RZ/A series

FSP Example Project Usage Guide

Introduction

This Flexible Software Package (FSP) Example Project Usage Guide provides steps and guidelines for operating example projects which use the RZ/A FSP.

Target Device

- RZ/A3UL
- RZ/A3M

Supported Board Edition

- RZ/A3UL Evaluation Board Kit QSPI Edition.
- RZ/A3UL Evaluation Board Kit OCTAL-SPI Edition.
- RZ/A3M Evaluation Board Kit Edition.

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1. Prerequisites

1. Tool experience: It is assumed that the user has prior experience working with integrated development environments, such as e^2 studio and terminal emulation programs, such as Tera Term.
2. Subject knowledge: It is assumed that the user has basic knowledge about microprocessors, embedded systems, and FSP to modify the example projects. First time users are recommended to refer to *Getting Started with Flexible Software Package*, paying special attention to sections as follow.
    - Set up a SMARC EVK RZ/A3UL and RZ/A3M EK.
    - Tutorial: Your First RZ MPU Project – Blinky
    - Importing an Existing Project into e^2 studio
3. The screen shots provided throughout this document are for reference. The actual screen content may differ depending on the version of software and development tools used.

2. Hardware and Software Requirements

RZ/A FSP Example projects are designed to operate using Evaluation Board Kit for RZ/A3UL and RZ/A3M MPU officially supported by Renesas.
Refer to the readme.txt file in the specific module folder of */example_projects* folder for additional hardware and software requirements for running the projects.

Note:

Some projects may require external hardware as mentioned in the respective readme.txt files.

Operating Environment

- Windows® 10 operating system
- RZ/A FSP v3.5.0
- e^2 studio 2024-01

3. Tool Installation

3.1 FSP and Tools Installation

Download and install the latest version of FSP and tools from FSP GitHub repository.

1. Open FSP GitHub repository: https://github.com/renesas/rza-fsp
2. Go to the ***Releases*** section of Git and navigate to latest FSP section.
3. Follow the instructions on installing and using FSP and e^2 studio.

4. Downloading and Running the Project

4.1 Downloading the Project

1. Download the example project which is "RZ/A FSP Example Project Bundle" from RZ/A Software Package | Renesas.

4.2 Running the Project

4.2.1 Importing the Project into e2studio

1. Import an existing project.
   Refer to the section *Importing an Existing Project into e2 studio* in *Getting Started with Flexible Software Package.*
2. Generate Project content.
   Double clicks to open **configuration.xml** and then click **Generate Project Content**.

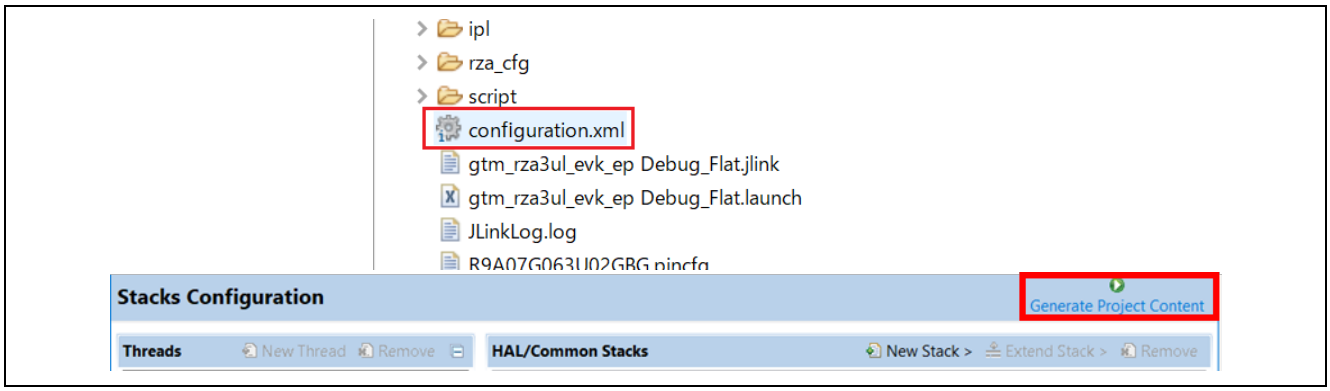


Figure 1: Generate project content

3. Build the project.
   There are three ways to build a project:
   a. Click on **Project** in the menu bar and select **Build Project**.

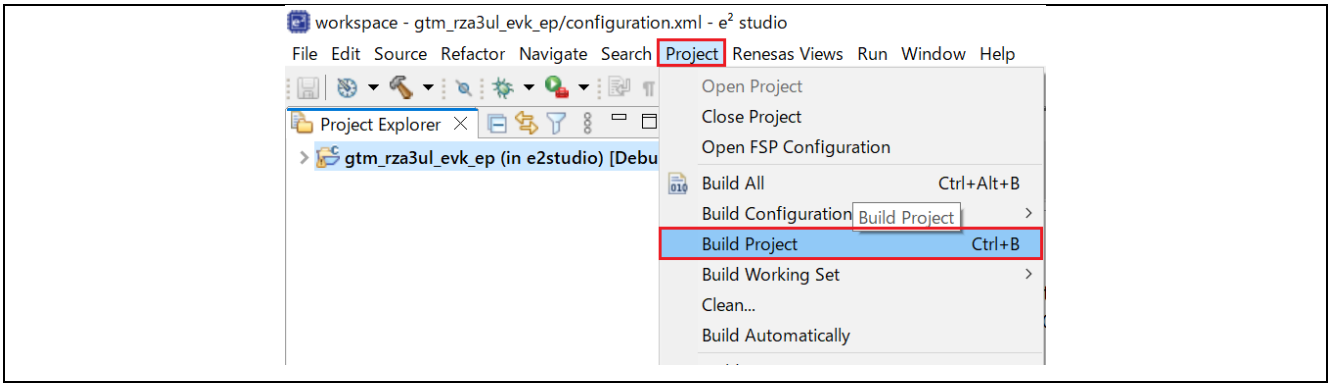


Figure 2: Build Project selection

   b. Click on the hammer icon.

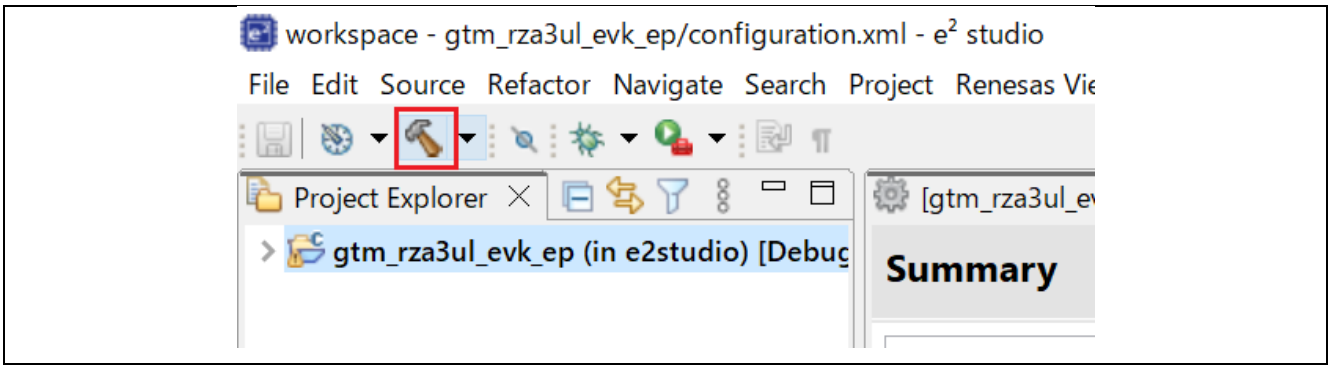


Figure 3: Click hammer icon

c. Right-click on the project and select **Build Project**.

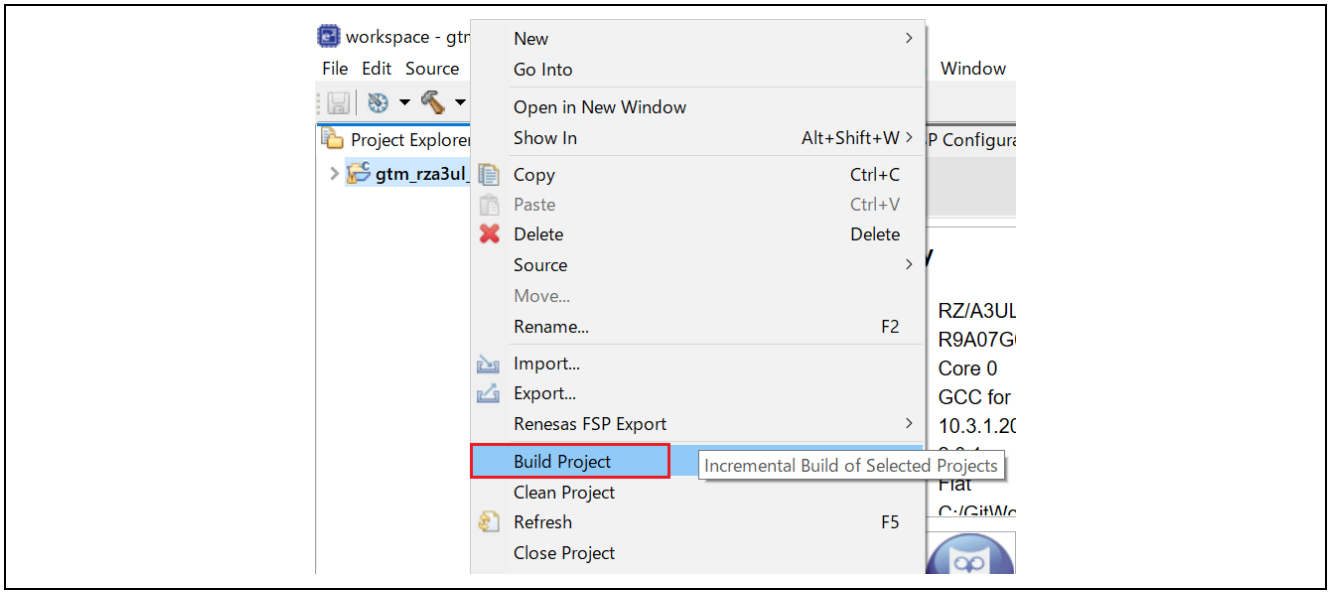


Figure 4: Build Project selection

4. Refer to the `readme.txt` file in the project folder and configure the hardware settings. Turn on the board and connect it to the PC. Set the configuration of Terminal Emulator.
   - Speed: 115200bps
   - Data: 8bit
   - Parity: None
   - Stop bits: 1bit
   - Flow control: None

5. Downloading the project image to the board.
   Click **Debug** to begin debugging the application.

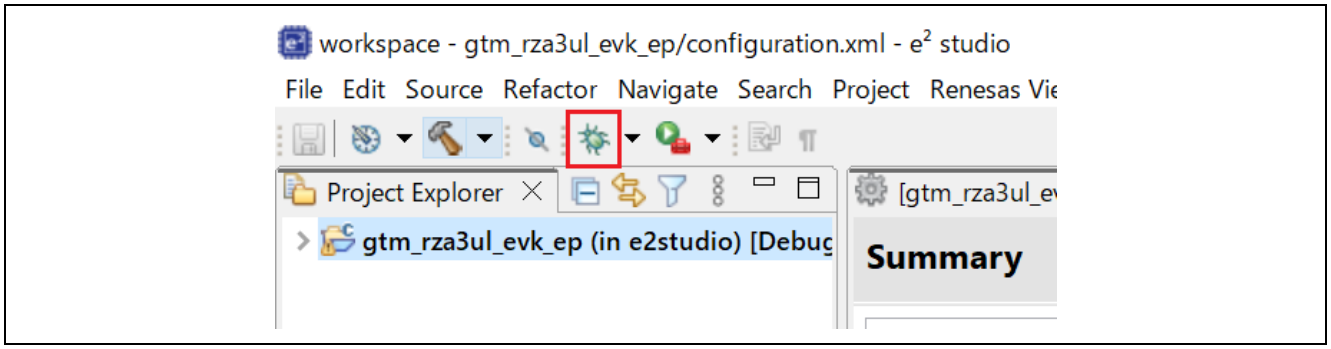


Figure 5: Debugging the application

6. In Debug mode, click **Run** > **Resume** or click on the **Play** icon twice.

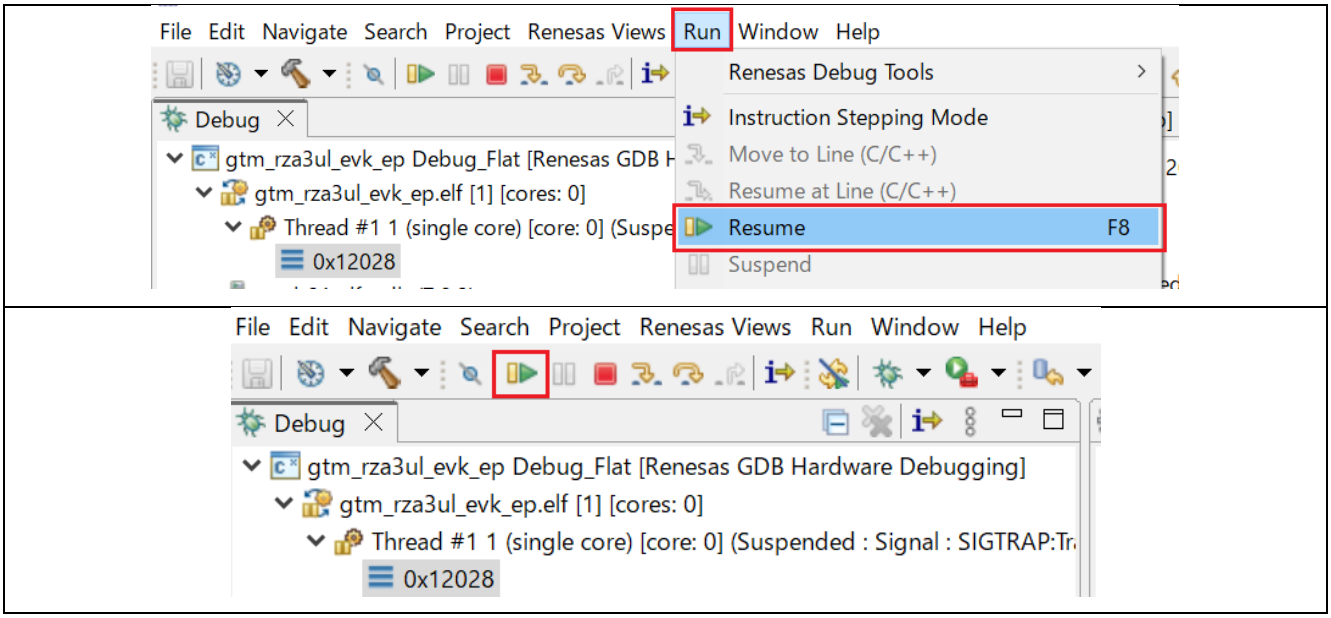


Figure 6: Run the project

7. Follow the instructions displayed on the Terminal Emulator as shown below.

Figure 7: Follow the instructions displayed on the Terminal Emulator

Note:

1. Example Projects do not support floating point or special characters or any non-numeric characters.
2. Example projects do not handle cases where the user input is greater than the expected input array size.

5. Change Board Edition Settings on the Project

The example projects for RZ/A3UL set RZ/A3UL Evaluation Board Kit QSPI Edition (Exec with DDR-SDRAM) as default. If you can use the project for other board edition of RZ/A3UL, follow the below procedure.

5.1 Change to RZ/A3UL Evaluation Board Kit QSPI Edition (eXecute-In-Place)

1. Change **Device Selection** to **RZ/A3UL Evaluation Board Kit QSPI Edition (eXecute-In-Place)** in FSP Configuration > BSP tab.

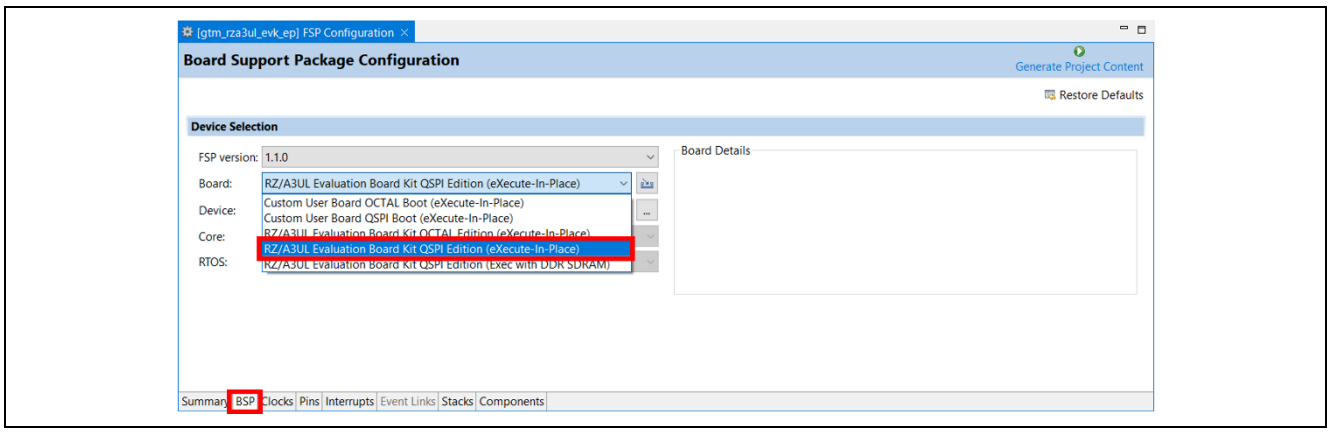


Figure 8: Change Device selection

2. Uncheck the box in **Generate data** of FSP Configuration > Pins tab.

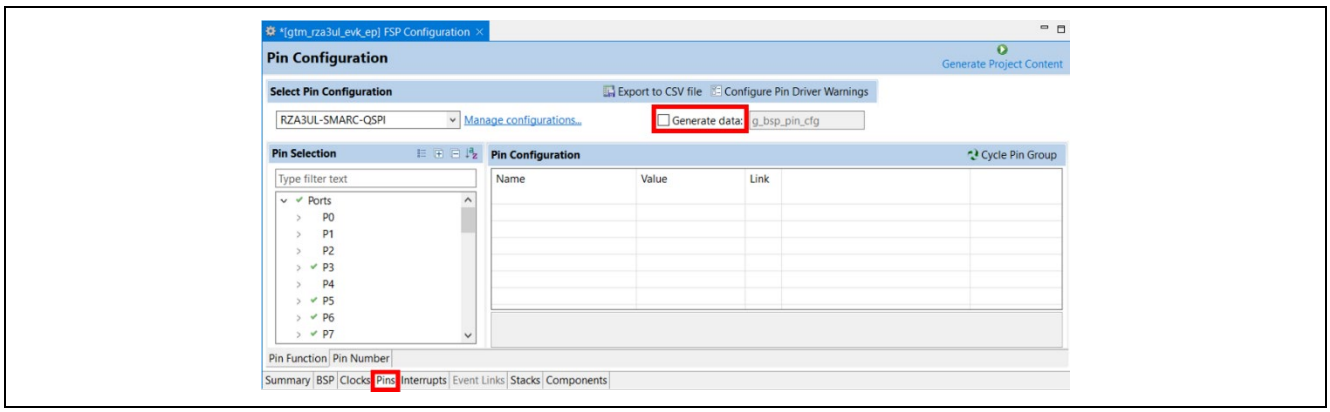


Figure 9: Uncheck the box in Generate data of FSP Configuration >Pins tab

3. Change **Select Pin Configuration** to **RZA3UL-SMARC-QSPI-XIP** in FSP Configuration > Pins tab.

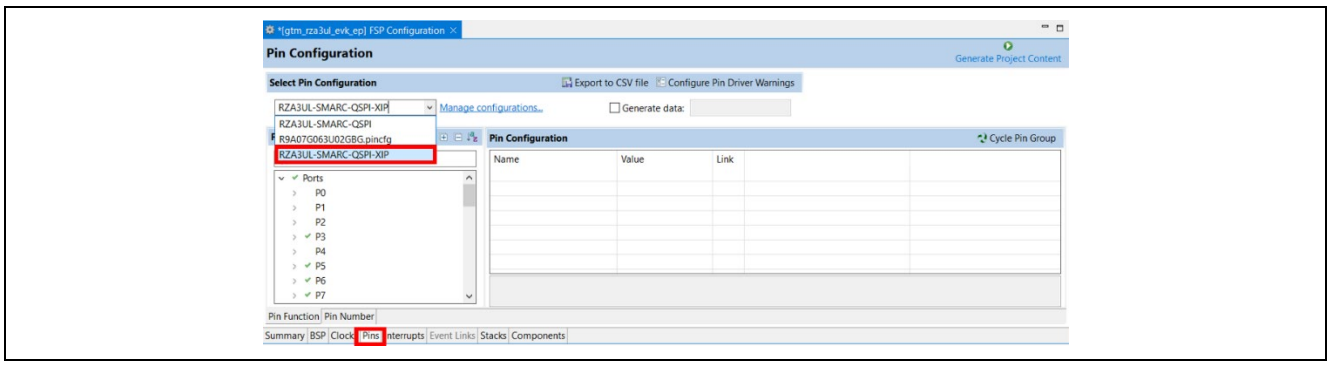


Figure 10: Change Select Pin Configuration

4. Check the box and enter **g_bsp_pin_cfg** in **Generate data** of FSP Configuration > Pins tab.

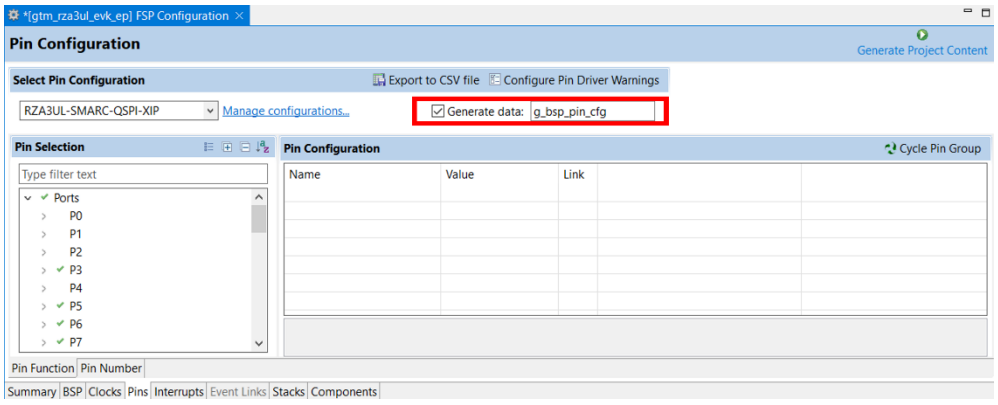


Figure 11: Check the box and enter g_bsp_pin_cfg

5. Click **Generate Project Content**.

Figure 12: Click Generate Project Content

6. Build the project.

5.2 Change to RZ/A3UL Evaluation Board Kit OCTAL Edition (eXecute-In-Place)

1. Change **Device Selection** to **RZ/A3UL Evaluation Board Kit OCTAL Edition (eXecute-In-Place)** in FSP Configuration > BSP tab.

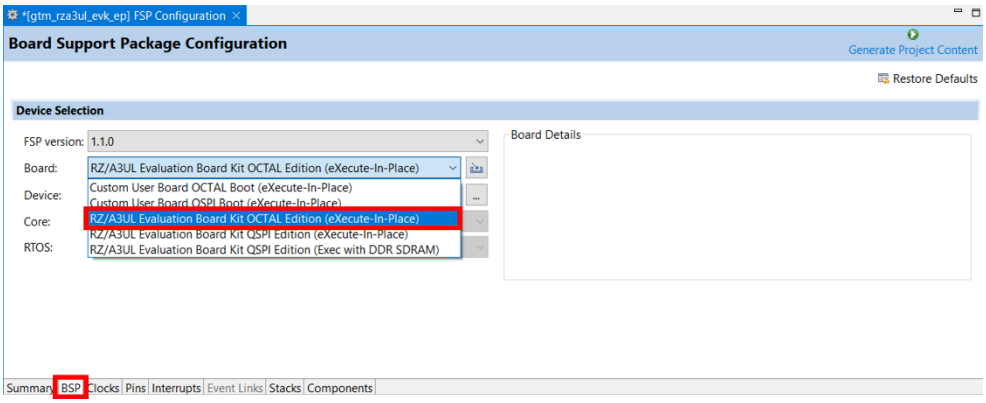


Figure 13: Change Device Selection to octal board

2. Uncheck the box in **Generate data** of FSP Configuration > Pins tab.

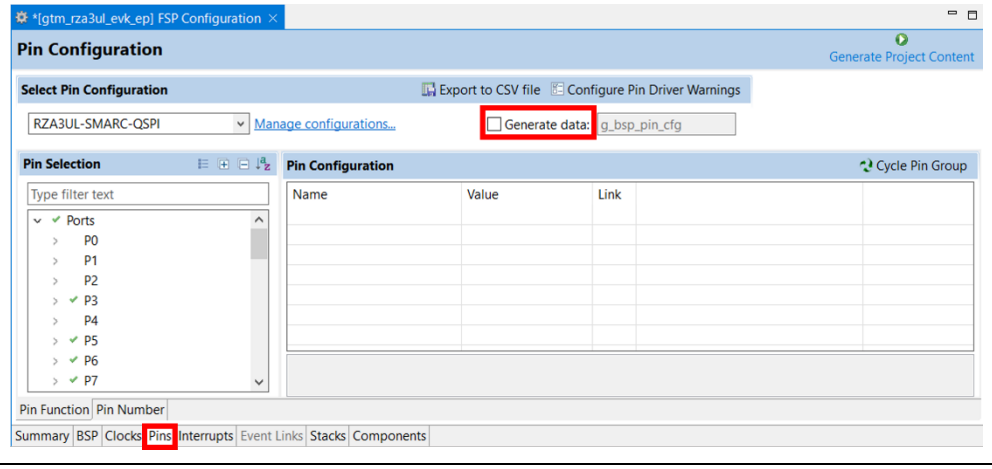


Figure 14: Uncheck the box in Generate data of FSP Configuration > Pins tab

3. Change **Select Pin Configuration** to **RZA3UL-SMARC-OCTAL-XIP** in FSP Configuration > Pins tab.

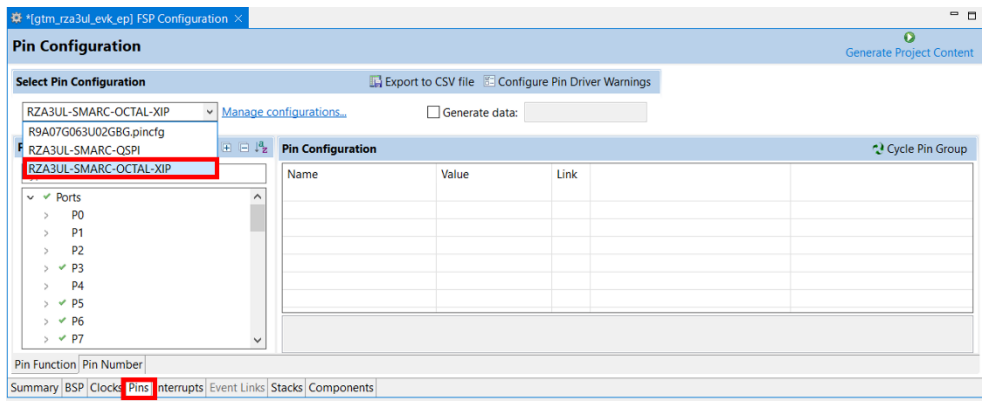


Figure 15: Change Select Pin Configuration

4. Check the box and enter **g_bsp_pin_cfg** in **Generate data** of FSP Configuration > Pins tab.

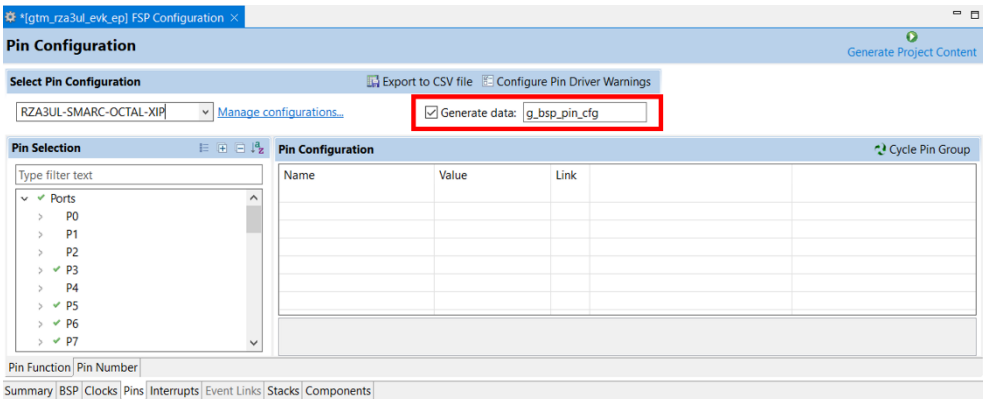


Figure 16: Check the box and enter g_bsp_pin_cfg Generate data of FSP Configuration > Pins tab

5. Click **Generate Project Content**.

Figure 17: Click Generate Project Content

6. Build the project.
7. Change Loaded file of IPL for OCTAL edition.
   1. Open **Debug Configurations** and move to **Startup** tab.

