Datasheet

DW01A

One Cell Lithium-ion/Polymer Battery Protection IC

FORTUNE' Properties For Reference Only

Fortune SEMICONDUCTOR CORPORATION

Fortune Semiconductor Corporation
富晶電子股份有限公司
28F,No.27, Sec. 2, Zhongzheng E. Rd.,
Danshui Dist, New Taipei City 251, Taiwan
Tel.：886-2-28094742
Fax：886-2-28094874
www.ic-fortune.com

FORTUNE' Properties For Reference Only

This manual contains new product information. **Fortune Semiconductor Corporation** reserves the rights to modify the product specification without further notice. No liability is assumed by **Fortune Semiconductor Corporation** as a result of the use of this product. No rights under any patent accompany the sale of the product.

1. General Description

The DW01A battery protection IC is designed to protect lithium-ion/polymer battery from damage or degrading the lifetime due to overcharge, overdischarge, and/or overcurrent for one-cell lithium-ion/polymer battery powered systems, such as cellular phones.
The ultra-small package and less required external components make it ideal to integrate the DW01A into the limited space of battery pack. The accurate ±50mV overcharging detection voltage ensures safe and full utilization charging. The very low standby current drains little current from the cell while in storage.

2. Features

- **Reduction in Board Size due to Miniature Package SOT-23-6.**
- **Ultra-Low Quiescent Current at 3μA (Vcc=3.9V).**
- **Ultra-Low Overdischarge Current at 3μA (Vcc=2.0V).**
- **Precision Overcharge Protection Voltage 4.3V ± 50mV**
- **Load Detection Function during Overcharge Mode.**
- **Two Detection Levels for Overcurrent Protection.**
- **Delay times are generated by internal circuits. No external capacitors required.**

3. Ordering Information

DW01A-G

PACKAGE TYPE
SOT-23-6(G stands for Green-Package)

TEMPERATURE RANGE
-40°C~+85°C

OVERCHARGE PROTECTION
4.3V± 50mV

4. Applications

- **Protection IC for One-Cell Lithium-Ion / Lithium-Polymer Battery Pack**

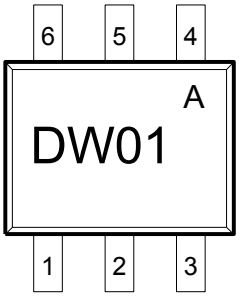
FORTUNE Properties For Reference Only

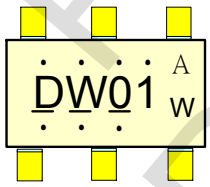
5. Product Name List

Model	Package	Overcharge detection voltage [VOCP] (V)	Overcharge release voltage [VOCR] (V)	Overdischarge detection voltage [VODP] (V)	Overdischarge release voltage [VODR] (V)	Overcurrent detection voltage [VOI1] (mV)
DW01A	SOT-23-6	4.300±0.050	4.100±0.050	2.40±0.100	3.0±0.100	150±30

6. Pin Configuration and Package Marking Information

Pin No.	Symbol	Description
1	OD	MOSFET gate connection pin for discharge control
2	CS	Input pin for current sense, charger detect
3	OC	MOSFET gate connection pin for charge control
4	TD	Test pin for reduce delay time
5	VCC	Power supply, through a resistor (R1)
6	GND	Ground pin

