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Shenzhen Fuman Electronics Group Co., Ltd.

SHEN ZHEN FINE MADE ELECTRONICS GROUP CO., LTD. 1 -cell lithium iron phosphate battery protection **IC**

FM2112 (File No.: S&CIC1574)

Overview

The FM2112 series ICs have built-in high-precision voltage detection circuits and delay circuits and are protection ICs for single-cell lithium iron phosphate rechargeable batteries.

This IC is suitable for protecting a 1-cell lithium iron phosphate rechargeable battery from overcharge, overdischarge, and overcurrent.

Features

The full range of FM2112 ICs has the following features:

(1) High-precision voltage detection circuit

ÿOvercharge detection voltage VCUn (nÿ1, 2) ÿOvercharge	3.600V~4.000V Accuracy ±25mV	
release voltage VCRn (nÿ1, 2) ÿOverdischarge detection	3.400V~4.000V Accuracy ±50mV	
voltage VDLn (nÿ1, 2) ÿOverdischarge release voltage	1.800V~2.200V Accuracy ±50mV	
VDRn (nÿ1, 2) ÿDischarge overcurrent detection voltage	1.80V~2.40V	Accuracy ±50mV
ÿCharge overcurrent detection	(selectable)	Accuracy ±15mV
voltage ÿLoad short-circuit detection	(selectable)	
voltage	0.85V (fixed) (2)	Accuracy ±300mV

Each delay time is set by the internal circuit (no external capacitor is required)

ÿ Overcharge detection delay time ÿ	Typical value 1200ms
Overdischarge detection delay time ÿ	Typical value 140ms
Discharge overcurrent detection delay time	Typical value 12ms
ÿ Charge overcurrent detection delay time ÿ	Typical value 8ms
Load short circuit detection delay time (3)	Typical value 400ÿs

Low current consumption

ÿ Working mode ÿ	Typical value 3.0ÿA, maximum value 6.0ÿA (VDD=3.2V)
Sleep mode	Maximum 0.1ÿA

(4) The terminals for connecting the charger are designed to withstand high voltage (CS terminal and OC terminal, the absolute maximum rating is 20V)

(5) Allow 0V battery charging function: You can select "Allow" or "Prohibit"

(6) Wide operating temperature range: -40ÿÿ+85ÿ

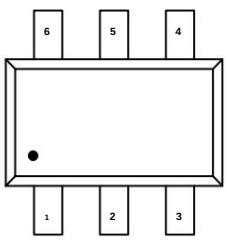
(7) Small package: SOT23-6

(8) FM2112 series is a halogen-free green environmentally friendly product

Application

ÿ 1 lithium iron phosphate rechargeable battery pack

Pin definition and function description



SOT23-6

Serial number symbol	illustrate
1 MOSFET gate connection terminal for OD discharge control	
2 CS overcurrent detection input terminal, charger detection terminal	
3 MOSFET gate connection terminal for OC charging control	
4 NC No connection	
5 VDD power supply terminal, positive power input terminal	
6 VSS ground terminal, negative power input terminal	

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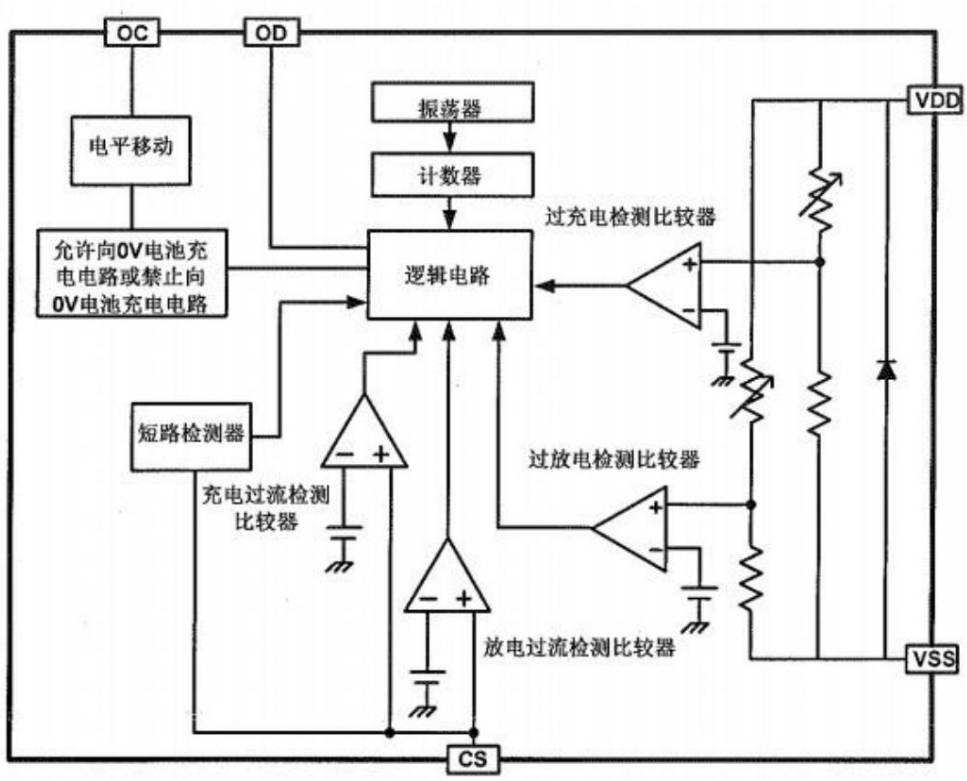
Product Catalog

