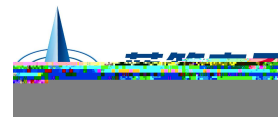


## / Revised record

| A | 2019-7-10      |  |  |  |  |
|---|----------------|--|--|--|--|
| B | 2021-11-2<br>6 |  |  |  |  |
|   |                |  |  |  |  |
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|   |                |  |  |  |  |



## / Descriptions

|             |             |             |
|-------------|-------------|-------------|
| BRCL3230BSE | /           | BRCL3230BSE |
|             | MOSFET      |             |
| BRCL3230BSE | ESOP-8      |             |
|             | BRCL3230BSE |             |

The BRCL3230BSE series product is a high integration solution for lithium-ion/polymer battery protection. BRCL3230BSE contains advanced power MOSFET, high-accuracy voltage detection circuits and delay circuits.

BRCL3230BSE is put into an ultra-small ESOP-8 package makes it an ideal solution in limited space of battery pack. BRCL3230BSE has all the protection functions required in the battery application including overcharging, overdischarging, overcurrent and load short circuiting protection etc. The low standby current drains little current from the cell while in storage. The device is not only targeted for digital cellular phones, but also for any other Li-Ion and Li-Poly battery-powered information appliances requiring long-term battery life.

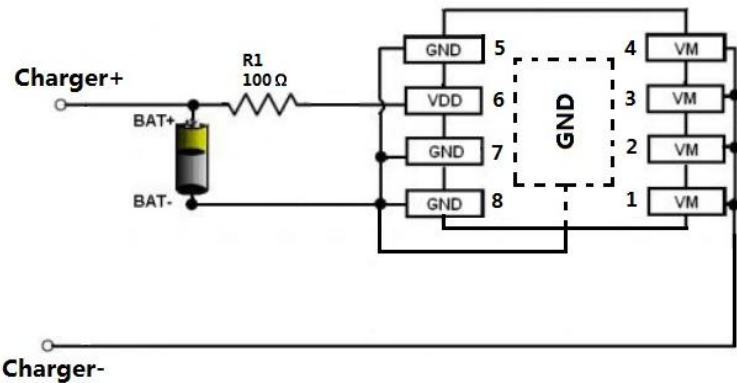
## / Features

- ◆ 15mΩ MOSFET
- ◆ ESOP-8
- ◆
- ◆
- ◆
- ◆ 2 1 2
- ◆
- ◆ 0V
- ◆ 7.0uA , 4.0uA ;
- ◆
- ◆ Integrate advanced power MOSFET with Equivalent of 15mΩ  $R_{DS(ON)}$ ;
- ◆ Ultra-small ESOP-8 package;
- ◆ No capacitance is required for peripheral circuits;
- ◆ Over-temperature Protection;
- ◆ Overcharge Current Protection;
- ◆ Three-step Overcurrent Detection: Overdischarge Current1, Overdischarge Current2, Load Short Circuiting;
- ◆ Charger detection function;
- ◆ 0V battery charging function, delay times are generated inside, High-accuracy voltage detection.
- ◆ Low Current Consumption, Operation Mode: 7.0μA typ, Power-down Mode: 4.0μA typ ;
- ◆ HF Product.

## / Applications

One-Cell lithium-ion battery pack; Lithium-Polymer battery pack.

/ Typical Application

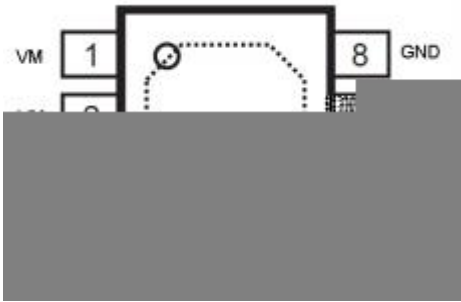


- (1)
- (2)

Notes:

- (1) The chip power consumption shall not exceed the maximum power consumed by the package.
- (2) This product has anti-static protection function, but do not exceed the maximum capacity of the product to withstand static electricity.

