One Cell Lithium-ion/Polymer Battery Protection IC

■ General Description

The LN8232 provides a high integration solution for lithium-ion/polymer battery protection. The LN8232 contains advanced power MOSFET, high-accuracy voltage detection circuits and delay circuits.

The LN8232 has all the protection functions required in the battery application including over-charging, over-discharging, over-current and load short circuiting protection etc. The low standby current drains little current from the cell while in storage.

The device is targeted for any Li-Ion and Li-Poly battery-powered information appliances requiring long-term battery life.

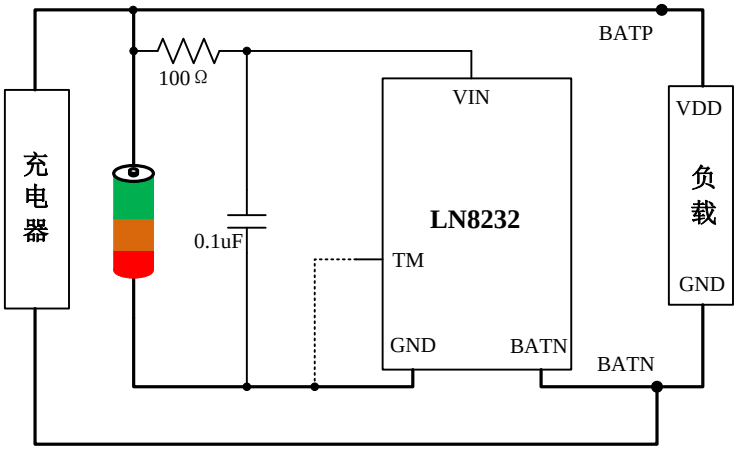
■ Features

- Protection of Charger Reverse Connection
- Protection of Battery Cell Reverse Connection
- High-accuracy Voltage Detection
- Charger Detection Function
- 0V Battery Charging Enable/Disable Function
- Integrate Advanced Power MOSFET(50mΩ)
- Low Current Consumption
  Operation Mode: 3.0μA typ.

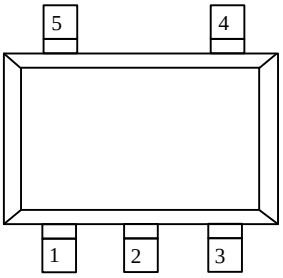
■ Application

- One-Cell Lithium-ion Battery Pack
- Lithium-Polymer Battery Pack

■ Application Information



Package



SOT-23-5L
(TOP VIEW)

■ Functional Pin Description

Pin	SOT23-5L	Note
1	TM	Test terminal. Floating or Conncet to GND
2	GND	Ground
3	VIN	Power Supply
4	BATN	The negative terminal of battery pack
5	BATN	The negative terminal of battery pack

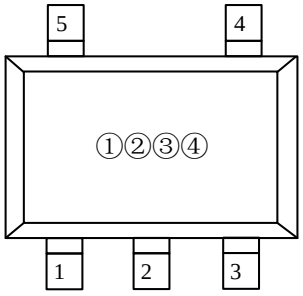
■ Ordering Information

LN8232 ①②③④⑤ - G

Designator	Symbol	VOV	VOVR	VUV	VUVR
①②③	C5A	4.300V	4.150V	2.500V	2.900V
	C5B	4.280V	4.150V	2.500V	2.900V
	C5C	4.430V	4.250V	2.500V	2.900V
	C5D	4.400V	4.250V	2.500V	2.900V
	C5F	4.220V	4.070V	2.450V	2.850V
④	M	SOT23-5L Package			
⑤	R	Reel			
	T	Tape			
G	Green epoxy molding compound				

■ Marking Information

Designator	Symbol	Description
①	C	LN8232
②	A	VOV：4.300V，VOVR：4.150V
	B	VOV：4.280V，VOVR：4.150V
	C	VOV：4.430V，VOVR：4.250V
	D	VOV：4.400V，VOVR：4.250V
	F	VOV：4.220V，VOVR：4.070V
③	M	SOT23-5L Package
④	Tracking information for internal quality	