parameter / model	Overcharge detection Voltage	Overcharge release Voltage	Over discharge detection Voltage	Over discharge release Voltage	Discharge overcurrent Detection voltage	Charging overcurrent detection Voltage measurement	Charge 0V battery Electrical function
	VCUn	VCRn	VDLn	The VDR	VDIP	VCIP	V0CH
FM2112-BB	3.75±0.025V	3.60±0.05V	2.10±0.05V	2.30±0.05V	150±15mV	-200±30mV	Allowed
FM2112-CB	3.75±0.025V	3.60±0.05V	2.10±0.05V	2.30±0.05V	200±15mV	-200±30mV	Allowed

Block Diagram



Absolute Maximum Ratings

(VSS=0V, Ta=25°C, unless otherwise specified)

project	symbol	Specification	unit
Input voltage between VDD and VSS	VDD	VSS-0.3~VSS+10	V
OC output terminal voltage	VOC	VDD-20~VDD+0.3	V
OD output terminal voltage	VOD	VSS-0.3~VDD+0.3	V
CS input terminal voltage Operating	VCS	VDD-20~VDD+0.3	V
temperature range Storage	TOP	-40~+85	ÿ
temperature range Allowable	TST	-40~+125	ÿ
power dissipation	PD	250	mW

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Electrical Characteristics

(VSS=0V, Ta=25°C, unless otherwise specified)

project	symbol	condition	Min	Typ	Max	Unit
Input voltage						
VDD-VSS operating voltage	VDSOP1	-	1.5	-	8	V
VDD-CS operating voltage current	VDSOP2	-	1.5	-	20	V
consumption						
Working current	IDD	VDD=3.2V	-	3.0	6.0	uA
Sleep current	IPD		-	-	0.1	uA
Detection voltage						
Overcharge detection voltage	VCU	3.6ÿ4.0V, adjustable	VCU-0.025	VCU	VCU +0.025	V
Overcharge release voltage	VCR	3.4ÿ4.0V, adjustable	VCR -0.05	VCR	VCR +0.05	V
Overdischarge detection	VDL	1.8ÿ2.2V, adjustable	VDL -0.05	VDL	VDL +0.05	V
voltage Overdischarge release	VDR	1.8ÿ2.4V, adjustable	VDR -0.05	VDR	VDR +0.05	V
voltage Discharge overcurrent	VDIP		VDIP -15	VDIP	VDIP +15 mV	
detection voltage Load short-circuit detection voltage	VSIP		0.55	0.85	1.15	V
Charge overcurrent detection voltage	VCIP	VDD=3.6V, 50mV<VCIP<150mV	VCIP -20	VCIP	VCIP +20	mV
		VDD=3.6V, 150mV<VCIP<250mV	VCIP -30	VCIP	VCIP +20	mV
		VDD=3.6V,VCIPÿ 250mV	VCIP -50	VCIP	VCIP +20	mV
Delay time						
Overcharge detection delay time	TOC		900	1200	1500	ms
Overdischarge detection delay time	TOD		105	140	170	ms
discharge overcurrent detection delay time	TDIP		9	12	15	ms
charge overcurrent detection delay time	TCIP	load	6	8	10	ms
short circuit detection delay time	TSIP	control	200	400	600	ÿs
terminal output voltage						
OD terminal outputs high voltage	VDH		VDD-0.1	VDD-0.02		V
OD terminal outputs low voltage	VDL			0.1	0.5	V
OC terminal outputs high voltage	VCH		VDD-0.1	VDD-0.02		V
OC terminal outputs low	VCL			0.1	0.5	V
voltage to charge 0V battery (enable or disable)						
Charger starting voltage (allows 0V Battery charging function)	V0CH	allows charging of 0V battery able	1.2	-	-	V
Battery voltage (do not charge 0V battery Electrical function)	V0IN	prohibits charging the 0V battery able	-	-	0.5	V

