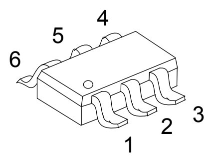
LITHIUM-ION/POLYMER BATTERY PROTECTION IC



SOT-26

■ DESCRIPTION

UTC **UB242** is a series of lithium-ion / lithium-polymer rechargeable battery protection ICs incorporating high accuracy voltage detection circuits and delay circuits.

UTC **UB242** is suitable for protection of single cell lithium-ion / lithium polymer battery packs from overcharge, over discharge and over current.

The ultra-small package and less required external components make it ideal to integrate the UTC **UB242** into the limited space of battery pack.

■ FEATURES

* Wide supply voltage range: V_{DD}=1.8V~9.0V
* Ultra-low quiescent current: I_{DD}=3.0μA (V_{DD}=3.9V)
* Ultra-low power-down current: I_{PD}=0.1μA (V_{DD}=2.0V)
* Overcharge detection voltage: V_{OCU}=4.200V~4.400V
* Overcharge release voltage: V_{OCR}=4.005V~4.225V
* Over discharge detection voltage : V_{ODL}=2.15V~3.00V
* Over discharge release voltage: V_{ODR}=2.32V~3.10V
* Over current detection voltage: V_{OI1}=0.05V~0.20V
* Short circuit detection voltage: V_{OI2}=1.35V (Fixed)
* Charger detection voltage: V_{CH}=-0.7V
  Reset resistance for over current protection: $R_{SHORT} > 500k\Omega$
* Delay times are generated by an internal circuit.
  (External capacitors are unnecessary.)
* Halogen Free

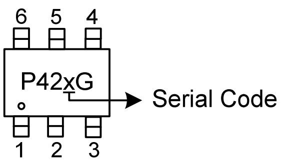
■ ORDERING INFORMATION

Ordering Number	Package	Packing
UB242xG-AG6-R	SOT-26	Tape Reel

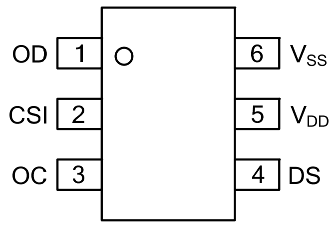
UB242xG-AG6-R

(1) Packing Type	(1) R: Tape Reel
(2) Package Type	(2) AG6: SOT-26
(3) Lead Plating	(3) G: Halogen Free
(4) Serial Code	(4) Refer To The Serial Code List

