

Fully-integrated Power Bank System-On-Chip with 1.2A charger, 1.2A boost converter and DCP support

1 Features

- **Synchronous switching charger and synchronous boost converter**
 - ◇ 1.2A synchronous switching charger, 1.2A synchronous boost converter
 - ◇ boost converter efficiency up to 93%
 - ◇ Switching charger efficiency up to 92%
 - ◇ Integrated power-path management, charging batteries and charging cellphones at the same time
- **Charger**
 - ◇ Adaptive charging current control, excellent adapter compatibility
 - ◇ Support 4.20V, 4.35V and 4.4V batteries
 - ◇ Support battery thermal protection (with NTC resistor)
- **State of charge (SOC) indicator**
 - ◇ Integrated LED controller supports 4/3/2/1 LEDs as the SOC indicator
 - ◇ Configurable charging/discharging curve makes the SOC indicate LEDs more even
- **Fully featured**
 - ◇ Integrated flashlight controller
 - ◇ Integrated cellphone plug-in and plug-out detector
 - ◇ Integrated DCP (Dedicated Charging Port) controller monitors USB data line voltage and automatically provides the correct electrical signatures on the data lines to charge compliant devices
- **Low power**
 - ◇ Smart load detector, switching to standby mode automatically
 - ◇ <100 μ A standby current
- **Ultra simplified BOM**
 - ◇ Integrated power FET, charging/boosting with a single inductor
 - ◇ Supports 1 μ H inductor
- **Multiple protections, high reliability**
 - ◇ Output over-current, over-voltage, short-circuit protection
 - ◇ Input over-voltage, over-current, battery over-charge, over-drain, over-current protection
 - ◇ Thermal regulation and thermal shutdown,

- ◇ battery NTC protection
- ◇ ESD 4KV, maximum 11V transit over-voltage sustainable

2 Applications

- Power bank, Portable Charger
- Mobile Phones, Smart Phones, Handheld Devices, Portable Media Player, Tablet

3 Description

IP5207T is a fully-integrated multi-function power management SOC. It integrates a boost converter, a Li battery charger management system and a battery state of charge indicate controller. It provides a turn-key solution for power bank and portable charger applications.

IP5207T's high integration and rich features make the minimized component number in application. It can effectively downsize the application and lower the BOM cost.

IP5207T only needs a single inductor to realize step-down and step-up. Supporting of low-cost capacitors and inductors.

IP5207T's synchronous step-up converter provides 1.2A output current. Its efficiency is up to 96%. It can switch to standby mode at empty load automatically, the standby current reducing to 100 μ A.

IP5207T's synchronous switching charger provides 1.2A charging current. Its efficiency is up to 93%. It regulates the charging current by IC temperature and input voltage.

IP5207T has integrated a fuel gauge algorithm, acquiring battery's state of charge precisely.

IP5207T can customize battery's SOC curve, and indicate the SOC accurately, with the SOC indicator of 4/3/2/1 LEDs and flashlight function.

IP5207T is available in QFN24.

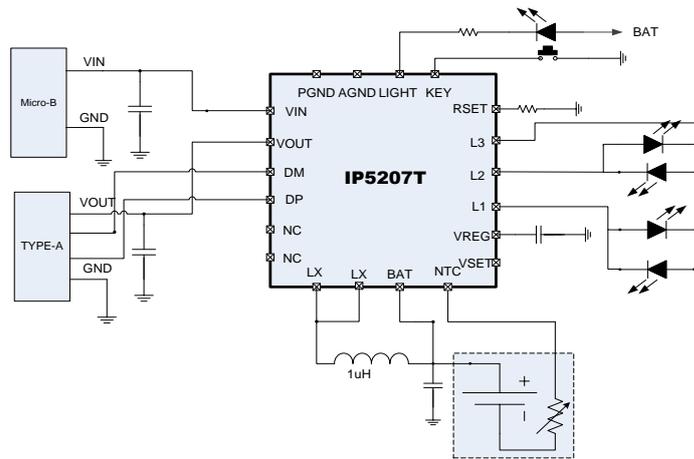


Fig 1 Simplified application schematic (4 LEDs as the SOC indicator)

