RL78/G1D

PowerPoint Presenter

R01AN3592EC0100
Rev. 1.00
Mar. 31, 2017

Introduction

This application note describes how to use microcontroller RL78/G1D to realize PowerPoint Presenter (thereafter PPT presenter) solution which exchanges data with PC through Bluetooth Low Energy (BLE) communication.

Target Device

RL78/G1D

When applying the sample program covered in this application note to another microcomputer, modify the program according to the specifications for the target microcomputer and conduct an extensive evaluation of the modified program.

Related Documents

Document Name		Document Number
Bluetooth Low Energy Protocol Stack		-
	User's Manual	R01UW0095
	API Reference Manual: Basics	R01UW0088
	API Reference Manual: HOGP	R01UW0093

Contents

1. Description 4
1.1 Abstract 4
1.2 Specifications and Main Technical Parameters 4
1.3 Function Description 5
2. Description of the Hardware 6
2.1 System Block Diagram 6
2.2 Main MCU 7
2.3 Power Supply Circuit 8
2.3.1 Power Supply Circuit Schematic 8
2.3.2 Power Supply Circuit Function Description 8
2.4 BLE Transceiver Circuit 9
2.4.1 BLE Transceiver Circuit Schematic 9
2.4.2 BLE Transceiver Circuit Function Description 9
2.5 LED Driving Circuit 10
2.5.1 LED Driving Circuit Schematic 10
2.5.2 LED Driving Circuit Function Description 10
2.6 Key Circuit 11
2.6.1 Key Circuit Schematic 11
2.6.2 Key Circuit Function Description 11
3. Schematic, PCB and Bill of Materials 12
3.1 Schematic 12
3.2 PCB 13
3.3 Bill of Materials 14
4. Description of the Software 15
4.1 Software Modules 15
4.1.1 Initialization Task 15
4.1.2 Broadcasting and Connection Task 15
4.1.3 Preparation Task 15
4.1.4 Notification Task 15
4.2 Integrated Development Environment 16
4.3 Option Byte Settings 16
4.4 Software Preparation 16
4.5 Software Flowcharts 17
4.5.1 Main Processing 17
4.5.2 rBLE API Initialization Processing 18
4.5.3 Key Scanning Processing 19
4.5.4 Key Status Confirmation Processing 20

5. Sample Code 21

6. Reference Documents 21

Website and Support 21

1. Description

1.1 Abstract

PPT presenter, also called electronical pointer, is a new type of electronic product exclusively used for computer and multimedia projector demonstration. It can remotely control a computer or a multimedia projector via BLE wireless method, so user can turn the PPT file to the next page or previous page just by pressing page-down key or page-up key on the PPT presenter easily when demonstrating a PPT file on the computer or multimedia projector.

1.2 Specifications and Main Technical Parameters

Specifications

- Low power consumption function: System is mainly in low power consumption status, except for BLE connecting with PC after powers on and system transmitting corresponding key values when pressing keys.
- Broadcasting connection function: After system powers on, PPT presenter broadcasts to PC, then PC connects to PPT presenter “Renesas-BLE-PPT” and installs built-in BLE driving program automatically.
- Page turning function: Press page-down key, PPT file is turned to the next page.
  Press page-up key, PPT file is turned to the previous page.
- Black screen function: Press black screen key, PPT file is turned to black screen status.
  In black screen status, press any key to exit.
- Operating temperature: -10℃ ~ 60℃

Technical Parameters

- Power supply: 3 V (CR2032 lithium battery)
- Low power consumption current (MCU): RF transmission 2.6 mA (TYP.) in RF low power consumption mode
  RF reception 3.3 mA (TYP.) in RF low power consumption mode
- 0.1 uA (TYP.) in RF Power Down mode
- Wireless type: Bluetooth
  BLE requirement: Support Bluetooth ver.4.0 and above (low energy specifications).
  Remote distance: 30 meters
  Applicable hardware: Notebook PC, desktop PC, mobile phone with Android system and tablet PC
  System platform: Windows/Android system

1.3 Function Description

Turn power supply switch to “ON”, red power supply indicator light turns on, and green status indicator light begins to blink at the same time. All these operations show PPT presenter is starting to broadcast.

Click the “Show the hidden icons” button in the lower right of the PC screen, then double click the Bluetooth icon .

In “Bluetooth Devices” window, click “Add a device”, then double click the device named “Renesas-BLE-PPT”, PC will establish a connection with it and will install HID BLE driving program automatically.

After the BLE driving program installation is finished, user can find a mouse icon named “Renesas-BLE-PPT” appeared in “Bluetooth Devices” window as figure 2.3 shows.

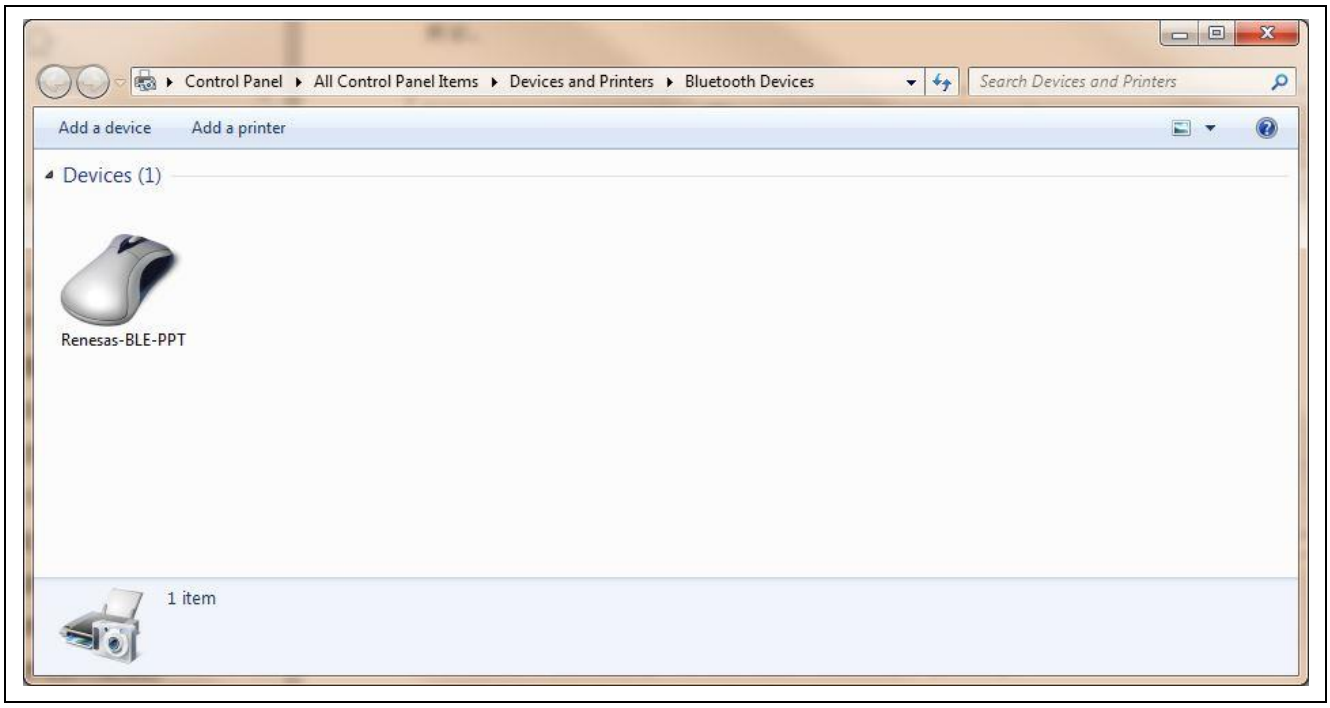

Figure 1.1 HID BLE Driving Program Installation Completed

Open a PPT file and make it play.

