One-cell Lithium-ion/Polymer Battery Protection IC SDC6073

General Description

The SDC6073 is a One-cell lithium-Ion (Li-Ion) and lithium-polymer (Li-Pol) battery protection IC that integrated an on-chip FET switch thus reducing manufacturing costs and increasing reliability. The device is designed to protect both Li-Ion and Li-Pol battery packs from either overcharge, overdischarge, or over-current.

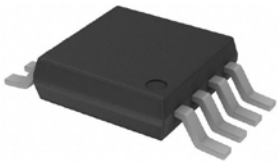
The device contains all required protection control circuits together with a very low resistive FET switch to minimize the number of external components.

Features

- Internal MOSFET, and reduce costs.
- Only two external capacitor required in the application.
- Over Temperature Protection.
- Charger Detection Function.
- Internal high accuracy voltage detection circuit.
- Internal high accuracy current detection circuit.
- Short-circuit protection.
- 0V charging function.
- Delay times are generated by an internal circuit, and no external capacitor is required.
- Overcharge current protection.

Applications

- Li-Ion Rechargeable Battery Packs
- Li-Pol Rechargeable Battery Packs



MSOP-8

Figure 1. Package Type

Pin Configuration

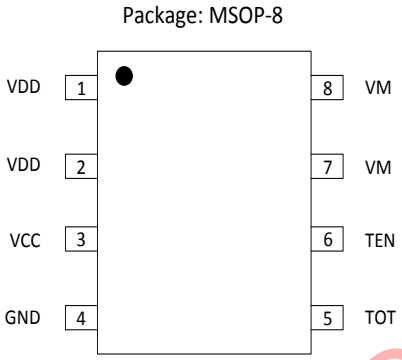


Figure 2. Pin Configuration

Pin Number	Pin Name	Function
1	VDD	Positive power input
2	VDD	Positive power input
3	VCC	Core circuit power supply pin
4	GND	Ground pin
5	TOT	Test mode output, connect to GND in normal operation
6	TEN	Test mode enable, connect to GND in normal operation
7	VM	Positive charge input, overcurrent detection
8	VM	Positive charge input, overcurrent detection

Table 1. Pin Description

Product Series

Model	Package	Overcharge Detection Vol.[V_{CU}](V)	Overcharge Hysteresis Vol.[V_{HC}](V)	Overdischarge Detection Vol. [V_{DL}](V)	Overdischarge Hysteresis Vol. [V_{HD}](V)	Overcurrent 1 Detection Cur. [I_{OC1}](A)	0V Bat. Charge Enable	Recovery
SDC6073AA	MSOP-8	4.30±0.05	0.175±0.025	2.50±0.05	0.40±0.05	3.0±0.9	yes	yes

