PTX105R/RA2E1 Quick Connect (QC) Demo

This document describes how to use the PTX IoT Reader demo application with the Renesas e² studio and running it on the Renesas EK-RA2E1 evaluation board with a PTX105RQC PMOD™ board.

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1. Introduction

This document describes the usage of the PTX IoT Reader demo application using e² studio and running it on the Renesas EK-RA2E1 evaluation board with a PTX105RQC board attached to the PMOD connector. For more information, see the PTX105R NFC Reader Evaluation Kit and PMOD Demonstration video.

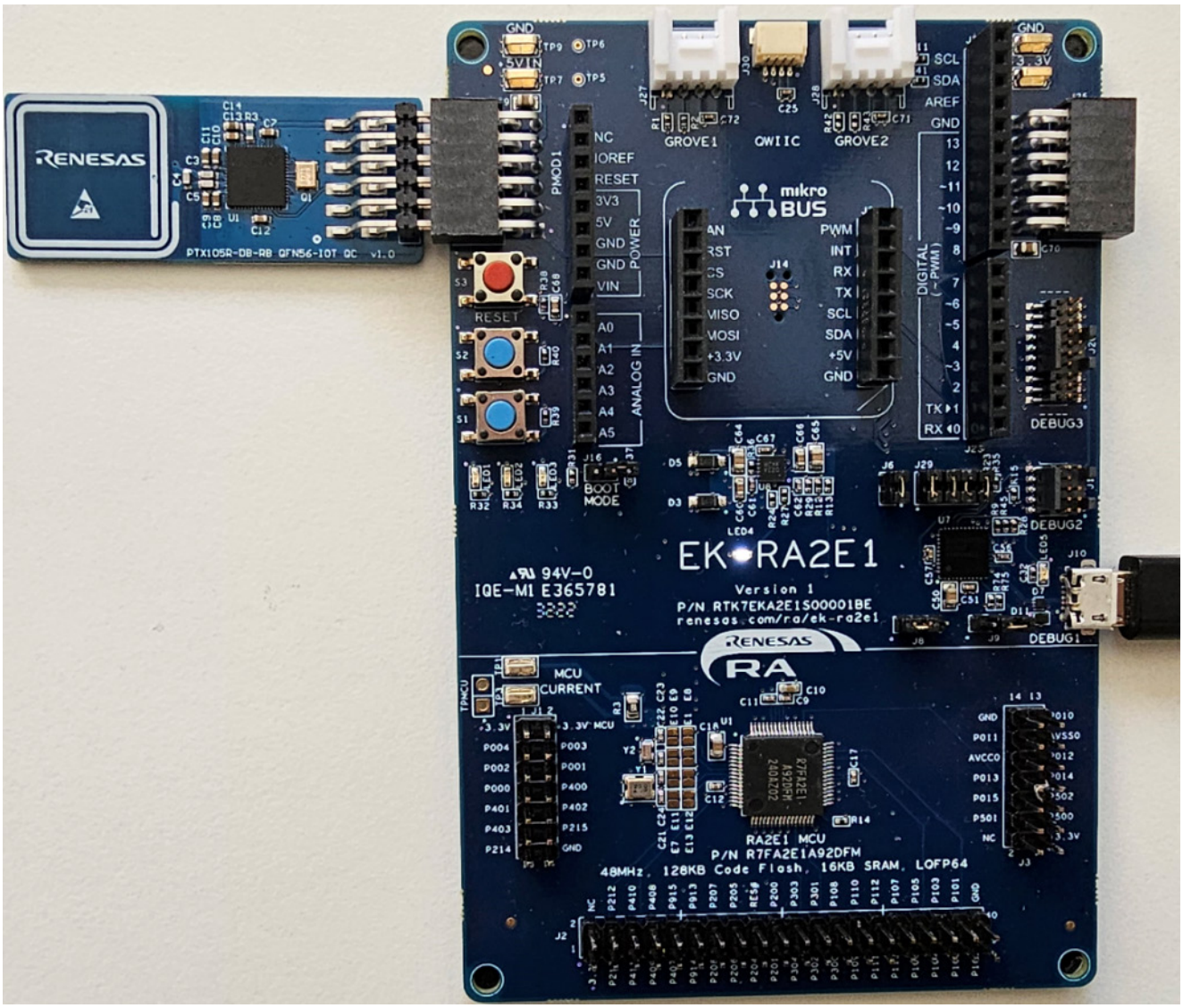

Figure 1. PTX105RQC and EK-RA2E1 Boards

2. Requirements

2.1 Hardware

- Renesas EK-RA2E1 (Evaluation Kit for RA2E1 MCU group)
- PTX105R Quick-Connect board
- Micro USB cable

2.2 Software

- Windows® 10 operating system
- e² Studio: Version 2025-01 or above
- Flexible Software Package FSP: Version 5.6.0 or above
- Toolchain GCC ARM Embedded (Version 13.3.1.arm-13-24)
- SEGGER J-Link® USB Serial Drivers
- SEGGER J-Link Real-Time Transfer (RTT) Viewer (virtual terminal emulation application). It is included in J-Link Software and Documentation Pack.
- IoT-Reader (Non-OS) SDK v7.2.0

3. PTX105R Quick-Connect (QC) Board

The compact design of the PTX105R Quick-Connect board allows user's to add NFC functionality to their design.

