

Fully-integrated power bank System-On-Chip with 2A/1A charger, 2A boost converter

1 Features

- **Synchronous switching charger and synchronous boost converter**
 - ◇ 2A synchronous boost converter
 - ◇ boost converter efficiency up to 95%
 - ◇ Switching charger efficiency up to 96%
 - ◇ Integrated power-path management, charging batteries and charging cellphones at the same time
- **Charger**
 - ◇ Adaptive charging current control, excellent adapter compatibility
 - ◇ Charger voltage accuracy $\pm 0.5\%$
 - ◇ 2A (**IP5108**) or 1A (**IP5108E**) synchronous boost converter
- **State of charge (SOC) indicator**
 - ◇ Integrated 14bit ADC and fuel gauge
 - ◇ Integrated LED controller supports 5/4/3 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
- **Low power**
 - ◇ Smart load detector, switching to standby mode automatically
 - ◇ $<50 \mu\text{A}$ 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, battery NTC protection
 - ◇ ESD 4KV, maximum 11V transit over-voltage sustainable
- **Fully customizable**
 - ◇ I2C interface makes customization flexible and low-cost

- Packaged in ESOP16L

2 Applications

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

3 Description

IP5108/IP5108E 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.

IP5108/IP5108E is high integration and rich features make the minimized component number in application. It can effectively downsize the application and lower the BOM cost.

IP5108/IP5108E only needs a single inductor to realize step-down and step-up. DC-DC converters work at 650KHZ with supporting of low-cost capacitors and inductors.

IP5108/IP5108E's synchronous step-up converter provides max 2A output current. Its efficiency is up to 95%. It can switch to standby mode at empty load automatically, the standby current reducing to 50uA.

IP5108/IP5108E's synchronous switching charger provides max 2.1A /1 A charging current. Its efficiency is up to 96%. It regulates the charging current by IC temperature and input voltage.

The built-in 14bit ADC in IP5108 measures battery voltage and current accurately. ADC data are available on I2C interface. IP5108 has

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

3/4/5 LEDs and flashlight function.

IP5108/IP5108E is available in ESOP16L.

IP5108 support with the SOC indicator of

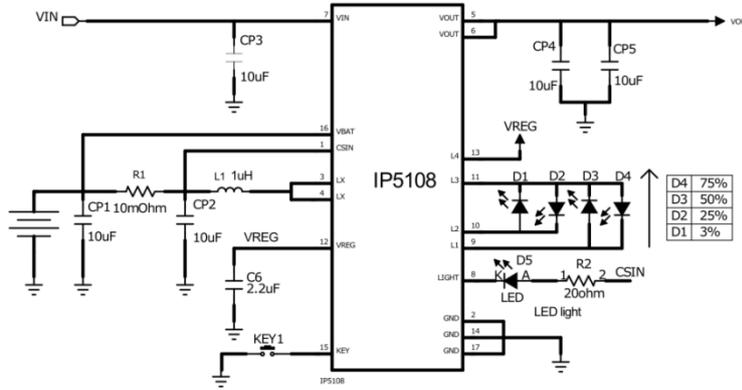


Fig 1 Simplified application schematic (4 LEDs as the SOC indicator)

4 Pin definition

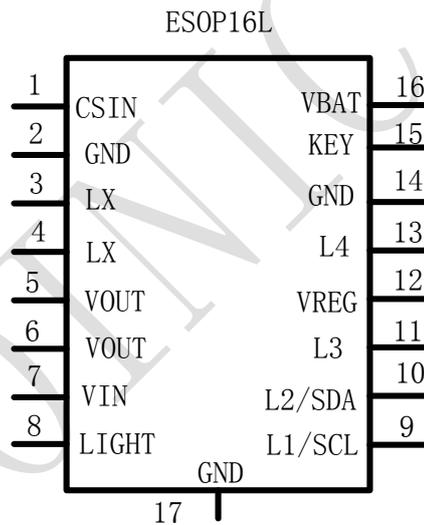


Fig 2 Pin Diagram

Pin		Descriptions
Index	Name	
1	CSIN	Current sense input
2	GND	GROUND
3、4	LX	DCDC switch node, connect inductor
5、6	VOUT	DCDC 5v OUTPUT pin
7	VIN	Charger 5V input pin
8	LIGHT	LED lighting driver
9	L1/SCL	Battery indicator pin1/I2C SCL
10	L2/SDA	Battery indicator pin2/I2C SDA