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4 Pin definition

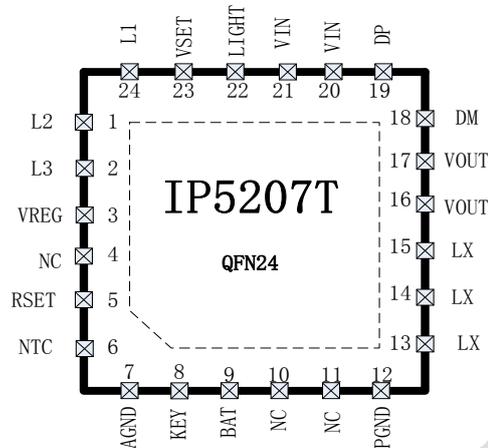


Fig 2 IP5207T Pin Diagram

Pin		Descriptions
Index	Name	
1	L2	Battery indicator pin2
2	L3	Battery indicator pin3
3	VREG	Regulator output pin
4	NC	No Connect
5	RSET	Battery resistance select
6	NTC	NTC pin
7	AGND	Analog gnd
8	KEY	Key input pin
9	VBAT	Battery voltage sense pin
10	NC	No Connect
11	NC	No Connect
12	PGND	Power gound
13、14、15	LX	DCDC switch node, connect inductor
16、17	VOUT	DCDC 5v OUTPUT pin
18	DM	USB DM
19	DP	USB DP
20、21	VIN	Charger 5V input pin
22	LIGHT	LED lighting driver
23	VSET	Battery voltage select
24	L1	Battery indicator pin1
25	GND	EPAD, should be connected to GND

5 Absolute maximum ratings

Parameter	symbol	value	Unit
Port input voltage range	V_{IN}	-0.3 ~6	V
Junction temperature	T_J	-40 ~ 150	°C
Storage temperature	T_{stg}	-60 ~ 150	°C
Thermal resistance (from junction to ambient air)	θ_{JA}	40	°C/W
Human-body model (HBM)	ESD	4	KV

* Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device.

These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6 Recommended operation conditions

Parameter	symbol	MIN	Typical	MAX	Unit
Input voltage	V_{IN}	4.65	5	5.5	V
Load current	I	0	1.2		A

*Beyond these operation conditions, the device's performance will not be guaranteed

7 Electrical Characteristics

$T_A=25^{\circ}\text{C}$, $L=1\mu\text{H}$ unless otherwise noted

Parameter	symbol	Test condition	MIN	TYP	MAX	Unit
Charger system						
Input voltage	V_{IN}	$V_{BAT}=3.7\text{V}$	4.65	5	5.5	V
Input OVP voltage	V_{INOV}		5.51	5.6	5.8	V
CV charge voltage	$CV_{4.2V}$	VSET is floating	4.21	4.24	4.27	V
	$CV_{4.35V}$	VSET is connected to GND	4.36	4.38	4.42	V
	$CV_{4.4V}$	VSET is connected to VBAT	4.41	4.43	4.46	V
Stop charge current	I_{stop}	$V_{IN}=5\text{V}$	200	300	500	mA
Charge current	I_{CHRG}		1A	1.2	1.4	A
Trickle charge current	I_{TRKL}	$V_{IN}=5\text{v}$, $BAT=2.7\text{v}$	50	150	300	mA
Trickle charge stop voltage	V_{TRKL}		2.9	3	3.1	V