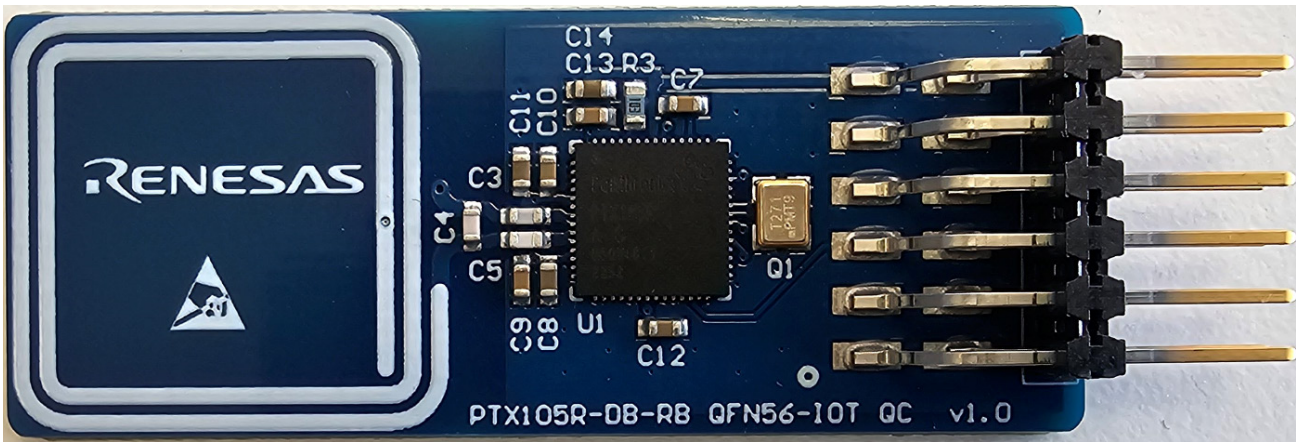

Figure 2. PTX105R Quick-Connect (QC) Board

The module contains a PTX105R chip with a 20 × 20 mm loop antenna. The board can be connected directly to the Renesas EK-RA2E1 via the PMOD connector. The SPI and IRQ pins are used for the communication and the required operating current is drawn from the 3V3 pin.

A detailed schematic can be found in the PTX105R QC Schematic section.

4. EK-RA2E1 Evaluation Kit

For more information about the RA2E1 board and evaluation kit, visit the EK-RA2E1 page.

5. Hardware Setup

1. Connect the PTX105R Quick-Connect board to the EK-RA2E1 PMOD1 connector (J26).

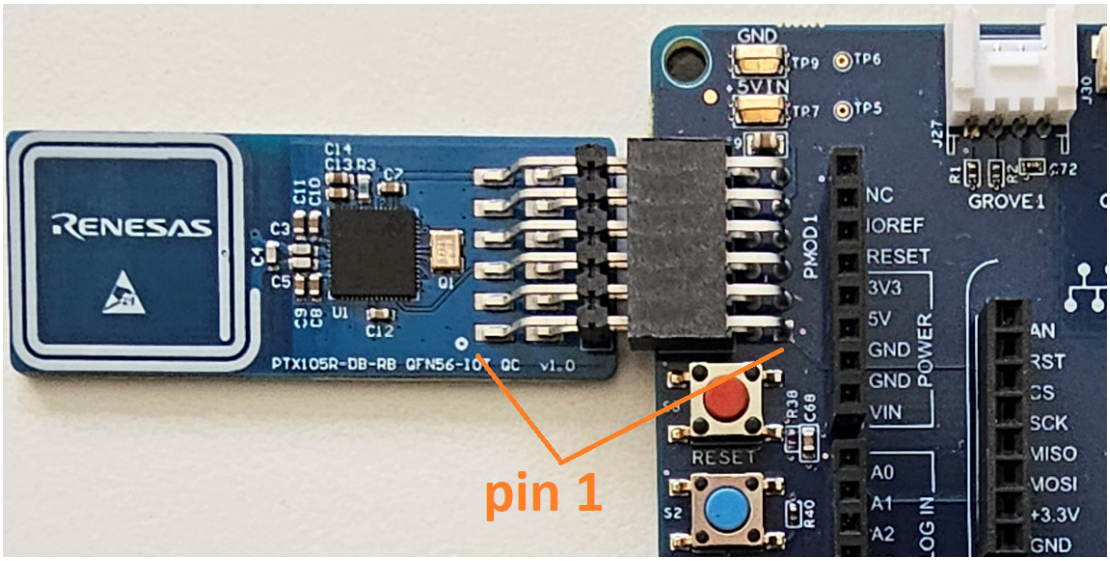

Figure 3. Connecting the PTX105RQC and EK-RA2E1 Boards

2. Plug in the micro-USB communication cable to the debugger USB connector (J10) on EK-RA2E1. When the cable is connected, the EK-RA2E1 board supplies the PTX105R Quick-Connect board with 3.3V.

