

## Single-cell lithium battery synchronous switch buck charging IC

### 1 Features

- Synchronous switch step-down charging
- Charging efficiency **94% (3.7V/2A)**
- Maximum charging current **3A**
- Charging current can be adjusted by external resistor
- Automatically adjusts the input current and is compatible with small current adapters
- Support **4.20V/4.30V/4.35V/4.4V** battery
- Support charging **NTC** temperature protection
- Supports **LED** charging status indication
- Built-in power **MOS**
- **750KHz** switching frequency, can support **1uH** inductor
- Input overvoltage and undervoltage protection
- IC over-temperature protection
- Charging timeout protection
- **ESD 4KV**

### 2 Applications

- Single-cell lithium battery/lithium-ion battery charging

### 3 Introduction

**IP2312** is a **5V** input that supports single-cell lithium battery synchronization Switching buck charge management IC.

**IP2312** integrates power MOS and adopts synchronous switching architecture to enable It requires only a few peripheral components during application and effectively reduces the overall The size of the solution reduces **the BOM** cost.

**IP2312** Boost Switching Charge Converter Operating Frequency 750KHz, the maximum charging current is 3A, **5V input, 3.7V/2A** conversion The conversion efficiency is 94%; the charging current can be set through an external resistor.

The input voltage of **IP2312** is 5V, and the input can intelligently adjust charging. current to prevent the adapter from being pulled.

**IP2312** is packaged in **ESOP8**.

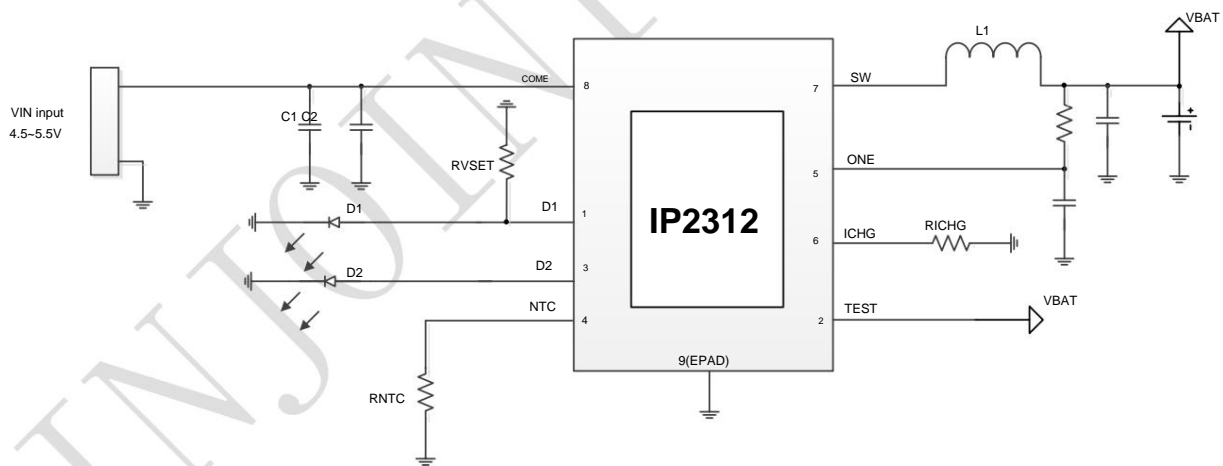


Figure 1 Simplified application schematic diagram

4 pin definition

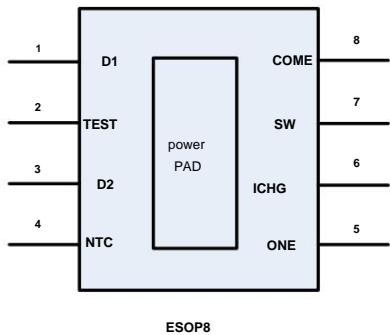


Figure 2 IP2312 pin diagram

Pin Name	Pin Number	Pin Description
D1	1	LED driver pin/battery type selection (IP2312_VSET)
TEST	2	Test pin, connect 1K resistor to the positive terminal of the battery
D2	3	LED driver pin
NTC	4	NTC temperature protection, connect NTC resistor
ONE	5	Connect the positive terminal of the lithium battery
ICHG	6	Charging current setting pin
SW	7	DC-DC switch pin
COME	8	5V charging input pin
EPAD	-	GND

