MM3511 series

OUTLINE

The MM3511 series are protection IC using high voltage CMOS process for overcharge, overdischarge and overcurrent protection of the rechargeable Lithium-ion or Lithium-polymer battery. The overcharge, overdischarge, discharging overcurrent, charging overcurrent, and short protection of the rechargeable one-cell Lithium-ion or Lithium-polymer battery can be detected. Each of these IC composed of four voltage detectors, short detection circuit, reference voltage sources, oscillator, counter circuit and logical circuits.

FEATURES

（Unless otherwise specified, Topr=+25℃）

1) Range and accuracy of detection/release voltage

・ Overcharge detection voltage	3.6V to 5.0V, 5mV steps	Accuracy±20mV
		Accuracy±25mV（Topr=-5 to +60℃）
・ Overcharge release voltage	3.6V to 4.5V, 50mV steps	Accuracy±30mV
・ Overdischarge detection voltage	2.0V to 3.0V, 50mV steps	Accuracy±35mV
・ Overdischarge release voltage	2.0V to 3.5V, 50mV steps	Accuracy±100mV
・ Discharging overcurrent detection voltage	+50mV to +300mV, 5mV steps	Accuracy±10mV
・ Charging overcurrent detection voltage	-50mV to -300mV, 5mV steps	Accuracy±20mV
・ Short detection voltage	0.5V fixed (Unless otherwise specified)	Accuracy±100mV

2) Range of detection delay time

・ Overcharge detection delay time	Selection from 143ms, 573ms, 1.2s
・ Overdischarge detection delay time	Selection from 38ms, 150ms, 300ms
・ Discharging overcurrent detection delay time	Selection from 4.5ms, 9ms, 18ms
・ Charging overcurrent detection delay time	Selection from 4.5ms, 9ms, 18ms
・ Short detection delay time	Selection from 300us, 400us

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

5) Low current consumption

・ Normal mode	Typ. 3.0uA, Max. 5.5uA
・ Stand-by mode	Max. 0.1uA

6) Absolute maximum ratings

・ VDD pin	VSS-0.3V to 12V
・ COUT pin and V- pin	VDD-28V to VDD+0.3V
・ DOUT pin	VSS-0.3V to VDD+0.3V
・ Storage temperature	-55 to +125℃
・ Operation temperature	-40 to +85℃

7) Package type

・ SSON-6A	1.80 × 2.00 × 0.75 [mm]
・ SSON-6J	1.40 × 1.40 × 0.55 [mm]
・ SON-6C	1.60 × 2.00 × 0.55 [mm]

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, Topr=+25℃

Parameter	Symbol	Conditions	Min.	Typ.	Max.	unit
INPUT/OUTPUT VOLTAGE						
Operating input voltage	VDD1	VDD-VSS	1.5	-	5.5	V
Maximum forbidden voltage for 0V charging ※1	Vst	"Prohibition" function	0.6	0.9	1.2	V
Minimum operating voltage for 0V charging ※1		"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	5.5	uA
Current consumption at stand-by	Is		-	-	0.1	uA
DETECTION/RELEASE VOLTAGE						
Overcharge detection voltage	Vdet1	Ta=+25℃	Typ-0.020	Vdet1	Typ+0.020	V
		Ta=-5～+60℃	Typ-0.025		Typ+0.025	
Overcharge release voltage ※2	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 ※3	Vrel2	Vdet2≠Vrel2	Typ-0.10	Vrel2	Typ+0.100	V
Discharging overcurrent detection voltage ※4	Vdet3		Typ-0.010	Vdet3	Typ+0.010	V
Charging overcurrent detection voltage	Vdet4		Typ-0.020	Vdet4	Typ+0.020	V
Short detection voltage ※4	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			tVdet2		ms
Discharging overcurrent detection delay time	tVdet3			tVdet3		ms
Charging overcurrent detection delay time	tVdet4			tVdet4		ms
Short detection delay time	tshort			tshort		us

※1 0V battery charge function is selected from "Prohibition" or "Permission".

