

# Protection for Lithium-Ion Batteries (for double protection) Monolithic IC MM1373

February 17, 1997

## Outline

This IC detects overcharging while charging lithium-ion batteries. It is designed for use with 3 or 4-cell batteries, and detects the battery voltage for each cell. An overcharge detection delay time can be set using an external capacitor. The overcharge detection signal output is NPN open collector and goes low when overcharging is detected. MM1451 is available for 1 to 3 cells. Overcharge detection signal output is PNP output and goes high when overcharging is detected.

## Features

- |   |                 |                     |
|---|-----------------|---------------------|
| 1. Consumption current  | $V_{CEL}=3.8V$  | 2.5 $\mu$ A typ.    |
| 2. Consumption current  | $V_{CEL}=2.3V$  | 0.20 $\mu$ A typ.   |
| 3. Input current between cells                                    | $V_{CEL}=3.8V$  | $\pm 0.3\mu$ A max. |
| 4. Overcharge detection voltage                                   | Type A          | 4.35V $\pm$ 50mV    |
| 5. Overcharge detection delay time                                | $C_T=0.22\mu$ F | 1.5s typ.           |
| 6. Detection voltage can be changed to accommodate customer needs |                 |                     |

## Package

- SOP-8C
- SOP-8E

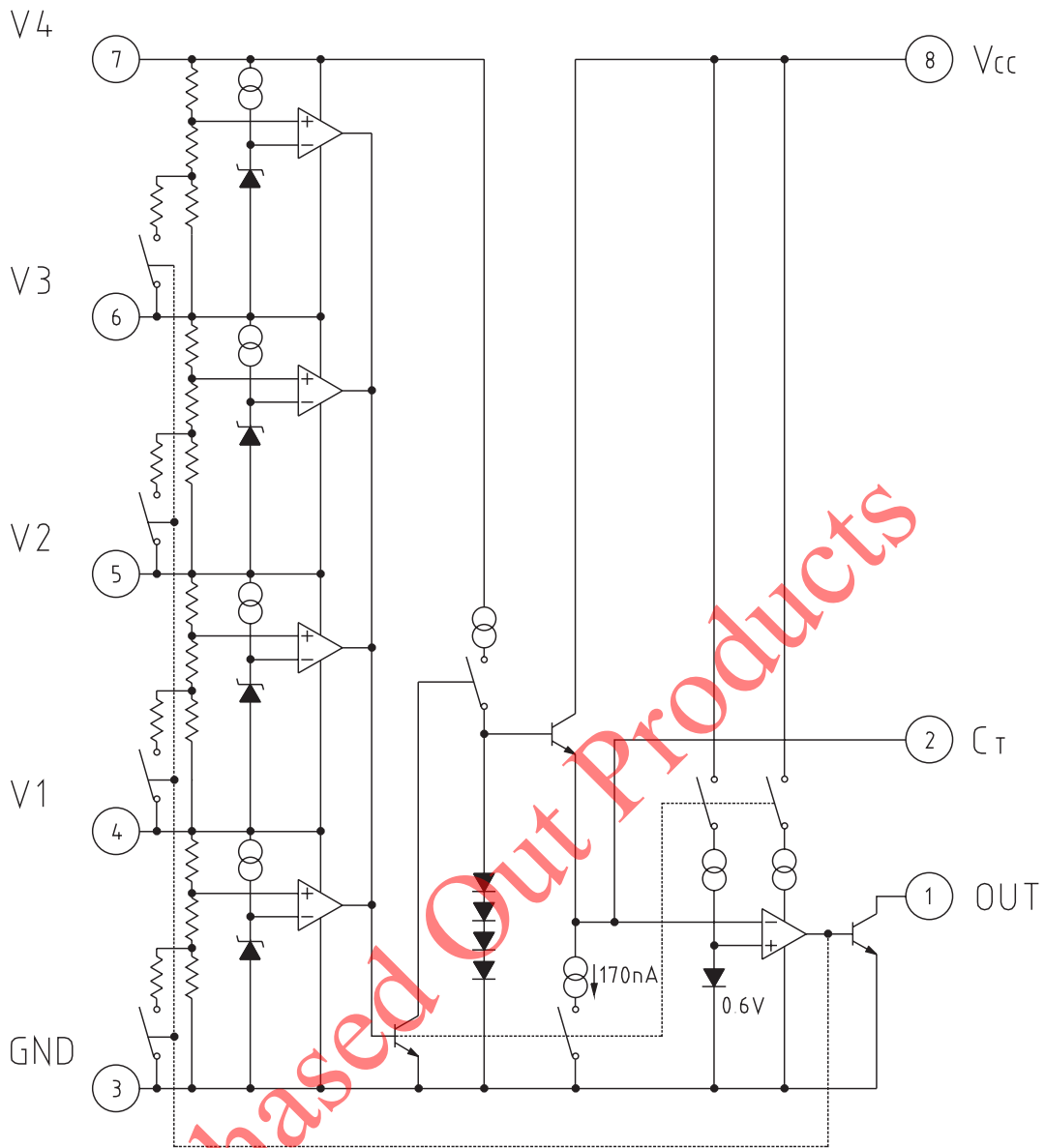
