

## RL78/G1D

R01AN3592EC0100

Rev. 1.00

### PowerPoint Presenter

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#### 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

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## 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:  $-10^{\circ}\text{C} \sim 60^{\circ}\text{C}$

#### 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

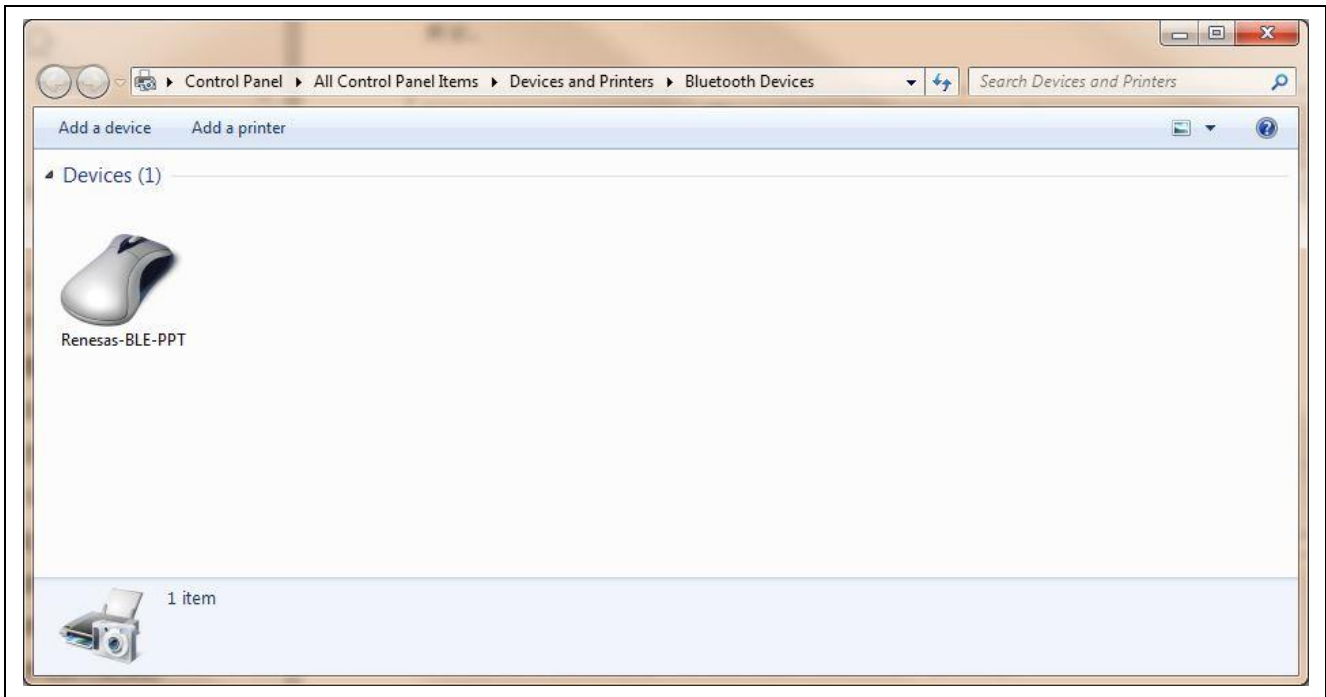
### 1.3 Function Description

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 <sup>Note</sup>.

Press any one of the SW1, SW2 and SW3 key, PPT file exits black screen mode <sup>Note</sup>.

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.

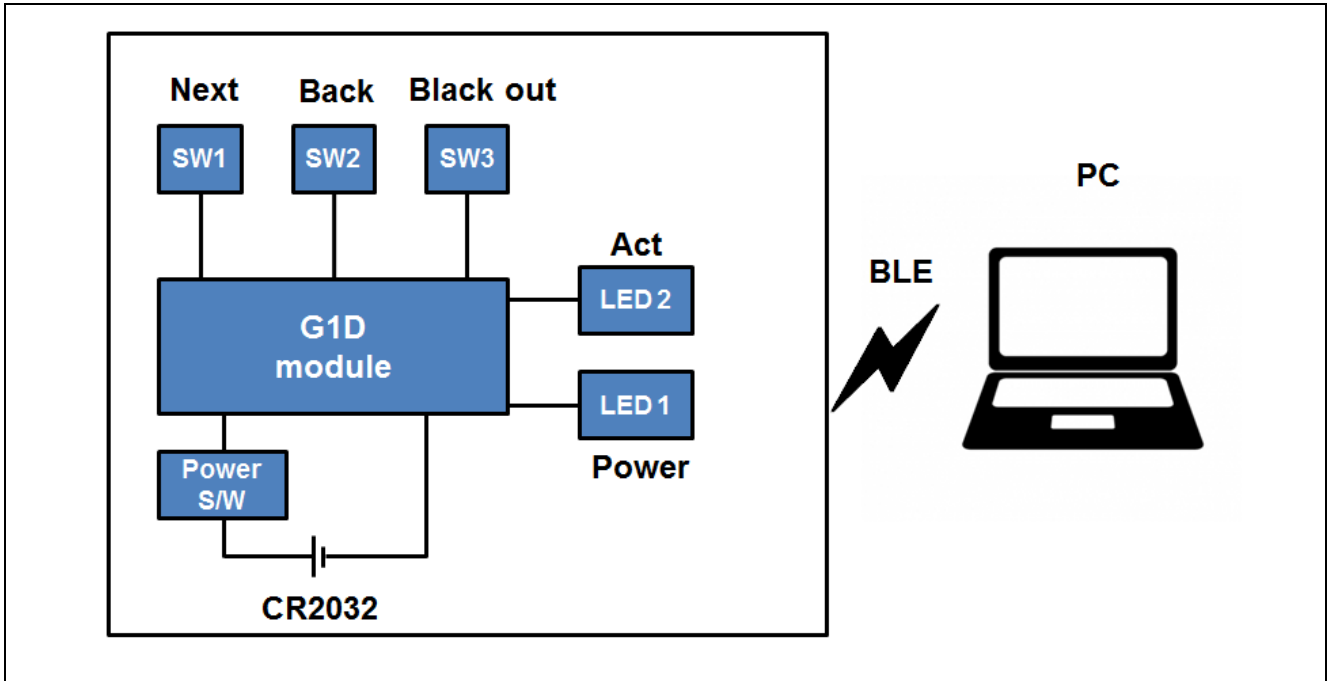


Figure 2.1 System Block Diagram

Figure 2.2 shows the demo board picture.

