

2.1A charging 2.4A discharging integrated DCP function mobile power SOC

1 Features

Synchronous switch charge

- and discharge 2.4A synchronous boost conversion, 2.1A synchronous switch charging boost efficiency up to
- 95% Charging efficiency up to 96%
- Built-in power path management, support charging and

discharging Adaptive charging current adjustment, matching all adapters

- Charging voltage accuracy: $\pm 0.5\%$; Support
- 4.20V, 4.30V, 4.35V and 4.4V batteries Support NTC temperature protection Power display Support

4 / 3 / 2 / 1 LED

- power display Battery power curve can be set, the display
- light is more uniform Function-rich built-in lighting driver Automatic

detection of

- mobile phone insertion and
- removal Integrated mobile phone charging
- current intelligent identification DCP low power consumption

Intelligent

- identification of load, automatic standby Standby
- power consumption is less than 50

μ A BOM minimalist

- power MOS built-in, single inductor to achieve charging and
- discharging 500K switching frequency, can support 1uH

inductor Multiple protections, high

- reliability Output overcurrent, overvoltage, short
- circuit protection Input overvoltage, overcharge, overdischarge,
- overcurrent discharge
- protection Whole machine overtemperature

protection ESD

- 4KV, instant withstand voltage 11V Deeply customized I2C interface, flexible and low-cost customized solutions

2 Applications

Mobile power/power bank

- mobile phones, tablets and other portable devices

3 Introduction

IP5209T is a multifunctional power management SOC that integrates boost converter, lithium battery charge management, and battery level indication, providing a complete power solution for mobile power.

The high integration and rich functions of **IP5209T** require only a few peripheral devices when applied, effectively reducing the size of the overall solution and lowering the **BOM** cost.

IP5209T only needs one inductor to realize buck and boost functions.

The **DC-DC** converter operates at 500KHz and can support low-cost inductors and capacitors.

The **IP5209T**'s synchronous boost system provides **2.4A** output current.

The conversion efficiency is as high as 95%. When no load, it automatically enters the sleep state and the quiescent current drops to **50uA**.

IP5209T adopts switch charging technology, provides **2.1A** current, and has a charging efficiency of up to 96%. The built-in IC temperature and input voltage intelligently adjust the charging current.

IP5209T can customize the battery charge curve and accurately display the battery charge. It supports 4, 3, 2, and 1 **LED** charge display and lighting functions.

IP5209T adopts **QFN24** package.

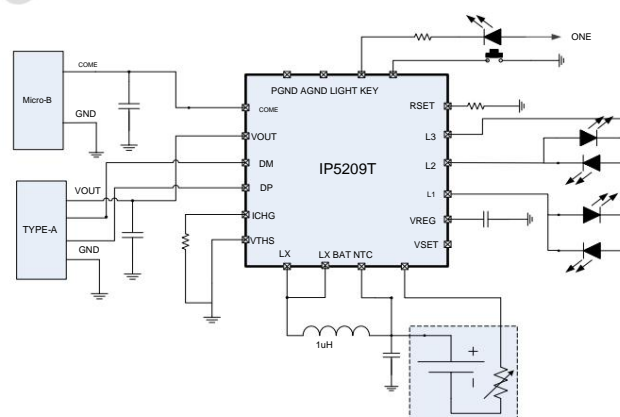


Figure 1 Simplified application schematic (4 LEDs indicating power)

