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IP2312U

Single-cell lithium battery synchronous switch step-down chargingIC

1characteristic

- Synchronous switching buck charging
- **charging efficiency94%(3.7V/2A)**
- **maximum charging current3A**
- **Charge Current External Resistor Adjustable**
- **Automatically adjust the input current, compatible with low current adapters**
- **support4.20V/4.30V/4.35V/4.4VBattery supports**
- **chargingNTCtemperature protection**
- **supportledCharging status indication**
- **powerMOSbuilt-in**
- **750KHzswitching frequency, can support1uHInductor input**
- **overvoltage and undervoltage protection**
- ICOver temperature protection
- Charge timeout protection
- **ESD 4KV**

2application

- **Single-cell Li-ion/Li-ion battery charging**

3Introduction

IP2312Uis a5VInput, support single-cell lithium battery synchronous switch step-down charging managementIC.

IP2312UIntegrated powerMOS, the synchronous switch architecture is adopted, so that it only needs very few peripheral devices in the application, and effectively reduces the overall the size of the body plan, reducing theBOMcost.
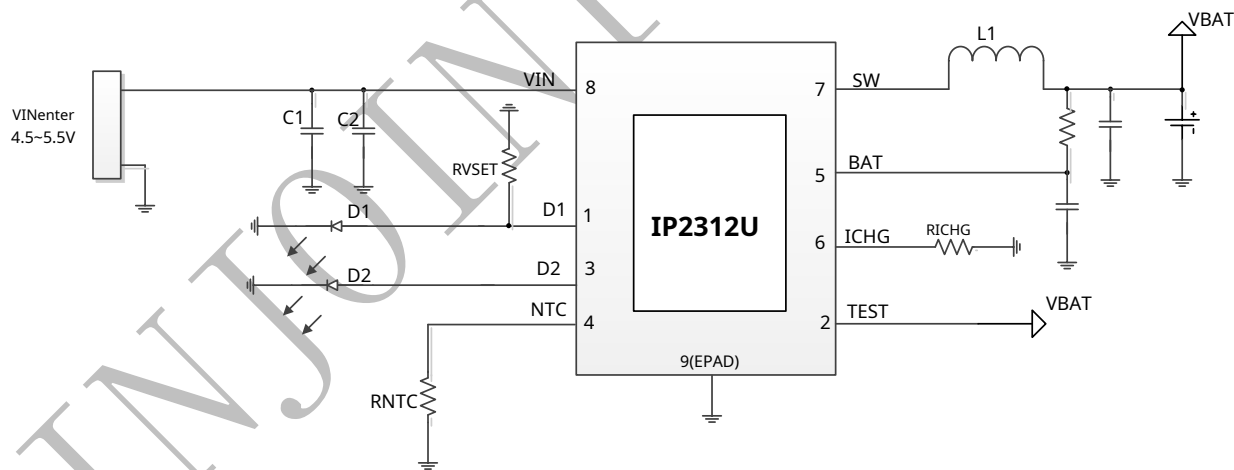
IP2312UThe boost switching charging converter operating frequency 750KHz, the maximum charging current is3A,5Venter,3.7V/2AConversion efficiency94%;The charge current can be set by an external resistor.

IP2312UThe input voltage is5V, the input can intelligently adjust the charging current to prevent the adapter from being pulled.
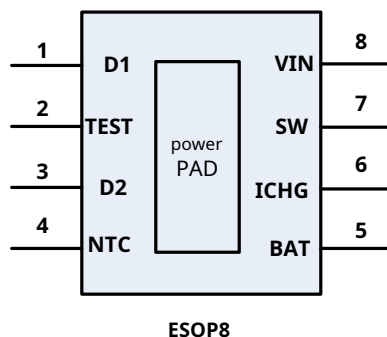
IP2312UuseESOP8package.

