One-cell li-ion/li-polymer battery protection IC
MM3638 Series

Outline

MM3638 series are protection IC for lithium-ion and lithium-polymer battery. MM3638 protects the battery pack from overcharge, overdischarge, and overcurrent, etc. by controlling FET SW. In the One-cell battery pack, on resistance of the FET SW has been used for overcurrent detection. MM3638 realize overcurrent protection with high accuracy and with no temperature dependence by using a chip resistor.

Features (Unless otherwise specified, Topr=+25°C)

(1) Range and accuracy of detection / release voltage

●Overcharge detection voltage	3.6V to 5.0V, 5mV steps	Accuracy±20mV
		Accuracy±25mV (Topr=–20 to +60°C)
●Overdischarge detection voltage	2.0V to 3.0V, 50mV steps	Accuracy±35mV
●Discharging overcurrent detection voltage	20mV to 65mV, 1mV steps	Accuracy±15%
	65mV to 300mV, 5mV steps	Accuracy±10mV
●Charging overcurrent detection voltage	–65mV to –20mV, 1mV steps	Accuracy±15%
	–300mV to –65mV, 5mV steps	Accuracy±10mV
●Short detection voltage	0.45V/0.6V	Accuracy±150mV
	0.9V	Accuracy±300mV

(2) Release condition from each protection mode

●Overcharge release condition

Charger open release

"VDD < Overcharge release voltage" and "Connecting load (V– > 0.4V)"

Voltage release

When charger is connected (V– < 0.2V) :

"VDD < Overcharge release voltage"

When charger is opened (V– > 0.4V) :

"VDD < Overcharge detection voltage"

●Overdischarge release condition

Charger connected release

"VDD > Overdischarge release voltage" and "Connecting charger (V– < 0.2V)"

Voltage release

When charger is connected (V– < 0.2V) :

"VDD > Overdischarge release voltage"

When charger is opened (V– > 0.4V) :

"VDD > Overdischarge detection voltage"

●Discharging overcurrent release condition "Removing load (V– < 0.2V)"

●Charging overcurrent release condition "Connecting load (V– > 0.4V)"

(3) Range of detection delay time

●Overcharge detection delay time	Selection from 0.25s, 0.5s, 1.0s
●Overdischarge detection delay time	Selection from 20ms, 24ms, 96ms, 125ms
●Discharging overcurrent detection delay time	Selection from 8ms, 12ms, 16ms, 20ms, 48ms
●Charging overcurrent detection delay time	Selection from 8ms, 12ms, 16ms, 20ms, 48ms
●Short detection delay time	Selection from 250μs, 400μs

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(4) 0V battery charge function Selection from "Prohibition" or "Permission"

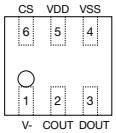
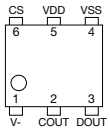
(5) Low current consumption

- ●Normal mode Typ. 3.0μA, Max. 6.0μA
- ●Stand-by mode Max. 0.1μA (For "Charger connection release" the overdischarge release condition.)
  Max. 0.6μA (For "Voltage release" the overdischarge release condition.)

(6) Absolute maximum ratings

- ●VDD pin VSS–0.3V to +12V
- ●COUT pin and V- pin VDD–28V to VDD+0.3V
- ●DOUT pin and CS pin VSS–0.3V to VDD+0.3V
- ●Storage temperature –55°C to +125°C
- ●Operation temperature –40°C to +85°C

Pin Assignment

Top view		Pin No.	Function
SSON-6J	SON-6C		
		1	Input terminal connected to charger negative voltage
		2	Output of overcharge detection (Output type is CMOS)
		3	Output of overdischarge detection (Output type is CMOS)
		4	VSS terminal (Connected to ground)
		5	VDD terminal (Connected to IC substrait)
		6	Input of overcurrent detection

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Selection Guide (SSON-6J ··· 3,000pcs/Reel)(SON-6C ··· 5,000pcs/Reel)

