Li-Ion/Polymer 1-cell Protector ME4210

Description

ME4210 series IC is a single lithium ion/lithium polymer battery protection IC with built-in high precision voltage detection circuit and delay circuit. It is suitable for overcharge, overdischarge, overcurrent, battery reverse connection, charger reverse connection and overheat protection of single rechargeable lithium ion/lithium polymer battery. The working voltage of the chip is 1.5V~5V, with built-in low impedance MOS and 3.0uA low static current in normal operation.

Feature

（1）High accuracy detection voltage

●Overcharge detection voltage V_{CU}	4.10V～4.50V	precision	±25mV
●Overcharge release voltage V_{CR}	3.90V～4.30V	precision	±50mV
●Overdischarge detection voltage V_{DL}	2.00V～3.20V	precision	±50mV
●Overdischarge release voltage V_{DR}	2.30V～3.40V	precision	±50mV

（2）Internal fixed output delay time（ not need external capacitors）

●Overcharge detection output Delay	typical values 160ms
●Overdischarge detection output Delay	typical values 40ms
●Overcurrent detection of discharge output Delay	typical values 10ms
●Overcurrent detection of charge output Delay	typical values 10ms
●Short Circuit detection output delay	typical values 75μs

（3）MOS with built-in low impedance

（4）Overcurrent and Short Circuit Protection of Discharge

（5）Simple peripheral, only one capacitor is needed, which greatly reduces the system space.

（6）Low current consumption

● At working conditions	typical values 3.0μA,the maximum 6.0μA（VDD=3.5V）
● At low consumption conditions	the maximum 1.5μA,the maximum 3.0μA（VDD=2.0V,VM floating）
● At sleeping conditions	the maximum 0.1μA（VDD=2.0V,VM floating）