6. IoT Reader Demo Application

The demo provides a reference implementation of an IoT-Reader with multiple card-type detection capabilities, running on a RA2E1 Arm Cortex®-M23 as an example host target platform.

6.1 IoT Reader Demo Application Package

The delivered package contains the User Integration Manual for IoT-Reader (Non-OS) SDK v7.2.0 and the ready to use e^2 Studio project.

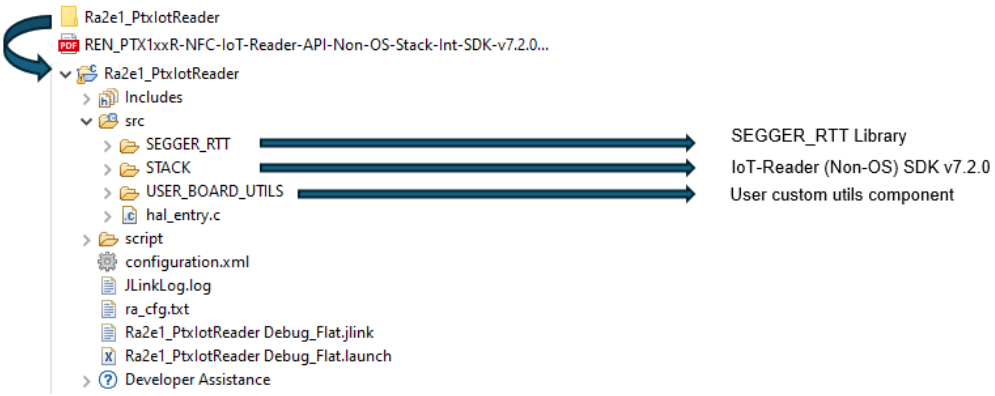

Figure 4. Software Package

This solution is intended for platforms without an operating system.

The application demonstrates the performance of the PTX105R for IoT applications and offers full support for all technologies: A, B, F, V type cards. It implements all steps required to initialize the PTX105R and to discover, activate, communicate, and deactivate a tag as described in Figure 5.

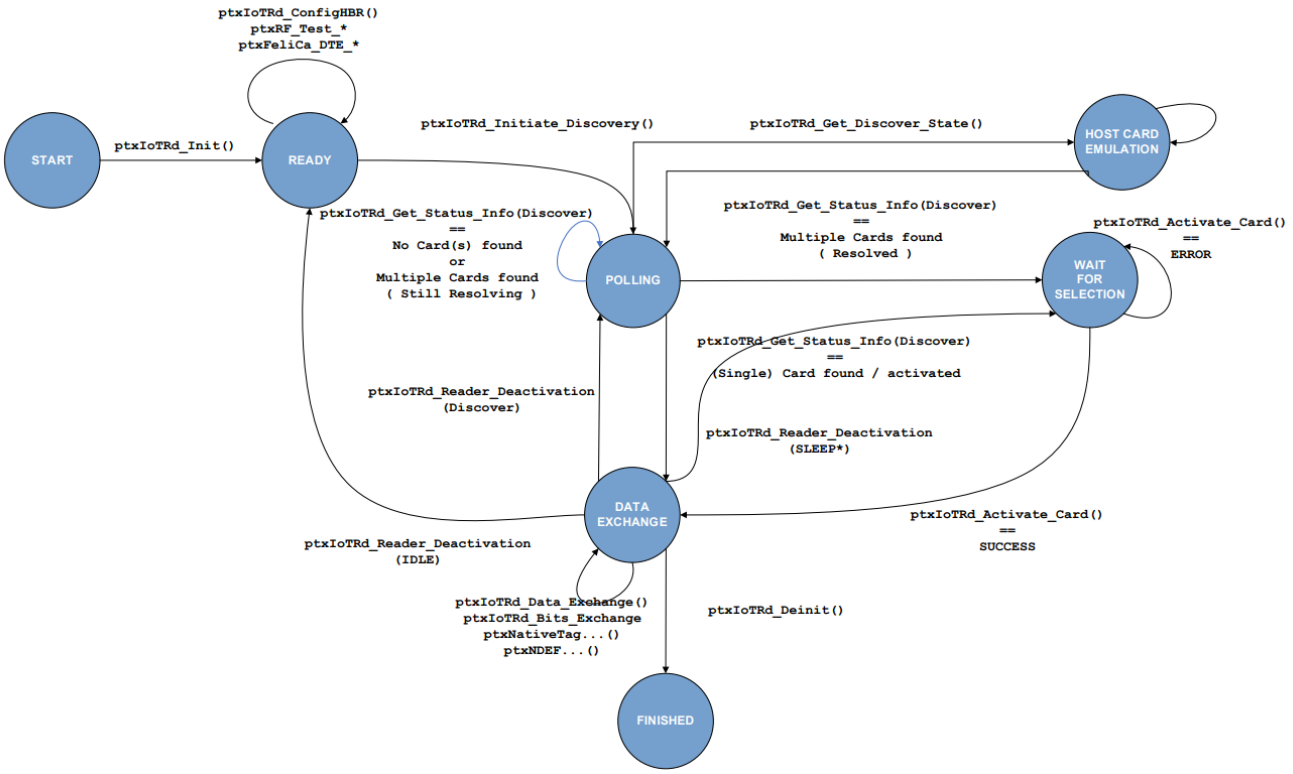

Figure 5. Application Flow Diagram

The application starts automatically after the demo kit is powered up. When a card is detected, it performs example data exchange depending on the card type and protocol.

