

Fully-integrated power bank System-On-Chip with 1.2A charger, 1.0A boost converter

1 Features

- **Synchronous switching charger and synchronous boost converter**
 - ✧ 1.2A synchronous switching charger, 1.0A synchronous boost converter
 - ✧ boost converter efficiency up to 91%
 - ✧ Switching charger efficiency up to 93%
 - ✧ Integrated power-path management, charging batteries and charging cellphones at the same time
- **Charger**
 - ✧ Adaptive charging current control, excellent adapter compatibility
 - ✧ Charger voltage accuracy $\pm 0.5\%$
 - ✧ Support 4.20V, 4.30V, 4.35V, 4.40V batteries
- **Fully featured**
 - ✧ Integrated Key ON/OFF
 - ✧ Integrated flashlight controller
 - ✧ Integrated cellphone plug-in and plug-out detector
 - ✧ Supports 4/3/2/1 LEDs indicator
- **Low power**
 - ✧ Smart load detector, switching to standby mode automatically
 - ✧ $<100 \mu A$ 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 regulation and thermal shutdown,
 - ✧ ESD 4KV

2 Applications

- Power bank, Portable Charger
- Mobile Phones, Smart Phones, Handheld Devices,

3 Description

IP5305 is a highly-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.

IP5305's high integration and rich features make the minimized component number in application. It can effectively downsize the application and lower the BOM cost.

IP5305 only needs a single inductor to realize step-down and step-up.

IP5305's synchronous step-up converter provides 1.0A output current. Its efficiency is up to 96%. It can switch to standby mode at empty load automatically.

IP5305'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.

IP5305 has integrated a voltage based fuel gauge algorithm, acquiring battery's state of charge precisely.

IP5305 is available in eSOP8.

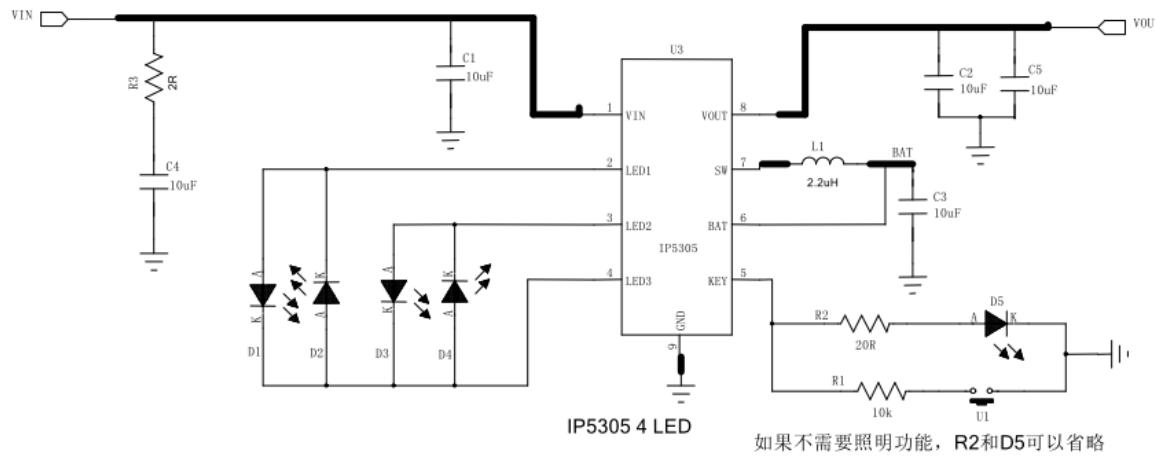


Figure 1 Simplified application schematic (4 LEDs as the SOC indicator)

