

## 42 V Input Window Voltage Detector for Automotive Applications

No. EC-405-191101

### OVERVIEW

The R3152N is a window voltage detector suited for achieving the functional safety. This device monitors over- and under- voltage of the output voltage from the power supply IC for a microprocessor and a sensor, and can prevent malfunction of system caused by abnormal voltage.

### KEY BENEFITS

- A stable voltage with supplying the battery voltage can provide the power supply and the voltage supervising separately.
- High-accuracy detection enables with Overvoltage/Undervoltage Detection Accuracy of -1.25% to 0.75% and Hysteresis of 1.5%.
- Small package of SOT-23-6 is adopted, and a safe and secure pin assignment with considering a short among adjacent pins.

### KEY SPECIFICATIONS

- Operating Voltage Range (Max. Rating): 3.0 V to 42.0 V (50.0 V)
- Operating Temperature Range: -40°C to 125°C
- Supply Current: Typ. 1.5  $\mu$ A
- Overvoltage Detection: 1.1 V to 5.9 V (0.01 V step)
- Undervoltage Detection: 1.0 V to 4.8 V (0.01 V step)
- Detection Release Hysteresis: A, Typ. 1.0% with hysteresis  
B, No hysteresis
- Detection Voltage Accuracy:  
 $\pm 0.5\%$  ( $T_a = 25^\circ\text{C}$ )  
 $-1.25\%$  to  $0.75\%$  ( $-40^\circ\text{C}$  to  $125^\circ\text{C}$ )
- Release Delay Time: Typ. 4 ms ( $C_D = 0.01 \mu\text{F}$ )
- Output Type: Nch. Open Drain

### SELECTION GUIDE

| Product Name      | Package  | Quantity per Reel |
|-------------------|----------|-------------------|
| R3152Nxxx\$-TR-#E | SOT-23-6 | 3,000 pcs         |

xxx: The combination of an overvoltage detection setting voltage ( $V_{OVSET}$ ) and an undervoltage detection setting voltage ( $V_{UVSET}$ )  
Refer to *Product-specific Electrical Characteristics* for more details.

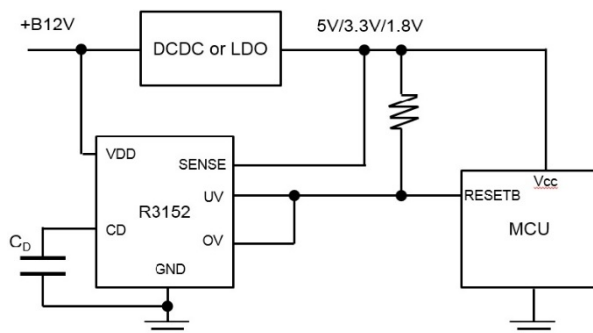
\$: Hysteresis

| \$ | Hysteresis |
|----|------------|
| A  | Yes        |
| B  | No         |

#: Quality Class

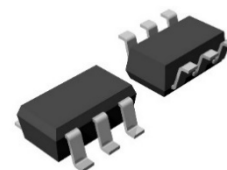
Refer to *SELECTION GUIDE* for details.

### TYPICAL APPLICATIONS



$C_D$ : a capacitor set according to the release delay times

### PACKAGE



SOT-23-6  
2.9 x 2.8 x 1.1 (mm)

### APPLICATIONS

- Power Supply Voltage Monitoring for ASIL-B/C/D Systems Including ECU and ADAS
- Power Supply Voltage Monitoring for Control Units Including EV Inverters and Charge Controllers

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## R3152N

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### SELECTION GUIDE

The overvoltage detection setting voltage ( $V_{OVSET}$ ) and the undervoltage detection setting voltage ( $V_{UVSET}$ ) are user-selectable options.

#### Selection Guide

| Product Name      | Package  | Quantity per Reel | Pb Free | Halogen Free |
|-------------------|----------|-------------------|---------|--------------|
| R3152Nxxx\$-TR-#E | SOT-23-6 | 3,000 pcs         | Yes     | Yes          |

xxx: The combination of an overvoltage detection setting voltage ( $V_{OVSET}$ ) and an undervoltage detection setting voltage ( $V_{UVSET}$ ).

Refer to *Product-specific Electrical Characteristics* for more details.

\$: Hysteresis

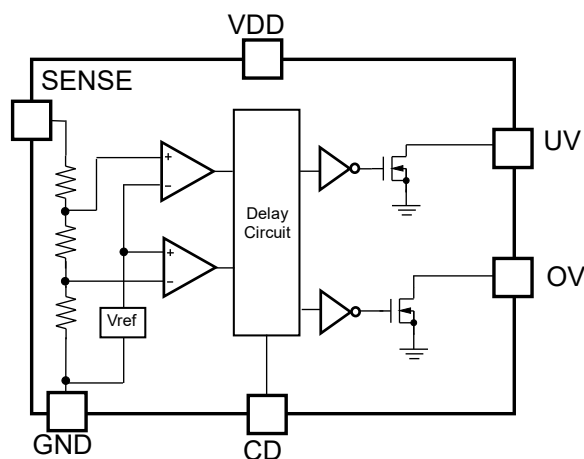
| \$ | Hysteresis |
|----|------------|
| A  | Yes        |
| B  | No         |

#: Quality Class

| # | Operating Temp. Range | Test Temp.      |
|---|-----------------------|-----------------|
| A | -40°C to 125°C        | 25°C, High      |
| K | -40°C to 125°C        | Low, 25°C, High |

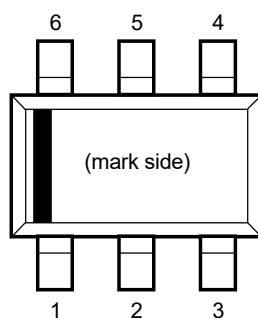
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### BLOCK DIAGRAM



R3152N Block Diagram

## PIN DESCRIPTIONS



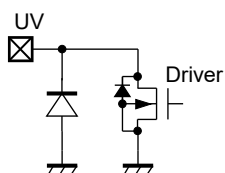
SOT-23-6 Pin Configuration

## Pin Description

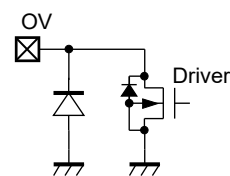
| Pin No. | Symbol | Description   |
|---------|--------|---|
| 1       | VDD    | Supply Voltage Pin  |
| 2       | CD     | VD Release Delay Time Set Pin<br>(for connecting with external capacitor for delay) |
| 3       | UV     | Undervoltage Detection Output Pin ("Low" at detection)                              |
| 4       | OV     | Overvoltage Detection Output Pin ("Low" at detection)                               |
| 5       | GND    | GND Pin   |
| 6       | SENSE  | SENSE Pin   |

## Internal Equivalent Circuit for Each Pin

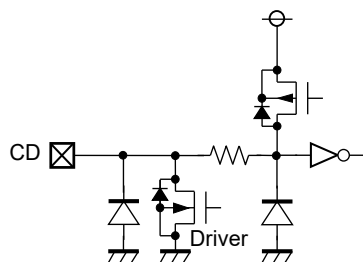
UV Pin



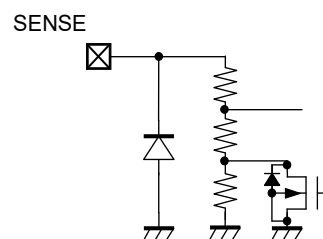
OV Pin



CD Pin



SENSE Pin



## R3152N

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### ABSOLUTE MAXIMUM RATINGS

#### Absolute Maximum Ratings

| Symbol      | Parameter   | Rating       | Unit |
|-------------|---|--------------|------|
| $V_{DD}$    | Supply Voltage                                    | -0.3 to 50.0 | V    |
|             | Peak Voltage <sup>(1)</sup>                       | 60           | V    |
| $V_{CD}$    | CD Pin Output Voltage                             | -0.3 to 50.0 | V    |
| $V_{UVOUT}$ | UV Pin Output Voltage                             | -0.3 to 7.0  | V    |
| $V_{OVOUT}$ | OV Pin Output Voltage                             | -0.3 to 7.0  | V    |
| $V_{SENSE}$ | SENSE Pin Input Voltage                           | -0.3 to 7.0  | V    |
| $I_{UVOUT}$ | UV Pin Output Current                             | 30           | mA   |
| $I_{OVOUT}$ | OV Pin Output Current                             | 30           | mA   |
| $P_D$       | Power Dissipation <sup>(2)</sup> (JEDEC STD.51-7) | 830          | mW   |
| $T_j$       | Junction Temperature Range                        | -40 to 150   | °C   |
| $T_{stg}$   | Storage Temperature Range                         | -55 to 150   | °C   |

#### ABSOLUTE MAXIMUM RATINGS

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

### RECCOMENDED OPERATING CONDITIONS

#### Recommend Operating Conditions

| Symbol      | Parameter                   | Rating     | Unit |
|-------------|-----------------------------|------------|------|
| $V_{DD}$    | Operating Voltage           | 3.0 to 42  | V    |
| $V_{SENSE}$ | SENSE Pin Input Voltage     | 0 to 6.0   | V    |
| $T_a$       | Operating Temperature Range | -40 to 125 | °C   |

#### 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 ratings by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

<sup>(1)</sup> Duration Time: 200 ms

<sup>(2)</sup> Refer to *POWER DISSIPATION* for detailed information.

## ELECTRICAL CHARACTERISTICS

$V_{DD} = 14\text{ V}$ ,  $C_D = 0.01\ \mu\text{F}$ , pulled-up to 5 V with 100 k $\Omega$ , unless otherwise specified.

The specifications surrounded by   are guaranteed by design engineering at  $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$ .