Figure 6 shows an example of the application output on the SEGGER RTT Viewer.

```
00> Restarting RF-Discovery ... OK
00> Waiting for discovered Cards ...
00> Card activated ... OK!
00> 01. RF-Technology = Type-A; SENS_RES: 4400; NFCID1_LEN: 07; NFCID1: 0415913A36A120; SEL_RES: 00; Protocol: T2T
00> TX = 3000
00> RX = 041591083A36A1208D480000E1103E0000
00> Restarting RF-Discovery ... OK
00> Waiting for discovered Cards ...
```

Figure 6. Application Output Example on the SEGGER RTT Viewer

When a card is placed in the field, the user LED 3 (red) is blinking indicating that there is an ongoing transaction.

7. Running the Example Application

1. Click **File** ⟶ **Import** to import the project into the workspace.

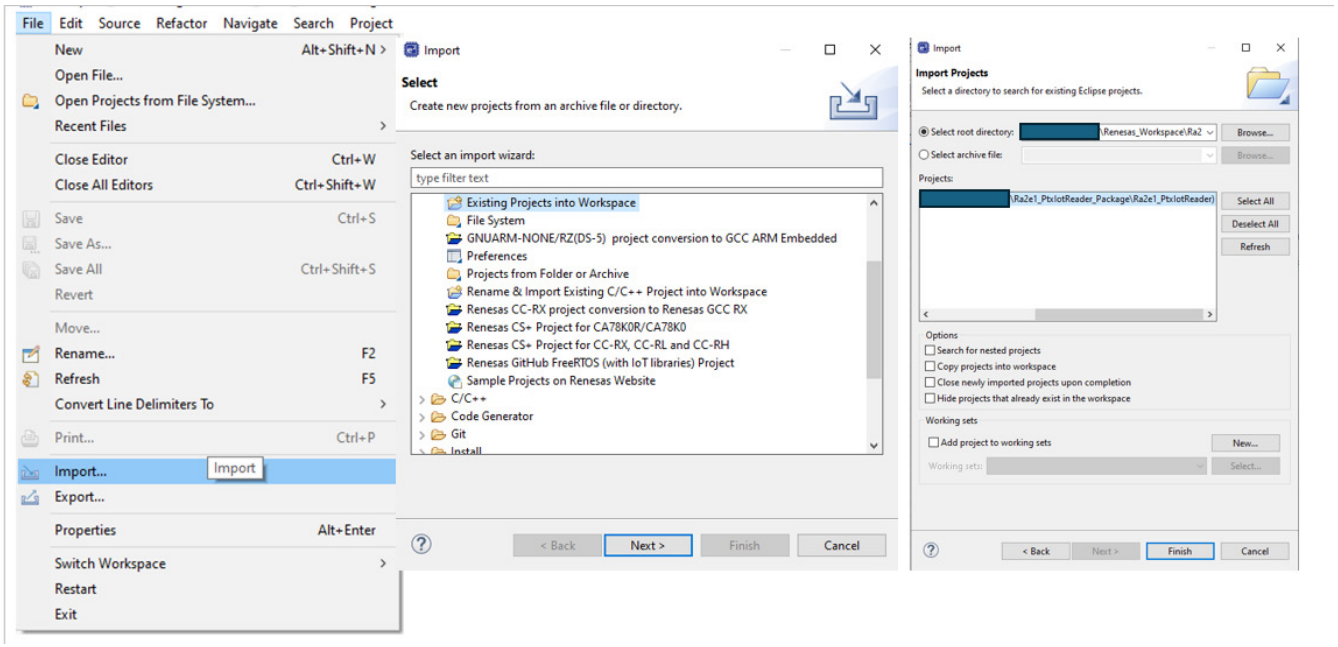

Figure 7. Import Projects Windows

2. Build the project by clicking on **Project** ⟶ **Build** Project or using the keyboard shortcut *Ctrl+B*.
3. Flash the application. After plugging in the debug micro USB cable, go to **Run** ⟶ **Debug Configurations**, double-click on *Renesas GDB Hardware Debugging*, and setup the debugger (see Figure 8).
4. Click **Debug** to flash the application on the board.