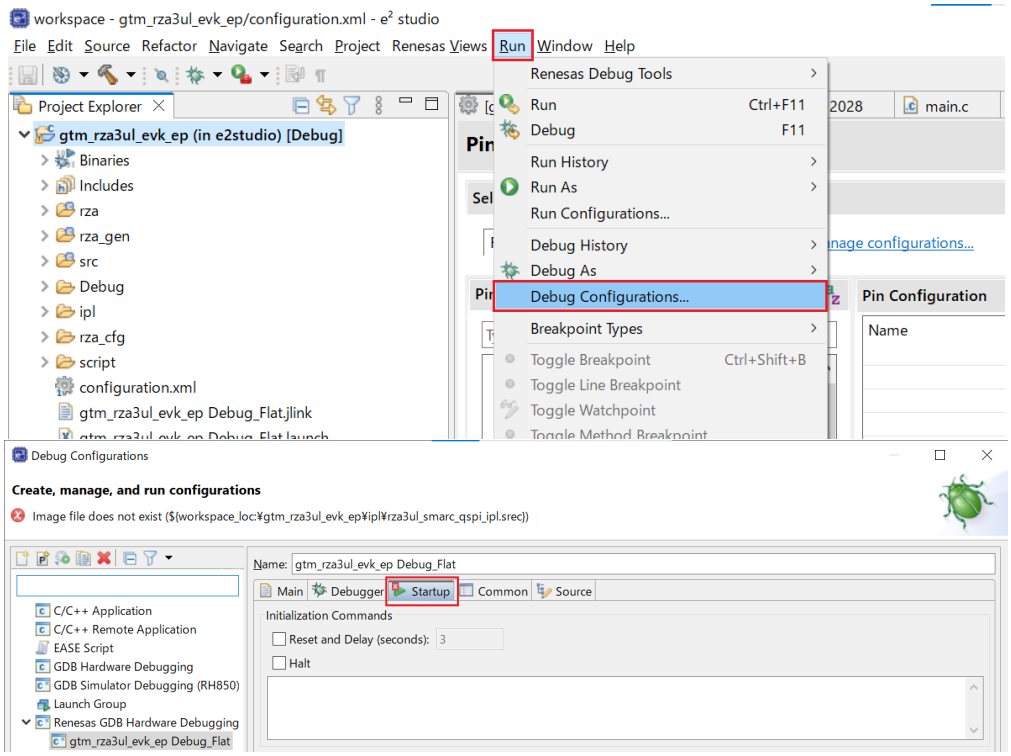


Figure 18: Open Debug Configurations and move to Startup tab

2. Click rza3ul_smarc_qspi_ipl.srec in **Load Image and Symbols** and click **Edit…**.

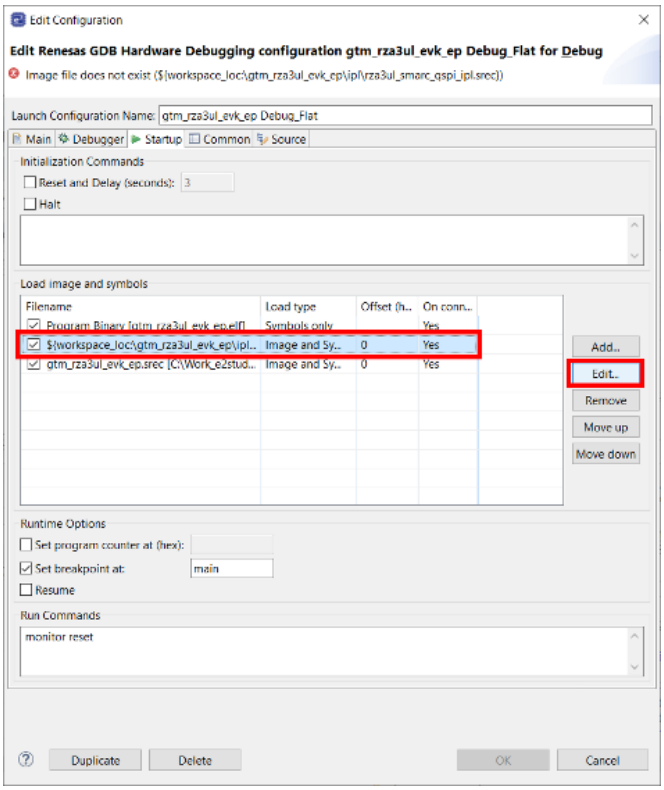


Figure 19: Click rza3ul_smarc_qspi_ipl_srec

3. Click **Workspace…** and select project/ipl/rza3ul_smarc_octal_ipl.srec.

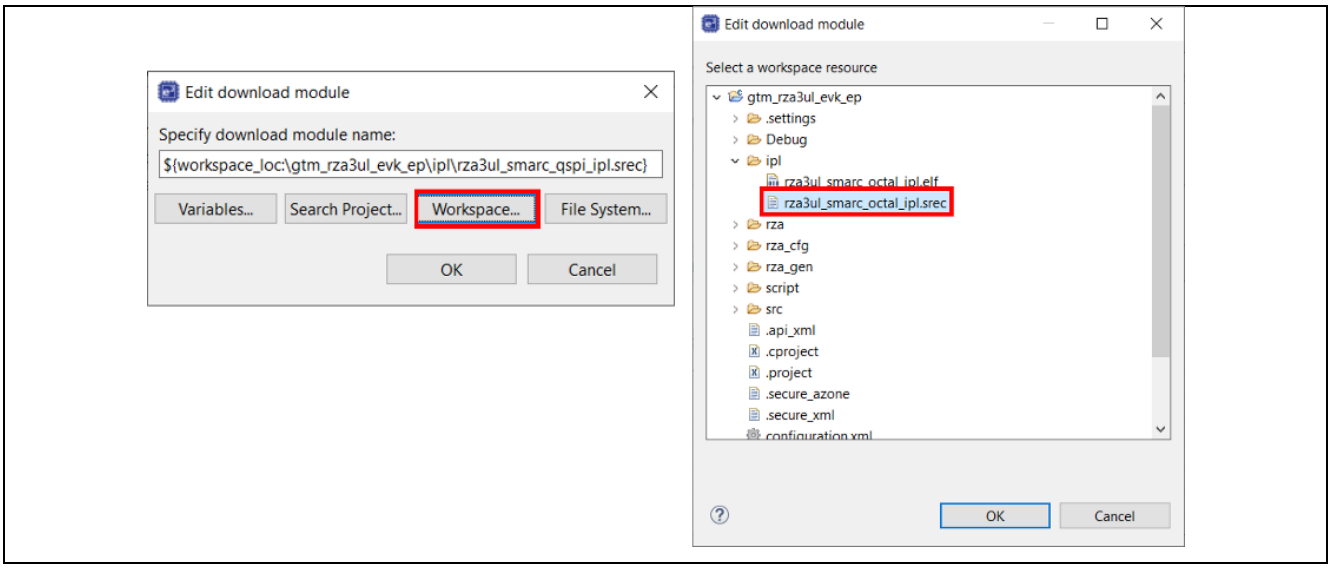


Figure 20: Click and select rza3ul_smarc_octal_ipl.srec

8. Click OK and apply the Debug Configuration.

6. About Examples

6.1 ADC

6.1.1 Project Overview

The example project demonstrates the typical use of the ADC HAL module APIs.
The project initializes the ADC in single scan or repeat scan mode based on user selection in RZ/A3UL configuration. Once initialized, the user can initiate the ADC scan and also stop the scan (in the case of repeat scan mode) using Tera Term by sending commands. Result and ADC status is displayed on the Tera Term.

6.1.2 Hardware Requirements

External hardware: External Variable Power Supply Unit (Rheostats 10K)

6.1.3 Hardware Settings

Please connect each hardware as below.

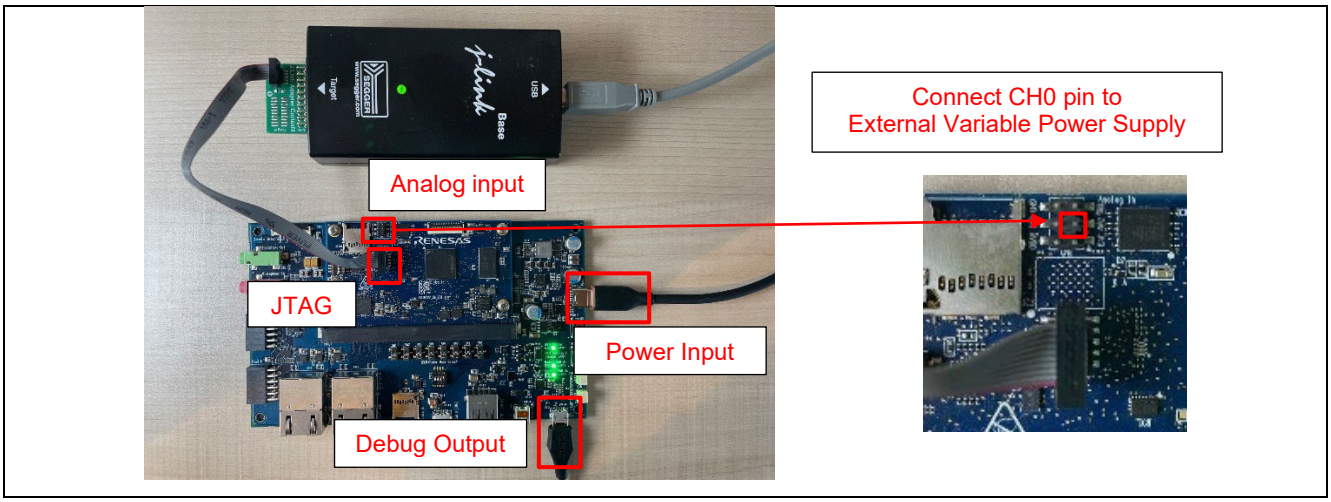


Figure 21: ADC_C example - Board Setting (RZ/A3UL)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4

6.1.4 Operation

After running the example, the message below is displayed on console. Then, user can run each options.

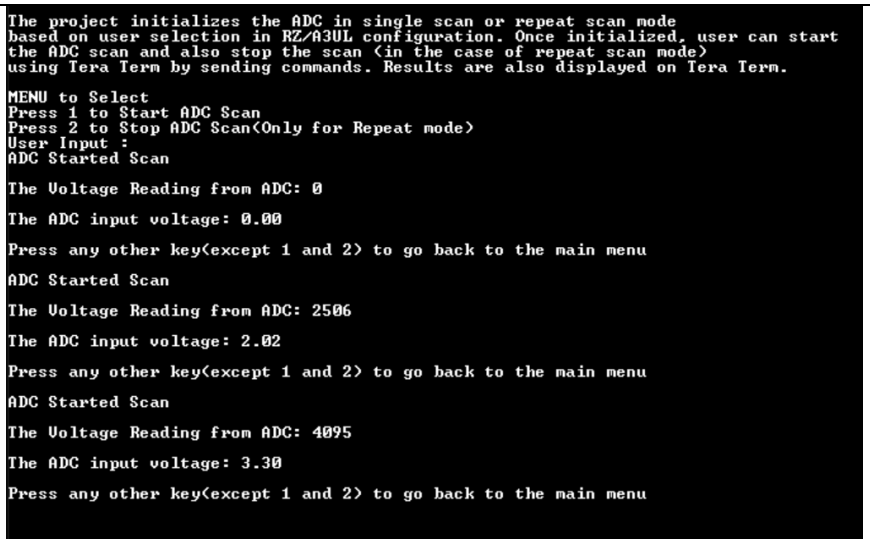


Figure 22: ADC_C example - Operaion

6.2 CANFD

6.2.1 Project Overview

The example project shows the operation of CAN-FD running on Renesas RZ MPUs using channel 0 and channel 1 on board.
On pressing any key on the Terminal Emulator, data is transmitted from one channel to another.
On the 1st transmission, Channel 0 transmits data to Channel 1. Channel 1 displays the received data.
On the 2nd transmission, Channel 1 transmits updated data to Channel 0 as ACK. Channel 0 displays the received data. then Channel 0 changes CAN frame to CANFD frame and updates data.
On the 3rd transmission, Channel 0 transmits updated data to Channel 1. Channel 1 displays the received data. Then Channel 1 changes CAN frame to CANFD frame and updates data to transmits back to Channel 0 as ACK.
On the 4th transmission, Channel 1 transmits updated data to Channel 0 as ACK. Channel 0 displays the received data.

6.2.2 Hardware Requirements

External hardware: PMOD LED

Also, The Evaluation Board Kit must have IC15 (to support CAN port) on the carrier board.

6.2.3 Hardware Settings

Please connect each hardware as below.

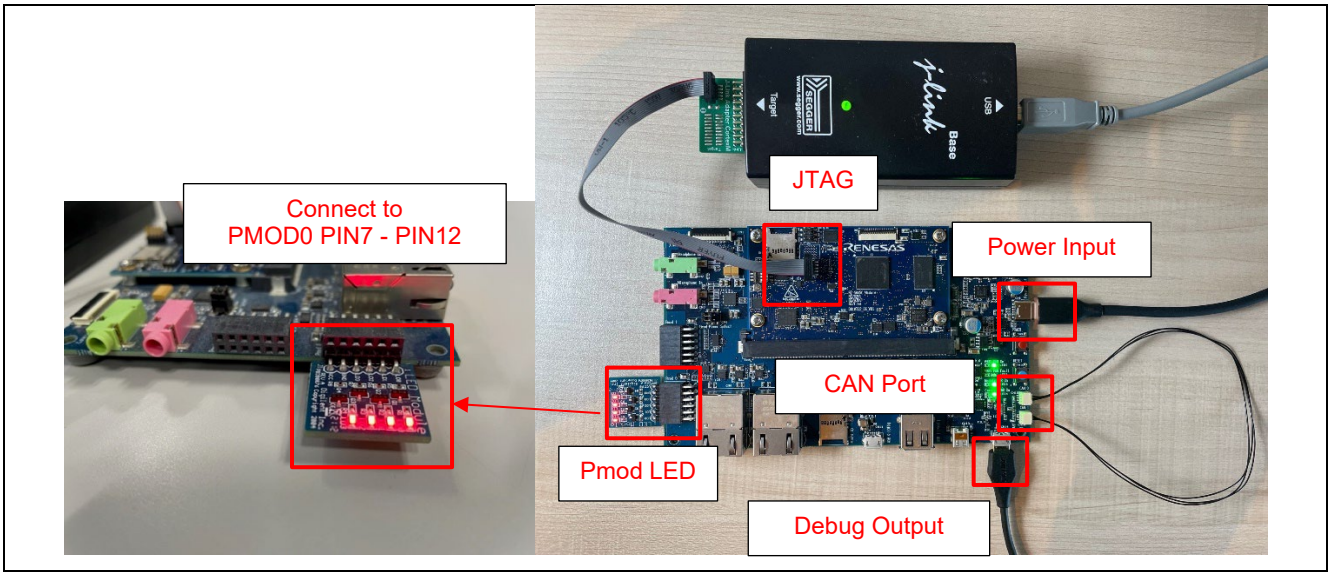


Figure 23: CANFD example - Board Setting (RZ/A3UL)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK
Module board	SW1-1: OFF SW1-2: OFF SW1-3: OFF
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: 1-2 SW8: 1-2 SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4

6.2.4 Operation

After running the example, the message below is displayed on console. After inputting any key, the transmission will be performed accordingly.

```
**************************************************************************
*    Renesas FSP Example Project for r_canfd Module                      *
*    Example Project Version 3.5.0                                       *
*    Flex Software Pack Version  3.5.0                                   *
**************************************************************************
Refer to readme.txt file for more details on Example Project and
FSP User's Manual for more information about r_canfd driver
 This Example Project demonstrates CAN FD operations on Renesas RZ MPUs
using 1 RZ/A3UL board. On pressing any key on the Terminal Emulator,
data is transmitted from one channel to other.
 On 1st transmission, Channel 0 transmits data to Channel 1. Channel 1
displays the received data.
 On 2nd transmission, Channel 1 transmits updated data to Channel 0 as ACK.
Channel 0 displays the received data,then Channel 0 changes
CAN frame to CANFD frame and updates data.
 On 3rd transmission, Channel 0 transmits updated data to Channel 1.
Channel 1 displays the received data, then Channel 1 changes CAN frame
to CANFD frame and updates data to transmits back to Channel 0 as ACK.
 On 4th transmission, Channel 1 transmits updated data to Channel 0 as ACK.
Channel 0 displays the received data.
Please enter any key on Terminal Emulator to initiate CAN transmission.

User input: h

 1. Transmission of data over classic CAN Frame
Classic CAN transmission is successful
Received 'TX__MESG' on classic frame.

 2. Responding with 'RX__MESG' using classic CAN frame
CAN transmission after receive is successful. Sent back the ACK using classic CAN frame
Received Acknowledgement for Classic CAN Frame transmission.
CAN operation Successful. Data length = 8

 3. Data transmission over FD frame
CAN transmission on FD Frame after receiving classic frame ACK is successful
Received data over FD Frame.
CAN operation Successful. Data length = 16

 4. Sending modified data over FD Frame now as acknowledgement for received FD data.
CAN transmission on FD Frame as acknowledgement is successful
Received Acknowledgement for FD Frame.
CAN operation Successful. Data length = 16

Please enter any key on Terminal Emulator to initiate CAN transmission.
```

Figure 24: CANFD example - Opearation

6.3 RIIC Master

6.3.1 Project Overview

The example project demonstrates the typical use of the RIIC master HAL module APIs.
The project initializes RIIC master module with fast mode and interfaces with PmodACL™ Board for ADXL345.
On power up after establishing the connection of sensor with RZ/A3 board, it displays accelerometer axis data on Terminal Emulator. Any API/event failure will be displayed on Terminal Emulator.
This project supports the DMAC feature. In cases where this feature is not used in the application, please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disabled on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack .

6.3.2 Hardware Requirements

External hardware: Pmod ACL

6.3.3 Hardware Settings

Please connect each hardware as below.

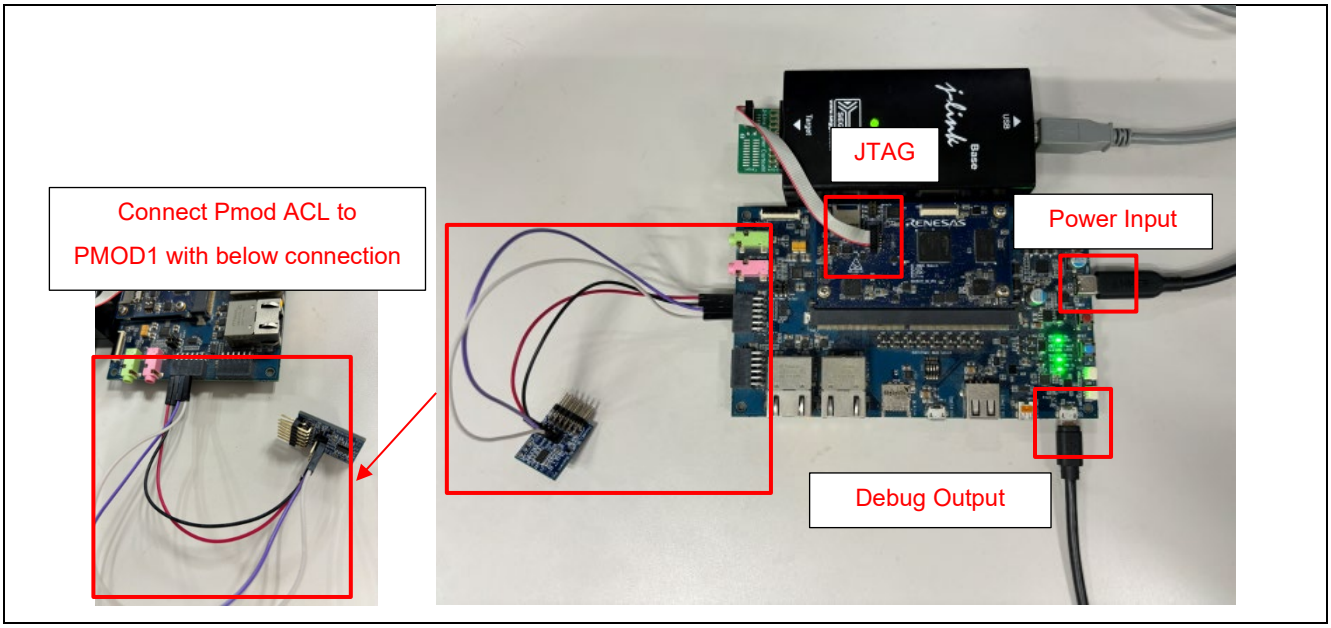


Figure 25: RIIC Master example - Board Setting (RZ/A3UL)

Please set the connection between Pmod ACL and PMOD1 on board as below.

Connection of Pmod ACL	
SCL:	Pmod ACL J2 PIN5 – PMOD1 PIN3
SDA:	Pmod ACL J2 PIN6 – PMOD1 PIN4
GND:	Pmod ACL J2 PIN7 – PMOD1 PIN5
VCC:	Pmod ACL J2 PIN8 – PMOD1 PIN6

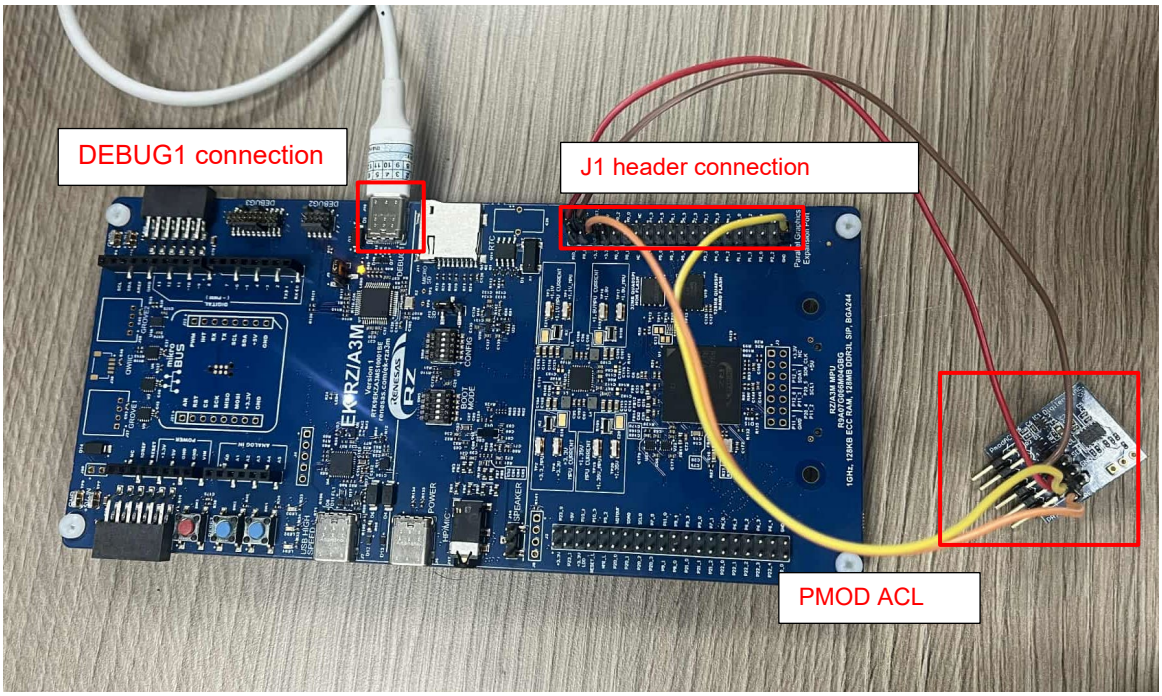


Figure 26: RIIC Master example - Board Setting (RZ/A3M)

Please set the connection between Pmod ACL and Pin header J1 on board as below.

Connection of Pmod ACL	
SCL:	Pmod ACL J2 PIN1 – J1 PIN4
SDA:	Pmod ACL J2 PIN2 – J1 PIN2
GND:	Pmod ACL J2 PIN3 – J1 PIN39
VCC:	Pmod ACL J2 PIN4 – J1 PIN5

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: 1-2. SW4: 1-2. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.3.4 Operation

After running the example, the message below is displayed on console.

```
This EP utilizes PMOD ACL sensor as iic slave device
Upon successful initialization, MPU displays sensor axis data
If SDA line is kept in LOW by any error
Please input 1 on Terminal Emulator to Open bus.

X-axis = 0.00, Y-axis = 0.00, Z-axis = 0.00
X-axis = 65530.00, Y-axis = 260.00, Z-axis = 65529.00
X-axis = 65533.00, Y-axis = 261.00, Z-axis = 65528.00
X-axis = 61.00, Y-axis = 173.00, Z-axis = 174.00
X-axis = 21.00, Y-axis = 65517.00, Z-axis = 245.00
X-axis = 65535.00, Y-axis = 259.00, Z-axis = 42.00
```

Figure 27: RIIC Master example – Operation

6.4 RIIC Slave

6.4.1 Project Overview

RZ/A3UL

The example project needs two RZ/A3UL Evaluation Board Kit. One is called Slave Board, and the another is called Master Board.
The example project demonstrates typical use of the RIIC slave HAL module APIs.
The project initializes RIIC slave and RIIC master module with standard rate and is made interfaced with loop-back mechanism.
It performs Slave read and write operation continuously once initialization is successful. On successful I2C transaction (6 bytes), transmitted and received data will be compared. Led blinks on data match else it is turned ON as sign of failure.
Output message for both boards corresponding slave operations will be displayed on Terminal Emulator.
Any API/event failure message will also be displayed.
This project supports the DMAC feature. In cases where this feature is not used in the application, please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disabled on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack.

RZ/A3M

The example project demonstrates typical use of the RIIC slave HAL module APIs.

The project initializes RIIC slave and RIIC master module with standard rate and is made interfaced with loop-back mechanism. It performs Slave read and write operation continuously once initialization is successful. On successful I2C transaction (6 bytes), Data transceived is compared. Led blinks on data match else it is turned ON as sign of failure Output message for both corresponding slave operations is displayed on Terminal Emulator.

Any API/event failure message is also displayed.

This project supports the DMAC feature. In cases where this feature is not used in the application,

please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disabled on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack .

6.4.2 Hardware Requirements

External hardware: Two Pmod LED.(RZ/A3UL)

6.4.3 Hardware Settings

Please connect each hardware as below.

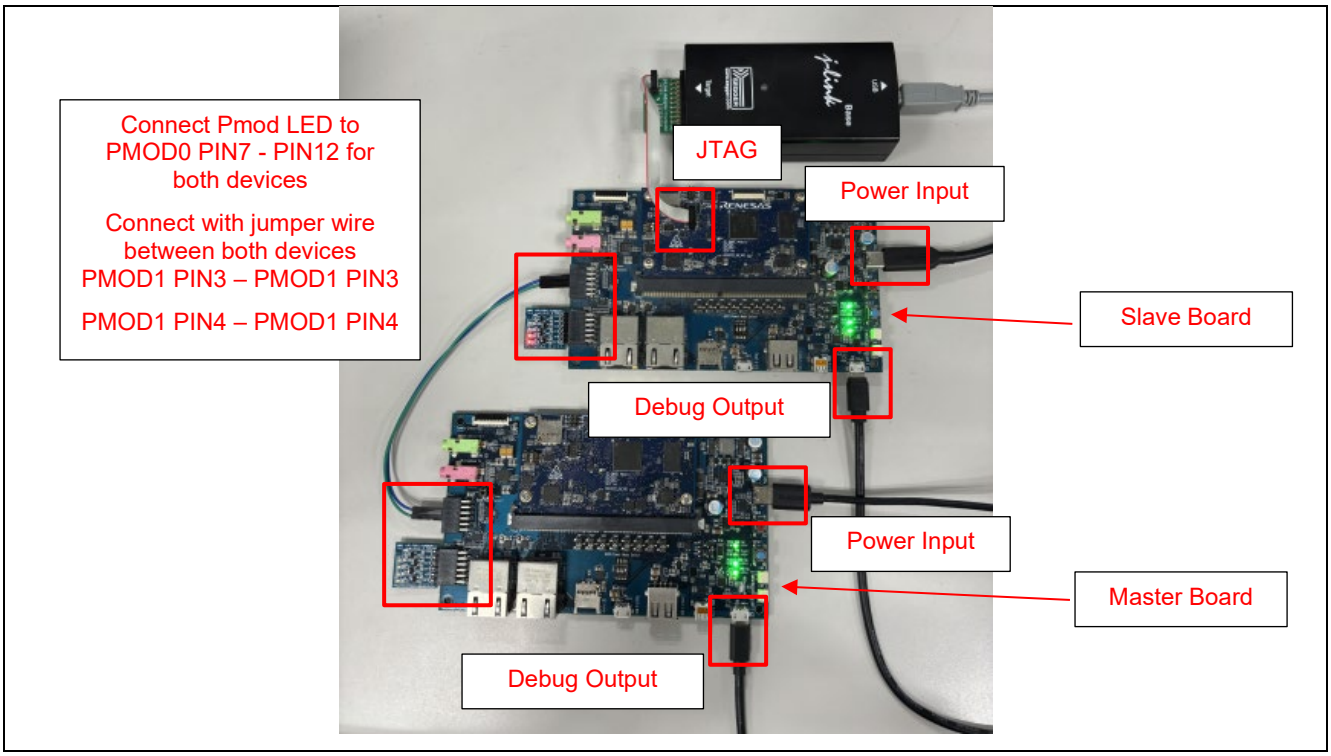


Figure 28: RIIC_Slave example - Board Setting (RZ/A3UL)

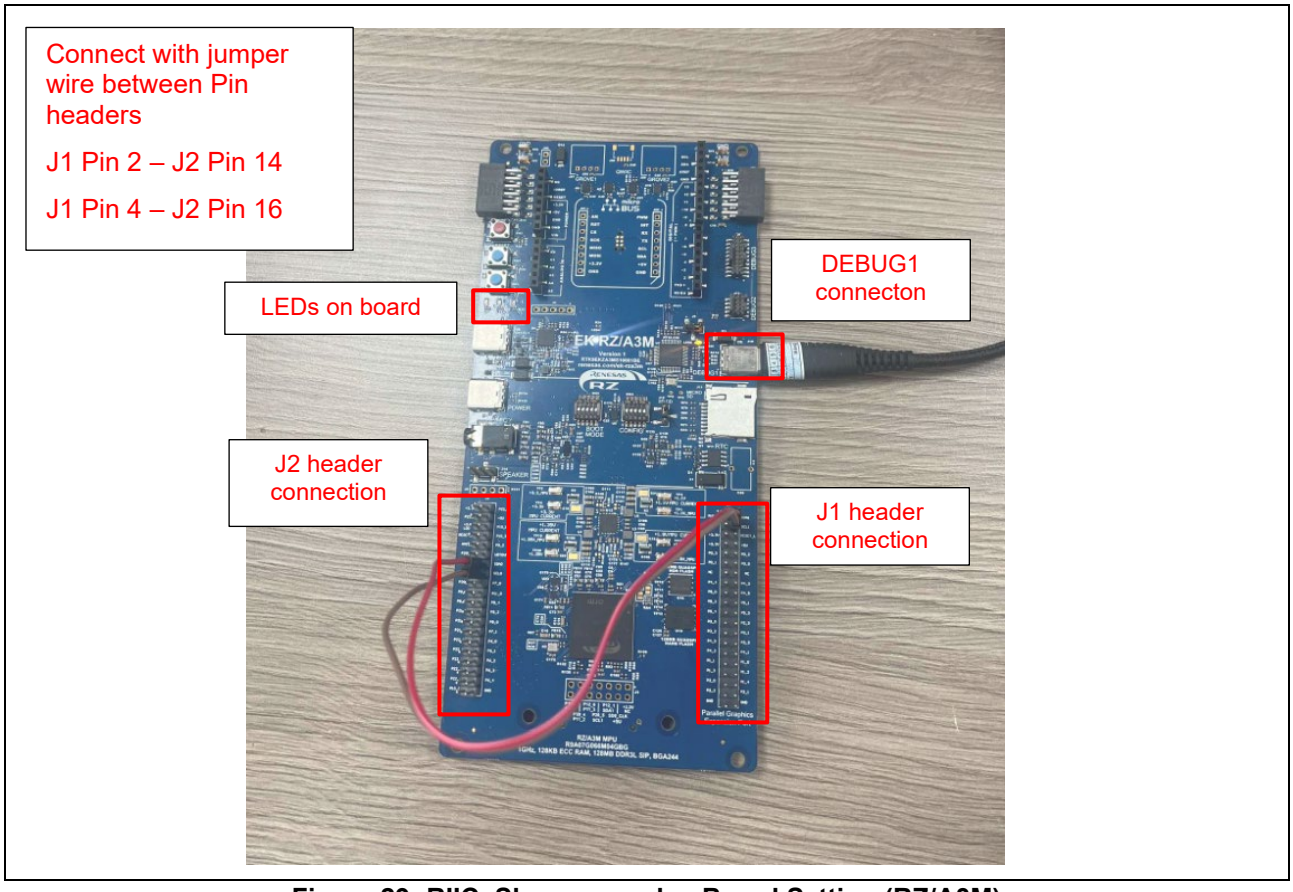


Figure 29: RIIC_Slave example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper for both boards as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: 1-2. SW4: 1-2. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.4.4 Operation

Note: For RZ/A3UL, need to run the example on Slave Board first, then run the example on Master Board. Make sure the slave board in operation when start running Master Board.