Recharge threshold	V_{RCH}		4.08	4.1	4.13	V
Charger safety timer	T_{END}		20	24	27	Hour
Boost system						
Battery operation voltage	V_{BAT}		3.0		4.4	V
Low Battery voltage	V_{BATLOW}	$I_{out}=1A$	2.85	2.95	3.1	V
Battery operation current	I_{BAT}	$V_{BAT}=3.7V$, $V_{OUT}=5.1V$, $f_s=500KHz$	2	5	20	mA
DC-DC output voltage	V_{OUT}	$V_{BAT}=3.7V$ @0A	5.0	5.12	5.25	V
		$V_{BAT}=3.7V$ @1.2A	4.75	5	5.25	V
Output voltage ripple	ΔV_{OUT}	$V_{BAT}=3.7V$, $V_{OUT}=5.0V$, $f_s=500KHz$	50	100	200	mV
Boost output current	I_{vout}		0	1.2		A
Boost output shutdown current	I_{off}		1.21	1.5	2	A
Load over-current detect timer	T_{UVD}	Output voltage continuously lower than 4.4V	10	30	50	ms
Load short-circuit detect timer	T_{OCD}	Output current continuously larger than 3.5A	100	150	200	us
Control system						
Switching frequency	f_s	Boost switching frequency	400	500	600	KHz
		Charger switching frequency	650	750	850	MHz
PMOS on resistance	r_{DSON}		30	40	50	mΩ
NMOS on resistance			25	35	45	mΩ
PMOS between VIN and VOUT on resistance		$V_{IN}=5V$	60	75	90	mΩ
Battery standby current	I_{STB}	$V_{IN}=0V$, $V_{BAT}=3.7V$	50	80	120	uA
LED lighting current	I_{light}		20	30	40	mA
LED indicator current	I_{L1} I_{L2} I_{L3}		2	10	20	mA
Load removal detect timer	T_{loadD}	Load current continuously lower than 45mA	25	32	44	s
Fractional load to shutdown current	I_{plout}	$V_{BAT}=3.7V$	20	45	80	mA
Push-button wake-up timer	$T_{OnDebounce}$		25	32	44	ms
Push-button light-on timer	$T_{Keylight}$		1.2	2	3	s

Thermal shutdown	TOTP	Rising temperature	125	140	150	°C
Thermal shutdown hysteresis	Δ TOTP		30	40	50	°C

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8 Function description

Boost converter

IP5207T integrates a 5V output step-up DCDC converter with 1.2A output capacity. It works at 500KHZ. When input voltage is 3.7V, its efficiency is 93% with the output of 5V/1A. Internal soft-start circuit prevents malfunction caused by starting inrush current. It integrate short-circuit, over-voltage, over-voltage protection, making the system stable and reliable.

IP5207T's boost converter has a thermal regulation loop, which can adaptively regulate the output current to insure IC temperature below the set one.

Charger

IP5207T integrates a synchronous constant-current and constant-voltage switching Li battery charger. When battery is below 3.0V, the charger is in trickle mode, and charging current is 100mA. When battery is above 3V, the charger turns to constant-current mode, and constant-voltage mode is used if battery voltage reaches 4.2V. When charge is over, recharge will begin if battery is below 4.1V.

IP5207T's switching charger has a 750KHZ switching frequency, and its maximum charging current is 1.2A, charging efficiency is up to 97%, shortening 3/4 charging time in comparison with the normal chargers.

IP5207T integrates an adaptive power-path management system with priority to output load. It can charge batteries as well as cellphones at the same time.

IP5207T's charger can adapt the charging current to the adapter of various load capacity, which can keep adapters away from malfunction.

Push Button

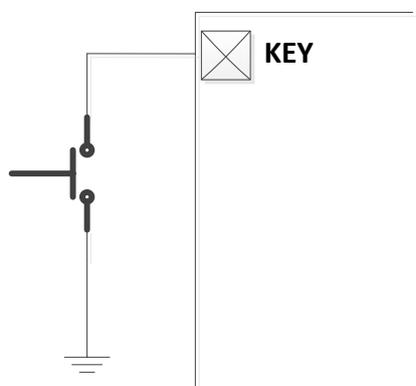


Fig 3 KEY button

Push button's connecting is shown in Fig 5. IP5207T can identify long push and short push.

