RL78/G1D

LED Lighting

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Rev.1.10
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Introduction

This user's manual describes Renesas Bluetooth Low Energy (BLE) microcontroller RL78/G1D application on RGB LED control (for Android). Please refer to the following documents for the program structure and usage information on Bluetooth Low Energy RL78/G1D applications.

Document	Document No.
User's Manual	R01UW0095E
API Reference Manual Basic	R01UW0088E
Quick Start Guide	R01AN2767E
Embedded Configuration Sample Application	R01AN3319E
RL78/G1D applications to communicate with RenesasBLE	R01AN3017E

Target Device

RL78/G1D

Contents

1. Outline of System Function

1.1 Introduction of LED Lighting

To demonstrate the application, the BLE protocol stack library and application program are required to be written into RL78/G1D demo board, and install the appropriate APP to Android smartphone, to achieve the RGB LED control with smartphone APP through BLE function. The demo board is composed of main control board (RL78/G1D module (RTK0EN0002C01001BZ)) and peripheral board (power supply circuit, RGB LED driver circuit etc.). RL78/G1D module (RTK0EN0002C01001BZ) is in the RL78/G1D evaluation board (RTK0EN0001D01001BZ).

1.2 Introduction of Operation

(1) Install APP of this application into Android smartphone, the smartphone operating system requires more than Android 4.4.

(2) Power on RL78/G1D demo board, it will automatically enter the broadcast status, and wait for the client connection. BLE status indicator LED1 will blink.

(3) Open APP to scan RL78/G1D demo board, and then click for connection, BLE status indicator LED1 will light.

(4) After connection successfully, enter the RGB LED control interface, to achieve the RGB LED display control.