For RZ/A3UL: After running the example, the message below is displayed on console for Slave Board.

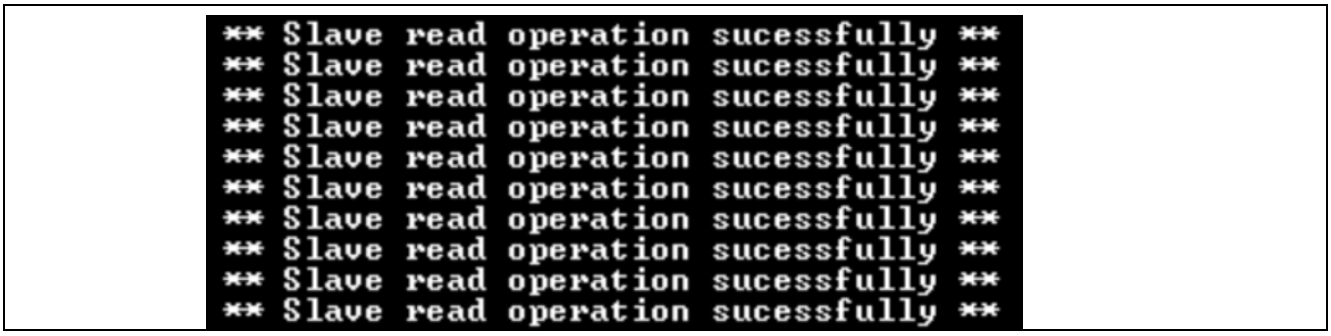


Figure 30: RIIC Slave example – Operation (Slave board - RZ/A3UL)

After running the example, the message below is displayed on console for Master Board.

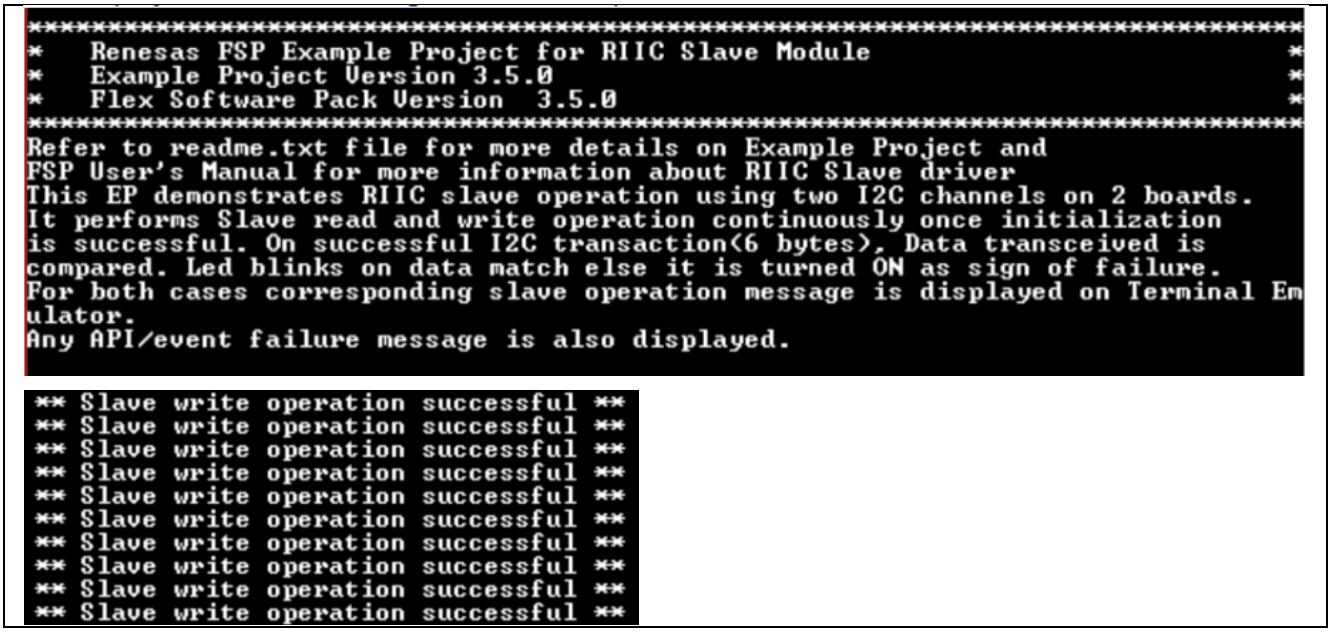


Figure 31: RIIC Slave example – Operation (Master board - RZ/A3UL)

For RZ/A3M: After running the example, the message below is displayed on console for RZ/A3M.

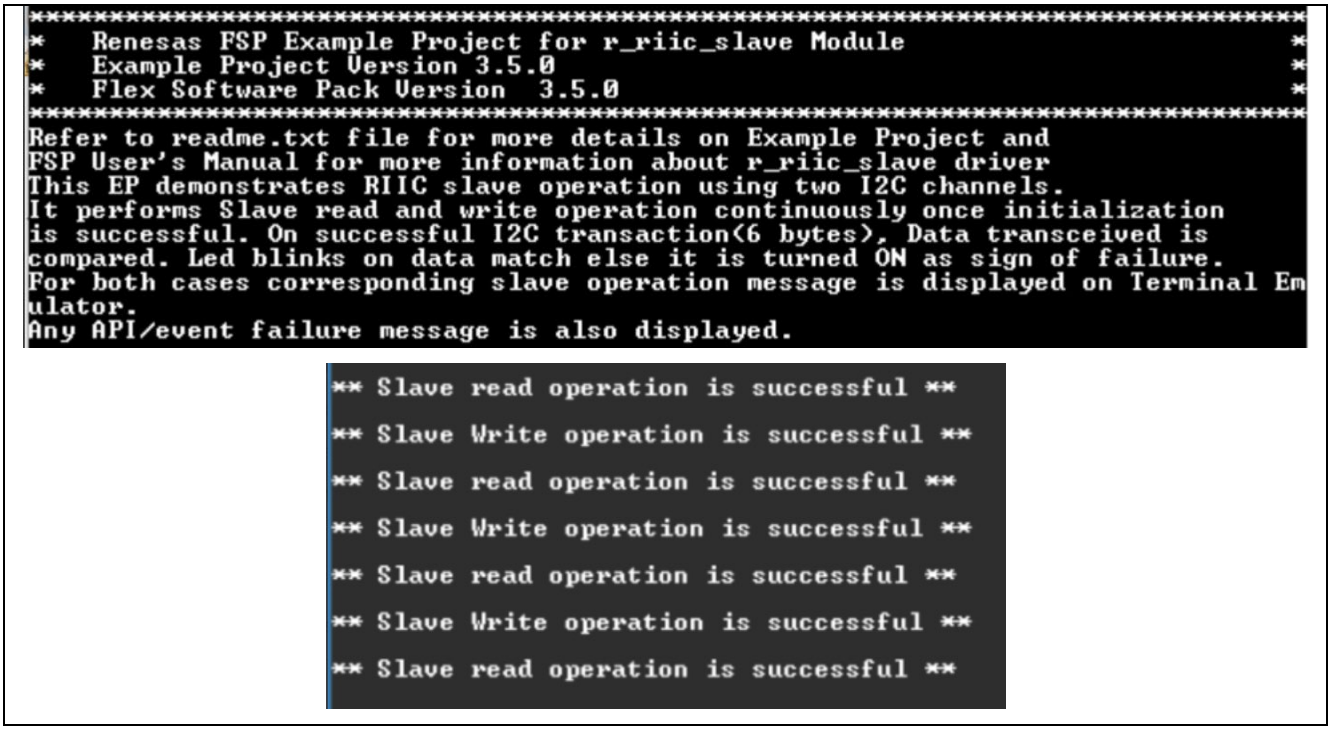


Figure 32: RIIC Slave example – Operation (RZ/A3M)

6.5 SSI

6.5.1 Project Overview

The example project demonstrates the typical use of the SSI HAL module APIs.
The project transfers sample audio data from source buffer to destination buffer by connecting Tx and Rx pins and compares the transferred data of two buffers.
The result of comparison will be displayed on Terminal Emulator.
This project supports the DMAC feature. In cases where this feature is not used in the application, please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disable on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack .

Steps to enable again the DMAC feature after disabled it:

- Set DMAC Support to Enable on the main stack of the driver in FSP Configuration.

- Add Transfer Driver on r_dmac in the DMAC sub stacks that linked to the main stack

- In the g_transfer0 SSIF_DMA_TX0, set DMA Activation Request Source Select to Requested by a transfer destination module

- In the g_transfer1 SSIF_DMA_RX0, set DMA Activation Request Source Select to Requested by a transfer source module

6.5.2 Hardware Requirements

External hardware: None

6.5.3 Hardware Settings

Please connect each hardware as below.

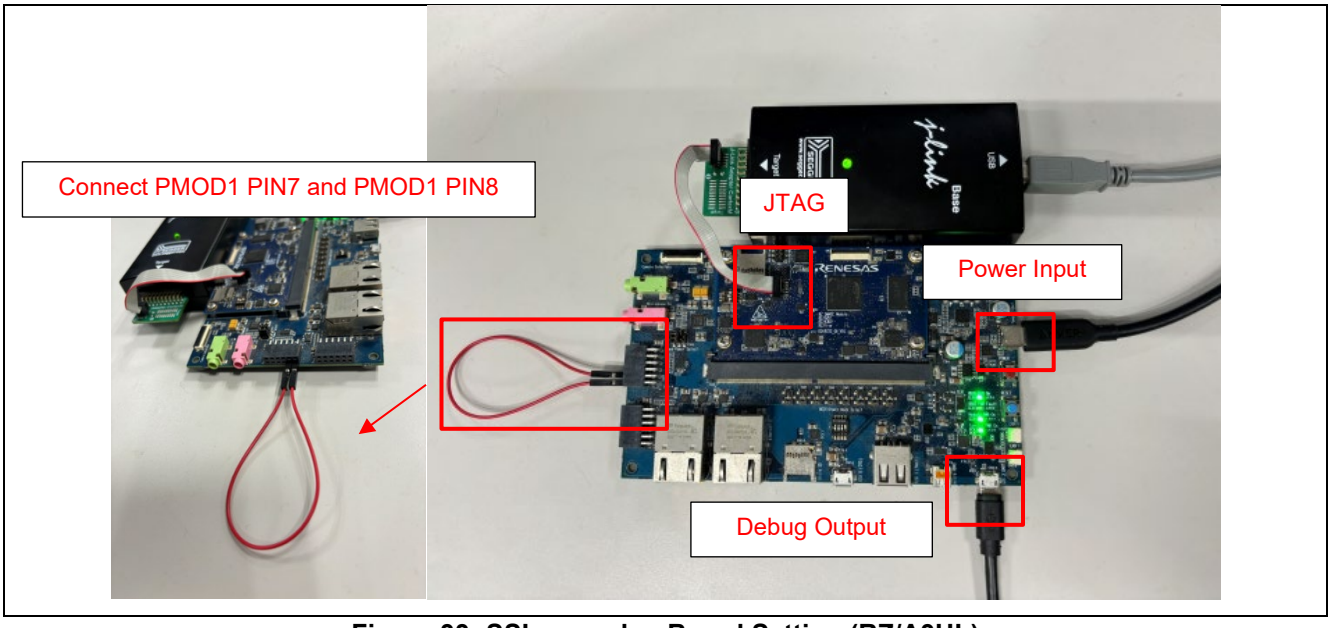


Figure 33: SSI example - Board Setting (RZ/A3UL)

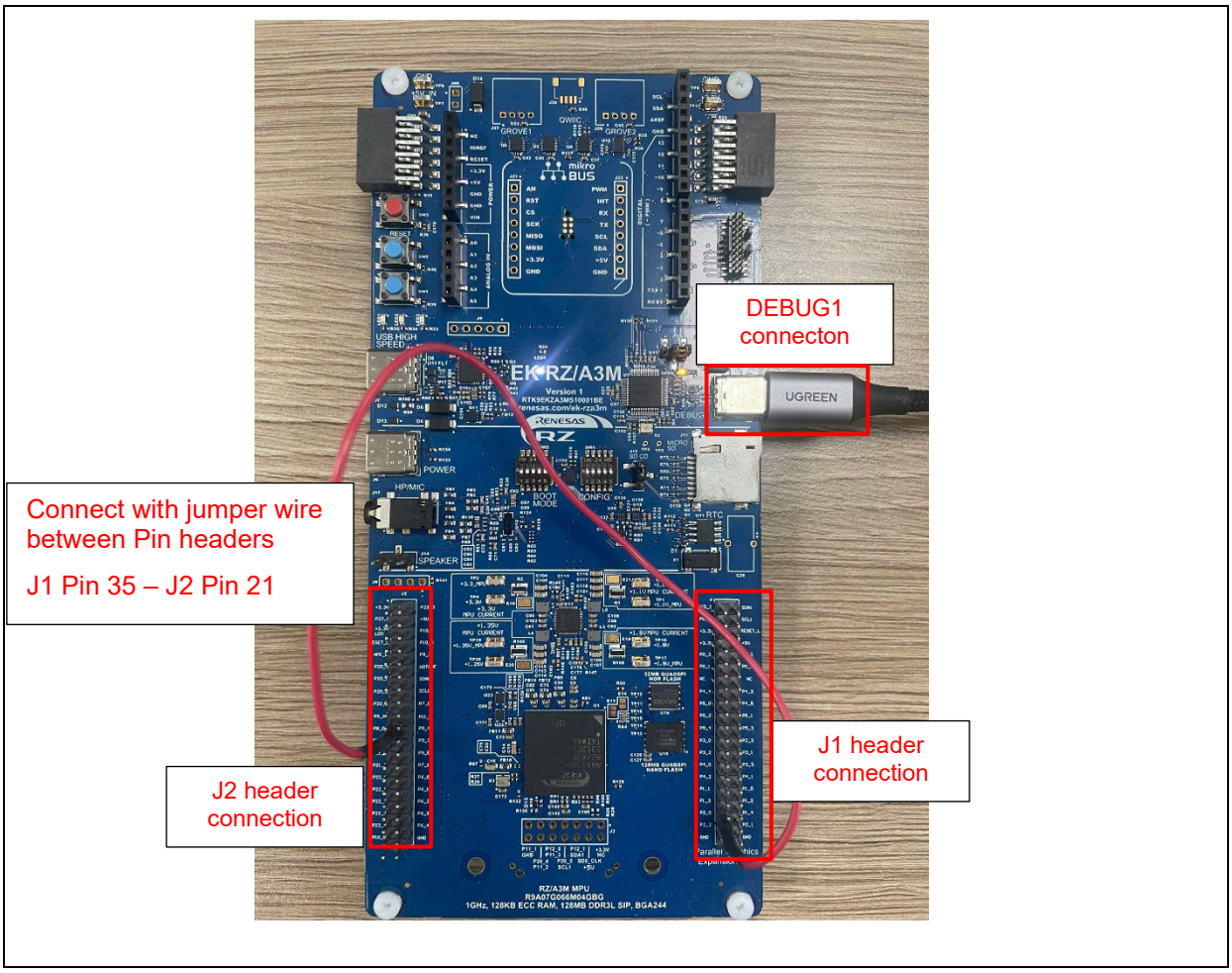


Figure 34: SSI example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 1-2. SW6: 1-2. SW7: 1-2. SW8: 1-2. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.5.4 Operation

After running the example, the message below is displayed on console.

```
The project demonstrates SSI module by transmitting and receiving
the sample audio data in loop back connection and prints the status
by comparing the transmitted and received data buffers.

Start transmit data

Complete receive data

Compared the transmitted sample audio data of SSI with received data is successf
ul.
```

Figure 35: SSI example – Operation

6.6 RSPI

6.6.1 Project Overview

The example project demonstrates the typical use of the RSPI HAL module APIs.
The project configures RSPI channels (Channel 1 and Channel 0) in Master and Slave mode.
Once the module is initialized and the channels are configured,Master and Slave can transmit and receive data based on commands from user sent through Terminal Emulator.
This project supports the DMAC feature. In cases where this feature is not used in the application, please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disabled on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack .

6.6.2 Hardware Requirements

External hardware: None

6.6.3 Hardware Settings

Please connect each hardware as below.

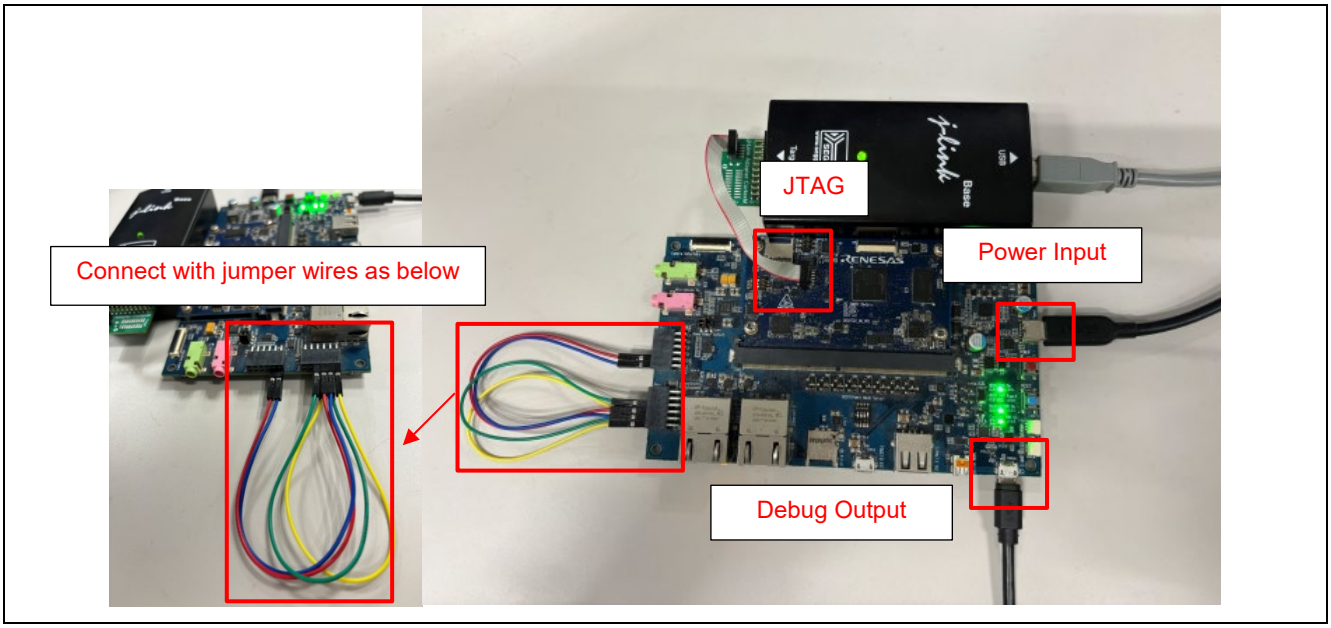


Figure 36: RSPI example - Board Setting (RZ/A3UL)

Please set the Pin Connection as below.

RZ/A3UL EVK	
MISO:	PMOD0 PIN3 - PMOD1 PIN8
MOSI:	PMOD0 PIN2 - PMOD1 PIN7
CK:	PMOD0 PIN4 - PMOD0 PIN8
SSL:	PMOD0 PIN1 - PMOD0 PIN9

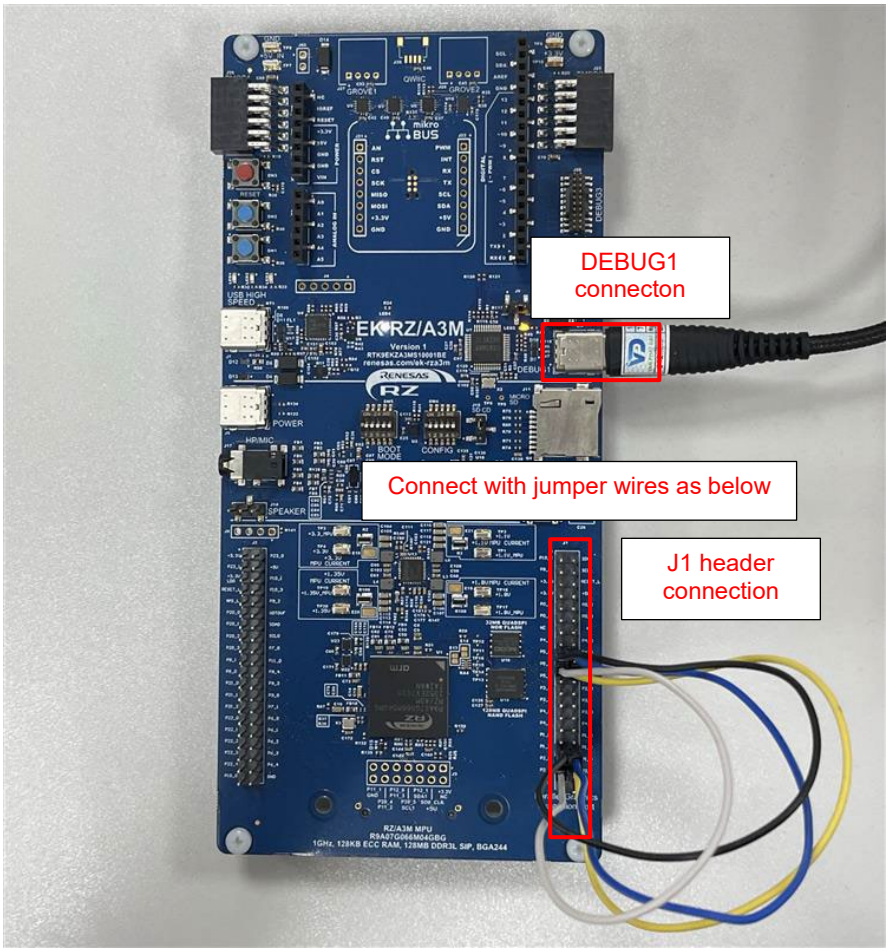


Figure 37: RSPI example - Board Setting (RZ/A3M)

Please set the Pin Connection as below.

EK RZ/A3M
MISO: P1_4 - P5_1 MOSI: P1_3 - P5_0 CK: P1_2 - P4_5 SSL: P2_0 - P5_2

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 1-2. SW6: 1-2. SW7: 1-2. SW8: 1-2. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.6.4 Operation

After running the example, the message below is displayed on console.

```
The project initializes SPI driver and configures SPI channels in
Master and Slave mode. After initialization, master and slave can
transmit and receive data based on the commands from user. Refer
to the MPU User Manual for valid bit rates and corresponding
clock settings.

** SPI INIT SUCCESSFUL **

Select from the below Menu options

Press 1 for Write() and Read()
Press 2 for WriteRead()
Press 3 to Exit
```

Figure 38: RSPI example – Operation (Initialize Console)

Enter “1” to run Write() and Read() example and transmission will be performed after input data from Master to Slave. Then, Slave sends back same data to Master.

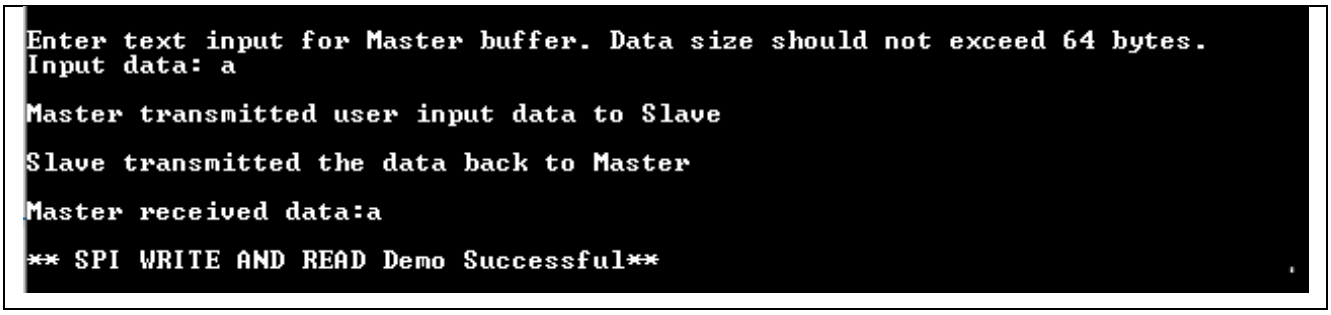


Figure 39: RSPI example – Operation (Command 1)

Enter “2” to run WriteRead() example. User can specify the data for Master and Slave. Transmission will be performed after inputting each data. Master received data and Slave received data will be shown on console once the transmission complete.

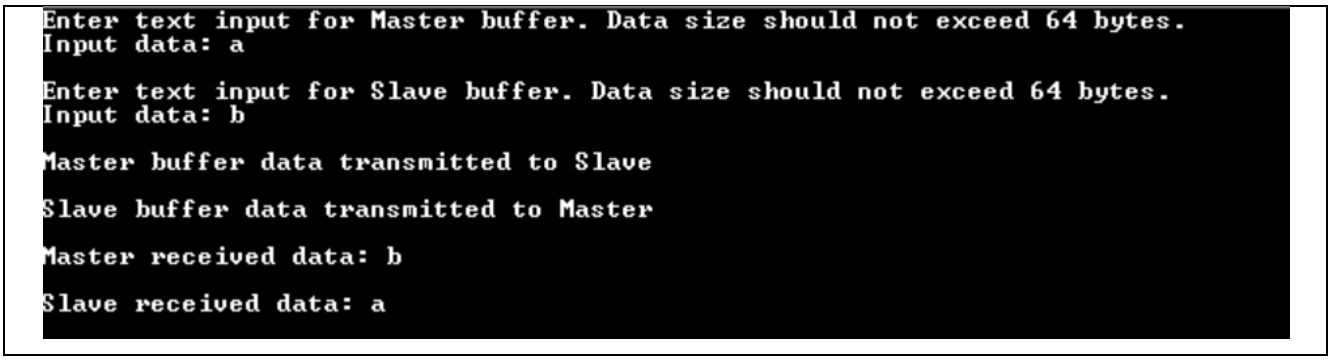


Figure 40: RSPI example – Operation (Command 2)

6.7 SCIg

6.7.1 Project Overview

The example project demonstrates the typical use of the UART HAL module APIs.
The project initializes the UART with Baud rate of 115200 bps and GTM.
Using a Terminal Emulator user can provide a value & press enter key to set the cycle of the Pmod LED signal.
This project supports the DMAC feature. In cases where this feature is not used in the application, please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disable on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack .

Steps to enable again the DMAC feature after disabled it:

- Set DMAC Support to Enable on the main stack of the driver in FSP Configuration.

- Add Transfer Driver on r_dmac in the DMAC sub stacks that linked to the main stack

- In the g_transfer0 SCIg_TXI0, set DMA Activation Request Source Select to Requested by a transfer destination module

- In the g_transfer1 SCIg_RXI0, set DMA Activation Request Source Select to Requested by a transfer source module

6.7.2 Hardware Requirements

External hardware: Pmod USBUART (for RZ/A3UL and RZ/A3M) and Pmod LED (For RZ/A3UL)

6.7.3 Hardware Settings

Please connect each hardware as below.

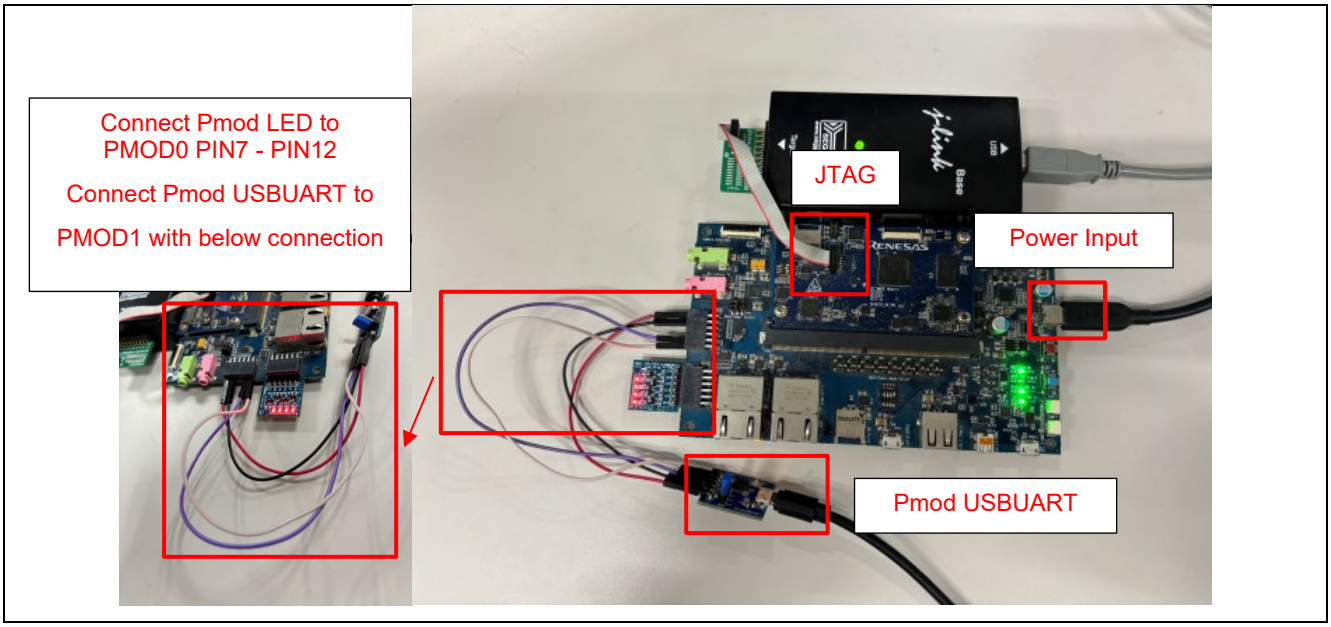


Figure 41: SCIg example - Board Setting (RZ/A3UL)

Please set the connection between Pmod USBUART and PMOD1 on the board below.

