

## 1 Li-ion/Li-polymer battery protects the IC

### Product feature

- Low working current
- Overcharge detection 4.280V, overcharge release 4.08V
- Overrelease detection 2.4V, overrelease 3.0V
- Overcurrent detection 0.16V, short circuit current detection 1.3V
- Charger detection
- Charging anomaly detection
- Overcurrent protection reset resistor
- With self-recovery function
- 0V charging enabled
- Wide operating voltage range
- Small package:SOT23-6

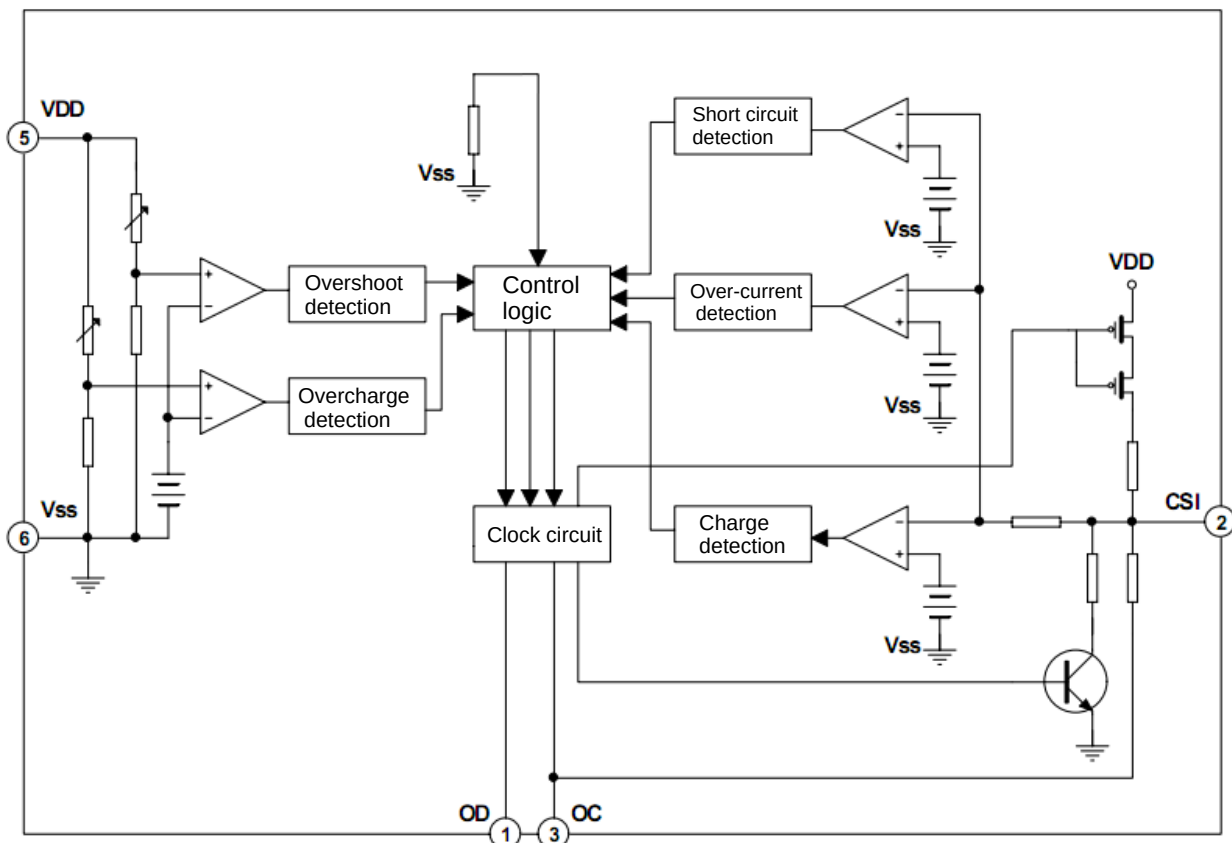
### Description:

DW01 is a lithium battery protection circuit, designed to avoid the lithium battery due to overcharge, overdischarge, excessive current resulting in shortened battery life or battery damage . It has high precision voltage detection and time delay circuit. With 0V charging function, charging abnormal detection, overcharge lock and overdischarge self-recovery function. It is not suitable for products with poor wireless and RF signal arrangement and shielding. Please make sure to verify the finished product before using this product.