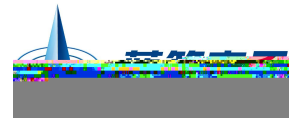
/ Pinning



|         |      |          |
|---------|------|----------|
|         |      |          |
| 1 2 3 4 | VM   | GND      |
| 5 7 8   | GND  |          |
| 6       | VDD  |          |
| 9       | EPAD | EPAD GND |

/ Marking

See Marking Instructions.

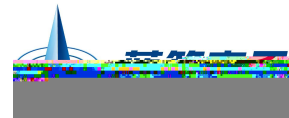


## / Absolute Maximum Ratings(Ta=25 )

| /Parameter                        | /Symbol          | /Value      | /Unit |
|-----------------------------------|------------------|-------------|-------|
| V <sub>DD</sub> input pin voltage | V <sub>IN</sub>  | -0.3 to +6  | V     |
| V <sub>M</sub> input pin voltage  | V <sub>VM</sub>  | -6 to +10   | V     |
| Power Dissipation                 | P <sub>D</sub>   | 400         | mW    |
| Maximum Junction Temperature      | T <sub>J</sub>   | 125         | °C    |
| Lead Temperature                  | T <sub>L</sub>   | 300         |       |
| Operating Junction Temperature    | T <sub>opr</sub> | -40 to +85  |       |
| Storage Temperature               | T <sub>stg</sub> | -55 to +150 |       |
| Package Thermal Resistance        | R <sub>θJA</sub> | 250         | /W    |
|                                   | R <sub>θJC</sub> | 130         | /W    |
| ESD                               | ESD              | 2000        | V     |

## / Electrical Characteristics( Ta=25 )

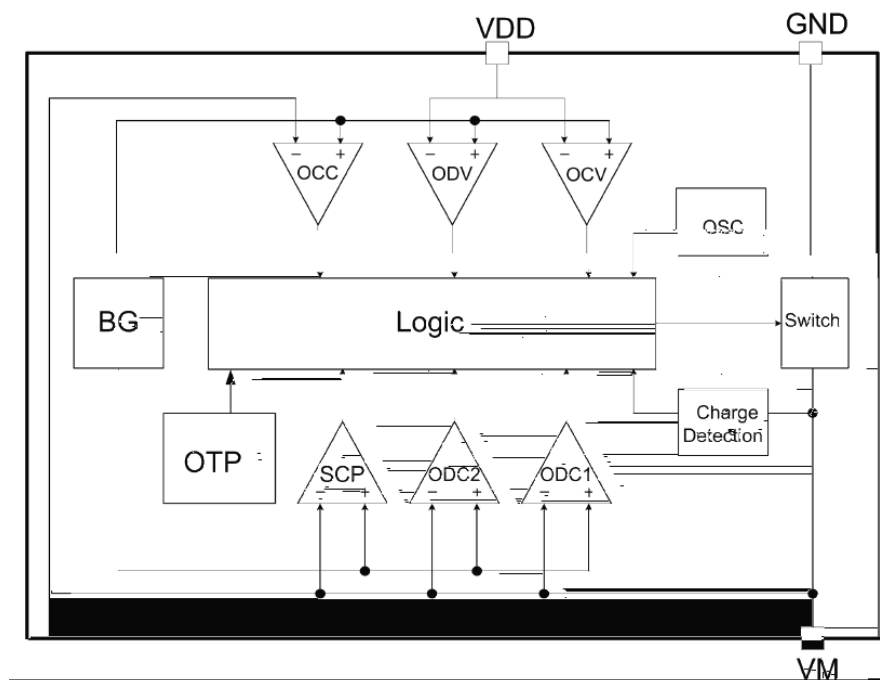
| /Parameter                              | /Symbol            | /Test Condition                              | /Min | /Typ | /Max | /Unit |
|-----------------------------------------|--------------------|----------------------------------------------|------|------|------|-------|
| <b>Detection voltage</b>                |                    |                                              |      |      |      |       |
| Overcharge Detection Voltage            | V <sub>CU</sub>    |                                              | 4.25 | 4.30 | 4.35 | V     |
| Overcharge Release Voltage              | V <sub>CL</sub>    |                                              | 4.05 | 4.10 | 4.15 | V     |
| Overdischarge Detection Voltage         | V <sub>DL</sub>    |                                              | 2.30 | 2.40 | 2.50 | V     |
| Overdischarge Release Voltage           | V <sub>DR</sub>    |                                              | 2.90 | 3.00 | 3.10 | V     |
| Charger Detection Voltage               | V <sub>CHA</sub>   |                                              | -0.3 | -0.4 | -0.5 | V     |
| <b>Detection current</b>                |                    |                                              |      |      |      |       |
| Overcharge Current Detection            | I <sub>IOCC</sub>  | V <sub>dd</sub> =3.6V                        | 9    | 11   | 13   | A     |
| Overdischarge Current1 Detection        | I <sub>IOV1</sub>  | V <sub>dd</sub> =3.6V                        | 8    | 10   | 12   | A     |
| Overdischarge Current2 Detection        | I <sub>IOV2</sub>  | V <sub>dd</sub> =3.6V                        | 14   | 19   | 22   | A     |
| Load Short-Circuiting Detection         | I <sub>SHORT</sub> | V <sub>dd</sub> =3.6V                        | 24   | 36   | 50   | A     |
| <b>Static current</b>                   |                    |                                              |      |      |      |       |
| Current Consumption in Normal Operation | I <sub>OPE</sub>   | V <sub>dd</sub> =3.6V V <sub>M</sub> =0V     | 3    | 7    | 10   | μA    |
| Current Consumption in power Down       | I <sub>PDN</sub>   | V <sub>dd</sub> =2V, V <sub>M</sub> floating | 1    | 4    | 6    | μA    |



