RICOH R5492N Series

One-cell Li-ion Battery Protection IC with High-accuracy Overcurrent Detection

OUTLINE
The R5492N is a high voltage tolerance protection IC for overcharge, overdischarge, and overcurrent of a rechargeable one-cell Lithium-ion (Li+) / Lithium-polymer battery. The R5492N supports the voltage release type at overcharging / overdischarging. Each output delay time of overcharge, overdischarge, and overcurrent is fixed internally. But, the delay shortening is able to shorten the detection and the release delay times at overcharging / overdischarging. Especially, the overcharge detection delay time can be shorten to approx.1/90.

FEATURES
- High Voltage Tolerant Process
  Absolute Maximum Ratings .......................... 30 V
- Low Supply Current
  Supply Current (at normal mode) ................. Typ. 4.0 µA, Max. 8.0 µA
  Standby Current .................................... Max. 0.5 µA
- High-accuracy Voltage Detection
  Overcharge Detection Voltage .................... 4.00 V to 4.50 V (in 5 mV steps)
  Overcharge Detection Voltage Accuracy ........ ± 20 mV (Ta = 25°C)
  ± 25 mV (-5°C < Ta < 55°C)
  Overdischarge Detection Voltage ................. 2.00 V to 3.00 V (in 0.1 V steps)
  Overdischarge Detection Voltage Accuracy .......... ±2.5%
  Discharge Overcurrent Detection Voltage ....... 0.05 V to 0.20 V (in 5 mV steps)
  Discharge Overcurrent Detection Voltage Accuracy ...... ±15 mV
  Charge Overcurrent Detection Voltage .......... -0.05 V to -0.20 V (in 5 mV steps)
  Charge Overcurrent Detection Voltage Accuracy ........ ±15 mV
  Short Detection Voltage .......................... 0.8 V fixed
- 0V Battery Charge Function
- Compact Package .................................... SOT-23-6 (2.9 mm x 2.8 mm)

APPLICATIONS
- Li+ / Li Polymer protection of overcharge, overdischarge, and overcurrent for Battery pack
- High precision protection for smart-phones and any other gadgets using on board Li+ / Li Polymer battery
**SELECTION GUIDE**

The set output voltages of overcharge, overdischarge, and discharge overcurrent are user-selectable options.

### Selection Guide

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Package</th>
<th>Quantity per Reel</th>
<th>Pb Free</th>
<th>Halogen Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5492Nxxx+$-TR-FF</td>
<td>SOT-23-6</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

xxx: Specify the combination of each detection voltage (VDET) and each release voltage (VREL).

- Overcharge Detection Voltage (VDET1): 4.00 V to 4.50 V (in 5 mV steps)
- Overdischarge Detection Voltage (VDET2): 2.00 V to 3.00 V (in 0.1 V steps)
- Discharge Overcurrent Detection Voltage (VDET3): 0.05 V to 0.20 V (in 5 mV steps)
- Charge Overcurrent Detection Voltage (VDET4): -0.05 V to -0.20 V (in 5 mV steps)
- Overcharge Release Voltage (VREL1)
- Overdischarge Release Voltage (VREL2)

*: Specify the combination of each delay time parameter. Refer to *Delay Time Code Table* for details.

### Delay Time Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>tVDET1(s)</th>
<th>tVDET2 (ms)</th>
<th>tVDET3 (ms)</th>
<th>tVDET4(ms)</th>
<th>tSHORT(µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>1.0</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
</tbody>
</table>

$: Specify the function code.

### Function Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Overcharge</th>
<th>Overdischarge</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Voltage Release Type</td>
<td></td>
</tr>
</tbody>
</table>
Product Code Table

The product code is determined by the combination of the set output voltage (overcharge detection / release voltage: $V_{DET1}$ / $V_{REL1}$, overdischarge detection / release voltage: $V_{DET2}$ / $V_{REL2}$, discharge / charge overcurrent detection voltage: $V_{DET3}$ / $V_{DET4}$) and the delay time (overcharge / overdischarge detection delay time: $t_{VDET1}$ / $t_{VDET2}$, discharge / charge overcurrent detection delay time: $t_{VDET3}$ / $t_{VDET4}$) and the function code.

