1cell Lithium-ion/Lithium-polymer battery protection IC
MM3645 Series

Outline

MM3645 series are protection ICs for Lithium-ion or Lithium-polymer secondary battery using high voltage CMOS process. They protect the battery pack/system from overcharge, overdischarge, and overcurrent, etc. by controlling FET SW.
They realize overcurrent detection with high accuracy and improved temperature dependence by using an external chip resistor. In addition, by using charging off mode, it reduces the off current of system and prevents Lithium-ion battery from discharging when the system is off.

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 300mV, 1mV steps	Accuracy±15%
●Charging overcurrent detection voltage	–20mV to –300mV, 1mV steps	Accuracy±15%
●Short detection voltage	0.45V to 0.9V, 50mV steps	Accuracy±100mV

(2) Release condition from each protection mode

●Overcharge release condition	”VDD < Overcharge release voltage” and ”Connecting load (V– > 0.4V)”
●Overdischarge release condition	”VDD > Overdischarge release voltage” and ”Connecting charger(V– < 0.2V)”
●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	250μs standard

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

(5) Forcible discharge OFF mode — CNT>VDD-0.4 : DOUT=L Discharge=OFF
CNT<VSS-0.4 : DOUT=H Discharge=ON

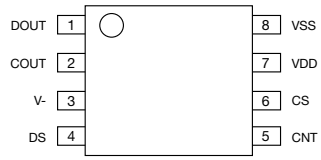
(6) Low current consumption

●Normal mode	Typ. 3.0μA, Max. 5.5μA
●Stand-by mode	Max. 0.1μA

(7) Absolute maximum ratings

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

Pin Assignment

Top view TSOP-8A	Pin No.	Function
	1	Discharge FET control terminal
	2	Charge FET control terminal
	3	Charger negative voltage input terminal
	4	Delay short terminal
	5	Discharge FET mode control terminal
	6	Overcurrent detection input terminal.
	7	Positive power supply voltage input terminal
	8	Negative power supply voltage input terminal

Selection Guide

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]	Short detection voltage [V]		
		Vdet1	Vrel1	Vdet2	Vrel2	Vdet3	Vdet4	Vshort		
MM3645A01VRE	TSOP-8A	4.430	4.330	2.300	2.300	37.0	−25.0	0.9	Permission	1
MM3645A02VRE	TSOP-8A	4.405	4.305	2.500	2.500	37.0	−37.0	0.9	Permission	1
MM3645B01VRE	TSOP-8A	4.430	4.330	2.400	2.400	43.0	−25.0	0.9	Prohibition	1
MM3645B02VRE	TSOP-8A	4.430	4.330	2.400	2.400	43.0	−25.0	0.6	Prohibition	1