11	L3	Battery indicator pin3
12	VREG	Regulator output pin
13	L4	Battery indicator pin4
14	GND	GROUND
15	KEY	Key input pin
16	VBAT	Battery voltage sense pin
17	GND	EPAD, should be connected to GND

5 IP serials power bank IC selection table

IC Model	Charging/Discharging		Main features						Package	
	Discharging	Charger	LED Num	Light	Push Button	I2C	DCP	QC2.0 quick charge	Package	Package compatibility
IP5101	1.0A	1.0A	1,2	-	-	-	-	-	eSOP8	
IP5205	1.2A	1.2A	3,4	✓	✓	✓	-	-	SOP16	
IP5206	2A(Max)	1.5A	3,4,5	✓	✓	-	-	-	eSOP16	PIN2PIN
IP5108E	2.0A	1.0A	3,4,5	✓	✓	-	-	-	eSOP16	
IP5108	2.0A	2.1A	3,4,5	✓	✓	✓	-	-	eSOP16	
IP5207	1.2A	1.2A	3,4,5	✓	✓	-	-	-	QFN24	PIN2PIN
IP5109	2.4A	3.0A	3,4,5	✓	✓	✓	-	-	QFN24	
IP5209	2.4A	3.0A	3,4,5	✓	✓	✓	✓	-	QFN24	
IP5209S	3A(Max)	4.8A	3,4,5	✓	✓	✓	-	✓	QFN24	

IP5108/IP5108E PO Model

PO Model	Cell Type
IP5108	4.20V
IP5108_4.30V	4.30V
IP5108_4.35V	4.35V
IP5108E	4.20V
IP5108E_4.30V	4.30V
IP5108E_4.35V	4.35V

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}	50	°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	2	2.1	A
Operating ambient temperature	T_A	0	--	70	°C

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

8 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}		4.5	5	5.5	V
Input current (charging)	I_{VIN}	$V_{IN}=5\text{V}$, $f_s=1.6\text{MHz}$			2	mA
Input current (standby)		$V_{IN}=5\text{V}$, Device not switching		100		uA
Target charge voltage	V_{TRGT}			4.2		V
Charge current	I_{CHRG}				3	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}	Rise voltage		4.5		V
Input under-voltage protection hysteresis	V_{UVLO}			200		mV
Boost system						
Battery operation voltage	V_{BAT}		3.0		4.4	V
Battery operation current	I_{BAT}	VBAT=3.7V, VOUT=5.1V, fs=650KHz		3		mA
		VIN=5V, Device not switching		100		uA
DC-DC output voltage	V_{OUT}	VBAT=3.7V		5.0		V
Output voltage ripple	ΔV_{OUT}	VBAT=3.7V, VOUT=5.0V, fs=650KHz		50		mV
Boost output current	I_{vout}			2		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 3A	150		200	us
Control system						
Switching frequency	f_s			1.5		MHz
PMOS on resistance	r_{DSON}			50		mΩ
NMOS on resistance				30		mΩ
VREG output voltage	V_{REG}	VBAT=3.5V		3.1		V
Battery standby current	I_{STB}	VIN=0V, VBAT=3.7V		50		uA
LDO output voltage	I_{LDO}			50		mA
LED lighting current	I_{light}			25		mA
LED indicator current	I_{L1}			4		mA
	I_{L2}					
	I_{L3}					
Load removal detect timer	T_{loadD}	Load current continuously lower than 45mA		32		s
Push-button wake-up timer	$T_{OnDebounce}$			50		ms
Push-button light-on timer	$T_{Keylight}$			2		s

Thermal shutdown	T_{OTP}	Rising temperature		125		°C
Thermal shutdown hysteresis	ΔT_{OTP}			40		°C

9 Function description

Boost converter

IP5108/IP5108E integrates a 5V output step-up DCDC converter with 2A output capacity. It works at 650KHZ. When input voltage is 3.7V, its efficiency is 94% 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.

