QCIOT-ISL76682POCZ

ISL76682 Light-to-Digital Sensor

The QCIOT-ISL76682POCZ (QCIOT-021) board enables quick prototyping of the ISL76682 auto light-to-digital sensor for automotive as well as industrial light sensing applications.

The board provides a standard PMOD™ Type 6A (Extended I²C) connection for the on-board sensor to plug into any MCU evaluation kit with a matching interface/connector.

The QCIOT-021 features PMOD connectors on both sides of the board allowing additional Type 6/6A boards to be connected in a daisy-chained solution with multiple sensors on the same MCU PMOD connector. With its standard connector and software support, the QCIOT-021 board is ideal for Renesas' QuickConnect Platform to rapidly create an IoT system.

Features

- Light-to-digital sensor
- 1.7V to 3.6V supply
- Low power: 65µA maximum operating current, 0.5µA maximum shutdown current. Configurable PNP-, NPN- and push-pull mode
- Ideal, close to human eye, spectral response
- Simple output code directly proportional to lux
- I²C (SMBus-compatible) output
- Sensor packaged in a small 2.0 × 2.1 mm 6-DFN

Board Contents

- ISL76682 Light-to-Digital Sensor

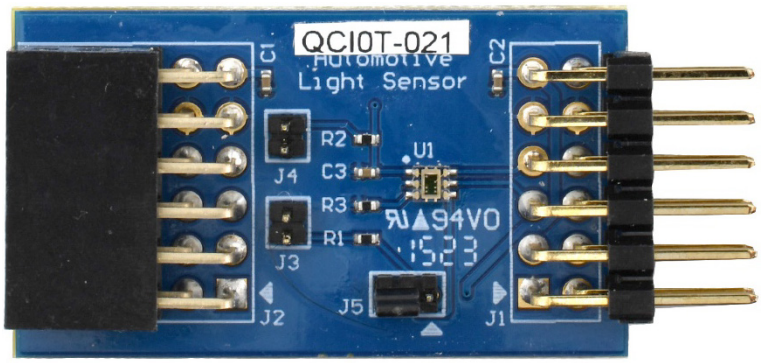

Figure 1. QCIOT-021 Light-to-Digital Sensor Board

Contents

Figures

1. Functional Description

The QCIOT-021 board is used as a QuickConnect prototyping solution for a light-to-digital value converting interface, enabling fast, simple and cost-effective applications evaluation for a Renesas ISL76682 device. This board can be used with any Renesas evaluation or fast prototyping MCU board. For evaluation kits, an interposer US082-INTERPEVZ board might be needed.

Figure 2 highlights the main parts of the system.

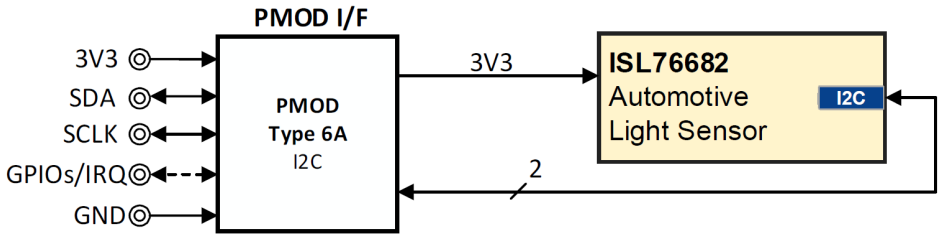

Figure 2. QCIOT-021 Board Block Diagram

The building block of the QCIOT-021 light sensor board consists of only one ISL76682 component and is very well suited for fast and cost-effective sensor evaluation.

1.1 Operational Characteristics

The QCIOT-021 board can be used as a starting point for light-to-digital sensor testing/development in industrial and automotive applications.

The board is designed with following characteristics:

- Input voltage: 2.25V to 3V
- Operating current up to 65µA
- Maximum shutdown current 0.5µA
- Selectable range using I^2C: 0.015 lux to 64000 lux

1.2 Setup and Configuration

The following hardware and software are required for setup and configuration:

Hardware:

- Renesas evaluation kit EK-RA2E1 or other EK or FPB board
- Renesas ISL76682 light-to-digital sensor PMOD™ board QCIOT-ISL76682POCZ
- Renesas interposer board US082-INTERPEVZ
- USB micro-B cable (provided with evaluation kit board)
- PC running Windows 10/11 with at least one USB port

Software:

- Renesas Flexible Software Package v4.5.0 platform
  - e2 studio 2024-01.1 (24.1.1) or later
  - FSP 4.5.0 or later
  - GCC Arm Embedded 10.3.1 (10 2021.10) or later
- Sample code files (available on the webpage for this device)

1.2.1 Software Installation

Install the FSP v4.5.0 version (supporting the QCIOT-021 board) and the latest version of the e2 studio installer.

1.2.2 Hardware Connections

Refer to Figure 3 and use the following procedures to setup the kit.

1. Connect the QCIOT-021 PMOD board to PMOD1 through an interposer board.
   a. For kits other than the EK-RA2E1, an I²C sensor board can be connected directly to the dedicated Type 6A PMOD connector (if a Type 6A PMOD is available). Otherwise, ensure that the kit can use the US082-INTERPEVZ interposer board. Insert the interposer board into the MCU connector before adding any sensor boards.
2. Ensure that pin 12 of the PMOD is 3.3V (this is requested by the QCIOT-021 board).
   a. For some evaluation boards, the pin 12 of the PMOD is 3.3V by default, thus, no change is required. Check the user manual before prior to usage.
   b. Only one set of I²C pull-up resistors should be used on the bus. If multiple PMOD connected boards are used, only one board should have the jumpers present.
   c. If multiple modules use the IRQ# line on the PMOD, only one pull-up jumper should be present.
   d. MCU kits typically do not have pull-up resistors present on the bus lines. Ensure to check if any are present.
3. Connect the evaluation kit with a computer using a USB micro-B cable. This is required for programming the board, debugging or for power.
4. The setup is now ready to be used in the system. For board testing, see section Quick Start Guide – Board Testing.

