



**THE DATASHEET OF  
MM3220H06NRH**



2cell Li-ion/Li-polymer battery protection IC

## MM3220 Series

### Description

The MM3220 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, short, charging, and overcurrent(optional) 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

- Accuracy and selectable range of detection/release voltage

	Range	Accuracy	
Overcharge detection voltage	4.0V to 4.5V	±20mV	Ta= 25degC
		±25mV	Ta= -5 to 60degC
Overcharge release voltage	3.9V to 4.5V	±30mV	Ta= 25degC
Overdischarge detection voltage	2.0V to 3.0V	±35mV	Ta= 25degC
Overdischarge release voltage	2.0V to 3.5V	±100mV	Ta= 25degC
Discharging overcurrent detection voltage 1	+50mV to +300mV	±10mV	Ta= 25degC
Discharging overcurrent detection voltage 2 ※1	+50mV to +700mV	±20%	Ta= 25degC
Charging overcurrent detection voltage ※1	-50mV to -300mV	±20mV	Ta= 25degC
Short detection voltage	0.9V fixed	±100mV	Ta= 25degC
		±300mV ※2	Ta= 25degC

- Current consumption

Normal mode	Typ. 4.0uA, Max. 8.0uA
Stand-by mode	Max. 0.1uA

### Applications

- Lithium-ion rechargeable battery pack
- Lithium polymer rechargeable battery pack

### Package type

- SOT-26A 2.90 × 2.80 × 1.15 [mm]

※1 Optional function

※2 When the discharging overcurrent detection voltage 2 function having

**Absolute maximum ratings**

Parameter	Symbol	Rating	Unit
Supply voltage	VDD	VSS-0.3 to 12	V
COUT terminal	VCOUT	VDD-28 to VDD+0.3	V
DOUT terminal	VDOUT	-0.3 to VDD+0.3	V
Operating ambient temperature	Topr	-40 to +85	degC
Storage temperature	Tstg	-55 to +125	degC

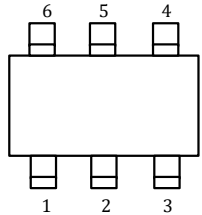
**Electrical characteristics**

Unless otherwise specified, Topr=+25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	unit
<b>INPUT/OUTPUT VOLTAGE</b>						
Operating input voltage	VDD1	VDD-VSS	1.5	-	12.0	V
Minimum operating voltage for 0V charging	Vst	VDD-V-	-	-	1.2	V
COUT pin Nch ON voltage	Vol1	Iol=30uA, VDD=9.0V	-	0.4	0.5	V
COUT pin Pch ON voltage	Voh1	Ioh=-30uA, VDD=7.0V	6.5	6.8	-	V
DOUT pin Nch ON voltage	Vol2	Iol=30uA, VDD=3.8V	-	0.2	0.5	V
DOUT pin Pch ON voltage	Voh2	Ioh=-30uA, VDD=7.0V	6.5	6.8	-	V
<b>CURRENT CONSUMPTION</b>						
Current consumption	IDD	Vcell=3.5V, V-=0V	-	4.0	8.0	uA
Current consumption at stand-by	IS	Vcell=1.9V, V-=3.8V	-	-	0.1	uA
DOUT pin Pch ON voltage	IBL	Vcell=3.5V, V-=0V	-300	-	300	nA
<b>DETECTION/RELEASE VOLTAGE</b>						
Overcharge detection voltage	Vdet1	Ta=+25°C	Typ-0.020	Vdet1	Typ+0.020	V
		Ta=-5~+60°C	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-0.10	Vrel2	Typ+0.100	V
Discharging overcurrent detection voltage 1	Vdet3-1		Typ-0.010	Vdet3-1	Typ+0.010	V
Discharging overcurrent detection voltage 2 ※1	Vdet3-2		Typ-20%	Vdet3-2	Typ+20%	V
Charging overcurrent detection voltage ※1	Vdet4		Typ-0.020	Vdet4	Typ+0.020	V
Short detection voltage	Vshort		0.8	0.9	1.0	V
<b>DETECTION DELAY TIME</b>						
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 1	tVdet3-1			tVdet3-1		ms
Discharging overcurrent detection delay time 2 ※1	tVdet3-2			tVdet3-2		ms
Charging overcurrent detection delay time ※1	tVdet4			tVdet4		ms
Short detection delay time	tshort		280	400	560	us