### Application:

- Single lithium battery protection circuit.

Functional block diagram

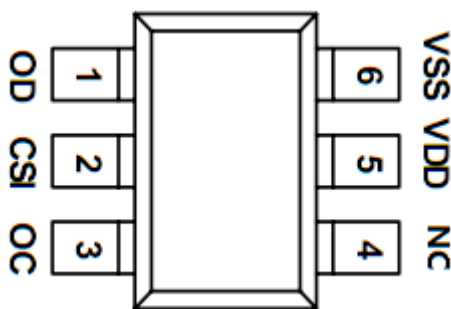


## Packaging and ordering information

| Type | Material condition | Package | Operating ambient temperature | Packaging                   |
|------|--------------------|---------|-------------------------------|-----------------------------|
| DW01 | halogen-free*1     | SOT23-6 | -40 °C to 85 °C               | Braid reel 3000 pieces/reel |

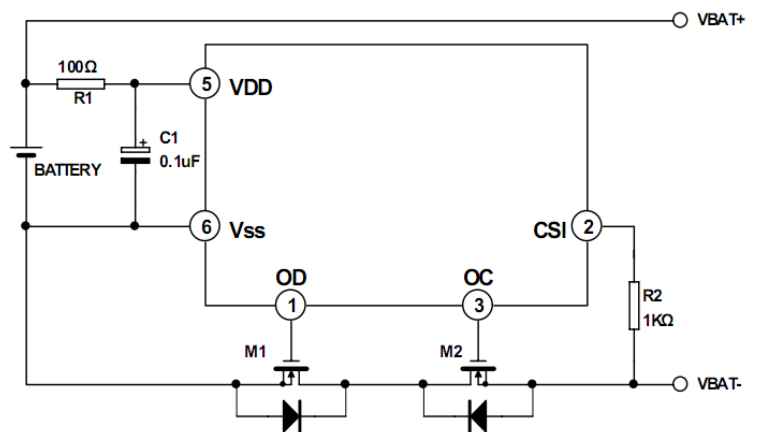
\*1: Lead-free halogen-free packaging is subject to order.

## Package and pin arrangement



SOT23-6 package

## Typical application



Typical application circuit diagram

## Pin function description

| Pin | Pin name | I/O | Functional description                         |
|-----|----------|-----|------------------------------------------------|
| 1   | OD       | O   | Discharge control FET threshold connection pin |
| 2   | CSI      | I/O | Current sensing input pin, charger detection   |
| 3   | OC       | O   | Charge control FET threshold connection pin.   |
| 4   | NC       | --- | Connectionless                                 |
| 5   | VDD      | I   | Positive power input pin                       |
| 6   | VSS      | I   | Negative power input pin                       |

## Absolute rating\*2

| Arguments             | Symbol | Parameter range value | Unit |
|-----------------------|--------|-----------------------|------|
| Supply voltage        | 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    |
| CSI input pin voltage | VCSI   | VDD-15~VDD+0.3        | V    |
| Operating temperature | Topr   | -40~+85               | °C   |
| Storage temperature   | Tstg   | -40~+125              | °C   |

Note 2: "Limit parameter" means that if the operating point exceeds this parameter, the chip may be permanently damaged. If the operating point is close to the limit parameter for a long time, the chip reliability may be reduced.

