

## R3152N Series

## **AEC-Q100 Compliant**

## 42 V Input Window Voltage Detector for Automotive Applications

No. EC-405-200904

#### **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 μA
- 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:

 $\pm 0.5\%$  (Ta = 25°C)

-1.25% to 0.75% (-40°C to 125°C)

- Release Delay Time: Typ. 4 ms (C<sub>D</sub> = 0.01 μF)
- 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 (Vovset) and an undervoltage detection setting voltage (Vuvset)

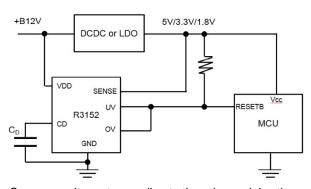
Refer to *Product-specific Electrical Characteristics* for more details.

#### \$: Hysteresis

\$	Hysteresis
Α	Yes
В	No

#: Quality Class Refer to SELECTION GUIDE for details.

#### **TYPICAL APPLICATIONS**



 $\ensuremath{\text{C}_{\text{D}}}\xspace$  : 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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#### **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 (Vovset) and an undervoltage detection setting voltage (Vuvset).

Refer to Product-specific Electrical Characteristics for more details.

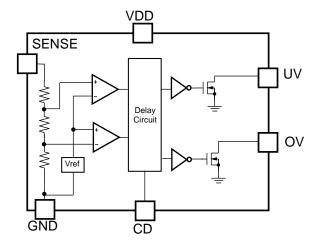
#### \$: Hysteresis

\$	Hysteresis						
Α	Yes						
В	No						

#### #: Quality Class

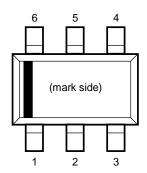
#	Operating Temp. Range	Test Temp.
Α	-40°C to 125°C	25°C, High
K	-40°C to 125°C	Low, 25°C, High

## **BLOCK DIAGRAM**



R3152N Block Diagram

## **PIN DESCRIPTIONS**



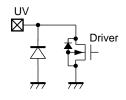
**SOT-23-6 Pin Configuration** 

**Pin Description** 

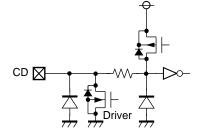
Pin No.	Symbol	Description
1	VDD	Supply Voltage Pin
2	CD	VD Release Delay Time Set Pin (for connecting with external capacitor for delay)
3	UV	Undervoltage Detection Output Pin ("Low" at detection)
4	OV	Overvoltage Detection Output Pin ("Low" at detection)
5	GND	GND Pin
6	SENSE	SENSE Pin

## **Internal Equivalent Circuit for Each Pin**

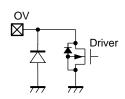




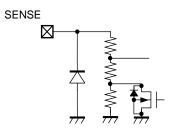
**CD Pin** 



**OV Pin** 



**SENSE Pin** 



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#### **ABSOLUTE MAXIMUM RATINGS**

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
\ /	Supply Voltage	-0.3 to 50.0	V
$V_{DD}$	Peak Voltage <sup>(1)</sup>	60	V
VcD	CD Pin Output Voltage	-0.3 to 50.0	V
V <sub>UVOUT</sub>	UV Pin Output Voltage	-0.3 to 7.0	V
Vovouт	OV Pin Output Voltage	-0.3 to 7.0	V
V <sub>SENSE</sub>	SENSE Pin Input Voltage	-0.3 to 7.0	V
Iuvouт	UV Pin Output Current	30	mA
Гоуоит	OV Pin Output Current	30	mA
PD	Power Dissipation <sup>(2)</sup> (JEDEC STD.51-7)	830	mW
Tj	Junction Temperature Range	-40 to 150	°C
Tstg	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** 

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Symbol	Parameter	Rating	Unit
$V_{DD}$	Operating Voltage	3.0 to 42	V
VSENSE	SENSE Pin Input Voltage	0 to 6.0	V
Ta	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.