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4 Pin definition

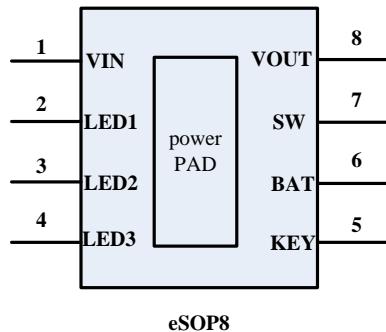


Figure 2 IP5305 Pin Diagram

Pin name	Pin number	Pin description
VIN	1	DC5V input pin
LED1	2	LED drive pin1
LED2	3	LED drive pin2
LED3	4	LED drive pin3
KEY	5	Input key pin
BAT	6	Battery pin, connect to Li+ battery.
SW	7	DCDC switch node
VOUT	8	Boost 5V output PIN
PowerPAD		Connecte to GND

5 IP serials power bank IC selection table

IC Model	Main features							Package	
	Boost	Charger	LED Num	Light	Push Button	I2C	DCP	Package	Package compatibility
IP5101	1.0A	1.0A	1,2	-	-	-	-	eSOP8	
IP5305	1.2A	1.0A	1,2,3,4	✓	✓	-	-	eSOP8	
IP5206	2A _(Max)	1.5A	3,4,5	✓	✓	-	-	eSOP16	PIN2PIN
IP5108E	2.0A	1.0A	3,4,5	✓	✓	-	-	eSOP16	
IP5108	2.0A	2.0A	3,4,5	✓	✓	✓	-	eSOP16	
IP5207	1.2A	1.2A	3,4,5	✓	✓	✓	✓	QFN24	
IP5109	2.1A	2.1A	3,4,5	✓	✓	✓	-	QFN24	PIN2PIN
IP5209	2.4A	2.1A	3,4,5	✓	✓	✓	✓	QFN24	

6 Absolute maximum ratings

Parameter	symbol	value	Unit
Port input voltage range	V_{IN}	-0.3 ~ 5.5	V
Operating free-air temperature range	T_A	0 ~ 70	°C
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.

7 Recommended operation conditions

Parameter	symbol	MIN	Typical	MAX	Unit
Input voltage	V_{IN}	4.5	5	5.5	V
Load current	I	0	1.0	1.2	A
Operating ambient temperature	T_A	0	--	70	°C

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

8 Electrical Characteristics

TA=25°C, L=2.2uH unless otherwise noted

Parameter	symbol	Test condition	MIN	TYP	MAX	Unit
Charger system						
Input voltage	V_{IN}		4.5	5	5.5	V
Input current (charging)	I_{VIN}	VIN=5V, fs=350kHz			2	mA
Input current (standby)		VIN=5V, Device not switching		100		uA
Target charge voltage	V_{TRGT}			4.2		V
Charge current	I_{CHRG}			1.0	1.2	A
Trickle charge current	I_{TRKL}	VIN=5V, BAT=2.7V		100		mA

Trickle charge stop voltage	V_{TRKL}			3		V
Recharge threshold	V_{RCH}			4.1		V
Charger safety timer	T_{END}			12		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
Low Battery voltage	V_{BAT}	When Battery voltage lower than V_{BAT} , the Boost will be shutdown	2.78	2.85	2.92	V
Battery operation current	I_{BAT}	$V_{BAT}=3.7V$, $V_{OUT}=5.1V$, $f_s=350KHz$	2	3	5	mA
		$V_{IN}=5V$, Device not switching	45	75	100	uA
DC-DC output voltage	V_{OUT}	$V_{BAT}=3.7V$ @0A	5.0	5.12	5.23	V
		$V_{BAT}=3.7V$ @1.2A	4.75	5	5.15	V
Output voltage ripple	ΔV_{OUT}	$V_{BAT}=3.7V$, $V_{OUT}=5.0V$, $f_s=650KHz$	50	100	150	mV
Boost output current	I_{vout}			1.0		A
Load over-current detect timer	T_{UVD}	Output voltage continuously lower than 4.2V		30		ms
Load short-circuit detect timer	T_{OCD}	Output current continuously larger than 2.0A	150		200	us
Control system						
Switching frequency		switching frequency		350		KHz
PMOS on resistance	r_{DSON}			80		$m\Omega$
NMOS on resistance				70		$m\Omega$
VREG output voltage	V_{REG}	$V_{BAT}=3.5V$	3	3.1	3.2	V
Battery standby current	I_{STB}	$V_{IN}=0V$, $V_{BAT}=3.7V$		50		uA
LED lighting current	I_{light}			25		mA
LED indicator current	I_{L1}					
	I_{L2}			2	4	5
	I_{L3}					mA
Load removal detect timer	T_{loadD}	Load current continuously lower than 45mA	25	32	44	s