Press SW1 key once, PPT file is turned to the next page.

Press SW2 key once, PPT file is turned to the previous page.

Press SW3 key once, PPT file is turned to black screen mode [Note].

Press any one of the SW1, SW2 and SW3 key, PPT file exits black screen mode [Note].

Note: When pressing SW1/SW2/SW3 key, PC key board must be in English input status.

2. Description of the Hardware

2.1 System Block Diagram

Figure 2.1 shows the system block diagram for this application.

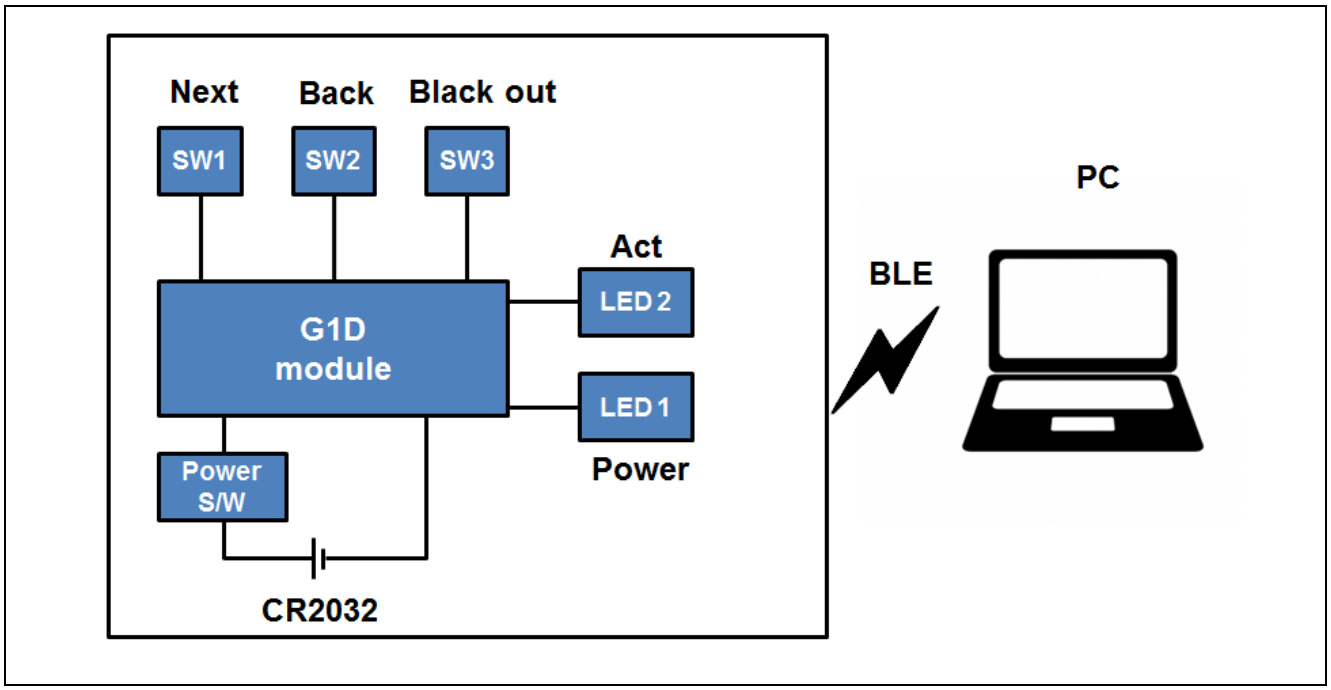

Figure 2.1 System Block Diagram

Figure 2.2 shows the demo board picture.

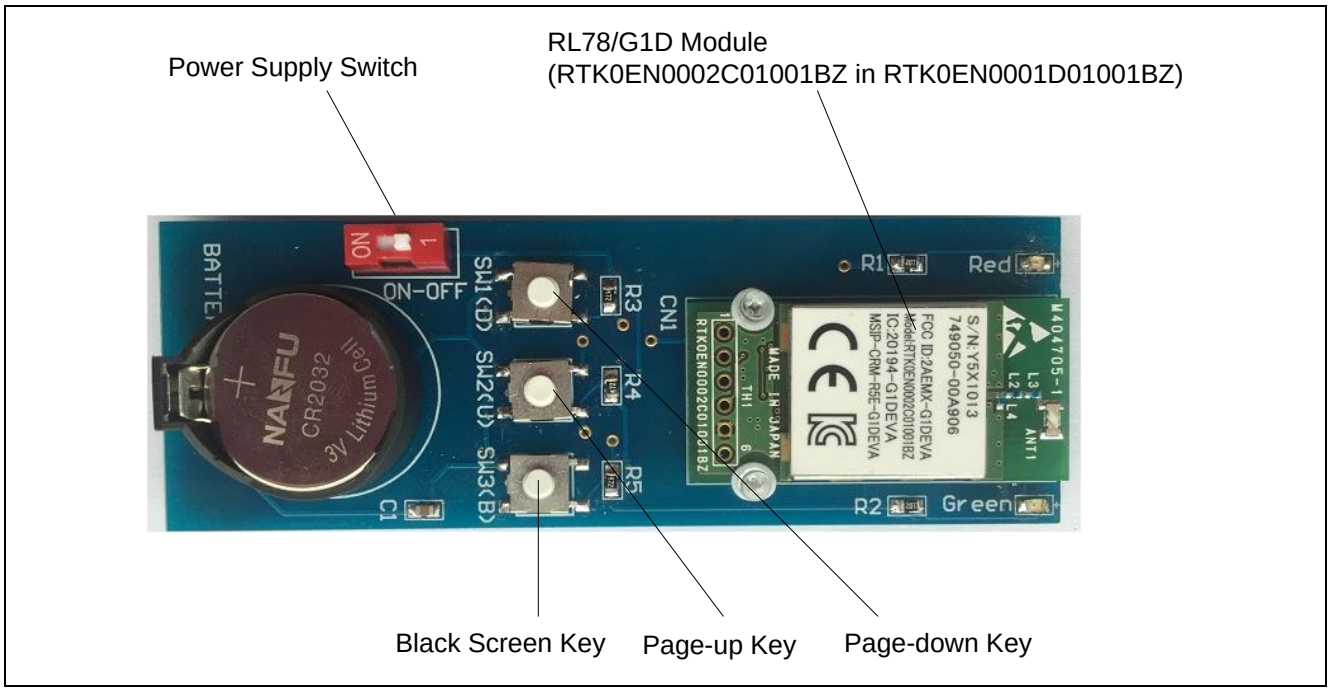

Figure 2.2 Demo Board Picture

2.2 Main MCU

PPT presenter uses RL78/G1D (R5F11AGJ) as main MCU. The Flash ROM size is 256 KB, RAM size is 20 KB. Table 2.1 lists the pins to be used by PPT presenter.

