MB39C601 LED LIGHTING SYSTEM
BULB 9W
ZIGBEE CONTROL

USER MANUAL

FUJITSU

Revision History

Version	Date	Updated by	Approved by	Modifications
1.0.0	2012-8-17	Denny Deng		First Draft

This manual contains 23 pages.

Contents

1 Introduction

1.1 Purpose

This user manual describes flash operation about LED Driver solution. This can light the LED, when the LED load is connected with the output and the AC source is impressed to the input. LED load: 350mA / 6-10 pieces in series.

1.2 Reference Documents

MB39C601-EVB-04_E1.0;

MB39C601_PO_E0.1.pdf.

2 Overview and Features

Overview and Features of System

2.1 Overview

The LED Driver use MB39C601 as controller IC. And MB39C601 is a flyback type switching regulator controller IC. The LED current is regulated by controlling the switching on-time or controlling the switching frequency, depending on the LED load. It is most suitable for the general lighting applications, for example residencial LED lighting.

The MB95560H is general-purpose, single-chip microcontrollers. In addition to a compact instruction set, the microcontrollers of these series contain a variety of peripheral resources.

2.2 Features

MB39C601:
・High power factor in Single Conversion
・High Efficiency
・High Performance flyback converter.
・Worldwide AC input (85V-265V) and use Zigbee module as dimmer
・Low EMI switching topology
・Suitable for LED lighting application (6W-15W).
・Built-in under voltage lock out function
・Built-in over load protection function
・Built-in over voltage protection function
・Built-in over temperature protection function

MB95560H:
・F2MC-8FX CPU core
・Clock
・Timer
・LIN-UART
・External interrupt
・8/10-bit A/D converter
・Low power consumption (standby) modes
・I/O port
・On-chip debug
・Hardware/software watchdog timer
・Power-on reset
・Low-voltage detection reset circuit
・Clock supervisor counter
・Dual operation Flash memory
・Flash memory security function

3 System Installation

Block and Connection of System

3.1 System Block
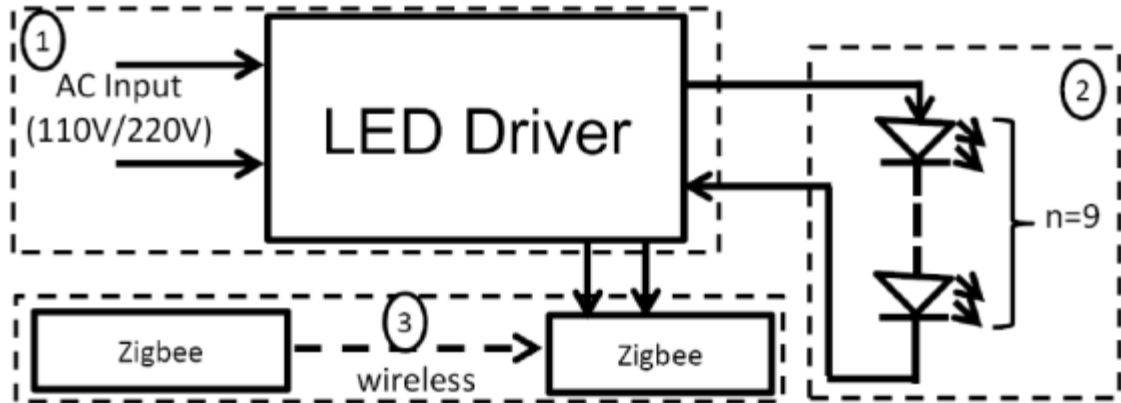
Remark: ①Power Box module-input AC110V/220V
②Lamp module-The LEDs are in the lamp
③Zigbee module-Zigbee Controller and receiver

Figure 3-1: System Block Diagram

Figure 3-2: Connection of the Boards

This demo system is made up with two daughter board. They are:

- Power Box Module

  This module contains electrical outlet, bulb holder and ON/OFF switch. Electrical outlet is the input of 110V AC/220V AC, and the lighting bulb is put in the bulb holder.

When the power on, using ON/OFF switch can turn on or off the lighting bulb. The detail is shown in figure 3-3.
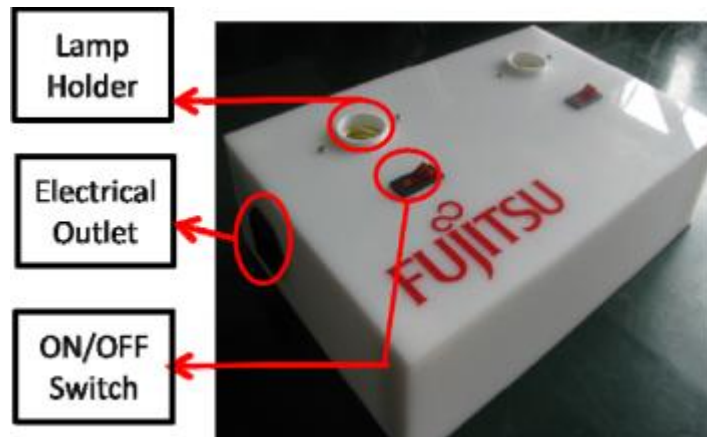
Figure 3-3: Power Box Module

- Lighting bulb Module

  The LED Driver Board is put in lighting bulb. It has two connectors, one is for PWM of Zigbee, and the other is for the loading. The details are shown in figure 3-4 (a) and (b) .
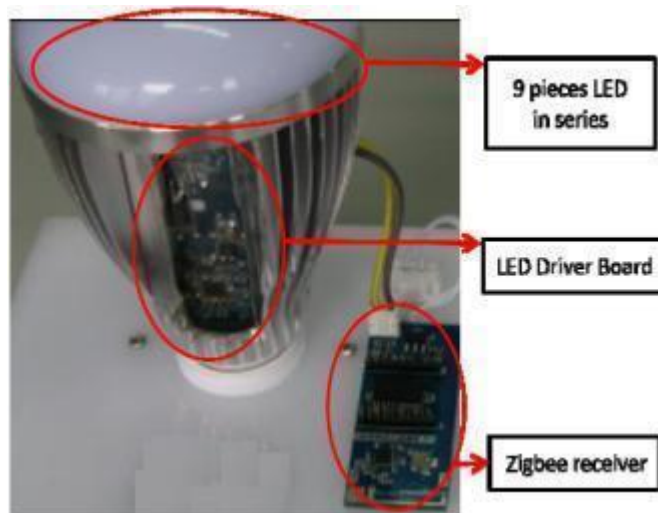
Figure 3-4: Lighting bulb Module (a)
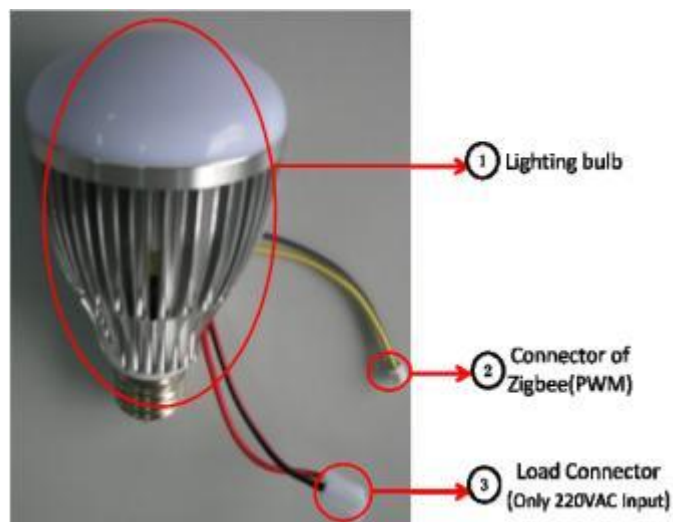
Figure 3-4: Lighting bulb Module (b)

