

One Cell Li-ion/Li-Polymer Battery Protection IC

## MM414x Series

### Outline

MM414x series are Li-ion battery protection IC and detect charge current / discharge current with high precision by current sensing resistor (Rsns). MM414x have two step discharge overcurrent detection. And system is protected appropriately in the next 2 state, Normal discharge mode and large current discharge mode.

### Applications

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

### Features

Detection Voltage Setting Ranges and Accuracy

	Range	Ta=25°C
Overcharge Detection Voltage	3.8V~4.8V, 5mV Step	±15mV
Overdischarge Detection Voltage	2.0V~3.0V, 50mV Step	±35mV
Discharging Overcurrent Detection Voltage 1	3mV ~50mV, 0.1mV Step	±1.00mV (MM4140 Series) ±0.75mV (MM4141 Series) ±0.50mV (MM4142 Series)
Discharging Overcurrent Detection Voltage 2	6mV~100mV, 0.5mV Step	±2.00mV (MM4140/MM4141 Series) ±1.50mV (MM4142 Series)
Charging Overcurrent Detection Voltage	-3mV~-50mV, 0.1mV Step	±1.00mV (MM4140 Series) ±0.75mV (MM4141 Series) ±0.50mV (MM4142 Series)
Short Detection Voltage1	10mV~150mV, 1mV Step	±2.5mV
0V Battery Charging Inhibition Voltage	1.2V~2.0V, 0.1V Step	±0.2V (1.2V) ±0.1V (1.3V~2.0V)

### Specification

Item	Specification	Unit
Operation temperature	-40~85	°C
Operating voltage	1.5~6.0	V

### Package

SSON-6J/SSON-6M/SSON-6U/SSON-6V  
SSON-6TA/SSON-6TB/SSON-6TC \*1  
SON-6F  
SON-6G

\*1 There is no the tab on the back of the package.



**Pin explanations**

Pin No	Symbol	Function
1	VM	Input terminal for charger negative voltage
2	COUT	Control terminal for charge FET
3	DOUT	Control terminal for discharge FET
4	VSS	Input terminal for negative power supply voltage
5	VDD	Input terminal for positive power supply voltage
6	CS	Input terminal for overcurrent detection

**Absolute Maximum Ratings**

Parameter	Symbol	Min	Max	Unit
Supply Voltage	VDD	VSS-0.3	VSS+6.0	V
VM Terminal voltage	VM	VDD-28	VDD+0.3	V
COUT Terminal voltage	VCOUT	VDD-28	VDD+0.3	V
DOUT Terminal voltage	VDOUT	VSS-0.3	VDD+0.3	V
CS Terminal voltage	VCS	VSS-0.3	VDD+0.3	V
Storage temperature	Tstg	-55	125	°C

**Electrical characteristics**

(Unless otherwise specified, Ta=25°C)

