US082-SSC3224EVZ

Sensor Signal Conditioner Pmod

Description

The US082-SSC3224EVZ evaluation board demonstrates the functionality and performance of the high-end 24-Bit ZSSC3224 sensor. The ZSSC3224 is a sensor signal conditioner IC for high-accuracy amplification and analog-to-digital conversion of a differential or pseudo-differential input signal. The US082-SSC3224EVZ evaluation board is a generic design enabling the customer to embed the sensor into their specific application

The board provides a standard Pmod™ Type 6A (extended I^2C) connection for the onboard sensor to plug into any required MCU evaluation kit with a matching connector. The US082-SSC3224EVZ evaluation board can be added to the end of a daisy-chained solution with multiple Type 6/6A devices on the same MCU Pmod connector.

The measured and corrected sensor values are provided at the digital output pins, which can be configured as I^2C (≤3.4MHz) or SPI (≤20MHz). Digital compensation of signal offset, sensitivity, temperature, and non-linearity is accomplished via a 26-bit internal digital signal processor (DSP) running a correction algorithm. Calibration coefficients are stored on-chip in a highly reliable, non-volatile, multiple-time programmable (MTP) memory. Programming the ZSSC3224 is accomplished via the serial interface.

Board Contents

- US082-SSC3224EVZ Sensor

Features

- Flexible, programmable analog front-end design; up to 24-bit analog-to-digital converter (ADC)
- Fully programmable gain amplifier for optimizing sensor signals: gain range 6.6 to 216 (linear)
- Internal auto-compensated 18-bit temperature sensor
- Digital compensation of individual sensor offset; 1st and 2nd order digital compensation of sensor gain as well as 1st and 2nd order temperature gain and offset drift
- Programmable interrupt operation
- High-speed sensing: for example, 18-bit conditioned sensor signal measurement rate >200s-1
- Typical sensor elements can achieve an accuracy of better than ±0.10% full scale output (FSO) at -40 to 85°C
- Integrated 26-bit calibration math digital signal processor (DSP)
- Standardized type 6A Pmod connector supports
- I^2C/SMBUS extended interface

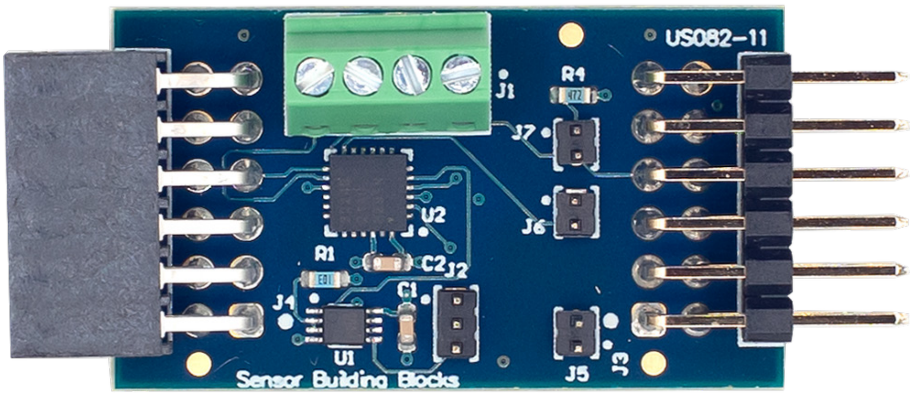

Figure 1. US082-SSC3224EVZ Pmod Board

Contents

Figures

1. Functional Description

The ZSSC3224 Pmod is intended as a quick connect prototyping solution for the ZSSC3224. Figure 2 highlights the main parts of the system.

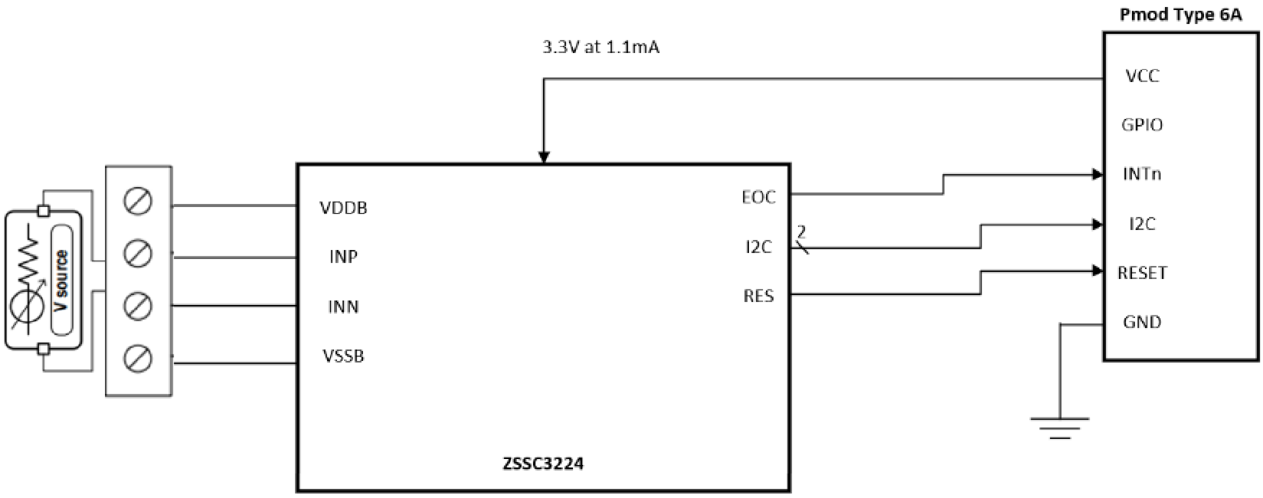

Figure 2. US082-SSC3224EVZ Functional Block Diagram

1.1 Setup and Configuration

The setup and configuration for the US082-SSC3224EVZ Pmod is comprised of the following required or recommended hardware:

- EK-RA6M4 Eval Kit
- USB micro-B cable (provided with EK-RA6M4 board)
- PC running Windows® 10/11 with at least one USB port
- US082-INTERPEVZ

The following software is required or recommended:

- Renesas Flexible Software Package (FSP) v5.2.0 platform installation:
  - e2 studio 2024-01 or later
  - FSP 5.2.0 or later
  - GCC Arm Embedded 13.2.1
- Sample code files (see the US082-SSC3224EVZ product page)

1.1.1 Software Installation and Usage

- Install the latest version of e2 studio.
- Install the latest version of J-Link RTT Viewer.

1.1.2 Kit Hardware Connections

Use the following procedures and refer to Figure 3 to set up the kit.

