IP5407

2A charge 2.1A / 2.4A discharge integrated DCP function mobile power SOC

1 Features

- **Charge and discharge of synchronous switch**
  - ✧ 2.1A / 2.4A synchronous boost conversion, 2.0A synchronous switch charging
  - ✧ Boost efficiency up to 93%
  - ✧ Charging efficiency up to 91%
  - ✧ Built-in power supply path management, supporting charging and discharging at the same time
  - ✧ Double click to turn on the Output supports linear compensation of 60mV
- **charging**
  - ✧ Automatically adjust the charging current to match the output capability of the adapter
  - ✧ Support 4.20V,4.35V batteries
- **Power display**
  - ✧ Support 4/2/1 LED power display
    Supports 4 light models: IP5407
    Support 2/1 light models: IP5407_2D1D
- **Multifunction**
  - ✧ Built-in floodlight driver
  - ✧ Automatically detect phone insertion and removal
  - ✧ Integrated mobile phone charging current intelligent identification DCP
  - ✧ Support battery NTC temperature protection.
- **Low power consumption**
  - ✧ Output fixed normally open 5V
  - ✧ Standby power consumption is less than 150uA
- **BOM are simple and few**
  - ✧ Built-in power MOS, single inductor realizes charging and discharging
- **Multiple protections and high reliability**
  - ✧ Output over-current, over-voltage, short-circuit protection
  - ✧ Input overvoltage, overcharge, overdischarge, overcurrent discharge protection
  - ✧ over-temperature protection

- ✧ ESD:4KV, instantaneous withstand voltage :11V

2 application

- **Power bank**
- **Mobile phones, tablets and other portable devices**

3 Introduction

IP5407 is a multi-function power management soc with integrated boost converter, lithium battery charge management, and battery power indication, providing a complete power solution for mobile power.

IP5407 has high integration and rich functions, so it only needs few peripheral devices in application，effectively reduce the size of the overall solution and reduce BOM cost.

IP5407's synchronous boost system provides 2.1A / 2.4A output current, and the conversion efficiency is as high as 93%. At light load, it automatically turns off the LED power indicator and maintains the 5V voltage output to sleep, and the quiescent current drops below 150uA.

IP5407 uses switch charging technology to provide 2.0a current at the input, with charging efficiency up to 91%.Built-in IC internal temperature and input voltage detection and intelligent adjustment of charging current.

IP5407 supports 4, 2, 1 LED power display and lighting functions.
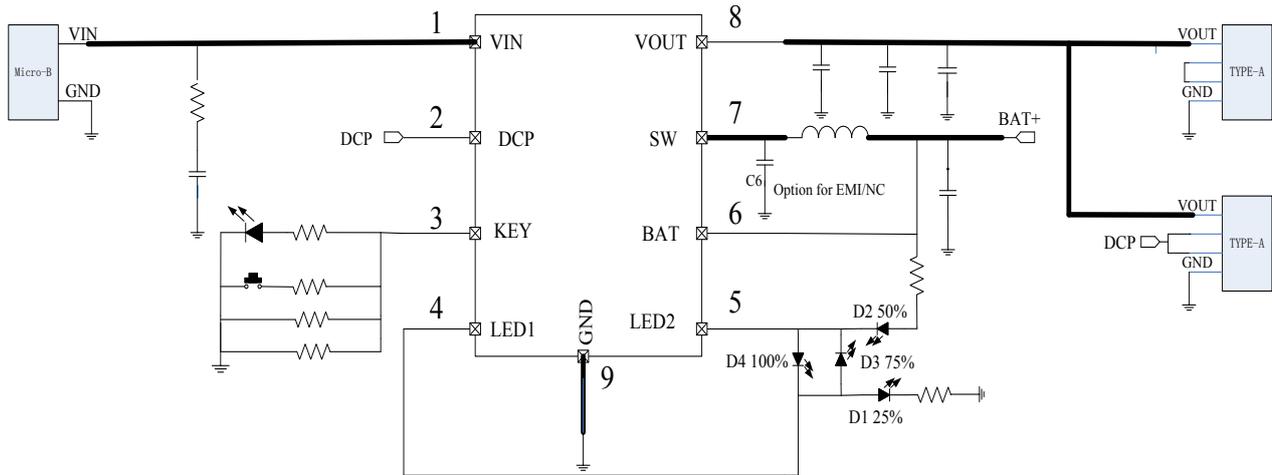**IP5407 is available in ESOP8 package.**