■ MARKING



■ PIN CONFIGURATION



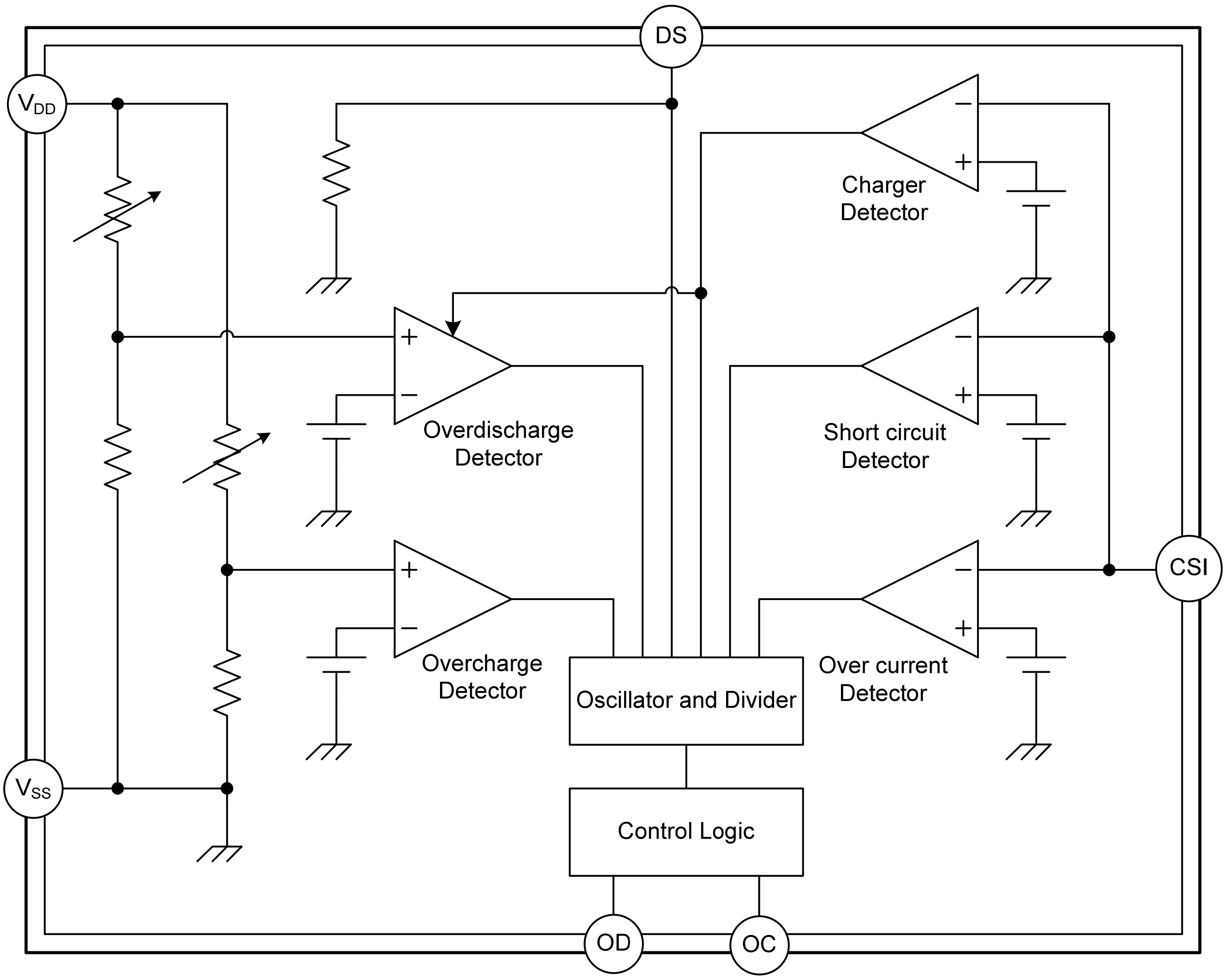
■ PIN DESCRIPTION

PIN NO	PIN NAME	DESCRIPTION
1	OD	For discharge control: FET gate connection pin
2	CSI	For current sense Input pin, and charge detect
3	OC	For charge control :FET gate connection pin
4	DS	For reduce delay time: test pin
5	V_{DD}	Positive power input
6	V_{SS}	Negative power input

■ SERIAL CODE LIST

Model	Code	Overcharge Detection Voltage [V_{OCU}](V)	Overcharge Release Voltage [V_{OCR}](V)	Over discharge Detection Voltage [V_{ODL}](V)	Over discharge Release Voltage [V_{ODR}](V)	Over Current Detection Voltage [V_{OI1}](mV)
UB242	A	4.325±0.050	4.075±0.050	2.50±0.10	2.90±0.10	100±30
	B	4.350±0.050	4.150±0.050	2.30±0.10	3.00±0.10	100±30
	C	4.325±0.050	4.075±0.050	2.50±0.10	2.90±0.10	150±30
	D	4.300±0.050	4.080±0.050	2.50±0.10	2.90±0.10	150±30
	E	4.300±0.050	4.080±0.050	2.50±0.10	2.90±0.10	100±30
	F	4.275±0.050	4.175±0.050	2.30±0.08	2.45±0.08	100±30
	G	4.280±0.050	4.175±0.050	2.90±0.10	3.00±0.10	150±30
	H	4.250±0.050	4.055±0.050	2.25±0.10	2.85±0.10	150±30

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING (V_{SS}=0V, Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Input voltage between V_{DD} and V_{SS} (Note2)	V_{DD}	V_{SS}-0.3 ~ V_{SS}+12	V
OC output pin voltage	V_{OC}	V_{DD}-15 ~ V_{DD}+0.3	V
OD output pin voltage	V_{OD}	V_{SS}-0.3 ~ V_{DD}+0.3	V
CSI input pin voltage	V_{CSI}	V_{DD}-15 ~ V_{DD}+0.3	V
DS input pin voltage	V_{DS}	V_{SS}-0.3 ~ V_{DD}+03	V
Operating Temperature	T_{ORP}	-40 ~ +85	°C
Storage Temperature	T_{STG}	-40 ~ +125	°C