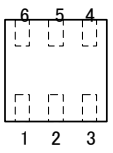
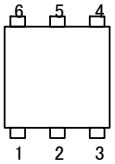
※2 There is occasion as follows of two kinds of release condition from the overcharge status.

a) In the case that the V- pin voltage is lower than the discharging overcurrent detection voltage (Vdet4), MM3511 releases the overcharge status when the battery voltage falls below the overcharge release voltage (Vrel1).

b) In the case that the V- pin voltage is higher than or equal to the discharging overcurrent detection voltage (Vdet4), MM3511 releases the overcharge status when the battery voltage falls below the overcharge detection voltage (Vdet1).This is a hysteresis cancellation function.

※3 The release condition from the overdischarge status is that the charger is connected and the V- pin voltage is lower than the discharging overcurrent detection voltage (Vdet3), and the battery voltage rise more then the overdischarge release voltage(Vrel2).

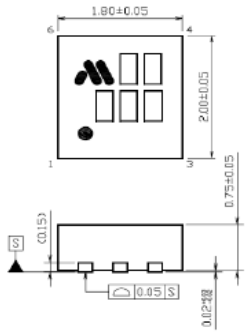
PIN EXPLANATIONS

Top view SSON-6A SSON-6J	Top view SON-6C	Pin No.	Symbol	Function
		1	DS	Delay shorten terminal.
		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	V-	Input terminal connected to charger negative voltage.

