Li-ION/POLYMER 2-CELL PROTECTOR

GENERAL DESCRIPTION

HM5531 Series is a protection IC for 2 serial-cell lithium-ion / lithium polymer rechargeable batteries and includes high accuracy voltage detection circuits 、delay circuits and Cell balance circuits。

HM5531 Series is suitable for protecting 2 serial-cell rechargeable lithium-ion / lithium polymer battery packs from over-charge, over-discharge, over-current , short-circuiting and cell-unbalance.

FEATURES

- Manufactured with High Voltage Tolerant Process Maximum Rating 28V
- Low supply current

Cell voltage 3.6V, Typ. 5μA(Iq)
Cell voltage 2.0V, Max. 1μA(Isd)

- CPC8 Package
- Variety of detector threshold

Over-charge detector threshold-Vcu:3.7V-4.5V step of 0.1V +/-25mV
Overcharge Release Voltage-V_{CL}=Vcu-0.2V +/-50mV
Over-discharge detector threshold V_{DL}:2.4V-3.0V step of 0.1V +/-80mV
Over-discharge Release Voltage- V_{DR} +/-100mV
Discharge-current threshold1 0.2V
Short detector threshold 1.5V (Fixed)
Charge-current threshold -0.2V

- Setting of Output delay time

Over-charge detector Output Delay 700ms
Over-discharge detector Output Delay 100ms
Discharge-current detector Output Delay 9ms
Charge-current detector Output Delay 9ms
Short Circuit detector Output Delay 100μs

- 0V Battery Charging Function
- Built-in Cell balance Function
- ESD HBM >4000V
- RoHS Compliant and Lead Pb Free

APPLICATIONS

Power Tools
Power Bank
Power Amplyfier
2 Cell Lithium-ion or Lithium polymer rechargeable battery pack