Push-button wake-up timer	$T_{OnDebounce}$			50		ms
Push-button light-on timer	$T_{Keylight}$		1.2	2	3	s
Thermal shutdown	T_{OTP}	Rising temperature	110	125	140	°C
Thermal shutdown hysteresis	ΔT_{OTP}			40		°C

9 Function description

Boost converter

IP5305 integrates a 5V output step-up DCDC converter with 1.0A output capacity. It works at 650KHZ. When input voltage is 3.7V, its efficiency is 92% 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.

IP5305's boost converter has a thermal regulation loop, which can adaptively regulate the output current to insure IC temperature below the set value.

Push Button

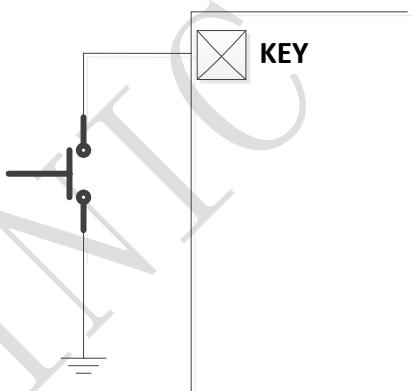


Figure 3 KEY button

Push button's connecting is shown in Fig 5. IP5305 can identify long push and short push.

- If button is pushed longer than 50ms but shorter than 2s, IP5305 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, IP5305 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 50ms, IP5305 will ignore the action.
- If two short push is detected within 1s, IP5305 will open or close flashlight LED

Fuel gauge and State Of Charge (SOC) indication

IP5305 has an integrated fuel gauge, which can indicate the battery's state of charge accurately.

IP5305 can support 1/2/3/4 LEDs as the SOC indicator with very simple configuration. By the built-in identification algorithm, IP5305 can automatically identify how many LEDs are used

as the SOC indicator.

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%≤SOC<25%	ON	OFF	OFF	OFF
0%<SOC<3%	1.5Hz blink	OFF	OFF	OFF
SOC=0%	OFF	OFF	OFF	OFF

Charging mode 4 LEDs as the indicator

SOC (%)	L1	L2	L3	L4
Full	ON	ON	ON	ON
75%≤SOC	ON	ON	ON	1.5Hz blink
50%≤SOC<75%	ON	ON	1.5Hz blink	OFF
25%≤SOC<50%	ON	1.5Hz blink	OFF	OFF
SOC<25%	1.5Hz blink	OFF	OFF	OFF

The displays of 3 LEDs and 5 LEDs are similar to that of 4 LEDs. The corresponding SOC of each LED is presented in the following table.

	D1	D2	D3	D4	D5
3 LEDs	3%	66%	100%	NA	NA
4 LEDs	25%	50%	75%	100%	NA
5 LEDs	20%	40%	60%	80%	100%

■ 2 LED

	state	LED1	LED2
Charging	In charging	Blink	OFF
	End of Charge	ON	OFF
Boost	In discharging	OFF	ON
	Low Battery	OFF	Blink

■ 1 LED

	状态	LED1
Charging	In charging	Blink
	End of Charge	ON
Boost	In discharging	ON
	Low Battery	Blink

Automatic cellphone plug-in detect

IP5305 can automatically detect the cellphone's plug-in. When detecting the plug-in, IP5305 will wake up from standby mode and open the 5V step-up converter without push button action. IP5305 supports modules without push buttons.

Charger

IP5305 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.

IP5305's switching charger has a 350kHz switching frequency, and its maximum charging current is 1.2A, charging efficiency is up to 93%, shortening 3/4 charging time in comparison with the normal chargers.

