2.1A charge, 2.4A Boost, integrated TYPE_C protocol, Power Bank SOC

1 Features

- **Switch buck charger and boost**
  - ✧ 2.1A Synchronous switching charger and 5V 2.4A 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
  - ✧ 2.1A charging
  - ✧ Support 4.20/4.35/4.40V batteries
  - ✧ Support battery temperature NTC comparison
- **State of charge (SOC) indicator**
  - ✧ Integrated LED controller supports 4/3/2/1 LEDs as the SOC indicator
  - ✧ The battery power curve can be set, and the display light is more uniform
- **Fully featured**
  - ✧ Automatically detect phone insertion and removal
  - ✧ Integrated TYPE-CDRP protocol, supports single-port input and output
  - ✧ Support load high current line compensation function
- **Low power**
  - ✧ Smart load detector, switching to standby mode automatically
  - ✧ <100 μA standby current
- **Ultra simplified BOM**
  - ✧ Integrated power FET, charging/boosting with a single 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 Shutdown, battery temperature NTC protection
  - ✧ ESD 4KV
- Deep customization
  - ✧ I2C interface, flexible and low-cost customized solutions

2 Applications

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

3 Description

IP5219 is a multi-function power management SOC with integrated boost converter, lithium battery charge management, battery power indication and TYPE_C protocol, providing a complete power solution for mobile power.

IP5219's high degree of integration and rich functions make it only require very few peripheral devices in application, and effectively reduce the size of the overall solution and reduce BOM cost.

IP5219 requires only one inductor to implement buck and boost functions, which can support low-cost inductors and capacitors.

IP5219's synchronous boost system provides a full 2.4A output current with a conversion efficiency as high as 93%. When no-load, it automatically enters the sleep state, and the quiescent current drops to 100uA.

IP5219 uses switch charging technology to provide a maximum current of 2.1A, and the

charging efficiency is as high as 92%. Built-in IC temperature and input voltage intelligently adjust the charging current.

IP5219 supports custom I2C interface to read chip information (custom model IP5219_12C), can customize battery power curve, and can accurately display battery power. Support 1/2/3/4 LED power display and lighting function

IP5219 in QFN24 package

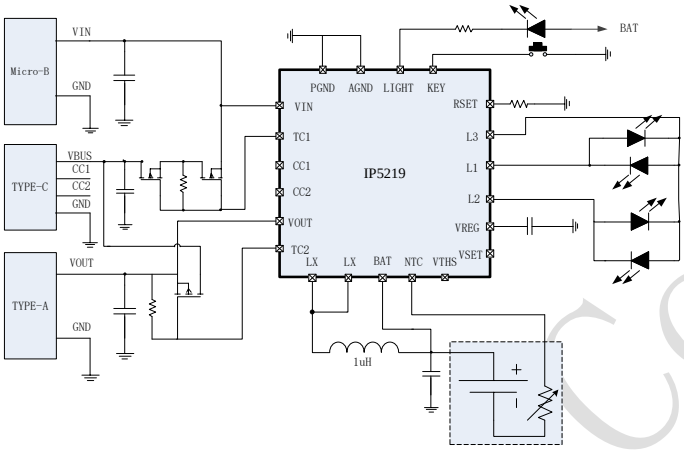


Figure1 Simplified application schematic (4LED indicates power)

4 Pin Definition

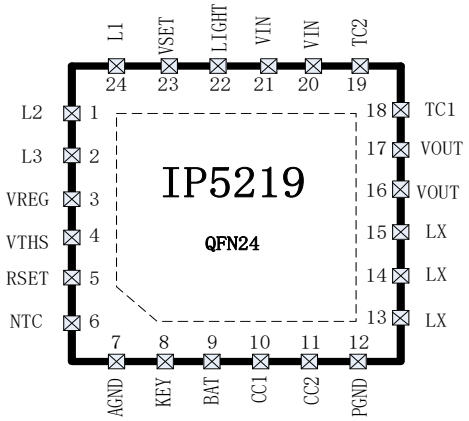


Figure2 IP5219 pin diagram

pin		Descriptions
Index	name	
1	L2/SDA	Battery indicator pin2,I2C function is SDA
2	L3	Battery indicator pin2
3	VREG	Chip 3.1V voltage output
4	VTHS	Battery OCV select
5	RSET	Battery resistance select
6	NTC	NTC pin
7	AGND	Analog gnd
8	KEY	Key input pin
9	BAT	Battery voltage sense pin
10	CC1	TYPE-C detection pin CC1
11	CC2	TYPE-C detection pin CC2
12	PGND	Power gound
13、14、15	LX	DCDC switch node，connect inductor
16、17	VOUT	DCDC 5v OUTPUT pin
18	TC1	VBUS charge input PMOS control pin.
19	TC2	VBUS charge input PMOS control pin.
20、21	VIN	Charger 5V input pin
22	LIGHT	LED lighting driver，Open-drain output.
23	VSET	Battery voltage select
24	L1/SCK	Battery indicator pin1，I2C function is SCK
25(EPAD)	GND	EPAD，should be connected to GND

