

5V Input Boost Charger for Two-cell Serial Li Battery

1. Features

- **Charging**
 - ✧ Integrated 15W synchronous switch-mode boost charger
 - ✧ 93% boost charging efficiency
 - ✧ Programmable constant voltage charging voltage by external resistor
 - ✧ Self-regulated input current, adaptive adapt-or load
 - ✧ LED for charging status indication
- **Minimal BOM**
 - ✧ Power MOSFETs integrated
 - ✧ 500kHz switching frequency, support 2.2uH inductor
- **Multiple protection, high reliability**
 - ✧ NTC thermal protection
 - ✧ Output OC, OV and Short circuit protection
 - ✧ Input voltage withstand 20V
 - ✧ ESD 4kV ability

2. Description

IP2325 is a 5V VIN, 2A two-cell synchronous boost Li/Li-Ion battery charger and system power path management device for two-cell serial Li/Li-Ion battery.

IP2325 integrate synchronous switching circuit with power FETs at 500kHz switching frequency. The charging efficiency is 93% when VIN is 5V and VOUT is 8V/1.2A

IP2325 has the function of input voltage limiting. The charge current is regulated automatically. Adaptive adapter load capacity

IP2325 supports an external resistor to adjust the charging voltage

IP2325 integrated NTC protection function, with NTC resistor

IP2325 is package in ESOP8

3. Typical Applications

- **Two-cell Li/Li-Ion battery charging management**

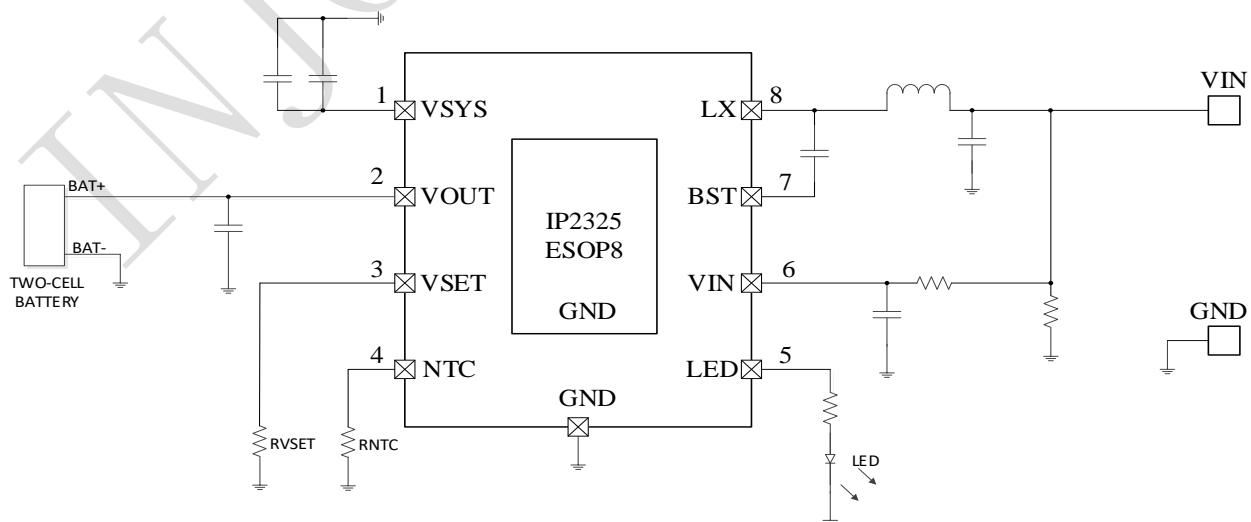


Figure 1 Simplified Application Schematic

4. PIN Description

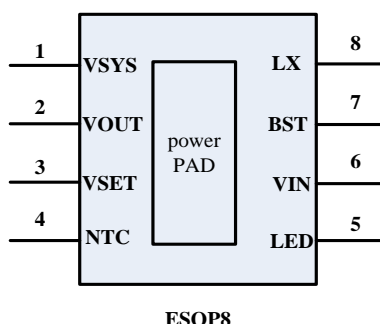


Figure 2 IP2325 Pin Assignment

Pin Name	Pin No.	Pin Description
VSYS	1	Two 22uF ceramic capacitors are placed close to the pin at the intermediate node of the boost output
VOUT	2	Boost output pin, connect battery positive
VSET	3	Constant voltage charging voltage setting pin
NTC	4	NTC thermal protection, output 20uA current, connect to NTC resistor
LED	5	LED charging status indication pin
VIN	6	Input power supply and check pin
BST	7	Bootstrap circuit pins with bootstrap capacitance 0.1uF placed next to BST and LX pins of the chip
LX	8	DCDC switch node, connect to external inductor
GND	EPAD	System ground and power ground

5. Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input Voltage Range	V_{IN}	-0.3 ~ 20	V
