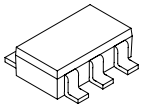
LI+ BATTERY PROTECTION CIRCUIT

DESCRIPTION

SC121 is a LI+ 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.



SOT-23-6

FEATURES

* Low supply current
* Over-charge detect 4.28V, Over-charge release 4.10V.
* Over-discharge detect 2.50V, Over-discharge release 2.90V.
* Over-current detect 0.15V, Short Current detect 1.00V.
* Overcharge/over-discharge/over-current detection delay
* Charger detection
* Reset resistance for over current protection
* Wide supply voltage range
* Small package

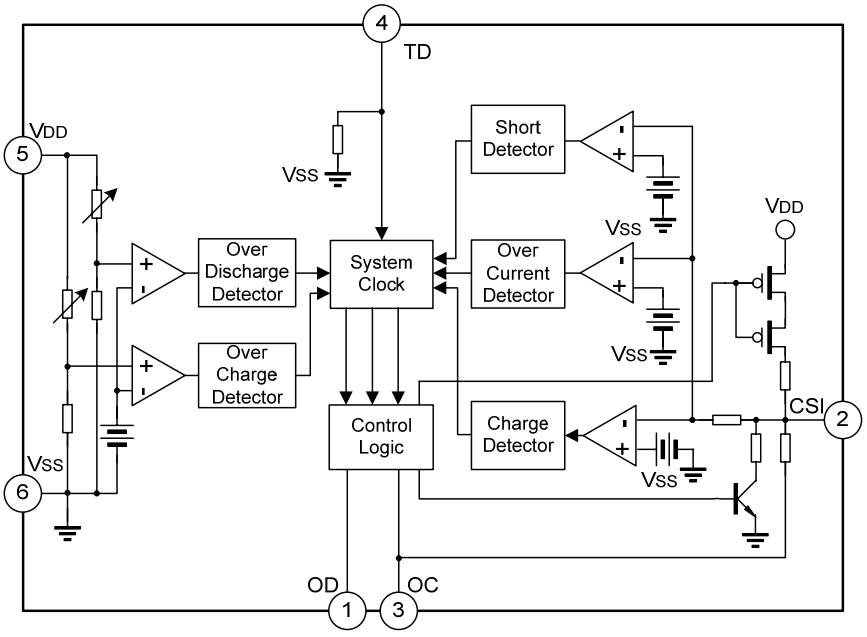
APPLICATIONS

* Protection IC for One-Cell LI+ Battery Pack

ORDERING INFORMATION

Device	Package	0 V Battery Charge Function
SC121N	SOT-23-6	Unavailable
SC121NA	SOT-23-6	Available

BLOCK DIAGRAM



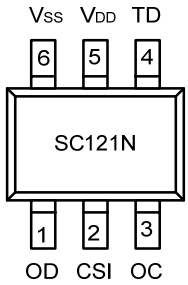
ABSOLUTE MAXIMUM RATING

Characteristics	Symbol	Value	Unit
Supply Voltage	V_{DD}	V_{SS}-0.3 ~ V_{SS}+12	V
OC Output Pin Voltage	V_{OC}	V_{DD}-15 ~ V_{DD}+0.3	V
OD Output Pin Voltage	V_{OD}	V_{SS}-0.3 ~ V_{DD}+0.3	V
CSI Input Pin Voltage	V_{CSI}	V_{DD}-15 ~ V_{DD}+0.3	V
Operating Temperature Range	T_{OPR}	-40 ~ + 85	°C
Storage Temperature Range	T_{STG}	-40 ~ +125	°C

ELECTRICAL CHARACTERISTICS (Tamb=25°C, unless otherwise specified)