<table>
<thead>
<tr>
<th>Product Code</th>
<th>$V_{DET1}$ (V)</th>
<th>$V_{REL1}$ (V)</th>
<th>$V_{DET2}$ (V)</th>
<th>$V_{REL2}$ (V)</th>
<th>$V_{DET3}$ (V)</th>
<th>$V_{DET4}$ (V)</th>
<th>$t_{VDET1}$ (s)</th>
<th>$t_{VDET2}$ (ms)</th>
<th>$t_{VDET3}$ (ms)</th>
<th>$t_{VDET4}$ (ms)</th>
<th>$t_{SHORT}$ (µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5492N101KL</td>
<td>4.250</td>
<td>4.050</td>
<td>2.500</td>
<td>3.000</td>
<td>0.200</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N102KL</td>
<td>4.350</td>
<td>4.150</td>
<td>2.500</td>
<td>3.000</td>
<td>0.200</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N110KL</td>
<td>4.280</td>
<td>4.080</td>
<td>2.300</td>
<td>3.000</td>
<td>0.125</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N149KL</td>
<td>4.280</td>
<td>4.080</td>
<td>2.900</td>
<td>3.100</td>
<td>0.125</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N163KL</td>
<td>4.280</td>
<td>4.100</td>
<td>3.000</td>
<td>3.200</td>
<td>0.100</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N173KL</td>
<td>4.200</td>
<td>4.100</td>
<td>2.800</td>
<td>2.900</td>
<td>0.100</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N187KL</td>
<td>4.250</td>
<td>4.050</td>
<td>3.000</td>
<td>3.200</td>
<td>0.150</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N218KL</td>
<td>4.250</td>
<td>4.050</td>
<td>2.800</td>
<td>3.000</td>
<td>0.150</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N227KL</td>
<td>4.375</td>
<td>4.175</td>
<td>2.500</td>
<td>3.000</td>
<td>0.200</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N280KL</td>
<td>4.425</td>
<td>4.225</td>
<td>2.400</td>
<td>2.900</td>
<td>0.150</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N345KL</td>
<td>4.475</td>
<td>4.275</td>
<td>2.500</td>
<td>2.900</td>
<td>0.150</td>
<td>-0.150</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N350KL</td>
<td>4.475</td>
<td>4.275</td>
<td>2.500</td>
<td>3.000</td>
<td>0.150</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N351KL</td>
<td>4.475</td>
<td>4.275</td>
<td>2.500</td>
<td>3.000</td>
<td>0.200</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>R5492N352KL</td>
<td>4.425</td>
<td>4.225</td>
<td>3.000</td>
<td>3.200</td>
<td>0.200</td>
<td>-0.100</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>300</td>
</tr>
</tbody>
</table>
BLOCK DIAGRAM

R5492N Block Diagram

PIN DESCRIPTION

R5492N (SOT-23-6) Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DOUT</td>
<td>Overdischarge detection voltage pin, CMOS output</td>
</tr>
<tr>
<td>2</td>
<td>V-</td>
<td>Negative power supply voltage pin</td>
</tr>
<tr>
<td>3</td>
<td>COUT</td>
<td>Overcharge detection voltage pin, CMOS output</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>5</td>
<td>VDD</td>
<td>Power supply voltage pin, the substrate potential of the IC.</td>
</tr>
<tr>
<td>6</td>
<td>VSS</td>
<td>Ground pin</td>
</tr>
</tbody>
</table>
ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Power supply voltage</td>
<td>0.3 to 12 V</td>
<td>V</td>
</tr>
<tr>
<td>V-</td>
<td>V- pin voltage</td>
<td>VDD-0.3 to VDD+0.3 V</td>
<td>V</td>
</tr>
<tr>
<td>VOUT</td>
<td>COUT pin voltage</td>
<td>VDD-0.3 to VDD+0.3 V</td>
<td>V</td>
</tr>
<tr>
<td>VDOUT</td>
<td>DOUT pin voltage</td>
<td>VSS-0.3 to VDD+0.3 V</td>
<td>V</td>
</tr>
<tr>
<td>PD</td>
<td>Power Dissipation(^{(1)}) (Standard Test Land Pattern)</td>
<td>150 mW</td>
<td></td>
</tr>
<tr>
<td>Tj</td>
<td>Junction Temperature Range</td>
<td>-40 to 125 °C</td>
<td>°C</td>
</tr>
<tr>
<td>Tstg</td>
<td>Storage Temperature Range</td>
<td>-55 to 125 °C</td>
<td>°C</td>
</tr>
</tbody>
</table>