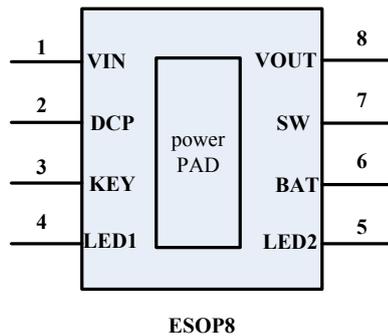**Figure 1 application schematic diagram (4LED indicates power)**

4 Pin definition

ESOP8

Figure 2 IP5407 pin diagram

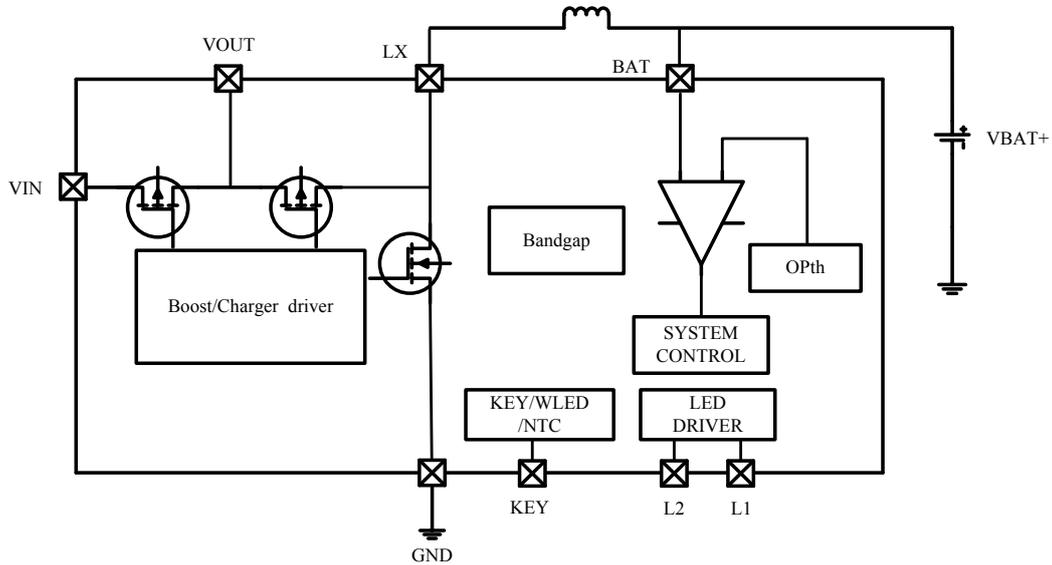| Pin Name	Pin Number	Pin Description
VIN	1	DC5V charge input pin
DCP	2	Connect to USBA D- D+
KEY	3	Key input, floodlight drive, NTC function reuse pin.
LED1	4	LED drive pin
LED2	5	LED drive pin
BAT	6	Boost input pin, connect the positive electrode of lithium battery.
SW	7	DC-DC switch pin
VOUT	8	5V boost output pin
PowerPAD		Connect to GND

5 The internal block diagram

Figure 3 IP5407 internal block diagram

6 IP series mobile power IC model selection table

IC TYPE	Charge and discharge		Main feature:									package	
	discharge	Charge	Number of LED	flood light	keys	I2C	DCP	USB C	QC 认证	PD3.0 /PPS		specification	Compatibility
IP5303	1.0A	1.2A	1,2	√	√	-	-	-	-	-		ESOP8	PIN2PIN
IP5305	1.0A	1.2A	1,2,3,4	√	√	-	-	-	-	-		ESOP8	
IP5306	2.4A	2.1A	1,2,3,4	√	√	√	-	-	-	-		ESOP8	
IP5406	2.4A	2.1A	1,2,4	√	√	-	-	-	-	-		ESOP8	
IP5407	2.4A	2.1A	1,2,4	√	√	-	-	-	-	-		ESOP8	
IP5207	1.2A	1.2A	3,4,5	√	√	-	√	-	-	-		QFN24	PIN2PIN
IP5207T	1.2A	1.2A	1,2,3,4	√	√	√	√	-	-	-		QFN24	
IP5109	2.1A	2.1A	3,4,5	√	√	√	-	-	-	-		QFN24	
IP5209	2.4A	2.1A	3,4,5	√	√	√	√	-	-	-		QFN24	
IP5310	3.1A	3.0A	1,2,3,4	√	√	√	√	√	-	-		QFN32	
IP5506	2.4A	2.1A	数码管	√	√	√	-	-	-	-		ESOP16	
IP5508	2.4A	2.1A	Nixie	√	√	√	√	-	-	-		QFN32	

			tube									
IP5322	18W	4.0A	1,2,3,4	√	√	√	√	-	√	-	QFN32	
IP5328P	18W	4.0A	1,2,3,4	√	√	√	√	√	√	√	QFN40	

