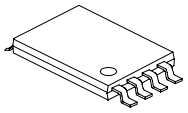
ONE-CELL LI+ BATTERY PROTECTION CIRCUIT WITH BUILT-IN MOSFET

DESCRIPTION

SC8821 is a Li+ battery protection circuit with built-in MOSFET. It is suitable for protecting LI+ battery against damage from over charge, over discharge, and over current. It contains high accurate voltage detection and delay circuits.



TSSOP-8-225-0.65

FEATURES

* Built-in low equivalent on-resistance (30mΩ) N-type MOSFET
* Low supply current
* Overcharge detection 4.28V, overcharge release 4.10V
* Overdischarge detection 2.50V, overchdisarge release 2.90V
* Over current detection 0.15V and short current detection 1.00V
* Built-in detection time delay of overcharge, overdischarge and overcurrent
* Charger detection
* Reset resistance for over current protection
* Wide supply voltage range

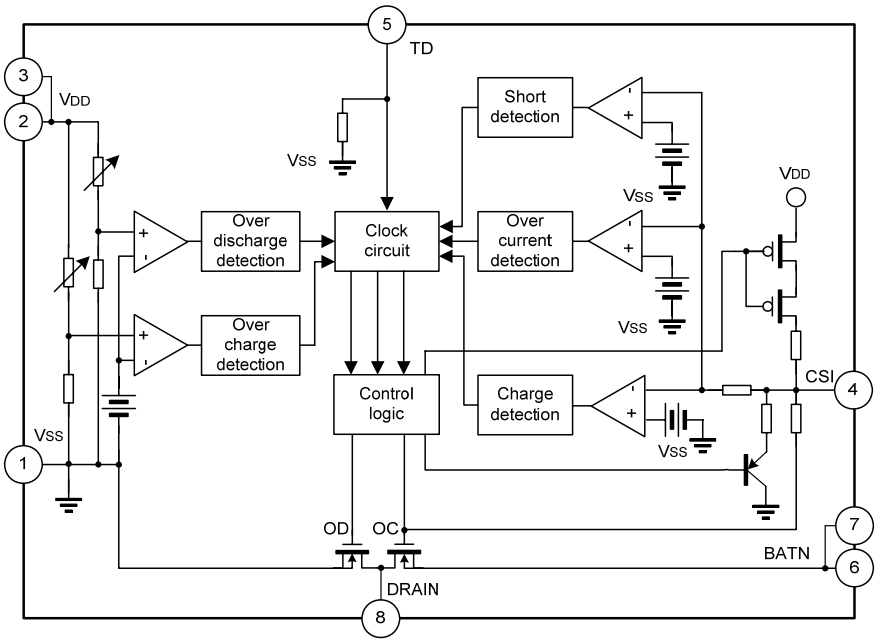
APPLICATIONS

* Protection IC for One-Cell Li+ Battery

ORDERING INFORMATION

Part No.	Package	0V Charging	Marking
SC8821	TSSOP-8-225-0.65	Forbid	8821
SC8821A	TSSOP-8-225-0.65	Allow	8821A

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

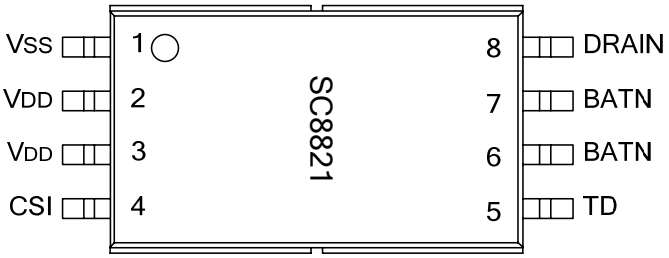
Characteristics	Symbol	Value	Unit
Supply Voltage	V_{DD}	V_{SS}-0.3 ~ V_{SS}+12	V
CSI Pin Voltage	V_{CSI}	V_{DD}-15 ~ V_{DD}+0.3	V
BATN Pin Voltage	V_{BN}	V_{DD}-15 ~ V_{DD}+0.3	V
Operating Temperature	T_{opr}	-40 ~ + 85	°C
Storage Temperature	T_{stg}	-40 ~ +125	°C