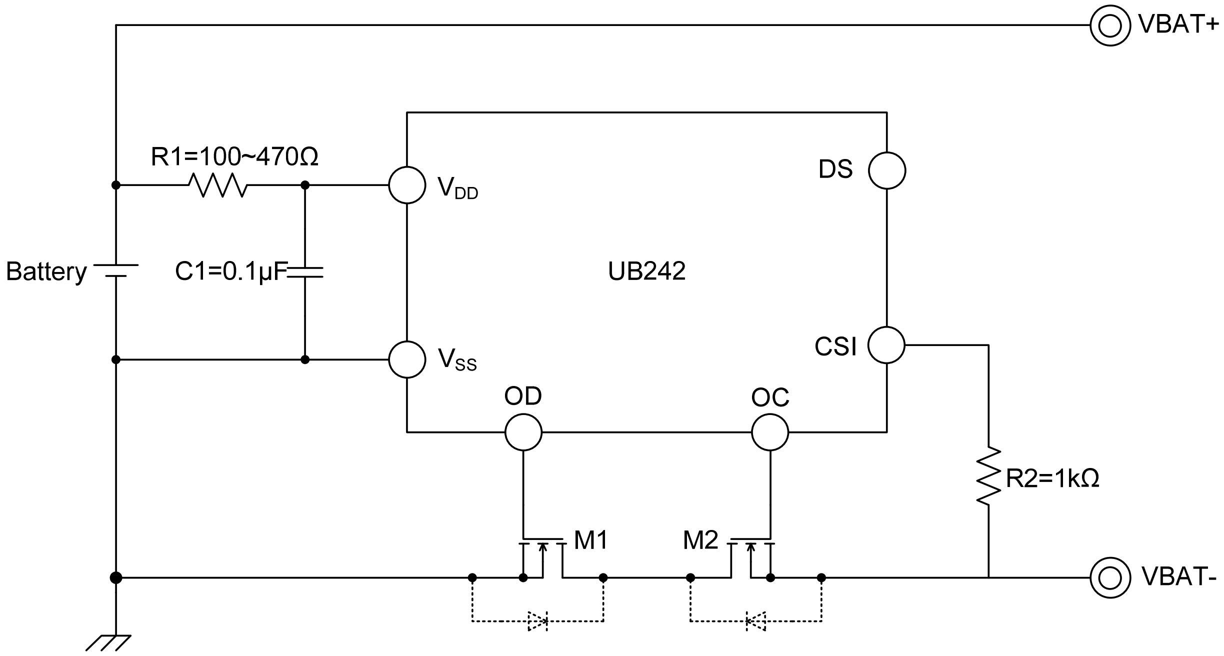
Note: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Pulse (μsec) noise exceeding the above input voltage (V_{SS}+12V) may cause damage to the IC.

■ ELECTRICAL CHARACTERISTICS (V_{SS}=0V, DS=Floating, Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
CURRENT CONSEMPTION						
Supply Current	I_{DD}	V_{DD}=3.9V		3.0	6.0	μA
Power-Down Current	I_{PD}	V_{DD}=2.0V			0.1	μA
OPERATING VOLTAGE						
Operating Input Voltage	V_{DS1}	V_{DD}-V_{SS}	1.8		9.0	V
DETECTION VOLTAGE						
Overcharge Detection Voltage	V_{OCU}		V_{OCU} -0.050	V_{OCU}	V_{OCU} +0.050	V
Overcharge Release Voltage	V_{OCR}		V_{OCR} -0.050	V_{OCR}	V_{OCR} +0.050	V
Overdischarge Detection Voltage	V_{ODL}		V_{ODL} -0.100	V_{ODL}	V_{ODL} +0.100	V
Overdischarge Release Voltage	V_{ODR}		V_{ODR} -0.100	V_{ODR}	V_{ODR} +0.100	V
Over Current Detection Voltage	V_{OI1}		V_{OI1} -0.030	$V_{O/1}$	V_{OI1} +0.030	V
Short Circuit Detection Voltage	V_{OI2}	V_{DD}=3.0V	1.0	1.35	1.75	V
Reset Resistance For Over Current Protection	R_{SHORT}	V_{DD}=3.6V	350	500	650	kΩ
Charger Detection Voltage	V_{CH}		-1.2	-0.7	-0.2	V
DELAY TIME						
Overcharge Detection Delay Time	T_{OC}	V_{DD}=3.6V to4.5V, DS=Floating	0.7	1.3	1.9	s
		V_{DD}=3.6V to 4.5V, V_{DS}=V_{DD}	10	20	30	ms
Overdischarge Detection Delay Time	T_{OD}	V_{DD}=3.6V to 2.0V, DS=Floating	100	180	260	ms
		V_{DD}=3.6V to 2.0V, V_{DS}=V_{DD}	6	11	17	ms
Over Current Detection Delay Time	T_{OI1}	V_{DD}=3.0V	5	10	20	ms
Short Circuit Detection Delay Time	T_{OI2}	V_{DD}=3.0V	5	10	50	μs
OTHER						
OC Pin Output "H" Voltage	V_{OH1}	V_{DD}=3.9V, I_{OH}=-50μA	3.4	3.7		V
OC Pin Output "L" Voltage	V_{OL1}	V_{DD}=4.5V, CSI=0V		0.1	0.5	V
OD Pin Output "H" Voltage	V_{OH2}	V_{DD}=3.9V, I_{OH}=-50μA	3.4	3.7		V
OD Pin Output "L" Voltage	V_{OL2}	V_{DD}=2.0V, I_{OL}=50μA		0.1	0.5	V

Note: If V_{DS}=V_{DD}, the delay time will be reduced, and the test time for V_{OCU} or V_{ODL} will also be reduced.