（7）Battery Back Connection Protection

（8）Charger Back Connection Protection

（9）Temperature Overheating Protection

（10）Zero Voltage Battery Charging Function

Applications

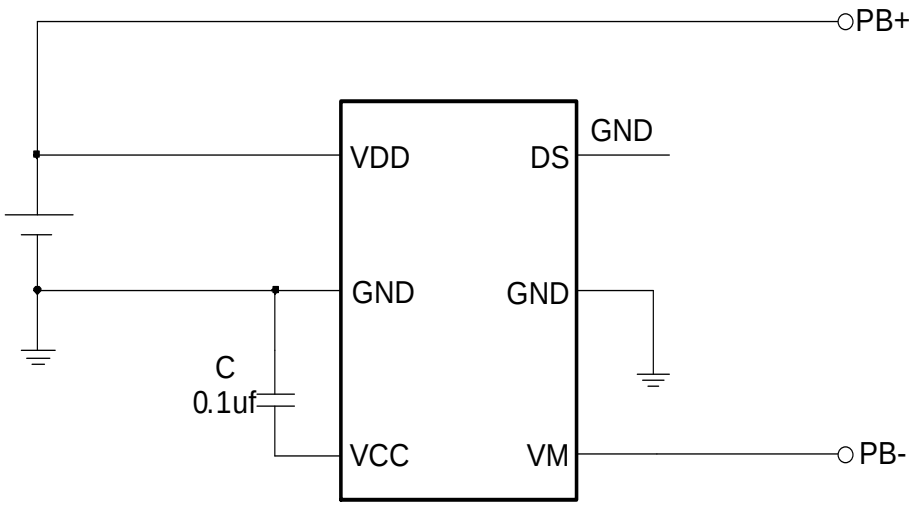
● Electronic cigarette

● Toys

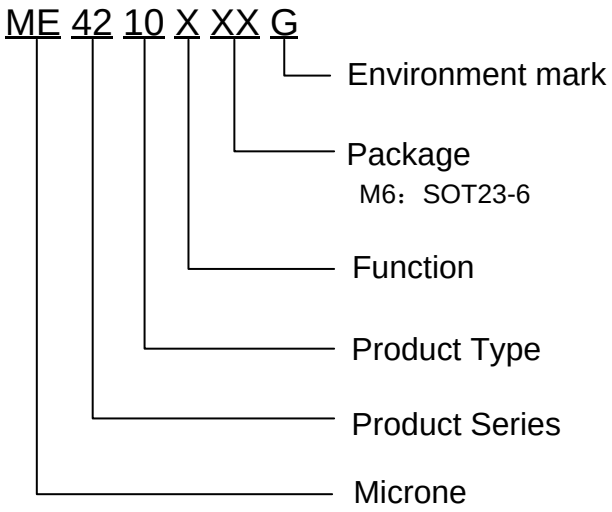
Package

● 6-pin SOT23-6

Typical Application Circuit

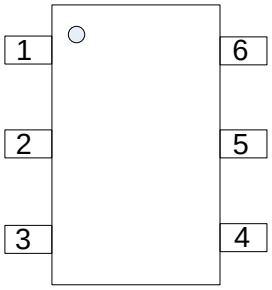


Selection Guide



Product model	Over charge detector voltage	Over charge release voltage	Over discharge detector voltage	Over discharge release voltage	Discharge Over current Detection Current	0V battery charge	Sleep or no	$R_{DS(on)}$
ME4210AM6G	4.15±0.025V	4.0±0.05V	2.4±0.05V	2.8±0.05V	3.2±0.8A	available	Self recovery	50mΩ

Pin Configuration



SOT23-6

Pin Assignment

PIN	Symbol	Description
1	VM	Charger detect pin
2,5	GND	Ground pin
3	DS	Short delay test terminal
4	VCC	Power supply pin
6	VDD	Battery the anode connection terminal