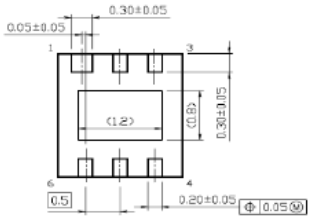
PACKAGE DIMENSIONS

SSON-6A

表面（Top View）

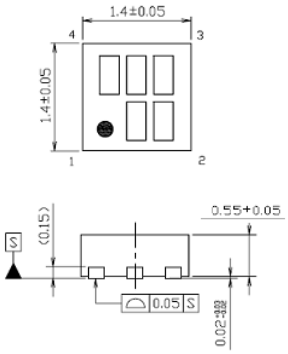


裏面（Bottom View）

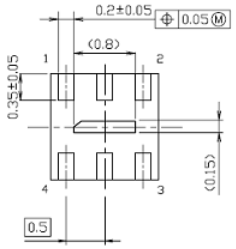


SSON-6J

表面（Top View）

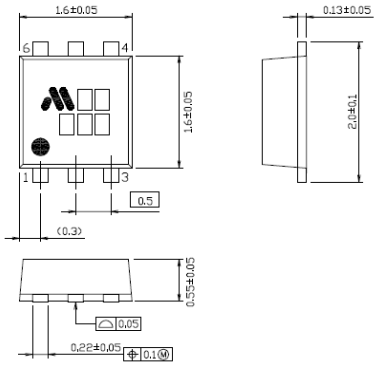


裏面（Bottom View）

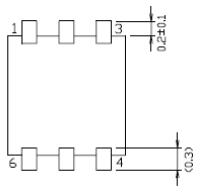


SON-6C

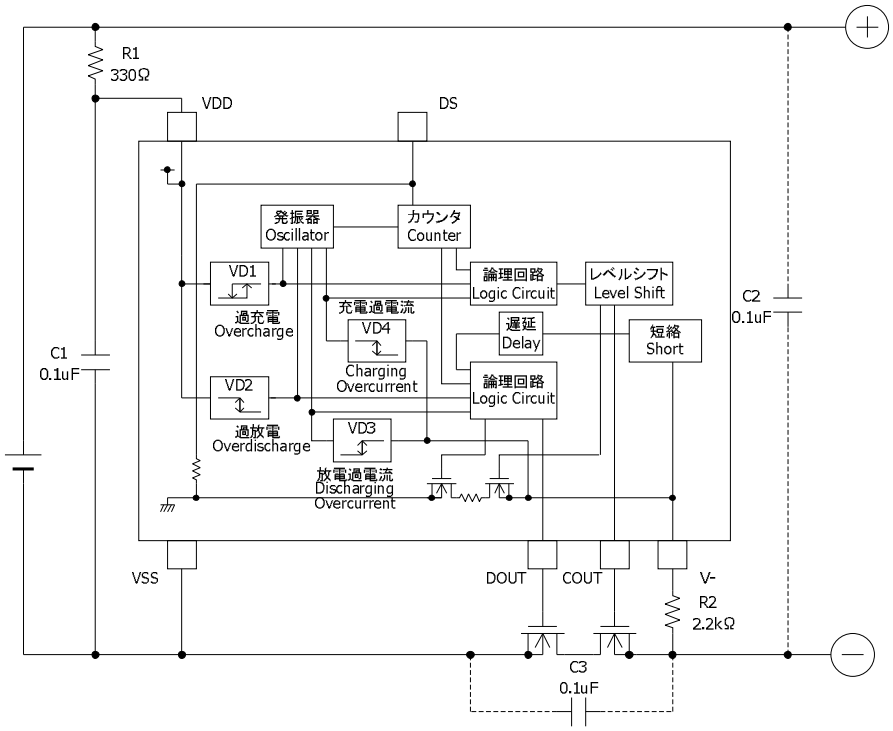
表面（Top View）



裏面（Bottom View）



BLOCK DIAGRAM / TYPICAL 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 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.

C2 and C3 capacitors have effect that the system stability about voltage ripple or extraneous noise. After check characteristics, decide that these capacitors should be inserted or not, where should be inserted, and capacitance value, please.