picture1**Simplified application schematic**

4pin definition

ESOP8

picture2**IP2312UPin Diagram**

Pin Name	Pin Number	Pin Description
D1	1	ledDrive Pin/Battery Type Selection
TEST	2	test pin, connect1Kresistor to battery positive
D2	3	leddrive pin
NTC	4	NTCtemperature protection, connectNTCresistance
BAT	5	Connect the positive pole of the lithium battery
ICHG	6	Charge Current Setting Pin
SW	7	DC-DCswitch pin
VIN	8	5Vcharge input pin
EPAD	- -	GND

5 Limit parameters

parameter	symbol	value	unit
VIN,SW,BATPin withstand voltage (less than10uSpulse)		9	V
VIN,SW,BATPin withstand voltage (greater than10uSpulse)		6.5	V
D1,D2,NTC,ICHG,TESTPin withstand voltage		6	V
built-inPMOS VDSVoltage		- 12	V
built-inPMOSMaximum continuous current		5	A
built-inNMOS VDSVoltage		12	V
built-inNMOSMaximum continuous current		6	A
Junction temperature range	T_J	- 40 ~ 150	°C
Storage temperature range	Tstg	- 60 ~ 150	°C
Thermal Resistance (Junction Temperature to Ambient)	θ_{JA}	60	°C/W
mannequin (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 Ratings conditions

Excessive exposure time may affect device reliability and lifetime

6 Recommended working conditions

parameter	symbol	minimum	Typical value	maximum value	unit
Input voltage	V_{IN}	4.5	5	5.5	V
recharging current	I_{CHRG}	0	2.1	3	A

* Beyond these operating conditions, device operating characteristics are not guaranteed.

7 Electrical Characteristics

Unless otherwise specified,TA=25°C,L=1uH,V$_{IN}$=5V,V$_{BAT}$=3.7V

parameter	symbol	Test Conditions	minimum value	typical value	maximum value	unit
charging system						
Input voltage	V_{IN}		4.5	5	5.5	V
charging target voltage	V_{TRGT}		4.15	4.2	4.23	V
Default charge current	I_{CHRG}	V$_{IN}$=5V,V$_{BAT}$=3.7V,R$_{ICHG}$=NC	1.8	2.1	2.4	A

Charge Current Setting Resistor maximum value	R_{ICHG}		170	175	180	KΩ
Charging switching frequency	f_S		650	750	850	KHz
Trickle Charge Current	I_{TRKL}	V_{IN}=5V,V_{BAT}=2.7V	50	100	300	mA
Trickle cut-off voltage	V_{TRKL}		2.9	3.0	3.1	V
recharge threshold	V_{RCH}		4.08	4.1	4.13	V
Charging cut-off time	T_{END}		20	twenty four	28	Hour
Input under-voltage protection voltage	$V_{IN-UVLO}$		4.4	4.5	4.6	V
Input overvoltage protection voltage	V_{IN-OVP}		5.5	5.6	5.7	V
PMOSOn resistance	r_{DSON}		30	35	40	mΩ
NMOSOn resistance			25	30	35	mΩ
Battery Input Standby Current	I_{STB}	V_{IN}=0V,V_{BAT}=3.7V	30	40	50	uA
ledDisplay drive current	I_{L1} I_{L2} I_{L3}		3	5	10	mA
Thermal Shutdown Temperature	T_{OTP}	rising temperature	110	135	150	°C
Thermal Shutdown Recovery Temperature	T_{OTP}	drop temperature	70	85	100	°C