Block Diagram

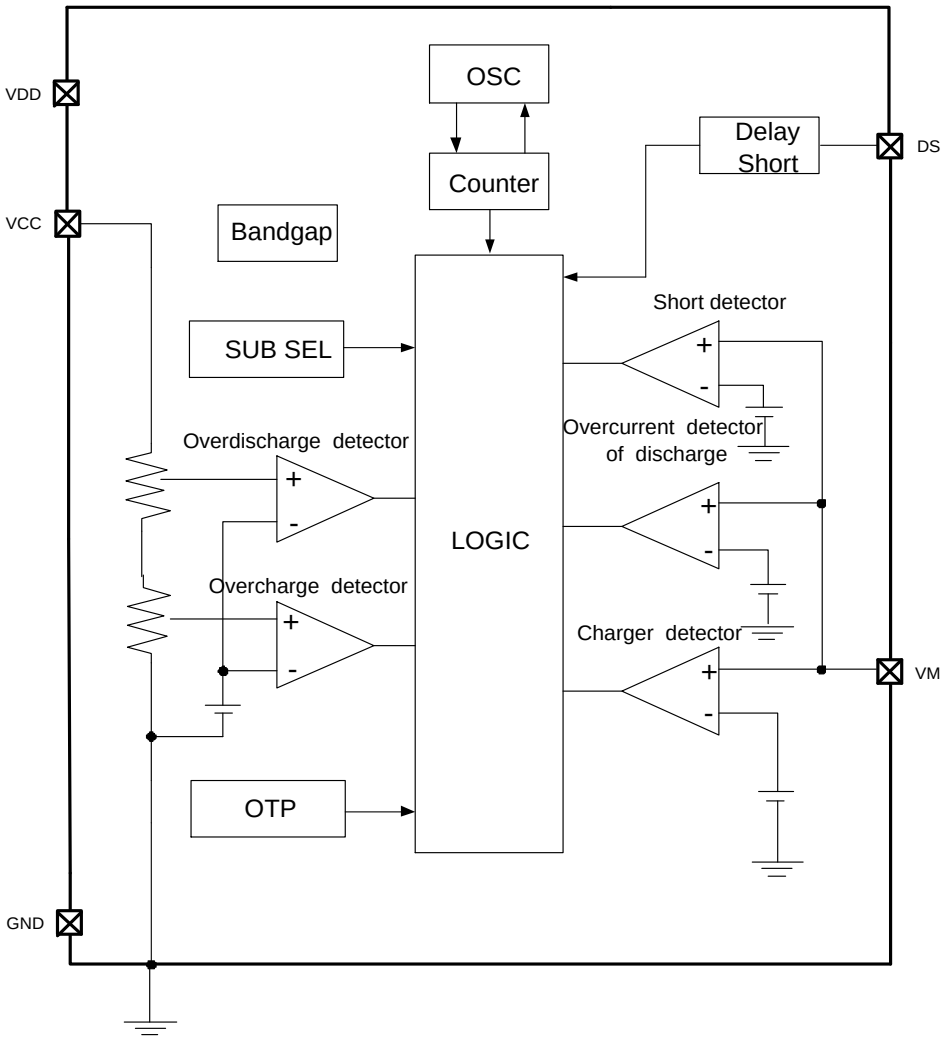


Diagram.1 Module function diagram

Absolute Maximum Ratings

Item		Symbol	Limit value	Unit
Input voltage between VDD and VSS pin		V_{DD}	-0.3~6.5	V
VCC input pin voltage		V_{CC}	-0.3~6.5	V
Charger input pin voltage		VM	V_{DD}-8~8	V
DS input pin voltage		V_{DS}	-0.3~6.5	V
Operating Ambient Temperature Range		T_{op}	-40～85	ºC
Storage Temperature Range		T_{ST}	-50～150	ºC
Junction temperature range		T_J	-40~150	ºC
Packege power dissipation	SOT23-6	P_D	600	mW
Packaging thermal resistance	SOT23-6	θ_{JA}	200	ºC/W

Note: the absolute maximum rating is the biggest physical damage limit value of the product can withstand,in any case, please do not exceed the rating.

Electrical Characteristics (VSS=0V, Ta=25°C unless otherwise specified)

Item	Symbol	Condition	Min	Typ	Max	Unit
Detection and release voltage						
Overcharge detection voltage	V_{CU}	option	V_{CU}-0.025	V_{CU}	V_{CU}+0.025	V
Overcharge release voltage	V_{CR}	option	V_{CR}-0.05	V_{CR}	V_{CR}+0.05	V
Overdischarge detection voltage	V_{DL}	option	V_{DL}-0.05	V_{DL}	V_{DL}+0.05	V
Overdischarge release voltage	V_{DR}	option	V_{DR}-0.05	V_{DR}	V_{DR}+0.05	V
Charger detection voltage	*V_{CHA}		-0.20	-0.12	-0.04	V
Detection current						
Discharge Overcurrent Detection Current	*I_{DIP}	VDD=3.5V	I_{DIP} *0.75	I_{DIP}	I_{DIP}*1.25	A
Short Circuit Detection Current	*I_{SHORT}	VDD=3.5V	10	20	30	A
Static consumption						
Normal mode	I_{DD}	VDD=3.5V,VM=0V	-	3.0	6	uA
Low consumption mode	I_{PDN}	VDD=2.0V,VM floating	-	1.5	3	uA
Sleep mode	I_{SLEEP}	VDD=2.0V,M floating	-	-	0.1	uA
VM pin impedance						
Impedance between VM and GND	*R_{VMS}	VDD=3.5V VM=1.0V	-	100	-	kΩ
Impedance between VM and GND	*R_{VMD}	VDD=2.0V VM=0V	-	320	-	kΩ
RDSON						
Equivalent impedance	*$R_{DS(on)}$	VDD=3.6V I_{VM} =1.0A	$R_{DS(on)}$ -10	$R_{DS(on)}$	$R_{DS(on)}$ +10	mΩ
Temperature protection						
Overheat Protection Temperature	*T_{SHD}		-	120	-	℃
Release temperature of overheating protection	*T_{SHR}		-	100	-	℃
Detection delay time						
Overcharge delay Time	*T_{OC}		80	160	240	ms
Overdischarge delay Time	*T_{OD}		20	40	60	ms
Overcurrent delay Time of discharge	*T_{DIP}	VDD=3.5V	5	10	15	ms
Overcurrent delay Time of charge	*T_{CIP}	VDD=3.5V	5	10	15	ms
Short circuit delay time	*T_{SHORT}	VDD=3.5V	38	75	112	us

Note:The parameter of "*" is guaranteed by design.