### R3152N (-AE) Electrical Characteristics

( $T_a = 25^\circ\text{C}$ )

| Symbol        | Parameter  | Test Conditions/Comments                                    | Min.  | Typ.                    | Max.  | Unit             |
|---------------|--|---|---|-------------------------|---|------------------|
| $V_{OVDET}$   | Overvoltage (OV) Detector Threshold                    | $T_a = 25^\circ\text{C}$                                    | x0.995  |                         | x1.005  | V                |
|               |  | $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$         | <span style="border: 1px solid black; padding: 0 2px;">x0.9875</span> |                         | <span style="border: 1px solid black; padding: 0 2px;">x1.0075</span> | V                |
| $V_{UVDET}$   | Undervoltage (UV) Detector Threshold                   | $T_a = 25^\circ\text{C}$                                    | x0.995  |                         | x1.005  | V                |
|               |  | $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$         | <span style="border: 1px solid black; padding: 0 2px;">x0.9875</span> |                         | <span style="border: 1px solid black; padding: 0 2px;">x1.0075</span> | V                |
| $V_{OVHYS}$   | Overvoltage (OV) Threshold Hysteresis                  | With Hysteresis   | $\frac{V_{OVDET}}{\times 0.005}$                                      | $V_{OVDET} \times 0.01$ | $\frac{V_{OVDET}}{\times 0.015}$                                      | V                |
|               |  | No Hysteresis   | <span style="border: 1px solid black; padding: 0 2px;">0</span>       |                         | <span style="border: 1px solid black; padding: 0 2px;">10</span>      | mV               |
| $V_{UVHYS}$   | Undervoltage (UV) Threshold Hysteresis                 | With Hysteresis   | $\frac{V_{UVDET}}{\times 0.005}$                                      | $V_{UVDET} \times 0.01$ | $\frac{V_{UVDET}}{\times 0.015}$                                      | V                |
|               |  | No Hysteresis   | <span style="border: 1px solid black; padding: 0 2px;">0</span>       |                         | <span style="border: 1px solid black; padding: 0 2px;">10</span>      | mV               |
| $I_{SS}$      | Consumption Current                                    | $V_{UVDET} < SENSE < V_{OVDET}$                             |   | 1.5                     | <span style="border: 1px solid black; padding: 0 2px;">3.2</span>     | $\mu\text{A}$    |
| $R_{SENSE}$   | SENSE Pin Resistance                                   | $V_{UVDET} \geq 1.6\text{V}$ , $V_{OVDET} \geq 2.0\text{V}$ | <span style="border: 1px solid black; padding: 0 2px;">7</span>       | 14                      | <span style="border: 1px solid black; padding: 0 2px;">28</span>      | $\text{M}\Omega$ |
|               |  | $V_{UVDET} < 1.6\text{V}$ , $V_{OVDET} < 2.0\text{V}$       | <span style="border: 1px solid black; padding: 0 2px;">3.0</span>     | 6                       | <span style="border: 1px solid black; padding: 0 2px;">12</span>      |                  |
| $V_{UVLO}$    | UVLO Detector Threshold                                |   |   | 1.8                     | <span style="border: 1px solid black; padding: 0 2px;">2.8</span>     | V                |
| $V_{UVLOHYS}$ | UVLO Threshold Hysteresis                              |   |   | 0.1                     | <span style="border: 1px solid black; padding: 0 2px;">0.2</span>     | V                |
| $V_{OVOUT}$   | Overvoltage (OV) pulled-up output voltage              |   |   |                         | <span style="border: 1px solid black; padding: 0 2px;">6.0</span>     | V                |
| $V_{UVOUT}$   | Undervoltage (UV) pulled-up output voltage             |   |   |                         | <span style="border: 1px solid black; padding: 0 2px;">6.0</span>     | V                |
| $V_{DDLOV}$   | Overvoltage (OV) Low-operating Voltage <sup>(1)</sup>  |   |   |                         | <span style="border: 1px solid black; padding: 0 2px;">1.7</span>     | V                |
| $V_{DDLUV}$   | Undervoltage (UV) Low-operating Voltage <sup>(1)</sup> |   |   |                         | <span style="border: 1px solid black; padding: 0 2px;">1.7</span>     | V                |
| $I_{OUT}$     | OV Pin Nch. Driver Output Current                      | $V_{DD} = 3.0$ , $V_{DS} = 0.1\text{ V}$                    | <span style="border: 1px solid black; padding: 0 2px;">0.8</span>     | 1.8                     |   | mA               |
|               | UV Pin Nch. Driver Output Current                      | $V_{DD} = 3.0$ , $V_{DS} = 0.1\text{ V}$                    | <span style="border: 1px solid black; padding: 0 2px;">0.8</span>     | 1.8                     |   | mA               |
| $I_{LEAK}$    | OV Pin Nch. Driver Leak Current                        | $V_{OVOUT} = 5.5\text{ V}$                                  |   |                         | <span style="border: 1px solid black; padding: 0 2px;">0.3</span>     | $\mu\text{A}$    |
|               | UV Pin Nch Driver Leak Current                         | $V_{UVOUT} = 5.5\text{ V}$                                  |   |                         | <span style="border: 1px solid black; padding: 0 2px;">0.3</span>     | $\mu\text{A}$    |
| $t_{DELAY}$   | Release Delay Time                                     |   | <span style="border: 1px solid black; padding: 0 2px;">2.5</span>     | 4                       | <span style="border: 1px solid black; padding: 0 2px;">8</span>       | ms               |

All test items listed under Electrical Characteristics are done under the pulse load condition ( $T_j \approx T_a = 25^\circ\text{C}$ ).

<sup>(1)</sup> Minimum value of power supply voltage when an output voltage will become less than 0.1V at detection.  
(Pulled-up resistance: 100 k $\Omega$ , Pulled-up voltage: 5 V)

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 $V_{DD} = 14\text{ V}$ ,  $C_D = 0.01\ \mu\text{F}$ , pulled-up to 5 V with 100 k $\Omega$ , unless otherwise specified.**R3152N (-KE) Electrical Characteristics**( $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$ )

| Symbol        | Parameter  | Test Conditions/Comments                                    | Min.                  | Typ.                 | Max.                  | Unit          |
|---------------|--|---|-----------------------|----------------------|-----------------------|---------------|
| $V_{OVDET}$   | Overvoltage (OV) Detector Threshold                    | $T_a = 25^\circ\text{C}$                                    | x0.995                |                      | x1.005                | V             |
|               |  | $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$         | x0.9875               |                      | x1.0075               | V             |
| $V_{UVDET}$   | Undervoltage (UV) Detector Threshold                   | $T_a = 25^\circ\text{C}$                                    | x0.995                |                      | x1.005                | V             |
|               |  | $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$         | x0.9875               |                      | x1.0075               | V             |
| $V_{OVHYS}$   | Overvoltage (OV) Threshold Hysteresis                  | With Hysteresis   | $V_{OVDET}$<br>x0.005 | $V_{OVDET}$<br>x0.01 | $V_{OVDET}$<br>x0.015 | V             |
|               |  | No Hysteresis   | 0                     |                      | 10                    | mV            |
| $V_{UVHYS}$   | Undervoltage (UV) Threshold Hysteresis                 | With Hysteresis   | $V_{UVDET}$<br>x0.005 | $V_{UVDET}$<br>x0.01 | $V_{UVDET}$<br>x0.015 | V             |
|               |  | No Hysteresis   | 0                     |                      | 10                    | mV            |
| $I_{SS}$      | Consumption Current                                    | $V_{UVDET} < \text{SENSE} < V_{OVDET}$                      |                       | 1.5                  | 3.2                   | $\mu\text{A}$ |
| $R_{SENSE}$   | SENSE Pin Resistance                                   | $V_{UVDET} \geq 1.6\text{V}$ , $V_{OVDET} \geq 2.0\text{V}$ | 7                     | 14                   | 28                    | M $\Omega$    |
|               |  | $V_{UVDET} < 1.6\text{V}$ , $V_{OVDET} < 2.0\text{V}$       | 3.0                   | 6                    | 12                    |               |
| $V_{UVLO}$    | UVLO Detector Threshold                                |   |                       | 1.8                  | 2.8                   | V             |
| $V_{UVLOHYS}$ | UVLO Threshold Hysteresis                              |   |                       | 0.1                  | 0.2                   | V             |
| $V_{OVOUT}$   | Overvoltage (OV) pulled-up output voltage              |   |                       |                      | 6.0                   | V             |
| $V_{UVOUT}$   | Undervoltage (UV) pulled-up output voltage             |   |                       |                      | 6.0                   | V             |
| $V_{DDLOV}$   | Overvoltage (OV) Low-operating Voltage <sup>(1)</sup>  |   |                       |                      | 1.7                   | V             |
| $V_{DDLUV}$   | Undervoltage (UV) Low-operating Voltage <sup>(1)</sup> |   |                       |                      | 1.7                   | V             |
| $I_{OUT}$     | OV Pin Nch. Driver Output Current                      | $V_{DD} = 3.0$ , $V_{DS} = 0.1\text{ V}$                    | 0.8                   | 1.8                  |                       | mA            |
|               | UV Pin Nch. Driver Output Current                      | $V_{DD} = 3.0$ , $V_{DS} = 0.1\text{ V}$                    | 0.8                   | 1.8                  |                       | mA            |
| $I_{LEAK}$    | OV Pin Nch.Driver Leak Current                         | $V_{OVOUT} = 5.5\text{ V}$                                  |                       |                      | 0.3                   | $\mu\text{A}$ |
|               | UV Pin Nch Driver Leak Current                         | $V_{UVOUT} = 5.5\text{ V}$                                  |                       |                      | 0.3                   | $\mu\text{A}$ |
| $t_{DELAY}$   | Release Delay Time                                     |   | 2.5                   | 4                    | 8                     | ms            |

All test items listed under Electrical Characteristics are done under the pulse load condition ( $T_j \approx T_a = 25^\circ\text{C}$ ).

<sup>(1)</sup> Minimum value of power supply voltage when an output voltage will become less than 0.1V at detection.  
(Pulled-up resistance: 100 k $\Omega$ , Pulled-up voltage: 5 V)

$V_{DD} = 14\text{ V}$ ,  $C_D = 0.01\ \mu\text{F}$ , pulled-up to 5 V with 100 k $\Omega$ , unless otherwise specified.

The specifications surrounded by   are guaranteed by design engineering at  $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$ .

## R3152N (-AE) Product-specific Electrical Characteristics

(Ta = 25°C)