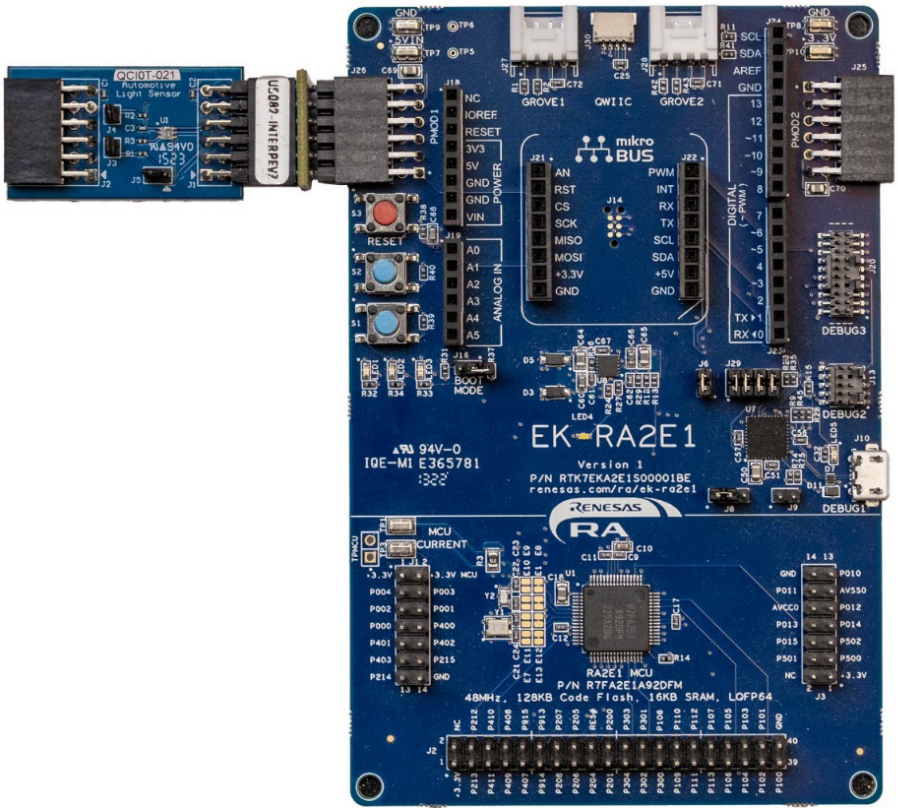

Figure 3. QCIOT-021 IO-Link Device CCE4503 Test Setup

2. Board Design

Figure 4. QCIOT-021 IO-Link Device Transceiver Board (Top)

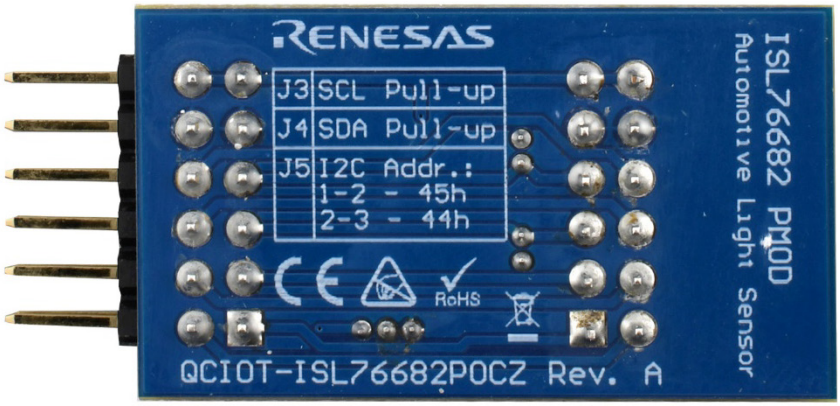

Figure 5. QCIOT-021 IO-Link Device Transceiver Board (Bottom)