Junction Temperature Range	T_J	-40 ~ 150	℃
Storage Temperature Range	T_{stg}	-60 ~ 150	℃
Junction Temperature(junction to ambient)	θ_{JA}	60	℃/W
Human Body Model (HBM)	ESD	4	kV

*Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

*Voltages are referenced to GND unless otherwise noted.

6. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN}	4.5	5	5.5	V
Charge Current	I	0	1.2	1.4	A

*Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

7. Electrical Characteristics

Unless otherwise specified, $T_A = 25\text{ }^{\circ}\text{C}$, $L = 2.2\mu\text{H}$, $V_{IN} = 5\text{V}$, $V_{OUT} = 7.4\text{V}$

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Charging System						
Input Voltage	V_{IN}		4.5	5	5.5	V
Input under-voltage threshold	V_{IN-UV}		4.4	4.5	4.6	V
Input over-voltage threshold	V_{IN-OV}		5.6	5.75	5.9	V
Input Current	I_{VIN}	$V_{IN}=5\text{V}$, $V_{OUT}=\text{NC}$, NO LED	10	20	30	mA
Standby Current	$I_{\text{standby-BAT}}$	$V_{IN}=0$, $V_{OUT}=7.4\text{V}$		0.7	1	μA
Charge Voltage Target	V_{TRGT}	$R_{VSET}=\text{NC}$	8.3	8.4	8.5	V
		$R_{VSET}=120\text{k}$	8.2	8.3	8.4	V
		$R_{VSET}=68\text{k}$	8.1	8.2	8.3	V
		$R_{VSET}=1\text{k}$	8.0	8.1	8.2	V
Charge Current	I_{CHRG}	Constant output current	1.0	1.2	1.4	A
Trickle Charge Current	I_{TRKL}	$V_{IN}=5\text{V}$, $V_{OUT}<3.6\text{V}$	30	50	70	mA
		$V_{IN}=5\text{V}$, $3.7\text{V}<V_{OUT}<6\text{V}$	50	100	150	mA
Charge Current Cut-off	I_{STOP}			200	300	mA
Control System						
LED Drive Current	I_{Led}	$V_{IN}=5\text{V}$			5	mA
Thermal Shutdown Temperature	T_{OTP}	Rising Threshold	125	135	145	$^{\circ}\text{C}$
Thermal Shutdown recovery Temperature	T_{OTP-H}	Falling Threshold	100	110	120	$^{\circ}\text{C}$

8. Type Description

Type name	Function
IP2325	Standard, two-cell charge (constant voltage charging voltage is 8.4V), charging current is 1.2A
IP2325_8V8	Base on IP2325 standard, the constant voltage charging voltage is increased by 0.4V
IP2325_DA	Base on IP2325 standard, modifies the lighting display: charging LED flash ,fully charged LED always bright
IP2325_3S	Three-cell charge(constant voltage charging voltage is 12.6V), charging current is 1A