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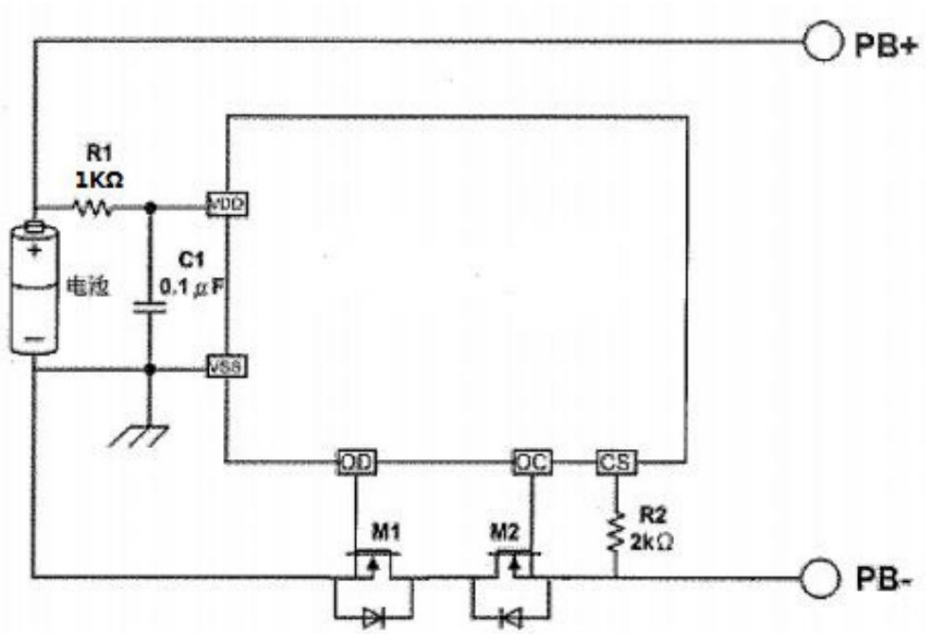
Application Circuit Diagram



Marking Device Name Resistance		Purpose:	Min. Typ. Max. Description			
R1		Current limiting, VDD stabilization, ESD current	100ÿ	100ÿ	470ÿ	*1
R2		limiting	100ÿ	2Kÿ	2Kÿ	*2
C1	Resistance Capacitance	filtering, VDD stabilization	0.01ÿF	0.1ÿF	1.0μF	*3
M1	N-MOSFET discharge control		·	·	·	*4
M2	N-MOSFET charging control		·	·	·	*5

1. R1 is connected to a resistor that is too large. The current consumption will cause a voltage drop on R1, affecting the accuracy of the detection voltage. When the charger is reversely connected, the current flows from the charger to the

If R1 is too large, the voltage between the VDD and VSS terminals may exceed the absolute maximum rating.

·2. If R2 is connected to a resistor that is too large, the charging current may not be cut off when a high voltage charger is connected.

For the reverse current, please select a larger resistance value as possible.

*3. C1 has the function of stabilizing the VDD voltage. Please do not connect capacitors below 0.01uF.

*4. When the threshold voltage of the used MOSFET is higher than the over-discharge detection voltage, discharge may stop before over-discharge protection.

*5. When the withstand voltage between the gate and source is lower than the charger voltage, the N-MOSFET may be damaged.