1. Ensure that the MCU development kit has at least one Type 6A Pmod.
   a. For the EK-RA6M4 board, a PMOD1 connector is available.
2. On the US082-SSC3224EVZ board, populate the J7, J6, and J5 jumpers and leave the other jumpers open.
3. Plug the US082-INTERPEVZ board into PMOD1 of the EK-RA6M4. Care must be taken to align Pin 1 on the Pmod board and MCU kit.
4. Plug in the US082-SSC3224EVZ board to the US082-INTERPEVZ board.
5. Connect the EK-RA6M4 board with a computer using a USB micro-B cable.
6. The device is now ready to be used in the system.

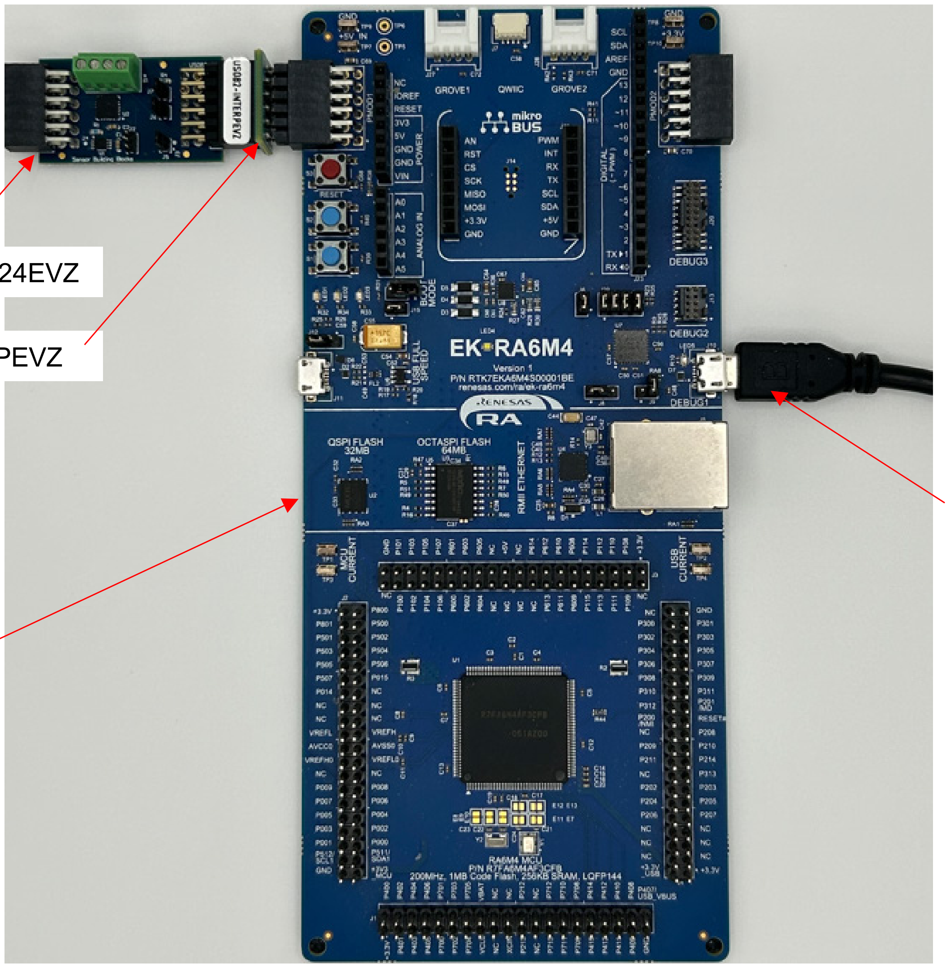

Figure 3. US082-SSC3224EVZ Pmod with EK-RA6M4 MCU Kit

2. Board Design

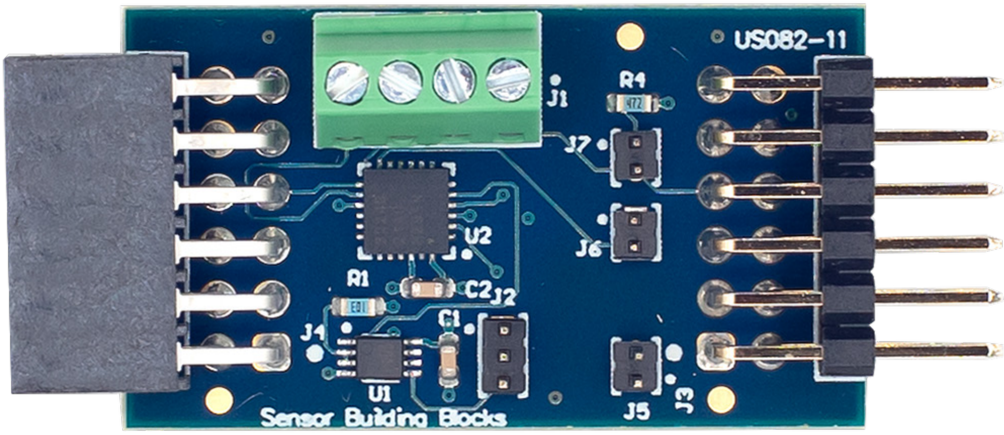

Figure 4. US082-SSC3224EVZ (Top)

Figure 5. US082-SSC3224EVZ (Bottom)

