Protection of Lithium Ion Batteries (one cell)
Monolithic IC MM1301

Outline

This IC provides protection for the MM1291 series of compact, high-precision type lithium ion batteries which have been in use for some time. Precision of ±30mV is guaranteed between 0°C and +50°C, and this IC can be used in applications where precision is crucial.

1-Cell Protection ICs

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 detection voltage (mV)	Overcharge detection voltage temperature conditions	Overcharge detection hysteresis voltage (mV)	Overdischarge detection voltage (V)	Overdischarge reset voltage (V)	Overcurrent detection voltage (mV)
	SOP-8D	VSOP-8A						
MM1301		AW	4.270±0.030	C	100±30	2.30±0.10	2.90±0.12	100±12
		BW	4.170±0.030	C	100±30	2.30±0.10	2.90±0.12	100±20
		CW	4.180±0.030	C	90±30	2.30±0.10	2.90±0.12	125±13
		DW	4.280±0.025	C	190±60	2.30±0.10	2.90±0.08	50±10
	EF		4.200±0.030	C	90±30	2.30±0.10	2.90±0.12	125±13
		FW	4.280±0.030	C	100±30	2.30±0.10	2.90±0.12	50±10
		GW	4.180±0.030	C	220±60	2.30±0.10	2.90±0.12	125±10
		HW	4.350±0.030	C	220±60	2.30±0.10	2.90±0.12	50±10
		JW	4.200±0.025	C	200±60	2.30±0.10	2.90±0.12	125±13
		KW	4.200±0.025	C	200±60	2.30±0.10	2.90±0.08	75±10
		LW	4.295±0.025	C	0~5	2.30±0.10	2.90±0.12	150±15
		NW	4.225±0.025	C	0~5	2.30±0.10	2.90±0.12	150±15
		SW	4.200±0.025	C	200±60	2.30±0.10	2.90±0.12	50±10

Features

1 Overcharge detection voltage Ta=0~+50°C V_{CC}±30mV, V_{CEL}±25mV
2 Overcharge detection delay time C_{TD}=0.082μF 1.0S typ.
3 Current consumption (normal operation V_{CC}=3.5V) 10μA typ.
4 Current consumption (overdischarge operation V_{CC}=1.9V) 0.7μA typ.
5 Overcurrent cancel conditions Load removed : Load of 5MΩ or greater across battery pack terminals
6 Overcurrent sensing dead time 10mS typ.

