1. General Description：

The DW01AD battery Detection IC is designed to protect lithium-ion/polymer battery from damage or degrading the lifetime due to overcharge, overdischarge, and/or overcurrent for one-cell lithium-ion/polymer battery powered systems, such as cellular phones.

The ultra-small package and less required external components make it ideal to integrate the DW01AD into the limited space of battery pack. The accurate ±50mV overcharging detection voltage ensures safe and full utilization charging. It is with 0V charging enable, self recovery function. Not suitable for products with poor arrangement and shielding to radio and radio frequency signal.

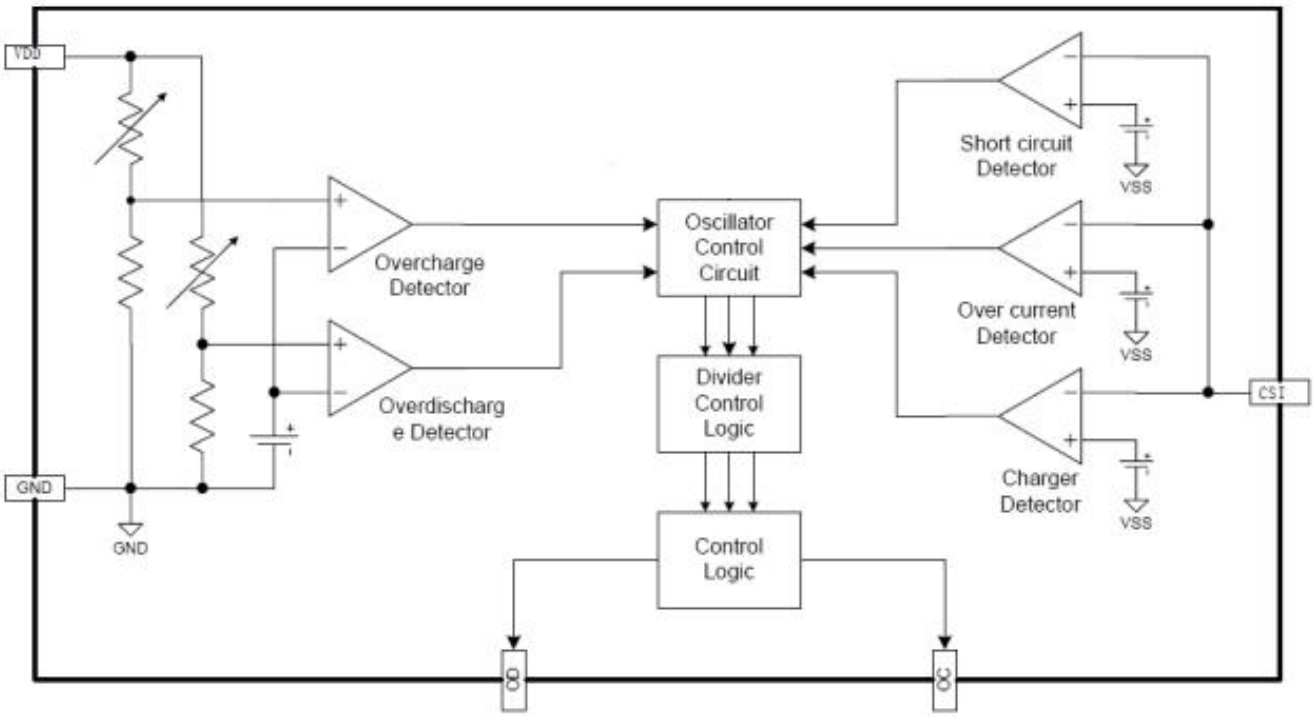
2. Features

- Ultra-Low Quiescent Current at 4μA(VDD=3.9V).
- Precision Overcharge Detection Voltage 4.30V & Over charge release Voltage 4.10V
- Precision Over discharge detection Voltage 2.5V & Over discharge release Voltage 2.9V
- Precision Overcurrent detection Voltage 0.16V & Short circuit current detection Voltage 1.3V
- Automatically detect the charger connection
- Automatically detect the current detection reset resistor
- With self recovery function
- with 0V charging enable
- Wide operating voltage range
- The ultra-small package of SOT23-6