Description of operation

a. Normal Status

ME4210 series IC continuously detects the voltage of batteries connected between VDD and VSS terminals, the voltage difference between VM and GND terminals, and the discharge current flowing between VM and GND to control charging and discharging. When the battery voltage is above the overdischarge detection voltage (V_{DL}) and below the overcharge detection voltage (V_{CU}), and the VM terminal voltage is above the charger detection voltage (V_{CHA}), and the discharge current between VM and GND is below the discharge overcurrent detection current (I_{DIP}), the IC is in normal working state, charging and discharging can be carried out freely.

Note: The initial connection core may not discharge, please disconnect the VM pin after short connection with GND.

b. Overcharge Status

When the battery voltage exceeds the overcharge detection Voltage (V_{CU}) and the state lasts longer than the overcharge protection delay Time (T_{OC}), the MOSFET used for IC closing charge control stops charging. This state is called "Overcharge State".

The overcharge state can be released in the following two cases, so that the charging control MOSFET can be turned on.

(1) Disconnect the charger. When the battery voltage is reduced below the overcharge relief voltage (V_{CR}) due to self-discharge, the overcharge state is released and returns to normal working state.

(2) Disconnect the charger and connect the load. When the battery voltage falls below the overcharge detection voltage (V_{CU}), the overcharge state is released and returns to normal working state.

Notice：

① If the battery is still connected to the charger, the overcharge state can not be released even if the battery voltage is lower than the overcharge relief voltage (V_{CR}). When the charger is disconnected and the VM terminal voltage rises above the charger detection voltage (V_{CHA}), the overcharge state can be released.

②When the battery voltage exceeds the overcharge detection voltage (V_{CU}), disconnect the charger and connect the load. If the battery voltage can not be reduced below the overcharge detection voltage (V_{CU}), the discharge current flows through the parasitic diode of the MOSFET. When the battery voltage falls below the overcharge detection voltage (V_{CU}), the charging control uses the MOSFET to conduct normal discharge.

③When the battery voltage exceeds the overcharge detection voltage (V_{CU}), but within the overcharge protection delay time (T_{OC}), the battery voltage falls below the overcharge detection voltage (V_{CU}), then the overcharge protection state will not be entered.

c. Overdischarge and sleep status

When the battery voltage drops below the overdischarge detection voltage (V_{DL}) and the state lasts longer than the overdischarge protection delay time (T_{OD}), the MOSFET used for closing the discharge control stops discharging. This state is called "overdischarge state".

When the MOSFET used for discharge control is turned off, the VM is pulled up from the internal resistance of IC to VDD, which reduces the current consumption of IC by nearly 0.1uA. This state is called "sleep state".

The over-discharge state can be released in the following two cases, so that the discharge control can be turned on by MOSFET.

（1）Connect the charger, if the VM terminal voltage is lower than the charger detection voltage (V_{CHA}), when the battery voltage is higher than the overdischarge detection voltage (V_{DL}), the overdischarge state is released and returns to normal working state.

（2）Connect the charger, if the VM terminal voltage is higher than the charger detection voltage (V_{CHA}), when the battery voltage is higher than the overdischarge discharge discharge relief voltage (V_{DR}), the overdischarge state is released and returns to normal working state.