4 Pin Definition

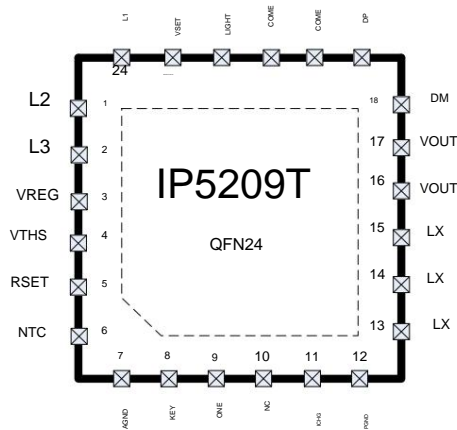


Figure 2 IP5209T pin diagram

Pinout		Description
Serial number	name	
1	L2/SDA Battery indicator driving pin L2, SDA for I2C function	
2	L3 Power light drive pin L3	
3	VREG chip 3.1V voltage output	
4	VTHS cell platform selection	
5	RSET Battery internal resistance compensation, can fine-tune the power curve	
6	NTC thermistor detection pin	
7	AGND Analog ground	
8	KEY key input pin	
9	VBAT boost input pin, connected to the positive electrode of the lithium battery.	
10	NC	NC
11	ICHG external resistor adjusts charging current	
12	PGND Power Ground	
13~14~15	LX	DCDC switch node, connect inductor
16~17	VOUT	5V boost output pin
18	DM	USB D-
19	DP	USB D+
20~21	COME	DC5V charging input pin
22	LIGHT Lighting drive pin, open drain output	
23	VSET Battery type setting	
24	L1/SCK The battery indicator drive pin L1, SCK for I2C function	
25(EPAD)	GND Power ground and heat dissipation ground, need to maintain good contact with GND	

5 IP Series Mobile Power IC Model Selection Table

IC Model	Discharge		main feature							Encapsulation	
	Discharge	Discharge and charge	LED <small>Number of lights</small>	Light button	I2C DCP	Type-C	QC certification	specification	compatible		
IP5303	1.0A 1.2A		1,2	ÿ	ÿ					eSOP8	2PIN PIN
IP5305	1.0A 1.2A	1,2,3,4		ÿ	ÿ					eSOP8	
IP5306	2.4A 2.1A	1,2,3,4		ÿ	ÿ					eSOP8	
IP5108	2.0A 2.0A	3,4,5		ÿ	ÿ	ÿ -				eSOP16	
IP5207T	1.2A 1.2A	3,4,5		ÿ	ÿ	ÿ ÿ				QFN24	
IP5109	2.1A 2.1A	3,4,5		ÿ	ÿ	ÿ -				QFN24	PIN2PIN
IP5209	2.4A 2.1A	3,4,5		ÿ	ÿ	ÿ ÿ				QFN24	
IP5209T	2.4A 2.1A	1,2,3,4		ÿ	ÿ	ÿ ÿ				QFN24	
IP5219	2.4A 3A	1,2,3,4		ÿ	ÿ	ÿ ÿ		ÿ		QFN24	
IP5312	15W 4A	2,3,4,5		ÿ	ÿ	ÿ ÿ			ÿ	QFN32	
IP5318Q	18W 4.8A	2,3,4,5		ÿ	ÿ	ÿ ÿ			ÿ	QFN40	PIN2PIN
IP5318	18W 4.8A	2,3,4,5		ÿ	ÿ	ÿ ÿ		ÿ	ÿ	QFN40	

6 Limit parameters

	symbol	value	unit
Parameter port input voltage range	COME	-0.3 ~ 5.5	IN
Junction temperature range	TJ	-40 ~ 150	°C
Storage temperature range	Tstg	-60 ~ 150	°C
Thermal resistance (junction to ambient)	θJA	40	°C/W
Human Body Model (HBM)	ESD	4	KV

* Stresses above those listed under the Absolute Maximum Ratings section may cause permanent damage to the device.

Excessive exposure time may affect the reliability and service life of the device

7 Recommended working conditions

parameter	symbol	Minimum	Typical Value	Maximum	unit
Input voltage	COME	4.75	5	5.5	IN
Load current	I	0	2.4		A

*Device operational characteristics are not guaranteed outside these operating conditions.

8 Electrical characteristics

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

parameter	symbol	Test Conditions	Minimum value	typical value	maximum value	unit
Charging System						
Input voltage	COME		4.75	5	5.5	IN
Input operating current	EVEN	VIN=5V, f _{sw} =750KHz			2 mA	
Input Quiescent Current		VIN=5V, Device not switching		100		μA
Charging target voltage	VTRGT			4.2		IN
recharging current	ICHRG			2.1		A
Trickle charge current	ITRKL	VIN=5V, V _{BAT} =2.7V		100		mA
Trickle cut-off voltage	VTRKL			3		IN
Recharge Threshold	TOP			4.1		IN
Charging deadline	TEND			24		Hour
Input undervoltage protection	VUVLO rising	voltage		4.5		IN