Connection of Pmod USBUART	
RXD:	Pmod USBUART J2 PIN2 – PMOD1 PIN7
TXD:	Pmod USBUART J2 PIN3 – PMOD1 PIN8
GND:	Pmod USBUART J2 PIN5 – PMOD1 PIN11
VCC:	Pmod USBUART J2 PIN6 – PMOD1 PIN12

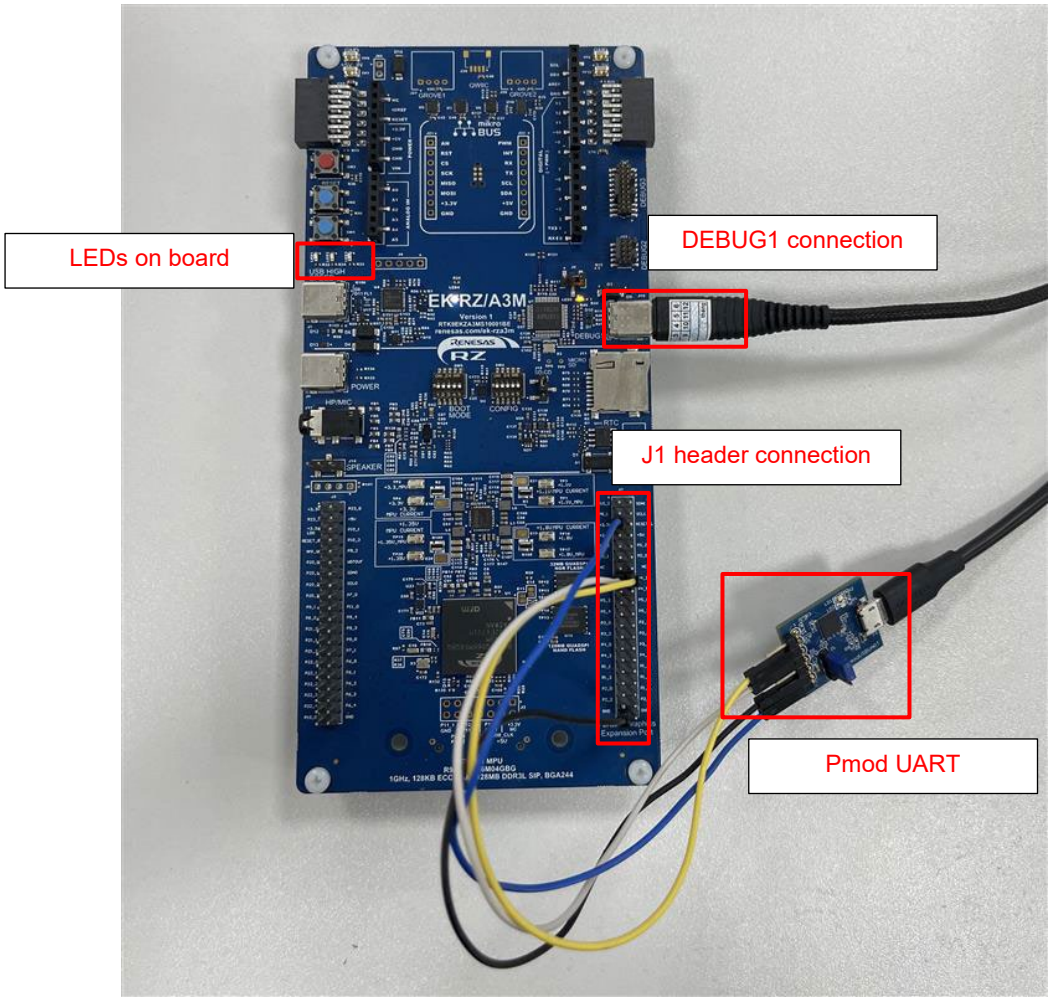


Figure 42: SCIg example - Board Setting (RZ/A3M)

Please set the connection between Pmod USBUART and J1 header on the board as below.

Connection of Pmod USBUART	
RXD:	Pmod USBUART J2 PIN2 – J1 Pin 16
TXD:	Pmod USBUART J2 PIN3 – J1 Pin 15
GND:	Pmod USBUART J2 PIN5 – J1 GND
VCC:	Pmod USBUART J2 PIN6 – J1 +3.3V

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 1-2. SW6: 1-2. SW7: 1-2. SW8: 1-2. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.7.4 Operation

After running the example, the message below is displayed on console.

Figure 43: SCIg example – Operation (Initialize Console)

User can specify a value for LED blinking on Terminal Program.

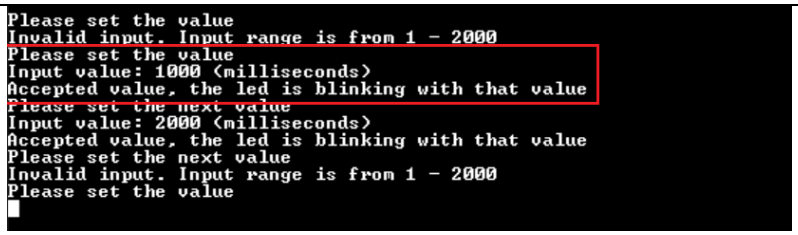


Figure 44: SCIg example – Operation (Specify value)

6.8 SCIF

6.8.1 Project Overview

The example project demonstrates the typical use of the UART HAL module APIs.
The project initializes the UART with Baud rate of 115200 bps and GTM.
Using a Terminal Emulator user can provide a value & press enter key to set the cycle of the Pmod LED signal.
This project supports the DMAC feature. In cases where this feature is not used in the application, please invalid the DMAC feature by the following steps.

- Set DMAC Support to Disabled on the main stack of the driver in FSP Configuration.

- Remove the DMAC sub stacks that linked to the main stack .

6.8.2 Hardware Requirements

External hardware: Pmod LED (for RZ/A3UL)

6.8.3 Hardware Settings

Please connect each hardware as below.

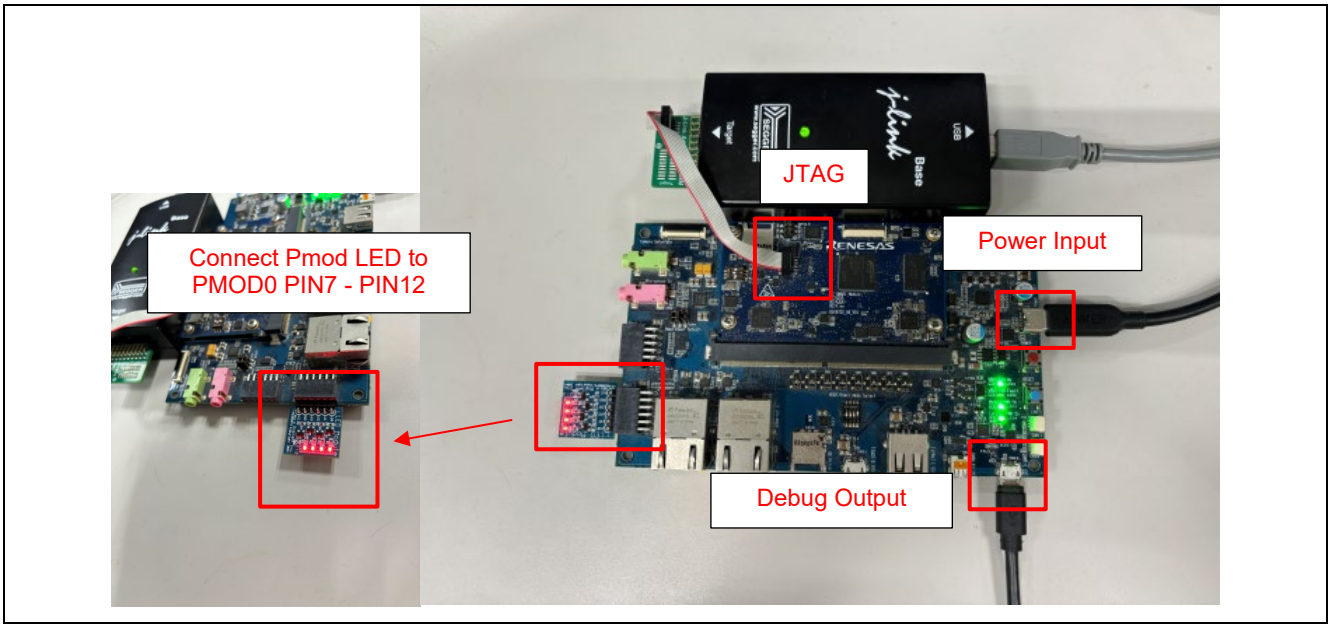


Figure 45: SCIF example - Board Setting (RZ/A3UL)

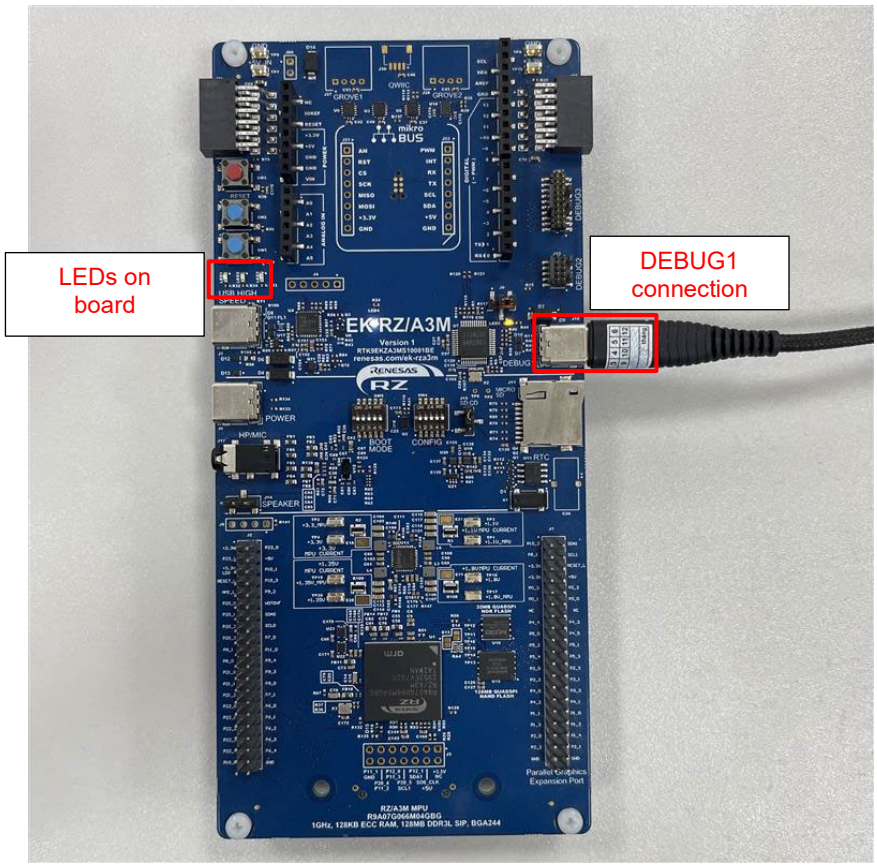


Figure 46: SCIF example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.8.4 Operation

After running the example, the message below is displayed on console. User can specify a value for LED blinking on Terminal Program.

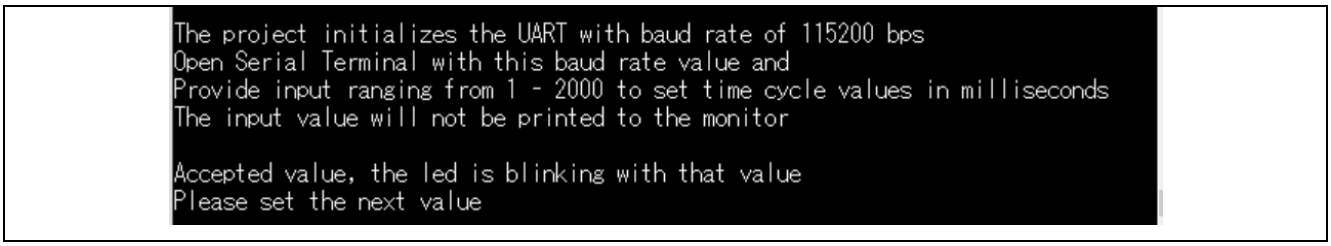


Figure 47: SCIF example – Operation

6.9 USB HHID

6.9.1 Project Overview

This example project demonstrates basic functionalities of USB HHID driver with FreeRTOS on Renesas RZ/A.MPUs based on Renesas FSP. USB HHID driver configures keyboard as a hhid device. On pressing key from the keyboard, received keycode is decoded and displayed on the Terminal Emulator. Error and info messages will be printed on Terminal Emulator.

6.9.2 Hardware Requirements

External hardware: USB PC Keyboard

6.9.3 Hardware Settings

Please connect each hardware as below.

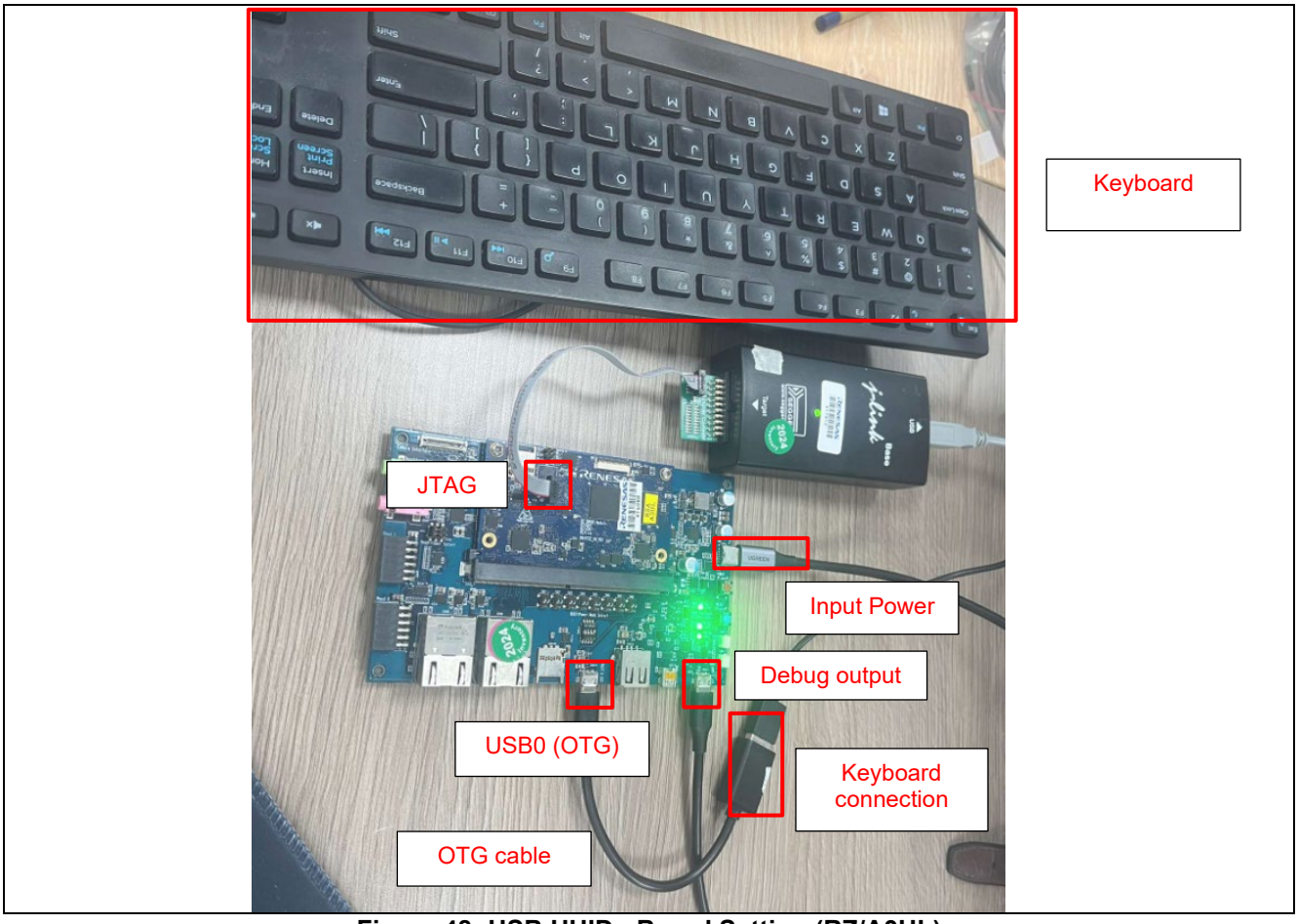


Figure 48: USB HHID - Board Setting (RZ/A3UL)

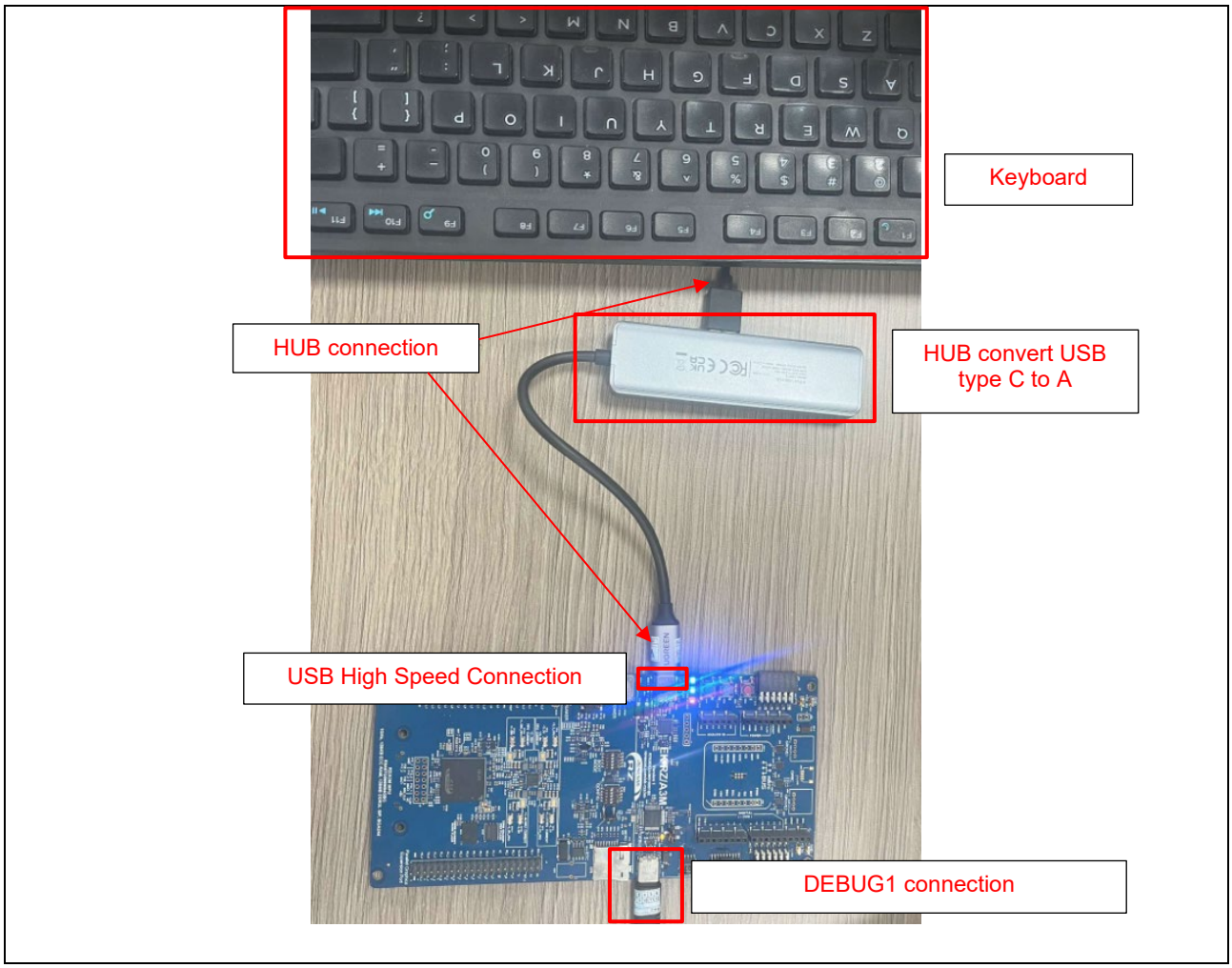


Figure 49: USB HHID - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.9.4 Operation

After running the example, the message below is displayed on console. Then, user can type some character on keyboard.

```
**************************************************************************
*   Renesas FSP Example Project for USB HHID Class Module                *
*   Example Project Version 3.5.0                                        *
*   Flex Software Pack Version  3.5.0                                    *
**************************************************************************
Refer to readme.txt file for more details on Example Project and
FSP User's Manual for more information about USB HHID Class driver
This example project demonstrates basic functionalities of USB Host Human
Interface Device. Class (HHID) driver with FreeRTOS on Renesas RZA3M MPU
based on Renesas FSP. USB HHID driver configures keyboard as a hhid device.
On pressing key from the keyboard, received keycode is decoded and displayed
on the Terminal Emulator.
Error and info messages will be printed on Terminal Emulator.


USB Configured Successfully
USB Status Request Completed Successfully
Enter any key as specified from a to z, A to Z, 0 to 9 and any special character
on keyboard
```

Figure 50: USB HHID example – Operation

6.10 USB HMSC

6.10.1 Project Overview

The sample code accompanying this file shows the operation of USB_HMSC running on Renesas RZ MPUs using RZ/A3 board, USB.
Format the USB driver with FAT32 file system before performing any operation
After successful USB connection with PC, the Terminal Emulator shows menu options with 4 options.

- The user select option 1 to write 10K data from app_buffer.
- The user enters data into the Terminal Emulator, and the data is saved to the rza_usb.txt file.
- The user select option 2 to Format USB Driver.
- The user select option 3 to Safely Eject the USB Driver before removing USB.
- The user select option 4 to Initialize FreeRTOS+FAT (Valid only after Safely_Eject option is executed)

6.10.2 Hardware Requirements

External hardware: USB MSC Device, Hub Type-C port (for RZ/A3M).

6.10.3 Hardware Settings

Please connect each hardware as below.

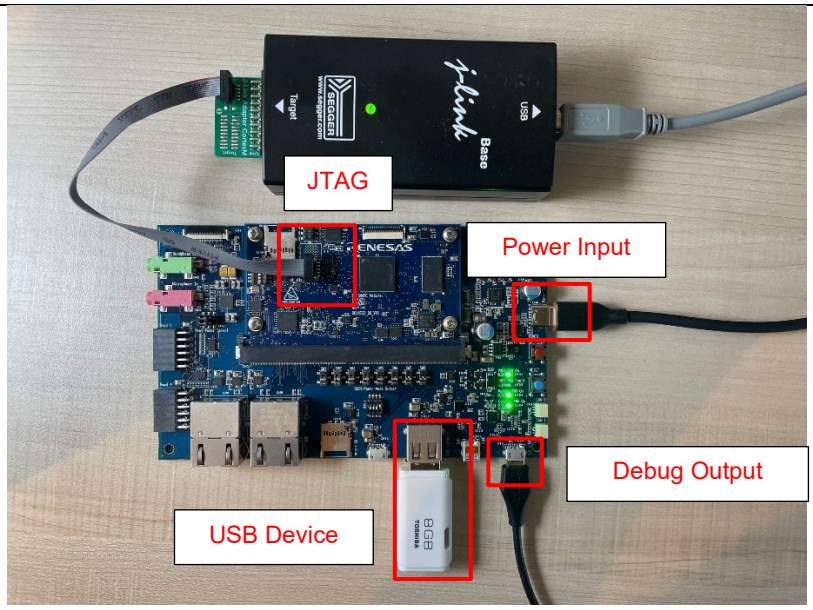


Figure 51: USB HMSC - Board Setting (RZ/A3UL)

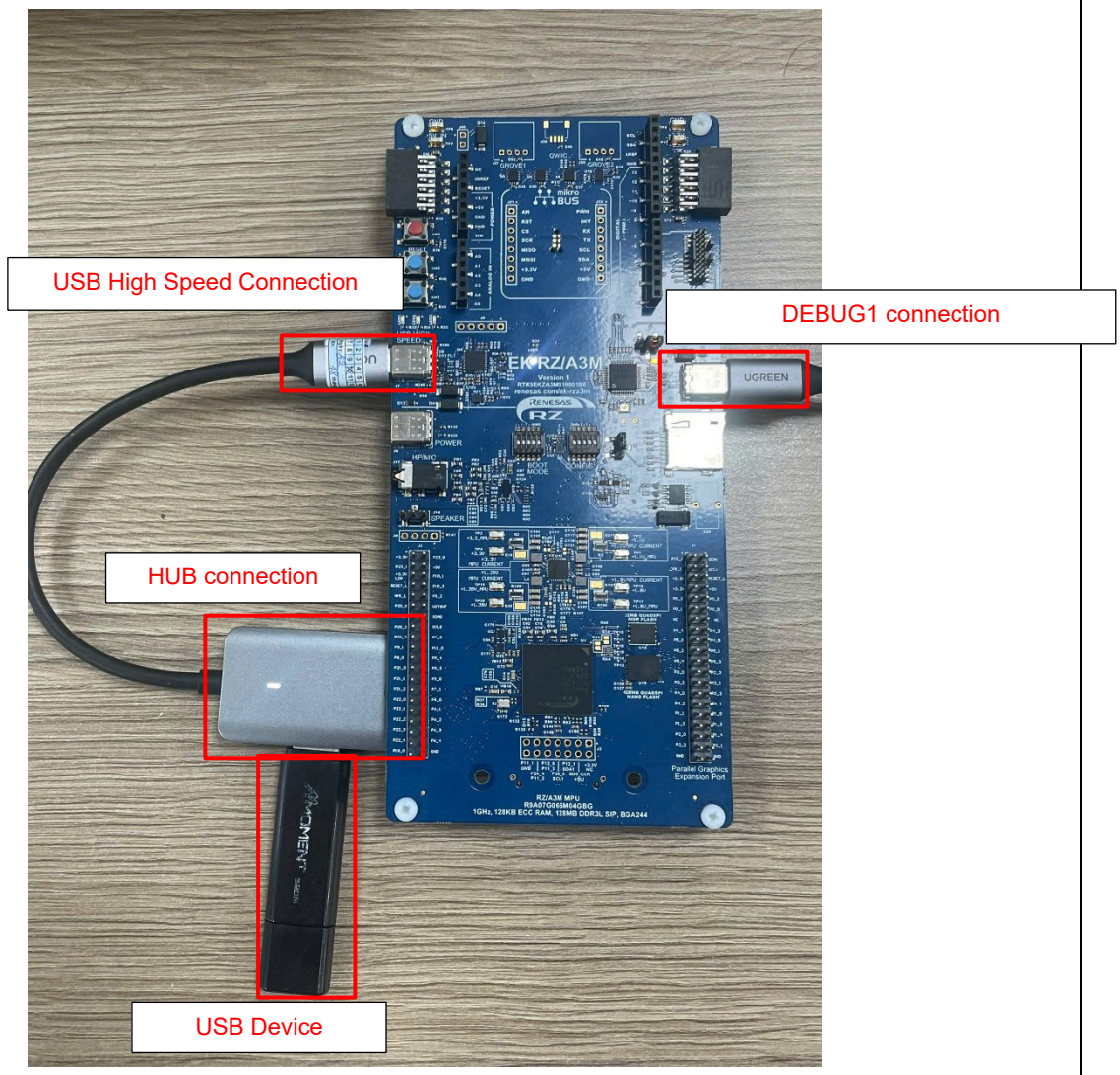


Figure 52: USB HMSC - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.10.4 Operation

After running the example, the message below is displayed on console. Then, user can run each options.

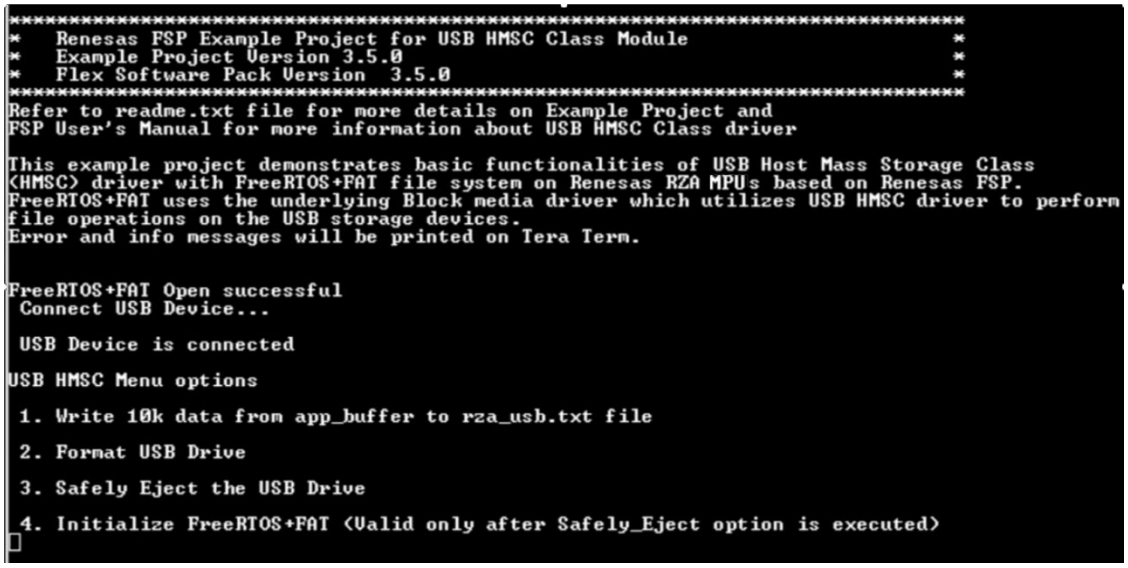


Figure 53: USB HMSC example – Operation

6.11 USB PCDC

6.11.1 Project Overview

This Example Projects demonstrates the basic functionalities of the USB_PCDC driver on Renesas RZA MPUs based on Renesas FSP

RZ/A3UL:
- On power up or RESET, all LEDs on PMOD LED start blinking at 1Hz.
- Press BTN0 button of PMOD BUTTON to change the blinking frequency of the PMOD LED.
  With every press BTN0 button, the frequency will switch from 1 Hz to 5 Hz to 10 Hz and cycle back.
- Open the serial port of the device using Terminal Emulator and press Enter key (keyboard on host PC).
  Press 1: Show kit information (show kit name, blinking frequency).
  Press 2: Show URLs to user visit.

RZ/A3M:

- On power up or RESET, all LEDs on USER LED start blinking at 1Hz
- Press SW1 button on Board to change the blinking frequency of the USER LED.
With every press SW1 button, the frequency will switch from 1 Hz to 5 Hz to 10 Hz and cycle back.
- Open the serial port of the device using Terminal Emulator and press Enter key (keyboard on host PC).

  Press 1: Show kit information (show kit name, blinking frequency).
  Press 2: Show URLs to user visit.

6.11.2 Hardware Requirements

External hardware:

PMOD LED, PMOD BUTTON (for RZ/A3UL).

1 Cable USB A to USB C (for RZ/A3M)

6.11.3 Hardware Settings

Please connect each hardware as below.