9. Function Description

9.1 Functional Block Diagram

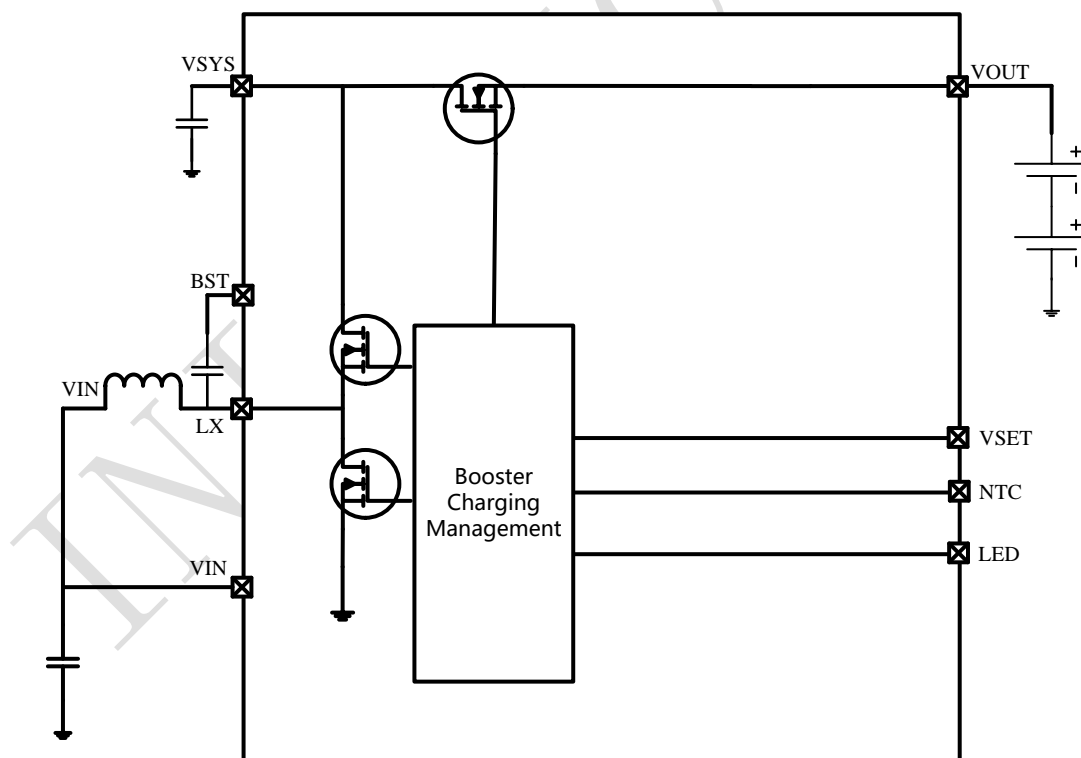


Figure 3 IP2325 Functional Block Diagram

9.2 Boost Charge

IP2325 integrated a synchronous boost charger with 500kHz switching frequency, the output boost to 8.4V for two-cell Li/Li-Ion battery. The efficiency is 93% at 5V input and 8V/1.2A output.

