



# LITHIUM-ION/POLYMER BATTERY PROTECTION IC

## DESCRIPTION

The UTC **UB24205** is a lithium-ion / lithium-polymer rechargeable battery protection IC with internal MOSFETs. It incorporates high accuracy voltage detection circuits and delay circuits.

The UTC **UB24205** is suitable for protection of single cell lithium-ion / lithium polymer battery packs from overcharge, over discharge and over current.

The small package and less required external components make it ideal to be integrated into limited space of battery pack.

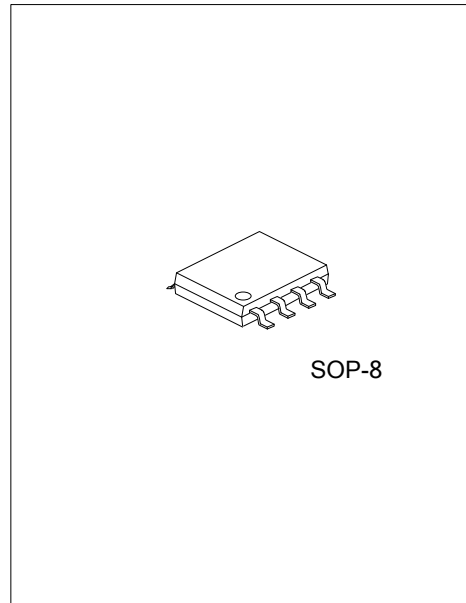
## FEATURES

- \* Wide supply voltage range:  $V_{DD}=1.8V\sim 9.0V$
- \* Ultra-low quiescent current:  $I_{DD}=3.0\mu A (V_{DD}=3.9V)$
- \* Ultra-low power-down current:  $I_{PD}=0.1\mu A (V_{DD}=2.0V)$
- \* Overcharge detection voltage:  $V_{OCU}=4.250V\pm 0.050V$
- \* Overcharge release voltage:  $V_{OCR}=4.055V\pm 0.050V$
- \* Over discharge release voltage:  $V_{ODL}=2.250V\pm 0.100V$
- \* Over discharge detection voltage:  $V_{ODR}=2.850V\pm 0.100V$
- \* Over current detection voltage:  $V_{OI1}= 0.150V\pm 0.030V$
- \* Short circuit detection voltage:  $V_{OI2}=1.35V (Fixed)$
- \* Charger detection voltage:  $V_{CH}=-0.7V$
- \* Reset resistance for over current protection:  $R_{SHORT} > 500k\Omega$
- \* No external MOSFETs
- \* Delay times are generated by an internal circuit (External capacitors are unnecessary).
- \* Halogen Free

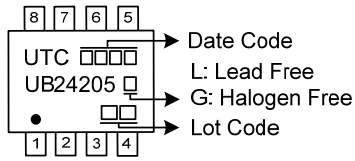
## ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
UB24205L-S08-R	UB24205G-S08-R	SOP-8	Tape Reel

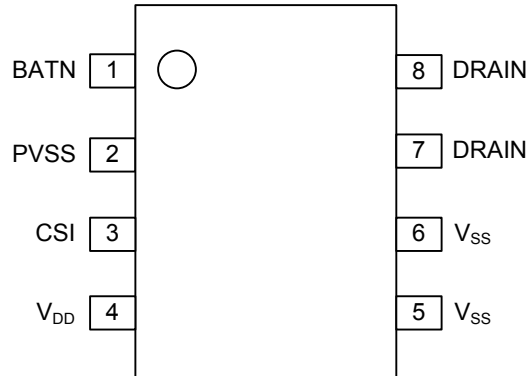
<p>UB24205G-S08-R</p> <p>(1)Packing Type (2)Package Type (3)Green Package</p>	<p>(1) R: Tape Reel (2) S08: SOP-8 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING



