/ Revised record

C	2018-4				
D	2019-3-25	1			
E	2020-1-3		Rdson 50		
F	2020-4-13	2	3230		

/ Descriptions

BRCL3160MF / BRCL3160MF
MOSFET
BRCL3160MF SOT23-6
BRCL3160MF

The BRCL3160MF series product is a high integration solution for lithium-lion/polymer battery protection.BRCL3160MF contains advanced power MOSFET, high-accuracy voltage detection circuits and delay circuits.
BRCL3160MF is put into an ultra-small SOT23-6 package and only one external component makes it an ideal solution in limited space of battery pack. BRCL3160MF has all the protection functions required in the battery application including overcharging, overdischarging, overcurrent and load short circuiting protection etc. The accurate overcharging detection voltage ensures safe and full utilization charging.The low standby current drains little current from the cell while in storage. The device is not only targeted for digital cellular phones, but also for any other Li-Ion and Li-Poly battery-powered information appliances requiring long-term battery life.

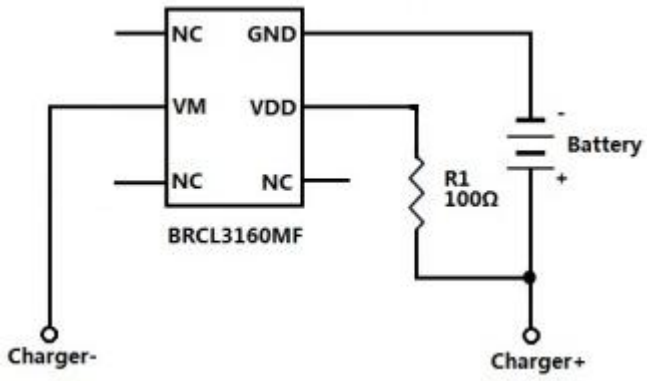
/ Features

- 50mΩ MOSFET
- SOT23-6
- 2
- 0V
- 2.8uA 1.5uA; ROHS
-
- Integrate advanced power MOSFET with Equivalent of 50mΩ $R_{DS(ON);}$
- Ultra-small SOT23-6 package;
- Over-temperature Protection; Overcharge Current Protection; Two-step Overcurrent Detection: Overdischarge Current; Load Short Circuiting.
- Charger detection function; 0V battery charging function; delay times are generated inside;High-accuracy voltage detection.
- Low Current Consumption; Operation Mode: 2.8uA typ; Power-down Mode: 1.5uA typ ; RoHS Compliant and Lead (Pb) Free.
- Halogen-free Product.

/ Applications

One-Cell lithium-ion battery pack; Lithium-Polymer battery pack.

/ Typical Application



(1)

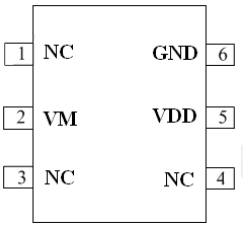
(2)

Notes：

(1) The chip power consumption shall not exceed the maximum power consumed by the package.

(2) This product has anti-static protection function, but do not exceed the maximum capacity of the product to withstand static electricity.

/ Pinning



Pin Number	Pin Name	Pin Description
1	NC	No electrical connection.
2	VM	The negative terminal of the charger. The internal FET switch connects this terminal to GND.
3	NC	No electrical connection.
4	VT	No electrical connection.
5	VDD	Power Supply.
6	GND	Ground, connect the negative terminal of the battery to this pin.