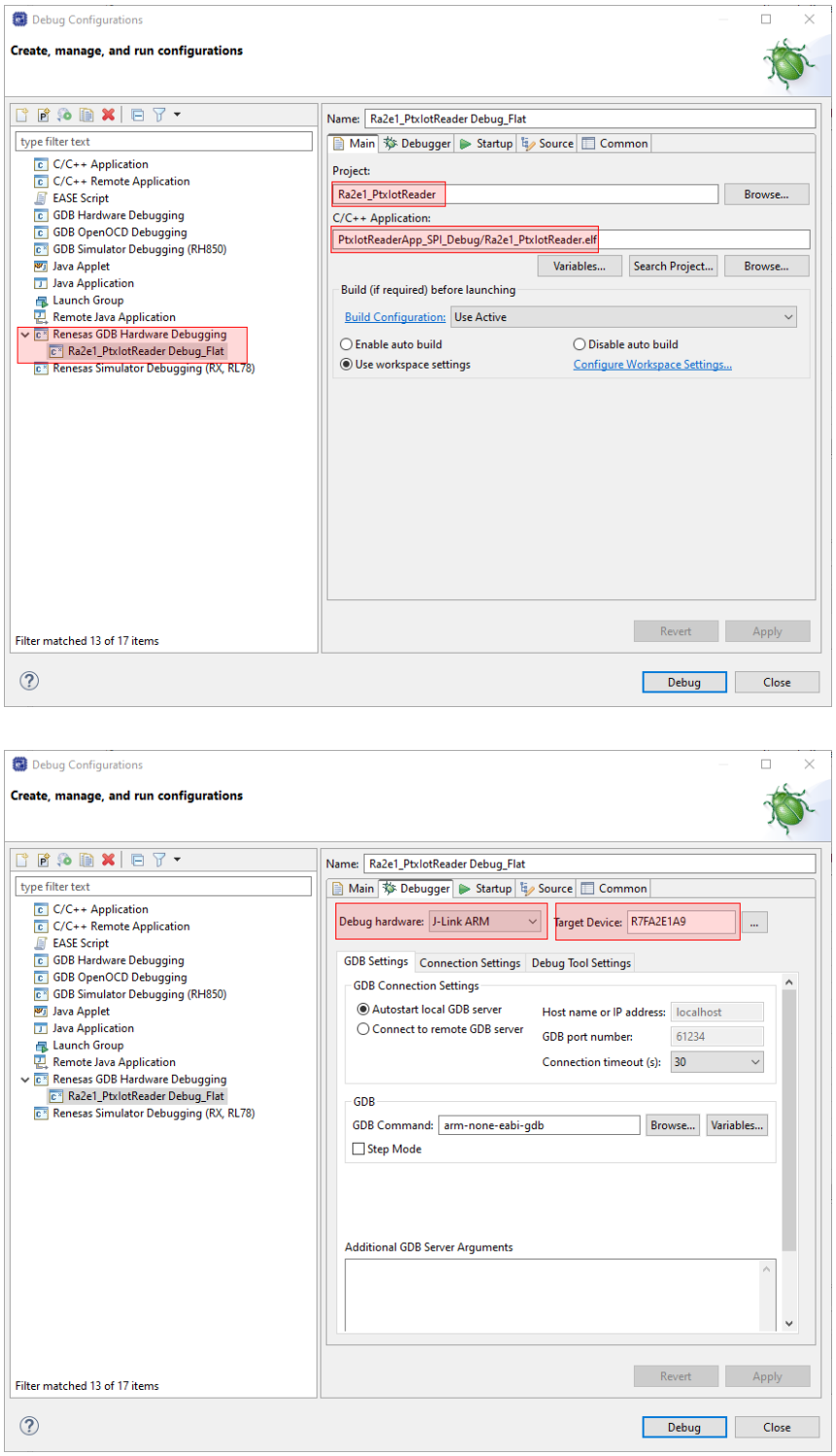

Figure 8. Debug Configuration Windows

5. When completed, click **Resume** twice to start the application (see Figure 9).

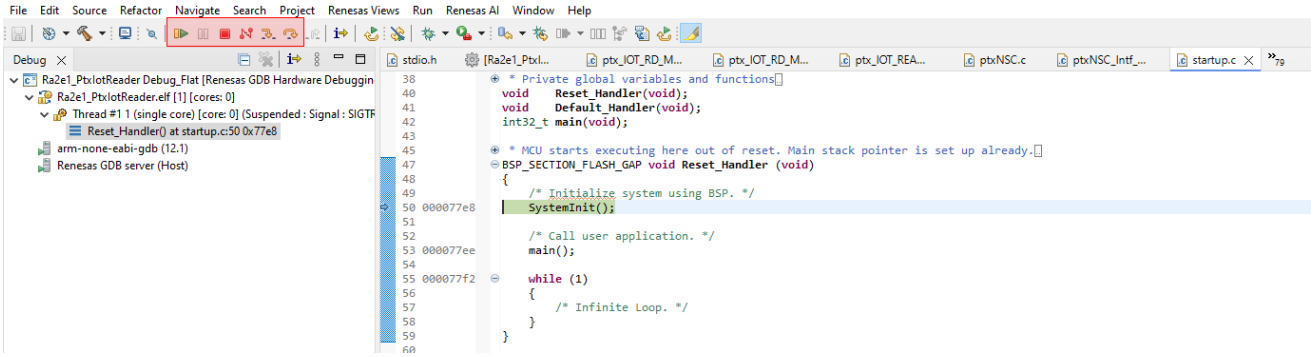

Figure 9. Application Startup Window

6. To view the application output, open the *SEGGER RTT Viewe*r using device **R7FA2E1A9**.

   When using Auto Detection option for the RTT Control Block, J-Link RTT Viewer may not be able to find the SEGGER_RTT variable in RAM memory due to restrictions on memory access imposed by TrustZone settings made by the Renesas Device Partition Manager. Restrictions are typically applied for TrustZone Example Projects if the RTT Control Block cannot be found by RTT Viewer. This can result in the output from an Example Project not being visible in the RTT Viewer Console with Auto Detection.