Undervoltage protection hysteresis	VUVLO			200		mV
Boost system						
Battery operating voltage	VBAT		3.0		4.4	IN
Switching battery input	DIFFERENT	VBAT=3.7V VOUT=5.1V fs=750KHz		3		mA
Current		VIN=5V Device not switching		100		uA
DC output voltage	VOUT VBAT=3.7V			5.0		IN
Output voltage ripple	VOUT VBAT=3.7V VOUT=5.0V fs=500KHz			50		mV
Boost system supply current IUSB				2.4		A
Load overcurrent detection time	TUVD output voltage continues to be lower than 4.4V			30		ms
Load short circuit detection time	TOCD output current continues to be greater than 3.5A		150		200	us
Control System						
On-off level	fs			500		KHz
PMOS on-resistance	rDS(on)			25		mΩ
NMOS on-resistance				15		mΩ
VREG output voltage VREG VBAT=3.5V				3.1		IN
Battery input standby current ISTB		VIN=0V VBAT=3.7V		50		uA
LDO Output Current	IN LINE			50		mA
LED lighting drive current Ilight				25		mA
LED display driving current	IL1 IL2 IL3 IL4			10		mA
Load automatic detection time	TloadD Load current is continuously less than 45mA			32		s
Short key wake-up time TONDebounce				50		ms
Turn on the light time	TKeylight			2		s
Thermal shutdown temperature	TOTP Rising Temperature			125		°C
Thermal shutdown temperature hysteresis ΔTOTP				40		°C

9 Functional Description

Boost

IP5209T integrates a boost DCDC converter with an output of 5V and a load capacity of 2.4A. The switching frequency is 500KHz and the Input, 5V/1A efficiency is 94%. Built-in soft start function to prevent malfunction caused by excessive inrush current at startup.

Output over-current, short circuit, over-voltage, over-temperature and other protection functions ensure stable and reliable operation of the system.

Charge

IP5209T has a constant current and constant voltage lithium battery charger with synchronous switching structure. When the battery voltage is less than 3V, a 100mA trickle current Charging; When the battery voltage is greater than 3V, it enters constant current charging, and the VIN input current limiting loop takes effect; When the battery voltage is greater than 4.2V, it enters constant voltage charging Charge. After charging is completed, if the battery voltage is lower than 4.1V, restart the battery charging.

IP5209T adopts switching charging technology, with a switching frequency of 750KHz, a maximum charging current of 2.1A, and a charging efficiency of up to 96%, which can shorten 3/4 of the charging time.

Adaptive power path management, supporting charging and discharging at the same time.

The IP5209T charger will automatically adjust the charging current to accommodate adapters with different load capacities, ensuring that the adapter is not hung.

IP5209T supports external ICHG PIN external resistor to adjust charging current

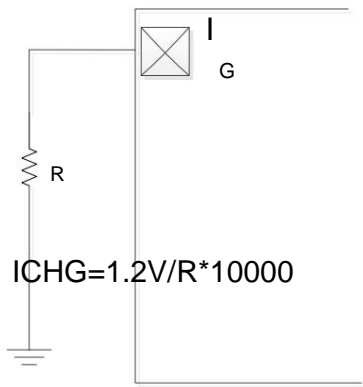


Figure 3 External resistor to adjust charging current

Typical current recommended resistance:

ICHG terminal resistance Kohm corresponds to the charging input current	
120K	1A
100K	1.2A
82K	1.5A
51K	2.4A
NC	Default value 1.9A

button

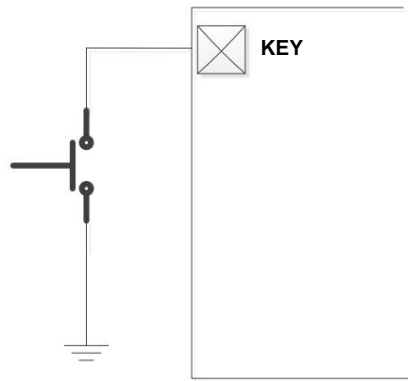


Figure 4 KEY button

The key connection method is shown in Figure 3, which can identify long key press and short key press operations.

If the button is pressed for longer than 60ms but less than 2s, it is a short press action. A short press will turn on the power indicator light and boost output.

If the button is pressed for longer than 2 seconds, it is considered a long press, which will turn the lighting LED on or off.

Key presses shorter than 60ms will not have any response.