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Job Description

ÿ Normal working state This IC

continuously detects the battery voltage connected between VDD and VSS, and the voltage difference between CS and VSS, to control charging and discharging. For ICs with discharge overcurrent detection voltage (VDIP), when the battery voltage is above the overdischarge detection voltage (VDL) and below the overcharge detection voltage (Vcu), and the CS terminal voltage is below the discharge overcurrent detection voltage (VDIP) , both the OC and OD terminals of the IC output high levels, making the charge control MOSFET and the discharge control MOSFET turn on at the same time. This state is called the "normal working state". In this state, both charging and discharging can be carried out freely.

Note: When you connect the battery for the first time, it may not be able to discharge. At this time, short-circuit the CS terminal and the VSS terminal, or connect a charger to restore it to normal working state.

ÿ Overcharge state When the

battery voltage exceeds the overcharge detection voltage (Vcu) during charging, and this state lasts longer than the overcharge detection delay time (TOC) , the FM2112 series IC will automatically turn off the MOSFET (OC terminal) used for charging control and stop charging. This state is called "overcharge state". The overcharge state can be released in the following two situations: When the charger is not connected (1) When the battery voltage drops below the overcharge release voltage

(VCR) due to self-discharge , the overcharge state is released

and the normal operation

is restored.

Working status.

(2) Connect a load to discharge. The discharge current first flows through the parasitic diode of the charge control MOSFET. At this time, the CS terminal detects a voltage of "diode forward conduction voltage drop (Vf). When the CS terminal voltage is above the discharge overcurrent detection voltage (VDIP) and the battery voltage drops below the overcharge detection voltage (Vcu), the overcharge state is released and the normal working state is restored. Note: (1) If the battery that has entered the overcharge state is still

connected

to the charger, the overcharge state cannot be released even if the battery voltage is lower than the overcharge release voltage (VCR). The overcharge state can only be released when the charger is disconnected and the CS terminal voltage is higher than the charge overcurrent detection voltage (VCIP) .

ÿ Over discharge state and sleep state

For a battery in normal working state, during the discharge process, when the battery voltage drops below the over-discharge detection voltage (VDL) and this state lasts longer than the over-discharge detection delay time (TOD) , the FM2112 series IC will turn off the discharge control MOSFET (OD terminal) and stop discharging. This state is called "over-discharge state".

When the discharge control MOSFET is turned off, CS is pulled up to VDD by the internal resistance of the IC, reducing the current consumption of the IC to the current consumption value during sleep. This state is called "sleep state".

There are two situations for releasing the over-discharge state:

(1) Connect a charger. If the CS pin voltage is lower than the charge overcurrent detection voltage (VCIP), the over-discharge detection voltage (VDL) will be exceeded. The discharge state is released and restored to normal working state.

(2) Connect a charger. If the CS terminal voltage is higher than the charge overcurrent detection voltage (VCIP) , and the battery voltage is higher than the overdischarge release voltage (VDR), When the over discharge state is released, it returns to normal working state.

ÿ Discharge overcurrent status (discharge overcurrent detection function and load short circuit detection function)

For batteries in normal working state, FM2112 continuously detects discharge current by detecting CS terminal voltage. Once CS terminal voltage exceeds discharge overcurrent detection voltage (VDIP) and this state lasts longer than discharge overcurrent detection delay time (TDIP), the MOSFET used for discharge control is turned off.

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(OD terminal), stop discharging, this state is called "discharge overcurrent state". Once the CS terminal

voltage exceeds the load short circuit detection voltage (VSIP), and this state lasts longer than the load short circuit detection delay time

When (TSIP) , the MOSFET (OD terminal) used for discharge control is also turned off to stop discharging. This state is called "load short-circuit state".

When the impedance connected between the positive battery electrode (PB+) and the negative battery electrode (PB-) is greater than the discharge overcurrent and load short-circuit release impedance, the discharge overcurrent state and load short-circuit state are released and the normal working state is restored. In addition, even if the impedance connected between the positive battery electrode (PB+) and the negative battery electrode (PB-) is less than the discharge overcurrent/load short-circuit release impedance, when the charger is connected and the CS terminal voltage drops below the discharge overcurrent protection voltage (VDIP), the discharge overcurrent state or load short-circuit state will be released and the normal working state will be restored.

Note: (1)

If the charger is accidentally connected in reverse, the current direction in the circuit is consistent with the current direction during discharge. If the CS terminal voltage is higher than the discharge overcurrent By detecting the voltage (VDIP), the device can enter the discharge overcurrent protection state, cut off the current in the circuit, and play a protective role.

