

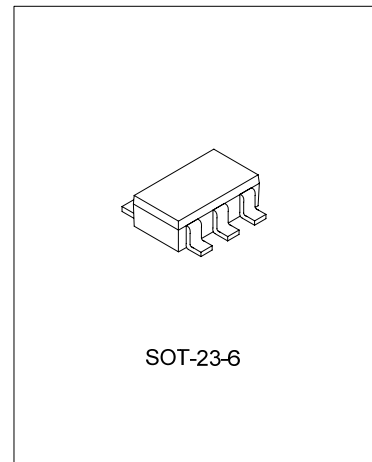
ONE-CELL LI+ BATTERY PROTECTION CIRCUIT

DESCRIPTION

SC8201 is a LiFePO4 battery protection circuit. It is suitable for protecting LI+ battery against damage from over charge, over discharge, and over current. It contains high accurate voltage Detection and delay circuits.

FEATURES

- * Low consumption current
VDD=3.4V, IDD=(Typ. 3μA)
VDD=1.8V, IDD=(Typ. 0.3μA)
- * Wide supply voltage range: (1.8V~8V)
- * Over-charge detection voltage 3.65V, Over-charge release voltage 3.45V.
- * Over-discharge detection voltage 2.00V, Over-discharge release voltage 2.50V.
- * Over current detect voltage 0.15V, Short Current detection voltage 1.00V.
- * Overcharge/over-discharge/over-current detection delay times are generated by an internal circuit
- * Charger detection
- * Over current protection
- * Small package



ORDERING INFORMATION

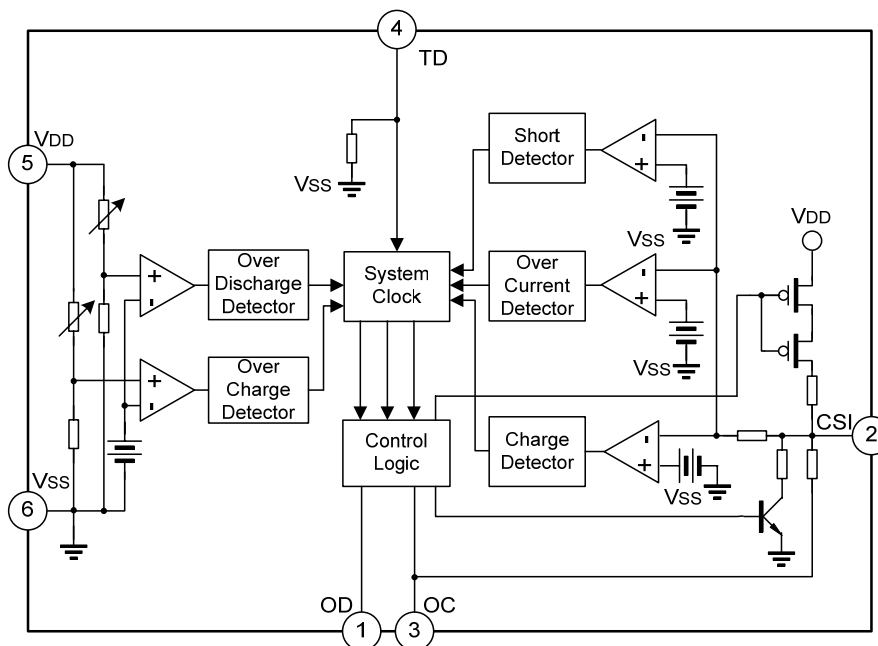
Device	Package	Seal Name
SC8201	SOT-23-6	8201

APPLICATIONS

- * Protection IC for One-Cell LiFePO4 Battery Pack

BLOCK DIAGRAM

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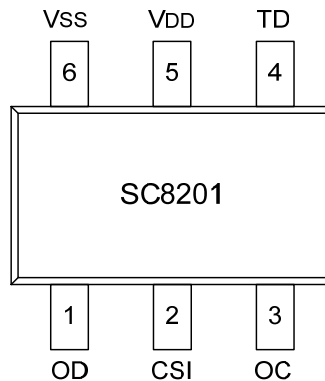
ABSOLUTE MAXIMUM RATING

