One-cell Li-ion/Li-polymer battery protection IC

# MM3638 series

## Outline

The MM3638 series are protection IC for Li-ion and Li-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,Ta=25℃)

1) Range and accuracy of detection/release voltage

| | | |
|---|---|---|
| ・Overcharge detection voltage | 3.6V to 5.0V, 5mV steps | Accuracy±20mV |
| ・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 | -20mV to -65mV, 1mV steps | Accuracy±15% |
| | -300mV to -65mV, 5mV steps | Accuracy±10mV |
| ・Short detection voltage | 0.4V / 0.5V / 0.6V | Accuracy±150mV |
| | 0.9V | Accuracy±300mV |

2) 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 | 250us fixed |

3) 0V battery charge function — Selection from "Prohibition" or "Permission"

4) Low current consumption

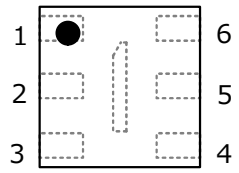
| | |
|---|---|
| ・Normal mode | Typ. 3.0uA, Max. 6.0uA |
| ・Stand-by mode | Max. 0.1uA |

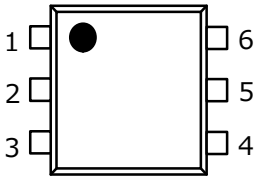
5) Package type

| | |
|---|---|
| ・SSON-6J | 1.40 × 1.40 × 0.55 [mm] |
| ・SON-6C | 1.60 × 2.00 × 0.55 [mm] |


Mitsumi Electric CO.,LTD.
Semiconductor Business Division
Strategy Engineering Department
tel:+81-46-230-3470

## Pin explanations

| SSON-6J | Pin No. | Symbol | Function |
|---|---|---|---|
|   | 1 | V- | Input terminal connected to charger negative voltage |
| | 2 | COUT | Output of overcharge detection. |
| | 3 | DOUT | Output of overdischarge detection. |
| | 4 | VSS | VSS terminal. Connected to ground. |
| | 5 | VDD | VDD terminal. Connected to IC substrate. |
| | 6 | CS | Input terminal for overcurrent detection. |

| SON-6C | Pin No. | Symbol | Function |
|---|---|---|---|
|   | 1 | V- | Input terminal connected to charger negative voltage |
| | 2 | COUT | Output of overcharge detection. |
| | 3 | DOUT | Output of overdischarge detection. |
| | 4 | VSS | VSS terminal. Connected to ground. |
| | 5 | VDD | VDD terminal. Connected to IC substrate. |
| | 6 | CS | Input terminal for overcurrent detection. |

## Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Supply voltage | VDD | -0.3 | 12 | V |
| V- terminal | V- | VDD-28 | VDD+0.3 | V |
| CS terminal | VCS | VSS-0.3 | VDD+0.3 | V |
| COUT terminal | VCOUT | VDD-28 | VDD+0.3 | V |
| DOUT terminal | VDOUT | VSS-0.3 | VDD+0.3 | V |
| Storage temperature | Tstg | -55 | 125 | ℃ |

## Recommended Operating Conditions

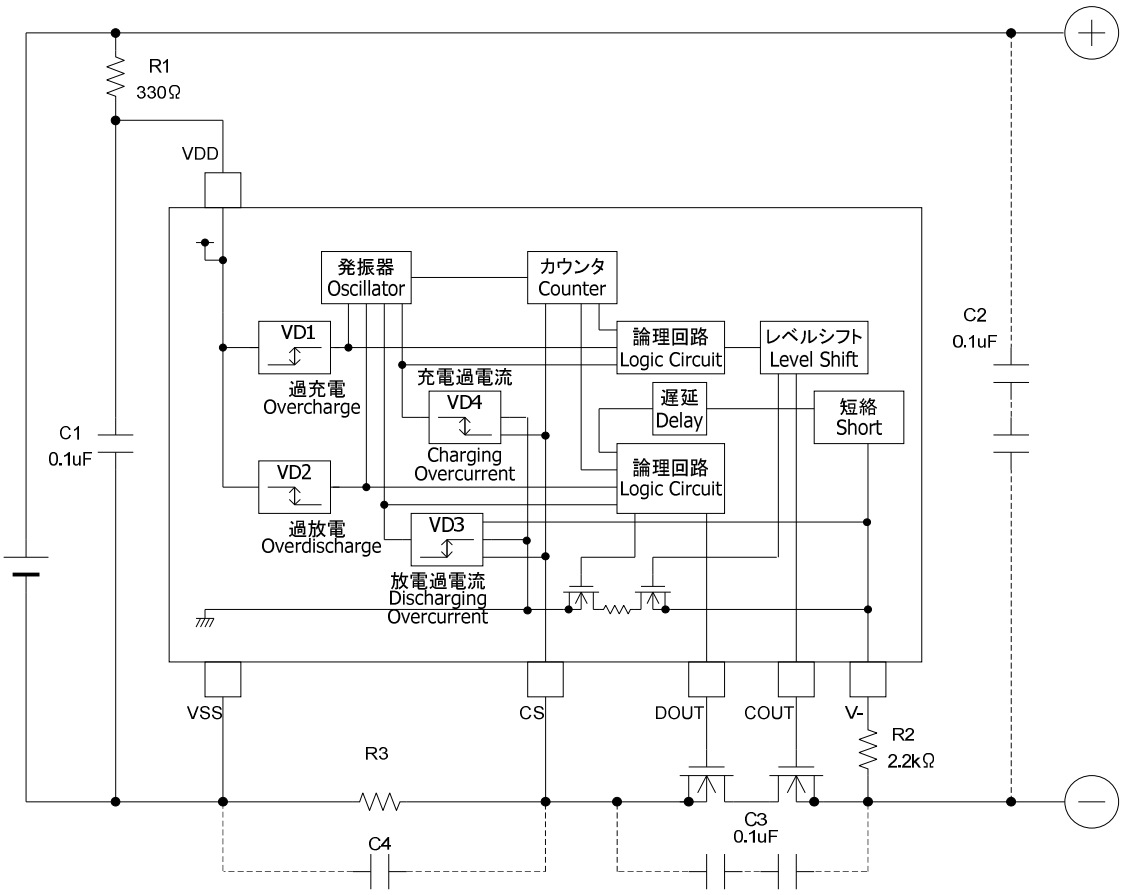
| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Operating ambient temperature | Topr | -40 | 85 | ℃ |
| Operating voltage | Vop | 1.5 | 5.5 | V |