5 The PartList of PowerBank SOC

PartNum	charger	Boost	Main Feature								Package	
			LEDs	Torch	KEY	I2C	DCP	USB C	Quick Charge	PD3.0 /PPS		
IP5303T	1.0A	1.2A	1,2	√	√	-	-	-	-	-	ESOP8	PIN2PIN
IP5305T	1.0A	1.2A	1,2,3,4	√	√	-	-	-	-	-	ESOP8	
IP5306	2.4A	2.1A	1,2,3,4	√	√	√	-	-	-	-	ESOP8	
IP5306H	2.4A	2.1A	1,2,3,4	√	√	√	-	-	-	-	ESOP8	
IP5406T	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
IP5209	2.4A	2.1A	3,4,5	√	√	√	√	-	-	-	QFN24	
IP5209U	2.4A	2.1A	3,4,5	√	√	√	√	-	-	-	QFN24	
IP5207T	1.2A	1.2A	1,2,3,4	√	√	√	√	-	-	-	QFN24	PIN2PIN
IP5189T	2.1A	2.1A	1,2,3,4	√	√	√	√	-	-	-	QFN24	
IP5189TH	2.1A	2.1A	1,2,3,4	√	√	√	√	-	-	-	QFN24	
IP5310	3.1A	3.0A	1,2,3,4	√	√	√	√	√	-	-	QFN32	
IP5506	2.4A	2.1A	nixie tube	√	√	-	-	-	-	-	ESOP16	
IP5508	2.4A	2.1A	nixie tube	√	√	-	√	-	-	-	QFN32	
IP5330	3.1A	3.0A	nixie tube	√	√	-	√	√	-	-	QFN32	
IP5566	3.1A	3.0A	1,2,3,4	√	√	-	√	√	-	-	QFN40	
IP5322P	18W	4.0A	1,2,3,4	√	√	√	√	-	√	-	QFN32	
IP5332	18W	4.0A	1,2,3,4	√	√	√	√	√	√	√	QFN32	
IP5328P	18W	4.0A	1,2,3,4	√	√	√	√	√	√	√	QFN40	
IP5356	22.5W	5.0A	nixie tube	√	√	-	√	√	√	√	QFN40	
IP5358	22.5W	5.0A	nixie tube	√	√	-	√	√	√	√	QFN48	
IP5568	22.5W	5.0A	nixie tube	√	√	-	√	√	√	√	QFN64	

6 Absolute Maximum Ratings

Parameter	symbol	MIN	Typical
Port input voltage range	V_{IN}	-0.3 ~ 6	**V**
Operating free-air temperature range	T_J	-40 ~ 150	℃
Junction temperature	Tstg	-60 ~ 150	℃
Storage temperature	θ_{JA}	40	**℃/W**
Thermal resistance (from junction to ambient air)	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.

7 Recommended Operation Conditions

Parameter	symbol	MIN	Typical	MAX	Unit
Input voltage	V_{IN}	4.75	5	5.5	V
Load current	I	0	2.4		A

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

8 Electrical Characteristics

TA=25℃, L=1uH unless otherwise noted

Parameter	symbol	Test condition	MIN	TYP	MAX	Unit
Charger system						
Input voltage	V_{IN}		4.65	5	5.5	V
Target charge voltage	V_{TRGT}		4.16	4.2	4.24	V
Charge current	I_{CHRG}	BAT current.		2.1	2.4	A
Trickle charge current	I_{TRKL}	VIN=5v，BAT=2.7v		250		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
Input under-voltage protection	V_{UVLO}	Rising voltage	4.4	4.5	4.6	V
Input under-voltage protection hysteresis	V_{UVLO}			200		mV
Boost system						
Battery operation voltage	V_{BAT}		3.0		4.4	V
DC-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	50	100	150	mV
Boost output current	I_{vout}			2.4		A
Boost system overcurrent shutdown current			2.65	3.05	3.4	A
Load over-current detect timer	T_{UVD}	Output voltage continuously lower than 4.4V		30		ms
Load short-circuit detect timer	T_{OCD}	Output current continuously larger than 3.5A	150		200	us
Control system						
Switching frequency	fs	Boost Switching frequency	450	500	550	KHz
		Charge Switching frequency	650	700	750	KHz
PMOS on resistance	r_{DSON}		30	35	40	mΩ
NMOS on resistance			25	30	35	mΩ
VREG output voltage.	V_{REG}	VBAT=3.5V		3.1		V