# Electrical Characteristics( Ta=25 )

| Equivalent FET on Resistance                |             |                           |     |     |      |    |
|---------------------------------------------|-------------|---------------------------|-----|-----|------|----|
| Equivalent FET on Resistance                | $R_{DS}$    | $V_{dd}=3.6V$ $I_{VM}=1A$ |     | 15  | 20   | mΩ |
| Over temperature protection                 |             |                           |     |     |      |    |
| Over Temperature Protection                 | OTP         |                           | 125 | 140 | 155  |    |
| Over Temperature Recovery Degree            | OTPR        |                           | 100 | 115 | 130  |    |
| Delay time                                  |             |                           |     |     |      |    |
| Overcharge Current Detection Delay Time     | $T_{OCC}$   | $V_{dd}=3.6V$             | 5.6 | 8   | 10.4 | ms |
| Overcharge Voltage Detection Delay Time     | $T_{CU}$    | $V_{DD}=3.6V\sim 4.4V$    | 95  | 135 | 175  | ms |
| Overdischarge Voltage Detection Delay Time  | $T_{DL}$    | $V_{DD}=3.6V\sim 2.0V$    | 25  | 35  | 45   | ms |
| Overdischarge Current1 Detection Delay Time | $T_{IOV1}$  | $V_{DD}=3.6V$             | 5.6 | 8   | 10.4 | ms |
| Overdischarge Current2 Detection Delay Time | $T_{IOV2}$  | $V_{DD}=3.6V$             | 0.7 | 1   | 1.3  | ms |
| Load Short-Circuiting Detection Delay Time  | $T_{SHORT}$ | $V_{DD}=3.6V$             |     | 100 | 300  | us |