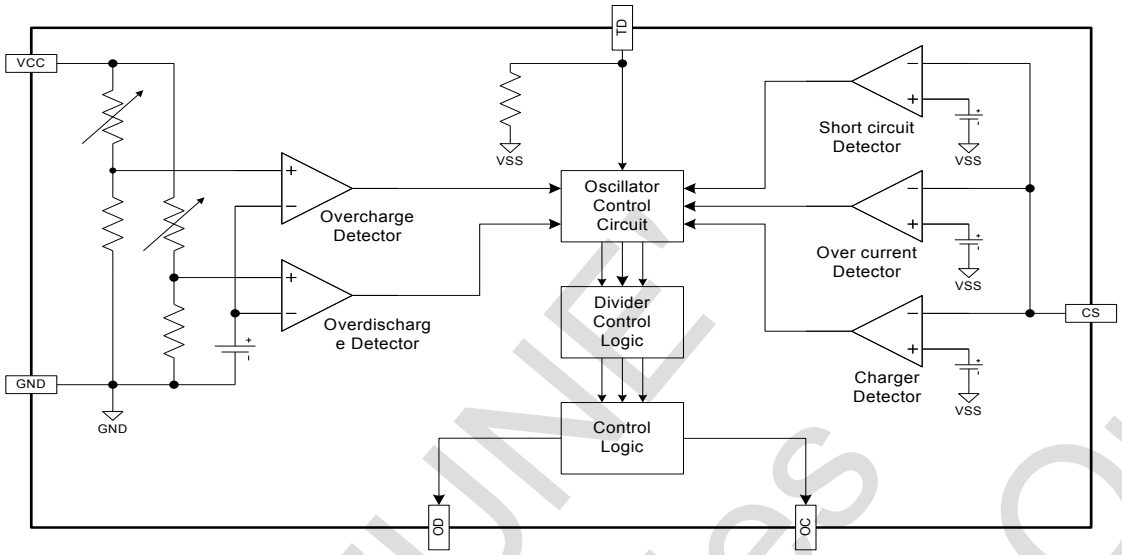




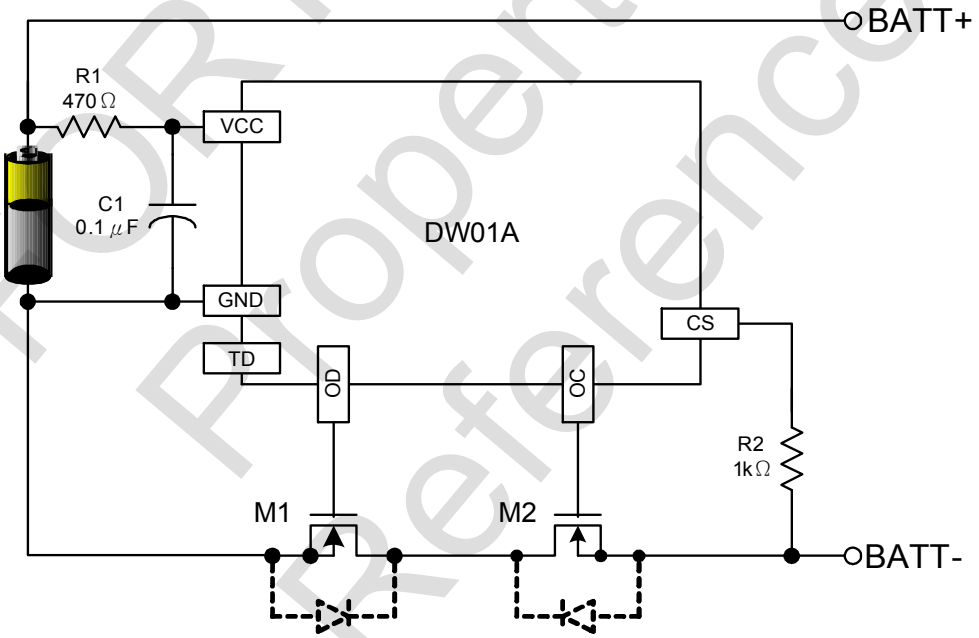
Top Point and Under_line：Lot No.
Bottom Point：Year
w : week, A~Z & A ~ Z

FORTUNE Properties For Reference Only

7. Functional Block Diagram



8. Typical Application Circuit



Symbol	Purpose	Recommended	Remakes
R1	ESD protection. For power fluctuation.	100~470Ω	Resistance should be as small as possible to avoid lowering of the overcharge detection accuracy caused by VDD pin current. Use 470Ω for better ESD protection.
C1	For power fluctuation.	0.1μF	
R2	Protection for reverse connection of a charger.	1k~2kΩ	Select a resistance as large as possible to prevent large current when a charge is connected in reverse.

FORTUNE Properties For Reference Only

9. Absolute Maximum Ratings

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

Item	Symbol	Rating	Unit
Input voltage between VCC and GND *	VCC	GND-0.3 to GND+10	V
OC output pin voltage	VOC	VCC -24 to VCC +0.3	V
OD output pin voltage	VOD	GND-0.3 to VCC +0.3	V
CS input pin voltage	VCS	VCC -24 to VCC +0.3	V
Operating Temperature Range	TOP	-40 to +85	°C
Storage Temperature Range	TST	-40 to +125	°C

Note: DW01A contains a circuit that will protect it from static discharge; but please take special care that no excessive static electricity or voltage which exceeds the limit of the protection circuit will be applied to it.