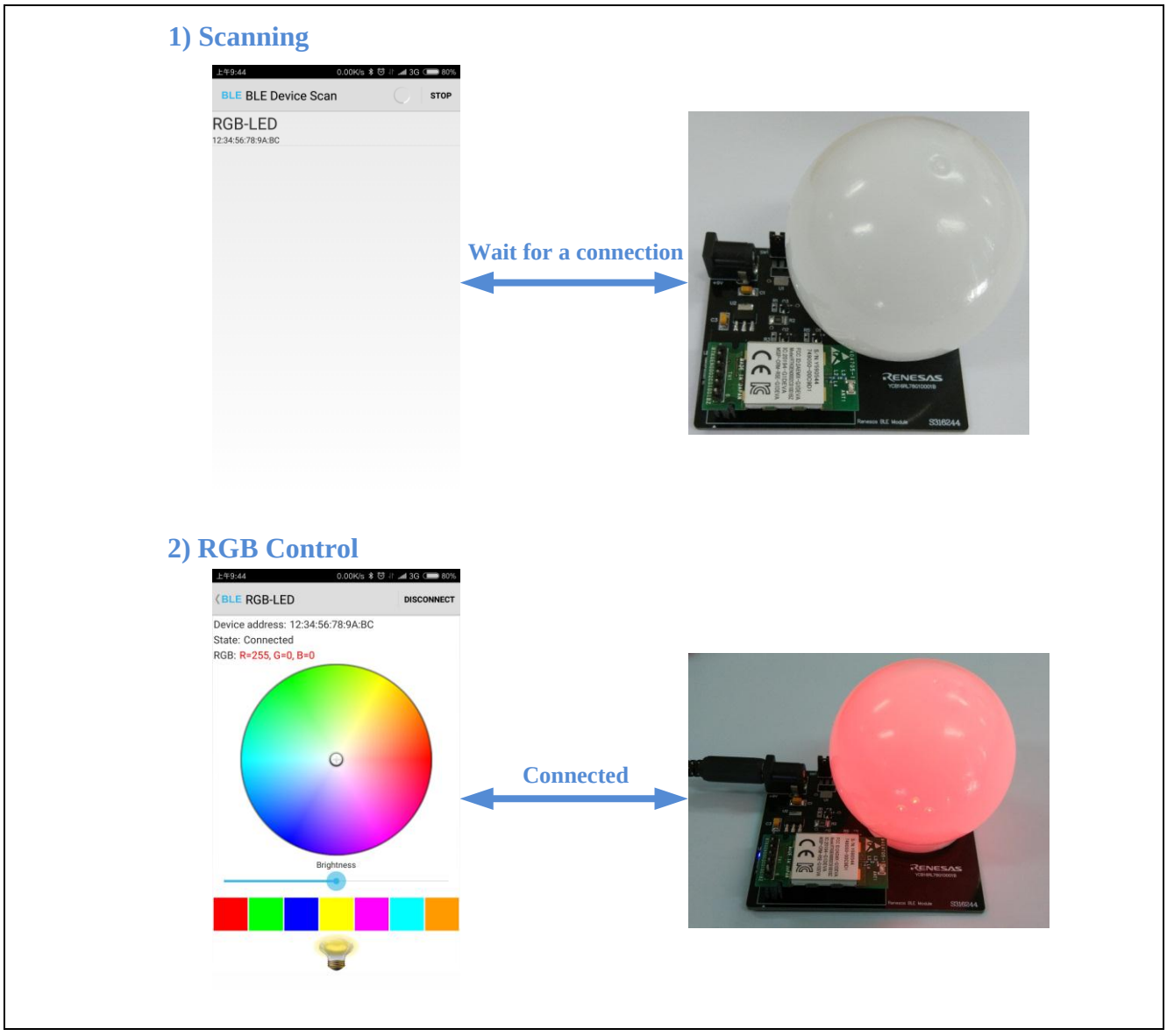

Figure 1.1 Operation Process

2. Introduction of Hardware

2.1 Introduction of PCB

The demo board of LED lighting is shown in Figure 2.1.

Figure 2.1 Demo Board of LED Lighting

2.2 Hardware Block Diagram

The hardware block diagram of LED lighting is shown in Figure 2.2.

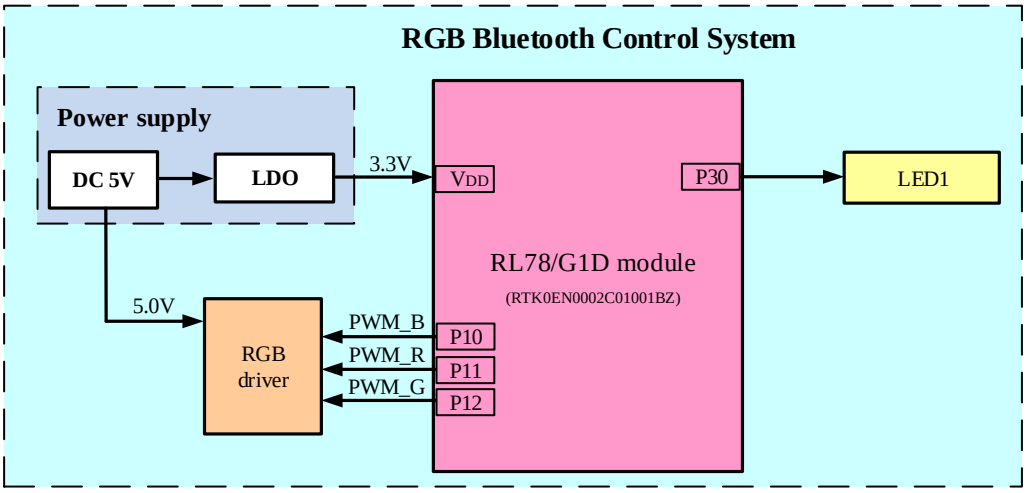

Figure 2.2 LED Lighting Hardware Block Diagram

2.3 Main MCU

The demo board of LED lighting uses RL78/G1D (R5F11AGJ) as main MCU. The Flash ROM size of RL78/G1D is 256 KB and the RAM size is 20 KB. The peripheral functions of RL78/G1D and their applications are shown in Table 2.1.

