OUTLINE
The R3150N is a voltage detector that provides high-voltage resistance, high voltage accuracy and low supply current. This device is suitable for battery voltage supervisor. The R3150NxxxxA/B provide VDD pin detection and the R3150NxxxxE/F provide SENSE pin detection. Detector threshold and Release voltage can be specified separately. Both the detector threshold accuracy and the release voltage accuracy are ±1.5% (25°C) (Detector Threshold Hysteresis is 5% to 20%).
The detect output delay time and the release output delay time (Power-on Reset Time) are adjustable by using external capacitors. The output types are Nch open drain “L” output and Nch open drain “H” output. The R3150N is available in SOT-23-6 package that is possible to achieve high-density mounting on boards.

FEATURES
- Operating Voltage Range (Maximum Rating) R3150NxxxxA/B: 1.4 V to 36.0 V (50.0 V) R3150NxxxxE/F: 3.6 V to 6.0 V (7.0 V)
- Operating Temperature Range −40°C to 105°C
- Supply Current R3150NxxxxA/B: Typ. 3.8 μA R3150NxxxxE/F: Typ. 3.5 μA
- Detector Threshold Range 5.0 V to 10.0 V (0.1 V step)
- Detector Threshold Accuracy ±1.5% (25°C) ±2.0% (~40°C to 105°C)
- Release Voltage Range (1) 5.3 V to 11.0 V (0.1 V step)
- Release Voltage Accuracy ±1.5% (25°C) ±2.0% (~40°C to 105°C)
- Detect Output Delay Time Accuracy −35% to 40% (~40°C to 105°C)
- Release Output Delay Time Accuracy −35% to 40% (~40°C to 105°C)
- Output Type Nch Open Drain
- Package SOT-23-6

Detect Output Delay Time and Release Output Delay Time are adjustable by external capacitor.

APPLICATIONS
- Voltage monitoring for electronic control units such as EV inverter and battery charge control unit.

(1) The release voltage can be adjusted by having the hysteresis set to 5% to 20% of the detector threshold.
VD Detector Threshold and Release Voltage for the ICs 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>R3150Nxxxx+-TR-#E</td>
<td>SOT-23-6</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

xxx: Specify a combination of Set Detector Threshold (-V<sub>SET</sub>) and Set Release Voltage (+V<sub>SET</sub>) by using serial numbers starting from 001.

- V<sub>SET</sub> can be designated between 5.0 V and 10.0 V in 0.1 V step.
- +V<sub>SET</sub> can be designated between 5.3 V and 11.0 V in 0.1 V step.

*: Select an output type from below.

A: V<sub>DD</sub> Voltage Detection Type "L" Output
B: V<sub>DD</sub> Voltage Detection Type "H" Output
E: SENSE Voltage Detection Type "L" Output
F: SENSE Voltage Detection Type "H" Output

#: Quality Class

<table>
<thead>
<tr>
<th>#</th>
<th>Operating Temperature Range</th>
<th>Test Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>−40°C to 105°C</td>
<td>Low, 25°C, High</td>
</tr>
</tbody>
</table>
BLOCK DIAGRAMS