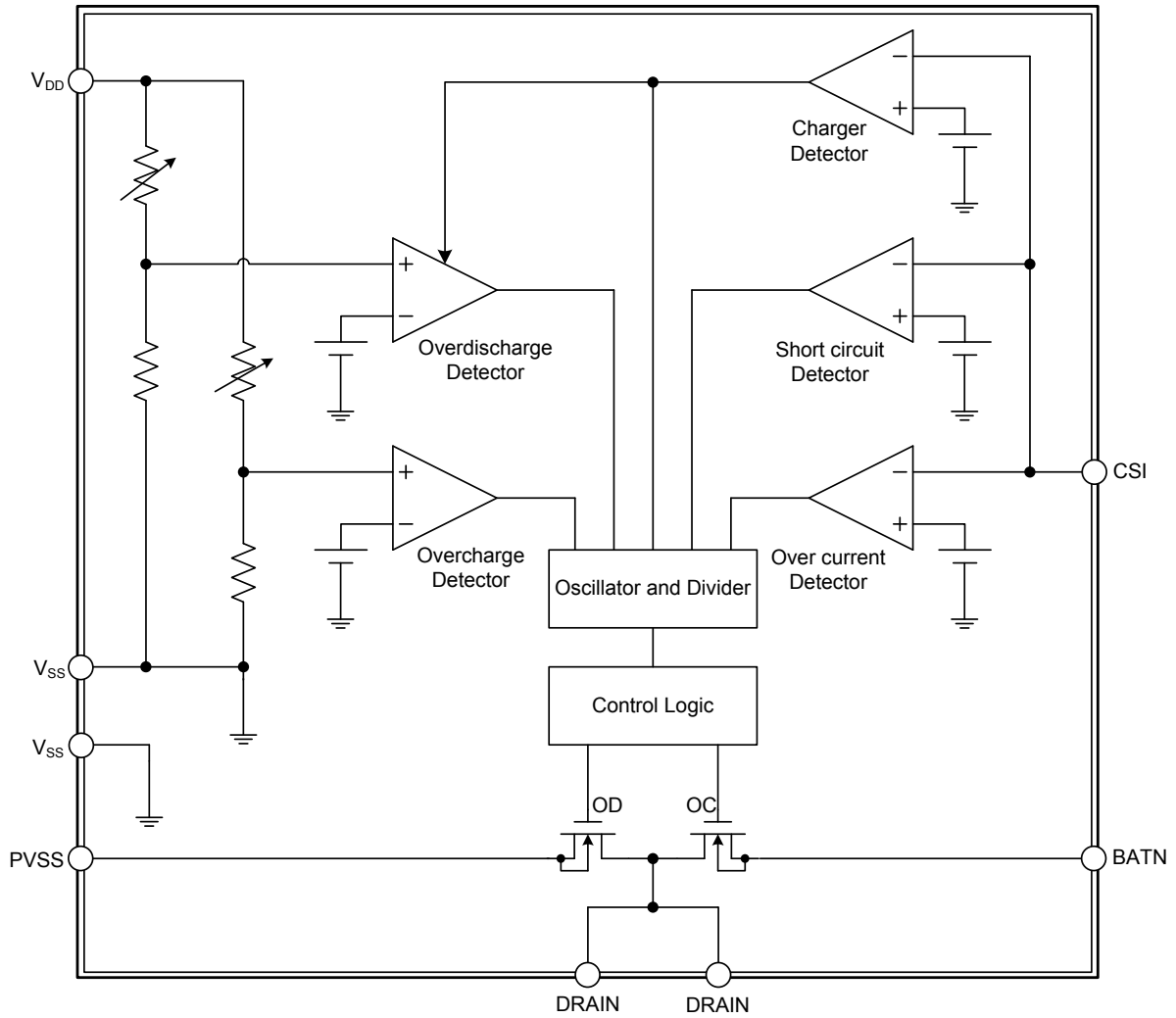
### PIN CONFIGURATION



### PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	BATN	Negative charge input, and load negative input
2	PVSS	Negative battery Input
3	CSI	Current sense Input, and charge detect
4	V <sub>DD</sub>	Positive power input
5,6	V <sub>SS</sub>	Negative power input
7,8	DRAIN	Output: the drain terminals of two internal MOSFETs