2.1 Schematic Diagrams

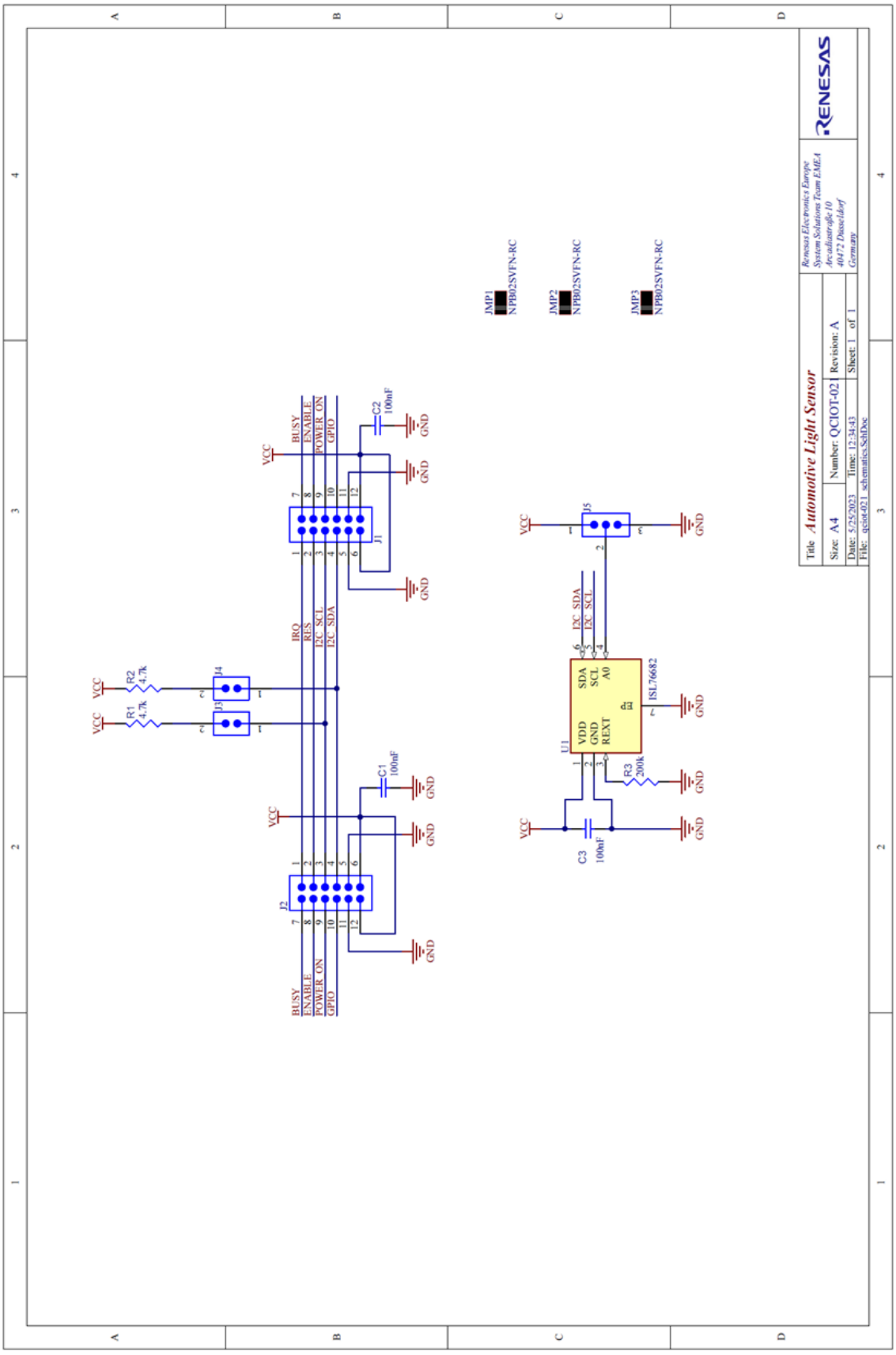

Figure 6. QCIOT-021 IO-Link Device Transceiver Schematics

2.2 Bill of Materials

Quantity	Designator	Description	Manufacturer	Manufacturer Part Number
3	C1, C2, C3	Chip Capacitor, 100nF ±20%, 10V, 0402	Yageo	CC0402KRX7R6BB104
1	J1	CONN HEADER R/A 12POS 2.54MM	Sullins	PRPC006DBAN-M71RC
1	J2	CONN HDR 12POS 0.1 GOLD PCB R/A	Sullins	PPPC062LJBN-RC
2	J3, J4	CONN HEADER VERT 2POS 1.27MM	Sullins	GRPB021VWVN-RC
1	J5	CONN HEADER VERT 3POS 1.27MM	Sullins	GRPB031VWVN-RC
3	JMP1, JMP2, JMP3	CONN JUMPER SHORTING 1.27MM	Sullins	NPB02SVFN-RC
1	R1	Chip Resistor, 4,7kΩ, ±1 %, 63mW, -55 to 155 °C, 0402	Yageo	RC0402FR-074K7L
2	R2, R3	Chip Resistor, 200kΩ, ±1 %, 63mW, -55 to 155 °C, 0402	Yageo	RC0402FR-07200KL
1	U1	Automotive Low Power, High Sensitivity, Light-to Digital Sensor With I²C Interface	Renesas	ISL76682AROZ-T7A