(Ta= 25°C)

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#### **ELECTRICAL CHARACTERISTICS**

R3152N (-AE) Electrical Characteristics

pulled-up output voltage

Low-operating Voltage<sup>(1)</sup>
Undervoltage (UV)

Low-operating Voltage(1)

Release Delay Time

OV Pin Nch. Driver Output Current

UV Pin Nch. Driver Output Current

**OV Pin Nch.Driver Leak Current** 

UV Pin Nch Driver Leak Current

Overvoltage (OV)

VDDLOV

 $V_{\text{DDLUV}}$ 

Гоит

**I**LEAK

**t**DELAY

 $V_{DD} = 14 \text{ V}, C_D = 0.01 \ \mu\text{F}, \text{ pulled-up to 5 V with 100 k}\Omega, \text{ unless otherwise specified.}$  The specifications surrounded by are guaranteed by design engineering at -40°C  $\leq$  Ta  $\leq$  125°C.

**Test Conditions/Comments** Symbol **Parameter** Min. Max. Unit Typ. Ta = 25°C x0.995 x1.005 V Overvoltage (OV) Detector VOVDET Threshold -40°C ≤ Ta ≤ 125°C x0.9875 x1.0075 V  $Ta = 25^{\circ}C$ x0.995 x1.005 V Undervoltage (UV) Detector VUVDET Threshold x0.9875 x1.0075 -40°C ≤ Ta ≤ 125°C V  $V_{O\underline{V}\underline{D}\underline{E}\underline{T}}$ VOVDET VOVDET With Hysteresis Overvoltage (OV) Threshold  $\times 0.005$ ×0.01 ×0.015 Vovers Hysteresis 0 No Hysteresis 10 m۷ VUVDET  $V_{\text{UVDET}}$ VUVDET With Hysteresis V Undervoltage (UV) ×0.01 ×0.015  $\times 0.005$ Vuvhys Threshold Hysteresis 0 No Hysteresis 10 m۷ 3.2 VUVDET < SENSE < VOVDET Iss Consumption Current 1.5 μΑ V<sub>UVDET</sub>≥1.6V, V<sub>OVDET</sub>≥2.0V 7 28 14 RSENSE SENSE Pin Resistance ΜΩ VUVDET < 1.6V, VOVDET < 3.0 12 6 2.0V 2.8 1.8 V  $V_{UVLO}$ **UVLO Detector Threshold UVLO Threshold Hysteresis** 0.1 0.2 V Vuvlohys Overvoltage (OV) 6.0 V  $V_{OVOUT}$ pulled-up output voltage Undervoltage (UV) V 6.0  $V_{UVOUT}$ 

All test items listed under Electrical Characteristics are done under the pulse load condition (Tj≈Ta = 25°C).

**RICOH** 

 $V_{DD} = 3.0, V_{DS} = 0.1 V$ 

 $V_{DD} = 3.0, V_{DS} = 0.1 V$ 

 $V_{OVOUT} = 5.5 V$ 

 $V_{UVOUT} = 5.5 V$ 

5

1.7

1.7

0.3

0.3

8

8.0

8.0

2.5

1.8

1.8

V

mA

mΑ

μΑ

μΑ

ms

<sup>&</sup>lt;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 V,  $C_D$  = 0.01  $\mu F$ , pulled-up to 5 V with 100  $k\Omega$ , unless otherwise specified.

R3152N (-KE) Electrical Characteristics

(-40°C ≤ Ta ≤ 125°C)