Table 2.1 Peripheral Functions and Their Applications

Peripheral functions	Usage
Channel 0 of TAU0	10ms timer
Channel 4 of TAU0	PWM function, used as master channel
Channel 5-7 of TAU0	PWM output function, used as slave channel
P10	RGB LED driver control port: B
P11	RGB LED driver control port: R
P12	RGB LED driver control port: G
P30	BLE status indicator LED
Bluetooth Low Energy (BLE) function	Refer to User's Manual (R01UW0095E)

The circuit board of RL78/G1D module (RTK0EN0002C01001BZ in the RTK0EN0001D01001BZ) is shown in Figure 2.3.

Figure 2.3 Circuit Board of RL78/G1D Module

The interface control circuit of RL78/G1D module (RTK0EN0002C01001BZ in the RTK0EN0001D01001BZ) is shown in Figure 2.4.

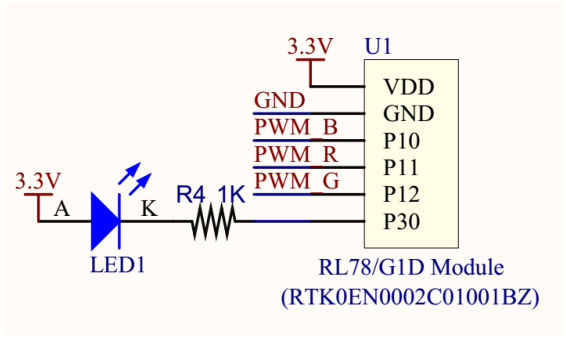

Figure 2.4 Interface Control Circuit of RL78/G1D Module

2.4 Power Supply Circuit

The power section needs to connect with external 5V DC, then gets stable 3.3V for power supply through AMS1117.

The power supply circuit is shown in Figure 2.5.

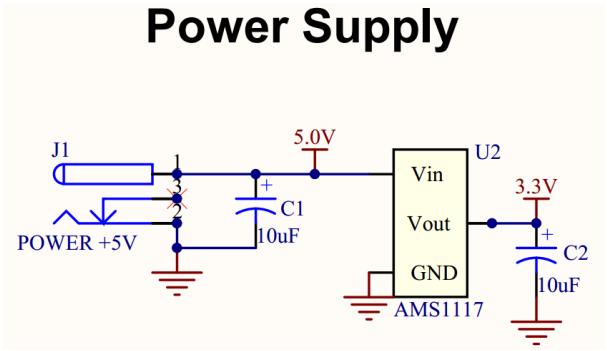

Figure 2.5 Power Supply Circuit

2.5 RGB LED Driver Circuit

The RGB LED driver circuit is achieved through 3 channels transistor (S8050), with 4 sets of RGB LED connected in parallel to increase the brightness. For the choice of resistance, please refer to the photoelectric parameters of RGB LED.

The RGB LED driver circuit is shown in Figure 2.6.

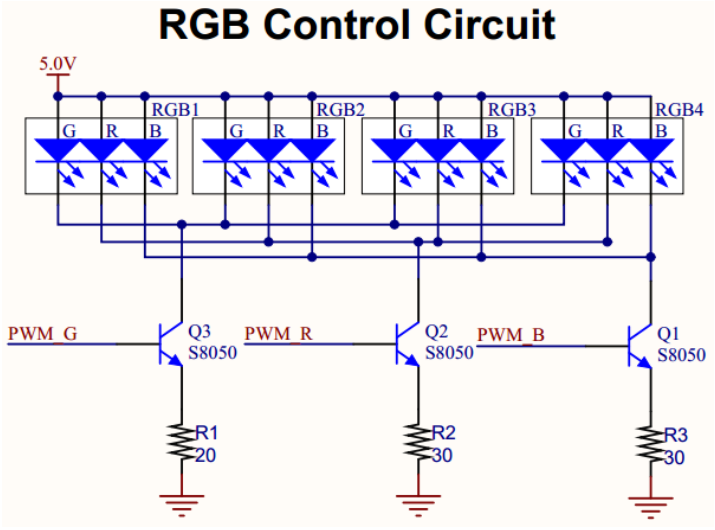

Figure 2.6 RGB LED Driver Circuit

3. Schematic, PCB and Bill of Materials

3.1 Schematic

The schematic of LED lighting is shown in Figure 3.1.