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ( $V_{SS}=0V$ ,  $T_a=25^{\circ}C$ , unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Input voltage between $V_{DD}$ and $V_{SS}$ (Note2)	$V_{DD}$	$V_{SS}-0.3 \sim V_{SS}+12$	V
CSI input pin voltage	$V_{CSI}$	$V_{DD}-15 \sim V_{DD}+0.3$	V
BATN input pin voltage	$V_{BATN}$	$V_{DD}-15 \sim V_{DD}+0.3$	V
Operating Temperature	$T_{ORP}$	-40 ~ +85	$^{\circ}C$
Storage Temperature	$T_{STG}$	-40 ~ +125	$^{\circ}C$

Note: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

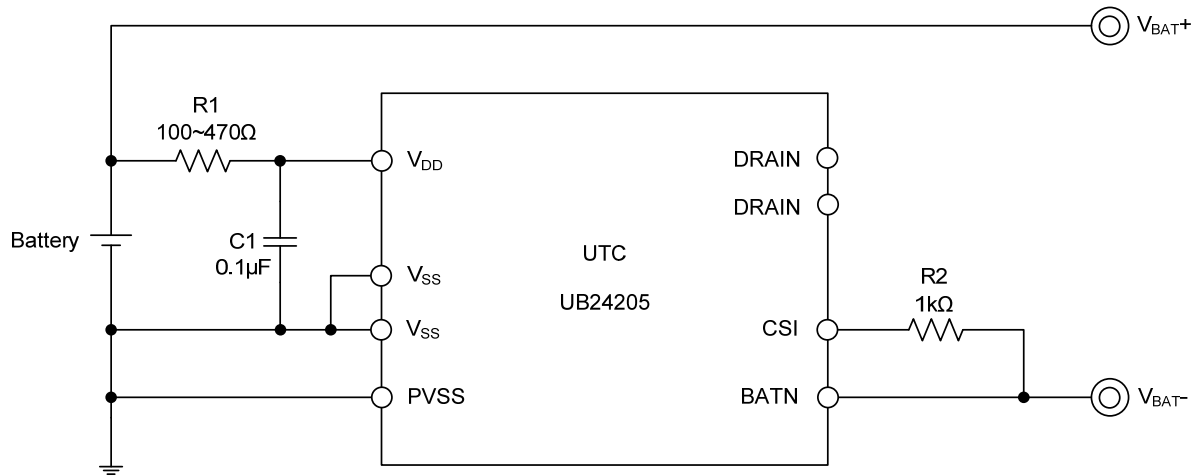
Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Pulse ( $\mu$ sec) noise exceeding the above input voltage ( $V_{SS}+12V$ ) may cause damage to the IC.

■ ELECTRICAL CHARACTERISTICS ( $V_{SS}=0V$ ,  $T_a=25^{\circ}C$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>CURRENT CONSEPTION</b>						
Supply Current	$I_{DD}$	$V_{DD}=3.9V$		3.0	6.0	$\mu A$
Power-Down Current	$I_{PD}$	$V_{DD}=2.0V$			0.1	$\mu A$
<b>OPERATING VOLTAGE</b>						
Operating Input Voltage	$V_{DS1}$	$V_{DD}-V_{SS}$	1.8		9.0	V
<b>DETECTION VOLTAGE</b>						
Overcharge Detection Voltage	$V_{OCU}$		4.200	4.250	4.300	V
Overcharge Release Voltage	$V_{OCR}$		4.005	4.055	4.105	V
Overdischarge Detection Voltage	$V_{ODL}$		2.150	2.250	2.350	V
Overdischarge Release Voltage	$V_{ODR}$		2.750	2.850	2.950	V
Over Current Detection Voltage	$V_{OI1}$		0.120	0.150	0.180	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	$k\Omega$
Charger Detection Voltage	$V_{CH}$		-1.2	-0.7	-0.2	V
<b>DELAY TIME</b>						
Overcharge Detection Delay Time	$T_{OC}$	$V_{DD}=3.6V \sim 4.5V$	0.7	1.3	1.9	S
Overdischarge Detection Delay Time	$T_{OD}$	$V_{DD}=3.6V \sim 2.0V$	100	180	260	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	65	$\mu S$
<b>MOSFET</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_{DS}=1\mu A$	20.0			V
		$V_{GS}=0V, I_{DS}=250\mu A$	20.6			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{GS}=0V, V_{DS}=20.0V$			1	$\mu A$
		$V_{GS}=0V, V_{DS}=20.6V$			250	$\mu A$
Gate Threshold Voltage	$V_{TH}$	$V_{GS}=V_{DS}, I_{DS}=1\mu A$	0.6		1.4	V
		$V_{GS}=V_{DS}, I_{DS}=250\mu A$	0.6		1.4	V
Equivalent Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{GS}=2.5V, I_{DS}=3A$			45	$m\Omega$
		$V_{GS}=4.5V, I_{DS}=1A$			35	$m\Omega$
		$V_{GS}=4.5V, I_{DS}=3A$			33	$m\Omega$