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITION

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD1</td>
<td>Operating Input Voltage</td>
<td>1.5 to 5.0 V</td>
<td>V</td>
</tr>
<tr>
<td>Ta</td>
<td>Operating Temperature Range</td>
<td>-40 to 85 °C</td>
<td>°C</td>
</tr>
</tbody>
</table>

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

\(^{(1)}\) Refer to \textit{POWER DISSIPATION} in \textit{SUPPLEMENTARY ITEMS} for detail information.
ELECTRICAL CHARACTERISTICS

The specifications surrounded by [ ] are guaranteed by Design Engineering at -5°C ≤ Ta ≤ 55°C.

### R5492NxxxKL Electronic Characteristics

- **Symbol**: \( V_{ST} \)
- **Parameter**: Minimum operating voltage for 0V charging
- **Conditions**: Voltage between VDD and V- pins, \( V_{DD} - V_{SS} = 0 \) V
- **Min.**: 1.8 V
- **Typ.**: 
- **Max.**: 
- **Unit**: V

- **Symbol**: \( V_{DET1} \)
- **Parameter**: Overcharge detection voltage
- **Conditions**: \( R1 = 330 \Omega \)
- **Min.**: \( V_{DET1}-0.020 \)
- **Typ.**: \( V_{DET1} \)
- **Max.**: \( V_{DET1}+0.020 \)
- **Unit**: V

- **Symbol**: \( V_{REL1} \)
- **Parameter**: Overcharge release voltage
- **Conditions**: \( R1 = 330 \Omega \)
- **Min.**: \( V_{REL1}-0.050 \)
- **Typ.**: \( V_{REL1} \)
- **Max.**: \( V_{REL1}+0.050 \)
- **Unit**: V

- **Symbol**: \( t_{VDET1} \)
- **Parameter**: Overcharge detection delay time
- **Conditions**: \( V_{DD} = 3.6 \text{ V} \rightarrow 4.4 \text{ V} \)
- **Min.**: 0.7 s
- **Typ.**: 1.0 s
- **Max.**: 1.3 s
- **Unit**: s

- **Symbol**: \( t_{VREL1} \)
- **Parameter**: Overcharge release delay time
- **Conditions**: \( V_{DD} = 4.5 \text{ V} \rightarrow 3.6 \text{ V} \)
- **Min.**: 11 ms
- **Typ.**: 16 ms
- **Max.**: 21 ms
- **Unit**: ms

- **Symbol**: \( V_{DET2} \)
- **Parameter**: Overdischarge detection voltage
- **Conditions**: Falling edge of supply voltage
- **Min.**: \( V_{DET2} \times 0.975 \)
- **Typ.**: \( V_{DET2} \)
- **Max.**: \( V_{DET2} \times 1.025 \)
- **Unit**: V

- **Symbol**: \( V_{REL2} \)
- **Parameter**: Overdischarge release voltage
- **Conditions**: Rising edge of supply voltage
- **Min.**: \( V_{REL2} \times 0.975 \)
- **Typ.**: \( V_{REL2} \)
- **Max.**: \( V_{REL2} \times 1.025 \)
- **Unit**: V

- **Symbol**: \( t_{VDET2} \)
- **Parameter**: Overdischarge detection delay time
- **Conditions**: \( V_{DD} = 3.6 \text{ V} \rightarrow 2.2 \text{ V} \)
- **Min.**: 14 ms
- **Typ.**: 20 ms
- **Max.**: 26 ms
- **Unit**: ms

- **Symbol**: \( t_{VREL2} \)
- **Parameter**: Overdischarge release delay time
- **Conditions**: \( V_{DD} = 2.2 \text{ V} \rightarrow 3.1 \text{ V} \)
- **Min.**: 0.7 ms
- **Typ.**: 1.2 ms
- **Max.**: 1.7 ms
- **Unit**: ms