## FunctionI Block Diagram



## / Functional Description

BRCL3230BSE

## MOSFET

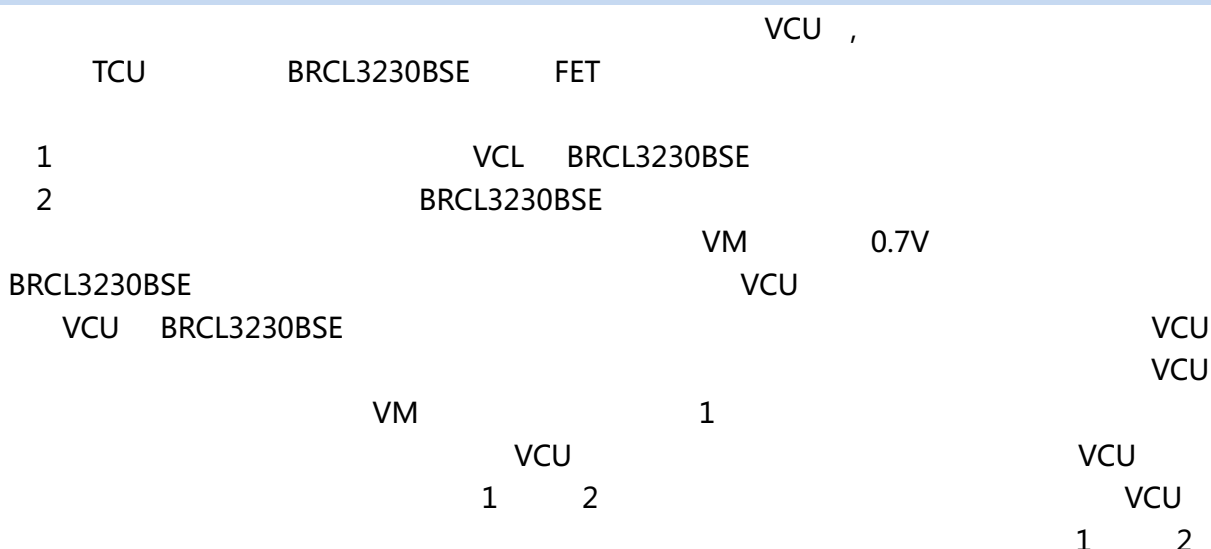
15mΩ

The BRCL3230BSE monitors the voltage and current of a battery and protects it from being damaged due to overcharge voltage, overdischarge voltage, overdischarge current, and short circuit conditions by disconnecting the battery from the load or charger. The peripheral circuit is very simple. The MOSFET is integrated and its  $R_{DS(ON)}$  is as low as 15mΩ typical.

## / Normal Operating mode

If no exception condition is detected, charging and discharging can be carried out freely. This condition is called the normal operating mode.

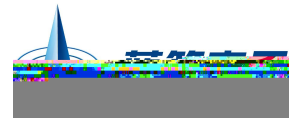
### / Overcharge Condition



When the battery voltage becomes higher than the overcharge detection voltage (VCU) during charging under normal condition and the state continues for the overcharge detection delay time (TCU) or longer, the BRCL3230BSE turns the charging control FET off to stop charging. This condition is called the overcharge condition.

The overcharge condition is released in the following two cases:

- 1 When the battery voltage drops below the overcharge release voltage (VCL), the BRCL3230BSE turns the charging control FET on and returns to the normal condition.
- 2 When a load is connected and discharging starts, the BRCL3230BSE turns the charging control FET on and returns to the normal condition. The release mechanism is as follows: the discharging current flows through an internal parasitic diode of the charging FET immediately after a load is connected and discharging starts, and the VM pin voltage increases about 0.7 V (forward voltage of the diode) from the GND pin voltage momentarily.