2.1 Schematic Diagrams

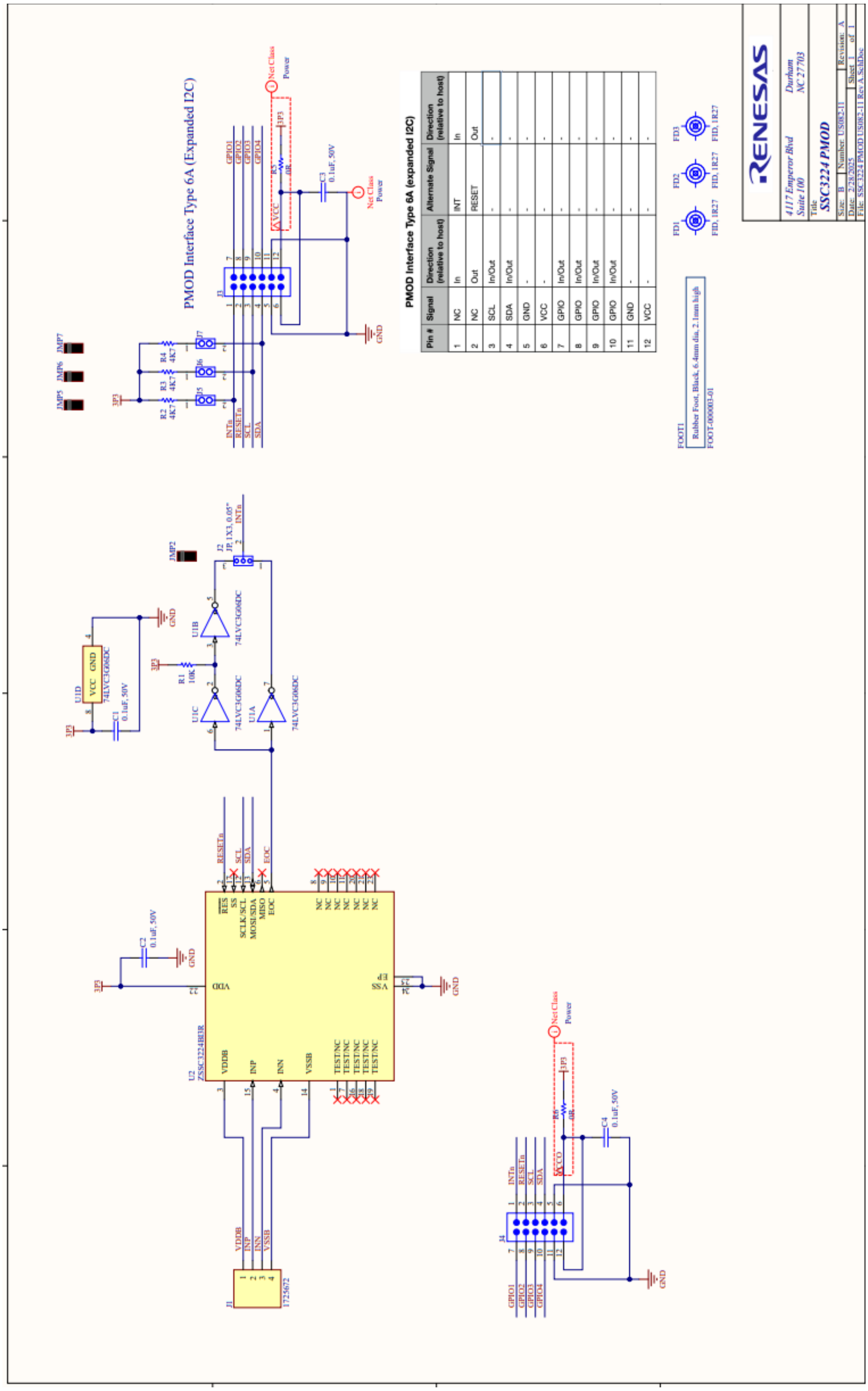

Figure 6. US082-SSC3224EVZ Schematic

2.2 Bill of Materials

Qty	Description	Designator	Manufacturer	Manufacturer Part Number
1	Connector, 1×4, 2.54mm, RA, Terminal Block, TH	J1	Wurth Electronics	691210910004
1	Jumper, 1×3, 0.05" Pitch	J2	Sullins	GRPB031VWVN-RC
1	Resistor, 10KΩ, 1/8W, 1%, SM	R1	KOA Speer	RK73H1JTTD1002F
3	Resistor, 4.7KΩ, 1/8W, 1%, SM	R2, R3, R4	KOA Speer	RK73H1JTTD4701F
2	Resistor, 0 ohms, 1/8W, 1%, SM	R5, R6	KOA Speer	RK73Z1JTTD
1	Sensor Signal Conditioner, Resistive Sensors, Differential and Pseudo-Differential Input signals, SM	U2	Renesas	ZSSC3224BI3R
3	Jumper, 1×2, 0.05" Pitch	J5, J6, J7	Sullins	GRPB021VWVN-RC
4	2 position Shunt Jumper, 0.05"	JMP2, JMP5, JMP6, JMP7	Sullins	NPB02SVFN-RC
4	Capacitor, 0.1µF, 50V, SM	C1, C2, C3, C4	Wurth Electronics	885012206095
1	Foot, Rubber, Self-adhesive, Black, 6.4mm diameter, 2.1mm tall	FOOT1	Bumper Specialties	BS25BL07X30RP
1	Male Header 0.1" pitch PMOD 2x6 Right Angle	J3	Wurth Electronics	61301221021
1	PMOD_6X2_RA_TH_SOCKET	J4	Wurth Electronics	613012243121
1	IC, Digital, Buffer, Triple, Inverting, Open Drain, SM	U1	Nexperia	74LVC3G07DC,125

2.3 Board Layout

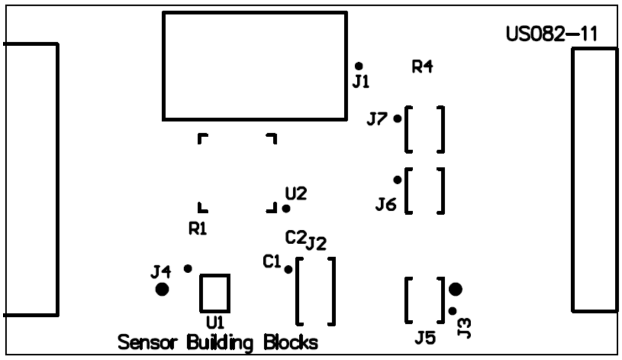

Figure 7. Top Overlay

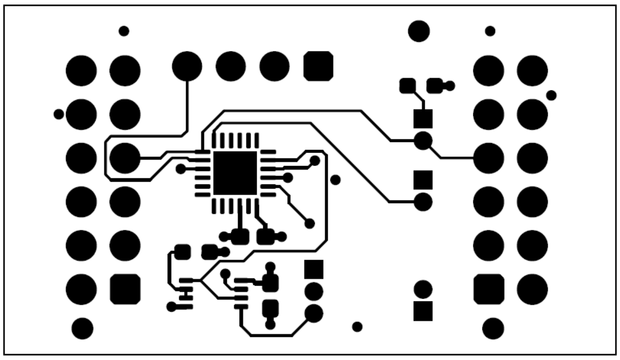

Figure 8. Top Layer

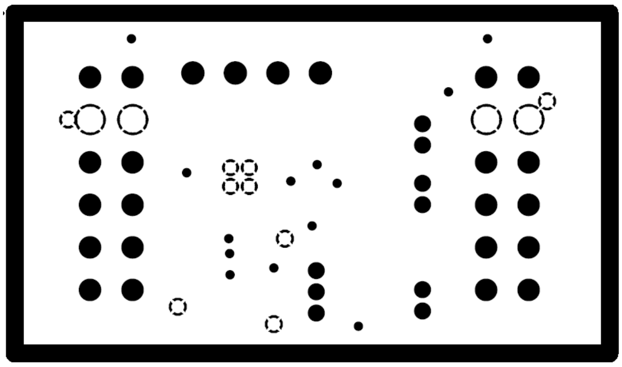

Figure 9. Int 1 (GND)