■ TYPICAL APPLICATION CIRCUIT



■ DESCRIPTION OF OPERATION

1. Normal Condition

The voltage of the battery connected between V_{DD} and V_{SS} can be monitored by the **UB242**.The voltage difference between CSI and V_{SS} can sense the charge and discharge scheme. Under this condition: $V_{ODL} < V_{DD} < V_{OCU}$ and $V_{CH} < V_{CSI} < V_{OI1}$, **UB242** will turn on the M2 (charging) and M1 (discharging) control MOSFETs.

2. Overcharge Condition

M2 will be turned off under this condition: the battery voltage becomes higher than the overcharge detection voltage (V_{OCU}) during normal charging condition through a delay time longer than T_{OC} (the overcharge detection delay time).

3. Release of Overcharge Condition

Two ways to return to normal condition from overcharge condition:

(1.) Under the condition: the battery is self discharging, and if $V_{DD} < V_{OCR}$ and $V_{OI1} > V_{CSI} > V_{CH}$ occurs, **UB242** will be back to normal condition.

(2.) Connect **UB242** to a load and remove the charger.

4. Overdischarge Condition

M1 will be turned off to stop discharging when the battery voltage falls below the overdischarge detection voltage (V_{ODL}) during discharging condition and through a delay time longer than T_{OD} (the overdischarge detection delay time).And then CSI will be pulled up to V_{DD} through an internal resistance.When $V_{CSI} > V_{OI2}$,the chip will enter into power-down mode. In this mode, the current consumption is lower than 0.1μA.

5. Release of Power-down mode

There are two ways back to normal condition:

(1.) If $V_{CSI} < V_{CH}$ (Charger detection), when $V_{DD} > V_{ODL}$

(2.) If $V_{CH} < V_{CSI} < V_{OI2}$, the condition $V_{DD} > V_{ODR}$

6. Charger Detection

Charger detection is this action: while connecting to a charger after entering into power-down mode, then if $V_{DD} < V_{CH}$, M1 will be turned on when $V_{DD} > V_{ODL}$, and then the system will be back to normal condition as described in 1) of previous section.

7. Abnormal Charge Current Condition

The abnormal charge current condition is when a charger is connected to the battery system in normal condition, then if $V_{DD} < V_{OCU}$ and $V_{CSI} < V_{CH}$ occurs through a delay time than T_{OC} (delay time of overcharge detection), and in this condition M2 will be turned off to stop this charging status.

8. Over Current/Short Circuit Condition

The over current (or short circuit) condition is when the current is too large during discharging under normal condition as a result of the voltage detected by CSI is greater than V_{OI1} (or V_{OI2}) through a delay time T_{OI1} (T_{OI2}).In this over current (or short circuit) condition: M1 will be turned off and CSI will be pulled down to V_{SS} through an internal resistance.

9. Release of Over Current/Short Circuit Condition

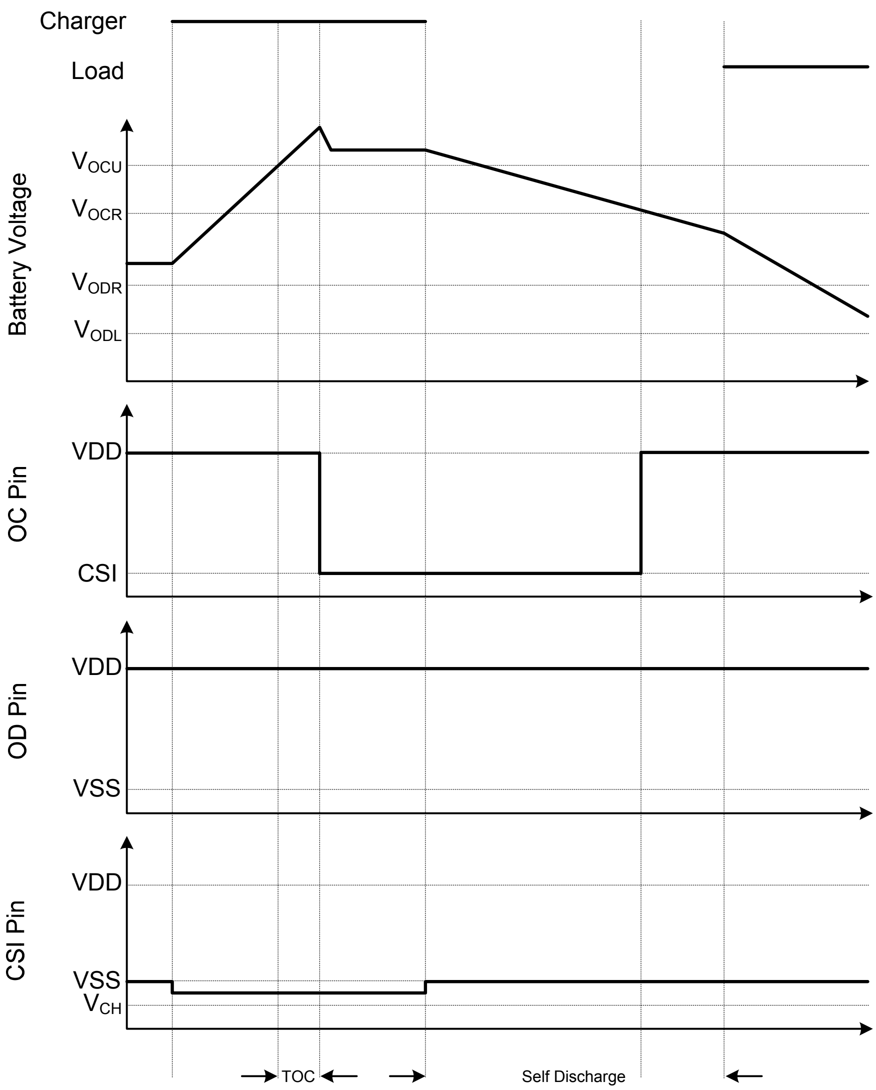
If the load is removed or the impedance between V_{BAT+} and V_{BAT-} is larger than 500kΩ as well as $V_{CSI} < V_{OI1}$, M1 will be turned on and the back to normal condition.

