英集芯科技 INJOINIC TECHNOLOGY

IP3005

Ultra-high precision built-inMOSFETSingle lithium battery protectionIC

1characteristic

- Single-cell Li-ion/Li-polymer battery protectionIC
- Built-in ultra-low on-resistanceMOSFET
  -Ron=25mΩ,(VDD=3.6V,I_{LOAD}=1A)
- Ultra-high precision voltage detection protection
  - Overcharge voltageV_{CU}:4V ~ 4.575V(25mVStepping
    Accuracy ±50mV
  - Overcharge recovery voltageV_{CL}:3.85V ~ 4.4V, (50mV Stepping
    Accuracy: ±100mV
  - Over discharge voltageV_{DL}:2.3V ~ 3V, (100mVStep)
    Accuracy ±100mV
  - Over discharge recovery voltageV_{DR}:2.4V ~ 3.1V, (100mV Stepping
    Accuracy: ±100mV
- Ultra-high precision current detection protection
  - Discharge current protection:4A~10A, (250mAStep)
    Accuracy ±15%
  - Charging current protection:2A~8A, (250mAStepping
    Accuracy ±15%
- 0V-Battery charging allowed
- Ultra-low power consumption:
  - Working Mode:3.0μA
  - Shutdown Mode:1.5μA
- Multiple protections, high reliability
  - Load short circuit protection
  - ESD 4KV
- Small heat sinkeSOP8LEncapsulation

2application

- Single-cell rechargeable lithium-ion/lithium-polymer battery devices
- Power Bank, Tablet Computer

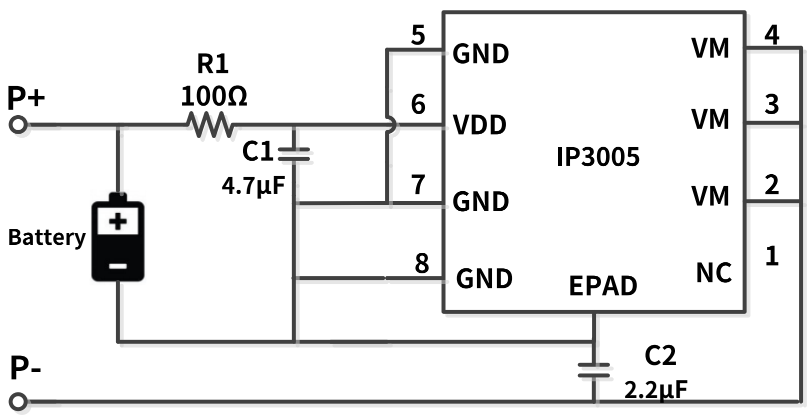
3Introduction

IP3005seriesICIt is an ultra-high precision single-cell lithium-ion/lithium polymer battery protection chip with built-in powerMOSFET, fully integrated with ultra-high precision overcharge voltage, over-discharge voltage, over-discharge current, and overcharge current detection protection circuits.

IP3005Adopts precise voltage judgment circuit to detect overcharge voltage, overcharge recovery voltage, overdischarge voltage and overdischarge recovery voltage. The measurement accuracy reaches ±50mVBy monitoring the built-in powerMOSFET The current makes the threshold of charge overcurrent and discharge overcurrent reach ±5% The accuracy does not change with battery voltage.

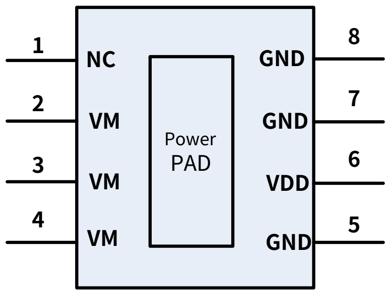
IP3005seriesICIt has a wide range of voltage protection and over-current detection options, and has fine gear steps, which can be adjusted according to user requirements. Achieve diversified customization.