**Electrical characteristic parameter** (Ta=25 ℃)

| Parameter                                    | Symbol | Test condition    | Min.    | Typ.     | Max. | Unit |
|----------------------------------------------|--------|-------------------|---------|----------|------|------|
| <b>Working voltage</b>                       |        |                   |         |          |      |      |
| Working voltage                              | VDD    | --                | 1.5     | --       | 8    | V    |
| <b>Current drain</b>                         |        |                   |         |          |      |      |
| Working current                              | IDD    | VDD=3.9V          | --      | 4.0      | 6.0  | uA   |
| <b>Detection voltage</b>                     |        |                   |         |          |      |      |
| Overcharge detection voltage                 | VOCU   | --                | 4.23    | 4.28     | 4.33 | V    |
| Overcharge releases voltage                  | VOCR   | --                | 4.03    | 4.08     | 4.13 | V    |
| Overdischarge detection voltage              | VODL   | --                | 2.30    | 2.40     | 2.50 | V    |
| Overdischarge releases voltage               | VODR   | --                | 2.90    | 3.00     | 3.10 | V    |
| Overcurrent 1 Detects voltage                | VOI1   | --                | 0.13    | 0.16     | 0.19 | V    |
| (short-circuit current) Detects voltage      | VOI2   | VDD=3.6V          | 0.80    | 1.30     | 1.75 | V    |
| Overcurrent reset resistor                   | Rshort | VDD=3.6V          | 5       | 10       | 20   | KΩ   |
| Charger test voltage                         | VCH    | --                | -1.2    | -0.7     | -0.2 | V    |
| Charging abnormal detection voltage          | VCIP   | VDD=3.6V          | -1.2    | -0.7     | -0.2 | V    |
| <b>Delay time</b>                            |        |                   |         |          |      |      |
| Overcharge detection delay time              | TOC    | VDD=3.6V~4.4V     | --      | 80       | 200  | ms   |
| Overdischarge detection delay time           | TOD    | VDD=3.6V~2.0V     | --      | 40       | 120  | ms   |
| Overcurrent 1 Detection delay time           | TOI1   | VDD=3.6V          | --      | 10       | 20   | ms   |
| (short-circuit current) detection delay time | TOI2   | VDD=3.6V          | -       | 50       | 120  | us   |
| Charging anomaly detection delay time        | TCIP   | VDD=3.6V,CS=-1.1V | --      | 10       | 20   | ms   |
| <b>Else</b>                                  |        |                   |         |          |      |      |
| OC pin output high level voltage             | Voh1   | --                | VDD-0.1 | VDD-0.02 | --   | V    |
| OC pin output low level voltage              | Vol1   | --                | --      | 0.1      | 0.5  | V    |
| OD pin output high level voltage             | Voh2   | --                | VDD-0.1 | VDD-0.02 | --   | V    |
| OD pin output low voltage                    | Vol2   | --                | -       | 0.1      | 0.5  |      |

**Functional description**
**● Normal conditions**

If  $VODL < VDD < VOCU$ , and  $VCH < CSI < VOI1$ , both M1 and M2 are turned on (see typical application circuit diagram). At this time, charging and discharging can be carried out normally.

**● Overcharge condition**

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

- Release the overcharged state

After entering the state of over-recording, there are two ways to release the state of over-recording and enter the normal state.

- 1) Disconnect the charger, if the battery self-discharge, and  $VDD < VOCR$ , M2 on, return to the normal state.
- 2) Disconnect the charger, connect the load, if  $VOCR < VDD < VOCU$ ,  $CSI > VOI1$ , M2 turn on, return to normal mode.

**Note: After overcharge is detected, if the charger is connected all the time, the overcharge state cannot be released even if the cell voltage is reduced to below VOCR. By disconnecting the charger connection, and  $CSI > VCH$  can release the overcharge state, which is the overcharge lock function.**

- Overdischarge detection

When the normal state enters the discharge state, the battery voltage can be detected through VDD. When the battery voltage enters the overdischarge state, the VDD voltage is less than VODL and the delay time is more than TOD, then M1 is turned off.

- Release the power off mode.

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

- Charge detection.

If there is a charger connected to the battery in power off mode, the voltage will change to  $VCSI < VCH$  and  $VDD > VODL$ . M1 Turns on and returns to normal mode.

- Abnormal state of charge

In the normal working state of the battery, during the charging process, if the CSI terminal voltage is lower than the charge anomaly detection voltage (VCIP), and the duration of this state exceeds the charge anomaly detection delay time (TCIP), the MOSFET (OC terminal) used for charge control is turned off and the charging is stopped, this state is called "charge anomaly state".