Table 2.1 Pins to be used by PPT Presenter

Pin Name	Function	Description
DCLIN	DCLIN	External inductance/capacitance connection pin for DC-DC converter
DCLOUT	DCLOUT	External capacitance connection pin for DC-DC converter
V_{SS_RF}	V_{SS_RF}	Ground for RF digital
V_{DD_RF}	V_{DD_RF}	Power supply for RF digital
AV_{SS_RF}	AV_{SS_RF}	Ground for RF analog
AV_{DD_RF}	AV_{DD_RF}	Power supply for RF analog
XTAL1_RF	XTAL1_RF	Crystal oscillation connection pin used by RF module reference clock
XTAL2_RF	XTAL2_RF	Crystal oscillation connection pin used by RF module reference clock
ANT	ANT	Pin connected to antenna
IC0	IC0	Internal connection pin
IC1	IC1	Internal connection pin
P16/TI01/TO01/INTP5	P16	SW1 connection pin
P23/ANI3	P23	SW2 connection pin
P22/ANI2	P22	SW3 connection pin
P120/ANI19	P120	LED2 connection pin

2.3 Power Supply Circuit

2.3.1 Power Supply Circuit Schematic

Figure 2.3 shows the schematic of the power supply circuit.

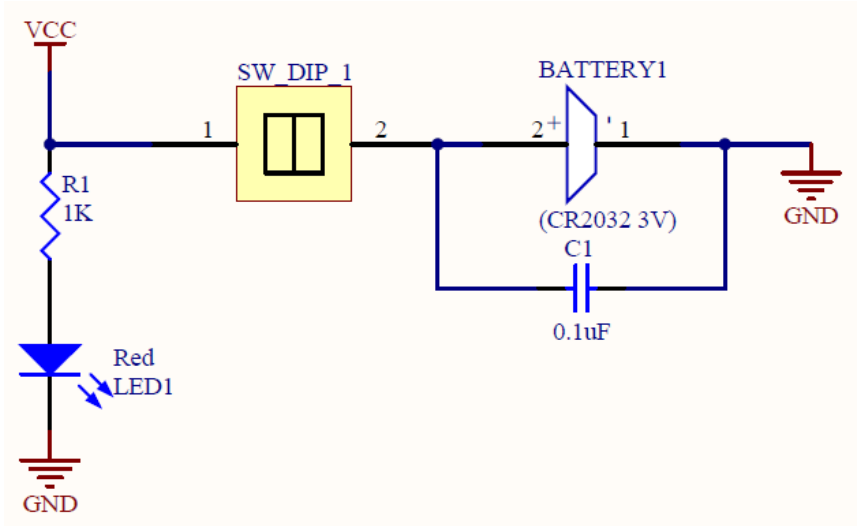

Figure 2.3 Power Supply Circuit

2.3.2 Power Supply Circuit Function Description

Power supply circuit uses CR2032 lithium battery as the power supply of PPT presenter, and uses a dial switch SW_DIP_1 to turn on/turn off power. When power is turned on, LED1 lights on.

2.4 BLE Transceiver Circuit

2.4.1 BLE Transceiver Circuit Schematic

Figure 2.4 shows the schematic of the BLE transceiver circuit.

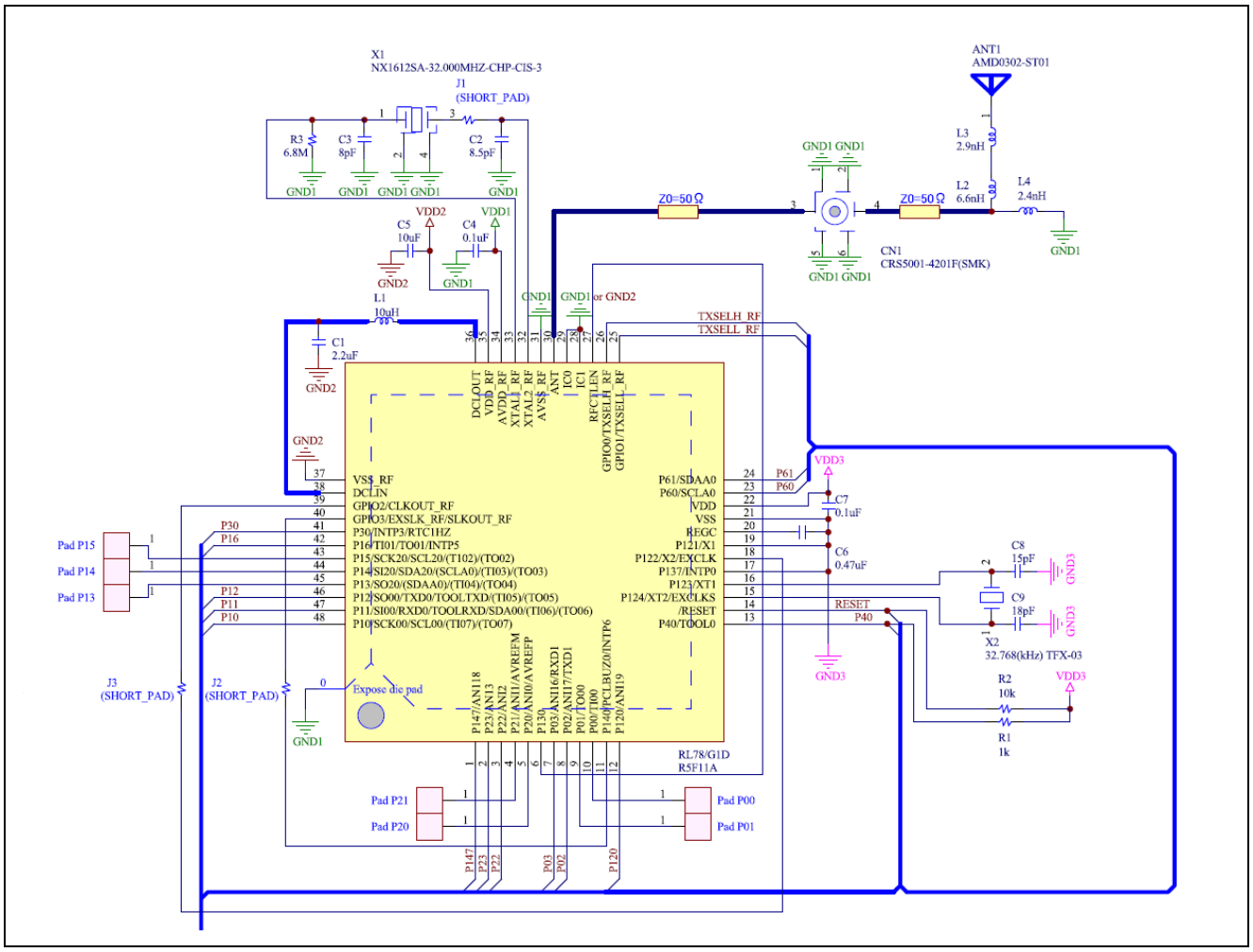

Figure 2.4 BLE Transceiver Circuit

2.4.2 BLE Transceiver Circuit Function Description

The BLE transceiver circuit in this application uses RL78/G1D BLE module (RTK0EN0002C01001BZ in RTK0EN0001D01001BZ), which can connect with the circuit board of the PPT presenter directly through a 24 pin socket (small-scale SMT).