Pressing the button twice within 1 second will turn off the boost output, power display and lighting LED.

Light display mode

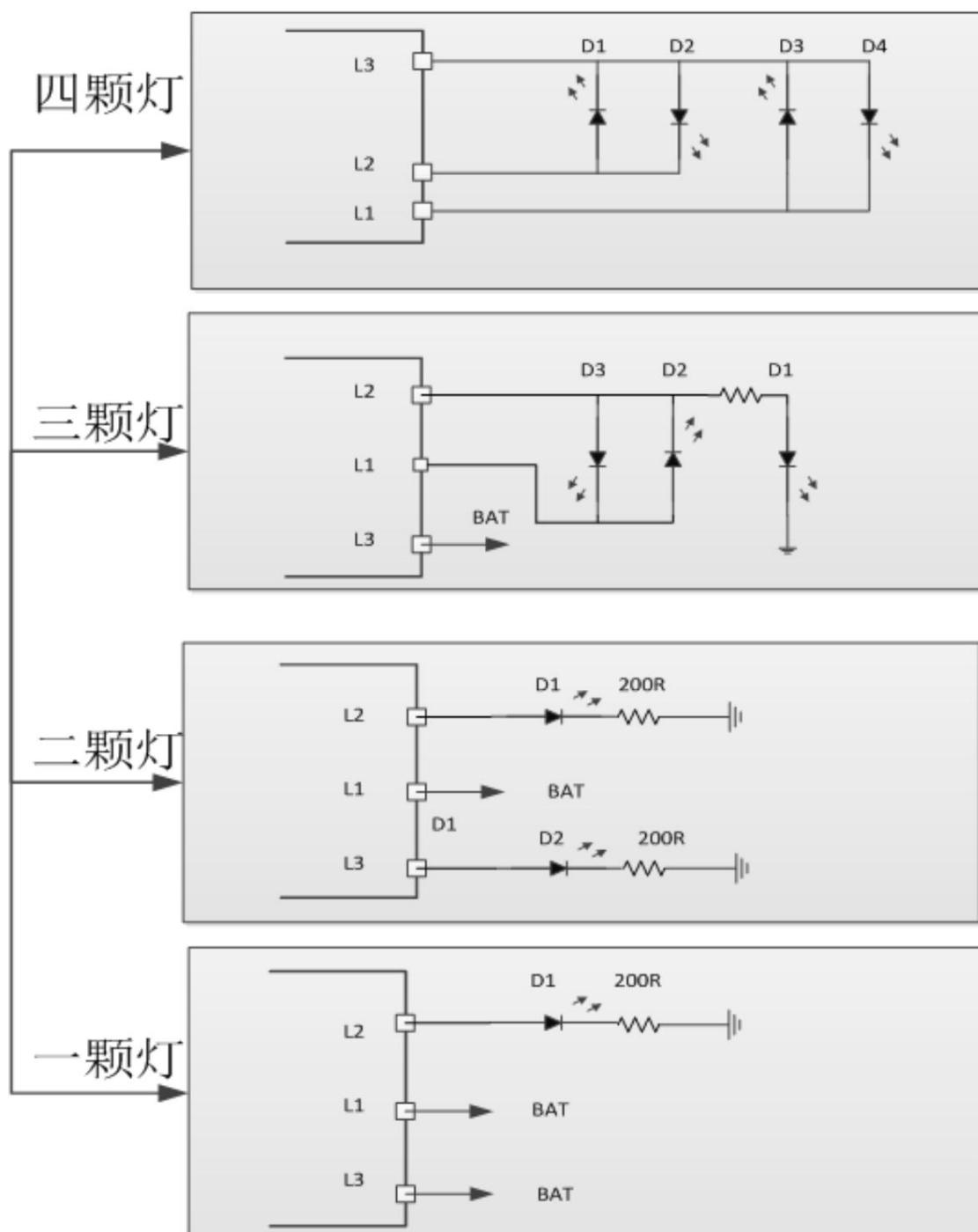


Figure 5 Light display mode



IP5209T

4 light modes

Discharge

Electricity C (%)	D1	D2	D3	D4
C \geq 75%	Bright	Bright	Bright	Bright
50% \leq C \leq 75%	Bright	Bright	Bright	Destroy
25% \leq C \leq 50%	Bright	Bright	Destroy	Destroy
3% \leq C \leq 25%	Bright	Destroy	Destroy	Destroy
0% \leq C \leq 3%	1.5Hz Flashing Off		Destroy	Destroy