IP5305 integrates an adaptive power-path management system with priority to output load. It can charge batteries as well as cellphones at the same time.

IP5305's charger can adapt the charging current to the adapter of various load capacity, which can keep adapters away from malfunction.

Flash Light

IP5305 has an integrated MOS FET. LIGHT PIN in IP5305 can drive lighting LED directly. Maximum driving current is 50mA.

10 Typical application schematic

IP5305 only needs capacitors, resistors, and inductors to realize a full featured power bank solution.

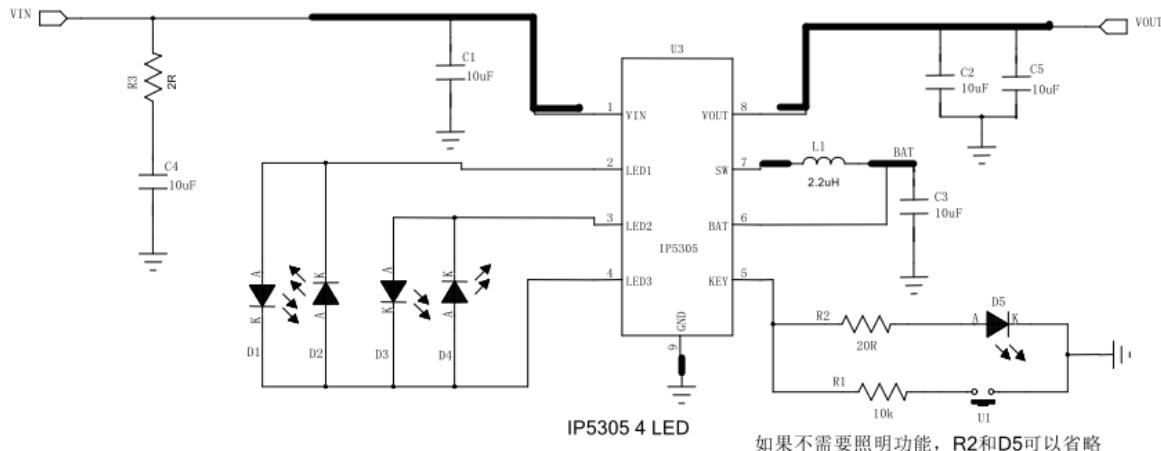