Characteristics	Symbol	Value	Unit
Supply Voltage	VDD	V _{SS} -0.3 ~ V _{SS} +12	V
OC Output Pin Voltage	VOC	VDD-15 ~ VDD+0.3	V
OD Output Pin Voltage	VOD	V _{SS} -0.3 ~ VDD+0.3	V
CSI Input Pin Voltage	VCSI	VDD-15 ~ VDD+0.3	V
Operating Temperature Range	T _{opr}	-40 ~ + 85	°C
Storage Temperature Range	T _{stg}	-40 ~ +125	°C

ELECTRICAL CHARACTERISTICS (T_{amb}=25°C, unless otherwise specified)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Voltage						
Operating Voltage	VDD		1.8		8.0	V
Current Consumption						
Supply Current	I _{DD}	VDD=3.4V		3.0	6.0	μA
Power Down Current	I _{PD}	VDD=1.8V		0.3	0.6	μA
Detection Voltage						
Over Charge Detection Voltage	VOCU		3.620	3.650	3.680	V
Over Charge Release Voltage	VOCR		3.415	3.450	3.485	V
Over Discharge Detection Voltage	VODL		1.90	2.00	2.10	V
Over Discharge Release Voltage	VODR		2.40	2.50	2.60	V
Over Current 1 Detection Voltage	VOI1		0.13	0.15	0.17	V
Over Current (Short Current)Detection Voltage	VOI2	VDD=3.6V	0.80	1.00	1.20	V
Over Current Reset Resistor	Rshort	VDD=3.6V	400	500	600	kΩ
Charger Detection Voltage	VCH		-0.8	-0.5	-0.2	V
Delay Time						
Over Charge Detection Delay Time	TOC		150	340	500	ms
Over Discharge Detection Delay Time	TOD	VDD=3.6V~2.0V	80	200	300	ms
Over Current 1 Detection Delay Time	TOI1	VDD=3.6V	5	13	20	ms
Over Current 2(Short Current)Detection Delay Time	TOI2	VDD=3.6V		5	50	μs
Other						
OC Pin Output "H" Voltage	Voh1		VDD-0.1	VDD-0.02		V
OC Pin Output "L" Voltage	Vol1			0.01	0.1	V
OD Pin Output "H" Voltage	Voh2		VDD-0.1	VDD-0.02		V
OD Pin Output "L" Voltage	Vol2			0.01	0.1	V

PIN CONFIGURATION



PIN DESCRIPTIONS

PIN No.	Symbol	I/O	Description
1	OD	O	FET gate connection pin for discharge control.
2	CSI	I/O	Detecting pin for current sense, charger detect.
3	OC	O	FET gate connection pin for charge control.
4	TD	I	Test pin for delay time.
5	VDD	I	Positive power input pin.
6	VSS	I	Negative power input pin.

FUNCTION DESCRIPTIONS

Normal state

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If $V_{ODL} < V_{DD} < V_{OCU}$ and $V_{CH} < V_{CSI} < V_{OI1}$, M1 and M2 (refer to the typical application circuit, they are used to control the charge/discharge state) are both turned on. The charging and discharging processes can be operated normally at this time.

Overcharge Detection

When enter overcharge state from normal state, the battery voltage can be detected from VDD. When the battery voltage VDD is larger than V_{OCU} over a delay time of T_{OC}, then enter the overcharge state from normal state and M2 is to be turned off.

Release of Overcharge State

There are two ways to return to normal state from overcharge state.

- If the battery is self discharging and $V_{DD} < V_{OCR}$ occurs, M2 is to be turned on and back to normal state.
- Remove the charger and connected to a load. If $V_{OCR} < V_{DD} < V_{OCU}$ and $V_{CSI} > V_{OI1}$ occurs, M2 is to be turned on and back to normal state.

Overdischarge Detection

When enter overdischarge state from normal state, the battery voltage can be detected from VDD. When the battery voltage VDD is smaller than VODL over a delay time of TOD; M1 is to be turned off. In the meanwhile, CSI is pulled to VDD by way of internal resistor RCSID. If $V_{CSI} > V_{OI2}$, the protection IC enters into Power-down mode. (Its current consumption is lower than 0.3 μ A).

Release of Power-down Mode

A charger is connected while the battery remains in Power-down mode, if $V_{CH} < V_{CSI} < V_{OI2}$ and $V_{DD} < V_{ODR}$ occur, M1 is still off but it releases Power-down mode. If $V_{DD} > V_{ODR}$ occurs, M1 is to be turned on and back to normal state.