ELECTRICAL CHARACTERISTICS (unless otherwise specified，T_{amb}=25°C)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Voltage						
Operating Voltage	V_{DD}		1.8		8.0	V
Current Consumption						
Supply Current	I_{DD}	V_{DD}=3.6V		3.0	6.0	μA
Standby Current	I_{PD}	V_{DD}=2.0V		0.3	0.6	μA
Detection Voltage						
Over Charge Detection Voltage	V_{OCU}		4.24	4.28	4.32	V
Over Charge Release Voltage	V_{OCR}		4.05	4.10	4.15	V
Over Discharge Detection Voltage	V_{ODL}		2.40	2.50	2.60	V
Over Discharge Release Voltage	V_{ODR}		2.80	2.90	3.00	V
Over Current 1 Detection Voltage	V_{OI1}		0.13	0.15	0.17	V
Over Current 1 Detection Current	I_{OI1}	V_{DD}=3.6V	1	2	3	A
Over Current 2(Short Current) Detection Voltage	V_{OI2}	V_{DD}=3.6V	0.80	1.00	1.20	V
Over Current Reset Resistor	R_{short}	V_{DD}=3.6V	400	500	600	kΩ
Charger Detection Voltage	V_{CH}		-0.8	-0.5	-0.2	V
Battery voltage when 0V charging is forbidden	V_{INH}	Product SC8821			1.5	V
Charger voltage when 0V charging is allowed	V_{CHA}	Product SC8821A	1.55			V
Delay Time						
Over Charge Detection Delay Time	T_{OC}	V_{DD}=3.6V~4.4V	150	340	500	ms
Over Discharge Detection Delay Time	T_{OD}	V_{DD}=3.6V~2.0V	80	200	300	ms
Over Current 1 Detection Delay Time	T_{OI1}	V_{DD}=3.6V	5	13	20	ms
Over Current 2(Short Current) Detection Delay Time	T_{OI2}	V_{DD}=3.6V		5	50	μs

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Low equivalent on-resistance N-type MOSFET						
Drain-Source Breakdown Voltage	BVDSS	V_G=0V,I_D=250μA	20.6			V
		V_G=0V,I_D=1μA	20			V
Drain-Source Breakdown Current	IDSS	V_G=0V,V_D=20.6V			250	μA
		V_G=0V,V_D=20V			1	μA
Threshold Voltage	VTH	V_G=V_D,I_D=250μA	0.62		1.455	V
Source-Drain On-Resistance	RDSON	VG=2.5V, I_D=3A			39.6	mΩ
		VG=4.5V, I_D=1A			30	mΩ
		VG=4.5V, I_D=3A			27.7	mΩ

PIN CONFIGURATION



PIN DESCRIPTIONS

PIN No.	Symbol	I/O	Description
1	V_{SS}	I	Negative power input pin
2, 3	V_{DD}	I	Positive power input pin
4	CSI	I/O	Current detection input
5	TD	I	Time delay testing terminal
6, 7	BATN	I/O	Negative terminal of charger or load
8	DRAIN	I/O	The common drain of the two N-type MOSFET

FUNCTION DESCRIPTIONS

Normal State

Refer to the typical application circuit. If V_{ODL}<V_{DD}<V_{OCU} and V_{CH}<V_{CSI}<V_{OI1}, the charging and discharging processes between VBAT+ and VBAT- can be operated normally.

Overcharge Detection

When enters charging state from normal state, the battery voltage can be detected from V_{DD}. When the charger is connected between V_{BAT+} and V_{BAT-}, if V_{DD} is larger than V_{OCU} over a delay time of T_{OC}, then the battery voltage enters the overcharge state, V_{BAT-} current is 0 and stop charging.

Release of Overcharge State

There are two ways to return to normal state from overcharge state

- If the battery is self discharging and $V_{DD}<V_{OCR}$ occurs, it returns to normal state.
- Remove the charger and connected to a load. If $V_{OCR}<V_{DD}<V_{OCU}$ and $V_{CSI}>V_{OI1}$ occurs, it returns to normal state.

Overdischarge Detection

When enters discharging state from normal state, the battery voltage can be detected from V_{DD}. When the load is connected between VBAT+ and VBAT-, if V_{DD} is smaller than V_{ODL} and the delay time is over TOD; then the battery voltage enters overdischarge state, VBAT- current is 0 and stop discharging. At the same time, CSI is pulled to V_{DD} with internal resistor R_{CSID}. If $V_{CSI}>V_{OI2}$, the protection IC enters into Power-down mode. (Its current consumption is lower than 0.3μA).