Table 2. Product Series

Functional Block Diagram

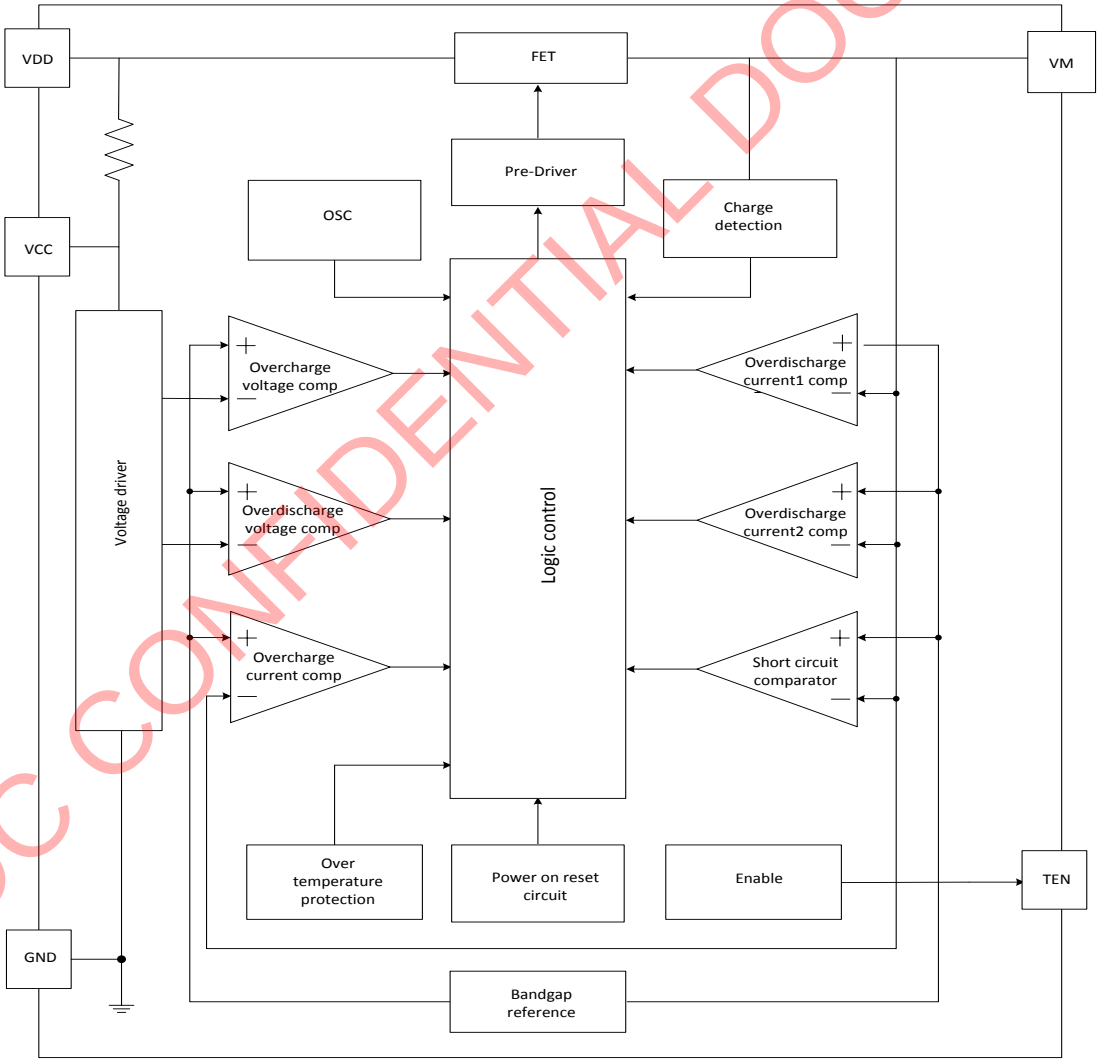
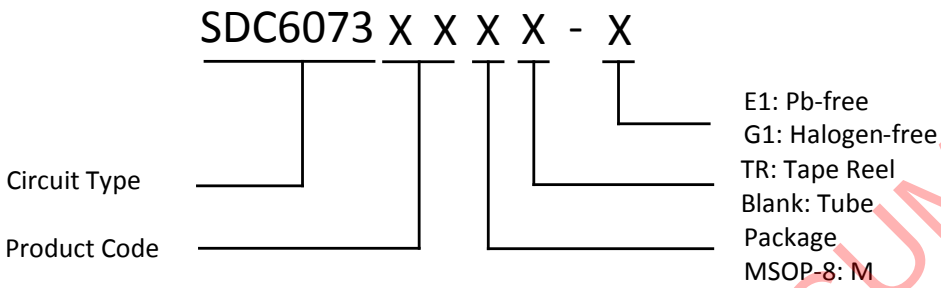


Figure 3. Functional Block Diagram

Ordering Information



Package	Temperature	Part Number		Marking ID		Packing Type
		Pb-free	Halogen-free	Pb-free	Halogen-free	
MSOP-8	-40℃~85℃	SDC6073AAMTR-E1	SDC6073AAMTR-G1	6073AA	6073AAG	Tape Reel
		SDC6073AAM-E1	SDC6073AAM-G1	6073AA	6073AAG	Tube

Absolute Maximum Ratings (NOTE: Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device.)

Parameter	Symbol	Value	Unit
Supply Voltage (between VDD and GND)	V_{DD}	-8.0~8.0	V
Charger Input Voltage (between VM and GND)	V_{MAX}	-10.0~10.0	V
ESD, HBM model per Mil-Std-883, Method 3015	HBM	2000	V
ESD, MM model per JEDEC EIA/JESD22-A115	MM	200	V
Latch-up test per JEDEC 78	-	200	mA
Storage Temperature Range	T_{STG}	-55~125	℃
Power Dissipation	P_{MAX}	500	mW

Table 3. Absolute Maximum Ratings

Note: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply voltage (between VDD and GND)	V_{DD}	2.0	4.5	V
Charger input voltage (between VM and GND)	V_{MAX}	4.5	5.5	V
Operating Temperature Range	T_{OPR}	0	45	℃