■ TYPICAL APPLICATION CIRCUIT



## ■ APPLICATION INFORMATION

### 1. Normal Condition

The voltage of the battery connected between  $V_{DD}$  and  $V_{SS}$  can be monitored by the UTC **UB24205**. 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  $V_{CH} < V_{CSI} < V_{O11}$ , the UTC **UB24205** will turn on the charging control MOSFET (internal) and discharging control MOSFET (internal), the battery's charging (or discharging) is in normal condition.

### 2. Overcharge Condition

When 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), the charging will be stopped.

### 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  $V_{O11} > V_{CSI} > V_{CH}$  occurs, the UTC **UB24205** will be back to normal condition.
- (2) Connect the UTC **UB24205** to a load and remove the charger.

### 4. Overdischarge Condition

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), the discharging will be stopped. And then CSI will be pulled up to  $V_{DD}$  through an internal resistance. When  $V_{CSI} > V_{O12}$ , the chip will enter into power-down mode. In this mode, the current consumption is lower than  $0.1\mu A$ .

### 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  $V_{CH} < V_{CSI} < V_{O12}$ , 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  $V_{DD} < V_{CH}$  and when  $V_{DD} > V_{ODL}$ , 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 the charging will be stopped.

### 8. Over Current/Short Circuit Condition

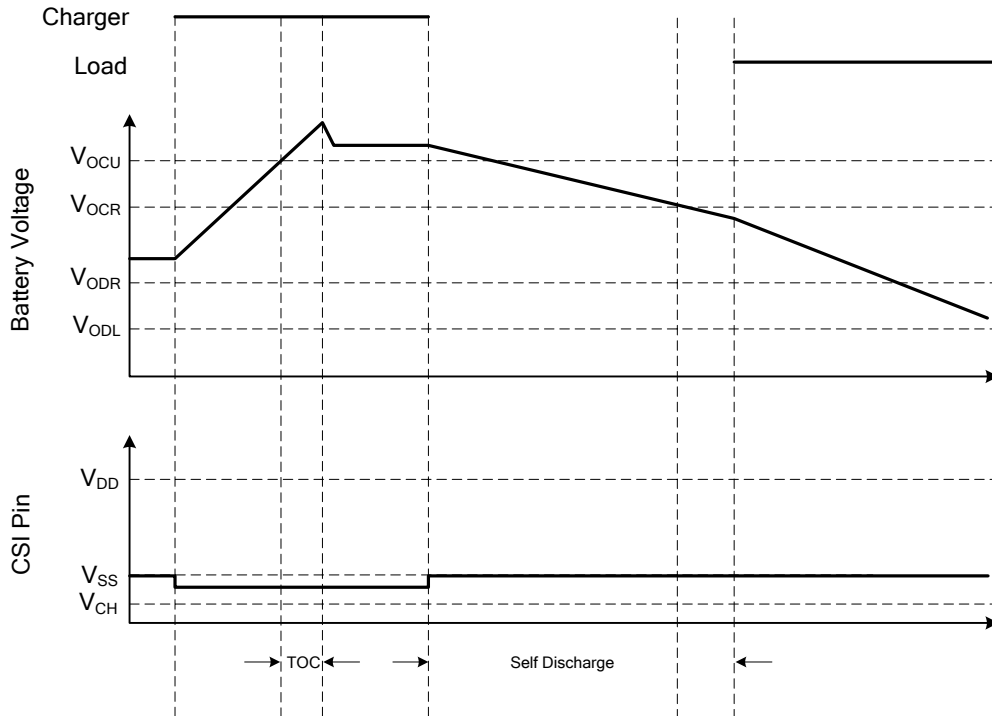
The over current (or short circuit) condition is when the current is too large during discharging under normal condition as a result of the voltage detected by CSI is greater than  $V_{O11}$  (or  $V_{O12}$ ) through a delay time  $T_{O11}$  ( $T_{O12}$ ). In this over current (or short circuit) condition, the discharging will be stopped and CSI will be pulled down to  $V_{SS}$  through an internal resistance.