- If button is pushed longer than 60ms but shorter than 2s, IP5207T will identify the action as short push. Short push will open SOC indicator LEDs and step-up converter
- If button is pushed longer than 2s, IP5207T will identify the action as long push. Long push will close step-up convertor, SOC indicator LED and flashlight LED.
- If button is pushed shorter than 60ms, IP5207T will ignore the action.
- If two short push is detected within 1s, IP5207T will open or close flashlight LED

Fuel gauge and State Of Charge (SOC) indication

IP5207T has an integrated fuel gauge, which can indicate the battery's state of charge accurately.

IP5207T can support 4/3/2/1 LEDs as the SOC indicator with very simple configuration. By the built-in identification algorithm, IP5207T can automatically identify how many LEDs are used as the SOC indicator.

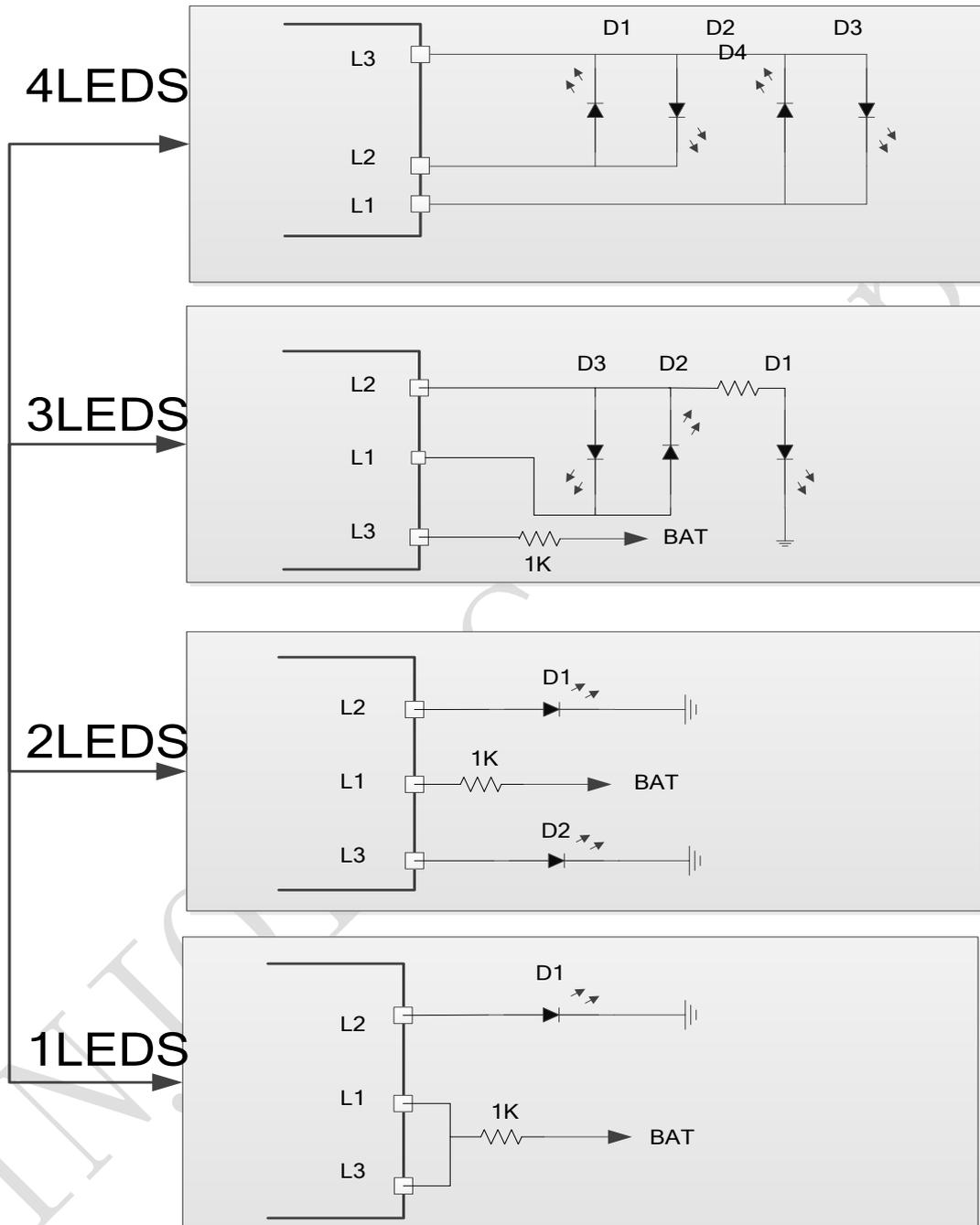


Fig 4 4/3/2/1 LED PIN configuration

Discharging mode, 4 LEDs as the indicator

SOC (%)	L1	L2	L3	L4
SOC ≥ 75%	ON	ON	ON	ON
50% ≤ SOC < 75%	ON	ON	ON	OFF
25% ≤ SOC < 50%	ON	ON	OFF	OFF

$3\% \leq \text{SOC} < 25\%$	ON	OFF	OFF	OFF
$0\% < \text{SOC} < 3\%$	1Hz blink	OFF	OFF	OFF
$\text{SOC} = 0\%$	OFF	OFF	OFF	OFF

Charging mode 4 LEDs as the indicator

SOC (%)	L1	L2	L3	L4
Full	ON	ON	ON	ON
$75\% \leq \text{SOC}$	ON	ON	ON	0.5Hz blink
$50\% \leq \text{SOC} < 75\%$	ON	ON	0.5Hz blink	OFF
$25\% \leq \text{SOC} < 50\%$	ON	0.5Hz blink	OFF	OFF
$\text{SOC} < 25\%$	0.5Hz blink	OFF	OFF	OFF

The displays of 3 LEDs are similar to that of 4 LEDs. The corresponding SOC of each LED is presented in the following table.

	D1	D2	D3	D4
3 LEDs	33%	66%	100%	NA
4 LEDs	25%	50%	75%	100%