Characteristics	Symbol	Status	Min.	Typ.	Max.	Unit
Operating Voltage						
Operating Voltage	V_{DD}		1.8		8.0	V
Current Consumption						
Supply Current	I_{DD}	V_{DD}=3.9V		3.0	6.0	μA
Power Down Current	I_{PD}	V_{DD}=2.0V		0.3	0.6	μA
Detection Voltage						
Over Charge Detection Voltage	V_{OCU}		4.24	4.28	4.32	V
Over Charge Release Voltage	V_{OCR}		4.05	4.10	4.15	V
Over Discharge Detection Voltage	V_{ODL}		2.40	2.50	2.60	V
Over Discharge Release Voltage	V_{ODR}		2.80	2.90	3.00	V
Over Current 1 Detection Voltage	V_{OI1}		0.13	0.15	0.17	V
Over Current 2(Short Current)Detection Voltage	V_{OI2}	V_{DD}=3.6V	0.80	1.00	1.20	V
Over Current Reset Resistor	R_{short}	V_{DD}=3.6V	400	500	600	kΩ
Charger Detection Voltage	V_{CH}		-0.8	-0.5	-0.2	V
Delay Time						
Over Charge Detection Delay Time	T_{OC}	V_{DD}=3.6V~4.4V	150	340	500	ms
Over Discharge Detection Delay Time	T_{OD}	V_{DD}=3.6V~2.0V	80	200	300	ms
Over Current 1 Detection Delay Time	T_{OI1}	V_{DD}=3.6V	5	13	20	ms
Over Current 2(Short Current)Detection Delay Time	T_{OI2}	V_{DD}=3.6V		5	50	μs
Other						
OC Pin Output “H” Voltage	V_{oh1}		V_{DD}-0.1	V_{DD}-0.02		V
OC Pin Output “L” Voltage	V_{ol1}			0.01	0.1	V
OD Pin Output “H” Voltage	V_{oh2}		V_{DD}-0.1	V_{DD}-0.02		V
OD Pin Output “L” Voltage	V_{ol2}			0.01	0.1	V
0 V battery charge starting charger voltage	V_{OCHA}	SC121NA	1.5			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	Input pin for current sense, charger detect.
3	OC	O	FET gate connection pin for charge control.
4	TD	I	Test pin for reduce delay time.
5	V_{DD}	I	Positive power input pin.
6	V_{SS}	I	Negative power input pin.

FUNCTION DESCRIPTIONS

Normal Status

If $V_{ODL}<V_{DD}<V_{OCU}$ and $V_{CH}<V_{CSI}<V_{OI1}$, M1 and M2 are both turned on (refer to Typical Application Circuits). The charging and discharging processes can be operated normally.

Overcharge Detection

When enter charging from normal status, the battery voltage can be detected from V_{DD}. When the battery is in overcharge status, V_{DD} is larger than V_{OCU} over a delay time of T_{OC}, M2 is to be turned off.

Release of Overcharge Status

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

- If the battery is self discharging and $V_{DD}<V_{OCR}$ occurs, M2 is to be turned on and back to normal status.
- 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 status.

Over discharge Detection

When enter discharging from normal status, the battery voltage can be detected from V_{DD}. When the battery is in over discharge status, V_{DD} is smaller than V_{ODL} over a delay time of TOD; M1 is to be turned off. In the meanwhile, CSI is pulled to V_{DD} 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 0.3μA).

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 status.

Charger Detection

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

Abnormal Charging Status

If a charger is connected to the battery in normal status, $V_{CSI}<V_{CH}$ 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 during discharging under normal status and the voltage detected from CSI is larger than V_{OIX} (V_{IO1} or V_{IO2}) for over a certain delay time T_{OIX} (T_{IO1} or T_{IO2}), it means the over current/short current status occurred. M1 is turned off. CSI is pulled to V_{SS} by way of an internal resistor RCSIS.

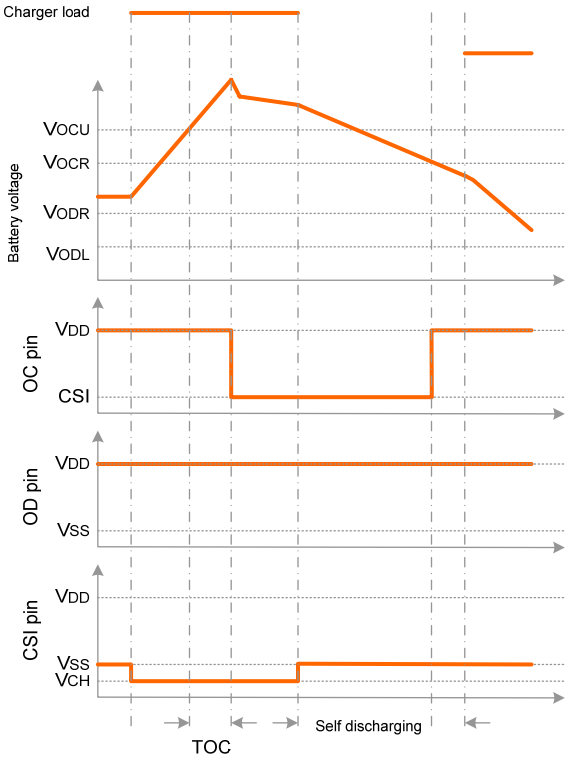
Release of Over Current/Short Current Status