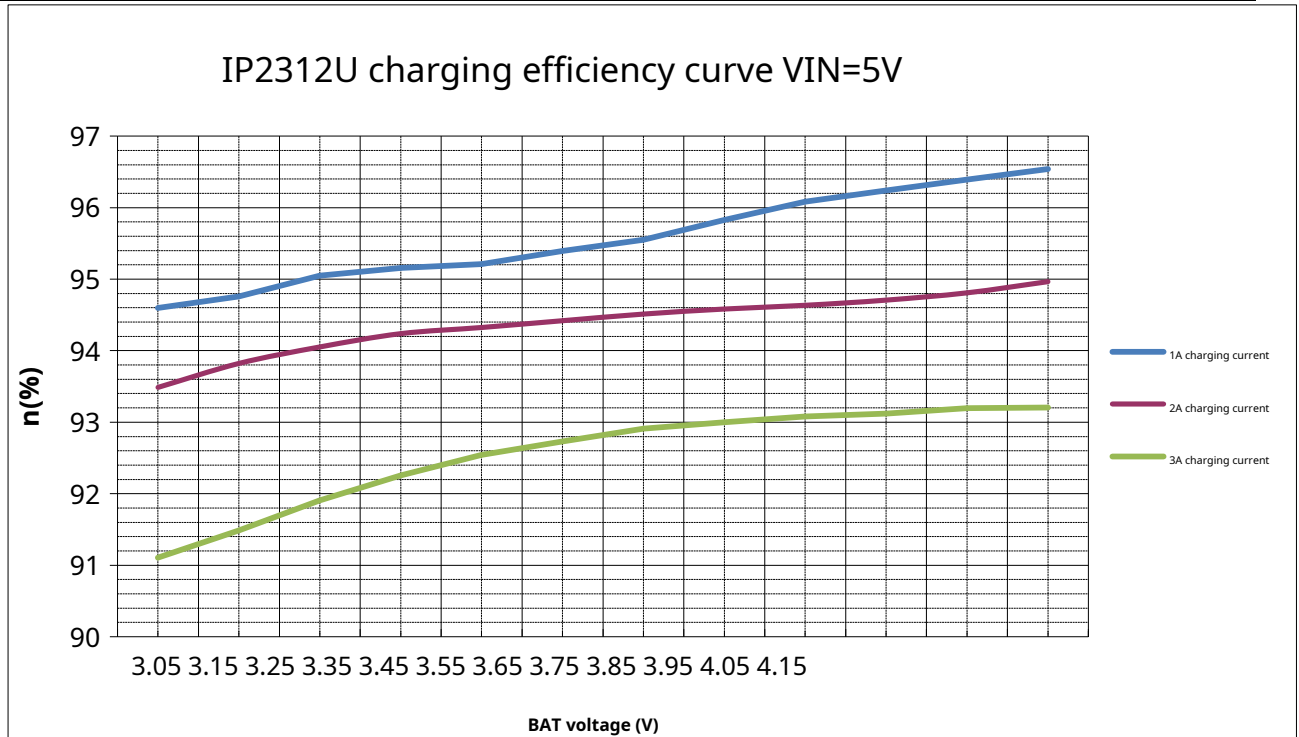**8Function description**

block diagram structure
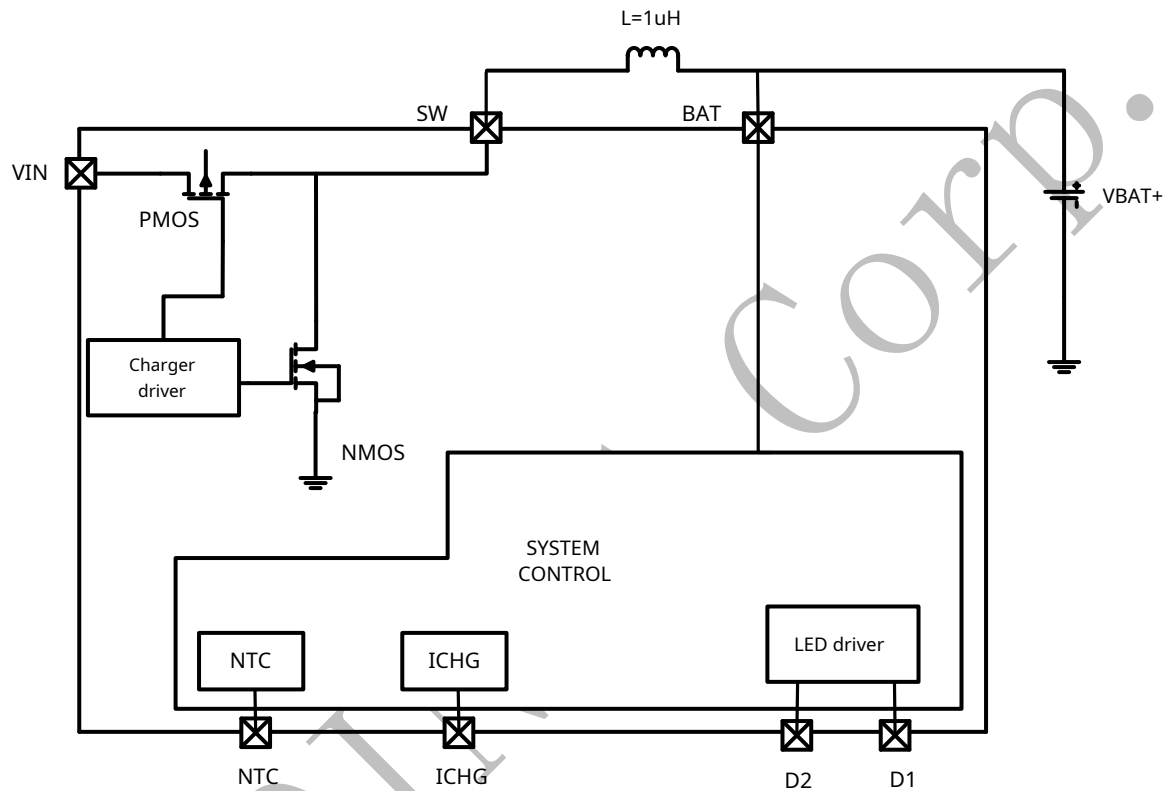
picture3   IP2312UInternal block diagram

Synchronous Switching Buck Converters

IP2312Uintegrate oneBuckSynchronous switching buck charge controller, switching frequency750KHz,5Venter,3.7V/2AThe output efficiency is 94%.

IP2312U charging efficiency curve VIN=5V

charging process

IP2312Uusing the completeCC/CVcharging mode.

- When the battery voltage is lower than3V, enter the trickle charge mode to100mAcharging current to charge the battery.

- When the battery voltage is greater than3VThen, enter the constant current charging mode to charge the battery with the set constant current charging current.

- When the battery voltage is close to full, and the charging current is less than300mA, enter the constant voltage charging mode. After entering the constant voltage mode, every4Stop charging after minutes and check if the battery voltage is higher than4.15V: if higher than4.15V, stop charging; otherwise, continue charging, and then4Check in minutes.

-When the battery is fully charged, if it is detected that the battery voltage is lower than4.1V, it will turn on again to charge the battery.

charging protection

IP2312UIt has perfect protection function. Built-in soft-start function to prevent failure caused by excessive inrush current during startup, integrated input over-voltage, under-voltage, over-temperature and other protection functions to ensure stable and reliable operation of the system.

- IP2312UintegratedVINInput undervoltage protection,VINThe input loop automatically adjusts the charge current whenIP2312Uinput voltage detected (p.8pin voltage) is lower than4.5V, the charge current is reduced so that the input voltage (p.8pin voltage) stabilized at4.5V, make sure you don't pull the adapter to death.

- IP2312UintegratedVINInput overvoltage protection, whenIP2312Uinput voltage detected (p.8pin voltage) higher than5.6VAfter that, charging will stop.

- IP2312UintegratedNTCtemperature protection function, withNTCthermistor, when the detected temperature is0~43Charge normally when the temperature is within the range; when the temperature is higher than43When the temperature is higher than45When the temperature is reached, stop charging.