Push Button

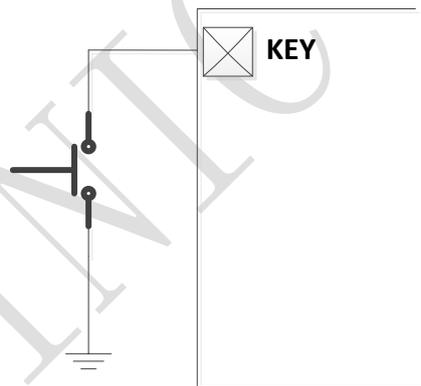


Fig 3 KEY button

- Push button's connecting is shown in Fig 3. IP5108/IP5108E can identify long push and short push.
- If button is pushed longer than 30ms but shorter than 2s, IP5108/IP5108E 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, IP5108/IP5108E will identify the action as long push. Long push will open or close flashlight LED.
- If button is pushed shorter than 30ms, IP5108/IP5108E will ignore the action.
- If two short push is detected within 1s, IP5108/IP5108E will close step-up convertor, SOC indicator LED and flashlight LED.

Fuel gauge and State Of Charge (SOC) indication

IP5108/IP5108E has an integrated fuel gauge, which can indicate the battery's state of charge accurately.

IP5108/IP5108E can support 3/4/5 LEDs as the SOC indicator with very simple configuration. By the built-in identification algorithm, IP5108/IP5108E can automatically identify how many LEDs are used as the SOC indicator.

