Single-cell high-precision lithium battery protection IC

The SL2112 series is equipped with a high-precision voltage detection circuit and delay circuit. By monitoring the battery's voltage and current, it provides protection against overcharging, over-discharging, over-current, and short circuits. It is suitable for protection circuits of single lithium-ion/lithium polymer rechargeable batteries.

■ Features

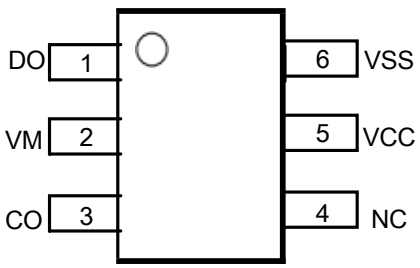
1) High-precision voltage detection：
   - Overcharge detection voltage 3.5 V ~ 4.5 V Accuracy ±50 mV
   - Overcharge hysteresis voltage 0.2 V Accuracy ±80 mV
   - Over discharge detection voltage 2.0 V ~ 3.2 V Accuracy ±100 mV
   - Over discharge hysteresis voltage 0.6 V Accuracy ±120 mV
2) Discharge overcurrent detection：
   - Overcurrent detection voltage 0.05V ~ 0.22 V Accuracy ±30mV
   - Short circuit detection voltage 1.0 V Accuracy ±200mV
3) Charge overcurrent detection voltage -0.10V ~ -0.20V Accuracy ±30mV
4) Load detection
5) Charger detection
6) 0VCharge
7) Low current consumption：
   - At work 2.7 μA (Typical) (Ta = +25。C)
   - At sleep 0.8μA (Typical) (Ta = +25。C)
8) Lead-free, halogen-free