Charge Detection

If a charger is connected to the battery remained in Power-down mode, if $V_{CSI} < V_{CH}$ and $V_{DD} > V_{ODL}$, M1 is to be turned on and back to normal state.

Abnormal Charging State

If a charger is connected to the battery in normal state, $V_{CSI} < V_{CH}$ occurs over a delay time longer than TOC, M2 is to be turned off.

Over Current/Short Current Detection

When the discharging current is too large under normal state and the voltage detected from CSI is larger than V_{OI1} (V_{OI2}) for over a certain delay time T_{OI1} (T_{OI2}), it means the over current/short current state occurred. M1 is turned off. CSI is pulled to VSS by way of an internal resistor RCSIS.

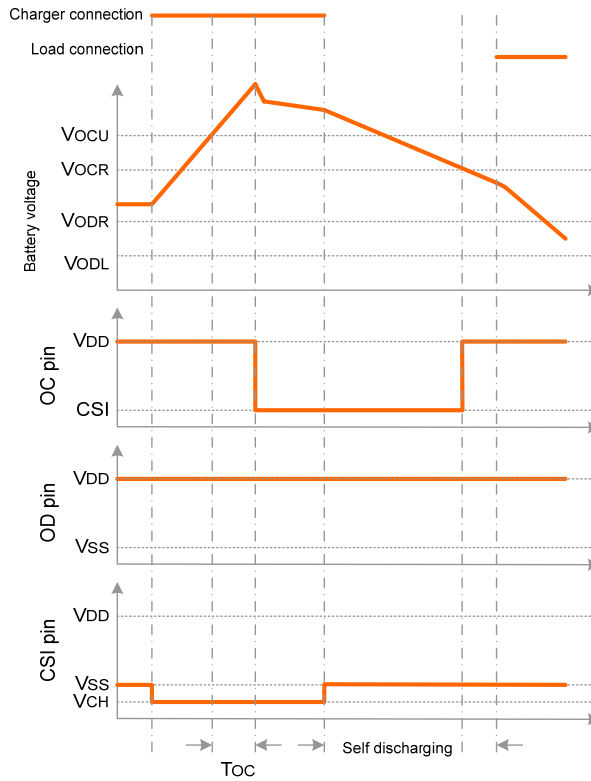
Release of Over Current/Short Current State

While the protection IC remains in Over Current/Short Current state and load is removed or the impedance between VBAT+ and VBAT- is larger than 500K Ω and $V_{CSI} < V_{OI1}$, M1 is to be turned on and back to normal state.

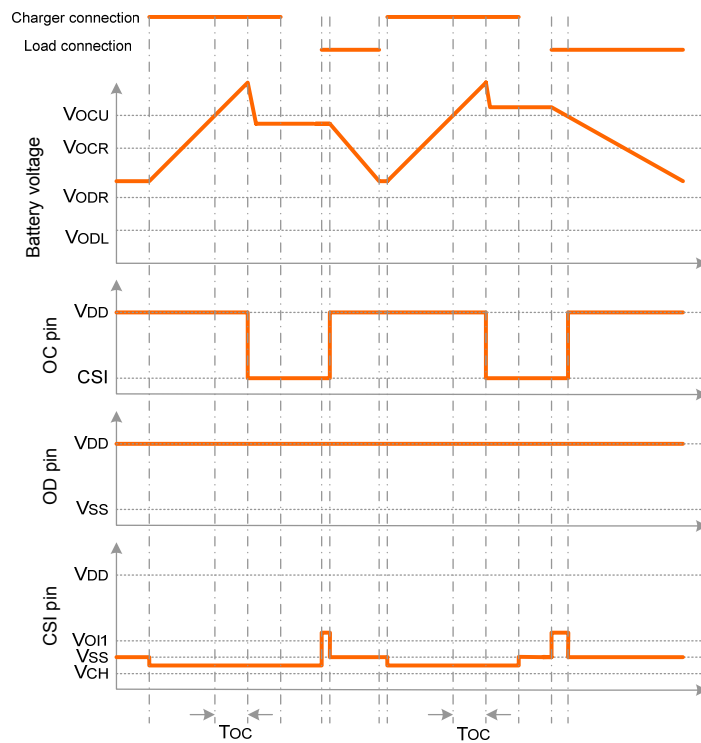
Note: when a battery is connected to a protection IC for the first time, the IC may not enter the normal state (not dischargeable state). If this occurs, set the CSI pin voltage equal to the VSS voltage (short the CSI and VSS pins or connect a charger) to enter the normal state.