R3150NxxxA

R3150NxxxB

R3150NxxxE

R3150NxxxF
## PIN DESCRIPTIONS

### SOT-23-6 Pin Configuration

![SOT-23-6 Pin Configuration](image-url)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CD</td>
<td>Release Output Delay Time (tdelay) Setting Pin</td>
</tr>
<tr>
<td>2</td>
<td>CR</td>
<td>Detect Output Delay Time (treset) Setting Pin</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No Connection (R3150NxxxxA/B)</td>
</tr>
<tr>
<td></td>
<td>SENSE</td>
<td>VD Voltage SENSE Pin (R3150NxxxxE/F)</td>
</tr>
<tr>
<td>4</td>
<td>VDD</td>
<td>Input Pin</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>6</td>
<td>DOUT</td>
<td>VD Output Pin (Nch Open Drain)</td>
</tr>
</tbody>
</table>
ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DD}$</td>
<td>Supply Voltage (R3150NxxxxA/B)</td>
<td>$-0.3\ to\ 50.0$</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Supply Voltage (R3150NxxxxE/F)</td>
<td>$-0.3\ to\ 7.0$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{SENSE}$</td>
<td>SENSE Pin Voltage (R3150NxxxxE/F)</td>
<td>$-0.3\ to\ 50.0$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DOUT}$</td>
<td>$D_{OUT}$ Pin Output Voltage</td>
<td>$-0.3\ to\ 7.0$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CD}$</td>
<td>$C_{D}$ Pin Output Voltage</td>
<td>$-0.3\ to\ 7.0$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CR}$</td>
<td>$C_{R}$ Pin Output Voltage</td>
<td>$-0.3\ to\ 7.0$</td>
<td>V</td>
</tr>
<tr>
<td>$I_{OUT}$</td>
<td>$D_{OUT}$ Pin Output Current</td>
<td>$20$</td>
<td>mA</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Power Dissipation$^{(1)}$</td>
<td>SOT-23-6</td>
<td>JEDEC STD. 51-7 Test Land Pattern</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$830$</td>
</tr>
<tr>
<td>$T_j$</td>
<td>Junction Temperature Range</td>
<td>$-40\ to\ 150$</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>Storage Temperature Range</td>
<td>$-55\ to\ 150$</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 CONDITIONS

Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DD}$</td>
<td>Operating Voltage</td>
<td>R3150NxxxxA/B</td>
<td>$1.4\ to\ 36.0$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R3150NxxxxE/F</td>
<td>$3.6\ to\ 6.0$</td>
</tr>
<tr>
<td>$V_{SENSE}$</td>
<td>SENSE Input Voltage</td>
<td>R3150NxxxxE/F</td>
<td>$0\ to\ 36.0$</td>
</tr>
<tr>
<td>$T_a$</td>
<td>Operating Temperature Range</td>
<td>R3150NxxxxE/F</td>
<td>$-40\ to\ 105$</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 POWER DISSIPATION for detailed information.
ELECTRICAL CHARACTERISTICS

$C_D = 1000 \text{ pF}, C_R = 1000 \text{ pF}, \text{ Pull-up resistance} = 100 \text{ k} \Omega, \text{ Pull-up voltage} = 5 \text{ V}, \text{ unless otherwise noted.}$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DOL}$</td>
<td>Minimum Operating Voltage$^{(1)}$</td>
<td>$V_{DD} = -V_{SET} - 0.1 \text{ V}$</td>
<td>1.4</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = +V_{SET} + 1.0 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{SS}$</td>
<td>Supply Current</td>
<td>$V_{DD} = -V_{SET} - 0.1 \text{ V}$</td>
<td>3.8</td>
<td>6.1</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = +V_{SET} + 1.0 \text{ V}$</td>
<td>3.8</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$-V_{DET}$</td>
<td>Detector Threshold</td>
<td>$V_{DD} = 4.5 \text{ V}, V_{DS} = 0.05 \text{ V}$</td>
<td>R3150NxxxA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = 4.5 \text{ V}, V_{DS} = 0.05 \text{ V}$</td>
<td>R3150NxxxB</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>$+V_{DET}$</td>
<td>Release Voltage</td>
<td>$V_{DD} = 4.5 \text{ V}, V_{CR} = 0.5 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = 4.5 \text{ V}, V_{CR} = 0.5 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_{reset}$</td>
<td>Detect Output Delay Time$^{(2)}$</td>
<td>$C_R = 1000 \text{ pF}, -40^\circ \text{C} \leq T_a \leq 105^\circ \text{C}$</td>
<td>6.5</td>
<td>10</td>
<td>14.0</td>
<td>ms</td>
</tr>
<tr>
<td>$t_{delay}$</td>
<td>Release Output Delay Time$^{(3)}$</td>
<td>$C_D = 1000 \text{ pF}, -40^\circ \text{C} \leq T_a \leq 105^\circ \text{C}$</td>
<td>6.5</td>
<td>10</td>
<td>14.0</td>
<td>ms</td>
</tr>
<tr>
<td>$I_{OUT}$</td>
<td>Output Current (Nch Driver Output Pin)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = 13 \text{ V}, V_{CD} = 0.5 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{CD}$</td>
<td>CD Pin Discharge Tr. On Resistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = 13 \text{ V}, V_{CD} = 0.5 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{CR}$</td>
<td>CR Pin Discharge Tr. On Resistance</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = 4.5 \text{ V}, V_{CR} = 0.5 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^{(1)}$ The minimum operating voltage is the voltage required for the stable operation of the devices.

