

## 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
  - ✧ Support 4.20V batteries
- **Fully featured**
  - ✧ Integrated Key ON/OFF
  - ✧ Integrated flashlight controller
  - ✧ Integrated cellphone plug-in and plug-out detector
  - ✧ Supports 4/3 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

IP9315 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.

IP9315's high integration and rich features make the minimized component number in application. It can effectively downsize the application and lower the BOM cost.

IP9315 only needs a single inductor to realize step-down and step-up.

IP9315'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

IP9315'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.

IP9315 has integrated a voltage based fuel gauge algorithm, acquiring battery's state of charge precisely.

IP9315 is available in ESOP8.

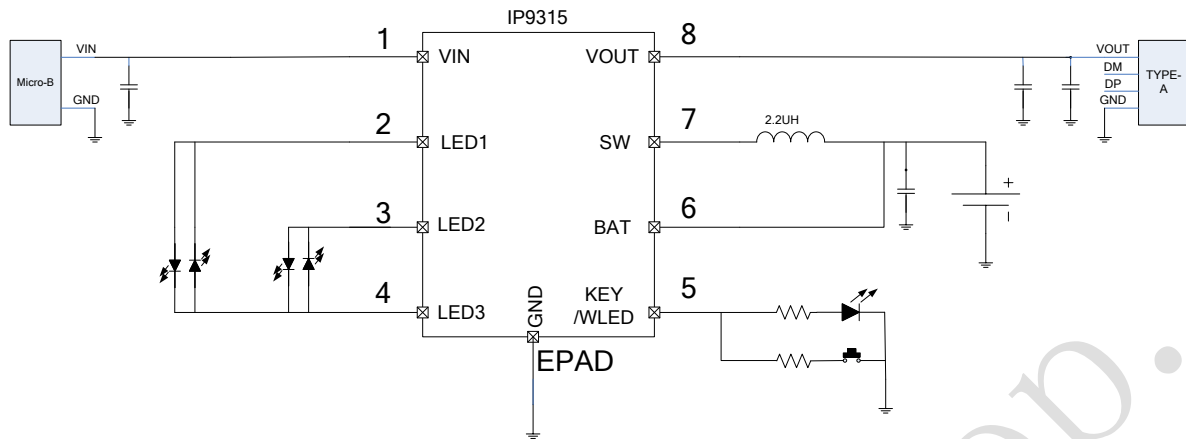


Figure 1 Simplified application schematic (4 LEDs as the SOC indicator)

## 4 Pin definition

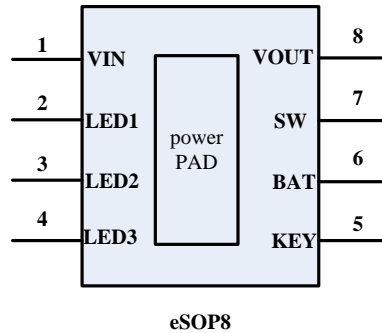


Figure 2 IP9315 Pin Diagram

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	PIN2PIN
IP5109	2.1A	2.1A	3,4,5	✓	✓	✓	–	QFN24	
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)	$\theta_{JA}$	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	$V_{IN}$	4.65	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

$T_A=25^{\circ}\text{C}$ ,  $L=2.2\mu\text{H}$  unless otherwise noted

Parameter	symbol	Test condition	MIN	TYP	MAX	Unit
<b>Charger system</b>						
Input voltage	$V_{IN}$		4.65	5	5.5	V
Input current (charging)	$I_{VIN}$	$V_{IN}=5\text{V}$ , $f_s=350\text{kHz}$			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	$I_{CHRG}$			1.0	1.2	A
Trickle charge current	$I_{TRKL}$	$V_{IN}=5\text{V}$ , $BAT=2.7\text{V}$		100		mA

Trickle charge stop voltage	$V_{TRKL}$		2.9	3	3.1	V
Recharge threshold	$V_{RCH}$		4.07	4.1	4.15	V
Charger safety timer	$T_{END}$		10	12	14	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
<b>Boost system</b>						
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	$\Delta V_{OUT}$	$V_{BAT}=3.7V$ , $V_{OUT}=5.0V$ , $f_s=650KHz$	50	100	150	mV
Boost output current	$I_{vout}$			1.0	2	A
Load over-current detect timer	$T_{UVD}$	Output voltage continuously lower than 4.2V	20	30	50	ms
Load short-circuit detect timer	$T_{OCD}$	Output current continuously larger than 2.0A	150	180	200	us
<b>Control system</b>						
Switching frequency		switching frequency		350		KHz
PMOS on resistance	$r_{DS(on)}$		60	80	90	mΩ
NMOS on resistance			50	70	80	mΩ
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	$I_{L1}$		2	4	5	mA
	$I_{L2}$					
	$I_{L3}$					
Load removal detect timer	$T_{loadD}$	Load current continuously lower than 45mA	25	32	44	s

Push-button wake-up timer	$T_{\text{OnDebounce}}$		30	50	250	ms
Push-button light-on timer	$T_{\text{Keylight}}$		1.2	2	3	s
Thermal shutdown	$T_{\text{OTP}}$	Rising temperature	110	125	140	°C
Thermal shutdown hysteresis	$\Delta T_{\text{OTP}}$			40		°C

## 9 Function description

### Boost converter

IP9315 integrates a 5V output step-up DCDC converter with 1.0A output capacity. It works at 350KHZ. 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.

