DESCRIPTION

The A4059A provides a high integration solution for lithium-ion/polymer battery protection. The A4059A contains advanced power MOSFET, high-accuracy voltage detection circuits and delay circuits.

The A4059A 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.

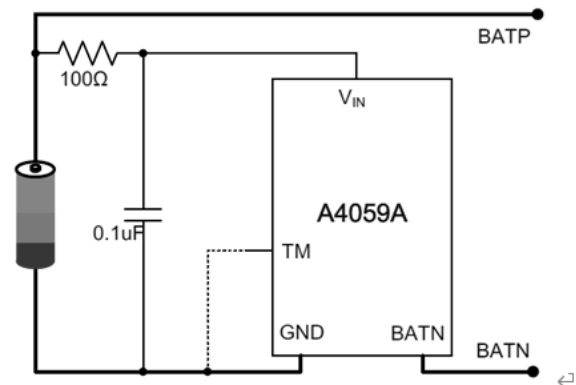The A4059A is available in SOT-25 package.

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.
● Available in SOT-25 package
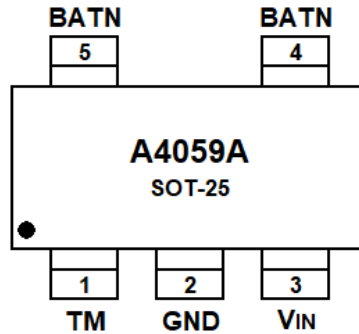
APPLICATION

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

TYPICAL APPLICATION

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	A4059AE5R
		A4059AE5VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

PIN DESCRIPTION

Top View

Pin #	Symbol	Function
1	TM	Test Terminal. Floating or Connect to GND
2	GND	Ground
3	V_{IN}	Power Supply
4	BATN	The negative terminal of battery pack
5	BATN	The negative terminal of battery pack

ABSOLUTE MAXIMUM RATINGS

V_{IN}, Supply Voltage	GND-0.3V ~ GND+6.0V
P_D, Power Dissipation @T_A=25℃	0.4A
Package Thermal Resistance (Junction to Ambient)	130℃/W
Lead Temperature	260℃
T_{OPA}, Ambient Temperature	-40℃ ~ +85℃
T_{STR}, Storage Temperature	-55℃ ~ 125℃
HBM, ESD Susceptibility	4000V

Stress beyond above listed "Absolute Maximum Ratings" may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

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

Parameter	Conditions	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	6	uA
Power Down Current	V_{DD}=2.0V, BATN floating	-	2	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

