

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.

Series Table

Temperature conditions A: Ta=-25 ~ 75°C, B: Ta=-20 ~ 70°C, C: Ta=0 ~ 50°C,
D: Ta=0 ~ 40°C, E: Ta=-20 ~ 25°C

Model	Package	Overcharge prohibition voltage (V)	Overcharge detection voltage temperature conditions	Overcharge detection hysteresis voltage (V)	Overdischarge detection voltage (V)	Discharge resumption voltage (V)	Overcurrent detection voltage (mV)
	SOP-8C, 8E						
MM1309	BF	4.350±0.050	B	45±15	2.40±0.09	2.65±0.16	—
	CF	4.250±0.050	B	45±15	2.35±0.09	2.60±0.16	—

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} =2.3V | 1µA typ. |
| 8. Charge prohibit detection function operation voltage | | B : 4.20V typ.
C : 4.10V typ. |
| 9. Excess discharge detection hysteresis voltage | | 250±75mV |

Package

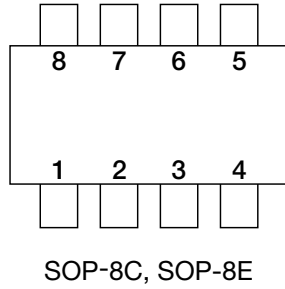
SOP-8C, SOP-8E (MM1309□F)