   The recommended approach is to search _SEGGER_RTT variable in the map file, generated upon successfully building a configuration of a Project, which is by default located in the address space for on-chip SRAM.

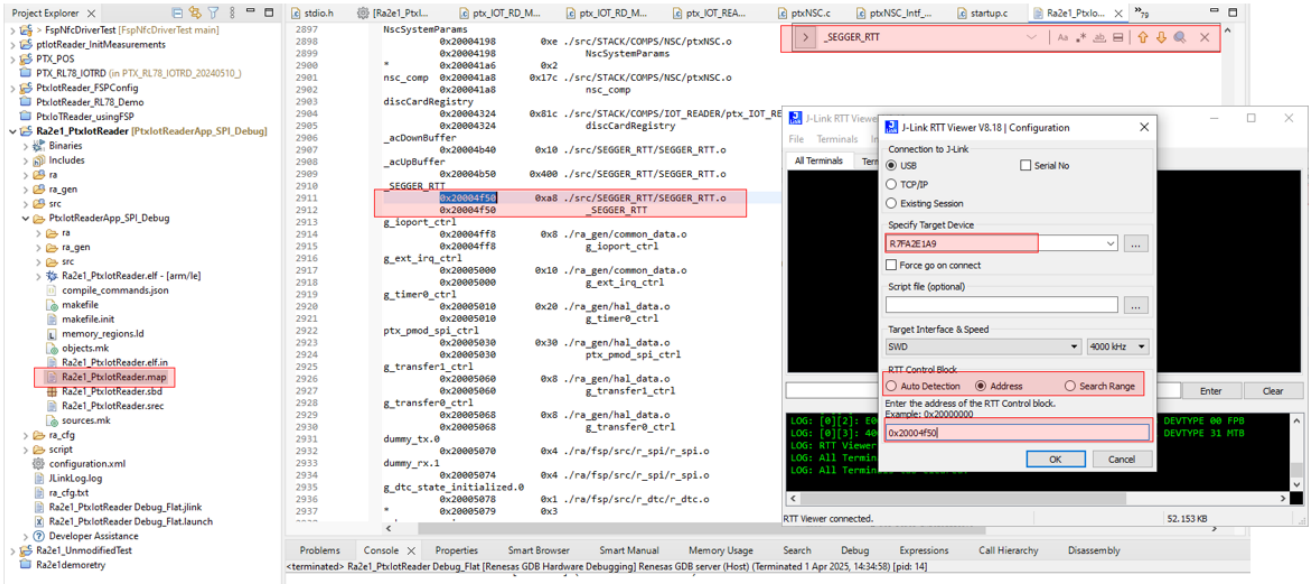

Figure 10. J-Link RTT Viewer Window

7. Once the SEGGER terminal is connected, the user can place a card in the field and view the terminal.

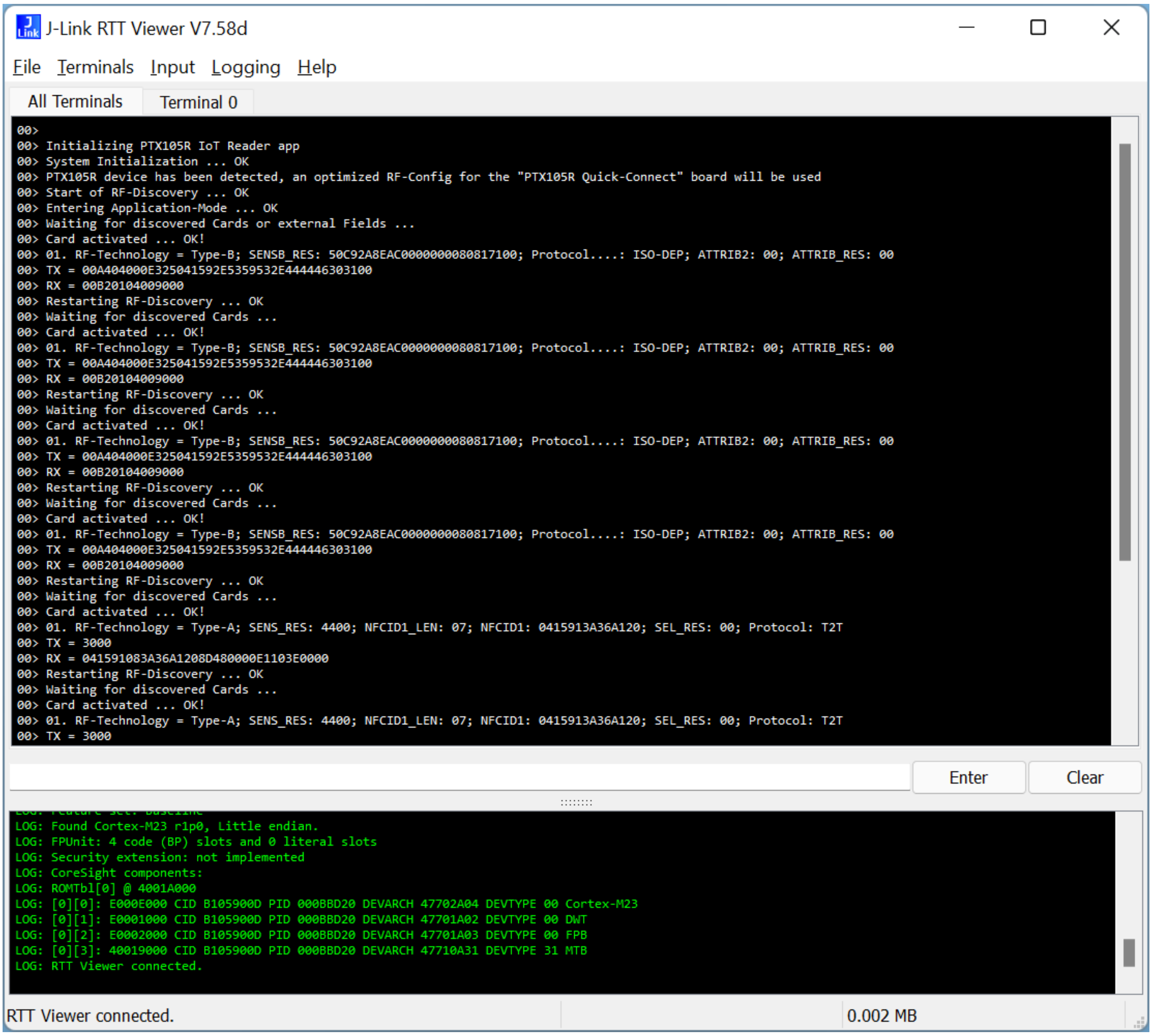

Figure 11. RTT Viewer Terminals Window

8. Using IoT Reader Library in a Custom Project

The PTX IoT Reader library provides an API for the following set of functions:

- Initialize the IOTRD API and NSC Stack
- Initialize the PTX105R chip