Figure 4 4 LEDs SOC indicator typical application schematic

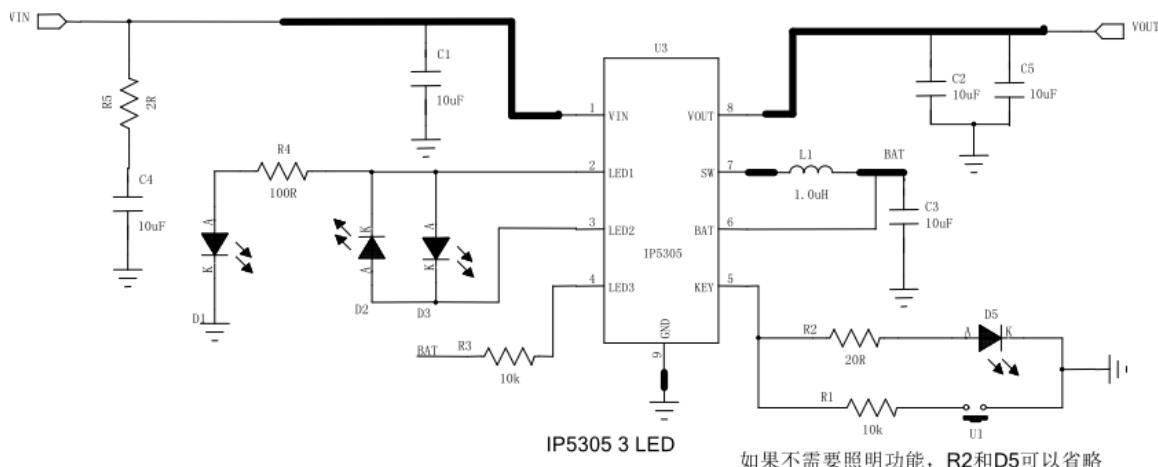


Figure 5 3 LEDs SOC indicator typical application schematic

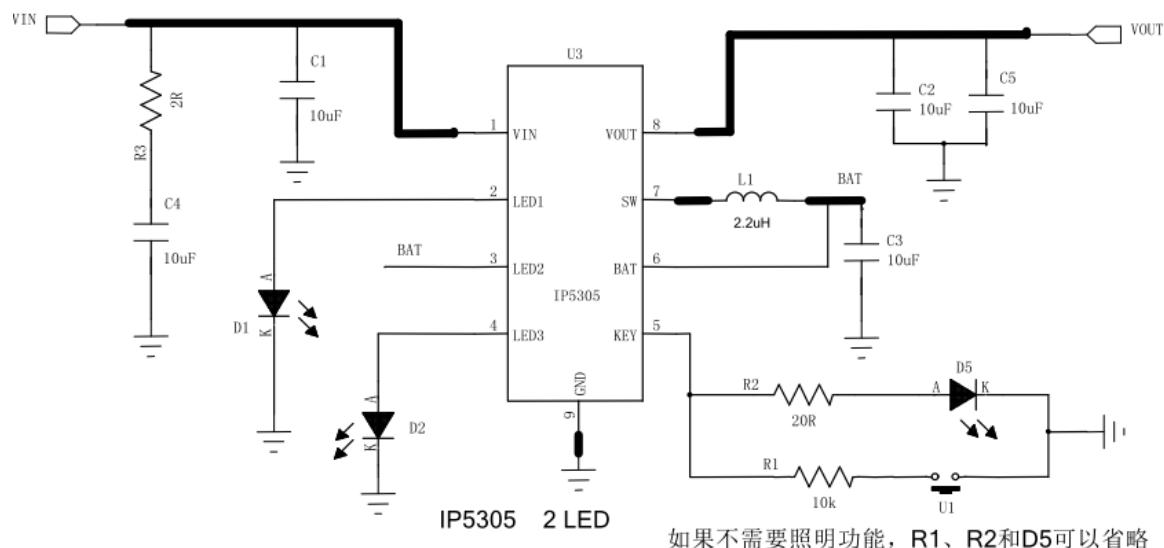


Figure 6 2 LEDs SOC indicator typical application schematic

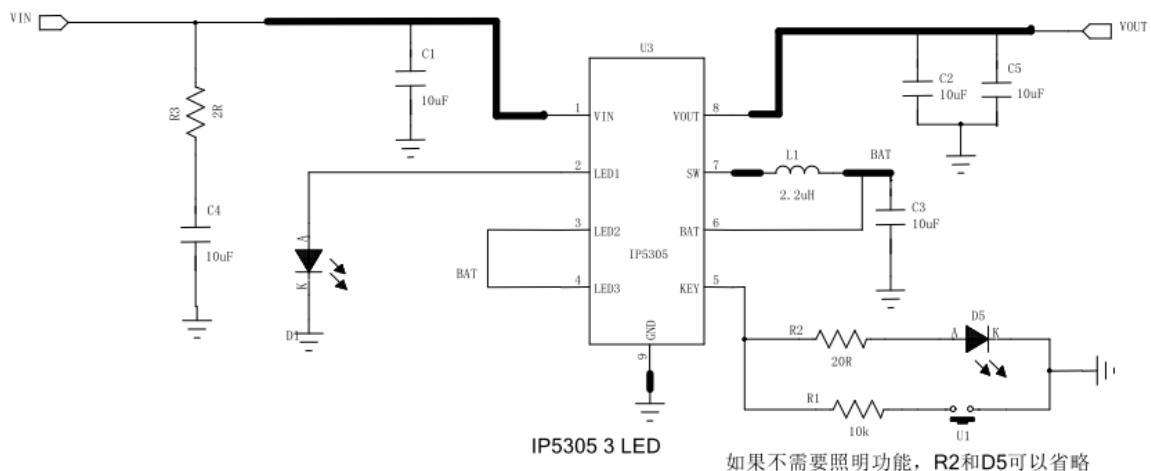
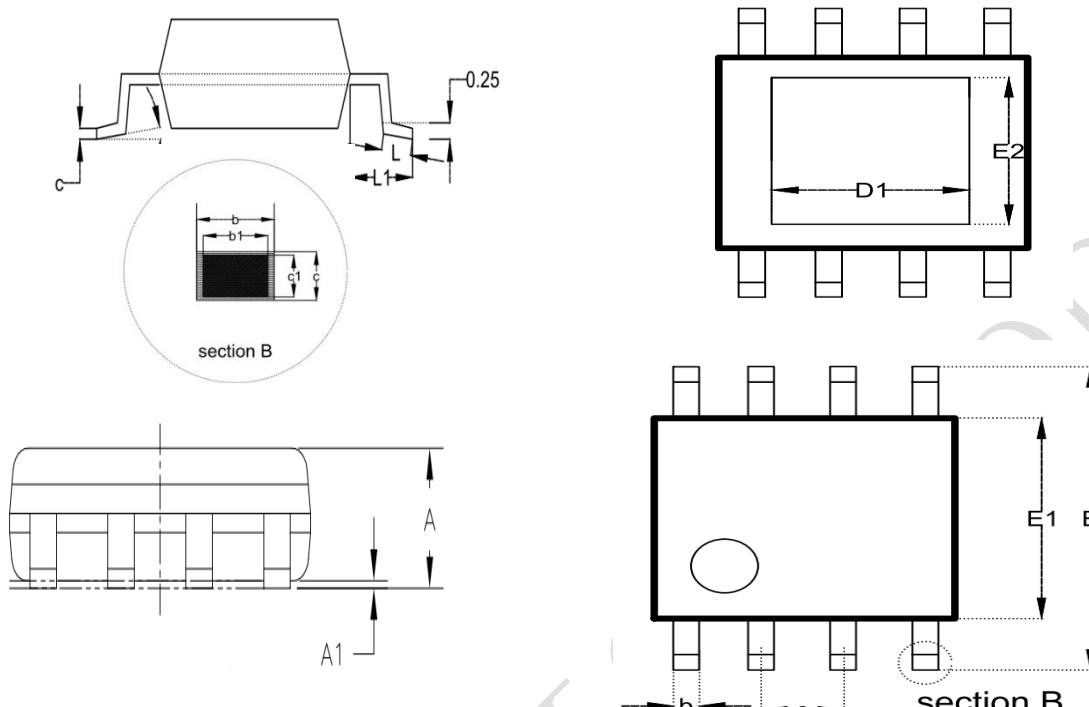


Figure 7 2 LEDs SOC indicator typical application schematic

11 BOM

序号	元件名称	型号&规格	单位	用量	位置	备注
1	IC	IP5305	PCS	1	U1	
2	SMD resistor	0603 10K 5%	PCS	1	R1	
3	SMD resistor	0603 2R 5%	PCS	1	R3	
4	SMD resistor	0603 20R 5%	PCS	1	R2	adjust the light LED brightness
5	SMD capacitor	0805 10uF 10%	PCS	5	C1、C2、C3、C4、C5	
6	SMD LED	0603	PCS	4	D1、D2、D3、D4	
7	Lighting LED	5mm	PCS	1	D5	
8	Inductor	CD43	PCS	1	L1	Isat、Idc> 2A, DCR< 0.05, 2.2uH @350KHz
9	USB socket	10mm USB A	PCS	1	J3	
10	Micro USB	Micro USB	PCS	1	J2	
11	Push-button	6.5mm*5.1mm	PCS	1	SW1	
12	AC wire	2*100mm	PCS	2	B+ B-	

12 Package information



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.65
A1	0.05	--	0.15
A	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		
h	0.25	--	0.50
L	0.50	0.60	0.80
L1	1.05BSC		
θ	0	--	8°
D1	--	2.09	--
E2	--	2.09	--