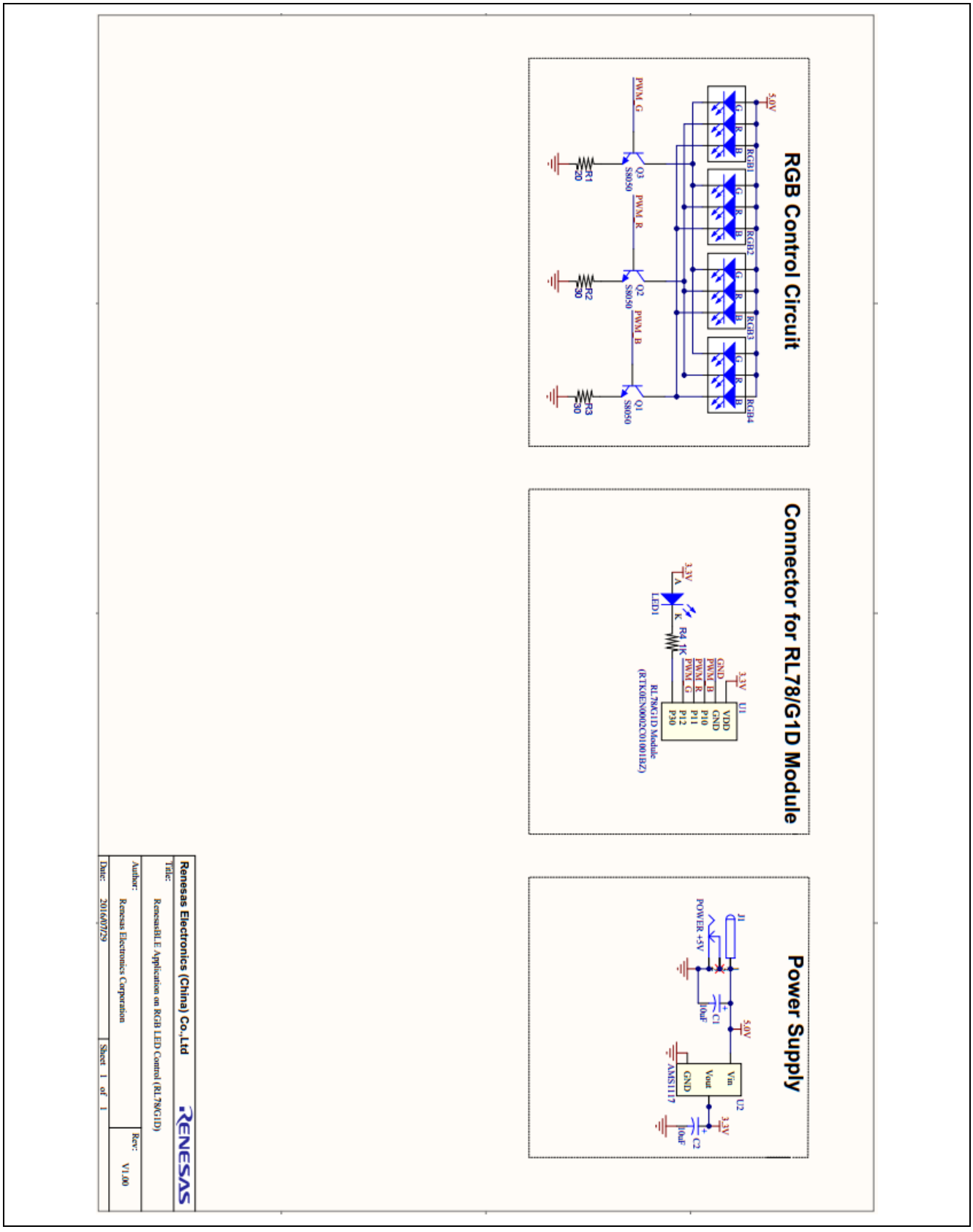

Figure 3.1 Schematic

3.2 PCB

The PCB of LED lighting is shown in Figure 3.2.