※1 Optional function

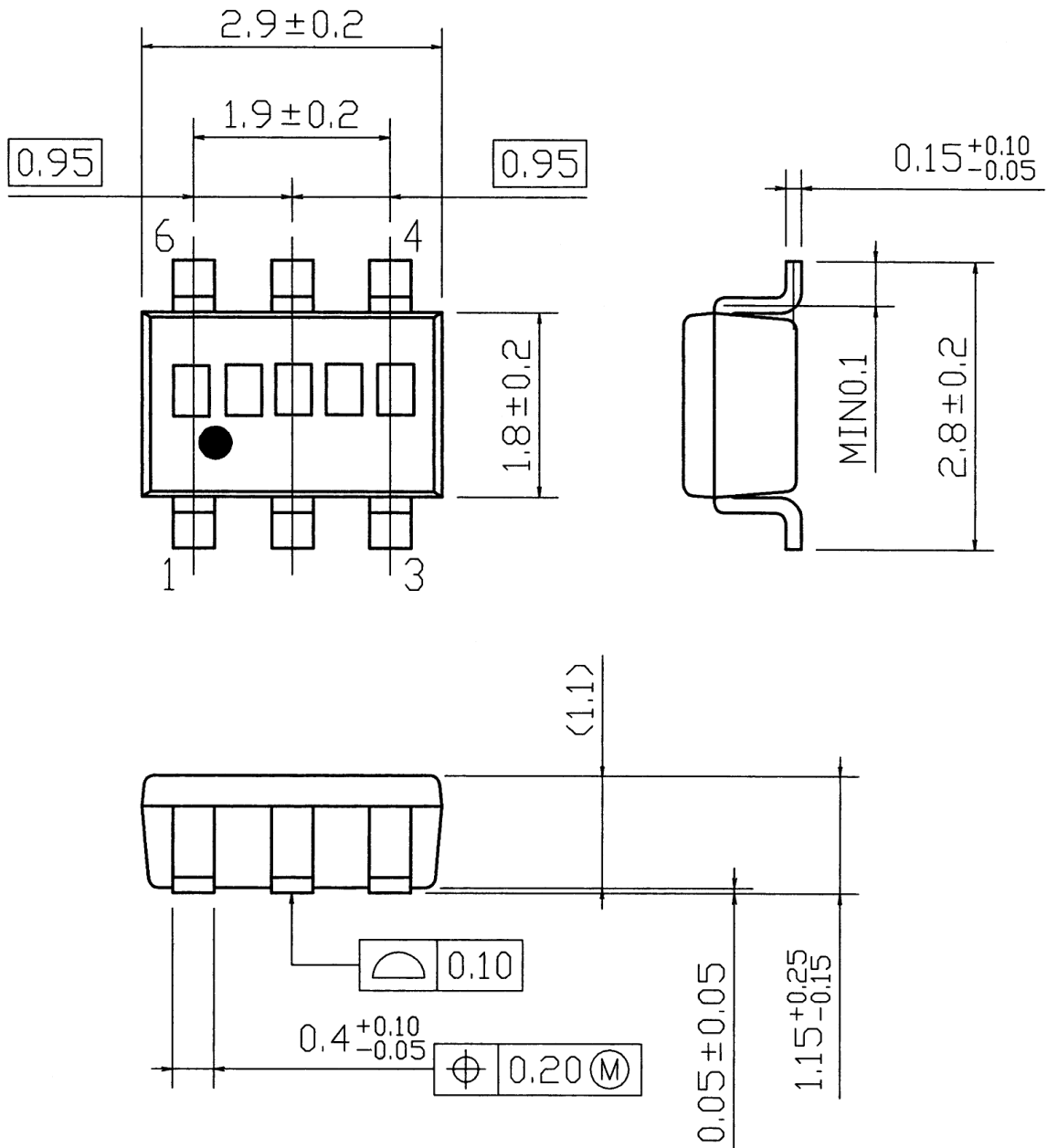
**Package and pin configuration**

SOT-26A	Pin No.	Symbol	Function
	1	DOUT	Output of overdischarge detection.
	2	COU	Output of overcharge detection.
	3	V-	Input terminal connected to charger negative voltage.
	4	VBL	Input terminal of the low side cell.
	5	VDD	Input terminal of the high side cell. Supply terminal.
	6	VSS	VSS terminal. Connected to ground.

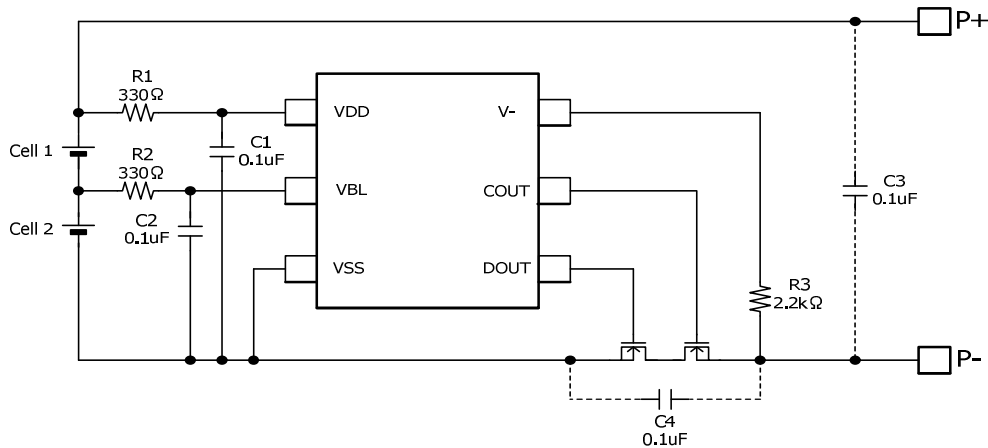
**Package dimensions**

Unit:mm

SOT-26A



**Typical application circuit**



R1 , C1 , R2 , C2 stabilize a supply voltage ripple. However, R1 is enlarged, the detection voltage shifts by voltage when current consumption flows into R1. Please decide it after confirming the characteristic. Moreover, adjust the value of C1 , C2 to 0.01uF or more to do the stability operation, please.

R1 and R3 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 R3 may cause a power consumption will be over rating of power dissipation, therefore the 'R1+R3' should be more than 1kohm. Moreover, if R3 is too enlarged, the charger connection release cannot be occasionally done after the overdischarge is detected, so adjust the value of R3 to 10kohm or less, please.

In the state of overdischarge, The current flows through overdischarge pull-up resistance built into between VDD terminal and V- terminal when the charger is connected. As a result, current that flows into VDD terminal increases. When current increases, the voltage is generated in R1. And hysteresis might be caused. Please use it after confirming the characteristic.

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.