| Product Name | $V_{OVDET}$ (V) |      |         | $V_{UVDET}$ (V) |       |         | $V_{OVHYS}$ (V)   |         |   | $V_{UVHYS}$ (V)   |         |   |
|--------------|-----------------|------|---------|-----------------|-------|---------|---|---------|---|---|---------|---|
|              | Min.            | Typ. | Max.    | Min.            | Typ.  | Max.    | Min.  | Typ.    | Max.  | Min.  | Typ.    | Max.  |
| R3152N001A   | 5.27350         | 5.30 | 5.32650 | 4.67650         | 4.70  | 4.72350 | <span style="border: 1px solid black; padding: 0 2px;">0.02650</span> | 0.05300 | <span style="border: 1px solid black; padding: 0 2px;">0.07950</span> | <span style="border: 1px solid black; padding: 0 2px;">0.02350</span> | 0.04700 | <span style="border: 1px solid black; padding: 0 2px;">0.07050</span> |
| R3152N002A   | 3.52230         | 3.54 | 3.55770 | 3.03475         | 3.05  | 3.06525 | <span style="border: 1px solid black; padding: 0 2px;">0.01770</span> | 0.03540 | <span style="border: 1px solid black; padding: 0 2px;">0.05310</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01525</span> | 0.03050 | <span style="border: 1px solid black; padding: 0 2px;">0.04575</span> |
| R3152N003B   | 3.55215         | 3.57 | 3.58785 | 2.48750         | 2.50  | 2.51250 | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N004A   | 1.86065         | 1.87 | 1.87935 | 1.73130         | 1.74  | 1.74870 | <span style="border: 1px solid black; padding: 0 2px;">0.00935</span> | 0.01870 | <span style="border: 1px solid black; padding: 0 2px;">0.02805</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00870</span> | 0.01740 | <span style="border: 1px solid black; padding: 0 2px;">0.02610</span> |
| R3152N005A   | 3.41285         | 3.43 | 3.44715 | 3.17405         | 3.19  | 3.20595 | <span style="border: 1px solid black; padding: 0 2px;">0.01715</span> | 0.03430 | <span style="border: 1px solid black; padding: 0 2px;">0.05145</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01595</span> | 0.03190 | <span style="border: 1px solid black; padding: 0 2px;">0.04785</span> |
| R3152N013A   | 1.32335         | 1.33 | 1.33665 | 1.16415         | 1.17  | 1.17585 | <span style="border: 1px solid black; padding: 0 2px;">0.00665</span> | 0.01330 | <span style="border: 1px solid black; padding: 0 2px;">0.01995</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00585</span> | 0.01170 | <span style="border: 1px solid black; padding: 0 2px;">0.01755</span> |
| R3152N014A   | 1.16415         | 1.17 | 1.17585 | 1.06963         | 1.075 | 1.08037 | <span style="border: 1px solid black; padding: 0 2px;">0.00585</span> | 0.01170 | <span style="border: 1px solid black; padding: 0 2px;">0.01755</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00538</span> | 0.01075 | <span style="border: 1px solid black; padding: 0 2px;">0.01613</span> |
| R3152N015A   | 1.28355         | 1.29 | 1.29645 | 1.15420         | 1.16  | 1.16580 | <span style="border: 1px solid black; padding: 0 2px;">0.00645</span> | 0.01290 | <span style="border: 1px solid black; padding: 0 2px;">0.01935</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00580</span> | 0.01160 | <span style="border: 1px solid black; padding: 0 2px;">0.01740</span> |
| R3152N017A   | 3.55215         | 3.57 | 3.58785 | 2.72630         | 2.74  | 2.75370 | <span style="border: 1px solid black; padding: 0 2px;">0.01785</span> | 0.03570 | <span style="border: 1px solid black; padding: 0 2px;">0.05355</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01370</span> | 0.02740 | <span style="border: 1px solid black; padding: 0 2px;">0.04110</span> |
| R3152N020A   | 1.24375         | 1.25 | 1.25625 | 1.11440         | 1.12  | 1.12560 | <span style="border: 1px solid black; padding: 0 2px;">0.00625</span> | 0.01250 | <span style="border: 1px solid black; padding: 0 2px;">0.01875</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00560</span> | 0.01120 | <span style="border: 1px solid black; padding: 0 2px;">0.01680</span> |
| R3152N201B   | 1.23380         | 1.24 | 1.24620 | 1.16415         | 1.17  | 1.17585 | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N101B   | 2.58700         | 2.60 | 2.61300 | 2.39795         | 2.41  | 2.42205 | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N102B   | 3.41285         | 3.43 | 3.44715 | 3.16410         | 3.18  | 3.19590 | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N203A   | 1.39300         | 1.40 | 1.40700 | 0.99500         | 1.00  | 1.00500 | <span style="border: 1px solid black; padding: 0 2px;">0.00700</span> | 0.01400 | <span style="border: 1px solid black; padding: 0 2px;">0.02100</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00500</span> | 0.01000 | <span style="border: 1px solid black; padding: 0 2px;">0.01500</span> |
| R3152N204A   | 1.62185         | 1.63 | 1.63815 | 1.40295         | 1.41  | 1.41705 | <span style="border: 1px solid black; padding: 0 2px;">0.00815</span> | 0.01630 | <span style="border: 1px solid black; padding: 0 2px;">0.02445</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00705</span> | 0.01410 | <span style="border: 1px solid black; padding: 0 2px;">0.02115</span> |
| R3152N103A   | 5.77100         | 5.80 | 5.82900 | 4.75610         | 4.78  | 4.80390 | <span style="border: 1px solid black; padding: 0 2px;">0.02900</span> | 0.05800 | <span style="border: 1px solid black; padding: 0 2px;">0.08700</span> | <span style="border: 1px solid black; padding: 0 2px;">0.02390</span> | 0.04780 | <span style="border: 1px solid black; padding: 0 2px;">0.07170</span> |

(-40°C ≤ Ta ≤ 125°C)

| Product Name | $V_{OVDET}$ (V)   |      |   | $V_{UVDET}$ (V)   |       |   | $V_{OVHYS}$ (V)   |         |   | $V_{UVHYS}$ (V)   |         |   |
|--------------|---|------|---|---|-------|---|---|---------|---|---|---------|---|
|              | Min.  | Typ. | Max.  | Min.  | Typ.  | Max.  | Min.  | Typ.    | Max.  | Min.  | Typ.    | Max.  |
| R3152N001A   | <span style="border: 1px solid black; padding: 0 2px;">5.23375</span> | 5.30 | <span style="border: 1px solid black; padding: 0 2px;">5.33975</span> | <span style="border: 1px solid black; padding: 0 2px;">4.64125</span> | 4.70  | <span style="border: 1px solid black; padding: 0 2px;">4.73525</span> | <span style="border: 1px solid black; padding: 0 2px;">0.02650</span> | 0.0530  | <span style="border: 1px solid black; padding: 0 2px;">0.07950</span> | <span style="border: 1px solid black; padding: 0 2px;">0.02350</span> | 0.04700 | <span style="border: 1px solid black; padding: 0 2px;">0.07050</span> |
| R3152N002A   | <span style="border: 1px solid black; padding: 0 2px;">3.49575</span> | 3.54 | <span style="border: 1px solid black; padding: 0 2px;">3.56655</span> | <span style="border: 1px solid black; padding: 0 2px;">3.01188</span> | 3.05  | <span style="border: 1px solid black; padding: 0 2px;">3.07287</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01770</span> | 0.0354  | <span style="border: 1px solid black; padding: 0 2px;">0.05310</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01525</span> | 0.03050 | <span style="border: 1px solid black; padding: 0 2px;">0.04575</span> |
| R3152N003B   | <span style="border: 1px solid black; padding: 0 2px;">3.52538</span> | 3.57 | <span style="border: 1px solid black; padding: 0 2px;">3.59678</span> | <span style="border: 1px solid black; padding: 0 2px;">2.46875</span> | 2.50  | <span style="border: 1px solid black; padding: 0 2px;">2.51875</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N004A   | <span style="border: 1px solid black; padding: 0 2px;">1.84663</span> | 1.87 | <span style="border: 1px solid black; padding: 0 2px;">1.88403</span> | <span style="border: 1px solid black; padding: 0 2px;">1.71825</span> | 1.74  | <span style="border: 1px solid black; padding: 0 2px;">1.75305</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00935</span> | 0.01870 | <span style="border: 1px solid black; padding: 0 2px;">0.02805</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00870</span> | 0.01740 | <span style="border: 1px solid black; padding: 0 2px;">0.02610</span> |
| R3152N005A   | <span style="border: 1px solid black; padding: 0 2px;">3.38713</span> | 3.43 | <span style="border: 1px solid black; padding: 0 2px;">3.45573</span> | <span style="border: 1px solid black; padding: 0 2px;">3.15013</span> | 3.19  | <span style="border: 1px solid black; padding: 0 2px;">3.21392</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01715</span> | 0.03430 | <span style="border: 1px solid black; padding: 0 2px;">0.05145</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01595</span> | 0.0319  | <span style="border: 1px solid black; padding: 0 2px;">0.04785</span> |
| R3152N013A   | <span style="border: 1px solid black; padding: 0 2px;">1.31338</span> | 1.33 | <span style="border: 1px solid black; padding: 0 2px;">1.33997</span> | <span style="border: 1px solid black; padding: 0 2px;">1.15538</span> | 1.17  | <span style="border: 1px solid black; padding: 0 2px;">1.17877</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00665</span> | 0.01330 | <span style="border: 1px solid black; padding: 0 2px;">0.01995</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00585</span> | 0.01170 | <span style="border: 1px solid black; padding: 0 2px;">0.01755</span> |
| R3152N014A   | <span style="border: 1px solid black; padding: 0 2px;">1.15537</span> | 1.17 | <span style="border: 1px solid black; padding: 0 2px;">1.17878</span> | <span style="border: 1px solid black; padding: 0 2px;">1.06156</span> | 1.075 | <span style="border: 1px solid black; padding: 0 2px;">1.08307</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00585</span> | 0.01170 | <span style="border: 1px solid black; padding: 0 2px;">0.01755</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00538</span> | 0.01075 | <span style="border: 1px solid black; padding: 0 2px;">0.01613</span> |
| R3152N015A   | <span style="border: 1px solid black; padding: 0 2px;">1.27387</span> | 1.29 | <span style="border: 1px solid black; padding: 0 2px;">1.29968</span> | <span style="border: 1px solid black; padding: 0 2px;">1.14550</span> | 1.16  | <span style="border: 1px solid black; padding: 0 2px;">1.16870</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00645</span> | 0.01290 | <span style="border: 1px solid black; padding: 0 2px;">0.01935</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00580</span> | 0.01160 | <span style="border: 1px solid black; padding: 0 2px;">0.01740</span> |
| R3152N017A   | <span style="border: 1px solid black; padding: 0 2px;">3.52537</span> | 3.57 | <span style="border: 1px solid black; padding: 0 2px;">3.59678</span> | <span style="border: 1px solid black; padding: 0 2px;">2.70575</span> | 2.74  | <span style="border: 1px solid black; padding: 0 2px;">2.76055</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01785</span> | 0.03570 | <span style="border: 1px solid black; padding: 0 2px;">0.05355</span> | <span style="border: 1px solid black; padding: 0 2px;">0.01370</span> | 0.02740 | <span style="border: 1px solid black; padding: 0 2px;">0.04110</span> |
| R3152N020A   | <span style="border: 1px solid black; padding: 0 2px;">1.23438</span> | 1.25 | <span style="border: 1px solid black; padding: 0 2px;">1.25937</span> | <span style="border: 1px solid black; padding: 0 2px;">1.10600</span> | 1.12  | <span style="border: 1px solid black; padding: 0 2px;">1.12840</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00625</span> | 0.01250 | <span style="border: 1px solid black; padding: 0 2px;">0.01875</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00560</span> | 0.01120 | <span style="border: 1px solid black; padding: 0 2px;">0.01680</span> |
| R3152N201B   | <span style="border: 1px solid black; padding: 0 2px;">1.22450</span> | 1.24 | <span style="border: 1px solid black; padding: 0 2px;">1.24930</span> | <span style="border: 1px solid black; padding: 0 2px;">1.15538</span> | 1.17  | <span style="border: 1px solid black; padding: 0 2px;">1.17877</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N101B   | <span style="border: 1px solid black; padding: 0 2px;">2.56750</span> | 2.60 | <span style="border: 1px solid black; padding: 0 2px;">2.61950</span> | <span style="border: 1px solid black; padding: 0 2px;">2.37988</span> | 2.41  | <span style="border: 1px solid black; padding: 0 2px;">2.42807</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N102B   | <span style="border: 1px solid black; padding: 0 2px;">3.38713</span> | 3.43 | <span style="border: 1px solid black; padding: 0 2px;">3.45572</span> | <span style="border: 1px solid black; padding: 0 2px;">3.14025</span> | 3.18  | <span style="border: 1px solid black; padding: 0 2px;">3.20385</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> | <span style="border: 1px solid black; padding: 0 2px;">0</span>       | -       | <span style="border: 1px solid black; padding: 0 2px;">0.01000</span> |
| R3152N203A   | <span style="border: 1px solid black; padding: 0 2px;">1.38250</span> | 1.40 | <span style="border: 1px solid black; padding: 0 2px;">1.41050</span> | <span style="border: 1px solid black; padding: 0 2px;">0.98750</span> | 1.00  | <span style="border: 1px solid black; padding: 0 2px;">1.00750</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00700</span> | 0.01400 | <span style="border: 1px solid black; padding: 0 2px;">0.02100</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00500</span> | 0.01000 | <span style="border: 1px solid black; padding: 0 2px;">0.01500</span> |
| R3152N204A   | <span style="border: 1px solid black; padding: 0 2px;">1.60963</span> | 1.63 | <span style="border: 1px solid black; padding: 0 2px;">1.64222</span> | <span style="border: 1px solid black; padding: 0 2px;">1.39238</span> | 1.41  | <span style="border: 1px solid black; padding: 0 2px;">1.42057</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00815</span> | 0.01630 | <span style="border: 1px solid black; padding: 0 2px;">0.02445</span> | <span style="border: 1px solid black; padding: 0 2px;">0.00705</span> | 0.01410 | <span style="border: 1px solid black; padding: 0 2px;">0.02115</span> |
| R3152N103A   | <span style="border: 1px solid black; padding: 0 2px;">5.72750</span> | 5.80 | <span style="border: 1px solid black; padding: 0 2px;">5.84350</span> | <span style="border: 1px solid black; padding: 0 2px;">4.72025</span> | 4.78  | <span style="border: 1px solid black; padding: 0 2px;">4.81585</span> | <span style="border: 1px solid black; padding: 0 2px;">0.02900</span> | 0.05800 | <span style="border: 1px solid black; padding: 0 2px;">0.08700</span> | <span style="border: 1px solid black; padding: 0 2px;">0.02390</span> | 0.04780 | <span style="border: 1px solid black; padding: 0 2px;">0.07170</span> |