Note：

The battery voltage is lower than the overdischarge detection voltage (V_{DL}), but within the overdischarge protection delay time (T_{OD}), the battery voltage rises to the overdischarge detection voltage (V_{DL}), then the overdischarge protection state is not entered at this time.

d. Overcurrent status of discharge (Overcurrent of discharge & Short circuit)

Under normal working condition, IC continuously detects discharge current by detecting VM terminal voltage. Once the VM terminal voltage exceeds the discharge overcurrent detection voltage ($V_{DIP} = I_{DIP} * R_{DS\ (on)}$, and the duration of this state exceeds the discharge overcurrent protection delay time (T_{DIP}), the MOSFET used for discharge control is turned off to stop discharge, which is called the "discharge overcurrent state". Once the VM terminal voltage exceeds the load short circuit detection voltage ($V_{SHORT} = I_{SHOR}T * R_{DS\ (on)}$,and the state lasts longer than the load short circuit protection delay time (T_{SHORT}), the MOSFET used for closing the discharge control stops discharging. This state is called "load short circuit state".

When the impedance between the positive electrode (PB+) and the negative electrode (PB-) of the battery is greater than 4M(typ.), the discharge overcurrent state and the load short circuit state are released. In addition, even if the impedance between the positive electrode (PB+) and the negative electrode (PB-) of the battery is less than 4M(typ.), when the charger is connected, the voltage of the VM terminal will be reduced below the discharge overcurrent protection voltage (V_{DIP}), and the discharge overcurrent or load short circuit state will be relieved and the

normal working state will be returned.

e. Overcurrent of charge status

If the VM terminal voltage is lower than the charger detection voltage (V_{CIP}) and the state lasts longer than the charge overcurrent protection delay time (T_{CIP}), the charge control MOSFET will be closed to stop charging. This state is called "charge overcurrent state".

After entering the charging overcurrent detection state, if the VM terminal voltage is higher than the charging overcurrent detection voltage (V_{CIP}) when the charger is disconnected, the charging overcurrent state is removed and returned to the normal working state.

f. Zero Volt Battery Charging

When the battery does not need to be self-discharged for a long time to reduce the battery voltage to zero volt, the connected charger can continue to charge the battery until the battery voltage returns to the normal working voltage and enters the normal charging mode.

g. Battery Back Connection Protection

When the positive and negative poles of the battery are connected back to the chip VDD and GND, the chip enters the protection of the battery reverse connection, which limits the reverse current so that the chip will not be burned down by the reverse high current. If the positive and negative poles of the battery are connected correctly to the chip VDD and GND, the normal working state can be restored.

h. Temperature Overheating Protection

When the battery is heated during charging or discharging due to excessive current or abnormal reasons, it can be detected by the chip and terminated the corresponding charging or discharging process to improve system security.

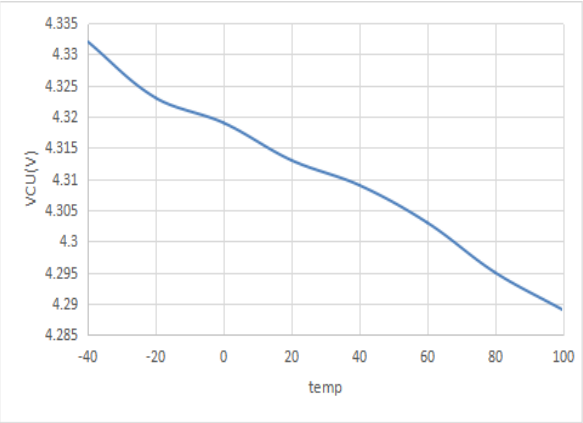
i. Charger Back Connection Protection

When the battery is charged, the battery connection is normal, but the charger connection is reversed. The chip can recognize this state and stop charging. The state can be removed by disconnecting the charger.