- Select a specific card in case multiple cards and/or protocols were discovered
- Retrieve card details like technical and/or activation parameters etc.
- Exchange RF-data and bitstreams
- Stop RF-communication

The complete list of available API's can be found in the project directory **src/STACK/COMPS/IOT_READER/ptx_IOT_READER.h**.

8.1 Integrating the Library in a Custom Project

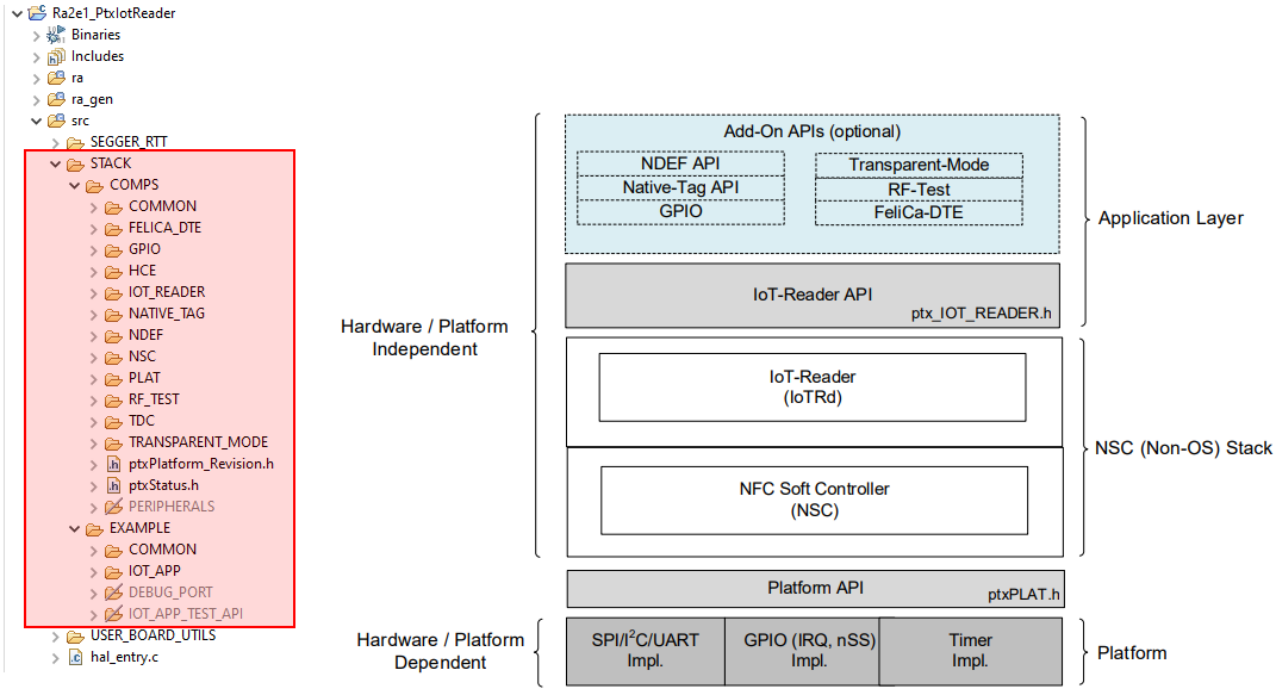

Figure 12. IoT-Reader SW Architecture

The IoT-Reader (Non-OS) SDK V7.2.0 is a source code collection so it can be easy integrated in any custom project. From Software Architecture point of view, the “Platform” layer is the only Hardware specific Software Component, and it must be reimplemented by the user.