### 9. Release of Over Current/Short Circuit Condition

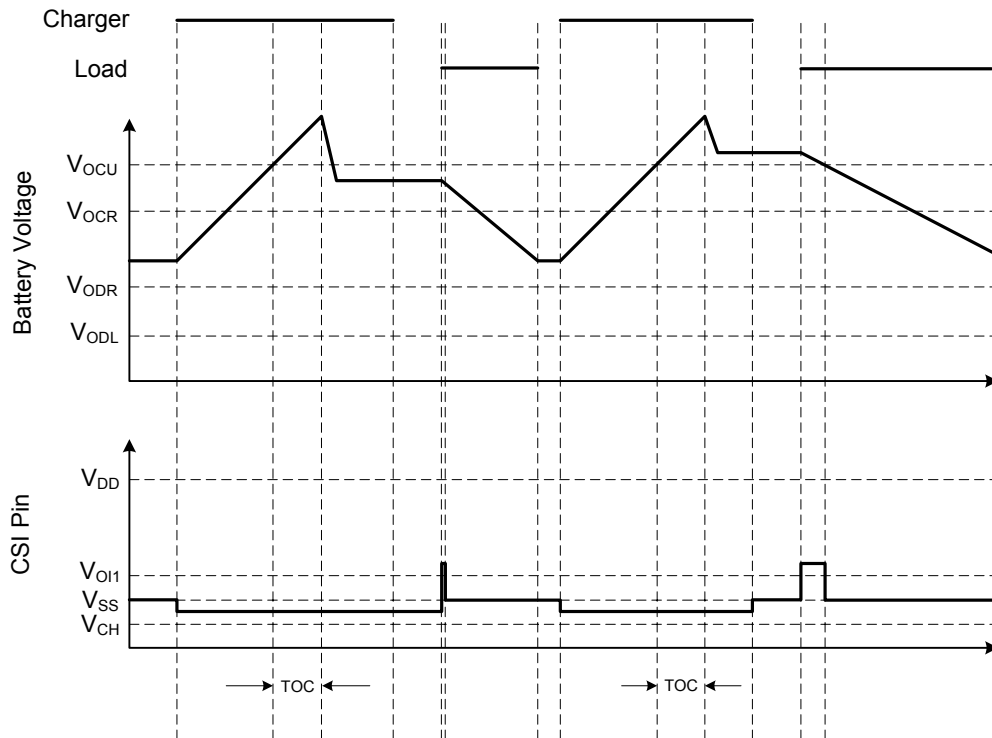
If the load is removed or the impedance between  $V_{BAT+}$  and  $V_{BAT-}$  is larger than  $500k\Omega$  as well as  $V_{CSI} < V_{O11}$ , the system will be back to normal condition.