IP9315'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

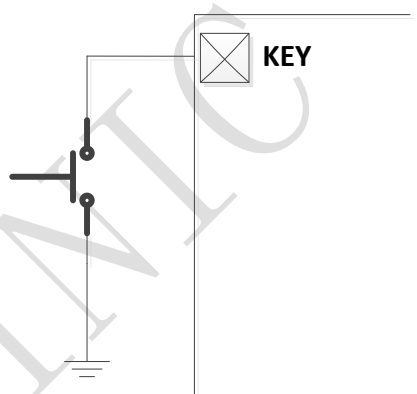


Figure 3 KEY button

Push button's connecting is shown in Fig 5. IP9315 can identify long push and short push.

- If button is pushed longer than 50ms but shorter than 2s, IP9315 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, IP9315 will identify the action as long push. Long push will close step-up converter, SOC indicator LED and flashlight LED.
- If button is pushed shorter than 50ms, IP9315 will ignore the action.
- If two short push is detected within 1s, IP9315 will open or close flashlight LED

### Fuel gauge and State Of Charge (SOC) indication

IP9315 has an integrated fuel gauge, which can indicate the battery's state of charge accurately.

IP9315 can support 3/4 LEDs as the SOC indicator with very simple configuration. By the built-in identification algorithm, IP9315 can automatically identify how many LEDs are used as

the SOC indicator.

Discharging mode, 4 LEDs as the indicator

SOC (%)	L1	L2	L3	L4
$SOC \geq 75\%$	ON	ON	ON	ON
$50\% \leq SOC < 75\%$	ON	ON	ON	OFF
$25\% \leq SOC < 50\%$	ON	ON	OFF	OFF
$3\% \leq SOC < 25\%$	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
$75\% \leq SOC$	ON	ON	ON	1.5Hz blink
$50\% \leq SOC < 75\%$	ON	ON	1.5Hz blink	OFF
$25\% \leq SOC < 50\%$	ON	1.5Hz blink	OFF	OFF
$SOC < 25\%$	1.5Hz 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	D5
3 LEDs	33%	66%	100%	NA	NA
4 LEDs	25%	50%	75%	100%	NA
5 LEDs	20%	40%	60%	80%	100%



## Automatic cellphone plug-in detect

IP9315 can automatically detect the cellphone's plug-in. When detecting the plug-in, IP9315 will wake up from standby mode and open the 5V step-up converter without push button action. IP9315 supports modules without push buttons.

## Charger

IP9315 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.

IP9315'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.

IP9315 integrates an adaptive power-path management system with priority to output load. It can charge batteries as well as cellphones at the same time.

IP9315's charger can adapt the charging current to the adapter of various load capacity, which can keep adapters away from malfunction.

## Flash Light

IP9315 has an integrated MOS FET. LIGHT PIN in IP9315 can drive lighting LED directly. Maximum driving current is 50mA.

## 10 Typical application schematic

IP9315 only needs capacitors, resistors, and inductors to realize a full featured power bank solution.