- **Symbol**: \( V_{DET3} \)
- **Parameter**: Charge overcurrent detection voltage
- **Conditions**: Rising edge of V- pin voltage
- **Min.**: \( V_{DET3}-0.015 \)
- **Typ.**: \( V_{DET3} \)
- **Max.**: \( V_{DET3}+0.015 \)
- **Unit**: V

- **Symbol**: \( t_{VDET3} \)
- **Parameter**: Discharge overcurrent detection delay time
- **Conditions**: \( V_{DD}=3.0\text{V}, V_-=0V \rightarrow 0.5V \)
- **Min.**: 8 ms
- **Typ.**: 12 ms
- **Max.**: 16 ms
- **Unit**: ms

- **Symbol**: \( t_{VREL3} \)
- **Parameter**: Discharge overcurrent release delay time
- **Conditions**: \( V_{DD}=3.0\text{V}, V_-=3V \rightarrow 0V \)
- **Min.**: 0.7 ms
- **Typ.**: 1.2 ms
- **Max.**: 1.7 ms
- **Unit**: ms

- **Symbol**: \( V_{SHORT} \)
- **Parameter**: Short-circuit detection voltage
- **Conditions**: \( V_{DD} = 3.0 \text{ V} \)
- **Min.**: 0.55 V
- **Typ.**: 0.80 V
- **Max.**: 1.00 V
- **Unit**: V

- **Symbol**: \( t_{SHORT} \)
- **Parameter**: Short-circuit detection delay time
- **Conditions**: \( V_{DD} = 3.0\text{V}, V_-=0V \rightarrow 3V \)
- **Min.**: 230 ms
- **Typ.**: 300 ms
- **Max.**: 500 ms
- **Unit**: ms

- **Symbol**: \( R_{SHORT} \)
- **Parameter**: Discharge overcurrent release resistance
- **Conditions**: \( V_{DD} = 3.6 \text{ V}, V_- = 1.0 \text{ V} \)
- **Min.**: 5 kΩ
- **Typ.**: 15 kΩ
- **Max.**: 25 kΩ
- **Unit**: kΩ

- **Symbol**: \( V_{DET4} \)
- **Parameter**: Charge overcurrent detection voltage
- **Conditions**: Falling edge of V- pin voltage
- **Min.**: \( V_{DET4}-0.015 \)
- **Typ.**: \( V_{DET4} \)
- **Max.**: \( V_{DET4}+0.015 \)
- **Unit**: V

---

(1) Refer to TEST CIRCUITS for details.
The specifications surrounded by are guaranteed by Design Engineering at -5°C ≤ Ta ≤ 55°C.

### R5492NxxxxKL Electrical Characteristics (Continued)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>tDET</td>
<td>Charge overcurrent detection delay time</td>
<td>VDD = 3.0V, V- = 0V → -1V</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>ms</td>
<td>G</td>
</tr>
<tr>
<td>tREL</td>
<td>Charge overcurrent release delay time</td>
<td>VDD = 3.0V, V- = -1V → 0V</td>
<td>0.7</td>
<td>1.2</td>
<td>1.7</td>
<td>ms</td>
<td>G</td>
</tr>
<tr>
<td>VDS</td>
<td>Short-circuit mode voltage</td>
<td>VDD = 4.4 V</td>
<td>-3.15</td>
<td>-2.55</td>
<td>-1.95</td>
<td>V</td>
<td>G</td>
</tr>
<tr>
<td>VIL</td>
<td>COUT Nch. ON voltage</td>
<td>IOL = 50μA, VDD = 4.5 V</td>
<td>0.4</td>
<td>0.5</td>
<td></td>
<td>V</td>
<td>H</td>
</tr>
<tr>
<td>VOH1</td>
<td>COUT Pch. ON voltage</td>
<td>IOH = -50μA, VDD = 3.9 V</td>
<td>3.4</td>
<td>3.7</td>
<td></td>
<td>V</td>
<td>I</td>
</tr>
<tr>
<td>VIL2</td>
<td>DOUT Nch. ON voltage</td>
<td>IOL = 50μA, VDD = 2.0 V</td>
<td>0.2</td>
<td>0.5</td>
<td></td>
<td>V</td>
<td>J</td>
</tr>
<tr>
<td>VOH2</td>
<td>DOUT Pch. ON voltage</td>
<td>IOH = -50μA, VDD = 3.9 V</td>
<td>3.4</td>
<td>3.7</td>
<td></td>
<td>V</td>
<td>K</td>
</tr>
<tr>
<td>IOD</td>
<td>Supply current</td>
<td>VDD = 3.9 V, V- = 0 V</td>
<td>4.0</td>
<td>8.0</td>
<td></td>
<td>μA</td>
<td>L</td>
</tr>
<tr>
<td>ISBY</td>
<td>Standby current</td>
<td>VDD = 1.8 V</td>
<td></td>
<td></td>
<td>0.5</td>
<td>μA</td>
<td>L</td>
</tr>
</tbody>
</table>