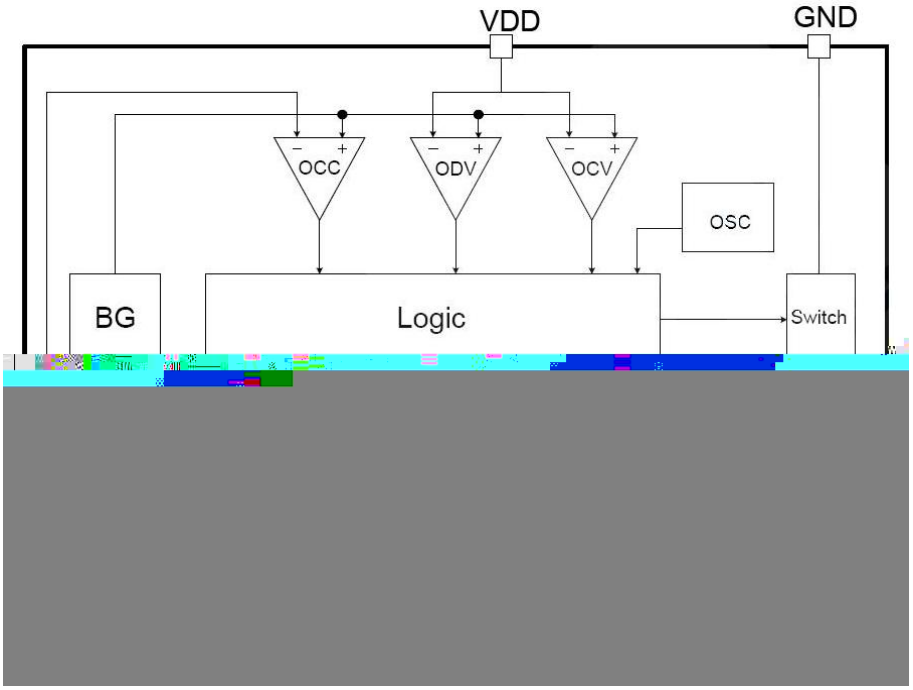
/ Marking

See Marking Instructions.

/Parameter	/Symbol	/Value	/Unit
V_{DD} input pin voltage	V_{IN}	-0.3 to +6.0	V
V_M input pin voltage	V_{VM}	-6.0 to +10	V
Power Dissipation	P_D	400	mW
Maximum Junction Temperature	T_J	125	℃
Lead Temperature	T_L	300	℃
Operating Junction Temperature	T_{opr}	-40 to +85	℃
Storage Temperature	T_{stg}	-55 to +150	℃
Package Thermal Resistance	$R_{\theta JA}$	250	℃/W
	$R_{\theta Jc}$	130	℃/W
ESD	ESD	2000	V

/Parameter	/Symbol	/Test Condition	/Min	/Typ	/Max	/Unit
Overcharge Detection Voltage	V_{CU}		4.25	4.30	4.35	V
Overcharge Release Voltage	V_{CL}		4.05	4.10	4.15	V
Overdischarge Detection Voltage	V_{DL}		2.30	2.40	2.50	V
Overdischarge Release Voltage	V_{DR}		2.90	3.00	3.10	V
Charger Detection Voltage	V_{CHA}			-0.12		V
Overdischarge Current1 Detection	I_{IOV1}	V_{dd}=3.5V		3.0		A
Load Short-Circuiting Detection	I_{SHORT}	V_{dd}=3.5V		12		A
C… Oper…				2.80		µA

Functionl Block Diagram



Functional Description

BRCL3160MF

MOSFET

50mΩ

The BRCL3160MF monitors the voltage and current of a battery and protects it from being damaged due to overcharge voltage, overdischarge voltage, overdischarge current, and short circuit conditions by disconnecting the battery from the load or charger. The peripheral circuit is very simple. The MOSFET is integrated and its $R_{DS(ON)}$ is as low as 50mΩ typical.

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 Condition

VCU ,
TCU BRCL3160MF FET

1 VCL BRCL3160MF
2 BRCL3160MF
VM 0.7V
BRCL3160MF VCU
VCU BRCL3160MF VCU
VCU
VM 1
VCU VCU
1 2 VCU
1 2

When the battery voltage becomes higher than the overcharge detection voltage (VCU) during charging under normal condition and the state continues for the overcharge detection delay time (TCU) or longer, the BRCL3160MF turns the charging control FET off to stop charging. This condition is called the overcharge condition.
The overcharge condition is released in the following two cases:
1 When the battery voltage drops below the overcharge release voltage (VCL), the BRCL3160MF turns the charging control FET on and returns to the normal condition.
2 When a load is connected and discharging starts, the BRCL3160MF turns the charging control FET on and returns to the normal condition.

