Getting started with PSOC™ 6 MCU on ModusToolbox™
  - PSOC™ 6 technical reference manuals
- For more information about the XENSIV™ PAS CO2 sensor portfolio and technical documentation, see CO2 sensors
- For more information about the XENSIV™ pressure sensor portfolio and technical documentation, see Pressure sensors
- For more information about the XENSIV™ 60 GHz radar sensor product portfolio and technical documentation, see XENSIV™ 60 GHz RADAR MMICs
- For more information about the XENSIV™ MEMS microphone portfolio and technical documentation, see XENSIV™ MEMS microphones for consumer electronics
- For more information about the OPTIGA™ Trust portfolio and technical documentation, see OPTIGA™ Trust

1.5 Technical support

For assistance, see Infineon support or post your questions in the Infineon developer community platform.

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

2 Kit operation

This chapter introduces you to various features of the SHIELD_XENSIV_A XENSIV™ sensor shield, including the theory of operation. The shield comes with firmware that interfaces the sensors present on the shield with the baseboard.

2.1 Theory of operation

The SHIELD_XENSIV_A XENSIV™ sensor shield is compatible with Arduino, allowing for easy interfacing of multiple sensors with the baseboard kits. This shield contains PDM microphones, a radar sensor, a barometric pressure sensor, and a CO2 sensor from Infineon's XENSIV™ family, as well as a motion sensor, a magnetometer sensor from Bosch, a digital humidity and temperature sensor from Sensirion, and a 0.96-inch TFT display.

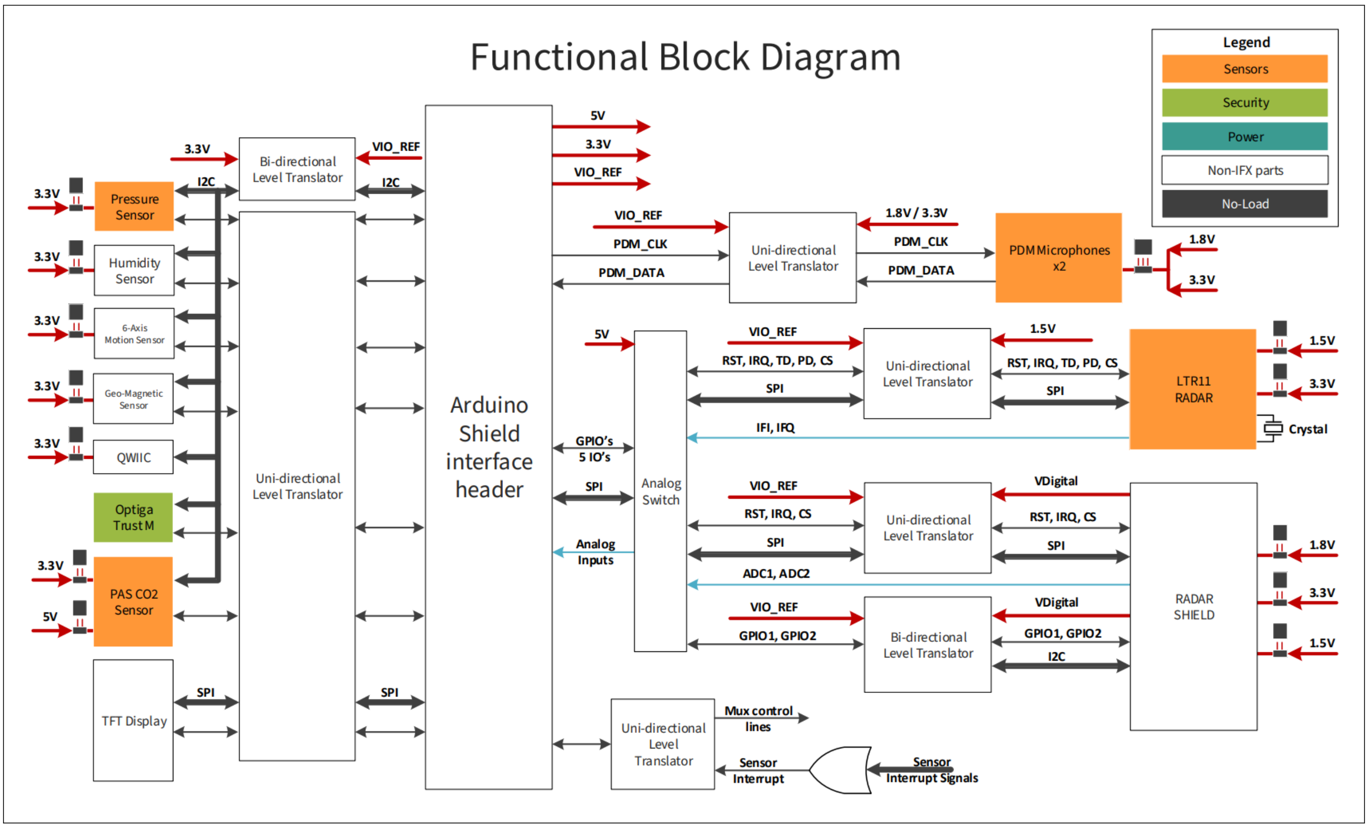


Figure 28 SHIELD_XENSIV_A XENSIV™ sensor shield functional block diagram

The components on the SHIELD_XENSIV_A XENSIV™ sensor shield are shown in Figure 29.

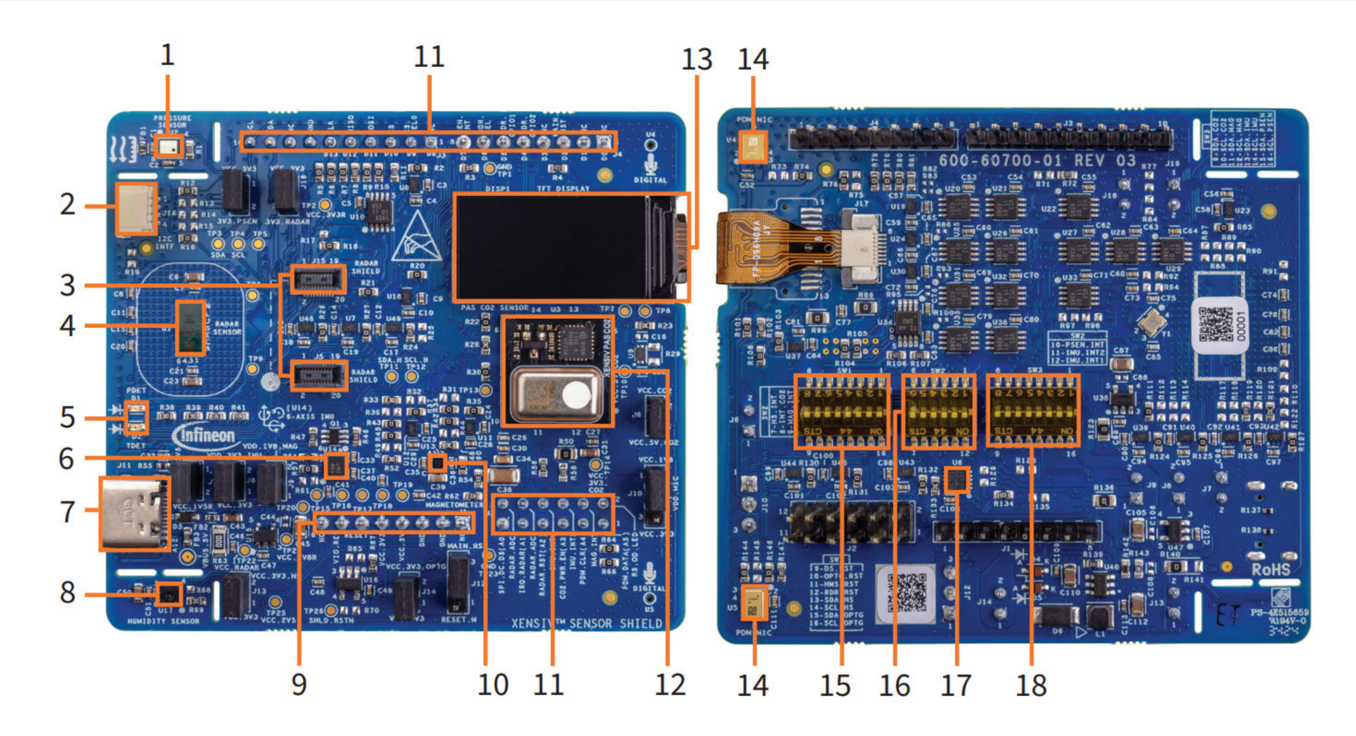


Figure 29 **SHIELD_XENSIV_A XENSIV™ sensor shield board details**

The board has the following peripherals:

1. **XENSIV™ digital barometric air pressure sensor (U2)**: This is an Infineon digital barometric pressure sensor with a built-in temperature sensor. This sensor uses an I^{2}C interface to transfer the sensor data
2. **I^{2}C connector (J16)**: This connector is used to connect various sensors and other components using the QWIIC interface without the need for soldering or wires
3. **Radar shield connectors (J5, J15)**: These are the Hirose connectors used to plug in the external radar shields
4. **XENSIV™ 60 GHz radar sensor BGT60LTR11AIP (U1)**: This is an Infineon XENSIV™ radar sensor that has a built-in motion and direction of motion detector
5. **BGT60LTR11AIP radar sensor status LEDs (D1, D2)**: These LEDs are used to represent the status of motion and direction of motion
6. **Motion sensor (U14)**: This is a 6-axis motion sensor, also known as an inertial measurement unit (IMU) that combines a 16-bit tri-axial gyroscope and a 16-bit tri-axial accelerometer. This sensor uses an I^{2}C interface to transfer the sensor data
7. **USB device connector (J11):** The USB Type-C cable can be connected to provide an additional voltage source for the on-board radar sensor, radar shield interface, magnetometer sensor, and PDM microphones when shield is not powered with 5 V Arduino-compatible power pin
8. **Digital humidity and temperature sensor (U17)**: This is a highly reliable digital humidity and temperature sensor that uses an I^{2}C interface to transfer data
9. **Power header compatible with Arduino UNO R3 (J1)**: This is an Arduino-compatible header designed to interface with the baseboard. It features an Arduino-compatible interface female connector, which provides power to this shield
10. **Digital geomagnetic sensor (U13)**: This is a digital geomagnetic sensor capable of measuring the earth's magnetic field in three perpendicular axes. This sensor uses an I^{2}C interface to transfer the sensor data
11. **I/O headers compatible with Arduino UNO R3 (J2, J3, J4)**: These are the Arduino-compatible headers used to interface the baseboard. The baseboard features an Arduino-compatible interface female connector, providing the I/O interface between the baseboard and the shield

12. **XENSIV™ PAS CO2 sensor (U3)**: This is an Infineon XENSIV™ disruptive CO2 sensor based on photoacoustic spectroscopy (PAS). This sensor uses an I^2C interface to transfer the sensor data
13. **0.96-inch TFT display (DISP1):** This is a 0.96-inch, 80 x 160 TFT display, which can interface with the baseboard via the SPI interface
14. **XENSIV™ digital MEMS microphones (U4, U5)**: These are two Infineon digital MEMS microphones used to capture sound and generate digital audio data, which is transferred through the PDM interface
15. **I^2C and RESET multiplexing switch (SW1):** This switch is used to enable or disable the I^2C lines and RESET signal to sensors
16. **Interrupt selection switch (SW2):** This switch is used to enable or disable the interrupt signals of the sensors
17. **OPTIGA™ Trust M controller (U6)**: OPTIGA™ Trust M is a high-security solution from Infineon. This uses the I^2C interface
18. **I^2C selection switch (SW3)**: This switch is used to enable or disable the I^2C lines to sensors

See Hardware functional description for details on various hardware blocks.

2.2 Using the code example

The XENSIV™ sensor shield is supported by ModusToolbox™ software examples with the Arduino UNO-based Infineon development platforms (referred as the “baseboard”). The Getting started section provides the list of code examples compatible with the XENSIV™ sensor shield, along with the instructions on creating a project to run on the baseboard.

3 Hardware

3.1 Schematics

Refer to the schematic files available on the Kit webpage.

3.2 Hardware functional description

3.2.1 Power supply system

3.2.1.1 Power supply inputs

The power supply inputs to the XENSIV™ sensor shield through the Headers compatible with Arduino (J1, J2, J3, and J4) and on-board USB connector (J11) are:

- **3.3 V supply from the baseboard**: This supply voltage is used to power all digital supplies of 3.3 V operated devices on the sensor shield, including the OPTIGA™ Trust M device, sensors, and other components
- **5 V supply from the baseboard**: This supply voltage is used as an input to the voltage regulator subsystem, which generates multiple supply voltages for the sensor shield
- **5 V supply from USB connector on shield**: This supply voltage is used to provide additional power requirements for the radar subsystem

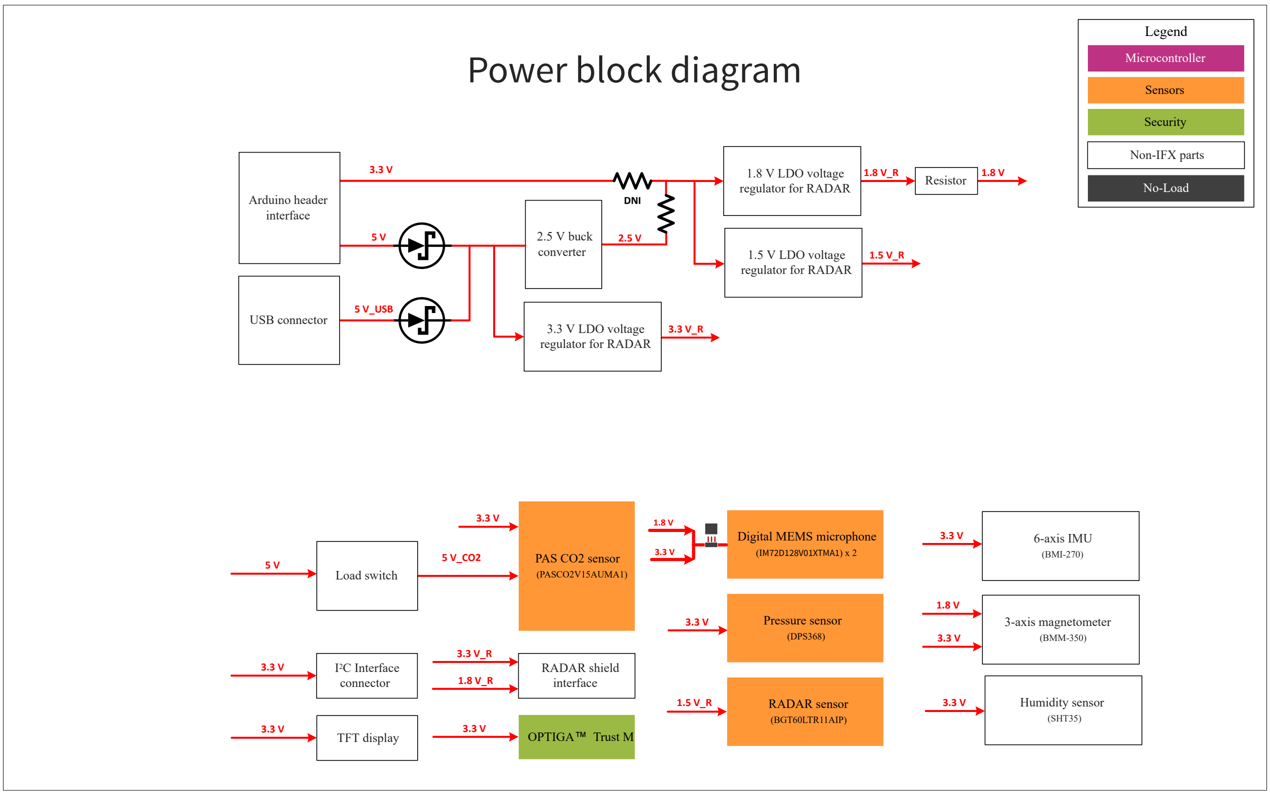


Figure 30 Block diagram of the power architecture of the sensor shield

***Note**: The XENSIV™ sensor shield consumes higher power when the RADAR sensor is configured in continuous wave mode and the PAS CO2 sensor is operated simultaneously. This can exceed the base board's power capabilities, leading to issues with sensor operation and system performance.*

To mitigate this issue, consider using the external USB power supply option (J11) provided on the XENSIV™ sensor shield if simultaneous operation is required.

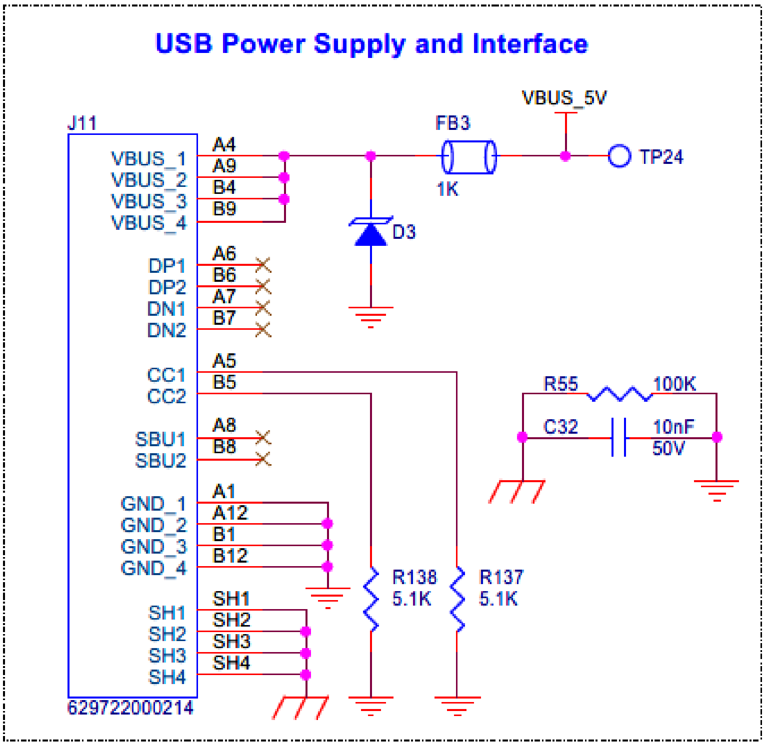


Figure 31 Schematic of external power supply from USB connector on sensor shield

Each sensor on the XENSIV™ sensor shield features a dedicated header with a jumper option, which allows for the current measurement of every sensor. This capability enables accurate monitoring of sensor power consumption, providing valuable insights to identify and address potential power-related issues.

3.2.1.2 Voltage regulators

The XENSIV™ sensor shield features a voltage regulator subsystem that efficiently generates multiple supply voltages from the 5 V input.