TIMING DIAGRAM

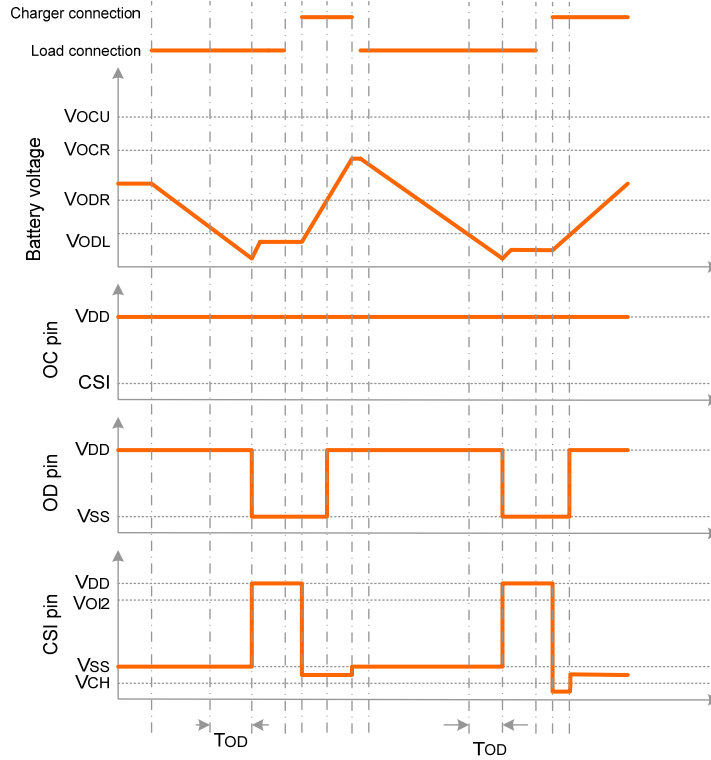
Overcharge State → Self Discharging → Normal State



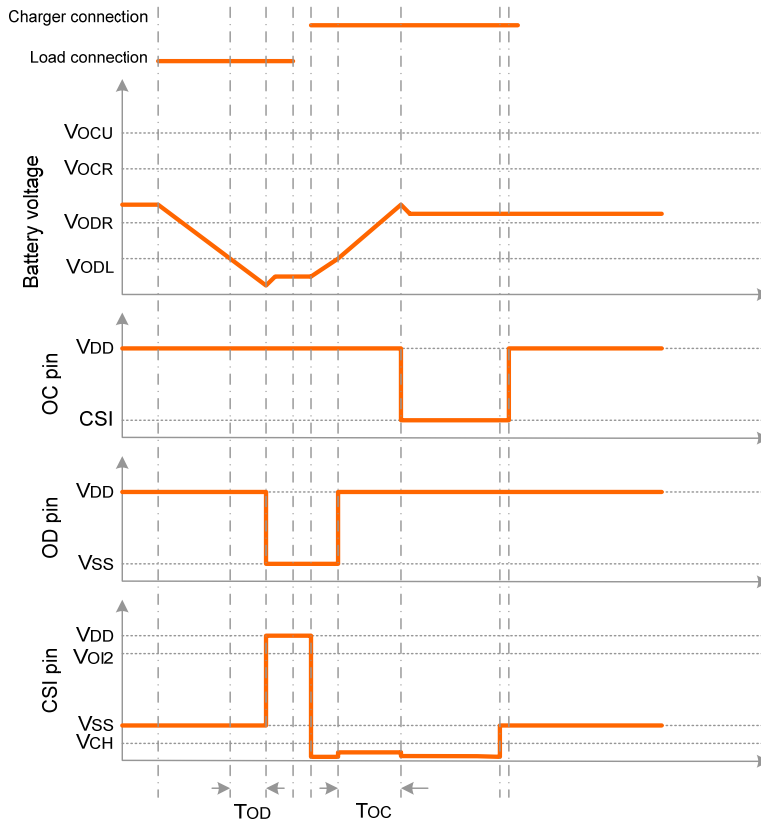
Overcharge state → load discharging → normal state