Charge

Electricity C (%)	D1	D2	D3	D4
full	Bright	Bright	Bright	Bright
75% \leq C	Bright	Bright	On 1.5Hz Flashing	
50% \leq C \leq 75%	Bright	On 1.5Hz Flashing Off		
25% \leq C \leq 50%	On 1.5Hz Flashing Off			Destroy
C \leq 25%	1.5Hz Flashing Off		Destroy	Destroy

3 light modes

The three-light display method is similar to the four-light display method. The battery power corresponding to each light is as follows:

	D1	D2	D3	D4
Three lights	3%	66%	100%	none
Four lights	25%	50%	75%	100%

2 Light Mode

	state	D1	D2
Charging	Flashing during charging process		
	Full of light and dark		
Normal discharge	charge, off		
	Low power off flashing		

1 Light Mode

	Status	D1
Charging	Flashing during charging process	
	Full and bright	
Normal discharge	charge, bright	
	Low battery flashing	



IP5209T

Battery internal resistance setting

IP5209T can set the battery internal resistance through the RSET pin, thereby adjusting the uniformity of the LED power display.

The set battery internal resistance is shown in the following table.

RSET terminal resistance Kohm corresponds to the battery set internal resistance (mOhm)	
10K	45
43K	67.5
120K	112.5
200K	90
NC	22.5

Battery Platform Selection

IP5209T can set the battery level through the VTHS pin. When VTHS is connected to VREG, it is set to a high level 3.7V battery; VTHS

When connected to GND, it is set to a low platform 3.6V battery.

Automatic detection of mobile phone insertion

IP5209T automatically detects when a mobile phone is inserted, wakes up from standby mode immediately, and turns on the 5V boost to charge the phone, eliminating the need for keystrokes.

Supports buttonless mold solution. If you do not need the automatic power-on function when the phone is inserted, you need to specify it when ordering the IC and set it to VOUT.

Pull down 1k resistor to GND.

Smart identification of mobile phone charging current DCP

IP5209T integrates the intelligent recognition function of mobile phone charging current, automatically switching the D+ and D- line connections for the connected mobile phone device, making the mobile phone

The charging current is adapted to the maximum value to speed up the charging of the mobile phone.

IP5209T supports D+, D- switching of Apple, Samsung and BC1.2 interface specifications.

Supports USB dedicated charging port with D+D- short circuit

Supports Apple 1.0A charging port with 2.0V voltage for D+ and 2.7V voltage for D-

Supports Apple 2.0A charging port with 2.7V voltage for D+ and 2.0V voltage for D-

Supports Samsung 2.0A charging port with 1.2V voltage applied to D+ and 1.2V voltage applied to D-

Supports Apple 2.4A charging port with 2.7V voltage for D+ and 2.7V voltage for D-

Battery Type Selection

IP5209T can set the battery type through the VSET pin. When VSET is left floating, it is set to a 4.2V battery; when VSET is connected to GND,

Set to 4.35V battery; when VSET is connected to VBAT, set to 4.4V battery.

NTC function

IP5209T integrates NTC function, which can detect battery temperature; when IP5209T is working, NTC PIN outputs 20uA

The current is measured and the voltage of the NTC PIN is detected to determine the current battery temperature.

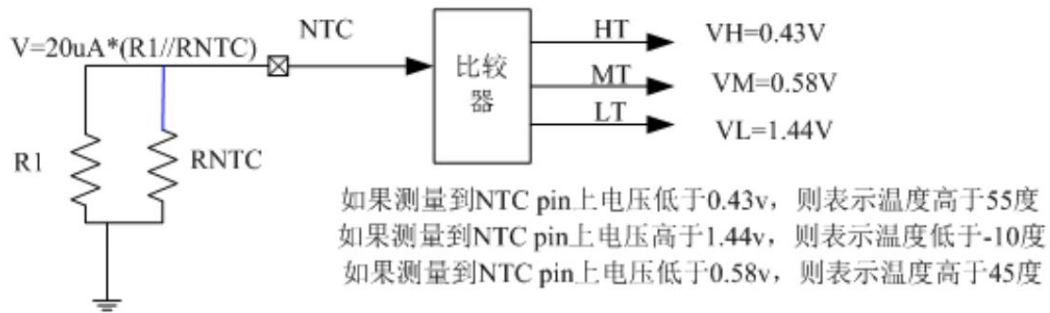


Figure 6 Battery NTC comparison

When the NTC detects that the temperature is within the range of -10 to 45 degrees, the charging and discharging will be normal. When the temperature is higher than 45 degrees, the charging current is reduced by half.