- Zigbee Module

  This module contains zigbee remote controller and receiver. But the zigbee receiver is connected to lighting bulb. The remote controller sends command to receiver with wireless. The detail is shown in figure 3-5.
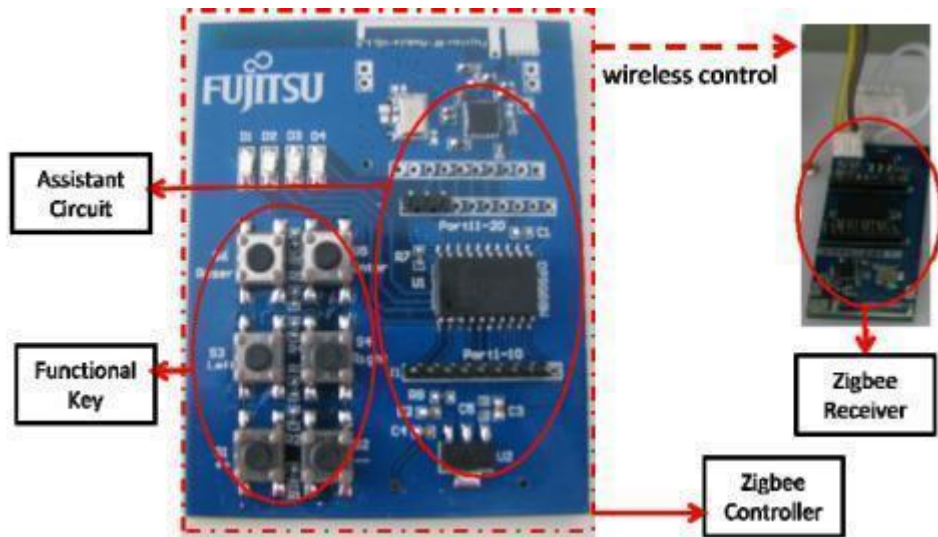
Figure 3-5: Zigbee Module

Zigbee remote controller is powered by 3 cells bailing, which is shown in figure 3-6.
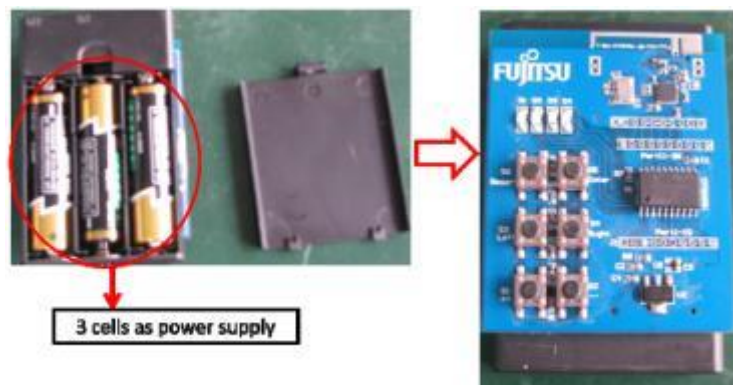
Figure 3-6: Power of Zigbee remote controller

The description of each part of zigbee remote controller is shown in figure 3-7. And the function descriptions of the controller are shown in the following table.
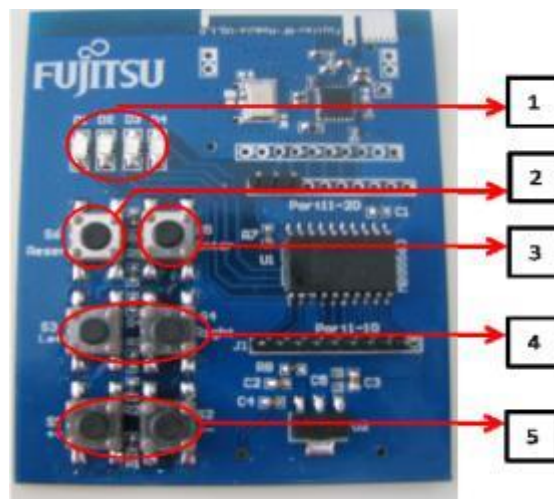
Figure 3-7: Zigbee remote controller description

Number	Port Designator	Description
1	D1-D4	Which LED lighting means that the corresponding bulb is lighting
2	S6	The key is not defined
3	S5	It means all lighting bulbs are chosen or not
4	S3-S4	With the "Left" and "Right" key, you can chose which bulb is lighting
5	S1-S2	Press the "++" or "--" key, you can control the bulb brighter or darker

3.2 System Connection

3.2.1 Step 1

Connect zigbee receiver to the power box, shown in figure 3-8.
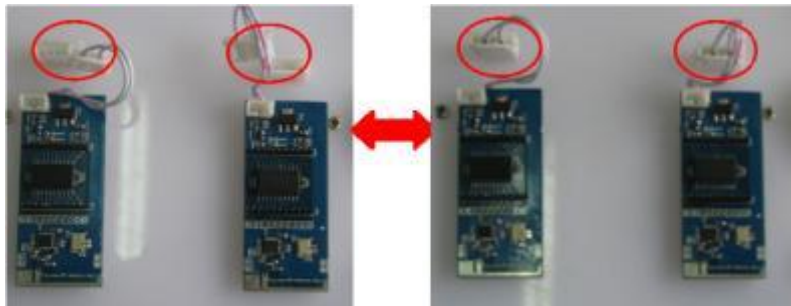
Figure 3-8: step 1- Connect zigbee receiver

3.2.2 Step 2

Install the lighting bulb on the box, and it is shown in figure 3-9.
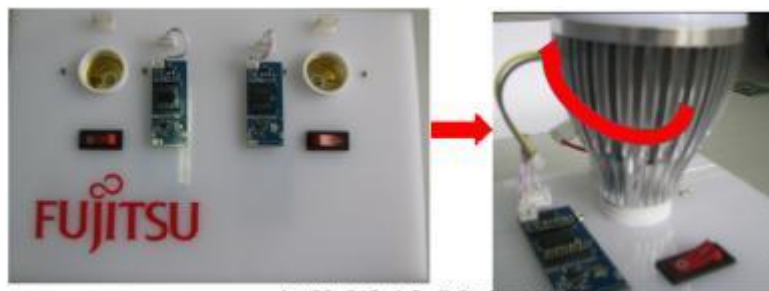
Install the lighting bulb with the shown direction

Figure 3-9: step 2-Install lighting bulb

And the completed state of installing is shown in figure 3-10.

Figure 3-10: step 2-Install lighting bulb (completed)