KO IOZIN (	-KE) Electrical Characteristics			(-40	C > la >	: 125 C)
Symbol	Parameter	Test Conditions/Comments	Min.	Тур.	Max.	Unit
.,	Overvoltage (OV) Detector	Ta = 25°C	x0.995		x1.005	V
VOVDET	Threshold	–40°C ≤ Ta ≤ 125°C	x0.9875		x1.0075	V
	Undervoltage (UV) Detector	Ta = 25°C	x0.995		x1.005	V
Vuvdet	Threshold	–40°C ≤ Ta ≤ 125°C	x0.9875		x1.0075	V
Voveys	Overvoltage (OV) Threshold	With Hysteresis	V <sub>OVDET</sub> ×0.005	V <sub>OVDET</sub> ×0.01	V <sub>OVDET</sub> ×0.015	V
010	Hysteresis	No Hysteresis	0		10	mV
Vuvhys	Undervoltage (UV)	With Hysteresis	V <sub>UVDET</sub> ×0.005	V <sub>UVDET</sub> ×0.01	V <sub>UVDET</sub> ×0.015	V
	Threshold Hysteresis	No Hysteresis	0		10	mV
Iss	Consumption Current	Vuvdet < SENSE < Vovdet		1.5	3.2	μΑ
_		V <sub>UVDET</sub> ≥1.6V, V <sub>OVDET</sub> ≥2.0V	7	14	28	
RSENSE	SENSE Pin Resistance	Vuvdet < 1.6V, Vovdet < 2.0V	3.0	6	12	ΜΩ
$V_{UVLO}$	UVLO Detector Threshold			1.8	2.8	V
Vuvlohys	UVLO Threshold Hysteresis			0.1	0.2	V
Vovout	Overvoltage (OV) pulled-up output voltage				6.0	V
Vuvouт	Undervoltage (UV) pulled-up output voltage				6.0	V
V <sub>DDLOV</sub>	Overvoltage (OV) Low-operating Voltage <sup>(1)</sup>				1.7	V
V <sub>DDLUV</sub>	Undervoltage (UV) Low-operating Voltage <sup>(1)</sup>				1.7	V
la	OV Pin Nch. Driver Output Current	$V_{DD} = 3.0, V_{DS} = 0.1 V$	0.8	1.8		mA
l <sub>out</sub>	UV Pin Nch. Driver Output Current	$V_{DD} = 3.0, V_{DS} = 0.1 V$	0.8	1.8		mA
l. e	OV Pin Nch.Driver Leak Current	Vovout = 5.5 V			0.3	μΑ
ILEAK	UV Pin Nch Driver Leak Current	Vuvouт = 5.5 V			0.3	μΑ
tDELAY	Release Delay Time		2.5	4	8	ms

All test items listed under Electrical Characteristics are done under the pulse load condition ( $Tj \approx Ta = 25$ °C).

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 $<sup>^{(1)}</sup>$  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)

 $V_{DD} = 14 \text{ V, } C_D = 0.01 \text{ } \mu\text{F, pulled-up to 5 V with 100 k}\Omega, \text{ unless otherwise specfied.}$  The specifications surrounded by \_\_\_\_\_ are guaranteed by design engineering at -40°C ≤ Ta ≤ 125°C.

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

 $(Ta = 25^{\circ}C)$ 

Product	V <sub>OVDET</sub> (V)			V <sub>UVDET</sub> (V)			Vovers (V)			Vuvhys (V)			
Name	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	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	
R3152N104A	3.38300	3.40	3.41700	1.59200	1.60	1.60800	0.01700	0.03400	0.05100	0.00800	0.01600	0.02400	

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

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

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

(-40°C ≤ Ta ≤ 125°C)

Product	V <sub>OVDET</sub> (V)			V <sub>UVDET</sub> (V)			Vovers (V)			Vuvhys (V)		
Name	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	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	O	-	0.01000	O	-	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	ı	0.01000
R3152N101B	2.56750	2.60	2.61950	2.37988	2.41	2.42807	0	-	0.01000	0	ı	0.01000
R3152N102B	3.38713	3.43	3.45572	3.14025	3.18	3.20385	0	-	0.01000	0	ı	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
R3152N104A	3.35750	3.40	3.42550	1.58000	1.60	1.61200	0.01700	0.03400	0.05100	0.00800	0.01600	0.02400

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

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

 $(Ta = 25^{\circ}C)$ 

	,										,	/
Product	V <sub>OVDET</sub> (V)			V <sub>UVDET</sub> (V)			Vovers (V)			Vuvhys (V)		
Name	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	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
R3152N104A	3.38300	3.40	3.41700	1.59200	1.60	1.60800	0.01700	0.03400	0.05100	0.00800	0.01600	0.02400