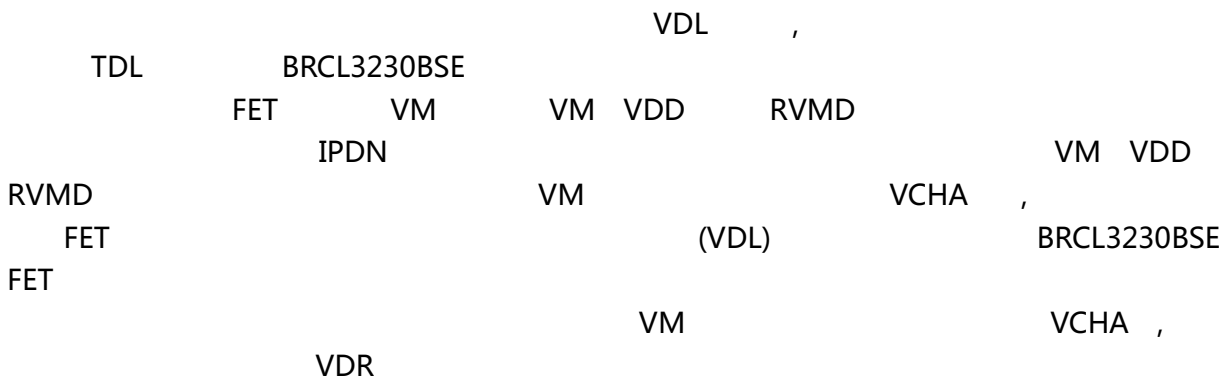


### / Overcharge Condition

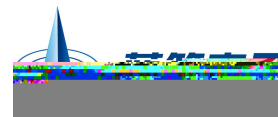
The BRCL3230BSE detects this voltage and releases the overcharge condition. Consequently, in the case that the battery voltage is equal to or lower than the overcharge detection voltage (VCU), the BRCL3230BSE returns to the normal condition immediately, but in the case the battery voltage is higher than the overcharge detection voltage (VCU), the chip does not return to the normal condition until the battery voltage drops below the overcharge detection voltage (VCU) even if the load is connected. In addition, if the VM pin voltage is equal to or lower than the overcurrent 1 detection voltage when a load is connected and discharging starts, the chip does not return to the normal condition.

Note: If the battery is charged to a voltage higher than the overcharge detection voltage (VCU) and the battery voltage does not drop below the overcharge detection voltage (VCU) even when a heavy load, which causes an overcurrent, is connected, the overcurrent 1 and overcurrent 2 do not work until the battery voltage drops below the overcharge detection voltage (VCU). Since an actual battery has, however, an internal impedance of several dozens of mΩ, and the battery voltage drops immediately after a heavy load which causes an overcurrent is connected, the overcurrent 1 and overcurrent 2 work. Detection of load shortcircuiting works regardless of the battery voltage.

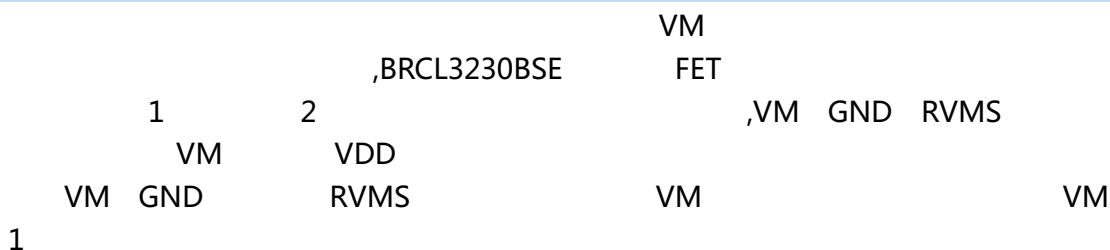
### / Overdischarge Condition



When the battery voltage drops below the overdischarge detection voltage (VDL) during discharging under normal condition and it continues for the overdischarge detection delay time (tDL) or longer, the BRCL3230BSE turns the discharging control FET off and stops discharging. This condition is called overdischarge condition. After the discharging control FET is turned off, the VM pin is pulled d



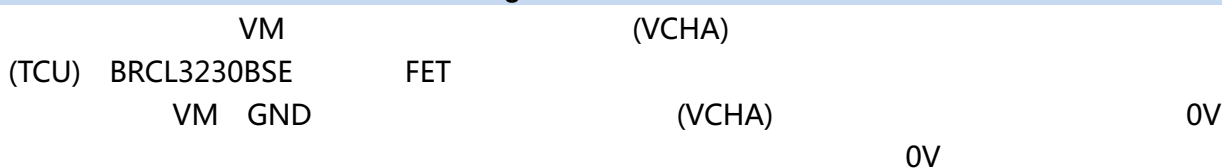
### / Overcurrent Condition



When the discharging current becomes equal to or higher than a specified value (the VM pin voltage is equal to or higher than the overcurrent detection voltage) during discharging under normal condition and the state continues for the overcurrent detection delay time or longer, the BRCL3230BSE turns off the discharging control FET to stop discharging. This condition is called overcurrent condition. (The overcurrent includes overcurrent, or load shortcircuiting.) The VM and GND pins are shorted internally by the RVMS resistor under the overcurrent condition. When a load is connected, the VM pin voltage equals the VDD voltage due to the load.