2.3 Board Layout

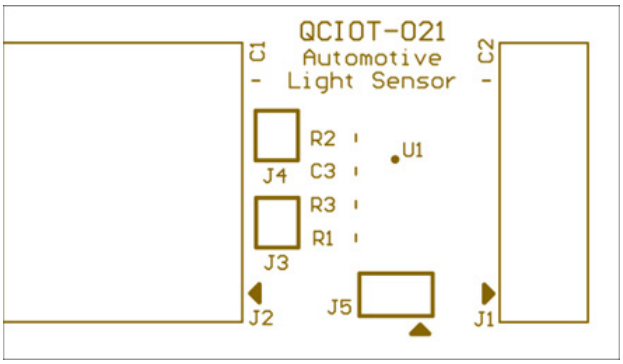

Figure 7. Top Silkscreen

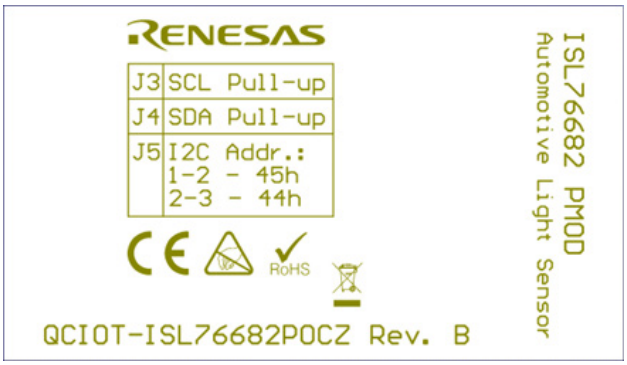

Figure 8. Bottom Silkscreen

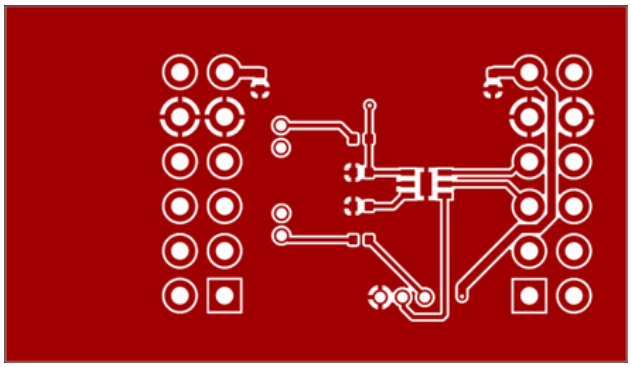

Figure 9. Top Layer

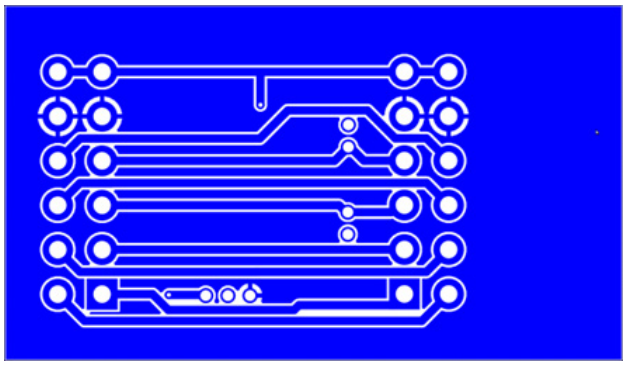

Figure 10. Bottom Layer

3. Software Design

This section provides a brief overview of the software implementation for the QCIOT-021 board which is based on the Renesas RA Family's Flexible Software Package (FSP). The following sub-sections describe the project's code structure, the system's software modules, and the main system flow. The application-level code is based on bare metal concept that does not use any RTOS and periodically serves all processes in a main loop.

3.1 Project Code Structure

The QuickConnect ISL76682 project is designed to be highly modular in terms of sensors and simple realization. Solutions can be easily configured independently of other modules (if required) or ported to different end-applications.

Figure 11 shows the e2 studio folder project structure.

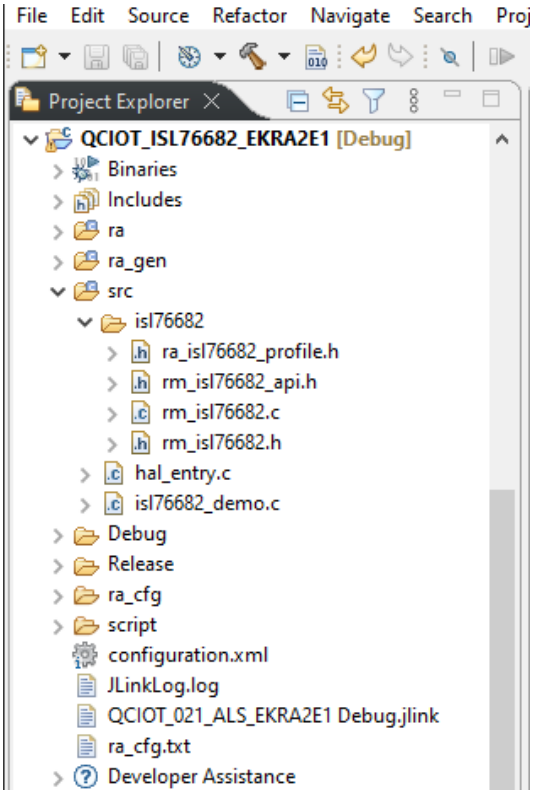

Figure 11. QCIOT-ISL76682-EKRA2E1 e2Studio Project Folder Structure

e2 studio folder structure:

- **ra** – automatically generated files for FSP drivers source code and header files
- **ra_gen** – generated files by FSP configuration
- **src** – application code that consists of:
  - **isl76682** – folder containing low level drivers and control procedures for the isl76682 sensor

Click on **configuration.xml** in the project and open the Stack Tab to see the FSP packages configuration (see Figure 12).