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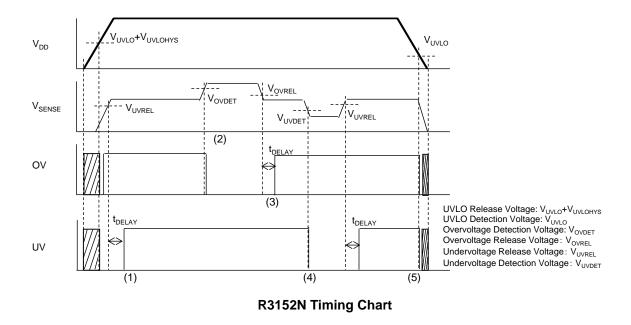
 $V_{DD}$  = 14 V,  $C_D$  = 0.01  $\mu F,$  pulled-up to 5 V with 100  $k\Omega,$  unless otherwise specfied.

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

 $(-40^{\circ}\text{C} \le \text{Ta} \le 125^{\circ}\text{C})$ 

	,											/
Product	V <sub>OVDET</sub> (V)			Vuvdet (V)			Vovers (V)			Vuvhys (V)		
Name	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	Max.	Min.	Тур.	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
R3152N104A	3.35750	3.40	3.42550	1.58000	1.60	1.61200	0.01700	0.03400	0.05100	0.00800	0.01600	0.02400

#### THEORY OF OPERATION



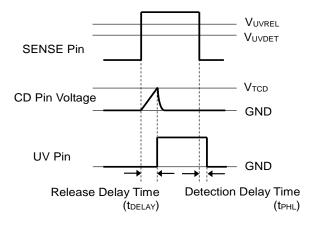
- (1) When the SENSE pin voltage (V<sub>SENSE</sub>) exceed the undervoltage release voltage (V<sub>UVREL</sub>), the UV pin output becomes "High" after the release delay time (t<sub>DELAY</sub>).
- (2) When V<sub>SENSE</sub> exceed the overvoltage detection voltage (V<sub>OVDET</sub>) by increasing in voltage, the OV pin output becomes "Low" after the detection delay time (Typ.10 µs) and enters the overvoltage detecting state
- (3) When V<sub>SENSE</sub> decreases less than the overvoltage release voltage (V<sub>OVREL</sub>), the OV pin output becomes "High" after the release delay time (t<sub>DELAY</sub>).
- (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 µs).
- (5) When the VDD pin voltage (V<sub>DD</sub>) decreases less than the UVLO detection voltage (V<sub>UVLO</sub>), 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 (tDELAY)**

#### 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.



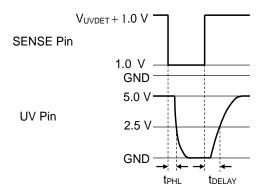
**Undervoltage Release Delay Timing Diagram** 

#### Calculation of Release Delay Time (t<sub>DELAY</sub>)

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

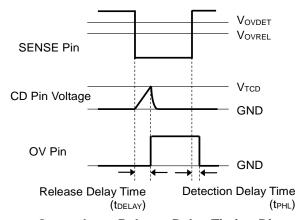
$$t_{DELAY}$$
 (s) = 0.73 ×  $C_D$  (F) / (1.5×10<sup>-6</sup>)

 $t_{DELAY}$  is the period from supplying a pulse voltage of 1.0 V  $\rightarrow$  (V<sub>UVDET</sub>) + 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.



