

Protection of Lithium Ion Batteries (three cells in series) Monolithic IC MM1309

Outline

This is a 3-cell series protection IC is for protecting a lithium ion battery from overcharging and excess discharging. If abnormalities occur during charging and excess voltage is applied, it has a function that turns off the external FET switch (overcharging detection). It also has a function that turns off the external FET switch when the voltage for each battery falls below a set voltage, to prevent excess discharge when discharging the battery (discharging detection). At that time, the IC is switched to low current consumption mode.

These functions comprise a protection circuit, with few external parts, for lithium ion batteries.

Features

| | | |
|--|-------------------------|------------------------------------|
| 1. Current consumption (for V _{CC} pin) | V _{CELL} =4.4V | 700μA typ. |
| 2. Current consumption (for V _{CC} pin) | V _{CELL} =4.2V | 300μA typ. |
| 3. Current consumption (for V _{CC} pin) | V _{CELL} =3.8V | 25μA typ. |
| 4. Current consumption (for V _{CC} pin) | V _{CELL} =2.2V | 0.1μA max. |
| 5. Current consumption (for BATH pin) | V _{CELL} =4.4V | 12μA typ. |
| 6. Current consumption (for BATH pin) | V _{CELL} =3.8V | 8μA typ. |
| 7. Current consumption (for BATH pin) | V _{CELL} =2.2V | 1μA typ. |
| 8. Charge prohibit voltage (T _a =−20°C~+70°C) | | B : 4.35V±50mV C : 4.25V±50mV |
| 9. Charge prohibit release voltage | | V _{CELLU} −45mV |
| 10. Charge prohibit detection function operation voltage | | B : 4.20V typ. C : 4.10V typ. |
| 11. Excess discharge detection voltage | | 2.40V±0.09V, 2.35V±0.09V |
| 12. Discharge resumption voltage | | B : 2.65V±0.16V C : 2.60V±0.16V |
| 13. Excess discharge detection hysteresis voltage | | 250±75mV |

Package

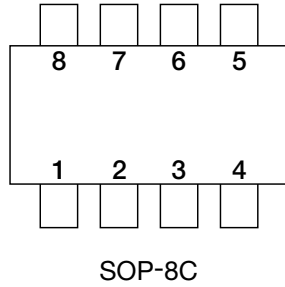
SOP-8C (MM1309□F)

*The box represents the rank resulting from the combination of protection functions.