Table 4. Recommended Operating Conditions

Electrical Characteristics (Ta=25°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Detection Voltage						
Overcharge Detection Voltage	V_{CU}	-	4.25	4.30	4.35	V
Overcharge Hysteresis Voltage	V_{HC}	-	0.15	0.175	0.20	V
Overdischarge Detection Voltage	V_{DL}	-	2.45	2.5	2.55	V
Overdischarge Hysteresis Voltage	V_{HD}	-	0.35	0.4	0.45	V
Charger Detection Voltage	V_{CHG}	-	V_{DD}+0.1	V_{DD}+0.15	V_{DD}+0.2	V
Detection Current						
Overcharge Current Detection Current	I_{COC}	V_{DD}=3.5V	2.1	3.0	3.9	A
Overdischarge Current 1 Detection Current	I_{OC1}	V_{DD}=3.5V	2.1	3.0	3.9	A
Overdischarge Current 2 Detection Current	I_{OC2}	V_{DD}=3.5V	4.5	6.0	7.0	A
Load Short-circuiting Detection Voltage	V_{SIP}	V_{DD}=3.5V	1.2	1.25	1.3	V
Current Consumption						
Current Consumption in Normal Operation	I_{OPEN}	V_{DD}=3.5V, VM pin floating	1.0	1.5	3.0	uA
Current Consumption in Power Down	I_{PD}	V_{DD}=1.5V, VM pin floating	-	-	0.23	uA
VM Internal Resistance						
Internal Resistance between VM and VDD	R_{VMD}	V_{DD}=3.5V,VM=1.0V	13	20	30	kΩ
Internal Resistance between VM and GND	R_{VMS}	V_{DD}=2.0V,VM=1.0V	300	450	675	kΩ
FET on Resistance						
Equivalent FET on Resistance	R_{ON}	V_{DD}=4V,I_{VM}=1A	-	29	-	mΩ
Over Temperature Protection						
Over Temperature Protection	T_{SHD+}	-	-	100	-	℃
Detection Delay Time						
Overcharge Voltage Detection Delay Time	t_{CU}	-	1.3	1.5	1.7	S
Overdischarge Voltage Detection Delay Time	t_{DL}	-	145	180	210	mS
Overdischarge Current 1 Detection Delay Time	t_{OC1}	V_{DD}=3.5V	9.0	11	13.5	mS
Overdischarge Current 2 Detection Delay Time	t_{OC2}	V_{DD}=3.5V	4.48	5.38	6.45	mS
Load Short-Circuit Detection Delay Time	t_{SIP}	V_{DD}=3.5V	300	450	600	uS
Overcharge Current Detection Delay Time	t_{COC}	V_{DD}=3.5V	9.0	11	13.5	mS

Table 5. Electrical Characteristics

Function Description

Normal Condition

If $V_{DL}<V_{CC}<V_{CU}$ & $V_{COC}<V_{CS}<V_{OC1}$, CO and DO are both high, the charging and discharging processes can be operated normally.

The SDC6073 is a one-cell lithium-Ion (Li-Ion) and lithium-polymer (Li-Pol) battery protection IC. Battery charge/discharge state is continuously monitored for fault conditions. In the event of an over-voltage, short-circuit, over-current or over-temperature failure, the device will automatically shut down through internal power switch, thus protecting the charging device, control system, and the battery.

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.

Overcharge voltage condition

When the battery voltage becomes higher than the overcharge detection voltage (V_{CU}) and continues for a period equal to overcharge voltage detection delay time (t_{CU}) or longer, the SDC6073 will control internal MOSFET to stop charging.

The overcharge condition is released in the following two cases.

(1). Charger is connected, battery voltage falls below overcharge release voltage V_{CL} ($V_{CL}=V_{CU}-V_{HC}$).

(2). Charger is disconnected and battery voltage falls below overcharge detection voltage V_{CU}.

If charger is disconnected and battery voltage is still higher than V_{CU}, battery will discharge through internal diode until battery voltage falls below V_{CU}.

Overcharge current condition

Under the charge condition, if current exceeds overcharge current I_{COC} and continues for overcharge current detection delay time t_{COC} or longer, The IC will control internal MOSFET to stop charging.

Release condition:

The SDC6073 will release the overcharge current condition as soon as the charge current is below I_{COC}.

Overdischarge voltage condition

When battery voltage falls below overcharge detection voltage V_{DL} and continues for overdischarge detection delay time tDL or longer, the SDC6073 will disconnect battery from load to stop further discharging. The situation is called overdischarge voltage condition.