- The buck voltage regulator (U48) generates a 2.5 V supply from the 5 V input, which is generated from the base board or the USB supply from the J11 connector on the shield (output of the power ORing diode circuitry). This 2.5 V supply serves as an input to the low dropout linear voltage regulators
- The 2.5 V supply powers the generation of low-noise 1.8 V and 5 V supplies. Additionally, the 5 V supply from the baseboard is used to produce a low noise 3.3 V supply using low dropout linear voltage regulators (U47, U15, and U38). These supply voltages power the radar subsystem of the XENSIV™ sensor shield

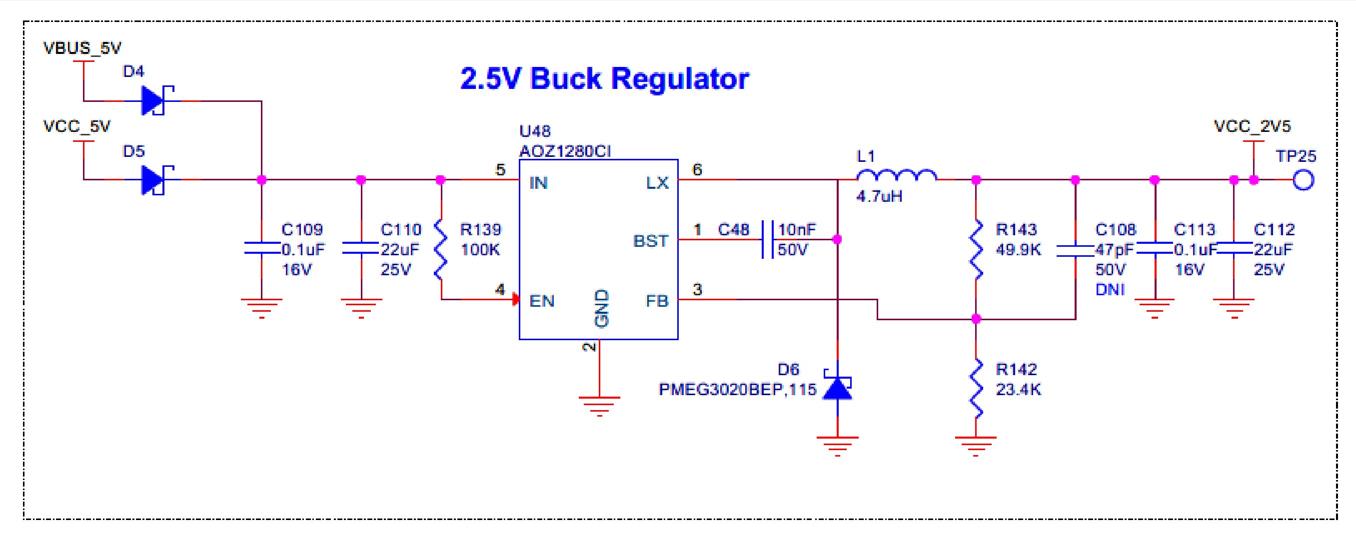


Figure 32 **Schematic for the buck voltage regulator of the sensor shield**

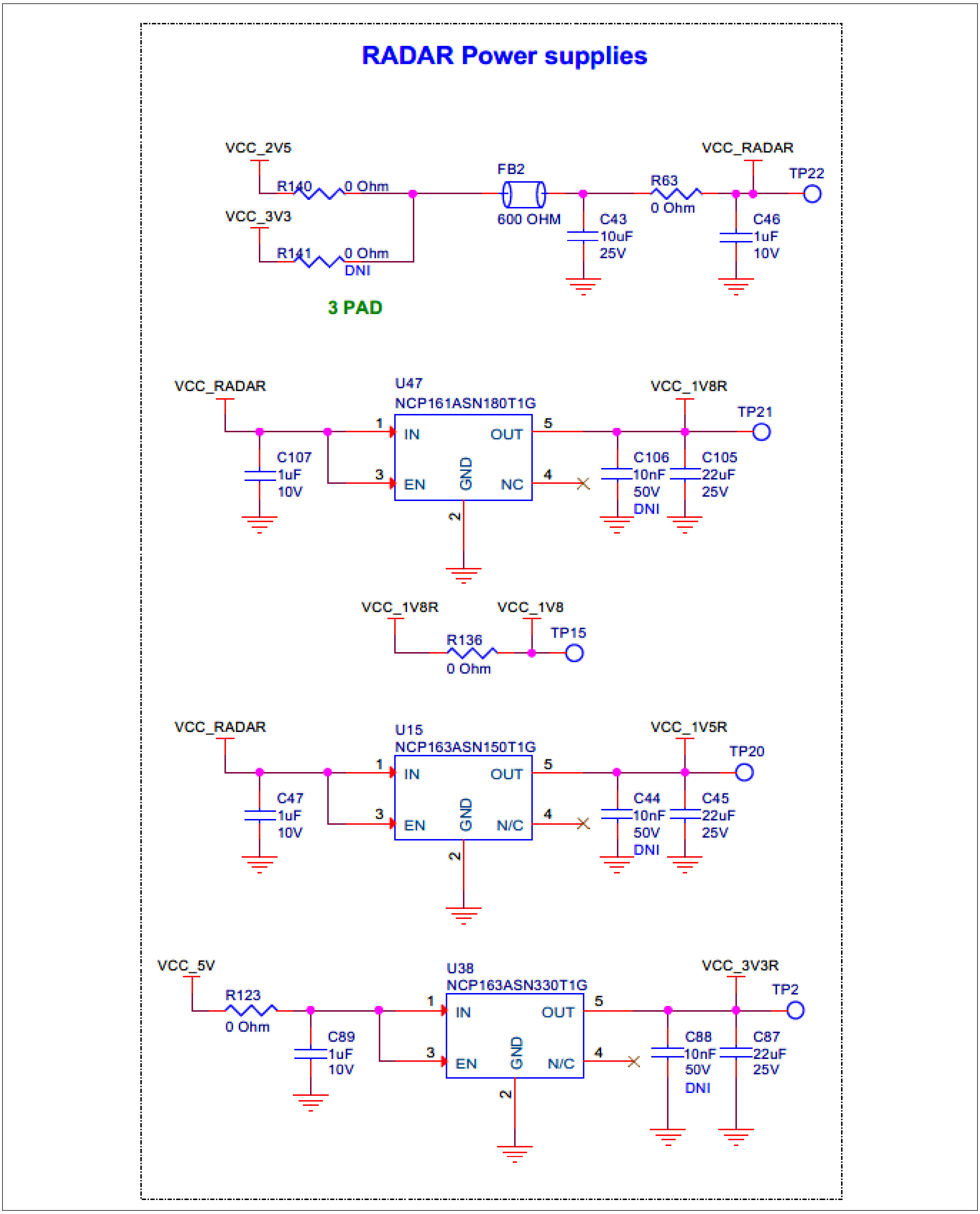


Figure 33 **Schematic for the LDO linear voltage regulators in the radar subsystem of the sensor shield**

3.2.2 RESET interface

The default reset source for the XENSIV™ sensor shield is the `MAIN_RST` signal from the host MCU on the base board through the Headers compatible with Arduino (J1, J2, J3, and J4). To prevent signal loading, the selected reset source is connected to a logic buffer (U59), which ensures that the reset signal can effectively drive the reset function of multiple devices without being affected by signal loading.

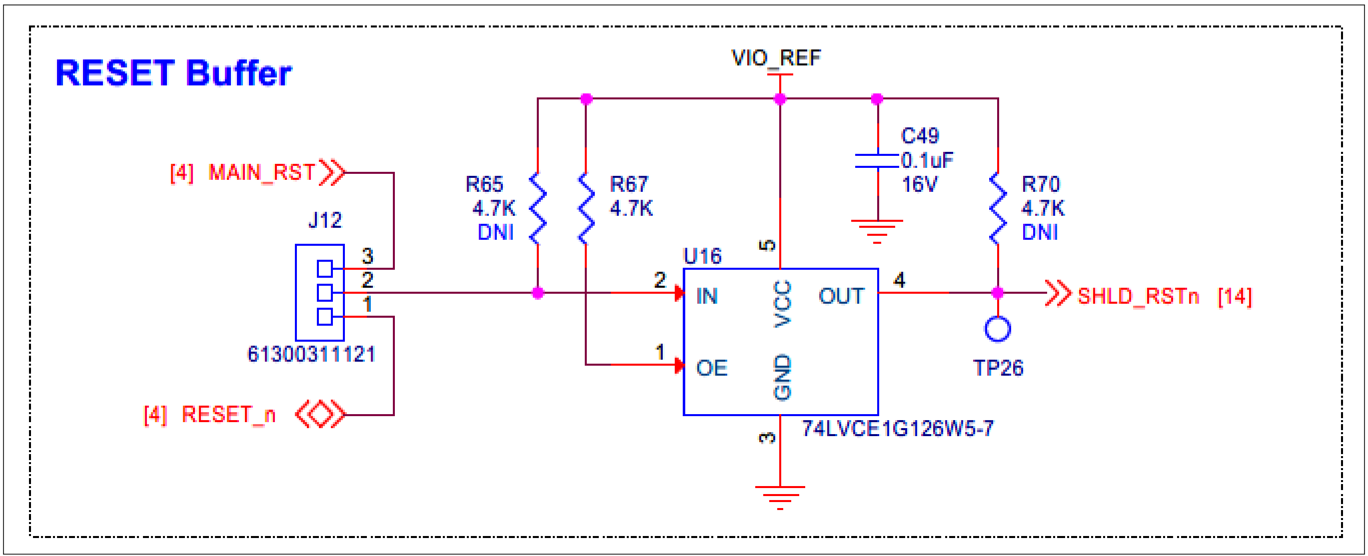


Figure 34 RESET signal buffer schematic

The XENSIV™ sensor shield provides a flexible reset mechanism, allowing users to select the reset source for the devices on the shield. The reset source can be either the buffered host MCU reset signal or a `MAIN_RST` signal controlled by the GPIO of the host MCU connected to the Headers compatible with Arduino (J1, J2, J3, and J4). A 3-pin header (J12) with a jumper option is provided to users for selecting the required reset source. Additionally, a dip switch (SW1) is used to connect and disconnect the selected reset source signal to the required devices on the XENSIV™ sensor shield.

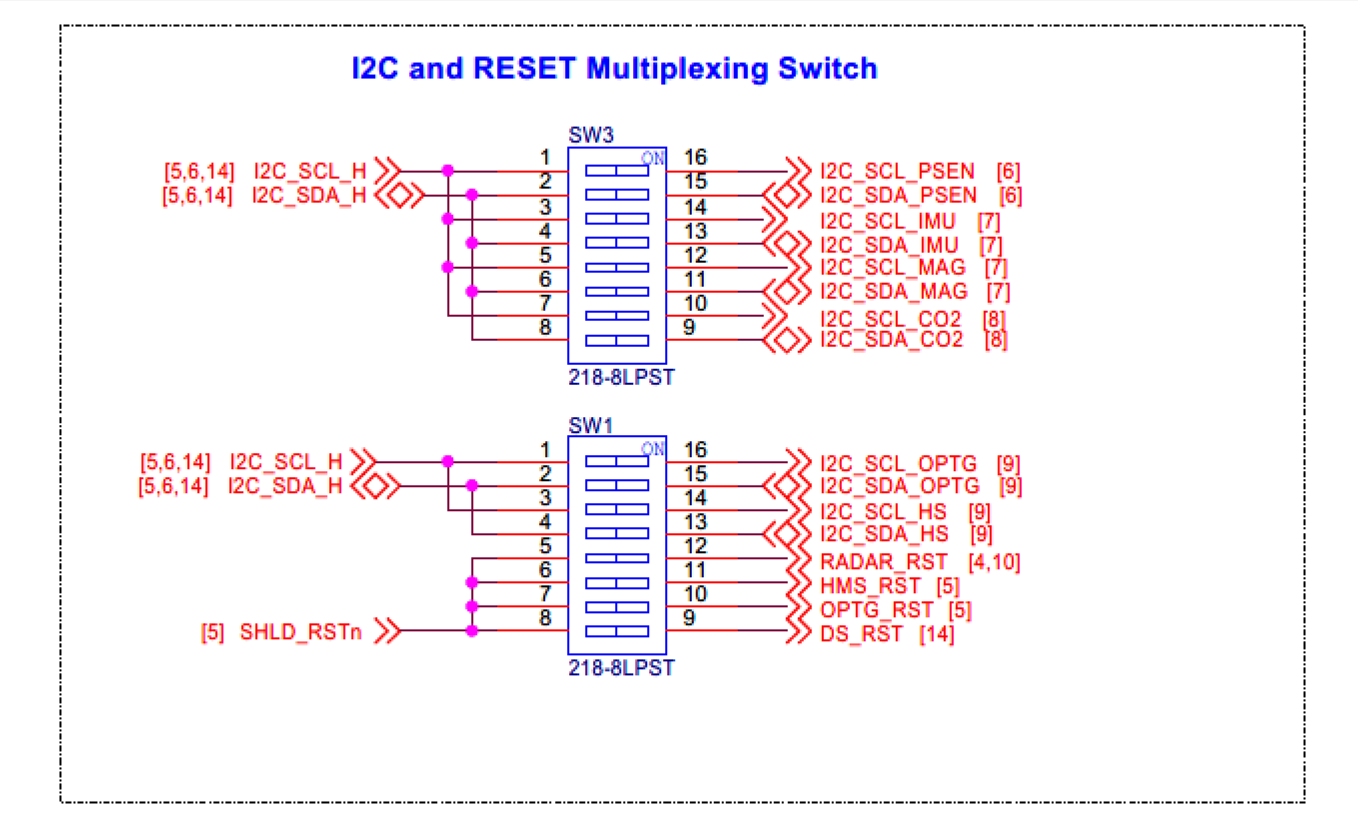


Figure 35 RESET signal source selection and multiplexing switch schematic

3.2.3 I²C and SPI interface

The I²C and SPI interfaces from the host MCU on the base board are level-translated on the XENSIV™ sensor shield and shared across the devices. Since all I²C interface-based sensors are configured to operate at 3.3 V, the I²C level translator (U34) translates the signals to the 3.3 V level.

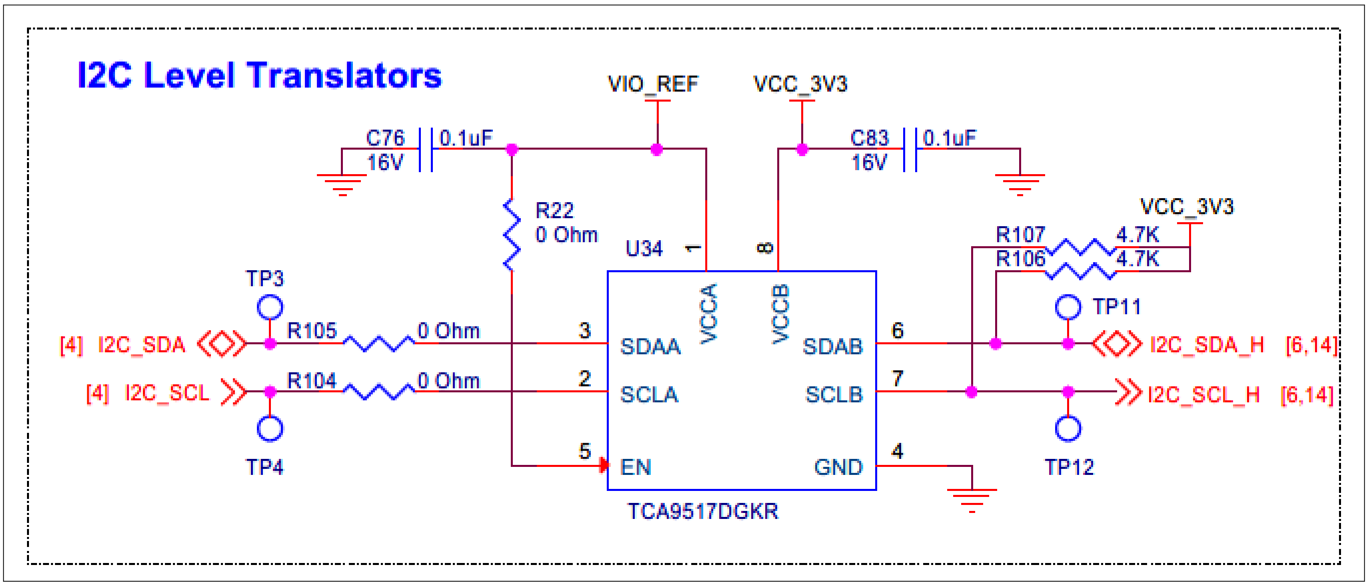


Figure 36 Schematic of the I²C level translator

A DIP switch (SW3) is provided to connect and disconnect the I²C interface with different sensors on the shield, offering flexibility to the user. This feature enables users to selectively enable specific devices with I²C interfaces and facilitates troubleshooting.