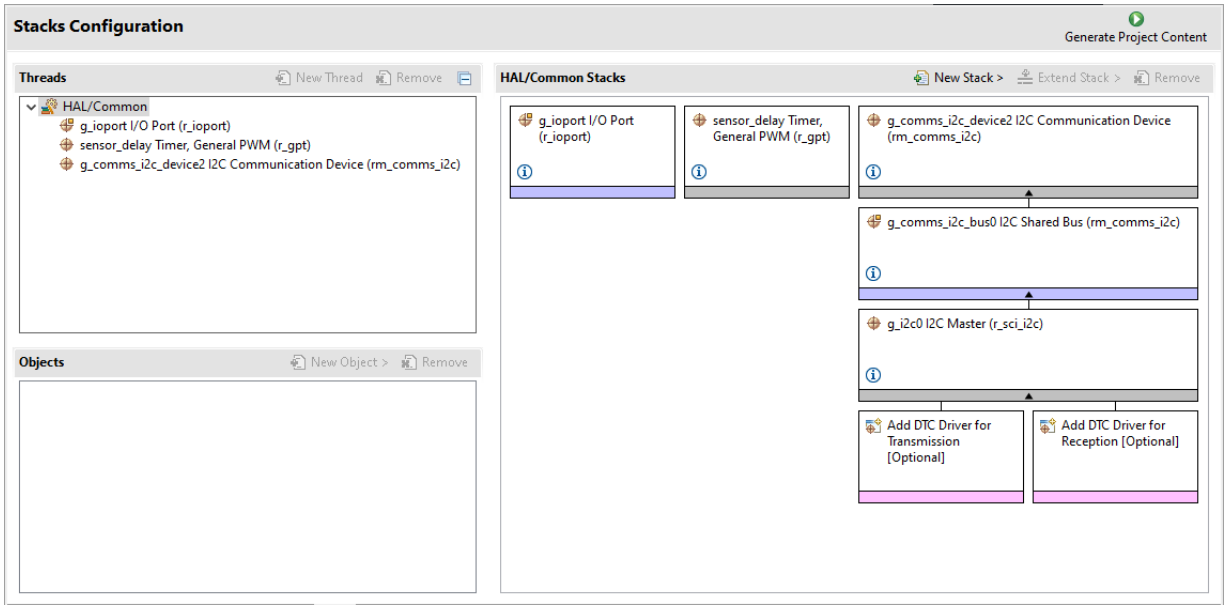

Figure 12. Stacks Configuration – Hal/Common

3.2 Application Structure

The application is running bare metal and starts in the **hal_entry()** function. FSP configuration is already setup and shown in Figure 12. The user application starts with initialization and then jumps straight forward to the **start_demo()** function containing demo code. The application flow diagram is shown in Figure 13.

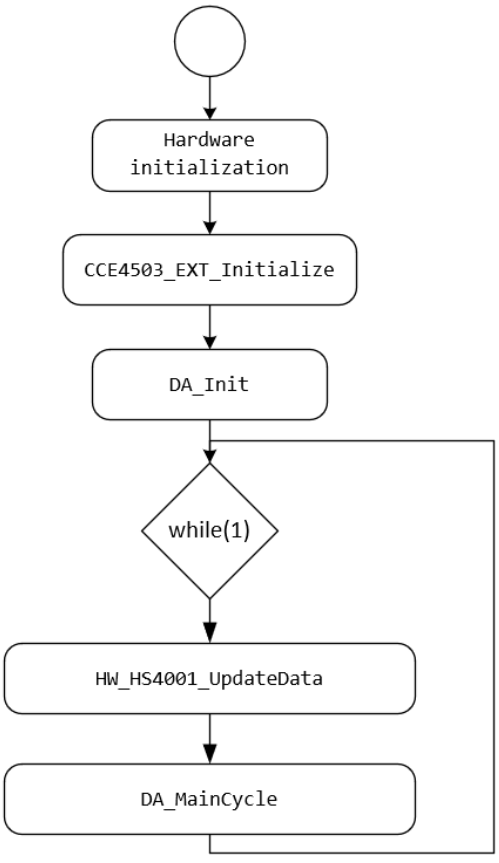

Figure 13. Application Flow Diagram

3.3 Initialization

Initialization consists of four steps:

1. Hardware from FSP configuration setup is initialized.
2. Delay timer setup.
3. MCU hardware dedicated for ISL76682 initialization.
4. ISL76682 sensor initialization.

3.4 Main Loop

In the sample application, the ISL76682 sensor is periodically read every 500ms in the main loop. After every readout, sensor values are printed to the Renesas Debug Virtual Console.

3.5 Data Exchange

Measurements data is exchanged by printing results to the Renesas Debug Virtual Console.

4. Quick Start Guide – Board Testing

See section 1.2 for the list of required hardware.

4.1 Setting Up the Boards and Cables

Connect the boards and cables as described below and in Figure 14.

1. QCIOT-021 to PMOD1 on EK-RA2E1 through interposer board.
2. Micro USB cable to J10 Debug port on EK-RA2E1 board.

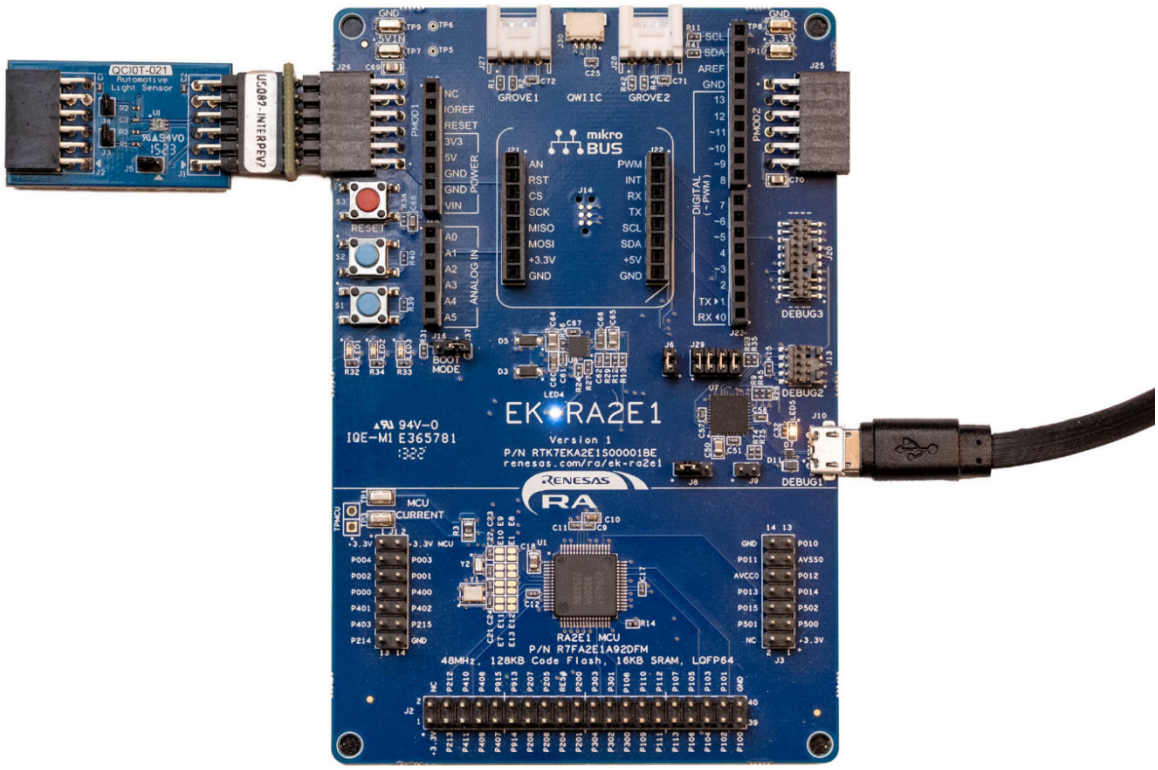

Figure 14. QCIOT-021 Light-to-Digital Sensor Test Setup

Note: Ensure that the interposer board is placed in between the sensor and EK board, and the silkscreen **MCU Side** is facing the EK board.

