One-cell Li-ion/Li-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,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 +300mV, 1mV steps	Accuracy±15%
・Charging overcurrent detection voltage	-300mV to -20mV, 1mV steps	Accuracy±15%
・Short detection voltage	0.25V to 0.9V, 50mV steps	Accuracy±100mV

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, 65ms, 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 standard

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

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

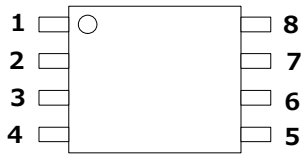
5) Low current consumption

・Normal mode	Typ. 3.0uA, Max. 5.5uA
・Stand-by mode	Max. 0.1uA (For "Charger connection release" the overdischarge release condition.)
	Max. 0.5uA (For "Voltage release" the overdischarge release condition.)

6) Package type

・TSOP-8A	2.00 × 2.30 × 0.75 [mm]

Pin explanations

TSOP-8A	Pin No.	Symbol	Function
	1	DOUT	Discharge FET control terminal
	2	COUT	Charge FET control terminal
	3	V-	Charger negative voltage input terminal
	4	DS	Delay short terminal
	5	CNT	Discharge FET mode control terminal
	6	CS	Overcurrent detection input terminal.
	7	VDD	Positive power supply voltage input terminal
	8	VSS	Negative power supply voltage input terminal

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage	VDD	-0.3	12	V
V- terminal	V-	VDD-28	VDD+0.3	V
CNT terminal	VCNT	VSS-0.3	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

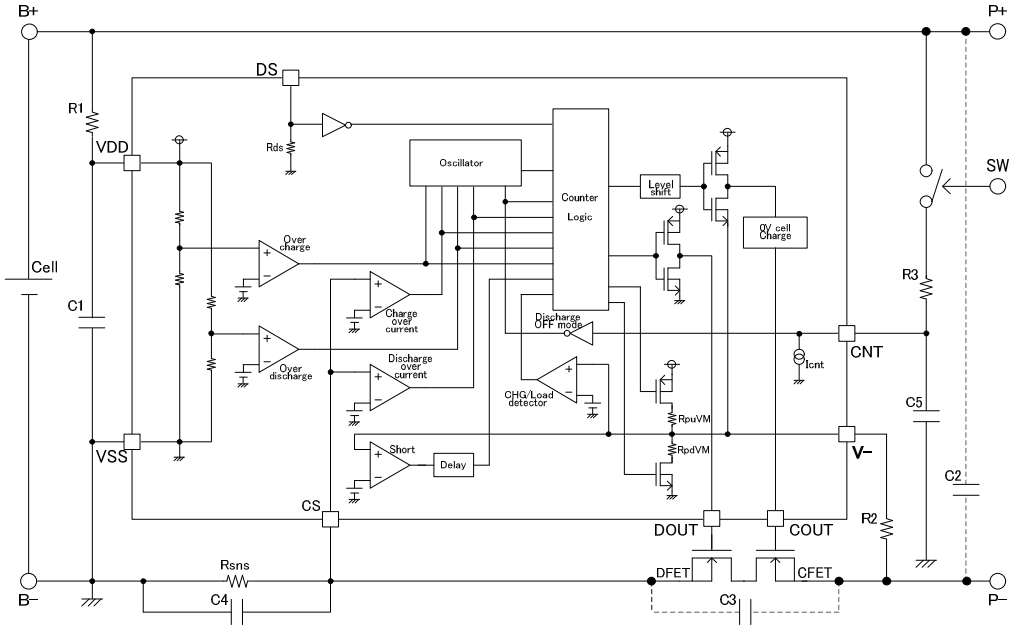
Parameter	Symbol	Min	Max	Unit
Operating ambient temperature	Topr	-40	85	℃
Operating voltage	Vop	1.5	5.5	V

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 L level output voltage	VcoL	ICOUT=30uA, VDD=4.5V	-	0.1	0.5	V
COUT H level output voltage	VcoH	ICOUT=-30uA, VDD=4.0V	VDD-0.5	VDD-0.1	-	V
DOUT L level output voltage	VdoL	IDOUT=30uA, VDD=2.0V	-	0.1	0.5	V
DOUT H level output voltage	VdoH	IDOUT=-30uA, VDD=4.0V	VDD-0.5	VDD-0.1	-	V
Current consumption						
Current consumption	Idd	VDD=4.0V, CS=V-=0V	-	3.0	5.5	uA
Current consumption at stand-by	Is	Vdet2＝Vrel2	-	-	0.1	uA
		Vdet2≠Vrel2	-	0.2	0.5	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-0.065	Vrel2	Typ+0.090	V
Discharging overcurrent detection voltage	Vdet3		Typ*0.85	Vdet3	Typ*1.15	V
Charging overcurrent detection voltage	Vdet4		Typ*1.15	Vdet4	Typ*0.85	V
Short detection voltage	Vshort		Typ-0.100	Vshort	Typ+0.100	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
Discharge OFF modedetection time	tDSGdet		0.80	1.00	1.20	s

Block diagram / Typical application circuit



Symbol	Part	Min.	Typ.	Max.	Unit
R1	Resistor	-	330	1k	Ω
C1	Capacitor	0.01	0.1	1.0	uF
R2	Resistor	-	2.2k	10k	Ω
Rsns	Sense resistor	5	-	-	mΩ
C2/C4/C5	Capacitor	-	0.1	-	uF
R3	Resistor	1k	-	100k	Ω
C3	Capacitor	-	0.01	-	uF

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.