Shenzhen Fuman Electronics Group Co., Ltd.

SHEN ZHEN FINE MAD ELECTRONICS GROUP CO., LTD.

FM3209F (File No.: S&CIC1371)

2.1A charging 2.1A discharge fully integrated mobile power management IC

Overview

FM3209F is a fully integrated charging management, lithium battery protection, DC-DC boost current limiter, flashlight lighting and power indicator multi-function power tube

理chips.

FM3209F's synchronous boost system provides a maximum output current of 2.1A, and the conversion efficiency is as high as 93%. The chip only needs one inductor to achieve buck and boost

Features. The DC-DC converter works at 1.5MHz, which can support low-cost inductors and capacitors; the chip supports the power indicator and flashlight function of 4 LED lights,

Support single-press, double-press and long-press functions. When there is no load, the system enters the dormant state and the working current drops to 50uA

FM3209F synchronous switch charging technology provides a maximum current of 2.1A, greatly shortening the charging time. The chip has a built-in temperature control circuit, according to the IC

Temperature and input voltage intelligently adjust the charging current.

Features

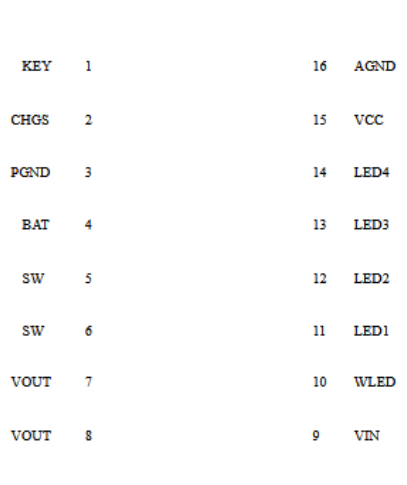
- ➢ 2.1A synchronous switching charger, 2.1A synchronous boost converter
- ➢ Single inductor architecture, 1.5MH z switching frequency, support 1uH inductor
- ➢ The boost efficiency is up to 93%
- ➢ Synchronous rectification switching charging technology
- ➢ 4 LED power display, built-in lighting driver
- ➢ The current power will be displayed after the four lights are all lit once at the first power on, and the power display LED will only decrease but not increase.
- ➢ Built-in adaptive power path management, supporting charging and discharging
- ➢ Automatically switch between standby mode and working mode
- ➢ Support key switch and automatic load identification
- ➢ Charging voltage accuracy: ±1.0%; boost voltage accuracy: ±1.0%
- ➢ Over current protection (OCP), over voltage protection (OVP), short circuit protection (SCP), over temperature protection (OTP)
- ➢ ESD 2KV, transient withstand voltage 11V, extremely high reliability
- ➢ Very low BOM cost
- ➢ Standby current 50uA
- ➢ Support 4.2V lithium battery
- ➢ Package form: ESOP-16