**5 limit parameters**

parameter	symbol	value	unit
Port input voltage range	COME	-0.3 ~ 6.5	IN
Junction temperature range	TJ	-40 ~ 150	°C
Storage temperature range	Tstg	-60 ~ 150	°C
Thermal resistance (junction temperature to ambient)	θJA	60	°C/W
Human Body Model (HBM)	ESD	4	KV

\*Stresses greater than those listed in the Absolute Maximum Ratings section may cause permanent damage to the device under any Absolute Maximum Rating conditions

Excessive exposure time may affect the reliability and service life of the device.

**6 Recommended working conditions**

parameter	symbol	minimum value	Typical value	maximum value	unit
Input voltage	COME	4.5	5	5.5	IN
recharging current	ICHRG	0	2.1	3	A

\*Beyond these operating conditions, device operating characteristics cannot be guaranteed.

**7 Electrical Characteristics**

Unless otherwise specified, TA=25°C, L=1μH, VIN=5V, VBAT=3.7V

parameter	symbol	Test Conditions	smallest value	typical value	maximum value	unit
Charging system						
Input voltage	COME		4.5	5	5.5	IN
Charging target voltage	VTRGT		4.15	4.2	4.23	IN
Default charging current	ICHRG	VIN=5V VBAT=3.7V RICHG=NC	1.8	2.1	2.4	A
Charging switching frequency	fs		650	750	850	KHz
Trickle charge current	ITRKL	VIN=5V VBAT=2.7V	50	100	300 mA	
Trickle cutoff voltage	VTRKL		2.9	3.0	3.1	IN
recharge threshold	TOP		4.08	4.1	4.13	IN
Charging end time	TEND		20	24	28	Hour
Input undervoltage protection voltage	VIN-UVLO		4.4	4.5	4.6	IN
Input overvoltage protection voltage	VIN-OVP		5.5	5.6	5.7	IN

PMOS on-resistance	r <sub>DS(on)</sub>		30	35	40 mΩ	
NMOS on-resistance			25	30	35 mΩ	
Battery input standby current	ISTB	V <sub>IN</sub> = 0V, V <sub>BAT</sub> = 3.7V	30	40	50	μA
LED display driving current	IL1					
	IL2		3	5	10 mA	
	IL3					
Thermal shutdown temperature	T <sub>OTP</sub> rising temperature		110	135	150	°C
Thermal shutdown recovery temperature	T <sub>OTP</sub> drop temperature		70	85	100	°C