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

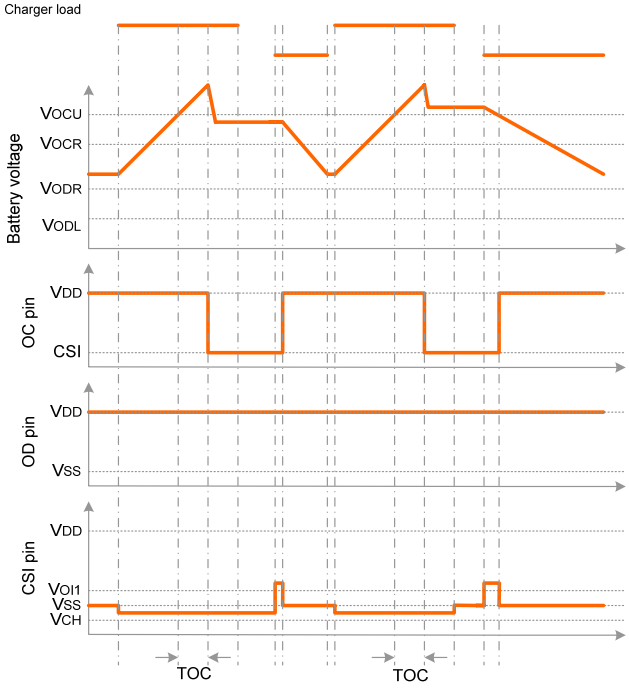
Note: when a battery is connected to a protection IC for the first time, the IC may not enter the normal status (not dischargeable status). If this occurs, set the CSI pin voltage equal to the V_{SS} voltage (short the CSI and V_{SS} pins or connect a charger) to enter the normal status.

TIMING DIAGRAM

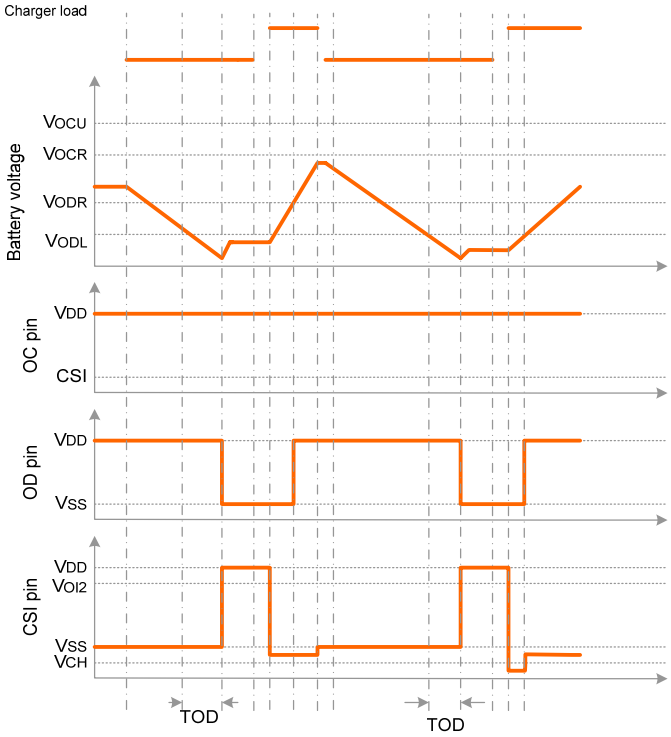
Overcharge Status →Self Discharging →Normal Status



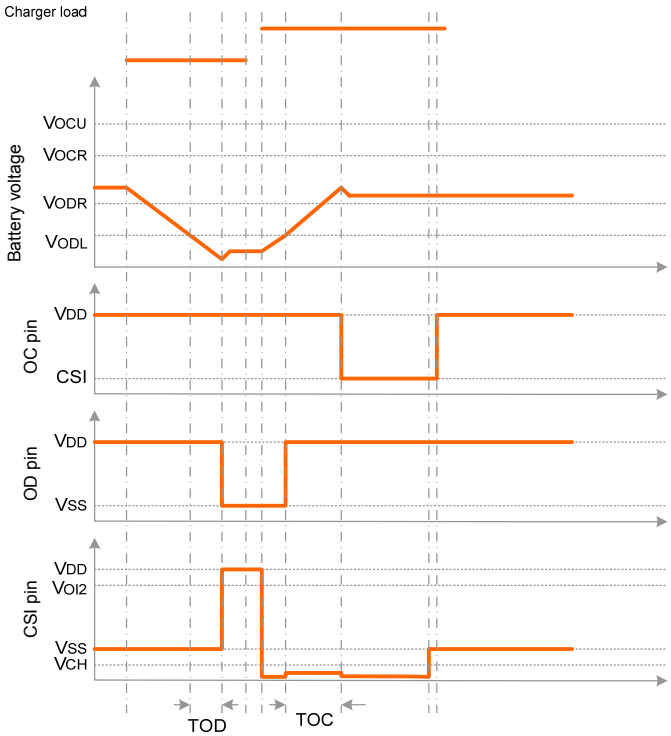
Overcharge Status→Load Discharging→Normal Status