Applications

1. Notebook PCs
2. Portable terminals
3. Others

Pin Assignment

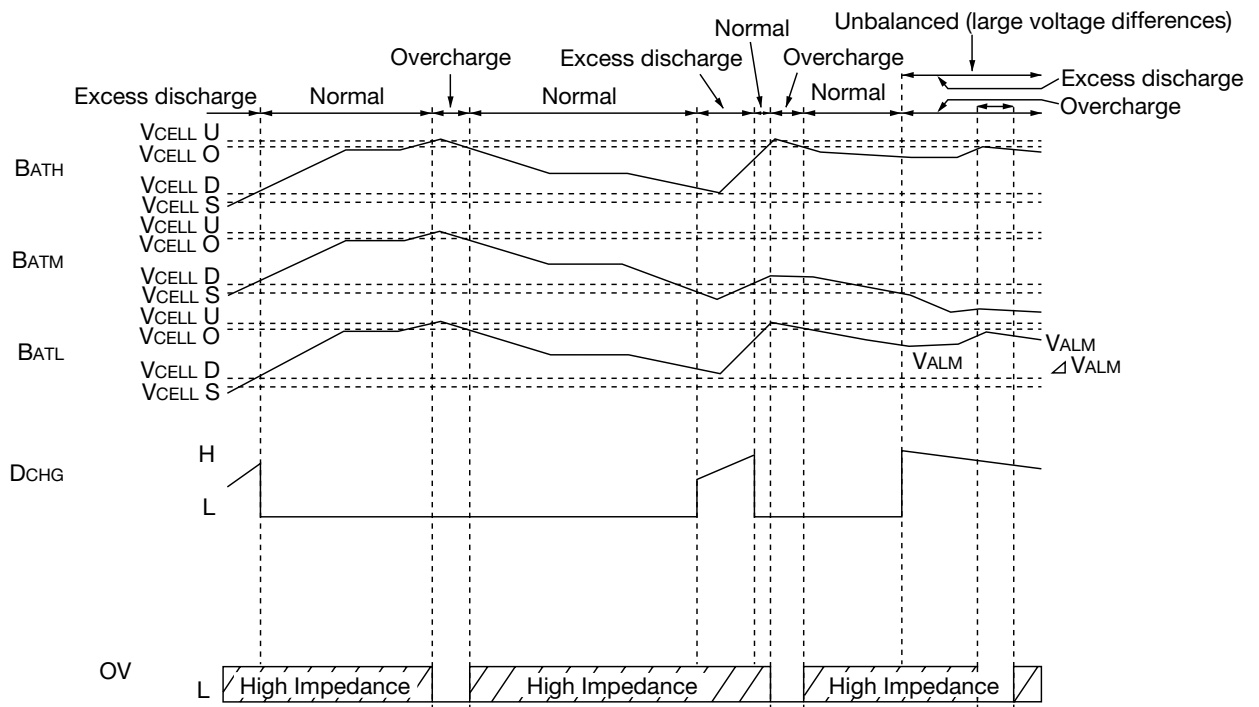


| | |
|---|------|
| 1 | DCHG |
| 2 | N. C |
| 3 | OV |
| 4 | GND |
| 5 | BATL |
| 6 | BATM |
| 7 | BATM |
| 8 | VCC |

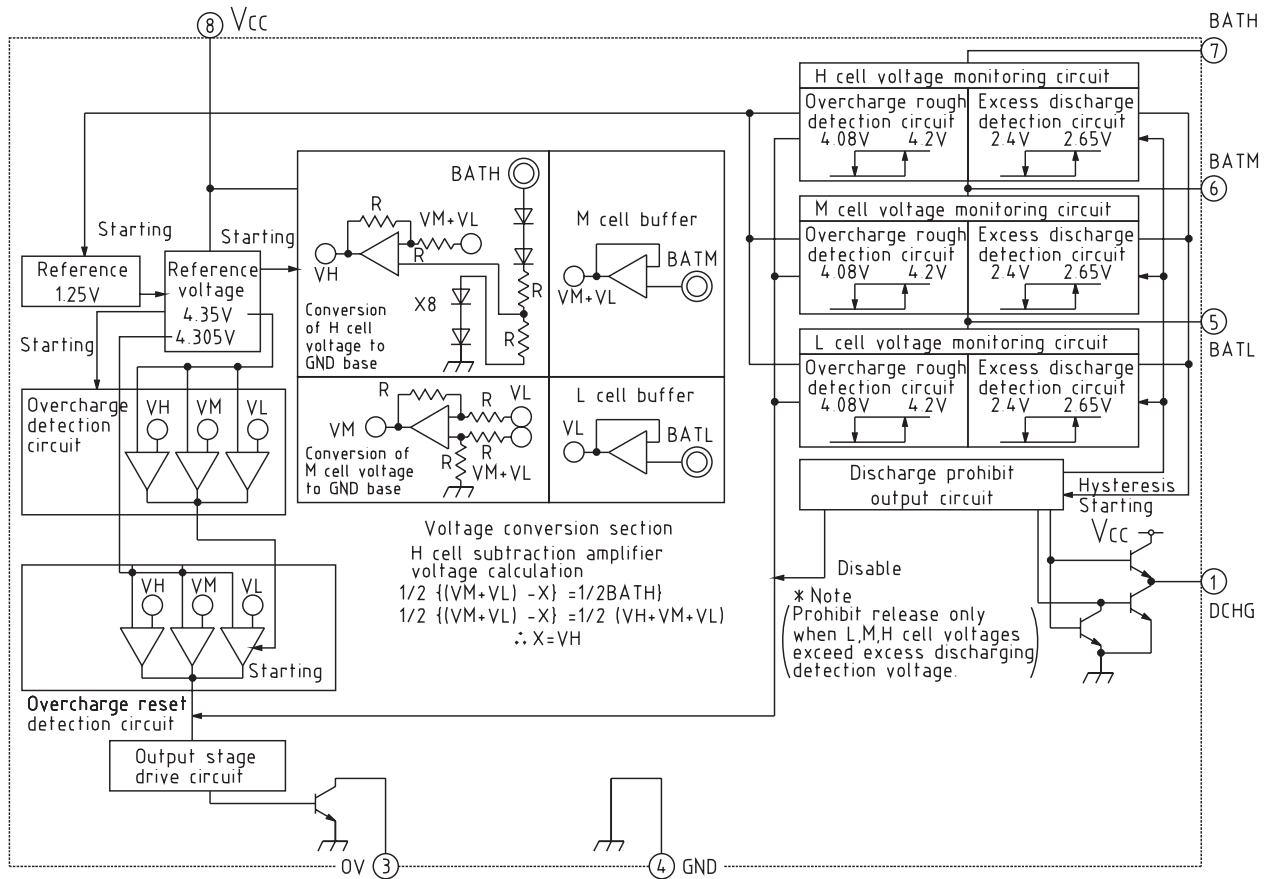
Pin Description

| No. | Pin | Output | Function |
|-----|------|--------|---|
| 1 | DCHG | Output | FET drive pin for excess discharge control |
| 2 | N. C | | |
| 3 | OV | Output | FET drive pin for overcharge control |
| 4 | GND | | Negative connection pin for the low side battery. Also, IC GND pin. (IC reference power supply pin) |
| 5 | BATL | Input | Positive connection pin for the low side battery, and negative connection pin for the middle side battery. |
| 6 | BATM | Input | Positive connection pin for the middle side battery, and negative connection pin for the high side battery. |
| 7 | BATM | Input | Positive connection pin for the high side battery. |
| 8 | VCC | | IC positive power supply input pin. |