Release of Power-Down State

When the battery remains in Power-down state, if a charger is connected between VBAT+ and VBAT-. And $V_{CH}<V_{CSI}<V_{OI2}$ & $V_{DD}<V_{ODR}$ occur, it releases Power-down state. If $V_{DD}>V_{ODR}$ occurs, it returns to normal state.

Charger Detection

If a charger is connected between VBAT+ and VBAT- while the battery remains in Power-down state, and the voltages become $V_{CSI}<V_{CH}$ and $V_{DD}>V_{ODL}$, it returns to normal state.

Abnormal Charging Detection

If a charger is connected between VBAT+ and VBAT- in normal state, if $V_{CSI}<V_{CH}$, and the delay time is over T_{OC} , then VBAT- current is 0 and stop charging.

Over Current/Short Current Detection

In normal state, the load is connected between VBAT+ and VBAT- ,when the discharging current is too big and the CSI voltage is larger than V_{OIX} (V_{IO1} or V_{IO2}),and the delay time is over T_{OIX} (T_{IO1} or T_{IO2}), it means the over current/short current state occurs. CSI is pulled to V_{SS} with an internal resistor R_{CSIS}, VBAT- current is 0 and VBAT- voltage is pulled to V_{DD} because of the load.

Release of Over Current/Short Current State

While the protection IC remains in Over Current/Short Current state, and the load is removed or the impedance between VBAT+ and VBAT- is larger than 500KΩ and $V_{CSI}<V_{OI1}$, it is back to normal state.

0V charging forbidden

When a charger is connected between VBAT+ and VBAT- and $V_{DD}<V_{INH}$, the current at VBAT- is 0 and battery can not be charged..

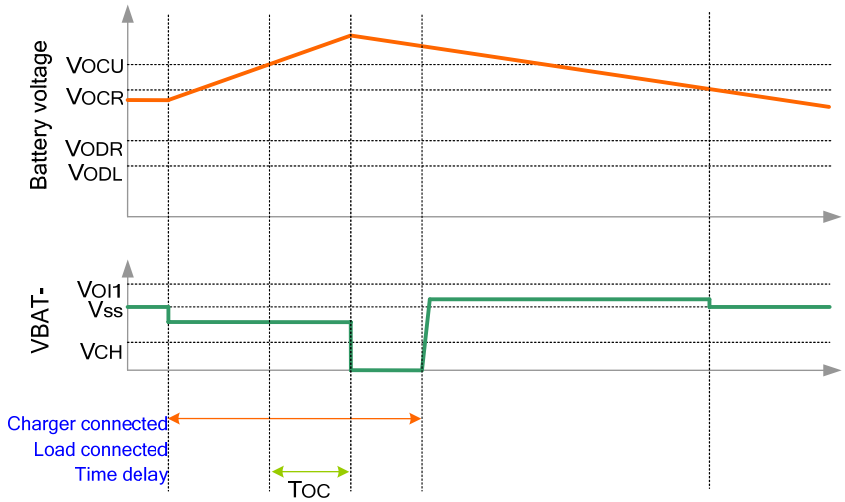
0V charging allowed

When a charger with the voltage over V_{CHA} is connected between VBAT+ and VBAT, the battery can be charged.

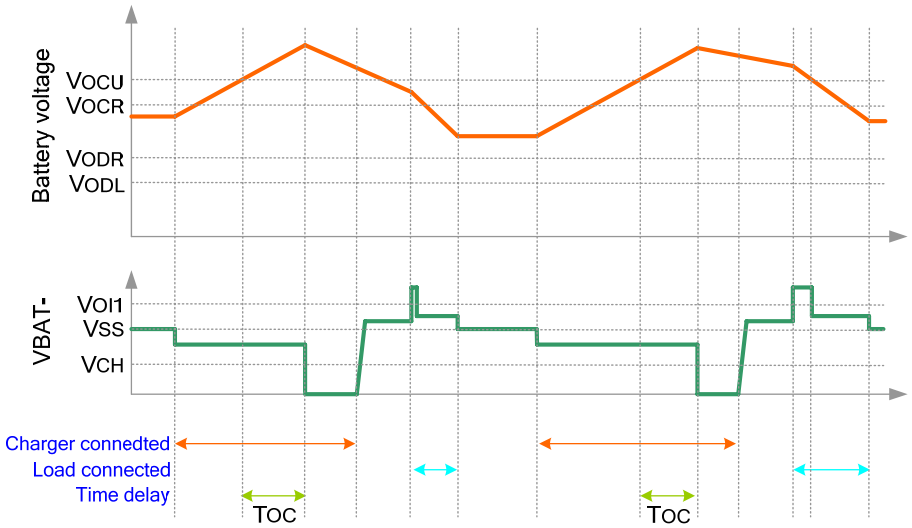
Note: when a battery is connected to a protection IC at first time, the IC may not enter the normal state, it can not discharge. If happens, please connect charger between VBAT+ and VBAT- to enter the normal state.