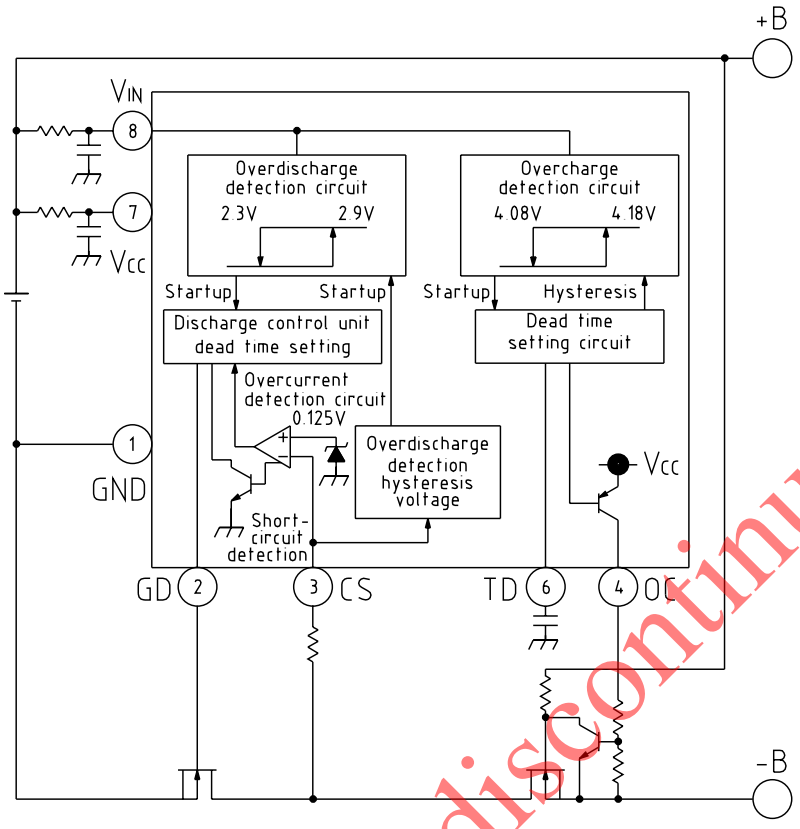
Package

VSOP-8A
SOP-8D

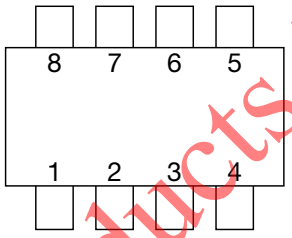
Applications

Lithium ion battery 1-cell protection.

Block Diagram



Pin Assignment



VSOP-8A

1	GND
2	GD
3	CS
4	OC
5	N.C
6	TD
7	VCC
8	VIN

Pin Description

Pin No.	Pin name	Function
1	GND	Negative power supply pin Also serves as voltage detection pin for battery connected between VIN and GND
2	GD	Gate connection pin for discharge-control FET (N-ch) Turns the gate off in overdischarge mode and overcurrent mode. Gate is turned on in overcharge and normal modes.
3	CS	Overcurrent detection input pin Discharge current detected by connection to drain pin of discharge-control FET. Discharge current = (CS-GND voltage) / (FET turn-on resistance)

4	OC	Overcharge detection output pin On overcharge, an external transistor is driven to turn off the charge-control FET (N-ch)
5	N.C	Not connected
6	TD	Overcharge detection dead time setting pin
7	V_{CC}	Positive power supply voltage pin
8	V_{IN}	Voltage detection pin for battery connected between V_{IN} and GND

Notes : Overcharge mode : Battery voltage > overcharge detection voltage
Normal mode : Overdischarge detection voltage < battery voltage < overcharge detection voltage, discharge current < overcurrent detection level
Overdischarge mode : Overdischarge detection voltage > battery voltage
Overcurrent mode : Discharge current > overdischarge detection level=CS-GND voltage > discharge current turn-on resistance (discharge-control FET)

Absolute Maximun Ratings

Item	Symbol	Ratings	Units
Storage temperature	T_{STG}	−40~+125	°C
Operating temperature	T_{OPR}	−20~+70	°C
Power supply voltage	V_{CC} max.	−0.3~+18	V
OC pin voltage CS pin voltage	V_{OC} max. V_{CS} max.	−0.6~V_{CC}	V
Allowable loss	Pd	300	mW

Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating temperature	T_{OPR}	−20~+70	°C
Operating voltage	V_{OP}	+0.9~+18	V

Electrical Characteristics (Except where noted otherwise, Ta=25°C) Models listed MM1301C