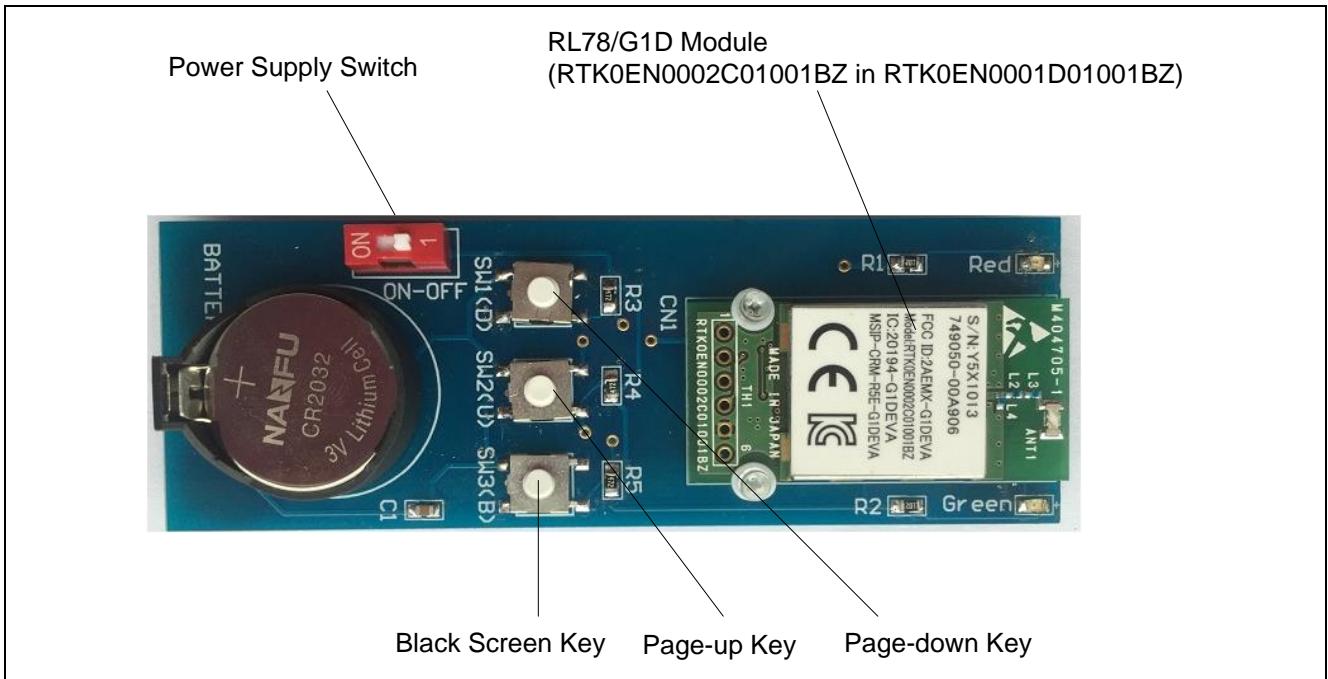


Figure 2.2 Demo Board Picture

## 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 <sub>SS_RF</sub>	V <sub>SS_RF</sub>	Ground for RF digital
V <sub>DD_RF</sub>	V <sub>DD_RF</sub>	Power supply for RF digital
AV <sub>SS_RF</sub>	AV <sub>SS_RF</sub>	Ground for RF analog
AV <sub>DD_RF</sub>	AV <sub>DD_RF</sub>	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.