■ 2 LED Display Mode

	Status	D1	D2
Charge	In charge	0.5HZ Blink	OFF
	End of charge	ON	OFF
Discharge	Boost	OFF	ON
	Low Battery	OFF	1HZ Blink

■ 1 LED Display Mode

	Status	D1
Charge	In charge	0.5HZ Blink
	Full charge	ON
Discharge	Boost	ON
	Low Battery	1HZ Blink

Battery impedance setting

IP5207T can set the battery impedance by RSET pin which make the SOC indicator LEDs display more evenly. The relationships between the resistance connected to RSET and battery impedance are shown in the following table.

RSET resistance Kohm	Battery impedance (mOhm)
10K	90
43K	135
120K	180
200K	60
NC	45

Automatic cellphone plug-in detect

IP5207T can automatically detect the cellphone's plug-in. When detecting the plug-in, IP5207T will wake up from standby mode and open the 5V step-up converter without push button action. IP5207T supports modules without push buttons.

Cellphone charging current smart detect

IP5207T integrates a DCP module which can smartly detect the cellphone's charging current. It automatically provides the correct signals on DP and DM. It makes the cellphone's charging current to the maximum, accelerating the charging speed on cellphone.

Battery voltage selection

IP5207T can support different batteries by changing the connecting of VSET PIN. When VSET is floating, 4.2V battery is set. When VSET is connected to GND, 4.35V battery is set. When VSET is connected to VREG, 4.4V battery is set.

NTC

IP5207T integrated NTC, and can detect battery pack temperature.

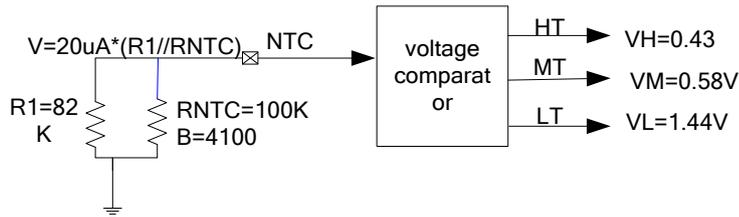


Fig5 Battery NTC threshold

Charge:

If NTC pin voltage > 1.44V, it indicates the battery temperature is below -10 °C, charger is stopped.