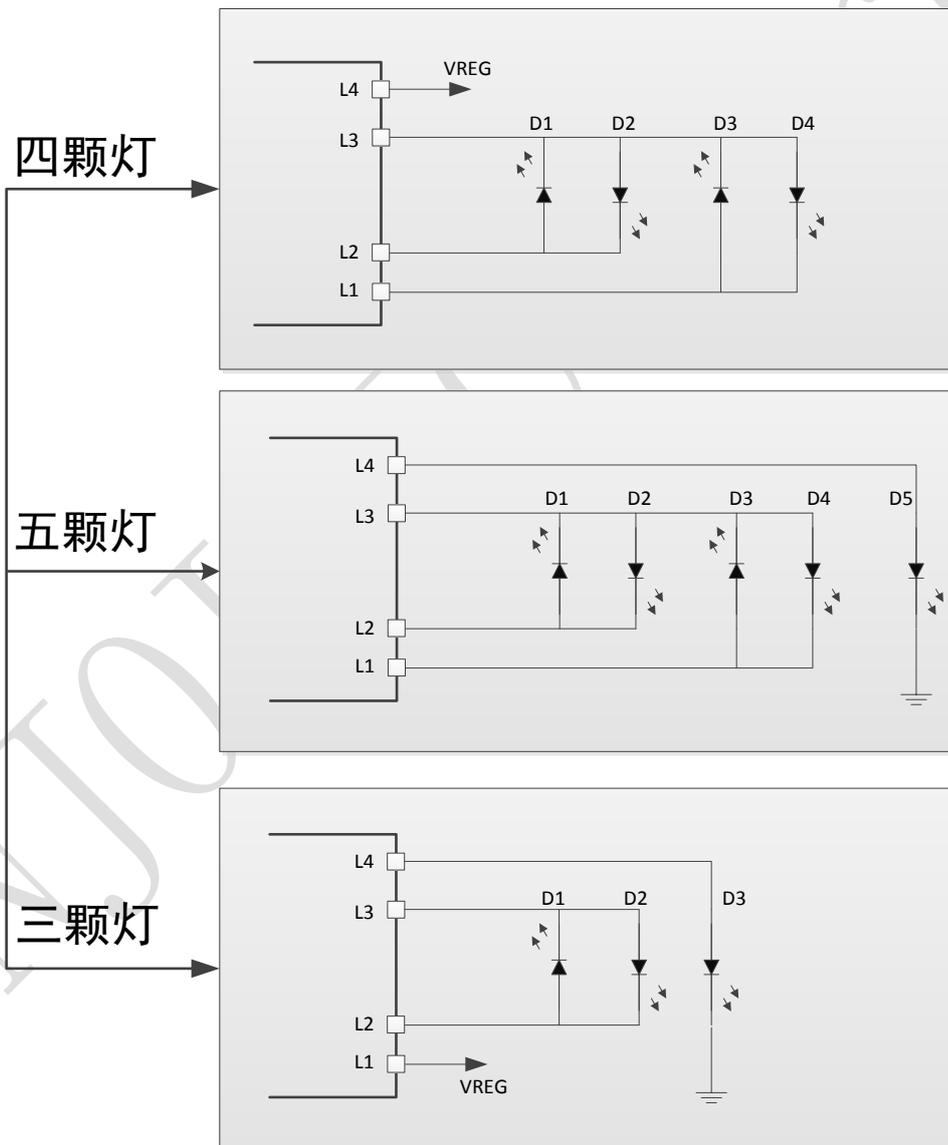


Fig 4 3/4/5 LED PIN configuration

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% ≤ 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%	无	无
4 LEDs	25%	50%	75%	100%	无
5 LEDs	20%	40%	60%	80%	100%

Cellphone plug-in auto detect

IP5108/IP5108E can automatically detect the cellphone's plug-in. When detecting the plug-in, IP5108 will wake up from standby mode and open the 5V step-up converter without push button action. IP5108 supports modules without push buttons. If this function is not need, please inform us when purchasing and tie a 1k ohm resistor from VOUT to GND.

Charger

IP5108/IP5108E 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.

IP5108's switching charger has a 1.6MHz switching frequency, and its maximum charging current is 2.5A, charging efficiency is up to 96%, shortening 3/4 charging time in comparison with the normal chargers. IP5108E Charge current is 1.0A.

IP5108/IP5108E integrates an adaptive power-path management system with priority to output load. It can charge batteries as well as cellphones at the same time.

IP5108/IP5108E is charger can adapt the charging current to the adapter of various load capacity, which can keep adapters away from malfunction.