application

- ➢ Power bank

➢ Backup power for IPAD and other digital equipment

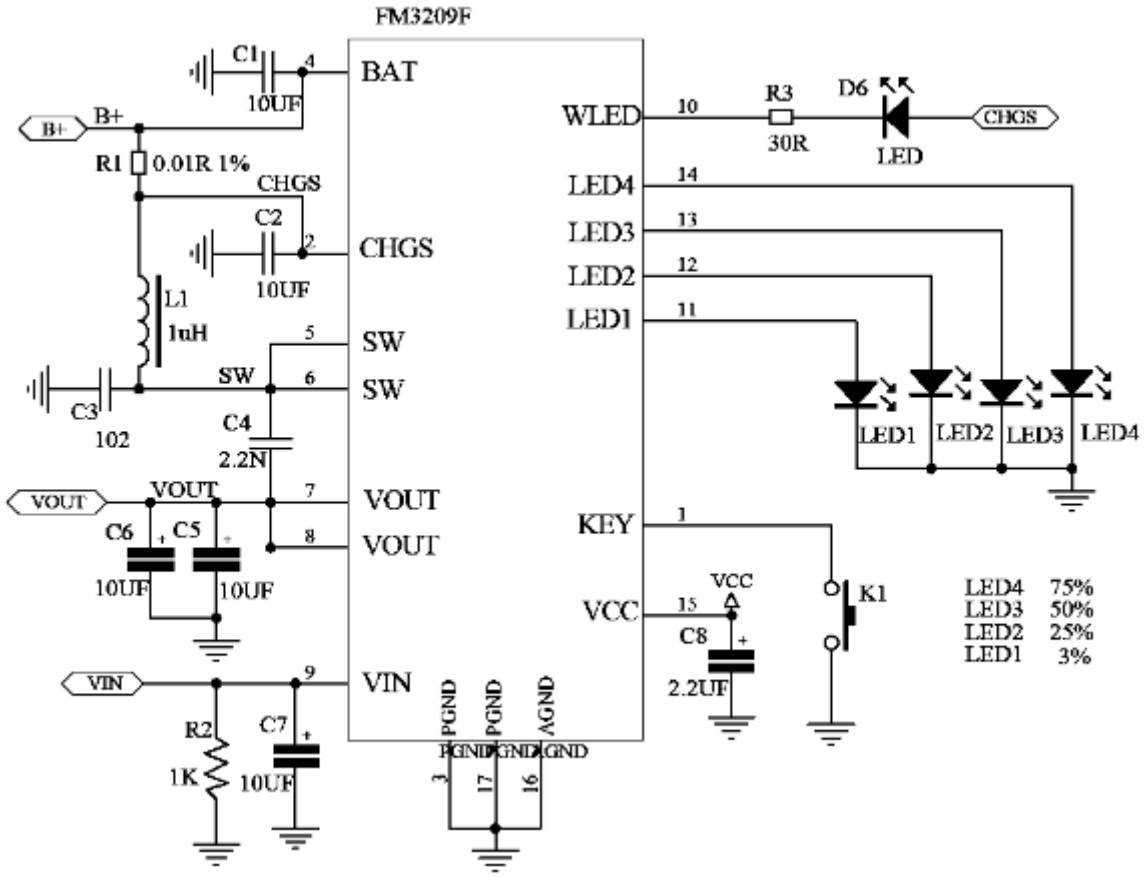
Pin diagram and description



ESOP-16

Serial number	name	Pin description
1	KEY	Key input
2	CHGS	Switch charging current detection terminal
3	PGND	Power ground
4	BAT	Battery positive
5, 6	SW	Inductance connection terminal
7, 8	VOUT	Boost 5V output
9	VIN	Charging 5V input
10	WLED	Flashlight end
11	LED1	Battery light LED1
12	LED2	Battery light LED2
13	LED3	Battery light LED3
14	LED4	Battery light LED4
15	VCC	3.1V LDO output
16	AGND	Analog ground

Typical application circuit



Electrical performance parameters

➢ Recommended scope of work

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parameter	symbol	range	unit
Input voltage	VDD	4.5~5.5	V
Working temperature	TOP	-20~85	°C

➢ Limit parameters

parameter	value	unit
PGND, GND voltage	-0.3~+0.3	V
Other pin voltage	-0.3~+7	V
recharging current	2.3	A
Discharge current	2.3	A
Storage temperature	-50~+150	°C
Operating junction temperature range	-40~150	°C
HBM	4000	V
MM	200	V

Note: The maximum limit parameter means that the IC may be damaged if it exceeds the working range. The recommended working range means that the IC works normally within this range, but it is not fully guaranteed. Certificates meet individual performance instructions. Electrical parameters define the DC and AC current of the device within the working range and under test conditions that guarantee specific performance indications Gas parameter specification. For unspecified upper and lower limit parameters, the specification does not guarantee its accuracy, but its typical value reasonably reflects the performance of the device.

➢ Electrical parameters

➢ Electrical parameters

Unless otherwise specified, TA=25°C, L=1uH

parameter	symbol	Test Conditions	The smallest value	typical value	maximum value	single Bit
Charging system						
Input voltage	V_{IN}		4.5	5	5.5	V
Input working current	I_{VIN}	VIN=5V, fs=1.5MHz	-	-	2	mA
Input quiescent current		VIN=5V, Device not switching	-	100	-	uA
Charging target voltage	V_{BAT}		4.16	4.2	4.25	V
recharging current	I_{CHRG}	R=10mΩ	1.8	2	2.5	A
Trickle charge current	I_{TRKL}		-	100	-	mA
Trickle cut-off voltage	V_{TRKL}		-	3	-	V
Recharge threshold	V_{RCH}		-	4.1	-	V
Input undervoltage protection	V_{UVLO}	Rising voltage	-	4.5	-	V