Product name	Package	Detection / Release voltage						0V battery charge function	Delay time combination *1
		Overcharge detection voltage [V]	Overcharge release voltage [V]	Overdischarge detection voltage[V]	Overdischarge release voltage [V]	Discharging overcurrent detection voltage [mV]	Charging overcurrent detection voltage [mV]		
		Vdet1	Vrel1	Vdet2	Vrel2	Vdet3	Vdet4		
MM3638A01RRE	SSON-6J	4.280	4.280	2.400	2.400	25.0	−20.0	Prohibition	1
MM3638A01YRE	SON-6C	4.280	4.280	2.400	2.400	25.0	−20.0	Prohibition	1
MM3638A02RRE	SSON-6J	4.405	4.405	2.400	2.400	32.0	−20.0	Prohibition	1
MM3638A02YRE	SON-6C	4.405	4.405	2.400	2.400	32.0	−20.0	Prohibition	1
MM3638A03RRE	SSON-6J	4.280	4.280	2.400	2.400	32.0	−30.0	Prohibition	1
MM3638B01RRE	SSON-6J	4.275	4.275	2.100	2.100	47.0	−25.0	Prohibition	1
MM3638B01YRE	SON-6C	4.275	4.275	2.100	2.100	47.0	−25.0	Prohibition	1
MM3638B02YRE	SON-6C	4.425	4.425	2.100	2.100	47.0	−25.0	Prohibition	1
MM3638D01YRE	SON-6C	4.225	4.025	2.500	2.500	75.0	−48.0	Prohibition	2
MM3638D02YRE	SON-6C	4.225	4.025	2.500	2.500	75.0	−48.0	Prohibition	2
MM3638D03YRE	SON-6C	4.225	4.025	2.500	2.500	75.0	−60.0	Prohibition	2
MM3638D04YRE	SON-6C	4.275	4.075	2.500	2.500	75.0	−48.0	Prohibition	2
MM3638D05YRE	SON-6C	4.225	4.025	2.500	2.500	50.0	−38.0	Prohibition	2
MM3638D06YRE	SON-6C	4.375	4.175	2.500	2.500	75.0	−60.0	Prohibition	2
MM3638D07YRE	SON-6C	4.325	4.125	2.500	2.500	75.0	−60.0	Prohibition	2
MM3638DA1YRE	SON-6C	4.400	4.200	2.500	2.900	75.0	−60.0	Prohibition	2
MM3638E01RRE	SSON-6J	4.280	4.280	2.400	2.400	80.0	−60.0	Prohibition	1
MM3638E02RRE	SSON-6J	4.280	4.280	2.400	2.400	90.0	−60.0	Prohibition	1
MM3638E04RRE	SSON-6J	4.405	4.405	2.400	2.400	80.0	−50.0	Prohibition	1
MM3638E09YRE	SON-6C	4.280	4.280	2.800	2.800	75.0	−60.0	Prohibition	1
MM3638E12RRE	SSON-6J	4.380	4.380	2.800	2.800	85.0	−50.0	Prohibition	1
MM3638E13RRE	SSON-6J	4.380	4.380	2.800	2.800	85.0	−50.0	Prohibition	4
MM3638E15RRE	SSON-6J	4.280	4.080	2.800	2.800	25.0	−20.0	Prohibition	1
MM3638F01RRE	SSON-6J	4.425	4.425	2.500	2.500	30.0	−30.0	Prohibition	1
MM3638F01YRE	SON-6C	4.425	4.425	2.500	2.500	30.0	−30.0	Prohibition	1
MM3638F03RRE	SSON-6J	4.275	4.275	2.350	2.350	47.0	−25.0	Prohibition	1
MM3638F04RRE	SSON-6J	4.280	4.280	2.400	2.400	32.0	−30.0	Prohibition	1
MM3638F07RRE	SSON-6J	4.405	4.405	2.400	2.400	32.0	−25.0	Prohibition	1
MM3638F09RRE	SSON-6J	4.230	4.230	2.800	2.800	80.0	−60.0	Prohibition	5
MM3638F11RRE	SSON-6J	4.430	4.330	2.400	2.400	32.0	−30.0	Prohibition	6
MM3638F12YRE	SON-6C	4.430	4.230	2.300	2.300	30.0	−30.0	Prohibition	7
MM3638F14RRE	SSON-6J	4.420	4.420	2.300	2.300	24.0	−20.0	Prohibition	1
MM3638F16RRE	SSON-6J	4.370	4.370	2.300	2.300	24.0	−20.0	Prohibition	1
MM3638F17RRE	SSON-6J	4.420	4.320	2.300	2.300	29.0	−27.0	Prohibition	1
MM3638F19YRE	SON-6C	4.425	4.425	2.400	2.400	30.0	−30.0	Prohibition	1
MM3638F20YRE	SON-6C	4.425	4.425	2.400	2.400	30.0	−30.0	Prohibition	3
MM3638F21YRE	SON-6C	4.425	4.425	2.400	2.400	37.0	−23.0	Prohibition	3
MM3638F22RRE	SSON-6J	4.425	4.425	2.800	2.800	30.0	−23.0	Prohibition	3
MM3638F22YRE	SON-6C	4.425	4.425	2.800	2.800	30.0	−23.0	Prohibition	3
MM3638F23RRE	SSON-6J	4.375	4.275	2.300	2.300	29.0	−27.0	Prohibition	1
MM3638FH1RRE	SSON-6J	4.470	4.470	2.465	2.465	40.0	−25.0	Prohibition	3
MM3638G05YRE	SON-6C	4.225	4.025	2.500	2.500	25.0	−23.0	Prohibition	2
MM3638H01YRE	SON-6C	4.280	4.180	2.300	2.500	32.0	−32.0	Permission	3

