Protection of Lithium Ion Batteries (four cells in series) Monolithic IC MM1294

Outline

This IC provides protection for lithium ion batteries in the event of overcharging, overdischarging and overcurrents. When anomalies occur during charging or at other times and excessive voltages are applied, after a certain time has elapsed for each cell an external FET switch is turned off (overcharging detection); and in order to prevent overdischarge of the battery during discharge, when the voltage of individual batteries falls below a fixed voltage, an external FET switch is turned off (overdischarge detection), and the IC is put into low-consumption current mode. When large currents flow due to a short-circuit or other cause, an external MOS switch is turned off (overcurrent detection).

4-Cell Protection ICs

Rank I	Overcharge	Overcharge	Overdischarge	Overdischarge	Overcurrent	At overcurrent	Overcurrent	
	detection voltage	hysteresis voltage	detection voltage	resume voltage	detection voltage	detection	release conditions	
А	4.35V±50mV	200mV typ.	2.35V typ.	3.05V typ.	150mV typ.	Pin 3 (DOHG pin) $L \rightarrow H$	Load release 300kΩ or more	
В	4.25V±50mV	Ļ	2.40V typ.	3.10V typ.	Ļ	Ļ	Ļ	
С	Same as rank A	200mV typ.	Same as rank A		Ļ	Ļ	Charging reset	

Features

		170 4 4
1. Current consumption (overcharging)	Vcell > Vcellu	170µА typ.
2. Current consumption (normal operation)	$V_{CELL} < V_{ALM}$	35µA typ.
3. Current consumption (overdischarge)	$V_{CELL} < V_{CELLS}$	0.1µA max.
4. Overcharge detection voltage (-20 to +70°C)	Vcell : L→H	4.25V±50mV/CELL
5. Overcharge hystereis voltage	Vcell : H→L	VCELLU-200mV/CELL typ.
6. Overcharge sensing dead time	C=0.1µF	1.0S typ.
7. Overcharge sensing operation voltage	Vcell : L→ H	4.10V±150mV/CELL
8. Overdischarge detection voltage	Vcell : H→L	2.40V/CELL typ.
9. Overdischarge sensing dead time	C=0.1µF	1.0S typ.
10.Overcurrent detection voltage		0.15V typ.

11.Overcharge and overdischarve voltages as well as the overcurrent detection voltage can be changed upon request.