PRODUCT LINEUP

Status of current IC	Product name	Package	0V battery charge function	Detection / Release voltage [V]						Detections delay time combination ※	Release function		
				Overcharge detection voltage	Overcharge release voltage	Overdischarge detection voltage	Overdischarge release voltage	Discharging overcurrent detection voltage	Charging overcurrent detection voltage		Overcharge release	Overdischarge release	Overcurrent release voltage
				Vdet1	Vrel1	Vdet2	Vrel2	Vdet3	Vdet4				
MP	MM3511A16Y	SON6C	Permission	4.275	4.175	2.300	2.400	0.100	-0.100	1	Auto	Latch	Vdet3
ES	MM3511A26Y	SON6C	Permission	4.280	4.080	2.300	2.300	0.080	-0.100	1	Auto	Latch	Vdet3
ES	MM3511A36Y	SON6C	Permission	4.280	4.080	2.300	2.300	0.100	-0.100	1	Auto	Latch	Vdet3
MP	MM3511A46Y	SON6C	Permission	4.275	4.075	2.300	2.300	0.150	-0.100	1	Auto	Latch	Vdet3
MP	MM3511A56Y	SON6C	Permission	4.280	4.280	2.800	2.800	0.050	-0.100	1	Auto	Latch	Vdet3
MP	MM3511A66Y	SON6C	Permission	4.280	4.280	3.000	3.000	0.075	-0.100	1	Auto	Latch	Vdet3
MP	MM3511A76Y	SON6C	Permission	4.275	4.175	2.300	2.400	0.050	-0.100	1	Auto	Latch	Vdet3
MP	MM3511A86Y	SON6C	Permission	4.300	4.100	2.300	2.300	0.130	-0.100	1	Auto	Latch	Vdet3
ES	MM3511AA6Y	SON6C	Permission	4.225	4.025	2.800	2.800	0.150	-0.100	9	Auto	Latch	Vdet3
MP	MM3511AB6Y	SON6C	Permission	4.225	4.025	3.000	3.000	0.060	-0.060	9	Auto	Latch	Vdet3
ES	MM3511B16Y	SON6C	Permission	3.900	3.800	2.300	2.400	0.100	-0.100	1	Auto	Latch	Vdet3
ES	MM3511B26Y	SON6C	Permission	3.950	3.850	2.300	2.400	0.100	-0.100	1	Auto	Latch	Vdet3
ES	MM3511B36Y	SON6C	Permission	4.000	3.900	2.300	2.400	0.100	-0.100	1	Auto	Latch	Vdet3
ES	MM3511B46Y	SON6C	Permission	4.050	3.950	2.300	2.400	0.100	-0.100	1	Auto	Latch	Vdet3
ES	MM3511B56Y	SON6C	Permission	4.100	4.000	2.300	2.400	0.100	-0.100	1	Auto	Latch	Vdet3
MP	MM3511C16Y	SON6C	Prohibition	4.280	4.080	2.300	2.300	0.100	-0.100	1	Auto	Latch	Vdet3
MP	MM3511C26Y	SON6C	Prohibition	4.280	4.080	2.300	2.300	0.130	-0.100	1	Auto	Latch	Vdet3
ES	MM3511C36Y	SON6C	Prohibition	4.280	4.130	2.600	3.100	0.150	-0.100	1	Auto	Latch	Vdet3
MP	MM3511C46Y	SON6C	Prohibition	4.280	4.130	2.800	3.100	0.150	-0.100	1	Auto	Latch	Vdet3
ES	MM3511C56Y	SON6C	Prohibition	4.200	4.100	2.800	2.900	0.150	-0.100	1	Auto	Latch	Vdet3
MP	MM3511C66Y	SON6C	Prohibition	4.280	4.130	2.800	3.100	0.100	-0.100	1	Auto	Latch	Vdet3
ES	MM3511C76Y	SON6C	Prohibition	4.280	4.130	2.800	3.100	0.050	-0.100	1	Auto	Latch	Vdet3
MP	MM3511C96Y	SON6C	Prohibition	4.280	4.130	2.800	2.800	0.150	-0.100	1	Auto	Latch	Vdet3
ES	MM3511CA6Y	SON6C	Prohibition	4.225	4.025	2.300	2.300	0.150	-0.120	1	Auto	Latch	Vdet3
MP	MM3511CC6Y	SON6C	Prohibition	4.280	4.130	2.800	3.100	0.150	-0.100	1	Auto	Auto	Vdet3
MP	MM3511E16Y	SON6C	Permission	4.325	4.075	2.500	2.900	0.150	-0.100	2	Auto	Latch	Vdet3
MP	MM3511G16Y	SON6C	Permission	4.350	4.150	2.300	3.000	0.200	-0.100	3	Auto	Latch	Vdet3
MP	MM3511H16Y	SON6C	Permission	4.280	4.180	2.300	2.300	0.120	-0.100	4	Auto	Latch	Vdet3
MP	MM3511H26Y	SON6C	Permission	4.275	4.075	2.800	3.100	0.100	-0.100	4	Auto	Latch	Vdet3
MP	MM3511H46Y	SON6C	Permission	4.275	4.175	2.400	2.400	0.120	-0.100	4	Auto	Latch	Vdet3
ES	MM3511H56Y	SON6C	Permission	4.280	4.180	2.300	2.300	0.090	-0.075	4	Auto	Latch	Vdet3
ES	MM3511K16Y	SON6C	Permission	4.275	4.275	2.300	2.300	0.100	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K26R	SSON6J	Permission	4.275	4.075	2.300	2.300	0.120	-0.100	5	Auto	Latch	Vdet3
MP	MM3511K26Y	SON6C	Permission	4.275	4.075	2.300	2.300	0.120	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K36R	SSON6A	Permission	4.275	4.075	2.300	2.300	0.130	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K36R	SSON6J	Permission	4.275	4.075	2.300	2.300	0.130	-0.100	5	Auto	Latch	Vdet3
MP	MM3511K36Y	SON6C	Permission	4.275	4.075	2.300	2.300	0.130	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K46R	SSON6J	Permission	4.275	4.075	2.300	2.300	0.150	-0.100	5	Auto	Latch	Vdet3
MP	MM3511K46Y	SON6C	Permission	4.275	4.075	2.300	2.300	0.150	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K56Y	SON6C	Permission	4.275	4.275	2.300	2.300	0.050	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K66R	SSON6J	Permission	4.270	4.070	2.300	2.300	0.100	-0.100	5	Auto	Latch	Vdet3
ES	MM3511K66Y	SON6C	Permission	4.270	4.070	2.300	2.300	0.100	-0.100	5	Auto	Latch	Vdet3
MP	MM3511K76Y	SON6C	Permission	4.275	4.075	2.300	2.300	0.130	-0.130	5	Auto	Latch	Vdet3
ES	MM3511K86R	SSON6J	Permission	4.275	4.075	2.600	2.600	0.110	-0.085	5	Auto	Latch	Vdet3
MP	MM3511K86Y	SON6C	Permission	4.275	4.075	2.600	2.600	0.110	-0.085	5	Auto	Latch	Vdet3
ES	MM3511K96Y	SON6C	Permission	4.275	4.075	2.600	2.600	0.190	-0.085	5	Auto	Latch	Vdet3