3. Applications

Protection IC for One-Cell Lithium-Ion / Lithium-Polymer Battery Pack。

4. Functional Block Diagram



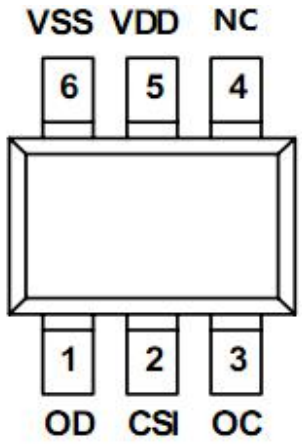
5. Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply voltage between VDD and GND *	VDD	VSS-0.3~VSS+8	*V*
OC output pin voltage	VOC	VDD-15~VDD+0.3	*V*
OD output pin voltage	VOD	VSS-0.3~VDD+0.3	*V*
CS input pin voltage	VCSI	VDD-15~VDD+0.3	*V*
Operating Temperature Range	Topr	-40~+85	℃
Storage Temperature Range	Tstg	-40~+125	℃

6.Electrical Characteristics(Ta=25°C unless otherwise specified)

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Operating voltage						
Operating voltage	VDD	--	1.5	--	8	V
Current consumption						
Operating current	IDD	VDD=3.9V	--	4.0	6.0	uA
Detection voltage						
0V Battery Charge Starting Charger Voltage	V_{0CHA}	--	1.2	--	--	V
Overcharge Detection Voltage	V_{OCD}	--	4.25	4.30	4.35	V
Overcharge Release Voltage	V_{OCR}	--	4.05	4.10	4.15	V
Overdischarge Detection Voltage	V_{ODL}	--	2.40	2.50	2.60	V
Overdischarge Release Voltage	V_{ODR}	--	2.80	2.90	3.00	V
Overcurrent Detection Voltage	V_{OI1}	--	0.13	0.16	0.19	V
Short Current Detection Voltage	V_{OI2}	VDD=3.6V	0.80	1.30	1.75	V
Overcurrent reset resistor	R_{short}	VDD=3.6V	50	100	150	KΩ
Charger Detection Threshold Voltage	V_{CH}	--	-1.1	-0.7	-0.3	V
Delay Time						
Overcharge Delay Time	T_{OC}	VDD=3.6V~4.4V	--	80	200	ms
Overdischarge Delay Time	T_{OD}	VDD=3.6V~2.0V	--	40	120	ms
Overcurrent Delay Time (1)	T_{OI1}	VDD=3.6V	--	10	15	ms
Overcurrent Delay Time (2)	T_{OI2}	VDD=3.6V	--	50	120	us
Others						
OC Pin Output “H” Voltage	V_{oh1}	--	VDD-0.1	VDD-0.02	--	V
OC Pin Output “L” Voltage	V_{ol1}	--	--	0.1	0.5	V
OD Pin Output “H” Voltage	V_{oh2}	--	VDD-0.1	VDD-0.02	--	V
OD Pin Output “L” Voltage	V_{ol2}	--	-	0.1	0.5	V

7. Pin Configuration



Pin No.	Symbol	I/O	Description
1	OD	O	MOSFET gate connection pin for discharge control
2	CSI	I/O	Input pin for current sense, charger detect
3	OC	O	MOSFET gate connection pin for charge control
4	NC	--	No connection
5	VDD	I	Power supply, through a resistor (R1)
6	VSS	I	Ground pin

8. Description of Operation

- **Normal condition**

If VODL<VDD<VOCU，and VCH<VCSI<VOIP（VOI1），then M1and M2 open（See typical application circuit diagram）. At this time, the charge and discharge can be normal.

- **Overcharge State**

When entering the charge state from the normal state, the battery voltage can be detected by VDD. When the battery voltage enters the state of charge, the VDD voltage is greater than VOCU, and the delay time exceeds TOC, then the M2 is off.

- **Overcharge Release**

After entering the state of the charge protection state, to eliminate the charge of the protection of the memory state into the normal state, there are two ways.

1) if the battery self discharge, and VDD<VOCR, then the M2 is turned on and returned to the normal state.

2) After removal of the charger and then connected load, if the VOCR<VDD<VOCU, VCSI>VOIP(VOI1), then M2 open and return to the normal mode.

- **Over discharge detection**

When discharged from the normal state, the battery voltage can be detected by VDD. When the battery voltage enters the over discharge state, if the VDD voltage is less than VODL and the delay time is over TOD, then the M1 is off.