IP3005seriesICuseeSOP8LPackage, with small heat sink, with built-in powerMOSFETExtremely low on-resistance, excellent heat dissipation under high power operation.



picture1Simplified Application Schematic

4Pin Definition



eSOP8

picture2 IP3005Pin Diagram

Pinout		describe
Serial number	name	
1	NC	NC pin, need to be left floating
2,3,4	VM	The negative electrode of the charger or load is connected to the powerMOSFETconnect.
5,7,8	GND	Ground, connected to the negative terminal of the battery, inside the chip With powerMOSFETconnect.(allGNDAll Must be connected, cannot float in the air)
6	VDD	Power supply, connect to the positive terminal of the battery
Power PAD		EPAD, the current needs to beGNDconnect

Product Model List

model	Key Features										Encapsulation
	Overcharge Voltage VCU /V	Overcharge recover Voltage VCL /V	Overrelease Voltage VDL /V	Overrelease Complex voltage VDR /V	Overcurrent Current A	Overcharge Voltage Accuracy mv	maximum continued Current A	MOS Internal resistance mΩ	0Velectricity Pool Charge electricity	application	
IP3001A	4.28	4.1	2.5	3.0	3.6	50	3	27	Yes	1A mobile power, blue Bluetooth Speaker	SOT23-5
IP3001B	4.42	4.2	2.5	3.0	3.6	50	3	27	Yes	1A mobile power, blue Bluetooth Speaker	SOT23-5
IP3003A	4.28	4.1	2.5	3.0	1.5	50	1	30	Yes	Wearable devices	DFN6
IP3003B	4.42	4.2	2.5	3.0	1.5	50	1	30	Yes	Wearable devices	DFN6
IP3005A	4.28	4.1	2.5	3.0	7	50	5	25	Yes	2A Power Bank	ESOP8
IP3005B	4.42	4.2	2.5	3.0	7	50	5	25	Yes	2A Power Bank	ESOP8
IP3006A	4.28	4.1	2.5	3.0	7	50	5	27	Yes	2A Power Bank	DFN6
IP3006B	4.42	4.2	2.5	3.0	7	50	5	27	Yes	2A Power Bank	DFN6

Minimum package:2.5K/roll

5Limit parameters

parameter	symbol	value	unit
VDDInput voltage	V_{DD}	- 0.3 ~ 10	V
VMInput voltage	Vm	- 3 ~ 7	V
Junction temperature range	T_J	- 40 ~ 150	℃
Storage temperature range	Tsj	- 60 ~ 150	℃
Thermal resistance (junction to ambient)	θ_{JA}	50	℃/W
Human body model (HBM)	ESD	4	KV

*Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device.

Exposure for too long may affect the reliability and service life of the device.