TIMING DIAGRAM

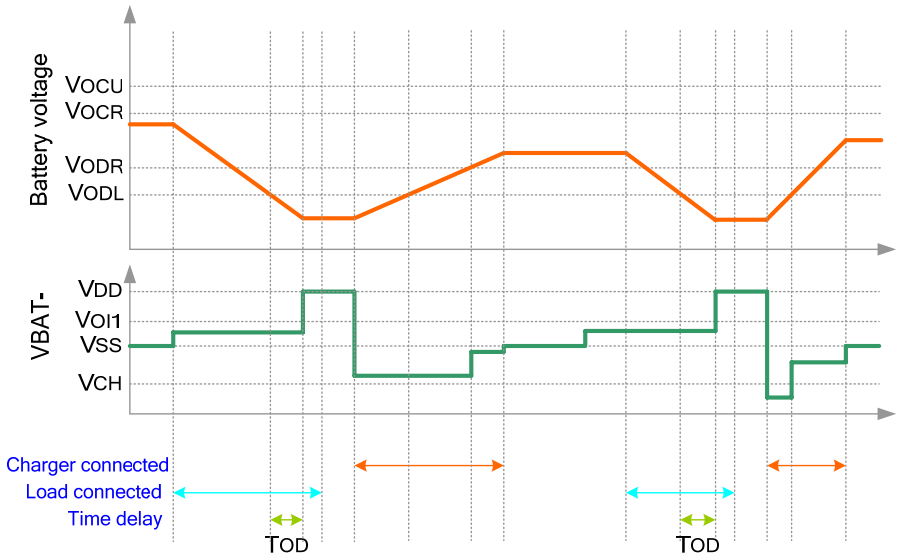
Overcharge state →self discharging →normal state



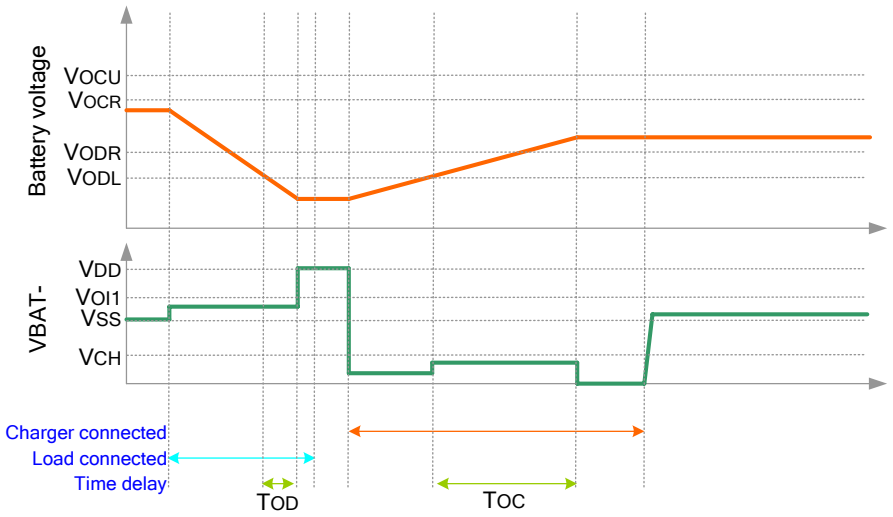
Overcharge state→load discharging→normal state