- IP2312UIntegrated charging timeout protection: when the total charging time exceedstwenty fourhours, or enter constant voltage charging for more than4hours will force the charging to stop.

- IP2312UIntegrated over-temperature protection: whenIP2312UIt is detected that the chip temperature reaches135℃, it will stop charging; when the temperature drops to85℃, IP2312UOnly think that the temperature has returned to normal and restart charging;

Battery type selection

IP2312U_VSETsupported byD1(p.1pin) to connect pull-down resistors with different resistance values   to select the corresponding battery type, which is related toledDisplay output multiplexing, such asTypical Application Schematic :

D1(p.1feet) onRVSET	Battery type selection (full battery voltage)
NC	4.2V
43K 1%	4.3V
75K 1%	4.35V
100K 1%	4.4V

Constant current charging current setting

Constant current charging currentI_{CC}able to pass$ICHG$Pin external resistorR_{ICHG}To set, the set current is the constant current charging current of the battery terminal: I_{CC}=135000/R_{ICHG}. (Charging current setting accuracy±10%)

R_{ICHG}maximum value170K, corresponding to the minimum charging current0.8A;R_{ICHG}more than the170KAfter that, it will be considered that there is no resistance connected (NC), the charging current returns to the default value2.1A;

$$ICHG = 135000 / R_{ICHG}$$
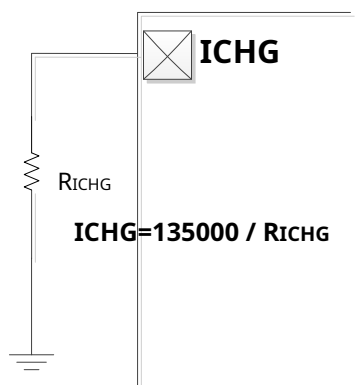
Typical current recommended resistance:

ICHGTerminal resistanceR_{ICHG}	Battery terminal constant current charging currentI_{CC}
135Kohm	1A
91Kohm	1.5A
45Kohm	3A

NC	Defaults2.1A

ChargeNTC

IP2312UsupportNTCprotection function, throughNTCThe pin detects the temperature of the battery, when the detected temperature exceeds the set temperature, it will be turned offcharger.
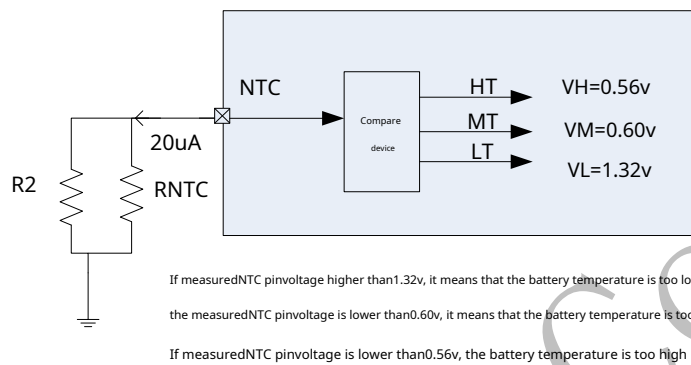
picture4 NTCblock diagram

- whenNTCtemperature detected at0~43Charge normally within the temperature range. when the temperature is higher than43When the temperature is higher than45When the temperature is reached, stop charging.

- if not neededNTCfunction, canNTCuse51Kresistor to ground,NTCThe pin cannot be left floating, otherwise it may cause abnormal charging.

- fromNTCrelease20uAcurrent,NTCconnect a resistor to theGND,This current produces a voltage drop across the resistor to determine the temperature range.