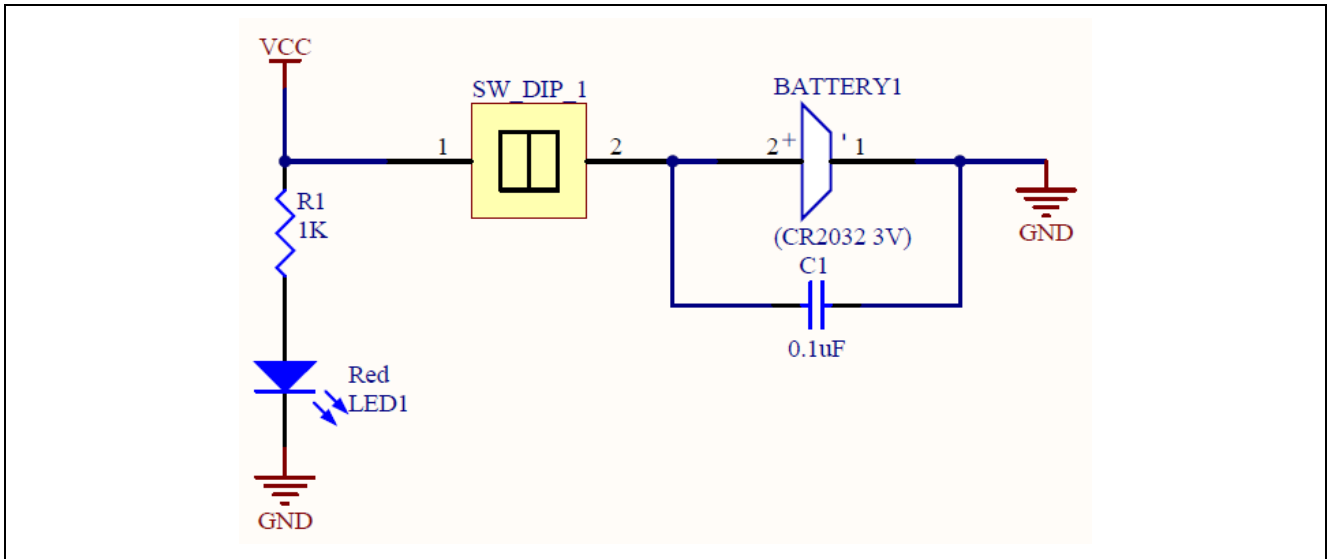


Figure 2.3 Power Supply Circuit

#### 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.

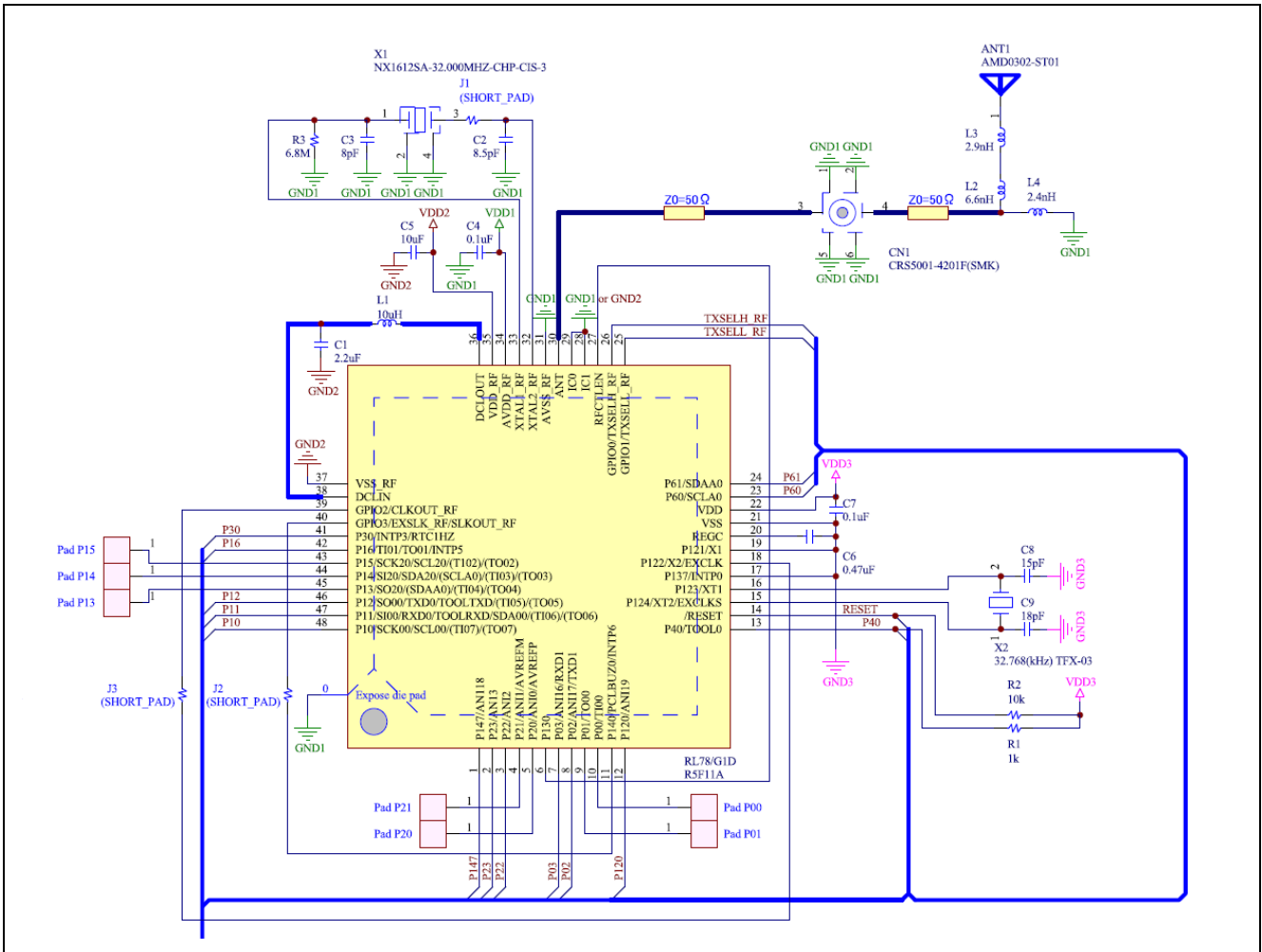


Figure 2.4 BLE Transceiver Circuit