■ TYPICAL CHARACTERISTICS

1. Overcharge Condition → Self Discharge → Normal Condition

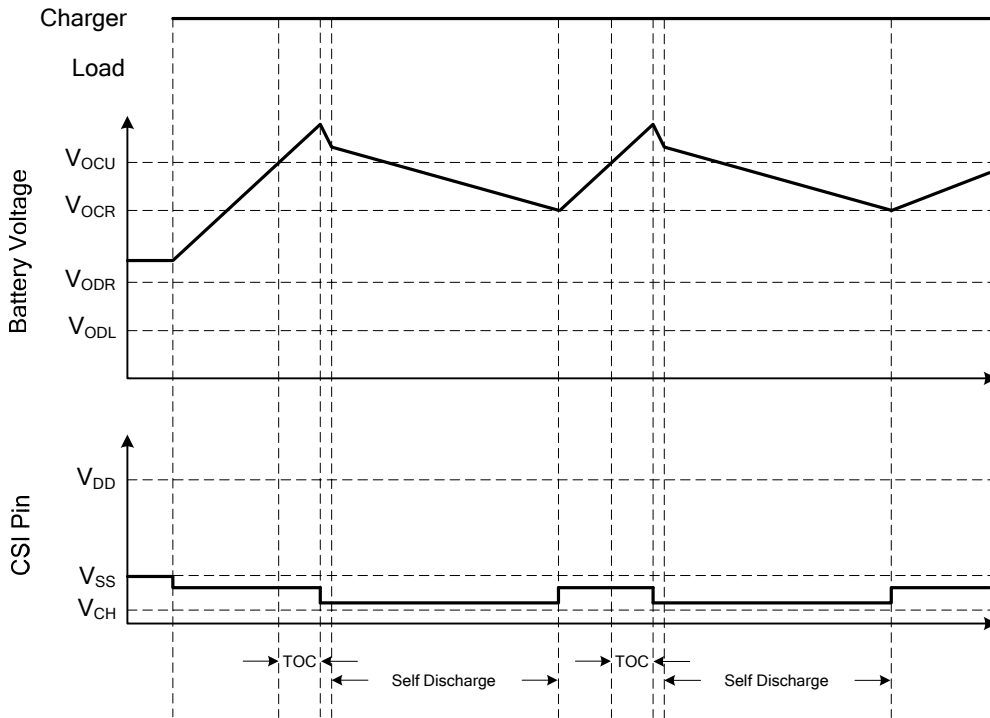


2. Overcharge Condition → Load Discharge → Normal Condition

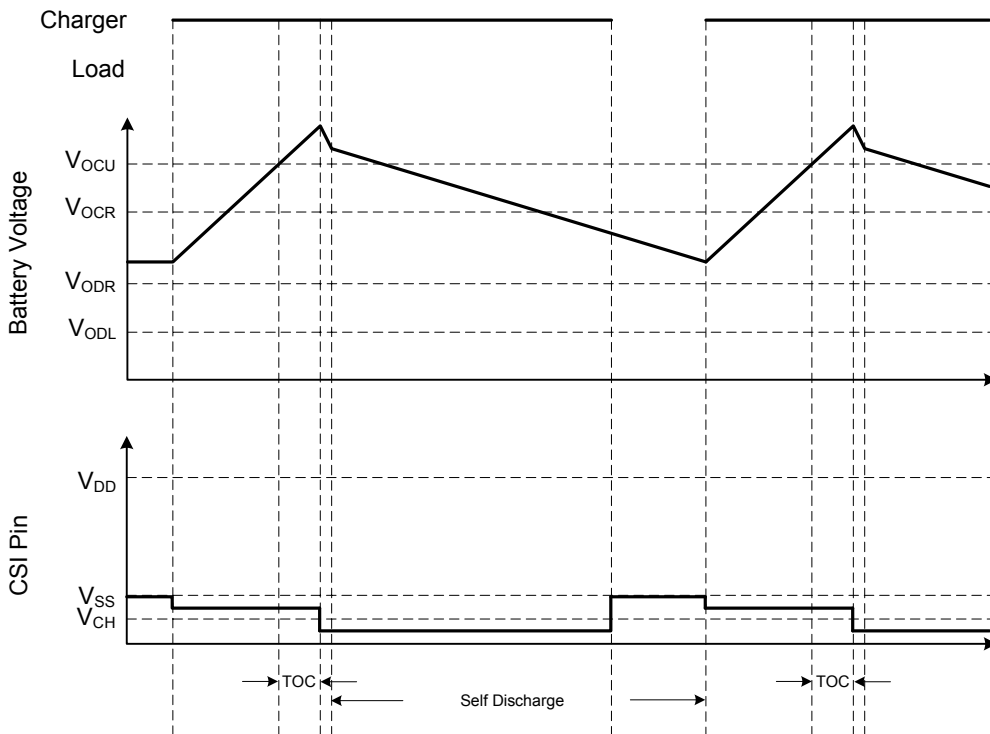


■ TYPICAL CHARACTERISTICS(Cont.)