**8Function** description

Block diagram structure

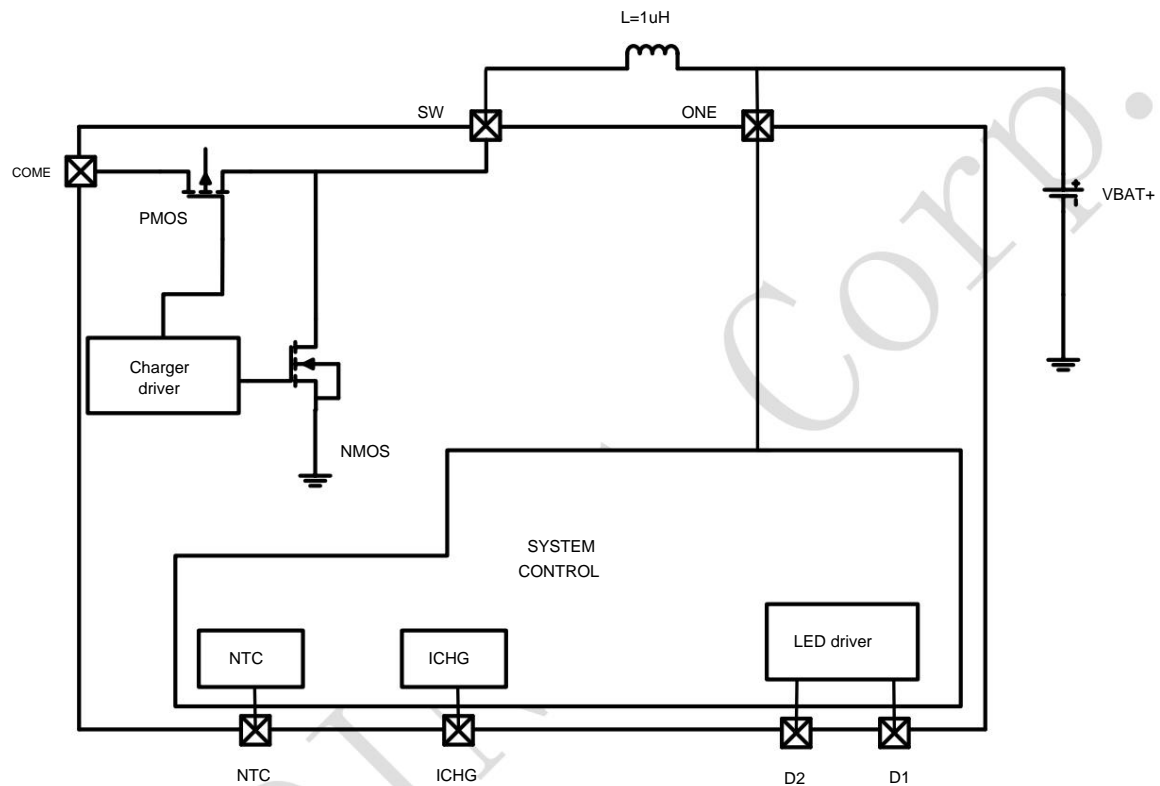
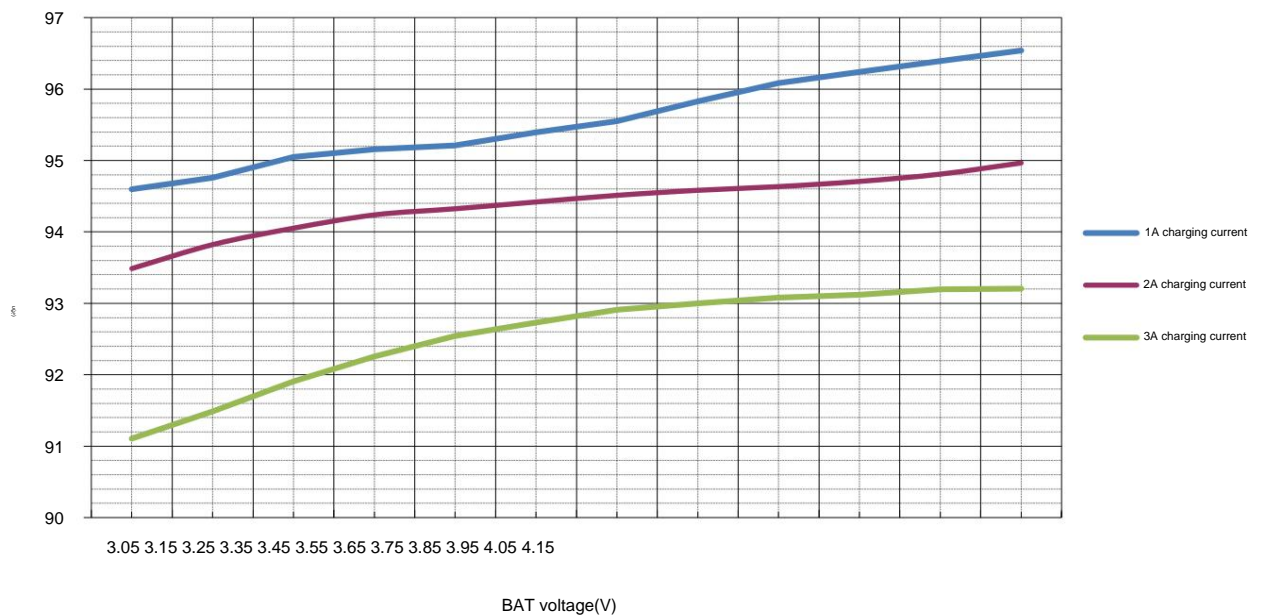