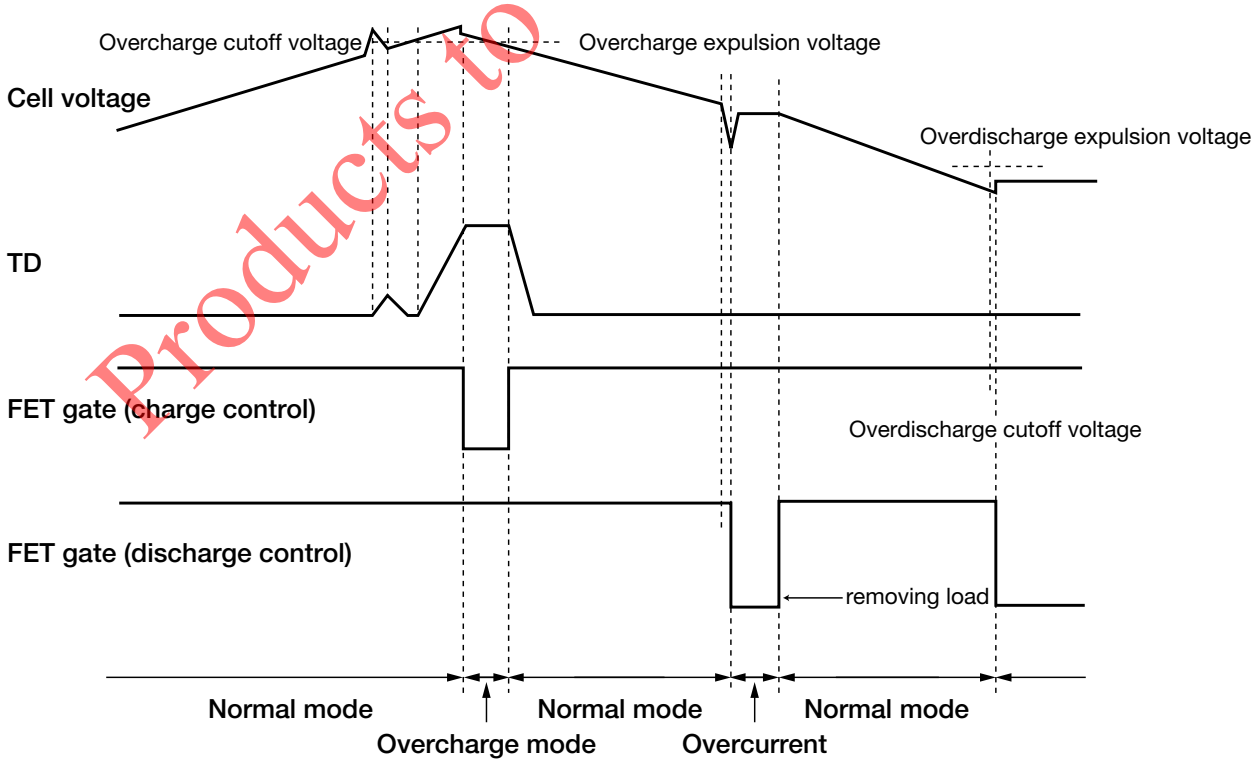
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Overcharge detection voltage	V_{OC}	V_{CC}=V_{IN}=L→H, Ta=0~50°C	4.15	4.18	4.21	V
Overcharge release voltage	V_{OCR}	V_{CC}=V_{IN}=H→L	4.04	4.09	4.14	V
Overcharge sensing hysteresis V_{OCH}=V_{OC}−V_{OCR}	V_{OCH}		60	90	120	mV
Overdischarge detection voltage	V_{ODC}1	V_{CC}=V_{IN}=H→L	2.20	2.30	2.40	V
Overdischarge release voltage	V_{ODR}	V_{CC}=V_{IN}=L→H	2.78	2.90	3.02	V
Overcurrent detection threshold	V_{CS}	V_{CS}=L→H	112	125	138	mV
Overcurrent short-circuit detection	V_{CSS}		0.35	0.45	0.55	V
Overcurrent release conditions		Load open : Load of 5MΩ or greater across battery pack terminals				
Consumption current 1 (Normal mode) (I_{S1}=I_{CC}+I_{IN})	I_{S1}	V_{CC}=V_{IN}=3.5V		10.0	14.0	μA
Consumption current 2 (Overdischarge mode)	I_{S2}	V_{CC}=V_{IN}=1.9V		0.7	1.0	μA

Overcurrent sensing dead time 1	$t_{CS}1$		5.0	10.0	15.0	mS
Overcurrent sensing dead time 2	$t_{CS}2$	*1		30	100	µS
Overdischarge sensing dead time	t_{OD}		5.0	10.0	15.0	mS
Overcharge sensing dead time	t_{OC}	C_{TD}=0.082µF *2	0.5	1.0	1.5	S
OC pin output current	I_{OC}	V_{CC}=V_{IN}=4.5V			–30	µA
GD pin "H" Output voltage (Normal mode)	V_{GDH}	V_{CC}=V_{IN}=3.5V	V_{CC} –0.3	V_{CC} –0.1		V
GD pin "L" Output voltage (Overcurrent mode)	$V_{GDL}1$	V_{CC}=V_{IN}=3.5V V_{CS}=0.5V		0.1	0.3	V
GD pin "L" Output voltage (Overdischarge mode)	$V_{GDL}2$	V_{CC}=V_{IN}=1.5V		0.2	0.4	V