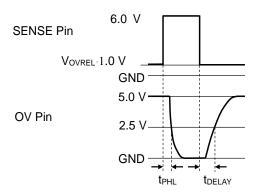
Overvoltage Release Delay Timing Diagram

#### Calculation of Release Delay Time (tDELAY)

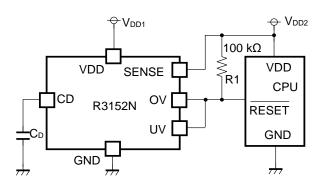
The following equation can calculate a typical value of the release delay time ( $t_{DELAY}$ ) with using the external capacitor ( $C_D$ ).

$$t_{DELAY}$$
 (s) = 0.73 ×  $C_D$  (F) / (1.5×10<sup>-6</sup>)

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



## **APPLICATION INFORMATION**



**R3152N Typical Application Circuit** 

#### **Recommended External Components**

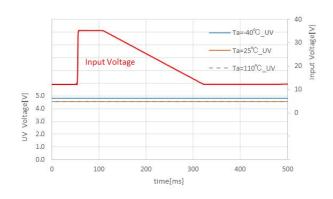
Symbol	Description
	A capacitor corresponding to setting of Release Delay Time is required. Refer to "Delay in
С	Operation and Released Delay Time (t <sub>DELAY</sub> )" in Operation Description for details.
	A resistor is required to set with consideration of the output current at Nch. driver's ON and the
R1	leakage current at Nch. driver's OFF. Refer to "Electrical Characteristic" for details – provided
	the evaluation result with using a resistor of $100k\Omega$ .

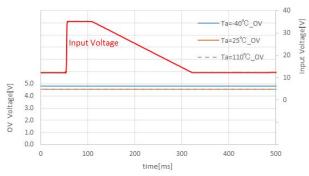
#### TYPICAL CHARACTERISTICS

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

#### 1) Load Dump

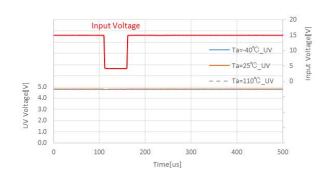
 $V_{UVSET} = 3.0 \text{ V}$ ,  $V_{OVSET} = 3.6 \text{ V}$ ,  $V_{SENSE} = 3.3 \text{ V}$ , Pulled-up to 5.0 V

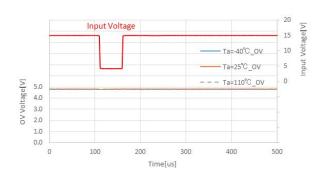




#### 2) Cranking

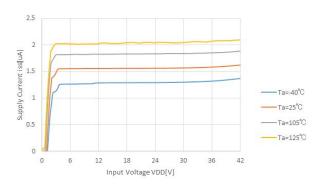
 $V_{UVSET} = 3.0 \text{ V}$ ,  $V_{OVSET} = 3.6 \text{ V}$ ,  $V_{SENSE} = 3.3 \text{ V}$ , Pulled-up to 5.0 V

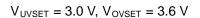


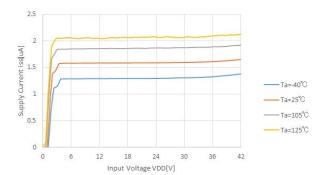


#### 3) Supply Current vs. VDD

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

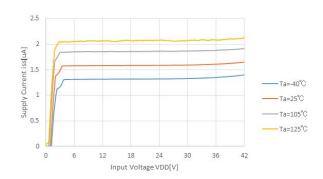




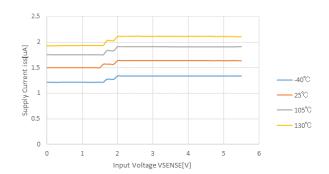


#### No. EC-405-200904

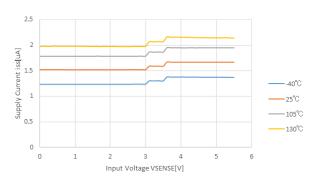
 $V_{\text{UVSET}} = 4.7 \text{ V}, V_{\text{OVSET}} = 5.3 \text{ V}$ 



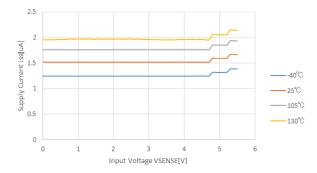
# 4) Supply Current vs. $V_{\text{SENSE}}$ $V_{\text{UVSET}} = 1.6 \text{ V}, V_{\text{OVSET}} = 2.0 \text{ V}$