$^{(2)}$ A time that $V_{DOUT}$ requires to reach 2.5 V when changed $V_{DD}$ from $-V_{SET} + 1.0 \text{ V}$ to $-V_{SET} - 1.0 \text{ V}$.

$^{(3)}$ A time that $V_{DOUT}$ requires to reach 2.5 V when changed $V_{DD}$ from $+V_{SET} - 1.0 \text{ V}$ to $+V_{SET} + 1.0 \text{ V}$. 

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RICOH
**C₀ = 1000 pF, Cᵣ =1000 pF, Pull-up resistance = 100 kΩ, Pull-up voltage = 5 V, unless otherwise noted.**

### Electrical Characteristics R3150NxxxE/F

(−40°C ≤ Ta ≤ 105°C)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDDL</td>
<td>Minimum Operating Voltage(1)</td>
<td>VDD = 5.0 V, VSENSE = -VSET - 0.1 V</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VDD = 5.0 V, VSENSE = +VSET + 1.0 V</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>I₈₄₅</td>
<td>Supply Current(2)</td>
<td>VDD = 5.0 V, VSENSE = -VSET - 0.1 V</td>
<td>3.5</td>
<td>5.5</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VDD = 5.0 V, VSENSE = +VSET + 1.0 V</td>
<td>3.5</td>
<td>5.6</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>RSENSE</td>
<td>SENSE Resistance</td>
<td></td>
<td>4.5</td>
<td>51.5</td>
<td></td>
<td>MΩ</td>
</tr>
<tr>
<td>-VDET</td>
<td>Detector Threshold</td>
<td>Ta = 25°C</td>
<td>x0.985</td>
<td>x1.015</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>−40°C ≤ Ta ≤ 105°C</td>
<td>x0.980</td>
<td>x1.020</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>+VDET</td>
<td>Release Voltage</td>
<td>Ta = 25°C</td>
<td>x0.985</td>
<td>x1.015</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>−40°C ≤ Ta ≤ 105°C</td>
<td>x0.980</td>
<td>x1.020</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>treset</td>
<td>Detect Output Delay Time(3)</td>
<td>Cr = 1000 pF, −40°C ≤ Ta ≤ 105°C</td>
<td>6.5</td>
<td>10</td>
<td>14.0</td>
<td>ms</td>
</tr>
<tr>
<td>tdelay</td>
<td>Release Output Delay Time(4)</td>
<td>Cr = 1000 pF, −40°C ≤ Ta ≤ 105°C</td>
<td>6.5</td>
<td>10</td>
<td>14.0</td>
<td>ms</td>
</tr>
<tr>
<td>IOUT</td>
<td>Output Current (Nch Driver Output Pin)</td>
<td>R3150NxxxE VDD = 5.0 V, VDS = 0.05 V, VSENSE = -VSET - 0.1 V</td>
<td>0.5</td>
<td>2.0</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R3150NxxxF VDD = 5.0 V, VDS = 0.05 V, VSENSE = +VSET + 1.0 V</td>
<td>0.5</td>
<td>2.0</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>RCD</td>
<td>C₀ Pin Discharge Tr. On Resistance</td>
<td>VDD = 4.5 V, VSENSE = 13 V, VCD = 0.5 V</td>
<td>0.50</td>
<td>2.60</td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>RCR</td>
<td>Cᵣ Pin Discharge Tr. On Resistance</td>
<td>VDD = 4.5 V, VSENSE = 4.5 V, VCR = 0.5 V</td>
<td>0.50</td>
<td>2.60</td>
<td></td>
<td>kΩ</td>
</tr>
</tbody>
</table>

(1) The minimum operating voltage is the voltage required for the stable operation of the devices.
(2) Not including the current for SENSE resistance.
(3) A time that V_{OUT} requires to reach 2.5 V when changed V_{SENSE} from “-V_{SET} + 1.0 V” to “-V_{SET} − 1.0 V”.
(4) A time that V_{OUT} requires to reach 2.5 V when changed V_{SENSE} from “+V_{SET} − 1.0 V” to “+V_{SET} + 1.0 V”.