3.2.3 Step 3

Connect lighting bulb to zigbee receiver and load. See it in figure 3-11.
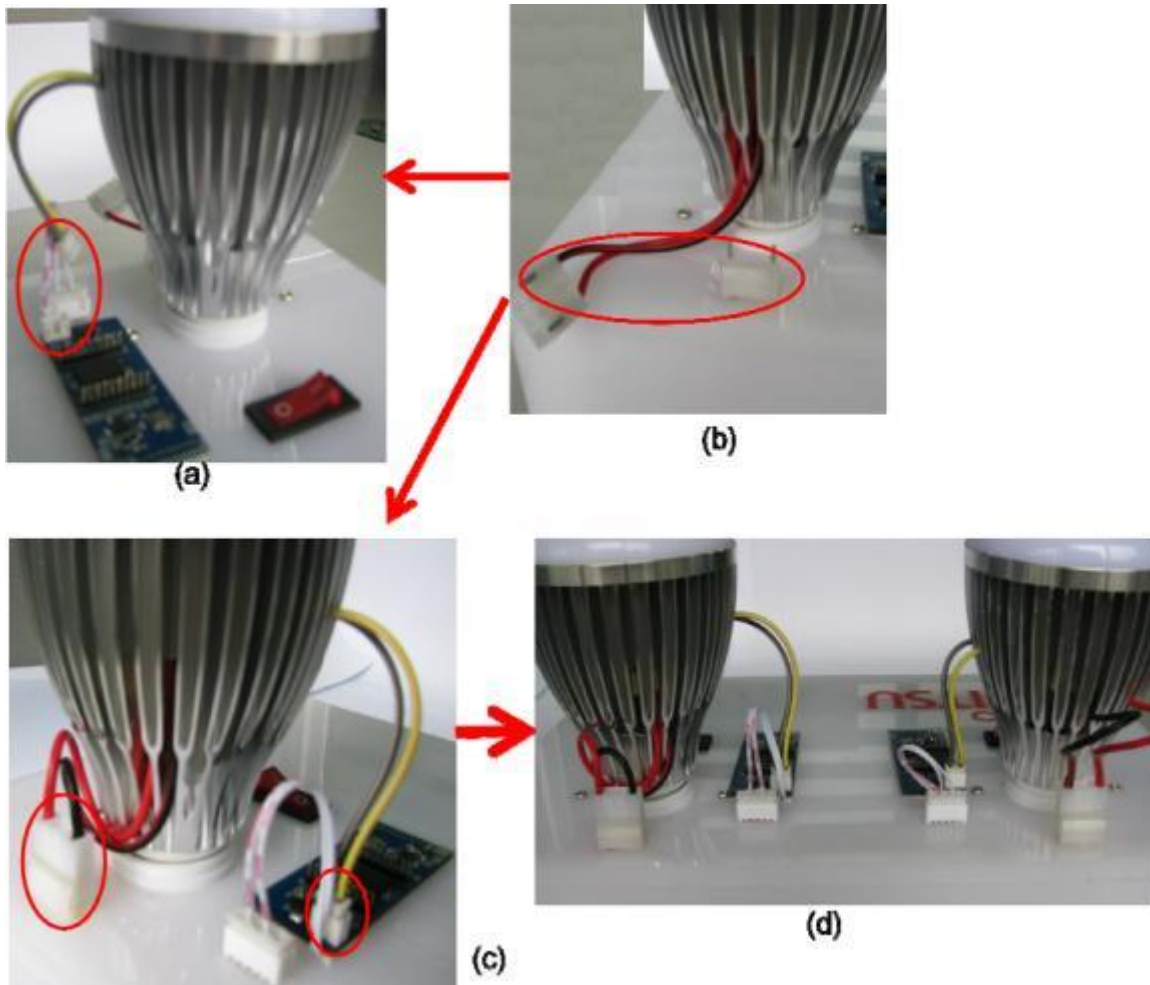
Figure 3-11: step 3-connect zigbee receiver and load

And for step 3, these operations are only for 110VAC input. But for 220VAC input, you needn't connect lighting bulb to load. The step 3 (b) can be ignored.

3.2.4 Step 4

Connect the power wire to the electrical outlet as shown in figure 3-12.
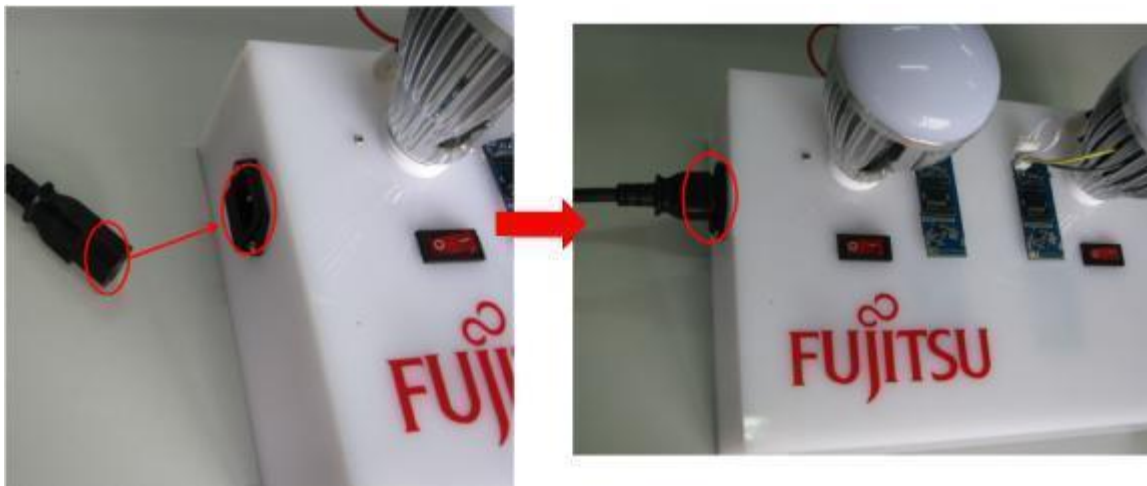
Figure 3-12: step 4-Connect power supply wire

4 Operation Description

Introduce operation about each module

4.1 Power On

We can give 110V/220V AC at the electrical outlet of power box module. Take 220VAC /60Hz for example. When press the power key shown in figure 4-1.

Figure 4-1: Power on

When we turn the left switch "ON", the first bulb is lighting. See it in figure 4-2. And then when we do the same operation for the right switch, the second bulb is lighting too. So when turn on the zigbee remote controller, we can control the lighting bulb with wireless.

Figure 4-2: Lighting bulb lighting

4.2   Bulb lighting

Give 220VAC to the system, and turn the Left switch "ON", the first bulb is lighting. See it in figure 4-3(a). And when we turn the other switch "ON", the secnond bulb is lighting too, see it in figure 4-3(b).
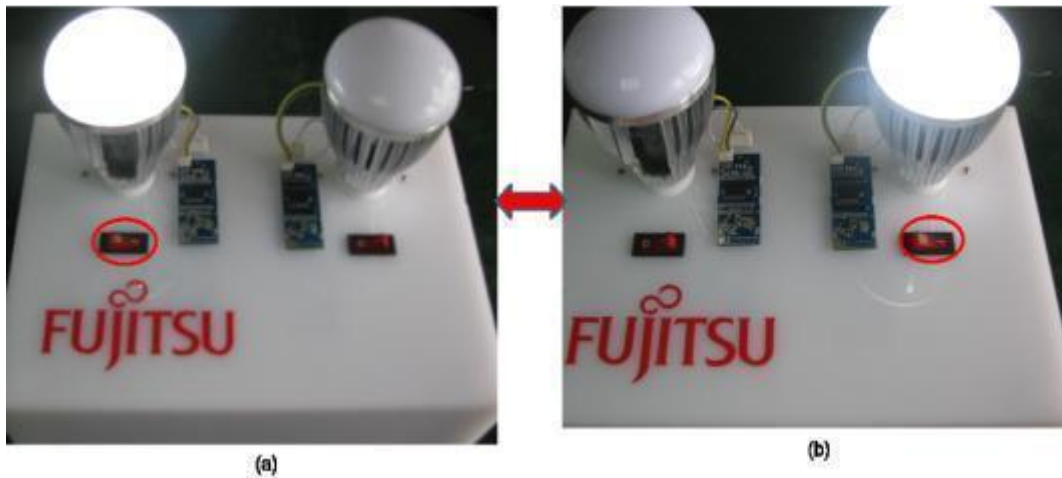
Figure 4-3: one bulb lighting

When we turn the both switches "ON", the both bulbs are lighting. Please see it in figure 4-4.

Figure 4-4: both bulbs lighting

4.3   Zigbee Controlling

Turn on zigbee remote controller. It is shown in figure 4-5. Then we can control the lighting bulb, making it brighter or darker.

Figure 4-5: turn on controller

It is set 7 levels from the darkest to brightest. And the levels can be changed by user with using softune, which is our MCU development tool.

Make switch "ON" and make bulbs keeping the lighting state. Turn on the remote controller, then D1 is turn on (it is defaulted when turn on the remote controller). It means the first bulb is chosen and it can be controlled by the remote controller.