**Lineup**

Product name (MM3220)	Package	Option		Detection / Release voltage							Detection delay time				
		Two stage overcurrent detecting function	Charging overcurrent detection	Overcharge detection voltage	Overcharge release voltage	Overdischarge detection voltage	Overdischarge release voltage	Discharging overcurrent detection voltage 1	Discharging overcurrent detection voltage 2	Charging overcurrent detection voltage	Overcharge detection delay time	Overdischarge detection delay time	Discharging overcurrent detection delay time 1	Discharging overcurrent detection delay time 2	Charging overcurrent detection delay time
AA1NRH	SOT26A	x	○	4.250V	4.050V	2.800V	3.000V	0.200V	-	-0.200V	1.00s	128.0ms	12.0ms	-	8.0ms
AA2NRH	SOT26A	x	○	4.250V	4.050V	2.800V	3.000V	0.100V	-	-0.100V	1.00s	128.0ms	12.0ms	-	8.0ms
C02NRH	SOT26A	○	x	4.300V	4.100V	2.000V	2.000V	0.100V	0.200V	-	1.00s	12.0ms	48.0ms	4.0ms	-
C03NRH	SOT26A	○	x	4.300V	4.100V	2.000V	2.000V	0.100V	0.200V	-	1.00s	12.0ms	256.0ms	2.5ms	-
C08NRH	SOT26A	○	x	4.300V	4.100V	2.000V	2.000V	0.065V	0.200V	-	1.00s	12.0ms	256.0ms	0.5ms	-
D01NRH	SOT26A	x	x	4.250V	4.100V	3.000V	3.000V	0.200V	-	-	1.15s	144.0ms	9.0ms	-	-
D05NRH	SOT26A	x	x	4.250V	4.100V	2.500V	2.500V	0.150V	-	-	1.15s	144.0ms	9.0ms	-	-
F01NRH	SOT26A	x	x	4.225V	4.075V	2.550V	2.550V	0.200V	-	-	1.15s	144.0ms	9.0ms	-	-
G01NRH	SOT26A	x	○	4.290V	4.050V	3.000V	3.200V	0.200V	-	-0.200V	1.00s	128.0ms	12.0ms	-	8.0ms
G06NRH	SOT26A	x	○	4.250V	4.100V	2.500V	3.000V	0.150V	-	-0.100V	1.00s	12.0ms	256.0ms	-	8.0ms
G07NRH	SOT26A	x	○	4.400V	4.250V	2.500V	3.000V	0.150V	-	-0.100V	1.00s	12.0ms	256.0ms	-	8.0ms
H01NRH	SOT26A	x	○	4.225V	4.075V	3.000V	3.000V	0.200V	-	-0.200V	1.15s	144.0ms	9.0ms	-	8.0ms
H02NRH※2	SOT26A	x	○	4.300V	4.150V	2.400V	2.400V	0.200V	-	-0.200V	1.15s	144.0ms	9.0ms	-	8.0ms
H03NRH	SOT26A	x	○	4.250V	4.100V	3.200V	3.200V	0.200V	-	-0.200V	1.15s	144.0ms	9.0ms	-	8.0ms
H04NRH※2	SOT26A	x	○	4.230V	4.080V	2.400V	2.400V	0.200V	-	-0.200V	1.15s	144.0ms	9.0ms	-	8.0ms
H06NRH※2	SOT26A	x	○	4.230V	4.080V	2.865V	2.865V	0.200V	-	-0.200V	1.15s	144.0ms	9.0ms	-	8.0ms
H09NRH※2	SOT26A	x	○	4.225V	4.150V	2.600V	2.600V	0.250V	-	-0.200V	1.15s	1.15s	9.0ms	-	8.0ms
H10NRH※2	SOT26A	x	○	4.250V	4.175V	2.600V	2.600V	0.250V	-	-0.200V	1.15s	1.15s	9.0ms	-	8.0ms
H11NRH	SOT26A	x	○	4.300V	4.150V	2.300V	2.300V	0.150V	-	-0.150V	1.00s	96.0ms	20.0ms	-	8.0ms
H13NRH	SOT26A	x	○	4.250V	4.050V	2.400V	2.400V	0.200V	-	-0.200V	1.00s	128.0ms	12.0ms	-	8.0ms
H15NRH※2	SOT26A	x	○	4.280V	4.130V	2.800V	2.800V	0.150V	-	-0.150V	1.00s	128.0ms	9.0ms	-	8.0ms
H16NRH	SOT26A	x	○	4.250V	4.100V	3.000V	3.000V	0.200V	-	-0.200V	1.00s	128.0ms	8.0ms	-	8.0ms
J01NRH※2	SOT26A	x	○	4.275V	4.275V	2.500V	2.500V	0.085V	-	-0.060V	0.25s	20.0ms	6.0ms	-	16.0ms
JA1NRH	SOT26A	x	○	4.250V	4.250V	2.800V	2.800V	0.100V	-	-0.100V	1.00s	96.0ms	10.0ms	-	6.0ms
K01NRH	SOT26A	○	○	4.300V	4.100V	2.000V	2.000V	0.125V	0.300V	-0.090V	1.15s	144.0ms	12.0ms	0.5ms	8.0ms
M01NRH※2	SOT26A	x	○	4.280V	4.080V	2.000V	2.000V	0.200V	-	-0.100V	1.00s	128.0ms	12.0ms	-	8.0ms
M04NRH※2	SOT26A	x	○	4.280V	4.080V	2.600V	2.600V	0.135V	-	-0.085V	1.00s	128.0ms	12.0ms	-	8.0ms
MB1NRH※2	SOT26A	x	○	4.425V	4.225V	2.800V	2.800V	0.150V	-	-0.100V	1.00s	128.0ms	8.0ms	-	8.0ms
MC1NRH※2	SOT26A	x	○	4.300V	4.100V	2.300V	2.300V	0.090V	-	-0.090V	1.00s	12.0ms	48.0ms	-	16.0ms
N01NRH	SOT26A	x	x	4.250V	4.100V	2.500V	3.000V	0.150V	-	-	1.15s	144.0ms	9.0ms	-	-
U01NRH※4	SOT26A	x	x	4.250V	4.100V	2.500V	3.000V	0.150V	-	-	1.15s	512.0ms	288.0ms	-	-
Z01NRH※3	SOT26A	○	x	4.300V	4.100V	2.000V	2.000V	0.100V	0.180V	-	1.00s	12.0ms	256.0ms	2.5ms	-