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

Status of current IC	Product name	Package	0V battery charge function	Detection / Release voltage [V]						Detections delay time combination ※	Release function		
				Overcharge detection voltage	Overcharge release voltage	Overdischarge detection voltage	Overdischarge release voltage	Discharging overcurrent detection voltage	Charging overcurrent detection voltage		Overcharge release	Overdischarge release	Overcurrent release voltage
				Vdet1	Vrel1	Vdet2	Vrel2	Vdet3	Vdet4				
ES	MM3511L16R	SSON6J	Permission	4.275	4.075	2.600	2.600	0.100	-0.085	5	Auto	Latch	Vdet3
MP	MM3511L16Y	SON6C	Permission	4.275	4.075	2.600	2.600	0.100	-0.085	5	Auto	Latch	Vdet3
ES	MM3511L36R	SSON6J	Permission	4.275	4.075	2.600	2.600	0.180	-0.120	5	Auto	Latch	Vdet3
MP	MM3511L36Y	SON6C	Permission	4.275	4.075	2.600	2.600	0.180	-0.120	5	Auto	Latch	Vdet3
MP	MM3511L56Y	SON6C	Permission	4.350	4.150	2.300	2.300	0.130	-0.100	5	Auto	Latch	Vdet3
MP	MM3511L66Y	SON6C	Permission	4.275	4.075	2.600	2.600	0.150	-0.100	5	Auto	Latch	Vdet3
ES	MM3511L76Y	SON6C	Permission	4.275	4.275	2.300	2.300	0.125	-0.100	5	Latch	Latch	Vdet3
MP	MM3511L86Y	SON6C	Prohibition	4.275	4.075	2.600	2.600	0.100	-0.080	5	Auto	Latch	Vdet3
MP	MM3511L96Y	SON6C	Prohibition	4.275	4.275	2.600	2.600	0.100	-0.080	5	Latch	Latch	Vdet3
MP	MM3511LA6Y	SON6C	Prohibition	4.375	4.375	3.000	3.000	0.150	-0.150	5	Latch	Latch	Vdet3
MP	MM3511M16RR	SSON6A	Prohibition	4.275	4.275	2.500	2.500	0.160	-0.100	1	Latch	Latch	Vdet3
MP	MM3511M16RL	SSON6A	Prohibition	4.275	4.275	2.500	2.500	0.160	-0.100	1	Latch	Latch	Vdet3
MP	MM3511M16YR	SON6C	Prohibition	4.275	4.275	2.500	2.500	0.160	-0.100	1	Latch	Latch	Vdet3
MP	MM3511M16YL	SON6C	Prohibition	4.275	4.275	2.500	2.500	0.160	-0.100	1	Latch	Latch	Vdet3
ES	MM3511N16Y	SON6C	Prohibition	4.280	4.080	2.400	2.400	0.050	-0.100	11	Auto	Latch	Vdet3
ES	MM3511P16Y	SON6C	Prohibition	4.225	4.125	2.000	2.000	0.200	-0.100	7	Auto	Latch	Vdet3
ES	MM3511W16Y※	SON6C	Permission	4.225	4.025	2.500	2.900	0.150	-0.150	8	Auto	Auto	Vdet3
MP	MM3511W26Y※	SON6C	Permission	4.375	4.175	2.400	2.800	0.145	-0.145	6	Auto	Auto	Vdet3
MP	MM3511WA6Y	SON6C	Prohibition	4.390	4.190	2.500	2.500	0.130	-0.125	10	Auto	Latch	Vdet3
MP	MM3511WB6Y	SON6C	Prohibition	4.390	4.190	2.500	2.500	0.200	-0.125	10	Auto	Latch	Vdet3

※ In these rank, the short detection voltage (Vshort) is 0.9V.

※ Detection delay time combination

		1	2	3	4	5	6	7	8	9	10	11
Overcharge detection delay time	tVdet1	1.2s	1.2s	143ms	1.2s	1.2s	1.0s	573ms	1.0s	1.2s	1.0s	1.2s
Overdischarge detection delay time	tVdet2	150ms	150ms	38ms	150ms	38ms	20ms	150ms	96ms	75ms	64ms	150ms
Discharging overcurrent detection delay time	tVdet3	9ms	9ms	18ms	18ms	9ms	12ms	4.5ms	12ms	9ms	8ms	4.5ms
Charging overcurrent detection delay time	tVdet4	9ms	9ms	9ms	9ms	9ms	16ms	4.5ms	6ms	9ms	8ms	9ms
Short detection delay time	tshort	300us	400us	300us	300us	300us	300us	300us	400us	300us	250us	300us

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