4.2 Programming the EK Board and Running the Example Code

Download the sample project from the QCIOT-ISL76682POCZ webpage and import it into e2 Studio. The procedure is shown below and in Figure 15:

1. Click on *File* menu in e2 Studio.
2. Click *Import*.
3. Choose **Existing Projects into Workspace**.
4. Click *Next*.
5. Click on the radio button for *Select archive file*.
6. Click on *Browse* to locate the sample project.
7. Click on the *Finish* button.

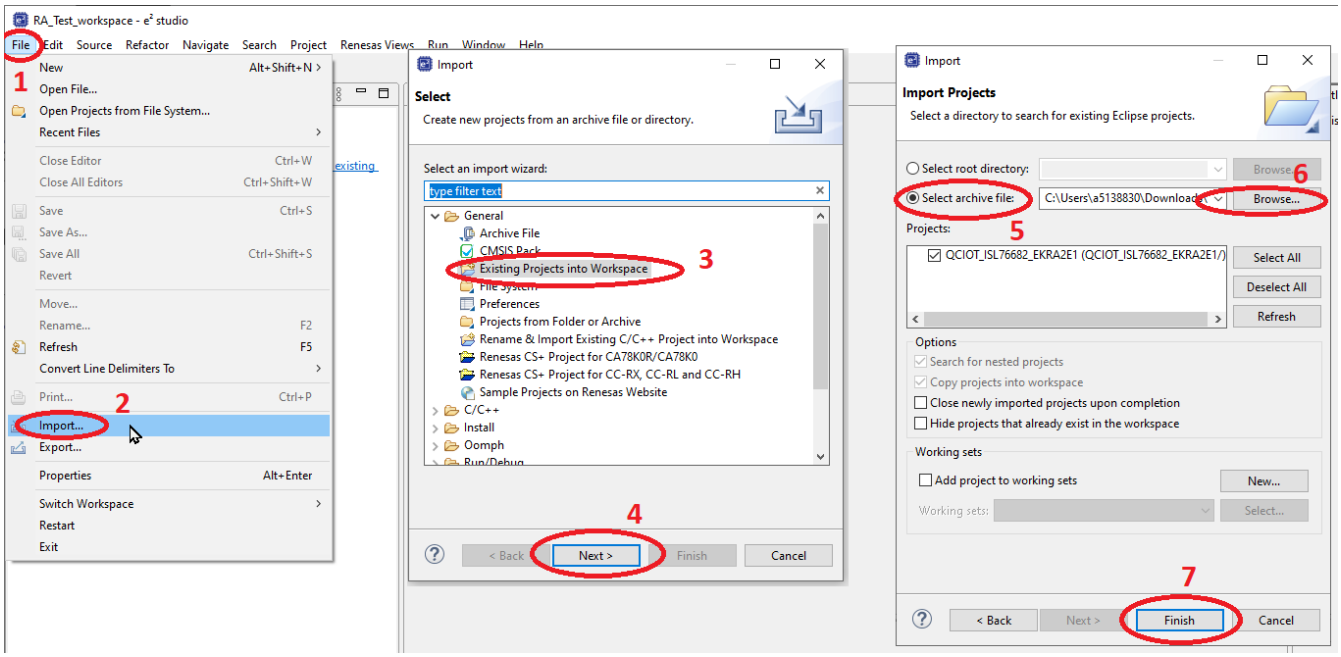

Figure 15. Import the Sample Project

8. After successfully importing the project, build it by clicking on the *Hammer* icon button (see Figure 16).

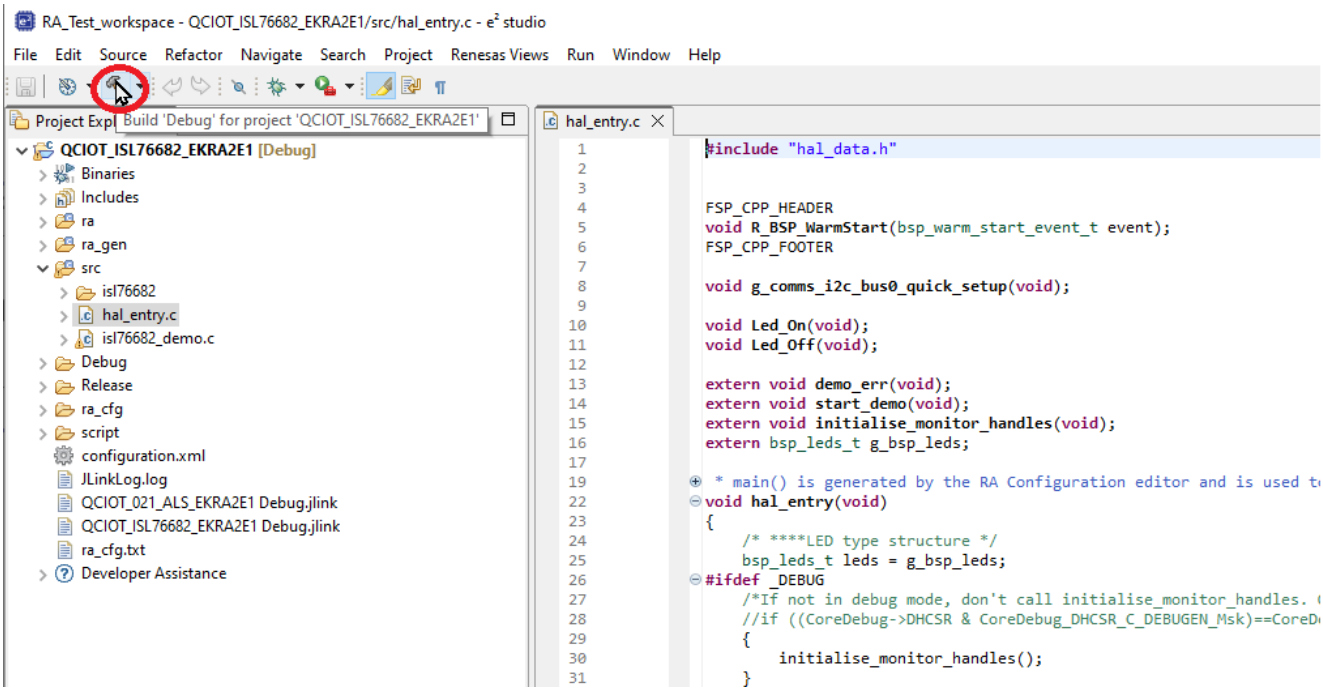

Figure 16. Build the Sample Project

The project should be built without any errors. Ignore any warnings that might appear. The build result appears at the bottom of the window.