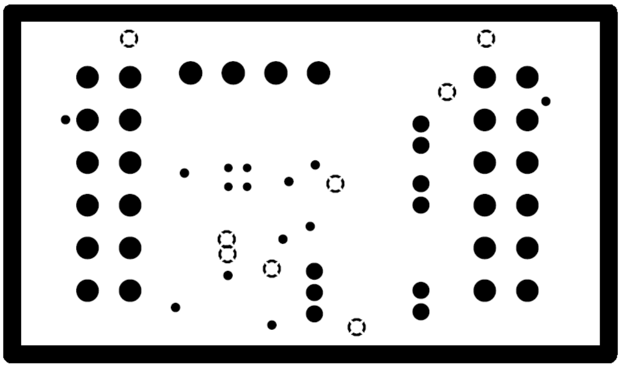

Figure 10. Int 2 (PWR)

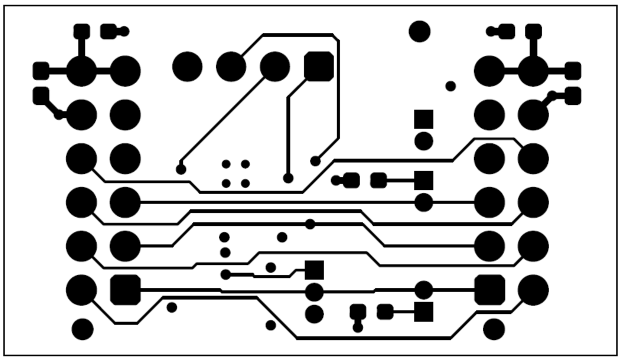

Figure 11. Bottom Layer

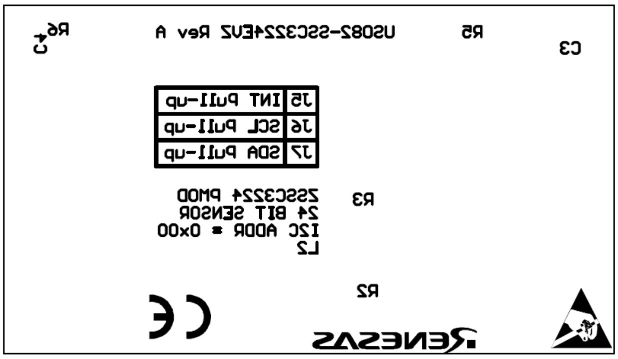

Figure 12. Bottom Overlay

3. Software Design

The following sections present an overview of the software implementation for the US082-ZSSC3224EVZ Pmod and detail the project's code structure, the system's software modules, and the main system flow.

3.1 Project Code Structure

The US082-ZSSC3224EVZ project is designed as a highly modular solution that can be easily configured independently of other modules (if required) or ported to other end applications.

The project is split into two main parts:

- ZSSC3224 driver – Device driver code for ZSSC3224 that includes the I^{2}C communication driver.
- Application code – Main system code that enables the driver code and implements system flow.

The driver module contains the C-source files and header files. The specific user configuration is included in the application code.

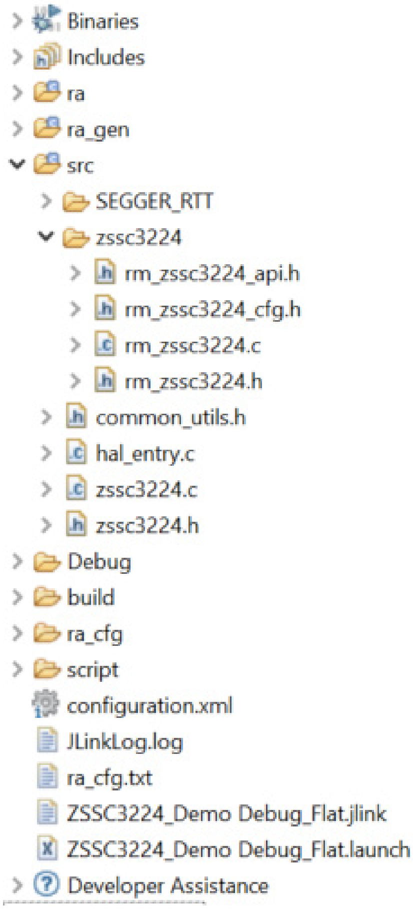

Figure 13. ZSSC3224 Project Structure

- SEGGER_RTT – RTT Viewer support files
- Zssc3224 – ZSSC3224 driver source code and header files:
  - rm_zssc3224_api.h – Driver function declarations
  - rm_zssc3224_cfg.h – Sensor configuration file
  - rm_zssc3224.c – Driver source file
  - rm_zssc3224.h – Driver header file
- Common_utils.h – Header file for application code in hal_entry.c – Start of code execution
- zssc3224.c – Device setup source file
- zscc3224.h – Device setup header file