When press the "++" key, the chosen lighting bulb becomes bright. If we press the key again, it changes brighter than before. When press the "--" key, the chosen lighting bulb becomes dark. If we press the key again, it changes darker than before. The detail is shown in figure 4-6.
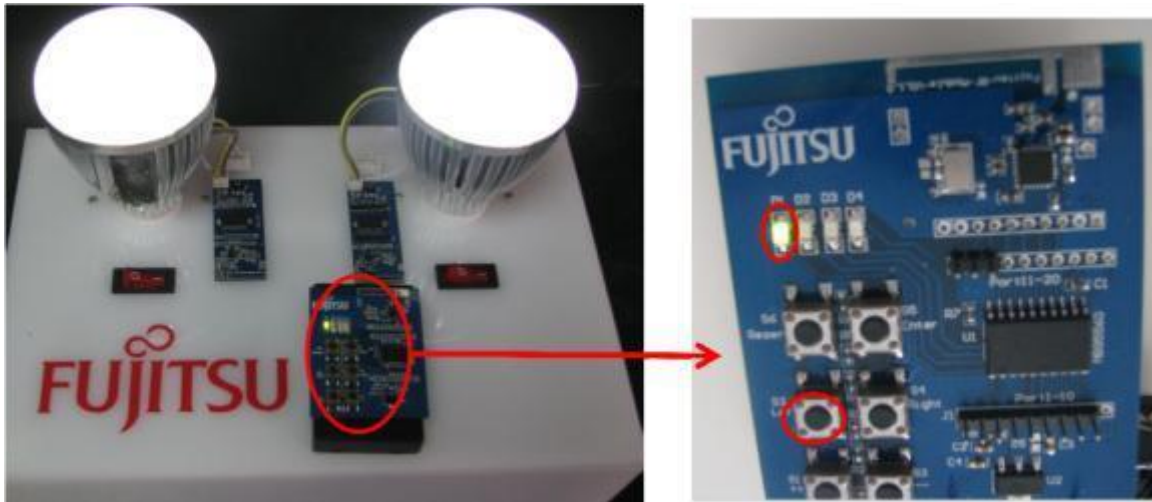
Figure 4-6: first bulb lighting with "Left" key

If keeping the first lighting bulb in one state, we chose the second lighting bulb. Press the "Right" key, D2 is turn on. It means the second bulb is chosen and it can be controlled by the remote controller.

When press the "++" key, the chosen lighting bulb becomes bright. If we press the key again, it changes brighter than before. When press the "--" key, the chosen lighting bulb becomes dark. If we press the key again, it changes darker than before. See the detail in figure 4-7.
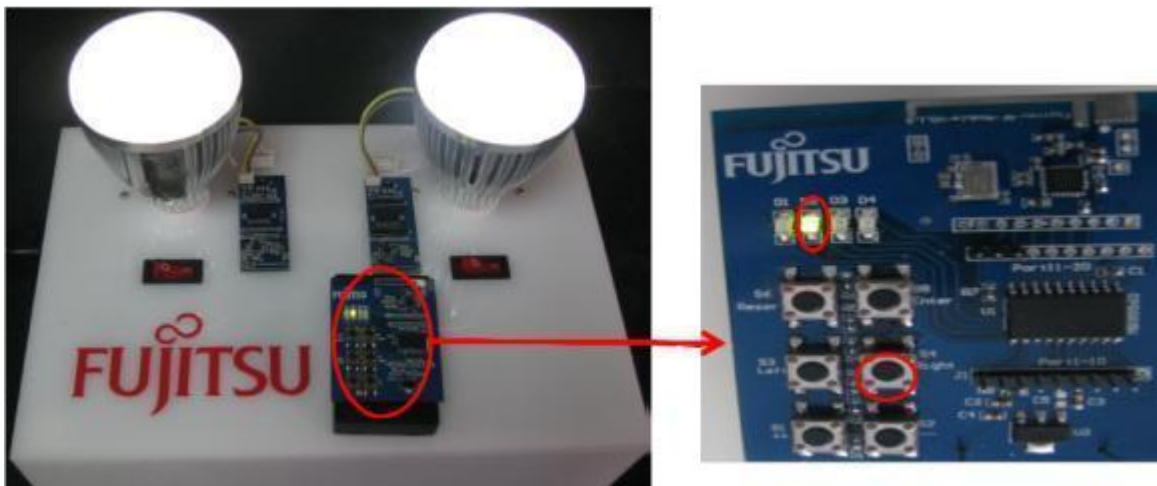
Figure 4-7: second bulb lighting with "Right" key

When first press the "Enter" key, D1, D2, D3 and D4 are turn on (but for this demo, it can control two bulbs). It means we can control the both bulbs with the remote controller. If press the same key again, D1 is turn on, and the others are turn off. It means only one lighting bulb can be controlled by the remote controller. But you can use the "Left" or "Right" key to change controlling state.

When press the "++" key, the both lighting bulbs becomes bright. If we press the key again, they changes brighter than before. When press the "--" key, the both bulbs becomes dark. If we press the key again, they changes darker than before.

The detail is shown in figure 4-8.
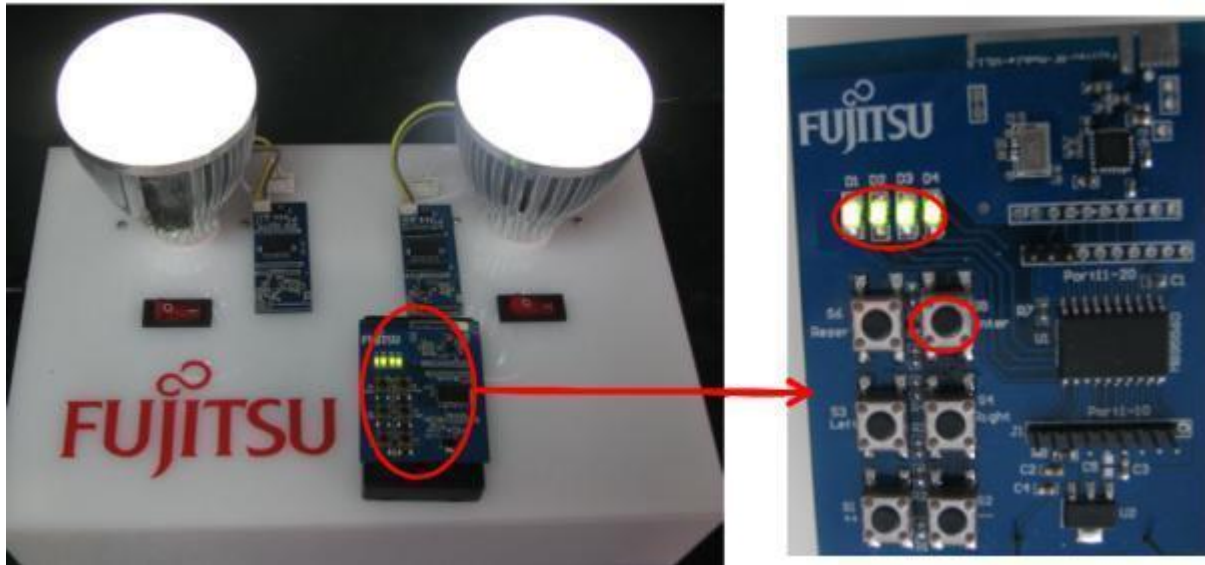
Figure 4-8: Bulb lighting with "Enter" key

5 Caution

Safety caution and warning

5.1 Warning

It must put 110V/200V AC at the electrical outlet of this demo system. If beyond the voltage range, it is not ensured that the system can operate normally. And MB39C601 may be destroyed, and also for LED Driver board.

Before assembly/disassembly any components & the demo set, please make sure that the power is off because for its high input voltage.

5.2 Safety Caution

Description of each connector about this system will be introduced in the following.

5.2.1 Zigbee receiver

There are two connectors about zigbee receiver, output terminal and input terminal.

When 220VAC power is on, the system can supply 5V to receiver through terminal A1 connecting to terminal A2. See it in figure 5-1.