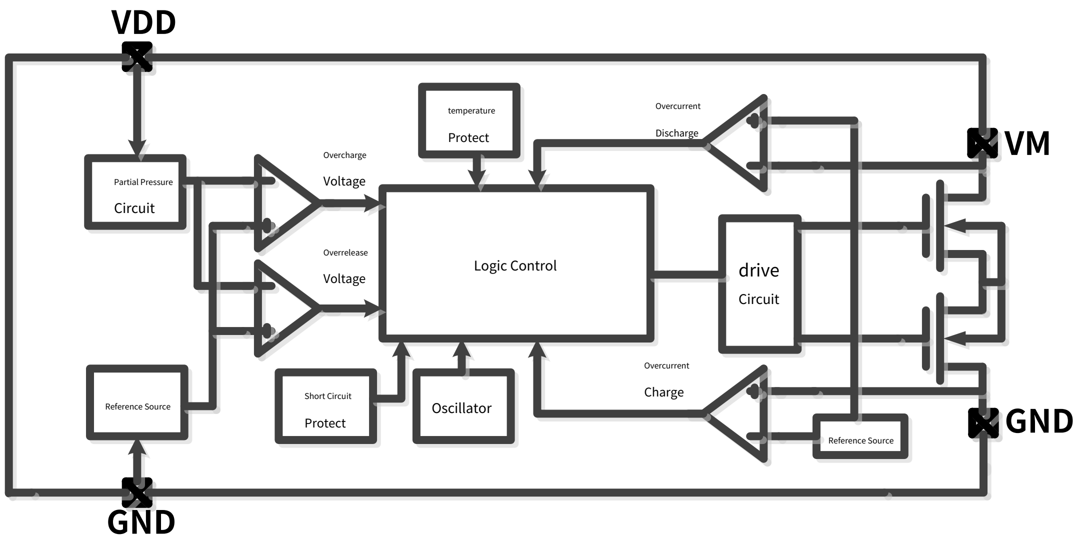
6Electrical Characteristics

Unless otherwise specified,TA=25℃

parameter	symbol	Test conditions	Minimum	Typical Value	Maximum	unit
Voltage detection						
Overcharge voltage V_{CU}= 4V~4.575V, 25mv step	V_{CU}		V_{CU}-0.05	V_{CU}	V_{CU}+0.05	V
Overcharge recovery voltage V_{CL}= 3.85V~4.4V, 50mv step	V_{CL}		V_{CL}-0.1	V_{CL}	V_{CL}+0.1	V
Over discharge voltage V_{DL}= 2.3V~3V, 100mv step	V_{DL}		V_{DL}-0.1	V_{DL}	V_{DL}+0.1	V
Over discharge recovery voltage V_{DR}= 2.4V~3.1V, 100mv step	V_{DR}		V_{DR}-0.1	V_{DR}	V_{DR}+0.1	V
Charge detection voltage	V_{CHA}		0	- 0.12	- 0.2	V
Overcharge voltage protection delay time	t_{CU}		240	320	400	ms
Over discharge voltage protection delay time	t_{DL}		40	80	120	ms
Current Sensing						
Discharge overcurrent I_{IOV}= 4A~10A, 250mA step	I_{IOV}		0.85* I_{IOV}	I_{IOV}	1.15* I_{IOV}	A
Charging overcurrent I_{IOC}= 2A~8A,	I_{IOC}		0.85* I_{IOC}	I_{IOC}	1.15* I_{IOC}	A

250mA step						
Short circuit current	I_{SC}		13		17	A
Discharge overcurrent protection delay time	t_{IOV}		5	10	15	ms
Charge overcurrent protection delay time	t_{IOC}		5	10	15	ms
Short circuit protection delay time	t_{SC}		200	600	1000	μs
Power consumption						
Normal operating current	I_{OPE}	VDD=3.6V,VM=0V		3.0	3.7	μA
Shutdown current	I_{PDN}	VDD=2V,VM=VDD		1.5	1.8	μA
Control System						
VMPull-up resistor	R_{VMD}			320		kΩ
VMPull-down resistor	R_{VMS}			30		kΩ
MOSFETOn-resistance	R_{on}	VDD=3.6V,I_{VM}=1A		25	27	mΩ

7Functional structure diagram



picture3Internal functional structure diagram

8Functional Description

Charging overvoltage

When the battery voltageVDD>V_{CU},andt>t_{CU}When , it is charging overvoltage state.IP3005Will control the internal charging logic and shut down the internal powerMOSFET, so that the battery stops charging. When the following two situations occur, the charging overvoltage state will be released:

(1) When the charger is connected, when the battery voltage drops to the overcharge recovery voltageV_{CL}When the chip turns on the internal power MOSFET, return to normal working state;

(2) When the charger is not connected, the chip turns on the internal powerMOSFET, return to normal working state.

The specific implementation is as follows: When the load is connected to the battery terminals, the battery starts to discharge and the current flows through the internal powerMOSFET The internal parasitic diode discharges, and at this timeVMThe voltage immediately changes from0VRise to0.7VAround (diode conduction voltage), the chip detects VMvoltage and release the overcharge state.VDD<=V_{CU}hour,IP3005In addition, when the load at both ends of the battery begins to discharge, ifVMThe voltage is too small to trigger the discharge detection and the circuit will not return to normal state.

whenVDD>V_{CU}Even if the load is connected to cause discharge overcurrent, the battery voltageVDDReduce toV_{CU}Because of the internal resistance of the battery, the battery voltage will drop at the moment the load that causes discharge overcurrent is connected.V_{CU}If the load is short-circuited, the battery voltage will drop toV_{CU}Below, it enters the short circuit protection state.

Discharge undervoltage

When the battery voltageVDD<V_{DL},andt>t_{DL}It is in discharge undervoltage state.IP3005Will control the internal discharge logic and shut down the internal powerMOSFET, so that the battery stops discharging.

When the internal powerMOSFETis turned off, the chip internalVMandGNDPull-up resistorR_{VMD}will makeVMThe voltage rises. VM>1.5V,I_{VDD}< I_{PDN}When the chip enters the shutdown sleep state. In the discharge undervoltage and shutdown sleep state,VM andVDD Through the resistorR_{VMD}When the charger is connected,VMandVDDThe pressure difference between1.3VThe shutdown sleep state will be released, but the internal powerMOSFETis still shut down, only when the battery voltage recovers to >=V_{DL}The chip will resume normal operation.