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

Applications

1. Notebook PCs
2. Portable terminals
3. Others

Pin Assignment

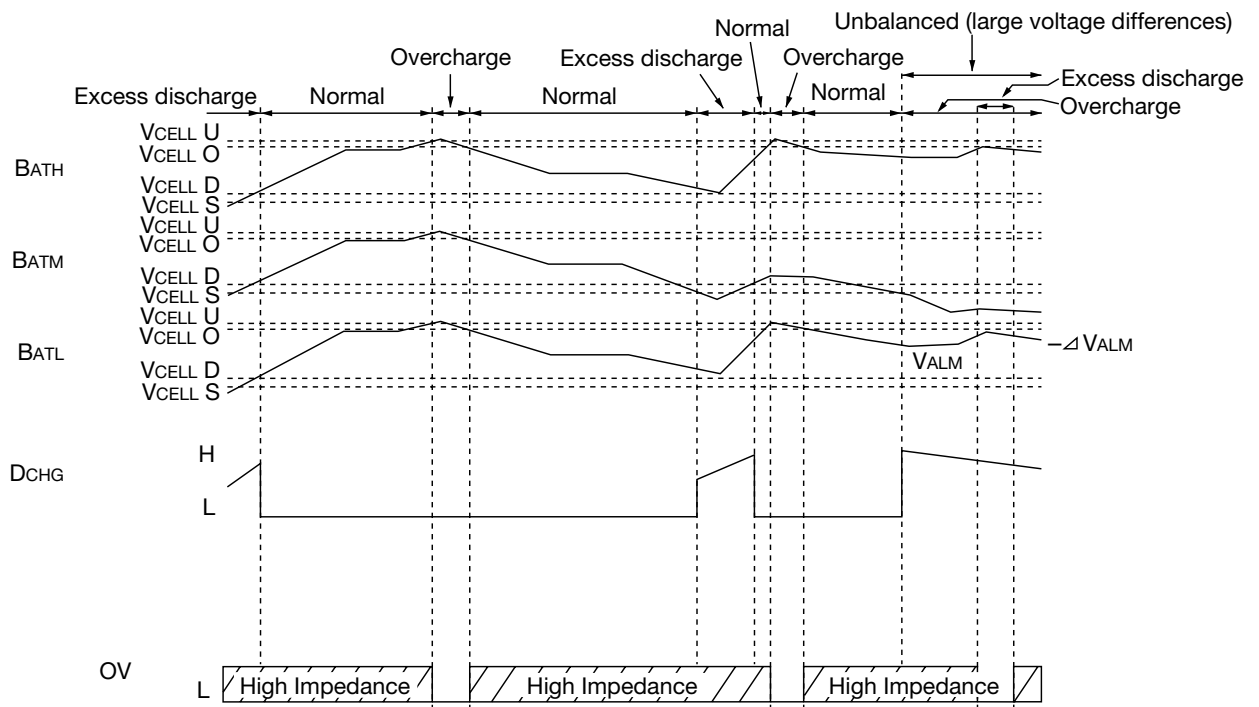


1	DCHG
2	N. C
3	OV
4	GND
5	BATL
6	BATM
7	BATH
8	VCC

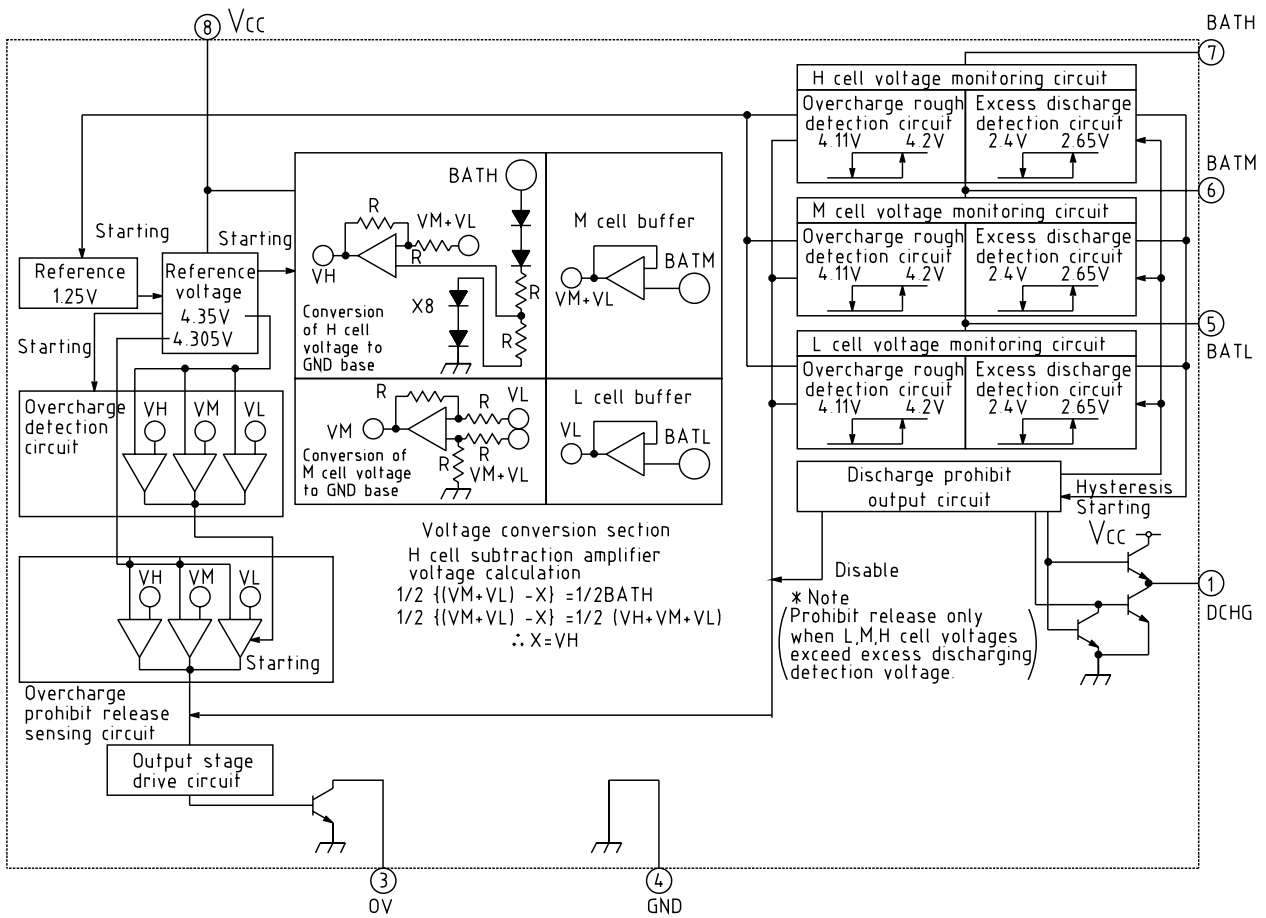
Pin Description

No.	Pin	Output	Function
1	DCHG	Output	FET drive pin for excess discharge control
2	N. C		Non connect
3	OV	Output	FET drive pin for overcharge control
4	GND		Negative connection pin for the low side battery. Also, IC ground 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	Normal	Overcharging prohibited status
DCHG	H	2.4V/CELL	4.35V/CELL	L
OV	High Impedance			L