3. Overcharge Condition → Charger remains connected and  $V_{CSI} > V_{CH}$  → Self Discharge



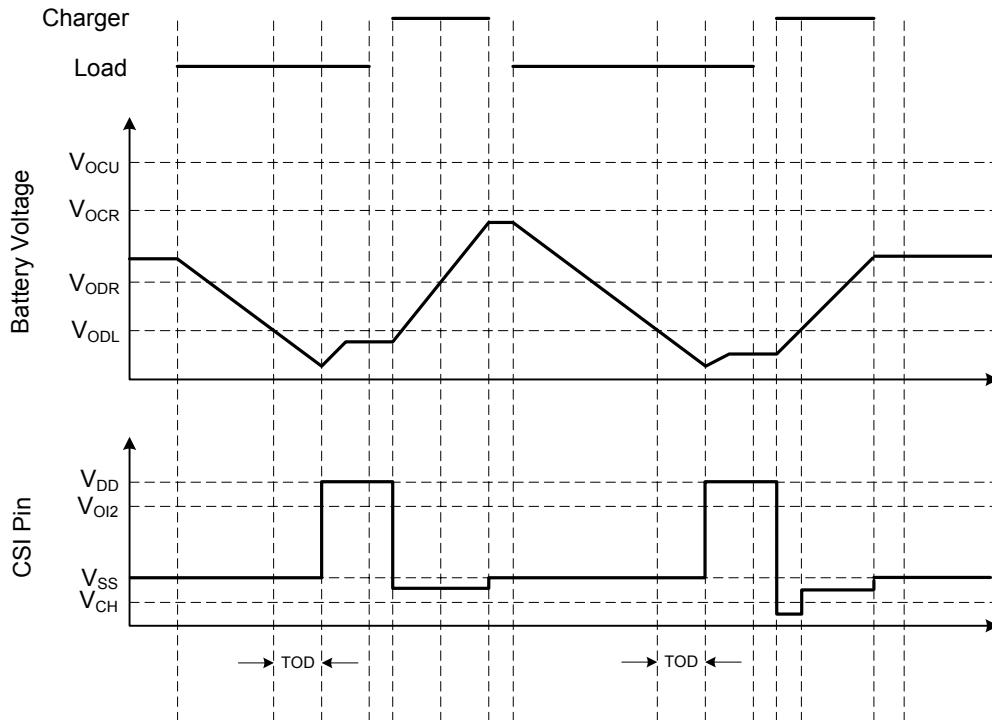
4. Overcharge Condition → Charger remains connected and  $V_{CSI} < V_{CH}$  → Self Discharge