When the charger is connected to a battery in a discharged undervoltage state, ifVMThe pin voltage is not less than the charge detection voltageV_{CHA} When the battery voltage >= over-discharge recovery voltageV_{DR}When the under-voltage state is released, the chip returns to normal working state.

Discharge overcurrent

During normal discharge, if the discharge current exceeds the discharge overcurrent thresholdI_{IOV},andt>t_{IOV}hour,IP3005Will control the discharge logic and shut down the internal powerMOSFET, stop discharging and enter the discharge overcurrent state.

When the discharge current is too high,VMandGNDThrough the internal resistorR_{VMS}When the load is connected,VMThe voltage is approximately equal toVDDVoltage, whenVM andVDDThe impedance betweenVMThe voltage drops toGNDWhen the load is disconnected, the discharge overcurrent state will be released. VMandGNDResistorR_{VMS} Short circuit,VMThe voltage drops directly toGND, the discharge overcurrent state will be released and the chip returns to normal working state.

Charging overcurrent

When the charging current exceeds the charging overcurrent thresholdI_{IOC},andt>t_{IOC}hour,IP3005Will control the charging logic and shut down the internal powerMOSFET, stop charging and enter the charging overcurrent state.

Charging overcurrent detection is only available whenVM<= V_{CHA}When the battery is over-discharged and under-voltage, if there is an overcharge current flowing in, it will only be turned on when the battery voltage returns to the over-discharge voltage.V_{DL}When the power is turned offMOSFET, stop charging.

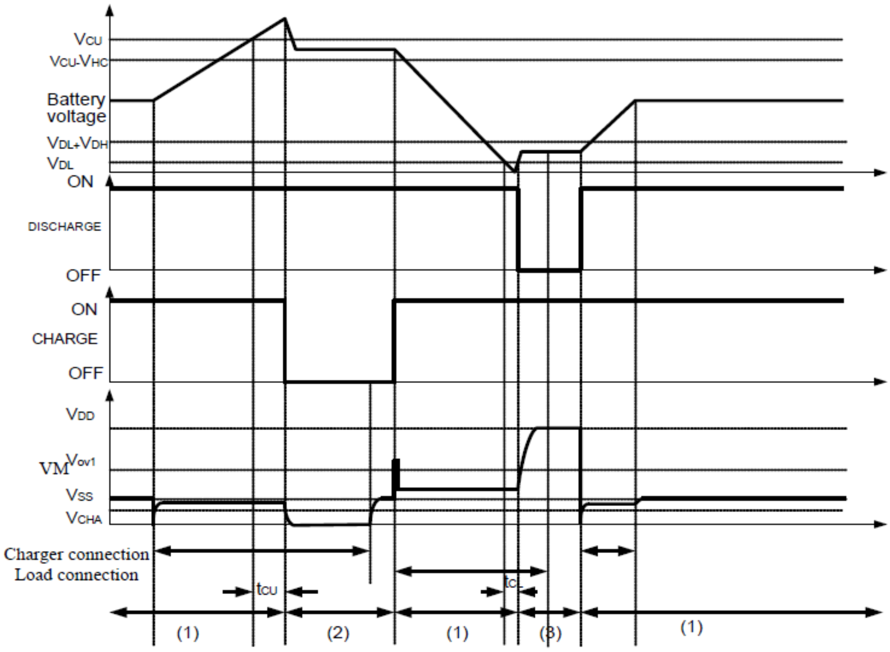
When the charger is disconnected,VM>=V_{CHA}The over-current state will be released only when0V-The battery charging function takes precedence over the overcharge current detection. When the battery voltage is very low, the charging overcurrent protection does not work.

0V-Battery Charging

When the battery voltage drops due to self-discharge0Vhour, Still able to charge.If one has0VThe charger for charging function is connected toP+andP-end,IP3005 Internal logic controls chargingMOSFETThe gate is equal toVDD,whenMOSFETWhen the gate-source voltage is greater than or equal to the start voltage of the charger voltage, the charger MOSFETTurn on and start charging. At the same time, dischargeMOSFETShut down, the charging current is charged through the internal parasitic diode, and the battery voltage is greater than the over-discharge recovery voltageV_{DR}When the chip enters normal working state.