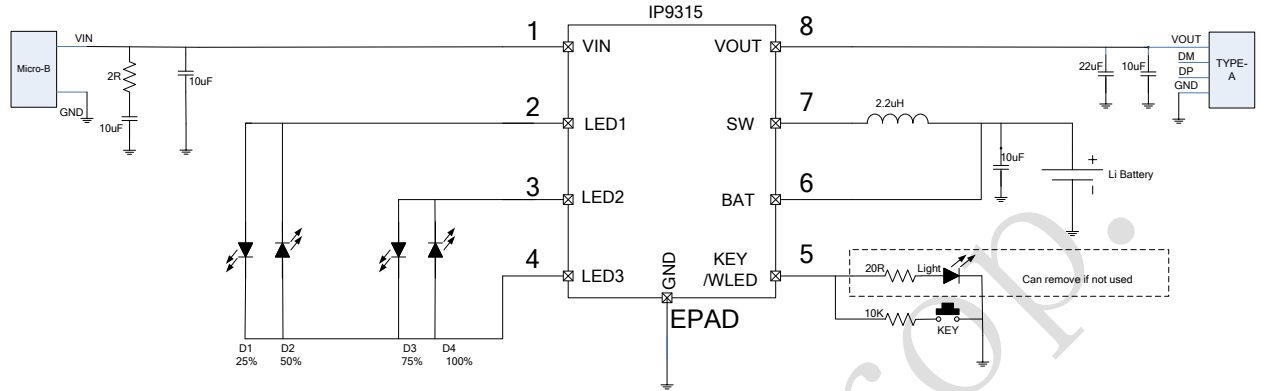


Fig3 4 LEDs SOC indicator typical application schematic

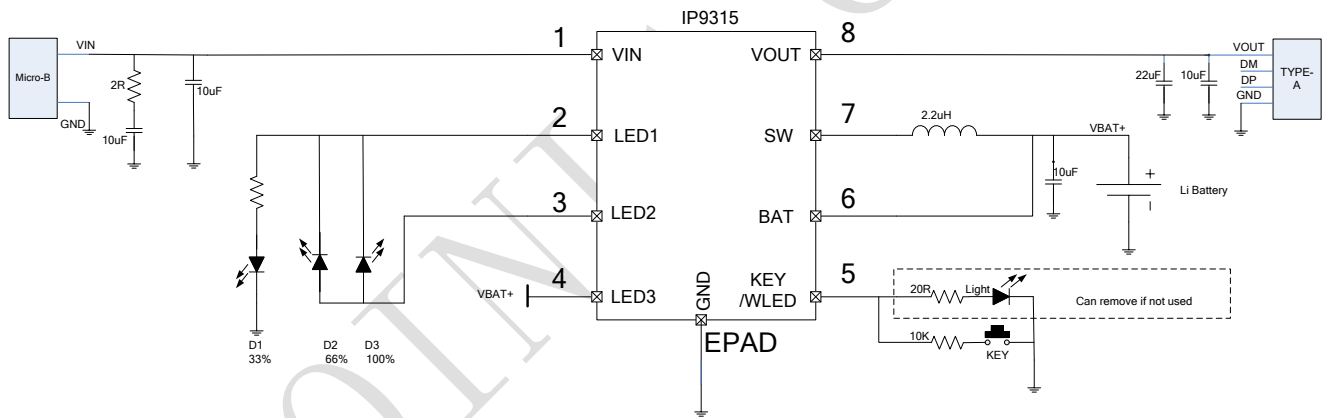
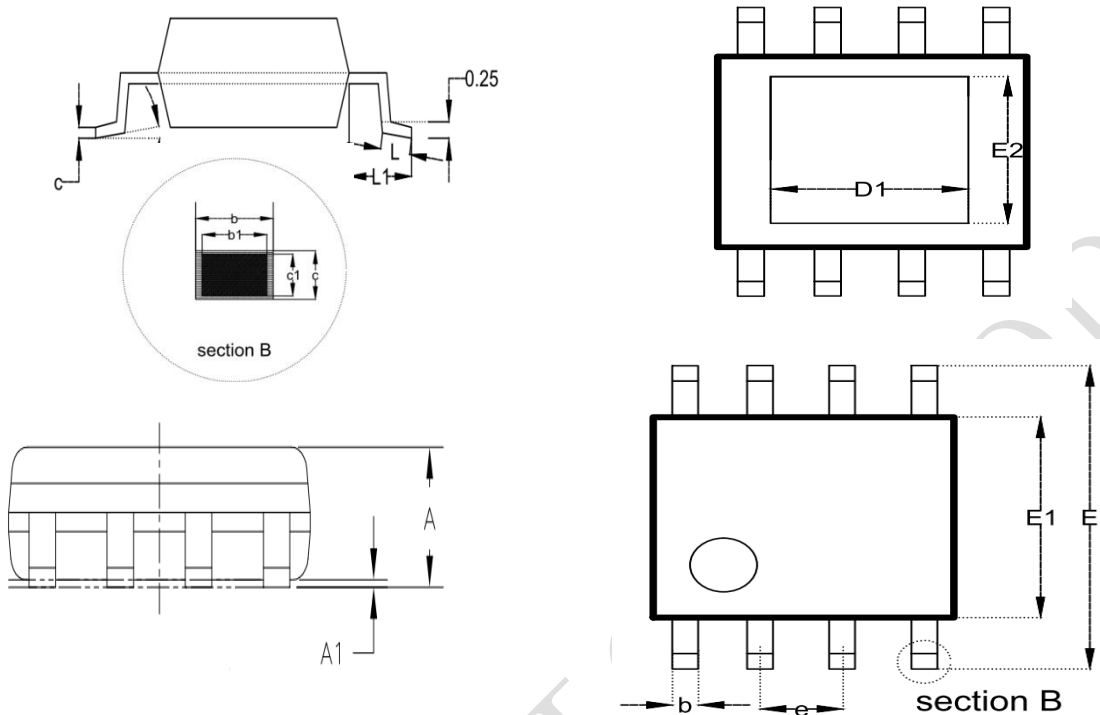


Fig4 3 LEDs SOC indicator typical application schematic

## 11 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	--

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