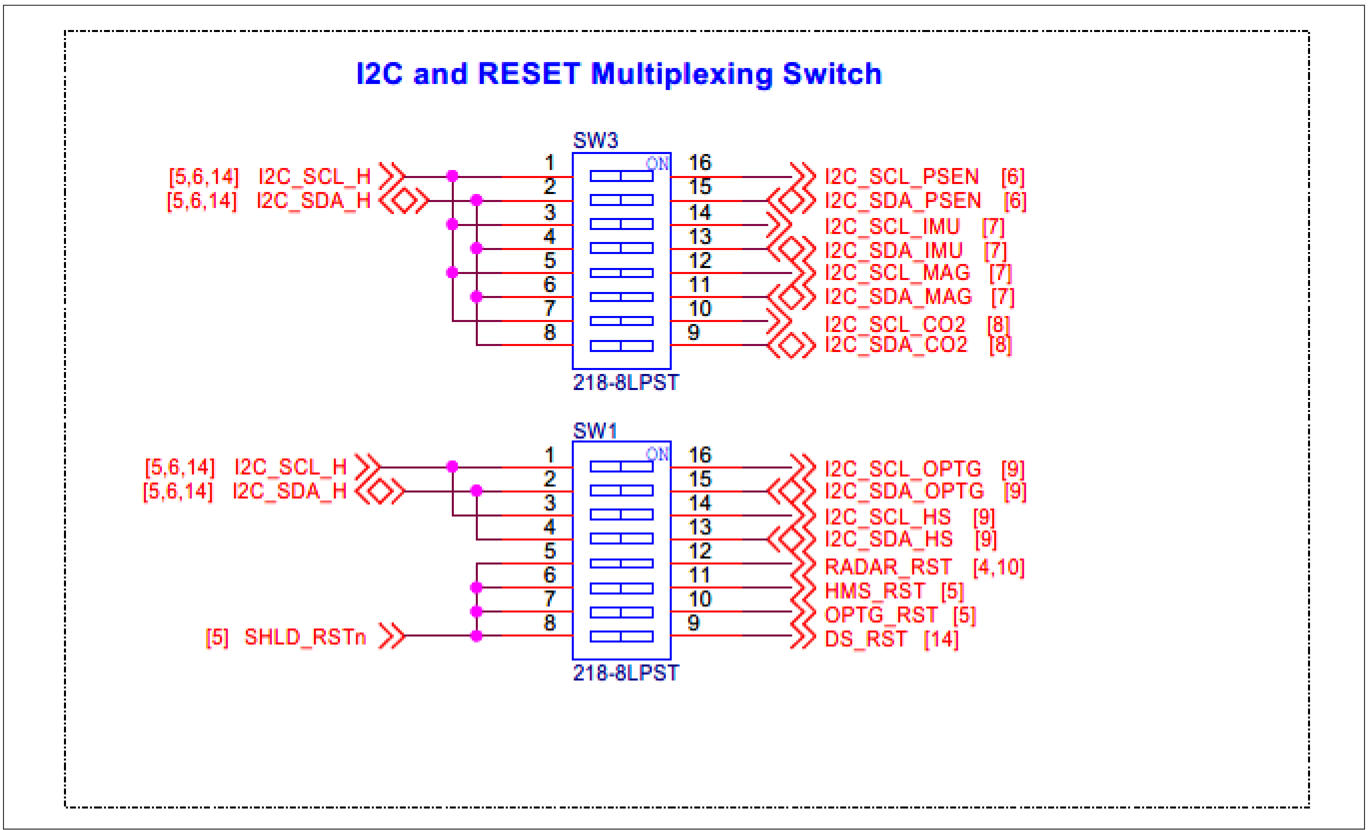


Figure 37 Schematic of the I²C interface multiplexing switch

The SPI interface is shared across the display and radar subsystem. The SPI interface shared with the TFT display is level-translated to 3.3 V to support the TFT display's I/O level. Additionally, the radar subsystem's SPI is level-translated based on the radar selection, whether it is the onboard radar or an external radar shield.

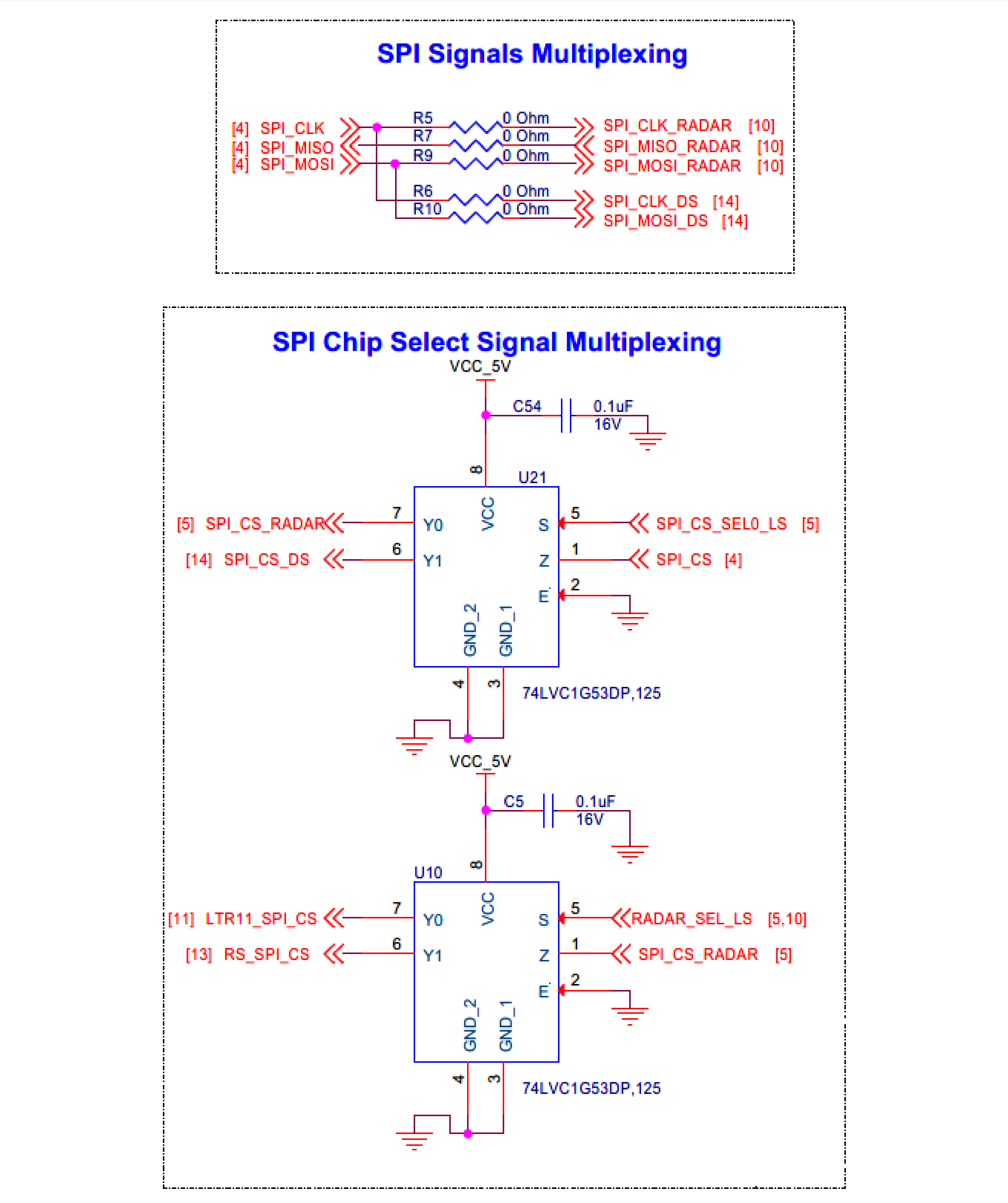


Figure 38 **Schematic of SPI interface multiplexing**

3.2.4 Sensor subsystem

3.2.4.1 XENSIV™ sensors

3.2.4.1.1 XENSIV™ digital barometric pressure sensor

The XENSIV™ sensor shield features Infineon's advanced digital barometric pressure sensor (U2), DPS368XTSA1, which includes a built-in temperature sensor. This sensor communicates with the host MCU via the inter-integrated circuit (I^2C) protocol. Although the sensor also supports the serial peripheral interface (SPI) protocol, this shield is designed to operate exclusively with I^2C.

I^2C device address configuration: The serial data out (*SDO*) pin of the pressure sensor is pulled down with a 2.2K resistor (R1), which determines the 7-bit I^2C device address of the sensor. The address of the sensor is dependent on the configuration of the *SDO* pin.

- **Default configuration**: If the pull-down resistor is loaded, the I^2C device address is 0 x 76
- **Alternative configuration**: If the pull-down resistor is not loaded, the I^2C device address is 0 x 77

Sensor interface and power supply: The DPS368XTSA1 pressure sensor uses an I^2C interface to communicate with the host MCU, accompanied by an interrupt signal, `PSEN_INT_LS`. The sensor has a separate I/O power supply pin (*VDDIO*) and main supply pin (*VDD*), which are connected to a 3.3 V supply.

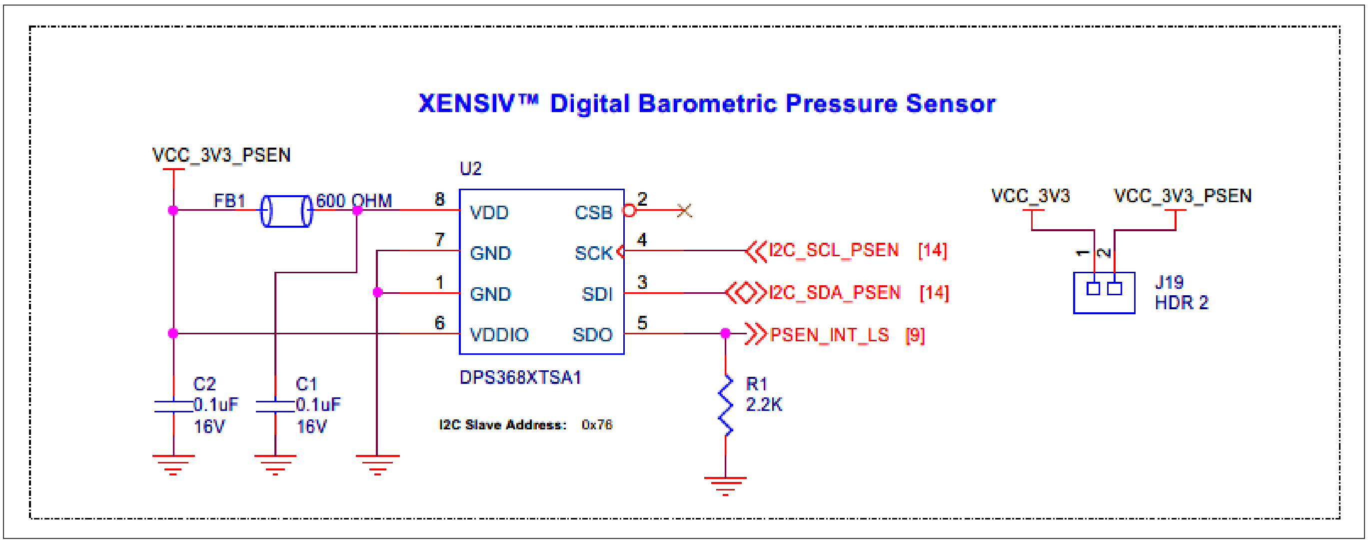


Figure 39 Schematic of XENSIV™ digital barometric pressure sensor interface

Level translation and interface: To ensure compatible logic levels between the sensor and the host MCU, an I^2C level translator (U34) and an I/O level translator (U23) for interrupt signals are used. The level-translated I^2C interface and level-translated interrupt signal, routed through an OR logic gate (U20, U25, and U31), are connected to the Headers compatible with Arduino (J1, J2, J3, and J4) for seamless interface with the base board.

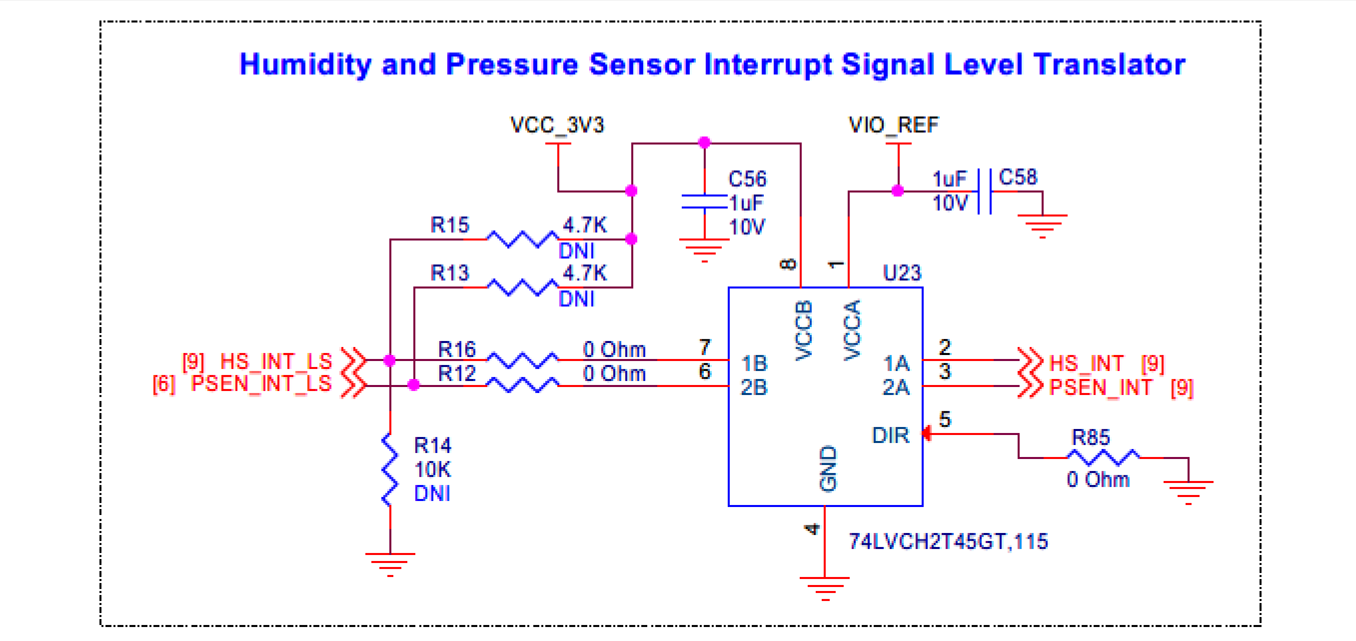


Figure 40 Schematic of pressure sensor interrupt level translator interface

3.2.4.1.2 XENSIV™ PAS CO2 sensor

The XENSIV™ sensor shield features Infineon's XENSIV™ PAS CO2 5 V sensor, PASCO2V15 (U3). The sensor communicates with the host MCU via the I²C protocol and has an I²C device address of 0 x 28. Although the sensor also supports the UART protocol and pulse width modulation (PWM) output, this shield is designed to exclusively operate with I²C.

Sensor interface and power supply: The PASCO2V15 CO2 sensor uses an I²C interface to communicate with the host MCU. It is accompanied by an interrupt signal, `INT_CO2_LS`. The sensor has a separate I/O power supply pin (*VDD3.3*) connected to a 3.3 V supply and a main supply pin (*VDD5*) connected to a 5 V supply through a load switch (U9).

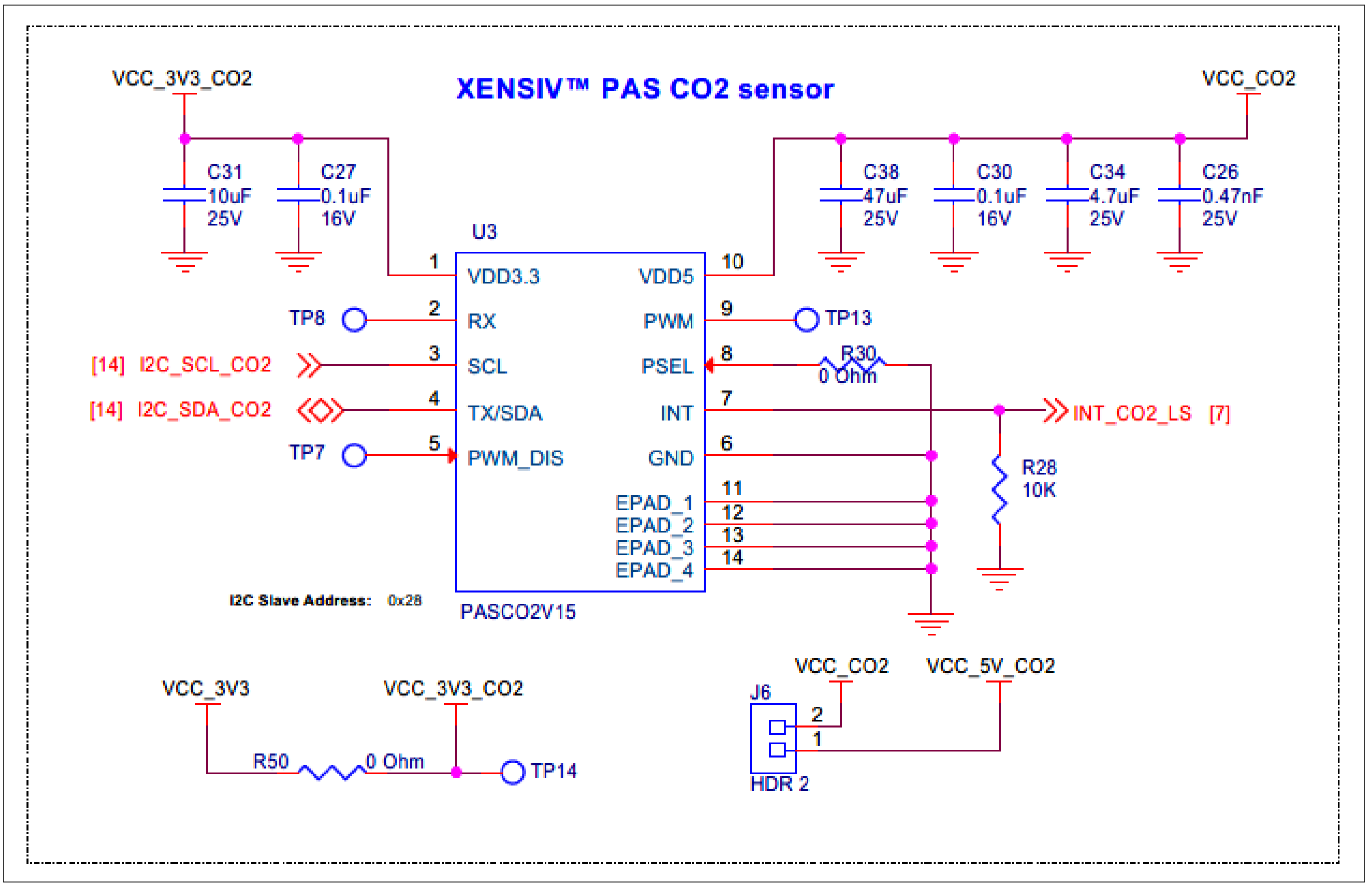


Figure 41 Schematic of XENSIV™ PAS CO2 sensor interface

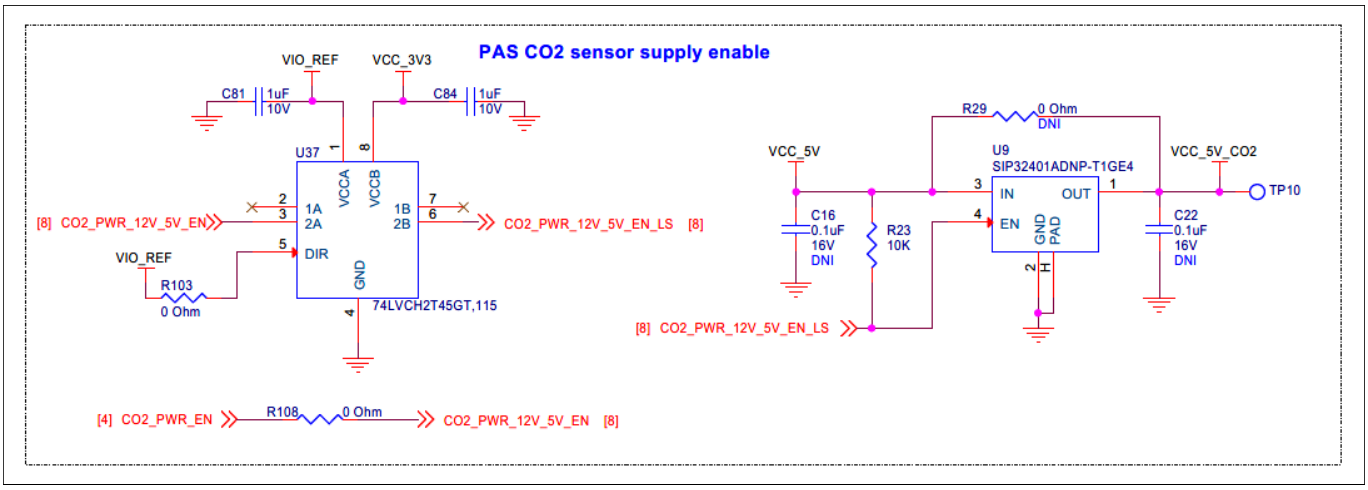


Figure 42 Schematic of CO2 sensor power enable interface

Note: *Ensure the 5 V supply is enabled before initializing the PAS CO2 sensor in the application firmware of the host MCU.*

Level translation and interface: To ensure compatible logic levels between the sensor and the host MCU, an I²C level translator (U34) and an I/O level translator (U11) for interrupt signals are used. The level-translated I²C interface and level-translated interrupt signal, routed through an OR logic gate (U20, U25, and U31), are connected to the Headers compatible with Arduino (J1, J2, J3, and J4) for seamless interface with the base board.