Figure 5-1: Caution of zigbee receiver (1)

And then, the receiver can supply PWM signal to the driver board in lighting bulb through terminal B2 connecting terminal B1. See it in figure 5-2.
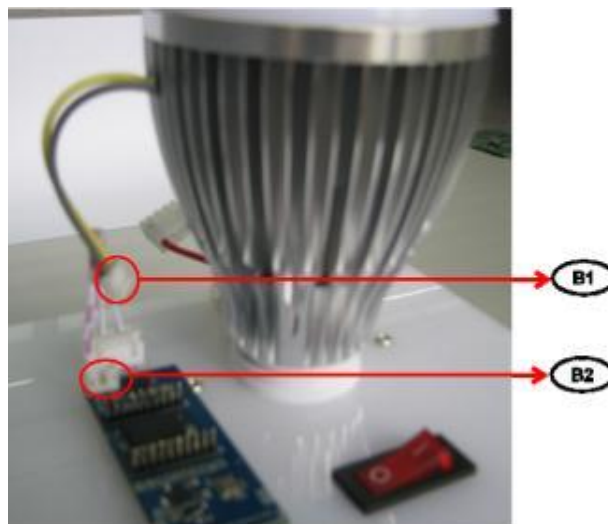
Figure 5-2: Caution of zigbee receiver (2)

5.2.2 Lighting bulb

There is one load connector of lighting bulb. When 220VAC power is on, the system can supply less than 27V at the terminal C2 (if 110VAC input, it will connected to terminal C1). It is the output of the LEDs in the system. See it in figure 5-3.

Figure 5-3: Caution of lighting bulb

6 Reference Data

Schematic, bomlist and layout of LED system

6.1 LED Driver schematic and Layout

6.1.1 LED Driver schematic

6.1.2 LED Driver bomlist

Here is the bomlist for LED Driver board.

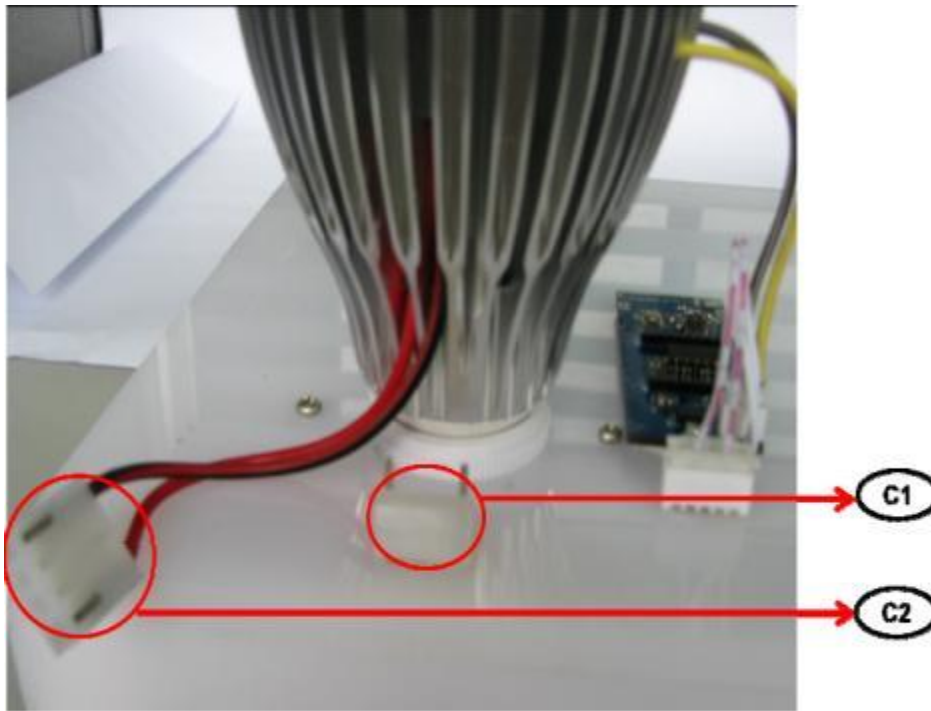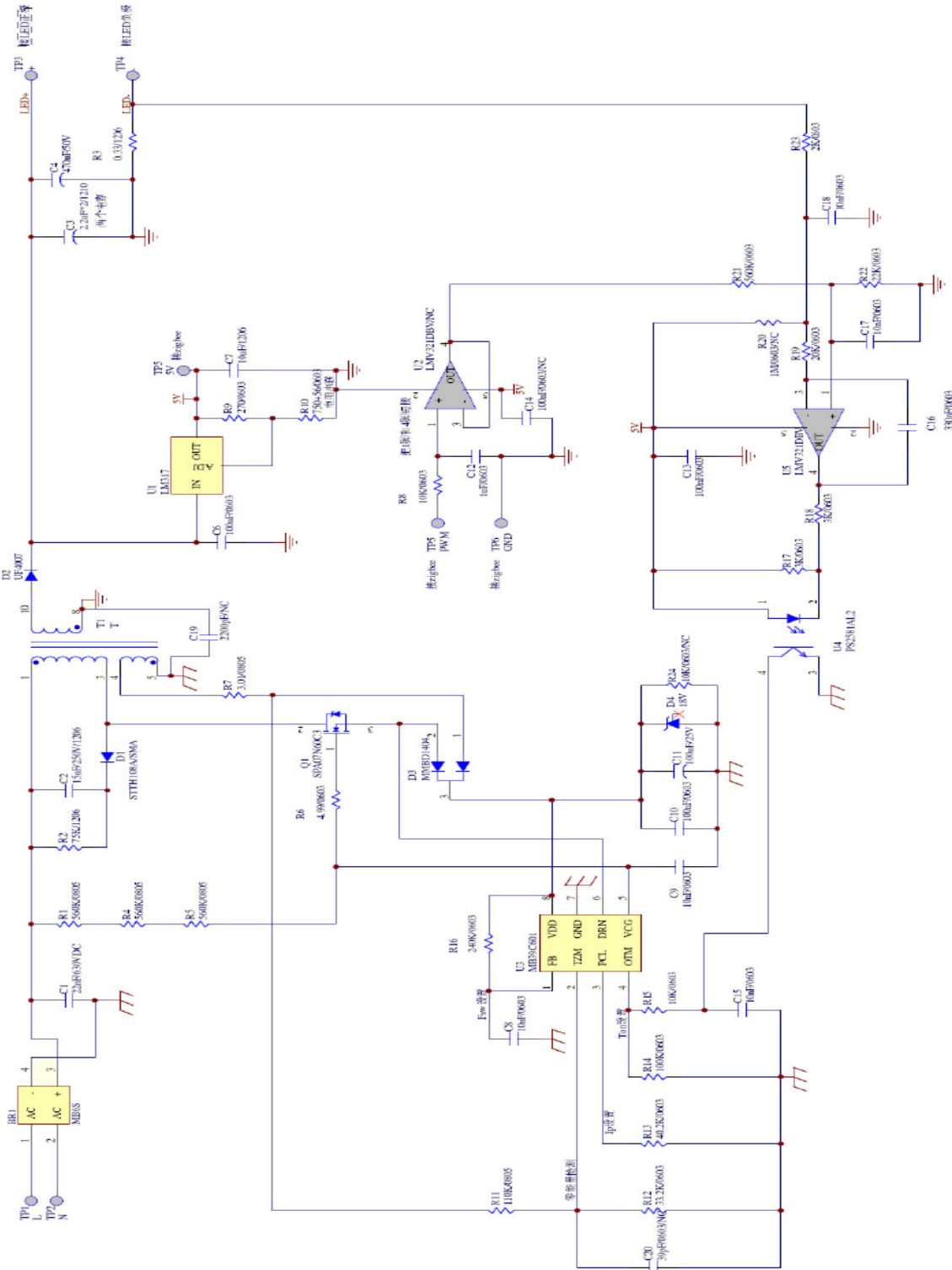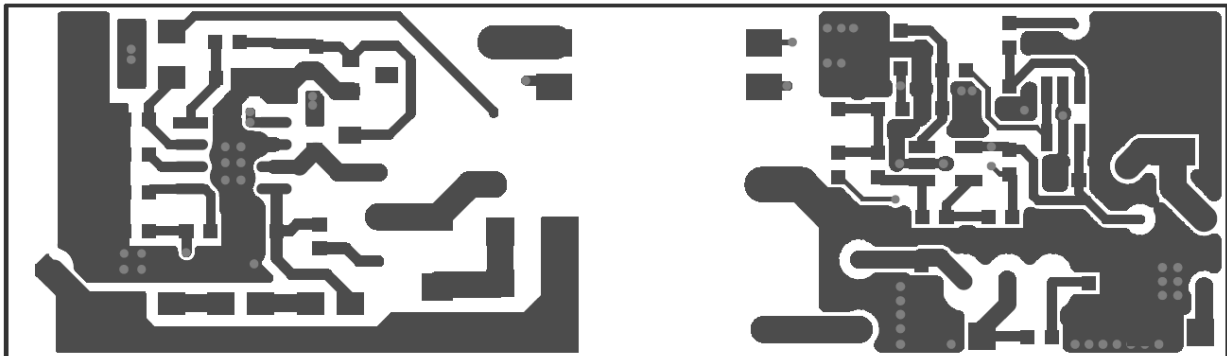| Count	Designator	Item Specification	Part Value	Package	Part Number	Description
1	U1	LDO	LM317	TO-220F	LM317	LDO
1	U3	Power IC	MB39C601	SOP-8	MB39C601	Power IC
1	U4	Opto-Coupler	PS2581L2	PS2581L2	PS2581L2	Opto-Coupler
1	U5	Operation Amplifier	LMV321DBV	SOT-235	LMV321DBV	Operation Amplifier
1	BR1	Rectifier Bridge	—	—	MB6S	Rectifier Bridge
1	C1	22nF, 630V DC	22nF			Capacitor
1	C2	15nF, 250V, 1206	15nF	1206		Capacitor
2	C3 (in parallel)	2.2uF, 50V, 1210	2.2uF	1210		Capacitor