ÿ Charge overcurrent state For a

battery in normal working state, during the charging process, if the CS terminal voltage is lower than the charge overcurrent detection voltage (VCIP), and this state lasts longer than the charge overcurrent detection delay time (TCIP) , the OC terminal output voltage changes from high level to low level, turning off the MOSFET (OC terminal) used for charge control, and stopping charging. This state is called "charge overcurrent state".

After entering the charge overcurrent detection state, if the charger is disconnected and the CS pin voltage is higher than the charge overcurrent detection voltage (VCIP), the charge overcurrent state The state is released and restored to normal working state.

ÿ 0V battery charging function allows

This function is used to recharge a battery that has self-discharged to 0V. When the charger voltage connected between the positive battery (PB+) and the negative battery (PB-) is higher than the "charger start voltage (V0CH) for charging a 0V battery", the gate of the charging control MOSFET is fixed to the potential of the VDD terminal. Since the charger voltage makes the voltage difference between the gate and source of the MOSFET higher than its conduction voltage, the charging control MOSFET is turned on (OC terminal) and charging begins. At this time, the discharge control MOSFET is still turned off, and the charging current flows through its internal parasitic diode. When the battery voltage is higher than the over-discharge detection voltage (VDL) , the FM2112 series IC enters normal operation.

Note: (1)

Some batteries that have been completely self-discharged cannot be recharged. This is determined by the characteristics of lithium batteries. Please ask the battery supplier. Confirm whether the power you purchased has the function of "allowing charging of 0V batteries" or "prohibiting charging of 0V batteries".

ÿ 0V battery charging function disabled

When an internally shorted battery (OV battery) is connected, the 0V battery charge prohibition function prevents it from being recharged. When the battery voltage is lower than the "0V battery charge prohibition battery voltage (V0IN)", the gate of the charge control MOSFET is fixed to the PB- voltage, prohibiting charging. When the battery voltage is higher than the "0V battery charge prohibition battery voltage (V0IN)" , charging is possible.

Note: (1)

Some batteries that have been completely self-discharged are not allowed to be recharged. This is determined by the characteristics of lithium batteries. Please ask the battery supplier. Please confirm whether the purchased battery has the function of "allowing charging of 0V battery" or "disabling charging of 0V battery".

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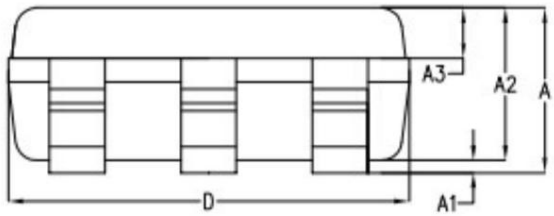
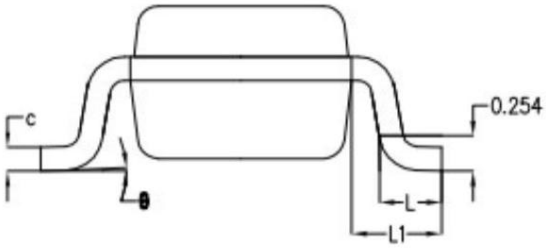
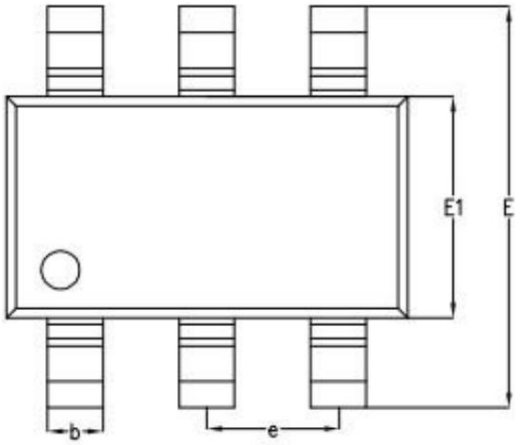
Packaging information

ÿ SOT23-6







SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	1.19	1.24
A1	-	0.05	0.09
A2	1.05	1.10	1.15
A3	0.31	0.36	0.41
b	0.35	0.40	0.45
c	0.12	0.17	0.22
D	2.85	2.90	2.95
E	2.80	2.90	3.00
E1	1.55	1.60	1.65
e	0.95BSC		
L	0.37	0.45	0.53
L1	0.65BSC		
θ	0°	2°	8°