The IoT-Reader (Non-OS) SDK V7.2.0 provides a reference implementation for RA4M2 Family. For this Demo purpose the “Platform” layer was adapted for EK-RA2E1 board with minimal effort.

8.2 Supported Architectures

Although the EK-RA2M1 platform is an ARM Cortex®-M23, IoT-Reader (Non-OS) SDK V7.2.0 being delivered as source code collection makes it independent of the target architecture.

If the user encounters any kind of incompatibility due to platform architecture or Toolchain support can be requested by contacting Renesas technical support.

8.3 Platform-Specific Implementation

As the SDK is common for all implementations, it must not use any hardware-dependent resources. The PLAT module can be used to define the interface functions to be implemented by the user. The required function declarations can be found in **ptxPLAT.h**. These functions must be individually implemented for the actual hardware.

The **ptxPLAT.c** code contains the basic low-level functions that the library uses for allocating memory area for objects, initializing and controlling timers, doing communication across SPI, etc.

The RA2E1 platform-specific implementation is located in **ptxPLAT.c**, but with the Renesas FSP platform API, the implementation is compatible with any variant of an RA family MCU. In this case, the device pin assignment might be the only configuration that needs to be adjusted.

9. PTX105R QC Schematic

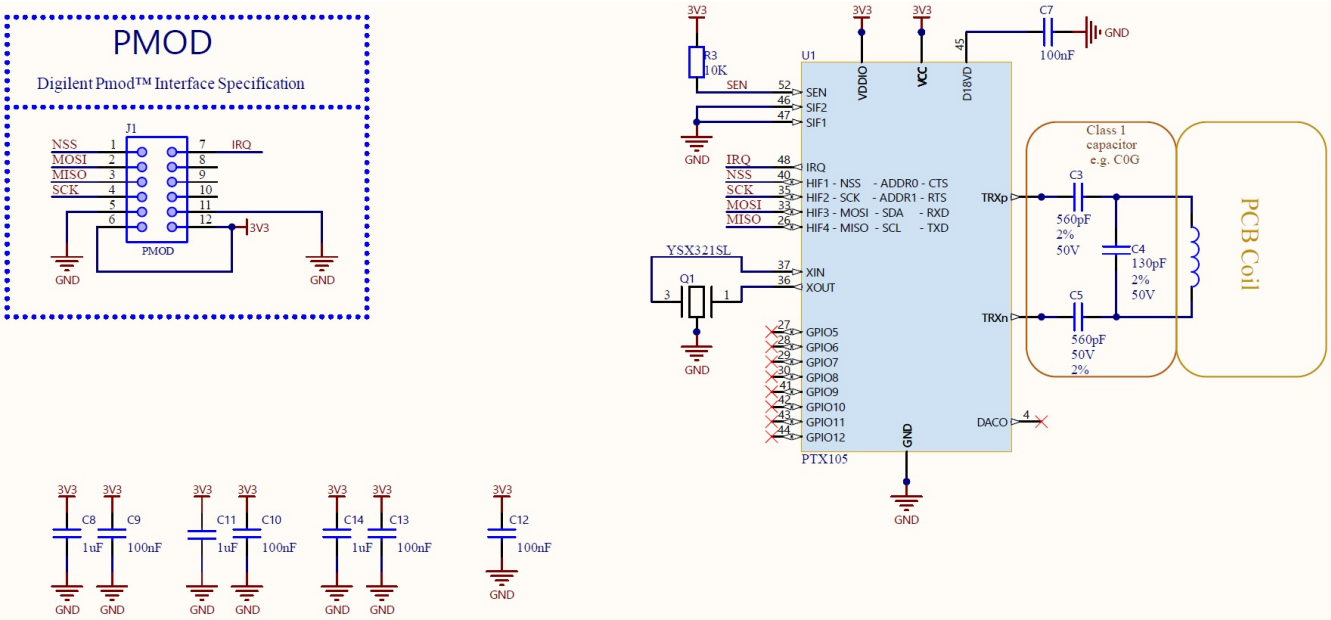

Figure 13. PTX105R-DB-RB QFN56-IOT QC Schematic

10. Revision History

Revision	Date	Description
1.01	Apr 03, 2025	▪ Updated e² Studio and FSP versions ▪ Updated content and figures based on new software package release (sections 2.2, 6, 6.1, 7, 8, 8.1, and 8.2)
1.00	Sep 25, 2024	Initial release.

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