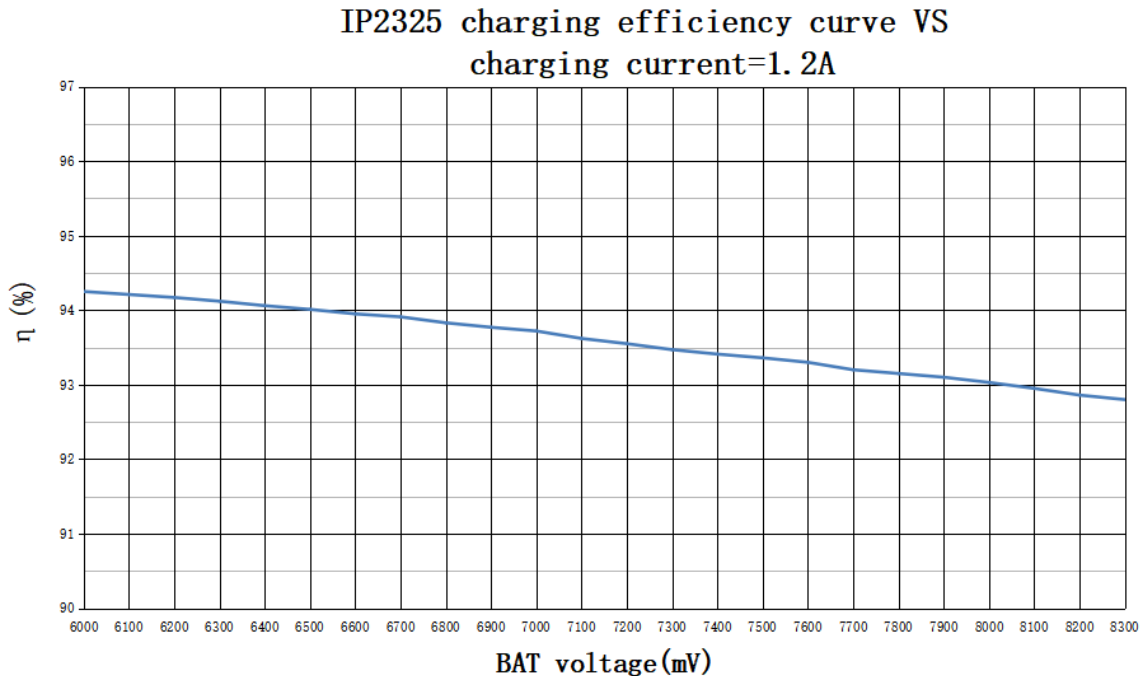


Figure 4 Efficiency curve chart

9.3 Charge Process

IP2325 deploy the complete CC (Constant Current)/CV (Constant Voltage) charging mode.

When the serial two-cell batteries' voltage is lower than 3.7V, charge the batteries in 50mA current.

When the serial two-cell batteries' voltage is between 3.7V and 6V, charge the batteries in 100mA current

When the serial two-cell batteries' voltage is above 6V, the charging current will be I_{CC} .

When the serial two-cell batteries' voltage reaches near 8.4V, the system will enter CV mode.

In the CV mode, the system will pause the charging after 30s if the charging current is less than 100mA. Detect whether the battery voltage is higher than the stop charging voltage, if it is higher, stop charging, if it is lower, continue charging.

When the charging process terminated after batteries are fully charged, and the input persists, if the battery voltage is less than 8V, the charging process will be start again.

9.4 Charge Protection

IP2325 has full protection functions, integrated output over-current, input under-voltage, over-voltage, over-temperature and other protection functions to ensure the system stable and reliable work.

IP2325 has an input voltage stabilizing loop for VIN. When the input voltage is close to 4.5V under-voltage threshold, the charging current will be lowered automatically to ensure the input voltage is stable near the input under-voltage threshold and that the adapter will not fail.

IP2325 integrated input over-voltage protection function, when detected input voltage is greater than 5.75V over-voltage threshold, it will stop charging.

IP2325 integrated NTC function, with NTC resistor, can detect the battery temperature, when it is too high or too low, the system can stop charging.

IP2325 integrated over-temperature protection function, when the chip internal temperature is detected more than 135°C, the system will be forced to stop charging.

9.5 Charging voltage set

IP2325 support VSET pin external resistor RVSET, to set constant voltage charging voltage.

RVSET sets constant voltage charging voltage

RVSET	Constant voltage charging voltage
1k	8.1V
68k	8.2V
120k	8.3V
NC	8.4V

9.6 Charge NTC

IP2325 support NTC protection function, and work with NTC resistor to detect the temperature of the battery.

IP2325 releases a 20 uA current through the NTC pin and then detects the voltage across the NTC resistor to determine the temperature. Turning the charge when the temperature exceeds the set temperature.

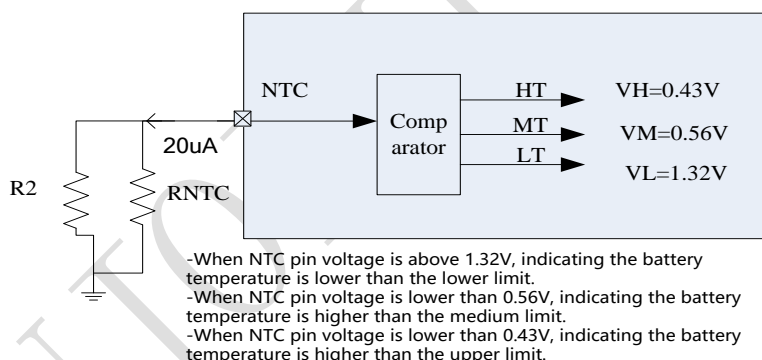


Figure 5 NTC circuit

When IP2325 detects the NTC pin voltage between 0.56V~1.32V, the battery is normal, the charging will be in normal working status.