2.5 LED Driving Circuit

2.5.1 LED Driving Circuit Schematic

Figure 2.5 shows the schematic of the LED driving circuit.

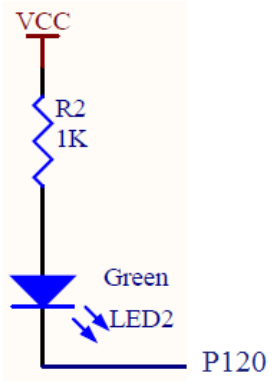

Figure 2.5 LED Driving Circuit

2.5.2 LED Driving Circuit Function Description

System uses a green SMD LED as the system status indicator light. It can reach the maximum brightness when current is 20 mA. Because the high level output current of a single pin of the MCU is only 10 mA, and the low level output current is usually 20 mA, system uses low level to light LED so as to adjust the LED brightness easily.

2.6 Key Circuit

2.6.1 Key Circuit Schematic

Figure 2.6 shows the schematic of the key circuit.

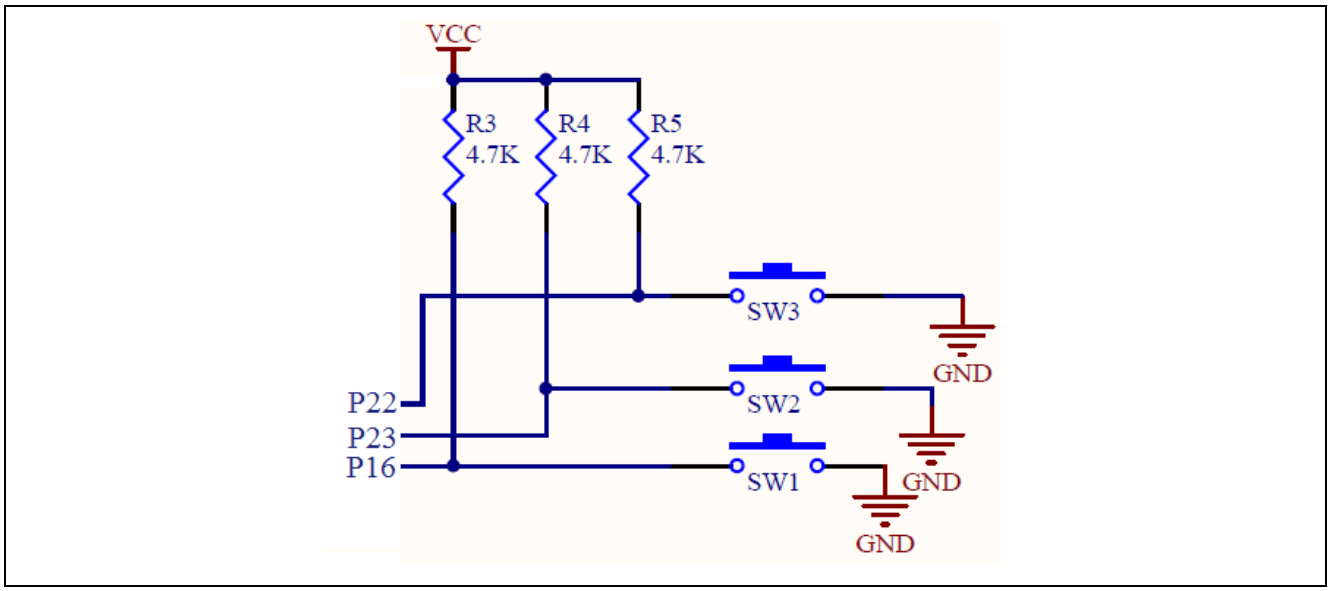

Figure 2.6 Key Circuit

2.6.2 Key Circuit Function Description

When demonstrating a PPT file on a PC or a multimedia projector, press SW1 key, PPT file is turned to the next page.

Press SW2 key, PPT file is turned to the previous page.

Press SW3 key, PPT file is turned to black screen mode.

Press any one of these 3 keys, PPT file exits black screen mode.

If there is no key pressed, the port value of the key circuit will be H. When there is a key pressed, port value will turn to L.

3. Schematic, PCB and Bill of Materials

3.1 Schematic

Figure 3.1 shows the schematic of the PPT presenter.