## Applications

For double protection for 3 to 4-cell lithium-ion batteries

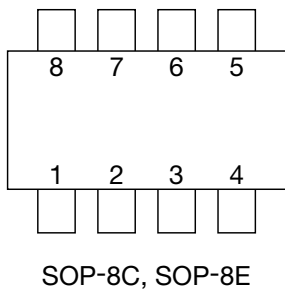
## Overcharge Detection ICs

MM1373	Detection voltage	Hysteresis
Rank A	4.350V	250mV
Rank C	4.225V	None
Rank D	4.130V	None
Rank E	4.450V	100mV

Block Diagram



Pin Assignment



1	OUT
2	C <sub>T</sub>
3	GND
4	V1
5	V2
6	V3
7	V4
8	V <sub>CC</sub>

Pin Description

Pin no.	Pin name	Function	Internal equivalent circuit diagram
1	OUT	Reset output pin	
2	CT	Delay capacitance pin	
3	GND	GND pin	
4	V1	Cell 1 power supply	
5	V2	Cell 2 power supply	
6	V3	Cell 3 power supply	
7	V4	Cell 4 power supply	
8	Vcc		

### Absolute Maximum Ratings

Item	Symbol	Ratings	Units
V <sub>CC</sub> input voltage	V <sub>CC</sub>	-0.3~24	V
V4 input voltage *1	V4		
V3 input voltage *1	V3		
V2 input voltage *1	V2		
V1 input voltage *1	V1		
C <sub>T</sub> pin voltage *2	V <sub>CT</sub>	-0.3~24	V
V <sub>OUT</sub> pin voltage	V <sub>OUT</sub>	-0.3~24	V
Allowable loss	Pd	300	mW
Operating temperature	T <sub>OPR</sub>	-20~+80	°C
Storage temperature	T <sub>STG</sub>	-40~+125	°C

\*1  $V_{CC} \geq V4 \geq V3 \geq V2 \geq V1 \geq -0.3$

\*2: A current no greater than 100µA should be passed through pin Ct.

### Recommended Operating Conditions

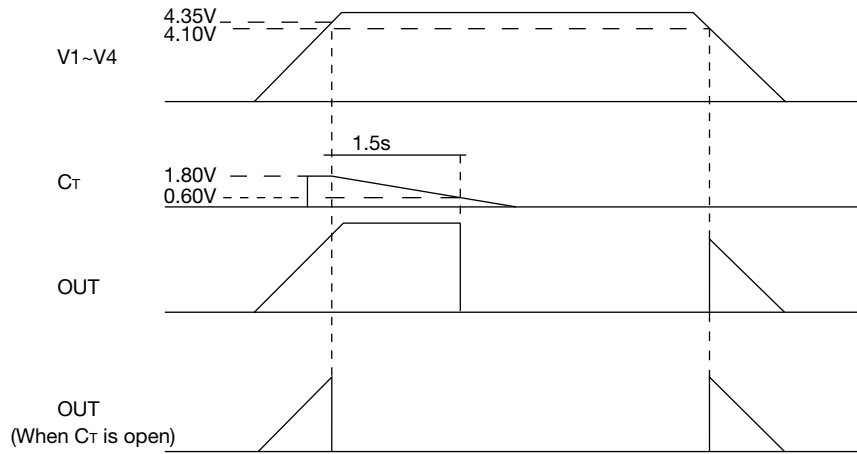
Item	Symbol	Ratings	Units
Input voltage between cells 1	V <sub>op1</sub>	2.0~4.35	V
V <sub>CC</sub> input voltage	V <sub>op2</sub>	4.0~18	V