Undervoltage protection hysteresis	V_{HYS}		-	900	-	mV
Boost system						
Battery working voltage	V_{BAT}		3.0	-	4.4	V
Switch working battery input Current	I_{BAT}	VBAT=3.7V, VOUT=5.1V, fs=1.5MHz	-	3	-	mA
		VIN=5V, Device not switching	-	100	-	uA
DC output voltage	V_{OUT}	VBAT=3.7V	5.0	-	5.15	V
Output voltage ripple	ΔV_{OUT}	VBAT=3.7V, VOUT=5.0V, fs=1.5MHz	-	100	-	mV
Boost system power supply current	I_{STB}		-	2.1	-	A
Load overcurrent detection time	T_{UVD}	The output voltage is continuously lower than 4.4V	-	30	-	ms
Load short circuit detection time	T_{OCD}	The output voltage is continuously lower than 4V	-	10	-	us
Control System						
On-off level	fs		-	1.4	-	MHz
PMOS on resistance	r_{DSON}		-	60	-	mΩ
NMOS on resistance			-	40	-	mΩ
LDO output voltage	V_{LDO}	VBAT=3.5V	-	3.1	-	V
Battery input standby current	I_{STB}	VIN=0V, VBAT=3.7V	-	50	-	uA
LDO output current	I_{LDO}		-	200	-	mA
LED lighting drive current	W_{LED}		-	100	-	mA
LED display drive current	ILED	I_{LED1} ,I_{LED2} ,I_{LED3} ,I_{LED4}	-	5	-	mA
Automatic load detection time	T_{loadD}	15mA	-	32	-	s
Short key wakeup time	$T_{OnDebounce}$		-	50	-	ms
Turn on WLED time	$T_{KeyWled}$		-	2	-	s
Thermal shutdown temperature	T_{OTP}	Rising temperature	-	125	-	°C
Thermal shutdown temperature hysteresis	ΔT_{OTP}		-	40	-	°C

Application note

➢ Charging function

FM3209F adopts synchronous switch charging technology, the switching frequency is 1.4MHz, when the chip pin VIN is kept above 4.85V, the Vbat terminal is the most
The large charging current is 2.1A, which greatly shortens the charging time of the battery.
FM3209F has a constant current and constant voltage lithium battery charger with a synchronous switch structure. When the battery voltage is less than 3V, use 100mA trickle
Current charging; when the battery voltage is greater than 3V, it enters constant current charging; when the battery voltage is greater than 4.2V, it enters constant voltage charging. After charging, if the battery

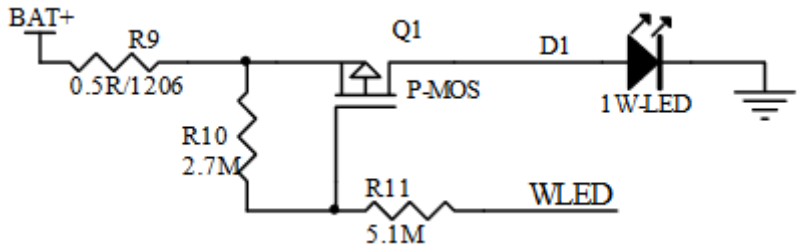
After the voltage is lower than 4.1V, restart the battery to charge.
FM3209F has built-in adaptive power path management, the chip will automatically adjust the charging current according to the VIN voltage, compatible with all adapters on the market.
There is an over-voltage protection circuit inside the chip. When the input voltage is higher than 5.6V, the chip will shut down the charging system to protect the internal circuit from high voltage damage.
FM3209F supports charging and discharging while giving priority to external loads.
FM3209F automatically monitors the IC temperature and automatically reduces the charging current when the IC temperature is higher than 100 degrees.

➢ Boost function

FM3209F integrates a step-up DC-DC converter with an output of 5V and a load capacity of 2.1A. Switching frequency 1.4MHz, you can use 1-1.2UH
The inductance helps reduce the overall cost of the PCB. Chip built-in soft start function, integrated output over current, over temperature, short circuit and VIN input over voltage
And other protection functions.
FM3209F has automatic detection of load insertion and turn on the boost discharge function, and the boost output terminal supports hot swap. 【In the boost state, such as plugging in
If the sub-load tester is used to test, the overload protection will be triggered due to the instantaneous peak current, and the battery indicator will go out for 0.3 seconds and then turn on again

➢ VCC function
There is a difference between Apple and Samsung mobile phones. Only when the D+ and D- voltages of the USB port are detected, the iPhone can be quickly charged; USB
The D+ and D- divider resistor power supply of the output port should be connected to VCC, not to VOUT; VCC has a constant output voltage of 3.1V, and the load can
The force is 200mA.