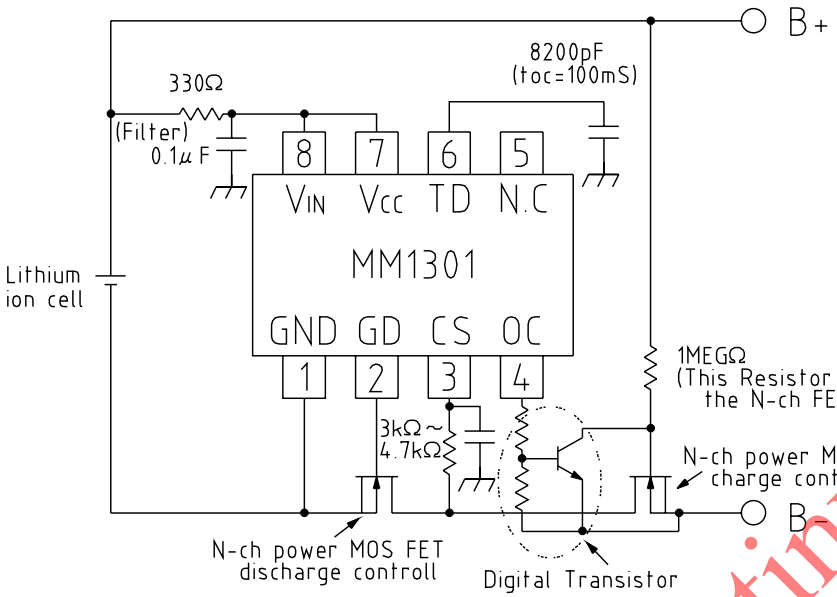
*1: The overcurrent short mode sensing dead time (overcurrent sensing dead time 2) is the response time of the IC itself.
In actual use, the time required for discharge of the gate capacitance of the discharge-controlling FET is added to this.
When excessive currents cause considerable voltage fluctuation, the bias current within the IC may be temporarily turned off, so that the response time is lengthened. The time constant of the capacitance and resistance connected to the power supply pin should be set to at least 100µS/V, to limit power supply fluctuations.

*2: Use the following formula to calculate the overcharge sensing dead time:
overcharge detection dead time t_{OC} = 12.2 C_{TD} [S]
[where C_{TD} is the external capacitance in µF]

Timing Chart



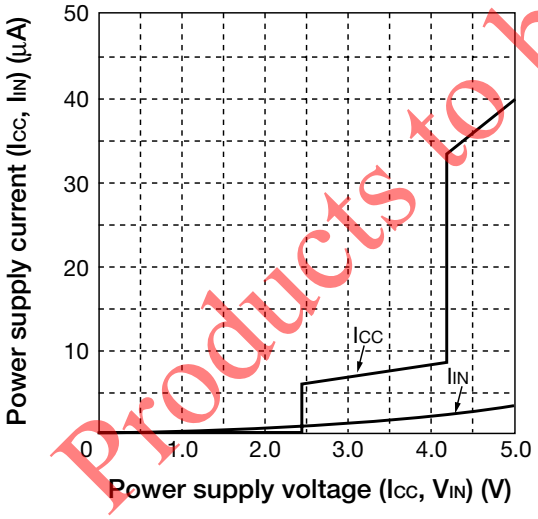
Application circuits



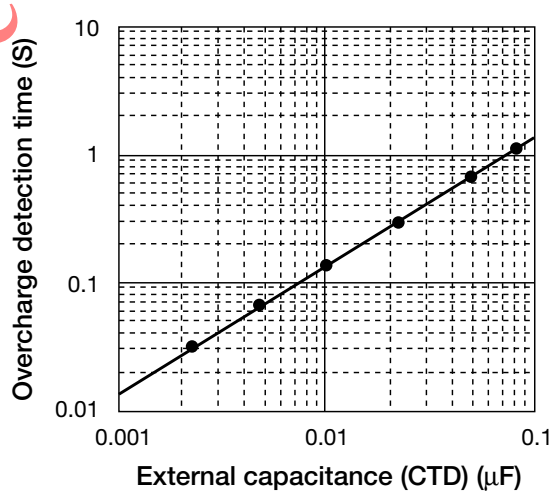
Please select appropriate values for the external resistor and capacitor values according to the usage environment.

Characteristics

■ Power supply current vs power supply voltage



■ Overcharge detection time



Note: The above specifications are representative, and are not guaranteed values.