Absolute Maximum Ratings

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 _{CC max.}	15	V
OV2 pin applied voltage	V _{O max.}	18	V
Allowable power dissipation	P _d	300	mW

Electrical Characteristics (Unless otherwise specified $T_a=25^{\circ}\text{C}$, $V_{IN}=15\text{V}$, $V_{CELL}=V_{BAT\text{H}}=V_{BAT\text{M}}=V_{BAT\text{L}}$)

Item	Symbol	Measurement Conditions	Min	Typ.	Max.	Units
Current consumption (V_{CC} pin) 1	I_{CC1}	$V_{CELL}=4.4\text{V}$		0.7	1.1	mA
Current consumption (V_{CC} pin) 2	I_{CC2}	$V_{CELL}=4.2\text{V}$		300	450	μA
Current consumption (V_{CC} pin) 3	I_{CC3}	$V_{CELL}=3.8\text{V}$		25.0	40.0	μA
Current consumption (V_{CC} pin) 4	I_{CC4}	$V_{CELL}=2.3\text{V}$			0.1	μA
Current consumption (BATH pin) 1	I_{BATH1}	$V_{CELL}=4.4\text{V}$		12.0	20.0	μA
Current consumption (BATH pin) 2	I_{BATH2}	$V_{CELL}=3.8\text{V}$		8.0	12.0	μA
Current consumption (BATH pin) 3	I_{BATH3}	$V_{CELL}=2.3\text{V}$		1.0	2.0	μA
Overcharge prohibit voltage	MM1309BF	$T_a=-20\sim 70^{\circ}\text{C}$ $V_{CELL}=4.0\text{V}\rightarrow 4.5\text{V}$	4.30	4.35	4.40	V
	MM1309CF		4.20	4.25	4.30	
Charge prohibit release voltage	V_{CELL0}	$V_{CELL}=4.5\text{V}\rightarrow 4.0\text{V}$	V_{CELL0} -60mV	V_{CELL0} -45mV	V_{CELL0} -30mV	V
Overcharge detection function operation voltage	MM1309BF	$V_{CELL}=3.8\text{V}\rightarrow 4.4\text{V}$	4.05	4.20	4.35	V
	MM1309CF		3.95	4.10	4.25	
Overcharge detection function operation voltage Hysteresis voltage	ΔV_{ALM}	$V_{CELL}=4.4\text{V}\rightarrow 3.8\text{V}$	50	90	130	mV
Excess discharging detection voltage	MM1309BF	$V_{CELL}=3.0\text{V}\rightarrow 2.0\text{V}$	2.31	2.40	2.49	V
	MM1309CF		2.26	2.35	2.44	
Discharge resumption voltage	MM1309BF	$V_{CELL}=2.0\text{V}\rightarrow 3.0\text{V}$	2.49	2.65	2.81	V
	MM1309CF		2.44	2.60	2.76	
Excess discharge detection hysteresis voltage	$\Delta V_{CS\text{D}}$	$V_{CELL\text{D}}-V_{CELL\text{S}}$	175	250	325	mV
BATL pin input voltage 1	$I_{BAT\text{L}}$	$V_{CELL}=3.8\text{V}$			± 300	nA
BATL pin input voltage 2	$I_{BAT\text{L}\text{A}}$	$V_{CELL}=4.4\text{V}$	0.7	1.0	1.3	μA
BATM pin input voltage 1	$I_{BAT\text{M}}$	$V_{CELL}=3.8\text{V}$			± 300	nA
BATM pin input voltage 2	$I_{BAT\text{M}\text{A}}$	$V_{CELL}=4.4\text{V}$	0.7	1.0	1.3	μA
DCHG pin source voltage	$I_{SO\text{DCH}}$	$V_{CELL} < V_{CELL\text{S}}$ SW1: A	20			μA
DCHG sink voltage	$I_{SI\text{DCH}}$	$V_{CELL} > V_{CELL\text{S}}$ SW1: A	20			μA
DCHG output voltage L	V_{THDcL}	BATH-DCHG $I_{\text{S}}=20\mu\text{A}$ SW1: B			1.16	V
DCHG output voltage M	V_{THDcH}	DCHG-GND $I_{\text{S}}=-20\mu\text{A}$ SW1: B			0.8	V
OV pin sink current	$I_{\text{SI}\text{OV}}$	$V_{\text{OV}}=0.4$, $T_a=-20\sim 70^{\circ}\text{C}$	200			μA

Application Circuits