10. DS Pin

The delay time of the overcharge and overdischarge can be reduced to within 50ms by forcing DS to V_{DD}. A 1.6MΩ pull down resistor should be connected between DS pin and V_{SS} internally. In the actual application DS pin should be left open or connected to V_{SS}.

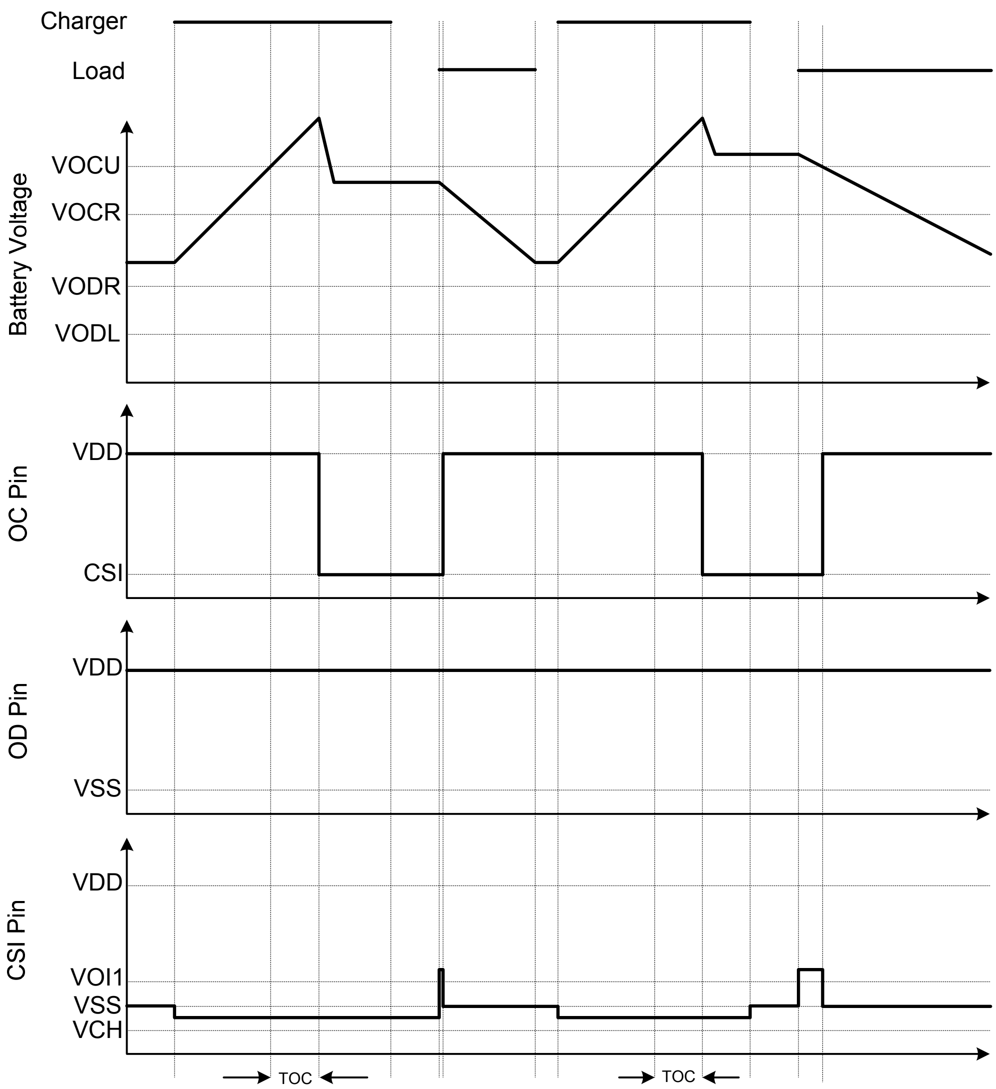
■ TIMING DIAGRAM

1. Overcharge Condition → Self Discharge → Normal Condition



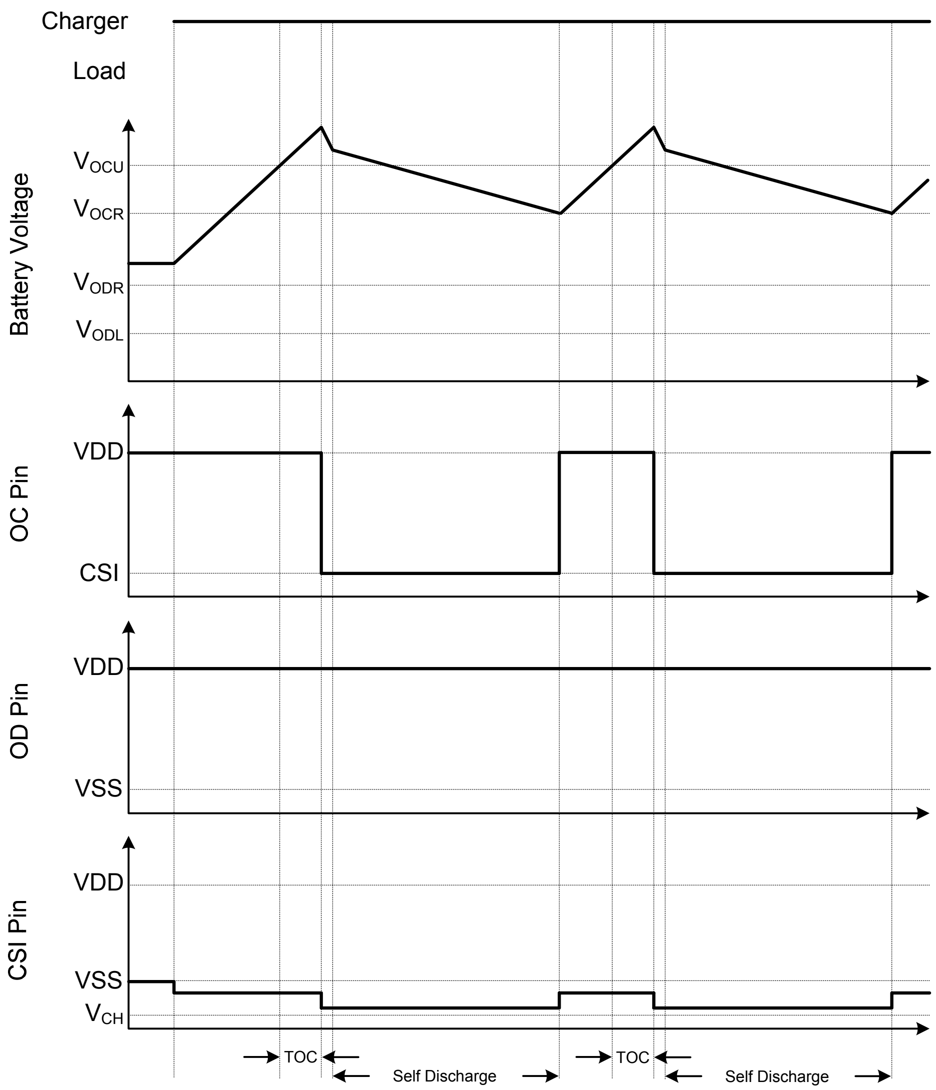
■ TIMING DIAGRAM(Cont.)