Order model

Order model	Instructions
IP5407	Standard product, support 4 lights display
IP5407_4V35	4.35V battery
IP5407_YYY	Double click to turn on the light
IP5407_YYY_4V35	Double click to turn on the light，4.35V battery.
IP5407_2D1D	Support two lights and one light display.
IP5407_2D1D _4V35	4.35V battery，support two lights and one light display

7 Silkscreen instructions

TOP Marking

Injoinic Logo   IP5407

LLLLLLLL

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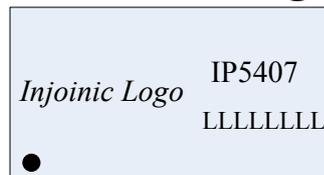
Notes:
IP5407: Part Number
LLLLLL: Lot ID

8 Absolute Maximum Ratings

parameters	symbol	Value	unit
Port input voltage range	V_{IN}	-0.3 ~6	**V**
Junction Temperature Range	T_J	-40 ~ 150	℃
Storage Temperature Range	Tstg	-60 ~ 150	℃
Thermal Resistance (Junction to Ambient)	θ_{JA}	40	℃/**W**
ESD (Human Body Model)	ESD	4	**KV**

* Stresses higher than the values listed in the Absolute Maximum Ratings section may cause permanent damage to the device. Excessive exposure to any absolute maximum rating conditions may affect device reliability and service life

9 Recommended working conditions

parameters	symbol	minimum	Classic value	maximum	unit
Input voltage	V_{IN}	4.65	5	6	V

* Beyond these operating conditions, device operating characteristics cannot be guaranteed.

# 10 Electrical characteristics

unless otherwise stated，TA=25℃，L=1.0uH

parameters	symbol	Test Conditions.	minimum	Classic value	maximum	unit
Charging system.						
Input voltage	V_{IN}	VBAT=3.7V		5		V
Input overvoltage.	V_{INOV}			5.6		V
CV constant voltage charging voltage.	$CV_{4.2V}$	4.2V battery configuration.		4.20		V
	$CV_{4.35V}$	4.345 battery configuration.		4.35		V
Charge cut-off current.	I_{stop}	Input 5V		300		mA
Charge current	I_{VIN}	VIN port charging current input terminal current.		1.9		A
Trickle charging current	I_{TRKL}	VIN=5v，BAT=2.7v		100		mA
Current cut-off voltage.	V_{TRKL}			3		V
Recharge Voltage Threshold	V_{RCH}			4.1		V
Charging deadline.	T_{END}			24		Hour
Boost system						
Battery operating voltage	V_{BAT}		3	3.7	4.4	V
Discharge cut-off voltage	V_{BATLOW}	IOUT=1A		2.95		V
DC output voltage.	V_{OUT}	VBAT=3.7V @0A	5.0	5.12	5.25	V
		VBAT=3.7V @2.1A	4.75	5	5.15	V
Output voltage ripple	ΔV_{OUT}	VBAT=3.7V，VOUT=5.0V，fs=500KHz		100		mV
Boost system over-current	I_{OVP}	VBAT=3.7V		2.8		A

shutdown current.						
Load overcurrent detect time	T_{UVD}	output voltage is continuously below 4.2V		30		ms
Load short-circuit detection time	T_{OCD}	Output current continuously higher than 5A		150		us
Control System.						
switching frequency	fs	Discharge switching frequency		950		KHz
		Charge switching frequency		500		KHz
PMOS on-resistance	r_{DSON}	VBAT=3.7V		40		mΩ
NMOS on-resistance		VBAT=3.7V		30		mΩ
VIN and VOUT PMOS	r_{DSON}	VIN=5V		80		mΩ
Input overcurrent protection.	I_{IDOCP}	VIN=5V		3		A
Battery input standby current	I_{STB}	VIN=0V，VBAT=3.7V		100		uA
LED lighting drive current	Ilight			20		mA
LED display drive current	I_{L1} I_{L2}			5		mA
Automatic load detection time	T_{loadD}	Load current is continuously less than 45mA		36		s
Light load off lamp current.	I_{plout}	VABT=3.7V		50		mA
Short press on key wake up time	$T_{OnDebounce}$			50		ms
Turn on the light time	$T_{Keylight}$			2		s
Thermal shut down temperature	T_{OTP}	Rising temperature		150		℃
Thermal shut down hysteresis	ΔT_{OTP}			40		℃