### 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.

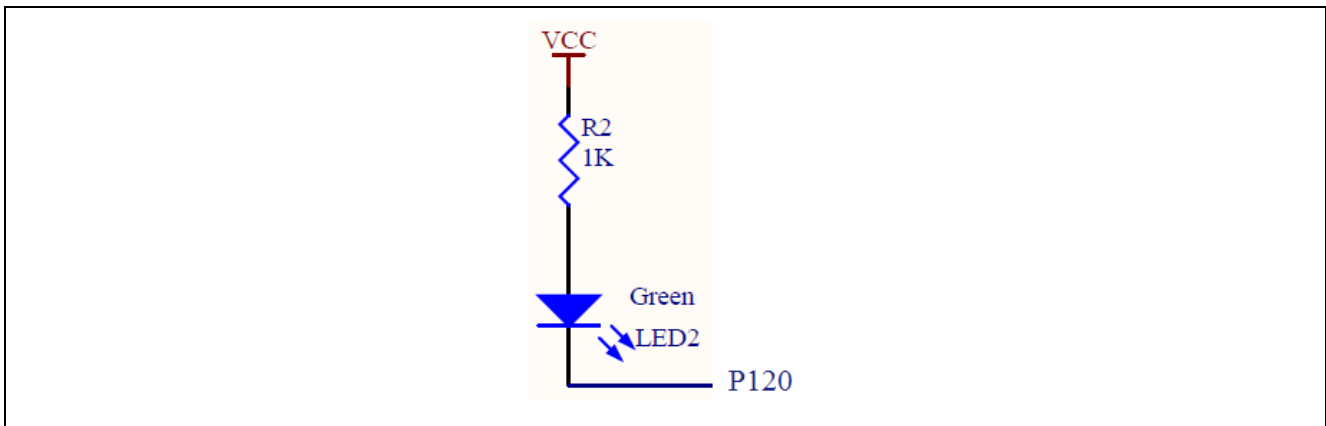


Figure 2.5 LED Driving Circuit

### 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.

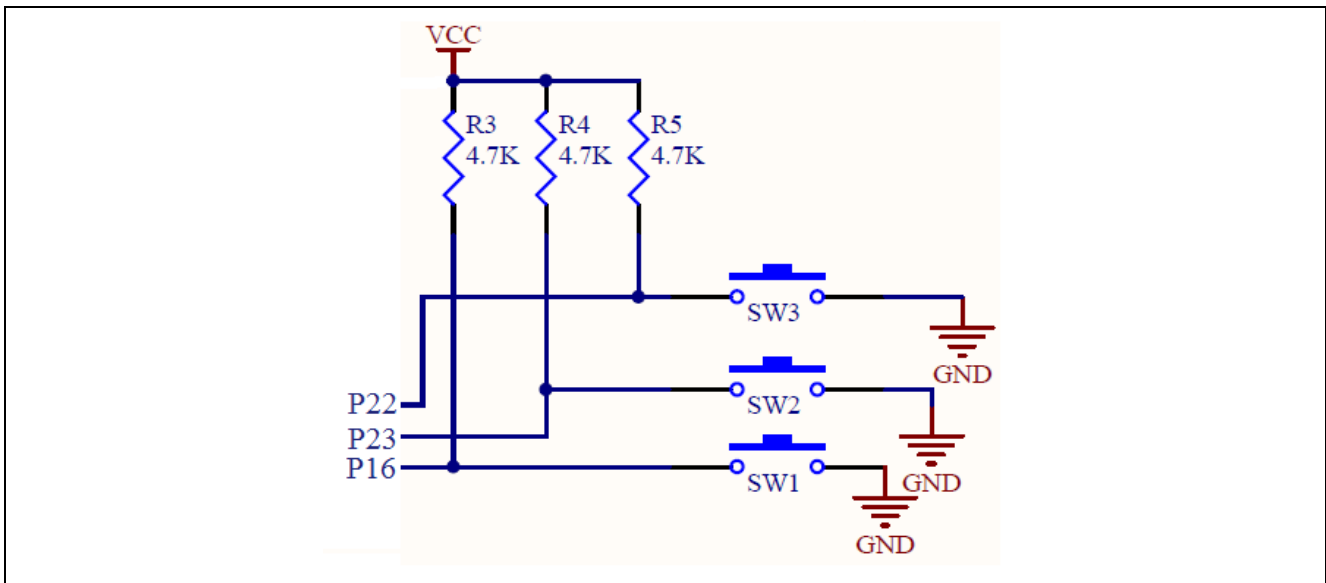