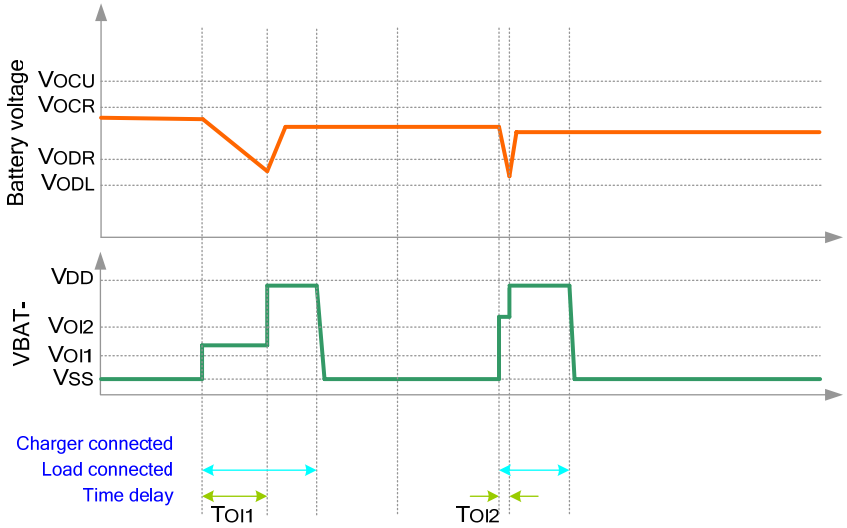
Overcharge state→normal charging by charger→normal state



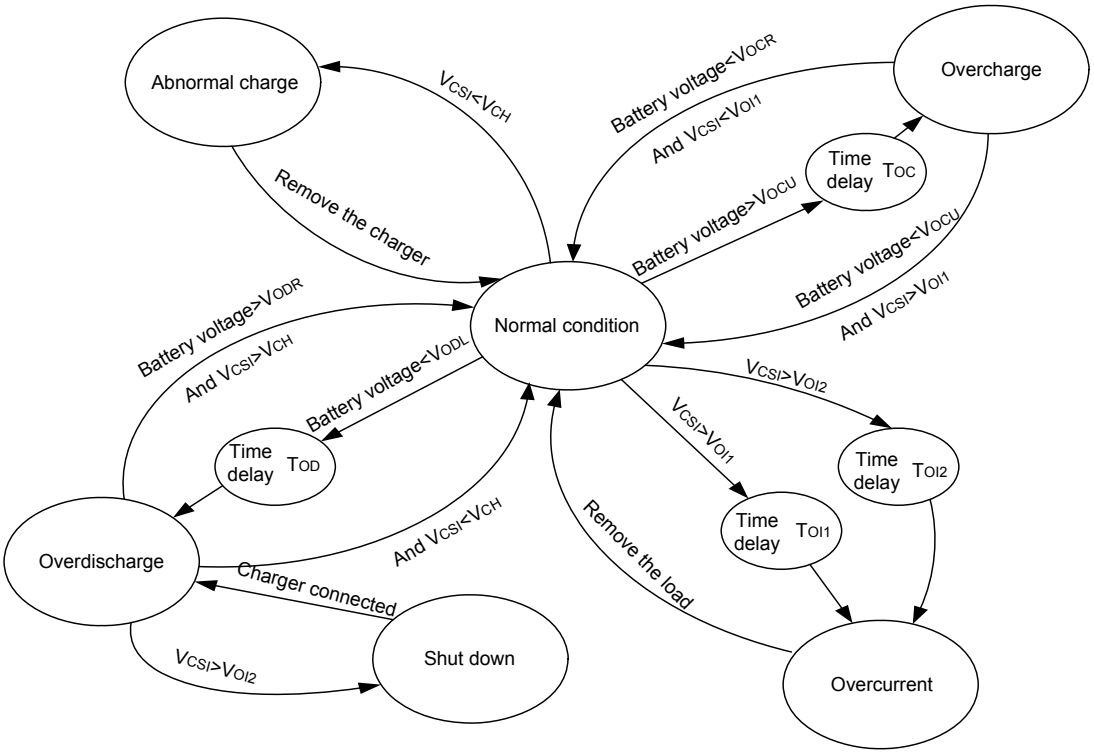
Overdischarge state→abnormal charging by charger→normal state