When IP2325 detects the NTC pin voltage between 0.43V~0.56V, it indicates that the battery temperature is on the high side, the charging current is reduced by half.

When IP2325 detects the NTC pin voltage drop to less than 0.43V, it indicates that the battery temperature is too high, stop charging.

When IP2325 detects the NTC pin voltage rising to more than 1.32V, it indicates that the battery temperature is too low, stop charging.

If the NTC function is not required, pull down to GND with a 51kOhm resistor.

Example: RNTC = 100k thermistor (B = 4100), R2 = 82k, corresponding temperature and NTC pin voltage:

Temperature (°C)	RNTC resistor value	R2//RNTC value	NTC pin voltage
0	346.7k	66.3k	1.32V
45	41.2k	27.8k	0.56V
55	28.4k	21.1k	0.43V

9.7 Charge Status Indication LED

Battery charging LED indicator light, charging process LED light, full charge LED out, detected abnormal

LED flashing.

Dual LED indicator lights can also be used. During the charging process, LED2 lights up, and after being fully charged, LED1 lights up. When an abnormality is detected, the LED flashes alternately. The schematic diagram of dual lights is as follows:

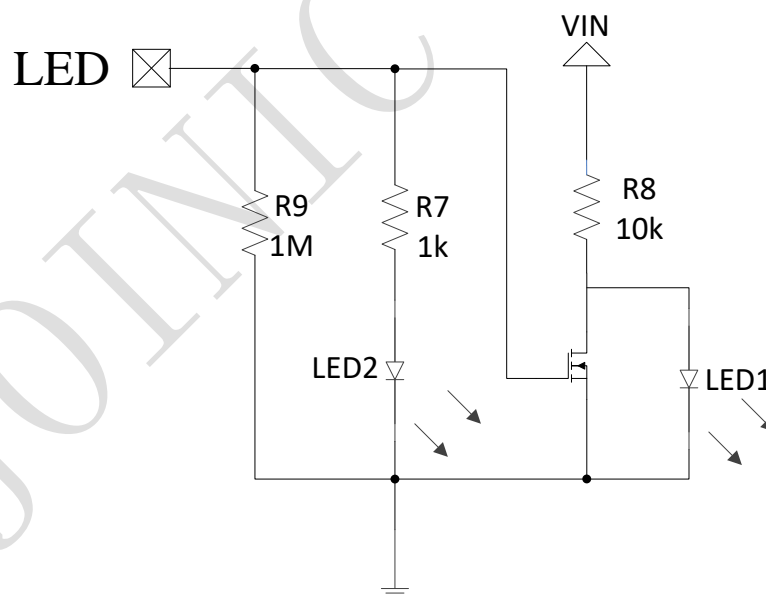