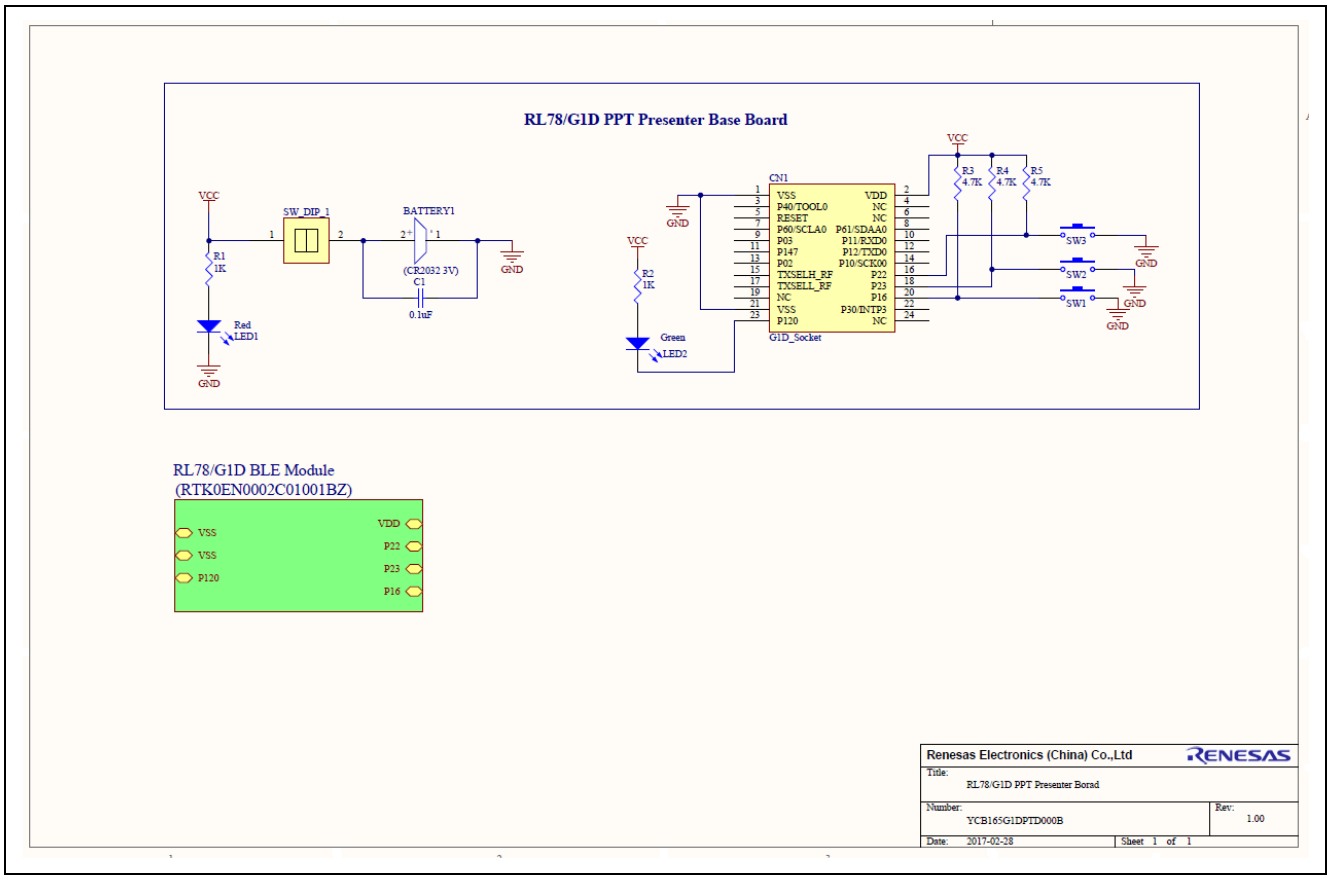

Figure 3.1 Schematic

3.2 PCB

Figure 3.2 shows the PCB of the PPT presenter.

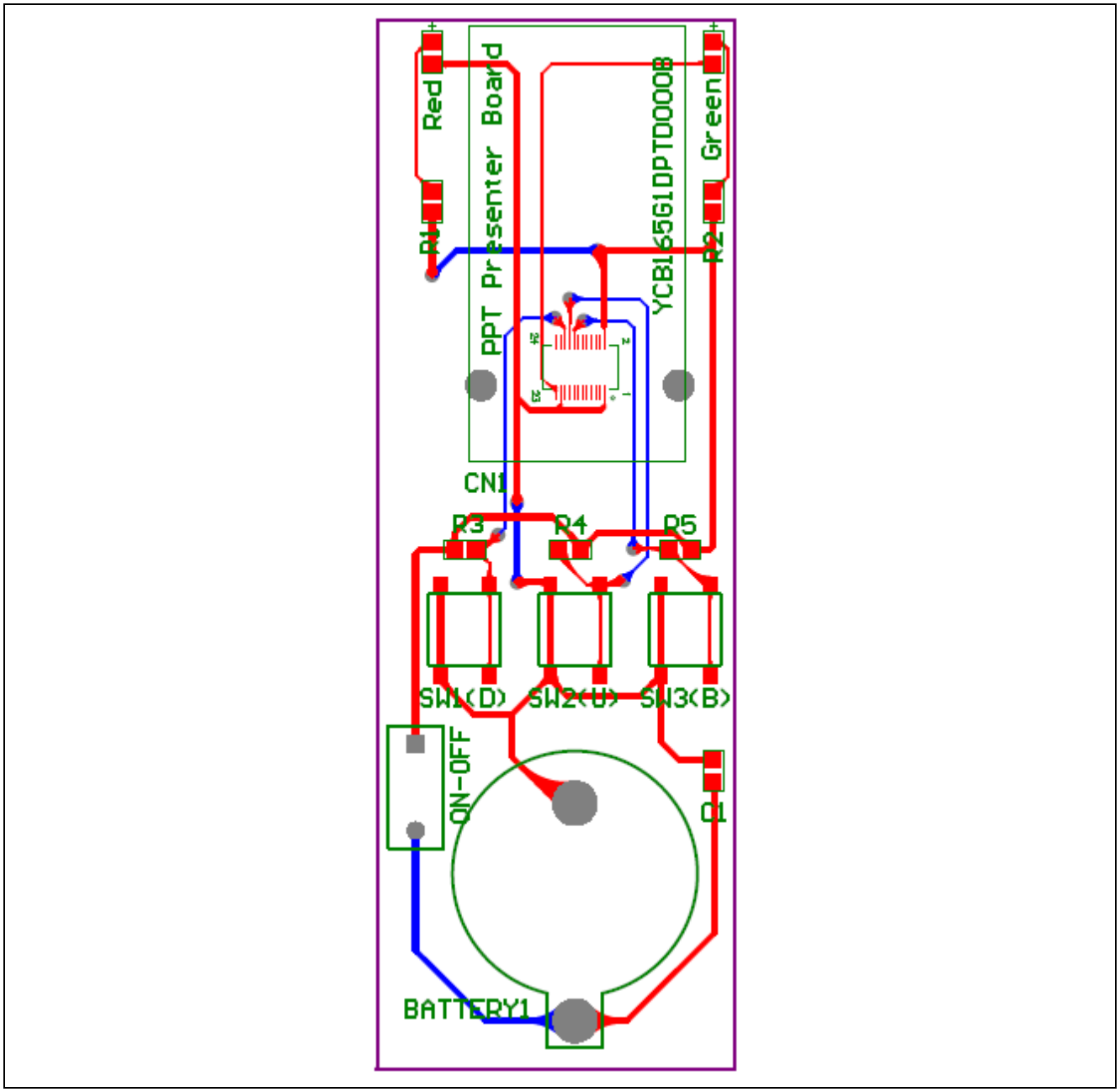

Figure 3.2 PCB

3.3 Bill of Materials

Table 3.1 lists the bills of materials of PPT presenter.

Table 3.1 Bills of Materials

Designator	Footprint	Quantity	Description
U1	-	1	RL78/G1D BLE Module (RTK0EN0002C01001BZ in RTK0EN0001D01001BZ)
CN1	CRS5001-24	1	RL78/G1D BLE Module Socket
BATTERY1	Baterry Socket	1	CR2032 PCB Coin Cell Battery Holder
C1	0805	1	Capacitor (0.1 uF)
R1, R2	0805	2	Resistor (1 K)
R3, R4, R5	0805	3	Resistor (4.7 K)
LED1	0805-LED	1	Power LED (red)
LED2	0805-LED	1	Action LED (green)
SW_DIP_1	Switch_DIP	1	DIP Switch for Power
SW1, SW2, SW3	SW1	3	Push Switch (6*6 SMT)

4. Description of the Software

4.1 Software Modules

The tasks of the whole system are listed as below: initialization task, broadcasting and connection task, preparation task, notification task.

Figure 4.1 shows the block diagram for the tasks transition.