- **Power-off mode release**

When the battery in the power-off mode, if connected to a charger, and at this time if VCH<VCSI<VOI2, VDD<VODR, then M1 is still closed, but the release of power off mode. If VDD>VODR, M1 is turned on and returned to normal mode. Or when the load is suspended, the VDD voltage is returned to VDD>VODR, and the M1 is turned on and returned to normal mode (self recovery function)

- **Charging detection**

The battery is connected to the battery when the battery is in the power off mode, the voltage will be VCSI<VCH and VDD>VODL. Then M1 is turned on and returned to normal mode.

- **Over current / short circuit current detection**

In normal mode, if the discharge current is too large, then the voltage detected on CSI Pin will greater than VOIX (VIO1 or VIO2), and if the delay time is longer than TOIX (TIO1 or TIO2), Indicates that the system in overcurrent or short circuit condition. Then the M1 is off, the CSI pin is pulled down to VSS through the internal resistance RCSIS.

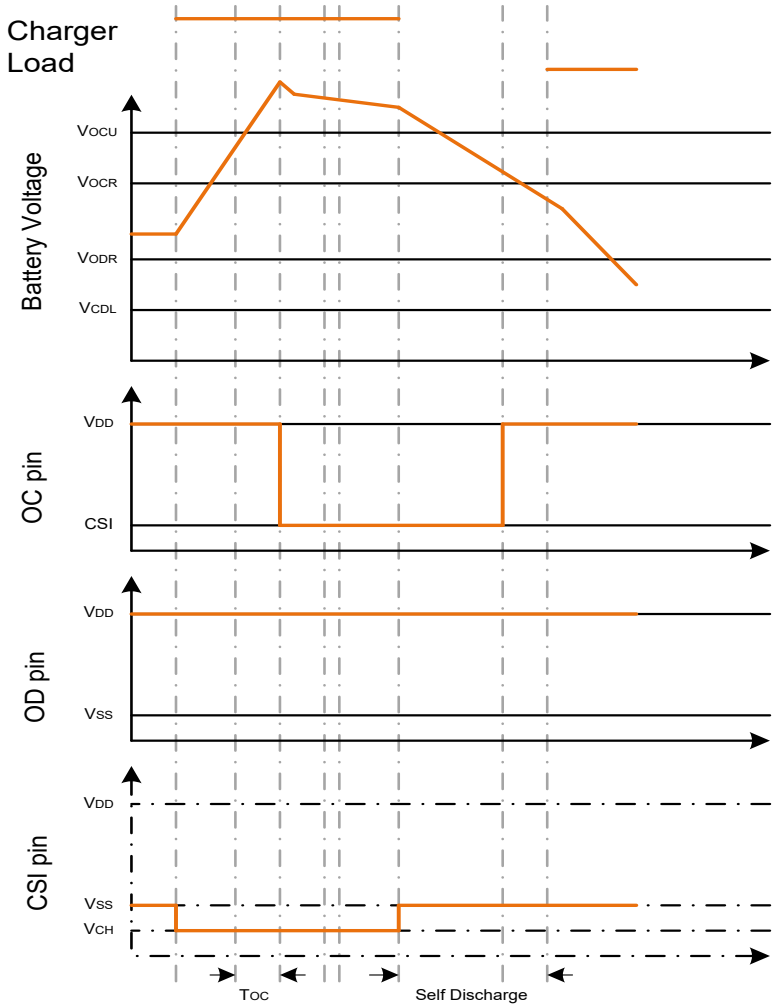
- **Over current release/ Short circuit release**

When the protection circuit maintains the overcurrent / short-circuit current state, remove the load or impedance is greater than between 500K ohm between VBAT+ and VBAT-, and VCSI<VOIP (VOI1) when then M1 open, the system returns to normal conditions.