Overcharge State → Charging By Charger → Normal State

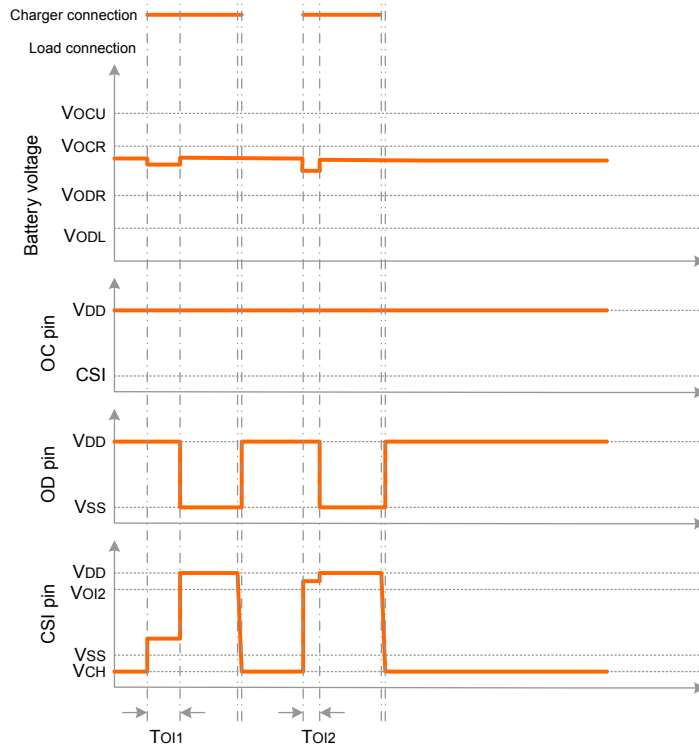


Overcharge State → Abnormal State → Normal State

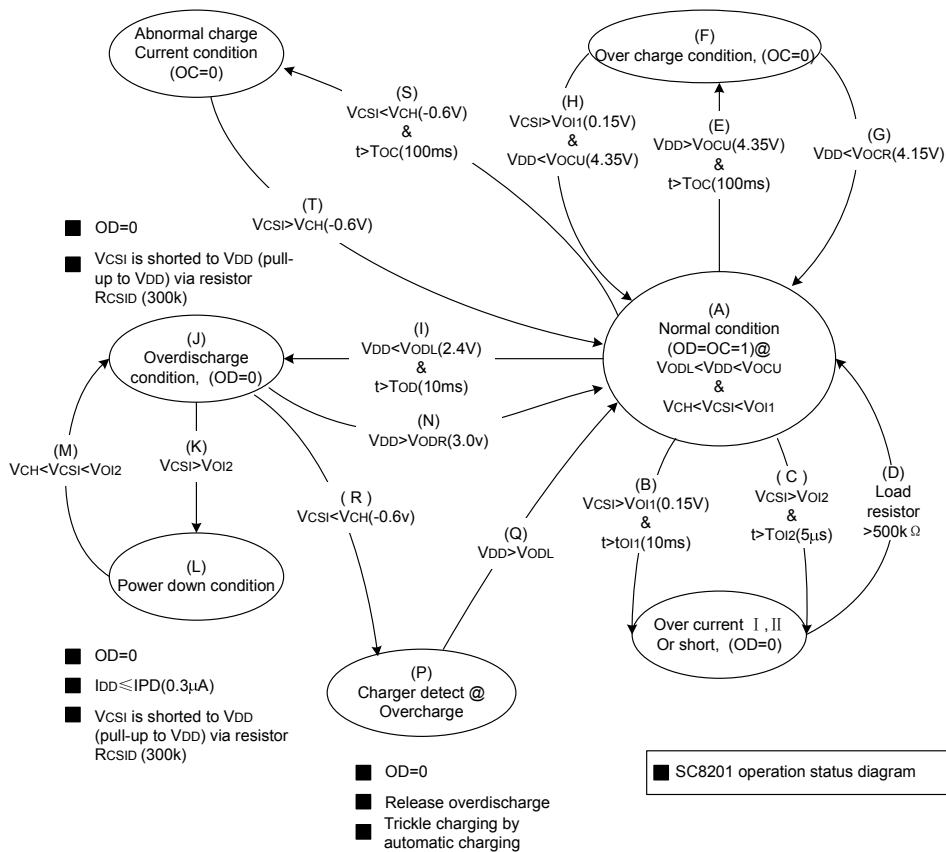


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Over Current State→Normal State