Flash Light

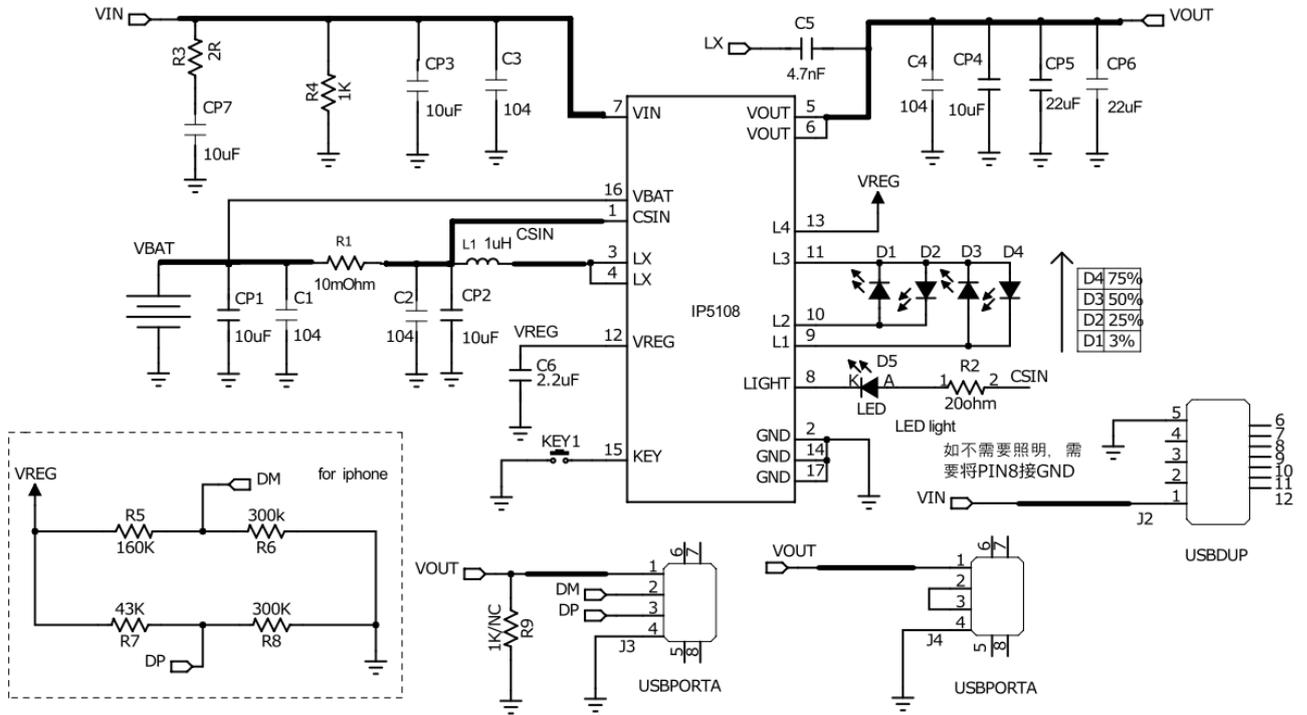
IP5108/IP5108E has an integrated MOS FET. LIGHT PIN in IP5108/IP5108E can drive lighting LED directly. Maximum driving current is 100mA. When Key is pushed longer than 2s, lighting LED is opened or closed. If flash light is not needed, light should connect to GND, IP5108/IP5108E will automatically close flash light.

VREG

VREG is an always on 3.1V LDO with 50ma load capacity.