When battery voltage is 1.5V (Typical) or lower, current consumption is reduced to power-down current consumption IPD. This situation is called power-down condition.

Release condition:

(1). The power-down condition is released when a charger is connected and voltage difference between pin VM and GND becomes 2.0V (Typical) or higher. Moreover when battery voltage becomes overdischarge detection voltage $V_{DL}+V_{HD}$ or higher, the SDC6073 returns to the normal condition.

(2). The overdischarge condition is released when a charger is connected and voltage difference between pin VM and GND becomes $V_{DL}+V_{HD}$ or higher, the SDC6073 returns to the normal.

Overdischarge Current Condition (Detection of Overdischarge current1, Overdischarge current 2)

Under normal condition, if discharge current exceeds Overdischarge current 1 I_{OC1} or Overdischarge current 2

I_{OC2}, and lasts for a period of overdischarge current1 delay time (t_{OC1}) or overdischarge current2 delay time (t_{OC2}) separately, battery will be disconnected from load.

Release condition:

The overdischarge current status is reset when impedance between VM pin and GND is larger than 500kΩ.

Charger reverse connect protection

If a charger is reversely connected, the SDC6073 will cut off the reverse charging current through the charger.

Release condition:

When the charger is disconnect, the SDC6073 returns to the normal condition.

Load Short-circuit condition

If voltage of VM pin is equal or below short circuit protection voltage V_{SIP}, the IC will stop discharging and the battery is disconnected from load. The maximum delay time to switch current off is t_{SIP}.

Release condition:

This status is released when voltage of VM pin is higher than V_{SIP}, such as disconnecting load.

Charger Detection

When a battery in overdischarge condition is connected to a charger and provided that voltage of VM pin is equal or higher than charger detection voltage V_{CHG}, the SDC6073 releases overdischarge condition when battery voltage becomes equal to V_{DL}.

When a battery in overdischarge condition is connected to a charger and provided that voltage of VM pin is equal or higher than 2.0V (Typical), and lower than charger detection voltage V_{CHA}, the SDC6073 releases overdischarge condition when battery voltage reaches overdischarge detection voltage $V_{DL}+V_{HD}$.