FORTUNE Properties For Reference Only

10. Electrical Characteristics

(Ta=25°C unless otherwise specified)

PARAMETER	TEST CONDITIONS	SYMBOL	Min	Typ	Max	UNIT
Supply Current	VCC=3.9V	ICC		3.0	6.0	μA
Overdischarge Current	VCC=2.0V	IOD		1.5	3	μA
Overcharge Protection Voltage	DW01A	VOCP	4.25	4.30	4.35	V
Overcharge Release Voltage		VOCR	4.05	4.10	4.15	V
Overdischarge Protection Voltage		VODP	2.30	2.40	2.50	V
Overdischarge Release Voltage		VODR	2.90	3.00	3.10	V
Overcurrent Protection Voltage		VOIP（VOI1）	120	150	180	mV
Short Current Protection Voltage	VCC=3.6V	VSIP（VOI2）	1.00	1.35	1.70	V
0V battery charge inhibition battery voltage		V_{0INH}			1.5V	V
Overcharge Delay Time		TOC		80	200	ms
Overdischarge Delay Time	VCC=3.6V to 2.0V	TOD		40	100	ms
Overcurrent Delay Time (1)	VCC=3.6V	TOI1		10	20	ms
Overcurrent Delay Time (2)	VCC=3.6V	TOI2		5	50	μs
Charger Detection Threshold Voltage		VCHA	-1.2	-0.7	-0.2	V
OD Pin Output “H” Voltage		VDH	VCC-0.1	VCC-0.02		V
OD Pin Output “L” Voltage		VDL		0. 1	0.5	V
OC Pin Output “H” Voltage		VCH	VCC-0.1	VCC-0.02		V
OC Pin Output “L” Voltage		VCL		0.1	0.5	V

FORTUNE Properties For Reference Only

11. Description of Operation

Normal Condition

If VODP<VCC<VOCP and VCH<VCS<VOI1, M1 and M2 are both turned on. The charging and discharging processes can be operated normally.

Overcharge Protection

When the voltage of the battery cell exceeds the overcharge protection voltage (VOCP) beyond the overcharge delay time (TOC) period, charging is inhibited by turning off of the charge control MOSFET. The overcharge condition is released in two cases:

The voltage of the battery cell becomes lower than the overcharge release voltage (VOCR) through self-discharge.

The voltage of the battery cell falls below the overcharge protection voltage (VOCP) and a load is connected.
When the battery voltage is above VOCP, the overcharge condition will not release even a load is connected to the pack.

Overdischarge Protection

When the voltage of the battery cell goes below the overdischarge protection voltage (VODP) beyond the overdischarge delay time (TOD) period, discharging is inhibited by turning off the discharge control MOSFET.

The default of overdischarge delay time is 10ms. Inhibition of discharging is immediately released when the voltage of the battery cell becomes higher than overdischarge release voltage (VODR) through charging.

Overcurrent Protection

In normal mode, the DW01A continuously monitors the discharge current by sensing the voltage of CS pin. If the voltage of CS pin exceeds the overcurrent protection voltage (VOIP) beyond the overcurrent delay time (TOI1) period, the overcurrent protection circuit operates and discharging is inhibited by turning off the discharge control MOSFET. The overcurrent condition returns to the normal mode when the load is released or the impedance between BATT+ and BATT- is larger than 500kΩ. The DW01A provides two overcurrent detection levels (0.15V and 1.35V) with two overcurrent delay time (TOI1 and TOI2) corresponding to each overcurrent detection level.

Charge Detection after Overdischarge

When overdischarge occurs, the discharge control MOSFET turns off and discharging is inhibited. However, charging is still permitted through the parasitic diode of MOSFET. Once the charger is connected to the battery pack, the DW01A immediately turns on all the timing generation and detection circuitry. Charging progress is sensed if the voltage between CS and GND is below charge detection threshold voltage (VCH).

Auto Power Down recovery

The IC continues to operate even after the overdischarge state has been entered. The battery voltage rising to the overdischarge release voltage(VODR) or higher is the only required condition for the IC to return to the normal state.

FORTUNE Properties For Reference Only

12. Design Guide

Selection of External Control MOSFET

Because the overcurrent protection voltage is preset, the threshold current for overcurrent detection is determined by the turn-on resistance of the charge and discharge control MOSFETs. The turn-on resistance of the external control MOSFETs can be determined by the equation: RON=VOIP/ (2 x IT) (IT is the overcurrent threshold current). For example, if the overcurrent threshold current IT is designed to be 3A, the turn-on resistance of the external control MOSFET must be 25mΩ. Be aware that turn-on resistance of the MOSFET changes with temperature variation due to heat dissipation. It changes with the voltage between gate and source as well. (Turn-on resistance of MOSFET increases as the voltage between gate and source decreases). As the turn-on resistance of the external MOSFET changes, the design of the overcurrent threshold current changes accordingly.