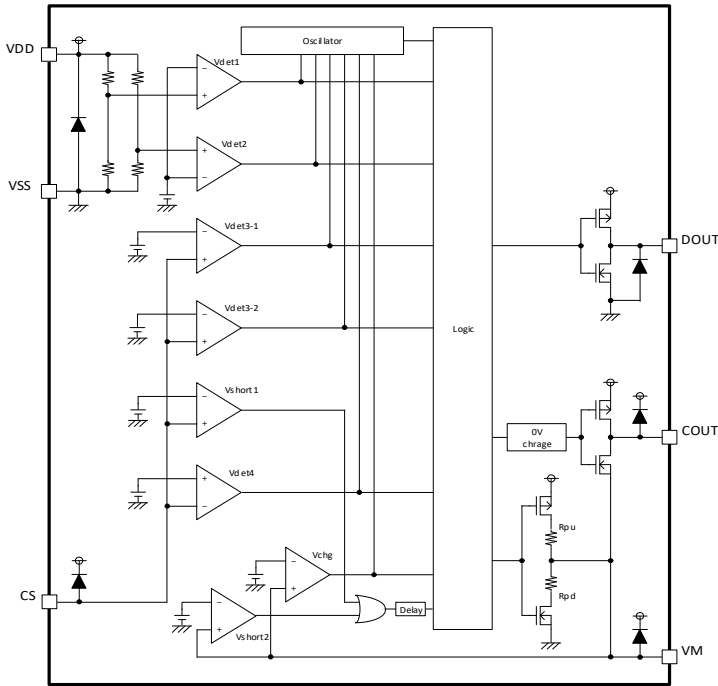
Parameter	Symbol	Note	Min	Typ	Max	Unit
<b>Input current</b>						
Current consumption	I <sub>dd</sub>	VDD=4.0V, VCS=VM=0V	-	2.5	4.0	µA
Stand-by Current Overdischarge Latch "ENABLE"	I <sub>s</sub>	VDD=1.5V VCS=0V, VM=open	-	-	0.1	µA
Stand-by Current Overdischarge Latch "DISABLE"		VDD=1.5V VCS=0V, VM=open	-	-	0.5	µA
		VDD=2.0V VCS=0V, VM=open	-	-	0.6	µA
<b>Internal resistance</b>						
VM pull up resistance	R <sub>pu</sub>	VDD=1.8V, VCS=VM=0V	500	1000	2000	kΩ
VM pull down resistance	R <sub>pd</sub>	VDD=3.6V VCS=0V, VM=2.0V	5	10	15	kΩ
COUT output resistance L	R <sub>coL</sub>	VDD=5.0V COUT=0.1V, VCS=VM=0V	-	3.0	6.0	kΩ
COUT output resistance H	R <sub>coH</sub>	VDD=4.0V COUT=3.9V, VCS=VM=0V	-	10.0	20.0	kΩ
DOUT output resistance L	R <sub>doL</sub>	VDD=1.8V DOUT=0.1V, VCS=VM=0V	-	2.0	4.0	kΩ
DOUT output resistance H	R <sub>doH</sub>	VDD=4.0V DOUT=3.9V, VCS=VM=0V	-	10.0	20.0	kΩ

**Electrical characteristics**

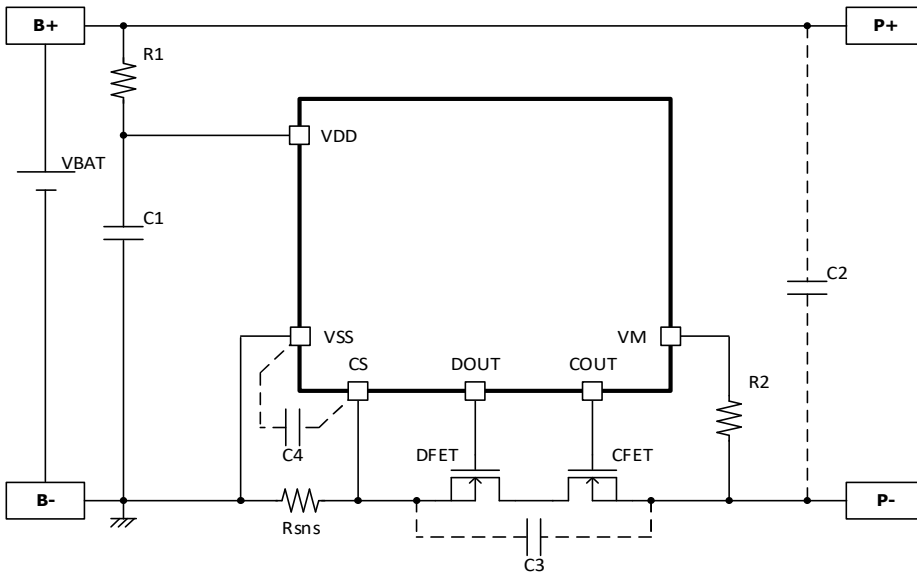
(Unless otherwise specified, Ta=25°C)