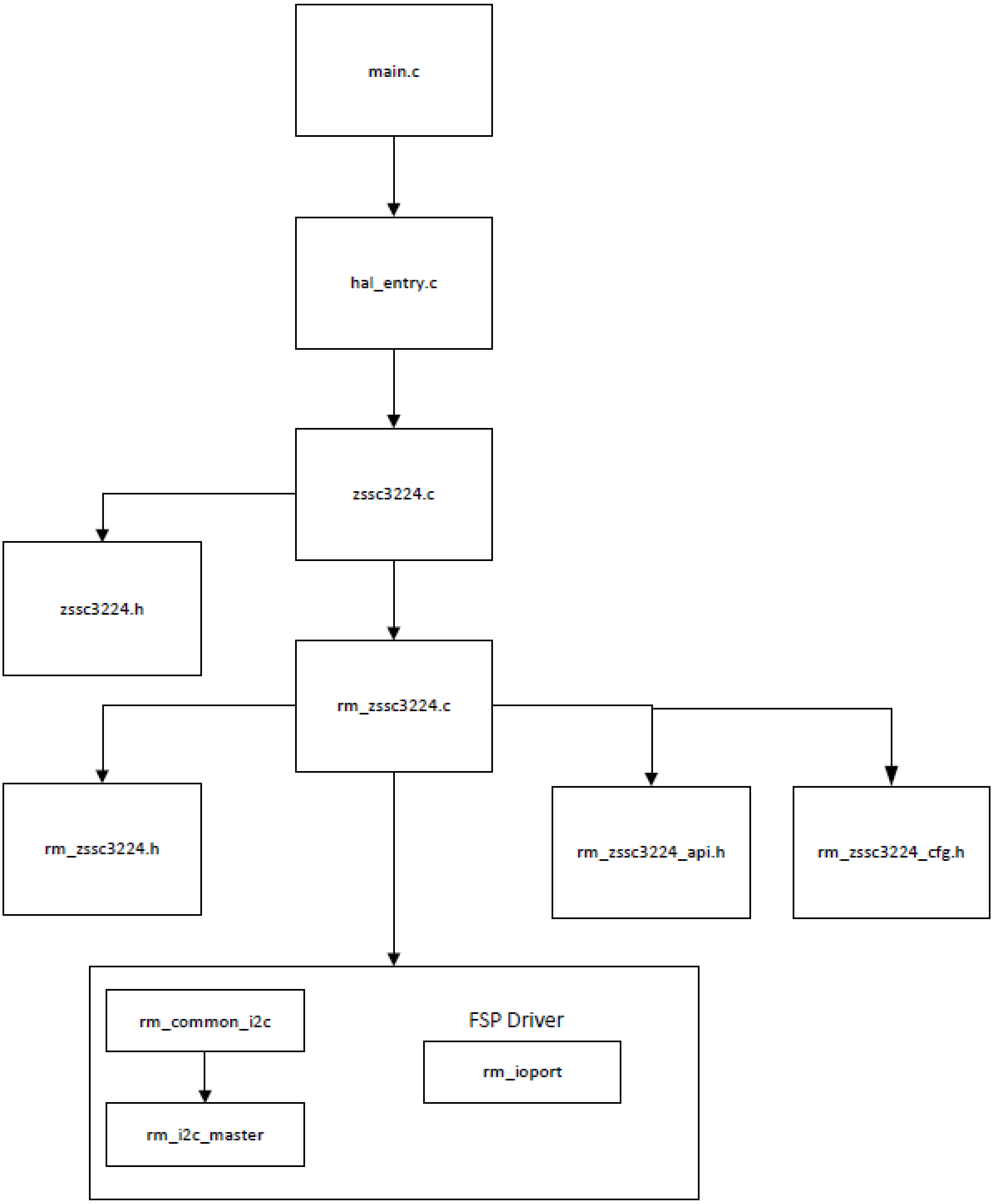

Figure 14. Code Dependency Graph

3.2 Software Module Overview

The ZSSC3224 demo shows the basic use of firmware API to setup and read sensor data from the ZSSC3224.

3.2.1 Hal_entry

This module is responsible for initializing the FSP I^2C driver and setting up the ZSSC3224 device with the user-configured settings. After setup, the module provides the following features:

- Performs device setup commands
- Reads sensor data
- Prints sensor data to RTT Viewer

3.2.2 Algorithm Flowchart

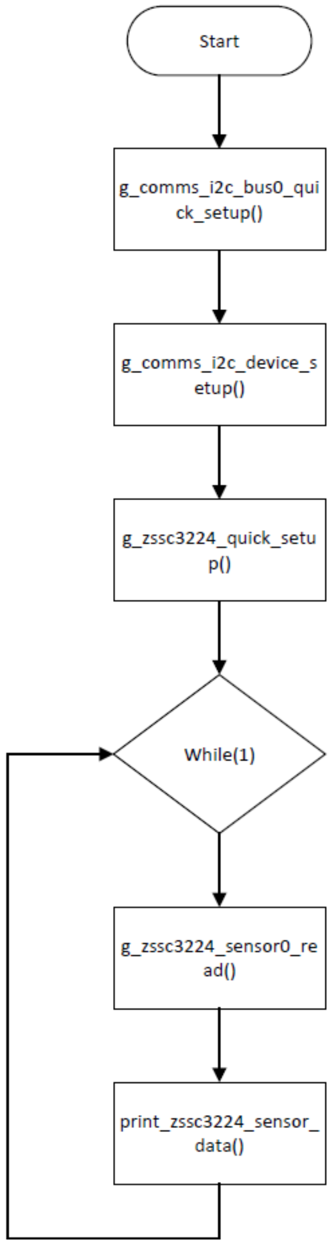

Figure 15. Algorithm Flowchart

3.2.3 Algorithm Overview

The I^{2}C bus is opened by **g_comms_i2c_bus0_quick_setup()** and **g_comms_device0_quick_setup()**. Next, the ZSSC3224 instance is opened by **g_zssc3224_quick_setup()**.

The main program loops continuously to get the sensor readings by calling **g_zssc3224_sensor0_read()**. The sensor readings can be seen in the Expression window or through RTT Viewer.

The functions outlined in Figure 15 are described as follows:

hal_entry ()

- Call **g_comms_i2c_bus0_quick_setup()**
  - Opens the I^{2}C driver. This must be performed before calling device setup.
- Call **g_comms_i2c_device0_quick_setup()**
  - Opens the I^{2}C Communications device instance. This must be performed before calling any COMMS_I2C_API.
- Call **g_zssc3224_quick_setup()**
  - Opens the ZSSC3224 instance. This must be performed before calling any ZSSC3224 API.
- Continuously call **g_zssc3224_sensor0_read()**
  - Sends the read data command to the ZSSC3224.
  - Waits for Measurement to finish.
  - Converts raw sensor data to calculated data.
- Continuously call **print_zssc3224_sensor_data()**
  - Prints sensor data to the RTT Viewer terminal.

4. Importing Project to e2 Studio

This section outlines how to import the ZSSC3224_Demo into e2 studio.