After entering the charging abnormal detection state, if the CSI terminal voltage is higher than the charging abnormal detection voltage (VCIP) by disconnecting the charger, the charging abnormal state will be removed and the normal working state will be restored.

- Overcurrent/short-circuit current detection

In normal mode, when the discharge current is too large, the voltage detected by the CSI pin is greater than VOIX (VIO1 or VIO2), and the delay is greater than TOIX (TIO1 or TIO2), then the overcurrent (short circuit) state is represented. M1 shuts down and CSI pulls to VSS via internal resistor RCSIS.

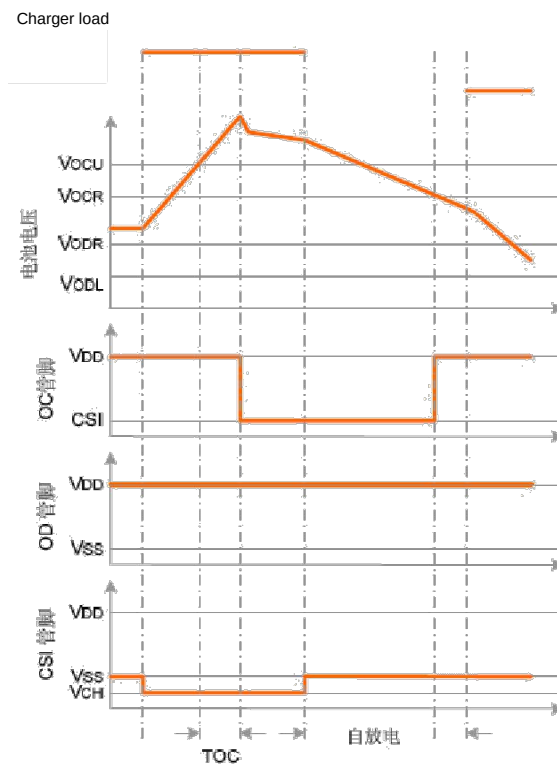
- Release overcurrent or short-circuit current

When the protection circuit remains in the overcurrent/short-circuit current state, the load is removed or the impedance between VBAT+ and VBAT- is greater than  $500\text{ k}\Omega$ , and  $VCSI < VOI1$ , then M1 turns on and returns to normal conditions.

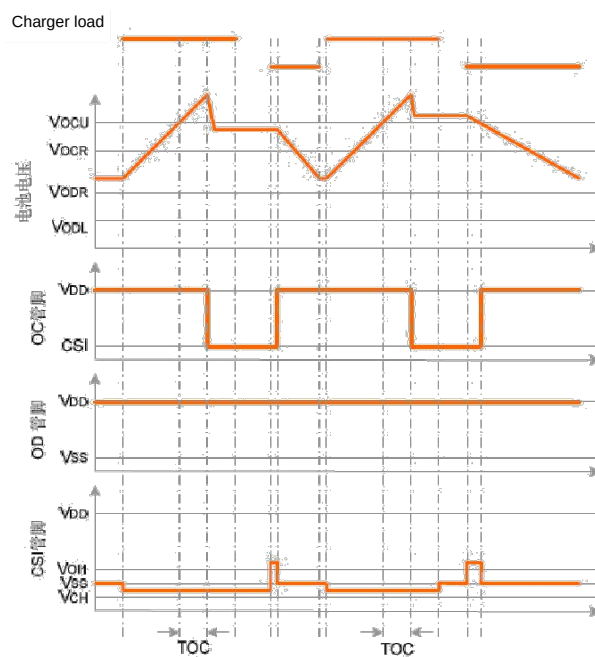
**Note:** When the battery is first connected to the protection circuit, this circuit may not enter normal mode and cannot discharge at this time. If this phenomenon occurs, the CSI pin voltage is equal to the VSS voltage (short circuit the CSI and VSS or connect the charger), you can enter the normal mode.