Suppressing the Ripple and Disturbance from Charger

To suppress the ripple and disturbance from charger, connecting R1 and C1 to VCC is recommended.

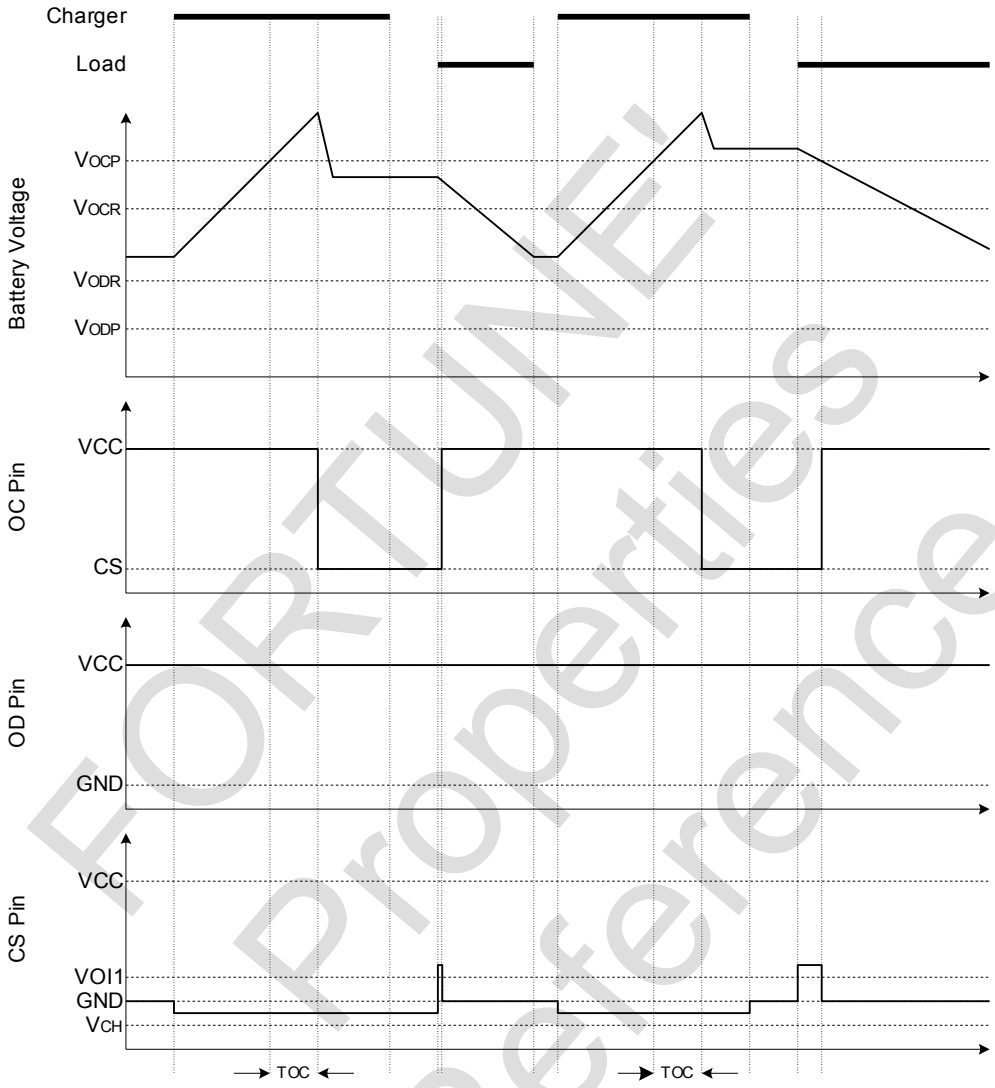
Protection the CS pin

R2 is used for latch-up protection when charger is connected under overdischarge condition and overstress protection at reverse connecting of a charger.