➢ Flashlight output
WLED is the negative driving end of LED flashlight lighting, the maximum driving current is 100mA, you can add series resistance to LED to reduce the indication
The current of the flashlight. Press and hold the S1 button for 2 seconds to turn on the flashlight, and repeatedly press and hold the S1 button for 2 seconds to turn off the flashlight.
If you need to drive multiple IED lights, you need to add a current expansion circuit. When designing the circuit, please note that the voltage of the WLED pin cannot be higher than 3.0V.
Please refer to the figure below for expansion circuit components:



➢ Key method
1. The duration of the key is longer than 30 milliseconds but less than 2 seconds, which is a short press action. A short press will turn on the battery indicator and boost output.
2. The key duration is longer than 2 seconds, which is a long press action. Long press will turn on or turn off the lighting LED.
3. Two short keystrokes in 1 second will turn off the boost output and power display.

➢ Reference table for discharge efficiency:

Input voltage	Input Current	The output voltage	Output current	effectiveness
4.2V	1.252	4.96	1A	94.33%
4.0V	1.319	4.96	1A	94.01%
3.8V	1.396	4.97	1A	93.69%

3.6V	1.482	4.97	1A	93.15%
3.4V	1.58	4.97	1A	92.52%
3.2V	1.691	4.98	1A	92.03%

Input voltage	Input Current	The output voltage	Output current	effectiveness
4.2V	2.572	4.96	2A	91.83%
4.0V	2.722	4.96	2A	91.11%
3.8V	2.899	4.97	2A	90.23%
3.6V	3.091	4.98	2A	89.51%
3.4V	3.327	4.98	2A	88.05%
3.2V	3.587	4.98	2A	86.77%

Note: The efficiency difference between the chips will also cause differences for different PCB traces.

➢ Work status and battery indicator

LED1～LED4 are charging and discharging status and power indicator, the pins must be connected in series with LED to GND; LED status under different conditions is as follows:

1. When VDD is connected, LED1 to LED4 will indicate the charging status according to the battery power. The LED that reaches the power level is always on, and the current power level is LED flashes at a frequency of 1Hz, LED1～LED4 are all on after fully charged;
2. In the standby state, if you press the button S1, the battery will be turned off after displaying the power for 32 seconds;
3. When discharging, LED1～LED4 indicate the current power according to the battery voltage; if the battery voltage is lower than 3.05V, LED1 will operate at a frequency of 1HZ
   The flashing rate indicates that the battery is low, until the battery voltage is lower than 2.8V, turn off the boost system, enter the low-power low-voltage protection mode, need to recharge
   The system can start boosting and discharging again when the power is above 3.4V;
4. Long press the S1 button for 2 seconds to turn on the flashlight, and long press the S1 button for 2 seconds to turn off the flashlight.

LED1~LED4 working status table

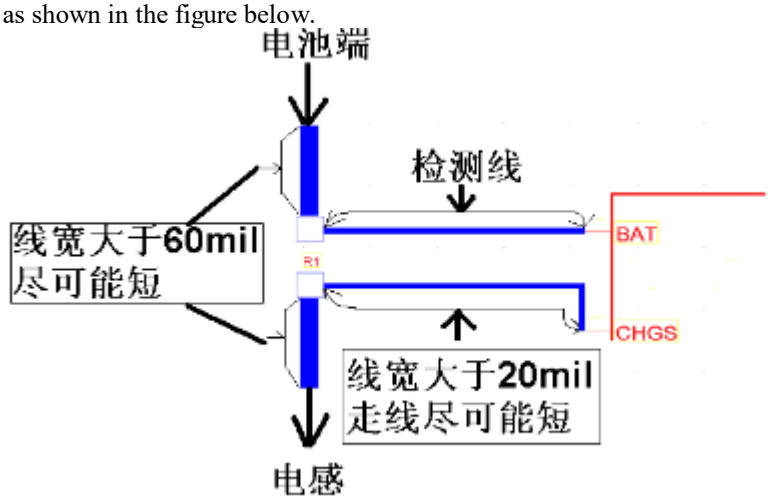
IC model	Charging mode					Discharge mode				
	Battery voltage (V)	LED1	LED2	LED3	LED4	Battery voltage (V)	LED1	LED2	LED3	LED4
FM3209F	C < 25%	Flashing	Extinguish	Extinguish	Extinguish	C=0%	Extinguish	Extinguish	Extinguish	Extinguish
						0% < C < 3%	Flash	Extinguish	Extinguish	Extinguish
	25%≤C < 50%	bright	Flashing	Extinguish	Extinguish	3%≤C < 25%	bright	Extinguish	Extinguish	Extinguish
	50%≤C < 75%	bright	bright	Flashing	Extinguish	25%≤C < 50%	bright	bright	Extinguish	Extinguish
	C≥75%	bright	bright	bright	Flashing	50%≤C < 75%	bright	bright	bright	Extinguish
	100%≤C	bright	bright	bright	bright	C≥75%	bright	bright	bright	bright

Note: The battery voltage in the above table is the standard voltage in the Typical case.

