

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

Package

SOP-8C (MM1309□F)

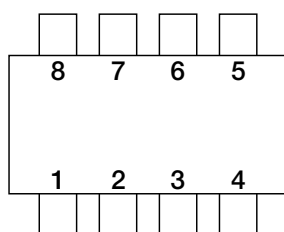
*The box represents the rank resulting from the combination of protection functions.

Applications

1. Notebook PCs
2. Portable terminals
3. Others



Pin Assignment



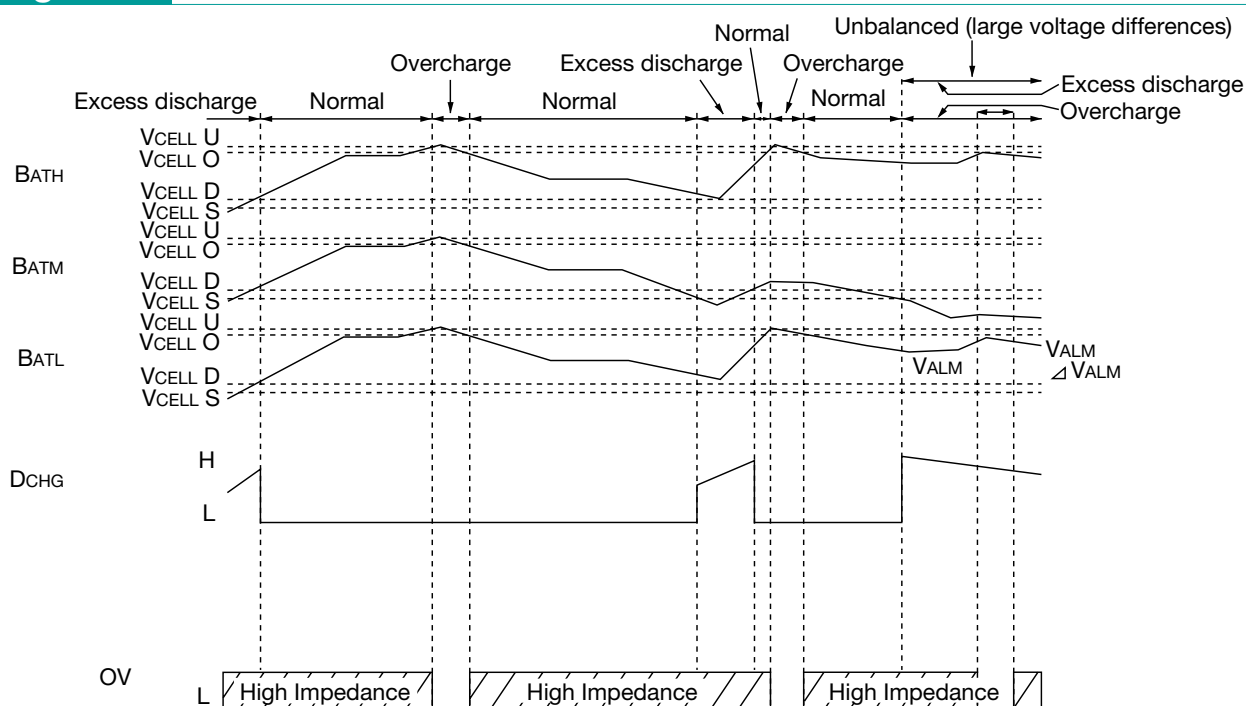
SOP-8C

1	DCHG
2	N. C
3	OV
4	GND
5	BATL
6	BATM
7	BATM
8	V _{CC}

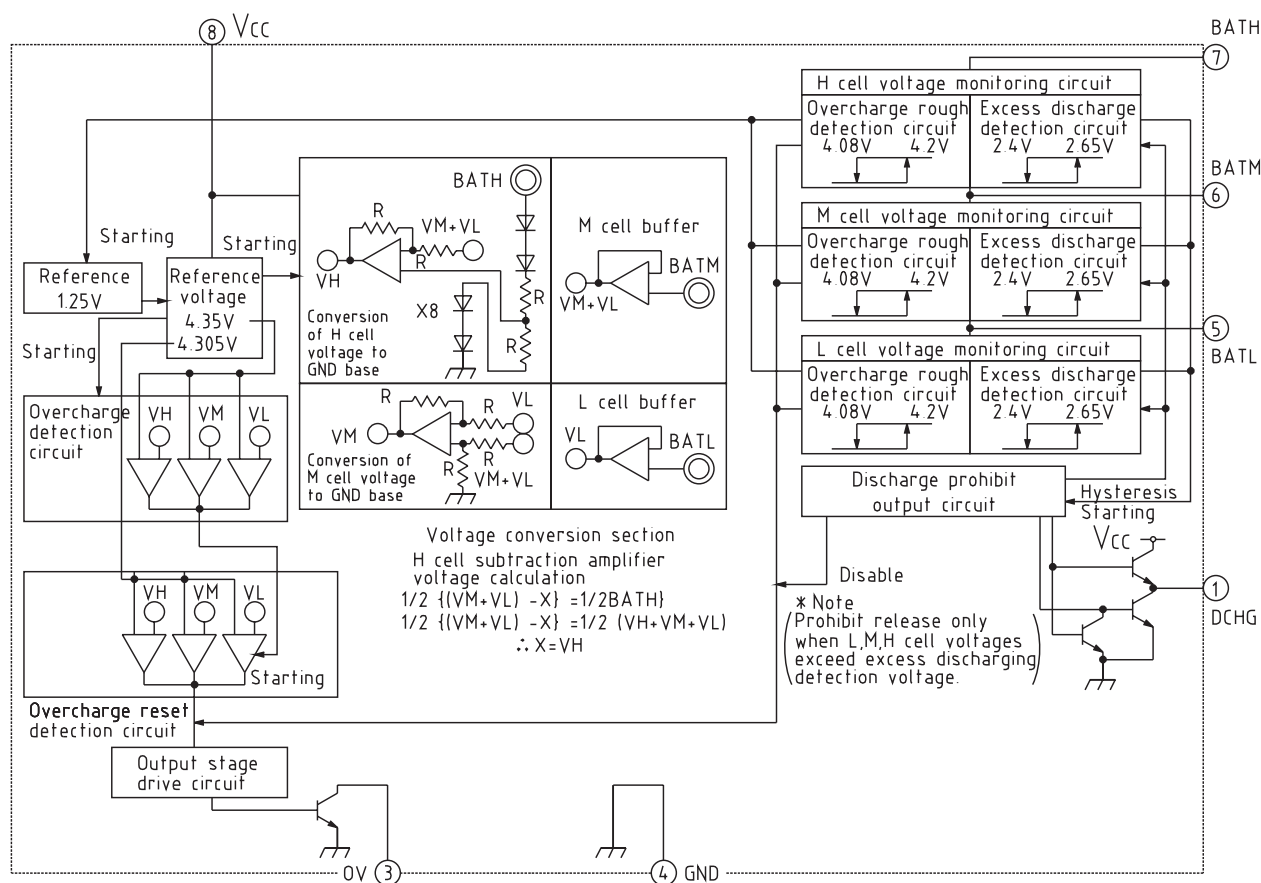
Pin Description

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	V _{CC}		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
OV		High Impedance		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 Ta=25°C, VIN=15V, VCELL=VBATH=VBATM=VBATL)

Item	Symbol	Measurement Conditions	Min	Typ.	Max.	Units
Current consumption (VCC pin) 1	ICC1	VCELL=4.4V		0.7	1.1	mA
Current consumption (VCC pin) 2	ICC2	VCELL=4.2V		300	450	μA
Current consumption (VCC pin) 3	ICC3	VCELL=3.8V		25.0	40.0	μA
Current consumption (VCC pin) 4	ICC4	VCELL=2.3V			0.1	μA
Current consumption (BATH pin) 1	IBATH1	VCELL=4.4V		12.0	20.0	μA
Current consumption (BATH pin) 2	IBATH2	VCELL=3.8V		8.0	12.0	μA
Current consumption (BATH pin) 3	IBATH3	VCELL=2.3V		1.0	2.0	μA