FORTUNE Properties For Reference Only

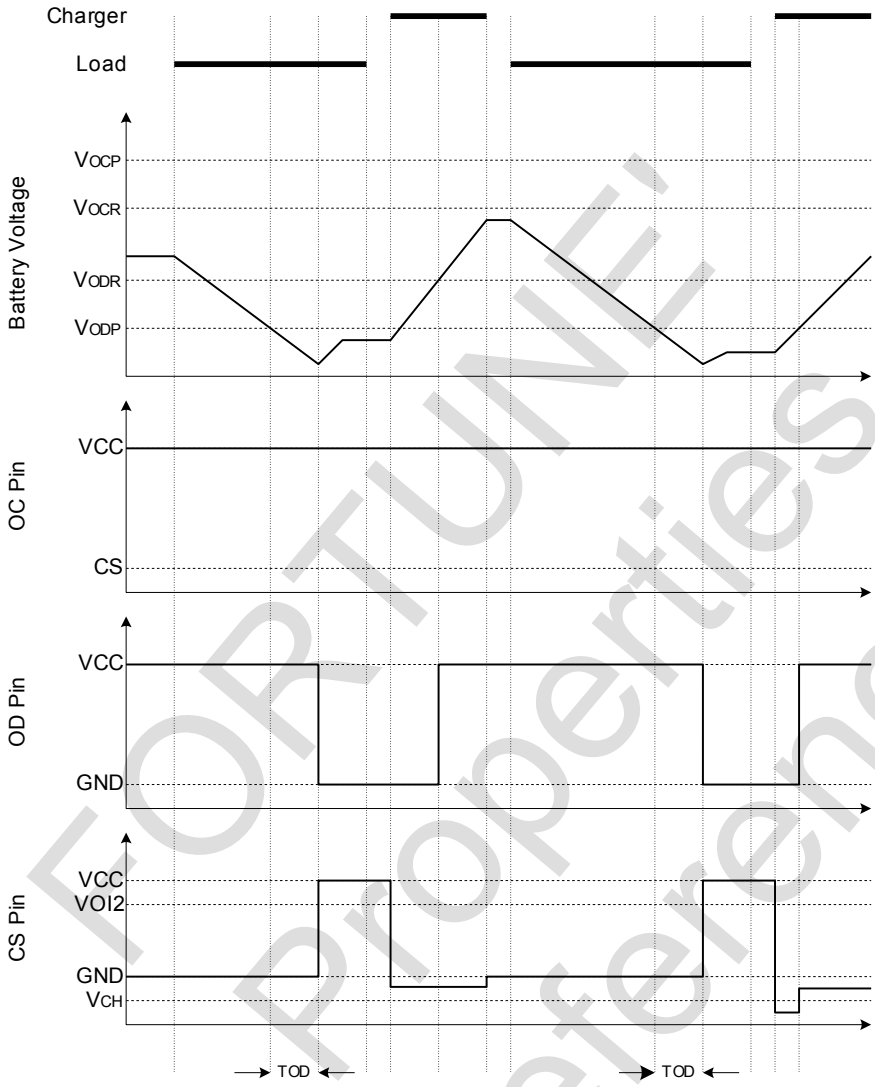
13. Timing Diagram

Overcharge Condition →Load Discharging → Normal Condition



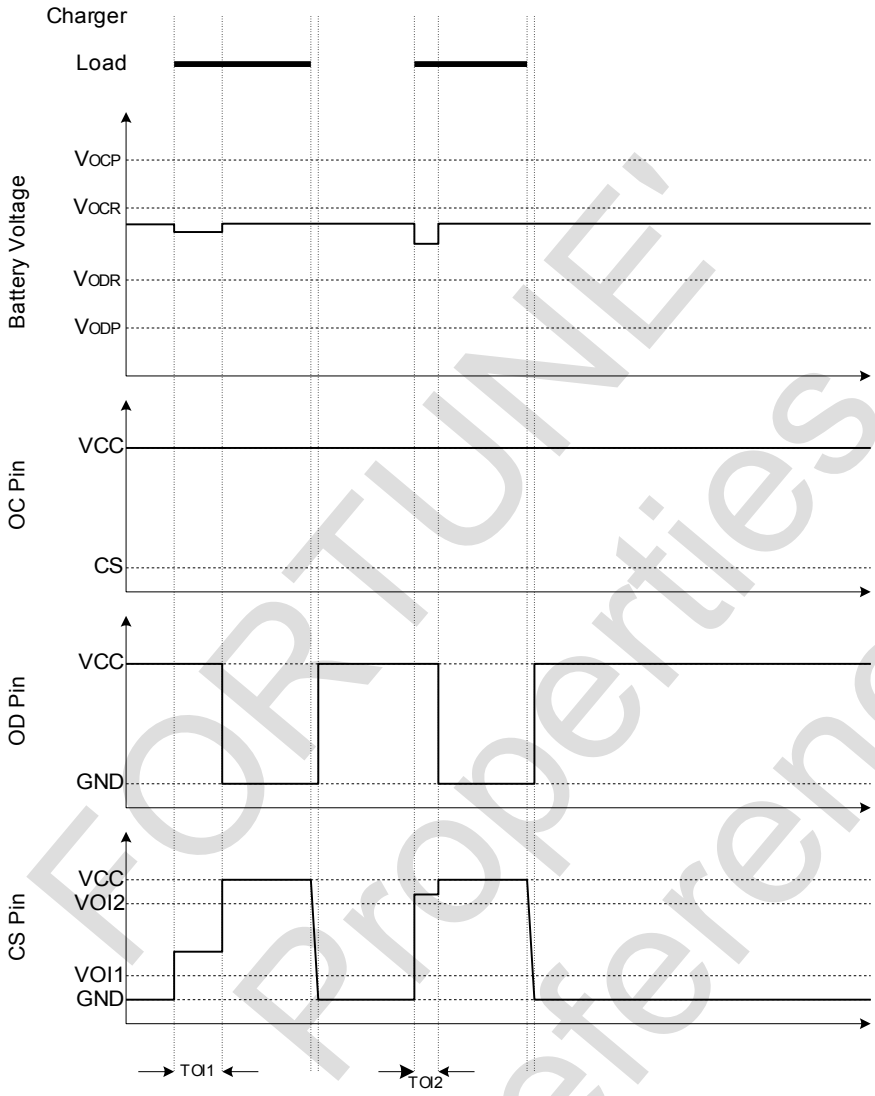
FORTUNE Properties For Reference Only

Overdischarge Condition → Charging by a Charger →Normal Condition



FORTUNE Properties For Reference Only

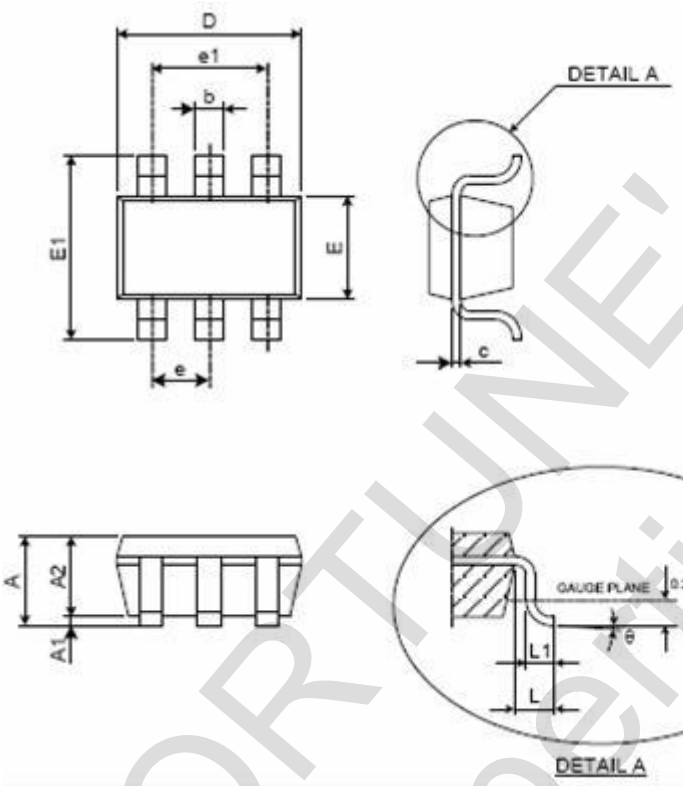
Over Current Condition → Normal Condition



FORTUNE Properties For Reference Only

14. Package Outline

Dimension



	Min.	TYP.	Max.
A	-	-	1.45
A1	0	-	0.15
A2	0.90	1.15	1.30
b	0.30	-	0.50
c	0.08	-	0.22
D	2.75	2.90	3.05
E	1.45	1.60	1.75
E1	2.60	2.80	3.00
e	0.95 BSC		
e1	1.90 BSC		
L	0.60 REF		
L1	0.30	0.45	0.60
Theta	0	4	8

15. Revision History

Version	Date	Page	Description
1.0	2009/06/24	ALL	New release
1.1	2010/06/10	8	Add Auto Power Down recovery
1.2	2011/09/07	13	Revise Package Outline
1.3	2011/09/16	5, 7	Revise Typical Application Circuit information Add 0V Charging prohibit

FORTUNE Properties For Reference Only