11 Function description

Boost

IP5407 integrates a Boost DCDC converter with an output of 5V and a load capacity of 2.1A. The switching frequency is 950KHz, 3.8V input, and the efficiency is 92% at 5V / 2.1A. Built-in soft-start function to prevent malfunction caused by excessive inrush current during startup. Integrated output over-current, short-circuit, over-voltage, over-temperature protection functions When an output overcurrent or short circuit is detected, the output will be restarted every second to ensure that the system works stably and reliably. IP5407 will turn on the 5V boost output and power display after the BAT voltage is greater than 3.2V. When the output current is less than 50mA and after 36s, the power display will be turned off and the output voltage will be fixed at 5V to enter the low power consumption mode. When the IP5407 detects that the BAT voltage is lower than 3.0V, it will turn off the output. After the BAT voltage rises, it needs to be charged and activated to output normally.
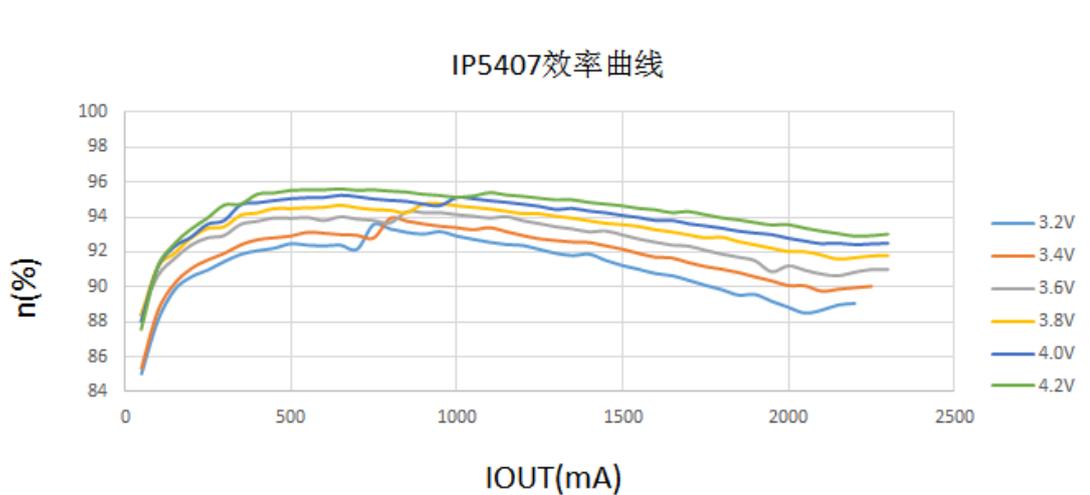
Figure 4 Boost efficiency curve

Charge

IP5407 has a constant current, constant voltage lithium battery charger with a synchronous switch structure. When the battery voltage is less than 3v, 100mA slip current charging is used; when the battery voltage is greater than 3V, it enters constant current charging, and the VIN input current limiting loop works; when the battery voltage is greater than 4.2V, it enters constant voltage charging.After the charging is completed, if the battery voltage is lower than 4.1V, restart the battery charging

P5407 adopts switch charging technology, with a switching frequency of 500KHz and a charging current of 2.0A at the VIN input terminal. The charging efficiency is up to 91%.

Adaptive power path management, support charge and discharge simultaneously.