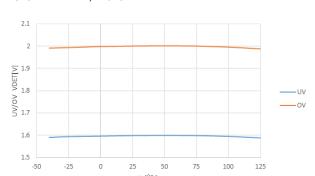
#### $V_{\text{UVSET}} = 3.0 \text{ V}, V_{\text{OVSET}} = 3.6 \text{ V}$



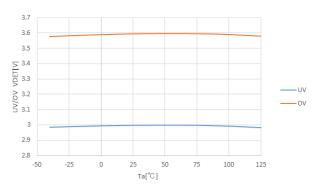
 $V_{UVSET} = 4.7 V$ ,  $V_{OVSET} = 5.3 V$ 



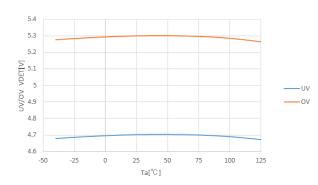
#### 5) UV/OV Detection Voltage vs. Ambient Temperature



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

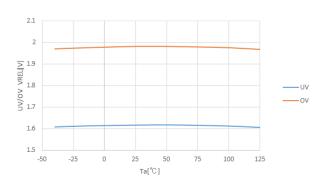


#### $V_{UVSET} = 4.7 \text{ V}, V_{OVSET} = 5.3 \text{ V}$

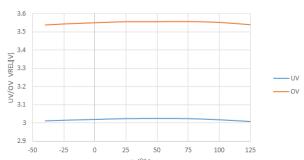


#### 6) UV/OV Release Voltage vs. Ambient Temperature

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

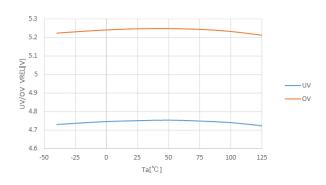






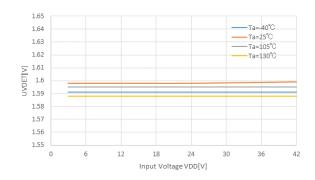
#### No. EC-405-200904

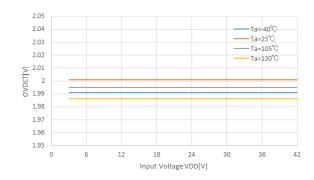
 $V_{\text{UVSET}} = 4.7 \text{ V}, V_{\text{OVSET}} = 5.3 \text{ V}$ 



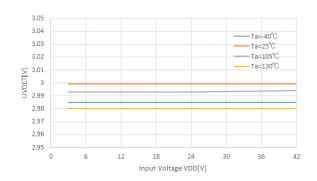
#### 7) UV/OV Detection Voltage vs. V<sub>DD</sub>

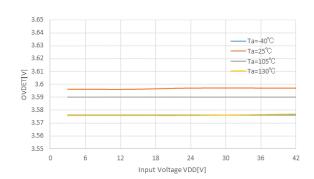
Vuvset = 1.6 V, Vovset = 2.0 V



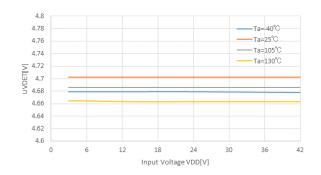


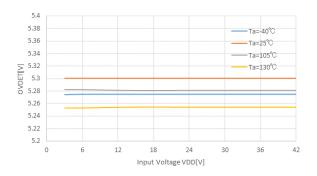
 $V_{UVSET} = 3.0 \text{ V}, V_{OVSET} = 3.6 \text{ V}$ 





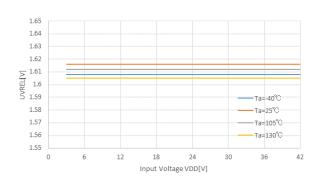
 $V_{UVSET} = 4.7 V$ ,  $V_{OVSET} = 5.3 V$ 