(1) Refer to TEST CIRCUITS for details.
Test Circuits

A

B

C

D

E

F

G

H

I

J
THEORY OF OPERATION

Overcharge Detector (VD1)
The VD1 monitors VDD pin voltage during charge. When the VDD voltage crosses overcharge detector threshold VDET1, the VD1 can sense overcharge and the output of COUT pin becomes “L” and stop charging by turning off the external Nch. MOSFET. After detecting overcharge, when the voltage of VDD pin is equal or less than the released voltage from overcharge, or when the VDD voltage is less than the overcharge detector threshold, if the charger is removed, VD1 is released, then the output level of COUT becomes “H” and by turning on the external Nch. MOSFET, the battery charger is ready to work again. However, depending on the characteristics of external components such as MOSFETs, release conditions may be not enough and a kind of load must be set to release the overcharge. When the Input level of VDD pin is equal or more than overcharge detector threshold, and while a charger is disconnected from the battery pack, if a load system is connected to the battery pack, the output level of COUT pin is “L”. However, load current can be flowed through a parasitic diode of an external Nch. MOSFET. Then, when the voltage level of VDD pin becomes lower than overcharge detector threshold, the output level of COUT pin becomes “H”. Output delay time for overcharge detect and released overcharge is internally fixed respectively. Although the VDD voltage goes up to a higher level than overcharge detector threshold within the output delay time, VD1 would not work for detecting overcharge. If the action for VD1 to release is done and the condition returns to the initial one within the output delay time, VD1 cannot be released. A level shifter is built in a buffer driver for the COUT pin, therefore, the “L” level is equal to the voltage level of V- pin. The output type of COUT pin is CMOS type. The Output level is between VDD and V-. 

Charge Overcurrent Detector (VD4)
While charge and discharge are acceptable with the battery pack, VD4 senses V- pin voltage. For example, if the battery pack is charged by an inappropriate charger, overcurrent flows, then the voltage of V- pin becomes less than charge overcurrent detector threshold. Then, the output of COUT becomes “L”, and protects against flowing overcurrent in the circuit by turning off the external Nch. MOSFET. Output delay of charge overcurrent is internally fixed. Even the voltage level of V- pin becomes lower than charge overcurrent detector threshold, if the voltage is higher than the VD4 threshold within the delay time, charge overcurrent state is not detected. Output delay time for release from charge overcurrent is also set internally. VD4 can be released by disconnecting a charger.
Timing Chart of Overcharging
Overdischarge Detector (VD2)

The VD2 monitors a VDD pin voltage during discharge. When the VDD voltage crosses the overdischarge detector threshold VDET2 from a high level to a lower level than VDET2, the VD2 senses overdischarge and stop discharge by turning off an external Nch. MOSFET.

To reset the VD2 with the DOUT pin level being “H” again after detecting overdischarge, if VDD voltage is equal or less than overcharge detector threshold, a charge current flows through a parasitic diode of the external Nch. MOSFET. After that, when VDD voltage is more than overdischarge threshold, DOUT pin becomes "H", and by tuning on the external Nch. MOSFET, discharge is possible. In the case that a charger is connected to the battery pack, and VDD level is more than overdischarge detector threshold, the output level of DOUT becomes “H” immediately. Without connecting a charger, if VDD pin voltage is equal or more than the released voltage from overdischarge, the output level of DOUT becomes “H”.

When a cell voltage is equal to 0V, connecting a charger to the battery pack makes COUT pin become "H" and the system is allowable for charge while the voltage of the charger is more than the maximum limit of the minimum operating voltage (Vst) for 0V charge.