## R3152N

No. EC-405-191101

$V_{DD} = 14\text{ V}$ ,  $C_D = 0.01\ \mu\text{F}$ , pulled-up to 5 V with 100 k $\Omega$ , unless otherwise specified.

### R3152N (-KE) Product-specific Electrical Characteristics

( $T_a = 25^\circ\text{C}$ )

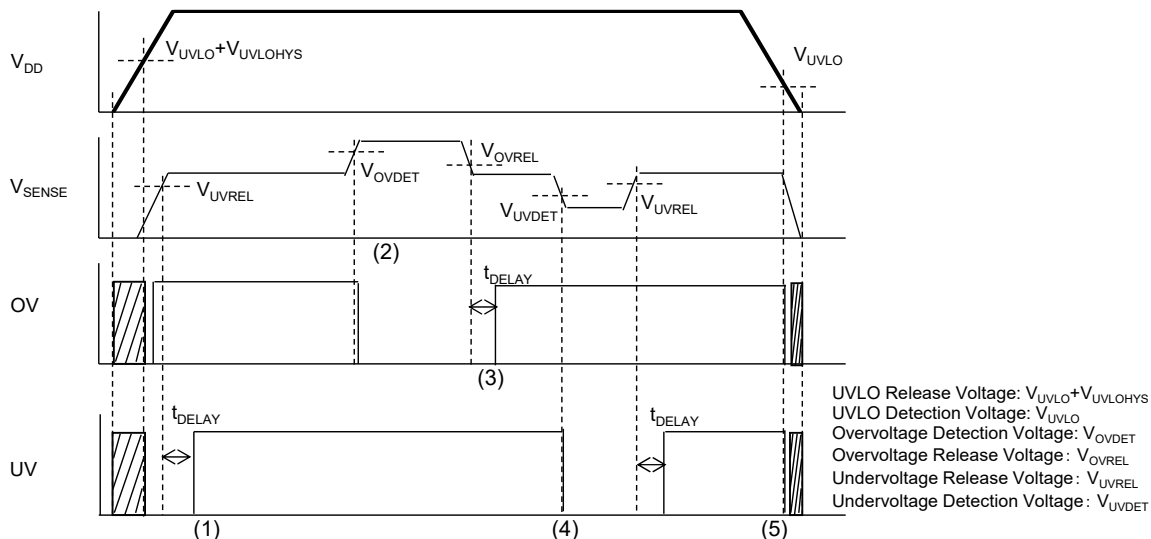
| Product Name | $V_{OVDET}$ (V) |      |         | $V_{UVDET}$ (V) |       |         | $V_{OVHYS}$ (V) |         |         | $V_{UVHYS}$ (V) |         |         |
|--------------|-----------------|------|---------|-----------------|-------|---------|-----------------|---------|---------|-----------------|---------|---------|
|              | Min.            | Typ. | Max.    | Min.            | Typ.  | Max.    | Min.            | Typ.    | Max.    | Min.            | Typ.    | Max.    |
| R3152N001A   | 5.27350         | 5.30 | 5.32650 | 4.67650         | 4.70  | 4.72350 | 0.02650         | 0.05300 | 0.07950 | 0.02350         | 0.04700 | 0.07050 |
| R3152N002A   | 3.52230         | 3.54 | 3.55770 | 3.03475         | 3.05  | 3.06525 | 0.01770         | 0.03540 | 0.05310 | 0.01525         | 0.03050 | 0.04575 |
| R3152N003B   | 3.55215         | 3.57 | 3.58785 | 2.48750         | 2.50  | 2.51250 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N004A   | 1.86065         | 1.87 | 1.87935 | 1.73130         | 1.74  | 1.74870 | 0.00935         | 0.01870 | 0.02805 | 0.00870         | 0.01740 | 0.02610 |
| R3152N005A   | 3.41285         | 3.43 | 3.44715 | 3.17405         | 3.19  | 3.20595 | 0.01715         | 0.03430 | 0.05145 | 0.01595         | 0.03190 | 0.04785 |
| R3152N013A   | 1.32335         | 1.33 | 1.33665 | 1.16415         | 1.17  | 1.17585 | 0.00665         | 0.01330 | 0.01995 | 0.00585         | 0.01170 | 0.01755 |
| R3152N014A   | 1.16415         | 1.17 | 1.17585 | 1.06963         | 1.075 | 1.08037 | 0.00585         | 0.01170 | 0.01755 | 0.00538         | 0.01075 | 0.01613 |
| R3152N015A   | 1.28355         | 1.29 | 1.29645 | 1.15420         | 1.16  | 1.16580 | 0.00645         | 0.01290 | 0.01935 | 0.00580         | 0.01160 | 0.01740 |
| R3152N017A   | 3.55215         | 3.57 | 3.58785 | 2.72630         | 2.74  | 2.75370 | 0.01785         | 0.03570 | 0.05355 | 0.01370         | 0.02740 | 0.04110 |
| R3152N020A   | 1.24375         | 1.25 | 1.25625 | 1.11440         | 1.12  | 1.12560 | 0.00625         | 0.01250 | 0.01875 | 0.00560         | 0.01120 | 0.01680 |
| R3152N201B   | 1.23380         | 1.24 | 1.24620 | 1.16415         | 1.17  | 1.17585 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N101B   | 2.58700         | 2.60 | 2.61300 | 2.39795         | 2.41  | 2.42205 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N102B   | 3.41285         | 3.43 | 3.44715 | 3.16410         | 3.18  | 3.19590 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N203A   | 1.39300         | 1.40 | 1.40700 | 0.99500         | 1.00  | 1.00500 | 0.00700         | 0.01400 | 0.02100 | 0.00500         | 0.01000 | 0.01500 |
| R3152N204A   | 1.62185         | 1.63 | 1.63815 | 1.40295         | 1.41  | 1.41705 | 0.00815         | 0.01630 | 0.02445 | 0.00705         | 0.01410 | 0.02115 |
| R3152N103A   | 5.77100         | 5.80 | 5.82900 | 4.75610         | 4.78  | 4.80390 | 0.02900         | 0.05800 | 0.08700 | 0.02390         | 0.04780 | 0.07170 |

( $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$ )

| Product Name | $V_{OVDET}$ (V) |      |         | $V_{UVDET}$ (V) |       |         | $V_{OVHYS}$ (V) |         |         | $V_{UVHYS}$ (V) |         |         |
|--------------|-----------------|------|---------|-----------------|-------|---------|-----------------|---------|---------|-----------------|---------|---------|
|              | Min.            | Typ. | Max.    | Min.            | Typ.  | Max.    | Min.            | Typ.    | Max.    | Min.            | Typ.    | Max.    |
| R3152N001A   | 5.23375         | 5.30 | 5.33975 | 4.64125         | 4.70  | 4.73525 | 0.02650         | 0.0530  | 0.07950 | 0.02350         | 0.04700 | 0.07050 |
| R3152N002A   | 3.49575         | 3.54 | 3.56655 | 3.01188         | 3.05  | 3.07287 | 0.01770         | 0.0354  | 0.05310 | 0.01525         | 0.03050 | 0.04575 |
| R3152N003B   | 3.52538         | 3.57 | 3.59678 | 2.46875         | 2.50  | 2.51875 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N004A   | 1.84663         | 1.87 | 1.88403 | 1.71825         | 1.74  | 1.75305 | 0.00935         | 0.01870 | 0.02805 | 0.00870         | 0.01740 | 0.02610 |
| R3152N005A   | 3.38713         | 3.43 | 3.45573 | 3.15013         | 3.19  | 3.21392 | 0.01715         | 0.03430 | 0.05145 | 0.01595         | 0.0319  | 0.04785 |
| R3152N013A   | 1.31338         | 1.33 | 1.33997 | 1.15538         | 1.17  | 1.17877 | 0.00665         | 0.01330 | 0.01995 | 0.00585         | 0.01170 | 0.01755 |
| R3152N014A   | 1.15537         | 1.17 | 1.17878 | 1.06156         | 1.075 | 1.08307 | 0.00585         | 0.01170 | 0.01755 | 0.00538         | 0.01075 | 0.01613 |
| R3152N015A   | 1.27387         | 1.29 | 1.29968 | 1.14550         | 1.16  | 1.16870 | 0.00645         | 0.01290 | 0.01935 | 0.00580         | 0.01160 | 0.01740 |
| R3152N017A   | 3.52537         | 3.57 | 3.59678 | 2.70575         | 2.74  | 2.76055 | 0.01785         | 0.03570 | 0.05355 | 0.01370         | 0.02740 | 0.04110 |
| R3152N020A   | 1.23438         | 1.25 | 1.25937 | 1.10600         | 1.12  | 1.12840 | 0.00625         | 0.01250 | 0.01875 | 0.00560         | 0.01120 | 0.01680 |
| R3152N201B   | 1.22450         | 1.24 | 1.24930 | 1.15538         | 1.17  | 1.17877 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N101B   | 2.56750         | 2.60 | 2.61950 | 2.37988         | 2.41  | 2.42807 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N102B   | 3.38713         | 3.43 | 3.45572 | 3.14025         | 3.18  | 3.20385 | 0               | -       | 0.01000 | 0               | -       | 0.01000 |
| R3152N203A   | 1.38250         | 1.40 | 1.41050 | 0.98750         | 1.00  | 1.00750 | 0.00700         | 0.01400 | 0.02100 | 0.00500         | 0.01000 | 0.01500 |
| R3152N204A   | 1.60963         | 1.63 | 1.64222 | 1.39238         | 1.41  | 1.42057 | 0.00815         | 0.01630 | 0.02445 | 0.00705         | 0.01410 | 0.02115 |
| R3152N103A   | 5.72750         | 5.80 | 5.84350 | 4.72025         | 4.78  | 4.81585 | 0.02900         | 0.05800 | 0.08700 | 0.02390         | 0.04780 | 0.07170 |