➢ PCB design reference

1. Capacitor C1 should be close to Pin4 of the chip to prevent ripples from inductance from interfering with the chip
2. The capacitor C2 needs to be close to Pin2 of the chip to prevent ripples from inductance from interfering with the chip
3. The capacitor C4 needs to be placed close to Pin6 and Pin7 of the chip, with a capacitance value of 2.2nF.

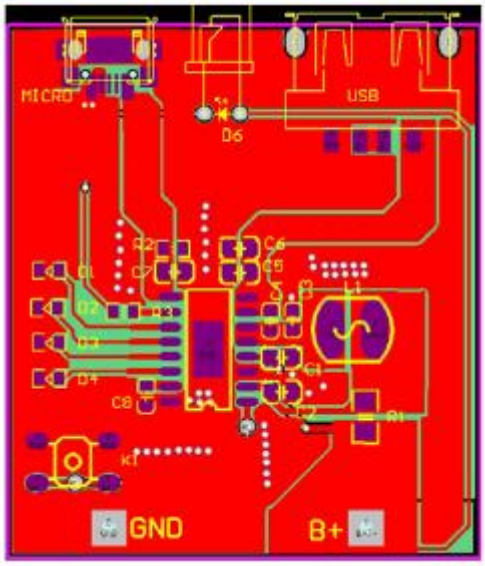
4. Capacitors C5 and C6 must be close to Pin7 and Pin8 of the chip, and the ground of the capacitor returns to the PGND pin from the bottom of the chip
5. The capacitor C7 must be close to the chip Pin9. C8 must be close to Pin15
6. The ground terminal of capacitor C3 needs to be connected to the ground of C5 and C6, and it cannot be directly connected to the ground terminal of PIN3.
7. PGND should be as close as possible to the negative terminal of the battery, and the wiring should be as thick as possible.
8. Capacitors C5 and C6 need to purchase branded capacitors with quality assurance to prevent load insertion identification failure and standby current increase caused by capacitor leakage.
9. The connection between the 10mohm resistor and the BAT/CHGS PIN of the IC adopts Kelvin connection, as shown in the figure below.