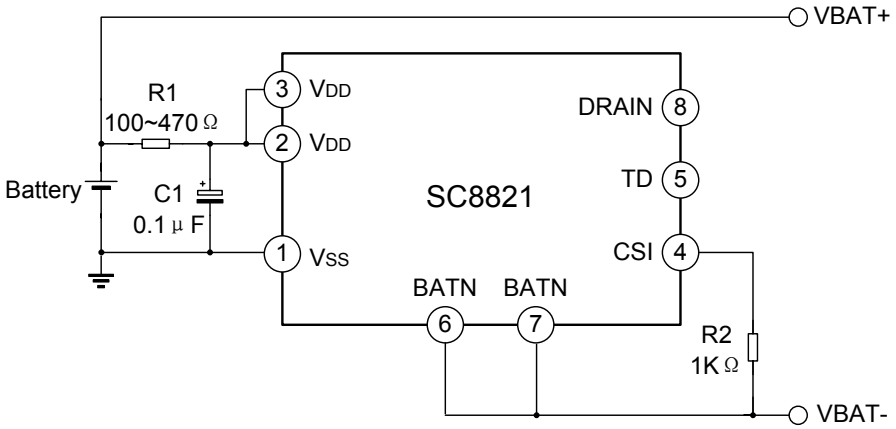
Over current state→normal state



STATE DIAGRAM OF OPERATION



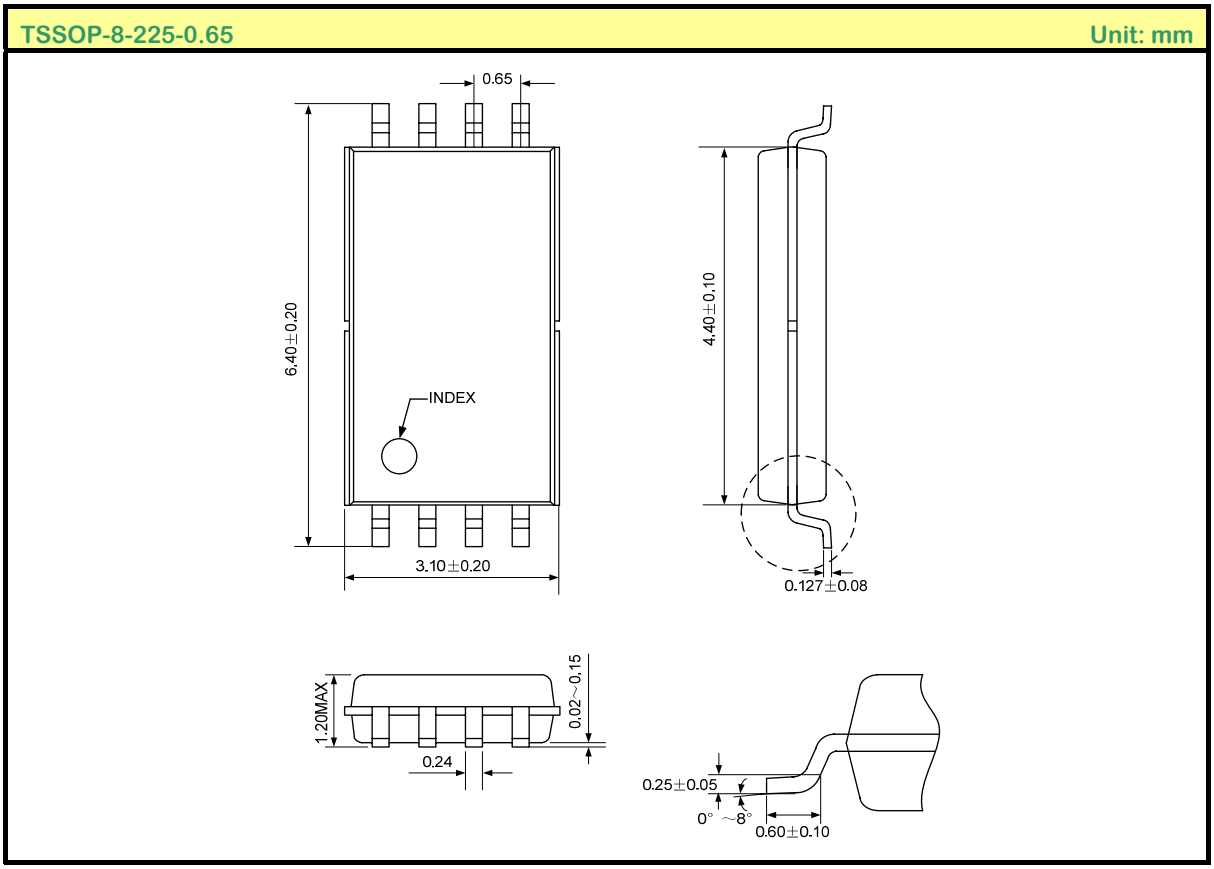
TYPICAL APPLICATION CIRCUITS



Note: The circuit and parameters are reference only, please set the parameters of the real application circuit based on the real test.

PACKAGE OUTLINE

TSSOP-8-225-0.65 Unit: mm



MOS DEVICES OPERATE NOTES:

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

Disclaimer:

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