## THEORY OF OPERATION



**R3152N Timing Chart**

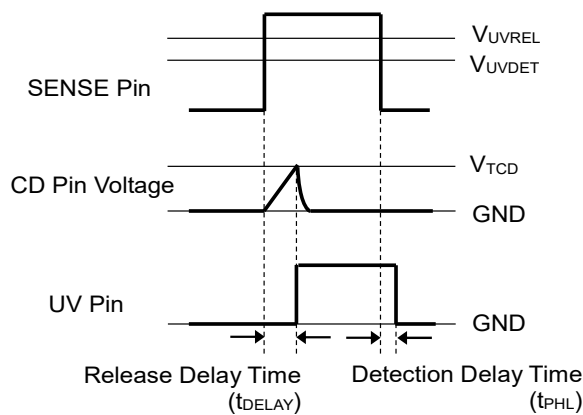
- (1) When the SENSE pin voltage ( $V_{SENSE}$ ) exceeded the undervoltage release voltage ( $V_{UVREL}$ ), the UV pin output becomes “High” after the release delay time ( $t_{DELAY}$ ).
- (2) When  $V_{SENSE}$  exceeded the overvoltage detection voltage ( $V_{OVDET}$ ) by increasing in voltage, the OV pin output becomes “Low” after the detection delay time (Typ.10  $\mu$ s) and enters the overvoltage detecting state.
- (3) When  $V_{SENSE}$  decreases less than the overvoltage release voltage ( $V_{OVREL}$ ), the OV pin output becomes “High” after the release delay time ( $t_{DELAY}$ ).
- (4) When  $V_{SENSE}$  decreases less than the undervoltage detection voltage ( $V_{UVDET}$ ), the UV pin output becomes “Low” after the detection delay time (Typ.10  $\mu$ s).
- (5) When the VDD pin voltage ( $V_{DD}$ ) decreases less than the UVLO detection voltage ( $V_{UVLO}$ ), the OV and UV pins output become “Low”.

Note: A certain tilting angle of power supply voltage of the R3152NxxxB may cause chattering at detection or at release. To prevent the occurrence of chattering, connect a 10-nF or more capacitor to the CD pin.

**Delay in Operation and Delay Time ( $t_{DELAY}$ )**

**At Undervoltage Detection**

When supplying a voltage higher than the undervoltage release voltage ( $V_{UVREL}$ ) to the SENSE pin, a charging to an external capacitor starts and the CD pin voltage ( $V_{CD}$ ) increases. The UV pin voltage ( $V_{UV}$ ) maintains “Low” until  $V_{CD}$  reaches the CD pin threshold voltage ( $V_{TCD}$ ). When  $V_{CD}$  exceeds  $V_{TCD}$ ,  $V_{UV}$  is inverted from “Low” to “High”. The release delay time ( $t_{DELAY}$ ) is the period from the SENSE pin voltage ( $V_{SENSE}$ ) exceeds  $V_{UVREL}$  to a rising edge of  $V_{UV}$ . When the output voltage turns from “Low” to “High”, a charge carrier of the external capacitor starts discharging. When the voltage lower than  $V_{UV}$  is supplied to the SENSE pin, the detection delay time ( $t_{PHL}$ ), which is the period that  $V_{UV}$  is inverted from “High” to “Low”, remains constant independent of the external capacitor.



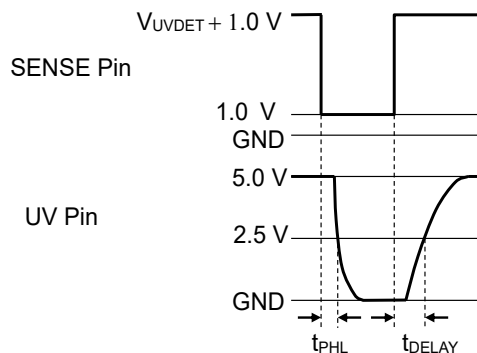
**Undervoltage Release Delay Timing Diagram**

**Calculation of Release Delay Time ( $t_{DELAY}$ )**

The following equation can calculate a typical value of the release delay time ( $t_{DELAY}$ ) with using the external capacitor ( $C_D$ ).

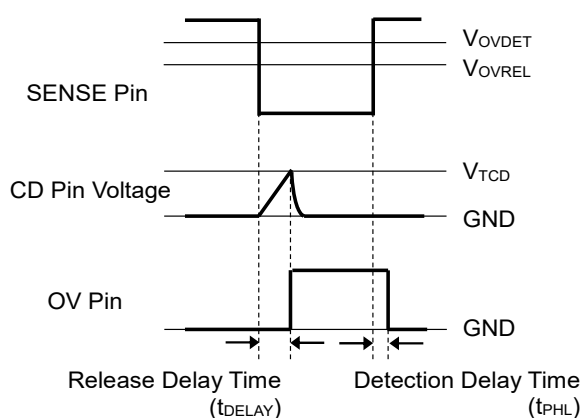
$$t_{DELAY} (s) = 0.73 \times C_D (F) / (1.5 \times 10^{-6})$$

$t_{DELAY}$  is the period from supplying a pulse voltage of 1.0 V  $\rightarrow$  ( $V_{UVDET}$ ) + 1.0 V to the SENSE pin to the UV pins reached 2.5 V.



### At Overvoltage Detection

When supplying a voltage lower than the overvoltage release voltage ( $V_{OVREL}$ ) to the SENSE pin, a charging to an external capacitor starts and the CD pin voltage ( $V_{CD}$ ) increases. The OV pin voltage ( $V_{OV}$ ) maintains “Low” until  $V_{CD}$  reaches the CD pin threshold voltage ( $V_{TCD}$ ). When  $V_{CD}$  exceeds  $V_{TCD}$ ,  $V_{OV}$  is inverted from “Low” to “High”. The release delay time ( $t_{DELAY}$ ) is the period from the SENSE pin voltage ( $V_{SENSE}$ ) falls below  $V_{OVREL}$  to a rising edge of  $V_{OV}$ . When the output voltage turns from “Low” to “High”, a charge carrier of the external capacitor starts discharging. When the voltage higher than  $V_{OV}$  is supplied to the SENSE pin, the detection delay time ( $t_{PHL}$ ), which is the period that  $V_{OV}$  is inverted from “High” to “Low”, remains constant independent of the external capacitor.



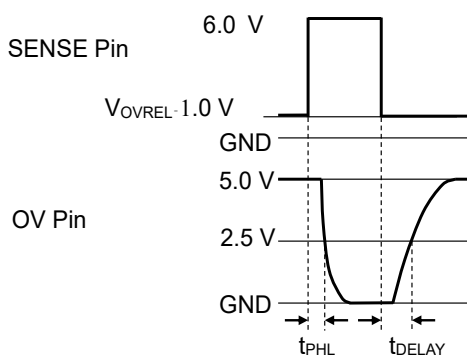
**Overvoltage Release Delay Timing Diagram**

### Calculation of Release Delay Time ( $t_{DELAY}$ )

The following equation can calculate a typical value of the release delay time ( $t_{DELAY}$ ) with using the external capacitor ( $C_D$ ).

$$t_{DELAY} \text{ (s)} = 0.73 \times C_D \text{ (F)} / (1.5 \times 10^{-6})$$

$t_{DELAY}$  is the period from supplying a pulse voltage of  $1.0 \text{ V} \rightarrow (V_{OVREL}) + 1.0 \text{ V}$  to the SENSE pin to the OV pin reached  $2.5 \text{ V}$  after the OV pin is pulled up to  $5 \text{ V}$  by connecting with a resistor of  $100 \text{ k}\Omega$ .

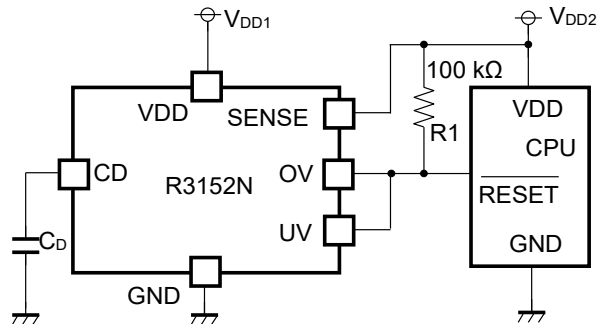


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**R3152N**

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No. EC-405-191101

**APPLICATION INFORMATION****R3152N Typical Application Circuit****Recommended External Components**

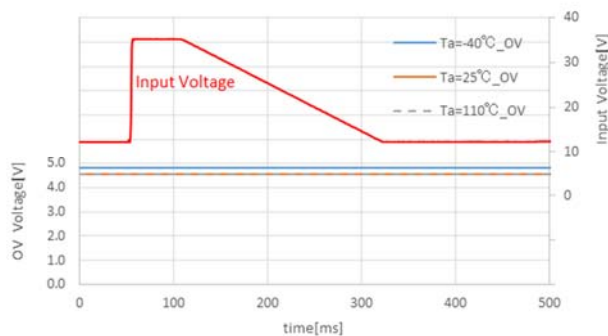
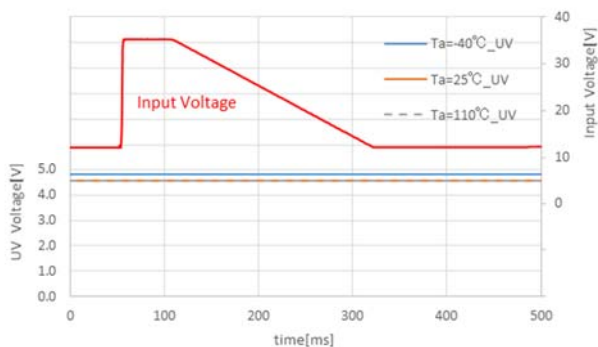
| Symbol         | Description  |
|----------------|--|
| C <sub>D</sub> | A capacitor corresponding to setting of Release Delay Time is required. Refer to “ <i>Delay in Operation and Released Delay Time (t<sub>DELAY</sub>)</i> ” in Operation Description for details.   |
| R1             | A resistor is required to set with consideration of the output current at Nch. driver’s ON and the leakage current at Nch. driver’s OFF. Refer to “Electrical Characteristic” for details – provided the evaluation result with using a resistor of 100kΩ. |

## TYPICAL CHARACTERISTICS

Typical Characteristics are intended to be used as reference data, they are not guaranteed.