Figure 2.6 Key Circuit

### 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.

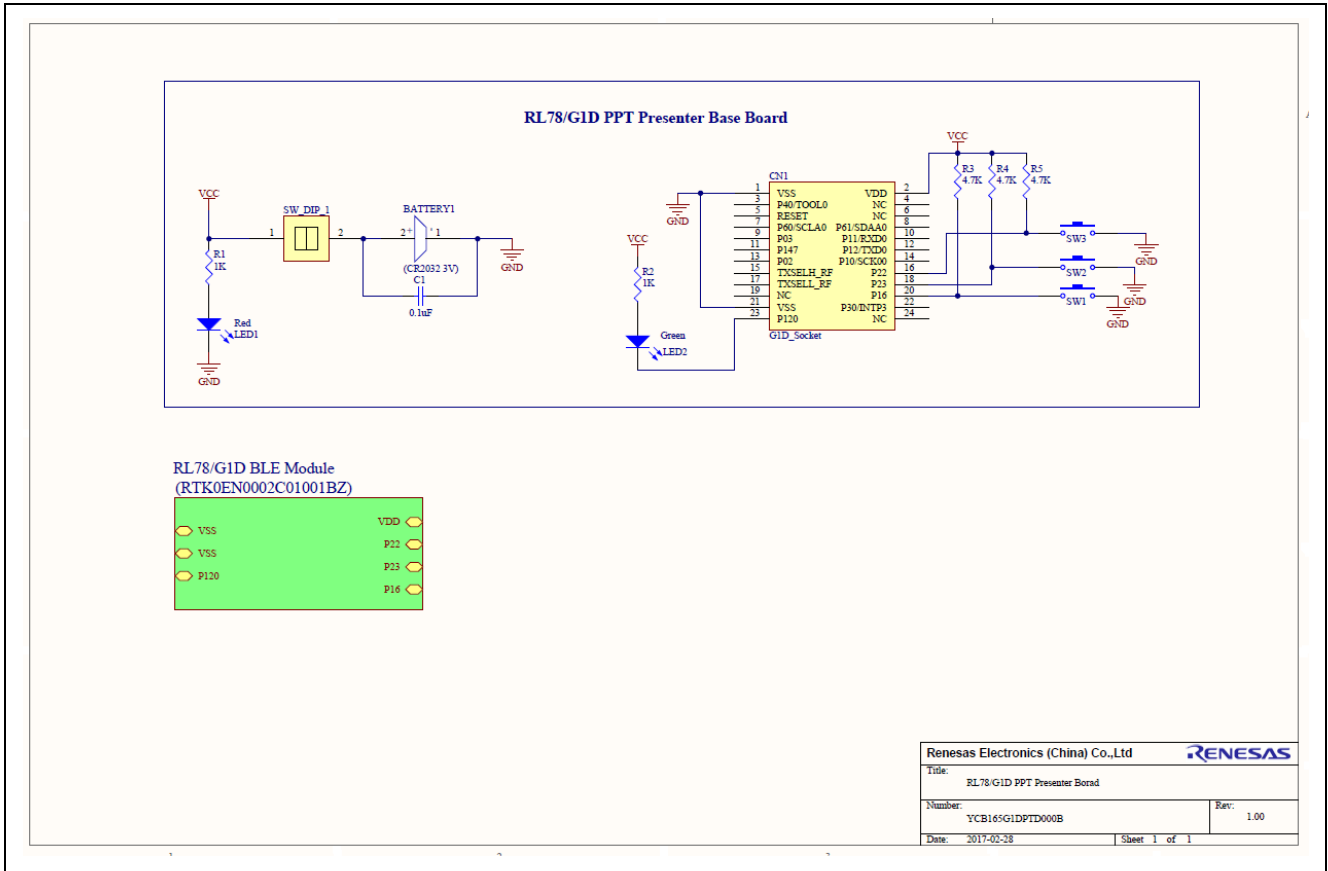


Figure 3.1 Schematic

### 3.2 PCB

Figure 3.2 shows the PCB of the PPT presenter.