1	C4	470uF, 50V, 1210	2.2uF	RB.2/.4		Electrolytic Capacitor
3	C6, C10, C13	100nF, 50V, 0603	100nF	0603		Capacitor
1	C7	10uF, 25V, 1206	10uF	1206		Capacitor
5	C8, C9, C15, C17, C18	10nF, 50V, 0603	10nF	0603		Capacitor
1	C11	100uF, 25V	100uF	DIP		Electrolytic Capacitor
1	C12	1uF, 50V, 0603	1uF	0603		Capacitor
1	C16	330nF, 50V, 0603	330nF	0603		Capacitor
1	D1	Diode	-	SMA	STTH108A	Diode
1	D2	Diode	-	DO-41	UF4007	Diode
1	D3	Diode	-	SOT-23	MMBD1404	Diode
1	D4	Regulator Diode		SOT-23		Regulator Diode
1	T1	Transformer	-	20x20	-	Transformer
1	Q1	MOFET	-	TO-220F	SPA07N60C3	MOSFET
3	R1, R4, R5	Resistor, 1%	560K	0805		Resistor
1	R2	Resistor, 1%	75K	1206		Resistor
1	R3	Resistor, 1%	0.33R	1206		Resistor
1	R6	Resistor, 1%	4.99R	0603		Resistor
1	R7	Resistor, 1%	3.01R	0805		Resistor
2	R8, R15	Resistor, 1%	10K	0603		Resistor
1	R9	Resistor, 1%	270R	0805		Resistor
1	R10	Resistor, 1%	750R	0805		Resistor
1	(in series)	Resistor, 1%	56R	0805		Resistor
1	R11	Resistor, 1%	110K	0805		Resistor
1	R12	Resistor, 1%	33.2K	0603		Resistor
1	R13	Resistor 1%	40.2K	0603		Resistor
1	R14	Resistor, 1%	100K	0603		Resistor
1	R16	Resistor, 1%	240K	0603		Resistor
2	R17, R18	Resistor, 1%	3K	0603		Resistor
1	R19	Resistor, 1%	20K	0603		Resistor
1	R21	Resistor, 1%	560K	0603		Resistor
1	R22	Resistor, 1%	22K	0603		Resistor
1	R23	Resistor, 1%	2K	0603		Resistor