Operation State Diagram

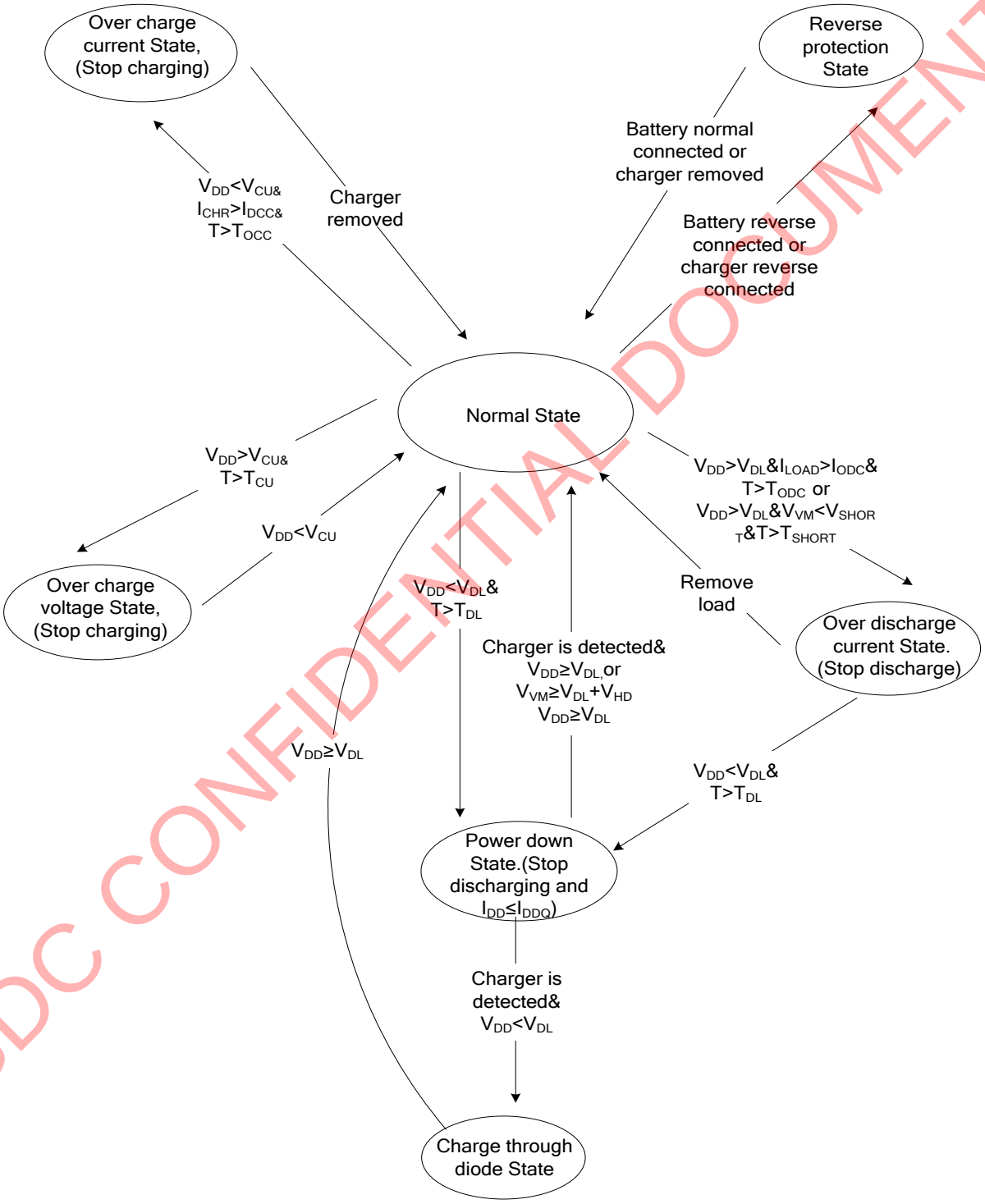
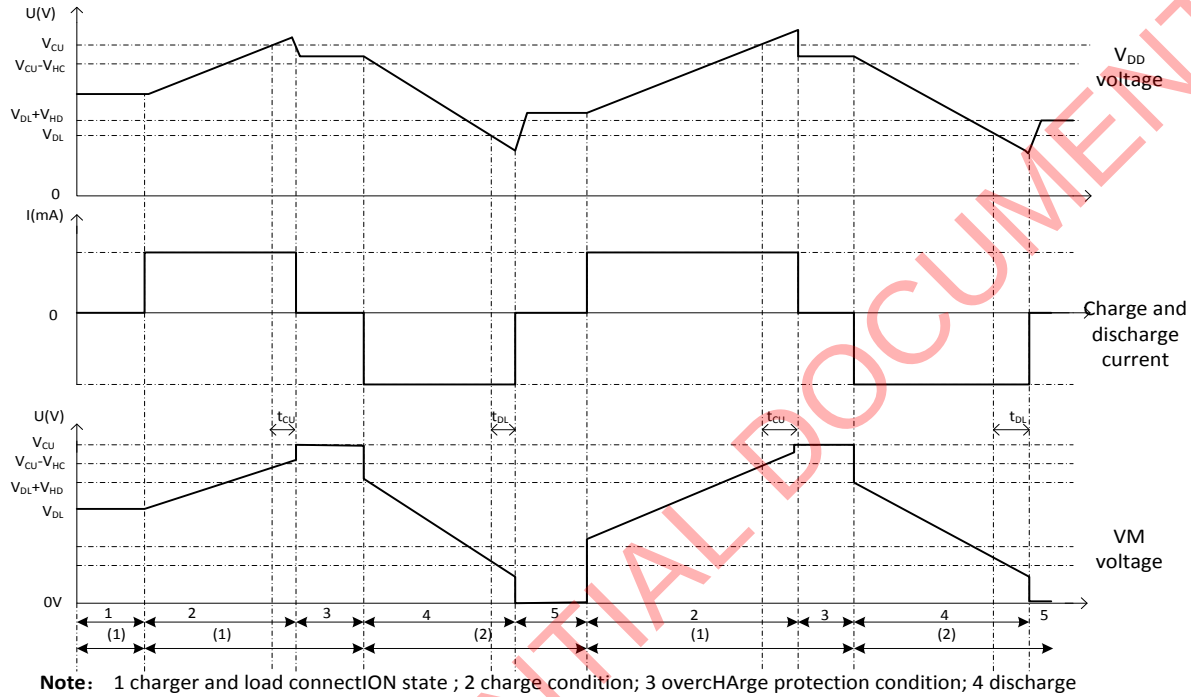