BLOCK DIAGRAM
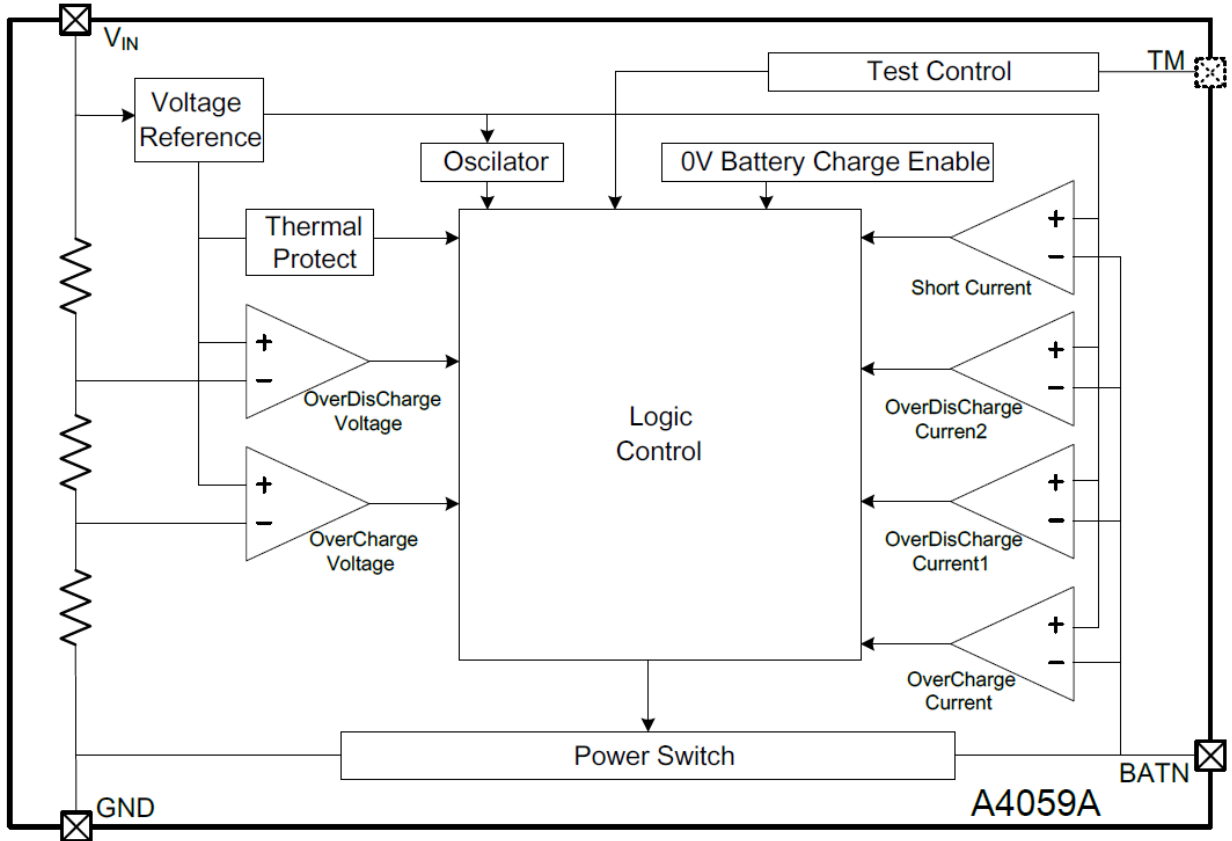
DETAILED INFORMATION

Typical Operating Characteristics

The A4059A 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 A4059A 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 A4059A 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 A4059A 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 A4059A turns off power switch FET to stop discharging, and the BATN pin is pulled up to high state by the internal control of A4059A. 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 A4059A 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.
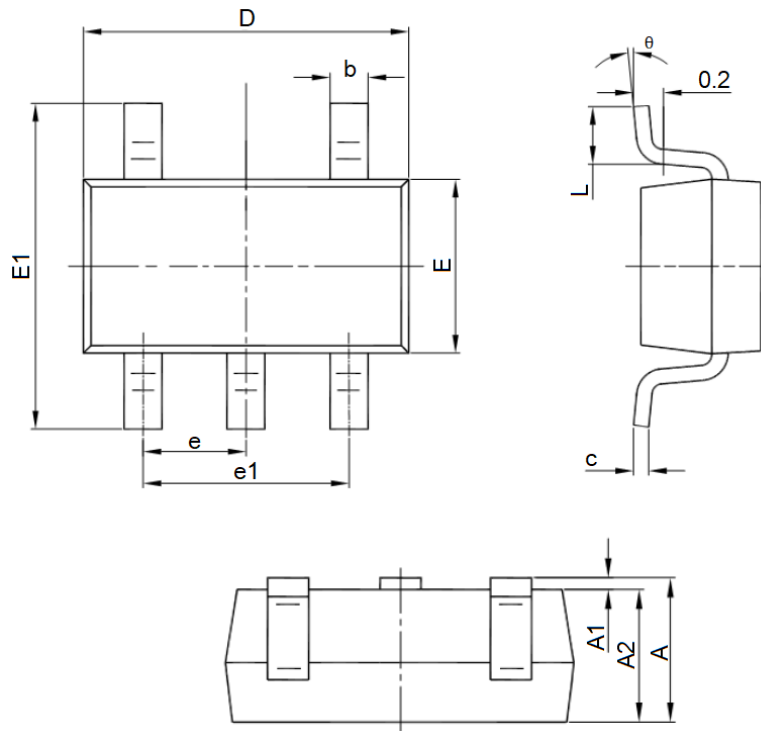
Delay Circuits
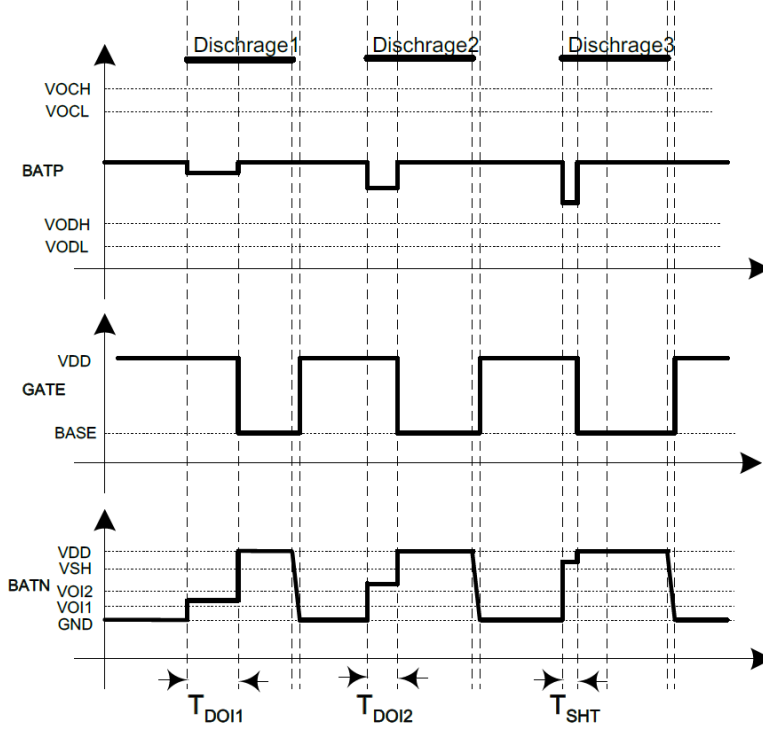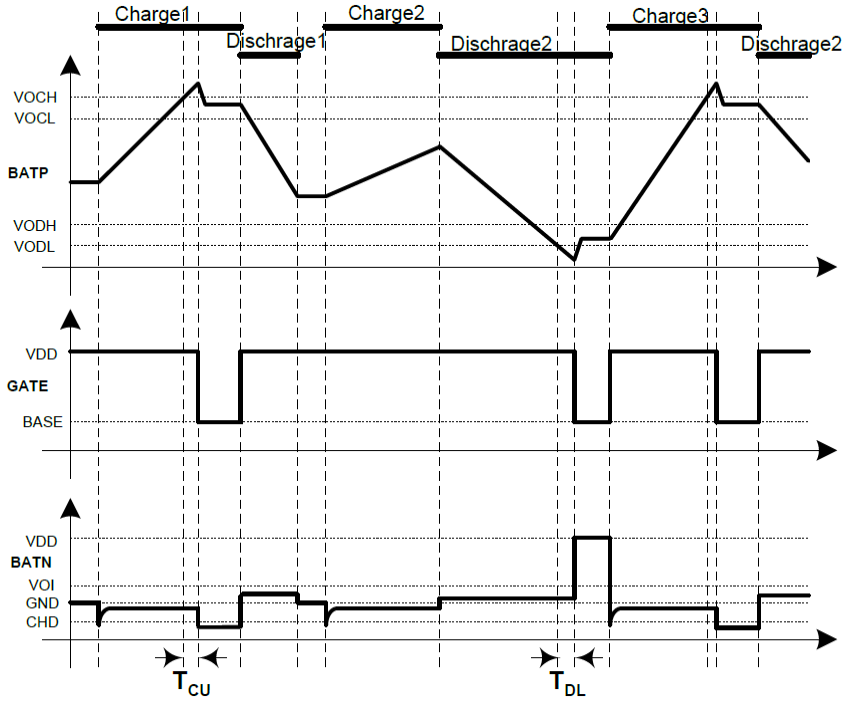
PACKAGE INFORMATION

Dimension in SOT-25 Package (Unit: mm)

Symbol	Millimeters		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°

IMPORTANT NOTICE

AiT Semiconductor Inc. (AiT) reserves the right to make changes to any its product, specifications, to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

AiT Semiconductor Inc.'s integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life support applications, devices or systems or other critical applications. Use of AiT products in such applications is understood to be fully at the risk of the customer. As used herein may involve potential risks of death, personal injury, or servere property, or environmental damage. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

AiT Semiconductor Inc. assumes to no liability to customer product design or application support. AiT warrants the performance of its products of the specifications applicable at the time of sale.