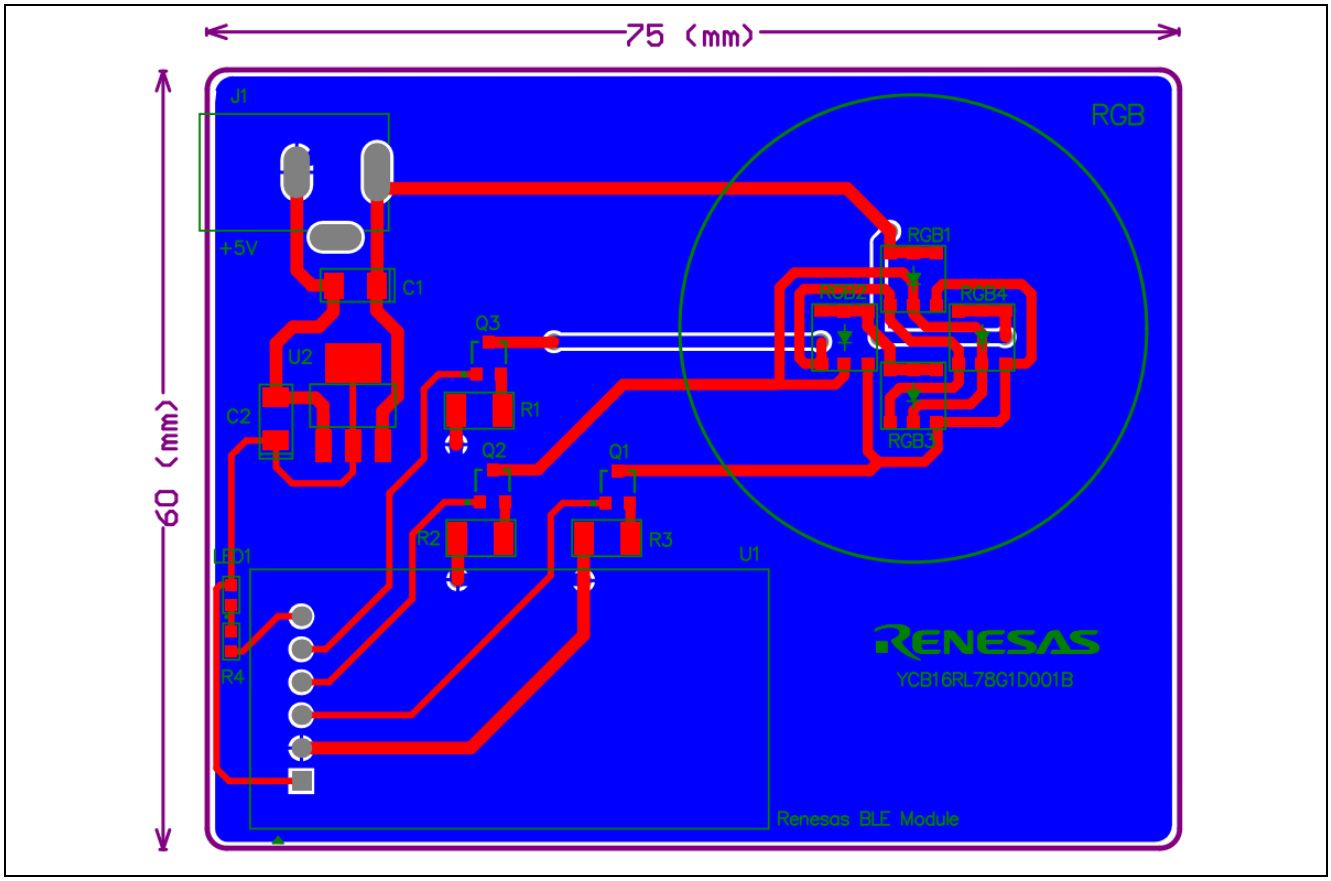

Figure 3.2 PCB

3.3 Bill of Materials

The bill of materials of LED lighting is shown in Table 3.1.