Figure 3 IP2312 internal block diagram

Synchronous Switching Buck Converter

IP2312 integrates a Buck synchronous switching step-down charge controller with a switching frequency of 750KHz, 5V input, and an efficiency of 94% at 3.7V/2A output.

**IP2312 charging efficiency curve VIN=5V****Charging process**

IP2312 adopts complete CC/CV charging mode.

• When the battery voltage is lower than 3V, it enters the trickle charging mode and charges the battery with a charging current of 100mA.

• When the battery voltage is greater than 3V, it enters the constant current charging mode and charges the battery with the set constant charging current.

• When the battery voltage is close to 4.2V and the charging current is less than 300mA, it enters constant voltage charging mode. After entering the constant voltage mode, it will stop charging after every 4 minutes and check whether the battery voltage is higher than 4.15V: if it is higher than 4.15V, stop charging; otherwise, continue charging, and then check after another 4 minutes.

• When the battery is fully charged, if it detects that the battery voltage is lower than 4.1V, it will start charging the battery again.

**Charging protection**

IP2312 has complete protection functions. The built-in soft-start function prevents faults caused by excessive inrush current during startup, and integrates input overvoltage, undervoltage, overtemperature and other protection functions to ensure stable and reliable operation of the system.

• IP2312 integrates VIN input under-voltage protection. The VIN input loop will automatically adjust the charging current. When IP2312 detects that the input voltage (voltage on pin 8) is lower than 4.5V, it will reduce the charging current to make the input voltage (voltage on pin 8) lower than 4.5V. The voltage on pin 8 is stable at 4.5V to ensure that the adapter will not be pulled to death.

• IP2312 integrates VIN input overvoltage protection. When IP2312 detects that the input voltage (voltage on pin 8) is higher than 5.6V, it will stop charging.

electricity.

IP2312 integrates NTC temperature protection function and cooperates with NTC thermistor to charge normally when the temperature is detected within the range of 0~43 degrees; when the temperature is higher than 43 degrees, the charging current is reduced by half; when the temperature is higher than 45 degrees, charging is stopped.

IP2312 integrated charging timeout protection: When the charging time exceeds 24 hours, charging will be forcibly stopped.

IP2312 integrated over-temperature protection function: When IP2312 detects that the chip temperature reaches 135°C, it will stop charging; when the temperature drops to 85°C, IP2312 only considers that the temperature returns to normal and restarts charging;

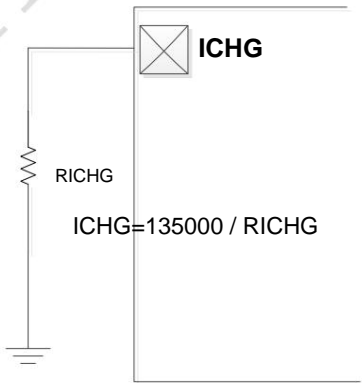
Battery type selection (only supported by IP2312\_VSET model)

IP2312 supports 4.2V lithium batteries by default. IP2312\_VSET supports connecting pull-down resistors of different values to D1 (pin 1) to select the corresponding battery type. The battery type is multiplexed with the LED display output, as shown in the typical application schematic:

RVSET on D1 (pin 1)	Battery type selection (battery full voltage)
NC	4.2V
43K 1%	4.3V
75K 1%	4.35V
100K 1%	4.4V

Constant current charging current setting

The constant current charging current ICC can be set by the external resistor RICHG on the ICHG pin. The set current is the constant current charging current at the battery end:  
 $ICC = 135000 / RICHG$



Typical current recommended resistor:

ICHG terminal resistance RICHG battery terminal	terminal constant current charging current ICC
135Kohm	1A
91 Kohm	1.5A
45Kohm	3A
NC	Default value 2.1A

Charging NTC

IP2312 supports NTC protection function. It detects the battery temperature through the NTC pin. When the detected temperature exceeds the set temperature, the charger is turned off.