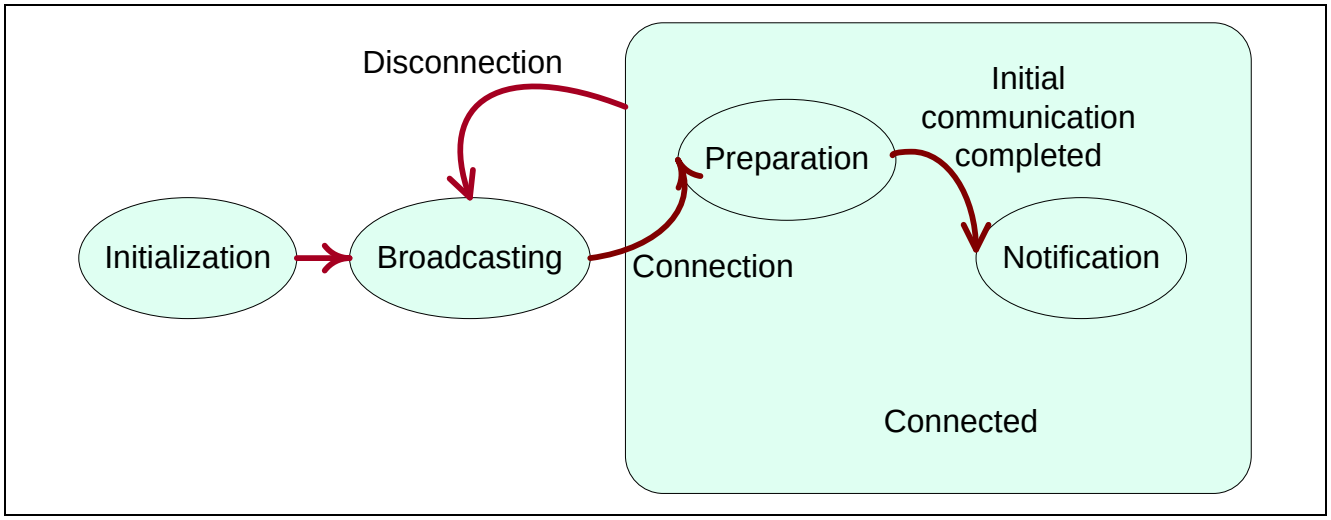

Figure 4.1 Tasks Transition Block Diagram

4.1.1 Initialization Task

After powers on, system initializes global variables, BLE configuration and related hardware.

4.1.2 Broadcasting and Connection Task

As soon as entering into broadcasting status, system starts to broadcast timely, and waits for the connection instruction from PC. After receiving the connection instruction, rBLE API begins to connect to PC. After the connection is established, system starts HOGP.

4.1.3 Preparation Task

After HOGP starts, upper device reads the characteristic value of protocol mode and PnP ID.

4.1.4 Notification Task

If system confirms these characteristic values are correct, PC will return RBLE_HGP_EVENT_HDEVICE_CFG_INDNTF_IND instruction. From this moment, application is started to use regularly.

4.2 Integrated Development Environment

Table 4.1 shows the tools which were used when developing the PPT presenter solution.

Table 4.1 Integrated Development Environment

Item	Description
Integrated development environment	CS+ for CC V4.01.00 (Manufactured by Renesas Electronic Corporation)
C compiler	CC-RL V1.03 (Manufactured by Renesas Electronic Corporation)
Debugger	E1 (Manufactured by Renesas Electronic Corporation)

4.3 Option Byte Settings

Table 4.2 shows the settings of the option bytes used in PPT presenter.

Table 4.2 Option Byte Settings

Address	Value	Description
000C0H	11101111B	Watchdog timer operation stops (stop counting after reset)
000C1H	11111111B	LVD: Turn-off
000C2H	10101010B	HOCO: 8 MHz, operating voltage: 1.8 V ~ 3.6 V
000C3H	10000101B	Enable on-chip debugger

4.4 Software Preparation

For using PPT presenter, please download BLE protocol stack library corresponding to your development environment from Renesas website and copy it to the following folder:

(Target folder)\workspace\renesas\lib

- BLE_CONTROLLER_LIB_CCRL.lib
- BLE_HOST_lib_CCRL.lib
- BLE_PROFILE_HGP_LIB_CCRL.lib
- BLE_PROFILES_COMMON_LIB_CCRL.lib
- BLE_rBLE_lib_CCRL.lib

BLE protocol stack library (ver.1.20):

https://www.renesas.com/en-us/software/D6000617.html

4.5 Software Flowcharts

4.5.1 Main Processing

Figure 4.2 shows the flowchart for the main processing routine.

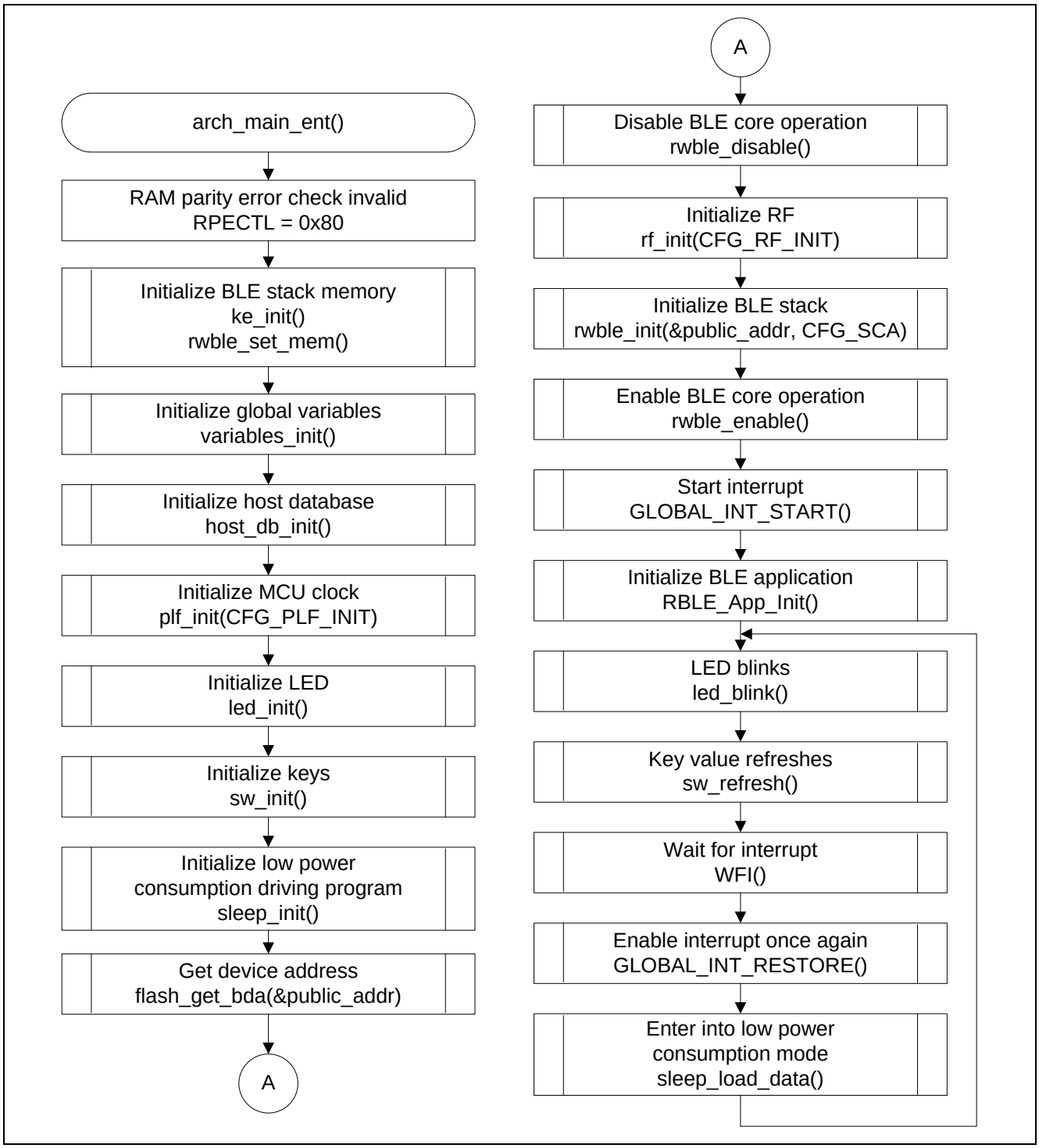

Figure 4.2 Main Processing

4.5.2 rBLE API Initialization Processing

Figure 4.3 shows the flowchart for the rBLE API initialization processing.