Charge prohibit voltage	MM1309BF	VCELLU Ta=-20~70°C VCELL=4.0V→4.5V	4.30	4.35	4.40	V
	MM1309CF		4.20	4.25	4.30	
Charge prohibit release voltage	VCELLU	VCELL=4.5V→4.0V	VCELLU -60mV	VCELLU -45mV	VCELLU -30mV	V
Charge prohibit detection function operation voltage	MM1309BF	VALM VCELL=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	ΔVALM	VCELL=4.4V→3.8V	50	90	130	mV
Excess discharging detection voltage	MM1309BF	VCELLS VCELL=3.0V→2.0V	2.31	2.40	2.49	V
	MM1309CF		2.26	2.35	2.44	
Discharge resumption voltage	MM1309BF	VCELLD VCELL=2.0V→3.0V	2.49	2.65	2.81	V
	MM1309CF		2.44	2.60	2.76	
Excess discharge detection hysteresis voltage	ΔVCS	VCELLD-VCELLS	175	250	325	mV
BATL pin input voltage 1	IBATL	VCELL=3.8V			±300	nA
BATL pin input voltage 2	IBATLA	VCELL=4.4V	0.7	1.0	1.3	μA
BATM pin input voltage 1	IBATM	VCELL=3.8V			±300	nA
BATM pin input voltage 2	IBATMA	VCELL=4.4V	0.7	1.0	1.3	μA
DCHG pin source voltage	ISO DCH	VCELL < VCELLS	20			μA
DCHG sink voltage	IS DCH	VCELL > VCELLS	20			μA
DCHG output voltage L	VTHDCL	BATH-DCHG IS=20uA			1.0	V
DCHG output voltage M	VTHDCH	DCHG-GND IS=-20uA			0.8	V
OV pin sink current	ISOV	VOV=0.4, Ta=-20~70°C	200			μA

Application