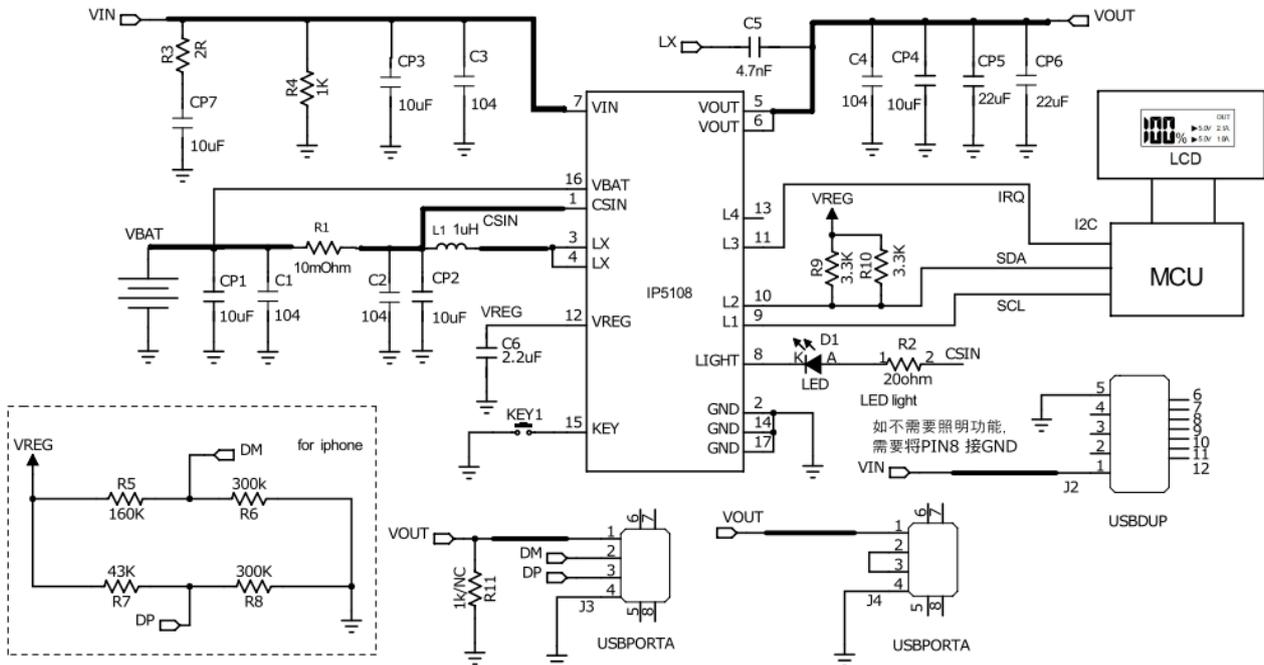
10 Typical application schematic

IP5108/IP5108E only needs capacitors, resistors, and inductors to realize a full featured power bank solution.



如果不需要手机插入自动开机功能·R9焊接1K,否则NC
 不需要手机插入开机功能·需要在订购IC时说明

Fig 5 4 LEDs SOC indicator typical application schematic



如果不需要插入负载自动开机功能，R11需要焊接1K，否则NC。

Fig 6 Typical application schematic with I2C

11 BOM

index	Component name	Part number& spec	Unit	Num	Position	Note
1	IC	IP5108/IP5108E	PCS	1	U1	
2	SMD resistor	1206 0.01R 1%	PCS	1	R1	accuracy 1%, package size 1206
5	SMD resistor	0603 20R 5%	PCS	1	R2	R2 can be adjust the light LED brightness
6	SMD resistor	0603 2R 5%	PCS	1	R3	
7	SMD resistor	0603 1K 5%	PCS	1	R4	
8	SMD resistor	0603 300K 5%	PCS	2	R6, R8	
9	SMD resistor	0603 43K 5%	PCS	1	R7	
10	SMD resistor	0603 160K 5%	PCS	1	R5	
11	SMD capacitor	0603 10UF 10%	PCS	5	CP1、CP2、CP3、 CP4、CP7	Ceramic capacitor rated voltage must be greater than 16v
12	electrolytic capacitor	0603 22UF 10%	PCS	2	CP5、CP6	