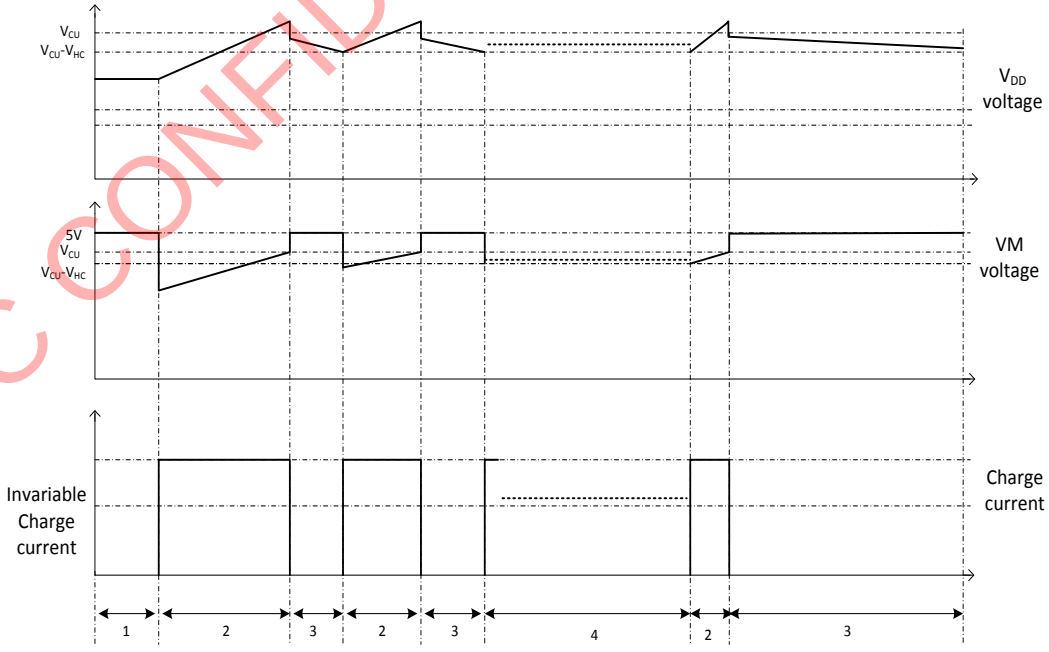
Figure 4. Operation State Diagram

Operation Timing Chart



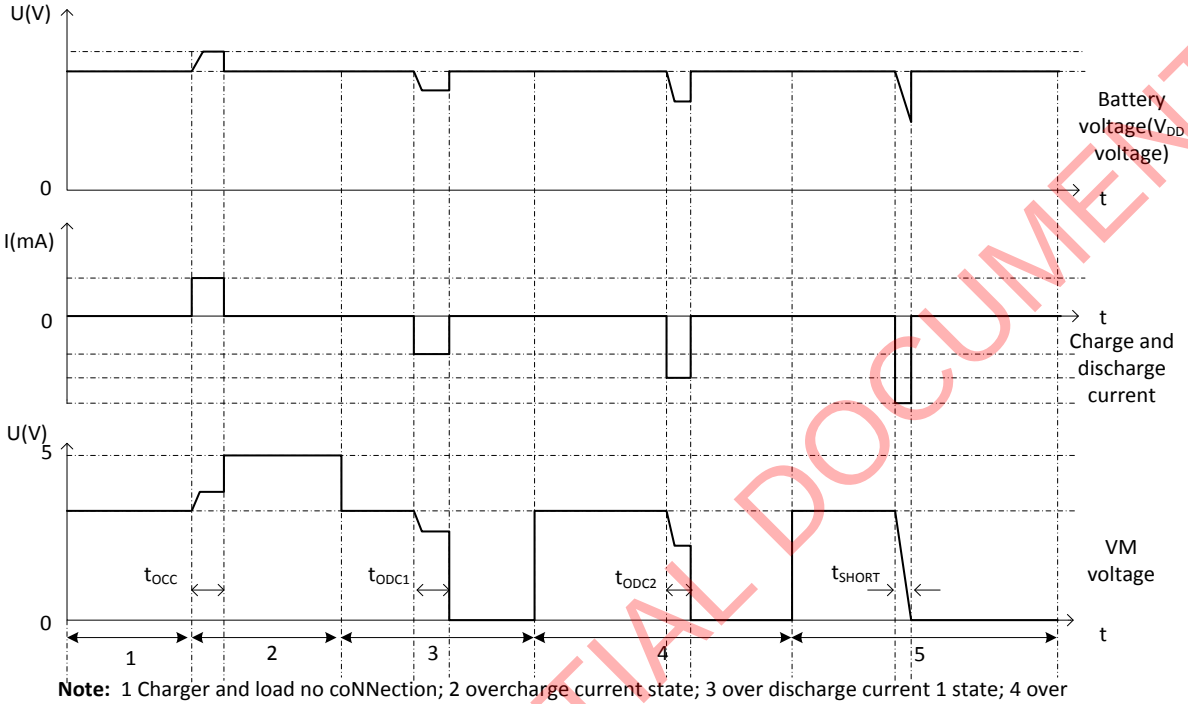
Note: 1 charger and load connectION state ; 2 charge condition; 3 overcHArge protection condition; 4 discharge condition ; 5 over discharge protection condition; （1） the time of charger connection ; （2） the time of load connection