Battery input standby current	I_{STB}	VIN=0V，VBAT=3.7V	45	75	100	uA
LDO output current.	I_{LDO}		5	5	10	mA
LED lighting drive current	Ilight		20	30	40	mA
LED displays drive current.	I_{L1} I_{L2} I_{L3}		1	10	20	mA
Load removal detect timer	T_{loadD}	Load current continuously lower than 45mA	25	32	44	s
Push-button wake-up timer	$T_{OnDebounce}$		30	50	500	ms
Push-button light-on timer	$T_{Keylight}$		1.2	2	3	s
Thermal shutdown	T_{OTP}	Rising temperature	110	125	140	℃
Thermal shutdown hysteresis	ΔT_{OTP}			40		℃

9 Functional Description

BOOST

IP5219 integrates a step-up DCDC converter with an output of 5V and a load capacity of 2.4A. Switching frequency is 500KHz, 3.7V input, 5V / 2A efficiency is 92%. Built-in soft-start function to prevent malfunction caused by excessive inrush current during start-up. Integrated output over-current, short-circuit, over-voltage, over-temperature protection functions to ensure stable and reliable operation of the system .

The output current of the boost system can be automatically adjusted with the temperature to ensure that the IC temperature is below the set temperature.

Charge

IP5219 has a constant current, constant voltage lithium battery charger with a synchronous switch structure. When the battery voltage is less than 3V, 100mA trickle charging is used; 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 the charging is completed, if the battery voltage is lower than 4.1V, restart the battery charging.

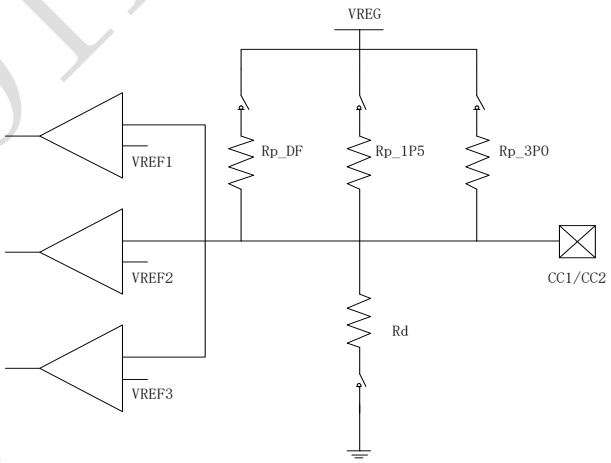
Adaptive power path management, giving priority to external loads, and supporting charging and discharging.

The IP5219 charger will automatically adjust the charging current to adapt to adapters with different load capabilities, ensuring that the adapter is not pulled.

TYPE-C

IP5219 integrates TYPE-CDRP input and output recognition interface, automatically switches the built-in pull-up resistor, and automatically recognizes the charge and Boost properties of the inserted device. With Try.SRC function, when connected to the other party as a DRP device, the other party can be charged first.

When working as a DFP, the external output can be set to the current capacity information of Default, 1.5A, 3A (three choices 1, default); when working as a UFP, the output current capacity of



the other party can be identified.

Pull-up resistor value and pull-down resistor value

Resistance name	Resistance Value
Rp_DF	33k
Rp_1P5	11k
Rp_3P0	4.2k
Rd	5.1K

Comparator threshold with pullup resistor Rp enabled

Table 4-21 CC Voltages on Source Side – Default USB

	Minimum Voltage	Maximum Voltage	Threshold
Powered cable/adapter (vRa)	0.00 V	0.15 V	0.20 V
Sink (vRd)	0.25 V	1.50 V	1.60 V
No connect (vOPEN)	1.65 V		

Table 4-22 CC Voltages on Source Side – 1.5 A @ 5 V

	Minimum Voltage	Maximum Voltage	Threshold
Powered cable/adapter (vRa)	0.00 V	0.35 V	0.40 V
Sink (vRd)	0.45 V	1.50 V	1.60 V
No connect (vOPEN)	1.65 V		

Table 4-23 CC Voltages on Source Side – 3.0 A @ 5 V

	Minimum Voltage	Maximum Voltage	Threshold
Powered cable/adapter (vRa)	0.00 V	0.75 V	0.80 V
Sink (vRd)	0.85 V	2.45 V	2.60 V
No connect (vOPEN)	2.75 V		

Comparator threshold with pull-down resistor Rd enabled

Table 4-25 Voltage on Sink CC pins (Multiple Source Current Advertisements)

Detection	Min voltage	Max voltage	Threshold
vRa	−0.25 V	0.15 V	0.2 V
vRd-Connect	0.25 V	2.04 V	
vRd-USB	0.25 V	0.61 V	0.66 V
vRd-1.5	0.70 V	1.16 V	1.23 V
vRd-3.0	1.31 V	2.04 V	