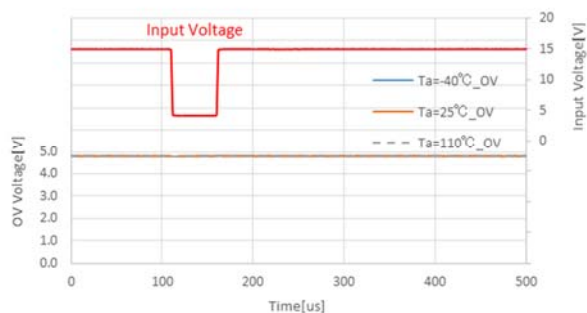
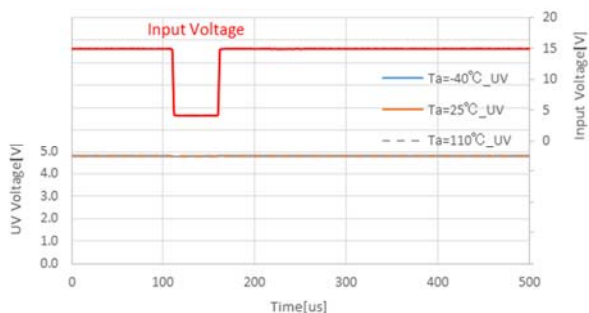
### 1) Load Dump

$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$ ,  $V_{SENSE} = 3.3\text{ V}$ , Pulled-up to 5.0 V



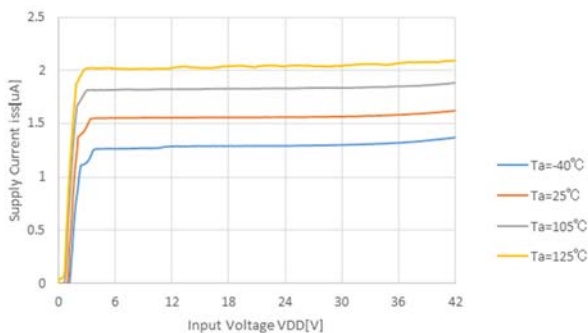
### 2) Cranking

$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$ ,  $V_{SENSE} = 3.3\text{ V}$ , Pulled-up to 5.0 V

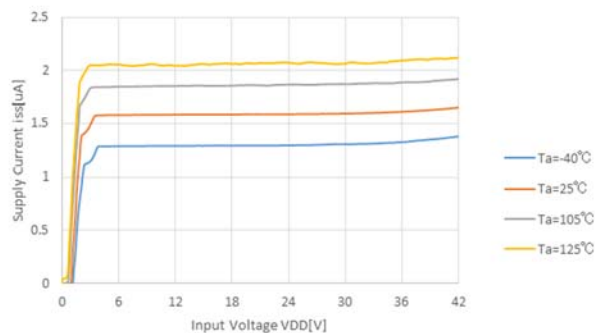


### 3) Supply Current vs. $V_{DD}$

$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$



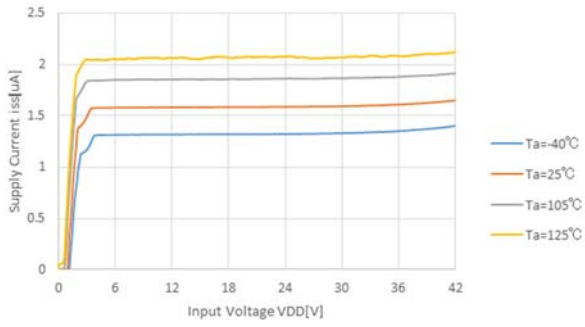
$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$



# R3152N

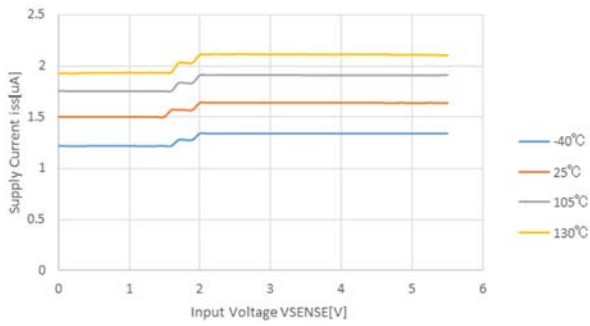
No. EC-405-191101

$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$

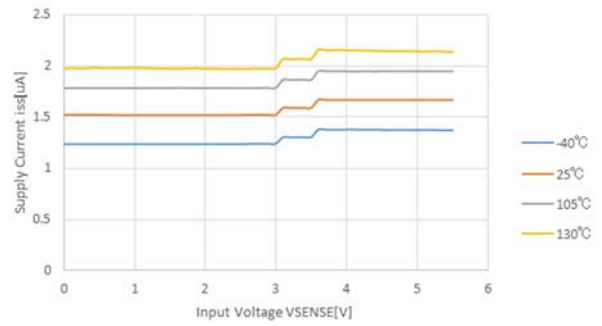


## 4) Supply Current vs. $V_{SENSE}$

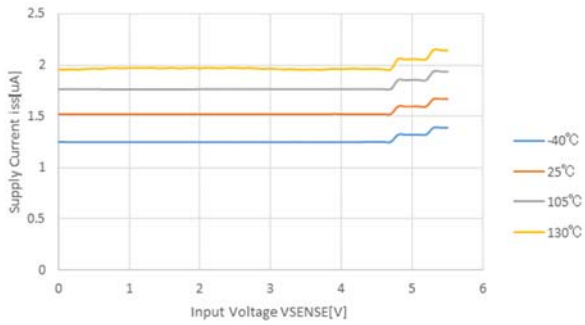
$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$



$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$

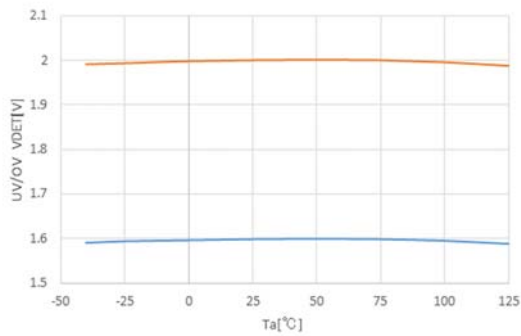


$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$

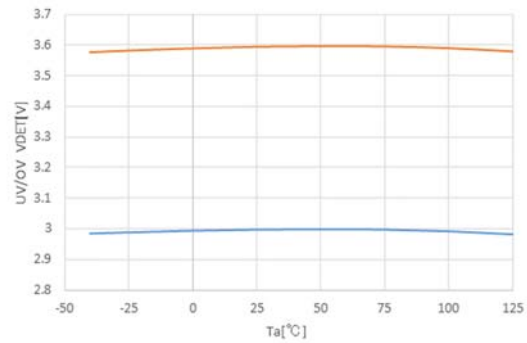


**5) UV/OV Detection Voltage vs. Ambient Temperature**

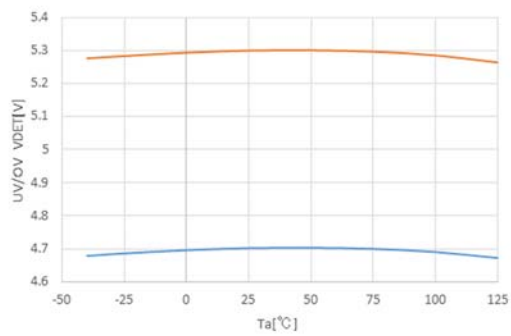
$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$



$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$

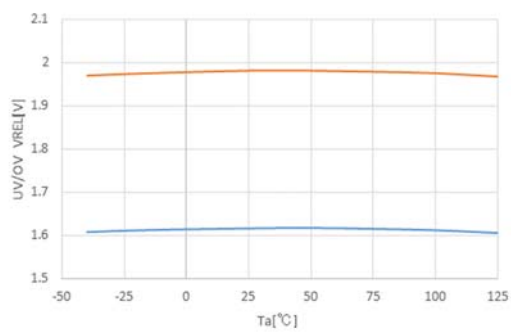


$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$

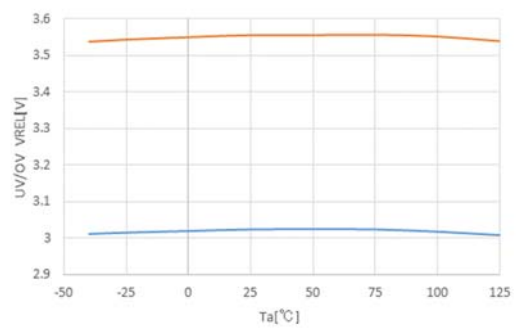


**6) UV/OV Release Voltage vs. Ambient Temperature**

$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$



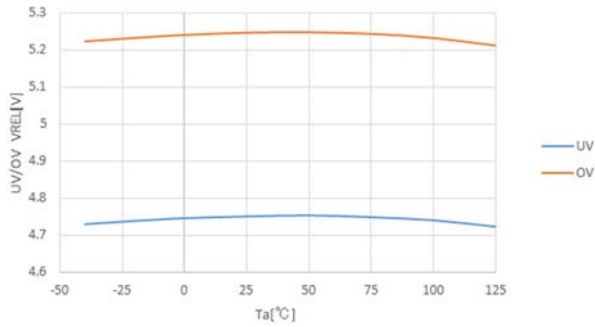
$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$



# R3152N

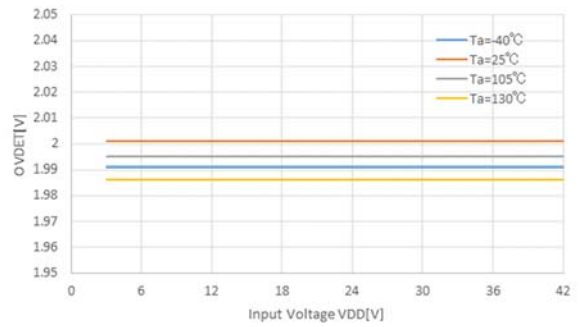
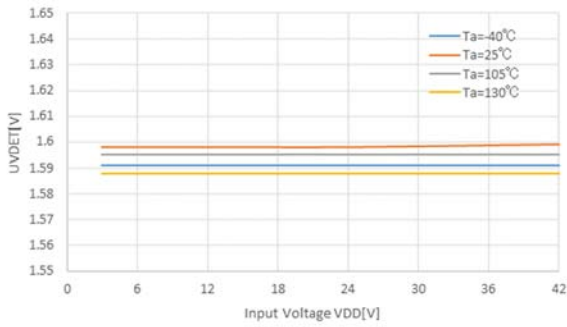
No. EC-405-191101

$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$

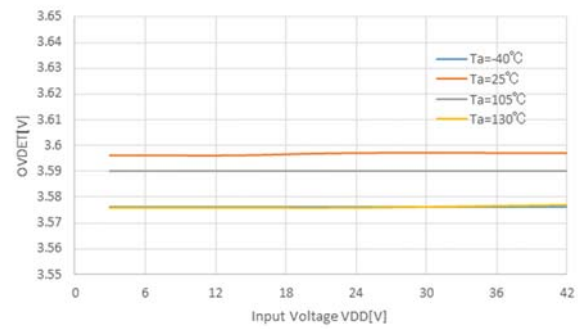
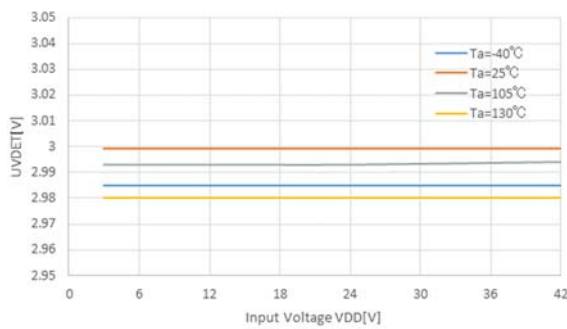