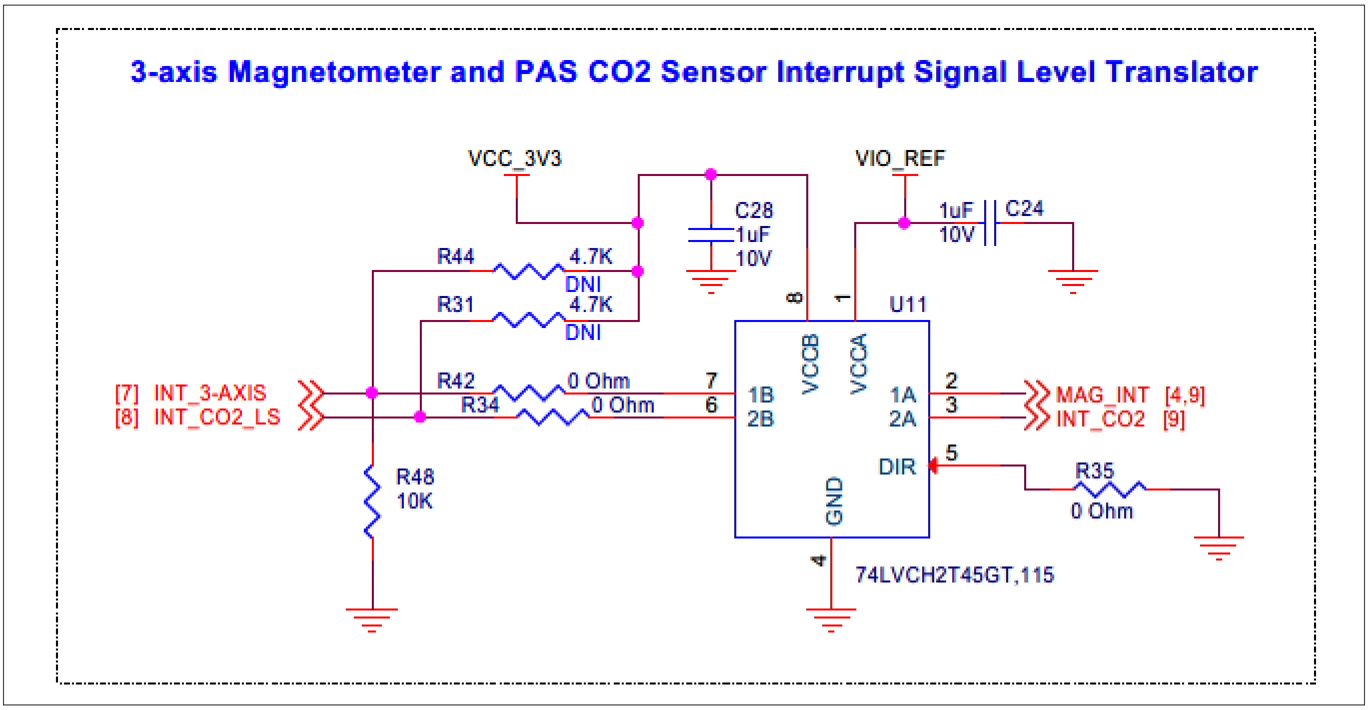


Figure 43 **Schematic of CO2 sensor interrupt level translator interface**

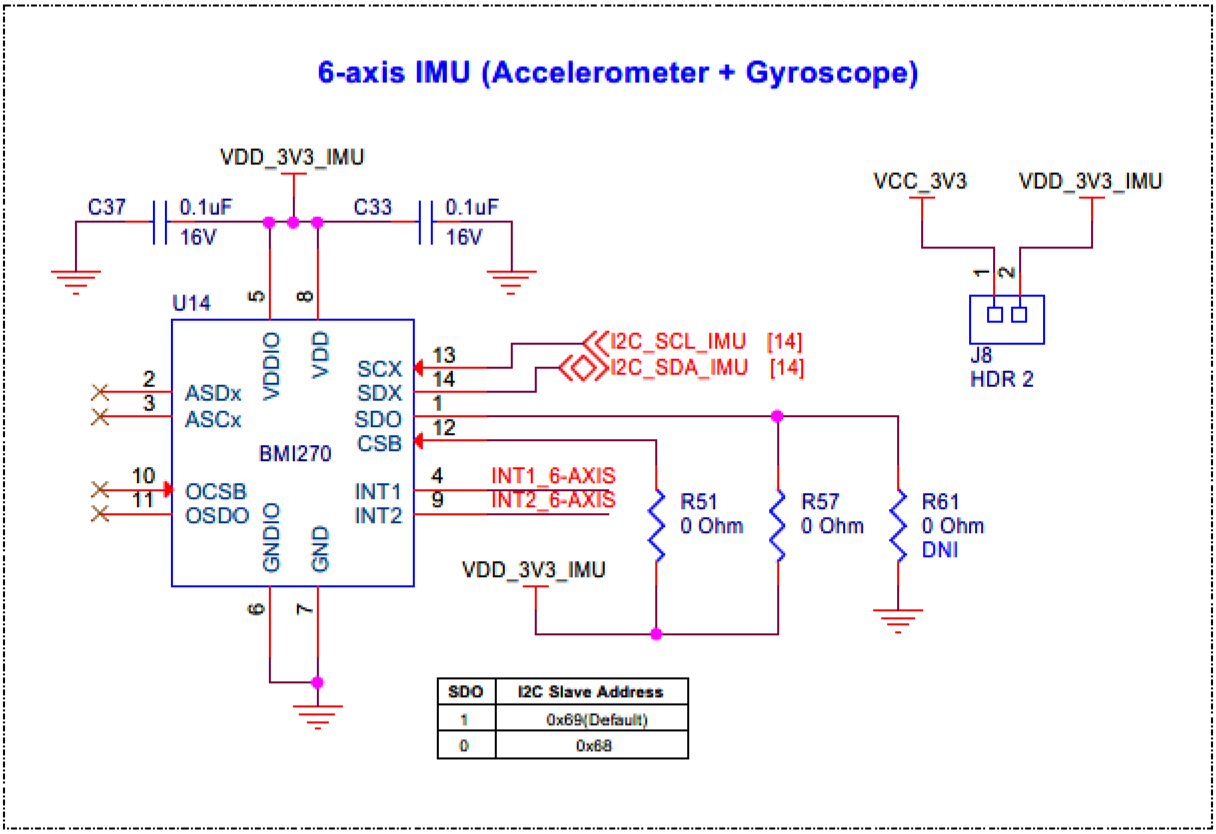
3.2.4.2 6-axis IMU (accelerometer + gyroscope)

The XENSIV™ sensor shield features a 6-axis motion sensor (U14), also known as the inertial measurement unit (IMU), which provides precise 3-axis acceleration and 3-axis gyroscopic angular rate data in each spatial direction. This allows for accurate measurement of the sensor's orientation, position, and movement.

Sensor interface and configuration: The sensor utilizes an I²C interface for communication with the host MCU, along with two interrupt signals connected to the *INT1* and *INT2* pins of the sensor. These interrupt signals can be used to trigger specific actions or events within the system.

I²C address configuration

- Default I²C address: 0 x 69
- Configurable I²C address: 0 x 68 (by removing R57 and populating R61)



SDO	I2C Slave Address
1	0x69(Default)
0	0x68

Figure 44 **Schematic of the 6-axis IMU (accelerometer + gyroscope)**

To ensure compatible logic levels between the sensor and the host MCU, an I^2C level translator (U34) and an I/O level translator (U12) for interrupt signals are employed. The interrupts are configured with active high logic and are pulled down with 10K resistors (R52, R33) by default, thereby ensuring reliable and accurate communication between the sensor and the host MCU.

The level-translated interrupt signal is routed through an OR logic gate (U20, U25, and U31), enabling efficient and reliable signal transmission. Additionally, the level-translated I^2C interface and level-translated interrupt signal, processed through the OR logic gate, are connected to the Headers compatible with Arduino (J1, J2, J3, and J4), ensuring a seamless interface with the base board. This allows for seamless integration and easy development of the system.

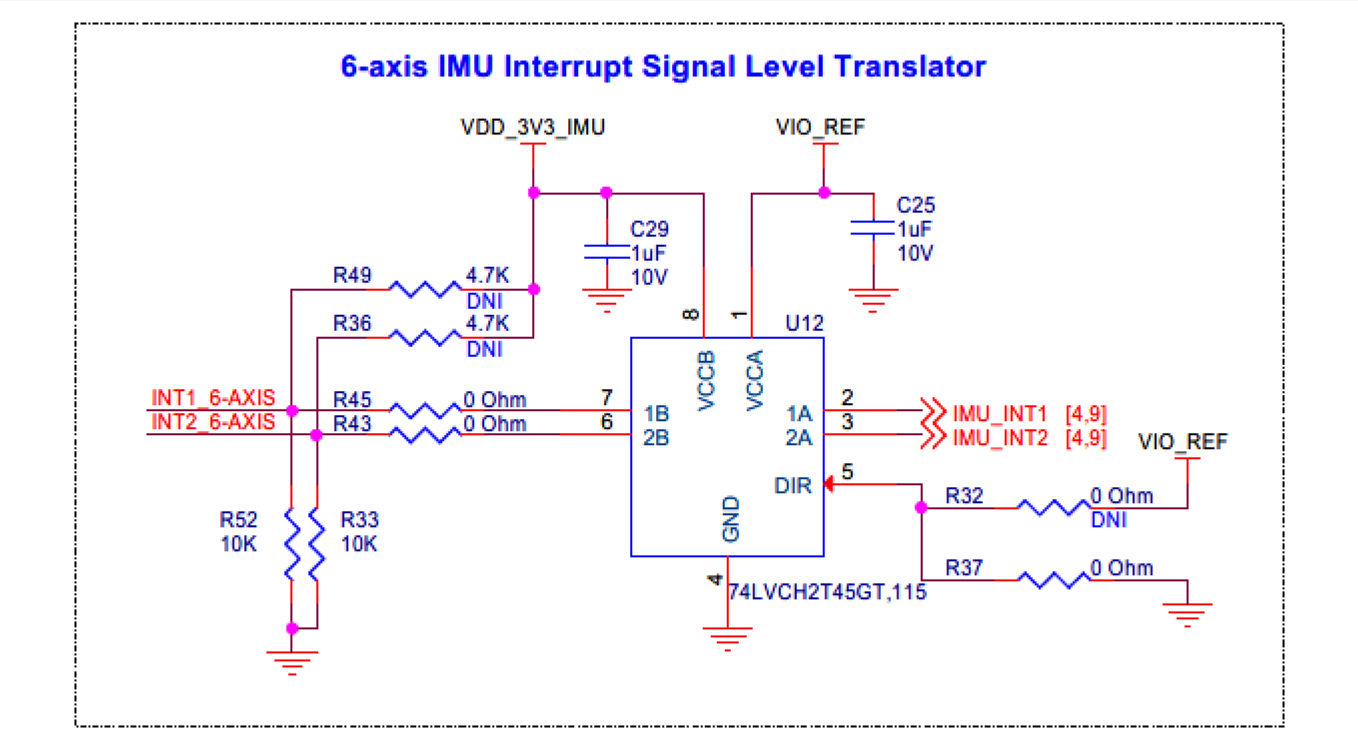


Figure 45 Schematic of the 6-axis IMU interrupt signal level translator

3.2.4.3 3-axis magnetometer

The XENSIV™ sensor shield is equipped with a 3-axis magnetometer sensor (U13), which delivers precise measurements of the direction and strength of the geomagnetic field.

Sensor interface and configuration: The sensor uses an I^{2}C interface to communicate with the Host MCU, accompanied by an interrupt signal connected to the *INT* pin of the sensor. The default I^{2}C address is 0 x 14.

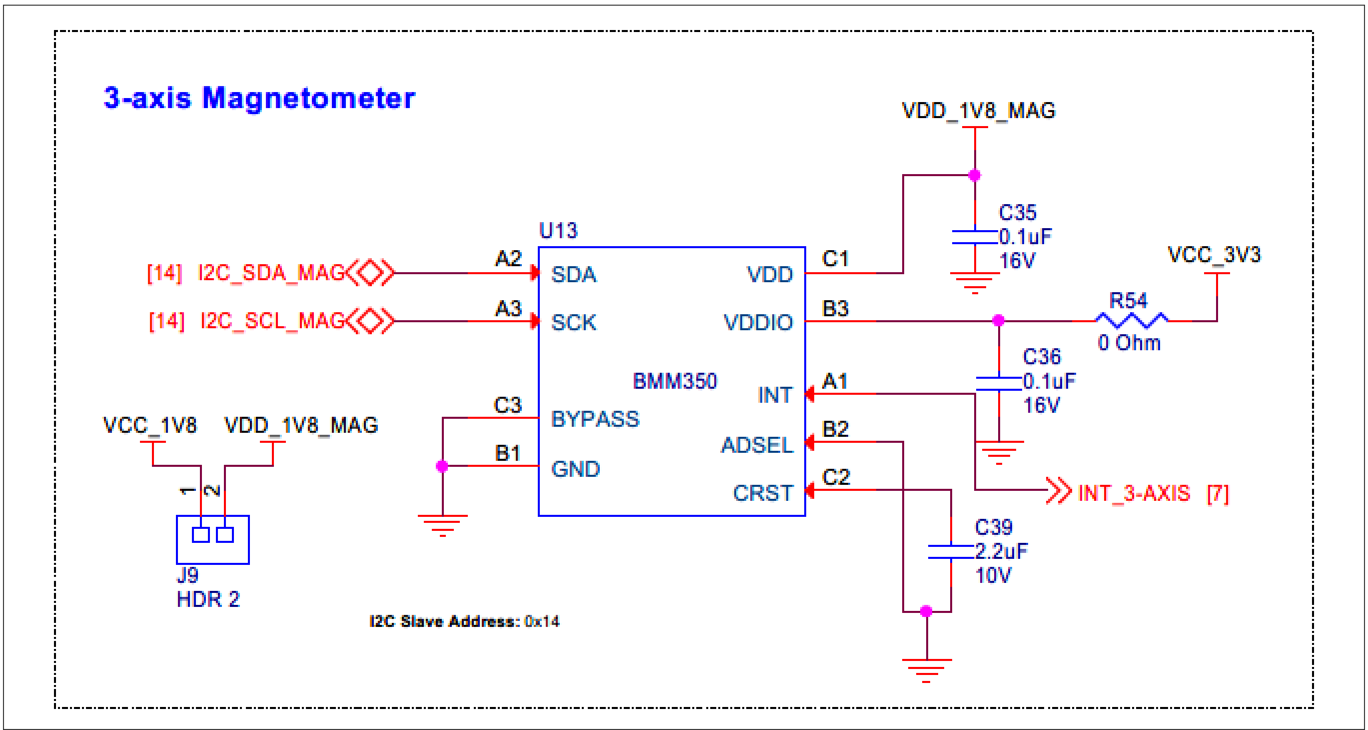


Figure 46 Schematic of a 3-axis magnetometer

Level translation and interface: To ensure compatible logic levels between the sensor and the host MCU, an I²C level translator (U34) and an I/O level translator (U11) for the interrupt signals. The interrupt is configured with active high logic and is pulled down by default with a 10K resistor (R48), ensuring reliable and accurate communication between the sensor and the host MCU.

The level-translated interrupt signal is routed through an OR logic gate (U20, U25, and U31), enabling efficient and reliable signal transmission. Both the level-translated I²C interface and the level-translated interrupt signal are connected to the Headers compatible with Arduino (J1, J2, J3, and J4), ensuring a seamless interface with the base board. This facilitates easy integration and development of the system.

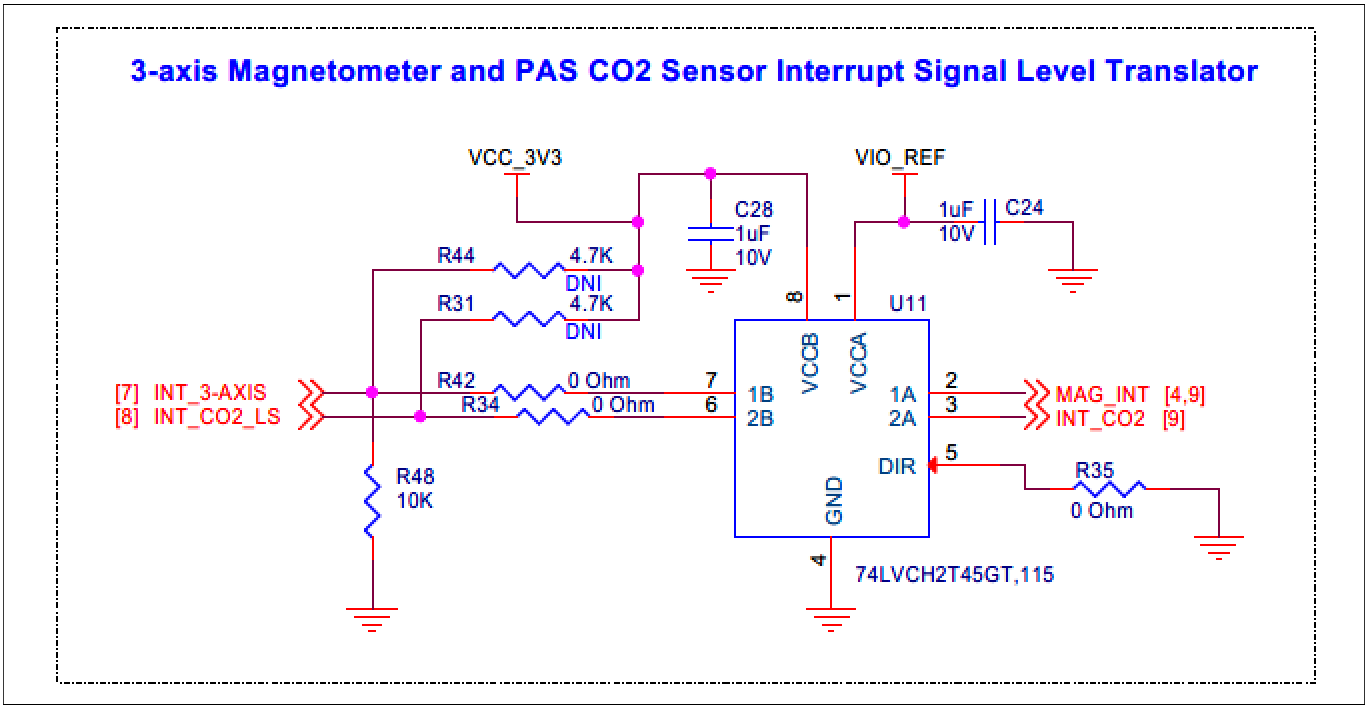


Figure 47 Schematic of the 3-axis magnetometer interrupt signal level translator

3.2.4.4 Digital humidity sensor

The XENSIV™ sensor shield features a digital humidity sensor SHT35 (U17), which comes equipped with a built-in temperature sensor. This sensor communicates with the host MCU via the I²C protocol.