9. Debug the project by clicking on the *Bug* icon (see Figure 17).

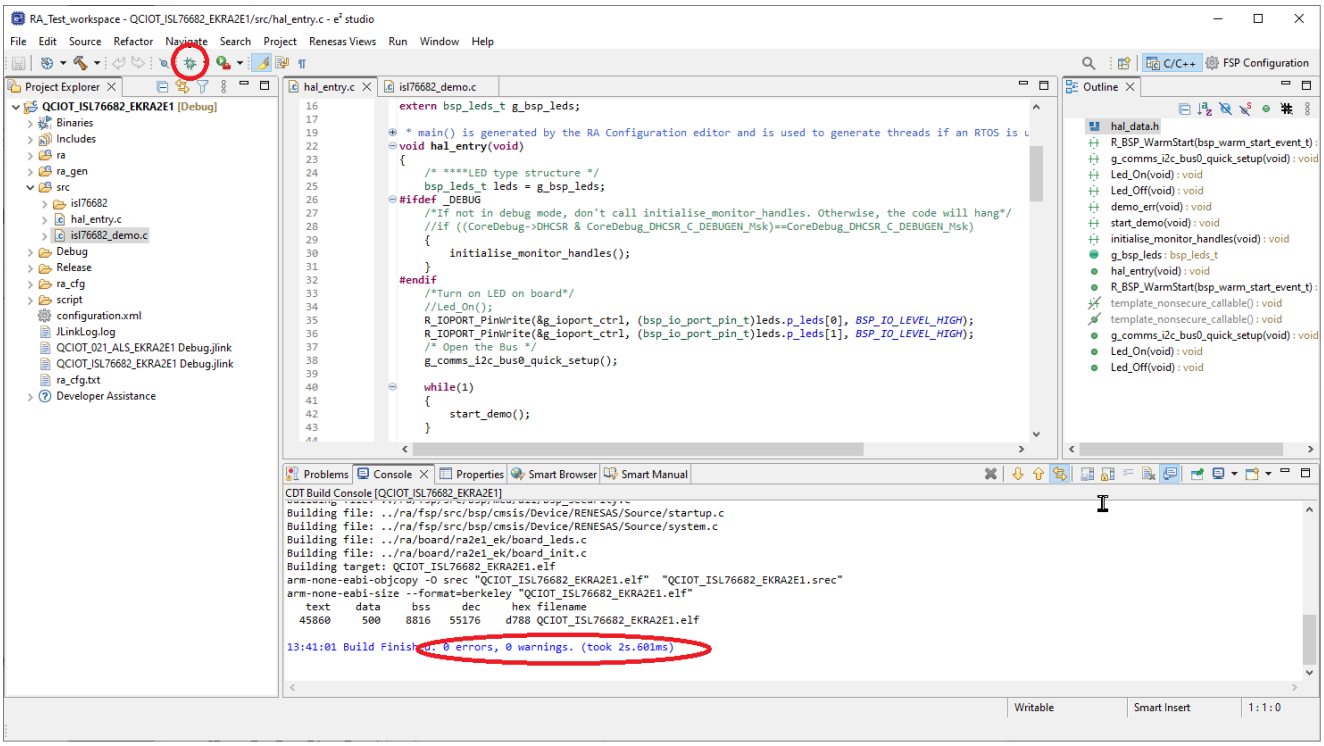

Figure 17. Flash and Debug the Sample Project

10. After the code has been flashed, click on the *Run* icon (see Figure 18).

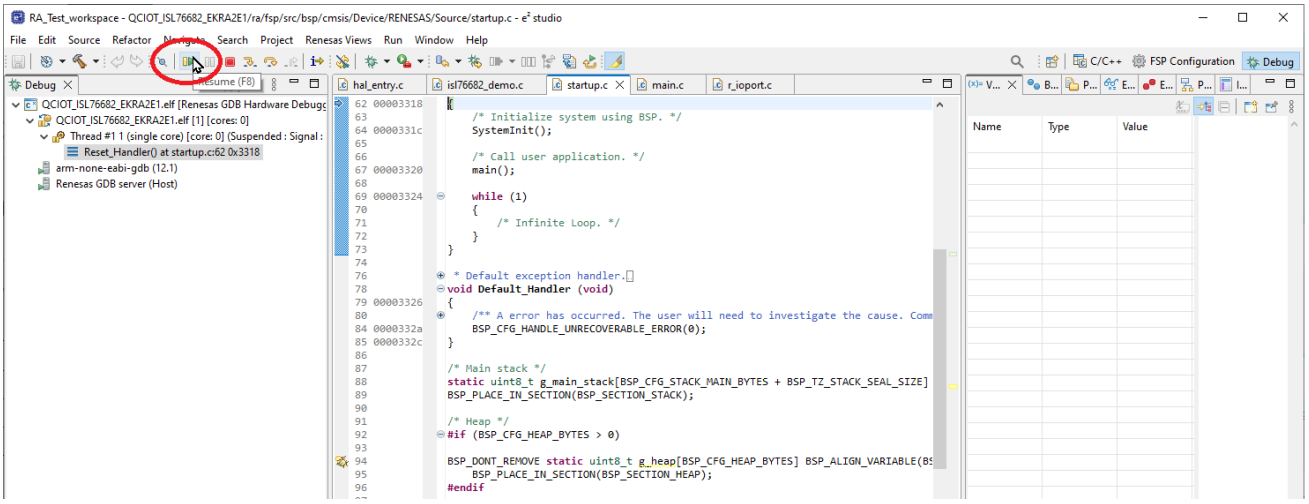

Figure 18. Run Sample Project

11. To view the measurements results, open the Renesas Debug Virtual Console as shown in Figure 19.