Figure 5. Charge and Discharge circle timing diagram



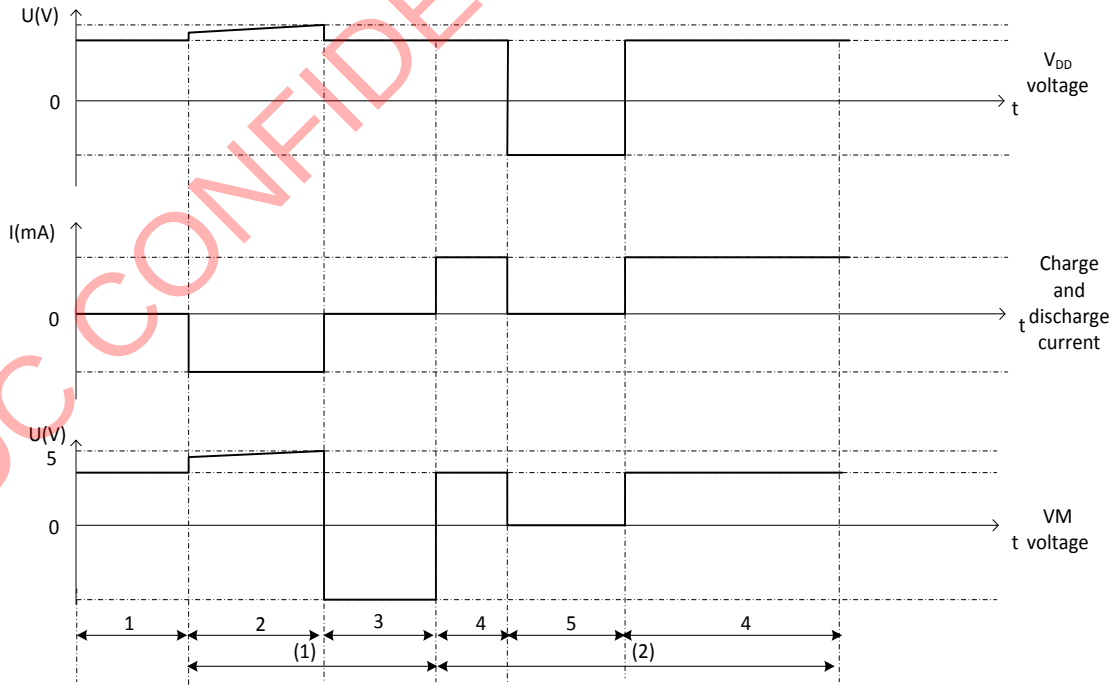
Note: 1 charge no connection state; 2 charge condition ; 3 overcharge protection ; 4 circle condition

Figure 6. Overcharge protection circle timing diagram



Note: 1 Charger and load no coNNection; 2 overcharge current state; 3 over discharge current 1 state; 4 over discharge current 2 state; 5 short-circuit state;

Figure 7. Overcurrent and short-circuit protection state timing diagram



Note: 1 charger and load no connection state ; 2 normally charge; 3 charger reverse connected state ; 4 normally discharge state; 5 Battery reverse connected state； (1) the time of charge connection； (2) the time of load connection