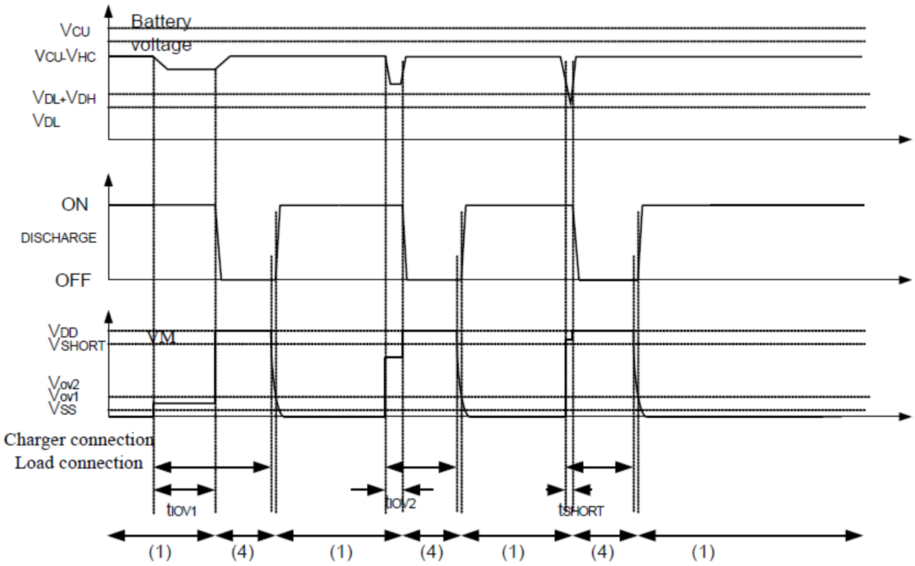
9Functional Timing

Overcharge and overdischarge detection



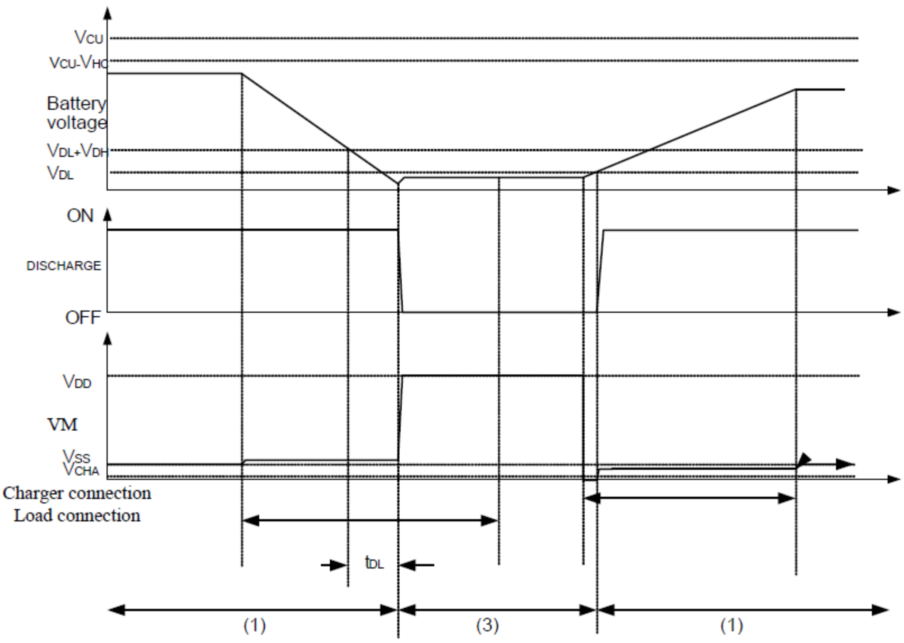
picture4Overcharge and overdischarge detection