TYPE-C detection cycle

Figure 4-36 DRP Timing

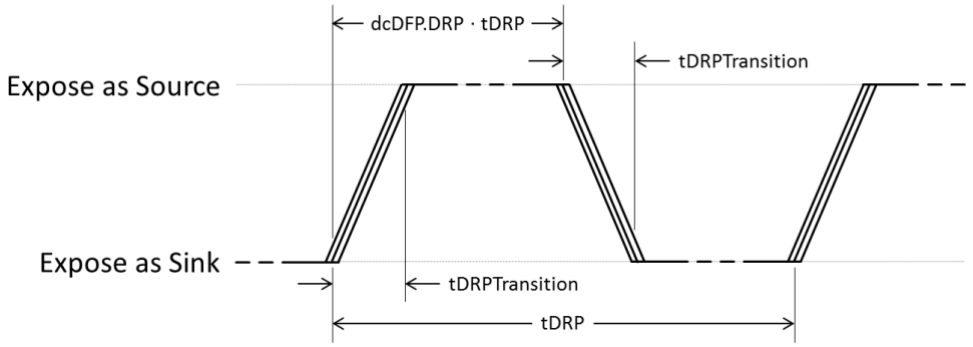
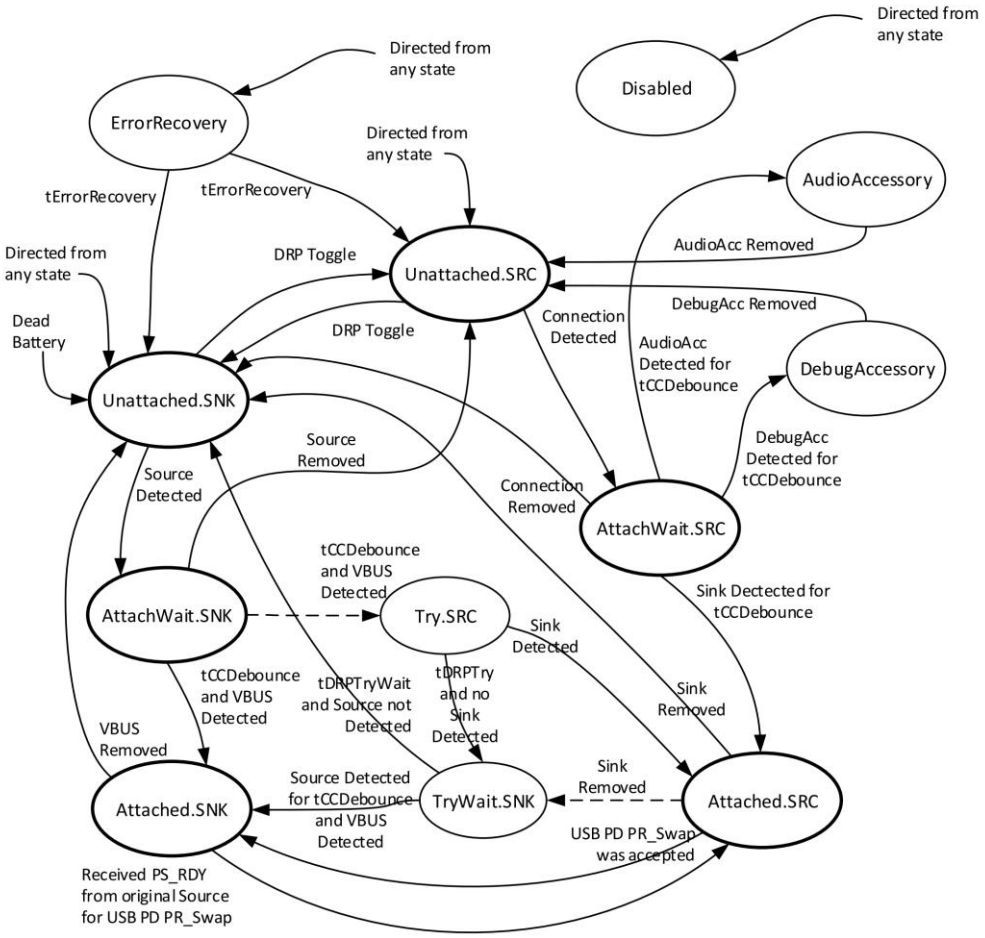