Figure 6 Schematic diagram of dual light mode

10. Typical Application Schematic

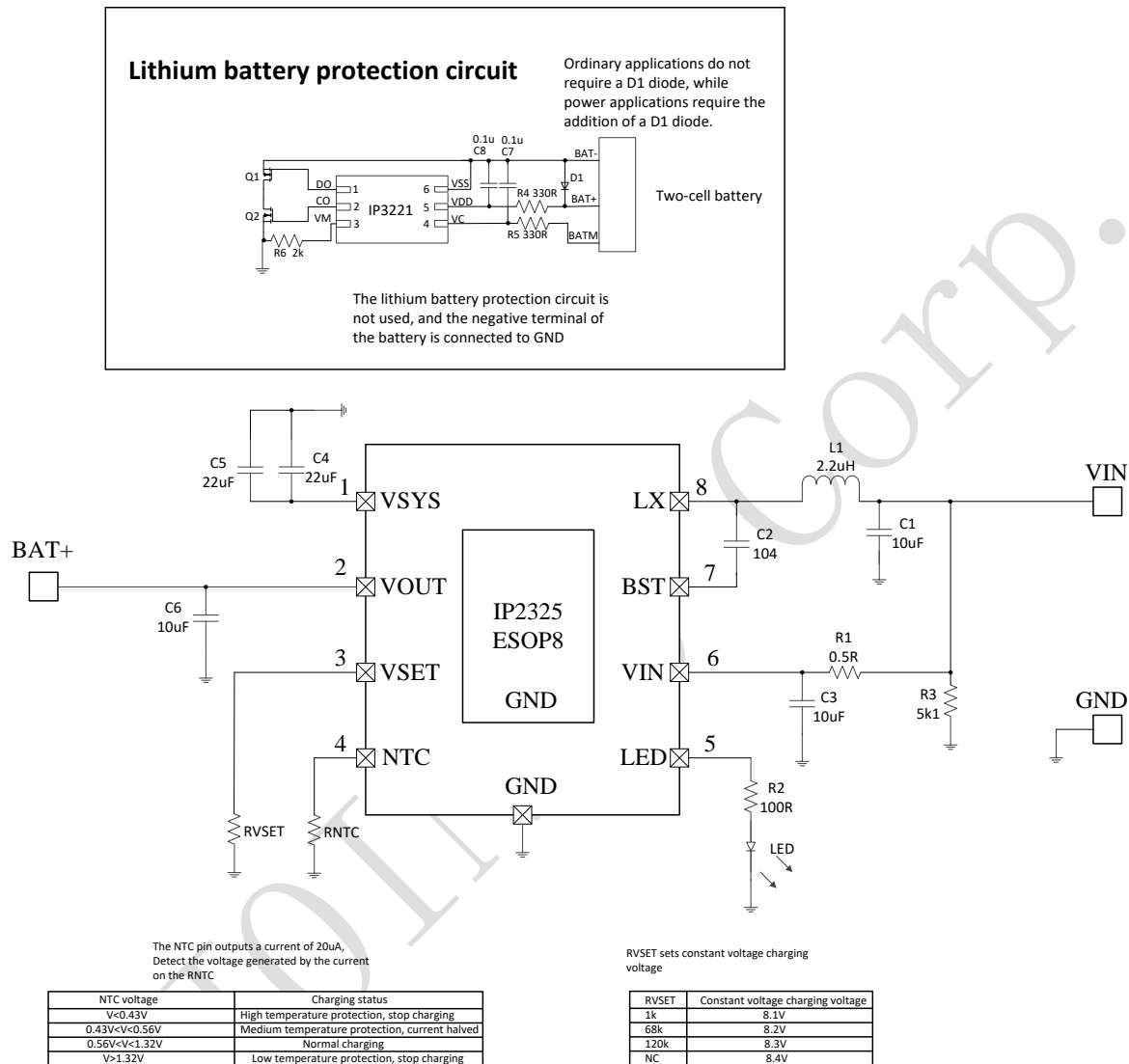


Figure 7 Typical Application Schematic

11.BOM

No.	Part Name	Type & Specification	Units	Quantity	Location	Note
1	IC	IP2325	PCS	1	U1	
2	IC	IP3221	PCS	1	U1	Lithium battery protection chip
3	Inductor	CD43	PCS	1	L1	Saturate current (Isat), temperature rise current (Idc) larger than 5A, DCR less than 20mΩ, inductance 2.2uH @ 500kHz
4	SMD Capacitor	0805 10uF 25V 10%	PCS	3	C1、C3、C6	Capacitor's voltage higher than 16V, SMD ceramic capacitor is required
5	SMD Capacitor	0805 10uF 25V 10%	PCS	2	C4、C5	Capacitor's voltage higher than 16V, SMD ceramic capacitor is required
6	SMD Capacitor	0603 104 25V 10%	PCS	1	C2	
7	SMD Resistor	0603 0.5R 5%	PCS	1	R1	
8	SMD Resistor	0603 100R 5%	PCS	1	R2	Adjust LED brightness
9	SMD Resistor	0603 5.1k 5%	PCS	1	R3	
10	SMD Resistor	0603 330R 5%	PCS	2	R4、R5	
11	SMD Resistor	0603 2k 5%	PCS	1	R6	
12	SMD LED	0603	PCS	1	D1	LED indicator, maximum drive capacity 5mA
13	SMD Resistor	0603	PCS	1	RVSET	Setting constant voltage charging voltage, choose according to your needs.
14	NTC Resistor	NTC Resistor	PCS	1	RNTC	Selection based on design temperature, when don't use it, pull