---

**RICOH**
Product-specific Electrical Characteristics

### R3150NxxxA (-JE)  
(Ta = 25°C)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>-$V_{DET}$ [V]</th>
<th>-$V_{DET}$ [V]</th>
<th>+$V_{DET}$ [V]</th>
<th>+$V_{DET}$ [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Ta = 25°C)</td>
<td>(-40°C ≤ Ta ≤ 105°C)</td>
<td>(Ta = 25°C)</td>
<td>(-40°C ≤ Ta ≤ 105°C)</td>
</tr>
<tr>
<td>R3150N018A</td>
<td>5.910</td>
<td>6.000</td>
<td>6.090</td>
<td>5.880</td>
</tr>
</tbody>
</table>

### R3150NxxxB (-JE)  
(Ta = 25°C)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>-$V_{DET}$ [V]</th>
<th>-$V_{DET}$ [V]</th>
<th>+$V_{DET}$ [V]</th>
<th>+$V_{DET}$ [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Ta = 25°C)</td>
<td>(-40°C ≤ Ta ≤ 105°C)</td>
<td>(Ta = 25°C)</td>
<td>(-40°C ≤ Ta ≤ 105°C)</td>
</tr>
<tr>
<td>R3150N014B</td>
<td>7.979</td>
<td>8.100</td>
<td>8.221</td>
<td>7.938</td>
</tr>
<tr>
<td>R3150N016B</td>
<td>5.418</td>
<td>5.500</td>
<td>5.582</td>
<td>5.390</td>
</tr>
</tbody>
</table>
### R3150NxxxE (-JE)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>-VDET [V] (Ta = 25°C)</th>
<th>-VDET [V] (−40°C ≤ Ta ≤ 105°C)</th>
<th>+VDET [V] (Ta = 25°C)</th>
<th>+VDET [V] (−40°C ≤ Ta ≤ 105°C)</th>
</tr>
</thead>
</table>

### R3150NxxxF (-JE)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>-VDET [V] (Ta = 25°C)</th>
<th>-VDET [V] (−40°C ≤ Ta ≤ 105°C)</th>
<th>+VDET [V] (Ta = 25°C)</th>
<th>+VDET [V] (−40°C ≤ Ta ≤ 105°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R3150N016F</td>
<td>5.418</td>
<td>5.500</td>
<td>5.582</td>
<td>5.390</td>
</tr>
</tbody>
</table>
THEORY OF OPERATION

R3150NxxxA (VDD VOLTAGE DETECTION TYPE)

**Block Diagram with External Capacitors**

- **Supplies Voltage (VDD)**
  - Release Voltage: +VDET
  - Detector Threshold: -VDET
  - Minimum Operating Voltage: VDDL

- **Output Voltage (VOUT)**
  - Pull-up Voltage
  - Detect Output Delay Time (tdelay)
  - Hysteresis
  - Unstable Output (treset)

**Operation Diagram**

1. The output voltage is equalized to the pull-up voltage.
2. The VDD voltage drops to the detector threshold (A point) which means
   \[ V_{\text{ref}} \geq V_{\text{DD}} \times \frac{R_b + R_c}{R_a + R_b + R_c} \]
   and the comparator output shifts from “L” to “H” voltage, and the output pin voltage shifts from the pull-up voltage to “L” voltage.
3. If the VDD voltage is lower than the minimum operating voltage, the output voltage becomes unstable.
4. The output pin voltage becomes “L” voltage.
5. The VDD voltage becomes higher than the release voltage (B point) which means
   \[ V_{\text{ref}} \leq V_{\text{DD}} \times \frac{R_b}{R_a + R_b} \]
   and the comparator output shifts from “H” to “L” voltage, and the output pin voltage is equalized to the pull-up voltage.

---

(1) **DOUT** pin should be pulled-up to an external voltage level.
(2) The gap between the release voltage and the detector threshold is hysteresis.
R3150NxxxB (VDD VOLTAGE DETECTION TYPE)

Block Diagram with External Capacitors

Supply Voltage (VDD)
- Release Voltage +VDET
- Detector Threshold -VDET
- Minimum Operating Voltage VDD

Output Voltage (VDOUT)
- Pull-up Voltage
- Detect Output Delay Time treset
- Released Output Delay Time t_delay

Operation Diagram

1. The output pin voltage becomes “L” voltage.
2. The VDD voltage drops to the detector threshold (A point) which means
   \[ V_{ref} \geq V_{DD} \times \frac{R_b + R_c}{R_a + R_b + R_c} \], and the comparator output shifts from “L” to “H” voltage and the output voltage is equalized to the pull-up voltage.
3. If the VDD voltage is lower than the minimum operating voltage, the output is the pull-up voltage.
4. The output voltage is equalized to the pull-up voltage.
5. The VDD voltage becomes higher than the release voltage (B point) which means
   \[ V_{ref} \leq V_{DD} \times \frac{R_b}{R_a + R_b} \], and the comparator output shift from “H” to “L” voltage and the output voltage becomes “L” voltage.