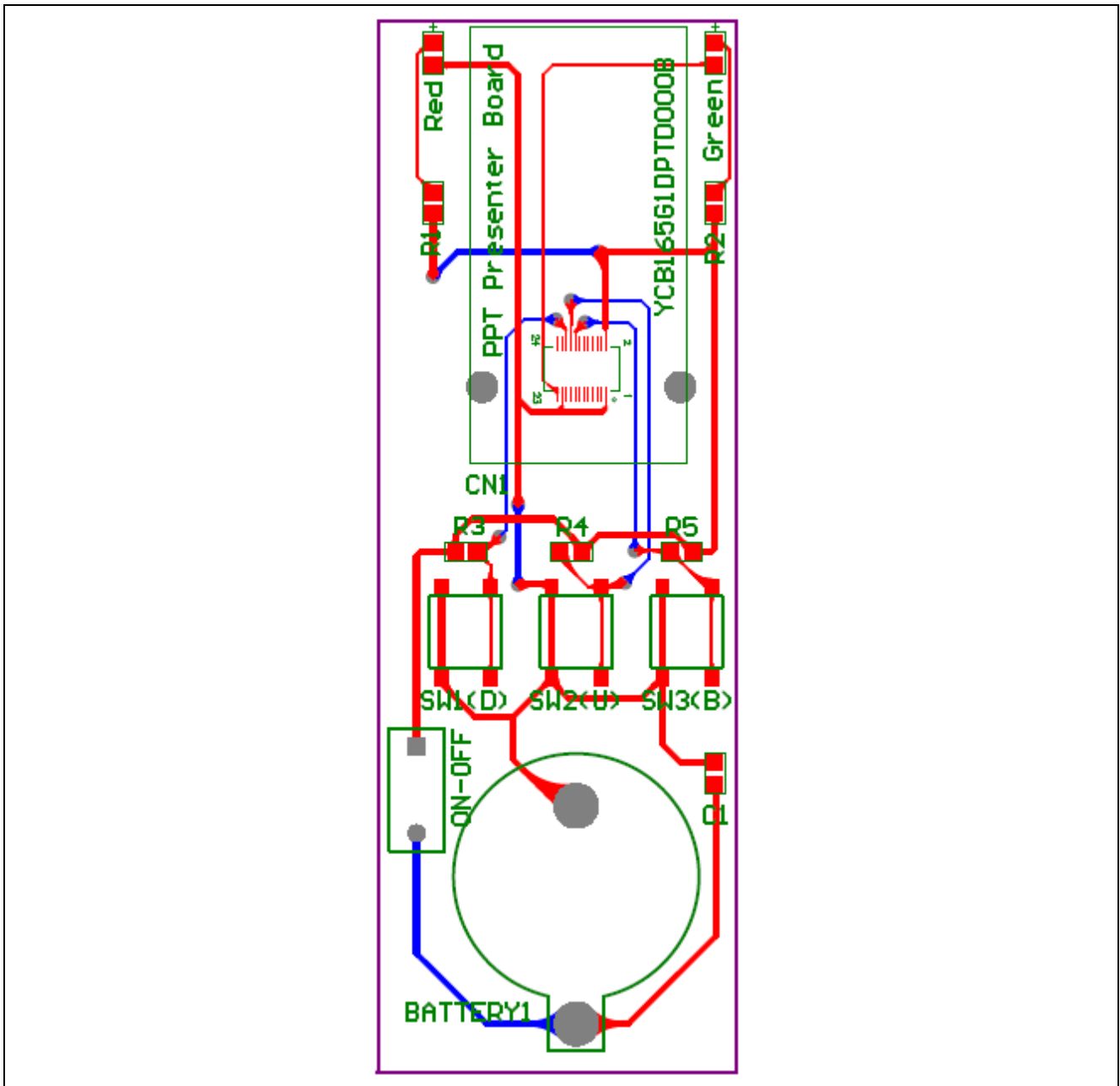


Figure 3.2 PCB

### 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	Battery 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.

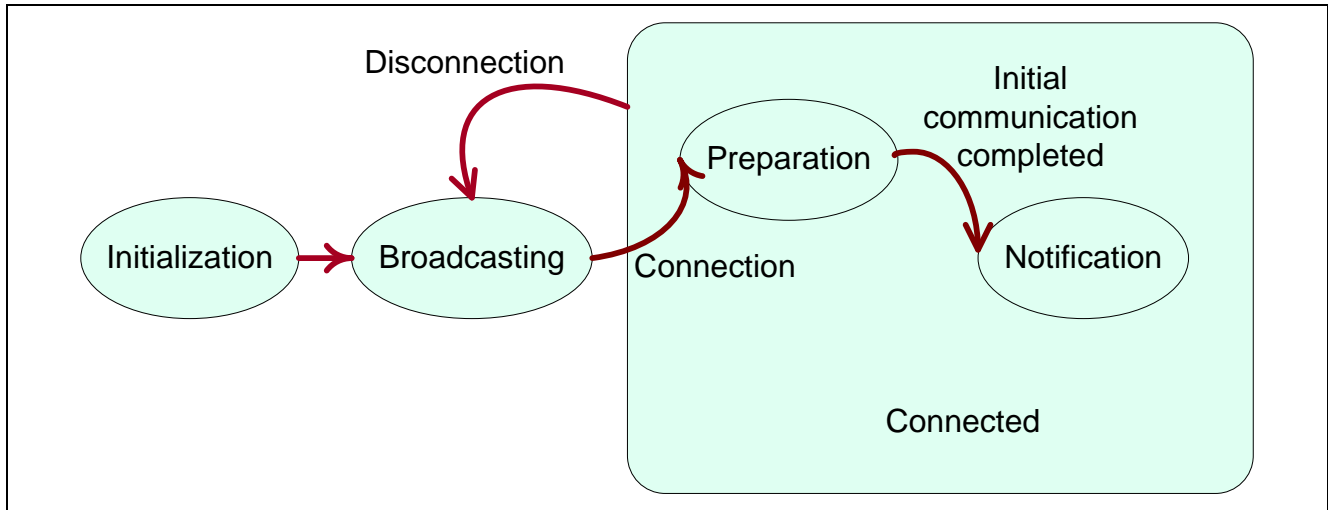


Figure 4.1 Tasks Transition Block Diagram

#### 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.

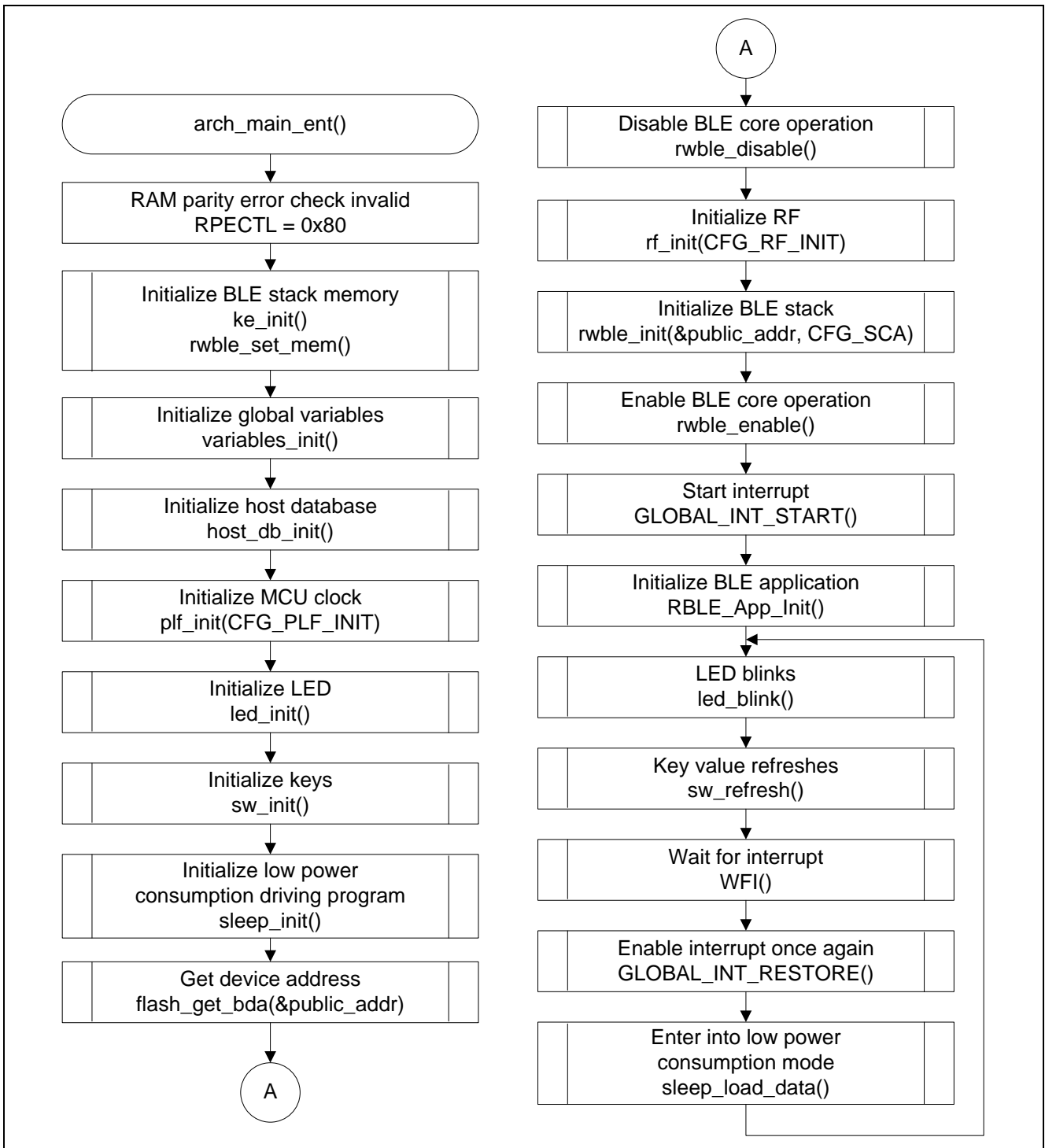