Overdischarge Condition

VDL ,
TDL BRCL3160MF
FET VM VM VDD RVMD
IPDN VM VDD
RVMD VM VCHA ,
FET (VDL) BRCL3160MF
FET
VM VCHA ,
VDR

When the battery voltage drops below the overdischarge detection voltage (VDL) during discharging under normal condition and it continues for the overdischarge detection delay time (tDL) or longer, the BRCL3160MF turns the discharging control FET off and stops discharging. This condition is called overdischarge condition. After the discharging control FET is turned off, the VM pin is pulled up by the RVMD resistor between VM and VDD in BRCL3160MF the current of the chip is reduced to the power-down current (IPDN). This condition is called power-down condition. The VM and VDD pins are shorted by the RVMD resistor. The power-down condition is released when a charger is connected and the potential difference between VM and VDD becomes typical or higher,at this time, the FET is still off. When the battery voltage becomes the overdischarge detection voltage (VDL) or higher (see note), the BRCL3160MF turns the FET on and changes to the normal condition from the overdischarge condition.
Note: If the VM pin voltage is no less than the charger detection voltage (VCHA), when the battery under overdischarge condition is connected to a charger, the overdischarge condition is released (the discharging control FET is turned on) as usual, provided that the battery voltage reaches the overdischarge release voltage (VDR) or higher.

Overcurrent Condition

VM ,
,BRCL3160MF FET
1 2 ,VM GND RVMS
VM VDD
VM GND RVMS VM VM
1

When the discharging current becomes equal to or higher than a specified value (the VM pin voltage is equal to or higher than the overcurrent detection voltage) during discharging under normal condition and the state continues for the overcurrent detection delay time or longer, the BRCL3160MF turns off the discharging control FET to stop discharging. This condition is called overcurrent condition. (The overcurrent includes overcurrent, or load shortcircuiting.) The VM and GND pins are shorted internally by the RVMS resistor under the overcurrent condition. When a load is connected, the VM pin voltage equals the VDD voltage due to the load.
Because of the connection between the VM and the GND by the RVMS resistor when the load is removed, the VM pin goes back to the GND potential since the VM pin is shorted the GND pin with the RVMS resistor. Detecting that the VM pin potential is lower than the overcurrent detection voltage (VIOV1), the IC returns to the normal condition.