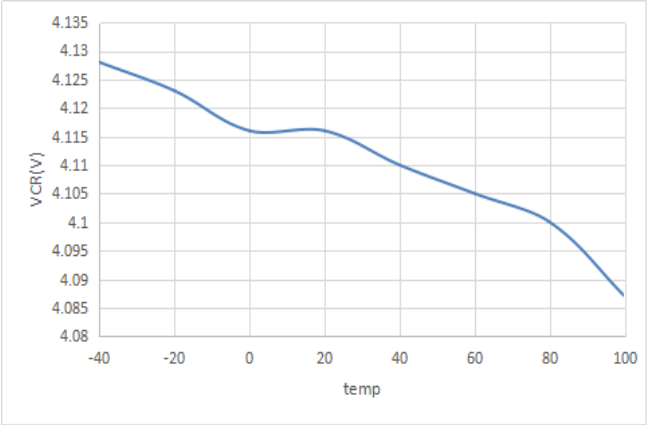
Typical performance curves

a. Overcharge Detection / Release Voltage, Overdischarge Detection / Release Voltage VS Temperature.

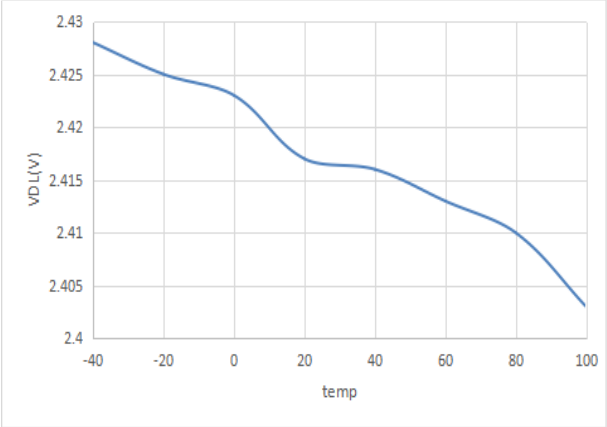
(1) V_{CU} VS temp



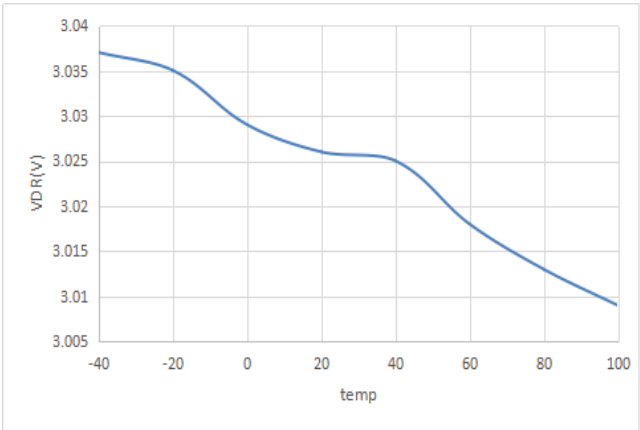
(2) V_{CR} VS temp



(3) V_{DL} VS temp

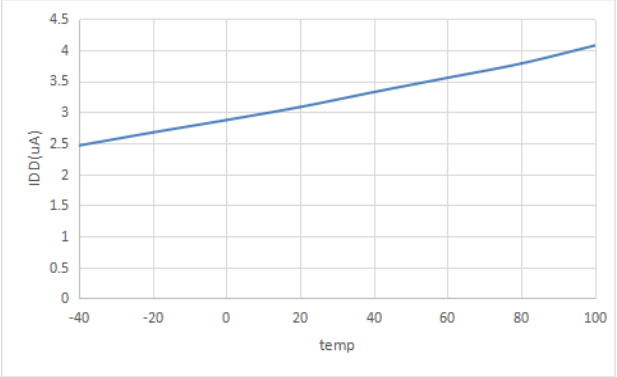


(4) V_{DR} VS temp



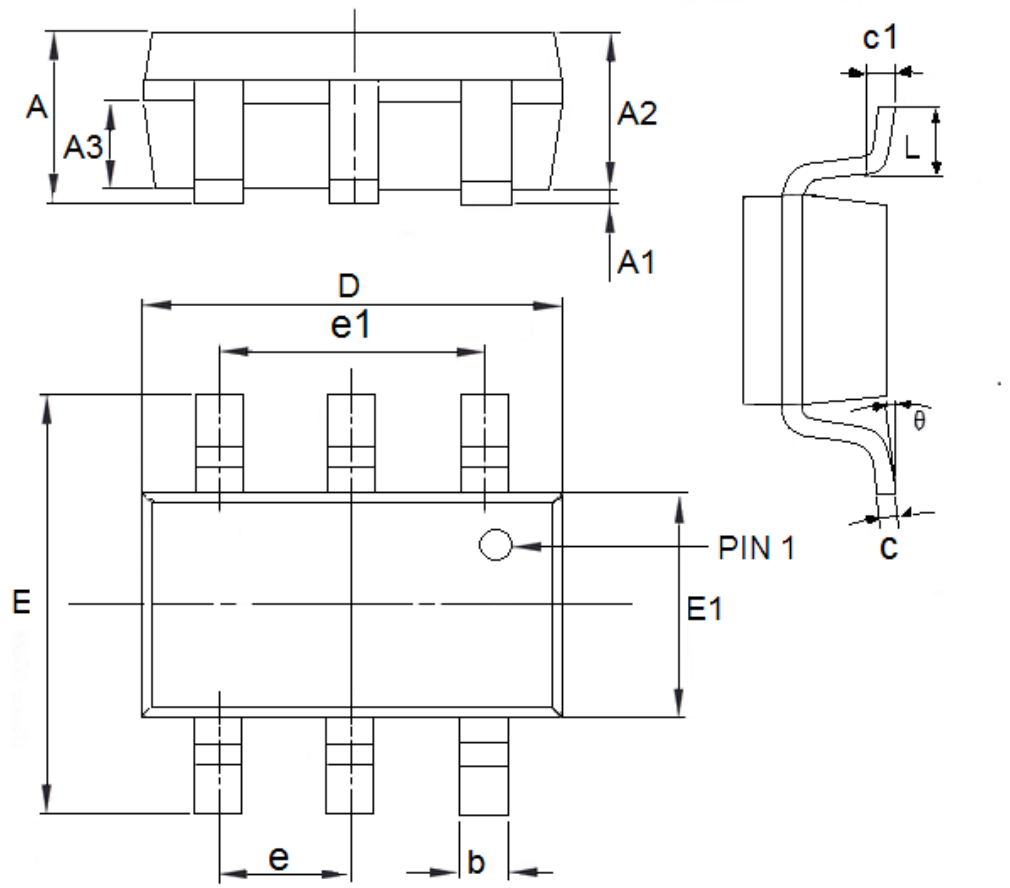
b. Current Consumption

(5) I_{DD} VS temp



Packaging information

●**Package type: SOT23-6**



Symbol	Size (mm)		Size (Inch)	
	MIN	MAX	MIN	MAX
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.55	0.75	0.0217	0.0295
b	0.25	0.5	0.0098	0.0197
c	0.1	0.25	0.0039	0.0098
D	2.7	3.12	0.1063	0.1228
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.1	0.1024	0.1220
E1	1.4	1.8	0.0551	0.0709
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

- The contents of this document will be updated with the product's improvement without prior notice. Please consult our sales staff before using this document to ensure that you are using the latest version.
- The application circuit examples described in this document are only used to indicate the representative use of the product and do not guarantee the design of mass production.
- Please use this product within the limits stated in this document. We will not be responsible for any damage caused by improper use.
- The products described in this document are not allowed to be used in equipment or devices that affect the human body without the written permission of our company, including but not limited to: health equipment, medical equipment, disaster prevention equipment, fuel control equipment, automobile equipment, aviation equipment and vehicle equipment.
- Although our company has always been committed to improving product quality and reliability, semiconductor products have a certain probability of malfunction or wrong work. To prevent personal injury or property damage caused by such accidents, please pay full attention to safety design, for example: Alternate design, fire protection design, and prevention of wrong action design.
- When exporting this product or this document overseas, you should abide by applicable import and export control laws.
- Copying or reprinting part or all of this document in any form without the permission of our company is strictly prohibited.