IP5407 charging will automatically adjust the charging current to adapt to adapters with different load capacities, without pulling the charger.
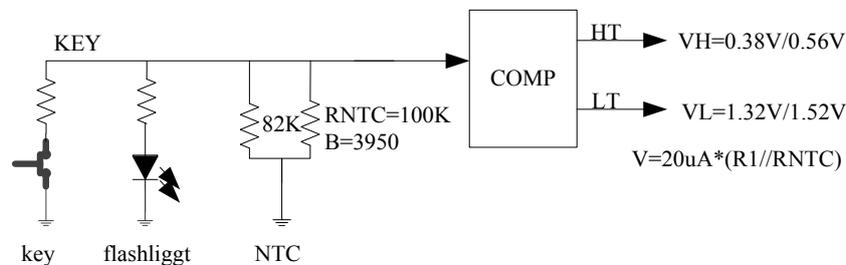
Key / Lights / NTC

IP5407's keys, lighting lamp drive, and NTC temperature detection are realized by time-multiplexing. Refer to the schematic diagram in Figure 5

IP5407 can recognize long and short button operation

- The key duration is longer than 50ms, but less than 2s, which is a short press action. A short press will turn on the power indicator and boost output.
- If the key is pressed for longer than 2s, it is a long-press action. A long-press will turn the lighting LED on or off.
- There will be no response when the key action is less than 50ms.

IP5407 integrates NTC function to detect battery temperature. When IP5407 is working, NTC PIN outputs a current of 20uA. At the same time, it detects the voltage of the NTC PIN to determine the current battery temperature.

Figure 5 Schematic diagram of key, lights, NTC

In the charging state: When NTC PIN detects a voltage of 1.32V, it means that the battery is 0 degrees , and stops charging the battery;

When NTC PIN detects a voltage of 0.56V, it means that the battery is at 45 degrees, and stops charging the battery;

In the discharge state:When NTC PIN detects a voltage of 1.52V, it means that the battery is -15 degrees low, and stops charging to discharge to the outside;

When NTC PIN detects a voltage of 0.38V, it means that the battery is 60 degrees, and stops discharging to the outside;

If the project does not require NTC, you need to connect the KEY pin to a 51K resistor to GND. Otherwise, it may cause abnormal charging and discharging. When the IP5407 detects a key press, it will maintain the NTC detection result before the key is pressed, and the NTC detection returns to normal after the key is released.

Light display mode
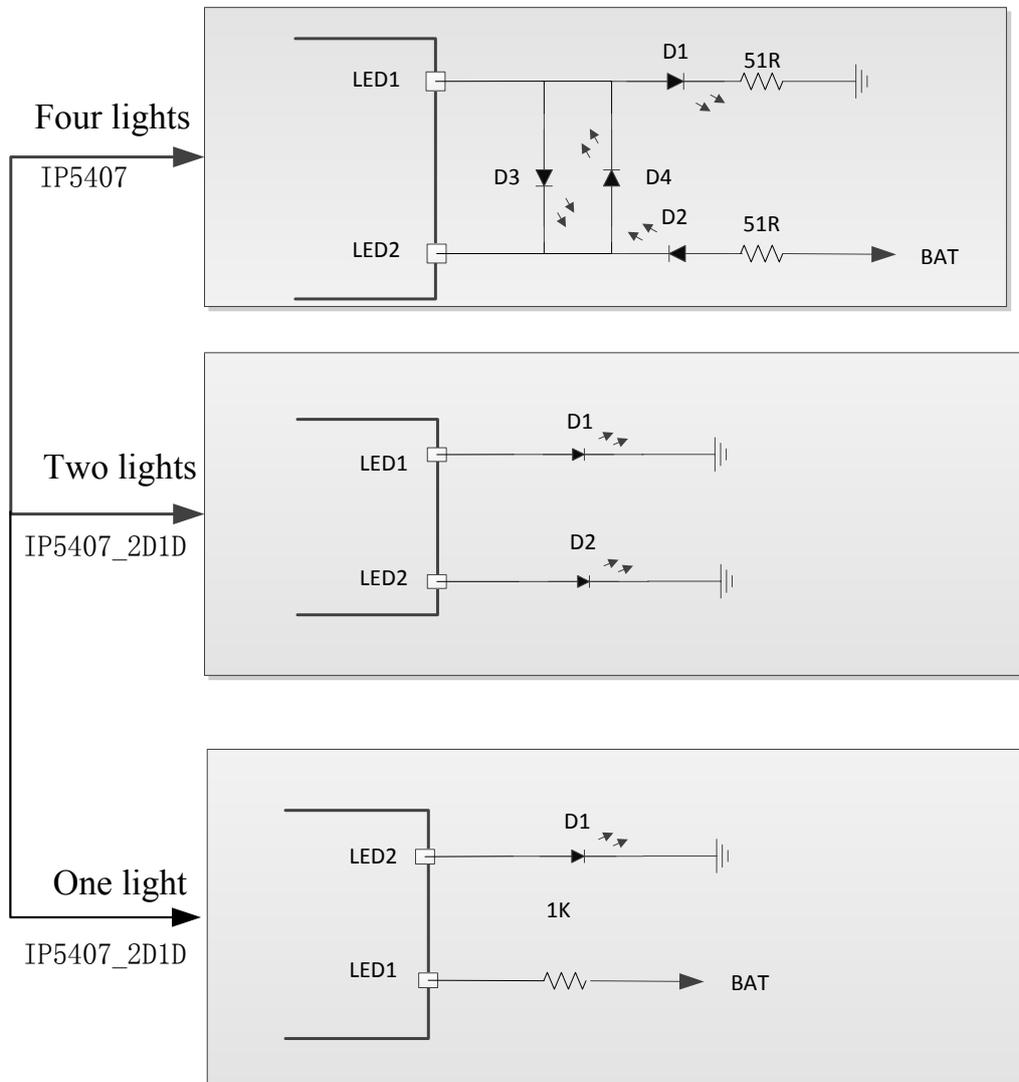
Figure 6 LED display mode