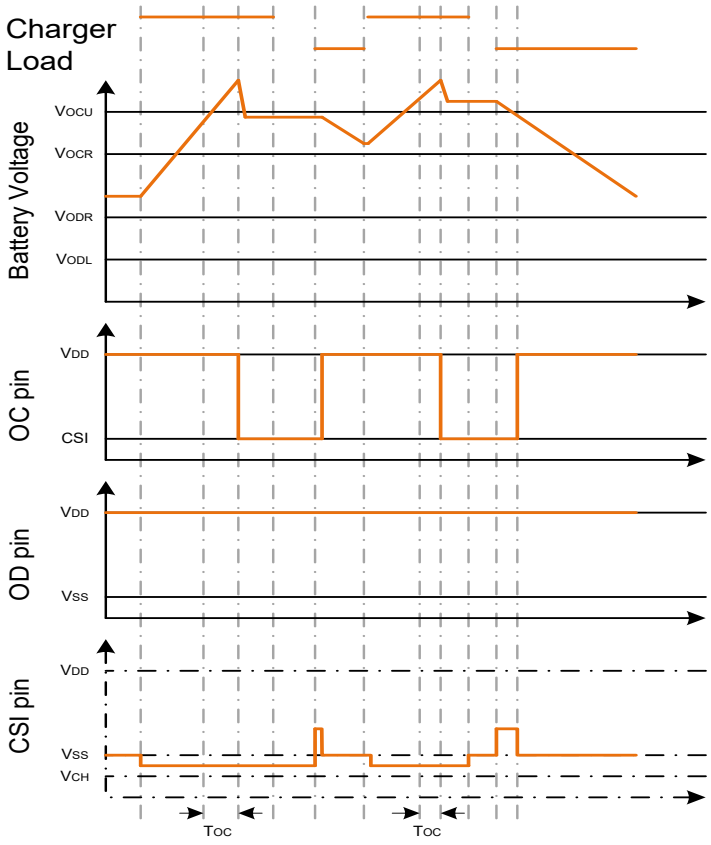
Note: when the battery is first connected to the protection circuit, the circuit may not enter the normal mode, at this time can not discharge. If this problem occurs, it is forced to CSI voltage equal to VSS voltage(Connect CSI to VSS for short or connect charger), the system can enter the normal mode.

9. Timing Diagram

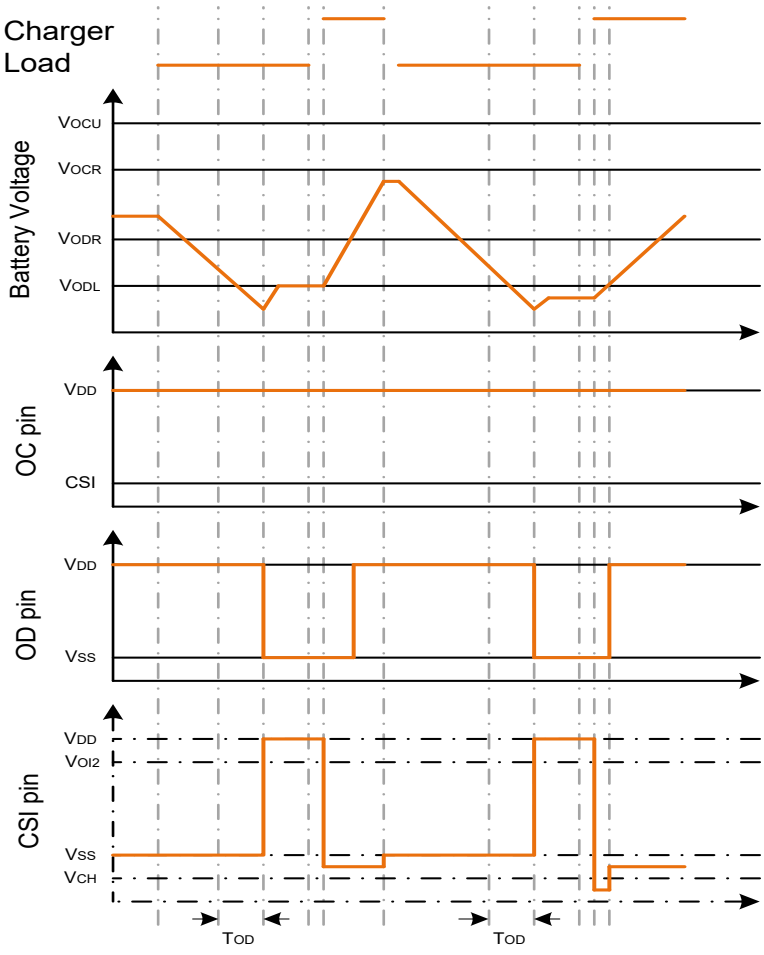
9.1 Overcharge state→Self discharge state→Normal state