※1 Optional functions ○ : Provided. x : Not provided.

※2 0V Charge Disabled

※3 The charging overcurrent function cannot be added to the Z01 rank.

※4 Overdischarge release method: voltage release

## NOTES

### **【Safety Precautions】**

- Though Mitsumi Electric Co., Ltd. (hereinafter referred to as "Mitsumi") works continually to improve our product's quality and reliability, semiconductor products may generally malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of this product could cause loss of human life, bodily injury, or damage to property, including data loss or corruption. Before customers use this product, create designs including this product, or incorporate this product into their own applications, customers must also refer to and comply with (a) the latest versions or all of our relevant information, including without limitation, product specifications, data sheets and application notes for this product and (b) the user's manual, handling instructions or all relevant information for any products which is to be used, or combined with this products. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. Mitsumi assumes no liability for customers' product design or applications.
- This product is intended for applying to computers, OA units, communication units, instrumentation units, machine tools, industrial robots, AV units, household electrical appliances, and other general electronic units.

### **【Precautions for Product Liability Act】**

- No responsibility is assumed by us for any consequence resulting from any wrong or improper use or operation, etc. of this product.

### **【ATTENTION】**

- This product is designed and manufactured with the intention of normal use in general electronics. No special circumstance as described below is considered for the use of it when it is designed. With this reason, any use and storage under the circumstances below may affect the performance of this product. Prior confirmation of performance and reliability is requested to customers.
  - Environment with strong static electricity or electromagnetic wave
  - Environment with high temperature or high humidity where dew condensation may occur
- This product is not designed to withstand radioactivity, and must avoid using in a radioactive environment.
- This specification is written in Japanese and English. The English text is faithfully translated into the Japanese. However, if any question arises, Japanese text shall prevail.

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