Table 4-19 DRP Timing Parameters

	Minimum	Maximum	Description
tDRP	50 ms	100 ms	The period a DRP shall complete a Source to Sink and back advertisement
dcSRC.DRP	30%	70%	The percent of time that a DRP shall advertise Source during tDRP
tDRPTransition	0 ms	1 ms	The time a DRP shall complete transitions between Source and Sink roles during role resolution
tDRPTry	75 ms	150 ms	Wait time associated with the Try.SRC state.
tDRPTryWait	400 ms	800 ms	Wait time associated with the TryWait.SNK state

TYPE-C detection state transition

Figure 4-16 Connection State Diagram: DRP with Accessory and Try.SRC Support



KEY

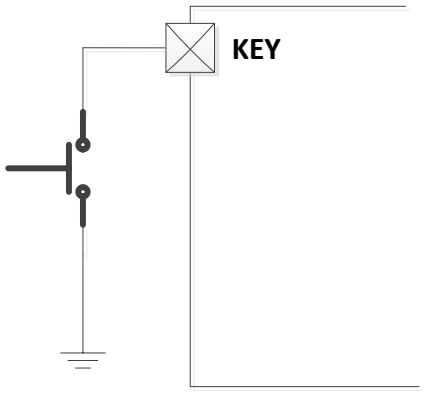


Figure3 KEY

The key connection method is shown in Figure3, which can recognize long and short push operations.

- If button is pushed longer than 30ms but shorter than 2s, IP5219 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, IP5219 will identify the action as long push. Long push will open or close flashlight LED.
- If button is pushed shorter than 30ms, IP5219 will ignore the action.
- If two short push is detected within 1s, IP5219 will close step-up convertor, SOC indicator LED and flashlight LED.