### Electrical Characteristics

(Except where noted otherwise, Ta=25°C, V<sub>CEL</sub>=V4-V3=V3-V2=V2-V1=V1-GND, V<sub>CC</sub>=4 × V<sub>CEL</sub>) Models listed MM1373AF

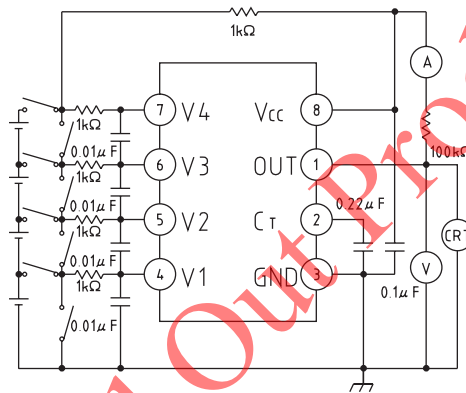
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Consumption current 1	I <sub>1</sub>	V <sub>CEL</sub> =3.8V		2.5	3.5	µA
Consumption current 2	I <sub>2</sub>	V <sub>CEL</sub> =3.8V, V <sub>CC</sub> =V <sub>CEL</sub> × 4		1.5	2.5	µA
Consumption current 3	I <sub>3</sub>	V <sub>CEL</sub> =2.3V		0.20	0.30	µA
Consumption current 4	I <sub>4</sub>	V <sub>CEL</sub> =2.3V, V <sub>CC</sub> =V <sub>CEL</sub> × 4		0.60	0.90	µA
Pin I/O current between cells	I <sub>3</sub>	V <sub>CEL</sub> =3.8V (V4, V3, V2, V1 side)		±0.0	±0.3	µA
Overcharge detection voltage	V <sub>s</sub>	V <sub>CEL</sub> =L→H, Ta=-20~+70°C	4.30	4.35	4.40	V
Hysteresis voltage	HSY	V <sub>CEL</sub> =L→H→L	0.20	0.25	0.30	V
Overcharge detection delay time	T <sub>PLH</sub>	C <sub>T</sub> =0.22µF	1.0	1.5	2.0	s
Output voltage L	V <sub>OL</sub>	I <sub>L</sub> =100µA			0.4	V
Output leakage current	I <sub>LEAK</sub>	V <sub>CEL</sub> =3.8V, V <sub>OUT</sub> =24V			0.1	µA

Timing Chart



Note : When pin Ct is shorted or left open, the output goes low when overcharging is detected.

Application Circuits



Note 1: By shorting each cell, two-, three- and four-cell series can be accommodated. A V4 cell should always be connected. If the V4 cell is shorted, the chip may not function correctly.

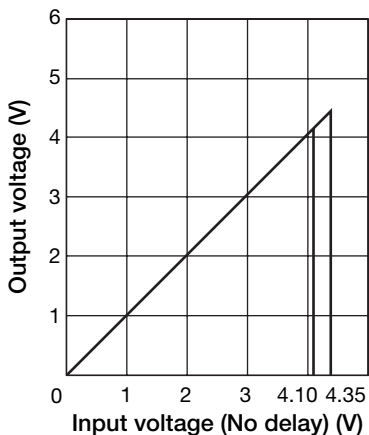
Note 2: The input resistance for each cell should be 1kΩ or lower. Also, please select the appropriate value for the external capacitor according to the usage environment.

Note 3: Connect in the following order when connecting the battery: GND → V4 and VCC → V2 → V1 or V3. However, when turning power on, output may go on momentarily. If there is a problem of mis-output when turning power on, connect the VCC pin last.

(Connecting the VCC pin last does away with mis-output and results in normal operation.)

Characteristics

Detection voltage



Output delay time