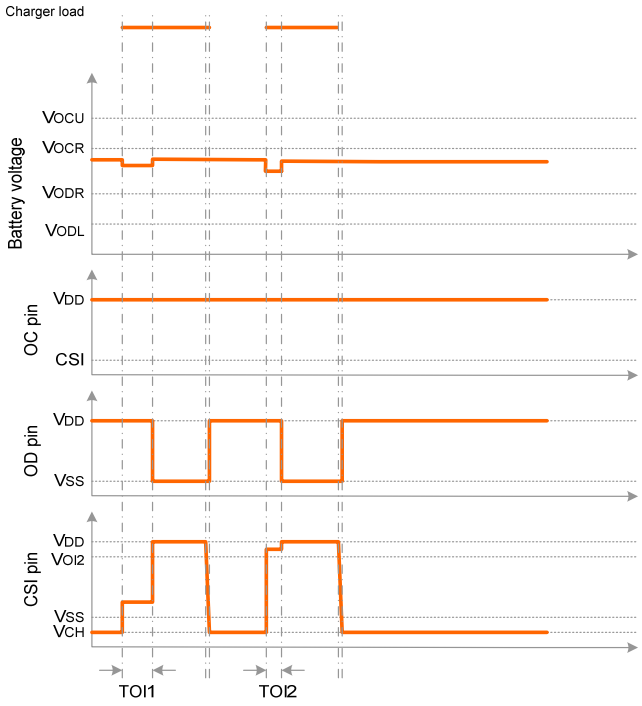
Overcharge Status→Charging By Charger→Normal Status



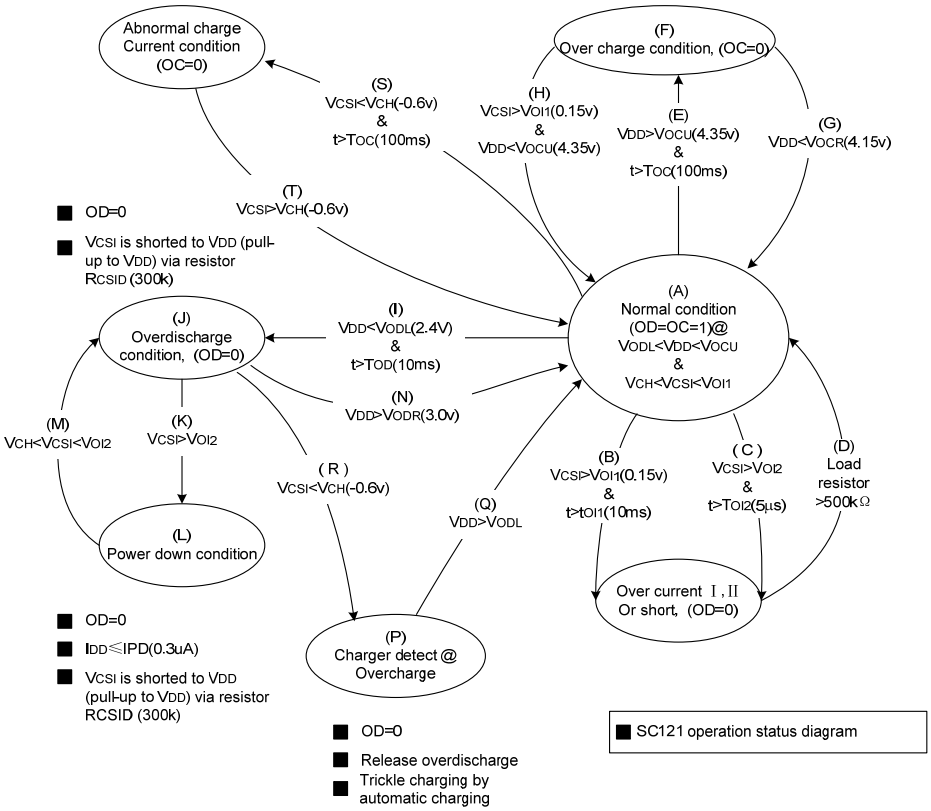
Overcharge Status→Abnormal Status→Normal Status