## 7) UV/OV Detection Voltage vs. VDD

$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$

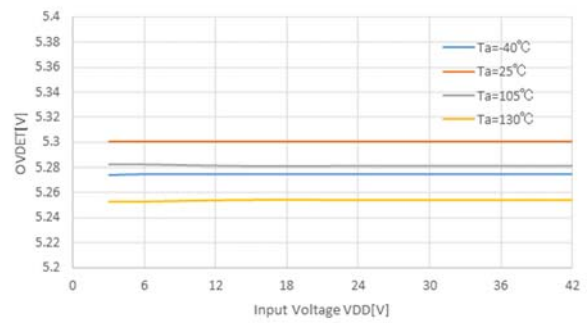
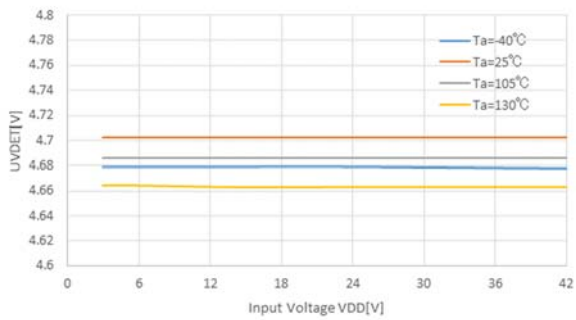


$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$



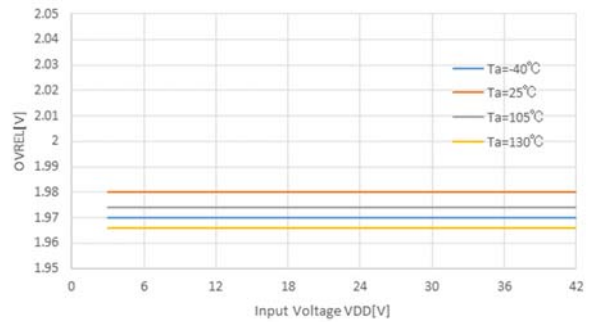
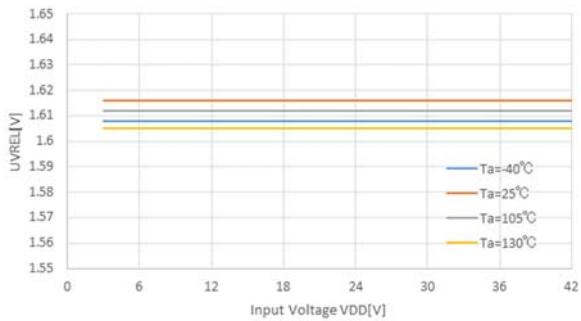


$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$

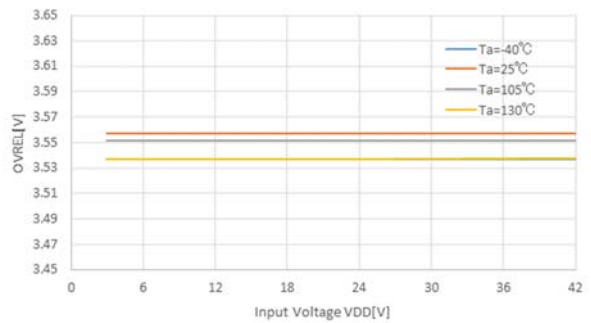
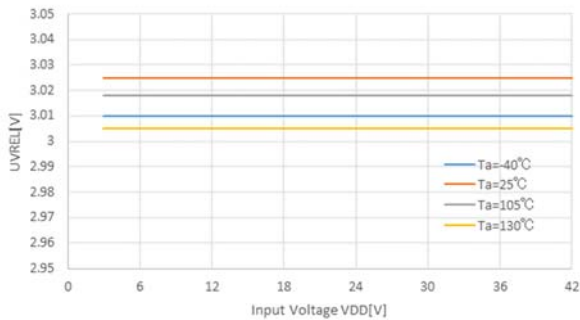


**8) UV/OV Release Voltage vs. VDD**

$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$



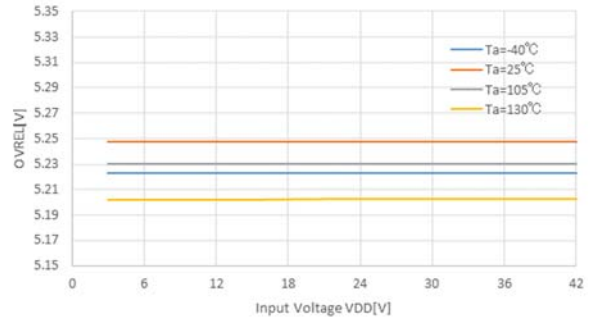
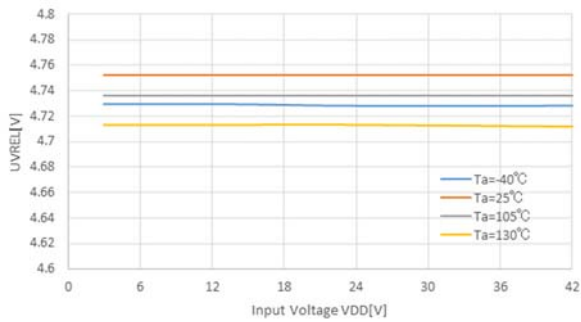
$V_{UVSET} = 3.0\text{ V}$ ,  $V_{OVSET} = 3.6\text{ V}$



# R3152N

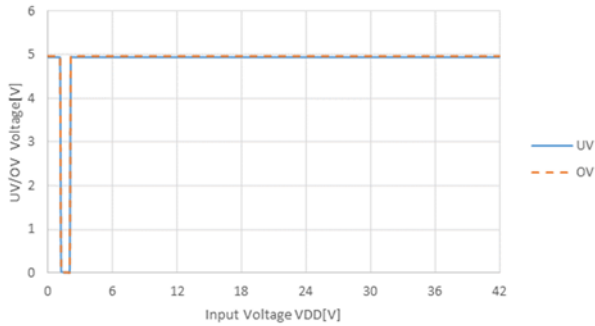
No. EC-405-191101

$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$

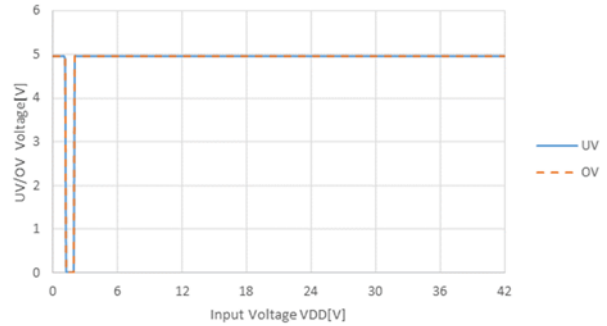


## 9) UV/OV Voltage vs. $V_{DD}$ ( $T_a = 25^\circ\text{C}$ )

$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$ , Pulled-up to 5.0 V

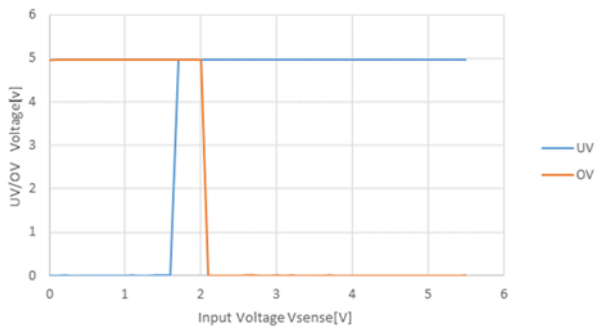


$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$ , Pulled-up to 5.0 V

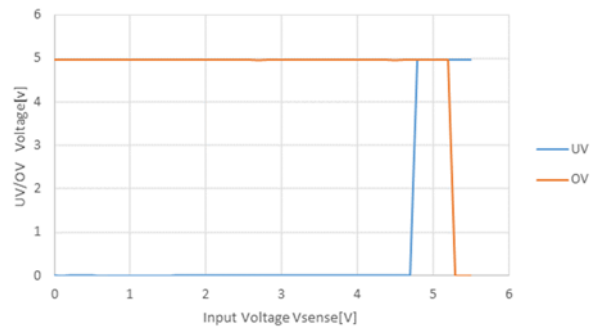


## 10) UV/OV Voltage vs. $V_{SENSE}$ ( $T_a = 25^\circ\text{C}$ )

$V_{UVSET} = 1.6\text{ V}$ ,  $V_{OVSET} = 2.0\text{ V}$ , Pulled-up to 5.0 V

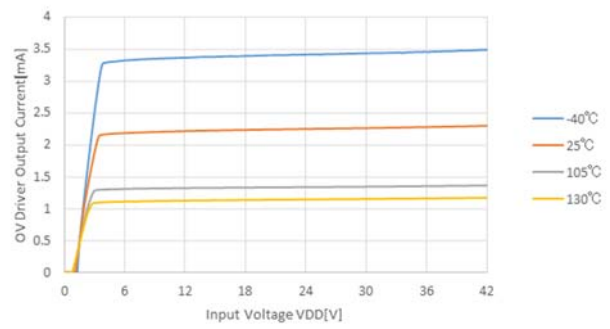
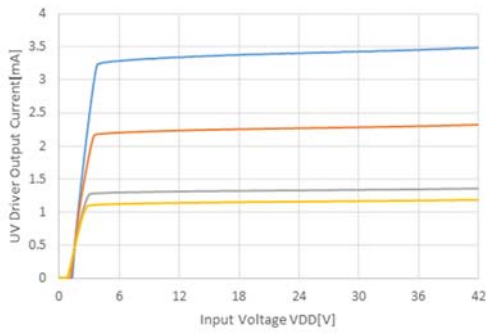


$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$ , Pulled-up to 5.0 V



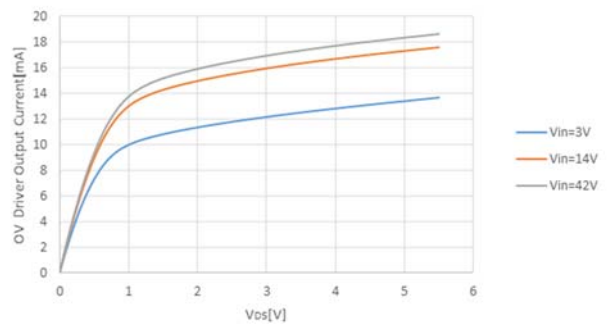
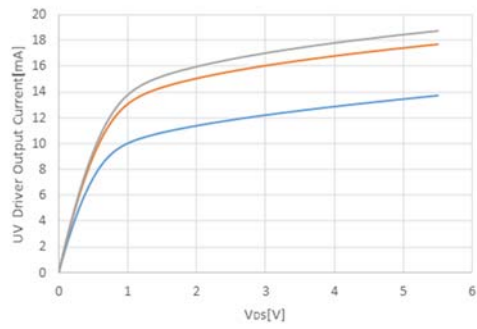
**11) Driver Output Current vs. V<sub>DD</sub>**