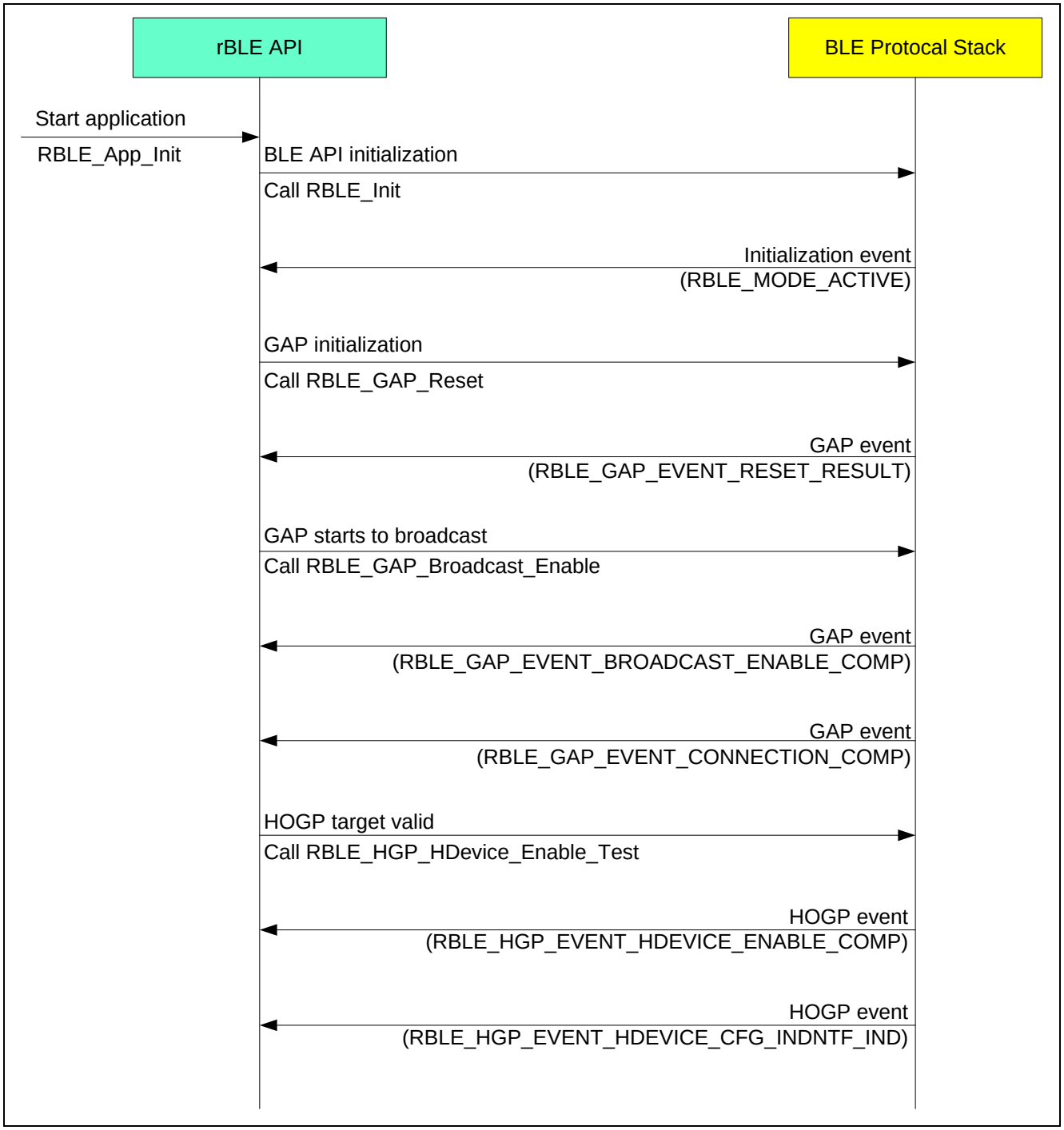

Figure 4.3 rBLE API Initialization Processing

4.5.3 Key Scanning Processing

Figure 4.4 shows the flowchart for the key scanning processing.