Figure 4.2 Main Processing

### 4.5.2 rBLE API Initialization Processing

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

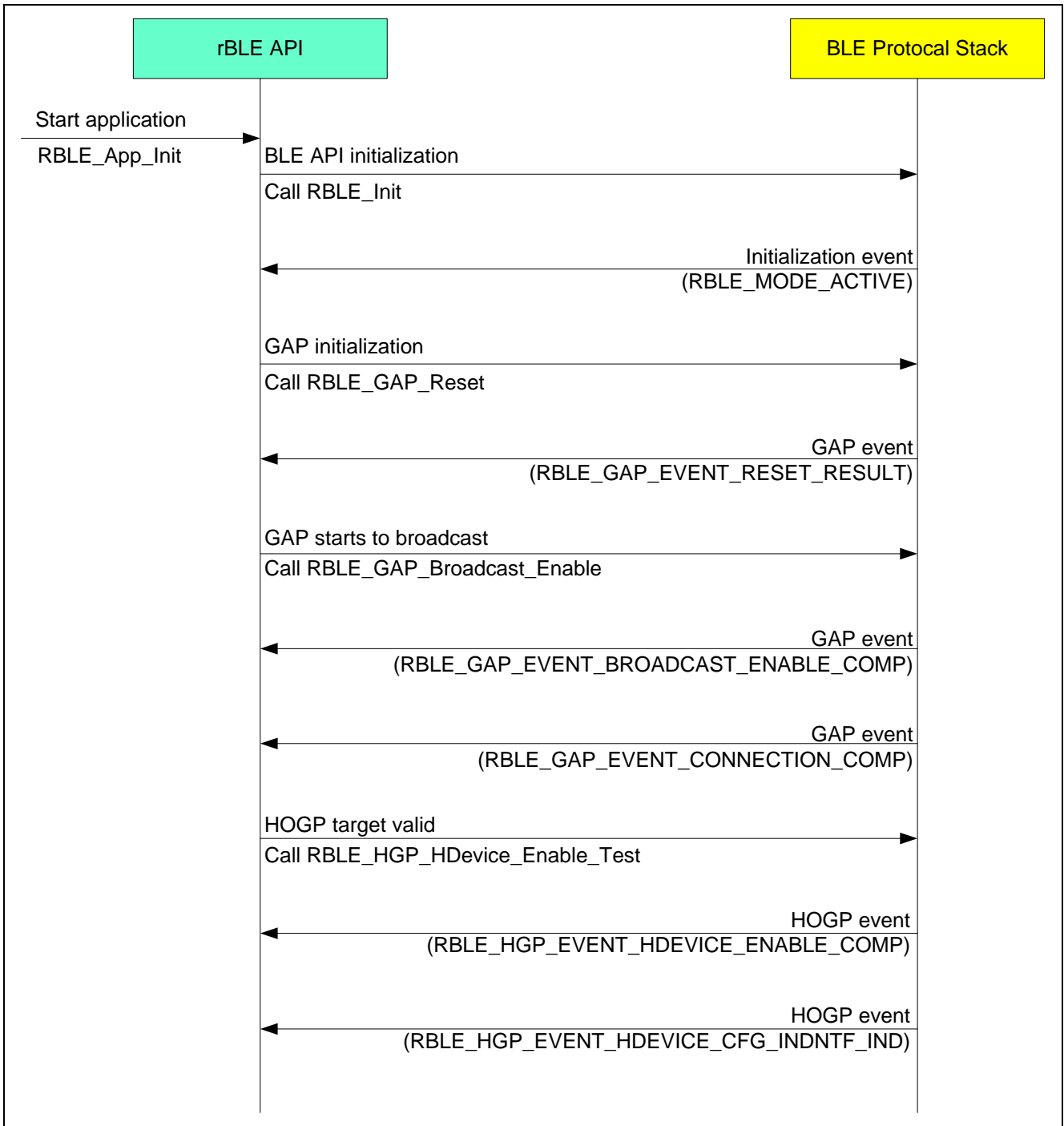


Figure 4.3 rBLE API Initialization Processing

### 4.5.3 Key Scanning Processing

Figure 4.4 shows the flowchart for the key scanning processing.