■ Application

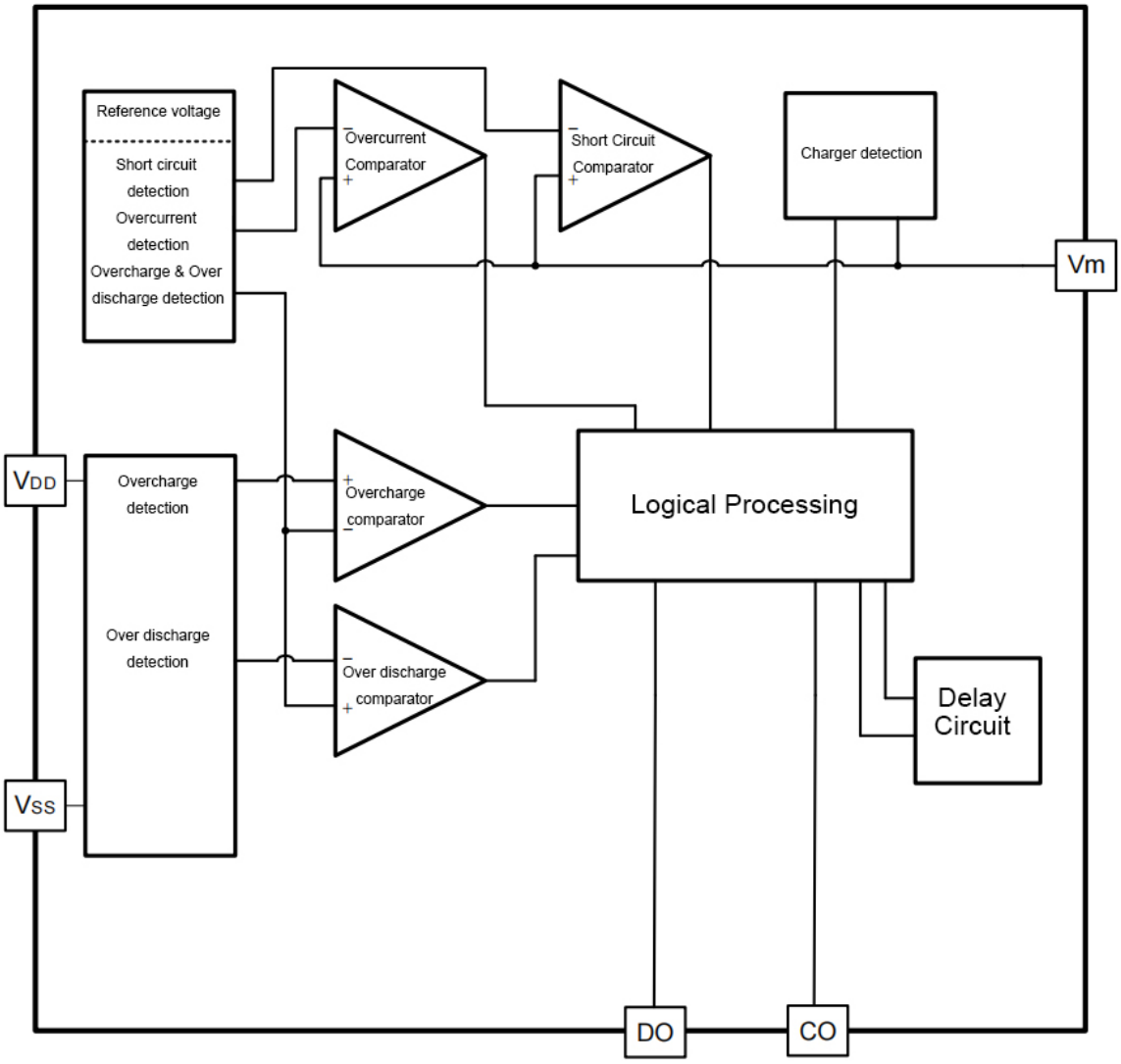
Phone batteries
Children's toys

■ Package

SOT23-6



■ System Function Block Diagram



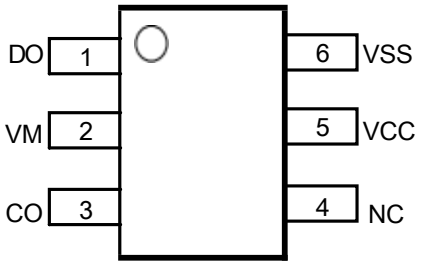
Picture 1

Model

	Overcharge protection voltage V_{OC}	Overcharge Release voltage V_{OCR}	Over discharge protection voltage V_{OD}	Over discharge release voltage V_{ODR}	Discharge overcurrent V_{EC1}	Short Circuit V_{SHORT}	Charging overcurrent V_{CHA}
SL2112	3.750 V	3.600 V	2.10 V	2.30 V	0.200 V	1.00 V	-0.150 V

Table 1

Pin



Picture 2

Pinout number	Symbol	Description
1	DO	Discharge MOSFET control terminal
2	VM	Charge and discharge current detection terminal, connected to the negative pole of the charger or load
3	CO	Charging MOSFET control terminal
4	NC	No connection
5	VCC	Power input terminal, connected to the positive pole of the power supply (battery)
6	VSS	Power ground terminal, connected to the negative pole of the power supply (battery)

Table 2

Absolute Maximum Ratings

(Unless specified, Ta = +25°C)

Item	Symbol	Applicable terminals	Absolute Maximum Ratings	Unit
Supply voltage	VCC	VCC	-0.3 ~ 7	V
VM input voltage	VM	VM	VCC-15 to VCC+0.3	V
Operating temperature	T_{OPR}	-	-40 ~ 85	°C
Storage temperature	T_{STG}	-	-40 ~ 125	°C

Table 3

Attention: Applying voltage exceeding the absolute maximum rating may cause irreversible damage to the chip.

Electrical Characteristics

(Unless otherwise specified : Ta = +25°C)

Item		Symbol	Test conditions	Min	Typ	Max	Uint
Chip power supply voltage		V_{CC}	-	1	-	6	V
Normal operating current		I_{VCC}	VCC=3.5V	-	2.7	-	μA
Sleep current		I_{STB}	VCC =2.0V	-	0.8	-	μA
Overcharge	Protection voltage	V_{OC}	VCC =3.5→4.5V	V_{OC} - 0.050	V_{OC}	V_{OC} / 0.05	V
	Release voltage	V_{OCR}	VCC =4.5→3.5V	V_{OCR} - 0.050	V_{OCR}	V_{OCR} +0.050	V
	Protection delay	T_{OC}	VCC =3.5→4.5V	40	80	160	ms
	Release delay	T_{OCR}	VCC =4.5→3.5V	5	20	40	μs
Over discharge	Protection voltage	V_{OD}	VC5=3.5→2.0V	V_{OD} - 0.100	V_{OD}	V_{OD} / 0.1	V
	Release voltage	V_{ODR}	VCC =2.0→3.5V	V_{ODR} - 0.120	V_{ODR}	V_{ODR} +0.120	V
	Protection delay	T_{OD}	VCC =3.5→2.0V	20	40	80	ms
	Release delay	T_{ODR}	VCC =2.0→3.5V	5	20	40	μs
Discharge Overcurrent	Protection voltage	V_{EC}	VM-VSS=0→0.20V	0.125	0.15	0.175	V
	Protection delay	T_{EC}	VM-VSS=0→0.20V	5	10	20	ms
	Release delay	T_{ECR}	VM-VSS=0.20→0V	1	2	4	ms
Charging Overcurrent	Protection voltage	V_{CHA}	VSS-VM=0→0.30V	-0.125	-0.15	-0.175	V
	Protection delay	T_{CHA}	VSS-VM=0→0.30V	5	10	20	ms
	Release delay	T_{CHAR}	VSS-VM=0.30V→0	1	2	4	ms
Short Circuit	Protection voltage	V_{SHORT}	VM -VSS=0→ 1.5V	0.8	1	1.2	V
	Protection delay	T_{SHORT}	VM -VSS=0→ 1.5V	150	300	600	μs