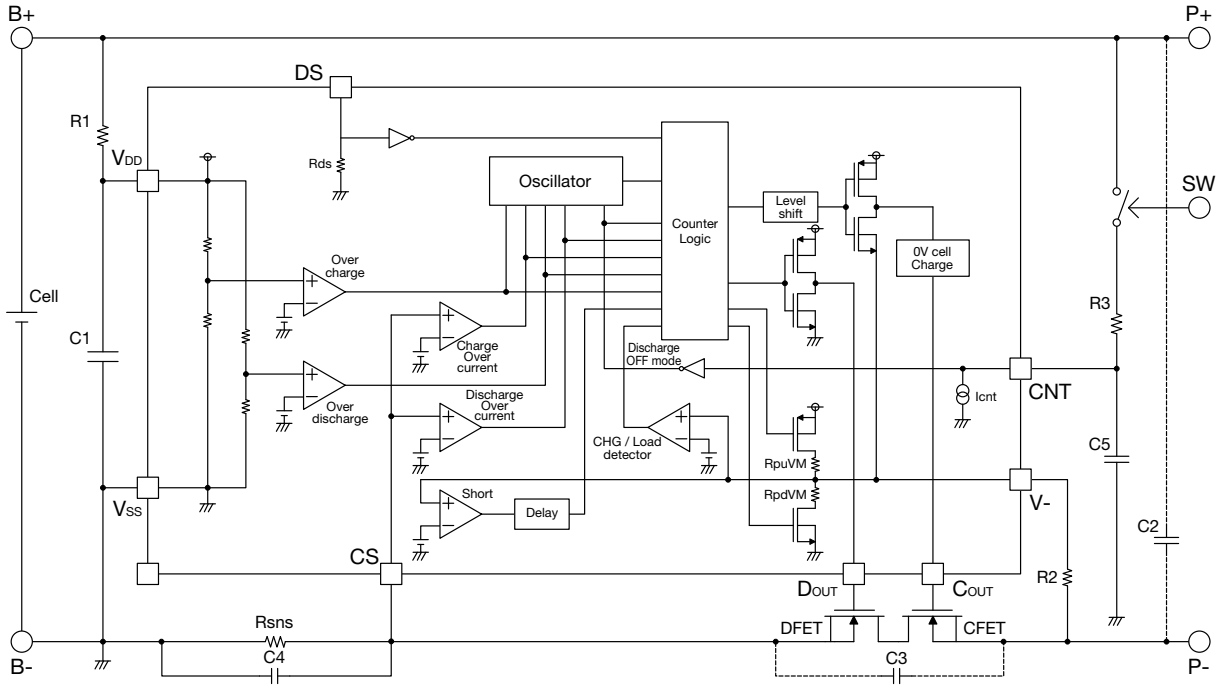
(TSOP-8A ··· 3,000pcs/Reel)

*1 Delay time combination

		1
Overcharge detection delay time	tVdet1	1.0s
Overdischarge detection delay time	tVdet2	125ms
Discharging overcurrent detection delay time	tVdet3	16ms
Charging overcurrent detection delay time	tVdet4	8ms
Short detection delay time	tshort	250µs

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

Application Circuit



· R1 and C1 stabilize a supply voltage fluctuation. However, the detection voltage rises by the current consumption of IC when R1 is too large, 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.

· Rsns is sense resistance for detect charge current and discharge current. 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 battery spec, after confirming the characteristic.

· Current threshold of discharging overcurrent detection and short detection (Idoc, Ishort) are expressed in the following equations.

Idoc = Vdet3 / Rsns

Ishort = Vshort / (Rsns + 2Ron)

*Ron : ON resistance of CFET and DFET

· Current threshold of charging overcurrent detection (Icoc) is expressed in the following equation.

Icoc = Vdet4 / Rsns

· C4 has removed the exogenous noise to CS terminal. Similarly R3 and C5 have removed the exogenous noise to a CNT terminal. Please select required value in consideration of the system characteristic, and arrange near the each terminal.

· C2 and C3 have effect that the system stability about voltage ripple and exogenous noise. Please decide that these capacitors should be inserted or not, where should be inserted, and capacitance value in consideration of the system characteristic.

· In the over discharge mode V- terminal pulled up to VDD by RpuVM. If charger is connected, Iv- flow to Pterminal from P+ and the voltage drop (⊿V) arises in R1. Therefore the cell voltage (Vcell) at overdischarge release is expressed in the following equation.

Vcell = Vrel2 + ⊿V

= Vrel2 + R1 *Iv-

= Vrel2 + R1 *Vchg / (R1 + RpuVM + R2)

* Vchg : Charger voltage

Symbol	Part	Min.	Typ.	Max.	Unit
R1	Resistor		330	1k	Ω
C1	Capacitor	0.01	0.1	1.0	μF
R2	Resistor		2.2k	10k	Ω
Rsns	Sense resistor				mΩ
C2	Capacitor		0.1		μF
R3	Resistor	1k		100k	Ω
C3	Capacitor		0.01		μF
C4 C5	Capacitor		0.1		μF
DFET CFET	Nch MOS FET				