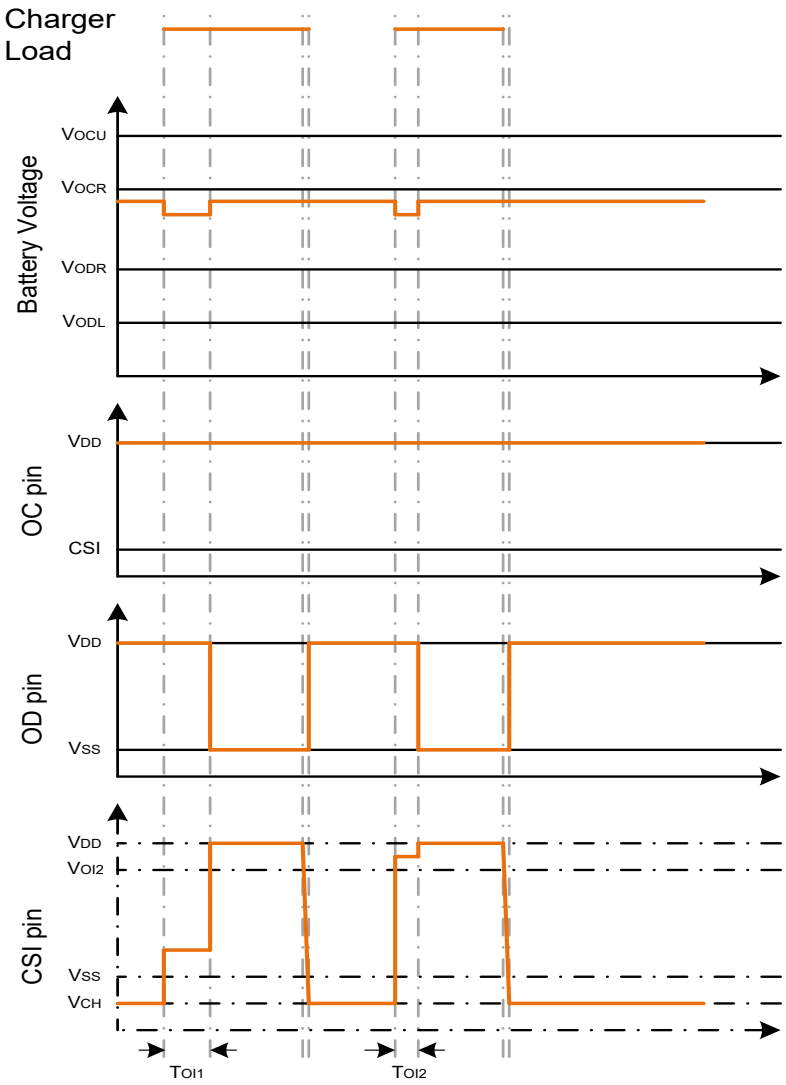
9.2 Overcharge state→Load discharge→Normal state