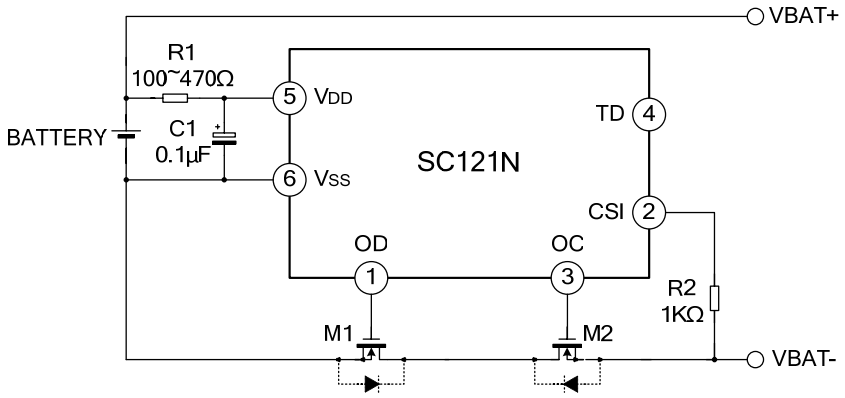
Over Current Status→Normal Status



STATE DIAGRAM OF OPERATION



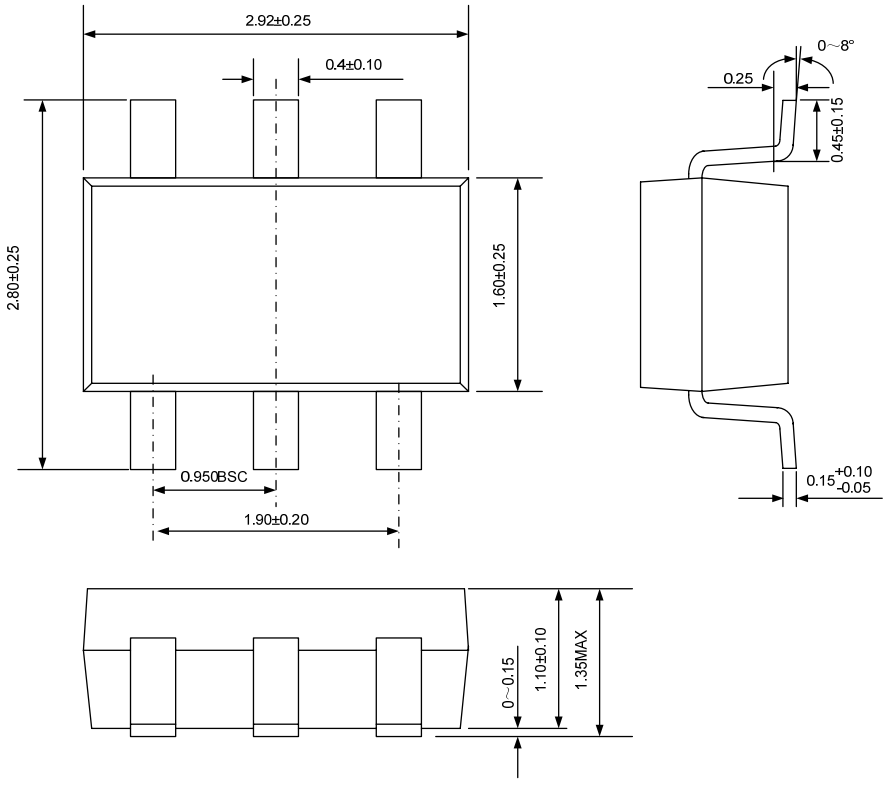
TYPICAL APPLICATION CIRCUITS



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.

Note：Silan reserves the right to make changes without notice in this specification for the improvement of the design and performance. Silan will supply the best possible product for customers.

ATTACH

Revision History

Data	REV	Description	Page
2007.11.26	1.0	Original	
2008.01.08	1.1	Modify the “FEATURES” and “TYPICAL APPLICATION CIRCUITS”	
2008.05.08	1.2	Modify the “ELECTRICAL CHARACTERISTICS”	
2008.06.12	1.3	Modify the “ABSOLUTE MAXIMUM RATING”	
2008.06.25	1.4	Modify the “TYPICAL APPLICATION CIRCUITS”	