State Of Charge (SOC) indication

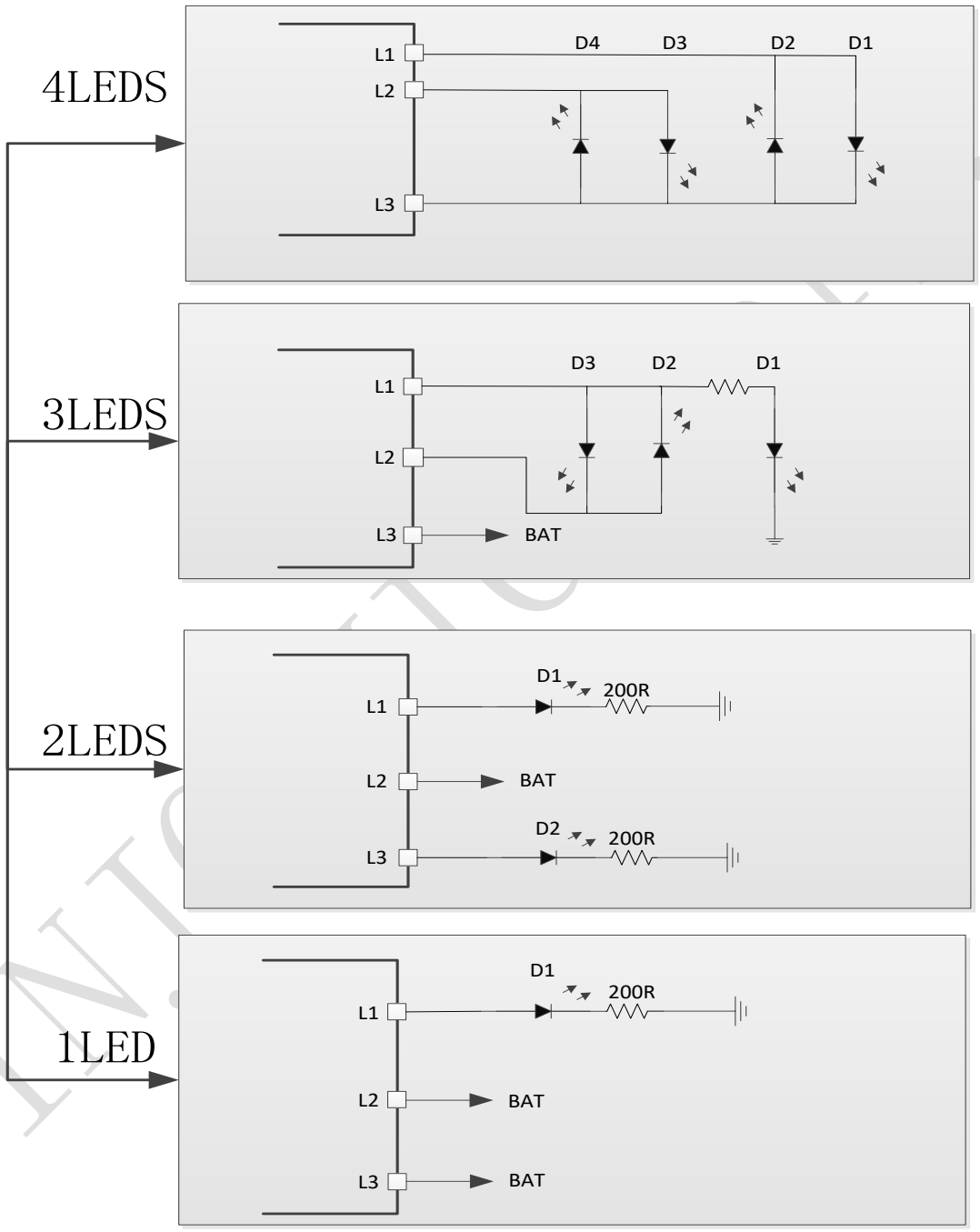


Figure4 4/3/2/1 LED PIN configuration

■ 4 LEDs mode

Discharging mode, 4 LEDs as the indicator

SOC（%）	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 blink	OFF	OFF	OFF

Charging mode 4 LEDs as the indicator

SOC（%）	D1	D2	D3	D4
Full	ON	ON	ON	ON
75%≤C	ON	ON	ON	0.5Hz blink
50%≤C＜75%	ON	ON	0.5Hz blink	OFF
25%≤C＜50%	ON	0.5Hz blink	OFF	OFF
C＜25%	0.5Hz blink	OFF	OFF	OFF

■ 3 LEDs mode

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

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

■ 2 LEDs mode

	state	D1	D2
Charging	In charging	blink	OFF
	End of Charge	ON	OFF
Boost	In discharging	OFF	ON
	Low Battery	OFF	blink

■ 1 LED mode

	state	D1
Charging	In charging	blink
	End of Charge	ON
Boost	In discharging	ON
	Low Battery	blink

Battery impendence setting

IP5219 can set the battery impendence by RSET pin which make the SOC indicator LEDs display more evenly. The relationships between the resistance connected to RSET and battery impendence are shown in the following table.

RSET resistance(Kohm)	Battery impendence (mOhm)
10K	45
43K	67.5
120K	112.5
200K	90
NC	22.5

Automatic cellphone plug-in detect

IP5219 can automatically detect the cellphone's plug-in. When detecting the plug-in, IP5219 will wake up from standby mode and open the 5V step-up converter without push button action. IP5219 supports modules without push buttons.

Battery voltage selection

IP5219 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.

Battery platform selection

IP5219 can set the battery platform through the VTHS pin. When VTHS is connected to VREG, it is set to a high platform 3.7V battery; when VSET is connected to GND, it is set to a low platform 3.6V battery.

NTC

IP5219 integrated NTC, and can detect battery pack temperature.

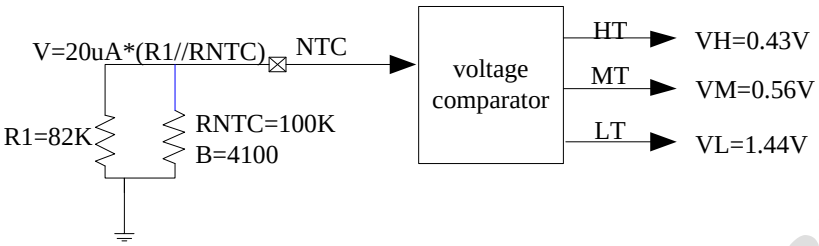


Figure5 Battery NTC comparison

Charge：

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

If NTC pin voltage<0.56V， it indicate the battery temperature is higher 45 °C, half charging current is used.

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

Discharge：

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

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

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

IP5219 has an integrated MOS FET. LIGHT PIN in IP5219 can drive lighting LED directly. Maximum driving current is 100mA. When button is pushed longer than 2s, lighting LED is opened or closed. If flash light is not needed, light should connect to GND, IP5219 will automatically close flash light.

VREG

VREG is an 3.1V LDO with 5mA load capacity.

10 Typical Application Schematic

IP5219 only needs capacitors, resistors, and inductors to realize a full featured power bank solution.