Abnormal Charge Current Detection

VM (VCHA)
(TCU) BRCL3160MF FET
VM GND (VCHA) 0V
0V

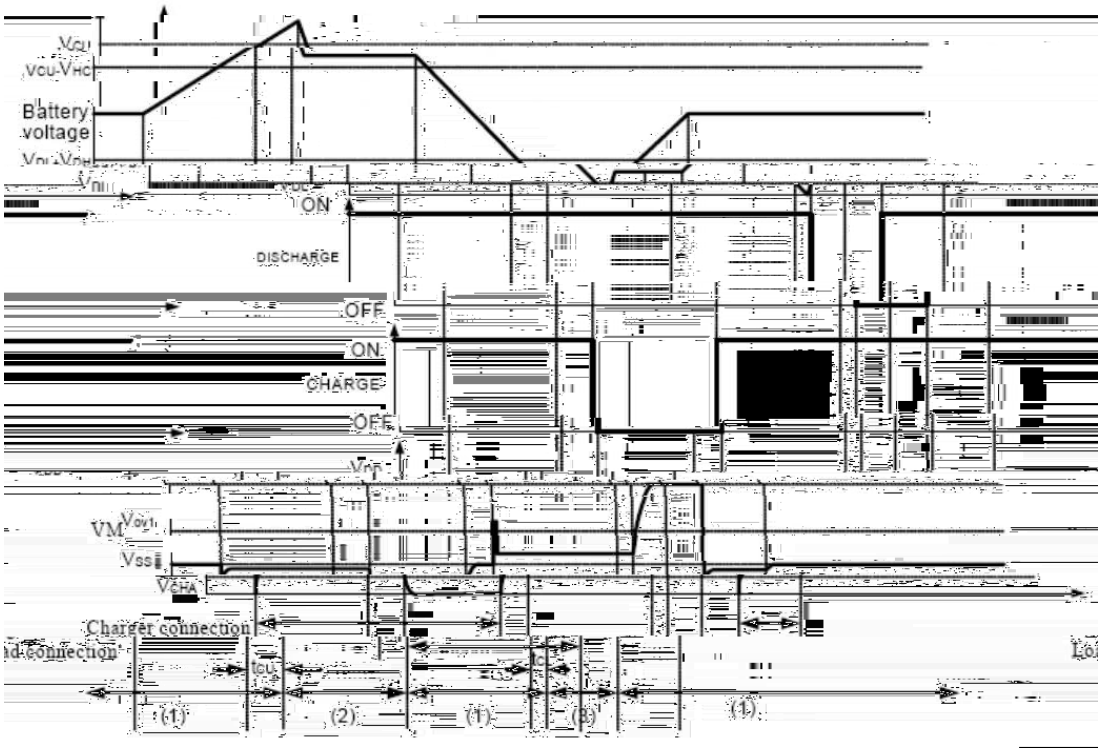
If the VM pin voltage drops below the charger detection voltage (VCHA) during charging under the normal condition and it continues for the overcharge detection delay time (TCU) or longer, the BRCL3160MF turns the charging control FET off and stops charging. This action is called abnormal charge current detection.
Abnormal charge current detection is released when the voltage difference between VM pin and GND pin becomes higher than the charger detection voltage (VCHA) by separating the charger. Since the 0 V battery charging function has higher priority than the abnormal charge current detection function, abnormal charge current may not be detected by the product with the 0 V battery charging function while the battery voltage is low.