V<sub>UVSET</sub> = 4.7 V, V<sub>OVSET</sub> = 5.3 V

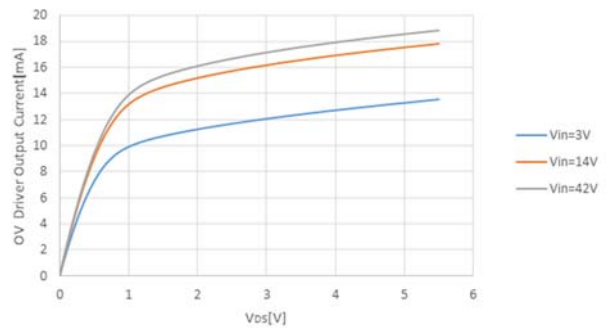
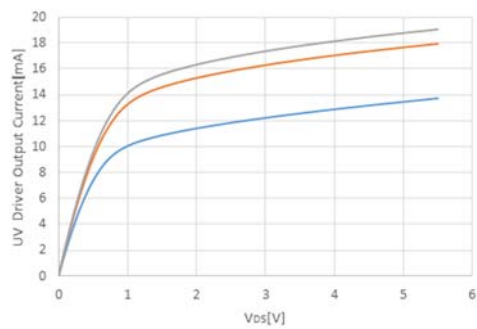


**12) Driver Output Current vs. V<sub>DS</sub> (Ta = 25°C)**

V<sub>UVSET</sub> = 1.6 V, V<sub>OVSET</sub> = 2.0 V

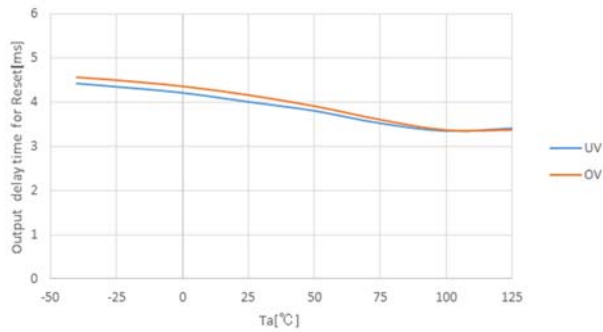


V<sub>UVSET</sub> = 4.7 V, V<sub>OVSET</sub> = 5.3 V



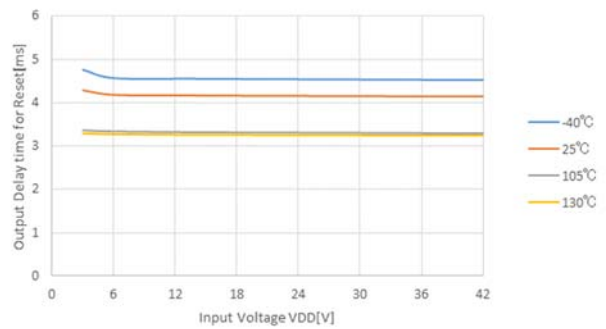
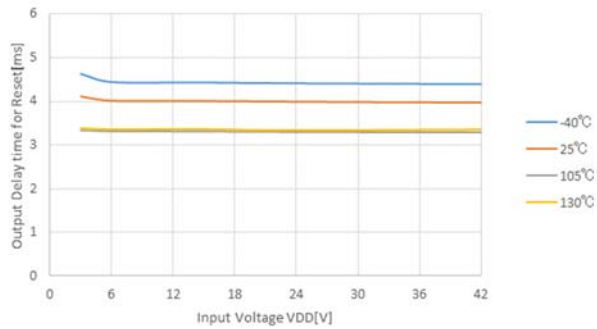
**13) Release Delay Time vs. Ambient Temperature**

$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$



**14) Release Delay Time vs.  $V_{DD}$**

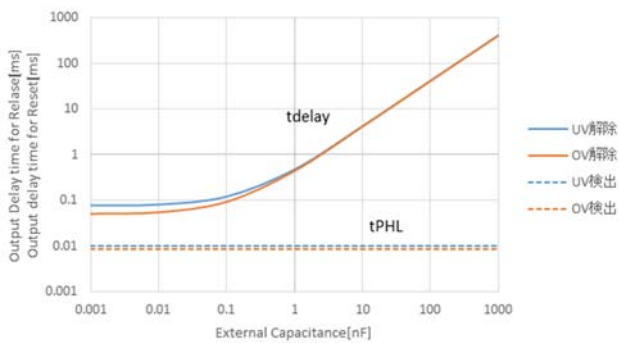
$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$



**15) Detection / Release Delay Time vs. External Capacitor for CD Pin**

( $T_a = 25^\circ\text{C}$ )

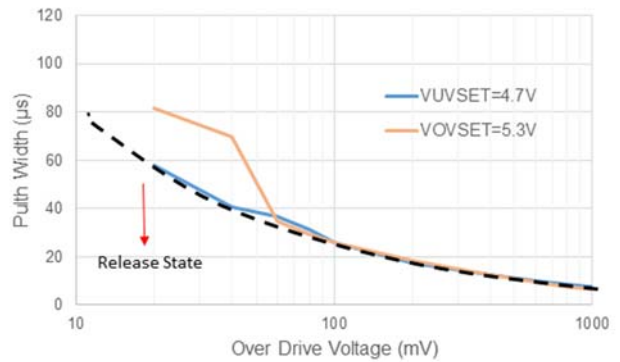
$V_{UVSET} = 4.7\text{ V}$ ,  $V_{OVSET} = 5.3\text{ V}$



**16) SENSE Pulse Width vs. Over Drive Voltage**

( $T_a = 25^\circ\text{C}$ )

Release State Threshold Pulse



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**

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

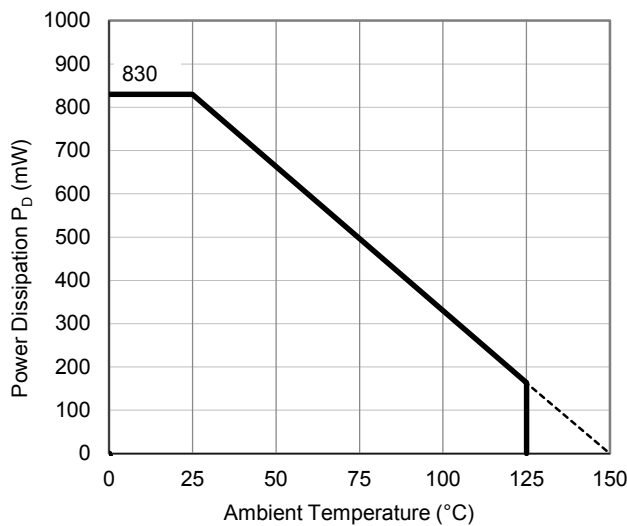
**Measurement Result**

(Ta = 25°C, Tjmax = 150°C)

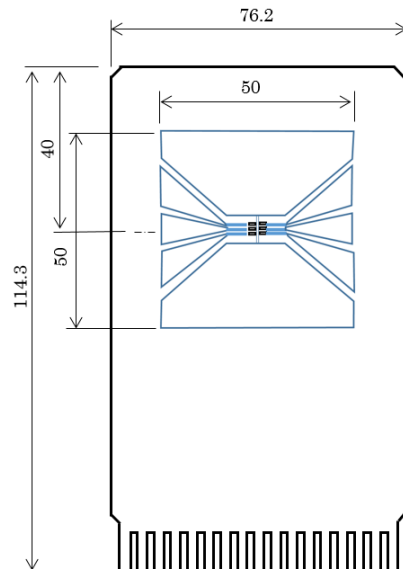
| Item                                     | Measurement Result |
|--|--------------------|
| Power Dissipation                        | 830 mW             |
| Thermal Resistance (θja)                 | θja = 150°C/W      |
| Thermal Characterization Parameter (ψjt) | ψjt = 51°C/W       |

θja: Junction-to-Ambient Thermal Resistance

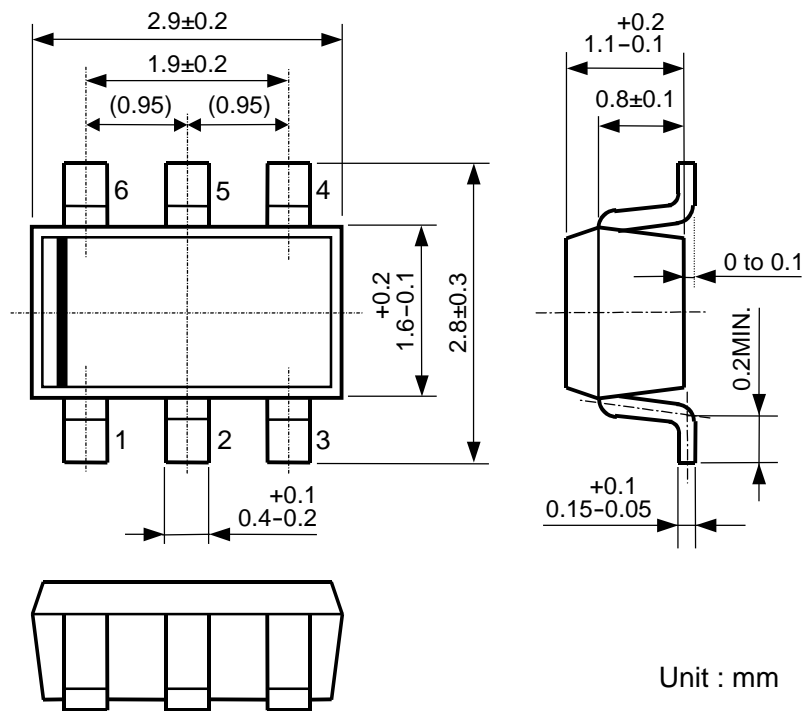
ψjt: Junction-to-Top Thermal Characterization Parameter



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



SOT-23-6 Package Dimensions



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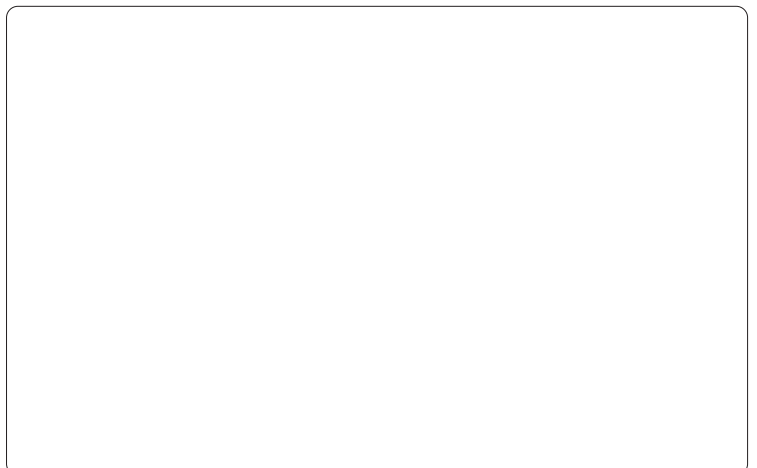
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