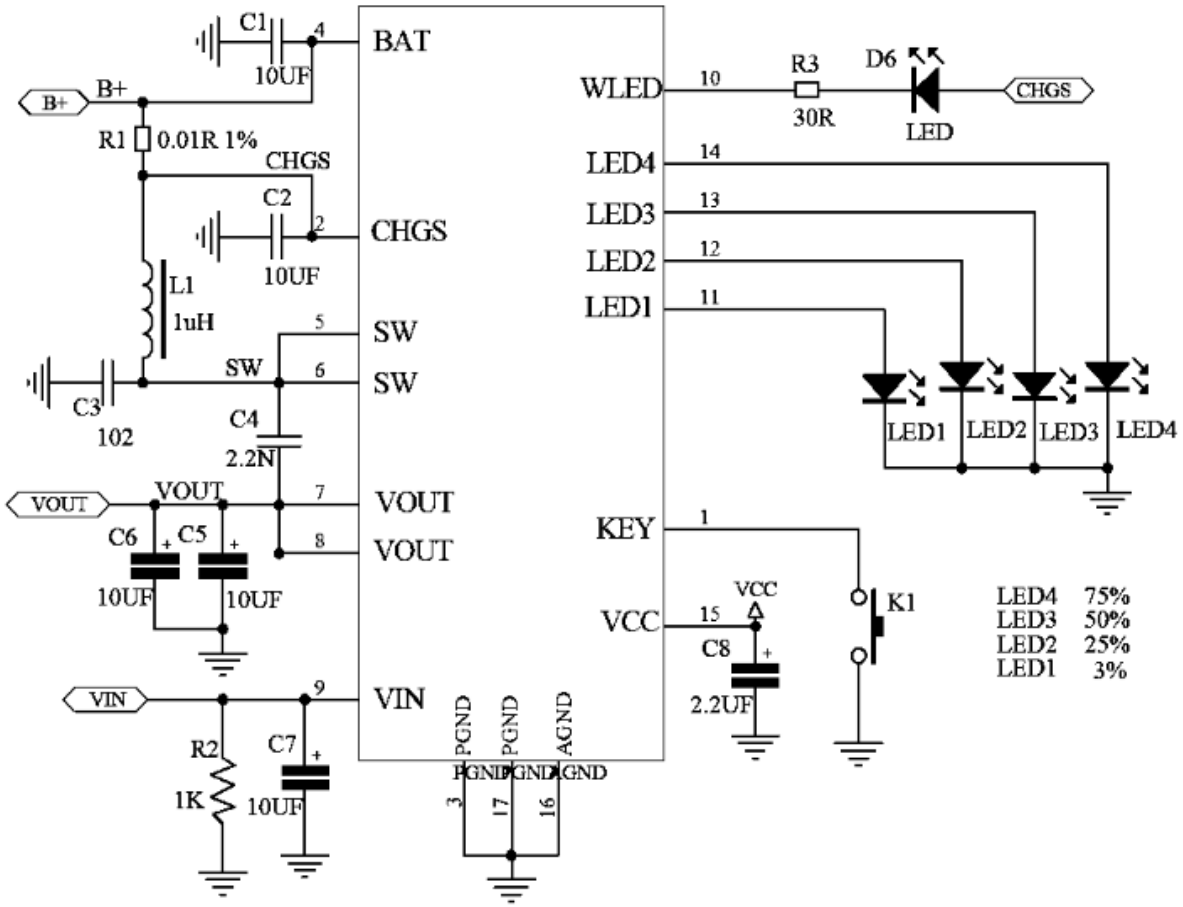
9-1. The traces connecting the two ends of the 10mohm resistor to the BAT/CHGS PIN of the IC need to be led out separately from the pads at both ends of R1.
Other traces of the BAT/CHGS network overlap, as shown in the figure above.
9-2, 10mohm->CHGS (ICPIN) wiring is very sensitive, keep it away from noise interference sources. Can not be placed directly under the inductor, nor can it walk on the inductor
Directly below the other side of the PCB; away from the SW trace; away from the VOUT output capacitor, not at the back of the VOUT capacitor and PGND
On the flow path. It is recommended that the trace width be greater than 20mil, and the trace should be as short as possible.
9-3. The switch signal line (KEY) cannot be placed directly under the inductor, nor can it go under the other side of the inductor PCB; try to stay away from the inductor

10. Please wear anti-static gloves during the test. In addition to preventing static electricity, it is more important to prevent human hands directly touching the PCB during the power-on test.
1. A short-circuit of two nodes caused the module to work abnormally and cause failure or leakage.
11. The positive and negative poles of the battery cannot be connected in reverse, otherwise the module will fail. Please set up necessary measures in the production process to prevent this problem from occurring
12. The heat sink at the bottom of the chip must have good contact with the PCB.
13. The thick line in the schematic diagram indicates the path of large current. The wiring should be short and thick, and try not to go through the hole. If you have to pass the hole, you must place a 0.4mm hole More than 5 diameters.

PCB trace diagram



Typical application circuit diagram



BOM sheet

Serial numbe	Component name	Model & Specification	unit	Dosage	position	Remarks
1	IC	FM3209F	PCS	1	U1	
2	SMD resistor 1206 0.01R 1%		PCS	1	R1	The resistance value accuracy is 1%,
3	SMD resistor 0603 1K 5%		PCS	1	R2	
4	SMD resistor 0603 30R 5%		PCS	1	R3	According to the brightness of the lighting Seek to choose the resistance value appropriately
5	SMD capacitor 0603 10uF 10%		PCS	5	C1, C2, C5, C6, C7	
6	SMD capacitor 0603 2.2nF 10%		PCS	1	C4	Withstand voltage greater than 10V, build
7	SMD capacitor 0603 102 10%		PCS	1	C3	Discuss the use of chip ceramic capacitors
8	SMD capacitor 0603 2.2uF 10%		PCS	1	C8	
9	SMD LED 0603 blue light		PCS	4	D1, D2, D3, D4	
10	LED 5mm white hair		PCS	1	D6	
11	inductance	CD-54	PCS	1	L1	Saturation Isat, temperature rise current Idc is greater than 4.5A, DCR Less than 0.03
12	USB female 10mm short body roll mouth		PCS	1	U2	
13	Mini USB Micro USB Female		PCS	1	USB1	
14	Key switch 6.5mm*5.1mm		PCS	1	SW1	