If NTC pin voltage < 0.58V, it indicates the battery temperature is higher 45 °C, half charging current is used.

If NTC pin voltage < 0.43V, it indicates the battery temperature is higher 55 °C, charger is stopped.

Discharge:

If NTC pin voltage > 1.44V, it indicates the battery temperature is below -10 °C, Output will be shutdown.

If NTC pin voltage < 0.43V, it indicates the battery temperature is higher 55 °C, Output will be shutdown.

If NTC function is not needed, the NTC pin should connect a 51K resistor to GND. The NTC pin cannot float otherwise may lead to abnormal.

Flash Light

IP5207T has an integrated MOS FET. LIGHT PIN in IP5207T can drive lighting LED directly. Maximum driving current is 100mA. When two short push is detected within 1s, lighting LED is opened or closed. If flash light is not needed, light should connect to GND, IP5207T will automatically close flash light.

9 Typical application schematic

IP5207T only needs capacitors, resistors, and inductors to realize a full featured power bank solution.

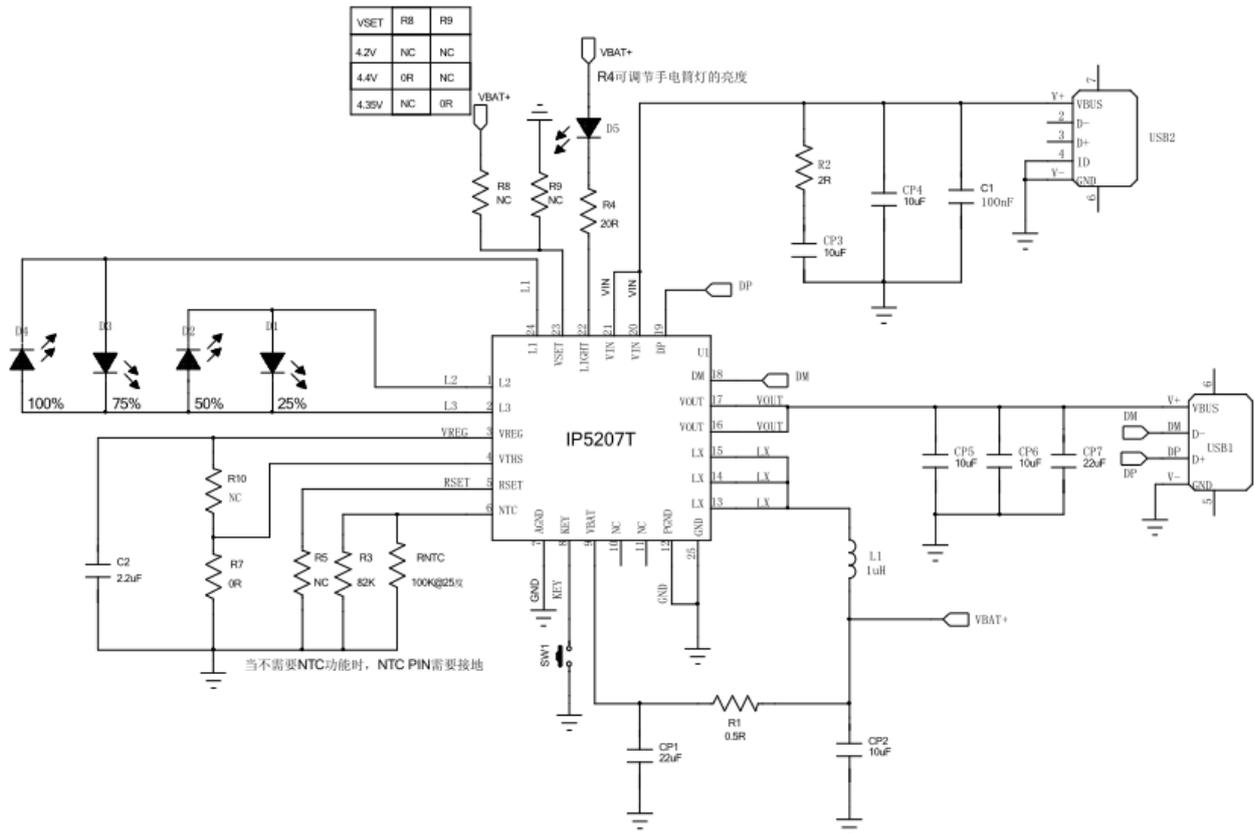
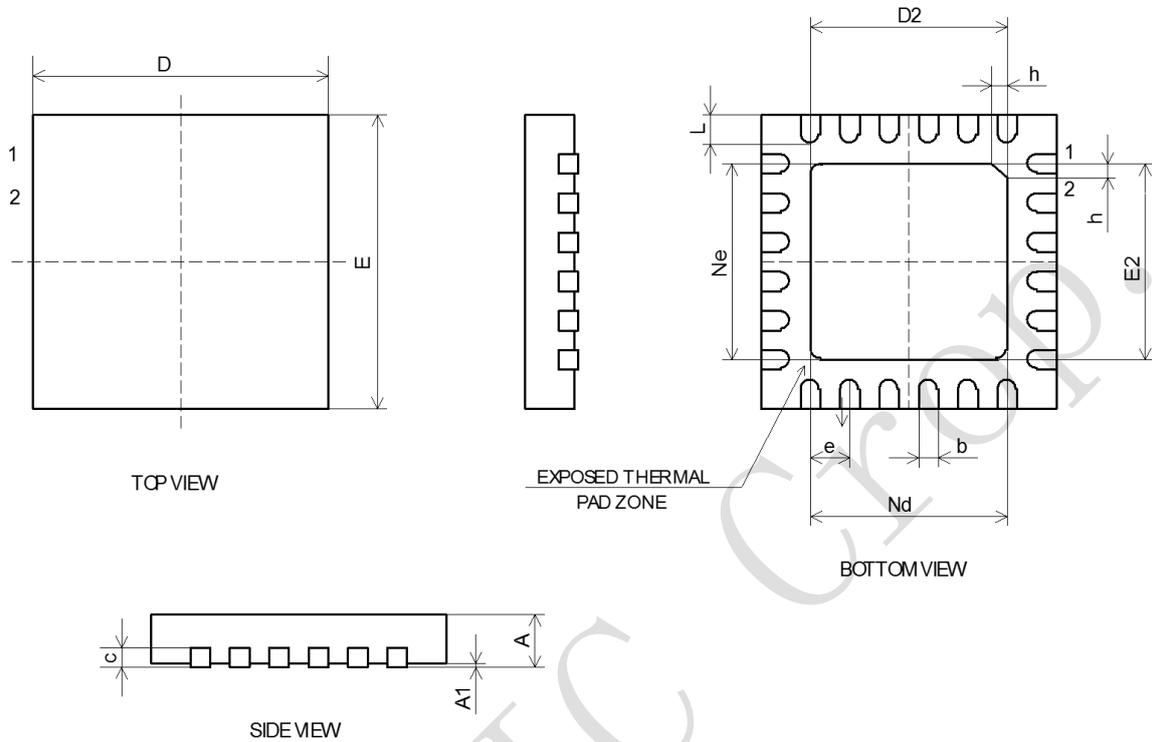


Fig 4 LEDs SOC indicator typical application schematic

Recommended inductor
 SPM50501R0

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.	
SPM50501R0	1.0	±20%	43	47	4.2	5.2	

10 Package information



SYMBOL	MILLIMETER		
	MIN	NOM	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
e	0.50BSC		
Ne	2.50BSC		
Nd	2.50BSC		
E	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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