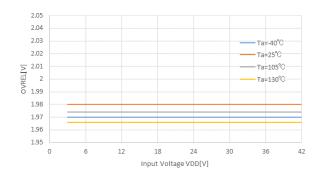




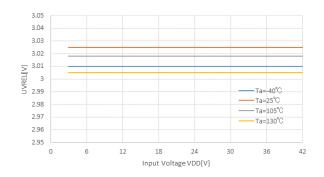
#### 8) UV/OV Release Voltage vs. V<sub>DD</sub>

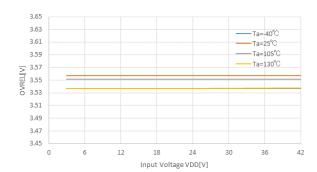
 $V_{\text{UVSET}} = 1.6 \text{ V}, V_{\text{OVSET}} = 2.0 \text{ V}$ 





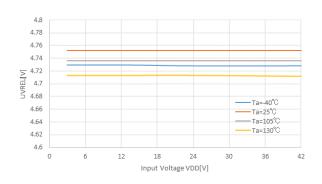
#### $V_{UVSET} = 3.0V, V_{OVSET} = 3.6 V$

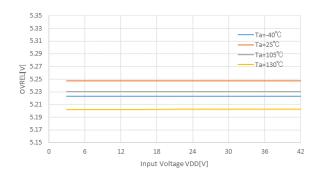




#### No. EC-405-200904

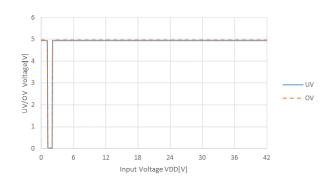
 $V_{UVSET} = 4.7 V$ ,  $V_{OVSET} = 5.3 V$ 

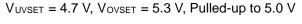


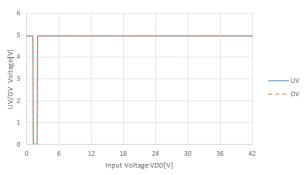


#### 9) UV/OV Voltage vs. V<sub>DD</sub> (Ta = 25°C)

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

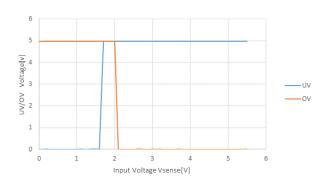




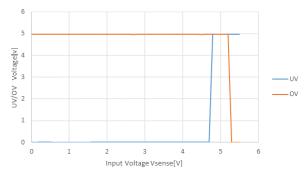


#### 10) UV/OV Voltage vs. V<sub>SENSE</sub> (Ta = 25°C)

V<sub>UVSET</sub> = 1.6 V, V<sub>OVSET</sub> = 2.0 V, Pulled-up to 5.0 V

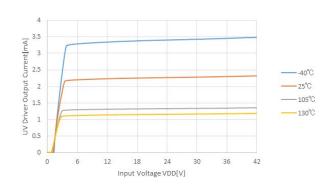


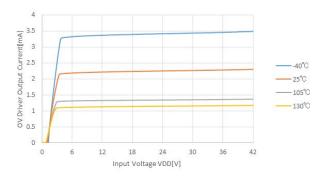
 $V_{UVSET} = 4.7 \text{ V}$ ,  $V_{OVSET} = 5.3 \text{ V}$ , Pulled-up to 5.0 V



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

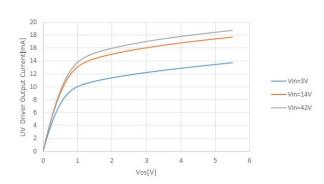
 $V_{\text{UVSET}} = 4.7 \text{ V}, V_{\text{OVSET}} = 5.3 \text{ V}$ 