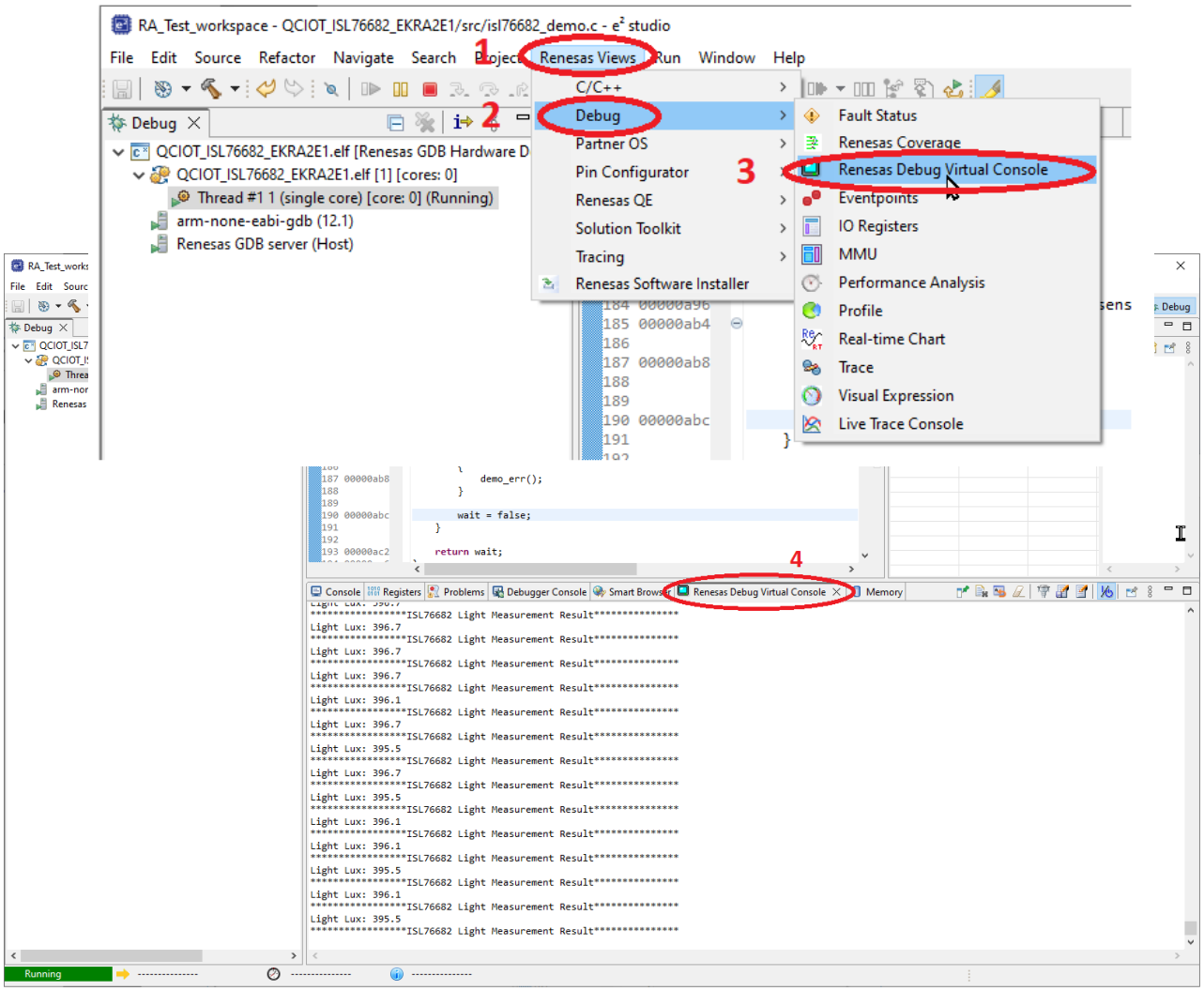

Figure 19. Renesas Virtual Debug Console

5. Ordering Information

Part Number	Description
QCIOT-ISL76682POCZ	ISL76682 Light-to-Digital Sensor PMOD™ Board
US082-INTERPEVZ	Renesas Interposer Board
RTK7EKA2E1S00001BE	EK-RA2E1 Evaluation Kit

6. Revision History

Revision	Date	Description
1.00	Aug 29, 2024	Initial release.

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