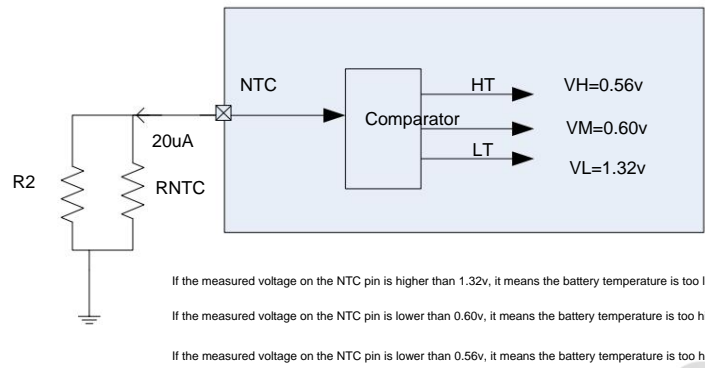


Figure 4 NTC block diagram

• When NTC detects that the temperature is within the range of 0–43 degrees, it charges normally. When the temperature is higher than 43 degrees, the charging current is reduced by half; when the temperature is higher than 45 degrees, stop charging.

• If the NTC function is not needed, you can connect the NTC to ground with a 51K resistor. The NTC pin cannot be left floating, otherwise it may cause abnormal charging.

• Discharge 20uA current from NTC, connect an external resistor to GND on NTC, and judge the temperature range by the voltage drop generated by this current on the resistor.

Example: RNTC=100K @25℃ thermistor (B=4100), R2=82K, corresponding temperature and NTC voltage:

Temperature (degrees)	Internal judgment voltage (V)
-20	1.52
-15	1.49
-10	1.44
0	1.32
43	0.60
45	0.56
50	0.49
55	0.43
60	0.38
65	0.33

Charging LED indication

IP2312 supports 1 or 2 LED indicators:

• 2 lights

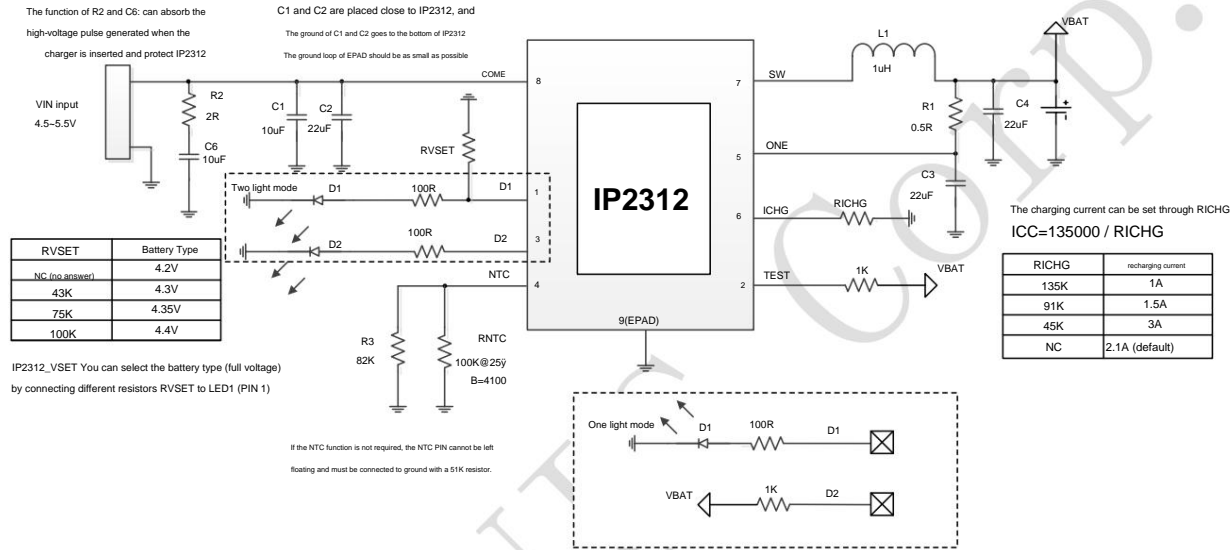
	state	D1	D2
During the charging process, it lights up and turns off when the battery is fully charged.			dim
			Bright