Load Short-circuiting Condition

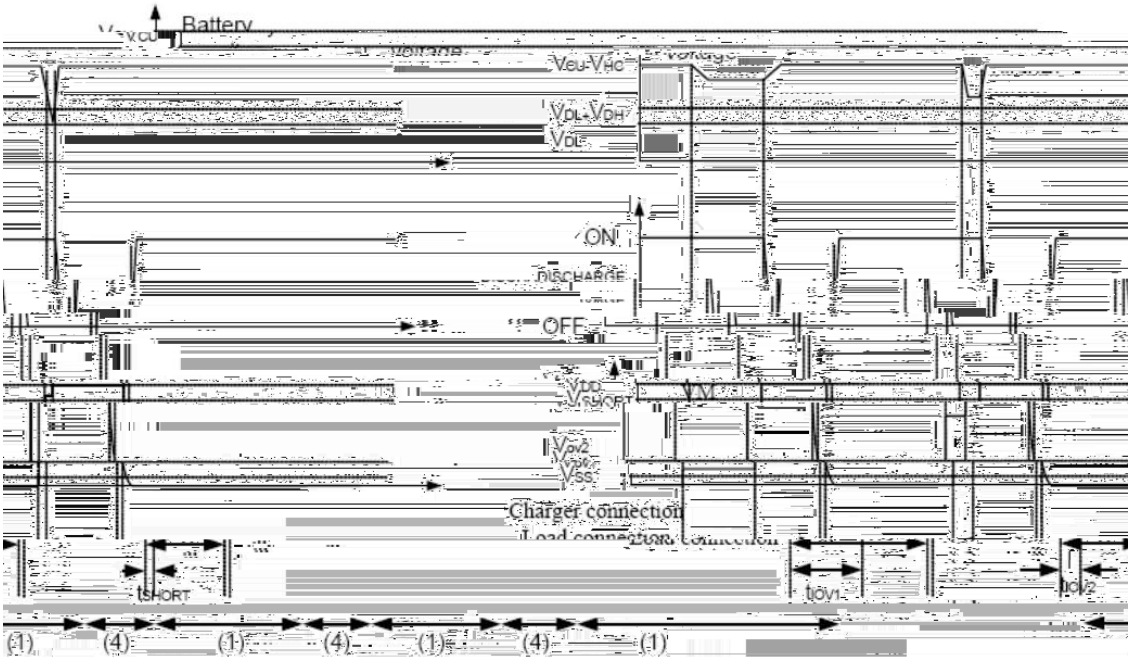
VM VSHORT tSHORT
BRCL3160MF VM VSHORT

Timing Chart

Overcharge And Overdischarge Detection