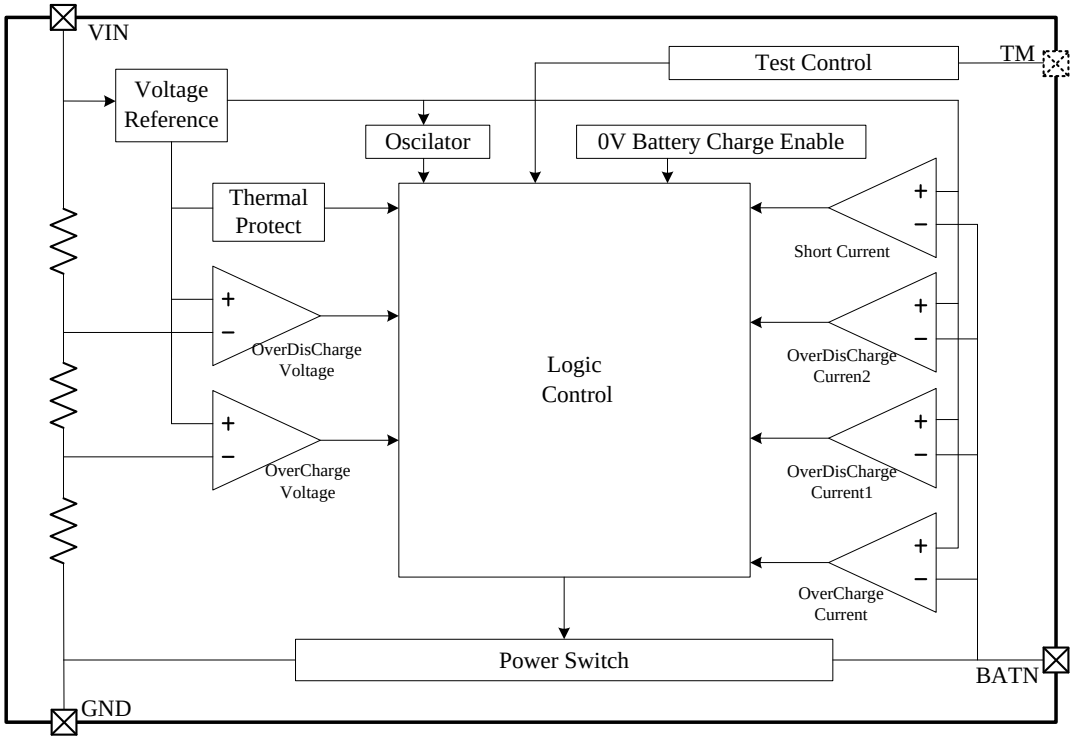


SOT-23-5L
(TOP VIEW)

■ Absolute Maximum Ratings

Parameter	Symbol	Max	Unit
Supply Voltage	VIN	GND-0.3～GND+6.0	V
Power Dissipation	PD@TA=25℃	0.4	W
Package Thermal Resistance(Junction to Ambient)		130	℃/W
Lead Temperature		260	°C
Ambient Temperature	Topa	-40～+85	
Storage Temperature	Tstr	-55～+125	
ESD Susceptibility	HBM	4000	V

■ Function Block Diagram



■ Electrical Characteristics

Note:V_{VIN} =3.5V, T_A=25℃,unless otherwise specification.

Parameters	Test Condition	Min	Typ	Max	Unit
Voltage					
Over-Charge Detection Voltage		4.27	4.30	4.33	V
Over-Charge Release Voltage		4.12	4.15	4.18	V
Over-Discharge Detection Voltage		2.46	2.50	2.54	V
Over-Discharge Release Voltage		2.86	2.90	2.94	V
Charger Detection Voltage			-0.50		V
Current					
Over-Discharge Current Detection 1	V_{DD}=3.5V		3		A
Over-Discharge Current Detection 2	V_{DD}=3.5V		10		A
Load Short Detection	V_{DD}=3.5V		20		A
Normal Operator Current	V_{DD}=3.5V, V_{BATN}=0V		3.0	6	uA
Power Down Current	V_{DD}=2.0V, BATN floating		2.0	4	uA
Delay Time					
Over-Charge Voltage Detection Delay Time			200		mS
Over-Discharge Voltage Detection Delay Time			50		mS
Over-Discharge Current Detection 1 Delay Time			12		mS
Over-Discharge Current Detection 2 Delay Time			2.5		mS
Load Short Detection Delay Time			40		uS
BATN Internal Resistance					
Internal Resistance between BATN and V_{DD}	V_{DD}=3.5V BATN=1.0V		320		kΩ
Internal Resistance between BATN and GND	V_{DD}=2.0V BATN=1.0V		100		kΩ
Power FET on Resistance	V_{DD}=3.5V, I_{BATN} =1.0A		50		mΩ
Over Temperature Protection			100		℃
Over Temperature Hybrid			20		℃
Note: Parameter with * is used for 4.35V Battery Protect, Other is for 4.2V Battery Protect					

■ Typical Operating Characteristics

T he LN8232 monitors the voltage and current of a battery and protects it from being damaged due to overcharge voltage, over-discharge voltage, over-discharge current, and short circuit conditions by disconnecting the battery from the load or charger. These functions are required in order to operate the battery cell within specified limits.

Normal operating mode

If no exception condition is detected, charging and discharging can be carried out freely. This condition is called the normal operating mode.