(Continued)

Count	Designator	Item Specification	Part Value	Package	Part Number	Description
6	TP1, TP2, TP3, TP4, TP5, TP6	Connecting Pins	—	—	—-	Molex Pin
Not Mounted	U2	Operation Amplifier	LMV321DBV	SOT-235	LMV321DBV	Operation Amplifier
	C20	39pF, 50V, 0603	39pF	0603		Capacitor
	C19	2200pF, NC	2200pF			
	C14	100nF, 50V, 0603	100nF	0603		Capacitor
	R20	Resistor, 1%	1M	0603		Resistor
	R24	Resistor, 1%	10K	0603		Resistor

6.1.3 LED Driver PCB layout
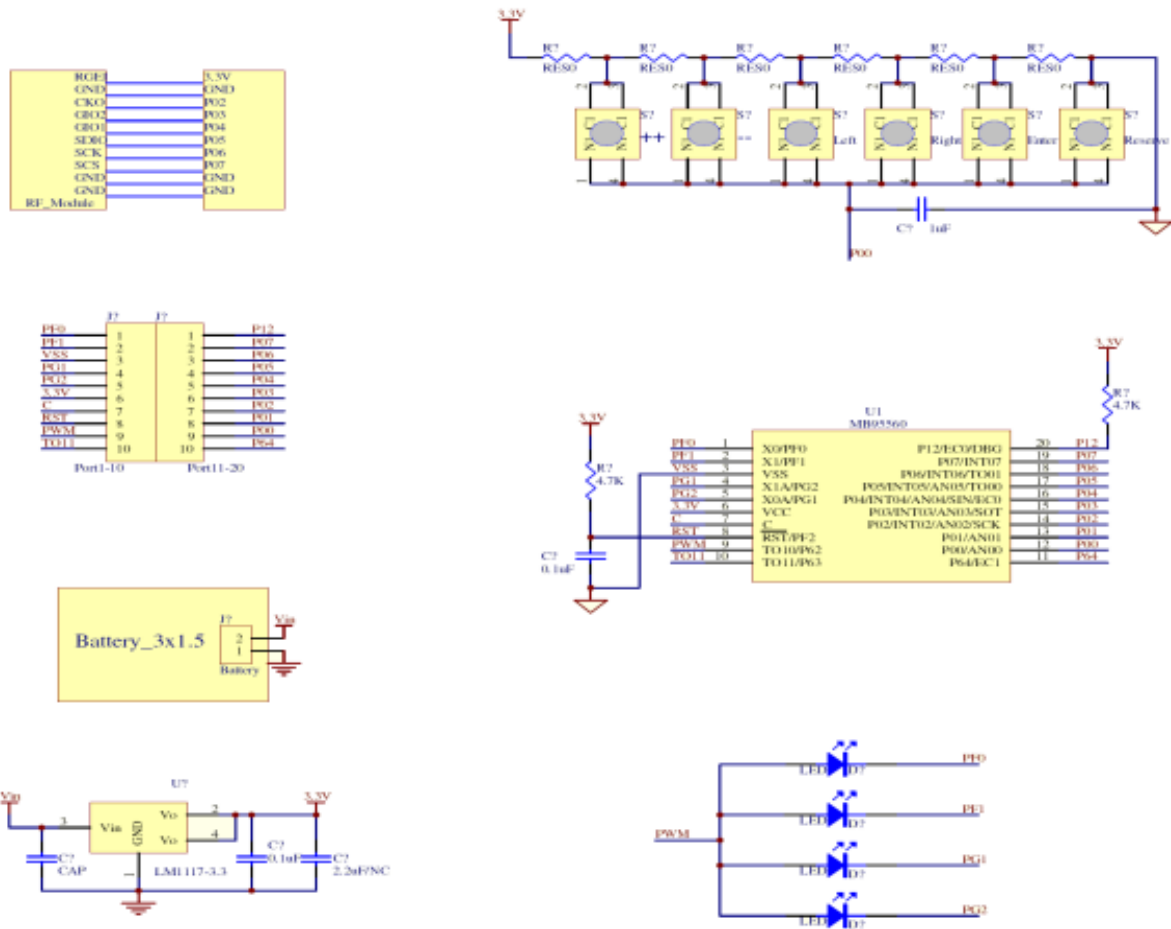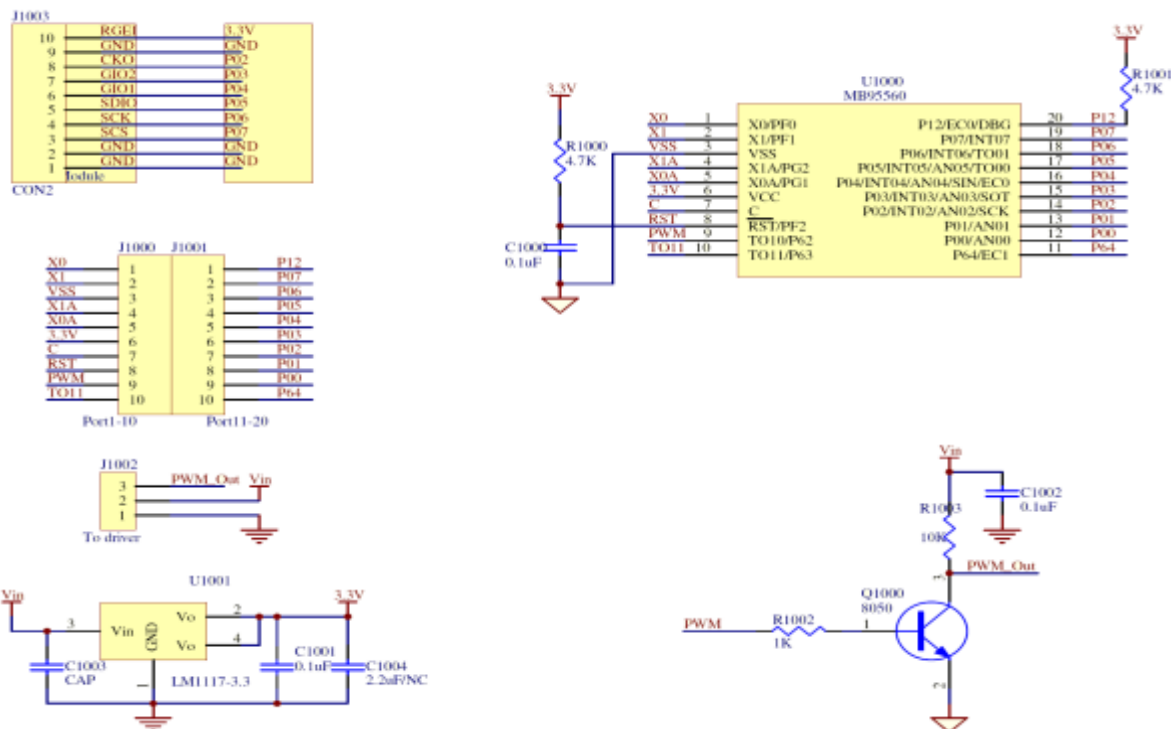
Top view

Bottom view

6.2 Zigbee control schematic and Layout

6.2.1 Zigbee control schematic

A、Remote Board

B、Node Board

6.2.2 Zigbee control Bomlist

Count	Designator	Item Specification	Part Type	Footprint	Description
4	C1003	0.1uF	0.1uF	0603	Capacitor
	C1001	0.1uF	0.1uF	0603	Capacitor
	C1000	0.1uF	0.1uF	0603	Capacitor
	C1002	0.1uF	0.1uF	0603	Capacitor
1	C1004	2.2uF	2.2uF	0603	Capacitor
1	R1002	1K	1K	0603	Resistor
2	R1000	4.7K	4.7K	0603	Resistor
	R1001	4.7K	4.7K	0603	Resistor
1	R1003	10K	10K	0603	Resistor
1	Q1000	8050	8050	SOT-23	Transistor
1	U1001	LM1117-3.3	LM1117-3.3	SOT-223	LDO
1	U1000	MB95560	MB95560	SOP20	MCU
23	J1000	Port1-10	Port1-10	HDR10_2.0	Header pin
	J1001	Port11-20	Port11-20	HDR10_2.0	Header pin
	J1002	To driver	To driver	HDR3_2.0	Header pin
6	S1	++	++	B4P	Key
	S2	--	--	B4P	Key
	S6	Reserve	Reserve	B4P	Key
	S4	Right	Right	B4P	Key
	S5	Enter	Enter	B4P	Key
	S3	Left	Left	B4P	Key
3	C2	0.1uF	0.1uF	0603	Capacitor
	C3	0.1uF	0.1uF	0603	Capacitor
	C4	0.1uF	0.1uF	0603	Capacitor
1	C5	2.2uF	2.2uF	0603	Capacitor
2	R7	4.7K	4.7K	0603	Resistor
	R8	4.7K	4.7K	0603	Resistor
7	C1	3.3K	3.3K	0603	Resistor
	R6	3.3K	3.3K	0603	Resistor
	R5	3.3K	3.3K	0603	Resistor
	R2	3.3K	3.3K	0603	Resistor
	R1	3.3K	3.3K	0603	Resistor
	R4	3.3K	3.3K	0603	Resistor
	R3	3.3K	3.3K	0603	Resistor
1	J3	Battery	Battery	BT	Battery

(Continued)

| Count	Designator	Item Specification	Part Type	Footprint	Description
4	D2	LED	LED	1206	LED Green
	D3	LED	LED	1206	LED Green
	D1	LED	LED	1206	LED Green
	D4	LED	LED	1206	LED Green
1	U2	LM1117-3.3	LM1117-3.3	SOT-223	LDO
1	U1	MB95560	MB95560	SOP20	MCU
20	J1	Port1-10	Port1-10	HDR10_2.0	Header pin
	J2	Port11-20	Port11-20	HDR10_2.0	Header pin