Because of the connection between the VM and the GND by the RVMS resistor when the load is removed, the VM pin goes back to the GND potential since the VM pin is shorted the GND pin with the RVMS resistor. Detecting that the VM pin potential is lower than the overcurrent detection voltage (VIOV1), the IC returns to the normal condition.

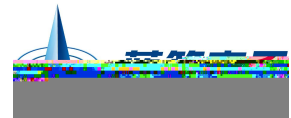
### / Abnormal Charge Current Detection



If the VM pin voltage drops below the charger detection voltage (VCHA) during charging under the normal condition and it continues for the overcharge detection delay time (TCU) or longer, the BRCL3230BSE turns the charging control FET off and stops charging. This action is called abnormal charge current detection.

Abnormal charge current detection is released when the voltage difference between VM pin and GND pin becomes higher than the charger detection voltage (VCHA) by separating the charger. Since the 0 V battery charging function has higher priority than the abnormal charge current detection function, abnormal charge current may not be detected by the product with the 0 V battery charging function while the battery voltage is low.





## 0V / 0V Battery Charging Function

(1) 0V VDL IC

(2) " 0V " " " 0V " " 0V "

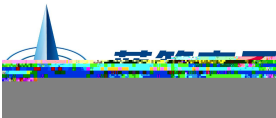
IC VDL

(3) VM GND VM GND

This function enables the charging of a connected battery whose voltage is 0V by self-discharge. When connects to a charger , the discharging control FET is off and the charging current flows through the internal parasitic diode in the discharging control FET. If the battery voltage becomes equal to or higher than the overdischarge release voltage (VDL), the normal condition returns.

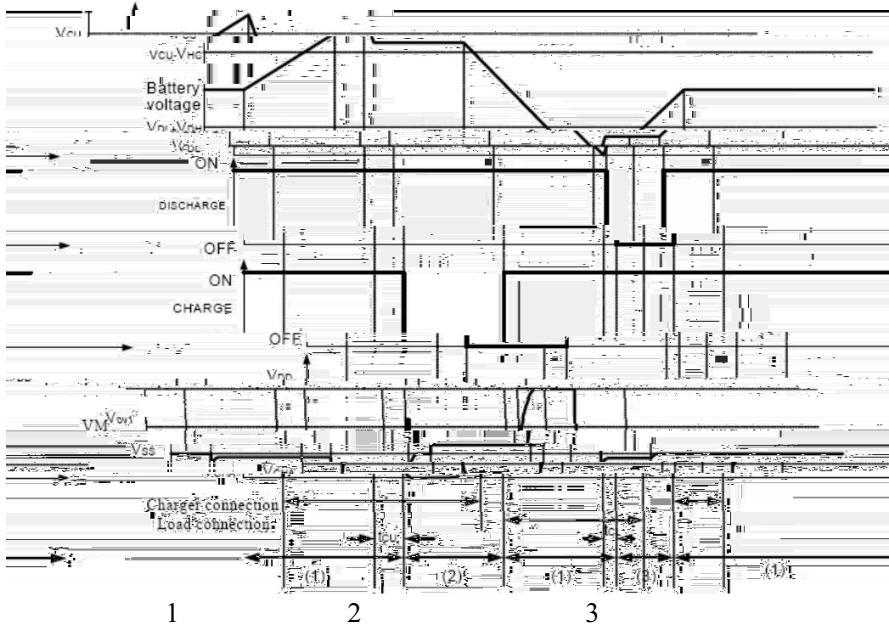
## Notes

(1) Some battery providers do not recommend charging of completely discharged batteries. Please