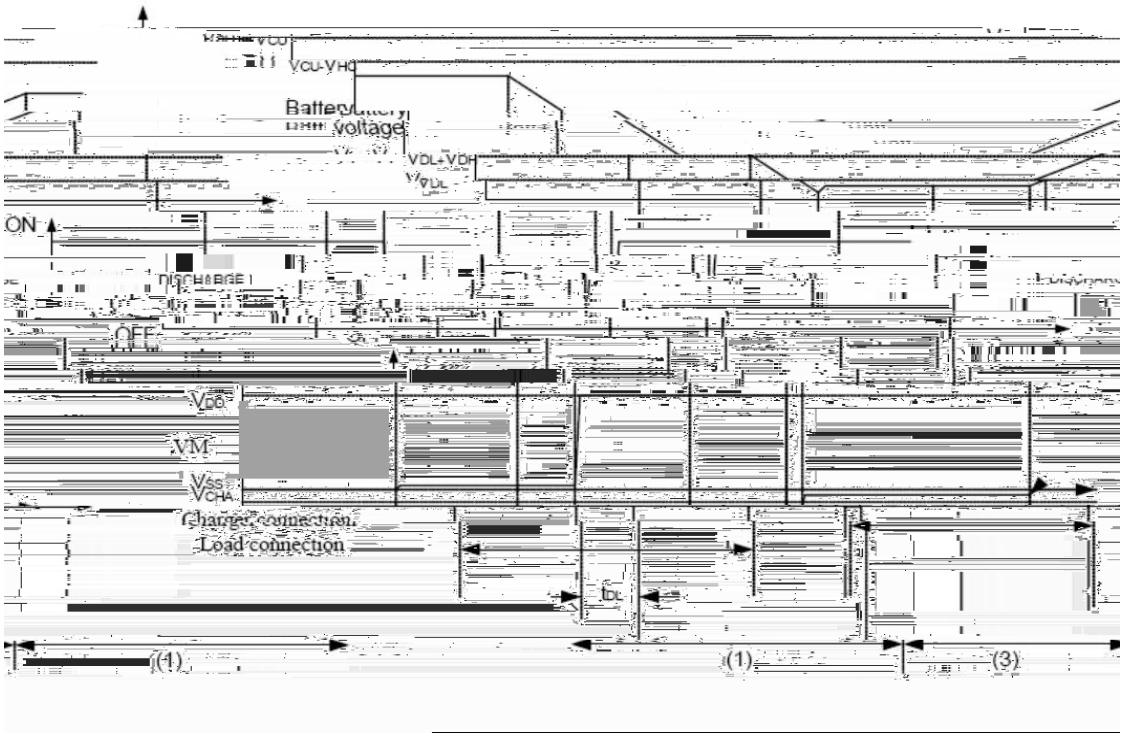


Overdischarge Current Detection

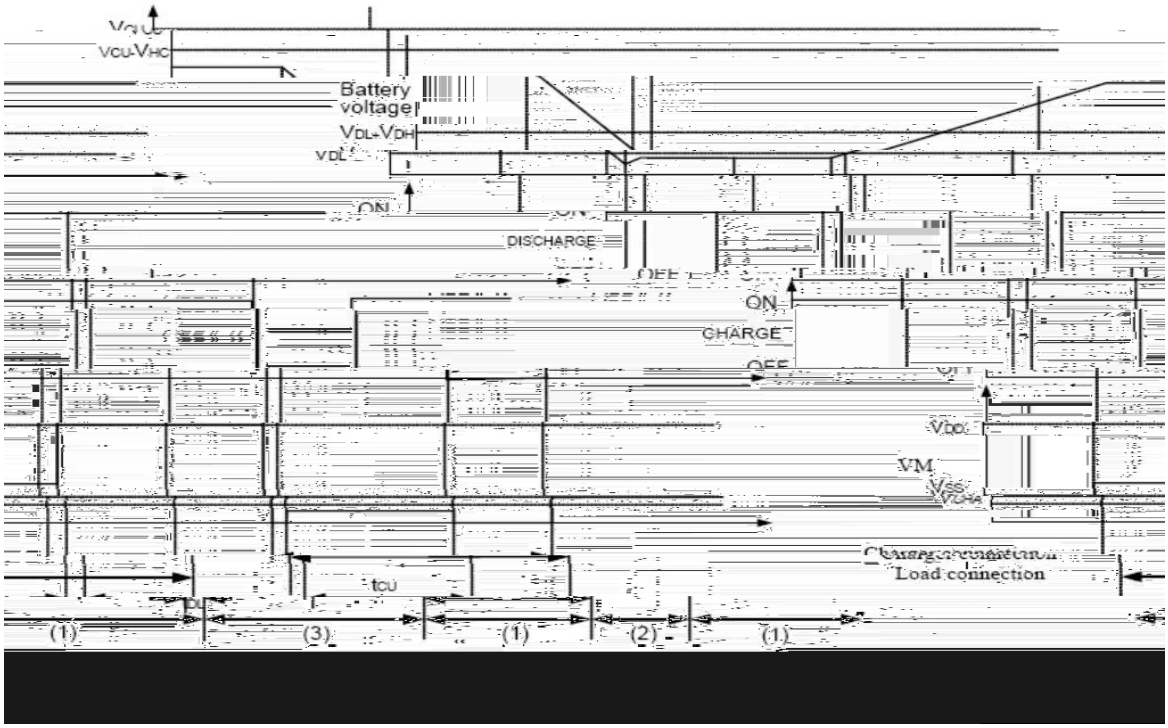


Timing Chart

Charger Detection

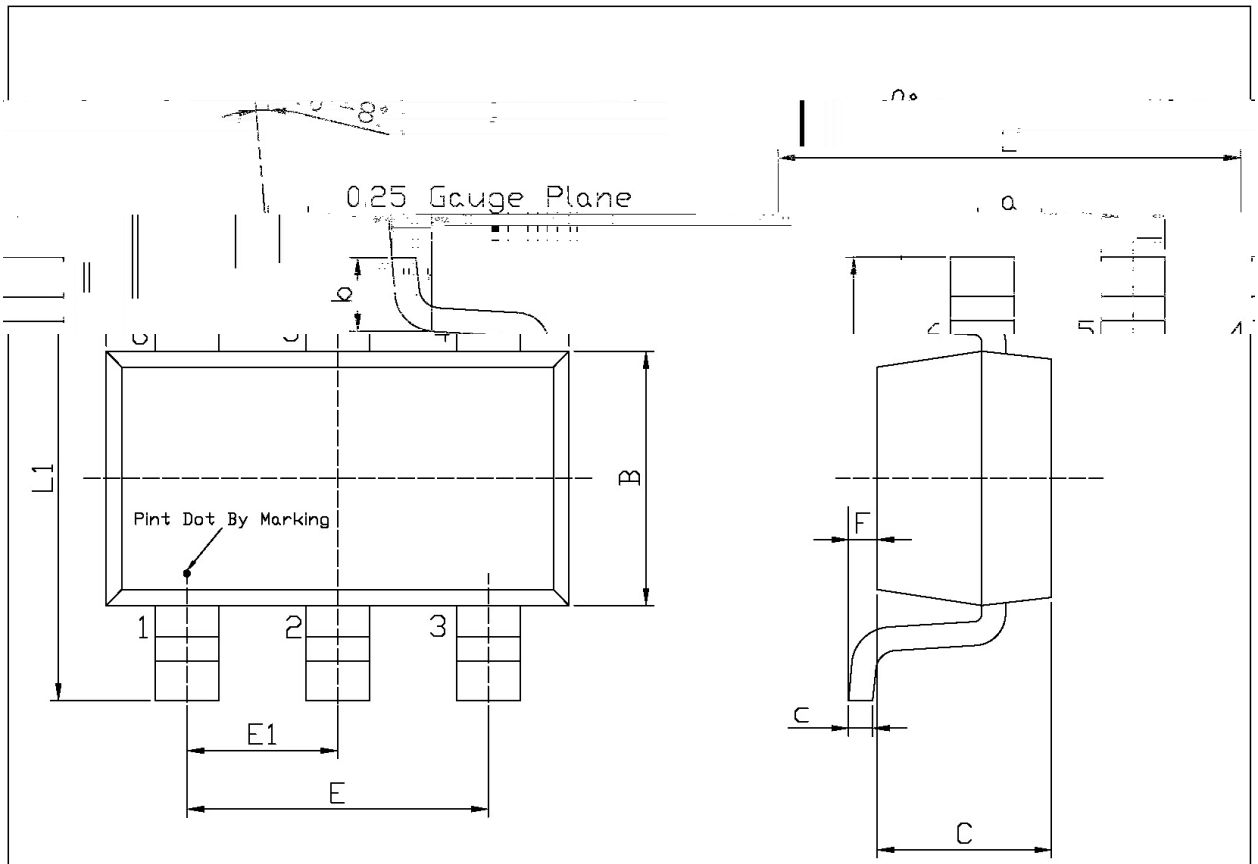