						down to GND with a 51kOhm resistor
15	diode	RS1M	PCS	1	D1	Ordinary applications do not require a D1 diode, while power applications require the addition of a D1 diode.
16	PMOS	3401	PCS	1	Q1	
17	NMOS	RU207C	PCS	1	Q2	

12.MARK DESCRIPTION



Instruction:


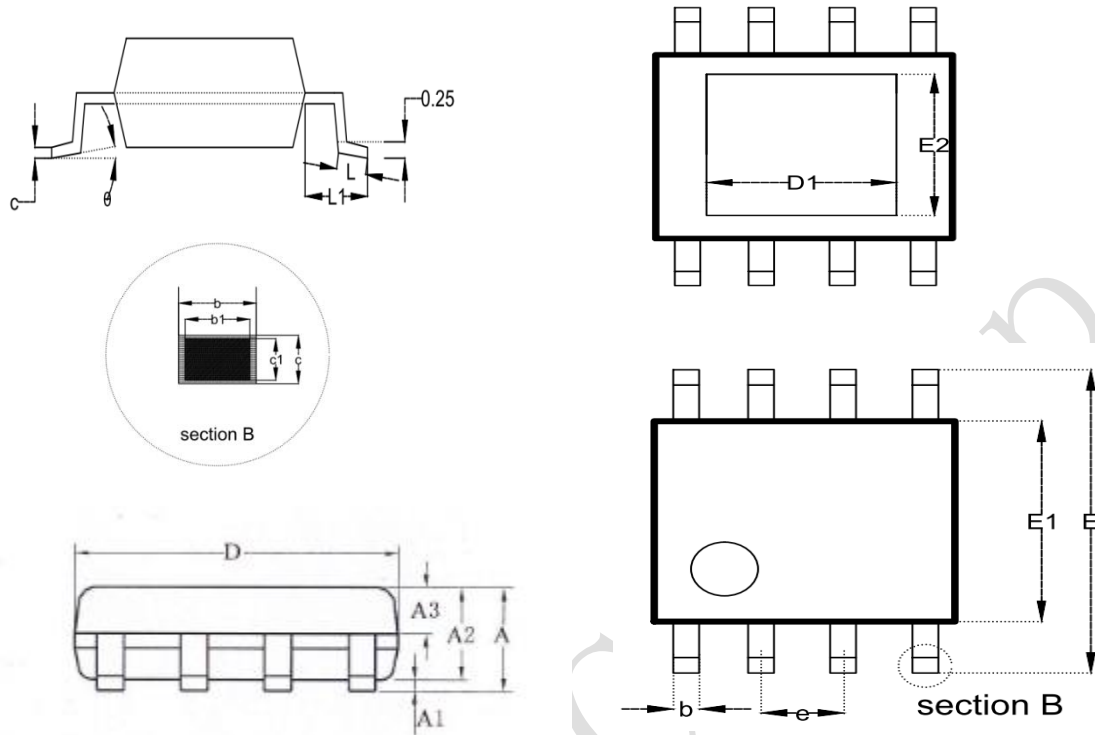
- 1、  --Injoinic logo
- 2、 IP2325 --Product model
- 3、 XXXXXXX --Production number
- 4、 ○ --PIN1 position

Figure 8 IP2325 chip mark illustration

13. PACKAGE 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	--	8°
D1	--	3.10	--
E2	--	2.21	--

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