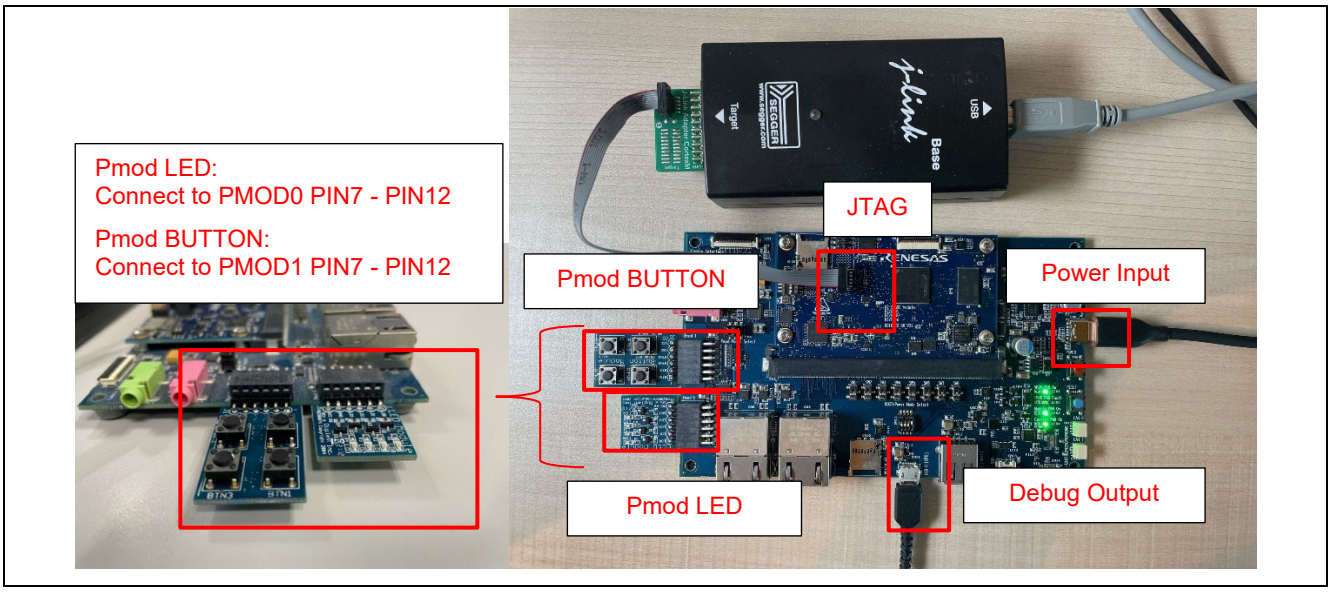


Figure 54: USB PCDC - Board Setting (RZ/A3UL)

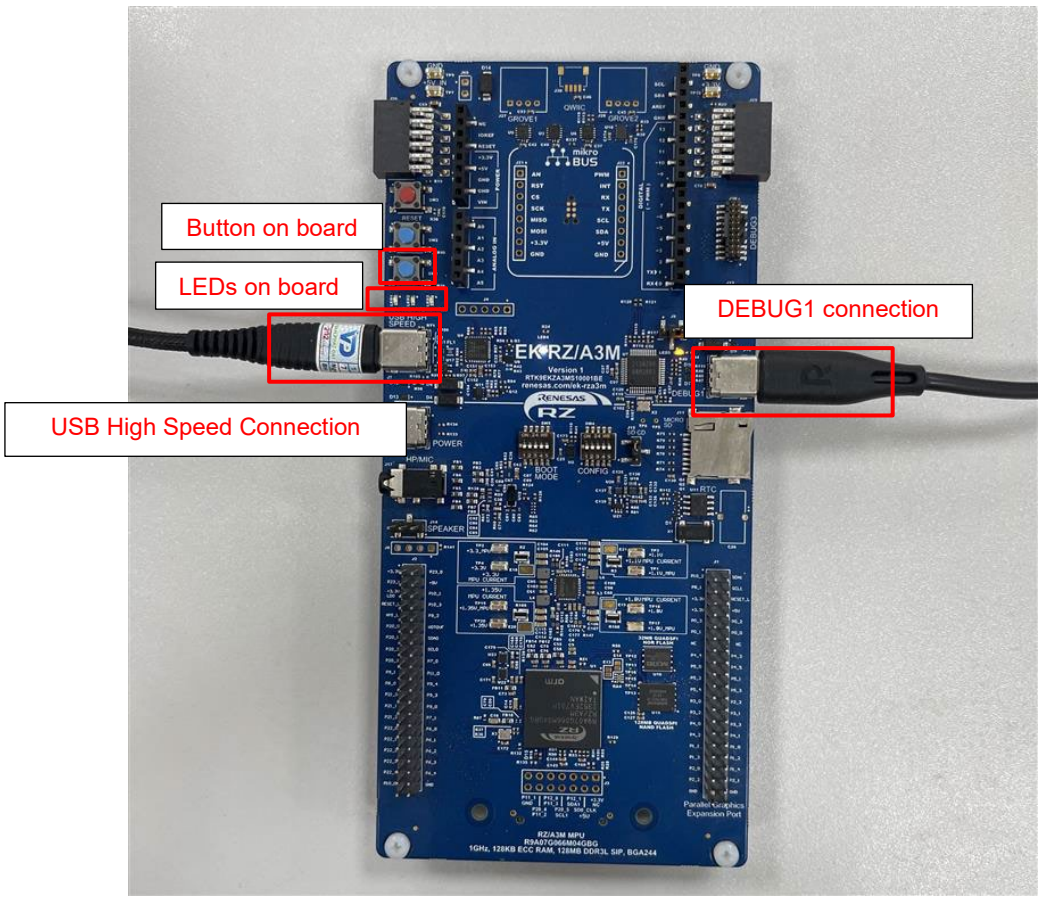


Figure 55: USB PCDC - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 3-2 SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.11.4 Operation

After running the example, please connect terminal with “USB Serial Device” as below.
After the connection, please input enter on the console, then user can see the message and run the options.
Also, the blinking frequency of the Pmod LED can be changed by pressing the BTN0 of Pmod BUTTON.
With every press BTN0 button, the frequency will switch from 1 Hz to 5 Hz to 10 Hz and cycle back.

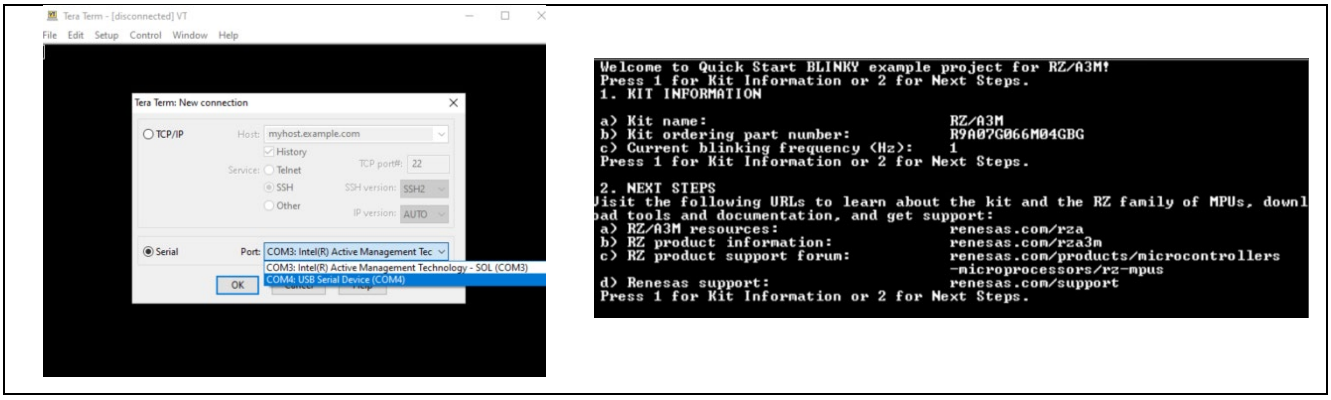


Figure 56: USB PCDC example – Operation

6.12 LCDC

6.12.1 Project Overview

This Example Project demonstrates the basic functionalities of LCDC device driver on Renesas RZ/A MPUs based on Renesas FSP.
On successful initialization of LCDC module, the EP will be able to read the display resolution and frame buffer set in the LCDC module and draw color bands to cover the entire screen of external LCD connected to RZ MPU. API Failure messages will be displayed on Terminal Emulator.

6.12.2 Hardware Requirements

External hardware:

RZ/A3UL: Mini HDMI to HDMI Cable, Parallel to HDMI Conversion board, A display supports HDMI port.

RZ/A3M: 1 MIPI Graphics Expansion Board 2 Version 1 (APP_LCD_EK_MIPI_2)

6.12.3 Hardware Settings

Please connect each hardware as below.

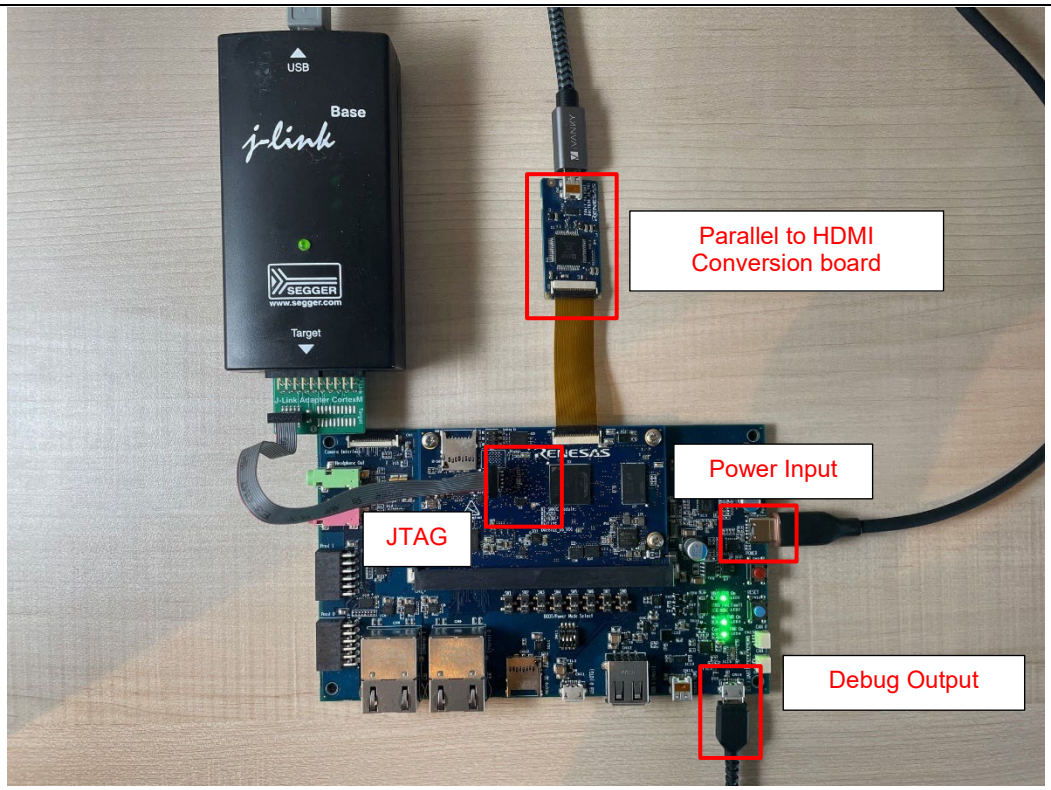


Figure 57: LCDC example - Board Setting (RZ/A3UL)

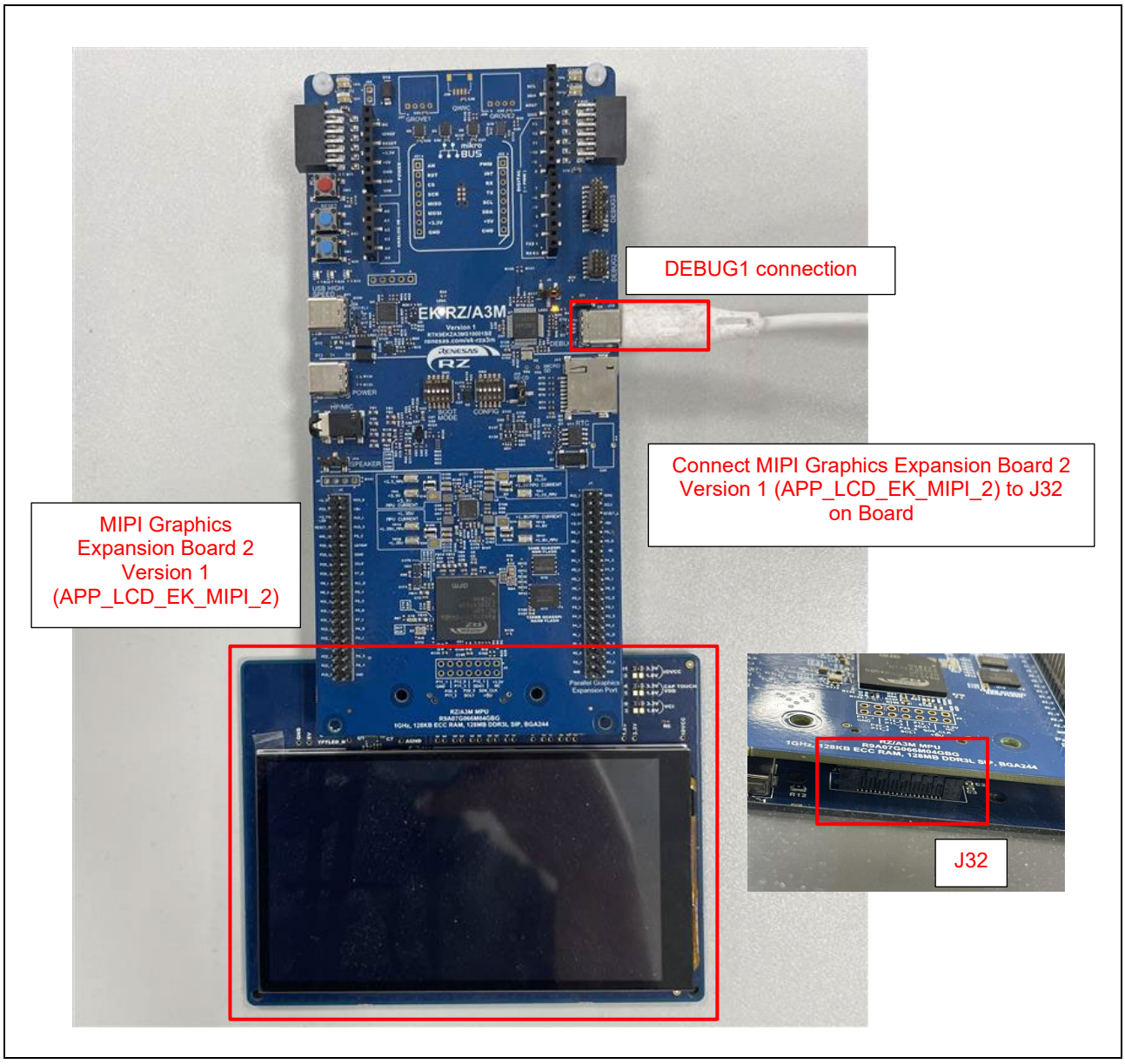


Figure 58: LCDC example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.12.4 Operation

After running the example, the message below is displayed on console. And external display will show the color bar image.

Figure 59: LCDC example – Operation (RZ/A3UL)

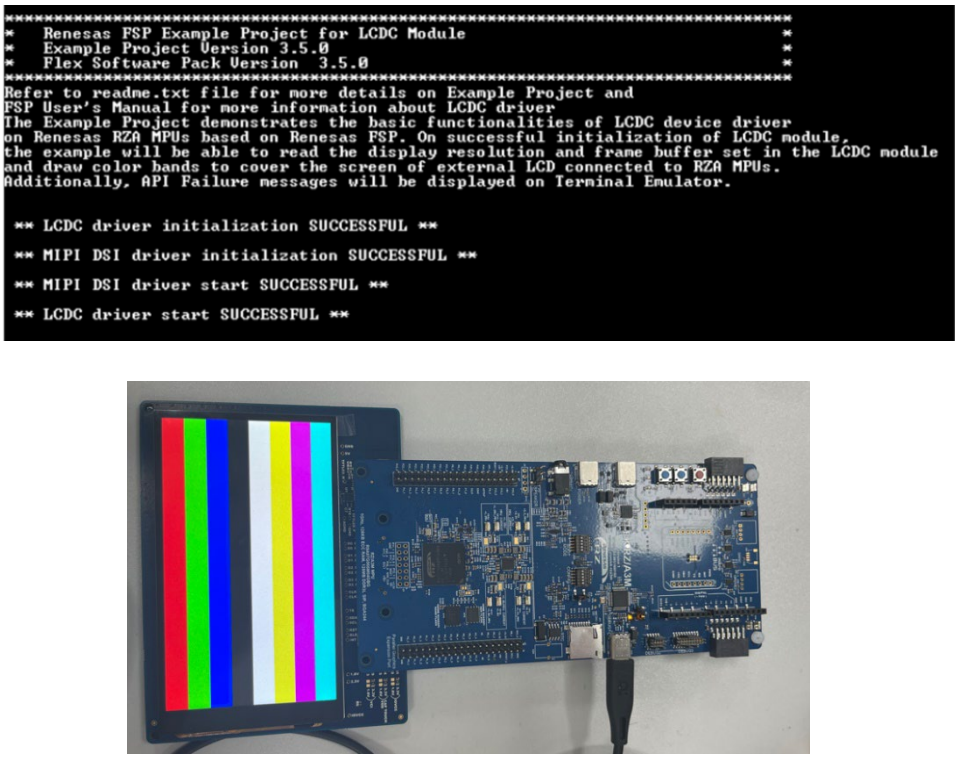


Figure 60: LCDC example – Operation (RZ/A3M)

6.13 INTC IRQ

6.13.1 Project Overview

The example project demonstrates the typical use of the INTC IRQ module APIs.
The project initializes the IRQ interrupt in Interrupt Controller User is requested to press the push button to trigger the external irq and this then will start toggling of user LED.

6.13.2 Hardware Requirements

External hardware: PMOD LED, PMOD BUTTON (RZ/A3UL)

6.13.3 Hardware Settings

Please connect each hardware as below.

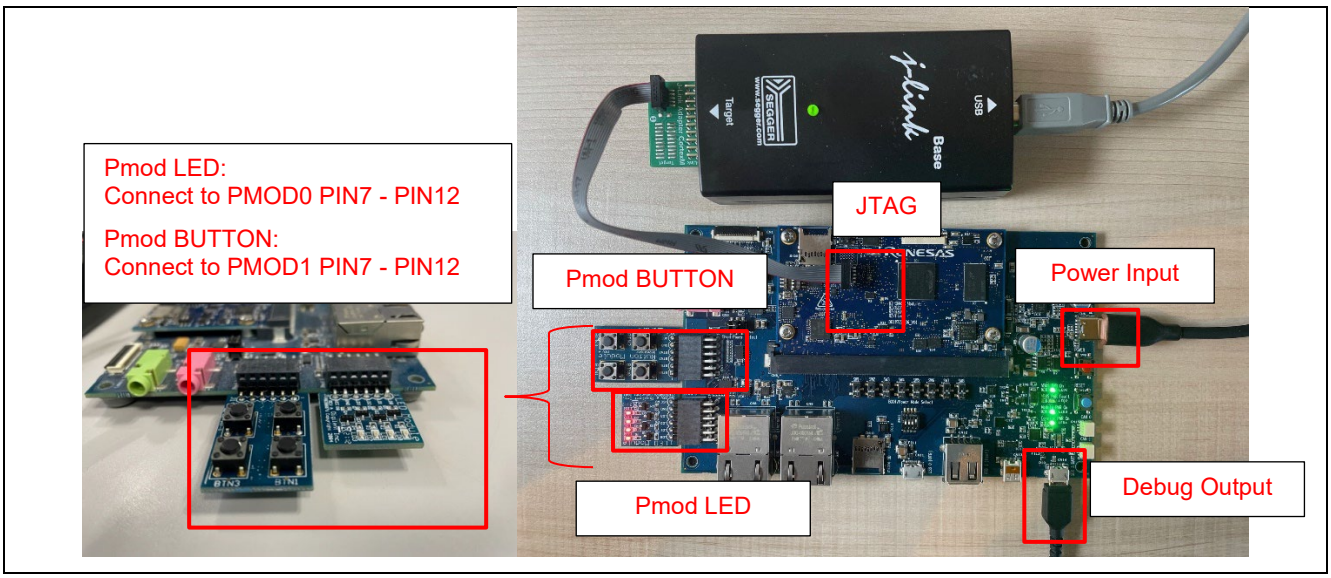


Figure 61: INTC IRQ example - Board Setting (RZ/A3UL)

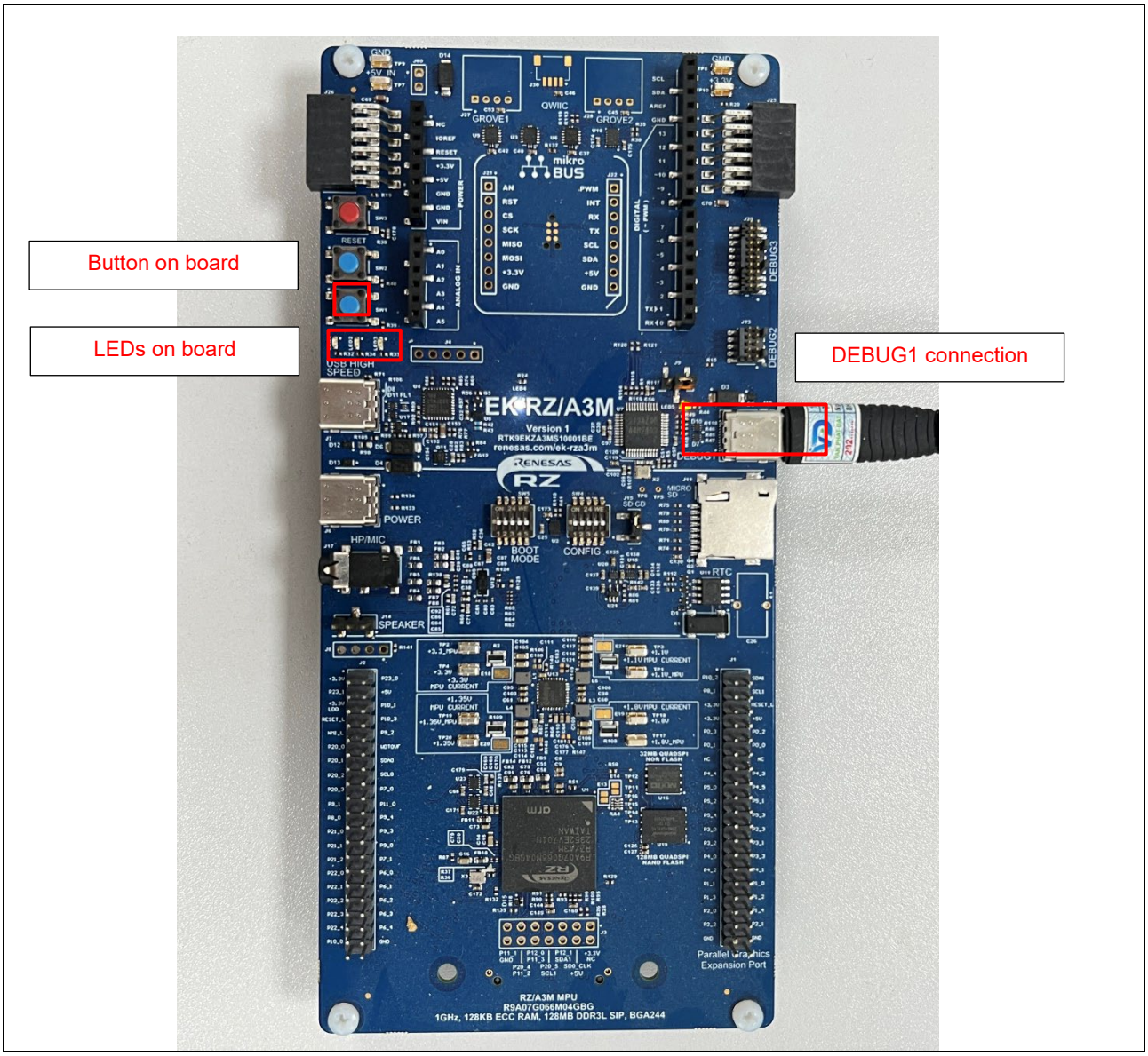


Figure 62: INTC IRQ example - Board Setting (RZ/A3UL)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 3-2 SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.13.4 Operation

After running the example, the message below is displayed on console. When pressing the BTN0 button of Pmod BUTTON, the LED status is displayed.

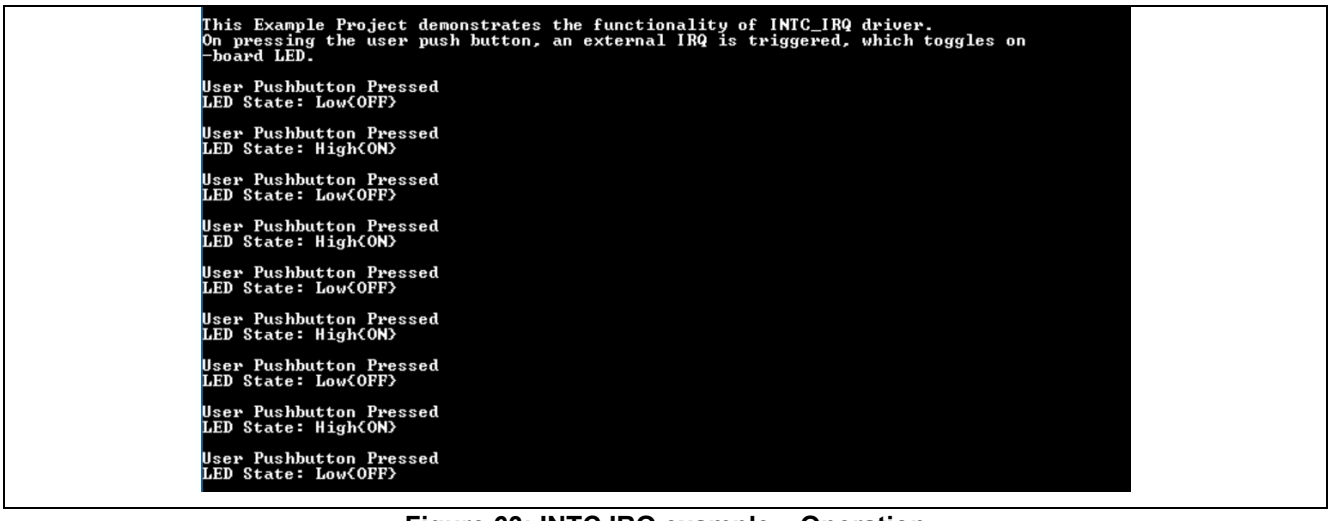


Figure 63: INTC IRQ example – Operation

6.14 INTC NMI

6.14.1 Project Overview

The example project demonstrates the typical use of the INTC NMI module APIs.

The project initializes the NMI interrupt in Interrupt Controller.

User is requested to press the button on PMOD BUTTON to trigger the external nmi

and this then will start toggling of User LED on-board.

6.14.2 Hardware Requirements

External hardware: PMOD BUTTON

6.14.3 Hardware Settings

Please connect each hardware as below.

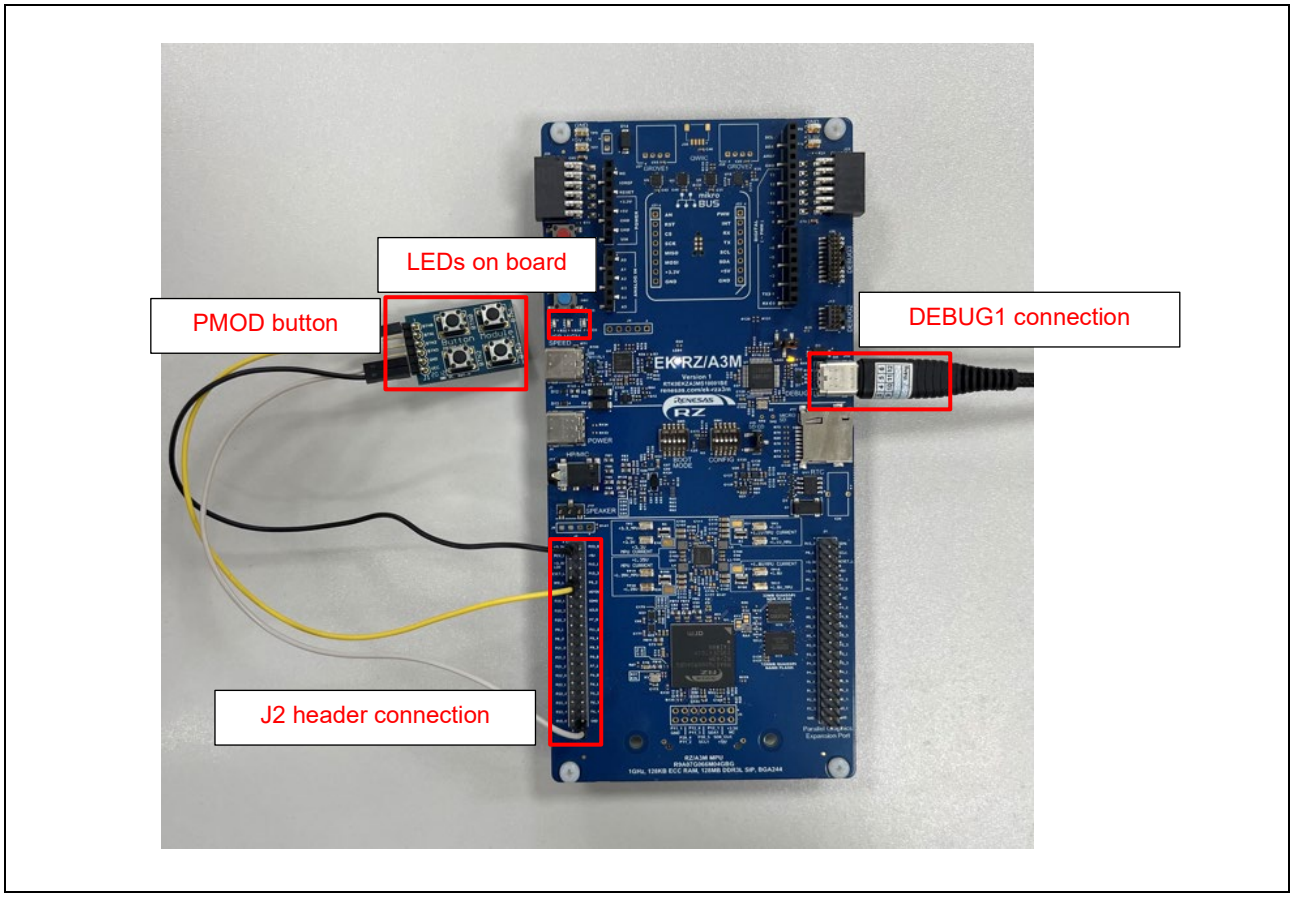


Figure 64: INTC NMI example - Board Setting

Please set each DIP switch and jumper as below.