I²C device address configuration: The *ADDR* pin of the humidity sensor is pulled down with a 10K resistor (R69). This configuration determines the 7-bit I²C device address of the sensor, which is dependent on the *ADDR* pin configuration.

- **Default configuration**: If the pull-down resistor is loaded, the I²C device address is 0 x 44
- **Alternative configuration**: If the pull-up resistor (R68) is loaded, the I²C device address is 0 x 45

Sensor interface and power supply: The SHT35 humidity sensor uses an I²C interface to communicate with the host MCU, accompanied by an interrupt signal, `HS_INT_LS`. Additionally, the sensor's power supply pin (*VDD*) is connected to a 3.3 V supply.

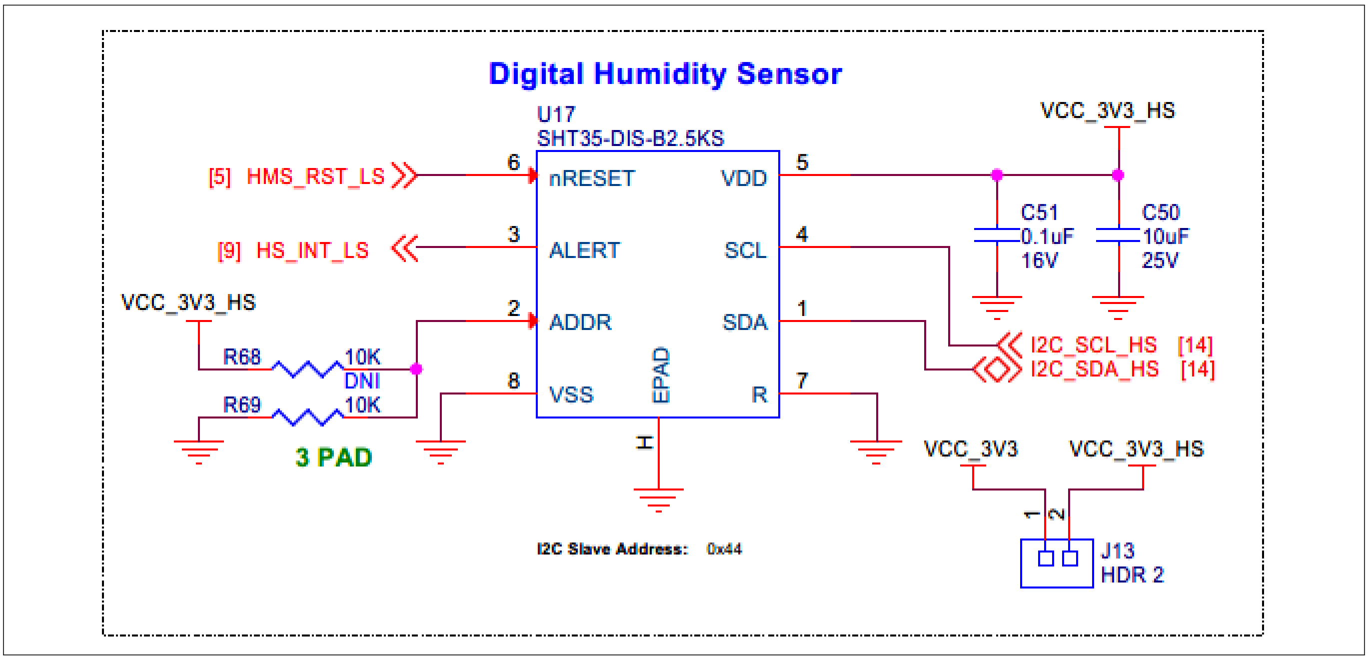


Figure 48 Schematic of the digital humidity sensor interface

Level translation and interface: To ensure compatible logic levels between the sensor and the host MCU, an I²C level translator (U34) and an I/O level translator (U23) for interrupt signals are used. The level-translated I²C interface and the level-translated interrupt signal, which are routed through an OR logic gate (U20, U25, and U31), are connected to the Headers compatible with Arduino (J1, J2, J3, and J4) for seamless interface with the base board.

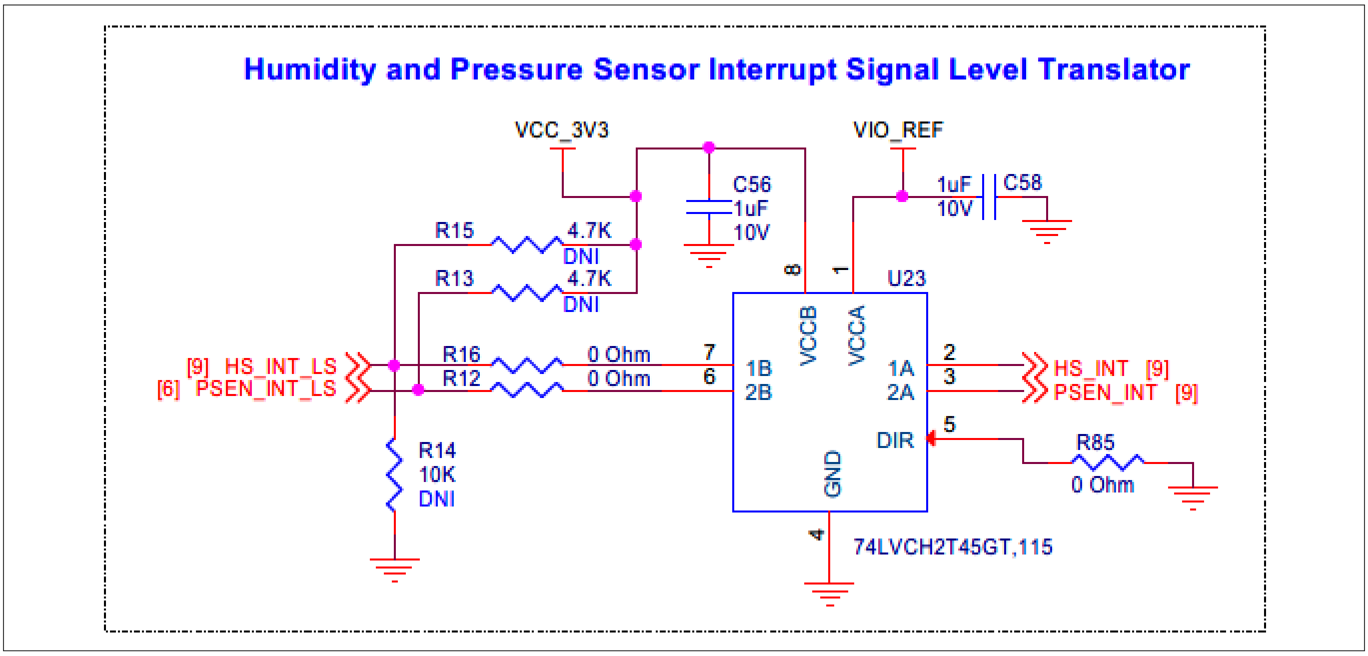


Figure 49 Schematic of the humidity sensor interrupt level translator interface

3.2.5 Audio subsystem

3.2.5.1 XENSIV™ MEMS digital microphones

The XENSIV™ sensor shield features two Infineon's digital PDM MEMS microphones, IM72D128V01XTMA1 (U5 and U4), which share a common PDM bus.

PDM microphone configuration: Each PDM microphone has a *SELECT* pin that determines the edge of the PDM clock on which the PDM data is available:

- If the *SELECT* pin is connected to GND, the PDM data is available on the falling edge of the PDM clock
- If the *SELECT* pin is connected to VDD, the PDM data is available on the rising edge of the PDM clock

Microphone interface configuration: The XENSIV™ sensor shield is configured as follows:

- The left PDM microphone (U5) has its *SELECT* pin tied to GND, making the PDM data available on the falling edge of the `PDM_CLK_IN`
- The right PDM microphone (U4) has its *SELECT* pin tied to `VDD_MIC`, making the PDM data available on the rising edge of the `PDM_CLK_IN`

Power supply options

The microphones can be powered from either 3.3 V or 1.8 V through a header (J10) and a jumper, providing flexibility in design and implementation.

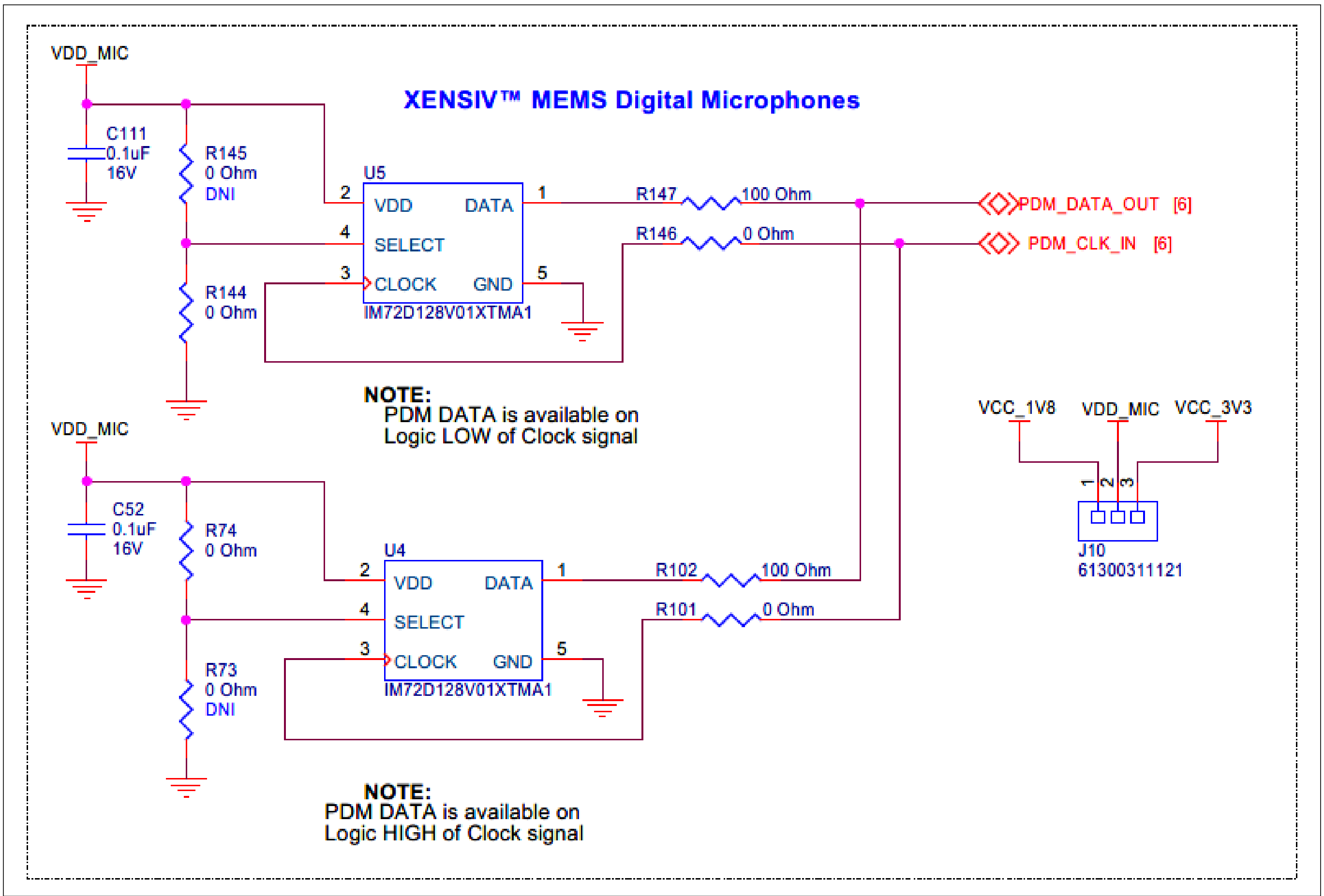


Figure 50 Schematic of XENSIV™ MEMS digital microphone interface

Level translation and interface: The PDM interface signals are level-translated to the baseboard I/O levels using level translators U44 and U45. These translators are connected to the Headers compatible with Arduino (J1, J2, J3, and J4) for seamless interface with the base board.

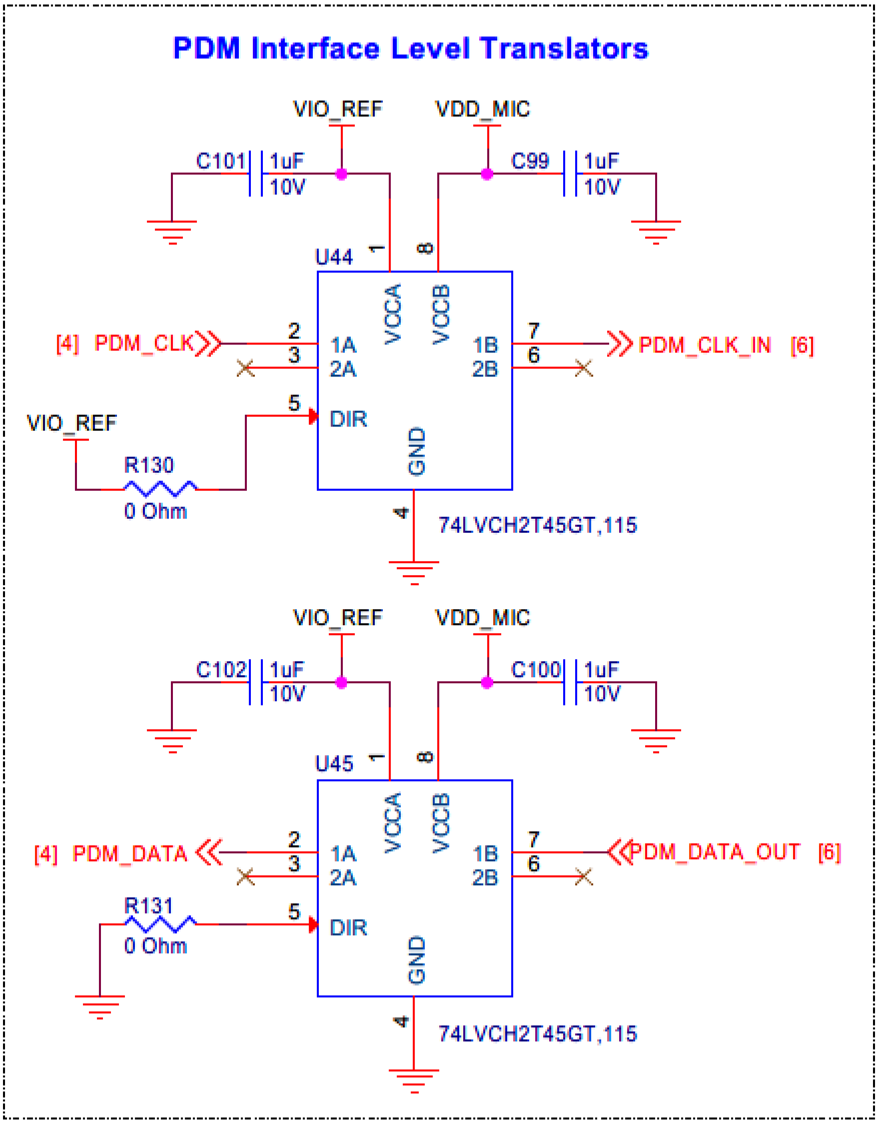


Figure 51 **Schematic of PDM interface level translators**

3.2.6 Radar subsystem

3.2.6.1 XENSIV™ 60 GHz radar sensor

The XENSIV™ sensor shield features Infineon's XENSIV™ 60 GHz radar sensor (U1) BGT60LTR11AIP monolithic microwave-integrated circuit (MMIC), which is equipped with integrated transmitting and receiving antennas. This sensor incorporates the antennas in package (AIP) concept, eliminating the need for antenna design complexity at the user's end and enabling the use of standard FR4 materials for PCB designing. See the Radar sensor webpage for more details. The BGT60LTR11AIP radar sensor uses the *TDET* and *PDET* pins connected to LEDs (D1 and D2) to indicate motion detection and the direction of motion.