---

(1) DOUT pin should be pulled-up to an external voltage level.
(2) The gap between the release voltage and the detector threshold is hysteresis.
R3150NxxxE (SENSE VOLTAGE DETECTION TYPE)

Block Diagram with External Capacitors

Output Voltage (V_{DOUT})

1. The output voltage is equalized to the pull-up voltage.
2. The SENSE pin voltage drops to the detector threshold (A point) which means
   \[ V_{\text{ref}} \geq V_{\text{DD}} \times \frac{(R_b + R_c)}{(R_a + R_b + R_c)} \], and the comparator output shifts from “L” to “H” voltage, and the output pin voltage shifts from the pull-up voltage to “L” voltage. (If the \( V_{\text{DD}} \) voltage is higher than the minimum operating voltage, the output remains as “L” voltage)
3. The SENSE pin voltage becomes higher than the release voltage (B point) which means
   \[ V_{\text{ref}} \leq V_{\text{SENSE}} \times \frac{R_b}{(R_a + R_b)} \], and the comparator output shifts from “H” to “L” voltage, and the output pin voltage is equalized to the pull-up voltage.

---

1. The \( D_{\text{OUT}} \) pin should be pulled-up to an external voltage level.
2. The gap between the release voltage and the detector threshold is hysteresis.
R3150NxxxF (SENSE VOLTAGE DETECTION TYPE)

Block Diagram with External Capacitors

SENSE Pin Voltage (VSENSE)

- Release Voltage +VDET
- Detector Threshold -VDET
- GND

Output Voltage (VOUT)

- Pull-up Voltage
- Detect Output Delay Time
- Release Output Delay Time
- treset
- GND

1. The output becomes “L” voltage if the SENSE pin voltage is higher than the detector threshold.
2. The SENSE pin voltage drops to the detector threshold (A point) which means
   \[ V_{\text{ref}} \geq V_{\text{SENSE}} \times \frac{R_b + R_c}{R_a + R_b + R_c} \]
   and the comparator output shifts from “L” to “H” voltage and the output voltage is equalized to the pull-up voltage. (If the VDD voltage is higher than the minimum operating voltage, the output remains as the pull-up voltage.)
3. The SENSE pin voltage becomes higher than the release voltage (B point) which means
   \[ V_{\text{ref}} \leq V_{\text{SENSE}} \times \frac{R_b}{R_a + R_b} \]
   and the comparator output shift from “H” to “L” voltage and the output voltage becomes “L” voltage.

Operation Diagram

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparator (-) Pin Input Voltage</td>
<td>I</td>
<td>II</td>
<td>I</td>
</tr>
<tr>
<td>Comparator Output</td>
<td>L</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Tr.1</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Output Tr. (Nch)</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

\[ I \quad \frac{R_b + R_c}{R_a + R_b + R_c} \times V_{\text{SENSE}} \]

\[ II \quad \frac{R_b}{R_a + R_b} \times V_{\text{SENSE}} \]

(1) DOUT pin should be pulled-up to an external voltage level.

(2) The gap between the release voltage and the detector threshold is hysteresis.
DETECT OUTPUT DELAY TIME (treset)

Detect Output Delay Time (treset) is defined as follows:
treset starts after the output pin (DOUT) is pulled up to 5 V with a 100 kΩ resistor and the VDD/VSENSE is shifted from “-VSET + 1.0 V” to “-VSET - 1.0 V”. treset ends when the output voltage reaches to 2.5 V.

treset is calculated by the following equation:

\[ treset = CR \times 10^7 \]

With the R3150NxxxA/B, if the VDD voltage after detection is 3.6 V or less, the normal detect output delay time cannot be expected due to insufficient voltage (The detect output delay time decreases along with the decrease of VDD voltage).
If the voltage lower than the detector threshold is applied to V_{DD}/SENSE pin while the voltage higher than the release voltage is applied to the V_{DD}/SENSE pin, the external capacitor starts to charge electricity and the C_{R} pin voltage starts to increase.