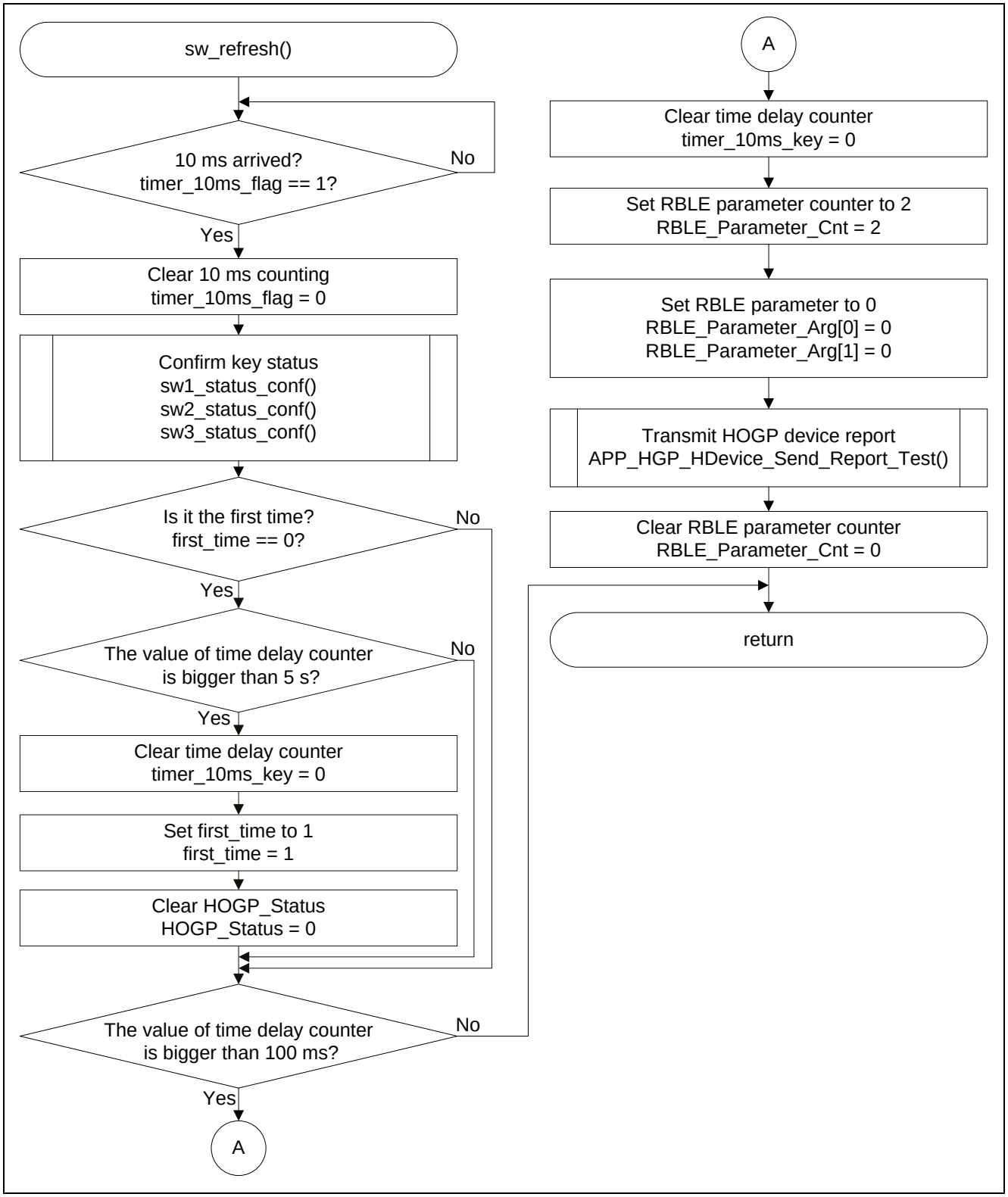

Figure 4.4 Key Scanning Processing

4.5.4 Key Status Confirmation Processing

Key status confirmation processing of SW3 is as same as SW1 and SW2. Figure 4.5 takes SW3 for example to show the flowchart for the key status confirmation processing.

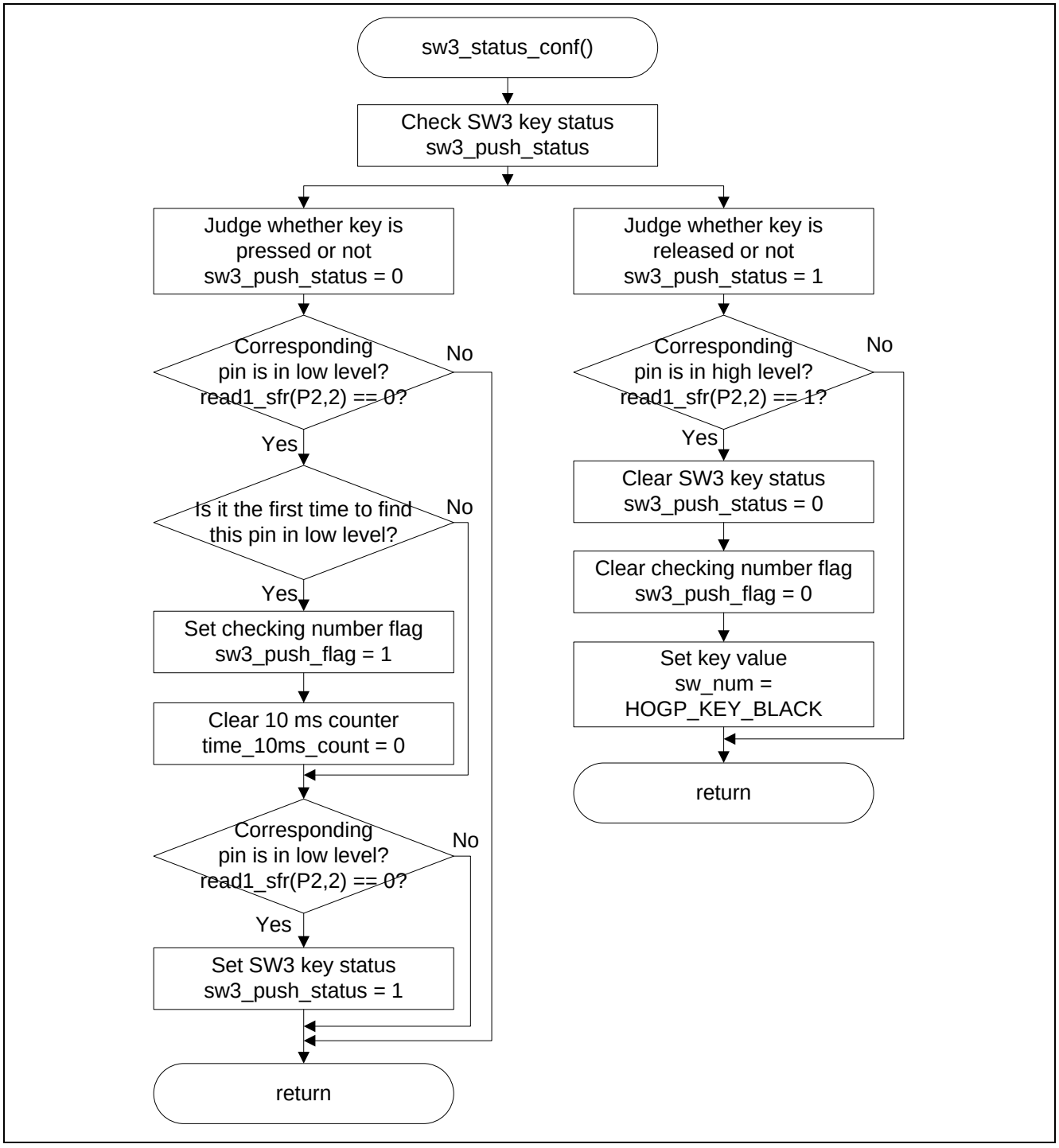

Figure 4.5 Key Status Confirmation Processing

5. Sample Code

The sample code is available on the Renesas Electronics Website.

6. Reference Documents

RL78/G1D User’s Manual: Hardware (R01UH0515E)

RL78 family User's Manual: Software (R01US0015E)

(The latest versions of the documents are available on the Renesas Electronics Website.)

Technical Updates/Technical News

(The latest information can be downloaded from the Renesas Electronics Website.)

Website and Support

Renesas Electronics Website

http://www.renesas.com/

Inquiries

http://www.renesas.com/contact/

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Mar. 31, 2017	—	First edition issued

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. 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other disputes involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawing, chart, program, algorithm, application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics products.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (space and undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. When using the Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat radiation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions or failure or accident arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please ensure to implement safety measures to guard them against the possibility of bodily injury, injury or damage caused by fire, and social damage in the event of failure or malfunction of Renesas Electronics products, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures by your own responsibility as warranty for your products/system. Because the evaluation of microcomputer software alone is very difficult and not practical, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please investigate applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive carefully and sufficiently and use Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall not use Renesas Electronics products or technologies for (1) any purpose relating to the development, design, manufacture, use, stockpiling, etc., of weapons of mass destruction, such as nuclear weapons, chemical weapons, or biological weapons, or missiles (including unmanned aerial vehicles (UAVs)) for delivering such weapons, (2) any purpose relating to the development, design, manufacture, or use of conventional weapons, or (3) any other purpose of disturbing international peace and security, and you shall not sell, export, lease, transfer, or release Renesas Electronics products or technologies to any third party whether directly or indirectly with knowledge or reason to know that the third party or any other party will engage in the activities described above. When exporting, selling, transferring, etc., Renesas Electronics products or technologies, you shall comply with any applicable export control laws and regulations promulgated and administered by the governments of the countries asserting jurisdiction over the parties or transactions.
10. Please acknowledge and agree that you shall bear all the losses and damages which are incurred from the misuse or violation of the terms and conditions described in this document, including this notice, and hold Renesas Electronics harmless, if such misuse or violation results from your resale or making Renesas Electronics products available any third party.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.3.0-1 November 2016)

RENESAS

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL II Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

Colophon 6.0