When the temperature is higher than 55 degrees, stop charging and discharging. When the temperature is lower than -10 degrees, stop charging and discharging.

If the solution does not require NTC, the NTC pin needs to be connected to GND. The NTC pin cannot be left floating, otherwise it may cause abnormal charging and discharging.

LIGHTLighting

IP5209T has built-in MOS tube for lighting driver. LIGHT PIN can directly drive lighting LED with maximum driving current of 100mA.

Press the KEY key for more than 2 seconds to turn the LED lighting on or off.

When the solution does not have the lighting function, connect the LIGHT PIN to GND, and IP5209T will automatically detect that there is no LIGHT lighting function.

VREG

VREG is a 3.1V LDO. When the IC is in working state, VREG outputs 3.1V. In sleep state, there is no output. The load capacity is 5mA.

10 Typical application schematic diagram

IP5209T only needs inductors, capacitors, and resistors to realize a fully functional mobile power solution.

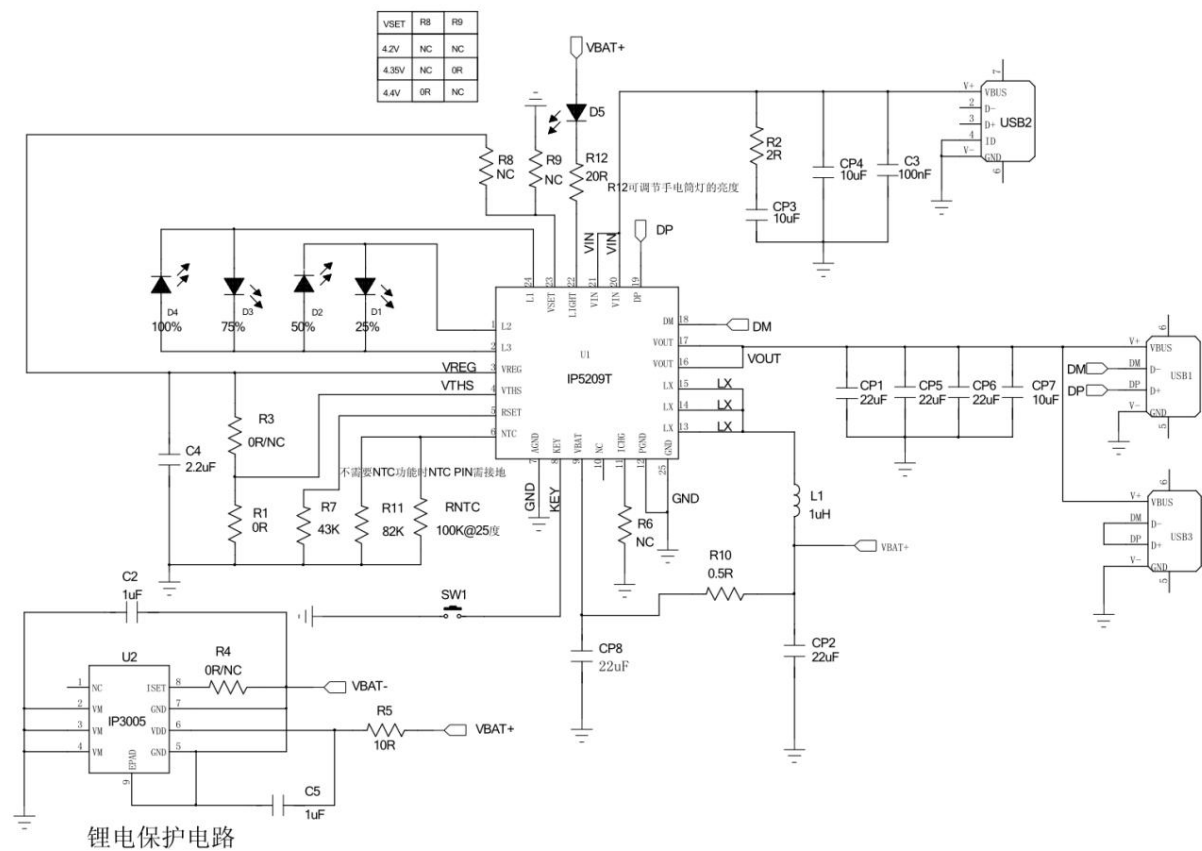


Figure 6 4LED power display typical application schematic

Recommended inductor model

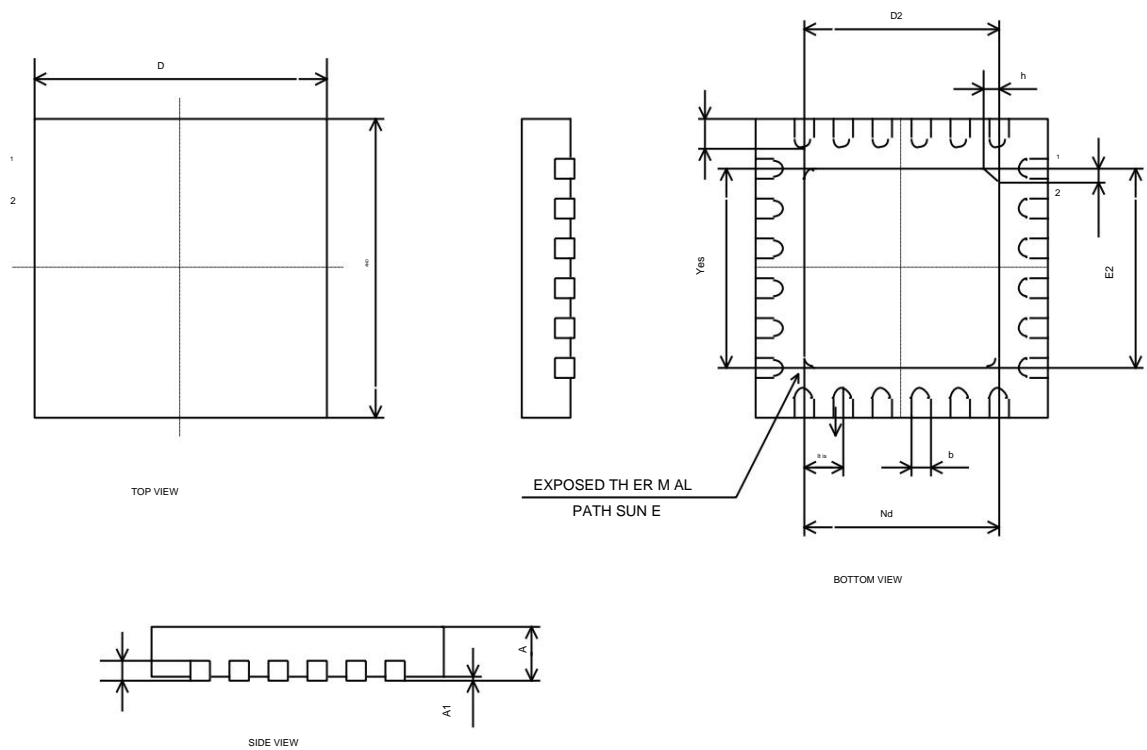
SPM70701R0

DARFON PIN	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
			Type.	Max.	Idc(A)Max.	Isat(A)Max.	
SPM70701R0	1.0	±20%	8.5	8	12	15	

Lithium battery IC recommended models

INJOINIC	Pack age	Overcharge Detection Voltage [VCU] (V)	Overdischarge Detection Voltage [VDL] (V)	Overcurrent Detection Current [IOV] (A)
IP3005A	ESOP8	4.28V	2.5V	7A

12 Packaging Information



SYMBOL	MILLIMETER		
	MIN	NAME	MAX
A	0.70	0.75	0.80
A1		0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	2.40	2.50	2.60
It is	0.50BSC		
Yes	2.50BSC		
Nd	2.50BSC		
AND	3.90	4.00	4.10
E2	2.40	2.50	2.60
L	0.35	0.40	0.45
h	0.30	0.35	0.40

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