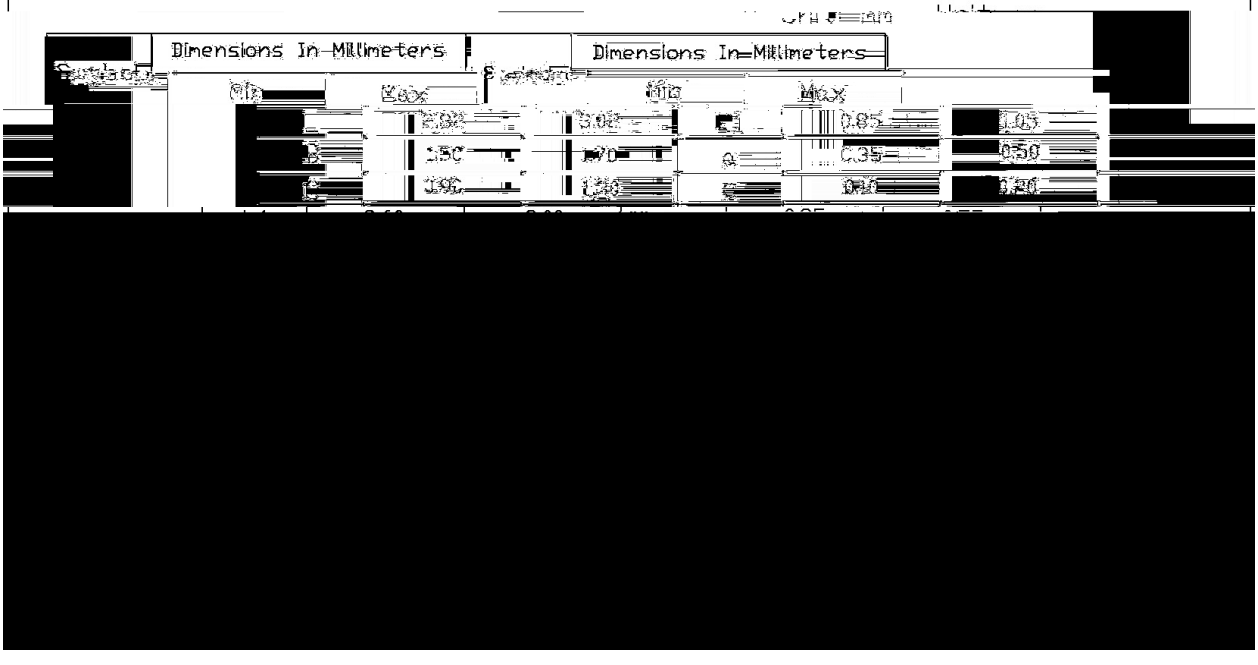
Abnormal Charge Detection

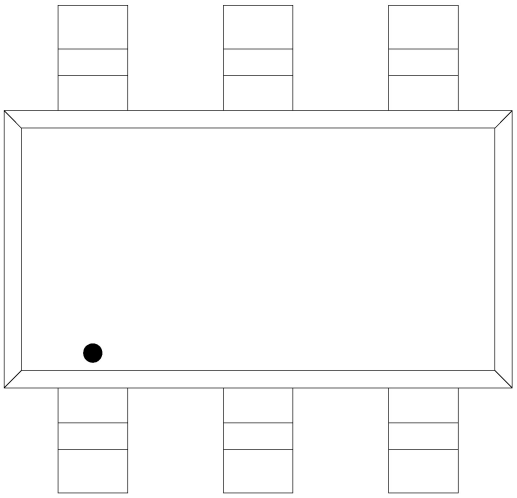


Notes: (1) Normal condition (2) Overcharge voltage condition (3) Overdischarge voltage