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 (Ta=−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

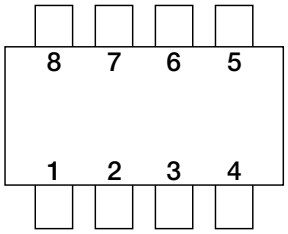
Package

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



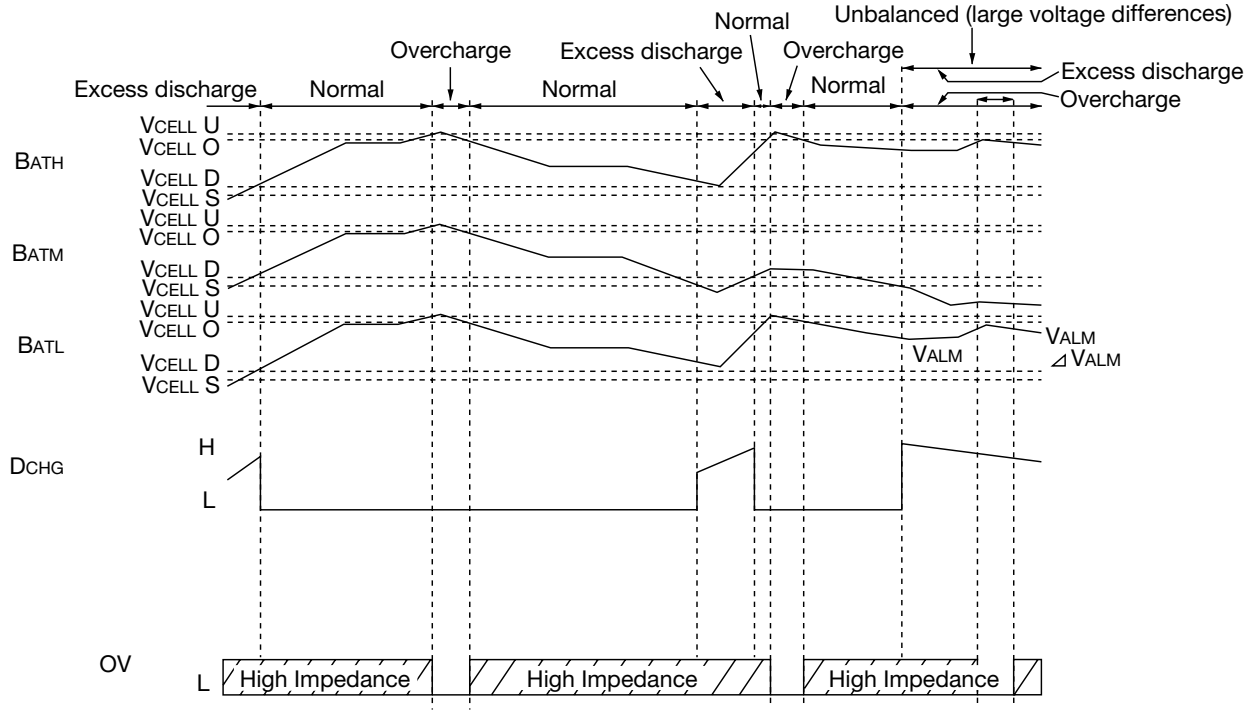
SOP-8C

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

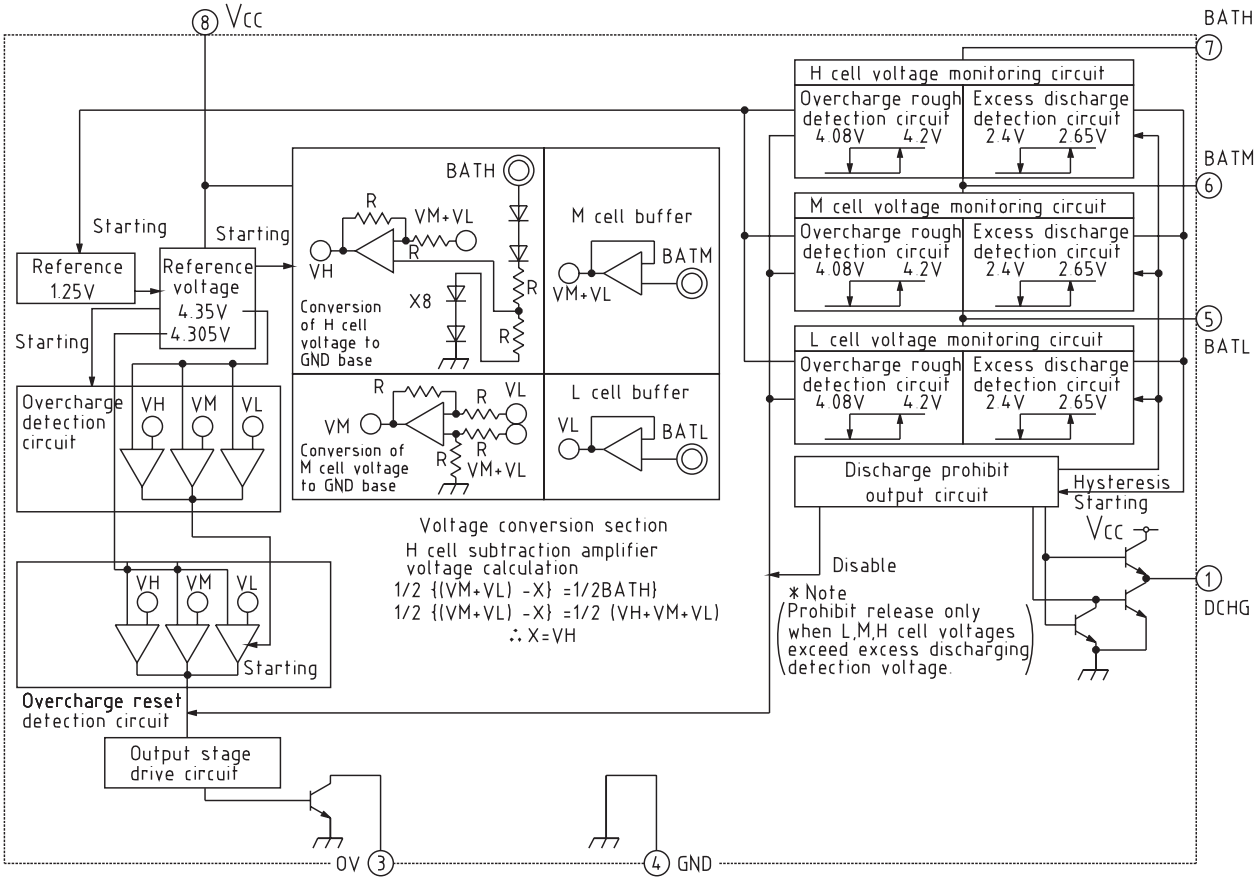
Pin Description

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.

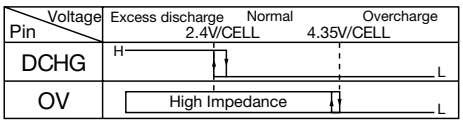
Timing Chart



Block Diagram



Output Pin Conditions



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	Pd	300	mW

Electrical Characteristics (Unless otherwise specified Ta=25°C, V_{IN}=15V, 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}	Ta=–20~70°C	4.30	4.35	4.40	V
	MM1309CF		V_{CELL}=4.0V→4.5V	4.20	4.25	4.30	
Charge prohibit release voltage		V_{CELLO}	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_{CSD}	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	uA
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	uA
DCHG pin source voltage		I_{SODCH}	V_{CELL} < V_{CELLS}	20			uA
DCHG sink voltage		I_{SIDCH}	V_{CELL} > V_{CELLS}	20			uA
DCHG output voltage L		V_{THDCL}	B_{ATH}–D_{CHG} IS=20uA			1.0	V
DCHG output voltage M		V_{THDCH}	D_{CHG}–GND IS=–20uA			0.8	V
OV pin sink current		I_{SIOV}	VOV=0.4, Ta=–20~70°C	200			uA

Application