Timing Chart



Block Diagram



Output Pin Conditions

| Pin | Voltage | Excess discharge 2.4V/CELL | Normal 4.35V/CELL | Overcharge |
|------|----------------|-------------------------------|----------------------|------------|
| DCHG | H | L | | L |
| OV | High Impedance | L | | L |

Absolute Maximum Ratings (Ta=25°C)

| Item | Symbol | Rating | Units |
|-----------------------------|-----------------------|----------|-------|
| Storage temperature | T _{STG} | -40~+125 | °C |
| Operating temperature | T _{OPR} | -20~+70 | °C |
| Charging voltage | V _{BAT} max. | 15 | V |
| Power supply voltage | V _{OC} max. | 15 | V |
| OV2 pin applied voltage | V _O max. | 18 | V |
| Allowable power dissipation | P _d | 300 | mW |

Electrical Characteristics (Unless otherwise specified $T_a=25^{\circ}\text{C}$, $V_{IN}=15\text{V}$, $V_{CELL}=V_{BATH}=V_{BATM}=V_{BATL}$)

| Item | Symbol | Measurement Conditions | Min | Typ. | Max. | Units |
|---|---------------------|--|-----------------------------|-----------------------------|-----------------------------|-------|
| Current consumption (V _{CC} pin) 1 | I _{CC1} | V _{CELL} =4.4V | | 0.7 | 1.1 | mA |
| Current consumption (V _{CC} pin) 2 | I _{CC2} | V _{CELL} =4.2V | | 300 | 450 | μA |
| Current consumption (V _{CC} pin) 3 | I _{CC3} | V _{CELL} =3.8V | | 25.0 | 40.0 | μA |
| Current consumption (V _{CC} pin) 4 | I _{CC4} | V _{CELL} =2.3V | | | 0.1 | μA |
| Current consumption (BATH pin) 1 | I _{BATH1} | V _{CELL} =4.4V | | 12.0 | 20.0 | μA |
| Current consumption (BATH pin) 2 | I _{BATH2} | V _{CELL} =3.8V | | 8.0 | 12.0 | μA |
| Current consumption (BATH pin) 3 | I _{BATH3} | V _{CELL} =2.3V | | 1.0 | 2.0 | μA |
| Charge prohibit voltage | MM1309BF | V _{CELLU} T _a =-20~70°C V _{CELL} =4.0V→4.5V | 4.30 | 4.35 | 4.40 | V |
| | MM1309CF | | 4.20 | 4.25 | 4.30 | |
| Charge prohibit release voltage | V _{CELL0} | V _{CELL} =4.5V→4.0V | V _{CELLU} -60mV | V _{CELLU} -45mV | V _{CELLU} -30mV | V |
| Charge prohibit detection function operation voltage | MM1309BF | V _{ALM} V _{CELL} =3.8V→4.4V | 4.05 | 4.20 | 4.25 | V |
| | MM1309CF | | 3.95 | 4.10 | 4.25 | |
| Charge prohibition sensing operation voltage Hysteresis voltage | ΔV _{ALM} | V _{CELL} =4.4V→3.8V | 50 | 90 | 130 | mV |
| Excess discharging detection voltage | MM1309BF | V _{CELLS} V _{CELL} =3.0V→2.0V | 2.31 | 2.40 | 2.49 | V |
| | MM1309CF | | 2.26 | 2.35 | 2.44 | |
| Discharge resumption voltage | MM1309BF | V _{CELLD} V _{CELL} =2.0V→3.0V | 2.49 | 2.65 | 2.81 | V |
| | MM1309CF | | 2.44 | 2.60 | 2.76 | |
| Excess discharge detection hysteresis voltage | ΔV _{CS} D | V _{CELLD} -V _{CELLS} | 175 | 250 | 325 | mV |
| BATL pin input voltage 1 | I _{BATL} | V _{CELL} =3.8V | | | ±300 | nA |
| BATL pin input voltage 2 | I _{BATLA} | V _{CELL} =4.4V | 0.7 | 1.0 | 1.3 | μA |
| BATM pin input voltage 1 | I _{BATM} | V _{CELL} =3.8V | | | ±300 | nA |
| BATM pin input voltage 2 | I _{BATMA} | V _{CELL} =4.4V | 0.7 | 1.0 | 1.3 | μA |
| DCHG pin source voltage | I _{so} DCH | V _{CELL} < V _{CELLS} | 20 | | | μA |
| DCHG sink voltage | I _{si} DCH | V _{CELL} > V _{CELLS} | 20 | | | μA |
| DCHG output voltage L | V _{TH} DcL | BATH-DCHG IS=20uA | | | 1.0 | V |
| DCHG output voltage M | V _{TH} DcH | DCHG-GND IS=-20uA | | | 0.8 | V |
| OV pin sink current | I _{si} Ov | VOv=0.4, T _a =-20~70°C | 200 | | | μA |

Application