condition (4) Overcurrent condition

/ Package Dimensions







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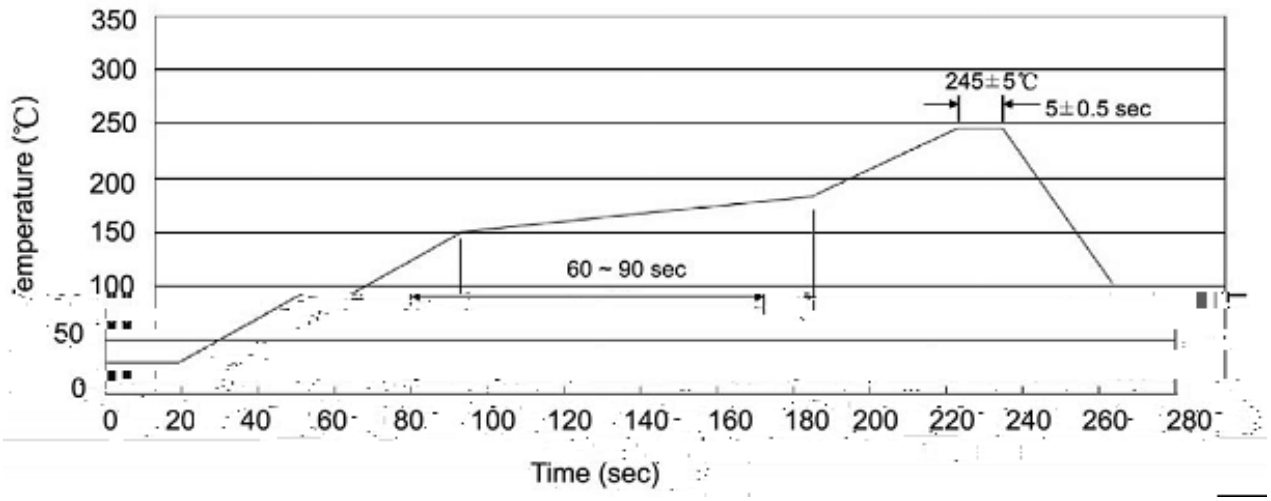

Note:

1 150 180 60 90se: 60 n