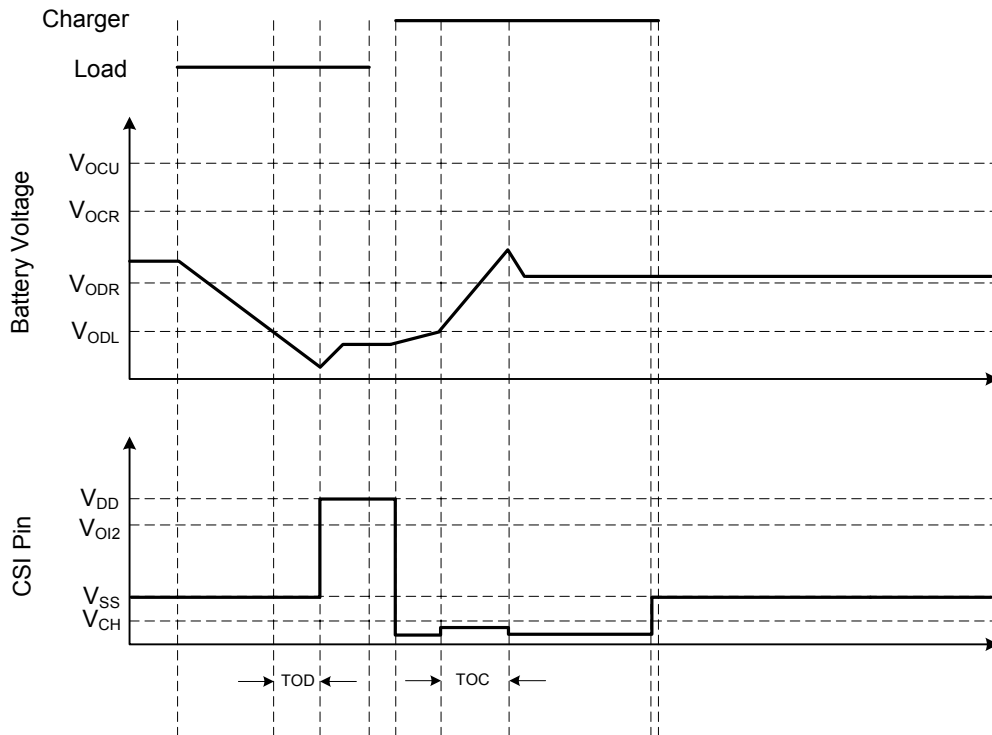


■ TYPICAL CHARACTERISTICS(Cont.)

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

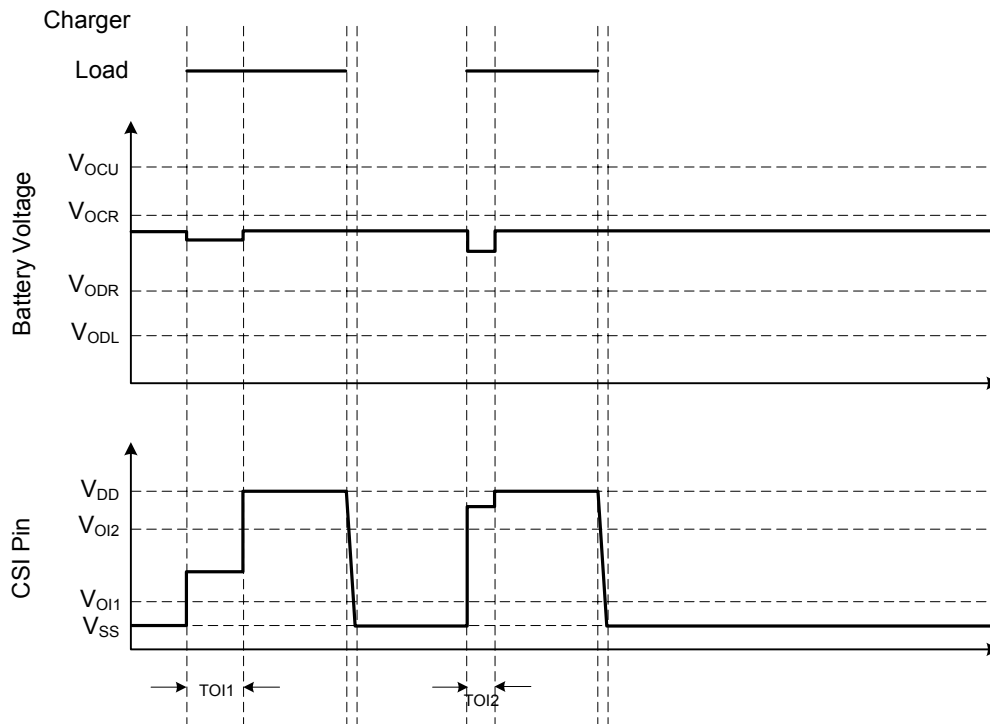


6. Overdischarge Condition → Abnormal Charger Current Condition → Normal Condition



■ TYPICAL CHARACTERISTICS(Cont.)

7. Over Current and Short Circuit Condition → Normal Condition



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