Table 3.1 Bill of Materials

Identifier	Comment	Package	Quantity
C1, C2	10uF	E10UF	2
R1	20	1210	1
R2, R3	30	1210	2
R4	1K	0603	1
LED1	LED	0603	1
POWER +5V	J1	POWER IN	1
Q1, Q2, Q3	S8050	SOT-23B	3
RGB1, RGB2, RGB3, RGB4	RGB 5050	RGB	4
U1	RTK0EN0002C01001BZ	G1D Module - 6PIN	1
U2	AMS1117	SOT-223	1

4. Introduction of Software

4.1 Integrated Development Environment

The integrated development environment of LED lighting is shown in Table 4.1 and Table 4.2.

Table 4.1 Integrated Development Environments for CS+ CC

Item	Contents
Integrated development environment	CS+ for CC V4.00.00 (Renesas Electronics Corporation)
C complier	CC-RL V1.03.00 (Renesas Electronics Corporation)
Debugger	E1 (Renesas Electronics Corporation)

Table 4.2 Integrated Development Environments for E2 Studio

Item	Contents
Integrated development environment	E2 studio V5.0.0.043 (Renesas Electronics Corporation)
C complier	CC-RL V1.03.00 (Renesas Electronics Corporation)
Debugger	E1 (Renesas Electronics Corporation)

4.2 List of Option Byte Setting

The option byte setting of LED lighting is shown in Table 4.3.

Table 4.3 Option Byte Setting

Address	Setting	Description
000C0H/010C0H	11101110B	Watchdog timer operation is stopped (count is stopped after reset)
000C1H/010C1H	11111111B	LVD: closed
000C2H/010C2H	10101010B	HOCO: 8 MHz, operation voltage range: 1.8 V~3.6 V
000C3H/010C3H	10000101B	On-chip debugging is enabled.

4.3 Installation Procedure

Followings are necessary to build the sample application.

Download the BLE protocol stack and EEPROM Emulation Library corresponding to your development environment from Renesas website and copy to the following folder.

(1) BLE protocol stack (ver.1.20)

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

(Destination folder)\renesas\lib

(2) EEPROM emulation library for CC-RL/e2 studio(CC-RL)

https://www.renesas.com/en-us/software/D3017960.html

(Destination folder)\renesas\src\driver\dataflash\cc_rl

- eel.h
- eel.lib
- eel_types.h
- fdl.h
- fdl.lib
- fdl_types.h

4.4 Flow Chart

4.4.1 Flow Chart of Firmware Main Program

The flow chart of firmware main program is shown in Figure 4.1.