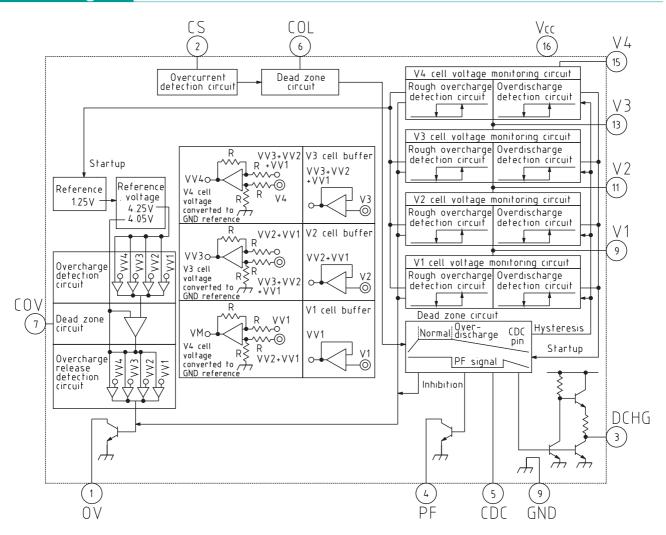
Package

SSOP-16

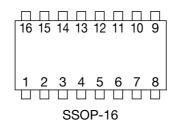
Applications

Lithium ion battery pack for notebook computers

Block Diagram



Pin Assignment



1	OV	9	V1
2	CS	10	
3	DCHG	11	V2
4	PF	12	
5	CDC	13	V3
6	COL	14	
7	COV	15	V4
8	GND	16	Vcc

Pin Description

Pin no.	Pin name	Input/	Function
		output	Orean henry latestica sutaut air
1	OV	Quitout	Overcharge detection output pin NPN transistor open collector output; normally high impedance, goes to L level on
	00	Output	overdischarge
			Overcurrent detection pin
2	2 CS Input		Monitors equivalent load current through source-drain voltage drop of discharge-controlling FET, and at or above the overcurrent detection voltage sets the DCHG pin to "H" and turns off the discharge-controlling FET. Following overcurrent detection, current is passed from this pin, and if the load is decreased, the overcurrent mode is canceled. Through this action there is a temporary consumption current (at the Vcc pin) of approx. 1 mA on resumption of discharge and detection of overdischarge. This function is disabled in overdischarge mode.
			Pin driving the discharge-controlling FET (P-ch)
3	DCHG	Output	Normally "L"; on overdischarge set to "H"
			Output pin for overdischarge detection signals
	PF		Overdischarge detection signal output pin When the overdischarge detector detects overdischarge at the open collector output
4		Output	of the NPN transistor, this pin is turned on. A delay is provided by setting a dead
			time until discharge ends, so that by utilizing a reset or other signal from a CPU or some other controlling device, the equipment can be put into standby mode.
	CDC	.	Pin to set the dead time for overdischarge detection
5	5 CDC Input		By connecting a capacitor between the CDC pin and GND, a dead time can be set.
			Pin to set the dead time for overcurrent detection
6	COL	Turnet	By connecting a capacitor between the COL pin and GND, a dead time can be set.
0		Input	If NC, protection is triggered in a short amount of time; the dead time should be
			set according to the application.
7	COV	Input	Pin to set the dead time for overcharge detection
		_	By connecting a capacitor between the COV pin and GND, a dead time can be set.
8	GND	Input	Ground pin
9	V1	Input	Pin for input of V1 cell high-side voltage and V2 cell low-side voltage
10			N.C
11	V2	Input	Pin for input of V2 cell high-side voltage and V3 cell low-side voltage
12			N.C
13	V3	Input	Pin for input of V3 cell high-side voltage and V4 cell low-side voltage
14			N.C
15	V4	Input	Pin for input of V4 cell high-side voltage
16	Vcc	Input	Power supply input pin
		mput	The same potential as the V4 pin should be input

Absolute Maximun Ratings (Ta=25°C)

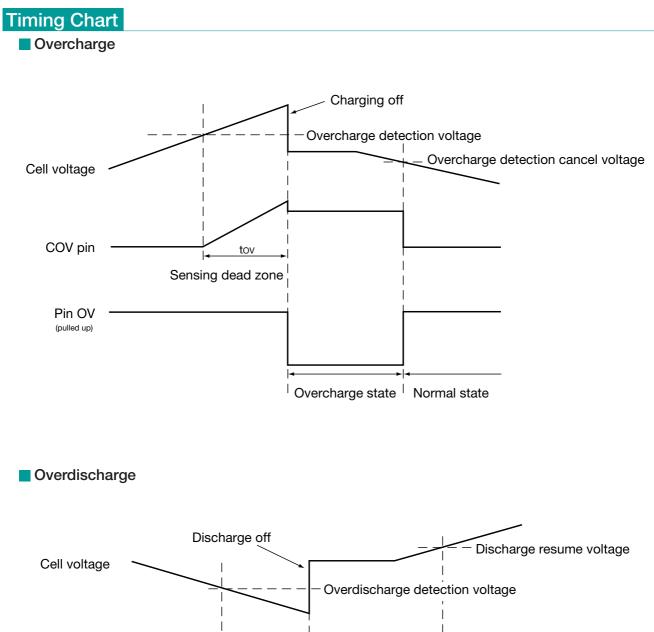
Item	Symbol	Ratings	Units	
Storage temperature	Tstg	-40~+125	°C	
Operating temperature	Topr	-20~+70	°C	
Charge voltage	VV4 max.	24	V	
Power supply voltage	Vcc max.	24	V	
Voltage applied to OV pin	Vov max.	24	V	
Allowable loss	Pd	300	mW	

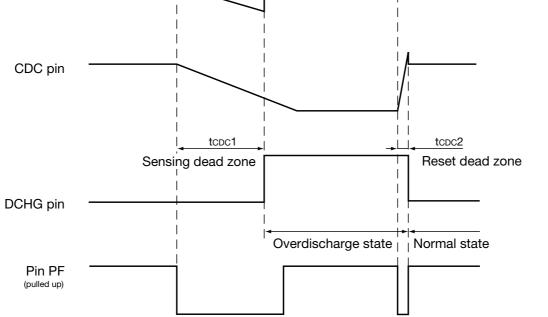
Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating temperature	Topr	-20~+70	°C
Operating voltage	Vopr	+2~+24	V

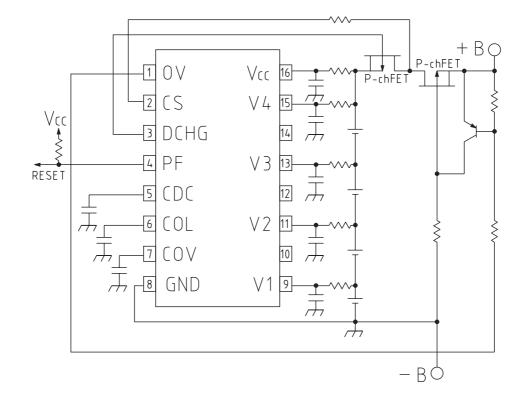
Electrical Characteristics (Except where noted otherwise, Ta=25°C, Vcc=20V, Vcell=V4=V3=V2=V1)