Over-Charge Condition

When the battery voltage becomes higher than the over-charge detection voltage (V_{CU}) during charging under normal condition and the state continues for the overcharge detection delay time (t_{CU}) or longer, the LN8232 turns off the power switch FET.

Over-Discharge Condition

When the battery voltage drops below the over-discharge detection voltage (V_{DL}) during discharging under normal condition and it continues for the over-discharge detection delay time (t_{DL}) or longer, the LN8232 turns off the power switch FET and stops discharging.

At the over-discharge condition, when a charger is connected, the power switch FET is still off. At this time, charging is still permitted through the parasitic diode of the power switch FET, when the battery voltage becomes higher than the over-discharge detection voltage (V_{DL}), the LN8232 turns on the power switch FET and changes to the normal condition from the over-discharge condition.

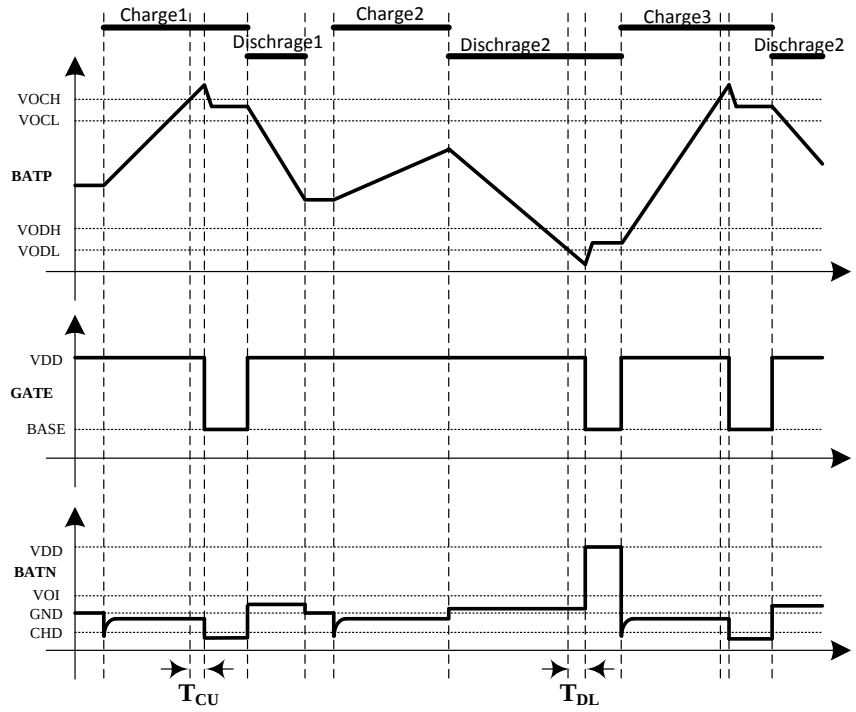
Over-Current Condition

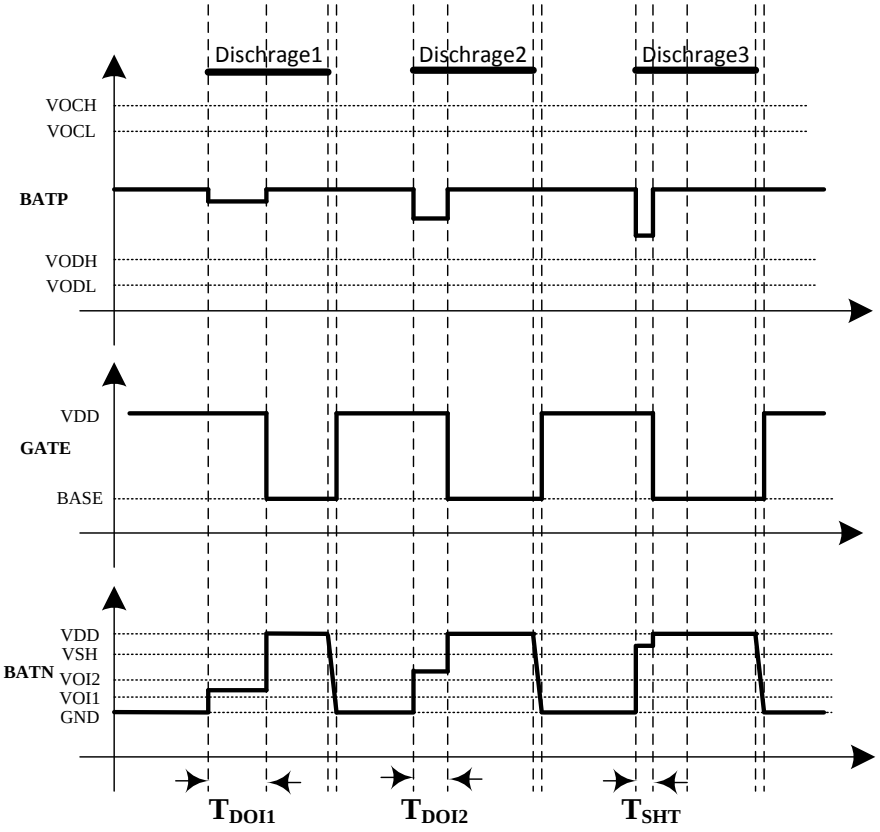
When the discharging current becomes equal to or higher than a specified value during discharging under normal condition and the state continues for the over-current detection delay time or longer, the LN8232 turns off power switch FET to stop discharging, and the BATN pin is pulled up to high state by the internal control of LN8232. This condition includes over-current1, over-current2 or load short-circuiting.