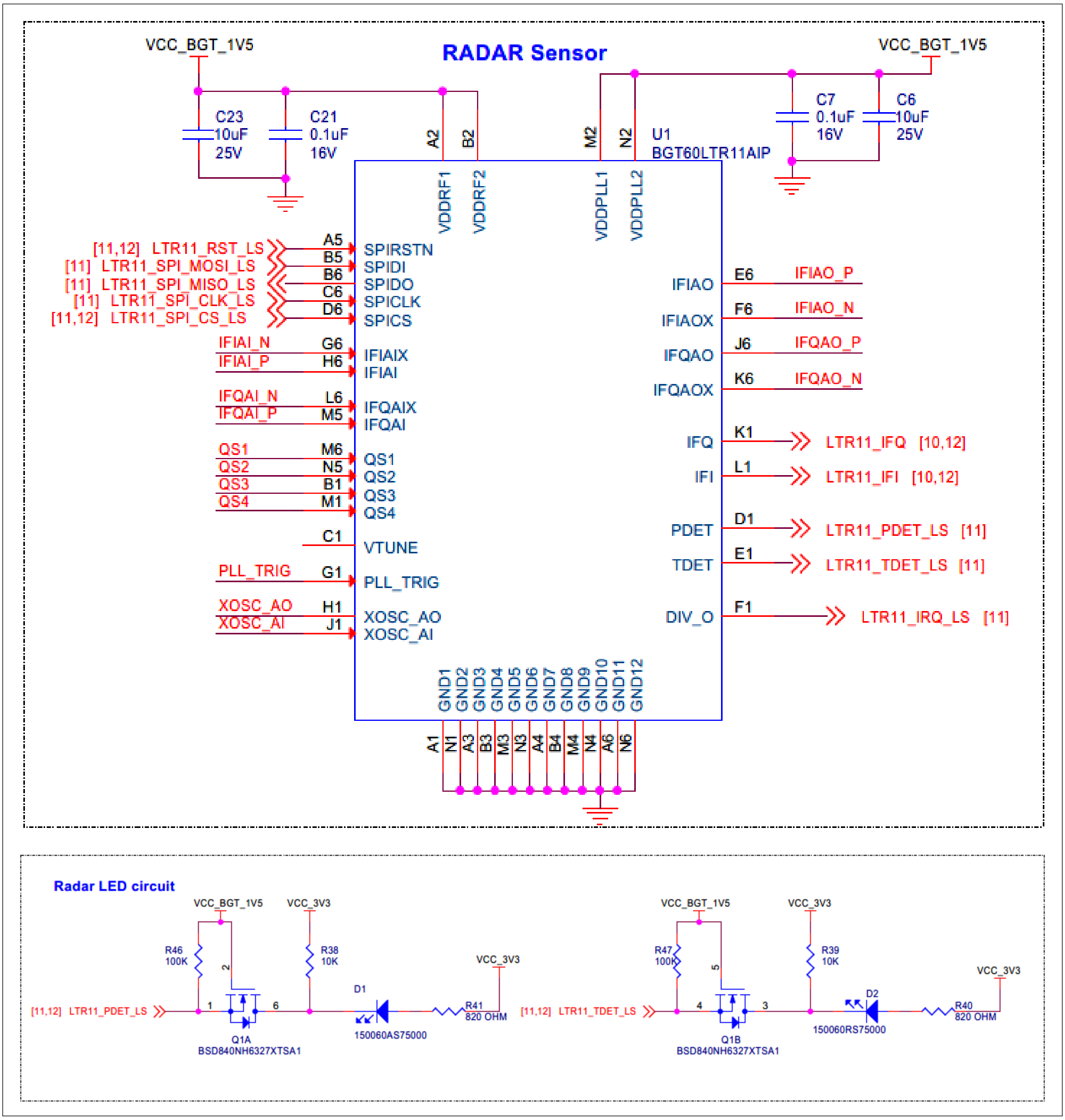


Figure 52 **Schematic of the onboard radar sensor interface**

The radar sensor uses external sample and hold capacitors for the analog IF signals coming out of the sensor.

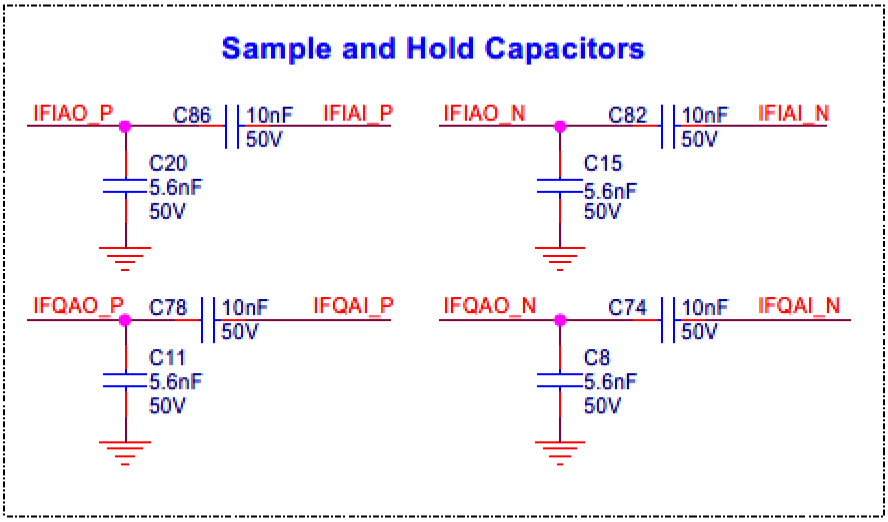


Figure 53 **Schematic of the onboard radar sample and hold capacitors**

External low-pass filters are used for filtering IF signals on the onboard radar sensor.

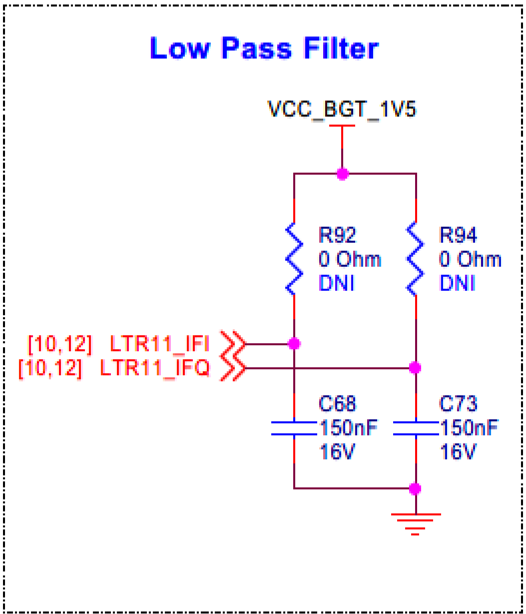


Figure 54 **Schematic of the external IF low-pass filters used on the onboard radar sensor**

A current measurement header (J7) is provided to measure the onboard radar sensor.

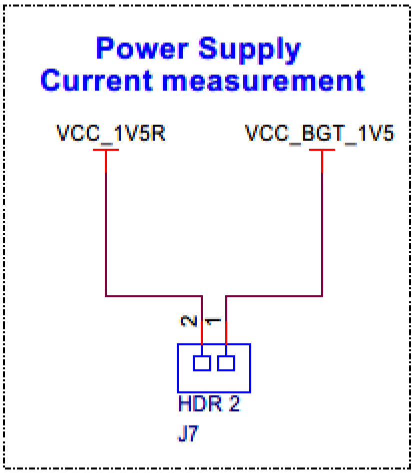


Figure 55 **Schematic of the onboard radar sensor current measurement header**

Figure 36 illustrates how an onboard crystal (Y1) feeds a 38.4 MHz clock input to the radar sensor.

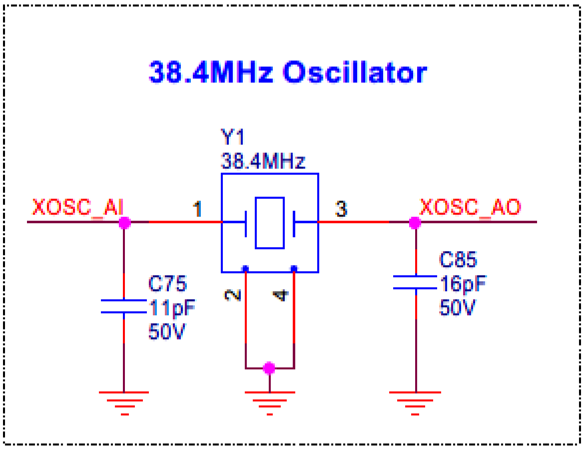


Figure 56 **Schematic of the crystal used for the radar sensor clock input**

The radar sensor parameters can configured using resistor provisions provided on the sensor shield. The onboard radar is configured to autonomous mode by default.

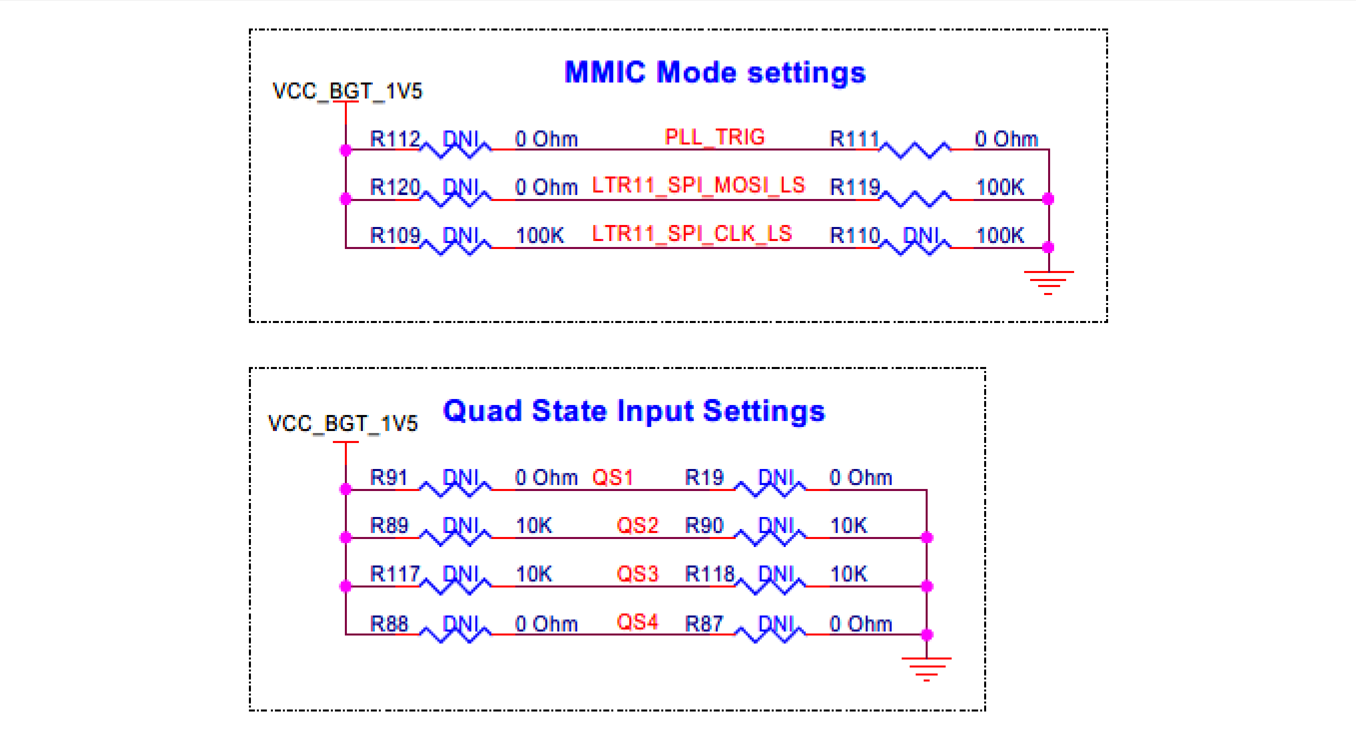


Figure 57 **Schematic of the onboard radar MIMC mode and quad state settings**

To enable other modes of the onboard radar sensor, see Table 5.

Table 5 **MIMC and quad state configurations for the onboard radar sensor operating modes**

Resistor setting	Operating mode
Mount R19 with 0 Ω resistor	Autonomous CW mode
Open R91 and R19 resistors	Autonomous pulsed mode
Mount R91 with 100 kΩ resistor	SPI mode with external 9.6 MHz clock enabled
Mount R91 with 0 Ω resistor	SPI mode

3.2.6.2 External radar sensor shield interface connector

The XENSIV™ sensor shield features two Hirose DF40HC(3.5)-20DS-0.4 V connectors (J15 and J5), offering high-density, high-reliability interfaces for external radar sensors. To connect to these interfaces, an external radar interface board with a matching mating connector (DF40C-20DP-0.4 V) is required.

These connectors provide a comprehensive set of signals, including:

- **Power supply lines**: 3.3 V, 1.8 V, 1.5 V, and GND, ensuring reliable power delivery to the external radar sensor
- **Digital interfaces**: SPI interface enabling communication between the host MCU and the external radar sensor
- **Control GPIO**: Dedicated general-purpose input/output lines (GPIO) for controlling the external radar sensor
- **Analog IF signals**: High-frequency analog signals from the external radar sensor, enabling advanced radar processing and analysis from the ADC of host device in the base board
- **GPIOs with configurable functionalities**: Programmable GPIO lines that can be configured to support various functions, such as interrupt handling, clock signals, or other custom applications

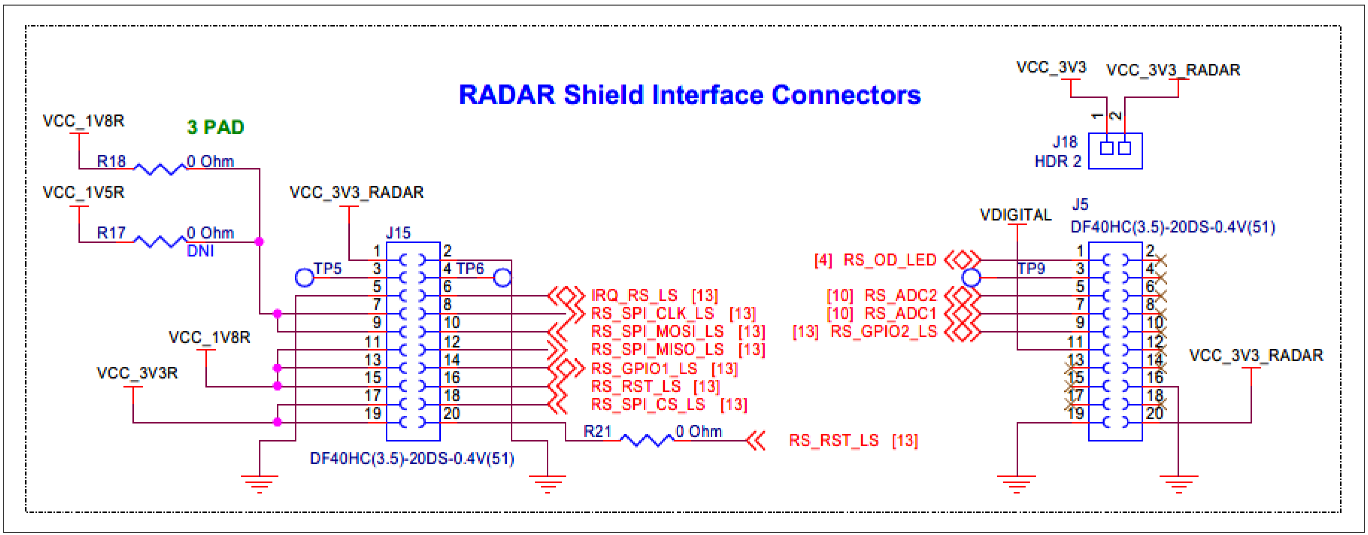


Figure 58 Schematic of the external radar interface connectors

3.2.6.3 Multiplexing of onboard and external RADAR interfaces

The XENSIV™ sensor shield multiplexes RADAR interface signals between the onboard RADAR and the external interface connector, enabling seamless switching between the two interfaces.

The RADAR_SEL_LS signal, a digital control signal, is responsible for selecting between the onboard RADAR interface (when RADAR_SEL_LS = 0) and the external interface (when RADAR_SEL_LS = 1).

The multiplexing is achieved using analog switches that select between the onboard and external RADAR signals based on the RADAR_SEL_LS signal. The specific multiplexing configurations are as follows:

- RADAR Reset signal
- RADAR Analog IF signal
- RADAR SPI interface
- RADAR GPIO signals

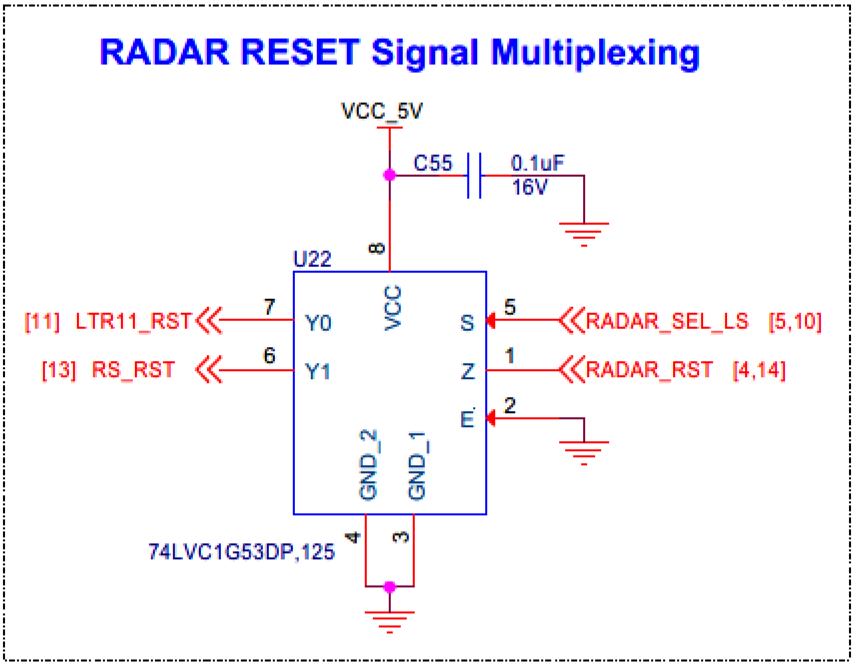


Figure 59 **Schematic of RADAR reset signal multiplexing**

Apart from the `MAIN_RST` and `XRES` of host MCU as reset source, an additional dedicated reset signal provided from the baseboard through Arduino headers.