■ **4 light mode (IP5407 standard only supports 4 lights)**

Discharge

battery capacity C(%)	D1	D2	D3	D4
C≥75%	ON	ON	ON	ON
50%≤C＜75%	ON	ON	ON	OFF
25%≤C＜50%	ON	ON	OFF	OFF
3%≤C＜25%	ON	OFF	OFF	OFF
0%＜C＜3%	1Hz Flash	OFF	OFF	OFF

Charge

battery capacity C(%)	D1	D2	D3	D4
battery full	ON	ON	ON	ON
75%≤C	ON	ON	ON	0.5Hz Flash
50%≤C＜75%	ON	ON	0.5Hz Flash	OFF
25%≤C＜50%	ON	0.5Hz Flash	OFF	OFF
C＜25%	0.5Hz Flash	OFF	OFF	OFF

■ **2 light mode（Custom model： IP5407_2D1D）**

	status	D1	D2
Charge	charging process	ON	OFF
	battery full	OFF	OFF
Discharge	regular discharge	OFF	ON
	low battery	OFF	1Hz Flash

■ **1 light mode （Custom model ： IP5407_2D1D）**

	status	D1
Charge	charging process	0.5HZ Flash
	battery full	ON
Discharge	regular discharge	ON
	low battery	1Hz Flash

## Mobile phone charging current intelligent identification DCP

IP5407 integrates the intelligent identification of mobile phone charging current, automatically switches the D + and D- line connection for the connected mobile phone device, so that the mobile phone charging current is adapted to the maximum value, and the mobile phone is charged faster.

Support D+D- short USB dedicated charging port

Support D + application 2.7V voltage, D- application 2.7V voltage Apple 2.4A charging port

12 Typical application schematic

　　IP5407 only need inductor, capacitor, resistor to achieve a complete function of the mobile power solution
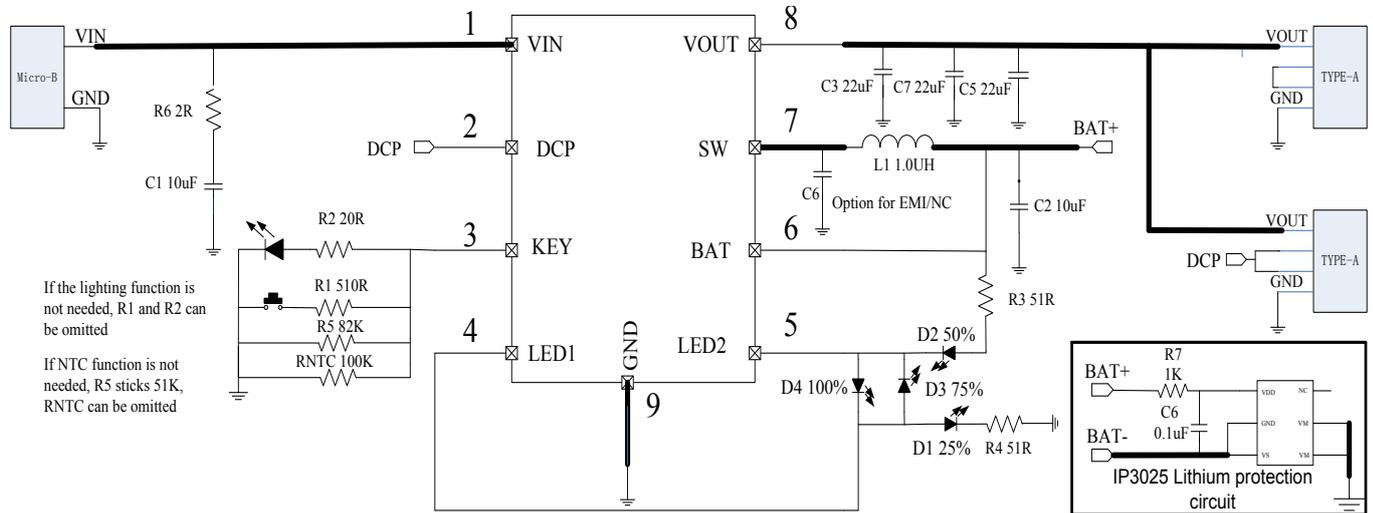
**Figure 7　4LED power display typical application schematic**