The over-current condition returns to the normal mode when the load is released or the impedance between BATP and BATN is larger than 500kΩ.

The LN8232 provides two over-current detection levels (3A and 10A) with two over-current delay time (T_{OI1} and T_{OI2}) corresponding to each over-current detection level.

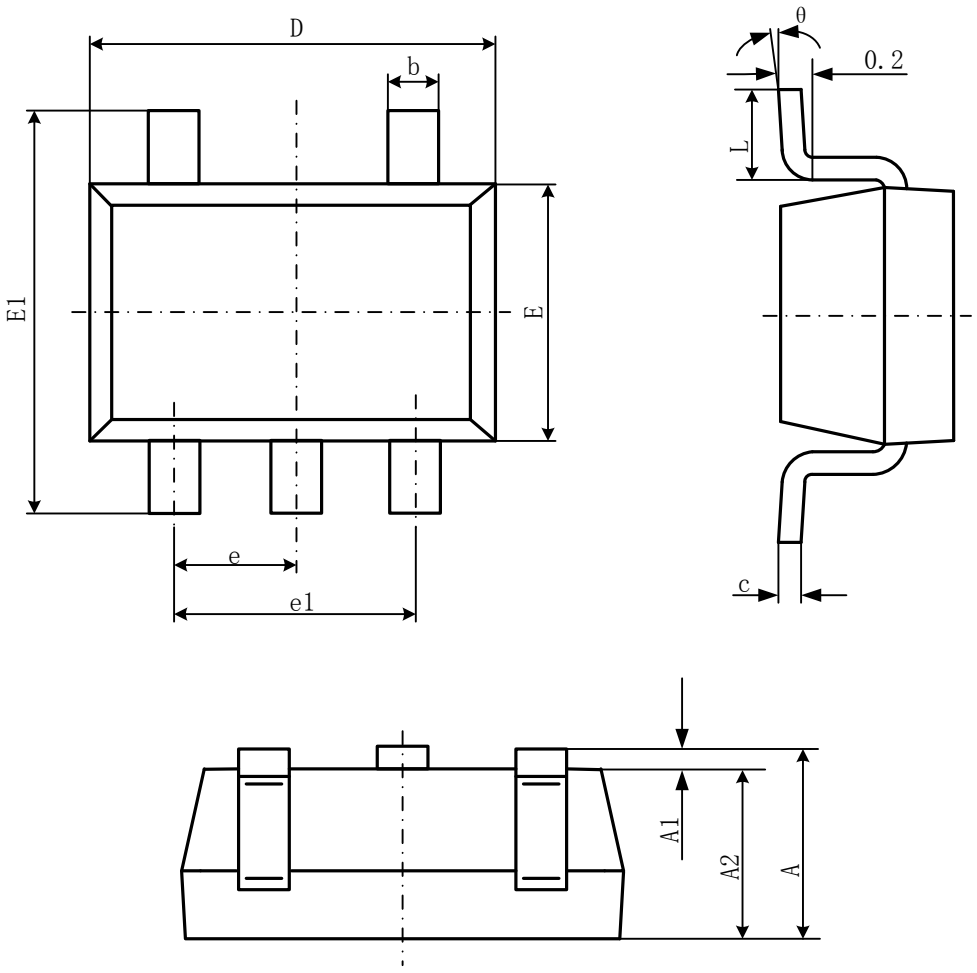
Delay Circuits


Charge1
Dischrage1
Charge2
Dischrage2
Charge3
Dischrage2
VOCH
VOCL
BATP
VODH
VODL
VDD
GATE
BASE
VDD
BATN
VOI
GND
CHD
T_{CU}
T_{DL}


Dischrage1
Dischrage2
Dischrage3
VOCH
VOCL
BATP
VODH
VODL
VDD
GATE
BASE
VDD
VSH
BATN
VOI2
VOI1
GND
T_{DOI1}
T_{DOI2}
T_{SHT}

■ Package Information

- **SOT23-5L**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°