6.2.3 Zigbee control Layout

A、Remote Board

Top view
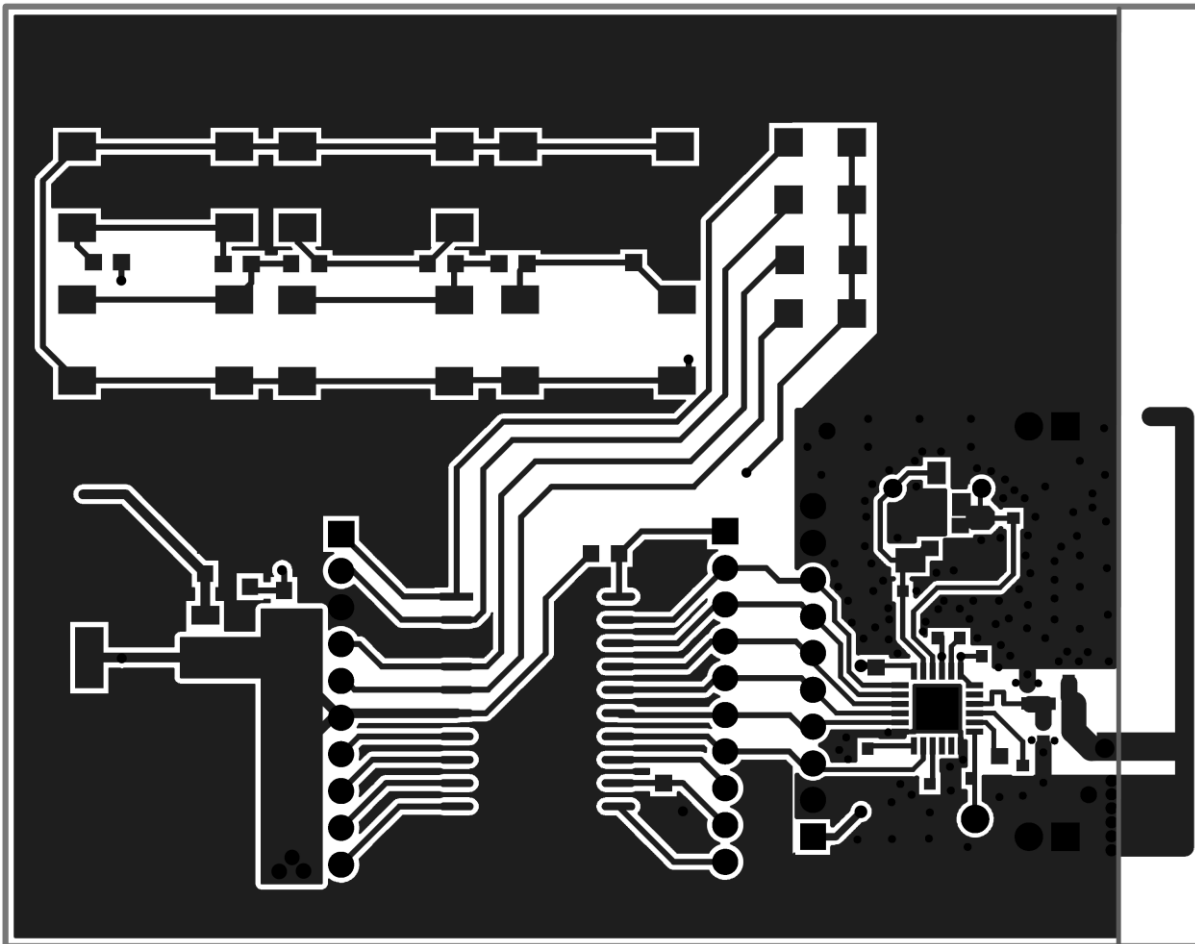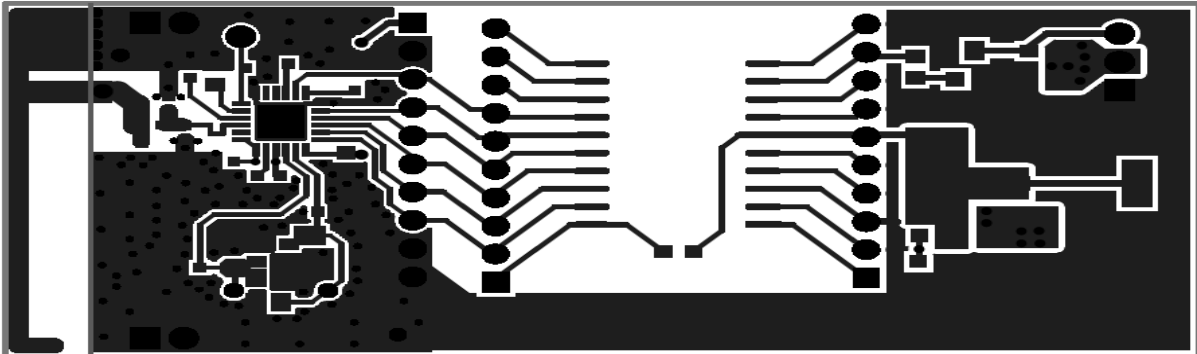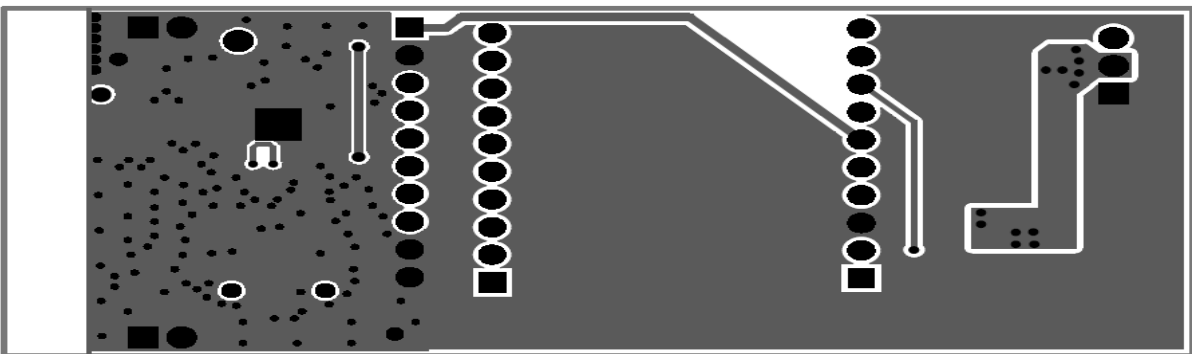
Bottom view
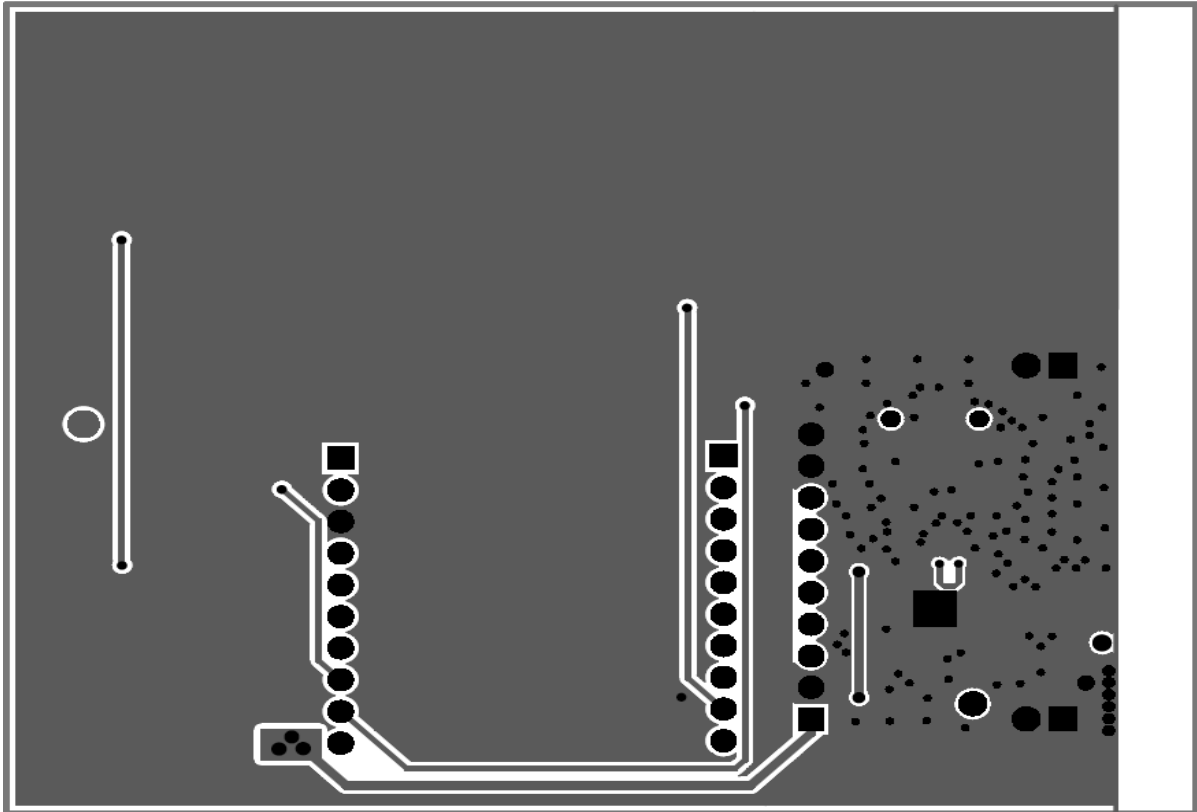
B、Node Board

Top view

Bottom view

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