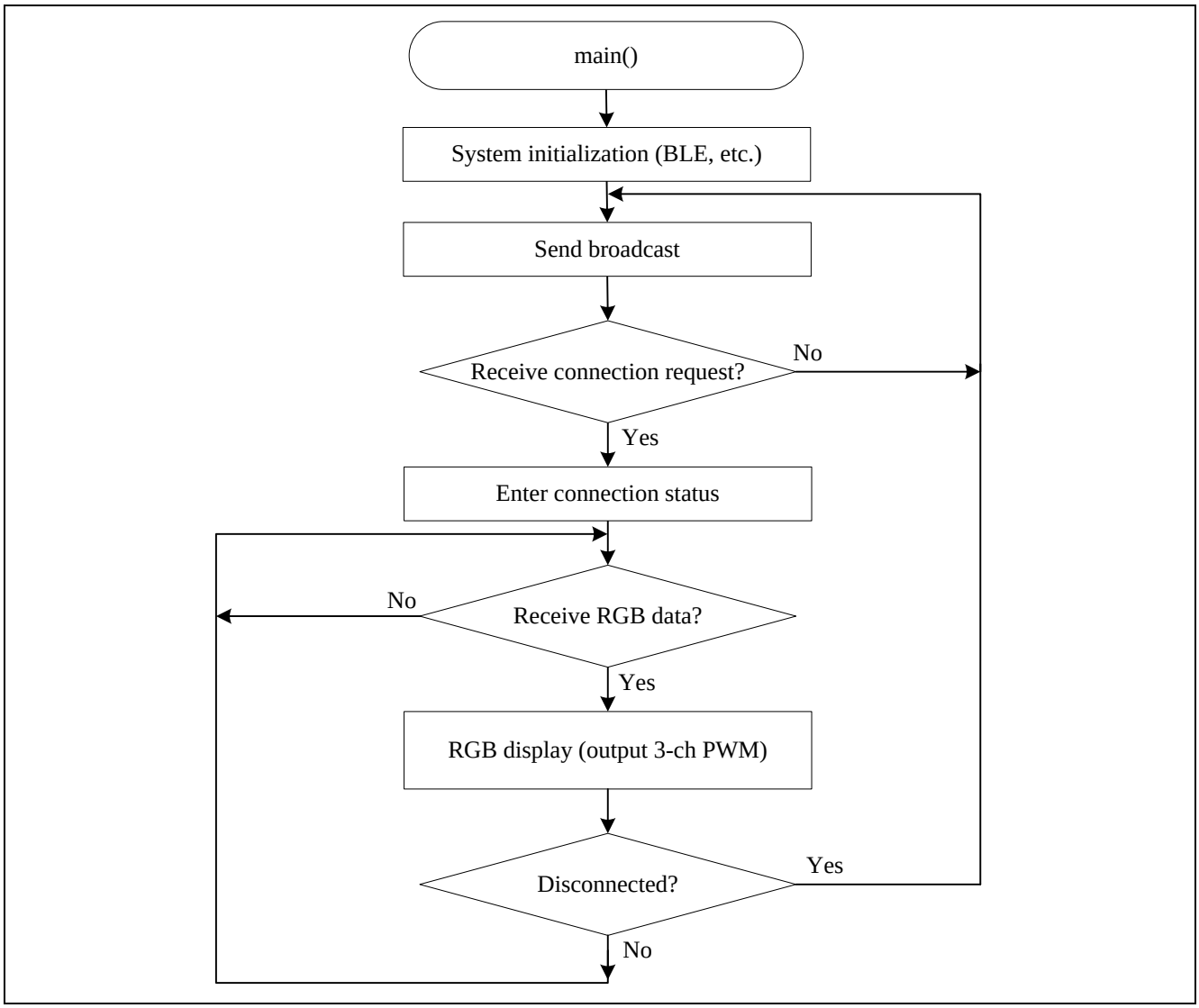

Figure 4.1 Flow Chart of Firmware Main Program

4.4.2 Flow Chart of Smartphone APP

The flow chart of smartphone APP is shown in Figure 4.2.