Board	EK RZ/A3M
Module board	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	None

6.14.4 Operation

After running the example, the message below is displayed on the console. When pressing the BTN0 button of PMOD button, the LED status is displayed.

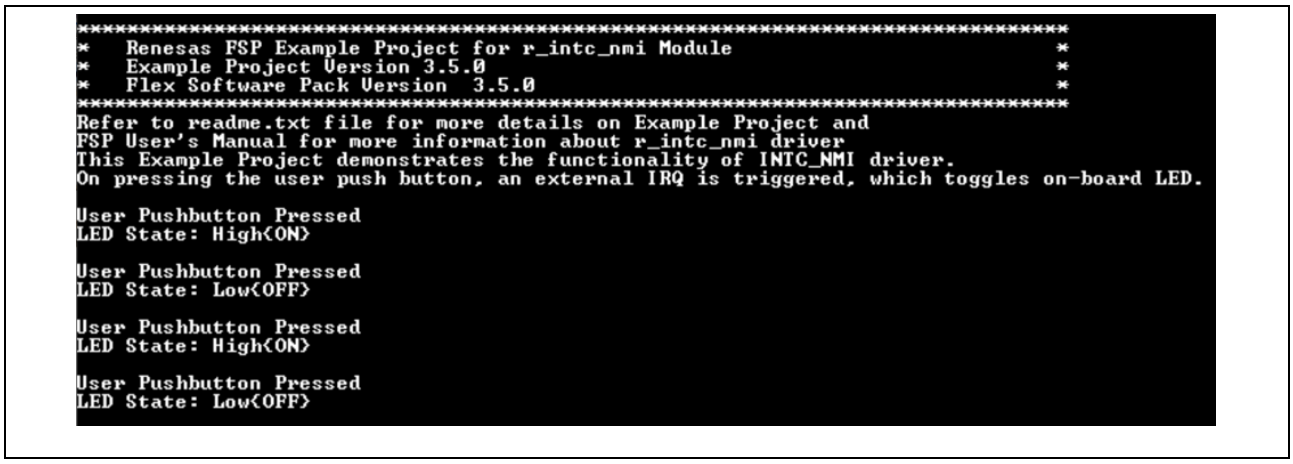


Figure 65: INTC NMI example - Operation

6.15 INTC TINT

6.15.1 Project Overview

The example project demonstrates the typical use of the INTC TINT module APIs.
The project initializes the TINT interrupt in Interrupt Controller.
The user is requested to press the push-button to trigger the external tint and then will start toggling of LEDs.

6.15.2 Hardware Requirements

External hardware: PMOD LED, PMOD BUTTON (RZ/A3UL)

6.15.3 Hardware Settings

Please connect each hardware as below.

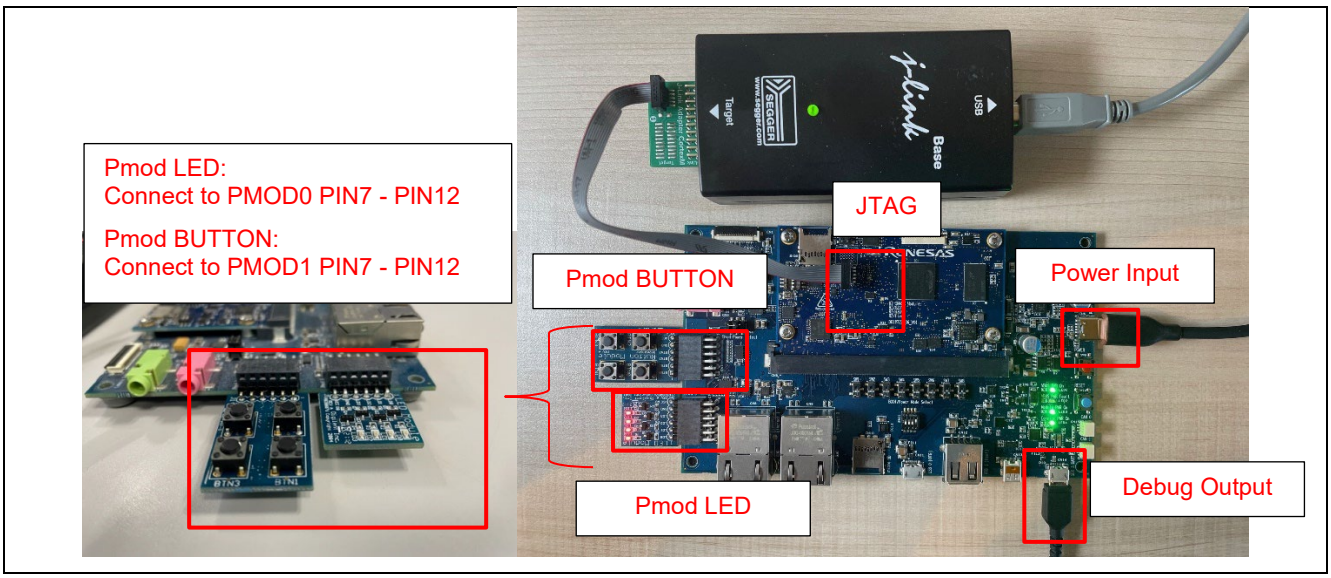


Figure 66: INTC TINT - Board Setting (RZ/A3UL)

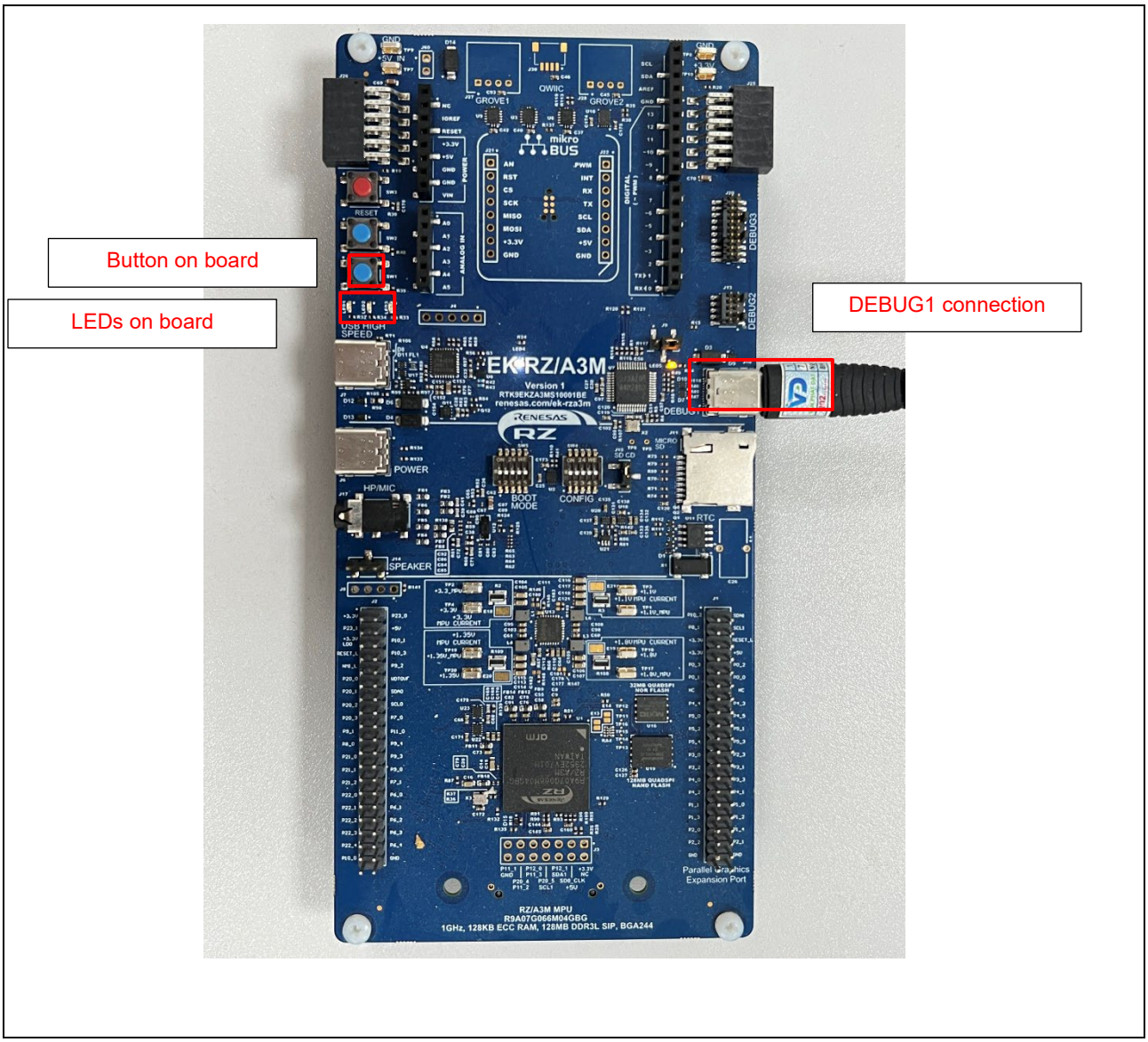


Figure 67: INTC TINT - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 3-2 SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.15.4 Operation

After running the example, the message below is displayed on console. When pressing the BTN0 button of Pmod BUTTON, the LED status is displayed.

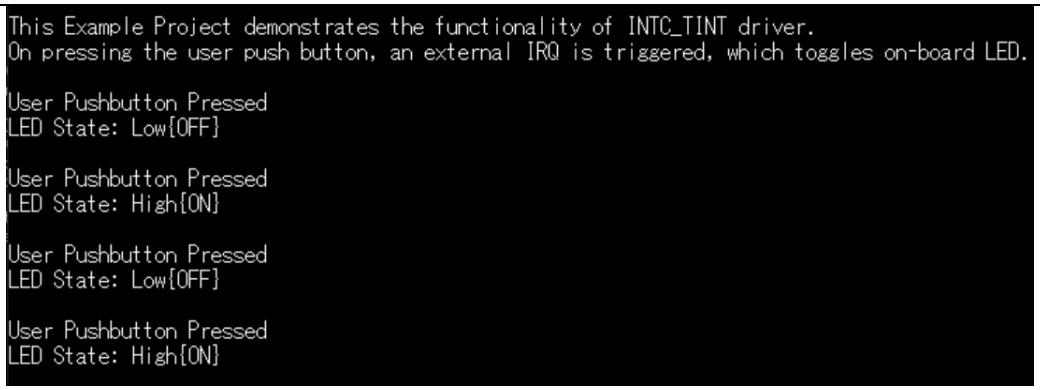


Figure 68: INTC TINT example – Operation

6.16 WDT

6.16.1 Project Overview

The example project demonstrates the use of WDT module with the collaboration of module IRQ, GTM, WDT and button/led.
The operation of this example is as below:

- Start GTM timer having a callback every 1 second, to refresh WDT and blink the led.

- If the button is pressed, IRQ is triggered to stop GTM timer, and after 2 seconds, WDT will reset MPU.

6.16.2 Hardware Requirements

External hardware: Pmod LED and Pmod BUTTON (RZ/A3UL)

6.16.3 Hardware Settings

Please connect each hardware as below.

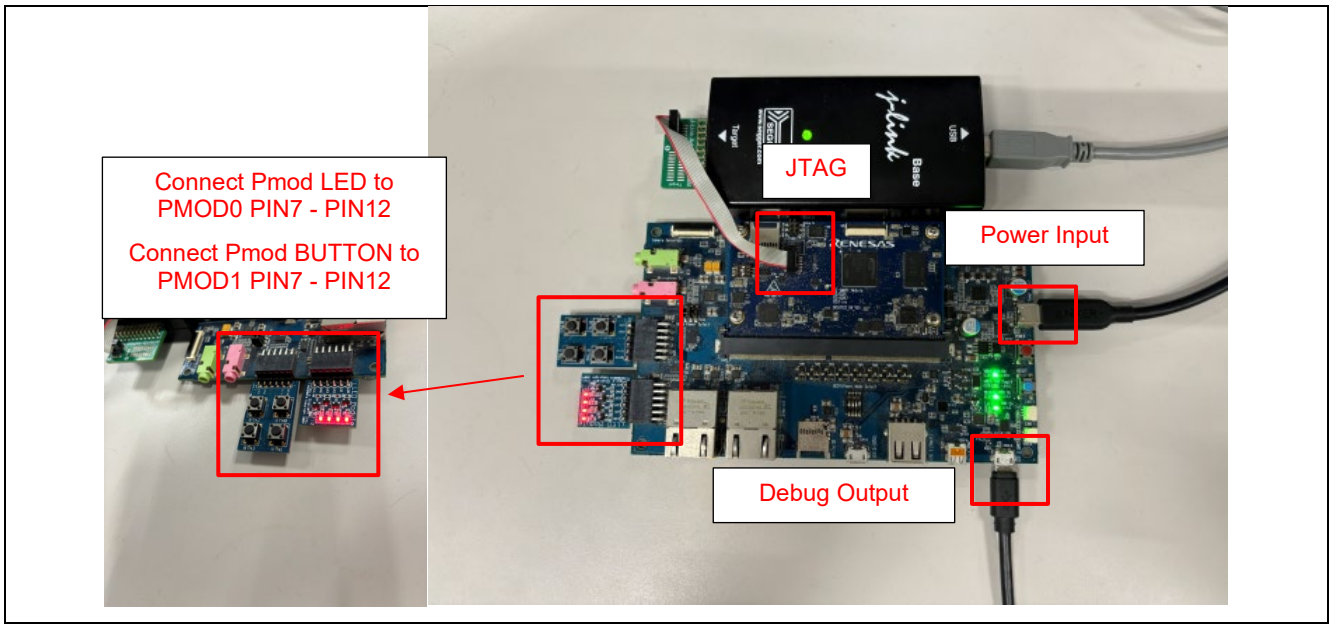


Figure 69: WDT example - Board Setting (RZ/A3UL)

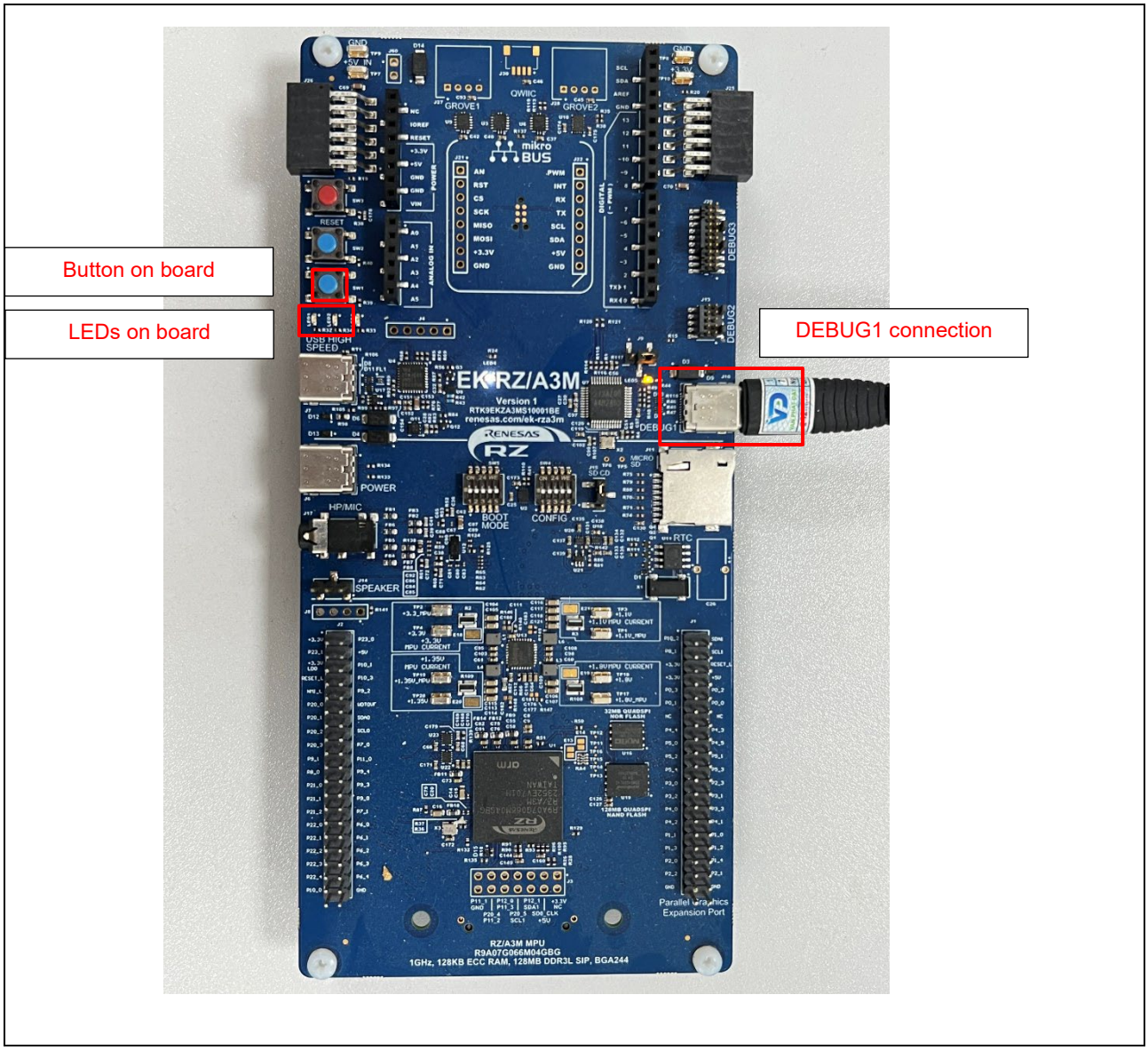


Figure 70: WDT example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: 3-2. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.16.4 Operation

After running the example, the message below is displayed on the console.

```
**********************************************************************************
*   Renesas FSP Example Project for r_wdt Module                                 *
*   Example Project Version 3.5.0                                                *
*   Flex Software Pack Version  3.5.0                                            *
**********************************************************************************
Refer to readme.txt file for more details on Example Project and
FSP User's Manual for more information about r_wdt driver

This example project demonstrates the typical use of the WDT HAL module APIs
User input initializes the WDT and start GTM timer
WDT counter is refreshed periodically every 1 second when the GTM timer expires
On pressing the Push button, WDT counter stops from refreshing
WDT resets the MPU in 2 seconds

Enter 1 to Enable WDT

User Input:
```

Figure 71: WDT example – Operation (Initialize console)

After inputting “1” to initial WDT and start GTM timer, the GTM timer will refresh WDT counter and blink the led. When pressing the button, IRQ is triggered to stop GTM timer, and after 2 seconds, WDT will reset MPU. At the same time, the WDT Reset will be detected in the next launch.

For RZ/A3UL

For RZ/A3M

Figure 72: WDT example – Operation (WDT reset)

6.17 Ether

6.17.1 Project Overview

The example project demonstrates the use of the FreeRTOS + TCP Module with Ethernet.
The example project demonstrates the usage of FreeRTOS DHCP Client, DNS Client and ICMP code.

- This Example Project has 2 modes for the user:
1. DHCP Mode, where the IP credentials are obtained from the DHCP Server on the Network.
2. Static IP Address mode, where in the Static IP address can be configured for the Ethernet based on the Availability of free address in the LAN.

Besides this example also checks, calculates, and shows the send and response time between the target board and server.

NOTE: User is expected to enter the static IP address according to the network settings of the LAN.

For example, set up Static IP Configuration in g_rm_freertos_plus_tcp0 -> FreeRTOS+TCP Wrapper to r_gether as below:

```
static uint8_t ucMACAddress[6] = {0x00, 0x11, 0x33, 0x55, 0x77, 0x99};
static uint8_t ucIPAddress[4] = {192, 168, 3, 109};
static uint8_t ucNetMask[4] = {255, 255, 255, 0};
static uint8_t ucGatewayAddress[4] = {192, 168, 3, 1};
static uint8_t ucDNSServerAddress[4] = {8, 8, 8, 8};
```

In case of DHCP, User just needs to run the application and DHCP client will communicate to the DHCP server and gets the IP address.

NOTE: While running the application using DHCP or Static Address mode, The following settings needs to be done in the configurator. The same projects can be used for both the settings.

DHCP mode

At FreeRTOS+TCP config stack change to table below:

FreeRTOS+TCP	Setting
Use DHCP	Enable
DHCP Register Hostname	Enable
DHCP Uses Unicast	Enable
DHCP Send Discover After Auto IP	Enable
DHCP callback function	Enable

Static IP Address mode

After run DHCP Mode we change IPv4 Address, Subnet Mask, Default Gateway, DNS Servers for Static IP config depending DHCP config printed at the console. At FreeRTOS+TCP config stack change to table below:

FreeRTOS+TCP	Setting
Use DHCP	Disable
DHCP Register Hostname	Disable
DHCP Uses Unicast	Disable
DHCP Send Discover After Auto IP	Disable
DHCP callback function	Disable

6.17.2 Hardware Requirements

External hardware: Ethernet Cable

6.17.3 Hardware Settings

Please connect each hardware as below.

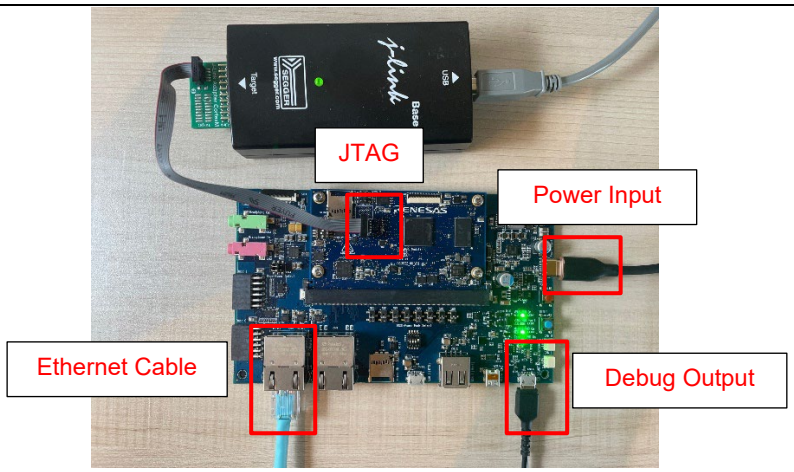


Figure 73: Ether example - Board Setting

Please set each DIP switch and jumper as below.

Board	**RZ/A3UL EVK**
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4

6.17.4 Operation

After running the example, the message below is displayed on the console. After connection successfully, the ping round trip time will be displayed.

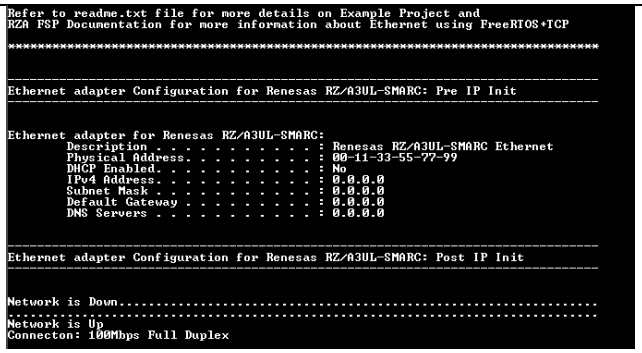


Figure 74: Ether example - Operation

6.18 FreeRTOS

6.18.1 Project Overview

The example projects demonstrate Message Queue and Semaphore between tasks and interrupt. Message Queue is demonstrated between Tasks and between Task and interrupt. GTM timer periodically generates interrupt at 1000msec.
For the first few seconds, messages are shared between Sender and Receiver Tasks and GTM ISR0. Receiver task pends on Message Queue, receives and displays message received on RTTViewer periodically at 500msec. For the next few seconds, Semaphore Task waits for semaphore until it is released by GTM ISR1. GTM ISR1 releases semaphore periodically at 1000msec. All the tasks run with equal priority level.

6.18.2 Hardware Requirements

External hardware: None.

6.18.3 Hardware Settings

Please connect each hardware as below.

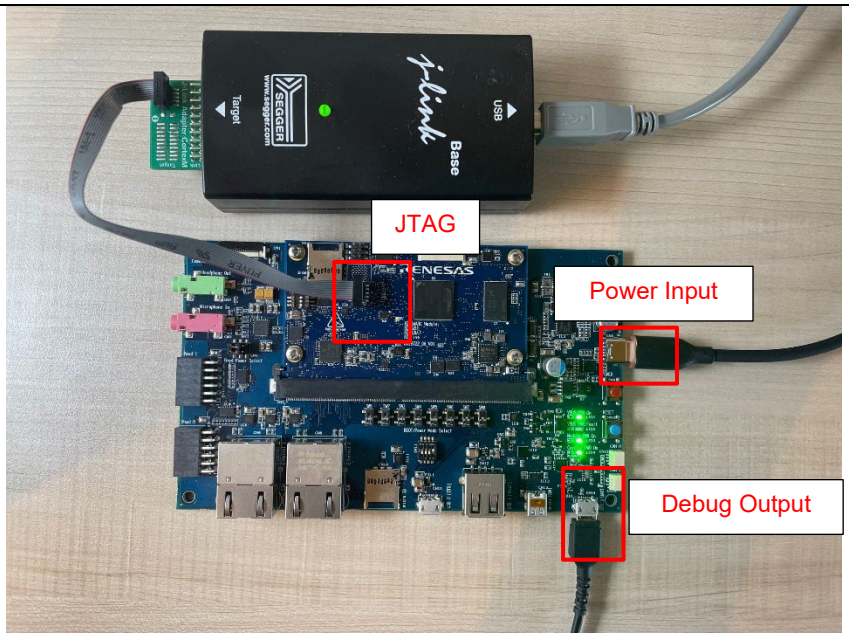


Figure 75: FreeRTOS example - Board Setting (RZ/A3UL)

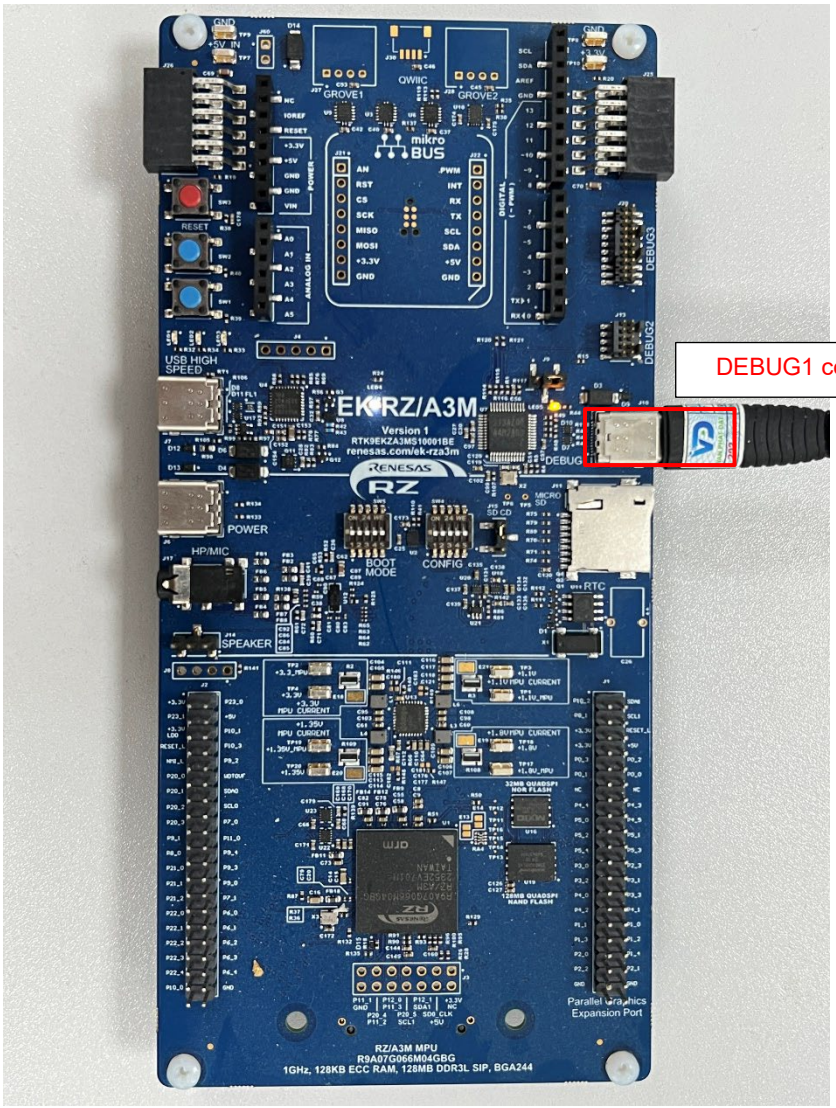


Figure 76: FreeRTOS example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.18.4 Operation

After running the example, the message below is displayed on console.

```
00> Messages are shared between Sender_Task, ISR and Receiver_Task for the first few seconds.
00> Later, Sender and Receiver Tasks will be suspended timer will be stopped. Semaphore is acquired
00> and released between Semaphore Task and ISR for the next few seconds and Semaphore Task is suspended.
00> To restart the application, power cycle the board.
00>
00>  Sender_Task : Starting g_periodic_timer_msgq timer
00> GTM Timer Started successfully
00>
00>  Sender_Task : Message posted on Queue successfully
00>  Sender_Task : Going on delay for 500ms
00> Receiver Task : Message received Successfully
00>     Data   : 100
00>     Sender : Sender_Task
00>
00>  Sender_Task : After delay of 500ms
00>
00>  Sender_Task : Message posted on Queue successfully
00>  Sender_Task : Going on delay for 500ms
00> Receiver Task : Message received Successfully
00>     Data   : 100
00>     Sender : Sender_Task
00>
00>  Sender_Task : After delay of 500ms
00>
00>  Sender_Task : Message posted on Queue successfully
00>  Sender_Task : Going on delay for 500ms
00> Receiver Task : Message received Successfully
00>     Data   : 100
00>     Sender : Sender_Task
00>
00> Receiver Task : Message received Successfully
00>     Data   : 200
00>     Sender : GTM Callback
00>
00>  Sender_Task : After delay of 500ms
00>
00>  Sender_Task : Message posted on Queue successfully
00>  Sender_Task : Going on delay for 500ms
00> Receiver Task : Message received Successfully
00>     Data   : 100
00>     Sender : Sender_Task
00>
00>  Sender_Task : After delay of 500ms
```

Figure 77: FreeRTOS example – Operation

6.19 SDHI

6.19.1 Project Overview

This example project demonstrates basic functionalities of sdhi driver with FreeRTOS+FAT file system on Renesas RZ/A MPU based on Renesas FSP.
FreeRTOS+FAT uses the underlying Block media driver. The Block media driver utilizes the SDHI driver to perform file operations on the SD Card. Error and info messages will be printed on Terminal Emulator.

6.19.2 Hardware Requirements

External hardware: Micro SD Card.