1. Open e2 studio and click *File* > *Import*.

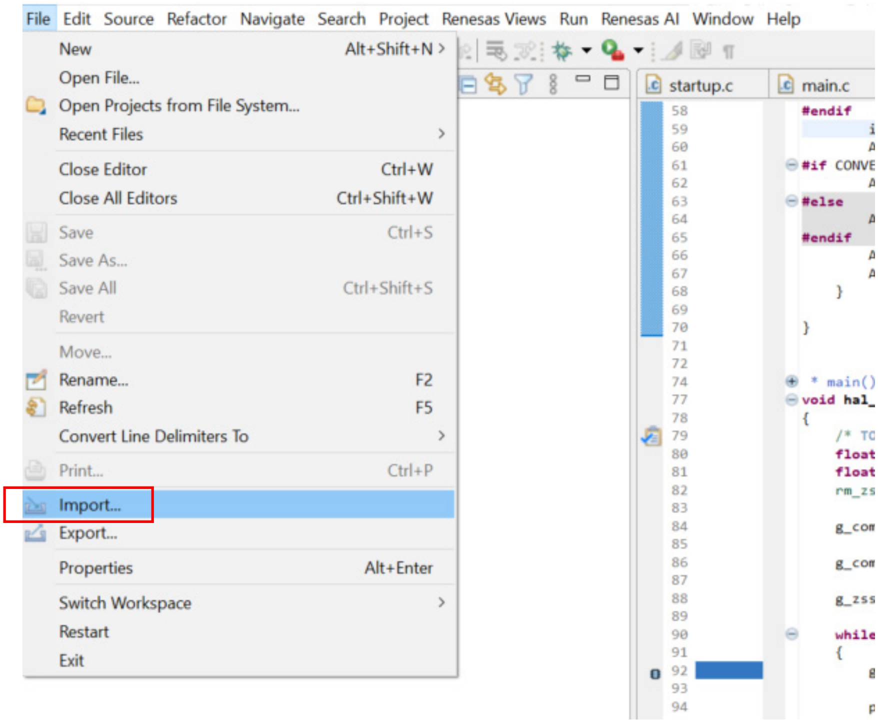

Figure 16. File Window

2. Select "Archive File", then click *Next*.

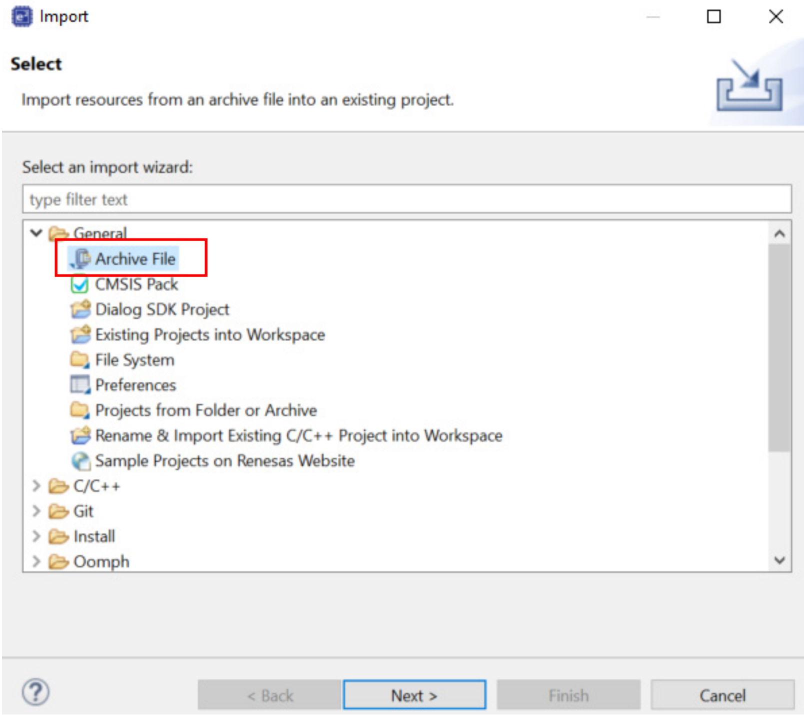

Figure 17. Import Window

3. Click *Browse*.

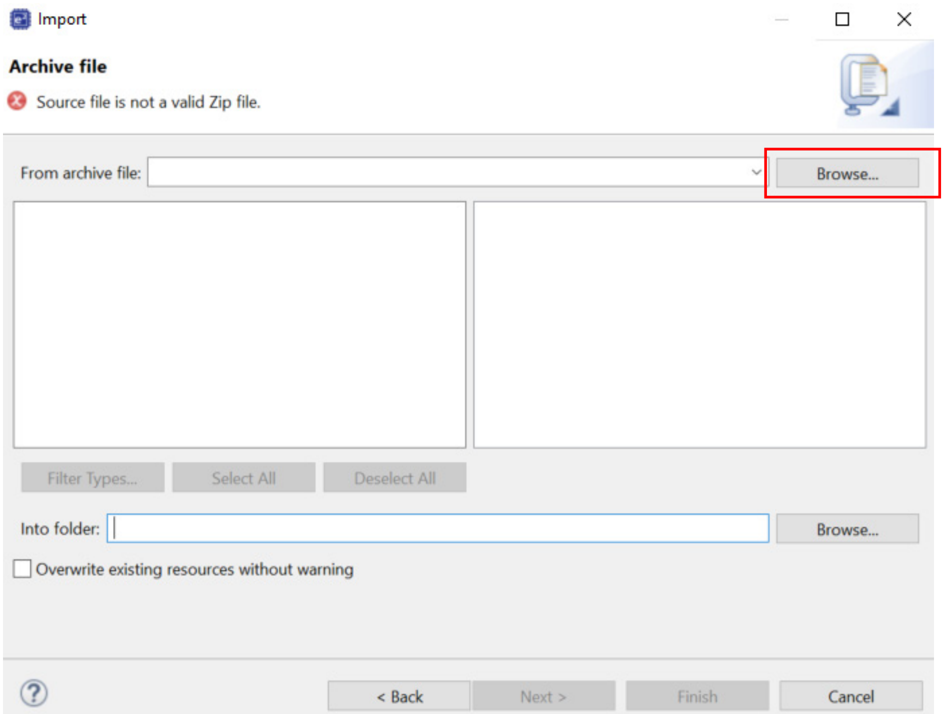

Figure 18. Import Selection Window

4. Select "ZSSC3224_Demo.zip" from your file system.
5. Click *Finish*.

5. Board Test

5.1 Setting Up the Boards and Cable

Verify that you have followed the procedure in Kit Hardware Connections.