An output delay for overdischarge detection is fixed internally. Although the voltage of VDD becomes equal or less than overdischarge detector threshold and if it becomes higher than overdischarge detector threshold within output delay time, overdischarge detector does not work. Output delay time for release from overdischarge is also set internally. After detecting overdischarge by VD2, supply current would decrease, because unnecessary circuits are halted and being standby.

The output type of DOUT pin is CMOS type and its output level is in between VDD and VSS.
Discharge Overcurrent Detector / Short-circuit Protector (VD3 / VSHORT)

While charge and discharge are acceptable with the battery pack, VD3 monitors the voltage level of V- pin. In the cause of such as the external short circuit, if the voltage level of V- pin may become more than the discharge overcurrent detection voltage and less than the short detection voltage, the discharge overcurrent detector works. When the voltage level of V- pin becomes more than short detection voltage, the short-circuit protector works and the output level of DOUT pin becomes “L”, and by turning off an external Nch. MOSFET, VD3 protects against flowing extremely large current into the circuit.

An output delay time for the discharge overcurrent detection is internally fixed. Although the voltage of V- pin becomes more than the discharge overcurrent detection voltage and less than short detection voltage, if it becomes less than the discharge overcurrent detection voltage within the output delay time, the overcurrent detector does not work. Output delay time for release from discharge overcurrent is also set internally.

In terms of short-circuit protector, output delay time is typically 300µs. The V- pin has a built-in pull down resistor, Typ. 15kΩ connected to the Vss pin.

After a discharge overcurrent or short circuit protection is detected, by removing a cause of overcurrent or external short circuit, the voltage level of V- is pulled down through the resistor for release from overcurrent to the Vss level. Then, when the voltage level of V- pin becomes less than the overcurrent detection voltage, both protection circuits are released automatically. Resistor for release from discharge overcurrent is active when discharge overcurrent or short-circuit is detected. While charge and discharge are acceptable for the battery pack, or normal mode, the resistor is inactive.

Output delay time for discharge overcurrent is necessarily set shorter than output delay time for overdischarge. Therefore, if discharge overcurrent is detected, and at the same time, VDD pin voltage becomes lower than overdischarge detection voltage, discharge overcurrent detector is predominant. By disconnecting load from the battery pack, the battery pack is automatically released from overcurrent state.
Timing Chart of Overdischarging, Discharge Overcurrent, and Short-circuit

Delay Shortening (DS)

When the COUT is "H", the output delay time of detection and release at overcharging / overdischarging can be shorter than default values by forcing lower than the delay shortening mode voltage to V- pin.
APPLICATION INFORMATION

Typical Application Circuit

R5492N Typical Application Circuit

Technical Notes on the Selection Components

- Since RVDD and CVDD stabilize a supply voltage to the IC, a recommended value of RVDD is less than 1 kΩ. If making RVDD larger, the conduction current flowed in the IC will make the detection voltage larger. For stabilizing operation, connect the CVDD of 0.01μF or more.

- RVDD and RV- limit a current when the battery pack is reverse-charged or when the charger having supply voltage exceeded the absolute maximum rating is connected. A total of RVDD and RV- should be 1kΩ or more. If RVDD and RV- become small value, the IC might exceed the power dissipation. Besides, RV- should be 10kΩ or less. If RV- becomes large value, a release by connecting with the charger might be impossible after overdischarging.

- Overvoltage and overcurrent exceeded the absolute maximum rating should not be forced to the protection IC and external components. If positive terminal and negative terminal of the battery pack short, even though the short-circuit protection is incorporated, during the delay time until detecting the short circuit, a large current may flow through an external MOSFET. Select an MOSFET with large enough current capacity in order to endure the large current during the delay time.

- The typical application circuit diagram is just examples. This circuit performance largely depends on the PCB layout and external components. In the actual application, fully evaluation is necessary.
PACKAGE DIMENSIONS

SOT-23-6

Ver. A

SOT-23-6 Package Dimensions

Unit: mm
1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.

2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.

3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.

4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh’s or any third party’s intellectual property rights or any other rights.

5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.

6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundant design, error check and the like.

7. Anti-radiation design is not implemented in the products described in this document.

8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.

9. WL CSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.

10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact Ricoh sales or our distributor before attempting to use AOI.

11. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

Halogen Free

https://www.e-devices.ricoh.co.jp/en/