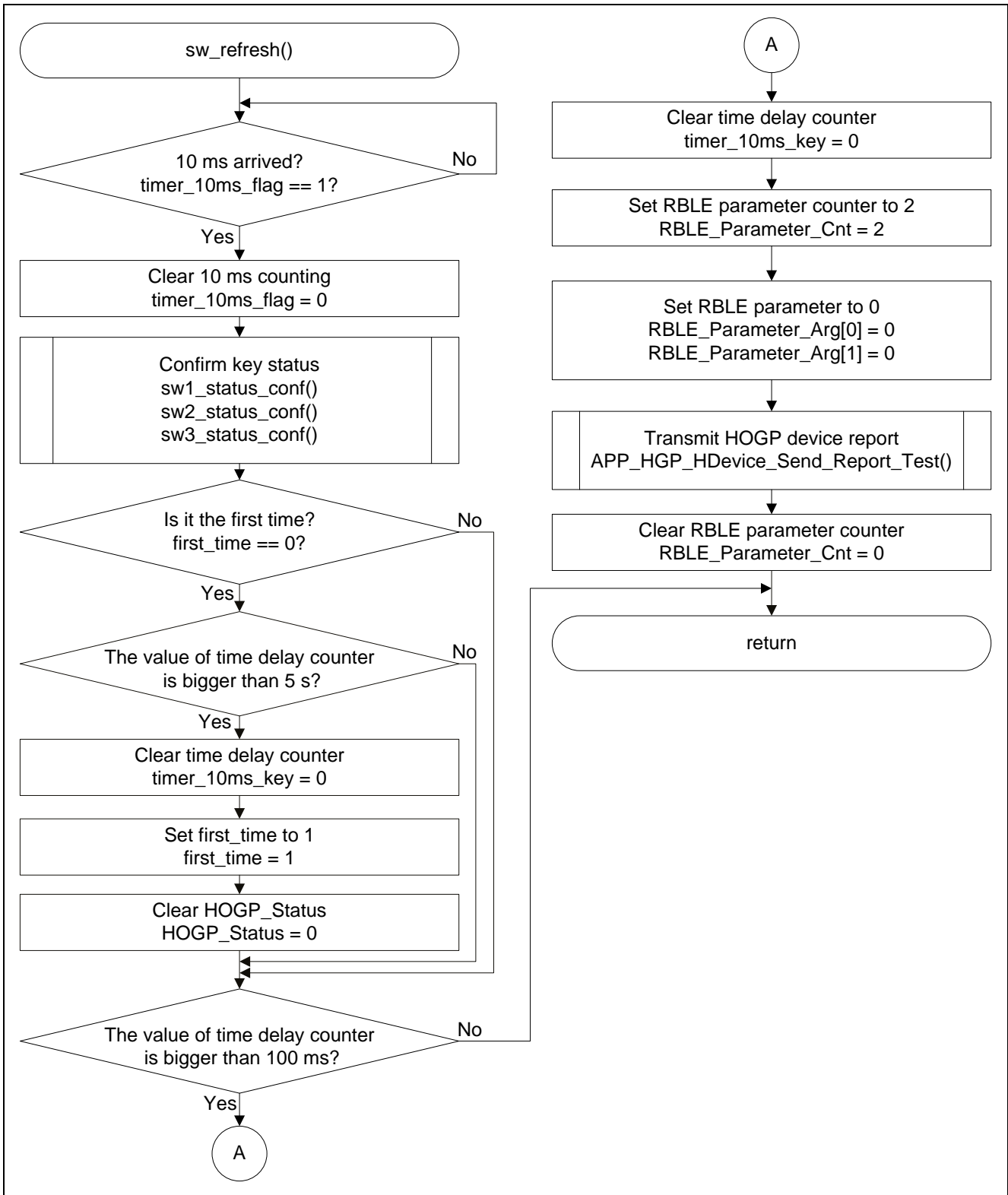


Figure 4.4 Key Scanning Processing

### 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.

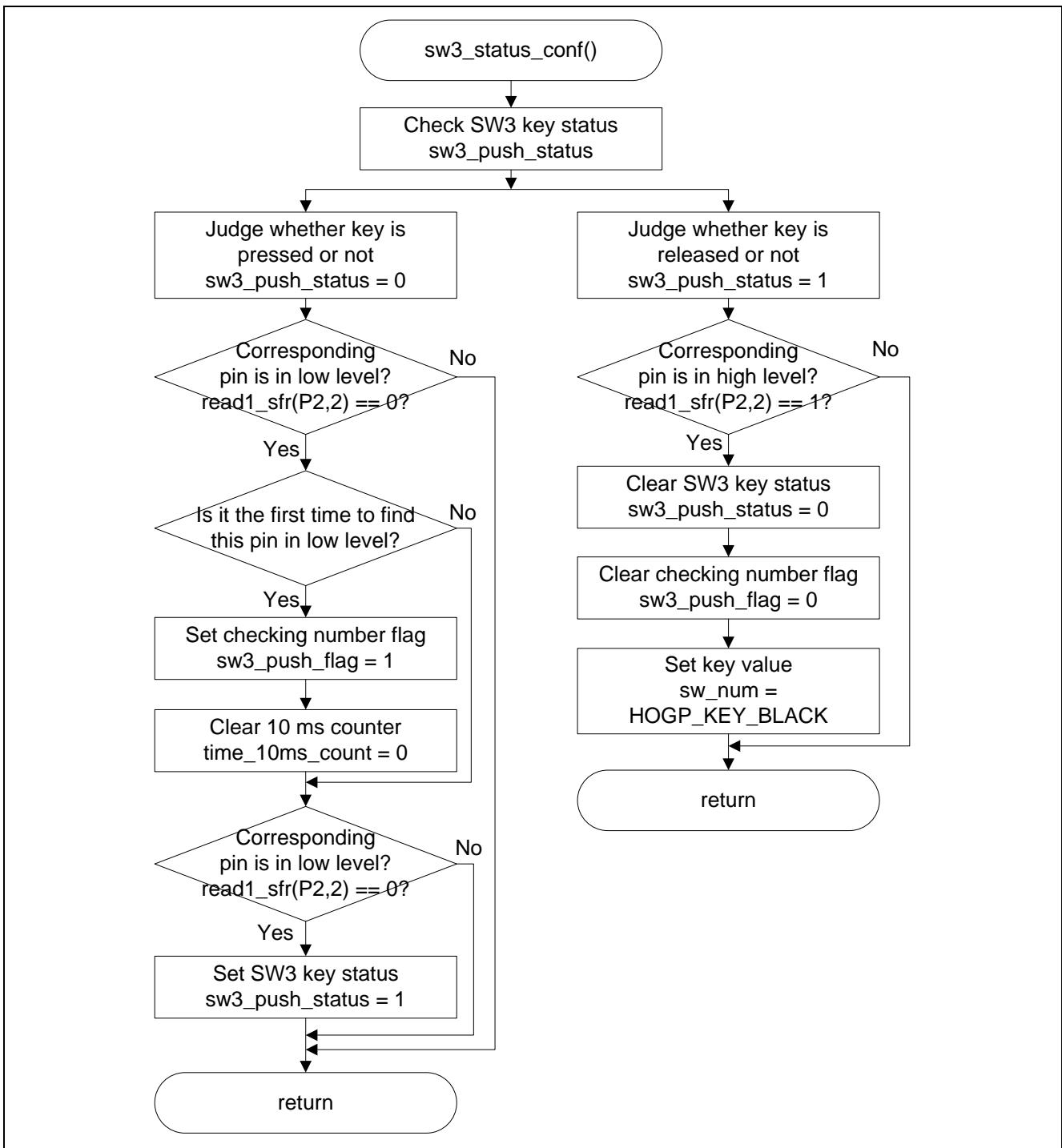


Figure 4.5 Key Status Confirmation Processing

## 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

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		<b>Page</b>	<b>Summary</b>
1.00	Mar. 31, 2017	—	First edition issued

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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.

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