Recommended inductor models:SPM70701R0

DARFON PIN	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
			Typ.	Max.	Idc(A)Max.	Isat(A)Max.	
SPM70701R0	1.0	±20%	8.5	8	10	12	

Recommended lithium battery IC models

INJOINIC	Pack age	Overcharge Detection Voltage [VCU] (V)	Overdischarge Detection Voltage [VDL] (V)	Overcurrent Detection Current [IOV] (A)
IP3025A	SOT23-6	4.3V	2.5V	7A

13 Package information.
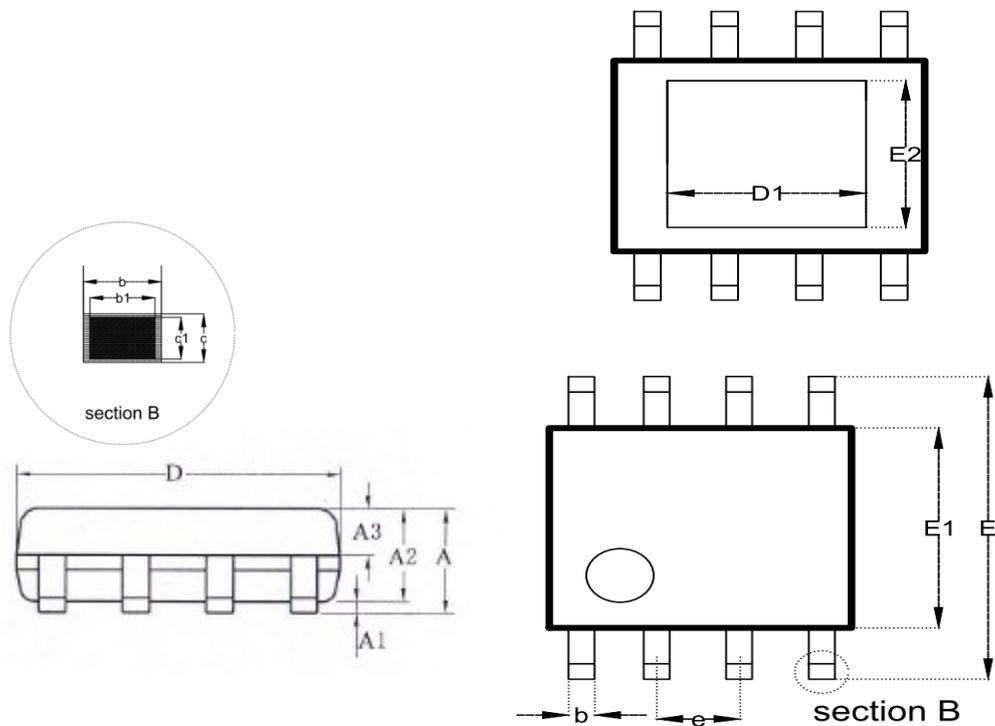
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.65
A1	0.05	--	0.15
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	--	0.48
b1	0.38	0.41	0.43
c	0.21	--	0.25
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
L	0.50	0.60	0.80
L1	1.05BSC		
θ	0	--	8º
D1	--	2.09	--
E2	--	2.09	--

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