Until the C_{R} pin voltage reaches to the detector threshold of the detect output delay pin (V_{TCR}), the output voltage maintains the release output. If the C_{R} pin voltage becomes higher than V_{TCR}, the output voltage shifts from the release output to the detection output.

In addition, if the output voltage shift from the release output to the detection output, the external capacitor starts to discharge electricity and the C_{R} pin voltage starts decrease.
RELEASE OUTPUT DELAY TIME (tdelay)

Release Output Delay Time (tdelay) is defined as follows:

tdelay starts after the output pin (DOUT) is pulled up to 5 V with a 100 kΩ resistor, and the VDD/VSENSE is shifted from “+VSET - 1.0 V” to “+VSET + 1.0 V”. It ends when the output voltage reaches to 2.5 V.

tdelay is calculated by the following equation:

tdelay (s) = C_D x 10^7
If the voltage higher than the release voltage is applied to the VDD/SENSE pin while the voltage lower than the detector threshold is applied to VDD/SENSE pin, the external capacitor starts to charge electricity and the CD pin voltage starts to increase.

Until the CD pin voltage reaches to the release voltage of the release output delay pin (VTCD), the output voltage maintains the release output. If the CD pin voltage becomes higher than the release voltage of the release output delay pin, the output voltage shifts from the detection output to the release output.

In addition, if the output voltage shifts from the detection output to the release output, the external capacitor starts to discharge electricity and the CD pin voltage starts to decrease.
START-UP AND SHUTDOWN SEQUENCES

The R3150NxxxE/F (SENSE Voltage Detection Type) supervise the SENSE pin voltage while the voltage higher than the minimum operating voltage is applied to VDD pin.

At start-up, either the VDD pin or SENSE pin can be started up first, however, if the VDD pin is started up with a voltage lower than the minimum operating voltage while the SENSE pin has already been started up, the start-up slope angle of the VDD pin should be 10 V/ms or less.

At shutdown, the SENSE pin should be shut down first, then after treset, the VDD pin should be shut down.

DETECTOR OPERATION VS. GLITCH INPUT VOLTAGE

The R3150N has built-in rejection of fast transients on the VDD (R3150NxxxA/B) or SENSE (R3150NxxxE/F) pins. The rejection of transients depends on both the pulse width and the overdrive voltage, as shown in Figure 1. The R3150N does not respond to transients that are short pulse width / large overdrive voltage or long pulse width/small overdrive voltage. Any combination of pulse width and overdrive voltage above the curve generates a reset signal. The overdrive voltage indicates between the minimum value of input voltage (VDD or VSENSE) and –VDET, as shown in Figure 2.

![Figure 1. Minimum Pulse Width at VDD/SENSE vs. Overdrive Voltage](image1)

![Figure 2. VDD/VSENSE Input Waveform](image2)
RELEASE OPERATION VS. GLITCH INPUT VOLTAGE
The R3150N has built-in rejection of fast transients on the VDD (R3150NxxxA/B) or SENSE (R3150NxxxE/F) pins. The rejection of transients depends on both the pulse width and the overdrive voltage, as shown in Figure 3. The R3150N does not respond to transients that are short pulse width/large overdrive voltage or long pulse width/small overdrive voltage. Any combination of pulse width and overdrive voltage above the curve generates a reset signal. The overdrive voltage indicates between the maximum value of input voltage (VDD or VSENSE) and +VDET, as shown in Figure 4.

**Figure 3.** Minimum Pulse Width at VDD/SENSE vs. Overdrive Voltage

**Figure 4.** VDD/VSense Input Waveform

![Graph of Pulse Width vs. Overdrive Voltage](image-url)
TIMING CHART

R3150NxxxA/B (V\textsubscript{DD} Voltage Detection Type)

R3150NxxxA

R3150NxxxB
R3150NxxxE/F (SENSE Voltage Detection Type)

![Diagram of R3150NxxxE/F (SENSE Voltage Detection Type)]
APPLICATION INFORMATION

TYPICAL APPLICATION

R3150NxxxA/B Typical Application

R3150NxxxE/F Typical Application
TECHNICAL NOTES

When connecting resistors to the device’s input pin
When connecting a resistor (R1) to an input of this device, the input voltage decreases by [Device’s Consumption Current] x [Resistance Value] only. And, the cross conduction current (1), which occurs when changing from the detecting state to the release state, is decreased the input voltage by [Cross Conduction Current] x [Resistance Value] only. And then, this device will enter the re-detecting state if the input voltage reduction is larger than the difference between the detector voltage and the released voltage.