5.2 Programming the Development Board and Running Example Code in Debug Mode

1. Open the sample project in e2 Studio.
2. Click the "Build" icon (see Figure 19).

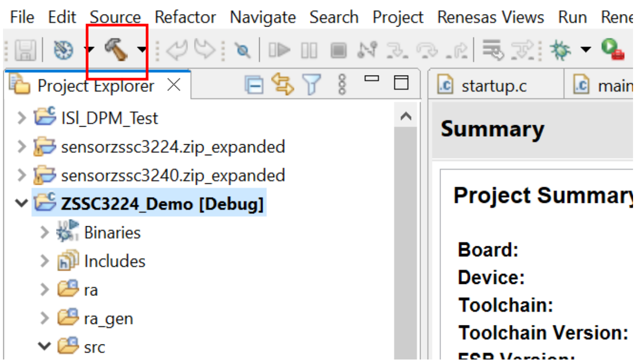

Figure 19. Project Build

3. From the menu bar, select *Run > Debug Configurations*.

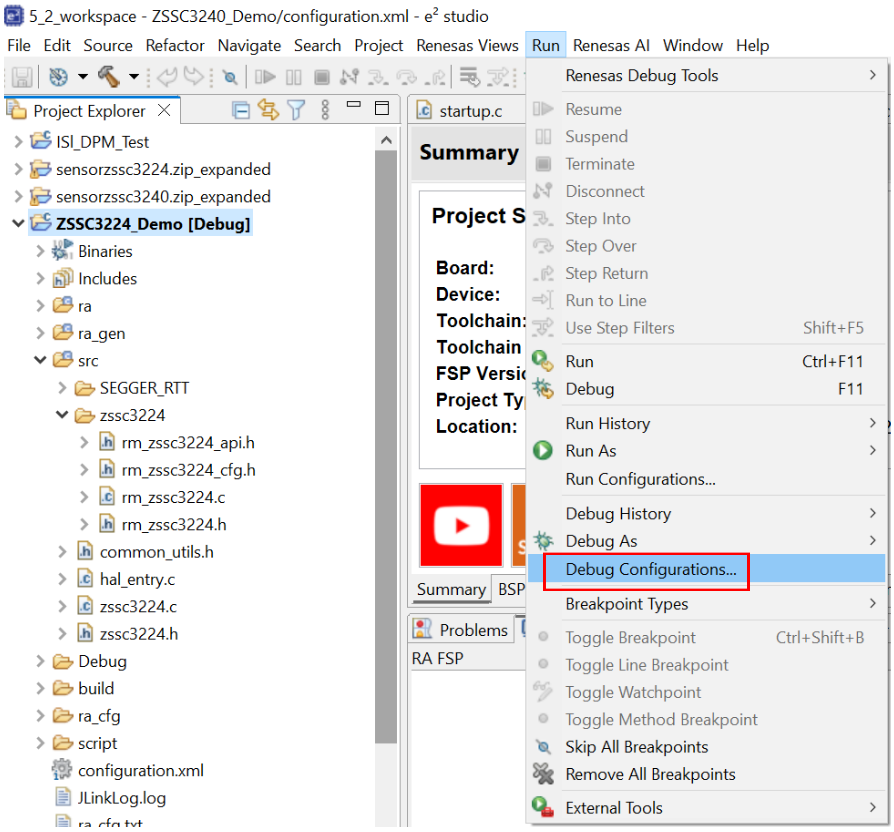

Figure 20. Debug Configurations

4. Select *Renesas GDB Hardware Debugging* > *ZSSC3224_Demo Debug_Flat* (see Figure 21).
5. Click the *Debug* button.

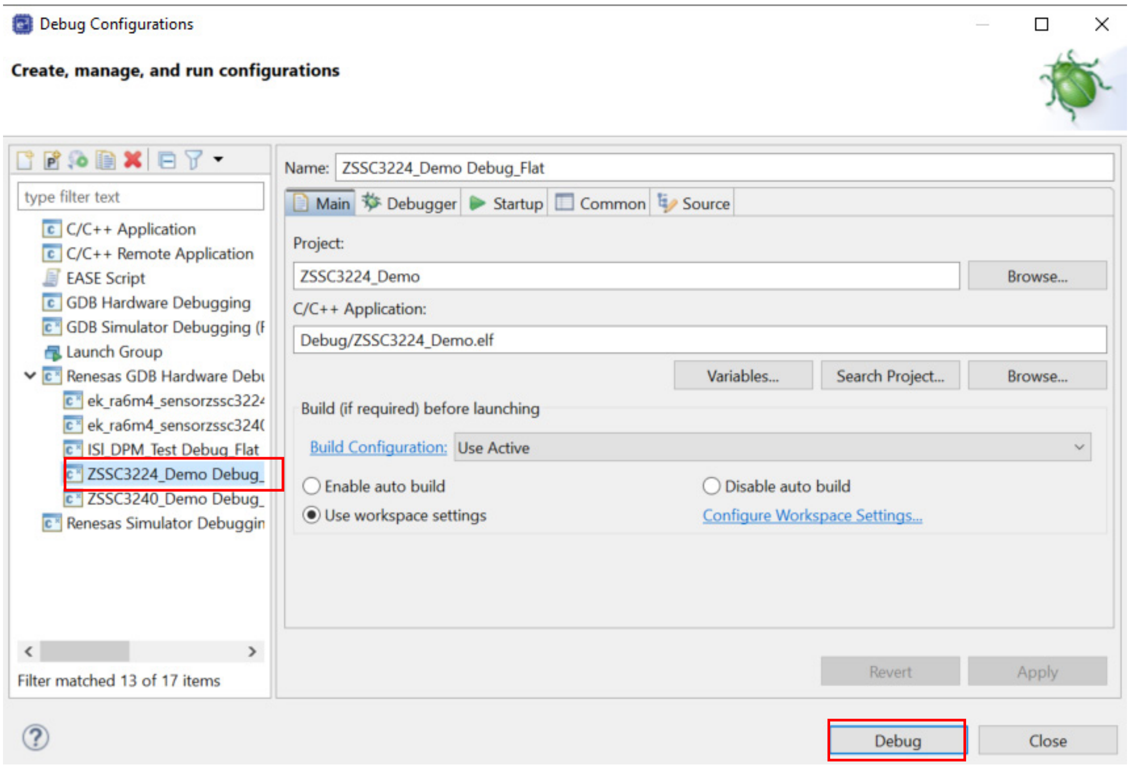

Figure 21. Start Debug Mode

6. Click the “Play” button to run the code (see Figure 22).

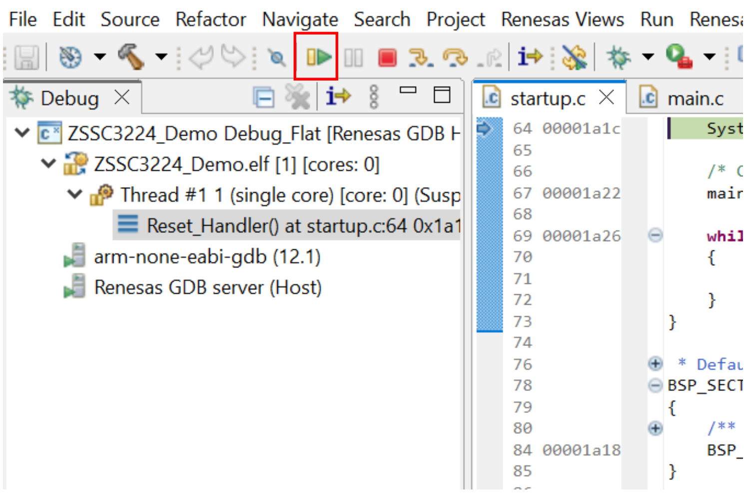

Figure 22. Running the Code

5.3 Using RTT Viewer

1. Open the J-Link RTT Viewer.
2. Unplug the EK-RA6M4 from your PC and then plug it back in.
3. Press **S3** on the EK-RA6M4.