Discharge overcurrent detection



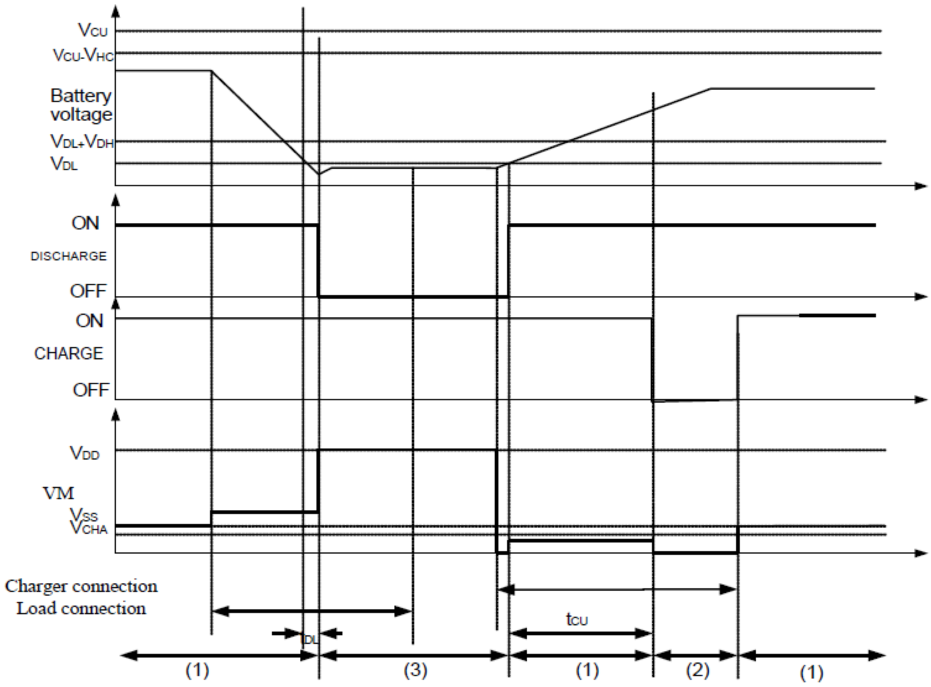
picture5Discharge overcurrent detection

Charging detection



picture6Charging detection

Charging overcurrent detection

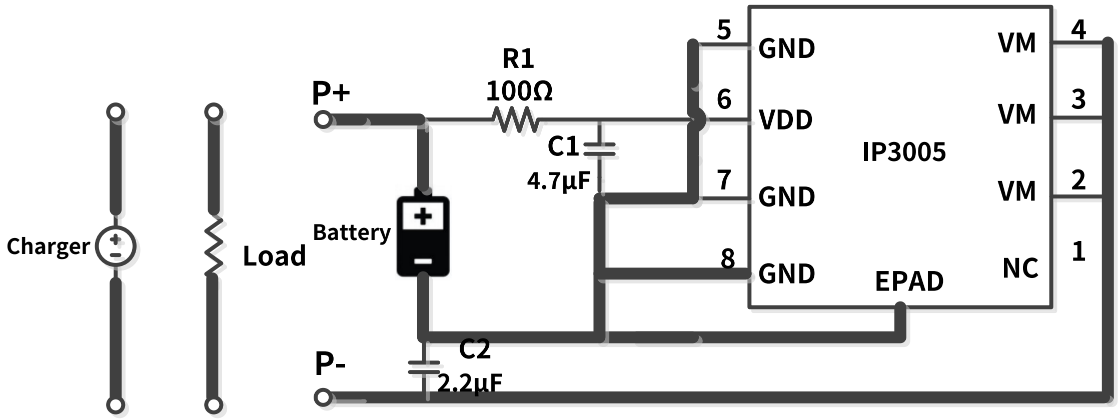


picture7Charging overcurrent detection

Notes: (1) Normal working status; (2) Charging overvoltage state; (3) Discharge undervoltage state; (4) Discharge overcurrent state;

10Typical application schematic diagram

As shown below8As shown in the typical application diagram, the thick line part is the high current path of the chip, so it is necessary to ensure that the line is as short as possible and the routing is as wide as possible to meet power and heat considerations.