When the input resistance value is large and the VDD is gone up at mildly in the vicinity of the released voltage, repeating the above operation may result in the occurrence of output.

As shown in Figure A/B, set R1 to become 100 kΩ or less as a guide, and connect CIN of 0.1 μF and more to between the input pin and GND. Besides, make evaluations including temperature properties under the actual usage condition, with using the evaluation board like this way. As result, make sure that the cross conduction current has no problem.

---

(1) In the CMOS output type, a charging current for OUT pin is included.
(2) Note the bias dependence of capacitors.
Prohibited Area of Supply Voltage Fluctuations (VDD Voltage Detection Type)

As for the steep change of the supply voltages in the prohibited area as shown in Figure C, the detector may cause a false detection if the supply voltage is over the detector threshold, as shown in Figure D. In addition, the detector may take an incorrect detect output delay time if the supply voltage is less than \(-V_{\text{DET}}\), as shown in Figure E.
TYPICAL CHARACTERISTICS
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Supply Current vs. Input Voltage

![Graph](image1.png)

![Graph](image2.png)

![Graph](image3.png)

![Graph](image4.png)
2) Detector Threshold vs. Temperature

**R3150NxxxA/B (V\textsubscript{DET} = 5.0 V)**

**R3150NxxxE/F (V\textsubscript{DET} = 5.0 V)**

**R3150NxxxA/B (V\textsubscript{DET} = 6.4 V)**

**R3150NxxxE/F (V\textsubscript{DET} = 6.4 V)**

**R3150NxxxA/B (V\textsubscript{DET} = 10.0 V)**

**R3150NxxxE/F (V\textsubscript{DET} = 10.0 V)**
3) Release Voltage vs. Temperature

R3150NxxxA/B ($V_{DET} = 5.3$ V)

R3150NxxxE/F ($V_{DET} = 5.3$ V)

R3150NxxxA/B ($V_{DET} = 7.3$ V)

R3150NxxxE/F ($V_{DET} = 7.3$ V)

R3150NxxxA/B ($V_{DET} = 11.0$ V)

R3150NxxxE/F ($V_{DET} = 11.0$ V)
4) Detector Threshold vs. Input Voltage

R3150NxxxE/F ($V_{DET} = 5.0$ V)

5) Release Voltage vs. Input Voltage

R3150NxxxE/F ($V_{DET} = 10.0$ V)

6) Output Voltage vs. Input Voltage ($T_a = 25°C$, $D_{OUT}$ pin is pulled-up to 5 V and 100 kΩ)

R3150NxxxA ($V_{DET} = 5.0$ V, $V_{DET} = 5.3$ V)

R3150NxxxB ($V_{DET} = 5.0$ V, $V_{DET} = 5.3$ V)
7) Output Voltage vs. SENSE pin Input Voltage (Ta = 25°C, DOUT pin is pulled-up to 5 V and 100 kΩ)
8) Nch Driver Output Current vs. Input Voltage

R3150NxxxxA (+V\text{DET} = 5.3\ V, V\text{DOUT} = 0.05\ V)

R3150NxxxxB (+V\text{DET} = 5.3\ V, V\text{DOUT} = 0.05\ V)

R3150NxxxxE (V\text{SENSE} = V\text{DET} - 1.0\ V, V\text{DOUT} = 0.05\ V)

R3150NxxxxF (V\text{SENSE} = +V\text{DET} + 1.0\ V, V\text{DOUT} = 0.05\ V)