Table 4

■ Functional Description

1. Overcharge status

When any battery voltage rises above V_{OC} and lasts for a period of time T_{OC}, the output of the CO terminal will reverse, turn off the charge control MOS tube, and stop charging. This is called the overcharge state. When all battery voltages drop below the overcharge release voltage V_{OCR} and last for a period of time T_{OCR}, the overcharge state will be released and restored to normal state.
After entering the overcharge state, there are two ways to release the overcharge state and restore to normal state:
1) Regardless of whether the charger is connected, when the battery voltage drops below the overcharge release voltage V_{OCR} due to self-discharge, the overcharge state is released and restored to normal working state.
2) Connect a load, if $V_{OCR}<V_{CC}<V_{OC}$, $V_{VM}>V_{EC}$, it will return to normal working state. This function is called load detection function.

2. Over discharge status

When any battery voltage drops below V_{OD} and lasts for a period of time T_{OD}, the output of the DO terminal will reverse, turn off the discharge control M_{OS} tube, and stop discharging. This is called the over-discharge state. When all battery voltages rise above the over-discharge release voltage V_{ODR} and last for a period of time T_{ODR}, the over-discharge state will be released and restored to the normal state.
After entering the over-discharge state, there are three ways to release the over-discharge state and restore to the normal state:
1) Connect a charger. If the VM terminal voltage is lower than the charge over-current detection voltage (V_{CHA}), when the battery voltage is higher than the over-discharge detection voltage (V_{OD}), the over-discharge state is released and restored to the normal working state. This function is called the charger detection function.
2) Connect a charger. If the VM terminal voltage is higher than the charge over-current detection voltage (V_{CHA}), when the battery voltage is higher than the over-discharge release voltage (V_{ODR}), the over-discharge state is released and restored to the normal working state.
3) When the charger is not connected, if the battery voltage recovers to be higher than the over-discharge release voltage (V_{ODR}), the over-discharge state is released and restored to the normal working state.

3. **Discharge overcurrent state**

When the battery is in the discharge state, the VM terminal voltage increases with the increase of the discharge current. When the VM terminal voltage is higher than VEC and lasts for a period of time TEC, the chip considers that there is a discharge overcurrent; when the VM terminal voltage is higher than VSHORT and lasts for a period of time TSHORT, the chip considers that there is a short circuit. When any of the above two states occurs, the output of the DO terminal will reverse, turn off the discharge control MOS tube, stop the discharge, and disconnect the load to restore to normal state.