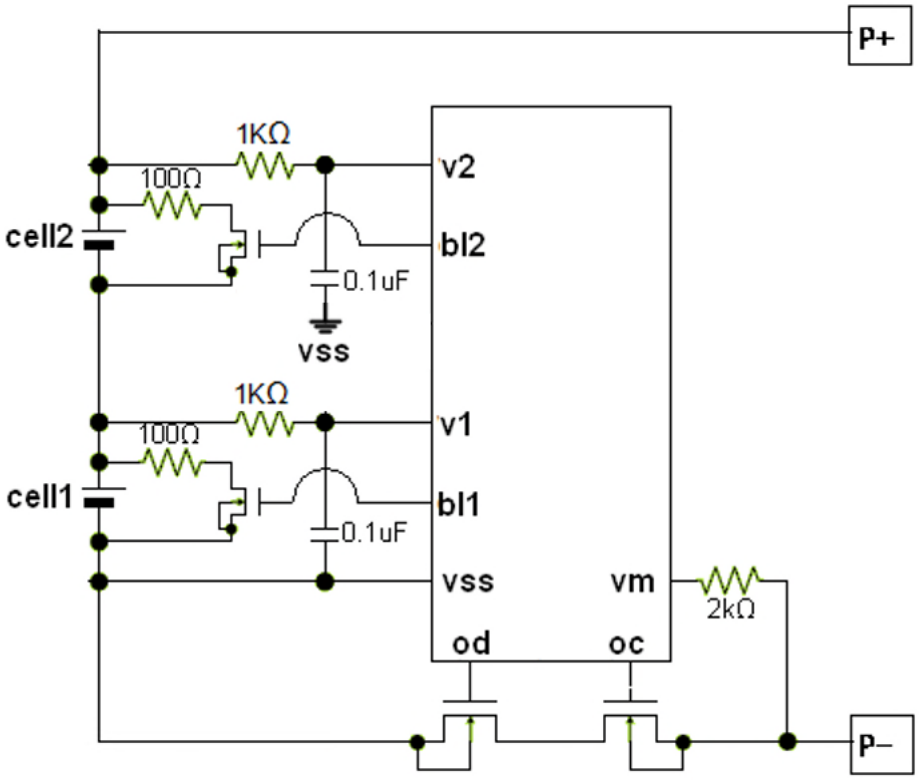

Figure 1. Typical Application Circuit

ORDERING INFORMATION

PART NUMBER	Overcharge Detection Voltage [V_{CU}]	Overcharge Release Voltage [V_{CL}]	Overdischarge Detection Voltage [V_{DL}]	Overdischarge Release Voltage [V_{DR}] *	Top Mark （Note）
HM5531DBA	4.28 ± 0.025V	4.08 ± 0.05V	2.9 ± 0.08V	3.0 ± 0.1V	HM5531 XXXYW
HM5531DGB	4.28 ± 0.025V	4.08 ± 0.05V	2.4 ± 0.08V	2.95 ± 0.1	
HM5531HGI	4.38 ± 0.025V	4.18 ± 0.05V	2.4 ± 0.08V	2.6 ± 0.1V	
HM5531DCA	4.28 ± 0.025V	4.08 ± 0.05V	2.8 ± 0.08V	3.0 ± 0.1V	
HM5531BCA	4.25 ± 0.025V	4.05 ± 0.05V	2.8 ± 0.08V	3.0 ± 0.1V	

Note: “YW” is manufacture date code, “Y” means the year, “W” means the week

XXX: Part number suffix, such as DBA、DGB and so on

*: Enter Sleep Mode after overdischarge, needs charging to activate normal discharge state

PIN CONFIGURATION

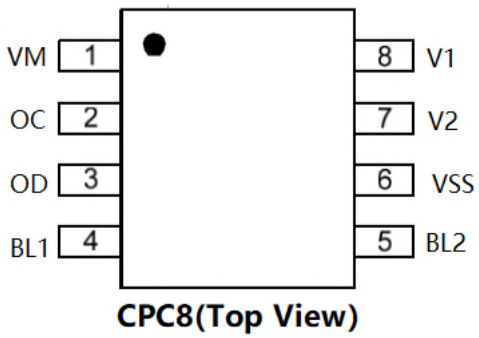

Figure 2. CPC8（TOP VIEW）

PIN DESCRIPTION

HM5531 SERIES PIN NUMBER	PIN NAME	PIN DESCRIPTION
1	VM	Voltage detection pin between VM pin and VSS pin (Overcurrent / charger detection pin)
2	OC	Connection pin of charge control FET gate (CMOS output)
3	OD	Connection pin of discharge control FET gate (CMOS output)
4	BL1	Cell balance control pin for Cell-1
5	BL2	Cell balance control pin for Cell-2
6	VSS	Ground, negative input Pin , negative terminal Pin for Cell-1
7	V2	Positive terminal Pin for Cell-2,VDD pin for the IC
8	V1	Positive terminal Pin for Cell-1 & negative terminal Pin for Cell-2

ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

PARAMETER	VALUE	UNIT
V2; VM	-0.3~30	V
OC	VSS-0.3~VSS+30	V
OD	VSS+0.3~VDD+0.3	V
BL1	VSS~VSS+5V	V
BL2	V1~V1+5V	V
Operating Ambient Temperature	-40 to 85	°C
Maximum Junction Temperature	125	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C
Power Dissipation at T=25°C	0.25	W
Package Thermal Resistance (Junction to Ambient) θ_{JA}	350	°C/W
Package Thermal Resistance (Junction to Case) θ_{JC}	50	°C/W
ESD(HBM)	4000	V

ELECTRICAL CHARACTERISTICS

Typicals and limits appearing in normal type apply for T_A = 25°C, unless otherwise specified

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Detection Voltage						
Overcharge Detection Voltage	V_{CU}		V_{CU}-25mV	V_{CU}	V_{CU}+25mV	V
Overcharge Release Voltage	V_{CL}		V_{CL}-50mV	V_{CL}	V_{CL}+50mV	V
Overdischarge Detection Voltage	V_{DL}		V_{DL}-80mV	V_{DL}	V_{DL}+80mV	V
Overdischarge Release Voltage	V_{DR}		V_{DR}-100mV	V_{DR}	V_{DR}+100mV	V
Charger Detection Voltage	V_{CHA}		-0.17	-0.2	-0.23	V
Discharger Detection Voltage	V_{DIS}		0.17	0.2	0.23	V
Current Consumption						
Current Consumption in Normal Operation	I_{OPE}	V_{DD}=7.2V VM =0V		5	12	uA
Current Consumption in power Down	I_{PDN}	V_{DD}=4V VM pin floating		0.1	1	uA
Detection Delay Time						
Overcharge Voltage Detection Delay Time	t_{CU}		500	700	900	mS
Overdischarge Voltage Detection Delay Time	t_{DL}		60	100	140	mS
Overdischarge Current Detection Delay Time	t_{IOV}		6	10	14	mS