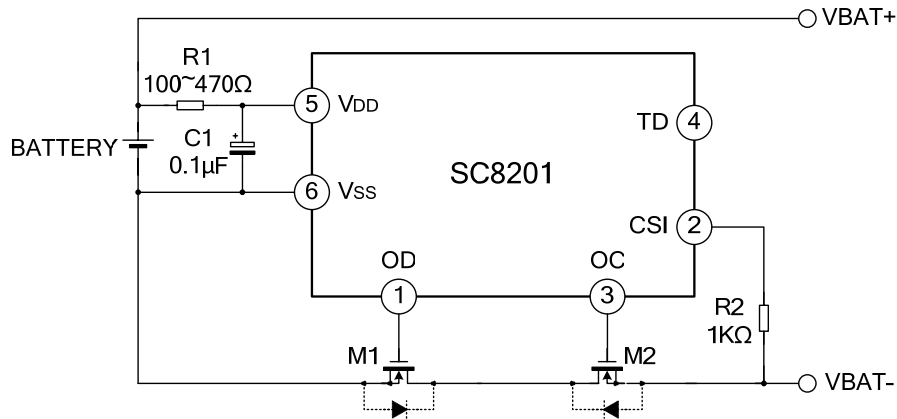


STATE DIAGRAM OF OPERATION



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TYPICAL APPLICATION CIRCUITS

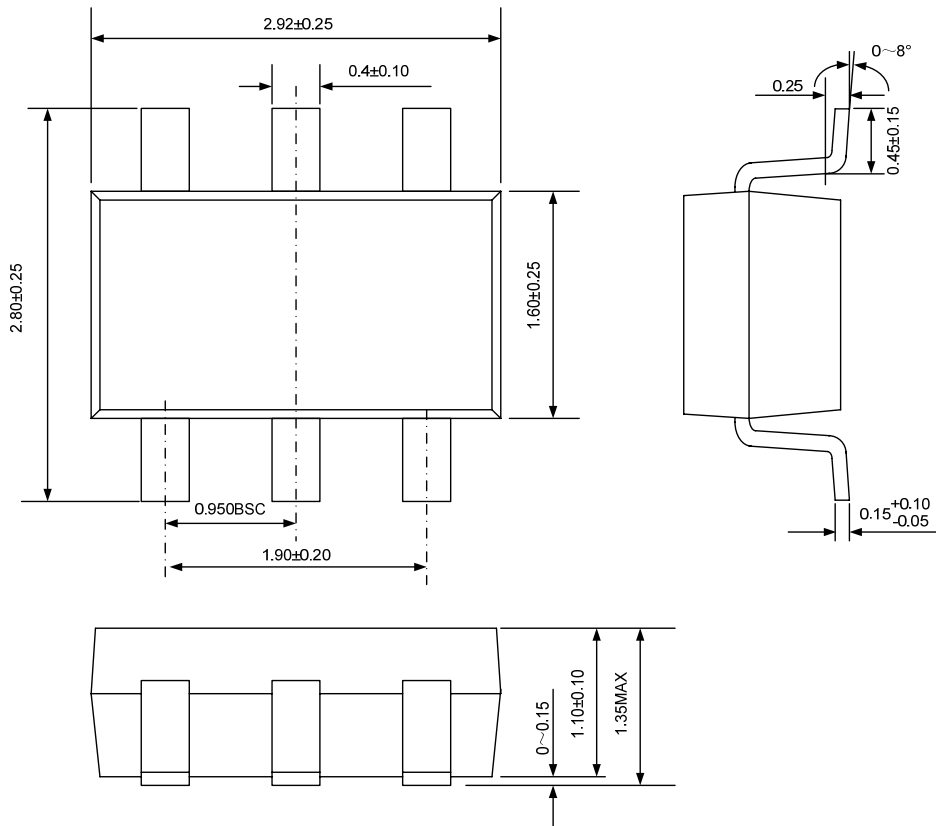


Note: The circuit and parameters are reference only, please set the parameters of the real application circuit based on the real test .

PACKAGE OUTLINE

SOT-23-6

Unit: mm



**HANDLING MOS DEVICES:**

Electrostatic charges can exist in many things. All of our MOS devices are internally protected against electrostatic discharge but they can be damaged if the following precautions are not taken:

- Persons at a work bench should be earthed via a wrist strap.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed for dispatch in antistatic/conductive containers.