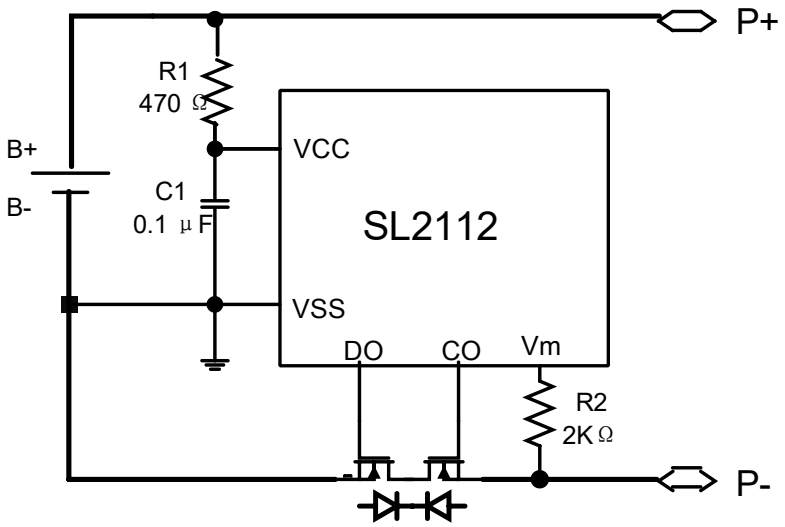
4. Charging overcurrent detection

For a battery in normal working state, during the charging process, if the VM terminal voltage is lower than the charge overcurrent detection voltage (V_{CHA}), and this state lasts longer than the charge overcurrent detection delay time (T_{CHA}), the MOSFET used for charge control is turned off and charging stops. This state is called the charge overcurrent state. After entering the charge overcurrent detection state, if the charger is disconnected so that the VM terminal voltage is higher than the charge overcurrent detection voltage (V_{CHA}), the charge overcurrent state is released and the battery returns to normal working state.

5. 0V charging

This function is used to recharge a battery that has self-discharged to 0V. When the charger voltage connected between the positive electrode (P+) and the negative electrode (P-) of the battery is higher than the charger starting voltage (V_{0VCH}) for charging a 0V battery, the gate of the charge control MOSFET is fixed to the potential of the VDD terminal. Since the charger voltage makes the voltage difference between the gate and source of the MOSFET higher than its conduction voltage, the charge control MOSFET is turned on (the CO terminal is open) and charging begins. At this time, the discharge control MOSFET is still off, and the charging current flows through its internal parasitic diode. When the battery voltage is higher than the over-discharge detection voltage (V_{OD}), the SL 2112 series IC enters normal operation.

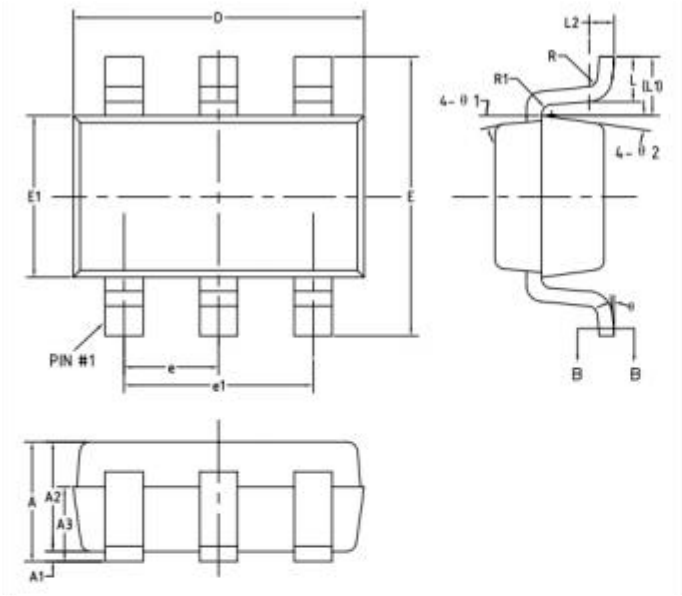
■ Application Circuit

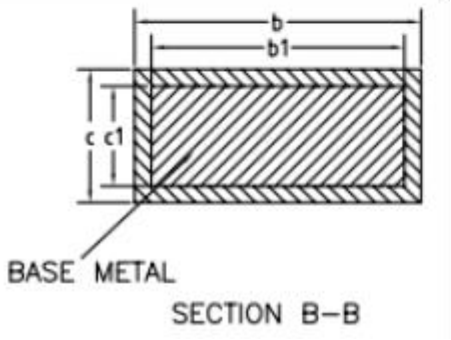


Picture 3

■ Packaging information

SOT23-6 Package size





SECTION B–B

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	–	–	1.45
A1	0	–	0.15
A2	0.90	1.15	1.30
A3	0.60	0.65	0.70
b	0.39	–	0.49
b1	0.35	0.40	0.45
c	0.08	–	0.22
c1	0.08	0.13	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.85	0.95	1.05
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.35	0.60	0.85
L2		0.25BSC	
R	0.10	–	–
R1	0.10	–	0.25
θ	0°	–	8°
θ1	7°	9°	11°
θ2	8°	10°	12°

NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD MO-178 C
DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.