6.19.3 Hardware Settings

Please connect each hardware as below.

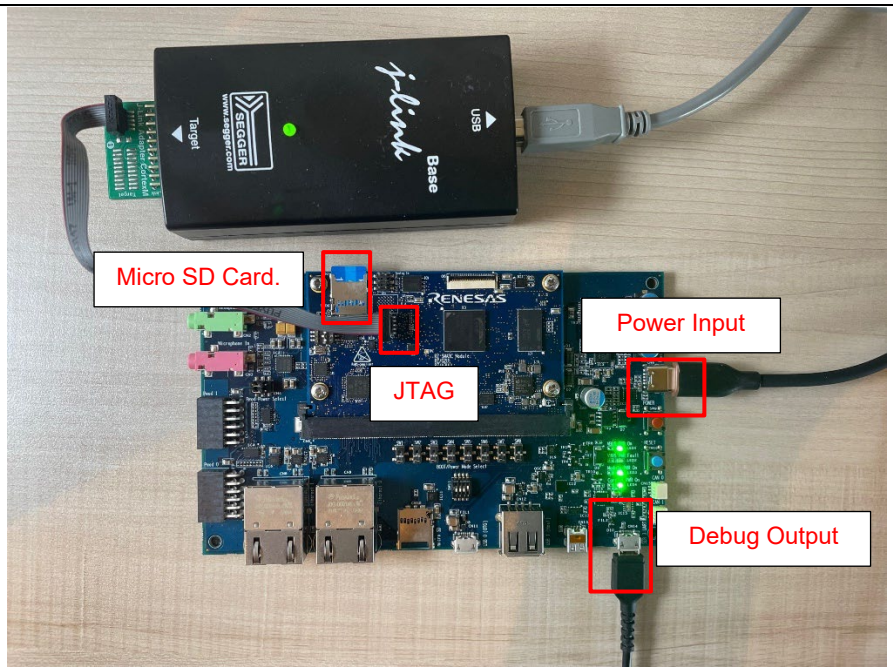


Figure 78: SDHI example - Board Setting (RZ/A3UL)

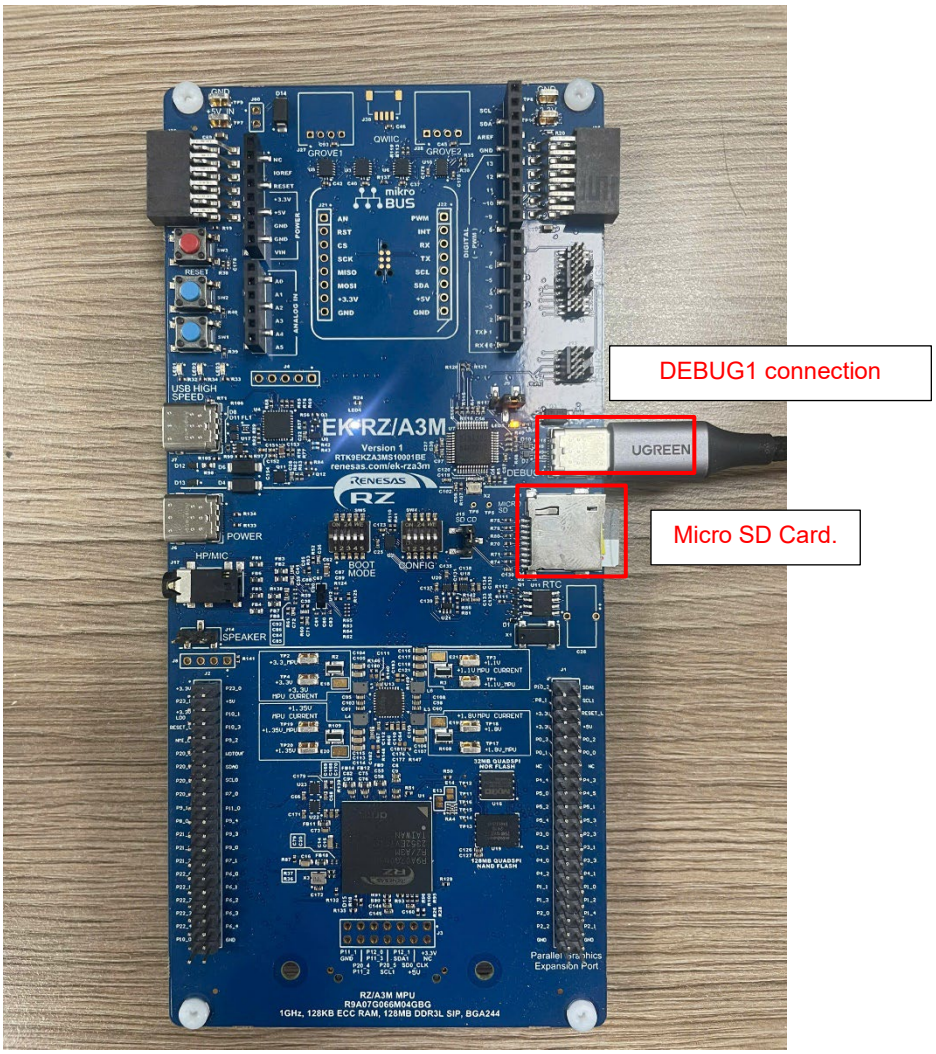


Figure 79: SDHI example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: ON SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3 J15 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.19.4 Operation

After running the example, the message below is displayed on console. User can select each option after connecting Micro SD card.

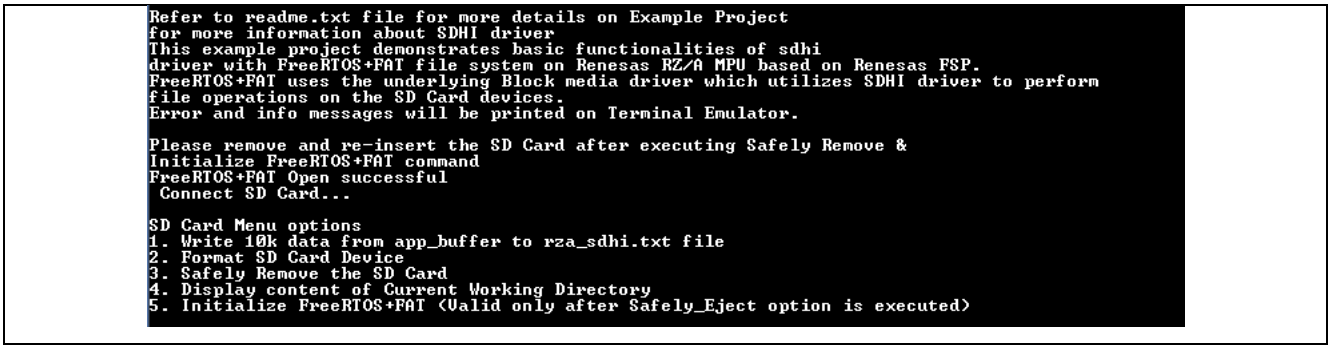


Figure 80: SDHI example – Operation

6.20 GTM

6.20.1 Project Overview

The example project demonstrates the function of GTM driver.
The project initializes the periodic Timer and one-shot Timer. (UART used to communicate.)
Using a Terminal Emulator, the user can provide a value & press enter key to set the period of the LED signal. The range of input values are displayed on the Terminal Emulator. Any failure will also be displayed using Terminal Emulator.

6.20.2 Hardware Requirements

External hardware: Pmod LED (RZ/A3UL)

6.20.3 Hardware Settings

Please connect each hardware as below.

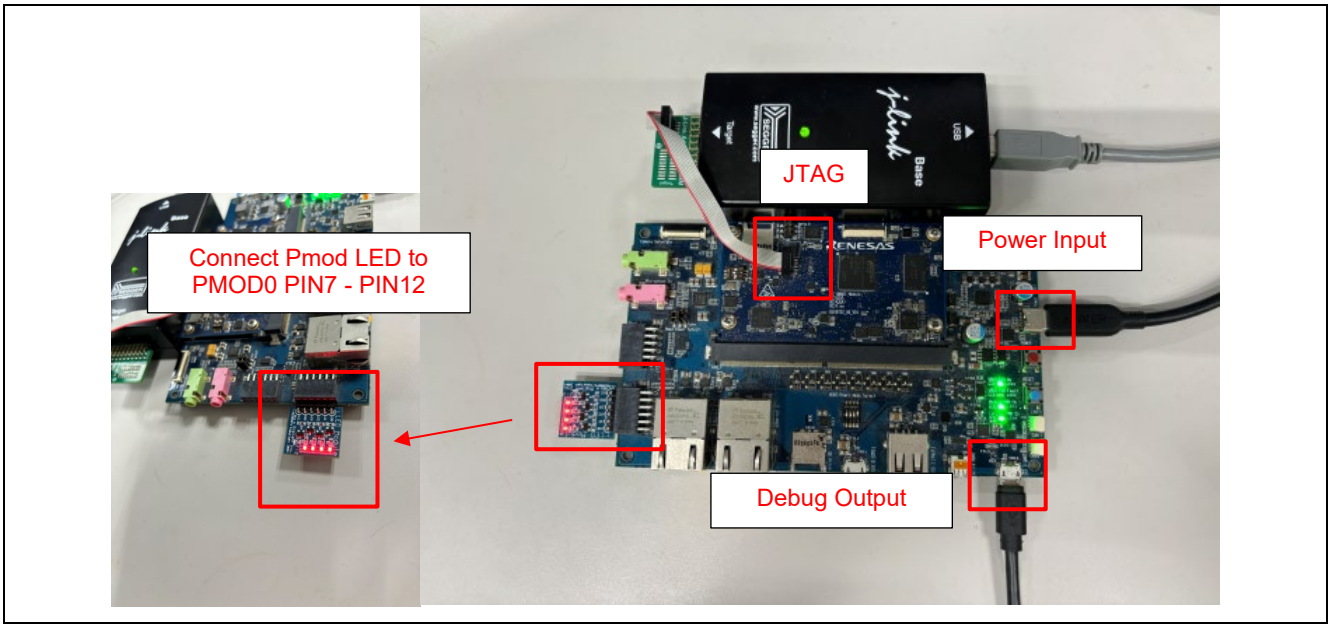


Figure 81: GTM example - Board Setting (RZ/A3UL)

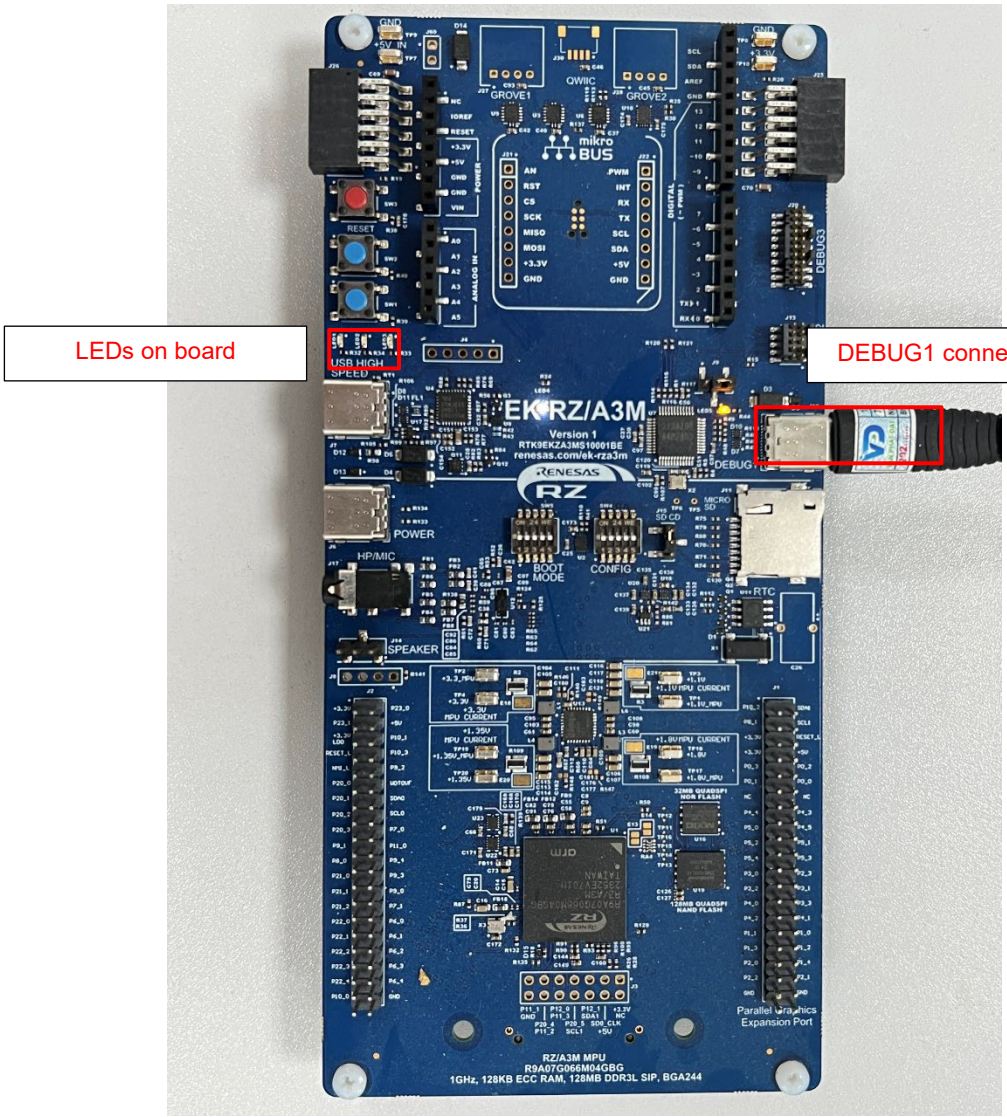


Figure 82: GTM example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.20.4 Operation

After running the example, the message below is displayed on console. Users can input the period for One-shot mode and Periodic mode.

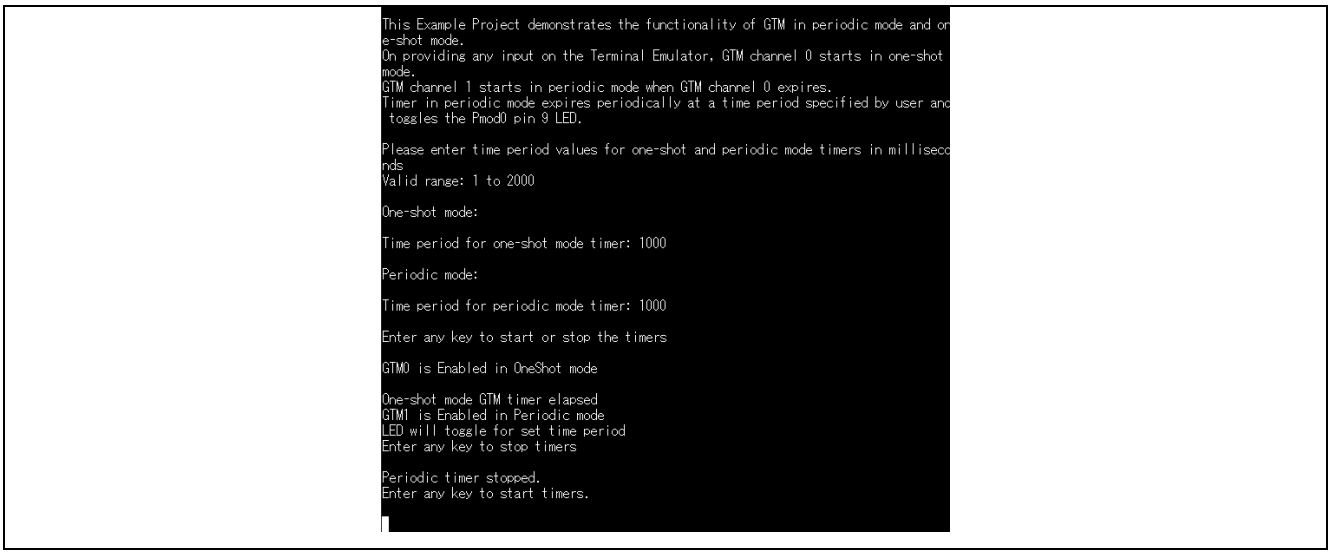


Figure 83: GTM example – Operation

6.21 MTU3a

6.21.1 Project Overview

The example project demonstrates typical use of MTU3 HAL module APIs.
User has the provision to input value as per displayed menu through a terminal application to select different MTU3 supported modes (Periodic, PWM, One-Shot).
In periodic mode, the user can enter the time period within the permitted ranges to change the frequency of the user LED.
In PWM mode, user can enter the duty cycle within the specified range to adjust the intensity of the user LED.
In One-Shot mode, output will be displayed on a terminal application. Any failure will also be displayed on a terminal application.

6.21.2 Hardware Requirements

External hardware: Pmod LED (RZ/A3UL)

6.21.3 Hardware Settings

Please connect each hardware as below.

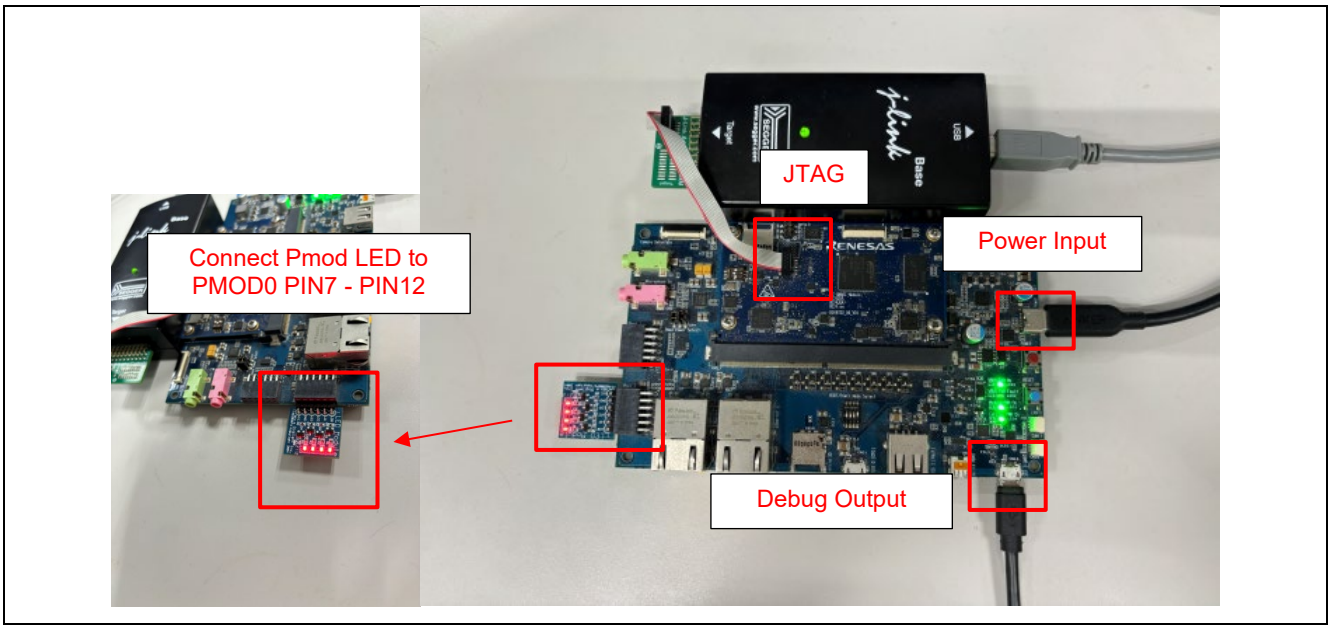


Figure 84: MTU3a example - Board Setting (RZ/A3UL)

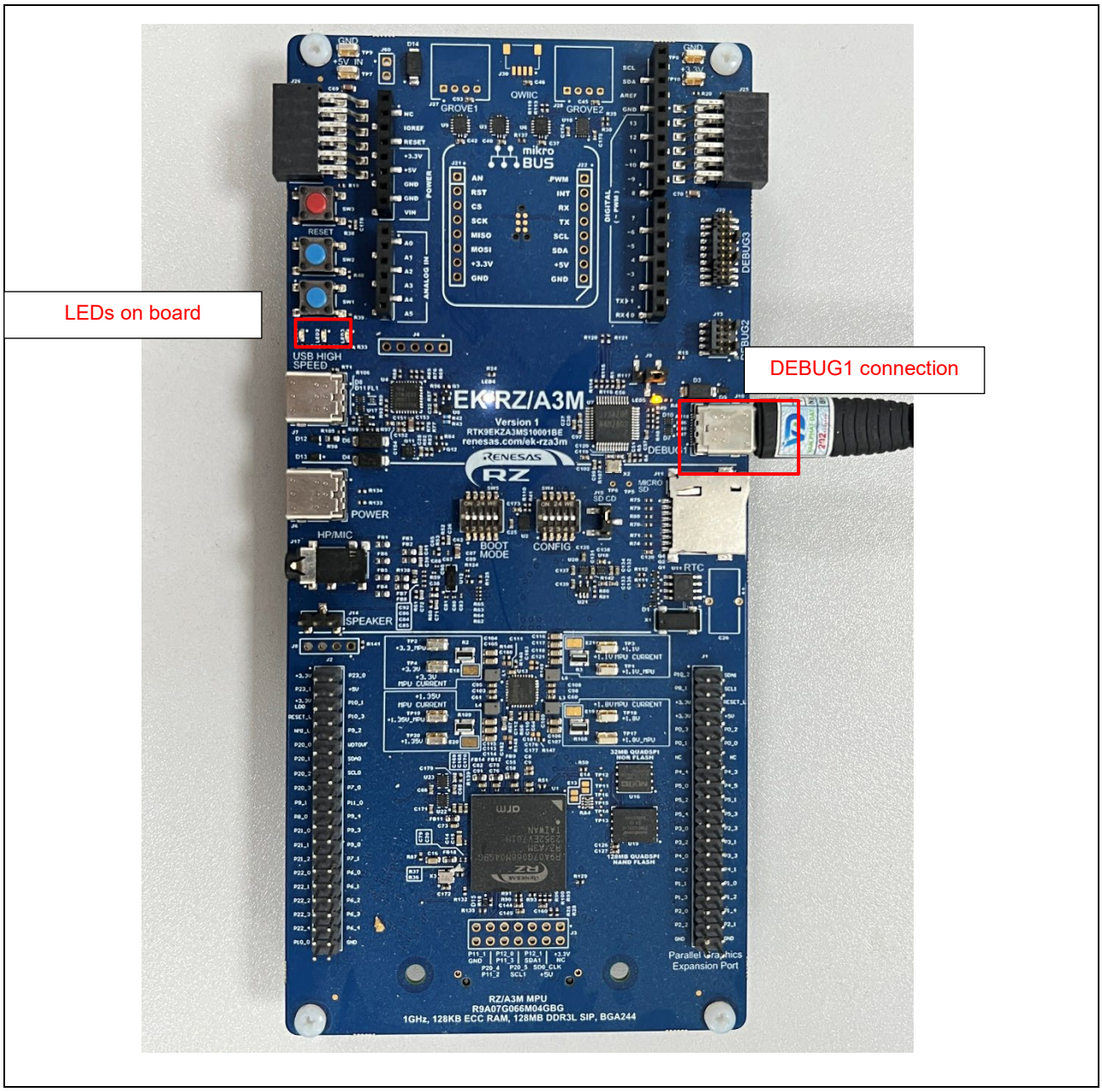


Figure 85: MTU3a example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : 1-2 open
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.21.4 Operation

After running the example, the message below is displayed on console. Users can select each option.

```
The project initializes MTU3 module in Periodic, PWM or One-shot
mode based on user input from the displayed menu options.

In periodic mode, user can enter the time period within the
permitted ranges to change the frequency of the user LED.

In PWM mode, user can enter the duty cycle within the specified
range to adjust the intensity of the user LED.

In ONE SHOT mode, Output will be displayed on terminal application
when timer expires.

Menu Options
1. Enter 1 for Periodic mode
2. Enter 2 for PWM mode
3. Enter 3 for one shot mode
User Input:
```

Figure 86: MTU3a example – Operation

6.22 DMAC

6.22.1 Project Overview

Project initializes 2 DMAC transfer instances. Upon successful initialization, a menu option is displayed. On selecting 1 from menu option, GTM generates 100ms interrupt to trigger a transfer from the source buffer to port control register for 60 times indicated by LED blinking for 60 times. On selecting 2 from menu option, DMAC (runs in Block mode) transfers data from the MTU counter register to destination which gets printed to Terminal Emulator.

6.22.2 Hardware Requirements

External hardware: PMOD LED (RZ/A3UL)

6.22.3 Hardware Settings

Please connect each hardware as below.

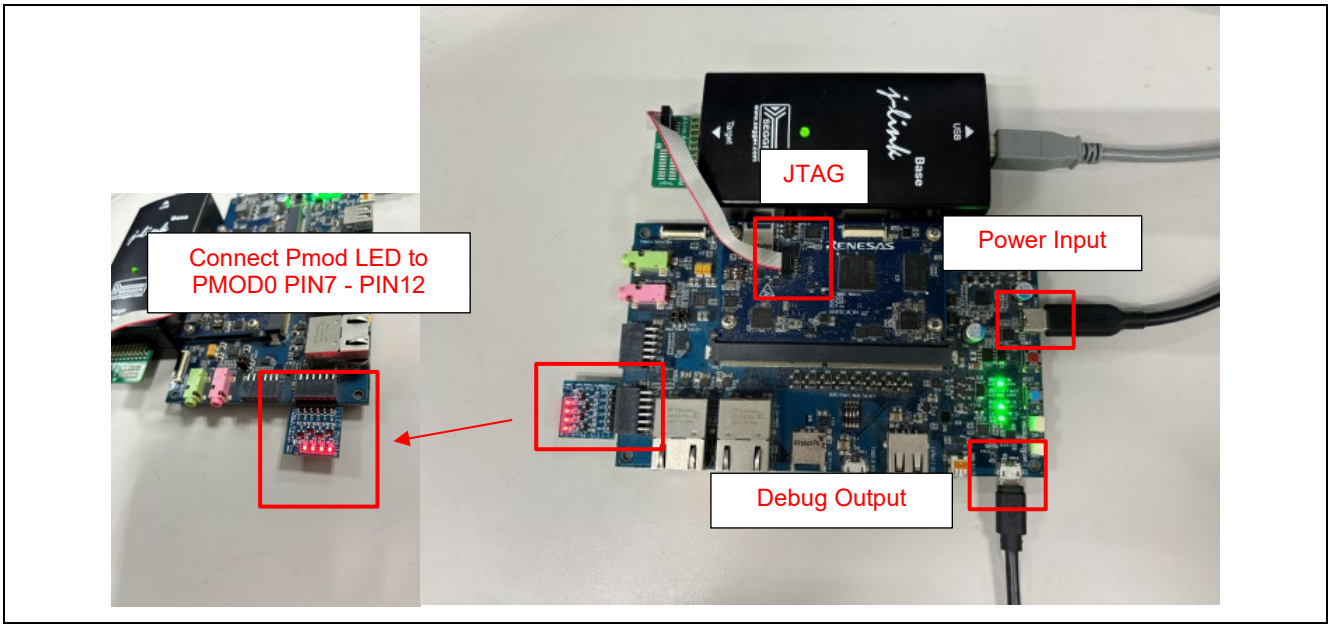


Figure 87: DMAC example - Board Setting (RZ/A3UL)

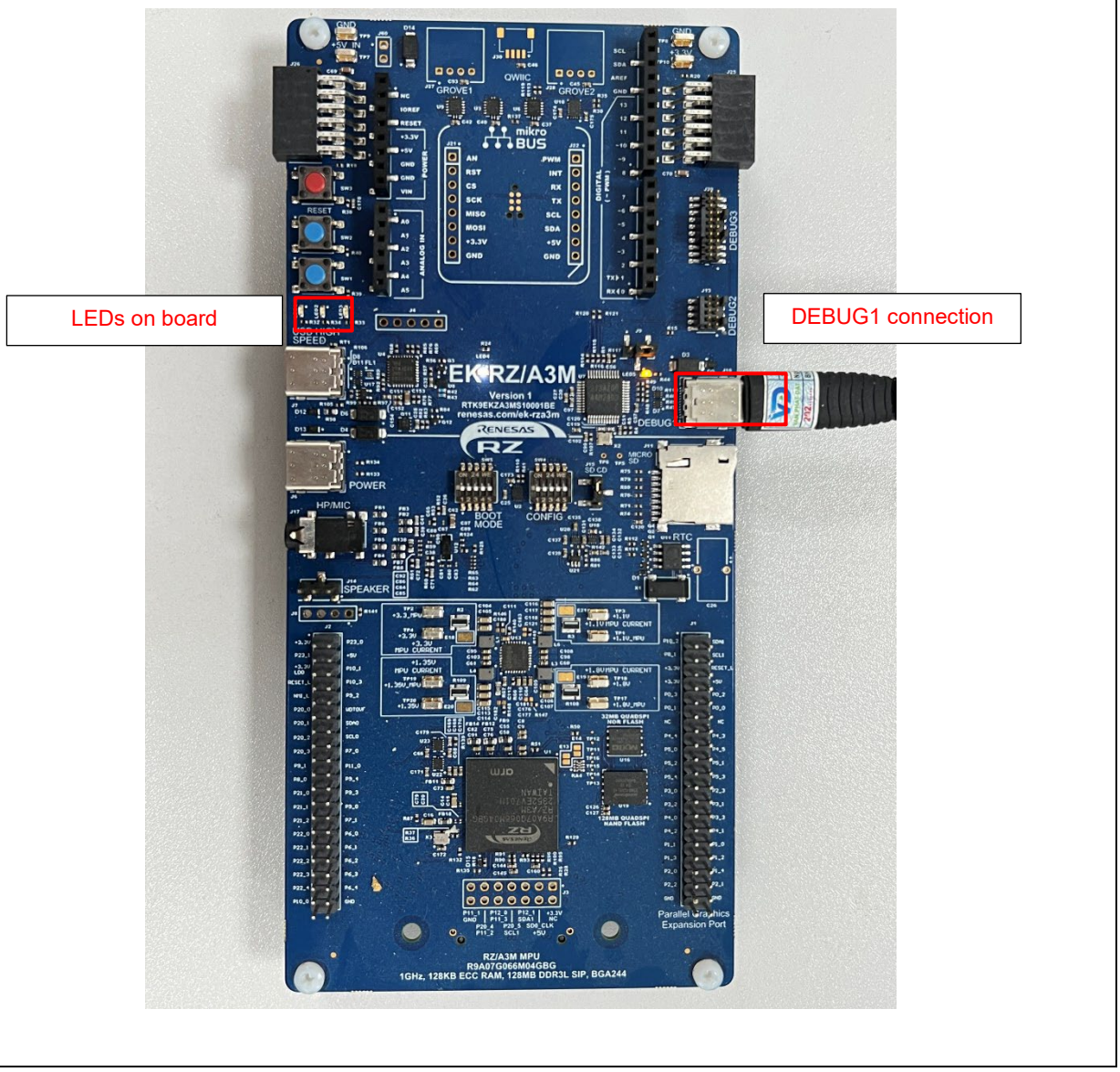


Figure 88: DMAC example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don’t care. SW1-3: OFF	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.22.4 Operation

After running the example, the message below is displayed on console. Users can select each option.

```
Project initializes 2 DMAC transfer instances.Upon successful
initialization,a menu option is displayed. On selecting 1 from menu
option,GTM generates 100ms interrupt to trigger a transfer from the
source buffer to port control register for 60 times indicated by LED
blinking for 60 times. On selecting 2 from menu option,DMAC (runs in
Block mode) transfers data from the MTU counter register to destination
which gets printed to Terminal Emulator.


Press 1 to transfer source array to LED Port in normal mode.
Press 2 to transfer MTU current timer value.
```

Figure 89: DMAC example – Operation

6.23 MIPI

6.23.1 Project Overview

This Example Project demonstrates the basic functionalities of the MIPI DSI device driver on Renesas RZA MPUs based on Renesas FSP. On successful initialization of the MIPI DSI module, the EP will display 8-color bars on the MIPI LCD (external LCD connected to RZA MPU) using the graphics and MPI-DSI modules in FSP. A user menu will be provided over the Terminal Emulator. User can choose the time to enter Ultra-Low-Power State(ULPS) and touch the screen to exit this mode. Status information and error messages will be printed on Terminal Emulator during the execution of the project.