2. Overcharge Condition → Load Discharge → Normal Condition



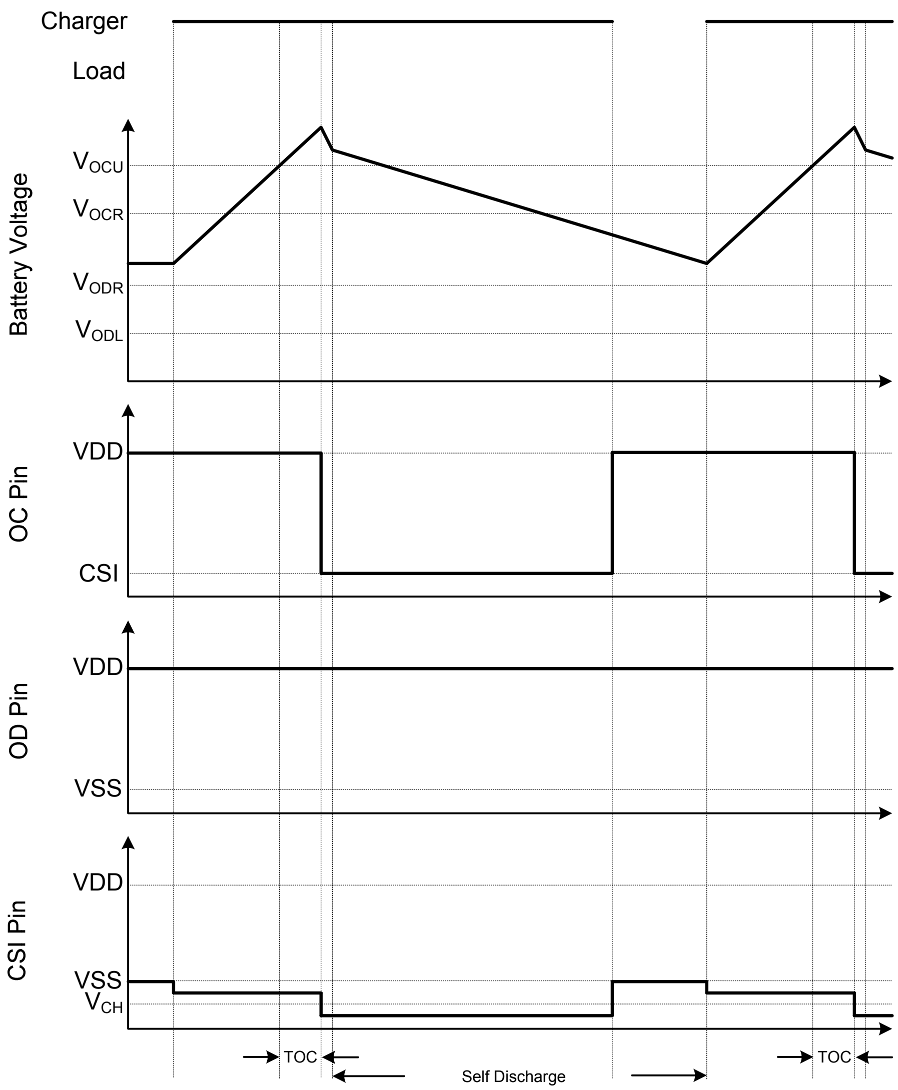
■ TIMING DIAGRAM(Cont.)

3. Overcharge Condition ➔ Charger remains connected and VCSI>VCH ➔ Self Discharge



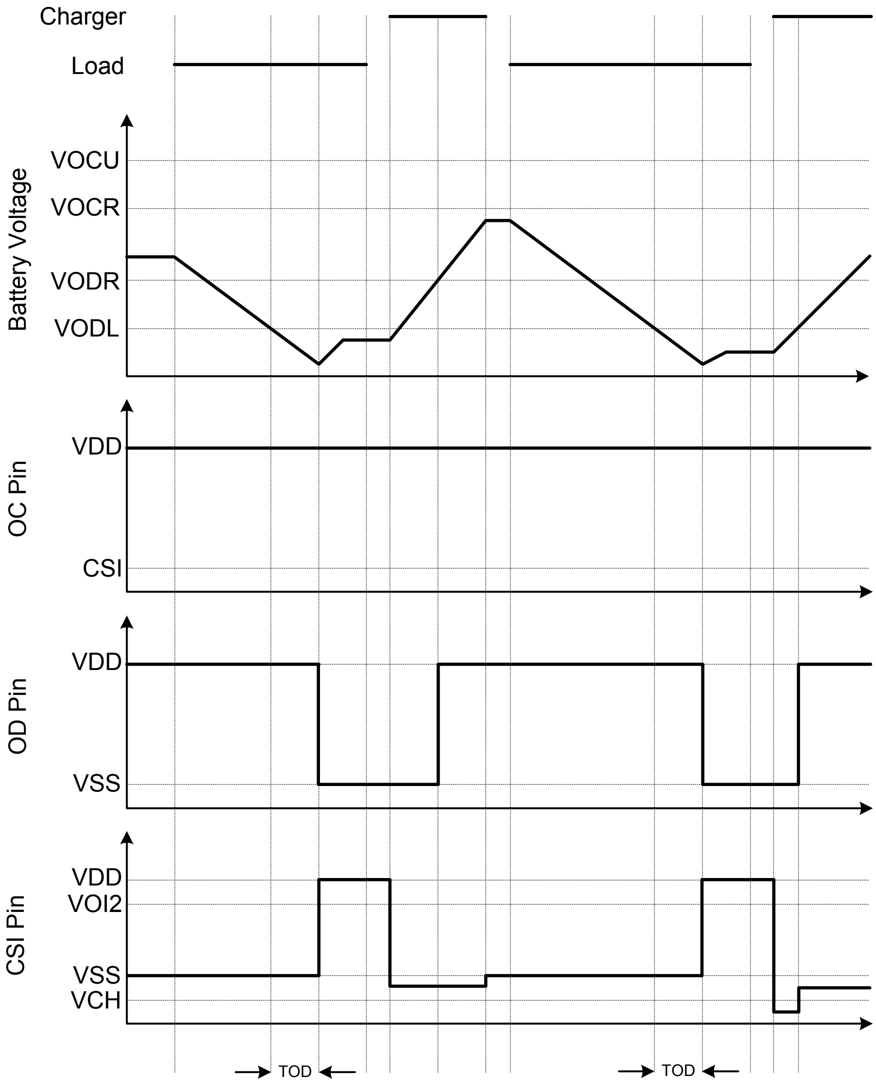
■ TIMING DIAGRAM(Cont.)