• 1 light

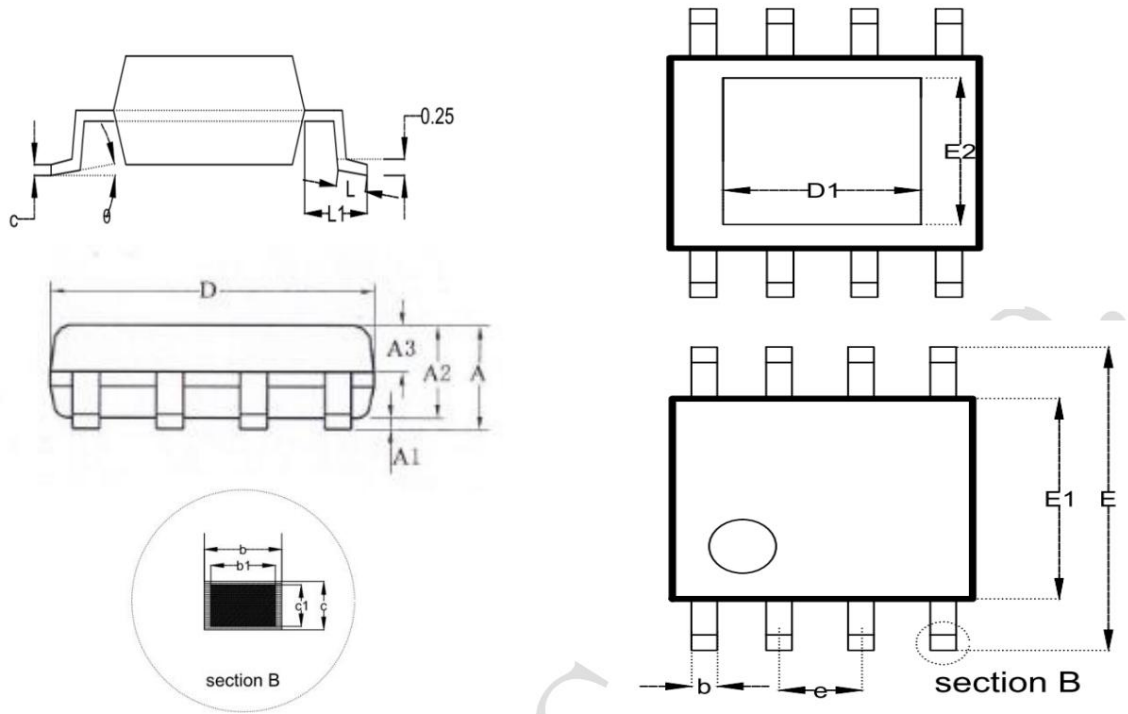


	Status	D1
charging	charging process 0.5Hz flashing	
	fullness	Bright

9Typical application schematics



10Package information



SYMBOL	MILLIMETER		
	MIN	NAME	MAX
A	-	-	1.65
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	-	0.25
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
and	5.80	6.00	6.20
E1	3.70	3.90	4.10
It is	1.27BSC		
L	0.50	0.60	0.80
L1	1.05BSC		
i	0	-	8th
D1	-	2.09	-
E2	-	2.09	-

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