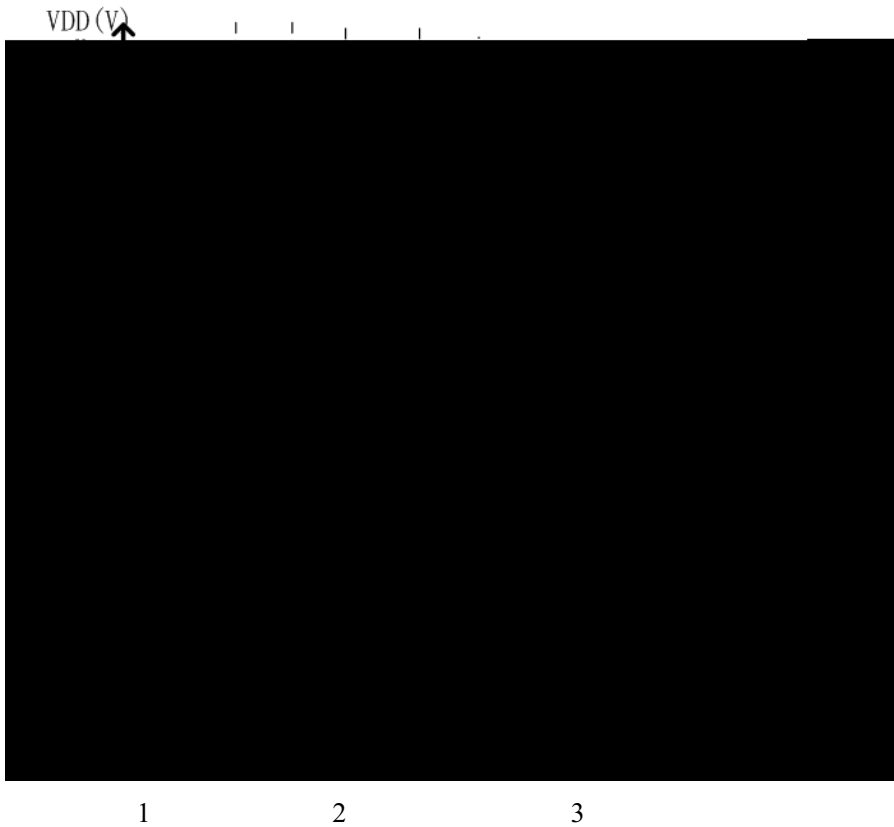


/ Timing Chart

/Overcharge And Overdischarge Detection



/Overcharge Overdischarge Current Detection



**BRCL3230BSE**

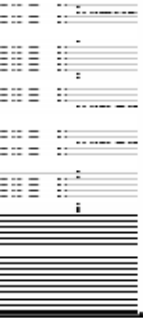
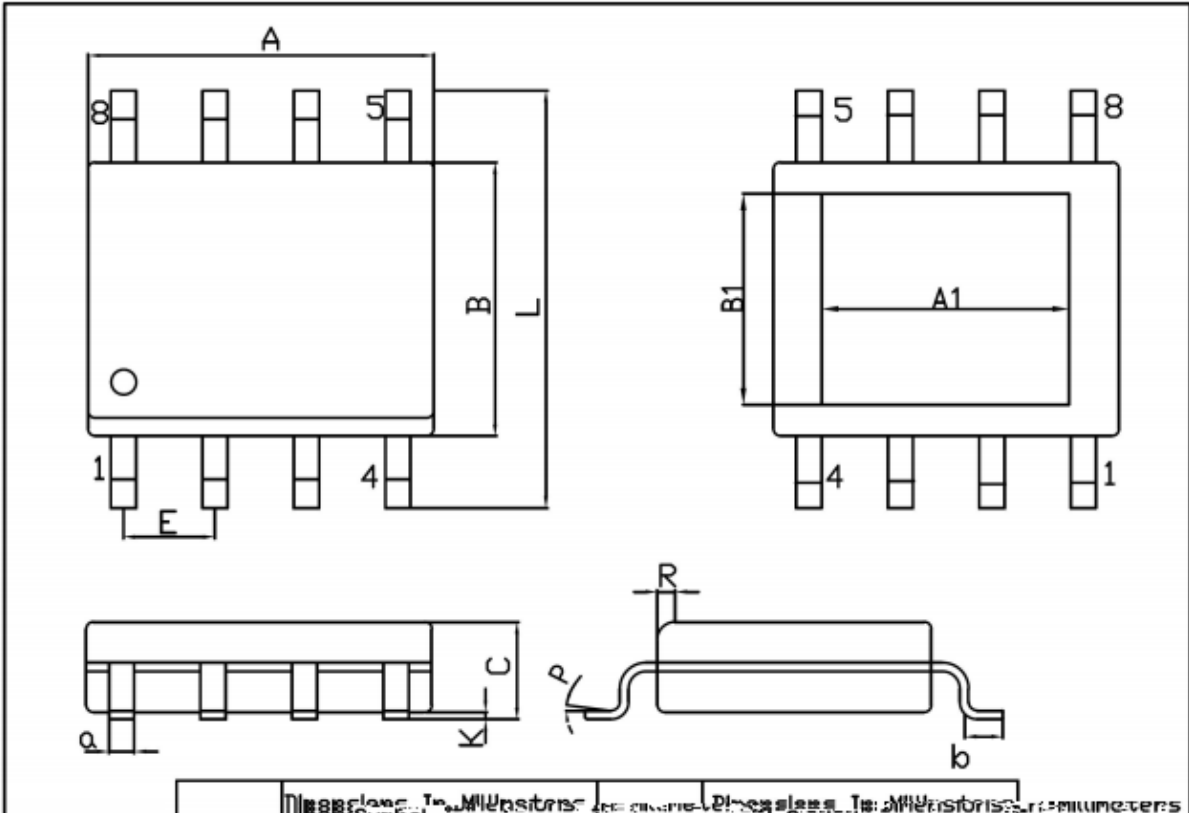
Rev.B Nov.-2021

**DATA SHEET**

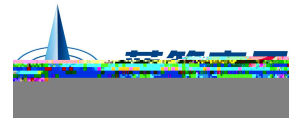
/ Package Dimensions

ESOP-8

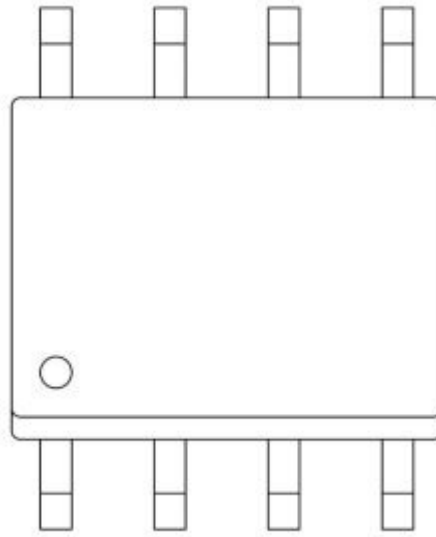
Unit:mm



| Dimensions in millimeters |         |      | Dimensions in inches |      |      |
|---------------------------|---------|------|----------------------|------|------|
| Symbol                    | Min.    | Max. | Symbol               | Min. | Max. |
| A                         | 4.70    | 5.10 | C                    | 1.35 | 1.75 |
| B                         | 3.70    | 4.10 | e                    | 0.35 | 0.49 |
| L                         | 6.00    | 6.40 | R                    | 0.30 | 0.60 |
| E                         | 1.27BSC |      | P                    | 0°   | 7°   |
| K                         | 0.02    | 0.10 | b                    | 0.40 | 1.25 |
| A1                        | 3.1     | 3.5  | B1                   | 2.2  | 2.6  |



**/ Marking Instructions**

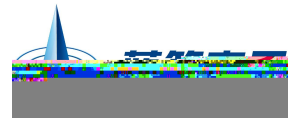


BR:

3230B

\*\*\*\*

Note:



## (    ) / Temperature Profile for IR Reflow Soldering(Pb-Free)

|  |
|--|
|  |
|  |
|  |
|  |
|  |
|  |
|  |

Note:

1            150   180            60   90sec;

1.Preheating:150~180°C, T