4. Overcharge Condition ➔ Charger remains connected and VCSI<VCH ➔ Self Discharge



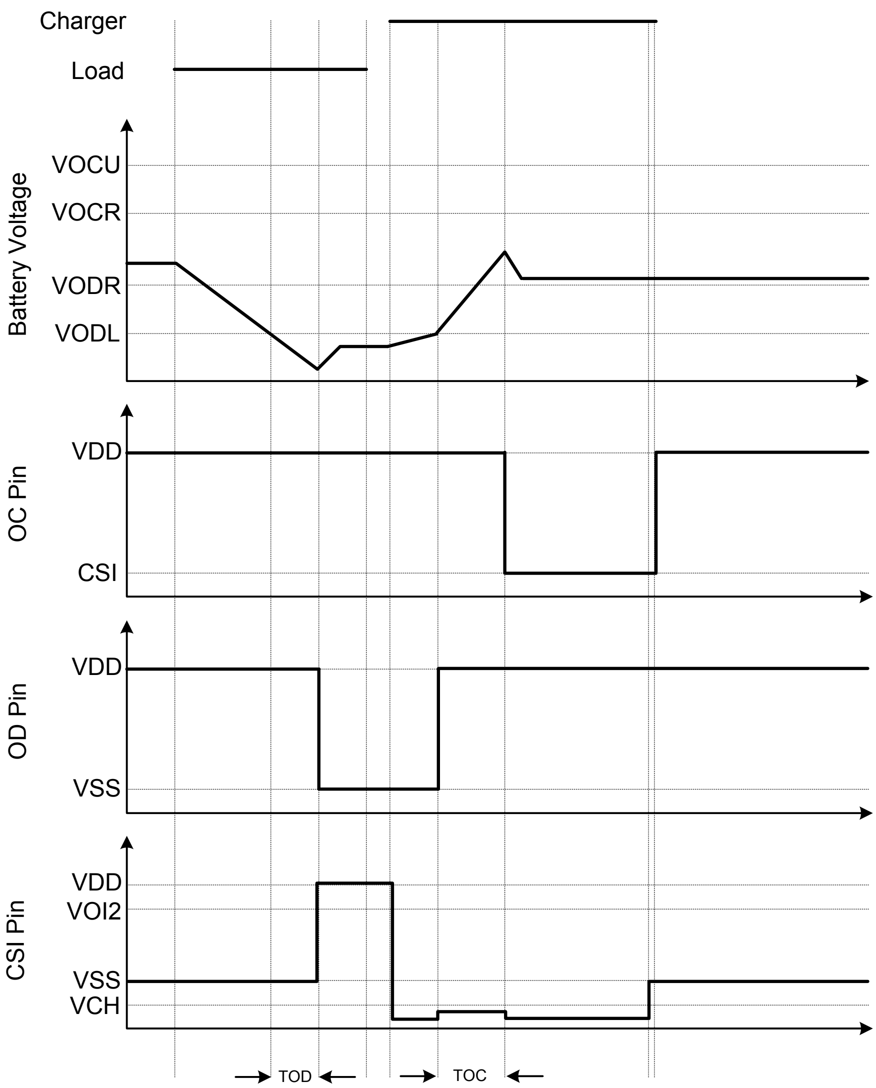
■ TIMING DIAGRAM(Cont.)

5. Overdischarge Condition → Charging By a Charger → Normal Condition



■ TIMING DIAGRAM(Cont.)

6. Overdischarge Condition → Abnormal Charger Current Condition → Normal Condition



■ TIMING DIAGRAM(Cont.)

7. Over Current and Short Circuit Condition → Normal Condition