picture8Typical application diagram

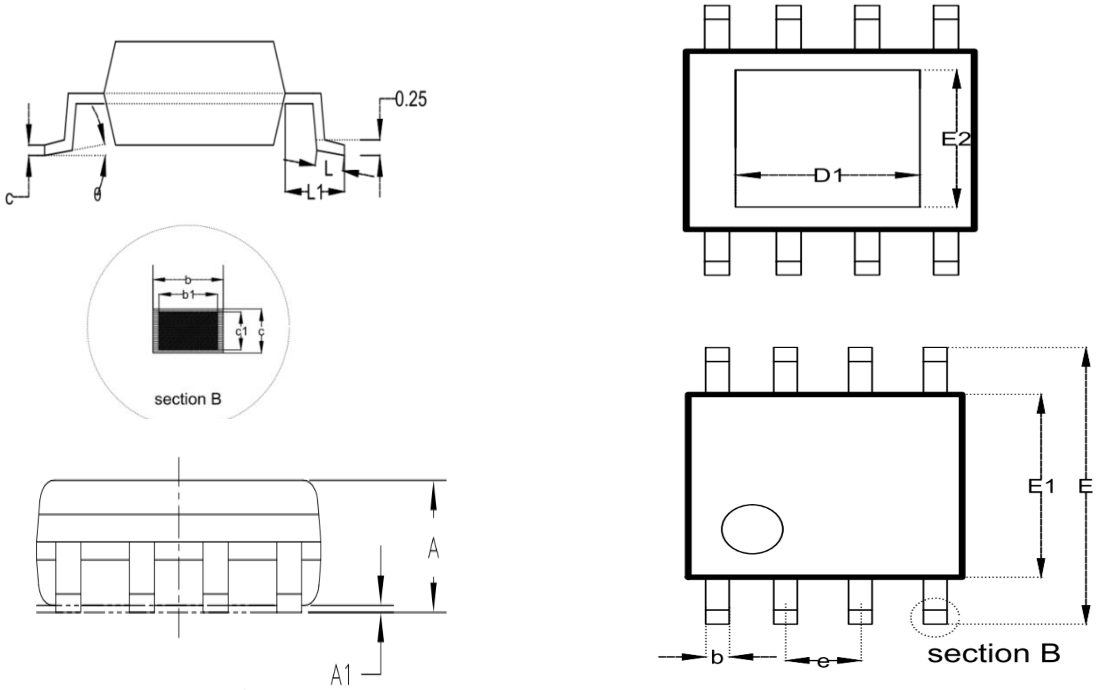
Component parameter description

(1) C1andR1It forms a power filter to suppress power ripple.C1Need to be closeVDDPin to enhance filtering effect, it is recommended to use 4.7μF.

(2) R1The resistance value should not be too large when charging or discharging>1AWhen the current monitoring function is turned on, the chip will start monitoring the current.VDDThe pin current will also increase accordingly.R1A resistance value that is too large will introduce excessive voltage drop.ICofVDDThe actual voltage of the pin is lower than the battery voltage.100Ω.

(3) C2It is used to suppressVMThe peak voltage of the port is prevented from being caused by the instantaneous change of large current.VMThe voltage jitter is too high, which may damage the chip.VMPin, recommended2.2μF.

11Packaging information



<table>
<tr><th rowspan="2">SYMBOL</th><th colspan="3">MILLIMETER</th></tr>
<tr><th>MIN</th><th>NOM</th><th>MAX</th></tr>
<tr><td>A</td><td>- -</td><td>- -</td><td>1.65</td></tr>
<tr><td>A1</td><td>0.05</td><td>- -</td><td>0.15</td></tr>
<tr><td>A</td><td>1.30</td><td>1.40</td><td>1.50</td></tr>
<tr><td>A3</td><td>0.60</td><td>0.65</td><td>0.70</td></tr>
<tr><td>b</td><td>0.39</td><td>- -</td><td>0.48</td></tr>
<tr><td>b1</td><td>0.38</td><td>0.41</td><td>0.43</td></tr>
<tr><td>c</td><td>0.21</td><td>- -</td><td>0.25</td></tr>
<tr><td>c1</td><td>0.19</td><td>0.20</td><td>0.21</td></tr>
<tr><td>D</td><td>4.70</td><td>4.90</td><td>5.10</td></tr>
<tr><td>E</td><td>5.80</td><td>6.00</td><td>6.20</td></tr>
<tr><td>E1</td><td>3.70</td><td>3.90</td><td>4.10</td></tr>
<tr><td>e</td><td colspan="3">1.27BSC</td></tr>
<tr><td>h</td><td>0.25</td><td>- -</td><td>0.50</td></tr>
<tr><td>L</td><td>0.50</td><td>0.60</td><td>0.80</td></tr>
<tr><td>L1</td><td colspan="3">1.05BSC</td></tr>
<tr><td>θ</td><td>0</td><td>- -</td><td>8°</td></tr>
<tr><td>D1</td><td>- -</td><td>2.09</td><td>- -</td></tr>
<tr><td>E2</td><td>- -</td><td>2.09</td><td>- -</td></tr>
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