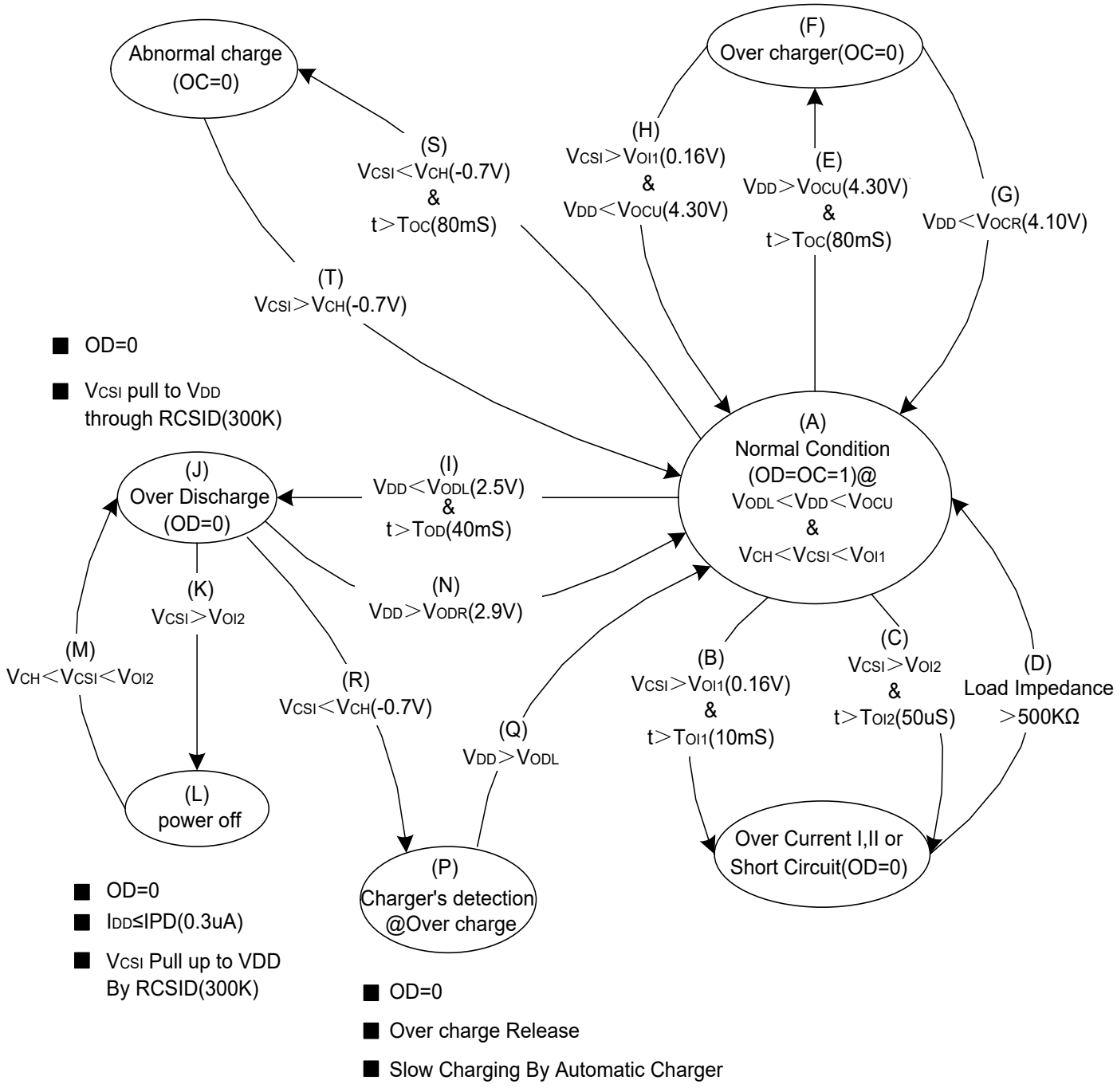
9.3 Overcharge state→Charger charge→Normal state



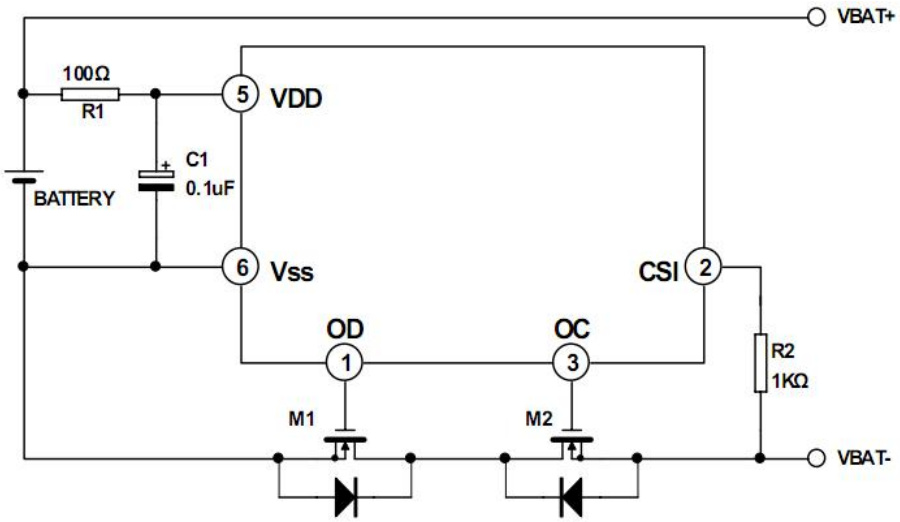
9.4 Overcharge state→Normal state



10. Operating state diagram



11. Typical Application Circuit



Note: the above line and parameters are only for reference, the actual application circuit, please set the parameters on the basis of the full measurement.

12.Package Outline（Unit：mm）

SOT23-6