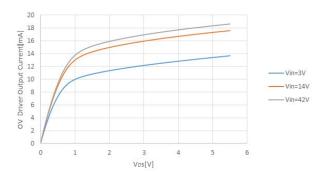




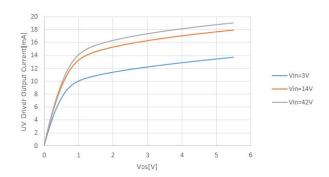
## 12) Driver Output Current vs. $V_{DS}$ (Ta = 25°C)

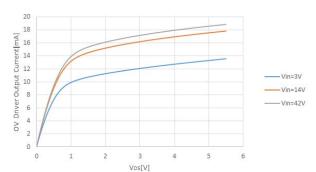
 $V_{UVSET} = 1.6 \text{ V}, V_{OVSET} = 2.0 \text{ V}$ 





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

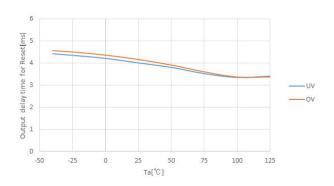




No. EC-405-200904

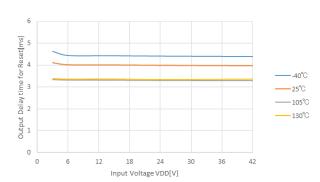
#### 13) Release Delay Time vs. Ambient Temperature

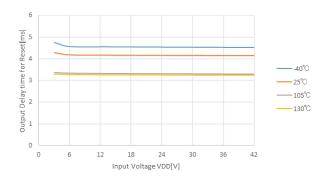
 $V_{\text{UVSET}} = 4.7 \text{ V}, V_{\text{OVSET}} = 5.3 \text{ V}$ 



#### 14) Release Delay Time vs. VDD

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



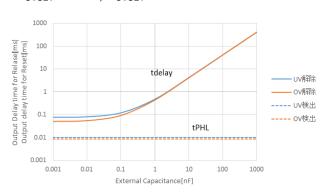


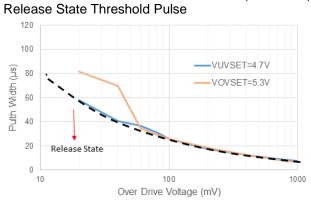
## 15) Detection / Release Delay Time vs. External Capacitor for CD Pin

16) SENSE Pulse Width vs. Over Drive Voltage

 $(Ta = 25^{\circ}C)$ 

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





 $(Ta = 25^{\circ}C)$ 

Ver. A

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 Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square				
Through-holes	φ 0.3 mm × 7 pcs				

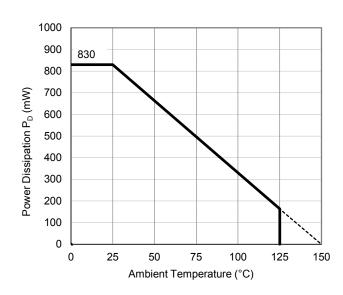
#### **Measurement Result**

 $(Ta = 25^{\circ}C, Tjmax = 150^{\circ}C)$ 

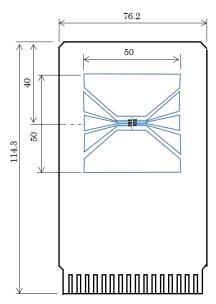
Item	Measurement Result		
Power Dissipation	830 mW		
Thermal Resistance (θja)	θja = 150°C/W		
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W		

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

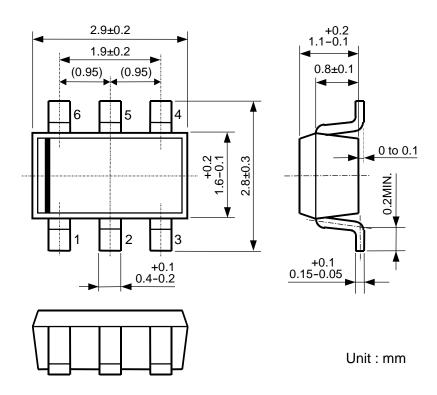


Power Dissipation vs. Ambient Temperature



**Measurement Board Pattern** 

Ver. A



**SOT-23-6 Package Dimensions** 



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