6.23.2 Hardware Requirements

External hardware:

1 Cable USB A to USB C.

1 MIPI Graphics Expansion Board (included in the kit).

6.23.3 Hardware Settings

Please connect each hardware as below.

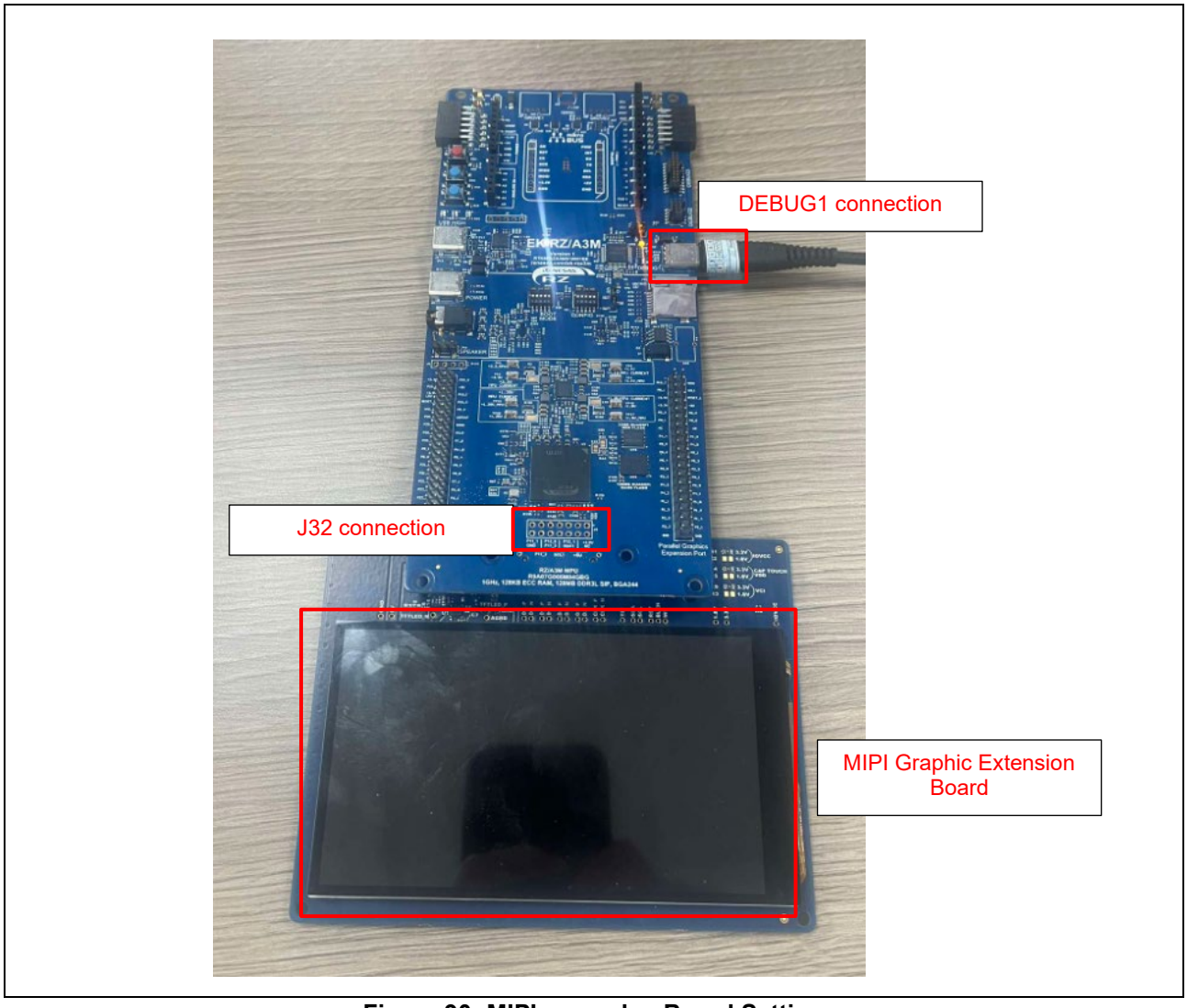


Figure 90: MIPI example - Board Setting

Please set each DIP switch and jumper as below.

Board	EK RZ/A3M
Module board	SW4-1 : Don't care SW4-2 : Don't care SW4-3 : Don't care SW4-4 : Don't care SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : Don't care SW5-4 : OFF SW5-5 : Don't care JP9 : Connects 2-3
Carrier board	None

6.23.4 Operation

After running the example, the message below is displayed on console

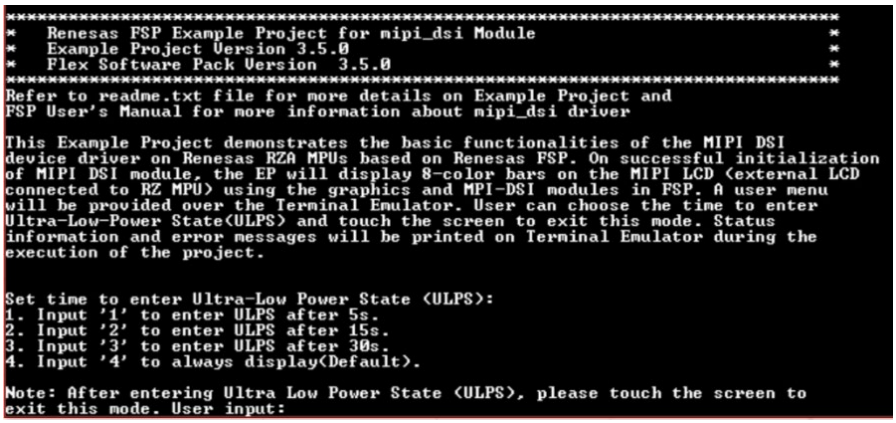


Figure 91: MIPI example – Operation (Initialize console)

Choose the time to enter ULPS

Figure 92: MIPI example – Operation (ULPS)

Exit the ULPS and display the touch point

Figure 93: MIPI example – Operation (display the touch point)

6.24 SPIBSC

6.24.1 Project Overview

This example project demonstrates the erase and write functionalities of the SPI flash device on RZ/A3M or RZ/A3UL MPU based on Renesas FSP. The sample code is executed by selecting the menu number on the console. In main menu, user selects operation for the flash device.

1. Erase and verify.
2. Write random data and verify.

And then, the user inputs the target address and size. After, the sample code execute the operation and show the result.

Erase example

a. In the erase example, input the start address and the size. Return to the main menu if the start address or the size is zero.

b. The erase start address must be equal to or greater than 0x40000(*1).

c. The erase start address must be aligned with "the erase size(*2)" listed in the Smart Configurator.

d. The erase size must be multiple of the erase size matched by the previous item.

e. The sample code starts erasing immediately after the user enters a valid size.

f. The sample code displays whether the erasure was successful and returns to the main menu.

Write example

a. In the write example, input the start address and the size. Return to the main menu if the start address or the size is zero.

b. The write start address must be equal to or greater than 0x40000(*1).

c. The write size must be greater than 1.

d. The sample code starts writing immediately after the user enters a valid size.

e. The sample code displays whether the write was successful and returns to the main menu.

[Note]

(*1) Address restrictions exist to prevent sample code from being corrupted by itself.

(*2) The erase start address must be aligned with one of the erase size in FSP configuration as marked below.

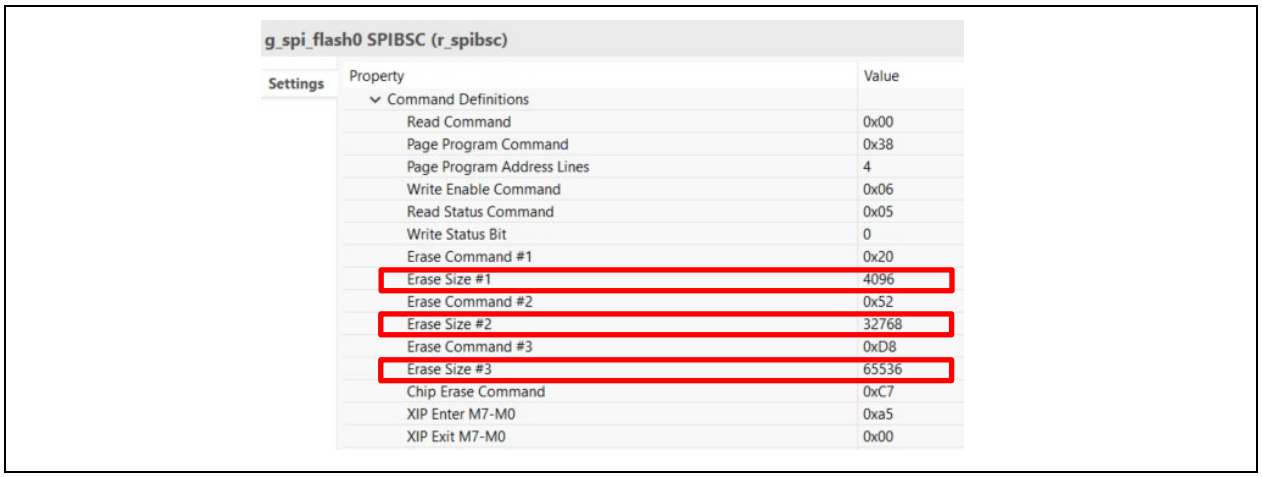


Figure 94: Erase size setting on FSP configuration

6.24.2 Hardware Requirements

External hardware: Pmod LED (RZ/A3UL)

6.24.3 Hardware Settings

Please connect each hardware as below.

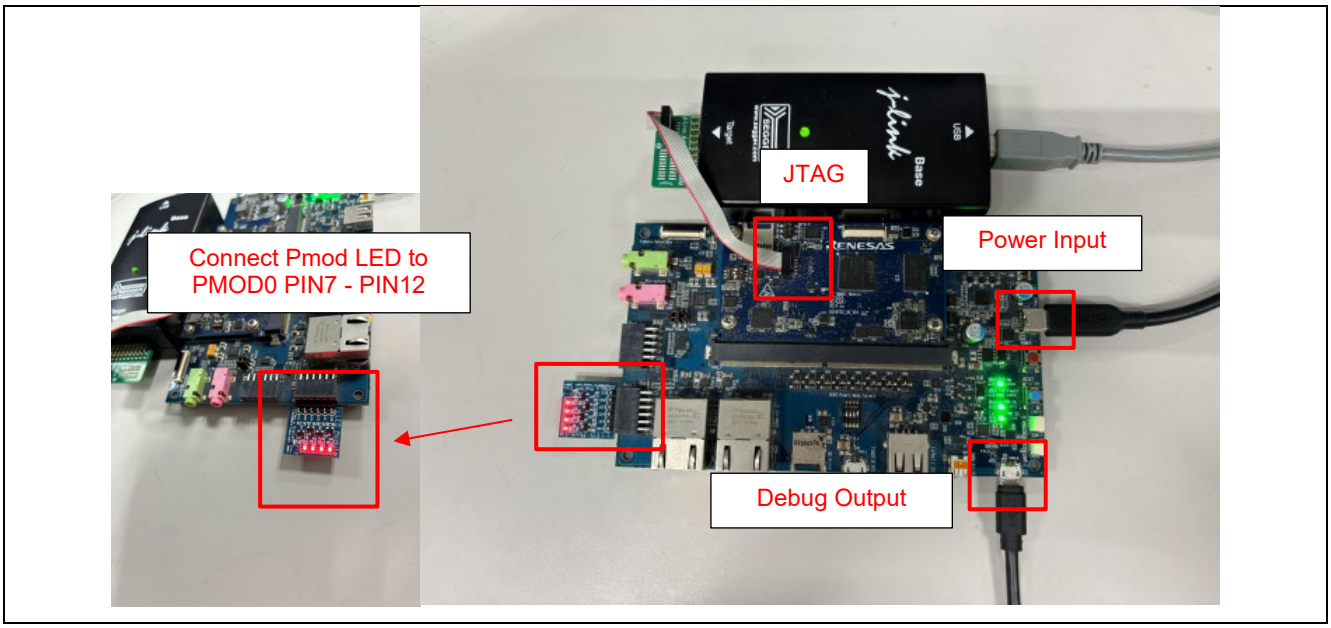


Figure 95 : SPIBSC example - Board Setting (RZ/A3UL)

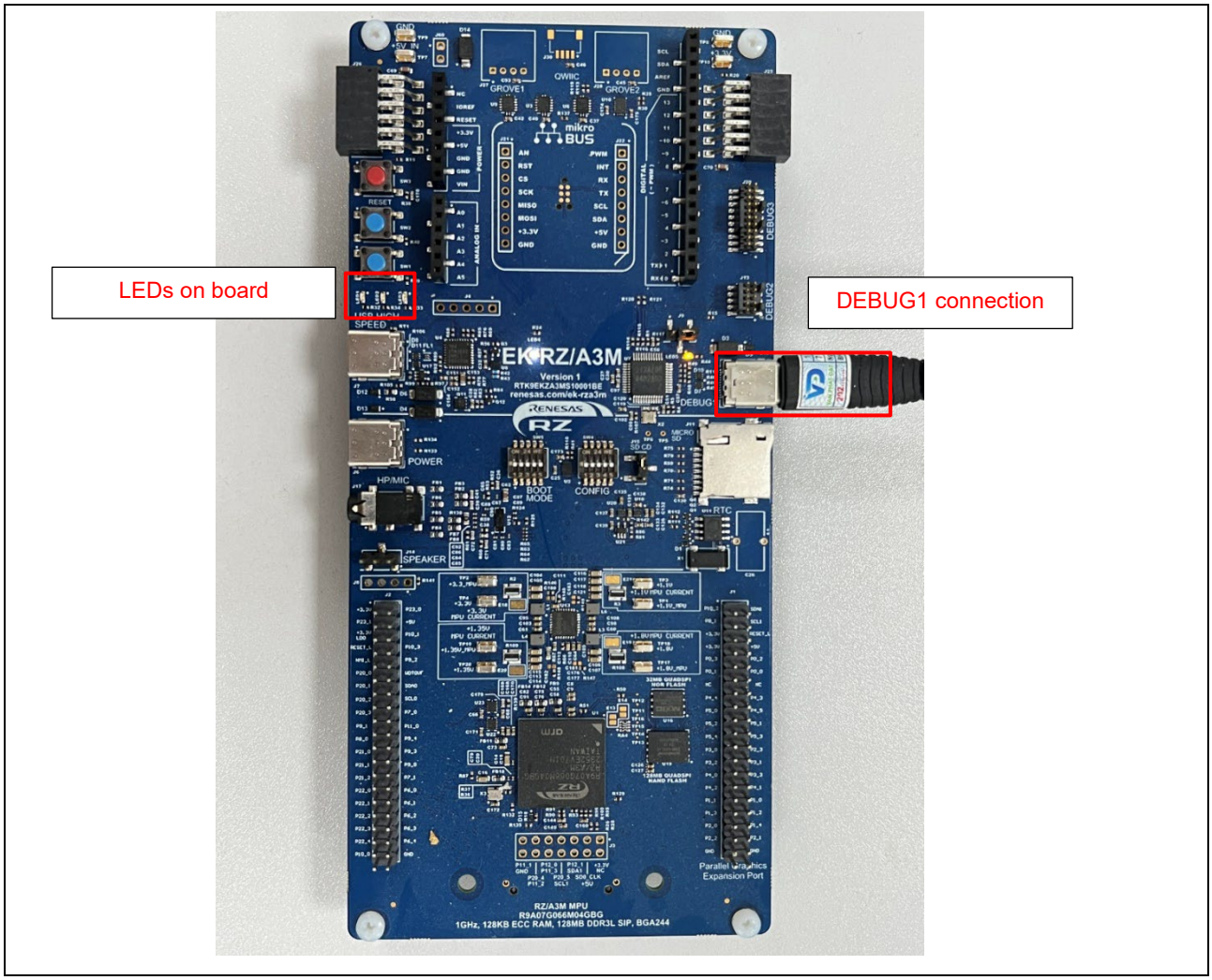


Figure 96: SPIBSC example - Board Setting (RZ/A3M)

Please set each DIP switch and jumper as below.

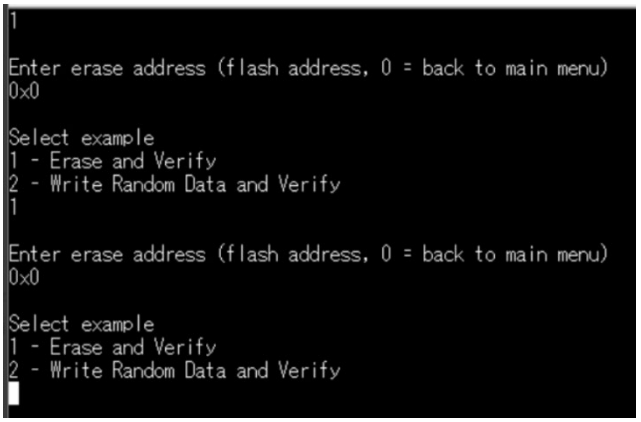
Board	RZ/A3UL EVK	EK RZ/A3M
Module board	SW1-1: OFF SW1-2: Don't care. SW1-3: OFF	SW4-1 : OFF SW4-2 : OFF SW4-3 : OFF SW4-4 : OFF SW4-5 : OFF SW5-1 : OFF SW5-2 : OFF SW5-3 : OFF SW5-4 : OFF SW5-5 : OFF JP9 : Connects 2-3
Carrier board	SW1: Don't care. SW2: Don't care. SW3: Don't care. SW4: Don't care. SW5: Don't care. SW6: Don't care. SW7: Don't care. SW8: Don't care. SW11-1: OFF SW11-2: OFF SW11-3: OFF SW11-4: ON CN4: Jumper connects 1-3 Jumper connects 2-4	None

6.24.4 Operation

After running the example, the message below is displayed on the console

Figure 97: SPIBSC example – Operation (Initialize console)

Return to the main menu if given 0 for address or size.



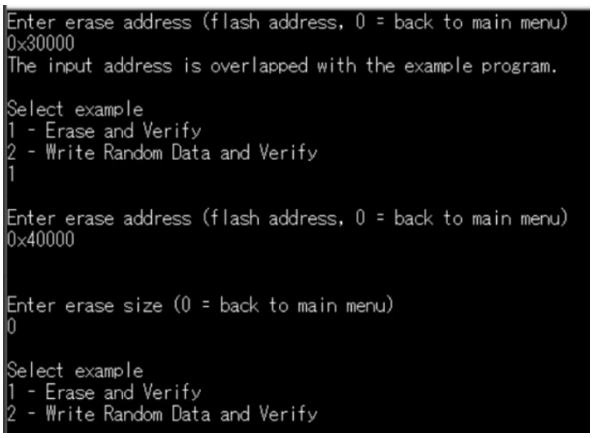


Figure 98: SPIBSC example – Operation (Erasing – return to menu)

Got an error if the address is less than 0x40000.

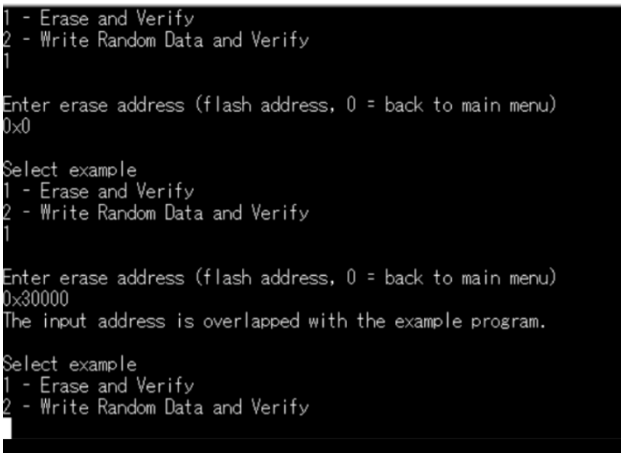


Figure 99: SPIBSC example – Operation (Erasing – address overlap)

Got an error if the address is not aligned in erase size listed in Smart Configurator.

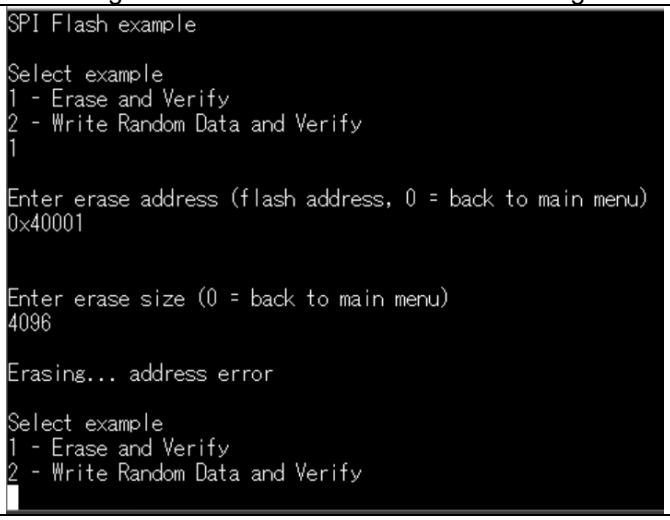


Figure 100: SPIBSC example – Operation (Erasing – address error)

Got an error if the size is not listed in Smart Configurator.

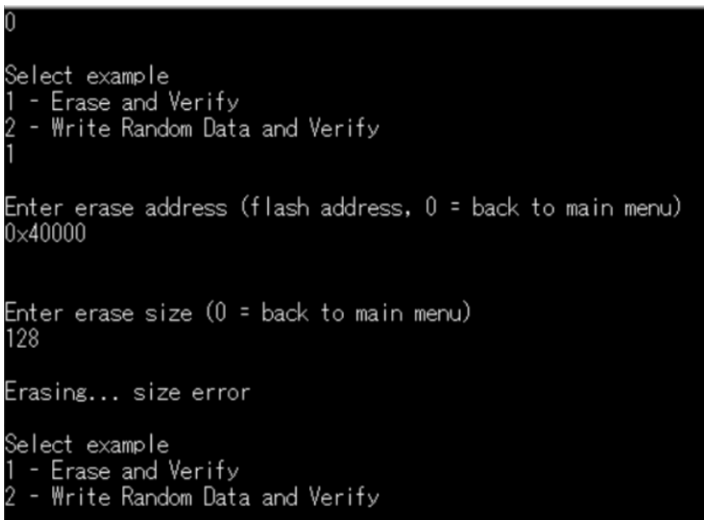


Figure 101: SPIBSC example – Operation (Erasing – size error)

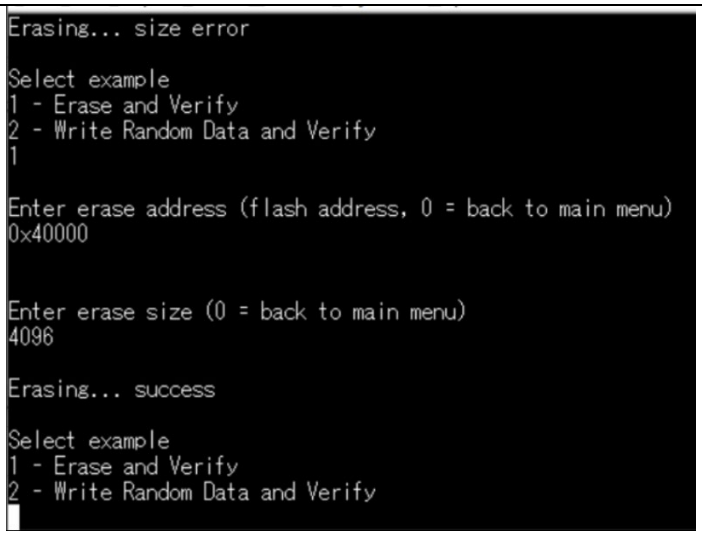


Figure 102: SPIBSC example – Operation (Erasing – success)

Return to the main menu if given 0 for address or size.

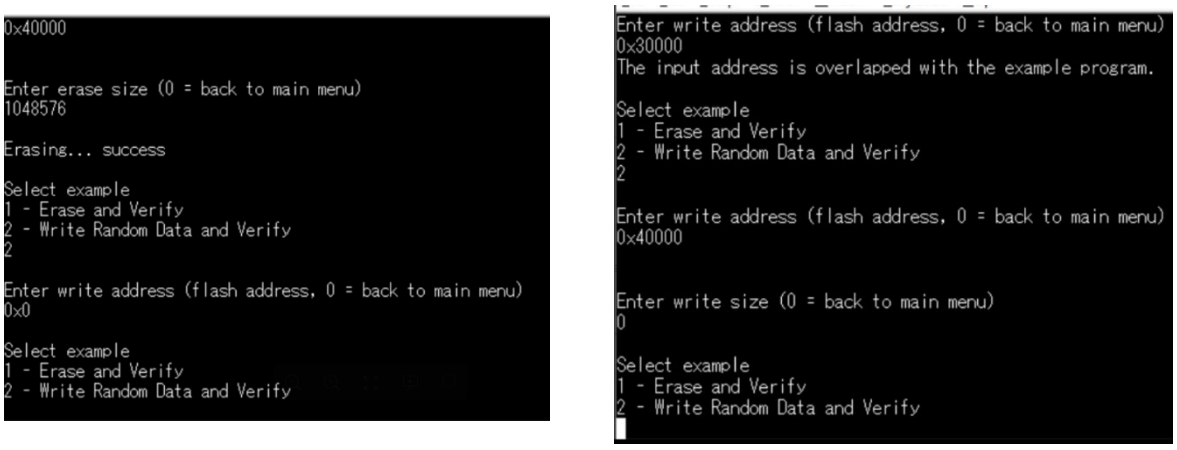


Figure 103: SPIBSC example – Operation (writing – return to menu)

Got an error if the address is less than 0x40000.

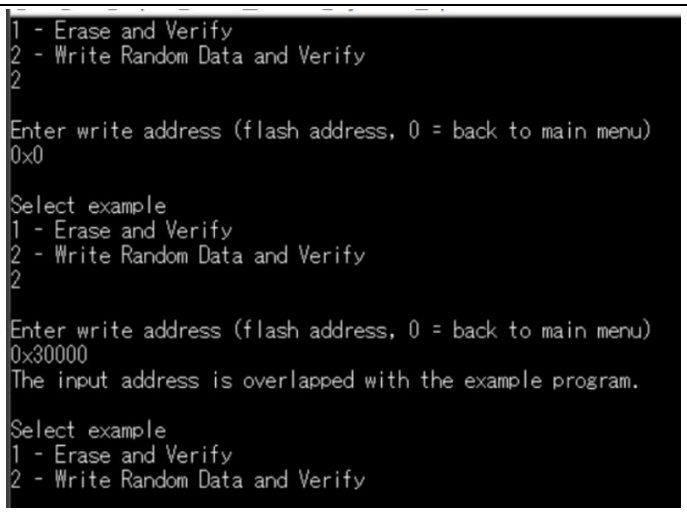


Figure 104: SPIBSC example – Operation (writing – address overlap)

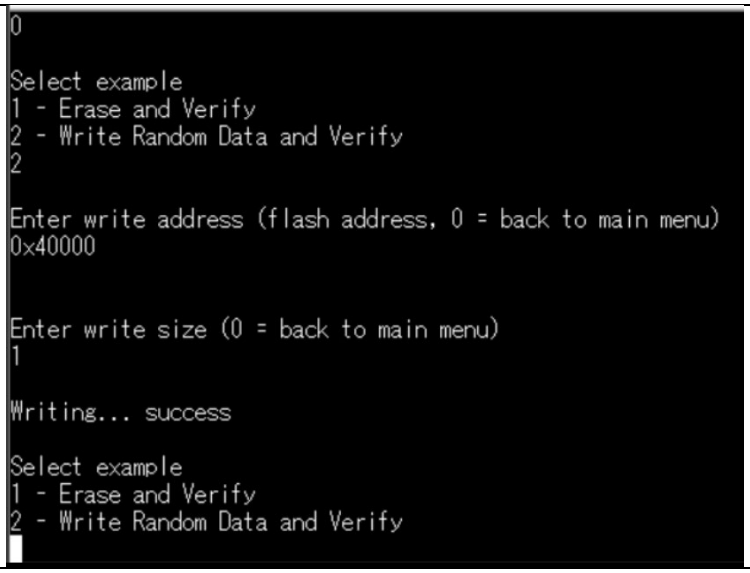


Figure 105: SPIBSC example – Operation (writing – success)

7. References

FSP GitHub:	github.com/renesas/rza-fsp
FSP User Manual:	renesas.github.io/rza-fsp/
Getting Started Guide	Getting Started with RZ/A Flexible Software Package V3.50 (renesas.com)
FSP Example Projects:	RZ/A Software Package | Renesas
Evaluation Kit Manuals:	RZ/A3UL-Evaluation-Board-Kit (renesas.com)
	EK-RZ/A3M Evaluation Kit (renesas.com)
Knowledge Base:	Knowledge Base (renesas.com)
Renesas Support:	RZ/A3UL - Support (renesas.com)
	RZ/A3M - Support (renesas.com)

Revision History

Rev.	Date	Description	
		Page	Summary
3.50	May.15.25	6	Added support for RZ/A3M
		15 to 55 58 to 82	Updated the description and figure based on the latest development environment
		56 to 57 83 to 90	Added INTC_NMI, MIPI and SPIBSC example
3.00	May.31.24	6	Updated the operating environment.
		16 to 59	Added the description of all examples.
1.10	Oct.27.23	3	Updated the version of FSP and e2 studio supported.
		4-6	Updated the section of running project.
1.01	Dec.9 22	–	Added a setting procedure to change the project to RZ/A3UL Evaluation Board Kit OCTAL Edition.
1.00	Nov.8.22	–	First release document.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
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