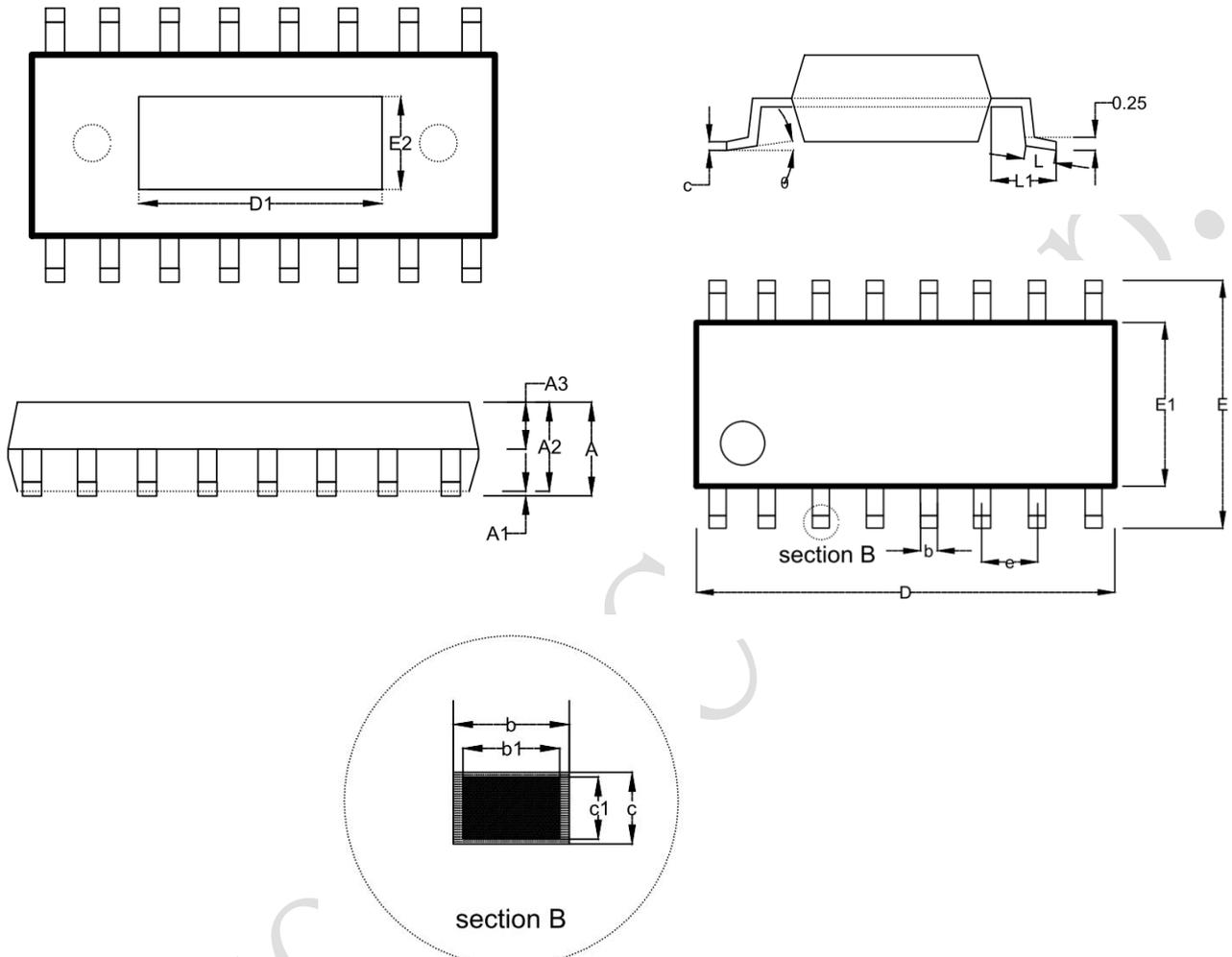
13	SMD capacitor	0603 104 10 %	PCS	4	C1、C2、C3、C4	
14	SMD capacitor	0603 4.7nF 10%	PCS	1	C5	
15	SMD capacitor	0603 2.2uF 10%	PCS	1	C6	
16	SMD LED	0603	PCS	4	D1、D2、D3、D4	
17	Lighting LED	5mm	PCS	1	D5	
18	Inductor	CD54	PCS	1	L1	Isat, Idc >3.8A,DCR<0.02ohm,1u H @1.5MHz
19	USB socket	10mm 短体卷口	PCS	2	J3、J4	
20	Mini USB	Micro USB 母座 5脚 全贴	PCS	1	J2	
21	Push-button	6.5mm*5.1mm	PCS	1	SW1	
22	AC wire	2*100mm 红 黑	PCS	2	B+ B-	

Recommended inductor

CD54

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.	
CD54	1.0	±30%	10	13	3.20	4.00	

12 Package information



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.75
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	-	0.26
c1	0.19	0.20	0.21
D	9.70	9.90	10.10
E	5.80	6.00	6.20

E1	3.70	3.90	4.10
e	1.27BSC		
h	0.25	-	0.5
L	0.50	-	0.80
L1	1.05BSC		
D1		4.57	
E2		2.41	