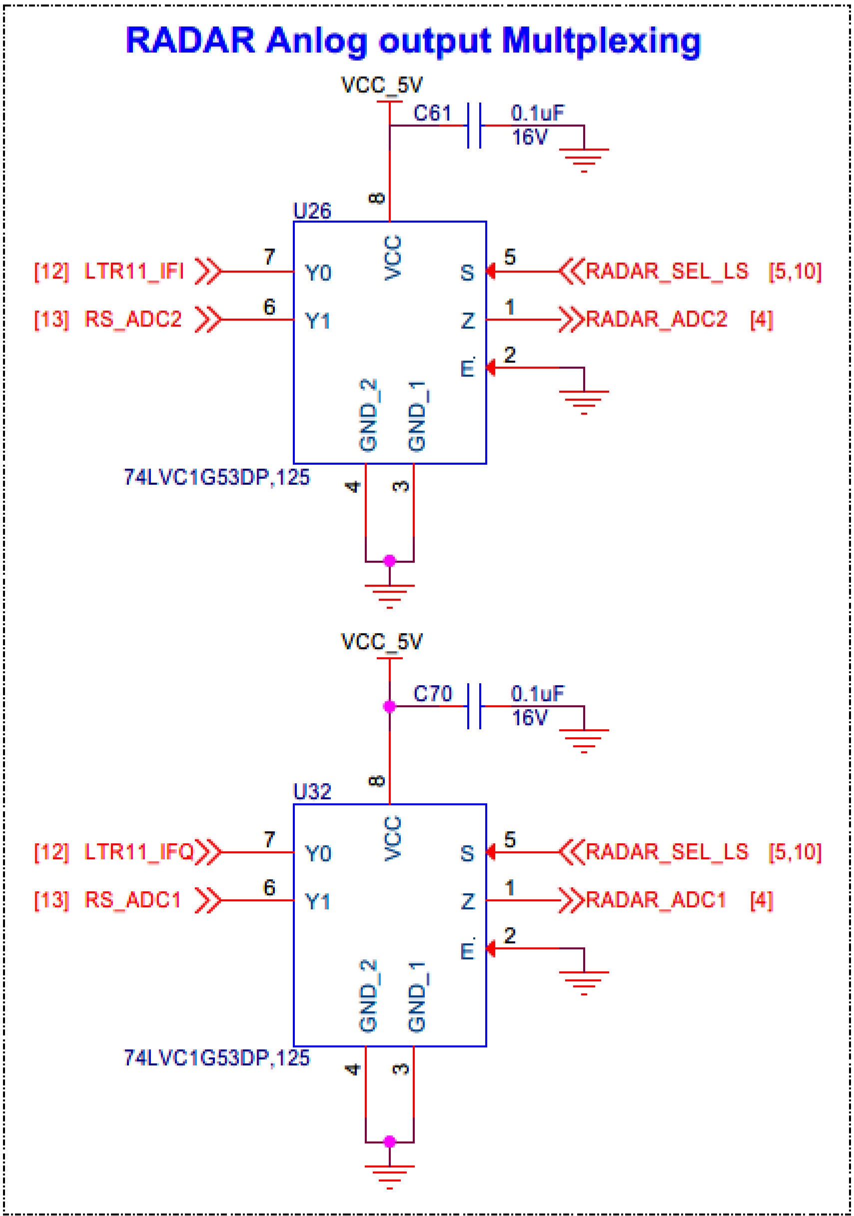


Figure 60 **Schematic of RADAR Analog IF signal multiplexing**

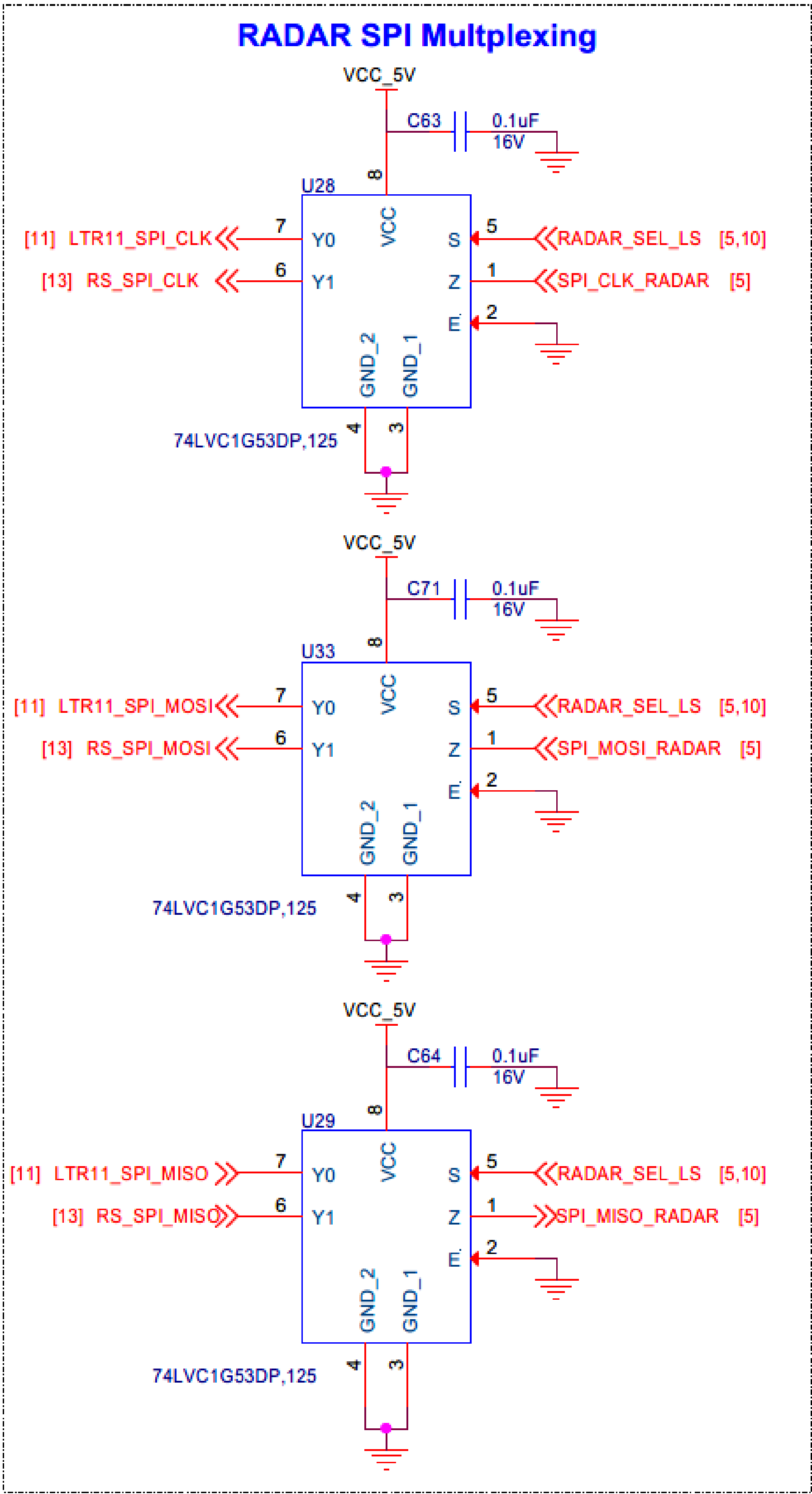


Figure 61 **Schematic of RADAR SPI interface multiplexing**

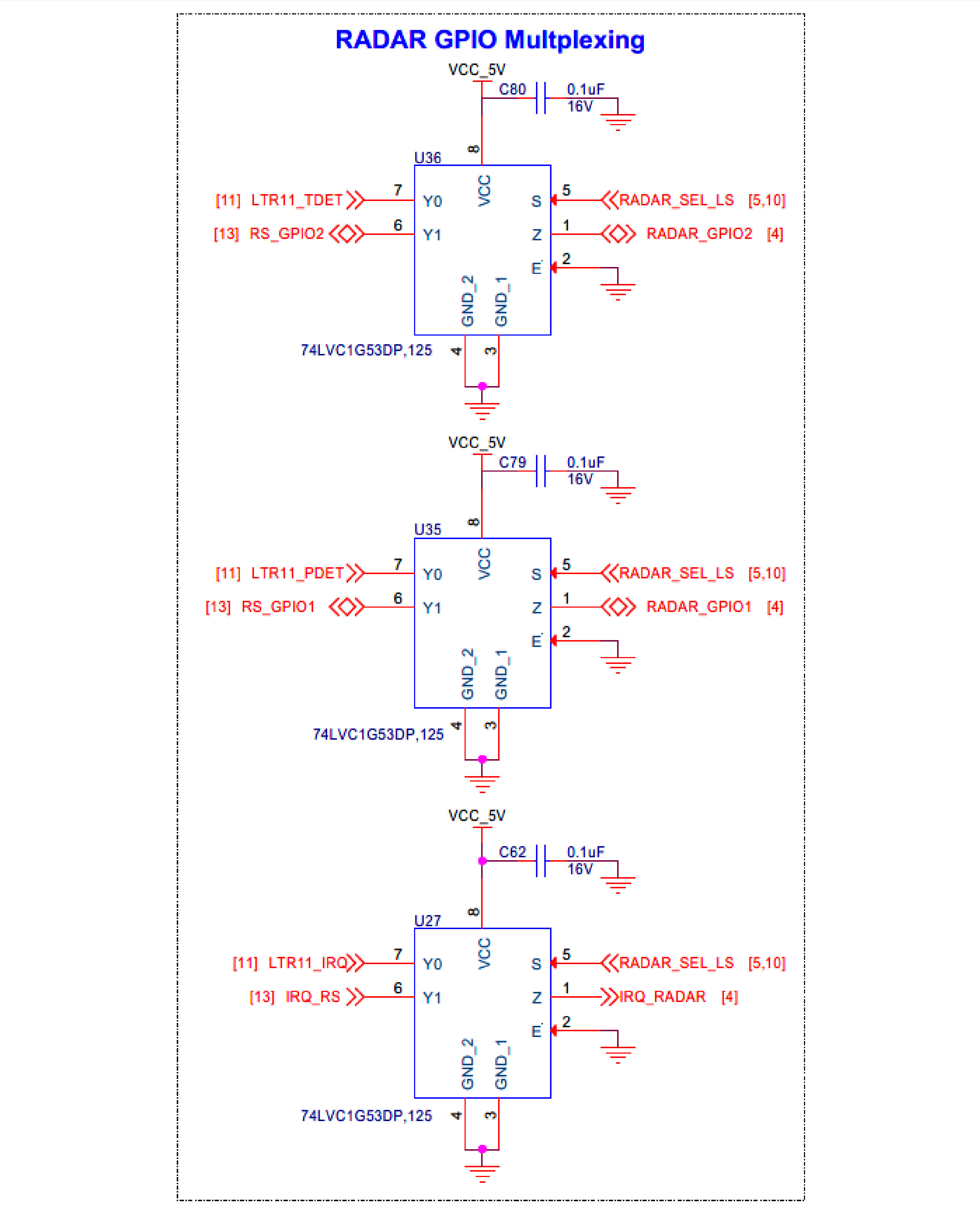


Figure 62 **Schematic of RADAR GPIO multiplexing**

These multiplexed signals were level translated to the RADAR sensor I/O levels.

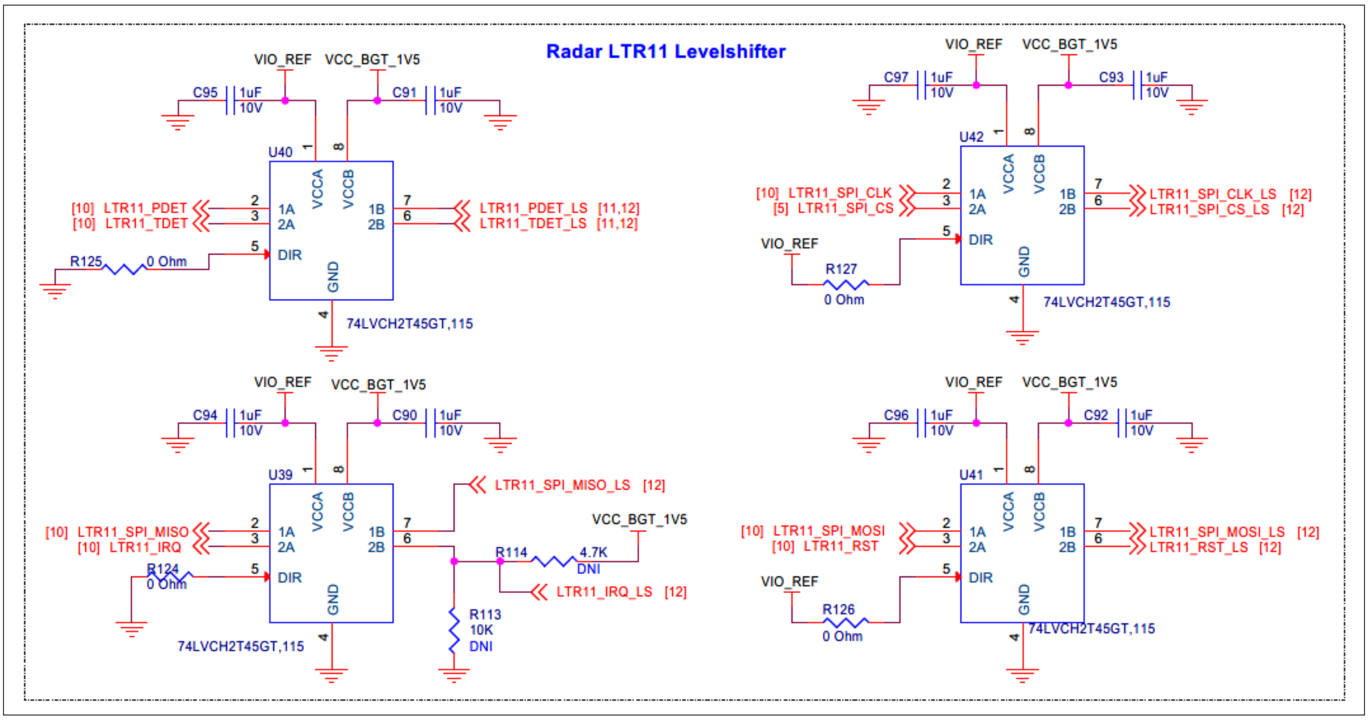


Figure 63 **Schematic of the onboard RADAR digital interface signal level translators**

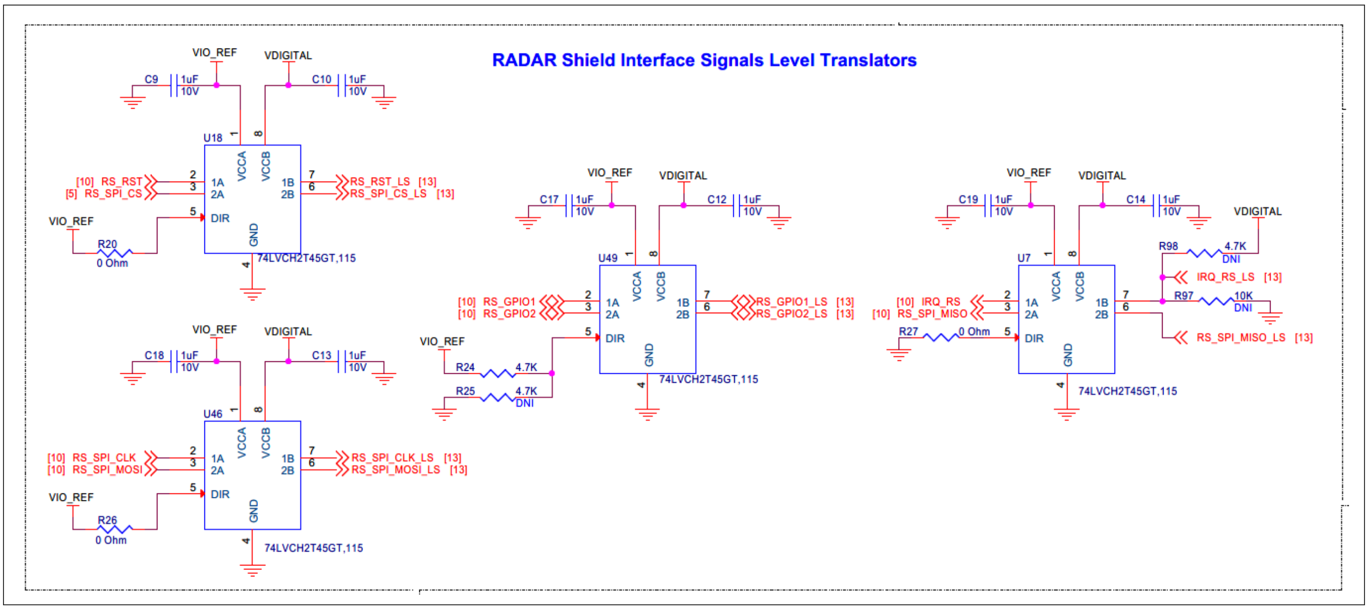


Figure 64 **Schematic of the external RADAR digital interface signal level translators**

3.2.7 Security subsystem

3.2.7.1 OPTIGA™ Trust M device

The XENSIV™ sensor shield features an OPTIGA™ Trust M device (U6), a highly secure embedded security device that provides advanced security features for IoT applications. The OPTIGA™ Trust M device is interfaced over I^{2}C, enabling secure communication and data exchange between the device and the baseboard.

Power supply

The OPTIGA™ Trust M device is powered by a 3.3 V power supply, ensuring reliable and efficient operation.

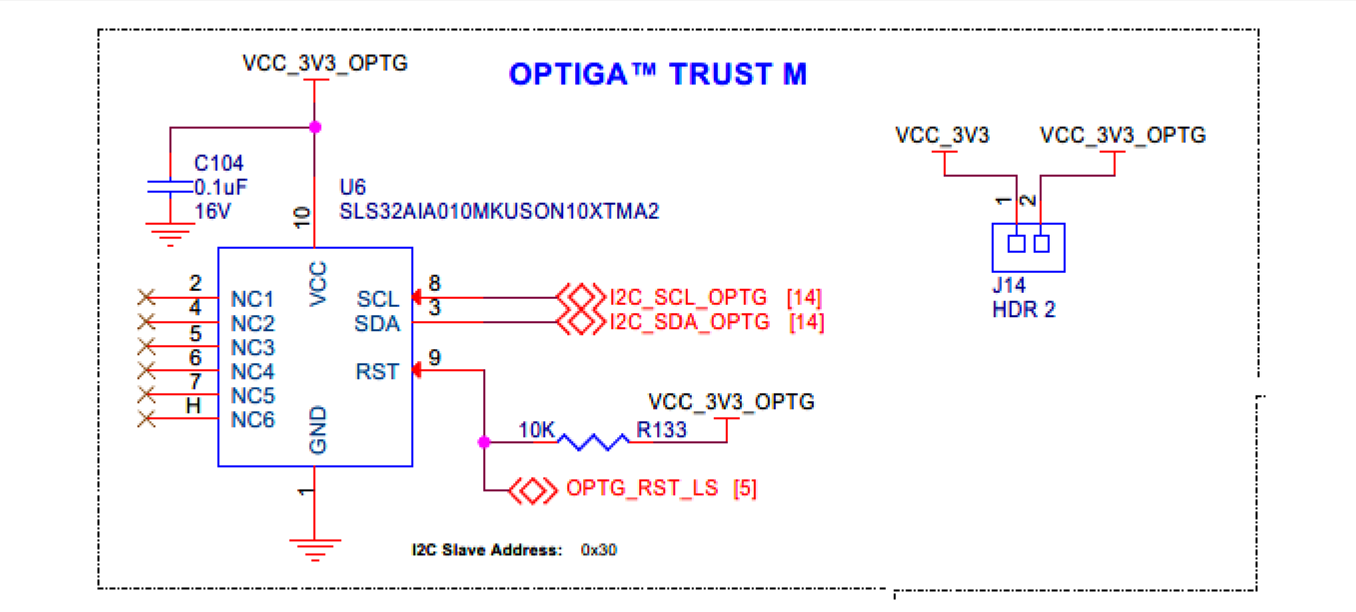


Figure 65 Schematic of OPTIGA™ Trust M device interface

I²C interface and level translation: To ensure compatible logic levels between the OPTIGA™ Trust M device and the host MCU signal levels, an I²C level translator (U34) is utilized. The level-translated I²C interface is connected to the Headers compatible with Arduino (J1, J2, J3, and J4) for seamless interface with the base board.