Figure 8. Reverse connected protection state timing diagram

Typical Application

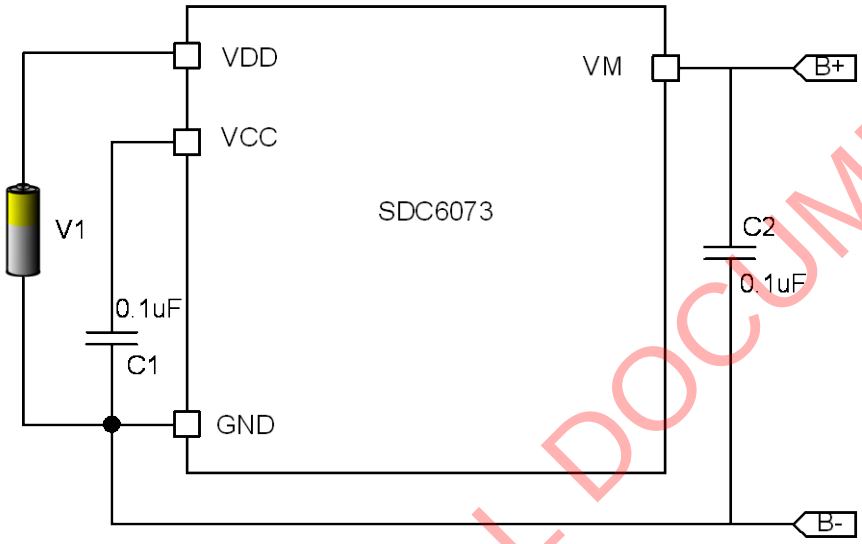


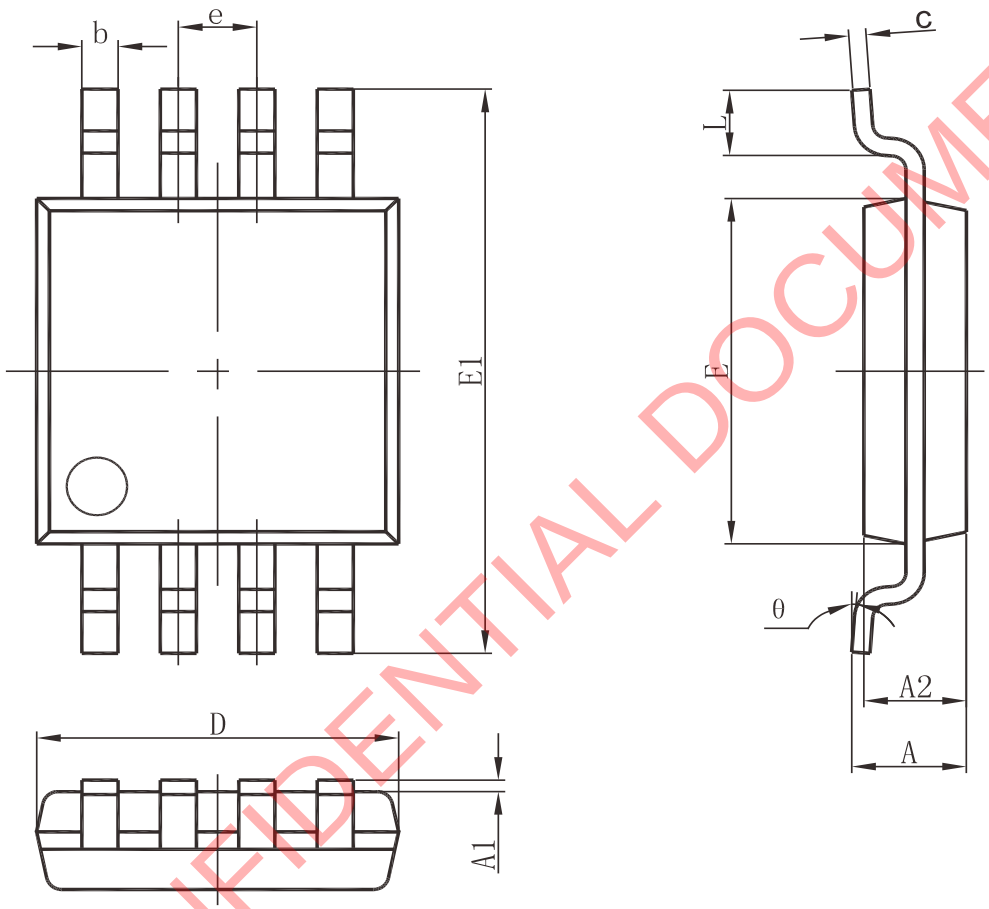
Figure 9. Typical Application

Note:

1. C1 is used for protecting power fluctuation. Recommend Value is 0.1uF, minimum value 0.022uF, and maximum value 1.0uF.
2. The above typical application can not guarantee all cases. Please adjust the value of C1 and C2 according to actual application.

Package Dimension

MSOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E1	4.750	5.050	0.187	0.199
E	2.900	3.100	0.114	0.122
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

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