Overcharge Current Detection Delay Time	t_{ICV}		6	10	14	mS
Load Short-Circuiting Detection Delay Time	t_{SHORT}		50	100	200	uS
Cell balance						
Cell Balance Voltage Threshold	Vbl_ Delta		70	100	130	mV

BLOCK DIAGRAMS

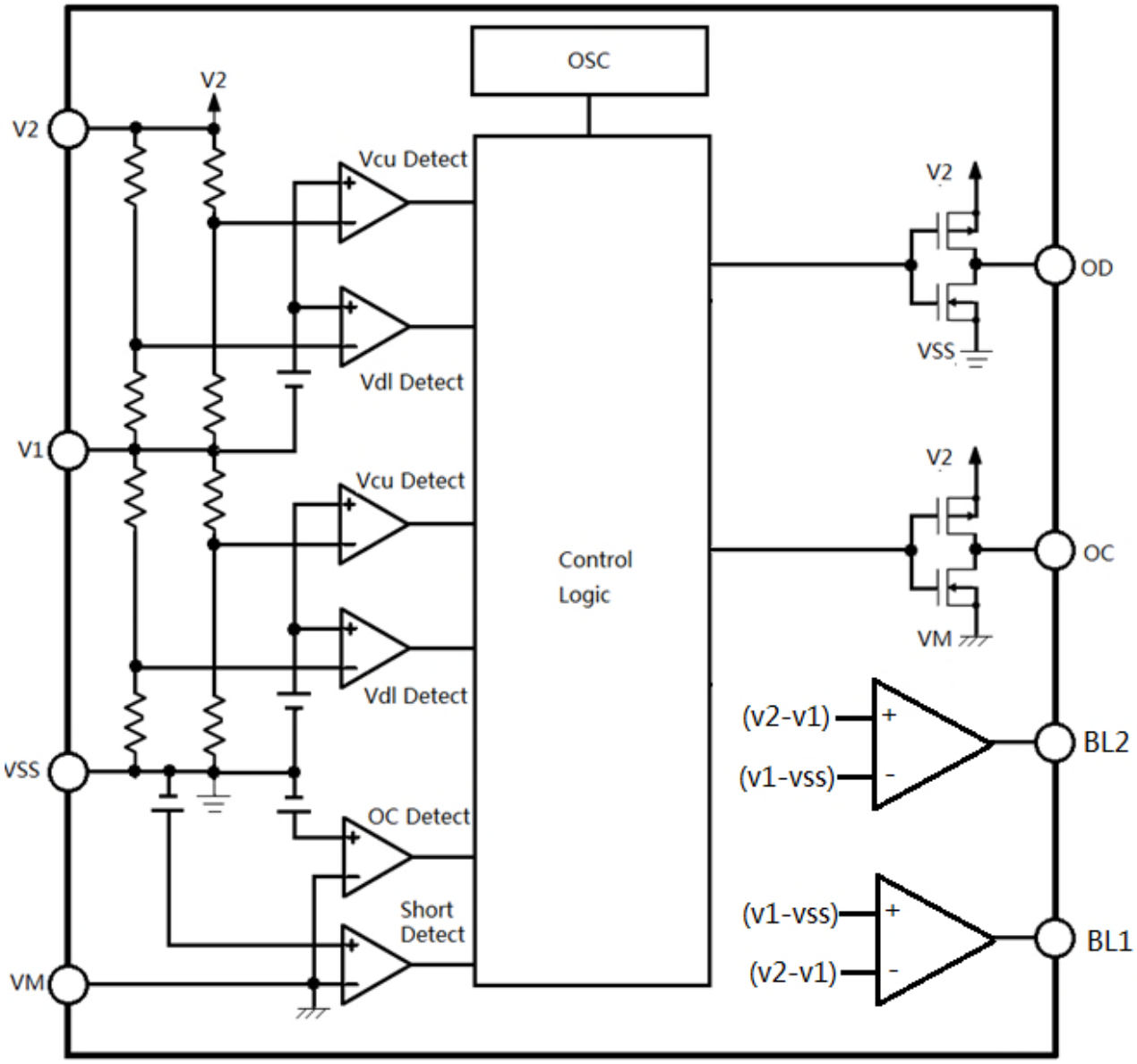

Figure 3. Functional Block Diagram

OPERATION

Over-Charge Detectors

While the cell is charged, the voltage between V1 pin and VSS pin (voltage of the Cell-1), the voltage between V2 pin and V1 pin (voltage of the Cell-2) are supervised. If at least one of the cells' voltage becomes equal or more than the over-charge detector threshold, the over-charge is detected, and an external charge control N-MOSFET turns off with OC pin being at "L" level via an external pull-down resister and charge stops.