## Electrical characteristics

(Unless otherwise specified,Ta=25℃)

| Parameter | Symbol | Note | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Input/Output voltage** | | | | | | |
| Maximum forbidden voltage for 0V charging | Vst | "Prohibition" function | 0.6 | 0.9 | 1.2 | V |
| Minimum operating voltage for 0V charging | | "Permission" function | - | - | 1.2 | V |
| COUT pin Nch ON voltage | Vol1 | Iol=30uA, VDD=4.5V | - | 0.4 | 0.5 | V |
| COUT pin Pch ON voltage | Voh1 | Ioh=-30uA, VDD=3.9V | 3.4 | 3.7 | - | V |
| DOUT pin Nch ON voltage | Vol2 | Iol=30uA, VDD=2.0V | - | 0.2 | 0.5 | V |
| DOUT pin Pch ON voltage | Voh2 | Ioh=-30uA, VDD=3.9V | 3.4 | 3.7 | - | V |
| **Current consumption** | | | | | | |
| Current consumption | Idd | VDD=3.9V, V-=0V | - | 3.0 | 6.0 | uA |
| Current consumption at stand-by | Is | Vdet2＝Vrel2 | - | - | 0.1 | uA |
| | | Vdet2≠Vrel2 | - | 0.3 | 0.6 | uA |
| **Detection/Release voltage** | | | | | | |
| Overcharge detection voltage | Vdet1 | Ta=+25℃ | Typ-0.020 | Vdet1 | Typ+0.020 | V |
| | | Ta=-20～+60℃ | Typ-0.025 | | Typ+0.025 | |
| Overcharge release voltage | Vrel1 | Vdet1≠Vrel1 | Typ-0.030 | Vrel1 | Typ+0.030 | V |
| Overdischarge detection voltage | Vdet2 | | Typ-0.035 | Vdet2 | Typ+0.035 | V |
| Overdischarge release voltage | Vrel2 | Vdet2≠Vrel2 | Typ-0.100 | Vrel2 | Typ+0.100 | V |
| Discharging overcurrent detection voltage | Vdet3 | +20mV < Vdet3 < +65mV | Typ*0.85 | Vdet3 | Typ*1.15 | V |
| | | +65mV < Vdet3 < +300mV | Typ-0.010 | Vdet3 | Typ+0.010 | V |
| Charging overcurrent detection voltage | Vdet4 | -65mV < Vdet3 < -20mV | Typ*1.15 | Vdet4 | Typ*0.85 | V |
| | | -300mV < Vdet3 < -65mV | Typ-0.010 | Vdet4 | Typ+0.010 | V |
| Short detection voltage | Vshort | Vshort = 0.4V/0.5V/0.6V | Typ-0.150 | Vshort | Typ+0.150 | V |
| | | Vshort = 0.9V | Typ-0.300 | | Typ+0.300 | V |
| **Detection delay time** | | | | | | |
| Overcharge detection delay time | tVdet1 | | Typ*0.8 | tVdet1 | Typ*1.2 | s |
| Overdischarge detection delay time | tVdet2 | | Typ*0.8 | tVdet2 | Typ*1.2 | ms |
| Discharging overcurrent detection delay time | tVdet3 | | Typ*0.8 | tVdet3 | Typ*1.2 | ms |
| Charging overcurrent detection delay time | tVdet4 | | Typ*0.8 | tVdet4 | Typ*1.2 | ms |
| Short detection delay time | tVshort | | 175 | 250 | 350 | us |

## Block diagram / Typical application circuit




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

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 1kohm or less. Moreover, adjust the value of C1 to 0.01uF 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 1kohm. 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 10kohm 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.