Item	Symbol	Measurement conditions	Min.	Тур.	Max.	Units
Consumption current (Vcc pin) 1	Icc1	VCELL=4.4V		170	340	μA
Consumption current (Vcc pin) 2	Icc2	VCELL=3.5V		35	70	μA
Consumption current (Vcc pin) 3	Icc3	VCELL=2.2V			0.1	μA
Consumption current (V4 pin) 1	IV41	VCELL=4.4V		15	30	μA
Consumption current (V4 pin) 2	IV42	VCELL=3.5V		5	10	μA
Consumption current (V4 pin) 3	IV43	VCELL=2.2V		2	4	μA
V3 pin input current 1	IV3	VCELL=3.5V			±300	nA
V3 pin input current 2	IV ₃ A	VCELL=4.4V	-0.6	-0.3	0	μA
V2 pin input current 1	IV_2	VCELL=3.5V			±300	nA
V2 pin input current 2	IV ₂ A	VCELL=4.4V	-0.6	-0.3	0	μΑ
V1 pin input current 1	IV_1	VCELL=3.5V			±300	nA
V1 pin input current 2	IV1A	VCELL=4.4V	-0.6	-0.3	0	μA
Overcharge detection voltage	VCELLU	Ta=-20~+70°C, Vcell : 3.7V→4.5V	4.20	4.25	4.30	V
Overcharge detection release voltage	Vcell0	Vcell:4.5V→3.7V	VCELLU -260mV	VcellU -200mV	VCELLU -140mV	V
Overcharge sensing dead time	tov	Cov=0.1µF	0.5	1.0	1.5	S
Overcharge sensing operation voltage	VALM	Vcell : 3.5V→4.4V	3.95	4.10	4.25	V
Overdischarge sensing hysteresis voltage	∠ VALM	Vcell : 4.4V→ 3.5V	130	230	330	mV
Overdischarge detection voltage	VCELLS	$V_{CELL}: 3.5V \rightarrow 2.0V$	2.30	2.40	2.50	V
Discharge resume voltage	VCELLD	$V_{CELL}: 2.0V \rightarrow 3.5V$	2.95	3.10	3.25	V
Overdischarge sensing hysteresis voltage	⊿VcsD	VcellD-VcellS	490	700	910	mV
Overdischarge sensing dead time	tcDc1	Ccdc=0.1µF	0.5	1.0	1.5	S
Overdischarge reset dead time	tcdc2	Ccdc=0.1µF, Vcs=Vcc+0.3V		7		mS
Overcurrent detection voltage	Voc	Vcc–Vcs, Dchg	0.135	0.150	0.165	V
Overcurrent sensing dead time	tcol1	Ссог=0.001µF, Dснд	5	10	15	mS
Overcurrent reset dead time	tcol2	Ссог=0.001µF, Dснд	5	10	15	mS
Overcurrent sensing delay time	tcol3	Ccol=0, Dchg		150		μS
Overcurrent reset delay time	tcol4	Ccol=0, Dchg		150		μS
Overcurrent protection release			Open-l	load cor	dition 3	300 kΩ
DCHG pin source current	IsoDcн	VCELL < VCELLS, SW1 : A, VDCHG=VCC-1.8V	20			μA
DCHG pin sync current	IsiDch	VCELL > VCELLS, SW1 : A, VDCHG=0.8V	20			μA
DCHG pin output voltage H	V THDcH	Vcc–Vdchg, Iso=20µA, SW1 : B			1.8	V
DCHG pin output voltage L	V THDcL	VDCHG-GND, ISI=-20µA, SW1 : B			0.8	V
OV pin sync current	IsiOv	Vov=0.4V, Ta=-20~+70°C	0.2			mA
PF pin sync current	IsiPf	V _{PF} =0.4V, Ta=-20~+70°C	10			μA



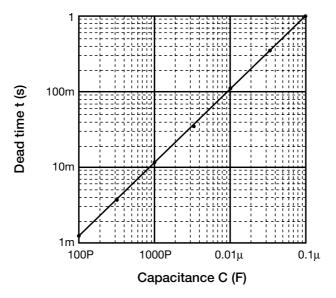


Application circuits



Characteristics

Overcharge, overdischarge sensing dead



Note : The above characteristics are representative and are not guaranteed.