Reset signal and level translation: The reset signal from the baseboard is also level-translated to 3.3 V on the shield using an I/O level translator (U43), ensuring a clean and stable signal to the OPTIGA™ Trust M device.

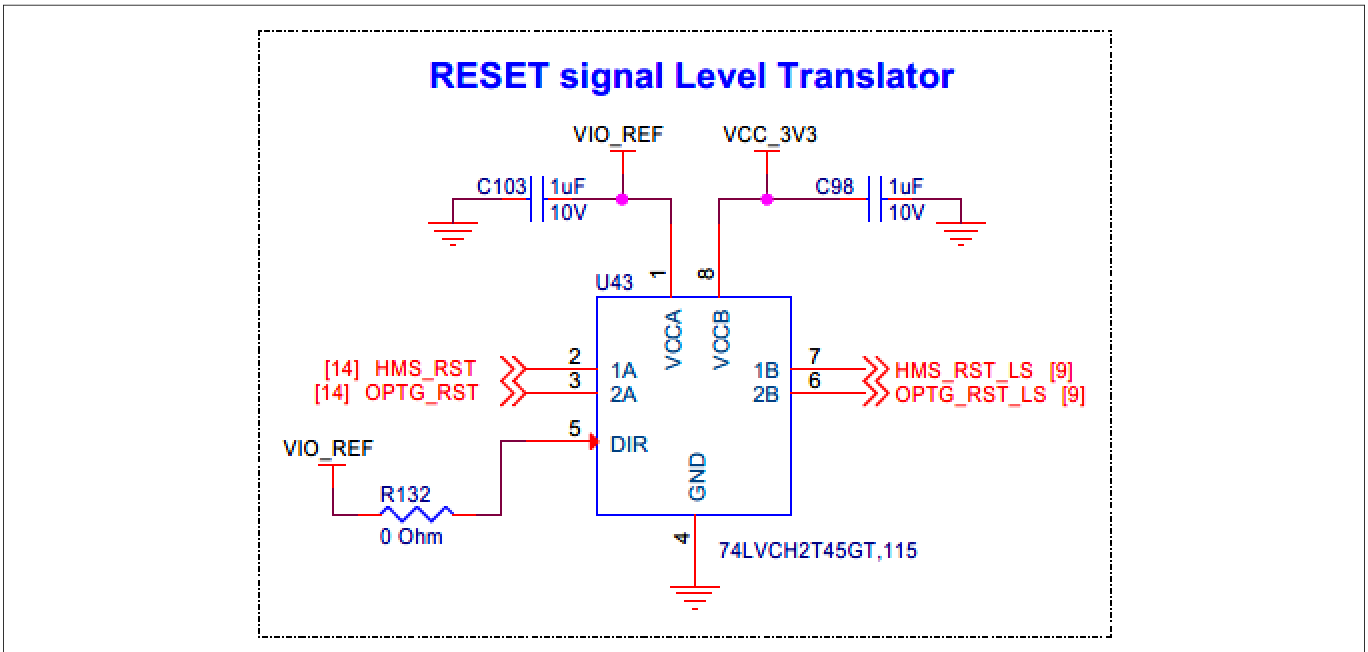


Figure 66 Schematic of OPTIGA™ Trust M reset signal level translator

3.2.8 TFT display

The XENSIV™ sensor shield features a 0.96-inch TFT IPS display with a resolution of 80 x 160, powered by the ST7735S controller. The display is equipped with an IPS (in-plane switching) panel, offering a wide viewing direction and supporting 4K/65K/262K colors.

Display interface and connectivity

The host MCU communicates with the display via the 4-wire SPI protocol. The display is connected through an 8-pin FPC connector (J17), with provisions available on the shield to connect chip-on-flex (COF) style display modules.

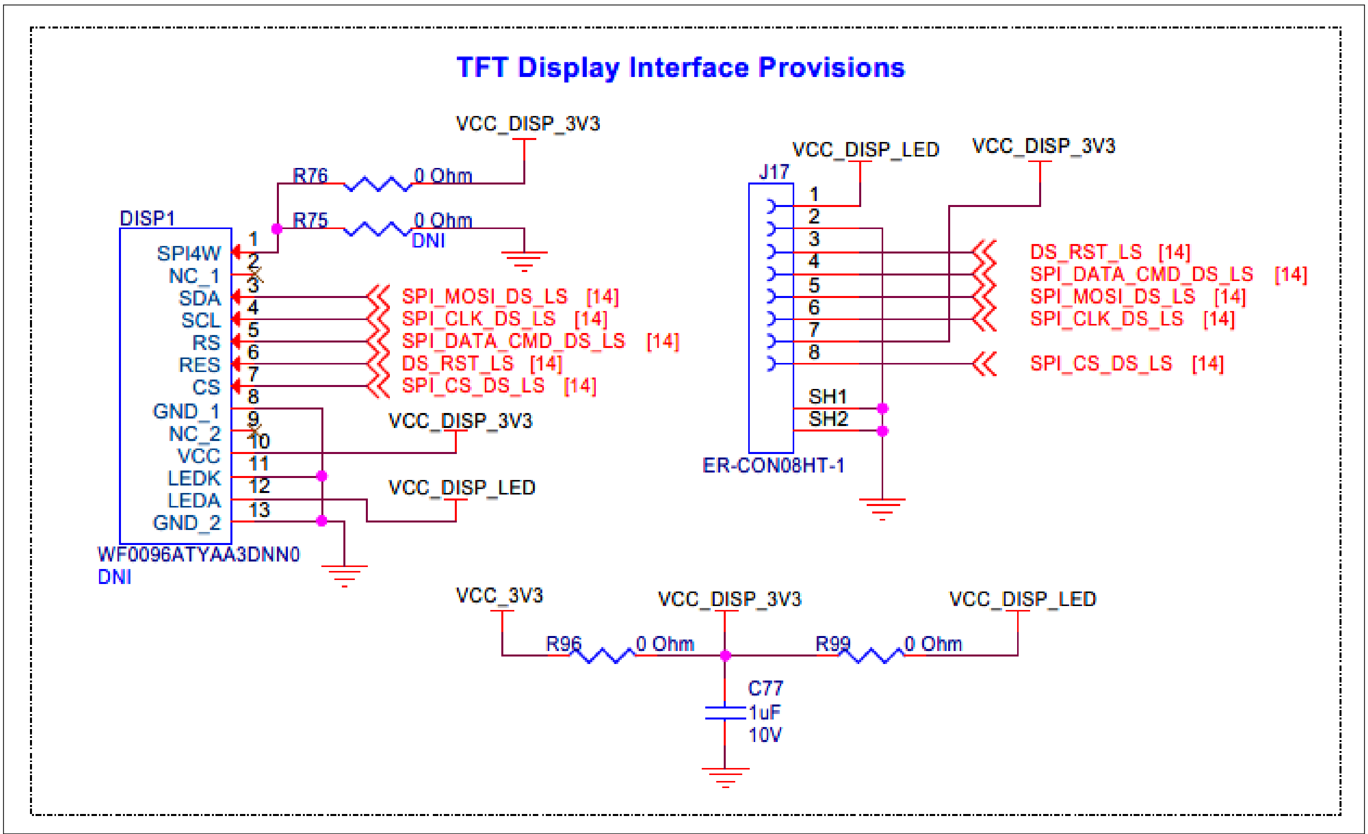


Figure 67 Schematic of TFT display interface

Power supply and level translation

The display uses a 3.3 V supply for both the TFT IPS LCD and backlight. The SPI interface and other control signals from the host MCU, transmitted through the Headers compatible with Arduino (J1, J2, J3, and J4), are level-translated using I/O level translators (U24, U30, and U19).

Reset signal

The reset signal for the display, originating from the DIP switch (SW1), is level-translated and then connected to the display.

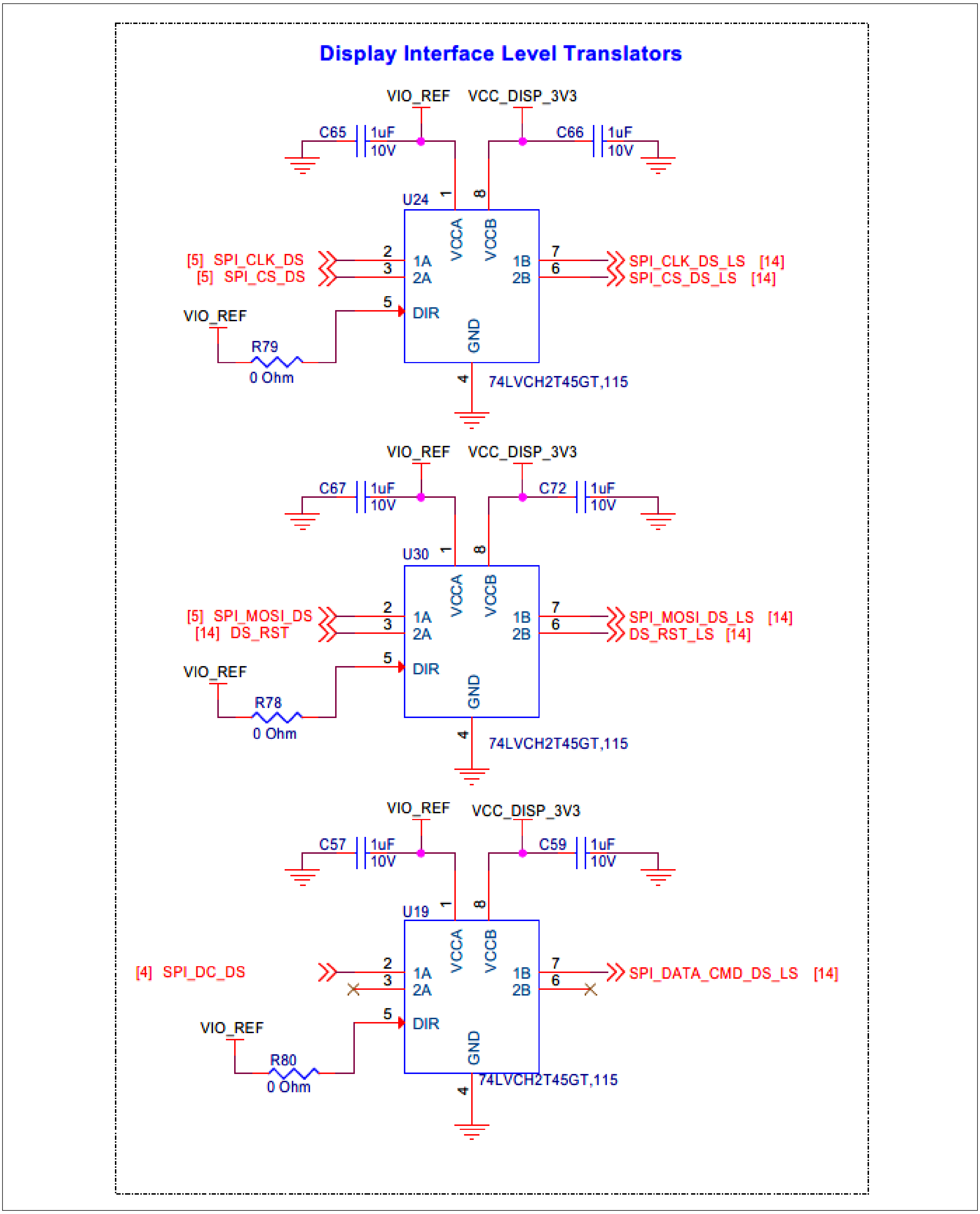


Figure 68 **Schematic of TFT display I/O level translator interface**

3.2.9 I²C interface connector

The XENSIV™ sensor shield features a 4-pin connector (J16) that extends the 3.3 V I/O level translated I²C interface from the baseboard, providing an extension capability specifically designed for adding I²C-based add-on boards. This design allows for expanded functionality and flexibility.

Compatibility with QWIIC connection system

The interface connector is compatible with QWIIC connection system boards, a product of SparkFun. By using the 4-pin connector (J16), you can easily attach QWIIC boards to the shield, expanding its functionality and enabling it to connect and interact with multiple system boards that support the QWIIC system.

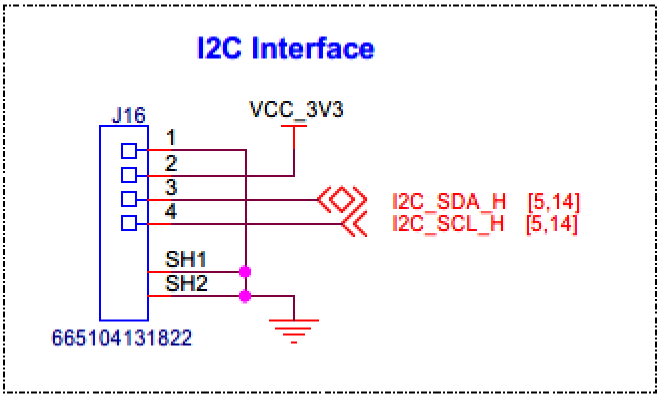


Figure 69 Schematic of the I²C interface connector

3.2.10 Headers compatible with Arduino (J1, J2, J3, and J4)

The XENSIV™ sensor shield features four headers compatible with Arduino: J1, J2, J3, and J4. These headers provide a convenient interface for connecting the baseboard to the sensor shield, enabling the power supply, I²C interface, SPI interface, Analog I/O interface, PDM interface, and control I/O of sensors and display.

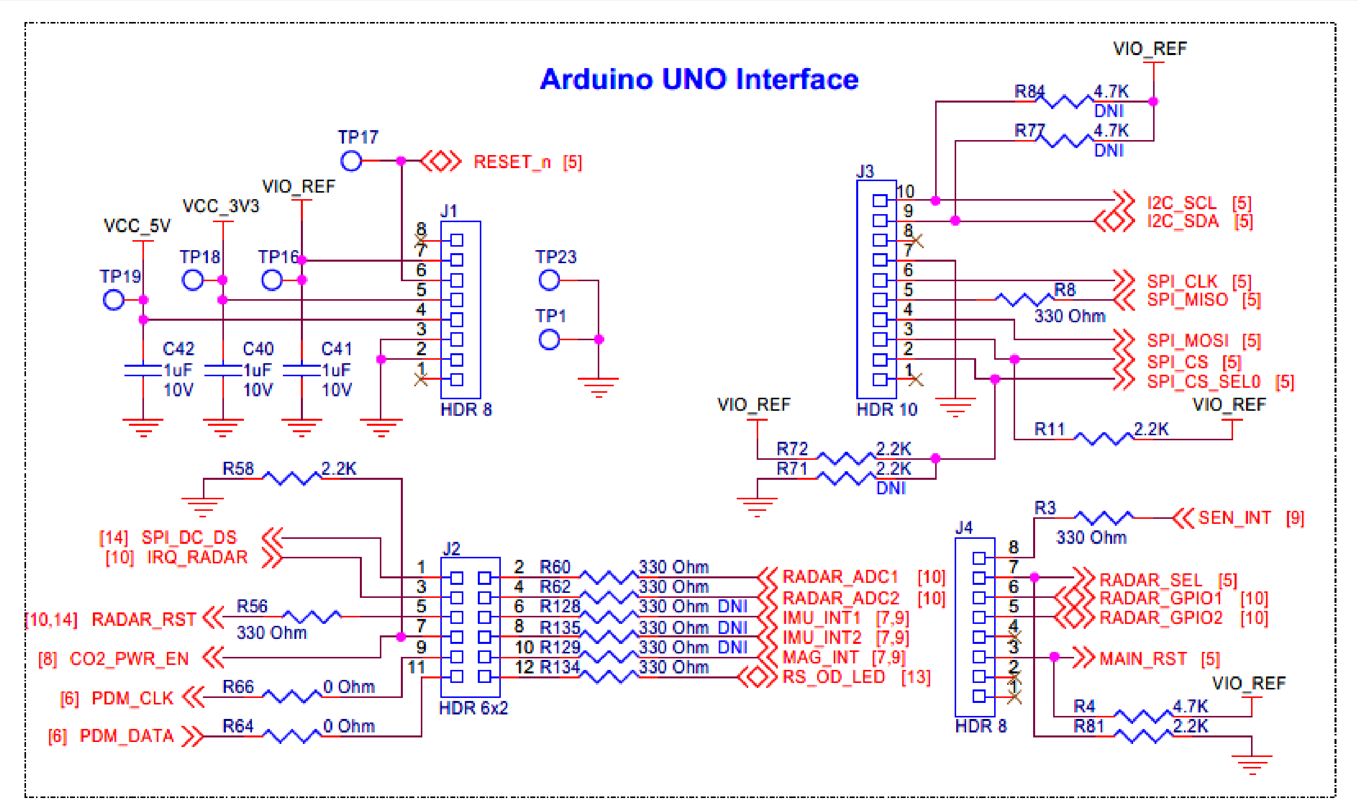


Figure 70 Schematic of the Arduino-compatible header interface

Pin assignments and signal mapping

For detailed information on the pin assignment of the Arduino-compatible headers and signal mapping to the baseboard, see the Board details section.

3.3 Bill of materials

See the Kit webpage for the bill of materials.

Glossary

ADC
Analog-to-digital converter

BOM
Bill of materials

CO2
Carbon dioxide

DC
Direct current

ECO
External crystal oscillator

ESD
Electrostatic discharge

GPIO
General-purpose I/O

I2C
Inter-integrated circuit

IC
Integrated circuit

IDE
Integrated development environment

IMU
Inertial measurement unit

IoT
Internet of things

LED
Light emitting diode

MEMS
Micro-electromechanical system

MIC
Microphone

PAS
Photoacoustic spectroscopy

PC
Personal computer

PCM
Pulse code modulation

PDET
Phase detect

PDL
Peripheral driver library

PDM
Pulse density modulation

PSOC™
Programmable system-on-chip

SDK
Software development kit

SPI
Serial peripheral interconnect

SRAM
Static random-access memory

SWD
Single wire debug

TDET
Target detect

UART
Universal asynchronous receiver or transmitter

USB
Universal serial bus

Revision history

Document version	Date of release	Description of changes
**	2024-09-27	Initial release
*A	2024-12-05	Added the following sections: • Connecting XENSIV™ sensor shield to CYW920829M2EVK-02 Bluetooth® LE MCU • Creating an out-of-box (OOB) application and programming using ModusToolbox™ • Code examples supported for XENSIV™ sensor shield on CYW920829M2EVK-02 • Sensor Hub Android application • Software requirements • Hardware requirements • Installation • Application UI description • Known limitations

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