Example:RNTC=100K @25℃ thermistor (B=4100),R2=82K, the corresponding temperature andNTCVoltage:

temperature (degree)	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

Chargeledinstruct

IP2312Usupport1or2grainledIndicator light: 2

- lamp

	state	D1	D2
Charge	charging process	Bright	extinguish

	full	extinguish	Bright

-1lamp

	state	D1
Charge	charging process	0.5Hzflicker
	full	Bright

9Typical Application Schematic

R2,C6Effect: can absorb
The high

pressure pulse, protectionIP2312

C1,C2nearIP2312placed, and C1,C2land
toIP2312under EPADThe ground loop
should be as small as possible

RVSET	Battery Type
NC(not answer)	4.2V
43K	4.3V
75K	4.35V
100K	4.4V

IP2312U_VSETthrough theLED1(PIN 1) with
different resistorsRVSET, to select the battery type
Type (full voltage)

able to passRICHGto set the charging current

$I_{CC}=135000/R_{ICHG}$

RICHG	recharging current
135K	1A
91K	1.5A
45K	3A
NC	2.1A(Defaults)

if not requiredNTCFunction,NTC PINCan not be
left in the air, use51KResistor to ground

picture5Typical Application Schematic

10Package information
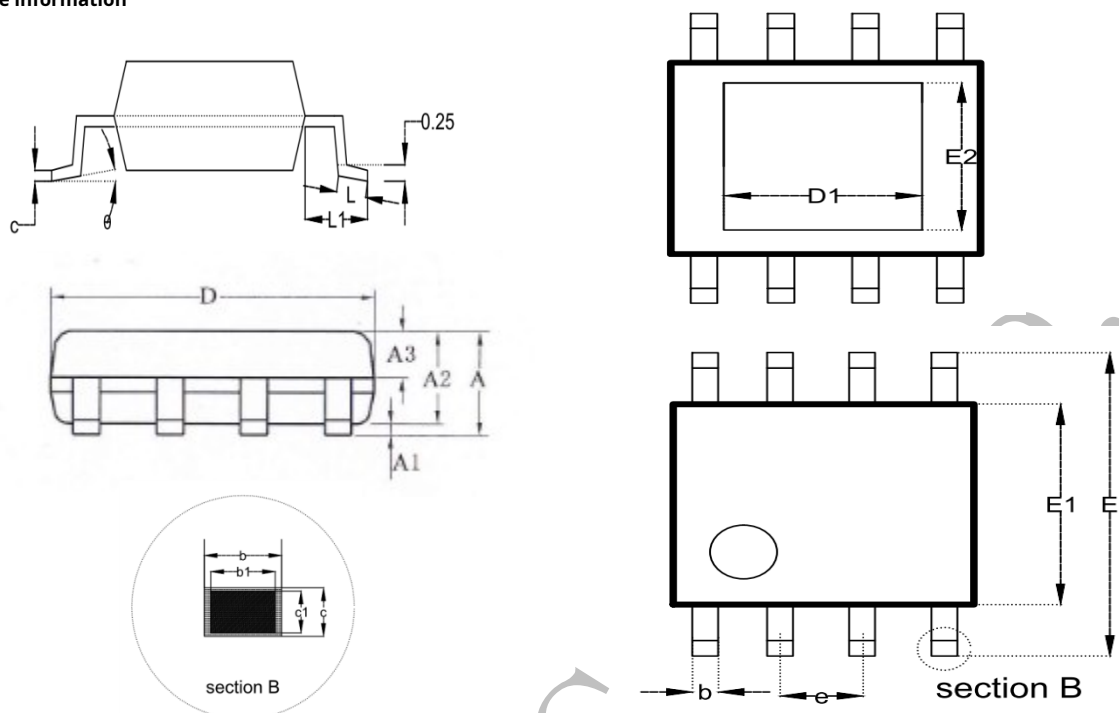
SYMBOL	MILLIMETER		
	MIN	**NOM**	**MAX**
A	- -	- -	1.65
A1	0.05	- -	0.15
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	- -	0.48
b1	0.38	0.41	0.43
c	0.21	- -	0.25
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
L	0.50	0.60	0.80
L1	1.05BSC		
θ	0	- -	8º
D1	- -	2.09	- -
E2	- -	2.09	- -

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