Parameter	Symbol	Note	Min	Typ	Max	Unit
Overcharge detection voltage	Vdet1	Ta=25°C	-0.015	Vdet1	+0.015	V
		Ta=-20 to 60°C	-0.020		+0.020	
Overcharge release voltage	Vrel1	Latch function is Disable.	-0.030	Vrel1	+0.030	V
Overdischarge detection voltage	Vdet2		-0.035	Vdet2	+0.035	V
Overdischarge release voltage	Vrel2	Latch function is Disable.	-0.065	Vrel2	+0.065	V
Charger detect voltage	Vchg	Overcharge mode Overdischarge mode	-0.100	Vchg	+0.100	V
Discharging overcurrent detection Voltage 1	Vdet3-1	Ta=25°C (MM4140)	-1.00	Vdet3-1	+1.00	mV
		Ta=25°C (MM4141)	-0.75		+0.75	
		Ta=25°C (MM4142)	-0.50		+0.50	
		Ta=-20 to 60°C (MM4140)	-1.50		+1.50	
		Ta=-20 to 60°C (MM4141)	-1.25		+1.25	
		Ta=-20 to 60°C (MM4142)	-1.00		+1.00	
Discharging overcurrent detection voltage 2	Vdet3-2	Ta=25°C (MM4140)	-2.00	Vdet3-2	+2.00	mV
		Ta=25°C (MM4141)			+1.50	
		Ta=25°C (MM4142)	-1.50		+1.50	
		Ta=-20 to 60°C (MM4140)	-2.50		+2.50	
		Ta=-20 to 60°C (MM4141)			+2.50	
		Ta=-20 to 60°C (MM4142)	-2.00		+2.00	
Discharging overcurrent release voltage	Vrel3		-0.400	VDD-1.0	+0.400	V
Charging overcurrent detection voltage	Vdet4	Ta=25°C (MM4140)	-1.00	Vdet4	+1.00	mV
		Ta=25°C (MM4141)	-0.75		+0.75	
		Ta=25°C (MM4142)	-0.50		+0.50	
		Ta=-20 to 60°C (MM4140)	-1.50		+1.50	
		Ta=-20 to 60°C (MM4141)	-1.25		+1.25	
		Ta=-20 to 60°C (MM4142)	-1.00		+1.00	
Charging overcurrent release voltage	Vrel4		-0.100	Vrel4	+0.100	V
Short detection voltage 1	Vshort1	Ta=25°C	-2.5	Vshort1	+2.5	mV
		Ta=-20 to 60°C	-3.0		+3.0	
Short detection voltage 2	Vshort2		-0.400	VDD-0.9	+0.300	V
Minimum Operating Voltage for 0V Charging	Vst		-	-	1.2	V
0V battery charge inhibition battery voltage	Vst	Vst=1.2V rank	-0.200	Vst	+0.200	V
		Vst=1.3V~2.0V rank	-0.100		+0.100	
Overcharge detection delay time	tVdet1		-20%	tVdet1	+20%	ms
Overdischarge detection delay time	tVdet2		-20%	tVdet2	+20%	ms
Discharging overcurrent detection delay time 1	tVdet3-1		-20%	tVdet3-1	+20%	ms
Discharging overcurrent detection delay time 2	tVdet3-2		-20%	tVdet3-2	+20%	ms
Charging overcurrent detection delay time	tVdet4		-20%	tVdet4	+20%	ms
Short detection delay time	tVshort		-30%	tVshort	+30%	us

**Block diagram**



**Typical application circuit**



Unit:Ω ,F

Symbol	Part	Min.	Typ.	Max.	Purpose
R1	Resistor	-	100	1k	For voltage fluctuation and ESD immunity
R2	Resistor	-	1k	-	For current limit of charger reverse connection
Rsns	Resistor	-	-	-	Charging and discharging current sensing
C1	Capacitor	0.047u	0.1u	2.2u	For voltage fluctuation
C2	Capacitor	-	0.1u	-	For exogenous noise
C3	Capacitor	-	0.1u	-	For exogenous noise
C4	Capacitor	-	0.1u	-	For exogenous noise
DFET	Nch MOS FET	-	-	-	Charge and discharge control
CFET					

\* The above application circuit and constant value do not guarantee proper operation. Please evaluate thoroughly by actual application to set up constants.