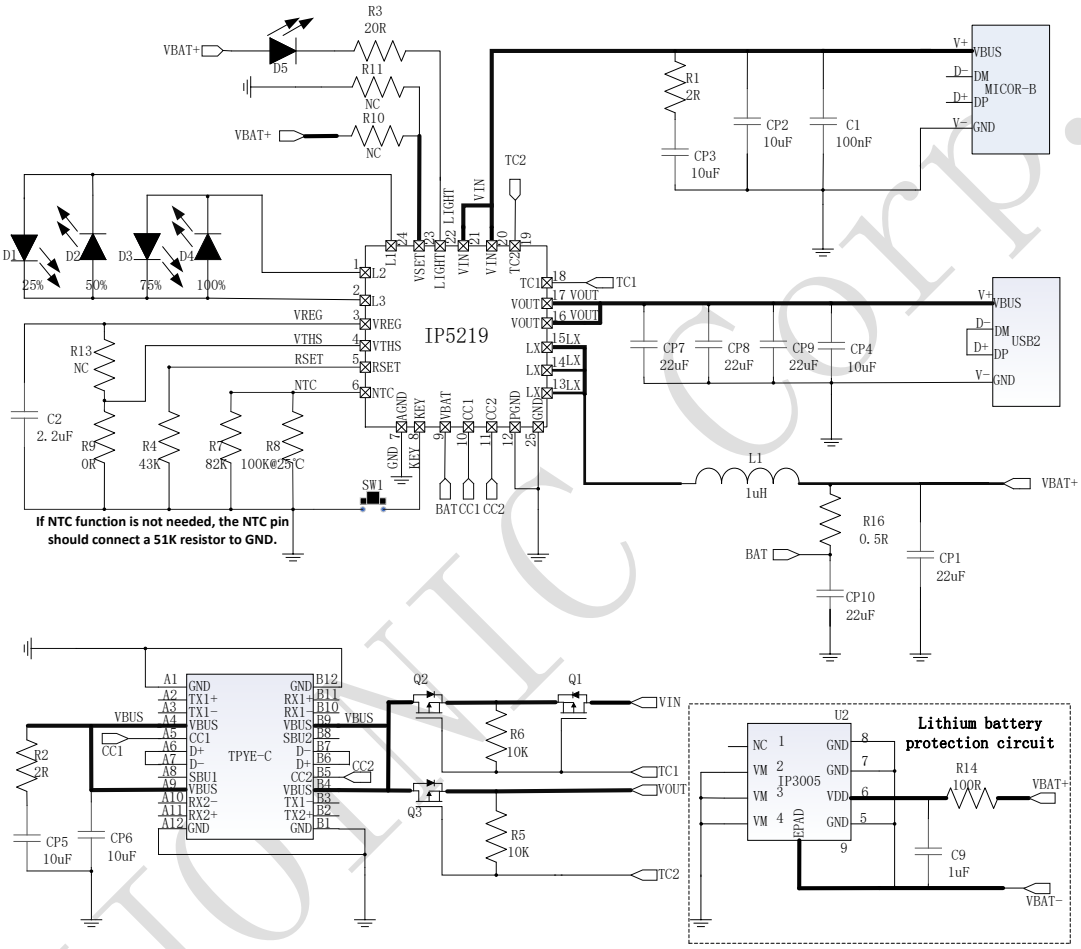


Figure6 4 LEDS power display typical application schematic

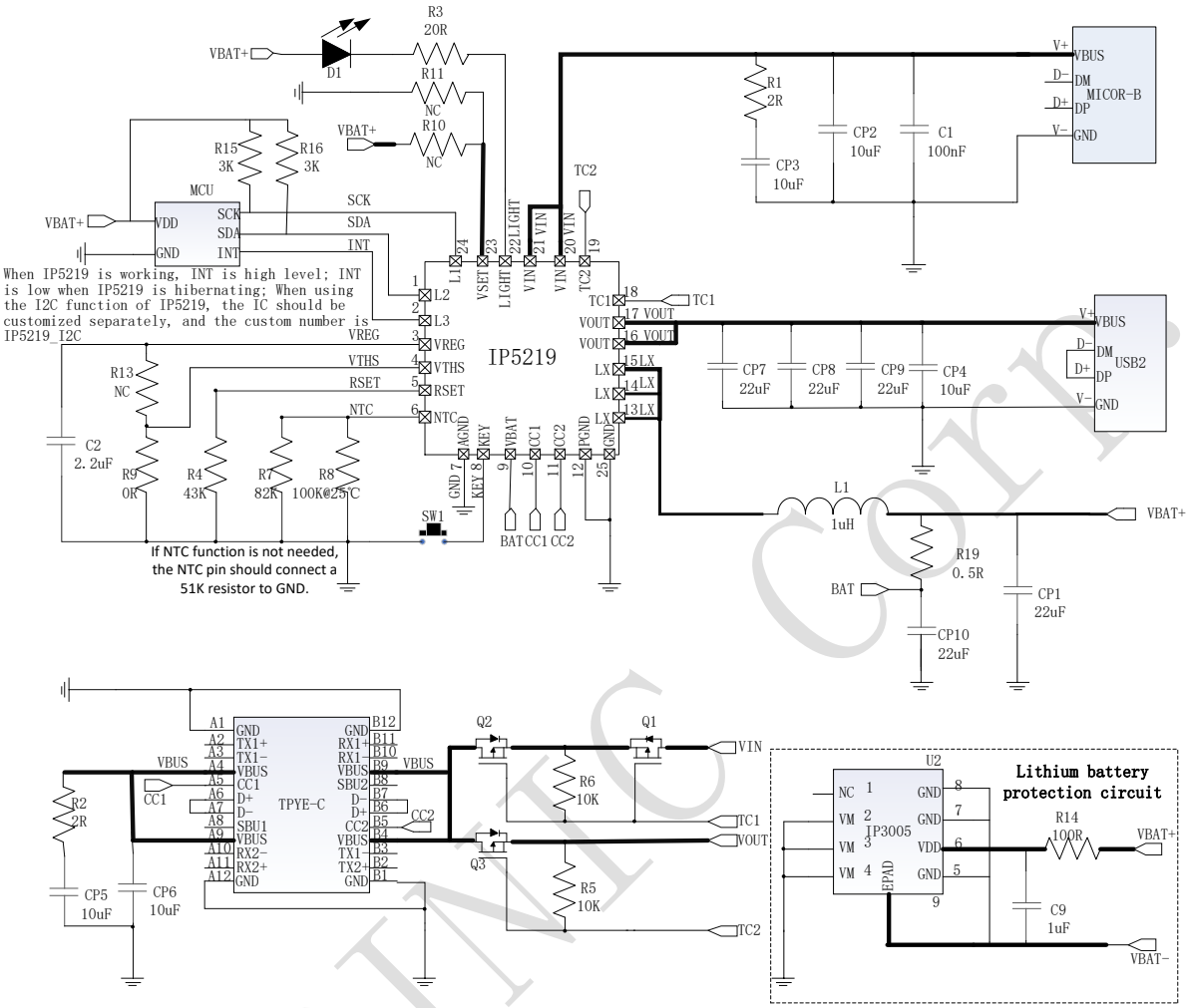


Figure7 I2C typical application schematic

Inductor recommends:

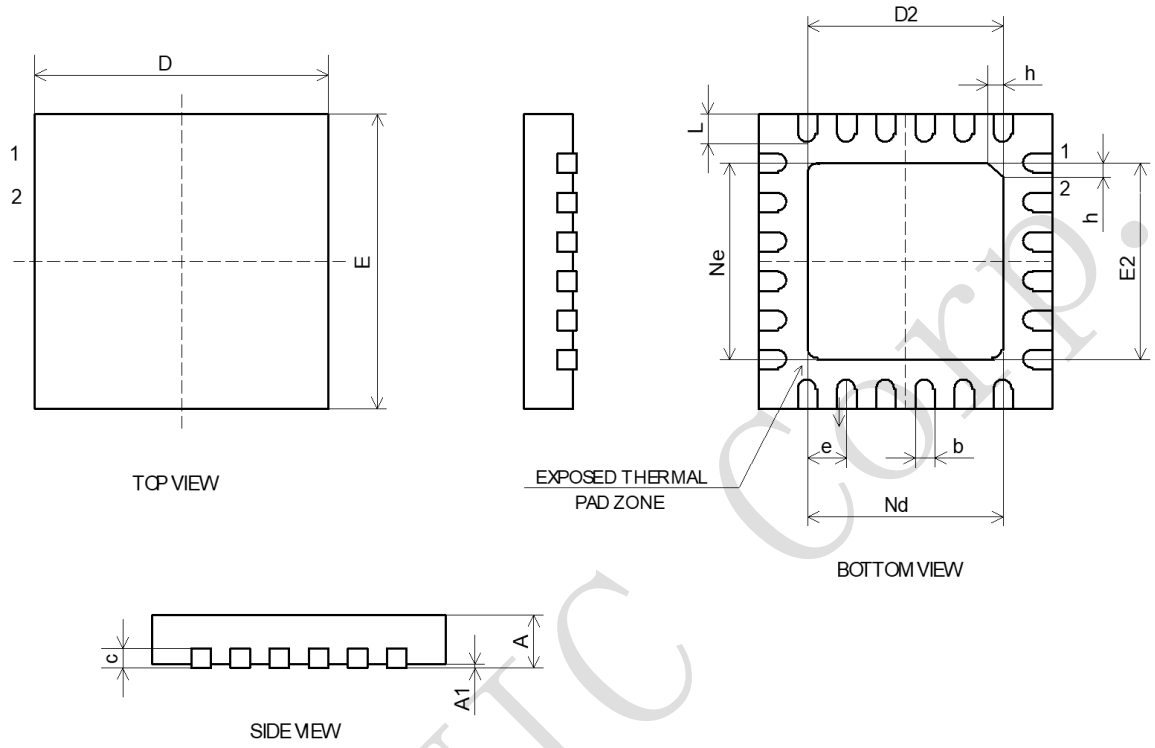
SPM70701R0

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	12	15	

Battery protection recommends:

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

11 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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