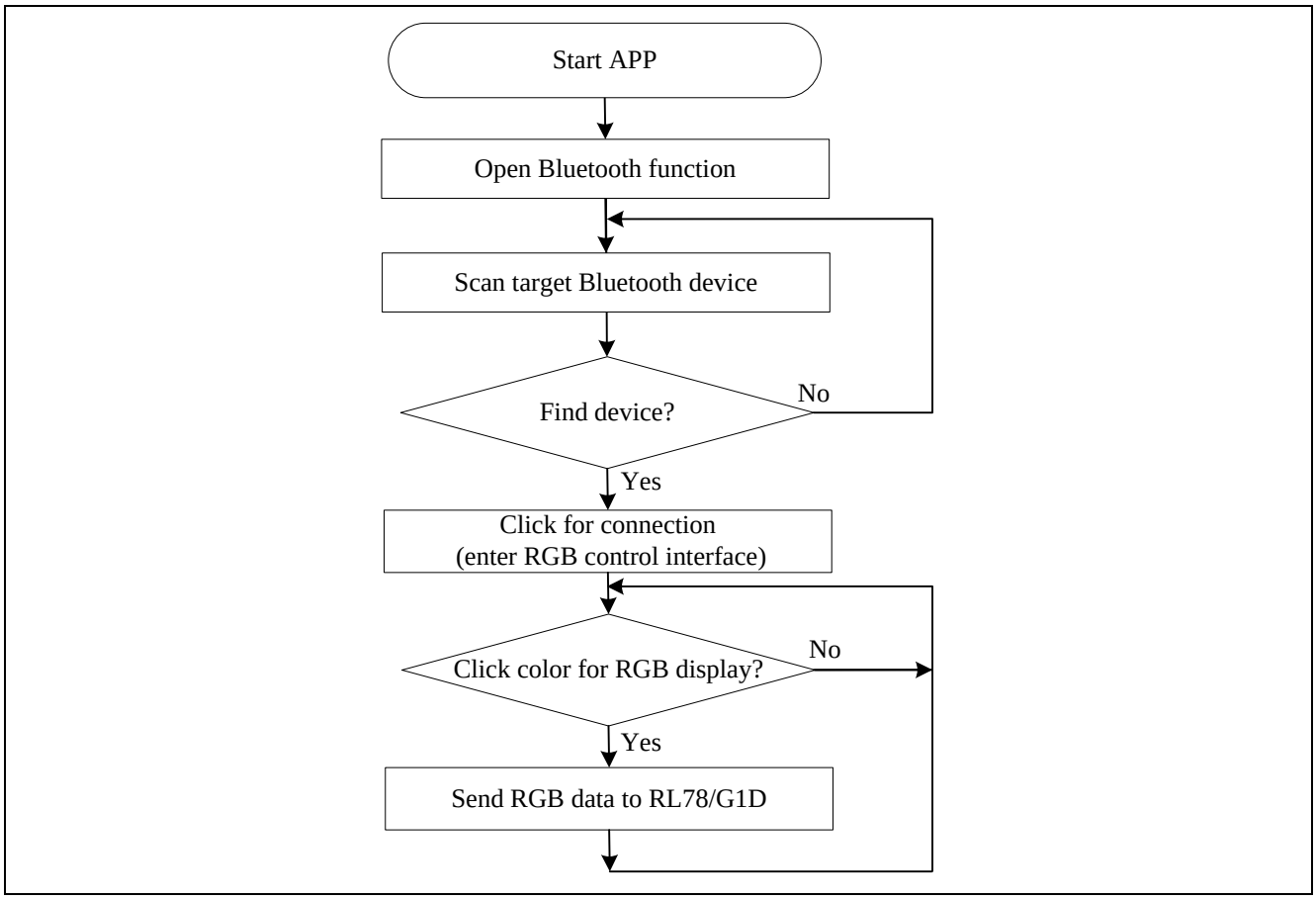

Figure 4.2 Flow Chart of Smartphone APP

5. Sample Code

The sample code is available on the Renesas Electronics Website.

6. Reference Documents

User's Manual

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.

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Feb.23.2017	-	First edition issued
1.10	Aug.23.2017	6-7	Changed the resistor R1 from 30 to 20, R2 from 20 to 30 in schematic
1.10	Aug.23.2017	9	Changed the resistor R1 from 30 to 20, R2 from 20 to 30
1.10	Aug.23.2017	9	Changed the capacitance of C1 and C2 from 1uF to 10uF
1.10	Aug.23.2017	10-11	Changed integrated development environments to CS+ CC and E2 studio.

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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.

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