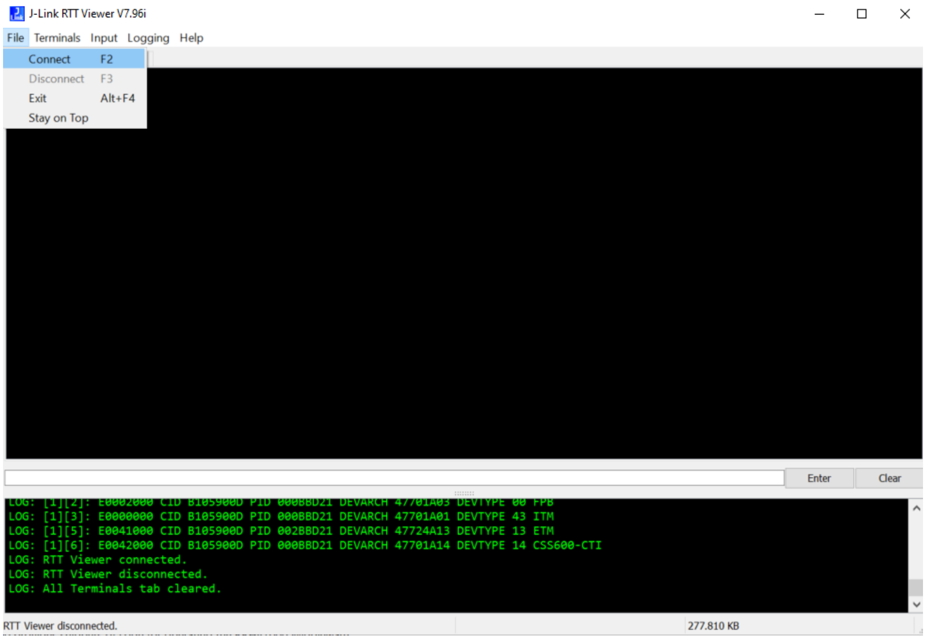

Figure 23. RTT Viewer

4. Click *File* > *Connect*.

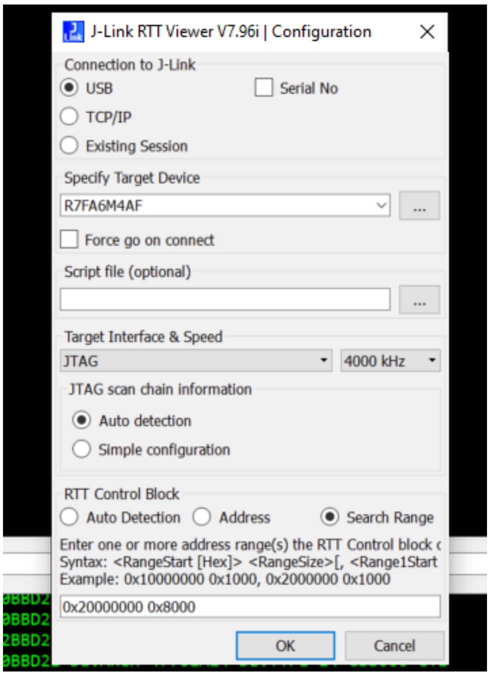

Figure 24. RTT Viewer Options

5. Ensure your configuration matches the configuration shown in Figure 24.
   a. Search Range: 0x20000000 0x8000.
6. Click *OK*.

7. The following output in the “All Terminals” tab is displayed (see Figure 25).

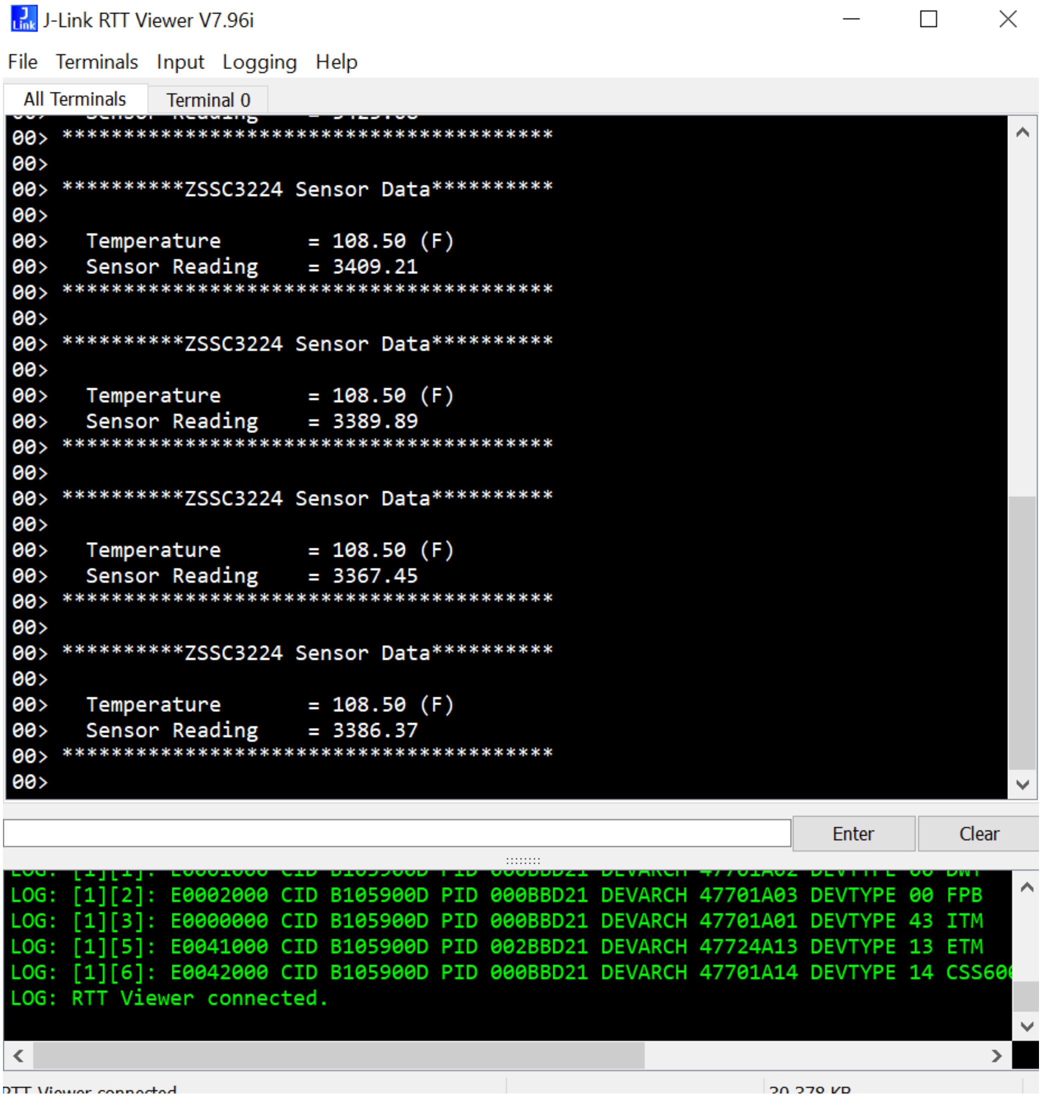

Figure 25. Demo Output

6. References

Use the following links to learn about key elements of the RA family, download components, related documentation, and obtain support.

[ZSSC3224 Product Page]

[e2 Studio Website]

[RA Product Information]

[RA Product Support Forum]

[RA Flexible Software Package]

[Renesas Support]

7. Ordering Information

Part Number	Description
US082-SSC3224EVZ	Sensor Signal Conditioner Pmod Board

8. Revision History

Revision	Date	Description
1.00	Mar 24, 2025	Initial release.

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