## Sequence chart

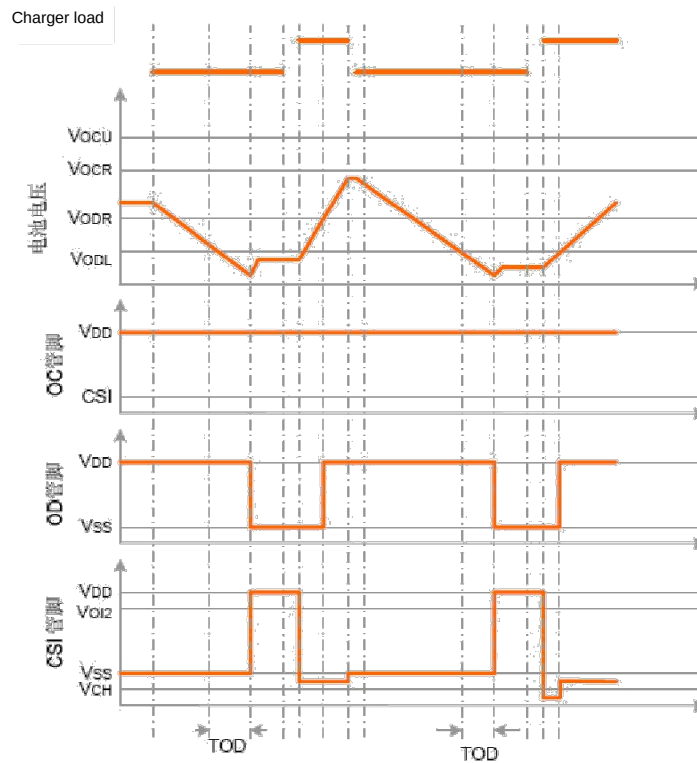
- Overcharge state → self-discharge state → Normal state



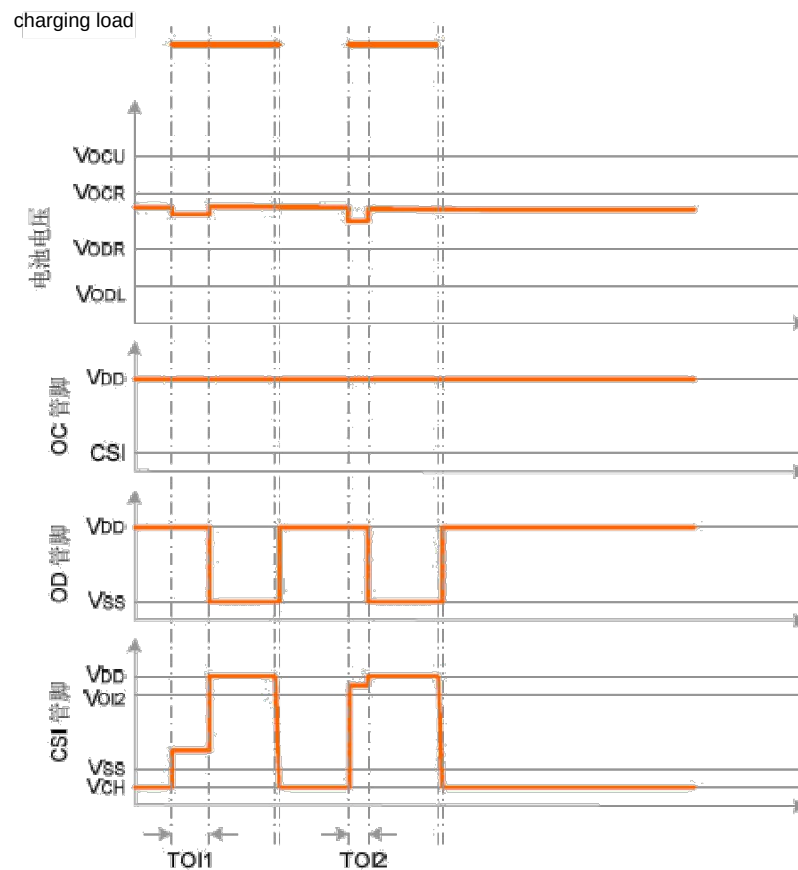
- Overcharge state → Load discharge state → Normal state



- Overcharge state → Charger charging state → Normal state



- Overcharge state → Normal state



Package size and outline drawing (unit: mm)

SOT-23-6