9) Nch Driver Output Current vs. V\text{DS}
10) Output Reset Time vs. Temperature ($C_R = 1.0 \ \mu F$)

\[
\begin{align*}
\text{R3150NXXXA/B} \\
\text{Temperature Ta (°C)} & \quad \text{Detect Delay Time (ms)} \\
-40 & \quad 14 \\
-25 & \quad 13 \\
0 & \quad 12 \\
25 & \quad 11 \\
50 & \quad 10 \\
75 & \quad 9 \\
100 & \quad 8 \\
105 & \quad 7 \\
\end{align*}
\]

\[
\begin{align*}
\text{R3150NXXXE/F} \\
\text{VDD=5.0V} \\
\text{Temperature Ta (°C)} & \quad \text{Detect Delay Time (ms)} \\
-40 & \quad 14 \\
-25 & \quad 13 \\
0 & \quad 12 \\
25 & \quad 11 \\
50 & \quad 10 \\
75 & \quad 9 \\
100 & \quad 8 \\
105 & \quad 7 \\
\end{align*}
\]

11) Output Delay Time vs. Temperature ($C_D = 1.0 \ \mu F$)

\[
\begin{align*}
\text{R3150NXXXA/B} \\
\text{Temperature Ta (°C)} & \quad \text{Release Delay Time (ms)} \\
-40 & \quad 14 \\
-25 & \quad 13 \\
0 & \quad 12 \\
25 & \quad 11 \\
50 & \quad 10 \\
75 & \quad 9 \\
100 & \quad 8 \\
105 & \quad 7 \\
\end{align*}
\]

\[
\begin{align*}
\text{R3150NXXXE/F} \\
\text{VDD=5.0V} \\
\text{Temperature Ta (°C)} & \quad \text{Release Delay Time (ms)} \\
-40 & \quad 14 \\
-25 & \quad 13 \\
0 & \quad 12 \\
25 & \quad 11 \\
50 & \quad 10 \\
75 & \quad 9 \\
100 & \quad 8 \\
105 & \quad 7 \\
\end{align*}
\]

12) Detector Threshold vs. Input Voltage

\[
\begin{align*}
\text{R3150NXXXE/F} \\
\text{Input Voltage VDD (V)} & \quad \text{Detect Delay Time (ms)} \\
3.6 & \quad 8 \\
4.0 & \quad 9 \\
4.4 & \quad 10 \\
4.8 & \quad 11 \\
5.2 & \quad 12 \\
5.6 & \quad 13 \\
6.0 & \quad 14 \\
\end{align*}
\]

13) Release Voltage vs. Input Voltage

\[
\begin{align*}
\text{R3150NXXXE/F} \\
\text{Input Voltage VDD (V)} & \quad \text{Release Delay Time (ms)} \\
3.6 & \quad 8 \\
4.0 & \quad 9 \\
4.4 & \quad 10 \\
4.8 & \quad 11 \\
5.2 & \quad 12 \\
5.6 & \quad 13 \\
6.0 & \quad 14 \\
\end{align*}
\]
14) Detector or Release Delay Time vs. \( C_D \) pin \( C_R \) pin External Capacity (\( Ta = 25^\circ C \))
The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

**Measurement Conditions**

<table>
<thead>
<tr>
<th>Item</th>
<th>Measurement Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Mounting on Board (Wind Velocity = 0 m/s)</td>
</tr>
<tr>
<td>Board Material</td>
<td>Glass Cloth Epoxy Plastic (Four-Layer Board)</td>
</tr>
<tr>
<td>Board Dimensions</td>
<td>76.2 mm × 114.3 mm × 0.8 mm</td>
</tr>
<tr>
<td>Copper Ratio</td>
<td>Outer Layer (First Layer): Less than 95% of 50 mm Square</td>
</tr>
<tr>
<td></td>
<td>Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square</td>
</tr>
<tr>
<td></td>
<td>Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square</td>
</tr>
<tr>
<td>Through-holes</td>
<td>φ 0.3 mm × 7 pcs</td>
</tr>
</tbody>
</table>

**Measurement Result**

(Ta = 25°C, Tjmax = 150°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Measurement Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Dissipation</td>
<td>830 mW</td>
</tr>
<tr>
<td>Thermal Resistance (θja)</td>
<td>θja = 150°C/W</td>
</tr>
<tr>
<td>Thermal Characterization Parameter (ψjt)</td>
<td>ψjt = 51°C/W</td>
</tr>
</tbody>
</table>

θja: Junction-to-Ambient Thermal Resistance  
ψjt: Junction-to-Top Thermal Characterization Parameter
SOT-23-6 Package Dimensions

Unit: mm
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