To reset the over-charge and make the OC pin level to "H" again after detecting over-charge, in such conditions that a time when all the cells' voltages are down to a level lower than over-charge released voltage. The output voltage of OC pin becomes "H", and it makes an external N-MOSFET turns on, and charge cycle is available. The over-charge detectors have hysteresis. Internal fixed output delay times for over-charge detection and release from over-charge exist. Even if one of voltage of Cells keeps its level more than the over-charge detector threshold, and output delay time passes, over-charge voltage is detected. Even when the voltage of each cell becomes equal or higher level than V_{CU} if these voltages would be back to a level lower than the over-charge detector threshold within a time period of the output delay time, the over-charge is not detected. Besides, after detecting over-charge, each cell voltage is lower than the over-charge detector released voltage, even if just one of cells' voltage becomes equal or more than the over-charge released voltage within the released output delay time, over-charge is not released.

Over-Discharge Detectors

While the cells are discharged, the voltage between V1 pin and VSS pin (the voltage of Cell-1), the voltage between V2 pin and V1 pin (Cell-2 voltage) are supervised. If at least one of the cells' voltage becomes equal or less than the over-discharge detector threshold, the over-discharge is detected and discharge stops by the external discharge control N-MOSFET turning off with the OD pin being at "L". The condition to release over-discharge voltage detector is that after detecting over-discharge voltage, all the cells' voltage becomes higher than the over-discharge released voltage, OD pin becomes “H”level, and by turning on the external N-MOSFET, discharge becomes possible. The over-discharge detectors have hysteresis.

Internal fixed output delay times for over-charge detection and release from over-charge exist. If at least one of the voltage of Cells is down to equal or lower than the over-discharge detector threshold, if the voltage of each Cell would be back to a level higher than the over-discharge detector threshold within a time period of the output delay time, the over-discharge is not detected. Output delay time for release from over-discharge is also set internally. After detecting over-discharge, supply current would be reduced and be into standby by halting unnecessary circuits and consumption current of the IC itself is made as small as possible.

Discharge-current Detector, & Short Circuit Protector

When the discharge is acceptable, VM voltage is supervised, if the load is short and VM voltage becomes equal or more than excess discharge current threshold, and equal or less than short detector threshold, the status becomes excess discharge current detected condition. If VM voltage becomes equal or more than short circuit detector threshold, the status becomes short circuit detected, then OD pin outputs "L" and by turning off the external MOSFET, large current flow is prevented. The excess discharge current detector and short detector has the fixed output delay time.

Charge-current detector

When the charge is acceptable, VM voltage is supervised, if the VM voltage becomes equal or more than excess charge current threshold， the status becomes excess charge current detected condition. then OC pin outputs "L" and by turning off the external MOSFET, large current flow is prevented. Output delay of excess charge current is internally fixed.

Cell balance function

When Vcell1 is 0.1V above Vcell2, BL1 pin will output “H” Logic.

When Vcell2 is 0.1V above Vcell1, BL2 pin will output “H” Logic.

When HM5531 goes into sleep mode, BL1 & BL2 pins will hold on “L” Logic。

The balance current can be set by one external resistor. absolute ratings must be cared.

If the cell balance function is unnecessary, BLn pin must be open.

PACKAGE OUTLINE(CPC8）

尺寸 / 标注	最小(mm)	最大(mm)	尺寸 / 标注	最小(mm)	最大(mm)
A	2.50	2.70	C	0.85	1.05
A1	0.35	0.45	C1	0.00	0.15
e	0.53 (BSC)		C2	0.15	0.18
B	2.50	2.70	L	0.40	0.60
B1	3.85	4.15	θ	0°	8°
b	0.16	0.26