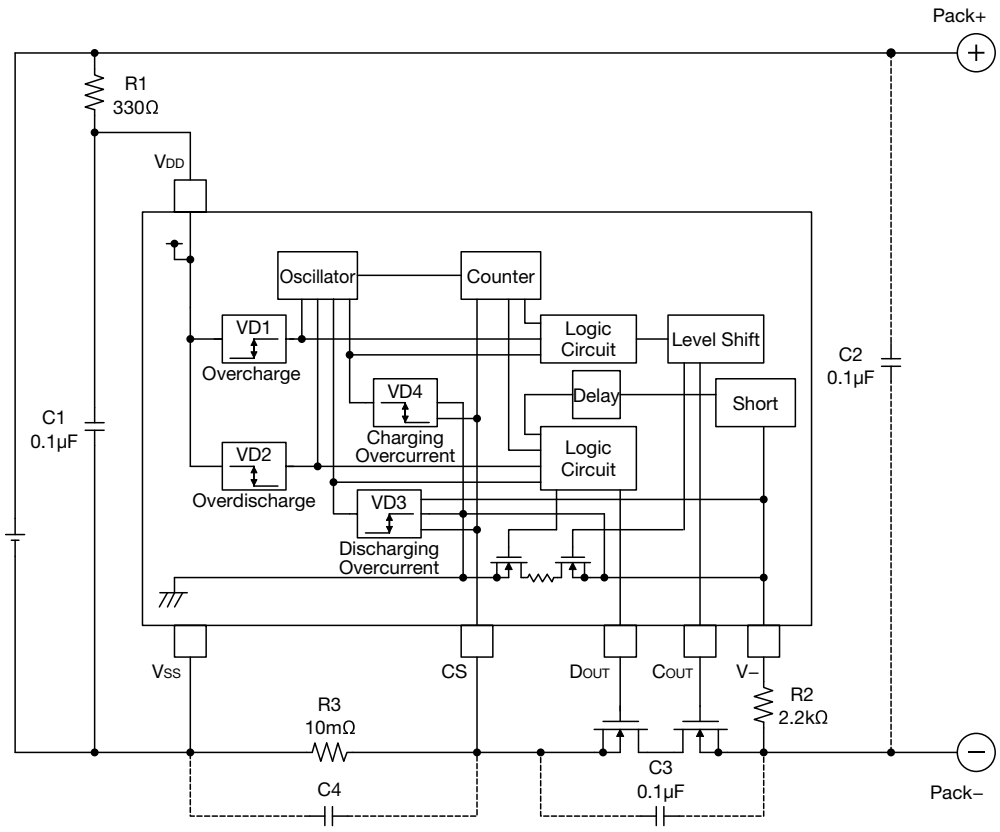
*1 Delay time combination

		1	2	3	4	5	6	7
Overcharge detection delay time	tVdet1	1.0s	1.0s	1.0s	1.0s	1.0s	1.0s	1.0s
Overdischarge detection delay time	tVdet2	125ms	96ms	125ms	125ms	20ms	20ms	20ms
Discharging overcurrent detection delay time	tVdet3	8ms	12ms	16ms	48ms	12ms	8ms	16ms
Charging overcurrent detection delay time	tVdet4	8ms	6ms	8ms	8ms	16ms	8ms	8ms
Short detection delay time	tshort	250µs	400µs	250µs	250µs	250µs	250µs	250µs

Please inquire to us, if you request a rank other than the above.

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Application Circuit



· R1 and C1 stabilize a supply voltage ripple. However, the detection voltage rises by the current of penetration in IC of the voltage detection when R1 is enlarged, and the value of R1 is adjusted to 1kΩ or less. Moreover, adjust the value of C1 to 0.01μF or more to do the stability operation, please.

· R1 and R2 resistors are current limit resistance if a charger is connected reversibly or a high-voltage charger that exceeds the absolute maximum rating is connected. R1 and R2 may cause a power consumption will be over rating of power dissipation, therefore the `R1+R2` should be more than 1kΩ. Moreover, if R2 is too enlarged, the charger connection release cannot be occasionally done after the overdischarge is detected, so adjust the value of R2 to 10kΩ or less, please.

· R3 is resistor to sense the discharge or charging current. R3 is shown by the following expression by discharging current IODCP, discharging overcurrent detection voltage Vdet3, charging current IOCCP, and charging overcurrent detection voltage Vdet4.

IODCP=Vdet3/R3 IOCCP=Vdet4/R3

If R3 is too enlarged, the power loss increases. Moreover, the power might exceed a dissipation of resistance by the overcurrent, please select R3 according to the cell spec, after confirming the characteristic.

· C2, C3 and C4 capacitors have effect that the system stability about voltage ripple or imported noise. After check characteristics, decide that these capacitors should be inserted or not, where should be inserted, and capacitance value, please. Please arrange C4 near the terminal and use a few uF from tens of pF.

Symbol	Part	Min.	Typ.	Max.	Unit
R1	Resistor	100	330	1k	Ω
C1	Capacitor	0.01	0.1	1.0	μF
R2	Resistor	1k	2.2k	10k	Ω
R3	Sense resistor		10		mΩ

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